OPERATING MANUAL

EXACTA 21 MONITORING AND CONTROL SYSTEM

FORM EXACTA 21 OM 11-07

WARNING: DEVIATION FROM THESE INSTRUCTIONS MAY LEAD TO IMPROPER ENGINE/MACHINE OPERATION WHICH COULD CAUSE PERSONAL INJURY TO OPERATORS OR OTHER NEARBY PERSONNEL.

NOTE: This manual provides basic information on operating, parameter setting, calibration, installation, and troubleshooting, to assist the operator with proper use of the Exacta 21 Control Panel. A companion manual, Exacta 21 Programming Guide is available for technicians and more knowledgeable operations personnel.

OVERVIEW

The following provides an overview for a typical **EXACTA 21** control panel. Since the actual configuration is variable to suit the customer's needs and choice of options, specific details may differ from those described.

1.0 INTRODUCTION

The fully-configurable **EXACTA 21** Monitoring and Control System has been developed as an *all-in-one* solution for controlling gas compressors and associated site equipment. This makes it ideal for new or retrofit packages. It performs all standard control functions, plus it has several unique features.

The system can be configured for large or small compressors, screw or reciprocating, with engine or electric drivers.

1.1 MONITORING

The **EXACTA 21** monitors temperatures, pressures, levels and other signals, through *smart* analog and discrete I/O boards. The system can handle a maximum of 192 I/Os. Each analog board contains 16 channels that can be individually configured to accept different input types:

- **4 to 20mA**
- **0 to 5V**
- **Discrete (switched)**
- **Thermocouple Type J and K**
- **Resistive temperature devices (RTDs)**
- **Resistive**

The controller has a 40-character x 8-line backlit display, allowing simultaneous display of many values.

Up and **Down** keys can be used to scroll between display screens if there are more inputs to be viewed than one screen can handle.

1.2 SHUTDOWNS, ALARMS AND ANNUNCIATION

The **EXACTA 21** uses the industry standard Class A, B, C, and D designations, with individual timers on all Class B's and C's (programmable default setting). The system can also be configured to add a delay to the shutdown or alarm, to debounce and eliminate nuisance shutdowns. An unlimited number of shutdowns and alarms can be added on any analog channel, which include the normal high and low shutdowns and alarms plus:

- **DIFFERENTIALS**
- **CALCULATED SHUTDOWNS**
- **TIME DELAYED SHUTDOWNS**
- **OUT OF RANGE**

For example, a calculated shutdown would calculate the dew point of acid gas and then shutdown and purge the unit if the gas temperature ever goes below the calculated curve.

The **EXACTA 21** annunciates the first-in shutdown and lists all other shutdowns and alarms. This must be acknowledged by the operator by pushing **Reset**. The system records the date and time of any shutdown or alarm and stores it for future reference. It also takes a snapshot of all the temperatures, pressures and other analog values when a first-in shutdown occurs and records data for 39 intervals back in time (usually 1 second apart).

If a compressor stalls, historical data helps determine the cause. The **EXACTA 21** computer saves 40 first-in shutdown data sets.

1.3 SEQUENTIAL CONTROL

The control system performs the sequence of starting, loading and stopping the compressor unit. It can handle all the pre-lubes, purges, cranking sequences, warm up cycles, loading, stopping and post-lubes. It can also control the valves associated with these functions. The sequence of steps can be programmed to work from both time and temperature data.

1.4 CAPACITY CONTROL

Up to 15 built-in **PID** controllers handle the loading and unloading of the compressor. This includes controlling:

- **SPEED OF THE ENGINE**
- **INLET SUCTION VALVE**
- **AUTO AND START-UP BYPASS VALVES**
- **SLIDE VALVE ON A SCREW-TYPE COMPRESSOR**

The built-in master controller allows the control of four inputs simultaneous with four different outputs. This allows for control of suction pressure, discharge pressure, and manifold pressure (or amperage on electric drives) with one setting for each. The system will automatically control to the input closest to it's setpoint.

1.5 DATA CAPTURE

The **EXACTA 21** automatically records all the temperatures, pressures and other analog inputs at regular intervals. The computer keeps a minimum of 1400 of these records in memory at any given time. If recorded at 15-minute intervals, 14 days worth of data can be stored (52 days if recorded once every hour, etc.) The operator can view this data, and scroll back and forth through time, to determine how well the unit is operating.

As mentioned previously, for diagnosing problems, the system continuously captures 40 records of data, usually at one second intervals, and can store data for 40 separate shutdowns in its memory. This data can be downloaded and put into a spreadsheet or **SCADA** system, and then graphed to do trending and performance calculations.

1.6 COMMUNICATIONS

The **EXACTA 21** has built-in **RS232** and **RS485/422** ports. All that is needed to communicate with the system is a simple terminal program like **Procomm Plus™** or **Microsoft Terminal™** or **HyperTerminal™**. The **EXACTA 21** can be linked to a **SCADA** system by using the Modbus protocol. The transmission medium can be direct, modem, FM transmitter, MSat satellite, or any other comparable method.

1.7 PROGRAMMING

The **EXACTA 21** combines all the programming and flexibility of a programmable logic controller with the ease and simplicity of a dedicated controller. The object-oriented programming language and state engine allows programming of very complex processes. The parameter setting capabilities allow quick and easy programming of specific functions like shutdowns, alarms, pre-lube, post-lube, crank sequences, etc.

1.8 MODBUS

This information can be read or written to the **EXACTA 21** Computer.

Item	Read/Write
Analog inputs	Read Only
Analog outputs	Read/Write
Discrete inputs	Read/Write
Discrete outputs	Read/Write
PID setpoints	Read/Write
PID Auto/Manual	Read/Write
Shutdown and alarm setpoints	Read/Write
Shutdown and alarm status	Read Only
Engine RPM	Read Only
First-in shutdown	Read Only
Hour meter	Read Only

The unit can be started, stopped, and reset remotely. Other functions can be performed by forcing discrete inputs **ON**.

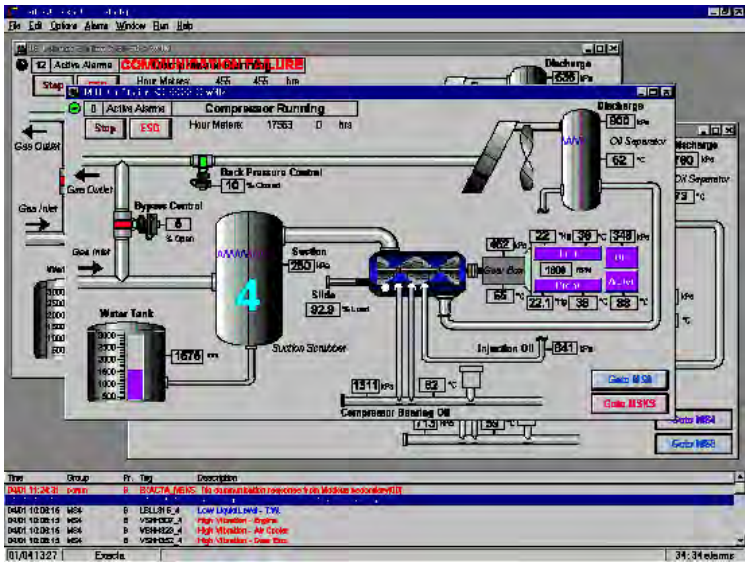
The data can be formatted in any of the following forms, assuming that the data can fit in a specific format. For example, analog values cannot be formatted as bytes or bit mapped.

- **Bit mapped (discrete inputs and outputs only)**
- **Byte**
- **Short word (2 Bytes)**
- **Long word (4 Bytes)**
- **IEEE Single Floating Point (4 Bytes)**
- **IEEE Double Floating Point (8 Bytes)**

Modbus RTU can be connected to either communications port (**RS232** or **RS485**). Selectable from 2400 to 19200 Baud, 8 Bit, No Parity (N 8 1).

1.9 COMPRESSOR CONTROL INTERFACE

An optional graphical user interface software can be used to enhance its existing remote monitoring and control capabilities. In addition to the standard **EXACTA 21** features, this software provides an interactive GUI interface, graphing, and a permanent data log.

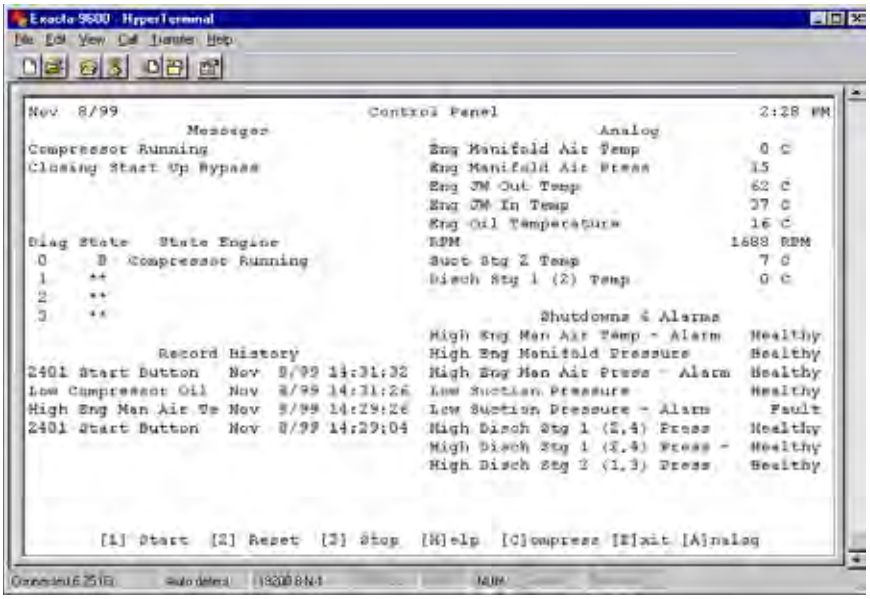


SAMPLE GRAPHICAL USER INTERFACE

1.10 SPECIAL FUNCTIONS

1.10.1 CONTROL PANEL SOFTWARE

Control Panel displays a combination of analog inputs, shutdowns, alarms, recorded history and events. It can be viewed on a laptop or PC computer using inexpensive software like **Procomm Plus™**, **Microsoft Terminal™** or **HyperTerminal™**.

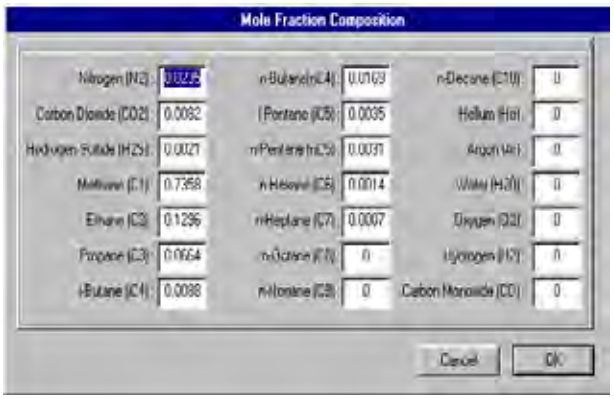


TYPICAL CONTROL PANEL DISPLAY

1.10.2 AGA CALCULATIONS

As an optional feature, the **EXACTA 21** is capable of performing **AGA 3** and **AGA 8** flow calculations. The calculations are based on the latest editions of **AGA Report No. 3, Part 3—Natural Gas Applications** and **AGA Report No. 8.—Compressibility Factors of Natural Gas & Other Related Hydrocarbon Gases**. Parameters can be set either through a HMI interface or from the **EXACTA 21** panel itself.

AGA CALCULATION DATA ENTRY



AGA CALCULATION RESULT

1.11 DATA CAPTURE

1.11.1 DOWNLOADING

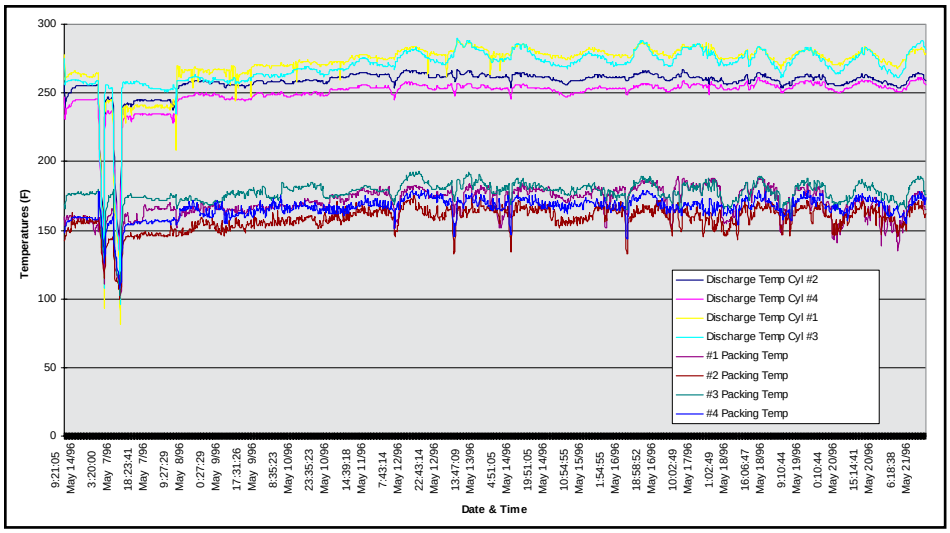
The **EXACTA 21** computer captures data by taking a snapshot at regular intervals. This data can be transferred to a PC and loaded into any spreadsheet. The column headers on the spreadsheet are downloaded with the data. The sample below was downloaded via Satellite (MSat).

Date	Time		#1 Suction Pressure	#1 Discharge Pressure	#2 Discharge Pressure	#3 Discharge Pressure	Engine Oil Pressure	Compressor Oil Pressure	Engine Manifold Air Pressure	Gas Detection #1	Fire Detection	Engine Coolant Inlet Temp	Engine Temperature	Engine Oil Temperature	24 Volt Input			RPM	#1 Suction Temp
May 6/96	10:35:00		16	70	267	817	76	61	5	0	4	115	144	175	25.8			1730	62
May 6/96	10:50:00		16	67	262	815	76	58	4	0	4	115	147	181	25.6			1730	64
May 6/96	11:05:00		16	65	258	813	76	57	4	0	4	115	149	185	25.6			1729	67
May 6/96	11:20:00		15	66	259	814	77	53	4	0	4	115	144	177	25.8			1730	69
May 6/96	11:35:00		15	65	257	814	77	61	4	0	4	114	143	177	25.8			1730	69
May 6/96	11:50:00		15	64	255	814	77	58	4	0	4	114	144	177	25.8			1730	70
May 6/96	12:05:00		14	63	253	813	76	54	4	0	4	115	145	179	25.8			1730	70
May 6/96	12:20:00		14	62	253	812	77	62	4	0	4	114	143	177	25.8			1730	71
May 6/96	12:35:00		14	62	253	812	77	61	4	0	4	113	143	177	25.8			1729	71
May 6/96	12:50:00		14	61	251	811	77	55	4	0	4	113	142	176	25.9			1728	70
May 6/96	13:05:00		13	60	250	813	77	58	4	0	4	114	144	179	25.8			1730	71
May 6/96	13:20:00		13	62	253	817	77	55	4	0	4	113	142	176	25.9			1730	70
May 6/96	15:35:00		13	59	246	813	77	54	4	0	4	112	140	176	25.9			1729	72
May 6/96	15:50:00		12	57	245	811	77	53	3	0	4	112	143	181	25.8			1731	73
May 6/96	16:05:00		12	58	246	811	77	58	3	0	4	111	140	176	26			1731	73
May 6/96	16:20:00		12	58	246	812	77	61	4	0	4	111	140	176	26			1729	73
May 6/96	16:35:00		12	58	245	809	77	58	3	0	4	111	140	176	26			1730	73
May 6/96	16:50:00		12	58	245	809	77	59	3	0	4	111	140	176	26			1731	73
May 6/96	17:05:00		12	58	246	808	78	53	3	0	4	111	140	176	26			1731	73
May 6/96	17:20:00		12	58	244	806	77	63	3	0	4	111	139	176	26			1731	73
May 6/96	17:35:00		12	58	243	804	77	62	3	0	4	111	140	176	26			1729	74
May 6/96	17:50:00		12	58	243	803	77	54	3	0	4	111	139	176	26			1729	73
May 6/96	18:05:00		12	58	244	803	77	53	3	0	4	111	140	176	26			1730	73
May 6/96	18:20:00		12	57	242	801	78	62	3	0	4	111	139	176	26			1730	74
May 6/96	18:35:00		12	57	242	799	78	57	3	0	4	110	139	176	26			1730	73
May 6/96	18:50:00		12	57	240	798	77	55	3	0	4	110	139	176	26			1729	74
May 6/96	19:05:00		12	57	241	797	78	58	3	0	4	110	139	176	26			1730	74
May 6/96	19:20:00		15	66	259	801	78	61	4	0	4	110	139	177	26			1730	73

TYPICAL DOWNLOADED DATA SET

1.11.2 TRENDING DATA

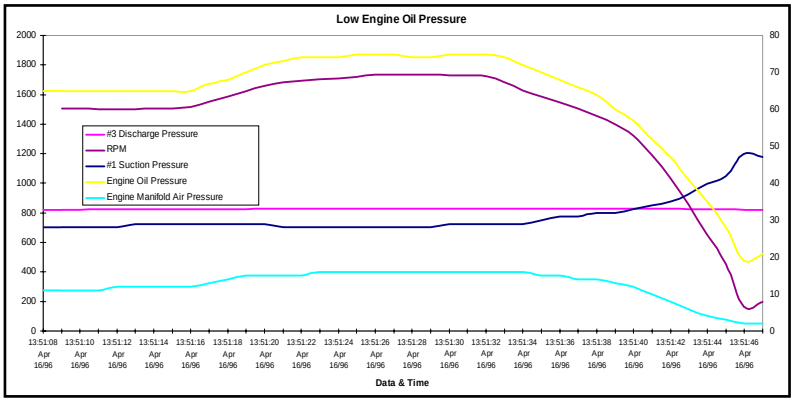
Once loaded into a spreadsheet. The data can then be graphed to show trends. The cylinder temperature graph below was taken over a period of three weeks. (The spikes indicate daily temperature changes.)



TYPICAL TRENDING DATA GRAPH

1.11.3 FIRST-IN SHUTDOWN DATA

Forty intervals of data before a shutdown can be downloaded into a spreadsheet. The data can then be graphed to make it easy to diagnose the cause of the shutdown.



TYPICAL FIRST-IN SHUTDOWN DATA GRAPH

1.12 PROGRAMMING

Below is an example of the shutdown and alarm list. Additional information on analog inputs, **PID** settings, discrete inputs and outputs, plus configuration information, can also be printed or downloaded onto a laptop or PC.

