FERGUSON BEAUREGARD

*i*NodeConfig *i*C

User Manual

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Overview

The *i*NodeConfig *i*C User Manual describes in detail the software application *i*NodeConfig *i*C, used to manage the Ferguson Beauregard Auto-Cycle *i*ntelligent Controller (AC*i*C). For detailed information on AC*i*C mechanical and electrical installation, operation and front panel display and keypad use, refer to the Ferguson Beauregard "Auto-Cycle Operator's Manual" (AC*i*C Manual).

Ferguson Beauregard AC*i*C

The AC*i*C system is a compact Remote Terminal Unit (RTU) designed for complete stand-alone operation in the harsh environmental conditions of the oilfield.

The AC*i*C's versatile microcomputer-based controller continuously monitors and optimizes the well-production process. AC*i*C onboard software includes Ferguson Beauregard's patented Auto-Cycle™ electronic well site controller and plunger-lift control algorithm. The controller records the analytical reservoir information so production problems can be diagnosed with greater accuracy and efficiency.

The AC*i*C provides physical connections for analog pressure sensors such as casing and tubing, as well as a variety of discrete (status) sensors. It can be equipped with virtually any point-to-point radio or cellular/wire modem to link with a host computer or back office. Pneumatic signals to control the well's tubing and auxiliary control valves are supplied from a remote single or dual latching valve assembly

The AC*i*C controller and the Auto-Cycle™ control algorithm provide proven production optimization. With automatic self-adjustment of time and pressure settings for well production cycle control, optimum plunger velocity and well performance are achieved. This system offers a unique approach to well production management, measurement and optimization. With an AC*i*C on duty, the well operator has remote control of motor valves, and can even monitor tanks and pits for high level alarms. It's like having an operator on site 24 hours a day.

AC*i*C user interfaces

The AC*i*C provides several options for user control and management. When on-site and performing simple configuration or data viewing, the built-in Keyboard Display Terminal (KDT) can be used. Instructions for using the KDT are detailed in the AC*i*C Operator's Manual. *i*NodeConfig *i*C is intended for detailed configuration and trend data analysis. *i*NodeConfig *i*C can be used locally by connecting a USB cable from a personal computer to the AC*i*C, or remotely by connecting through the internet and/or a radio network. Finally, a cell-modem equipped AC*i*C supports text messages (SMS), allowing a user to receive alarms and status information, as well as making configuration changes remotely.

*i*NodeConfig *i*C basics.

Save and Refresh icons.

The **Save** and **Refresh** icons are located at the top left-hand side of every AC*i*C screen beneath the screen tabs, visible in Figure 1 below. Since **Save** and **Refresh** are used for nearly every operation described in this manual, these functions are explained first.

Like many RTUs, configuration changes made in *i*NodeConfig *i*C are not automatically sent to the AC*i*C. Similarly, AC*i*C data changes are not automatically updated in the *i*NodeConfig *i*C view. The user must either **Save** changes made to AC*i*C configuration, or **Refresh** *i*NodeConfig *i*C to see recent AC*i*C data changes.

Save icon.

Changes made to *i*NodeConfig *i*C configuration settings are sent to the AC*i*C when the **Save** icon is clicked.

Refresh icon.

*i*NodeConfig *i*C will not automatically retrieve and display data and configuration from the AC*i*C except during initial connection. Data and configuration will change as the AC*i*C adjusts settings and as new data is collected. To see the most recent AC*i*C data and configuration, click the **Refresh** icon .

Help.

Most items on each screen have a brief description of their purpose. This help text is displayed at the bottom of the window when an item is highlighted. To highlight an item, point at it and click the left mouse button.

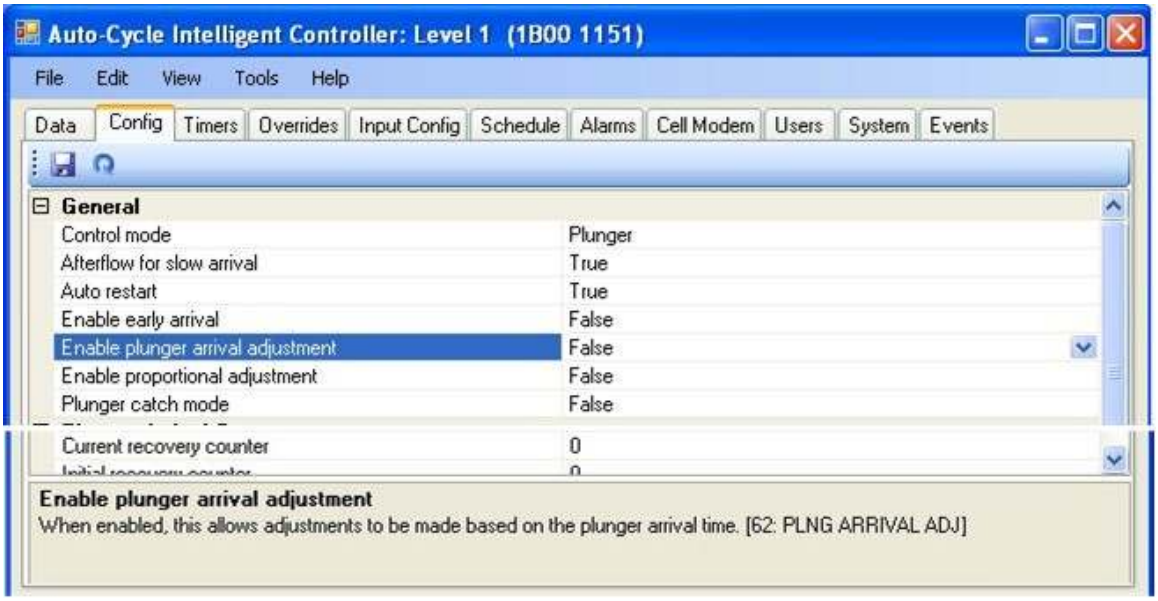


Figure 1. AC*i*C help example.

In Figure 1, “Enable plunger arrival adjustment” is highlighted. At the bottom of the screen, the help text for that item is now displayed. If a Hot Key code (in this case, 62) for the KDT interface is available, it is also shown.

*i*NodeConfig *i*C configuration

This section describes the initial installation of *i*NodeConfig *i*C and the process for connecting *i*NodeConfig *i*C for communication with an AC*i*C.

Installing *i*NodeConfig *i*C

Please see Appendix A.

Connecting to the AC*i*C and starting *i*NodeConfig *i*C

Connecting with the USB port

For local configuration and management *i*NodeConfig *i*C can be run on a personal computer (PC) when it is connected to the AC*i*C via a USB interface.

1. Open the AC*i*C outer door, then open the AC*i*C KDT module door. See Figure 2.
2. Locate the USB port on the KDT module door and the USB port on the PC and connect a USB cable between the two ports.

Figure 2. AC*i*C opened with USB cable attached

3. On the PC, start *i*NodeConfig *i*C.
4. *i*NodeConfig *i*C will automatically recognize the AC*i*C connected to the PC and display the Connection Screen, as shown in Figure 3.
5. Double click on the AC*i*C. *i*NodeConfig *i*C will connect and the AC*i*C opening screen will be displayed as shown in Figure 4.

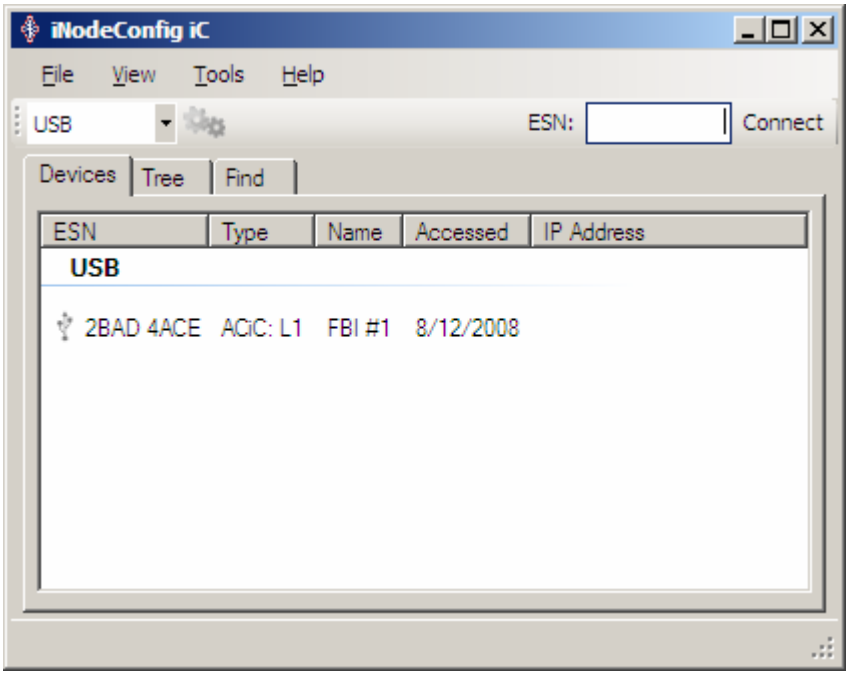


Figure 3. *i*NodeConfig *i*C Connnection Screen

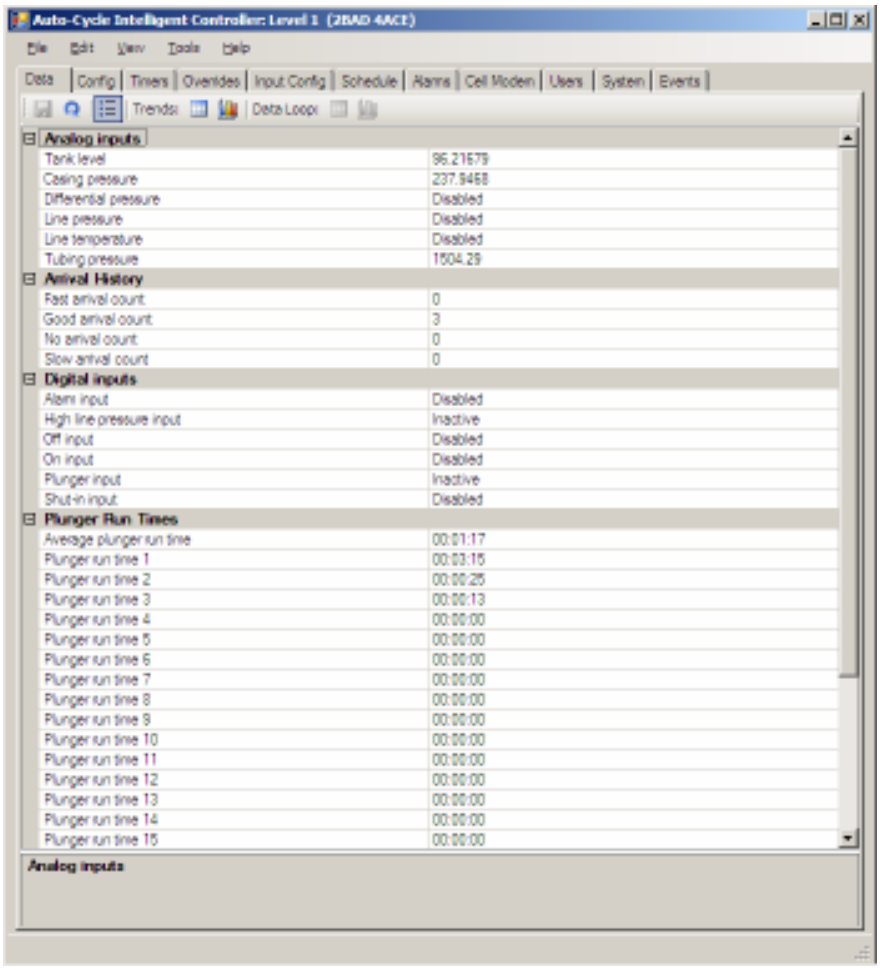


Figure 4. AC*i*C Opening Screen

AC*i*C configuration

This section describes the process for initial AC*i*C configuration prior to set up for a specific well or location, including

- Firmware update
- General configuration
- Communications setup

Updating firmware

AC*i*C firmware can be updated using *i*NodeConfig *i*C, either from a file saved on a personal computer (PC) or from a file saved on a Secure Digital (SD) card inserted into the AC*i*C.

Updating firmware with a PC

1. Save the new firmware file (named similar to "ACiC_L_1_PCB2 1.00.08.00.hex") into a directory on the PC.
2. From the *i*NodeConfig *i*C toolbar, select **Tools,** then **Update Firmware…**.
3. A File Explorer screen will be displayed. Browse to the directory where the AC*i*C firmware is saved, select the firmware file and click **Open**.
4. *i*NodeConfig *i*C will show the loading progess at the bottom of the screen. When the firmware load is completed, the AC*i*C will reset, *i*NodeConfig *i*C will close, restart and reopen the data screen.
5. Confirm the new firmware version by checking **Firmware Version** on the **System** screen.

Updating firmware from an SD card

1. Insert the SD card into the AC*i*C. See Figure 2 for the SD card location.
2. From the *i*NodeConfig *i*C toolbar, select **File**, then **Device SD card**, then **Load Firmware…**.
3. On the resulting screen, click on the firmware filename to highlight it (similar to FIRMWARE.HEX) and click **OK**.
4. *i*NodeConfig *i*C will show the loading progess at the bottom of its screen. When the firmware load is completed, the AC*i*C will reset, *i*NodeConfig *i*C will close, automatically restart and reopen the Data screen.
5. Confirm the new firmware version by checking **Firmware Version** on the **System** screen.

General configuration

Set the following parameters during initial AC*i*C installation.

a. **Device Name** - Names the AC*i*C.
b. **Battery** – The AC*i*C is available with either a 6V or 12V battery. The **Battery** setting must be set to the correct voltage for Energy level and power management to display and operate correctly.

c. **KDT password** – When a password is used, no changes can be made to the AC*i*C using the KDT without entering the correct password. The password must be 4 digits (0-9); 0 disables the password requirement.
d. **Serial port usage** – **Modem** enables the cell modem communications, **Modbus** enables Modbus communications via the RS-232 port and **Disable** disables the port.
e. **Tank/Tubing Low battery action** – Sets the tank and tubing valves to open, close or do nothing on a low battery condition.
f. **Sync Clock** – The AC*i*C clock must be set. iNodeConfig will synchronize the AC*i*C to the PC clock.

Setting general parameters

1. Select the **System** screen and enter values or select options for the above parameters.
2. Save the selections by clicking the **Save** icon. 
3. Select **Tools**, then **Sync Clock** to set the clock.

Setting up communications

Cell modem

When equipped with a cell modem, the AC*i*C provides remote access to data, status and configuration. To utilize the cell modem service, the user must have a cell phone with text messaging services known as Short Message Service (SMS). The AC*i*C cell modem must be provisioned and activated. To protect the AC*i*C from tampering, access is limited to either text messages preambled with the AC*i*C's unique security code, or the user's cell phone information must be entered on the **Users** screen. For comprehensive instructions on the use of SMS with an AC*i*C, see the "AC*i*C SMS User Manual".

Enable/disable cell phone

To use the cell modem, the AC*i*C serial port must be set to **Modem** for cell phone communications. If factory-equipped with a cell modem, **Modem** will already be selected.

1. Select the **System** screen.
2. Click on the **Serial port usage** setting and choose **Modem** or **Disable** as appropriate.
3. Save the selections.

Cell modem provisioning

Call Ferguson Beauregard support.

Cell modem activation

Call Ferguson Beauregard support.

Cell modem reset

Select **Tools,** then **Cell Modem**, and then **Reset Cell Modem**.

Text messaging security code

1. Select the **Cell Modem** screen.

2. For **Text messaging security code**, enter up to a 6 digit code (upper or lower case A-Z and 0-9). A blank code will allow any AC*i*C formatted phone text message access to this AC*i*C. The factory default code is '654321'.
3. Save the selections.

Users

The AC*i*C allows multiple users to remotely access the AC*i*C to receive data updates and alarms and to make configuration changes. Contact information and privileges for each user are configured on the **Users** screen.

Text message services

Each user can have text message services configured individually as follows:

- **Scheduled** - The user will receive scheduled data updates from the AC*i*C. (The schedule is the same for all users.)
- **Alarms** - The user will receive alarms.
- **Can query** - The user can remotely query data from the AC*i*C using KDT hot key numbers.
- **Can modify** - The user can remotely modify AC*i*C configuration using KDT hot key numbers.

