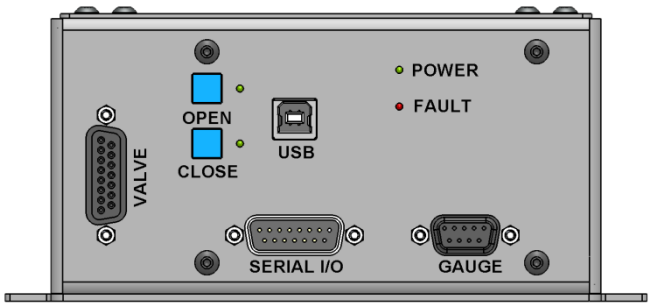
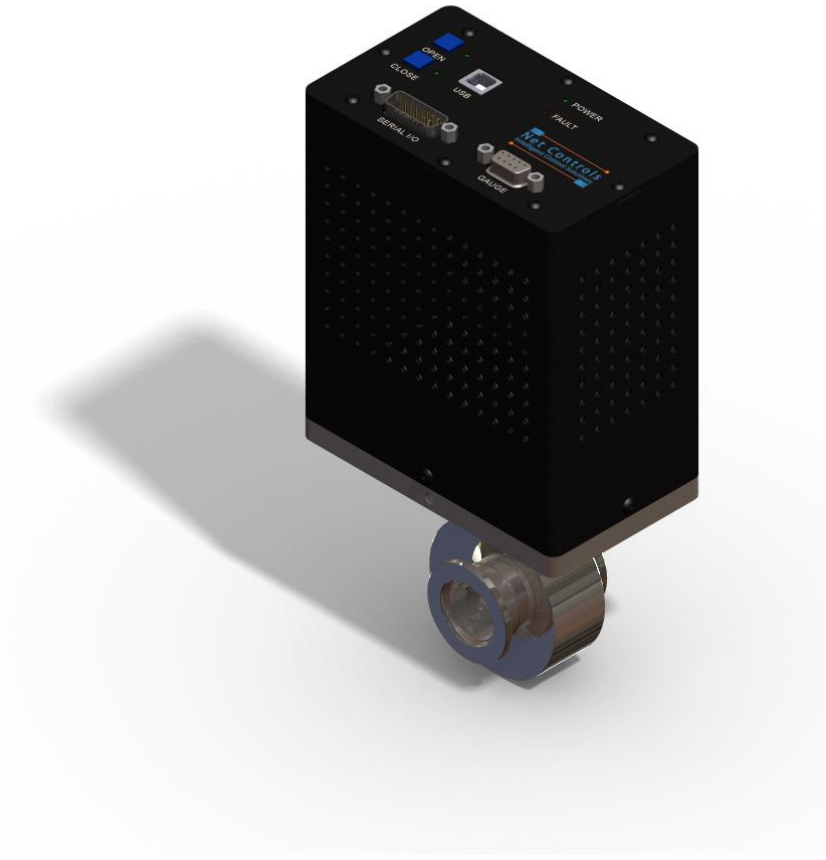
98-9913 Rev D, 1/2013

98 Series Universal Valve Controllers
Operator's Manual





98 Series Universal Valve Controllers for Direct Drive Throttling Butterfly Valves

Integrated & Remote Versions

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Please note:

This manual from Net Controls, LLC is the latest version for the revision indicated. The information contained herein is subject to change without notice. It is advised that if this information is used in a critical application, that it be verified with Net Controls.

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Safety Information

This manual utilizes the three icons below to alert the reader to particular areas of importance where special attention should be focused.

 **Note:** *Special uses of the controller and installation pointers are revealed.*

 **CAUTION:** *Heed warning to prevent damage to controller or other equipment.*

 **WARNING:** *Controller hazards that could create serious bodily harm or death.*

Section One: General Information

Introduction

Congratulations on purchasing a new 98 Series downstream Process Controller from Net Controls, LLC! We are glad you chose the 98-XX-XXXX for your application and it is our goal to give you excellent service and support.

Prior to installation, read this manual to insure you are thoroughly familiar with the controller's capabilities and operational characteristics. If you have any problems or questions, please contact NC Customer Service at (530) 894-3358 or visit our website at **www.n-controls.com.**

NC 98 Series Universal Valve Controllers are designed for various automation tasks including downstream pressure control (Model 98). Typical applications are for vacuum system throttling butterfly valves sized from 1" to 12". The 98-XX-XXXX small footprint incorporates all control electronics and associated pressure control software. Two versions are available: "remote" with separate controller and "integrated" with the controller inside the valve case.

A valve open/close switch, local status LEDs, and a convenient USB debug port to facilitate firmware downloading and controller troubleshooting, are located on the controller front panel. Remote operation and monitoring can be done with the serial RS-232 communication interface. An alternate Ethernet communications connection is available on select controllers.

Controller Models Covered

This manual is applicable to the following controller models:

- **98-05-XXXX** Integrated Valves with Advanced Adaptive Controller
- **98-00-9913** DC Powered Remote Advanced Adaptive Controller
- **98-01-9913** 90 -260 VAC Powered Remote Advanced Adaptive Controller
- **98-02-9913** AC Powered Remote Advanced Adaptive Controller w/Touch Screen
- **98-03-9913** DC Powered Remote Advanced Adaptive Controller w/Battery Back-up

All controllers are compatible with Net Controls Throttling Butterfly Valves (both heated and unheated versions). Additionally, all controllers can either be accessed via computer or from an optional touch screen available from NC. Integrated controllers are packaged on the valve. Remote controllers are separate boxes that can be located up to 10 feet from the valve. Many cables are available to facilitate installation in a variety of environments.

Manual Organization

This manual is organized to provide instructions on installation, set-up, operation, and troubleshooting. Before proceeding, make sure you are familiar with the caution and warning figures outlined at the beginning of the manual. Pay careful attention to all warning and caution indications found within the following pages.

Section One, *General Information*, outlines the product.

Section Two, *Installation*, details the unpacking of the product and environmental considerations for the application of the product.

Section Three, *Overview*, describes the front and rear panel of the 98 Series Process Controller and electrical connections, and theory of operation.

Section Four, *System Set Up*, explains initialization, normal operation, vacuum gauge configuration, changing set points, position and pressure selection, valve calibration, and changing phase and gain.

Section Five, *Operation*, highlights how the controller is used and the common commands and requests/responses used.

Section Six, *Troubleshooting*, provides a table to solve potential problems.

Appendix A, *Product Specifications*, lists the specifications of the controller.

Appendix B, *Command and Request Reference*, lists the ASCII commands.

Appendix C, *ASCII Request and Response Reference*, lists the RS-232 requests and responses.

Appendix D, *Warranty*, enumerates the Net Controls, LLC warranty for the 98 Series Process Controller.

Customer Support

If you encounter any questions or difficulties during the installation, set-up, or use of the controller, please contact NC Customer Support.

Contact Phone Number: (530) 894-3358.

Website: www.n-controls.com

If it is found necessary to return the controller to NC, contact Customer Support to obtain additional instructions or a Return Materials Authorization number.

WARNING: *All returned products to NC must be free of all contaminants, including harmful, corrosive, radioactive, or toxic materials.*

Section Two: Installation

Unpacking the 98 Series Universal Valve Controller

- Inspect the shipping container prior to unpacking
- Report any damage to NC or to the transportation company
- As the product is removed from the box, look for any damage
- If you must return the product to NC, please contact NC Customer Service (see page 10 of this manual) to obtain a Return Material Authorization (RMA) Number.

Note: *Keep the packing materials until you are sure the controller is satisfactory*

Unpacking Checklist

1. 98 Series Universal Valve Controller

Optional Supplied Cables

1. Interface Cable for connection to HOST computer: DB-9 connector to controller.
2. Gauge Cable for connection to pressure gauge(s): DB-9 connector to controller.
3. AC power cord for Touch-Screen remote controller.
4. Valve Drive cable for remote controllers: DB-15 terminated connectors.

Preliminary Controller Check

All products are stringently tested and then carefully packed for shipment. However, sometimes shipment can cause damage to occur. Therefore, it is advisable to check the unit prior to installation. We recommend the user:

- Connect the 98 Series controller to the valve and suitable power source.
- After the power is turned on, the valve will complete a 30 second initialization sequence during which the valve plate will cycle open to closed. This applies only to valve sizes 4” and below. Larger valves have a software interlock that inhibits valve movement (see ASCII Commands section).
- The valve will initialize to the open position.
- Pushing the “OPEN/CLOSE” switch on the controller front panel allows you to further manually exercise the valve. For touch-screen controllers, refer to Section 5 (Operation) for instructions on navigating to the “Valve Control Center.”

- For Integrated Controllers, the HOST system needs to be connected to Initialize and test. See Section Four, System Set-Up.
- Contact NC Technical Support if the valve does not operate as outlined above.

Safety Conditions

WARNING: *Keep body parts and other items away from valve due to valve plate pinching hazard.*

CAUTION: *Check to make sure the voltage setting is correct for your local electrical source. The power supply must be plugged into a properly grounded outlet.*

Product Location and Requirements

The "remote version" controller (models **98r** and **98er**) may be mounted away from the valve in any orientation, up to 10 feet away. Two mounting holes are located on the controller case to facilitate mounting. It is recommended to mount the controller such that the LEDs on the front panel can be seen by an operator or technician for troubleshooting purposes. Environmental conditions required for proper operation:

- Operating temperature: 65°C
- Acceptable ambient humidity: 0 to 95% non-condensing
- Allow at least 3-1/2" of access at the rear panel for connections (remote model)
- Allow at least 3-1/2" of access at the front panel for debug port clearance (remote model)
- Allow at least 3-1/2" of access to the top of the integrated controller where LEDs and connectors are located

Note: ***The Interface Cable (RS-232 Serial Communications) must be an overall braided shielded cable, properly grounded at both ends, to meet CE specifications.***

Section Three: Overview

Front Panel

Figure 3.1 below shows the front panel of the 98 Series Universal Valve Controller. **Table 3.1** explains the function of each component.