Exacta 21
Electric Motor
Sample Program

Programming
Date: Mar 14, 06
Time: 9:00 AM

Shutdown and Alarm List

Dev	Name	Tag	Type	Class	Mode	Wired	Delay	Channel	Diff	Set Point
1 Low Suction Pressure	PT-105	Analog	B 120 Sec	Low Shutdown		0.0 Sec	1			75
2 High Suction Pressure	PT-105	Analog	B 120 Sec	High Shutdown		0.0 Sec	1			700
3 Low Oil to Suction Differential	PT-112	Diff	B 15 Sec	Low Shutdown		0.0 Sec	2	1		345
4 High Discharge Pressure	PT-200	Analog	A	High Shutdown		0.0 Sec	3			2000
5 High Discharge Gas Temperature Alarm	TE-116	Analog	A	High Alarm		0.0 Sec	4			90
6 High Discharge Gas Temp Shutdown	TE-116	Analog	A	High Shutdown		5.0 Sec	4			100
7 High Lube Oil Temp Alarm	TE-115	Analog	A	High Alarm		0.0 Sec	5			700
8 High Lube Oil Temp. Shutdown	TE-115	Analog	A	High Shutdown		0.0 Sec	5			80
9 Suction Scrubber High Level	LSHH-101	Discrete	A	Shutdown	NC	0.0 Sec	2107			
10 High Vibration - Compressor	VSHH-107	Discrete	A	Shutdown	NC	0.0 Sec	2108			
11 High Vibration - Motor	VSHH-109	Discrete	A	Shutdown	NO	0.0 Sec	2109			
12 Oil Separator Low Temp - Alarm	TE-210	Analog	B 120 Sec	Low Alarm		0.0 Sec	11			55
13 Oil Seperator Low Temp - Shutdown	TE-210	Analog	B 120 Sec	Low Shutdown		0.0 Sec	11			52
14 Economizer - High Liquid Level	LSHH-220	Discrete	B 20 Sec	Shutdown	NC	0.0 Sec	2112			
15 Propane Injection Low Pressure	PDLL-228	Discrete	A	Shutdown	NC	0.0 Sec	2113			
16 High Gas Level Alarm	CM-100	Discrete	A	Alarm	NC	0.0 Sec	1103			
17 High Gas Level Shutdown	CM-100	Discrete	A	Shutdown	NC	0.0 Sec	1104			
18 Motor Stopped	ZSO-108	Discrete	B 20 Sec	Shutdown	NO	0.0 Sec	1102			
19 Remote Stop		Discrete	A	Shutdown	NC	0.0 Sec	1108			
20 ESD (Emergency Shutdown)	HS-108	Discrete	A	Shutdown	NC	0.0 Sec	1101			

Analog and Discrete Inputs

Num	Name	Device	Type	Decimals	High Calibration	Low Calibration	Filter	Degree	Accuracy
1 Suction Pressure	2101	4 - 20 MA	0	862	61855	0 12732	1	3	16
2 Compressor Oil Pressure	2102	4 - 20 MA	0	2100	61728	0 12701	1	3	16
3 Discharge Pressure	2103	4 - 20 MA	0	2100	61247	0 12604	1	3	16
4 Discharge Temperature	2104	RTD	0	110	29264	0 20482	1	5	16
5 Lube Oil Temperature	2105	RTD	0	70	26016	0 20488	1	5	16
6 Slide Valve Potentiometer	2106	Voltage	1	100.0	60000	0.0 4000	1	3	16
7 High Liquid Level - Suction Scrubber	2107	Discrete	0	100	65535	0 0	1	7	16
8 High Vibration - Compressor	2108	Discrete	0	100	65535	0 0	1	7	16
9 High Vibration - Motor	2109	Discrete	0	100	65535	0 0	1	7	16
10 Economizer Pressure	2110	4 - 20 MA	0	2100	61026	0 11783	1	1	16
11 Oil Seperator Temperature	2111	RTD	0	110	28688	0 20512	1	5	48
12 Economizer - High Liquid Level	2112	Discrete	0	100	65535	0 0	1	7	16
13 Propane Injection - Low Pressure	2113	Discrete	0	100	65535	0 0	1	5	16
14 Economizer Level	2114	4 - 20 MA	0	1000	60976	0 11751	1	3	16
15 Motor Current	2115	4 - 20 MA	1	80.0	61775	0.0 12708	1	3	16

Analog Outputs

Num	Name	Device	Type	Decimals	High Span		Low Span	
1	Bypass Valve I/P	2101	4 - 20 MA	2	20.00	65535	4.00	0
2	Suction Valve I/P	2102	4 - 20 MA	2	20.00	65535	4.00	0
3	Spare	2103	4 - 20 MA	2	20.00	65535	4.00	0
4	Spare	2104	4 - 20 MA	2	20.00	65535	4.00	0

SAMPLE PROGRAM

1.13 SUMMARY OF FEATURES

- Built-in gas compressor programming
- AGA 3 and AGA 8 gas flow calculations (optional)
- Customized programming for individual requirements
- Customized diagnostic messages
- Up to 192 discrete inputs or outputs (relay, triac or transistor)
- Up to 128 analog inputs (RTD's, T/C's, 4 to 20mA, voltage or resistive)
- Up to 32 analog outputs (4 to 20mA)
- High speed pulse inputs (e.g., RPM monitoring)
- Built-in PID and time proportional control (up to 15 loops)
- Shutdowns and alarms for discrete, analog and differentials
- Rated for Class I, Div. 2
- Non-incendive discrete inputs, analog inputs and outputs
- 33.6K modem, capable of paging and faxing through land line or cell phone (optional)
- One RS232 port, one RS485/422 port, and one parallel port
- Extensive memory for trending, first-in shutdowns, and event monitoring
- Data capture, online

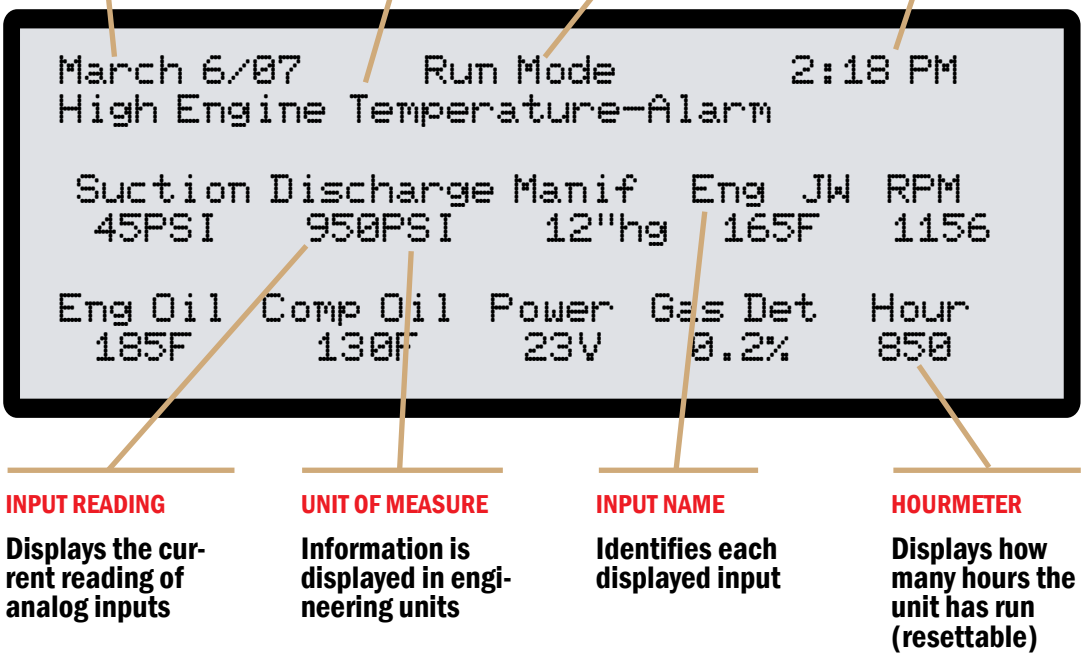
2.0 BASIC OPERATION

2.1 MAIN RUN MODE SCREEN

During normal operation, and when the computer is first turned on, the **Main Run Mode** screen will be displayed (after some initialization screens are cycled through).

This screen shows the most important unit parameters, and provides an hourmeter, real-time clock with date, and a message line.

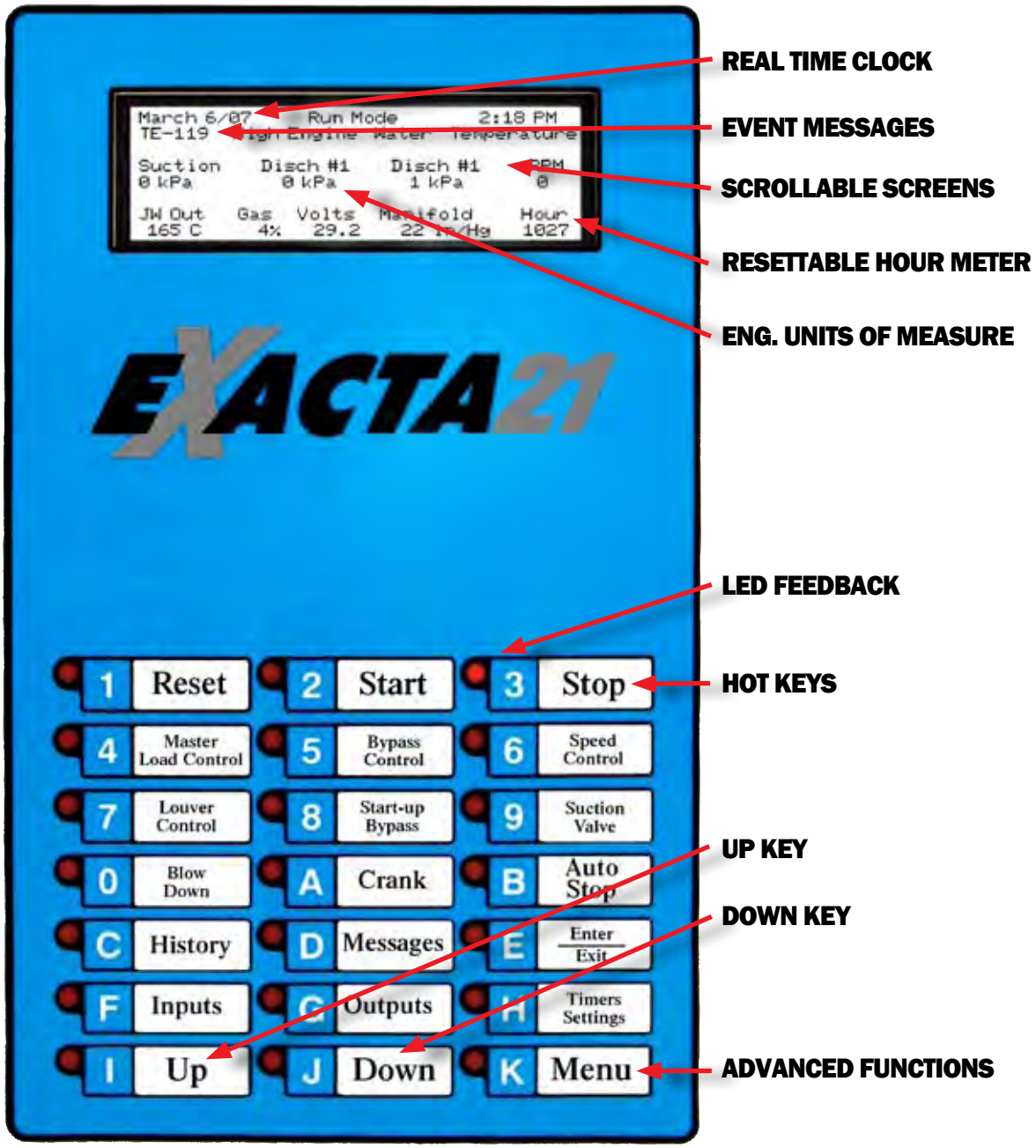
The values on the **Main Run Mode** screen (or its auxiliary screens) are the current readings taken from the end devices. These are displayed in engineering units, and the units are shown.



2.2 TYPICAL PANEL LAYOUT

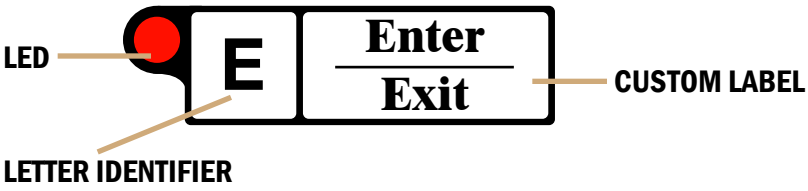
Although the 21-key keyboard is fully programmable, certain functions will usually be present on engine-driven units:

- Reset
- Stop
- Up
- History
- Messages
- Status (may also be labeled as Inputs)
- Enter/Exit
- Outputs
- Auto Stop
- Menu
- Master Load Control
- Start
- Crank
- Down
- Timers and Settings



2.3 USING THE KEYBOARD

Each of the 21 keys has three elements: an **LED** indicator, a small square containing a number or letter and a larger rectangle for the custom label. The number/letter and label act as a single pushbutton.



While the key is pressed, the **LED** will illuminate. It will normally go out as soon as the key is released. If it doesn't go out the computer is performing some function, an error has occurred, or in some cases it may be programmed to stay on or flash. For example, **LED** for key **1**/**Reset**, will normally be programmed to flash whenever a shut-down occurs and it will continue to flash until the problem has been cleared and the key is pushed.

The small squares (**0** through **9** and **A** through **K**) are used to enter your choices (or data) after the computer requests it. Whenever the computer asks for a number or word, press the appropriate keys to enter it.

In addition, each key can be programmed to perform a special function whenever the computer is in **Run Mode** (normal operation). For example, the **E** key is used to enter information or acknowledge an action.

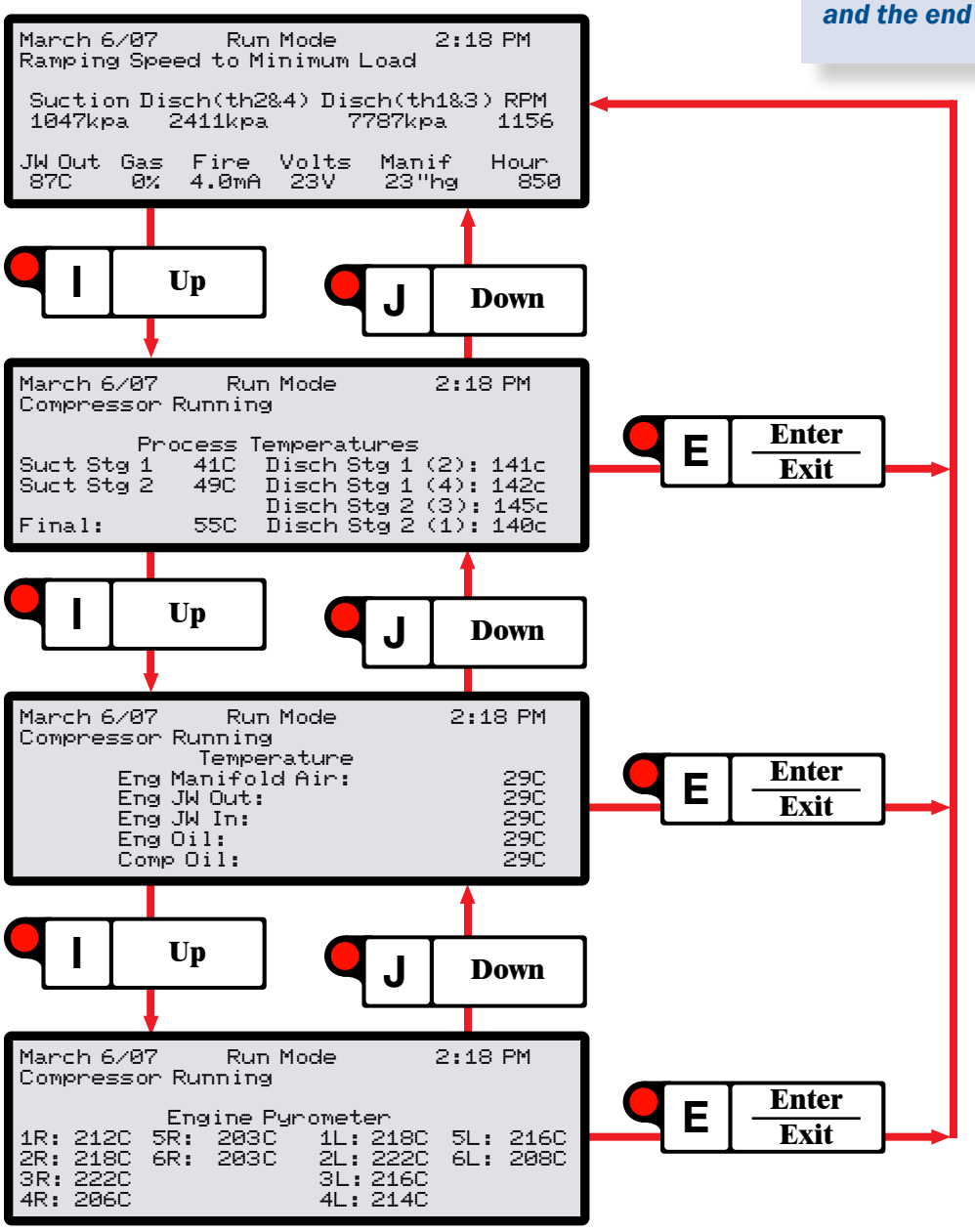
2.4 MULTI-SCREEN SCROLLING

The functions of all of the common keys are explained in SECTION 2.6; however, the **Up, Down** and **Enter/Exit** keys are used for basic navigation as explained in the following.

It is often inadequate, or not possible, to put all necessary information on one screen at the same time. The **EXACTA 21** has the ability to distribute the information on several screens which you can scroll through using the **Up, Down** and **Enter/Exit** keys.

The **Up** key will display the next screen in the string. The **DOWN** key will bring you back to the previous screen. The **Enter/Exit** key will always return you to the **Main Run Mode** screen.

Note that the actual information shown on your system will depend on the programming, application, and the end devices used.



2.5 ADJUSTING SCREEN CONTRAST

The type of display used in the **EXACTA 21** has a small degree temperature sensitivity (darker when warmer), and is also subject to varying light levels within the unit. This means it may be necessary to adjust the contrast periodically to suit the operating conditions.

This is a very easy process:

With any **Run Mode** screen showing, press **Menu**.
The **Menu** screen will be displayed.

```
Mar 6/07 I6        Menu            8:50 AM

[1] Program Mode    [4] Display Modes
[2] History Menu    [6] Software Version
[3] Contrast Adjust

                    [E] Exit
```

Choose **3/Contrast Adjust**, by pressing the **3** key.
The **Contrast Adjust** screen will be displayed

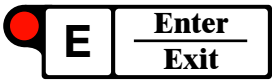
```
Mar 6/07    Contrast Adjust     2:18 PM

   Contrast Adjust (150 - 250): 176


[I] Darker [J] Lighter [K] Adjust [E]xit
```

Choose and hold the **I/Up** key to make the screen darker.

Choose and hold the **J/Down** key to make the screen lighter.

OR

Choose **K/Adjust**
The value desired from 150 to 250 can then be entered.



Press **Enter/Exit** to save the changes and return to the **Main Run Mode** screen.

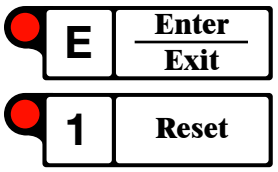
2.6 KEYBOARD FUNCTIONS

This section is based on a typical keyboard layout. Some keys may be different or missing, or perform differently, depending on the program for your unit. This section is intended only as a guide to basic operation for a typical unit.

2.6.1 RESET

When the compressor is running and a shutdown occurs, the **LED** for the **Reset** key will flash to indicate that a shutdown has occurred. (The **LED** will also flash when the system is first turned on.) The second line of the screen will show the **first in** fault, such as **High Engine Jacket Water Temperature** and the system is taken out of **Run Mode**.

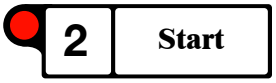
Press **Enter/Exit** to get back to **Run Mode**. Note that the **Reset** key only works as a reset in **Run Mode**.



After a shutdown, before you can restart the unit, all faults have to be cleared on the unit, and you have to press **Reset** to reset the system. If the **LED** still flashes after **Reset** is pressed, another fault (or multiple faults) still remain(s). After all faults are cleared, pressing **Reset** will stop the flashing and bring up an **OK to Start** message.

To show all the current faults press **Messages**. To determine when the fault occurred press **History** then choose **2/Event History**.

2.6.2 START



Start is used to initiate the starting sequence of the compressor. This key will not initiate a start until all shutdown faults have been cleared and the **Reset LED** has stopped flashing. The screen will display an **OK to Start** message on the **Run Mode** screen.

After pressing **Start** the start screen will be displayed.

```
Mar 6/07 I6      Run Mode        8:50 AM

Start Using:  [1] Auto Crank
              [2] Manual Crank
              [3] Exit (Cancel Start)
```

FOR ENGINE-DRIVEN UNITS:
Choosing **1/Auto Crank**, initiates the automated start sequence described in **SECTION 3.1.1**. Choosing **2/Manual Crank** initiates that same sequence, except that you will have to manually press the **Crank** key when the message **OK to Crank** appears. Choosing **3/Exit** aborts the start.

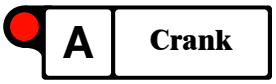
```
Mar 6/07 I6      Run Mode        8:50 AM

          Action On Selection


Perform Action:                  [1] Yes
                                 [2] No
```

FOR ELECTRIC-DRIVE UNITS:
Choosing **1/Yes** will begin the automated start sequence, and choosing **2/No** will abort the start.

As stated above, when starting from the control panel, the **Reset** must be pressed first. In the case of a remote start, the system will automatically reset, then start.

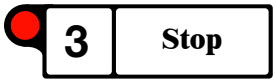
Usually the first functions performed after pressing **Start** are the purge and partial pressurization steps, followed by pre-lube cycles.

2.6.3 CRANK



On an engine-driven unit, pressing **Crank** at any time when the unit is not running will manually crank the engine. The manual key is locked out whenever the unit is above 75 rpm. This key is used during a manual start-up or to test the cranking system.

2.6.4 STOP



Stop is normally used to perform a fast shutdown (partially-sequenced) of the compressor. After pressing the **Stop** key, the **Reset** key will start to flash even if there is no fault. This requires the operator to press **Reset** before restarting the compressor.

If you do not have an **Auto Stop** key, the **Stop** key may be programmed to perform a controlled shutdown sequence instead of a fast shutdown. The fast shutdown would be accomplished by pressing the red **Stop** button on the panel.

A non-sequenced **Emergency Shutdown** option is also available and is actuated from **ESD** pushbuttons on the panel and at other locations.

2.6.5 AUTO STOP

This key is programmed to perform a controlled shutdown sequence. Typically it will only work if the unit is operating above the adjustable **Idle RPM**. Pressing this key will turn the **Master PID Control** to **OFF** and gradually ramp the speed down while opening the bypass valve on a reciprocating compressor or unloading the slide valve on a screw-type compressor. Once the unit reaches the adjustable **Minimum Load RPM** the controller will ramp the unit down to **Idle RPM** for an adjustable length of time, then shut it down and perform post lube operations. This sequence of events depends on your unit's configuration.

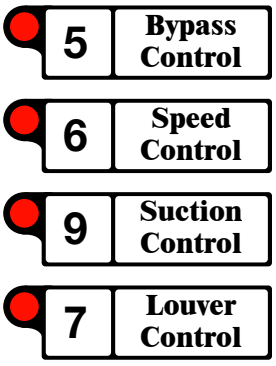
The **Reset** key must still be pressed after this type of shutdown.

