Model 600A20

Echo® Monitoring Software

Installation and Operating Manual

**For assistance with the operation of this product,
contact the PCB Piezotronics, Inc.**

Toll-free: 800-959-4464
24-hour SensorLine: 716-684-0001
Fax: 716-684-3823
E-mail: imi@pcb.com
Web: www.imi-sensors.com

Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its "Lifetime Warranty Plus" on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty**.

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

PCB Piezotronics, Inc.
3425 Walden Ave.
Depew, NY14043 USA
Toll-free: (800) 828-8840
24-hour SensorLine: (716) 684-0001
General inquiries: info@pcb.com
Repair inquiries: rma@pcb.com

For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:

DANGER
Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.

CAUTION
Refers to hazards that could damage the instrument.

NOTE
Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this manual:

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	O	O	O	O	O	O
PCB板	X	O	O	O	O	O
电气连接器	O	O	O	O	O	O
压电晶体	X	O	O	O	O	O
环氧	O	O	O	O	O	O
铁氟龙	O	O	O	O	O	O
电子	O	O	O	O	O	O
厚膜基板	O	O	X	O	O	O
电线	O	O	O	O	O	O
电缆	X	O	O	O	O	O
塑料	O	O	O	O	O	O
焊接	X	O	O	O	O	O
铜合金/黄铜	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O： 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.
Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

Echo® Monitoring Software User's Manual

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1 Introduction

The Echo® Wireless Vibration System is used for unattended predictive maintenance and condition monitoring of plant equipment. Echo® Wireless Vibration Sensors and EchoPlus® Wireless Junction Boxes activate automatically on a user defined schedule to capture and transmit vibration data wirelessly to one or more Echo® Receivers. The receivers, in turn, are connected by a wired Ethernet network to the Echo® Data Monitor Service Software running on a server or PC collecting and saving the transmissions to an SQL database. The Echo® Data Monitor Service also has a Modbus over TCP/IP server interface. The SQL interface is not required if only the Modbus function is to be used. If the SQL interface is active the vibration data are stored in the database and compared against alarm values. Machinery status is displayed in an alarm panel, and alarm notifications sent via email if desired. The data can be viewed, reported, and trended using the Echo® Data Presentation Software.

This manual is intended to assist users with the installation of the Echo® Monitoring Software package that includes model 600A20 Echo® Service Software and Echo® Data Presentation Software. Specific instructions for System Installation, Echo® Wireless Vibration Sensors, EchoPlus® Wireless Junction Boxes, and Echo® Receivers can be found in their respective manuals.

1.1 Components Overview

The Echo® Wireless Vibration System consists of the following components;

- Single channel Echo® Wireless Vibration Sensors
- 8-channel EchoPlus® Wireless Junction Box
- Echo® Receiver (Echo® Sensor Data server-Ethernet Interface)
- Microsoft® Windows® Based PC or Laptop with
    - Windows 7 or 10 Operating System
    - Model 600A20 Echo® Monitoring Software
        - Echo® Data Monitor Service Software (runs as Windows Service) with an SQL interface and a Modbus® interface.
        - Echo® Data Presentation Software
    - Microsoft SQL Server® Database software
        - Echo® Database (EchoSQLData.mdf)

1.2 Regulatory Information

1.2.1 United States of America - FCC Notice

FCC ID: ZOC-IMI673A01

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.2.2 Canada - Industry Canada (IC) Notice

IC: 9732A-IMI673A01

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

1.2.3 Other Countries

The Echo® devices have been certified and found to comply with the limits regulated by the regulatory agencies of several other countries and the European Union. Contact PCB® for more information.

1.3 System Installation Overview

The typical system installation will be integrated into a company's industrial LAN to ensure the receiver and PC's can communicate freely over Ethernet. This configuration would consist of:

- Echo® Wireless Vibration Sensor(s) and/or EchoPlus® Wireless Junction Box(s)
- Echo® Receiver(s).
- Dedicated PC or Server running 24/7 with a TCP/IP Ethernet interface to host the SQL database and Echo® Data Monitor Service Software with SQL and/or Modbus interfaces.

- Echo® Data Presentation Software - required to view SQL data if the SQL interface is enabled.
- Sensors can be configured using any Echo software component.
- End-user PC(s) to host additional instances of the Echo® Data Presentation Software (optional and only applicable if the SQL interface is enabled).

The PC and the receiver(s) can be configured to acquire their IP addresses dynamically from the host network's DHCP server and would be connected as any other device on the network with an Ethernet cable, (Note: the Echo® Receiver is not a wireless Ethernet device). The receiver can also be set up to have a fixed IP address which often times is preferred since knowledge of the receiver's IP address is required by the software. A fixed IP address eliminates dynamic address expiration issues.

Echo® RF data transmissions are received by the Echo® Receiver and sent (Ethernet-TCP/IP) to the Echo® Data Monitor Service Software component of the Echo® Monitoring Software which runs as a service on the PC. For installations where the SQL interface is enabled, the sensor transmissions are saved in an SQL database running either on the same PC or a configured SQL server on the network. This data can be viewed on the acquisition PC or remotely using the Echo® Data Presentation Software component of the Echo® Monitoring Software. Data can also be exported or sent in response to a request (e.g. Modbus) to other industrial monitoring applications. For additional information on exporting data, contact IMI® Sensors.

NOTE: The Echo® system can also be set up as an isolated private LAN consisting of the PC and the receiver, both of which would be configured with fixed IP addresses and be connected using a crossover Ethernet cable. Echo® Sensor transmissions would be saved in the SQL database (also on the PC) and viewed using the Echo® Data Presentation Software.

2 Scope

This document describes the Echo® Monitoring Software installation and its use. It is assumed that the user is familiar with the hardware components of the system. This document applies to both the 916 MHz and the 868 MHz versions of the hardware.

3 Software Installation

There are two software components required for a typical installation; Echo® Monitoring Software and Microsoft SQL Server software. Microsoft SQL Server Express software is bundled with the Echo® Monitoring Software for easy access or can be downloaded separately from Microsoft. Alternatively, if the end-user already has Microsoft SQL Server installed then the Echo® database can simply be attached to it.
Note: The SQL component is not required if only the Modbus interface software is to be used.

The Echo® Monitoring Software is composed of two separate applications; Echo® Data Monitor Service Software and the Echo® Data Presentation Software. These programs are described below.

NOTE: You will need administrative rights to load the software and will most likely require the help of your IT department.

3.1 Echo® Data Monitor Service Software Installation

The service software should be installed on a server or dedicated PC that runs continuously (i.e. 24/7). The service has SQL and Modbus interfaces (model 600A20 software).
To install the Echo® Service Software, run the setup.exe file located on CD 1 (of 2) for the 600A20 software. If auto run is enabled the installation process will begin automatically. The CDs with the service also contain the SQL Express 2008 installer for 64 bit operating systems. For 32 bit operating systems download SQL Express from Microsoft's website.

The Echo® default directory is **C:\PCB\Echo** and should be used if possible. This installer installs the Echo® Service and a utility (PCBEchoNotify.exe) that runs in the notification tray to provide status and configuration information for the Echo® Service. After this installation completes an additional utility runs to configure the client software as a service and to update the windows registry. This software should typically be installed on only one PC.

3.2 Echo® Data Presentation Software Installation

To install the Echo® Data Presentation software, run the setup.exe located on CD 2 (of 2) of the 600A20 software and follow the instructions. If auto run is enabled the installation process will begin automatically. The default directory is **C:\PCB\Echo** and should be used if possible; however, if it is changed, it MUST match the directory that the Echo® Service Software is installed in. The Echo® Data Presentation software may be installed on multiple PC's.

3.3 Microsoft SQL Server Software

The Echo® Monitoring Software requires the installation of a compatible SQL Server application installed either locally (i.e. on the same PC) or available over a network connection if the Data Presentation Software is to be used. Microsoft SQL Server 20xx Express is a freely downloadable and distributable version of Microsoft SQL Server 20xx that satisfies this requirement. See section 5 for Microsoft SQL Server 2008 R2 Express installation instructions. Microsoft SQL Server 2012 Express installation is similar. Subsequent references to SQL Server in this document refer to SQL Server 2008 R2.

3.3.1 SQL Server Initialization and Database Attachment

After the Echo® Data Monitor Service, Echo® Monitoring Software and the SQL database engine are installed there are two important steps required to connect the these applications, if the SQL interface is used, so the sensor data can be stored and retrieved from the database;

- The Echo® Sensor Database supplied with the software must be 'attached' to the database server. Alternatively, an SQL query (*C:\PCB\Echo\Database\Create EchoDB vX.XX.sql)* is provided that can be run in MS SQL Server Management Studio to create the EchoSQLData database on the database server.
- The Universal Data Link (UDL) file must be configured to link the software queries to the database server.
- A Database Source Name (DSN) file can also be used. However, if you use a DSN, then the commands must be translated from OLE DB to ODBC through the OLE DB Provider for ODBC. Therefore, it is more efficient, and recommended, to use UDLs as the method of connection with the database if an OLE DB Provider is available.

3.3.2 Windows Install Location

Prior to Attaching' the database you should copy the Echo® database files;

- ***C:\PCB\Echo\Database\ EchoSQLData.mdf***
- ***C:\PCB\Echo\Database\ EchoSQLData.ldf***

To the SQL server data directory typically;

- ***Win 7 64-bit - C:\Program Files\Microsoft SQL Server \ MSSQL10_50.SQLEXPRESS\MSSQL\DATA***

3.3.3 Database Attachment

Once the Echo® database files are copied to the appropriate SQL application directory then the database must be attached to the SQL server. If you are not familiar with this process refer to section 5.1 for instructions.

3.4 Universal Data Link (UDL) File Configuration

The next requirement is to link the Echo® Monitoring applications to the database engine. This is done by configuring Universal Data Link (UDL) file. To do this;

- Locate the file; C:\PCB\Echo\Database\ EchoDataSQL.udl
- Double click on it or open with OLE DB Core Services. The dialog in Figure 1 will appear
- Enter <Your PC Name>\SQLEXPRESS as the data source and make sure items 2 & 3 are as shown. **Note**: If you have a standard version of SQL Server, then do not add '\SQLEXPRESS' to the data source name.

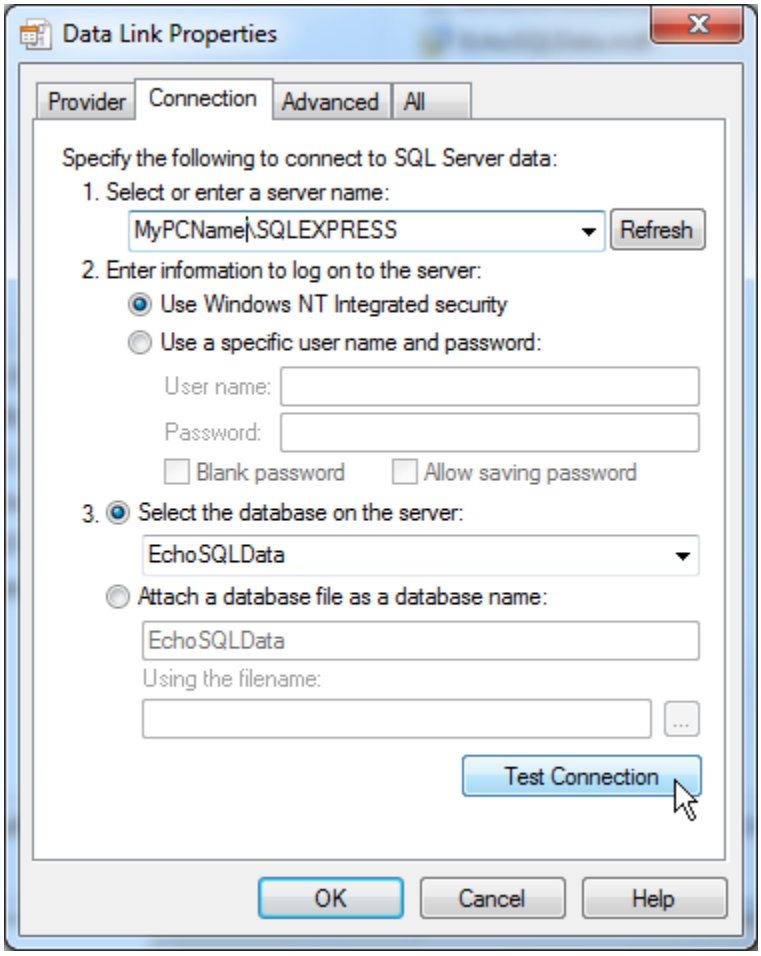


Figure 1 – Universal Data Link (UDL) File Definition Utility

- Next click the 'Test Connection' button and verify the connection test succeeds. If not check to make sure the Server Name (from Figure 151) matched the Data source in the UDL file.

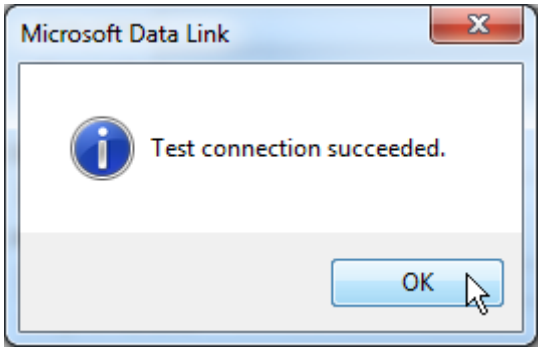


Figure 2 – Universal Data Link – SQL Database connection success

4 Echo® Monitoring Software

The Echo® Monitoring Software consists of two applications; The Echo® Data Monitor Service and the Echo® Data Presentation software.

4.1 Echo® Data Monitor Service

The **Echo® Data Monitor Service Software** is sold with SQL and Modbus interfaces (model 600A20). The software can be configured for Modbus only operation, if desired, by disabling the SQL interface.

The Echo® Data Monitor Service Software collects transmissions and, if SQL is enabled, stores them in the database and sends alert emails in the event a transmission's data is out of range. If Modbus is enabled then the last transmission received from a sensor is saved and is used by the Echo® Modbus Server to respond to requests by a Modbus over TCP/IP client.
As its name implies this software runs as a windows service. The benefit of this is that it will start automatically when the PC is turned on, whether or not a user is logged on, and it will remain active even after a user logs off. This is essential for 24/7 industrial monitoring programs.

There are two ways to ensure the service is functional.

- Open the Services window, Start | Control Panel | Administrative Tools | Services, and look for 'PCB Echo Data Monitor,' as shown in Figure 3 below (It should be 'Started' with options to Stop, Pause or Restart. Click Start if necessary).
- Right click the PCB icon (PCB Echo Service utility) in the notification tray (typically on the bottom right of the screen) as shown in Figure 4. This will show an option to 'Open Echo Status'. Selecting this opens the window shown in Figure 5. Clicking the **Get Status** button will update the status to show the Echo® receivers the service is connected to and the last transmission each has received.
    - The PCB Echo® Status application must run with administrative privileges because it can stop a service. Because of this it may not start automatically at startup in Windows 7. It can be run manually from Start | All Programs | PCB Echo Monitoring Software | PCB Echo Service Status or you can set it up as a scheduled task using the Administrative Tools | Task Scheduler

NOTE: There should NEVER be more than one instance of the Echo® Data Monitor Service running on a PC.

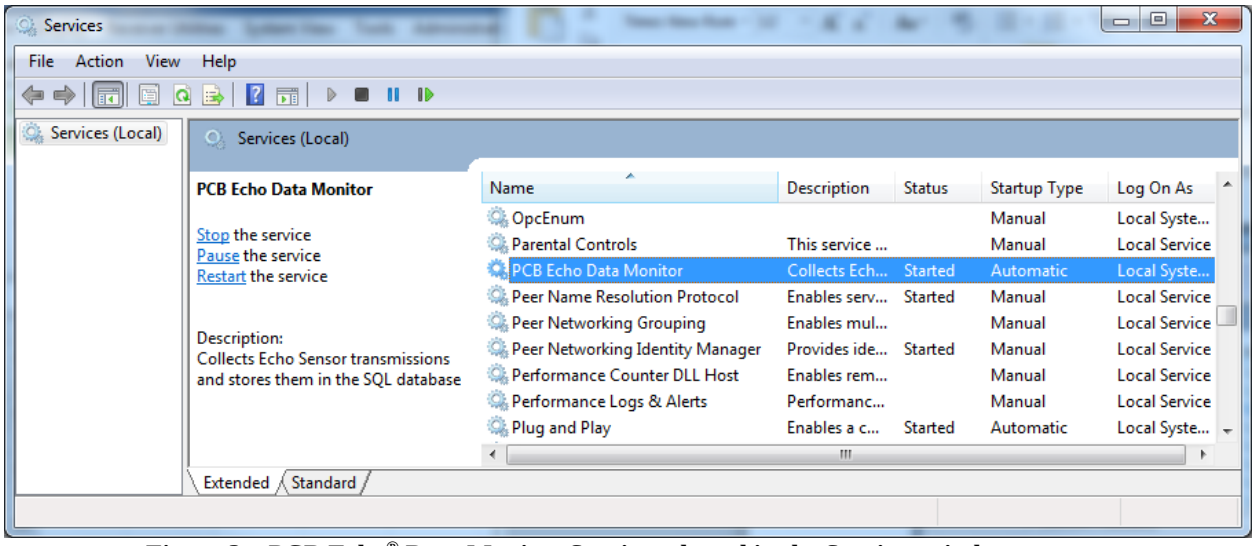


Figure 3 – PCB Echo® Data Monitor Service selected in the Services window

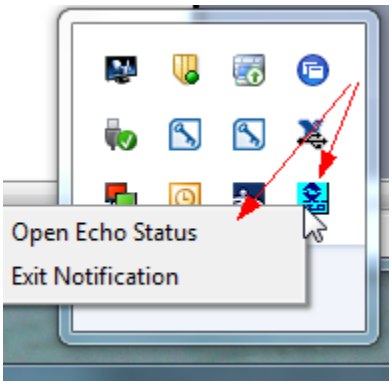


Figure 4 –PCB Echo® Status utility icon in the notification tray

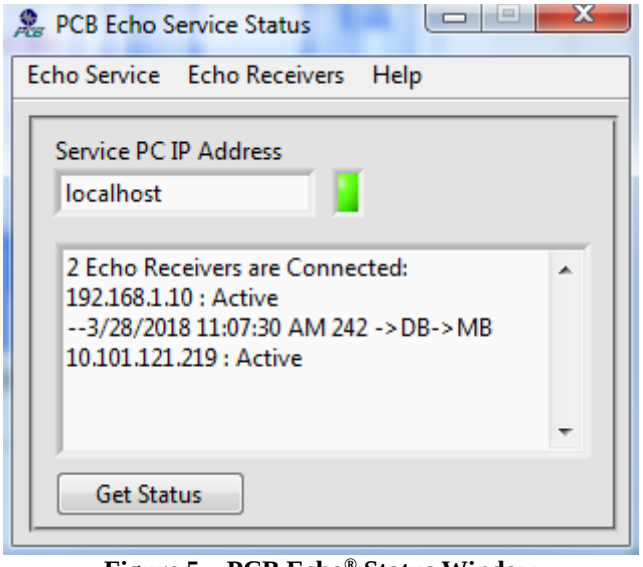


Figure 5 – PCB Echo® Status Window

The Echo® Status Utility provides control and status of the Echo® Data Monitor Service that runs continuously in the background collecting and storing Echo® sensor transmissions. This program should launch silently when a user logs on to the PC since a shortcut to it is placed in the startup directory when it is installed. However, if this fails to happen for some reason run: Start | All Programs | PCB Echo Monitoring Software | PCB Echo Service Status (PCBEchoNotify.exe in the install directory).
This utility's functions are accessed from the menu bar and the **Get Status** button. The service being queried for status can be on the same pc as this utility (localhost) or on a remote PC. To access a remote PC enter its IP address in the '**Service PC IP Address**' field and ensure the firewall has an exception entered for utility to get through to the remote PC.

NOTE: Only the Get Status and Find functions will work for remote PC access. You must be on the same PC as the service to configure, start or stop it.

Status is ascertained by activating the **Get Status** button. This sends a query to the service to which it responds with;

- The receivers it is tasked to monitor.
- The status of the connection to those receivers.
- The last transmission received from each receiver.

The last transmission indication shows the date and time that the transmission was received and may also contain "->DB" and/or "->MB". DB indicates the transmission was from a sensor registered for that receiver and was stored in the SQL database. MB indicates the Modbus interface is enabled and it was entered in the Modbus response file. An example of a status response is shown in Figure 5 above.

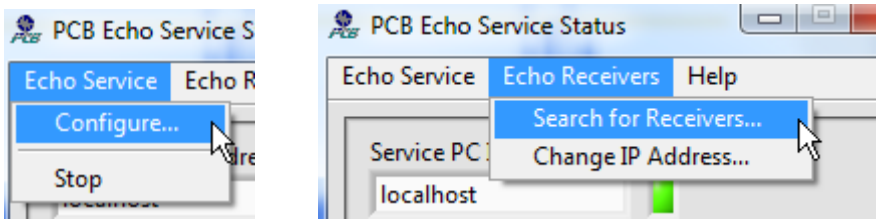


Figure 6 – PCB Echo® Data Service Status Window Menu options

The other functions available are accessed from the menu bar and include the following;

4.1.1 Search for Receivers

Echo Receivers | Search for Receivers… – In order to connect to a receiver, the receivers IP address must be determined and entered in the Receiver Parameter list's IP Address field. The procedure for setting a receiver's IP address is described in Section 4.2.14.2. To determine a receiver's IP address run the **Echo® Receiver Discovery Tool** from the menu bar. The screen shown in Figure 7 will appear. Clicking 'Search' should reveal the Echo® receivers, their assigned IP address and their internal unit ID. Enter the IP address seen here in the IP Address field of the Receiver Parameter list.

The utility starts with the 1st 3 octets set to the same values as the PC's IP address it is running on with 255 in the last octet. If this setting fails to find a receiver, then try changing the 3rd and 4th octets to 255 and try again.

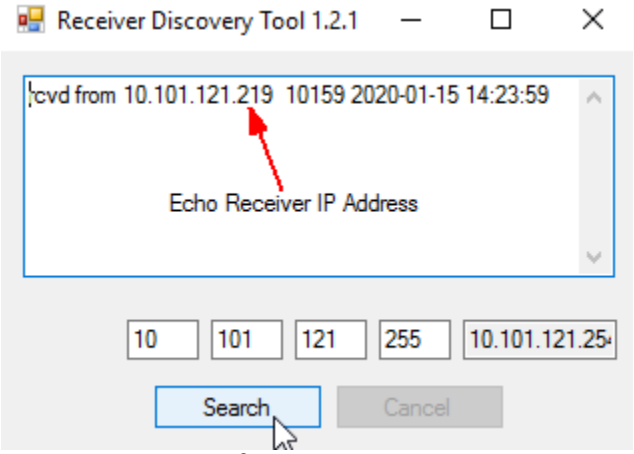


Figure 7 – PCB Echo® Receiver Discovery Tool Window

4.1.2 Configure the Receiver IP Address

Echo Receivers | Change IP Address… – The utility to configure a receivers IP address can be accessed from this application. See section 4.2.14.2 for details.

4.1.3 Stop the Service

If it becomes necessary to stop the service for any reason select the stop option. To Restart use the Windows 'Service' window found at Windows; Start | Control Panel | Administrative Tasks | Services. See Figure 13.

4.1.4 Configure the Service SQL Interface

Echo Service | Configure (the service) – Selecting 'Configure' will bring up the window shown in Figure 8 below. This window allows you to enter the parameters necessary to monitor a receiver, enable or disable the SQL interface and, if the Modbus option is installed, configure the Modbus responses to Modbus client requests. After any configuration changes are made they must be saved and the service must be stopped and restarted for them to take effect.

4.1.4.1 Receivers Tab

Receiver Parameters – All Echo® receivers are configured here. To add a receiver, enter the parameters in an available (dim) entry. To remove a receiver: right-click on the receiver of interest, and select the delete option.

- **Receiver Name –** Enter any name you like to refer to the receiver.
- **IP address –** Enter the IP address assigned to the receiver. You can use the Find utility described below to determine this.

- **SQL Server UDL File Path –** Enter the UDL or DSN file path that defines what database the transmissions should go to. This is required if SQL DB Enable is checked.
- **SQL DB Enable –** Check this box to have the Echo® transmissions stored in the database.
- **Save Button –** Saves the current configuration information.
- **OK Button** - closes the window.

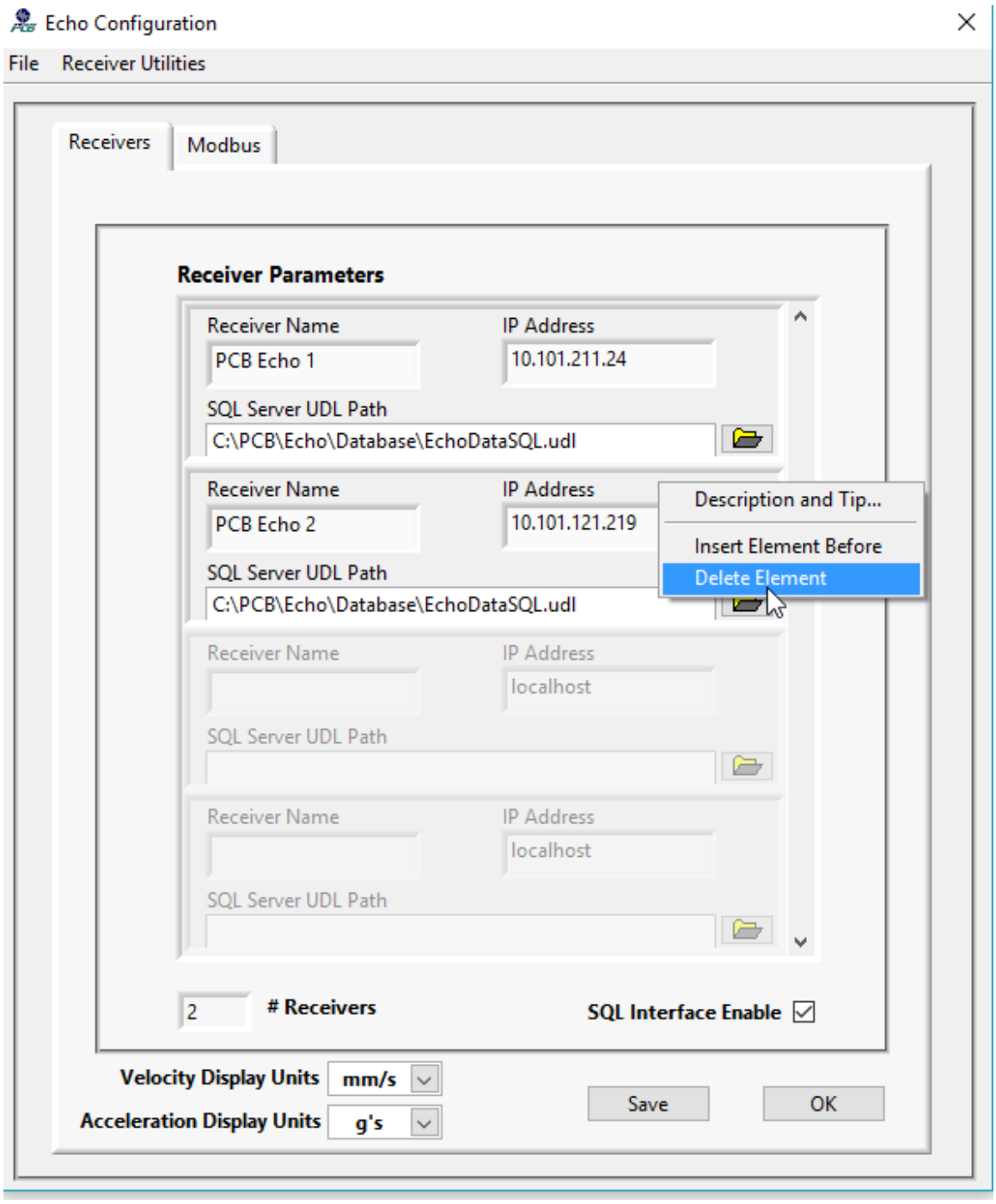


Figure 8 – PCB Echo® Receiver Configuration Window

4.1.5 Echo® Data Modbus over TCP/IP Server Interface

Model 600A20 software also hosts a Modbus Server capability in addition to the normal SQL Database interface. Its function is to service requests for Echo® data from a third party monitoring system (e.g. PI) using a Modbus over TCP/IP interface. Requests are made to the IP address of the PC hosting the Echo® Data Monitor Service Software using function code 0x03, Read Holding Registers, or 0x04, Read Input Registers. Which function code is used is up to the Modbus data client, they are responded to in the same way by the Echo® Modbus server.
The Modbus Ethernet slave daemon is launched automatically by the service when it starts. It listens on the default Modbus port (502 - but can be configured to use any port) and can accommodate multiple simultaneous connections.
The Echo® Data Monitor Service Software offers two mapping methods to accommodate Modbus client requests for data; Register and Sensor. These are described below.

Velocity and Acceleration Display Units – Separate controls for selecting the display units of velocity and acceleration data are located at the bottom left of this screen for use in systems where only the Echo Service is installed. These affect how the Modbus data is displayed and transmitted in response to a Modbus client request. For velocity data select ips – English or mm/s – Metric. For acceleration data select g's – English or m/s^2 – Metric.

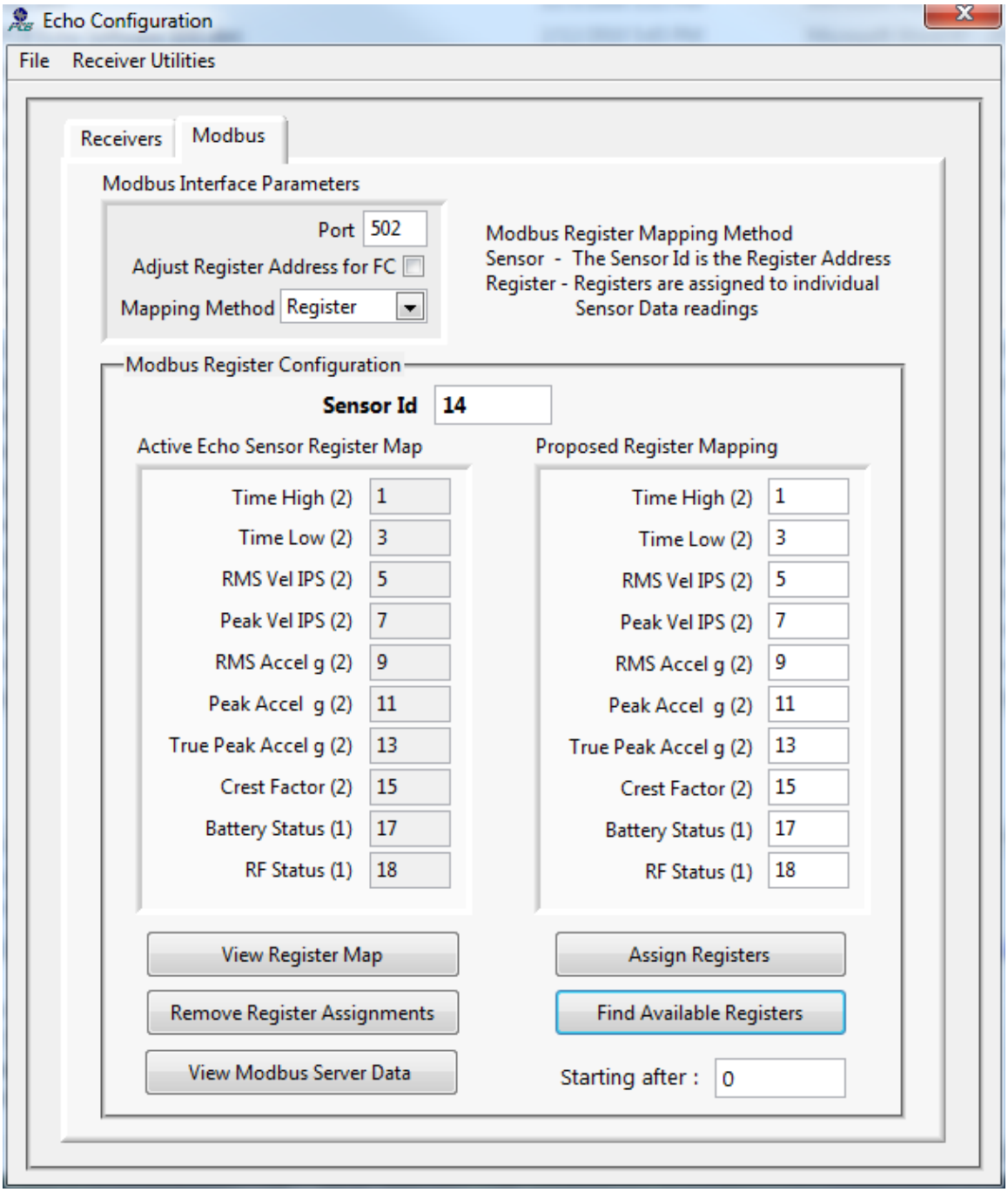


Figure 9 – PCB Echo® Data Service Configuration for Modbus

4.1.5.1 Modbus Register Mapping Method

The Register mapping method implements a traditional Modbus interface where data for a specific measurement is returned in a register or register pair. For Echo® Data a measurement is data for a single sensor and can be one of the following;

- RMS Velocity (IPS or mm/s)
- Peak Velocity (IPS or mm/s)

- RMS Acceleration (g's or m/s^2)
- Peak Acceleration (g's or m/s^2)
- True Peak Acceleration (g's or m/s^2)
- Crest Factor

Additionally, there are 3 status items available; Battery Status, RF Status and the time the measurement was taken.

Measurement data is sent in response to Function code 0x03, Read Holding Registers, or Function code 0x04, Read Input Registers requests. All measurement data items are held in two register pairs (32 bits total) which need to be cast as IEEE single precision floating point numbers in the Modbus client software that receives the request response. For example, if the reading was 1.0 and the registers assigned to it are 5 & 6 it will be returned in 2 16-bit registers as 0x3F80 & 0x0000 where 0x3F80 is in the low address register (5) and 0x0000 is in the next higher address register (6).
The RF and Battery Status values (strength) are each returned in 1 16-bit register with a value between 0-3 where 3 is best.
The Time of acquisition is a 64-bit double precision value that represents the number of seconds since midnight January 1, 1904 GMT. This is returned in 4 16-bit registers as two measurement values time high and time low, each of which is 32 bits.

When the Register Mapping Method is used every measurement value of every sensor configured in the system must have Modbus registers assigned to it if its data is to be requested by the Modbus client software. The Echo® software makes the register assignment process simple. The control descriptions below Refer to Figure 9 when 'Register' is selected as the mapping mode. In Sensor mode, described later, none of these controls are relevant and are disabled.

4.1.5.1.1 Function Code based Register Addressing

Some Modbus clients will adjust the Address of a register by a value that is based on the Modbus message function code. Under this scheme, the Client SW specifies the function code and enters registers starting at address 0. For instance, their register address internally for the 1st register using a function code of 3 will be 40001 but the message will ask for register 0. Checking **Adjust Register Address for FC** will add the offset back to the message ensuring a 1-1 correspondence of the actual registers mapped between the Echo® Modbus server and the external Modbus client.
Supported Function code offsets are:

- FC 3 - Read Holding Registers – Incoming addresses will have 40001 added
- FC 4 - Read Input Registers - Incoming addresses will have 30001 added

The Echo® Modbus Server register mapping should start at 30001 or 40001 if this is used by the client

Sensor Id – Enter the Id of the sensor whose data is being assigned to registers. When an Id is entered the software will search to see if the sensor already has registers assigned. If

so the values will appear on the left side of the screen under the 'Active Echo Sensor Register Map'. If no registers are assigned yet then the values will be 0. 0 is an invalid register assignment and will never be used.

Find Available Registers button – If no registers are assigned, or you want to change a sensors current assignment, then you can activate the '**Find Available Registers'** button. This button, used in conjunction with the '**Starting After'** control causes the software to search for available registers after the register number in the starting after control. Alternatively, you can enter the register values by hand. In any event, after each data item has a register assigned activate the '**Assign Registers'** button to record them for the Modbus server to use.

Assign Registers button – Activation of this button causes the register values in the 'Proposed Register Mapping' section to be assigned to the selected sensor.

Remove Register Assignments button – Activation of this button causes the register values currently reserved for the selected sensor, shown in the 'Active Echo Sensor Register Map' section to be cleared.

View Register Map button – Activation of this button causes the window shown below in Figure 10 to open and display all registers assignments currently in the system.

View Modbus Server Data button – Activation of this button causes the window shown in Figure 12 to open and display the last data received from the Modbus configured sensor. It is this data that will be sent in response to a Modbus Client request for the specified register.

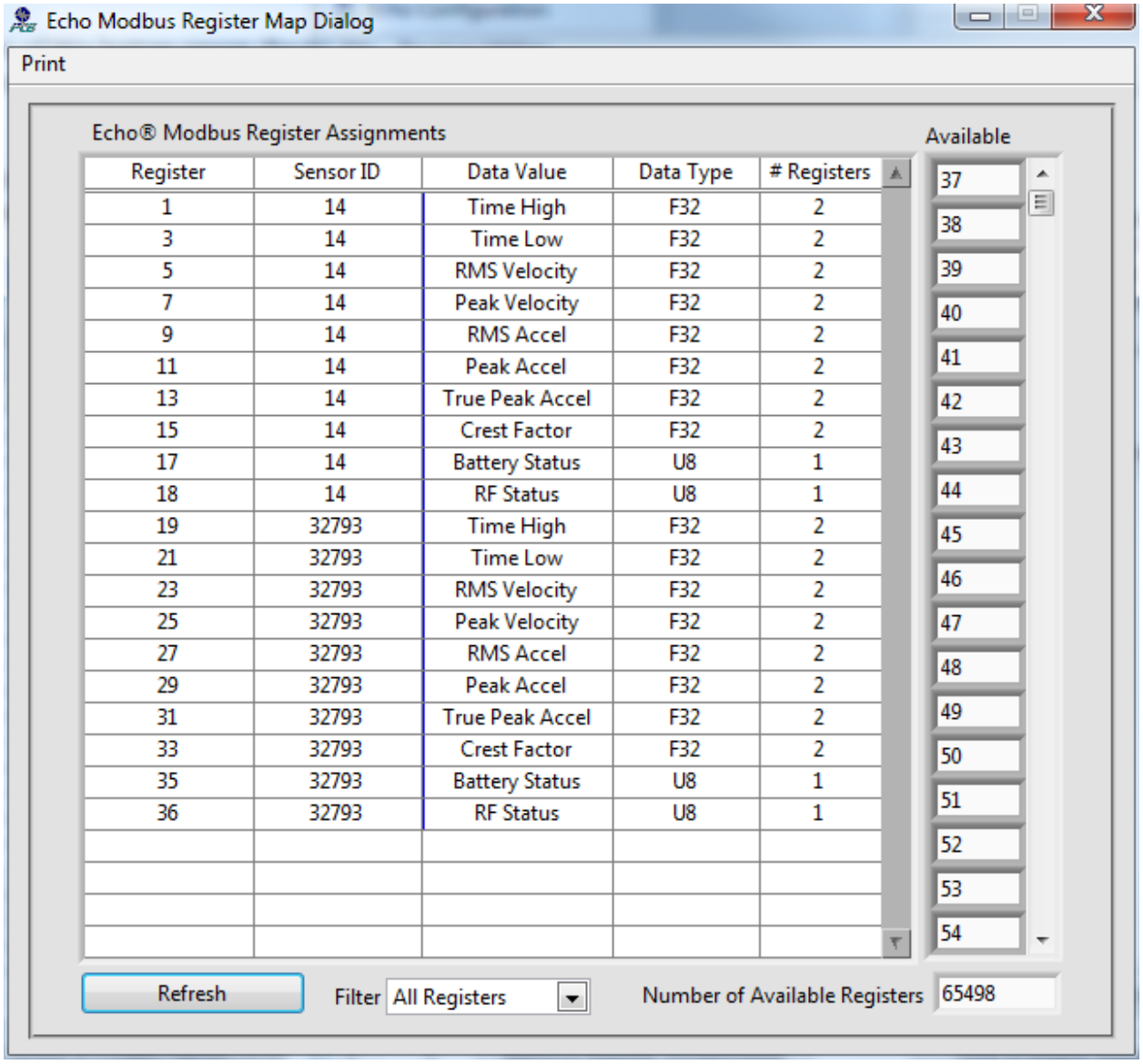


Figure 10 –Modbus Register Assignment Screen

In this screen the register number is displayed along with the Sensor Id and data value it is associated with. The data values numeric type and the number of consecutive registers required to hold it. The register assignments can also be displayed by data type by selecting a filter at the bottom of this screen as shown in Figure 11.

On the right of the screen is a list of available registers that have yet to be assigned.

A printout of the register assignments can be made by selecting '**Print'** from the menu bar. Two options are available; Print all and Print selected registers. To select registers to print, click the mouse in the table and drag it to highlight (in blue) the registers of interest.

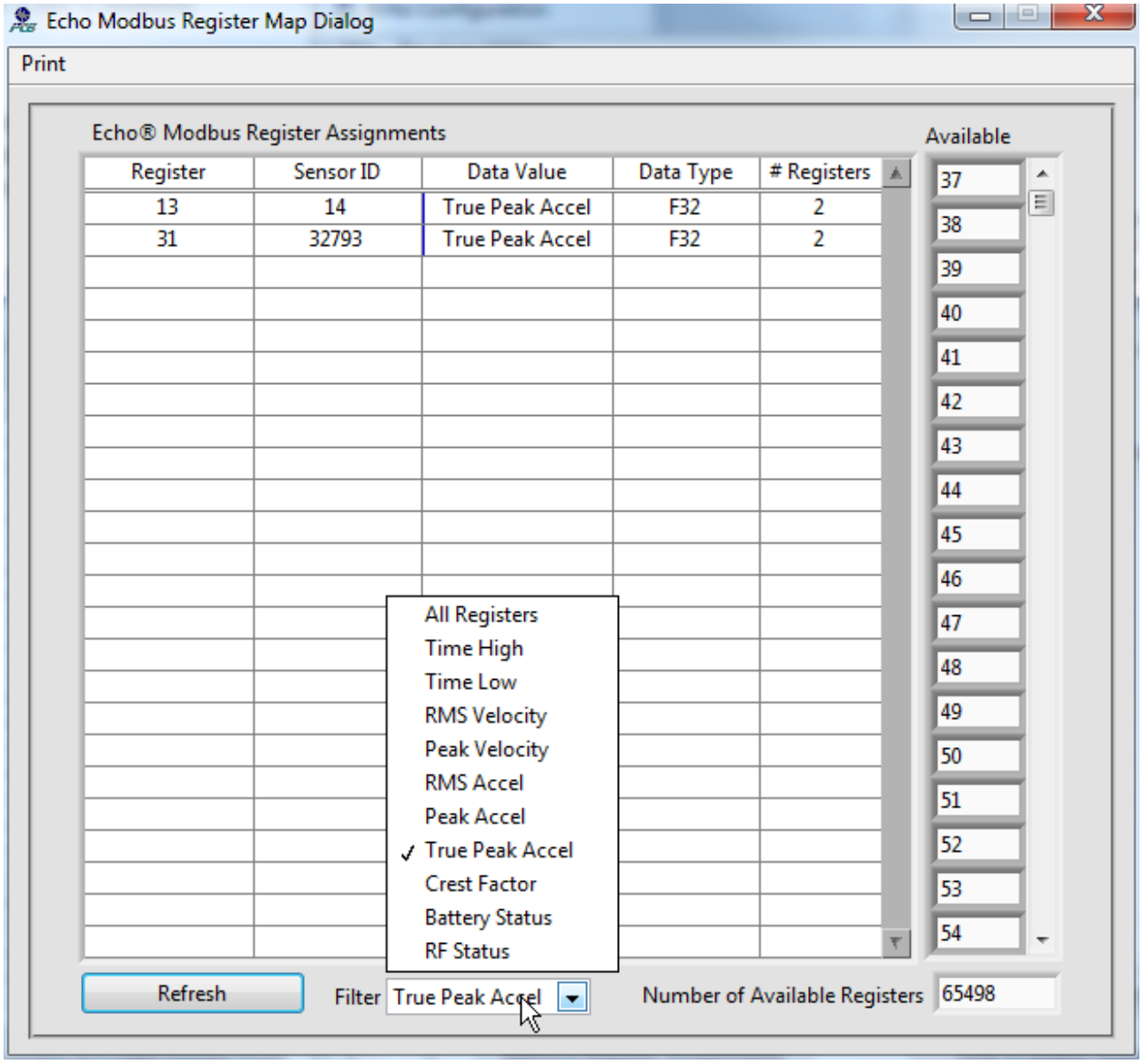


Figure 11 –Modbus Register Assignment Screen – Filtered

To close the window click the 'X' in the top right of the screen. This will return control to the Modbus configuration screen.