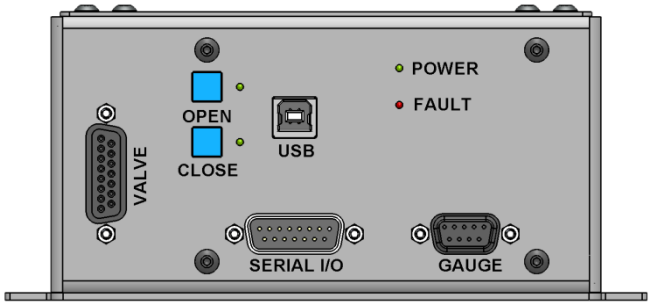


Figure 3.1 – Front Panel

Table 3.1 Front Panel Configuration

Front Panel Component	LED Color	Function
Open/Closed Switches		Opens and closes the valve. Pressing both for 5 seconds will initialize the valve.
Fault LED	Red	Illuminated briefly during the initialization sequence after power-up and whenever the controller experiences a fault
Open LED	Green	Illuminated when valve is open
Closed LED	Green	Illuminated when valve is fully closed
Control LED	Green	Illuminated whenever the controller is performing set point control (pressure or position)
Power LED	Green	Illuminated when power is applied to controller
Debug Port/USB		USB port that is used to download firmware and assist Net Controls in troubleshooting*

* Can be used for customer interfacing

Rear Panel Remote Controller

Figure 3.2 below shows the rear panel lay-out of the 98 Series REMOTE controller. **Tables 3.2 and 3.3** detail the pin-outs required for each connector.

Table 3.2 – Gauge Connector, DB-9 Receptacle

PIN #	FUNCTION
1	CDG1 +
2	+15V supply to gauge*
3	-15V supply to gauge*
4	Not Used
5	CDG2 +
6	CDG2 -
7	Not Used
8	CDG1 -
9	Power supply common*

Table 3.3 – Serial I/O Connector, DB-15 Receptacle to HOST computer

PIN #	FUNCTION
1	Not Used
2	RS-232 Rxd (transmitted by the 98 to the HOST)
3	RS-232 Txd (transmitted by the HOST to the 98)
4	RS232 Common
5	Power V-
6	Not Used
7	Power V+
8	TTL Common
9	Programmable TTL I/O Input (24VDC)
10	Programmable TTL I/O Input (24VDC)
11	Not Used
12	TTL Out Common
13	Programmable TTL I/O Output (24VDC)
14	Programmable TTL I/O Output (24VDC)
15	Chassis

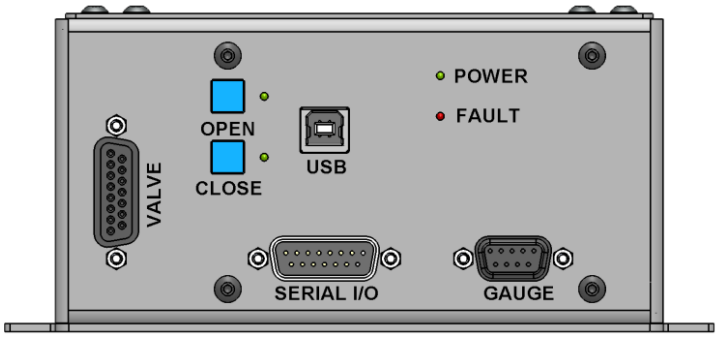


Figure 3.2 - Rear Panel Configuration

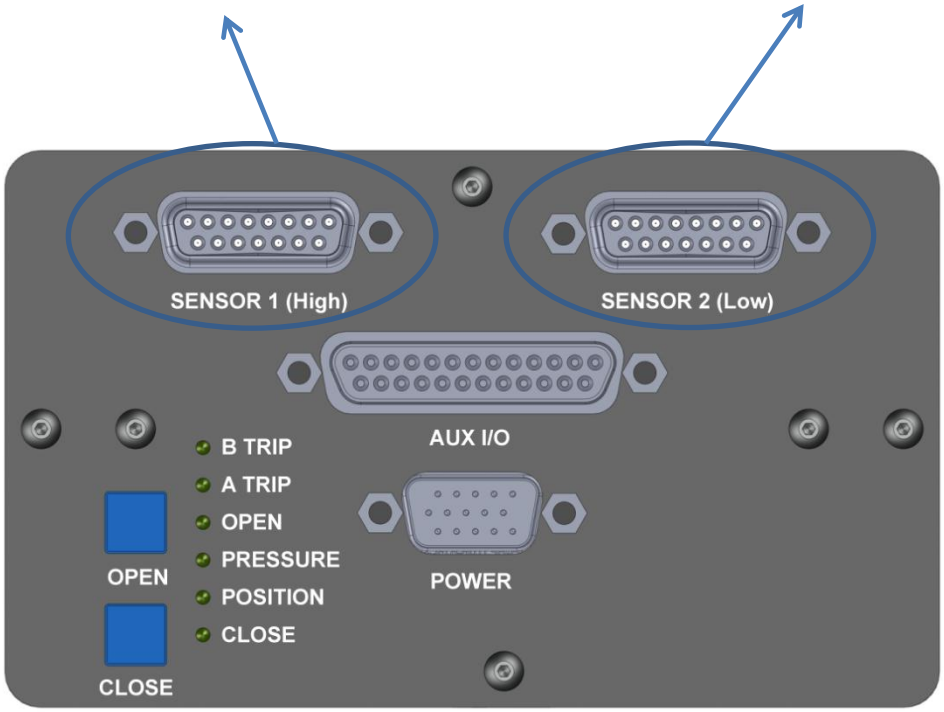
Top Panel Analog Integrated Control Valve

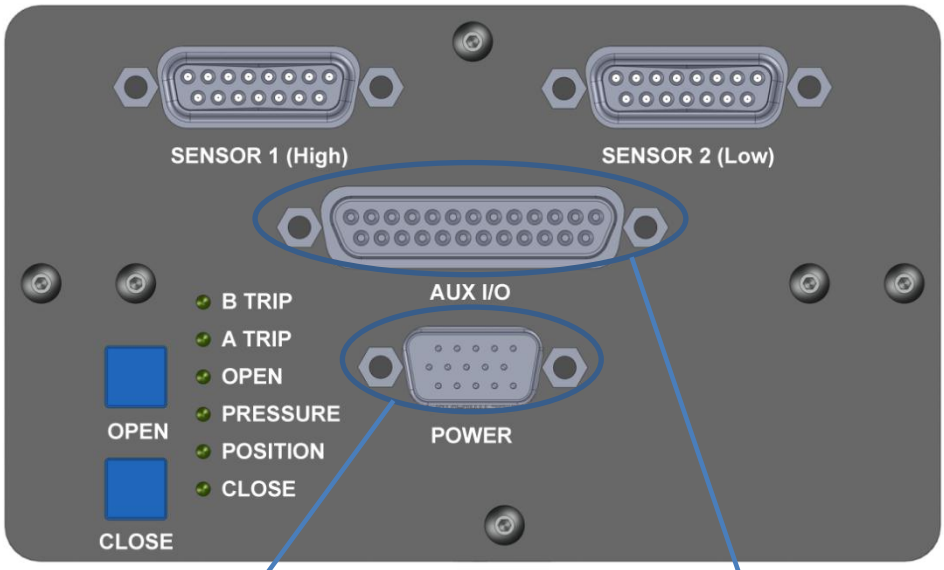
Sensor 1 (High) DB15 Female

Pin Number	Description/Function
1	Not Connected
2	Analog Input Signal (+)
3	Not Connected
4	Not Connected
5	Power Supply Common
6	-15VDC Power Out
7	+15VDC Power Out
8	Not Connected
9	Not Connected
10	Not Connected
11	Not Connected
12	Analog Input Signal (-)
13	Not Connected
14	+24VDC Power Out
15	Chassis Ground

Sensor 2 (Low) DB15 Female

Pin Number	Description/Function
1	Not Connected
2	Analog Input Signal (+)
3	Not Connected
4	Not Connected
5	Power Supply Common
6	-15VDC Power Out
7	+15VDC Power Out
8	Not Connected
9	Not Connected
10	Not Connected
11	Not Connected
12	Analog Input Signal (-)
13	Not Connected
14	+24VDC Power Out
15	Chassis Ground





J3: External Power Connector DB9 Male

Pin Number	Description/Function
1	+24VDC Power Input
2	+24VDC Power Input
3	24VDC Power Return
4	24VDC Power Return
5	+15VDC Power Input
6	15VDC Return
7	-15VDC Power Input
8	Not Connected
9	Chassis Ground

J4: Aux/Analog IO

Pin Number	Description/Function
1	RS-232 RXD (transmitted by the TBV to the HOST)
2	RS-232 TXD (transmitted by the HOST to the TBV)
3	Valve Open (Input)
4	Valve Close (Input)
5	Position/Pressure (Input)
6	Not Connected
7	Not Connected
8	Not Connected
9	Analog Setpoint (+)
10	Analog Setpoint (-)
11	Analog Pressure Out (+)
12	Analog Position Out (+)
13	Analog Ground
14	Relay A Normally Open
15	Relay A Normally Closed
16	Relay A Common
17	Relay B Normally Open
18	Relay B Normally Closed
19	Relay B Common
20	Valve Open (Output)
21	Valve Closed (Output)
22	Valve Inhibit (Input)
23	Remote Zero (Input)
24	Digital/TTL Common
25	Chassis Ground