2.6.6 MASTER LOAD CONTROL

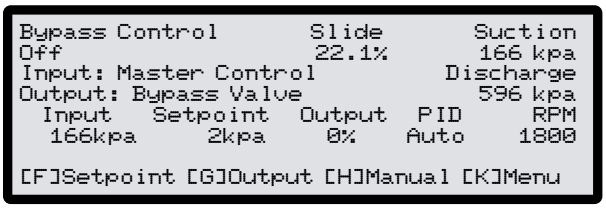
The **Master Load Control** is used to adjust the set points used by the control system to load the compressor. This screen can also be used to toggle the **Master PID** between Auto and Manual.

MASTER PID

2.6.7 BYPASS CONTROL, SPEED CONTROL, SUCTION CONTROL, AND LOUVER CONTROL



These keys are used to make changes to their respective **PID's**. **SECTION 4** explains **PID's** and some important precautions. All of the **PID** screens are identical except for the name in the top left hand corner. The information displayed is dependent on the type of compressor.



BYPASS CONTROL

These keys are used to switch between **Auto** and **Manual** and make adjustments to the setpoint or output. In **Auto** mode, this screen is used to adjust the setpoint of the appropriate **PID.** In **Manual** mode, this screen is used to adjust the 4 to 20mA output signal which controls the **PID**. To toggle back and forth between **Auto** mode and **Manual** mode press the **H** and answer **Yes** to the **Switch to Manual** or **Switch to Auto** question. If the **LED** is on for this button the **PID** is in **Manual**. Normally, the **Bypass Valve** and **Speed Control** setpoints are controlled from the Master **PID** and cannot be modified from these screens unless the Master **PID** is in **Manual**.

The setpoint or output can be adjusted either with the **Up** or **Down** keys, or by typing the value directly.

To use the **Up** or **Down** keys, push and hold one of the keys until the desired value has been reached.

To type a value directly, choose **F/Setpoint** to select the setpoint, or push the **G/Output** key to select output, and then type the desired value on the key board.

Press the **D** button to enter a decimal. Once the value has been typed push **E** to enter the value into the controller.

2.6.8 SLIDE VALVE CONTROL

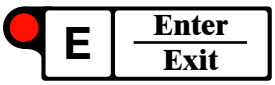
The **Slide Valve Control** is a special pulsed **PID** used to control the slide valve on screw-type compressors. This type of **PID** can only be forced with the **Outputs** key **(SEE SECTION 2.6.18)** or from special **Manual Load** or **Manual Unload** keys programmed into controllers for screw-type units.

2.6.9 ENTER/EXIT

The **Enter/Exit** key is one of the most important keys on the keyboard.

Whenever a number or name is typed, this key must be pressed to tell the system to *enter* the information.

The **Enter/Exit** key is also used to *exit* from a screen or menu back to a previous screen or menu.



2.6.10 UP

The **Up** key is used for several different functions. When using it to adjust a setpoint, it will increase the value of the setpoint as long as the key is being pressed. When using it in conjunction with the screens under the **Inputs**, **Messages** or **History** keys, it is used to move on to the next input or page of information.

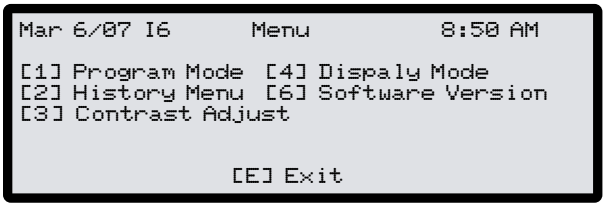
2.6.11 DOWN

The **Down** key is very similar to the **Up** key. When using it to adjust a setpoint it will decrease the value of the setpoint as long as the key is being pressed. When using it in conjunction with the screens under the **Inputs**, **Messages** or **History** keys, it is used to move on to the previous input or page of information.

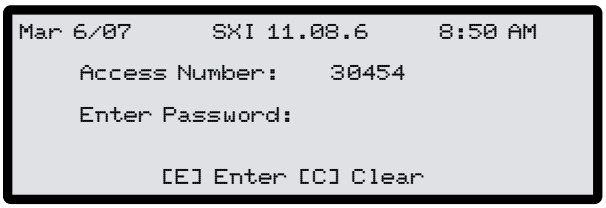
NOTE: If the Output High Limit value is lower than the Output Low Limit value, the Up and Down keys will have a reverse action when manually forcing outputs from a PID key. That is, the Up key will cause the output to ramp down and the Down key will cause the output to ramp up.

2.6.12 MENU

The **Menu** key is used to enter **Program Mode**. When this key is pressed the system will display the menu screen. When **[1] Program Mode** is chosen, the system will ask for a password **(SEE SECTION 4.3)**. The correct level of password is required to enter the program mode.



MENU SCREEN



PASSWORD SCREEN

PROGRAM MENU SCREEN

From some screens, for example certain **PID** screens, analog input screens, or timers and settings **Menu** also allows access to a more detailed setup.

The **Menu** key also allows access to the **History**, **Contrast Adjust**, **Display Modes** and **Software Version**. The **History** key is discussed in **SECTION 2.6.15**. **Contrast Adjust** was discussed earlier in **SECTION 2.5**. **Display Modes** is used to set the units of measure for display purposes (either Metric or English).

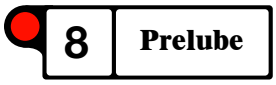
2.6.13 REMOTE/LOCAL

The **Remote/Local** key is used when a **SCADA** host system is connected to the panel through modbus communications. Such a connection allows remote control of the system and remote setting of various parameters.

When **Remote** is chosen, the system will allow changes to setpoints remotely by the host computer. When **Local** is chosen, the host cannot make any changes or control the unit, and the host will receive the setpoint entered on the system panel as its new setpoint. The system must be in **Local** to allow changes to be made directly from the system panel, otherwise the host will override the system with its own setpoints.

The system may be programmed to ask **Perform Action: [1] Yes [2] No** or it may simply toggle the system on pushing the button. The **LED** for **Remote/Local** will typically be **On** in **Remote** .

2.6.14 PRELUBE



The **Pre-lube** key enables the operator to manually pre-lube the engine and/or compressor. Pushing this key turns on the pre-lube pump(s). The system may be programmed to ask **Perform Action: [1] Yes [2] No**. The pumps will run for a preset length of time (adjusted under **Timers and Settings**) and then turn to **Off**. If programmed, pushing the button again while the pumps are running will also turn them to **Off**.

2.6.15 HISTORY

To select one of the options on the menu, press the numbered key shown in **[ ]** brackets. Select **E** to exit.

```
Mar 6/07     History Menu        8:50 AM

         [1] First in Shutdowns
         [2] Event history
         [3] Captured data


                [E] Exit
```

HISTORY MENU SCREEN

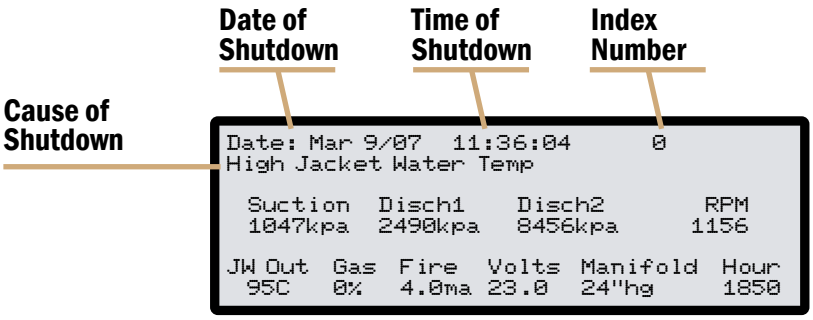
[1] First In Shutdowns will display a list of shutdowns in reverse order of occurrence. The system will display five shutdowns at one time.

Press **F** to scroll to the next five shutdowns. Push **E** to return to the **History Menu** screen. For details about any shutdown enter its number.

```
Mar 6/07 I6   Select Shutdown   8:50 AM

[1] High Jacket Water Temp     11:36:04
[2] Low Engine Oil Pressure     Mar 2/07
[3] High Discharge Pressure     Feb 1/07
[4] Low Compressor Oil Level    Jan 9/07
[5] Low Engine Oil Level        Dec 9/06
           [E] Exit [F] Forward
```

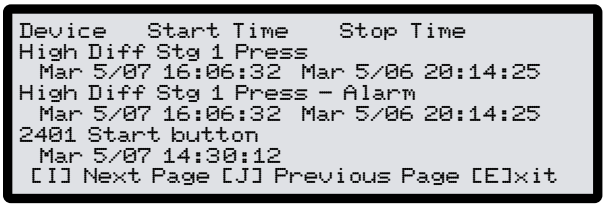
FIRST IN SHUTDOWNS SCREEN

When selecting more detail, the system displays the main **Run Mode** screen at the time that the shutdown occurred. It is possible to scroll to the other detail screens by using the **Up** and **Down** keys. In addition, it is possible to move back in time by using the **B** key. As the **B** key is pressed, the time will start going backwards at one-second intervals. The index will increase in value at the same time. The **F** key can be used to go forward in time. The index reads zero at the time of the last shutdown. The system keeps 40 time slots-worth of data for each shutdown.



SAMPLE FIRST IN SHUTDOWN DETAIL DISPLAY

[2] Event History displays all current and previous shutdowns (not just first in) and other events in reverse chronological order, showing the date and time when they occurred. This screen also shows other events such as when the compressor was started.



EVENT HISTORY SCREEN

This screen shows both a start time and stop time. The stop time tells when the event ended or the fault was cleared. For shutdowns, the fault must be cleared and then **Reset** must be pressed before the stop time and date are set. The **I** key is used to scroll to the next set of three events on the screen, and the **I** key can be used to scroll back to the previous screen. The **E** key is used to exit to the **History Menu**. The system will store **385** events in memory.

[3] Captured Data displays a screen similar to **Event History**, but will not show a shutdown cause. Once again the **B** key and the **F** key can be used to scroll back and forth through time. The **Up** and **Down** keys can be used to scroll between screens. The time interval is typically set to 15 minutes and will show temperatures and pressures regardless of whether the compressor is running or not. The computer will store a minimum of 2 weeks worth of data when set to a 15-minute interval. Captured data is generally used when graphing trends by downloading to a spreadsheet **(SEE SECTION 7.3)**.

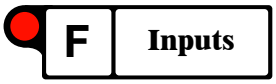
2.6.16 MESSAGES

The **Messages** key displays a screen showing all the current messages being written to the screen including shutdowns and alarms affecting the compressor. This screen shows four items at one time. If there are more than four messages the screen will show the **[I] More Messages** option at the bottom of the screen. To display the next four messages press the **I** key. When the last page of messages is displayed, pressing the **I** key again will cause the first page of messages to be re-displayed. The system displays the messages in order of priority and then a "first in" order. Since all shutdowns have the same priority they will be shown in "first in" order.

```
Mar 6/07 I6   Show Messages      8:50 AM

Push Reset Button To Clear
VSHH-206  High Vibration - Engine
TSHH-227  High Oil Temperature - Engine
LSLL-233  Low Level - Jacket Water

      [E] Exit   [I] More Messages
```

MESSAGES SCREEN

2.6.17 STATUS



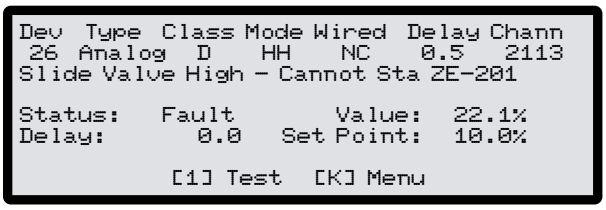
This key allows you to view the status of various items. To select one of the options on the menu, press the number key shown in brackets beside the option. Press **E** to exit to **Run Mode**.

```
Mar 6/07      Status Menu        8:50 AM

[1] Shutdowns:  10  [5] Analog Inputs
[2] Alarms:      0  [6] Discrete Inputs
[3] Faults:      2  [7] Analog Outputs
[4] Shutdown List   [8] Discrete Outputs

                [E] Exit
```

STATUS MENU SCREEN

[1-4] Shutdowns, Alarms, Faults and Shutdown List displays up to four shutdowns and alarms and their status when any of these options is chosen. Push the number beside a specific shutdown or alarm to see the detail screen. The screen shows if the input is currently faulty or healthy. For analog or differential shutdowns, it will display the current reading and the setpoint. The delay time (zero with a healthy input) will start counting down when the shutdown or alarm goes from healthy to faulty. When the timer reaches zero, the shutdown or alarm will take affect.

```
Mar 6/07        Shutdowns        8:50 AM

[1] Slide Valve High - Cannot S    Fault
[2] Suction Scrubber Level High    Fault
[3] Compressor Oil Level Low       Fault
[4] Engine Oil Level Low           Fault

[J] More                       [E] Exit
```

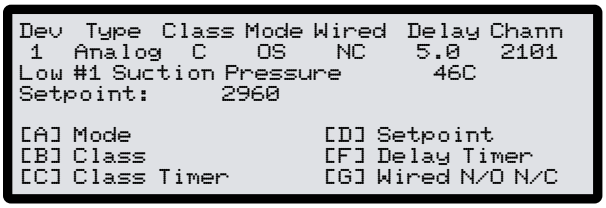


SHUTDOWNS AND ALARMS SCREEN (DETAIL)

The **Up** and **Down** keys can be used to scroll forward and backward four Shutdowns/Alarms at a time. The **1** key is used to enter **Test Mode**. **SEE SECTION 4.1**

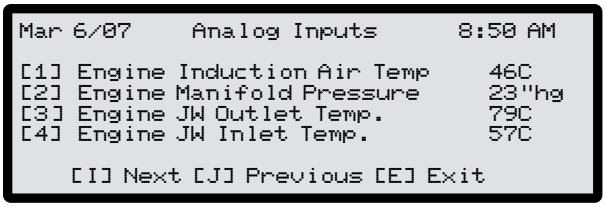
For the particular shutdown or alarm being displayed, the **K** key is used to display the **Shutdown Parameter Entry Screen**. This screen allows you to quickly change parameters. The system will ask for a password before allowing access to this menu.

All the parameters for a particular shutdown or alarm can be accessed by choosing an option from this screen. If an option is not applicable for the particular shutdown or alarm, the screen will display a message. To make a change, choose the parameter, type in the new information (or in some cases toggle between the options given) and choose **Enter**. **SEE SECTION 4.2**



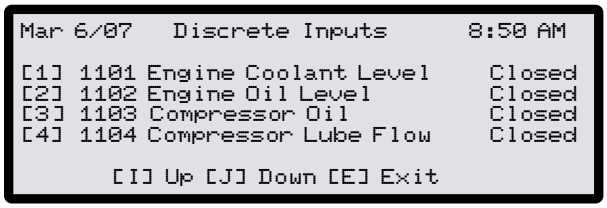
SHUTDOWN PARAMETER ENTRY SCREEN

[5] Analog Inputs displays the **Analog Inputs** screen with four inputs displayed at a time. To scroll to the next four inputs, press the **Up** key. Press **Down** to scroll back through the previous screens. Exit to the **Input Menu** by pressing the **Exit** key. Pushing the number beside the input displays the calibration screen. **SEE SECTION 5.2**



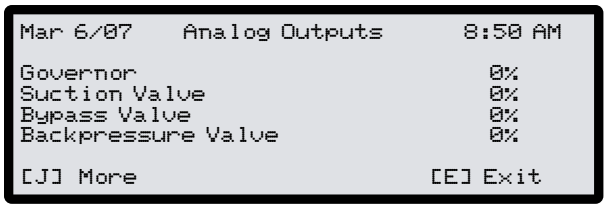
ANALOG INPUTS SCREEN

[6] Discrete Inputs shows the status of four discrete inputs. **Closed** means that the contacts on the input are closed which is normally the healthy position. **Open** means that the contacts are open. The **Up** and **Down** keys can be used to scroll forward and backward, four inputs at a time.



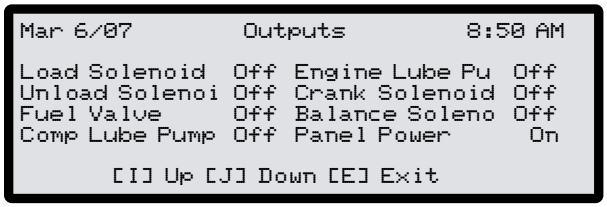
DISCRETE INPUTS SCREEN

[7] Analog Outputs shows the status of four analog outputs. The **Up** and **Down** keys can be used to scroll forward and backward, four outputs at a time.



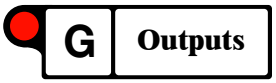
ANALOG OUTPUTS SCREEN

[8] Discrete Outputs shows the status of eight Discrete outputs. The **Up** and **Down** keys can be used to scroll forward and backward, eight outputs at a time. See the **Outputs** button below for overriding outputs.



DISCETE OUTPUTS SCREEN

2.6.18 OUTPUTS



The **Outputs** key is used to force discrete (switch) outputs to **On** or **Off**. This is very useful when checking out the equipment to see if it is wired up and functioning correctly. To switch an output to **On** or **Off**, press the **Outputs** key. The resulting screen shows eight outputs at a time. Use the **F** key to scroll to the next screen and the **B** key to scroll back to the previous screen.

Select the output desired by choosing the corresponding number. A **<** will display on the right side of the one selected. Choose **[K] Toggle** to change (toggle) the output state to **On** or **Off**. Choose **[H] Momentary** to momentarily switch to **On** or **Off** while the key is held.

Option **[G] Auto** was set up to toggle between **Auto Mode** (enable programming) and **Manual Mode** (disable programming); however, this feature has not been activated. The program will still show an **M** in front of the **On** or **Off** when the output has been put in the **Manual Mode**, but this has no effect.

```
Mar 6/07          Outputs          8:50 AM

[1] Fuel Gas     On <[5] BC Drain      Off
[2] Crank       Off  [6] Blowdown V M Off
[3] Eng Prelub  Off  [7] SU Bypass     Off
[4] BC Fill     Off  [8] ESD Block     Off

[H]Momentary [K]Toggle [F]orward [G]Auto
```

DISCRETE OUTPUTS SCREEN

2.6.19 TIMERS/SETTINGS

The **Timers/Settings** key is used to change parameter settings for various control functions. This menu will vary for each compressor depending on the type of compressor and the options associated with the compressor. When one of the options is selected, the system will ask for a password. This password will then be good for one hour and will not need to be re-entered each time.

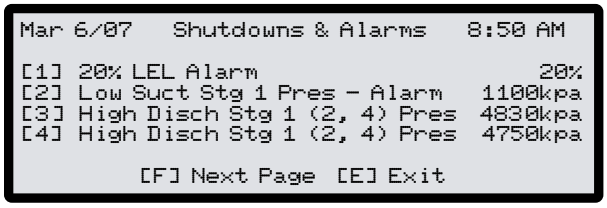
```
Mar 6/07    Timers & Settings   8:50 AM

[1] Shutdown Alarm     [6] Dump Timers
[2] Prelube Settings   [7] Purge Timers
[3] Crank Settings     [8] Load Settings
[4] Warm Up            [9] Test
[5] Post Lube
                  [E] Exit
```

TIMERS AND SETTINGS SCREEN

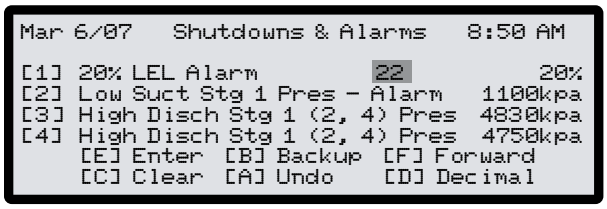
When one of the options is selected from the **Timers and Settings Menu** the system will display a list of four numbered parameters. Scroll through the list using the keys shown at the bottom of your screen to find the specific parameter you want.

2.6.19 TIMERS/SETTINGS (CONTINUED)

To change a parameter press the number to the left of your choice. Pressing the **1** key in the example below causes the system to go into number edit mode. The new setpoint value can be typed. Pressing the **Enter** key will cause the system to accept any changes. The **[A] Undo** option can be selected at any time up until the **Enter** key is pressed.



