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Water-Jacketed,
IR Autoflow Automatic CO_2 Incubator

Models
NU-2500, 2600, 2700
NU-2500E, 2600E, 2700E

Operation & Maintenance Manual

Revised
April, 1994

Manufactured by:
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IR Autoflow Automatic CO_2, Water-Jacketed Incubator

Models
NU-2500, 2600, 2700
NU-2500E, 2600E, 2700E
OPERATION & MAINTENANCE MANUAL

1.0 General Description

The NuAire IR Autoflow Automatic CO_2 water-jacketed incubator has been designed to provide a reliable controlled in vitro environment for optimum tissue cell culture growth. Five parameters contribute to optimum growth conditions. These are:

1. Humidity
2. Precision temperature control
3. Precise CO_2 control
4. Sterility
5. Reliability

Like all NuAire equipment, the IR Autoflow has been designed to provide the highest quality standards of performance with matching computer technology, precise temperature control and infrared CO_2 gas control system combining state-of-the-art technology with years of design, quality and manufacturing experience.

In order to accomplish the foregoing objectives, the IR Autoflow features the following:

1.1 Extra Large (16 gallon) Water-Jacket - Each Chamber

The outer stainless steel wall is lined with a space-age insulation providing a R5.0 rating, minimizing heat loss. The large 16 gallon (60.56 liters) water-jacket utilizes water, one of natures best "sinks" of heat. Its high capacity to hold heat makes it the ideal medium to surround a chamber in order to obtain temperature uniformity. In fact, the ability of materials to hold heat, called the specific heat, uses water as the comparative standard. the large water-jacket surrounding the chamber permits the water to circulate within the jacket, producing a temperature uniformity of ± 0.2°C. the larger the mass, the less susceptible within the chamber to environmental fluctuations outside. It also adds cabinet stability for the growth of vibration sensitive cells.

1.2 NuAire Incubator Control Electronics

The NuAire Incubator Control Electronics is a state-of-the-art microcomputer based control system specifically designed to service the precise control requirements of the chambers environment, providing optimum programmable conditions for culture growth. The microcomputer is "user friendly" with status indicators, LED display of control parameters and nine digit tough control key pad with additional select and enter keys permits efficient operator entry of data.

The microcomputer is supported with Read Only Memory (ROM) containing executable software, Random Access Memory (RAM) for temporary storage and Electronically Erasable Programmable Read Only Memory (EEPROM) for control set points and parameters. The EEPROM provides for indefinite storage of these values during periods of power off or power interruption (power fault tolerant).

The microcomputer includes a complete internal diagnostic software package that permits fault isolation detection down to the failed component. Entering "9734" allows access to any diagnostic function including microcomputer output and input tests.

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1.3 Infrared CO_2 Sensor

The NuAire IR Autoflow employs a solid-state Single Gas Analyzer for carbon dioxide. this innovative analyzer utilizing a filter correlation technique for nondispersive infrared analysis of CO_2 offers unparalleled stability. This analyzer consists of an optical bench incorporating an infrared source, sample cell, and infrared detector. It accurately monitors CO_2 concentrations over extended periods of time without need of calibration.

The analyzer, utilizing a ratio technique for signal measurement and accurate temperature control of the bench, provides unparalleled stability which will enhance the IR Autoflow's performance, decrease the maintenance requirements, and save you money on ancillary equipment required to support the gas analyzer measurement. The gas analyzer measurement of CO_2 is independent of humidity and temperature variations within the chamber.

1.4 All Stainless Steel Construction

The IR Autoflow's exterior is constructed of 16 gauge, type 304 stainless steel with the interior being 16 gauge, type 304 polished stainless steel using crevice free construction, which provides an easily cleanable (for decontamination) inert surface that does not in itself promote biological growth. In addition all shelves, shelf supports and guide rails are easily removable and can be autoclaved to remove contamination. Remember: the chamber is not selective. The growth environment is applied to all microorganisms within the interior, equally.

1.5 Humidity

Humidification of the chamber is achieved through the process of water evaporation from a water reservoir placed within the autoflow chamber. In addition water condensation, which actually lowers the relative humidity within the chamber, is prevented by having all interior surfaces exposed to the constant temperature water-jacket, or heated separately via an integrated control that regulates door heat to maintain a condensation-free glass door. Without condensation and with an easily cleanable stainless steel interior, the probability of contamination is minimized.

1.6 CO_2 Backup System

The NuAire IR Autoflow employs a unique user optional CO_2 backup system in the event of a CO_2 fault. If the CO_2 backup system is activated in the configuration function, upon a catastrophic CO_2 fault (ex. CO_2 sensor calibration fault or failure) the incubator will indicate a CO_2 fault with a timed audible alarm and constant yellow LED. The CO_2 backup system will then air purge the chamber of all CO_2 for 120 minutes to establish a baseline point of NO CO_2 . Then, starting from the NO CO_2 baseline point, the CO_2 backup system will inject a set amount of CO_2 into the chamber to achieve the CO_2 setpoint. The backup system will continue this process every 24 hours at 12:00 a.m. until the alarm condition is cleared by turning the mode switch on the front panel.

2.0 Performance Parameters

2.1 The IR Autoflow's exterior is constructed of 16 gauge, type 304 stainless steel with the interior being 16 gauge, type 304 polished stainless steel, using crevice free construction. All exposed edges are deburred to insure that there are no sharp edges. The exterior is finished in a textured polyurethane finish, which is resistant to chemicals and easily cleaned using mild household detergents.

2.2 Each chamber's water-jacket holds 16 gallons (60.56 liters) of water, that in conjunction with the microcomputer control system provides an interior chamber temperature uniformity of ± 0.2°C at 37.0°C.

2.3 The IR Autoflow's microcomputer temperature control system has three temperature sensors with their location being: two in the water-jacket and one in the chamber. The chamber temperature sensor compares the values to the setpoint and executes a time proportional control algorithm that energizes a solid-state switch, supplying power to the heater.

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2.4 The CO_2 percentage is individually controlled per chamber by a solid-state infrared gas analyzer which is temperature compensated and non-sensitive to humidity variations.

2.5 Calibration of infrared gas analyzer is accomplished simply through a front panel diagnostic procedure to assure accuracy and minimize downtime.

2.6 Automatic recovery of CO_2 after a door opening to 5.0 ± 0.2% CO_2 within 2 minutes for a single chamber.

2.7 The outer door includes a radiant heater in order to minimize condensation on the inner glass door. A magnetic outer door gasket helps to insure a tight seal against the cabinet.

2.8 The inner glass door is 3/16" tempered with smooth-ground edges and seals air tight against a U-grooved silicone rubber gasket. The door latch is cam action. An all solid-state magnetic switch monitors door motion.

2.9 All electronic controls are modular and easily removed through the front or top service control center.

2.10 All control electronics are protected with a circuit breaker that may trip at 110% of load rating but will trip at 145% of loading in less than 2 seconds. Should the circuit breaker open (pop-out button will appear), merely depress to reset.

2.11 A water fill access port is provided on the front of the IR Autoflow. A 1/4 inch NPT plated brass fill plug is removed and a 1/4 inch NPT hose adapter is provided.

2.12 The IR Autoflow has factory installed adjustable leveling legs to compensate for uneven laboratory surfaces.

2.13 The entire interior shelving assembly is easily removable for decontamination. The shelves are constructed from 18 gauge, type 304 polished stainless steel.

2.14 A through-wall access port is provided for operating electrical appliances such as roller apparatus, rockers, etc.

2.15 A CO_2 sample port is provided on the front panel to check the concentration of CO_2 in the chamber.

2.16 A water level sensor is provided to monitor the level of water within the jacket.

2.17 A water-jacket drain is provided on the bottom of the unit for ease of maintenance.

3.0 Models & Features

NuAire offers three configurations of the basic Model NU-2500/2500E Water-Jacketed IR Autoflow Automatic. These are (1) Model NU-2500/2500E the basic single chamber unit. (2) Model NU-2600/2600E a side-by-side unit and (3) Model NU-2700/2700E two single chamber units vertically stacked over/under.

3.1 **Dimensions** (See also specification drawings BCD-03987, BCD-03988, and BCD-03989)

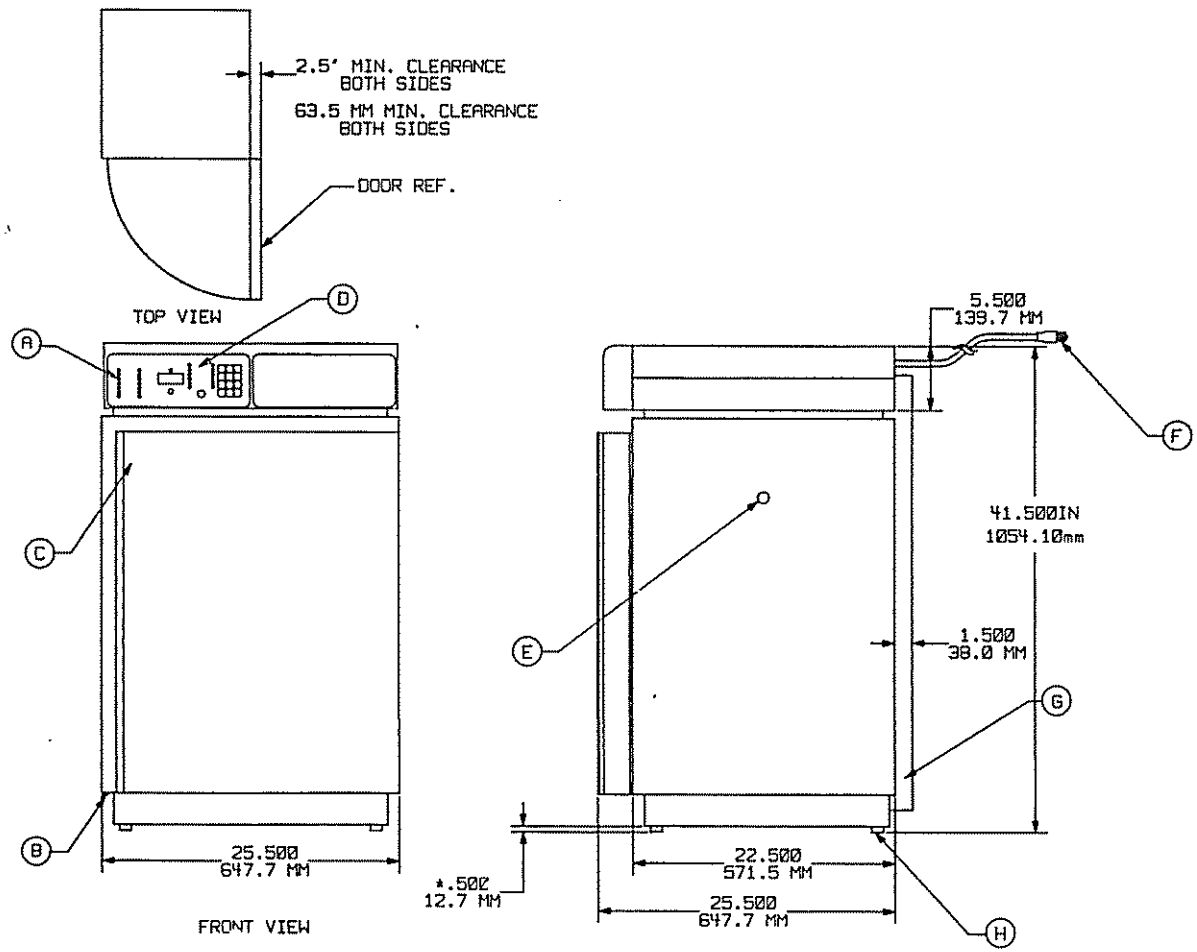
	Model NU-2500	Model NU-2600	Model NU-2700
Overall Dimensions - inches (mm):	Single Unit	Side-by-Side Unit	Vertical Unit
Width:	25.5 (647.7)	52 (1320.8)	25.5 (647.7)
Height:	41.5 (1054.1)	41.5 (1054.1)	75.5 (1917.7)
Depth:	27(685.8)	27 (685.8)	27 (685.8)

The side-by-side IR Autoflow is two independent chambers with individual controls. Doors open from the center.

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REV	ECO	DESCRIPTION	DATE	INL	INL



TEMP. RANGE: 5°C ABOVE AMBIENT TO 55°C
TEMP. SENSITIVITY ± 0.125° C
TEMP. UNIFORMITY ± 0.2 AT 37°C
CO_2 RANGE: 0 TO 20%
CO_2 ACCURACY ± 0.1%
CO_2 RECOVERY TO 5%: 2 MINUTES
ELECTRICAL: 115 VAC. 550 W. 50/60HZ.
220 VAC. 550 W. 50/60HZ.
DIMENSIONS INTERIOR:
25.500'H x 21.500'W x 21'D
647.7 X 546.1 X 533.4 MM
DIMENSIONS EXTERIOR:
41.500' H x 25.500' W X 27.000' D
1054.1 H X 647.7 W X 685.8 D MM
SHELF: 19.250' x 19.250'
488.9 X 488.9 MM

A - FRONT PANEL CONTROLS & INDICATORS
B - WATER JACKET DRAIN
C - WATER FILL ACCESS PORT (BEHIND DOOR)
D - REMOVABLE PLUG IN/OUT CONTROL PANEL
E - ELECTRICAL ACCESS PORT (1.125' DIA. 28.5 MM)
F - POWER CORD 8' 2.5M.
G - WIRE COVER
H - LEG LEVELER ± .500 ADJUSTMENT
12.7 MM

DFTM	PS	4/1/87
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE SPECIFICATION
DRAWING MODEL NU-2500/2500E
AUTOMATIC CO_2 INCUBATOR

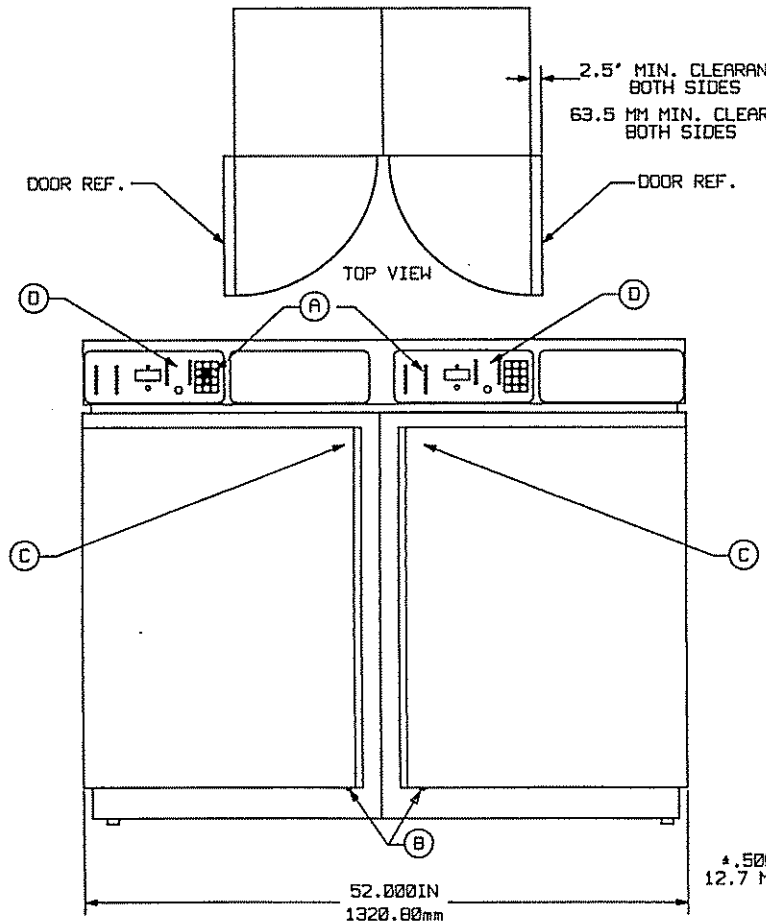
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SCALE

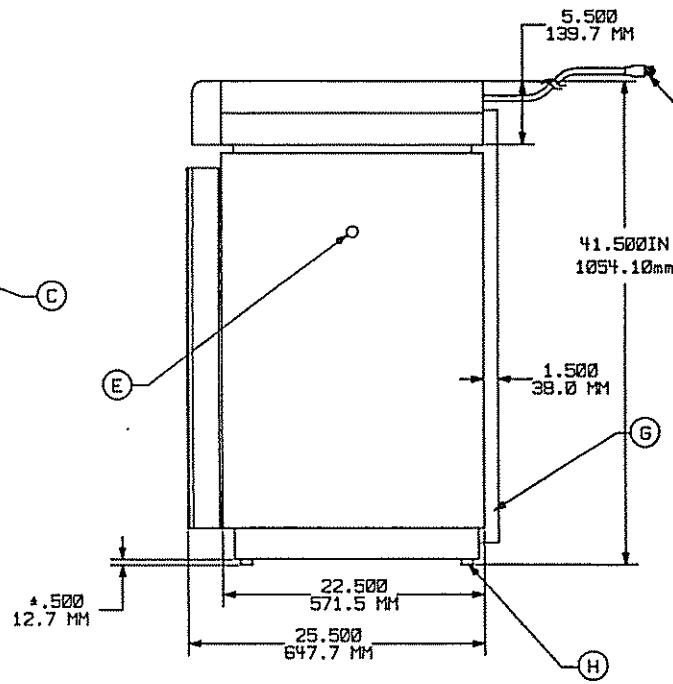
SHEET 1 OF 1

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REV	ECO	DESCRIPTION	DATE	INL	INL



FRONT VIEW



RIGHT SIDE VIEW

TEMP. RANGE: 5°C ABOVE AMBIENT TO 55°C
TEMP. SENSITIVITY ± 0.1° C
TEMP. UNIFORMITY ± 0.2 AT 37°C
CO_2 RANGE: 0 TO 20%
CO_2 ACCURACY ± 0.1%
CO_2 RECOVERY TO 5%: 2 MINUTES
ELECTRICAL: 115 VAC, 1100 W, 50/60 HZ.
220 VAC, 1100 W, 50/60 HZ.
DIMENSIONS INTERIOR: (EACH CHAMBER)
25.500'H x 21.500'W x 21'D
647.7 H X 546.1 W X 533.4 D MM
DIMENSIONS EXTERIOR:
41.500' H x 52.000' W x 27.000' D
1054.1 H X 1320.8 W X 685.8 D MM
SHELF: 19.250' x 19.250'
488.9 X 488.9 MM

A - FRONT PANEL CONTROLS & INDICATORS
B - WATER JACKET DRAIN
C - WATER FILL ACCESS PORT (BEHIND DOOR)
D - REMOVABLE PLUG IN/OUT CONTROL PANEL
E - ELECTRICAL ACCESS PORT (1.125 DIA 28.5 MM)
F - POWER CORD 8' 2.5M
G - WIRE COVER
H - LEG LEVELER ± .500 ADJUSTMENT
12.7 MM

DFTM	PS	1/18/92
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE SPECIFICATION
DRAWING MODEL NU-2600/2600E
AUTOMATIC CO_2 INCUBATOR

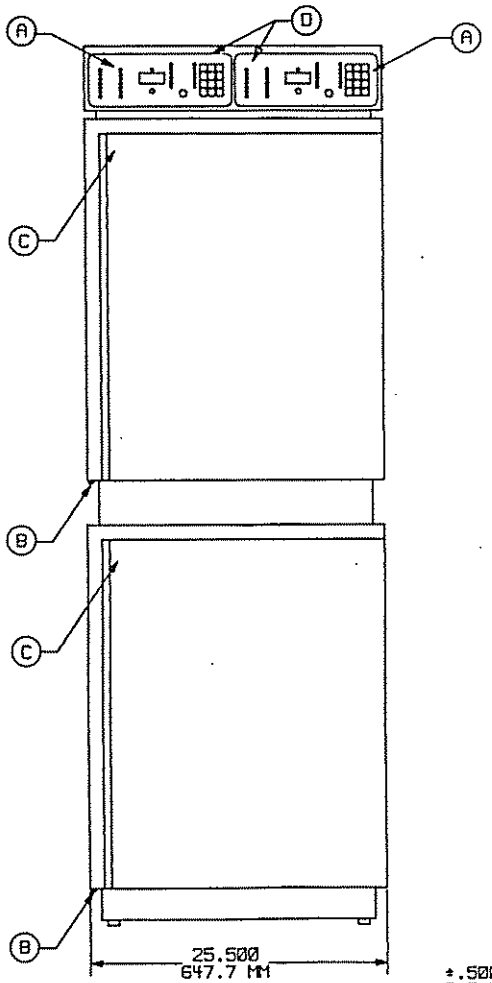
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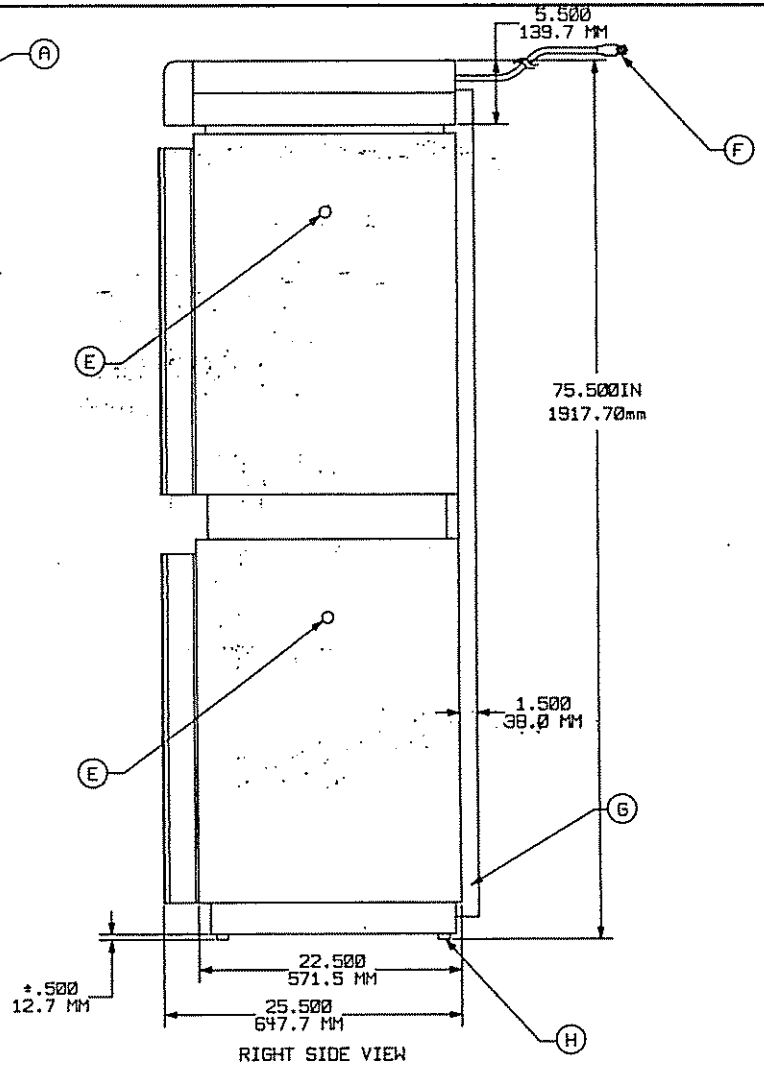
SHEET 1 OF 1

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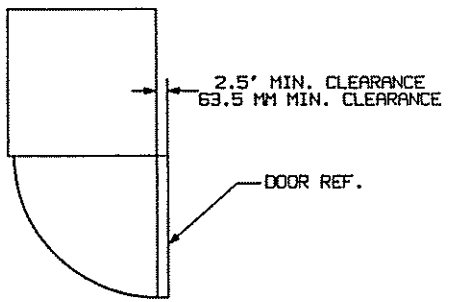
REV	ECO	DESCRIPTION	DATE	INL	INL



FRONT VIEW



RIGHT SIDE VIEW



TOP VIEW

A - FRONT PANEL CONTROLS & INDICATORS
B - WATER JACKET DRAIN
C - WATER FILL ACCESS PORT (BEHIND DOOR)
D - REMOVABLE PLUG IN/OUT CONTROL PANEL
E - ELECTRICAL ACCESS PORT (1.125 DIA. 28.5 MM)
F - POWER CORD 8' 2.5 M
G - WIRE COVER
H - LEG LEVELERS ±.500 12.7 MM ADJUSTMENT

TEMP. RANGE: 5°C ABOVE AMBIENT TO 55°C
TEMP. UNIFORMITY: ±0.2 AT 37° C
TEMP. SENSITIVITY ± 0.0125° C
CO_2 RANGE 0 TO 20 PERCENT
CO_2 ACCURACY ± 0.1%
CO_2 RECOVERY TO 5% : 2 MINUTES
ELECTRICAL: 115 VAC. 1100 W. 50/60 HZ.
220 VAC. 1100 W. 50/60 HZ.
DIMENSIONS INTERIOR: (EACH CHAMBER)
25.500'H x 21.500'W x 21'D
647.7 H X 546.1 W X 533.4 D MM
DIMENSIONS EXTERIOR:
75.500' H x 25.500' W X 27.000' D
1917.7 H X 647.7 W X 685.8 D MM
SHELF: 19.250' x 19.250'
488.9 X 488.9 MM

DFTM	PS	1/18/92
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE SPECIFICATION DRAWING
MODEL NU-2700/2700E OVER/
UNDER AUTOMATIC CO2 INCUBATOR

DRAWING NUMBER BCD-03989

SCALE

SHEET 1 OF 1

3.2 Standard Features

- 100% stainless steel chamber construction
- Large capacity water-jacket (16 gallon) (60.56 liters)
- NuAire Incubator Control Electronics Temperature Range: 5°C above ambient to +55°C
- Chamber temperature uniformity: ±0.2°C at 37°C
- Temperature sensitivity: ±0.0125°C
- CO_2 Range: 0-20%
- CO_2 Accuracy: ±0.1%
- CO_2 Recovery to 5.0 ± 0.2%: 2 minutes

3.3 Standard Items Packed with Unit (per chamber*)

- (4) Stainless Steel Shelves*
- (8) Stainless Steel Shelf Brackets*
- (4) Stainless Steel Shelf Bracket Supports*
- (1) Full Size Water Pan with Supports*
- (1) Fill Port Fitting
- (1) Fill Port Plug*
- (1) Gas Tube with Filter
- (1) 6 feet (2m), Fill Tube
- (1) Electrical Cord 8 foot (2.5m)
- (1) Operation & Maintenance Manual
- (1) Operating Instructions

3.4 Optional Features

- Model Number I01 Automatic CO_2 Tank Switch
- Model Number I05 Com/Chart Interface (RS-232/RS-485)
- Model Number I06 Security Key Lock
- Model Number I07 Humidity Display (Single Unit)
- Model Number I08 Humidity Display (Dual Unit)
- Model Number I10 Left Hand Door Hinge
- Model Number I11 Internal Coil for Chilled Water

3.5 Accessories

- Model NU-1550 Automatic Tank Switch (External)(115 VAC)
- Model NU-1550E Automatic Tank Switch (External)(220 VAC)
- Model NU-1552 CO_2 Tank Alarm (115 VAC)
- Model NU-1552E CO_2 Tank Alarm (220 VAC)
- Model NU-1553 Stacking Rack (Single Unit)
- Model NU-1554 Stacking Rack (Dual Unit, Side/Side)
- Model NU-1555 Additional Stainless Steel Water Pan
- Model NU-1556 Additional Tubing Kit
- Model NU-1557 Additional Shelves
- Model NU-1559 CO_2 Analyzer Fyrite Kit (Dry) 0-20% (Replacement fluid required)
- Model NU-1561 Replacement Fluid for CO_2 Analyzer (Two bottles/carton)*
- Model NU-1564 CO_2 Regulator, Two-Stage
- Model NU-1590 CO_2 Regulator, Single-Stage
- Model NU-1566 Platform
- Model NU-1571 Platform w/Casters
- Model NU-1575 Moisture Proof Duplex Outlet (115 VAC)
- Model NU-2568 Surge Protector (115 VAC)

*Fyrite Replacement Fluid may only be ordered when shipment is possible by UPS Ground Service.

