User Manual

SCADA Platform

Griffin I'Net, Inc.

NOTICE!

These units are to be installed by trained personnel only.

Read all instructions before using the product.

System input power should be 24 volts DC and absolutely must be between 15 and 30 volts DC. DO NOT USE 120V/220V AC! Any such attempt will immediately destroy the unit.

PROPER GROUNDING MUST BE PRESENT! While the unit may operate without being grounded, it is a serious safety risk to leave the unit ungrounded.

Do not open the panel or otherwise service the unit when it is raining. The internals are not waterproof and can easily be damaged by water ingress.

Do not mount the unit in such a way that the display window is exposed to direct sunlight! The plastic window is UV resistant, but it will darken over time with excessive direct sunlight and cause the display to become unreadable.

DO NOT CUT AWAY THE PLASTIC WINDOW IN FRONT OF THE DISPLAY. If the window darkens too much during sun exposure (which should take many years), the unit should be sent back to the manufacturer for refurbishment.

The RJ45 (Ethernet) panel connector is not waterproof without the cap in place. If an installation requires a permanent connection, a special matching cable connector is required. A standard Ethernet cable will not be waterproof in this application.

Pay careful attention to any note that uses this exclamation point:

Table of Contents

Applications Overview

The SCADA platform unit is designed to use in the oilfield as a production data monitoring platform. When used in conjunction with supported downhole sensors, the system provides reservoir data from up to four wells to upstream systems.

There are three common deployment scenarios:

1) Oilfield network using MODBUS over radio links
    - Live data is pulled over MODBUS using a serial port (RS485/RS422 or RS232)
    - Serial radio links transmit the data to the central office
    - Usually only configured for live pressure and temperature data, sometimes one or two additional data registers (see MODBUS register map)

1) Oilfield network using Ethernet over radio or cellular modem links (MODBUS)
    - Live data is pulled over MODBUS using the SCADA unit's Ethernet port
    - Radio or cellular data links transmit the data to the central office
    - Usually only configured for live pressure and temperature data, sometimes one or two additional data registers (see MODBUS register map)

1) Oilfield network using Ethernet over radio or cellular modem links (IT tool)
    - Live data is pulled by a server at the central office using the SCADAInterface custom tool
    - Radio or cellular data links provide the necessary Ethernet connection
    - Full historical record and additional auxiliary support data available
    - Full usage of data viewer and export tools at company office available

1) Standalone pad data logging scenario
    - Data is logged locally and periodically retrieved by field personnel
    - Months or years of data storage
    - Full historical record and additional auxiliary support data available
    - Full usage of data viewer and export tools at company office available

Please note that in all scenarios, the data is logged locally anyway. Data can be downloaded from the unit at any time to fill gaps left by problems in any radio network (system failures, power outages).

System Hardware Specifications

General Specifications

-40 to 75 °C ambient temperature range
NEMA 4 enclosure
(See section *Power Requirements* for power usage tables)

CPU Module

454MHz ARM-based CPU
128MB DDR2 SDRAM
512MB Internal FLASH storage
MicroSD slot for additional storage space
10/100 Ethernet port
USB host port
USB OTG port (host or device)
1 RS232/RS485 (standard DB9) serial port
2 RS232/RS485 (jumper selectable) serial ports
1 auxiliary RS232 serial port
Optional system serial port (Linux console)
RTC module with wide temperature coin-cell battery backup
System temperature sensor
System expansion bus port

SCADA System Backplane

Wide 24VDC input (15-30VDC)
High efficiency 24V to 5V 1A DC/DC converter
4 expansion card connectors, 1 optional display connector
TEC line voltage input, up to 56V
Optional 5V input header

Gauge TEC Line Driver Expansion Card

Up to 56V 675mA
Software configurable voltage and current limit
Voltage and current waveform readback
FPGA-accelerated communications

30V or 48V Power Modules

Wide 24VDC input (15-30V, significantly reduced power when under 18V)
Supplies 28-30V or 48V power for TEC lines
One 48V power module for up to 48V per TEC or two modules can be wired in series for 56V

Access Bracket

Main system 24V input
On/off slide switch
System protection fuse
Convenient test point access to power and TEC lines
Common point of routing for TEC lines

System Software Specifications

Linux Operating System

Kernel version is currently 2.6.35
SSH secure shell service for remote console login
SSH uses two-factor authentication: key and password
Standard Linux command line utilities

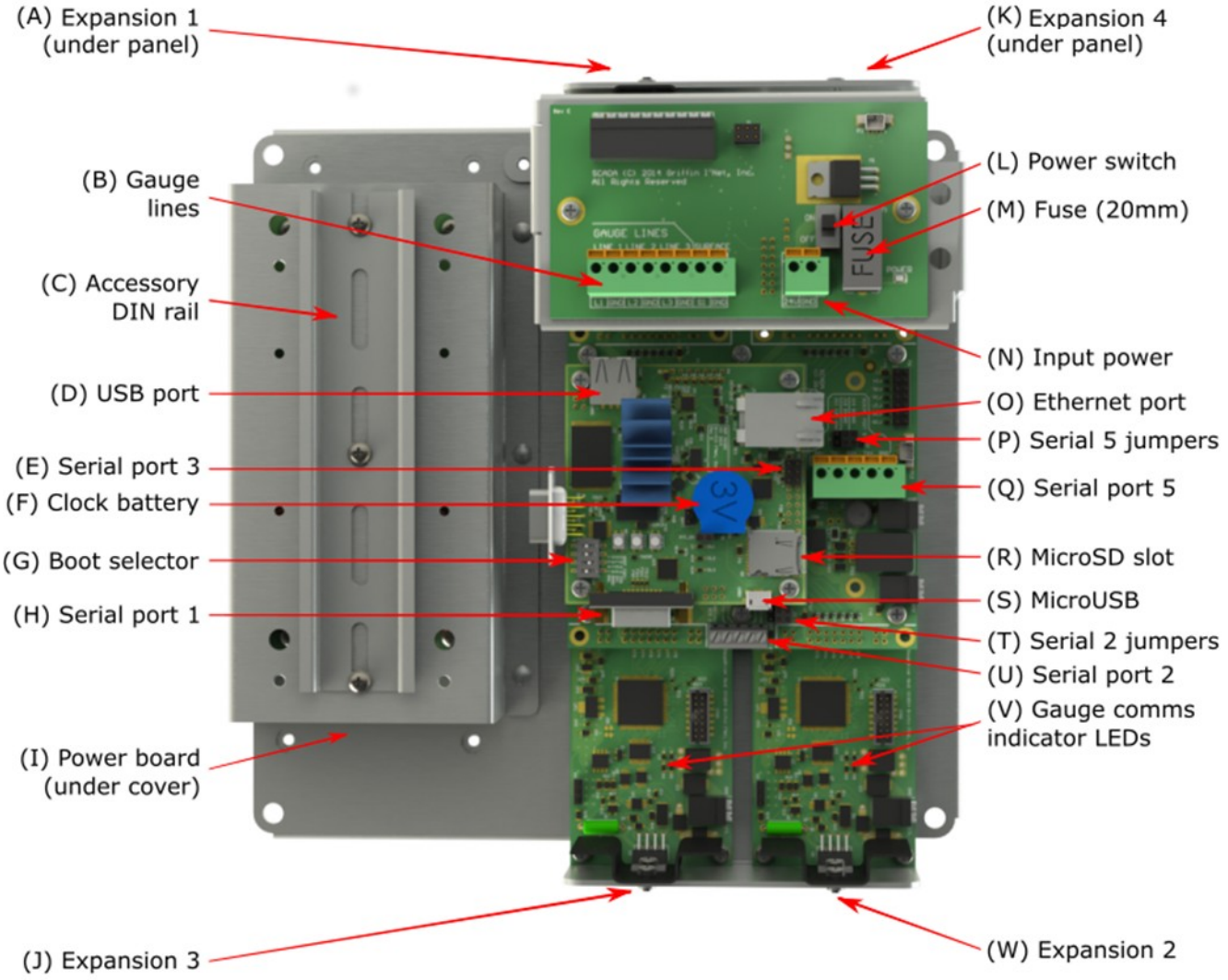
SCADA Platform

Software version is currently 3.30
Ethernet interface for configuration, control, and data transfer
Operates and logs data from gauges as configured by SCADA Client
Configurable RS232/RS485 port function map (Modbus, gauge interfaces, etc)
Modbus over RS485, Ethernet
    Configurable register map

SCADA Client

Windows and Linux versions are available
Connects to a SCADA unit over Ethernet
Configures gauges for each TEC line
Controls TEC line voltage and current limit
Monitors TEC line voltage and current
Views live gauge data (real-time or historical)
Downloads gauge data to the PC for processing
Exports downloaded gauge data to CSV files
Support for custom software branding/logos

System Components (Amarok version)



This diagram points out various components of the SCADA platform unit.

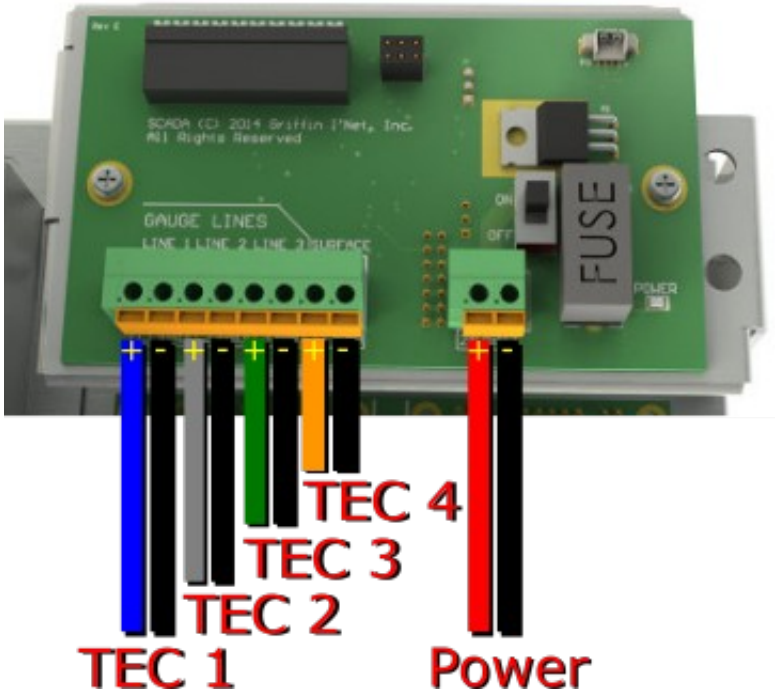
The most common items a field installer will need to be familiar with are:

- Gauge line terminals (B), where cables to downhole sensors are connected
- Power switch (L), to turn the unit on and off
- Input power terminal (N), where external power is supplied to the unit
- Serial port 5 (Q) and it's jumpers (P), where MODBUS serial connections are made
- MicroSD slot (R), where the data storage card is placed
- Serial port 2 (U) and it's jumpers (T), another serial port connection
- Gauge communications indicator LEDs (V), which flash regularly when communicating with the downhole gauges

Serial port 4 is not listed as it is now used by the access panel board for system power measurements.

Wiring (Amarok version)

To wire up the SCADA system, you should locate the access panel in the upper right side of the enclosure:



The main connections that a field operator should need to make for standard applications are all right here on this panel. Wires can simply be pushed into the green terminals. Use your finger to lightly push the orange lever down to release the wire, if necessary.

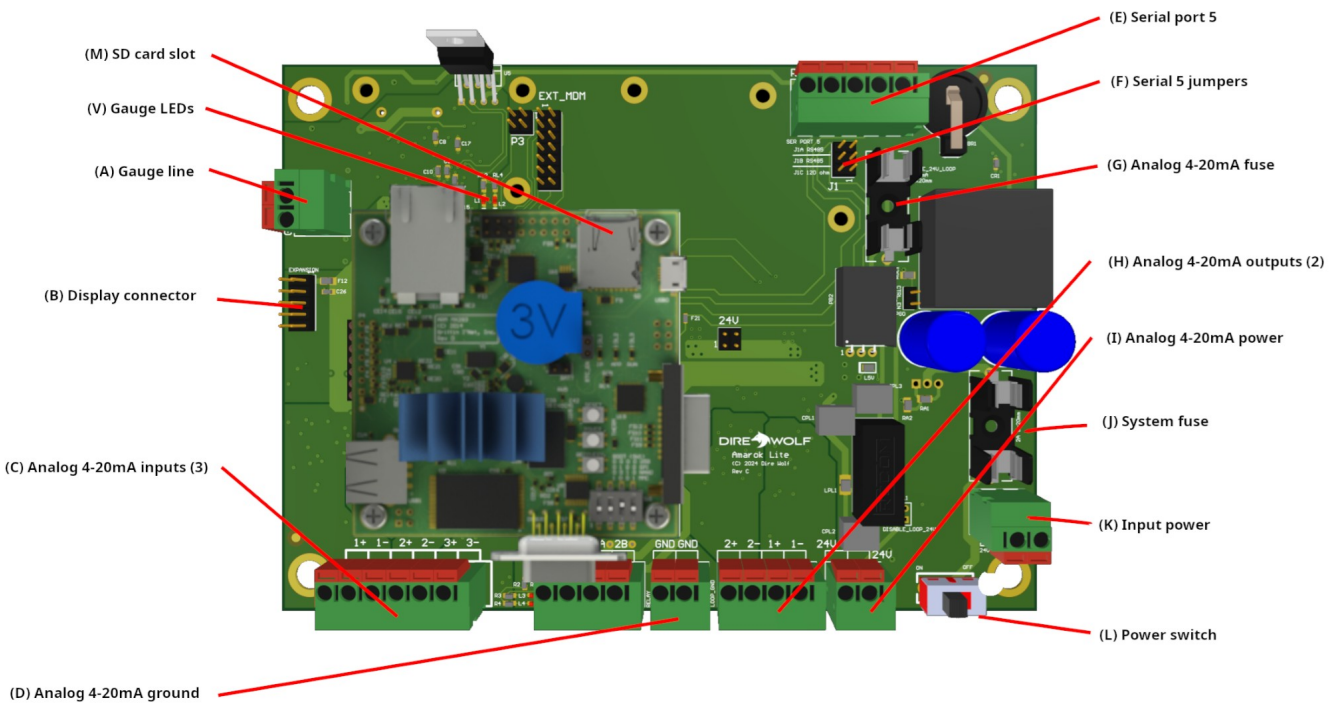
The main power connection is the two-position terminal on the bottom right, near the power switch. Note the 24V is on the left, with ground on the right. These positions are labelled on the circuit board below the terminal.

The TEC sensor lines will be wired to the 8-position terminal on the bottom left. The positions are labelled below the terminal, and follow the convention of the positive terminal on the left side, and the ground terminal on the right side. The first TEC line is on the left side.

PLEASE NOTE that the well sensor lines are NOT isolated from each other. Since the negative terminals of the well sensor lines are earthed very thoroughly by the wells themselves, this should not be a problem with installed sensors.

Additionally, you may need to follow the instructions in the section *"MODBUS over RS485/422"*.

System Components (Amarok Lite version)



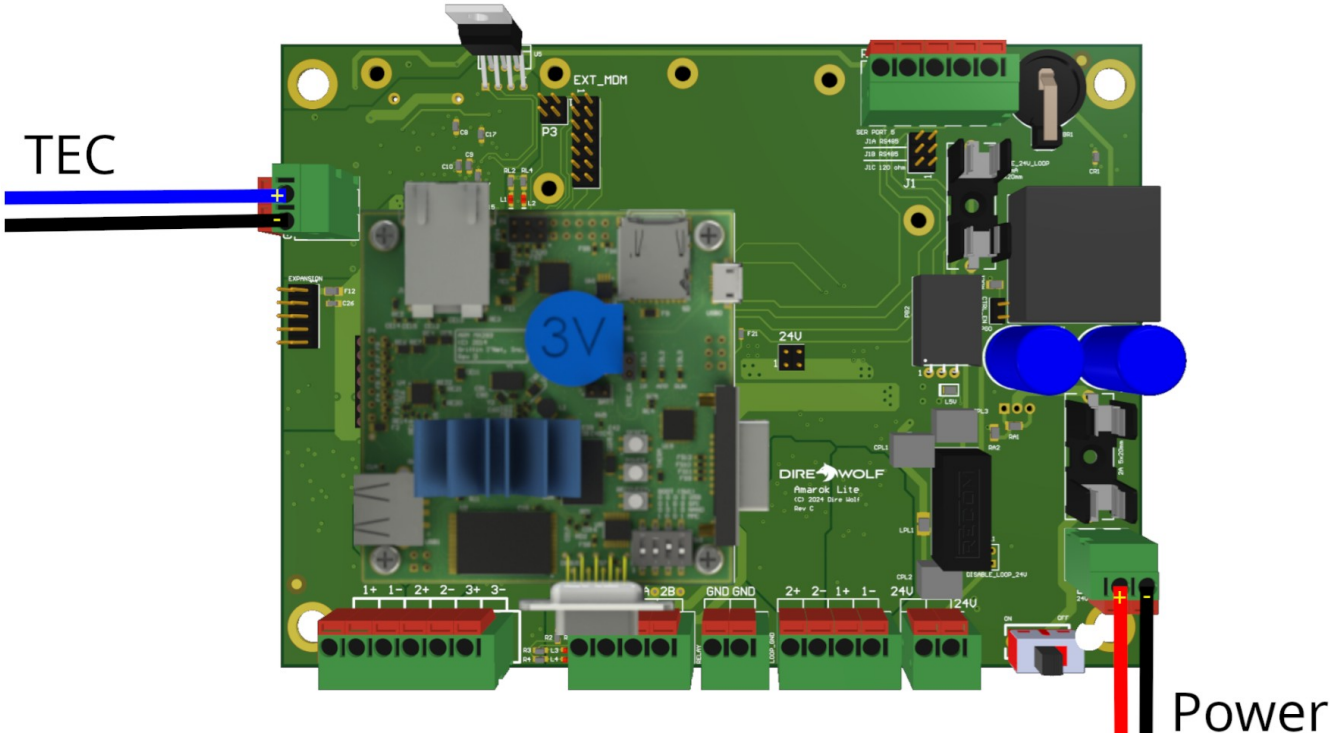
This diagram points out various components of the Lite version of the SCADA platform unit.

The most common items a field installer will need to be familiar with are:

- Gauge line terminal (A), where the cable to downhole sensors is connected
- Power switch (L), to turn the unit on and off
- Input power terminal (K), where external power is supplied to the unit
- Serial port 5 (E) and it's jumpers (F), where MODBUS serial connections are made
- MicroSD slot (M), where the data storage card is placed
- Gauge communications indicator LEDs (V), which flash regularly when communicating with the downhole gauges

Warning! If the display connector (B) becomes disconnected, pay extremely close attention to the pin 1 indicator on the PCBs for both the main board and the display connector. Connecting the display cable in incorrectly will permanently damage the PCBs!

Wiring (Amarok Lite version)



To wire up the SCADA system, nearly all of the connections are on the large backplane:

Wires can simply be pushed into the green terminals. Use your finger to lightly push the orange lever down to release the wire, if necessary.

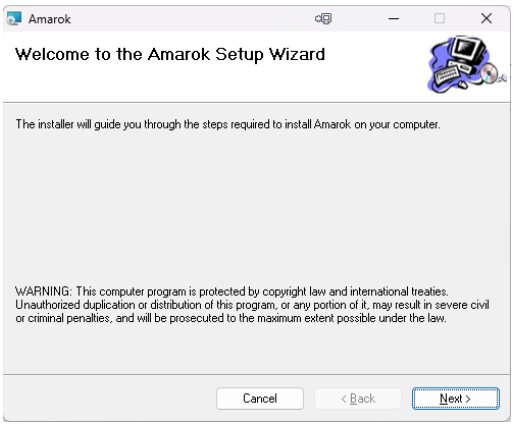
The main power connection is the two-position terminal on the bottom right, near the power switch. Note the 24V is on the left, with ground on the right. These positions are labelled on the circuit board below the terminal.

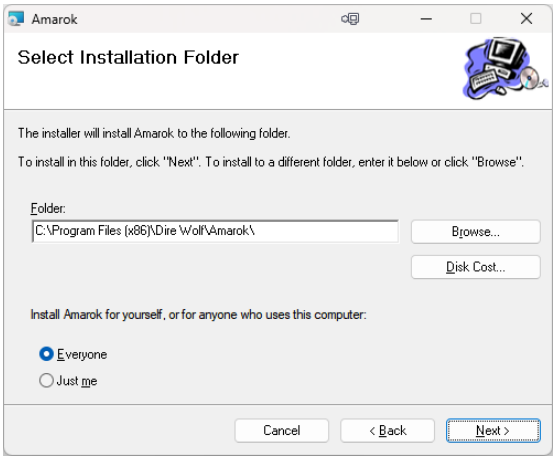
The TEC sensor lines will be wired to the 2-position terminal on the upper left. The positions are labelled below the terminal, where the positive terminal is on the top and the ground terminal on bottom.

Additionally, you may need to follow the instructions in section *“MODBUS over RS485/422”*.

