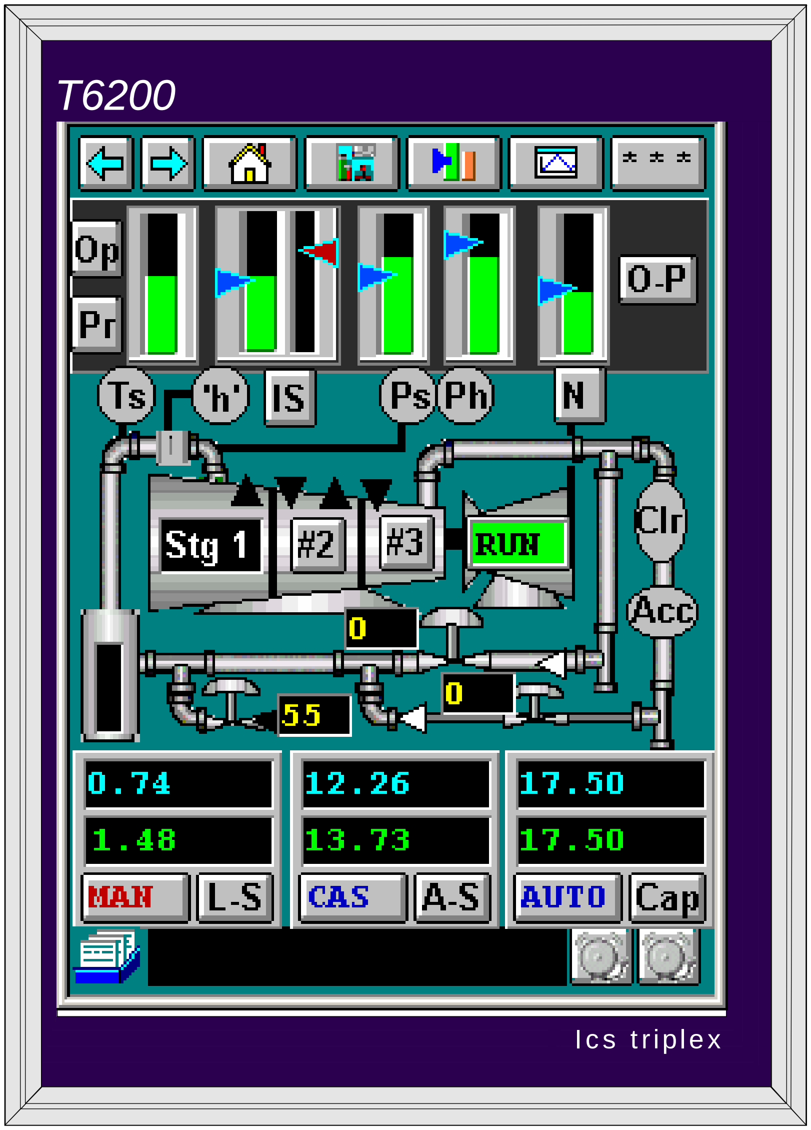


User's Guide

T6200

Compressor Anti-Surge and Capacity Controller

Issue 1
May 2004

T6200
USER'S GUIDE

ICS Triplex p/n 9001-0220

Issued May 2004

ICS Triplex, Inc.
4325 West Sam Houston Pkwy. North
Suite 100
Houston, Texas 77043-1219 USA
Phone: 713-353-2400 Fax: 713-353-2401

www.icstriplextmc.com

TABLE OF CONTENTS

SECTION 1 – PRODUCT OVERVIEW

SECTION 2 – INPUT/OUTPUT CIRCUIT DESCRIPTION

SECTION 3 – HARDWARE INSTALLATION/MAINTENANCE

SECTION 4 - SOFTWARE INSTALLANTION

SECTION 5 - T6200 CONTROLLER OPERATION

SECTION 6 – HMI-6200 OPERATOR INTERFACE

SECTION 7 – CONTROL PRIMER

SECTION 8 – CONFIGURATION

SECTION 9 – SPECIFICATIONS

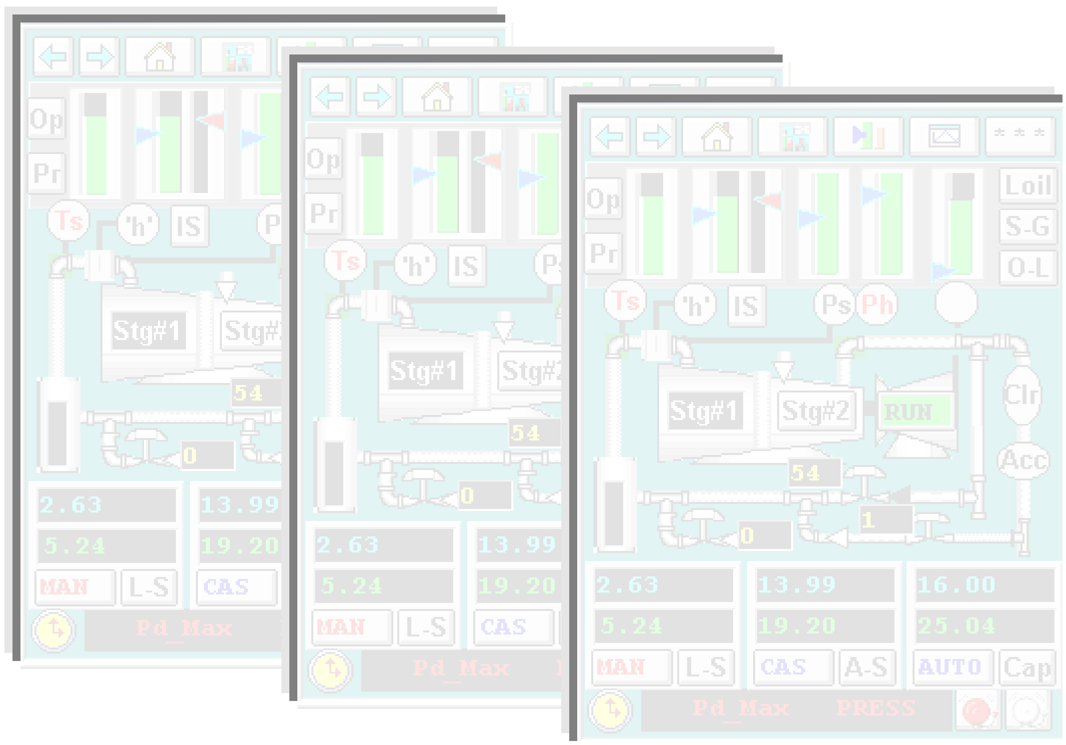
APPENDIX A – DATA STRUCTURES AND EXPRESSIONS

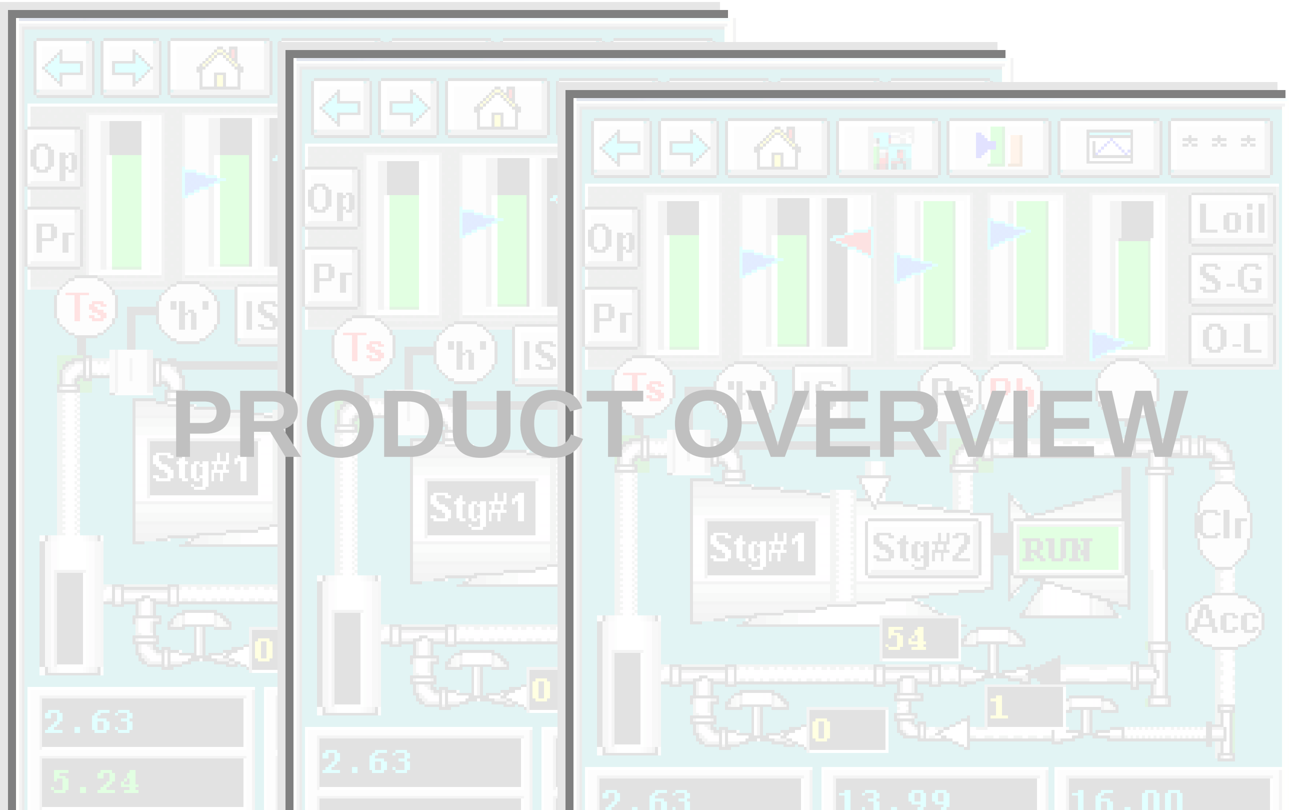
APPENDIX B – MODBUS INTERFACE – RS-232

1

Section One

Product Overview


Op
Pr
Ts
'h'
IS
Ps
Ph
Stg#1
Stg#2
RUN
Clr
Acc
Loil
S-G
O-L
54
0
1
2.63
5.24
13.99
19.20
16.00
25.04
MAN
L-S
CAS
A-S
AUTO
Cap
Pd_Max
PRESS



PRODUCT OVERVIEW

The T6200 Controller is made up of two parts: The Operator Interface and the T6200 Controller. The Operator Interface with the Windows CE platform enables complete interaction with the T6200 Controller. Through the touch screen and LCD display users can change setpoints, outputs, start/stop devices, scroll through trends, or acknowledge alarms. The T6200 Controller functions as a multiapplication Controller or intelligent RTU capable of performing all data acquisition, continuous control, batch control, logic control and RTU requirements. Each T6200 Controller includes 999 function blocks in which control/logic functions can reside. The integral input/output (I/O) section of each T6200 Controller accommodates 32 I/O points. The large library of functions (over 100) and the practically unlimited number of blocks allow for pre-configuration of a wide variety of strategies by the factory and permits field application optimization.

Design Structure

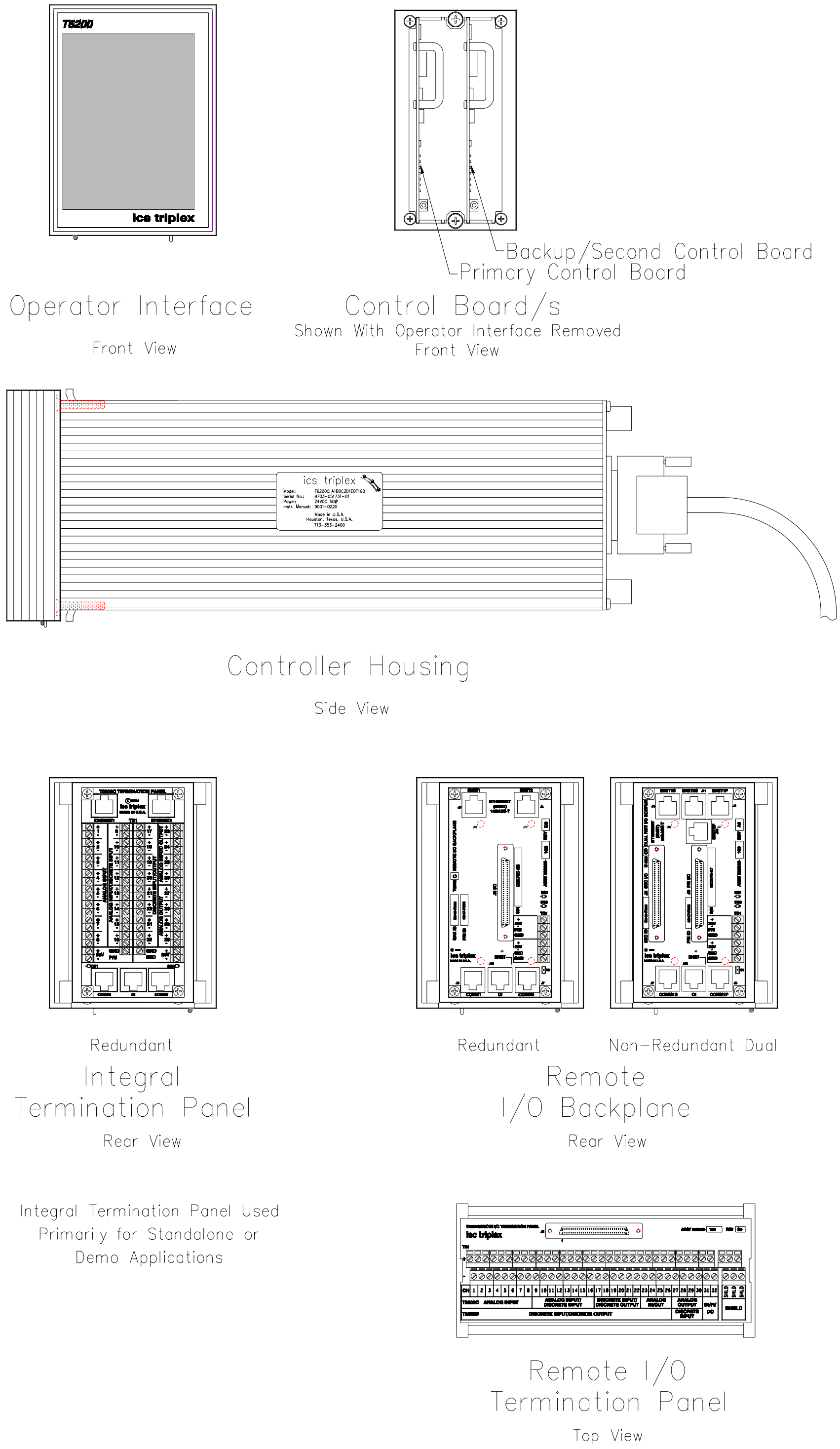
The Operator Interface is an embedded PC. It is independent of the T6200 Controller and it communicates with the T6200 Controller via Ethernet.

The T6200 Controller consists of three physical parts: the control board/s (single or redundant), the controller housing, and the termination panel. Refer to Figure 1-1. The termination panel may also include a remote termination panel for the I/O connections.

The control boards are a single printed circuit board design. The board contains the microprocessor circuitry, the memory chips, the communication interfaces, and the input/output conditioning components. Primary and backup control boards are identical.

FIGURE 1-1.

T6200 Unit Controller



Analog and Discrete Input/Output

Analog inputs can be either current or voltage. High common mode (200 Volts) amplifiers are utilized. Each input has a separate input amplifier. Also, each two wire transmitter input (4-20mA) is provided with a separate internal 24 volt regulator. Analog outputs source up to 20 milliamperes to the user's receiver (load).

Most discrete inputs are opto-isolated (refer to specifications). The sample rate resolution of one millisecond provides for first out sequence of events capability. Three of these inputs can be configured as frequency/pulse inputs. Discrete outputs are transistor configurations. A separate internal 24 volt regulator is supplied for each input/output.

The internal I/O section of the Controller accommodates 32 I/O points. Refer to Table 1-1 for I/O channel assignment information.

TABLE 1-1.

Input/Output Channel Assignments

<table>
<tr><th rowspan="2">Type</th><th colspan="6">I/O Channel Numbers</th></tr>
<tr><th>1 - 8</th><th>9 – 16</th><th>17 - 22</th><th>23-26</th><th>27 - 30</th><th>31 - 32</th></tr>
<tr><td>T6200C</td><td>Analog Input</td><td>Analog or Discrete Input</td><td>Discrete I/O *</td><td>Analog I/O</td><td>Analog Output</td><td>Discr I/O*</td></tr>
<tr><td>T6200D</td><td colspan="4">Discrete I/O</td><td>Discrete Input</td><td>Discr I/O*</td></tr>
</table>

** Channels 22, 31 and 32 can also be configured as a frequency/pulse input. Channel 32 can also be configured as a frequency/pulse output.*

The process signals supported by the T6200 Controllers are:

- Analog Inputs (4-20 mA, ±20 mA, ±10 Vdc) internally or externally powered
- Analog Outputs (4-20 mA, 0-20 mA)
- Discrete Inputs (On-Off contacts) internally or externally powered
- Discrete Outputs - internally or externally powered
- Pulse Inputs (up to 25 kHz)

Line Power and Transmitter Power

The T6200 Controllers operate on 26 Vdc power. The T6200R subrack supplies redundant AC to DC power supplies or the 26 Vdc can be obtained from any other reliable power source. Terminal blocks are provided on the termination panel for primary and secondary (redundant) 26 Vdc power input. Power for field transmitters, I/Ps, field switches, etc., is distributed through the T6200 Controller eliminating separate input/output power supplies and circuitry.

Both power supplies operate continuously. If one unit fails, it is not necessary to switch to the other power supply. Both of the 26 Vdc sources are diode-isolated in the T6200 Controller to prevent the failure of one from affecting the other. The supplies feed redundant power distribution traces on the termination panel.

System Security

The Controller maximizes its reliability and availability by a design incorporating complete redundancy of memory, intelligence, communication, and power. The redundancy includes total process input/output circuitry backup. And, since each termination panel can accommodate both the primary and backup control boards, the architecture allows for simple plug-in of the redundant control board. No wiring or cabling is required for redundant configurations.

The integral backup communication link of each unit assures that both control boards (primary and backup) maintain the same data base. Each control board has its own on-line, sophisticated diagnostics and also monitors the status of the other control board which provides for a reliable transfer and redundancy scheme.

On Line Diagnostics

The T6200 Controller has on-line diagnostics designed to identify failures quickly. On all (primary and backup) operator interfaces, highways, local communications, the Controller run diagnostics on a continuous basis. These routines continuously check the status of critical device functions to detect failures.

If a failure is detected an alarm is activated to inform the operator and the backup unit is enabled.

Configuration Security

The T6200 Controllers maintain identical configuration at all times. At startup, when both control boards are powered up, the backup control board's memory is always cleared, and the active control board transfers the configuration to the backup control board through the backup serial link, if it has a backup control board.

During operation (runtime), if new configuration is downloaded (to active control board), it automatically goes to both the primary and the backup control board. Thus configuration integrity is achieved and there are no mismatches.

Uninterrupted communication and control is provided by automatically transferring all configuration and communications of the active control board to the backup redundant control board. There is a complete transparency in the redundant control board. Apart from notification of failure, there is no change in the operator interface.

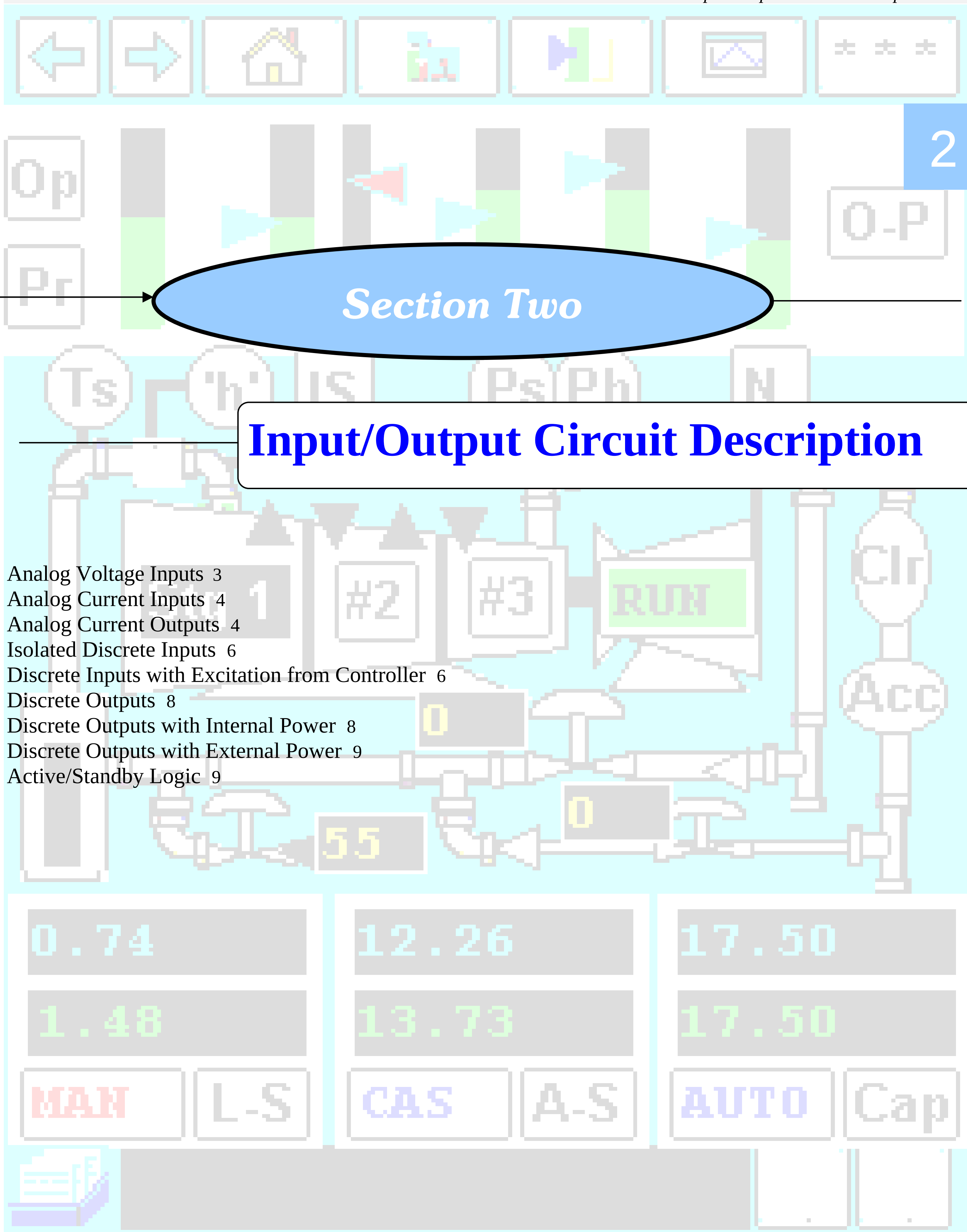
Controller Redundancy

The T6200 Controller redundancy concept allows the user to simply plug-in a backup control board side-by-side with the primary control board. The user has no installation or cable connection requirements. Termination panel data links enable the backup to copy the input/output and control configuration of the primary control board and to assume virtually immediately the input/output and control functions in case of a primary malfunction.

Each control board contains, in addition to the input/output functions, an extensive library of control algorithms. Thus, the T6200 Controllers can be configured as totally stand-alone intelligent controllers or RTUs. This minimizes dependency on communications, resulting in high reliability.

Dual Non-Redundant Controller

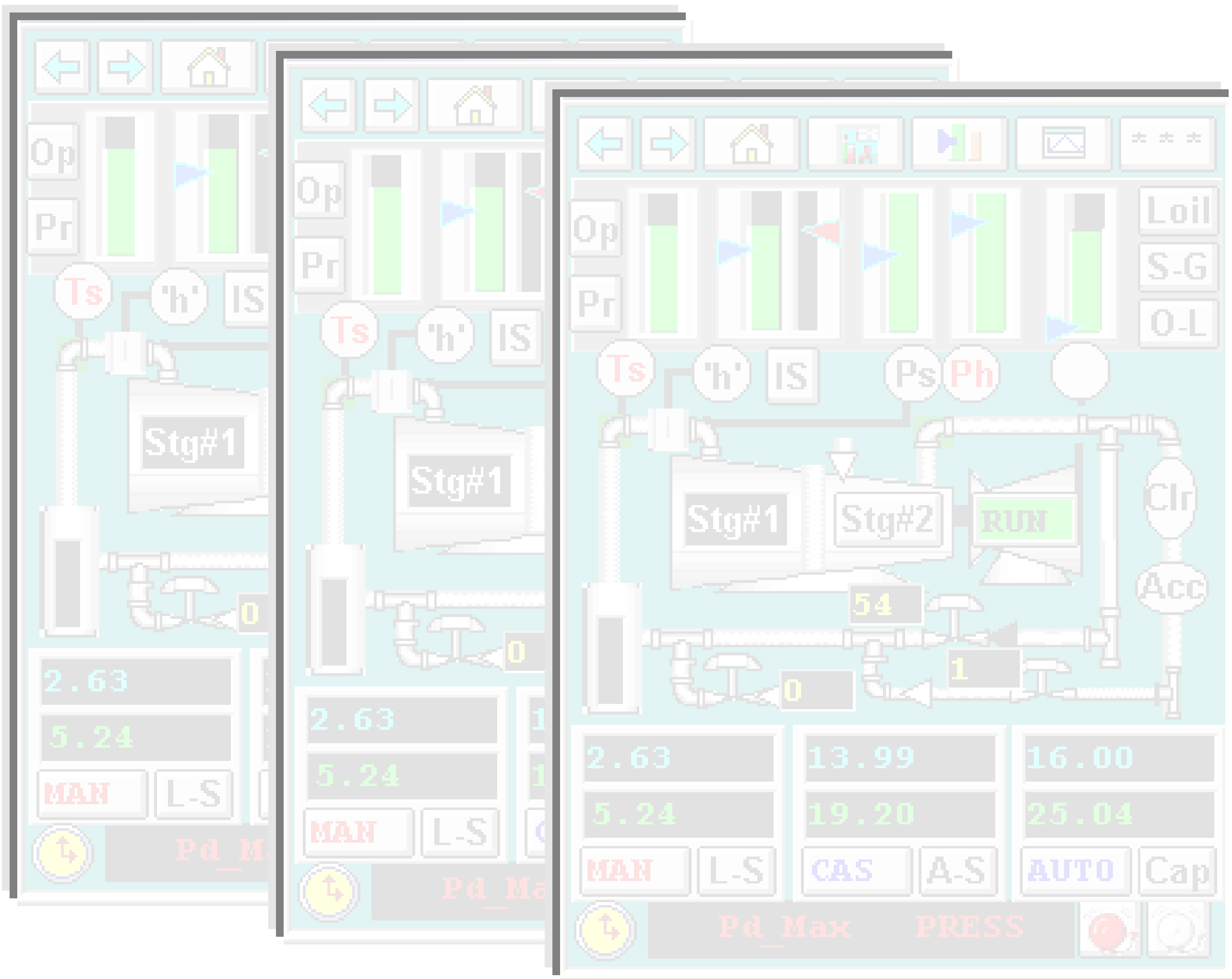
The T6200 Dual Non-Redundant Controller concept allows the user to have two independent controllers (a primary and a second controller) in one chassis thereby reducing the required panel space by half. With this option, two T6200-C Controller cards or two T6200-D Controller cards or a T6200-C and a T6200-D Controller card may be plugged into a single chassis. Two Remote I/O Termination Panels (one for the primary controller and one for the second controller) are required with this concept. The Dual Non-Redundant Controller option should only be used when controller redundancy is not foreseen as a requirement.

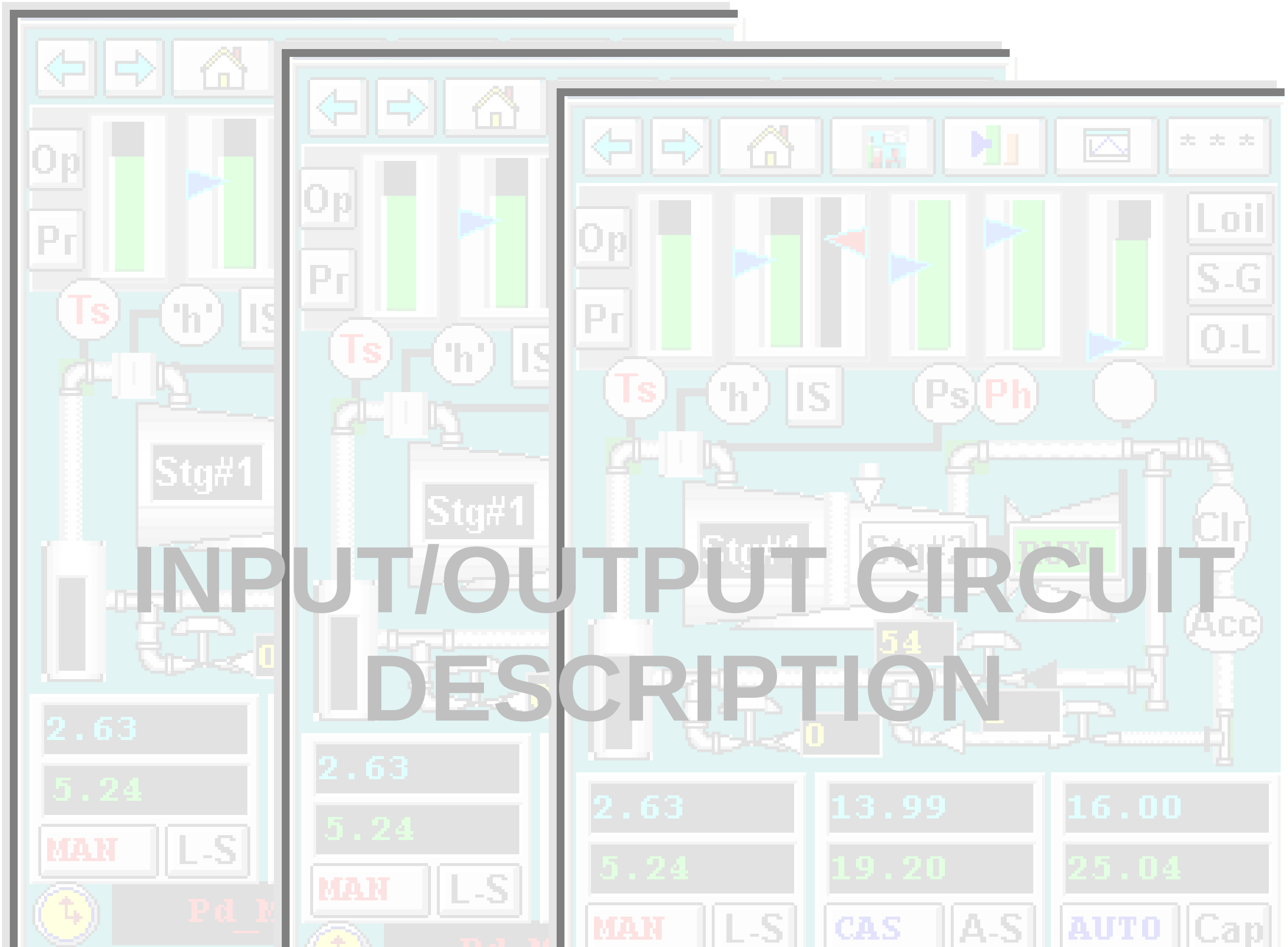


2

Section Two

Input/Output Circuit Description


Op
Pr
Ts
'h'
IS
Ps
Ph
Loil
S-G
O-L
Stg#1
Stg#2
RUN
Clr
Acc
54
1
0
2.63
5.24
13.99
19.20
16.00
25.04
MAN
L-S
CAS
A-S
AUTO
Cap
Pd_Max PRESS



INPUT/OUTPUT CIRCUIT DESCRIPTION

Each control board in the T6200 Controller incorporates the µP, memory, communications and I/O circuitry. Separate I/O modules are not required.

Analog Voltage Inputs

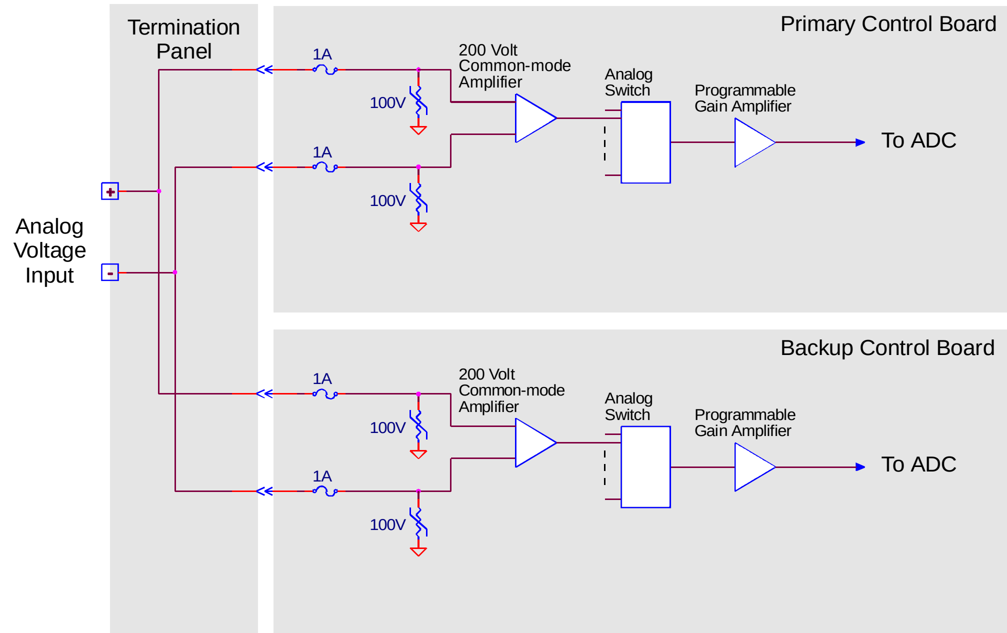
Up to 20 channels in the T6200-C Controller can be configured with field changeable jumpers for voltage inputs. In reference to Figure 2-1, the input amplifier does not have galvanic isolation but it appears to have it in most applications because of its high common-mode voltage and its high input resistance. The 100 volt transient absorbers on each input will allow up to 100 volts dc or 75 volts ac (rms, sine wave) continuously or up to 104 volts impulse voltage to enter the amplifier. The amplifier will continue to operate with up to 200 volts on its inputs.

Each input has a separate input amplifier. The output of each of these amplifiers passes to the analog switch. Only one of these inputs is selected at one time. The selected signal continues to the programmable gain amplifier (PGA). The microprocessor selects the optimum gain setting for the PGA. The possible input full scale ranges that can be selected are 0.625, 1.25, 2.5, 5, and 10 volts. Inputs may be either polarity.

The voltage input configuration can be used as a current input by putting a resistor between the "+" and "-" input terminals. Use a 250 ohm resistor for a 4 to 20 milliampere loop and a 100 ohm resistor for a 10 to 50 milliampere loop.

FIGURE 2-1

Analog Voltage Input



Analog Current Inputs

The current input is similar to the voltage input with 250 ohm resistor across the amplifier inputs. Field changeable jumpers are used to select between voltage or current input. The maximum continuous input current is 20 mA and 40 mA momentary. Refer to Figure 2-2. Also the gain is increased in the PGA by a factor of two when a backup control board is present, to compensate for the decrease in voltage that the additional 250 ohm resistor will cause.

When an isolated two-wire 4 to 20 milliampere transmitter is used, the circuit shown in Figure 2-3 may be used. In this configuration a separate internal +24 volt voltage regulator is used for each transmitter. Each voltage regulator has thermal, reverse voltage, and short-circuit protection. In this arrangement, one end of the 250 ohm resistor is connected to circuit common. The two-wire 4-20 mA represents the standard analog input jumper selection.

Analog Current Outputs

The T6200 Controller can be configured from four to eight current outputs. The current output will source from 0 to 20 milliamperes to the user's receiver (load). The receiver must share the same circuit common as the T6200 Controller. The maximum receiver resistance is 1000 ohms.

In reference to Figure 2-4, the digital to analog converter (DAC) receives a digital value from the microprocessor and converts it to an analog voltage. The voltage to the current converter, combined with transistor Q1 and the 50 ohm resistor, converts the voltage to a current signal.

The output of the primary and backup control boards are connected together on the Controller termination panel. The output is only enabled in the active control board. The diode is used to block the current from the active control board.

FIGURE 2- 2

Analog Current Input

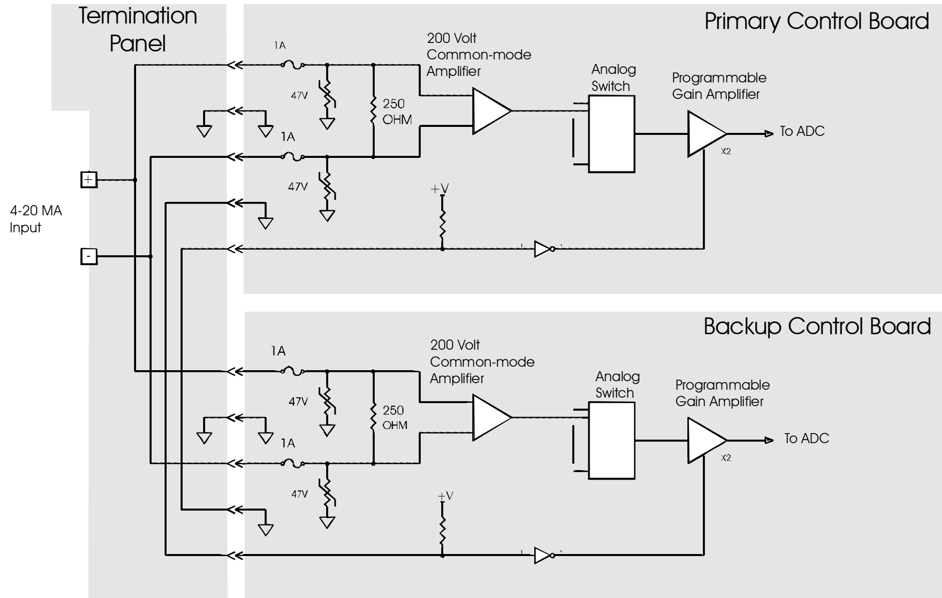


FIGURE 2- 3

Two-Wire Transmitter Input

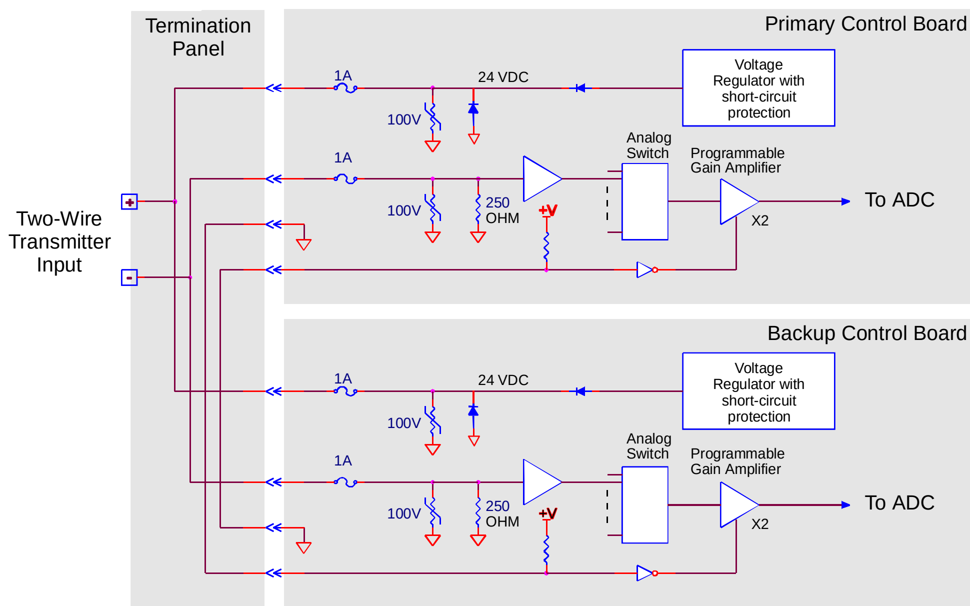
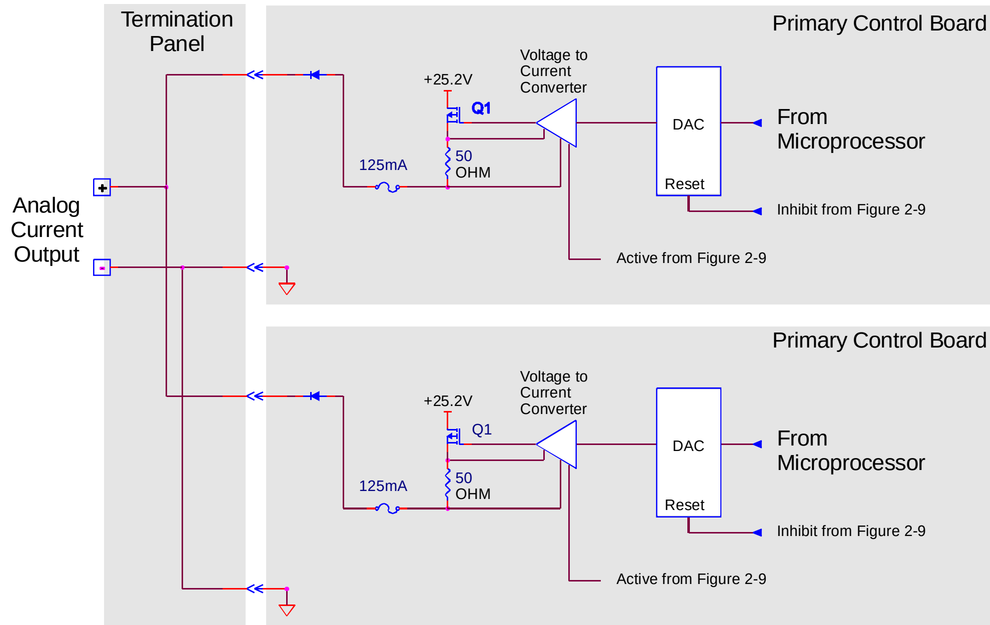


FIGURE 2-4.

Analog Current Output



Isolated Discrete Inputs

The T6200-C Controller can be configured for up to 16 isolated discrete inputs. The T6200-D Controller can be configured for up to 28 isolated discrete inputs in addition to the four internally power discrete inputs. The resistor, in series with the input, is used to limit the maximum current to less than 6.5 milliamperes. In reference to Figure 2-5, the resistor across the opto-isolator is used to increase the minimum input current to greater than one milliampere.

The opto-isolator provides electrical isolation between inputs and other circuits. Each input is protected with fuses. A 100 volt transient absorber is provided on each input terminal to prevent arcing between conductors on the circuit board. The maximum voltage that can be applied continuously is 38 volts dc or 30 volts ac (rms, sine wave). Discrete input channels 22, 31, and 32 can be used as frequency inputs, with input frequencies up to 25 kHz. Other discrete inputs can be used as frequency inputs with input frequencies up to 500 Hz.

Discrete Inputs with Excitation from Controller

The discrete input is similar to the isolated discrete input above, without the isolation. The input is internally powered. In this configuration a separate internal +24 volt regulator is provided for each dry contact input. Each voltage regulator has thermal, reverse voltage, and short circuit protection. The regulator supplies up to five milliamperes.

A contact closure between + and – terminals will activate the input. Refer to Figure 2-6. The internally powered discrete input represents the standard discrete input jumper selection. The T6200 Controller has a minimum of four internally powered discrete inputs.

FIGURE 2- 5.

Isolated Discrete Input

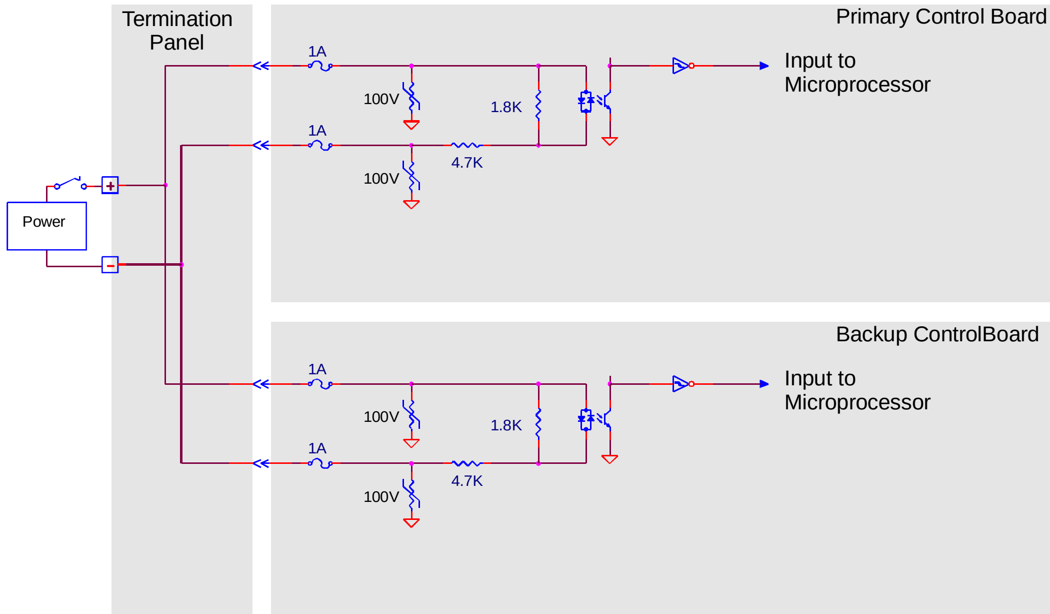
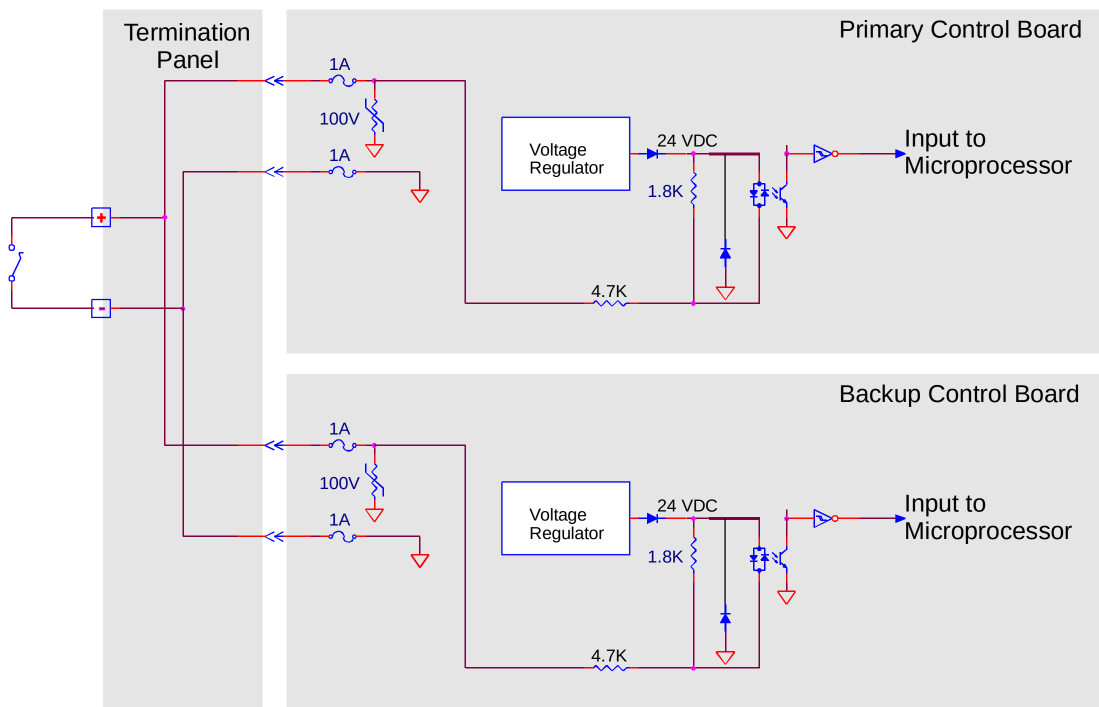


FIGURE 2-6.

Discrete Input with Excitation from Controller



Discrete Outputs

The T6200-C Controller can be configured for up to eight discrete outputs. The T6200-D Controller can be configured for up to 28 discrete outputs. A 100 volt transient absorber is connected on each terminal to protect the output transistor and to prevent arching between conductors on the circuit board. Each terminal is protected with a one ampere fuse.

The output transistor in the standby (not ACTIVE) control board is always open.

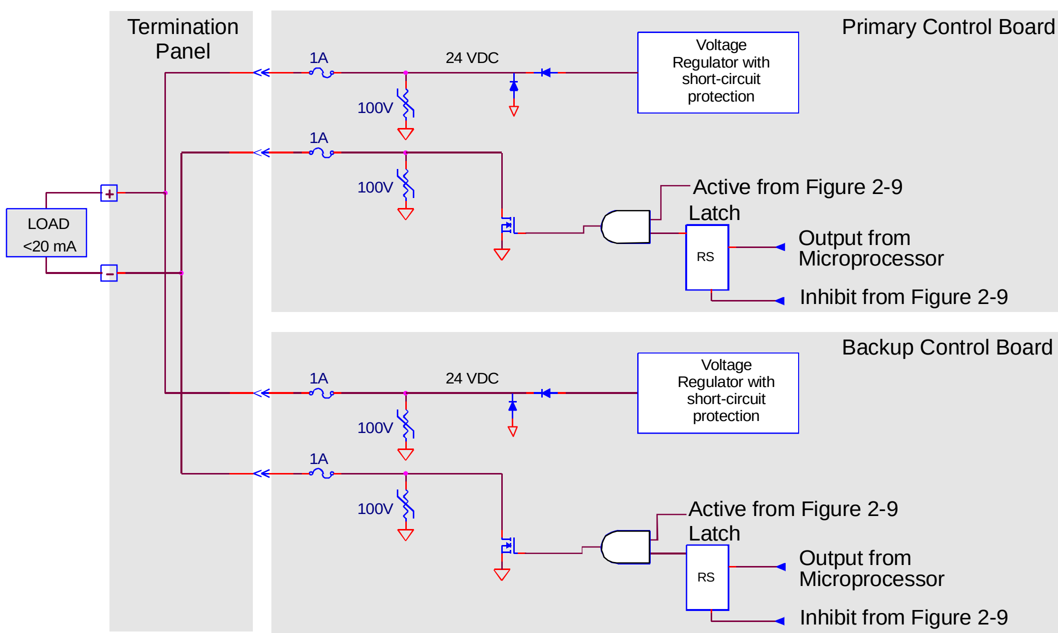
Discrete output 32 can be used as frequency output, with output frequencies up to 10 kHz. Other discrete outputs can be used as frequency outputs with output frequencies up to 100 Hz.

Discrete Outputs with Internal Power

In reference to Figure 2-7, a separate internal +24 volt voltage regulator is provided for each output. Each voltage regulator has thermal, reverse voltage, and short-circuit protection. The regulator can supply 24 Vdc power for a load up to 20 milliamperes continuously and 100 milliamperes momentarily.

FIGURE 2-7

Discrete Output with Internal Power

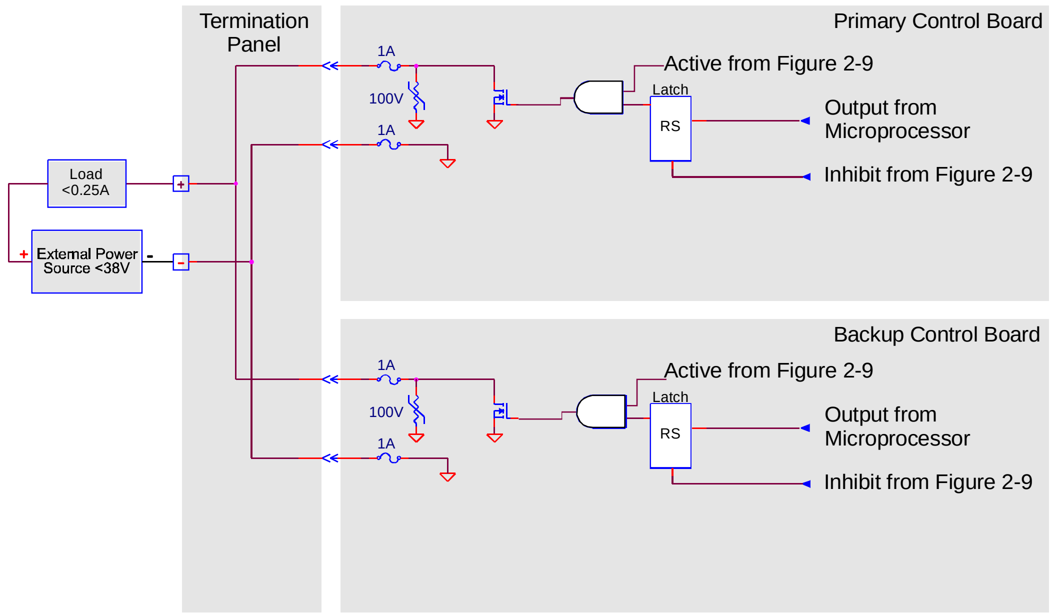


Discrete Outputs with External Power

In reference to Figure 2-8, the discrete transistor output with an external power source can sink up to 0.25 amperes continuously and one ampere momentarily. The maximum voltage that can be applied continuously is 38 volts DC. The return (-) of the external power source must be connected to the “-” input or “-” power terminal of the T6200 Controller.

FIGURE 2-8.

Discrete Output with External Power



Active/Standby Logic

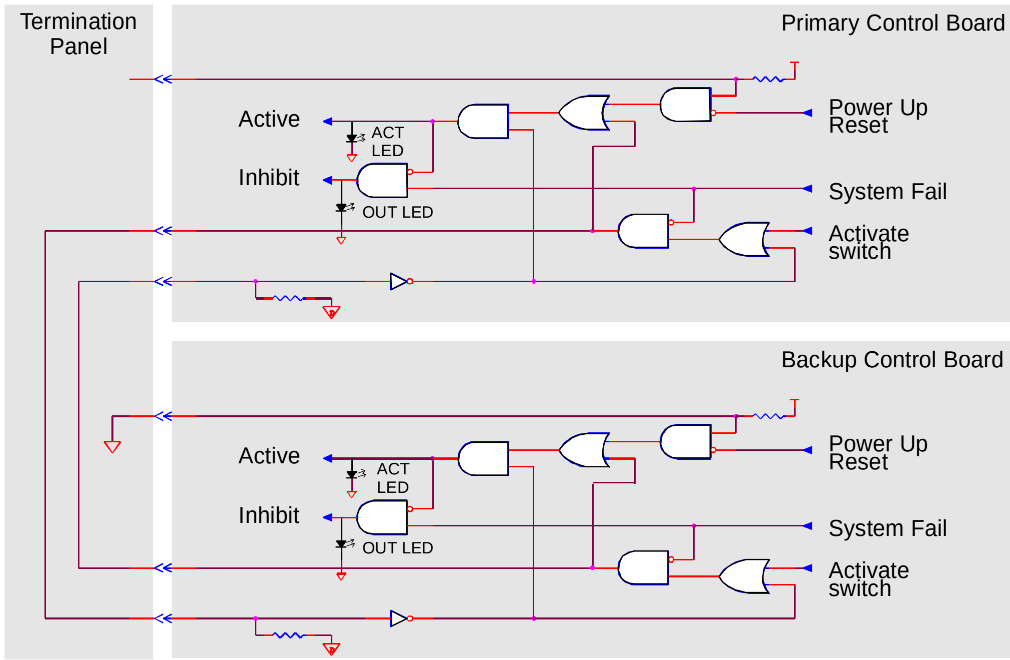
The active/standby logic determines which control board (primary or backup) is active and if the outputs are active. Only one control board can assume the active role at any given time. Refer to Figure 2-9.

The inhibit signal is true when the control board is not active and the system fail signal is true. The inhibit signal when true will reset the analog outputs to zero and reset the discrete output latches causing the output transistors to open.

The only time the inhibit signal can be true, in a primary control board that does not have a good control board in its backup position, is the first 0.2 second after power is first applied. This will allow the outputs to reset on power up and to freeze the outputs if the system fail signal should become true when the control board is active and must remain active.

FIGURE 2-9

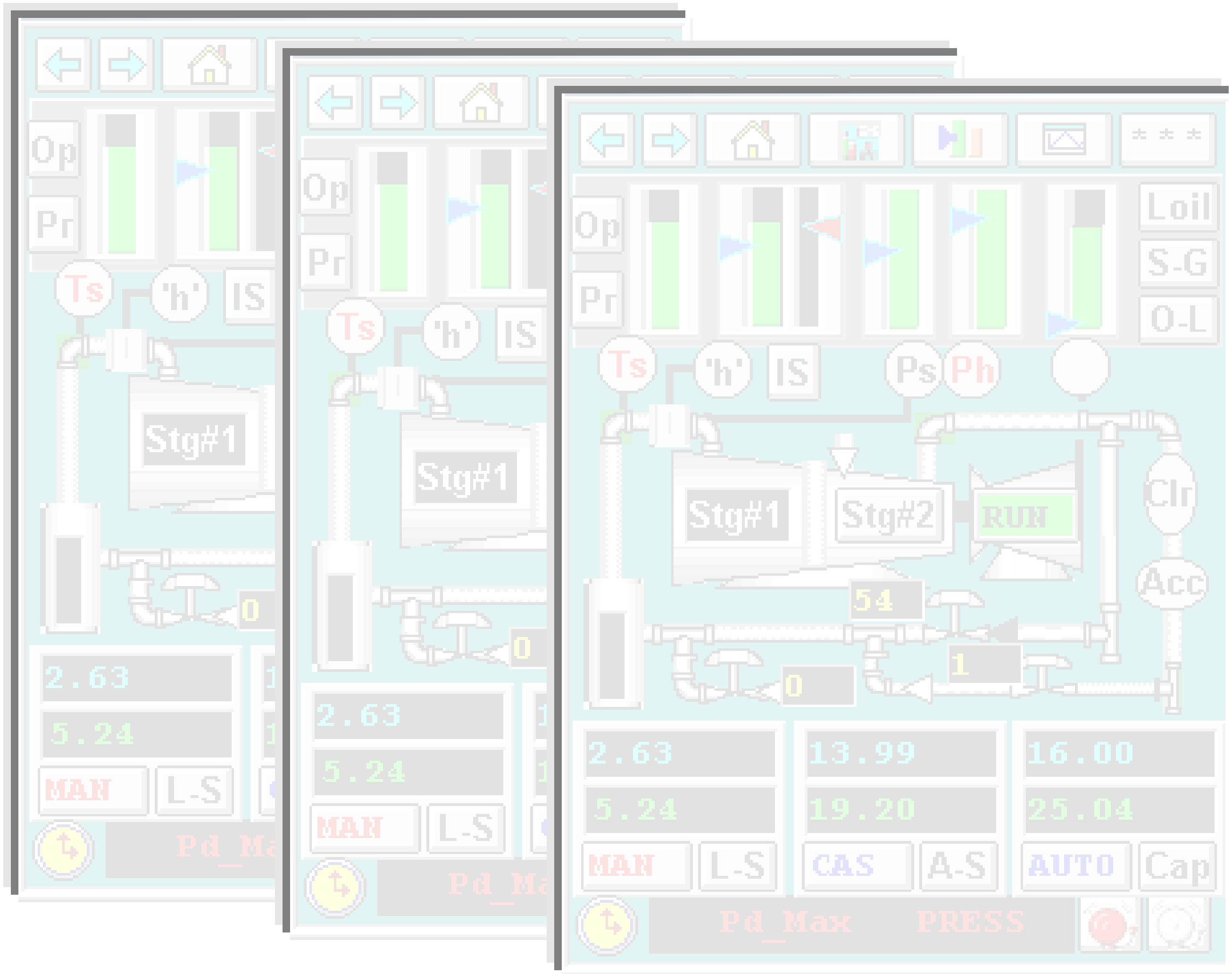
Active/Standby Logic



3

Section Three

Hardware Installation/Maintenance


Op
Pr
Loil
S-G
O-L
Ts
'h'
IS
Ps
Ph
Stg#1
Stg#2
RUN
Clr
Acc
54
0
1
2.63
5.24
13.99
19.20
16.00
25.04
MAN
L-S
CAS
A-S
AUTO
Cap
Pd_Max
PRESS

Hardware Installation/Maintenance

Site Selection Considerations

The T6200 Controller requires following conditions during normal operation:

- 32 to 122° F (0 to 50° C)
- 5 to 96% Relative humidity
- Protection from direct contact with water, chemicals, and conductive dust.
- Protection from exposure to sulfur compounds, acid, other corrosive or reactive vapors or fumes, dust, and lint.