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4.0 Test Performance & Procedures

All equipment is thoroughly inspected at the NuAire Factory at the time of shipment. Quality control is maintained by constant surveillance over the product, beginning at the receipt of purchased material and concluding with a final inspection which certifies the IR Autoflow's performance to the specifications. In all instances where product quality cannot be easily assessed on the end item (i.e. water-jacket leak tightness), the product is inspected during sub-assembly fabrication. The following test procedures are conducted on each cabinet and a copy of the test report is included with each unit.

4.1 Visual Inspection

4.1.1 Each IR Autoflow is visually inspected to insure that the interior is clean and free from scratches, nicks burrs and that all welds, both interior and exterior are ground and polished smooth.

4.1.2 Painted surfaces are inspected to be free of scratches, nicks, insufficient covering and runs.

4.1.3 The door opens/closes freely without binding of the hinges. The vinyl gasket seals the inner glass door tightly. The glass door is free of scratches.

4.2 Electrical Tests

4.2.1 Electrical Leakage Test
115 VAC electrical leakage shall not exceed 500 microamperes using a Simpson Model 229 or equivalent tester. 220 VAC electrical leakage shall not exceed 750 microamperes.

4.2.2 Dielectric Voltage - Withstand
1250 volts is applied between dead metal parts and the hot/neutral power source lead with no electrical breakdown using a Slaughter Model 101-2.5 for 115 VAC units. 1500 volts is applied for 220 VAC units.

4.3 Functional Tests

The following functional tests are performed on every unit at the end of a continuous 48 hour burn in period.

4.3.1 Control Systems
All diagnostic functions are exercised to insure proper operation of control systems, components and alarms.

4.3.2 CO_2 Control
Each unit is calibrated to function at 5%. CO_2 is introduced into the chamber and allowed to stabilize for ten minutes at 5% concentration. The concentration is checked with a fyrite. Each unit is monitored during the 48 hour burn in period and only accepted with zero failures.

4.3.3 CO_2 Recovery
Each unit is exercised for CO_2 recovery time at the end of the 48 hour burn in period. The door is opened for 1 minute to deplete the CO_2 . After the door is closed, the unit shall recover to 0.2% within 2 minutes. A dual chamber unit will recover each chamber to 0.2% within 4 minutes.

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5.0 Warranty

NuAire, Inc. warrants that it will repair F.O.B. its factory or furnish without charge F.O.B. its factory a similar part to replace any material in its equipment within 18 months after the date of sale if proved to the satisfaction of the company to have been defective at the time it was sold provided that all parts claimed defective shall be returned, properly identified to the company at its factory, charges prepaid. Factory installed equipment or accessories are warranted only to the extent guaranteed by the original manufacturer and this warranty shall not apply to any portion of the equipment modified by the user. Claims under this warranty should be directed to NuAire, Inc. setting forth in detail the nature of the defect, the date of the initial installation and the serial and model number of the equipment.

NuAire, Inc. warrants the water-jacket and will repair or replace F.O.B. its factory or furnish without charge F.O.B. its factory the water-jacket within five years after the date of sale if proved to the satisfaction of the company to have been defective at the time it was sold.

This warranty shall not apply to any NuAire product or part thereof which has been subject to misuse, abuse, filling the water-jacket improperly, using additives in water-jacket, accident, shipping damage, improper installation or service, or damage by fire, flood or acts of God. If the serial number of this product is altered, removed or defaced as to be illegible, the Warranty shall be null and void in its entirety.

The warranty is for the sole benefit of the original purchaser and is not assignable or transferable. Prior to returning any item, for any reason, contact NuAire for a Return Authorization Number. This number must accompany all returns. Any product shipped to NuAire without this number will be returned, refused shipment or collect freight.

6.0 Shipments

NuAire, Inc. takes every reasonable precaution to assure that your Incubator arrives without damage. Motor carriers are carefully selected and shipping cartons have been specifically designed to insure your purchase. However, damage can occur in any shipment and the following outlines are steps you should take on receipt of a NuAire Incubator to be sure that if damage has occurred, the proper claims and actions are taken immediately.

6.1 Damaged Shipments

6.1.1 Terms are F.O.B. factory, unless stated otherwise. Therefore, it is important to check each shipment before acceptance.

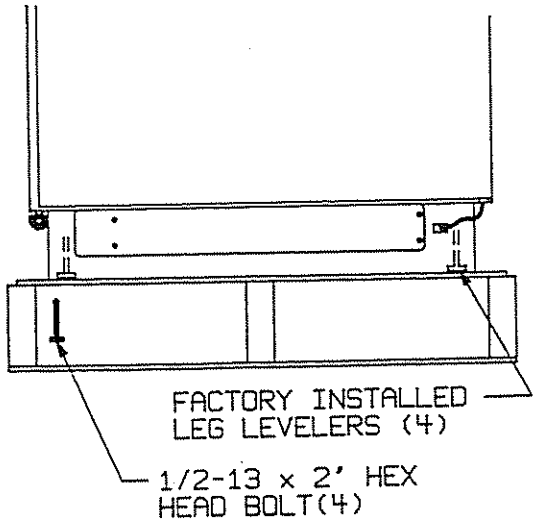
6.1.2 If there is visible damage, the material can be accepted after the driver makes a notation on the consignee's copy of the freight bill. Then an inspection must be made to verify the claim against the carrier. This inspection is the basis of your filing the claim against the carrier.

6.1.3 If concealed damage is found, it is absolutely necessary to NOTIFY THE FREIGHT AGENT AT ONCE, and request an inspection. Without this inspection, the transportation company may not accept a claim for loss or damage. If the carrier will not perform the inspection, an affidavit must be prepared stating that he/she was contacted on a certain date and that he/she failed to comply with the request. This along with other papers in the customer's possession will support the claim.

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7.0 Installation

The IR Autoflow is fastened to the base skid and it is usually the best procedure to leave the skid attached until the IR Autoflow is located in its approximate position, to facilitate ease in handling. The base skid can then be removed by removing the four bolts holding the cabinet to the skid. Examine the IR Autoflow carefully. INSPECT both the exterior and the interior of the IR Autoflow for any transit damage before discarding the shipping crate (see section 6.1.3).

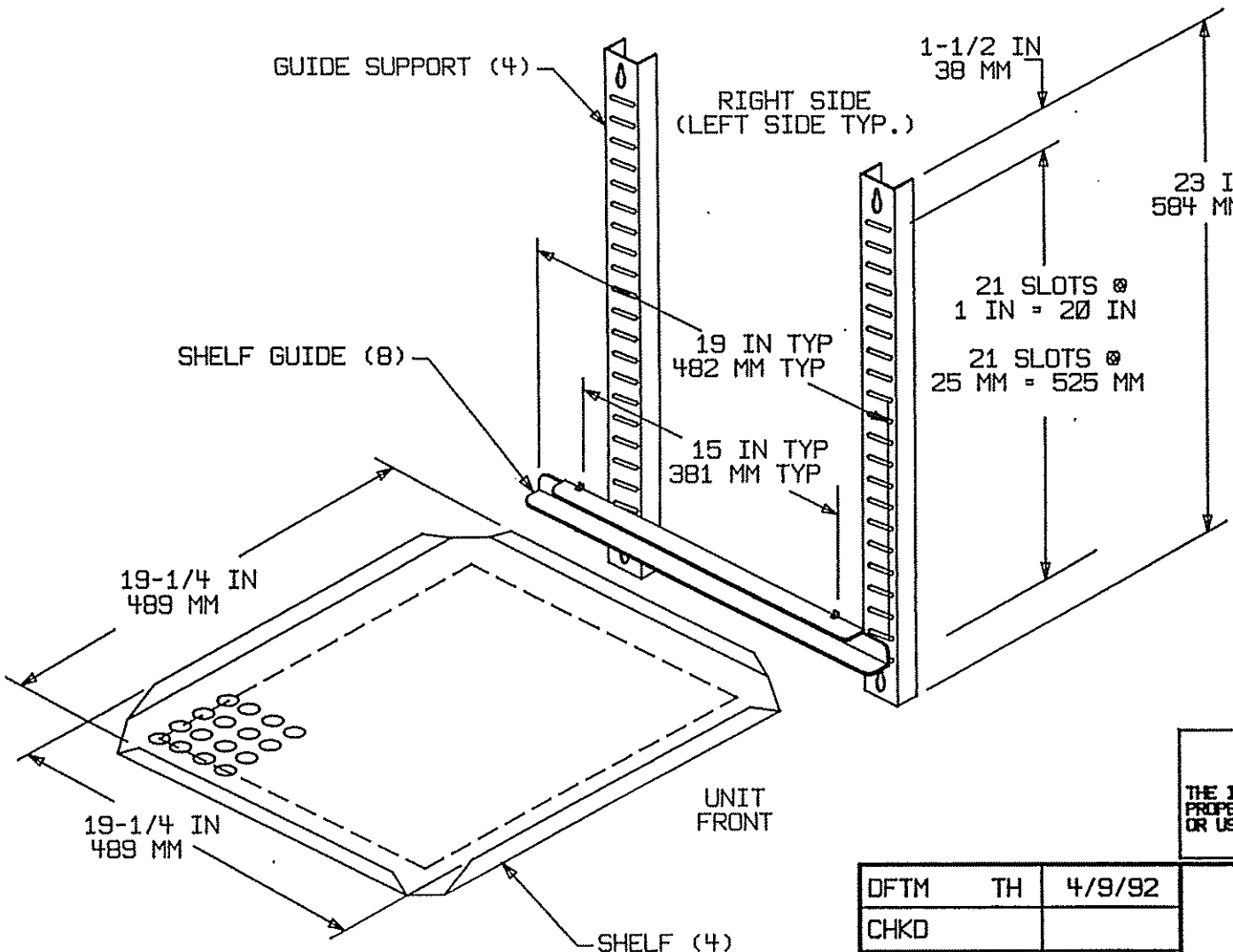


7.1 Location

In locating the IR Autoflow, consider all possible conditions that might affect its performance as well as laboratory procedures for its intended purpose. Do not locate near heating or cooling ducts, or next to equipment that generates heat (steam radiators, stoves, ovens, autoclaves, etc.). Avoid direct sun rays and rapidly moving air currents. The IR Autoflow needs even heat loss on all surfaces in order to maintain an internal temperature variation of less than 0.2 degrees C. As a result, a minimum of 2 inches (50 mm) must be allowed between the rear and sides of the IR Autoflow and any walls, partitions or obstructions to facilitate adequate convection of air around the IR Autoflow's water-jacket. For maintenance/service purposes, the control center top containing the electronics should remain accessible.

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REV	ECO	DESCRIPTION	DATE	INL	INL



FOUR SQUARE STAINLESS STEEL SHELVES WITH REMOVABLE INTERIOR SHELF ASSEMBLY GREATLY SIMPLIFIES DECONTAMINATION PROCEDURES.

PROPRIETARY

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DFTM	TH	4/9/92
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE
SHELF INSTALLATION

DRAWING NUMBER ACD-04119

SCALE

SHEET 1 OF 1

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7.2 Leveling

The IR Autoflow should be leveled prior to filling with water, and should rest firmly on the bench or floor. Uneven water levels may cause false "add water" indications on the front panel as well as to affect the water circulation paths within the water-jacket, which could cause condensation on the walls of the chamber. Leveling feet are provided for this purpose, factory installation into the base of the IR Autoflow. Turning the adjustable leveling feet counter-clockwise raises the IR Autoflow. The leveling feet height should be approximately 1/4 inch (6 mm) below the IR Autoflow Base.

7.3 Shelf & Water Pan Installation

Before installation of the shelves, NuAire recommends to decontaminate all surfaces within the interior chamber, lass door and outer door with gasket. They can be wiped down with a disinfectant of 70 percent alcohol or similar non-corrosive antimicrobial agent.

Provided with each IR Autoflow are four shelves. The shelves are easily installed per Drawing ACD-04119, by attaching the guide supports to the stainless steel pins in the interior of the chamber. Additional shelves and shelf guides are available. The water pan is installed on two shelf guides.

7.4 Electrical

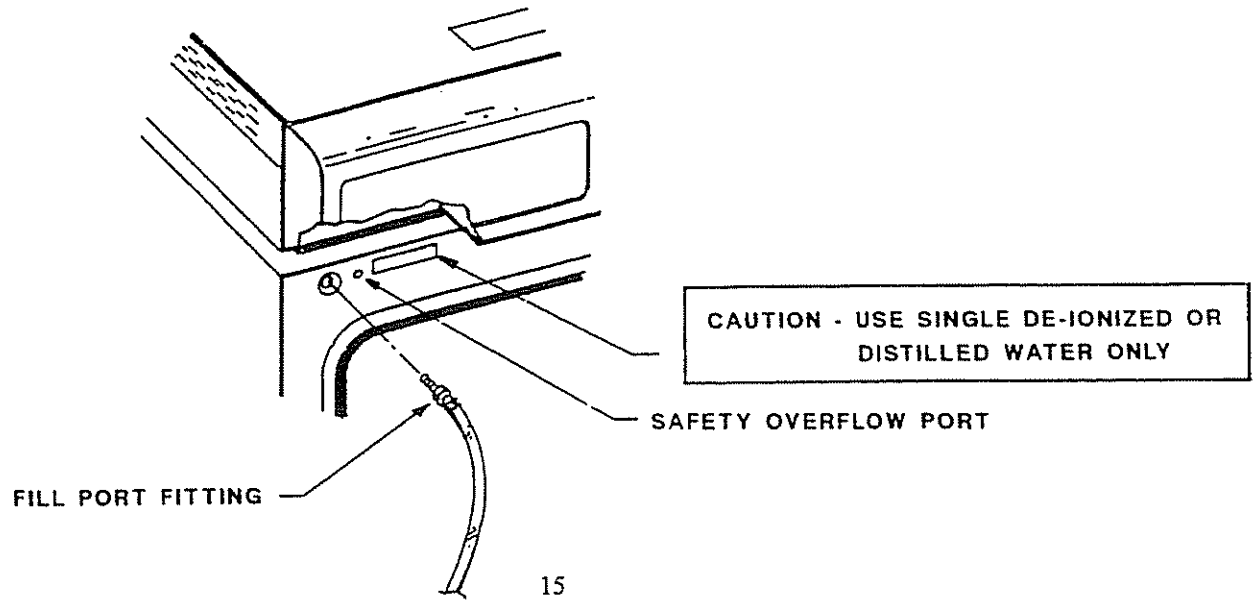
The electrical supply circuit to the IR Autoflow must conform to all national and local electrical codes. Consult the IR Autoflow's serial-data plate, located inside the door, for voltage, cycle, phase and ampere requirements before making connection. Plug the power cord securely into the grounded power source. VOLTAGE SHOULD NOT VARY MORE THAN 5% FROM SERIAL PLATE RATINGS. A separate branch circuit is recommended to prevent possible loss of produce due to overloading or failure of other equipment on the same circuit. A SURGE PROTECTOR IS STRONGLY RECOMMENDED to avoid power related faults.

7.5 Precaution for IR Autoflow Filling

To prepare the IR Autoflow for filling, turn on main power switch located on back panel and set mode switch to standby/setup. The digital indicator should light up as well as the add water light.

7.6 Filling & Draining the Water-Jacket

The fill port plug is located on the front top left side behind the exterior door. Install the fill port fitting. Place the tubing over the adapter and connect the other end to either a funnel or serrated tap. **USE SINGLE DISTILLED OR DEMINERALIZED WATER**. No purer than 5 MEGOHM water should be used. Fill the water-jacket until the "ADD WATER" light turns off. Add an additional 3 to 4 liters of water, remove the tube adapter and replace with the fill port plug.



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CAUTION

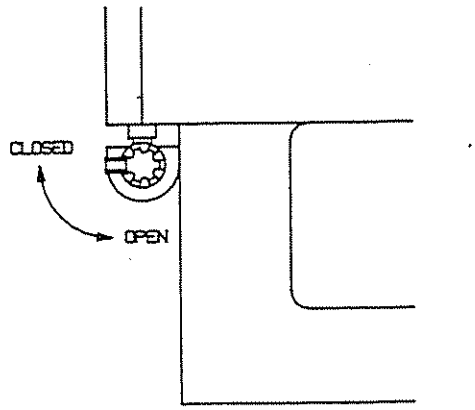
Be sure to position and level the IR Autoflow as desired before filling water.

DO NOT OVERFILL!

The water-jacket requires no anti-bacterial agents. The IR Autoflow already incorporates a copper tube producing copper sulfate which eliminates bacterial growth within the water-jacket. **ABSOLUTELY NO CHLORINATED OR HALOGEN MATERIALS ARE TO BE USED IN THE WATER-JACKET.**

A safety overfill port is located next to the fill port plug so if overfill does occur, the water will be relieved through the port.

The water-jacket can be drained from the drain plug located on the bottom left side. The drain uses a ball valve to control the drain water. If the valve stem is horizontal, the drain is closed and if it is vertical, the drain is open. A white safety plug must be removed prior to draining located on the bottom of the ball valve. It also insures no leakage will occur.



7.7 CO_2 Tube Connection

Included with every IR Autoflow is a tubing kit consisting of (1) six foot (2m) vinyl tube and (1) 50 mm polypropylene 0.3 micron HEPA filter.

7.7.1 CO_2 Supply

1. Before the CO_2 supply is turned on to the IR Autoflow, fill the water-jacket and set the temperature. (See Section 8.)

CAUTION

CO_2 pressure to the IR Autoflow inlet is rated at 20 PSIG or 1.4 BAR.
DO NOT exceed 25 PSIG or 1.8 BAR.

2. CO_2 of medical grade is recommended.

3. A two-stage pressure regulator, Linde #998343, or equal, is recommended.

4. DO NOT USE a single stage regulator.

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7.7.2 CO_2 Regulators

The regulator's high pressure stage direct from supply cylinder must have range of from 0 to 2000 PSI or 0 to 140 BAR. This gauge indicates actual tank pressure. The low pressure stage should have a range of from 0 to 30 PSI or 0 to 2 BAR (100 PSI or 6 BARS maximum). This gauge will indicate the actual CO_2 pressure into the IR Autoflow system. Some single stage CO_2 pressure regulators have two gauges. USE A TWO STAGE REGULATOR. All NuAire Autoflow's use CO_2 in such small quantities that precise metering of CO_2 input pressure is important for maximum performance of the IR Autoflow.

To connect the regulator: First open the CO_2 cylinder slightly, for an instant (this is termed "cracking the valve."). This will blow out dust or dirt that may have collected in the valve outlet. BE SURE to keep your face away from the valve outlet to protect your eyes from dust or dirt. Second, MAKE SURE the regulator pressure-adjusting screw is released by turning it counterclockwise until it turns freely. Third, attach the regulator to the cylinder valve and tighten the connection nut with a wrench. BE SURE DISC GASKET IS IN PLACE BEFORE MAKING CONNECTION.

7.7.3 CO_2 Connection

Connect the CO_2 supply from the low-stage of the two-stage regulator, to the inlet fitting located on the incubator back panel. The filter should be inserted downstream of the low-stage regulator before the inlet nozzle to the IR Autoflow. Observe proper flow orientation of the filter (look for "in" on filter). The tubing is easily cut with a sharp knife.

7.7.4 CO_2 Supply Adjustment

With the regulator OFF (i.e. fully counterclockwise), open the cylinder valve slowly; usually 1 to 2 turns is sufficient.

NEVER STAND IN FRONT OR BEHIND THE REGULATOR WHEN OPENING THE VALVE. ALWAYS STAND TO ONE SIDE.

The cylinder tank pressure should read 700 to 800 PSI or 48 to 55 BAR, more or less, depending on the temperature of the cylinder. Next turn the regulator's pressure adjusting screw clockwise until the low-pressure gauge reads 20 PSI or 1.4 BAR. The CO_2 connection is now complete.

NOTE

OSHA requires the CO_2 tanks to be physically restrained (i.e. via chained to wall) to prevent accidental damage to cylinder.

If Model NU-2560, an Automatic Tank Switch is purchased; separate installation instructions are provided.

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8.0 IR Autoflow Operation

The IR Autoflow is designed to provide a sterile, constant temperature and high humidity controlled atmosphere for optimum growth of tissue cell cultures or other organisms requiring this precise environment. To operate the IR Autoflow properly, the following parameters must be reviewed, carefully set and/or prepared.

8.1 Sterility

The environment provided by the IR Autoflow is not selective. As a result, any contamination with the chamber is subjected to the same environment as the specimens. Therefore, before placing any cultures in the IR Autoflow, the shelves, and shelf brackets should be sterilized. The interior side walls, top, bottom, door as well as the gasket should be wiped clean with a 70% solution of isopropyl alcohol or other disinfectant, to remove any contamination. Use mild detergent to clean interior of IR Autoflow.

8.2 Humidity

Humidification of the IR Autoflow is achieved through the process of water evaporation (vapor water pressure) from a stainless steel water pan (NuAire Model NU-1555) placed on the bottom of the IR Autoflow shelf rack. Materials of different thermal residence (i.e. glass, plastic) do not offer sufficient thermal recovery and are not recommended for use. Although some metals offer better thermal coefficients than stainless steel, dissimilar metals cause electrolysis in the acid atmosphere (carbonic acid) and should **never** be used, or placed within the IR Autoflow's chamber.