Software: Installation

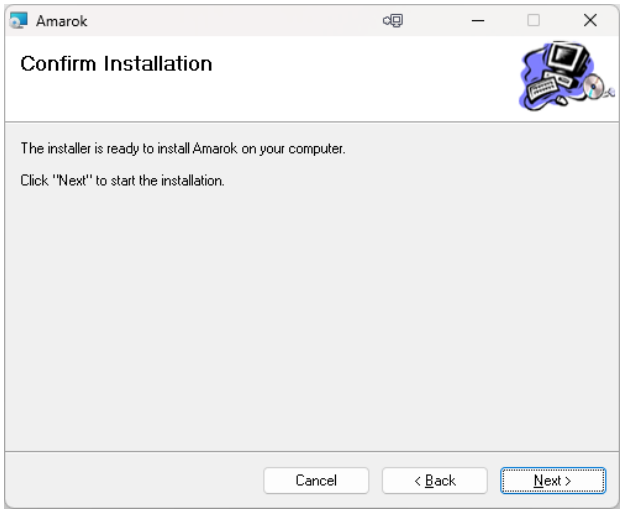
The SCADA units require software on your PC to use to them. You should receive a ZIP file with a name like “AmarokSetupDW_v3.30.zip”, where “DW” may be different letters for different companies and the serial number of course may change. Double-click the file with Windows Explorer and then double-click the MSI file inside:



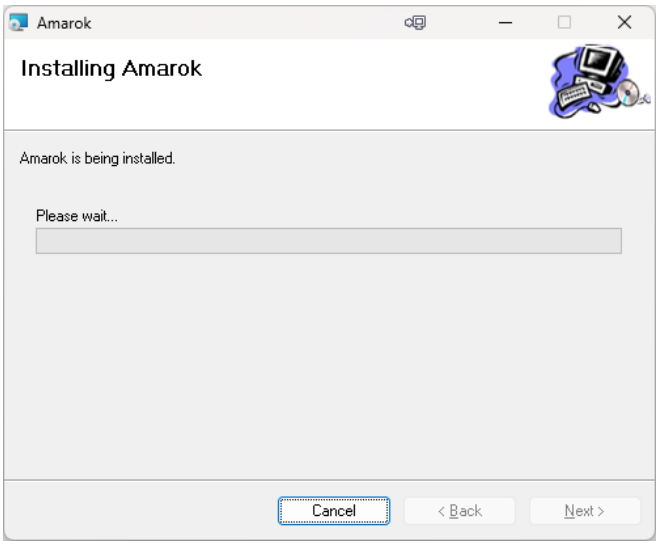


Click the “Next >” button to continue:

If you need to change where the software is installed, you may do so here. Otherwise, click “Next >” again to continue.

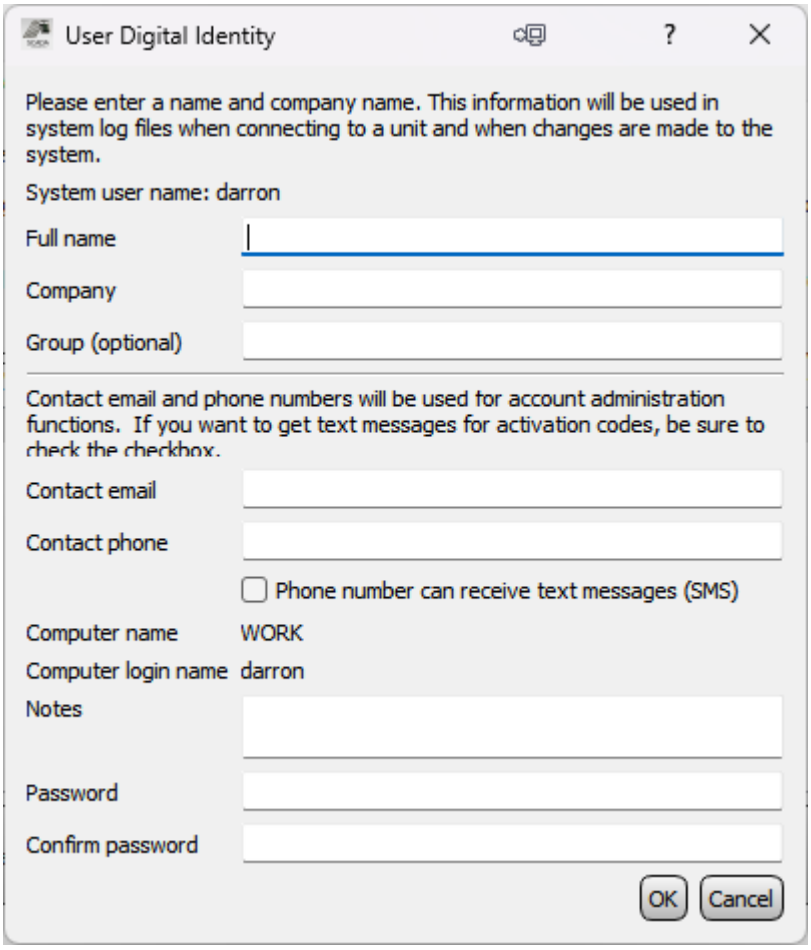


You will see the confirmation page above. Click “Next >” once again to install the software. You will see a progress bar. Once the installation is complete, you can click “Close” to exit the software installation wizard.



You should then see a “Amarok” icon on your desktop. You can also start the program through your start menu. Click the icon to open the PC interface application.

The very first time you install the software, you see a dialog where you will need to enter your user information. This is used to identify you and in some instances sets the permissions you will have when using the software:

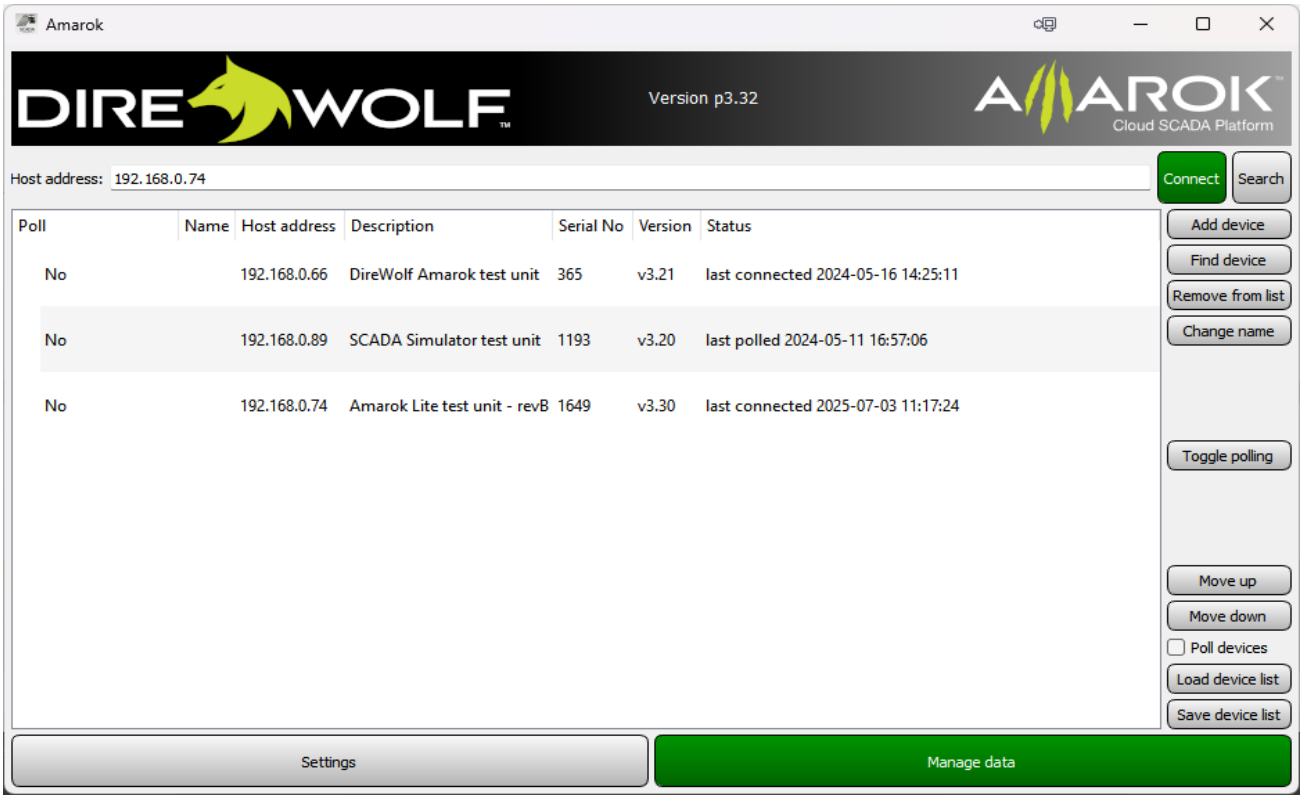


Choose a new password for the “Password” field at the end. Re-enter it in the “Confirm password” field. DO NOT USE YOUR WINDOWS PASSWORD. This may be needed to transfer your user information to a new computer at some point.

Fill in the dialog and hit “OK”.

The application will exit. Restart the application, and then you should see the main software interface screen described in the next section, *“Software: Main Screen Overview”*.

Software: Main Screen Overview



The main screen is the screen that displays when you start the PC application, before connecting to any unit:

The PC version is shown in the upper middle section.

To connect to a SCADA unit, you will normally click the “Search” box. Follow the *“Software: Connecting to SCADA Units”* section for more information. You can also simply enter an IP address or computer name in the “Host address” field and press “Connect”.

You can type in an address and press “Add device” to save a SCADA IP address to a device list. Once done, you can use “Change name” to give the SCADA unit a more user friendly name in the device list. “Remove from list” removes an entry from this list. You can also load and save device lists to share them with colleagues.

“Move up” and “Move down” will let you rearrange the order of the units in the list. “Load device list” and “Save device list” will load and save the entire list of units for transfer to/from other computers. “Toggle polling” will cause the software to start polling that unit and display it’s serial number, version, and a timestamp when it was last successfully polled.

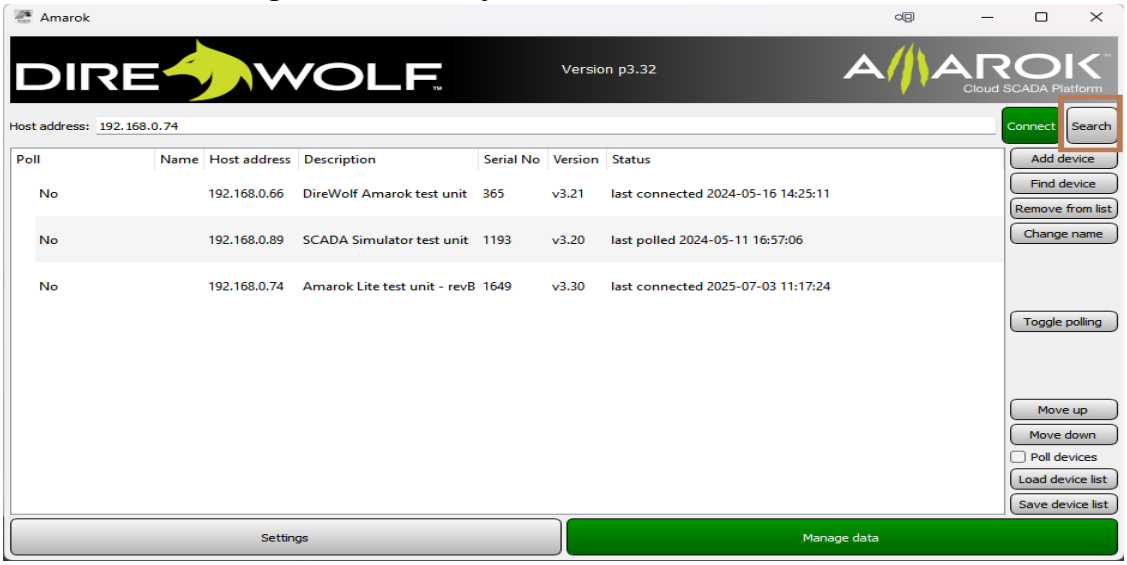
Other functions:

“Settings” – change system display units. *“Software: Global Settings”*
“Manage data” – display and export data already downloaded from a SCADA unit. *“Software: Manage Data”*

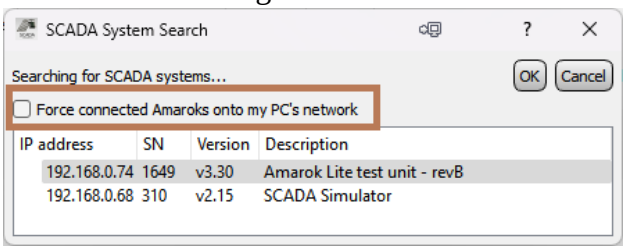
Software: Connecting to SCADA Units

Power on the SCADA unit you want to connect to and connect to it with an Ethernet cable from your laptop or computer.

Wait until the unit has finished booting up. Units with a display will show a “PLEASE WAIT : BOOTING APPLICATION” message until it is ready. Click the “Search” button from the main screen:



This will bring up the SCADA unit search dialog:



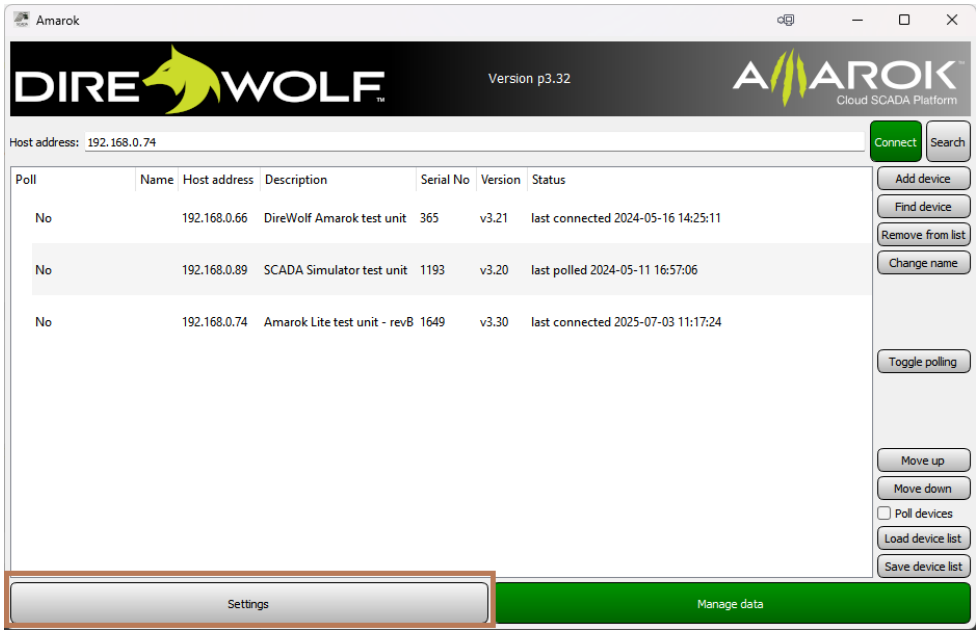
If you are connecting directly to the unit with an ethernet cable from your laptop or computer, make sure the highlighted “Force connected Amaroks onto my PC’s network” button is checked. This will cause your computer to send out a global request for any units the local network can reach to make themselves reachable to your computer. They will then show up in the list.

DO NOT USE the force connect checkbox on a company network. The SCADA unit will assign itself a random IP address on your network subnet and may interfere with other computers on the network.

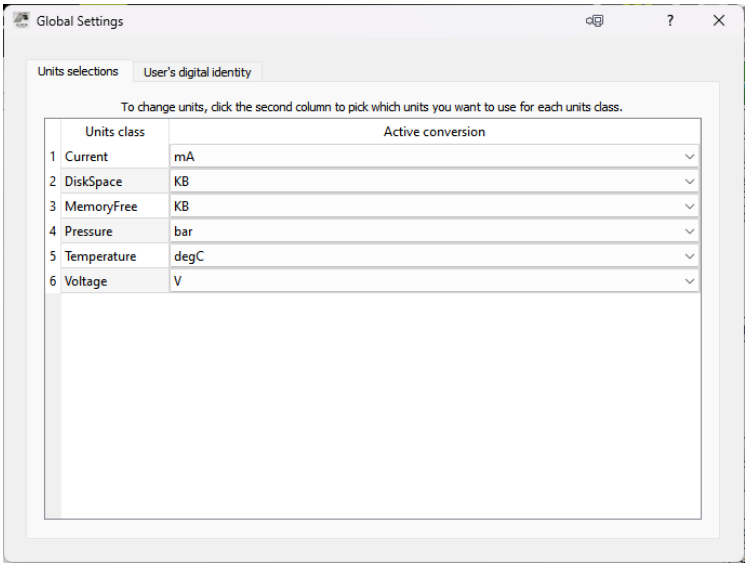
Once a SCADA unit shows up in the list, double-click it or select it and hit “OK” to connect.

Software: Global Settings

To view or modify global settings in the software, click the “Settings” button from the main screen:

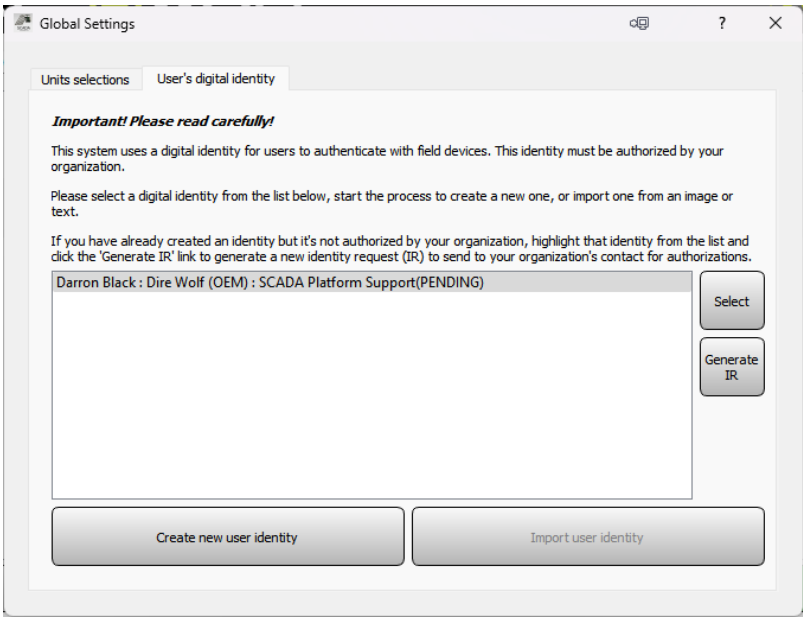


You will now see the global settings dialog:



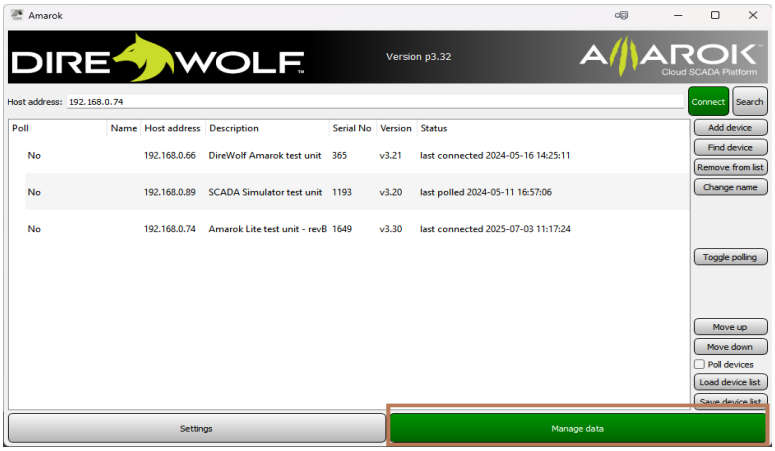
To change the units that are used in displaying and exporting data, just choose the units you want to use for each category. Common units would be selecting either “psi” or “kPa” for Pressure, and “degC” or “degF” for Temperature.

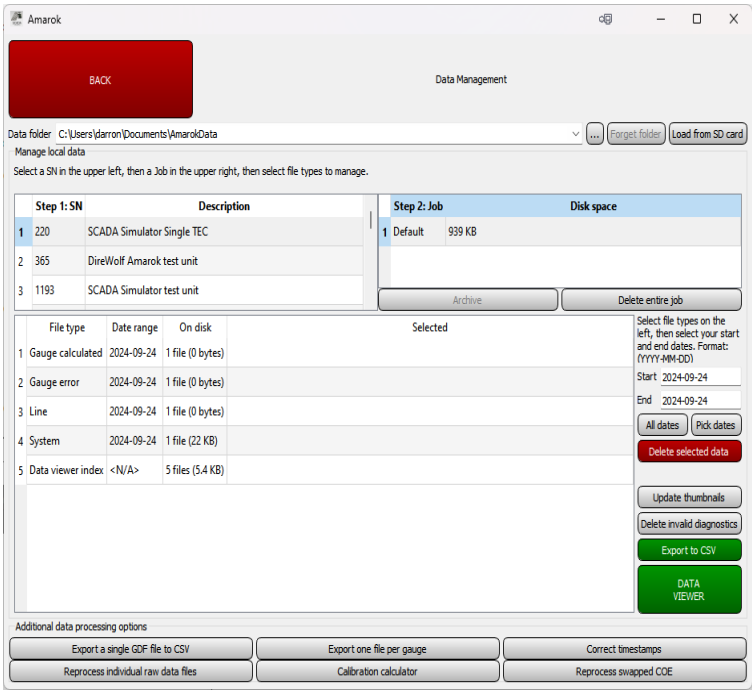
The other tab, “User’s digital identity”, allows you to view and change the information used to identify the user operating the PC software. The “digital identity” is also used to determine what permissions the current user has when using the software.



Software: Manage Data

To view and export data already downloaded to your PC from a SCADA unit, press the “Manage Data” button from the main screen:





You will see the Data Management screen:

The “Data folder” selection dropdown will default to the standard download location on your computer. You probably don’t need to change this. This is usually in an “AmarokData” folder inside your “My Documents” location. You can use the “…” button to browse to a new location, or type one in yourself. Recent directories are recorded in the drop down list. An entry in the drop down list can be removed with the “Forget” button. This only removes the folder from the drop down list, it does not remove any data from the computer.

To use this screen:

- If you are trying to process data on an SD card, click the “Load from SD card” button, then skip the serial number step.

- Select a serial number (SN) from the upper left box. Once a serial number is selected, a list of jobs downloaded from that SCADA unit will be shown on the upper right box.

- Select a job from the job list, and the file contents list will be populated for that job.

- The buttons on the lower right now operate on the selected job’s data.