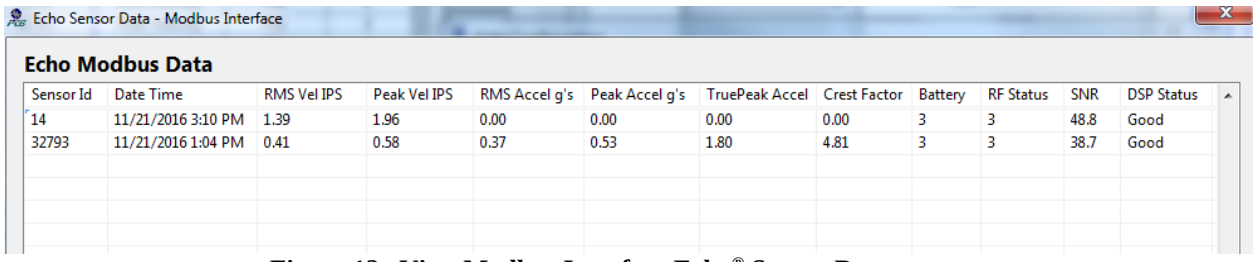


Figure 12 –View Modbus Interface Echo® Sensor Data

NOTE: For ANY changes to become effective, the changes must be saved by selecting the File | Save Configuration AND restarting the PCB Echo® Data Monitor Service as shown below.

After all registers are configured in the Echo® software they must also be configured in the third party monitoring software's Modbus client.

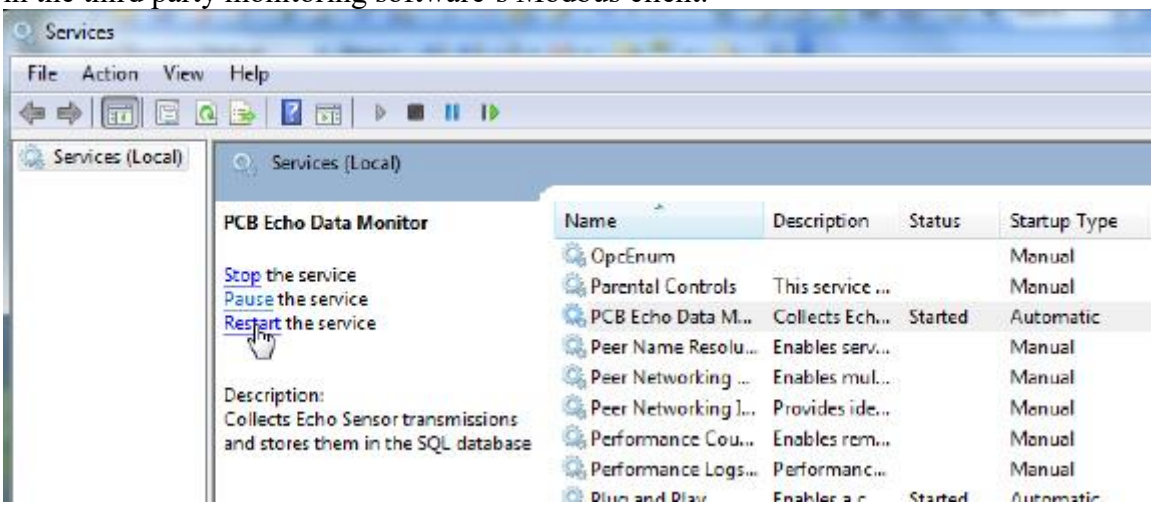


Figure 13 –Restarting the PCB Echo® Data Monitor Service

4.1.5.2 Echo® Modbus Server – Sensor Mapping Method

The Echo® Modbus Server sensor mapping method is a simple implementation that maps the register address (1-65,535) provided with function code 3 or 4 to an Echo® sensor id which also has a range of 1-65,535. The resulting response from the Echo® Modbus server is the 34 byte, most recent sensor transmission data, described below. The quantity values that accompany the start address field are ignored since only one response is possible in this mode. If no transmission is available for the requested sensor then exception code 4 is returned.

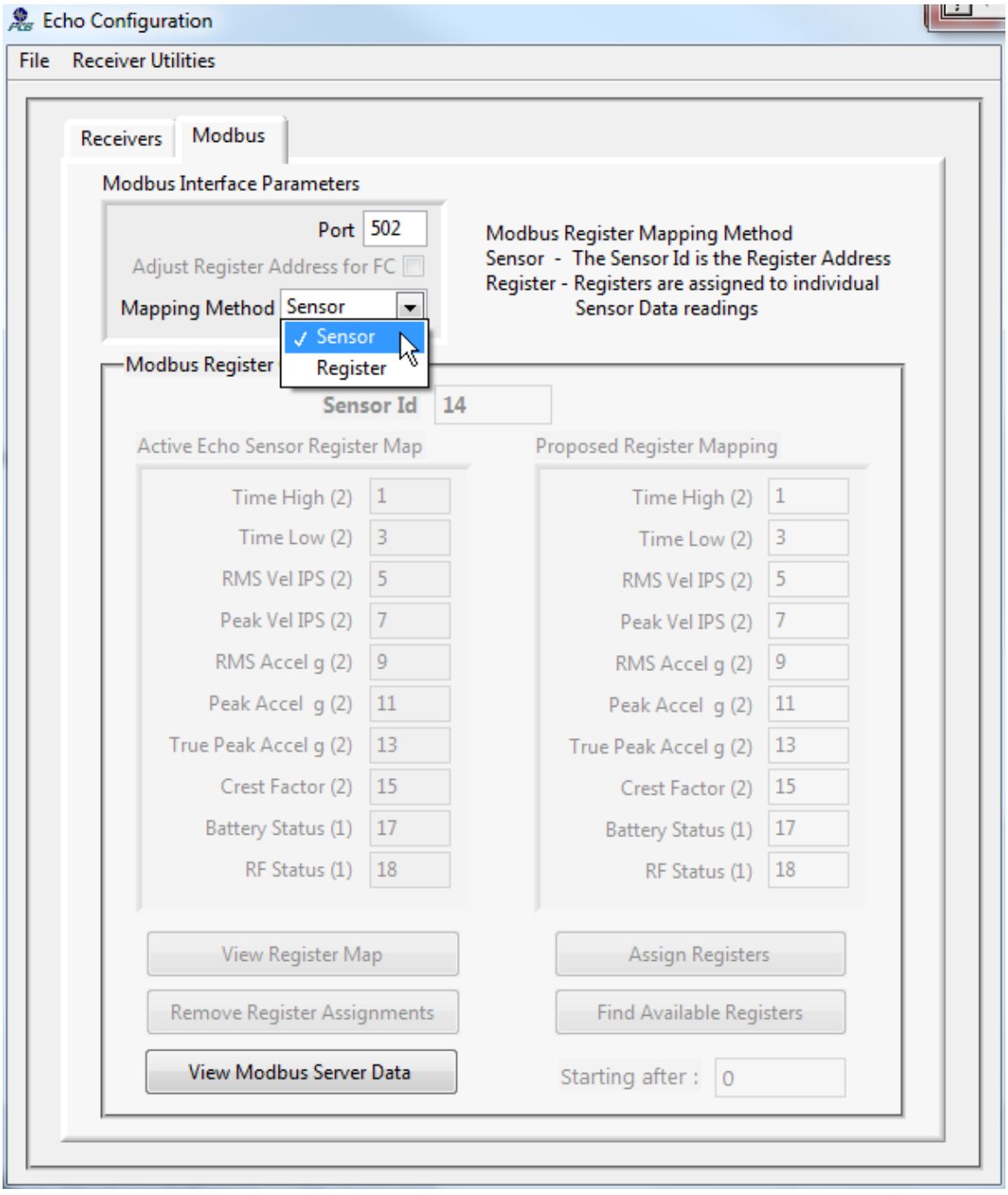


Figure 14 –Modbus Configuration Screen – Sensor Mapping Method

The following tables explain the how the registers are mapped to the sensors and how to interpret the data that is returned.

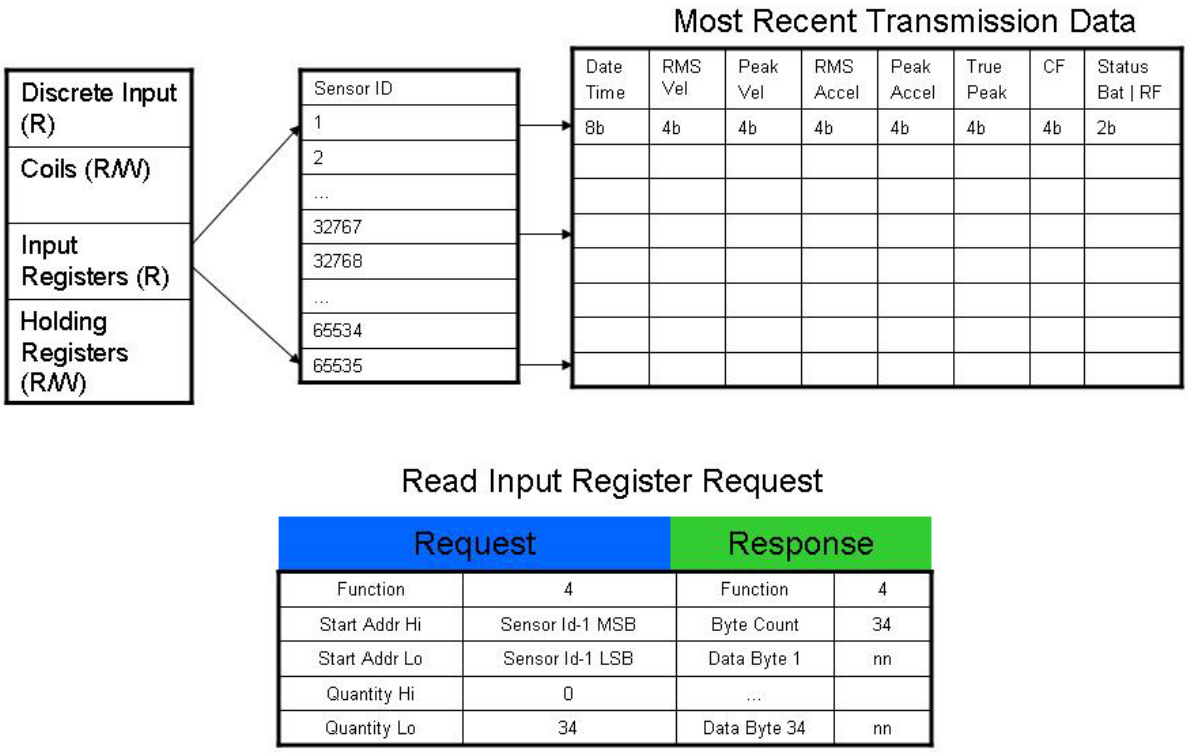


Figure 15 –Modbus Sensor Mapping Method Request/Response Diagram

4.1.5.2.1 Echo® Modbus Sensor Mapping Method Response Translation

The following table shows how the Modbus client software must translate the 34 byte Echo® data response to see it in a meaningful form.

Field	Bytes	Cast	Interpretation or Units
Transmission data and time	0-7	64-bit IEEE double-precision format	Number of seconds since 12:00:00.000 AM 1/1/1904 (Universal Time)
RMS Velocity	8-11	32-bit IEEE single-precision format	IPS or mm/s
Peak Velocity	12-15	32-bit IEEE single-precision format	IPS or mm/s
RMS Acceleration	16-19	32-bit IEEE single-precision format	g or m/s^2
Peak Acceleration	20-23	32-bit IEEE single-precision format	g or m/s^2
True Peak Acceleration	24-27	32-bit IEEE single-precision format	g or m/s^2
Crest Factor	28-31	32-bit IEEE single-precision format	True Peak Accel / RMS Accel

Battery Status	32	8-bit unsigned integer	0-3; 3=best quality
RF Status	33	8-bit unsigned integer	0-3; 3=best quality

Figure 16 –Modbus Sensor Mapping Method Response Translation Table

4.2 Echo® Data Presentation Software

The **Echo® Data Presentation** software is run by selecting Start | All Programs | PCB Echo Monitoring Software | Echo Data Presentation. Or running the Echo Monitoring.exe program located in the C:\PCB\Echo directory. This application is only applicable if the Echo® Data Service was configured for SQL Database operations since it presents the data and determines status based on information stored in the database.

The Echo® Data Presentation Software is used to view:

- Trend data collected from the receivers
- Status of the machines being monitored.
- Status of the sensors sending data to the receivers

When the Echo® Data Presentation software is run the screen shown in Figure 18 will appear. This screen can be resized by dragging the bottom right corner in or out. On the left is a list of sensors in a tree structure, organized by Plant | Group | Machine and Sensor Location (these terms are user configurable) from values entered in the sensors channel definition.

4.2.1 Echo® Main Screen Graphs

Clicking on a sensor in the left panel will cause its data, for each data type, to be displayed in the graphs located on the right panel. These graphs display trend data along with their associated critical and warning alarm levels. The screen can be used to view 6 graphs, one for each data type, or it can be used to zoom in on a particular data types. The data can be viewed in either English (ips & g's) or Metric (mm/s & m/s^2) units.

When all six graphs are displayed their data can be scaled simultaneously by using the scale tool of the True Peak Acceleration graph in the bottom left of the screen  . When scaled using this tool the data period will remain scaled to these dates until either the 'Reset Graph' option is selected from the menu options that appear by right clicking the graph or changing the display period from the Display Preferences screen (Figure 56).To enable or disable the 'Link' feature check or uncheck the menu bar item **Display | Main Screen Graphs | Link Graph Scales to True Peak Accel**.

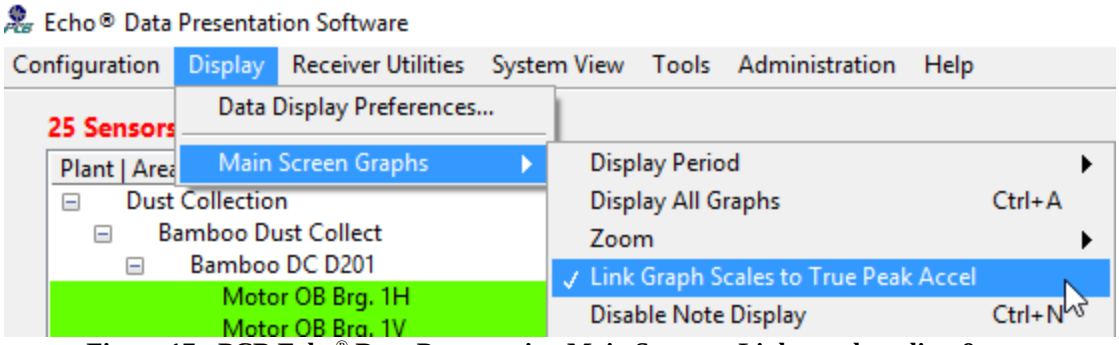


Figure 17 - PCB Echo® Data Presentation Main Screen – Link graph scaling & cursors

When enabled the True Peak Acceleration graph label will be blue, when disabled the label will be black. Additionally, the cursors on all other graphs can be moved by moving the True Peak Acceleration graph cursor when this feature is enabled.

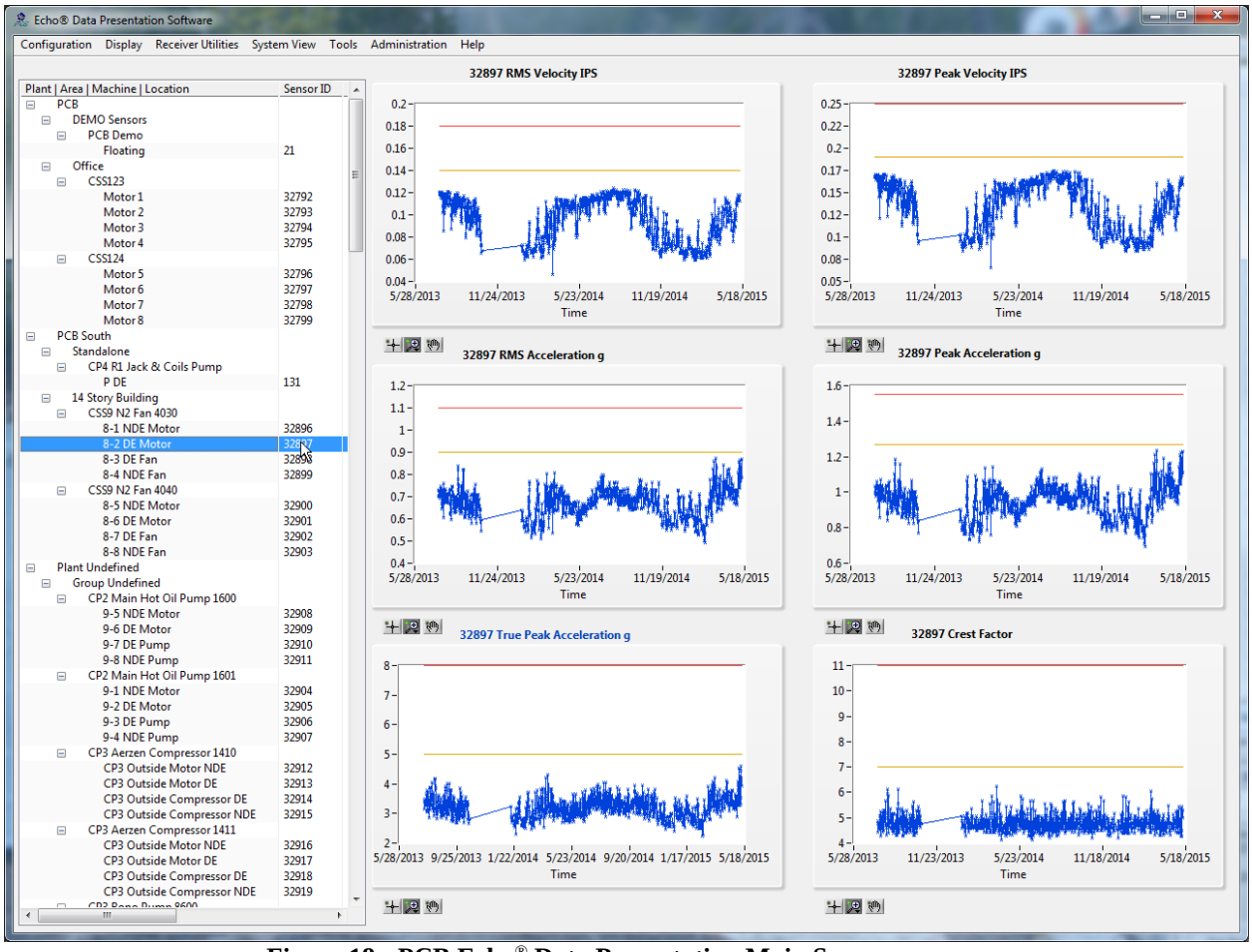


Figure 18 - PCB Echo® Data Presentation Main Screen

If the operator preference is to see a particular data type in an enlarged graph then right-click on the graph, as shown in Figure 19, and select the Zoom option.

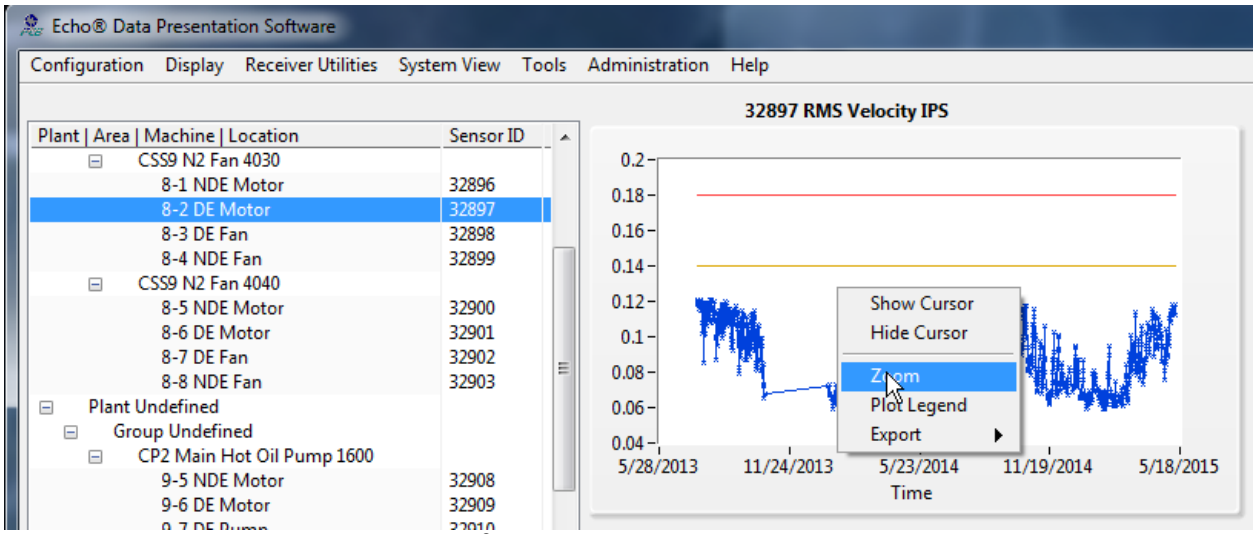


Figure 19 - PCB Echo® Data Presentation Main Screen Zoom

This will cause the main screen to appear as shown in Figure 20. This action can also be accomplished using the menu bar items shown in Figure 21 (or <ctrl> 1 through 6).

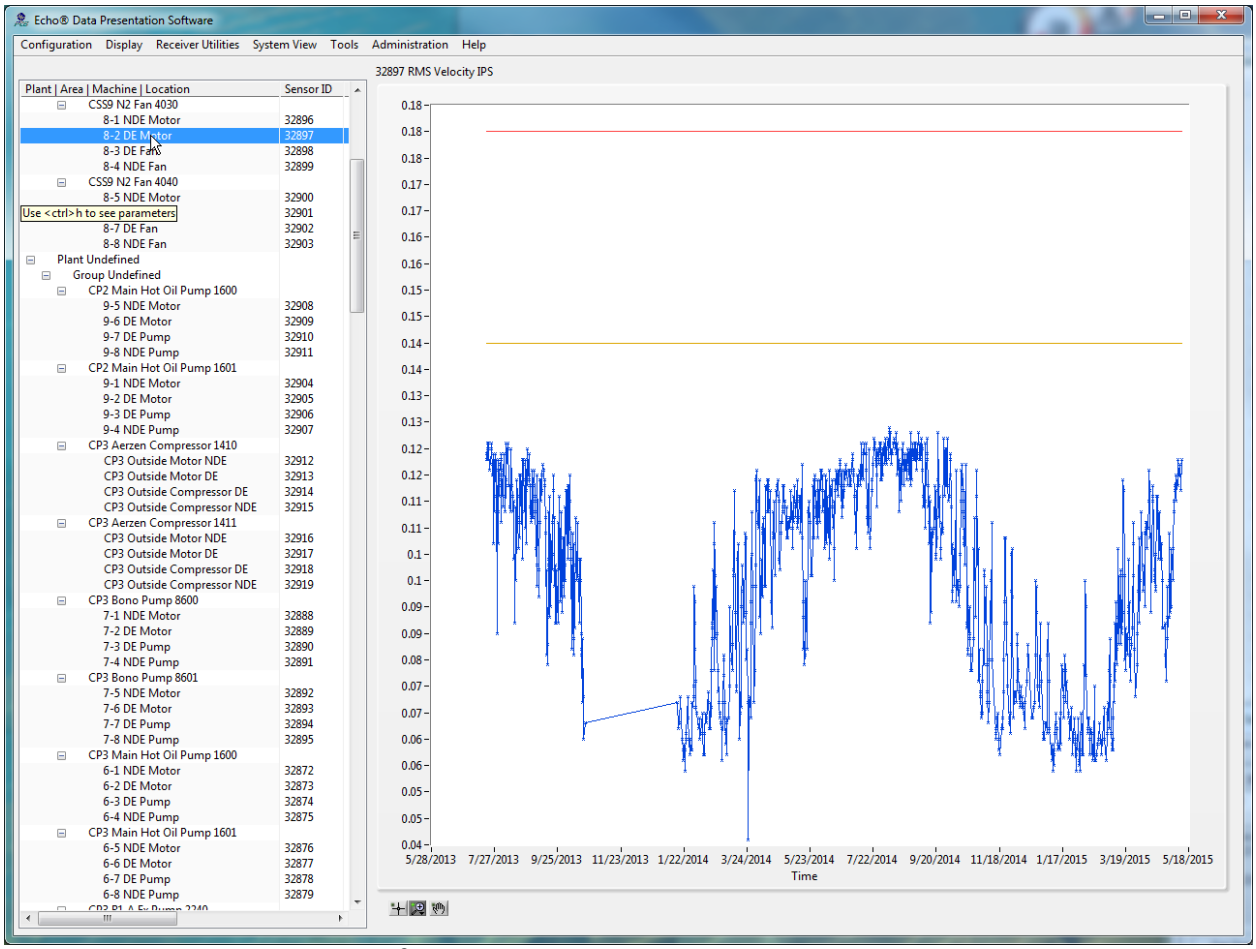


Figure 20 - PCB Echo® Data Presentation Main Screen with enlarged graph

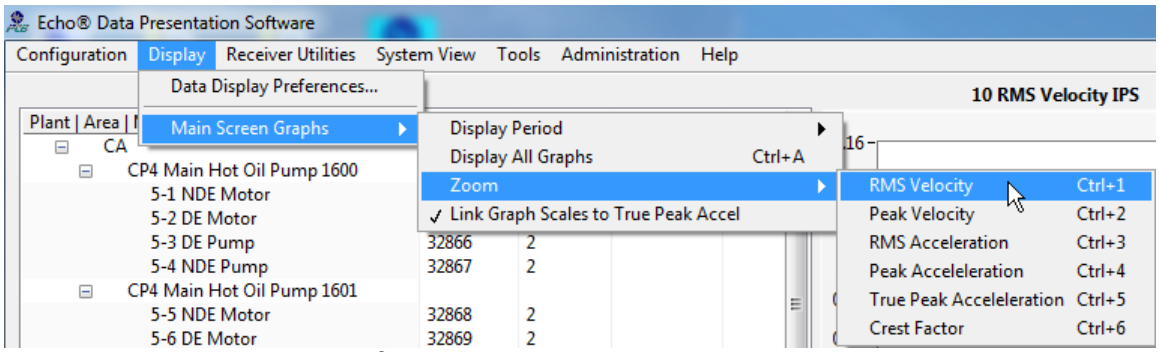


Figure 21 - PCB Echo® Data Presentation Main Screen Menu bar Zoom options

To return to the six graph display, right click on the enlarged graph and click the 'Display All Graphs' option (or <ctrl> A).

4.2.2 Echo® Main Screen Graph Cursors

Cursors can be displayed on the main screen graphs to track and display information about individual data points displayed in the graph. They can be displayed individually by selecting **Show Cursor** from the shortcut menu displayed when you right click on any graph. Once displayed, move the mouse cursor over the graph cursor and press the left mouse button to grab the graph cursor so it can be moved to the desired data point.
In the example below the True Peak Acceleration graph is displayed. Notice its label is colored blue. This is because collective scaling is enabled and scaling the data on this graph, or displaying its cursor, or moving its cursor, will cause the same action to occur on all graphs. When a cursor is displayed a label will also display showing the x (date & Time) and y (magnitude) axis values for the selected data point.

To remove the cursor from the graph, select the **Hide Cursor** option from the short cut options.

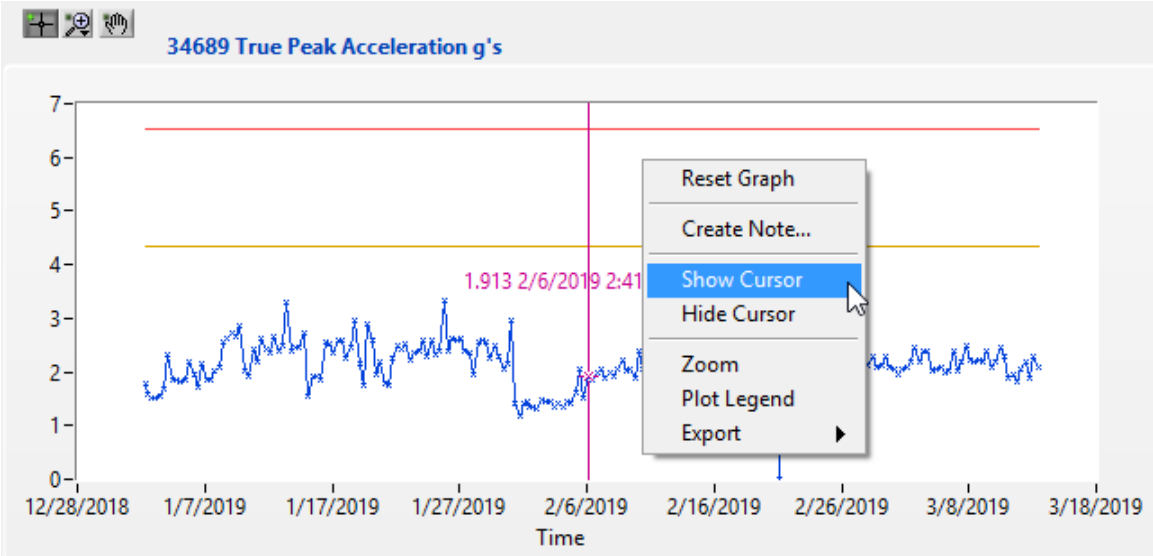


Figure 22 - PCB Echo® Data Presentation Main Screen Show Cursor option enabled

Figure 23 below shows the screen with the cursors enabled on all graphs and tied to the True Peak Acceleration graph actions.

Note: While the True Peak Acceleration graph movements will be reflected on the other graphs while in this state, the other graphs can be manipulated individually (scaled, cursor moved etc.) without affecting the other 5 graphs.

Figure 23 - PCB Echo® Data Presentation Main Screen with tracking cursors

4.2.3 Echo® Main Screen Status Updates

Initially status updates are disabled on the main screen and the sensors in the sensor tree will not show status colors. Generally the main screen is not the optimal screen to view status as it doesn't convey enough overall system information to determine how many monitored points need attention. For this 'at-a-glance' function the Echo® System Overview screen is recommended, preferably on a separate monitor.
However, status may be viewed on the main screen by setting the **Main Screen Refresh Rate** to a value greater than 0 on the **Display Preferences Dialog** screen, Figure 24, (Display | Display Data Preferences… from on the Main screen menu bar). This interval, in minutes, sets the update rate which also enables the status information to be displayed.

When status indications are enabled the sensor Id in the left panel will have one of five colors assigned to it;

- Green – there are No active alarms for any data type being reported by the sensor.
- Yellow - there is a Warning level alarm for one or more any data type being reported by the sensor.
- Red - there is a Critical level alarm for one or more any data type being reported by the sensor.
- Gray – No data has been collected for this sensor yet but alarms are enabled.
- White – Alarms for the sensor are disabled.

Additionally the number of sensors in alarm will be displayed in red at the top of the sensor tree and. if context help is displayed <Ctrl-h>, a list of sensors in alarm will be displayed (Figure 25) when the cursor is on the sensor tree.

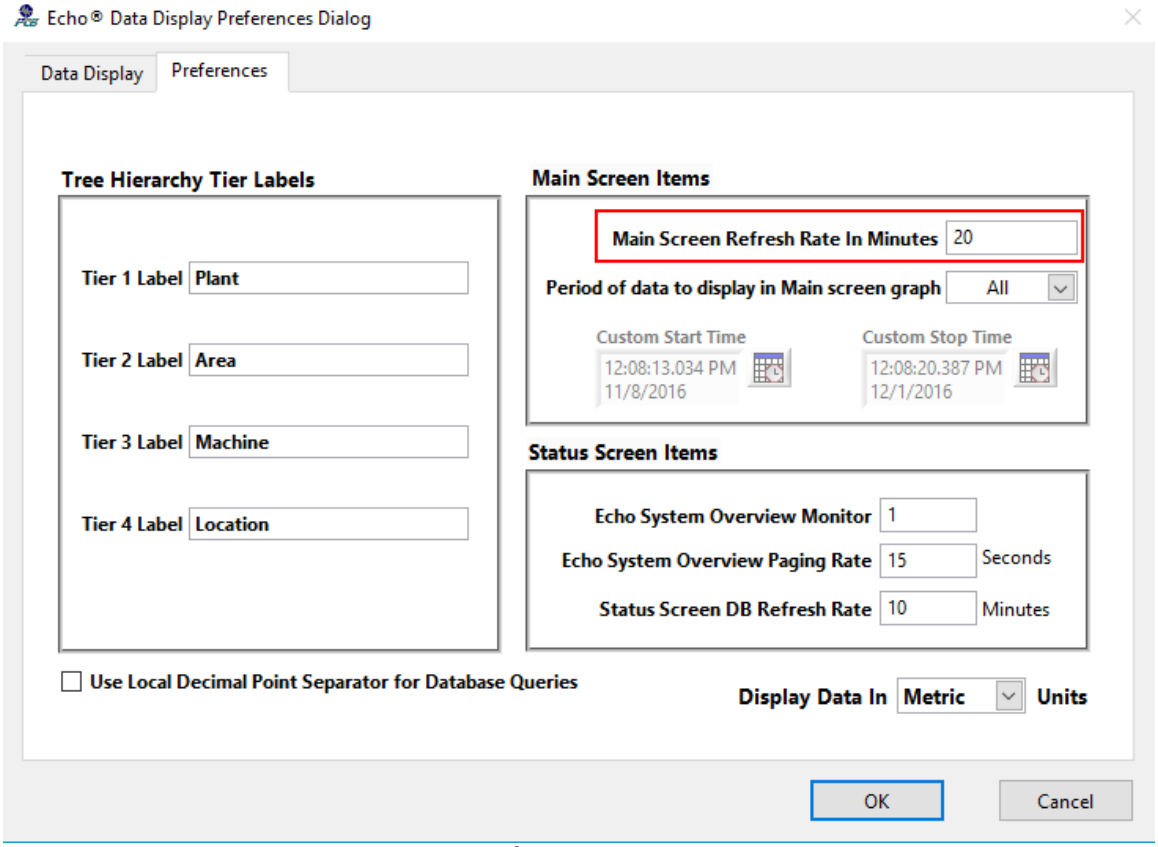


Figure 24 – PCB Echo® Data Display Preferences Screen

To quickly view the alarm levels and other configuration information for a sensor enable the context help window (Help| Show context Help or <ctrl h>) and click on a sensors graph. To see a list of the sensors in alarm move the cursor over the sensor tree. Figure 26 shows the Main screen with status indications enabled and the context help window displayed.

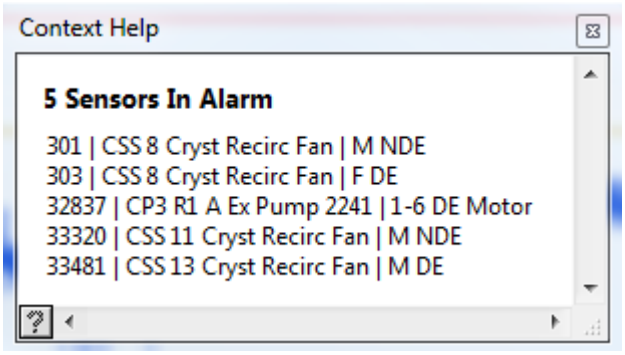


Figure 25 – Context Help window when cursor is on the Sensor Tree

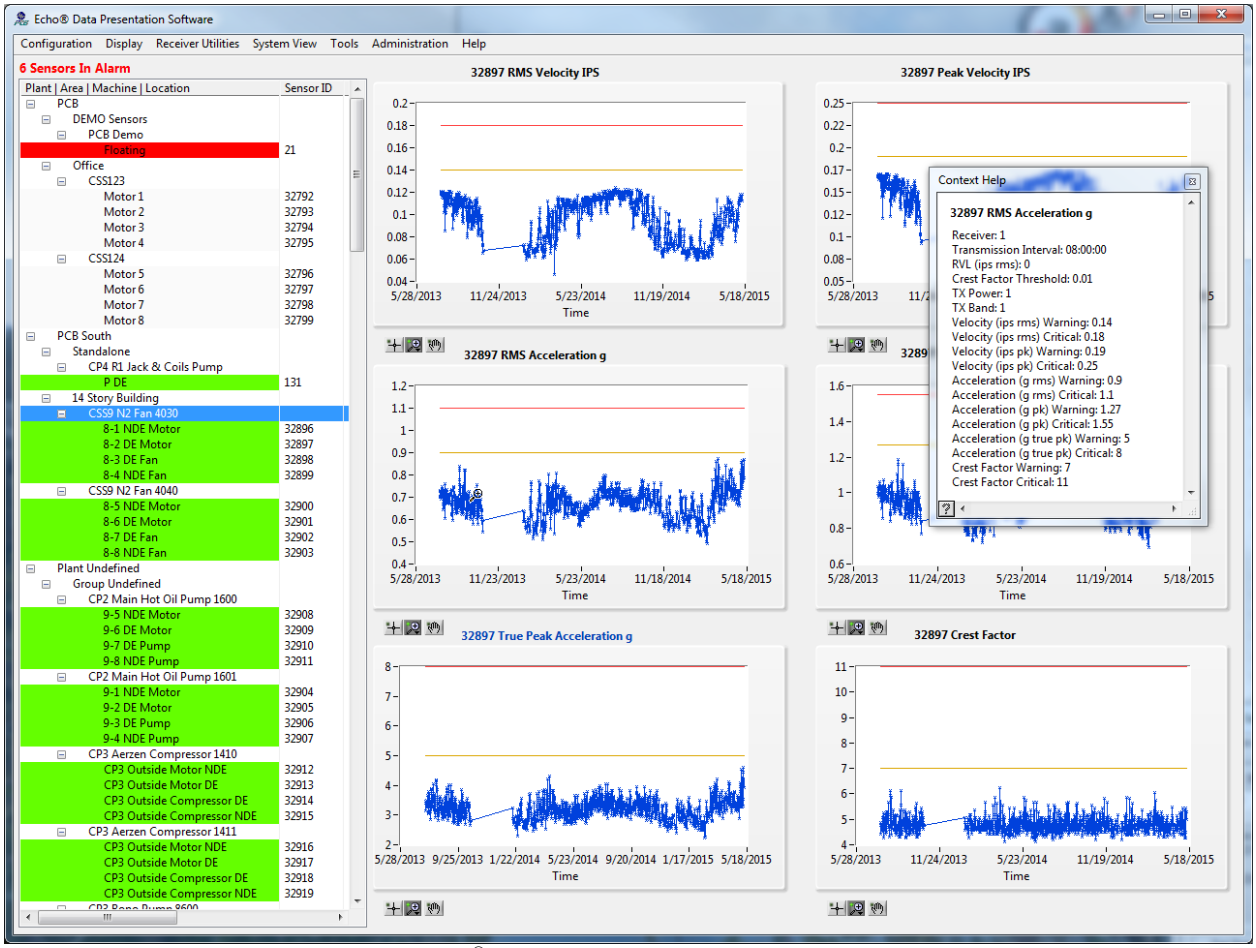


Figure 26 – PCB Echo® Main Screen showing status indications

Other functions can be accessed quickly by clicking on a sensor to select it and then right-clicking the mouse to display the list's shortcut menu (Figure 27).

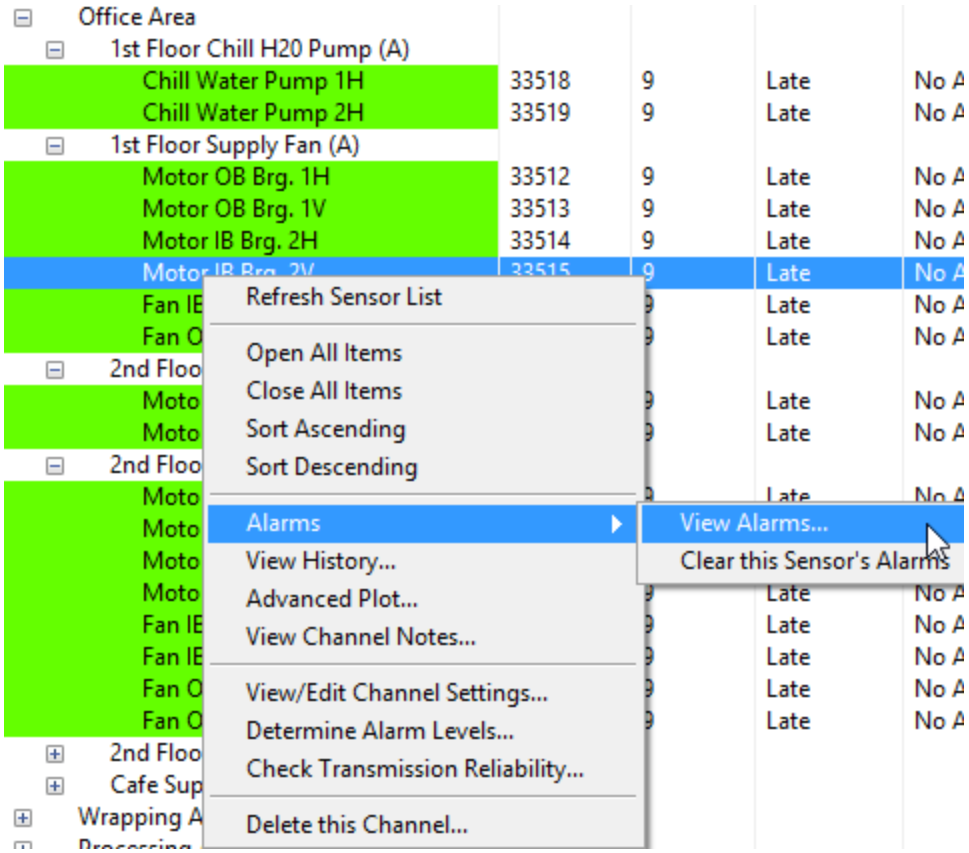


Figure 27 – Main Screen Sensor Tree Short Cut Menu

From this short cut list you can;

- Refresh the sensor list to see if and changes have occurred.
- Sort the tree or a section of the tree in ascending or descending order.
- View the Alarm screen for the selected sensor (Figure 125).
- Clear the selected sensor's alarms.
- View the History screen for the selected sensor (Figure 104).
- Display the Advanced Plot window to better view the data (Figure 109).
- View, or edit, Channel Notes that have been assigned. (Figure 63)
- View or Edit the sensors parameters (Figure 36). (Editing them requires the user to be logged in Administration | Login…)
- Run the Alarm Level utility for the selected channel.
- Run the Transmission Reliability Utility for the selected channel.
- Delete the selected channel (This function also requires the user to be logged in)

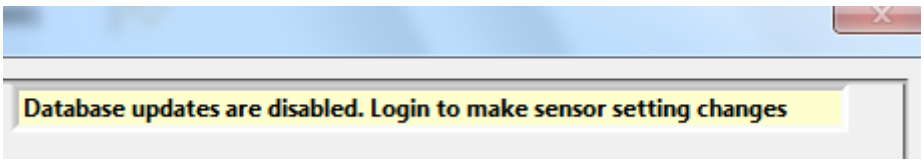
It is recommended that the sensors be configured and added to the database, prior to the receiver connection so that their transmissions will be logged in the database.