Use only distilled or mineral free water in the stainless steel pan. The water should be changed at least once a week, preferably more often. FLOODING THE BOTTOM OF THE IR AUTOFLOW IS NOT RECOMMENDED since it is difficult to change the water weekly and almost necessitates the use of chemicals which are not recommended and may damage the stainless steel. Also it promotes condensation on the IR Autoflow's inner walls because it steals the natural convection, heat flow through the inner chamber and condensation points occur. **ABSOLUTELY NO CHLORINATED OR HALOGEN MATERIALS ARE TO BE USED IN THE CHAMBER.**

Humidity recovery will be back to 95% within 15-20 minutes after a 30 second door opening with a water reservoir area of 361 square inches (i.e. a NU-1555 full-sized pan). Contamination in the water pan may be avoided by adding a small amount of copper sulfate to the water pan after every decontamination of the chamber.

Condensation on the door walls, top or bottom of the chamber indicates an incorrect balance of door heat which should be calibrated to allow the main temperature control to heat the chamber, not the door heater.

8.3 System Introduction

The NuAire Incubator Control Electronics system is designated to service the control requirements of the IR Autoflow incubator chamber. Temperature and CO_2 level are controlled by preset values to provide optimum conditions for culture growth within a chamber. Operator input is coordinated through the control panel keypad and status displays. Figure 1 shows the various inputs and outputs of the system.

The NuAire Incubator Control Electronics is a state-of-the-art microcomputer based system that provides:

8.3.1 Single or dual chamber control in a single electronic package.

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8.3.2 Enhanced information presentation. The control panel presents:

- Chamber temperature (set point and actual)
- CO_2 level (set point and actual)
- Optional, humidity level (actual)
- Optional, security key lock
- Time of day
- Culture days
- Output and alarm status:
    - Water-jacketed heater status
    - Door heater status
    - CO_2 control status
    - Water-jacket low water status
    - Chamber door ajar
    - System alarm condition status
    - CO_2 tank selection

8.3.3 Simplified operator controls. The control panel is operated using a numeric keypad with the additional of SELECT and ENTER keys. As the SELECT key is repeatedly depressed, the display shows the value corresponding to the indicated parameter. Each depression advances to the next parameter. Entry of a numeric value (with mode switch in standby/setup) followed by depression of ENTER changes the control set point.

8.3.4 Automatic notification of abnormal situations. The red alarm LED on the control panel indicators will light to indicate a fault within the system. Such faults include:

- Power Failure
- System Intermittent
- Control Fault (i.e. temperature exceeds set point tolerance)
- Sensor Out of Calibration

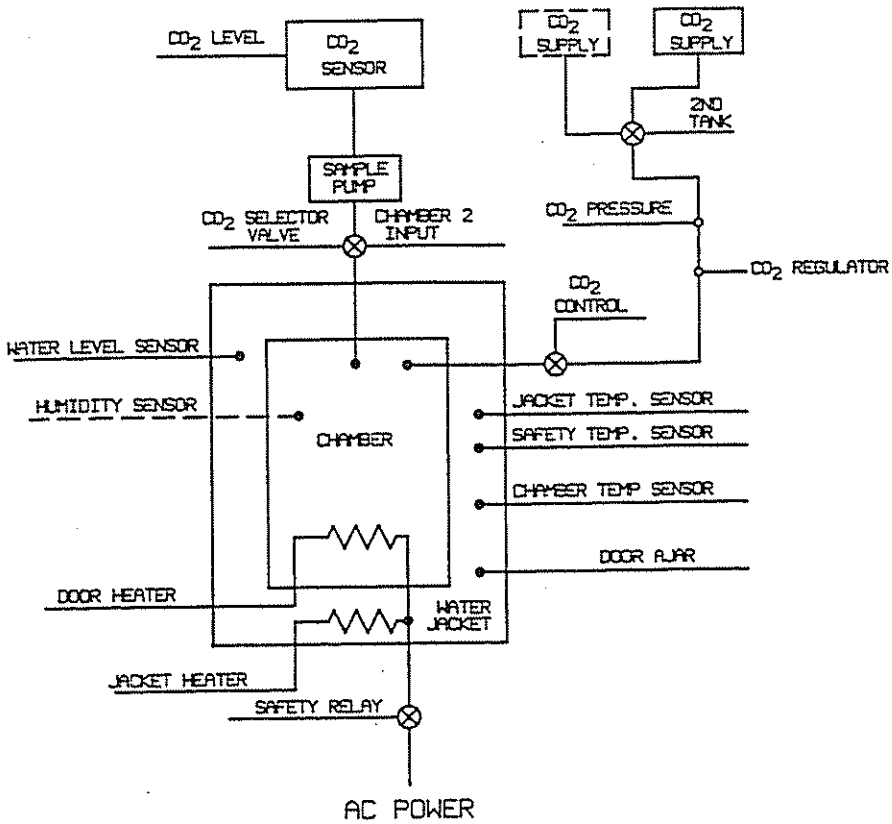


Figure 1. IR AUTOFLOW CONTROL INPUTS & OUTPUTS

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8.3.5 Provision for add on expansion capability. Options include:
- Remote communication capability (RS-232/RS-485)
- Local printer support for hardcopy of monitored data
- Chart recorder output of monitored values
- Automatic tank switch
- Humidity display

8.3.6 Diagnostic and calibration assists. By entering a special code when resetting the culture days value, diagnostic mode is entered. In this mode:
- Individual analog inputs may be displayed to assist calibration
- Individual outputs may be forced to an on or off condition
- Individual digital inputs may be displayed
- Front panel lamps may be tested
- Memory and internal processor diagnostics may be selected
- All options may be individually tested
- System configuration parameters may be altered

Packaging is designed such that all modules are easily removed and replaced. All external wiring is connected through screw terminal connectors. All expansion modules are plug in. All printed circuit boards are held in place with machine screws and all connector blocks to expansion modules are keyed to insure correct placement.

8.4 Front Control Panel

The system front control panel contains the following functions described in detail (see Drawing BCD-04136).

8.4.1 Jacket Heat Status LED

The jacket heat green LED indicates when the chamber heater is turned on.

8.4.2 Door Heat Status LED

The door heat green LED indicates when the door heater is turned on.

8.4.3 Door Ajar Status LED

The door ajar yellow LED indicates when the inner glass door is not closed. The LED acts upon a magnetic switch located along the lower right corner of the inner glass door.

8.4.4 Low Water Status LED

The low water yellow LED indicates when the water-jacket requires additional water. If the low water light is lit, the water-jacket should be filled as soon as possible to avoid uneven heating of the chamber.

8.4.5 Control CO_2 Status LED

The control CO_2 green LED indicates when the CO_2 control valve is open and flowing CO_2 into the chamber.

8.4.6 CO_2 Tank 1 Status LED (Option)

The CO_2 tank 1 green LED indicates when the IR Autoflow is consuming CO_2 from tank 1.

8.4.7 CO_2 Tank 2 Status LED (Option)

The CO_2 tank 2 yellow LED indicates when the IR Autoflow is consuming CO_2 from tank 2.

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8.4.8 Alarm/Error Status LED

The alarm/error red LED indicates a failure condition or an invalid entry of data. A blinking LED indicates a keyboard entry error, press "SEL" key to clear. If the LED is on continuously a catastrophic condition exists. A catastrophic temperature control condition will de-energize the safety relay and cause the chamber to cool below the set point. then again the temperature control will try to control. CO_2 and humidity will not catastrophically fail, but cause the alarm to blink and continue to try to control.

8.4.9 Chamber Sample

The chamber sample port is provided to measure CO_2 percentage manually with a fyrite CO_2 indicator, or other suitable instrument.

8.4.10 Value Indicators

The value indicators, located above the mode switch, indicate the value being shown in the four digit display. The LED corresponding to the value being displayed will be lit. the yellow LED (left side) indicate setup mode selection. The green LED (right side) indicate run mode selection.

Normally, only a single yellow or green LED will be lit. If both LEDs are lit, an abnormal situation has occurred. A power failure will cause both Time of Day LEDs to be lit. If the system is in run mode, the yellow LEDs in the temperature, CO_2 percent, or RH percent (optionally) indicate a control or sensor fault.

8.4.11 Mode Switch

The mode switch is used to select the operating mode of the IR Autoflow chamber, standby/setup or run.

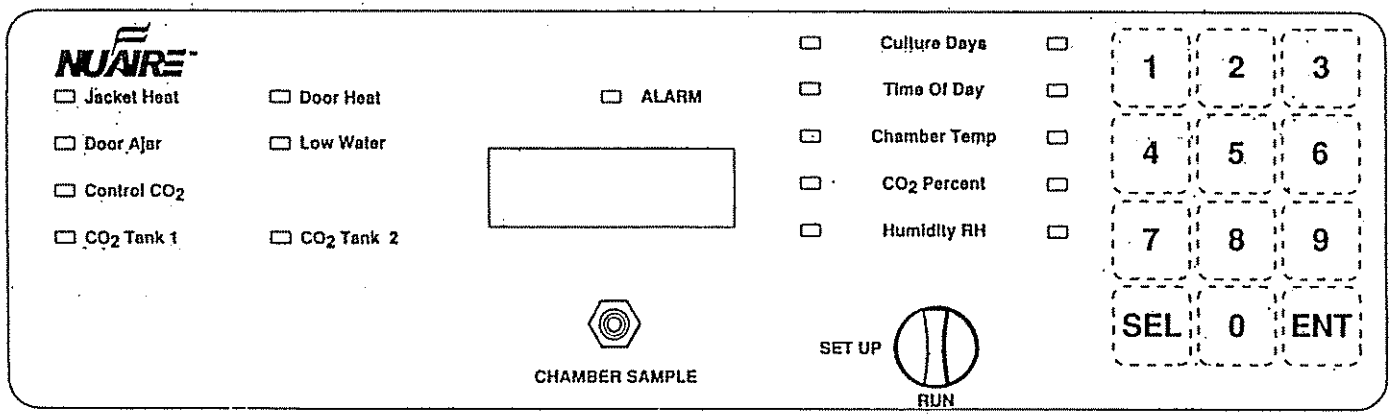
8.4.12 Selection and Entry Keypad

The selection and entry keypad (KEYPAD INPUT SHOULD BE DONE WITH FINGER ONLY, DO NOT USE PENCIL OR SHARP INSTRUMENTS), locate at the right of the control panel, is used for all operator interaction with the NICE system. The "SEL" key is always active, repeated depression of this key causes display of the next value in sequence as listed for the value indicators in a round robin fashion.

When the NICE system is in setup mode, the "ENT" key becomes active and allows the operator to alter set point values. In run mode, depression of the "ENT" key will clear the failure indicator corresponding to the value being displayed.

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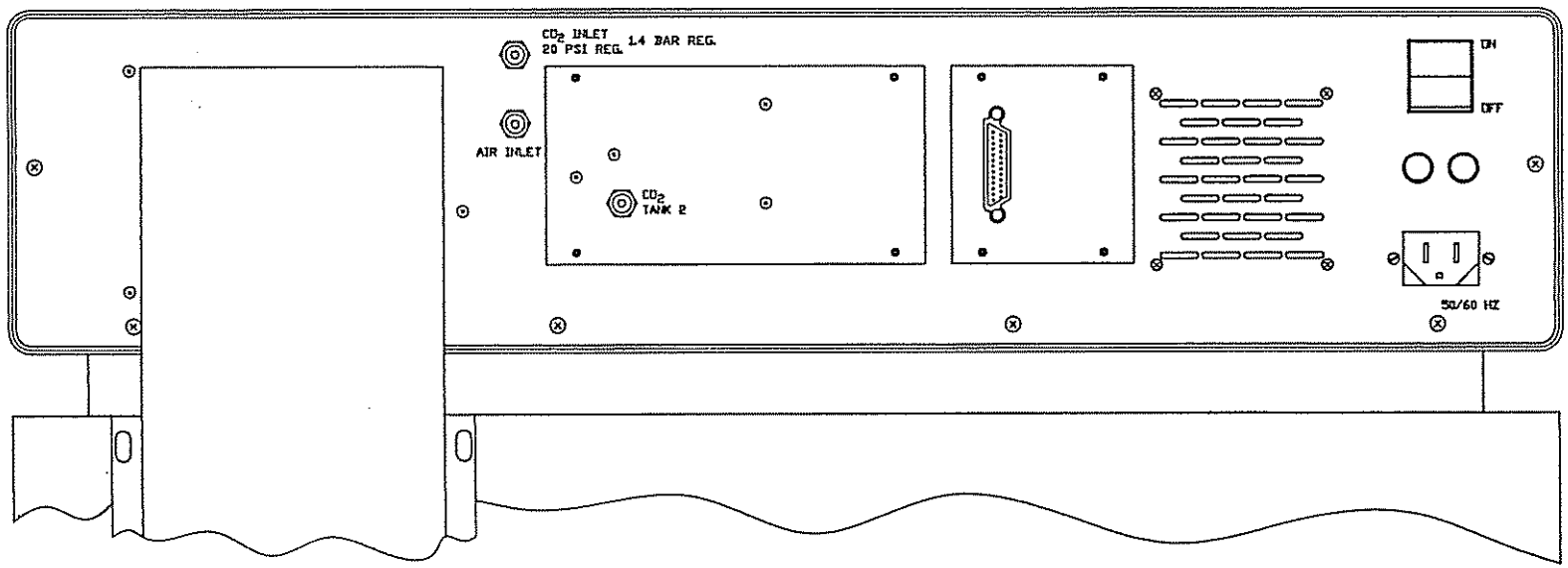
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CHKD			TITLE: CONTROL PANEL
APPR			DRAWING NUMBER: BCD-04136
MATERIAL			SCALE / SHEET OF
APPLICABLE SERIES			

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DFTM TH 4/7/92 CHKD APPR	TITLE NU-2500 REAR PANEL, ARRANGEMENT
MATERIAL 16 GA. CRS	
SHEET 1 OF 1	DRAWING NUMBER BCD-04111 A

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8.5 IR Autoflow Rear Panel

The IR Autoflow rear control panel contains the following functions described in detail (see Drawing BCD-04111).

8.5.1 Power Cord

The power cord is 8 foot (2m) in length, type "SVT" molded plug, allowing for long life and easy cleanability.

8.5.2 Circuit Breaker

All control electronics are protected with a circuit breaker that may trip at 110% of load rating but will trip at 145% of load rating in less than 2 seconds. Should the circuit breaker open (pop-out button will appear), merely depress to reset.

8.5.3 CO_2 Inlet

The CO_2 inlets provide a fitting for clear vinyl tubing. Be sure to follow the recommended inlet pressure to insure proper flow rates and consistent CO_2 percentage readings.

8.5.4 Air Inlet

The air inlet provides a fitting for clear vinyl tubing. The air inlet is provided with clear vinyl tubing and 0.3 micron HEPA filter. This is a free air supply, DO NOT CONNECT with pressurized source.

8.5.5 Power Switch

The power switch, located at the right of the rear panel, controls all power to the incubator.

8.5.6 Internal Tank Switch (Option)

The internal tank switch is an option which is customer installed in the field or factory installed at the time of manufacture. The tank switch performs the critical back-up function of switching tank 1 and tank 2 and back again when each depleted tank is replaced.

8.5.7 Communications (Option)

The communications is an option which is customer installed in the field or factory installed at the time of manufacture. The communication option provides for two way communication with the control system utilizing either the RS-232 or RS-485 interconnect standards. RS-232 provides a short range (50 feet) simple point-to-point connection. RS-485 provides for multiple connections up to 32 IR Autoflow's controllers on a single two or four wire twisted pair with a RS-485/RS-422 device.

Communications utilizes a ten bit character frame with a start bit, eight data bits (with no parity), and stop bit. The baud rate is selectable. To permit multiple systems to share a common communication cable, all communication is half duplex. The IR Autoflow does not echo characters received on the communication line and does not respond until a complete and valid command is received.

8.5.8 Humidity Display (Option)

The humidity display is an option which is customer installed in the field or factory installed at the time of manufacture. The humidity monitor uses a solid state analog humidity sensor and indicates the RH percentage value on the display. the humidity is produced from the stainless steel water pan.

8.6 Run Mode Operator Interactions

In general, there is no need for operator interaction in "run" mode. Operator interaction is provided to permit inspection of current operating conditions. To view a specific parameter, simply press the "SEL" key until the green LED appears next to the desired parameter. Repeated depression of the "SEL" key advances in a round robin fashion to the next value parameter.

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If an abnormal condition has, or does, exist for a particular parameter, the yellow LED next to the parameter will be lit. This could be a catastrophic alarm condition, which could harm the tissue culture cells. It does indicate an operational abnormality and should be checked. To acknowledge the abnormality, simply turn the mode switch to standby/setup and back to run to clear the system. The yellow LED will then extinguish. If the abnormality still exists, the yellow LED will again be lit.

to illustrate the abnormality, the chamber temp yellow LED is lit. Turn the mode switch to standby/setup then back to run. Let run normally, if yellow LED doesn't come back one, everything is normal. If the yellow LED does come back on, enter into diagnostic mode and recalibrate temperature offset (see Section 9.1). If the yellow LED still remains lit, call for service.

The following list provides reasons for abnormality, Also, use the troubleshooting guide (see Section 11.0).

Parameter	**Reason for Abnormality**
Time of Day	Power Interruption
Chamber Temp	System Intermittent, sensor out of calibration or sensor fault
CO_2 Level	System Intermittent, sensor out of calibration or sensor fault
RH Percent	System Intermittent, sensor out of calibration or sensor fault

Catastrophic faults would cause the system to alarm/error and limit control of the chamber environment. for example, if the chamber temp reached 1°C above setpoint, the alarm red LED would light, the system would interrupt power to the heater until the chamber temp returned to setpoint. The heater would then again try to control. If the chamber temp again reached 1°C above setpoint, the alarm would again interrupt power to the heater. this cycle would continue until the unit is checked and the fault corrected.

8.7 Setup Mode Operator Interactions

8.7.1 Chamber Temperature Setpoint, CO_2 Percent Setpoint, Humidity Percent Setpoint

Setpoint values are entered by selecting the desired parameter and pressing the "SEL" key, each depression will advance, in a round robin fashion, to the next value parameter. The value of the selected parameter will be shown in the display in the form "XX.X". To enter a setpoint, perform the following:

Culture Days

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press (0) [ENT].
- Turn mode switch back to run.

Time of Day (24 hour Clock)

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to time of day.
- Enter current time, press (XX.XX), [ENT].
- Turn mode switch back to run.

Chamber Temp

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to chamber temp.
- Enter desired temp setpoint, press (XX.X), [ENT].
- Turn mode switch back to run.

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CO_2 Percent

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to CO_2 percent.
- Enter desired CO_2 percent setpoint, press (XX.X), [ENT].
- Turn mode switch back to run.

Humidity RH (Optional)

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to humidity RH.
- Enter desired humidity RH setpoint, press (XX), [ENT].
- Turn mode switch back to run.

NOTE: If an entry error is made, press [SEL] and re-enter data.

8.8 Diagnostic Interactions

The system provides for complete diagnostic procedures to be performed in the field. Selection of the diagnostic function is entered by performing the following:

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0"

The diagnostic allows the operator to perform offsets and check individual components for proper operation. Below, is a list of all diagnostic functions with their associated number. After performing a diagnostic function, press "SEL" key to zero and clear the current command and prepare for the next.

While in diagnostics, the display will alternate between showing the selected diagnostic value and the diagnostic number.

Diagnostic Functions

x Internal Tests
0 - Exit Diagnostics
1 - Lamp/LED test
2 - CO_2 Sensor Calibration
3 - Memory Test
5 - Communication Loopback test
8 - Reload Default Configuration
9 - Enter Configuration Mode

1x Show Digital Inputs
10 - CO_2 Tank pressure (tank switch option)
11 - Door status
12 - low water status

2x Show/Adjust Analog Inputs
20 - Jacket temperature
22 - Chamber temperature
23 - Safety temperature
24 - CO_2 percent (or Busy/OFF)
25 - RH percent

3x Show/Force Digital Outputs
30 - Safety relay (Enab/Safe)
31 - Jacket heater
32 - Door heater
33 - Air inlet valve
34 - CO_2 inject valve

Examples:

1) Press "11" "ENT" key, the door status should be closed. To check, open the glass door and display should then indicate open. Press "SEL" key to zero command.

2) Press "1" "ENT" key, the display and indicator lights should activate though a sequence to identify any display faults. Press "SEL" key to zero command.

3) Press "34" "ENT" key, the CO_2 control valve should display and indicate off. To exercise any digital output, press any "1-9" key to turn on the valve and the "0" key to turn off the valve. Note: The display and status indicator LED should also indicate an on or off condition. Press "SEL" key to zero command.

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xFunctions - Internal Diagnostics

Function 0 - Exit Diagnostic Function Mode
Selection of this function returns to setup of Culture Days.

Function 1 - Lamp Test
This function will turn all individual LED's and value segments on, sequentially turn them all off and repeat the sequence until another function is selected.

Function 2 - CO_2 Sensor Calibration
This function will allow the zero and span calibration of the CO_2 sensor. A user friendly prompt will advance through the procedure to assure proper sensor calibration (see Section 9.3.2).

Function 3 - Memory Test
This memory test function will perform a non-destructive test of all random access memory in the system. Upon completion of the test, the display will show "Pass" or Fail". If the result is "Fail", service is required on the unit.

Function 5 - Communication Loopback Test (Communications Option)
The communication test is designed to output the NICE software revision level on the communication port and to receive it back. To do this, a special test plug is needed for the communication port.

If the test is successful, "PASS" is displayed. If not, "FAIL" is shown in the value display.

Function 8 - Reload Default Configuration
This function causes a reload of the default configuration and a restart of the system. It is provided in the event that memory is destroyed. See Section 8.8.1.

1x Functions - Show Digital Inputs
For all digital input functions, press the "ENT" key will advance to the next input value.

Function 10 - CO_2 Tank Pressure (Tank Switch Option)
This function shows the current state of the CO_2 tank pressure sensor. The value display will show "Hi" or "Lo" corresponding to the pressure.

NOTE

This function will require that the CO_2 inject valve (Function 34) be momentarily activated to bleed any excess pressure from the line.

Function 11 - Door Status
This function will display the status of the chamber door as "OPEN" or "CLOS".

Function 12 - Low Water Status
This function shows the current state of the water level sensor in the jacket. The value display will show "HI" or "Lo" corresponding to the water level.

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2x Functions - Show Analog Input

Function 20 - Jacket Temperature
Function 22 - Chamber Temperature
Function 23 - Safety Temperature
Function 24 - CO_2 Percent
Function 25 - RH Percent

For all analog input functions, pressing the "ENT" key will advance to the next value input.

Function 20 - Jacket Temperature
This function shows the current value of the temperature sensor located in the water jacket.

Function 22 - Chamber Temperature
This function shows the current value of the temperature sensor located in the chamber.

Function 23 - Safety Temperature
This function shows the current value of the temperature sensor located in the water jacket.

Function 24 - CO_2 Percent
This function shows the current value of CO_2 percentage in the chamber.

Function 25 - RH Percent (Option)
This function shows the current value of RH percentage in the chamber.

3x Functions - Force Digital Outputs

Function 30 - Safety Relay (Enablesafe)
Function 31 - Jacket Heater
Function 32 - Door Heater
Function 33 - Air Inlet Valve
Function 34 - CO_2 Inject Valve

For all digital output functions, pressing the "ENT" key will advance to the next value output.

These functions display the current state of the selected digital output as "OFF" or "ON". Two possible entries may be made to force a specific condition:

- Press 1-9 Force Output On
- Press 0 Force Output Off

CAUTION

Output must be off before selecting new function.

8.8.1 Reload Default Configuration

The Reload Default Configuration diagnostic function 8 is the last effort to correct operational faults which otherwise cannot be solved.

By reloading the default configuration, the entire memory will be reset and ALL CALIBRATION OFFSETS WILL BE LOST. Chamber temperature, door temperature and CO_2 sensor calibration will need to be performed following a Function 8 command.

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To reload default configuration, perform the following: (If dual unit, perform procedure on left front panel.)

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "8" [ENT], display reads 00.0 and both time of day LEDs light.
- Turn unit off and back on again via power switch on back panel.

The procedure is now complete. Proceed to calibrate chamber temperature, door temperature and CO_2 sensor. If unit is a dual chamber, the right side control panel will need to be turned on. Perform the following on the left control panel:

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "CONF 0".
- Press "9" [ENT], display blinks "CONF 0".
- Press "10" [ENT], display blinks "CONF 10" and "Ch. 1".
  (Turn right side front panel mode switch to standby/setup.)
- Press "1" key, display blinks "Ch. 2". (Right side control panel should light up.)
- Press [SEL] until display blinks "FUNC 0". (Proceed to calibrate chamber temperature, door temperature and CO_2 sensor for both chambers.)