Remote Touch-Screen Controller

Figure 3.4 below shows the rear panel lay-out of the 98 touch-screen. **Tables 3.7** and **3.8** detail the pin-outs required for each connector.
*Optional

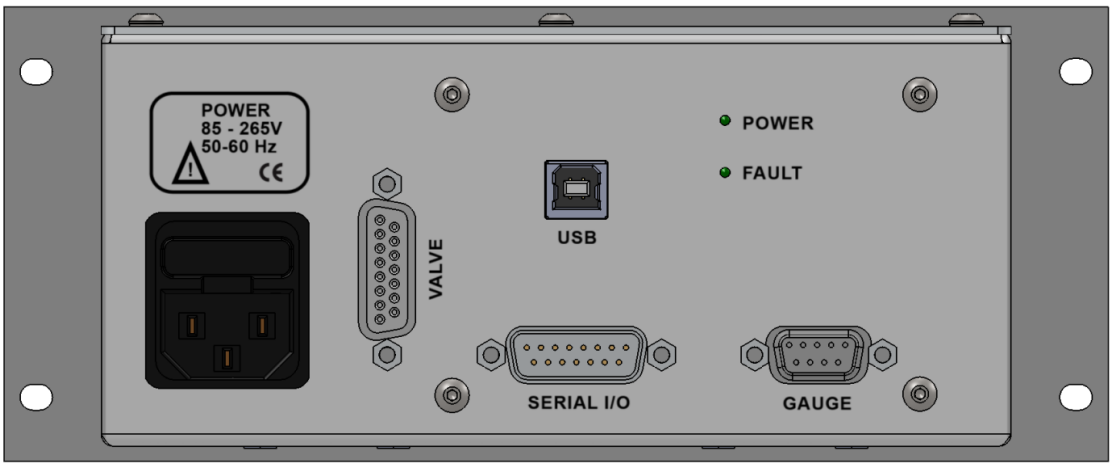


Figure 3.4 – Rear Panel – Touch Screen Controller

Table 3.7 – (J1)
Gauge Connector,
DB-9 Receptacle

PIN #	FUNCTION
1	CDG1 +
2	+15V supply to gauge*
3	-15V supply to gauge*
4	Not Used
5	CDG2 +
6	CDG2 -
7	Not Used
8	CDG1 -
9	Power supply common*

Table 3.8 – (J2)
Comm Port,
DB-15 Plug

PIN	FUNCTION
1	Not Used
2	RS-232 Rxd (transmitted to the HOST)
3	RS-232 Txd (transmitted by the HOST)
4	RS232 Common
5	Power V-
6	Not Used
7	Power V+
8	TTL Common
9	Programmable TTL I/O Input (24VDC)
10	Programmable TTL I/O Input (24VDC)
11	Not Used
12	TTL Out Common
13	Programmable TTL I/O Output (24VDC)
14	Programmable TTL I/O Output (24VDC)
15	Chassis

Labels

Serial Number Label

The serial number label (located on the side of the remote controller cover only) lists the following:

- The serial number
- Product model number
- Date that the controller was manufactured
- Displays the CE mark signifying compliance with European CE regulations
- Net Controls, LLC contact information
- Country of manufacture

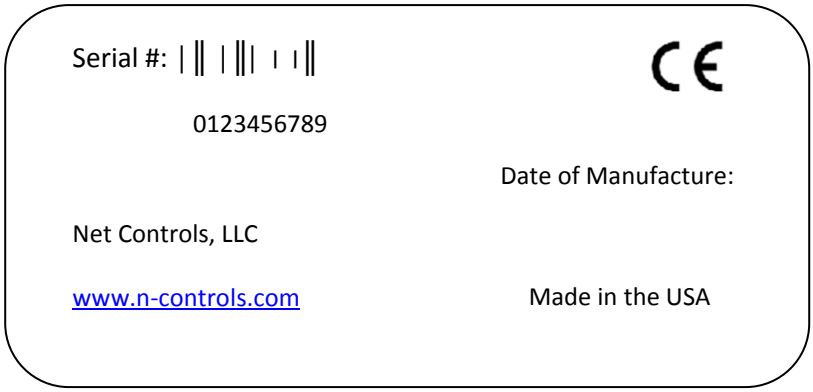


Figure 3.5 - Serial Number Label

Theory of Operation

Figures 3.6 and 3.7 show typical 98 Series Universal Valve Controller applications in which the downstream pressure of a vacuum chamber is controlled with a throttle valve. **Figure 3.6** depicts a remote mounted controller and **Figure 3.7** depicts an integrated controller. The controller is connected to the throttling valve, whose valve plate (flapper) acts as the throttling element. The valve plate varies the conductance of the valve opening. The controller calculates the required position of the valve plate to achieve the set point pressure. A stepper motor actuates the valve. A HOST computer or optional Touch Screen Controller is used to communicate to the valve controller and one or two vacuum gauges. Typically a gauge such as a Capacitance Diaphragm Gauge (CDG) is used for pressure measurement.

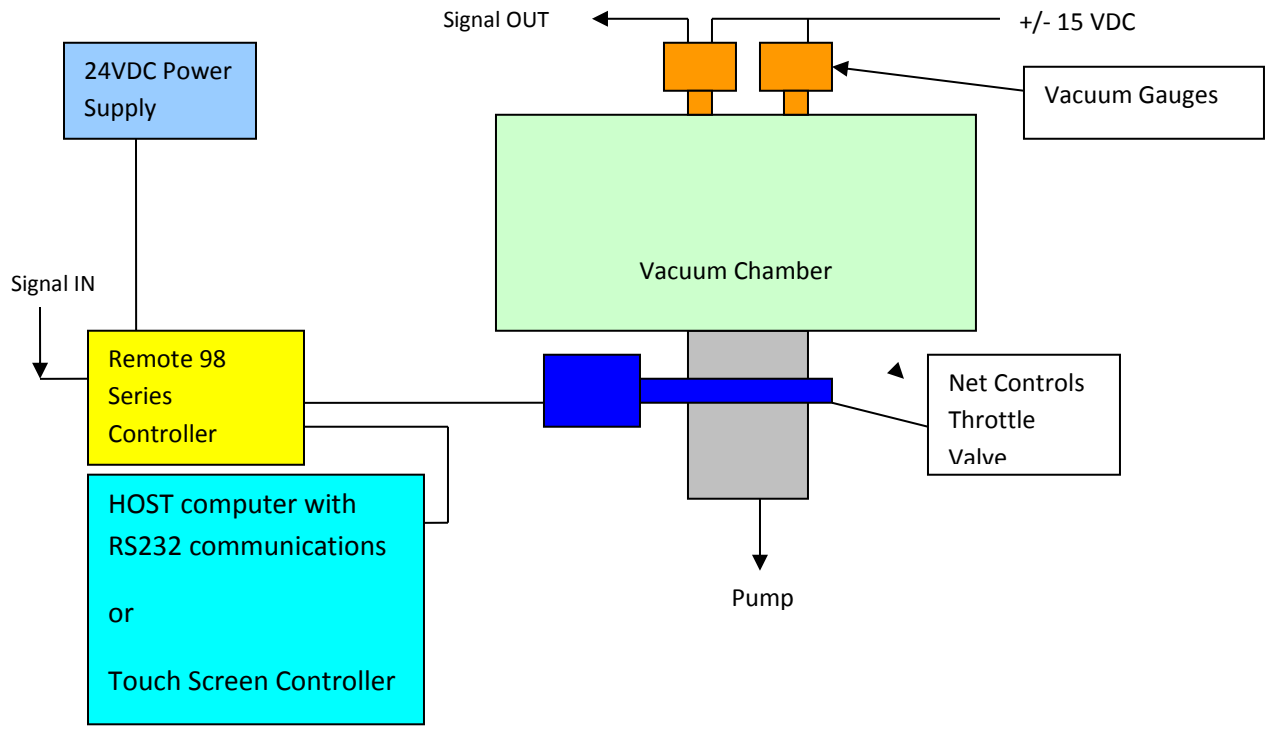


FIGURE 3.6 – Typical Installation and Configuration of a Remote 98 Series Pressure Control System