For estimating heat load requirements, the T6200 Controller dissipates a maximum of 10 BTU/hr. (or 24 KGM-CAL/Hr) to the inside of the control panel.

Access Considerations

There are very few restrictions on the mounting position of the T6200 Controller. The following should be taken into consideration:

- All electrical power and input/outputs are connected on the rear termination panel. Because as many as 70 conductors and four cables can be terminated to each T6200 Controller adequate wireway space should be provided.
- The T6200 Controller is operated from the front of the unit with switches on the bottom. The Operator Interface slides up 0.5 in. (12 mm) to remove.

- The control boards slide out the front of the unit.
- To ensure a proper viewing angle, the Controller should be installed approximately 64 inches (1.6 m) above the floor.
- Outdoor installation is not recommended. However, for outdoor installations, the face of the Controller should be shielded from direct sunlight, since bright light produces a poor display contrast.

T6200 Controller Mounting

T6200 Controller Mounting

Figure 3-1 provides mounting dimensions for the T6200 Controller. Dimensions are shown in inches (mm).

- Remove Operator Interface by pushing up and pulling out at the bottom. Disconnect cable from Operator Interface
- Use the two Phillips head screws and clamps to mount the T6200 Controller in the user's panel.
- When the T6200 Controller is positioned properly, hand-tighten both clamps in place. *Note: Do not exceed 15 in-lbs (17 cm-kgs) of torque on panel clamp screws.*

The panel cut-out dimensions, as well as the Operator Interface front outline dimensions are shown in Figure 3-2. The T6200 Controller would normally be mounted in a vertical position.

Figure 3-3 provides mounting dimensions for the optional Remote I/O Termination Panel. The I/O cable that connects the T6200 Controller to the Remote I/O Termination Panel is 6 ft. (2m) long. Dimensions are shown in inches (mm). The Remote I/O Termination Panel can be snapped onto a user supplied standard 35 mm DIN rail.

T6200R Subrack Mounting

Each T6200R Subrack Housing accommodates up to six redundant T6200 Controllers. The subrack may also include two power supplies, Operator Interface, and two Ethernet hubs. Refer to Figure 3-4 for T6200R Subrack mounting dimensions. The subrack should be mounted in a EIA standard 19 inch rack. Refer to **Section Nine Specifications** for more detailed physical dimensions.

FIGURE 3-1.

T6200 Mounting Dimensions

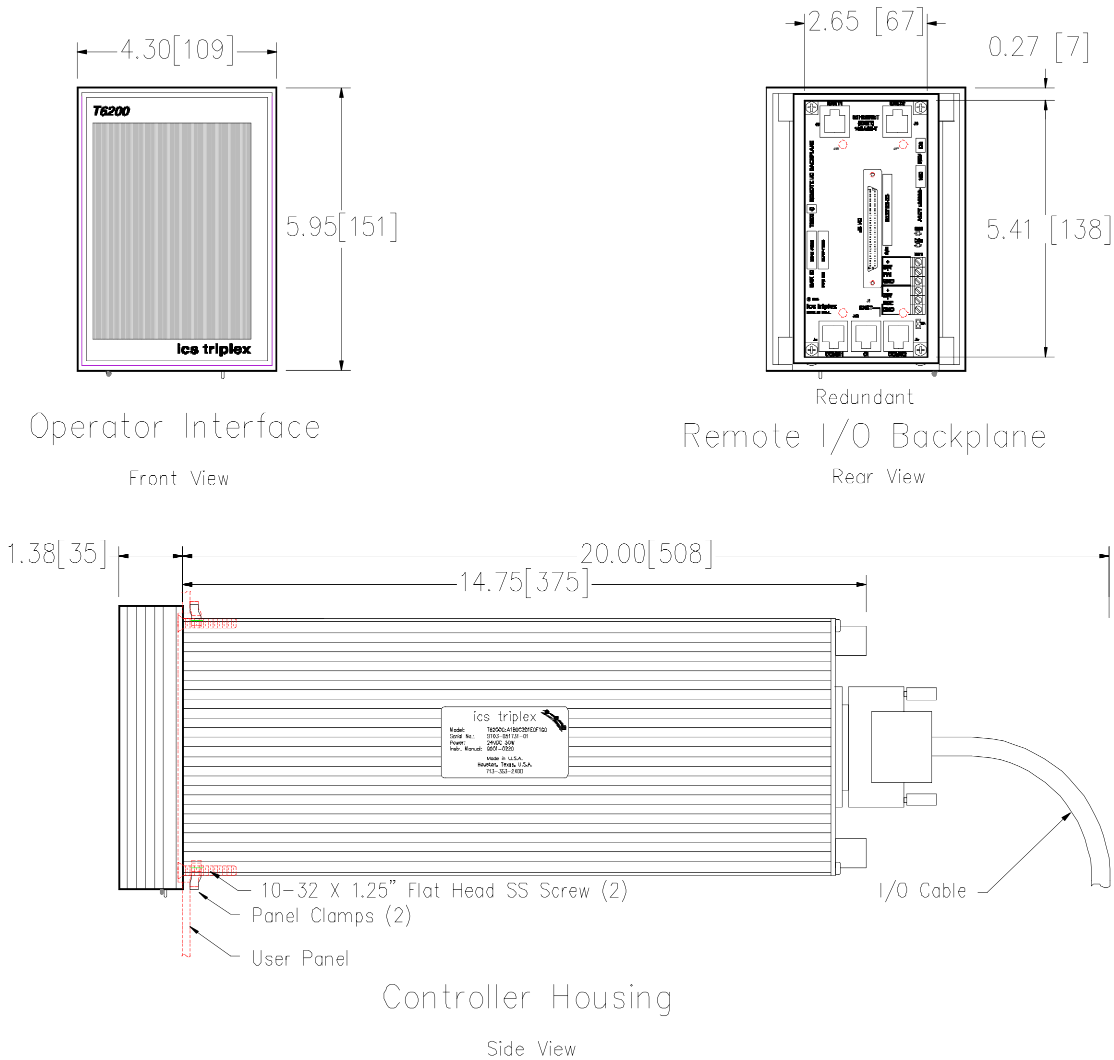


FIGURE 3-2.

T6200 Controller Panel Cutout Dimensions

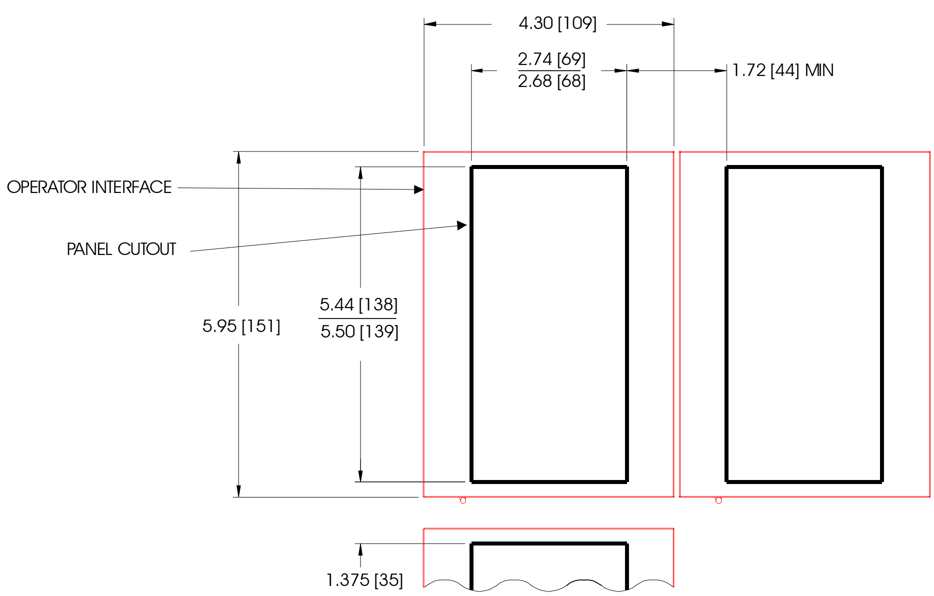
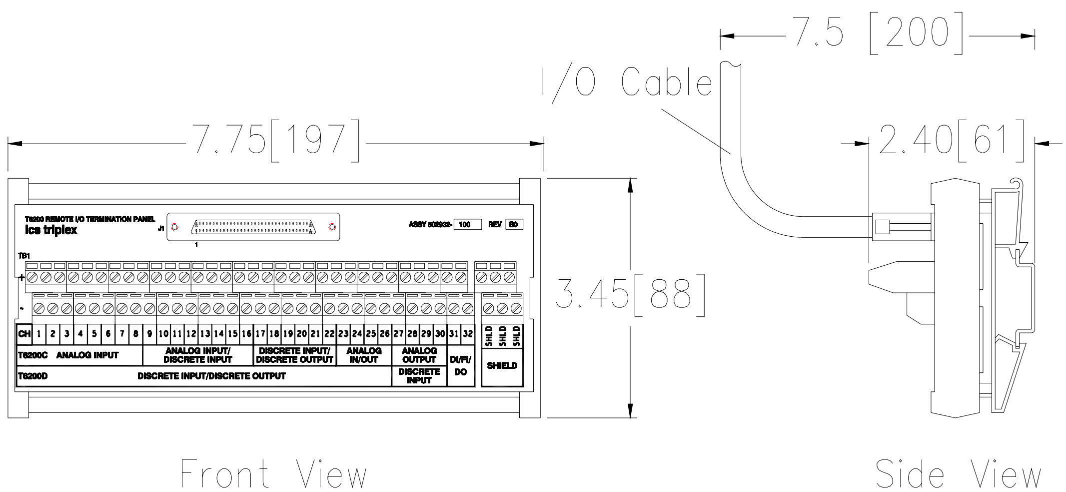


FIGURE 3-3

Remote I/O Terminal Panel Mounting Dimensions



T6200 Controller Electrical Power Wiring

The guidelines below should be followed when wiring the power to the T6200 Controller:

- The maximum wire size is 16 AWG stranded.
- All wiring should be multi-stranded annealed copper with insulation that meets the requirements of all applicable electrical codes.
- AC power wiring should be run in a separate conduit from the T6200 Controller power and the I/O.
- The stripped portion of the wire should be 3/16” (5 mm) long.
- Wires should be inserted in the clamp type terminals until they touch the internal stops. The terminal screw should be tightened while holding the wire in place. Check for proper clamp pressure with a gentle tug on the wire.
- Electrical power should be provided from a redundant, highly reliable, dedicated 26 Vdc power source.
- Power consumption is 15 watts for the T6200 Controller and 15 watts for the Operator Interface, not including field devices.

The T6200 Controller has redundant 26 Vdc power supply connections.

FIGURE 3-4

T6200R Subrack Mounting Dimensions

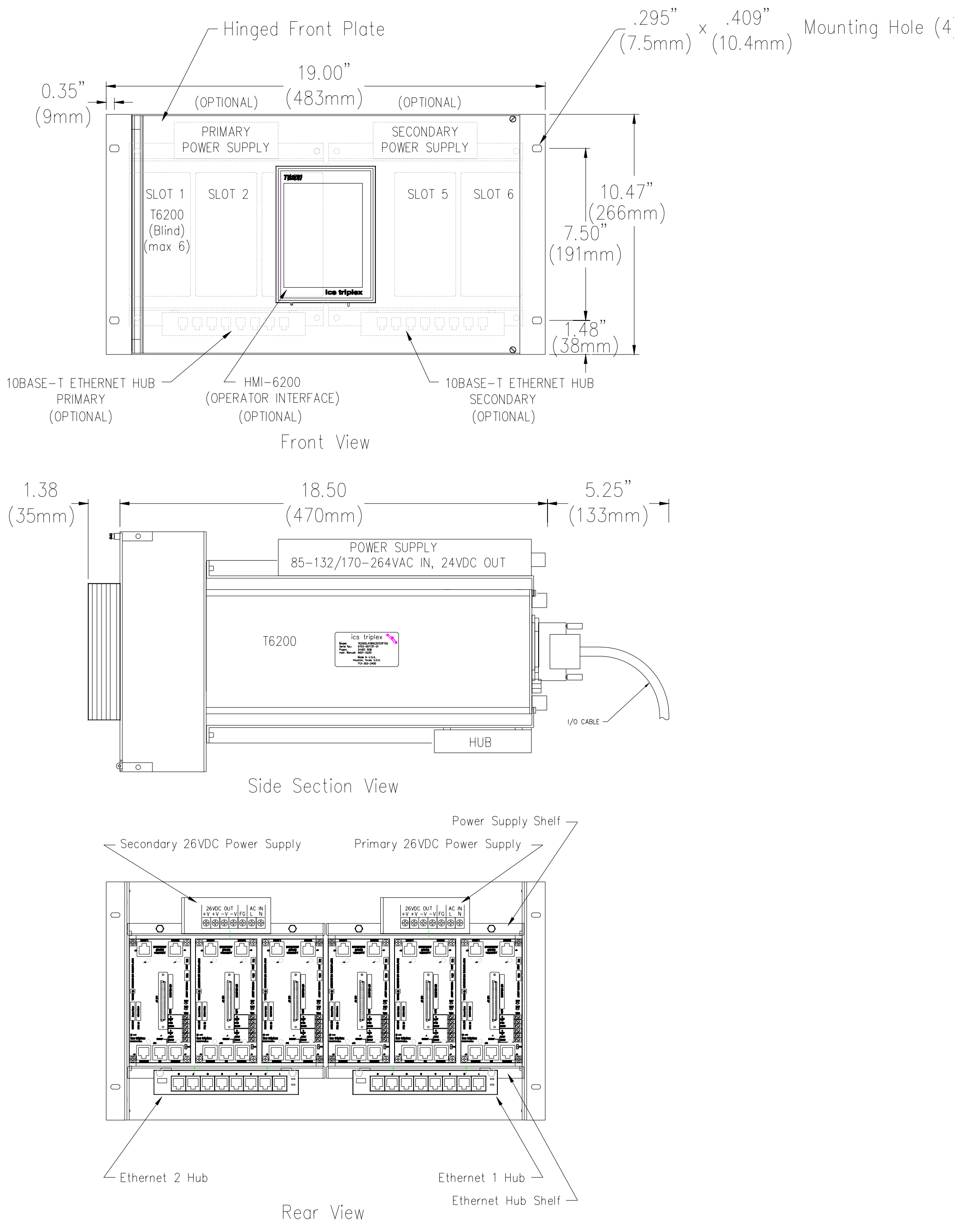
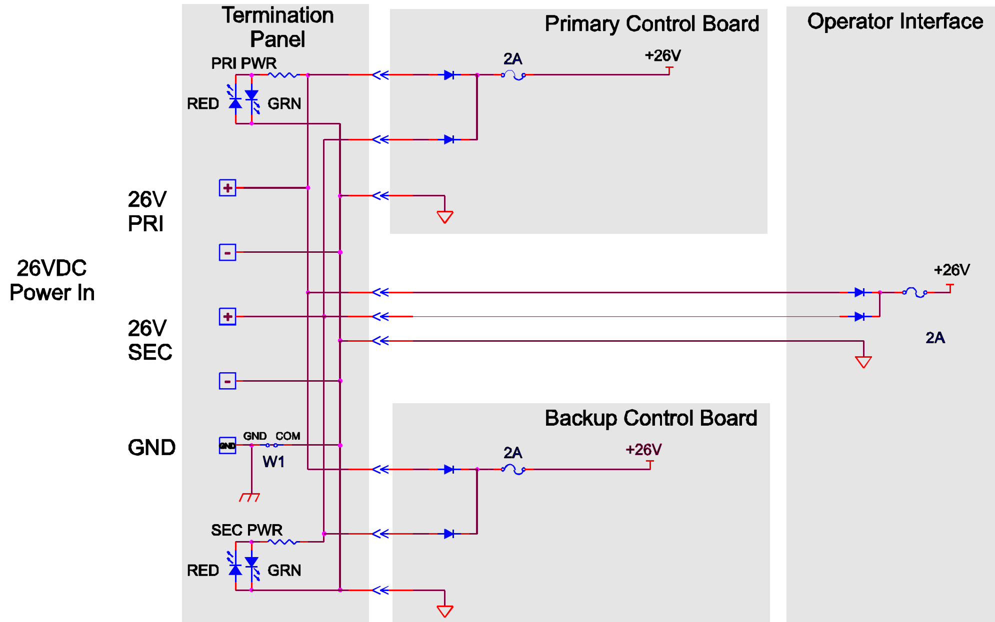


Figure 3-5 shows the internal power distribution for the T6200 Unit Automation System. Connect 26 Vdc (18-32 Vdc) power to the **26V PRI** (Primary) terminals and to the **26V SEC** (Secondary) terminals.

There is a jumper (W1) on the T6200 Termination Panel that connects the minus side of the 26 volt supply to earth ground. This jumper may be cut if the power source is referenced to earth ground somewhere else in the system.

FIGURE 3-5

Internal Power Distribution



T6200R Subrack Electrical Power Connection

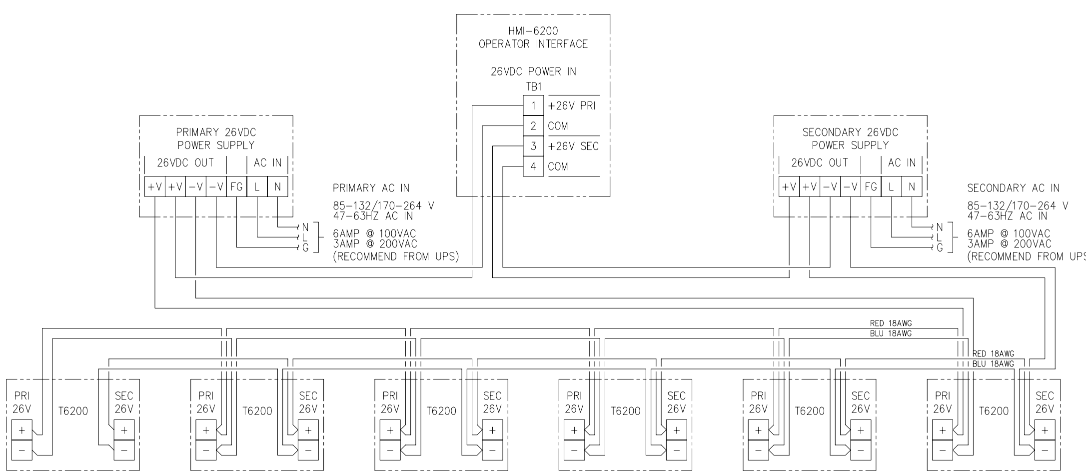
Once the T6200R Subrack is mounted, plug the included external power supply's DC power cord into the matching power jack on each of the Ethernet Hub's rear panel. The Ethernet Hub shelf may be removed to connect the power. Plug each of the power supply's transformers into an AC receptacle that is six feet (two meters) or less away. The green **"Pwr"** LED should light up.

Refer to the guidelines in **T6200 Controller Electrical Power Wiring** above and Figure 3-6 and connect AC power wiring to each of the 26 Vdc Power Supplies.

The 26 Vdc power to the T6200 Controllers and Operator Interface is usually prewired as shown in Figure 3-6.

Figure 3-6

T6200R Subrack Power Wiring



Input/Output Hardware Configuration

There are several different ways the hardware can be configured for each input/output. Refer to **Section Two Input/Output Circuit Description** for details on each configuration. The different configurations are achieved by the placement of jumpers (shorting bars) on a multi-pin headers located on the printed circuit board. Each channel has a separate header and can be configured independently. To access the jumpers:

- Unplug the optional front panel Operator Interface
- Carefully slide the printed circuit board out the front of the chassis.

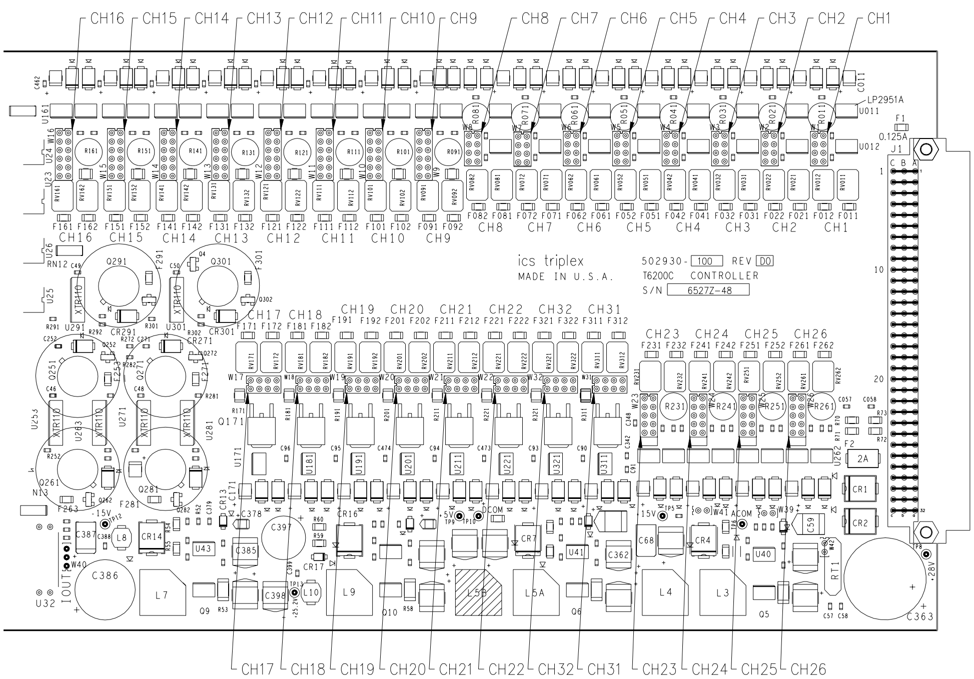
CAUTION

The Controller contains parts susceptible to damage by electrostatic discharge. Normal precautions should be taken to avoid high static voltages.

When facing the component side of the printed circuit board with the LEDs on the left, the headers/jumpers will be at the right Pin one on the headers will be as shown in the illustrations. Pin one also has a square pad on the circuit side of the printed circuit board. Refer to Figure 3-7 for T6200C. Refer to Figure 3-11 for T6200D.

FIGURE 3-7.

T6200C Control Board



Hardware configuration jumpers

The headers may vary from input/output group to group. All the headers are oriented the same way within one group. A group is where a`ll consecutive inputs/outputs have the same configuration options. For example, channels one through eight are in the same group.

Signal Wiring

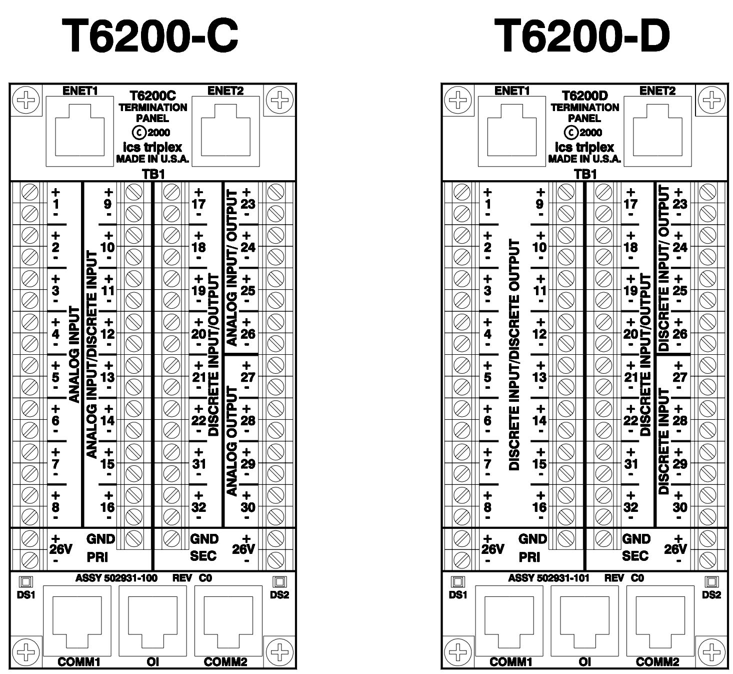
Individually shielded wires are not required (except for frequency inputs). Twisted pairs and overall cable shields are recommended. Each multipair cable should contain a few pairs of spare wires. Shields and unused conductors should be terminated to ground at Controller end only. Refer to appropriate Wiring and Jumper Placement.

The following general guidelines apply to all signal wiring discussed in the following paragraphs.

- Wire size range for the terminal panel is 26-16 AWG stranded; recommended wire size range is 18-14 AWG.
- Wire size range for the remote I/O terminal is 26-14 AWG stranded; recommended wire size range is 18-14 AWG.
- All wiring should be multi-stranded annealed copper with insulation that meets the requirements of all applicable electrical codes.
- Keep all wire runs as short and direct as possible. Long wire runs are vulnerable to picking up stray electrical noise. Use care when running signal wiring near to or crossing conduit or wiring that supplies power to motors, solenoids, lighting, horns, bells, etc.
- Avoid bringing signal wiring into junction boxes which contain other wiring.
- AC power wiring should be run in a separate conduit from the signal wiring.
- The stripped portion of the wires should be 5/16” (8 mm) long.
- Wires should be inserted in the clamp type terminals until they touch the internal stops. The terminal screw should be tightened while holding the wire in place. Check for proper clamp pressure with a gentle tug on the wire.

FIGURE 3-8

Integral Termination Panels



Integral Termination Panel

Integral Termination Panel Used Primarily for Standalone or Demo Applications

FIGURE 3-9

Redundant Remote I/O Termination Panel

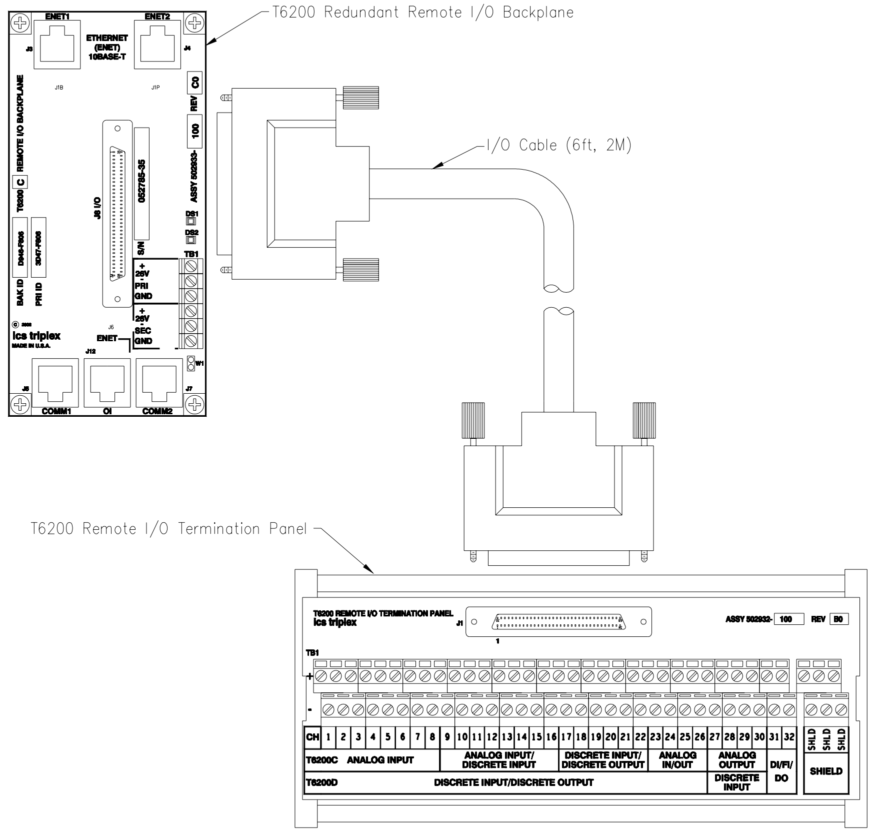
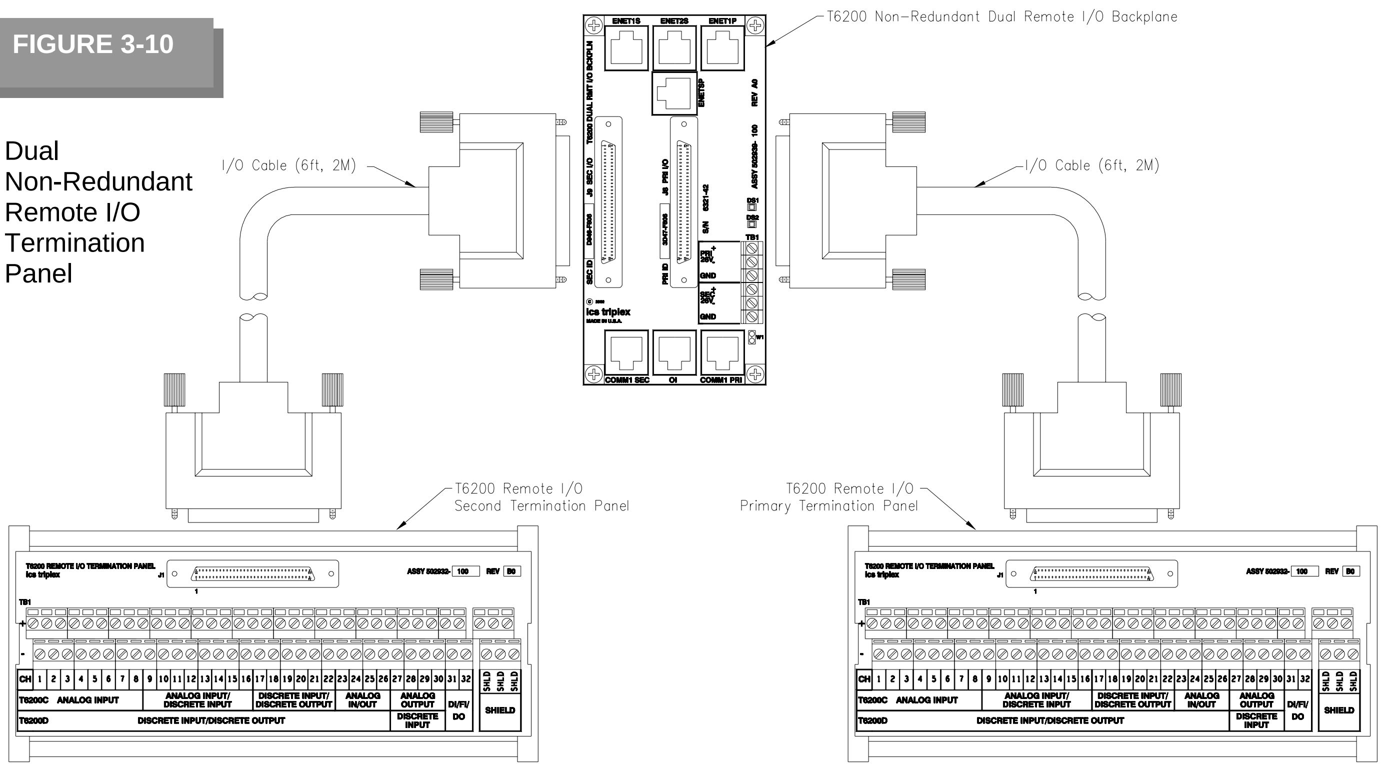


FIGURE 3-10

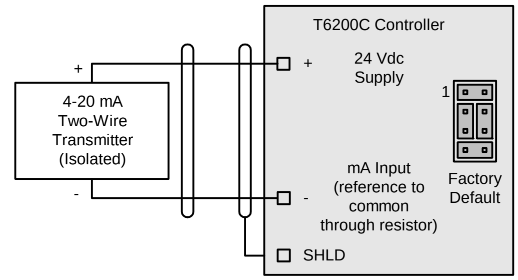
Dual Non-Redundant Remote I/O Termination Panel



Wiring and Jumper Placement for T6200C Channels 1-8

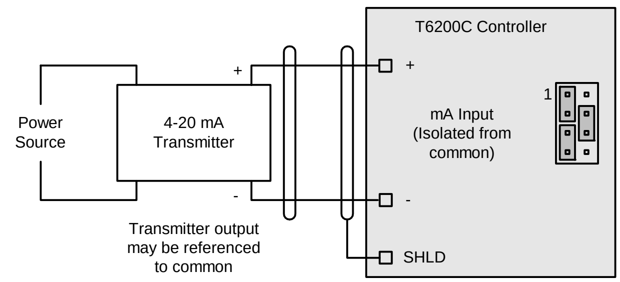
Two-Wire Transmitter

This wiring and jumper placement is normally used with isolated two-wire transmitters where the transmitter power is supplied by the Controller. Refer to Figure 2-3.



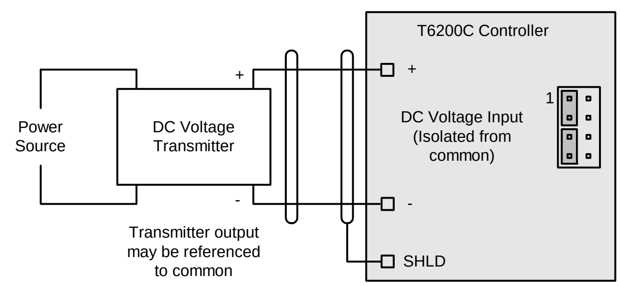
Analog Current Inputs

This wiring and jumper placement is normally used with four-wire current transmitters when the power is *not* supplied by the Controller. Refer to Figure 2-2.



Analog Voltage Inputs

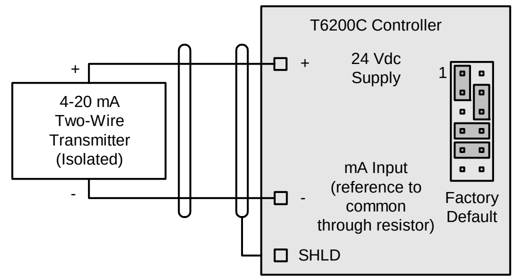
This wiring and jumper placement is for voltage inputs. Refer to Figure 2-1.



Wiring and Jumper Placement for T6200C Channels 9-16

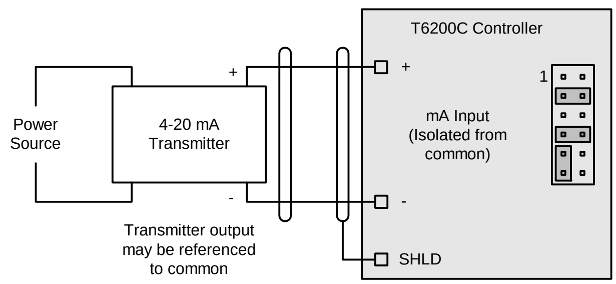
Two-Wire Transmitter

This wiring and jumper placement is normally used with isolated two-wire transmitters where the transmitter power is supplied by the Controller. Refer to Figure 2-3.



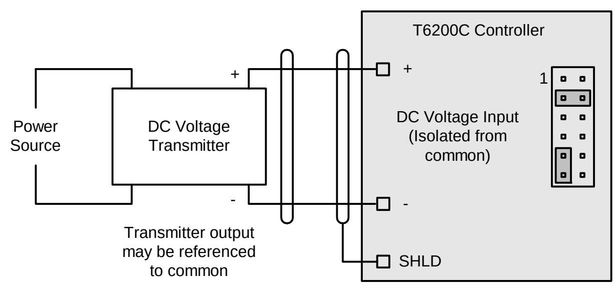
Analog Current Input

This wiring and jumper placement is normally used with four-wire current transmitters when the power is *not* supplied by the Controller. Refer to Figure 2-2.



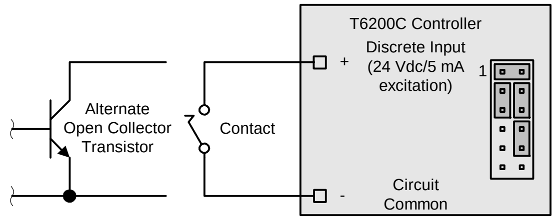
Analog Voltage Input

This wiring and jumper placement is for voltage inputs. Refer to Figure 2-1.



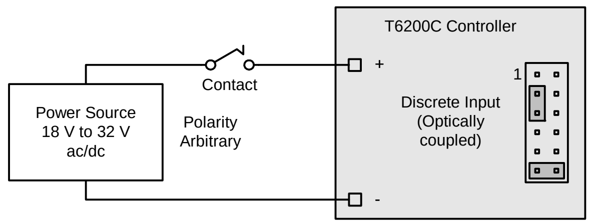
Discrete Inputs with Excitation from Controller

This wiring and jumper placement is for discrete (On/Off) inputs. The Controller supplies 24 VDC power for the input. Refer to Figure 2-6.



Isolated Discrete Inputs

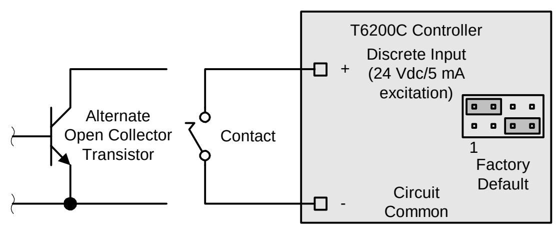
This wiring and jumper placement is for discrete (On/Off) inputs. The discrete inputs are isolated from other circuits and the external power for the input is either 18-32 Volt AC or DC. Refer to Figure 2-5.



Wiring and Jumper Placement for T6200C Channels 17-22, 31, and 32

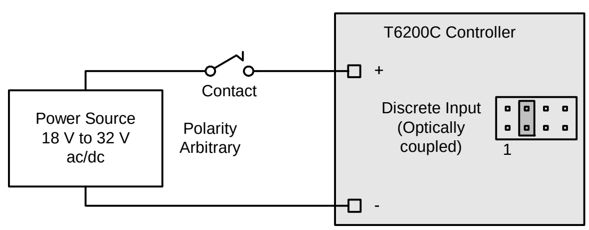
Discrete Inputs with Excitation from Controller

This wiring and jumper placement is for discrete (On/Off) inputs. The Controller supplies 24 VDC power for the input. Refer to Figure 2-6.



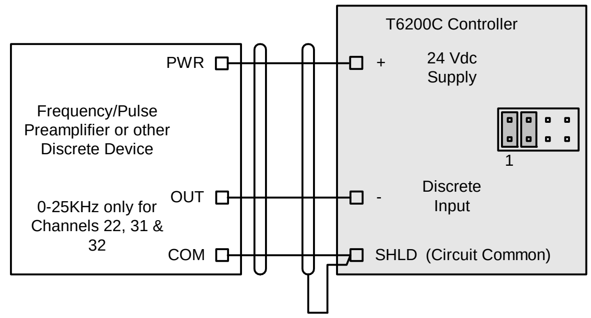
Isolated Discrete Inputs

This wiring and jumper placement is for discrete (On/Off) inputs. The discrete inputs are isolated from other circuits and the external power for the input is either 18-32 Volt AC or DC. Refer to Figure 2-5.



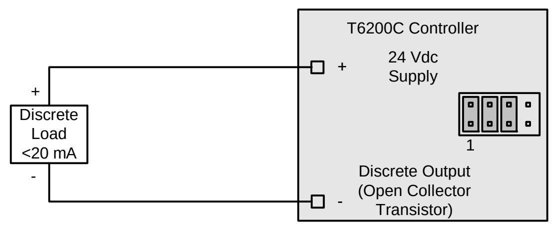
Frequency Inputs

This wiring and jumper placement is for a frequency/pulse preamplifier input with the Controller supplying the power (Channel 22,31 and 32).



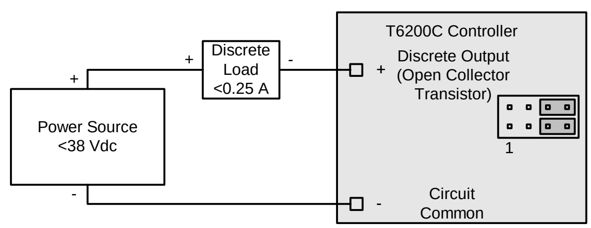
Discrete Outputs with Internal Power

This wiring and jumper placement is for discrete (On/Off) outputs. The Controller supplies 24 VDC power for the 20 mA max load. Load Example: Entrelec RB 131 (010055.23) relay. Refer to Figure 2-7.



Discrete Outputs with External Power

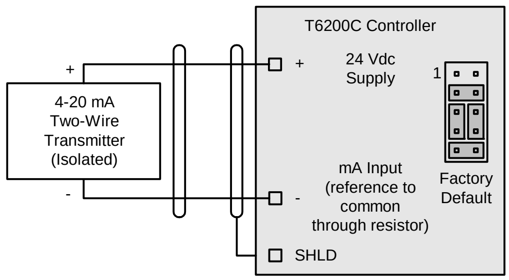
This wiring and jumper placement is for discrete (On/Off) outputs. The power source (less than 38 VDC) is external. The discrete load is 0.25 Amp max. Refer to Figure 2-8.



Wiring and Jumper Placement for T6200C Channels 23-26

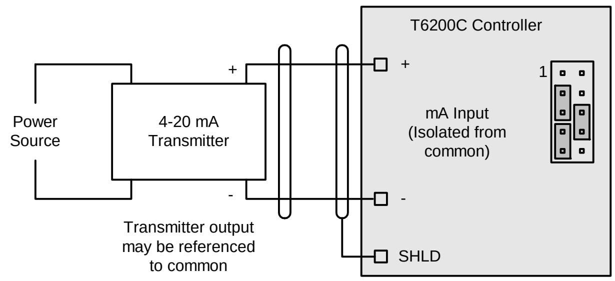
Two-Wire Transmitter

This wiring and jumper placement is normally used with isolated two-wire transmitters where the transmitter power is supplied by the Controller. Refer to Figure 2-3.



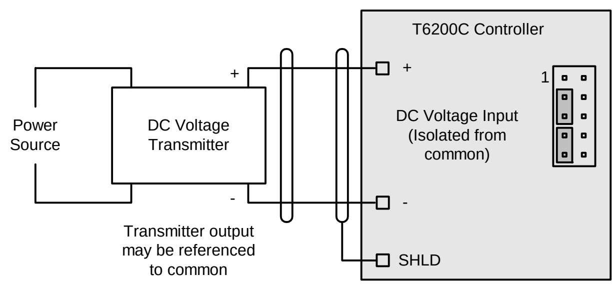
Current Inputs

This wiring and jumper placement is normally used with four-wire current transmitters when the power is *not* supplied by the Controller. Refer to Figure 2-2.



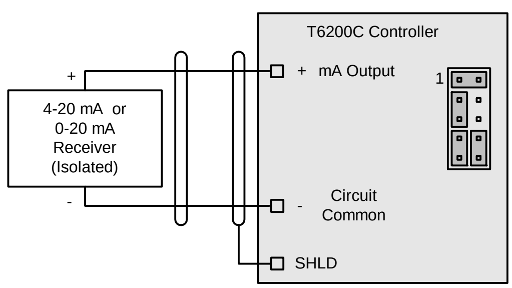
Analog Voltage Inputs

This wiring and jumper placement is used for voltage input. Refer to Figure 2-1.



Analog Current Outputs

0-20mA (4-20mA) Analog current outputs. Refer to Figure 2-4.



Wiring for T6200C Channels 27-30

Analog Current Outputs

0-20mA (4-20mA)
Analog current outputs.
Refer to Figure 2-4.
Channels 27-30 do not have jumper placements.

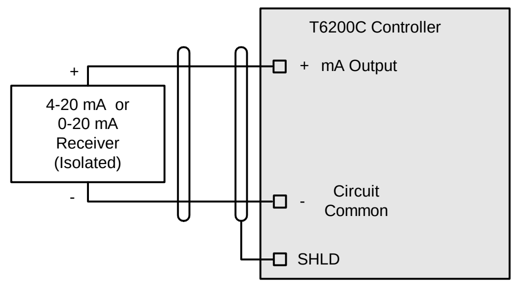
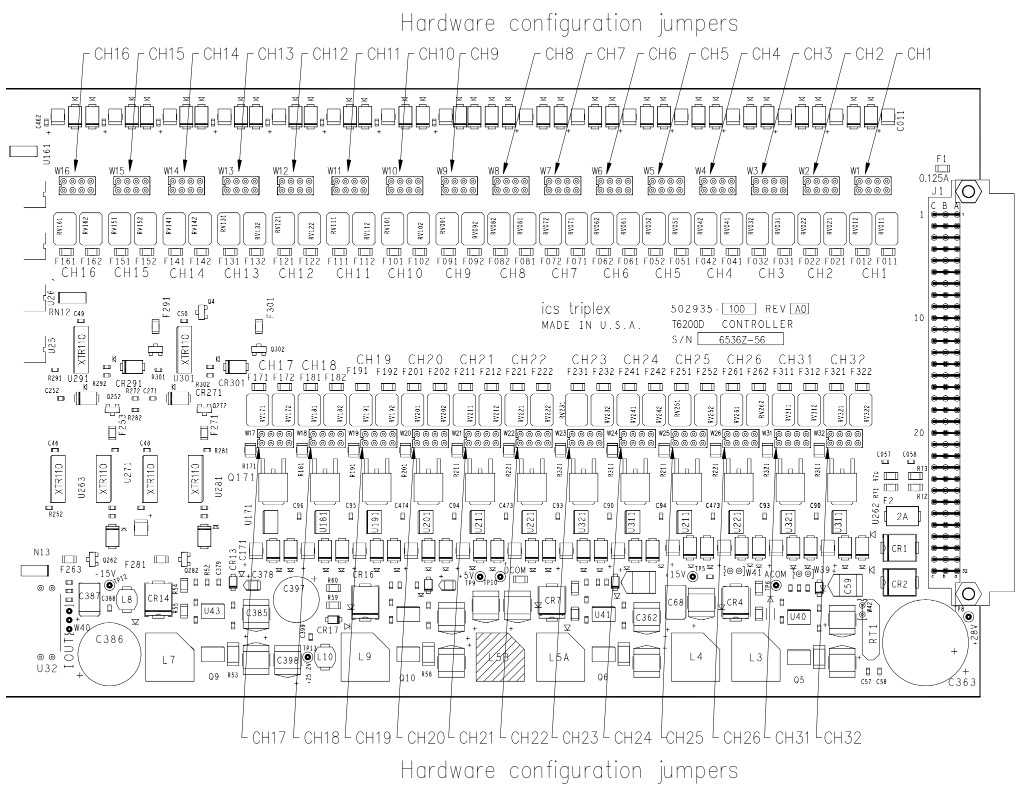


FIGURE 3-11

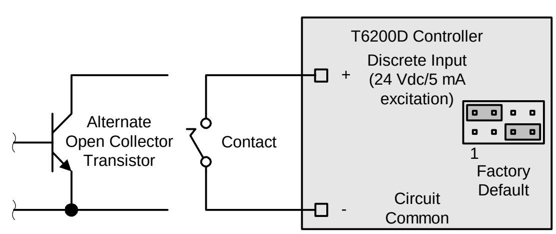
T6200D Control Board



Wiring and Jumper Placement for T6200D Channels 1-26, 31, and 32

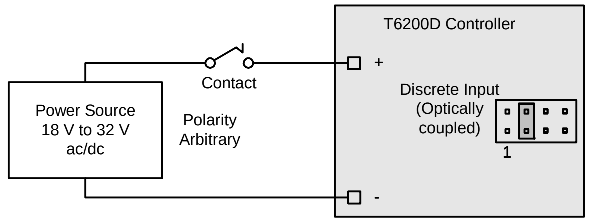
Discrete Input with Excitation from Controller

This wiring and jumper placement is for discrete (On/Off) inputs. The Controller supplies 24 VDC power for the input. Refer to Figure 2-6.



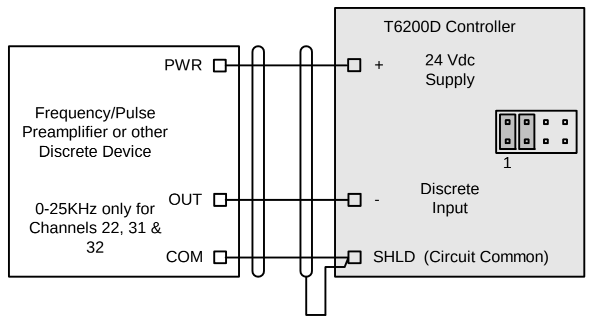
Isolated Discrete Input

This wiring and jumper placement is for discrete (On/Off) inputs. The discrete inputs are isolated from other circuits and the external power for the input is either 18-32 Volt AC or DC. Refer to Figure 2-5.



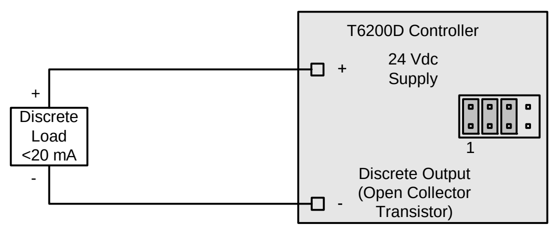
Frequency Input

This wiring and jumper placement is for a frequency/pulse preamplifier input with the Controller supplying the power (Channel 22,31 and 32).



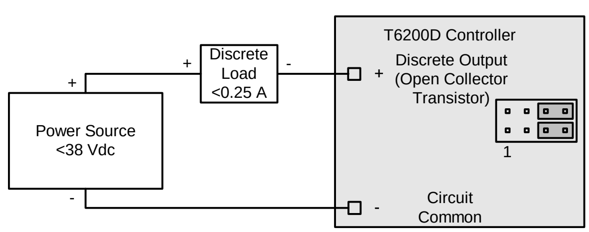
Discrete Output with Internal Power

This wiring and jumper placement is for discrete (On/Off) outputs. The Controller supplies 24 VDC power for the 20 mA max load. Load example: Entrelec RB 131 (010055.23) relay Refer to Figure 2-7.



Discrete Outputs with External Power

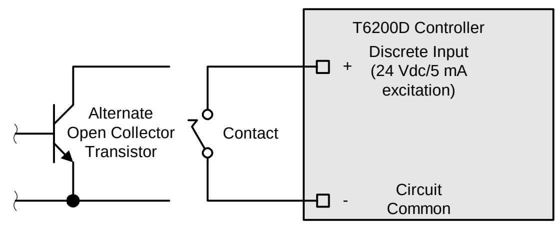
This wiring and jumper placement is for discrete (On/Off) outputs. The power source (less than 38 Vdc) is external. The discrete load is 0.25 Amp max. Refer to Figure 2-8.



Wiring for T6200D Channels 27-30

Discrete Inputs with Excitation from Controller

These channels are for placement is for discrete (On/Off) Inputs only. The Controller supplies 24 VDC power for the input. Refer to Figure 2-6 Channels 27-30 do not have jumper placements.



Ethernet Communication Network

The T6200 Controller uses IEEE 802.3 10Base-T Ethernet communication network. Ethernet uses the Carrier Sense, Multiple Access, Collision Detect (CSMA/CD) datalink protocol, which employs a broadcast method for communicating with nodes. When a station senses that the network is idle and it is ready to send, it transmits its data packets to the network. Since all nodes hear the data, each node checks to see if the packet is intended for it. The station that matches the destination address in the packet is the one that responds. The collision detection part of CSMA/CD tells nodes to halt transmission if a collision is detected and to try again later at a randomly determined delay period.

Network Security

The T6200 Controller incorporates automatic control redundancy to insure process equipment operation in the event of failure. Redundant network components can further enhance overall system security by maintaining communications in case of certain device malfunction and by allowing online repair of faulty components. With proper redundancy implementation an Ethernet network can detect when a particular path cannot pass data and then automatically switch to a backup path. Refer to *T6200 Equipment Selection and Planning Guide* for more information on network security.

Ethernet Network Connectors

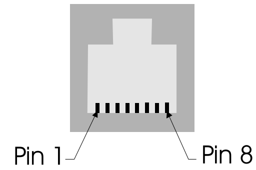
The T6200 Controller includes two individual IEEE 802.3 10Base-T Ethernet connections (ENET1 and ENET2) with standard RJ-45 connectors to facilitate control network communication. Refer to Figure 3-8 (Integral Termination Panel), Figure 3-9 (Redundant Remote I/O Backplane) or Figure 3-10 (Non-Redundant Dual Remote I/O Backplane) for connector location and Figure 3-12 for Ethernet ENET1 and ENET2 connector pin assignments.

Note on Figure 3-10 (Non-Redundant Dual Remote I/O Backplane) ENET1 on the Primary Control Board is referenced as ENET1P and ENET2 is referenced as ENET2P. ENET1 on the Second Control Board is referenced as ENET1S and ENET2 is referenced as ENET2S.

FIGURE 3-12

Ethernet
ENET1 and ENET2
Connector
Pin Assignments

Pin	Signal
1	TXD+
2	TXD-
3	RXD+
4	NC
5	NC
6	RXD-
7	NC
8	NC



Network Cabling

Ethernet is used as the high-speed wire media to provide the control network communication capabilities for the T6200 Controller systems. Typically, the control network is an isolated Ethernet network that provides communication between the T6200 Controller and workstations. It uses Ethernet hubs and/or switches for communication connections.

Use Ethernet category five (Cat 5) cables for the Ethernet network cables. The maximum cable length from the T6200 Controller to the hub/switch is 10 ft. (3 m). The maximum cable length from the hub/switch to any other node is 330 ft. (100 m) for longer distances, fiber optic cables are required.

Non-Redundant Network

The basic simplex network consists of a hub and Cat 5 cables that connect to each node. The T6200 Controllers have redundant Ethernet ports as a standard feature (whether they contain simplex or redundant control boards). When installing a simplex network, using Ethernet 2 port is optional. Refer to Figure 3-13 for a single T6200 Controller and Figure 3-14 for multiple T6200 Controllers.

FIGURE 3-13

Non-Redundant Network with Single T6200 Controller and Single Workstation

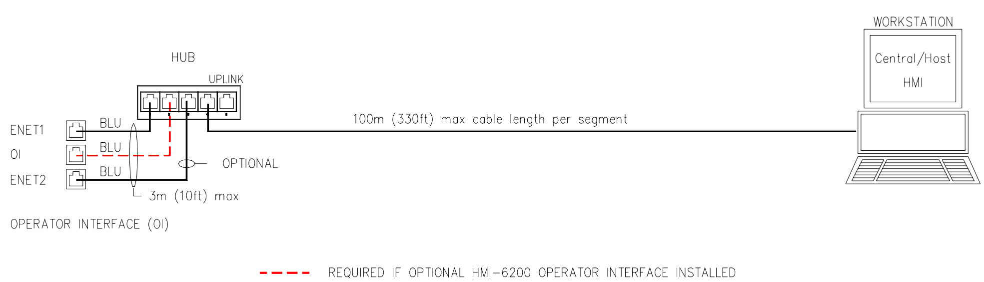
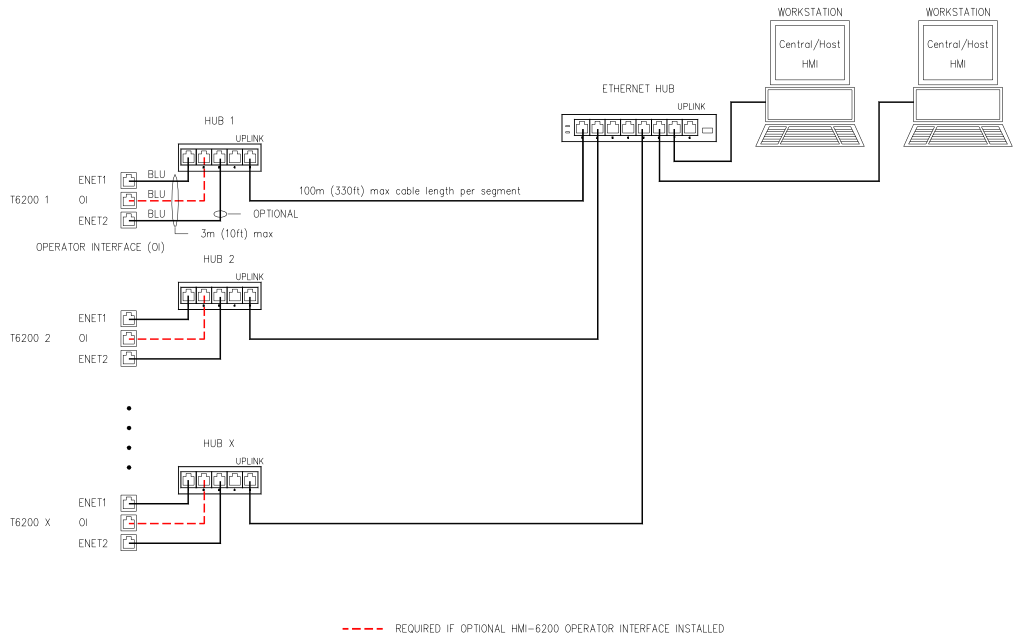


FIGURE 3-14

Non-Redundant Network with Multiple T6200 Controllers and Dual Workstations



Redundant Network

Network redundancy for communication security is provided by a secondary hub and cables that establish a secondary network identical to the primary network. The secondary network is connected to the redundant communications port of each workstation and Controller, and is connected to a separate hub/switch. Refer to Figure 3-15.