8.9 Configuration Interactions

The system provides for complete configuration procedures to be performed in the field. Selection of the configuration functions should only be performed when field installing an option or when calibrating the CO_2 and humidity sensor. Since the configuration functions are the total operating parameters of the IR Autoflow, EXTREME CAUTION should be exercised not to accidentally change any operating parameters. Only access the parameters that are required.

Selection of the configuration function is entered by performing the following:

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "9" [ENT], display blinks "CONF 0".

Below is a list of all the configuration functions with their associated number. After performing a configuration, press "SEL" to zero and clear the current command and prepare for the next.

While in configuration, the display will alternate between showing the selected configuration value and the configuration function number.

All system parameters are as specified in Analog Significance Units (ASU). The current ASU value corresponds to the following actual parameter values.

Temperature 1°C	= 20 ASUs
CO_2 Percent 1%	= 20 ASUs
RH Percent 1%	= 20 ASUs

For example, Function 35, maximum above setpoint allowed is set 1°C above setpoint or 20 analog significance units.

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Configuration Functions

x Chamber Configuration
0 - Exit to Diagnostic Mode
1 - 12 or 24 hour clock display
2 - CO_2 enable (on/off)
3 - Humidity display enable (on/off)
4 - Humidity alarm enable (on/off)
5 - CO_2 back up enable (on/off)
6 - N/A
7 - IR Industries sensor enable (on/off)
8 - Valtronics sensor enable (on/off)

1x System Configuration
10 - 1 or 2 chamber support
11 - 1 or 2 CO_2 tank support
12 - Default tank
13 - Communication enable (on/off)
14 - RS-232 or RS-485 Communications
15 - Dual CO_2 sensor enable (on/off)
16 - Print CO_2 rezero enable (on/off)

4x Humidity Control Parameters
40 - (Humidity Display
41 - Algorithm, Do Not
42 - Access)
43 - N/A
44 - N/A
45 - Max above setpoint allowed (ASU/180)
46 - RH Timeout (minutes/180)

5x CO_2 Control Parameters
50 - Max control period (seconds/120)
51 - Air inject time (seconds/3)
52 - CO_2 switch time (seconds/20)
53 - Post inject recovery time Ch. 1 (seconds/20)
54 - Post inject recovery time Ch. 2 (seconds/20)
55 - Max above setpoint allowed (ASU/20)
56 - CO_2 time out (minutes/130)
57 - Proximity to setpoint (ASU/4)
58 - Inject contribution Ch. 1 (multiplier/4)
59 - Inject contribution Ch. 2 (multiplier/4)

2x System Parameters
20 - Automatic Select (seconds/5)
21 - Sonic alarm timer (seconds/15)
22 - Comm baud rate (display x 100)
23 - Comm address for protocol (0)
24 - Print frequency (minutes/0)
25 - Lines per printer page (60)
26 - Chart Parameter Ch. 1 (0, 1, 2, 3)
27 - Chart Parameter Ch. 2 (0, 1, 2, 3)

3x Temperature Control Parameters
30 - (Temperature Control
31 - Algorithm, Do Not
32 - Access)
33 - N/A
34 - N/A
35 - Max above setpoint allowed (ASU/20)
36 - Maximum sensor differential (ASU/40)
37 - Door Heater Ch. 1 (Percentage on/40)
38 - Door Heater Ch. 2 (Percentage on/40)

6x CO_2 Auto-zero and Backup Parameters
60 - Auto-zero purge time (seconds, 60)
61 - Auto-zero recovery time (seconds, 45)
62 - Auto-zero cycle time (hours/12)
63 - Amount of zero drift Ch. 1 (MV)
64 - Amount of zero drift Ch. 2 (MV)
65 - Calibration CO_2 inject time (seconds/90)
66 - CO_2 Warm-up time (minutes, 30)
67 - Backup purge time (minutes, 120)
68 - Backup CO_2 inject time Ch. 1 (multiplier, 8)
69 - Backup CO_2 inject time Ch. 2 (multiplier, 8)

7x CO_2 Scaling Base Point Parameters

8x (Do Not Access)

9x

( ) - Indicates normal default values

Examples:

1) Press "1" "ENT" key, the display should indicate either "12 hr" or "24 hr". To change, press any "1-9" key or "0" key to return to original setting. Press "SEL" key to zero command.

2) Press "11" "ENT" key, the display should indicate either "tn-1" or "tn-2". This lets the tank switch option to be enabled if purchased and installed. To change, press any "1-9" key or "0" to return to original setting. Press "SEL" key to zero command.

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x Functions - Chamber Configuration

Function 0 - Exit Configuration Mode
This function returns to Diagnostic Mode. No other entry is possible.

Function 1 - Select 12 Hour Clock
On entry, the value display will show "12Hr" to "24Hr". In twelve hour mode, the time of day display has a decimal point to the right of the minute display lit to indicate PM.

Function 2 - CO_2 Enable
On entry, the value display will show "OFF" or "ON". If control is disabled, no setpoint may be entered via the setup procedure, the tank select lights will be extinguished, and NO CO_2 control or inspection of the analog input will be permitted.

Function 3 - Humidity Display Enable
On entry, the value display will show "OFF" or "ON". If display is disabled, no setpoint may be entered via the setup procedure.

Function 4 -
On entry, the value display will show "OFF" or "ON". If the alarm is disabled, no alarm will occur if the water pan is empty.

Function 5 - CO_2 Back Up Enable
On entry, the value display will show "OFF" or "ON". If display is disabled, NO CO_2 back up system will exist for CO_2 alarms.

Function 7 - IR Industries Sensor Enable
On entry, the value display will show "OFF" or "ON". If display is disabled, the incubator must be using the Valtronics IR sensor.

Function 8 - Valtronics Sensor Enable
On entry, the value display will show "OFF" or "ON". If display is disabled, the incubator must be using the IR Industries IR sensor.

1x Functions - System Configuration

Function 10 - Enable Second Chamber Support
On entry, the value display will show "CH-1" or "CH-2". If a single chamber mode is selected, the second operator control panel, if present, will be disabled. If entry is being made from the second panel, it will cease to operate after disabling the second chamber.

Function 11 - Enable Dual CO_2 Tank Support
This function will enable or disable processing of a secondary CO_2 supply tank. On entry, the value display will show "tn-1" or tn-2".

Function 12 - Select Default CO_2 Tank
This function permits selection of the primary CO_2 tank to be used in the event that the system is restarted. This selection is normally made automatically during operation as tank switching occurs. No switching is performed when this action is made.

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Function 13 - Communication Enable
This function enables or disables communication capability. On entry, the value display will show "OFF" or "ON".

Function 14 - Select Communication Mode
This function selects the communication driver and receiver to be used to communicate with the outside word. Selection is made from "R.232" and "R.485".

Function 15 - Dual CO_2 Sensor Enable
This function will enable or disable processing of a second IR sensor for a dual chamber unit. On entry, the value display will show "OFF" or "ON".

Function 16 - Print CO_2 Rezero Enable
This function will enable or disable processing of a second IR sensor for a dual chamber unit. On entry, the value display will show "OFF" or "ON".

2x Functions - System Parameters

Function 20 - Automatic Select
This parameter specifies the length of time the front panel will display the current parameter before advancing to the next. The unit must be in run mode to display the parameters in a round robin fashion automatically.

Function 21 - Sonic Alarm Timer Value
This parameter determines the length of time that the sonic alarm will sound if the "Alarm" LED is lit on the front panel. The value is given in seconds. If desired, entering 128 seconds will initiate a constant alarm until the mode switch is turned to standby/setup and back to RUN.

If the alarm LED is activated, the sonic alarm will also be activated for the period specified. Depression of any keyboard key will silence the alarm until another activation condition is encountered.

Function 22 - Communication Baud Rate Selection
This parameter specifies the baud rate (multiplied by 100) that communications are to run at. Valid numbers are 3, 6, 12, 24, 48 and 96. Any other entry will default to 1200 baud.

Function 23 - Communication Address
This parameter specifies the address of this IR Autoflow unit on a multidrop communication link. If specified, the address must be contained in every communication command to the system. Use of this identifier (a number between 0 and 99) permits multiple systems to share the same RS-485 communication line.

Function 24 - Print Frequency
This parameter specifies the frequency (in minutes) that lines are to be printed on a status report. If the frequency is specified as zero, no report will be printed.

Function 25 - Printer Page Length
This parameter specifies the length of a page on printed (on displayed) output. when a page is full, NICE automatically advances the paper and prints headers on the new page.

Function 26 - Chart Recorder Parameter (Ch. 1)
This parameter specifies the output parameter of the chart recorder. "0" no output, "1" temp, "2" CO_2, and "3" humidity option.

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Function 27 - Chart Recorder Parameter (Ch. 2)
This parameter specifies the output parameter of the chart recorder. "0" no output, "1" temp, "2" CO_2, and "3" humidity option.

3x Functions - Temperature Control Parameters

Function 30 **(Temperature Control Algorithm,**
Function 31 **Do Not Access)**
Function 32
Function 33
Function 34

Function 35 - Maximum Deviation Above Setpoint Allowed (MaxOver)
This value determines the maximum deviation, measured in analog significance units, that the chamber is permitted above the specified setpoint before an alarm condition is declared. An alarm conditions will cause the chamber to enter a safe condition where no power is enabled to any of the system output controls until the situation is rectified.

Function 36 - Maximum Sensor Differential (MaxDiff)
This value specifies a maximum differential, measured in analog significance units, that any two temperature sensors may deviate from one another or from the last read value. If this differential is exceeded, a warning LED is shown on the running chamber. If multiple sensors fail to read within the specified limits, an alarm condition is declared. An alarm condition will cause the chamber to enter a safe condition where no power is enabled to any of the system output controls until the situation is rectified.

Function 37 - Door Heater (Ch. 1)
This value specifies a percentage the door heater is on. For example, if the value shows "50" the door heater is on 50% or every other second.

Function 38 - Door Heater (Ch. 2)
This value specifies a percentage the door heater is on. For example, if the value shows "50" the door heater is on 50% or every other second.

4x Functions - Humidity Control Parameters

Function 40 **(Humidity Control Algorithm,**
Function 41 **Do Not Access)**
Function 42
Function 43
Function 44

Function 45 - Maximum Deviation Above Setpoint Allowed (MaxOver)
This value determines the maximum deviation, measured in analog significance units, that the chamber is permitted above the specified setpoint before an error condition is declined.

Function 46 - RH Timeout (Minutes)
This value specifies the time, in minutes, for the RH percentage to achieve setpoint. If the RH percentage doesn't achieve setpoint within this time period, the RH percent parameter yellow LED will light. This fault usually indicates low water in the water pan.

5x Functions - CO_2 Control Parameters

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Function 50 - Max Control Period
This value determines the maximum control period (cycle) on any chamber between air injections.

Function 51 - Air Inject Time
This value specifies the time, in seconds, for an injection of air into the chamber. Operates for single or dual chamber systems.

Function 52 - CO_2 Switch Time
This value determines the time, in seconds, after the CO_2 sensor has air injected to wait until the CO_2 sensor has a proper sample to control.

Function 53 - Post Inject Recovery (Ch. 1)
This value specifies the time, in seconds, for an injection of CO_2 to be measurable at the sensor. When CO_2 is injected into the chamber, the system delays until this period has elapsed before making a new control decision. In this manner tubing induced delays to not cause the CO_2 system to overshoot the control setpoint.

Function 54 - Post Inject Recovery (Ch. 2)
This value specifies the time, in seconds, for an injection of CO_2 to be measurable at the sensor. When CO_2 is injected into the chamber, the system delays until this period has elapsed before making a new control decision. In this manner tubing induced delays to not cause the CO_2 system to overshoot the control setpoint.

Function 55 - Maximum Deviation Above Setpoint Allowed (MaxOver)
This value determines the maximum deviation, measured in analog significance units, that the chamber is permitted above the specified setpoint before an error condition is declared.

Function 56 - CO_2 Time Out
This value specifies the time, in minutes, for the CO_2 percentage to achieve setpoint. If the CO_2 percentage doesn't achieve setpoint within the time period, the CO_2 percent parameter yellow LED will light. This fault usually indicates low CO_2 cylinder incoming pressure or an empty tank.

Function 57 - Proximity to Setpoint
This value determines the proximity to setpoint, measured in analog significant units, how close to the setpoint the actual CO_2 reading must be to overt an alarm indication.

Function 58 - Inject Contribution (Ch. 1)
These functions define the amount of CO_2 introduced into the chamber for each second of valve activation.

Function 59 - Inject Contribution (Ch. 2)
These functions define the amount of CO_2 introduced into the chamber for each second of valve activation.

6x Functions - Auto-Zero and Backup Parameters

Function 60 - Auto-Zero Purge Time
This value determines the time, in seconds, the inject filtered ambient air into the CO_2 sensor for the auto-zero function.

Function 61 - Auto-Zero Recovery Time
This value determines the time, in seconds, after the auto-zero purge occurs to wait until the CO_2 sensor has a proper sample to control.

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Function 62 - Auto-Zero Cycle Time
This value determines the length of time between the performance of the auto-zero function. Typically, the auto-zero function will occur at 12:00 AM and PM which has been determined to must effectively auto-zero the IR Autoflow.

Function 63 - Amount of Zero Drift (Ch. 1)
This value indicates the amount of CO_2 sensor drift that has occurred from the last CO_2 sensor calibration. The amount of indicated drift will be either positive or negative. This positive drift will indicate between (0 to 127 MV). The negative drift will indicate (256 - (0-127MV). If either the positive reaches 127 or the negative reaches 129 a CO_2 sensor calibration is required.

Function 64 - Amount of Zero Drift (Ch. 2)
This value indicates the amount of CO_2 sensor drift that has occurred from the last CO_2 sensor calibration. The amount of indicated drift will be either positive or negative. This positive drift will indicate between (0 to 127 MV). The negative drift will indicate (256 - (0-127MV). If either the positive reaches 127 or the negative reaches 129 a CO_2 sensor calibration is required.

Function 65 - Calibration CO_2 Inject Time
This value determines the time, in seconds, to inject CO_2 into the chamber while in the span operation of the CO_2 sensor calibration.

Function 66 - CO_2 Warm-Up Period in Minutes
This value defines the number of minutes required to make sure the CO_2 sensor and electronics are stable before trying to control CO_2.

Function 67 - Backup Purge Time
This value determines the time, in minutes, to purge the chamber with filtered ambient air after a CO_2 fault condition has occurred and the CO_2 backup system is initiated.

Function 68 - Backup CO_2 Inject Time (Ch. 1)
This value is the multiplication factor times the CO_2 setpoint to determine the backup CO_2 inject time (Ex. value = 8.0 x 5.0% CO_2 setpoint = 40 second CO_2 inject time).

Function 69 - Backup CO_2 Inject Time (Ch. 2)
This value is the multiplication factor times the CO_2 setpoint to determine the backup CO_2 inject time (Ex. value = 8.0 x 5.0% CO_2 setpoint = 40 second CO_2 inject time).

7x CO_2 Scaling Base Point Parameters
8x (Do Not Access)
9x

8.9.1 CO_2 Backup System
The CO_2 backup system is a user optional feature that must be turned on in configuration Function 5.

To turn on the CO_2 backup system, perform the following:

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "9" [ENT], display blinks "CONF 0".
- Press "5" [ENT], display blinks "CONF 5" and "OFF".
- Press "1" Key, display blinks "CONF 5" and "ON".
- Press [SEL] until display blinks "FUNC 0".
- Turn mode switch to run.

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The CO_2 Backup system being user optional must be fully understood before the decision to activate. The CO_2 Backup system is a programmed sequence in the microcomputer that is accessed upon a catastrophic CO_2 fault (Ex: CO_2 sensor calibration fault or failure). If a CO_2 fault occurs, the incubator will indicate the CO_2 fault with a timed audible alarm and constant yellow LED next to the CO_2 percent. The backup system will then air purge the chamber of all CO_2 for 120 minutes to establish a baseline point of NO CO_2. The air purge time of 120 minutes is necessary to assure, upon a CO_2 fault of too much CO_2, that all the CO_2 has been purged to establish the baseline point of NO CO_2. Then, starting from the NO CO_2 baseline point, the backup system will inject a set amount of CO_2 into the chamber to achieve the CO_2 setpoint. The incubator will then remain at a stationary point losing approximately 0.1% CO_2 every hour. The backup system will then activate every 24 hours at 12:00 AM with the air purge and CO_2 inject cycle. The backup system will continue in effect until the alarm condition is cleared by turning the mode switch on the front panel.

Questions to consider before turning on the CO_2 Backup system.

- Can your cell line tolerate a low or NO CO_2 level for a 2 hour period?
- Can your cell line tolerate a low CO_2 level (2 percent below setpoint) for a 12 hour period?
- Does your laboratory technician often check the incubator front panel for visual alarm indicators?

If your answer to any of the above questions is no, it would not be desirable to activate the CO_2 Backup system.

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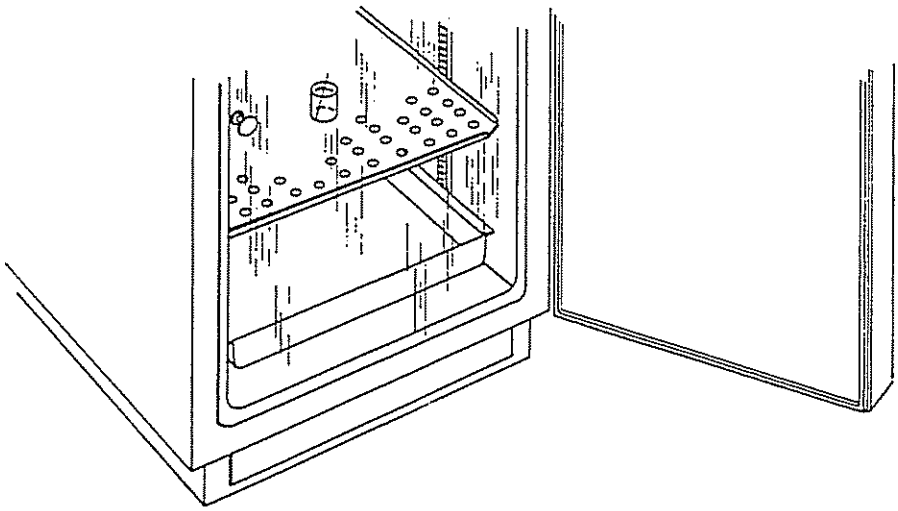
9.0 Calibration

The calibration of the IR Autoflow is accomplished in three steps which are chamber temperature, door temperature and CO_2 sensor. The first two, chamber and door temperature should be completed and stabilized before any CO_2 sensor calibration is performed. Below, each calibration procedure is described in detail. For the best results, follow the procedure carefully, and if the desired result is not achieved, try procedure again from the start.

9.1 Chamber Temperature Calibration

The IR Autoflow's TEMPERATURE CALIBRATION MUST BE PERFORMED WITHIN 1°C OF THE PLANNED OPERATING TEMPERATURE. Normally, 37.0°C is the must common setpoint. To initiate the procedure, turn on the IR Autoflow via the power switch on the back panel. turn mode switch to standby setup to check the temperature value parameter for your planned operating temperature and change if necessary. Turn mode switch back to run and let stabilize for 8 to 12 hours.

At the beginning of this procedure, set a mercury glass thermometer in the glass beaker filled with water resting on a shelf in the middle of the IR Autoflow chamber. Do not place the glass beaker on the bottom of the chamber because it will result in a slightly higher temperature due to the heater pan being located just below the chamber bottom. Placing the thermometer in glass beaker in the middle shelf will give the most accurate results for calibration.



When the unit has stabilized at the operating temperature, perform the following calibration procedure.

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "20" [ENT], display blinks "FUNC 20 and the chamber temperature".
- (Enter thermometer temperature),
- Press "XX.X" [ENT], display blinks "FUNC 20 and the new chamber temperature".
- Press [SEL], display blinks "FUNC 0".
- Turn mode switch to run.

The chamber temperature calibration is complete. Let unit stabilize for 8 to 12 hours. If the chamber temperature (actual thermometer) still does not match the display, perform the above procedure again. In some cases it might be necessary to calibrate several times to achieve a stable condition due to ambient conditions of temperature and humidity within the laboratory.

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9.2 Door Temperature Calibration

The IR Autoflow's inner glass door temperature calibration is best accomplished by running the incubator 24 hours with the water pan in place and perform the following calibration sequence if required.

Open the incubator door and look for general condensation. Some condensation on the glass door is desirable as an indication of adequate humidity in the chamber. Typically one to two inches of condensation in the corners of the glass door indicates a properly calibrated door heater. However, if calibration is required, simply perform the procedure as stated below. The door heater operates as a percentage ON/OFF (0 is Off, 100 if Full ON). Typically, 40 to 60 percent is the must effective setpoint range.

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "9" [ENT], display blinks "CONF 0".
- Press "37" [ENT], display blinks "CONF 37/door heat % ON (XX)".
- (Enter door heat % ON desired),
- Press "XX" [ENT], display blinks "CONF 37 and the new door heat % ON".
- Press [SEL], display blinks "CONF 0".
- Press [SEL], display blinks "FUNC 0".
- Turn mode switch to run.

Note: If performing calibration on a dual unit, the second chamber, lower or right side is calibrated as above in configuration "38".

9.3 CO_2 Calibration

The IR Autoflow infrared CO_2 sensor has two calibration techniques performed, CO_2 control and CO_2 sensor calibration. The CO_2 control procedure is a simple offset performed on the NICE front panel similar to the temperature offset requiring no tools. The CO_2 sensor procedure is more in depth requiring a few tools which takes approximately one half hour to perform.

The IR Autoflow's infrared CO_2 sensor calibration must be performed at the planned operating temperature. Normally 37°C is the must common setpoint. Both calibration procedures require the use of a CO_2 fyrite measuring instrument with a 0 to 20 percent measuring range. Be sure to read the CO_2 fyrite operating instructions for proper CO_2 measurements.

9.3.1 CO_2 Control Calibration

CO_2 Control Calibration can be performed anytime the CO_2 fyrite measurement doesn't correlate to the front panel display. However, not that this calibration SHOULD NOT BE PERFORMED MORE THAN ONCE PER WEEK. Calibration should be performed, if the CO_2 fyrite measurement doesn't match the display after one week within ±0.3 percent. First, check the change the incubator in-line filters within the chamber and control center to assure the proper sample flow rate through the IR sensor. Second, refer to the CO_2 sensor calibration procedure, section 9.3.2.

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When unit is stabilized at the operational temperature and CO_2 percentage, take a CO_2 fyrite measurement and, if necessary, perform the following calibration procedure.

- Turn mode switch to standby/setup.
- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "24" [ENT], display blinks "FUNC 24 and busy or the CO_2 percent". (When display blinks function 24 and the CO_2 percent, proceed to next step)
- Press "0" [ENT], (clears any previous offsets). (note the CO_2 percent. Compare the display CO_2 percent to your fyrite measurement. If these two readings have a difference greater than 2.0 percent, refer to the CO_2 Sensor Calibration Procedure, section 9.3.2. If these two readings have a difference less than 2.0 percent, proceed to enter the fyrite value.)
- Enter fyrite value, press "XX.X" [ENT], display blinks function 24 and the new CO_2 percent.
- Press [SEL], display blinks "FUNC 0".
- Turn mode switch to run.

Note: Calibration is required for both chambers, if dual unit, since each chamber is operating independently.

9.3.2 CO_2 Sensor Calibration

CO_2 sensor calibration should be performed as a preventative maintenance function on a periodic basis or when required due to reoccurring error indicators. The CO_2 sensor has two calibration points, a zero point (ambient CO_2 percentage) and a span point (high CO_2 percentage). The tools required for this procedure are the zero/span adjustment tool (located in unit) and a CO_2 fyrite instrument. The following calibration procedure should be performed ONLY after the chamber temperature is stabilized and the infrared CO_2 sensor has been operating at the stabilized temperature for 2 hours. If the incubator has been in operation for a year or more, in line filter replacement may be necessary. After the above conditions are satisfied, proceed with the following:

Step 1: Remove control center top panel.

Step 2: Check and replace if necessary in line filters (see section 10.0).

Step 3: If performing the calibration a dual unit, only perform on one side at a time. turn the mode switch on the other chamber to standby/setup.

Step 4: Turn mode switch to standby/setup on control panel.

- Press [SEL] to indicate yellow LED next to culture days.
- Press "9734" [ENT], display blinks "FUNC 0".
- Press "2" [ENT], display blinks "door and C.02".