- To view data, use the “DATA VIEWER” button. This launches the Data Viewer, which is described in the section *“Software: Data Viewer”*. To rebuild thumbnail data for the data viewer, you may need to click the “Update thumbnails” button on this screen. This thumbnail data is usually downloaded from the SCADA unit, but it may not be, depending on download settings described in *“Software: Downloading Data”*.

- To export data from the selected job data you have downloaded, press the “Export to CSV” button. This process is described in *“Software: Exporting Data”*.

- To remove data from your computer (this does NOT remove any data from the SCADA unit), simply select the types of files you want to delete and click “Delete selected data”. You can change the date range of data you want to delete using the “Start” and “End” date fields. For convenience, an “All dates” button will select all available dates in the job data, and a “Pick dates” will bring up a calendar to select dates from.

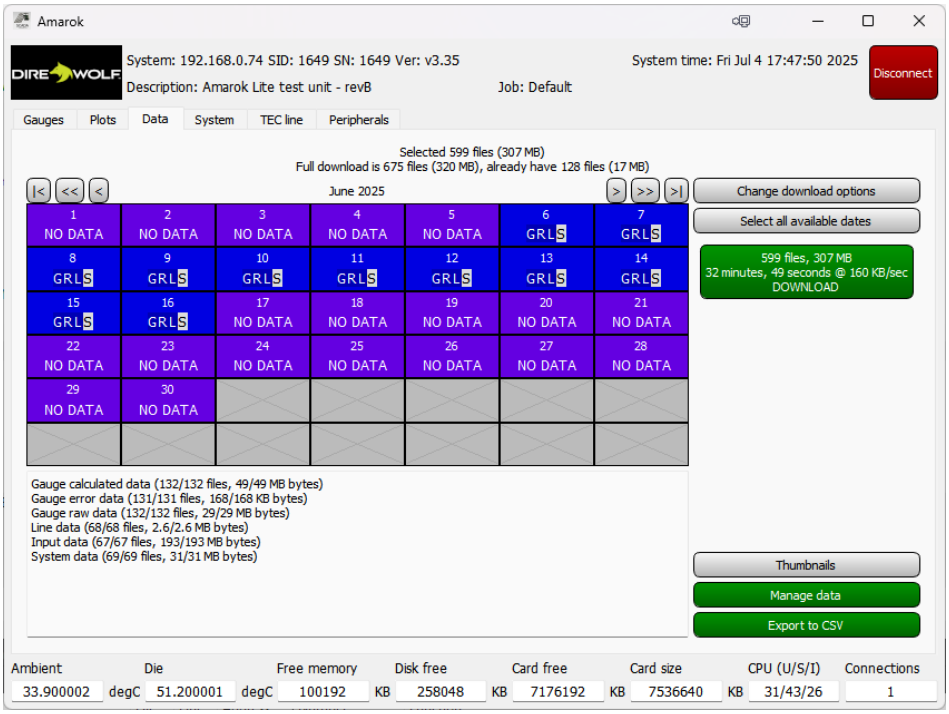
Additional options on this screen:

“Export a single GDF file to CSV” – This option will let you browse on your computer for GDF files, which are the native, binary file format files for the recorded SCADA data. You can then export a single GDF file to CSV. Since GDF files only cover a single day’s data, you would not normally use this feature. It is for specific troubleshooting use.

“Reprocess raw data files” – This option will allow you to select a GDF file on your computer (A rawData.gdf file from the job’s “gauges” folder tree) and a COE coefficients file to reprocess the data using updated coefficients, if your gauge type supports data reprocessing.

Software: Downloading Data

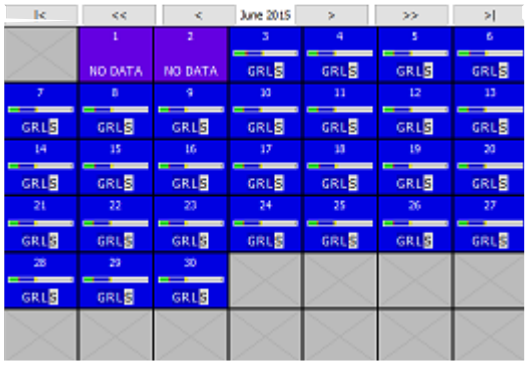
In order to view or export data from a SCADA unit, you need to first download the data to your local computer. When connected to a SCADA unit, the “Data” tab is located along the top set of tabs after “Gauges” and “Plots”:



This screen manages the downloading of job data to your computer. You can also export data from this screen, using the “Export to CSV” button, described in *“Software: Exporting Data”*. You can also view and delete data from the “Manage Data” screen, described in *“Software: Manage Data”*. **Please note that both of these functions will automatically select the SCADA serial number and job you are on.** You will not see a data folder, serial number, or job field on the Manage Data screen, for instance.

The “Thumbnails” button will instruct the SCADA unit to begin updating (or re-creating) it’s thumbnail files for the Data Viewer. You will then see a yellow banner across the top that will show the unit’s progress. This process could take a long time if there is a lot of data on the unit.

To begin downloading data, we first need to understand how dates are selected. The calendar shows data available for download one month at a time.



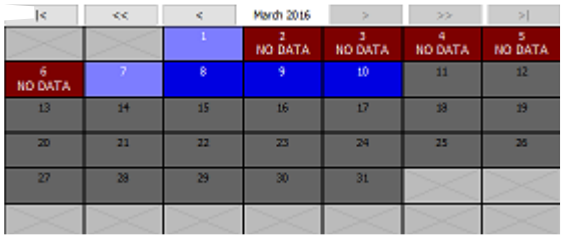
The “NO DATA” dates show dates that the unit was not recording data. Dates with data are in blue (light blue or dark blue), and dates that fall outside any job data for the SCADA unit are shown in grey.

Navigation: To navigate across months, use the “<” and “>” buttons. The “<<” and “>>” buttons move in one year increments. The “|<” and “>|” buttons move to the first and last month available, respectively.

Available Data Letters: There are up to five letters that will be displayed in each date to indicate what type of data is available for download. These types are “G” for gauge data, “R” for raw data, “L” for line data, “S” for system data, and “D” for diagnostics data. These letters may or may not show up depending on your download options you selected in the “Change download options” page (see “Software: Download Options”). (By default, you will not see any “R”s as raw data is not a default download option)

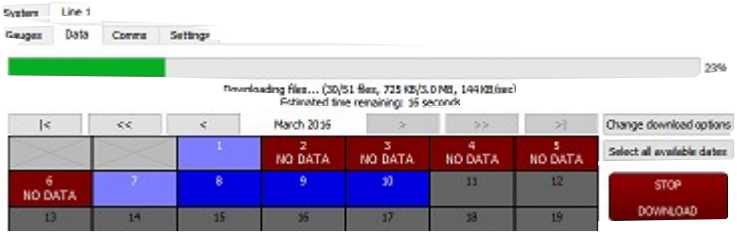
Graphs: There are small graphs in each date (if the screen is large enough). These graphs can help greatly in identifying data you might need to download for troubleshooting purposes. The graph shows data not yet downloaded divided by type of data. The green part of the graph is gauge sensor data, the blue part of the graph is raw sensor data, and the grey part of the graph is system data. Error data is in red. **To troubleshoot gauge issues, look for the first day with a significant red portion in the graph, showing a lot of errors. Download the dates immediately before and after this, and you will have the data across this problem event.** This is a very useful way to avoid downloading months of data to locate a problem. These graphs are also affected by the download options you have selected.

Selecting specific date ranges: To select a date range to download, click on the start and end dates that you want to download. **Every click of the mouse on a date will select that date as either the start or end of the range of dates to download.** For example, if you click on "March 10th", first only that day will be selected. Clicking then on "March 8th" will select the date range of the 8th through the 10th. Selected dates will be in dark blue, non-selected dates will be in a lighter blue.



Date range March 8th – March 10th selected

Once you have selected data to download, click the "DOWNLOAD" button. You will then see a progress bar across the top of the view, and the download button with change to a "STOP" button.

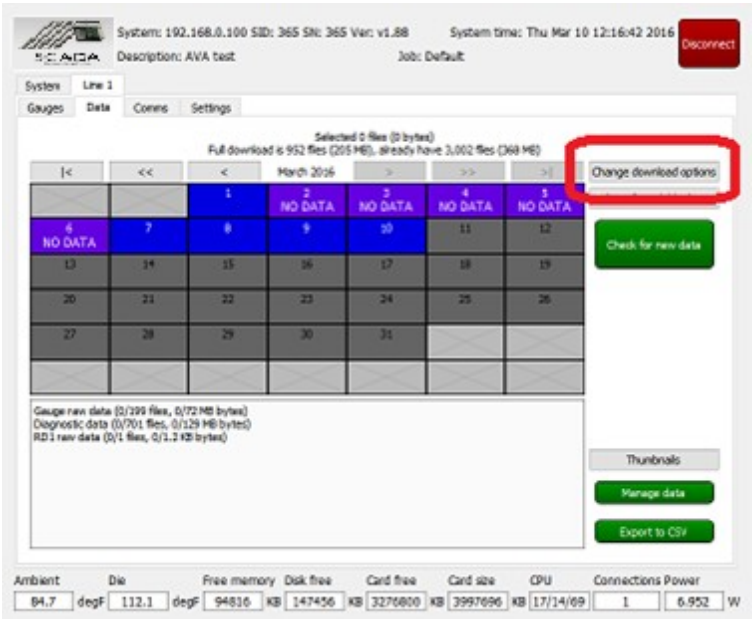


The information section will change to show the number and size of data being downloaded, and an estimate on how long the download will take. This estimate will usually become more accurate after a minute or so of downloading data.

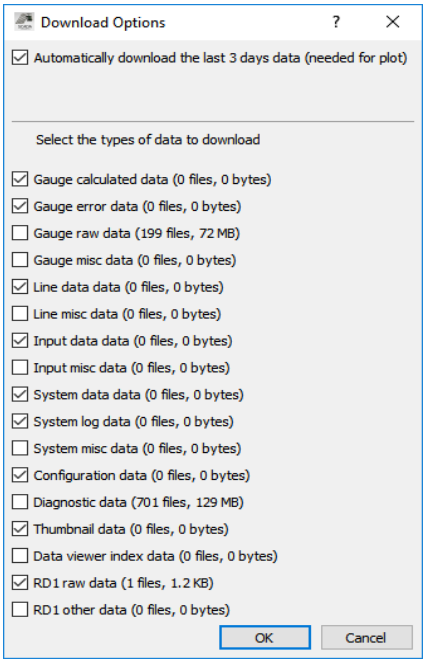
Note: If you do not see any available data letters, you have either already downloaded that day's data to your computer, or you have that type of data turned off in your download options. See *"Software: Download Options"* for more information on selecting types of data for download.

Software: Download Options

To view or change your selected download options, choose the “Change download options” button from the data downloading page when connected to a SCADA unit:



This displays the Download Options dialog shown below. This allows you to choose what data you want to download from the SCADA unit. The most common choices are shown below. A glossary of what these items mean is on the next page.



This dialog also selects if the PC program automatically downloads the last 3 days of data when you connect to a SCADA unit. This is needed for the gauge live plots to show some history.

Software: Data Download Options Glossary

Gauge calculated data - This contains the time, pressure, temperature, and a simple status value for each gauge. This is what most export data pulls from.
Gauge error data. This logs any errors that may occur during communications with the gauges. Theoretically useful for troubleshooting, but not useful otherwise.
Gauge raw data. This contains the exact data the gauges send to the surface system. If you have incorrect coefficients loaded, you may want these to reprocess the gauge data using corrected coefficient files later on. This is also useful for troubleshooting (in fact, more so than the error data files).

Gauge misc data. Any other files that happen to be in the gauge folders. Unlikely to be necessary.

Line data data. (slightly redundant naming) This contains time, voltage, and current for each gauge line... fairly useful for troubleshooting any communication issues, but not really necessary otherwise.
Line misc data. Any other files that happen to be in the line folders. Unlikely to be necessary.

Input data data. This contains the 4-20mA surface values. Very important if you have surface sensors, otherwise not necessary.
Input misc data. Any other files that happen to be in the input folders. Unlikely to be necessary.

System data data. This contains a good bit of information on the overall system health. It contains surface ambient temperature (inside the box, anyway), CPU temperature, memory usage, storage space remaining, cpu load, and a few things like that.
System log data. This is a pretty useful log file that stores major events (like system restarts, moving of data from internal storage to the SD card, etc). It also contains the user information of people who connect to the SCADA unit. Useful for troubleshooting.
System misc data. Any other files that happen to be in the system folders. Unlikely to be necessary.

Configuration data. This contains gauge, input, and general system configuration files and coefficient files. You'll almost always want these to assist in proper exporting of the data. (Finding the gauge names, etc)

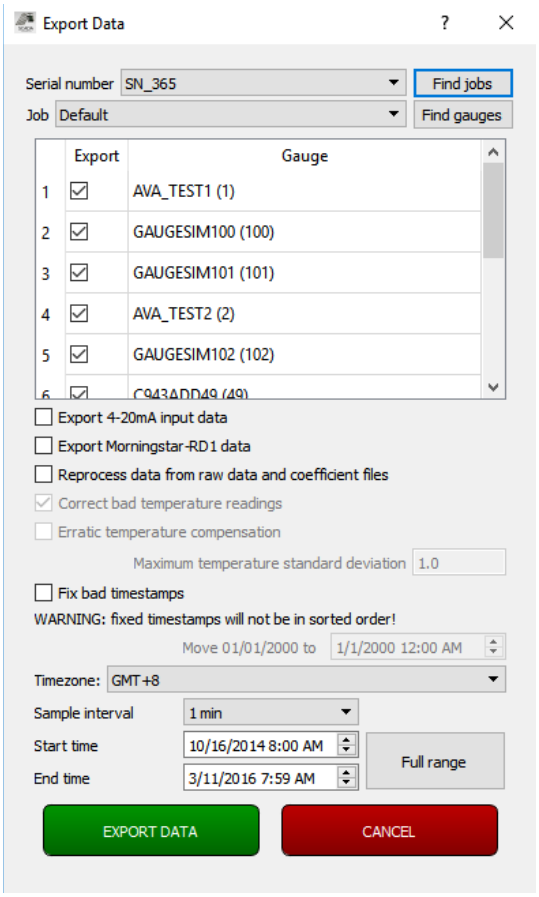
Diagnostic data. This data contains recordings of raw line voltage and current during communications with gauges. Only 10 are stored per day, per gauge... and only if there was a problem. This can be pretty useful for troubleshooting, but only by sensor experts with special software. It's a whole lot of data and it's usually best to select this only when selecting a few days to download from.

Thumbnail data. This contains precomputed thumbnails for the Data Viewer built in to the PC application. The PC application can regenerate these anyway, so they're not necessary... but they're so small that it's usually easier to just download them.
Data viewer index data. This is not going to be necessary as the PC application always regenerates these.

The important ones to export properly are "**Gauge calculated data**", "**Input data data**" (if there are surface sensors), and "**Configuration data**". "**Thumbnail data**" is so small you might as well include it unless you NEVER use the build in viewer. For troubleshooting, we usually ask for “Line data data”, "**System data data**”, and “**System log data**”.

Software: Exporting To CSV

To export data, select “Export to CSV” from the Manage Data or Data Download screens. You will see the following dialog:



The top options are “Serial number” and “Job”. Select a serial number to pick a different SCADA unit to export from, and then select the correct job you want to export data from. These will normally be populated already depending on the system you were connected to or viewing. If you have opened this dialog from the “Data” tab while connected to a unit, these will not be present.

The next section is the gauge list. All gauges are selected by default. Turn on or off any gauges you do not want to export data for at this time.

The next option, “Export 4-20mA input data”, will add surface sensor data to your export file, from any connected 4-20mA sensors.

“Export Morningstar-RD1 data” will include data from a RD1 solar battery monitor device, if configured.

“Reprocess data from raw data and coefficient files” This data is useful if you have updated the coefficient files of any gauges and you want to reprocess older data using the new coefficient files. You need to select “Gauge raw data” from the download options page and download the gauge raw data before using this option.

“Correct bad temperature readings” will try to remove blatantly wrong temperatures (like 1000 °C, etc)

“Erratic temperature compensation” is another way to ignore faulty temperature readings. It uses the “Maximum temperature standard deviation” number to identify temperature readings that are too inconsistent, and only exports data that fits the expected profile.

“Fix bad timestamps” and the “Move 01/01/2000 to” field are useful for failed system clock situations. A failed SCADA clock will move data to the date 01/01/2000 after a reboot. You can adjust for this failure by identifying the correct time of the start of the data and entering that in the “Move” field**. Note that data will not be sorted to match the entered date, the corrected timestamps will still appear first in the export file based on the original 01/01/2000 date.**

For “Timezone”, you can select the timezone you want to export the data for. This defaults to your local computer’s current timezone.

“Sample interval” defines how often data points are stored in the export file. This is usually 1 minute. However, data is usually recorded much more often (every 2.5 seconds or so)

The “Start time” and “End time” fields define the time and date range you want to export data for. The “Full range” button will set this to the full data time range available.

When you’re done, click the “EXPORT DATA” button. **The data will be exported into your download area, inside the job folder for the current serial number. The filename will be “export.csv”.** For example, if you are connected to SCADA serial number 424 and are exporting data for the “Job123” job, the data would be exported to your “My Documents\AmarokData\SN_424\Job123” folder.

Here is a sample of the exported data in Excel:

	A	B	C	D	E	F	G
1	Well: Default						
2	DATE	TIME	GAUGESIM100_PRESS	GAUGESIM100_TEMP	GAUGESIM101_PRESS	GAUGESIM101_TEMP	GAUGE
3	2/29/2016	13:31:00	3000.32	262.792	3050.33	271.797	3100
4	2/29/2016	13:32:00	3000.32	262.847	3050.31	271.828	3100
5	2/29/2016	13:33:00	3000.34	263.077	3050.34	272.032	3100
6	2/29/2016	13:34:00	3000.36	263.472	3050.39	272.492	3100
7	2/29/2016	13:35:00	3000.39	264.026	3050.39	273.049	310

Individual gauges will have their gauge name, then “_PRESS” appended for pressures, and “_TEMP” appended for temperatures.

Software: Data Viewer

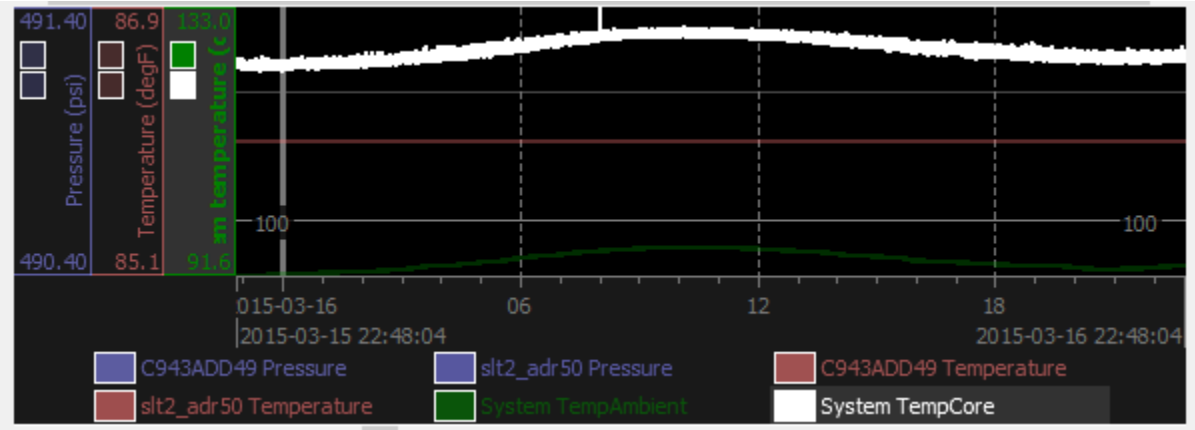
The Data Viewer is a very useful tool for data analysis. Select “DATA VIEWER” from the Manage Data screen to start this subsystem. A special online version is also available by clicking “Plots” from the top line of tabs when connected to a SCADA unit. This online version will not show the thumbnail view, and only covers the last several days of data. This online version will update live as you are connected to the unit. Here’s the full version from the Manage Data screen:

The screen may take a little time to load initially to create index files. It will be much faster after these index files are created.

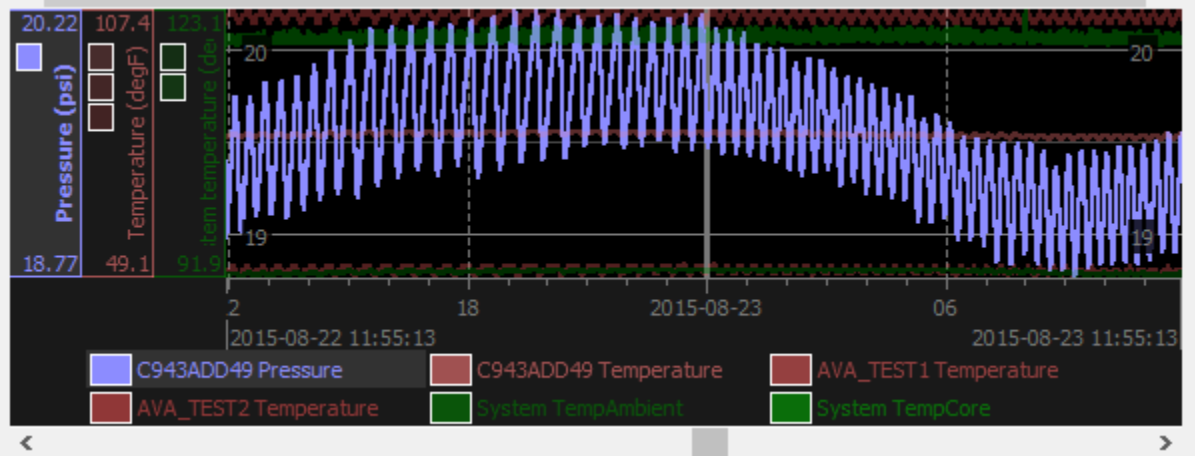
Thumbnail view: The top view is the thumbnail view, which shows data from the thumbnail files downloaded from the unit. This will show some of the available data across all the data recorded on the unit. In the above graph, the thumbnail is showing about a year and a half of data from a test system. Clicking and/or dragging on this graph will move the main graph to look at this time. The currently viewed region of time will be shown with a dark grey rectangle.