FIGURE 3-15

Redundant Network with Single T6200 Controller and Redundant Workstations

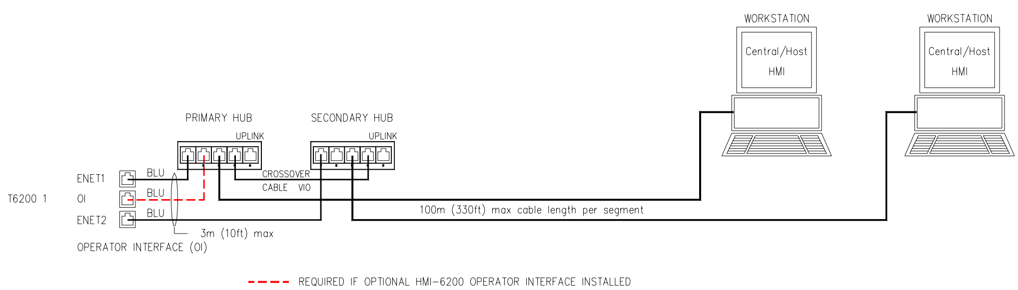


FIGURE 3-16

Redundant Network with Multiple T6200 Controllers and Redundant Workstations

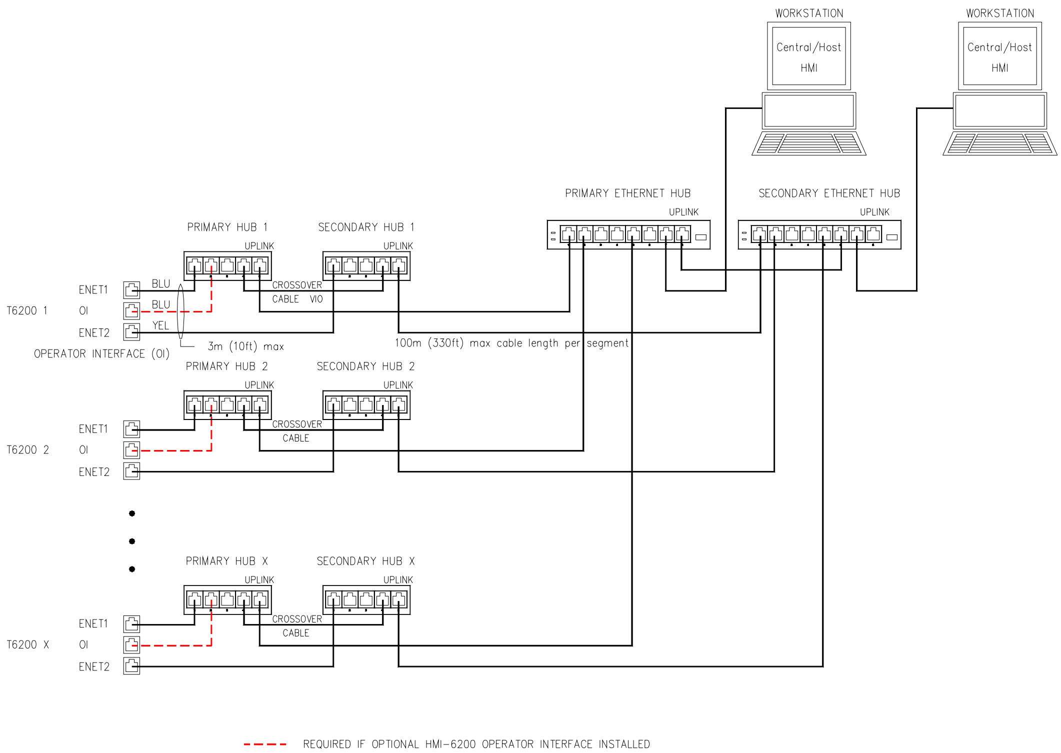


FIGURE 3-17

Redundant Network with Multiple T6200 Controllers Mounted in a T6200R Subrack and Redundant Workstations

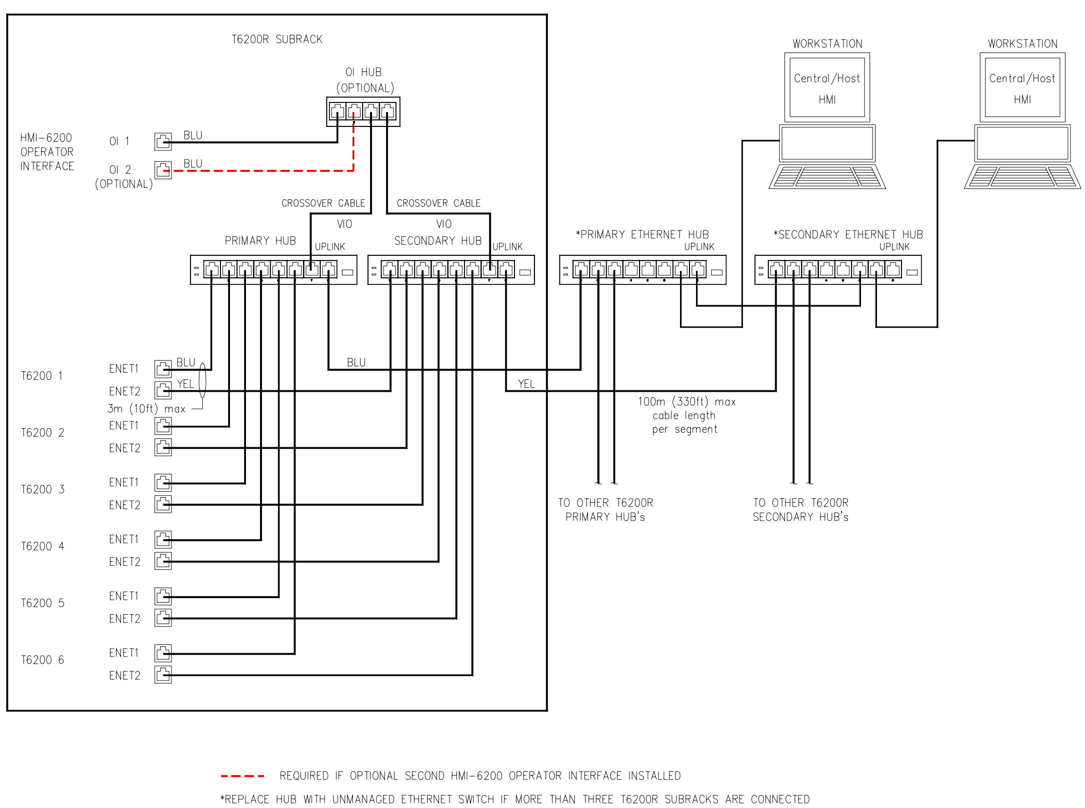


FIGURE 3-18

Non-Redundant Network with Single Dual T6200 Controller and Single Workstation

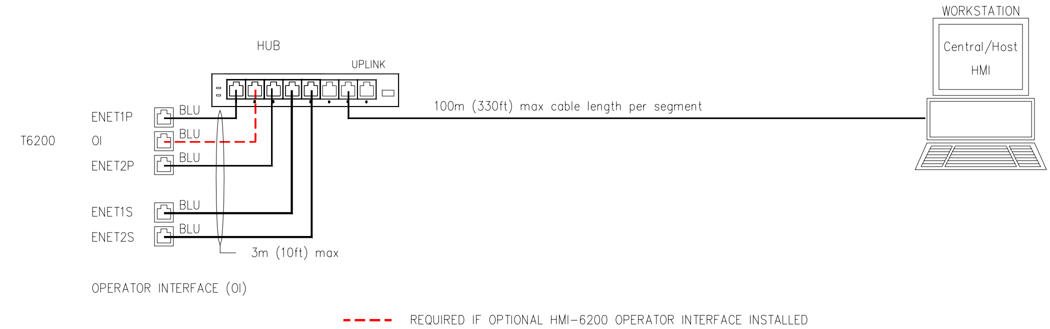
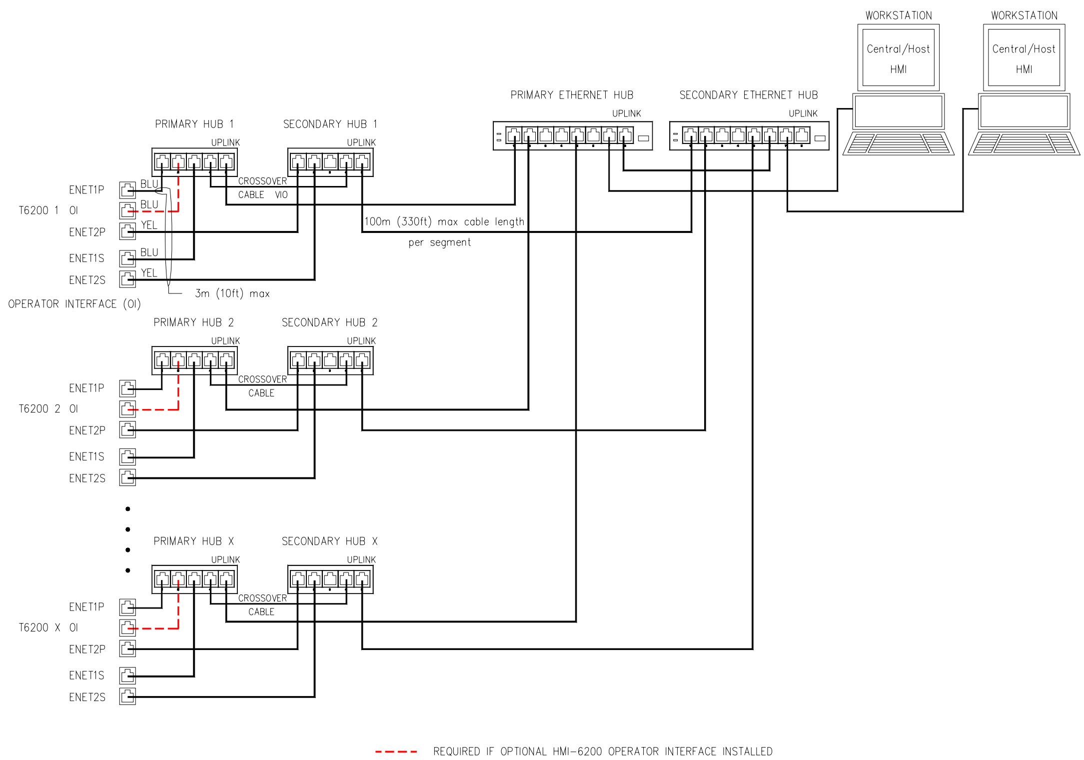


FIGURE 3-19

Redundant Network with Multiple Dual T6200 Controller and Redundant Workstations



T6200R Subrack Ethernet

The Ethernet Hubs on the T6200R Subrack are usually connected as shown in Figure 3-17.

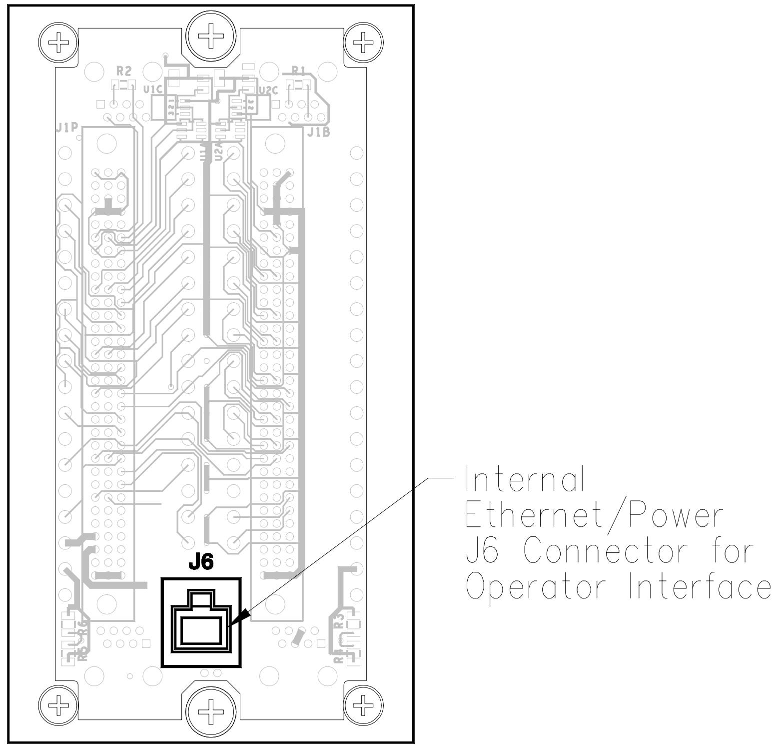
If the workstation is not part of an existing network, connect the workstation to port eight on the hubs. Set the Up-Link switch to “Normal”.

To connect the hubs to an existing network; set the Up-Link switch to “Up-Link” and connect existing network to port eight.

The Operator Interface is usually connected to port seven on Ethernet 1 Hub.

FIGURE 3-20

Internal Ethernet/Power J6 Connector for Operator Interface



Operator Interface Installation

Ethernet/Power Cable Installation

The Operator Interface Ethernet/Power cable is routed thru the center of the T6200 Controller housing and plugged into connector J6 inside the Controller on the Termination Panel or I/O Backplane. Refer to Figures 3-20 and 3-21. The Ethernet cable carries the 10Base-T Ethernet communications and the 26Vdc power from the T6200 Controller. Refer to Figure 3-22 for connector J6 pin assignments.

FIGURE 3-21

Operator Interface Internal Ethernet/Power Cable Installation

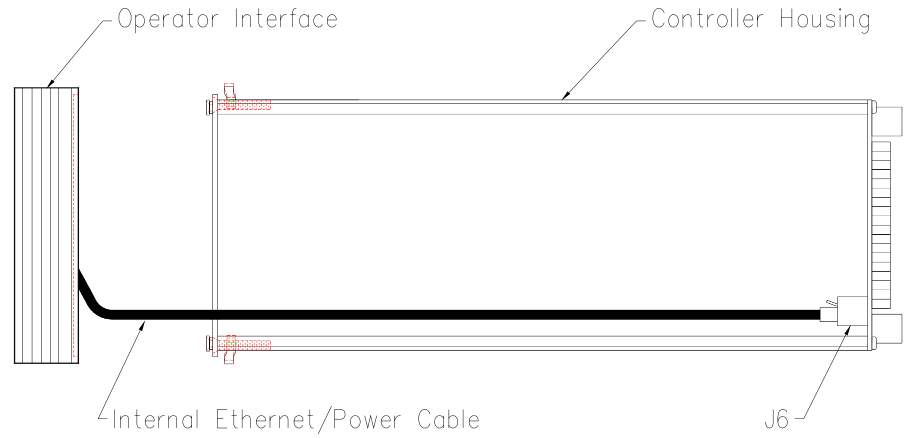
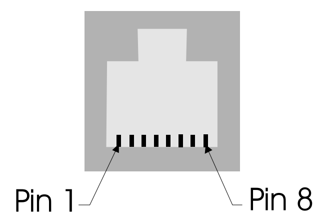


FIGURE 3-22

Operator Interface J6 Connector Pin Assignments

Pin	Signal
1	TXD+
2	TXD-
3	RXD+
4	+26V PRI
5	+26V SEC
6	RXD-
7	COM
8	COM



Operator Interface Attachment to T6200 Chassis

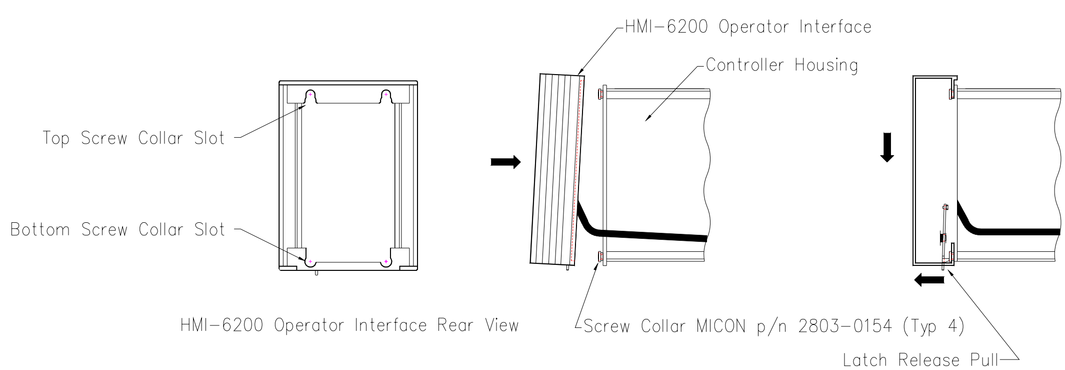
The Operator Interface is attached to the T6200 Chassis by four screw collars.

The Operator Interface is installed by placing the two top screw collar slots at the rear of the case over the two top screw collars. The case should be angled slightly out at the bottom. Once the top screw collars align thru the top screw collar slots, the case can be straightened vertically and then slide down until it stops on the case slots edge. Refer to Figure 3-23.

The Operator Interface may be removed by pulling the Latch Release Pull located at the bottom right of the case at the same time sliding the case up then away from the T6200 Chassis.

FIGURE 3-23

Operator Interface Attachment to T6200 Chassis

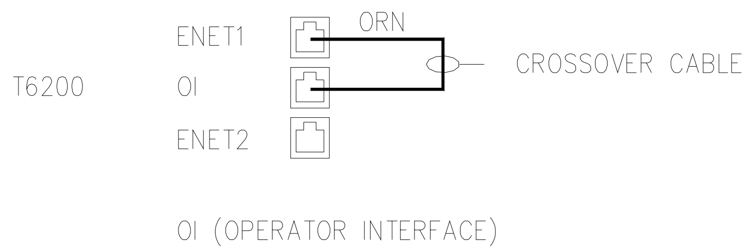


Standalone T6200 Controller Operator Interface Ethernet External Cable Connection

For Standalone T6200 Controller applications where no communications to other controllers or workstations are required, the T6200 Controller ENET1 connector may be connected directly to the OI (Operator Interface) connector with a short Ethernet **crossover** cable (ICS Triplex p/n 6009-0030) eliminating the necessity of an Ethernet hub. Refer to Figure 3-24.

FIGURE 3-24

Standalone T6200 Controller Operator Interface Ethernet Crossover External Cable Connection



Firmware Changes

Firmware is the software, operating system, and function library that has been programmed into an EPROM (erasable programmable read-only memory). Should it become necessary to update the firmware or install a custom firmware in the field, the EPROM will have to be replace. To change the EPROM:

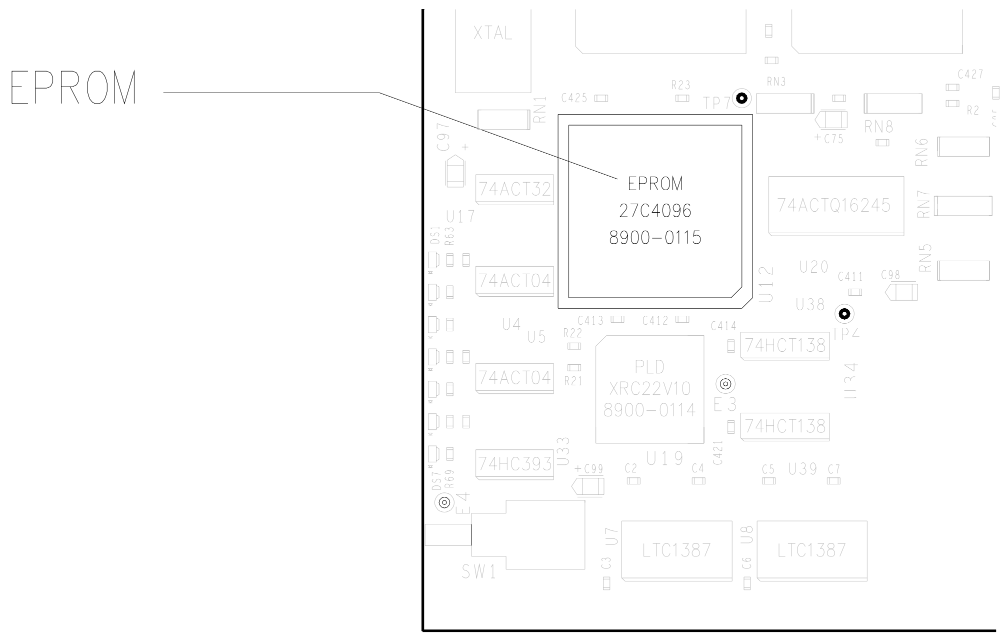
CAUTION

The Controller contains parts susceptible to damage by electrostatic discharge. Normal precautions should be taken to avoid high static voltages.

- Carefully slide the control board out the front of the chassis.
- Use an Amp 44 pin PLCC extraction tool number 82159-1 to remove the EPROM from the socket. The EPROM is the 44 pin IC with a label. Refer to Figure 3-25.
- Install the new EPROM. The EPROM is keyed with a notch on one corner. This notch must be in the same orientation as the notch on the EPROM socket while plugging the EPROM into the socket.
- Replace the control board.
- Load configuration.

FIGURE 3-25

T6200 EPROM Placement



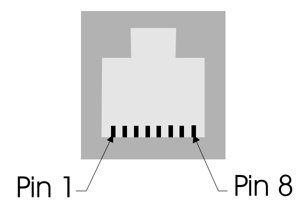
Serial Communication Connection

The T6200 includes two individual RS-232/RS-485 serial port connections (COMM 1 and COMM 2) with RJ-45 connectors to facilitate serial communication. COMM 1 and COMM 2 are software configurable for either RS-232 or RS-485. See **Appendix C Modbus Interface RS-232** for COMM 1 and COMM 2 RS-232/RS-485 Configuration. Note: RS-485 is not multidrop. Refer to Figure 3-8, Figure 3-9, or Figure 3-10 for appropriate COMM 1 and COMM 2 connector location. Note: Non-Redundant Dual Remote I/O Backplane (Figure 3-10) has only COMM 1 for the Primary and Second Control Board. Refer to Figure 3-26 for COMM 1 and COMM 2 connector pin assignments.

FIGURE 3-26

Serial Communication Connector

Pin	Signal
1	NC
2	NC
3	TD (RS-232)/COMM-(RS-485)
4	SG (SIGNAL GND)/COM
5	SG (SIGNAL GND)/COM
6	RD (RS-232)/COMM+ (RS-485)
7	NC
8	NC



Section Four

4

Software Installation

Software Installation

Instructions for the installation of the *MICON OPC Server* and a sample *OPC Client* software on Microsoft Windows XP.

The Micon OPC Server Compact Disc

The *MICON OPC* compact disc contains the *Micon OPC Server*, a sample *OPC Client*e. The setup program for the *MICON OPC Server* software and the sample *OPC Client* software are located in the "**MICON**" folder. Create a directory "**C:\MICON**" on the installation computer. Note that the "**MICON**" folder must be in the root directory of the "C" drive.
IMPORTANT NOTE: If you plan to use the IEC-61131 based graphical configurator from MICON called "Straton for MICON", then you **MUST** install that package before installing the MICON OPC Server.

Install The Packet Driver Software

Open the **Network Connections** window**:**

- Right-click **"My Network Places"** icon, located on the desktop (Figure 4-1)
- Select **"Properties"**

Figure 4-.1

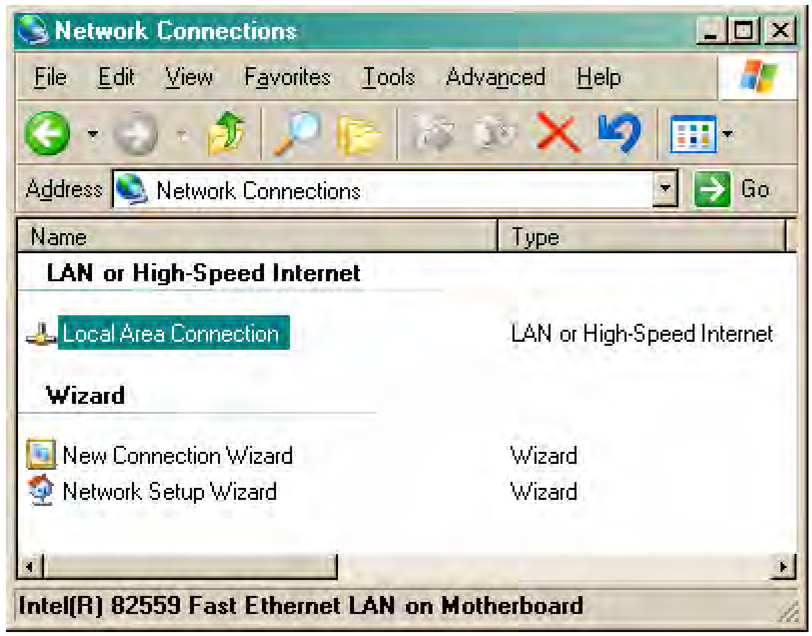
Desktop Window

Open the "**Local Area Connection Properties"** window**:**

- Right-click "**Local Area Connection"** (Figure 4-2)
- Select "**Properties"**

Figure 4-2

Network Connections Window



Open the "**Select Network Component Type"** window:

- Select "**Install…"** (Figure 4-3)

Open the "**Select Network Protocol"** window**:**

- Select "**Protocol"** (Figure 4-4)
- Select "**Add…"**

Open the "**Install From Disk"** window**:**

- Select "**Have Disk…"** (Figure 4-5)

Figure 4-3

Local Area Connection Properties Window

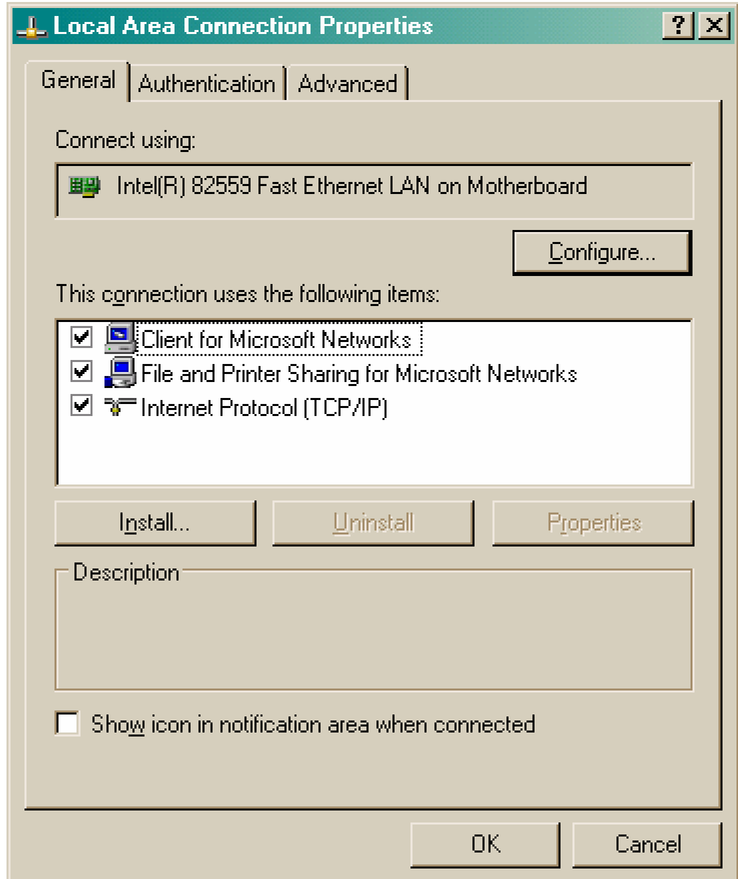
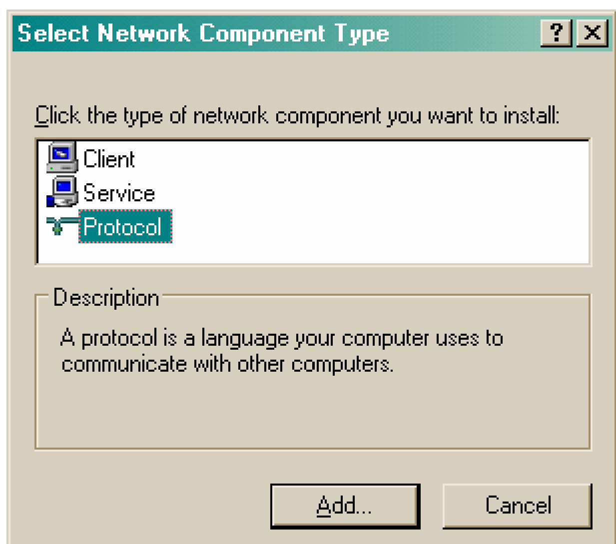


Figure 4-4

Select Network Component Type Window



Open the "**Locate File**" window**:**

- Select "**Browse**" (Figure 4-6)
- Locate the "**\ndisnt**" folder on the installation CD
- Select "**OK**"

Figure 4-5

Select Network Protocol Window

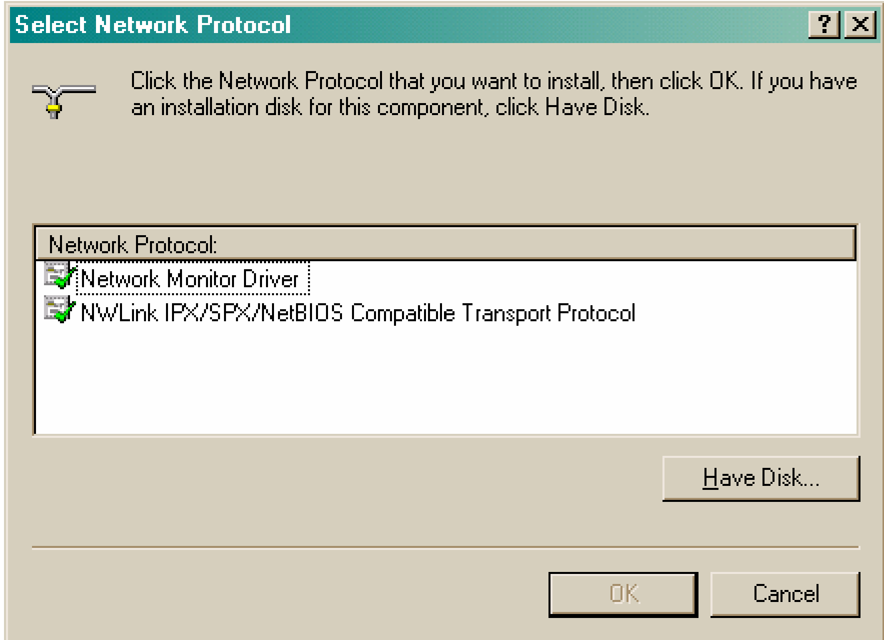
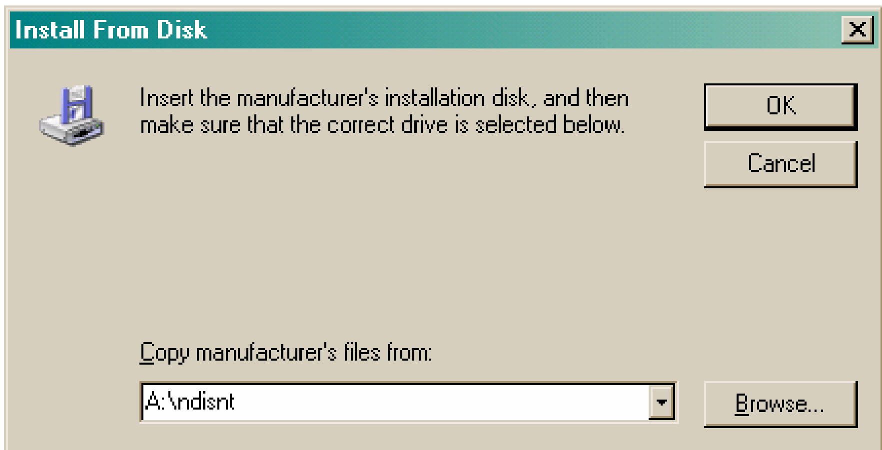


Figure 4-6

Install From Disk Window



Windows will select "**OEMSETUP.INF**" in the "**File name:**" field as shown in Figure 4-7. Select "**Open**" to install the NDIS3P2K.INF driver.

The **"Virtual Packet Driver"** will be highlighted as shown in Figure 4-8. Select "**OK**" to complete the driver installation.

Install the MICON OPC Server and Related Components

Install the MICON OPC Server and related components. Execute the file "**\MICON\Setup.exe" on the CD**:

- Double click "**MICON**" folder located in the root directory of the CDROM drive
- Double click "Setup**.exe**". The setup program will copy various files to your hard disk drive and copy the OPC Server and related files to a directory of your choice. Then the setup program will proceed to install the OPC Data Access components. This will open the "**InstallShield Self-extracting EXE"** window (Figure 4-9).

- Select "**Yes**". This will open the "**Readme Information"** window (Figure 4-10).
- Select "**Next**". This will open the "**Setup Complete"** window (Figure 4-11).
- Select "**Finish**"

Figure 4-7

Locate File Window

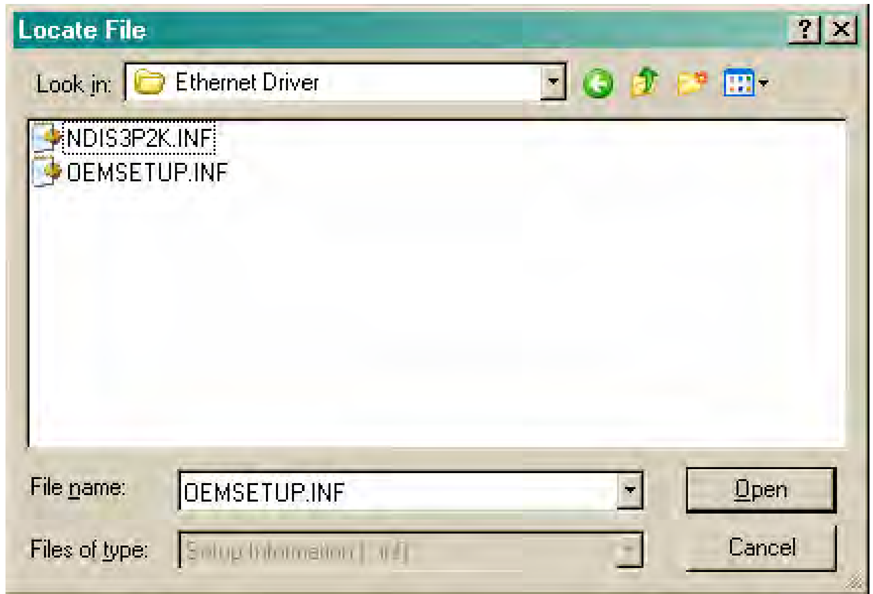


Figure 4-8

Select Network Protocol Window

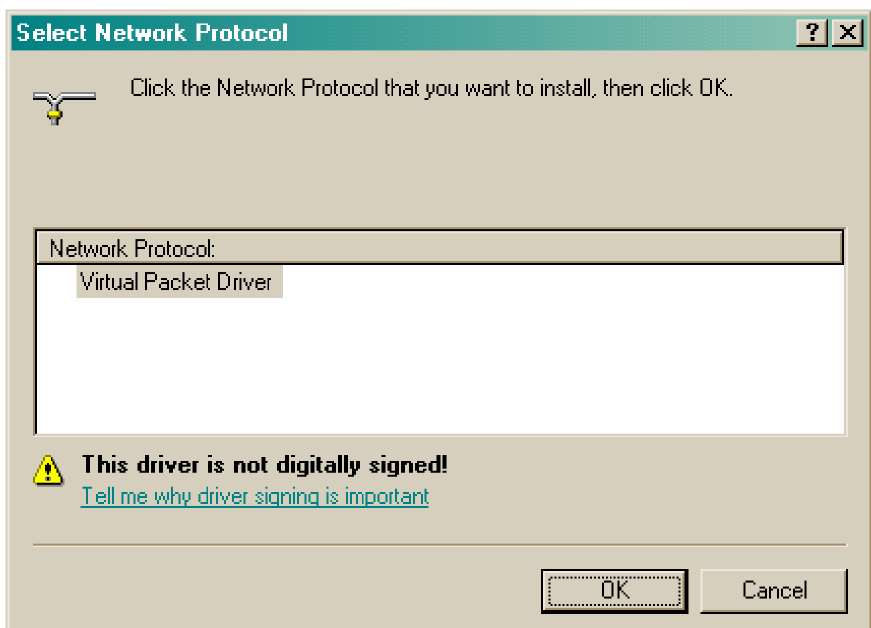


Figure 4-9

InstallShield Self-extracting EXE Window

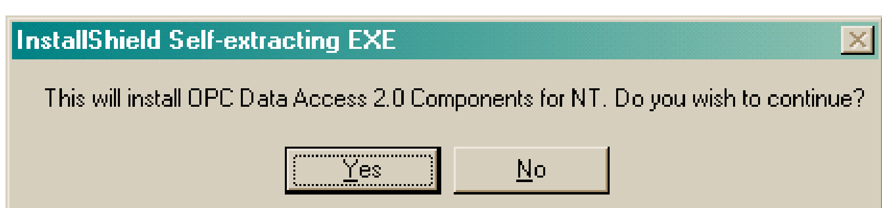


Figure 4-10

Readme Information Window

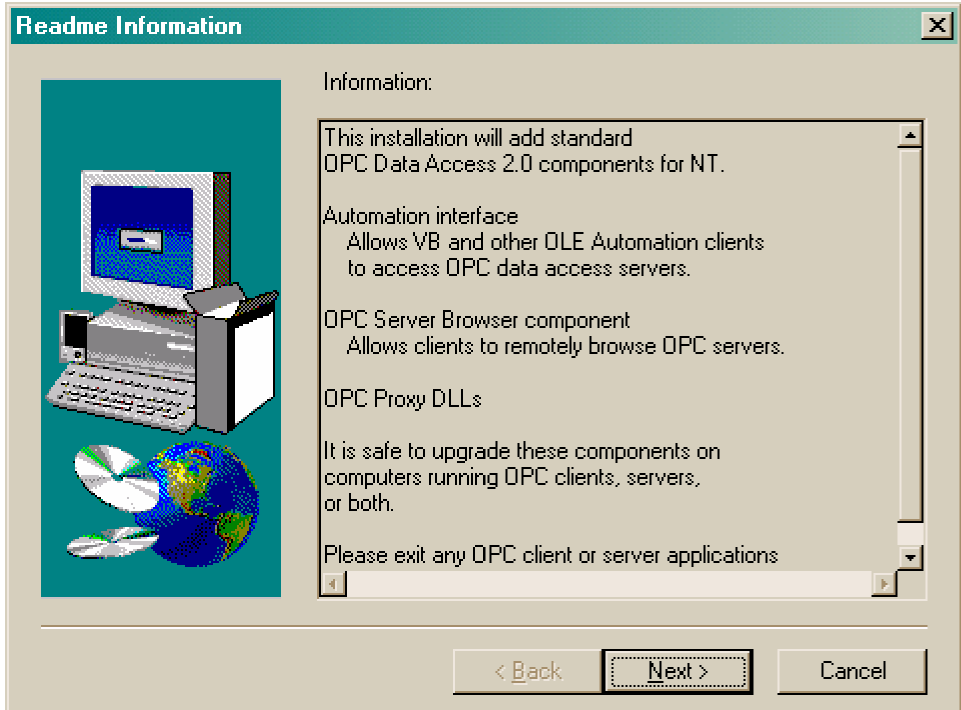
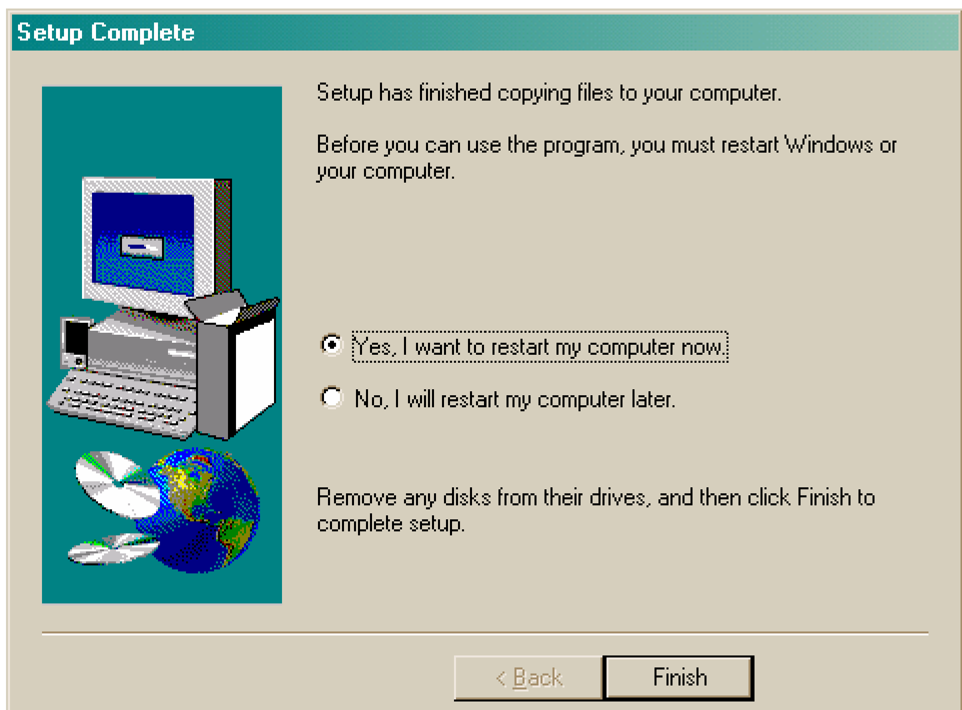


Figure 4-11

Setup Complete Window



Ethernet Addresses

Edit or create a file "**C:\MICON\devlist.txt**" using Notepad or some other text editor. In this file, add one line for each T6200 Controller's Ethernet addresses as follows:

Primary Control Board Ethernet Address

Backup Control Board Ethernet Address

UC254,00:08:9A:D2:05:02,00:0D:9A:D2:05:02,

UC255,00:08:9A:D2:06:02,00:0D:9A:D2:06:02,

BAK ID from I/O Backplane

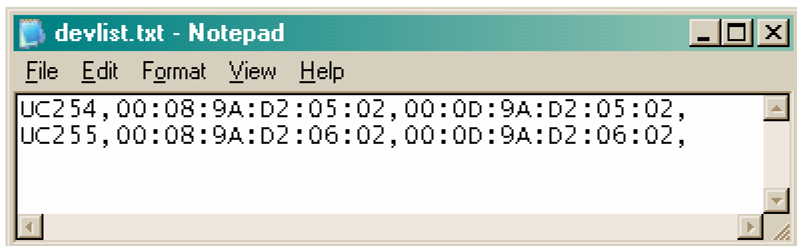
PRI ID from I/O Backplane

T6200 Controller Name

The strings are separated by a comma. The first string is the name for the T6200 Controller. The second string is the Ethernet address for the primary control board and the third string is the Ethernet address for the backup. Make sure there is a comma at the end of each line. There can be only one Controller per line. Refer to Figure 4-12. The Controller/s listed in this file will be the only one/s that the *MICON OPC Server* will communicate with at runtime.

Figure 4-12

devlist.txt – Notepad Window

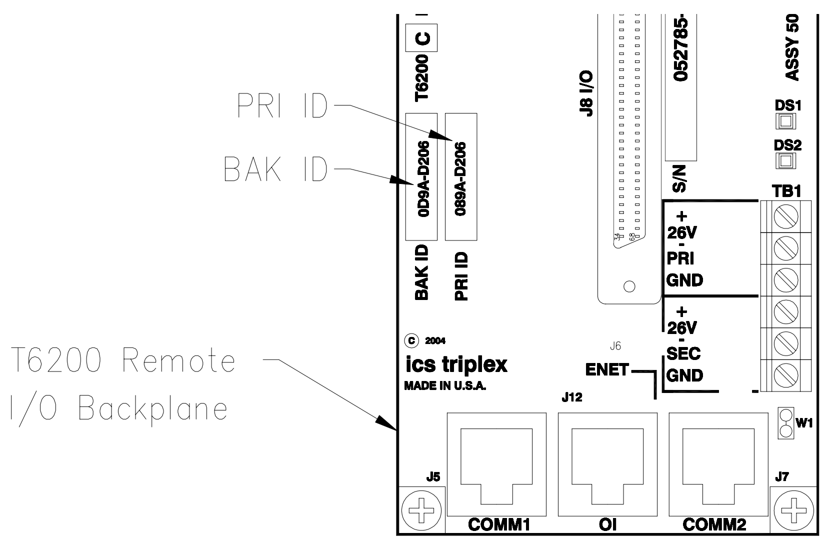


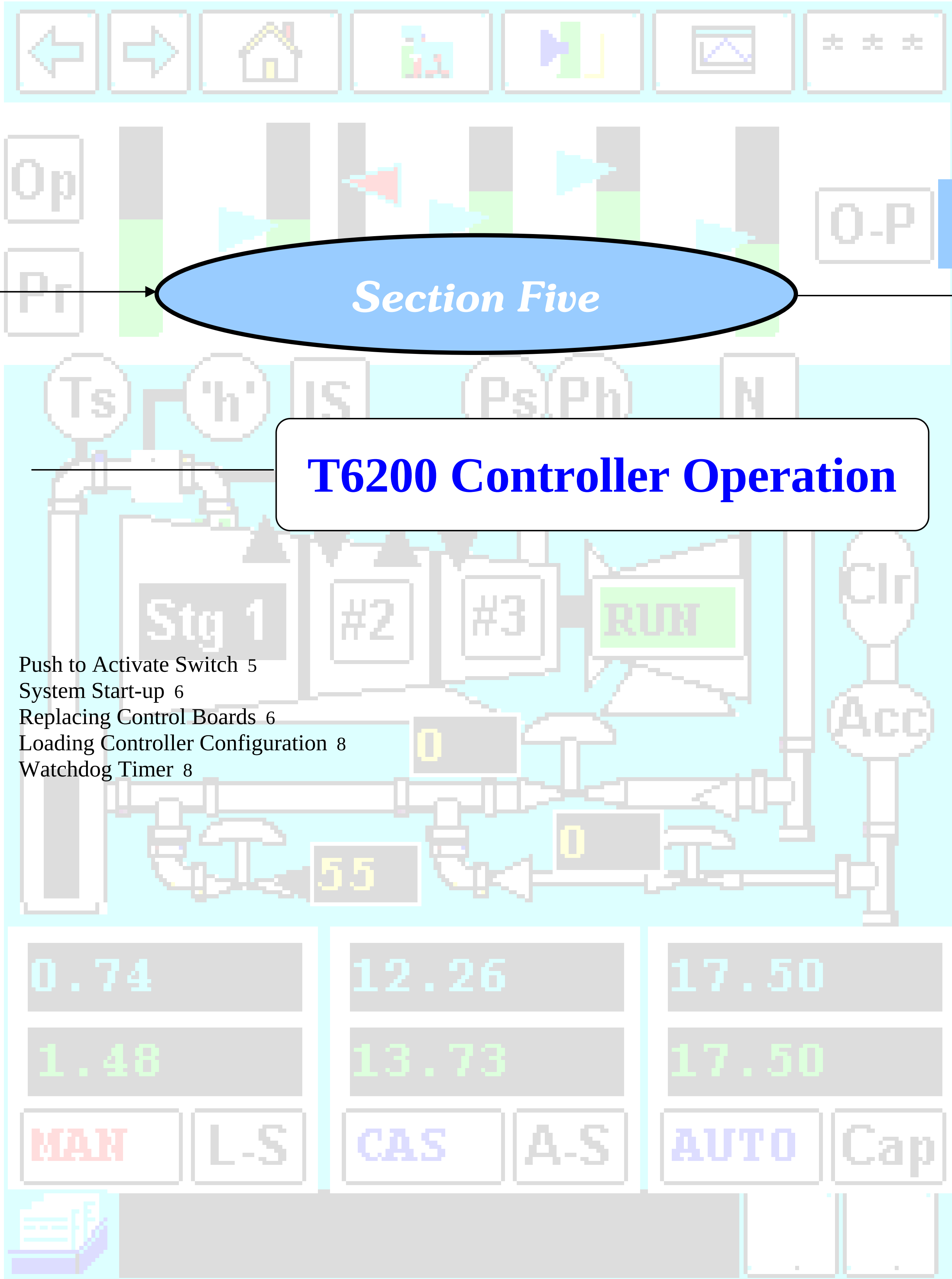
The T6200 Controller name must be a unique name and should have from one to 16 alphanumeric, dash (-), and/or underscore (_) characters. The name cannot contain spaces (blanks) or other symbols. The first character of a name cannot be a dash or number. Both upper and lower case letters are accepted.

The **PRI ID** and **BAK ID** numbers on the T6200 Controller I/O Backplane is used to build the Ethernet addresses. Refer to Figure 4-13. Add "**00:**" in front of each number, add "**:**" between every other digit, and add "**:02,**" to the end.

Figure 4-13

T6200 PRI ID and BAK ID





5

Section Five

T6200 Controller Operation


Op
Pr
Loil
S-G
O-L
Ts
'h'
IS
Ps
Ph
Stg#1
Stg#2
RUN
Clr
Acc
54
1
0
2.63
5.24
13.99
19.20
16.00
25.04
MAN
L-S
CAS
A-S
AUTO
Cap
Pd_Max
PRESS

T6200 Controller Operation

The redundant T6200 Controller consists of two identical control boards, ***primary*** and ***backup***, and one termination panel. Refer to Figure 5-1. The primary control board is always on the left and the backup is always on the right. Normally, the primary board is the ***active*** board and the backup board is the ***standby*** board. These roles may be reversed. When the backup board is active, it transmits a "Backup Active" alarm to the host.

The active board controls both the analog and discrete outputs to the field. The analog and discrete outputs are disabled on the standby board. Refer to Figure 5-2. When the outputs are required to feedback as inputs, the outputs of the active board are used in both boards. A primary board without a backup is always active. The active and standby boards have the same inputs and configuration.

Push to Activate Switch

A PUSH TO ACTIVATE switch (SW1) is located at the front of each control board at the bottom. Refer to Figure 5-3. The switch has three functions:

- Used to activate a standby Controller. The NORMAL LED must be illuminated before this Controller can be activated. If the Controller is activated, the redundant Controller will be deactivated automatically.

- This switch can also be used to clear all the configuration in the Controller memory. This can be accomplished only during the first three seconds when the Controller is being powered up by depressing the switch for one second or more.

- Each time this switch is depressed, the Controller identification number will be transmitted to the host over the Ethernet communications. This may be used when adding a Controller to the network.

FIGURE 5-1

T6200 Primary and Backup Control Boards

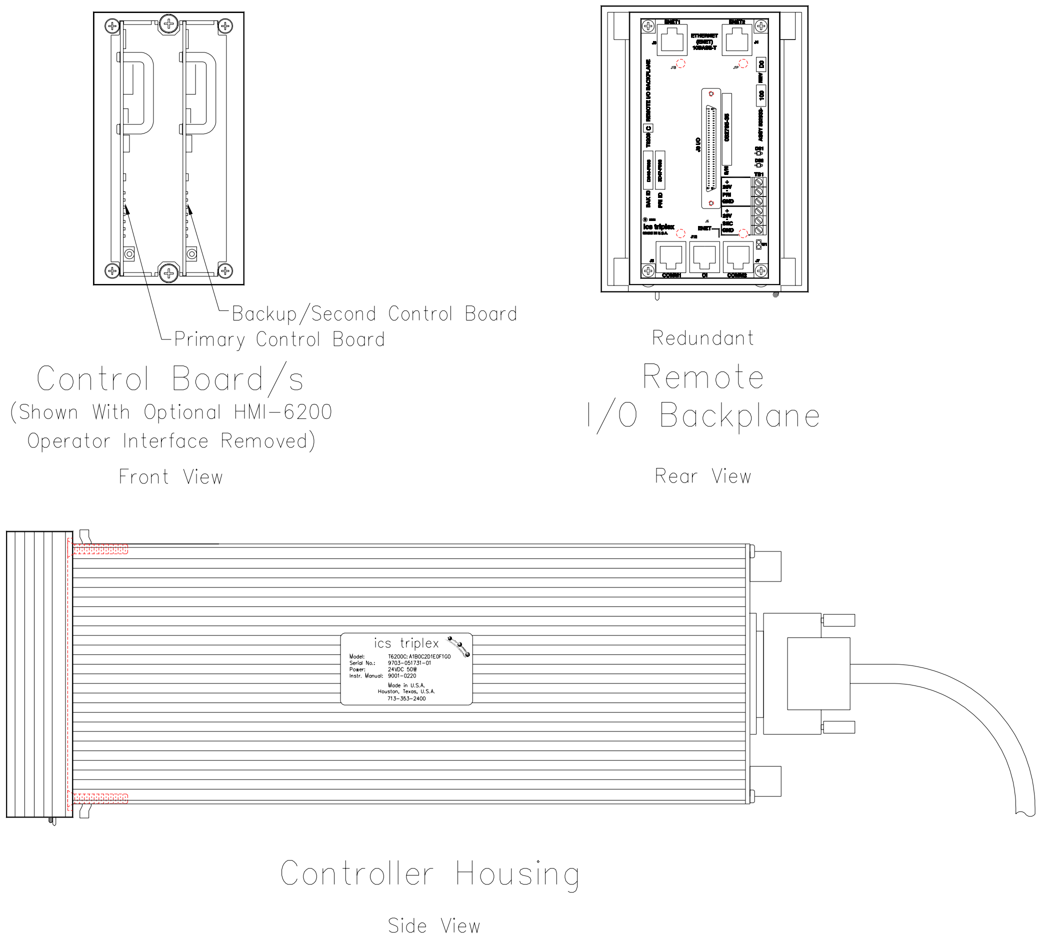
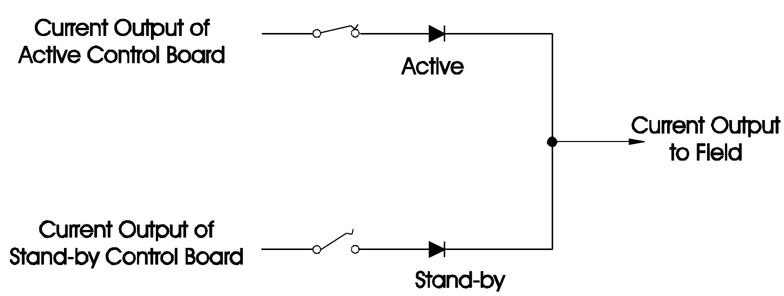


Figure 5-2

T6200-C Active and Standby Current Outputs



System Start-up

When power is first applied, the T6200 Controller forces the analog outputs to zero and the discrete outputs to open. Next, the T6200 Controller starts the self-test and flashes the COMM LEDs. After the self-test has been successfully completed, the primary board will become active. The OUT LED will illuminate on the backup board during this wait period. There must be a board in the primary position when running the Controller Definition program in A/S VIEW. If the T6200 Controller does not have a primary board when power is first applied the backup board outputs will remain in their power-up reset condition.

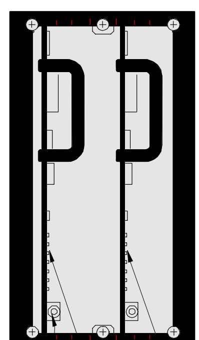
TABLE 5-1

Control Board LEDs

LED	NAME	COLOR	DESCRIPTION
ACT (TOP)	Active	Green	This LED shows the Active/Standby status of the Controller. When illuminated, the Controller is "Active" and controls the outputs. When a backup Controller is used, either primary or backup can be active, but not both of them.
NOR	Normal	Green	The LED shows the status of the watchdog timer. The LED is illuminated when the microprocessor is properly toggling the watchdog timer.
EN1	Ethernet 1	Yellow	This LED will flash when data is being transmitted or received on Ethernet 1
EN2	Ethernet 2	Yellow	This LED will flash when data is being transmitted or received on Ethernet 2
COMM1	Communication 1	Green	This LED will flash when data is being transmitted or received on COMM 1 or backup communication
COMM2	Communication 2	Green	This LED will flash when data is being transmitted or received on COMM 2
OUT	Outputs	Red	This LED illuminates when the outputs are inhibited. This condition normally occurs during power up. The backup control board cannot be active if this LED is illuminated.

Figure 5-3

Push to Activate Switch



If the primary board has a configuration in its memory, it will start the loop processing. If the primary boards do not have configuration, the outputs will remain in their power-up reset condition.

At startup, the backup board's memory is always cleared, and the primary board transfers the configuration to the backup board through the backup serial link.

During runtime operation, if a new configuration is downloaded, it automatically goes to the active board. If the active board is the primary board, the backup board's memory is cleared, and the primary board transfers the configuration to the backup board through the backup serial link. The standby primary board's memory cannot be cleared during runtime operation without removing the board. To transfer a configuration from a backup board to a primary board, the primary board must be removed (unplugged) and reinstalled, clearing the memory at the same time (see **Replacing Control Boards** below). The primary board, with cleared memory, will then request a configuration transfer from the active backup board.

Replacing Control Boards

In a system with redundant boards, the backup board can be activated to allow removal of the primary board without upsetting the system. Depressing the **PUSH TO ACTIVATE** switch will activate the backup board. The **NOR**mal LED must be illuminated and the **OUT** LED must not be illuminated before the board can be activated. When the backup board is active, it transmits a "Backup Active" alarm to the host on the Ethernet. This alarm cannot be cleared as long as the backup board is active.

After the backup board has been activated, the primary board may be removed by pulling on the handle on the front of the board to unplug it.

The memory must be cleared in the replacement board. To clear the memory, plug in the replacement board and depress the **PUSH TO ACTIVATE** switch for one or more seconds within the first three seconds. The **OUT** LED will illuminate for a few seconds while it gets the configuration from the backup board and then compiles it. After the **OUT** LED goes off, depress the **PUSH TO ACTIVATE** switch to activate the primary board.

CAUTION

If you do not clear the memory, the replacement board will retain its old configuration.
Before plugging in a replacement Controller, verify it is the same model and the jumper placements are the same.
Refer to the jumper placement in Section Three, Hardware Installation/Maintenance.

Each Controller model has a different mechanical key to prevent the incorrect model from being plugged into the termination panel.

Plug in the replacement Controller. The **NOR**mal LED will not illuminate for a few seconds while it gets the configuration from the Backup Controller and then compiles it. After the **NOR**mal LED illuminates, depress the PUSH TO ACTIVATE switch to activate the Primary Controller.

When replacing a Controller that does not have a backup and the application process is shutdown, the Controller can just be unplugged and the matching replacement board plugged in its place. If the replacement board has an undesirable configuration, it can be cleared by depressing the **PUSH TO ACTIVATE** switch for more than one second within the first three seconds after the Controller has been plugged in. A new configuration can be down loaded from the host.

Loading Controller Configuration

If a Controller is unplugged or power is removed long enough for the capacitor (that is used to keep the RAM alive) to discharge (usually about one week) the above process will have to be repeated.

Watchdog Timer

The microprocessor toggles the watchdog timer at least once every 100 milliseconds. If the watchdog timer is not toggled within this time period, the watchdog timer will reset the microprocessor. If the board is on standby, the outputs will be disabled. If the board is active, control will be transferred to the backup board. If there is no backup board or if the **OUT** LED is illuminated, the outputs will remain at the condition before the watchdog timer reset the microprocessor.

