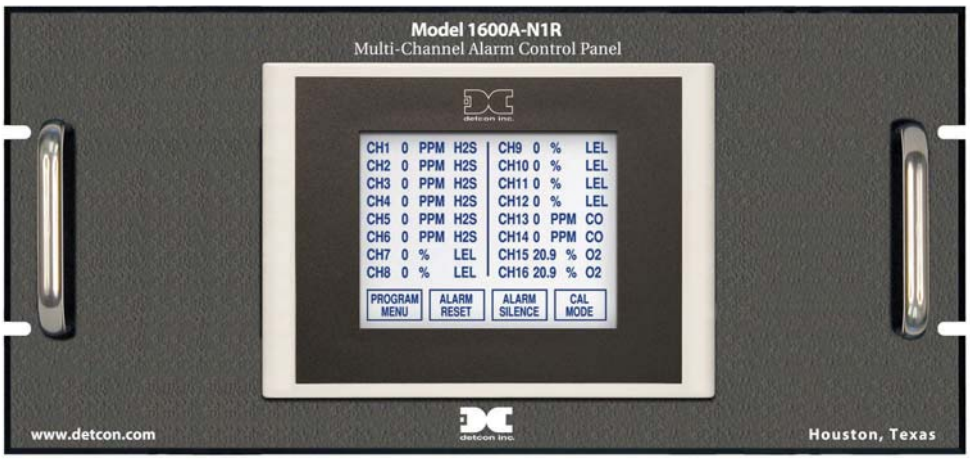
Model 1600A-N1R

NEMA 1 Control Panel



Operator's Installation and Instruction Manual

DETCON, Inc.
3200 Research Forest Dr., A-1
The Woodlands, Texas 77381
Ph.281.367.4100 / Fax 281.298.2868
www.detcon.com

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1.0 Introduction

The Detcon Models 1600A-N1R is a "user-configurable" multi-channel alarm controller. The 1600A is configurable for up to 16 channels. Through the use of I/O modules the 1600A can receive analog inputs from either 4-20mA or contact closure modules, and can alternatively poll serial sensors via RS-485 Modbus™.

The 1600A-N1R controller uses a modular design approach that allows the user to customize the selection of stand-alone input and output modules. I/O modules are available in four channel sets for 4-20mA inputs, contact closure input, relay outputs, and 4-20mA outputs. Detcon's I/O Modules are DIN rail mounted and stackable allowing for seamless system expansion. These addressable I/O modules can be located remotely near the gas sensors to simplify wiring.

The status of sensor inputs is displayed on a backlit graphic display that utilizes a touch-screen user interface. Typical sensor status includes channel number, tag name, gas type, concentration, and alarm/fault status. Each input channel can be assigned up to three alarm levels and fault. A standard RS-485 or optional RS 232 serial output is provided for communication with PLC's, PC's, and monitoring devices.

The controller can be powered by 110/220VAC, 20-30VDC, or both. The enclosure is rated for NEMA 1 locations. Remote mounted gas sensors (purchased separately) can include serial or 4-20mA input devices such as; toxic gas, combustible gas, or oxygen deficiency sensors or contact closure inputs such as liquid level, temperature, pressure, heat, smoke, pull station, etc. Additional features include: one-touch Alarm Inhibit, Alarm Reset, and Alarm Silence (Acknowledge) functions. An Alarm Reset Switch is also mounted on the outside of the enclosure on the left side. The 1600A controller provides for a unique combination of user programming flexibility and customizable expansion capability, in a low-cost and simple-to-operate package.

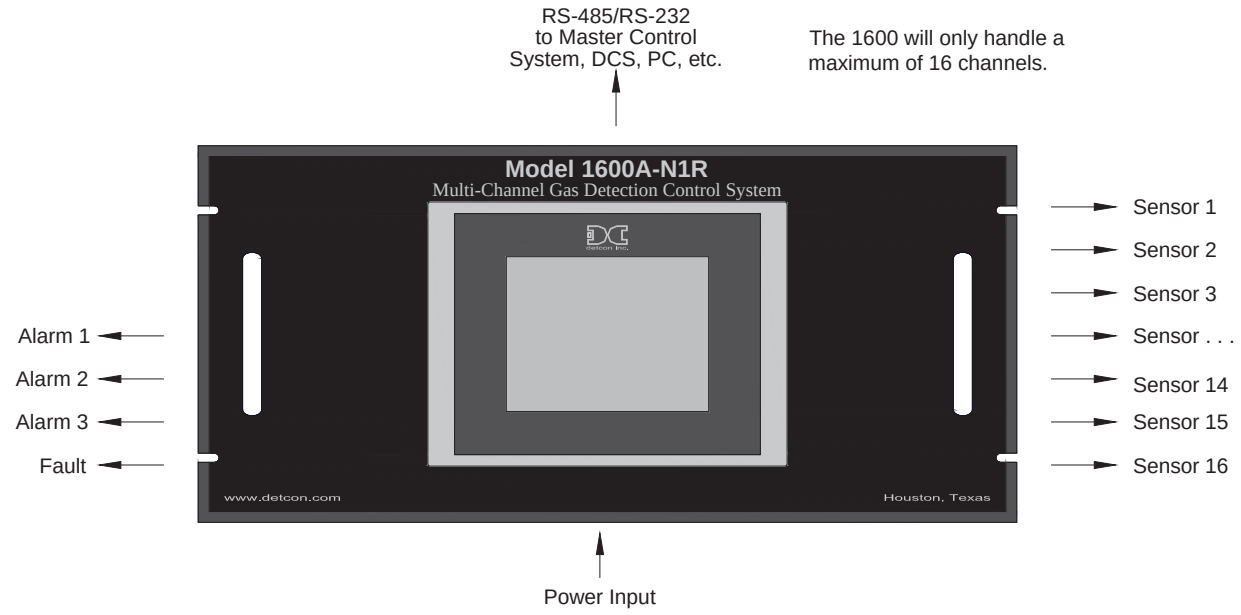

Figure 1 Block Diagram

2.0 System Configuration

2.1 Hardware Configurations

The Model 1600A-N1R is a "user configurable" alarm controller platform. The basic 1600A-N1R Controller includes the NEMA 1 19" Rack Mount enclosure with Controller Module (including display), Power Supply, two AC and one DC breakers, and DC over-voltage protection module. NOTE: I/O modules are factory installed unless specifically instructed otherwise. A maximum of 1 I/O modules will fit on the standard N1P enclosure. I/O Modules are purchased separately.

The available Detcon I/O modules include:
Model DA-4 – Four channel analog 4-20mA input module
Model RL-4 – Four channel relay output module
Model AO-4 – Four channel analog 4-20mA output module
Model DI-4 – Four channel contact input module

Detcon I/O modules are individually addressable and operate on 11.5-30 VDC. Each module communicates with the controller via the RS-485 Modbus™ RTU protocol. Only 10 I/O modules can be mounted in the N1P enclosure. Other modules need to be mounted in separate enclosures.

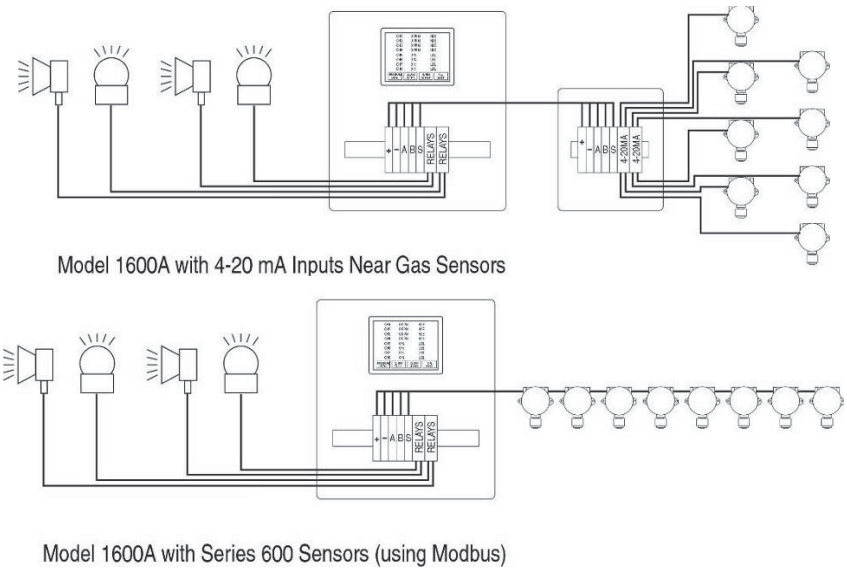

Figure 2 System Configurations

2.2 Programming Configuration

The 1600A controllers are normally configured at Detcon based on application specific information provided by the customer on the Configuration Form. It must be verified that the correct quantity and type of I/O modules have been purchased to support the customer's configuration requirements. On the Configuration Form, the customer should supply all site-specific information pertaining to:

1) Number of gas channels
2) Range, units, and gas type for each channel
3) Alarm level(s) for each gas channel
4) Tag Name for each channel
5) Assignment and set-up information for each relay contact

NOTE: The set-up configuration is fully field-programmable and can easily be executed by the user in the field, refer to Section 4.0 Setup. Modifications to the set-up configuration are expected to take place at the customer's site due to requirement changes and/or system expansions.

2.3 Specifications

Capacity
User Configurable
Up to 16 analog, switch or serial inputs (Model 1600A)

Inputs
Analog 4-20mA (DA-4 Modules)
Contact Closure (DI-4 Modules)
RS-485 Modbus™ RTU

Outputs
User Configurable:
Form C Relay Contacts (RL-4 Modules)
4-20mA outputs (AO-4 Modules)
Standard: RS-485

Accuracy/Repeatability
Display: < 1% F.S.
DA-4: < 1% F.S.
AO-4: < 1% F.S.

Power Input
110-230VAC
20-30VDC

Power Consumption
Base 1600A Controller: 20 Watts at 24VDC
Total Power is dependent on number of I/O modules, number of gas sensors, and type of gas sensors
Total power of unit with I/O modules and gas sensors not to exceed 120 Watts

Display
5 inch diagonal Graphic Backlit LCD with Touch screen

Electrical Classification
NEMA 1 19 inch rack mount

Dimensions
10.5"W x 8"H x 14"D

Operating Temperature Range
0°C to +50°C

Warranty
One year

3.0 Installation

Securely mount the Model 1600A-N1R in a suitable 19 inch rack. Allow at least 16” of depth for wiring.

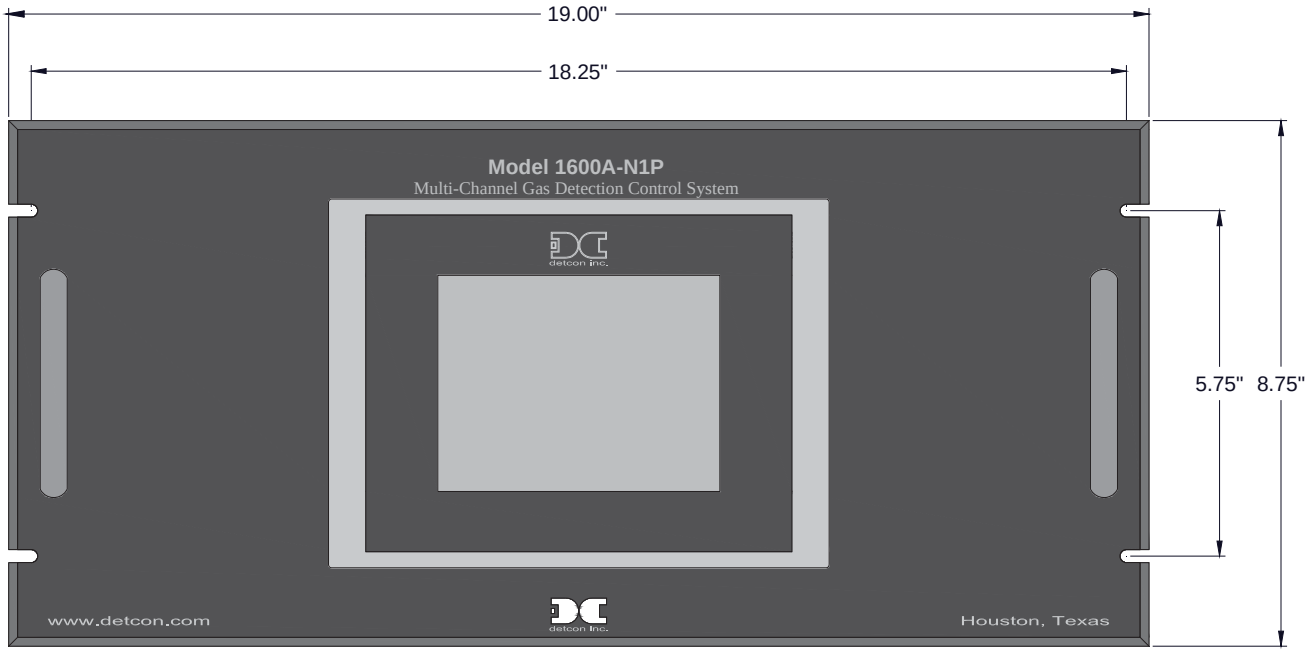

Figure 3 Unit Mounting and Dimensional

Connect 110/220VAC input wiring to the terminals labeled “ACV (L1)”, “Neutral (L2)”, and “Ground” (See Figure 4). The Power Supply is capable of handling AC inputs from 100-240VAC 50-60Hz without degradation.

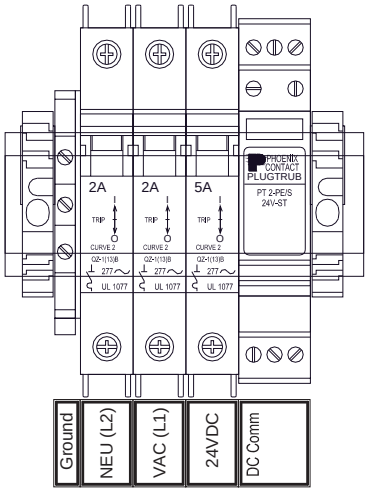

Figure 4 AC/DC Inputs

If applicable, connect 24 VDC to the terminals labeled “24VDC” and “DC Comm”. This input can be used for primary power or back-up power in the event of AC power failure.