4.2.4 Echo® Configuration Administration Privilege

To add or edit a sensor's configuration parameters you must be logged into the Echo® Software. This screen is shown immediately when the software is started. At other times to log in select **Administration | Login…,** from the main screen menu bar.
This will bring up the Login Dialog window shown in Figure 28. Passwords are case sensitive. If the software is being run for the first time the password is blank. Just click OK to log in. Once logged in you can select Administration | Change Password… to set a new password.

Figure 28 – Administration Log in Dialog window

If you are not logged in and you open window where configuration changes are made you will see a message similar to the one below displayed on the screen. Additionally, some menu options may be disabled.



4.2.5 Echo® Receiver Configuration

To configure the Echo® Software for data collection or data viewing click on the Configuration | Receivers… item as shown.

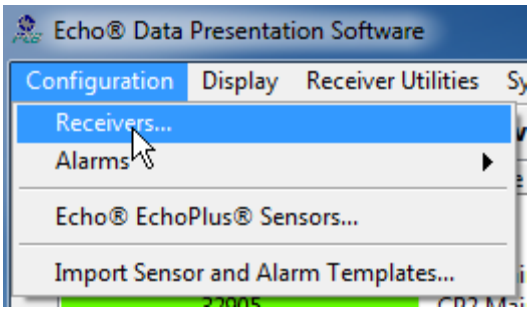


Figure 29 – Echo® Monitoring Receiver Configuration Menu Option

Selecting the Configuration | Receivers… option will bring up the screen shown in Figure 8. This window allows you to enter the parameters necessary to monitor a receiver, enable or disable the SQL interface After any configuration changes are made they must be saved and the service must be stopped and restarted for them to take effect.

4.2.5.1 Receivers Tab

Receiver Parameters – Use this function to configure Echo® receivers, if it becomes necessary to remove a configured receiver from the system, right-click on the list and select the delete option.

- **Receiver Name –** Enter any name you like to refer to the receiver.
- **IP address –** Enter the IP address assigned to the receiver. You can use the Find utility described below to determine this.
- **SQL Server UDL File Path –** Enter the UDL or DSN file path that defines what database the transmissions should go to. This is required if SQL DB Enable is checked.
    - **SQL DB Enable –** Check this box to have the Echo® transmissions stored in the database.

Note: the Modbus parameters are never presented in the Echo® Data Presentation Software since it is not applicable here. See the Echo® Data Monitor Service for a description of the Modbus interface and configuration.

4.2.6 Echo® Sensor Configuration

It is important that the sensors be configured properly so they:

- Send data at the appropriate interval and within the proper frequency band.
- Get registered in the database allowing data received from them to be stored.
- Can be referenced in terms that make more sense than the ID number they are manufactured with.

The Echo® Monitoring Software provides a screen for this purpose which can be accessed through the 'Add Echo® or EchoPlus® Sensors…' item on the main screen menu bar shown below in Figure 30.

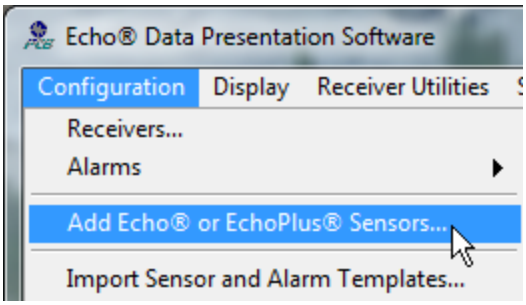


Figure 30 – Echo® Monitoring Sensor Configuration Menu Option

Selecting **Configuration | Add Echo® EchoPlus® Sensors…** will bring up a dialog screen to add a sensor or junction box to the database (Figure 31). Enter the Sensor Id of a 670A01 standalone Echo® sensor or the 1st channel id of a 672A01 EchoPlus® junction box and click the Add button.

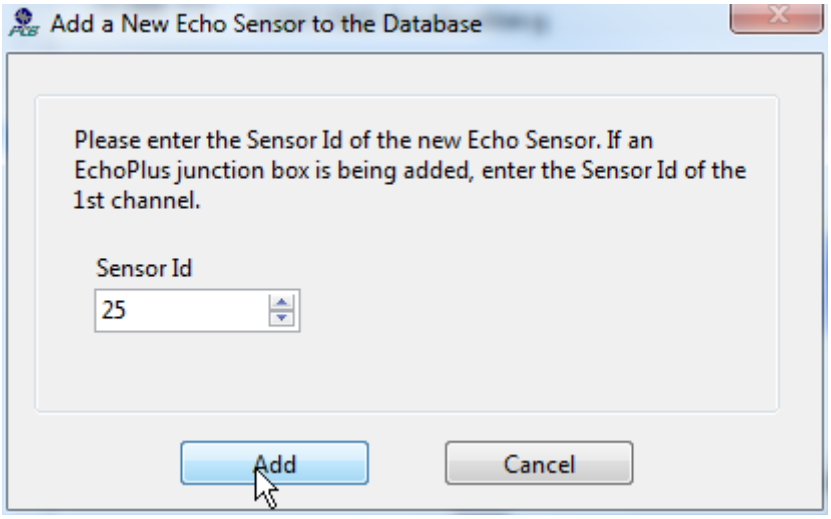


Figure 31 – Echo® add sensor dialog

If the Sensor Id entered is not already defined in the database then an information dialog will appear stating that fact and defaults will be used for its parameters.

Clicking OK on the dialog box will display the Echo® Sensor Parameter Editor screen shown in Figure 32 or Figure 36. If the Sensor Id is less than 32768 then the sensor is a standalone 670A01 Echo® sensor. In this case the single channel dialog is displayed.

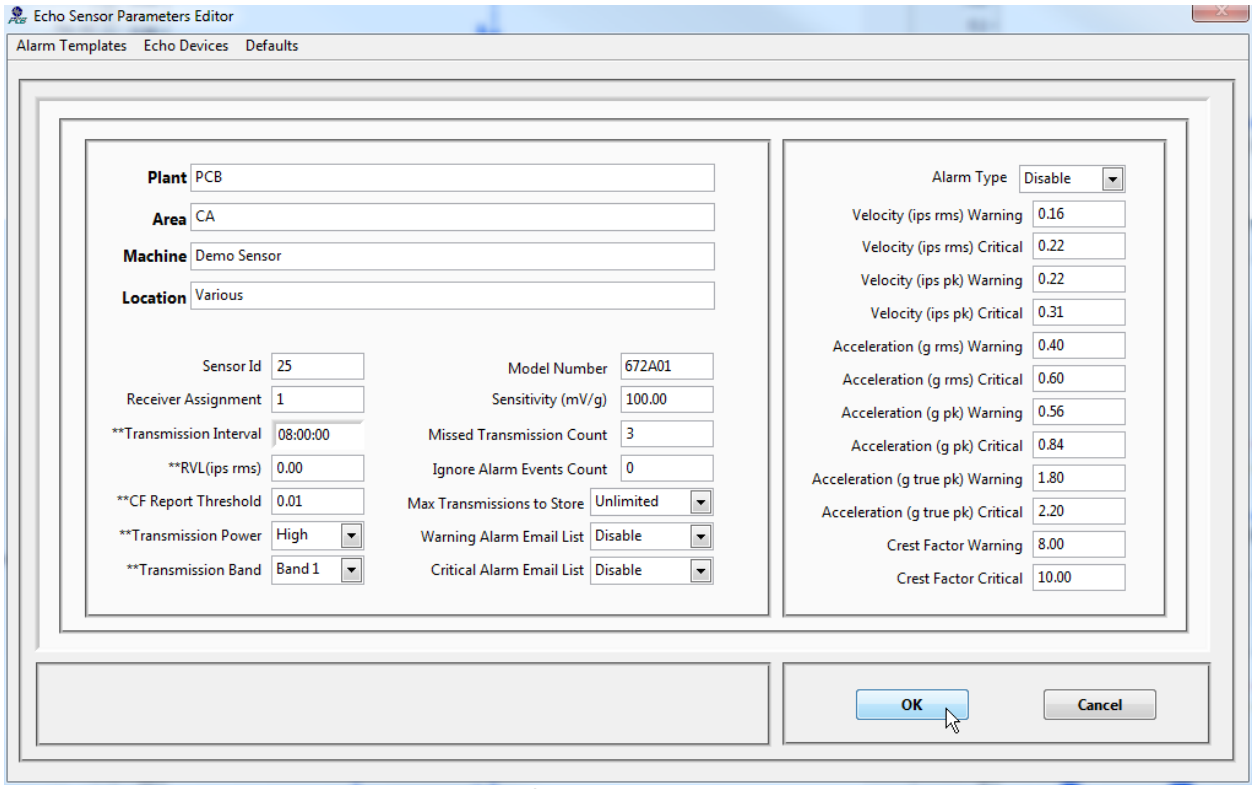


Figure 32 – 670A01 Echo® Sensor Parameter Editor Screen

When adding channels to the database the 1st action should be to connect to the device, if possible, configure its parameters and then finish with the other parameters on the editor screen. This sequence will synchronize the settings in the sensor with their database counterparts automatically. This method provides the best assurance that what is subsequently seen in a sensors database fields accurately reflects the actual sensor configuration. However, if it is not convenient to connect to the sensor then, at a minimum, you must set up the data base fields manually so the sensors transmissions will be recorded.

To connect to a device select the 'Echo Device | Connect…' item in the menu bar.

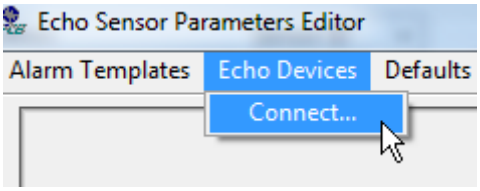


Figure 33 – Echo® Connection Menu item

Selecting 'Connect…' will cause the appropriate device configuration screen to be displayed. Before proceeding though you must connect the appropriate serial port cable to the sensor. For the Echo® sensor the cable is a DB9 to mini-USB. For EchoPlus® it is a standard, straight through, serial cable with DB9 connectors on each end. For Echo® sensors the screen shown in Figure 34 will appear, for EchoPlus® the screen in Figure 40 (Section 4.2.6.4) will appear.

4.2.6.1 Echo® Sensor Hardware Configuration Utility

The Echo® Configuration Utility provides a mechanism to read and write the sensor parameters. Typically the only parameters that would require modification are the Transmission Interval, the Residual Vibration Level (RVL), the Transmission Power and the Transmission Band. The Sensor ID is set at the factory and must not be changed.

To connect, click on the 'Link to Echo®' button. If the sensor is active (the magnetic switch is activated and the small LED blinks every 4 seconds[1]) then you should only click the button when the sensor is not taking a measurement or transmitting otherwise a communication error may occur. A sensor is taking a measurement if the blue LED is dimly lit continuously for several seconds and it is transmitting if the LED is brightly lit for several seconds.

When the link is successful the green LED on the screen will be bright and after several seconds the sensor parameters will appear in the fields as in Figure 35.

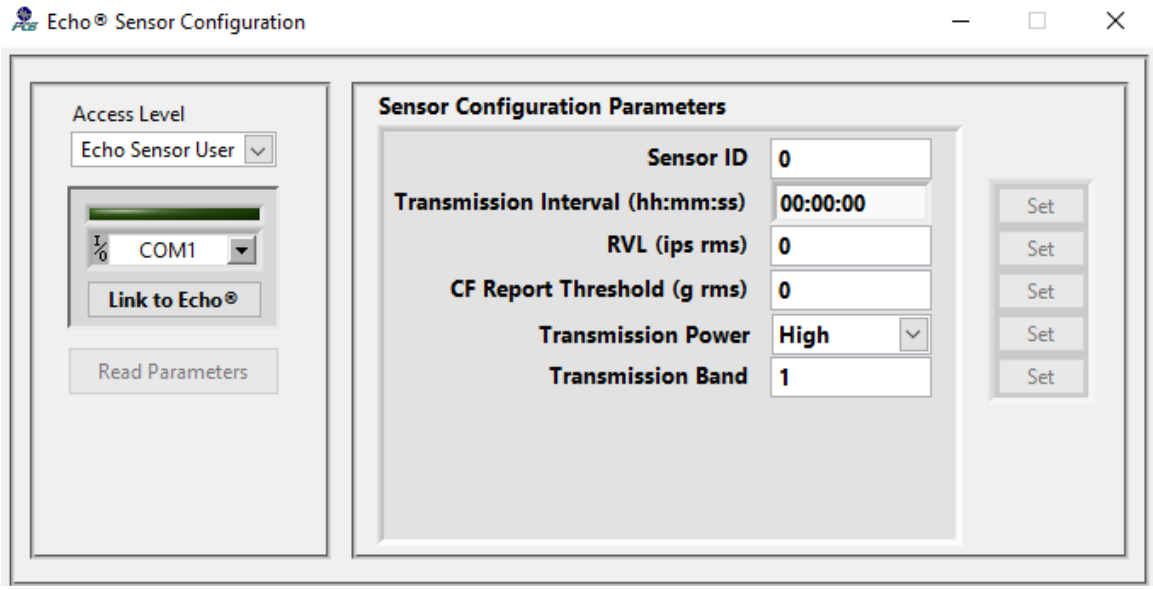


Figure 34 – Echo® Configuration Utility

The **Transmission Interval** determines how often the sensor wakes up to take a reading and transmit[2]. The format is HH:MM:SS with a resolution is 4 seconds. If you set a value that is not a factor of 4 seconds the utility will automatically adjust it to be one (ex: if you set it to 30 seconds it will change it to 28 seconds and display 28 after the sensor is updated). For 868MHz systems there is a minimum transmission interval of 7.5 minutes (1% duty cycle for a 4.5 second RF transmission). There is no minimum for 916 MHz systems.

[1] The sensor is not active if the LED blinks at 8 second intervals. You may connect to it when it is inactive
[2] This setting directly affects the battery life. Transmitting every 32 seconds will drain the battery quickly. Transmitting every 8 hours and the battery should last ~ 1year.

Residual Vibration Level (RVL) it the minimum IPS RMS level the sensor must detect before transmitting the data. If this value is 0 the sensor will transmit every reading.

The **Crest Factor Report Threshold** is an RMS acceleration value. If the measured RMS acceleration is less than this value, a zero is reported for the Crest Factor. If it is equal to or greater than the threshold value, the actual Crest Factor is reported. This feature exists because there is 2 kHz HP filter in the acceleration circuit. If there isn't any HF in the signal, the RMS acceleration data will essentially be noise and thus the CF will be invalid.
The **Transmission Power** for a sensor can be set to High (normal) or Low. Typically this will be set to High. If the sensor is close to the receiver then Low should be selected.

The **Transmission Band** setting (1-12 for 619MHz systems or 1-9 for 868MHz EU systems) must be coordinated with the receiver since only transmissions in a specific band will be recognized by a receiver. This feature is useful in situations where multiple receivers are present since you only want one receiver processing each sensor.

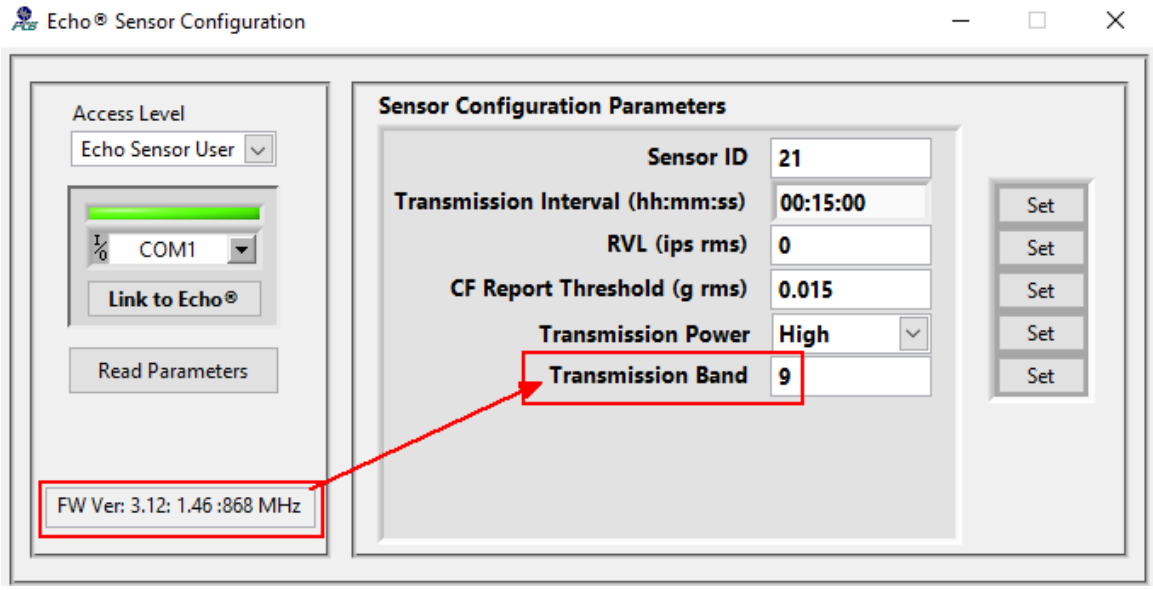


Figure 35 – Echo® Configuration Utility Connected

When the sensor configuration is complete you can close the utility by clicking the 'X' in the top right corner of the screen.

Several database fields will be filled in initially for a new sensor that has just been configured with the utility. These are the Sensor ID through the Sensitivity fields. *These should NOT be changed.* Next enter the rest of the channel parameters as described below.

4.2.6.2 Echo® Sensor Database Parameters

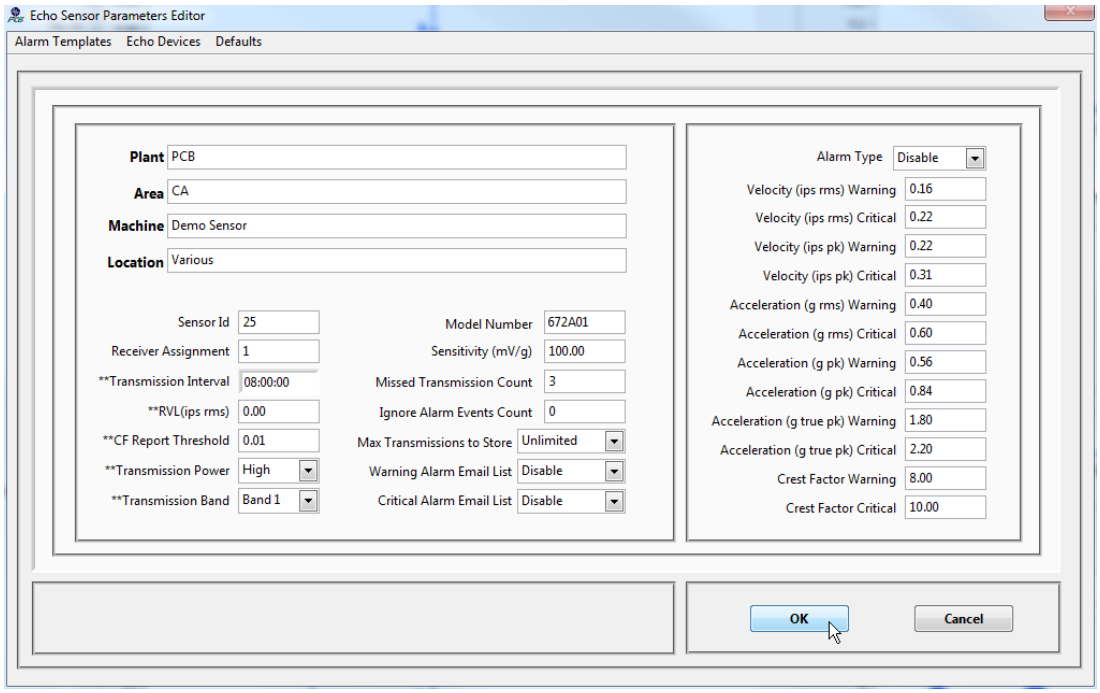


Figure 36 – Echo® Sensor Parameter Editor

The **Plant**, **Area**, **Machine**, **Location** and the **Alarm** fields will automatically be populated with the values of the previous sensor's data since many sensors will have similar values and this makes the data entry task easier. The Echo® Monitoring software uses this information to determine if an alert should be issued and to better identify a sensor using the machine and location values whenever a sensor is referenced or selected.

The **Plant**, **Area**, **Machine**, **Location** fields are used to organize sensors in the tree structures on the Main and Alarm screens. If no Plant or Area value is entered then the sensor will be put in the Plant Undefined or Group Undefined section.
To aid in the task of entering alarm levels there is a menu item to automatically fill the alarm values in by selecting then from an alarm template. To use this feature click on the Alarm Templates Menu item (shown below) and select the appropriate alarm template option. These templates can be set up by the end user to suit their needs. The process is described in section 4.2.9.
NOTE: To disable a specific measurements ability to trigger an alarm, set its alarm level to 0.

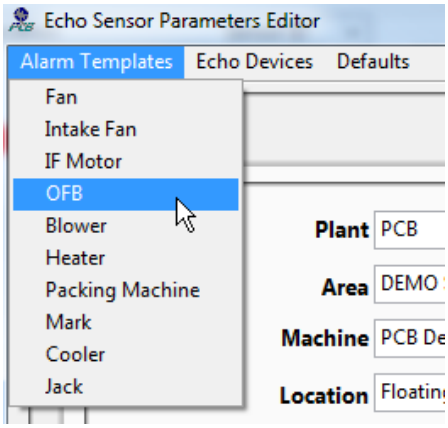


Figure 37 – Set alarm values from a template

Additional channel parameters are;

- **Alarm Type** – Disable; Latch, meaning hold the alarm until the operator clears it; Non-Latch – the alarm will go away if the next transmission does not exceed the alarm threshold.
- **Missed Transmission Count** – This is the number of missed transmissions that can be tolerated before a **Late Data** alarm is declared.
- **Max Transmissions to Store** – This is the number of readings to keep in the database for this sensor, when the number of readings stored exceeds this number the oldest readings are deleted automatically. To keep all readings select 'Unlimited'. Any transmission can be saved indefinitely if desired by setting the Save Flag from the Historical Data | Maintenance screen, see section 4.2.14.5.1
- **Ignore Alarm Events Count** - An alarm level must be exceeded this number of *consecutive* times before an alarm is declared on a channel with an alarm type set to 'Latch'. Set the count to 0 to disable this feature and declare an alarm for every reading that exceeds the set alarm level if alarms are enabled. If consecutive alarm events occur and the alarm is set then each subsequent alarm will also trigger an alarm until the alarm is cleared.
    - **NOTE: by setting Ignore Alarm Events Count to a value other than 0 the user acknowledges that alarm status and email notifications will be delayed, in some cases for a significant period of time, especially if the transmission reliability for a particular sensor is not good.**
- **Alarm Type**
    - **Disable** – no alarms are generated for this sensor.
    - **Latch** - hold the alarm until the operator clears it.
    - **Non-Latch** - the alarm will go away if a subsequent transmission does not exceed the alarm threshold
- **Warning and Critical Alarm Email Lists** – These pull down controls select the email list associated with warning and critical alarms for this sensor. If alarms are enabled and a list is selected then, when an alarm occurs for the sensor, whoever is in the list will get an email with the alarm details.

After all these fields are entered click on the **OK** button to complete the process. The dialog box in Figure 38 will be displayed.

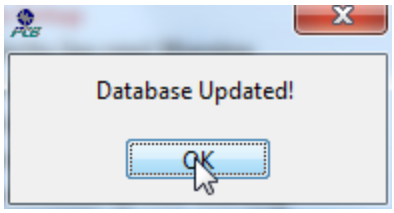


Figure 38 – Echo® Database Update Complete Dialog

Clicking **Cancel** discards any changes made to the sensor database parameters.

4.2.6.3 EchoPlus® Sensor Database Parameters

If the device being added is a 672A01 EchoPlus® device then the screen that appears is similar to the 670A01 but it has features to quickly configure multiple channels.

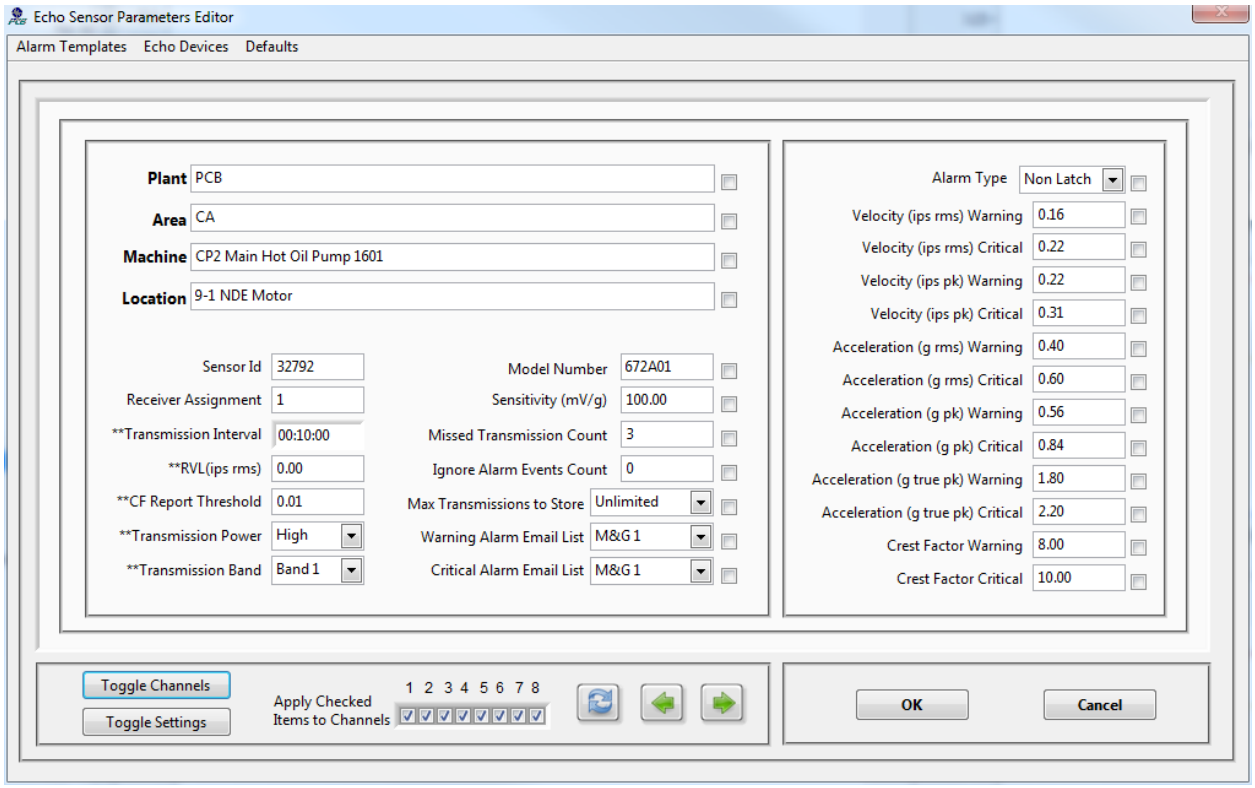


Figure 39 – EchoPlus® Sensor Parameter Editor

Next to most items is a check box. Click (check) this box if you want that parameter applied to more than the selected channel. You can also click the **Toggle Settings** button to set or clear all setting checkboxes. Next click the **Toggle Channels** button to select, or clear, all channels, or individually select the channels to apply the parameters to by clicking the channel check boxes at the bottom of the screen. When the parameters are set and the check boxes are checked click on the **Update** button to apply the settings. **Note**: the Update button only appears when more than 1 channel is selected.

To cycle through the channels click the left or right arrow buttons. These navigate through the channels and display the channels parameters. When all parameters are set appropriately click **OK** to close the window and write the settings to the database. Alternately, to cancel and changes, click the **Cancel** button.

The menu bar has two quick setting items to set the alarms for the displayed channel from the **Alarm Templates** or to set the parameters to their **Default** values. It also has an **Echo Devices** entry to access the junction box or standalone sensor configuration windows. **Note**: the **Echo Devices** function requires you to connect to the physical hardware with the appropriate serial cable.

Note: The Sensor ID for junction boxes is always in groups of 8 starting with the id 32768. The editor will make sure this convention is followed. The 1st channel will always be set to an 8 channel multiple and next 7 will increment from it. Additionally, the **Transmission Power** (High/Low) and **Transmission Band** (1-12 for 619MHz systems or 1-9 for 868MHz EU systems) values apply to all channels in the junction box. Whenever they are changed, that settings will be applied to all channels no matter which channel of the junction box is displayed when they are changed.

4.2.6.4 EchoPlus® Sensor Device Configuration Utility

The EchoPlus® Device Configuration Utility provides a mechanism to read and write the sensor parameters for all of the channels in an EchoPlus® junction box. These values are saved on and used by the hardware itself. It is similar to the Echo® Configuration Utility except it works with multiple channels and provides a calibration capability to fine tune the data transmitted for the sensors connected to it which, unlike the single channel 670A01, can have different sensitivity sensors connected to it. As with the Echo® Sensors, the only parameters that would require modification are the Transmission Interval, the Residual Vibration Level (RVL) and the Crest Factor Threshold. The Calibration utility available on the menu bar should be used to change the channel gain for acceleration and velocity. The Sensor ID is set at the factory and must not be changed. See section **4.2.6.1** for a detailed description of these parameters.

To connect, click on the 'Link to EchoPlus®' button as shown in Figure 40 below. If the junction box is not transmitting this connection will cause all 8 blue LEDS in the box to light and stay lit until the cable is disconnected. When in this state the box will not transmit data.

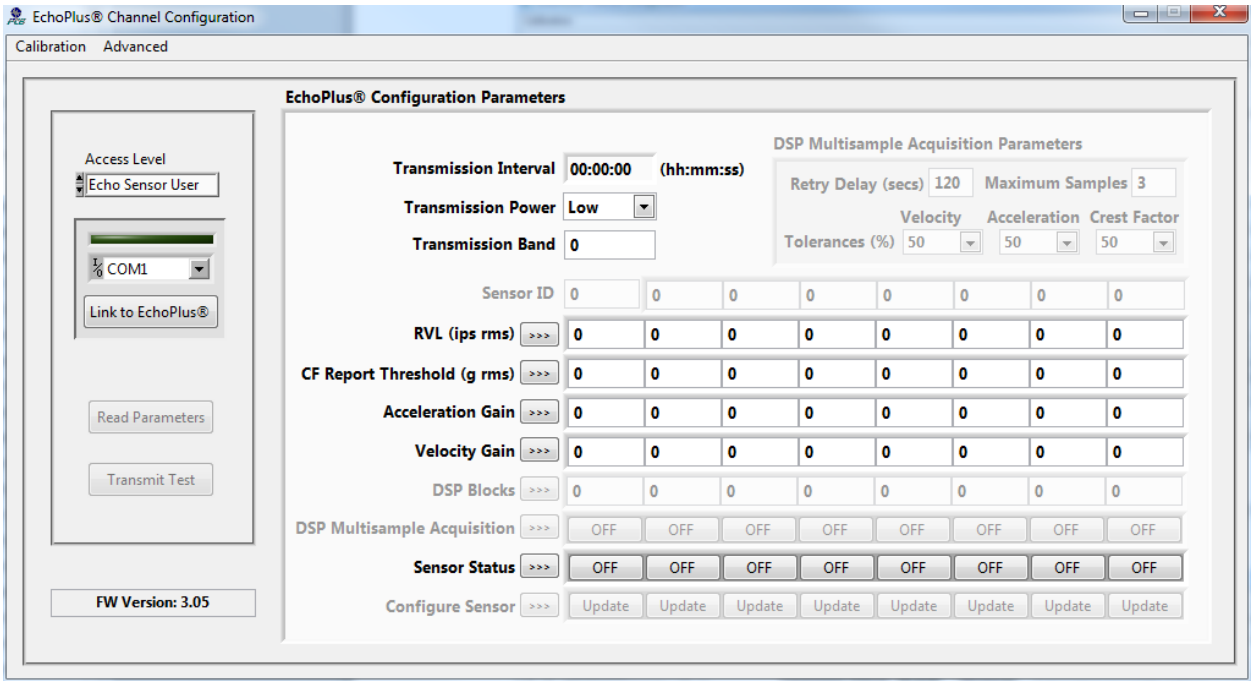


Figure 40 – EchoPlus® Configuration Utility

Once connected the software will read the settings from the junction box and display them on the screen. An example of this is shown in Figure 41.

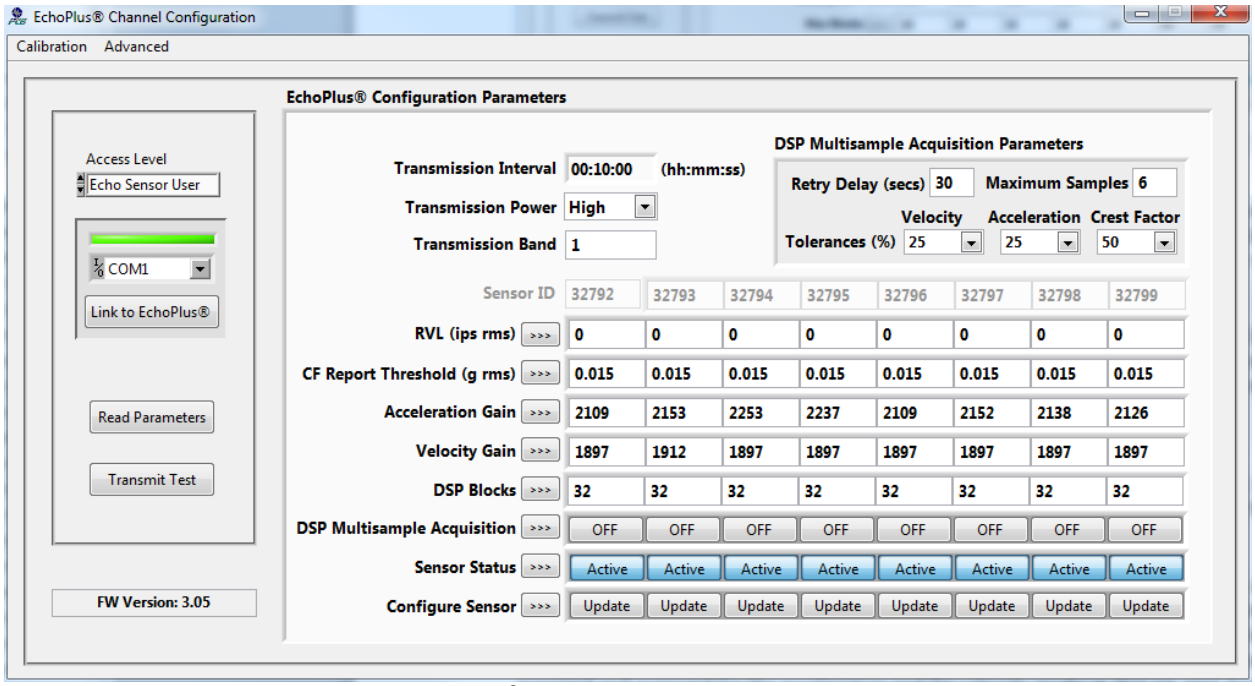


Figure 41 – EchoPlus® Configuration Utility Connected

The parameters are listed top to bottom on the left with each column representing a channel's settings. Most channel parameters can be set individually except for Transmission Interval, Band, Power and the Multi Sample Acquisition Parameters. These are unit parameters. All enabled channels will transmit data at this interval, power level and band if they meet the RVL criteria. The Multi Sample Acquisition Parameters are implemented for a channel if that channel has Multi Sample Acquisition set to Active. Otherwise the normal data acquisition algorithm is used. See section 4.2.6.4.2.

Note the column of buttons on the left with the '>>>' designation. These facilitate setting all channels to the same value as channel 1 for the associated parameter. To accomplish this task set a value in channel 1 for the parameter of interest and then click on its '>>>' button to set that parameter for all channels.

4.2.6.4.1 Minimum Transmission Interval

916 MHz Systems – None
868 MHz systems (EU) – 1% Duty Cycle. Each transmission requires 4.5 seconds to complete. Therefore each channel must be inactive for 450 seconds after a transmission.

The following table defines the minimum transmission intervals for EchoPlus® junction boxes based on the number of channels in the unit that are active (enabled).

Active Channels	Minimum Transmission Schedule hr:min:sec (s)
1	0:07:30 (450)
2	0:15:00 (900)
3	0:22:30 (1350)
4	0:30:00 (1800)
5	0:37:30 (2250)
6	0:45:00 (2700)
7	0:52:30 (3150)
8	1:00:00 (3600)

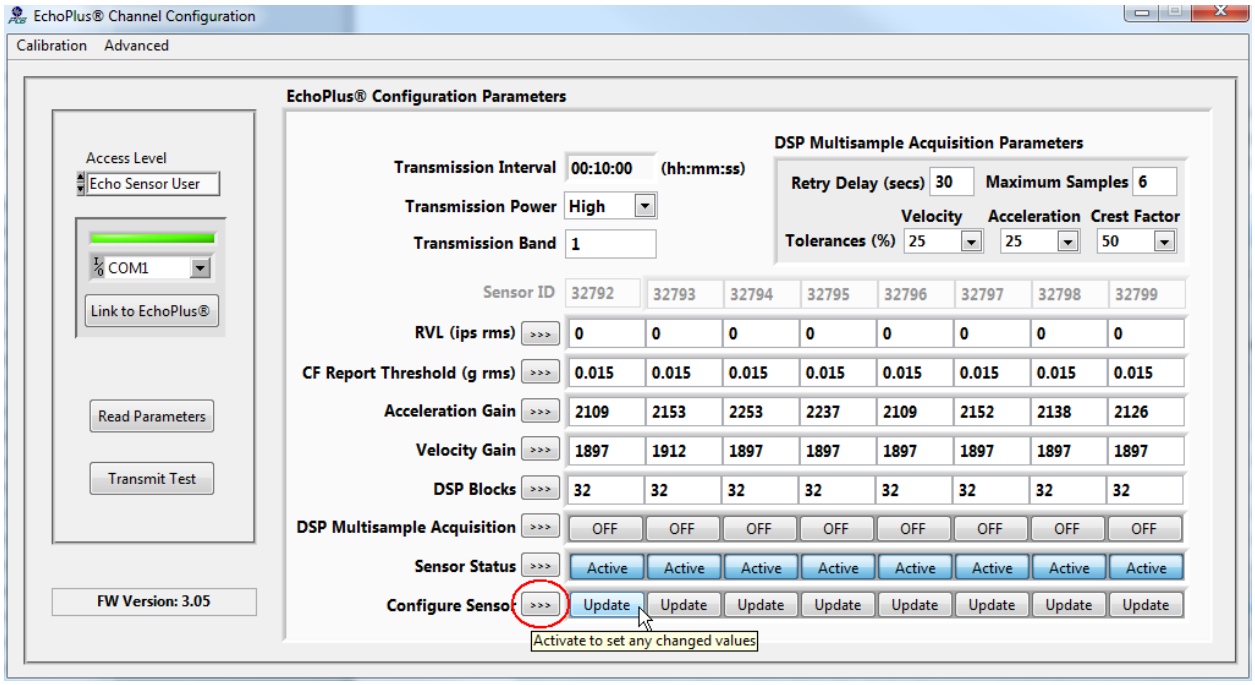


Figure 42 – EchoPlus® Configuration Utility Update

When all parameters for a channel are set, click on the **Update** button for that channel and the parameters will be sent to the channel. If a channel is not connected or the data is not collected then set the **Sensor Status** setting for that channel to the **OFF** setting and **Update** it. This will disable the channel. Note the red circled button above, activation of it will update all enabled channels rather than activating the individual channel **Update** buttons.

EchoPlus® channel numbers are always assigned at the factory and should never be changed. Additionally the ID numbers are always greater than or equal to 32768 and channel 1 will always be a multiple of 8 (examples of channel 1 IDs are 32768, 32776, 32784 etc..).

The **DSP Blocks** size parameter is unique to the junction box and can be set on a per channel basis. The Echo® Multichannel system acquires acceleration and velocity data in sample blocks over 0.328 seconds, consisting of 2048 samples of velocity data and 18432

samples of acceleration data. The DSP Blocks variable controls the number 0.328 second blocks that are acquired and averaged for the acceleration and the velocity readings that are sent back to the receiver. For any given reading, the first 7 blocks are used to set the analog gains for the sensor inputs; thus a setting of 16 results in an acquisition times of (16-7)*0. 328 s= 2.952 s, while a setting of 128 results in an acquisition time of (121)*0.3 s=39.688 s. This variable can be set individually for each channel so that a specific sensor can be sampled for a longer time period. Following is a table of total acquisition time required for several DSP Block size assignments. Note that there is some overhead time required for each channel so the total time is greater the acquisition time described above.