Main view: The main view shows the data currently selected to view and is zoomed in to usually the last day or so of data. There are a lot of ways to control this view, so please read these instructions carefully.

Legend area: This part of the main view is along the bottom and shows a legend of the colors used to each data item. Gauge names are identified here if known. Turn on and off the legend with the “Show legend” checkbox. You can click on a legend item to toggle highlights for that item:

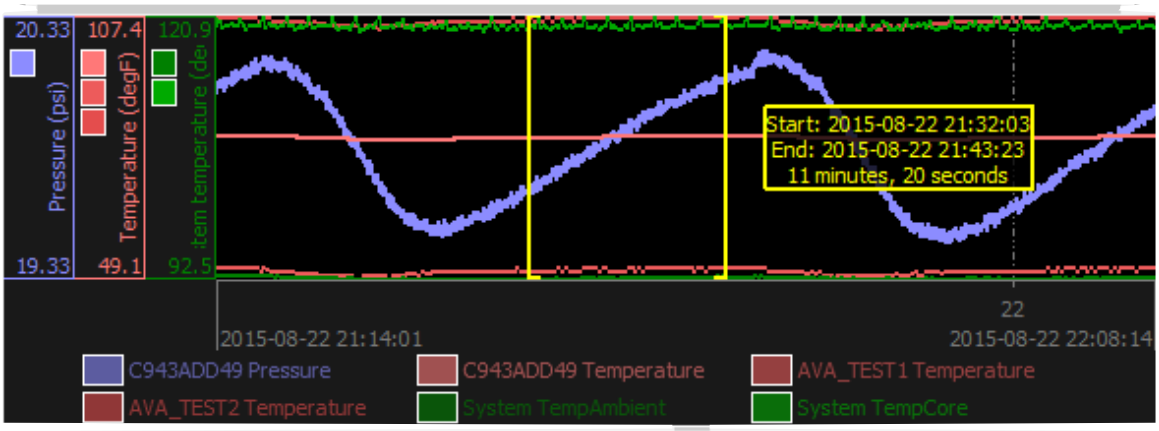


Scale area: This area shows groups of available data that are plotted together on a common plot scale. Clicking on a color box inside the scale area will highlight that specific data item in the exact same way as clicking on the item in the legend. If you click on a particular scale area itself, all the items in that scale group will be in bold and other values will fade to the background. A plot scale grid will also be shown.

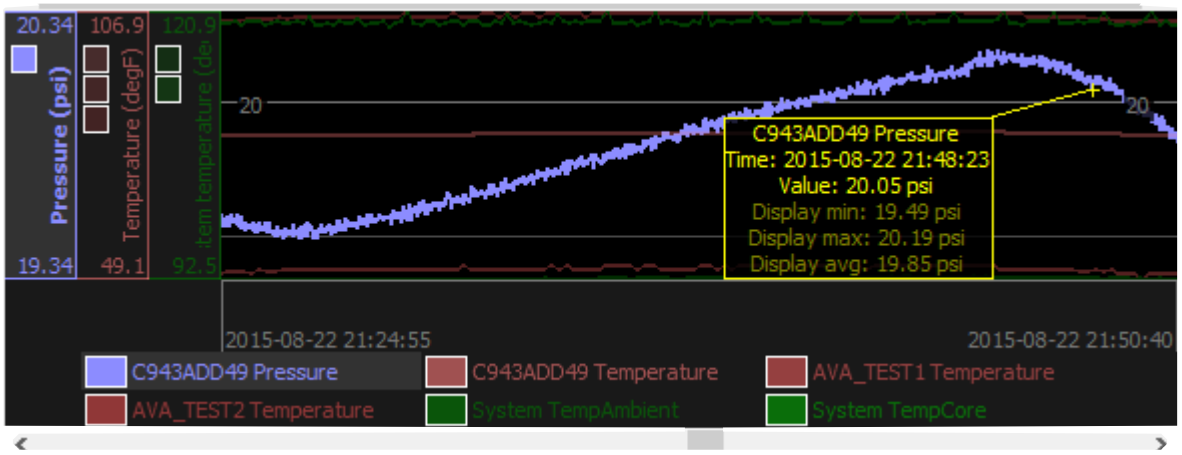


Navigation: There are several ways to navigate through the data on the main view:

- Click with the left mouse button when no item or scale group is highlighted and drag left or right.
- Click with the right mouse button and release without moving the mouse to zoom out. Click with the right mouse button and drag to another point to define a region to zoom in:



- When a scale area or data item is highlighted, the usage of the left mouse button changes. In this mode, left-clicking on the plot will show a yellow information window with information about the data point closest to your mouse click:

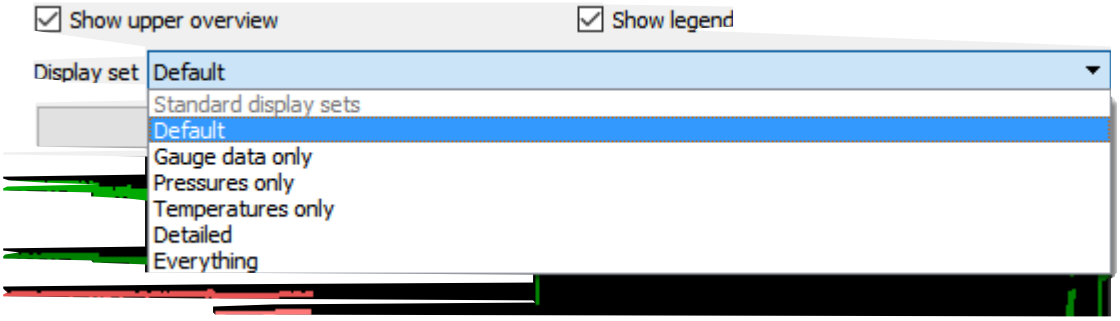


Click and drag the left mouse button to explore data values.

There are several predefined display sets you can use to look at different types of data logged by the SCADA unit. See the next section “Software: Display Sets” for more information.

Software: Data Viewer Display Sets

Display sets are very useful collections of similar items or items that are useful to view together using the data viewer. To select a pre-configured or saved display set, use the “Display set” dropdown from the data viewer:

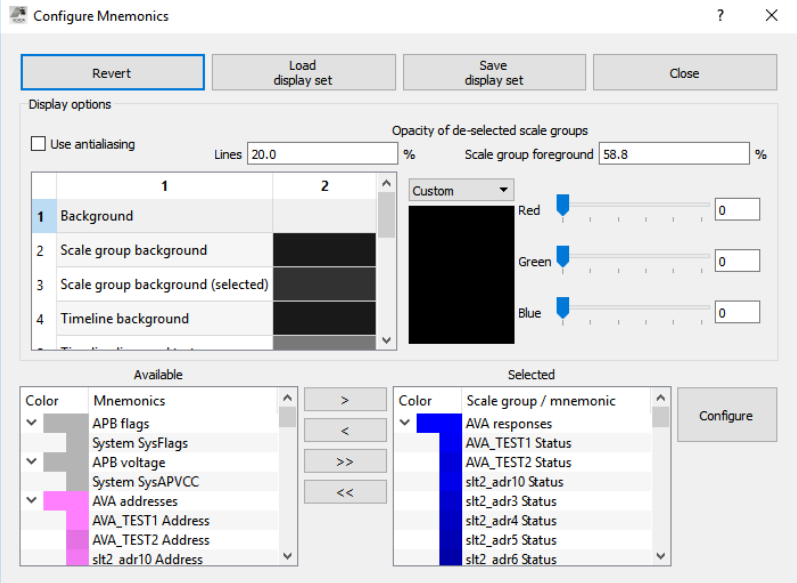


The “Default” set shows system temperatures, along with gauge sensor pressure and temperature data. The “Gauge data only” set shows only gauge pressures and temperatures. Similarly, “Pressures only” shows only gauge pressures, and “Temperatures only” shows only gauge temperatures. “Detailed” shows much more information such as the CPU load, system memory usage, connections, system input voltage and current, line voltage and currents, and so on. “Everything” shows a truly huge data set.

Detailed display set

Everything display set

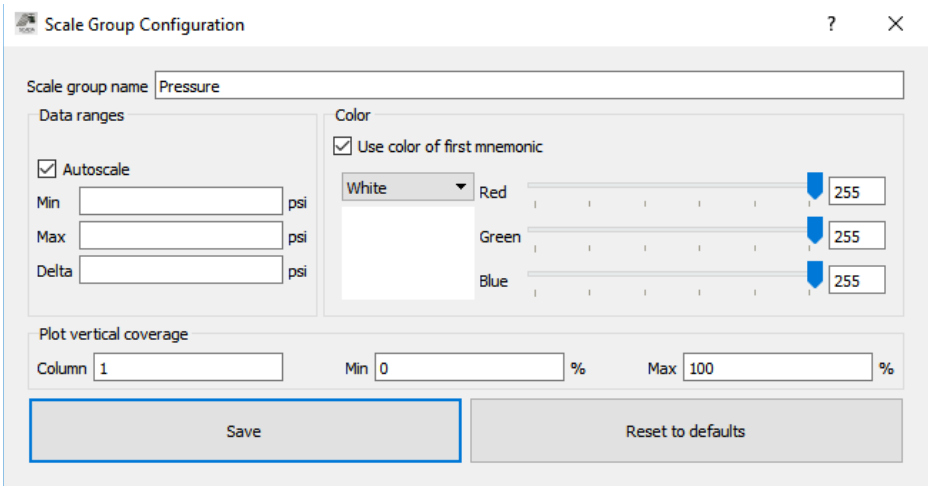
To customize a display set, choose the “Configure display set” option.



The display set configuration dialog is a complex one. The top section allows you to change the colors for various items in the plots, including the background. Select an item on the list on the upper left, and then select the color using the section on the upper right.

To view or hide different display items, use the bottom section of this dialog. Data items that are available but hidden are shown on the bottom left, and data items that are currently shown are on the bottom right. To show an item, click on it (or an entire section) on the bottom left and click the “>” button to move it to the selected list. To hide an item, click on it (or an entire section) on the bottom right and click the “<” button to move to back to the available list.

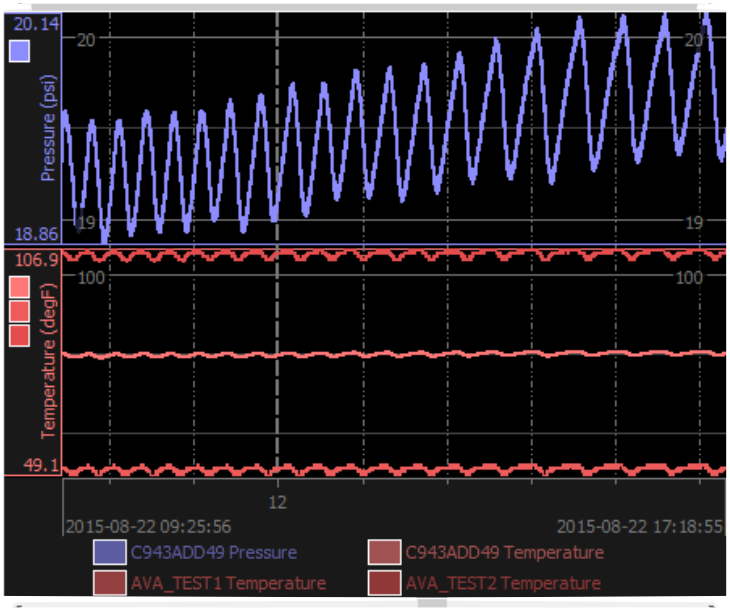
To configure the plot scales for a scale group, click on the section name (like “Pressure”) on the bottom right box, and click “Configure”. You will see a scale group configuration dialog:



To change the group’s color, use the color window on the upper right. By default, it is easiest to check the “Use color of first mnemonic” so that the group will take the color of the first data item in the group.

You can change the way the data is scaled on the screen using the "Data ranges" section. To automatically scale the plot's Y axis using the data available on that screen, use the "Autoscale" checkbox. This checkbox will use the "Delta" setting, so that the view will always be at least "Delta" units tall. This prevents the graph from zooming "into the noise" and showing confusing noise data. Autoscaling is the most common option, but you can turn autoscaling off and enter a specific range if you desire.

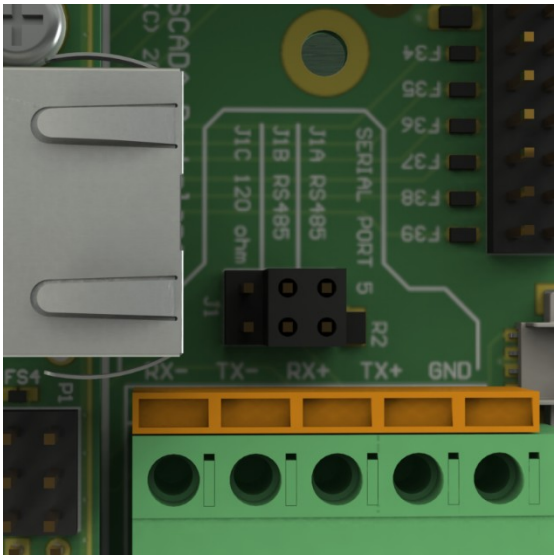
The "Plot vertical coverage" section is useful to show scale groups side-by-side on top of one another. To use it, put multiple scale groups on the same column, at different min/max percentages. For instance, in the plot below the Pressure scale group was set to Column 1, Min 0, Max 50. The Temperature scale group was set to Column 1, Min 51, Max 100.



MODBUS over RS485/422

Hardware setup

In most cases, you will want to use the green, 5-position terminal on the backplane board to wire up any RS485 connection. **This is serial port 5 in the software**. There are three jumper positions above the green terminal block, which configure the RS485 or RS422/RS232 selection, as well as an optional 120 ohm resistor. The two jumpers labelled “RS485” should be installed by default, which tie the negatives and positives of RS422 together for RS485 mode.



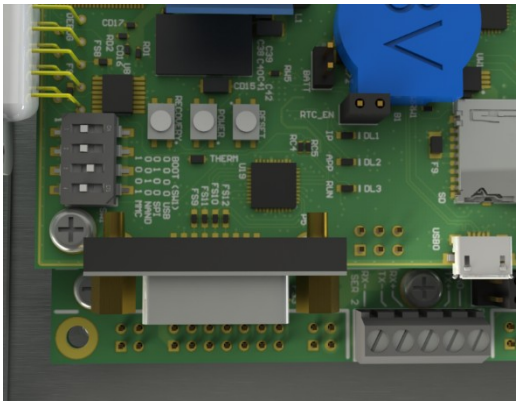
Serial Port 2 operates in exactly the same way, and it’s a smaller 5-position black terminal block located in the middle of the bottom edge of the backplane board. The three jumpers for serial port 2 are just to the upper right of the terminal block. In the picture below, the terminal block is at the bottom right. *Serial port 2 is only found on the Amarok versions. The Amarok Lite does not have this connector.*

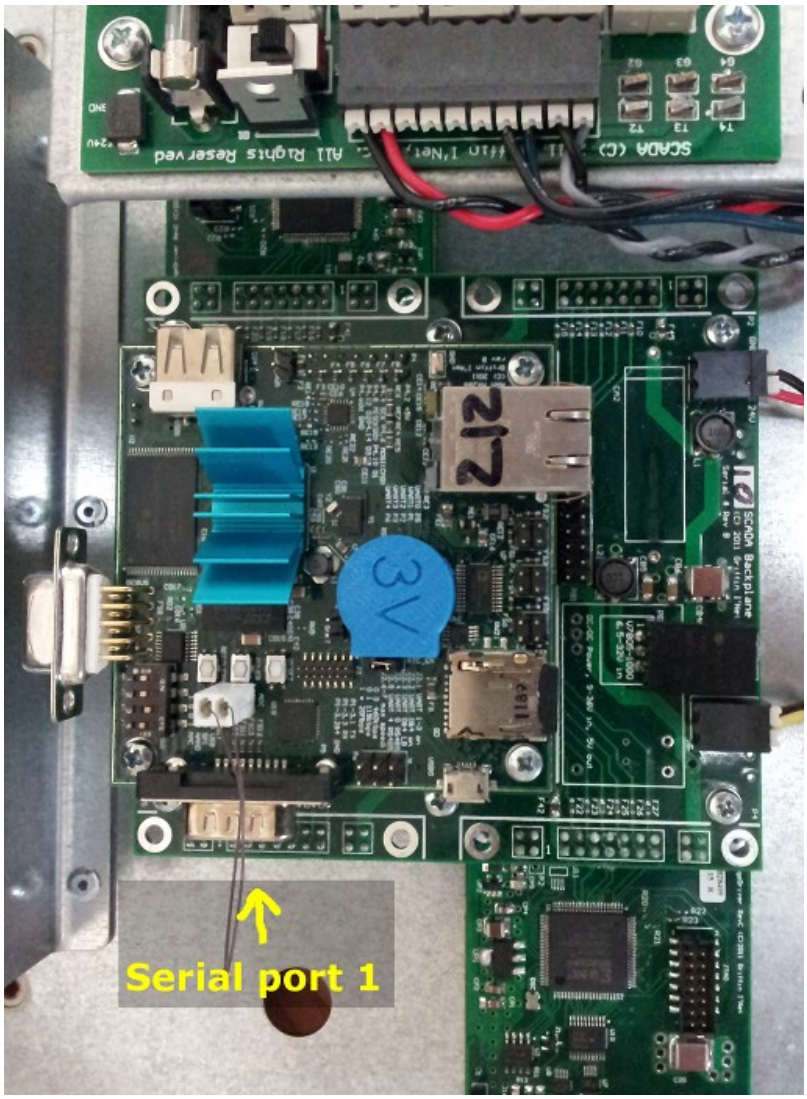
Serial Port 1 (DB9)

Serial port 1 is the male DB9 connector facing down on the main CPU board (see the picture below). On the Amarok Lite version of the units, this connector is facing to the right. In RS485/422 mode, the pinout of this connector is:

Pin 2: RxD-
Pin 3: TxD-
Pin 5: GND
Pin 7: TxD+
Pin 8: RxD+

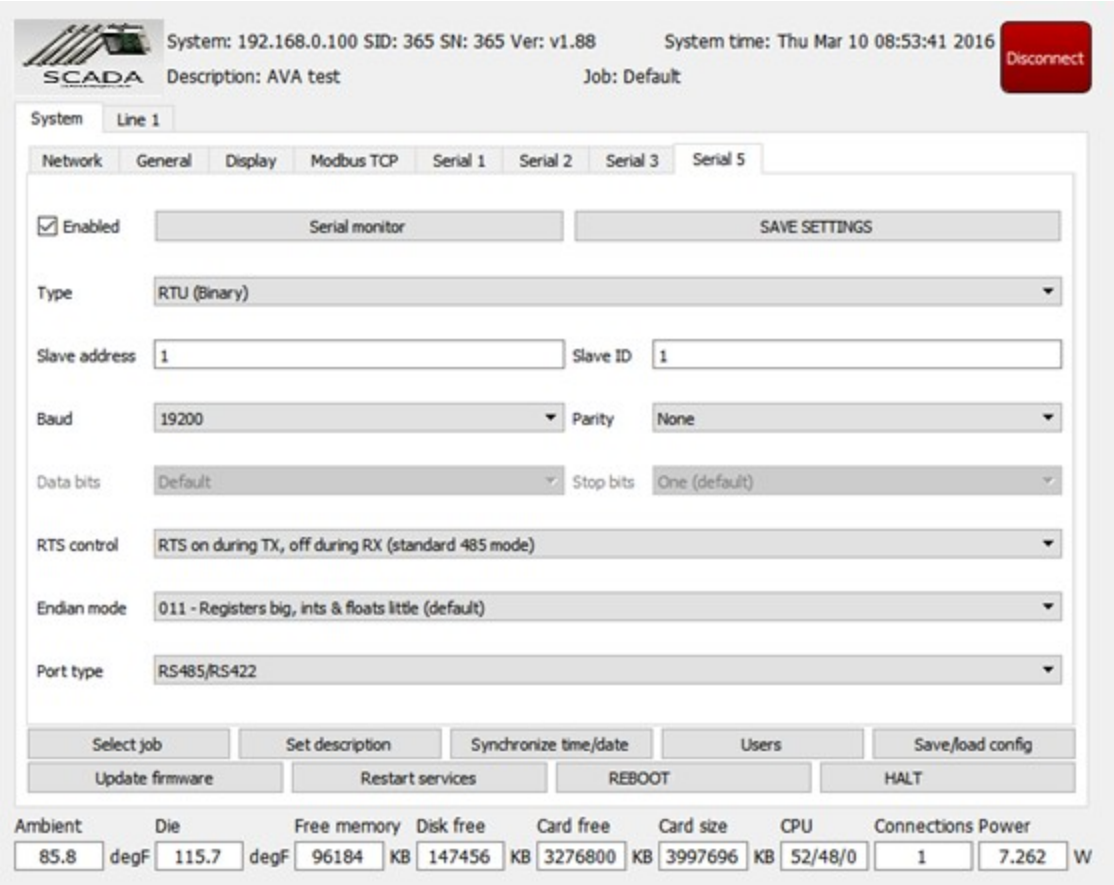
For RS485 instead of RS422: tie the RxD- and TxD- pins together (2 & 3), as well as the TxD+ and RxD+ pins (7 & 8).