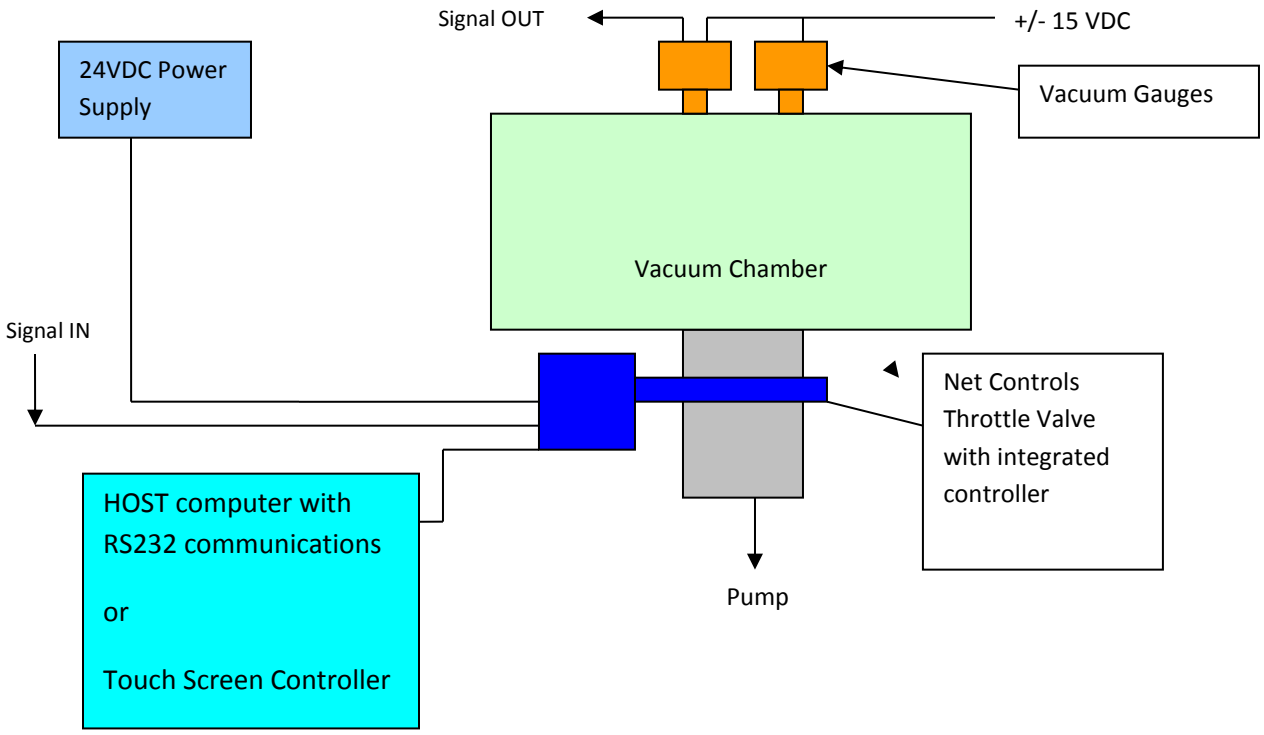


FIGURE 3.7 – Typical Installation and Configuration of an Integrated 98 Series Pressure Control System

Section Four: System Set-Up

Overview

The System Set-Up encompasses how the 98 Controller operates with the valve and the system as a whole. We take you from the initialization sequence through normal operation and then show how to input the commands for pressure and position control, inputting set points, and valve calibration from the HOST to the controller. It is these commands which dictate the controller's parameters and corresponding responses.

Initialization Routine

Turn on the controller. The initialization routine, which takes 30 seconds, occurs when the 98 Controller is first powered up. During this operation the controller finds the fully open and closed points, and allows motor/position calibration steps to run. The red FAULT light is on while initializing. Upon completion of the initialization, the valve moves to the open position and the green OPEN LED will light up.

Normal Operation

Normal operation of the valve follows initialization. One of two modes of operation can be selected:

a) position control mode

b) pressure control mode

In position control mode, the HOST or Touch Screen solicits a command based on a position set point to the valve to move the valve to a specific position. This mode is useful where known conductance limiting factors may be present, i.e. chamber baffling or throttling.

Pressure control mode, regulates system pressure to a specific level. By communicating a set-point to the controller from the HOST or Touch Screen, the valve is moved to attain that set point with speed and precision. The advantage of this mode is that despite outside influences to the chamber, the controller makes up for the pressure peaks and valleys automatically to maintain the set-point (which can be changed by the HOST or Touch Screen at any time).

Tuning

The 98 Series Process Controller utilizes a highly optimized adaptive control algorithm that has been designed to work over a wide range of flow and pressure combinations. However, some vacuum system designs may affect the pressure control time constants and as a result, pressure control performance may at times be affected. If satisfactory pressure control cannot be achieved with the installed algorithm, please contact Net Controls Customer Support.

Set up of the operating parameters of the controller is accomplished only through the sending of serial commands from the HOST computer via the Interface Port cable or from the Touch Screen. So, once the valve has been demonstrated to open and close during the Pre-installation phase, you are now ready to

begin set-up of the controller. First the vacuum gauge(s) will be programmed, and then the pressure set point(s) will be input.

Vacuum Gauge

The 98 Series controller is equipped to receive a pressure signal from one or two vacuum gauges via the DB-9 cable input on the rear panel labeled J1 GAUGE. ±15 VDC is available to power the gauges from this port. The second gauge is an option.

Note: ***If the power requirement of the two gauges exceeds the controller's rated power output, then a separate power source must be furnished by the user.***

Configuring Pressure Gauge Parameters

The 98 is factory configured to use Torr as the pressure unit, 10 Torr as the sensor full range for CDG1 and 0 Torr (not connected) for CDG2 and 0 to 10 Volts for the sensor input signal. When only one gauge is used, then the pressure signal must be connected to the CDG1+ and CDG1- signal pins. Using two gauges requires the following:

A. The full scale range of the two gauges must be at least one but no more than four decades (factors of ten) apart.

B. Only one gauge is active at a time.

Steps to programming CDG1 and CDG2

1. Program the full scale range of CDG1 with the command:

N1xx where xx is the value found in Table 4.1 indicating the full scale range of CDG1. For example, enter N500 if CDG1 is a 500 Torr gauge.

2. Program the full scale range of CDG2 with the command:

N2xx where xx again is found in Table 4.1, for the CDG2 full scale. The full scale of CDG1 must always be greater than that of CDG2.

Note: ***It is unnecessary to program the gauge full scale range when only one gauge is used.***

Table 4.1 – Values for xx for Use With Dual Range Mode

CDG1 or CDG2 Full Scale (in Torr)	Value of xx
0.1	0.1
0.2	0.2
0.5	0.5
1	1
2	2
5	5
10	10 (CDG1 default)
50	50
100	100
500	500
1000	1000
0	Not connected (CDG2 default)

Changing Set Points 1 Through 5

Follow the steps below to change the set points. The set point must be programmed *before* using the set point to control either pressure or position. Five programmable set points are user selectable by issuing the following command:

Snxx.xx where xx.xx is a number from 0.00 to 100.00, for the gauge full scale percentage and n is a number 1, 2, 3, 4, or 5 representing programmable set points. One or no decimal places may also be used, i.e. x.x. or x. For instance *S125* would make set point number 1, 25% of full scale of the pressure gauge.

The set points can now be used to control either pressure or position.

Selecting Valve Position Control or Pressure Control

Set point input values are the same for position or pressure control. To program the 98 to the desired type of control, position or pressure, input the commands below. The factory default setting is pressure control.

For set point 1: T10 = position. A “zero” in the second digit indicates “position”.

For set point 1: T11 = pressure. A “one” in the second digit indicates “pressure”.

Other set points will be made available in the future.

Controlling System Pressure

To activate set point1 input the D1 command. Keep in mind that the set point value must already be entered by using the S1xx.xx command as outlined in *Changing Set Points 1 Through 5.* This will allow the user to put the 98 in pressure control mode while supplying a pressure set point.

The pressure set point is proportional to the vacuum gauge’s full scale range.

NOTE: The set point can be changed at any time before, during, or after pressure control and a different set point can be activated at any time as well.

Activating Dual Pressure Gauges

When two pressure gauges are connected to the 98 Controller, one of three operating modes can be used:

1. First gauge primary: (this is the power-on default)

Controller only recognizes and reports CDG1. The serial command is L1.

2. Second gauge primary:

Controller only recognizes and reports CDG2. The serial command is L2.

For dual chamber systems venting to one downstream exhaust valve and using two pressure gauges (one per chamber), the controller can effectively control each chamber by using the L1 and L2 command and controlling pressure in each chamber by continuous switching from one gauge to the other.

3. Dual range:

The command for this mode is LØ. For this case two gauges are used to cover the dynamic pressure range: one for the high range and one for the low range. In this mode gauges can be switched. By predefining the range of each gauge, as shown on page 19 in the section entitled *Configuring Pressure Gauge Parameters*, the 98 Controller determines the pressure at which it will switch from reading one CDG to another. The automatic switch over occurs at:

90% of the full scale value of the lower range gauge when the pressure is *decreasing*Greater than 99% of the full scale value of the lower range gauge when the pressure is *increasing*

NOTE: All set point commands are with respect to the high range gauge (CDG1).

Controlling Valve Position

Valve Position Control allows the 98 Controller to move the throttle valve plate to a desired set point position of 0% (closed) to 100% (open). Table 4.2 lists the various commands associated with each valve response for valve position.

Table 4.2 Valve Position Commands

Valve Response	Serial Command	Note
OPEN	O	Valve opens
CLOSED	C	Valve closes
HOLD	H	Valve stops at current position
Opens to any position	Vxx.xx	xx.xx is a number from 0.00 to 100.00% full open
Will accept position commands	T10	Sets the set point type to "position control"*

* Next, follow the information outlined in the *Changing Set Points 1 Through 5* and *Controlling System Pressure* sections located on page 20 of this manual.

Calibrating the Valve

By typing in J *value* where *value* is C to remove inhibit, 1 to initialize to open and 2 to initialize to close, you calibrate the valve to the starting position of the valve stroke. The motor will move a few steps and stop. The green CLOSE or OPEN LED will illuminate. The red FAULT LED will turn off.

Changing PID Gain

Gain may be changed from the default factory setting if the command M1 *value* where *value* is % gain and 1 indicates set point 1, is given by the HOST. However, this change is not normally required for most applications because of the special control algorithm employed by the 98 controller. To maintain backwards compatibility use command SG.