Adding and Configuring users

1. Select the **User** screen.
2. Click the **Add** button.
3. Enter the user name in the **Full name** box.
4. For text messaging to a cell phone, enter the **Phone Number** and click to check the services to be enabled within the **Text Message Information** area.
5. Save the selections.

Enabling login information

(*CURRENTLY UNSUPPORTED*).

Removing users

1. Select the **User** screen.
2. Click on the user information to highlight.
3. Click the **Remove** button.
4. Save the selections.

Scheduled data reporting

The AC*i*C can be configured to regularly uplink data and status to the user. The data can be uplinked via supported WAN connections (satellite, cellular, etc.). Limited data and status can also be sent to a user via text messaging.

Adding Scheduled data uplinks

1. Select the **Schedule** screen.
2. Click the **Add** button.
3. Enter the time of day in the **When** box, select the frequency from the **Repeats** box drop down menu, and optionally select days of the week from the **Repeat on** selections.

4. Choose the data type by checking **Text Message** for status data or **Uplink** (*CURRENTLY UNSUPPORTED*) for user selected data.
5. Save the selections.

Setting up a well

This section describes the process for setting up an AC*i*C for a specific well or location. The process includes setting up:

- Analog inputs
- Digital inputs
- Mode and general settings
- Timers, automatic adjustments and counters
- Tank mode
- Sync mode
- Overrides
- Alarms

and

- Saving and importing configurations
- Resetting the AC*i*C
- Viewing data
- Viewing Event logs
- Saving Trend data and Event logs

Analog inputs

The AC*i*C has four inputs: three configurable signals and the plunger arrival switch (also known as a Magnetic Shut Off or MSO). The three configurable signals can be used as analog or digital inputs. This section describes how to configure these as analog signals.

General

The AC*i*C provides the following options for sampling and storing trend data.

- **Analog channel scan rate** – The rate the AC*i*C samples the analog input: Disabled (for digital or no inputs), 3 second, or 1 minute. Faster sample rates consume more energy and will deplete the battery more quickly. Choose the slowest sample rate that meets the need. Use Disabled if there are no analog inputs configured.
- **Trend storage rate** – The time span over which the analog inputs are averaged for each stored trend sample: Disabled or 3 minutes.
- **Reference voltage** – The reference voltage used for factory calibration of the analog inputs. Do not change the factory setting.

Assigning inputs

1. Select the **Input Config** screen. Input signals can be assigned in **Analog Setup**.
2. For the desired signal, for example **Casing pressure**, select the desired input Analog 1 to Analog 3 from the drop down menu to the right of **Casing pressure**. (The drop down menu is accessed by clicking on the existing selection.)
3. Assign all of the desired inputs, leaving unused signals as **unused**.
4. Save the selections.

Calibrating inputs

Each assigned input must be calibrated to accurately represent the monitored signal. A two point calibration procedure is provided. For each point, low or high, the current value of the signal is entered as the engineering unit. The input is then sampled, low or high, and is thereby assigned to the current engineering unit. Alternately if the minimum and maximum input voltage range and the associated engineering units are known, they can be entered for a rough calibration.

1. Select the **Input Config** screen.
2. Set the engineering units low to the desired value. For example, if the casing pressure is 0 PSI, set the engineering units low to 0.
3. Highlight the **CP sample low** and click on **Sample Voltage**. The voltage on the CP input will be read and associated with engineering unit low of 0 PSI.
4. Save the selection.
5. Repeat 1-4 for the high sample.

Digital inputs

The three AC*i*C inputs can be configured as either analog or digital. This section describes how to configure these as digital signals. When used as a digital input, the signal is compared to an internal 2.5 VDC reference voltage. The signal is **on** if it is above 2.5 VDC or **off** if below.

Assigning inputs

1. Select the **Input Config** screen. Input signals can be assigned in **Digital Setup**.
2. For the desired signal, for example **High LP**, select the desired input, Analog 1 to Analog 3, from the drop down menu to the right of **High LP**. (The drop down menu is accessed by clicking on the existing selection.)
3. Assign all of the desired inputs, leaving unused signals as **unused**.
4. Save the selections.

Configuring mode and general settings

Modes

The AC*i*C can be operated in one of 5 modes. Each mode has unique capabilities and associated parameter settings that control these capabilities.

- **Manual**: The controlled valves are manually set for open or closed.
- **Plunger**: The tubing valve cycles are controlled by the AC*i*C using the settable timers and automated adjustments to optimize the plunger cycle.
- **Tank**: The tubing and tank valves cycles are controlled by the AC*i*C using the settable timers and automated adjustments to optimize the plunger cycle.
- **Intermitter**: The tubing cycle is preset to fixed values that do not change.
- **Liquilift Tank**: The same as **Plunger** mode, but adding a tank recovery mode to modify the off time for no arrival conditions.

Selecting Mode

1. Select the **Config** screen.

2. Under **General,** select the desired mode from the **Control Mode** drop down menu.
3. Save the selection.

General settings

The AC*i*C provides various operational options which will be defined later within the detailed screen descriptions. They include:

- **Afterflow for slow arrival**: Allows afterflow during slow arrivals.
- **Auto restart**: Allows restart in previous mode, verses manual mode.
- **Enable early arrival**: Enables early arrival window. If this is disabled, all arrivals prior to fast time are considered fast arrivals.
- **Enable plunger arrival adjustment**: Allows cycle adjustments based on plunger arrival time.
- **Enable proportional adjustment**: Allows proportional cycle time adjustments depending on variance from Good Window.
- **Plunger catch mode**: Allows plunger to be caught on next arrival and well is shut-in.

Selecting General Settings

1. Select the **Config** screen.
2. Under **General,** select the desired condition (True or False) for each option enable.
3. Save the selection.

Configuring timers, automatic adjustments and counters

Timers and automatic adjustments

The AC*i*C optimizes plunger lift system control by developing a performance history of plunger arrival times and adjusting operating parameters to improve efficiency. The adjustment process compares the plunger arrival times to defined time windows of the tubing cycle. The operating windows are created by setting the Tubing On Time, Fast Time and Slow Time. The example below indicates a typical set of windows for an 8,000’ tubing depth.

<table>
<tr><td>START TIME</td><td>0 Min</td><td></td></tr>
<tr><td></td><td></td><td rowspan="2">Fast Window</td></tr>
<tr><td>FAST TIME</td><td>10 Min</td></tr>
<tr><td></td><td></td><td rowspan="2">Good Window</td></tr>
<tr><td>SLOW TIME</td><td>15 Min</td></tr>
<tr><td></td><td></td><td rowspan="2">Slow Window</td></tr>
<tr><td>ON TIME</td><td>30 Min</td></tr>
<tr><td></td><td></td><td>No Arrival</td></tr>
</table>

A plunger arriving at the surface in less than 10 minutes would fall in the Fast Window, arrival between 10 and 15 minutes would fall in the Good Window, arrival between 15

minutes and 30 minutes would fall in the Slow Window and any not arriving within 30 minutes are No Arrivals.

The AC*i*C provides the ability to control the plunger cycle by adjusting the Afterflow Time (flow allowed after arrival) and Off Time (flow disabled) by user defined times. Adjustments are made for arrivals within the windows as follows:

FAST WINDOW	Increase Afterflow Time and decrease Off Time
GOOD WINDOW	No changes
SLOW WINDOW	Decrease Afterflow Time and increase Off Time
NO ARRIVAL	Decrease Afterflow Time and increase Off Time

Setting Timers and Automatic Adjustments

1. Select the **Config** screen.
2. Enter the desired times for each parameter within the **Tubing Off Cycle**, **Tubing On Cycle**, **Tubing Afterflow**, **Tubing Fast Arrival Adjustments**, **Tubing No Arrival Adjustments** and **Tubing Slow Arrival Adjustments**.
3. Save the selections.

Timers screen

The timer values can be viewed and adjusted using a graphical interface provided on the **Timers** screen. The control mode can be changed and On or Off cycles can be started.

- **Cycle windows** - The graphical interface allows the user to drag the window bars to increase or decrease the times, or enter numerical values into the window boxes.
- **Control mode** - The mode may be changed by selecting the desired mode from the **Control Mode** drop down window.
- **Start On/Off cycle** – Either On or Off cycles can be started by clicking the **Start On Cycle** or **Start Off cycle**.

Counters

The AC*i*C provides plunger arrival history counters which act as triggers to force shut-in or allow afterflow when plunger arrival is consistently within a timer window. For example, the well will shut in when the plunger has not arrived during the number of cycles set in the **Initial no arrival counter**.

Setting Counters

1. Select the **Config** screen.
2. Enter the desired initial counts for each initial counter within the **Plunger Arrival Counters**. The current counts will reset to the initial counts when an On or Off cycle is forced to start; otherwise the current counters will continue to decrement. You may set the current counters if desired.
3. Save the selections.

Configuring Tank Mode

When Tank Mode is selected the following parameters may be set.

- **Current recovery counter**: Number of consecutive no arrivals until recovery mode. Resets to initial recovery counter on plunger arrival or 0. (Liquilift tank mode only.)
- **Initial recover counter**: Initial number of consecutive no arrivals before recovery mode. (Liquilift tank mode only.)
- **Reset afterflow to minimum on recovery**
- **Tank delay mode**: Time delay to tank valve opening from start of On cycle.
- **Tank on time**: Tank valve on time provided plunger has not arrived.
- **Tank recovery time**: Used instead of Off time when **Current recovery counter** reaches 0. (Liquilift tank mode only.)

Setting Tank Mode Parameters

1. Select the **Config** screen.
2. Under **Tank Mode,** set the desired values.
3. Save the values.

Configuring Sync Mode

TBD

Configuring Overrides

The AC*i*C allows for setting safety valve overrides. These overrides are based on the limits within which the production pressures are allowed to operate. If pressures exceed the limits, valves are opened or closed as defined. The user sets these initial limits. The AC*i*C also provides the ability to automatically adjust these limits based on the plunger arrival history and the application of settable increments to the initial limits.

Example: The following parameters are set as shown. The initial range is 400 to 500 PSI (in the examples below, this range is written as "400-500")

Casing Pressure Overrides	
Open if CP is greater than	500
Close if CP is less than	400
Fast arrival, high CP decrease	5
Slow arrival, high CP increase	10
No arrival, high CP increase	15
Fast arrival, low CP decrease	5
Slow arrival, low CP increase	10
No arrival, low CP increase	15
Max CP shut in	700

- If the initial pressure is greater than 500, the valve opens; if less than 400, the valve closes. Regardless of the range, the well will shut in if the pressure exceeds 700 PSI.
- If a fast arrival follows, the range is decreased by 5: from 400-500 to 395-495.

- If a slow arrival follows, the range is increased by 10: from 400-500 to 410-510.
- If a no arrival follows, the range is increased by 15: from 400-500 to 415-515.

Override categories

- **Casing Pressure**
- **Differential Pressure**
- **Line Pressure**
- **Tubing Pressure**
- **Misc**
  - **Open if TP-LP is greater than** - Allows user to enter a differential set point of tubing pressure minus line pressure. Provided minimum off-time has been satisfied, the algorithm will override the remaining offtime period and open the plunger valve, if the differential condition occurs.
  - **Open if fluid slug is less than** - Attempts to calculate fluid slug size. Opens the plunger valve and overrides the remaining off-time period (provided the minimum off-time period has been completed). The slug is calculated continuously with the following: (Casing pressure minus tubing pressure divided by casing pressure minus line pressure), i.e. (CP-TP)/(CP-LP)=FSLUG.

Setting Overrides

1. Select the **Overrides** screen.
2. Under the desired category set the desired values.
3. Some values can either be "Disabled" or set to a specific value. To set a specific value, the alarm must first be enabled to change the value. Click the value and open the drop down menu that appears. Check or uncheck the **Enable** as desired. If enabled, change the value as desired.
4. Save the values.

Configuring alarms

The AC*i*C can be configured to send alarms to one or more users by various methods (for example to a cell phone). The alarm values or conditions are disabled, or set to specific trigger values. When the alarm trigger value is met, an alarm is generated. Alarms can be delayed such that the alarm condition must persist for a set time before an alarm will be generated. An "all clear" message (the alarm condition no longer exits) can be selected to be sent or not sent. For a user to receive alarms, contact information and an enable must be set up on the **Users** page.

Alarm categories

- Battery
- Casing Pressure
- Differential Pressure
- General
- Level
- Line Pressure

- Line Temperature
- Tubing Pressure

Setting Alarms

1. Select the **Alarms** screen.
2. Each alarm value can be either "Disabled" or set to a specific trigger value. The alarm must first be enabled to change the value. Click the value and open the drop down menu that appears. Check or uncheck the **Enable** as desired.
3. If enabled, change the value as desired.
4. Save the values.

Saving and importing configurations

*i*NodeConfig *i*C provides the ability to export (save) or import (load) a configuration. An exported configuration is a file that contains the complete configuration of the AC*i*C at the time the configuration is saved. The exported configuration may be imported into any AC*i*C. The configuration file may be exported to or imported from a PC, or an SD card inserted into the AC*i*C.

Exporting and importing with a PC

1. Export the configuration
    a. Select **File**, then **Export Configuration,** from the *i*NodeConfig *i*C toolbar. The PC's File Explorer will open.
    b. Using File Explorer, find or create a directory into which to save the configuration.
    c. Name the file in **File Name** and click **Save**. The file is saved.
2. Import a configuration
    a. Select **File**, then **Import Configuration**, from the *i*NodeConfig *i*C toolbar. The PC's File Explorer will open.
    b. Using File Explorer, find the directory where the configuration file is saved.
    c. Click on the desired file. The file name will be entered into the **File name** box. Click Open. The configuration will be loaded into the AC*i*C.

Exporting and importing with the SD card.

1. Export the configuration
    a. Select **File**, then **Device SD card**, then **Save Configuration As…**, from the *i*NodeConfig *i*C toolbar. The **Save As** window will open.
    b. Using **Save As**, name the file in **File Name** and click **OK**. The file is saved. Note the file name is limited to 8 characters using A-Z and 0-9 only.
2. Import a configuration
    a. Select **File**, then **Import Configuration**, from the *i*NodeConfig *i*C toolbar. The **Load File From SD Card** window will open.
    b. Click on the desired file and click **OK**. The configuration will be loaded into the AC*i*C

Resetting the AC*i*C to its default configuration

The AC*i*C may be returned to its default factory configuration.

1. Select **Tools**, then **Reset ACiC to defaults**.

Viewing Data

Well status, history and trend data can be easily viewed using *i*NodeConfig *i*C.

Viewing well status and history

Status and history items are displayed on either the Data or the Config screen depending on the parameter.

1. Select the **Data** screen and click the data list button. 
2. The following data categories are displayed. To see the most recent instantaneous data, click the **Refresh** icon. 
    a. **Analog inputs** – Analog input level for the enabled inputs
    b. **Arrival history** – Plunger arrival history (fast, good, slow, no)
    c. **Digital inputs** – Digital input level for selected inputs
    d. **Plunger run times** – Last 15 run arrival times, and average arrival time.
    e. **Plunger totals** – Total cycles, on and off time, and arrival counts.
    f. **Tank totals** – Total tank cycles and on time.
3. Select the **Config** screen.
4. The following data categories are displayed.
    a. **General** – Current mode, settings and enables.
    b. **Plunger Arrival Counters** – Initial and current arrival counts for each window.
    c. **Sync mode** – Displays the sync modem enable and the allowed flow time.
    d. **Tank Mode** – Tank settings and times.
    e. **Tubing** – Current On/Off/Afterflow times and arrival adjustments.

Clearing well status and history

Various status and history items can be cleared (set to '0') with *i*NodeConfig *i*C. Click on **Tools**, then click:

a. **Clear Totals** – Clears the following counts:
    - **Arrival History**
    - **Plunger Run Times**
    - **Plunger arrival counts**
    - **Total tubing cycles**
    - **Tubing off/on time**
    - **Tank cycles**
    - **Tank on time**

b. **Reset Plunger –** clears the **Lifetime plunger arrival** count.

Trend data

Time stamped trend data for the enabled analog inputs and AC*i*C battery are saved to volatile memory. Trend data can be viewed in either a tabular or graphical representation.

Tabular

1. Select the **Data** screen and click the tabular trend button. 
2. Data will be shown in a tabular form for the enabled analog inputs and battery voltage level. Data is presented oldest first - scroll down to the end of table for the most recent data.