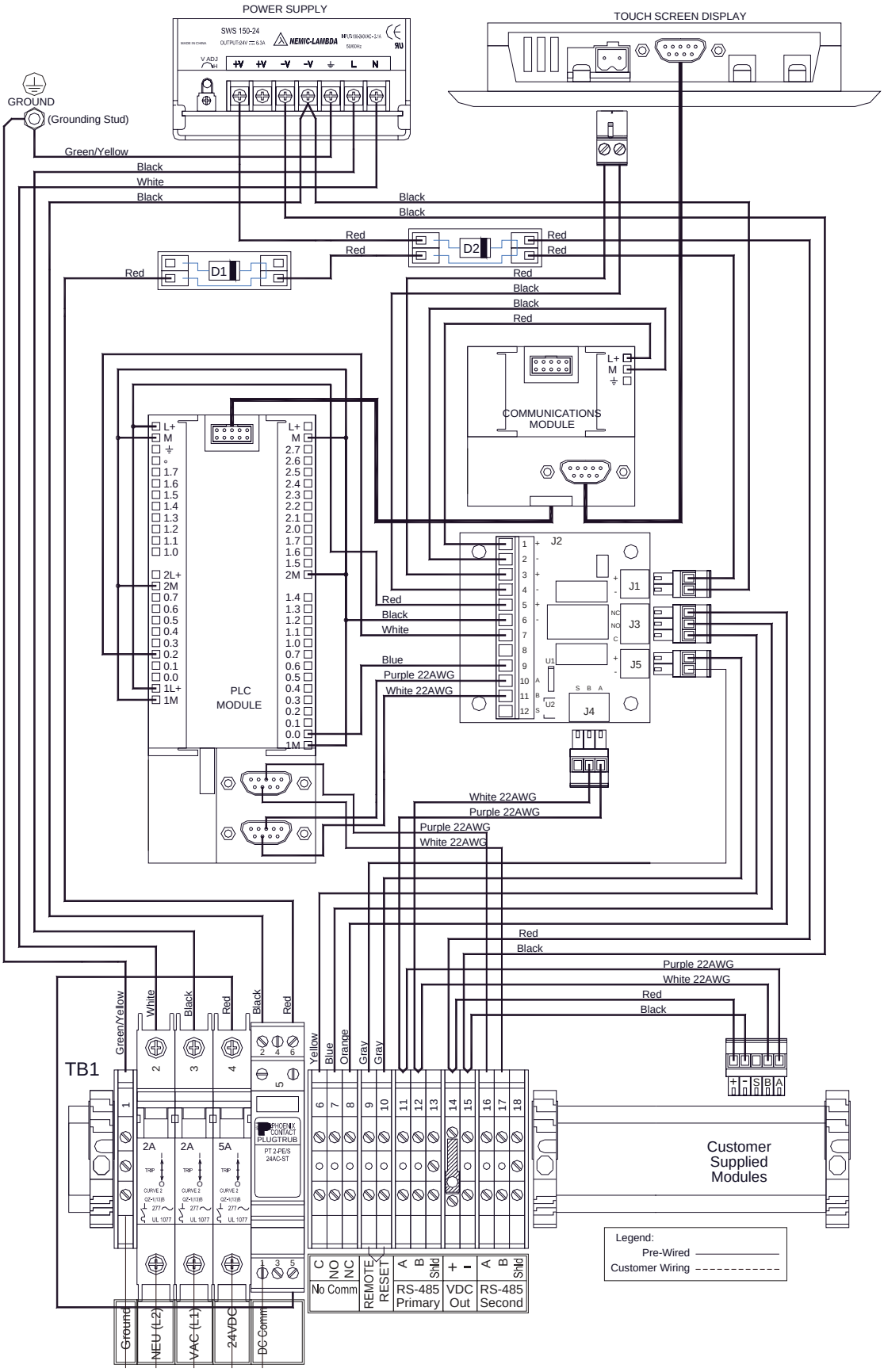

Figure 5 Interconnect Wiring Diagram

Connect the RS-485 wiring from remotely located I/O devices to the terminals located on the Back Panel. These terminals are labeled RS-485 “A” (+), “B” (–), and “Shld” (shield) for primary RS-485 communication (Figure 6). RS-485 wiring should consist of a two conductor, shielded twisted pair (Belden cable P/N 9841 is recommended). Also available are two output terminal blocks to provide 24VDC to external RS-485 devices. This power should be used only to power remotely located I/O modules and/or sensors, and should not exceed a total of 3 Amps accumulative for all I/O modules and sensors attached to the controller. (I.E. if there are two modules mounted on the enclosure that have an accumulative current draw of 0.5Amps, the sensors and/or I/O modules connected to the output 24VDC should not exceed 3.0Amps.) Refer to each module and sensor manual for maximum expected current draw from each device.

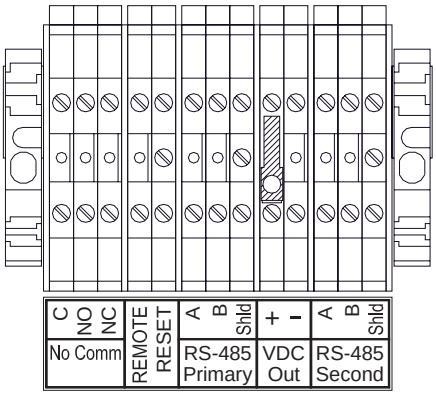

Figure 6 Interface wiring Terminals

WARNING: Do not attach more devices to the controller power supply than the power supply has the capacity for, as damage may occur to the controller and will void the warranty. Modules and sensors attached to the unit that exceed this 3Amp power rating should be powered by an external power supply capable of handling the extended load.

The secondary serial RS-485 port from the controller is connected to a set of Terminal Blocks on the DIN Rail (Figure 6). The Terminal Blocks are labeled Secondary “A, B & Shld” and can be connected to a PLC, PC/HMI, DCS, or other Modbus™ master polling serial communications device, refer to Secondary Modbus™ Port Section 5.5.

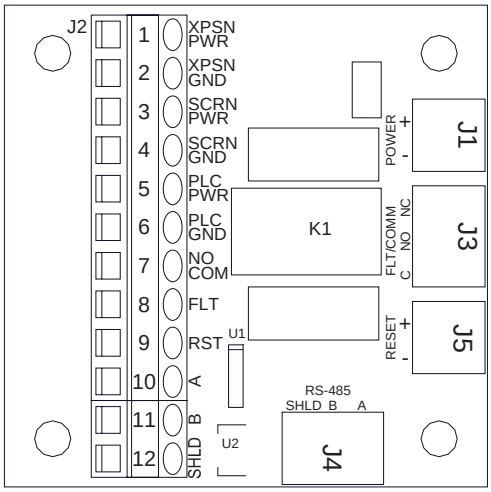

Figure 7 Interface PCA

The No Communications Fault Relay is connected to a set of Terminal Blocks on the DIN Rail (Figure 7 and Figure 5.) The Terminal Blocks are labeled “NO COMM” “C”, “NO” and “NC”. The Interface PCA, mounted on the back of the Display Panel, will de-energize the No Comm/Fault relay in the event there is a Communication Fault with any activated device. A ‘No Communication Fault’ condition will create a ‘short’ between the ‘Common’ and ‘Normally Closed’ contacts, and create an open between the ‘Normally Open’ and ‘Common’ relay contacts. This is required for fail-safe operation. There is a two-minute delay before any active device will trigger a no communication condition.

The unit includes connections for an optional Remote Alarm Reset Switch. A set of Terminal Blocks is supplied for the connection of a Remote Alarm Reset Switch that can be mounted anywhere outside the unit. The Remote Alarm Reset incorporates a set of normally closed contacts that cause the unit to reset the Alarms when contact is broken. To install a Remote Reset Switch the jumper between terminal blocks 8 and 9 (labeled “Remote Reset”) ***must*** be removed and the switch wired to these terminals. Connect only a normally closed switch to these terminal blocks. If more than one switch is to be connected, the switches ***must*** be connected in series.

> **NOTE:** The Remote Alarm Reset switch should be a ‘Normally Closed’ Switch and should be wired as such. Failure to wire the switch correctly will cause the Enclosure Alarm Reset and all subsequently connected Remote Alarm Reset Switches to be non operational.

3.1 Installing the I/O Modules

Normally, maximum of one (1) I/O module may be installed on the main NEMA 1 rack. Additional modules should be mounted in a separate enclosure.

I/O modules are mounted to industry-standard 37.5 x 7.5 mm din-rail. Install the first I/O module on the din rail and slide it all the way to the right side stop. When installing additional I/O modules, make sure there is about 0.5 inch clearance spacing on either side of the module and snap onto the din rail (the 0.5” spacing is to allow for connector clearance). Once the I/O module is snapped onto the din-rail, slide it to the right and assure that it firmly plugs into the next module. Repeat as necessary for the balance of the modules. The 1600-A Controller Enclosure has room for a maximum of two (2) I/O modules (provided the Modbus™ Spacers are removed). Additional modules should be mounted in a separate enclosure..

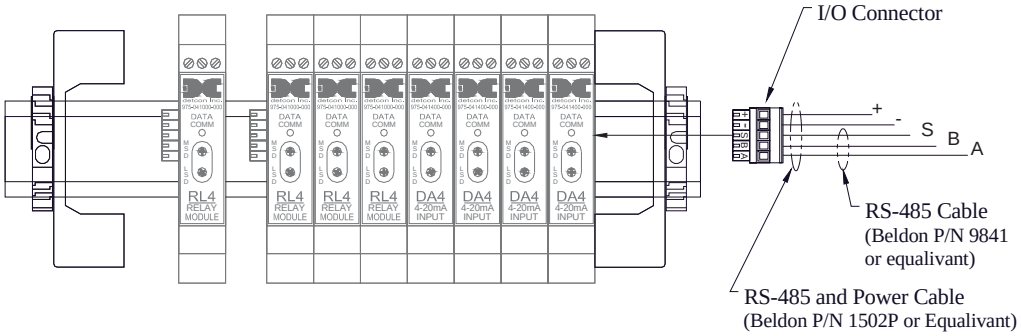

Figure 8 I/O Module Installation

For addressable I/O modules or Modbus™ sensors that are being located remotely from the Model 1600A-N1P controller use Belden 1502P cable for serial and power connections. For serial only connections use Belden 9841 cable.

3.2 Connecting to the I/O Modules

4-20mA Gas Sensors

Connect 4-20mA type gas sensors to the Model DA4 4-20mA input modules. There are four 4-20mA inputs in each Model DA4 module.

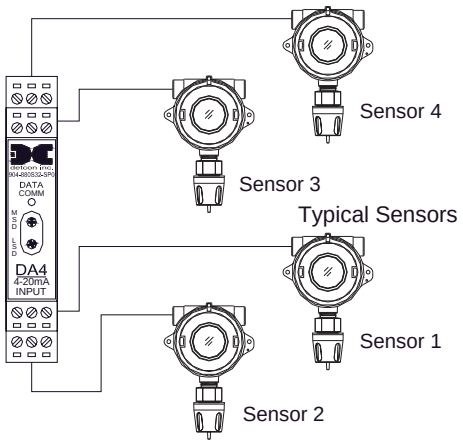

Figure 9 Model DA-4 and 4-20mA Gas Sensors

RS-485 Modbus Gas Sensors

Connect the five wires from the Modbus™ gas sensors (Detcon Model 600 and Model 700 Series types) to the din rail mounted terminals labeled RS-485 "A", "B", and "Shld" and VDC "+" and "-". Note: the controller power supply is only capable of handling 3-3.5Amps accumulative. If the external sensors plus the controller's internal modules exceeds this rating, only three wires (RS-485 "A", "B", and "Shld") should be used and a remote DC power source should be utilized to provide DC power for the remote mounted gas sensors.

NOTE: A 120Ω end of line resistor should be installed on the last gas sensor in the serial loop to enhance communications reliability.

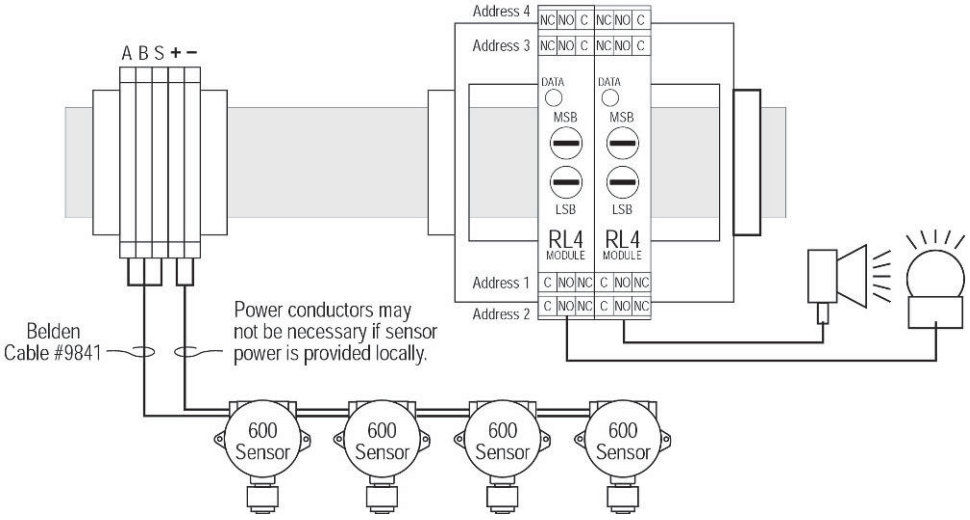

Figure 10 Modbus™ Gas Sensor Connections

Relay Output Contact Modules

There are four 'Form C' 5 Amp relay contacts in each Model RL4 module. These can be used to fire annunciating devices or as signal inputs to other control devices. Connect to the relay contacts of the Model RL4 module as shown
Figure 11. Note that the Amp rating of the relay contact should not be exceeded.