DSP Block	Time(s)
128	55
80	37
80	36
72	34
64	31
40	23
32	20
20	15.5
16	14

Figure 43 – EchoPlus® Total Acquisition Time per Channel Table

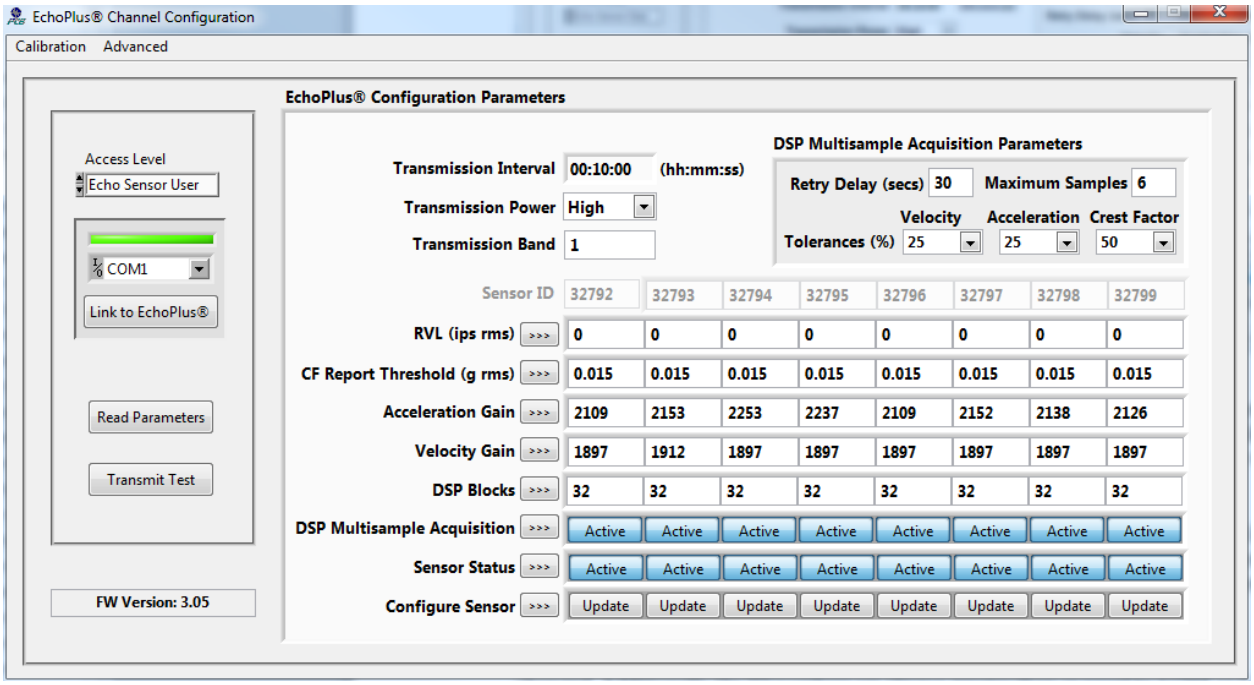


Figure 44 – EchoPlus® Configuration Utility with Multi-Sample Acquisition Active

4.2.6.4.2 EchoPlus® Multi-Sample Acquisition Parameters

The Multi Sample Acquisition Parameters are used to implement a sophisticated data acquisition algorithm for industrial situations where transient noise may be present which could be picked up by a sensor or the cabling and interfere with the normal data acquisition that generates the velocity and acceleration readings. If the **Multi-sample**

Acquisition setting is turned on, the following process is followed in the junction box firmware. First, 3 initial readings are acquired by the microcontroller from the DSP and if the 3 readings are within the specified **Tolerance ranges** for velocity, acceleration and crest factor, then the last reading (reading number 3) is transmitted back to the receiver. If the first 3 readings are not within the tolerance range, then an additional (fourth) reading is acquired from the DSP and the most recent 3 readings (2, 3 & 4) are evaluated to be within the tolerance range. If so then the fourth reading is transmitted to the receiver. If not, then the process is repeated, up to the number of sample readings specified in the **Maximum Samples** setting (up to 10), looking for 3 successive readings within the specified tolerances. If 3 successive readings are not within the specified tolerances, then the system "sleeps" for the time specified in the **Retry Delay** setting and then repeats the process. The parameter definitions are as follows:

- **Multi-sample Acquisition Enable** (ON/OFF) – Turns the multi-sample acquisition on or off for the specified channel. If multi-sample acquisition is OFF then a single reading is taken based on the DSP block size and transmitted without checking multiple samples for tolerance levels.
- **Maximum Samples** (3-10) – Number of samples to take while looking for 3 consecutive readings that are within tolerance.
- **Retry Delay** (5-255 seconds) – time to wait until the next acquisition attempt if the first pass of finding 3 consecutive readings within tolerance fails. This delay stops processing until it expires resulting in increased data collection time for the active transmission interval. Care should be taken to ensure the maximum possible time to acquire all enabled channels in the junction box does not exceed the **Transmission Interval** itself.
- **Tolerance Percent's** (50, 25, 12.5, 6.25, 3.125) – These are the available selections, in percent, for determining if the 3 consecutive samples are close enough to declare a good reading has been acquired and can be transmitted to the receiver. They are individually set for Velocity, Acceleration and Crest Factor. **Note**: Crest Factor only allows selections of 50, 25 and 12.5.
- **Multi-sample processing results –** the results of the multi-sample acquisition is provided by the **DSP Status** value transmitted with each channels data. The DSP Status can be viewed in the channels **History** table accessible from the **Echo Data Presentation Software** main screen. The values are as follows
    - **0 –** No error, the 1st 3 consecutive samples were found to be in tolerance (or Multi sample is turned off for the channel).
    - **1 –** The transmitted data was out of tolerance in the 1st three sample comparison but was valid with subsequent sampling before the need to delay and retry.
    - **2 –** 3 consecutive samples were found to be in tolerance on the 2nd pass after the retry delay.
    - **3 -** 3 consecutive samples were not found to be in tolerance.

4.2.6.4.3 EchoPlus® Sensor Calibration Utility

The calibration utility is included to improve the accuracy of the readings that are transmitted by the junction box. The initial gain settings of each channel assume that the attached sensor has a sensitivity of 100mV/g. If the actual calibrated sensitivity is known or the sensor sensitivity has a different general rating such as 10, 50, or 500 mV/g then that can be adjusted for here.

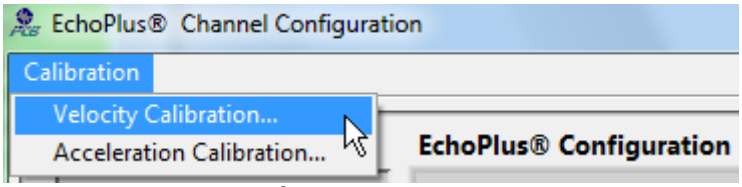


Figure 45 – EchoPlus® Configuration Utility Menu Options

To access the calibration utility, select the appropriate signal type; Velocity (low band) or Acceleration (high band) from the Calibration menu. This will bring up the screen shown in Figure 46 below.

The screen layout has 6 columns and 8 rows. Each row represents a channel. The Columns are as follows

- Current Cal column - shows the current value for the channel.
- Nominal Sensitivities column – select the appropriate nominal sensitivity for the attached sensor
- Actual Sensitivity – enter the sensors actual sensitivity from the calibration certificate here if it is known. If not make this the same as the nominal value.
- Calculate – click on this button when the sensitivities are entered.
- New Cal – this shows the new calculated calibration factor.
- Accept – click to accept the value.

When all channel values are entered, close the window. The accepted values will be written to the junction box channel.

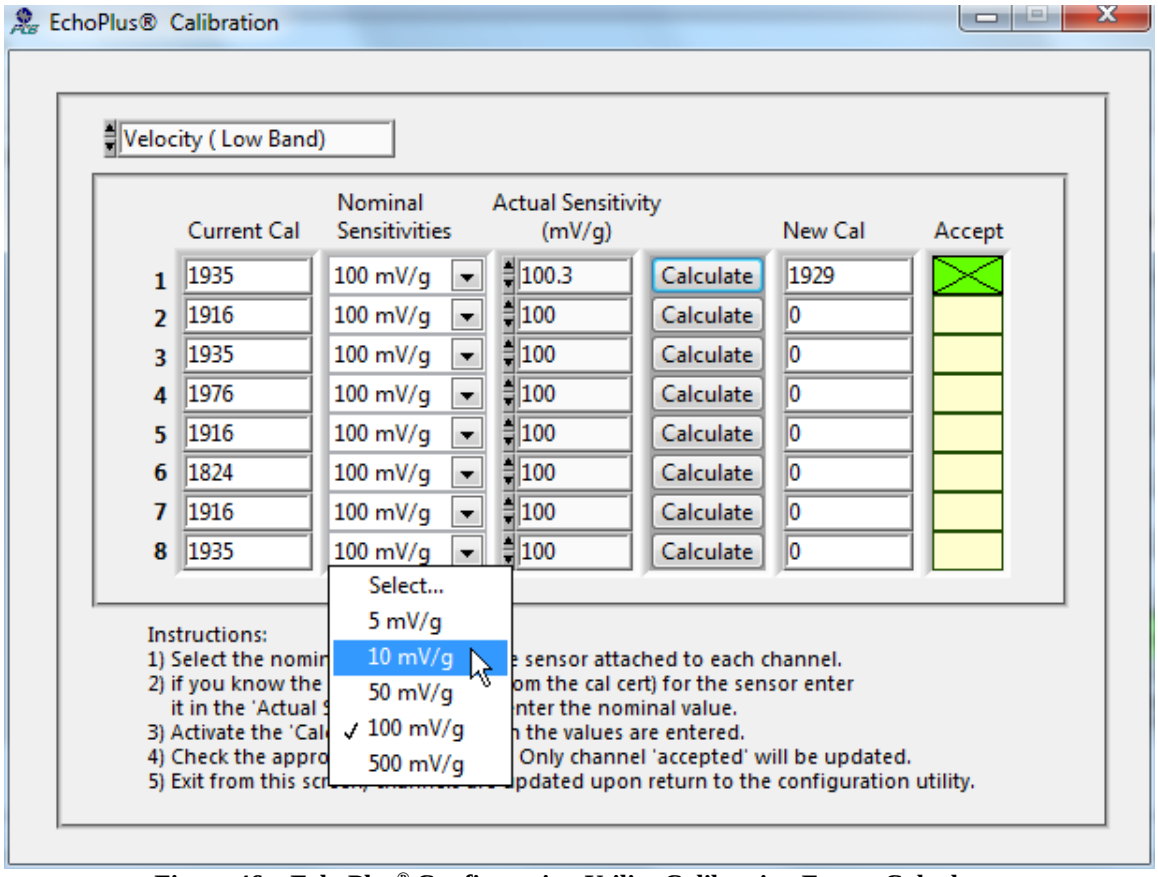


Figure 46 – EchoPlus® Configuration Utility Calibration Factor Calculator

4.2.7 Importing Echo® Sensor Configurations from Excel

If you have Microsoft Office 2010 Excel® then you can import the Echo® Sensor configurations and Alarm templates. The Echo® Data Presentation software installer will put an Excel spreadsheet file *Echo Sensor Import Template.xlsx* in the directory C:\PCB\Echo\Database. Open this file with Excel 2010 and enter sensor data in the **Sensor Definition** sheet and, if you have Alarm templates, enter them in the **Alarm Lists** sheet.

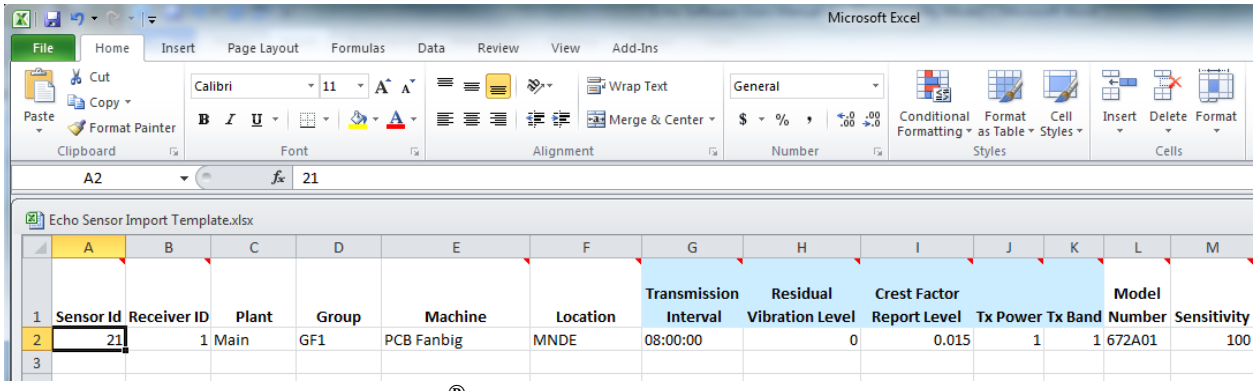


Figure 47 – Import Echo® Sensor Definitions from an Excel Spreadsheet

If you want to have a sensor's alarm levels set by an alarm template defined in the spreadsheet then enter the alarm templates number in the 'Alarm List' entry of the sensor definition. If an 'Alarm List' entry is not 0 then the alarm values are taken from the list. If the 'Alarm List' entry is 0 then the alarms come from the sensor

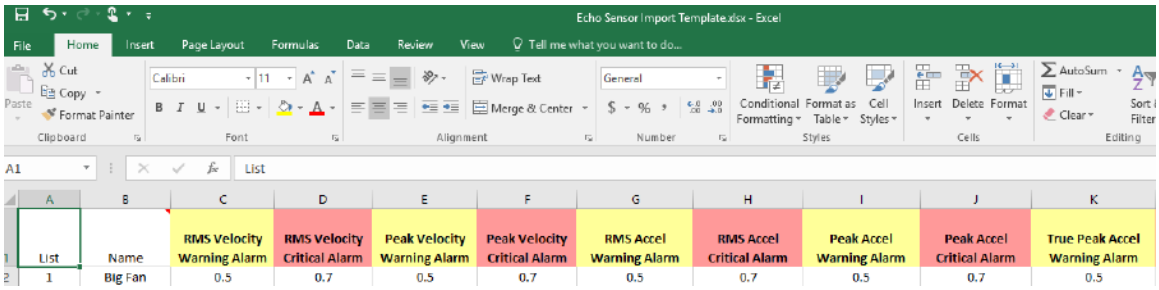


Figure 48 – Import Echo® Alarm Templates from an Excel Spreadsheet

To import the speradsheet settings to the Echo® database select Configuration | Import Sensor and Alarm Templates… from the main menu. This will cause the following screen to appear. At the bottom of the screen select the location of the excel file and click the Import File button. This reads the excel data into the screen. At this point nothing has been added ot the Echo® database.

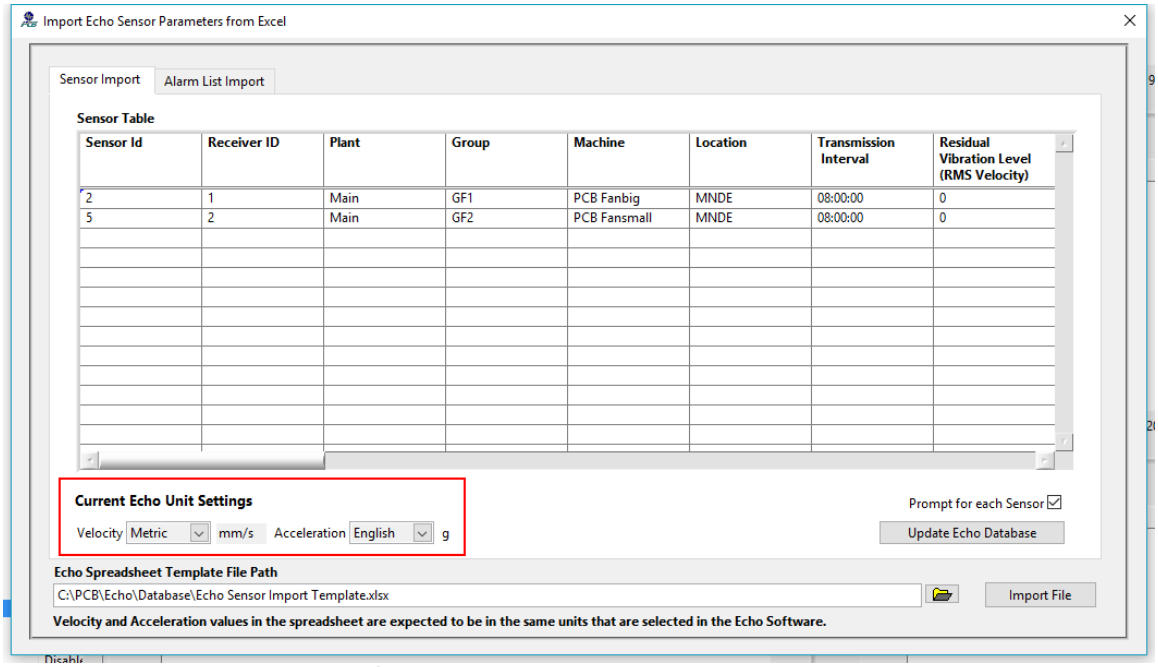


Figure 49 – Echo® Import Sensor Definitions from Excel Dialog screen

To import the sensor definitions click the **Update Echo Database** button. If you want to select which sensors are added the check the **Prompt for each Sensor** box.

Indicators at the bottom of the screen (red box above) show the current Echo software unit selections for velocity and acceleration readings. The spreadsheet alarm values **MUST** match these unit selections (i.e. no unit conversion is done between the spreadsheet and the database import.

***Note**: You must be logged in as an Administrator to save anything to the database.*

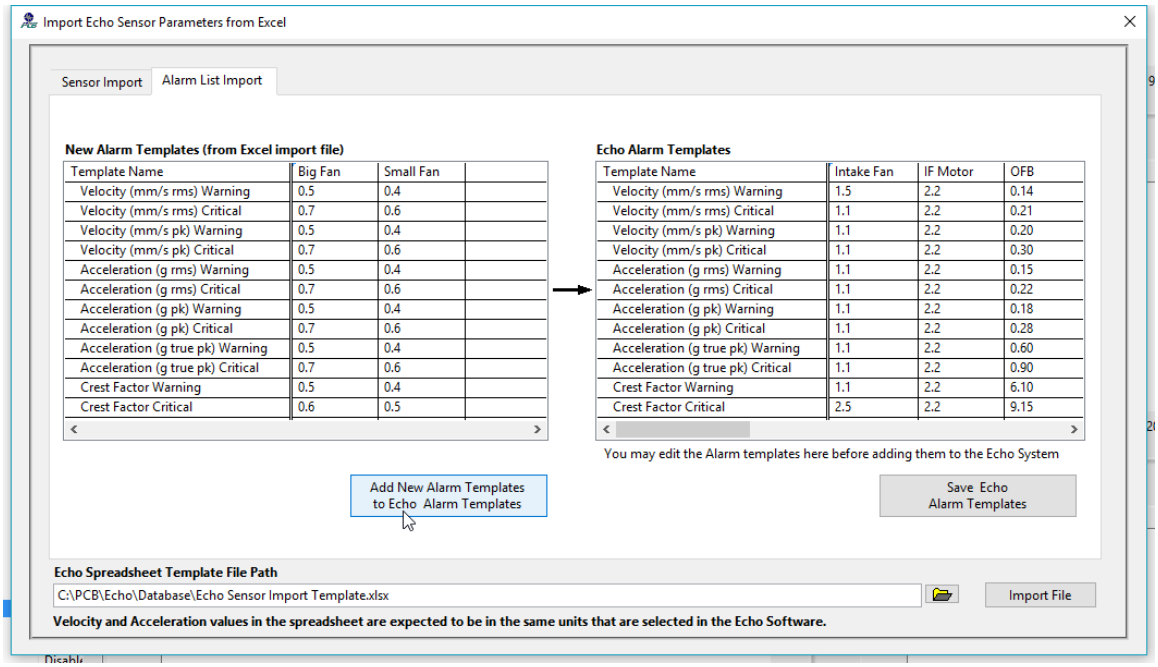


Figure 50 – Echo® Import Alarm Templates from Excel Dialog screen

The Alarm templates import process requires 2 steps. Clicking the **Add New Alarm Templates to Existing Echo Templates** button will transfer the templates found in the spreadsheet to the **Echo Alarm Templates** table as shown below. When this action is complete the dialog shown in Figure 51. Now you can edit the alarm templates in the table on the right before saving them by clicking the **Save Echo Alarm Templates** button. If you want to edit the list (select a column and rt-click it) then choose the Cancel option on this dialog then edit the table and then click the **Save Echo Alarm Templates** button

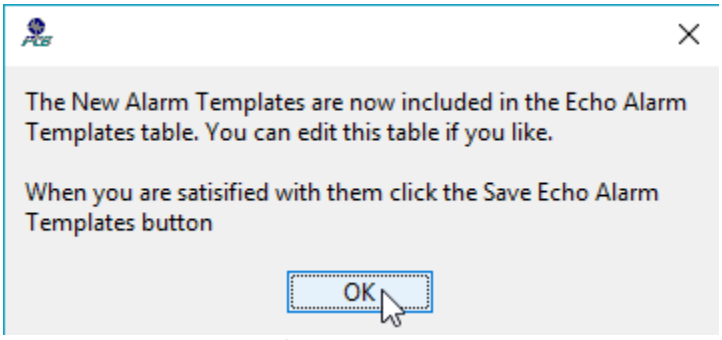


Figure 51 – Echo® Add Alarm Templates Dialog

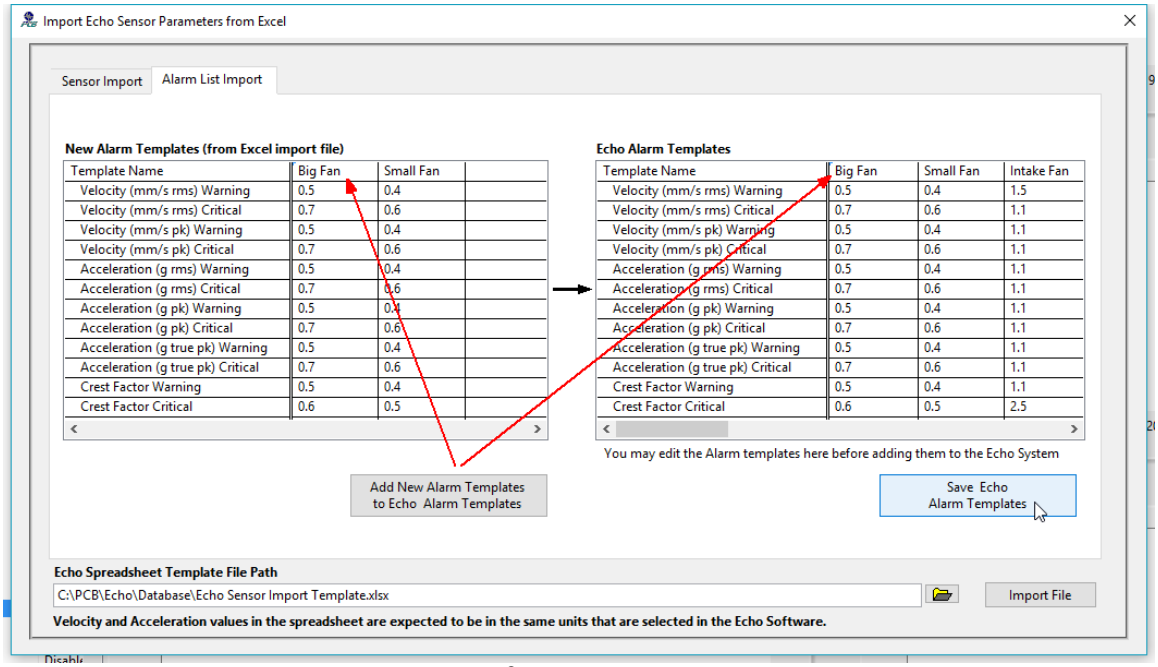


Figure 52 – EchoPlus® Import Alarm Templates Screen

4.2.8 Echo® Sensor Data Display Preferences

The screens that display Echo® transmission data (Live Data and Historical Data screens) can be customized to show some or all of the transmission fields. Additionally the order of the data columns can be selected. To accomplish this, select the Data Display Preferences option from the Main Screen menu bar as shown in Figure 53.

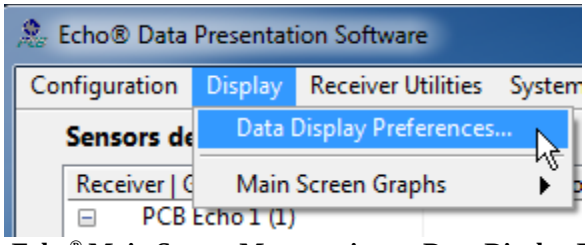


Figure 53 – Echo® Main Screen Menu options – Data Display Preferences

When activated the 1st tab is the Data Display tab which contains the data field selections shown in Figure 54. This screen has two columns; the column on the left shows the data items NOT being displayed on the data screens. The column on the right shows what is already being displayed. To display a new field or to remove a field, simply highlight it by clicking on the item and drag it either to the right column to display it or to the left column to stop displaying it.

The 2 screens in Figure 54 and Figure 96 Figure 55 show an example of the Average SNR data field, which was previously not displayed, being dragged to the displayed items list.

It is important to note that where the item is dragged to on the right side list determines its column position in the tables. In this case the Average SNR data will be displayed in the 3rd column on the screens that display it.

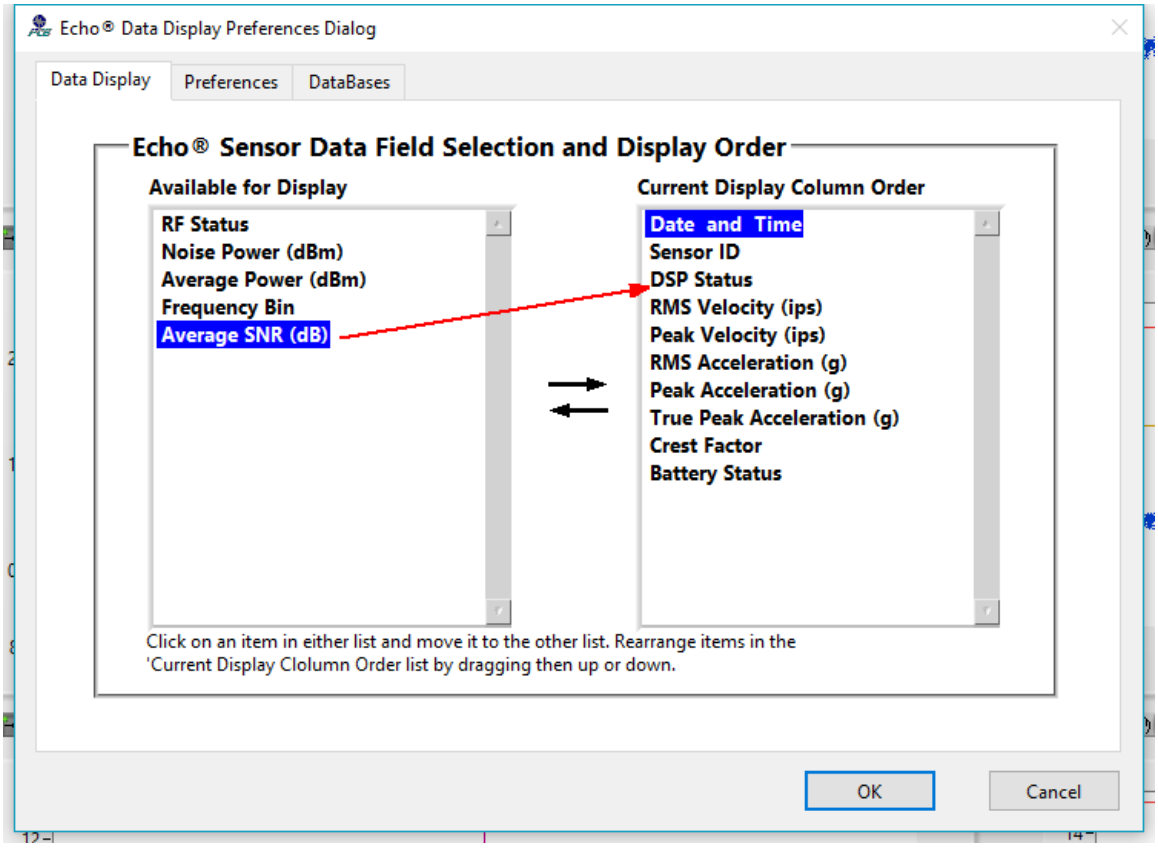


Figure 54 – Echo® Data Display Preferences Screen before change

It is also possible to reorder the columns of data fields already being displayed. To do so, click on a data item in the right column so it highlights and drag it up or down to the position it is to be displayed in. When all selections are made, click on the Close button to save them. Any screens currently open that display these fields will need to be closed and reopened to see the new selections.

.

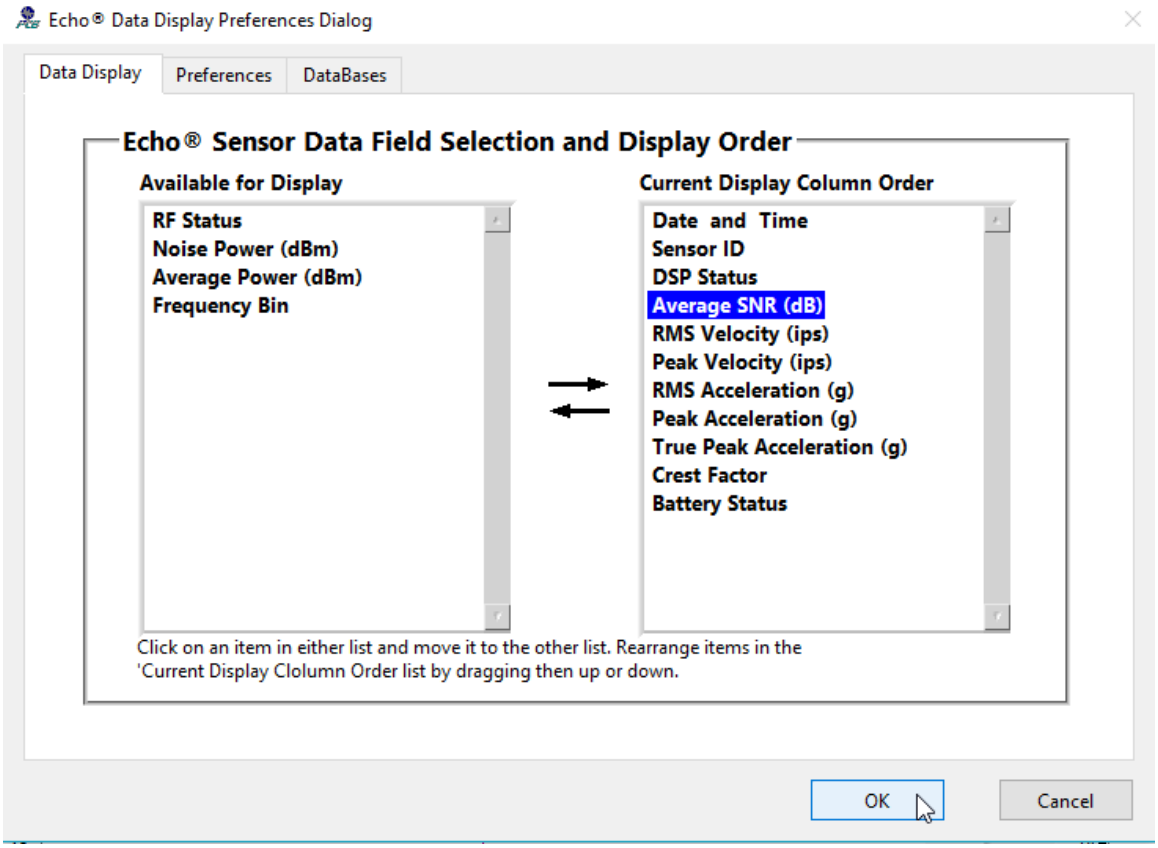


Figure 55 – Echo® Data Display Preferences Screen after change

The **Preferences** tab of the Data Display Preferences Dialog window, Figure 56, provides controls for the Tier labels and how and when certain screens refresh their data.

Tree Hierarchy Tier Labels - Use the 4 tier name controls for the naming of the 4 tiers on the sensor tree used in on the main screen and the alarm status screen.

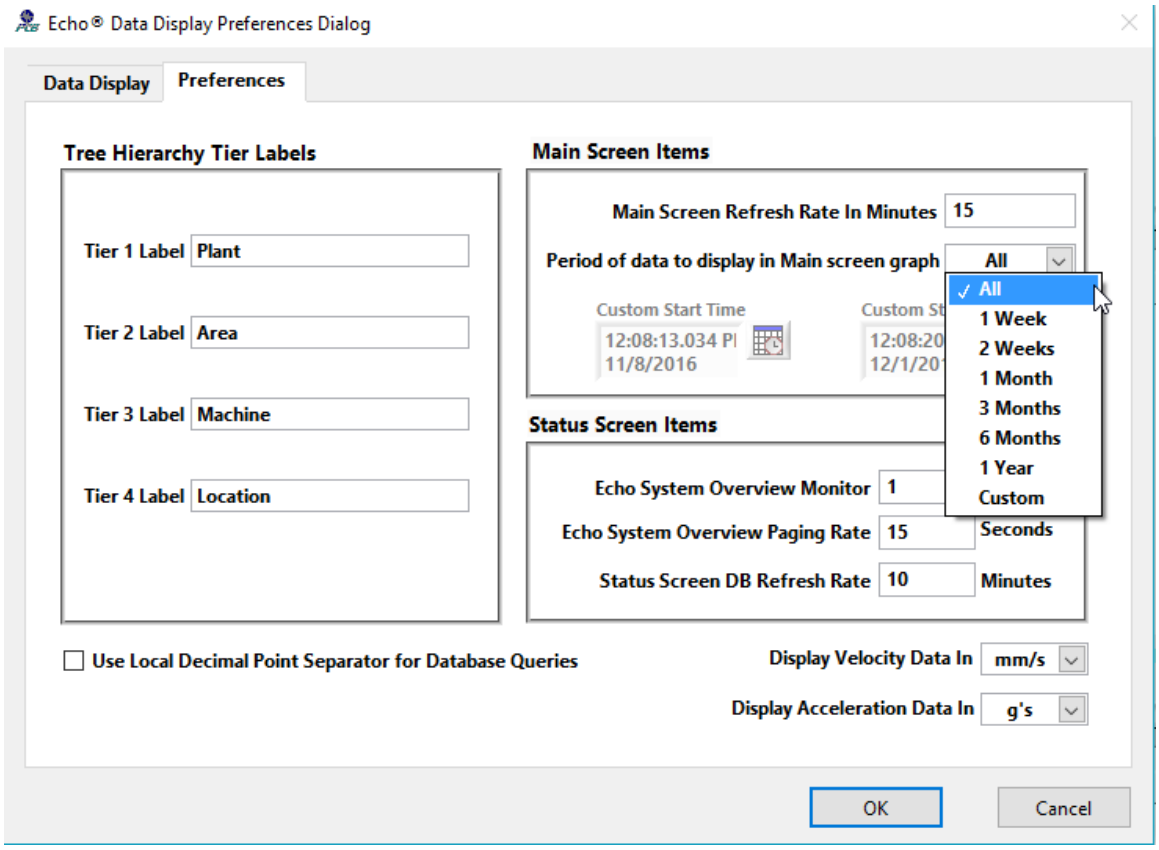


Figure 56 – Echo® Data Display Preferences Screen

Main Screen Items

- **Main Screen Refresh Rate** determines how often, in minutes, the main screen refreshes its sensor list to show up to date status. A setting of 0 disables the status update.
- **Period of data to display in main screen graph** – This setting determines the amount of data to display in the graph on the main screen when a sensor is selected from the list in the left panel. The options are shown in the pull down list above. To select a period not listed select 'Custom' and set the Custom Start and Stop times. Its purpose is to increase performance when large data sets are kept in the database or to compare data from different sensors without having to reselect the period manually when each sensor is selected. NOTE – The data select tool  on the True Peak Acceleration graph can be used to set the Custom period temporarily.

Status Screen Items

- **Echo System Overview Monitor** – This selects which monitor, on a multi-monitor PC, the Echo® System Overview Screen displays on. The number 1 selects the primary display monitor.
- **Echo System Overview Paging Rate** – If the number of sensors exceeds the ability of the software to show them in a single page on the Echo® System Overview Screen then the software will break up the list into pages. This is the rate, in seconds, at which the pages change.
- **Status Screen DB Refresh Rate** – This is the rate, in minutes, which the database is queried to refresh the data of various status screens. These screens include the Echo® System Overview screen, the System Alarm screens and the Sensor Status screens.

The '**Use Local Decimal Point Separator'** control is used for data type conversions between the Echo® Data Presentation Software and the SQL Server database. If checked the conversion will always use a '.' as a decimal point in a real number. This may be required for the installed SQL Server. If checked then the local convention as defined by the PC's operating system will be used (e.g. a comma ',' is used in Europe and South America). The default is to always use '.' (not checked).

Velocity and Acceleration Display Units – Separate controls for selecting the display units of velocity and acceleration data are located at the bottom right of this screen. For velocity data select ips – English or mm/s – Metric. For acceleration data select g's – English or m/s^2 – Metric. These are universal settings. If mm/s is selected for velocity then all screens that display velocity data readings will display them in mm/s units (mm/s). Likewise for acceleration data, if g's is selected for acceleration data, then all screens that display acceleration data readings will display them in g's.

Note: Data is <u>always</u> stored in the SQL database in English units and converted to Metric for display if necessary. This document displays data in English units.

4.2.8.1 Multiple Databases

If you have more than 1 database identified in the receiver configurations then the 'Databases' tab will appear. Here you will select the database you'd like to view data from for this instance of the Echo® Data Presentation software. If you check the 'Use this database selection' box then in other situations where a database could be selected you will not be prompted to select one and the one selected here will be used. If you are only using one database then this tab will not be shown.

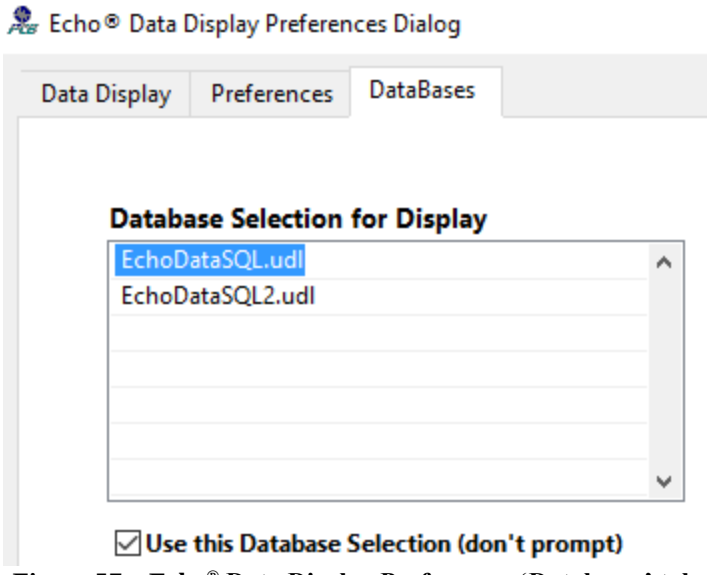


Figure 57 – Echo® Data Display Preferences 'Databases' tab

4.2.9 Echo® Channel Notes

Channel Notes are a way to add annotations to a channel's data or to document information about the channel itself in the form of a general note. Notes can be up to 50 characters long and those that are associated with a transmission are color coded.

Echo® Notes can be added to annotate a channels data by using the cursor on the True Peak Acceleration graph of a channel on the main screen to select a specific transmission and right clicking the cursor and then selecting the 'Create Note' option (Figure 58). This can also be done on the Advanced Plot Screen.

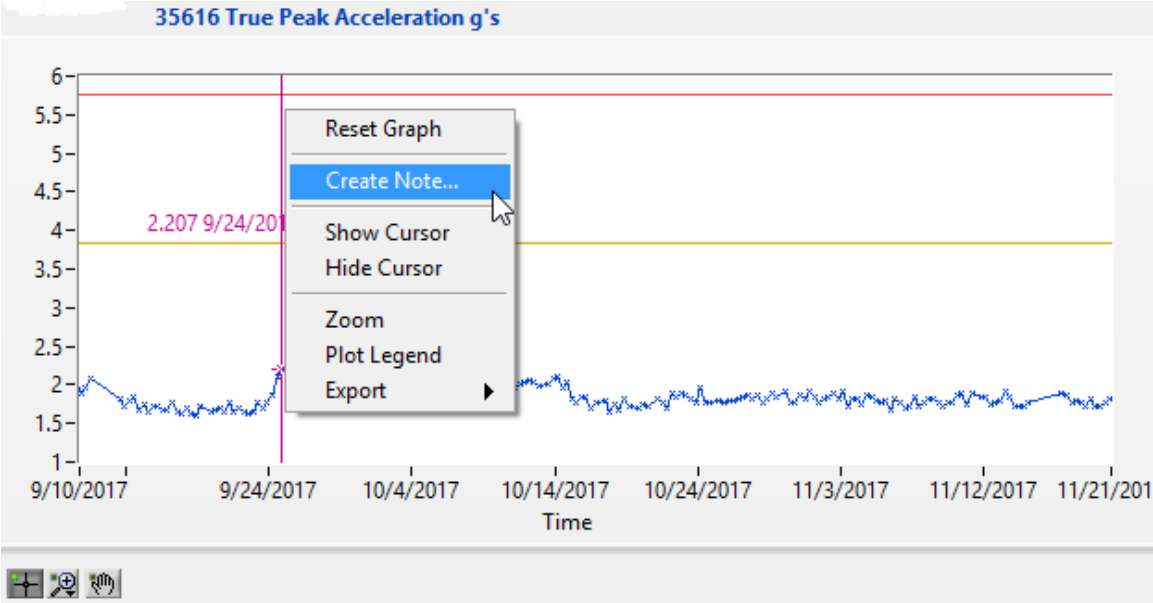


Figure 58 – Echo® Add Channel Note

When 'Create Note' is selected the Create Channel Note dialog screen will appear where you can type in the note. Select the color for the note by clicking on the color box and selecting a color from the resulting pallet. To disassociate a note from a specific transmission, click (check) the 'General Note' box.

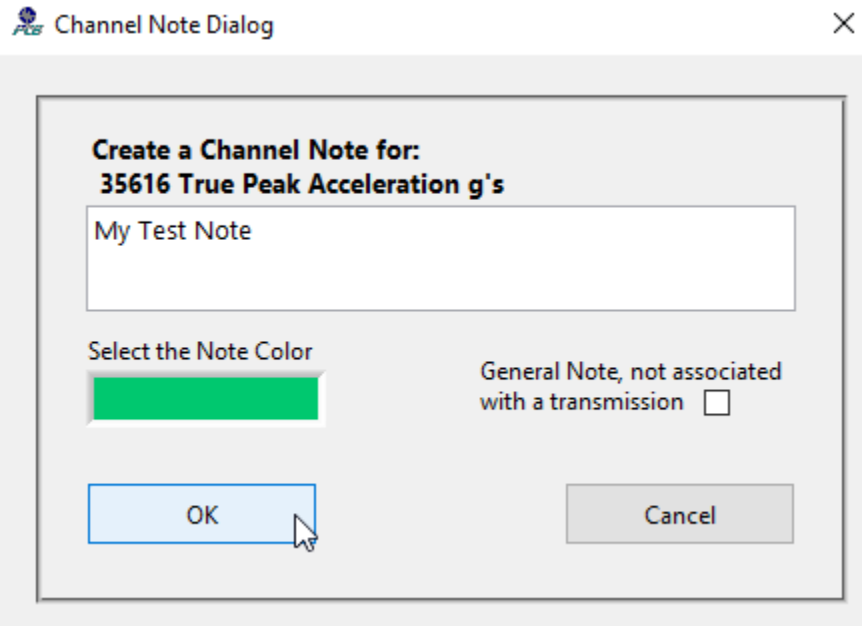


Figure 59 – Echo® Channel Note Dialog Screen

To create the note, click OK. The note will appear on all of the data graphs for the selected channel on the main screen and on the graph in the Advanced Plot screen.

Tip: Notes can be moved on the data graph by selecting the cursor tool  , clicking on the note itself and dragging it.

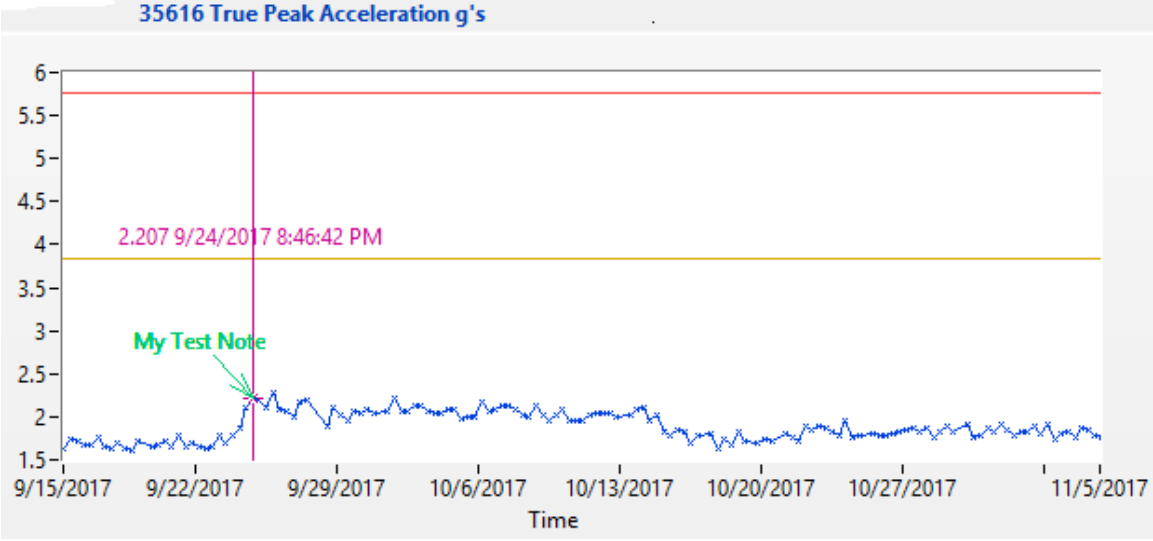


Figure 60 – Echo® Data graph with Channel Notes displayed

To suppress the display of channel notes on the main screen graphs select Display | Main Screen Graphs | Disable Note Display from the main menu bar of type <ctrl> N.