Step 5: Open inner glass door and evacuate chamber for 1 minute. Close door and allow chamber environment to stabilize for 1 minute.

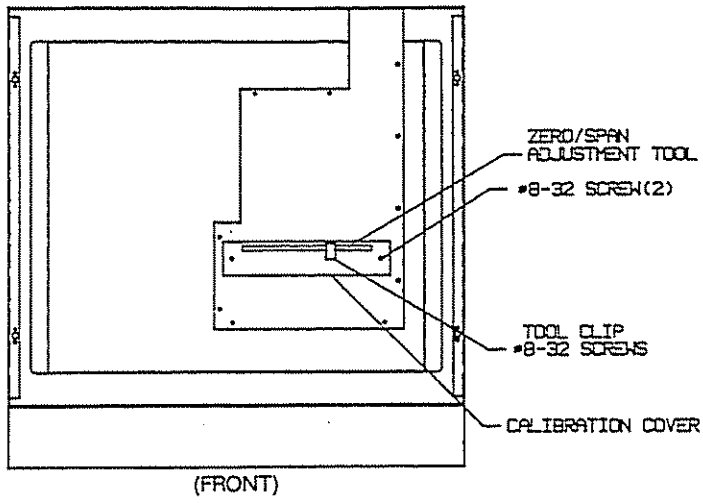
Step 6: Locate IR sensor housing in the control center.

Step 7: Remove calibration cover from housing along with calibration trim pot tool.

NOTE:

Do not remove should cover as it is required to maintain a stable temperature.

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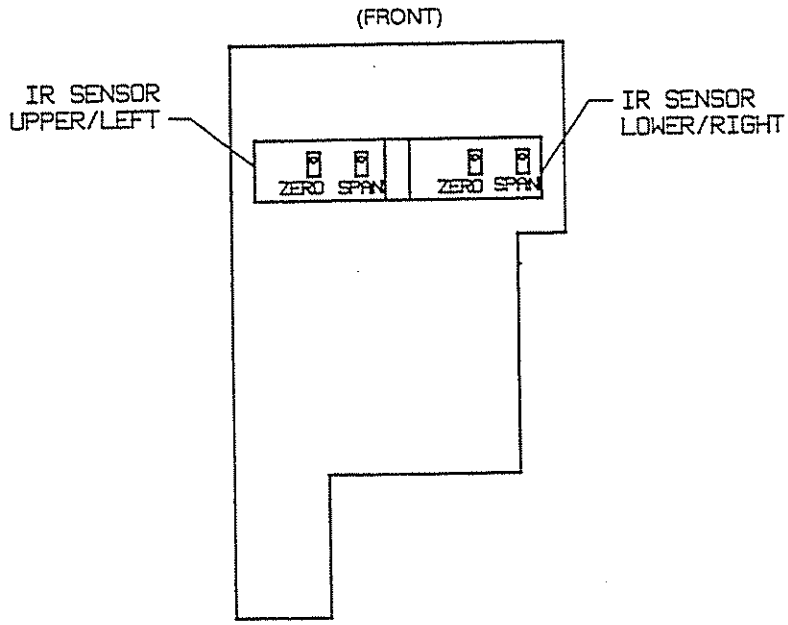


IR SENSOR HOUSING IN CONTROL CENTER

Step 8: Zero CO_2 Sensor.

- Press [ENT], display blinks zero and a positive or negative number.

Locate the zero POT (blue) on the CO_2 Sensor and adjust with blue trim pot tool provided until the display reads 0 ± 5. (Allow 15-20 seconds between adjustments for sensor to stabilize.)



CO_2 SENSOR ADJUSTMENT IN CONTROL CENTER

Step 9: Span CO_2 Sensor

- Press [ENT], display blinks SPAN and the CO_2 percent.

Allow the unit to self inject CO_2 for 90 seconds. Wait an additional minute or until the display CO_2 percent reading is stable. The CO_2 inject green LED will indicate CO_2 flow into the chamber during the 90 second automatic CO_2 injection.

Step 10: Fyrite the incubator to determine correct CO_2 percentage.

Locate the SPAN POT (blue) and adjust with Trim Pot Tool until the display CO_2 percent is the same as the fyrite CO_2 percentage. (Allow 15-20 seconds between adjustments for sensor to stabilize.)

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Step 11: Open inner glass door and evacuate chamber for 1 minute. Then, close the door.

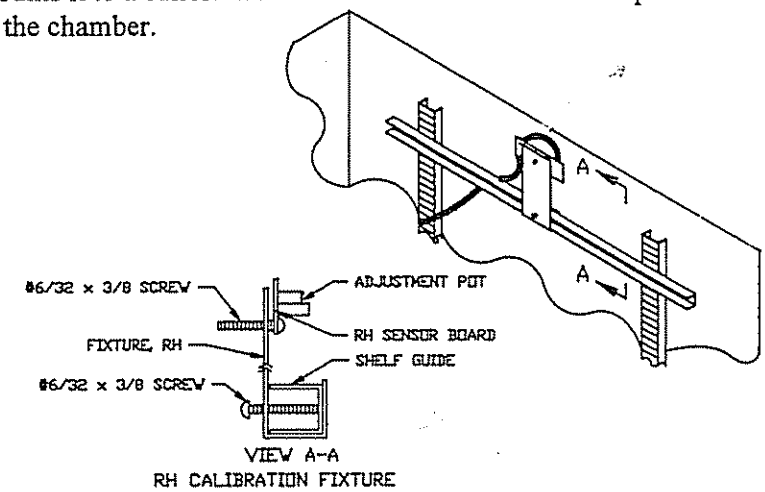
- Press [SEL], display blinks "FUNC 0".
- If performing the calibration on a dual unit, perform a second chamber calibration now. Be sure to turn the mode switch on the first chamber to standby/setup and follow steps 3 through 11. Once all the calibration is complete, turn the mode switch(es) back to run.

Allow unit to run and stabilize for 2 hours. check calibration with the fyrite. Compare the display CO_2 percent to your fyrite measurement. If these two readings have a difference greater than 0.5 percent, repeat the above procedure beginning with step 2. If these two readings have a difference of less than 0.5 percent, perform the CO_2 control calibration procedure in section 9.3.1.

9.4 Relative Humidity Calibration (Option)

Relative Humidity Calibration can be performed anytime if the relative humidity display option has been installed. The relative humidity sensor can be calibrated from a known source of humidity source within the incubator chamber. Typically, the water pan is used because it has a known humidity level of 96 percent. The adjustment potentiometer (pot) is located on the humidity sensor board in the upper rear wall of the chamber.

Since the location of the humidity sensor board is difficult to reach. The calibration method described below, removes the humidity sensor board from the rear wall and mounts it to a calibration fixture next to the side access port of the chamber to allow the calibration to be performed outside the chamber.



RH SENSOR CALIBRATION

Step 1: Remove RH sensor from upper wall of chamber.

Step 2: Attach RH sensor cable extended and calibration fixture. Be sure the RH sensor adjustment pot is accessible though the side access port with the same adjustment tool as the CO_2 sensor calibration.

Step 3: Close incubator doors and with the water pan in place, let incubator stabilize for a minimum of one hour.

Step 4: When unit is stabilized and the operational temperature, CO_2 percentage and water pan in place, perform the following calibration procedure.

- Turn Mode Switch to Standby/Set Up
- Press [SEL] to Indicate Yellow LED Next to Culture Days
- Press "9734" [ENT], Display Blinks "FUNC 0"
- Press "25" [ENT], Display Blinks "FUNC 25 and the RH Percent"
- Press "0" [ENT], Display Blinks "FUNC 25 and the RH Percent" (or 96)
  (If the RH Percent is between 93 to 99 percent, skip to RH ~~Offset~~ Calibration, if not proceed.)
  (~~Open Incubator Outer Door and locate the humidity sensor pot within the chamber. Open inner glass door quickly, adjust pot counterclockwise to increase display or clockwise to decrease display. The goal is to achieve 96 percent. After some adjustment is made, close the door and continue procedure.~~)
- Press [SEL], Display Blinks "FUNC 0"
- Turn Mode Switch to Run

Allow incubator to stabilize for 2 hours and repeat above steps if necessary.

RH CONTROL CALIBRATION

- Enter "96" [ENT], Display Blinks "FUNC 25 and 96 %"
- Press [SEL], Display Blinks "FUNC 0"
- Turn Mode Switch to Run

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10.0 Maintaining Your IR Autoflow

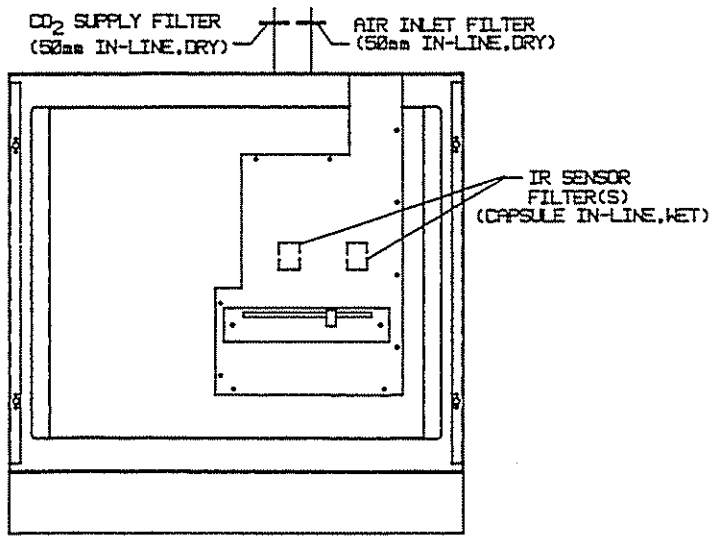
IR Autoflow Chamber
The chamber maintenance is only required as to the extent of cleanliness and sterility. The shelves and bracket supports are all removable and autoclavable. The interior should be wiped down with an appropriate disinfectant such as 70% ISOPROPYL or equivalent. **DO NOT USE ANY CHLORINATED OR HALOGEN MATERIALS IN THE CHAMBER.** *The humidity pan should also be sterilized and the water changed regularly to assure sterility. A small amount of copper sulfate may be added to the humidity pan to inhibit bacterial growth.*

IR Autoflow Water-Jacket
The water-jacket required no anti-bacterial agents. The IR Autoflow already incorporates a copper tube producing copper sulfate which eliminates bacterial growth within the water-jacket. **DO NOT USE ANY CHLORINATED OR HALOGEN MATERIALS IN THE WATER-JACKET.**

CO_2 Supply Filter (50 mm In-Line, Dry)
The CO_2 Supply Filter should be replaced every fifth empty CO_2 tank or when the filter is visibly discolored (yellow-brown). Note direction of flow (IN is labeled on one side of filter) when replacing filter.

Air Inlet Filter (50 mm In-Line, Dry)
The Air Inlet Filter is located on the pack panel. The purpose of the filter is to cleanse the room air which is drawn into the chamber, via the CO_2 sensor sample pump, for three seconds every minute to assure the proper amount of oxygen is available to the cultures. The air inlet filter should be replaced every six months.

IR Sensor Filter (Capsule In-Line, Wet)
The IR Sensor Filter should be replaced EVERY TWO YEARS to assure optimum performance. A visual check should be performed during the CO_2 sensor calibration to assure filter integrity. Remove sensor housing cover to perform visual check.



CONTROL CENTER FILTERS

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11.0 Error Indicators & Troubleshooting

Step 1: NOTE ALL ERROR INDICATOR. When the incubator is running, any and all red or yellow LEDs indicate an error.

Step 2: CLEAR ERROR INDICATORS. Error indicators can be cleared by turning mode switch to standby/setup and back to run.

Step 3: MONITOR RE-OCCURRENCE OF ERROR INDICATORS. If re-occurrence of the error indicator is immediate or daily, use guide below to correct the situation.

Error Indicator Troubleshooting Guide

CHAMBER TEMPERATURE

■ CHAMBER TEMP	Indicator: (3) Temperature sensors are not calibrated. Correction: Perform chamber temperature calibration (see section 9.1).
■ CHAMBER TEMP	Indicator: Chamber over temp
■ ALARM	Correction: Perform chamber temperature calibration (see section 9.1). If not calibration, temp sensor or main control board fault.
Incubator Does Not Heat	Correction: Check fuse on main control board inside control center. If not fuse, main control board fault.

CO_2 PERCENT

NOTE: If the CO_2 Percent indicator is lit, as shown below, the backup CO_2 control system is in effect. Turning the mode switch to standby/setup and back to run will clear the error indicator and allow the CO_2 control system to resume as normal. If the error indicator re-occurs, make the appropriate correction as stated below.

■ CO_2 PERCENT	Indicator: CO_2 Percent over setpoint by more than 1 percent. Correction for New Unit: Reduce CO_2 gas cylinder regulator pressure. Correction for Existing Unit: Replace In-Line Filters and perform CO_2 Sensor Calibration (see section 9.3.2).
Incubator CO_2 Percent does not match the Fyrite Instrument	Correction: Perform CO_2 Control Calibration (see section 9.3.1).
Rapidly Fluctuating CO_2 Percentage	Correction: Replace In-Line Filters and perform CO_2 Sensor Calibration (see section 9.3.2).

RH PERCENT

■ RH PERCENT	Indicator: RH Percent over or under setpoint. Correction: Perform RH Percent Calibration (see operating instructions).

GENERAL INDICATORS

■ TIME OF DAY □	Indicator: Interruption of power to incubator. Correction: Turn mode switch to standby/setup and back to run.

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ER:AC	Indicator: Power to incubator is below 90 VAC.
ER:AD	Indicator: Main control board fault. Correction: Replace main control board.
ER:12	Indicator: Failure of 12 VDC source from power supply. Correction: Replace power supply or main board.
ER:SU	Indicator: Main control board failed to read correct setup information. Correction: If error signal is continuous, replace main control board. If error signal appears once, recalibrate incubator temperature and CO_2 control.
dely	Indicator: CO_2 Control is in delay for one of the following reasons: 1) Power interruption just occurred. Will resume CO_2 Control within 20 minutes. To bypass delay, perform following procedure: • Turn Mode Switch to Standby/Setup. • Press [SEL] to indicate yellow LED next to culture days. • Press "9734" [ENT], display blinks "FUNC 0". • Press "24" [ENT], display blinks function 24 and CO_2 percent or busy. • Press [SEL], display blinks "FUNC 0". • Turn mode switch back to run. 2) Chamber temp is not within 2.0°C of setpoint. Cannot bypass this delay.
■ LOW WATER	Indicator: Low water in jacket. Correction: Add water to jacket via fill port.
Audible Alarm with No Error Indicators Lit	Indicator: Tank switch occurrence Correction: Turn mode switch to standby/setup and back to run.

For further assistance, call NuAire customer service at 1-800-328-3352 or (612) 553-1270

12.0 Remote Alarm Contacts

The NuAire IR Autoflow contains a set of contact points to connect to a remote alarm system. the two contact points are located on the main control board, connector (P5) positions 7 and 8. the contact points upon an alarm produce a 12 VDC signal capable of energizing a relay coil up to 20 ma. The alarm contact points do not distinguish between a CO_2 or temperature alarm. Each will produce a signal to the alarm system.

The contact points are shown on the electrical schematics BCD-04110 and BCD-04112. The actual connection is made by inserting a bare wire into the connector and screwing down tight. the wire may be neatly routed through the existing wire routings in the control center.

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13.0 Replacement Parts List

13.1 115 VAC Parts List

The following is a list of replacement parts. Please consult NuAire for parts not listed. To order, specify model no., serial no., and part no.

Part Number	Description	Quantity NU-2500	NU-2600/ NU-2700
A-2500-482	NU-2500 Main Control Board	1	---
A-2500-483	NU-2600 Main Control Board	---	1
A-2500-483	NU-2700 Main Control Board	---	1
A-2500-123	Nice Front Panel Board	1	2
B-990237	Label, Front Membrane	1	2
A-999863	Power Supply	1	1
A-999309	EMI Filter	1	1
F-2500-631	Mode Switch Assy.	1	2
A-999805	Infrared CO_2 Sensor	1	1
F-2500-628	CO_2 Control Valve (2 Way)	1	2
A-999807	Main Power Switch	1	1
A-999747	Water Level Sensor	1	2
A-999605-06	Sensor, Chamber	1	2
A-999605-06	Sensor, Water Jacket	2	4
A-980554	CO_2 Regulator	1	1
A-999134-06	Circuit Breaker (8 amp)	1	---
A-999134-07	Circuit Breaker (15 amp)	---	1
A-1500-010	Magnetic Door Gasket	1	2
F-1500-629	Door Panel Heater Assy.	1	2
A-1500-051	Glass Door	1	2
F-1500-124	Heater Pan Assembly (115 V)	1	2
A-1500-065	Shelf Brackets (Pair)	AR	AR
A-980444	Leg Levelers	AR	AR
A-999550	Electrical Cord 3. Cond. 8 Ft.	1	1
A-980324	1/4" NPT Hose Adapter	AR	AR
A-980308	Hose Barb (1/8" NPT x 3/16" Tube)	6	6
F-1500-309	Magnetic Door Assy. Switch	1	2
A-980464	Magnet	1	2
A-980758	Drain Valve	1	2
A-999760	Safety Relay	1	2
A-999014	Fan 12 VDC	1	2
A-999314-04	Fuse (IR Sensor, 1 amp, 250 Volt)	1	2
A-999314-02	Fuse (Main Control Board, 5 amp, 250 Volt)	1	2
A-980385	50 mm In-Line Filter (Dry)	2	2
A-999008	Pump Sample (115 V)	1	2
F-2500-629	Air Inlet Valve (3 Way) (12 VCD)	1	2
A-980398-01	Capsule In-Line Filter (Wet)	1	2
A-999645	MOV Suppresser (115 V)	1	2
A-2500-611-01	Heater, Back Channel (Single)	1	---
A-2500-612-01	Heater, Back Channel (Dual)	---	1
A-2500-359-01	Heater, Sensor Housing	1	1

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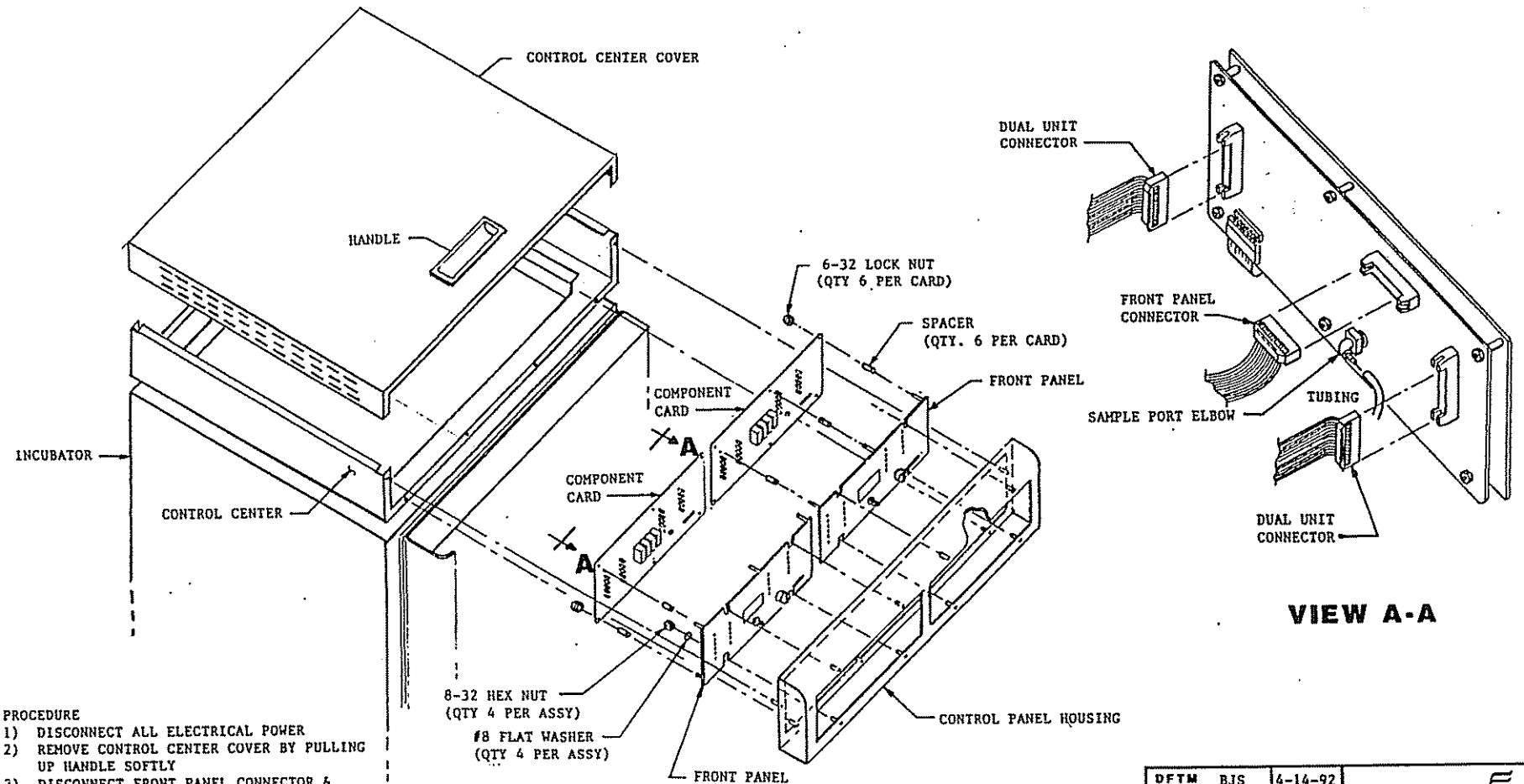
13.2 220 VAC Parts List

The following is a list of replacement parts. Please consult NuAire for parts not listed. To order, specify model no., serial no., and part no.