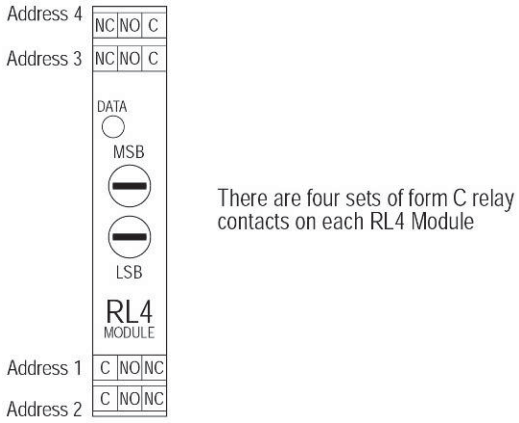

Figure 11 Model RL-4 Relay Module

4-20mA Output Modules

There are four 4-20mA outputs in each Model AO-4 module. These can be used as signal inputs to other control devices. Connect to the AO-4 modules as shown in Figure 12:

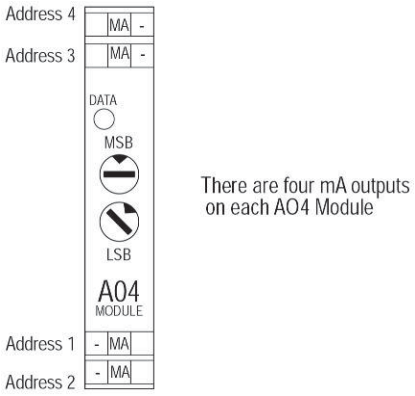

Figure 12 Model AO-4 Module

Contact Input Modules

There are four addressable contact inputs in each DI-4 Module. The Module is powered by 24VDC, and the voltage is used to produce a 4mA level when the contacts are open and a 20mA level when the contacts are closed.

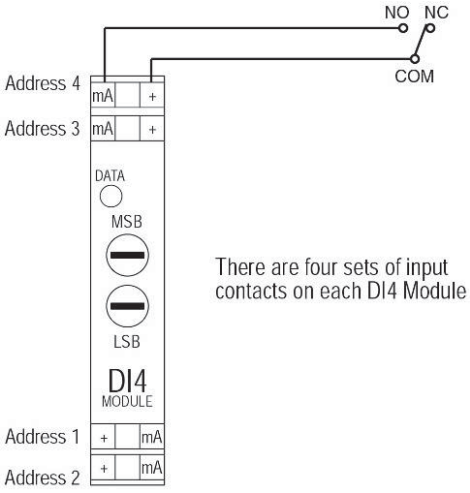

Figure 13 Model DI-4 Module

General Wiring Notes:

- ❖ When I/O Modules are located at a remote distance from the controller, an end-of-line terminating resistor is required to enhance communications reliability. Identify the last I/O Module in the loop, and open the module casing using the clip release points. Locate and install the jumper on JP6 (TERM). This adds a 120Ω resistor to the end of the line. If applicable, add a 120Ω resistor to the last Modbus™ gas sensor.
- ❖ Follow generally accepted guidelines for RS-485 serial networks. Do not wire I/O Modules and/or Modbus™ gas sensors in long-distance 'T-Tap' configurations. Stay with direct serial configurations. See Appendix A for serial communications configuration guidelines.
- ❖ Use Detcon Recommended cabling whenever possible.
  - Belden P/N 1502P cable is recommended for a single cable providing serial communications and power.
  - Belden 9841 cable is recommended for a single cable providing serial communications only.
- ❖ Ground the cable shielding at the Model 1600A-N1R Controller ***only***. Other points of grounding may cause a ground loop, and induce unwanted noise on the RS-485 line, which in turn may disrupt communications.

3.3 Initial Power Checks

Before applying power, make sure that all I/O Modules are correctly installed and that all wiring connections between I/O modules and external devices are made correctly.

NOTE: Applying power with devices hooked up incorrectly may cause damage.

Turn the applicable AC and DC Breaker Switches to the ON positions. Verify that the main touch-screen LCD comes on displaying gas readings. After 5 seconds, verify that all the I/O modules are being polled by observing a sequence of blinking LED's on the I/O Modules representing successful serial communication.

NOTE: The polling of the input devices takes place more frequently than the communications to the relay output devices. The sequence of polling communication will follow the order of the I/O device switch addresses.

3.4 Setting Device Identification on the I/O Modules

NOTE: If the Model 1600A controller has been configured at Detcon, you may elect to skip to the Operator Interface (Section 4.0) for further review of system operation.

For a unit that has not been properly configured, the I/O modules must be serially addressed to establish correct communications. Typically, the I/O modules will be identified from 01 to FF starting from the module on the right hand side of the stack. The I/O module's identification is established by setting the two rotary switches to the correspondingly correct position. The top rotary switch sets the most significant bit (MSB). The bottom rotary switch sets the least significant bit (LSB). For an address of 01, set the top switch to 0 and the bottom switch to 1. See Appendix B for Decimal to Hexadecimal conversion.

NOTE: All addresses must be unique. There can be no duplication of addresses or a failure to communicate will occur.

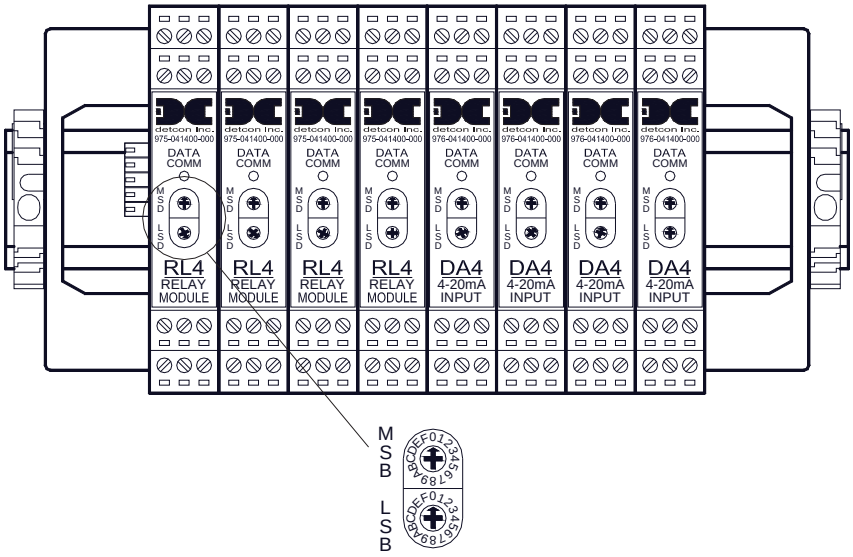

Figure 14 Setting Device Addresses

4.0 Setup

4.1 Program Menu Selections

To enter the Program Menu touch Program Menu and see Passwords in Section 5.4.

NOTE: If any configuration changes are made to the system, the Modbus must be reset to ensure the system operates normally. See section 5.3for more information.

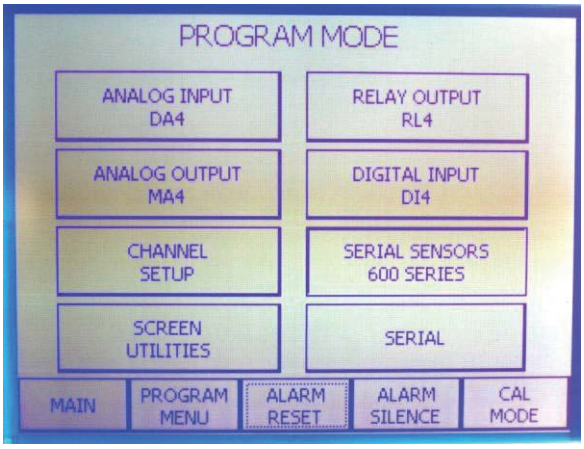

Figure 15 Program Menu

4.1.1 Channel Setup

The individual Channel set up screen is used to activate/disable each channel for which the 1600A is currently programmed. The 1600 has a maximum of 16 active input channels. This number must be consistent with the number of sensors and I/O modules connected to the system. Activating more channels than are attached to the I/O Modules installed will cause a “Communication Fault”, and should not be attempted. It is possible, however, to activate fewer channels than are attached to the I/O Modules installed. Channel Setup (Figure 16) is where Channel Activation, Label/Tag. Alarm 1, Alarm 2, Alarm 3, Relays for Alarms, Range, Units, and Gas type is set. Press ‘ENTER’ after the appropriate selections have been made for the current active gas channel. The Channel Information is displayed for the current channel being set-up (Figure 17). To exit the channel touch MAIN, Channel Setup, PREV or NEXT. To exit Channel Setup touch Program Menu or Main.

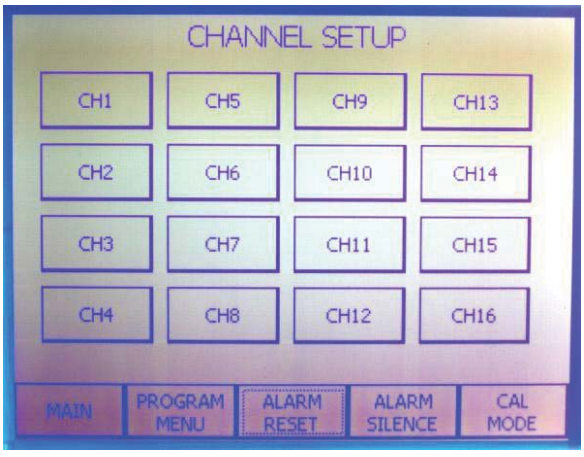

Figure 16 Channel Setup

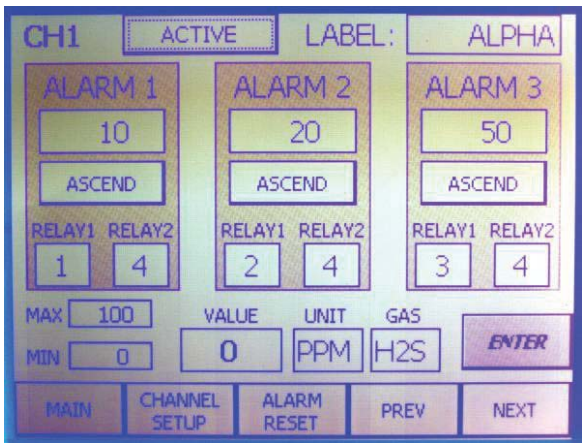

Figure 17 Individual Channel Setup

Channel Activation: If the channel is active, touch the ACTIVE button to disable it; touch the *ENTER* button to save change. If the channel is disabled, touch the DISABLED button to activate it; touch the *ENTER* button to save change. The main display will show "DISABLED" if a channel is selected as disabled.

Tags/Labels: The Main, Zone 2 and individual channel screens displays the current tag names assigned to each active gas channel. To add or change a Tag Name, enter Channel Setup, press the channel desired to change, press the current tag/label, type the new tag on the screen, press "↵" (enter key on on-screen keyboard). When each entry in the channel setup screen is complete, press the 'ENTER' key to save the entry.

Alarm 1, 2, 3: Set point, direction, and relay assignments are all handled in the 3 alarm blocks. The Set points are changed by touching the value window below each alarm designation. The example shown in figure 17 is 10 for ALARM 1, 20 for ALARM 2, 50 for ALARM 3. Touch the current value window, enter the new value on the screen touch pad, touch *ENTER* to save change. Touching the Ascend and Descend window will toggle between Ascend and Descend. Each Alarm has up to two relays assigned to it. To change a relay assignment touch the relay window, enter the new relay on the screen touch pad, touch "↵", touch *ENTER* to save change.

> **NOTE:** Relay output assignments can be set as discrete or common and a relay can be used as many times as desired. However, relay outputs can only be set up one way (relative to latching, energized, silence able) and will be applied in that way for every function they are assigned.
>
> **NOTE:** The relay state as it pertains to latching/unlatching, energized/non-energized, and silenceable / non-silenceable are configured in the RELAY OUTPUT on the PROGRAM MENU. See section 4.1.3.

Range: To change the range of a channel touch the MIN or MAX window, enter the new value on the screen touch pad, touch "↵", touch *ENTER* to save change.

Units: To change the units of a channel touch the UNIT window, select the new unit (% or PPM) on the screen touch pad, touch "↵", touch *ENTER* to save change.

Gas Type: To change the Gas Type touch the GAS window, Select Gas Type from the selection on the screen touch pad, touch "↵", touch *ENTER* to save change.

Press the 'ENTER' key after the completed set-up selections for each gas channel are made

4.1.2 DA4 set up

Touch the Analog Input/DA4 button. This function enables up to 4 DA4 modules. They are identified as CH 1-4, CH 5-8, CH 9-12, and CH13-16. There are four sensor inputs for each DA4 module, labeled 1 – 4. The address for each module is:

CH 1-4	01 Hex
CH 5-8	05 Hex
CH 9-12	09 Hex
CH 13-16	0D Hex

The DA4 menu is entered by pressing the Analog Input from the Program Menu. Channels 1 thru 4 are in Module 1-4. Channels 5 thru 8 are in Module 5-8 and so on. Simply press the Module button for each module you wish to enable. When done press the Program Menu button.

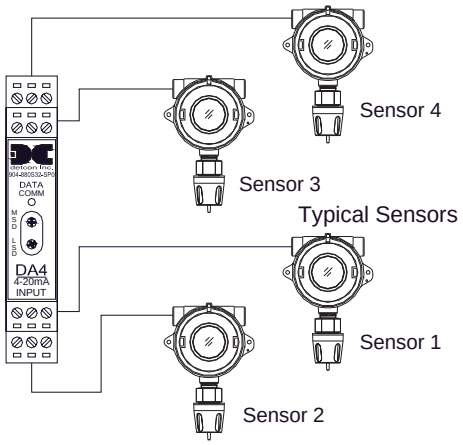

Figure 18 Addressing DA Modules

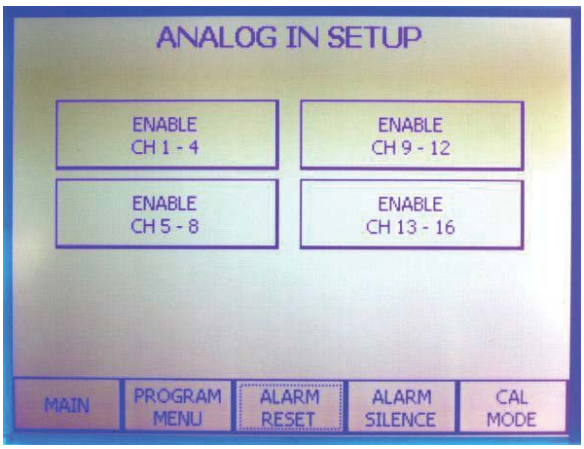

Figure 19 DA4 / Analog input Activation

Example: The 1600A is to be set up for two Model DA4 input modules. Make sure that the switch setting for the first Model DA4 module is set to 01, representing the first gas input and is wired to terminal connection #1, for position 1 on the module's wiring connector. The first Model DA4 module would look like this:

CH #	DA4 Address
01 thru 04	01 Hex

The second Model DA4 module with identification switches set to 05 and handling sensor inputs 5 – 8, would appear as follows:

CH #	DA4 Address
05 thru 08	05 Hex

4.1.3 Relay Activation and Configuration.

For the Relay Output set-up, follow the same logic as with the gas channel set-up. Press the enable "ENABLE" key for the CH1-4 box to use the first RL4 module and then set its Device# to 41. Note, the block now shows as "ENABLED". The second part of Relay Setup requires the decision of how the individual relay contacts will be configured. Press the block labeled "CONFIGURE CH 1-4", and a relay setup screen will appear. Each relay must be selected as latching or non-latching, energized or non-energized, and silenceable or non-silenceable. These selections are shown in three small blocks to the right of the Relay # input. Make selections by pressing the buttons on screen (Figure 22). Entries are saved automatically when exiting the screen by pressing MAIN or Device Setup. Continue this sequence for all other relays.

