

Agilaire Model 8872 – A Detailed View

The Model 8872 has been in development for over two years and in detailed testing for the last 12 months, including beta test sites and a few mission-critical systems, such as the Opacity monitoring system at Vanderbilt University. A digital-only version has also been in use at the South Coast Air Quality Management District (SCAQMD) in the Los Angeles area since May 2011. The unit has been commercially available since May in limited release, but official public release is scheduled for December 2011.



While the device is new this year, it is Agilaire's intention to ensure the Model 8872 meets the standards set by the Model 8816 and 8832 for reliability.

Given that the device is PC-based and relies on the Windows operating system, this is no small feat. Unlike the embedded kernel / operating system in the Model 8832, Windows lacks the 'pre-emptive' functions of an embedded OS, which simply means that a particular Windows task can take control of all CPU functions and refuse to release it to other processes, interrupting the data acquisition process. Agilaire's design uses various 'watchdog' processes to ensure the real-time data collection is not hung up, restarting the process in the background if necessary.

Secondarily, another weak spot in Windows is the inability to properly manage unexpected power failures. All PC-logger implementations utilize temporary files to store 'in process' calculations (hourly averages being built), and a sudden power failure in the middle of a write to that file can cause difficulty for the PC logger software to correctly come back to where it was. Many PC-based loggers have reported difficulties with this situation. Agilaire's software design mitigates this issue in most cases, but a small UPS with a link to the Model 8872 to force a 'clean' software shutdown is provided as an additional protection (and strongly recommended in the case where the Customer may choose to use their own PC hardware).

The Model 8872 platform also utilizes a fanless PC core and solid state hard drive (SSD) to eliminate any mechanical components that can fail over the expected 10-14 year life span.

For these reasons, we feel that the Model 8872 represents the convenience of a PC-based logger without the historical drawbacks of a platform that uses the Windows OS in a mission-critical, real-time data acquisition environment, and represents the best PC-based logger on the market, by a large margin.

TECHNICAL SPECIFICS – SITE NODE LOGGER

The 8872 Site Node Logger is represented here as a packaged system that Agilaire offers for the convenience of its customers, as a package that can be easily rack mounted and provides the same I/O layout as its predecessor Model 8816 and Model 8832 data loggers. An internal circuit board also provides additional protection for the internal I/O modules, and provides for easier connections. Additional connectors are available for specialized connections, such as instrument power outputs.



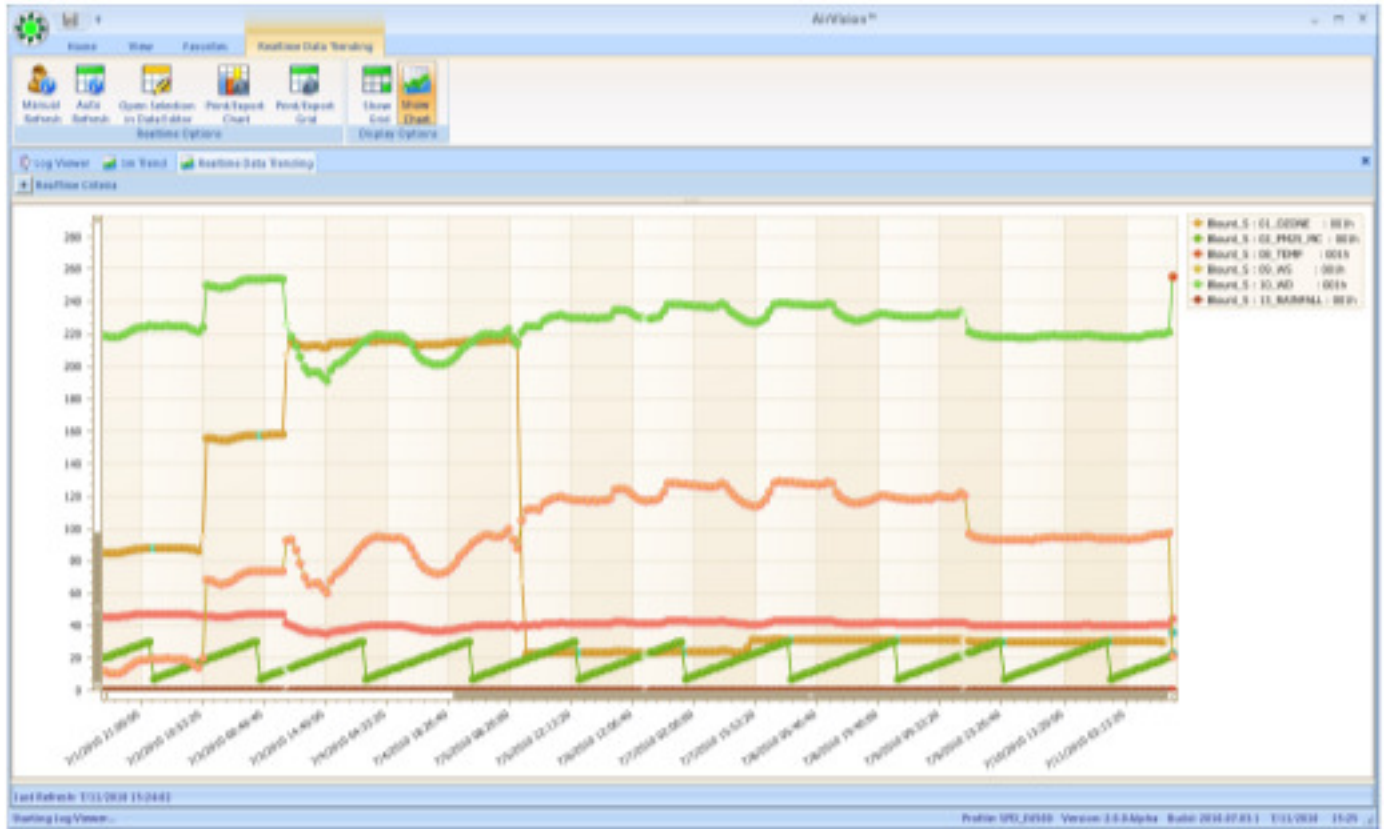
However, at its core, it is a PC system, and thus can be implemented, if desired, on any standard desktop PC. The represented packaging just eliminates the “science project” external wiring common with PC-based loggers with external I/O modules. For this project, any PC could be provided, but our base proposal assumes use of our existing dedicated 8872 hardware with integrated I/O protection board.

The 8872 Site Node Logger system uses the same code base as AirVision, and typically uses a MS-SQLExpress database as the local storage to save licensing costs (SQLExpress is free, but limited to an 8GB total database size, typically useful for about a year of minute data before data is automatically archived and removed from the database).

What distinguishes an 8872 Site Node Logger from the AirVision Central is an additional service that runs on the PC (Site Node Logger and a related WatchDog Service) that manage the real-time “logger” functions of the Site PC, such as:

- Real-Time serial, Ethernet, and legacy I/O data collection and averaging
- Real-time limit checking and validation
- Automated calibration programs (zero/span, precision, multipoint)
- Other scheduled digital event programs

The Site Node Logger can then represent data to the station user or a remote user via real-time trends, data editors, reports, etc. The station/remote user can flag data, enter annotations, create logbook entries, and operate manual calibrations/control functions on the Site Node Logger.