MODBUS Software Setup

The MODBUS settings in the SCADA software are on the "System" tab. There's another row of tabs under the "System" tab for various options including the MODBUS port settings. Click the correct serial port tab there, usually "Serial port 5" for the green terminals. You should see a screen that looks like this:



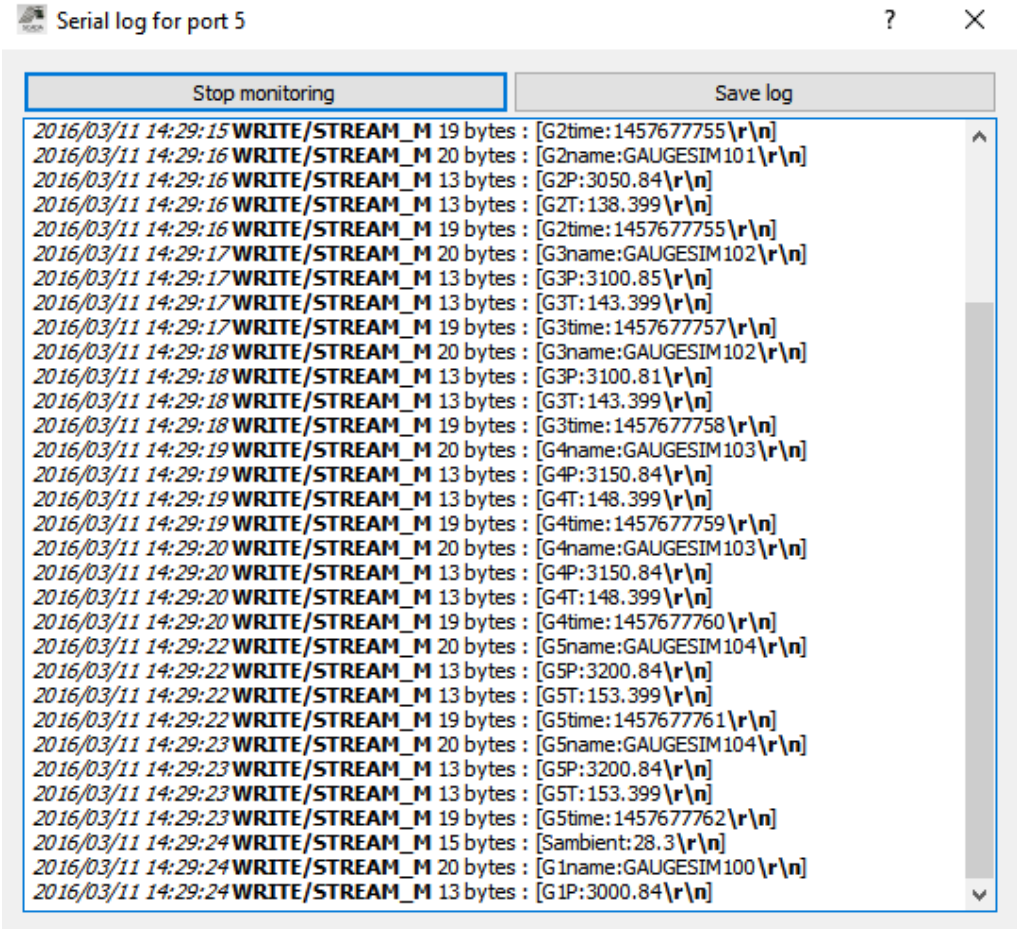
From here, set your slave address, slave ID, and serial port settings. The "RTS control" should stay in the "485 mode" shown. Ensure that the “Port type” setting matches the mode you need (RS232 or RS485/RS422).

IMPORTANT: make sure to click the "SAVE SETTINGS" button after you change anything on this page. You should then click “Restart services” and reconnect to the unit when it’s done restarting.

Unfortunately, different MODBUS systems tend to organize data differently, so you'll very possibly need to experiment with the endian settings and possibly even the register numbers on the other end (some software uses 0-based registers, so that 30001 would be 0 or 1. Others have even used 30000 for register 30001) There doesn't even seem to be a 'most common' endian setting. The only thing that tends to go together would be the last two numbers... so there are commonly only 4 settings to try (000, 011, 100, 111).

Once you wire up the system and enable the serial port with the checkbox shown (port 1 probably comes enabled by default), then you should be able to poll registers. Try 30001. If that fails to give any value then try 0, 1, and even 30000. These must be read as input registers (MODBUS function code 04), not holding registers. Once you get a value, then go to the SCADA software and start trying different endian modes (remembering to hit "SAVE SETTINGS" between attempts) and you should find a combination that works for your software.

There is a “Serial monitor” which should greatly aid in getting the initial communications up and running. To use this, press the “Serial Monitor” button on the serial port tab you want to monitor. All traffic sent and received by the unit will be displayed on this monitor screen. Below is an example of the serial monitor logging data being sent by the SCADA unit.



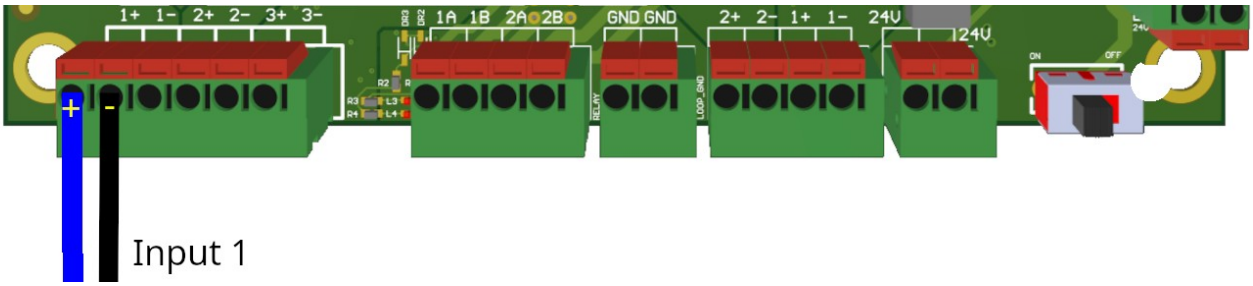
The format is consistent between different data types. The sections are:

- Date/time of the data sent/received
- Direction and format of the data
    - WRITE or READ – data sent or received by the unit
    - <format> - the format of the data sent/received
- Length of data
- [<data>] – data displayed in a user-friendly way

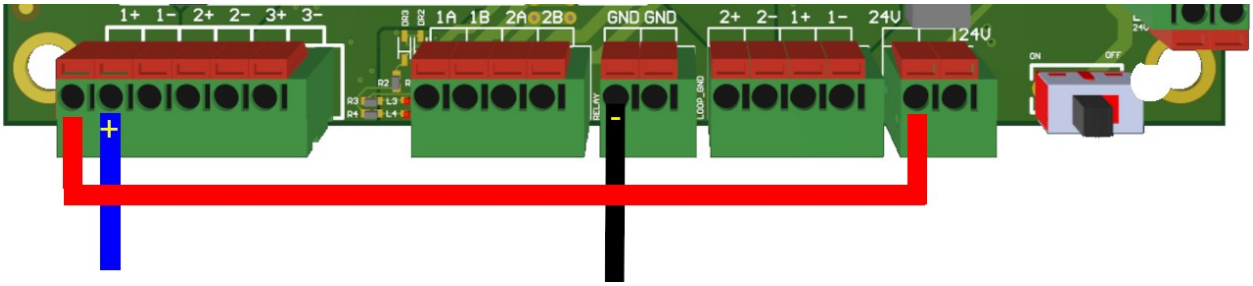
Amarok Lite Peripherals: 4/20 Inputs

The Amarok Lite can have up to three 4/20 inputs. They can be configured for either internal or externally supplied loop power. Here are some examples:

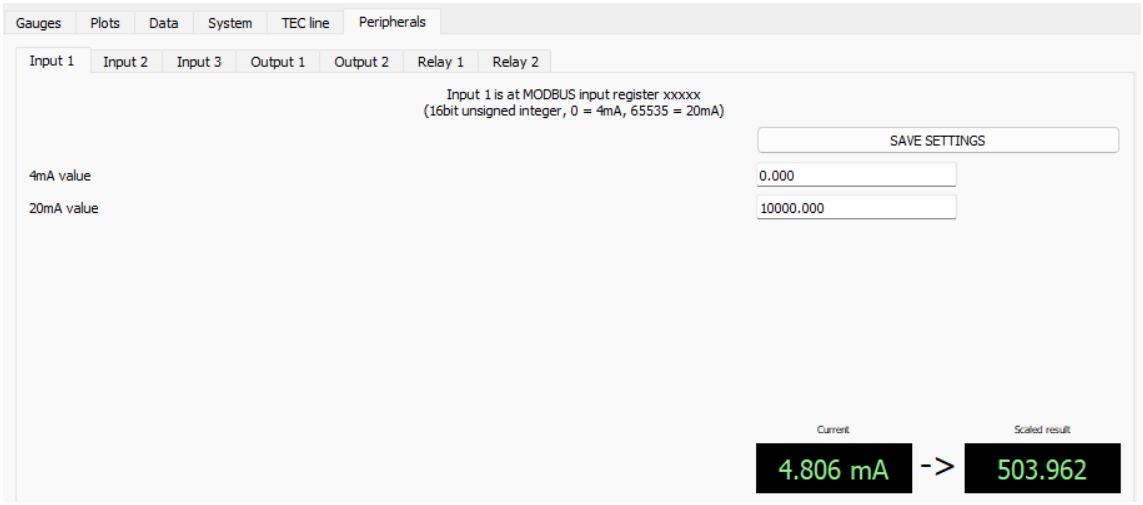
One 4/20 input, externally powered:



One 4/20 input, loop power provided by Amarok Lite:



These function the same way in the software. To configure a 4/20 input, go to the "Peripherals" tab, then choose the "Input 1" tab (or 2 or 3) under that:

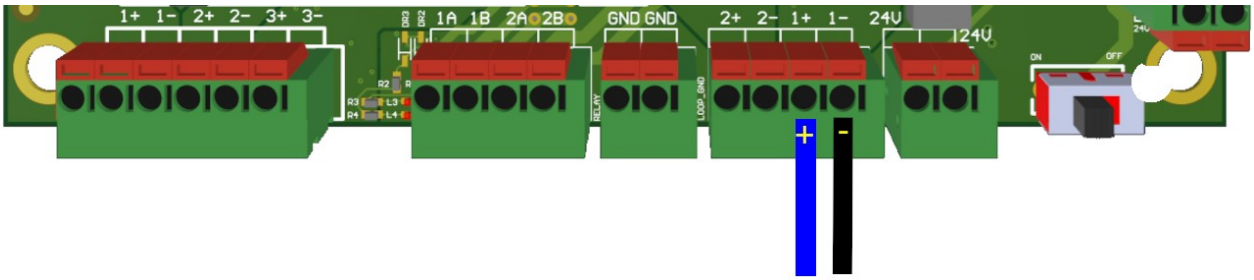


Enter the value that should be output on the MODBUS register when the input is 4mA in the "4mA" text field. Enter the value for 20mA in the "20mA" field. The above example writes 5000 in the MODBUS register when the value is 12mA. Remember to hit "SAVE SETTINGS" after changes are made.

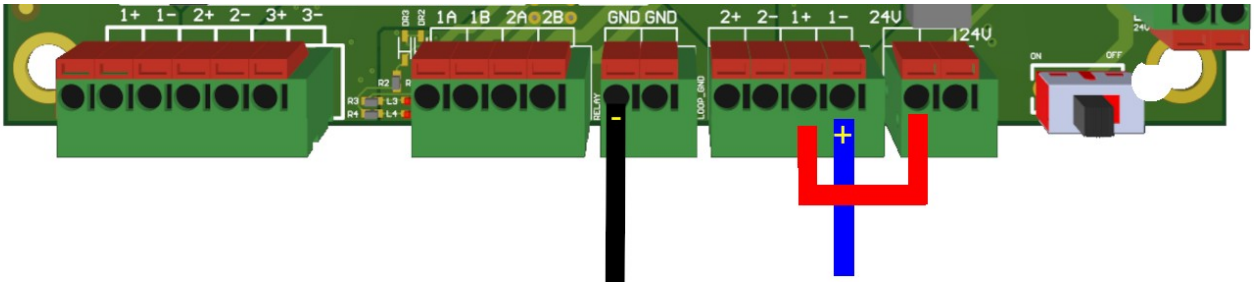
Amarok Lite Peripherals: 4/20 Outputs

The Amarok Lite can have up to two 4/20 outputs. They can be configured for either internal or externally supplied loop power. Here are some examples:

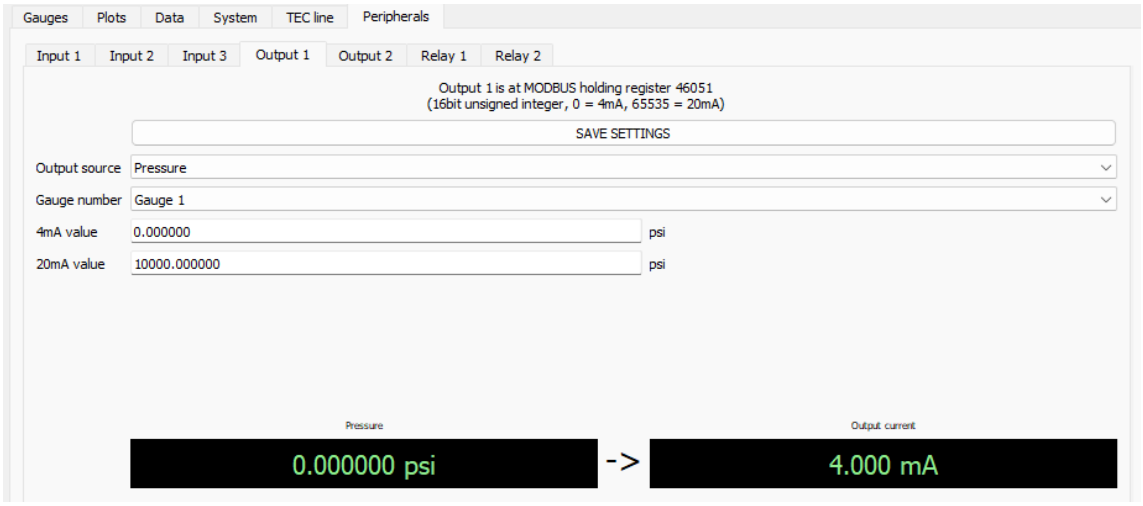
One 4/20 output, externally powered:



One 4/20 output, loop power provided by Amarok Lite:



These function the same way in the software. To configure a 4/20 output, go to the “Peripherals” tab, then choose the “Output 1” tab (or 2) under that:

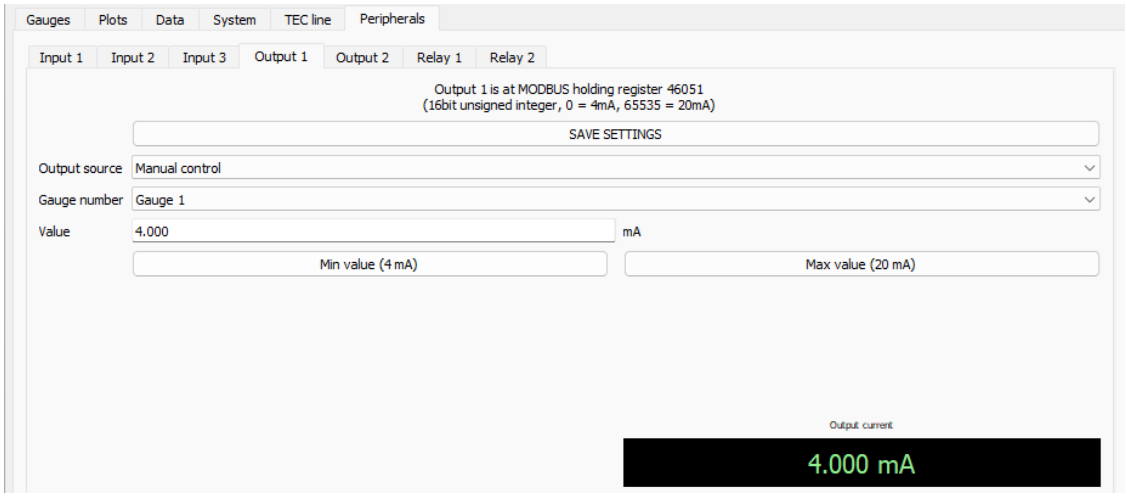


Choose a source for the data that is output on the 4/20 loop. In the above example, gauge #1’s pressure value will be output on the 4/20 line. To choose which gauge feeds the output, use the “Gauge number” dropdown. These numbers are the same as the order on the “TEC line” page.

A 0 psi value will output 4mA, and a 20mA value will be output for 10,000 psi.

Remember to hit “SAVE SETTINGS” when any changes are made!

You can also output a fixed, manual value. To do that, choose “Manual control” on the “Output source” dropdown.



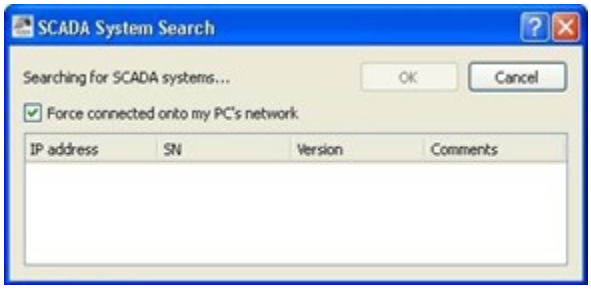
Here, just enter the desired output current in the “Value” text field. You can also quickly set this value to 4mA with the “Min value (4 mA)” button, as well as 20mA with the “Max value (20 mA)” button. Again, “SAVE SETTINGS” must be pressed if any changes are made.

System Updates

Extract the ZIP file into a temporary folder and run the “setup.exe” to install the new software. You do not need to remove the old version first.

Once that's complete, start the SCADA software.

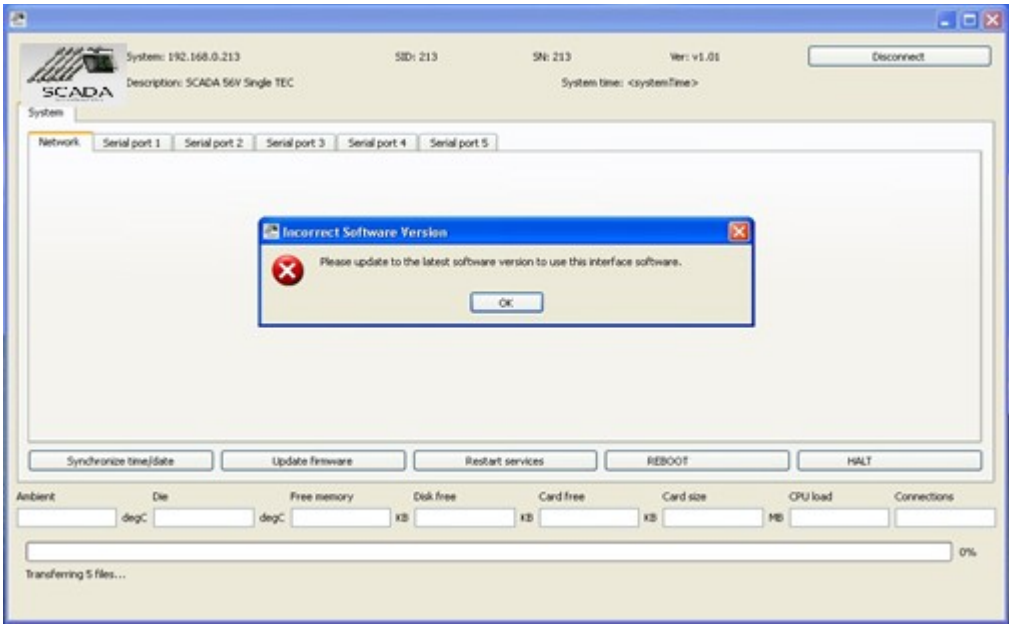
Connect to a unit. If there is no local network, then you must connect directly to the unit, wait for Windows to generate a random IP address, and then click “Search” on the PC software. Check the “Force SCADA onto my PC's network” checkbox to tell the SCADA to configure itself to talk to you:



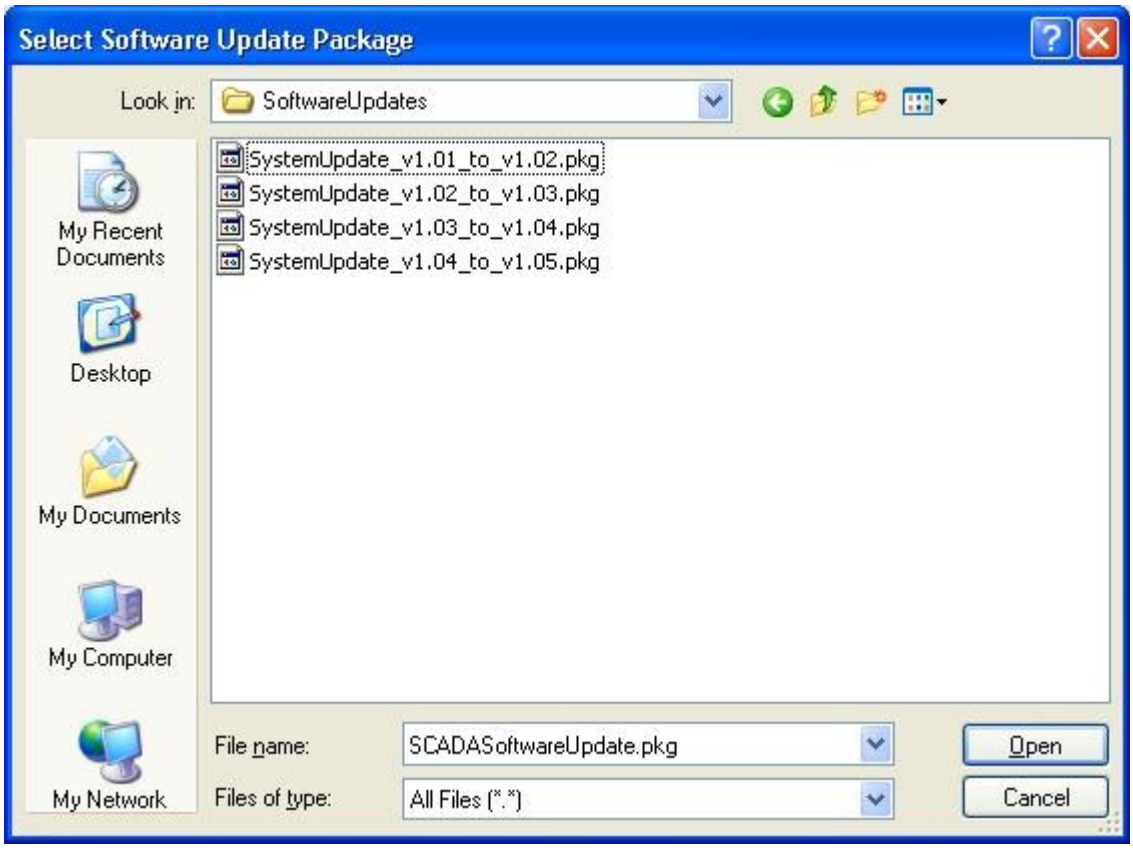
While this checkbox is enabled and this search window is open, any SCADA units that can receive the search requests will change their IP address to a random IP on your PC's network. If there are any other systems on the network besides your PC, this might collide with an existing IP address. Because of this, the SCADA units will reconfigure to a new random IP address every 30 seconds that this dialog is open.