Changing PID Phase

"Lead" or Phase may be changed from the default factory setting if the command X1 *value* where *value* is seconds and 1 indicates set point 1, is given by the HOST. However, this change is not normally required for most applications because of the special control algorithm employed by the 98 controller. To maintain backwards compatibility use command SP.

Note: ***Hardware handshaking connections are not available.***

Note: ***The* default *factory RS-232 communications parameter settings are 9600 Baud, 1 stop bit and no parity.***

Every serial input command sent by the HOST has an end-of-line delimiter, carriage return ASCII 0x0D [hex], or the line feed character ASCII 0x0A [hex], or the carriage return and line feed character in that order. The 98 device end-of-line delimiter is the carriage return and line feed characters.

Section Five: Operation

Messages sent to the 98 Series controller are either commands that instruct the controller to change an operating parameter, or *requests* that prompt the controller to report status information. Responses sent by the 98 Series controller reply to a request message issued by your computer's RS-232 communication software or the Touch Screen's software.

All messages must use a carriage return-line feed (CRLF) as the end-of-line delimiter. Use your HOST computer's communication software to assign the CRLF action to the Enter key.

Operation of the 98 Series controller is done through the commands and requests/responses which are listed in **Appendices B and C.**

ASCII Command and Request/Response Examples

Commonly used command and request/response examples are detailed below. Oftentimes reading or verifying of commands is done immediately after inputting commands. The 98 serial command protocol is not case sensitive. The **Bold typed** letter/number combinations that follow represent the commands and requests/responses. To input commands, type the **bold** faced letters/numbers as shown and press Enter. See **Appendix C** for a complete table of requests and responses.

Reading the Set point

The set point is communicated from the serial port to the HOST by inputting:

R1 To verify the set point

S1+xx.xx is the controller response where **xx.xx** is the set point value.

Verifying the Control Mode

To verify the set point for either pressure control or position control, enter the command:

R25 Analog STPT

R26 The 98 controller responds with:

T1x where x is **Ø** for position control or **1** for pressure control (default).

Reading the Valve Position

The command below reports the valve position as a % of full open:

R6 The controller then responds with the valve position using the format:

Vxx.xx where **xx.xx** is a number from 0.00 to 100% of valve open position.

Reading System Pressure

Pressure from the system gauge(s) to the 98 Controller is reported via the Interface Port with command **R5.** Both signals from CDG1 and CDG2 can be read independently.

The Controller will respond with: **P+xx.xx** where **+** signifies the polarity of the value and **xx.xx** is a number.

The CDG pressure gauge reading, **xx.xx,** is expressed as a percentage of full scale between 0.00 and 100.00. The exception is a CDG that has drifted. In that case the reading can be less than 0, but no greater than 101.5%.

If two CDGs are used, the 98 Controller will report the pressure as a percentage of the high range gauge. For example, if the system has a 1000 Torr gauge attached to CDG1 and a 10 Torr gauge attached to CDG2 and the actual system pressure is 0.1 Torr the response to the R5 command will be P+0.010.

Reading the Pressure Gauge Set-Up

The 98 calculates the ratio of the two CDGs' full scale settings through the Interface Port. The two CDGs have a maximum set ratio limit of 1000:1.

To verify the CDG full scale settings, a report may be elicited by using the following commands:

For CDG1, type **RN1.** The controller will respond with:

N1xx.xx where **xx.xx** is the full scale range of CDG1.

For CDG2, type **RN2**: The controller will respond with:

N2xx.xx where xx.xx is the full scale range of CDG2.

Touch Screen Operation

The 98 series touch-screen controller is a menu-driven, full-color, User Interface (UI). Operation is identical to the remote and integrated versions, with most commands accessed via the touch-screen. The main screen, **Figure 5.1**, is drawn when the screen is touched (anywhere) after power up.

Main Menu

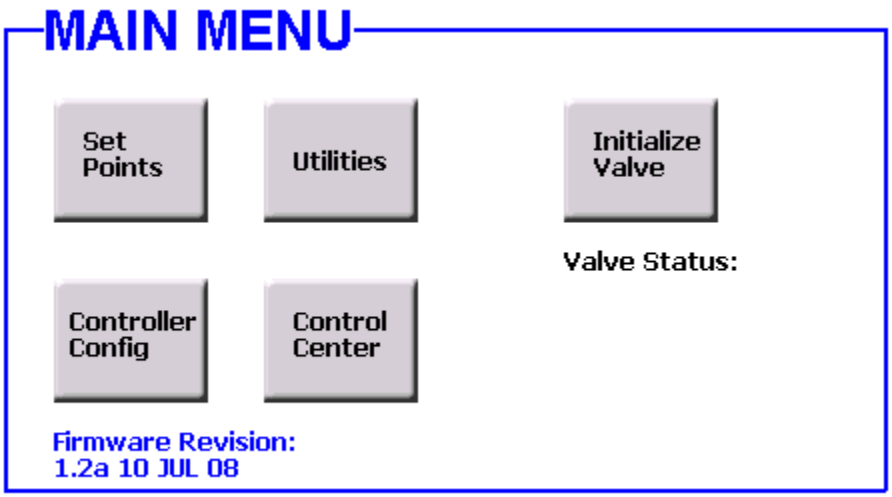


Figure 5.1: Main Menu

The main menu is the starting point for all operations. This menu provides for initializing the valve (required after power loss or non-recoverable error), touch screen utilities, controller configuration, set point configuration, as well as navigation to the main control center.

Note: The firmware revision is always visible via the main menu screen.

Set Points

To modify the set points, including any associated gain parameters, start by pressing the ***Set Points*** button located in the upper left-hand corner of the ***Main Menu*** screen. The set points screen will be loaded, and all set point information will be visible, see **Figure 5.2**.

Each set point has individual parameters that can be individually configured as set points 1–5. Start by pressing the numbered button representing the set point of interest. The ***Set Parameters*** menu will be displayed to enable editing of Set Point in % Full Scale, Phase, Gain, and Ksi (steady state stability), **see Figure 5.3**.

Each time a single parameter is set, the controller will return to the set point screen. Additionally, each parameter is saved in non-volatile memory, thus the set points need not be configured during every power cycle.

Note: Set point, expressed as % Full Scale of the gauge, is entered and displayed as a floating point number. Gain, Phase, and Ksi are entered and displayed as integers.

To exit the Set Point menu, simply press anywhere on the lower half of the screen.

Figure 5.2: Set Point Menu

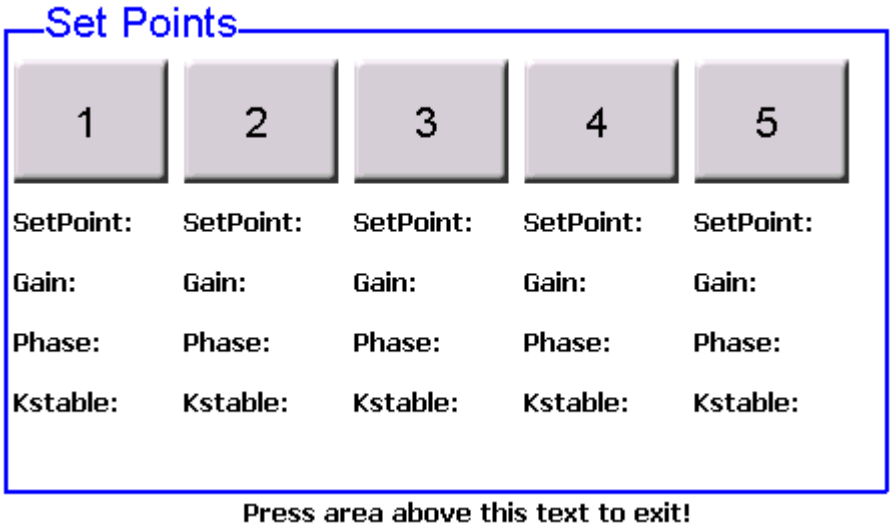
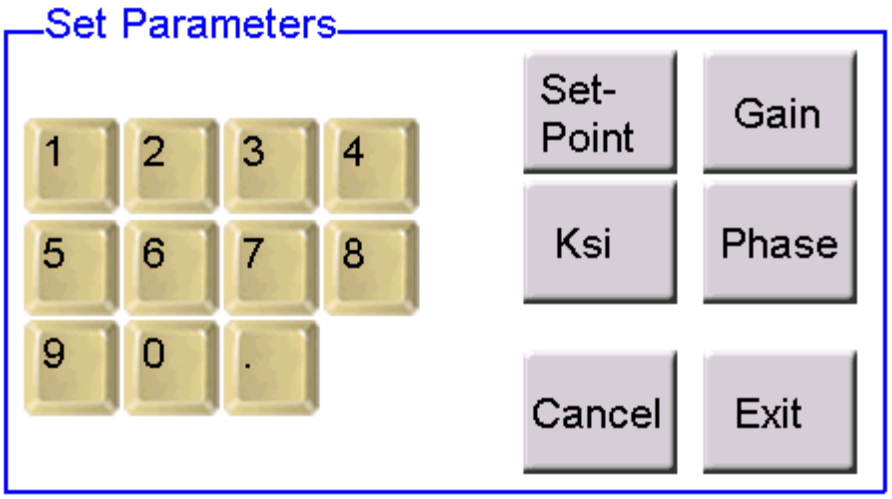


Figure 5.3: Set Point Parameter Menu



Controller Configuration Menu

The controller configuration menu provides the user access to various configuration settings, including engineering units (% F/S or Torr) and gauge ranges. By default, the controller uses % F/S referenced to the high gauge (Gauge 1). If this is the desired display, no configuration is needed. If the Pressure Units are set to display Torr, the gauge range must be set.