Graphical

1. Select the **Data** screen and click the graphical trend button. 
2. Data will be shown in a graphical format for the enabled analog inputs and the battery voltage level. The data is presented with the values on the Y axis and the associated time stamp on the X axis.
3. To zoom in on data, hold the left mouse button down and draw a square around the data of interest. The data will expand to fill the screen.
4. While the cursor is inside the graph, click the right mouse button to display Options for the graphical screen. The following options are displayed.
    - **Copy** – Copies the graphical image for pasting.
    - **Save Image As…** - Opens a window to save the image in a desired format, jpeg for instance.
    - **Page Setup** – Opens a window to adjust the page settings for printing.
    - **Print** – Opens a window to print the graph.
    - **Show Point Values** – Enables the viewer to see the values for individual points on the graph by passing the cursor over the point.
    - **Un-Zoom -**
    - **Undo All Zoom/Pan**
    - **Set Scale to Default**
    - **Individual Y Axes**

Logs

Event log

The AC*i*C records an Event log to volatile memory (the log will be erased if power is removed from the AC*i*C). The log contains the time, source, type, reason and description of the event in tabular form. The log can be cleared to start a fresh log.

Viewing and clearing the Event log

1. Select the **Events** screen. The Event log will be loaded and displayed with the lastest event at the top of the screen.
2. To refresh the Event log, click **Refresh**.
3. To clear the Event log, click on **Clear Events**.

Trend Data log

If trend storage is enabled and an SD card is installed, trend data will be automatically saved once an hour by the AC*i*C in a Trend Data log on the SD card.

Saving Trend Data and Event Logs

Trend Data and Event logs provide a permanent history which is automatically updated to the SD card once an hour by the AC*i*C.Trend Data and Event logs can be saved in two ways on the SD card:

Method 1 manually updates the automatically updated log on the SD card, saving the history immediately without waiting for the next automatic update.
Method 2 allows the user to save the history for later viewing.

Update log

1. Select **File**, then **Device SD Card**, and **Save Trend to Restorable Memory**, the trend log is updated. **Save Configuration To Restorable Memory** and **Save Event Log To Restorable Memory** are also available, but are redundant as they are automatically updated following changes.

Snapshot log

1. Select **File**, then **Device SD Card**, and **Save Trend Snapshot As…** or **Save Event Log Snapshot As…**. The **Save As** window will open.
2. Using **Save As**, name the file in **File Name** and click **OK**. The file is saved. Note the file name is limited to 8 characters using A-Z and 0-9 only.

*i*NodeConfig *i*C Screen Reference

The *i*NodeConfig *i*C graphical user interface has two windows. The Connect window, which opens when *i*NodeConfig *i*C is started, provides general setup for iNodeConfig and the means to select and connect to AC*i*C s. Once an AC*i*C is selected and the connection is made, a second window is opened. The AC*i*C window provides access to the AC*i*C for management and data viewing. This section describes each window and screen and the items and parameters on each screen.

Connect window

The Connect window utilizes a menu bar, toolbar and screen selection tabs for management and viewing.

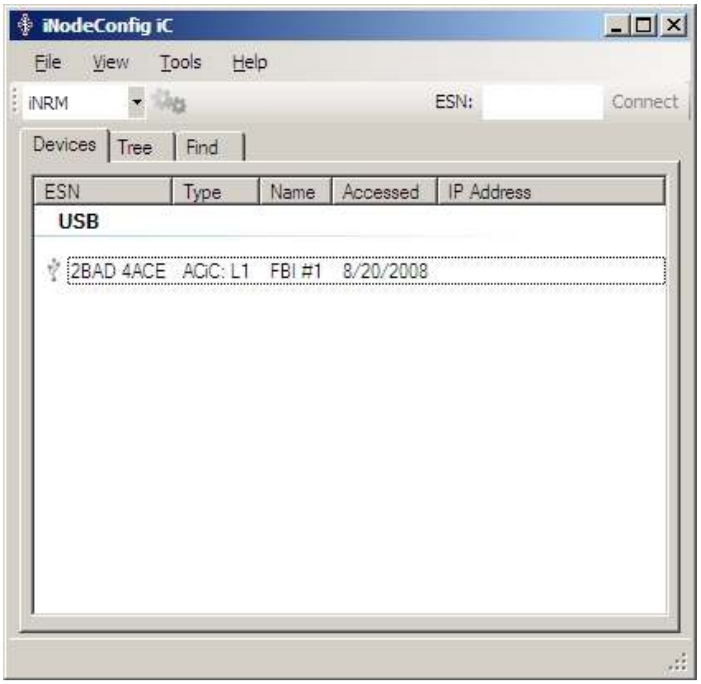


Figure 5 Connect Window

Menu bar

The menu bar, located at the top of the window, has the following dropdown menu selections:

- **File** – User levels (Pumper, Installer and Administrator) and Exit
- **View** – An alternate way to select the screen to be viewed.
- **Tools** – Various tools such as Connect to Device, Cancel Connection, Clear Found Devices, Connection Properties and Options.
- **Help** – Help screens and version information.

Note: Some items in the menu bar selections are non-operational at this time.

Tool bar

The tool bar is located underneath the menu bar. It will allow the user to choose the connection path (iNRM, TCP/IP or USB), the properties for each path, and a means to

enter the AC*i*C's ESN to connect. From the user standpoint, it is presently non-operational.

Screens

Devices

The Devices screen displays the device to which *i*NodeConfig *i*C is currently connected.

Tree

Non-operational.

Find

Non-operational.

AC*i*C window

The AC*i*C window utilizes a menu bar, toolbar and screen selection tabs for management and viewing of the AC*i*C.

Menu bar

The menu bar, located at the top of the screen, consists of:

- **File** – File related tasks; importing/exporting configuration, SD memory card access.
- **Edit** - *Non-operational*
- **View** – Opens a separate window to view internal AC*i*C status messages.
- **Tools** – Various tools such as clock sync, counter resets, firmware updates.
- **Help** – Help screens and version information.

Screen tabs

The screen selection tabs, located under the toolbar near the top of the window, allow the user to switch between the various screens. Each screen provides an interface to the AC*i*C for viewing data and status, and configuring AC*i*C parameters and settings. There are eleven screen tabs:

- **Data** – Current values for inputs, plunger and cycle history, and trend data.
- **Config** – Setup configuration and status for various modes, cycle times and automatic adjustments.
- **Timers** – Graphical representation of the cycle windows and manual mode and timing adjustments.
- **Overrides** – Configuration and status of control overrides and automatic adjustments.
- **Input Config –** Configuration and calibration of analog and digital inputs.
- **Schedule –** Configuration of data and text message uplink schedules.
- **Alarms –** Configuration of alarm settings.
- **Cell Modem –** Configuration and status of cell modem and security.
- **Users –** Configuration of users allowed to access AC*i*C.
- **System –**View AC*i*C system status.
- **Events –** View log of AC*i*C events.

Screens

Data

The **Data** screen shows current values for inputs, plunger and cycle history, and trend data. The **Data** screen provides three different data viewing options:

1. Tabular data and totals.
2. Tabular trend data.
3. Graphical trend data.

Tabular data and totals

The following describes the items on the **Data** screen by section when the **Data** screen list button is selected.

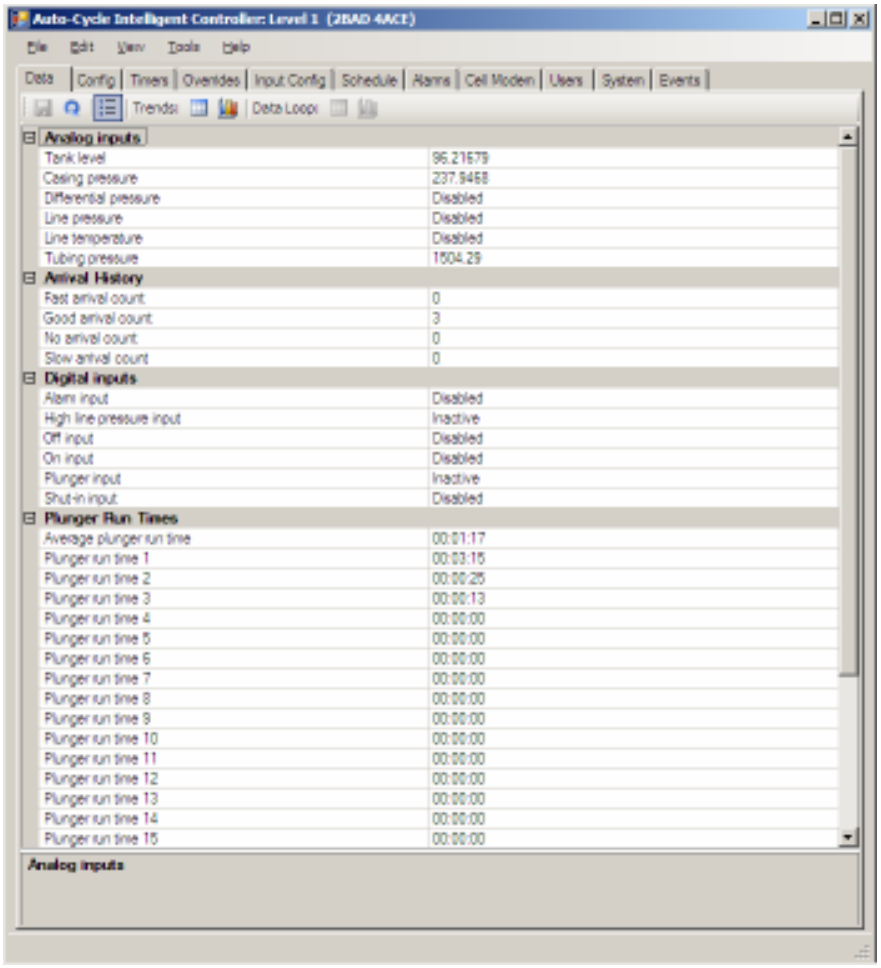


Figure 6 Tabular Data Screen

Analog inputs – Analog channel input level for enabled inputs, otherwise shows "Disabled". Channel assignments are made on **Input Config** screen.

Table 1. Analog Inputs

Input	***Description***
Tank level	Tank level in inches.
Casing pressure	Casing pressure in PSI.
Line pressure	Line pressure in PSI.
Line temperature	Line temperature in degrees F.
Tubing pressure	Tubing pressure in PSI.

Arrival history – Plunger arrival count history (fast, good, slow, no). Reset to 0 on **Clear Totals** command.

Table 2. Arrival History

Count	***Description***
Fast arrival count	Count of plunger arrivals within the Fast window.
Good arrival count	Count of plunger arrivals within the Good window.
No arrival count	Count of no plunger arrivals within Tubing on time.
Slow arrival count	Count of plunger arrivals within the Slow window.

Digital inputs – Digital input status of "Active" (on) or "Inactive" (off) for enabled inputs, otherwise shows "Disabled". Channel assignments are made on **Input Config** screen.

Table 3. Digital Inputs

Input	***Description***
Alarm input	Status of digital input assigned to Alarm input
High line pressure input	Status of digital input assigned to HL pressure input
Off input	Status of digital input assigned to Off input
On input	Status of digital input assigned to On input
Plunger input	Status of digital input assigned to Plunger input
Shut-in input	Status of digital input assigned to Shut-in input

Plunger run times – last 15 run arrival times, and average arrival time.

Table 4. Plunger Run Times

Run Time	***Description***
Average plunger run time	Average or last 15 plunger run times.
Plunger run time 1 - 15	Plunger run time from On cycle to arrival.

Plunger totals – Total cycles, on and off time, and arrival counts. All are set to 0 on **Clear Totals** command, except for Lifetime plunger arrival count.

Table 5. Plunger Totals

Totals	***Description***
Lifetime plunger arrival count	Reset only on **Replace plunger command**.
Plunger arrival count	Arrival count since **Clear Totals**.
Total tubing cycles	Tubing cycles since **Clear Totals**.
Total tubing off time	Tubing valve off time since **Clear Totals**.
Total tubing on time	Tubing valve on time, including afterflow, since **Clear Totals**.

Tank totals – Total tank cycles and on time. All are set to 0 on **Clear Totals** command.

Table 6. Tank Totals

Totals	***Description***
Total tank cycles	Tank valve cycles since **Clear Totals**.
Total tank on time	Tank valve on time since **Clear Totals**.

Tabular Trend Data

Time stamped trend data for the enabled analog inputs and AC*i*C battery can be viewed in a tabular format when the Data screen tabular trend button  is selected. Data is presented oldest first; scroll down to the end of table for the most recent data. Trend data can be cleared using the toolbar **Tools – Clear Devices Trend Data** button.

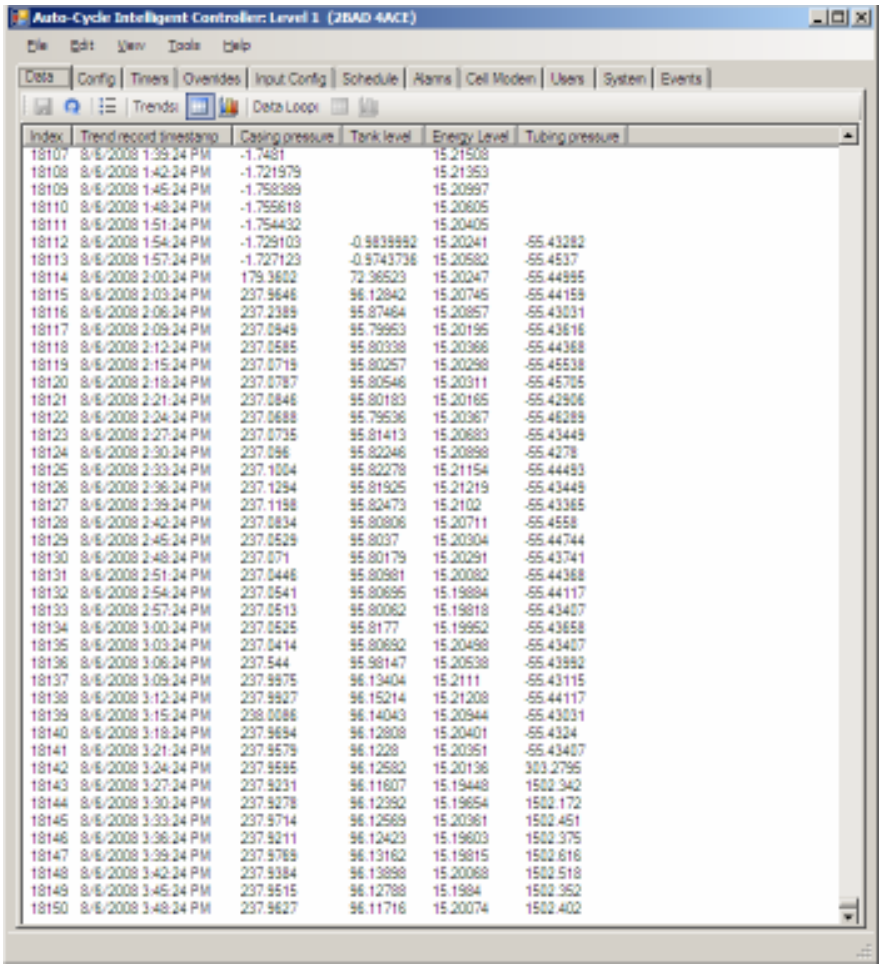


Figure 7. Tabular Trend Screen

Graphical Trend Data

Time stamped trend data for all enabled analog inputs and AC*i*C battery voltage can be viewed in a graphical format when the Data screen graphical trend button  is selected. The data is presented with the values on the Y axis and the associated time stamp on the X axis. To zoom in on an area, hold the left mouse button down, draw a square around the data of interest and release the mouse button. The data will expand.