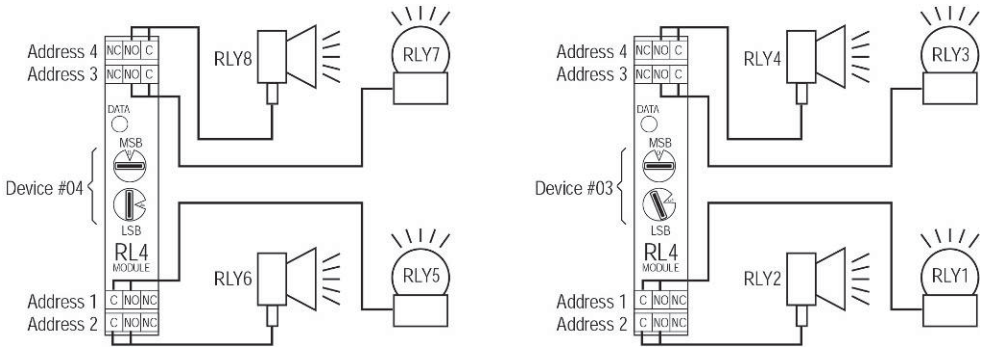

Figure 20 Addressing Relay Modules

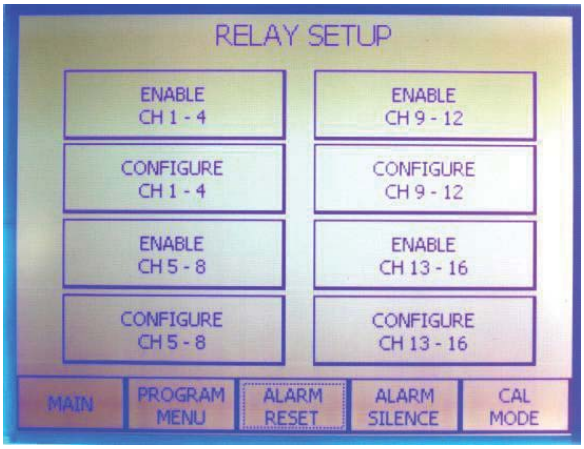

Figure 21 Activating Relay Outputs

Figure 22 Setting up Relay Outputs

NOTE: This selection controls the output state for that relay regardless of how many alarm/fault conditions for which the relay output may be used. A single relay output can only be set up in one configuration.

The set-up for the first Model RL4 module would look like this:

Relay #	**RL4 Address**
01 thru 04	41 Hex

The second Model RL4 module set to 69 (45Hex) and handling relays 5 – 8, would appear as follows:

Relay #	**RL4 Address**
05 thru 08	45 Hex

4.1.4 Serial Inputs

Activating Serial Inputs

The 1600A can handle 16 serial inputs from either a model 600 or model 700 series sensor. To activate the serial inputs enter Program Mode. Touch the Serial Sensors button to read "Serial Sensors 700 Series" or toggle to "Serial Sensors 600 Series". This is a global command and as such all sensors must be either 600 or 700 series. See Figure 23 touch the Serial button and select each channel that is to be enabled or disabled, Figure 24

WARNING: If the wrong 600/700 selection is made while sensors are connected, The Modbus may need to be reset to re-initialize Modbus communications. Refer to the "Modbus Reset" function in the SCREEN UTILITIES menu to re-start Modbus™ polling (Section 5.3).

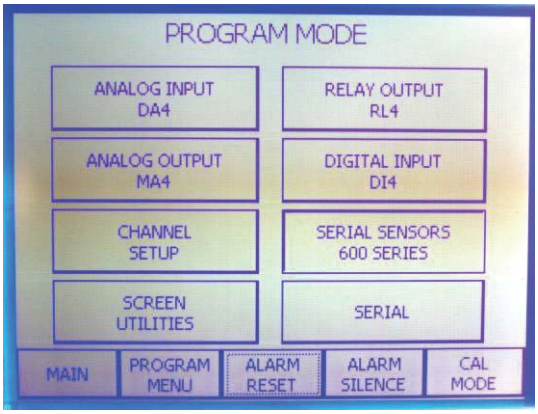

Figure 23 Accessing Serial Setup

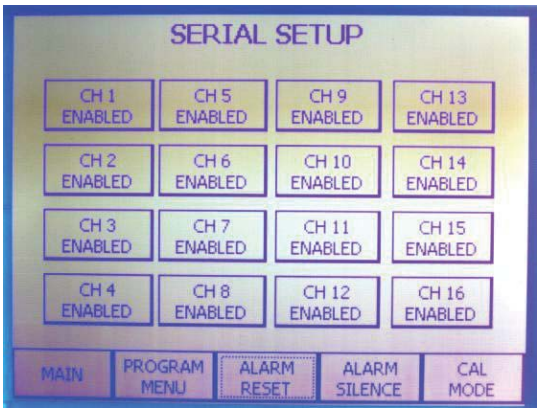

Figure 24 Serial Setup screen

Addressing Serial Sensors

When connecting to a Detcon Model 600 or Model 700 Series sensor, the addressing procedure is different. First, note how the gas sensors are addressed. Each sensor must be set to a different address. The addresses start from 01 and count up to 16 (hex 10). An example is shown below to explain the procedure. To address the gas sensors, set the following:

CH #	Sensor Address	CH #	Sensor Address
01	01 Hex	09	09 Hex
02	02 Hex	10	0A Hex
03	03 Hex	11	0B Hex
04	04 Hex	12	0C Hex
05	05Hex	13	0D Hex
06	06 Hex	14	0E Hex
07	07 Hex	15	0F Hex
08	08 Hex	16	10 Hex

NOTE: the CH# is the gas channel number displayed on the Main Display. The sensor address is the serial ID address (in Hexadecimal) set at the 600 or 700 Series sensor.

NOTE: The 1600A Device # is in decimal format, and the serial address switch setting for the 600 or 700 Series Sensor is in hexadecimal format. This means that device number 10 decimal on the 1600A corresponds to the 600 or 700 Series Sensor at address 0A hexadecimal.

4.1.5 DI4s / Switch inputs

DI4s set up

The DI4 module is used to provide a switch input. The 1600A will display it as 0 for an open switch and 100 for a switch closure. The modules are CH 1-4, CH 5-8, CH 9-12, CH13-16. Each module takes 4 channels and has 4 inputs. The module address for each module is:

CH 1-4	01 Hex
CH 5-8	05 Hex
CH 9-12	09 Hex
CH 13-16	0D Hex

To activate a DI4 module, enter the Program Menu and press the Digital Input/DI4 button. Touch the button for each module to be enabled or disabled.

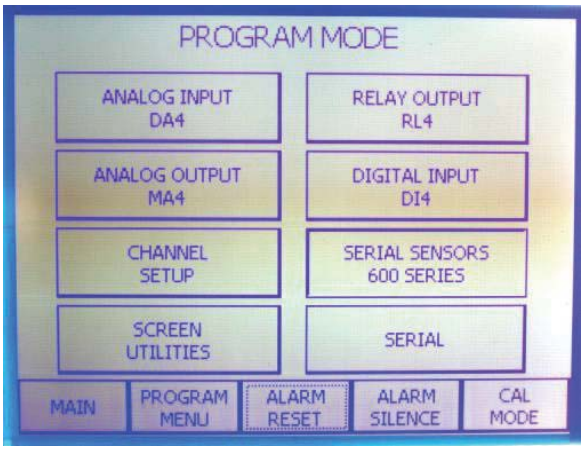

Figure 25 Accessing DI4 Setup Screen

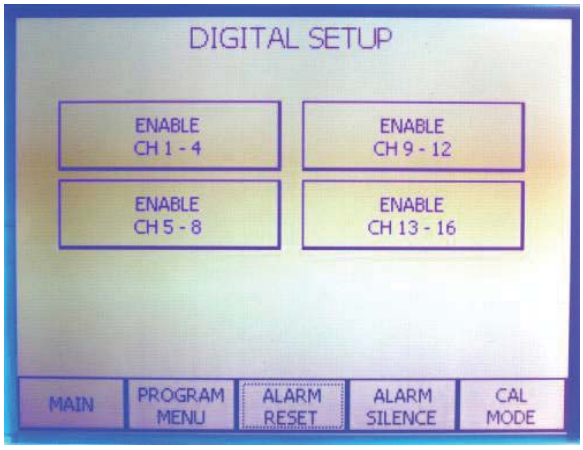

Figure 26 Digital Input / DI4 Activation

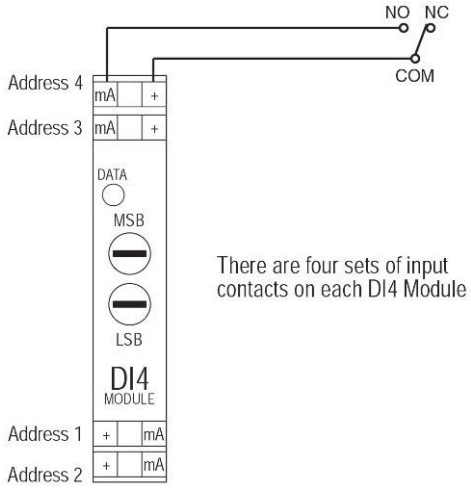

Figure 27 Model DI-4 Module

4.1.6 4-20mA Output Setup

This menu entry is used to address Detcon AO-4 modules 4-20mA output.

NOTE: If there are no AO-4 modules being used, *do not* enter any device and address information on this screen. Misinformation entered here will cause the controller to generate a 'No Communication Fault'.

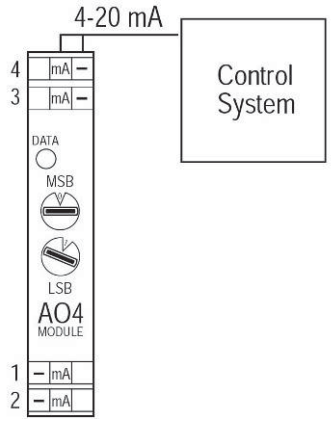

Figure 28 Set-up 4-20mA Outputs

For example, assume setting up two AO-4 modules. Make sure to set each AO-4 module to a unique ID# using the front panel switches. If Device #s 1 through 4 are already being used for DA-4 and RL-4 modules, then set these two AO-4 modules to 5 and 6. The entered values should then look like this:

CH#	AO4 Address
01 thru 04	81 Hex
05 thru 08	85 Hex
09 thru 12	89 Hex
13 thru 16	8D Hex

5.0 System Operation

5.1 Using the Touch-screen Display

The Operator Interface is conducted through a graphic touch-screen backlit display. A suitable small blunt device such as the Detcon stylus wand should be used to conduct touch-screen interaction.

> **NOTE:** Sharp objects such as pens, pencils, screwdrivers, etc, are not permissible as they may permanently damage the display and will void the warranty. The use of fingertips to activate keys is permissible, but is difficult due to the small press key areas in some cases. A pencil's eraser tip is a suitable alternative.

In general, displayed items that are outlined with a box represent Press Keys. Press Keys should be firmly pressed down for about 0.5 seconds to engage properly. The outline of the key will change momentarily when activated properly.

The graphic display is back lit. The contrast can be adjusted using the 'Screen Utilities' function described in section 5.3.

5.2 Main Display

The main display shows the status of the active gas channels. They are labeled by channel number, reading, units, and gas type. Example: CH1 - 0ppm - H2S – User Tag – (F, NC, C). When there is an active alarm or fault condition, the problem channel # will be shown in reverse video. A channel number in flashing reverse video represents a channel that is actively in alarm/fault/No Comm or has cleared alarm but was set to latching mode in the relay output. A Fault will also be represented by the letter "F" flashing after the user tag. A No Comm condition will also be represented by the letters "NC" flashing after the user tag. An in-cal condition will be represented by the letter "C" flashing after the user tag.

Figure 29 Main Display

Channels are displayed in groups of eight per screen, called 'Zones'. The 'Zones' are represented by a key at the bottom of the main display as Main or Zone 2 for the 1600. To view a particular 'Zone', press the appropriate key on the screen. During normal operation, the display will rotate between zones at 10-second intervals, displaying each zone for 10 seconds and moving on to the next zone.

The controller may be configured to have less than eight channels per 'Zone'. Only those 'Zones' with active channels will be displayed. Channels that have been disabled will show "DISABLED" in lieu of sensor information. When any channel in a 'Zone' has an alarm or fault condition the controller will automatically display the channels in that 'Zone'. When there are alarms or faults in multiple 'Zones', the controller will display each zone for 10 seconds and rotate to the next 'Zone'. The display will continue to rotate through each 'Zone' until a 'Zone' key is selected by the user.

The main function keys reside across the bottom of the Main Display area. They are: Main or Zone 2, Program Menu, Alarm Reset, Alarm Silence, and Cal Mode.

Program Menu requires a username and password to logon (see Passwords in Section 5.4) and takes the operator to the functions for configuration and set-up.

Alarm Reset is used to reset all relay output contacts that have been set up as "latching" outputs, ***only*** after the condition has cleared. If the alarm condition has not cleared, then the Alarm Reset will not reset the relay output. If no alarms have been set-up as "latching" then the Alarm Reset has no function.

NOTE: Alarm Reset can also be accomplished using an externally mounted Alarm Reset switch.

Alarm Silence is used to reset all relay output contacts that are in an active alarm state. Alarms that have been silenced will remain silenced until they clear or another alarm is triggered. Once cleared, the alarms will fire again if the alarm condition repeats.