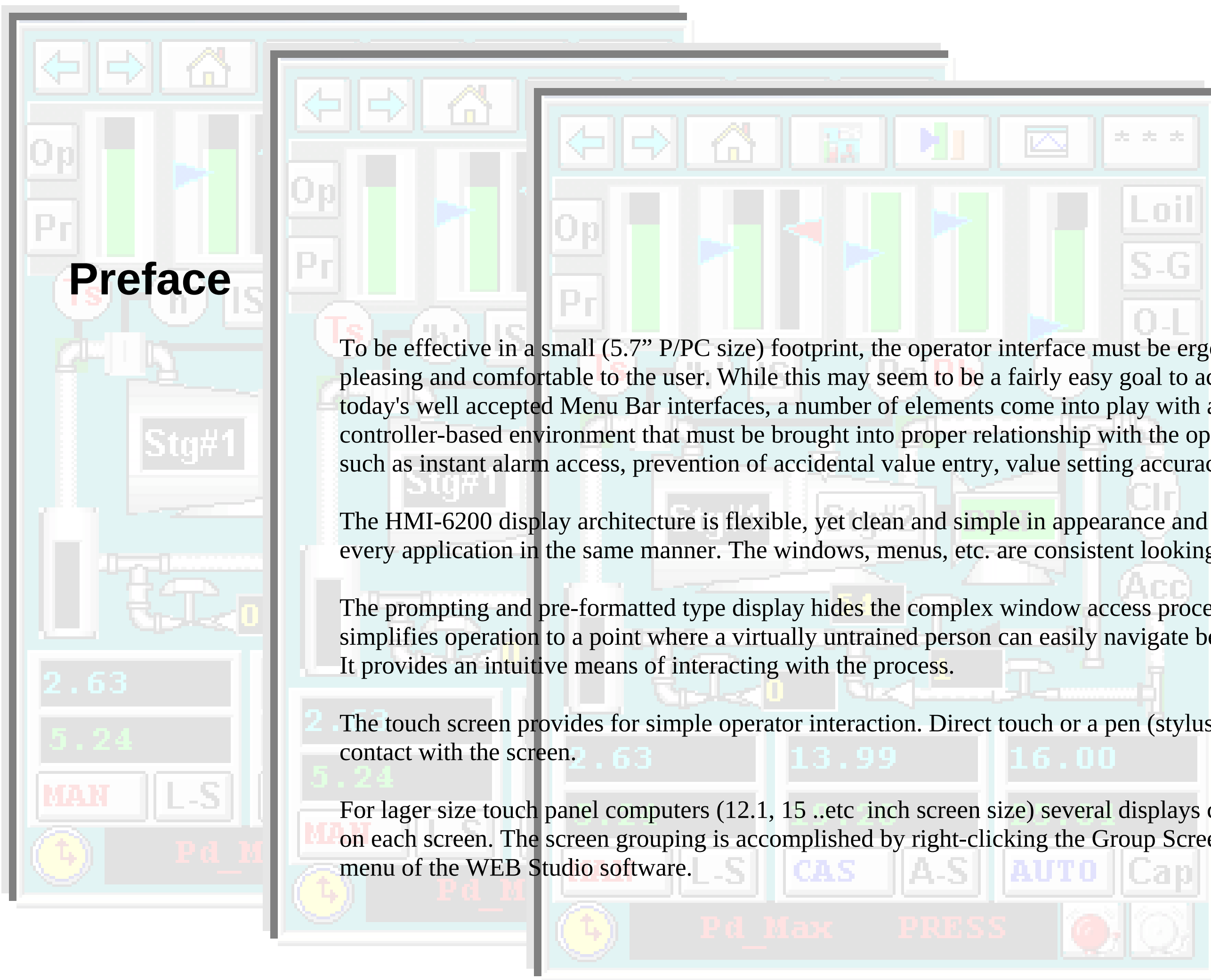
If the microprocessor does not start after being reset, the watchdog timer will continue to reset the microprocessor every 1.6 seconds. If the microprocessor does restart in a redundant system, the board will remain in the standby mode. If there is no backup board, the primary board will resume the active mode.

6

Section Six

HMI-6200 Operator Interface

HMI-6200
OPERATOR INTERFACE



Preface

To be effective in a small (5.7" P/PC size) footprint, the operator interface must be ergonomically pleasing and comfortable to the user. While this may seem to be a fairly easy goal to achieve with today's well accepted Menu Bar interfaces, a number of elements come into play with a process controller-based environment that must be brought into proper relationship with the operator-elements such as instant alarm access, prevention of accidental value entry, value setting accuracy, etc.

The HMI-6200 display architecture is flexible, yet clean and simple in appearance and interacts with every application in the same manner. The windows, menus, etc. are consistent looking and behaving.

The prompting and pre-formatted type display hides the complex window access procedure and simplifies operation to a point where a virtually untrained person can easily navigate between displays. It provides an intuitive means of interacting with the process.

The touch screen provides for simple operator interaction. Direct touch or a pen (stylus) are used for contact with the screen.

For lager size touch panel computers (12.1, 15 ..etc inch screen size) several displays can be grouped on each screen. The screen grouping is accomplished by right-clicking the Group Screen on the Screen menu of the WEB Studio software.

Overview of HMI-6200 Features

A standard option of the T6200 Unit Automation System is to incorporate an integral 5.7 inch P/PC based full-featured human-machine interface – HMI-6200.

This Operator and Engineering Interface Software offers…
- **Standard and Customized Screens**
- **On-Line Operation and Control**
- **On-Line and Remote Diagnostics**
- **Alarm and Event Management**
- **Critical Event Archiving**
- **Trend and Historian**
- **OPC Compliant Client-Server Architecture**
- **Unit Asset Condition Management - UAM**

HMI-6200 Microcontroller –
- Intel StrongARM SA1110 microprocessor
- 32 MB Flash Memory
- 64 MB SDRAM Memory
- Integrated LCD controller
- Ethernet connectivity
- CompactFlash slot
- Card Speaker

Database Management –
Object oriented database
- Fill-in-the-blank definitions
- Data accessible system wide

Standard Environment –
Based on Microsoft's DNA architecture
- Industry standard operating system – Windows CE
- Distributed COM
- XML technology

True Multi-User Capabilities –
- Supports multiple P/PC's and workstations
- Networkable on popular local and wide area nets
- Web enabled to serve HTML pages over the Web with real-time data
- Allows sub-division of process responsibilities to different users

Business Interoperation –
Unit control can be integrated into a total plant/business system.
- Integrates TMC Unit Control and Business Asset technology
- Imports and exports real-time data and reports in XML
- Protected data ownership and security

OPC Client/Server –
The build-in CE OPC Server is compatible with the StrongARM processor
Enables communication with control modules
- Open systems OPC link
- Server identifier
- Configurable data update rate

If an operator interface other than the HMI 6200 is selected make sure that the OPC server is compatible with its processor.

Comprehensive GUI –
Based on WEB Studio, the graphical user interface offers object oriented easy to use graphics. User-defined and pre-defined graphic displays. Used to monitor and control a TMC process.

- Pre-defined displays include:
  Home; Graphics, Face-Plates; AIN/AO; DIN/DO; Alarm Summary, Alert Summary; Trend; Historical Trend;
- Scripting language including math expressions, statistic and logical functions, module activation functions, etc.
- Build hierarchies and networks of displays
- Displays real-time & historical data
- Translation Tool for multi-language operation

Time-Scheduled Tasks –
Provides time-based user defined operations
- Event types: Reports, Recipes, Calculations, data logs, match/logic functions or any program
- Scheduling intervals from seconds to years
- Quickly defined and interactive
- Schedules application programs

Alarms and Alerts Processing –
Provides comprehensive alarm reporting
- SOE (sequence of events) capabilities
- Individual or multiple alarm acknowledgements
- Remote Ack (acknowledge)
- User definable priorities
- User definable status colors (start, ack, norm)
- Archive storage and call back

Real-Time and Historical Trending –
All data base points may be selected for trending
- Selectable plot scales, time spans, colors, grid sizes
- Up to 8 plots per window
- Selectable curve type (X/t, X-Y)
- Save On Trigger or Save on Tag Change selection
- Archive storage and call back

Recipes and Reports –
Facilitates assessment of unit performance
- Easy creation of reports (without programming tool)
- Load recipes and retrieve values in XML format

Event Information Processing

The following describes the information structure for alarm and alert handling and for trend and historical recording

Alarm and Alert Definition –

The T6200 includes comprehensive detection and notification of alarms and alerts. Alarms are defined as conditions which require user acknowledgement; alerts are records of actions/conditions for which operator acknowledgement may or may not be specified (Ack is configuration selectable).

Alarm and Alert Detection –

For reliability and speed-of-response alarm and alert detection and processing takes place in the control module of the T6200. All alarms and alerts are time-stamped upon detection.

Deterministic Alarming –

Deterministic alarms/alerts are generated by comparing the performance of combinations of discretes and/or variables against pre-defined limits of alarmable conditions of operations. Practically unlimited logic/math/selection functions are provided in the control module of the T6200 to allow for simple or sophisticated alarm/alert interlocking.

Deterministic alarm configurations serve basically two purposes - 1) they can be used to advise or take action based on the nature of alarm combinations or 2) deterministic alarming can also be used to disregard alarms/events that are merely further effects of a fault that has already been recognized. Two examples of combinational alarms would be:

- Do not generate a low flow alarm if a corresponding pump is turned off.
- Alarm on deviation of a process signal from a trip-point only if the rate of change or another variable exceeds specification at the same time that certain valves are fully open and a feed pump is off.

Alarm and Alert Suppression –

Alarm and alert processing can be suppressed at the control module level. The configured suppression may be for specific alarm/alert points or groups and is normally process condition related. Notification of suppression is provided via alarm “cutout” attributes.

Alarm and Alert Notification –

The HMI-6200 (operation interface) provides several features for notification of alerts and alarms. These include: HMI display, audible annunciation and optional control triggering.

FIGURE 6-2

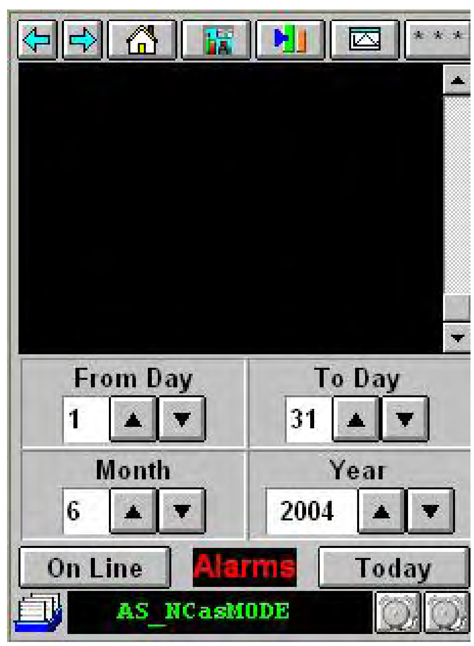
Alerts - Summary Display

Historical Alarm and Alert Display -

The Alarm/Alert History display provides for means of viewing past Alarm and Alert events. Historical data can be retrieved with convenient date/time selection buttons.

FIGURE 6-3

Alarms - History Display



Dynamic Trending Module –

The HMI-6200 trend capability provides for viewing of real-time and historical data. A trend display format, with up to six plots, is included.

Trend Configuration –

The contents of the Trend and the Trend History display are defined by trend window templates as shown below.

FIGURE 6-4

Trend History Definition Windows

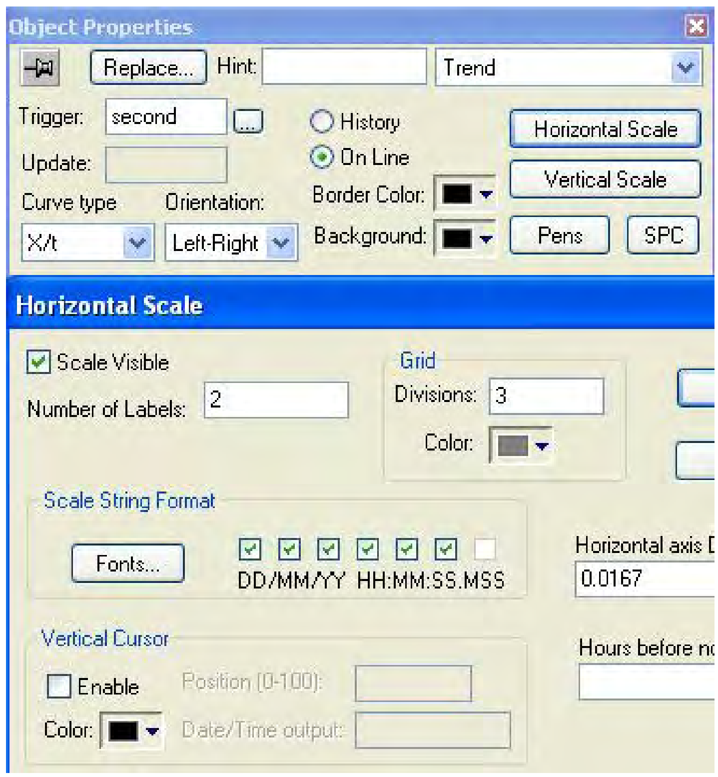
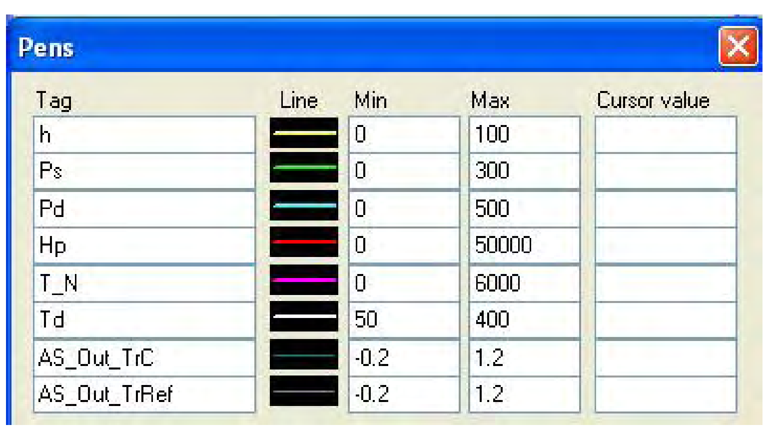


FIGURE 6-5

Trend Points Configuration Window

Compressor App

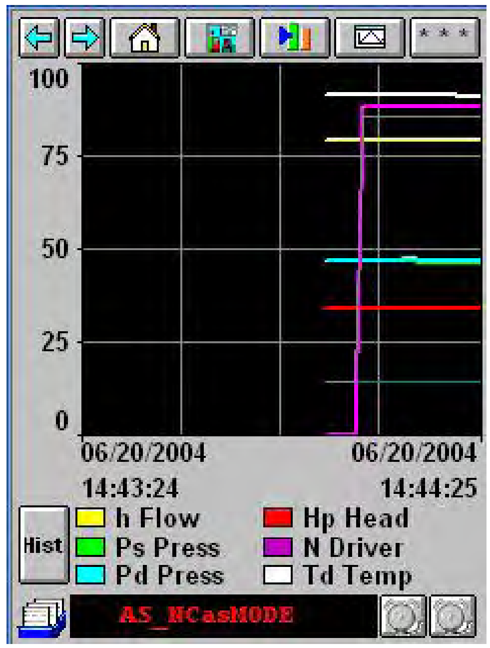


Trend Display –

The trend display is presented in the popular strip chart recorder format.

FIGURE 6-6

On-Line Trend Display



Historical Tend Display -

The Trend History display provides for a comprehensive means of viewing process and calculated data over periods of time. Historical data can be retrieved with convenient date/time selection buttons

FIGURE 6-7

Trend History
Date/Time Selection

Display Layout

Preformatted displays provide the basic operations interface for: compressor/turbine control, continuous process control, batch/sequence control, SCADA alarms, trends, etc. Information is presented in an easily understood manner.

The operational displays are organized into a structural hierarchy consisting of overview(s), graphics, face-plates, etc. Displays are called up through a simple menu bar procedure. In addition to the menus, the user is provided with "go-to" display buttons to allow for customized window selection.

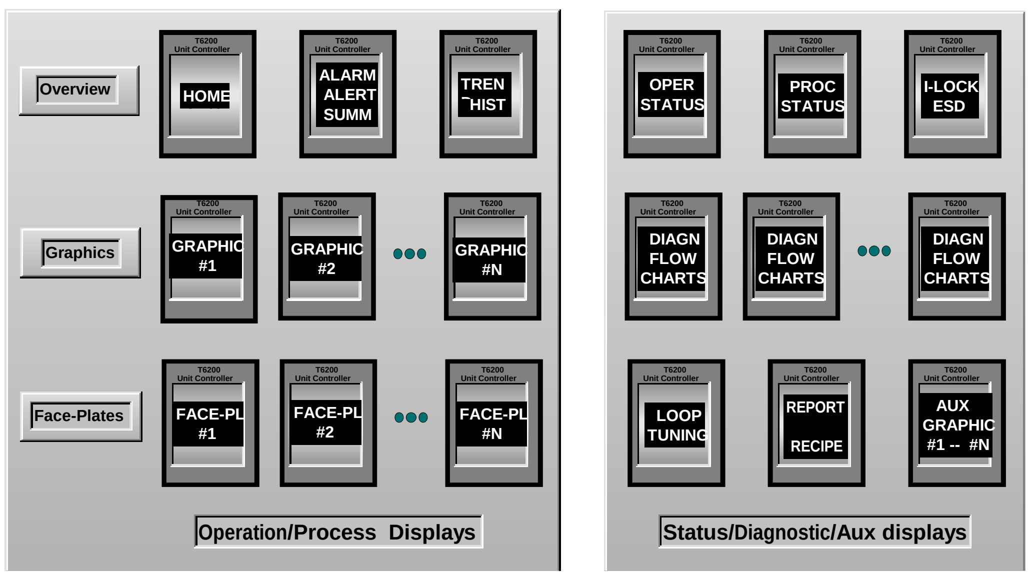
Besides the configuration at the time the systems is set up, some configuration is normally done later on, such as building additional graphics.

Analysis of process conditions is fully supported. A standard trend display (real-time and historian trend), alarm and alert indication (real-time and historical) and diagnostic displays allow for quick process analysis and situation correction.

Reports and Recipe screens and the ability to retrieve values in XML format facilitate the assessment and correlation of unit performance.

FIGURE 6-8

Operational Display Hierarchy -



The HMI-6200 is designed to facilitate operation at all levels. It allows simplified access to the controls, provides a logical display format, and incorporates methods for easy interaction with the process. Operation and management may call up displays from many different unit areas for a concise picture of unit and plant/pipeline performance.

The HMI-6200 also supports engineering functions in the creation and scheduling of reports and recipes.

Status displays, diagnostic flow charts, tuning indication and other user-defined auxiliary displays enable rapid situation correction.

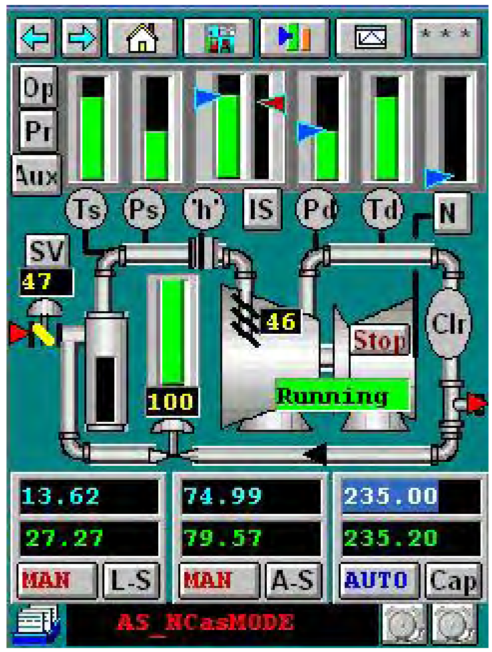
HMI-6200 Header and Footer Template

The Web Studio screen editor allows you to create a variety of windows and dialogs which feature user inputs by screen selection and touch pad. The following relates to the HMI-6200's process display access formats that are pre-defined by a standard Header and Footer template.

FIGURE 6-1

Graphic display of a Column with Top and Bottom Reflux

Pre-defined Header and Footer template described below



Header 

- Next (►) and Last (◄)
- Home display access
- Graphic display(s) access
- Face-Plate display access
- Trend/Historian display access
- *** Miscellaneous display access

Footer 

- UAM displays access
- Alarm Summary/History display access
- Alert Summary/History display access

General Display Description

“Home” Display – 

The “Home” display typically provides for an overview presentation of the compressor performance with an “at a glance” identification of off-normal and alarm conditions. The operator can select directly subdisplays (Graphics, Face-Plates, Diagnostics and Operation etc.) from this display to bring details into view.

Graphic Display(s) – 

While pre-defined custom graphic displays meet the need of most users, many still may wish to create additional displays that are specific to their respective TMC operations.

The displays normally consist of graphical symbols, bar-graphs and alphanumeric information. They represent real-time database information graphically and allow for user-specific actions and control. From the graphic display(s) the operator can also directly select sub-displays (Face-Plates, Operation and Process Status, Diagnostics, etc.).

Face-Plate Displays – 

These displays show PID “face-plates” and process control parameters associated with the displayed loops – Anti-Surge, Incipient Surge, Capacity, Load Share, I/O Overview.

Direct go-to buttons to displays of Operation Status, Diagnostics, Interlocks, Tuning are provided.

Alarm Summary Display – 

The alarm summary display identifies and summarizes all new alarm points along with other acknowledged alarm points. It lists time of occurrence and description. The display shows 16 alarms per page. A scroll-bar is used to access all alarms.

Alarm priority and filter as well as the message color are defined during configuration (creation of the alarm worksheet).

The Alarm History display allows for dissemination/ diagnostics of historical alarm conditions. This display includes convenient date and time selection.

Alert Summary Display – 

In order to provide segregation between alarms and alerts/events a separate alerts group is included. Operation and function of this display is identical to the alarm summary display.

Trend Display – 

The trend module displays analog and discrete points on trend of any tagged system variable. The trend display can contain up to six variables (plots) – continuously updated. Plot colors, scale (Min, Max), Cursor Value and time span are selectable. Curve type can either be X/t or XY.

One can store the trend points in a history file for data collection and display. The historian module includes a dead band (for data storage reduction) and incorporates save on Trigger or Tag Change selection. The Trend History display also contains time and date selection.

Miscellaneous Displays - 

Operation and Process Status Displays –

Operation indication is structured to quickly and accurately determine process status and to allow for fast response.

Diagnostic Displays –

The unit maintenance functions can be supported by diagnostic displays which provide the user with a flow-chart type view of the control loops.

Analog and Discrete I/O Displays –

The I/O displays provide a summary of the analog and discrete point values. Each rectangle includes the abbreviated point name and the value.

Equipment Condition Displays –

Condition display(s) can be provided to illustrate status (Interlock, ESD status, etc.) and pertinent values of the process equipment.

Detail Display(s)

Displays for calculation and fall-back value settings are typically included to provide an overview of key parameters.

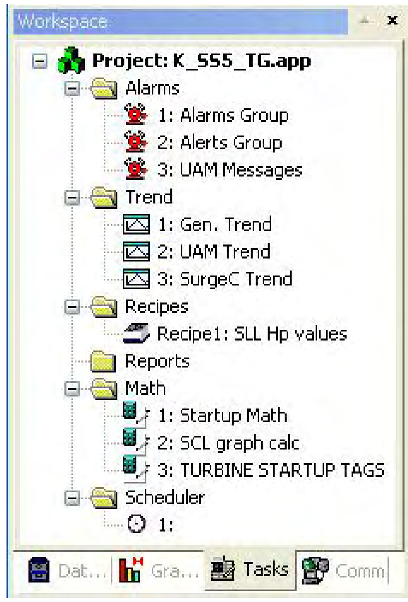
Reports and Recipes –

Reports can be created without needing any special programming tool (like VB, etc.). Using the report workstheet and the scheduler, reports can be custom designed and scheduled for display and transmission.

The recipes module (worksheet) is used to create, load and delete recipes. Recipes, in this case, means a group of tags that have their values saved and retrieved like a database. The values can be retrieved from the ASCII file in standard format or the XML format.

FIGURE 6-9

Workspace Window Task Tab



Scheduler –

Critical and control related timed-tasks normally reside in the T6200 control module(s). However, timed tasks for reports, supervisory recipes, trend and math are typically handled by the HMI-6200 Scheduler module.

The timed-task module (scheduler) supports reports, logs, recipes and general actions (math and logic functions). It provides for the scheduling, definition and detection of timed tasks. The tasks may be scheduled to execute automatically once, or any number of times at fixed intervals as pre-defined by the user.

The Clock event is used to trigger actions based on regular time intervals such as timers and counters. The base time (minimum of 100 ms) is set in the Time column. In the Tag column, one must configure the tag that will receive the result from the expression configured in the Expression column. The Disable field can be used to prevent an expression in the line from being executed.

The Calendar event is used to trigger actions on a scheduled time. Also, it is possible to specify a fixed date for an event in the Date column.

The Change event is used to trigger an action upon a change in tag value (such as special trend on incip-on). In the Trigger column, one must configure a tag that will be used to trigger the event when the change in value has occurred.

FIGURE 6-10

Scheduler Configuration Example for Incip-Initiated Trending

	Event	Trigger	Time	Date	Tag	Express
1	Clock		00:00:05		TagTrend	not TagTr
2	Clock		00:00:01		counter	counter+1
3	Change	counter			showclock	0
4	Change	counter			counter	0
5	Change	Incip_On			DisableTrd	not Incip_
6	Clock		00:00:01		counter1	counter+1
7	Change	counter1			Incip_On	0
8	Change	counter1			counter1	0

Graphic Displays Configuration

The HMI-6200 graphics software is a runtime-only version of the workstation PC graphics. All configurations of graphic displays are made using a workstation PC and then downloaded to the HMI-6200 P/PC Operator Interface. Once in run-time mode, the user is able to execute all runtime functional dynamics that have been added/defined during configuration.

Powerful HMI Visualization -

A complete set of drawing and animation tools is furnished. One can create graphic objects and build displays using any combination of drawing tools (boxes, lines, circles, text, etc.); save the graphic objects in a library, add expressions and animation.

Dynamic Object Animation –

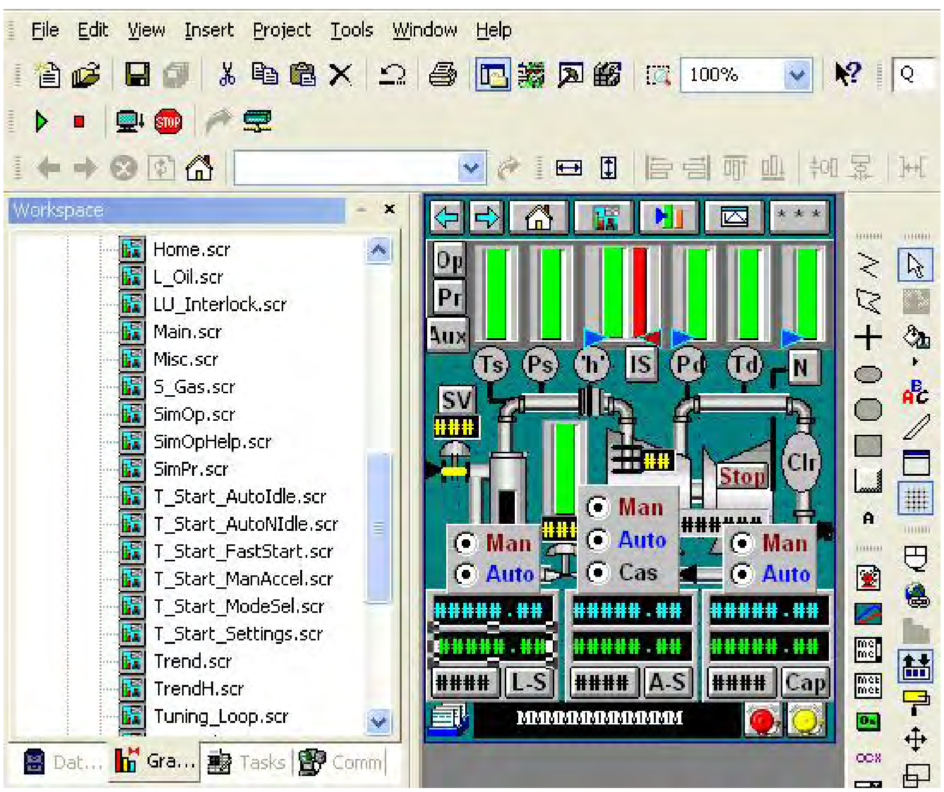
Considering the small (P/PC size operator interface) footprint, it is important to provide high-performance animation effects based on dynamic real-time links. The dynamic action tool offers rotation, animation, analog color, flash, etc.

Summary of Graphic Features:

- High Performance Object-based Graphics
- Powerful Display Creation Tools
- Dynamic Animation
- Import Popular Display Formats
- Extensive Symbol Library
- Built-in Math, Expressions and Calculations

FIGURE 6-11

Graphics Configuration Screen



HMI Example – Single Stage Compressor

The following shows an example of a T6200 Compressor Unit HMI for single stage centrifugal machines.

The HMI is designed to facilitate operation at all levels. It permits simplified access to the unit, provides a logical display hierarchy, and a choice of navigation for easy interaction with the process.

FIGURE 6-12

Compressor Home Screens display the Performance Map and process values at "a glance"

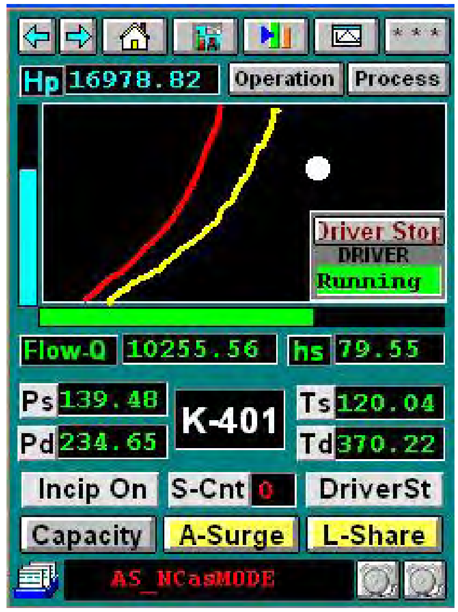
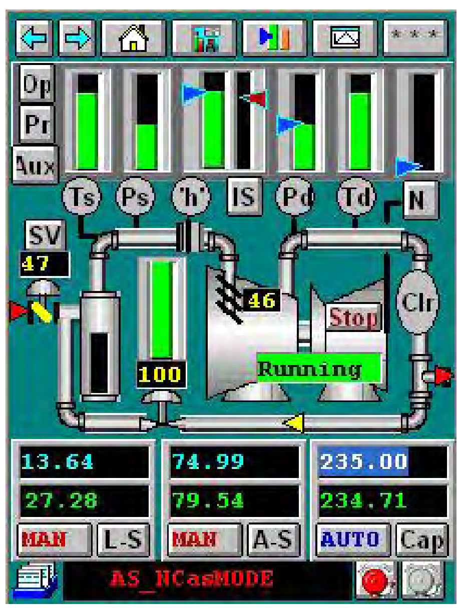


FIGURE 6-13

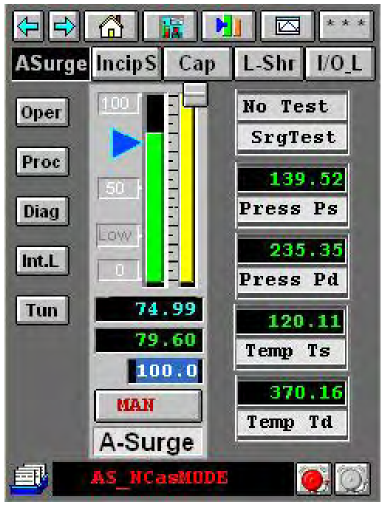
Compressor Graphic Screens provide for visual overview and for control



Graphic Overview Display/Control

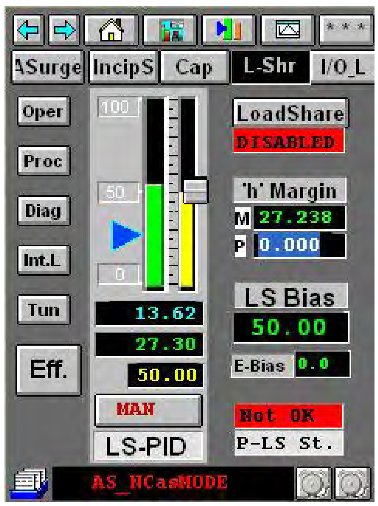
FIGURE 6-14

Compressor FacePlate Screens and Aux Displays provide for traditional operation convenience

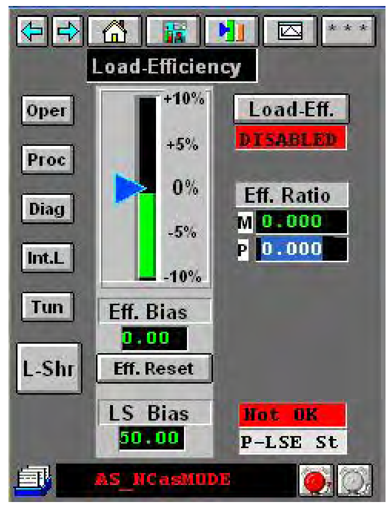


A/S Face-Plate Display/Control

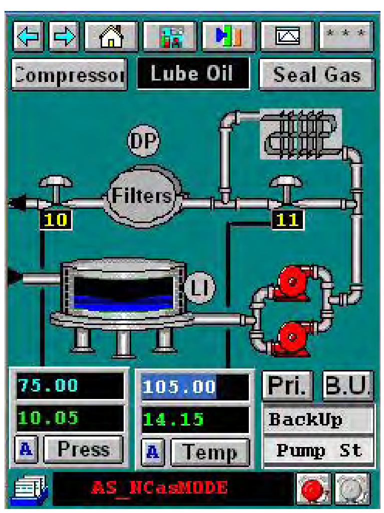
Capacity Face-Plate Display/Control



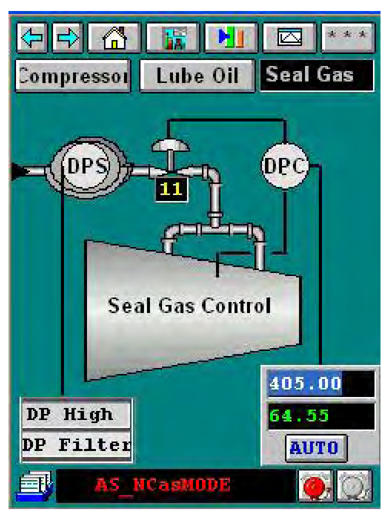
LS Face-Plate Display/Control



LSE Face-Plate Display/Control



Lube Oil Display/Control

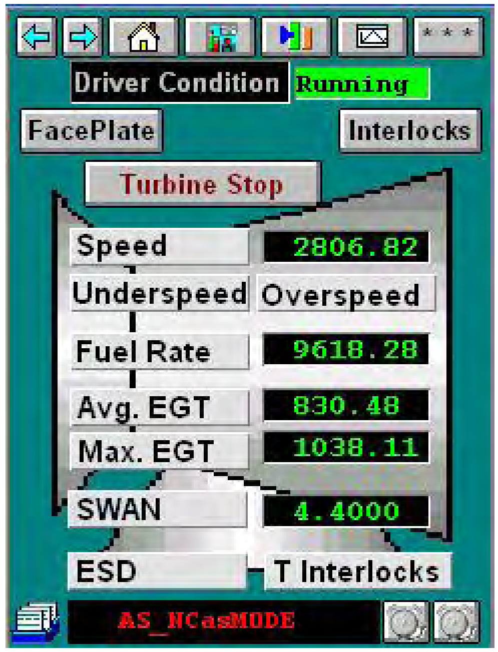


Seal Gas Display/Control

From operator displays to maintenance screens to engineering displays the HMI-6200 covers the full interface spectrum. This color LCD display represents an HMI with full DCS/SCADA capabilities. It provides a complete "window" on the process by which one can operate/control, maintain and manage the process unit.

FIGURE 6-15

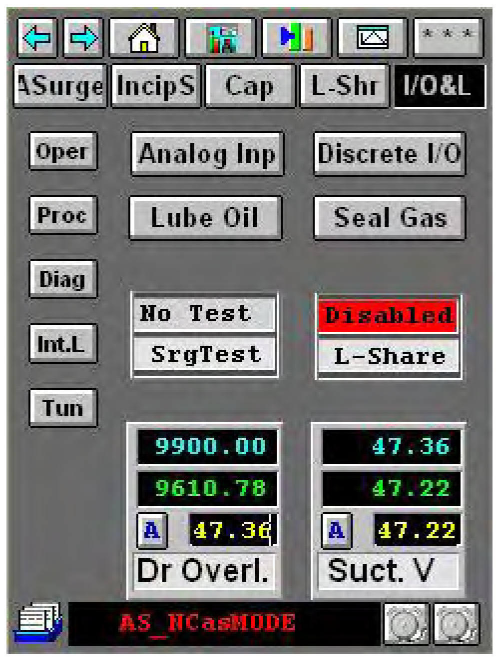
Compressor Driver Display provides for Turbine Status Indication



Driver Status Display

FIGURE 6-16

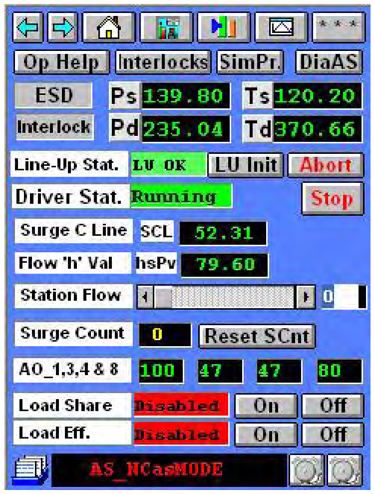
Quench Control
Overload Control
Suction Control –
all on one display



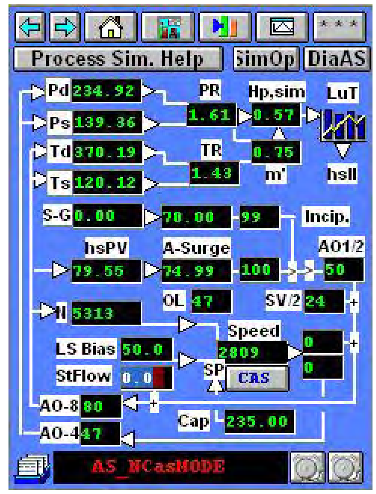
Quench & Overload Face Plates

FIGURE 6-17

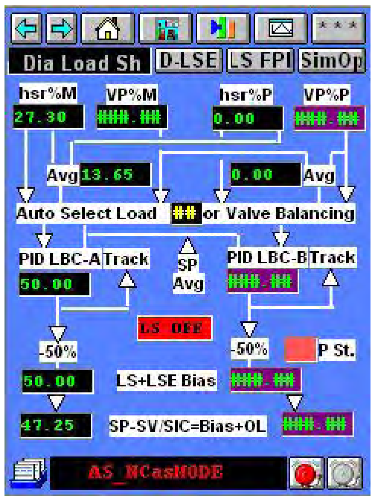
Maintenance Screens facilitate process and control diagnostics



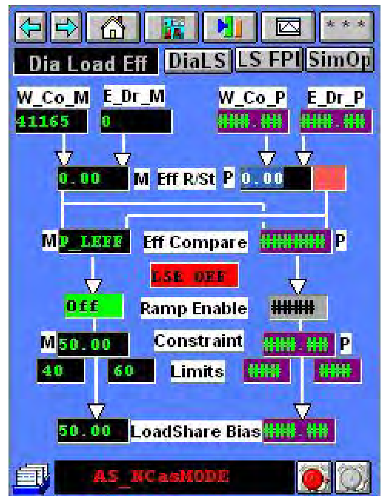
Operation Status Display



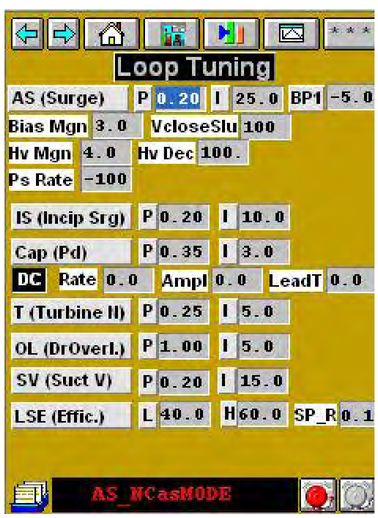
Process Status Display



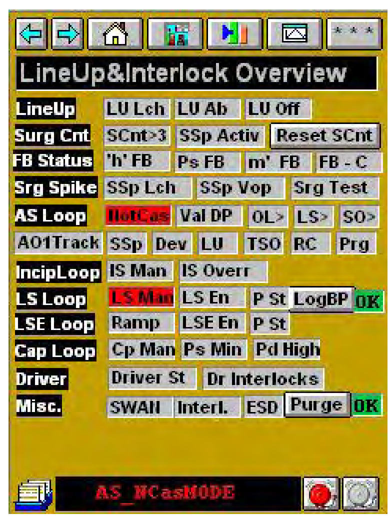
Load Share Diagnostic Display



Load Efficiency Diagnostic Display



Loop Tuning Display/Entry



Interlock Display

Adaptation of Pre-Defined Displays

The general HMI-6200 operator interface consists of preformatted displays. These displays are structured into overview(s), graphics, face-plates, trend, etc. The user is provided with an operator interface that allows for easy customization and adaptation to the specific process/plant configuration. Besides adaptation at the time of system set-up, some display configuration is usually done later on.

System Requirements

The HMI-6200 operator interface is based on Web Studio. To develop/adapt an application with Web Studio software, the following hardware and software is recommended for the Host computer...

- IBM-compatible computer with an Intel compatible processor
- Windows NT/XP/2000 operating system
- 128 MB of RAM
- 200 MB of free hard disk space
- MS Internet Explorer 4.0 or higher
- CD-ROM drive (only for initial setup)
- Ethernet connection for downloading applications

Installing Web Studio

The installation CD is used to install InduSoft Web Studio. The development environment runs on Microsoft Windows NT/XP/2000; the CEView runtime environment, which is downloaded to the HMI-6200 operator interface, comes pre-installed on the runtime workstation.

The Web Studio provides the tools needed to adapt the pre-formatted HMI-6200 operator interface to the customer's specific application. Refer to InduSoft Web Studio installation instructions.

Screen Editing and Configuration

The screen editor permits to change the pre-defined ICS TRIPLEX screens and create new screens and dialogs. The configuration task allows for changing any element in the configuration, including the database. An emulation of the revised/extended application can be run and tested on the development computer before downloading it to the HMI-6200 operator interface.

Refer to the on-line Technical Reference and User Manual under the Help tab for detailed instructions.

Tag Database

The T6200 is delivered with a pre-configured Application Tag database. These tags are shown/declared under the Tag List and Datasheet View of the Database tab.

The pre-configured Application Tag database consists of generic tags. It is recommended that this generic tag structure be retained and that custom tag requirements be accommodated by simple labels on faceplates, etc. (not database tag changes).

Class Tags

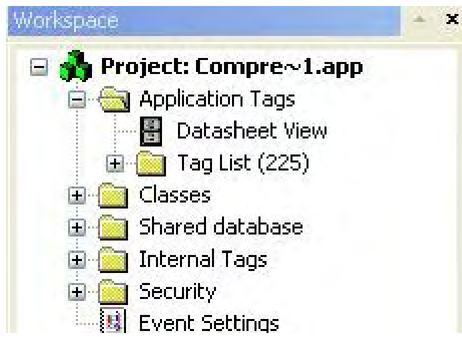
Loop tags – PV, SP, Out, Mode – are defined in a tag format called "classes". This permits a high degree of encapsulation. When a class-type tag is created, it does not contain a single value, but a set of values associated with the loop. When a new loop is created, it is recommended to follow the pre-defined class type definition.

Database Exercise

In the development computer Workspace window, select the Database tab. Click the Application Tags folder to expand it and double-click the Datasheet View line to open the database worksheet.

FIGURE 6-18

Workspace Window Database Tab selection of Application Tags



Note that the database was updated during the development (tags appear as they are created and empty spaces are present as a result of deletions).

For this database exercise example, we add/define a discharge temperature tag and associated alarm tags. We need to configure the Application Datasheet as follows (in order to fill in the field, click on the field after the last defined tag and type the data).

On line # 64… Name: type Td_a; Array Size: type 3 (four stage compressor, 0-3); Type: click ▼ and select Real; Description: type Td Absolute (Deg R or K); Web Data: click ▼ and select Local or Server.

On line # 65… Name: type Td_FB; Array Size: type 3; Type: click ▼ and select Boolean; Description: type FALLBACK Disch Temp; Web Data: click ▼ and select Local or Server.

Repeat the data entry on line # 66 as shown below, to define the high temp alarm.

FIGURE 6-19

Application Datasheet Analog Input configuration

64	Td_a	3	Real	Td Absolute (Deg R or K)
65	Td_FB	3	Boolean	FALLBACK Disch Temp
66	Td_High	3	Boolean	Alarm-Hi Disch Temp

We have created an additional analog input with High and FB alarms; now expand the Tag List folder to verify the database addition you have created. Note that during the screen development, when you type in a nonexistent tag, Web Studio will prompt you to check if you desire to create a new tag (if you accept, it will create a window which permits to create the tag).

Changing/Expanding Screens

Before changing and/or expanding screens, you should consider the pre-defined structure of the application screens. For new screens, you can use existing screens (including the Standard screen), saving it under different names. To update/change an existing screen, insert/change the objects in the window between the header and footer. **It is not recommended to change the header or footer arrangement itself.**

The standard header and footer was used as template for all application screens. The footer area includes a single line alarm object that displays the latest active alarm. The individual objects that make up graphics, faceplates, etc. on the application screens are taken from the pre-configured objects in the Library.

Database Updates/Additions Recommendation:
For most applications there **are no update or addition requirements of the pre-defined Tags that are stored in the Application Database**. Or in other words, the pre-defined generic Application Database does not have to be changed in most cases; user tags are accommodated by tag labels (not database tags) 'drawn' with the screen editors' A/N characters.

If updating/changing Application Tags is required, keep the following syntax rules in mind:

- Although the maximum Tag length is 32 characters, **Tags should be as short as possible (typically not exceeding 12 characters)**
- **Tags must begin with a letter**. They can be composed of letters, numbers, and the underscore character (_)
- The tag name must be **different** from the Web Studios' **reserved internal tag names** and math functions
- While tag names are NOT case sensitive, **both uppercase and lowercase characters should be used to make tag names more clear**

Make sure that <u>No</u> DRAG is set before working with any screen (see screen, lower right-hand corner DRAG status). Enable DRAG (strike Ctrl > D on keyboard) only if you need to move/reposition objects on the screen.

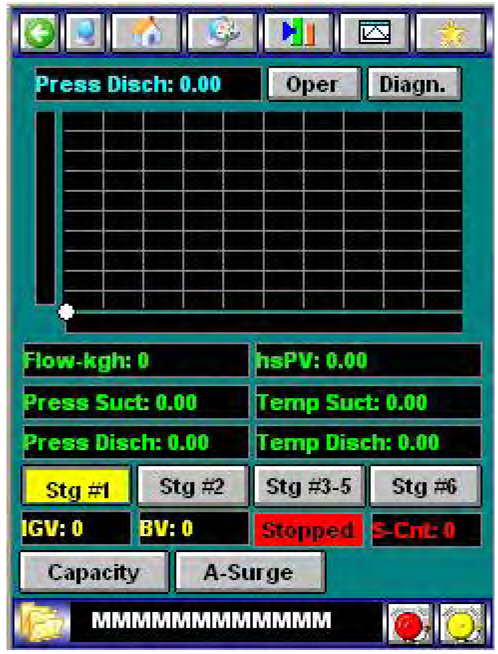
Surge Curve Screens

FIGURE 6-20

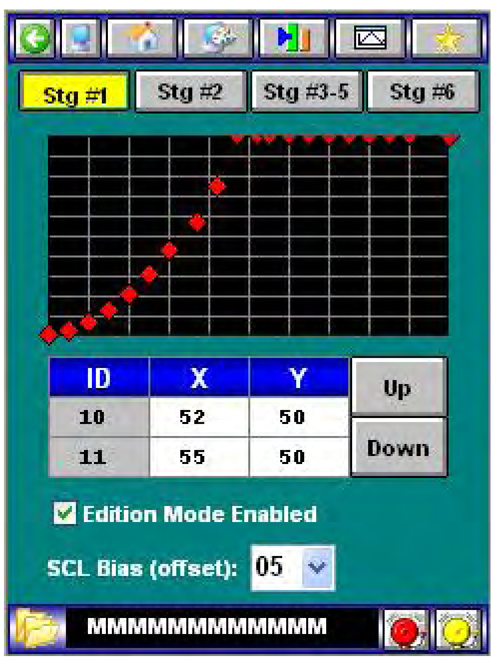
Surge Curve-
Op Point Display:

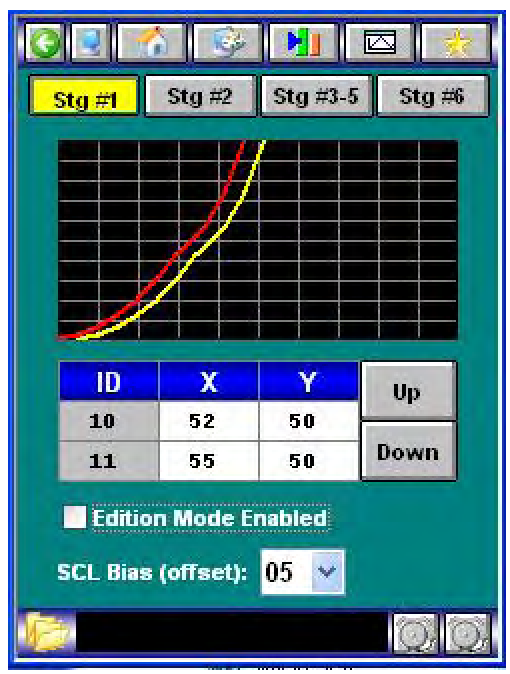
X/Y Map

SLL Configuration
below



- **Surge Curve Configuration**: The Surge Limit Line (SLL) is arranged in a lookup table format with linear vector interpolation. Up to 20 points can be defined. The X points define the domain input – Hp,sim. The Y points define the range (output) – Q2,sim.
- Click on Edit Mode Enable check. Drag the surge points to the desired position or use the Up/Down buttons to position the surge points.





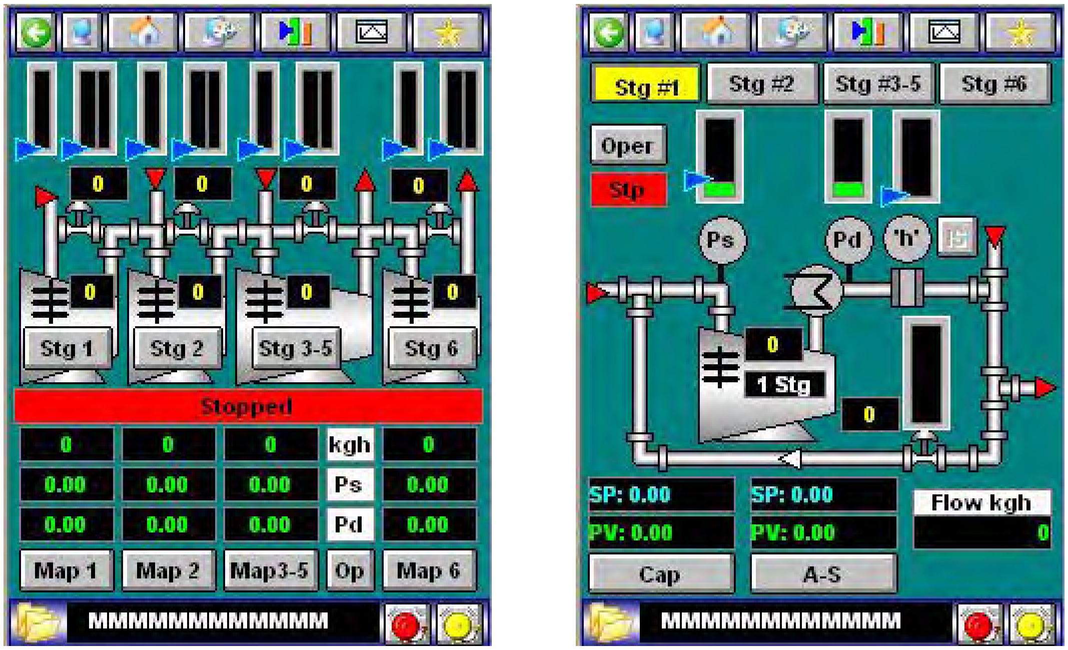
Custom Graphic Screens

While the pre-defined operating displays that are provided with the HMI-6200 operator interface meet the needs of some users, many still wish to create displays that are specific to their respective unit operations. Like the pre-defined displays, user-defined graphic displays are constructed via the Web Studio Object Toolbar and by importing symbols from the Library.

FIGURE 6-21

Overview Graphic
Stage Graphics
Screens:

Custom Graphics generated from pre-defined examples



The Overview screen (on left hand side above) is customized to provide a key variable type graphical representation of the actual multi-stage CO compressor application.

The Stage graphic screen (on right hand side above) is configured to show the individual compressor stages. One graphic screen is provided for each stage.

Control of process equipment should be built into the graphic displays so that an operator can select Loops, etc. and command the equipment associated with it. By providing users with graphical illustrations of the equipment, control is simplified and easier to understand. It is however recommended that several steps requiring confirmation and authorization of control be used to minimize the chance of accidentally actuating equipment. Carefully consider the Object Properties (such as Confirm and Password) and evaluate if Security (see Configuration of the Security System) should be enabled for the screen and/or specific control variables/points.

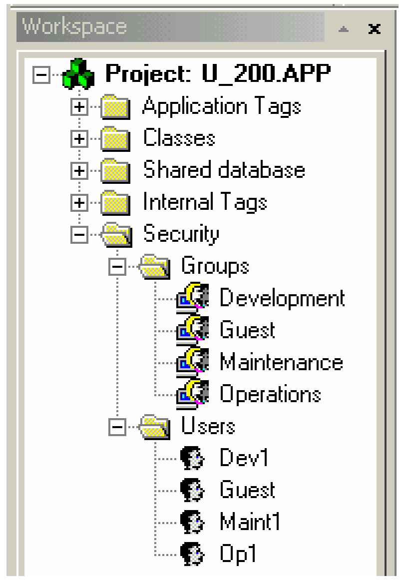
Configuring the Security System

The Security folder allows you to define Groups and Users as well as their access privileges to Web Studio tools and to the application. Through the Database tab, you can tailor Groups and Users to your security needs.

FIGURE 6-22

Workspace Window Task Tab

Selection of Security



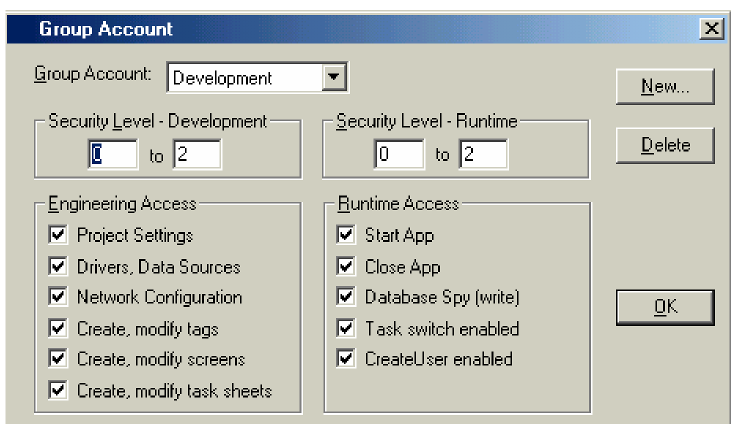
- **Password**: __________ is pre-defined as the Main Password. You will need to enter the password each time you access the Security System (**so it is mandatory that your remember it**). To change the Main Password contact the factory.

- **Development Group**: Double-click Development, enter the Password, and the Group Account window will open.

FIGURE 6-23

Security Group Account Window

Development Group



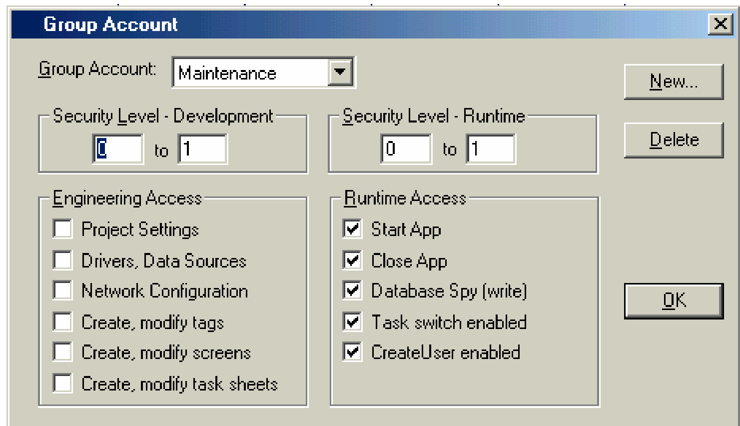
In this window, you enable/disable the Development Group operations and you set the range levels. Verify that the Security Levels and Access are defined in accordance with your application requirements.

- **Maintenance Group**: Double-click Maintenance, enter the Password, and the Group Account window will open.

FIGURE 6-24

Security
Group Account Window

Maintenance Group



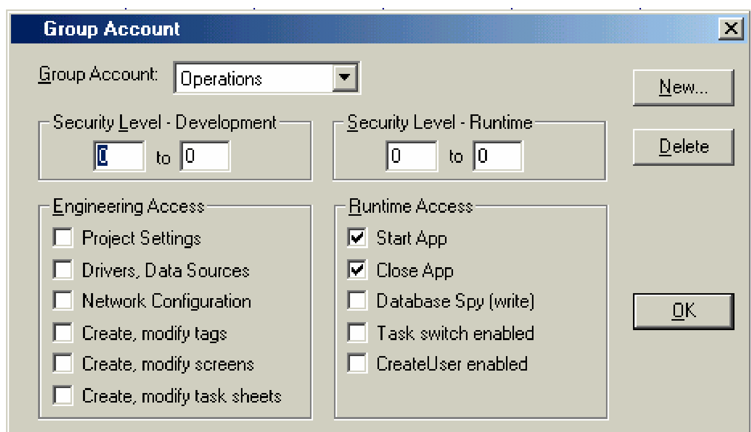
In this window you enable/disable the Maintenance Group operations and you set the range levels. Verify that the Security Levels and Access are defined in accordance with your application requirements.

- **Operations Group**: Double-click Operations, enter the Password, and the Group Account window will open.

FIGURE 6-25

Security
Group Account Window

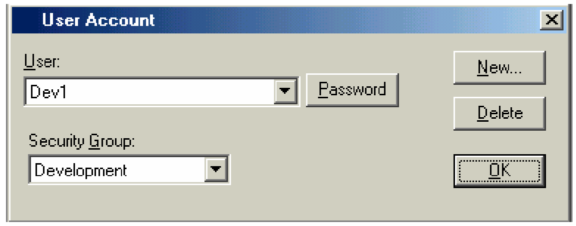
Operations Group



In this window you enable/disable the Operations Group operations and you set the range levels. Verify that the Security Levels and Access are defined in accordance with your application requirements.