Standardized Connections

The Model 8872 platform comes equipped with four (4) RS-232C ports, four (4) USB ports, two (2) Ethernet ports, and one VGA port. Through external expansion, the system can support 32 or more serial ports and additional USB ports as needed. Standard Windows hardware is supported (keyboards, mouse, wireless adapters, USB drives, etc).

Easy Configuration Management Integration with AirVision

The Side Node Logger is normally polled at a defined frequency (usually every few minutes to every hour) over TCP/IP connection, using a database synchronization system based on MS Sync Framework. AirVision manages the entire configuration and setup of the sync connections, so the users/administrators do not need to go into SQL to manage these functions. The connections can be set to either unidirectionally or bidirectionally synchronize the data, and the syncs can be set up to the granularity of each database table entry if desired. Normally, AirVision comes preloaded with two main sync programs:

- Bidirectional sync of channel / cal configuration settings (so changes can be made on either end).
- Download of average data, cals, logbook entries, annotations, edits, flags from Site to Central

No other logger currently offers remote configuration management and synchronization.

Legacy modem polling using 8816/8832 command-response strings is also available, to support dial-up modem sites and systems still based on the older E-DAS software.

System Requirements / Alternate Platforms

By no means is the the Customer locked into the Model 8872 hardware platform designed by Agilaire. This form factor is designed to ease upgrades/connections, and provide additional analog signal protection not found in other products. However, the Site Node Logger software can run on any Windows platform meeting the following specifications:

- 2 GB RAM minimum
- Windows XP, Windows 7, or Server 2008
- MS-SQL Express
- 40GB Hard Drive, Solid State Drive (SSD) recommended
- UPS with automatic shutdown software recommended

Automatic Data Validation Processor

Agilaire's patented Automatic Data Validation Processor represents one of the most significant advances in the last 10 years for data quality assurance and ensuring data integrity. The Customer may already have this capability available at the Central data management server, but this capability is also available at the Model 8872 Site Node as well. From the Site Node, the ADVP can detect unusual suspect or invalid data conditions through sophisticated, multi-stage rules and comparisons. Based on these findings, data can be flagged, annotated, or an email alert can be sent directly from the site to appropriate personnel.

This system can also integrate data from externally polled devices (e.g., BAMs, Partisols) with the continuously measured data (e.g., distinguishing dust storm data by comparing BAM PM measurements to average of peak wind speeds).

Full GUI and Reporting Functions

The Model 8872 / Site Node Logger, derived from AirVision, includes a full suite of configuration forms (easy to use for users already familiar with AirVision), data editors, real-time strip-chart trends, tabular data reports, wind roses, etc. Examples screen shots are provided in Appendix A.

Comprehensive Integration with AirVision

In addition to integration of the configuration, the Model 8872 / Site Node Logger software allows an exceptional level of data integration that would be unavailable with other solutions, including:

- Site User-Entered Annotations
- Site User Data Edits
- Site Electronic Logbook Entries

In addition, it should be evident that the Model 8872 uses the same interface, menu structure, and forms as the AirVision central data management software. This offers a significant benefits:

- Familiarity
- Reduced training costs
- Consistency of procedures
- Consistency and accuracy of configuration
- East of Use

DIGITAL INSTRUMENT INTERFACES

Of course, the primary goal of many agencies is the transition from analog data collection to digital data collection where available (and support for 'legacy' I/O where necessary).

Agilaire, and its predecessor, ESC have a 20-year history with digital data collection, beginning with a USEPA Superfund site monitoring project in 1991, where an early Model 8816 had to collect 32 parameters from an automated GC, and even handle the GC switching between BTEX and speciated sampling modes.

Out of this grew the Generic Serial Interface (GSI), an open driver system that makes it easy to create new drivers for new instrumentation without code changes. This interface served the industry well when digital data acquisition was in its infancy, protocols were vendor-specific, and integration was difficult.

Seeing the industry difficulties, Agilaire lobbied hard for the major analyzer manufacturers to adopt an open standard, and roughly ten years later, the first Modbus-capable analyzers hit the market. ESC/Agilaire was ready to utilize this superior approach to digital data collection:

<u>Requirement</u>	<u>Serial Interface</u>	<u>Modbus/Ethernet</u>
Ease of implementation	Difficult, due to vendor-specific protocols and firmware-specific variations	Easy, as Modbus is a well-defined standard in use for over 25 years. Various third-party tools exist for integration and testing.
Ease of connection	Difficult: 8+ cable / port variations, baud rate concerns, hardware handshaking variations.	Easy- standard Ethernet connection into a switch. Minimal work to set IP addresses.
Data acquisition speed	Many analyzers limited to 9600 baud, limiting primary measurements to every 5-10 seconds, secondary measurements to once/minute	Very fast (10 or 100 megabit connections), connection does not limit data acquisition speed. Modbus protocol is very compact and allows for multiple items to be read at once.
Vendors currently supporting	EnviroNics, API, Ecotech, Thermo, 2B Tech, Climatronics, Magee, MetOne, Vaisala	API, Thermo. Ecotech and EnviroNics have indicated they are working on Modbus implementation.

We continue to push some vendors today to adopt the open standard already adopted by several other manufacturers. (Because of business conditions, some manufacturers have not yet moved to Modbus, so GSI remains a critical gap-filler.

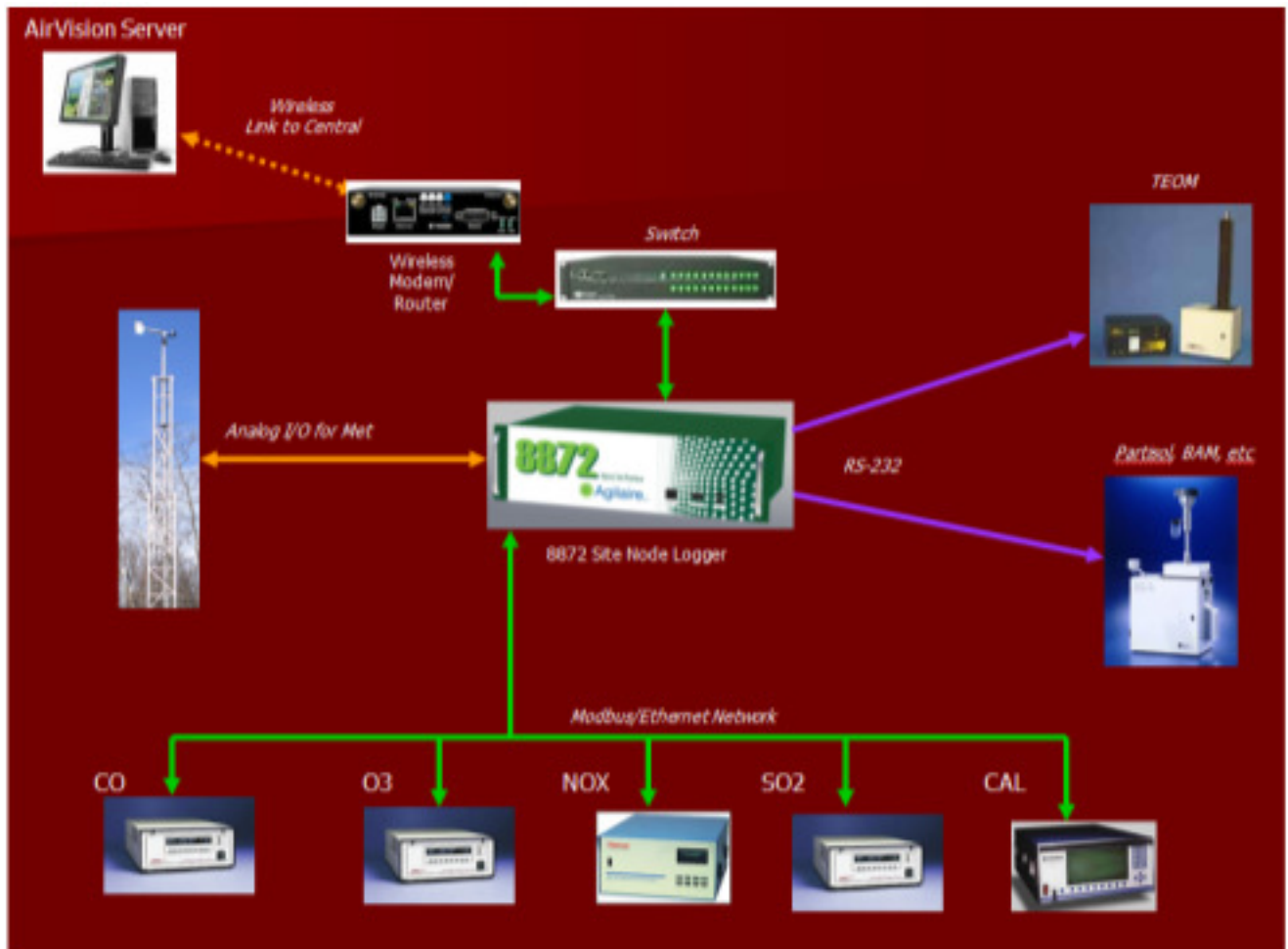
In the case of both serial and Ethernet/Modbus interfaces, the Open Driver system utilized by Agilaire ensures protection of investment, ability to support network growth of digital instruments, and ability to support forthcoming technological advancements in sensor / monitor development. Adding a new monitor to the library can take a matter of minutes, and driver development can be done by either the Customer or Agilaire. No special programming expertise is required. No other DAS offers this open system.