Part Number	Description	Quantity NU-2500E	NU-2600E/ NU-2700E
A-2500-484	NU-2500E Main Control Board	1	---
A-2500-485	NU-2600E Main Control Board	---	1
A-2500-485	NU-2700E Main Control Board	---	1
A-2500-123	Nice Front Panel Board	1	2
B-990237	Label, Front Membrane	1	2
A-999863	Power Supply	1	1
A-999309	EMI Filter	1	1
F-2500-631	Mode Switch Assy.	1	2
A-999805	Infrared CO_2 Sensor	1	1
F-2500-628	CO_2 Control Valve (2 Way)	1	2
A-999807	Main Power Switch	1	1
A-999747	Water Level Sensor	1	2
A-999605-06	Sensor, Chamber	1	2
A-999605-06	Sensor, Water Jacket	2	4
A-980554	CO_2 Regulator	1	1
A-999134-01	Circuit Breaker (5 amp)	2	---
A-999134-02	Circuit Breaker (10 amp)	---	2
A-1500-010	Magnetic Door Gasket	1	2
F-1500-630	Door Panel Heater Assy.	1	2
A-1500-051	Glass Door	1	2
F-1500-302	Heater Pan Assembly (220 V)	1	2
A-1500-065	Shelf Brackets (Pair)	AR	AR
A-980444	Leg Levelers	AR	AR
A-999582	Electrical Cord 3. Cond. 2.5 meters	1	1
A-980324	1/4" NPT Hose Adapter	AR	AR
A-980308	Hose Barb (1/8" NPT x 3 mm Tube)	6	6
F-1500-309	Magnetic Door Assy. Switch	1	2
A-980464	Magnet	1	2
A-980758	Drain Valve	1	2
A-999760	Safety Relay	1	2
A-999014	Fan 12 VDC	1	2
A-999314-04	Fuse (IR Sensor, 1 amp, 250 Volt)	1	2
A-999314-03	Fuse (Main Control Board, 3 amp, 250 Volt)	1	2
A-980385	50 mm In-Line Filter (Dry)	2	2
A-999776	Pump Sample (220 V)	1	2
F-2500-629	Air Inlet Valve (3 Way) (12 VCD)	1	2
A-980398-01	Capsule In-Line Filter (Wet)	1	2
A-999644	MOV Suppresser (220 V)	1	1
A-2500-611-02	Heater, Back Channel (Single)	1	---
A-2500-612-02	Heater, Back Channel (Dual)	---	1
A-2500-359-02	Heater, Sensor Housing	1	1

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REV	ECO	DESCRIPTION	DATE	INL



VIEW A-A

PROCEDURE
1) DISCONNECT ALL ELECTRICAL POWER
2) REMOVE CONTROL CENTER COVER BY PULLING UP HANDLE SOFTLY
3) DISCONNECT FRONT PANEL CONNECTOR & DUAL UNIT CONNECTOR IF APPLICABLE
4) SEPARATE COMPONENT CARD FROM FRONT PANEL BY REMOVING 6-32 LOCKNUTS & SPACERS
5) REMOVE FRONT PANEL BY REMOVING (4) 8-32 HEX NUTS AND WASHERS
6) TO INSTALL NEW FRONT PANEL REVERSE THE ABOVE STEPS

DFTM	BJS	4-14-92
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE
FRONT / TOP PANEL ASSEMBLY

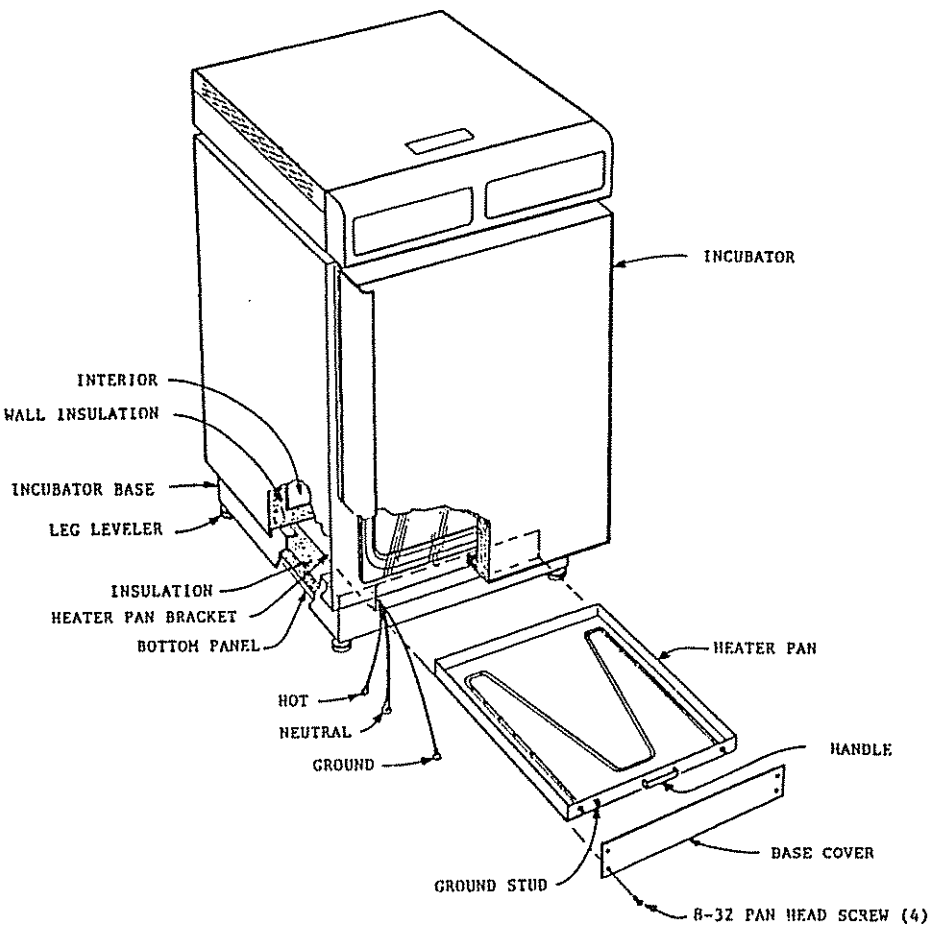
DRAWING NUMBER
BCD-04122

SCALE

SHEET 1 OF 1

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REV	ECO	DESCRIPTION	DATE	INL

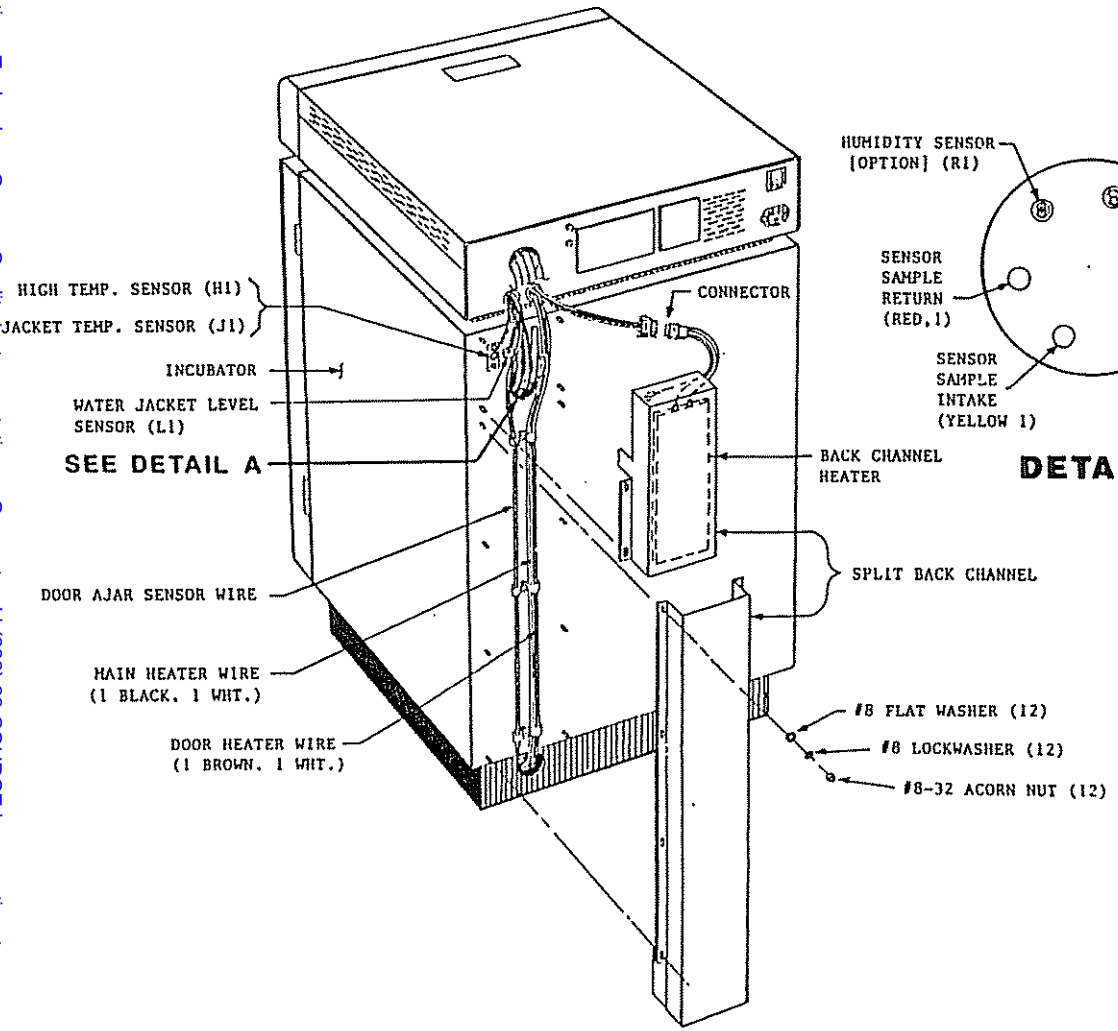


PROCEDURE:
1. DISCONNECT ALL ELECTRICAL POWER.
2. REMOVE (4) SCREWS AND BASE COVER.
3. REMOVE WIRE TERMINATIONS WITH 3/8" OPEN END WRENCH (HOT, NEUTRAL, AND GROUND).
4. TO REMOVE HEATER PAN, SLOWLY PULL HANDLE OUTWARD.

DFTM BJS	4/9/92	NUAIRE PLYMOUTH, MINNESOTA
CHKD		
APPR		TITLE: HEATER PAN ASSEMBLY
MATERIAL		DRAWING NUMBER: BCD-04120
APPLICABLE SERIES		SCALE: NONE SHEET OF

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REV	ECO	DESCRIPTION	DATE	INL



DETAIL A

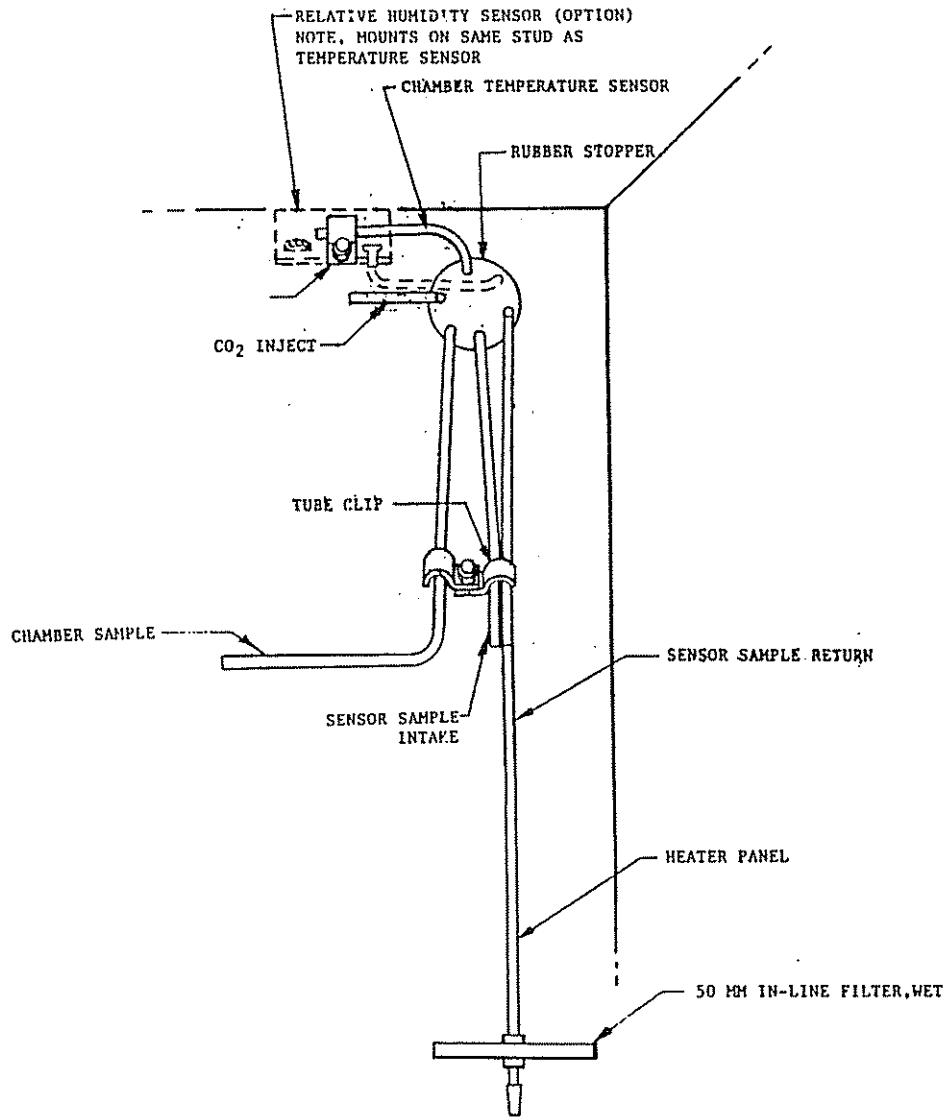
PROCEDURE

1) DISCONNECT ALL ELECTRICAL POWER.
2) REMOVE #8-32 NUTS AND WASHERS HOLDING THE SPLIT BACK CHANNEL.
3) GENTLY REMOVE BACK CHANNEL HEATER. NOTE: DISCONNECT THE CONNECTOR AND SET ASIDE.
4) COMPONENT REPLACEMENT IS MADE BY IDENTIFYING THE COMPONENT AT FAULT. REMOVE AND REPLACE -- MAKE NOTE OF COMPONENT IDENTIFICATION AND ELECTRICAL COLOR CODES.
5) REVERSE STEPS 3, 2 AND 1 TO RE-ATTACH SPLIT BACK CHANNEL.

DFTM BJS	4-9-92	NUAIRE PLYMOUTH, MINNESOTA
CHKD		
APPR		TITLE: BACK CHANNEL ASSEMBLY
MATERIAL		DRAWING NUMBER: BCD-04121
APPLICABLE SERIES		SCALE / SHEET 1 OF 1

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REV	ECO	DESCRIPTION	DATE	INL



DFTM	BJS	4-14-9?
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE
CHAMBER TUBING ASSEMBLY

DRAWING NUMBER
BCD-04135

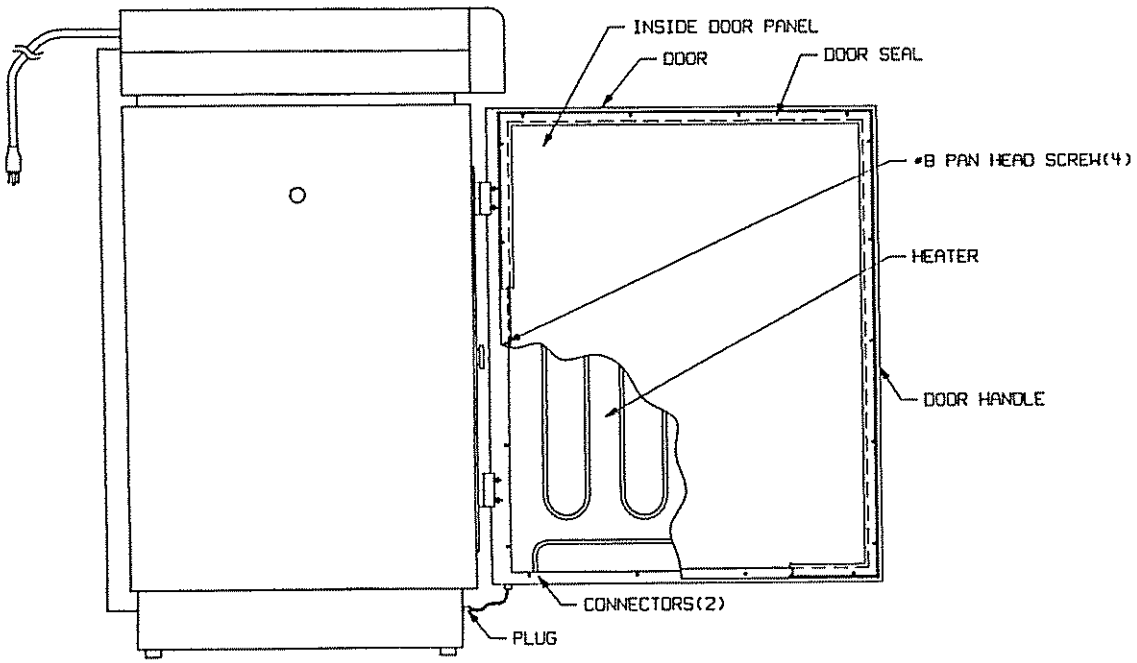
SCALE

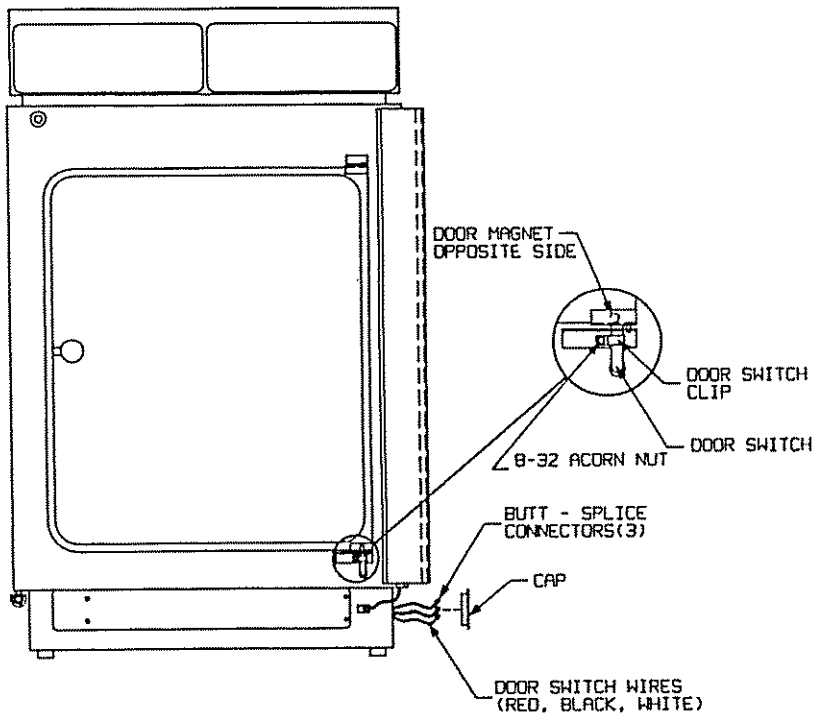
SHEET 1 OF 1

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REV	ECO	DESCRIPTION	DATE	INL	INL





DOOR SWITCH
REPLACEMENT PROCEDURE

1. DISCONNECT ALL ELECTRICAL POWER.
2. REMOVE DOOR SWITCH CLIP (1) 8/32 ACORN NUT.
3. PULL SWITCH AWAY FROM DOOR HINGE AREA.
4. REMOVE BLACK CAP ON SIDE OF BASE COLLAR.
5. PULL OUT DOOR SWITCH WIRES.
6. CUT BUTT SPLICE (3) AND PULL OUT DOOR SWITCH FROM FRONT OF UNIT.
7. INSTALL NEW DOOR SWITCH FROM FRONT OF UNIT REVERSING THE ABOVE STEPS. NOTE COLOR CODE. (NOTE, CHECK DOOR SWITCH OPERATION SO, THE DOOR SWITCH IS ACTIVATED BY THE MAGNET.)

DOOR HEATER
REPLACEMENT PROCEDURE

1. DISCONNECT ALL ELECTRICAL POWER.
2. REMOVE (10) #8 PAN HEAD SCREWS LOCATED UNDER THE DOOR SEAL.
3. REMOVE DOOR PANEL W/SEAL, MOVING SLOWLY AWAY FROM DOOR EXPOSING WIRES.
4. CUT BUTT SPLICE CONNECTORS FROM DOOR HEATER. NOTE COLOR CODE.
5. REMOVE DOOR HEATER.
   -PULL OFF DOOR HEATER AND REPLACE.
   - NOTE,SILICON RTV MUST BE APPLIED TO CORNERS OF HEATERS
6. REPLACE DOOR HEATER REVERSING THE ABOVE STEPS.

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DFTM	TH	3/20/92
CHKD		
APPR		
MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE
DOOR HEATER AND SWITCH ASSEMBLY

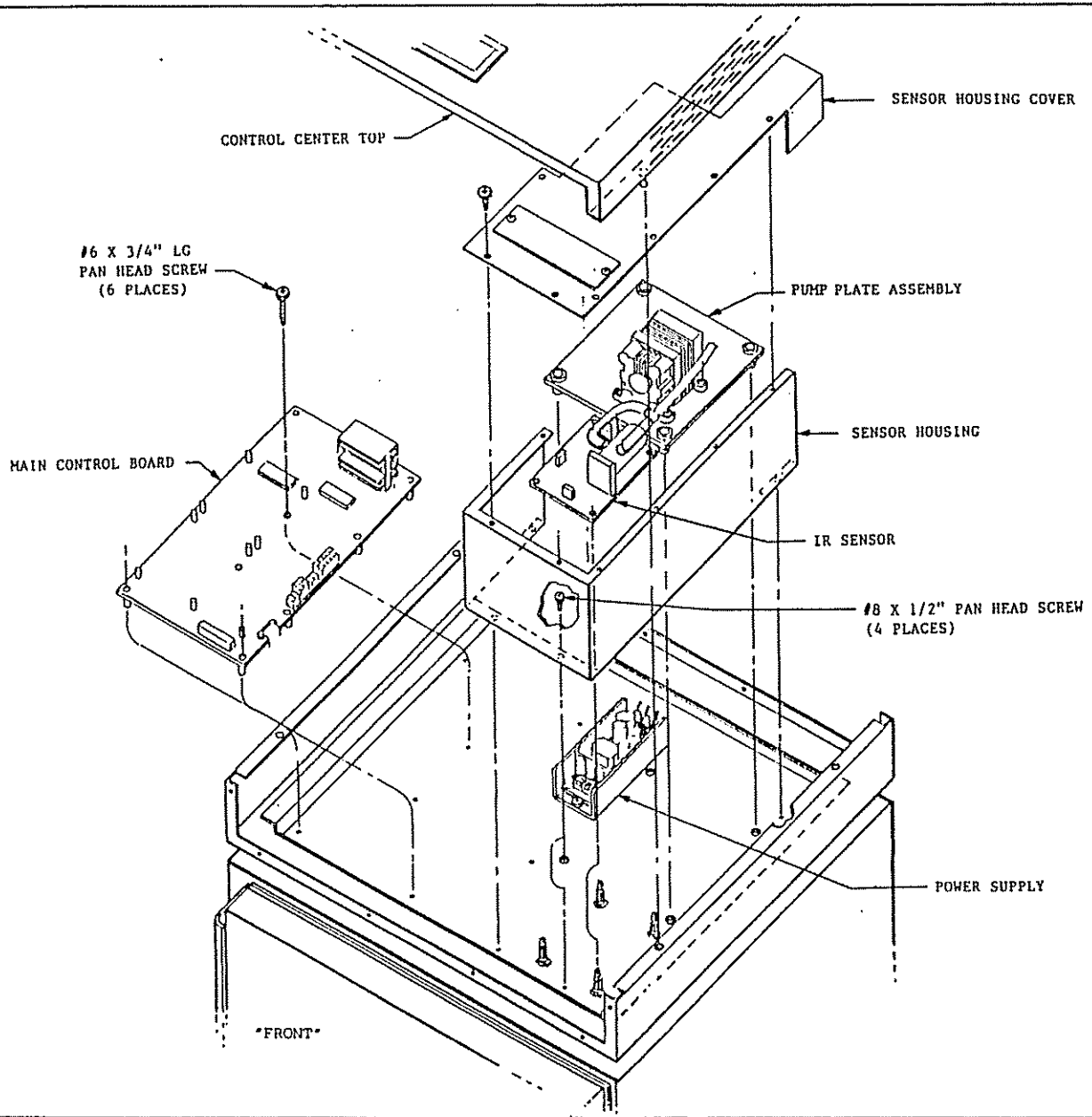
DRAWING NUMBER BCD-04104

SCALE

SHEET 1 OF 1

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REV	ECO	DESCRIPTION	DATE	INL

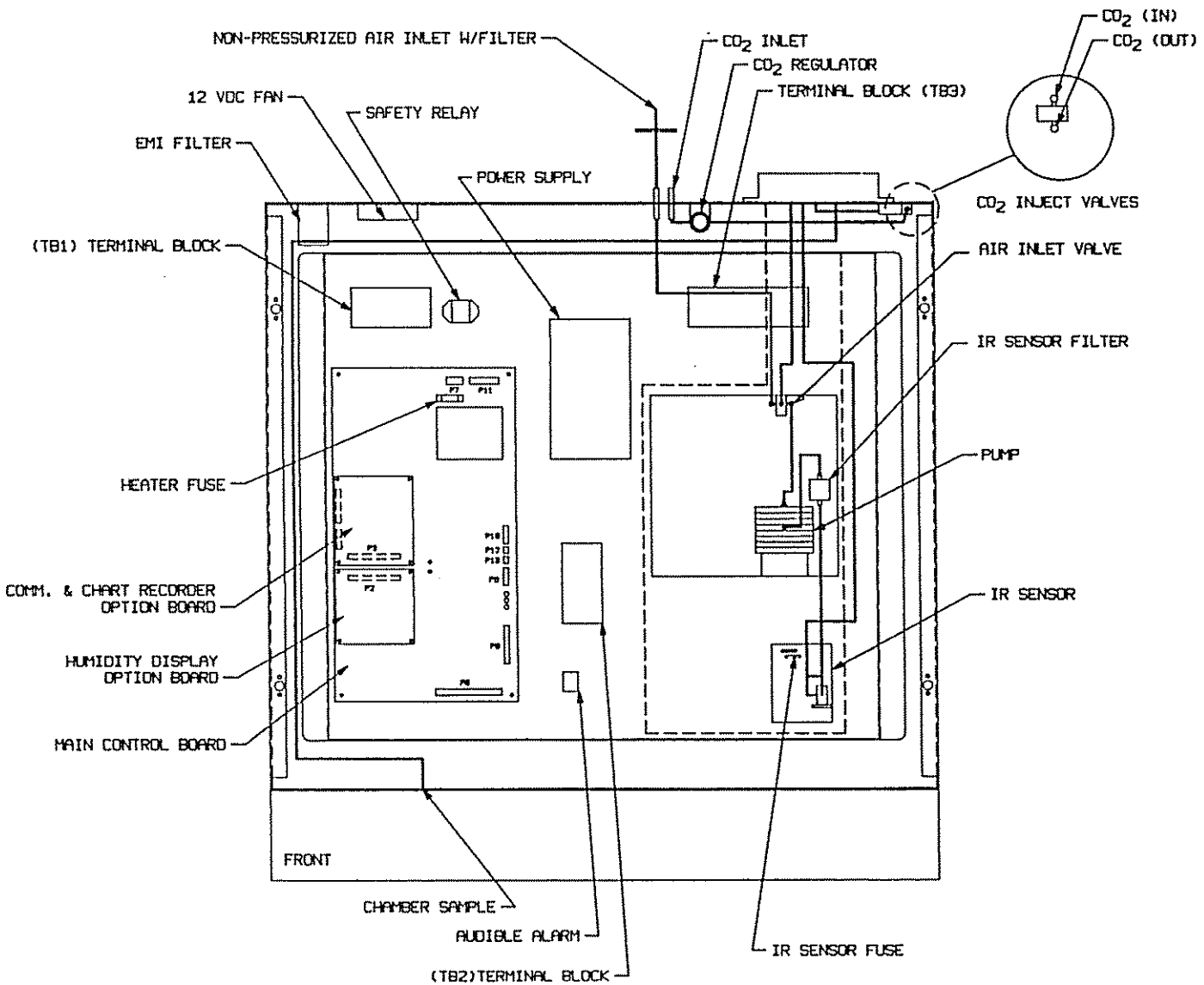


PROCEDURE

1. DISCONNECT ALL ELECTRICAL POWER.
2. IDENTIFY COMPONENT FOR REPLACEMENT.
3. DISCONNECT ANY ELECTRICAL CONNECTIONS
   NOTE COLOR CODE
4. REMOVE COMPONENT AS SHOWN.
5. REPLACE COMPONENT BY REVERSING
   THE ABOVE STEPS.