- **Users**: Double-click the User Account labels of the Security System window, enter the Password, and the individual User Account windows will open.

FIGURE 6-26



User Account Windows
- Dev1
- Maint1
- Op1

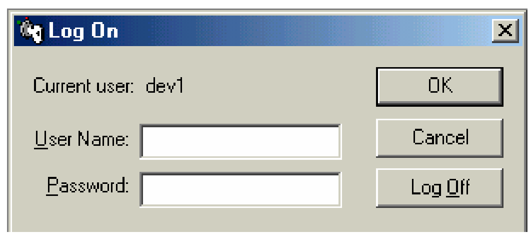
In these windows, you create and maintain accounts for application users. Verify (and if needed re-define) the application users that will be in each group in the Group Account list. Users can also be accessed by selecting the User option under Insert on the Main Menu Bar.

Password Button – Opens the User Password window, in which you can define a password for the user. **The pre-defined User Password is 64266**.

- Guest User: After you initialize Web Studio, a default user is logged on the Guest user. If no user is logged on or the current user has logged off, Guest user is automatically logged on. Thus, the Guest group has default privileges. Since the installation parameters of the Guest group leave all tasks enabled, you should change it and set as few privileges as you want for a start up procedure.

Log On/Log Off: This utility is used to log on or off. For development purposes, you can log on or off by selecting Logon under Project on the Main Menu Bar. The Log on/off feature on the HMI-6200 operator interface is provided by the Log on/off button (using the Web Studio Scripting Language function) on the Miscellaneous screen (Misc scr). **The pre-defined Log On password is 64266.**

FIGURE 6-27



Log On Window

Security System Review/Setup

Before beginning to verify/change the security system, **it is important to have the groups and users you want to configure in mind**. You need to define the rights that each group has in your environment. Each group has a range for the level in Development and Runtime. You should carefully review the Security of all operation/maintenance/engineering screens (Screen Attributes, Security) and the individual point security access on those screens.

Do not forget to review Object Properties for security access (Security level entry) of critical buttons (with commands configured to turn on/off equipment) and of critical pre-set calculation/fallback values.

Communications

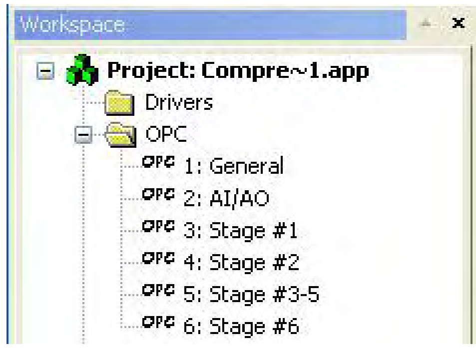
OPC Communication

The Web Studio OPC Client module communicates with the MICON OPC Server module using the OPC Data Access Standard. The Tag Names passed between the OPC Client and Server are defined under OPC in the Comm tab.

FIGURE 6-28

Workspace Window
Comm Tab

Selection of
OPC Sheets



OPC Worksheets: Double-click on the desire OPC item (GEN, AI/AO, Stage) to open the OPC Client worksheets.

FIGURE 6-29

OPC Worksheet:

GENeral Parameters

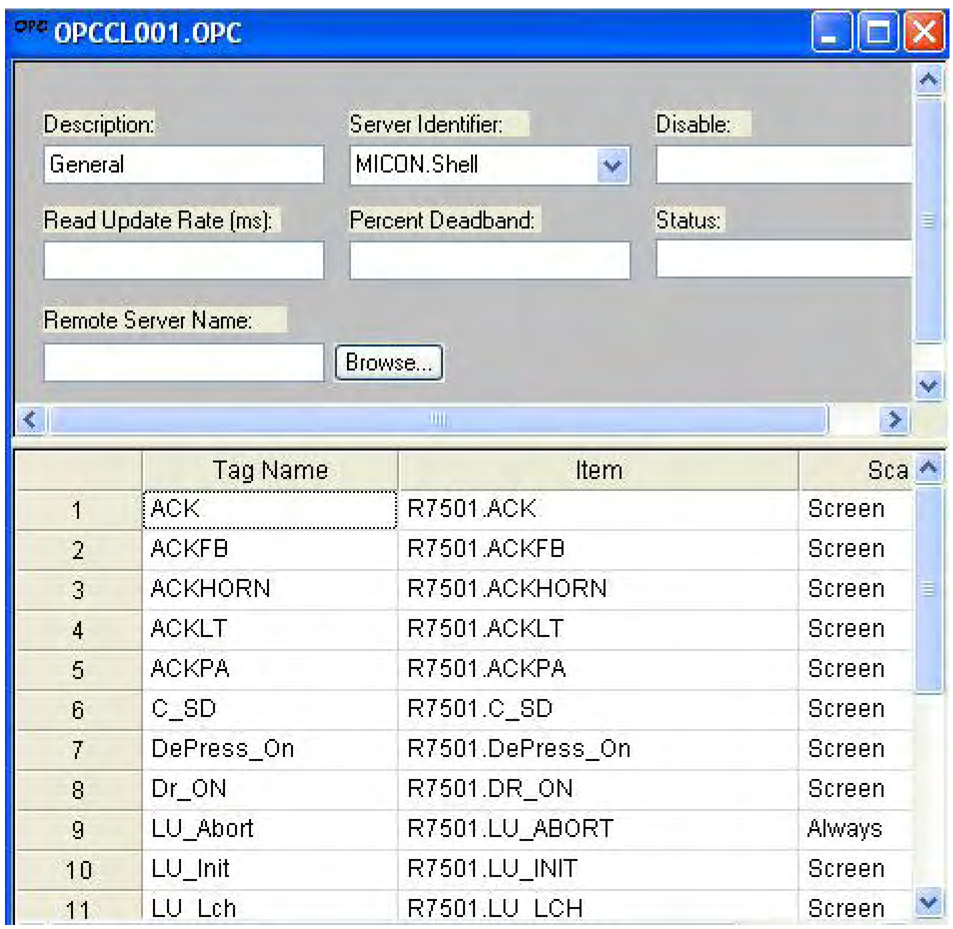
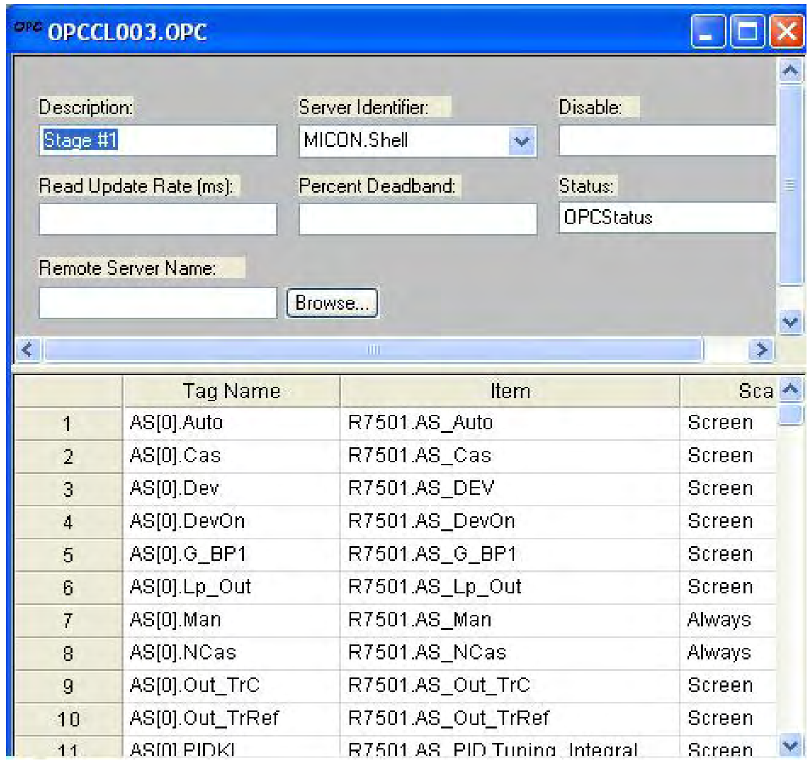


FIGURE 6-30

OPC Worksheets:

Stage#1 Parameters



	Tag Name	Item	Sca
1	AS[0].Auto	R7501.AS_Auto	Screen
2	AS[0].Cas	R7501.AS_Cas	Screen
3	AS[0].Dev	R7501.AS_DEV	Screen
4	AS[0].DevOn	R7501.AS_DevOn	Screen
5	AS[0].G_BP1	R7501.AS_G_BP1	Screen
6	AS[0].Lp_Out	R7501.AS_Lp_Out	Screen
7	AS[0].Man	R7501.AS_Man	Always
8	AS[0].NCas	R7501.AS_NCas	Always
9	AS[0].Out_TrC	R7501.AS_Out_TrC	Screen
10	AS[0].Out_TrRef	R7501.AS_Out_TrRef	Screen
11	AS[0].PIDKI	R7501.AS_PID.Tuning_Integral	Screen

	Tag Name	Item	Sca
53	FAL[0]	R7501.FAL	Screen
54	FB_Com[0]	R7501.FB_Com	Screen
55	h_FB[0]	R7501.h_FB	Always
56	h_Low[0]	R7501.h_Low	Always
57	h_Min[0]	R7501.h_Min	Always
58	hd[0]	R7501.hd	Always
59	Hp[0]	R7501.Hp	Screen
60	Hp_Lo[0]	R7501.Hp_Lo	Screen
61	Hp_sim[0]	R7501.Hp_sim	Screen
62	hsll[0]	R7501.hsll	Screen
63	hsPV[0]	R7501.hsPV	Screen
64	IGV_C[0]	R7501.IGV_C	Screen
65	Incip_Hi[0]	R7501.Incip_High	Screen

Verify that <u>all</u> dynamic tags required by the HMI-6200 Operator Interface are listed under Tag Name and are associated with the correct OPC Server item. Also, make sure that tags are <u>not</u> selected as Scan Always unless the specific tags require continuous scanning, such as Alarm/Alert related tags.

Tag Names are obtained from the Database (double-click on Tag Name column). To associate the Tag Name to the OPC Server item, right click on the item column and hit OPC Browser. This enables you to browse all the OPC Server configured items. If the T6200 connection is not already established it will open the OPC Server link.

WEB Communication:

Web Studio allows you to save your application screens in HTML format and export them to Internet Browsers (Internet Explorer).

You need to set the parameters in the Web tab in the Program Settings dialog window and save the screens which you desire for Web communications as HTML (menu File – Save as HTML). Caution: The Web Pages generated by the Save As HTML function are independent of the screen file they were generated from. As such if you make a change to the Display Screen that change will not appear on the Web page until you again Save As HTML.

Any tags which are used to display data or input commands need to have their web settings changed to server in order to communicate over the web. Select Application Tags in the Database and verify the Web Data column.

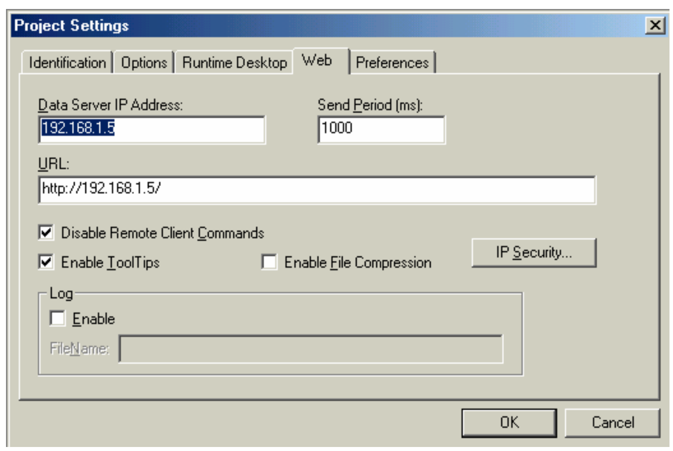
FIGURE 6-31

Name	Array Size	Type	Description	Web Data
AIN_1_LO	0	Boolean		Server
AIN_1_HI	0	Boolean		Server
AIN_1_FB	0	Boolean		Server

Application Datasheet
Database Tab
Web Data selection

The computer where the HTML files are stored (Page Server) must be a WEB Server (HTTP Server driver) and the computer where the application is running (Data Server) should have a fixed IP address. Note the Page Server and the WEB Server can, but do not have to be, the same computer. For T6200, **the Page and WEB Servers are both contained in the operator interface.**

FIGURE 6-32



Project Settings
Web Tab

To be able to view your web pages you must first configure the web setting. These can be found in the **Project Settings** window under the **Web** tab (see above). First you need to input the **Data Server IP Address**, this is the IP address where the application is running. Next you need to enter the **URL** in the following format**: http://<the IP address of the unit where the web server is running>/<path from the server to the web page directory>/**. Once these two fields are correct click the ok button. Then go to Tools on the menu bar and select Verify application (if you have any windows open in the development system Studio will demand you close them before verifying the application).

Caution: If you change any of the web information under the Project Settings you will need to Re-Verify the application for the new setting to take affect. Because the Web Pages Display information from the application through the **Web Server**, the **Runtime System**, the **Web Server** and the **TCP/IP Server** need to be running to view the Web Pages.

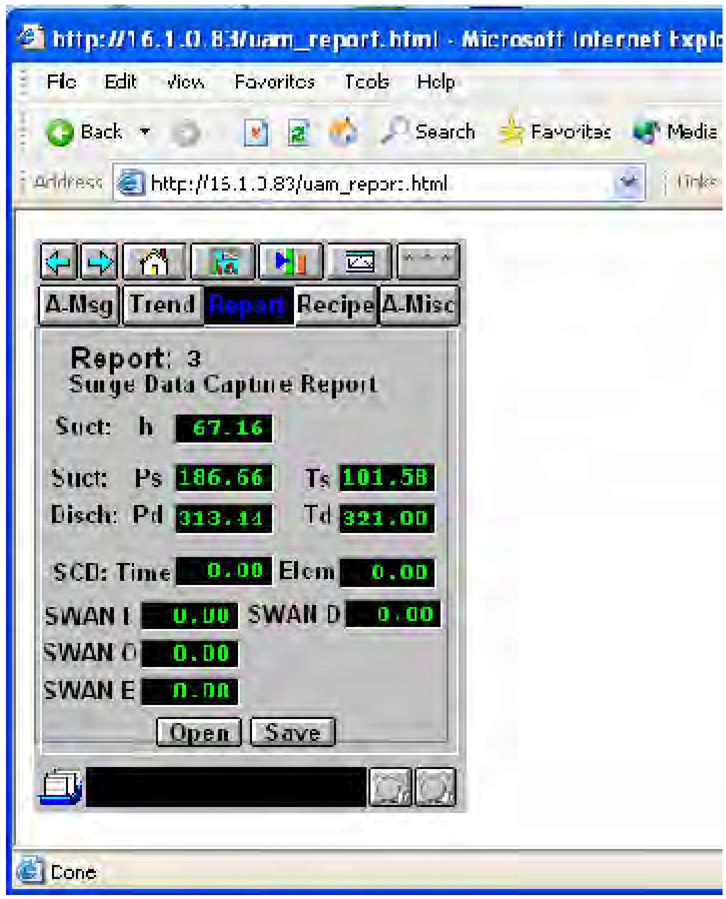
Once all the settings are correct, turn on the Web Server then run the application. With both of these running you should be able to use Internet Explorer to connect to the application By selecting the URL (**http://<the IP address of the unit where the web server is running>/<path from the server to the web page directory>/<application screen name>.html**). A prompt for a username and password will appear, enter one of the username and passwords from the security section. Once the screen appears you can interact with the application.

Example: UAM Report screen on-line data exported to Internet Explorer.

FIGURE 6-33

UAM Report Screen

Real-Time Web Data



Downloading the Updated Application

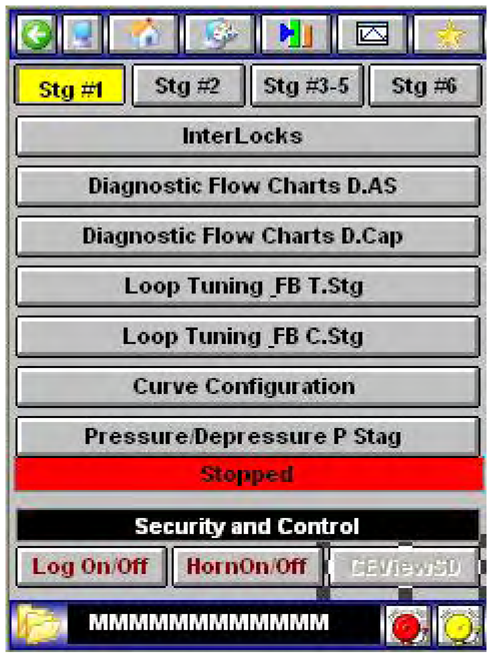
After the adaptation of the pre-defined displays is completed, connect the development computer to the controller operator interface via a direct HMI Crossover Ethernet cable or via the controllers' Primary Ethernet connection (T6200 rear termination panel, Ethernet 1). If the connection is made through the Primary Ethernet at the controller termination panel, make sure that the T6200 control board(s) is unplugged and that the connection from the termination panel is made direct to the development computer using a standard Ethernet cable.

HMI-6200 operator interface Arrangement

Select the Miscellaneous Screen (click on the *** button on the Header of the operator interface display) Log Off and press the CEViewSD (CE View Shutdown, grayed out before Log Off confirmation) button on lower right area of the screen. The operator interface will exit the CE View program and display a Remote Agent window.

FIGURE 6-34

Button
Log On/Off and
CEViewSD on
Misc *** Screen



- Remote Agent Window
The user needs to move the "Remote Agent" window down only if he cannot see the information that he wants to see. Typically, this will be required in order to expose the "My Computer" and "T6200 Configuration" icons.

- Delete existing COMPR_~1 Folder: Double-click the My Computer icon and then double-click the IPSM folder icon to access the COMPR_~1 folder. Click the COMPR_~1 folder and click File and Delete. The "Confirm Folder Delete" pop-up window with the text "Are you sure you want to remove the folder 'COMPR_~1'and all its contents?" will appear. Press Yes and close the pop-up. The COMPR_~1 folder will be deleted. Close the window. The Remote Agent window (as it was previously positioned) will appear.

Development Computer Arrangement

Make sure that the operator interface is properly connected to the development computer.

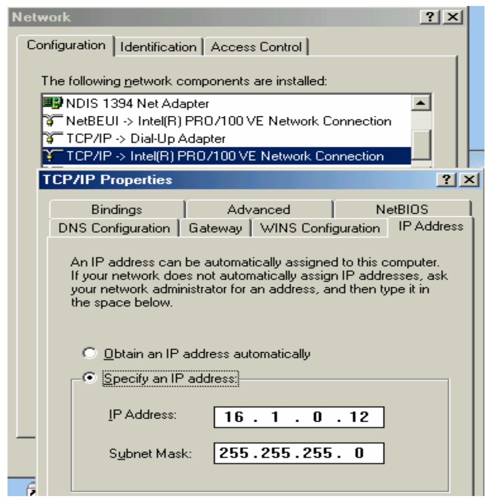
Network TCP/IP Properties Adaptation

Setting > Control Panel > Network. You will need to change the IP address on the development computer only if the first three digits of the development computer's IP address do not exactly match the first three digits of the Operator Interface's IP address. By default, the Operator Interface will come up with the IP address of 16.1.0.21.

FIGURE 6-35

Network Window

TCP/IP Properties
IP address



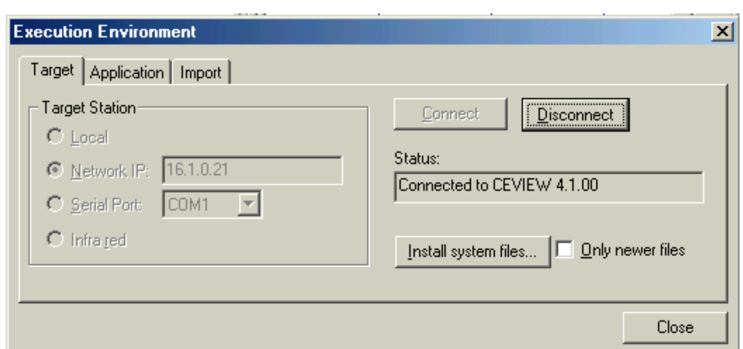
Execution Environment

Open the Execution Environment window (click on the Execution Environment icon on the Web Studio Execution Toolbar, or select Execution Environment from the Project menu).

FIGURE 6-36

Execution Environment
Target Tab

Connect/Disconnect



- **Target Tab**: Click on the Network IP radio button. Enter the IP address of the Operator Interface which is displayed in the title bar of the “Remote Agent” window on the Operator Interface. Make sure that the first three digits of the IP address of the Development Computer exactly match the first three

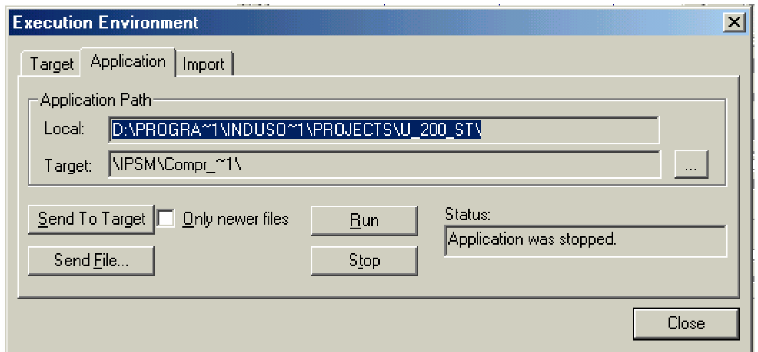
digits of the Operator Interface's IP address. Then press Connect. The Status line will confirm the connection as shown above.
Note: After completion of application downloading, do not forget to return the radio button selection from Network IP to Local.

FIGURE 6-37

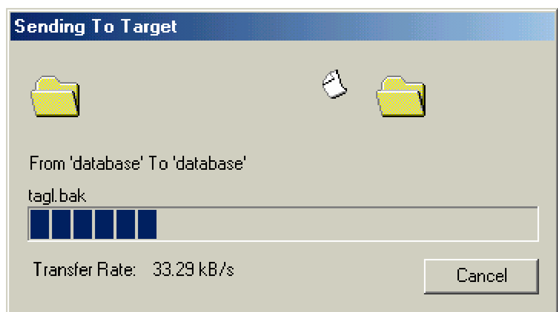
Execution Environment
Application Tab
Send to Target
HMI-6200 Operator Interface

Sending to Target
Pop-up below

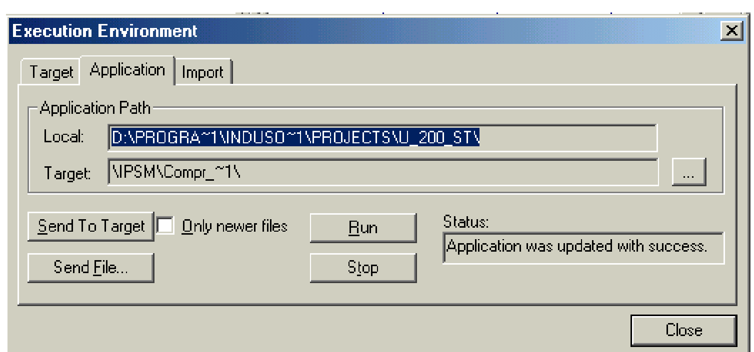
Status
Application updated below



- **Application Tab**: Once the connection is confirmed, select the Application Tab and press the Send To Target button. This command sends the new/revised application to the HMI-6200 operator interface. Make sure that the destination folder has "\IPSM\Compr_~1" as its value. If you have created this folder on the Operator Interface, then make sure you delete it before clicking on the "Send to Target" button.



-**Application Update Completion**: The Status line will confirm that the Application was updated with success (see below).



Note: After completion of application downloading, do not forget to select the Target tab, press Disconnect and to return the radio button selection from Network IP to Local.

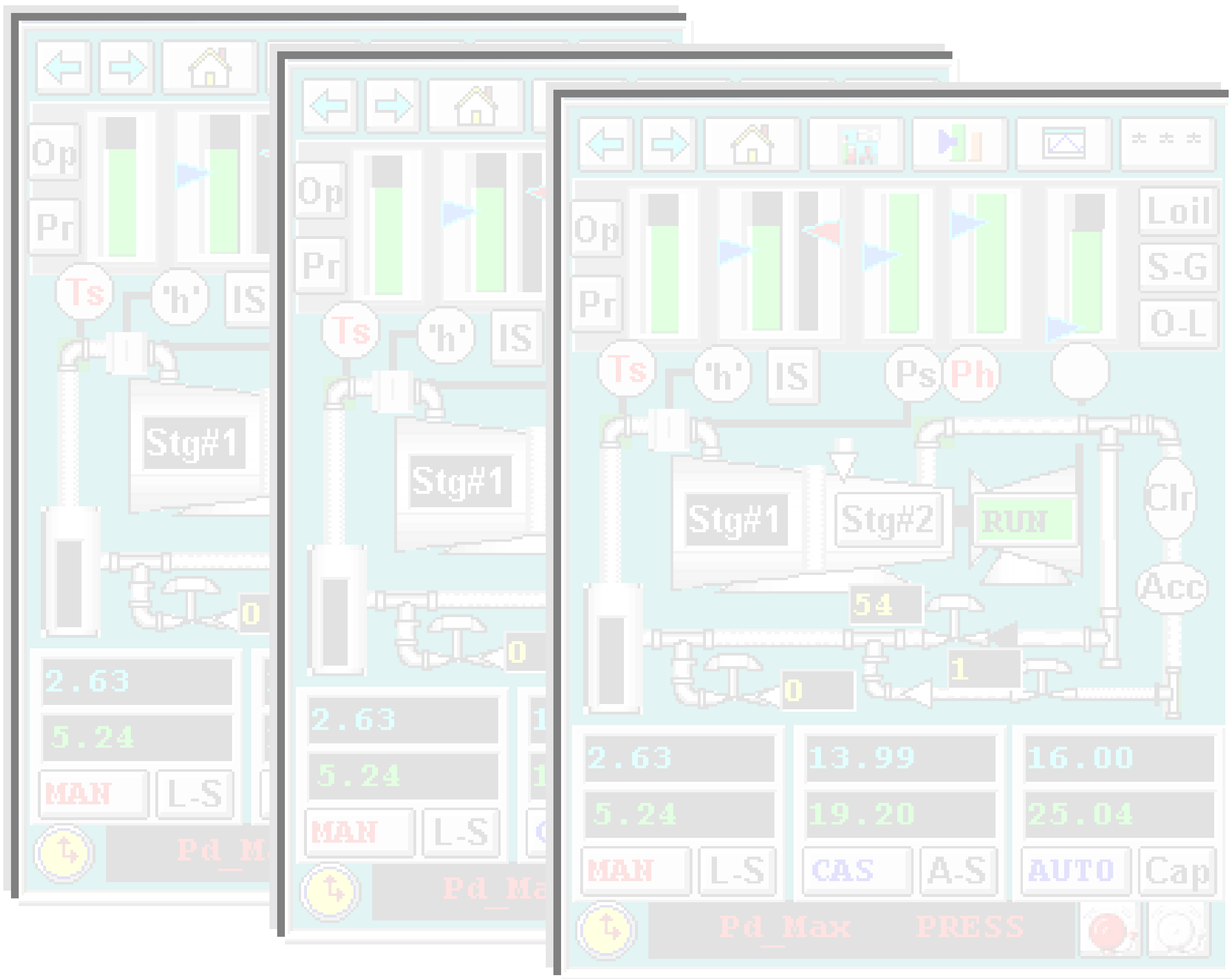
Running the Application

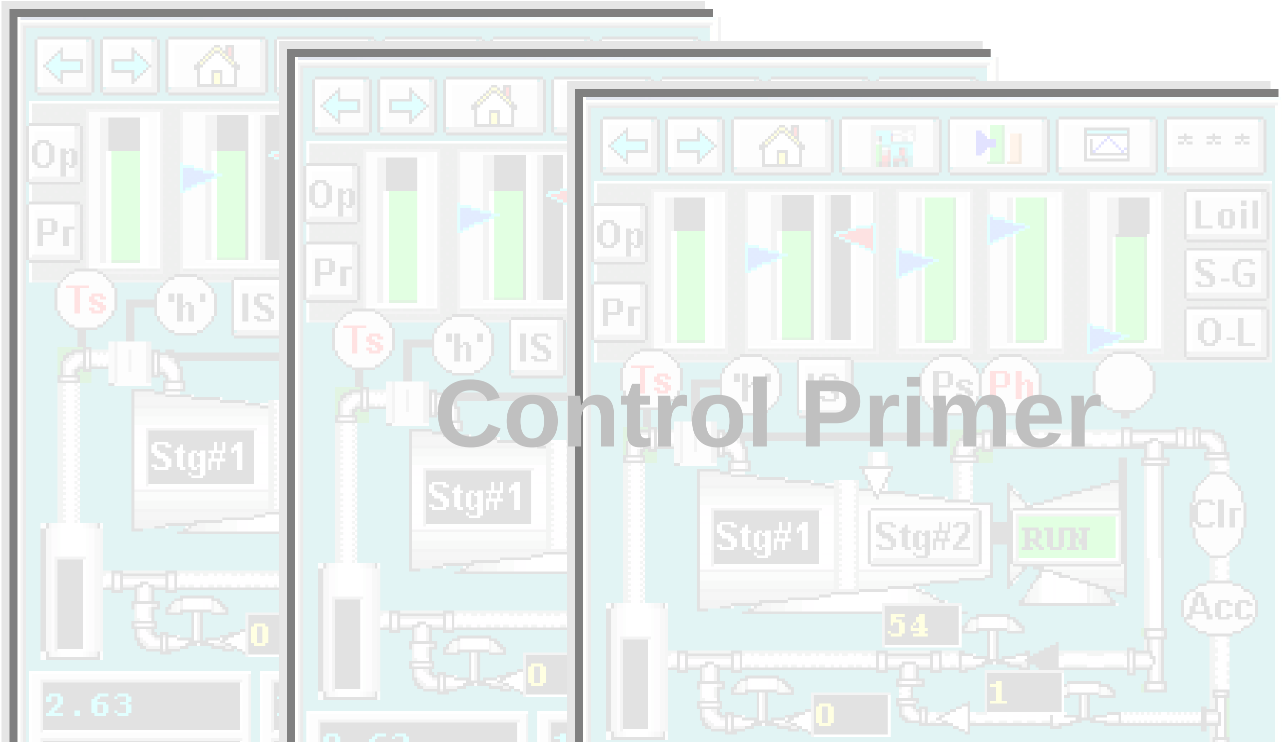
After the new/revised application has been successfully downloaded to the HMI-6200 operator interface, lunch it by pressing the Start button on the Remote Agent window.

7

Section Seven

Control Primer


Op
Pr
Loil
S-G
O-L
Ts
'h'
IS
Ps
Ph
Clr
Acc
Stg#1
Stg#2
RUN
54
1
0
2.63
5.24
13.99
19.20
16.00
25.04
MAN
L-S
CAS
A-S
AUTO
Cap
Pd_Max
PRESS



Control Primer

Controllers are used by the process industries as well as other industries. They are usually used, among other things, to improve accuracy, efficiency, safety, environmental, and to automate, ie., when the controller takes action it has a way to measure the result and then modify the action. Most of these controllers are used in a closed-loop with negative feedback. Sometime they are used in an open-loop, normally referred to as feedforward control.

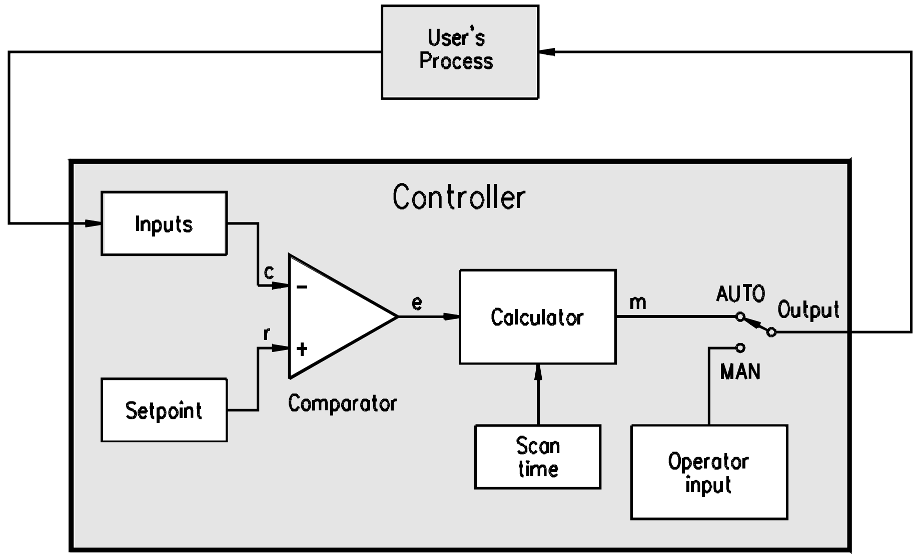
With feedback control the output of the controller could be used to regulate a process, usually by controlling a valve, and the input to the controller monitors the same process and compares it to a reference, normally called the setpoint. If an error exists the output of the controller will change the process to correct the error. In a typical feedforward control, the input to the controller would be from a point ahead of the process being controlled. The controller, by measuring this disturbance, would try to predict the required changes to the process and make them.

Feedback is either positive or negative. Positive feedback tries to produce an unbalance condition causing instability. In an application where a pump is used to fill a tank and positive feedback was used in the controller, the controller is intended to control the level of a tank by turning the pump on and off. In a condition where the pump was on and the level was above the desired level, the pump would continue to run, overfilling the tank. With negative feedback the controller works to restore balance. The pump would stop when the level in the tank reaches the desired level.

The controller is made up of several elements. Figure 7-1 represents a simplified digital controller showing the most common elements.

Figure 7-1.

A Simplified Feedback Controller in a Process Loop



The input block represents the input signal conditioning circuits. The setpoint is the controller's reference. The setpoint is usually set by an operator, but sometimes the setpoint is the output of another controller. The comparator compares the input and setpoint and the difference is called the error. This error is passed on to the calculator. The expression for the error is:

$$e = r - c \tag{7-1}$$

where: *c = controller input*
e = comparator error
r = controller setpoint

In an analog controller, the calculation is done continuously. In a digital controller, the calculations are done on a predetermined interval called the scan time. This scan time is fast enough that the result is the same.

The calculator performs the proportional-plus-integral-plus-derivative (PID) algorithm. The P-I-D is called the mode of the controller. The controller may use one or more of these functions, ie., P, I, PI, PD, or PID (the D and DI are not normally used). A process controller that can perform all three modes is called a PID controller even if it is not using all three modes.

Proportional (P) Action

The proportional action has a linear response. The controller output response will have the same shape as the controller error response but the amplitude may be different and it may also have an offset. Refer to Figure 7-2.

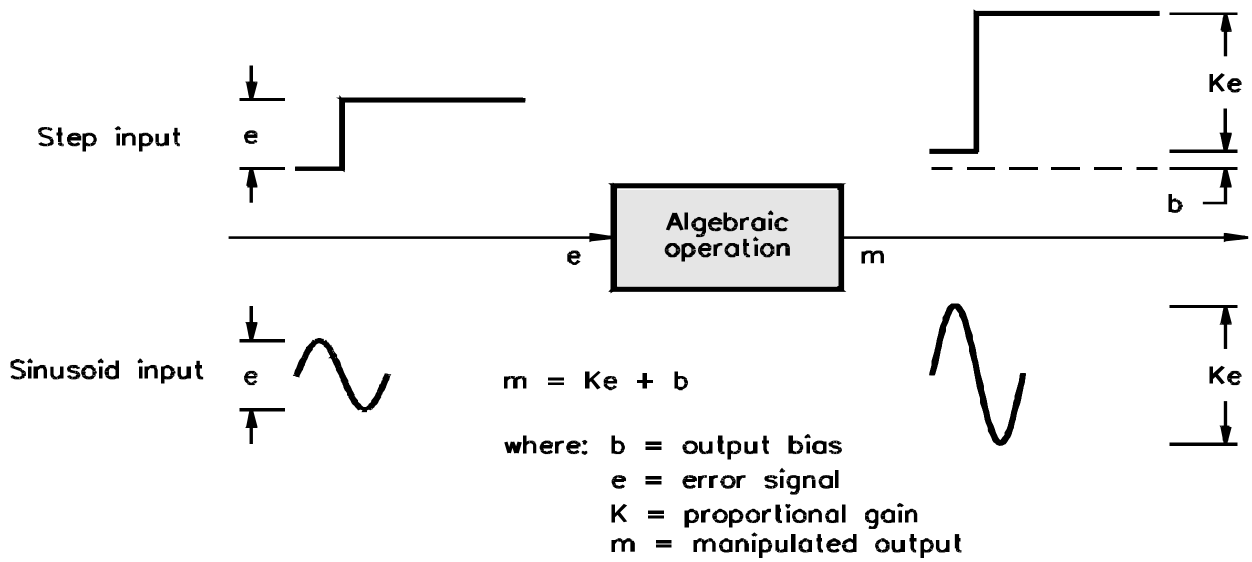
Sometimes the proportional action is expressed in percentage and is called *proportional band* (PB). The expression for proportional band is:

$$PB = 100/K + b \qquad (7\text{-}2)$$

where:
b = output bias in %
K = controller gain

Figure 7-2

Proportional (P) Control Action



The advantages of the proportional action are: it is simple, easy to tune, and has a rapid response. The disadvantage is that it has an offset.

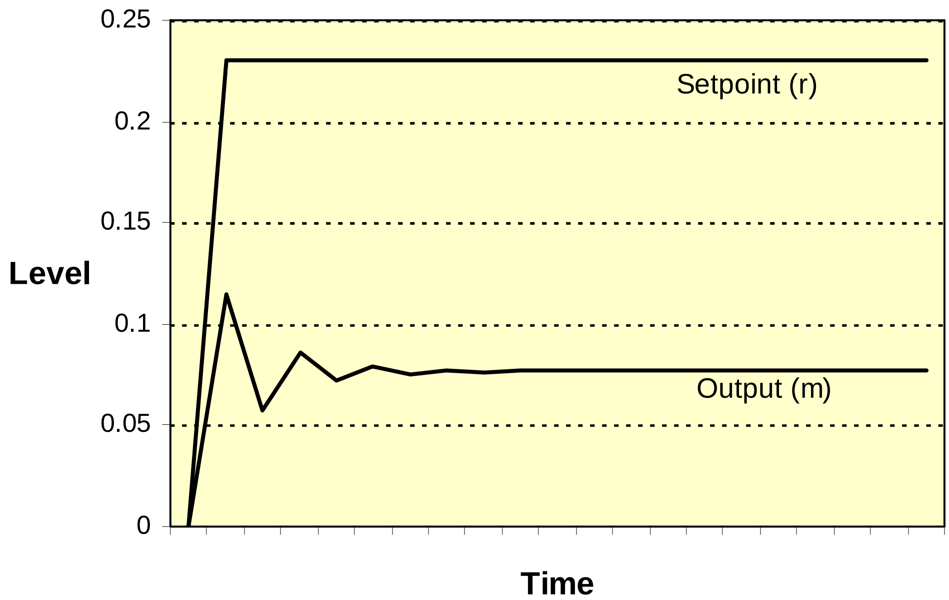
Using the expression in Figure 7-2 and substituting *e* with expression 7-1 yields the expression for m the manipulated output:

$$m = K\,(r - c\,) + b \qquad (7\text{-}3)$$

Figure 7-3 is an example of how the offset can be shown by repeatedly solving for the manipulated controller output (*m*) in expression 7-3. Let the setpoint (*r*) change from 0 to 0.23, gain (*K*) = 0.5, bias (*b*) = 0, and $c_n = m_{n-1}$.

Figure 7-3

Proportional (P) Control Action Offset Example



The offset is: r - c = 0.23 - 0.077 = 0.153

The ideal controller would work to make it's input equal to the setpoint. In this example the controller stabilizes with a difference between the input and the setpoint of 0.153. This is called the offset.

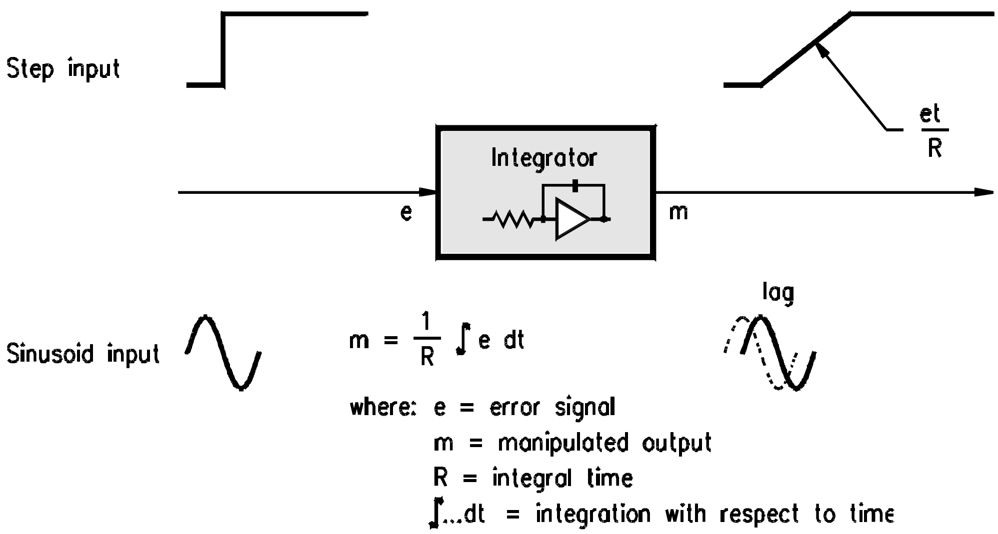
This offset can be eliminated by using proportional and integral action together, as described later.

Integral (I) Action

The integral action, also called "reset" action, has a dynamic response. The controller output response may *not* have the same shape as the controller error response, as it does in proportional action. Refer to Figure 7-4. The controller error is integrated over time. The integral time, also called the "reset" time, is the time constant of the controller.

Figure 7-4

Integral (I) Control Action



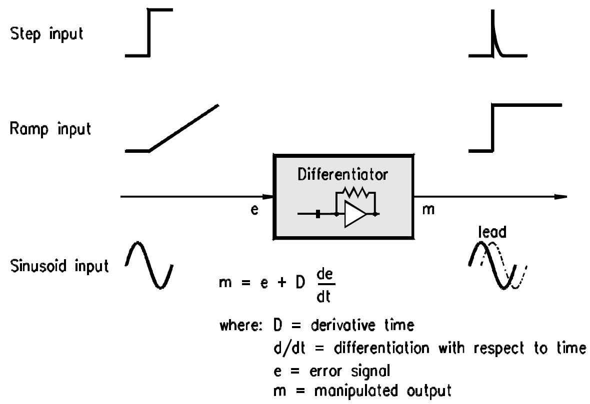
The advantage of the integral action is that it does not have the offset problem that the proportional action has. The disadvantage is that it has a lag, causing it to have a slower response time than the proportional action.

Derivative (D) Action

The derivative action, also called "rate control", also has a dynamic response, but is the inverse of integral action. This action takes the derivative of the controller error with respect to time, refer to Figure 7-5. Derivative action is not used by itself. It is normally used with proportional action or with proportional-plus-integral action. This action is normally in the controllers output stage rather than in the calculator.

Figure 7-5

Derivative (D) Control Action



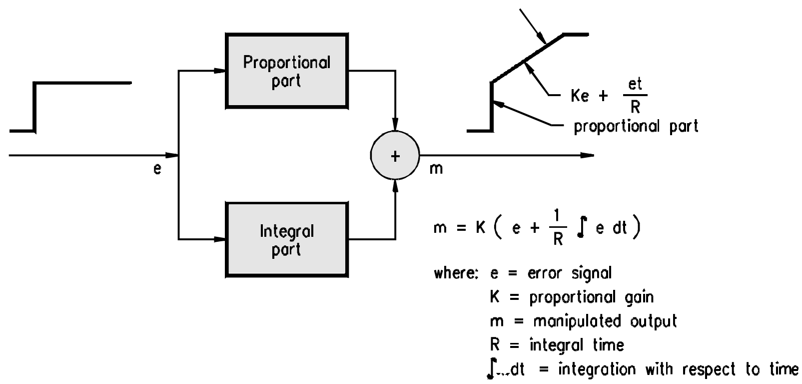
Proportional-Plus-Integral (PI) Action

Adding proportional and integral action in the same controller eliminates the offset of the proportional action and improves the response time compared to just the integral action along.

Referring to Figure 7-6, the output responds to the step input immediately and then integrates to a stable output.

Figure 7-6

Proportional-Plus-Integral (PI) Control Action

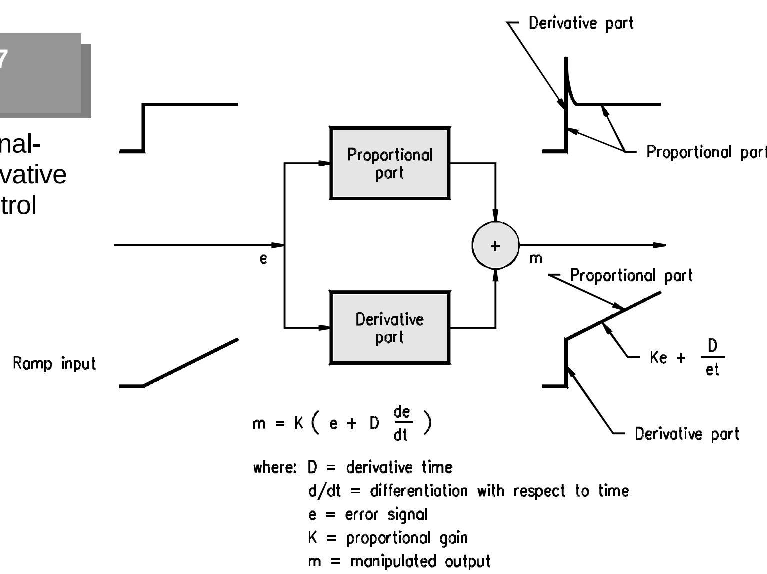


Proportional-Plus-Derivative (PD) Action

The advantage of adding derivative action to other actions in the controller is that it has a lead that can be used to compensate for lag in the process (Figure 7-7). Adding this lead will improve the loop response time. A disadvantage is that derivative action over responds to process noises and high frequencies and is not easy to use or tune. It's application is usually restricted to processes with large lags such as temperature control of a large volume.

Figure 7-7

Proportional-Plus-Derivative (PD) Control Action

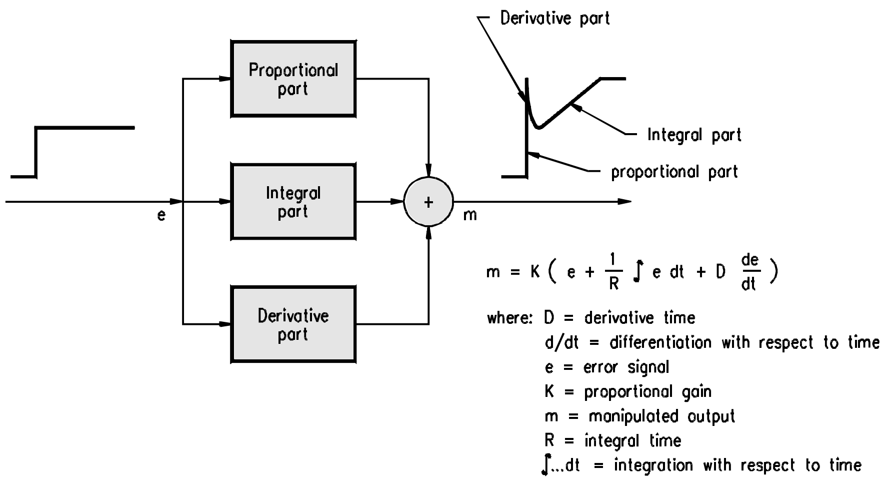


Proportional-Plus-Integral-Plus-Derivative (PID) Action

Proportional-plus-integral-plus-derivative action is a combination of all three actions (Figure 7-8). It is the most complicated type of controller and does not have many practical applications. It has good control ability, fast response time and no offset, but is very difficult to tune.

Figure 7-8

Proportional-Plus-Integral-Plus-Derivative (PID) Control Action



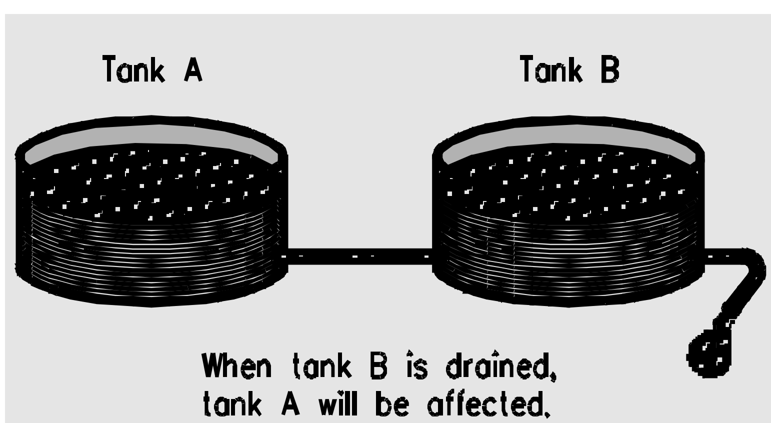
Interactive and Non-interactive Control

Interactive control action is when action of one function influences the action of other functions within the controller. Non-interactive control is when functions are independent.

Interactive action is illustrated in Figure 7-9. In this illustration, tank B is being drained and this, in turn, influences the level in tank A. Non-interactive action is illustrated in Figure 7-10. In this illustration, tank B is being drained and tank A is being drained into tank B. Changing the drain rate in tank B in this case does not influence the level of tank A.

Figure 7-9

Interactive Control Action



Deadtime

The interval of time between the input of a change to a process and the beginning of a detectable response in the process is called the deadtime. For the step input illustrated in Figure 7-11, the deadtime is the time between the step input and the first indication of a change on the output.

Figure 7-10

Non-Interactive Control Action

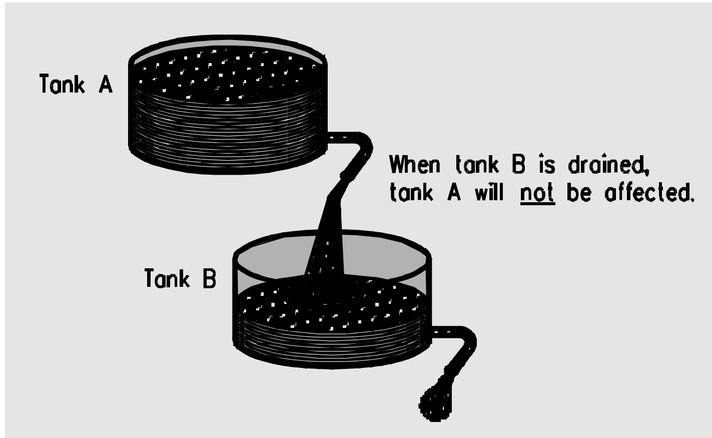
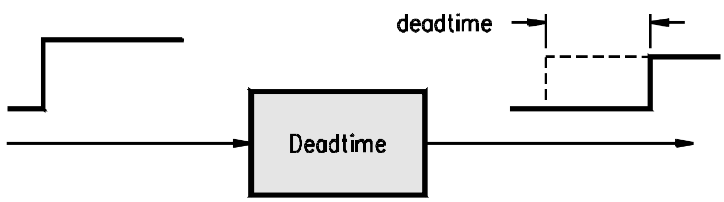


Figure 7-11

Deadtime



Deadtime is not the same as lag. An example showing the difference is an empty garden hose connected to a water faucet. When the water faucet is turned on there is a delay before any water reaches the other end of the hose.

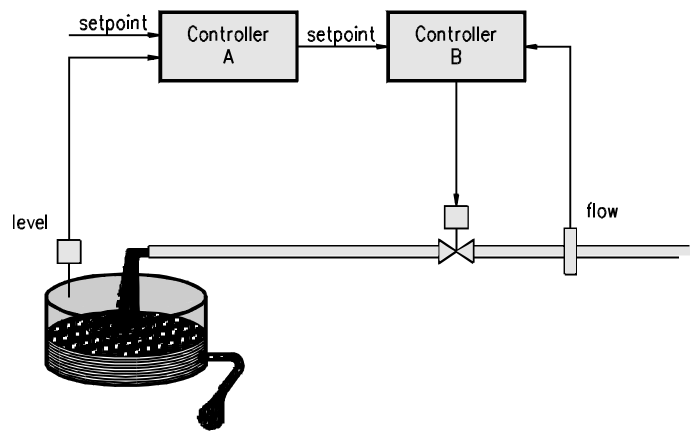
This delay is called the deadtime. Lag is the time the first drop of water reaches the end of the hose until its reaches maximum flow.

Cascade Control

Cascade control is where the setpoint of a controller is automatically altered by some variable or controller other than an operator. Controller B in Figure 7-12 is an illustration of a controller used in a cascade application. The master controller maintains the master variable at its desired level by adjusting the setpoint of the slave controller.

Figure 7-12

Cascade Control Used to Control Tank Level



The basic advantage of cascade control is that the faster slave controller can correct its process disturbance before the influence is felt by the master variable thus enabling faster control action.

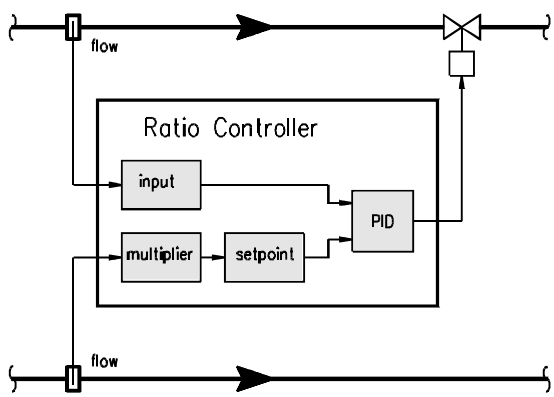
Adding cascade control can, however, also de-stabilize the master control if the process delays in the slave control are not much shorter (five times or more) than those in the master control. It follows that the time constant must be faster in the slave control than the master control. If these two conditions are not satisfied, the master control will be less stable than it would be without cascade control.

Ratio Control

A ratio controller is used to maintain a relationship (ratio) between two variables. Ratio controllers are mostly applied to flow loops. An example of this is shown in Figure 7-13. The controller is controlling the flow in one line and its setpoint is from the flow in the other line. The setpoint has a multiplier that is used to control the ratio.

Figure 7-13

A Controller Used to Control the Ratio of Flow



Damping

The damping in the process system is the reduction of energy causing amplitude of the oscillation of the process loop to reduce. Figure 7-14 is an example of an under damped process loop and Figure 7-15 is an over damped loop

Figure 7-14

Response Curve for an Under-Damped Response

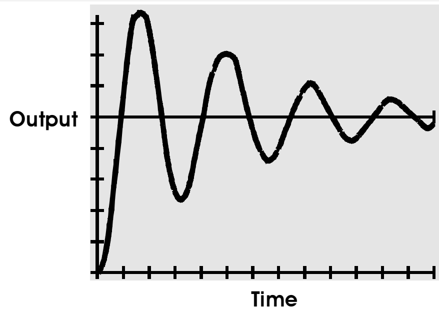
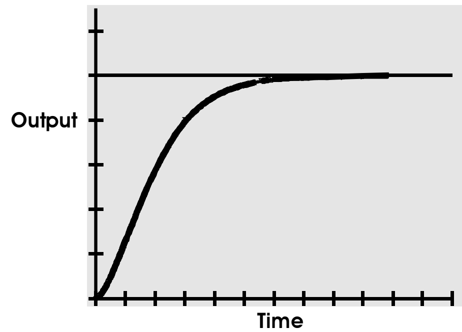

Output
Time

Figure 7-15

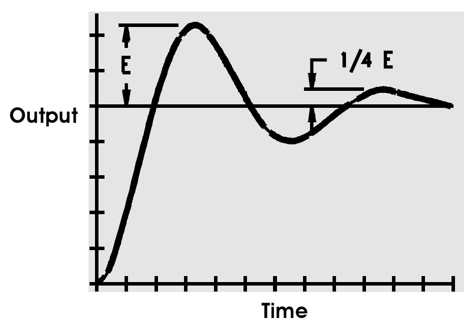
Response Curve for an Over-Damped Response



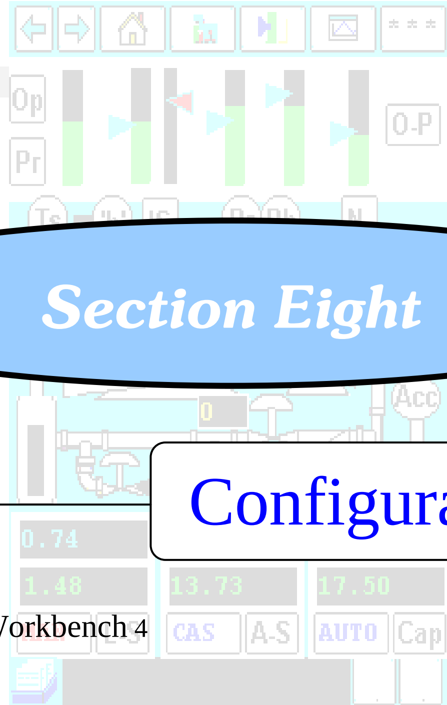
A process loop with a loop gain of one would oscillate continuously. The oscillation can be stopped by reducing the gain of the loop. Reducing the gain also increases the damping. The most common damping used in the process industry is 1/4 amplitude damping, refer to Figure 7-16. A proportional type controller with a gain of 0.5 would be 1/4 amplitude damped.