Cal Mode is used to disable all relay outputs so that the user can go off-line and calibrate the gas sensors without activating any alarm devices. After pressing Cal Mode, the button converts to an alternating display of "IN CAL" and "60-minute" countdown cycle, and the gas channels switch to reporting "IN CAL" to let the user know the system has been temporarily taken out of service. At the conclusion of the 60-minute cycle, the unit will automatically return to normal operating mode and all relay outputs will become activated again. Any time during the 60-minute countdown the user can return to normal operating mode by pressing the Cal Mode button again.

5.3 Touch Screen Utilities

This menu item is provided for field adjustment of the LCD screen contrast and provides the means to readjust calibration of the graphic touch screen should this become necessary. The Touch Screen Utilities key is located at the bottom center of the Program Menu Screen (Figure **15**) and is accessed by pressing the touch key. Adjust the screen contrast using the up and down arrows.

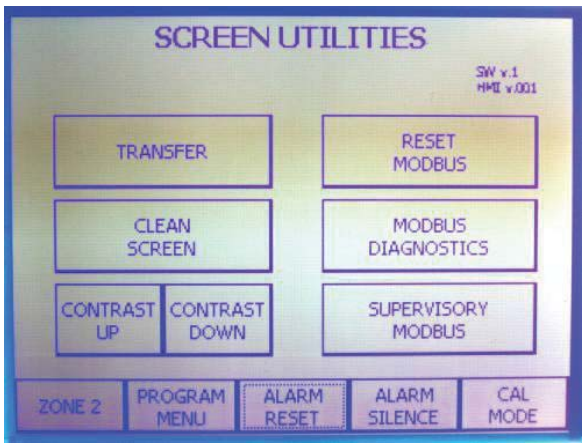

Figure 30 Screen Utilities

Transfer Mode
To place the 1600A in transfer mode, press the "TRANSFER" key. The system will begin shutting down and automatically go into transfer mode. Transfer mode allows the user to load critical updates from Detcon, Inc to the touch screen.

Clean Screen
The touch screen can be cleaned while the 1600A-N1R is operational. To do this, the user must press the "CLEAN SCREEN" key. Once the cleaning screen is activated, touch screen operation is locked for 30 seconds. During this time period the user may clean the screen as needed. The time remaining for the lockout is indicated by a progress bar.

Reset Modbus
In the event of a Modbus communication error, press the "RESET MODBUS" key to restart Modbus polling.

Modbus Diagnostics
To view the status of slave devices, relay modules, and analog output modules, press the "MODBUS DIAGNOSTICS" key. Modbus diagnostics will generate a two page list, displaying real-time status, of 16 slave devices, 4 relays modules, and 4 analog output modules.

Supervisory Modbus
When using the 1600A as a Modbus slave, press the "SUPERVISORY MODBUS" key to adjust Modbus slave settings. See section 5.5 for Modbus slave settings.

5.4 Password Protection

A simple form of Program Menu protection is provided to the end-user. This will allow the user to functionally operate the unit, but will not allow the user the capability to change any important configuration parameters.

When switching between the unprotected mode and the Program Menu protected mode, the user must touch Program Menu, the User window(Figure 31), type ABCD, press "↵", touch the Password window, type ABCD, press "↵ (Figure 32), touch OK.

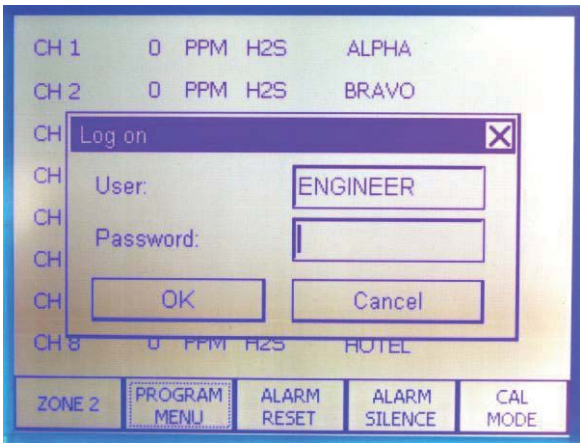

Figure 31 Password Window

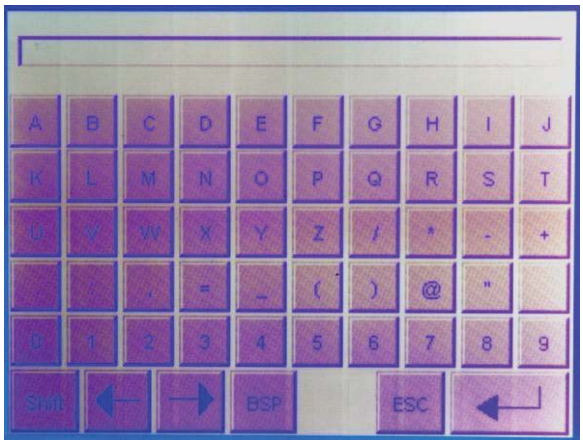

Figure 32 On-Screen Keyboard

5.5 Secondary Modbus™ Port

Model 1600A controllers feature Modbus™ compatible communications protocols and are addressable by a PLC, PC/HMI, DCS, or other Modbus™ RTU master device. Communication is accomplished by two wire half duplex RS-485, 9600 or 19,200 baud, 8 data bits, 1 stop bit, no parity, with the 1600A Controller secondary port setup as a slave device. Wiring should be brought directly to the back of the controller (See section 3.0 and). A Modbus™ RTU master device up to 4000 feet away can theoretically poll up to 64 different controllers. This number may not be realistic in harsh environments where noise and/or wiring conditions would make it impractical to place so many devices on the same pair of wires. If a multi-point system is being utilized, each controller must be set to a different device address.

Modbus™ Register Detail:
Read Holding Registers is the only code supported by the 1600A controllers. The 1600A contains 21 holding registers that reflect the status its 16 channels. The register data is shown below.

Register #	
40000	Channel 1 Reading
40001	Channel 2 Reading
40002	Channel 3 Reading
40003	Channel 4 Reading
40004	Channel 5 Reading
40005	Channel 6 Reading
40006	Channel 7 Reading
40007	Channel 8 Reading
40008	Channel 9 Reading
40009	Channel 10 Reading
40010	Channel 11 Reading
40011	Channel 12 Reading
40012	Channel 13 Reading
40013	Channel 14 Reading
40014	Channel 15 Reading
40015	Channel 16 Reading

40016 Fault Status Bits
High Byte
Bit 7 1 = Channel 16 Fault 0 = Channel 16 no Fault

Bit 6	1 = Channel 15 Fault	0 = Channel 15 no Fault
Bit 5	1 = Channel 14 Fault	0 = Channel 14 no Fault
Bit 4	1 = Channel 13 Fault	0 = Channel 13 no Fault
Bit 3	1 = Channel 12 Fault	0 = Channel 12 no Fault
Bit 2	1 = Channel 11 Fault	0 = Channel 11 no Fault
Bit 1	1 = Channel 10 Fault	0 = Channel 10 no Fault
Bit 0	1 = Channel 9 Fault	0 = Channel 9 no Fault
Low Byte		
Bit 7	1 = Channel 8 Fault	0 = Channel 8 no Fault
Bit 6	1 = Channel 7 Fault	0 = Channel 7 no Fault
Bit 5	1 = Channel 6 Fault	0 = Channel 6 no Fault
Bit 4	1 = Channel 5 Fault	0 = Channel 5 no Fault
Bit 3	1 = Channel 4 Fault	0 = Channel 4 no Fault
Bit 2	1 = Channel 3 Fault	0 = Channel 3 no Fault
Bit 1	1 = Channel 2 Fault	0 = Channel 2 no Fault
Bit 0	1 = Channel 1 Fault	0 = Channel 1 no Fault

40017 Alarm 1 Status Bits

High Byte		
Bit 7	1 = Channel 16 Alarm 1	0 = Channel 16 no Alarm 1
Bit 6	1 = Channel 15 Alarm 1	0 = Channel 15 no Alarm 1
Bit 5	1 = Channel 14 Alarm 1	0 = Channel 14 no Alarm 1
Bit 4	1 = Channel 13 Alarm 1	0 = Channel 13 no Alarm 1
Bit 3	1 = Channel 12 Alarm 1	0 = Channel 12 no Alarm 1
Bit 2	1 = Channel 11 Alarm 1	0 = Channel 11 no Alarm 1
Bit 1	1 = Channel 10 Alarm 1	0 = Channel 10 no Alarm 1
Bit 0	1 = Channel 9 Alarm 1	0 = Channel 9 no Alarm 1
Low Byte		
Bit 7	1 = Channel 8 Alarm 1	0 = Channel 8 no Alarm 1
Bit 6	1 = Channel 7 Alarm 1	0 = Channel 7 no Alarm 1
Bit 5	1 = Channel 6 Alarm 1	0 = Channel 6 no Alarm 1
Bit 4	1 = Channel 5 Alarm 1	0 = Channel 5 no Alarm 1
Bit 3	1 = Channel 4 Alarm 1	0 = Channel 4 no Alarm 1
Bit 2	1 = Channel 3 Alarm 1	0 = Channel 3 no Alarm 1
Bit 1	1 = Channel 2 Alarm 1	0 = Channel 2 no Alarm 1
Bit 0	1 = Channel 1 Alarm 1	0 = Channel 1 no Alarm 1

40018 Alarm 2 Status Bits

High Byte		
Bit 7	1 = Channel 16 Alarm 2	0 = Channel 16 no Alarm 2
Bit 6	1 = Channel 15 Alarm 2	0 = Channel 15 no Alarm 2
Bit 5	1 = Channel 14 Alarm 2	0 = Channel 14 no Alarm 2
Bit 4	1 = Channel 13 Alarm 2	0 = Channel 13 no Alarm 2
Bit 3	1 = Channel 12 Alarm 2	0 = Channel 12 no Alarm 2
Bit 2	1 = Channel 11 Alarm 2	0 = Channel 11 no Alarm 2
Bit 1	1 = Channel 10 Alarm 2	0 = Channel 10 no Alarm 2
Bit 0	1 = Channel 9 Alarm 2	0 = Channel 9 no Alarm 2
Low Byte		
Bit 7	1 = Channel 8 Alarm 2	0 = Channel 8 no Alarm 2
Bit 6	1 = Channel 7 Alarm 2	0 = Channel 7 no Alarm 2
Bit 5	1 = Channel 6 Alarm 2	0 = Channel 6 no Alarm 2
Bit 4	1 = Channel 5 Alarm 2	0 = Channel 5 no Alarm 2

Bit 3	1 = Channel 4 Alarm 2	0 = Channel 4 no Alarm 2
Bit 2	1 = Channel 3 Alarm 2	0 = Channel 3 no Alarm 2
Bit 1	1 = Channel 2 Alarm 2	0 = Channel 2 no Alarm 2
Bit 0	1 = Channel 1 Alarm 2	0 = Channel 1 no Alarm 2

40019 Alarm 3 Status Bits

High Byte		
Bit 7	1 = Channel 16 Alarm 3	0 = Channel 16 no Alarm 3
Bit 6	1 = Channel 15 Alarm 3	0 = Channel 15 no Alarm 3
Bit 5	1 = Channel 14 Alarm 3	0 = Channel 14 no Alarm 3
Bit 4	1 = Channel 13 Alarm 3	0 = Channel 13 no Alarm 3
Bit 3	1 = Channel 12 Alarm 3	0 = Channel 12 no Alarm 3
Bit 2	1 = Channel 11 Alarm 3	0 = Channel 11 no Alarm 3
Bit 1	1 = Channel 10 Alarm 3	0 = Channel 10 no Alarm 3
Bit 0	1 = Channel 9 Alarm 3	0 = Channel 9 no Alarm 3
Low Byte		
Bit 7	1 = Channel 8 Alarm 3	0 = Channel 8 no Alarm 3
Bit 6	1 = Channel 7 Alarm 3	0 = Channel 7 no Alarm 3
Bit 5	1 = Channel 6 Alarm 3	0 = Channel 6 no Alarm 3
Bit 4	1 = Channel 5 Alarm 3	0 = Channel 5 no Alarm 3
Bit 3	1 = Channel 4 Alarm 3	0 = Channel 4 no Alarm 3
Bit 2	1 = Channel 3 Alarm 3	0 = Channel 3 no Alarm 3
Bit 1	1 = Channel 2 Alarm 3	0 = Channel 2 no Alarm 3
Bit 0	1 = Channel 1 Alarm 3	0 = Channel 1 no Alarm 3

40020 Cal Status Bits

High Byte		
Bit 7	1 = Channel 16 Cal	0 = Channel 16 no Cal
Bit 6	1 = Channel 15 Cal	0 = Channel 15 no Cal
Bit 5	1 = Channel 14 Cal	0 = Channel 14 no Cal
Bit 4	1 = Channel 13 Cal	0 = Channel 13 no Cal
Bit 3	1 = Channel 12 Cal	0 = Channel 12 no Cal
Bit 2	1 = Channel 11 Cal	0 = Channel 11 no Cal
Bit 1	1 = Channel 10 Cal	0 = Channel 10 no Cal
Bit 0	1 = Channel 9 Cal	0 = Channel 9 no Cal
Low Byte		
Bit 7	1 = Channel 8 Cal	0 = Channel 8 no Cal
Bit 6	1 = Channel 7 Cal	0 = Channel 7 no Cal
Bit 5	1 = Channel 6 Cal	0 = Channel 6 no Cal
Bit 4	1 = Channel 5 Cal	0 = Channel 5 no Cal
Bit 3	1 = Channel 4 Cal	0 = Channel 4 no Cal
Bit 2	1 = Channel 3 Cal	0 = Channel 3 no Cal
Bit 1	1 = Channel 2 Cal	0 = Channel 2 no Cal
Bit 0	1 = Channel 1 Cal	0 = Channel 1 no Cal

5.6 Firmware Upgrade

The 1600A-N1P is capable of firmware upgrades for both the PLC and touch screen device. Upgrades will be performed by the user. The following components are needed to perform firmware upgrades:

- ProSave Software (can be Downloaded free at http://www.siemens.com)
- S7-200 USB PPI cable
- S7-200 Memory cartridge
- DB9 Gender Changer

Figure 33 S7-200 USB/PPI Cable

5.6.1 Touch Screen Upgrade

1. Disconnect blue DB9 cable from PLC Communications Module (Figure 34).
2. Using a Gender Changer, connect the USB/PPI cable to the DB9 Cable disconnected from the PLC Communications Module, and connect the USB end of the USB/PPI cable to a PC or laptop.