SHUTDOWN AND ALARMS SCREEN



CHANGING SETTINGS SCREEN

2.6.20 TYPICAL TIMERS AND SETTINGS PARAMETERS

SHUTDOWNS & ALARMS - This is a sample of the setpoints for the analog inputs

[1] 20% LEL Alarm	20%
[2] Low Suct Stg 1 Pres - Alarm	1100kpa
[3] High Disch Stg 1 (2,4) Pres	4830kpa
[4] High Disch Stg 1 (2,4) Pres - Alarm	4750kpa
[5] High Disch Stg 2 (1,3) Pres	9300kpa
[6] High Eng Oil Temp - Alarm	100C
[7] High Disch Stg 2 (1,3) Pres - Alarm	9200kpa
[8] High Eng JW Out Temp	99C
[9] High Disch Stg 1(2) Temp	160C
[A] UV Fire Detection	49.0

PRE-LUBE SETTINGS - These settings control the Pre-lube Cycle

[1] Engine Pre-lube	20.0 Sec	Set to Zero for No Pre-lube
[2] Engine Pre-lube Press	3.0 psi	Set to Zero for No Pressure Test
[3] Comp Pre-lube Time	20.0 Sec	Set to Zero for No Pre-lube
[4] Comp Pre-lube Press	10.0 psi	Set to Zero for No Pressure Test

CRANK SETTINGS

[1] Crank On Time	14.0 Sec	The Engine will Crank for this Time
[2] Crank Off Time	4.0 Sec	The Time between Cranks
[3] Crank Time Out	120.0 Sec	Quits Crank Sequence after this time
[4] Crank Cut Out	200 RPM	Cuts out the Crank Solenoid

WARM UP

[1] Min Time	30.0 Sec	Minimum Warm Up Time
[2] Maximum Time	600.0 Sec	Maximum Warm Up Time
[3] JW Temperature	150 F	Temperature Permissible

POST LUBE

[1] Eng Post Lube	10.0 Sec	Set to zero for no Post Lube
[2] Comp Post Lube	0.0 Sec	Set to zero for no Post Lube

BLOW CASE - Blow Case Control Parameters

[1] BC Drain Delay	4.0 Sec
[2] Blow Time	120.0 Sec
[3] BC Fill Delay	2.0 Sec

PURGE TIMERS

[1] Start Purge	2.0 Sec	Delay before turning on fuel
[2] Stop Purge	0.0 Sec	Delay before turning off ignition

LOAD SETTINGS

[1] Minimum Load RPM	1200 RPM	RPM will never go below this speed while loaded

2.7 ENTERING ALPHABETICAL DATA with the 21-KEY KEYBOARD Software Version 11.07F5 and Earlier

2.7.1 KEY FUNCTIONS

When the computer asks for a name or other non-programmed data, the functions of some keys change to the following:

KEY	Action
1	change to next character in the list
2	change to previous character in the list
3	toggle between upper and lower case
4	insert a capital J (half way in the character string)
F	move the cursor forward one position
B	move the cursor back one position
C	clear the entire line
D	delete the current character
A	insert a space
E	enter the changes made

NOTE: There may be a menu set at the bottom of the screen to help with this process, but it will not show all of these keys.

2.7.2 THE CHARACTER LIST

Not all characters are available on the keyboard. A special keyboard process must be used.

Pressing the **[1]** or **[2]** keys changes the current character up or down in the following continuous sequence:

(space)!”#$%&*+,-./0123456789:;< = >? @
ABCDEFGHIJKLMNOPQRSTUVWXYZ[ ]^_’
abcdefghijklmnopqrstuvwxyz

2.7.3 EXAMPLE OF A NAME ENTRY

A. When the computer is asking for a name the cursor will be flashing at the entry point.

B. Use the **1** key to scroll up to the desired character (holding it down will scroll rapidly while pressing it momentarily will advance one character at a time through the list).

Use the **2** key to scroll in the opposite direction.

Use the **3** key to toggle between upper and lower case as necessary or alternatively scroll to the desired character using **1** or **2**.

Use the **4** key to move to a capital J (mid-list).

C. When the desired character is reached use the **F** key to move forward to the next character or the **B** key to move back one character if necessary.

D. At the end of the word press **A** to insert a space then continue with the next character.

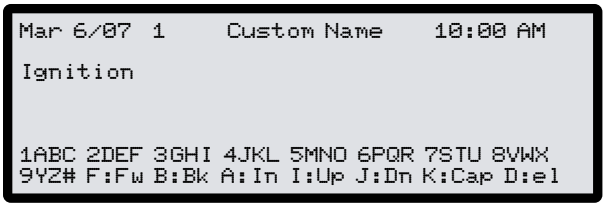
E. The **C** key will clear the current line and the **D** key will delete the current character.

F. When the name is correct push **E** to enter it.

2.8 ENTERING ALPHABETICAL DATA with the 21-KEY KEYBOARD Software Version 11.07F6 and Later

The 21-key keyboard makes it easy to enter numerical data by simply pressing the appropriate numbers.

Entering alphabetical data is slightly more complicated. Each character must be entered and adjusted separately using the **Custom Name** screen and the 21-key keyboard.



CUSTOM NAME SCREEN

2.8.1 THE CHARACTER LIST

Not all characters are available on the keyboard. A special keyboard process must be used.

Pressing the **1** to **9** keys cycles the current character through the four characters shown for each key at the bottom of the **Custom Name Menu**. For example, **2** scrolls through **2DEF**.

Press the **I** key to scroll forward and the **J** key to scroll backward through the following sequence of characters:

(space)!”#$%&*+,-./0123456789:;< = >? @
ABCDEFGHIJKLMNOPQRSTUVWXYZ[ ]^_’
abcdefghijklmnopqrstuvwxyz

Once the desired character is reached, use the **F** key to move forward or the **B** key to move backward to the next character in the sequence.

The **D** key deletes the current character and the **K** key toggles between caps and lowercase modes.

2.8.2 EXAMPLE OF A NAME ENTRY

A. When the computer is asking for a name the cursor will be flashing at the entry point.

B. Use the **1** through **9** keys to scroll up to the desired character (holding down the **I** key will scroll rapidly while pressing it momentarily will advance one character at a time through the list).

Use the **J** key to scroll in the opposite direction.

Use the **K** key to toggle between upper and lower case as necessary or alternatively scroll to the desired character using **I** or **J**.

C. When the desired character is reached use the **F** key to move forward to the next character or the **B** key to move back one character if necessary.

D. At the end of the word press **A** to insert a space then continue with the next character.

E. The **C** key will clear the current line and the **D** key will delete the current character.

F. When the name is correct push **E** to enter it.

3.0 CONTROL SEQUENCES

The **Exacta 21 Control System** is used to monitor, control, and protect the drive and compressor package. All shutdowns, alarms, start-up and shutdown sequences, as well as speed, bypass, and suction control are performed by the control system. This includes pre-lube sequence, auto crank sequence, engine warm up, loading, auto cooldown, and automatic depressurization on shutdown.

Password protected adjustable timers and analog settings are accessible from the **Timers and Settings** key **(SEE SECTION 2.6.19)**. This allows easy access to the various timers and settings for changing most parameters.

3.1 ENGINE-DRIVEN RECIPROCATING UNIT

3.1.1 START-UP SEQUENCE

Any time the unit is shutdown (either due to a shutdown, or pushing the **Stop** or **Auto Stop** key, or receiving a remote shutdown or stop command) the system goes to **State 1: Shutdown**.

STATE 0: INITIALIZING

1. Power is switched to **ON**
2. The **Exacta 21 Controller**:
   a. records the power loss
   b. initializes I/O boards (software versions 11.07F6 and earlier)
   c. switches **ESD Test** subroutine to **ON**
   d. switches **PID's** for louver control to **ON** (if applicable)
3. Advances to **State 1**
4. The **ESD Test** subroutine monitors the fire, gas and H2S detection systems, and the **ESD** pushbuttons (if any of these are tripped the controller stops the unit, opens the blow down valve and closes the block valves)

STATE 1: SHUTDOWN

1. The controller immediately switches all the discrete outputs except the ignition and blow down valve, to **OFF**.
2. Turns the ignition **OFF** after the **Stop Purge Timer** elapses (typically 3 seconds).
3. Forces the analog (variable) outputs to a value of **0** which:
   a. closes the suction valve
   b. opens the bypass valve
   c. forces the governor to minimum speed
4. Turns all the **PID** control loops except louver controls to **OFF**.
5. Activates the logic for separator and scrubber dump control.
6. Turns output to suction and discharge block valves **OFF**, closing them.
7. Uses an **Auto Blow Down** routine to open the blow down valve until the discharge pressure is below **Maximum Start Pressure**
8. Switches the **Beacons and Fans** subroutine to **ON**, which activates the beacons whenever fire, gas or H2S detection alarms,

and turns the exhaust fan **ON** whenever gas or H2S detection alarms. If the alarm condition clears, the beacons and exhaust fan is deactivated.

9. Checks to see if **Post Lube Sequence** is active. If so, continues to energize the post lube timers; if not, de-energizes post lube pumps.
10. Waits for the **Reset** key to be pressed and no shutdowns to be active; then proceeds to **State 2**.

    Any time there are active shutdowns; the **LED** beside the **Reset** key will be flashing. (Clear the shutdown cause, press **Enter** to get to **Run Mode**, then **Reset** to get to **State 2**).
11. Turns output for blow down valve **ON** (it closes).

STATE 2: OK TO START COMPRESSOR

1. **LED** beside **Reset** key is **OFF**.
2. Message **OK to Start Compressor** is displayed.
3. To start the unit, push the **Start** key
4. A choice of **[1] Auto Start**, **[2] Manual Start** or **[3] Exit** is displayed.

   Typically the **Auto Start** is selected; however, if **Manual Start** is selected the operator will have to manually push the **Crank** key, once the unit is ready to crank.
5. Advances to **State 3** when option **[1] Auto Start** or **[2] Manual Start** is chosen.

STATE 3: PRESSURIZE/DEPRESSURIZE (OPTIONAL)

1. The controller opens the main suction **ESD** valve.
2. Typically the blow down valve and purge valves are used to either depressurize or pressurize the unit.
3. If the discharge pressure is above **Maximum Start Pressure** the discharge block valve is closed, the suction control valve is closed (after 10 seconds) and the blow down valve opens until the discharge pressure is below **Maximum Start Pressure**.
4. If the discharge pressure is below **Minimum Start Pressure** the purge valves and blow down valve are opened for 120 seconds.

   After 120 seconds, the blow down valve is closed. Waits for discharge pressure to get above **Minimum Start Pressure** then closes the purge valves.
5. Waits until the discharge pressure is above **Minimum Start Pressure** and below **Maximum Start Pressure** then opens the discharge block valve.
6. Returns to **State 1** if this is not achieved within 600 seconds.
7. Advances to **State 4**.

STATE 4: PRELUBING

1. Energizes the engine and compressor pre-lube pumps.
2. Both pumps run for a minimum of the **Minimum Pre-lube Time** (typically 10 seconds).
3. Waits for the engine oil pressure to be greater than **Engine Oil Perm** (typically 5 kPa) and the compressor oil pressure to be greater than **Compressor Oil Perm** (typically 21 kPa).

4. Returns to **State 1** if this is not achieved within the **Pre-lube Fail Time** (120 seconds).
5. Advances to **State 5**.

STATE 5: OK TO CRANK

If **[2] Manual Crank** was chosen in **State 2**:

1. The controller waits for the **Crank** key to be pressed.

   The **Crank** button is a momentary switch; the crank solenoid will be turned off as soon as it is released.
2. The operator can manually determine the **Crank On Time** and **Time Between Cranks** and the message **OK to Crank** is displayed, otherwise the same sequence as **[1] Auto Start** in the following is used.

If **[1] Auto Start** was chosen in **State 2**:

1. Energize the **Crank Failure Timer** (typically 120 Seconds).
2. Initiate the **Auto Crank Sequence**:
   a. show message **Auto Crank Sequence**
   b. energize the crank solenoid
   c. wait for 20 RPM; then go to **State 6**

      If this does not happen within the **Crank Failure Time**, de-energize crank solenoid and go back to **State 1**.

STATE 6: ENGINE CRANKING AND FUEL

1. Energize the ignition.
2. After the **Fuel Delay Timer** has expired (typically 3 seconds) energize the fuel gas solenoid.

   The fuel gas solenoid gets energized when the speed is above 50 RPM and de-energized when the speed is less than 30 RPM.
3. Crank the engine for the **Crank On Time** (typically 30 seconds). If the engine does not start; de-energize the crank solenoid for the **Time Between Cranks** (typically 5 seconds).
4. Continue this cycle until the **Crank Failure Time** (typically 120 seconds) is exceeded (returns to **State 1**) or until the unit starts (continues).
5. Crank sequence remains energized until the speed exceeds the **RPM Crank Cut Out** (typically 250 RPM).
6. Once the engine speed exceeds the **Underspeed** setpoint (typically 600 RPM) the system advances to **State 7**.

   The **Underspeed** is configured in the speed setup, which can only be accessed while in **[1] Program Mode** under the **Menu** key.

STATE 7: ENGINE WARM UP CYCLE

1. The controller starts the **Maximum Warm Up Timer** (typically a minimum of 720 seconds).
2. Activates **Run Status** and locks off the **Crank** key.
3. Waits for the **Minimum Warm Up Timer** (typically 30 seconds) to expire and then waits for the engine JW temperature to exceed the **Warm Up Temperature** (typically 60°C).

   At this time, energizes a **Suction Start-up PID** (low setpoint) to ensure minimal suction pressure is maintained.

4. Once both the minimum time and temperature have been achieved, starts to load up the unit in **State 8**.

   Advance to **State 8** if the **Warm Up Temperature** has not been achieved within the period of the **Maximum Warm Up Timer**.

   This warm up delay is to allow sufficient warm up time, but the maximum time is limited to allow for very cold temperatures, where an unloaded unit may never reach the **Warm Up Temperature**. Disabled in some programs to ensure adequate warm up.

STATE 8: COMPRESSOR RUNNING

1. Locks **Purge** and **Crank** keys **OFF**, energizes logic for **Manifold Pressure Override** (optional) and arms the **Post Lube Sequence**.
2. Assuming all the **PID** controllers are in **Auto Mode**, the unit will start to load.

   In **Manual Mode**, operator must manually ramp engine speed.
3. Displays message **Ramping Speed**.
4. The controller first ramps up the engine speed to **Minimum Load RPM** (typically **1000 RPM** on a **1200 RPM** rated engine).

   This is done by energizing a **Speed Ramp PID** with a setpoint high enough to ramp up the speed over the **Minimum Load RPM**. This **PID** typically has a low gain and no derivative to gradually ramp up the speed.
5. Once the **Minimum Load RPM** is achieved:
   a. de-energize **Speed PID**
   b. energize **Suction Control PID**
   c. energize **Manifold Pressure Override PID** (optional)
   d. energize **Master PID**
   e. de-energize **Suction Start-up PID**
6. The **Suction Control PID** has a built in ramp to gradually ramp the setpoint from the current suction pressure to the setpoint in the **PID**.

   This only occurs when the **PID** is first switched to **ON**. The time period for this ramp is usually 2 minutes.
7. The **Master PID** is set up so that as long as the suction pressure is above the **Suction Pressure Override** and the final discharge pressure is below the **Discharge Pressure Override** the unit controller gradually closes the bypass valve, and ramps the speed up to full-rated RPM.
8. Once the bypass valve is 100% closed, the **Master PID** adds an offset value to the **Discharge Pressure Override** and subtracts an offset value from the **Suction Pressure Override** only on the **Bypass PID**.

   This is to prevent the **Speed PID** and the **Bypass PID** from fighting each other.
9. If a shutdown occurs, returns to **State 1**.
10. Both the pressure overrides are adjustable from the **Master Load Control** key.

NOTE: Ensure suction control valve setpoint is a minimum of 50 kPa higher than the Master PID suction pressure setpoint.

NOTE: Master PID suction setpoint MUST be lower than suction control valve setpoint at all times for unit to load.

NOTE: Recommended minimum 10% difference between the two setpoints.

3.1.2 TYPICAL SHUTDOWN SEQUENCE

The **Exacta 21** controller has the conventional Class A, B, and C shutdowns. Class A shutdowns are always active. Class B shutdowns get activated after the unit is up and running and the Class B timer has expired (typically 120 seconds). Class C shutdowns are only active once the initial setpoint has cleared; for example, the **Low Suction Pressure** shutdown becomes active once the suction pressure climbs above the setpoint. In the **Exacta 21** controller, Class C shutdowns can also have an overriding timer, such that if the value does not exceed the shutdown setpoint within a certain time, the timer will activate the alarm or shutdown.

THE SEQUENCE FOR A SHUTDOWN IS AS FOLLOWS:

1. Any time the unit is shutdown due to a logic triggered shutdown, or by someone pushing the **Stop** or **Auto Cooldown** keys, the system goes to **State 1**, the **Shutdown State**.
2. The controller switches all the discrete outputs to **OFF** immediately, except the ignition and the blow down valve.

   The ignition is deactivated after the **Stop Purge Timer** has elapsed.
3. Forces the analog (variable) outputs to a value of zero.

   This effectively closes the suction valve, opens the bypass valve, and forces the governor to minimum speed (providing the governor is set up properly).
4. Deactivates all the **PID** control loops except the louver controls.
5. Uses an **Auto Blow Down** routine to open the blow down valve until the suction pressure is below the **Maximum Start Pressure**.
6. Initiates a postlube sequence if the unit was in the loading or run state.

   This sequence turns on the lube pumps until the **Post Lube Timer** has expired (typically 120 seconds).

Under the **Timers and Settings** key, the operator can adjust the **Post Lube Timer** from the **Post Lube** menu, the **Stop Purge Timer** from the **Purge Timers** menu, and the **Maximum Start Pressure** from the **Start Pressures** menu.

3.1.3 SUBROUTINES

AUTO SLOW DOWN

The **Auto Slow Down** sequence is used to gradually unload the compressor package and let it run unloaded for several minutes before shutting down the package. It is initiated by pushing the **Auto Slow Down** key and answering **[1] Yes** when the controller asks if you want to perform the action. The controller performs the following actions when the **Auto Slow Down** is initiated:

1. Switches the Master **PID** to **OFF**.
2. Ramps down the speed to **Minimum Load RPM**.
3. Gradually opens the bypass valve.
4. Gradually closes the suction valve.
5. Once the bypass valve is fully open and the suction valve is fully closed, the controller slows the engine down to idle speed.
6. Waits for approximately 3 minutes and then shuts down the unit.

MANIFOLD PRESSURE OVERRIDE

The **Manifold Pressure Override** sequence uses the suction control valve to control manifold pressure.

On a V-type engine, there are both **Left** and **Right Manifold Pressure Override PIDs**. Four setpoints are used: **Left Manifold Pressure Override On**; **Left Manifold Pressure Override Off**; **Right Manifold Pressure Override On**, and; **Right Manifold Pressure Override Off**. These are all adjusted from the **Manifold Overrides** menu under the **Timers and Settings** key.

The control setpoint for these **Manifold Pressure Override PID's** are usually set very close or equal to the **Manifold Pressure Override On** setpoints. This prevents cycling back and forth between suction pressure control and manifold pressure control. On an inline engine there is only one **Manifold Pressure Override PID** and two corresponding setpoints.

The controller performs the following actions:

1. Whenever the left or right manifold pressure exceeds the **Manifold Pressure Override On** setpoint, the controller deactivates the main suction **PID** and activates either the **Right** or **Left Manifold Pressure Override PID** depending on which of the manifold pressures exceeded the setpoint.
2. A message will appear on the display stating either **Left** or **Right Manifold Override** depending on which override is active.
3. When the manifold pressure drops below the **Manifold Pressure Override Off** setpoint for the corresponding **Manifold Pressure Override PID**, the controller deactivates the **Manifold Pressure Override PID** (right or left) and activates the **Suction Control PID**.

REMOTE IDLE

The **Remote Idle** sequence is used to gradually unload the compressor package and let in run unloaded (on full bypass) until the **Remote Idle** is turned **OFF**. The unit will gradually load up and go back to normal operating condition when the **Remote Idle** is turned **OFF**. The **Remote Idle** sequence is initiated remotely via the RS485 using the Modbus RTU protocol.

The controller performs the following actions:

1. Deactivates the **Master PID** control.
2. Ramps the speed down to **Minimum Load RPM**.
3. Gradually opens the bypass valve.
4. Gradually closes the suction valve.
5. Slows the engine to idle speed once the bypass valve is fully open and the suction valve is fully closed.
6. Waits until the **Remote Idle** is deactivated and then essentially reverses the Remote Idle process to load the engine up again.

   This involves ramping the speed up to the **Minimum Load RPM**, activating the **Master Control PID** (closes the bypass valve and ramps the engine speed to **Full RPM** unless a suction or discharge override exists), and turning on the **Suction Control PID**.

ENGINE JACKET WATER/OIL TEMPERATURE OVERRIDE AND THE BLOW DOWN VALVE

This sequence is used in some remote locations to automatically reduce the engine speed when the engine jacket water or oil temperature exceeds the **JW Temp High** or **Eng Oil Temp High** setpoints respectively.

The controller performs the following actions:

1. If one of the above setpoints is exceeded the controller puts the **Speed Control PID** in **Manual** and use a separate **PID** to reduce the engine speed to **1100 RPM** (unless the engine speed is already less than **1100 RPM**).
2. Waits for 5 minutes and checks the engine JW and oil temperature again.
3. If either one is still above its respective setpoint, reduces the engine speed to **1000 RPM**.
4. Five minutes later, checks the engine JW and oil temperature again and if they are below the high setpoints the unit will continue to run at **1000 RPM** until both the temperatures are below the **JW Temp Low** or **Eng Oil Temp Low** setpoints respectively.
5. If either temperature exceeds the high setpoints at any time after the five minutes in **Step 4** has expired, initiates an **Auto Slow Down** sequence.

To ramp the unit back up to full speed the controller essentially reverses the process:

1. When the temperatures are below the **JW Temp High** or **Eng Oil Temp High** setpoints respectively, the controller first checks the engine speed.
2. If the speed is already above **1050 RPM**, deactivates the **JW/Oil Temperature Override** and puts the speed control back into **Auto**.

   The **Master PID** now takes over the speed control and ramps it up to full speed (unless a suction or discharge override exists).
3. If the engine speed is below **1050 RPM** the controller ramps the speed up to **1100 RPM**, waits 5 minutes, and monitors the temperatures.

   As long as they both remain below the setpoints, deactivates the **JW/Oil Temperature Override** and puts the **Speed Control PID** back into **Auto**.