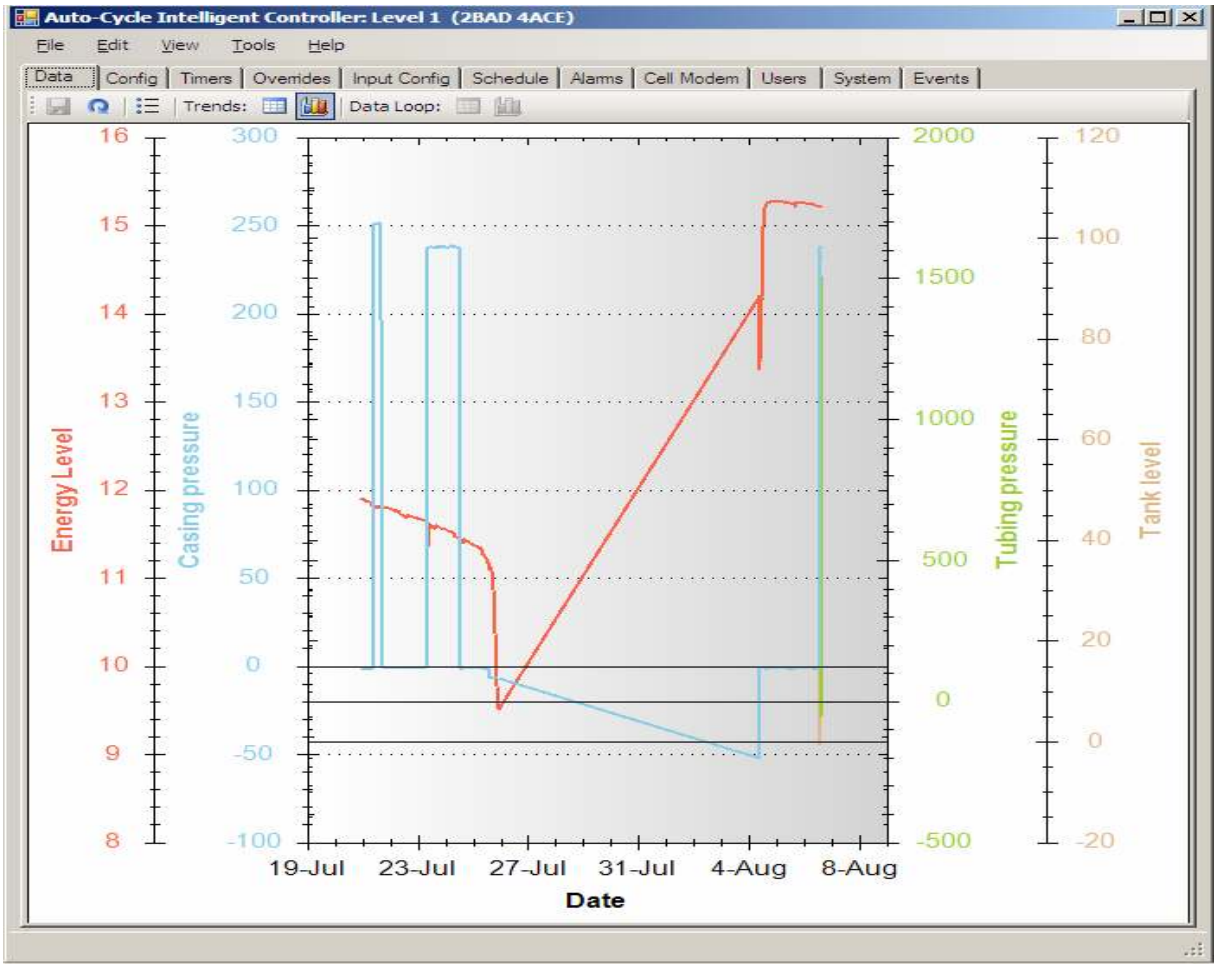


Figure 8. Graphical Trend Screen

To display graphical screen options, click the right mouse button on the graph. The options menu contains the following options.

- **Copy** – Copies the graphical image for pasting.
- **Save Image As…** - Opens a window to save the image in a desired format, jpeg for instance.
- **Page Setup** – Opens a window to adjust the page settings for printing.
- **Print** – Opens a window to print the graph.
- **Show Point Values** – Enables the viewer to show the values for individual points on the graph by passing the cursor over the point.
- **Un-Zoom -** Displays all data.
- **Undo All Zoom/Pan -**
- **Set Scale to Default -**
- **Individual Y Axes -**

Config

The **Config** screen provides setup configuration and status for various modes, cycle times and automatic adjustments. Remember to save any modifications that are made.

The following describes the items on the **Config** screen by section.

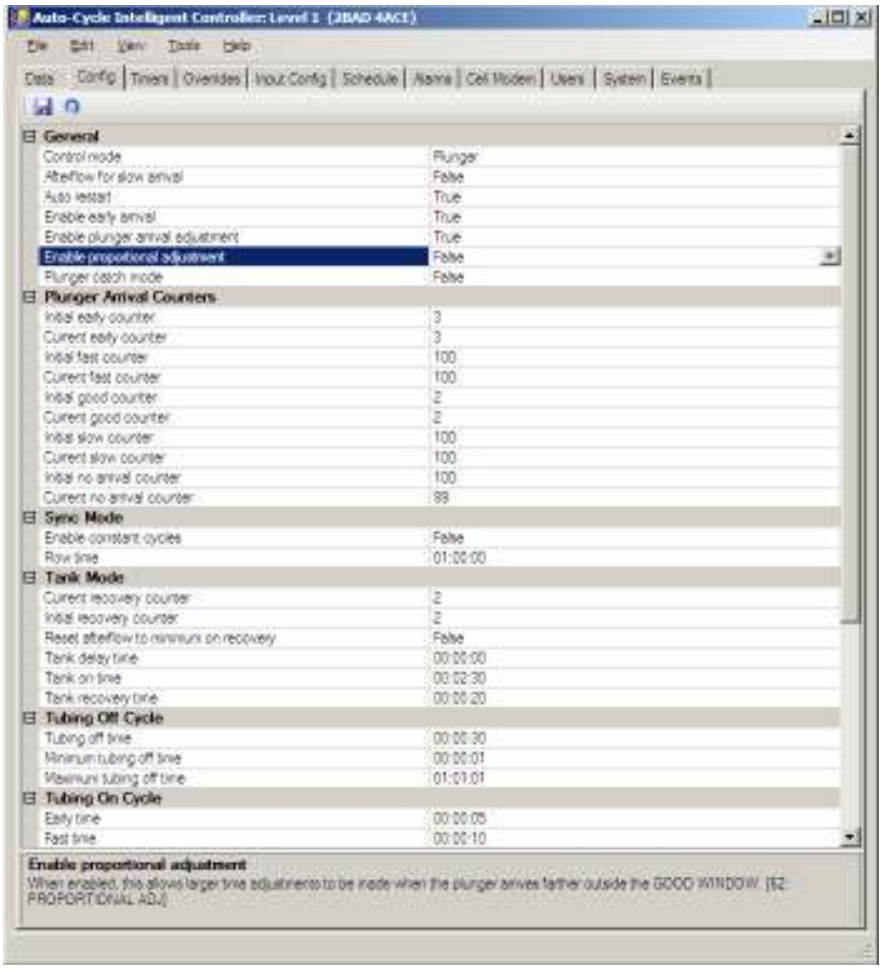


Figure 9. Config Screen

General – General configuration settings.

Table 7. Config General

Item	*Description*
Control Mode	Sets the operation mode of the controller: Manual, Plunger, Tank, Intermitter, Liquilift
Afterflow for slow arrival	When True, the AC*i*C will allow the well to afterflow even when the plunger arrives in the SLOW WINDOW. When False, on a slow plunger arrival the well will be shut in and will not afterflow.
Auto restart	Controls how the AC*i*C will respond when restarting after a power loss or reset. When False, the AC*i*C will resume in Manual mode with the well shut in. When True, the AC*i*C will resume the control mode it was in before it restarted.
Enable early arrival	When True, the early arrival window is enabled. When False, the early arrival window is ignored, and all arrivals before the fast time are considered to be within the fast arrival window.
Enable plunger arrival adjustment	When True, this allows adjustments to be made based on the plunger arrival time. When False, no adjustments will be made.
Enable proportional adjustment	When True, this allows larger time adjustments to be made when the plunger arrives farther outside the GOOD WINDOW. When False, fixed adjustments are made according to the settings in the Adjustments sections, explained in the Adjustments tables below.
Plunger catch mode	When enabled, the plunger will be caught and held the next time it arrives. This will stop any cycles that are being run.

Plunger Arrival Counters – Plunger arrival initial count setting and current counts.

Table 8. Plunger Arrival Counters

Item	*Description*
Initial early counter	Number of early arrivals that must occur before the well is shut-in and an error is raised.
Current early counter	Number of early arrivals remaining before the well is shut-in and an error is raised. This is decreased by one each time a plunger arrives in the EARLY WINDOW. Any arrival that is not in the EARLY WINDOW will reset this count to the initial early counter value.
Initial fast counter	Number of fast arrivals that must occur before allowing afterflow to commence.
Current fast counter	Number of fast arrivals remaining before allowing afterflow to commence. This is decreased by one each time a plunger arrives in the FAST WINDOW. Any SLOW or NO ARRIVALS will reset this count to the initial fast counter value.
Initial good counter	Number of good arrivals that must occur before allowing afterflow to commence.
Current good counter	Number of good arrivals remaining before allowing afterflow to commence. This is decreased by one each time a plunger arrives in the GOOD WINDOW. Any SLOW or NO ARRIVALS will reset this count to the initial good counter value.
Initial slow counter	Number of slow arrivals that must occur before the well is shut-in.
Current slow counter	Number of slow arrivals remaining before the well is shut-in. This is decreased by one each time a plunger arrives in the SLOW WINDOW. Any FAST or GOOD ARRIVALS will reset this count to the initial slow counter value.
Initial no arrival counter	Number of no arrivals that must occur before the well is shut-in.
Current no arrival counter	Number of no arrivals remaining before the well is shut-in. This is decreased by one each time a plunger does not arrive. Any FAST or GOOD ARRIVALS will reset this count to the initial no arrival counter value.

Sync Mode – Allows wells to have syncronized flow times for use on a common gather system.

Table 9. Sync Mode

Item	*Description*
Enable constant cycles	When True, allows the user to enter a flow time so that each on/off cycle takes a constant amount of time. This makes it possible to syncronize wells in the same gathering system.
Flow time	The total time that the sales valve can be on. This setting is only applicable if Enable constant cycles is True.

Tank Mode – General Tank mode settings.

Table 10. Tank Mode

Item	***Description***
Current recovery counter	The current number of no arrivals remaining before the recovery off time will be used in place of the off time.
Initial recovery counter	Initial counter setting for the Liquilift tank mode recovery counter. It sets how many consecutive no arrivals are allowed before the AC*i*C uses the tank recovery time instead of the off time.
Restart afterflow to minimum on recovery	When True, the afterflow time will be reset to the minimum afterflow time when the AC*i*C starts the recovery time.
Tank delay time	Time from the start of the tubing cycle before the AC*i*C has to open the tank valve to reduce the pressure and surface the plunger. This is bypassed if the plunger arrives before the Tank delay time has elapsed.
Tank on time	Time that the tank valve will be open, provided the plunger has not arrived.
Tank recovery time	Special off time used in Liquilift tank mode. When the recovery counter runs out due to consecutive no arrivals, this time will be substituted for the off time.

Tubing: Off Cycle – Tubing Off Cycle configuration.

Table 11. Tubing Off Cycle

Item	***Description***
Tubing off time	Amount of time that the well will stay off or shut in. The AC*i*C can adjust this value based on cycle performance.
Minimum tubing off time	Minimum value to which the tubing off time can be adjusted.
Maximum tubing off time	Maximum value to which the tubing off time can be adjusted.

Tubing: On Cycle – Tubing On Cycle configuration.

Table 12. Tubing On Cycle

Item	***Description***
Early time	Time from the start of the tubing cycle to the boundary between the early window and the fast window.
Fast time	Time from the start of the tubing cycle to the boundary between the fast arrival window and the good window.
Slow time	Time from the start of the tubing cycle to the boundary between the good window and the slow arrival window.
Tubing on time	Maximum amount of time the AC*i*C will wait for the plunger to arrive at the surface. When this time is reached, the plunger is considered a no arrival.

Tubing: Afterflow – Tubing Afterflow configuration.

Table 13. Afterflow

Item	***Description***
Afterflow time	The amount of time that the well will be allowed to flow after the plunger has surfaced. The controller can adjust this value based on cycle performance.
Minimum afterflow time	Minimum value to which the afterflow time can be adjusted.
Maximum afterflow time	Maximum value to which the afterflow time can be adjusted.

Tubing: Fast Arrival Adjustments – Tubing Fast Arrival Adjustment configuration.

Table 14. Fast Arrival Adjustments

Item	***Description***
Afterflow time increase	If the plunger arrives within the fast arrival window, the afterflow time will be increased by this value. Typical range is 1 to 5 minutes.
Tubing off time decrease	If the plunger arrives within the fast arrival window, the tubing off time will be decreased by this value. Typical range is 1 to 5 minutes.

Tubing: No Arrival Adjustments – Tubing No Arrival Adjustments configuration.

Table 15. No Arrival Adjustments

Item	***Description***
Off time increase	If the plunger does not arrive, the tubing off time will be increased by this value. Typical range is 30 to 60 minutes.

Tubing: Slow Arrival Adjustments – Tubing Slow Arrival Adjustments configuration.

Table 16. Slow Arrival Adjustments

Item	***Description***
Afterflow time decrease	If the plunger arrives within the slow arrival window, the afterflow time will be decreased by this value. Typical range is 1 to 5 minutes.
Tubing off time increase	If the plunger arrives within the slow arrival window, the tubing off time will be increased by this value. Typical range is 1 to 5 minutes.

Timers

The **Timers** screen is a graphical representation of the plunger cycle windows. It allows the user to view and modify the Control Mode and associated cycle windows, and start the On and Off cycles. Remember to save any changes made on this screen.

Changing modes - The mode may be changed by selecting the Control Mode drop down menu and selecting the desired mode.

Starting cycles – The On and Off cycle may be forced to start by clicking the appropriate **Start On Cycle** or **Start Off Cycle** button.

Changing window settings – The window sizes may be changed either by entering a new value in the time setting, or by using the cursor to drag the boundary between the windows. To change the boundary, place the cursor on the boundary, left click and then drag the boundary to the desired location. The time displayed in the associated box will change accordingly.

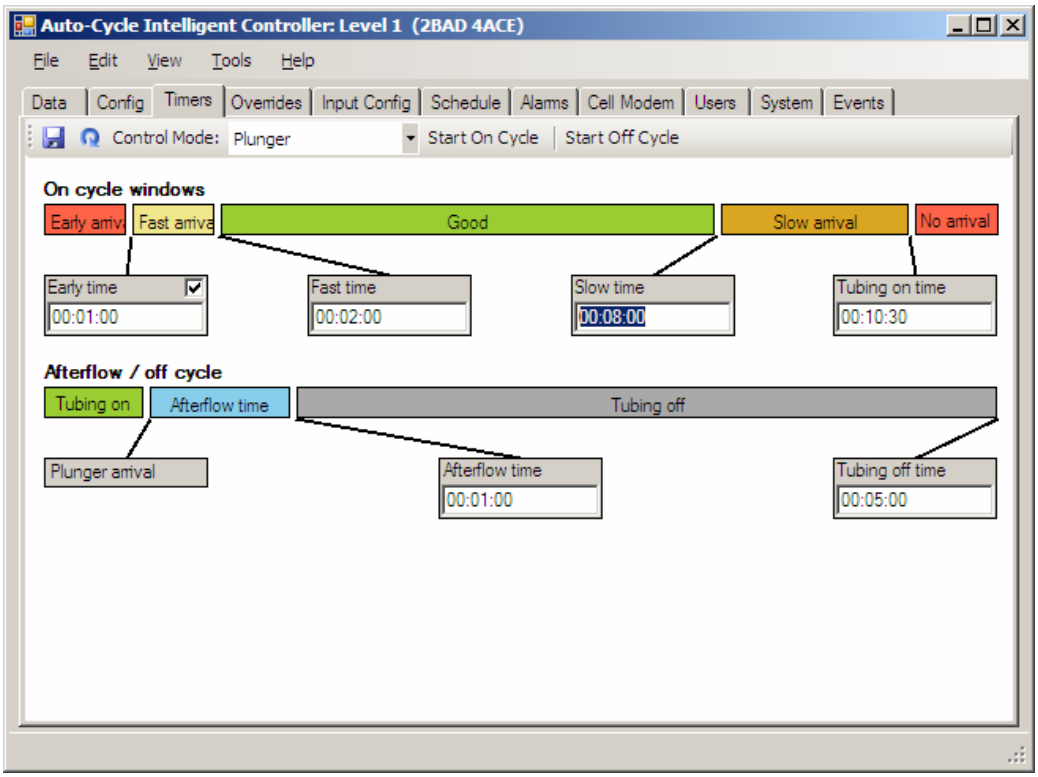


Figure 10 Timers Screen

Overrides

The **Overrides** screen displays the configuration and status of control overrides and automatic adjustments. Save any modifications.