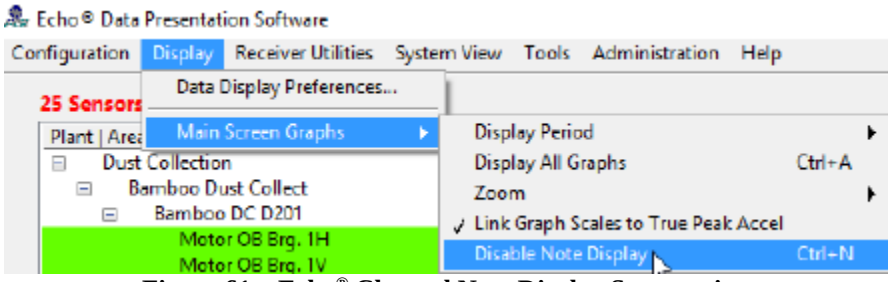


Figure 61 – Echo® Channel Note Display Suppression

To view, edit, delete or search the channel notes select, Tools | View/Edit Channel Notes, from the main screen menu bar, or, right click any channel in the channel list and select View/Edit Channel Notes to display the Echo® Channel Note Viewer (Figure 63).

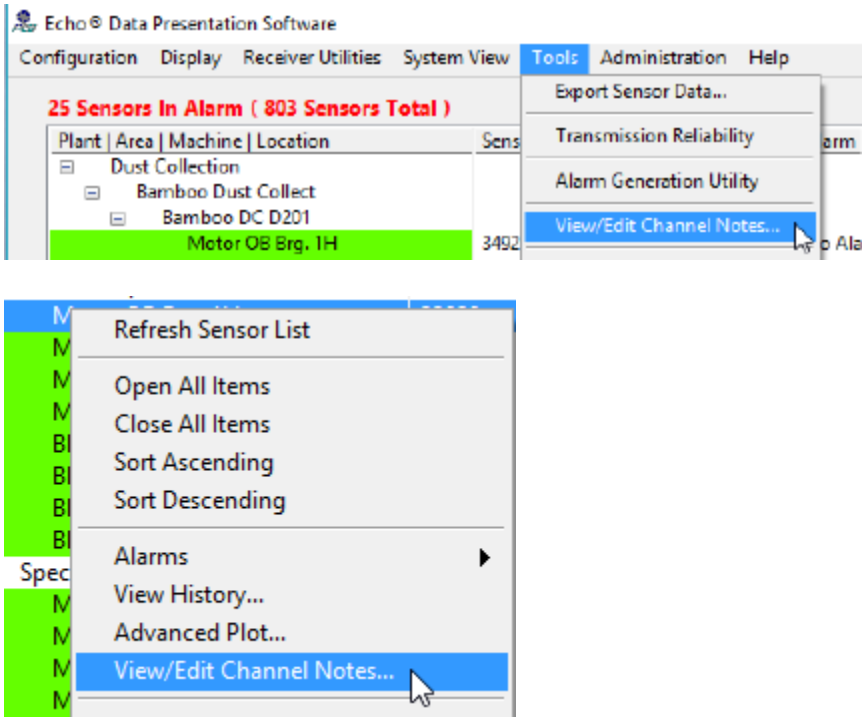
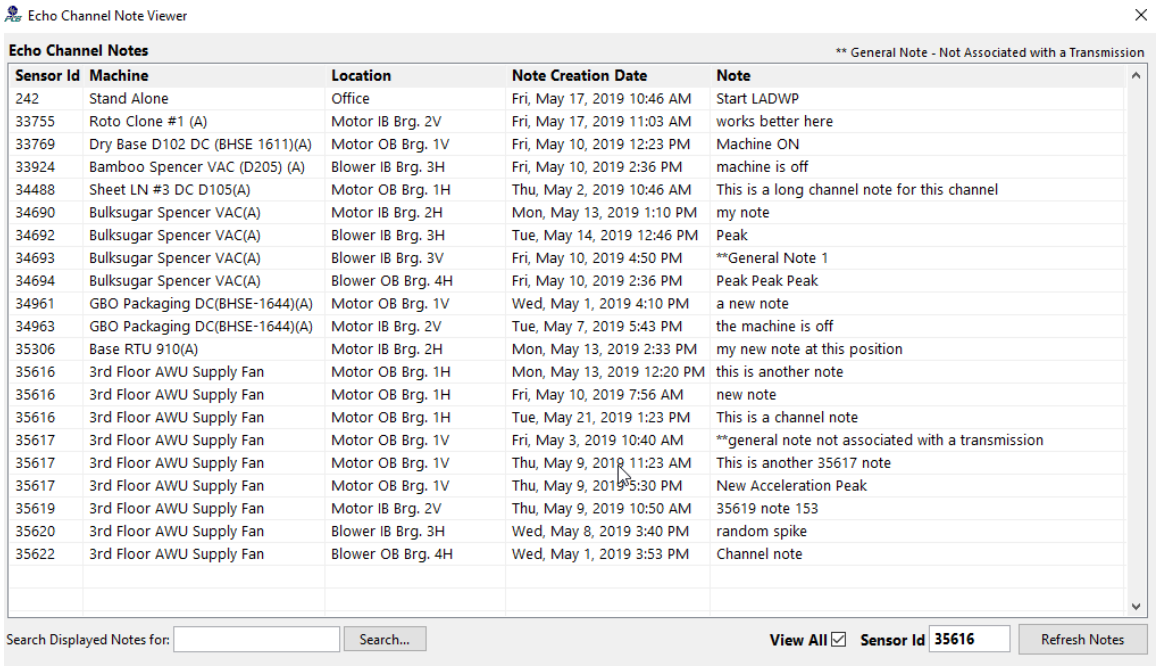


Figure 62 – Echo® Channel Note Viewer Access

4.2.9.1 Echo® Channel Note Viewer

The Channel Note Viewer (Figure 63) displays a specific channel's notes or all existing channel notes. Notes can be edited, deleted or searched using this utility. General notes, those not associated with a transmission, can be created here. General notes are identified in the table by '**'being prepended to the text in the **Note** column. Most Channel Note functions are accessed by right clicking on the table (Figure 64) and selecting a function. Multiple notes can be selected by holding down the <ctrl> key while clicking on notes



Sensor Id	Machine	Location	Note Creation Date	Note
242	Stand Alone	Office	Fri, May 17, 2019 10:46 AM	Start LADWP
33755	Roto Clone #1 (A)	Motor IB Brg. 2V	Fri, May 17, 2019 11:03 AM	works better here
33769	Dry Base D102 DC (BHSE 1611)(A)	Motor OB Brg. 1V	Fri, May 10, 2019 12:23 PM	Machine ON
33924	Bamboo Spencer VAC (D205) (A)	Blower IB Brg. 3H	Fri, May 10, 2019 2:36 PM	machine is off
34488	Sheet LN #3 DC D105(A)	Motor OB Brg. 1H	Thu, May 2, 2019 10:46 AM	This is a long channel note for this channel
34690	Bulksugar Spencer VAC(A)	Motor IB Brg. 2H	Mon, May 13, 2019 1:10 PM	my note
34692	Bulksugar Spencer VAC(A)	Blower IB Brg. 3H	Tue, May 14, 2019 12:46 PM	Peak
34693	Bulksugar Spencer VAC(A)	Blower IB Brg. 3V	Fri, May 10, 2019 4:50 PM	**General Note 1
34694	Bulksugar Spencer VAC(A)	Blower OB Brg. 4H	Fri, May 10, 2019 2:36 PM	Peak Peak Peak
34961	GBO Packaging DC(BHSE-1644)(A)	Motor OB Brg. 1V	Wed, May 1, 2019 4:10 PM	a new note
34963	GBO Packaging DC(BHSE-1644)(A)	Motor IB Brg. 2V	Tue, May 7, 2019 5:43 PM	the machine is off
35306	Base RTU 910(A)	Motor IB Brg. 2H	Mon, May 13, 2019 2:33 PM	my new note at this position
35616	3rd Floor AWU Supply Fan	Motor OB Brg. 1H	Mon, May 13, 2019 12:20 PM	this is another note
35616	3rd Floor AWU Supply Fan	Motor OB Brg. 1H	Fri, May 10, 2019 7:56 AM	new note
35616	3rd Floor AWU Supply Fan	Motor OB Brg. 1H	Tue, May 21, 2019 1:23 PM	This is a channel note
35617	3rd Floor AWU Supply Fan	Motor OB Brg. 1V	Fri, May 3, 2019 10:40 AM	**general note not associated with a transmission
35617	3rd Floor AWU Supply Fan	Motor OB Brg. 1V	Thu, May 9, 2019 11:23 AM	This is another 35617 note
35617	3rd Floor AWU Supply Fan	Motor OB Brg. 1V	Thu, May 9, 2019 5:30 PM	New Acceleration Peak
35619	3rd Floor AWU Supply Fan	Motor IB Brg. 2V	Thu, May 9, 2019 10:50 AM	35619 note 153
35620	3rd Floor AWU Supply Fan	Blower IB Brg. 3H	Wed, May 8, 2019 3:40 PM	random spike
35622	3rd Floor AWU Supply Fan	Blower OB Brg. 4H	Wed, May 1, 2019 3:53 PM	Channel note

Figure 63 – Echo® Channel Note Viewer Screen

4.2.9.1.1 Searching Channel Notes

To search the notes type the search string in the search control in the bottom left of the screen and click the search button. Any note that contains the search string in any of the displayed fields will be highlighted. The search string is case sensitive.

4.2.9.1.2 Viewing Channel Notes

To view all notes check the View All box and click Refresh Notes. Alternatively, to view only the notes for a specific channel, clear the View All box and enter the sensor id and click the Refresh Notes button.

4.2.9.1.3 Deleting Channel Notes

Notes can be deleted by selecting a note (or notes) in the table, right clicking the mouse and selecting 'Delete Selected Notes'. A confirmation dialog will appear and, if accepted, the notes will be deleted.

Notes will also be deleted if the transmission they are associated with is deleted from the database using one of the transmission maintenance screens (Section 4.2.14.5.1).

4.2.9.1.4 Viewing Sensor Data associated with a Note

The 'View this Channel's Data' option will cause the Note Viewer window to close and the calling (Main, Advanced Plot, or Transmission maintenance) screen to refresh with the selected sensor's data.

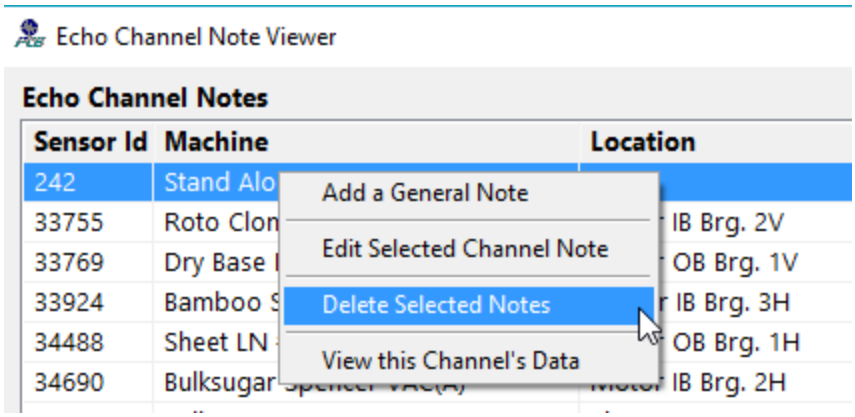


Figure 64 – Echo® Channel Note Viewer table menu options

4.2.10 Determining Echo® Alarm Levels

Alarm levels can be set for both warning and critical levels, of each data type, for each sensor. These levels are defined in the sensor configuration screens. Accurately determining these levels is critical for efficient monitoring of machinery health. The Echo® Data Presentation Software provides a powerful tool for determining the alarm levels based on data captured by the sensors. It also provides a simple method to set up alarm templates if the levels are already known.

4.2.10.1 Echo® Alarm Generation Utility

Select **Tools | Alarm Generation Utility** from the Echo® Data Presentation Software main screen menu bar or Right-click the Sensor tree and select the **Determine Alarm Levels** option to access the Alarm Generation Utility and display the screen shown in Figure 65. This screen has four major components; the sensor list, the Alarm Generation tab, the Selected Channel data tab and the Selected Channel Alarm tab.

4.2.10.1.1 Alarm Generation Tab

This tab contains the indicators and controls to determine alarm levels from the collected data.

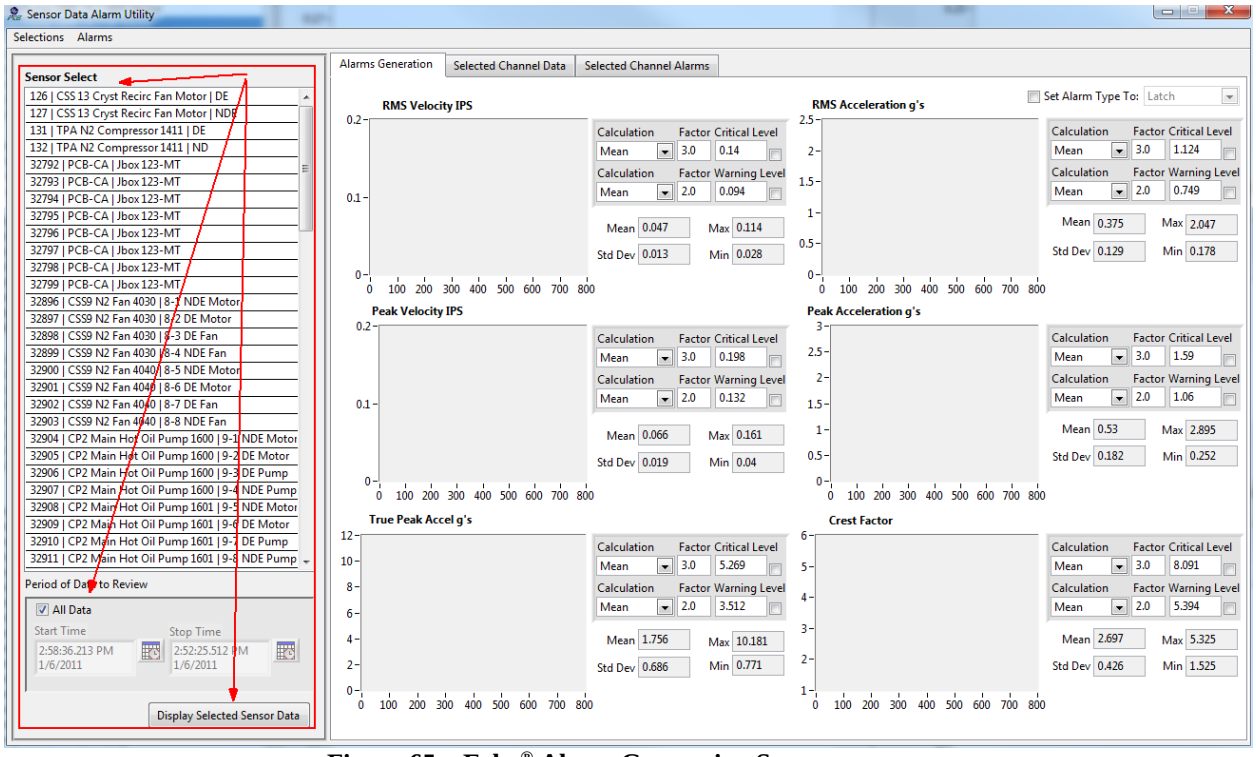


Figure 65 – Echo® Alarm Generation Screen

On the left of the screen, highlighted above, is a sensor list which contains all of the sensors in the selected database (the software can be set up to use several databases – up to 1 per receiver). From this list, one or more, sensors can be selected to provide data for the alarm generation utility. This list can be customized to display only sensors of a desired type by following the process described in section 4.2.10.1.2. Clicking a single sensor causes its data to be immediately displayed in all graphs. To add sensors, use the <ctrl> or <shift> keys while clicking on sensors in the list**.**

Please note that if more than 10 sensors are selected, only the 1st 10 will be displayed in the Selected Channel Data and Selected Channel Alarm tabs. However, the data from all selected sensors will be averaged for display on the main Alarm Generation tab graphs.

To use this utility select the desired sensors, as described above, and the period over which to analyze the data, then click the **Display Selected Sensor Data** button located below the sensor list. This causes data to be retrieved from the data base and **averaged** to create a single waveform for each data type. This data is displayed in the six graphs shown on the Alarm Generation tab, Figure 66 . The mean, standard deviation, maximum and minimum values for each waveform are also calculated and displayed for each data type.

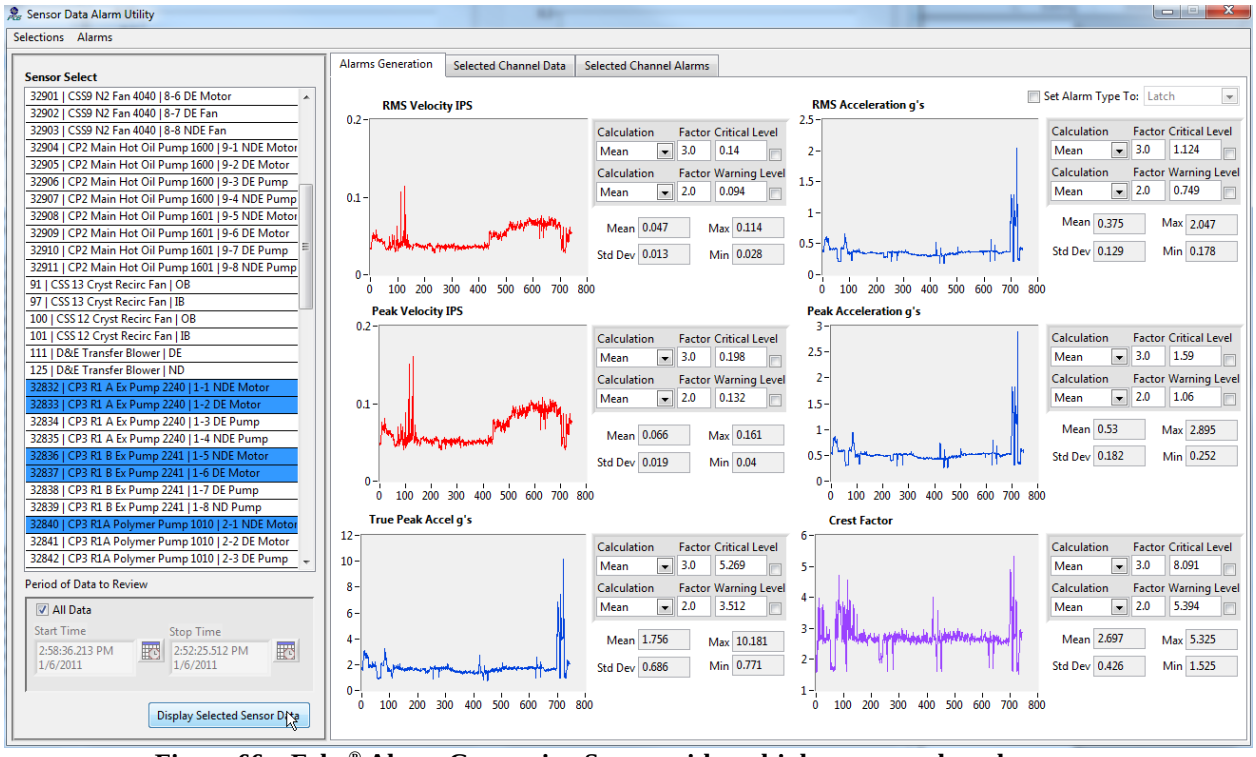


Figure 66 – Echo® Alarm Generation Screen with multiple sensors selected

To further refine the data used to create an alarm the data set can be edited to remove data points that are considered abnormal. To do this right-click on the graph whose data is to be modified and select Edit Data as shown in Figure 67.

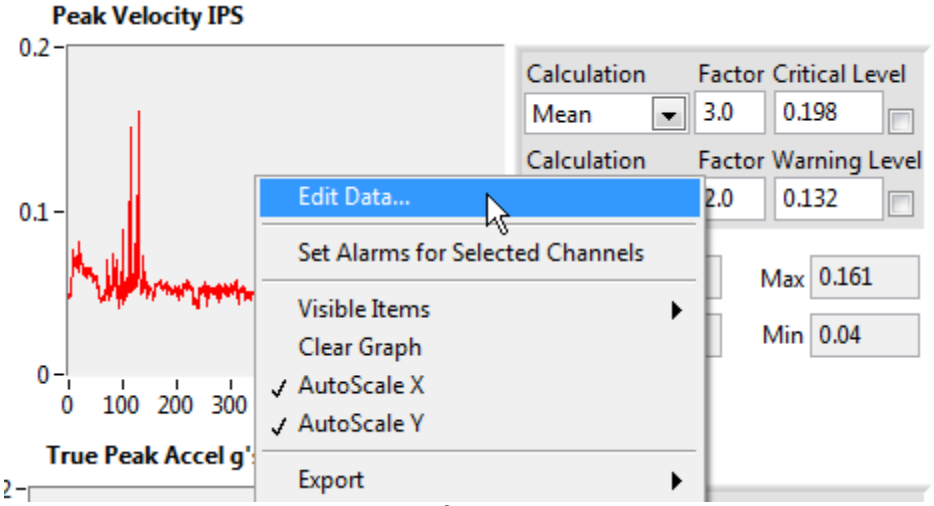


Figure 67 – Echo® Alarm Generation Utility, Edit data set.

This displays the **Edit Averaged Data for Alarms** dialog box (Figure 68). In this dialog select the data to delete from the data set for this data type (in this case remove values greater than 0.1). You can also apply this action to all data types by checking the **Apply To all Data Types** box.

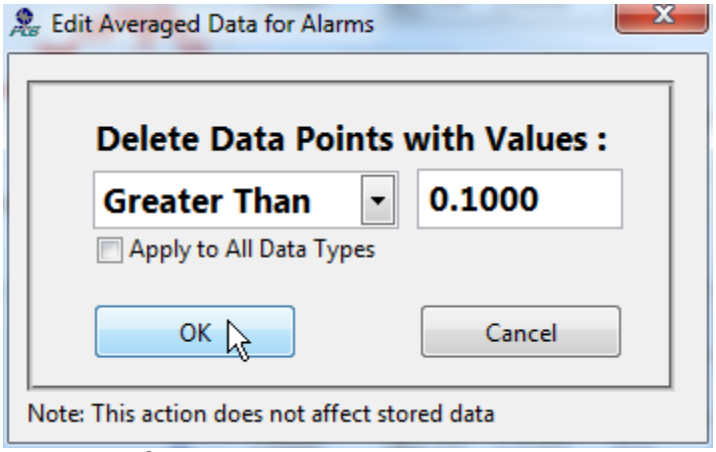


Figure 68 – Echo® Alarm Generation Utility, Edit Averaged Data dialog

Figure 69 shows the Peak Velocity data after this operation and the selections that can be used to calculate an alarm automatically.

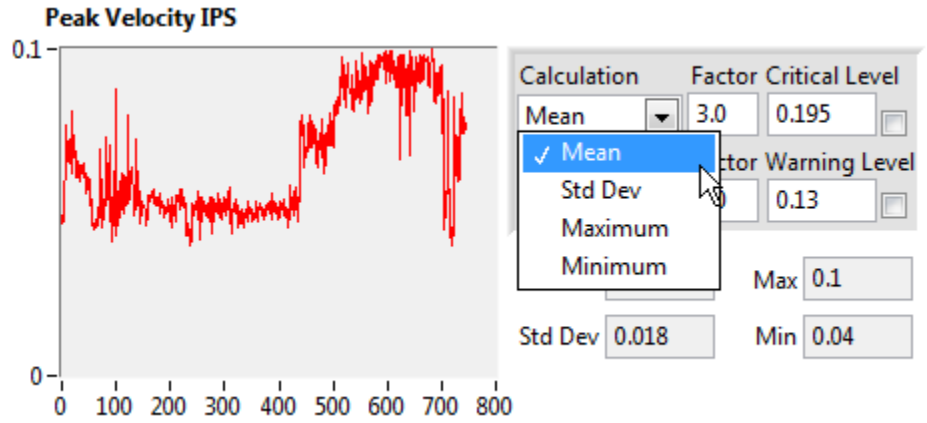


Figure 69 – Echo® Alarm Utility, Post edit operation

Alarms for warning and critical levels are determined in the same way; select a **Calculation** method and set a **Factor** to multiply it by. The level will be displayed in the box next to the factor setting. Alternatively the level can be set manually by simply typing it in the Warning or Critical level controls.

Figure 70 shows an alarm setting example.

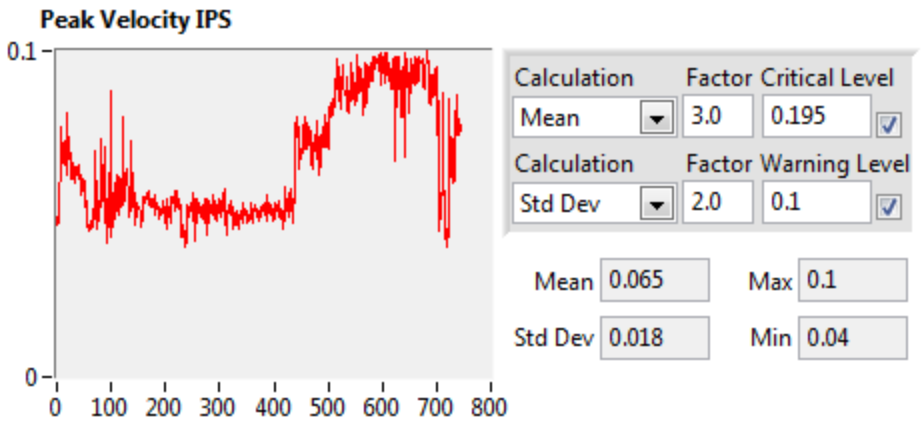


Figure 70 – Echo Alarm Utility, Alarm Set Example

The calculated Mean= 0.065; Standard Deviation=0.018; Max= 0.1; Min=0.04

- Critical Level – Mean (0.65) * Factor (3.0) = 0.195 IPS
- Warning Level – Std Dev (0.018) * Factor (2.0) +Mean (0.065) = 0.10

After the alarm levels are calculated the last step, prior to assigning them to the sensor by updating the sensor's configuration in the database, is to set the alarm type. In the top right of the Alarm Generation tab is a check box to set the alarm type (Figure 71). If this box is checked the alarm type for each selected sensor will be set to the indicated alarm type.

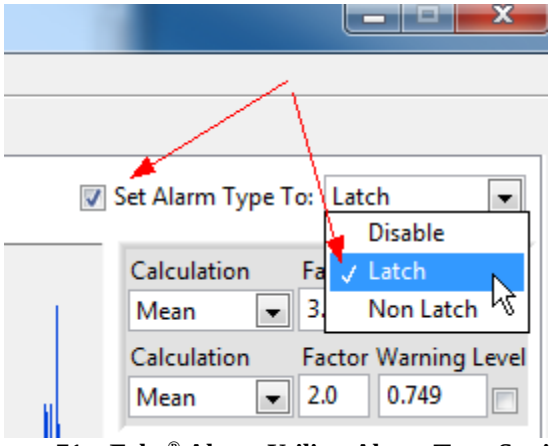


Figure 71 – Echo® Alarm Utility, Alarm Type Setting

Checking the Critical Level and/or Warning Level boxes for each data type determines which alarm levels are updated. They can be set manually or use the Alarm Generation Utility menu bar quick links (Figure 72).

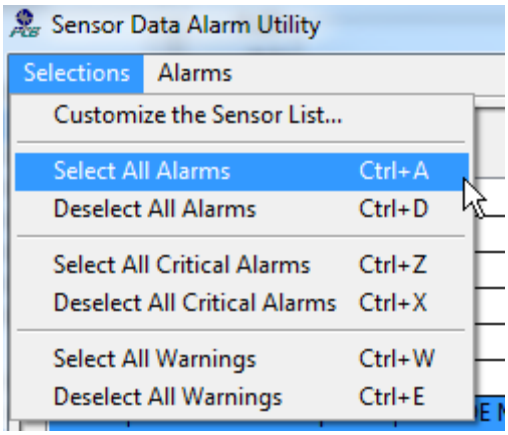


Figure 72 – Echo® Alarm Utility menu bar items

Finally, when all the values are set, click the **Set Selected Alarms** menu item (Figure 73) to update the sensor configuration in the database.

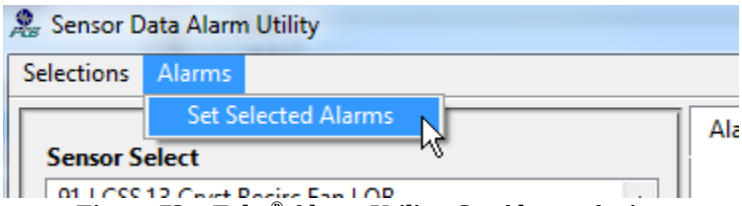


Figure 73 – Echo® Alarm Utility, Set Alarms Action

4.2.10.1.2 Customizing the Sensor List

To limit the sensors presented in the sensor list to those of a particular type use the **AlarmGen Custom Sensor Query** function. Selecting **Selections | Customize the Sensor List** from the menu bar brings up the dialog box (Figure 74). This utility uses one of the three sensor naming fields established in the sensor configuration process to determine which sensors populate the list. Choose the Machine, Location or Group ID field and then type the key word to search for and click the **Search** button. In this example we want all sensors with the word '**Hot Oil'** in the **Machine** field. This search reveals 24 sensors in the database that match that criterion and lists them in the results table for review. When satisfied click the OK button to return to the Alarm Utility main screen when the sensor list now only contains the entries from the search (Figure 75) making it easier to select data from similar data sources for analysis and, ultimately, alarm level setting.

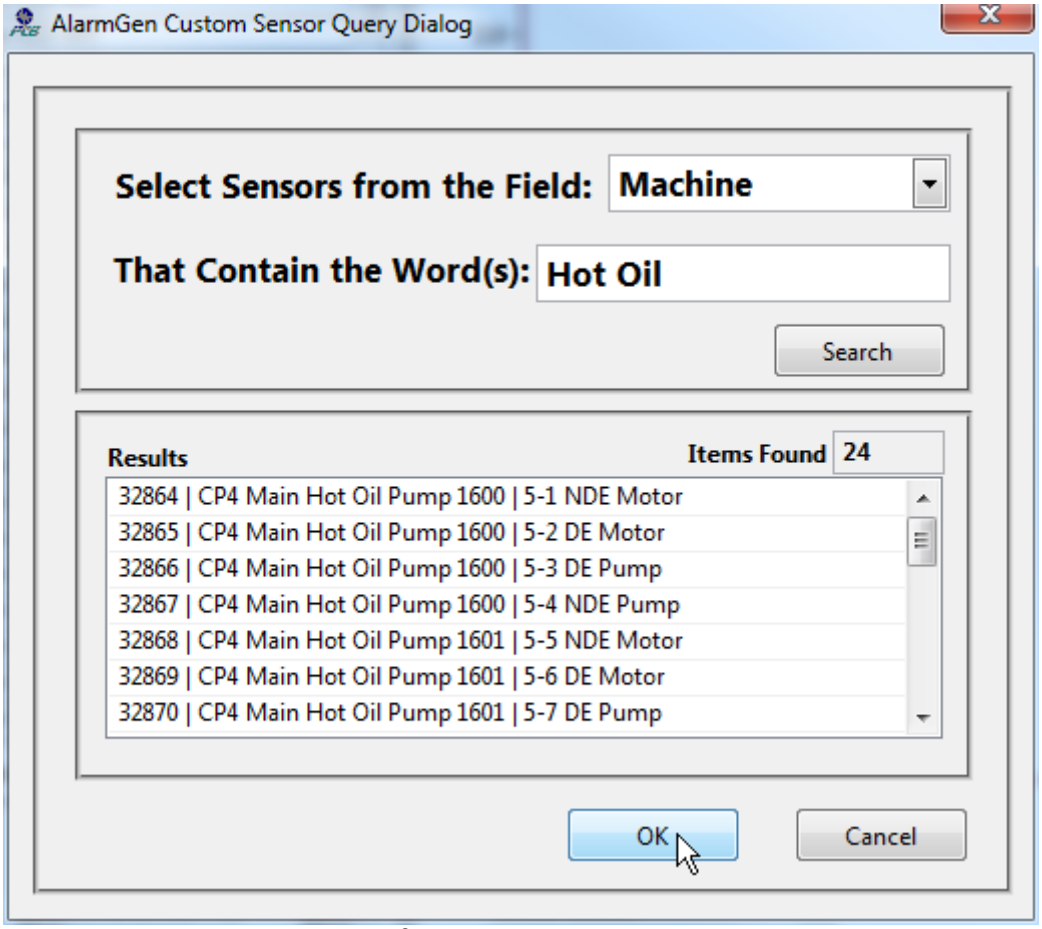


Figure 74 – Echo® Alarm Utility, Custom Sensor Query

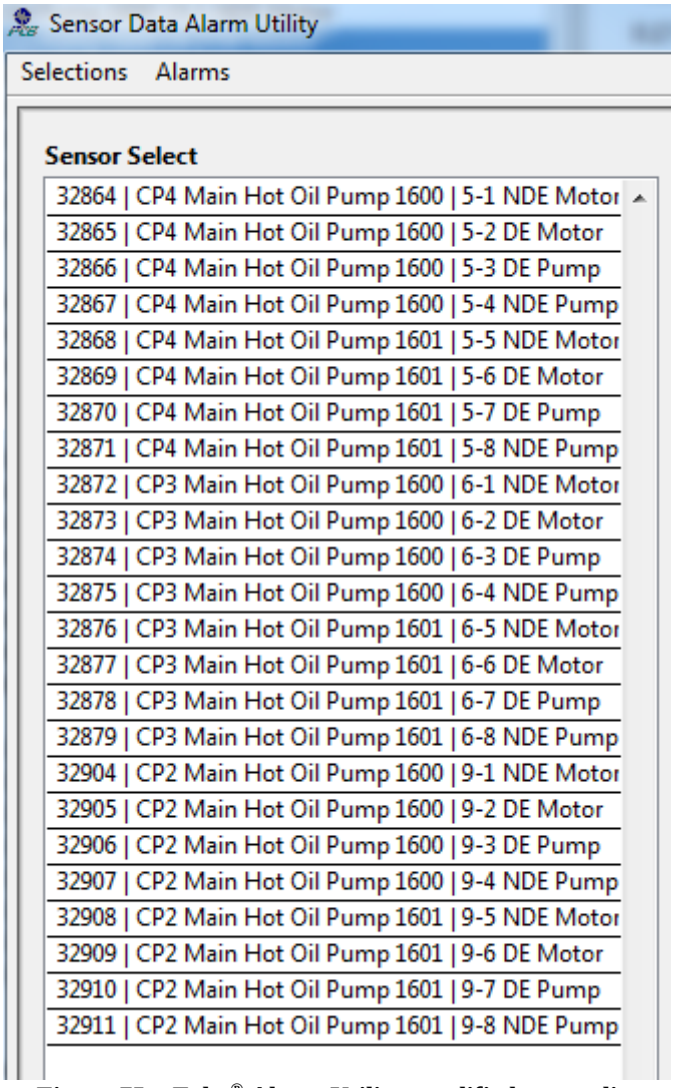


Figure 75 – Echo® Alarm Utility, modified sensor list

4.2.10.1.3 Alarm Generation - Selected Channel Data Tab

This tab, Figure 76, displays a large graph of the selected data type for the selected sensors. Up to 10 waveforms can be displayed simultaneously. Data is displayed after the sensors are selected on the left and the **Display Selected Sensor Data** button is activated. Along with the waveform data is the mean value of all readings for each waveform, displayed to the right of the graph legend, and an overall mean value of all waveforms.

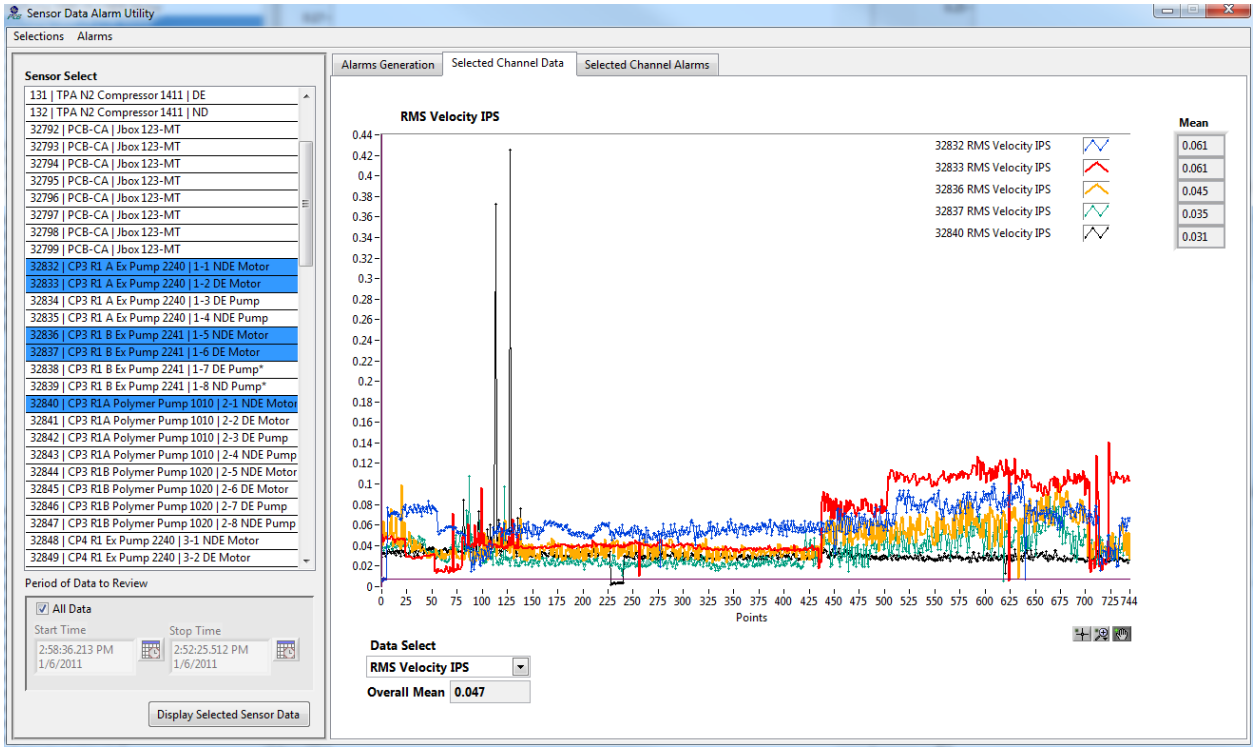
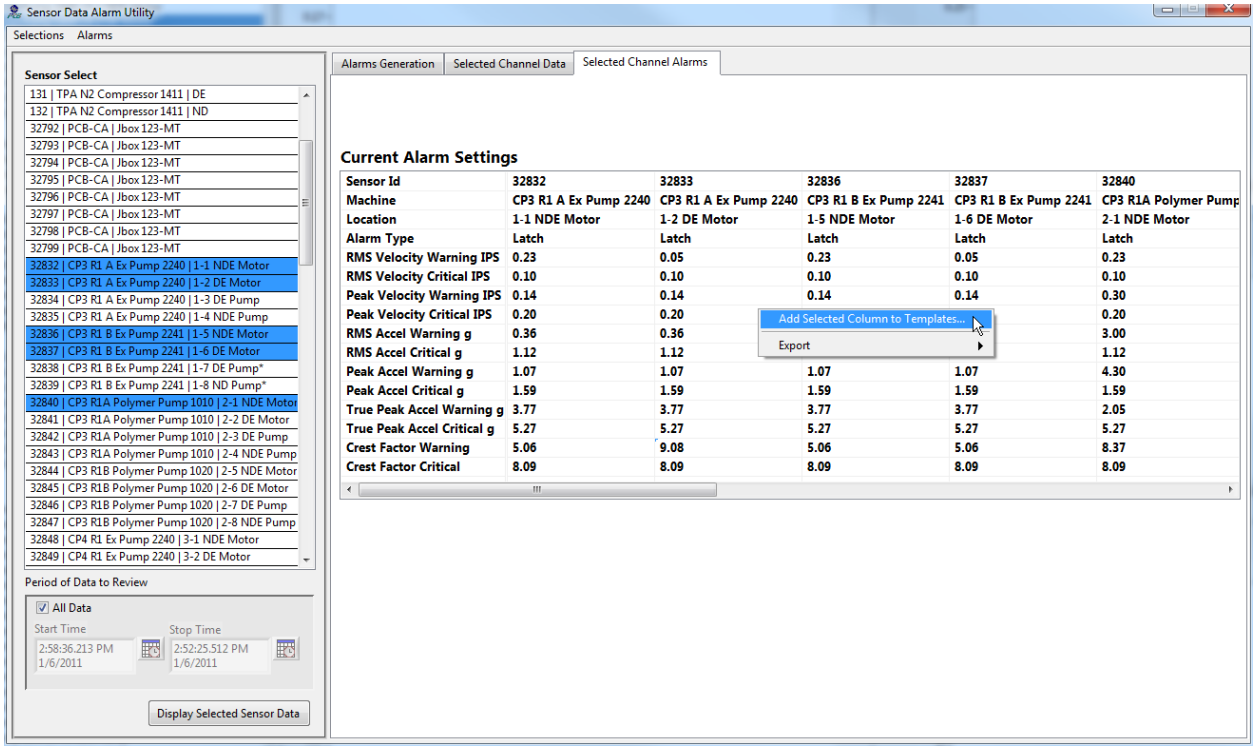


Figure 76 – Echo® Alarm Utility, Selected Channel Data tab

This screen is provided for informational purposes only.

4.2.10.1.4 Alarm Generation - Selected Channel Alarms Tab

This tab, Figure 77, provides a table of the current alarm settings for up to 10 selected sensors. These values will update when new alarms are generated from the Alarm Generation tab. This screen is provided primarily for informational purposes but it does provide a convenient way to create an alarm template.



Sensor Id	32832	32833	32836	32837	32840
Machine	CP3 R1 A Ex Pump 2240	CP3 R1 A Ex Pump 2240	CP3 R1 B Ex Pump 2241	CP3 R1 B Ex Pump 2241	CP3 R1A Polymer Pump
Location	1-1 NDE Motor	1-2 DE Motor	1-5 NDE Motor	1-6 DE Motor	2-1 NDE Motor
Alarm Type	Latch	Latch	Latch	Latch	Latch
RMS Velocity Warning IPS	0.23	0.05	0.23	0.05	0.23
RMS Velocity Critical IPS	0.10	0.10	0.10	0.10	0.10
Peak Velocity Warning IPS	0.14	0.14	0.14	0.14	0.30
Peak Velocity Critical IPS	0.20	0.20			0.20
RMS Accel Warning g	0.36	0.36			3.00
RMS Accel Critical g	1.12	1.12			1.12
Peak Accel Warning g	1.07	1.07	1.07	1.07	4.30
Peak Accel Critical g	1.59	1.59	1.59	1.59	1.59
True Peak Accel Warning g	3.77	3.77	3.77	3.77	2.05
True Peak Accel Critical g	5.27	5.27	5.27	5.27	5.27
Crest Factor Warning	5.06	9.08	5.06	5.06	8.37
Crest Factor Critical	8.09	8.09	8.09	8.09	8.09

Figure 77 – Echo® Alarm Utility, Selected Channel Alarm Tab

To create an alarm template that can be used when configuring sensors, click in the desired column and then right-click to display the short-cut menu and select the **Add Selected Column to Templates…** item. This will display the dialog shown in Figure 78.