   The **Master PID** now takes over the speed control and ramps it up to full speed (unless a suction or discharge override exists).

3.2 TYPICAL ENGINE-DRIVEN SCREW UNIT CONTROL SEQUENCE CHANGES

With screw-type compressors, the most noticeable difference is in the load/unload sequences. The slide valve is forced to **<10%** before a start sequence is allowed.

During the start up sequence, typically the bypass valve is forced closed in the warm up state. After the engine is warmed up, the controller proceeds to the **Compressor Running** state.

During the **Loading** sequence, the slide valve is ramped to a fully loaded position, the speed is ramped to full **RPM**, and the bypasss valve is kept in the closed position.

In the override condition, one of these unload sequences will occur:

- Unload slide valve, ramp speed down to **Minimum Load RPM**, and open the bypass valve.
- Ramp speed down to **Minimum Load RPM**, unload the slide valve, and open the bypass valve.

3.3 TYPICAL ELECTRIC DRIVE CONTROL SEQUENCE CHANGES

With an electric drive, the load/unload sequence is simplified dramatically. In the load sequence, the slide valve is forced to <10% before a start sequence is allowed (if applicable). The pre-lube, cranking, and warm up states are all removed.

As soon as the **Start** key is pressed, the controller displays a message **Perform Action [1] Yes [2] No**. If **[1] Yes** is chosen, the controller sends a signal to the MCC to start the drive motor. Once the motor is started, the load sequence is initiated in similar fashion to an engine drive.

During a shutdown, the motor contacts are opened, the bypass valve is opened, the postlube sequence is initiated (if applicable) and (in a screw compressor) the slide valve is unloaded.

4.0 SETTING SYSTEM PARAMETERS

4.1 TEST MODE

Test Mode is used to check shutdowns with the compressor running. One or more shutdowns can be under test at any time. When a shutdown is in **Test Mode** it is still possible to move around the various screens, adjust setpoints, manually adjust the engine speed, and so on. When **Test Mode** is activated, a **Count Down Timer** starts at 1200 seconds (20 minutes) and counts down until it reaches zero. If this timer reaches zero, all shutdowns in **Test Mode** will revert to normal operation.

When any shutdowns are under test, the main **Run Mode** screen of the controller will display **Test Mode** instead of **Run Mode**. A resettable **Count Down Timer** appears where the clock is normally displayed. This display shows the amount of time left before the current shutdowns under test are reactivated. If any shutdowns are still faulty when the timer reaches zero the compressor will shut down. The timer can be extended back to 1200 seconds (20 minutes) at any time by selecting **[G] Reset**.

```
Mar 6/07        Test Mode          550 Sec
Low Engine Oil Level While Running

  Suction   Disch (1)   Disch (2)   RPM
  1047kpa   2411kpa     7787kpa     1156

JW Out   Gas   Fire   Volts   Manif   Hour
  87C     0%   4.0ma   24V    23"hg   1850
```

MAIN RUN MODE SCREEN WITH TEST MODE ACTIVE

Select a shutdown by choosing from options **[1-4] Shutdowns**, **Alarms**, **Faults,** and **Shutdown List** under the **Status** or **Inputs** key.

SEE SECTION 2.6.17 FOR DETAILS ON THE STATUS KEY.

When this option is chosen, the controller shows a list of up to four shutdowns or alarms. Use the **Up** and **Down** keys on the keyboard to show more.

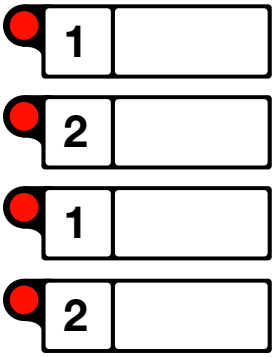
Select the number beside the desired shutdown to display the detail screen.

Choose **[1] Test** to switch the selected shutdown to **Test Mode**.

```
Dev  Type   Class Mode Wired  Delay Chann
  7 Analog  A     HH   NC     2.0   2103
Discharge Pressure High       PT-204

Status:   Healthy      Value:    596kpa
Delay:      2.0     Setpoint:   2172kpa

            [1] Test  [K] Menu
```

SHUTDOWN DETAIL (NOT IN TEST MODE)

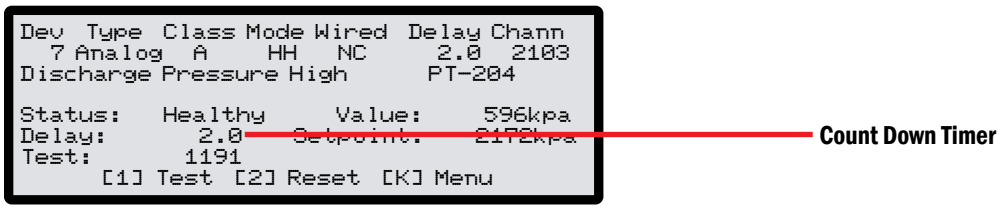
If **[1] Test** is chosen, the controller will ask **OK To Go Into Test Mode [1] Yes** or **[2] No**.



Choose **[1] Yes** to switch the current shutdown into **Test Mode**.

If the shutdown is an analog input the computer will ask **Freeze Analog Input: [1] Yes** or **[2] No**. Answering **Yes** will cause the analog input to be frozen at the current value.

The controller will show the **Count Down Timer**. It is now possible to move to the next shutdown and place it into **Test Mode**. Only those shutdowns with the **Count Down Timer** shown are in **Test Mode**.

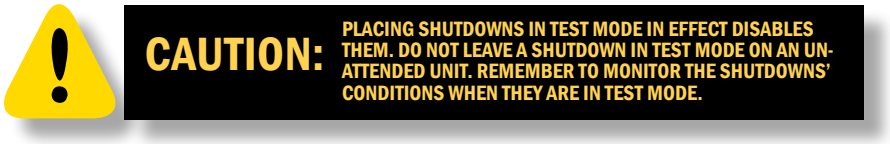


SHUTDOWN IN TEST MODE

To exit **Test Mode** choose **[1] Test** and answer **[1] Yes**.

Do this for each shutdown until the **Count Down Timer** is no longer displayed.

Alternately, wait until the timer counts down to zero.



4.2 SHUTDOWNS AND ALARMS

One of the main functions of the control system is to perform shutdowns and alarms. The **Exacta 21 Controller** uses standard **A, B, C, D and E Classifications**, with individual timers that include a programmable default setting on all **Class B** shutdowns and alarms. In addition, a delay can be added to the shutdown or alarm to debounce and eliminate nuisance shutdowns.

An unlimited number of shutdowns and alarms can be added on any channel, which includes the normal **High** and **Low Shutdowns and Alarms**, plus **Differentials**, **Time Delayed Shutdowns**, and **Calculated Shutdowns**. An example of a calculated shutdown would be to calculate the dewpoint of acid gas and then shutdown and purge the unit if the gas temperature ever goes below the dewpoint curve.

The controller annunciates the **First In Shutdown** and lists all other shutdowns and alarms which must be acknowledged and reset by the operator by pressing **Reset**. The controller also records the date and time when any shutdown or alarm occurs, and stores this for future reference. In addition, the controller takes a snap shot of all the temperatures, pressures and other signals at the moment when a first in shutdown occurs. The controller records these values for forty intervals before the shutdown occurs, usually one second apart, in order to give a true picture of the shutdown cause. If a compressor stalls, it is desirable to go back in time to find the real cause.

The following describes some of the terminology used:

TYPE: Refers to the source type of the shutdown or alarm.

- **Discrete** — Discrete input
- **Analog** — Analog input
- **Differential** — Difference between two analog inputs
- **Calculated** — Calculated from one or more inputs (special calculations programmed in C code)

MODE: Selects either **Shutdown** or **Alarm** plus **High** or **Low**.

- **High High (HH)** — High Shutdown
- **High (H)** — High Alarm
- **Low (L)** — Low Alarm
- **Low Low (LL)** — Low Shutdown

CLASS: Controls how the shutdown is armed or reset.

- **Class A** — Enabled at all times; for example, low engine jacket water level. Resets with the **Reset** key after condition is cleared.
- **Class B** — Enabled after the bypass timer times out following a start sequence; for example, engine oil pressure, which takes a certain amount of time to build up. Resets with the **Reset** key after condition is cleared.

- **Class C** — Enabled after the input point is initially satisfied following a start sequence. An example is low suction pressure. It must increase above its shutdown setpoint before it is armed. Resets with the **Reset** key after condition cleared. A maximum timer can also be programmed to shutdown/alarm if the condition is not cleared at the end of the timed period.
- **Class D** — Must be satisfied to start. Bypassed after start during normal operation.
- **Class E** — Must be satisfied to start, but is bypassed for a timed period after start.

CLASS TIMER: Classes B, C and E have an arming delay timer.

DELAY TIMER: Debounce delay time. The amount of time after a change from healthy to faulty or faulty to healthy before being recognized.

WIRED NC/NO: Discrete devices can be connected with their contacts normally closed or normally open.

CHANNEL: The I/O channel associated with the input. Two channels are required for differentials.

SETPOINT: Used by analogs, differentials and calculated shutdowns to determine the shutdown or alarm point.

STATUS: Either Healthy or Faulty

4.3 CHANGING PASSWORDS

System access to specific functions and menu selections is password-protected. On start-up, whenever the operator requests a change, or if the **Program Mode** is entered, a password will be requested.

Three levels of password are available:

Level 3 permits viewing only.
Level 2 permits changing basic setpoints commonly adjusted in the field.
Level 1 allows full access to setpoints, calibrations, programming, etc.

The **Level 1** password allows set up of **Level 2** and **Level 3** passwords.

Passwords are set under the **Program Mode**. When the **Program Mode** is entered, a screen will come up asking for a password to proceed. Enter your password (must be **Level 1**) to access **Program Mode**. If you want to change/setup passwords, use the following procedure.

If the password is forgotten or a technician needs a temporary password for diagnostics, a one-time password may be obtained by choosing **[K] Menu** then **[1] Program Mode** and recording the number displayed on the screen. Phone **Altronic Controls** or your authorized **Exacta** integrator with the access number and the technician will give you a one-time password for **Level 1, 2 or 3**.

To change passwords:

Press [K] Menu

Choose [1] Program Mode

Choose [2] Set Up Menu

Choose [3] Change Password

The controller will ask **Change Password [1] Yes** or **[2] No**

Choose **[1] Yes**; the controller will ask **Are You Sure [1] Yes** or **[2] No**

Choose **[1] Yes** again

4.4 CONTROLLING UNIT VARIABLES (PIDS)

This section describes the method used to control unit variables **(process variables)** at their control setpoint.

SEE SECTION 2.6 TO CHANGE SETTINGS, DISPLAY INFORMATION, ETC.

4.4.1 PROCESS CONTROL THEORY

Basic elements of any process control system **(control loop)**:

- **PROCESS VARIABLE**
- **CONTROL VARIABLE**
- **CONTROL SETPOINT**

The variable to be controlled is the **process variable**. It is the input to the control loop; for example, the unit suction pressure.

The variable used to control the **process variable** is the **control variable**. It is the output from the control loop; for example, the inlet control valve position.

Changing the **control variable** (inlet control valve position) causes a change in the measured **process variable** (unit suction pressure). Opening the valve further increases the unit suction pressure; closing it will decrease the unit suction pressure.

The actual value at which the control loop attempts to control the **process variable** is the **control setpoint**. The **control setpoint** is entered into the control panel and remains at the entered value until it is manually changed.

For example, if the unit suction pressure is to be controlled at a value of 1400 kPa, the **control setpoint** is entered as 1400 kPa.

When the **process variable** is not at the **control setpoint**, the control loop will change the **control variable** until the **process variable** is at the **control setpoint**.

If the **process variable** is at the **control setpoint**, the **control variable** remains constant at its last value.

A control loop uses proportional-integral-derivative **(PID)** control logic to change the **control variable** in response to changes in the **process variable** or **control setpoint**.

4.4.2 PID CONTROL THEORY

PID control continuously compares the **process variable** to the **control setpoint** and calculates an **error** value:

Error = Process Variable – Control Setpoint

The **error** is used to calculate the value of the **control variable**.

The **control variable** is made up of three components:

Control Variable = Proportional Control + Integral Control + Derivative Control

PID control is developed from complex mathematics. Full explanation is beyond the scope of this manual, but the theory can be simplified as in the following subsections.

PROPORTIONAL CONTROL

The proportional component of the **control variable** is the main output of **PID** control. It calculates an output amount that is proportional to the **error**. The larger the **error**, the larger the proportional component will be, in an attempt to make the **process variable** equal to the **control setpoint**. Proportional control alone cannot eliminate all of the error.

INTEGRAL CONTROL

The integral control component is proportional to both the **error** and the length of time the error exists. The larger the **error** and the longer the **error** exists, the larger the integral component will be, in an attempt to make the **process variable** equal to the **control setpoint**.

The integral control component is used to eliminate all remaining **error**.

DERIVATIVE CONTROL

The derivative control component is proportional to the rate of change of the **error**. The faster the **process variable** moves away from the **control setpoint**, the larger the derivative control component will be, in an attempt to quickly return the **process variable** to equal the **control setpoint**.

NOTE: When a Suction Control Valve is controlling suction pressure, the Master PID acts as an override. In this case the setpoint for the Master PID should always be lower than the setpoint for the Suction Control Valve PID setpoint. Similarly if there is a Discharge Back Pressure Control Valve the Master PID setpoint should always be set higher than the Discharge Control Valve PID setpoint.

4.4.3 TUNING PID CONTROL

In **PID** control there is a gain setting for each of the three types of control. Determining the appropriate values for each of these gains is referred to as **tuning** a controller. With a properly tuned **PID** controller, the **process variable** will be maintained at the **control setpoint** during steady-state (normal) conditions. The **PID** controller will also react quickly to return the **process variable** to the **control setpoint** when disturbances occur (such as sudden load changes).

CAUTION: IT IS RECOMMENDED THAT ALL CHANGES, EXCEPT ADJUSTING THE SETPOINTS OR OUTPUT AS DESCRIBED IN SECTION 2, BE DONE BY A QUALIFIED INSTRUMENT TECHNICIAN. WRONG SETTINGS CAN EASILY CAUSE FAULTY OPERATION OR UNIT MALFUNCTION/DAMAGE.

5.0 CALIBRATE ANALOG LOOPS

5.1 DETERMINING THE SOFTWARE VERSION

To determine which version of software is installed in your unit, use the following procedure:

Press the **Menu** key **[K]**

Choose **[6] Software Version**

The software version will be displayed

5.2 CALIBRATION PROCEDURE

Analog end devices should be calibrated or checked periodically to guarantee accuracy and reliability. Basically the **Exacta 21** requires two known points to calibrate any device. This will require hand pumps, a calibrated gauge to calibrate pressure inputs, and a thermo-couple simulator or RTD simulator to calibrate temperature inputs.

To calibrate for pressures the two calibration points are typically zero and full span. For temperatures these two points usually are 0°C (32°F) and some higher point close to the maximum operating temperature. (The temperatures can still go above and below these values.)

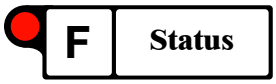
To perform a calibration:

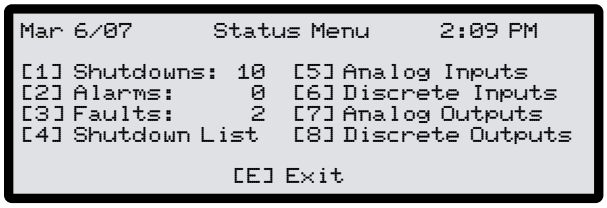
1. **Open and select a channel**
2. **Freeze the input**
3. **Check the switches**
4. **Check the span settings**
5. **Calibrate high and low ends**
6. **Check loop and end device operation**

A linear offset may be added to the calibration if the loop is off by a similar amount at both the high and low points.

5.2.1 OPENING PROCEDURE

From the **Run Mode** screen, press the **[F] Status** or **Inputs** button. The **Exacta 21** will display the **Status Menu** screen.





STATUS MENU SCREEN

Choose **[5] Analog Inputs**. The **Exacta 21** will display the **Analog Inputs** screen.

```
Mar 6/07      Analog Inputs      4:42 PM

[1] Engine Oil Pressure          150kpa
[2] Engine Manifold Pressure   10.8inHg
[3] Gear Box Oil Pressure         35kpa
[4] Discharge Gas Temperatur        7C

[J] More      [I] Previous   [E] Exit
```

ANALOG INPUTS SCREEN

Choose **[I] Up** or **[J] Down** to scroll through the inputs until the desired one is displayed.

Choose the input desired by entering the number associated with the text. The **Exacta 21** will ask for a technician-level password.

```
Jan 15/05     SXI 11.07F3       12:20 PM

     Access Number:       75770

     Enter Password:


          [E] Enter  [C] Clear
```

PASSWORD ENTRY SCREEN

Type the password and press **Enter/Exit**. The **Exacta 21** will display the **Analog Inputs** screen for the selected input.

```
Suction Pressure
 In:   6012kpa  [A] H:  10342  [D] 61754
ADC:  41024     [C] L:      0  [G] 12244
      Name        Class  Mode  SetP  Stat
[1] Low Suction Pr  C    0  LL   100   H
[2] Suction Pressu    A    SD         H
[3] High Suction P    -    HH   6000  H
[9] CalMode[H]Tog ADC [J]Force [K]Offset
```

ANALOG INPUT (CALIBRATION) SCREEN

This screen shows the current analog value in engineering units, with the ADC value below on the left-hand side of lines 2 and 3. The high and low span settings in both engineering units and ADC values are on the right-hand side of lines 2 and 3. The screen also shows the alarm and shutdown setpoints associated with the channel on lines 5, 6 and 7. (These can be set and adjusted from the calibration screen but are not part of the calibration procedure). The choices on this screen are explained in the calibration procedures which follow.

5.2.2 FREEZING THE INPUT

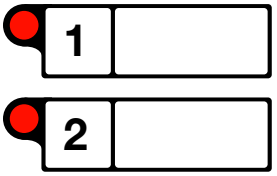
CAUTION: FORCING AN INPUT DISABLES THE PROTECTION PROVIDED BY THE CONTROL SYSTEM. IT IS THE TECHNICIAN'S RESPONSIBILITY TO ALWAYS MONITOR THE UNIT FOR SAFE VALUES, UNTIL FORCING IS REMOVED.

During calibration, to avoid entering alarms or shutting down the unit, the technician would normally freeze the input being calibrated. Use the following procedure to do this:

Choose **[J]** to force the input. The **Exacta 21** will display the up-coming forced value and ask if you want to **Force Input?**

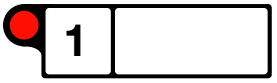
Forcing an input will put all alarms, shutdowns, PIDs, and programming into a bypassed mode.

Choose **[1] Yes** to force the input or **[2] No** to return to the **Analog Inputs** screen chosen in SECTION 5.2.1 without freezing the input.

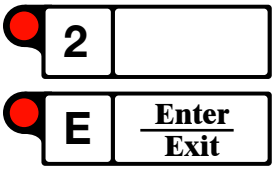


If you chose **[1] Yes** in the previous step, the **Exacta 21** will give you two choices.

Choose **[1] Freeze at current value** to freeze the input at the currently displayed value.



Choose **[2] Force a specific value** to force the input to a specific value by entering the value wanted and pressing **Enter/Exit**.



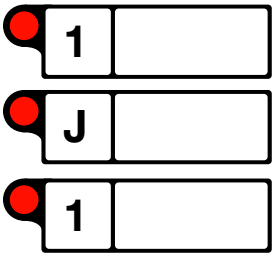
The **Exacta 21** will revert to the **Analog Inputs** screen chosen earlier, but the value will remain frozen.

An indication of freezing is given by an **F** displayed at the end of line and in front of the value displayed in the **Run Mode** screens.

The calibration screen will continue to show the real values from the end device, provided it is connected and operating.

To remove the forcing, either:

- Power down and restart the panel
- Exit the **Analog Input** screen chosen in step **A** and the **Exacta 21** will ask **Unfreeze Input?** Choose **[1] Yes**.
- Choose **[J]**, the **Exacta 21** will ask **Unfreeze Input?** Choose **[1] Yes**.

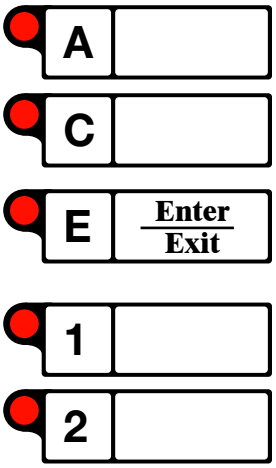


5.2.3 CHECK SWITCHES

Appropriate switches on the analog board need to be set for input devices to work properly. Normally these would not require changing unless the device type changes (or someone intentionally changes them).

ANALOG INPUT	SWITCH POSITION 1	2
"J" TYPE TC	OFF	OFF
"K" TYPE TC	OFF	OFF
RTD	OFF	OFF
VOLTAGE (0-5 VDC)	OFF	ON
CURRENT (4-20 MA)	ON	OFF
RESISTIVE (POTENTIOMETER)	OFF	OFF
DISCRETE (SWITCH)	OFF	ON

5.2.4 CHECK SPAN SETTINGS



Normally the span settings are preset during programming and would not require changing. The settings are displayed on the **Analog Input (Calibration)** screen. To make changes:

Choose **[A]** or **[C]** to select the high or low span setting. The chosen setting will display a flashing cursor over the engineering units.