Figure 7-16

Damping Response Curve for a ¼ Amplitude Damping

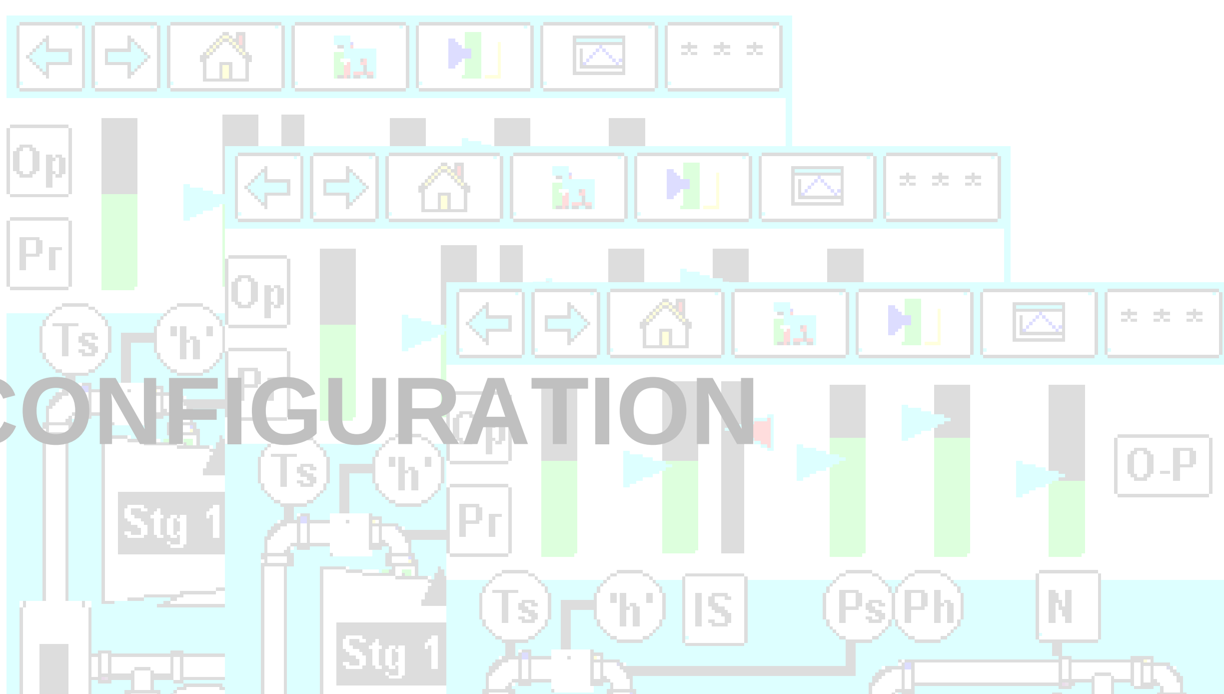


These are straight forward examples of various types of control choices - there are many more. The best choice will depend on the process characteristics and the control objectives (eg. hold a level very close to setpoint or let it drift up and down while holding the flow out of the tank as consistent as possible).



Section Eight

Configuration



CONFIGURATION

Preface

The T6200 Unit Automation System is configured by selecting pre-programmed control functions to satisfy the control requirements. There are more than 100 different control functions that reside in the library of each controller. A function is a software routine that performs a given control task. Most functions may be used more than once within a configuration.

A good knowledge of the compressor/turbine and the process and a clear idea of what the turbomachinery requirements are will be helpful in developing the controller configuration.

Configuration Studio

The Studio manages all aspects of the control configuration, including configuration reports. Based on a modular approach to system configuration, Configuration Studio allows you to create and maintain control strategies in the T6200 controller.

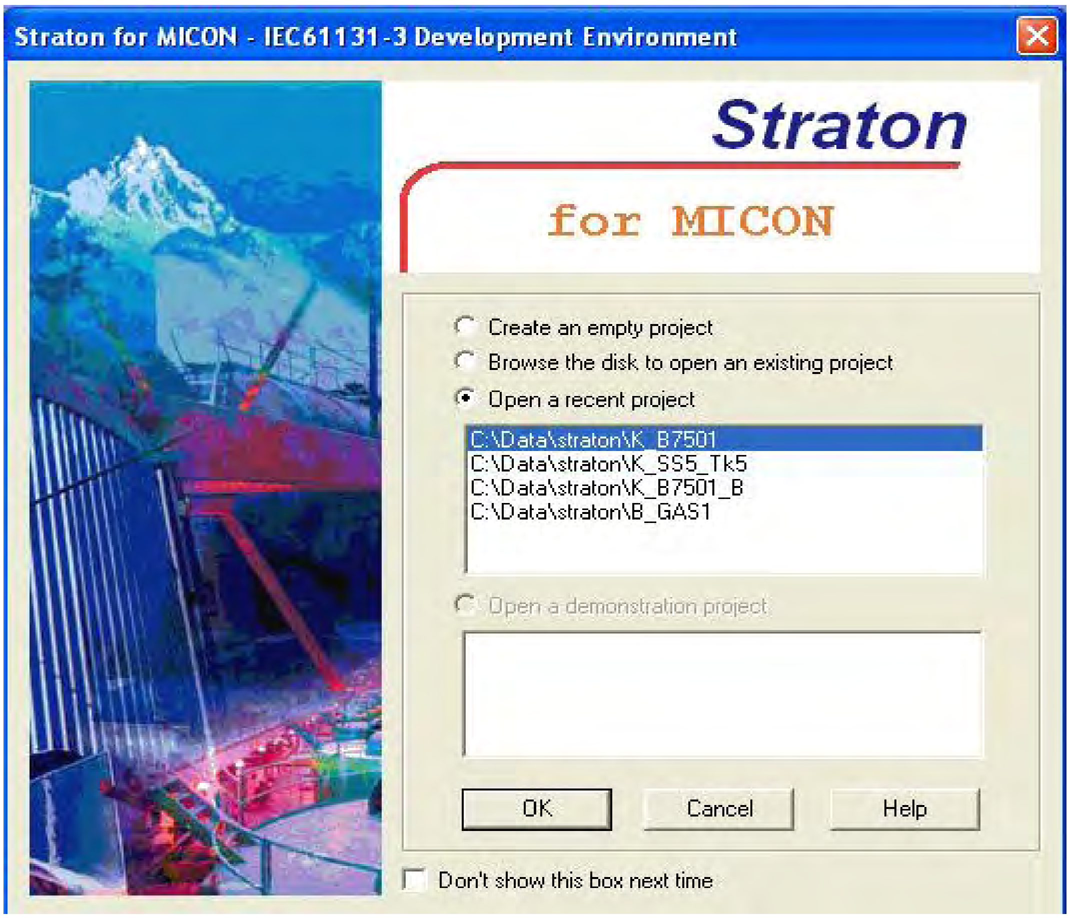
You will be able to choose either Text File Configuration or Graphical Function Block Diagram (FBD) Configuration. You can select the configuration format that is appropriate for your process requirements**. Control strategy development with graphical configuration is visually more intuitive (making it easier for first time users) than text file configuration.**

The Function Block Diagram – FBD - Configurator is based on the Straton for MICON programming tool, a flexible IEC-61131-3 environment.

FIGURE 8-1

Graphical Configurator

Home Page



Running the FBD Configurator Workbench

When you launch the FBD Workbench from Windows, a box appears and guides you through the main possible options (as shown above). You can…

- Select the “Create…” option to start with a new empty project
- Select the “Browse…” option for opening an existing project (you will have to select its location on disk)
- Select the “Open a Recent Project” option to open an existing project

The Main Window

The Main Window is a control panel that groups main commands of the Workbench and provides all shortcuts for managing other Windows.

From any window, you can press this button to restore and focus the main window.

The main window enables you to control the whole application. Minimizing, restoring or closing the main window acts on all windows.
Below are the main controls available in the Main Window:

FIGURE 8-2

Main Window Controls

1 2 3 4 5 6 7 8

1. **"Always On Top"**: Click on this button to set the main window as always visible.
2. **Create a New Project:** Start with a new empty project.
3. **Browse the disk for opening an Existing Project:** Select its location on the disk
4. **Open the list of Programs for defining the structure of the Application**
5. **Open the Variable Editor**
6. **List of open windows**: This control acts as a taskbar for focusing open windows.
7. **Build**: Press this button to run the compiler to build the application code.
8. **Language**: ICS TRIPLEX configuration is based on the Function Block Diagram language.

Windows

All windows have this button in their toolbar, for restoring the main window. This command is also available from the "Window" menu.

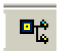
All windows have in their "View" menu commands for displaying or hiding:
- the toolbar
- the menu (when the menu is hidden, it can be displayed from the system menu of the window)
- the status bar
- the information pane (pane on the left that provides information & help links about the tool)

All windows can be freely moved or resized. The software retains memory of the position and size of each window, for each project. Display options are also restored when a window is re-opened.

The list of open windows is always available from the main window. When you minimize a window, it is hidden, but remains in the list of open windows.

All windows include in their status bar a small box that enables searching for a text in the contents of the window

Defining Programs (Loops)



Press this button in the main window to open the program list.

The program list enables you to declare and manage the programs (loops) of your application. It shows the list of all programs according to their execution order in the target.

Creating Programs

Press this button in the toolbar for creating a new program (loop)

Renaming Programs

Each program is created with a default name. You can change it by clicking on its name or by pressing F2 and directly enter the new program name in the list It is possible to enter a description at this time. The description must follow the program name, and be entered between "**(***" and "***)**" separators. For instance:

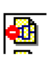
MyProgram (*this is my program*)

Alternatively you can run the "Rename" command from the "File" menu to enter the program name and its description through a dialog box.

Programs must have unique names. The name cannot be a reserved keyword of the programming languages and cannot have the same name as a standard or "C" function or function block. A variable should not have the same name as a declared variable The name of a program should begin by a letter or an underscore ("_") mark, followed by letters, digits or underscore marks. It is not allowed to put two consecutive underscores within a name. Naming is case insensitive. Two names with different cases are considered as the same.

Opening Programs

Press Enter or double click on a program to open it with the FBD editor.



When a program is open, it is marked with a small red sign in the list. An open program cannot be renamed or deleted.

Copying Programs

Use the "File / Copy" command for duplicating the selected program. Copy cannot be used for erasing an existing program. You must enter a new name for the destination of the copy.

Moving Programs

Commands of the "Edit" menu allows you to move a program in the list. Remember that the order shown in the list directly corresponds to the execution order of programs at run time.

Description

Each program may have a multi-line description text. You can edit this text by running the "Edit / Description" command. This command is also available when you edit the program.

Variable Editor

Press this button in the main window to open the variable editor. The same button is available in all program editing windows.

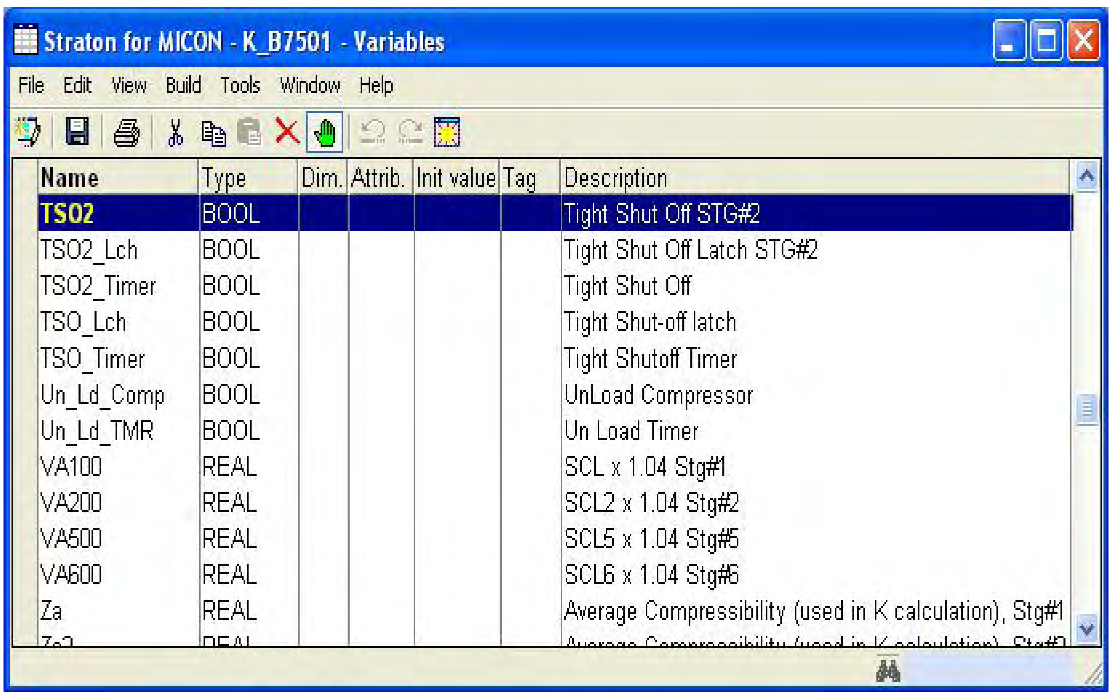
The variable editor is a grid tool that enables you to declare all variables of the application. Variables in the editor are sorted by groups:
- global variables
- variables local to a program.

Please refer to the description of variables in the language reference for a more detailed overview.

Each group is marked with a gray header in the variable list. The "-" or "+" icon on the left of the group header can be used to expand or collapse the group:

FIGURE 8-3

Declaration of Variables



Creating New Variables

Hit INSERT key in the variable editor to create a new variable in the selected group. The variable is added at the end of the group. Variables are created with a default name. You can rename a new variable or change its attribute using the variable editing grid.

Variable List - Active Grid

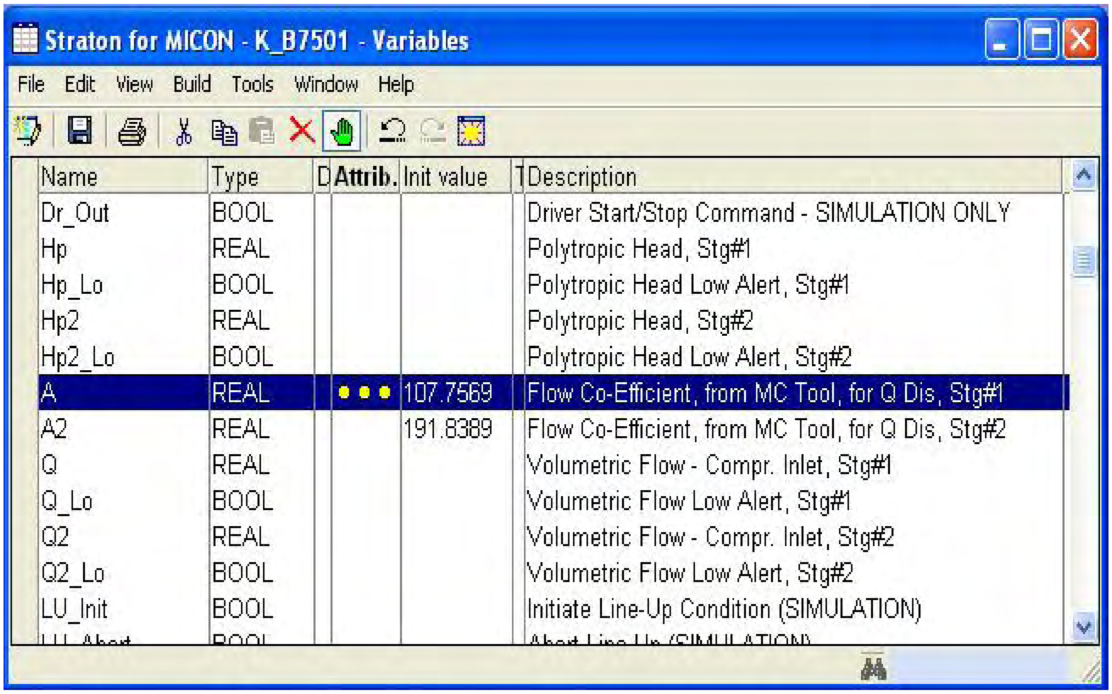
Press this button or hit SPACE bar to enable or disable changes to the active grid.

The variable editor enables you to enter directly each piece of information in the cells of an active grid. The active grid can be activated or disabled at any moment.

When the active grid is disabled, modifying a variable is done through a dialog box. Press the ENTER key when the grid is inactive to open the variable setting box.
When the active grid is active, the name of the selected column is displayed in bold characters. The text of selected cell (or ". . ." if empty) is marked in bold yellow characters:

FIGURE 8-4

Variable Editor Active Grid



At any time you can drag with the mouse column separators in the main grid header for resizing columns.

Sorting Variables

At any moment you can sort variables of a group according to their name, type or dimension. For that you simply need to:
1- move the cursor to the header of the group
2- click on the name of the wished column

The configurator always keeps the original order of declared variables, in order to allow safe On Line change. Each time you insert a new variable or expand/collapse a group, the original sorting is re-applied.

Naming a Variable

To change the name of the variable, enable the modification mode in the grid and move the cursor to the selected "name" cell. Then press ENTER or hit the first character of the new name. Name is entered in a small box. Hit ENTER to validate the name or ESCAPE to cancel the change.

A variable must be identified by a unique name within its parent group. The variable name cannot be a reserved keyword of the programming languages and cannot have the same name as a standard or "C" function or function block. A variable should not have the same name as a program or a user defined function block.

The name of a variable should begin by a letter or an underscore ("_") mark, followed by letters, digits or underscore marks. It is not allowed to put two consecutive underscores within a variable name. Naming is case insensitive. Two names with different cases are considered as the same.

Variable Data Type and Dimension

To change the type and dimension of the variable, enable the modification mode in the grid and move the cursor to the appropriate cell and press ENTER.
Each variable must have a valid data type. ICS TRIPLEX supported data types are BOOL, DINT, STRING and REAL. Do not use other data types as they will not be compiled for ICS TRIPLEX controllers. Variables of STRING data type are only used for the LET_REAL, LET_INT, and LET_BOOL function blocks.

Arrays of these basic data types can also be created by entering a dimension for the variable in the “Dim.” column. The starting index for an array is zero (0). This means that to refer to the first element of an array MyArray in your configuration, you must enter the string MyArray[0]. Note that although the ICS TRIPLEX Graphical Configurator supports arrays, the MICON OPC Server does not support arrays. Any such array variables will not be accessible in a Windows HMI via the MICON OPC Server.

Attributes of a Variable

Each variable have an attribute displayed in the corresponding column of the grid. For each internal variable, you can select the "**Read Only**". Otherwise, the "attribute" column of an internal variable is empty.
To change the attribute of an internal variable, enable the modification mode in the grid and move the cursor to the selected "attribute" cell. Then press ENTER to set or reset the "Read Only" attribute.

Initial Value of a Variable

A variable may have an initial value. The value must be a valid constant expression that fits to the data type of the variable. The initial value is displayed in red if it is not a valid expression for the selected data type.

To change the initial value of a variable, enable the modification mode in the grid and move the cursor to the selected "init value" cell. Then press ENTER to enter the new value. Array variables cannot be initialized in the configurator. To initialize individual array elements, values must be assigned in the configuration.

Variable Tag and Description

The configurator enables you to freely enter for each variable two strings that describe the variable:
- The "Tag" is a short comment, that can be displayed together with the variable name in graphic languages.
- The "Description" is a long comment text that describes the variable

To change the tag or description of a variable, enable the modification mode in the grid and move the cursor to the corresponding cell. Then press ENTER to enter the new text.

Variable Properties

The configurator enables you to embed in the application code extra information for each variable. Run the "Edit / Properties" when a variable is selected in the grid to edit its properties in a separate box. You also can set the "View / Properties" menu option to display variable properties in one more column in the grid.
<u>Publishing properties</u>
Select the "Publishing" tab to enter the pieces of information you want to embed in the target application and publish for extra embedded software. For each variable, you can embed:
- its symbol
- a numerical tag (a number between 1 and 65535)

- a profile name
- a list of OEM defined properties

The list of properties is entered in the grid at the bottom of the box, and corresponds to the selected profile. Refer to OEM instructions for further description of available profiles.
To change a value in the property list, double click on a line, or hit the first character of the value. Press ENTER to validate a value or ESCAPE to cancel the change.

Function Block Diagram (FBD) Editor

The FBD editor is graphical tool that enables you to enter and manage Function Block Diagrams according to the IEC 61131-3 standard. The editor supports advanced graphic features such as drag and drop, object resizing and connection lines routing features, so that you can rapidly and freely arrange the elements of your diagram.

Using the FBD toolbar

The vertical toolbar on the left side of the editor contains buttons for all available editing features. Push the wished button before using the mouse in the graphic area.

Selection: In this mode, you cannot insert any element in the diagram. The mouse is used for selecting objects and lines, select tag name areas, move or copy objects in the diagram. At any moment you can press the ESCAPE key to go back to the Selection mode.

Insert Block: In this mode, the mouse is used for inserting blocks in the diagram. Click in the diagram and drag the new block to the wished position. The type of block that is inserted is the one currently selected in the list of the main toolbar.

Insert variable: In this mode, the mouse is used for inserting variable tags. Variable tags can then be wired to the input and output pins of the blocks. Click in the diagram and drag the new variable to the desired position.

Insert comment text: In this mode, the mouse is used for inserting comment text areas in the diagram. Comment texts can be entered anywhere. Click in the diagram and drag the text block to the desired position. The text area can then be selected and resized.

Insert connection line: In this mode, the mouse is used to wire input and output pins of the diagram objects. The line must always be drawn in the direction of the data flow: from an output pin to an input pin. The STRATON FBD editor automatically selects the best routing for the new line. You can change the default routing by inserting corners on lines. (see below)

You also can drag a line from an output pin to an empty space. In that case the editor automatically finished the line with a user defined corner so that you can continue drawing the connection to the desired pin and force the routing while you are drawing the line.

Insert corner: In this mode, the mouse is used for inserting a user-defined corner on a line. Corners are used to force the routing of connection lines, as the FBD editor imposes a default routing only between two pins or user defined corners. Corners can then be selected and moved to change the routing of existing lines.

Insert network break: In this mode, the mouse is used for inserting a horizontal line that acts as a break in the diagram. Breaks have no meaning for the execution of the program. They just help the understanding of big diagrams, by splitting them in a list of networks.

Insert label: In this mode, the mouse is used for inserting a label in the diagram. A label is used as a destination for jump symbols (see below).

Insert jump: In this mode, the mouse is used for inserting jump symbols in the diagram. A jump indicates that the execution must be directed to the corresponding label (having the same name as the jump symbol). Jumps are conditional instructions. They must be linked on their left side to a Boolean data flow.

FBD variables

All variable symbols and constant expressions are entered in FBD diagrams using small boxes. Press the following button in the FBD toolbar for inserting a variable tag:

Insert variable: In this mode, the mouse is used for inserting variable tags. Click in the diagram and drag the new variable to the desired position.

Double click on a variable tag to open the variable selection box and either select the symbol of the desired variable or enter a constant expression.

Variables tags must then be linked to other objects such as block inputs and outputs using connection lines.

You can resize a variable box vertically in order to display together with the variable name its tag (short comment text), its description text. The variable name is always displayed at the bottom of the rectangle:

tag
description
% location
name

FBD comments

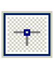
Comment text areas can be entered anywhere in a FBD diagram. Press the following button in the FBD toolbar for inserting a new comment area:

Insert comment text: In this mode, the mouse is used for inserting comment text areas in the diagram. Comment texts can be entered anywhere. Click in the diagram and drag the text block to the wished position.

Double click on the comment area for entering or changing the attached text. When selected, comment texts can be resized

FBD corners

Corners are used to force the routing of connection lines, as the FBD editor imposes a default routing only between two pins or user defined corners. All variable symbols and constant expressions are entered in FBD diagrams using small boxes. Press the following button in the FBD toolbar for inserting a corner on a line:



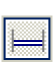
Insert corner: In this mode, the mouse is used for inserting a user defined corner on a line.

You can drag a new line from an output pin to an empty space. In that case the editor automatically finished the line with a user defined corner so that you can continue drawing the connection to the wished pin and force the routing while you are drawing the line.

Corners can then be selected and moved to change the routing of existing lines.

FBD network breaks

Network breaks can be entered anywhere in a FBD diagram. Breaks have no meaning for the execution of the program. They just help the understanding of big diagrams, by splitting them in a list of networks. Press the following button in the FBD toolbar for inserting a new break:



Insert network break: In this mode, the mouse is used for inserting a horizontal line that acts as a break in the diagram.

The break line is drawn on the whole diagram width. No other object can overlap a network break. Break lines can then be selected and moved vertically to another location.

Drawing FBD connection lines

Press this button before inserting a new line.

- The configurator enables you to terminate a connection line with a boolean negation represented by a small circle. To set or remove the boolean negation, select the line and press the SPACE bar.

Connection lines must always be drawn in the direction of the data flow: from an output pin to an input pin. The FBD editor automatically selects the best routing for the new line. Connection lines indicate a data flow between the following possible objects:

Connection lines can also be entered when in the seclection mode by bringing the cursor close to the output of a block/variable. When the cursor is close enough, the arrow cursor of the selection mode automatically changes to four inward pointing triangles. When it does so, the user can start entering a connection line.

To select an existing line on a FBD, simply hold down the CTRL key and click on the line. This will turn the solid line into a dotted line and select it for other operations.

Block: Refer to the help on the block for the description of its input and output pins, and the expected data types for the coherency of the diagram.

Variable: Variable can be connected on their right side (to initiate a flow) or on their left side for forcing the variable, if it is not “read only”. The flow must fit the data type of the variable.

Jump: a jump must be connected on its left side to a Boolean data flow.

Selecting FBD variables and instances

Press this button or press ESCAPE before any selection.

To select the name of the declared variable to be attached to a graphic symbol, you must be in “Selection” mode. Simply double click on the tag name gray area. The following types of object must be linked to valid symbols:

Block: If it is a function block, you must specify the name of a valid declared instance of the corresponding type.

Variable: Must be attached to a declared variable. Alternatively, a variable box may contain the text of a valid constant expression.

Label: Must have a name. The name must be unique within the diagram.

Jump: must have the same name as its destination label.

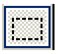
Symbols of variables and instances are selected using the STRATON variable list that can be used as the STRATON variable editor. You can simply enter a symbol or constant expression in the edit box and press OK. You also can select a name in the list of declared object, or declare a new variable by pressing the “Create” button.

Viewing FBD diagrams

The diagram is entered in a logical grid. All objects are snapped to the grid. You can use the commands of the “View” menu for displaying of hiding the points of the grid. The (x,y) coordinates of the mouse cursor are displayed in the status bar. This helps you locating errors detected by the compiler, or aligning objects in the diagram.

At any moment you can use the commands of the “View” menu for zooming in or out the edited diagram. You also can press the [+] and [-] keys of the numerical keypad for zooming the diagram in or out.

Moving or copying FBD objects



Press this button or press ESCAPE before selecting objects.

The FBD editor fully supports drag and drop for moving or copying objects. To move objects, select them and simply drag them to the desired position.

To copy objects, you may do the same, and just press the CONTROL key while dragging. It is also possible to drag pieces of diagrams from a program to another if both are open and visible on the screen.

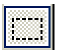
At any moment while dragging objects you can press ESCAPE to cancel the operation.

Alternatively, you can use classical Copy / Cut / Paste commands from the Edit menu. When you run the Paste command, the editors turns in “Paste” mode, with a special mouse cursor. Click in the diagram and move the mouse cursor to the desired position for inserting pasted objects.

Inserting FBD objects on a line

The FBD editor enables you to insert an object on an existing line and automatically connect it to the line. This feature is available for all objects having one input pin and one output pin, such as variable boxes.

Resizing FBD objects



Press this button or press ESCAPE before selecting objects.

When an object is selected, small square boxes indicates you how to resize it with the mouse. Click on the small square boxes for resizing the object in the desired direction.

Not all objects can be resized. The following table indicates possible operations:

Variable	Horizontally and vertically (*)
Block	Horizontally
Labels and jumps	Horizontally
Comment area	In all directions

(*) Resizing a variable box vertically enables you to display together with the variable name its tag (short comment text), its description text. The variable name is always displayed at the bottom of the rectangle:

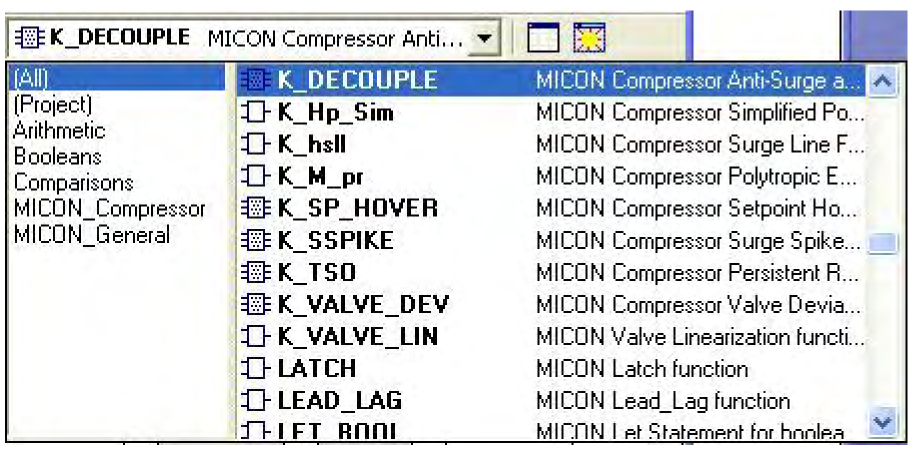
% location
description
tag
name

Selecting function blocks

When inserting a new block in the diagram, you must first select its type in the list of the main toolbar. The list of available blocks is sorted into categories. The "(All)" category enables you to see the complete list of available blocks:

FIGURE 8-5

Function Block Selection Widow



Press the F1 key when a block is selected to have help about its function, input and output pins. In selection mode, you also can double click the mouse on a block of the diagram to change its type, and set the number of input pins if the block can be extended.

Selecting variables and instances

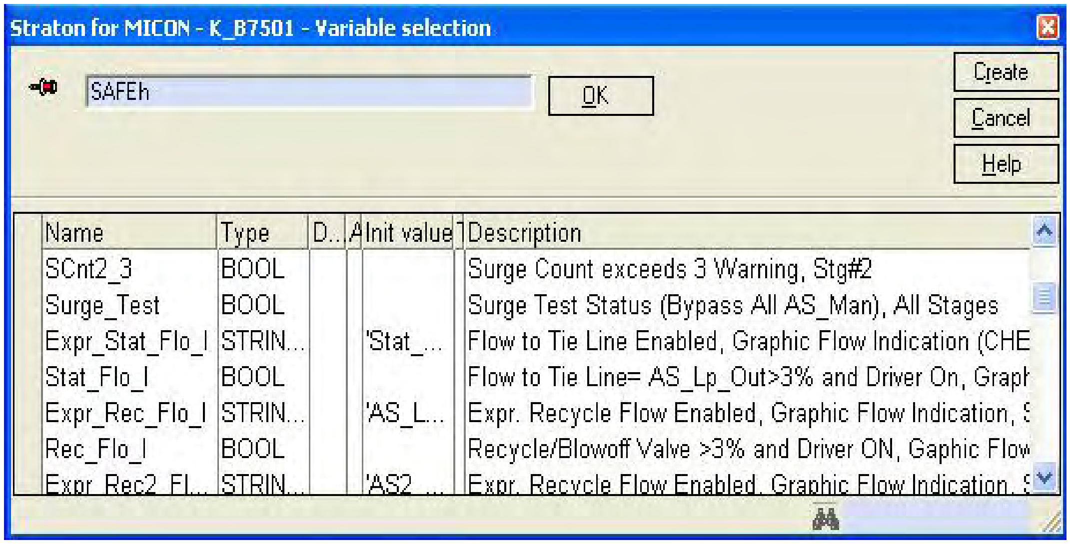
Symbols of variables and instances are selected using the variable list, that can be used in the variable editor. Selecting variables is available from all editors:

- *In FBD diagrams, double click on a variable box or a FB instance name to select the associated variable.*

-

FIGURE 8-6

Selection of an associated variable



You can simply enter a symbol or constant expression in the edit box and press OK. You also can select a name in the list of declared object, or declare a new variable by pressing the "Create" button.

When you press "Create", a new variable is added to the selected group with default name and attributes. The variable grid is turned in input mode so you can immediately enter the name of the variable, select its type and fill other description fields.

At any moment you can hit the SPACE bar when the grid is active in order to switch on or off the input mode.

Quick Search

You can use commands of the "Edit" menu to find and replace texts in the diagram. Alternatively, you can use the "Quick Search" box in the status bar:

This feature can be used in any window.

Simply click on the edit box, enter the text you want to search and press ENTER key. You also can press the small icon for searching the next occurrence of the searched text.

Miscellaneous Workbench Features

Build Project


Press this button in the main window or press F7 key to build the project. When managing or editing programs, F7 key is also available.

The project must be built (compiled) before it is simulated or downloaded to the target.
The compiler runs in a separate window where compiling messages are reported. If compiling errors occur, just double click on an error message for opening the corresponding program at the appropriate location. The compiler also provide commands to:

- "Clean" the project: This command deletes all files created during the last compiling.
- Set the compiling options

You can setup the compiling options by using the "Build / Compiling Options" menu command.

Definitions

The compiler supports the definition of aliases. An alias is a unique identifier that can be used in programs to replace another text. Definitions are typically used for replacing a constant expression and ease the maintenance of programs.

Three levels of definitions are provided:
- common to all the projects installed on your machine
- global to all programs of a project
- local to one program

Common and global definitions can edited from the "Tools" menu of the STRATON main window. Local definitions can be edited from the "Tools" menu of program editors.

Definitions are entered in a text editor. Each definition must be entered on one line of text according to the following syntax:
#define *Identifier* *Equivalence* (* *comments* *)

Below are some examples:

```
#define OFF    FALSE          (* redefinition of FALSE constant *)
#define PI     3.14           (* numerical constant *)
#define ALARM  (bLevel > 100) (* complex expression *)
```

You can use a definition within the contents of another definition. The definition used in the other one must be declared first. Below is an example:

```
#define PI     3.14
#define TWOPI  (PI * 2.0)
```

<u>Note:</u>
The use of definitions may disturb the program monitoring and make error reports more complex. It is recommended to restrict the use of definitions to simple expressions that have no risk to lead to a misunderstanding when reading or debugging a program.

Cross references

The Cross Reference tool enables you searching for declared variables in the whole application. It can also be used as a powerful navigation tool for editing changes in the application programs.

Run the Cross References from the "Tools" menu in the main window or in editors.

Search in all programs

The Cross Reference tool enables you to search for a text in all programs. To do that, just enter the searched text in the edit box and hit enter. You also can use the drop down list to get a text already searched. The text is searched in all the programs of the project. Occurences are listed in the Cross Reference list. You can double click on an occurrence to open the program at the appropriate location.
At any moment you can run the "File / Find in files" menu command to update the list.

Listing unused variables:

Use the "File / List Unused" command to display the list of declared variables that are not used in the programs of the application. This command is particularly useful when cleaning a project.

Find / replace in all programs:

The "File / Replace in files" command enables you to replace a text in all the programs of the application. The cross reference tool provides a visual interface for replacing texts, and enables you to skip some replacements. Use the following buttons when replacing texts in files:

Finds the next occurrence of the searched text in the current file.

Replace the found text and search for the next occurrence.

Replace all the occurrences of the searched text in the current file and continues searching in the next file.

Skip the current file and continues searching in the next file.

Stops the search sequence

All replaced occurrences are listed in the report box.
Notes:

- You must close open programs before running the global Find / Replace command. Texts cannot be replaced in the programs currently open for editing.
- Depending on your license, Global Replace feature may not be available.

Export / Import Projects

The Workbench enables you to archive projects for exchanging them. An archive is a unique compressed ZIP file that contains all the files of a project.

Use the commands of the "File" menu in the main window to save the project to a ZIP file or open a project from a ZIP file.

When you export a project, you can select to embed in the archive the definition of the library elements (function blocks) referenced in the project. It is recommended to check this option if you are using custom functions or blocks that may not be installed on other machines.

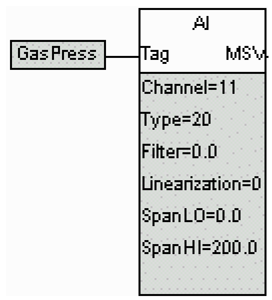
When you import a ZIP archive, the program builds a new project where the archive is decompressed. You can select the name of the created project and its location on the disk. If you decide to import to your local library the library items embedded in the archive, you will have to confirm the copy in case of an overwrite. You can select in which library you want to put imported library elements.

Note that it is not possible to overwrite in the import library an item currently defined in another library.

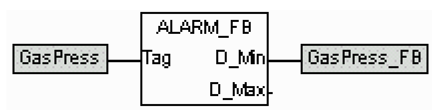
Function Block Diagram (FBD)

A Function Block Diagram is a data flow between constant expressions or variables and operations represented by rectangular blocks. Operations can be basic operations, function calls, or function block calls.

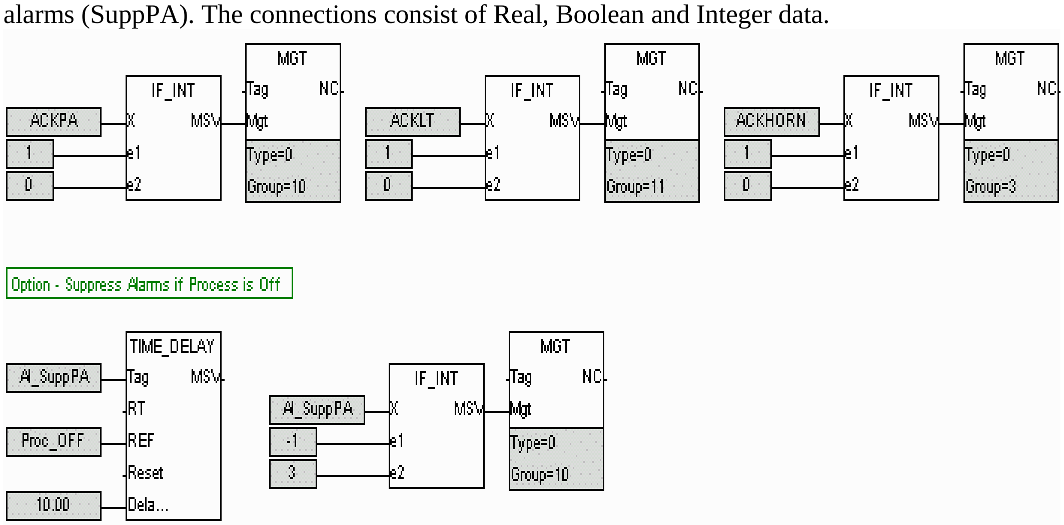
The name of the operation or function, or the type of function block is written within the block rectangle. In case of a function block call, the name of the called instance must be written upon the block rectangle, such as in the example below:



The data flow may represent values of any data type. All connections must be between input and outputs points having the same data type. In case of an analog alarm (such as ALARM_XM, ALARM_FB see below, etc.), the input to the function block is a real value and the output is a boolean connection.



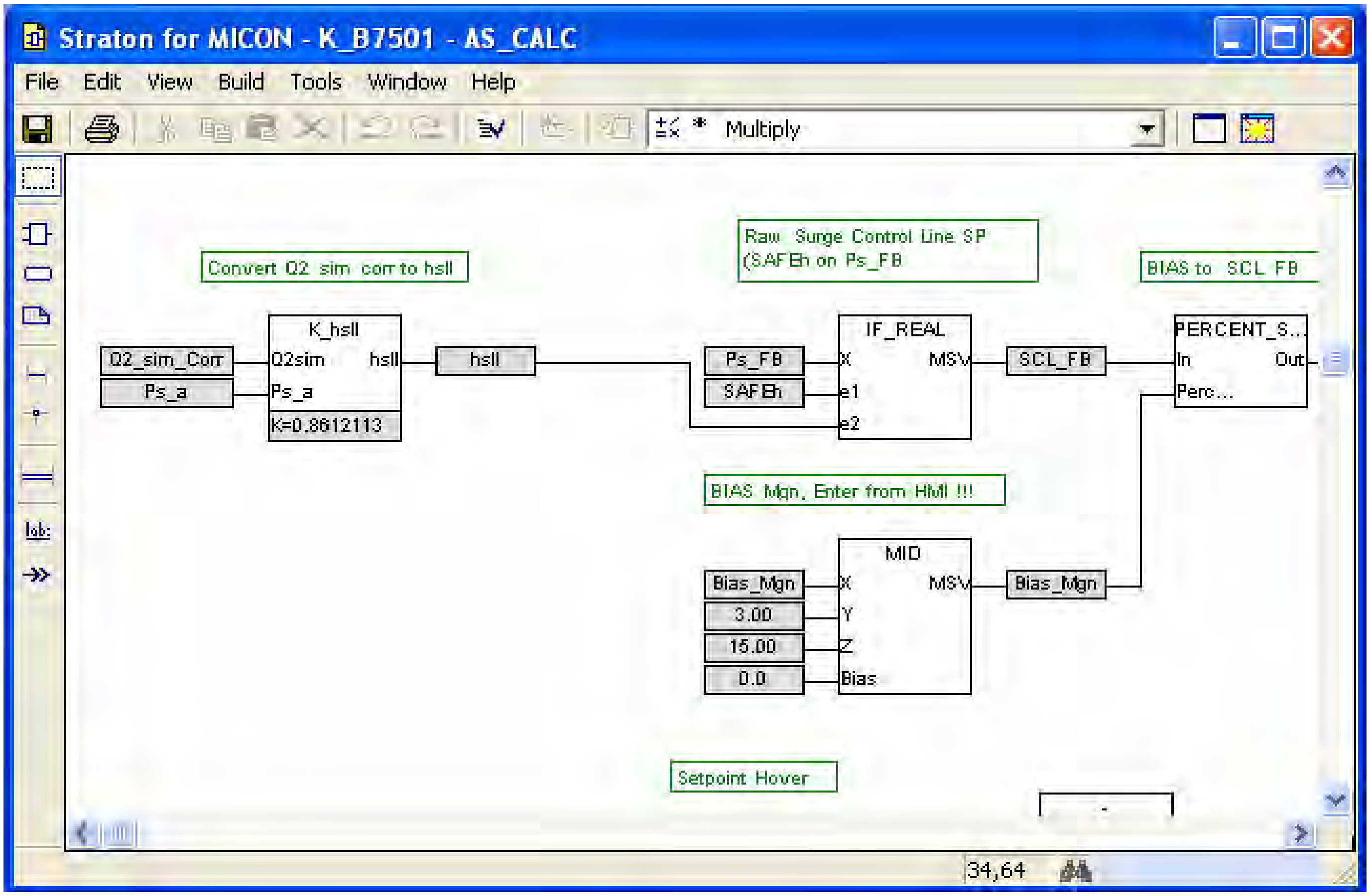
The following is an example of alarm management (MGT) functions with suppression of process alarms (SuppPA). The connections consist of Real, Boolean and Integer data.



The data flow must be understood from the left to the right and from the top to the bottom. It is possible to use labels and jumps to change the default data flow execution.

Loop (Program) Configuration

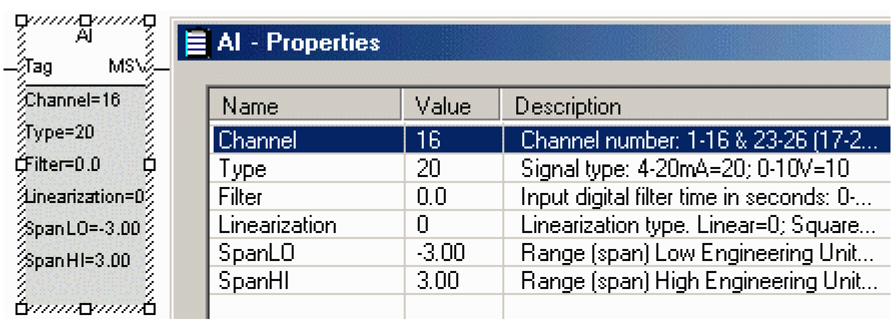
A configuration consists of one or more loops (programs). A loop is a group of Function Blocks that are executed sequentially (from the left to the right and from the top to bottom). The minimum PID loop configuration is shown in the Function Block diagram below.



The allowable argument names and values depend on the function. The Properties of the function may be shown as part of the function block or may be hidden by re-sizing the block. Right-click on the function and select the "Properties" option to show details of the function properties (see below). Double-clicking in the gray area of the function block will also bring up the properties window for that function block.

FIGURE 8-7

Loop Configuration (above) and Function Properties



The Analog Input function (shown above) processes the field analog signal and converts it to engineering units. The output of each function is called the "Main Signal Value" (MSV)

Program Organization Units

An application is a list of programs. Programs are executed sequentially within the target cycle, according to the following model:

Begin cycle
| exchange I/Os
| execute first program
| ...
| execute last program
| wait for cycle time to be elapsed
End Cycle

Programs are executed according to the order defined by the user. The number of programs in an application is limited to 255.

Programs must have unique names. The name cannot be a reserved keyword of the programming languages and cannot have the same name as a standard or "C" function or function block. A program should not have the same name as a declared variable. The name of a program should begin by a letter or an underscore ("_") mark, followed by letters, digits or underscore marks. It is not allowed to put two consecutive underscores within a name. Naming is case insensitive. Two names with different cases are considered as the same.

Data Types

Below are the available basic data types. Although Straton supports more data types, use only the following three data types when creating configurations for the ICS TRIPLEX controllers.

BOOL Boolean (bit) - can be FALSE or TRUE - stored on 1 byte

DINT Signed integer on 32 bits (from -2147483648 to +2147483647)

REAL Single precision floating point - stored on 32 bits

STRING Variable length string with declared maximum length of 255 characters

Variables

All variables used in programs must be first declared in the variable editor. Each variable belongs to a group and must be identified by a unique name within its group.

Groups

A group is a set of variables. A group identifies the variables local to a program. Below are the possible groups:

GLOBAL	Internal variables known by all programs in this project
PROGRAMxxx	All internal variables local to a program (the name of the group is the name of the program)

Data type

Each variable must have a valid data type. It must be a basic data type

Refer to the list of available data types for more information.

Naming a variable

A variable must be identified by a unique name within its parent group. The variable name cannot be a reserved keyword of the programming languages and cannot have the same name as a standard or "C" function or function block. A variable should not have the same name as a program.

The name of a variable should begin by a letter or an underscore ("_") mark, followed by letters, digits or underscore marks. It is not allowed to put two consecutive underscores within a name. Naming is case insensitive. Two names with different cases are considered as the same.

Constant expressions

Constant expressions can be used in all languages for assigning a variable with a value. All constant expressions have a well defined data type according to their semantics. If you program an operation between variables and constant expressions having inconsistent data types, it will lead to syntactic errors when the program is compiled. Below are the syntactic rules for constant expressions according to possible data types:

BOOL: Boolean

There are only two possible boolean constant expressions. They are reserved keywords **TRUE** and **FALSE**.

DINT: 32 bit (default) integer

32 bit integer constant expressions must be valid numbers between -2147483648 to +2147483647. DINT is the default size for integers: such constant expressions do not need any prefix. You can use "**2#**", "**8#**" or "**16#**" prefixes for specifying a number in respectively binary, octal or hexadecimal basis.

REAL: Single precision floating point value

Real constant expressions must be valid number, and must include a dot ("**.**"). If you need to enter a real expression having an integer value, add "**.0**" at the end of the number. You can use "**F**" or "**E**" separators for specifying the exponent in case of a scientist representation. REAL is the default precision for floating points: such expressions do not need any prefix.

Examples

Below are some examples of valid constant expressions

TRUE	TRUE boolean expression
FALSE	FALSE boolean expression
123456	DINT (32 bit) integer
16#abcd	DINT integer in hexadecimal basis
0.0	0 expressed as a REAL number
1.002E3	1002 expressed as a REAL number in scientist format

Below are some examples of typical errors in constant expressions

BooVar := 1;	0 and 1 cannot be used for booleans
1a2b	basis prefix ("16#") omitted

Adaptation of Pre-Defined Configuration

The T6200”C” or T6200”D” controller is delivered as a pre-configured package in Function Block Diagram format.

System Requirements

The T6200 configuration file utilizes the MICON OPC Configuration Studio interface as the configuration upload and download utility and the Straton for MICON FBD programming tool. To develop/adapt an application with the Configuration Studio software, the following hardware and software is recommended as a minimum for the Host computer...

- IBM-compatible computer with an Intel compatible processor
- Windows NT/XP/2000 operating system
- 128 MB of RAM
- 200 MB of free hard disk space
- CD-ROM drive (only for initial setup)
- Ethernet connection for downloading applications

Installing the OPC Server

The installation CD is used to install the MICON OPC Server. The OPC Server runs on Microsoft Windows NT/XP/2000. Refer to Software Installation, Section Four of this manual, for installation instructions.

Installing the Straton for MICON Configurator Workbench

The installation CD is used to install the STRATON configuration tool. The development environment runs on Microsoft Windows NT/XP/2000. Refer to Software Installation, Section Four of this manual, for installation instructions.

Installing the Straton for MICON configurator includes the following three steps:

a) *Install the WIBU software by running the program “\WIBU\WkRt-Int.exe” on the installation CD. On most screens, use the default options.*
b) *Then run the program “\Straton\Setup.exe” on the Installation CD and follow the prompts. By default, the program will install in the folder “C:\Program Files\Straton for MICON”. A group titled “Straton for MICON” will be created in the “Start Menu->Programs” menu. Before running the program, is necessary to enter the license code. The license code is available on the installation CD in a file called “license.txt”.*
c) *To enter the license code, run the “License” program from the “Start Menu->Programs->Straton for MICON” program group. Enter the license code provided in the license.txt file.*

Finally, to run the Configurator, select the “Straton for MICON” option from the same location.

Configuration File Interface

The Configuration File Interface of the OPC Server permits to interact with the pre-defined configuration file. The Configuration File Interface task allows for uploading, downloading, compiling, executing, preserving, halting and deleting of the T6200 controller configuration file.

Controller T6200 Tag Database

The T6200 is delivered with a pre-configured Application Tag database. The pre-configured Application Tag database consists of <u>generic tags</u> (Ps, Pd, AS_PID, Cap_PID, AO_01, etc.). It is recommended that this generic tag structure be retained and that custom tag requirements be accommodated by simple graphic labels on faceplates, etc. (not database tag changes) at the Operator Interface level (refer to Section Six of this manual).

Changing/Adapting the T6200 Configuration

Before changing the configuration file, you should consider the pre-defined structure of the T6200 application. Also, make sure to take the following T6200 database Syntax Rules into account. For new applications, you can use an existing application, saving it under different names.

Database Updates/Additions Recommendation:

For most applications there **are no update or addition requirements of the pre-defined Tags**.

If updating/changing Application Tags or Labels is required, keep the following syntax rules in mind:

- Although the maximum Tag and Label length is 16 characters, **Tags and Labels should be as short as possible (typically not exceeding 12 characters)**
- **Tags and Labels must begin with a letter**. They can be composed of letters, numbers, and the underscore (_) character. They cannot contain spaces (blanks)
- The Tag or Label name must be **different** from the Function Compilers' **Reserved Tag names**
- While Tag names are NOT case sensitive, **both uppercase and lowercase characters should be used to make tag names more clear.** For internal processing lower case letters are converted to upper case (therefore on-line Tag monitoring will show all upper case letters)

Global Tags/Variables -

Global Tags/Variables, or Tags for short, are assigned to system variables and can be used/accessed anywhere within the system network. Each tag must be unique and must end with a period (example: AIN_10**.**).

Local Tags –

Local Tags are defined in the firmware and consist of two parts, the loop tag (a Global Tag) and a tag such as PV, SP_TARG, DEV, etc. For example the Local Tag for the Process Variable (PV) of a loop whose tagname is LOOP_1 is: LOOP_1.PV
Local Tags such as… PV, SP_CUR, SP_TARG, DEV, RATIO, BIAS, OUT, MODE, CGAIN, CRESET, CRATE, MANUAL_RESET, PERIOD, SCAN_TIME exist in each loop.

Peer-to-Peer Tags –

Peer-to-Peer tags use the Controller Tag, a double colon, followed by the Global Tag. For example C0001::AIN_15 or C001::!DI_23.

Labels **–**

Labels are not tags, they are user-defined symbols or code names that are assigned to configuration steps and are used only as address reference for "go to" or "read" (access) functions.

When changing/adding configuration, **make sure that any and all <u>new</u> Tags are defined.**

T6200 FBD Configuration File Verification

The following relates to the pre-configured Straton for MICON **Function Block Diagram – FBD** - configuration file for a T6200 multi-stage anti-surge and capacity control application.

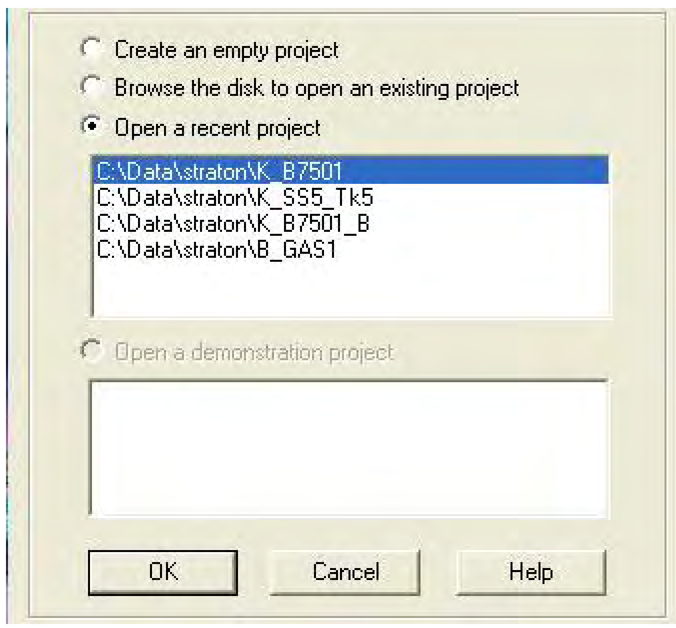
Launch the FBD Configurator Workbench

On your computer Desktop click on the Straton for MICON Icon and select the folder in which your T6200 compressor configuration file, generated by the FBD programming tool, resides. The configurator home page will pop-up. Click on the desired file.

FIGURE 8-8

Straton for MICON

Home Page



The main window control panel than provides the commands of the Workbench.

FIGURE 8-9

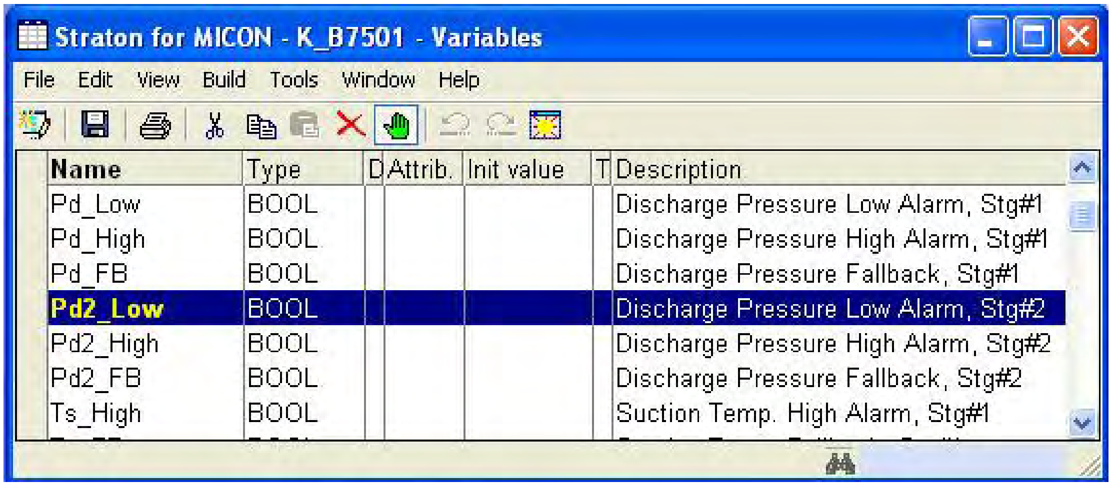
Window Commands of the Workbench

T6200_FBD Variable Editing

- **Variable Editing**: On the FBD configurator Main Window, press the button to call up the Variable Editor.

FIGURE 8-10

Variable Editing



Variables in the editor are sorted by groups. Each group is marked with a gray header in the variable list. The "-" or "+" icon on the left of the group header can be used to expand or collapse the group.

The pre-configured Application Tag (Variable) database consists of generic tags (h, Pd, Pd, FB, Pd_High, Ps, etc.). As mentioned before, it is **recommended that this generic tag structure be retained and that custom tag requirements be accommodated by simple graphic labels on the Operator Interface** (not database tag changes, refer to Section Six of this manual).

Tags (Variables) may have local, global or peer scope. Global tags include all tags which are specifically created as global and all loop names. Local tags belong to one loop and are automatically created from within that loop.

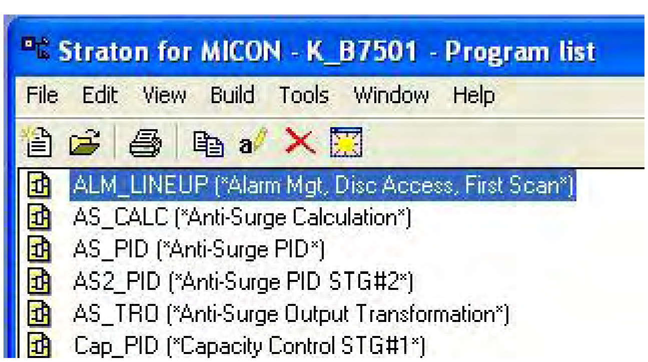
Peer tags are global as well. Peer tags are however not part of Variable Editing but are handled by the Peer-to-Peer EXPORT and IMPORT functions (see FBD Function Editing). Each of these functions provides for nine Tags (3 real, 3 boolean, 3 integer).

T6200 FBD Function Editing

On the FBD Main Window, press the button to open the program (loop) list.

FIGURE 8-11

Program (Loop) List



Select the desired loop to view the function blocks.

T6200 Loop Organization

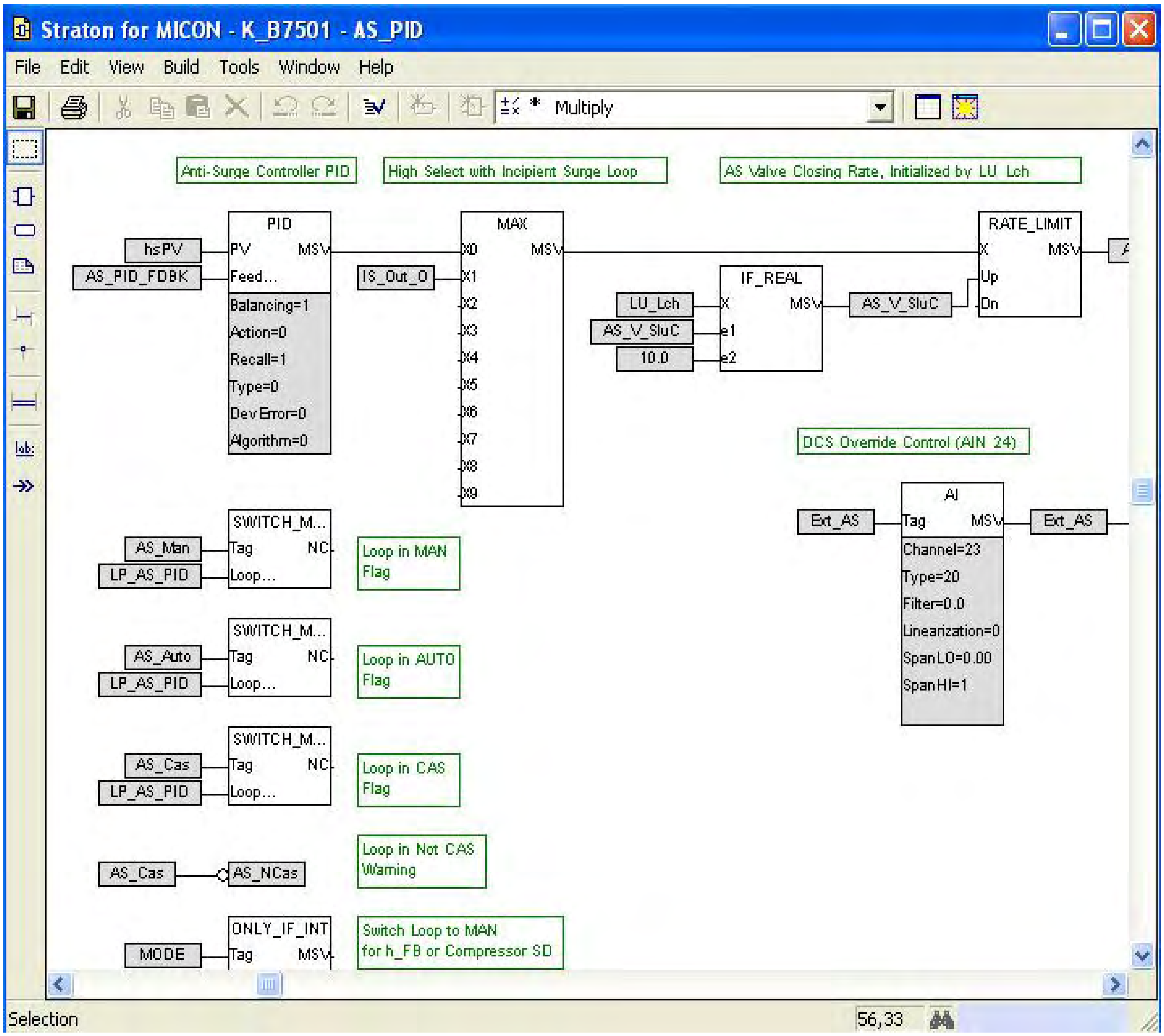
FIGURE 8-12

Function Block Arrangement with Execution Numbers

Function Block Arrangement:

The Function Blocks are organized from left to right and from top to bottom to confirm to the data flow. Although it is possible to use labels and jumps to change the default data flow execution, it is recommended to arrange the function blocks in a logical left-to-right, top-to-bottom manner in order to facilitate configuration documentation and analysis.