Non-Continuous Measurements

Data loggers (PC-based or embedded), by their very nature, are oriented towards collecting and averaging continuous streams of data. Analog, GSI, and Modbus streams are very well suited to this type of connection. However, some instruments do not represent continuous data streams (BAM-1020, Partisol FRM, etc).

Digital interfaces to these instruments must take this into account, and even potentially work around specific instrument quirks (e.g., not to request data or tolerate communication outages caused by internal sample operations).

AirVision supports the direct polling of stored data by these instruments, and this same capability is available in the Model 8872 / Site Node Logger software. Thus, a Site Node could collect data continuously from gas analyzers, run calibrators, and collect non-continuous PM measurements, all ready for data synchronization to the AirVision Central.



SITE COMMUNICATIONS

The Model 8832, Model 8872, and Site Node Logger software (if implemented on user platforms) all support cellular, DSL, satellite, and any form of IP-based communications in a generic manner to support future IP network types. Support for legacy “dial up” modems can also be provided, by setting the Model 8872 to support polling commands that mimic the Model 8816 / 8832 series.

Agilaire has assisted numerous agencies with equipment upgrades to change the site communications to TCP/IP, primarily through the use of cellular-based modems/routers. The device we most commonly recommend is the SixNet BT-6000 Series, although other devices (Sierra AirLink) will work as well.



The BT-6000 Series supports CDMA, GSM, and GPRS technologies. An external antenna can be used to boost signal strength where normal cellular connections are nominal. The device includes a full router with IPSEC capabilities (to ‘lock down’ the site so that it can only be accessed from defined locations). It supports both Ethernet and RS-232 connections.

Agilaire has used this device in projects for several years, with extremely high reliability and easy setup.

The device can also be accessed remotely through administration tools (BluVue software) for remote diagnosis and configuration:



ANALYZER REMOTE CONNECTIONS / DIAGNOSTICS

As mentioned earlier, the Model 8872 / Site Node Logger has the capability to continuously collect, store, and report primary measurements and secondary diagnostic measurements from digital-capable analyzers, and use digital interfaces to control calibrations. These values can be displayed or reported to indicate the “health” of the analyzer, and e-mail / SMS alarms can be generated based on variations from normal values.

```
Found Reading Matching Alarm: [High Limit Alarm] Criteria at:9/29/2011 02:19:00 for Parameter:
[GreatFalls:PM2.5:001m]
Alarm: [High Limit Alarm] for Parameter: [GreatFalls:PM2.5:001m] Starting at: 9/29/2011
02:19:00 has been Returned to Normal with an End Date of: 9/29/2011 02:34:00.
```

Some additional remote control and analyzer adjustment capabilities can be provided through vendor-specific software, such as iPort and APICOM. The Model 8872 / user PC platform can easily support these software packages alongside the Site Node Logger functions. However, we do not “integrate” the software into our application GUI, as integrating third party components (especially those that are not a key focus of the authoring company) is an invitation to obsolescence issues. Running the software on the same Windows platform and allowing access via remote programs (VNC, Remote Desktop, etc) is a technologically superior approach, for a platform with a 10-14 year intended life span. It allows the analyzer vendor software to update their products independently, without affecting the stability of the DAS package.

This approach would allow remote access/control from Central office, or any other locations permitted by the security settings in the site networking equipment.

PRODUCT ROAD MAP

Agilaire routinely takes product enhancement suggestions during training sessions, EPA technical conferences, and as part of regular support activities. Enhancement suggestions are reviewed for their applicability to the user base, and recommendations are ranked based on ease of implementation and their utility to the entire user base. Items which are easy and/or have wide appeal tend to be given higher priority, while those with higher difficulty or more limited appeal are placed further down on the priority list.

As the Model 8872 / Site Node Logger share a common code platform with AirVision, many enhancements provided to the AirVision user base will also be available for Site Node Logger upgrades.

A review of AirVision's release history demonstrates Agilaire's commitment to implementation of customer recommendations and needs as part of our ongoing product enhancement strategy. We view it as critical to maintaining our premier position in the market. Recent enhancements specific to Site Node Logger users include:

- Improved historical graphing tools (scrolling, automatic dual-range graphs)
- Add 'test' button to email server setup
- Manual export/import for telephone modem only or no communication sites
- Display Annotations in hover-over on charts

Planned enhancements for January 2012 include:

- Drag-select and "average" in real-time display
- User-configurable tabular data display

From a hardware/technology perspective, we have disassociated the software platform from the hardware platform in such a way that the Site Node Logger can be easily adapted to new evolving hardware standards and platforms (e.g., new backplanes and connectors, new video output technologies, new operating systems, new networking technologies, etc). Upgrading the system to a new platform and carrying over existing configuration settings is simple, as all settings remain within the single database- there are no local preference files or permanent settings outside of the database. This approach also makes disaster recovery a very easy process (see next section).

INSTALLATION ASSISTANCE

Agilaire is available for on-site transition assistance, and has performed several re-wiring projects with little to no existing site documentation. This work is generally performed on a time and materials basis, with fixed quoted costs for labor rates and travel expenses. In a recent example, Agilaire rewired three SO₂ / Met sites without existing documentation in under three days.

However, it should be noted that, in the case of the Model 8872 hardware, the device is designed to be plug-compatible with Model 8816 / Model 8872 connections, so it should be primarily a matter of unplugging the old logger and plugging in the new logger, with minimal wiring changes.