The following describes the items on the **Overrides** screen by section.

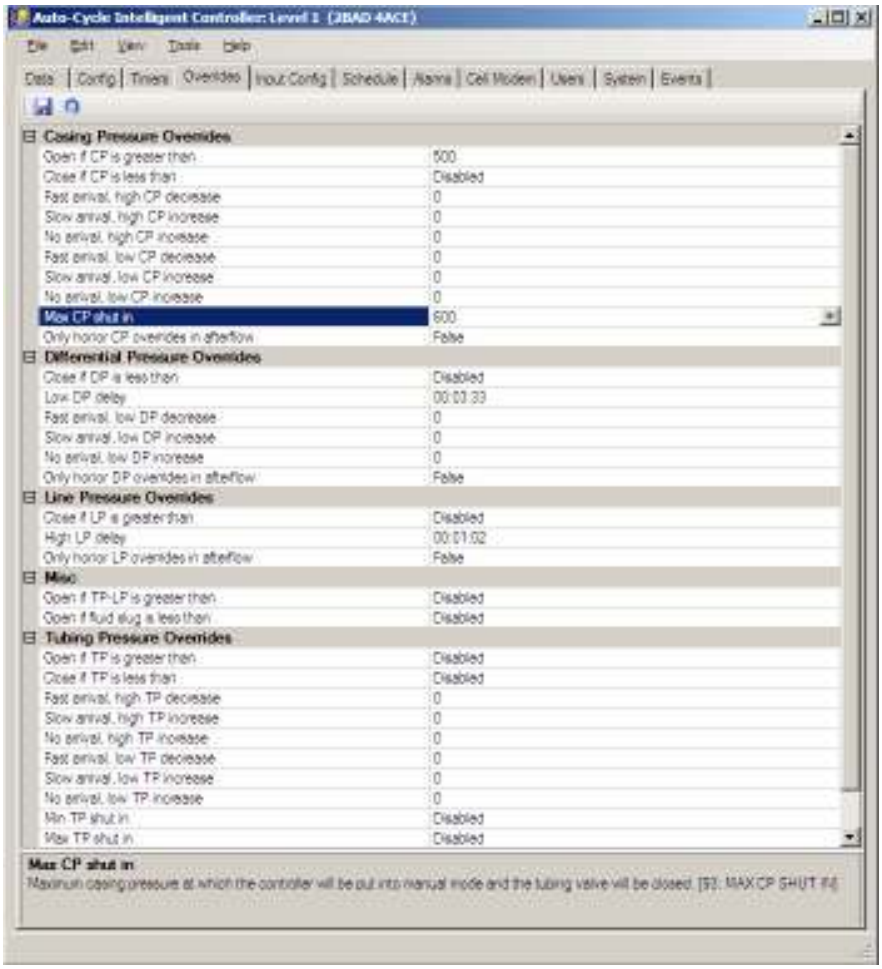


Figure 11. Overrides Screen

Casing Pressure Overrides – Casing Pressure Overrides configuration.

Table 17. CP Overrides

Item	*Description*
Open if CP is greater than	Opens the tubing valve if the Casing Pressure is greater than or equal to the PSIG setting. Will only override if Minimum Off Time has expired.
Close if CP is less than	Closes the tubing valve if the Casing Pressure is less than or equal to the PSIG setting.
Fast arrival, high CP decrease	Amount the "Open if CP is greater than" value will be decreased by for each fast cycle.
Slow arrival, high CP increase	Amount the "Open if CP is greater than" value will be increased by for each slow cycle.
No arrival, high CP increase	Amount the "Open if CP is greater than" value will be increased by for each no arrival.
Fast arrival, low CP decrease	Amount the "Close if CP is less than" value will be decreased by for each fast cycle.
Slow arrival, low CP increase	Amount the "Close if CP is less than" value will be increased by for each slow cycle.
No arrival, low CP increase	Amount the "Close if CP is less than" value will be increased by for each no arrival.
Max CP shut in	Maximum casing pressure at which the AC*i*C will be put into manual mode and the well will be shut in.
Only honor CP overrides in afterflow	When True, the AC*i*C will only honor casing pressure overrides for closing valves during the afterflow cycle.

Differential Pressure Overrides - Differential Pressure Overrides configuration.

Table 18. DP Overrides

Item	*Description*
Close if DP is less than	Closes the tubing valve if the Differential Pressure is less than or equal to the PSIG setting.
Low DP delay	Time the Differential pressure must remain below the set point before the tubing valve is closed.
Fast arrival, low DP decrease	Amount the "Close if DP is less than" value will be decreased by for each fast cycle.
Slow arrival, low DP increase	Amount the "Close if DP is less than" value will be increased by for each slow cycle.
No arrival, low DP increase	Amount the "Close if DP is less than" value will be increased by for each no arrival.
Only honor DP overrides in afterflow	When True, the AC*i*C will only honor differential pressure overrides for closing valves during the afterflow cycle.

Line Pressure Overrides – Line Pressure Overrides configuration.

Table 19. Line Pressure Overrides

Item	***Description***
Close if LP is less than	Close the tubing valve if the Line Pressure is less than or equal to the PSIG setting.
High LP delay	A delay feature for use with a line pressure switch gauge. This delay time allows the normal cycle to make and break contact with the switch during the early part of the on cycle and continue to operate. If the line pressure is high after the delay expires, the well will shut in. Once the line pressure drops, the off cycle will be started.
Only honor LP overrides in afterflow	Configures the AC*i*C to only honor the line pressure overrides for closing valves during the afterflow cycle.

Misc - Miscellaneous Overrides configuration.

Table 20. Miscellaneous Overrides

Item	***Description***
Open if TP-LP is greater than	Open the tubing valve if the (Tubing Pressure - Line Pressure) is equal to or greater than the PSIG setting. Will only override time if Minimum Off Time has expired.
Open if fluid slug is less than	Open the tubing valve if the fluid slug calculation is greater than or equal to the PSIG setting.

Tubing Pressure Overrides – Tubing Pressure Overrides configuration.

Table 21. TP Overrides

Item	***Description***
Open if TP is greater than	Opens the tubing valve if the Tubing Pressure is greater than or equal to the PSIG setting. Will only override time if Minimum Off Time has expired.
Close if TP is less than	Closes the tubing valve if the Tubing Pressure is less than or equal to the PSIG setting.
Fast arrival, high TP decrease	Amount the "Open if TP is greater than" value will be decreased by for each fast cycle.
Slow arrival, high TP increase	Amount the "Open if TP is greater than" value will be increased by for each slow cycle.
No arrival, high TP increase	Amount the "Open if TP is greater than" value will be increased by for each no arrival.
Fast arrival, low TP decrease	Amount the "Close if TP is less than" value will be decreased by for each fast cycle.
Slow arrival, low TP increase	Amount to increase the "Close if TP is less than" value will be increased by for each slow cycle.
No arrival, low TP increase	Amount to increase the "Close if TP is less than" value will be increased by for each no arrival.
Min TP shut in	Minimum tubing pressure at which the controller will be put into manual mode and the tubing valve will be closed.
Max TP shut in	Maximum tubing pressure at which the controller will be put into manual mode and the tubing valve will be closed.
Only honor TP overrides in afterflow	When True, the AC*i*C will only honor tubing pressure overrides for closing valves during the afterflow cycle.

Input Config

The **Input Config** screen allows configuration and calibration of analog and digital inputs. Save any modifications made on this screen.

The following describes the items on the **Input Config** screen by section.

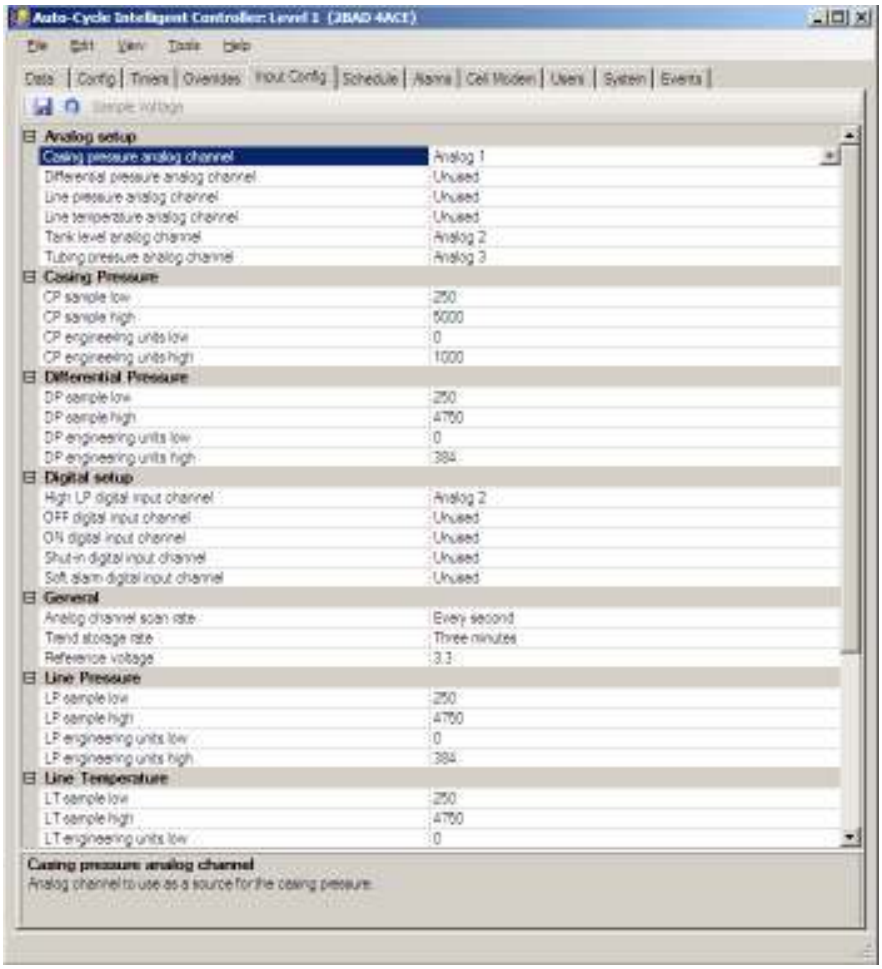


Figure 12. Input Config Screen

Analog setup – Analog input channel configuration assigns analog input channels to a selected process data type.

Table 22. Analog Setup

Item	*Description*
Casing pressure analog channel	Analog channel to use as a source for casing pressure.
Differential pressure analog channel	Analog channel to use as a source for differential pressure.
Line pressure analog channel	Analog channel to use as a source for line pressure.
Line temperature analog channel	Analog channel to use as a source for temperature.
Tank level analog channel	Analog channel to use as a source for tank level.
Tubing pressure analog channel	Analog channel to use as a source for tubing pressure.

Casing pressure - These settings are used to calibrate analog input channels assigned as casing pressure signals.

Table 23. Casing Pressure

Item	*Description*
CP sample low	Low sample point of the casing pressure calibration in millivolts.
CP sample high	High sample point of the casing pressure calibration in millivolts.
CP engineering units low	Low sample point of the casing pressure calibration in psig.
CP engineering units high	High sample point of the casing pressure calibration in psig.

Differential pressure – These settings are used to calibrate analog input channels assigned as differential pressure signals.

Table 24. Differential Pressure

Item	*Description*
DP sample low	Low sample point of the differential pressure calibration in millivolts.
DP sample high	High sample point of the differential pressure calibration in millivolts.
DP engineering units low	Low sample point of the differential pressure calibration in psig.
DP engineering units high	High sample point of the differential pressure calibration in psig.

Digital setup - Digital channels are used for signals that have only one of two states, high or low. The high or low states are recognized as high or low, or ON or OFF states that are used to trigger an alarm or action.

Table 25. Digital Setup

Item	***Description***
High LP digital input channel	Digital channel to use as a source for high line pressure.
OFF digital input channel	Digital channel to use as a source for OFF action.
On digital input channel	Digital channel to use as a source for ON action.
Shut-in digital input channel	Digital channel to use as a source for shut-in action.
Soft alarm digital input channel	Digital channel to use as a source for a soft alarm. This is used to send an SMS alarm to warn of an approaching alarm condition.

General – General analog input configuration.

Table 26. Input Configuration General

Item	***Description***
Analog channel scan rate	Rate at which the analog channels are scanned: Once per second, once per minute, or disabled.
Trend storage rate	Rate at which analog channel scans are averaged and stored to the trend log: Three minutes or disabled.
Reference voltage	Reference voltage for the analog signals. FACTORY SETTING - DO NOT CHANGE.

Line pressure - These settings are used to calibrate analog input channel signals to be assigned as line pressure signals.

Table 27. Line Pressure

Item	***Description***
LP sample low	Low sample point of the line pressure calibration in millivolts.
LP sample high	High sample point of the line pressure calibration in millivolts.
LP engineering units low	Low sample point of the line pressure calibration in psig.
LP engineering units high	High sample point of the line pressure calibration in psig.

Line temperature - These settings are used to calibrate analog input channel signals to be assigned as line temperature signals.

Table 28. Line Temperature

Item	*Description*
LT sample low	Low sample point of the line temperature calibration in millivolts.
LT sample high	High sample point of the line temperature calibration in millivolts.
LT engineering units low	Low sample point of the line temperature calibration in degrees Fahrenheit.
LT engineering units high	High sample point of the line temperature calibration in degrees Fahrenheit.

Tank level - These settings are used to calibrate analog input channel signals to be assigned as tank level signals.

Table 29. Tank Level

Item	*Description*
Tank level sample low	Low sample point of the tank level calibration in millivolts.
Tank level sample high	High sample point of the tank level calibration in millivolts.
Tank level engineering units low	Low sample point of the tank level calibration in inches.
Tank level engineering units high	High sample point of the tank level calibration in inches.

Tubing Pressure – These settings are used to calibrate analog input channel signals to be assigned as tubing pressure signals.

Table 30. Tubing Pressure

Item	*Description*
TP sample low	Low sample point of the tubing pressure calibration in millivolts.
TP sample high	High sample point of the tubing pressure calibration in millivolts.
TP engineering units low	Low sample point of the tubing pressure calibration in psig.
TP engineering units high	High sample point of the tubing pressure calibration in psig.

Schedule

The **Schedule** screen allows configuration of scheduled AC*i*C status messages sent to users designated on the **Users** screen. Schedule times can be added, defined and deleted. The screen is divided into two sections. The upper screen lists the existing schedules and provides the means to add or remove a scheduled item. The lower screen, **Schedule Details,** provides the specific configuration items for a new scheduled item. Save any modifications made on this screen.

The following describes the configuration items on the **Schedule** screen.