Enter the desired span setting (the cursor will indicate the next digit to be entered).

Once the correct value is showing, press **Enter/Exit**. For all non-zero numbers, the **Exacta 21** will ask you if **The Value is [1] Positive** or **[2] Negative?** at the bottom of the screen.

Make your choice and the screen will revert to the **Analog Input (Calibration)** screen using the new span setting.

5.2.5 CALIBRATING

4 TO 20mA CHANNELS

After selecting and freezing the input, and checking the switches and span settings (if necessary), use the following procedure to calibrate a 4 to 20mA channel.

Isolate the end device from the process.

Apply the lower span process value to the end device. The screen should show the low span setting as the current value in engineering units.

If not, choose **[G]** and the current ADC value will be inserted for the lower span ADC value.

Connect an accurate calibrator and/or simulator to the end device for the channel.

Apply the correct upper span process value to the end device. The screen should show the upper span setting as the current value in engineering units.

If not, choose **[D]** and the current ADC value will be inserted for the upper span ADC value.

Complete final loop checkout SEE SECTION 5.2.6.

NOTE: This procedure assumes correct operation of the end device and field wiring. That is, the device output is approximately 4mA when the lower process value is applied and 20mA with the upper process value, and that the device is linear. This can be determined from the ADC values indicated on the panel. The ADC value should be approximately 12000 for a 4mA signal and 62000 for a 20mA signal from the transmitter. If the ADC values vary excessively a full end-device calibration should be completed before continuing with this calibration procedure.

THERMOCOUPLE TEMPERATURE CHANNELS

After selecting and freezing the input, and checking the switches and span settings (if necessary), use the following procedure to calibrate a thermocouple channel.

Connect a thermocouple calibrator at the field end in place of the thermocouple. This will calibrate and test the integrity of the temperature measurement loop.

Set the calibrator to simulate the lower span value. The screen should show the low span setting as the current value in engineering units.

If not, choose **[G]** and the current ADC value will be inserted for the lower span ADC value.

Set the calibrator to simulate the upper span value. The screen should show the upper span setting as the current value in engineering units.

If not, choose **[D]** and the current ADC value will be inserted for the upper span ADC value.

Complete final loop checkout SEE SECTION 5.2.6.

NOTE: This procedure assumes correct operation of the thermocouple end device and field wiring. The thermocouple mV output should correspond with published thermocouple tables. If the mV output does not correspond, a full end device checkout should be completed before continuing with this calibration procedure.

NOTE: For proper operation, the use of grounded thermocouples is required.

NOTE: This procedure assumes correct operation of the RTD end device and field wiring. The RTD's resistance should correspond with published RTD tables. If the resistance does not correspond, a full end device verification should be completed before continuing with this procedure.

RTD TEMPERATURE CHANNELS

After selecting and freezing the input, and checking the switches and span settings (if necessary), use the following procedure to calibrate an RTD channel.

Connect an RTD calibrator at the field end in place of the RTD. If it is not possible or practical to connect to the field end, the RTD calibrator may be connected to the terminals in the panel. This will calibrate and test the integrity of the temperature measurement loop.

Choose **[9] CalMode**. This places the RTD input channel into a special calibration mode to correctly activate the excitation voltage for the channel.

Set the calibrator to simulate the lower span value. The screen should show the low span setting as the current value in engineering units.

If not, choose **[G]** and the current ADC value will be inserted for the lower span ADC value.

Set the calibrator to simulate the upper span value. The screen should show the upper span setting as the current value in engineering units.

If not, choose **[D]** and the current ADC value will be inserted for the upper span ADC value.

Press **Enter/Exit** to exit from the calibration screen to deactivate calibration mode.

Complete final loop checkout **SEE SECTION 5.2.6**.

NOTE: This procedure assumes correct operation of the end device and field wiring. The device output should be approximately 0.5Vdc when the lower process value is applied and 4.5Vdc with the upper process value, and that the device is linear. This can be determined from the ADC values indicated on the panel. The ADC value should be approximately 6000 for a 0.5Vdc signal and 56000 for a 4.5Vdc signal from the transmitter. If the ADC values vary excessively, then a full end-device calibration should be completed before continuing with this calibration procedure.

0 TO 5V CHANNELS

After selecting and freezing the input, and checking the switches and span settings (if necessary), use the following procedure to calibrate a 0 to 5V channel (usually a pressure transducer).

Isolate the end device from the process.

Connect an accurate calibrator and/or simulator to the end device for the channel.

Apply the lower span process value to the end device. The screen should show the low span setting as the current value in engineering units.

If not, choose **[G]** and the current ADC value will be inserted for the lower span ADC value.

Apply the correct upper span process value to the end device. The screen should show the upper span setting as the current value in engineering units.

If not, choose **[D]** and the current ADC value will be inserted for the upper span ADC value.

Complete final loop checkout **SEE SECTION 5.2.6**.

5.2.6 FINAL LOOP CHECKOUT

Reconnect the end device. The screen should indicate the current process conditions.

If the indicated engineering value does not correspond with the current process conditions, a complete end-device and field wiring checkout should be completed. (If the error is small and linear, an offset could be used, see below.)

After loop integrity has been verified, unfreeze the input as described in SECTION 5.2.2.

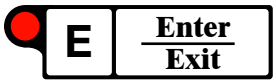
5.2.7 ADDING AN OFFSET

If the calibration is off at both the lower and upper ends by a similar small amount (linear offset) then the operator can enter an offset value by pressing the **[K] Offset** key, and entering the desired current value. (There is no way to tell later if an input has been offset.)

Choose **[K] Offset**. The **Exacta 21** will ask **Set Specific Input Value [1] Yes, [2] No**.

Choose **[1]** and type the current value desired in engineering units.

Press **Enter/Exit**. The **Exacta 21** will ask if **The Value is [1] Positive, [2] Negative** at the bottom of the screen.



Make your choice and the screen will revert to the **Analog Input** (Calibration) screen, using the offset setting for the current value.

5.2.8 USING ENTERED CALIBRATION POINTS

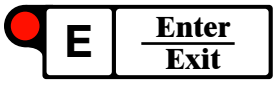
During a calibration, entering a specific calibration value (ADC units) instead of using the value sent by the device, can be accomplished with the **[H] Tog ADC**, key.

Follow the normal procedure, but before choosing **[D]** or **[G]**, choose **[H] Tog ADC**. The **Exacta 21** will display an **S** at the top-right of the screen.

Choose **[D]** or **[G]** as per the normal procedure. A flashing cursor will indicate to enter the digits in ADC instead of automatically accepting the device's value.

Type in the desired ADC value and press **Enter/Exit**.

Proceed with the calibration.



6.0 TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTIONS
RPM not reading	Magnetic pickup broken	Check magnetic pickup for damage or metal filings.
	Broken cable or loose terminations	Check cable for continuity. Check cable ends and terminations.
	5Vdc missing from 12X12 I/O board	Check voltage from test point TP2 to Vss.
	RPM setup not correct	Ensure correct analog channel has been selected and that the program points to the correct discrete point.
Gas detection reading negative 24%	Signal from transmitter less than 4mA	Ensure that there is 24Vdc supply at the transmitter.
		Ensure that the transmitter is connected correctly to the input channel (signal leg connected to the + terminal and 0Vdc to the – terminal).
	Faulty Analog input board	Using industry-standard calibration equipment simulate 4-20mA signal directly to board and monitor gas detection indication.
Gas detection reads over range	Signal from transmitter reversed	Check conductor terminations at both ends. Ensure the signal line is connected to the B terminal of the input channel.
	4 to 20mA input not correctly set up on analog board	Incorrect switch positions on analog board. For 4-20 mA, sw1 on, sw2 off .
		Analog input is not set at 4 to 20mA in the controller.
		Analog input setup as 4 to 20mA (10ohm) in the controller with a 4 to 20mA (200ohm) installed.
	Faulty analog input board	Using industry-standard calibration equipment, simulate 4-20mA signal directly to board and monitor gas detection indication.
Gas detection reads incorrectly	Sensor type incorrect	Ensure the sensor type for that channel has been set at 4 to 20mA.
		Calibrate gas detector.
Temperature reads over range	Open thermocouple or conductors (open circuit)	Check thermocouple with a calibrator. Check conductor terminations at both ends.
	Faulty Analog input board	Using industry-standard calibration equipment, simulate appropriate thermocouple (J or K) signal directly to board and monitor temperature indication.
Temperature decreases as heat is applied	Thermocouple wired backwards	Correct the connections. Ensure the conductors are connected with the correct polarity from the thermocouple to the analog input board.

PROBLEM	POSSIBLE CAUSE	SOLUTIONS
Temperature readings are erratic	Loose connections	Check and tighten all terminals.
	Thermocouple wire not used throughout the loop	Replace non-thermocouple wire with the correct type of thermocouple wire.
	Faulty analog input board	Using industry-standard calibration equipment, simulate appropriate thermocouple (J or K) signal directly to card and monitor temperature indication.
	Bad thermocouple	Replace thermocouple.
	Thermocouple is grounded	Replace thermocouple.
Single pressure channel reading negative	Open connections	Check connections and circuits for open curcuit.
	Needs calibrating	Calibrate using hand pump. SEE SECTION 5.2.5.
	Span settings mismatched	Confirm span settings in controller match. Transmitter calibrated span.
Multiple pressure channels reading negative	Improper supply voltage to sensors	Check for proper supply voltage. Correct as necessary.
	Faulty analog input board	Using industry-standard calibration equipment, simulate a 4-20mA signal directly to board and monitor pressure indication.
Pressure reading too high	Calibration	Check calibration.
	Wires shorted (causes reading pegged high)	Check wiring and terminations.
	Faulty analog input board	Using industry-standard calibration equipment, simulate 4-20mA signal directly to board and monitor pressure indication.
Single discrete reads faulty continuously	24Vdc supply conductor shortened to ground	Remove both field wires from terminals and resistance conductor to ground.
	Defective end device	Check end divice.
	Defective discrete input	Jumper across field terminals and monitor discrete input status on pannel.
Multiple discrete inputs faulty	24Vdc common wire connected to the 12X12 I/O board is loose	Check wiring and terminations.

PROBLEM	POSSIBLE CAUSE	SOLUTIONS
Single discrete input reads healthy continuously	Conductor shorted to ground	Check wiring at terminations.
	Defective end device	Check end device.
	Defective discrete input	Remove field wires from terminals and/or from board terminals and monitor discrete input status on panel.
Analog boards do not initialize	No voltage at Exacta port on analog board	Check voltages on Exacta port at pins #1, #5, #9, with respect to pin #3 as reference (ground).
Controller screen is blank or black	Controller screen Is blank	Push <Enter/Exit> key.
	No power, blown fuse, loose connections	Check 24Vdc power supply, fuses and wiring.
	Contrast needs adjusting	Adjust contrast.
Date and time wrong		Set date and time.
Single output channel not working	Output in manual mode	Switch to Auto. Use the <Outputs> key to check for letter "M" before the words "On" or "Off". Push the number beside the output and then <G> to toggle back to Auto mode.
	Fuse blown or loose connection	Check the fuse on the 12X12 I/O board. Check the wiring and the terminations.
Multiple outputs not working	Fuse blown or loose connection	Check the 24Vdc main fuse in the panel. Check the 24Vdc wire that runs from the fuse to the 12X12 I/O board. Check the 24Vdc common that runs to each output end device.
Fuel solenoid not energizing	Engine crank speed is less than the minimum required purge value. Approx 30-50 (varies with engine type)	Check the RPM while cranking. SEE RPM NOT READING if no RPM is reading.
	Output not working	SEE SINGLE OUTPUT CHANNEL NOT WORKING.
No Crank signal	Manual crank selected on start	Push <Stop> then <Start> and select [1] Auto Crank.
	Output not working	SEE SINGLE OUTPUT CHANNEL NOT WORKING.
Ignition not energizing	Engine crank speed less than minimum required purge value. Approx 30-50 (varies with engine type)	Check RPM while cranking. SEE RPM NOT READING if no RPM reading.
	Output not working	SEE SINGLE OUTPUT NOT WORKING.

PROBLEM	POSSIBLE CAUSE	SOLUTIONS
Solenoid valve not responding	Output in Manual, fuse or wiring	SEE SINGLE OUTPUT CHANNEL NOT WORKING.
Analog valves frozen	Analog board in calibration mode	Power down and then up to reset.
		SEE SECTION 5.2.2 to unfreeze.
	Faulty analog input board	Using industry-standard calibration equipment, simulate appropriate signal directly to board and monitor analog indication.
Unit cranks but it does not start	No RPM detection	Check the RPM while cranking. SEE RPM NOT READING if no RPM reading.
Cannot clear Class Shutdowns	Shutdowns not cleared	Push <Messages> key to determine the cause and check them one at a time.
	Shutdown improperly set up	SEE SECTION 4.2.
	Defective discrete input	SEE SINGLE DISCRETE INPUT READS FAULTY CONTINUOUSLY or MULTIPLE DISCRETE INPUTS FAULTY.
Bypass valve not opening on High discharge or Low suction	Bypass control valve in Manual (LED On)	Push <Bypass Control> key and choose [H], Auto and answer [1], Yes.
	Master load control in Manual (LED On)	Push <Master Load Control> key and choose [H], Auto and answer [1], Yes.
	Master load controller locked up	Place Master Controller, bypass controller, and speed controller into manual. Then place all controllers back into automatic. (Specific sequence not required).
Speed not decreasing during High discharge or Low suction conditions	Speed controller in Manual (LED On)	Push <Speed Control> key and choose [H] Auto and answer [1] Yes.
	Master load control in Manual (LED On)	Push <Master Load Control> key and choose [H] Auto and answer [1] Yes.
	Master load controller locked up	Place Master Controller, bypass controller, and speed controller into manual. Then place all controllers back into automatic. (Specific sequence not required).

7.0 COMMUNICATIONS

7.1 REQUIREMENTS

To permit logging onto the **Exacta 21**:

1. A remote computer, either laptop or desktop running **Windows 3.11™, Windows 95/98™ or Windows ME/XP™** with a terminal emulation program such as **Hyperterminal™ or Procomm Plus™, or Windows Terminal™**.

   If not running **Windows™**, you will require some other communication program such as **Procomm™**.

2. An **Exacta 21** to **PC** serial interface cable, Part #CW1642.

   The pin-out of this cable is:

Exacta 21	PC
2 TXD	2 RXD
3 RXD	3 TXD
4 RTS	8 CTS
5 CTS	7 RTS
6 DSR	4 DTR
7 GND	5 GND
8 DCD	—
9 DTR	6 DSR

3. A **Level 1 password** from Altronic or your **Exacta 21** integrator (usually owner or distributor only) for uploading/downloading binary files (code) or a **Level 2 password** for downloading reports.

7.2 EXACTA 21 SETTINGS

The **Exacta 21** has one **RS232** and one **RS485/RS482** port located on the bottom of the unit. The **RS232** port is the 9-pin D connector furthest to the right when looking at the back of the controller. The **RS485** is the second port from the right when looking at the back of the controller.

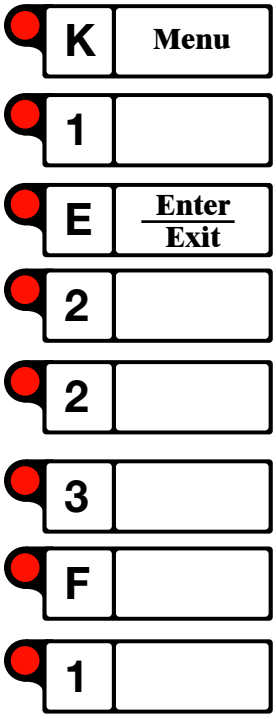
The following covers the use of the **RS 232** port to communicate with the **Exacta 21**, which is the most common method. Special procedures and hardware (**RS232/RS485 Convertor**) are required to communicate using the **RS485** port. Contact Altronic or your **Exacta 21** integrator if for some reason the **RS232** port cannot be used.

7.3 HOW TO SET UP THE PORT AND LOG ON

Before you can log on with a PC, the settings on the PC's communication port should be configured as follows:

- **19,200 Baud**
- **No Parity**
- **8 Bits**
- **1 Stop Bit**
- **Transfer Protocol X Modem**
- **No software or hardware flow control.**

To change the port settings if necessary:



Press the **[K]** or **Menu** key.

Select option **[1] Program Mode** by pressing **1**.

Enter your password **(Level 2 required)** and press **E Enter**.

Choose **[2] Set Up Menu**.

Choose either **[2]** or **[3]**, depending on which port you will be logging into.

The **Port Settings** screen will appear. Push **F** on the keyboard. You will be asked: **Default Settings? [1] Yes or [2] No**.

Select **[1] Yes**. The port is now configured to log on.

```
[0] State:ON        [6] Device:Computer
[1] Baud:9600       [7] Type:VT100
[2] Parity:None     [8] Display:One
[3] Size:8          [9] Exacta Link
[4] Stop Bits:1     [A] Test RS232
[5] HS:  DTR  CTS   [B] Echo Mode
```

PORT SETTINGS SCREEN

Connect the **Exacta 21 to PC** cable, ensuring the cable is oriented properly. One end is marked **To Exacta** the other **To PC**.

Start the terminal emulation program. Ensure the cable is connected to the correct com port on the PC. Typically **COM 1**.

A. Select **Connect** using: **Direct to Com x** (x being the **RS232** port being used).

B. Set communication parameters to **19200, 8,N,1, No Flow Control** to match the **Exacta 21**.

C. Select **Properties** then **Settings** then **Emulation** and make it **VT100**.

Hyperterminal's help files are provided at the end of this document for your convenience in the field.

On the PC, press **Enter** or **Return** three times. The **Exacta 21** splash screen will appear on the PC for a few seconds, changing to **Enter Password**. Enter your password and press **Enter**, the PC will show the **Exacta 21 Program Menu**.

7.4 HOW TO DOWNLOAD REPORTS

This procedure is used to print reports; for example, captured data, history, or modbus table. Reports are first transferred from the **Exacta 21** to the PC.

Connect and log on to the unit from the PC as described above.

After entering your password, press **Enter** or **Return**. You will now be at the **Program Menu** on the PC.

Choose **[4] Print Reports**.

Select the file you want to download between:

[1] Programming

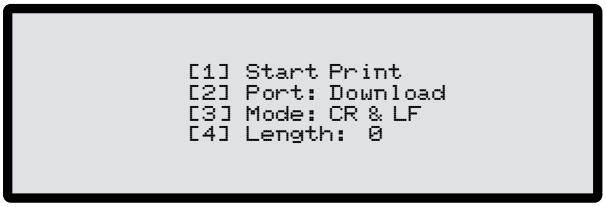
[2] I/O Summary

[3] Power Loss

[4] Record History

[5] Capture Data (In this case **Print Capture Data** appears; answer **Yes** or **No**. **Are You Sure** appears; answer **Yes** or **No**. Select **Data Set A** or **B**. If **A** is chosen the computer will ask for the shutdown you want to download. The **Print Menu** appears.

[6] Modbus Table.



PRINT MENU SCREEN

Ensure the **[2] Port** and **[3] Mode** settings are as shown on the screen.

Select **[1] Start Print**. The message **Printing** will be displayed. If **Capture Data** was chosen will appear.

Follow the emulation software's procedures for receiving a text file (a pop-up window will appear to show data transfer.) Hyperterminal's help files are provided at the end of this document for your convenience in the field.

NOTE: There is a limited time (@ 60 sec.) to start this or the download will fail.

XModem is the recommended protocol. Give the file an appropriate name, version number and extension. We recommend that '.txt' be used as an extension since this is reconizable by most text viewing programs and word processing packages.

When **[5] Data Capture** is selected the computer gives you a choice between **[1] Data Set A** (first-in shutdowns) or **[2] Data Set B** (standard trending data normally set to every 15 minutes). If **[1]** is selected, the list of shutdowns will appear. Choose one of them and proceed.

7.4.1 SAMPLE DOWNLOAD USING HYPERTERMINAL™

After entering your password, press the **Enter** key. You will then be at the **Program Menu**.

Select **[4] Print Reports**.

Select the report you would like to print. In this example we will be selecting option **[1] Programming**. The screen will change to the **Print Menu Screen**.

Option **[2] Port** should be set to **Download**. If it requires changing, choose **[2]** until it changes to **Download**. Then press **1** to start the print and the screen will change to **Printing**.

Move your mouse to the **Transfer Menu** and select **Receive File**. A screen will appear allowing you to select a folder.

Click on **Browse** and select the appropriate drive and file folder.

Click on **OK** and then **Receive** and type a file name. An appropriate name would be **Sitename-Prog.txt**. After entering the name, press the **Receive** button, to begin capturing the text to a file. When the capture is complete the screen will change back to the **Report Menu** screen.

7.5 HOW TO UPLOAD BINARY FILES (CODE)

This procedure is used to upload binary files (code) from the PC or laptop to the **Exacta 21**.

Connect and log on to the unit from the PC.

After entering your password Choose **[2] Set Up Menu**.

Choose **[7] Up Load**.

Choose **[1] Programming**.

Answer **[1] Yes** to the next two questions displayed.

The **Save Calibrations Screen** will be displayed.

```
[1] Save Calibrations:  [1] Yes
                        [2] No
```

SAVE CALIBRATIONS SCREEN

Follow the emulation software's procedures for sending a file, choosing the file you want to upload. XModem is the recommended protocol.