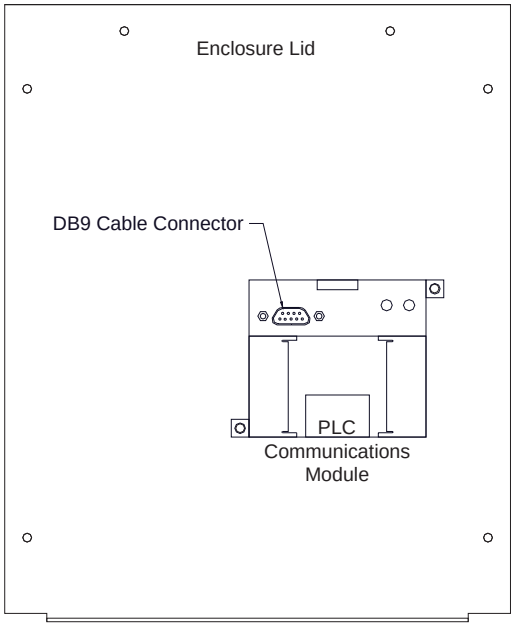

Figure 34 Display Back Panel

3. From the touch screen display, switch to transfer mode by selecting:
   Program Menu ► *Screen Utilities* ► *Transfer*
4. Open ProSave software on PC or laptop:
   Start ► *All Programs* ► *Simatic* ► *ProSave* ► *ProSave*
5. Click on the “General” tab.
6. Under "Device Type", select TP 177A 6”.
7. Under "Connection", select Serial (via USB-PPI cable) for connection.
8. Click on the “Restore” tab.
9. Select the firmware file named “Detcon_1600AN1P_HMI_vXX.psb”. (*XX represent current version.)*
10. Ensure that “Booting” check box is unchecked.
11. Press “Star Restore” to start the firmware upgrade.

NOTE: This operation may take some time, depending on the type of connection selected.

NOTE: Before entering Program Menu, an appropriate username and password may be required.

12. "Downloading successful" will display on the ProSave software once firmware upgrade has completed.
13. Remove USB/PPI cable from touch screen.
14. Cycle the power on the Model 1600A.
15. Verify the proper touch screen firmware version has been loaded.
    Touch screen version can be found in the top right corner of the "Screen Utilizes" menu.
    Program Menu ► Screen Utilities: HMI v.XX

5.6.2 PLC Upgrade

1. Install memory cartridge with new firmware (refer to Figure 35 for memory cartridge location).

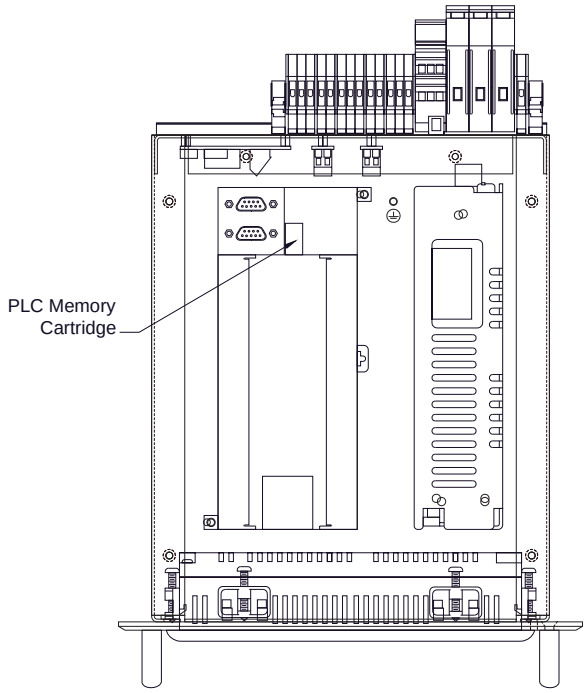

Figure 35 PLC Memory Module

2. Cycle the power on the Model 1600A.
   Firmware and CPU configuration are copied to the system once the system power cycles. This operation takes approximately 15 seconds.

3. Once the 1600A power has been cycled and the unit has returned to normal operation, remove memory cartridge.

   NOTE: Powering on a PLC with a blank memory cartridge, or a memory cartridge that was programmed in a different model of PLC will cause an error.

4. Verify the proper PLC firmware version has been loaded.
   PLC version can be found in the top right corner of the "Screen Utilizes" menu.
   Program Menu ► Screen Utilities: PLC v.XX

6.0 Spare Parts

Recommended spare parts list:

Detcon Part #	Description
975-041400-000	RL-4 Relay Module (As applicable)
976-041400-000	DA-4 4-20mA Input Module (As applicable)
975-041401-000	AO-4 4-20mA Output Module (As applicable)
975-041402-000	DI-4 Contact Input Module (As applicable)
320-283934-700	VAC (230VAC) Over Voltage Module
320-283931-800	VDC (24VAC) Over Voltage Module
360-SWS150-024	24VDC Power Supply
500-003053-001	Optional RS-232 Serial Communications Module PCB
976-485485-000	RS-485 Isolated Repeater

7.0 Warranty

Detcon, Inc., as manufacturer, warrants under intended normal use each new Model 1600A-N1R controller to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Should the controller fail to perform in accordance with published specifications within the warranty period, return to Detcon, Inc., for necessary repairs or replacement. All warranties and service policies are FOB the Detcon facility located in The Woodlands, Texas.

The over-voltage protection modules are designed to fail preferentially based on lightening strikes and other abnormal power fluctuations. These are not covered under the warranty policy.

Appendix A

RS-485 System Integration Wiring

RS-485 is a generic electrical specification only. It does not specify connector types, protocols, or cable type. It is the responsibility of the installer to provide a correct physical installation for the RS-485 network to function properly.

RS-485 is very inexpensive and inherently rugged, allowing multiple devices to communicate over a single twisted pair of wires. Detcon has chosen to implement the Modbus™ protocol using the RS-485 electrical specification.

RS-485 is a two way half-duplex data bus made up of a transceiver (transmitter and receiver). In its simplest form, one transceiver is located on each end of a twisted pair cable of up to 4,000 feet maximum. Data can be sent in either direction, but can only be sent in one direction at a time.

The specification allows for the connection of up to 40 unit loads (UL's) to the twisted pair. An older transceiver chip would have represented 1 UL. Connection of more than 40 UL's to the bus will limit the drivers and cause attenuation of the signal, thus preventing the system from operating properly.

Since RS-485 allows multiple devices to be connected to the bus, wiring is not as straightforward as it is in a bus with only 2 devices. The best wiring scheme is the daisy-chain connection from device 1 to device 2 to device 3 to device n. All devices that tap into the bus should not be at the end of long stubs, branches, or t-taps. A true daisy-chain has direct wiring between devices with no minor branches.

Detcon equipment contains four wiring terminals for RS-485 connections. Two for A(+) and two for B(-). All connections should be made directly to these. Figure 3.1 shows an electrical representation of a simple RS-485 bus with 4 transceiver chips.

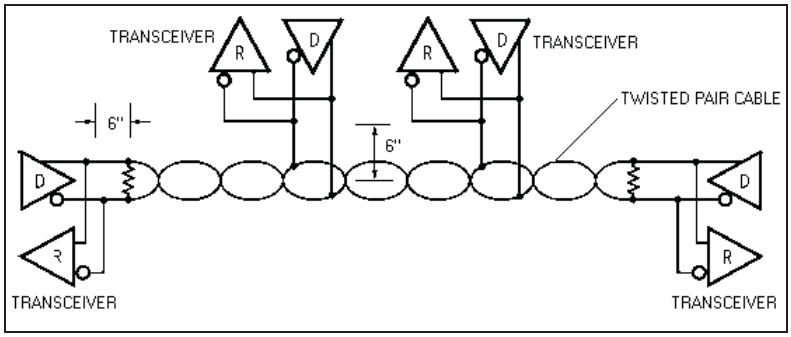

Figure 36 RS-485 Bus with 4 transceiver chips

The use of a daisy-chain connection will perform the best in all applications given the bus is properly terminated. The RS-485 standard specifies the transceiver characteristics only, not the interconnection of the transceivers themselves. Depending on the environment, distance and other factors it is possible to connect transceivers using flat cable, twisted pair cable, even PCB traces. However, for the most reliable data transfer in industrial environments, shielded twisted pair is required. Wiring of 24 AWG is highly recommended, but 18 to 28AWG can be used.

The characteristic impedance of the cable must be between 100 to 120 ohms. Twisted pair is used because if the cable does run near a noise source both conductors will pick up the same amount of noise; therefore, effectively canceling it out.

Incorrect Wiring Schemes

Among the biggest problems with an RS-485 bus is the use of incorrect wiring schemes mixed with improper or no line termination.

Most existing installations do not have wire runs in a daisy-chain like fashion; instead, wire runs typically originate from a central point and run to different devices in a star-like pattern. This is a very undesirable way to wire an RS-485 bus. The chances of problem free operation over the life of the equipment decreases dramatically the further you stray from a straight daisy-chain wiring scheme. The bus needs to be terminated at each end of the cable run to operate ideally. Other wiring schemes introduce multiple "cable ends" making it impossible to balance the lines. Wiring as in Figure 37 (A, B & C) would provide reliable data flow. Figures D, E & F could possibly work, but would require many repeaters and an experience worker with RS-485 communications and networks knowledge to achieve implementation.

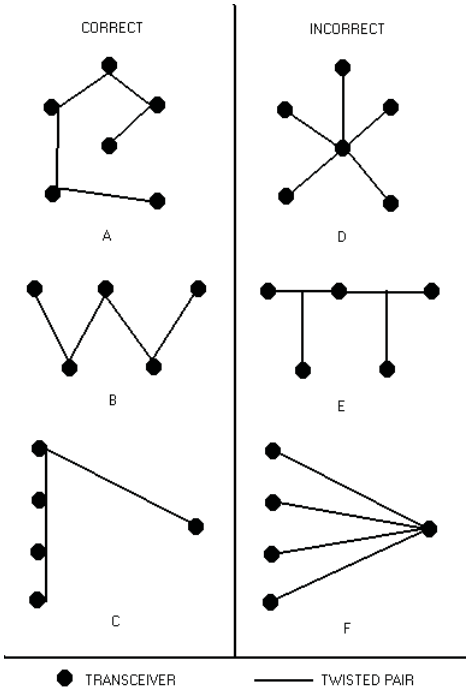

Figure 37 Correct and incorrect wiring schemes

Figure 38 shows a typical RS-485 communication setup using 2-wire digital communication. Each RS-485 loop should have (1) beginning and (1) end, with a 120-ohm resistor at the end of each loop.

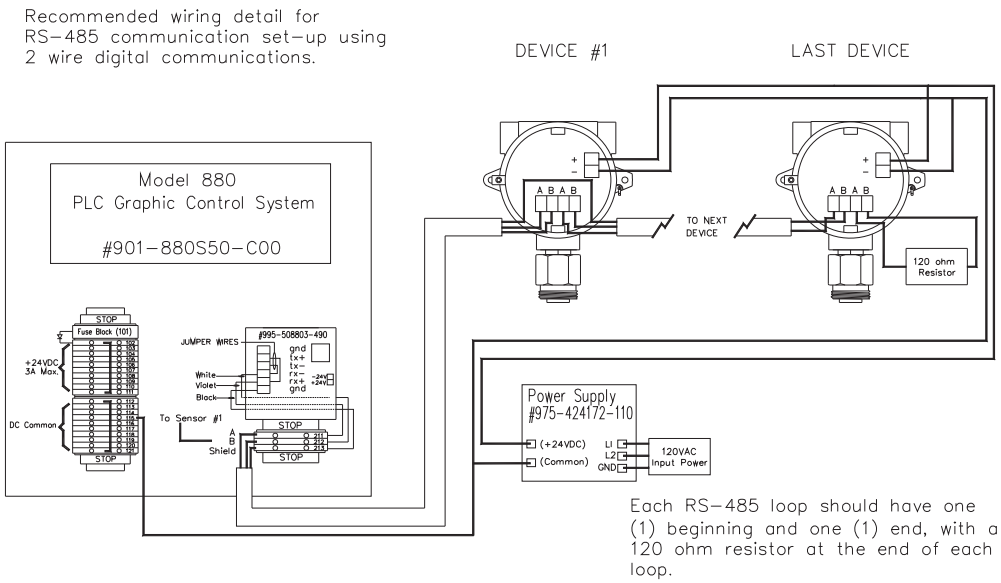

Figure 38 Recommended RS-485 communications set-up

Grounding

Another problem that can occur with RS-485 is incorrect grounding. Neither one of the two conductors in the cable is ground. Both of the conductors are supplying a current to maintain a voltage level relative to an external reference. A third conductor must be supplied to establish a reference through earth ground.

RS-485 is specified be able to work normally with a ±7V ground potential difference and survive ±25V surges. In most applications, the equipment is powered from its own DC power supplies. This is good as long as the supplies are located in the same physical location, and the DC commons are tied together and tied to earth ground.

Problems occur when part of the data bus is powered by one supply and the second part of the bus is powered by a power supply located elsewhere. In this case, earth ground is being relied upon to be the reference between the two sections of the bus. If noise is induced onto the earth ground of one power supply and not the other, data errors may occur. This is even more likely to occur when the distance between ground references is large. A solution to this problem is to install an isolated repeater into the data bus to isolate the grounds from each other, thus enabling the bus to use only one of the two references.

Isolated Repeaters

Repeaters can play many rolls in the implementation of an RS-485 data bus. Repeaters can: 1) Extend the distance if needed to go further than 4000 feet. 2) Allow for the addition of more devices to the bus. 3) Increase signal strength and integrity. 4) Solve grounding problems and solve some of the problems that occur when an incorrect wiring scheme is implemented.

A repeater consists of two transceivers working together. One transceiver is connected to the main data bus and the other transceiver connects to the remainder of the devices as it creates a new and separate data bus. Figure 39 depicts a data bus that implements an undesirable branched wiring scheme. Depending on the length of the taps of slave 1 and slave 2, they may or may not communicate properly back to the master. Long lengths of cable to slaves 1 and 2 create four ends to the cable instead of two, which cannot be balanced with the two terminating resistors on the extreme ends. Without a balanced bus, the long taps of slave 1 & 2 will introduce reflections to the signal that can lead to problematic operation in the field. These problems can be very hard to diagnose, isolate, and fix.