To set the **Pressure Units** and **Gauge Range**, press the ***Controller Config*** button, accessible from the **Main Menu**. Pressing the ***Select*** button will toggle the **Pressure Units** between % Full Scale and Torr, see **Figure 5.4**. To set the **Gauge Range**, press the associated ***Select*** button then select a pre-defined gauge full scale range, see **Figure 5.5**.

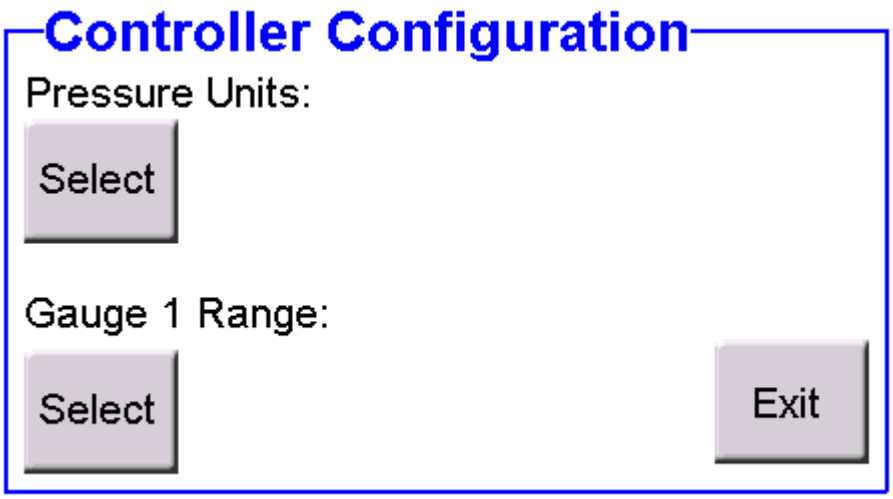


Figure 5.4: Controller Configuration Menu

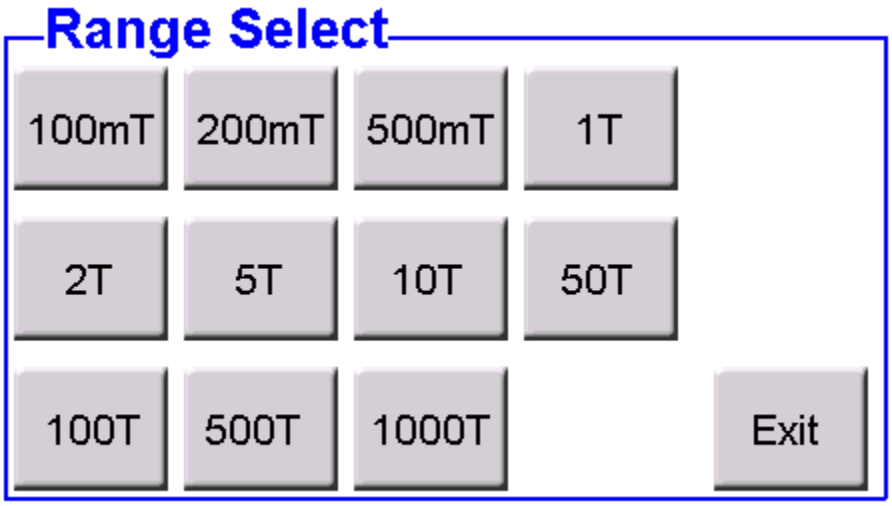


Figure 5.5: Gauge Range Select Menu

Utilities Menu

The **Utilities Menu** is used to activate the touch screen calibration routine, change the screen brightness and to load new firmware into the controller, see **Figure 5.6**. To access the **Utilities Menu**, press ***Utilities*** from the **Main Menu**.

Note: Brightness settings need to be adjusted on every power cycle as they are **not** stored in non-volatile memory.

Note: The ***Firmware Loader*** button should not be pressed unless instructed to do so by a qualified factory representative.

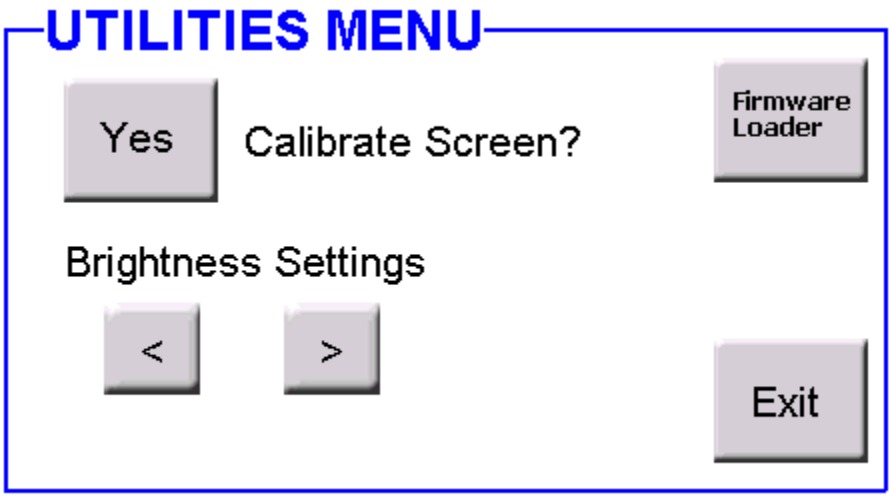


Figure 5.6: Utilities Menu

Valve Initialization

Once all of the rear panel connections have been made and the valve is installed, the valve and controller can be initialized. This calibrates the motor position and resets the controller to a known good position. During initialization, the controller is not operable and all communication ports are disabled.

To start the initialization process, press ***Initialize Valve*** from the **Main Menu**. The screen will temporarily change during the initialization sequence to alert the operator of this action. Upon completion, the **Main Menu** is re-enabled and the **Valve Status** is changed to ***Ready***. See **Figure 5.7**.

Note: Initialization should be performed after every power cycle. The valve will not operate when the **Valve Status** indicates ***Not Ready*** or ***Error***.

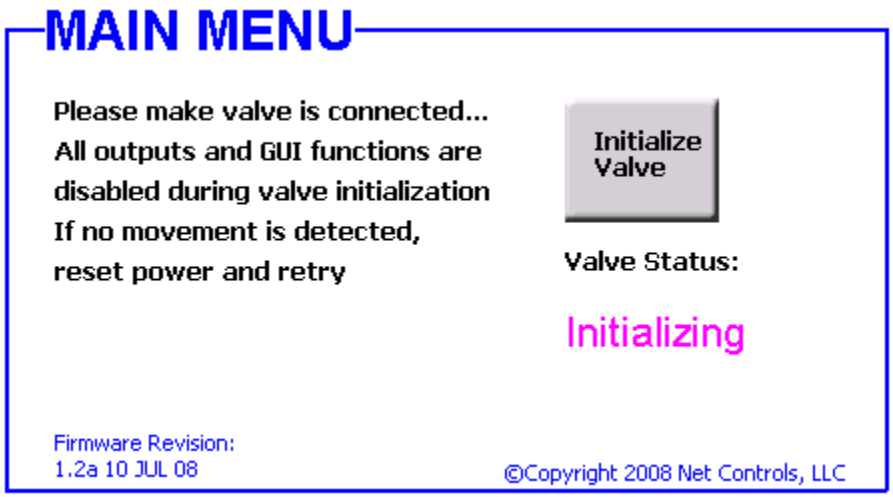


Figure 5.7: Initialization Alert

Control Center

The Control Center is used to open and close the valve, activate set points, set discrete valve positions, and display trend data, see **Figure 5.8**. To access this area, press the ***Control Center*** button from the **Main Menu**.

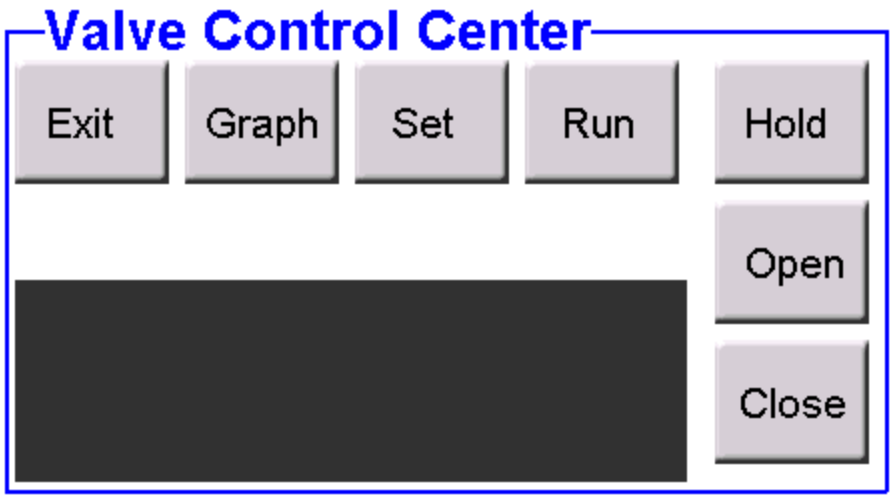


Figure 5.8: Control Center Screen

Once the Valve Control Center screen is displayed, the user can access all functions that affect valve movement and control. Pressing the ***Open*** button opens the valve to 100% (90°). If in control mode, the valve will stop control regardless of the pressure and set point. Pressing the ***Closed*** button will immediately close the valve regardless of pressure and set point. Pressing the ***Hold*** button will immediately halt the valve at the present position, regardless of pressure and set point.