Select a file with an appropriate name, version number and extension. **Exacta 21** standard extensions are as follows:

- **.txt** **Reports (Cannot be Uploaded)**
- **.ep** **Exacta 21 Program**
- **.el** **Link file (Modbus)**
- **.er** **Record History**
- **.ec** **Capture File**

NOTE: Option [1] Yes saves the calibrations already in the Exacta 21. Only choose [1] when all end devices were previously calibrated and you are sure you want these values saved. [2] No overwrites with new calibrations from the new programming.

NOTE: EVERY TIME A NEW PROGRAM IS UPLOADED it is highly recommended to power down and up to properly re-initialize the controller with the new programming.

7.6 HOW TO DOWNLOAD BINARY FILES (CODE)

This procedure is used to download programming from the **Exacta 21** to a PC or laptop.

Connect and log on to the unit from the PC.

After entering your password, choose **[2] Set Up Menu**.

Choose **[8] Down Load**.

Choose **[1] Programming**.

Answer **[1] Yes** to the next two questions displayed.

Follow the emulation software's procedures for receiving a file, choosing the one you want to download. XModem is the recommended protocol.

Give the file an appropriate name, version number and extension. **Exacta 21** standard extensions are as follows:

- **.txt Reports (Cannot be Uploaded)**
- **.ep Exacta 21 Program**
- **.el Link file (Modbus)**
- **.er Record History**
- **.ec Capture File**

7.7 HOW TO LOG ON BY MODEM TO DOWNLOAD REPORTS

An optional modem is available with the **Exacta 21**. This modem allows access from a remote location. This feature is used for troubleshooting problems with the site, as well as viewing information, uploading and downloading files, and changing some control setpoints (with an appropriate password). The following procedure is for **Hyperterminal™** found in all **Windows 95™** and above operating systems and allows for dialing into the sites and downloading the appropriate reports.

Run **Hyperterminal™** by clicking on the **Windows Start** button.

Move the mouse to the **Program Menu**, a new screen will appear.

Move the mouse to the **Accessories Group** then click on the **Hyperterminal™** file. A screen to enter a name and pick an icon will appear. After one or two seconds a screen will appear with the file name and number to be dialed.

Type a suitable name and press **OK** (assign an icon if you wish). A phone number screen will appear.

Type in the correct phone number and press **OK**.

Press **Dial**. You will then see a window displaying the status.

Once the call has been connected you will see the **Enter Password** screen. You have made a successful connection.

7.8 HYPERTERMINAL™ HELP FILES

7.8.1 SET UP A NEW CONNECTION:

On the **File Menu** click **New Connection**.

Type a name that describes the connection, click the appropriate icon and click **OK**.

Enter the information for the call and click **OK**.

Click **Dial**.

7.8.2 CALL A REMOTE COMPUTER:

On the **File Menu** click **Open** and double-click the connection you want to use.

Click **Dial**.

7.8.3 CHANGE THE PORT SETTINGS FOR A MODEM CONNECTION:

On the **File menu** click **Open**.

Right-click the connection you want to change and click **Properties**.

Click the **Connect To** tab and click **Configure**.

Click the **Connection Tab**.

Click **Port Settings** and make the changes.

Click **Advanced** to change settings such as flow control and error correction.

NOTE: The changes that you make to the port settings affect only this connection.

7.8.4 CHANGE THE SETTINGS FOR MAKING A CALL:

In the **HyperTerminal** folder, double-click the connection you want to change.

On the **File Menu** click **Properties**.

Click the **Connect To** tab and make the changes you want.

Click the **Settings** tab to change settings such as the terminal type.

7.8.5 SEND A FILE TO A REMOTE COMPUTER:

On the **Transfer Menu** click **Send File**.

In the **Filename** type the path and name of the file you want to send.

Click **Send**.

NOTE: You can change the send protocol by clicking the one you want in Protocol. You can also send a text file to a remote computer by clicking Send Text File on the Transfer Menu. In most cases the file-transfer software on the remote computer needs to be configured to receive the file. For more information, contact the administrator of the remote computer.

7.8.6 RECEIVE A FILE FROM A REMOTE COMPUTER

Use the software on the remote computer to send (download) the file to your computer.

On the **Transfer Menu** click **Receive File**.

Type the path of the folder in which you want to store the file.

In **Use Receiving Protocol** click the protocol the remote computer is using to send your file.

7.8.7 SAVE A HYPERTERMINAL SESSION TO A FILE

NOTE: You can also send the session text directly to a printer by clicking the Transfer Menu and then clicking Capture to Printer. When you end the call, the text will be sent to your default printer.

On the **Transfer Menu** click **Capture Text**.

Type a descriptive file name or click **Browse** to select the path and file name, then click **Start**.

7.8.8 ADJUST THE HYPERTERMINAL WINDOW SIZE

On the **View Menu** click **Font**.

In **Size** enter a point size, using larger numbers to increase the size of the terminal window or smaller numbers to decrease it.

To adjust the **HyperTerminal** window to the size of the terminal window, right-click in the terminal window, and then click **Snap**.

8.0 MASTER CONTROLLER

8.1 MASTER CONTROLLER INPUTS

The master controller **(MC)** can accept up to four analog inputs; the ranges for which are designated by the configuration applied to each analog input. For example:

Suction Pressure	**4 to 20 mA**	**Span 0 to 6895 kPa**
Discharge Pressure	**4 to 20 mA**	**Span 0 to 6895 kPa**
Manifold Pressure	**4 to 20 mA**	**Span 0 to 250 In.H20**
Unit Flow	**Mapped**	**Span 0 to 250 103m3**

Upon initial configuration of the **MC**, each input will be assigned an **Action** based upon what the process variable **(PV)** will do during normal unit operation. This **Action** dictates to the **MC** the corrective action required to keep all **PV's** within the setpoints **(SP)** input by the operator. For example:

Suction Pressure	**Action = decrease**	**Offsets subtracted from SP**
Discharge Pressure	**Action = increase**	**Offsets added to SP**
Manifold Pressure	**Action = increase**	**Offsets added to SP**
Unit Flow	**Action = increase**	**Offsets added to SP**

In the **MC** these actions are input as either **Low** (for decreasing action) or **High** (for increasing action). The offsets are either added or subtracted from the actual setpoint for the controllers that are not being acted upon.

8.2 MASTER CONTROLLER SETPOINTS

Each input will then be assigned a **Setpoint** (in engineering units, not percentage). This allows for easier setpoint input by the operator as no unit conversion is required. For example:

Suction Pressure	**Setpoint = 90 kPa**
Discharge Pressure	**Setpoint = 1750 kPa**
Manifold Pressure	**Setpoint = 190 In.$H_2$0**
Unit Flow	**Setpoint = 185 103m3**

Each setpoint will then be assigned an **Offset** value which is input in Engineering units during initial **MC** configuration. For example:

Suction Pressure	**Offset = 15 kPa**
Discharge Pressure	**Offset = 50 kPa**
Manifold Pressure	**Offset = 50 In.$H_2$0**
Unit Flow	**Offset = 15 103m3**

8.3 MASTER CONTROLLER PID'S

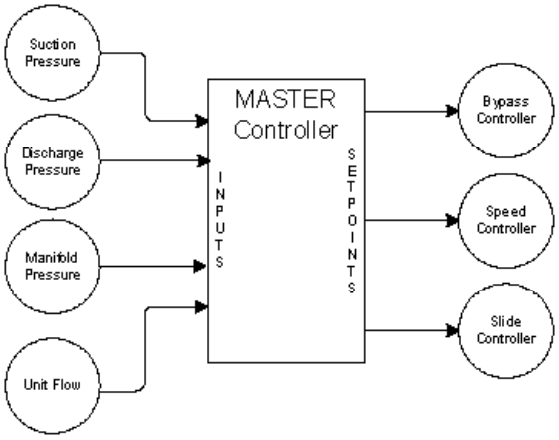
The **MC** can be configured to change the setpoint on up to four controllers **(PIDs)**. For example:

Bypass Valve Controller
Governor Controller
Slide Valve Controller

The order these controllers are configured is important as it determines the order in which they will be manipulated during the loading/unloading of the compressor.

8.4 MASTER CONTROLLER OPERATION

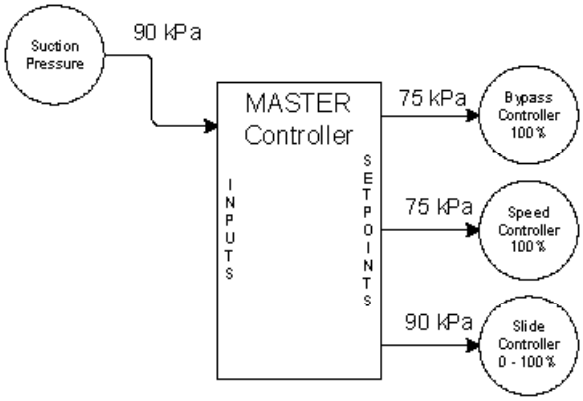
During normal operation there will only be one controller being manipulated to maintain the inputs within setpoint. This is accomplished through the use of the previously configured **Offsets** and the order which the controllers are configured to sequence.



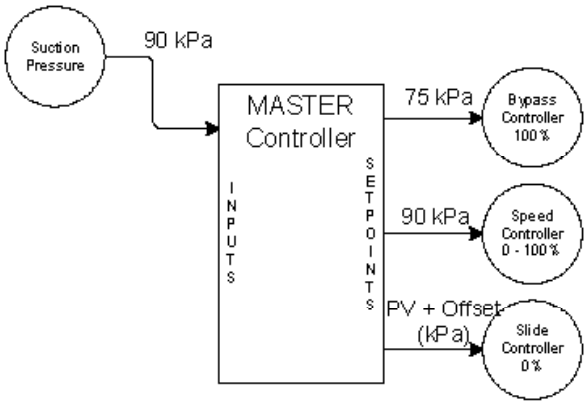
8.4.1 EXAMPLE

Suppose a screw-type unit is 100% loaded, RPM is at 100%, and the bypass valve is 100% closed. The suction pressure has decreased to the setpoint value in the **MC**—90kPa. The first controlled device will be the slide valve. To accomplish this, the **MC** will subtract the offset value from the actual setpoint and will place this in the two controllers not being manipulated. In this case the speed and bypass controllers. The slide valve controller will receive the actual setpoint and will manipulate the slide valve to maintain suction at setpoint.

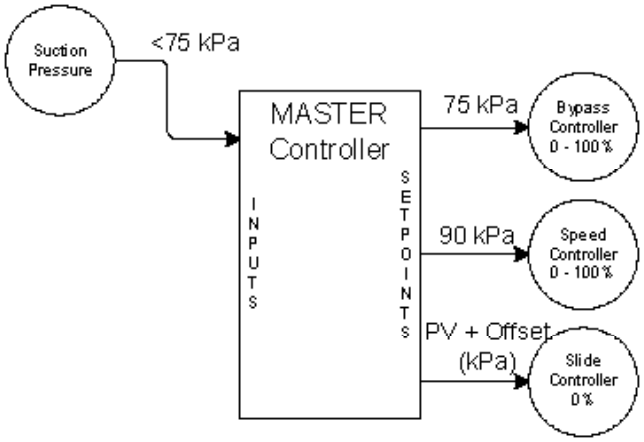
As the suction pressure continues to decrease the slide valve will continue to unload to attempt to maintain suction pressure at setpoint. The slide will continue to unload until it reaches 0%, or until the desired suction pressure is obtained:



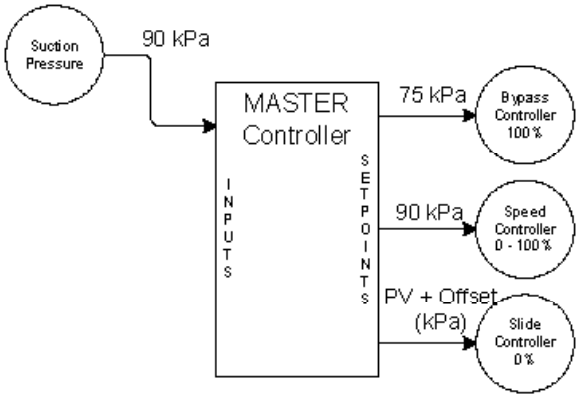
The **MC** will calculate the setpoint to the slide valve, by adding the offset value to the current process value (suction pressure). It will place the actual setpoint (90kPa) into the next controller, in this case the speed controller, and the setpoint in the bypass controller will remain the same:



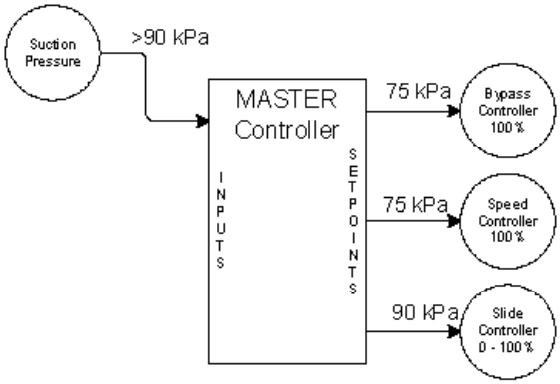
The speed will be manipulated to attempt to maintain suction pressure at the setpoint of 90kPa. With the offsets applied to the controllers as shown above it is clear how the **MC** sequences the controllers. The only time more than one controller will be changing its controlled variable will be if the suction pressure was to decrease rapidly below the actual setpoint minus the offset, for our example 75kPa. At this point, both speed and bypass valve would be reacting to changes in suction pressure:



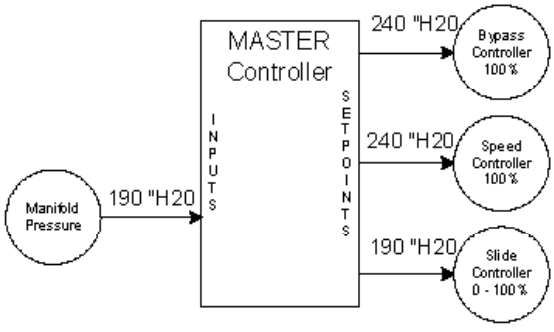
If the suction pressure began to increase, the unit would begin loading. Starting with the controller currently being controlled and sequencing through the controllers. For example, if the speed is being manipulated to maintain suction at 90kPa the setpoints in the three controllers would be as follows:



The speed would continue to increase to attempt to maintain suction pressure at 90kPa. Once the speed controller output increased to 100%, the next controller, in this case the slide valve controller, would get the actual setpoint and the speed controller would get a setpoint equal to the actual minus the offset value:



Using the same initial conditions—slide 100%, speed 100% and bypass 100% closed. If the Manifold pressure increases above setpoint the **MC** would insert the setpoint for the manifold pressure into the slide controller. The speed and bypass valve controllers would receive the manifold pressure setpoint plus the offset for the manifold pressure. The same sequencing will occur to attempt to control the manifold pressure at setpoint.



NOTE: The remaining analog inputs, although not currently being controlled, are still monitored and will become the controlling variable if required.
The tuning of the MC is accomplished through the tuning of each separate control loop. This provides for apparent dynamic tuning based on the item being manipulated. For example, the speed loop can be tuned differently than the bypass controller in order to maintain stable control. The setpoints cannot be changed directly in the speed or bypass controllers. They must be changed from the MC.

8.5 PANEL INDICATIONS

The following is a **MC** screen representation. From the data shown, it can be said that currently all conditions are satisfied. However, the **MC** is designed to look at the **PV** that is closest to setpoint on a percentage basis. Below you can see an asterisk beside the **Suct Stg 1 Press**. This means that currently suction is closest to setpoint.

```
Jun 19/07     Master PID       8:30 AM
Mode: Auto
        PV Name     Setpoint  PV
*[1] Suct Stg1 Press     200  322
 [2] Disch Stg 2 (2)    7400  4600
 [3] Eng Manifold Pre    750  435

 [E]xit  [H]Manual  [F]Setpoint  [K]PIDs
```

The next example shows the load on the unit has increased and now the **Eng Manifold Press** is selected as current because it's closest to setpoint.

```
Jun 19/07     Master PID       8:30 AM
Mode: Auto
        PV Name     Setpoint  PV
 [1] Suct Stg1 Press     200  322
 [2] Disch Stg 2 (2)    7400  4600
*[3] Eng Manifold Pre    750  704

 [E]xit  [H]Manual  [F]Setpoint  [K]PIDs
```

In both of the above cases the selection of a setpoint; that is, **Suction** or **Manifold**, does not indicate the control panel is unloading the unit based upon that controlled variable. To check this, pressing the **[K] PIDs** button will bring up the next screen as shown following.

This screen indicates by the asterisk the controller that is currently attempting to control the unit. For the above example, you can see that speed is selected by the position of the asterisk, however, the output to governor is at **100%**. This confirms the previous statement.

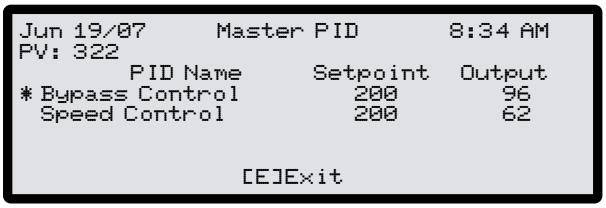
```
Jun 19/07     Master PID       8:34 AM
PV: 322
        PID Name     Setpoint  Output
 Bypass Control         122      100
*Speed Control      )   200      100


                [E]Exit
```

For the next screen capture the suction pressure has now decreased below setpoint. It is selected as the **PV** to be controlled. This is indicated by position of the asterisk.

```
Jun 19/07     Master PID       8:30 AM
Mode: Auto
        PV Name     Setpoint  PV
*[1] Suct Stg1 Press     200  195
 [2] Disch Stg 2 (2)    7400  4600
 [3] Eng Manifold Pre    750  704

 [E]xit  [H]Manual  [F]Setpoint  [K]PIDs
```

We can see that some corrective action should be taking place; for example, **RPM** reducing or **Bypass Valve** opening. To determine what is currently being manipulated to attempt to control suction at setpoint pressing the **[K] PIDs** button will bring up the following screen.

This time we can see the speed controller has begun to reduce the output to the governor in an attempt to control the suction pressure at setpoint. This output will be reduced until the engine has reached **Minimum Load RPM**. At this time control will now be switched to the next controller in the list. For this example the bypass control. The screen will now look as follows. The asterisk beside the bypass control indicates it is the controller currently being manipulated to attempt to control suction.



You can see the output to the governor has decreased to **62%**, which should correspond with the **Minimum Load RPM**. The bypass has now begun to reduce output to the bypass valve in an attempt to control suction at setpoint.

If the suction were to increase back above setpoint, the bypass would be the first to increase output. When it reached **100%**, the speed would then begin to increase. This order will always be the same unless either the speed or bypass has been placed into **Manual** mode. If any controller is in **Manual** the **MC** will ignore it.