If the SCADA unit and your computer are both on a normal network or a router / Wi-Fi router with DHCP enabled (usually the case for routers), do NOT select the “Force SCADA onto my PC’s network” checkbox.

Once you connect to a unit, it may display a warning that the unit's software is out of date:



You should click the “Update firmware” button near the bottom, click the browse button (“...”), and find the “SystemUpdate_v1.08.pkg” file under the “SoftwareUpdates” folder:



Click “APPLY” to send the update to the unit.

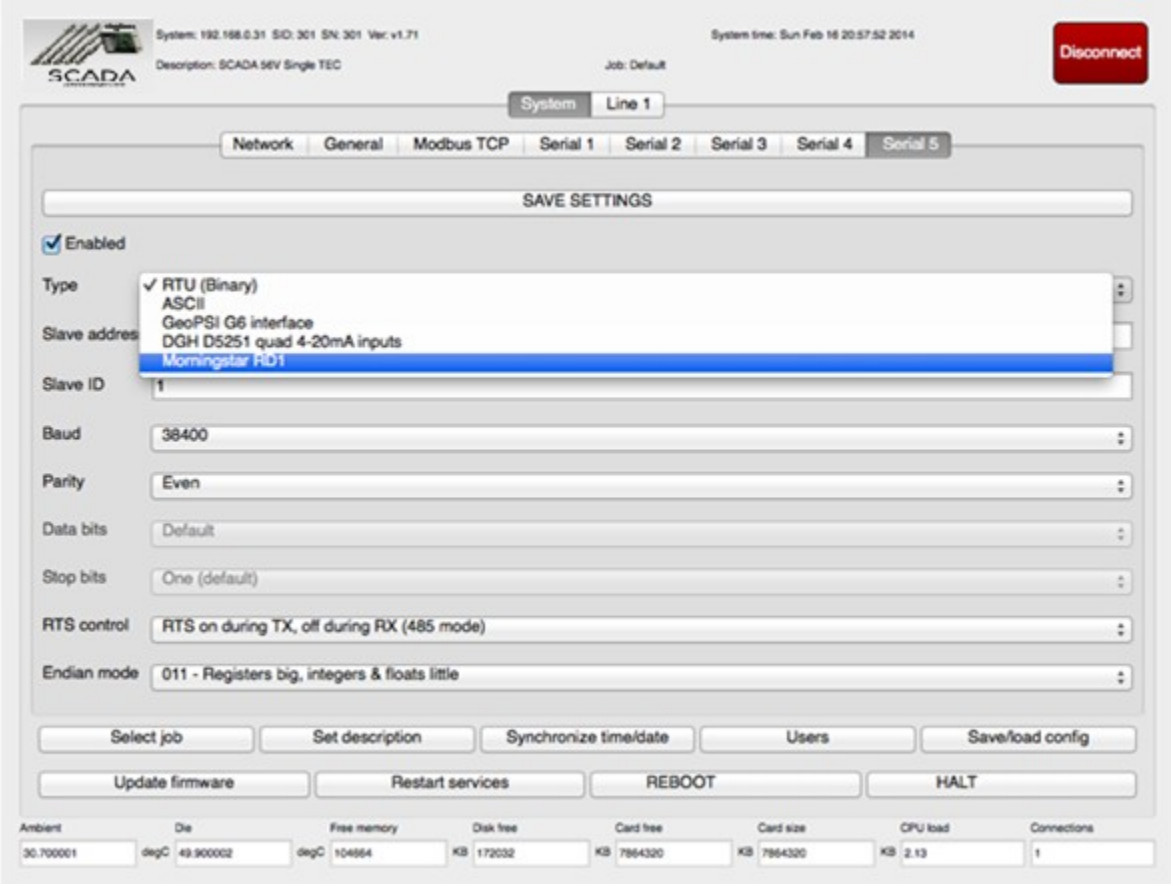
The unit will disconnect, apply the update, and restart its firmware. You will need to reconnect. The unit may not let you connect for a minute or so while it restarts.

Configuring Morningstar RD-1 Solar Battery Monitor

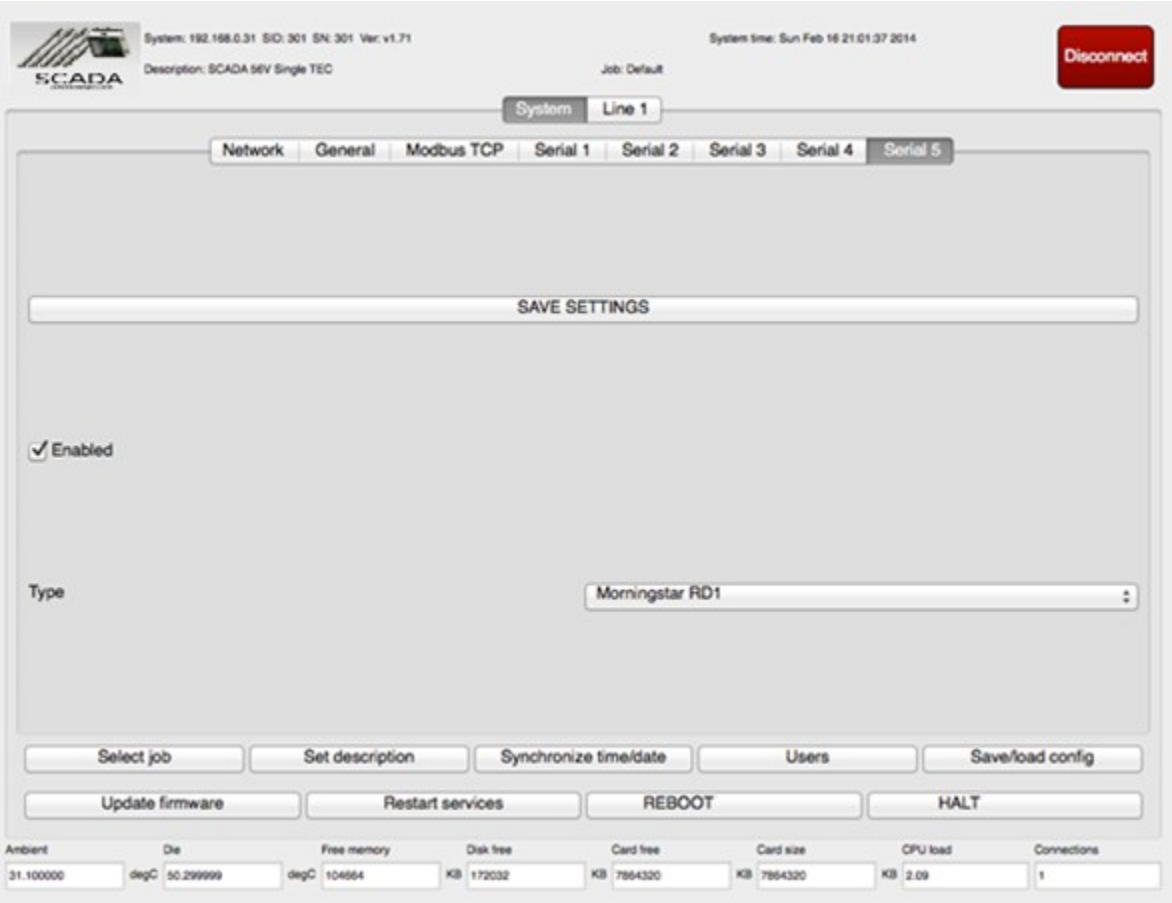
1) Connect to the SCADA unit.

2) Navigate to the System tab, and the “Serial 5” tab under that section.

3) Click the “Type” dropdown, and select “Morningstar RD1” from the dropdown:



4) The screen should now look like this:

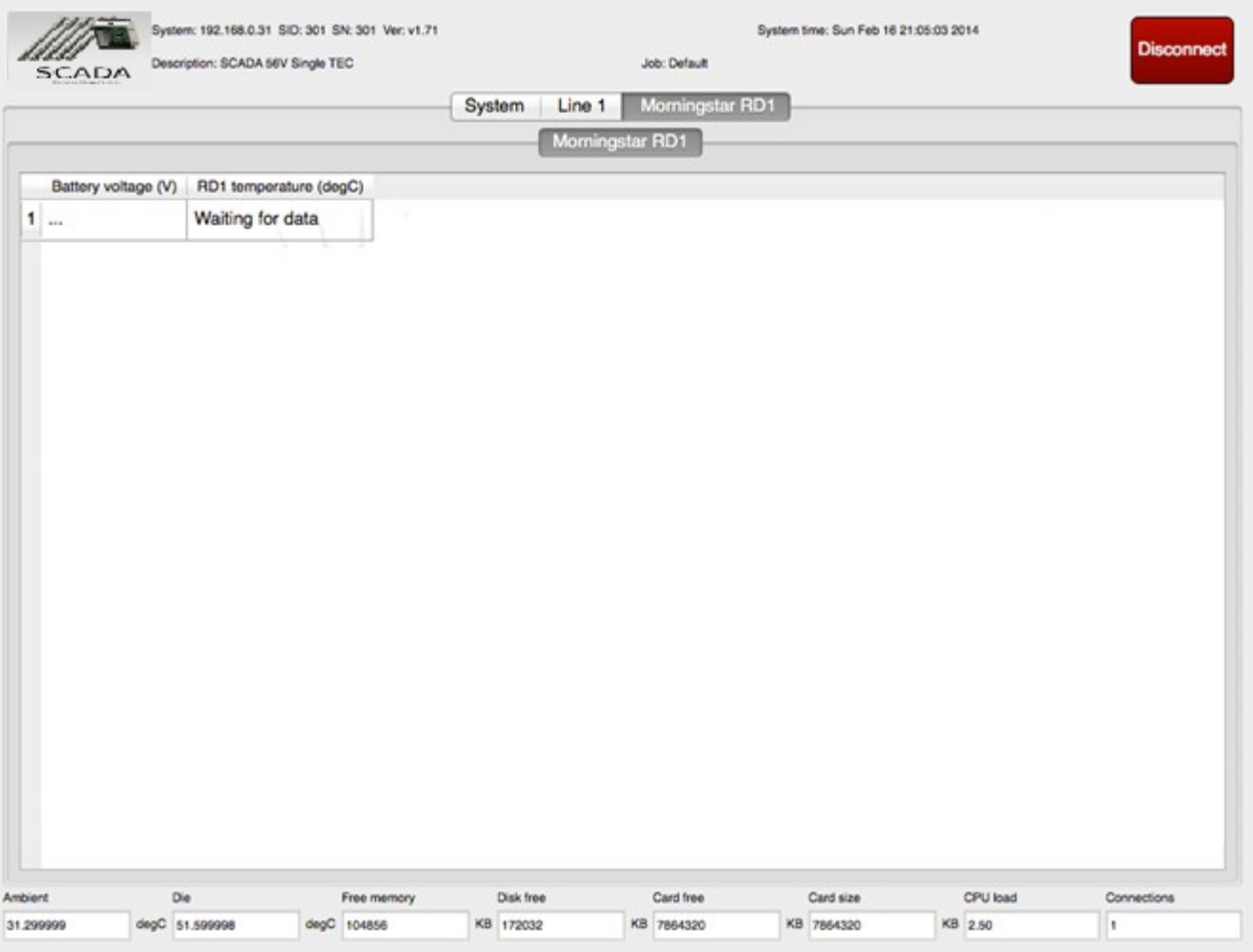


5) Make sure the “Enabled” checkbox is checked.

6) Click the “SAVE SETTINGS” button.

7) Click the “Restart services” button. The SCADA will disconnect and restart its services with the Morningstar RD1 enabled.

8) Reconnect. You should now see a “Morningstar RD1” tab. Selecting it will show you a screen displaying the measured battery voltage and RD1 temperature:

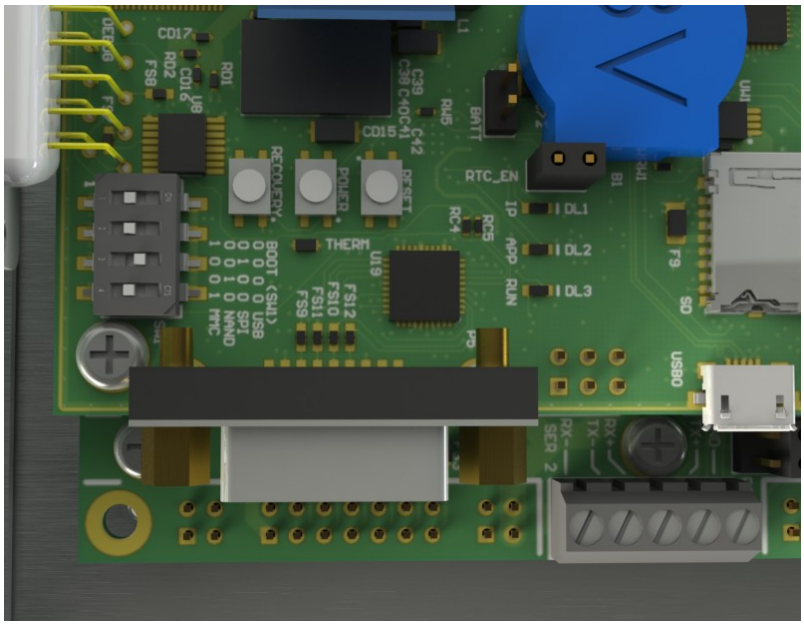


REMINDER: To export RD1 values with your data, be sure to click the “Export Morningstar-RD1 data” checkbox on the Export Data screen.

Installing a DGH D5251 (quad input 4-20mA module)

In case you don't have a pre-wired D5251 module, here's a wiring diagram.

Wire up to the black 5 pin connector on the bottom of the backplane board. The black connector (shown in gray on the bottom-right in the image below) corresponds to serial port 2 in the software.

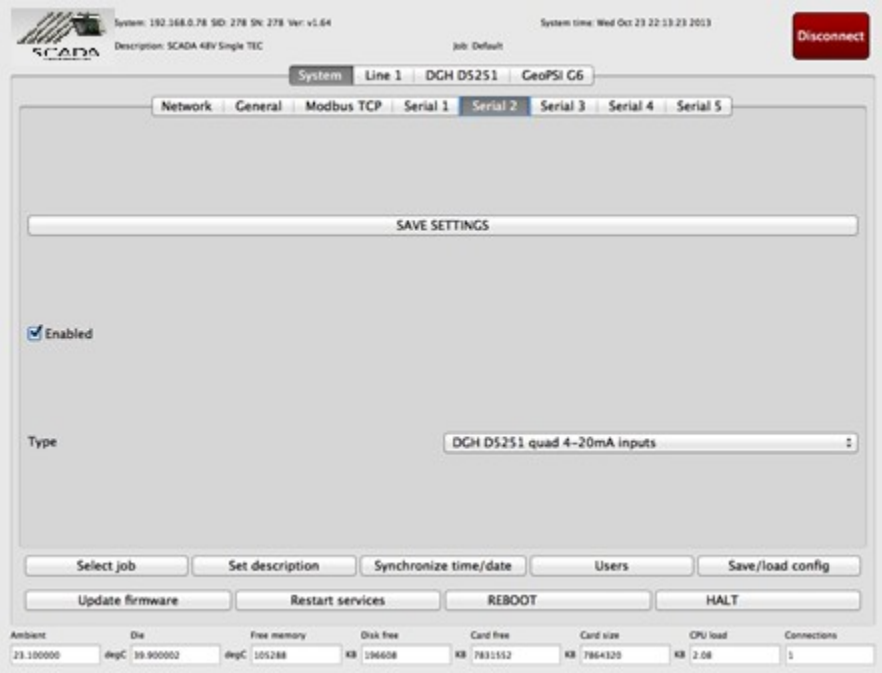


The “Serial port 2 RX from CPU” wire should be wired to pin 1 on the board (labelled “RX-“), or the left-most pin. The “Serial port 2 TX from CPU” pin should be wired to pin 2 on the board (labelled “TX-“).

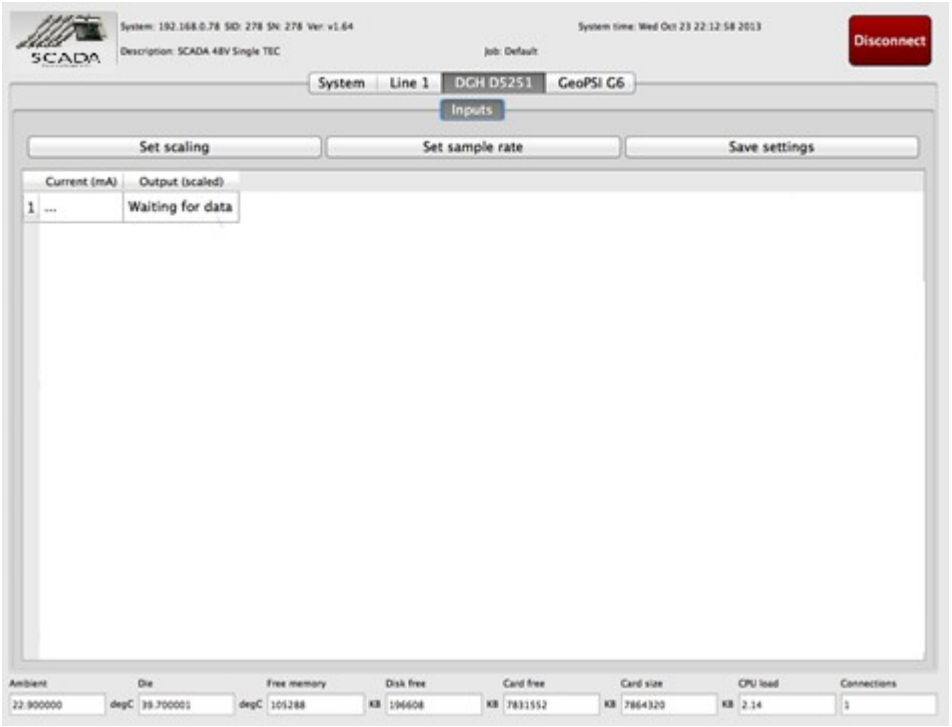
REMOVE the two jumpers if present on the three jumper locations on the upper right side of the black connector.

DGH-5251 Software Setup

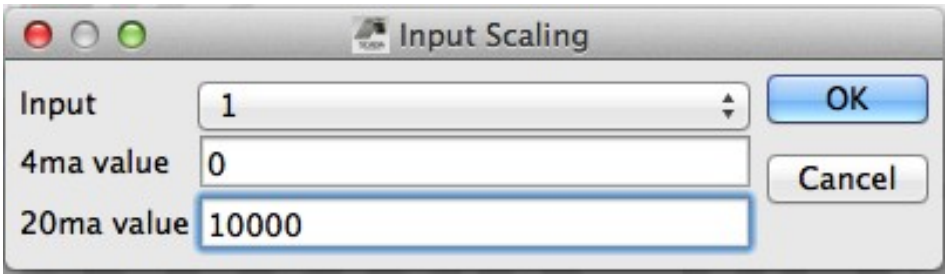
First, go to the System → Serial Port 2 page, and configure as shown on the screen. Set the “enabled” checkbox, and select “DGH D5251 quad 4-20mA inputs” from the “Type” dropdown. Select “RS232” if there is a port type field present. Be sure to hit “SAVE SETTINGS”, then click “Restart services” for the changes to take effect.



Once configured, there will be a “DGH D5251” tab when you connect to the SCADA. It will normally show four outputs here.



To configure the Output value, you will need to press the “Set scaling” button. There, enter the values that should be used for both the low (4mA) and high (20mA) values from the sensor. This defaults on a new install to 0-10000, for 10K psi pressure gauges. Click “Save Settings” on the main “DGH D5251” screen once this is done.



SCADAInterface

SCADA Command-Line Utility

Overview

The SCADAInterface command-line utility allows you to download data from SCADA units and export that data to CSV. The command-line nature of this tool allows for the inclusion of these processes in a nightly batch job schedule for automation purposes.

This document is intended as a guide for IT personnel to use to configure these automation processes. This is a potentially complex process, and as such this should not be the only reference used to set such a process up. Assistance is available to help this process along as needed.

This is a two-step process. First, you run the tool to download the raw data you want from the SCADA unit. Second, you run the tool again to create a CSV export file from the previously downloaded raw data.