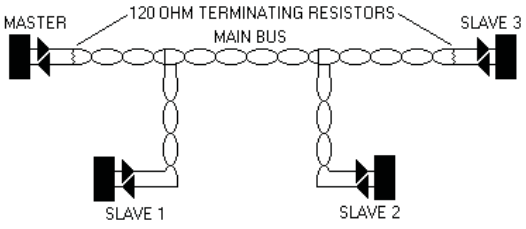

Figure 39 Unbalanced Data Bus

The addition of 2 repeaters (Figure 40) can solve this problem. The repeaters look like short stubs to the main bus, and at the same time they create 2 new buses that have all the same characteristics as the main bus. Each leg must have termination resistors to balance the new data bus.

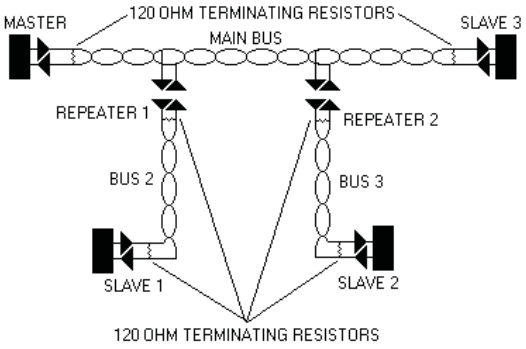

Figure 40 Data Bus using two repeaters

Be sure to check the equipment being installed. Some manufacturers include a built-in terminating resistor that can be selected by a jumper or dipswitch. Detcon Model 880 has such a jumper located on the FA-isonet card. The jumper is labeled “120 ohm Term.”

Detcon 600 series gas sensors and DA1 modules do not include this resistor, and therefore, if one of these devices is the last on the RS-485 bus, a discrete 120 ohm resistor should be placed across the “A” and “B” terminals on the connector board. Figure 41 illustrates the wiring scheme of a repeater when used in a wiring bus with DA-1 devices.

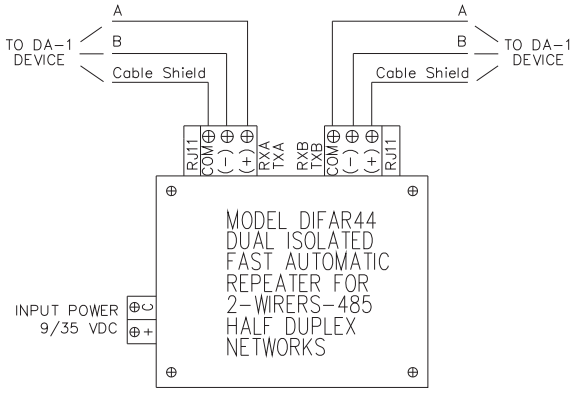

Figure 41 Repeater wiring diagram

Device Hook-Up

Installation should begin by deciding where devices will be located and how the connections between devices and the master will be established. The ideal scenario would look like Figure 42. The example shows the 880 Controller connected to 11 slave devices using a daisy-chain wiring scheme. This would require 2 different twisted pair cables, one pair for power, and the other for the RS-485 data bus.

Connections would be point-to-point starting at the master and running to the last slave. The RS-485 data cable should come into the sensor enclosure and be connected to the A & B terminals. The next segment of cable should also connect to the A & B terminals and leave the enclosure headed for the next device. The shields must be tied together inside the enclosure and not allowed to short to any other wires or surfaces. The shield should be connected only inside the Model 880 cabinets to the shield terminal. The Rt label in the drawing shows where the termination resistors would be installed.

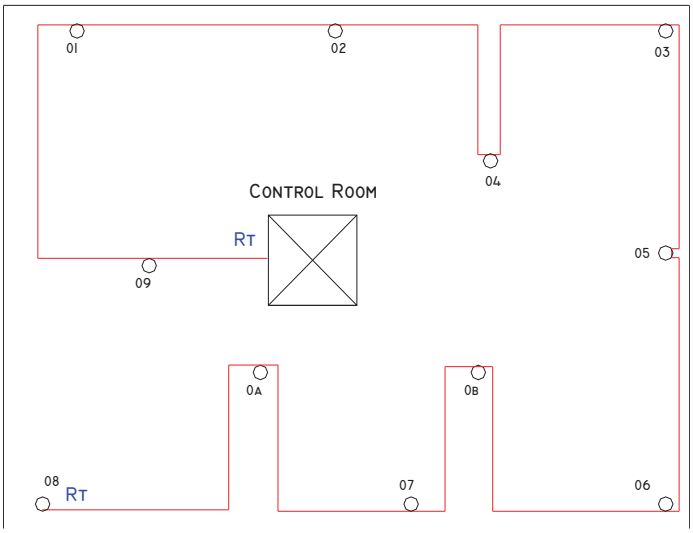

Figure 42 Daisy Chain wiring diagram

Daisy Chain Wiring is ideal, although wiring may already exist or the wiring cannot be run this way for some reason. Figure 43 shows a more realistic wiring situation that may occur.

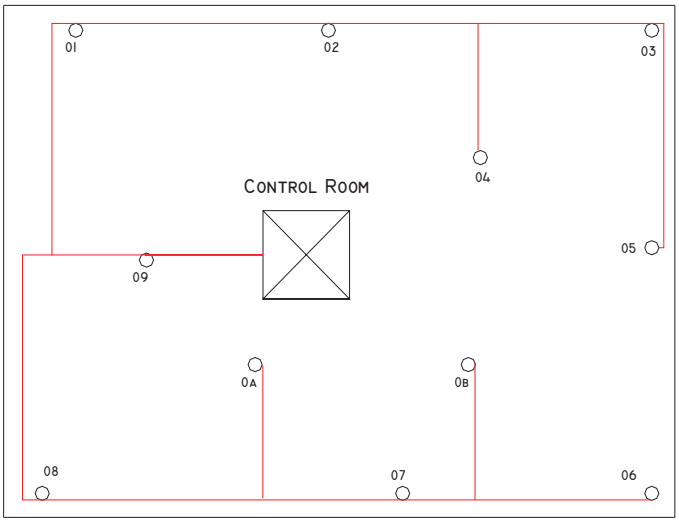

Figure 43 Unbalanced Data Bus

In this case it is impossible to balance the data bus because there is no distinct beginning or end to the cable run. The best way to make this type of installation successful is to install repeaters in a few key areas as shown in Figure 44. Repeaters are used to eliminate the t-taps or stubs, which can cause communication problems. The location and number of stubs will dictate where repeaters need to be installed. Four repeaters are installed to eliminate the stubs.

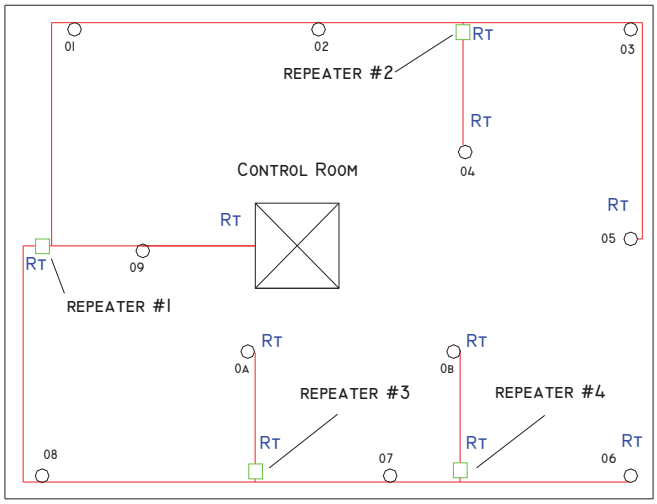

Figure 44 Four repeater Data Bus

Notice there are 5 different data buses that make up the communications network. The first one consists of the master located in the control room, device 09, repeater #1, device 01, device 02, repeater #2, device 03, and device 05. Notice the termination resistors at the beginning and end of this bus section. The second bus starts at repeater #2. It consists of the repeater and device 04. Since this is a new bus, it has terminating resistors at each end. The third bus starts at repeater #1. It includes device 08, repeater #3, device 07, repeater #4, and device 06. It also has its own resistors. The fourth bus starts at repeater #3 and consists of the repeater, device 0A, and the terminating resistors. The fifth bus starts at repeater #4 and consists of the repeater, device 0B, and termination resistors. This configuration isolates all of the t-tap stubs. This configuration should function properly as long as the wire type and proper distances are observed.

The following chart shows an approximation of wire length vs. data speed. Detcon operates its equipment at 19,200bps (baud) and lower.

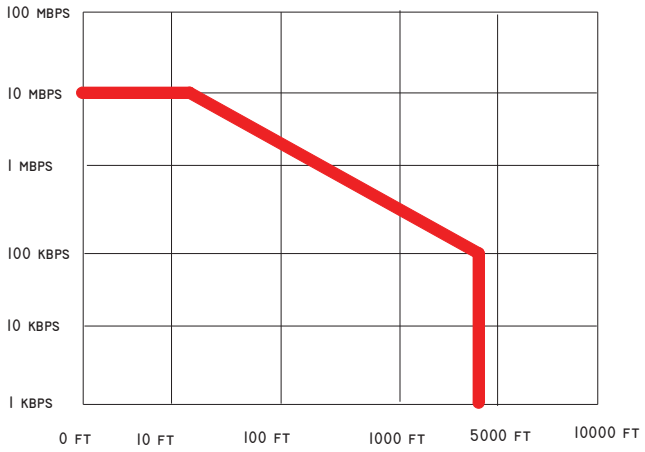

Figure 45 wire length vs. data speed

Appendix B

Hexadecimal Table

ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2	ID#	SW1	SW2
none	0	0	43	2	B	86	5	6	129	8	1	172	A	C	215	D	7
1	0	1	44	2	C	87	5	7	130	8	2	173	A	D	216	D	8
2	0	2	45	2	D	88	5	8	131	8	3	174	A	E	217	D	9
3	0	3	46	2	E	89	5	9	132	8	4	175	A	F	218	D	A
4	0	4	47	2	F	90	5	A	133	8	5	176	B	0	219	D	B
5	0	5	48	3	0	91	5	B	134	8	6	177	B	1	220	D	C
6	0	6	49	3	1	92	5	C	135	8	7	178	B	2	221	D	D
7	0	7	50	3	2	93	5	D	136	8	8	179	B	3	222	D	E
8	0	8	51	3	3	94	5	E	137	8	9	180	B	4	223	E	F
9	0	9	52	3	4	95	5	F	138	8	A	181	B	5	224	E	0
10	0	A	53	3	5	96	6	0	139	8	B	182	B	6	225	E	1
11	0	B	54	3	6	97	6	1	140	8	C	183	B	7	226	E	2
12	0	C	55	3	7	98	6	2	141	8	D	184	B	8	227	E	3
13	0	D	56	3	8	99	6	3	142	8	E	185	B	9	228	E	4
14	0	E	57	3	9	100	6	4	143	8	F	186	B	A	229	E	5
15	0	F	58	3	A	101	6	5	144	9	0	187	B	B	230	E	6
16	1	0	59	3	B	102	6	6	145	9	1	188	B	C	231	E	7
17	1	1	60	3	C	103	6	7	146	9	2	189	B	D	232	E	8
18	1	2	61	3	D	104	6	8	147	9	3	190	B	E	233	E	9
19	1	3	62	3	E	105	6	9	148	9	4	191	B	F	234	E	A
20	1	4	63	3	F	106	6	A	149	9	5	192	C	0	235	E	B
21	1	5	64	4	0	107	6	B	150	9	6	193	C	1	236	E	C
22	1	6	65	4	1	108	6	C	151	9	7	194	C	2	237	E	D
23	1	7	66	4	2	109	6	D	152	9	8	195	C	3	238	E	E
24	1	8	67	4	3	110	6	E	153	9	9	196	C	4	239	F	F
25	1	9	68	4	4	111	6	F	154	9	A	197	C	5	240	F	0
26	1	A	69	4	5	112	7	0	155	9	B	198	C	6	241	F	1
27	1	B	70	4	6	113	7	1	156	9	C	199	C	7	242	F	2
28	1	C	71	4	7	114	7	2	157	9	D	200	C	8	243	F	3
29	1	D	72	4	8	115	7	3	158	9	E	201	C	9	244	F	4
30	1	E	73	4	9	116	7	4	159	9	F	202	C	A	245	F	5
31	1	F	74	4	A	117	7	5	160	A	0	203	C	B	246	F	6
32	2	0	75	4	B	118	7	6	161	A	1	204	C	C	247	F	7
33	2	1	76	4	C	119	7	7	162	A	2	205	C	D	248	F	8
34	2	2	77	4	D	120	7	8	163	A	3	206	C	E	249	F	9
35	2	3	78	4	E	121	7	9	164	A	4	207	C	F	250	F	A
36	2	4	79	4	F	122	7	A	165	A	5	208	D	0	251	F	B
37	2	5	80	5	0	123	7	B	166	A	6	209	D	1	252	F	C
38	2	6	81	5	1	124	7	C	167	A	7	210	D	2	253	F	D
39	2	7	82	5	2	125	7	D	168	A	8	211	D	3	254	F	E
40	2	8	83	5	3	126	7	E	169	A	9	212	D	4	255	F	F
41	2	9	84	5	4	127	7	F	170	A	A	213	D	5			
42	2	A	85	5	5	128	8	0	171	A	B	214	D	6			

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Appendix C

Drawings and Diagrams

1. 1600A-N1R Dimensional Overview
2. 1600A-N1R Unit Overview
3. 1600A-N1R Wiring Diagram