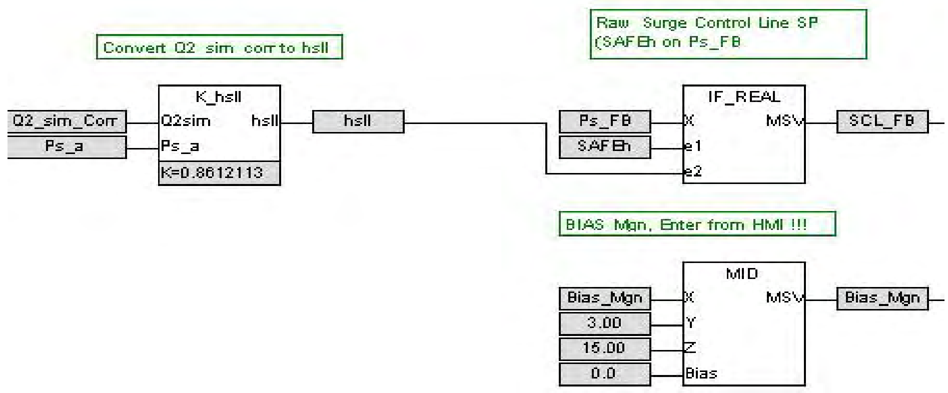
Click Tools and Execution Order to view and verify the numbering sequence of the functions to assure that they confirm with the desired data flow sequence.



Function Blocks:
The name of the operation or function, or the type of function block is written within the block rectangle (such as K_sll below). In case of a function block call, the name of the called instance must be written upon the block rectangle.

FIGURE 8-13

Function Block Name and Type



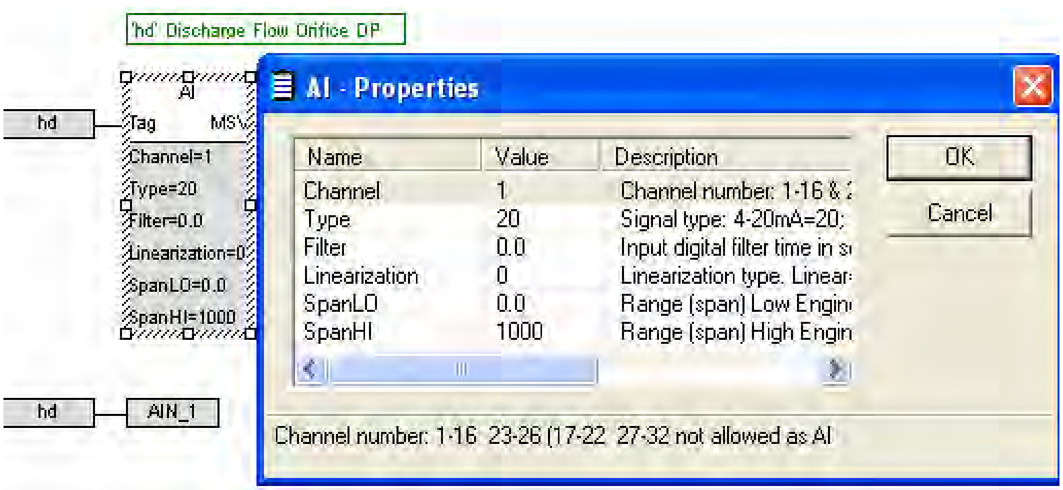
The data flow may represent values of any data type. All connections must be between input and outputs points having the same data type

T6200 Analog Input FB

Analog Input Block Editing:

FIGURE 8-14

AI Function Block



Analog Input Parameter Adaptation: Verify all AI parameters to make sure that they meet the requirements of your application.

- The Channel number to which the analog input is connected to
- The Input signal type (20= 4-20 mA)
- The Filter requirements of the analog input signal, if any
- The Linearization, Linear or Square Root (do not select square root for h or hd inputs!)
- The Transmitter range of analog input in **Engineering Units**

If special linearization, oscillation monitoring, etc is required, specify AI_C in place of AI.

Transmitter and Fallback Alarm Block Editing:

FIGURE 8-15

XM Alarm Properties

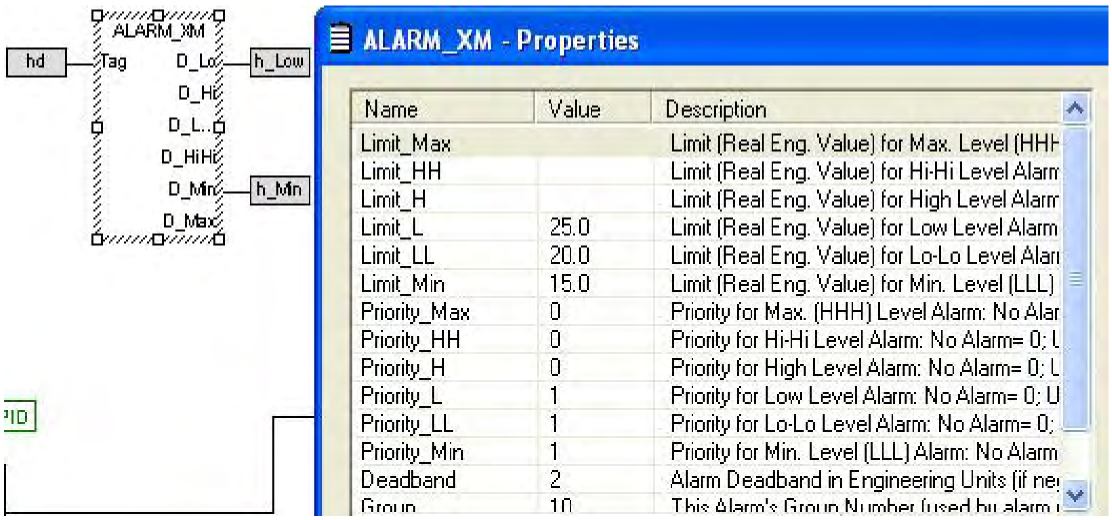
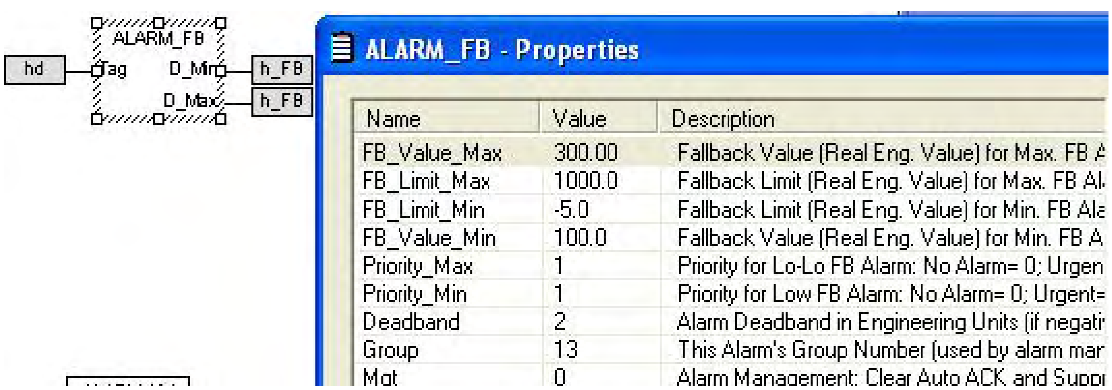


FIGURE 8-16

FB Alarm Properties



Analog Input Alarm Parameter Adaptation: Verify all alarm parameters to make sure that they meet the requirements of your application.

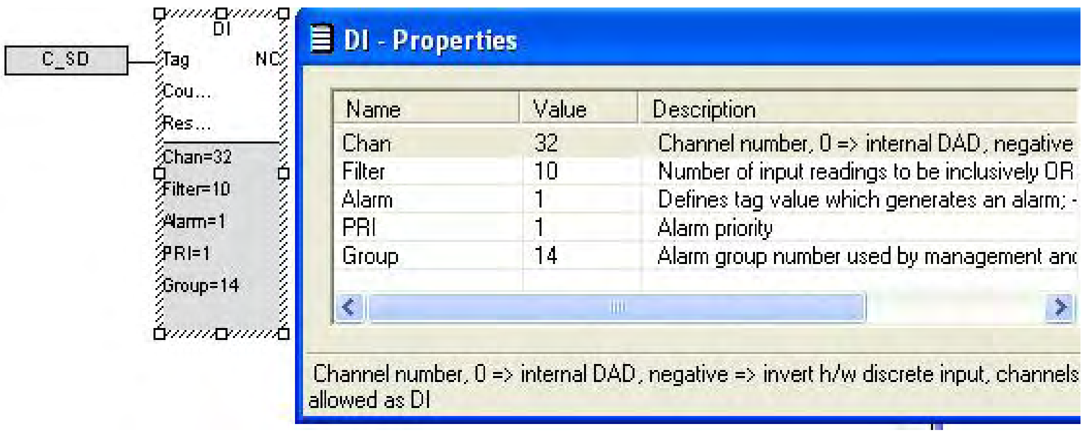
- The alarm Limit settings
- The alarm Priorities
- The alarm Deadband settings (for transmitter, XM, alarms make sure to enter a Deadband)
- The alarm Group selection
- The alarm Management- Mgt – if there is any conditional suppression requirement

T6200 Discrete Input FB

- **Discrete Input Block Editing**:

FIGURE 8-17

DI Function Block

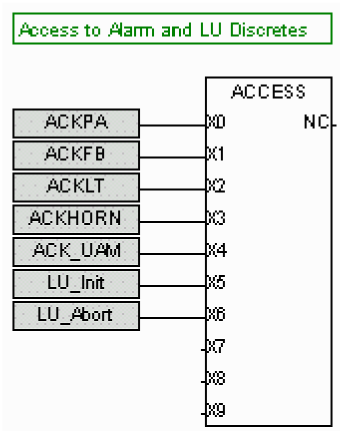


Discrete Input and Alarm Parameter Adaptation: Verify <u>all</u> DI parameters to make sure that they meet the requirements of your application.

- The Channel number to which the discrete input is connected to
- The Filter requirements of the analog input signal, if any
- The alarm Priorities
- The alarm Group selection

Access to Discretes

To change the logic statue of a virtual discrete (VDI) or internal switch (IS) via the Operator Interface, the VDI or IS has to be configured as accessible. This also applies to Alarm and Line-Up configuration.

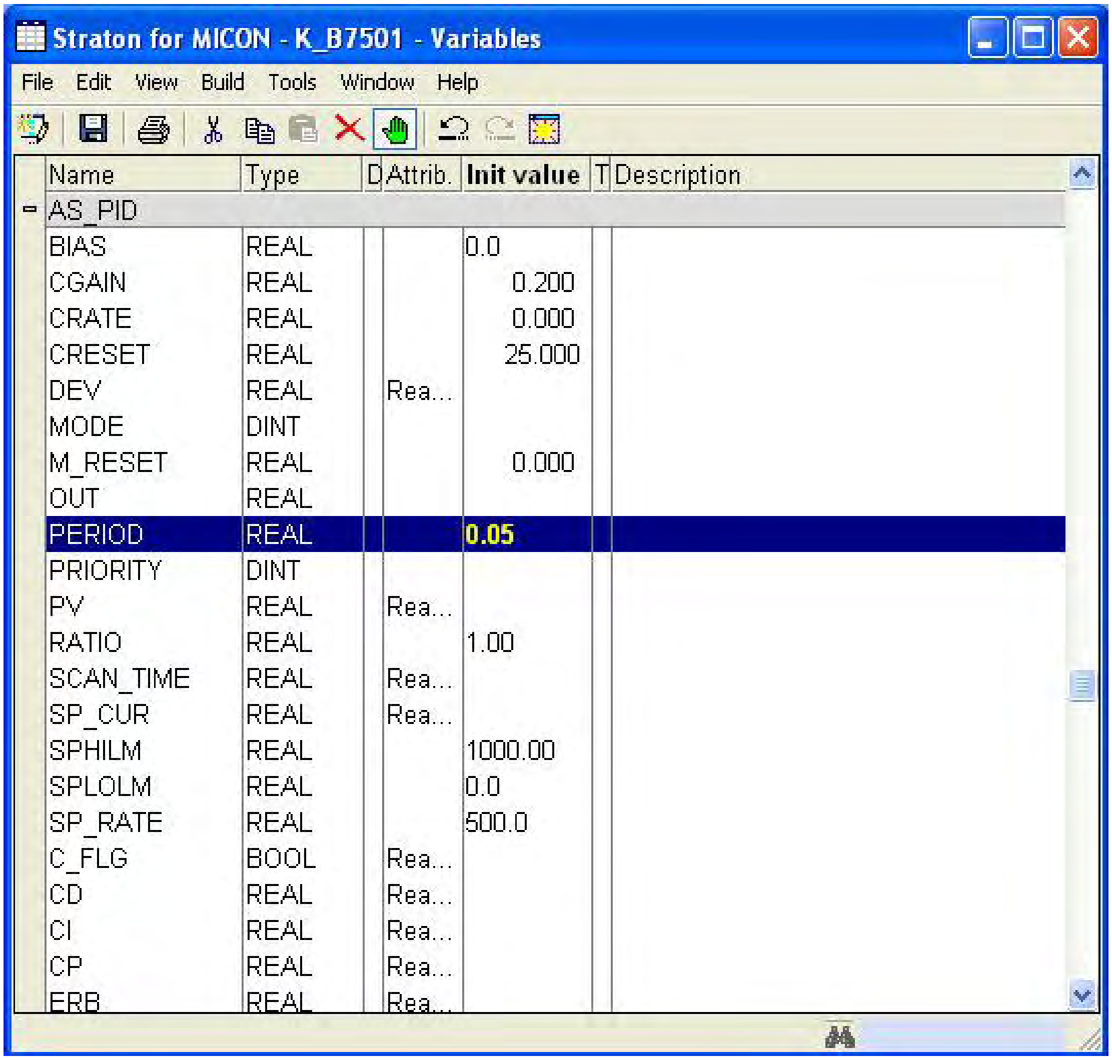


T6200 – PID FB & Variables

- **Loop Variable Editing** : On the FBD configurator Main Window press the button to call up the Variable Editor.

FIGURE 8-18

Loop Variables



Name	Type	D	Attrib.	Init value	T	Description
AS_PID						
BIAS	REAL			0.0		
CGAIN	REAL			0.200		
CRATE	REAL			0.000		
CRESET	REAL			25.000		
DEV	REAL		Rea...			
MODE	DINT					
M_RESET	REAL			0.000		
OUT	REAL					
PERIOD	REAL			0.05		
PRIORITY	DINT					
PV	REAL		Rea...			
RATIO	REAL			1.00		
SCAN_TIME	REAL		Rea...			
SP_CUR	REAL		Rea...			
SPHILM	REAL			1000.00		
SPLOLM	REAL			0.0		
SP_RATE	REAL			500.0		
C_FLG	BOOL		Rea...			
CD	REAL		Rea...			
CI	REAL		Rea...			
CP	REAL		Rea...			
ERB	REAL		Rea...			

Loop Parameter Adaptation: Verify the loop parameters to make sure that they meet the requirements of your application.

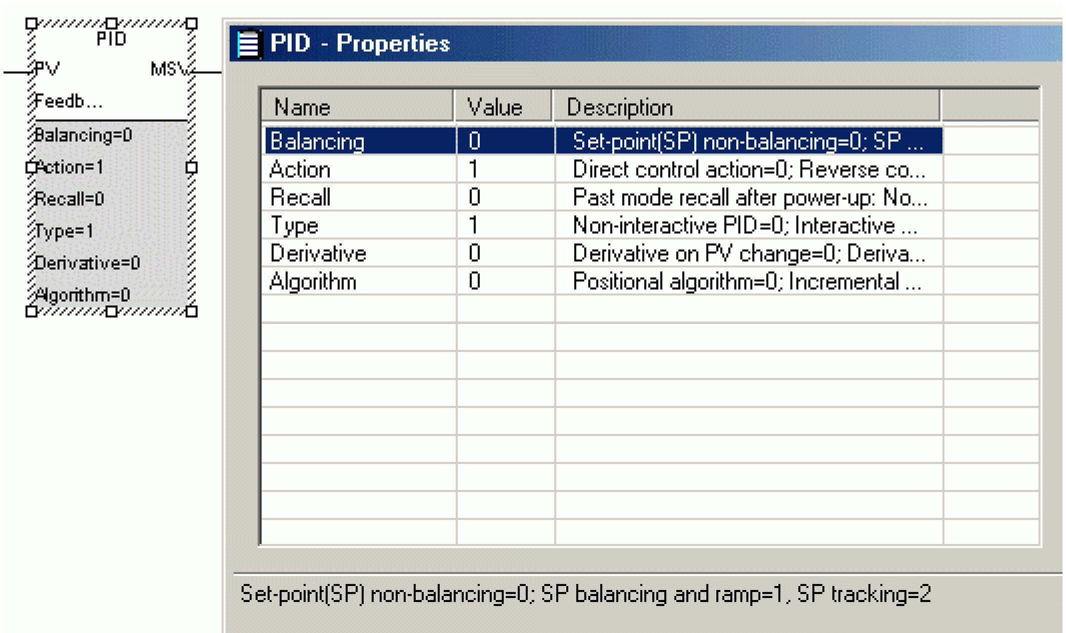
Check the following…

- PID Tuning Constants, CGAIN, CRESET, CRATE: Enter proper settings for each loop
- Loop Scan Time, PERIOD: Except for special requirements (AS_PID), select 0.30 seconds
- Loop Scan Priority, PRIORITY: Except for special requirements, leave default setting
- Ratio Value of PID block, Ratio: Except for Ratio requirements, select 0
- Bias Value of PID block, Bias: Except for Bias requirements, select 0
- Loop Span Limits, SPANLO and SPANHI: Enter desired Span limits for each loop
- Setpoint Limits, SPHILM and SPLOLM: Enter desired settings for each loop
- Setpoint Rate Limit, SP_RATE: Enter desired settings for each loop

- **PID Function Block Editing** : On the configurator Main Window press the  button to open the Program (Loop) List, then click on the PID block in the selected loop.
-

FIGURE 8-19

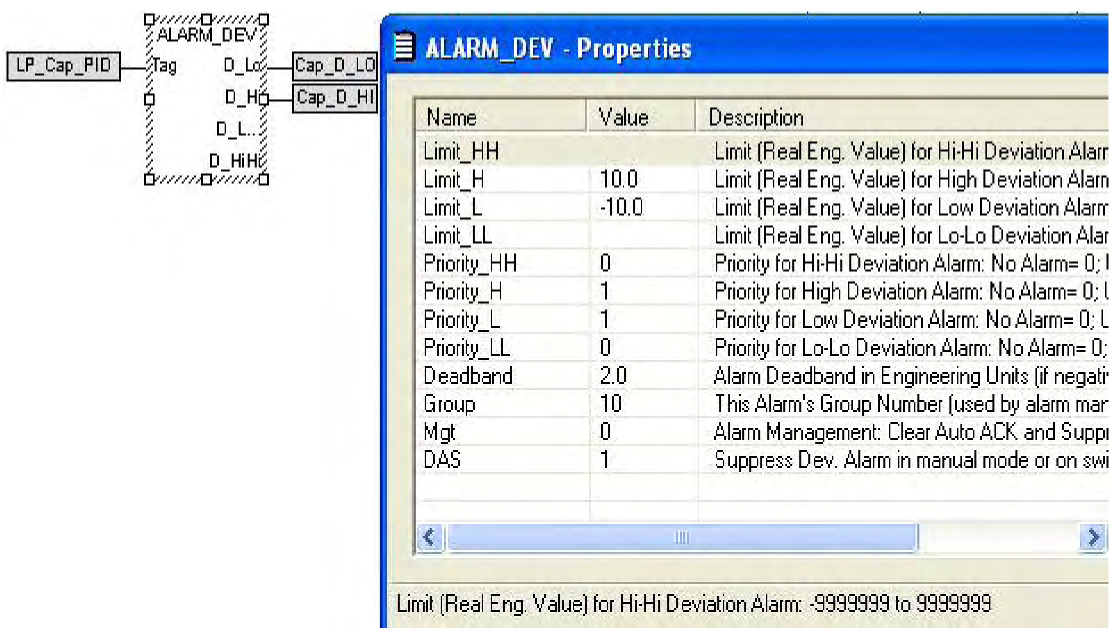
PID FB Configuration



Deviation Alarm Block Editing:

FIGURE 8-20

DEV Alarm Properties



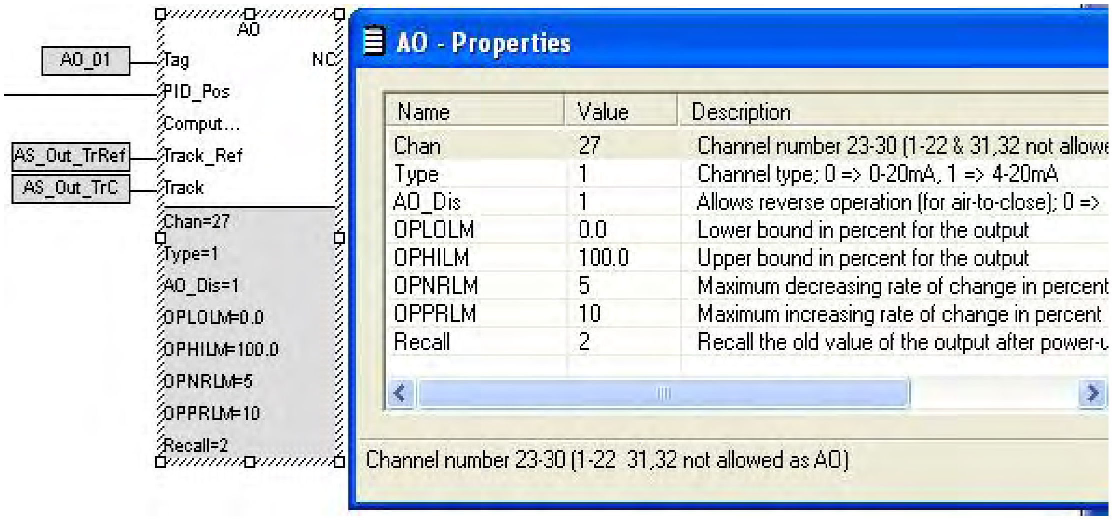
PID Parameter Adaptation: Verify all PID and DEV alarm parameters to make sure that they meet the requirements of your application.

T6200 – Analog Output Definition

- **Analog Output Block Editing**:

FIGURE 8-21

AO FB Configuration



Analog Output Parameter Adaptation: Verify <u>all</u> AO parameters to make sure that they meet the requirements of your application.

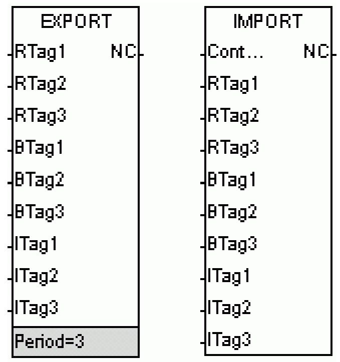
- The Channel number to which the analog output is connected to
- The Output signal type (1= 4-20 mA)
- The Output display indication, AO_Dis: 0= Direct indication (air to open); 1= Reverse indication (air to close)
- The Lower bound (in percent) for the output, OPLOLM: Normally 0
- The Upper bound (in percent) for the output, OPHILM: Normally 100
- The max. Decreasing Rate (in % per sec), OPNR.M: Normally 100
- The max. Increasing Rate (in % per sec), OPPR.M: Normally 100
- The Recall of the old output value, Recall: 0= Start with zero; 1= Start at old value; 2= Same as PID in this loop (default)

T6200 – Export-Import Definition

- **Export and Import Block Editing**:

FIGURE 8-22

Export & Import Blocks

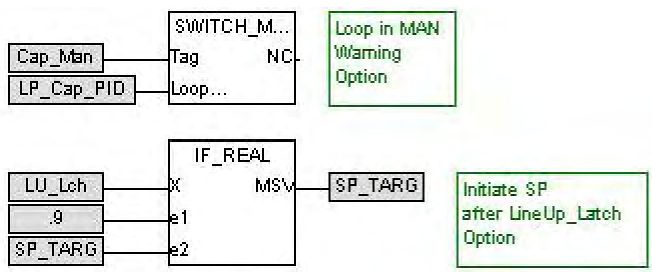


Peer tags are handled by the Peer-to-Peer EXPORT and IMPORT functions. Each of these functions provides for nine Tags (3 real, 3 boolean, 3 integer). The Period entry of the Export function defines the frequency at which to transfer the Tags. The Controller connection of the Import function requires a Variable input with the real Controller Tag. All Peer tags are global.

- **Provision for SP Initialization and Loop in MAN Warning**:

FIGURE 8-23

Initiate SP and Loop in MAN Blocks



For operation convenience Line-Up functionality, initialization of Setpoints after process start up is typically desired. Also, Loop in MANual warning is often requested. There are many other function blocks that facilitate process unit and plant operations. Contact ICS TRIPLEX's application engineers at the factory for additional information.

T6200 – Project Build

Project Compilation : On the configurator Main Window press the button to re-build the project if any changes are made to the configuration.

The project must be built (compiled) before it is converted to the MLP language file and then downloaded to the T6200 controller via the OPC server.

The compiler runs in a separate window where compiling messages are reported. If compiling errors occur, just double click on an error message for opening the corresponding program at the appropriate location. The compiler also provide commands to:

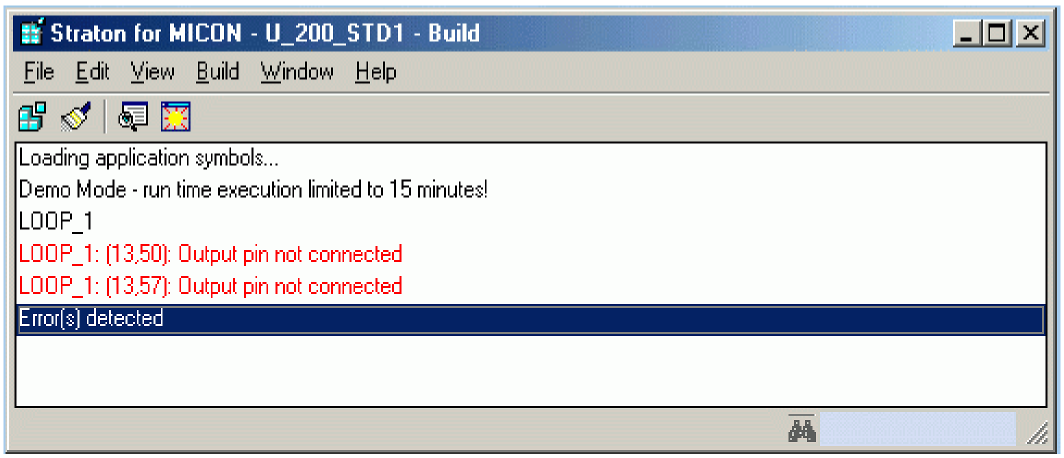
"Clean" the project: This command deletes all files created during the last compiling.

Note: When basic configuration changes are made to applications, it is recommended to “Clean” the project and then press the project compilation button again.

Project with compilation errors:

FIGURE 8-24

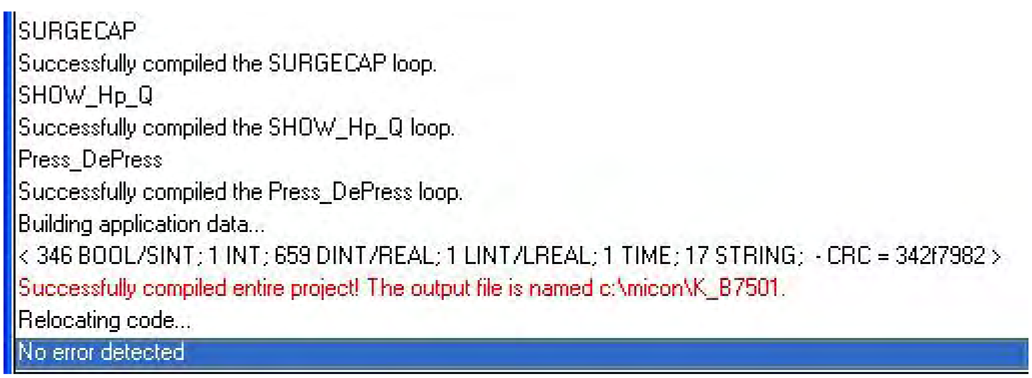
Compilation Message: Errors detected



Project without compilation errors:

FIGURE 8-25

Compilation Message: No Errors



Refer to OPC Server Configuration File Interface for information on downloading the MLP protocol file to the T6200 controller.

T6200 – Variable, Alarm & Tuning Settings

Enter/verify <u>all</u> settings & make sure that they comply with the requirements of **<u>your</u> application**. Ensure that these settings are defined in the Straton for MICON FB Program and Variable List. Setting apply to **each compression stage**!

Table T1. - Anti-Surge Variables – Initial Settings

Name	Init. Value	Description
K		Co-Efficient= (R2/R1)*(Za/Zs)*(1/A**2) – Enter K value from M/C Tool
M_pr_FBset		M_pr Fallback Value (k-1/K*Pe), FB on Ps|Ts Fail – Verify with M/C Tool
SAFEh		SAFE 'h' Fallback Value if Suction Press XTMR fails – Verify with M/C Tool
A		Flow Co-Efficient (for Q display) – from M/C Tool
Zs		Inlet Compressibility (indication, used in K and Q calculations)
Zd		Discharge Compressibility (indication)
MW_Set		Molecular Weight Entry (for display only, not used in surge calculations)
R1		R1 Gas Constant for Q and K calculations (EU=10.73, MU= 0.08478)
R2		R2 Gas Constant for Hp and K calculations (EU= 1545, MU= 847.80)

Table T2. - Anti-Surge and Incipient Surge Fallback (FB) Alarm Values and Limits

Name	Description	Value_Max	Limit_Max	Limit_Min	Value_Min
Ps	Suction Pressure				
Pd	Discharge Pressure				
Ts	Suction Temp				
Td	Discharge Temp				
h	Flow 'h' (Suct or Disch)				
Incip_SG	SurgeGard Input				

Table T3. - Anti-Surge and Incipient Surge Process (XM) Alarm Limits for Compressor

Name	Description	Max	HH	H	L	LL	Min
Ps	Suction Pressure						
Pd	Discharge Pressure						
Ts	Suction Temp						
Td	Discharge Temp						
h	Flow 'h' (Suct or Disch)						
Incip_	SurgeGard Input						

Recommended Alarm Levels: Ps=High-Low-Min; Pd=High-Low; Ts=High; Td=High; h=Low-Min; Incip_SG= High

Table T4. - Anti-Surge Op Tracking and Surge Spike Settings

Name	Init. Value	Description
SP_Hv_Thr		Setpoint Hover (Op Tracking) Enable % above SCL-Surge Control Line
SP_Hv_Mgn		Setpoint Hover (Op Tracking) Margin (track % to Op Point)

SP_Hv_Dec		Setpoint Hover (Op Tracking) Dec Rate (inches or mm H2O per minute)
SSP_Ampl		Surge Spike Amplitude Threshold (hsPV inches or mm H2O)
SSP_Rate		Surge Spike Dec Rate Threshold (hsPV inches or mm H2O per second)
SSP_SCL_Offset		% of SCL (Surge Control Line) increment (per number of Surge Spikes)
SSP_Valve_Offset		% of Recycle/Blowoff Valve increment (per number of Surge Spikes)

Table T5. - Anti-Surge and Incipient Surge PID Tuning Settings

Name	Init. Value	Description
Bias_Mgn		% Bias Addition to SCL (Surge Control Line) – Enter from HMI
AS_V_SluC		AS Valve (Recycle/BV) Slew Closing Rate (typically set at 1% per sec)
AS_G_BP1		Adapt Gain Break Point (< SCL; Slope m1 gain increase if below BP1)
AS_CGAIN		AS_PID.Tuning_Proportional (Gain is typically set at 0.20)
AS_CRESET		AS_PID.Tuning_Integral (typically preset at 20 repeats/min)
IS_CGAIN		IS_PID.Tuning_Proportional (Gain is typically set at 0.20)
IS_CRESET		IS_PID.Tuning_Integral (typically preset at 15 repeats/min)

Table T6. - Decoupling and Pressure Rate Constraint Settings

Name	Init. Value	Description
DC_LeadT		Decoupling Lead Time in Seconds
DC_Ampl		Decoupling Signal Amplitude (Recycle/Blowoff Valve % change, 0-1)
DC_Rate		Decoupling Signal Rate (Recycle/Blowoff Valve Rate of change)
Ps_RC_Set		Suction Pressure Rate Constraint (units/sec); Alt. Pd, PR, h constraint

Table T7. - Loadshare Efficiency Settings

Name	Init. Value	Description
LSE_SP_Rate		Efficiency Setpoint Ramp Rate Setting
LSE_SPHILM		Efficiency Setpoint High Limit
LSE_SPLOLM		Efficiency Setpoint Low Limit

Table T8. - Capacity Control Settings

Name	Init. Value	Description
Cap_CGAIN		Cap_PID.Tuning_Proportional (Gain is typically set at 0.40)
Cap_CRESET		Cap_PID.Tuning_Integral (typically preset at 10 repeats/min)
Cap_D_Hi		Cap PID Deviation Alarm High (eng units)
Cap_D_Lo		Cap PID Deviation Alarm Low (eng units)
LU_Lch_P		Initialization SP Value (Ps, Pd, PR) after LineUp Latch Option

Table T9. - Other Loops – Turbine, OL, SV, etc. - Control Settings

Name	Init. Value	Description

Note: The above settings do not cover all applications. Specific applications may require Overload PID settings, Valve Motion Error Detection settings, Persistent Recycle/Blowoff Valve Motion Error Detection, etc settings. Turbine drivers require settings for startup/shutdown sequences, critical speed settings, etc (see configuration examples of turbine driven compressors).

MICON OPC Server Start-up

The MICON OPC server (MOPS) is used to interact with the T6200 controllers for Configuration and Operator Interface purposes. Although most of the following description is related to communication setup and explanation of OPC server screens and fields that are not directly associated with control configuration, it is helpful to understand the full functionality of the OPC server. **If you are already familiar with the basic functionality of the MICON OPC server, you can directly proceed to the OPC Server Configuration Interface section**

MOPS can be started up in two ways. The manual mechanism involves executing the application “mlpcomm2d.exe” which must have been installed on the hard drive when the OPC server was installed. Automatic startup of MOPS occurs when an OPC client tries to make a connection to MOPS and MOPS is not already running on the computer. The automatic startup occurs even if the connection request from the OPC client comes over a network from a remote computer.

When MOPS starts up, it reads the registry where it has saved the following parameters:
window location, window minimization, enable/disable downloading of time, and the refresh rate in seconds.

If MOPS was shut down the last time in the minimized mode, then it will start up again in the minimized mode. If MOPS was shut down maximized on the desktop, then it reads the registry for the window co-ordinates and starts up at the same location on the desktop. Enabling/disabling of time download and Refresh rate are described below.

When MOPS is started up, it reads a file “C:\ICS Triplex\devlist.txt” for Ethernet addresses for the controllers. The devlist.txt file is a simple ASCII text file, contains three fields, and must be formatted as follows:

<dev_name>, <primary Ethernet address>, <secondary Ethernet address>,CR,LF

Multiple records can be added on separate lines with one record for each device. The commas delimiting each field and the carriage return and line-feed delimiting each record are not optional. An example file for an installation with five controllers would be as follows:

```
U200_5,0:54:19:OB:00:02,0:19:be:1a:0:02,
R100,00:86:46:f8:06:02,00:9a:46:f8:06:02,
R101,00:62:af:3f:00:2,0:2:be:4c:0:02,
R103,00:42:1B:5:0:4,00:62:20:5:0:4,
U201,00:53:21:8:0:2,00:95:1e:5:0:2,
RCMB,00:12:ef:6b:0:02,00:02:af:3f:0:2,
```

No additional headers or footers are required in the file.

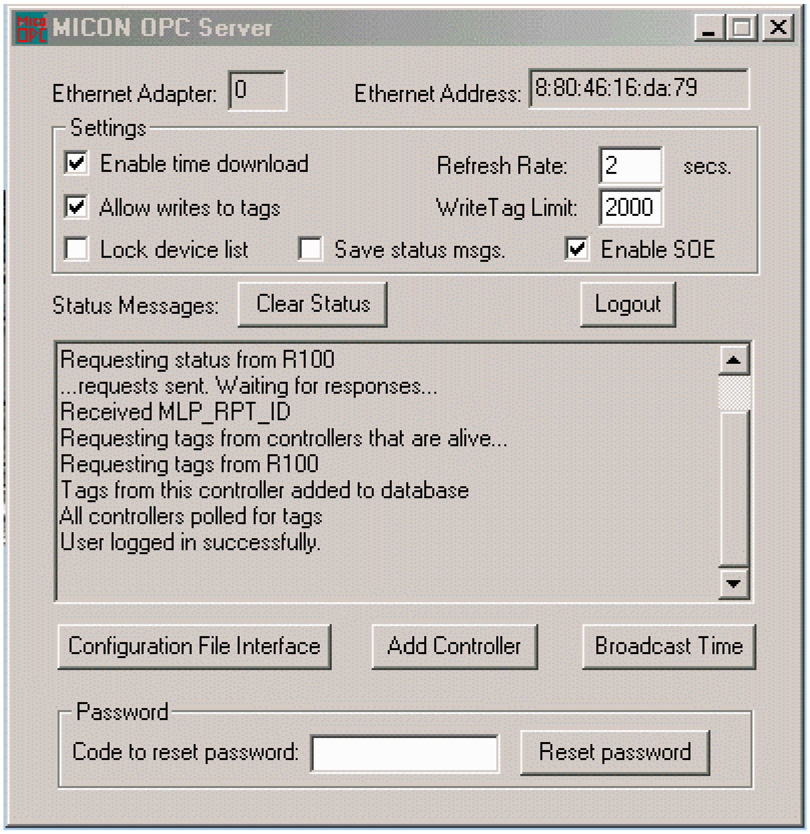
If a controller comes alive with its memory cleared while the MOPS is running on a PC on the same network, the MOPS will initialize that controller’s device name. All controllers that are alive on the network when the MOPS is started, will be polled by the MOPS for their tag lists. The tag definitions received from each controller will be added to the MOPS database and MOPS will serve these tags to OPC clients.

MICON OPC Server Initialization

When MOPS starts up, the following screen is displayed:

FIGURE 8-26

OPC Server Main Screen



On startup, MOPS always tries to connect to the controllers defined in the devlist,.txt file. If it is able to get a response from a controller, it requests the tags available in that controller. This process is repeated for each controller in the database. At the end of the startup sequence, MOPS's database is initialized with the tags available in all controllers that are alive and responding to queries. After startup, if any controller comes on-line, and if that controller has been defined in MOPS's device database, then that controller's tags are automatically requested and added to the database.

If a controller comes on-line after MOPS has been started, and if it did not exist in MOPS' device database, then that controller's tags are added to MOPS's database only if the controller has been initialized with a valid ID (name). Such a controller is also added to MOPS's device database (devlist.txt) so that all future startups of MOPS automatically upload this controller's tag list. Note that this functionality assumes that the checkbox titled "Lock Device List" is not checked.

The various fields and buttons on this screen are described in the following sections.

OPC Server Screens and Fields

Ethernet Adapter

The MOPS communicates with the ICS TRIPLEX controllers through the Ethernet adapter. This text box displays the ID of the adapter used for communications with the controllers. This field cannot be changed during run-time. If your computer has more than one Ethernet adapter, and the controllers are on a network which is connected to an adapter which does not have the ID of zero (0), then you will need to configure MOPS to point to the correct adapter ID. This can be done by using the registry and changing the Adapter ID key in the MICON OPC Server group in the registry. This change in Adapter ID should be effected only when the MICON OPC Server is not running on the computer.

Ethernet Address

This text box displays the six byte Ethernet address for the adapter chosen for communications with the controllers. Once again, the Ethernet address field cannot be changed by the user without changing the Adapter ID item in the registry.

Settings:

Refresh Rate

This box tells the MOPS the refresh rate to use in the refresh mode when reading tag values from the ICS TRIPLEX controllers. The ICS TRIPLEX controllers support a mode in which a tag list is sent to controllers by a host device (such as the MOPS). Once such a tag list has been sent to the controllers, they automatically send the values for those tags to the host at the refresh rate. This is called the refresh mode.

The ICS TRIPLEX controllers support multiple refresh taglists (one for each host). This allows for MOPS to be running on multiple computers at the same time. MOPS checks the destination address of all packets from the controllers and processes only those packets destined for its computer.

Settings:

Enable Time Download

ICS TRIPLEX controllers receive time of day information from host computers. If a SPARC based A/S View system is present on the network, then MOPS's "Time Download" capability should be disabled. On any network, only one computer (MOPS or SPARC) should be enabled for time download to controllers.

Settings:

Allow writes to tags

If it is desired to disallow OPC clients to write new values to tags on controllers, then this check box must not be checked.

Settings:

WriteTag Limit

The number entered in this box decides how many tags can be written to per second.

Settings:

Lock Device List

To prevent MOPS from adding controllers automatically to the device list, check this box. As described above, if this box is not checked, then MOPS will automatically add to the device list file any controllers which do not already exist in its database and which are found on the network.

Status message window and Clear Status button

The window with the vertical scroll bars will display all status messages received from all ICS TRIPLEX controllers on the network. This window can be cleared by simply clicking on the "Clear Status" button.

Add

Controller

This button allows a user to add a controller to the MOPS device database file (devlist.txt). As described above, the user can create the devlist.txt file using a text editor. MOPS also provides an automatic method for creating this file and adding controllers to the file. Simply click on the "Add Controller" button, then press the button on the controller which makes it send its identification information on the Ethernet, then enter the name to be used for that controller and click on OK. The controller will be added to the MOPS device database, and its tags will be requested and added to the MOPS tag database.

Broadcast Time

This button on the main screen allows a user to force the MOPS to send out a time message to all controllers on the network. Controllers utilize the time when reporting status messages and alarms to the host.

Reset Password

Some of the functionality of MOPS is protected with a password. If the user forgets this password, then it will be necessary to reset the password to the factory default value. To reset the password, enter the "reset code" in the corresponding text box and click on the "Reset password" button. If the "reset code" entered is valid, the password will be reset to the factory default value. To obtain the "reset code", call ICS TRIPLEX at (713) 353-2400.

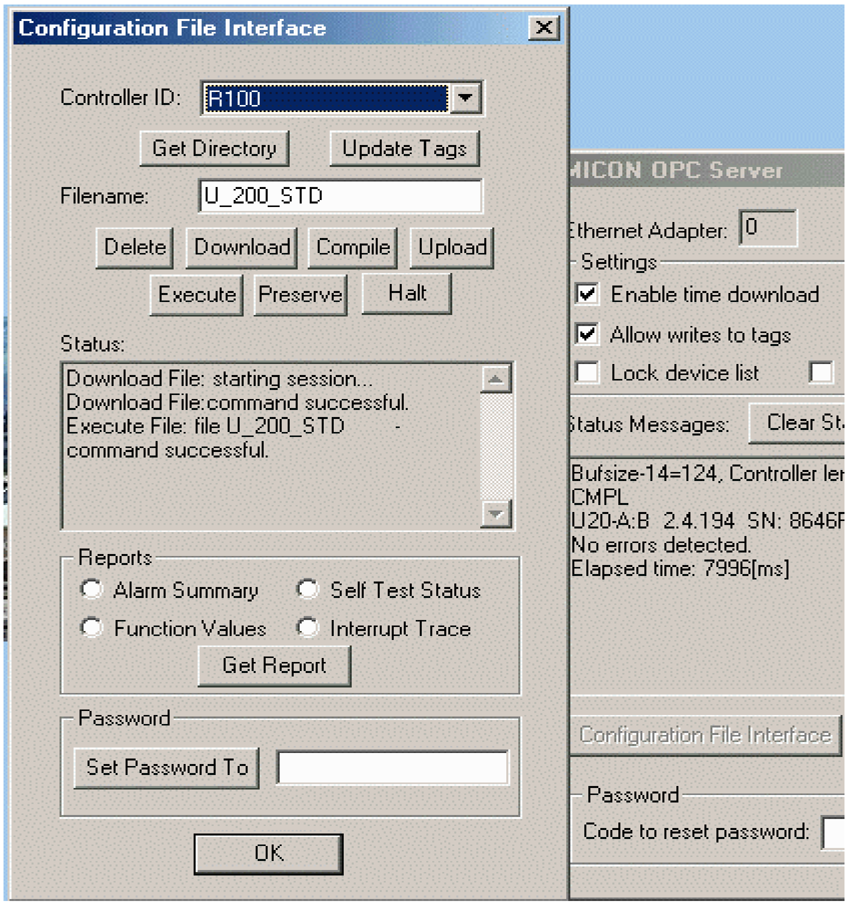
OPC Server Configuration File Interface

With the MICON OPC started up and displayed on your PC screen, click on Configuration File Interface.

This button allows a user to interact with the ICS TRIPLEX controllers. Most of the interaction with the controllers tends to be related to the configuration files for the controllers. The MOPS allows a user to download, compile, execute, preserve, halt and delete configuration files on the controllers. It is assumed that the user has created a configuration file on his PC using a text editor. Clicking on the "Configuration" button brings up the following window.

FIGURE 8-27

Configuration File Interface Window



Most of the functions supported by the new window are self-explanatory. The MOPS will provide a list of controllers in the list box. This list will contain only those controllers that have responded to queries from the MOPS or have sent in their heartbeat message to the MOPS at some time. Just because a controller is displayed in the list, does not imply that the MOPS will be able to communicate with it. The controller could have gone off-line after it had sent some heartbeat messages to the MOPS. In such a case, an interaction with that controller will timeout and the MOPS will display a time-out error in the status box on the "Configuration File Interface" dialog box.

The "Update Tags" button should be utilized to get the latest list of tags from a controller into the MOPS database. If a user changes the configuration file that was executing on a controller, then the user MUST get the latest list of tags available on that controller.

When the user tries to update the tags available in the MOPS database using the "Update Tags" button, then the MOPS will force the user to shutdown the OPC interface of the MOPS. This is done because OPC clients can get confused if the tags that are being served to them are changed at run-time. It is strongly recommended that all OPC clients be disconnected from the MOPS before trying to change the MOPS tag database.

> *The "Configuration File Interface" window also allows a user to upload reports from a controller. Simply select the radio button of the report of interest and then click on the "Get report" button to upload the report. All reports are stored on the 'C' drive in the folder "\ICS Triplex". The filename corresponds to the report uploaded. All reports should be viewed using "Wordpad" (instead of "Notepad") as the report files are easier to view in "Wordpad".*

Finally, the "Configuration File Interface" window allows a user to change the password utilized by MOPS. Simply enter the password in the corresponding text box and click on the "Set password" button. The new password becomes effective immediately.

It is strongly recommended that the "Configuration File Interface" window be closed during normal conditions so that unauthorized users do not have access to the configuration files on the controllers.

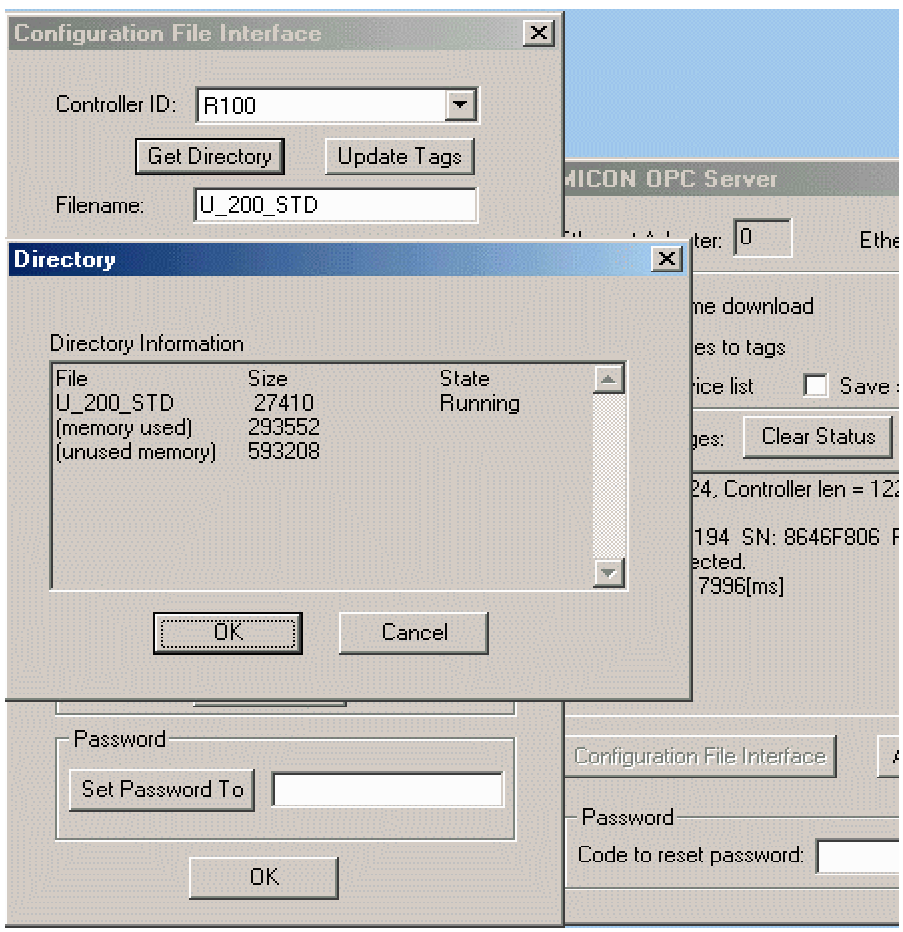
OPC Configuration File Interaction Exercise

Click on the Configuration File Interface button of the MICON OPC server window. On the Configuration File Interface window, click on Controller ID Arrow and select a controller (example: R100). Click on Get Directory to verify the status (File, Size, State) of the selected controller.

FIGURE 8-28

MICON OPC Server

Configuration File Directory Information



Halt and Delete a Controller File:

Click on Halt and confirm that you want to halt the processing of the file (click “Yes” on the confirm pop-up). The Status window (see Status, following left-side display) will advise that “Tags from this controller have NOT been removed from the OPC Server’s database. Do NOT serve tags from this controller until you re-execute the same or an equivalent file on this controller.”

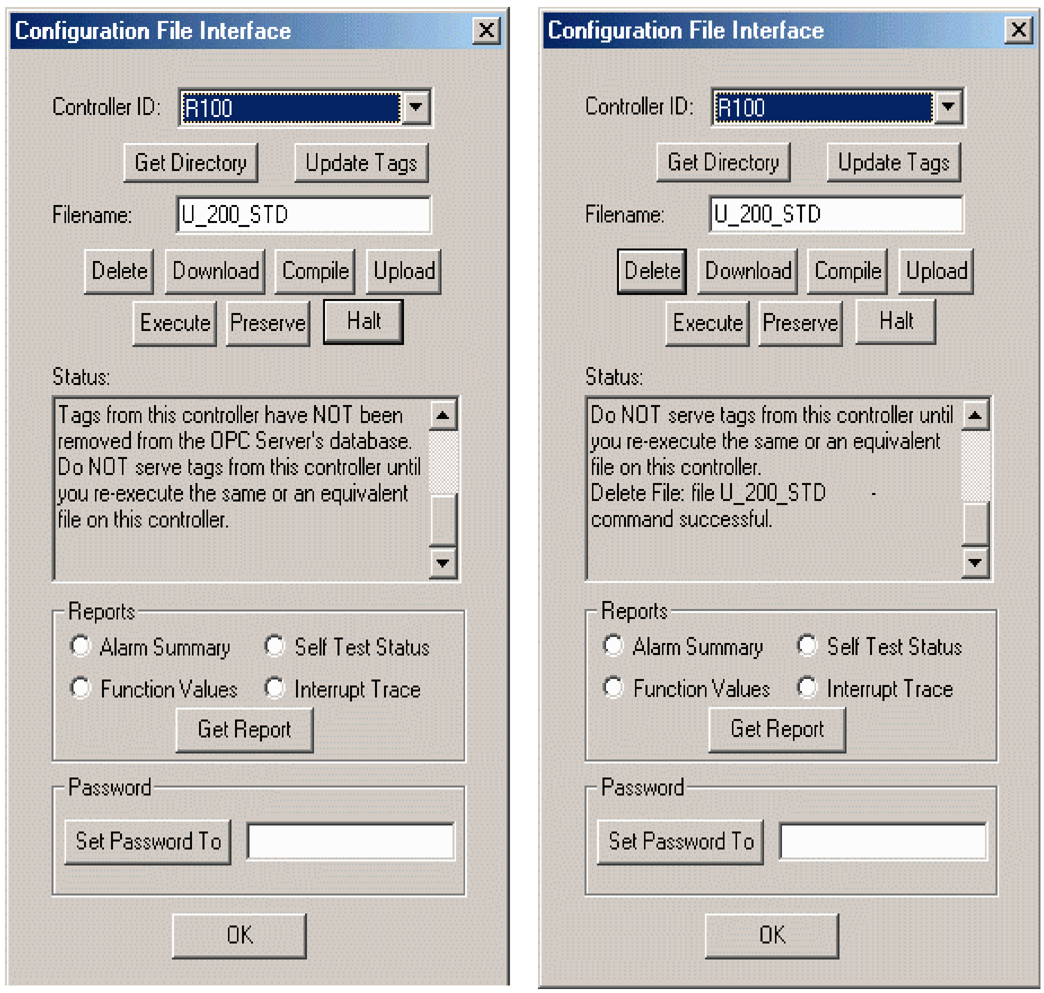
Click on Delete and confirm that you want to delete the processing of the file (click “Yes” on the confirm pop-up). The Status window (see Status, following right-side display) will advise “Do NOT serve tags from this controller until you re-execute the same or an equivalent file on this controller. and, Deleted File_________ command successful”.

FIGURE 8-29

Configuration File Interface

Left-Side Window: **Halt** Controller File

Right-Side Window: **Delete** Controller File



Note for applications with basic configuration file changes (deleted file is completely different file than the file to be downloaded): After a file is deleted and <u>before proceeding with Download of a new file, it is recommended to clear the memory of the controller board</u>. This is accomplished by removing and re-seating the control board(s) and then immediately (during the first 3 seconds) depressing the Push to Activate button for two (2) seconds or more.

Download and Execute a Controller File:

Click on Download. The Status window (see Status, following left-side display) will advise that "Download File is starting and that the Download File command was successful."

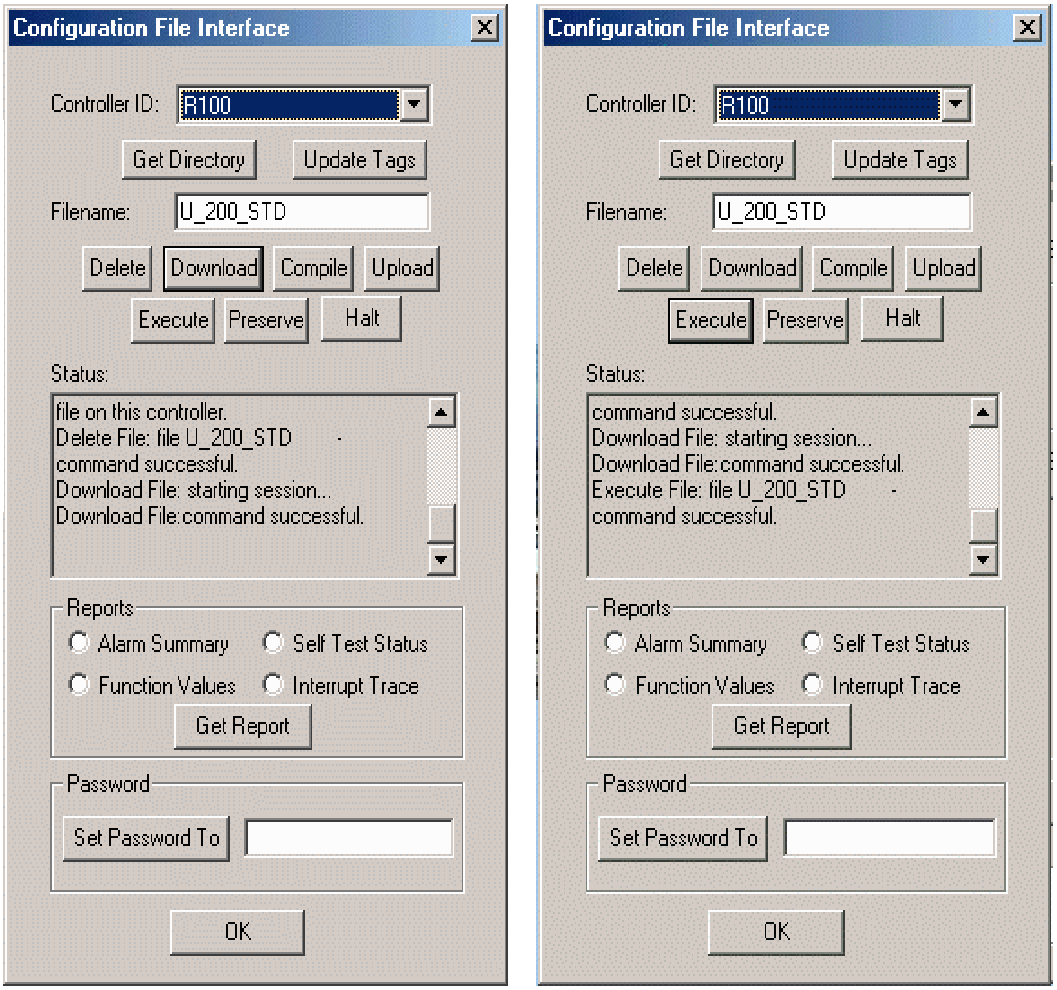
Click on Execute and confirm that you want to execute the processing of the file (click "Yes" on the confirm pop-up). The Status window (see Status, following right-side display) will advise "Execute File ______________ command was successful".