Help

The basic command-line options are available through a help option. So, to get a quick help screen, just type:

```
SCADAInterface -h
```

Downloading Data

To download all available data, you can simply call the SCADAInterface utility with the IP-address of the unit you want to download data from as a parameter:

`SCADAInterface <ip-address-of-box>` (ex: SCADAInterface 192.168.0.213)

If you want to limit the date range, then one way would be to use the `-st` or `-rsdo` options:

```
SCADAInterface 192.168.0.213 -st 20130601000000
```
(this starts at 6/1/2013 at midnight)

<OR>

```
SCADAInterface 192.168.0.213 -rsdo 1
```
(this starts at midnight yesterday)

The format for the `-st` and `-et` options is "yyyyMMddhhmmss". The `-rsdo` option parameter is the number of days ago. So, `-rsdo 2` would be the day before yesterday.

It's usually easier in an automation environment to have a fixed script to call every night or so. To that end, you can select dates and times to download and export using a relative time syntax.
To select yesterday's data, use `-rsdo 1 -redo 1`, which means "relative start date offset" and "relative end date offset". By default, `-rsdo` uses 00:00:00 on the given date, and `-redo` uses 23:59:59 on the given date. You can further limit this with `-rsto` and `-reto`, which are times on the relative day to start or end at. So, to start exporting at 3:30am the day before yesterday and stop exporting on 5:15pm yesterday... use: `-rsdo 2 -rsto 033000 -redo 1 -reto 171500`. Most of the time you'll just want `-rsdo 1 -redo 1` to export the previous day's data.

Exporting Data

After downloading the data you want, you need to re-run the utility using different options to export that data to CSV format.

To create a CSV file, use the `-csv` option to give it a filename. You'll also need to include the `-sn` serial number and `-job` job name options at a minimum. If your job name has spaces in it, you'll need to put the entire job name in quotes ("). As before, specify time ranges using the `-rsdo` and `-redo` options.

It's easiest to verify the correct job name by connecting to the unit with the SCADA PC software. The current job name will be listed on the upper portion of the window when connected to a unit.

Here's an example:

```
SCADAInterface -nodownload -csv nightlyexport_sn234.csv -sn 234 -job
Default -rsdo 2 -redo 2 -linedata -sysdata
```

The export command should contain the `-nodownload` option. This will create the CSV file from data downloaded before. The CSV option must have local data to function... the tool can't get CSV files directly from the device. If you specified the download location (`-D <path>`) when you downloaded data, you will need to use that same parameter again on the export. Here's an example:

```
SCADAInterface -nodownload -D C:\temp\logs -csv
nightlyexport_sn234.csv -sn 234 -job Default -rsdo 1 -redo 1 -
linedata -sysdata
```

Sample Intervals

The tool will default to 1 minute intervals. If you want a different interval, the `-interval` option will change it. You could do `-interval 15` for 15 second intervals... `-interval 300` for 5 minute intervals, etc. The sensors require just over 2 seconds per sample and must be read sequentially... so if you have say 4 gauges connected a complete cycle would take 8-10 seconds.

Re-imaging a SCADA system with the Recovery SD card

1) Make sure you have the right recovery SD card. The recovery SD cards have a red “R” on them, and come in a clear case marked with a red “R”:

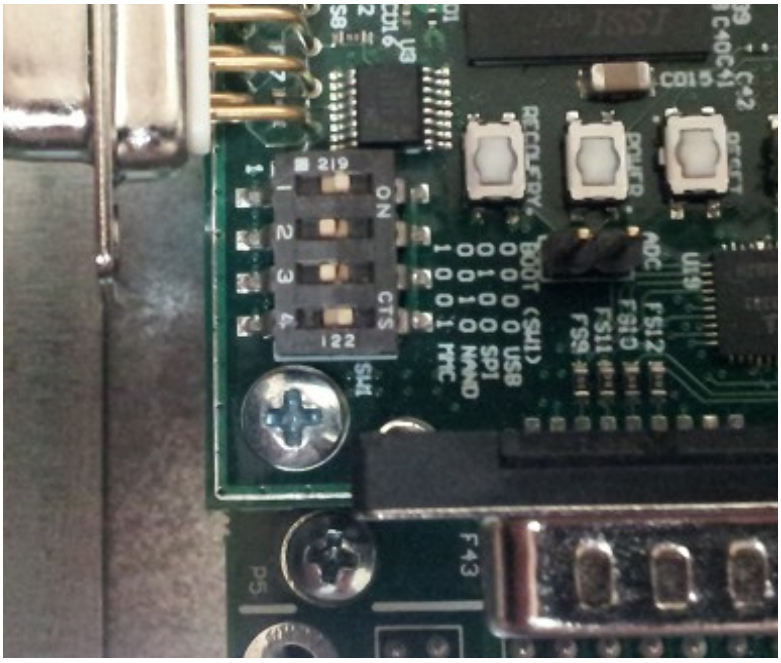
2)

Switch the power to the unit off.

3) Remove the data SD card from the card slot and place it somewhere safe.

4) Insert the Recovery SD card into the card slot.

5) Configure the boot DIP switch “SW1” to “1 0 0 1” as shown:



6) **For serial numbers below 300:** Connect the SCADA unit to a computer or simply to a switch. The need here is to monitor the SCADA system's Ethernet lights. **For serial numbers 300 and above:** This step is not necessary. Lights on the CPU card will blink instead.

7) Power on the SCADA system.

8) In about half a minute or so, the Ethernet lights should turn on if the unit is connected. Around that point, a 30 second countdown will begin before the Recovery SD card starts re-imaging the unit.

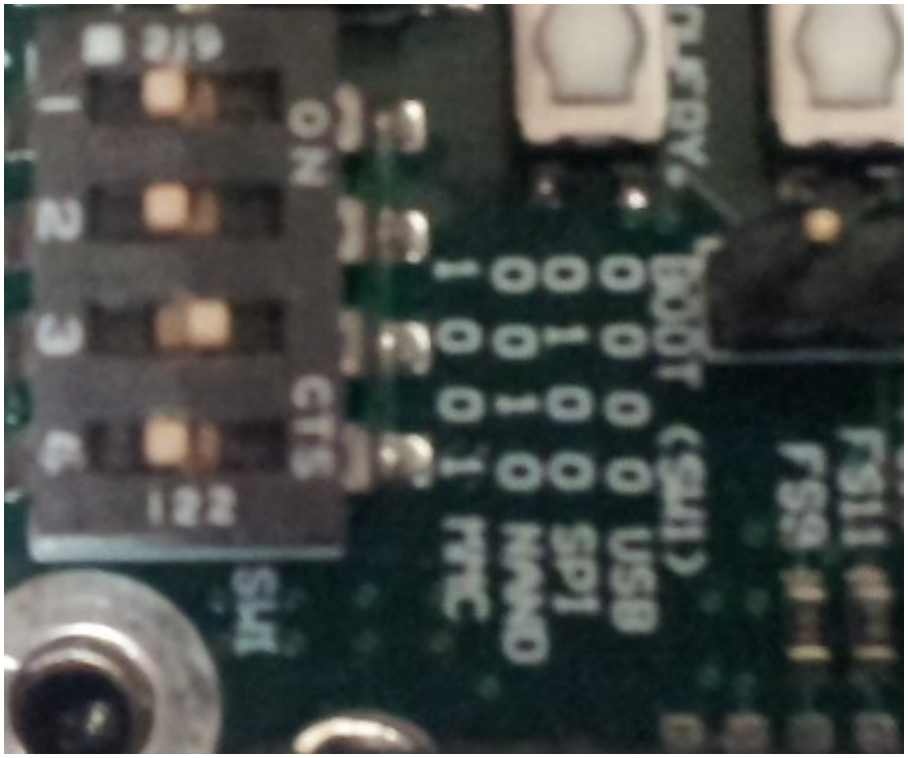
9) **For serial numbers below 300:** The Ethernet lights should start to cycle when the re-image operation is complete. This will be approximately 5-10 seconds on, 5-10 seconds off. **For serial numbers 300 and above:** The “IP” and “APP” lights should start to blink together on and off every second. This should be approximately 6-9 minutes after the system booted up.

10) Switch the power to the unit off again.

11) Remove the Recovery SD card from the card slot and put it back in its case for safe keeping.

12) Insert the data SD card you removed in step #3 back into the card slot. Make sure it is correctly inserted.

13) Now, toggle the boot DIP switch “SW1” back to the original “0 0 1 0” position as shown:



14) You're done! Turn the unit on and configure it with the PC software.

SCADA Platform MODBUS Map

Register	Width	Description	Units	Format
0-9999		Reserved		
10001-19999		Reserved		
30001	2	Gauge 1 Pressure	Psi	32bit float
30003	2	Gauge 2 Pressure	Psi	32bit float
…	…	…	…	…
30099	2	Gauge 50 Pressure	Psi	32bit float
30101	2	Gauge 1 Pressure	Kpa	32bit float
30103	2	Gauge 2 Pressure	Kpa	32bit float
…	…	…	…	…
30199	2	Gauge 50 Pressure	Kpa	32bit float
30201	2	Gauge 1 Pressure	Mpa	32bit float
30203	2	Gauge 2 Pressure	Mpa	32bit float
…	…	…	…	…
30299	2	Gauge 50 Pressure	Mpa	32bit float
30301	2	Gauge 1 Pressure	Bar	32bit float
30303	2	Gauge 2 Pressure	Bar	32bit float
…	…	…	…	…
30399	2	Gauge 50 Pressure	Bar	32bit float
30400-30500		Reserved		
30501	2	Gauge 1 Temperature	°F	32bit float
30503	2	Gauge 2 Temperature	°F	32bit float
…	….	….	….	….
30599	2	Gauge 50 Temperature	°F	32bit float
30601	2	Gauge 1 Temperature	°C	32bit float

30603	2	Gauge 2 Temperature	°C	32bit float
…	….	….	….	….
30699	2	Gauge 50 Temperature	°C	32bit float
30700-30850		Reserved		
30851	1	Gauge 1 Status Bitmask	b0=enabled b8=timeout b9=comm error b10=sensor error	16bit unsigned
30852	1	Gauge 2 Status Bitmask	“	16bit unsigned
…	…	…	…	…
30900	1	Gauge 50 Status Bitmask	“	16bit unsigned
30901	2	Gauge 1 Reading Timestamp	Unix time_t	32bit unsigned
30903	2	Gauge 2 Reading Timestamp	Unix time_t	32bit unsigned
…	…	…	…	…
30999	2	Gauge 50 Reading Timestamp	Unix time_t	32bit unsigned
31001	10	Gauge 1 Name	Text	20 bytes
31011	10	Gauge 2 Name	Text	20 bytes
…	…	…	…	…
31491	10	Gauge 50 Name	Text	20 bytes
31501	1	Gauge 1 Error Count	does not roll over	16bit unsigned
31502	1	Gauge 2 Error Count	“	16bit unsigned
…	…	…	…	…
31550	1	Gauge 50 Error Count	“	16bit unsigned
31551-33000		Reserved		
33001	2	Input 1 Reading	If 4-20mA, mA	32bit float
33003	2	Input 2 Reading	If 4-20mA, mA	32bit float
…	…	…	…	…
33099	2	Input 50 Reading	If 4-20mA, mA	32bit float
33101	2	Input 1 Scaled	User scaled value (0-	32bit float

			10000 psi, etc)	
33103	2	Input 2 Scaled	User scaled value	32bit float
…	…	…	…	…
33199	2	Input 50 Scaled	User scaled value	32bit float
33201	1	Input 1 Reading	Scaled 0-25mA → 0-65535	16bit unsigned
33202	1	Input 2 Reading	Scaled 0-25mA → 0-65535	16bit unsigned
…	…	…	…	…
33250	1	Input 50 Reading	Scaled 0-25mA → 0-65535	16bit unsigned
33251-33300		Reserved		
33301	10	Input 1 Name	Text	20 bytes
33311	10	Input 2 Name	Text	20 bytes
…	…	…	…	…
33799	10	Input 50 Name	Text	20 bytes
33801	1	Input 1 Status Bitmask	b0=open (<1mA) b1=shorted (>23mA)	16bit unsigned
33802	1	Input 2 Status Bitmask	“	16bit unsigned
…	…	…	…	…
33850	1	Input 50 Status Bitmask	“	16bit unsigned
33851-36020		Reserved		
36021	5	System Serial Number	Text	10 bytes
36026	10	Reserved		
36036	5	System Application Version	Text	10 bytes
36041	30	Reserved		
36071	30	System Description	Text	60 bytes
36101	1	System Gauge Count		16bit unsigned
36102	1	System Input Count		16bit unsigned
36103	2	System Ambient Temperature	°C	32bit float

36105	2	System CPU Temperature	°C	32bit float
36107	2	System CPU Load	Unix load metric	32bit float
36109	2	System Timestamp	Unix time_t	32bit unsigned
36111	2	System Memory Free	KB	32bit unsigned
36113	2	System Storage Free, Internal	KB	32bit unsigned
36115	2	System Storage Free, Memory Card	KB	32bit unsigned
36117	1	Reserved		
36118	1	System Memory Card Size	MB	16bit unsigned
36119-36200		Reserved		
36201	2	Gauge Line #1 Voltage	Volts	32bit float
36203	2	Gauge Line #2 Voltage	Volts	32bit float
…	...	...	...	...
36209	2	Gauge Line #5 Voltage	Volts	32bit float
36211	2	Gauge Line #1 Current	mA	32bit float
36213	2	Gauge Line #2 Current	mA	32bit float
…	…	…	…	…
36219	2	Gauge Line #5 Current	mA	32bit float
36221	2	Battery Voltage	Volts	32bit float
36223	2	Battery Monitor Temperature	°C	32bit float
36225-40000		Reserved		
40001	2	Gauge 1 Pressure (current minute)	Select using register 49971	32bit float
40003	2	Gauge 1 Pressure (1 minute old)	“	32bit float
...	...	...	...	...
40029	2	Gauge 1 Pressure (14 minutes old)	“	32bit float
40031	2	Gauge 2 Pressure (current minute)	“	32bit float
...	...	...	...	...
41499	2	Gauge 50 Pressure (14 minutes old)	“	32bit float

41500-42000		Reserved		
42001	2	Gauge 1 Temperature (current minute)	Select using register 49972	32bit float
42003	2	Gauge 1 Temperature (2 minutes old)	“	32bit float
…	…	…	...	…
42029	2	Gauge 1 Temperature (14 minutes old)	“	32bit float
42031	2	Gauge 2 Temperature (current minute)	“	32bit float
…	…	…	…	…
43499	2	Gauge 50 Temperature (15 minutes old)	“	32bit float
43500-47000		Reserved		
47001	2	Gauge 1 historical data T+0 (configure from 49971-49980)	As configured	32bit float
47003	2	Gauge 1 historical data T+1	As configured	32bit float
…	…	…	…	…
47029	2	Gauge 1 historical data T+14	As configured	32bit float
47031	2	Gauge 2 historical data T+0	As configured	32bit float
…	…	…	…	…
48499	2	Gauge 50 historical data T+14	As configured	32bit float
48500-49970		Reserved		
49971	1	Pressure units selection for 40001 – 41499	0 = PSI, 1 = KPa, 2 = Mpa, 3 = Bar	Default 0
49972	1	Temperature units selection for 42001 – 43499	0 = °F, 1 = °C	Default 0
49973	1	Historical data type for 47001 - 48499	0 = Pressure, 1 = Temperature	Default 0
49974	1	Historical data units selection for 47001 – 48599 (this must be set before running the query, cannot be changed after)	If configured for pressure, same as 49971 else same as 49972	Default 0

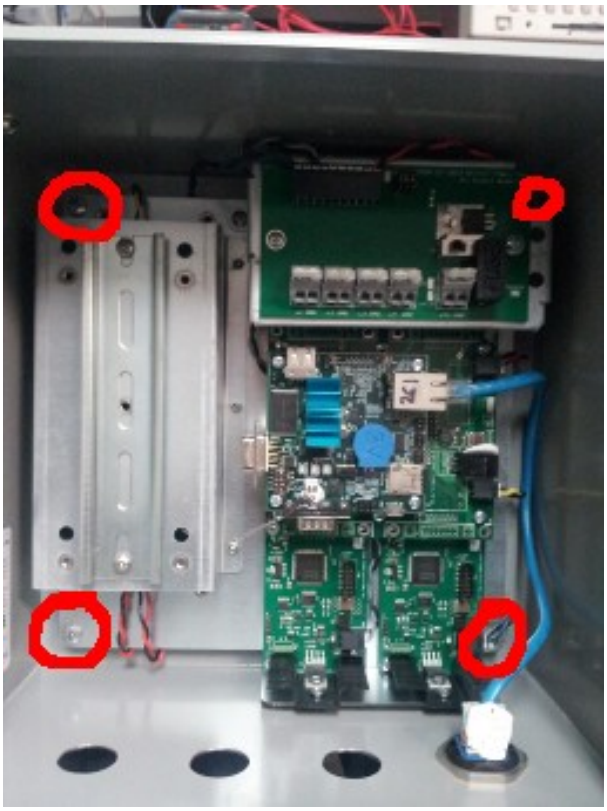
49975	1	Historical data start year (UTC/GMT)	2013+	
49976	1	Historical data start month (UTC/GMT)	1-12	
49977	1	Historical data start day (UTC/GMT)	1-31	
49978	1	Historical data start hour (UTC/GMT)	0-23	
49979	1	Historical data start minute (UTC/GMT)	0-59	
49980	1	Historical data start second (UTC/GMT)	0-59	
49981	1	Historical data command NOTE: write a value of 1 to start the historical data query (registers 49973 – 49980 must be prepopulated) Registers 49973-49981 will be cleared to 0 until the query is complete. This register will read 1 when the last query is ready. Notice that the data order for the historical data is in increasing time order (oldest first), while the data in the 40001-41449 & 42001-43499 sets is in decreasing time order (newest first).	1=lookup data	
49982-49996		Reserved		
49997	1	MODBUS Byte Order	0=big endian (STANDARD), 1=little endian	
49998	1	MODBUS 32bit Integer Word Order	0=MSB in lower register (default), 1=MSB in upper register	
49999	1	MODBUS 32bit Float Word Order	0=word containing sign and exponent in lower register (default), 1=sign and exponent in higher register	

WITS Level 0 Map

Record	Index	Description	Units	Format
30	1-50	Pressure, gauges 1 – 50	Psi	32bit float
31	1-50	Temperature, gauges 1-50	°C	32bit float
32	1-50	Measurement timestamp, gauges 1-50	Unix time_t	32bit unsigned
33	1	System internal ambient temperature	°C	32bit float

Replacing a Gauge Interface Card

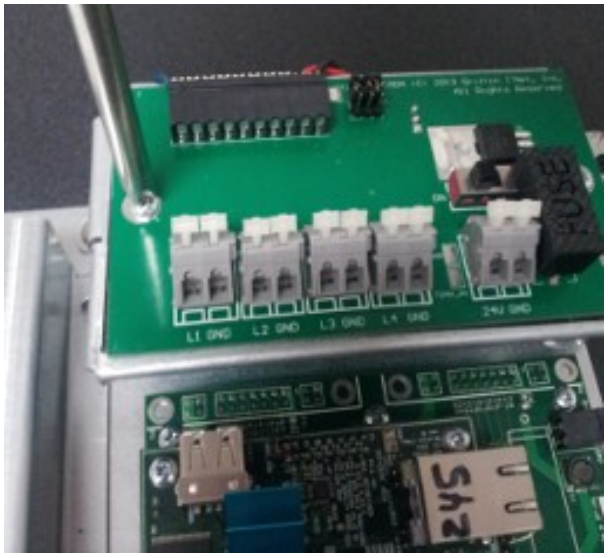
Remove the system from the enclosure. There are four screws in the corners of the back plate that must be removed in order to accomplish this.



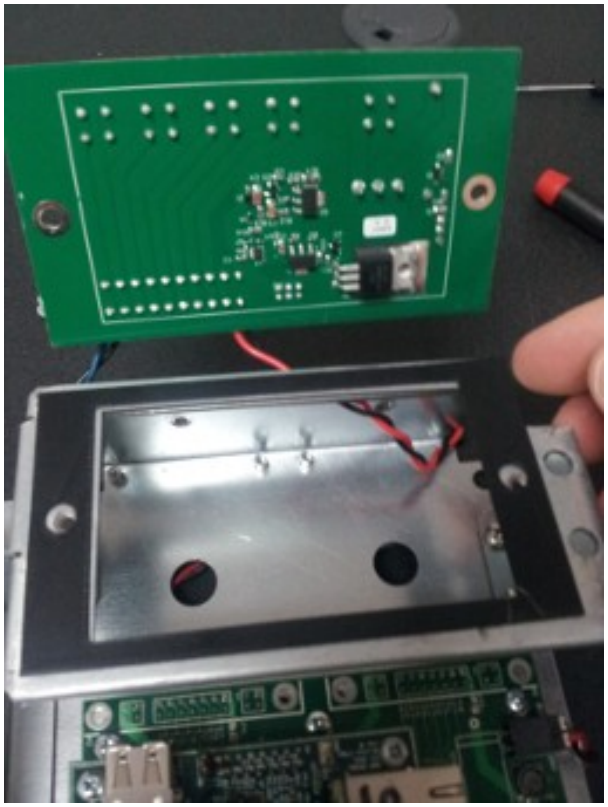
If the gauge card is underneath the access panel bracket, you will need to remove the bracket.