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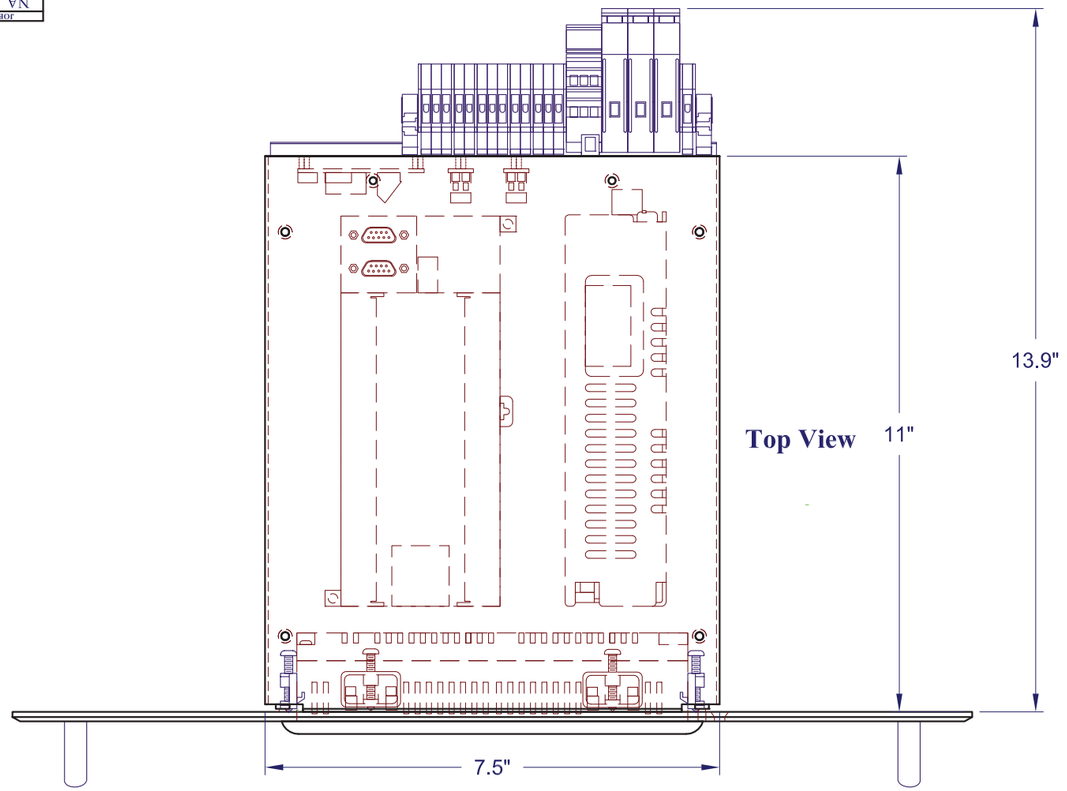
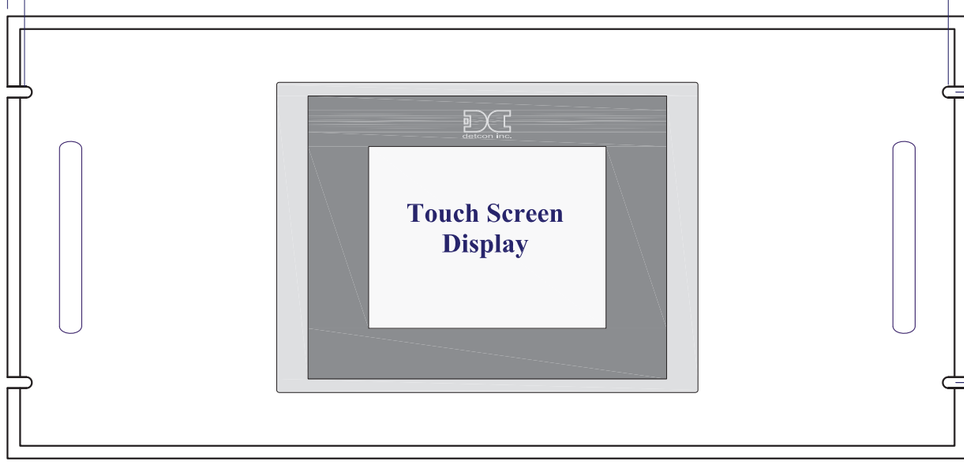


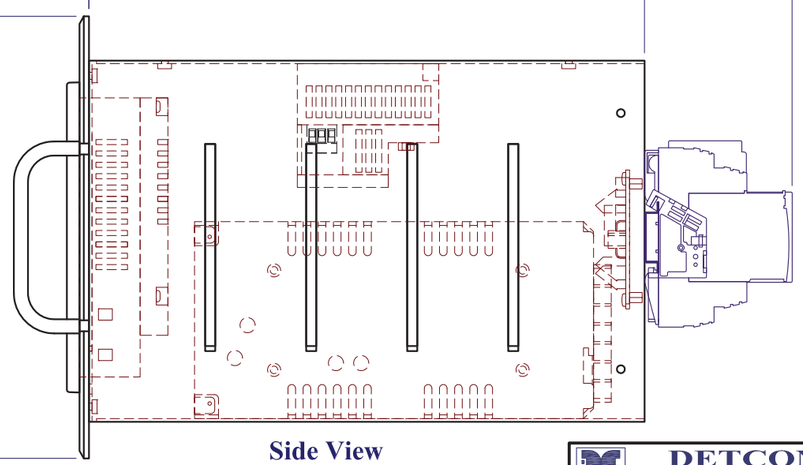
NOTES:

Customer Modules not shown

Customer ability to add only two modules to back of unit. All other modules must be mounted elsewher, and wired to unit.



Front View



Side View

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PROJECT: NA			
DRAWN BY: R HUTSKO	SCALE: NTS	SALES ORDER NO.: NA	DRAWING NO.: 3464-1
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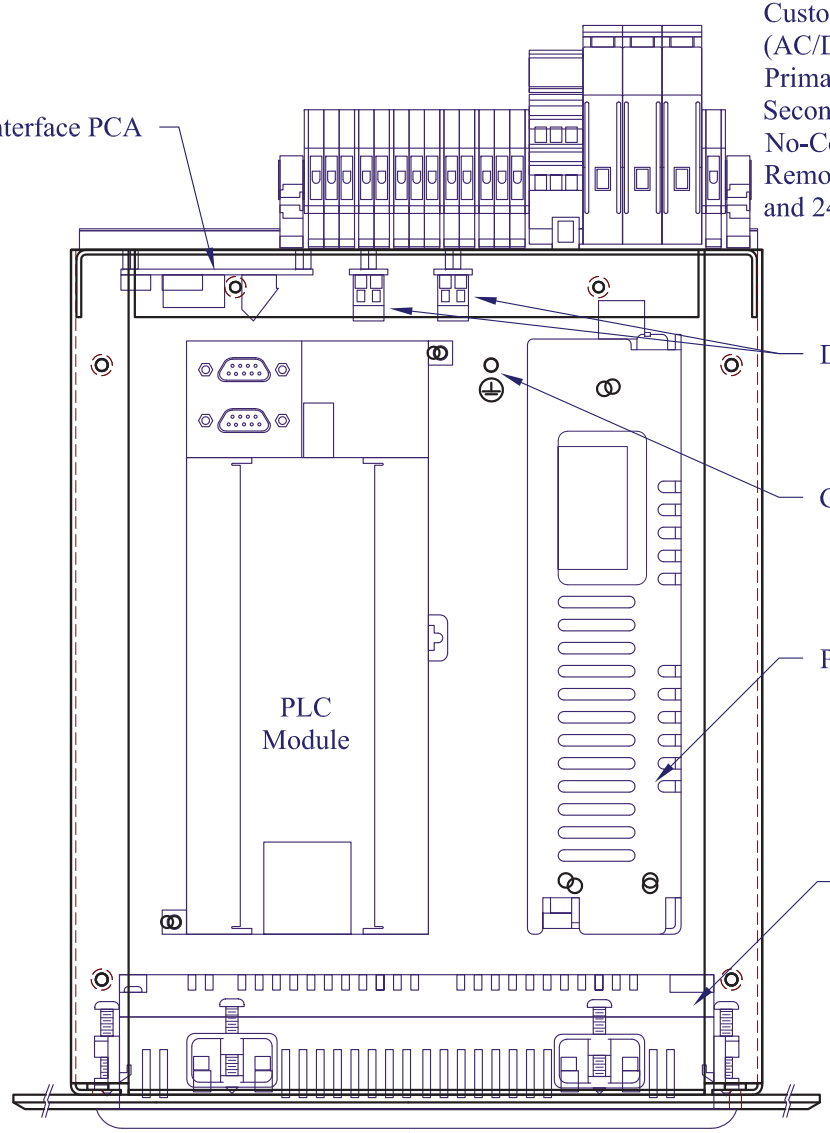

Enclosure
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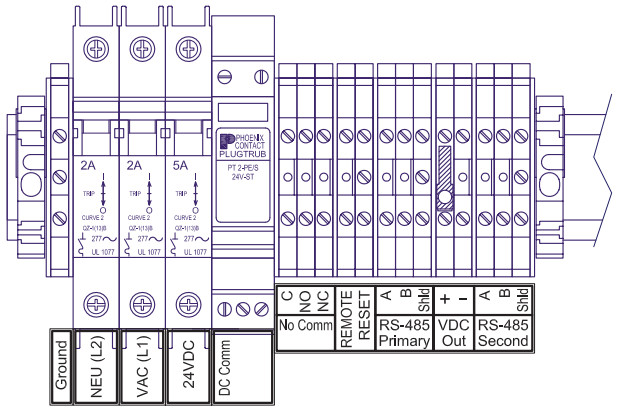
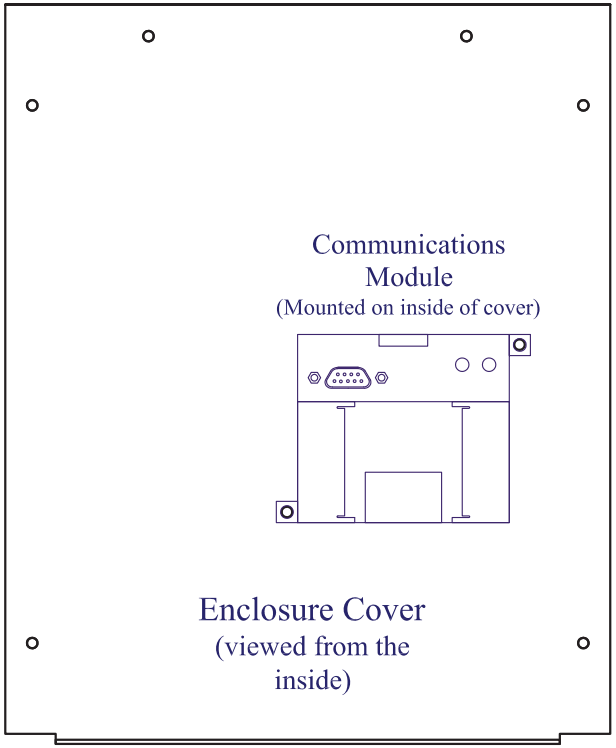


Customer Terminal Connections



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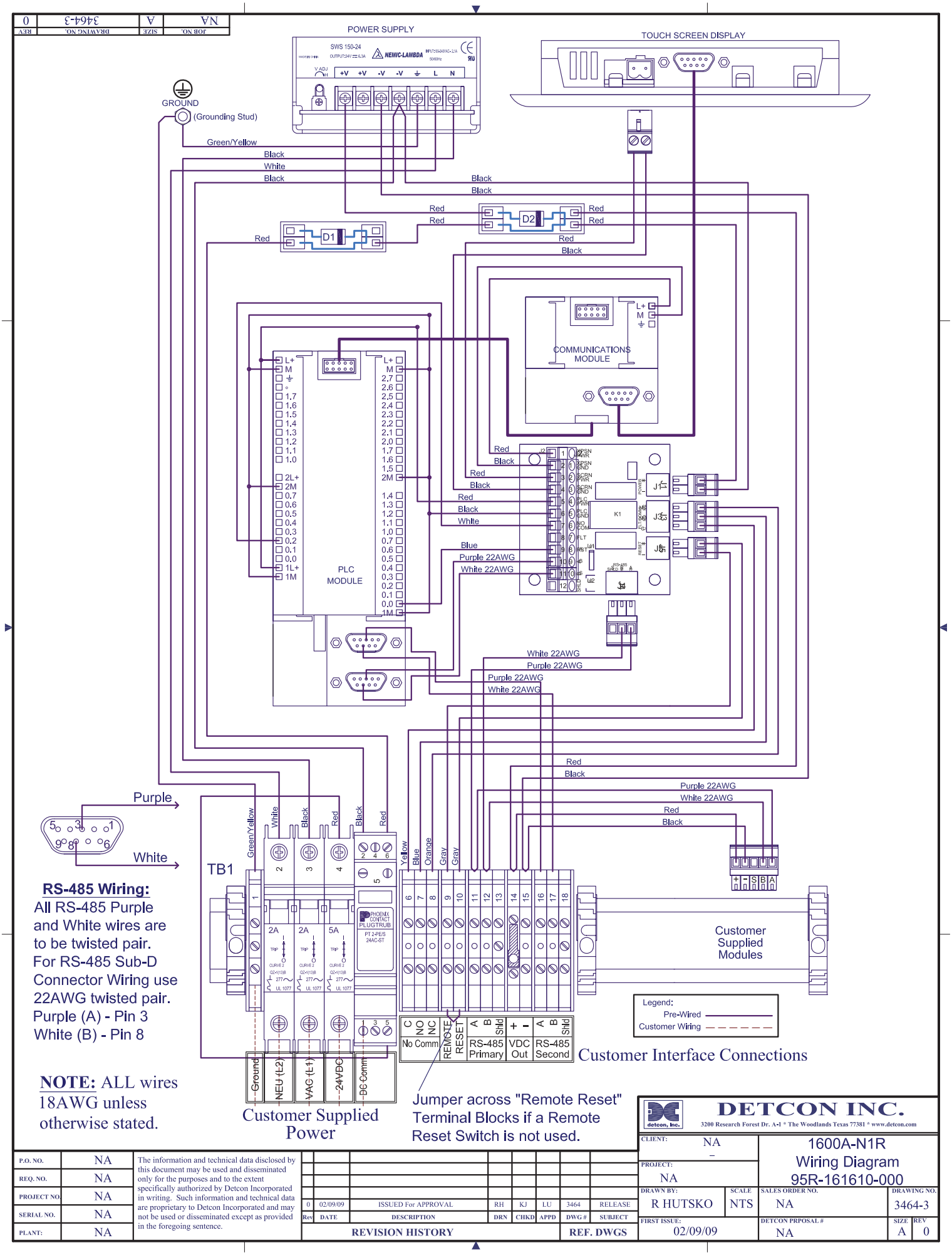

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