DFTM BJS	4-16-92	NUAIRE PLYMOUTH, MINNESOTA
CHKD		
APPR		
MATERIAL		TITLE: CONTROL CENTER ASSEMBLY
APPLICABLE SERIES		DRAWING NUMBER: BCD-04138
SCALE ~		SHEET 1 OF 1

REV	ECO	DESCRIPTION	DATE	INL	INL



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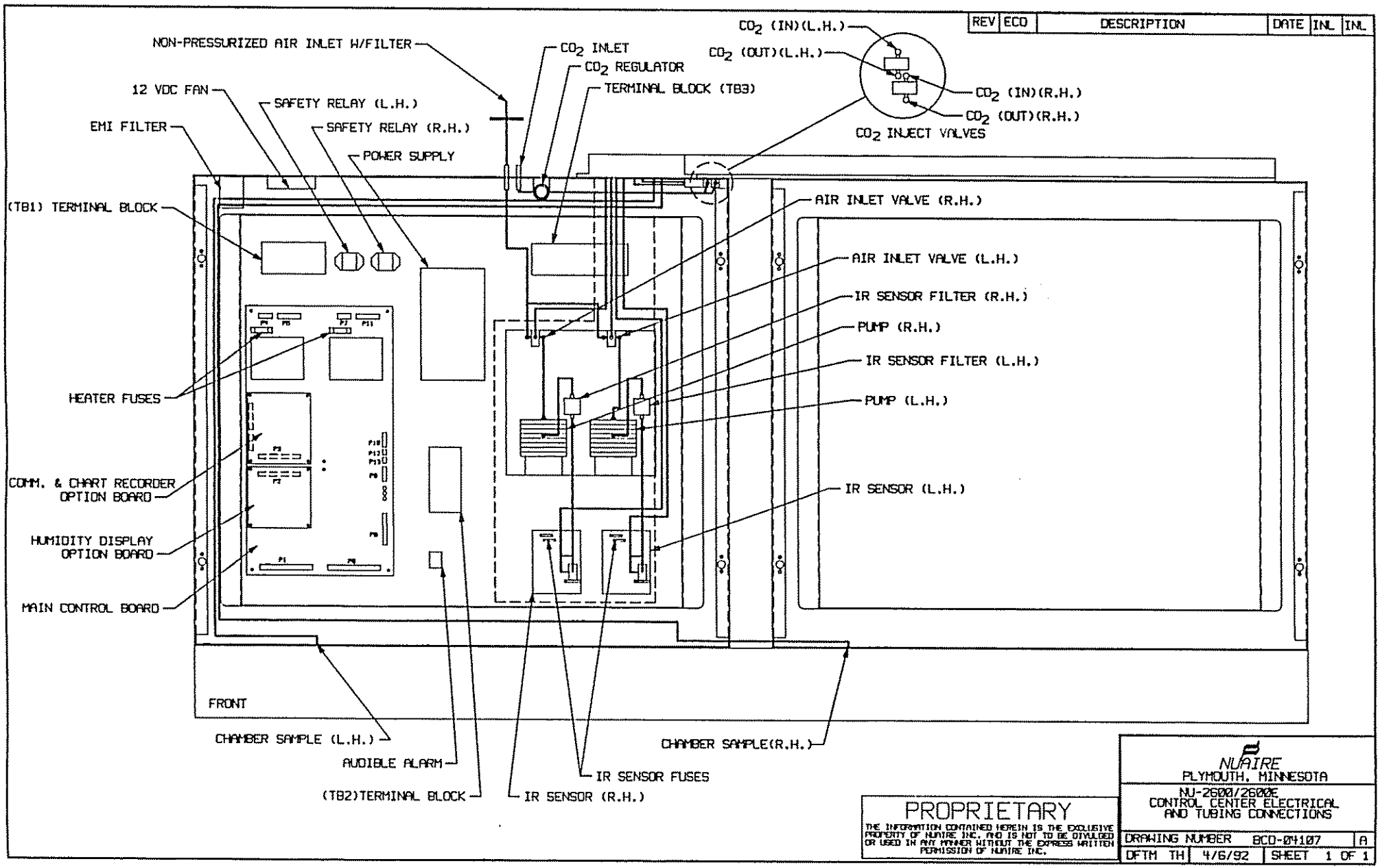
NUAIRE
PLYMOUTH, MINNESOTA

NU-2500/2500E
CONTROL CENTER ELECTRICAL AND TUBING CONNECTIONS

DRAWING NUMBER	BCD-0H106	A
DFTM TH	4/6/92	SHEET 1 OF 1

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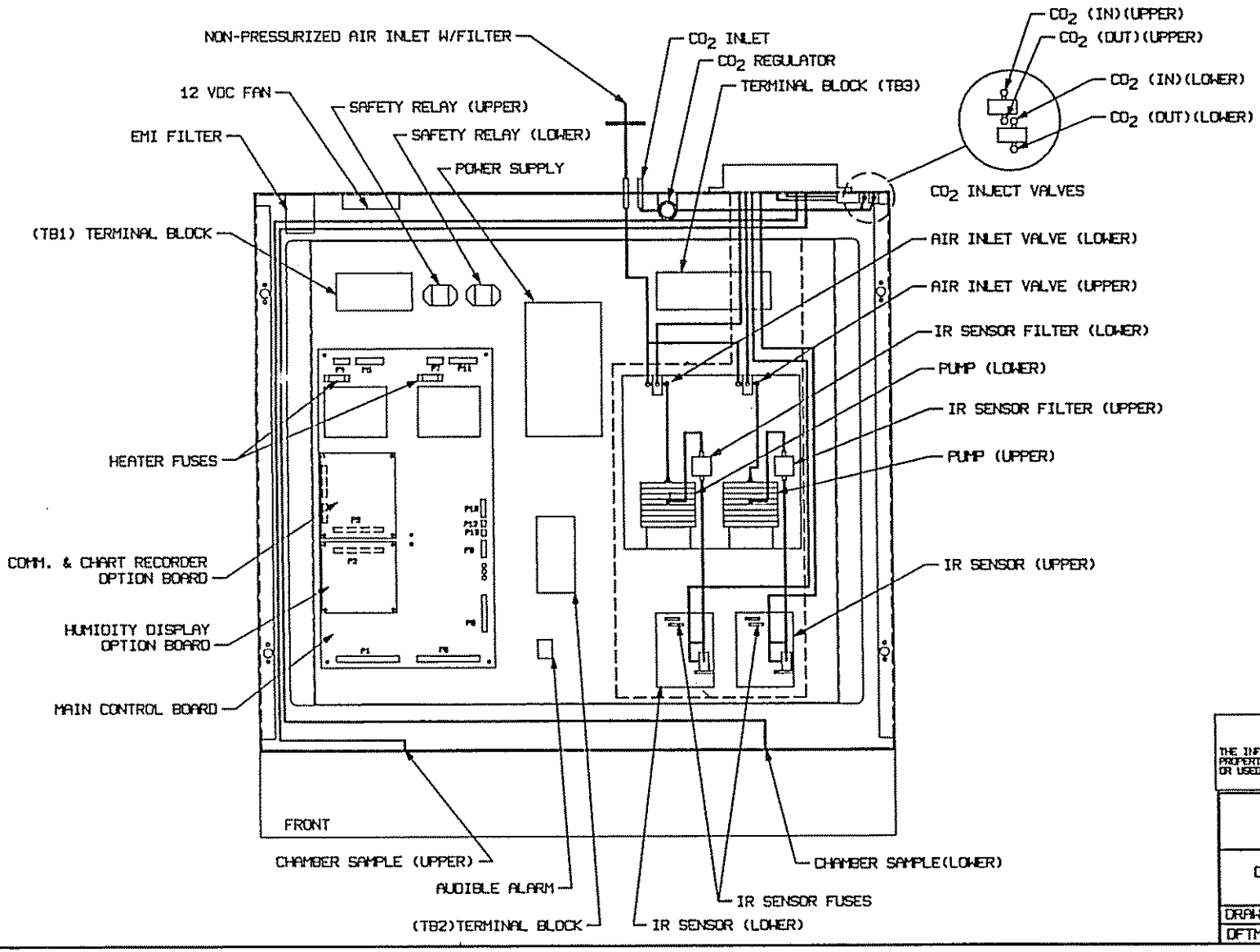
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NU-2600/2600E
CONTROL CENTER ELECTRICAL AND TUBING CONNECTIONS

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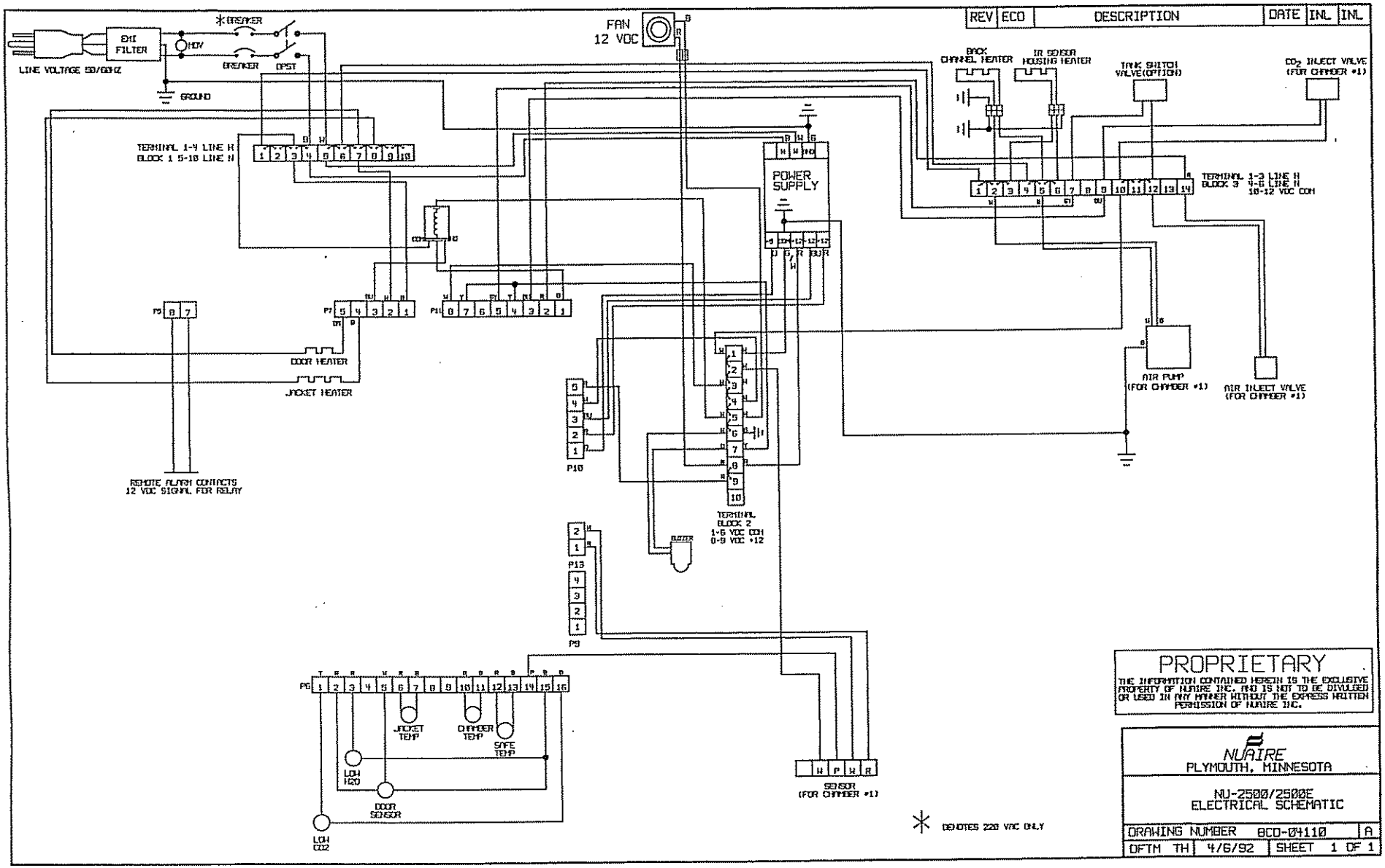