Removing the Access Panel Bracket

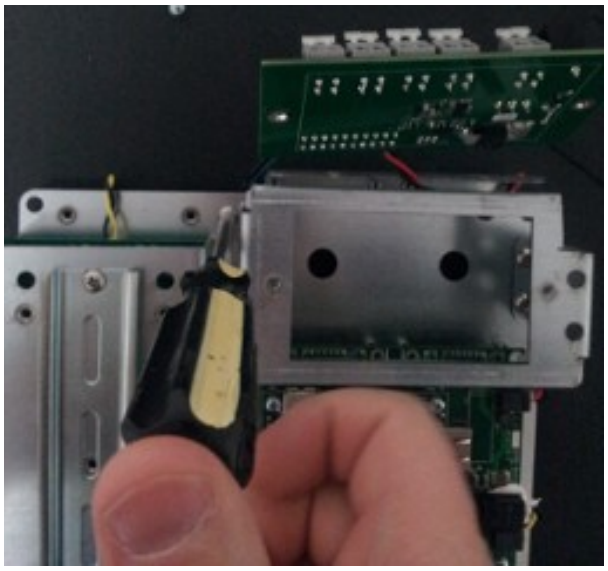
1) Unscrew the two screws on the access panel PCB:



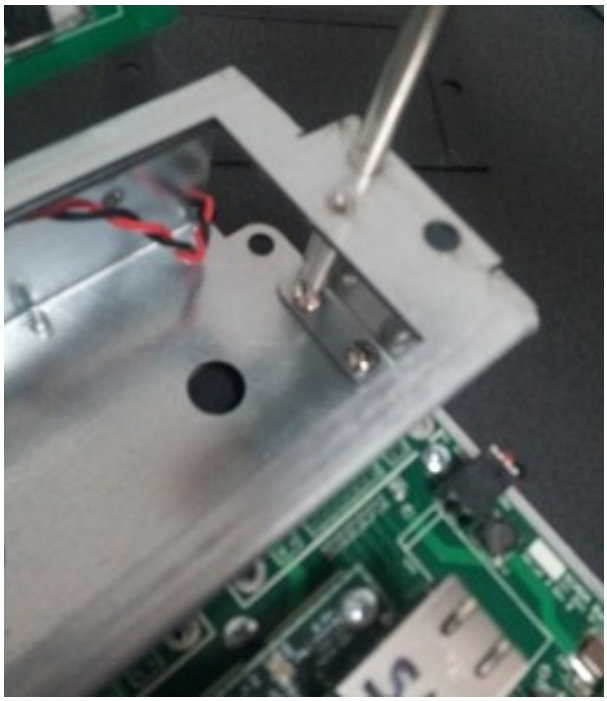
2) Rotate the access panel PCB up and out of the way, then remove the plastic insulator:



3) Unscrew the bracket. There is one screw on the left side:

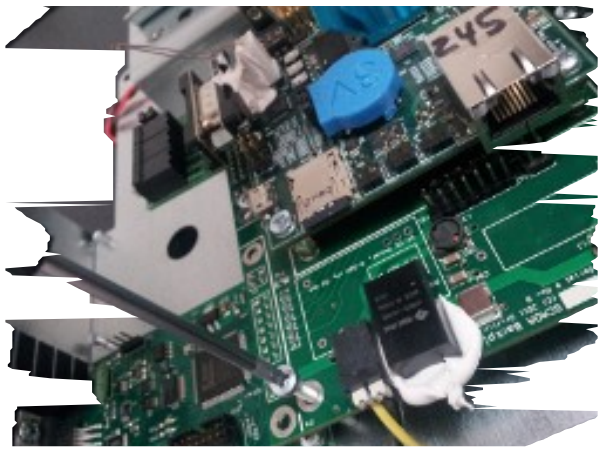


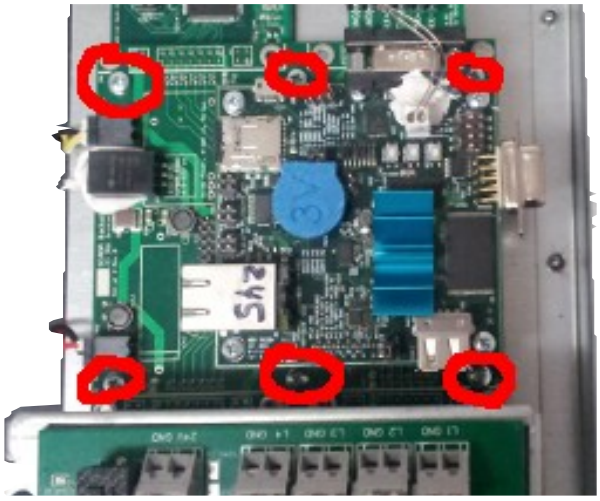
3) There are two more screws on the right. The right hand screws are accessed via the holes in the bracket itself.



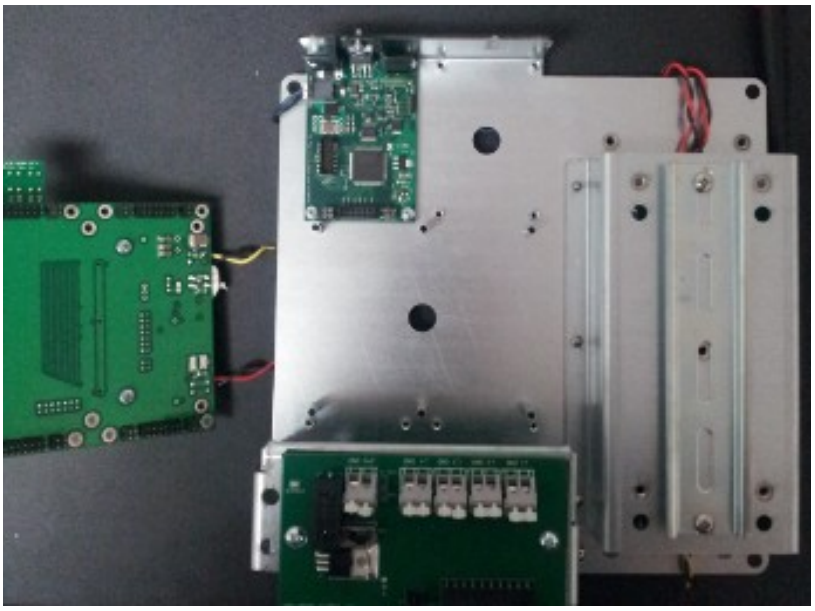
Replace the Gauge Interface Card

1) Unscrew the six screws from the backplane PCB:



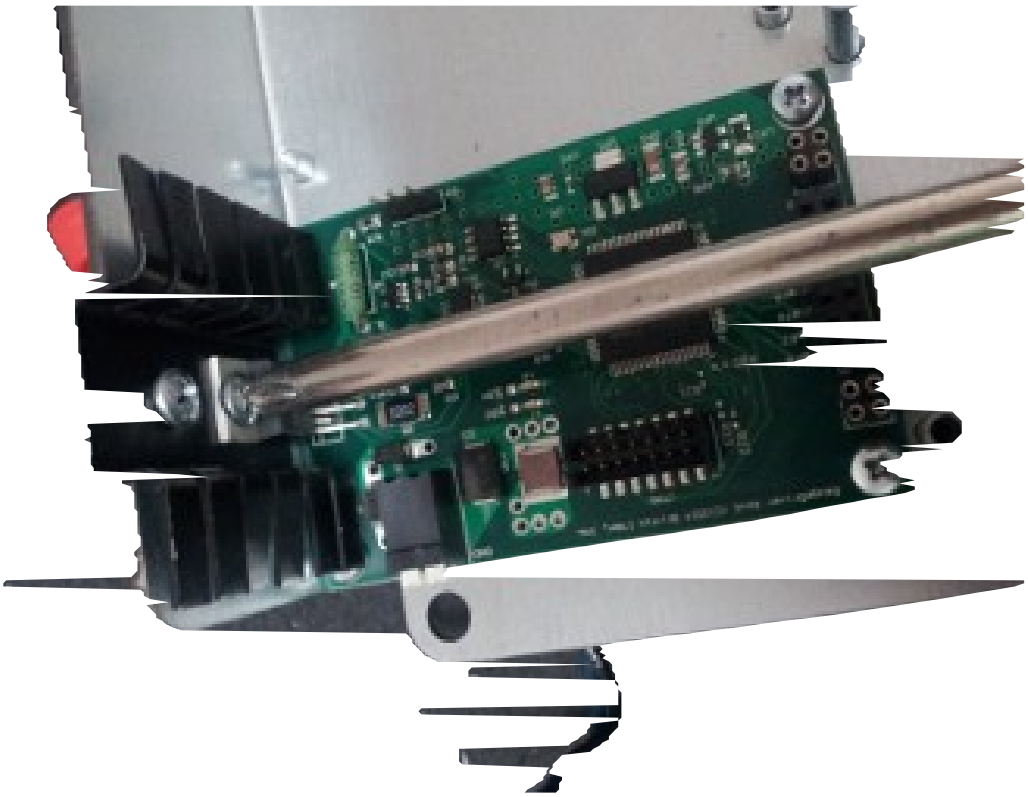


2) Lift evenly on the backplane board from both sides to pull it out without bending any pins. Once it is clear of the connectors, rotate the backplane board out to the side:

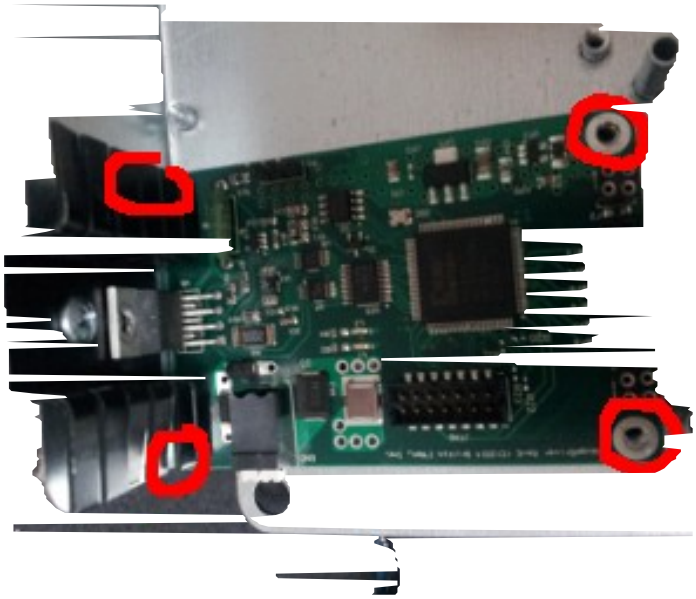


4) Remove the gauge line cable from the gauge interface card. Push in on the connector's white buttons to remove each wire:

5) Remove the bottom screw in the heat sink. This screw is probably pretty tight:



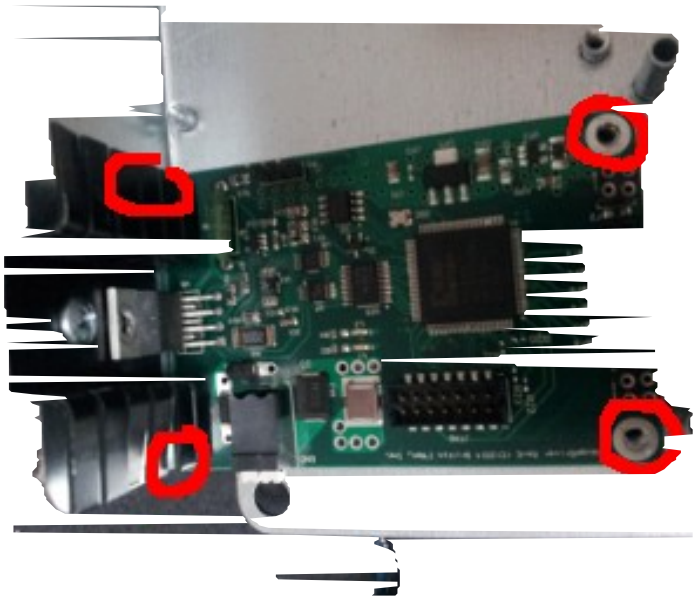
6) Remove the four screws from the corners of the gauge interface card. Two screws may be obscured by the edges of the heat sink:



7) Carefully remove the gauge card:

8) Insert the replacement gauge card in the same location.

9) Put the four corner screws in the new gauge card, but do not tighten them yet:

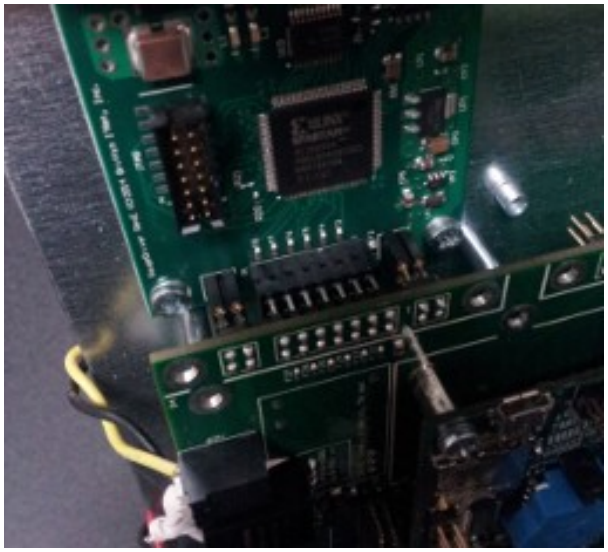


10) Screw the power amp to the heat sink. Make sure this connection is tight, but don't strip the screw:

11) Tighten the four corner screws from step 9.

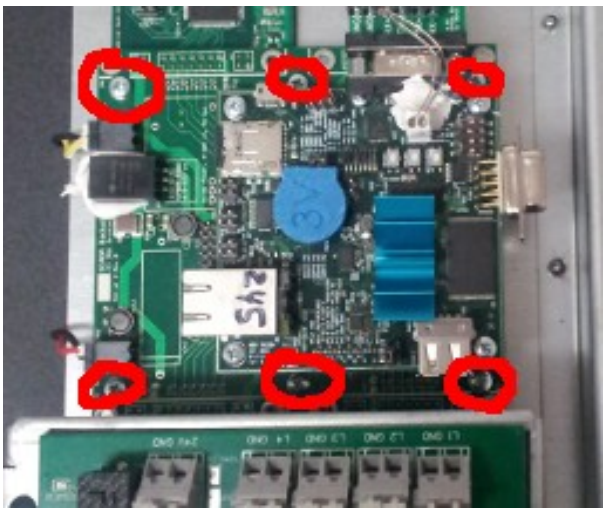
12) Plug the gauge line wires into the new gauge interface card. The black wire goes to the “GND” side of the connector, towards the middle of the SCADA unit. The colored wire goes to the “TOOL” side nearest the heat sink. Bend the wire around the edge of the sheet metal and away from the mounting screw hole.

13) Rotate the backplane board back around and carefully align the pins from the backplane board to the gauge interface board's connector. If the system has multiple gauge cards, make sure each gauge interface connector is aligned.



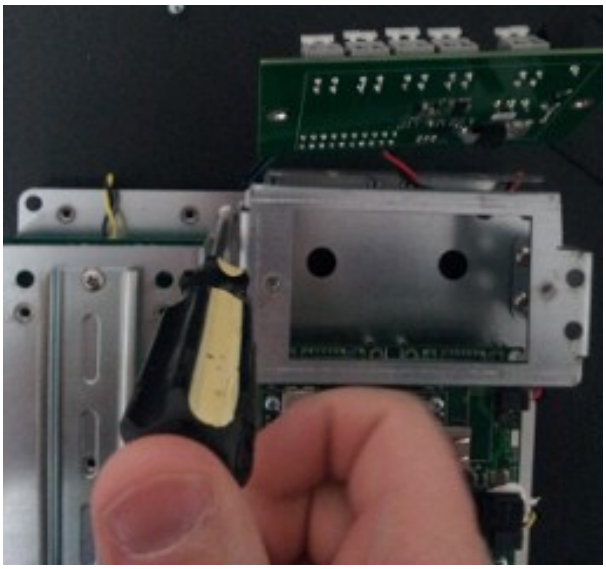
14) Once aligned, push the backplane board down to seat the connector.

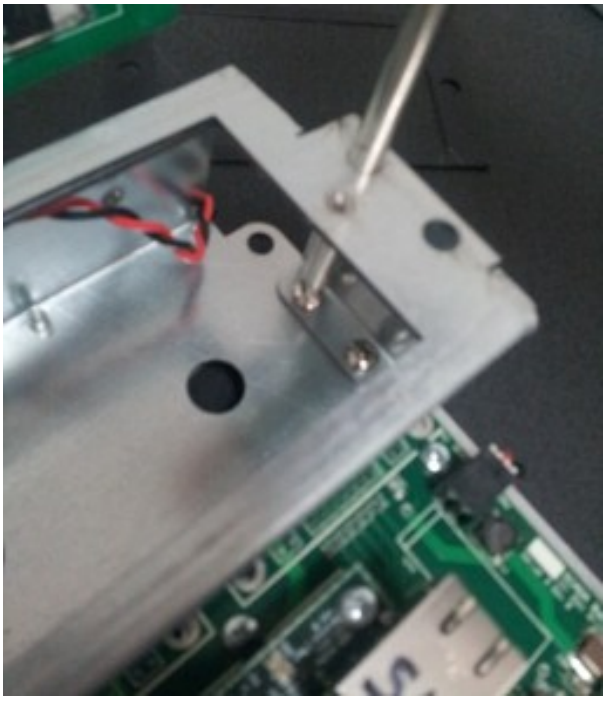
15) Reinstall the six long screws in the backplane board to secure it in place.



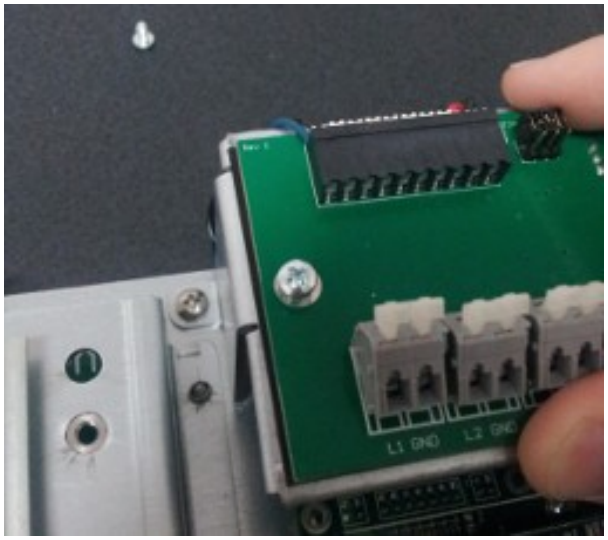
Replacing the Access Panel Bracket

1) Reinstall the sheet metal bracket first using three screws.





2) Place the plastic insulator on top of the bracket, then rotate the access panel PCB back into position. Be sure to align the plastic insulator's holes with the PCB mounting holes.



3) Secure the access panel PCB with two screws.

Data Logging Storage Times

The SCADA Platform has internal storage of about 200MB available to store readings. The system continuously logs several health statistics (system ambient and die temperatures, memory available, CPU load, etc) which currently consumes about 697KB/day. After this, each active gauge will consume about 40 bytes per pressure and temperature reading. Various errors are also logged, but should not consume much storage space.

Gauge data files are stored per gauge, on a one-file-per-day basis. Once the storage location (external or internal) reaches 90% capacity, the system will begin to recycle the storage space used by the OLDEST data first.

Storage usage matrix (approximate)

System health data	1 day	1 week	1 month	1 year
Storage used	697KB	4.9MB	21MB	254MB

20 second updates

Duration	1 gauge	2 gauges	4 gauges	8 gauges	16 gauges	24 gauges
1 day	173KB	346KB	691KB	1.4MB	2.8MB	5.5MB
1 week	1.2MB	2.4MB	4.8MB	9.7MB	19MB	39MB
1 month	5.2MB	10.5MB	21MB	42MB	84MB	168MB
1 year	63MB	126MB	252MB	503MB	1GB	2GB

So, with 20 second updates the system can store data for 8 gauges approximately 3 months on the internal storage alone. With a 4GB SD storage card in the SD media slot, there is room for over 5 years of data.

2.5 second updates

Duration	1 gauge	2 gauges	4 gauges	8 gauges	16 gauges	24 gauges
1 day	1.4MB	2.8MB	5.5MB	11MB	22MB	44MB
1 week	9.7MB	19.5MB	39MB	78MB	155MB	310MB
1 month	42MB	84MB	168MB	336MB	673MB	1.35GB
1 year	505MB	1GB	2GB	4GB	8GB	16.2GB

With 2.5 second updates, an 8 gauge system will fill a 4GB SD memory card in just under a year.

Base system power (without TEC power modules)

Idle power	0.75W
Idle power, Ethernet enabled	1.25W
Full CPU power	1.25W
Full CPU power, Ethernet enabled	1.75W

One TEC Line (2x 30V Power Modules)

System Voltage	8 gauges @ 16mA	8 gauges @ 25mA (HT)
12V	14W	18W
18V	14W	19W
24V	14W	21W
31V	17W	21W

Two TEC Lines (2x 30V Power Modules)

System Voltage	8 gauges @ 16mA	8 gauges @ 25mA (HT)
18V	25W	35W
24V	26W	35W
31V	27W	37W

Three TEC Lines (2x 30V Power Modules)

System Voltage	8 gauges @ 16mA	8 gauges @ 25mA (HT)
18V	35W	52W
24V	35W	52W
31V	37W	*TBD*

TEC Line Shorting Performance

All specifications are at 24VDC system power, 60V TEC line voltage. Be sure to add the base system power to these numbers.

One TEC Line (2x 30V Power Modules)

Conditions	Power
320mA short	23W
400mA short	28W
450mA short	30W
682mA short	45W

Two TEC Lines (2x 30V Power Modules)

Conditions	Power
320mA short, other line at 130mA	40W
400mA short, other line at 130mA	45W
450mA short, other line at 130mA	50W
600mA short, other line at 130mA	59W
682mA short, other line at 130mA	69W
320mA short, other line at 200mA (HT)	45W
400mA short, other line at 200mA (HT)	50W
450mA short, other line at 200mA (HT)	54W
682mA short, other line at 200mA (HT)	74W
Both lines shorting at 320mA each	54W
Both lines shorting at 430mA each	71W

Three TEC Lines (2x 30V Power Modules)

Conditions	Power
320mA short, other two lines at 130mA	49W
450mA short, other two lines at 130mA	59W
550mA short, other two lines at 130mA	66W
600mA short, other two lines at 130mA	71W
400mA short, other two lines at 200mA (HT)	66W
450mA short, other two lines at 200mA (HT)	71W
TWO 320mA shorts, other line at 200mA (HT)	71W

Notes