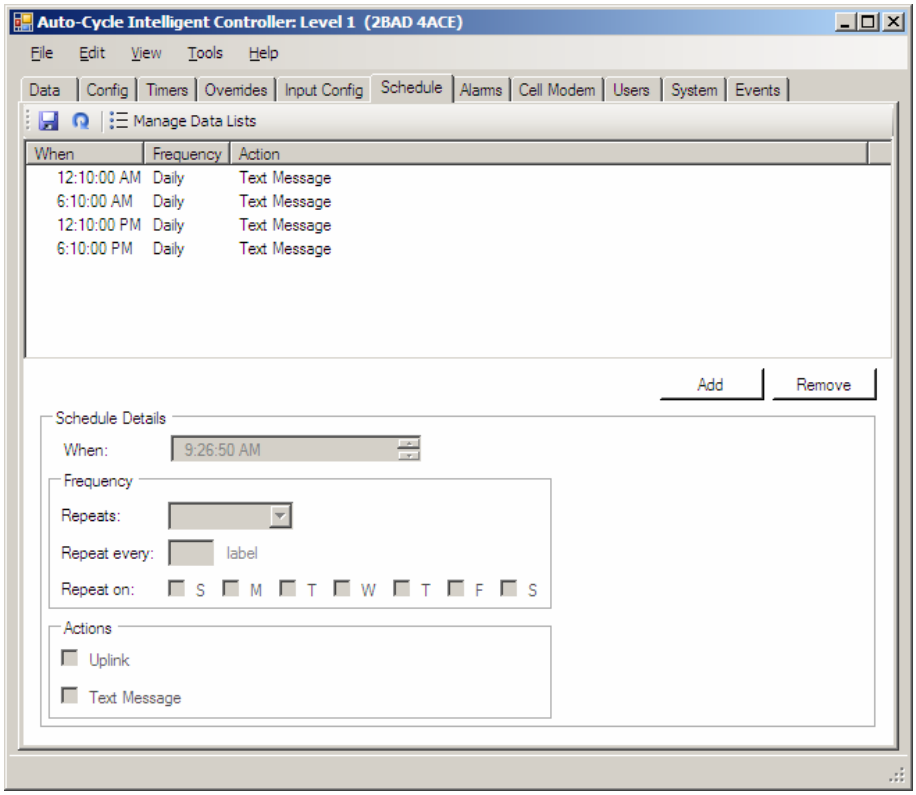


Figure 13 Schedule Screen

Upper screen - The upper screen shows an entry for each scheduled item. Each scheduled item has the following characteristics:

Table 31. Schedule Upper Screen

Item	***Description***
When	The time of day when the scheduled item will be sent.
Frequency	The frequency the scheduled item will be sent. For example: hourly, daily, weekly.
Action	The type of data item that will be sent. For example: Uplink or text message.
Add	Adds a new item to the schedule list when clicked.
Remove	Removes the highlighted schedule item when clicked.

Schedule Details - The schedule details screen provides the following configuration items for each scheduled item. The scheduled item is configured by first highlighting the item and then selecting the desired configuration items. The following describes the configuration items.

Table 32. Schedule Details

Item	***Description***
When	The time of day when the scheduled item will be sent.
Frequency – Repeats	The frequency the scheduled item will be sent. For example: hourly, daily, weekly.
Frequency – Repeat every	*Currently unsupported.*
Frequency – Repeat on	Day of the week on which to uplink when **weekly** is selected. Multiple days can be selected.
Actions – Uplink	Configures the AC*i*C to uplink the scheduled item via TCP/IP (internet). *Currently unsupported*.
Actions – Text message	Configures the AC*i*C to uplink the scheduled item as a text message via cell phone SMS. *Currently the scheduled item will only a uplink a status message containing the current tubing cycles and plunger counts, average run times, battery voltage and solar charge current.*

Alarms

The **Alarms** screen provides configuration for setting alarm conditions that will result in an alarm being sent to designated users. Save any modifications made on this screen.

The following describes the items on the **Alarms** screen by section.

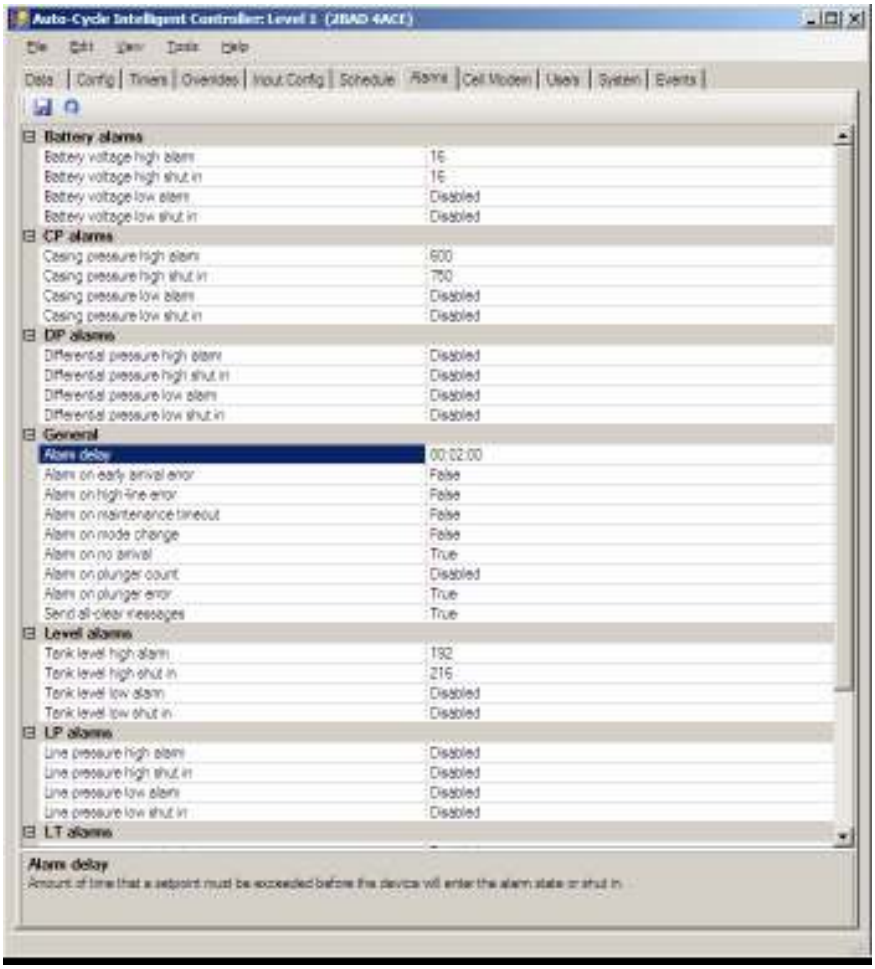


Figure 14 Alarms Screen

Battery alarms – These are alarm settings for the AC*i*C battery voltage. High and low battery charge levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 33. Battery Alarms

Item	***Description***
Battery voltage high alarm	High setpoint for the battery voltage at which the AC*i*C will enter the alarm state.
Battery voltage high shut in	High setpoint for the battery voltage at which the AC*i*C will shut in and enter the alarm state.
Battery voltage low alarm	Low setpoint for the battery voltage at which the AC*i*C will enter the alarm state.
Battery voltage low shut in	Low setpoint for the battery voltage at which the AC*i*C will shut in and enter the alarm state.

CP alarms – These are alarm settings for the casing pressure. High and low levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 34. CP Alarms

Item	***Description***
Casing pressure high alarm	High setpoint for the casing pressure at which the AC*i*C will enter the alarm state.
Casing pressure high shut in	High setpoint for the casing pressure at which the AC*i*C will shut in and enter the alarm state.
Casing pressure low alarm	Low setpoint for the casing pressure at which the AC*i*C will enter the alarm state.
Casing pressure low shut in	Low setpoint for the casing pressure at which the AC*i*C will shut in and enter the alarm state.

DP alarms – These are alarm settings for the differential pressure. High and low levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 35. DP Alarms

Item	*Description*
Differential pressure high alarm	High setpoint for the differential pressure at which the AC*i*C will enter the alarm state.
Differential pressure high shut in	High setpoint for the differential pressure at which the AC*i*C will shut in and enter the alarm state.
Differential pressure low alarm	Low setpoint for the differential pressure at which the AC*i*C will enter the alarm state.
Differential pressure low shut in	Low setpoint for the differential pressure at which the AC*i*C will shut in and enter the alarm state.

General – These are general alarm settings typically not directly associated with a process parameter.

Table 36. Alarms General

Item	*Description*
Alarm delay	Amount of time that a setpoint must be exceeded before the AC*i*C will enter the alarm state or shut in.
Alarm on early arrival error	Indicates whether the AC*i*C will enter an alarm state when an early arrival error occurs. True or false.
Alarm on high-line error	Indicates whether the AC*i*C will enter an alarm state when a high-line error occurs. True or false.
Alarm on maintenance timeout	Indicates whether the AC*i*C will enter an alarm state when a maintenance timeout occurs. True or false.
Alarm on mode change	Indicates whether the AC*i*C will enter an alarm state when a control mode change occurs. True or false.
Alarm on no arrival	Indicates whether the AC*i*C will enter an alarm state when the plunger does not arrive. True or false.
Alarm on plunger count	High setpoint for the plunger count at which the AC*i*C will enter the alarm state.
Alarm on plunger error	Indicates whether the AC*i*C will enter an alarm state when a plunger error occurs. True or false.
Send all-clear messages	When enabled, the AC*i*C will send all-clear messages when the AC*i*C leaves an alarm state and resumes normal operation. True or false.

Level alarms – These are alarm settings for the tank levels. High and low levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 37. Level Alarms

Item	*Description*
Tank level high alarm	High setpoint for the tank level at which the AC*i*C will enter the alarm state.
Tank level high shut in	High setpoint for the tank level at which the AC*i*C will shut in and enter the alarm state.
Tank level low alarm	Low setpoint for the tank level at which the AC*i*C will enter the alarm state.
Tank level low shut in	Low setpoint for the tank level at which the AC*i*C will shut in and enter the alarm state.

LP alarms - These are alarm settings for the line pressure. High and low levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 38. LP Alarms

Item	*Description*
Line pressure high alarm	High setpoint for the line pressure at which the AC*i*C will enter the alarm state.
Line pressure high shut in	High setpoint for the line pressure at which the AC*i*C will shut in and enter the alarm state.
Line pressure low alarm	Low setpoint for the line pressure at which the AC*i*C will enter the alarm state.
Line pressure low shut in	Low setpoint for the line pressure at which the AC*i*C will shut in and enter the alarm state.

LT alarms - These are alarm settings for the line temperature. High and low levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 39. LT Alarms

Item	*Description*
Line temperature high alarm	High setpoint for the line temperature at which the AC*i*C will enter the alarm state.
Line temperature high shut in	High setpoint for the line temperature at which the AC*i*C will shut in and enter the alarm state.
Line temperature low alarm	Low setpoint for the line temperature at which the AC*i*C will enter the alarm state.
Line temperature low shut in	Low setpoint for the line temperature at which the AC*i*C will shut in and enter the alarm state.

TP alarms - These are alarm settings for the tubing pressure. High and low levels can be set to trigger a soft alarm (AC*i*C alarms only) or shut in (AC*i*C alarms and shuts in enabled valves).

Table 40. TP Alarms

Item	***Description***
Tubing pressure high alarm	High setpoint for the tubing pressure at which the AC*i*C will enter the alarm state.
Tubing pressure high shut in	High setpoint for the tubing pressure at which the AC*i*C will shut in and enter the alarm state.
Tubing pressure low alarm	Low setpoint for the tubing pressure at which the AC*i*C will enter the alarm state.
Tubing pressure low shut in	Low setpoint for the tubing pressure at which the AC*i*C will shut in and enter the alarm state.

Cell Modem

The **Cell Modem** screen provides configuration for the AC*i*C internal cell modem. Save any modifications made on this screen.

The following describes the items on the **Cell Modem** screen by section.

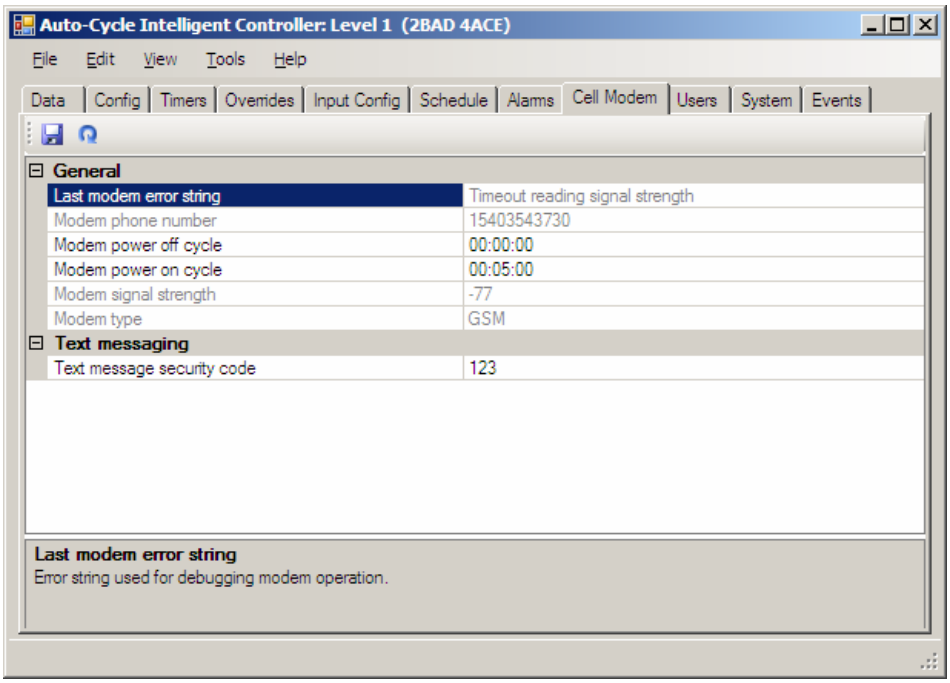


Figure 15. Cell Modem Screen

General – These are general cell modem configuration items.

Table 41. Cell Modem General

Item	*Description*
Last modem error string	Error string used for debugging modem operation. Represents the last error encountered, thus may show an error even if the condition no longer exists.
Modem phone number	The phone number of the AC*i*C modem. This is number dialed to send a text message to the AC*i*C.
Modem power off cycle	Amount of time that the cell modem will be powered off in its on/off cycle. Set to zero to have the modem always on. Used to create a cell modem on/off cycle to minimize power consumption at the AC*i*C. The cell modem is inaccessible during the off cycle.
Modem power on cycle	Amount of time that the cell modem will be powered on in its on/off cycle. Used to create a cell modem on/off cycle to minimize power consumption at the AC*i*C.
Modem signal strength	Signal strength that the modem is getting from the cell network.
Modem type	Type of the cell mode. (CDMA or GSM)

Text messaging – These are text messaging specific parameters.

Table 42. Cell Modem Text Messaging

Item	***Description***
Text message security code	Global password to allow access to the text message system of the AC*i*C. Users that are not specifically approved through the users list on the **Users** screen must enter this code in the message to use access the AC*i*C with text messaging.

Users

The **Users** screen provides the management of users who have the ability to received data and manage the AC*i*C via remote access (for example, cell phones using SMS). The user settings can be configured to allow the user to receive data and alarms, view data, and modify the AC*i*C configuration. The screen is divided into two sections. The upper screen lists the existing users and their authorizations, and provides the means to add or remove a user. The lower screen, **User Details**, provides the specific configuration items for a new user. Save any modifications made on this screen.

The following describes the configuration items on the **Users** screen.

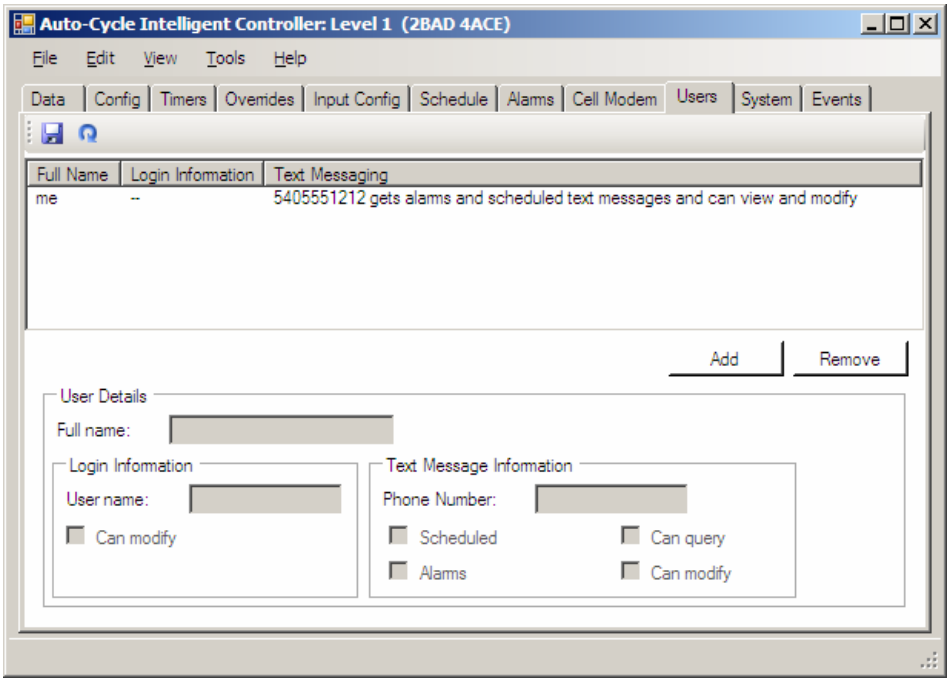


Figure 16. Users Screen

Upper screen - The upper screen shows an entry for each user. Each user has the following characteristics:

Table 43. User Upper Screen

Item	***Description***
Full Name	User's name.
Login Information	*Not supported*
Text Messaging	Users phone number and authorizations.
Add	Adds a new user when clicked.
Remove	Removes the highlighted user when clicked.