If 10 templates already exist the dialog will ask you to select which one to replace, as shown, and to name the new template. Click **OK** to save the new template and exit the dialog screen or **Cancel** to exit without saving the template.

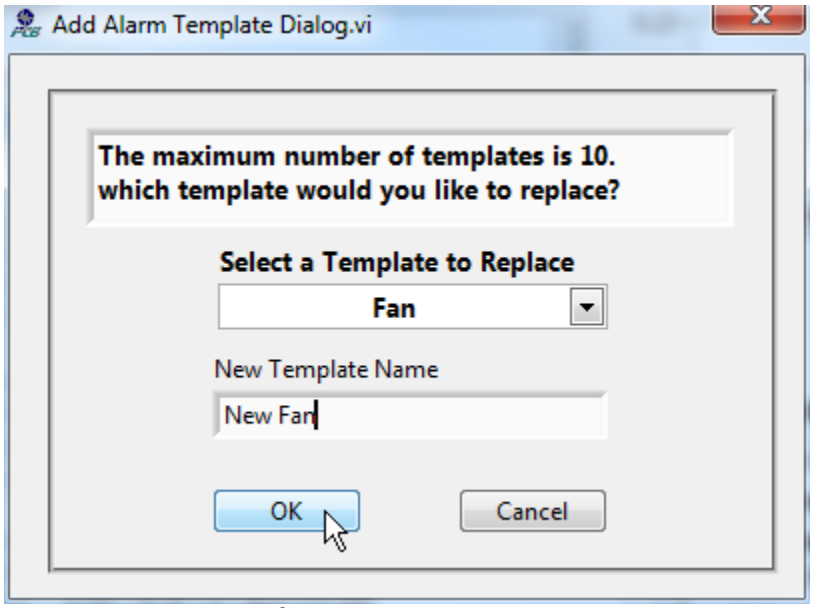


Figure 78 – Echo® Alarm Utility, Create a New Template

4.2.10.2 Echo® Alarm Templates

When sensors are added to the system it is suggested that alarm levels be established so it can be easily ascertained that a machine is beginning to have problems. An easy way to set alarm levels that removes the tediousness from the process is to set up templates for machine types and then simply assign the template values to a sensor with one mouse click. To set up a template, click on the main screen menu bar, shown below, and select the **Edit Alarm Templates** option.

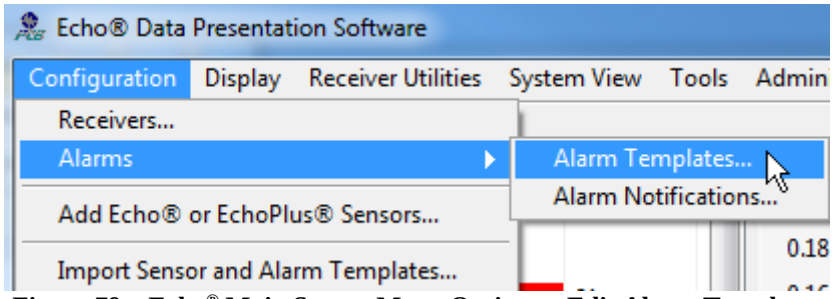
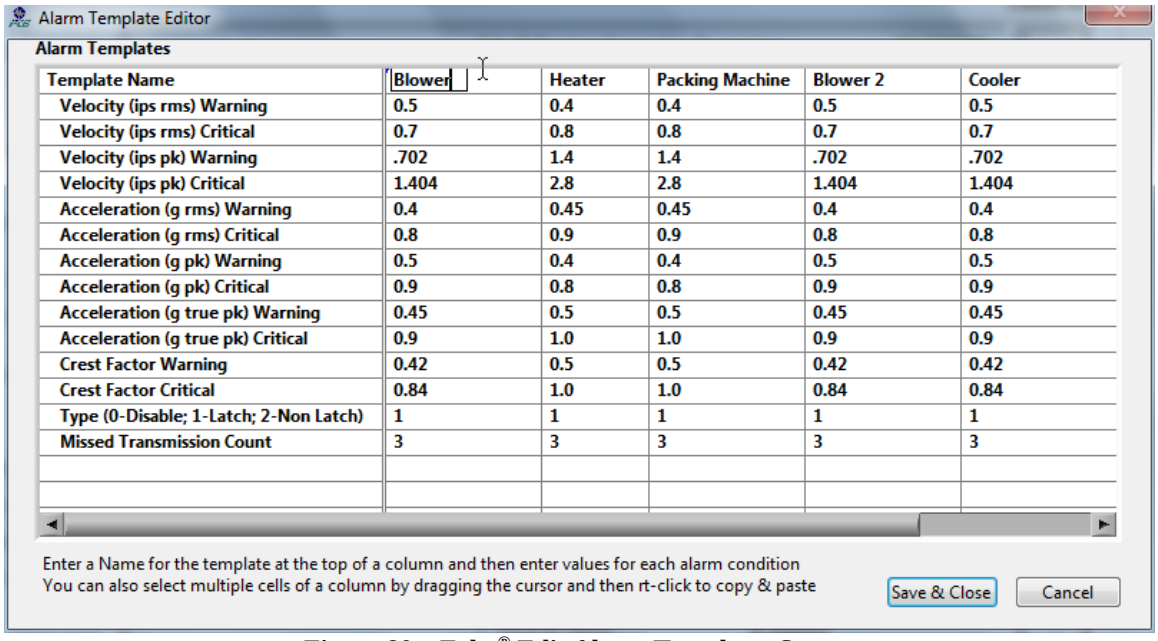


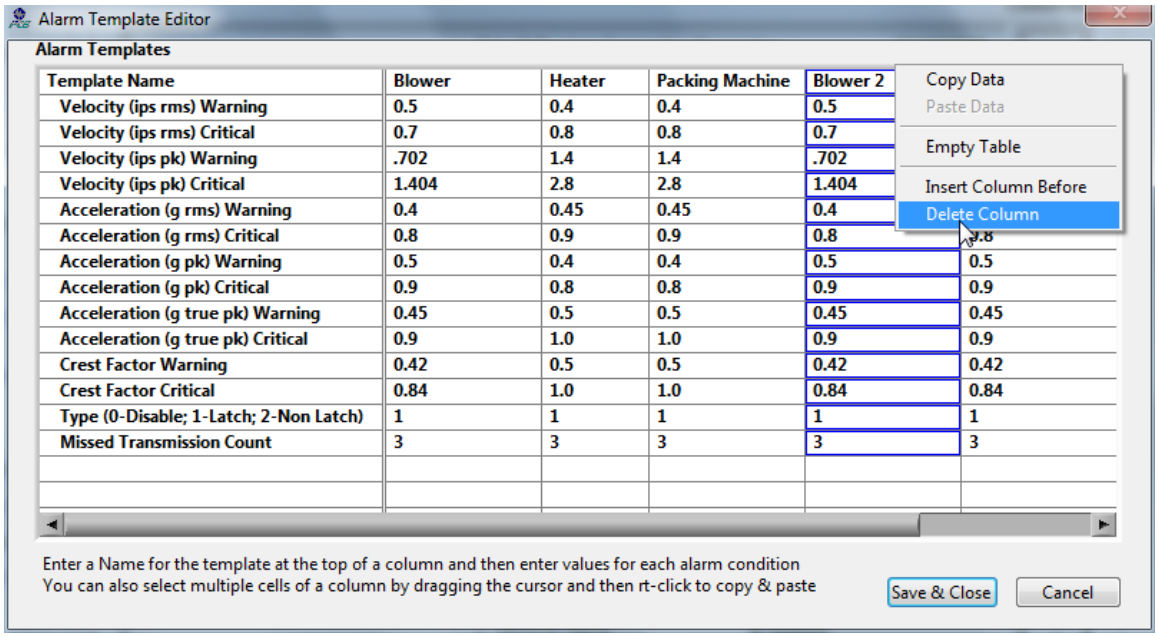
Figure 79 – Echo® Main Screen Menu Options – Edit Alarm Templates

When selected the screen shown in Figure 80 will appear. The top row contains the name for a template and the values below it are the alarm levels that will be assigned to the sensor for each data type. The columns can be deleted or copied by clicking at the top of a column and dragging across it to select the entire column (Figure 81). This will be evident by the entire column being outlined in blue. Next right click the mouse and select the operation to perform.



Template Name	Blower	Heater	Packing Machine	Blower 2	Cooler
Velocity (ips rms) Warning	0.5	0.4	0.4	0.5	0.5
Velocity (ips rms) Critical	0.7	0.8	0.8	0.7	0.7
Velocity (ips pk) Warning	.702	1.4	1.4	.702	.702
Velocity (ips pk) Critical	1.404	2.8	2.8	1.404	1.404
Acceleration (g rms) Warning	0.4	0.45	0.45	0.4	0.4
Acceleration (g rms) Critical	0.8	0.9	0.9	0.8	0.8
Acceleration (g pk) Warning	0.5	0.4	0.4	0.5	0.5
Acceleration (g pk) Critical	0.9	0.8	0.8	0.9	0.9
Acceleration (g true pk) Warning	0.45	0.5	0.5	0.45	0.45
Acceleration (g true pk) Critical	0.9	1.0	1.0	0.9	0.9
Crest Factor Warning	0.42	0.5	0.5	0.42	0.42
Crest Factor Critical	0.84	1.0	1.0	0.84	0.84
Type (0-Disable; 1-Latch; 2-Non Latch)	1	1	1	1	1
Missed Transmission Count	3	3	3	3	3

Figure 80 – Echo® Edit Alarm Templates Screen



Template Name	Blower	Heater	Packing Machine	Blower 2	Cooler
Velocity (ips rms) Warning	0.5	0.4	0.4	0.5	
Velocity (ips rms) Critical	0.7	0.8	0.8	0.7	
Velocity (ips pk) Warning	.702	1.4	1.4	.702	
Velocity (ips pk) Critical	1.404	2.8	2.8	1.404	
Acceleration (g rms) Warning	0.4	0.45	0.45	0.4	
Acceleration (g rms) Critical	0.8	0.9	0.9	0.8	
Acceleration (g pk) Warning	0.5	0.4	0.4	0.5	0.5
Acceleration (g pk) Critical	0.9	0.8	0.8	0.9	0.9
Acceleration (g true pk) Warning	0.45	0.5	0.5	0.45	0.45
Acceleration (g true pk) Critical	0.9	1.0	1.0	0.9	0.9
Crest Factor Warning	0.42	0.5	0.5	0.42	0.42
Crest Factor Critical	0.84	1.0	1.0	0.84	0.84
Type (0-Disable; 1-Latch; 2-Non Latch)	1	1	1	1	1
Missed Transmission Count	3	3	3	3	3

Figure 81 – Editing Alarm Templates Example

When editing is complete click the Save & Close button. To assign these alarm values select the Configuration | Add Echo® or EchoPlus® Sensors menu bar option and follow the screen instruction for editing a sensors database entry.

4.2.10.3 Echo® Alarm Email Notifications

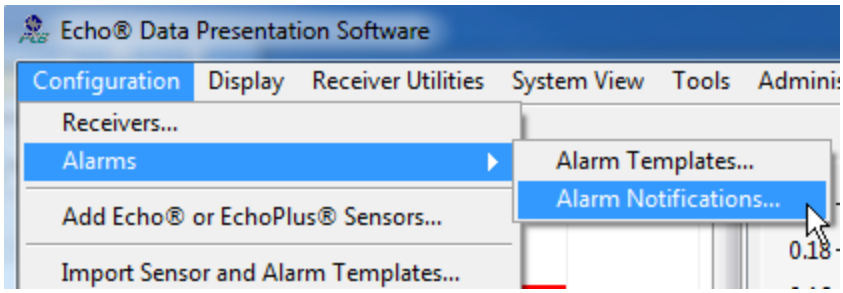


Figure 82 – Echo® Main Screen Menu Options – Alarm Email Notifications

Selecting Alarm Notifications from the main menu bar will bring up the screen shown below in Figure 83.

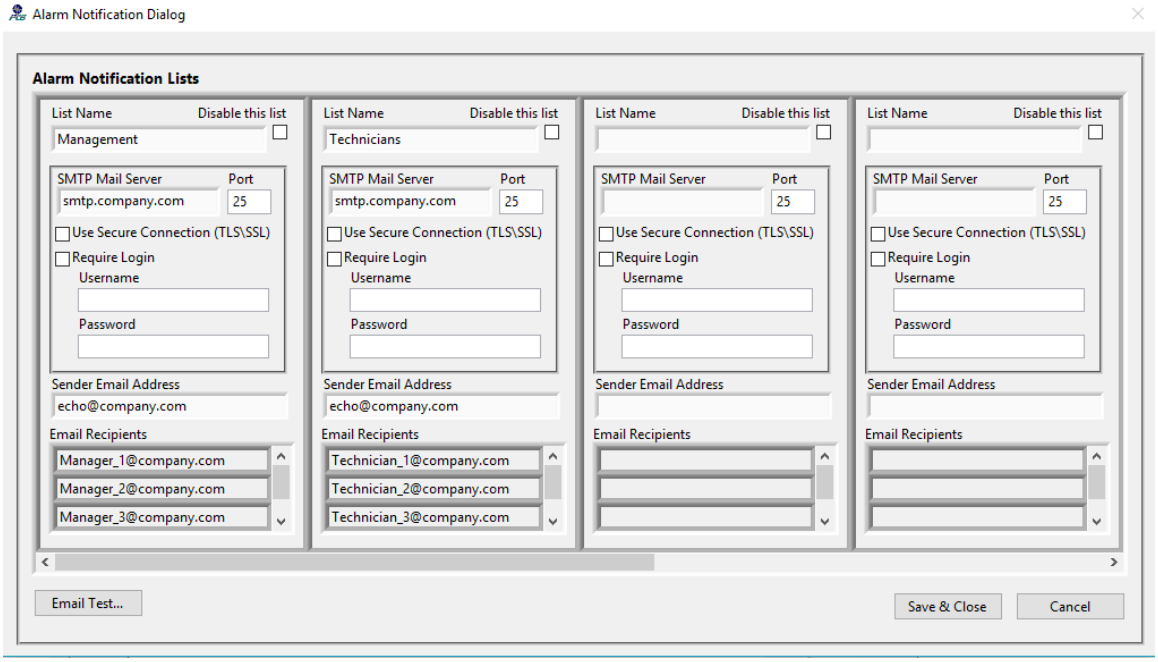


Figure 83 – Echo® Alarm Email Notification configuration screen

This screen provides for the configuration of up to 6 email lists. Each list can have multiple recipients. Each recipient will receive an email notification whenever a sensor with the specified list produces a reading greater than or equal to the set alarm level. Each sensor's warning and critical alarms can be configured with separate notification lists. To establish a list simply fill in the fields shown above.

- **List Name** – This can be any name you chose. These names will be listed in the Sensor configuration window when you Right-Click next to the Warming or Critical Email list fields.
- **SMTP Mail Server** – Enter the name or IP address of your companies outgoing SMTP email server.
- **Port** – Enter the SMTP server port number. Typically it is 25 or 587
- **Use Secure Connection** – This specifies whether to use Transport Layer Security (TLS) for added security when communicating with the SMTP server.

- **Require Login, Username, Password** – If your server requires authentication then use these fields to specify the log-in username and password for the SMTP server you specify. **NOTE**: The Password is saved using the Blowfish encryption algorithm.
- **Email Recipients** – enter the email address of people who should receive the notifications. The first three of each list are initially shown in the window, use the scroll bar on the right of each list to scroll down to add or see more recipients.
- **Disable this List** – This is a quick way to disable an email notification list in the event you know there is a problem and you do not wish to get the notifications. This is easier than going into the sensor configuration window and removing notifications altogether.

4.2.10.3.1 Email Notification Test

Email Test provides a way to check the alarm notification email settings.

Clicking the Email Test button displays the Email Test List Selection Dialog screen that is used to specify which email list is to be used for the test.

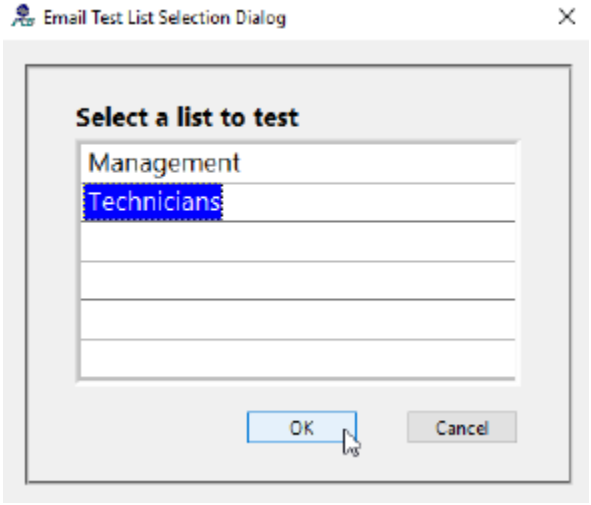


Figure 84 – Echo® Alarm Email Notification Test List Selection

Select a list and click OK to continue or Cancel to cancel the process and close the window.
Selecting OK displays the Email Test Utility screen shown in Figure 85. All of the parameters from the selected list are transferred to the appropriate field in the utility. All fields can be edited as necessary. Multiple recipients are separated with a comma ',' in the utility.
Click the **Send Email** button to send the test message.

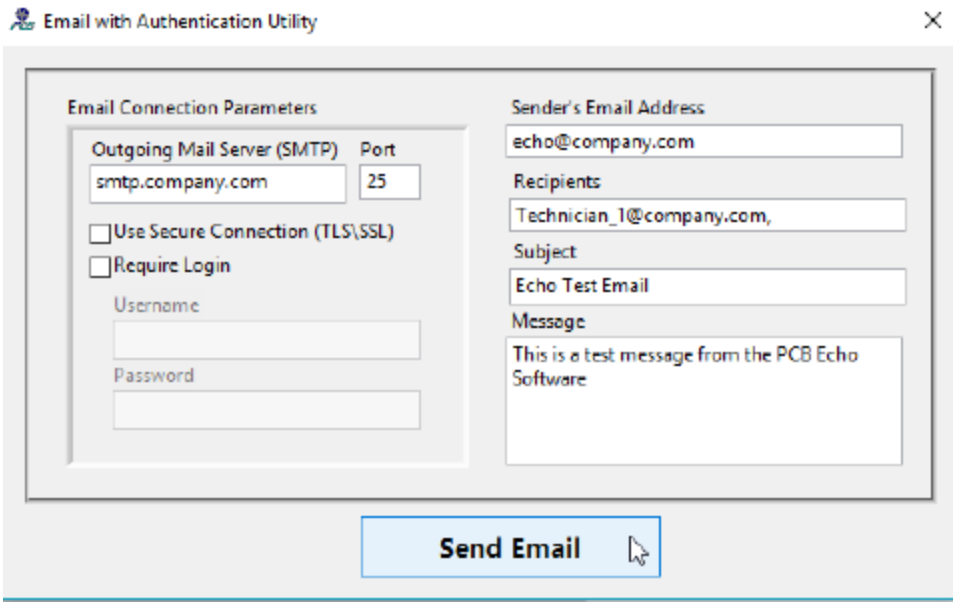
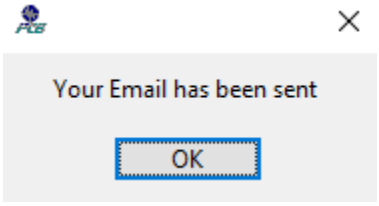


Figure 85 – Echo® Alarm Email Notification Test Screen

After a successful email transmission the success dialog box, shown below, will appear.



If an error occurs then an error message will appear.

4.2.11 Sensor Transmission Reliability Utility

The Sensor Transmission Reliability Utility, Tools | Transmission Reliability on the main screen menu bar, is used to determine if junction box and sensor transmissions are being received reliably or if the receiver and/or antenna needs to be moved to a more optimal location. It could also be used to determine if another receiver and antenna might be beneficial to the system. For instance, take the situation where several junction boxes and sensors are installed with one receiver and data is being received reliably without any issues. Now it is necessary to add more junction boxes and/or sensors to another location in the building. This necessitates moving the receiver and antenna. The question is how much of an impact does this have on the original sensors transmission reliability? This utility would answer that question. By running it for the period before the move and then the period after the move you can see what difference it made.

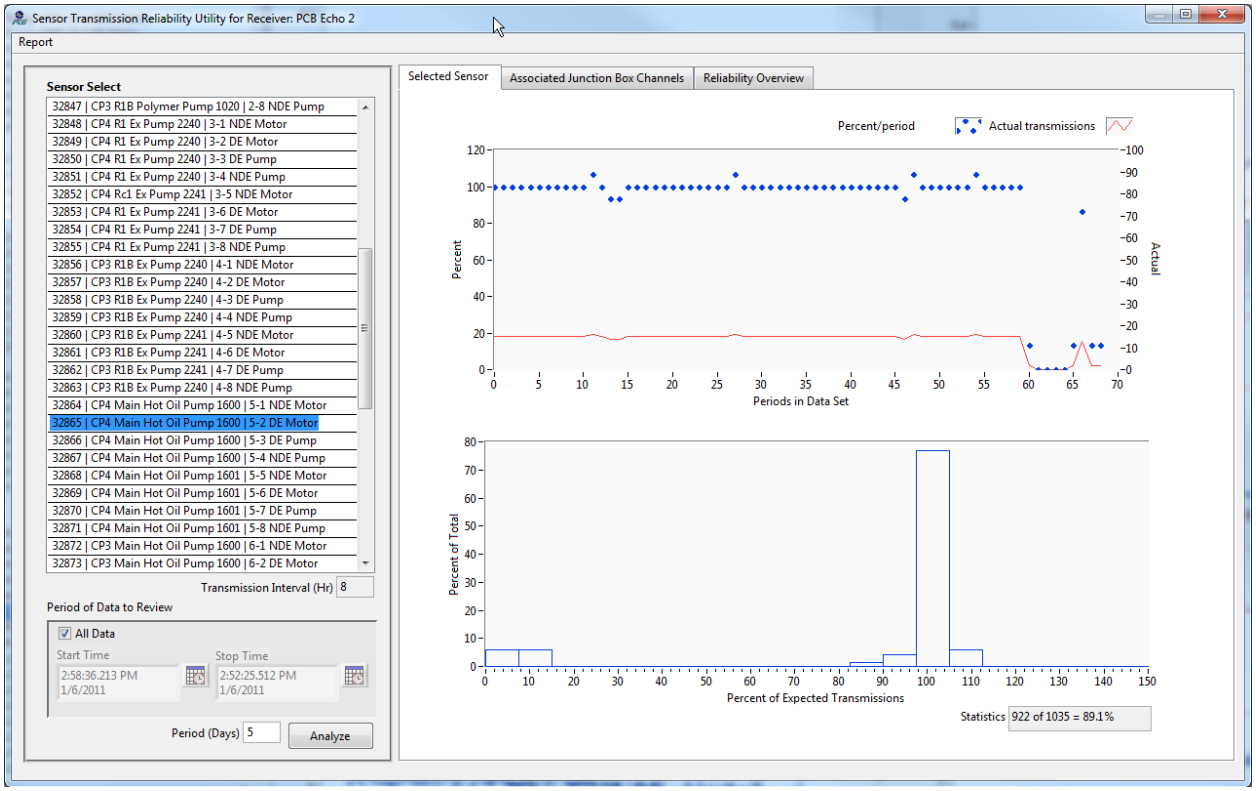


Figure 86 – Echo® Sensor Transmission Reliability Utility – Selected Sensor Tab

The major components of the screen are:

- **The Sensor Selection List** – located on the left, this table lists the sensors assigned to the receiver. Selecting a sensor, by clicking the mouse on an entry, causes data for the period defined to be analyzed.
- **Time Period of Data to Review** – located at the bottom left of the screen you can check the **All Data** box to use all data collected for the selected sensor or, if this box is unchecked, you can define a specific period of time to analyze the data using the Start and Stop Time controls.
- **Period (days) –** This is the period over which transmissions will be grouped to form a single data point for analysis. For instance, if a sensor is scheduled to

transmit every 8 hours (3 times a day), and the period is set to 5 days then 15 transmissions should be found in the database for every 5 day interval in the Time Period being analyzed to get a rating of 100% of expected transmissions for the period. If only 5 transmissions were found then the percent of expected transmissions for the period would be 33%. These calculations are used to plot the actual performance in the graphs on the tab section of the screen.

- **Selected Sensor Tab(** Figure 86) - This tab contains two graphs and an overall statistic of how many transmissions were expected and how many were received.
    - The graph on the top shows % of transmissions received for each period (defined by Period (days)) on the left y-axis (blue diamonds) and actual transmissions on the right y-axis over time. In the example used above a bule diamond point of 100% equates to a red data point of 15 transmissions.
    - The graph on the bottom is a histogram of how often, in groups of 10%, that percent of transmissions was achieved. In the bottom graph shown in Figure 86 we see that 100% of the selected sensors transmissions were received almost 80% of the time for the period reviewed. This is excellent since occasionally more than 100% were received, which can happen if the power is cycled on the sensor to produce 'extra' transmissions. And we see the over some periods 0% were received indicating power was likely removed for maintenance or some other reason.
- **Associated Junction Box Channels Tab** (Figure 88) – This tab is only displayed if the sensor being analyzed is a juncrion box channel. This tab contains histograms and the overall transmission statistic for all channels on the selected sensor junction box. This is the same data that is shown for the selected sensor on the bottom graph of the **Selected Sensor** tab
- **Reliability Overvies tab (**Figure 89) – This tab shows the overall reliability of every device assigned to the selected receiver. Each entry is an icon of either a junction box or a standalone sensor. Below each icon is a transmission reliability statistic for the time period analyzed. The number associated with each statistic is the sensor ID for that sensor. For junction boxes the 1st channel of the box is used. The color of the icon represents the reception quality at a glance in 20% steps. Bright green= >80%; Light Green=60-80%; Light Yellow=40-60%; Dark Yellow=20-40%; Red=<20%

Figure 87 – Echo® Sensor Transmission Reliability Utility – Reliability tab icons

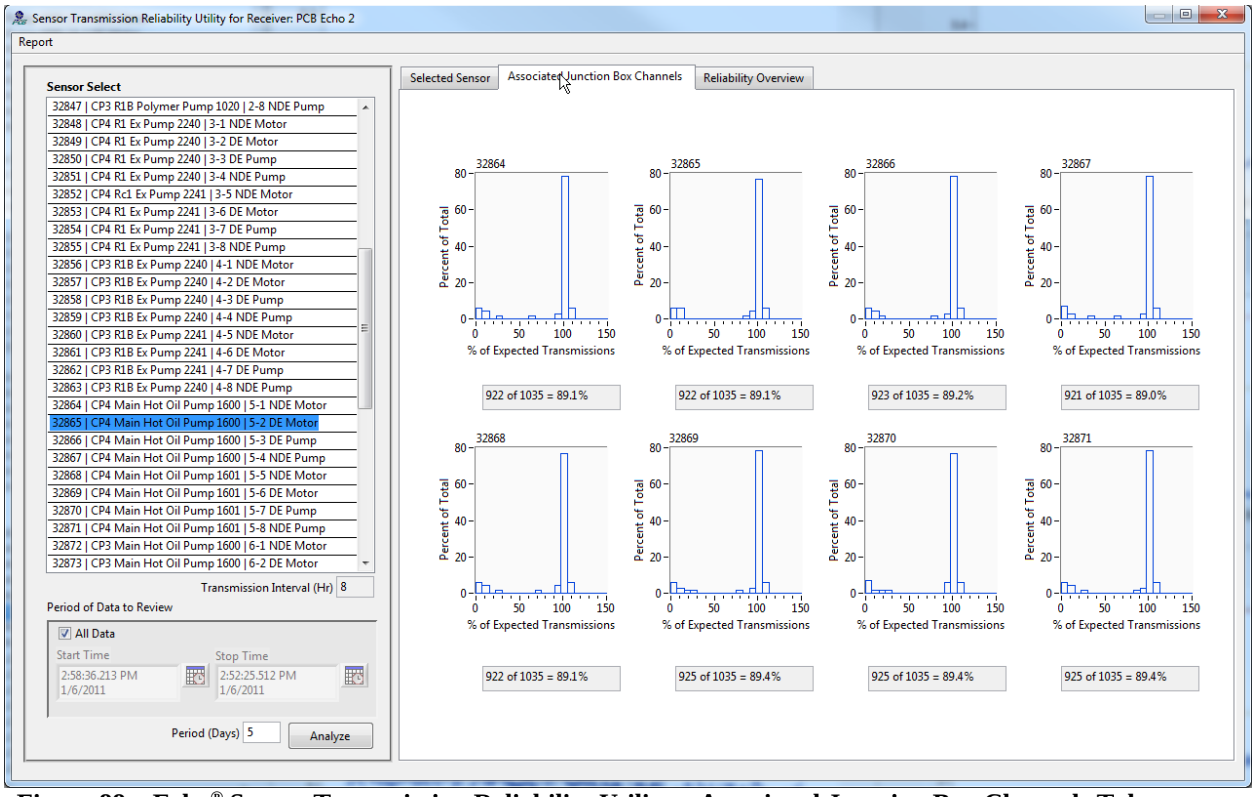


Figure 88 – Echo® Sensor Transmission Reliability Utility – Associated Junction Box Channels Tab

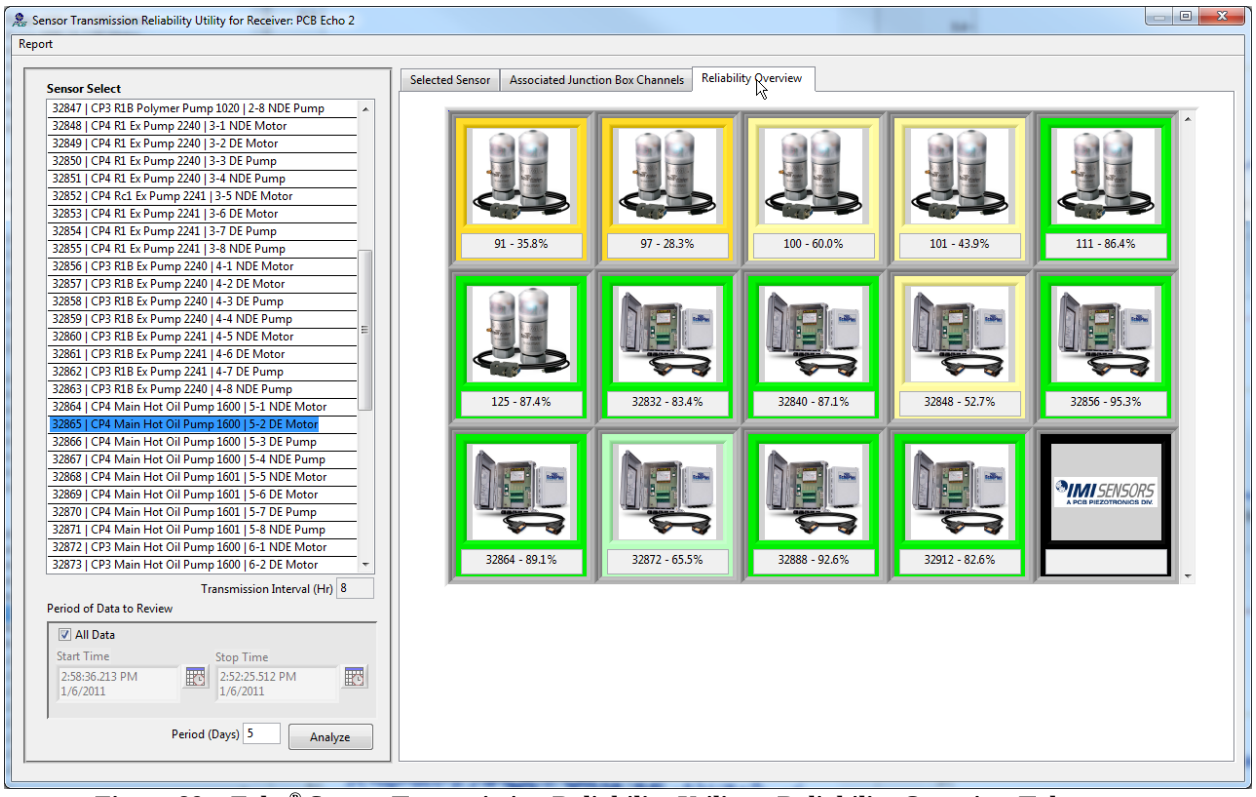


Figure 89 – Echo® Sensor Transmission Reliability Utility – Reliability Overview Tab

4.2.12 Export Sensor Data

This utility is used to quickly export several sensors data to a text based spreadsheet file format. It is accessed using Tools | Export Sensor Data on the main screen menu bar. On an individual sensor basis this same function is available on a sensor's History display. In this utility all of the sensors assigned to a receiver are shown in the sensor list on the left.

- **Sensor List** - One to all sensors can be selected using the **Select All** button or <shift> & <ctrl> in combination with clicking the mouse.
- **Period of Data to Export** – Select **All Data** by checking the check box or a specific period using the **Start and Stop Time** controls.
- **Show Gap Indications** – If a transmission is missed then an asterisk is appended to the time and date of the next received transmission. This can be seen on the history screen. This asterisk causes problems with Excel's Time and date functions so it is excluded in these files unless specifically asked for by checking this box.
- **Prompt for File Names** – If checked the operator can specify the name of each file. If left unchecked the utility will automatically name the files using the following convention: <sensor id> <mm-dd-yyyy> <hh-mm-ss>.dat (ex. 126 04-01-2015 15-56-59.dat). The files will be placed in the directory specified in the **Directory where data files will be stored** control.
- **Export Data Button** – activate to export the data

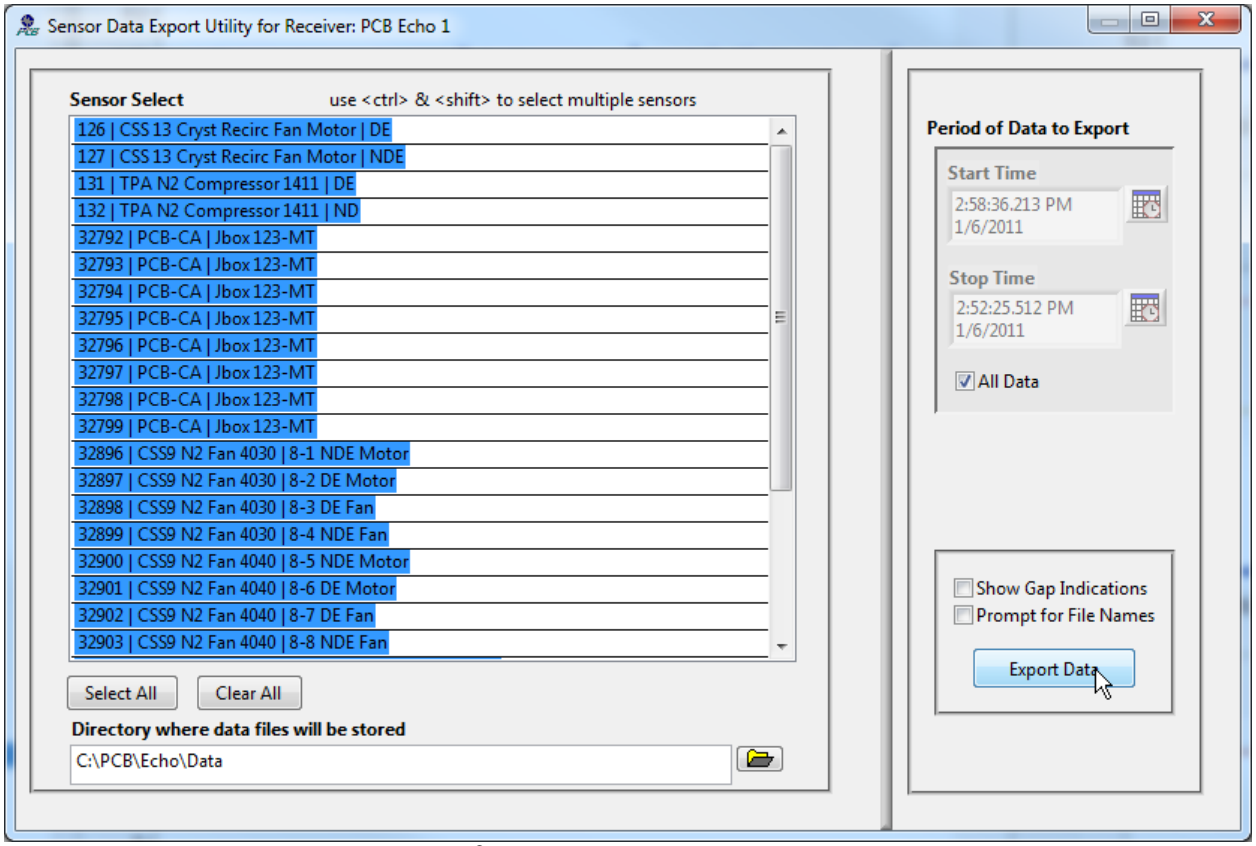


Figure 90 – Echo® Sensor Data Export Utility Screen

4.2.13 DSP Status

The Digital Signal Processor (DSP) status utility is used to check for situations where the sensor signal received by the junction box fluctuates outside the allowed threshold established for measurement consistency. If the DSP processor encounters problems with the stability of the data sets it captures from the sensor it will set status bits in the transmission indicating a DSP alarm condition. The alarm conditions are as follows;

- 0= Passed first 3 samples
- 1= Passed without re-transmit, but not on first 3 samples
- 2= Retry completed and passed
- 3= Retry completed and failed

The DSP alarm screen, shown in Figure 91, is used to query the database to see where, if at all, this is happening. If sensors show up with a status of 3 or you find many instances where the alarm is greater than 0, the sensor and ground should be checked.
This query can be run on all transmission records (check the **All Records** box) or over a certain time period (clear the **All Records** checkbox and set the time parameters). The **Remove Duplicates** checkbox is used to remove multiple table entries for the same channel. Checking it will show just the most recent transmission with a problem. Using it is a good way to get an overall picture of how many channels are having a problem.

NOTE: If a transmission is received with a DSP status of failure (3) and ZeroDSPFail is set to TRUE in the **PCB EchoReceiver.ini** file then the transmission is saved in a log file named **DSPic Alerts.txt** in the 'Data' directory and the values are zeroed before entry in the database.

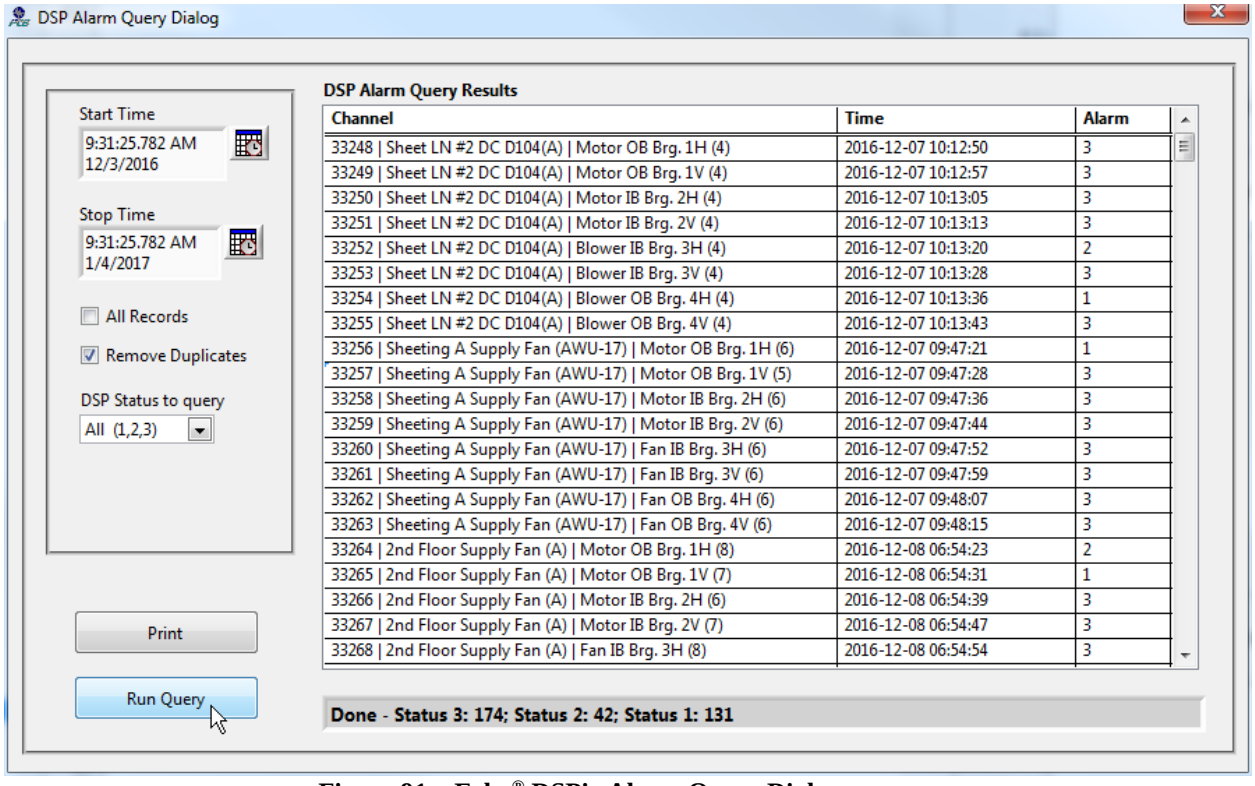


Figure 91 – Echo® DSPic Alarm Query Dialog

4.2.14 Main Screen Features

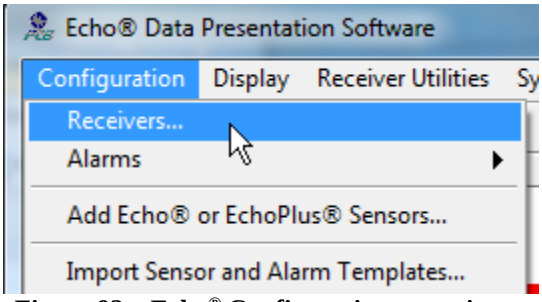


Figure 92 – Echo® Configuration menu items

4.2.14.1 Receiver Connection Parameters

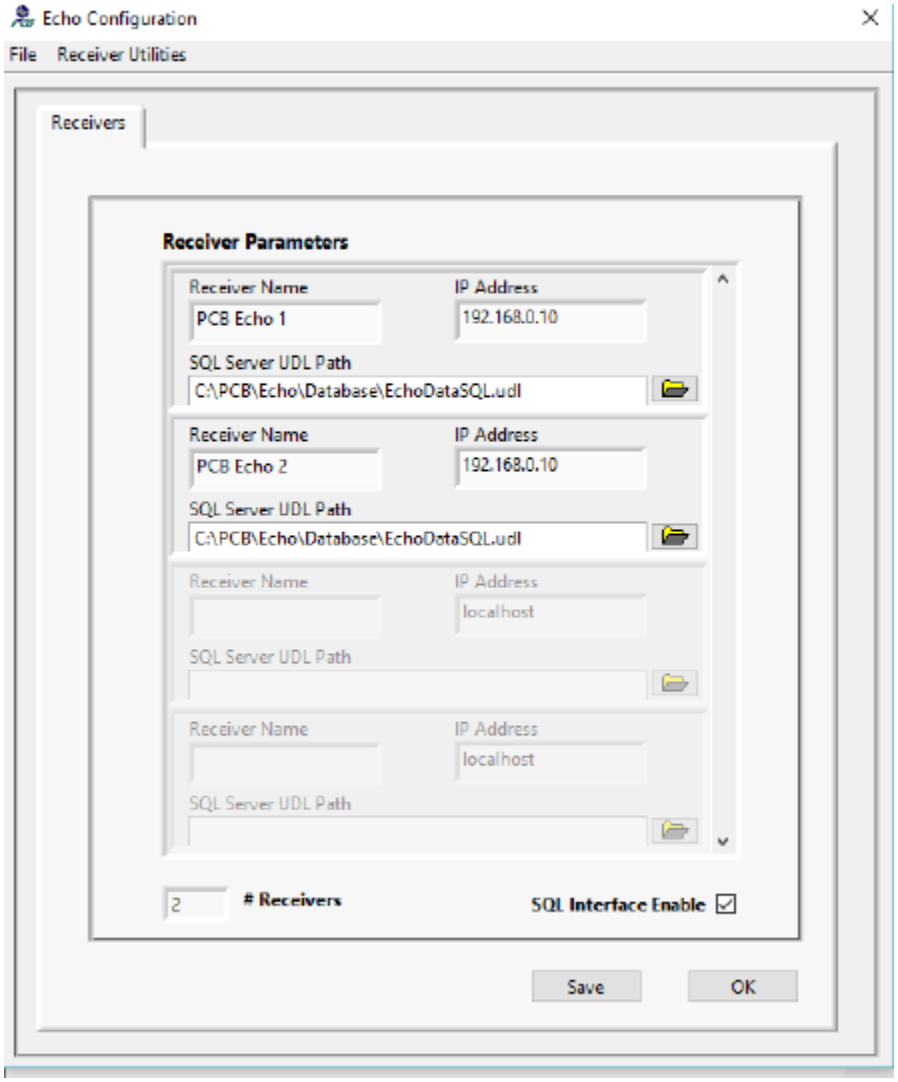


Figure 93 – Echo® Receiver Connections

This section describes the parameters used to connect to a receiver. To change these values select **Configuration | Receivers**… from the menu bar. This will bring up the Receiver Configuration screen shown in Figure 93.