We are also available for, and quite experienced with the networking setups for the sites (setting up routers, networking the analyzers, etc), and can assist with that work remotely or on-site.

WARRANTY AND SERVICE

The Model 8872 and/or Site Node Logger software comes with a full 12-month warranty, and the warranty can be optionally extended by agreement. Service can be performed by Agilaire, or performed by the Customer staff using Agilaire-provided documentation.

The internals of the Model 8872 are very modular, such that component replacement is a simple way to resolve most issues. The primary components are:

- Fanless PC Module
- Input / Output Module(s)
- Internal Ethernet Switch
- Power Supply
- Power Entry Module

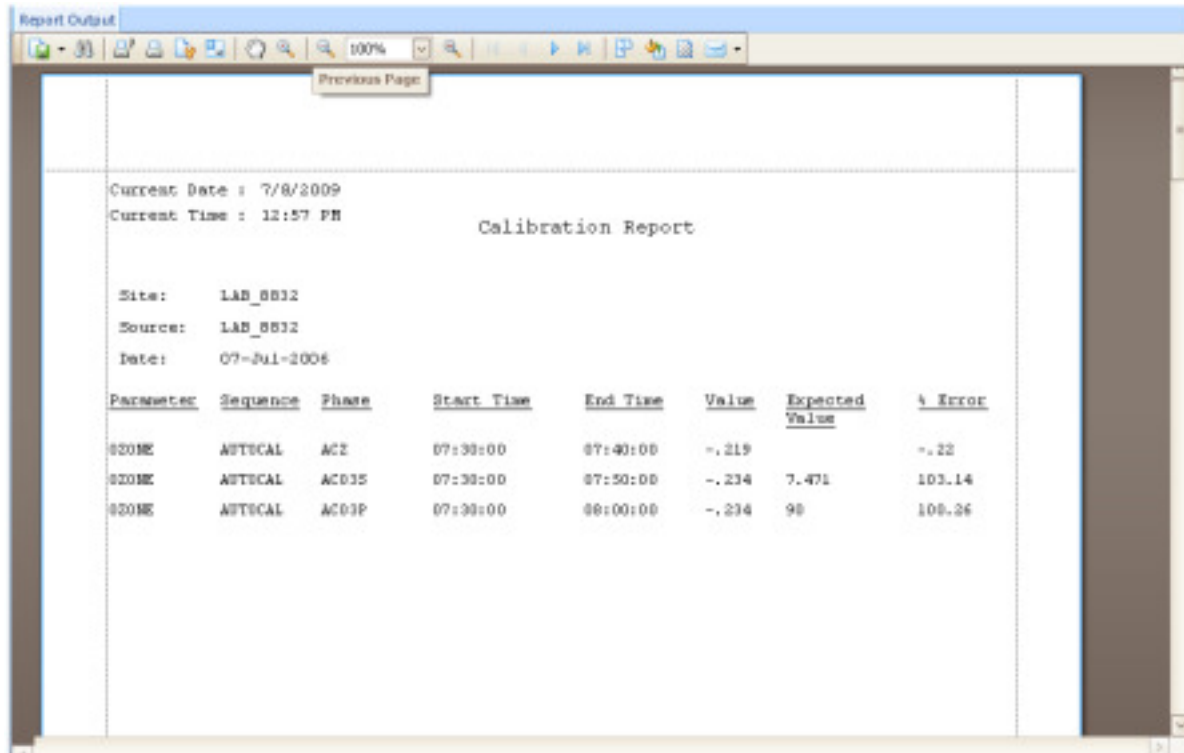
The Fanless PC Module can also be individually serviced to replace memory, solid state disk, etc if needed.

DELIVERY

The Model 8872 / Site Node Logger is commercially available at this time, and we regularly maintain an inventory of 10 - 20 units.

APPENDIX A: Example Figures and Screen Shots.

Figure A-1: Calibration Results Report



Report Output

Previous Page

Current Date : 7/8/2009
Current Time : 12:57 PM

Calibration Report

Site: LAB_8832
Source: LAB_8832
Date: 07-Jul-2006

<u>Parameter</u>	<u>Sequence</u>	<u>Phase</u>	<u>Start Time</u>	<u>End Time</u>	<u>Value</u>	<u>Expected Value</u>	<u>% Error</u>
020ME	ASTSCAL	AC2	07:30:00	07:40:00	-.219		-.22
020ME	ASTSCAL	AC03S	07:30:00	07:50:00	-.234	7.471	103.14
020ME	ASTSCAL	AC03P	07:30:00	08:00:00	-.234	98	100.26