FIGURE 8-30

Configuration File Interface

Left-Side Window:
Download Controller File

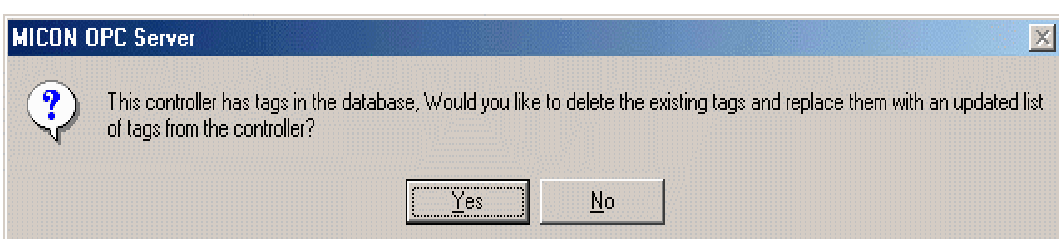
Right-Side Window:
Execute Controller File

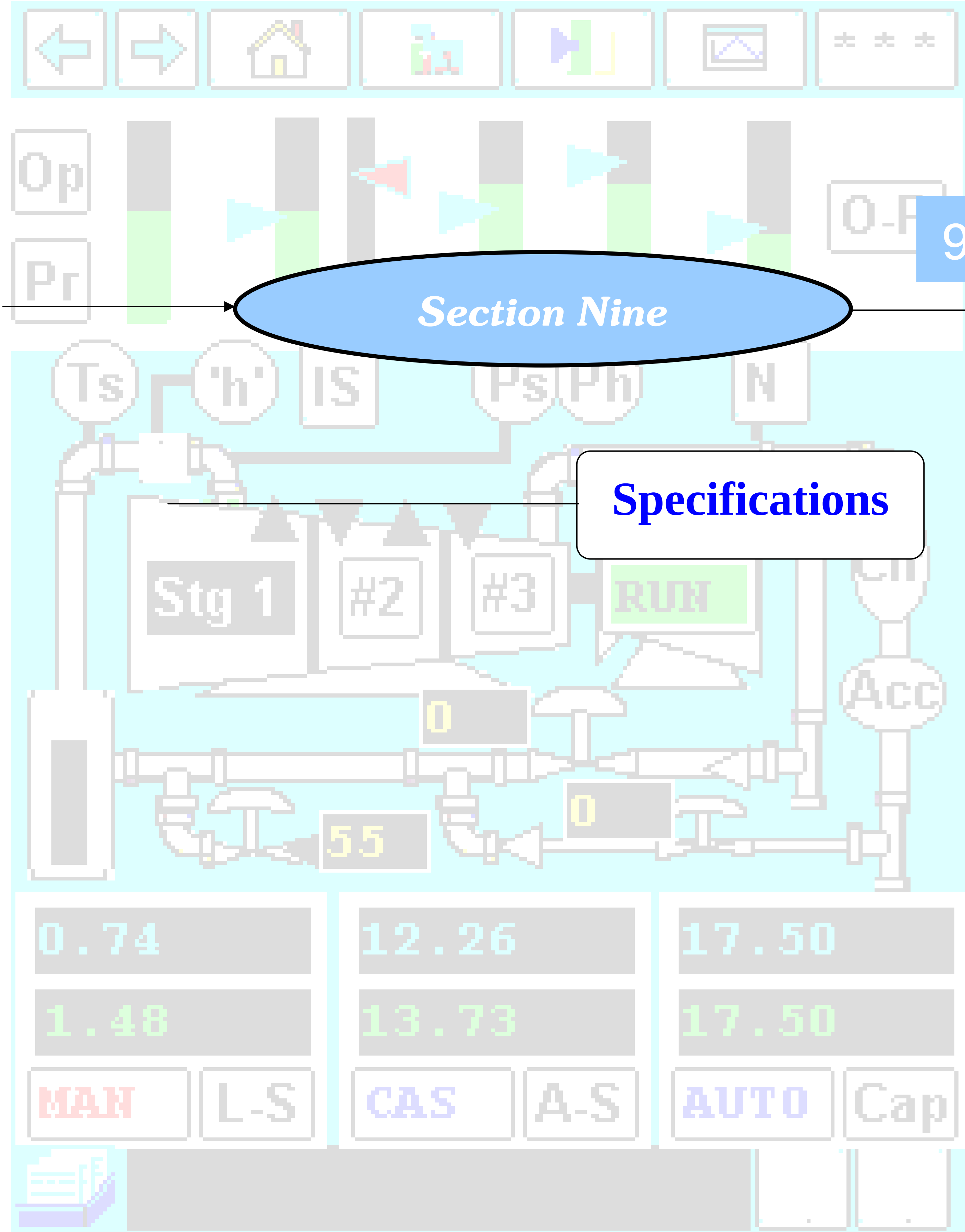


Do not forget to click Update Tags on the Configuration File Interface window if you made changes in the database of the newly downloaded and executed file. Click "Yes" on the following pop-up.

FIGURE 8-31

Update Tag
Pop-Up



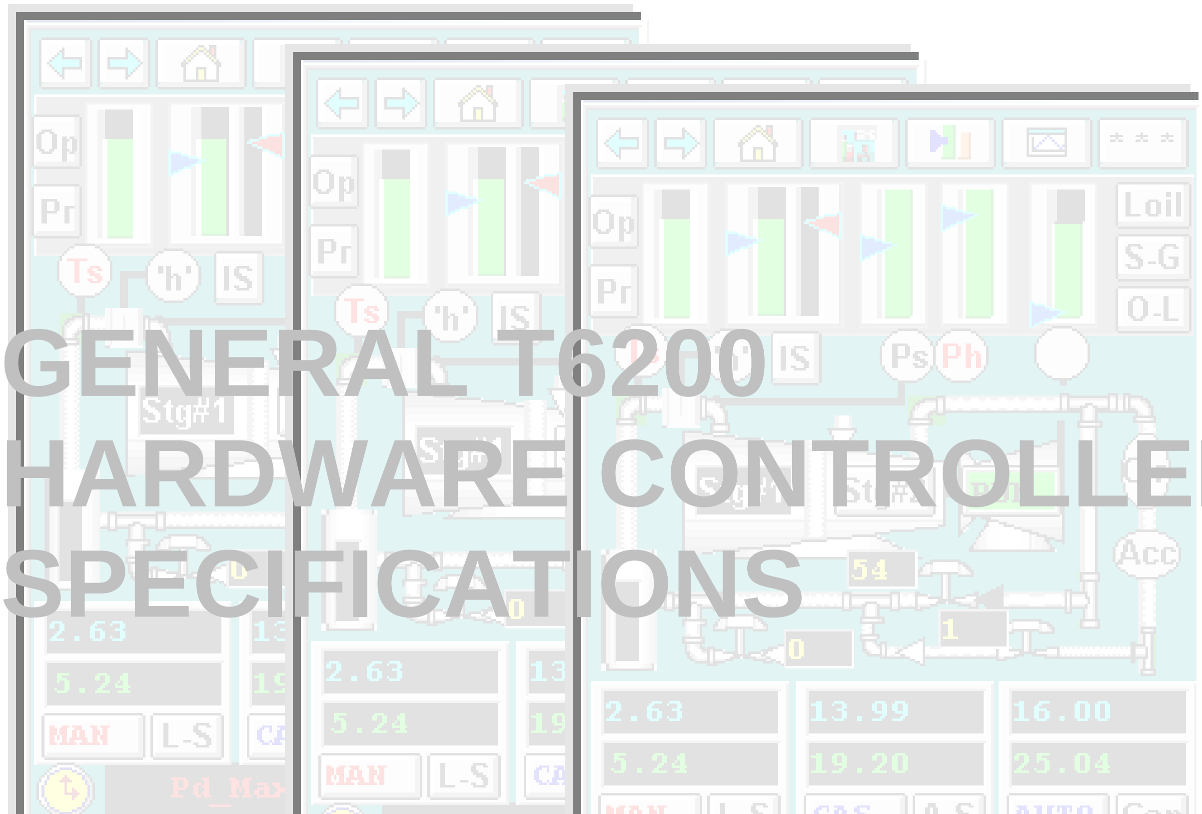


9

Section Nine

Specifications


Op
Pr
Ts
'h'
IS
Ps
Ph
Loil
S-G
O-L
Clr
Acc
Stg#1
Stg#2
RUN
54
1
0
2.63
5.24
13.99
19.20
16.00
25.04
MAN
L-S
CAS
A-S
AUTO
Cap
Pd_Max
PRESS



GENERAL T6200 HARDWARE CONTROLLER SPECIFICATIONS

The following electrical characteristics (Table 9-1) are valid at 25°C after a warm-up period of at least 20 minutes (unless otherwise stated).

Important Note: The termination panel of the T6200 accommodates **32 I/O points**. The 32 I/O points in the T6200 Controller are jumper selectable on a point per point bases as follows:

T6200C

8 are Analog Input Only
4 are Analog Output Only
8 are Analog Input or Discrete Input
5 are Discrete Input or Discrete Output
3 are Discrete Input, Frequency Input or Discrete Output
4 are Analog Input or Analog Output

T6200D

25 are Discrete Input or Discrete Output
4 are Discrete Input Only
3 are Discrete Input, Frequency Input or Discrete Output

Refer to Table 1-1 in Section 1 for I/O channel assignment information.

Table 9-1

T6200 Controller Electrical Characteristics (T6200"C" module)

Characteristics	Performance
Analog-To-Digital Conversion	T6200C only
Accuracy	± 0.2% of full scale
Non-Linearity	± 0.05% of full scale
Resolution	12-bits + sign
Noise	± 0.1% of full scale
Programmable Gain Amplifier	T6200C only
Gain Settings	1, 2, 4, 8 and 16
Accuracy G=1/2/4/8/16	± 0.05% / ± 0.05% / ± 0.10% / ± 0.15% / ± 0.15%
Analog Inputs	T6200C only
Number of Inputs:	Up to 20
Signal Types:Voltage	± 625 mVdc, ± 1.2 Vdc, ± 2.5 Vdc, ± 5 Vdc, and ± 10 Vdc, auto ranging ± 2.5 mAdc, ± 5 mAdc, ± 10 mAdc, and ± 20 mAdc, auto-ranging
Current	80 dB @ 60 Hz (*When configured as an isolated input)* 100 V transient absorbers
Common Mode Rejection Common Mode Protection	800 kΩ differential and 400 kΩ common mode
Input Res.:Voltage Mode Current Mode	250 Ω +0/-0.04% differential and 400 kΩ common mode *When configured as an isolated input*
Analog Outputs	T6200C only
Number of Outputs: Signal Type Output Load Resolution Accuracy Non-Linearity	4 to 8 0-20 (4-20) mAdc, current sourcing 0-350 Ω; Larger resistance may be used, (see I/O Circuit Description) 12 bits ± 150μA ± 10 μA
Discrete Inputs (On/Off)	

Characteristics	Performance
Number of Inputs:	Up to 16 T6200"C"; Up to 32 T6200"D"
Signal Type	On/off status monitoring
Input Voltage Range:	0-4 V ac/dc = Off; 18-32 V ac/dc = On
Input Resistance	4.7 kΩ
Input Isolation	Opto-isolated, when configured for external power
Input Protection	100 V transient absorbers
Internal Power for Inputs	+24 Vdc
Frequency Range	0-1 kHz, channels 9-16; 0-25 KHz, channels 22, 31 & 32; T6200"C" 0-1 kHz channels 1-21, 23-30; 0-25kHz, channels 22,31 &32 T6200"D"
Discrete Outputs (On/Off)	
Number of Outputs:	Up to 8 T6200"C"; Up to 28 T6200"D"
Output Type	Open drain (collector) transistor
Maximum Output Current	0.25 A continuously, 1 A momentarily, externally powered; 20 mA continuously, 100 mA momentarily, internally powered
Internal Power Source	Separate +24 Vdc regulator for each channel Each has thermal, reverse voltage and short-circuit protection
Controller Field Connections	
Signal Inputs/Outputs	
Internal Term.Panel	Clamping type terminal blocks for 16 AWG (1.5mm^2)
Remote Term Panel	Clamping type terminal bocks for 14 AWG (2.5mm^2)
Power Supply	Clamping type terminal blocks for 16 AWG (1.5mm^2)
Communication	RJ-45 Connector
Power Supply	
Input Voltage Range	18-32 Vdc
Input Power	15 W, not including field devices or HMI-6200 Operator Interface
Redundancy	Two power sources
Input Voltage Ripple	0.5 V maximum
Redundancy	The ICS TRIPLEX T6200 concept provides 100% redundancy with plug-in automatic backup and bumpless transfer

Characteristics	Performance
Microprocessor	<u>Two</u> Motorola MC68EN302
Architecture:	16/32-bit processor 16/32-bit Data and Address Registers 56 Instruction Types Operations on five Main Data Types Memory Mapped I/O 14 Addressing Modes Clock Frequency: 25 MHz
Memory	
EPROM	One CMOS EPROM, 256K x 16
RAM	Two CMOS SRAMs, 512K x 8 each with board mounted capacitor for seven days backup.
Ethernet 1 and Ethernet 2	
Type	IEEE 802.3 10BASE-T Carrier
Data Rate	10Mbps
Connector	RJ-45
Media Type	10Mbps UTP
Media Max Length	100 meters (328 feet)
Protocol	Ethernet OPC
Optional Interface Comm 1 and Comm 2	To HMI-6200 Operator Interface to Ethernet 1 only
Type	RS-232/RS-485 (Software Selectable)
Data Rate	RS232:20Kb/s Max; RS-485:38.4 Kbaud Max
Connector	RJ-45
Media Type	RS-232☹1) shielded pair; RS-485:;(1) shielded pair
Media Max Length	RS-232:15.2 meters (50 feet); RS-485:1.2Kmeters (4000 foot)
Optional Interface	MODBUS (RS-232 or RS-485) on Comm 2 only NOTE: RS-485 is not multidrop

Table 9-2

T6200 Controller Environmental Specifications

Characteristics	Performance
Operating Temperature	32 to 122^{o}F (0 to 50^{o}C). Up to 140^{o}F (60^{o}C) intermittent.
Storage Temperature	-40^{o} to +185^{o}F (-40^{o} to 85^{o}C)
Relative Humidity	5% - 98% RH, non-condensing

Vibration	5 Hz - 60 Hz @ .01 inch X-Y-Z axes excursion
Chemical Resistance	Protection against traces of H_2S, SO_2, salt, sand and dust is provided
EMI/RFI	Complies with Federal Communications Commission Docket 20780 Meets German VDE 0875 and British Standard 727

Note: The T6200 controller is designed for stand-alone and multi-unit (T6200R) 19" Subrack mounting.

Table 9-3

T6200C/T6200D Unit Controller Mechanical Specifications

Characteristics	Performance
T6200C/T6200D Unit Controller (with HMI-6200 Operator Interface)	
Weight	5.1 lb (2.3 kg)
Height	5.95" (151 mm)
Width	4.30" (109 mm)
Depth	16.98" (431 mm)
Type	1/8 DIN (5.44" (139mm) x 2.68" (68 mm cutout)
T6200C/T6200D Remote Termination Panel	
Weight	0.59 lb (268 g)
Height	3.45" (88 mm)
Width	7.75" (197 mm)
Depth	2.40" (61 mm)
Type	DIN Rail Mounted
T6200R Subrack (with 6 T6200C/T6200D Power Supplies Ethernet Hubs and HMI-6200 Operator Interface)	
Weight	42.5 lb (19.4 kg)
Height	10.5" (267mm) ANSI Standard
Width	19" (483 mm) ANSI Standard
Depth	19.88" (505 mm)
Type	Europac

FIGURE 9-1

T6200C and T6200D Controller Module Physical Dimensions

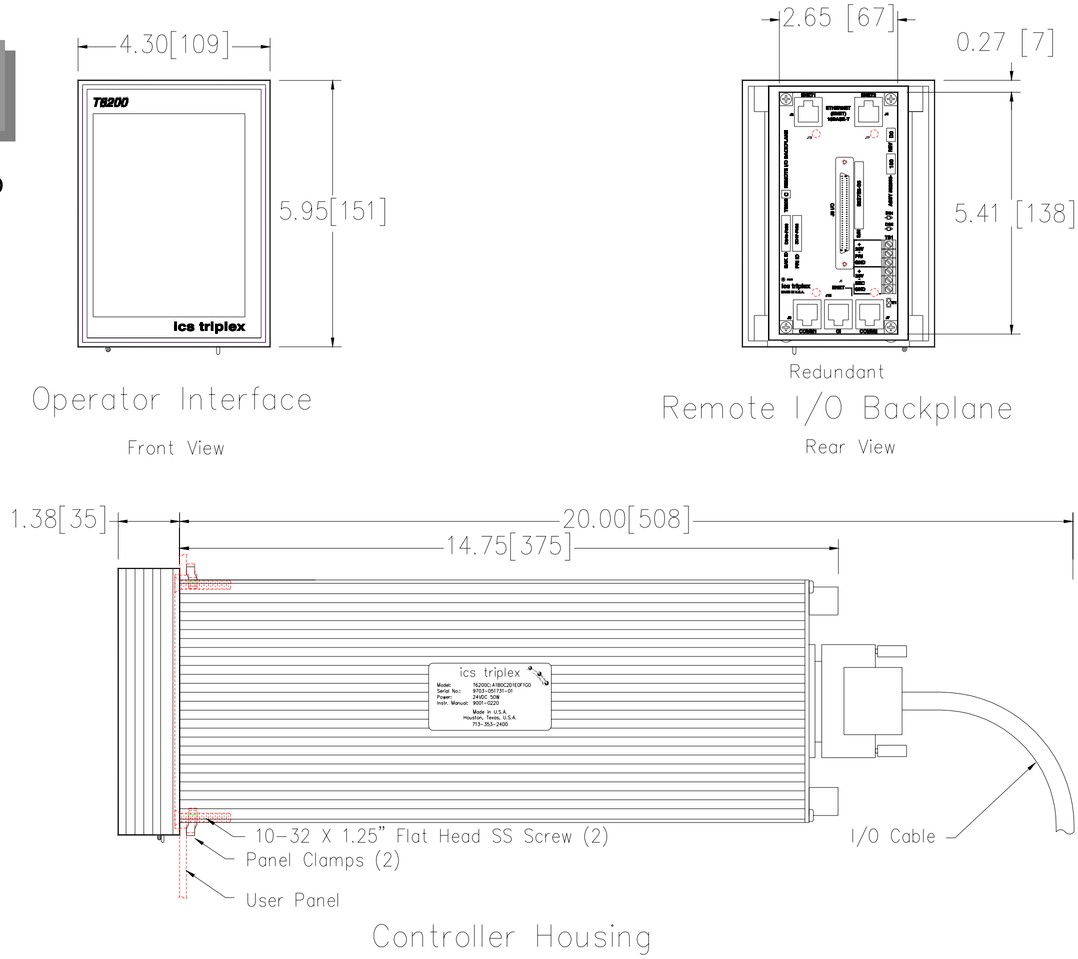


FIGURE 9-2

T6200C and T6200D Remote I/O Backplane Physical Dimensions

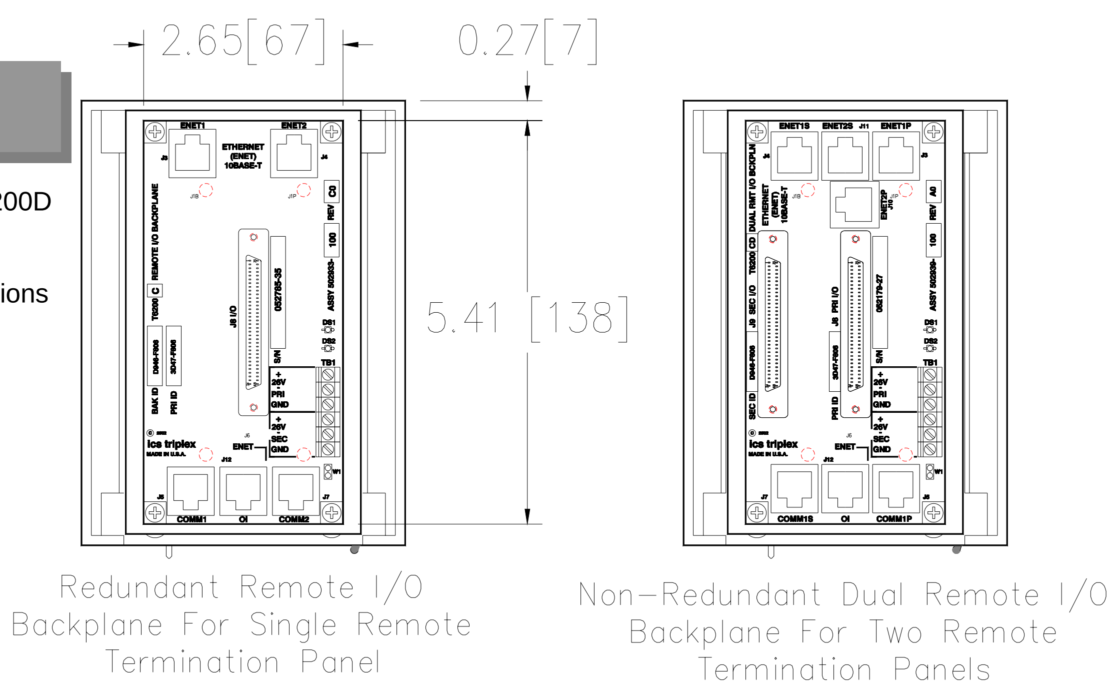


FIGURE 9-3

T6200C and T6200D Remote Termination Panel Physical Dimensions

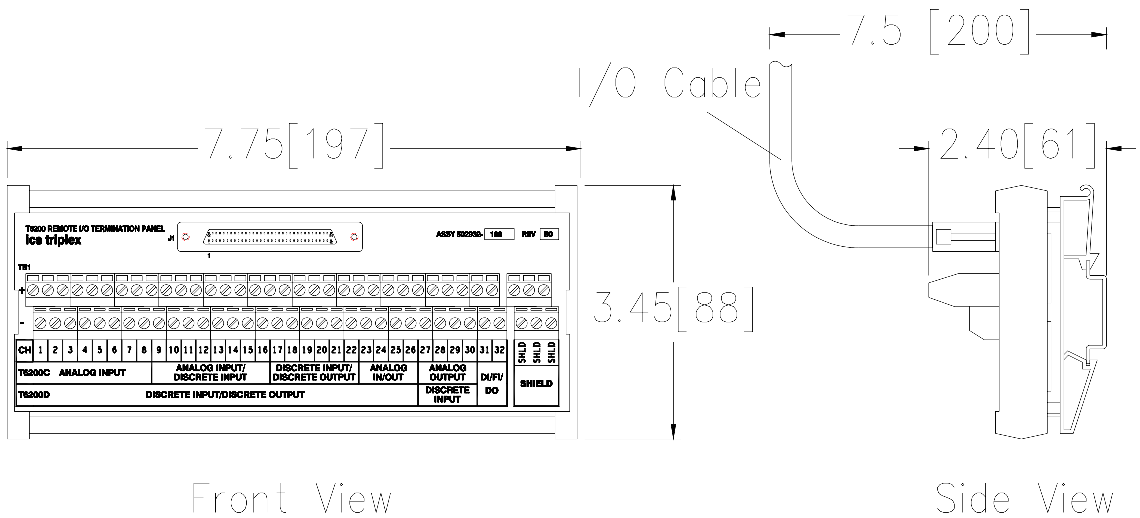
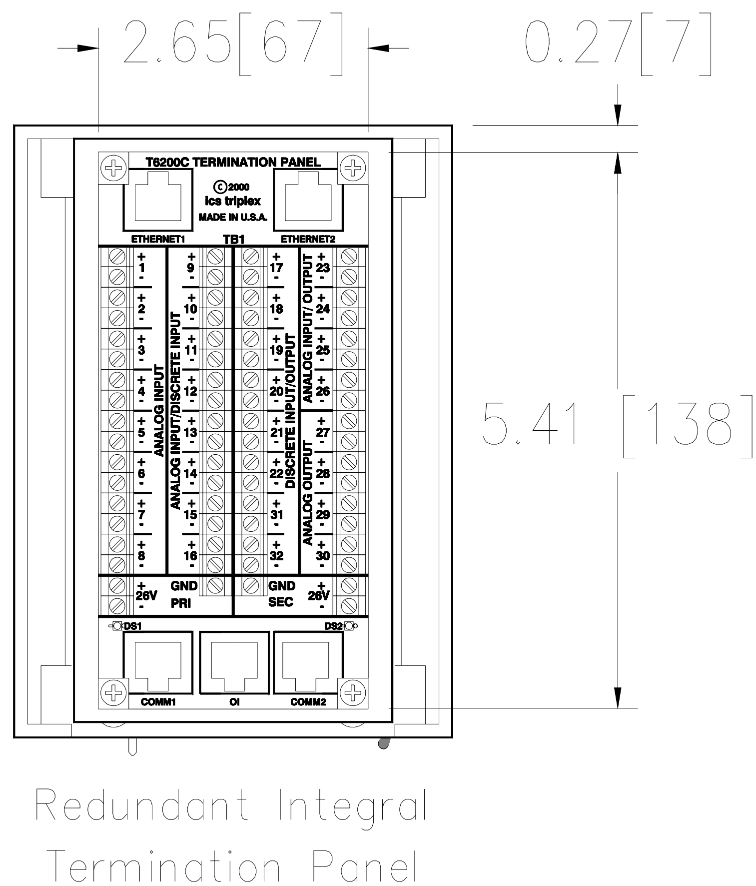


FIGURE 9-4

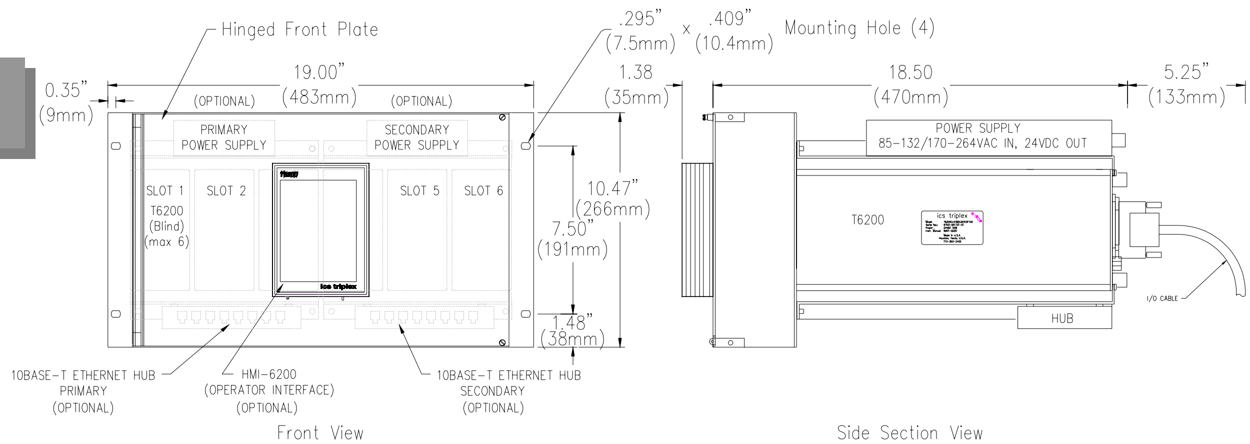
T6200C and T6200D Redundant Integral Termination Panel Physical Dimensions

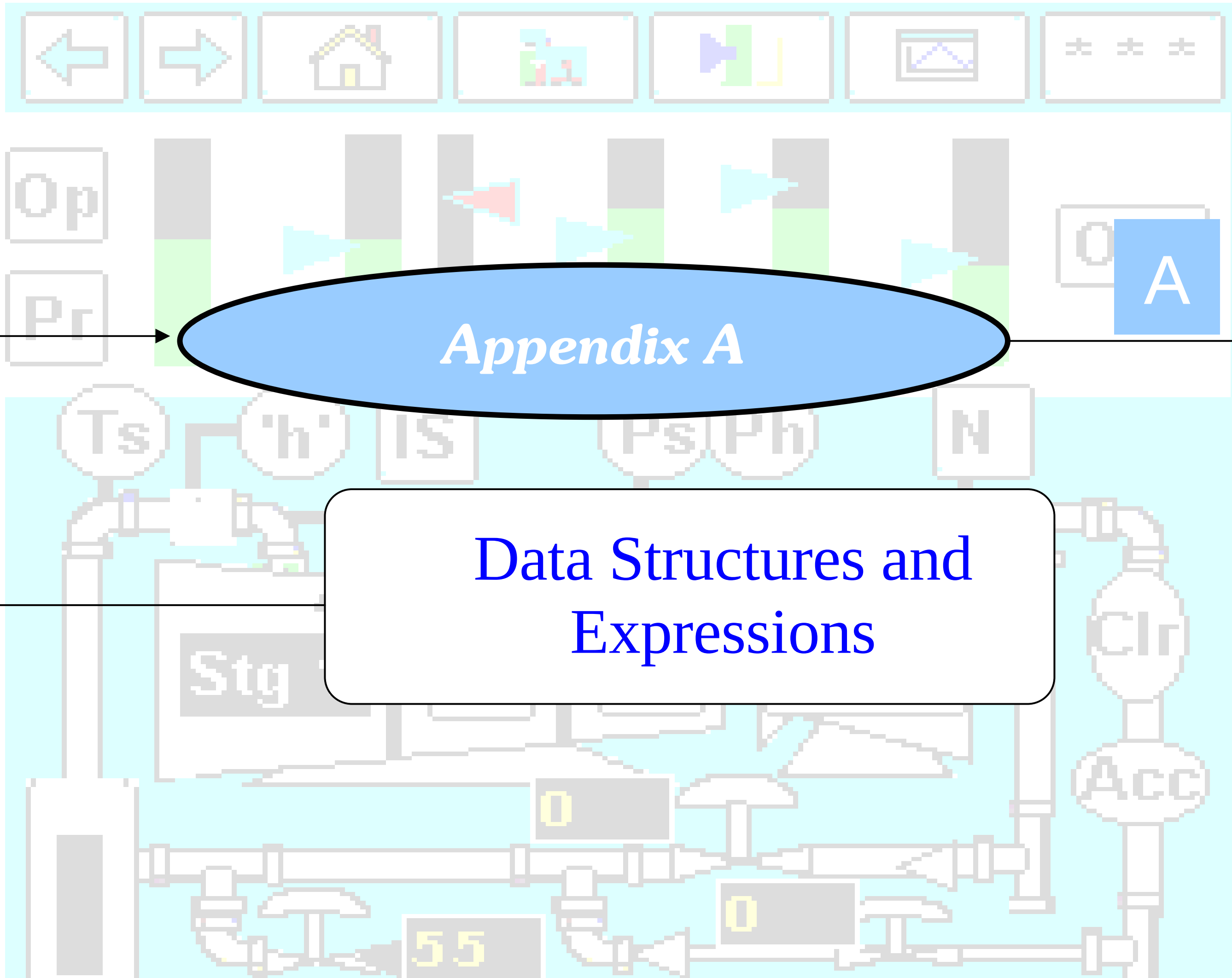


Note: The Redundant Integral Termination Panel Is used primarily for Standalone or Demo Applications.

FIGURE 9-5

T6200R Subrack Physical Dimensions





Appendix A

A

Data Structures and Expressions

Op
Pr
O-P
Ts
'h'
IS
Ps
Ph
N
Stg 1
#2
#3
RUN
Clr
Acc
0
55
0
0.74
1.48
MAN
L-S
12.26
13.73
CAS
A-S
17.50
17.50
AUTO
Cap

Tags

Tags are user or factory defined symbols or code names. Tags are assigned to system variables and are used to access and/or alter the value or status of a variable or it may be used just as a reference to an item, such as a table.

Tags should have from 1 to 16 alphanumeric, and/or underscore(_) characters. Tags cannot contain spaces (blanks) or other symbols. The first character of a tag cannot be a dash or number. Both upper and lower case letters are accepted but A/S VIEW will convert lower case letters to upper case for processing.

Tags assigned to variables by the user are global and can be accessed from any Controller or Operator Interface within the system network. Tags in the firmware are assigned at the factory in each Controller. These tags are local to the loop and cannot be accessed from outside of the loop that they are assigned to, without the user assigning a prefix to the tag. A tag can be assigned by the user to only one variable within a system network and cannot be assigned to another variable in a different loop or Controller.

A tag assigned in the firmware can be accessed from outside of the loop by adding an extension to the user assigned loop tag and separating them with a period(.).

For example, in a loop where the user has assigned FIC254 as the tag for the loop, the firmware assigned tag PV (process variable) can be accessed from outside the loop via using the tag:

FIC254.PV

Tags are also used for one Controller to access the value or status of a variable from a different Controller via the peer-to-peer communication. When a Controller makes a request for access to a tag from a different Controller, it must put the tag name of the Controller (that the information is being requested from) followed by two colons (::) in front of the tag for the information that is being requested.

For example, a Controller with a tag name of UC254 and an analog input with the tag FT254, the input could be accessed by a different Controller by requesting the following tag:

UC254::FT254

Tags assigned by the firmware, their data types, and their descriptions are listed in a Table A1.

Reserved Tags

Tag	Data Type	Description
ACTIVE_FLG	Boolean	This controller is controlling the process. It is not a reserve controller.
BIAS	Real	Bias auxiliary for PID ratio and bias subfunctions.
CD	Real	Derivative gain as calculated so far during this scan. It is initialized at the start of each scan from the loop auxiliary CRATE.
CGAIN	Real	Loop proportional gain auxiliary.
CI	Real	Integral gain as calculated so far during this scan. It is initialized at the start of each scan from the loop auxiliary CGAIN.
CP	Real	Proportional gain as calculated so far during this scan. It is initialized at the start of each scan from the loop auxiliary CGAIN.
CRATE	Real	Loop derivative gain auxiliary.
CRESET	Real	Loop integral gain auxiliary.
DEV	Real	Loop deviation auxiliary.
HOLD-TIME	Real, Minutes	Length of time the sequence control function is held in the current batch state. (FNC #40)
H_FLG	Boolean	Horn flag. This Boolean is set true whenever an alarm becomes active and is reset to false when the acknowledge button is pressed. It may also be set to false by the user's configuration.
LOCAL_ONLY	Boolean	When true, host write-tag commands are rejected unless "local" is true (in the command). Note: the host must have "local" on to turn LOCAL_ONLY off. This tag may be controlled by the LOI to prevent inadvertent updates by the central operator.
MANUAL-RESET	Real	Manual reset as calculated so far during this scan. It is

		initialized at the start of each scan from the loop auxiliary, M_RESET.
MODE	Integer	Loop operating mode auxiliary: 0 Manual 1 Automatic 2 Cascade
M_RESET	Real	PID manual reset auxiliary
MSV	Real	The tag name of the value passed from the last scanned step.
M_FLG	Boolean	Manual flag. This loop is in automatic or cascade mode, but was not on the previous scan.
OPHILM	Real	Loop output high limit auxiliary
OPLOLM	Real	Loop output low limit auxiliary
OUT	Real	Loop analog output auxiliary
PERIOD	Real	Loop scan time auxiliary
PRIMARY_FLG	Boolean	This controller is installed in the primary position.
PV	Real	Loop process variable auxiliary.
R_FLG	Boolean	Reset flat. This is the first scan of this loop since power up reset or new configuration.
RATIO	Real	Ratio auxiliary for PID ratio and bias subfunctions.
SCAN_TIME	Real	The actual time in seconds since this loop was last scanned.
SPAN	Real	Loop span. This is used to convert process value to a fraction in the PID algorithm.
SPHILM	Real	Upper limit of setpoint [100]
SPLOLM	Real	Lower limit of setpoint [0]
SP_CUR	Real	Current setpoint value
SP_RATE	Real	Setpoint ramp rate limit [100]
SP_TARG	Real	Target setpoint value
STATE	Integer	Current batch state from sequence control function.
STATE_TIME	Real	Length of time (minutes) in current batch state while not held.
TOD	Integer	Time of day counter. May be converted to engineering units (seconds, minutes...) using the T_... time conversion expression functions.

Reserved Words

The Controller uses certain character strings (words) with predefined meaning for tags or functions. The user cannot use these words as tag names or labels in the Controller configuration. The following is a list of these reserved words:

ABS	ERB	MOVING_AVERAGE	SIN
ACOS	ERR	MSV	SINH
ACTIVE_FLG	EVERY	MULTI_STATE_DI	SP_CUR
AI	EXP	NAN	SP_RATE
AI_TC	EXTEND	NOP	SP_TARG
AI_TEST	FILTER	OPHILM	SPAN
ALARM	GAIN	OPLOLM	TC
ANALOG_LOGIC	GOTO	OUT	SPHILM
AO	GOTO_MODE	PERIOD	SPLOLM
ARRAY	GOTO_TIMED	PI32	SQRT
ASIN	H_FLG	PID	STATE
ATAN	HOLD_TIME	PID_A_B	STATE_TIME
AVG	HOURS	PID_A_R	SWITCH_MODE
BATCH_SWITCH	IF	PID_CASCADE	T_DAY
BIAS	INF	PID_GAP	T_HR
C_FLG	INTERLOCK_ALARM	PID_R_B	T_MIN
CD	ISZERO	POLY	T_MS
CGAIN	LABEL	POS	T_MSI
CI	LATCH	PRESS_A	T_SEC
CONSTRAINT	LEAD_LAG	PRESS_G	TAN
COS	LET	PRIMARY_FLG	TANH
COSH	LN	PRIORITY	TCI
COUNTER	LOCAL_ONLY	PULSE	TEMP_C
CP	LOG	PULSER	TEMP_F
CRATE	LOOKUP	PV	TIME_DELAY
CRESET	M_FLG	R_FLG	TIMER
CUTOFF	M_RESET	RAD	TOD
DAD_RESET	MANUAL_RESET	RATE	TOD_DATE
DEAD_TIME	MANUAL_STATION	RATE_LIMIT	TOD_LOCAL
DEAD_TIME_DELAY	MAX	RATIO	TOTAL
DEADBAND	MEAN	RECIPE	TOTALIZE
DEF	MEDIAN	SCAN_TIME	TPO
DEG	MGT	SCANNING	TRACE
DELAY	MID	SELECT	TVEC
DEV	MIN	SEQUENCE_CONTROL	VALVE_CONTROL
DEV_BAR	MODE	SEQUENCE54	VC_ACCESS
DI	MODE_INTERLOCK	SGN	WDI
DO	MOTOR_CONTROL	SGNAL_SWITCH	

Labels

Labels are user defined symbols or code names. Labels are assigned to configuration steps and are used as step (address) references for GOTO function or steps that are to be accessed from other functions. Labels must be unique within one loop but a label can be used in more than one loop within the Controller or system.

Labels should have from 1 to 16 alphanumeric, and/or underscore(_) characters. Labels cannot contain spaces (blanks) or other symbols. The first character of a label cannot be a dash or number. Both upper and lower case letters are accepted but A/S VIEW will convert lower case letters to upper case for processing.

Data Types

There are four data types used by the T6200 Controller:

REAL
Real numbers are the most common and that have a fractional component. They can assume any 32 bit IEEE floating point value.

Examples: 12.45, 345.592, 0.021

INTEGER
Integers are numbers that do not have a fractional component. Their value can range from 2,147,483,648 to +2,147,483,647.

Examples: 5, 38, 1053

BOOLEAN
Boolean variables are two state logic variables that has either a value of one or zero.

Examples: Discrete Input, Discrete Output, Internal Switch

FUZZY
Fuzzy numbers are real numbers between zero and one and they are used with logic operands AND, OR, and XOR.

Examples: 0, 1, 0.2, 0.99

Logical Operations

Operator	Description	Example
&	AND	A&B
|	OR	A|B
^	Exclusive OR	A^B
-	NOT	-A
?	Only if	A?B

Arithmetic Operations

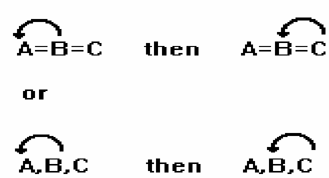
Operator	Description	Example

+	Addition	2+5
-	Subtraction	5A
*	Multiplication	A*3
/	Division	6/3
**	Exponentiation	3**2
,	Sequence (comma)	3,5,A
%	Modulo	9%8
=	Assignment	A=B

Relational Operations

Operator	Description	Example
= =	Equal to	A= =B
<>	Not equal to	A<>B
<	Less than	A<B
>	Greater than	A>B
<=	Less than or equal to	A<=B
>=	Greater than or equal to	A>=B

The relational operator cannot be so grouped eg, "a<b<c" is not valid, but "a+b+c" is valid. The assignment and sequence operators have the value of the right operand eg, A=B=C means copy B to A then copy C to B.



Unary Operations

Operator	Description	Example
%	Convert to real	%A
&	Convert to fuzzy	&A
#	Convert to integer	#A
!	Convert to Boolean	!A
-	Negation	-A

Expression

Mathematical and logic expressions are a valid series of constants, variables, and functions that can be connected by operation symbols to describe a desired computation.

Order of Operations

When an expression contains more than one operation, the Controller performs the operations in the following order of precedence from highest to lowest:

1. Exponentiation
2. Multiplication, division, and modulo
3. Addition and subtraction
4. Comparison
5. AND
6. Exclusive OR
7. OR
8. Assignment
9. Only if
10. Sequence

Data types and other unary operations are performed as required in the expression. If there is a tie, expressions are evaluated left to right except exponentiation. To force a different order of operations, you can supply parentheses in an expression.

You can also use parentheses simply to improve the readability of expression, even if the parentheses do not change the order in which the Controller would normally perform the operations.

Spaces between tags, variables, constants, and/or operators are optional and will be ignored during expression operations. The bracket [] and brace {} characters are used by the ARRAY function and cannot be used to change the order of an expression operation.

Examples:

Valid Expressions	Invalid Expressions
A + B	[(A-B) * 2]/D
A+B	
A*(B-C)	2 * {B-6}
2 * (4 + A)	
((B-3) * 6)/3	

Data conversions are custom to the needs of each operator and the data types of its operands.

Exponentiation (**)

Both operands must be real, fuzzy, or integer. They are converted to real before the operation. The result is real.

Multiply (*), divide (/), add (+), subtract (-), compare (==, <>, <=, >=)

If either operand is real or fuzzy, both are converted to real: otherwise both operands are converted to integer. The result is the same as the converted operands.

Modulo (%)

Both operands must be scalar. (If either is fuzzy or Boolean an error is reported.) The operands are converted to integer. The result is integer.

AND(&), OR(|), Exclusive OR(^)

Both operands are converted to the same data type, in reference to the table below;

- if either operand is fuzzy, the operation is fuzzy
- real with real is fuzzy, otherwise Boolean
- integer with Boolean is Boolean
- integer with integer is the bit-wise operation on both integers

Operand 1	Operand 2 R	F	I	B
R	F	F	B	B
F	F	F	F	F
I	B	F	I	B
B	B	F	B	B

R = Real

F = Fuzzy

I = Integer

B = Boolean

AND, OR, and XOR Operation and Result Data Types

The result is the type of the converted operands.

Assignment (=)

The right operand is converted and stored into the type of the left operand. The value of the expression is the right operand.

Sequence (,)

Used to separate multiple expressions the value of the left operand is discarded. The value of the expression is the right operand.

Only if (?)

The right operand is evaluated and converted to Boolean. If the right operand is logically true, the left operand is evaluated and its resulting value is discarded. The value of the expression is the right operand.

Truth Tables

NOT A	-A
0	1
1	0

OR A	B	A|B
0	0	0
0	1	1
1	0	1
1	1	1

AND A	B	A&B
0	0	0
0	1	0
1	0	0
1	1	1

XOR A	B	A^B
0	0	0
0	1	1
1	0	1
1	1	0

Logic Evaluation Rules

Commutative Property:
A & B = = B & A
A | B = = B | A

Associative Property:
A & (B & C) = = (A & B) & C
A | (B | C) = = (A | B) | C

Distributive Property:
A & (B | C) = = (A & B) | (A & C)
A | (B & C) = = (A | B) & (A | C)

Absorptive Property:
A & (A | B) = = A
A | (A & B) = = A

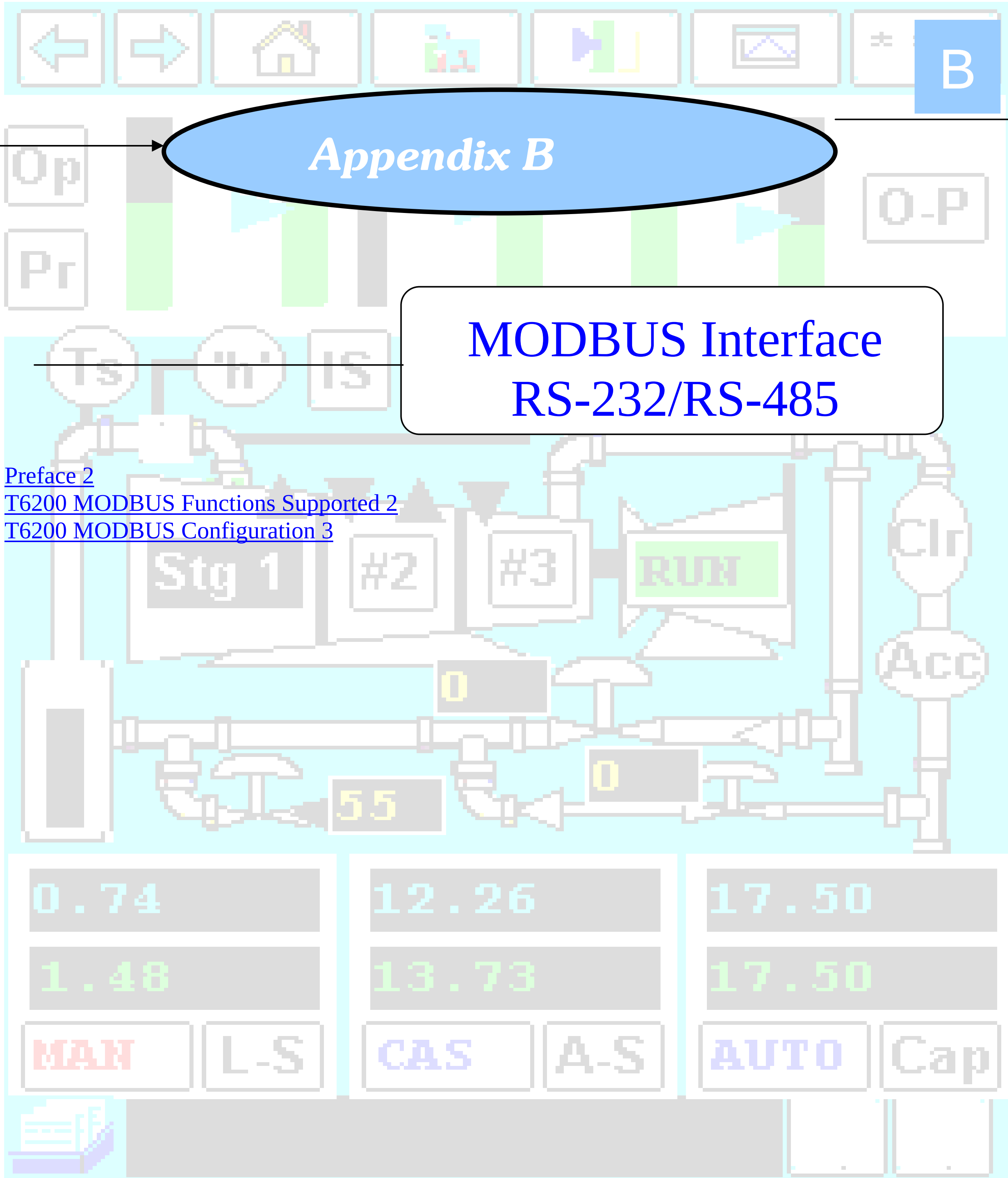
DeMorgan's Theorem:
-(A & B & C) = = -A | -B | -C
-(A | B | C) = = -A & -B & -C

XOR Identity:
A ^ B = = (-A & B) | (A & -B)
-(A^B)= =A^B= =-A^B
= = (-A & B) | (A & B)

Theorems:
A & 0 = = 0 A & 1 = = A
A | 0 = = A A | 1 = = 1
A & A = = A A & -A = = 0
A | A = = A A | -A = = 1

Boolean Logic Rules

Expression	Result
-0	= =1
-1	= =0
A&0	= =0
A&1	= =A
A&A	= =A
A&-a	= =0
A|0	= =A
A|1	= =1
A|A	= =A
A|-A	= =1
A&A (A|B)	= =A
A|A (A&B)	= =A



B

Appendix B

MODBUS Interface RS-232/RS-485

MODBUS Interface – RS-232/RS-485

Preface

The MODBUS communication link permits the T6200 to converse with DCS/SCADA systems from other vendors or to interface data from a variety of PLCs. The T6200 can act as either a MODBUS master or slave. In the master mode, the T6200 can accommodate up to 2500 PLC points. This interface is a standard T6200 feature which does not require any special hardware or software.

The standard RS-232 or RS-485 electrical interface, COMM2, is used between the communucation ports for Modbus devices. The serial interface operates in the half-duplex mode at a selectable data rate from 2400 to 38,400 bits per second.

IMPORTANT NOTE: Although the T6200 supports the RS-485 signal levels (electrical interface), the software drivers on the communications ports of the T6200 do not support addressing of multiple devices. Hence, if the RS-485 mode of operation is selected, care should be taken to ensure that only one other device (in addition to the T6200) is connected on the communication link.

T6200 MODBUS Functions Supported

The following T6200 Modbus functions are supported:

01 Read Discrete Output Status. Obtains current status (ON-OFF) of a group of discrete outputs.

02 Read Discrete Input Status. Obtain current status (ON-OFF) of a group of discrete inputs

03 Read Setpoints, Analog Outputs, Loop Auxiliaries, Alarms, etc. Obtain current binary value in any group of holding registers.

04 Read Analog Input Values. Obtain current binary value in any group of input registers.

05 Modify Discrete Output Status. Force Discrete Outputs to a state of ON or OFF.

06 Modify Analog Values. (Register Groups) Place a specific binary value into a register.

T6200 MODBUS Configuration

The T6200 supports communications with foreign devices using the MODBUS communications protocol. The user interface is through global tags which reside in the T6200 (configured as remote tags). The T6200 communications port may be configured for MODBUS as a Master or a Slave device using the PORT command.

The data points configured with tag names and optional scaling for REAL data points. The following table describes the format of the PORT command for MODBUS communications configuration:

PORT <port> <ll-def> <protocol> <unit> …..

<port>	{1}
<II-def>	<baud><parity><d-bits><stop><line-type>
<baud>	{2400, 4800, 9600, 19200, 38400}
<parity>	{N,O,E}
<d-bits>	{7,8}
<stop>	{1,2}
<line-type>	{RS232, RS-485}
<protocol>	MODBUS [RTU, ASCII] <MB-role>
<MB_role>	{MASTER, SLAVE} <poll-parm>…";"

The PORT directive introduces the MODBUS configuration. As a MODBUS master, the T6200 will poll the port for current data. As a MODBUS slave, it will respond with the same data on the port.

The logical link definition <ll-def> specifies the baud rate, parity (None, Odd, Even), number of data bits (must be 8 for RTU), number of stop bits, and electrical line type.

The protocol, <protocol>, is MODBUS RTU or ASCII Hex. RTU is a binary protocol which uses a 16-bit Cyclic Redundancy Check (CRC) algorithm to verify data integrity. In this mode, parity is usually not required. ASCII Hex protocol uses an LRC check algorithm. The characters are ASCII and may be easily displayed on a terminal.

The MODBUS role, <MB_role>, is either MASTER or SLAVE. In the master role, the T6200 polls the foreign unit(s). In the slave role, the T6200 is polled by the foreign master; it responds as one or more MODBUS units. In the master role, polling parameters, <poll-parm>, may be specified here and on the unit statement.

<poll-parm>	"@"{0.1 .. 60}
	EXCEPTION <e-bits>
	GAP <g-bits> <g-regs>
	MAX <m-bits> <m-regs>
	OFFSET {0,1}
	PRIORITY {0,..2}
	RETRY {0..99} ["/" {0..60}

The polling parameters, <poll-parm>, determine the polling characteristics of a MODBUS master as well as the possible offset between point addresses and on-the-wire addresses (OFFSET). Only OFFSET and EXCEPTION apply to MODBUS slaves.

"@"	Polling interval in seconds
<e-bits>	Exception handling control flags. 2 Exception on bad poll address 4 Limit response quantity to poll quantities 8 No response on bad poll address
<g-bits>	Number of unused coils or inputs which may be polled to poll succeeding coils or inputs.
<g_regs>	Number of unused holding or input registers which may be polled to poll succeeding values.

<m-bits>	Maximum number (1..2000) of coils or inputs to poll with one message.
<m-regs>	Maximum number (1...125) of registers to poll with one message.
OFFSET	Difference between point number and on-the-wire address. (Modicon specifies 1)
PRIORITY	Unit priority scan. Default priority is 1. Place only a small number of high priority points at priority zero.
RETRY	Retry count and optional interval. Interval defines the expected response time of the unit.

Table 1 Polling Parameter Values

The default polling parameters are:

"@ 3

GAP 0 0 MAX 16 10 OFFSET 1
RETRY 10 / 1 PRIORITY 1"

The lowest numbered priorities take precedence over higher numbered priorities. In order to insure that all points cannot possibly be scanned as frequently as specified, the priority scan is cascaded: Whenever a priority level is completed, at lease one poll will be performed at the next level even if it is already time to poll a higher priority block.

<unit>	UNIT {1..247}[=<unit-tag>][<poll-parm>] points>…
<points>	<address> {[<scale>]<tag-def>}…
<address>	<coil/input-nr>
<scale>	{"+" | "-"} [":" [["-"] <bits>]] [H [, L[, h[, I]]]]
<bits>	{-15.. 16, 32}

Table 2 UNIT Directive

The UNIT directive introduces each MODBUS unit. Units may be numbered from one to 247 according to the MODBUS specification. The optional <unit-tag> is reserved for the future reporting of off-line unit alarms. Most of the polling parameters, <poll-parm>, apply only to MODBUS masters. The specific syntax depends upon the <protocol> selection.

The <points> define global tags and assign MODBUS addresses to them in the current unit and port. Once an address is specified, tags will be assigned successive addresses until a new starting address is specified. Multiple tags may not be assigned to a single address. Use a comma to separate point tag names only if a break in polling messages is required there; otherwise separate tag names with a space. The values of tags can be shared with the reserve controller over the backup link: prefix the tag name with '&' to include it in backup data sent from the active to the reserve controller. Subsequent tags will also be sent to backup until a comma delimiter or a new address.

MODBUS <coil/input-nr> specify the corresponding remote data type. Coils and inputs are discretes which can only be assigned to U-32 Boolean tags. Input and holding registers are sixteen or thirty-two bit integers which can be assigned to any data type. If no data type is otherwise specified for a controller tag, it defaults to the type of the remote point.

00001..09999[1]	Coils
10001..19999	Discrete inputs
30001..39999	Input registers
40001..49999	Holding registers

Table 3 <coil/input-nr>

[1]Since the first digit of <coil/input-nr> specifies the MODBUS data-type, intervening leading zeros may be omitted. For example "00001" may be written "01" for the first coil and "40001" may be written "41" for the first holding register.

Boolean tags may be defined in a remote register block. Such tags are packed into register's least significant bit first. A comma between Boolean tags will force the start of a new register. When the register is written by the remote device, all of the Boolean tags will be updated. Conversely, if any Boolean is modified, the whole register will be written.

The <scale> modifier provides for the automatic conversion of engineering unit scales between the remote points and the local tag values. Scaled tags are real and all real tags are scaled. Without scaling, remote register point default to integer values; with scaling, remote register points default to real values.

Register points may be treated as signed or unsigned and fewer than sixteen significant bits may be either left or right justified within the register. Signed (-) or unsigned (+) registers are specified by the leading "-" or "+" which introduces the <scale> modifier.

Register width and alignment is specified by the optional [":"a[["-"]a<bits>]] field. The number of bits ranges from –15 to 16 or 32. A negative number of bits specifies left alignment.

When a non-zero number of bits is specified, the [h,al] values default to the range of the register field so that, if they are not overridden, (H,aL] is the resulting conversion range; however H alone specifies conversion scale factor. When <bits> is zero, [h,al] default to (1,0) so that the register is treated as an integer. The [H,aL,ah,al] values default to (1,0,1,0) when not otherwise specified. If [H [, L [, h[, l]]]] is not specified, then the default data type remains integer. When <bits> is 32, two registers are joined; the first (lower numbered) register is the most significant half. The engineering unit conversion is as follows:

$$EU = H * reg$$

Equation 1 Scale Factor Conversion

$$EU = (H - L) * \frac{reg - l}{h - l} + L$$

Equation 2 Conversion to Engineering Units

Tags are defined in the usual way, with the exception that the sequence "/+" or "-" turns on or off access by the host rather than the single character ("+" or "-") which is all that is required in other contexts. Tags are not separated by commas, a Comma marks the end of a MODBUS master polling block.

Example #1:

```
PORT 5 9600 E81 RS-232 MODBUS RTU SLAVE OFFSET 0;
UNIT 1

01

C1100 C1101 C1102

41

H1100 !CH110101 !CH110102 !CH110103, CH110201 CH110202

;
LOOP LP1;
END;
```

Example #2:

```
PORT 5 9600 N81 R2-232 MODBUS RTU MASTER RETRY 10/0.750 @3.5;
UNIT 23 RETRY 10 @3
 01 'COILS_23-01-32[32], 11 'DI_23-01-32[32], 41 COUNT -0.01 SPEED_SP SPEED_PV +:16
100 SPEED_CMD
+:-12 1200,1000,0xFFF0,0x3330 TEMP;
END;
ACCESS SPEED_SP;

/* Allow operator to send a new speed from host. */
LOOP L1;
END;
```

Register scaling is as follows:

REG	**SYMBOL**	**DATA TYPE**	**EU VALUE**		
			0	**100_{10}**	**0X8000**
1.	COUNT	INT	0	100	32768
2.	SPEED_SP	REAL	0	1.0	-327.68
3.	SPEED_PV	REAL	0	1.0	-327.68
4.	SPEED_CMD	REAL	0	0.0015	50.0008
5.	TEMP	REAL	0	950.3816	1075.0305