INDEX

F

H

I, J

K, L

M

N, O

U, V

Z

FIGURES SECTION:

FIG. 1 EXACTA 21 SYSTEM DRAWING AND SPECIFICATIONS

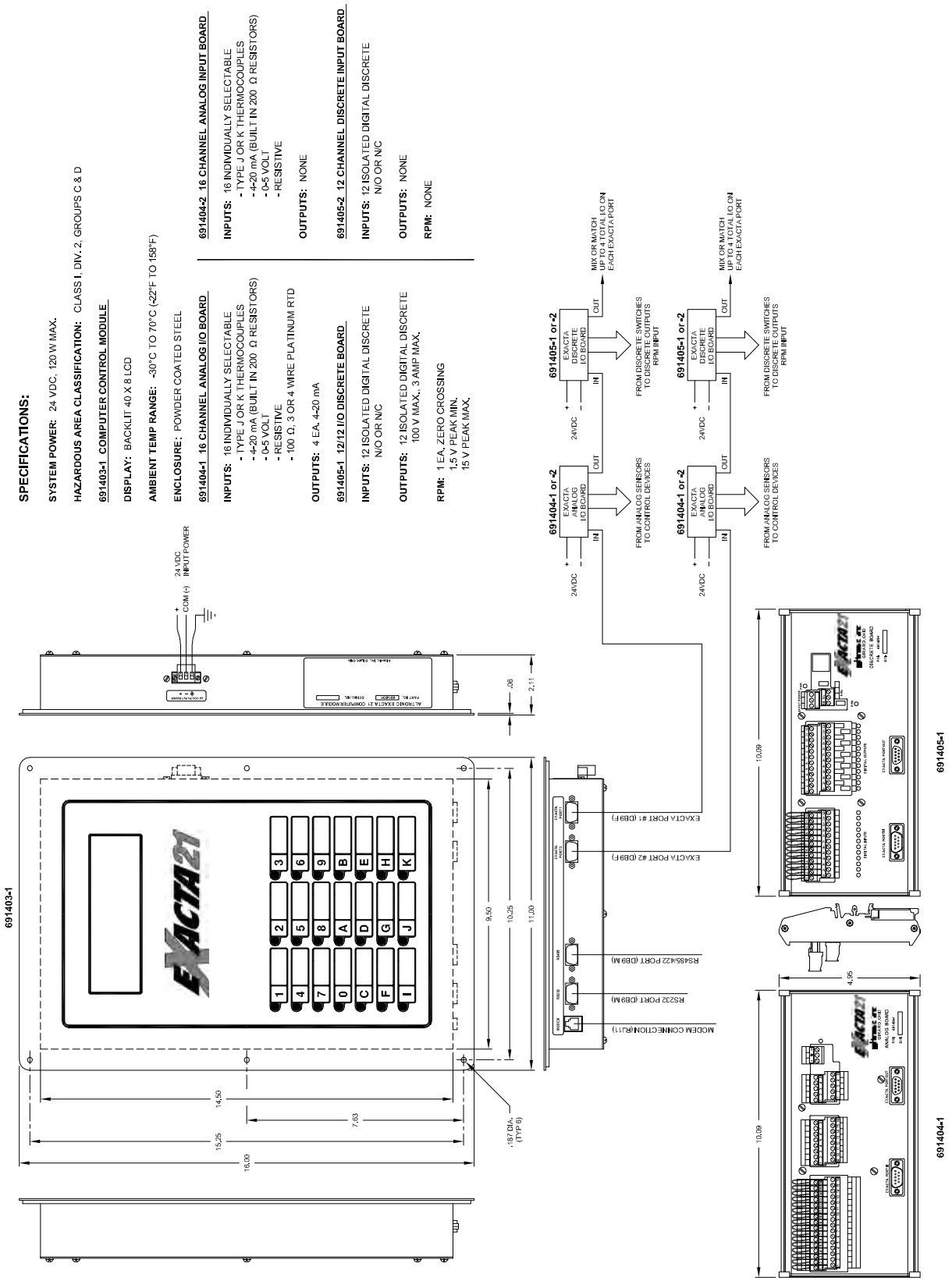
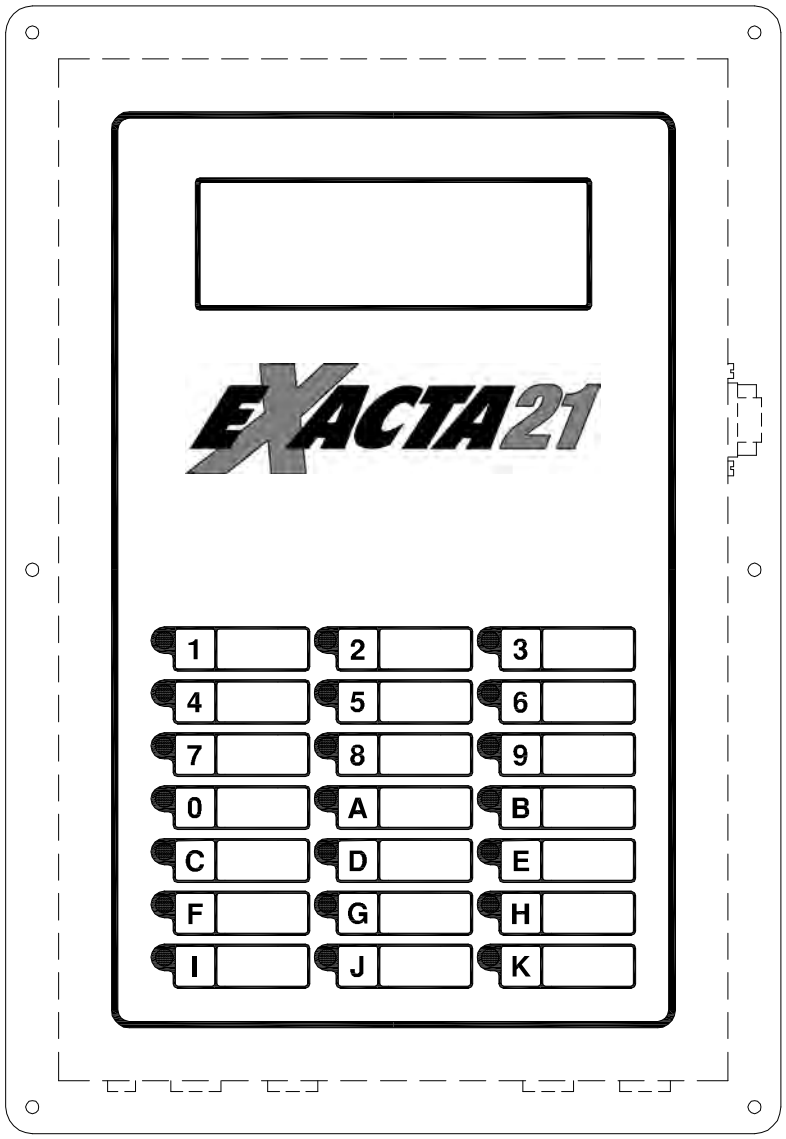
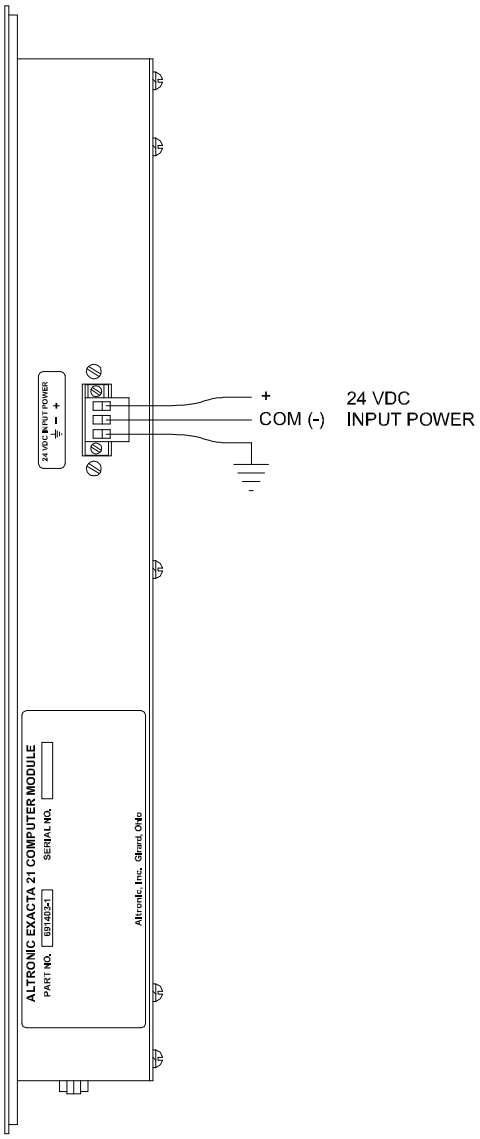
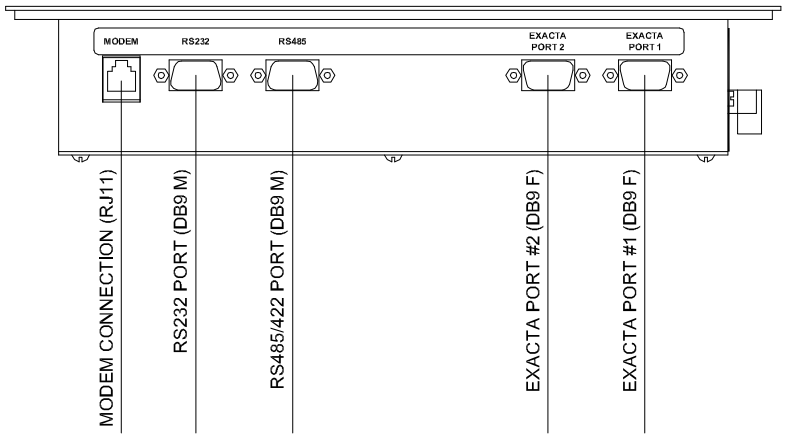


FIG. 2 LAYOUT - COMPUTER MODULE 691403-1







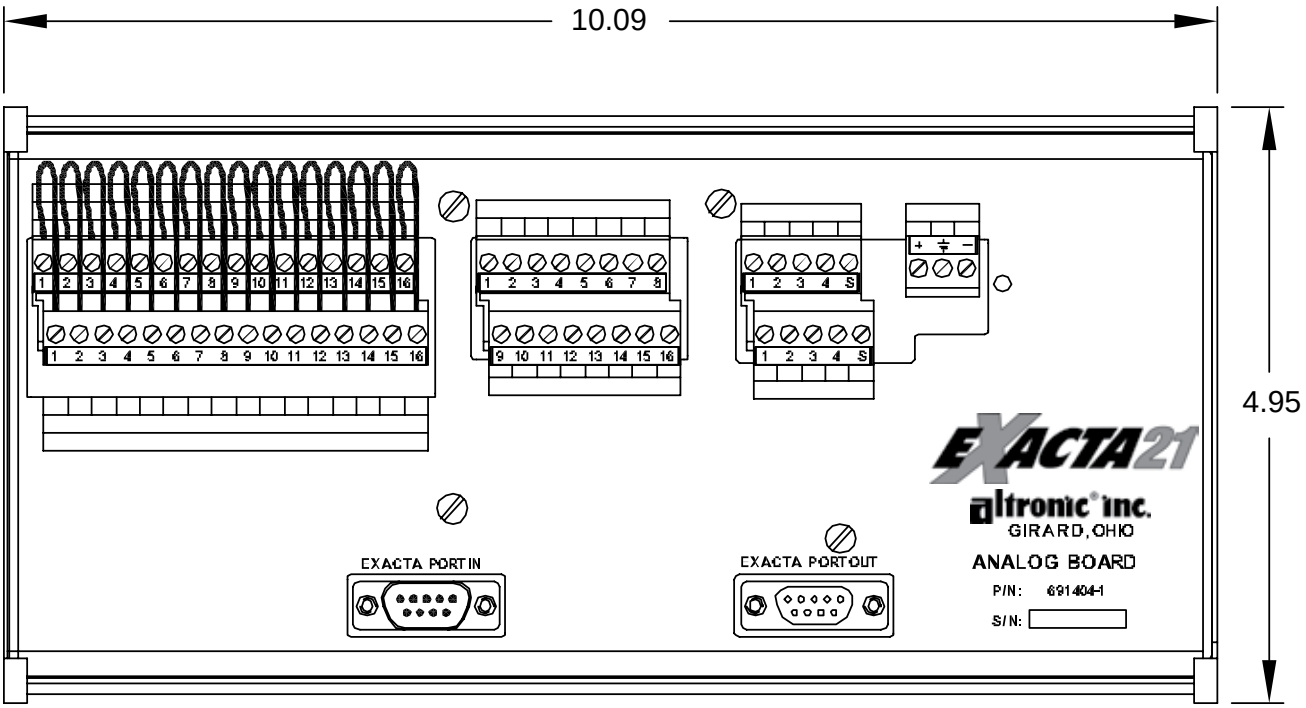
SPECIFICATIONS:

DISPLAY: BACKLIT

AMBIENT TEMP. RANGE: -30°C TO 70°C (–22°F TO 158°F)

ENCLOSURE: POWDER COATED STEEL

FIG. 3 ANALOG I/O BOARD 691404-1

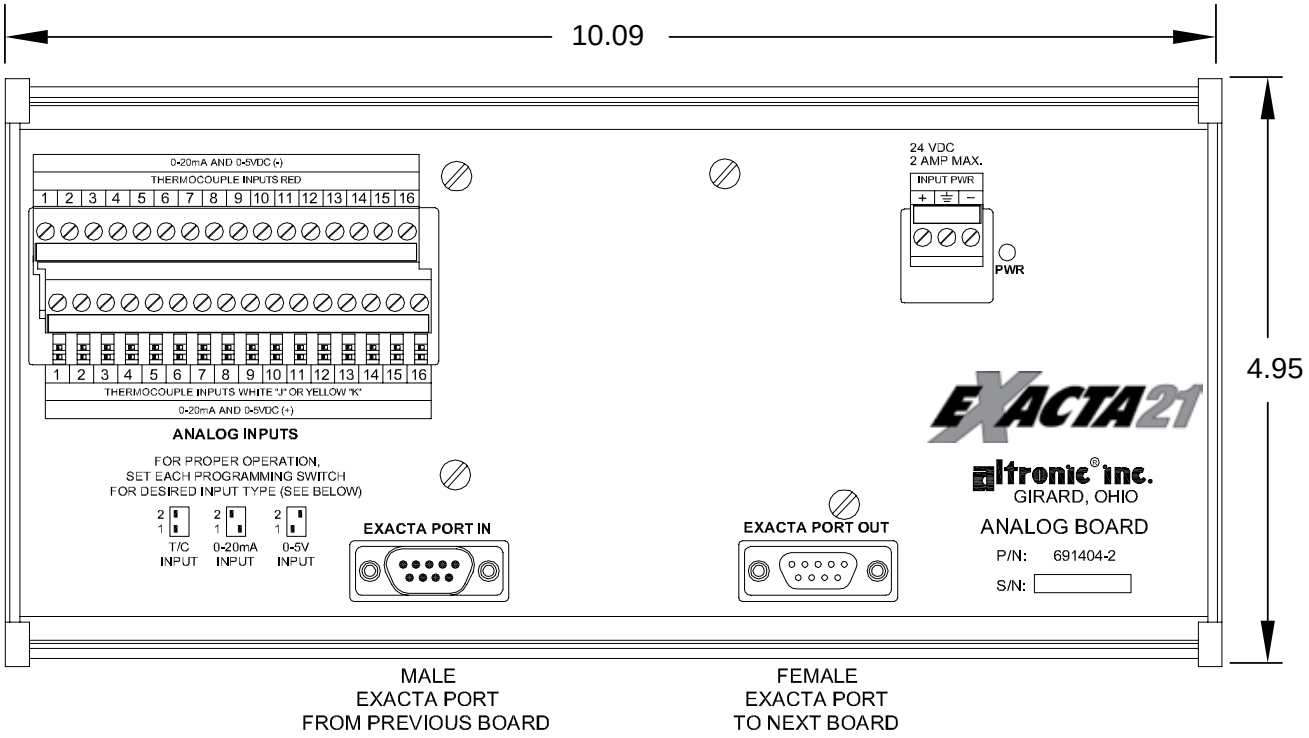


SPECIFICATIONS:

INPUTS: 16, INDIVIDUALLY SELECTABLE
- TYPE J OR K THERMOCOUPLES
- 4-20mA (BUILT-IN 200Ω RESISTORS)
- 0-5 VOLT
- RESISTIVE
- 100Ω, 3 OR 4 WIRE PLATINUM RTD

OUTPUTS: 4 EACH, 4-20mA

FIG. 4 ANALOG INPUT BOARD 691404-2

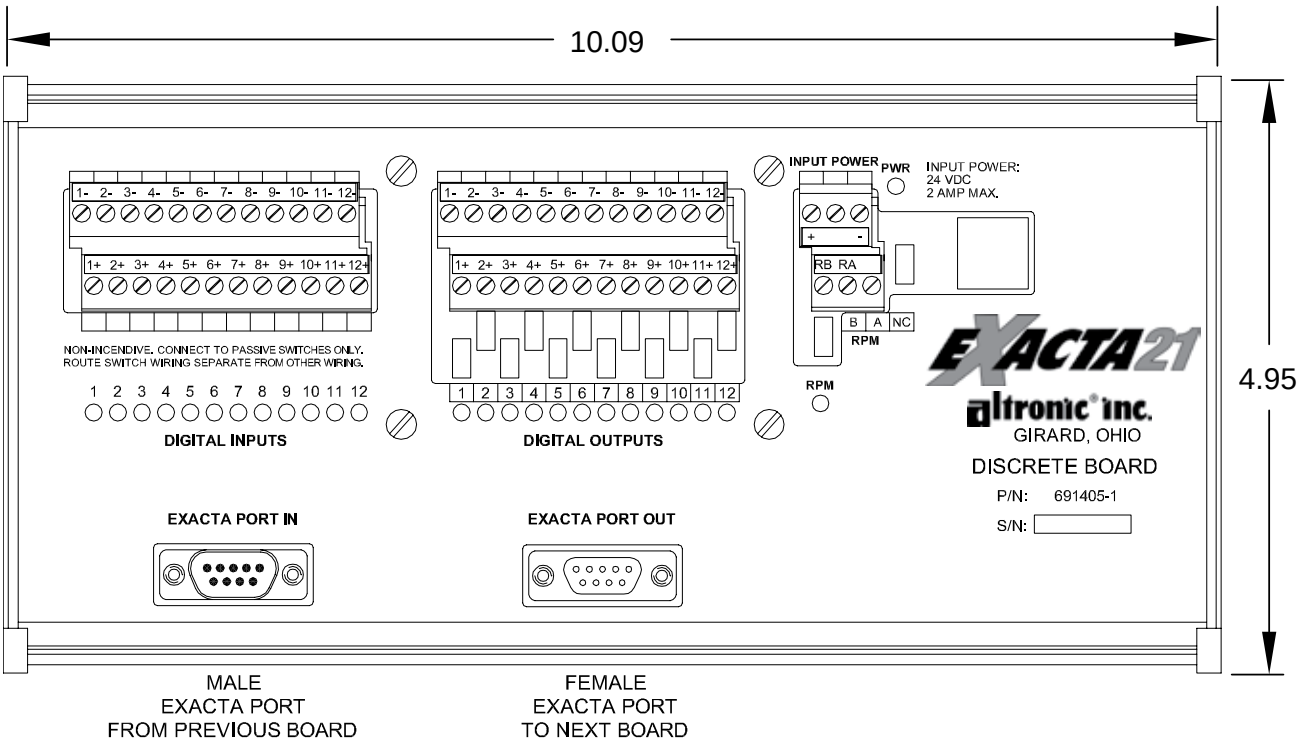


SPECIFICATIONS:

INPUTS: 16, INDIVIDUALLY SELECTABLE
- TYPE J OR K THERMOCOUPLES
- 4-20mA (BUILT-IN 200Ω RESISTORS)
- 0-5 VOLT
- RESISTIVE

OUTPUTS: NONE

FIG. 5 DISCRETE I/O BOARD 691405-1



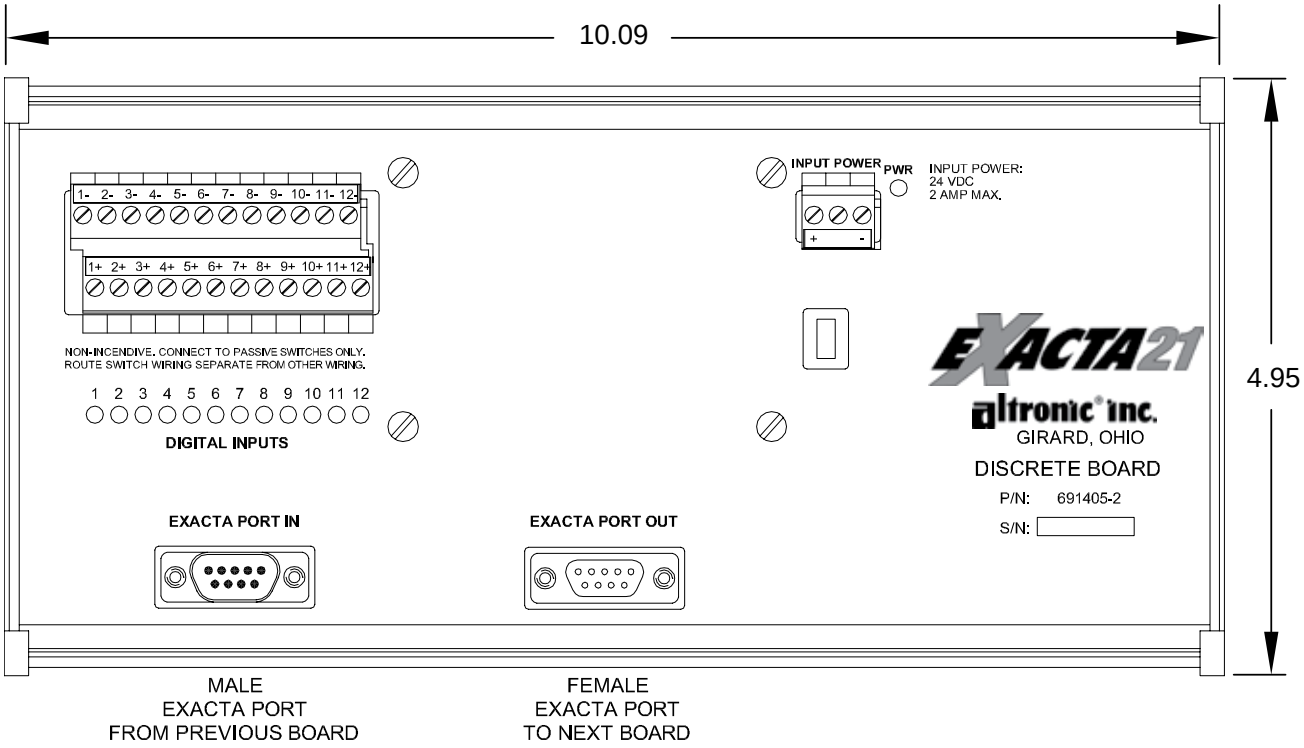
SPECIFICATIONS:

INPUTS: 12, ISOLATED DIGITAL DISCRETE
N/O OR N/C

OUTPUTS: 12, ISOLATED DIGITAL DISCRETE
100 V MAX., 3 AMP MAX.

RPM: 1 EA., ZERO CROSSING
1.5 V PEAK MIN.
15 V PEAK MAX.

FIG. 6 DISCRETE INPUT BOARD 691405-2



SPECIFICATIONS:

INPUTS: 12, ISOLATED DIGITAL DISCRETE
N/O OR N/C

OUTPUTS: NONE

RPM: NONE