User Details - The **User** details screen provides the following configuration items for each user. The user is configured by first highlighting the user and then selecting the desired configuration items. The following describes the configuration items.

Table 44. User Details

Item	***Description***
Full name	Name to identify user.
Login information – User name	Name used for remote login. *Not supported.*
Login information – Can modify	Allows remote user to modify AC*i*C settings. *Not supported.*
Text Message Information – Phone number	Users cell phone number which will receive alarms and scheduled data.
Text Message Information – Scheduled	Enables this user to receive scheduled text data at the above cell phone number.
Text Message Information – Alarms	Enables this user to receive text alarms at the above cell phone number.
Text Message Information – Can query	Authorizes this user to request and view AC*i*C data with text messages.
Text Message Information – Can modify	Authorizes this user to modify AC*i*C parameters and settings with text messages.

System

The **System** screen provides management and status of items specific to the AC*i*C. The following describes the items on the **System** screen by section. Some items are user settable (shown in normal black on the screen), and others are status that can only be viewed (shown in gray on the screen). Save any modifications made on this screen.

Figure 17. System Screen

General – General AC*i*C system configuration items.

Table 45 System General

Item	***Description***
Device ESN	Electronic serial number is used to identify the AC*i*C.
Device Name	User-defineable name for the AC*i*C.
Device Type	Numeric type of the AC*i*C.
Hardware Version	Hardware version of the AC*i*C 's main board.
Firmware Version	Firmware version of the AC*i*C 's main board.
Energy Level	Energy level, in volts, of the AC*i*C's battery.
Charge Current	Current, in milliamps, that the solar panel is putting out to charge the battery.
Device Clock	Current real time clock value.
Battery	This must be set to match the type of battery that the AC*i*C is using. The AC*i*C may be supplied with either a 6V or 12V battery. For the AC*i*C to correctly monitor the battery voltage (energy level), this setting must agree with installed battery.
KDT password	A four digit password used to access the AC*i*C using the KDT. If a password is set, the user must enter that password to change any item with the KDT. The default is "0000" which allows KDT use without a password.

Misc – Miscellaneous AC*i*C configuration items.

Table 46. System Miscellaneous

Item	***Description***
Serial port usage	Selects which type of device connected to the internal serial port of the AC*i*C. Options are **Disabled**, **Modem** and **Modbus**, which must match the desired connection, **Modem** for cell phone modem, or **Modbus** for Modbus. Only one option can be chosen, i.e. a Modbus enabled AC*i*C cannot utilize the cell phone.
Tank valve low battery action	Specifies action to take with the tank valve when a low battery condition is detected. Options are **No Action**, **Close** and **Open**. The low battery condition occurs at 4.8V for a 6V battery and 9.6V for a 12V battery.
Tubing valve low battery action	Specifies action to take with the tubing valve when a low battery condition is detected. Options are **No Action**, **Close** and **Open.** The low battery condition occurs at 4.8V for a 6V battery and 9.6V for a 12V battery.

Self-Test – Self-test status and results from the automated self-test run after power-up or reset.

Table 47. System Self-Test

Item	*Description*
FLASH self-test	Self-test results on the FLASH memory. Status can be: **FLASH OK**, **FLASH not recognized**, **FLASH has too many bad blocks**, **FLASH not initialized** and **FLASH not supported**.
Modem self-test	Self-test results for the cell modem. Status can be: M**odem OK**, **Modem did not respond**, **Unsupported modem type**, **Poor signal quality**, **Could not configure**, **No network**, **No GPRS**, **Modem not supported** and **Not checked**.
NRM status	Self-test results for the radio module (NRM). Status can be: **NRM OK**, **NRM not detected**, **NRM not initialized**, **NRM initialization error** and **NRM not supported**.
Reset source	Source of the last system reset. Status can be: **Power up reset**, **Watchdog reset**, **Software reset**, **User/NRST reset** and **Brownout reset**.
RTC self-test	Self-test results for the real-time clock (RTC). Status can be: **RTC OK**, **RTC XSTP fault** (a hardware failure), **RTC Reset invalid time**.
SD card self-test	Self-test results for the SD card (removable memory card). Status can be: **Not checked**, **SD card OK**, **Low-level failure (SD send op cond failed)**, **Low-level failure (MMC send op cond failed)**, **Read OCR failed**, **Set block length failed**, **MMC not supported** and **SD Card not supported**.
SRAM self-test	Self-test results on the SRAM (internal memory). Status can be: **SRAM OK** and **SRAM failed**.

Events

The Events screen provides a log of AC*i*C events. The events are initially displayed with the latest event first. The events may be sorted as desired, by clicking the header (time, source, type, reason or description). The event log may contain up to 962 events. Scroll down the list using the slider on the right side of the screen. The oldest events will be lost once the log is full and new events occur. The log may be cleared using **Clear Events** on the toolbar above the events listing. Each event has information, if applicable, for the following items.

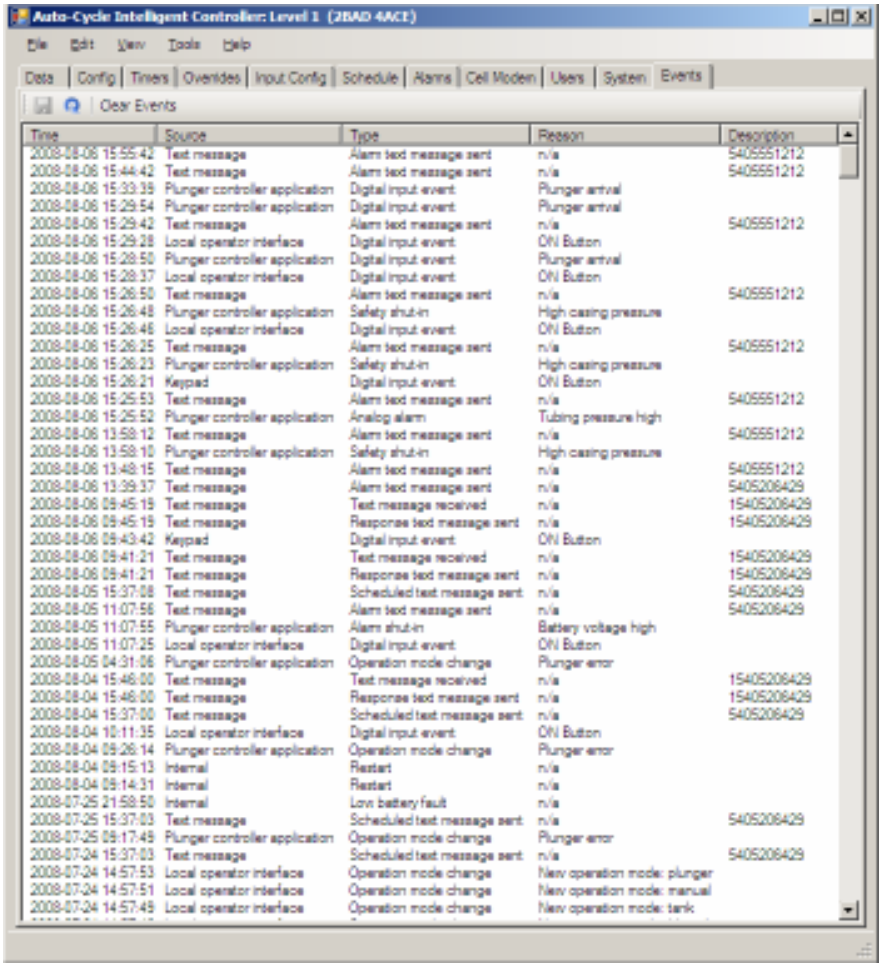


Figure 18, Events Screen

Table 48. Events

Item	***Description***
Time	Time stamp of the event
Source	The source that triggered the event. Sources include: Internal, Keypad, Local operator interface (iNodeConfig via USB), Modbus master, Plunger controller, Plunger controller application and Text message.
Type	Each event gives a type description that includes: Alarm shut-in, Alarm text message sent, Analog alarm, Digital alarm, Digital input event, Error (SMS to email) sent, Error text message sent, Firmware upgrade, Low battery fault, Modem reset, Operation mode change, Response text message sent, Restart, RTU configured, Safety shut-in, Scheduled text message sent, Software reset, Text message log-in, Text message received, Time change and Valve change.
Reason	Each event gives a reason description that includes: Analog shut-in, Battery voltage high, Battery voltage low, Casing pressure high, Casing pressure low, Code from host, Code from SDCard, Configuration initialized, Differential pressure high, Differential pressure low, Digital override shut-in, Early arrival error, High casing pressure, High injection pressure, High line error, High tubing pressure, Injection pressure high, Injection pressure low, Invalid security code, Keypad reset, Line pressure high, Line pressure low, Line temperature high, Line temperature low, Logged in via email, LOI reset, Low tubing pressure, Missing security code, n/a, New operation mode: LL tank, New operation mode: manual, New operation mode: other, New operation mode: plunger, New operation mode: tank, New operation mode: timer, No error, OFF Button, ON Button, Plunger arrival, Plunger error, SMS security not enabled, Successful SMS log in, Tank level high, Tank level low, Tubing pressure high, Tubing pressure low, Valve closed and Valve opened.
Description	The description adds additional information for the event if applicable.

Appendix A

Installing and starting *i*NodeConfig *i*C

The following is a description of the installation of *i*NodeConfig *i*C. The installation varies depending if the PC has a previous version of *i*NodeConfig *i*C installed. If there is a previous version installed it must first be removed. If there was no previous version, the USB hardware driver must be installed.

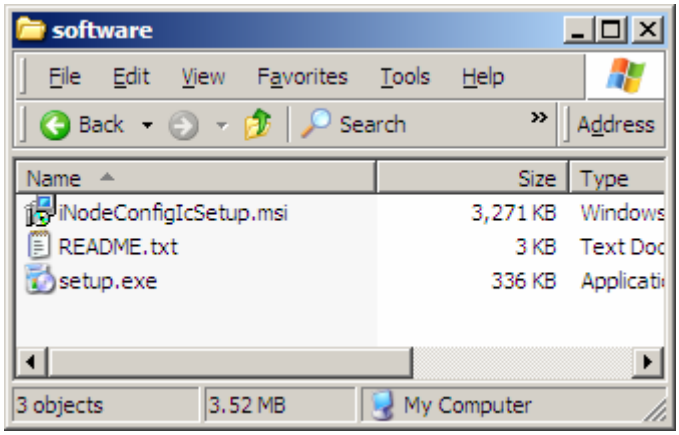
Removing a previous version of *i*NodeConfig *i*C

If there is a previous version of *i*NodeConfig *i*C on the PC, perform the following before proceeding, else proceed to "Install *i*NodeConfig *i*C":

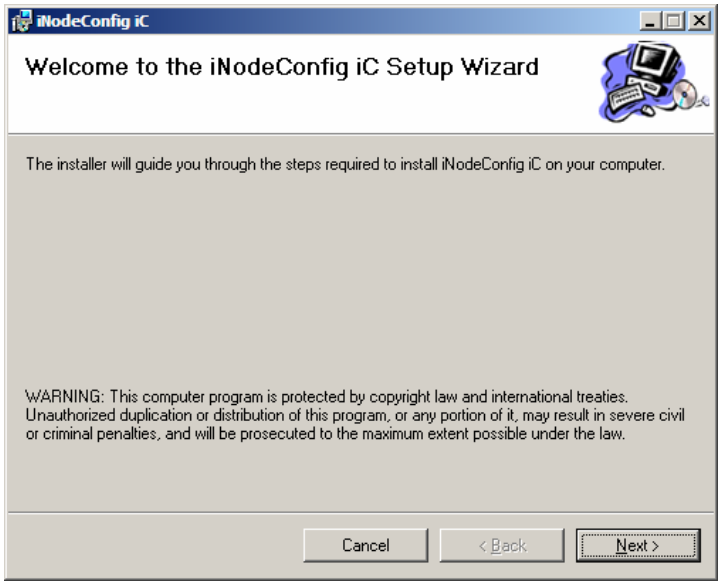
1. Open **Add or Remove Programs** by clicking **Start**, **Settings**, **Control Panel**, **Add or Remove Programs**. Wait for the screen to populate with the installed software.
2. Scroll down to and click *i*NodeConfig *i*C.
3. Click the **Remove** button and then **Yes** to the question to remove or not. *i*NodeConfig *i*C will be removed.

Install *i*NodeConfig *i*C

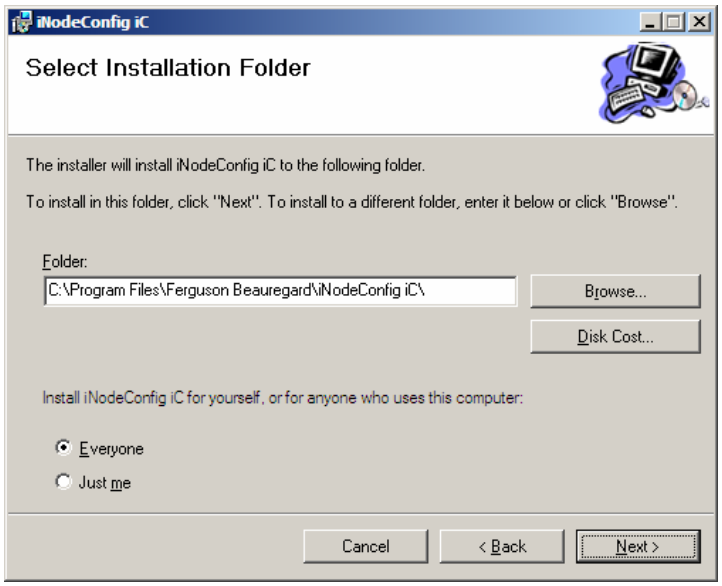
1. Create a folder and load the new *i*NodeConfig *i*C software or insert the disk containing the software into your PC. The software files will typically be the following:



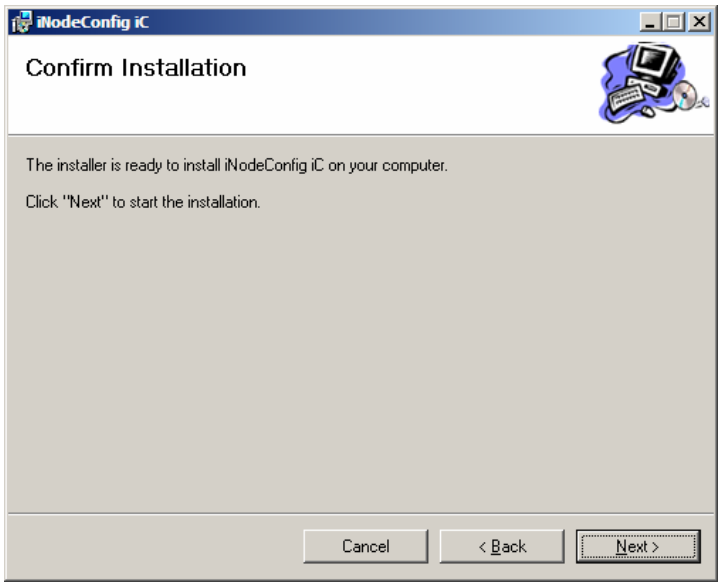
2. Open the folder or disk and run "Setup.exe"
3. On the "Welcome to the *i*NodeConfig *i*C Setup Wizard" screen click **Next**.