CAUTION: When pressing the ***Hold*** button, care must be taken to ensure the pressure in the vacuum system does not exceed safe levels.

CAUTION: Stopping/**Holding** the valve in the near closed position with gas flow on can cause chamber pressure to rise quickly.

Setting and Running the Active Set Point

The active set point is selected by pressing the ***Set*** button from the Valve Control Center Screen and navigates the user to the **Set Point Select** screen, see **Figure 5.9**. With the **Set Point Select** screen active, the user can select any previously configured set point (refer to the **Set Points** section in this manual). Further, the user can configure each set point to control valve position or pressure using the **Type Select**. The **Type Select** is toggled by pressing the ***Pressure*** and ***Position*** buttons.

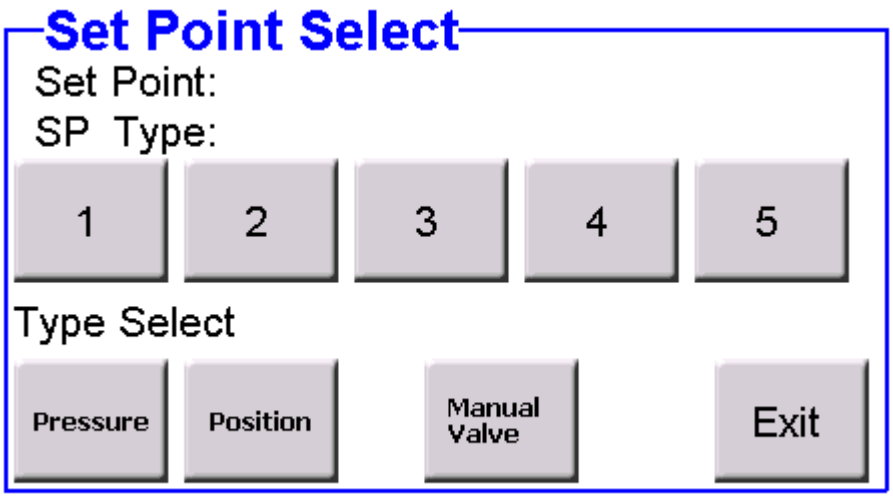


Figure 5.9: Set Point Select Screen

From the **Set Point Select** screen, the user can also select **Manual Valve Control Mode**. This is done by pressing the ***Manual Valve*** button and entering a valve position using the touch pad on the **Set Valve Position** screen, see **Figure 5.10**.

Note: The valve position is entered as a floating point number from 0.0 to 100.0%. This represents the valve stroke from 0 to 90 degrees. Example: 100% = 90.0 degrees, or **Open**.

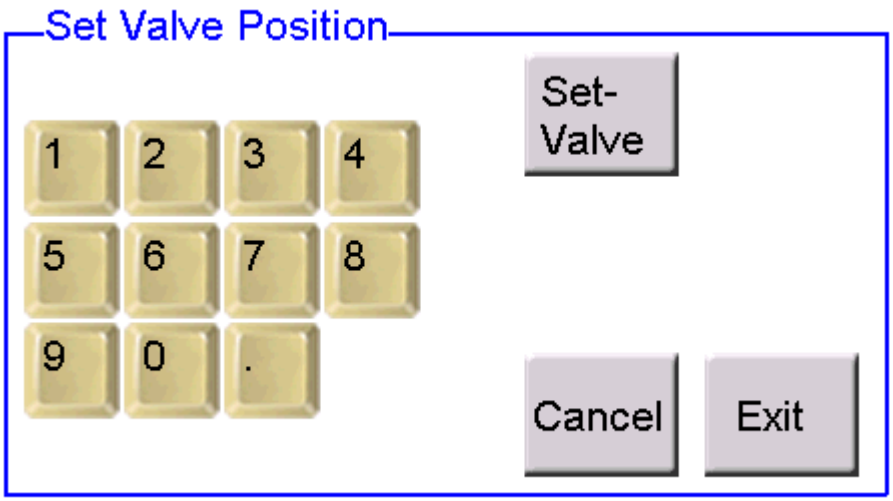


Figure 5.10: Manual Set Valve Position Screen

Note: ***Pressing the Set Valve button on the Set Valve Position screen will result in the valve immediately moving to the desired position. This is not the case with when using a set point and the Position set point Type, which requires the Run button to be pressed as well.***

After the active set point and set point type have been selected, the user must press ***Exit*** and return to the **Valve Control Center** screen and select ***Run*** to control to the desired set point. Selecting ***Run*** immediately puts the controller in control mode and the valve will begin to move. Pressing the ***Graph*** button will allow the user to graphically view the valve position and pressure as well as monitor system performance.

Note: ***Once the control mode is activated via the Run button, the controller remains in control mode until the Hold, Open, or Closed buttons are selected.***

Section Six: Troubleshooting

WARNING: ***The 98 is used in conjunction with a valve plate that can exhibit excessive force. Care must be exercised to insure that body parts are not in or near the valve plate, a piece that moves suddenly and expectedly and can cause significant harm and possibly dismemberment. NC recommends that a lock-out and tag-out procedure be strictly followed whenever human physical intervention is required on all of its 98 Controllers.***

Some basic troubleshooting can be performed by the user referring to the instructions and suggestions in the table below which describes common symptoms and recommended actions. The 98 controller module is designed for years of maintenance free operation. The electronics MTBF is more than 10,000 hours of continuous operation. There are no user serviceable parts or components inside the enclosure. If a problem does occur with the 98 control electronics or software, please refer to the basic troubleshooting instructions below or contact NC Customer Support to obtain additional instructions or a Return Materials Authorization number.

WARNING: ***All returns to NC must be free of harmful, corrosive, radioactive, or toxic materials.***

TABLE 6.1 – POSSIBLE FAILURE MODES AND RECOMMENDED ACTIONS

SYMPTOM	POSSIBLE CAUSES	RECOMMENDED ACTION
The controller does not appear to turn on. No LEDs are illuminated.	The controller is not receiving power properly Switch S1 is not in the correct position. 2. 24VDC is not present at S2.	Check external power supply, cabling and pin assignments. Try to restart the controller by reconnecting power supply. Operate OPEN/CLOSE switches.
The controller is on (one or more LEDs illuminated) but it will not respond to commands	The initialization safety lock function is active. The red FAULT LED should be on	Issue the JC command via the serial port to execute the initialization sequence.
	The RS-232 serial connections are not properly made	Check cabling and pin assignments. Make sure CTS, RTS, and DSR connections are not made.
	Communications settings disagree between the controller and the HOST	Make sure HOST is set for 9600 Baud, 1 stop bit and no parity. Handshaking should be disabled.

SYMPTOM	POSSIBLE CAUSES	RECOMMENDED ACTION
	A communications timeout has occurred	Call Net Controls Technical Support
The controller does not operate and only the red FAULT LED is on.	The valve plate and/or actuator is jammed	Cycle power to attempt re-initialization. Or, with power OFF, try to move valve plate by hand. If stuck, call Net Controls Technical Support
	There is something wrong with the motor drive circuitry or the internal power supply circuitry	Call to obtain an RMA #
The valve plate position does not agree with the indicated position	The controller software has lost track of valve position	Cycle power and allow for re-initialization. If problem repeats or persists, call Net Controls Technical Support
Pressure control performance is unsatisfactory	The controller is not receiving the gauge pressure signal, or the signal is very noisy	Check the gauge cabling and signal stability. Also, check for electrical noise or system vibrations, especially if a 100 mTorr (or smaller) gauge is used
	The controller is in valve position control mode	Put the controller in the correct mode by issuing the proper RS-232 command
	System design or operating range may be outside the capabilities of the special pressure control algorithm	Call for Net Controls Applications Support
The controller/valve will not respond to a new set point value	The new set-point value is too close to the old set-point value	When using serial communications, the difference between two set-point values should be more than 0.01%.

Appendix A: Product Specifications

The following tables summarize specifications essential to the installation and hook-up of the 98 Series Universal Valve Controller. Please note that the information herein is limited to the 98 Series Controller. For valve installation instructions and guidelines, please refer to the appropriate valve Operating Manual.

Table A.1 – Series 98 universal valve controller General Equipment Specifications

Feature	Specification
Dimensions	5.1”W x 1.8”H x 3.9”D
Weight	0.8 lbs (0.36kg)
Rated Input Voltage	24VDC +/- 10%
Rated Input Protection	28VDC max, reverse input protection with automatically resettable PTC fuse
Power	24VDC @ 3.0A Peak 24VDC @ 1.25A Nominal: 30W* *without CDG option
Rated Output Power (for gauge excitation)	Option: ± 15VDC @ 500 mA
Protection Class	1
Degree of Protection (IP)	X0
Laser Class	1 (LED’s)
Certification/EU Directives	CE Standard for Process Equipment
Operating Temperature	65°C for electronics Valve: to 150°C with optional heaters
Allowable Ambient Humidity	0 to 95% non-condensing

Note: ***EMC Directive 89/336/EC for D/C powered models. Low Voltage Directive 2006/95/EC to EN 61010-1***

Table A.2 – Series 98 universal valve controller RS-232 Serial I/O specifications

Feature	Specification
Set Points	5 set points with dedicated PID settings (see Appendix B)
Communications	RS-232 via Dedicated Port
Analog Signal Inputs	For 0-5V / 0-10V CDG signals
Pressure Output (Optional)	0-5 VDC or 0-10 VDC
Valve Angle Output (Optional)	0-5 VDC or 0-10 VDC. 5V or 10V is open.