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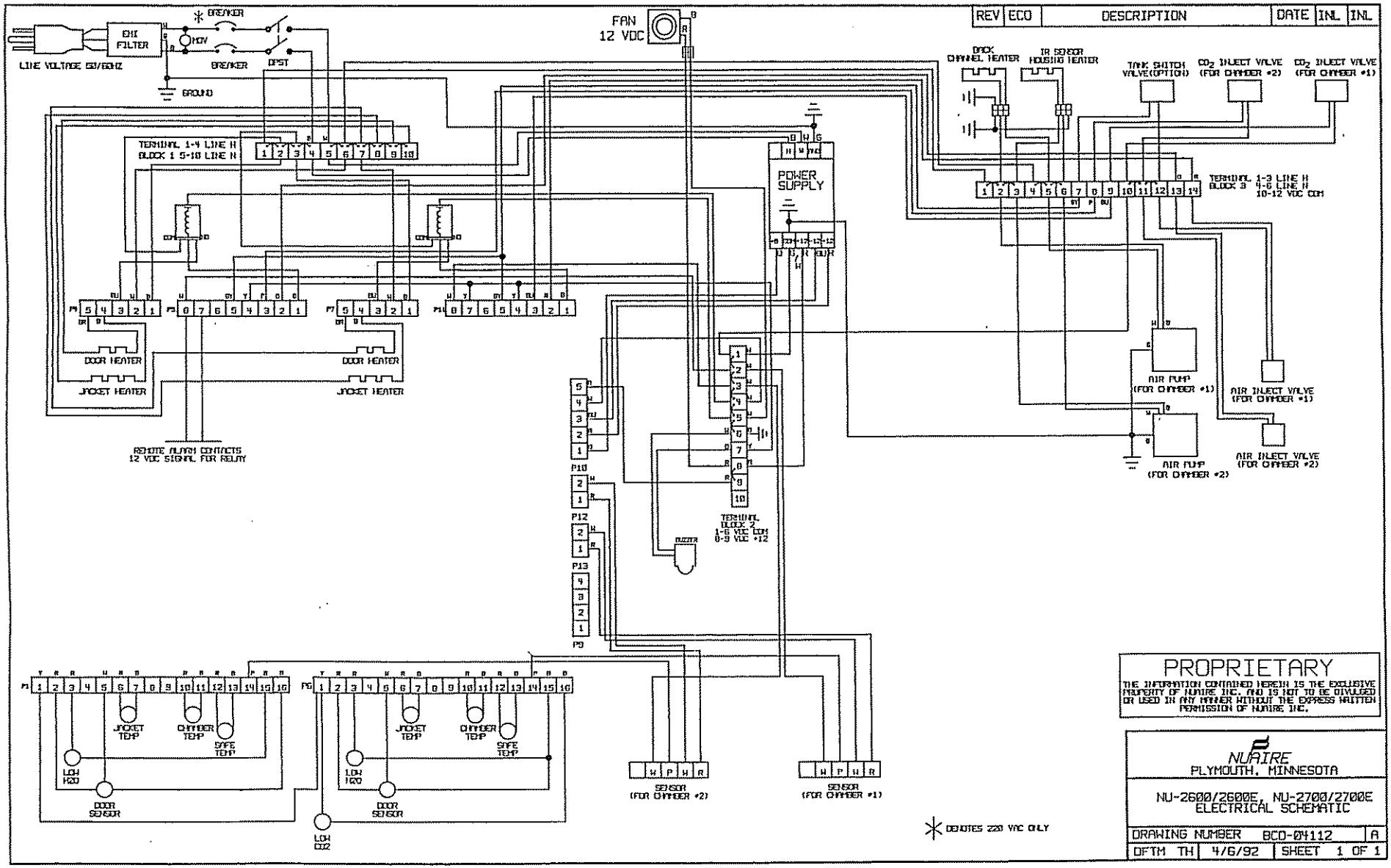
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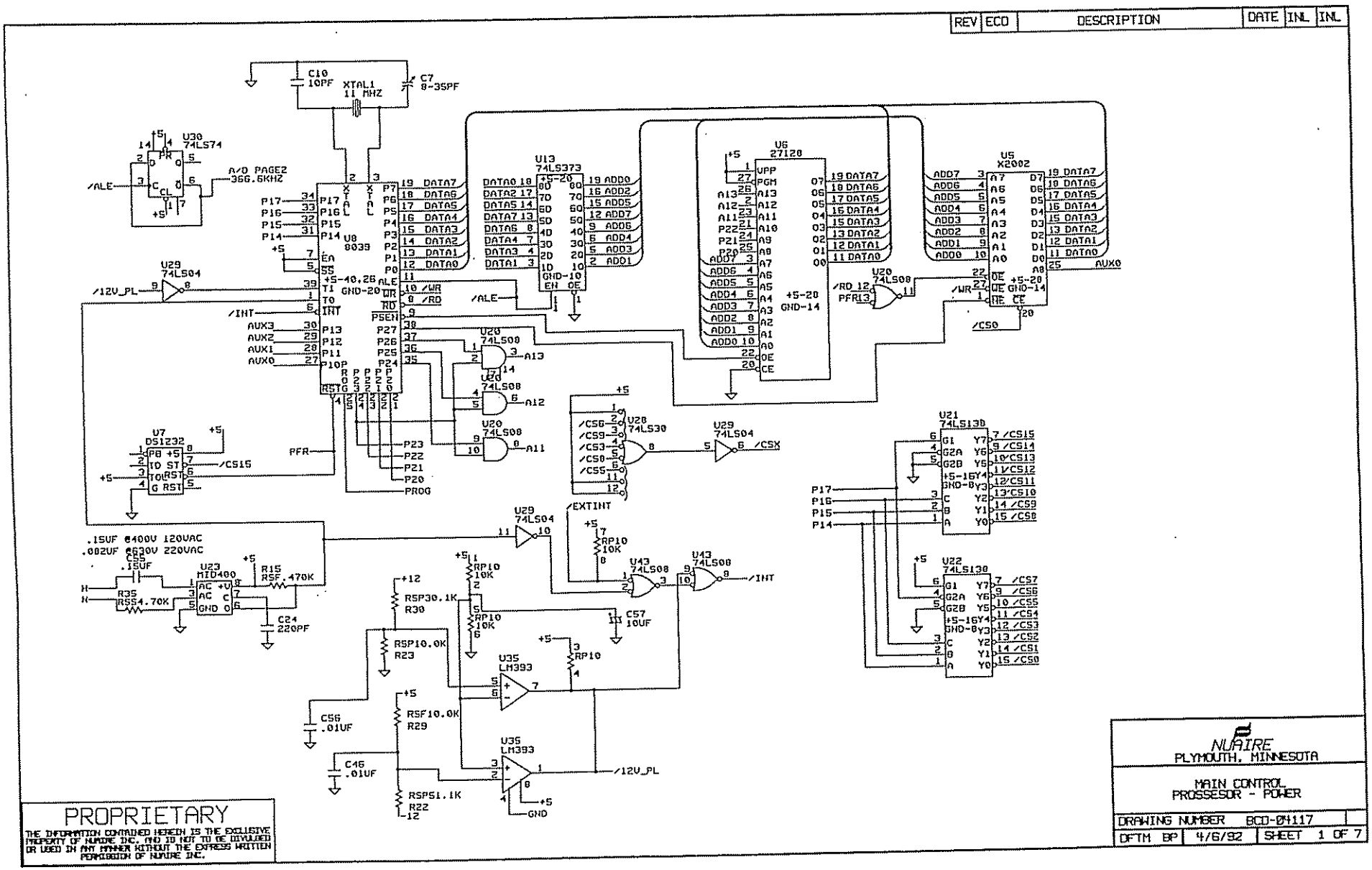
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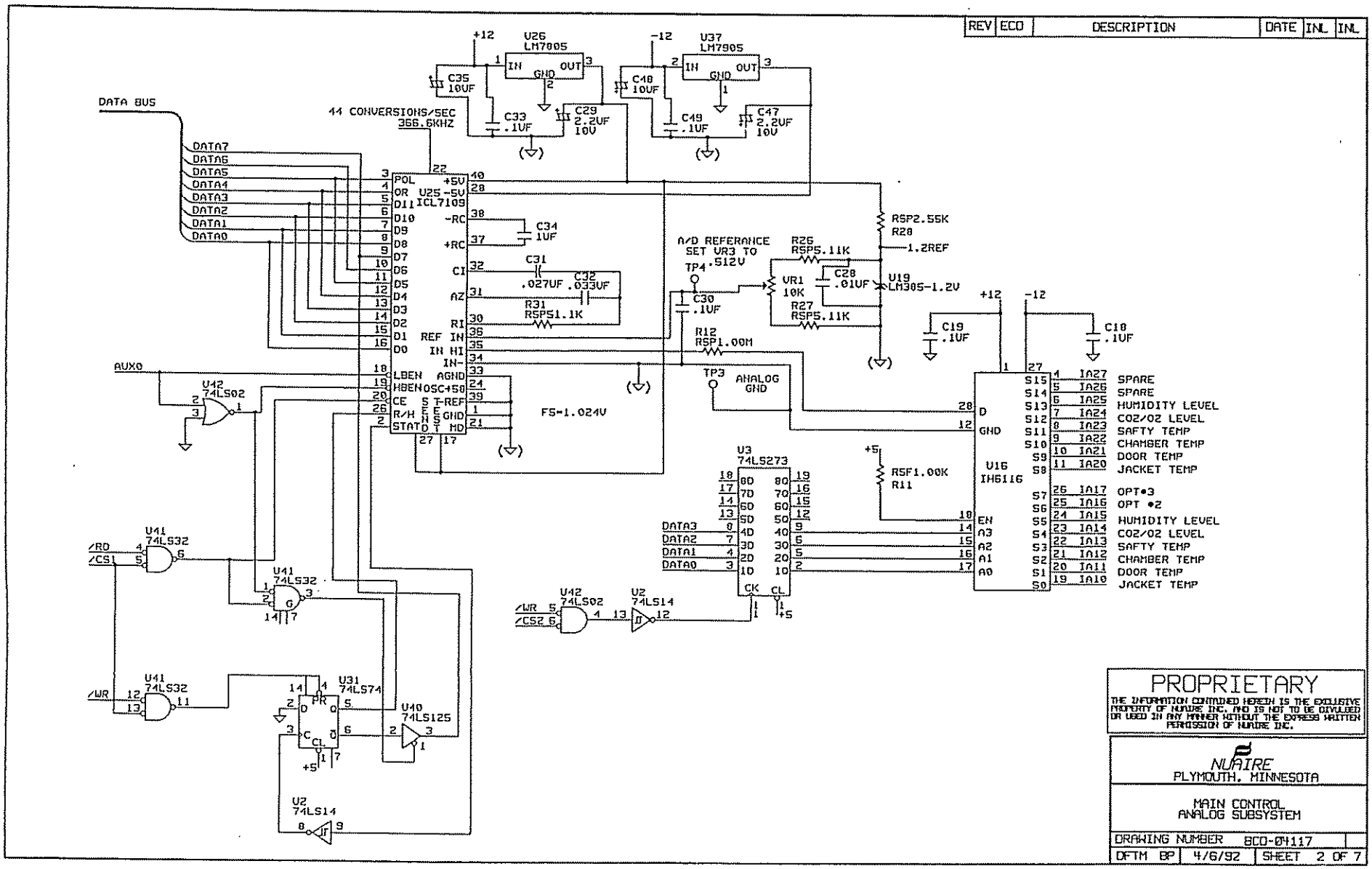
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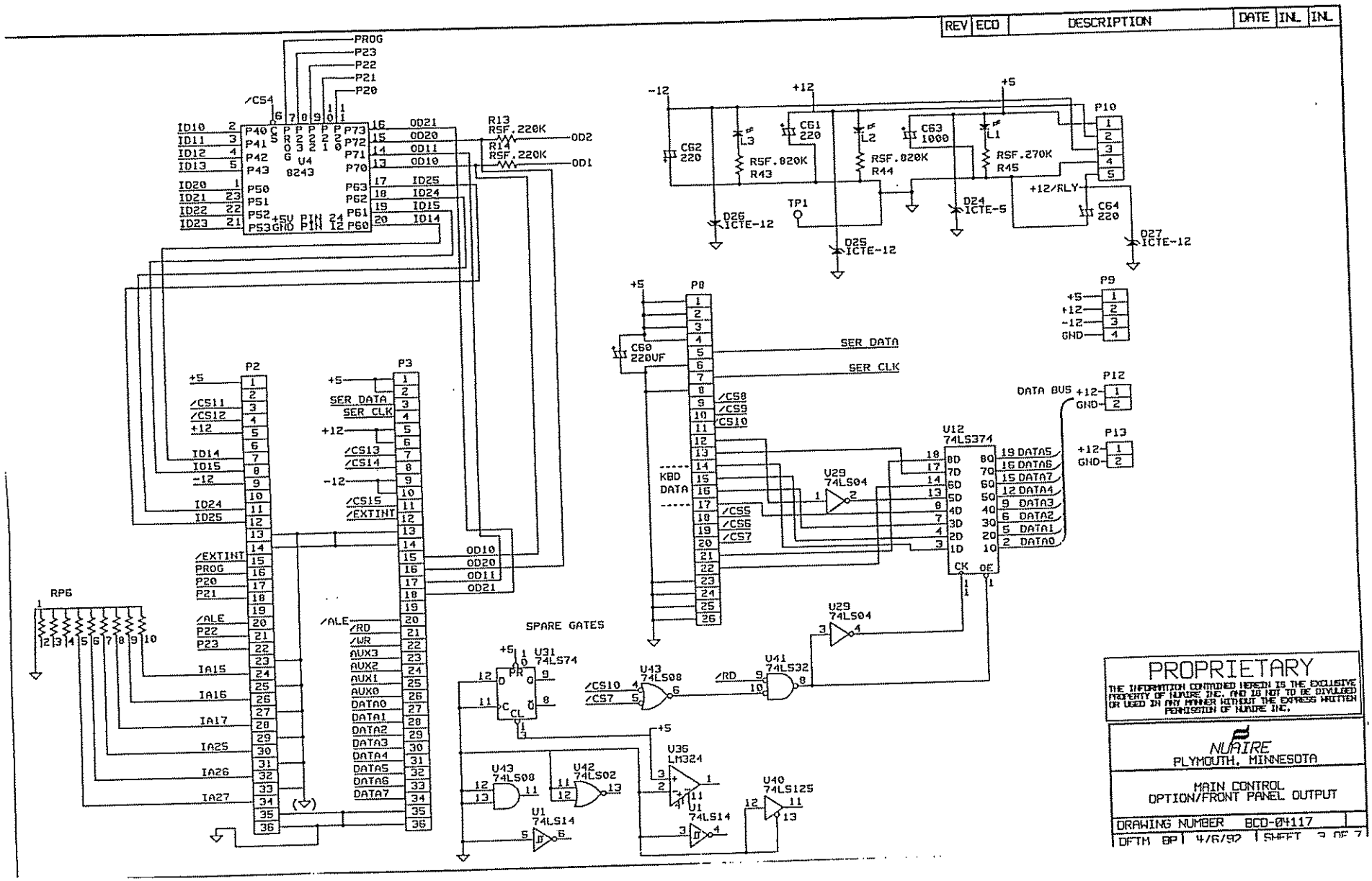
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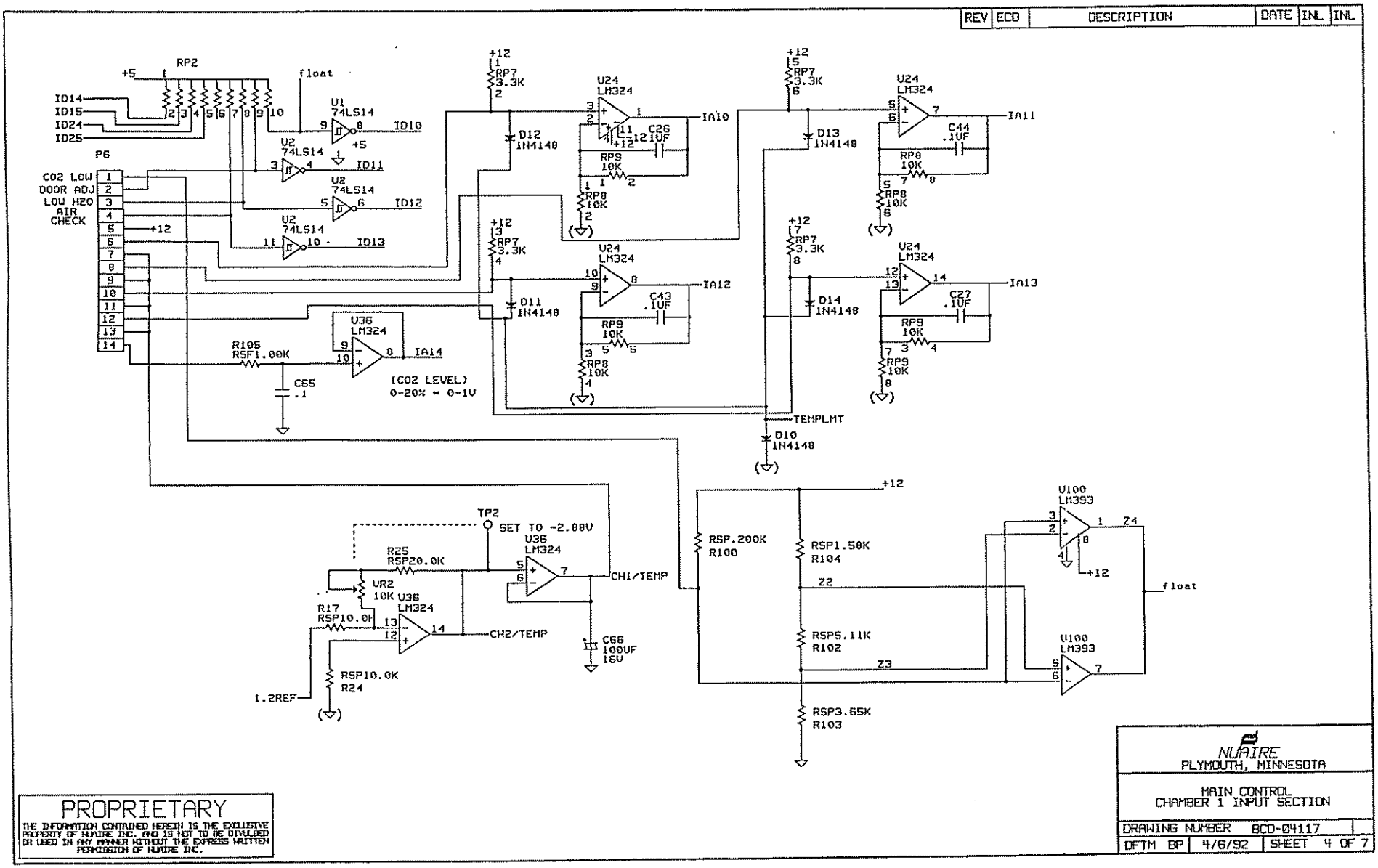
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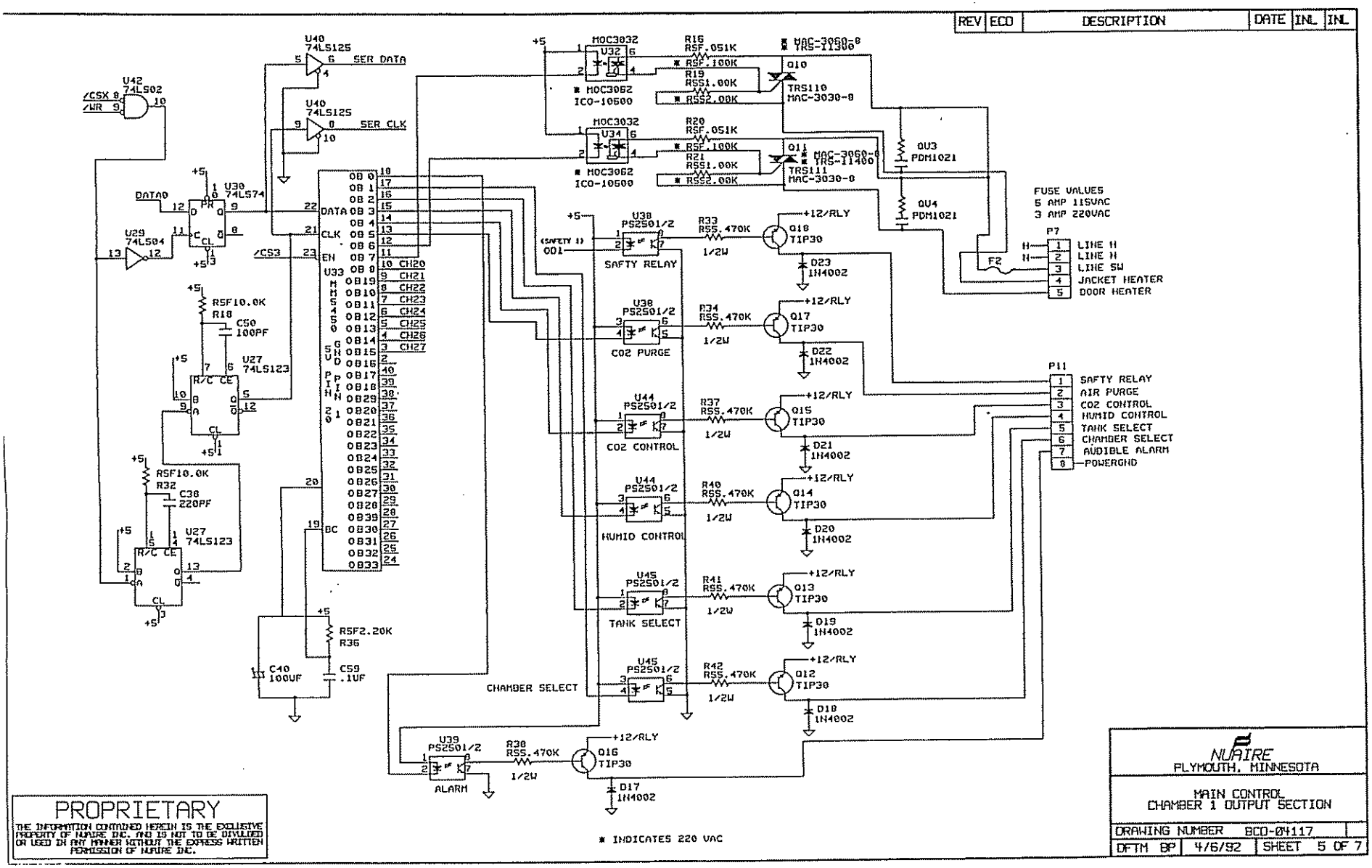
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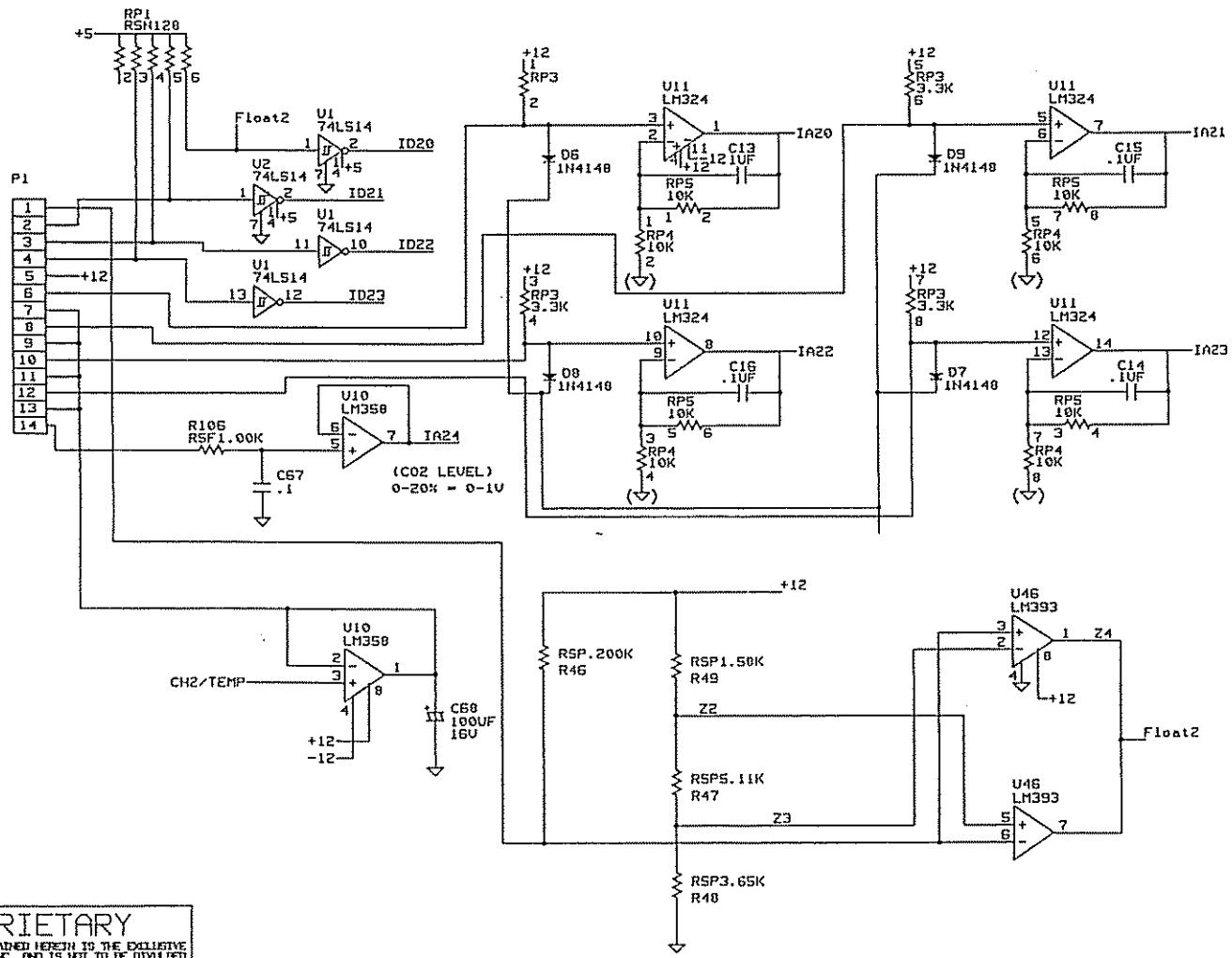
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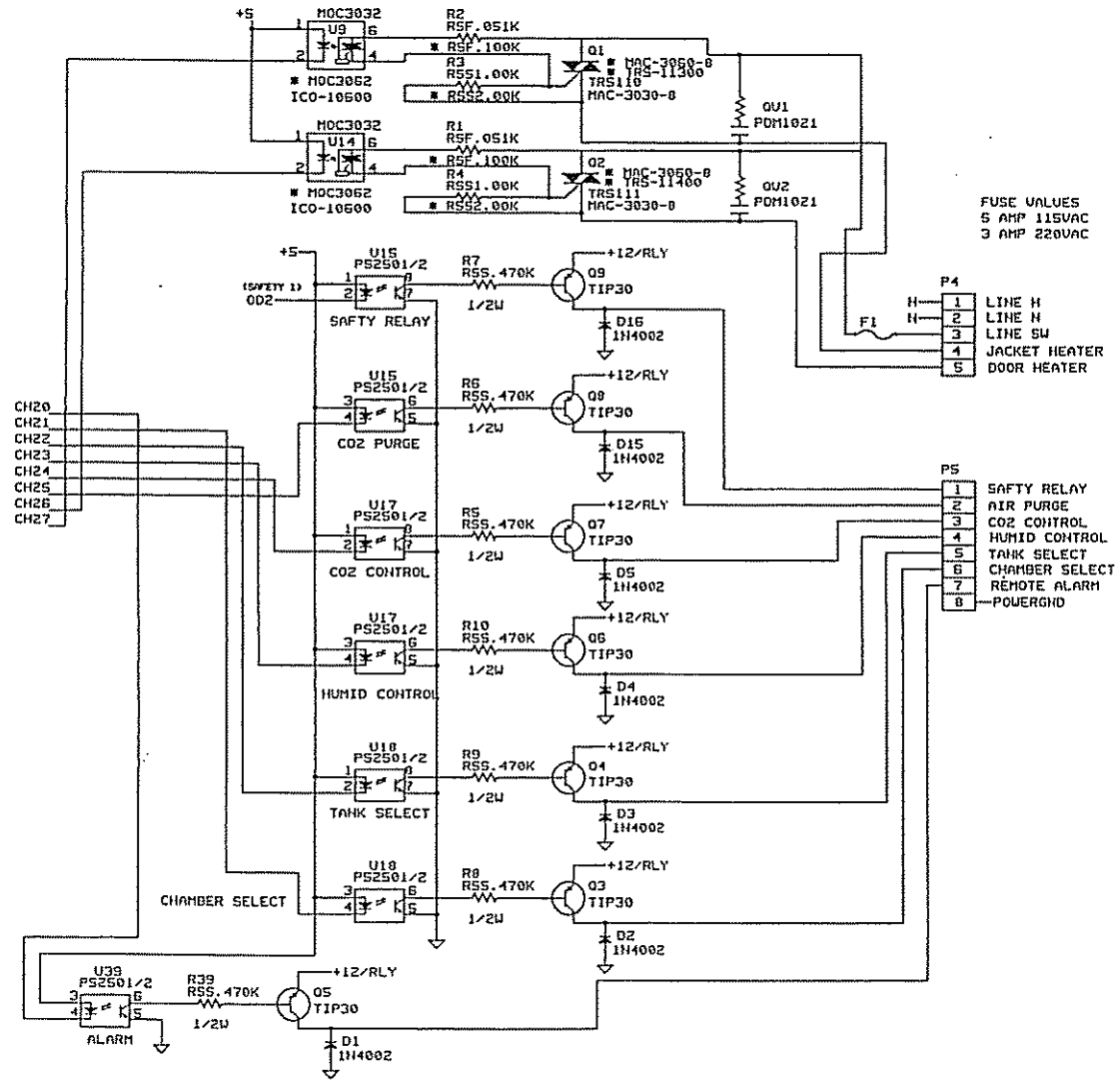
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CHAMBER 2
ANALOG SUBSYSTEM

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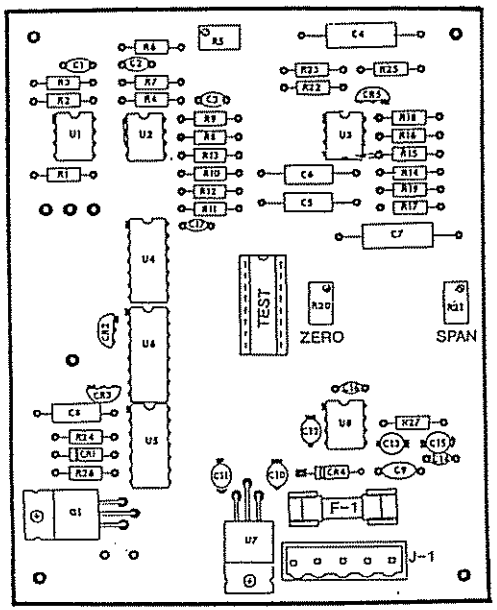
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MAIN CONTROL
CHAMBER 2 OUTPUT SECTION

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DFTM BP	4/6/92	SHEET 7 OF 7

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DFTM	4/10/92
CHKD	
APPR	
MATERIAL	
APPLICABLE SERIES	

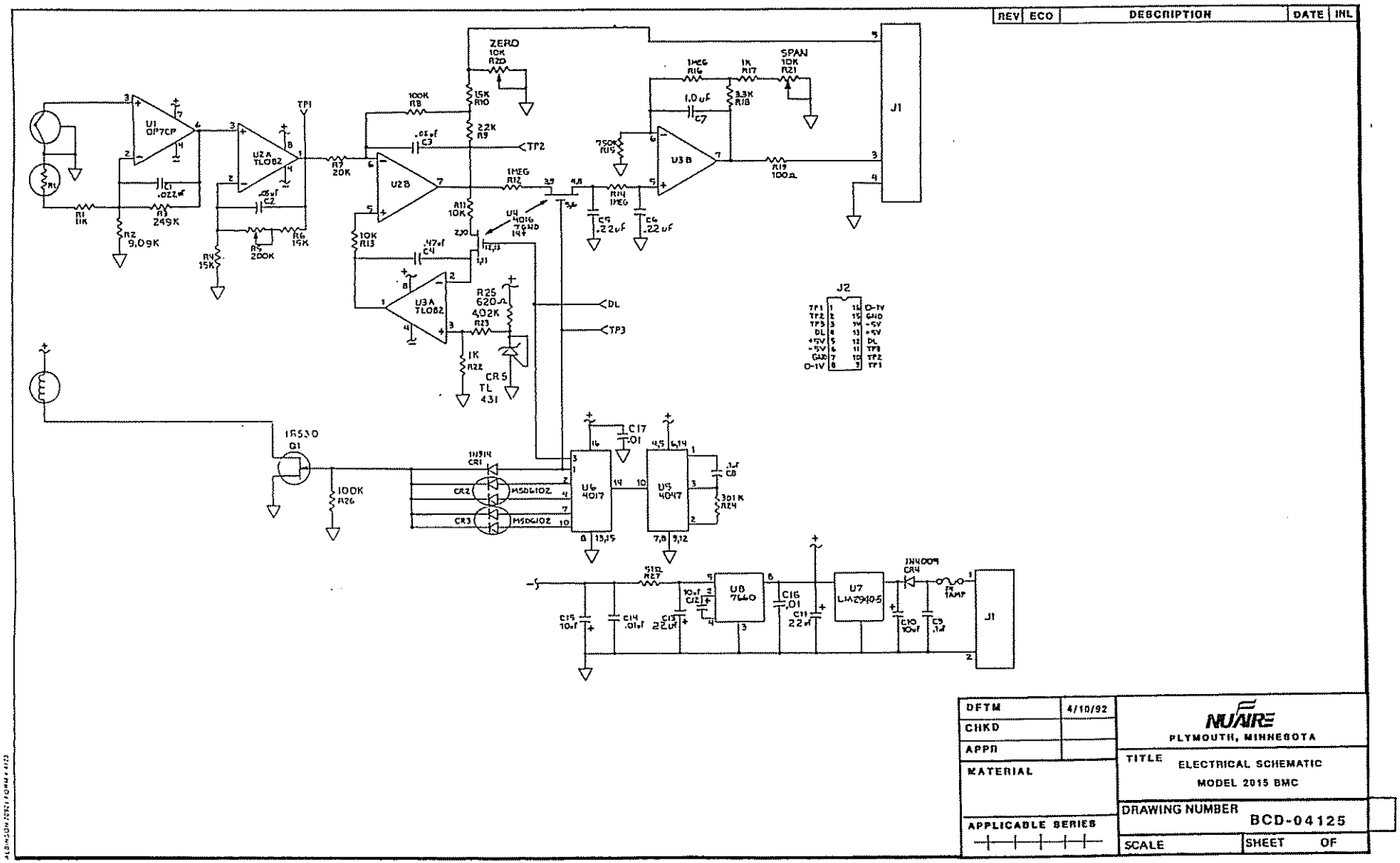
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MODEL 2015 BMC

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