The Receiver parameters consist of the 3 items;

- **Receiver Name** – This provides a unique identifier for a receiver. You may name it anything you like. This name will appear in the title of many subsequent screens associated with data transmitted by this receiver.
- **IP Address** – In order to connect to a receiver, the receivers IP address must be ascertained and entered here. The procedure for setting a receivers IP address is described in Section 4.2.14.2. The receivers are set up to dynamically receive an IP address assignment from the network's DHCP server at the factory. In the event no assignment is made the receiver will likely default to an address of **169.254.nnn.nnn** where the nnn octets are randomly assigned. There are two methods to determine a receivers IP address;
    - The preferred method is to run the **Echo® Receiver Discovery Tool** (Receiver Utilities | Find Echo Receivers...) from the main menu bar - Figure 94. The screen shown in Figure 95 below will appear. Clicking 'Search' should reveal the Echo® receivers, their assigned IP address and their internal unit ID. Enter the IP address seen here in the IP Address field of the Echo® Receiver Connection Parameters found on the main Echo® software screen. The ID is marked on the receiver itself so positive identification can be made. The utility will start with the 1st 3 octets set to the same values as the PC's IP address and 255 in the last one. If this fails to find the receiver then change the 3rd octet to 255 and try again.

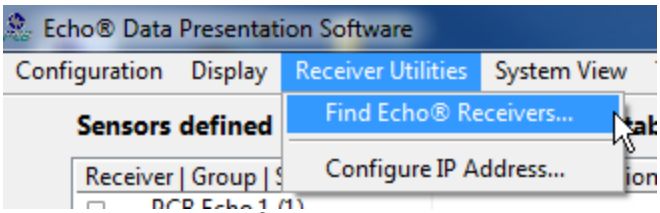


Figure 94 – Echo® Receiver Utility Menu Items

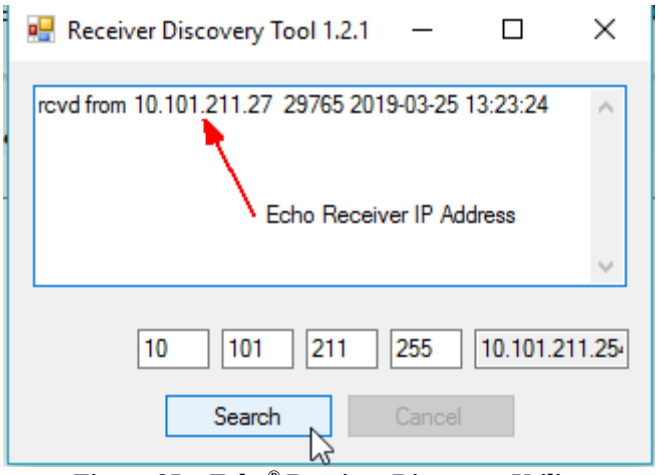


Figure 95 – Echo® Receiver Discovery Utility

- In the event the Discovery utility fails, the supplied serial cable can be connected to the unused power/serial connector on the receiver and the other end to a laptop. Running a terminal emulation program such as HyperTerminal (Figure 96) with the serial parameters set to; Baud=38400, 8 data bits, no parity and 1 stop bit. This will show a data stream that is continually output and contains the IP address[3].

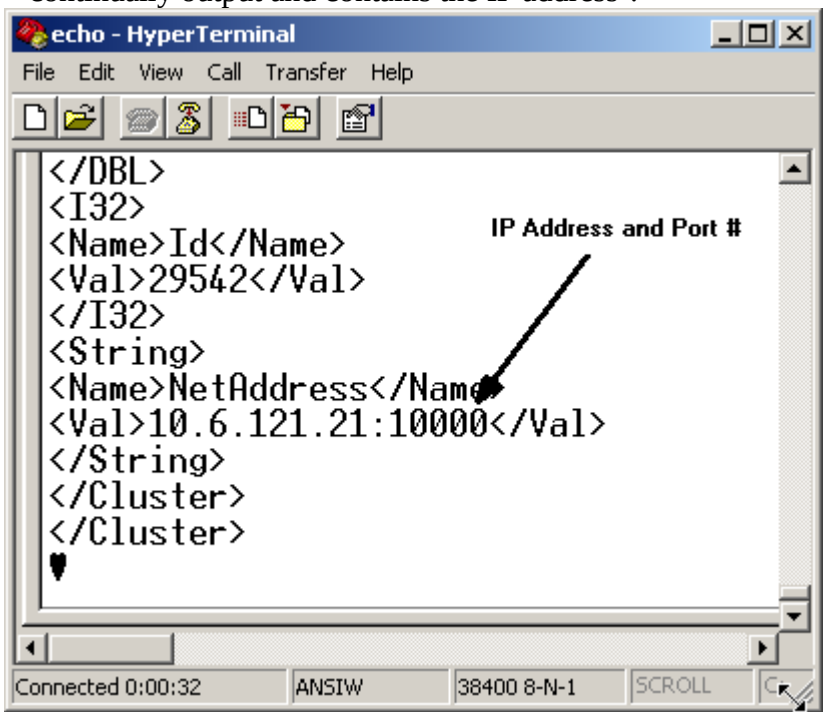


Figure 96 – Echo® Receiver IP determination using the serial port

- **SQL Server UDL Path** – The UDL File path is required if the Echo® transmissions are to be stored in an SQL database. This provides the connection between the application and the database engine. The UDL file configured in section 3.4 is identified here[4].

The Receiver Connection Parameters determine which physical receiver is being viewed when the 'Live Data' button is activated and what database is being queried by the other button functions.

4.2.14.2 Setting the Receiver IP Address

The Echo® Receiver IP address can be setup to be dynamically assigned or configured with a static assignment (recommended). To configure the IP address, connect the Receiver to the PC using the supplied serial port cable, and then select the menu option Receiver Utilities | Configure IP Address shown in Figure 97.

[3] The software connects to the receiver at the specified IP address using port 10000
[4] There may be multiple UDL files. Each receiver can store data to a separate database if desired.

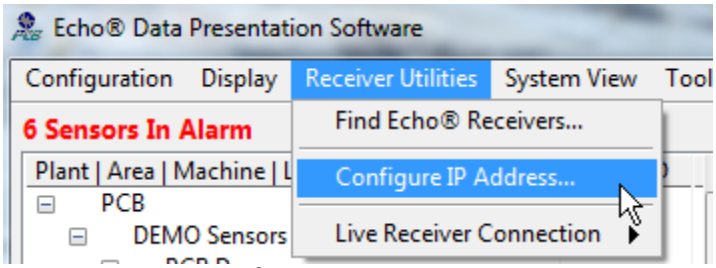


Figure 97 – Echo® Receiver IP Address Utility Select

When activated the screen shown in Figure 98 will appear. If you want the DHCP server on your network to assign an IP address to the receiver automatically when the receiver powers up then select the Dynamic option shown below and activate the Apply Update button. Changes made to the receiver will take approximately 30 seconds to complete. When complete the **Success** status light will illuminate.

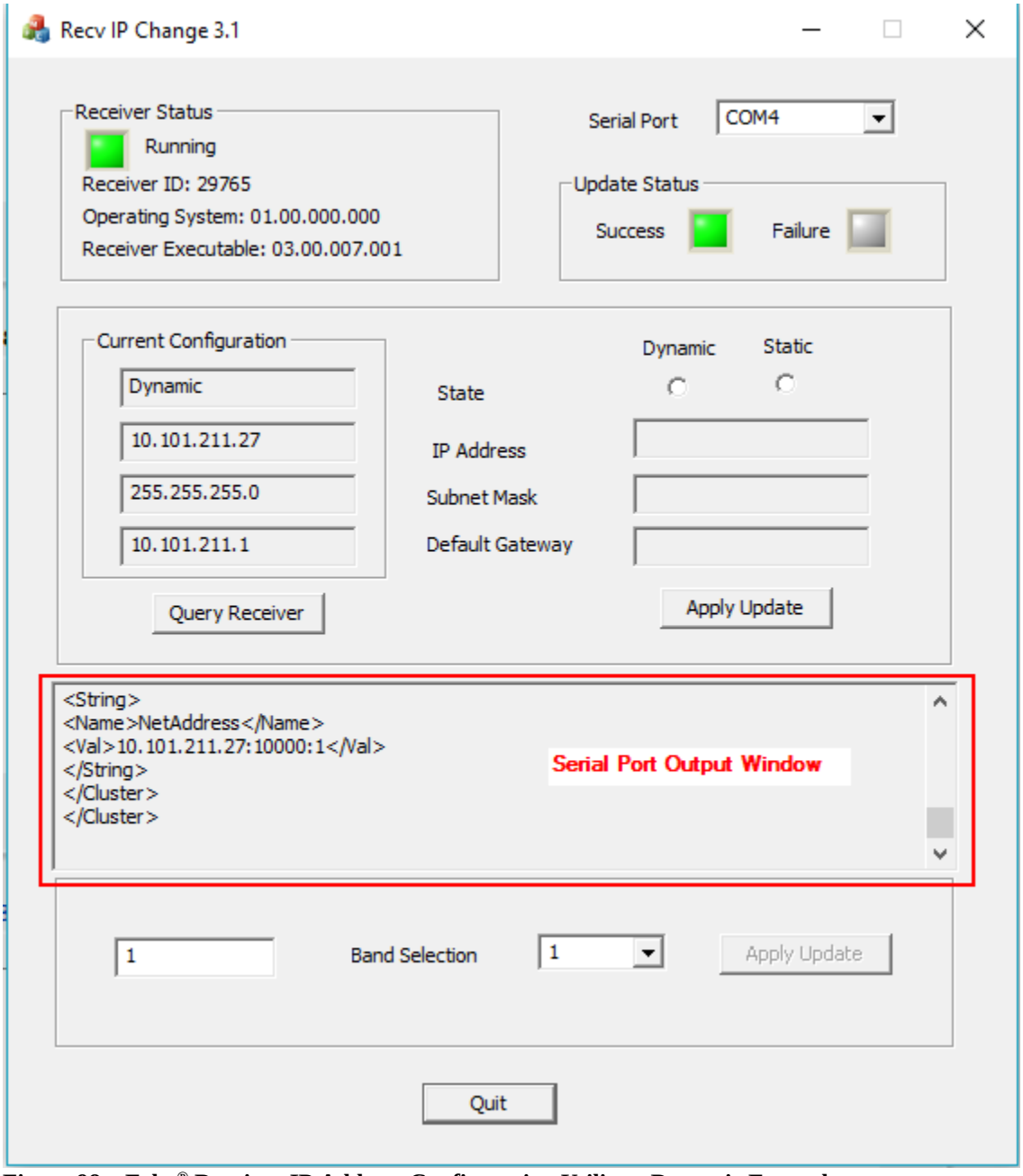


Figure 98 – Echo® Receiver IP Address Configuration Utility – Dynamic Example

To set a static IP address on the receiver then select the Static option and fill in the IP address parameters as shown in Figure 99 below. Next activate the Apply Update button and wait for the assignment to complete (~30 seconds). When complete the fields on the left will reflect the new assignment and the Success light should be lit.

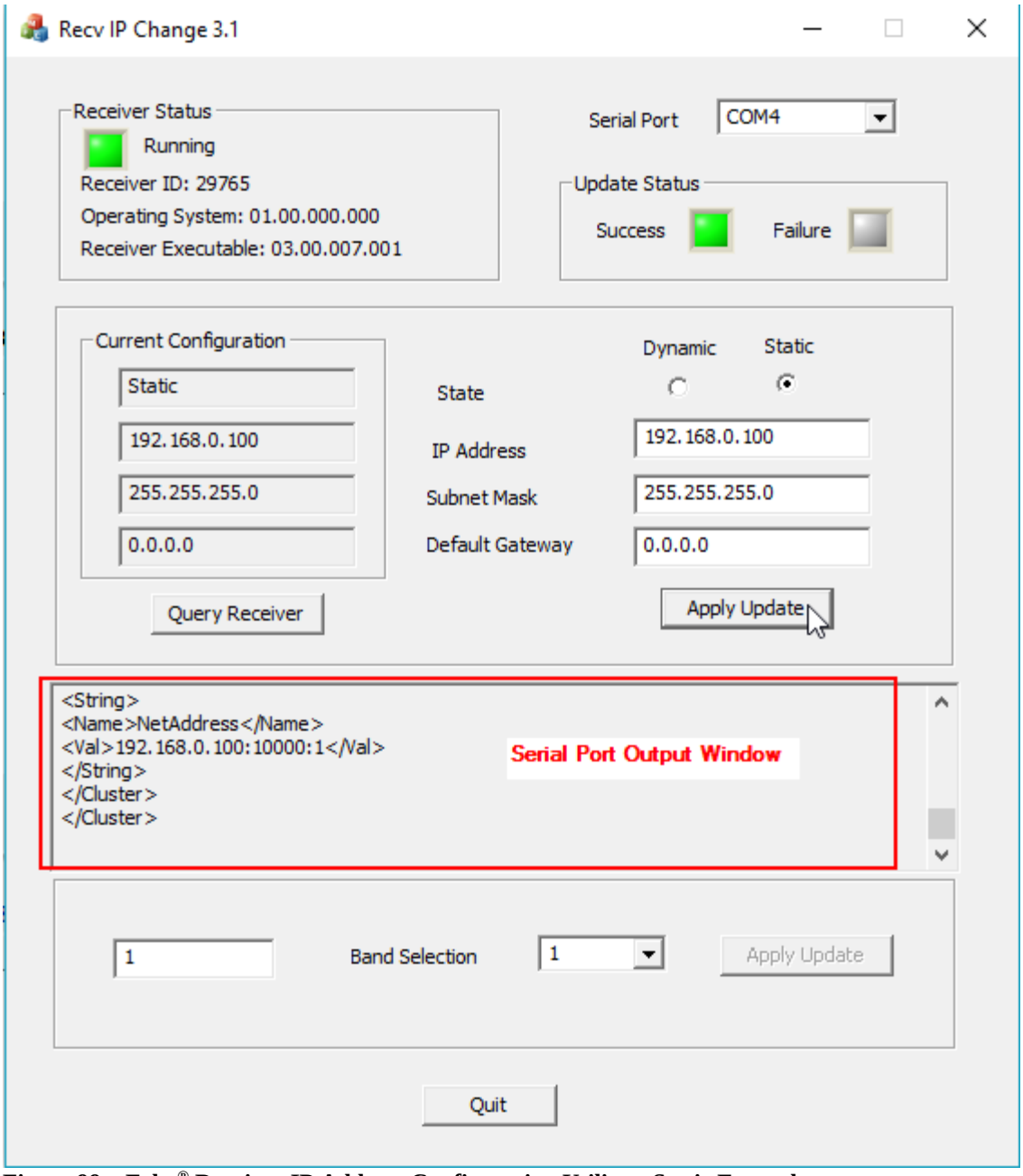


Figure 99 – Echo® Receiver IP Address Configuration Utility – Static Example

Band Selection – You must coordinate the transmission band selection between the sensor(s) and the receiver. The default for both sensors and receivers is band 1. For 916 MHz systems (US, CA etc.) there are 12 band selections. For 868 MHz systems (EU) there are 9.

Serial Port Output - The center of the screen displays the output of the receiver's serial port. This is useful for troubleshooting purposes.

4.2.14.3 Live Data Screen

The Echo® Data Presentation software provides a mechanism to see all transmissions received by each receiver. To access these screens select **Receiver Utilities | Live Receiver Connection** from the main screen menu bar and select the receiver of interest.

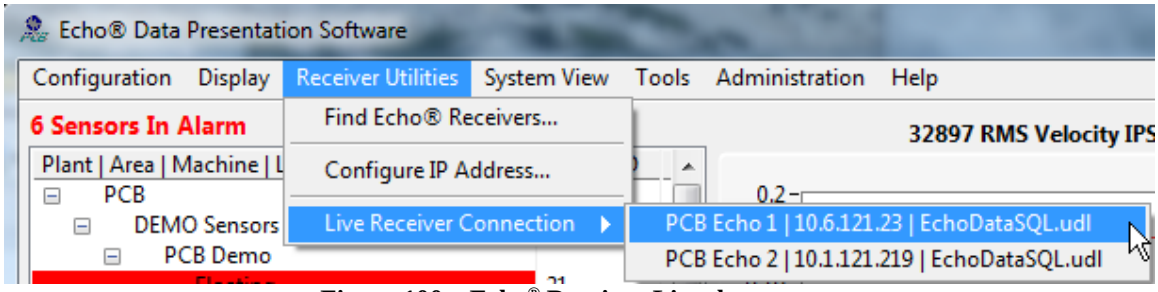


Figure 100 – Echo® Receiver Live data screen

Activating this menu item brings up the window shown in Figure 101. The ***PCB Echo Receiver Client screen*** is used to see all transmissions that the receiver collects regardless of whether the sensor is registered with that receiver in the database or not. This is the only screen that shows all transmissions being captured by a receiver. All others will only show data for sensors configured for the receiver. (e.g. Two Echo® sensors may both be in range of two receivers. Both receivers will pickup the transmissions but the receiver's client service will only store the transmission in the database if the sensor is configured for that receiver.)

When a connection has been made the fields at the top of the screen will look similar to the ones shown in Figure 101. The **LED** will be green, the **Noise** field will display some value and the **ID** field will contain the receiver ID and the IP address the port number and the reception band of the connection. As sensor transmissions are received the data will show up in the table below with the most recent transmission at the top and the oldest at the bottom. This screen will only show the most recent 50 transmissions. Which data items and what order the data is displayed in can be customized using the method discussed in section 4.2.8.

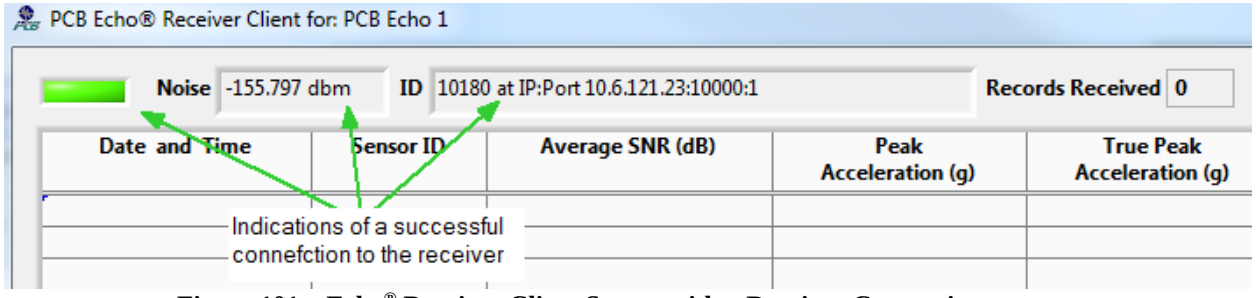


Figure 101 – Echo® Receiver Client Screen with a Receiver Connection

At the bottom of the Receiver Client screen is a 'Log Transmissions to File' check box. If this box is checked two additional controls will appear; 'Insert Break' and a text field to type a comment. When the 'Log transmissions' box is checked every transmission

received will be logged in a file named 'Echo Log R<x> <mm-dd-yy hh-mm-ss>.txt'. Where <x> is the receiver number and the rest is the date & time.
Click the 'Insert Break' button to insert a break (<CR><LF>) in the Log file. The break will be a blank line or whatever text is contained in the 'Comment' control to the right. This breaks up the stream of transmission records and provides annotation for testing the system. Every time this box is checked a new break is inserted. The log file is useful when doing surveys to determine the best receiver placement. Note: A new file is generated every time the Log Transmission box is toggled.

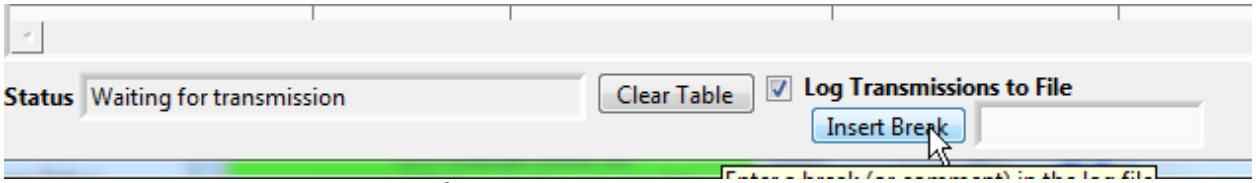


Figure 102 – Echo® Receiver Client Screen Log File Controls

4.2.14.4 Sensor List short-cut Menu Functions

To access additional screens like the transmission history screen and the advanced plot screen simply right-click on the main screen sensor tree and select an option. Generally the screen will display for the selected sensor.

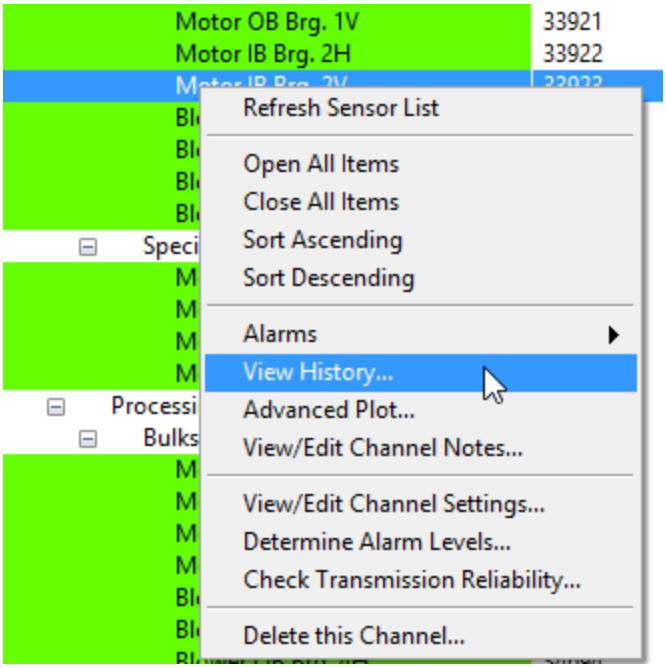
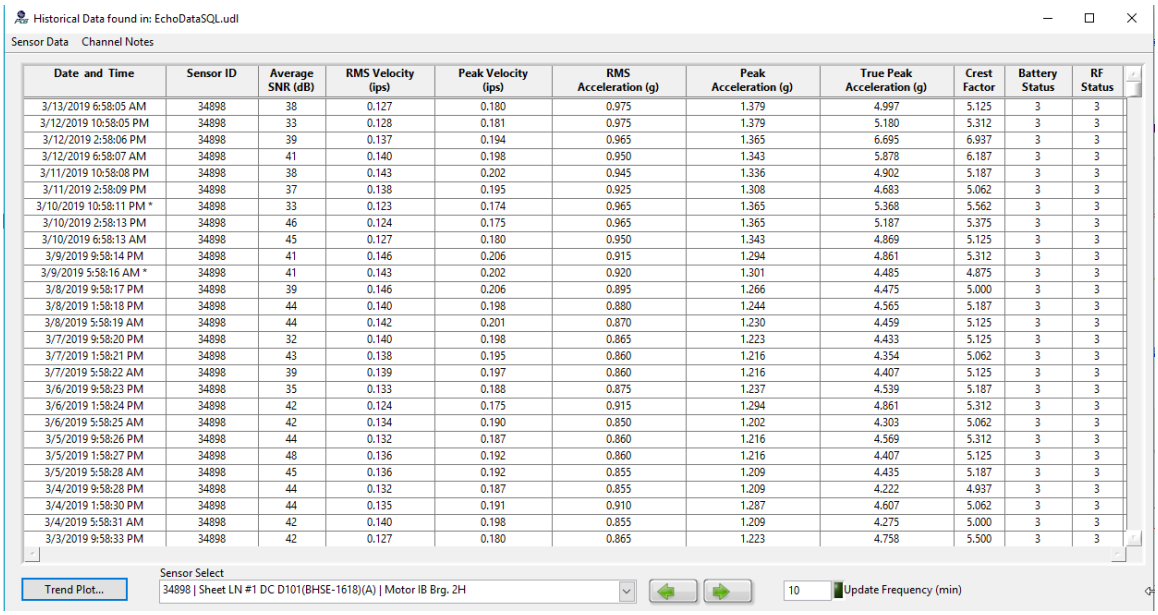


Figure 103 – Main Screen Sensor Tree Short Cut Menu to other Screens and Functions

4.2.14.5 Historical Data Screen

Activation of the Historical Data button on the main screen brings up the screen shown below in Figure 104. This screen has the following controls:

- **Sensor Select**. Clicking on this control reveals a list of all sensors assigned to this receiver. Selection of a sensor in the list will cause all stored data transmissions for that sensor to be displayed.
- **Left & Right Arrow Buttons** – These provide a quick method to scroll through the data. They move the Sensor Select to the next or previous sensor and plot its data automatically.
- **Update Frequency.** This controls the frequency, in minutes, at which the screen is updated from the database.
- **Trend Plot** button. Activation of this button brings up the screen shown in Figure 109 which provides a graphical representation of the data and the ability to compare it with other sensors.



Date and Time	Sensor ID	Average SNR (dB)	RMS Velocity (ips)	Peak Velocity (ips)	RMS Acceleration (g)	Peak Acceleration (g)	True Peak Acceleration (g)	Crest Factor	Battery Status	RF Status
3/13/2019 6:58:05 AM	34898	38	0.127	0.180	0.975	1.379	4.997	5.125	3	3
3/12/2019 10:58:05 PM	34898	33	0.128	0.181	0.975	1.379	5.180	5.312	3	3
3/12/2019 2:58:06 PM	34898	39	0.137	0.194	0.965	1.365	6.695	6.937	3	3
3/12/2019 6:58:07 AM	34898	41	0.140	0.198	0.950	1.343	5.878	6.187	3	3
3/11/2019 10:58:08 PM	34898	38	0.143	0.202	0.945	1.336	4.902	5.187	3	3
3/11/2019 2:58:09 PM	34898	37	0.138	0.195	0.925	1.308	4.683	5.062	3	3
3/10/2019 10:58:11 PM *	34898	33	0.123	0.174	0.965	1.365	5.368	5.562	3	3
3/10/2019 2:58:13 PM	34898	46	0.124	0.175	0.965	1.365	5.187	5.375	3	3
3/10/2019 6:58:13 AM	34898	45	0.127	0.180	0.950	1.343	4.869	5.125	3	3
3/9/2019 9:58:14 PM	34898	41	0.146	0.206	0.915	1.294	4.861	5.312	3	3
3/9/2019 5:58:16 AM *	34898	41	0.143	0.202	0.920	1.301	4.485	4.875	3	3
3/8/2019 9:58:17 PM	34898	39	0.146	0.206	0.895	1.266	4.475	5.000	3	3
3/8/2019 1:58:18 PM	34898	44	0.140	0.198	0.880	1.244	4.565	5.187	3	3
3/8/2019 5:58:19 AM	34898	44	0.142	0.201	0.870	1.230	4.459	5.125	3	3
3/7/2019 9:58:20 PM	34898	32	0.140	0.198	0.865	1.223	4.433	5.125	3	3
3/7/2019 1:58:21 PM	34898	43	0.138	0.195	0.860	1.216	4.354	5.062	3	3
3/7/2019 5:58:22 AM	34898	39	0.139	0.197	0.860	1.216	4.407	5.125	3	3
3/6/2019 9:58:23 PM	34898	35	0.133	0.188	0.875	1.237	4.539	5.187	3	3
3/6/2019 1:58:24 PM	34898	42	0.124	0.175	0.915	1.294	4.861	5.312	3	3
3/6/2019 5:58:25 AM	34898	42	0.134	0.190	0.850	1.202	4.303	5.062	3	3
3/5/2019 9:58:26 PM	34898	44	0.132	0.187	0.860	1.216	4.569	5.312	3	3
3/5/2019 1:58:27 PM	34898	48	0.136	0.192	0.860	1.216	4.407	5.125	3	3
3/5/2019 5:58:28 AM	34898	45	0.136	0.192	0.855	1.209	4.435	5.187	3	3
3/4/2019 9:58:28 PM	34898	44	0.132	0.187	0.855	1.209	4.222	4.937	3	3
3/4/2019 1:58:30 PM	34898	44	0.135	0.191	0.910	1.287	4.607	5.062	3	3
3/4/2019 5:58:31 AM	34898	42	0.140	0.198	0.855	1.209	4.275	5.000	3	3
3/3/2019 9:58:33 PM	34898	42	0.127	0.180	0.865	1.223	4.758	5.500	3	3

Figure 104 – Echo® Historical Sensor Data Screen

4.2.14.5.1 Maintaining Transmission Records

Transmission data can be marked for saving or deleted from the database from this screen. To access this screen click the menu bar, shown in Figure 105 and select 'Maintenance' which will bring up the screen shown in Figure 106 below.

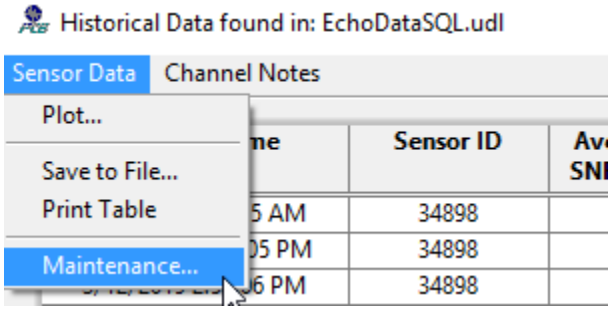


Figure 105 – Echo® Historical Sensor Data Screen Menu bar

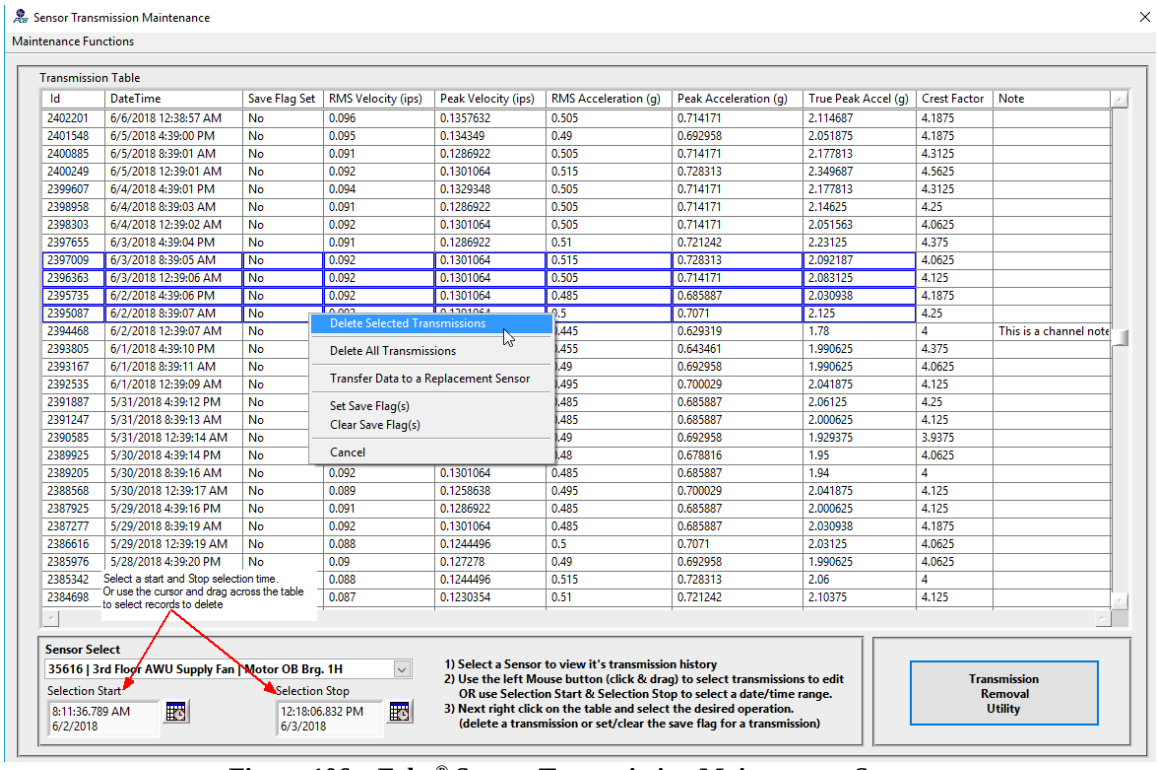


Figure 106 – Echo® Sensor Transmission Maintenance Screen

To delete transmissions drag the mouse across the table to select the records to be deleted. The selected records will highlight in blue as shown above. Next right click on the table and select the operation to perform. The **Delete Selected Transmissions** option will only delete the highlighted records. Selecting **Delete All Transmissions** will delete all of the records for the selected sensor. Selection of either option will cause a verification dialog to appear before the action is taken.

From this screen the data from any sensor assigned to the receiver can be deleted by selecting the desired sensor from the **Sensor Select** control. Additionally, specific time periods can be selected within the displayed data by editing the **Selection Start** and **Selection Stop** controls. Alternatively large data sets of transmissions, from multiple sensors, can be removed from the database by activating the **Transmission Removal Utility**. See section 0.

Set Save Flag is a feature to ensure a specific transmission is not deleted even if it is in the selection of records to delete. Additionally this will protect a transmission from deletion if it would ordinarily be deleted by the function that deletes older records if the 'Max Transmissions to Store' value in the sensor setup table is not set to 'All' transmissions (0). When set the value in the 'Save Flag Set' will be 'Yes', if not set the value will be 'No'. To clear the Save flag select the **Clear Save Flag** option.

4.2.14.5.2 Transmission Removal Utility

The transmission removal utility allows a user to delete a large number of transmissions for one or many channels by setting a few parameters and clicking the Delete Sensor Data button.

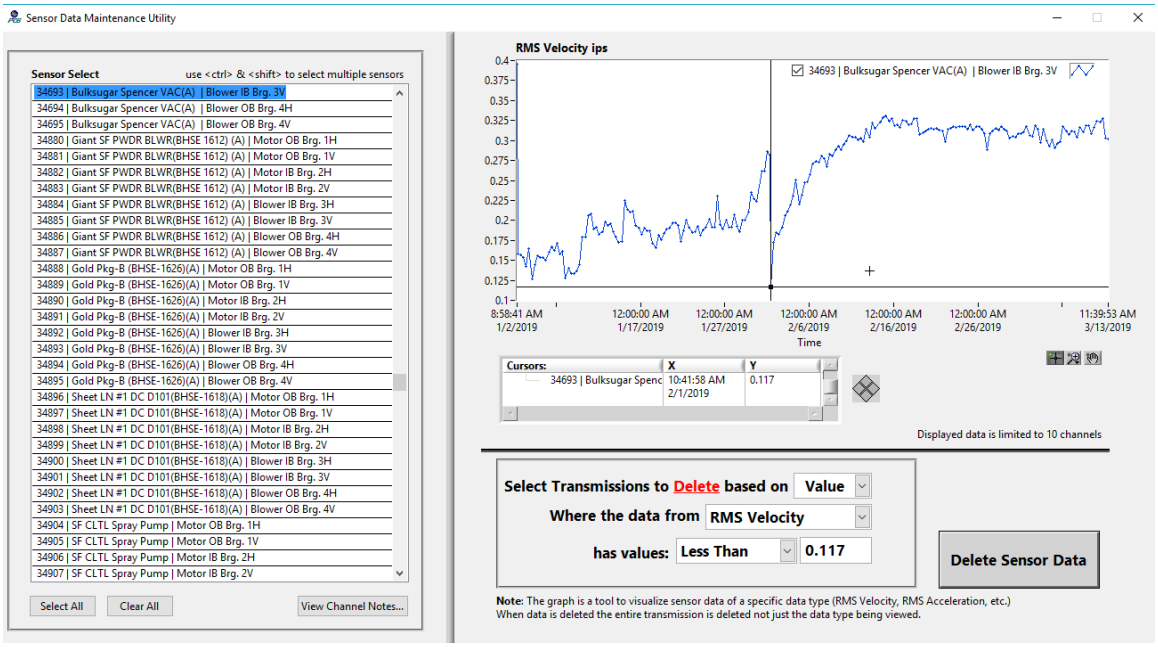


Figure 107 – Echo® Transmission Removal Utility Screen

To use this feature select as many sensors from the **Sensor Select** control on the left of the screen as necessary. Selection of sensors will display data, for the selected data type, in the graph on the right. Up to 10 channels can be viewed in the graph.
Next, select deletion by Value or Time from the Value/Time control. If Value is selected then select Less Than or Greater Than as the criteria and a value to complete the instruction. If Time is selected then start and stop time controls will appear in place of the value controls so a time period, or, all data, can be selected. When all parameters are set click the Delete Sensor Data button to complete the task.
Activating the **View Channel Notes** brings up the Channel Notes Viewer display (Figure 63)

***Note**: The Data Type control is only used to display data in the graph for use as a visual aid. When a transmission is deleted from the database the entire transmission (velocity, acceleration, crest factor etc.) is deleted.*

4.2.14.5.3 Saving Transmission Records to a File

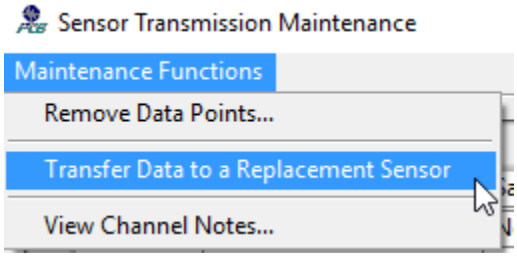
Selecting the **Save to File** option from the **Historical Data** screen menu bar will cause the data shown for the selected sensor to be saved to a comma delimited spreadsheet file. The data can then be viewed outside this application.

4.2.14.5.4 Print Transmission Records

Selecting the **Print Table** option from the **Historical Data** screen menu bar will cause the data shown for the selected sensor to be printed on the default printer.

4.2.14.5.5 Transfer Transmission Records to a Replacement Sensor

A sensors transmission records can be transferred to another sensor by rt-clicking on the table and selecting the Transfer Data to a Replacement Sensor option or by selecting the menu option shown below. This may be necessary if a sensor is replaced for some reason and you want to keep the monitored points history.



Selecting the Transfer Data to a Replacement Sensor option will display the screen shown in Figure 108. In this screen select the Sensor to transfer the data to and, if all transmissions are to be transferred, also check the Transfer All Transmissions box. If this box is not checked then only the transmissions selected in the previous screen will be transferred.

NOTE: *The sensor the transmissions are being transferred to MUST already exist in the database. Additionally the transmissions will no longer exist for the original sensor*.

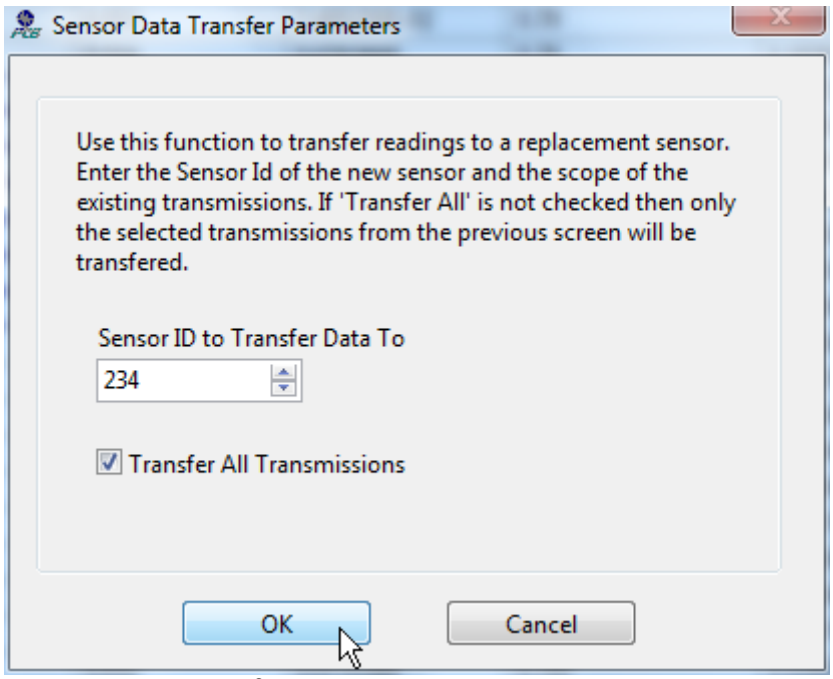


Figure 108 – Echo® Transfer data to a replacement sensor Screen

4.2.14.5.6 Trend Plot Display Screen

Activation of the Trend Plot button from the history screen will bring up the display shown in Figure 109 below. This action will also occur if the **Plot…** option from the **Historical Data** screen menu bar is selected or the **Advanced Plot…** item is selected from the main screen Channel List short cut options.

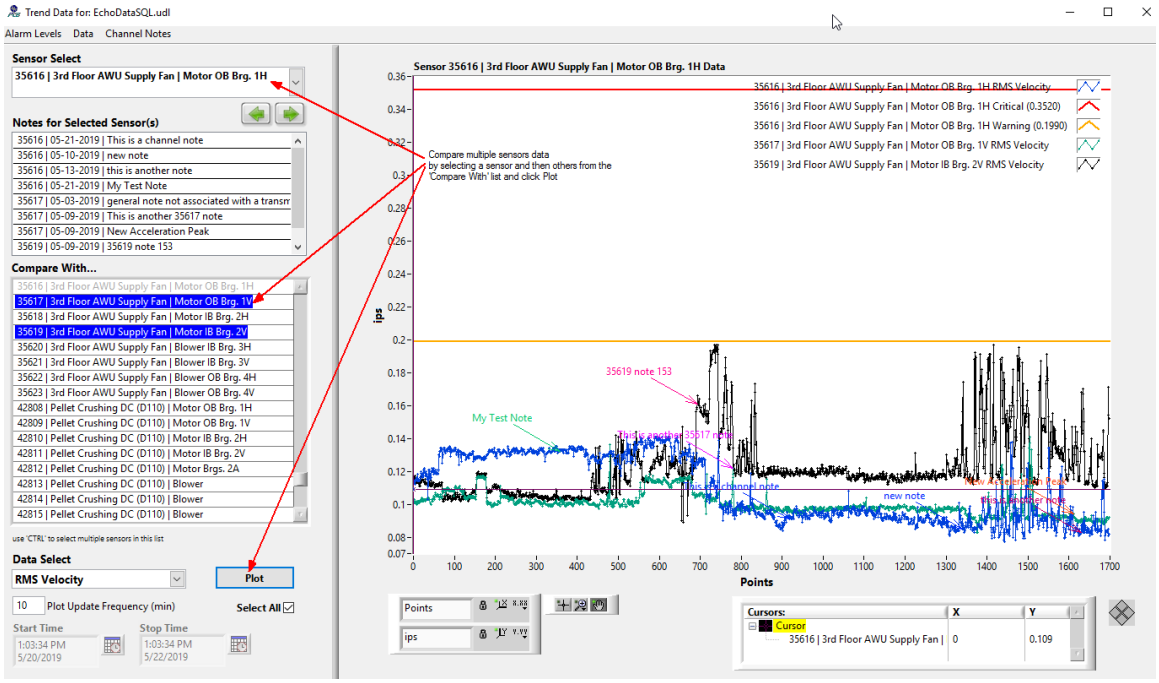


Figure 109 – Echo® Sensor Data Trend Screen

The data trend screen provides a graphical representation of the selected data type over a selectable period of time. Additionally other sensors data, of the same type, can be compared in the same screen. The following paragraphs explain the data selection controls at the bottom right of the display.