Figure A-2: Cal History Trend

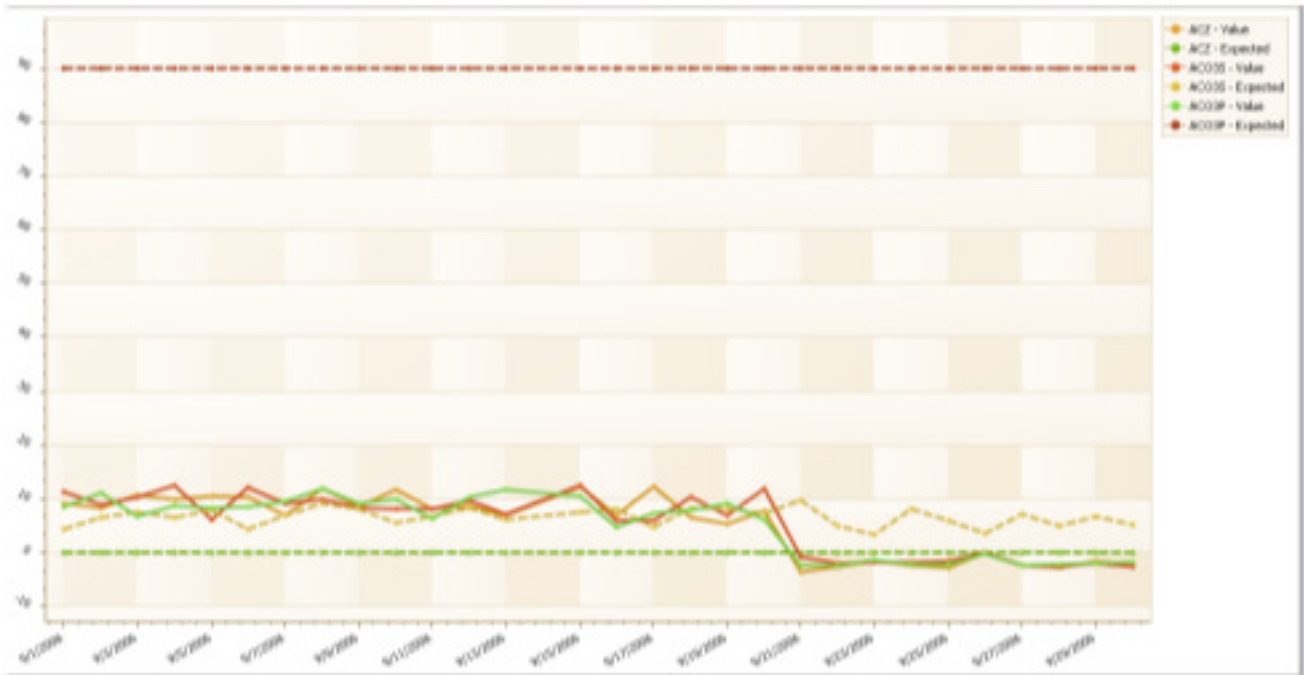


Figure A-3: Cal Response Plot

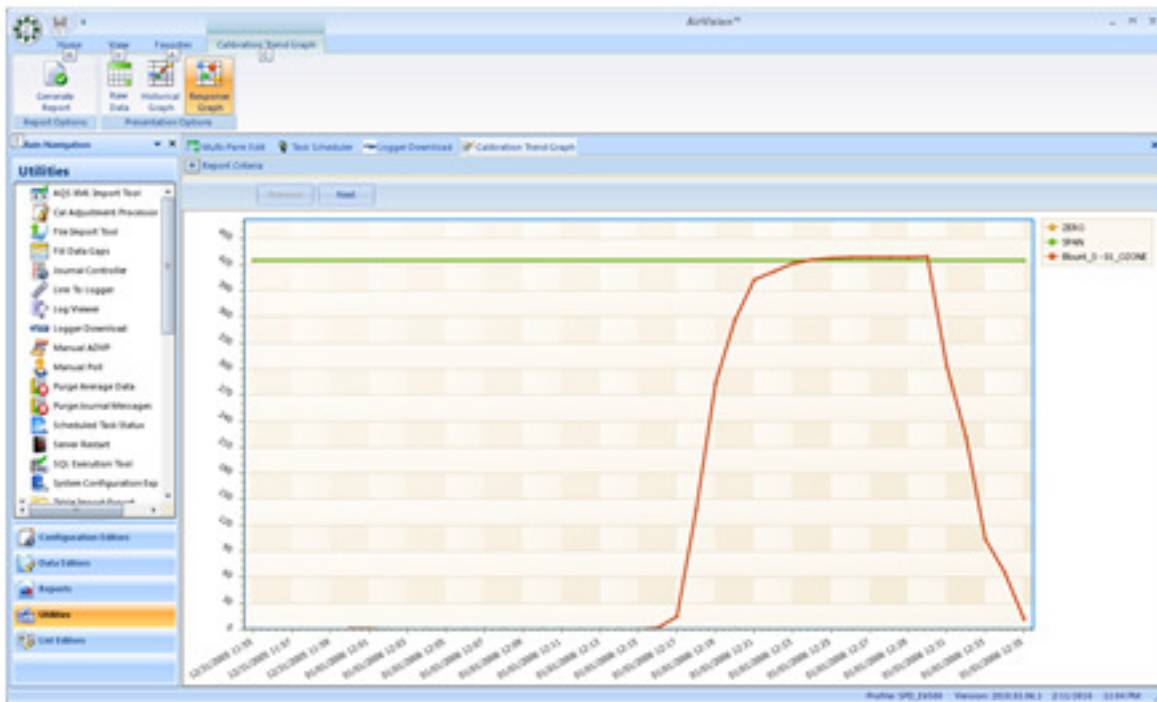


Figure A-4: Real-Time Chart

(Chart and Grid mixed shown).

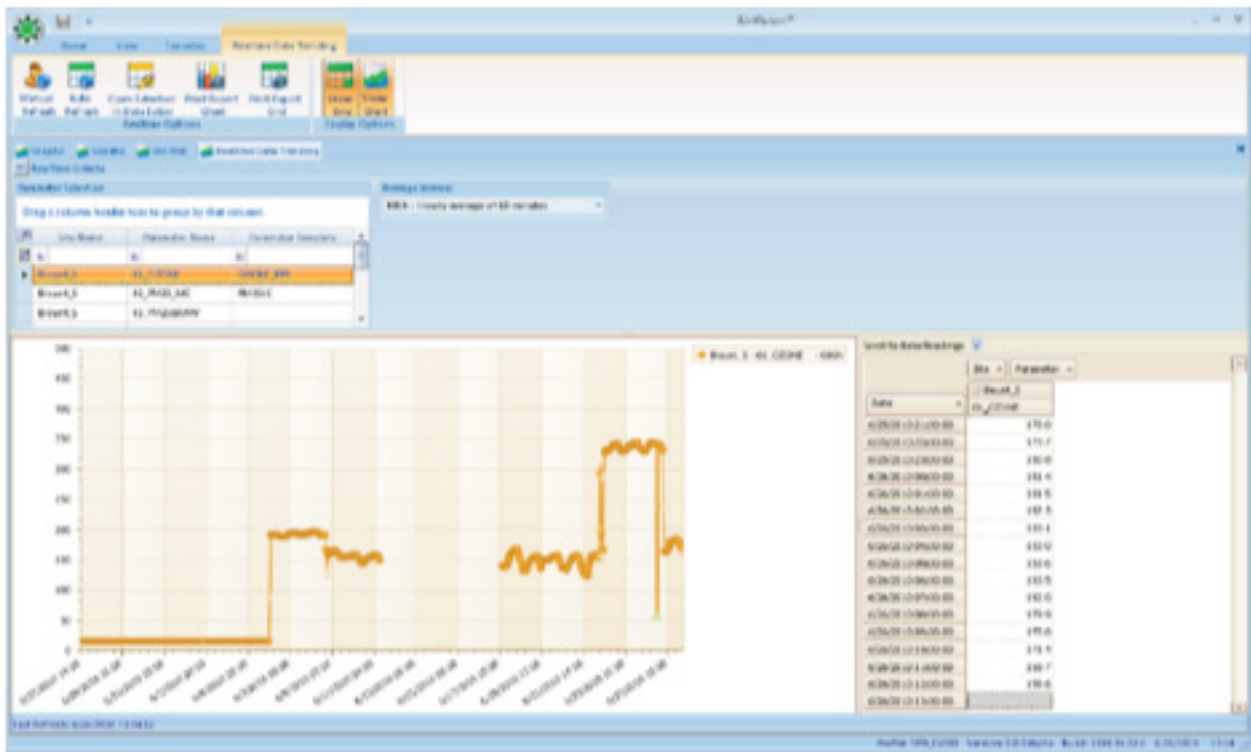


Chart Only:

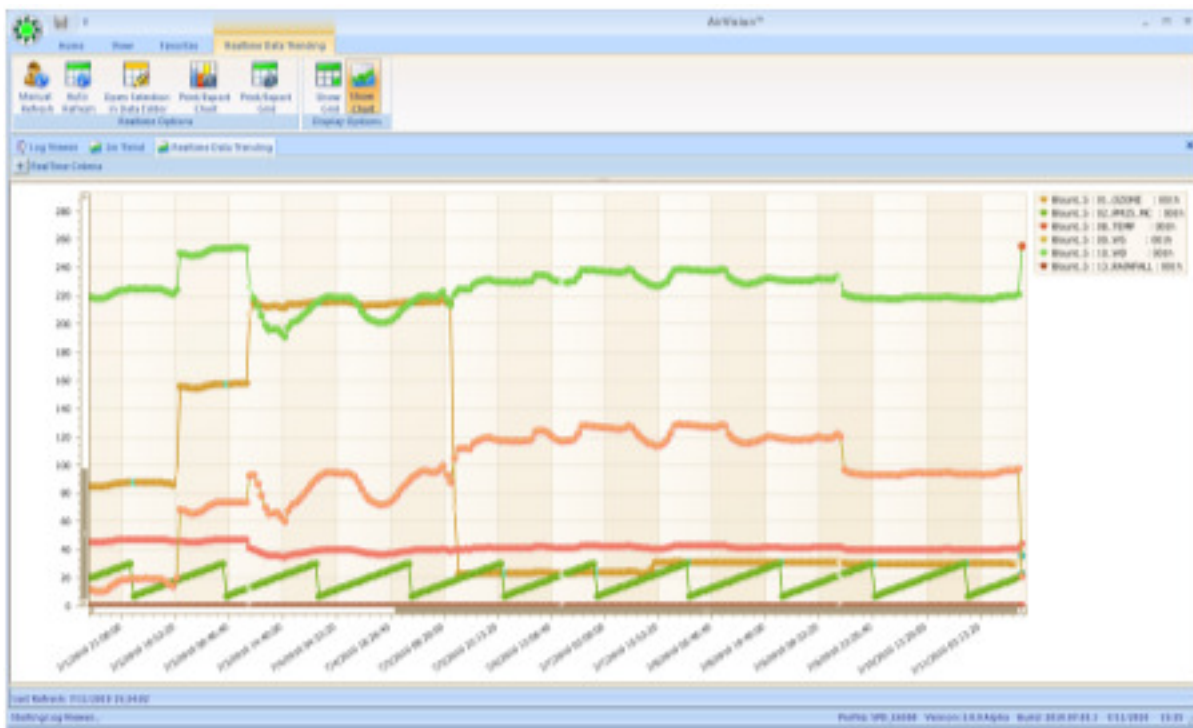


Figure A-5: Daily Summary Report

Current Time: 7:57 AM

Daily Summary Report

Site: OAKRIDGE

2/6/2006

Interval: 001h

Hour	01_CO PPM	02_SO2 PPB	03_NOX PPB	04_NO2 PPB	05_NO PPB	06_PM25_MC UG/MB	12_AMB_TEMP None	14_RAINFALL None	16_BAROMETR None
00:00	<	<	<	<	<	.9	.2	.08	734.5
01:00	.1	1.0	2.9	1.3	.5	1.0 W	-3	.08	734.9
02:00	.1	1.0	2.2	1.0	.4	3.9	-7	.08	735.3
03:00	.1	1.0	3.9	2.1	.7	2.6 W	-1.1	.08	735.8
04:00	.1	1.3	8.3	3.3	3.9	.4 W	-1.2	.08	736.1
05:00	.1	1.2	10.0	4.1	4.8	2.1	-1.0	.08	736.4
06:00	.1	1.0	3.7	2.0	.8	3.1	-1.1	.08	736.7
07:00	.3	1.0	11.5	5.1	5.5	1.8	-1.5	.08	737.1
08:00	.2	1.0	11.6	5.8	4.8	3.4	-1.3	.08	737.5
09:00	.3	1.0	9.9	4.7	4.3	3.8	-8	.08	737.7
10:00	.3	1.0	10.2	4.6	4.6	4.1	-5	.08	737.7
11:00	.2	1.0	6.2	3.1	2.2	2.1	-5	.08	737.7
12:00	.2	1.0	8.1	3.7	3.6	3.8	-6	.08	737.8
13:00	.2	1.0	7.7	4.3	2.4	5.1	.0	.08	737.7
14:00	.2	1.0	11.3	5.6	4.7	3.2	-1.2	.08	738.1
15:00	.2	1.0	22.9	10.7	11.2	3.2	-1.8	.08	738.4
16:00	.3	1.0	12.4	7.2	4.2	7.9	-1.1	.08	738.7
17:00	.3	1.0	13.4	6.5	5.4	5.2	-1.1	.08	739.1
18:00	.2	1.0	9.7	5.2	3.4	3.2	-1.4	.08	739.4
19:00	.2	1.0	5.9	3.6	1.2	5.7	-1.6	.08	739.4
20:00	.2	1.0	7.7	4.1	2.5	3.0	-1.8	.08	739.4
21:00	.1	1.0	8.5	4.7	2.7	3.9	-1.7	.08	739.4
22:00	.1	1.0	3.6	2.3	.4	5.6	-1.7	.08	739.1
23:00	.1	1.0	3.3	2.3	.4	2.5	-1.7	.08	739.4
Average	0.1	1	8.4	4.2	3.2	3.3	-1.0	0.08	737.6
Max	.3	1.3	22.9	10.7	11.2	7.9	.2	.08	739.4
Min	.1	1.0	2.2	1.0	.4	.4	-1.8	.08	734.5
Count	23	23	23	23	23	24	24	24	24