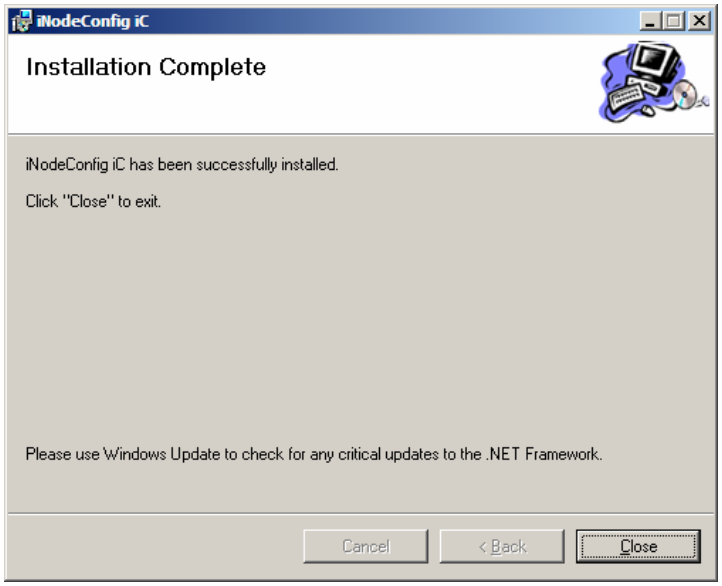
4. On the "Select Installation Folder" screen click **Next**.



5. On the "Confirm Installation" screen click **Next**.



6. An installation screen for iNodeConfig will follow. When complete the "Installation Complete" screen will be shown. Click **Close** and the installation of *i*NodeConfig *i*C will be complete. A new "*i*NodeConfig *i*C" icon will appear on your PC's desktop. NOTE: If the USB hardware driver has not been installed and this is a new installation, proceed to "Installing the USB hardware driver" before starting *i*NodeConfig *i*C.



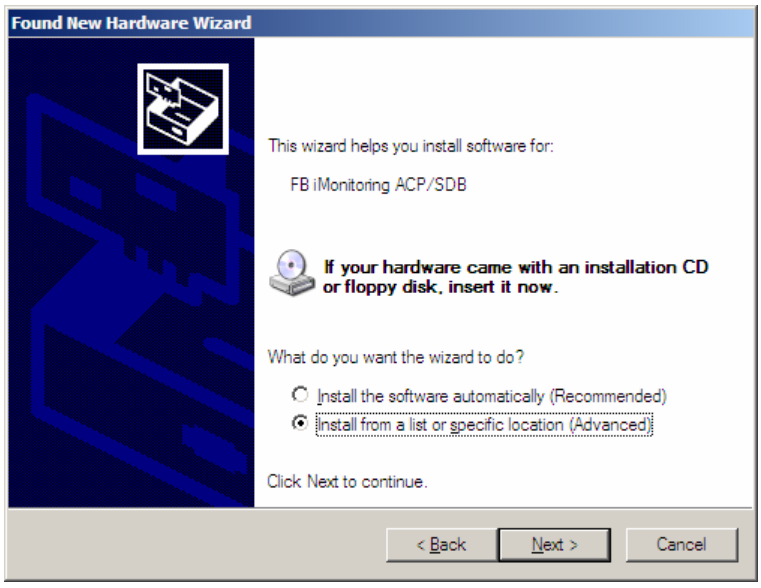
Installing the USB hardware driver

If this is a new installation of *i*NodeConfig *i*C on the PC, the installation is not complete. Continue on to the following steps. If *i*NodeConfig *i*C had been previously installed and

then removed for this update, the installation is complete and you can run *i*NodeConfig *i*C.

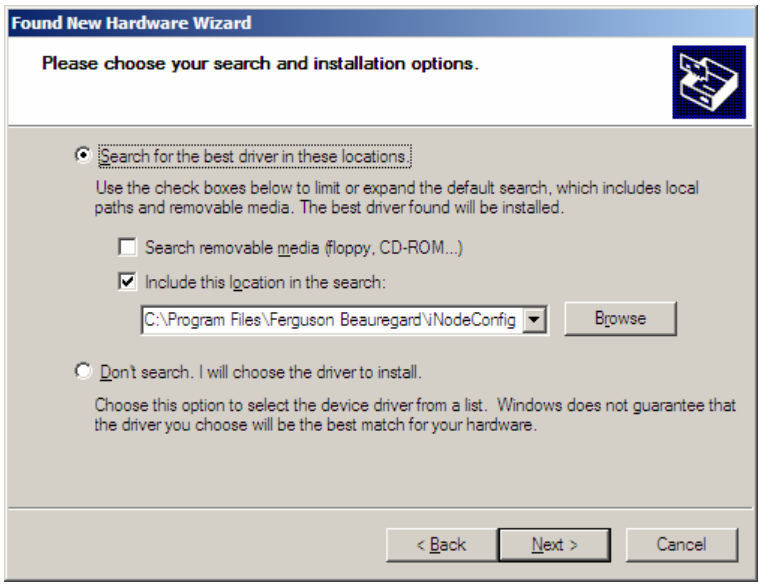
1. Connect the AC*i*C USB port to the PC USB connector with a USB cable.
2. In the lower right of the PC screen a series of "found new hardware" icons will display and disappear.
3. The "Found New Hardware Wizard" screen will be displayed. Click on the "No, not this time" selection and click **Next**.

4. On the next screen click "Install from a list or specific location (Advanced)" and then click **Next**.

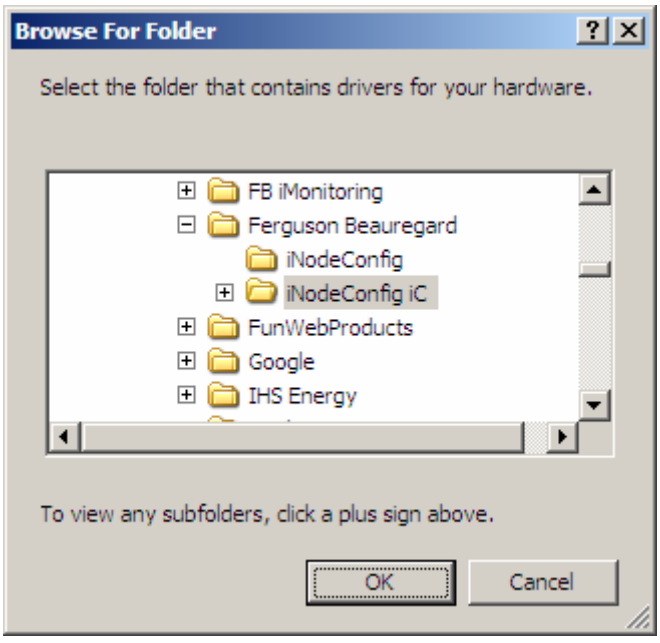


5. On the next screen choose "Include this location in the search:" and choose one of the following options to define the location that contains the driver:

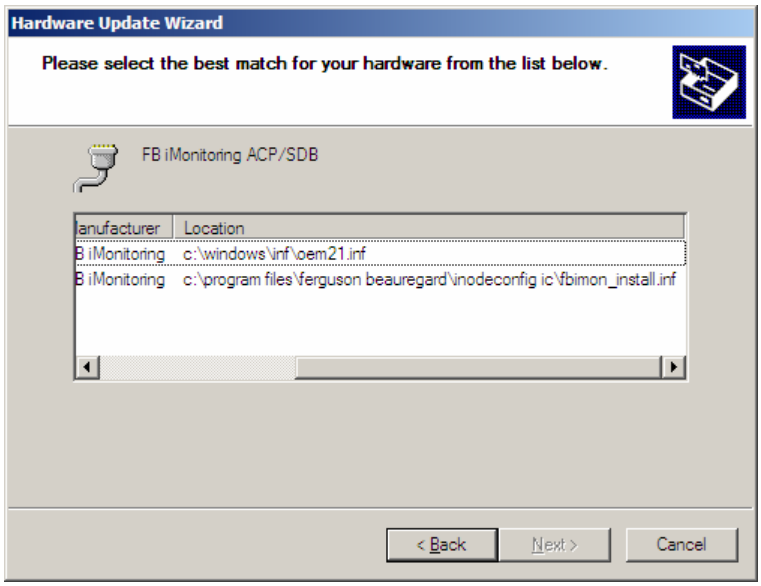
a. Enter "C:\Program Files\Ferguson Beauregard\ iNodeConfig iC" into the box to the left of the **Browse** button and click **Next**, or



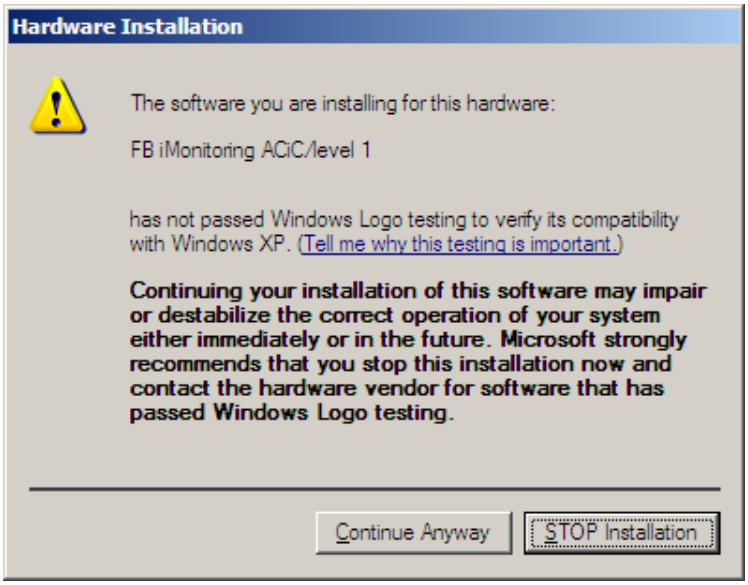
b. Click the **Browse** button. Using the "Browse for folders" screen find the directory my computer, local disk, program files, Ferguson Beauregard, *i*NodeConfig *i*C. Click on the "iNodeConfig iC" so that the folder icon is pictured as open. Click **OK**. Click **Next** on the resulting screen as above.



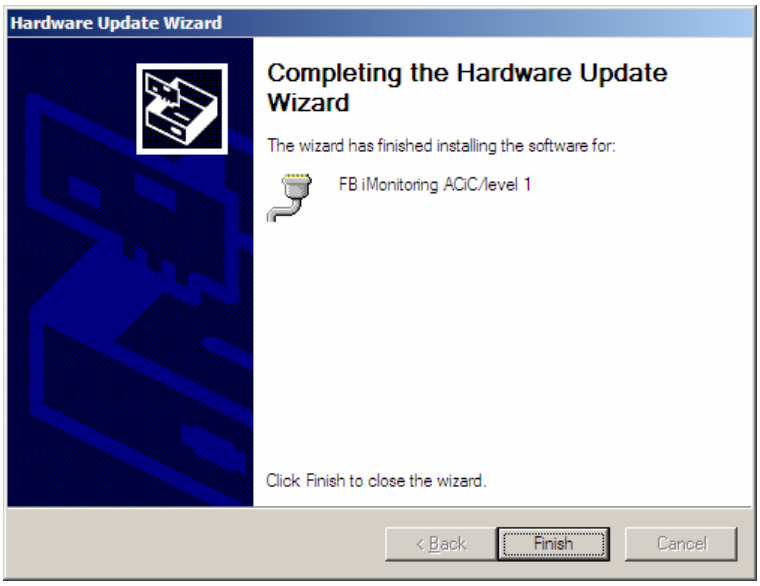
6. If the PC has had a previous installation of iNodeConfig and the USB driver has been changed you may get a screen similar to the following. Choose "C:\Program Files\Ferguson Beauregard\iNodeConfig iC\fbimon_install.inf" and click **Next**.



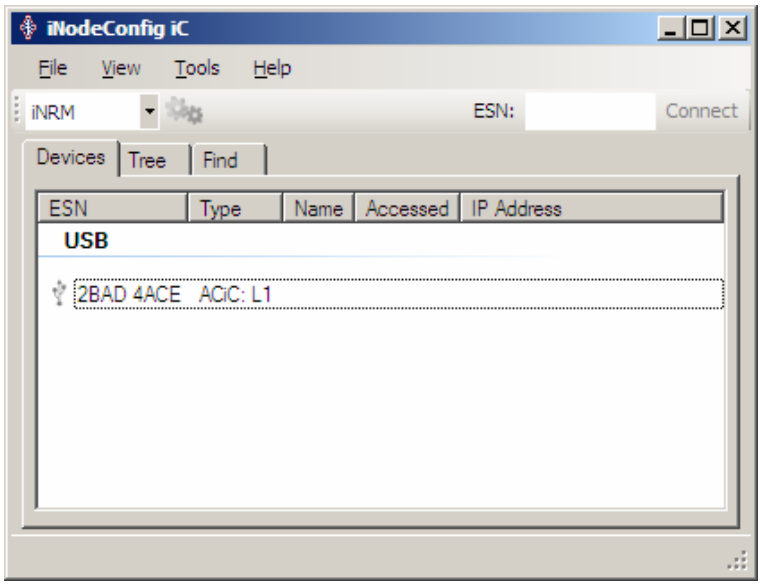
7. A warning screen will appear concerning "compatibility testing", click **Continue Anyway** and the installation process will continue.



8. After the file installation process is complete, click **Finish** on the resulting screen.



9. Open *i*NodeConfig *i*C by clicking the icon. *i*NodeConfig *i*C will open with the following screen.



10. Double click on the AC*i*C entry displayed on the screen. *i*NodeConfig *i*C will connect and the AC*i*C opening screen will be displayed as shown below.

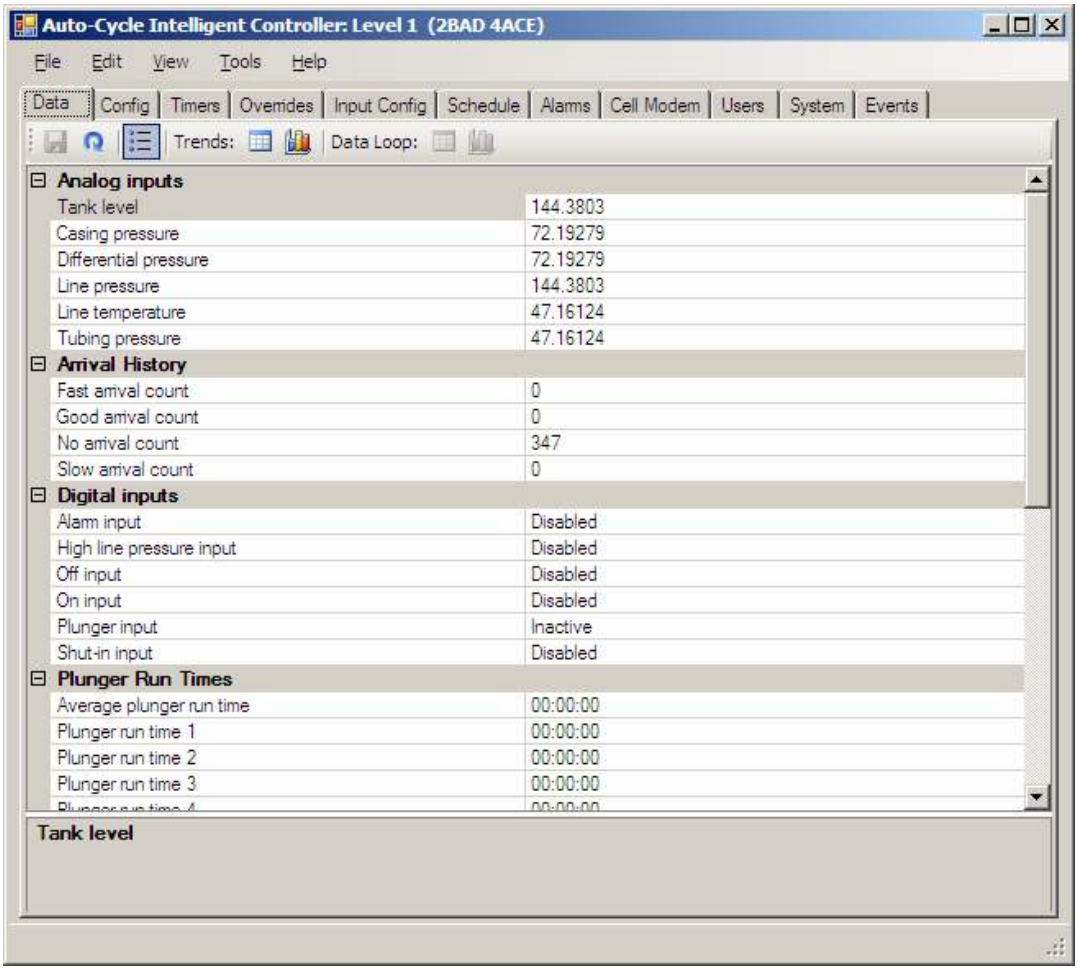


Figure 19. *i*NodeConfig *i*C Opening Screen