Table A.3 – Series 98 universal valve controller Performance specifications

Feature	Specification
Valve Speed (open to closed)	90 to 350msec depending on valve size
Control Range	0.5% to 100% of input voltage
Accuracy	0.25% of reading
Repeatability	0.12% of reading

Table A.4 – Series 98 universal valve controller Reliability specifications

Feature	Specification
Electronics MTBF	>10,000 hours
Warranty	1 year

APPENDIX B: ASCII COMMAND REFERENCE

TABLE B.1 – ASCII SERIAL COMMANDS

SERIAL COMMAND	DESCRIPTION	NOTES
SP	Sets phase for active set-point	
SG	Sets gain for active set-point	
C	Close the valve	Same function as pressing the CLOSE switch
O	Open the valve	Same function as pressing the OPEN switch
H	Hold the valve in the current position	Stops active pressure control, if device is in that mode
Snxx.xx	Used to program a value for n=1-5, where n identifies the programmable set point and xx.xx is any number between 0.00 and 100.00, representing the % of gauge full scale	S125, for example, programs the value of the first set point at 25%. When using a 1 Torr gauge, this corresponds to 250 mTorr.
Vxx.xx	Go to valve position	xx.xx is 0 to 100% of full open
L0	Auto select CDG1 or CDG2 for best resolution	Default two gauge configuration
L1	Control to and report CDG1 values only	Selects Gauge 1 for maintenance function.
L2	Control to and report CDG2 values only	Selects Gauge 2 for maintenance function.
N1xx	Sets the full scale range of CDG1	Values for xx can be found in Table 4.1
N2xx	Sets the full scale range of CDG2	Values for xx can be found in Table 4.1
D1	Select set point 1	
D2	Select set point 2	
D3	Select set point 3	
D4	Select set point 4	
D5	Select set point 5	
G *value*	Sensor voltage range *value* 0 = 1 Volt 1 = 5 Volts 2 = 10 Volts	
P1 *value*	Set low threshold for process limit 1 *value* is % of F.S.	Requires installed options
P2 *value*	Set high threshold for process limit 1 *value* is % of F.S.	Requires installed options
P3 *value*	Set low threshold for process limit 2 *value* is % of F.S.	Requires installed options
P4 *value*	Set high threshold for process limit 2 *value* is % of F.S.	Requires installed options
J *value*	Calibrate the valve, where *value* is: C = Remove Inhibit 1 = Initialize to open 2 = Initialize to close	
T1 *value*	Set point 1 type where *value* is: 0 = position 1 = pressure	
T2 *value*	Set point 2 type where *value* is: 0 = position	

SERIAL COMMAND	DESCRIPTION	NOTES
	1 = pressure	
T3 *value*	Set point 3 type where *value* is: 0 = position 1 = pressure	
T4 *value*	Set point 4 type where *value* is: 0 = position 1 = pressure	
T5 *value*	Set point 5 type where *value* is: 0 = position 1 = pressure	
B *value*	Valve position output range where *value* is: 0 = 5 Volts 1 = 10 Volts	Requires installed options
X1 *value*	Set phase of set point 1, where *value* = 0 to 1000	
X2 *value*	Set phase of set point 2, where *value* = 0 to 1000	
X3 *value*	Set phase of set point 3, where *value* = 0 to 1000	
X4 *value*	Set phase of set point 4, where *value* = 0 to 1000	
X5 *value*	Set phase of set point 5, where *value* = 0 to 1000	
M1 *value*	Set gain of set point 1, where *value* = 0 to 1000	
M2 *value*	Set gain of set point 2, where *value* = 0 to 1000	
M3 *value*	Set gain of set point 3, where *value* = 0 to 1000	
M4 *value*	Set gain of set point 4, where *value* = 0 to 1000	
M5 *value*	Set gain of set point 5, where *value* = 0 to 1000	

TABLE C.1 – ASCII SERIAL REQUESTS AND RESPONSES

Serial Request	Description	Response
R5	Requests the current pressure	P+xx.xx, where xx.xx is a number from 0.00 to 100.00
R6	Requests the current valve position	V +xx.xx, where xx.xx is a number from 0.00 to 100.00
R38	Requests the software version	98 – [version#] [version date]
GSN	Get the serial number of the device	Serial nb xxxxxx
R1	Set point 1 value	S1 *value* Where value is % of F.S.
R2	Set point 2 value	S2 *value* Where value is % of F.S.
R3	Set point 3 value	S3 *value* Where value is % of F.S.
R4	Set point 4 value	S4 *value* Where value is % of F.S.
R10	Set point 5 value	S5 *value* Where *value* is % of F.S.
R11	Low threshold Process limit #1	P1 *value* Where *value* is %FS
R12	High threshold Process limit #1	P2 *value* Where *value* is %FS
R13	Low threshold Process limit #2	P3 *value* Where *value* is %FS
R14	High threshold Process limit #2	P4 *value* Where *value* is %FS
R26	Set point 1 type (either pressure or position)	T1 *type*, where *type* equals: 0 = position 1 = pressure
R27	Set point 2 type (either pressure or position)	T2 *type*, where *type* equals: 0 = position 1 = pressure
R28	Set point 3 type (either pressure or position)	T3 *type*, where *type* equals: 0 = position 1 = pressure
R29	Set point 4 type (either pressure or position)	T4 *type*, where *type* equals: 0 = position 1 = pressure
R30	Set point 5 type (either pressure or position)	T5 *type*, where *type* equals: 0 = position 1 = pressure
RN1	Sensor range of gauge 1	E *value*, where *value* equals: 0 = 0.1 10 = 1000 1 = 0.2 11 = 5000 2 = 0.5 12 = 10000 3 = 1 13 = 1.33 4 = 2 14 = 2.66 5 = 5 15 = 13.33 6 = 10 16 = 133.3 7 = 50 17 = 1333 8 = 100 18 = 6666 9 = 500 19 = 13332

RN2	Sensor range of gauge 2	E *value*, where *value* equals: 0 = 0.1 10 = 1000 1 = 0.2 11 = 5000 2 = 0.5 12 = 10000 3 = 1 13 = 1.33 4 = 2 14 = 2.66 5 = 5 15 = 13.33 6 = 10 16 = 133.3 7 = 50 17 = 1333 8 = 100 18 = 6666 9 = 500 19 = 13332
R35	Sensor full scale voltage range	Sensor FS voltage: *value* 0 = 1 Volt 1 = 5 Volts 2 = 10 Volts
R37	System status	M*abc* For the *value of a*: 0 = Local 1 = Remote For the *value of b:* 0 = not learning 1 = learning system 2 = learning valve For the *value of c:* 0 = open 1 = close 2 = stop 3 = set point 1 4 = set point 2 5 = set point 3 6 = set point 4 7 = set point 5 8 = Analog set point
R41	Phase 1 value	X1 *value* Where *value* is Phase/Lead
R42	Phase 2 value	X2 *value* Where *value* is Phase/Lead
R43	Phase 3 value	X3 *value* Where *value* is Phase/Lead
R44	Phase 4 value	X4 *value* Where *value* is Phase/Lead
R45	Phase 5 value	X5 *value* Where *value* is Phase/Lead
R46	Gain 1 value	M1 *value* Where *value* is gain
R47	Gain 2 value	M2 *value* Where *value* is gain
R48	Gain 3 value	M3 *value* Where *value* is gain
R49	Gain 4 value	M4 *value* Where *value* is gain

R50	Gain 5 value	M5 *value* Where *value* is gain
RP	Reports Phase on active set-point	Phase: *value* Where *value* is Phase of active set point
RG	Reports Gain on active set-point	Gain: *value* Where *value* is Gain of active set point

APPENDIX D: WARRANTY

Net Controls, LLC Warranty

Each product sold by Net Controls, LLC (NC) is warranted to be free from the manufacturing defects that adversely affect the normal functioning thereof during the eighteen (18) month period immediately following delivery thereof by NC (or in the case of products or components of any product purchased by NC from another for any lesser period of time that such manufacturer warrants said product or component to NC), provided that the same is properly operated under conditions of normal use and that regular, periodic maintenance and service is performed or replacements made, in accordance with the instructions provided by NC. The foregoing warranty shall not apply to any product or component that has been repaired or altered by anyone other than an authorized NC representative or that has been subject to improper installation or abuse, misuse, negligence or accident. NC shall not be liable for any damage, loss, or expense, whether consequential, special, incidental, direct or otherwise, caused by, arising out of or connected with the manufacture, delivery (including any delay in or failure to deliver), packaging, storage or use of any product sold or delivered by NC shall fail to conform to the foregoing warranty or to the description thereof contained herein, the purchaser thereof, as its exclusive remedy, shall upon prompt notice to NC of any such defect or failure and upon the return of the product, part or component in question to NC at it's factory, with transportation charges prepaid, and upon NC's inspection confirming the existence of any defect inconsistent with said warranty of any such failure, be entitled to have such defect or failure cured at the NC factory and at no charge therefore, by replacement or repair of said product, as NC may elect. NC MAKES NO WARRANTY OR REPRESENTATION OF ANY KIND, EXPRESS OR IMPLIED, (INCLUDING NO WARRANTY OR MERCHANTABILITY), EXCEPT FOR THE FOREGOING WARRANTY AND THE WARRANTY THAT EACH PRODUCT SHALL CONFORM TO THE DESCRIPTION THEREOF CONTAINED HEREIN, and no warranty shall be implied by law.