Figure A-6: Monthly Report

Current Date: 3/1/2010 10:47 AM		Monthly Report																		Avg Interval: 1 hour							
Site Name: Blount_S		January 2010																		Units: PPB							
Parameter: 01_OZONE		Hours																		Summary							
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Avg	Max	#Ds
01	16.0	16.4	17.2	18.7	19.3	18.5	14.4	13.0	13.9	14	15.7	15.5	15.2	15.8	15.0	13.5	10.4	7.7	6.4	5.4	3.8	1.2	1.5	5 E	114.2	439.8	46
02	8	8	5.6	8	6	5.6	7	5.6	3.8	9.1	9.7	11.4	15.7	9.8	9.9	8.8	4.3	4.1	6.8	7.9	9.1	9.7	18.5	7.7	6	11.7	23
03	7.2	5.5	8.8	10.6	14.6	16.8	19.1	24.1	24.4	28	27.4	30.4	30.8	32.3	32.2	32.1	30.5	29.8	30	27.2	30.4	18.6	16.8	22.4	32.3	23	
04	23	22.1	24.3	19.2	17.9	14.3	11.0	18.2	26	28.6	30.5	29.9	30.8	29.0	28.4	27.1	22.6	24.8	40.9	38.9	37.1	26.2	33.8	25.4	46.9	23	
05	21.3	24.2	23	21.7	22.1	19.3	15.7	18.3	14.9	13.7	11.8	10	9.4	5.9	4.4	1.8	0.9	3.8	5.5	6.6	8.6	4.1	9.3	10.9	24.2	23	
06	17	15.5	18.5	20.1	18.4	16.8	15.1	17.8	15.6	17.9	19.8	22.4	22.2	22.6	22.5	26.8	31.2	27.3	22.6	27.7	26.6	27.9	27.7	22.0	21.2	23	
07	26.7	25.0	24	22.9	28.2	31.8	22.0	33.4	35.5	26.1	36.8	28.2	26.7	30.9	28.5	32.2	26.1	26.8	25.7	28.5	29.6	27.2	30.4	31.2	26.9	23	
08	28.1	27.3	24.8	22.2	18.8	17.4	15.3	13.8	14.6	15	14.4	15.2	18.7	19	18	11.4	12.2	8	10.7	11.8	15.4	15.6	16.1	15.6	28.1	23	
09	13.8	13.0	13.7	15.4	17.1	16.8	17	19.3	30	28.1	19.5	21.0	26.1	21.0	13												
10	19	21.5	24.1	26.9	28.5	29.4	29.6	29.2	31.7	21	20.4	28.1	28.1	30.4	21.2	27.7	13.9	16.3	18.4	28	17	19	20.7	24.7	21.7	23	
11	14.3	13.7	14.8	11.8	8.4	8.8	12	28.7	24.9	28.3	26.3	26.1	28.4	34	33.3	31.8	28.3	29.8	28.1	28.8	29.8	23.6	16.2	33.6	38.1	23	
12	23.8	22.7	18.9	15.6	13.7	12.7	13.6	14.5	14.9	18.2	17.5			24.5	23.8	19.2	5	5.7	10.4	9.3	6.6	8.9	4	14.0	24.5	21	
13	4.1	4.7	8.8	4.6	4.8	3.8	2.6	8.8	10.1	12.2	19.3	22.7	28.8	24.7	22.2	21.8	22.1	26.1	22.1	22.8	20.7	28.1	22.1	20.3	28.9	23	
14	24.3	24.2	33	22.3	22.6	24.2	26.4	34	33.9	28.2	26.2	24.9	33	29.6	28.3	17.1	12.3	14.7	30.9	28.4	26.6	28.5	24.4	29.7	28.2	23	
15	32.7	32.0	32.7	32.3	24.4	25	25.7	27.2	29.4	28.1	30.3	28.2	26.1	29.5	28.7	29.8	28.7	28	30	27.1	37	26.4	25.8	37	28.7	23	
16	24.8	24	22.2	20	28.7	27.8	25.9	28.1	22.4	22.3	24	24.8	28.4	24.8	22.8	20.3	28.8	21.8	29.3	17.4	16.6	18.1	19.4	25.3	25.4	23	
17	16.8	19.6	18	15.6	9.5	7	5.6	12.2	23.6	23.5	26.1	28.1	28.4	31	28.5	12.6 E											
18	26.8	26.6	27.7	29.2	28.4	26.4	27.4	26.1	25.3	25.5	29.5	40.4	48	19.2	1.8	2.7	8.4	11.4	10.6	13.2	16.1	22.0	25.2	27.2	41.4	23	
19	26.2	29.2	28.1	28.7	27.6	27.2	28.1	27	27.4	27.7	27.3	27.6	28.3	29.6	28	21.8	8.3	14	23.8	21.2	20	18.6	18.8	24.7	28.5	23	
20	20.8	19.5	13.9	12	12	10.1	9.5	8.8	15.9	12.6	14.8	10	12.4	9.5	5.9	5.1	4.3	4.4	4.7	8	0	19	6.5	10.4	28.5	23	
21	14.8	15	17	22.2	28.2	29.8	29.0	21.1	20.4	28.1	31.5	28.6	28.8														
22	33.4	32.2	24.2	26.7	28.7	24.8	32.7	32	24.1	24.7	26.3	27.4	28.8	29.1	28.1	22.8	22.7	17	23.9	18.8	17.8	18.1	20.7	20.7	28.1	23	
23	26	22.4	20	20	21.7	22.8	24.9	28	25.2	25.5	32.4	28.7	28	29.5	29.3	24.1	21.5	19.8	20.9	18.9	19.6	22.6	22.2	29.2	26	23	
24	17.8	15.6	15.9	14.5	8.8	6.3	8.9	18.8	20.7	27.6	20.3	21.9	23	22	22.5	27.8	28.9	22.2	29.2	28.5	29.6	28.7	21.2	22.2	22	23	
25	14.8	12.6	9.2	7.3	8.1	10.7	12.6	18	15.7	23	21.3	19.4	26.1	20.9	28.2	19.8	18.6	16.1	17.1	24.1	26.6	26	26.7	17.1	28.5	23	
26	24.3	25.0	28.3	26.6	28.5	26.8	26	25.7	26.6	27.5	29.8			26.5	27.9	27.6	27.6	27.5	27.6	27.9	27.7	28.1	27.8	27	28.5	21	
27	25.8	24.6	22.4	19.7	18.8	16.8	11.4	14.8	20	28.1	29.3	28.4	21.8	24.2	22.8	26.8	18.9	16.1	22.4	18.1	12.8	13.6	13.8	21.6	24.2	23	
28	12.3	14.0	14.5	14.4	15.2	12.8	12.6	13.2	15.6	24.9	20.8	25.7	26.4	25.6	22.5	21.5	22.0	21	19.7	18.3	15.3	12.9	10.2	19.2	28.5	23	
29	5.8	6.6	4.8	4.9	3.4	2.7	2.4	7.4	9.6	12.7	15.4	21.1	28.7	29.5	25.0	25.3	24.2	26.3	19.2	28.2	21.5	14.9	12.8	14.7	28.7	23	
30	12.8	13.6	13.3	12.7	11.2	7.8	6.3	18.3	14.8	18.5	24.2	28.6	28	26.1	23	21.8	23.6	21.8	22	22.2	22.2	22.8	29.3	16.7	28	23	
31	25.2	27.2	27.3	27	27	26.4	25.7	28.8	25.6	27.4	24.5	24	24.7	22.6	22.7	22.8	22.4	21.3	19	18.2	15.2	21.9	24.1	22.9	27.4	23	
Min	429.0	28.5	29.6	27.7	26.2	28.4	28.4	27.4	27.2	29.4	28.1	28.5	41.4	40	29.5	28.7	28.8	29.7	28	40.8	28.9	27.1	26.4	26.8	429.6	429.6	429.6
Average	204.6	28.7	29.9	29.4	28	19.7	18.1	16.8	28.4	23	24.6	28.9	27	27.9	26.9	24.5	22.8	19.3	18.4	19.7	29.6	29.3	29.9	28.9	25.4	29.4	28.4
Count	26	01	31	21	31	31	01	31	01	31	01	29	29	28	30	28	20	29	29	30	28	31	01	722	722	722	

Figure A-7: Wind Rose Plot

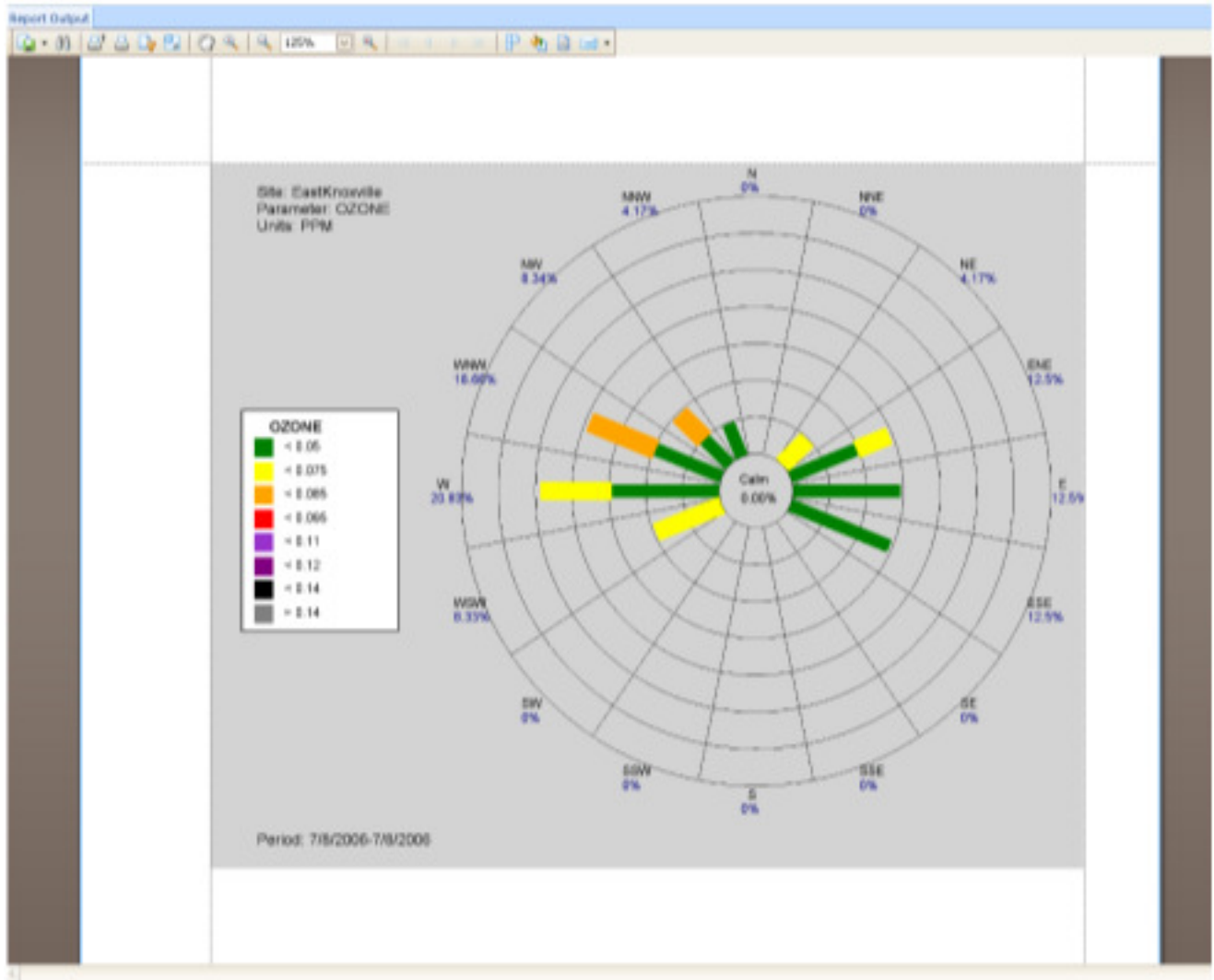
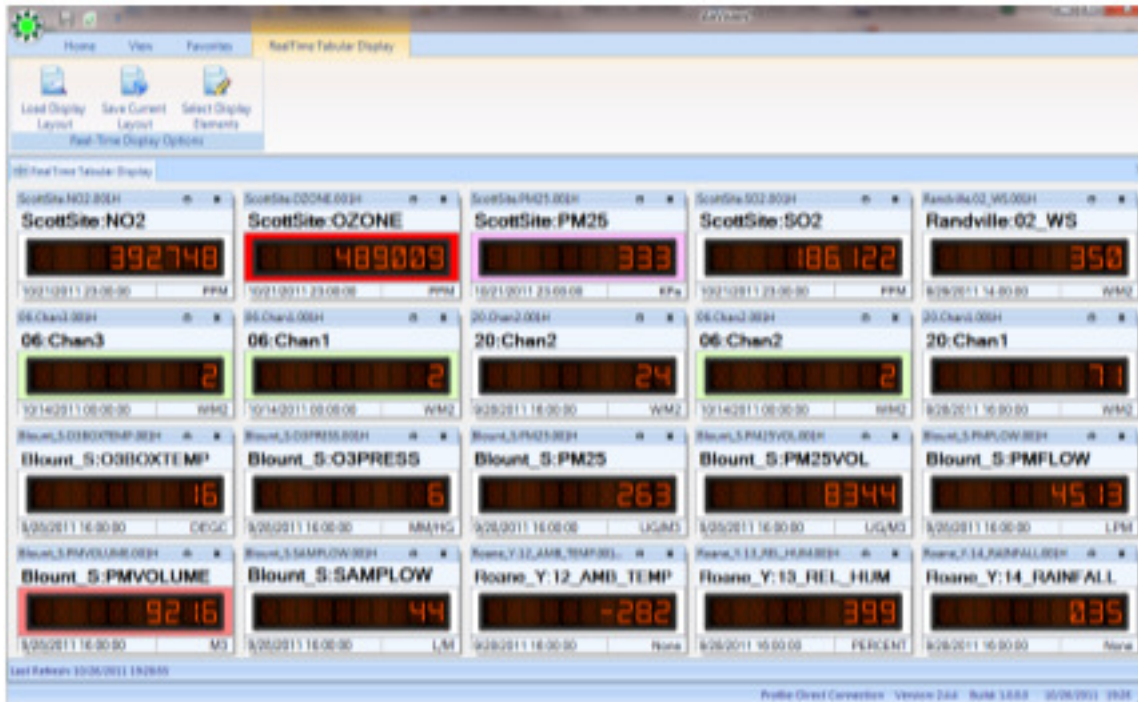
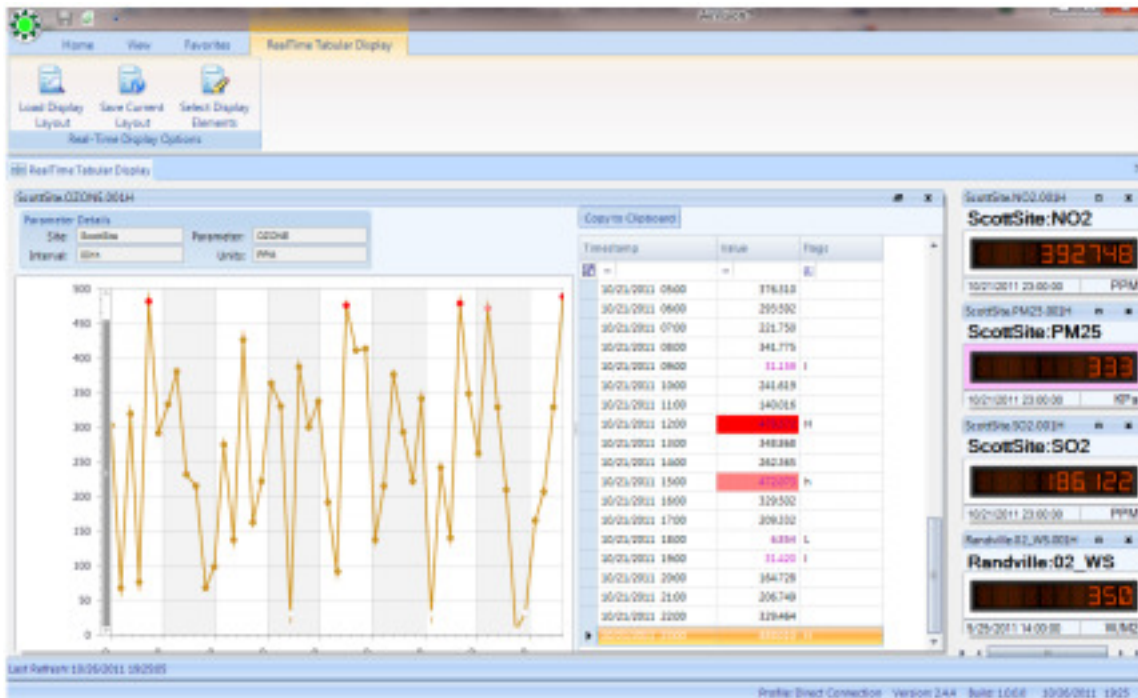


Figure A-8: Tabular Data Display, with Zoom Capability



All parameters shown



Zoomed view (by double-clicking on one parameter)