- **Sensor Select** – This selects the primary sensor for which data will be displayed. This sensors alarm limits for the selected data type will also be displayed on the graph. When this value changes the new data for the specified data type and time period will automatically display
- **Left & Right Arrow Buttons** – These provide a quick method to scroll through the data. They move the Sensor Select to the next or previous sensor and plot its data automatically.
- **Notes for Selected Sensor(s)** – any notes created for the selected sensors will be displayed in this list. The notes are also displayed on the graph if the note display is not disabled.
- **Compare With** – This control allows you to select other sensors to display with the main sensor selection. Multiple sensors can be selected from it by holding the <ctrl> key while you click on sensor entries. Once selected click on the Plot button to update the graph. To unselect an entry by just clicking on it again. An

easy way to unselect all entries is to select the disabled (dimmed) entry which represents the main sensor selection.

- **Data Select** – this control specifies what data value from each transmission will be displayed. When this value changes the new data for the specified sensor and time period will automatically display.
- **Plot Update Frequency** – this control determines how often, in minutes, the displayed data will be refreshed from the database.
- **Start & Stop Time** – These controls allow the selection of a subset of data for a specific period of time to be displayed. After selecting a new time period, activate the Plot button to update the graph (see Figure 110). When the screen is entered this control will be set to the last 2 days of data.
- **Select all** – Clicking this check box causes the Start & Stop Time controls to be ignored and all data for the sensor is displayed.
- **Plot Button** – Activate this to update the graph to reflect recent selection changes.

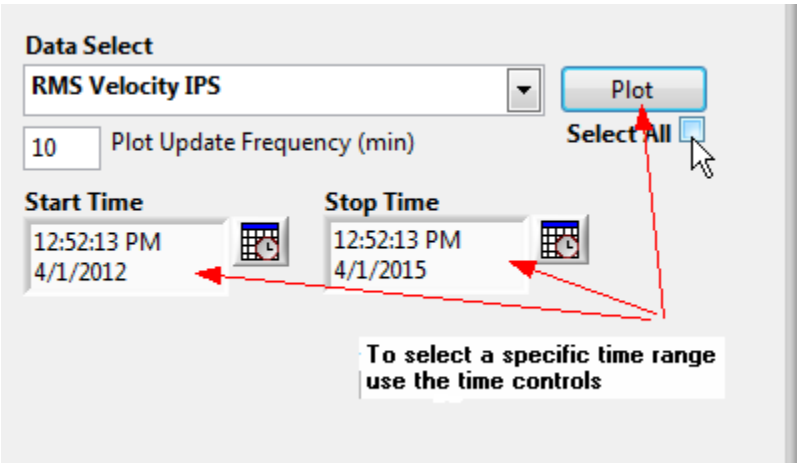
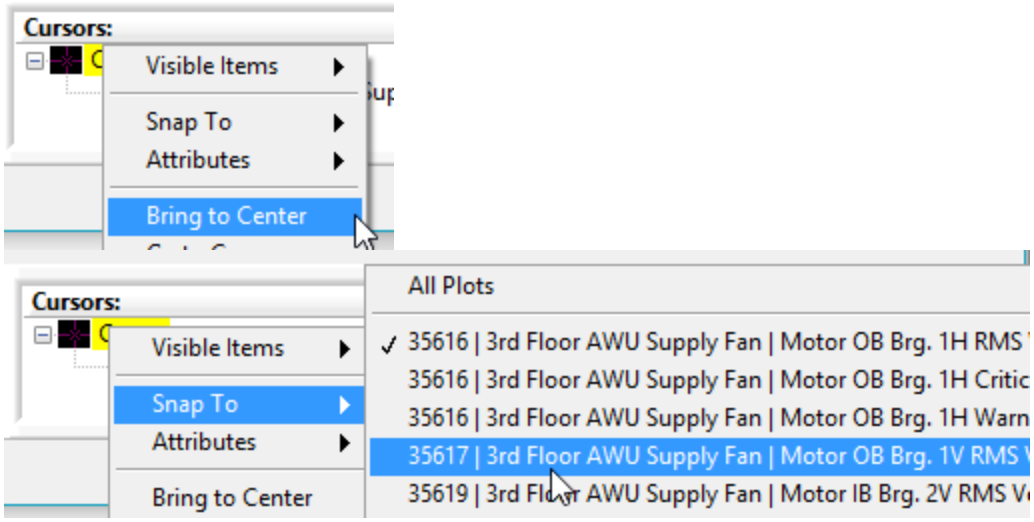


Figure 110 – Echo® Sensor Data Trend Screen Data Selection Fields

This screen also features graph controls that are useful for zooming in on the displayed data and moving a cursor around to identify the data values of specific points on the graph. Figure 111 below shows the location of these controls on the screen. To control the cursor click on the Cursor select tool and then place the mouse pointer over the cursor on the screen and click and drag the cursor to the desired position. The data values are displayed in the cursor indicator on the bottom left of the screen. Additional controls are available by right clicking on the cursor item itself, shown in yellow below. Use it to center the cursor or to select the sensor data it should be associated with (snap to).



These tools are especially useful when assigning a note to the data.

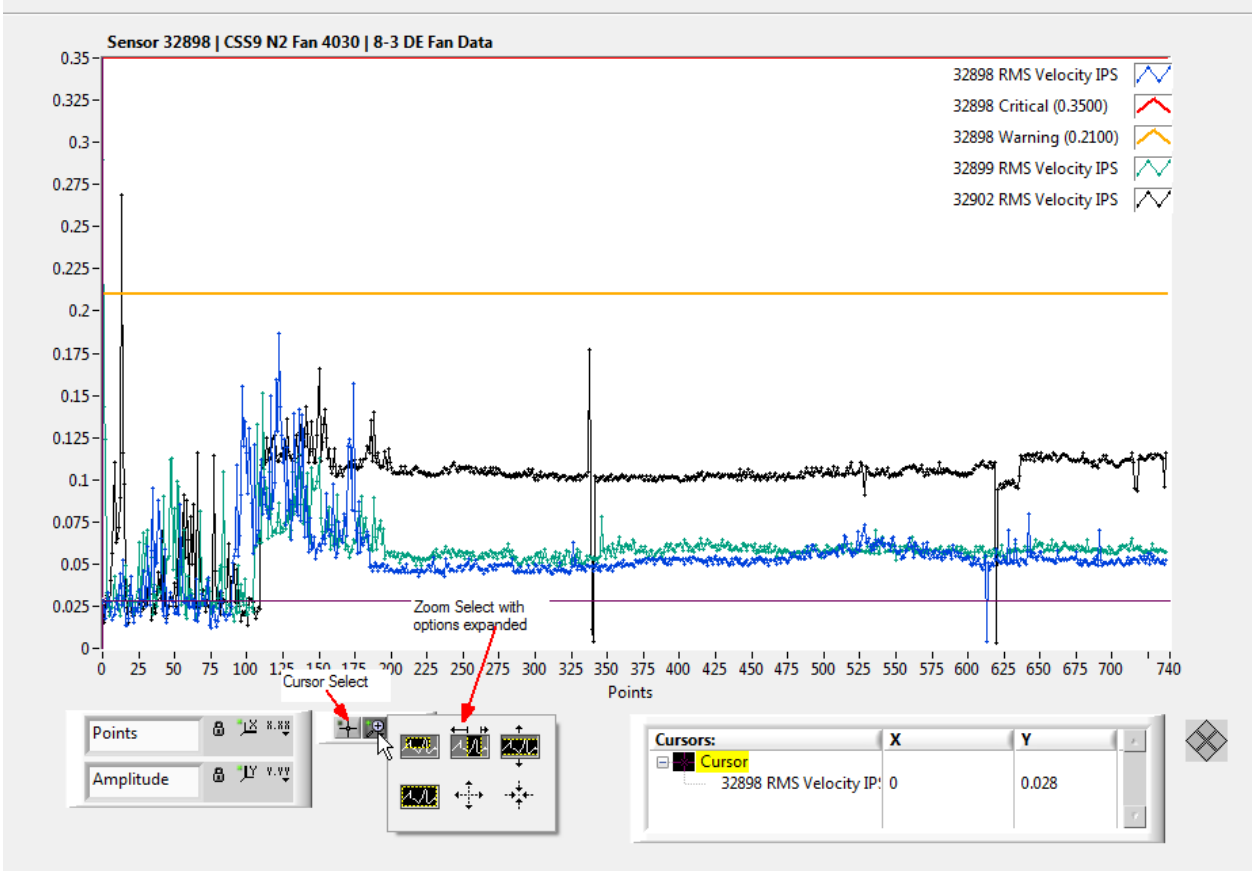


Figure 111 – Echo® Sensor Data Trend Screen Graph Tools

Also shown in Figure 111 is the zoom tool. Clicking on it will display the sub menu shown that allows you to select the type of zoom desired. Clicking on the 'x' or 'y' icons below the tools will restore the graph to its original scale.

To assign a channel note to the data use the cursor and zoom tools described above to position the cursor on the data point that is to be annotated. Next, right click on the graph and select the Create Note option. This will start the note creation process described in section 4.2.9.

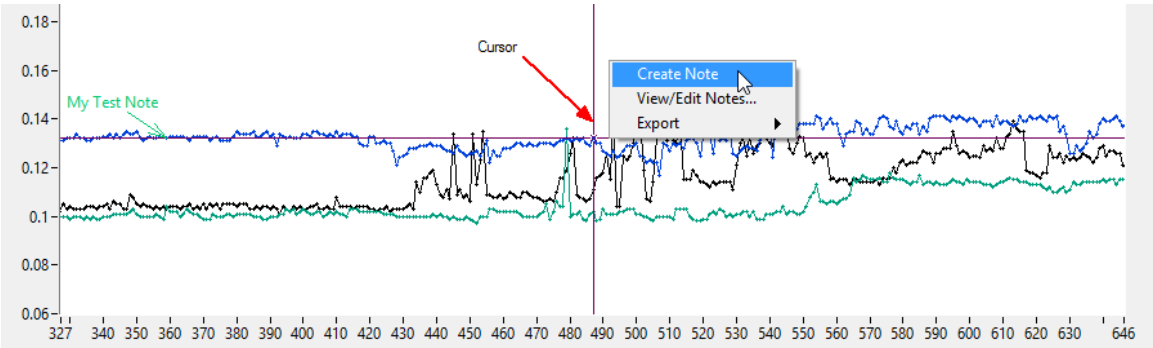


Figure 112 – Echo® Sensor Data Trend Screen Create Note process

Additional graph menu items provide a short cut to the Channel Note viewer and several data Export functions for transferring data in image or spreadsheet file formats.

The menu bar on the Trend Data screen, shown in Figure 113, provides access to the Alarm Level screen shown in Figure 114 that allows you to change the alarm levels easily for the displayed sensor and data type and the Data Deletion utility screen shown in Figure 116. The Channel Note options provide the capability to;

- Clear the displayed notes
- Disable displaying the channel notes
- View/Edit the Channel Notes (Figure 63)

Activating the Print option provides a printout of the graph as it is shown on the screen.

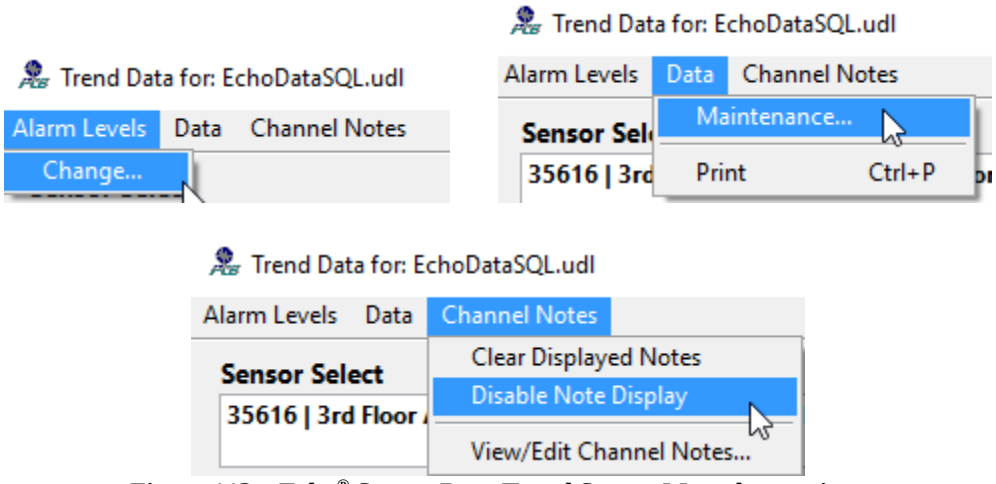


Figure 113 – Echo® Sensor Data Trend Screen Menu bar options

4.2.14.5.7 Change Alarm Levels Screen

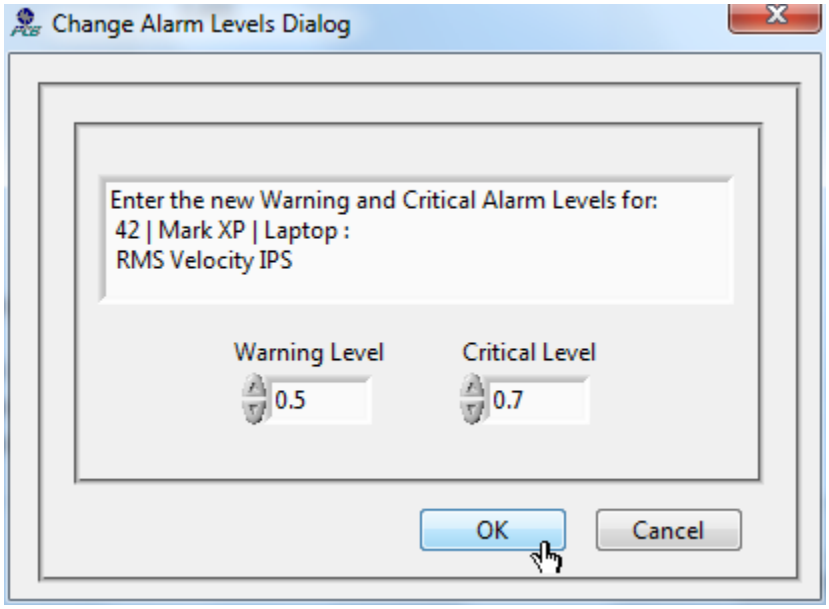


Figure 114 – Echo® Change Alarm Level Dialog Screen

The sensor whose alarm is being changed and the data type that the alarm applies to is shown in the text entry at the top of the screen. The two numeric controls will initially show the current critical and warning alarm values. These can be changed to different values if necessary. Clicking the OK button will save them in the database and cause the verification dialog shown in Figure 115 to be displayed. The Cancel button exits the window with no change.

Figure 115 – Echo® Change Alarm Confirmation

4.2.14.5.8 Echo® Data Deletion Utility Screen

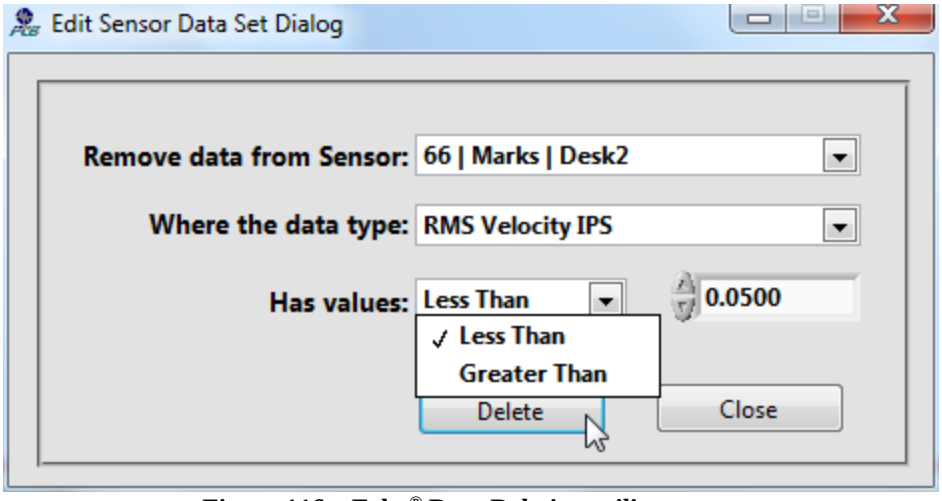


Figure 116 – Echo® Data Deletion utility screen

This utility provides a way to remove unwanted data from the database that is either greater than or less than a specified threshold. To use this function; select the sensor of interest and the data type that the threshold will refer to. Next set the less than or greater than operation and the threshold value and click the **Delete** button.

Note: the delete action will remove the entire transmission record from the database so the other data type values for this sensor transmission will be deleted as well.

After this action is taken the data on the calling screen will be redisplayed to reflect the change in data.

The **Close** button or top right X will close the screen

4.2.14.5.9 Sensor Status Screen

Activation of the Sensor Status button on the main screen brings up the screen shown below in Figure 117 and Figure 118. This screen shows an at-a-glance view of the battery status, RF/Power status and whether the sensor is reporting data on schedule. Above the status table is a message indicator to warn of any battery issues that exist for sensors assigned to the specified receiver. The messages reflect the designations for battery status described below.

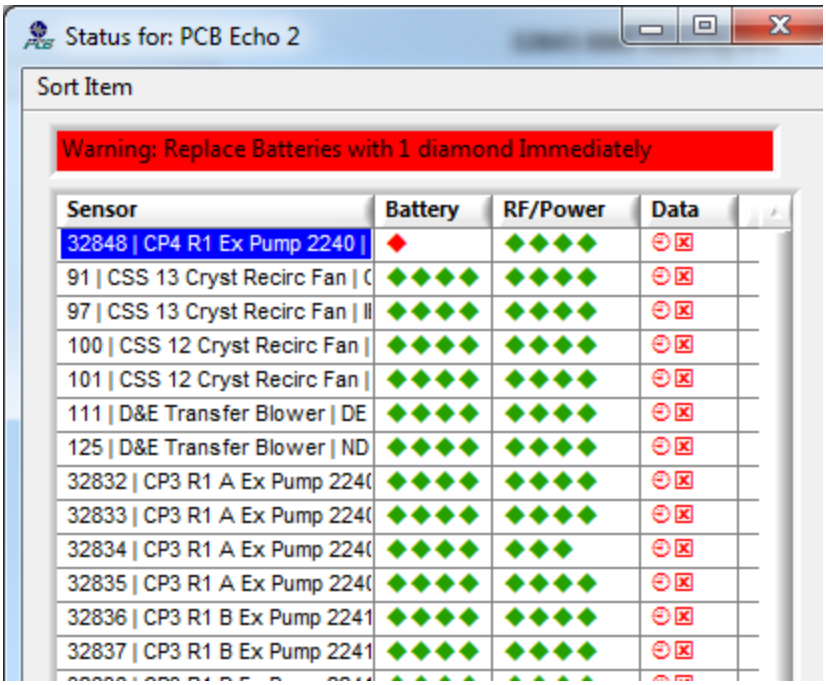


Figure 117 – Echo® Sensor Status Screen - Replace Battery

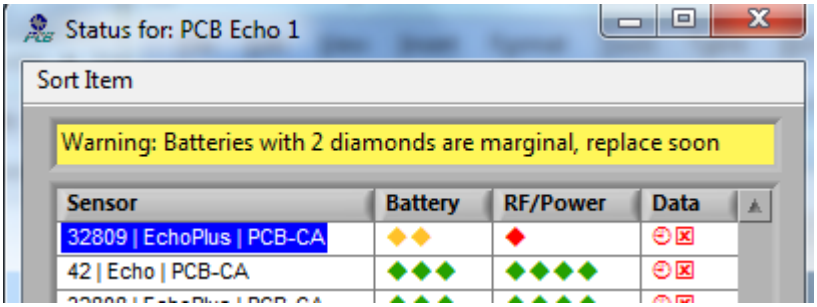


Figure 118 – Echo® Sensor Status Screen - Replace Battery Soon

Battery Status

- 1 red diamond means the battery is poor – replace battery immediately
- 2 yellow diamonds mean the battery is low – replace soon, battery is marginal
- 3 green diamonds mean the battery is good – however you should order a battery
- 4 green diamonds mean the battery is excellent – no action required

RF/Power Status

- 1 red diamond means average SNR was less than 15dB.
- 2 yellow diamonds mean average SNR was 15dB to 20dB.
- 3 green diamonds mean average SNR was 20dB to 25dB.
- 4 green diamonds mean average SNR was over 25dB.
- 4 orange diamonds mean average transmission power was over -65dBm. This supersedes the SNR-based definitions.

Data Transmission Frequency

The icons in this field are either;

- Green - the sensor transmissions are being received on schedule.
- Red – a transmission has not been received for the number of transmissions specified in the 'missed transmission count' field of the database entry for the sensor.

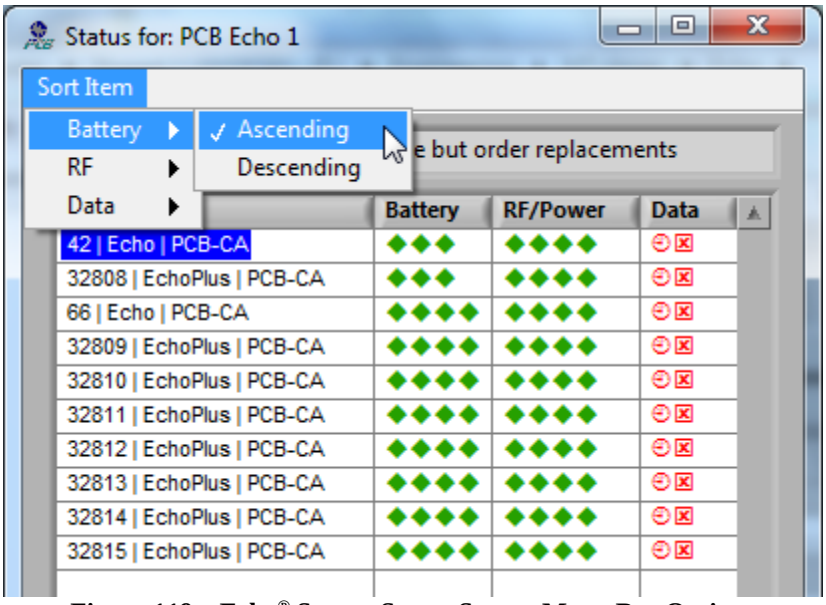


Figure 119 – Echo® Sensor Status Screen Menu Bar Options

The sensor status screen can be set up to display the data for any item in ascending or descending order to highlight which sensors are fine and which may be experiencing a problem (Figure 119). To set this up click on the **Sort Item** entry on the menu bar then the data type and whether to display it in ascending or descending order.

4.2.15 System Level Alarm & Status Screens

Selecting **System View | Alarms…** or **System View | Sensor Status…** from the main screen menu bar will bring up screens described below. These system level screens display entries for all receivers contained in a single Echo® database.

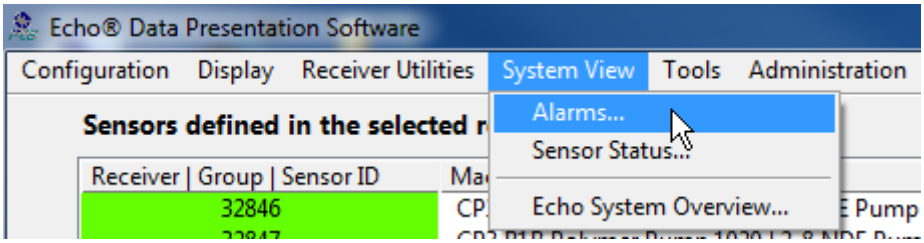


Figure 120 – Echo® System View Options

If multiple databases are in use the operator will be prompted to select which database to use for the system view.

4.2.15.1 System Alarm Screen

This screen shows the current sensor alarm status for the selected database and refreshes at the rate configured in the Preferences screen. The summary tab display shows a color coded status of all sensors assigned to the indicated receiver. The coding is as follows;

- Red – A **CRITICAL** level alarm has been triggered.
- Yellow – A **WARNING** level alarm has been triggered.
- Green – **NO Alarm** has been triggered.
- Grey – **No transmissions** have been received for this sensor.
- White – This sensor is disabled from alarm processing.

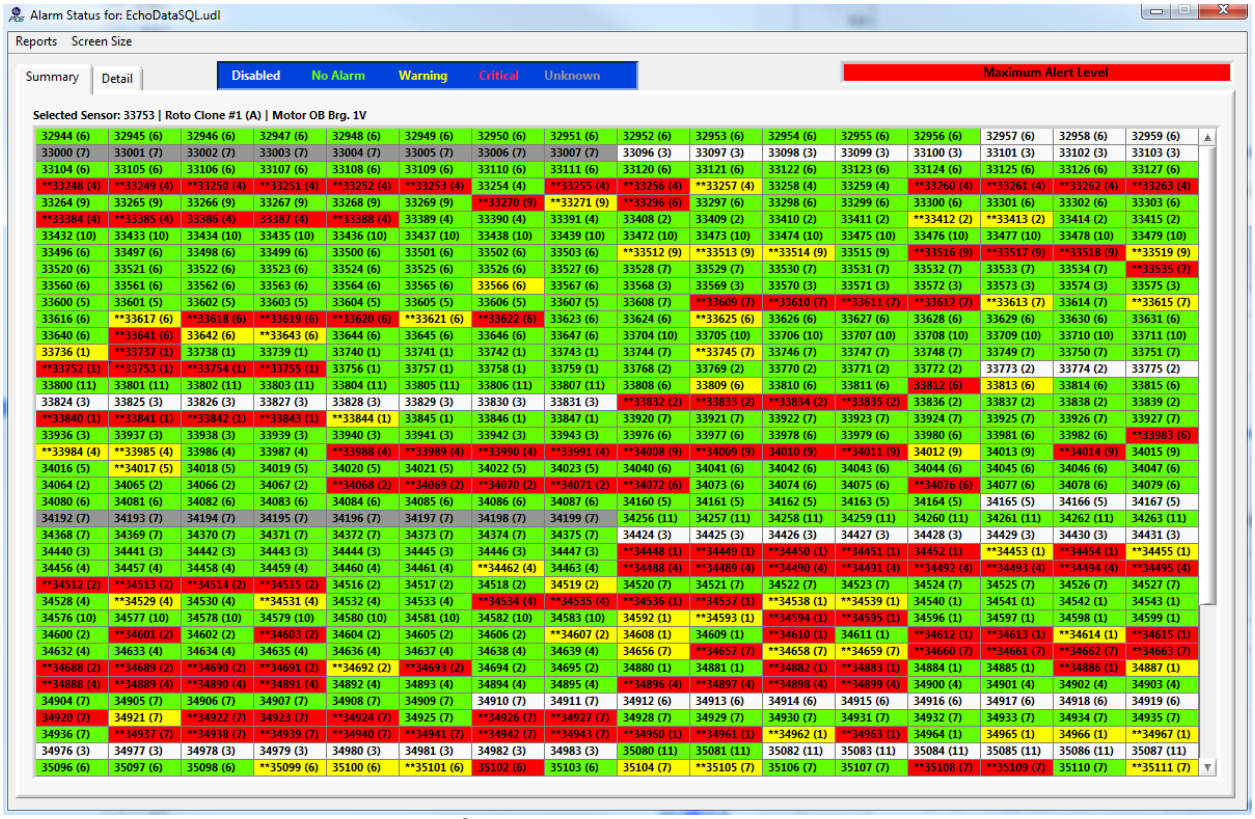


Figure 121 – Echo® Alarm Status Screen – Summary Tab

Each cell in the summary table represents a single sensor. Clicking on a cell selects the indicated sensor for the options presented when the right mouse button is clicked (shown below). It will also turn the sensor's cell color to blue giving a clear indication of which sensor is selected. Additionally, the sensors other identifying information (machine & location) will show at the top of the table, the tip strip and in the Context Help window (ctrl-h) also shown below.

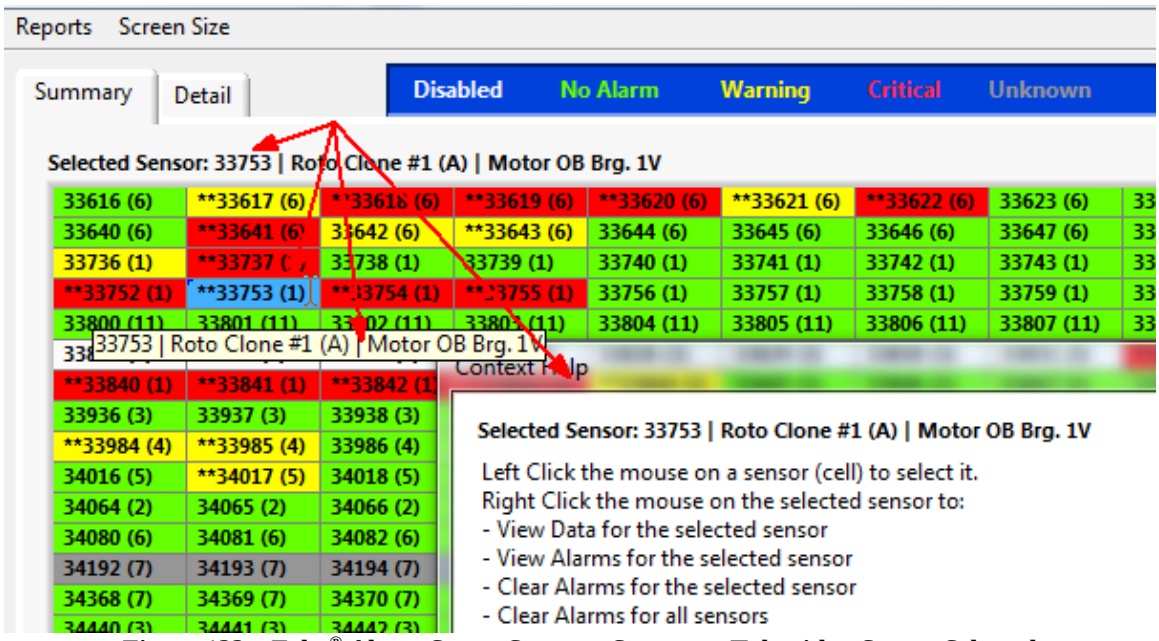


Figure 122 – Echo® Alarm Status Screen – Summary Tab with a Sensor Selected

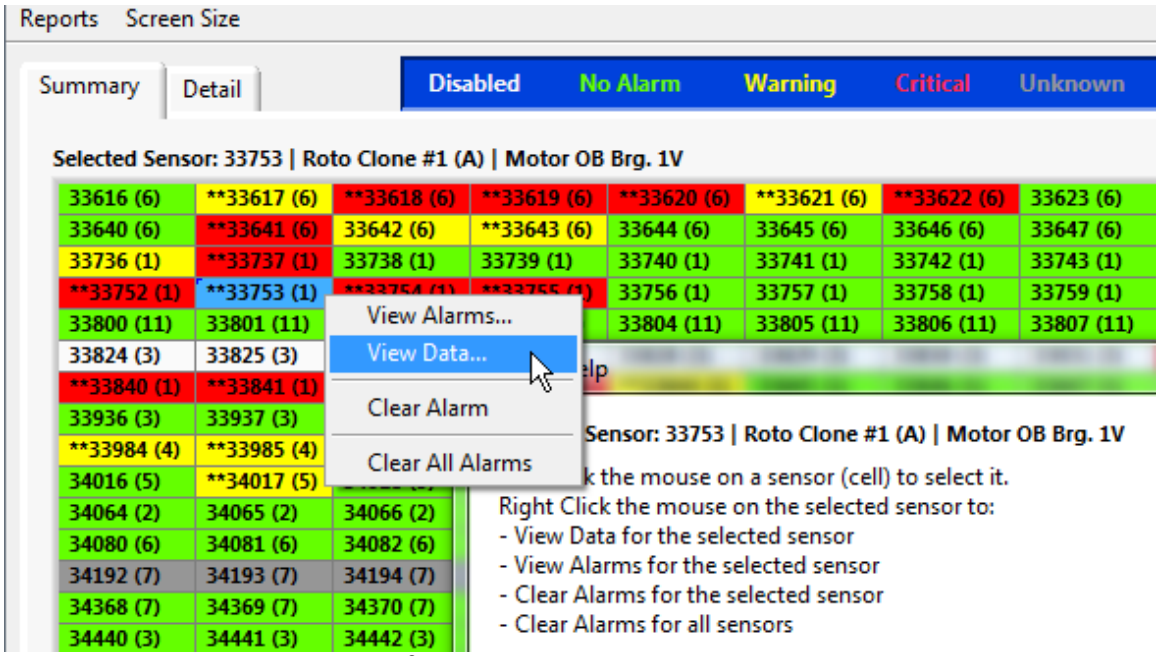


Figure 123 – Echo® Alarm Status Screen – Selected Sensor Options

- **View Alarms**… brings up the screen (Figure 125)
- **View Data**… brings up the Trend Data screen (Figure 109)
- **Clear Alarm** will reset the selected sensors alarm
- **Clear All Alarms** clears all alarms

At the top of the Echo® Alarm Status screen below is a Maximum Alert Level indicator. This will be the background color of the highest alert level currently being reported by a sensor assigned to the receiver. This indication is important in the event there are a large number of sensors in the system and they cannot all be viewed at once on the screen. If all cells in the display were green but this indication was red then it would alert the user to scroll through the table to find the sensor with the critical alarm. To maximize the Alarm screen select **Screen Size | Maximize** on the menu bar.

The Echo® Alarm Status screen also has a Detail tab shown below in Figure 124. This table provides detailed information about the sensor and the alarm. The columns it shows are as follows;

- Column 1 – Sensor Id
- Column 2 – The machine name and location where the sensor is located
- Column 3 – Alarm Level, this shows the highest alarm level and an indication (**) if there is more than 1 alert present for the sensor.
- Column 4 – Alarm time
- Columns 5 – 7 are sensor status fields for battery, RF and reporting frequency.

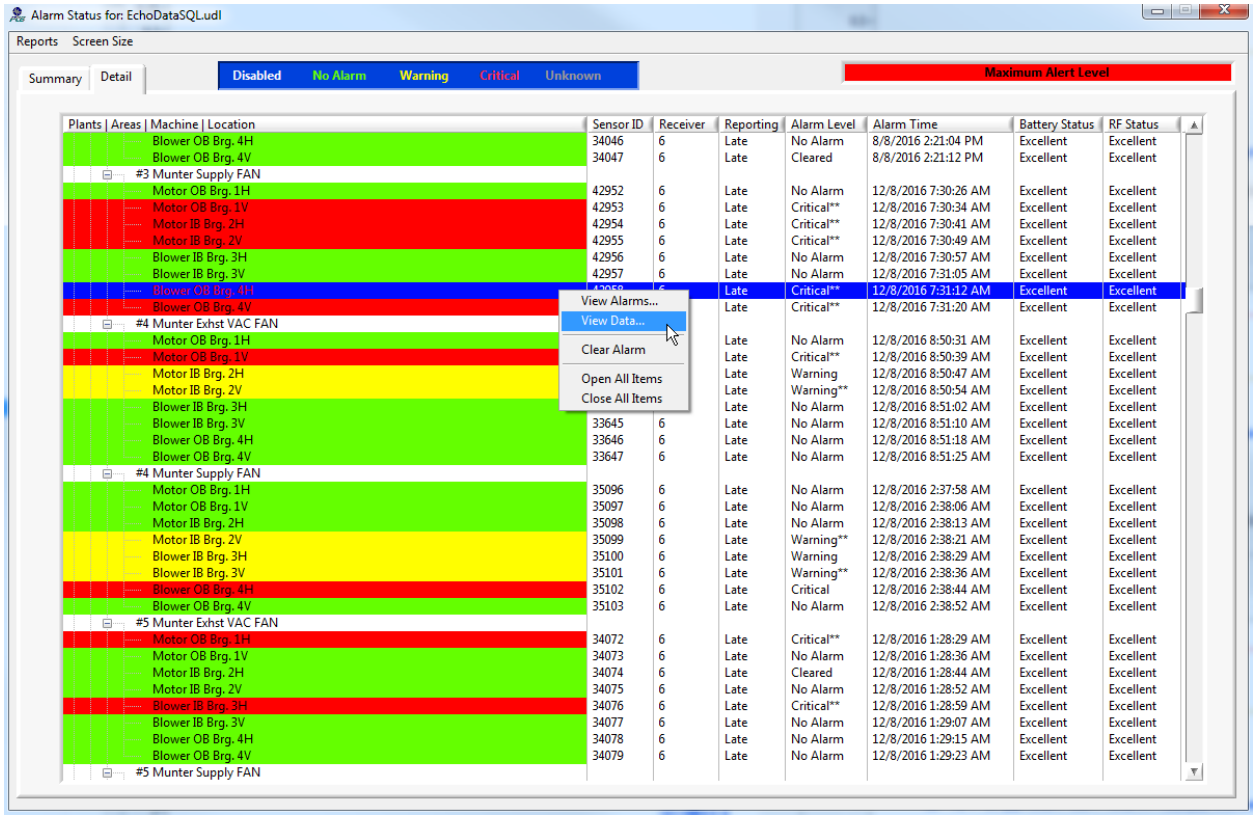


Figure 124 – Echo® Alarm Status Screen – Detail Tab

Right clicking the mouse on a sensor row in Figure 124 will bring up the short-cut menu.

- **View Alarms**… brings up the screen (Figure 125)
- **View Data**… brings up the Trend Data screen (Figure 109)
- **Clear Alarm** will reset the selected sensors alarm and show the alarm level in column 3 as 'cleared'

4.2.15.1.1 Channel Alarm Dialog Screen

The Channel Alarm Dialog screen is accessed from several locations including right-clicking on the System Alarm Status Screen (either tab) or by right-clicking the main screen sensor tree and selecting View Alarms… It provides detailed information regarding the alarms being reported for a sensor. It indicates;

- What data reading(s) triggered the alarm
- The current alarm level set for the data type
- The actual reading that triggered it
- The time it occurred

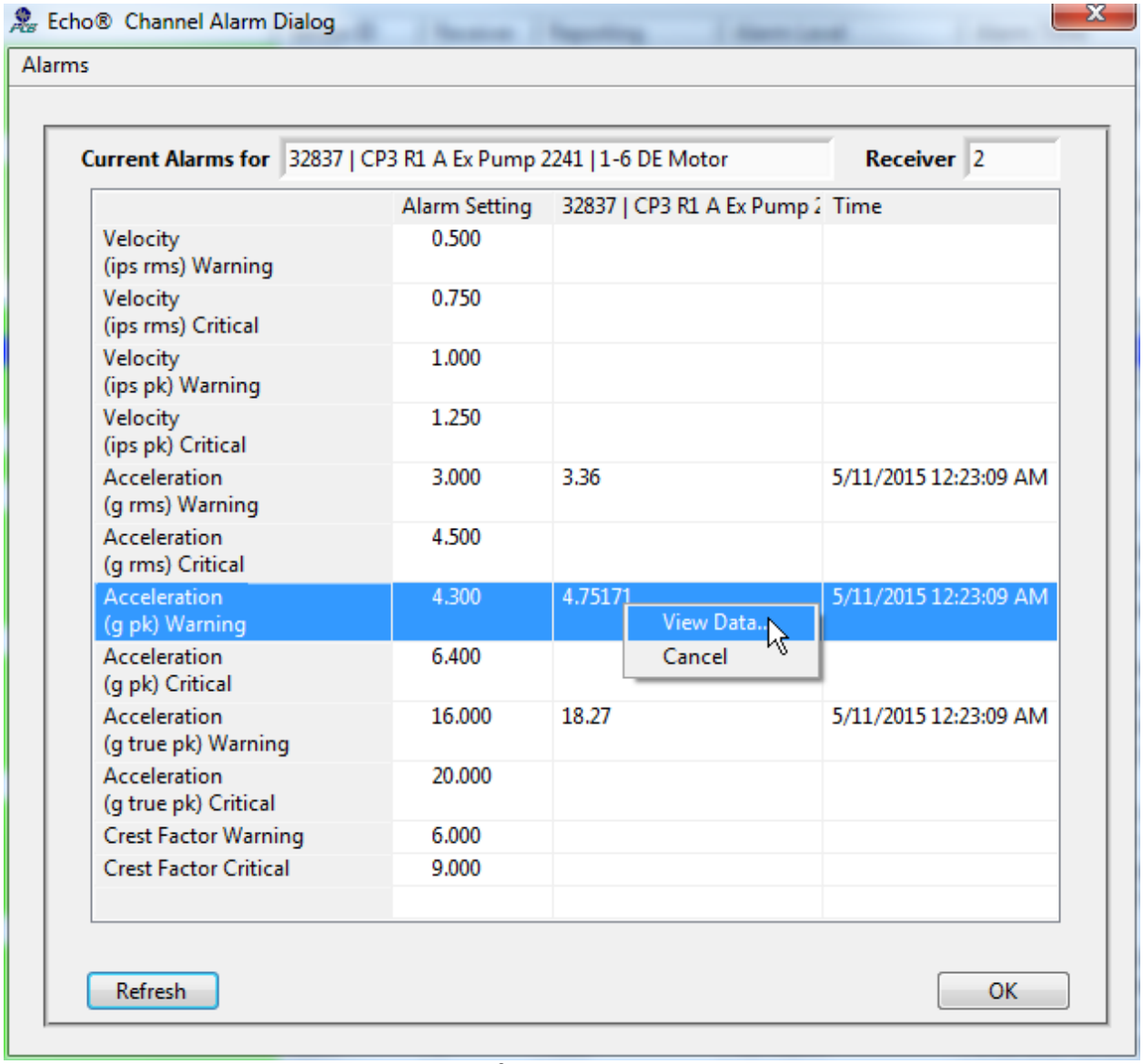


Figure 125 – Echo® Channel Alarm Dialog

The **Refresh** button will update the displayed data
The **OK** button will close the screen and return to the calling window.

Right Click on a selected data types alarm to close this window and view its data in greater detail.

From the menu bar (Figure 126) you can:

- **Clear** the selected alarm (click on a row in the table to select one)
- **Change Alarm Level…** This brings up the Change Alarm Level Dialog (Figure 114)
- **Print** This will print a report of the displayed alarms.

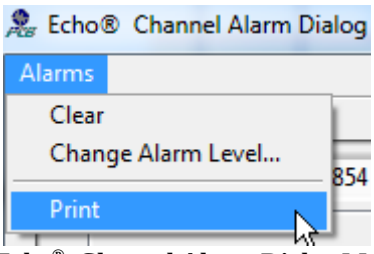


Figure 126 – Echo® Channel Alarm Dialog Menu Bar Items

4.2.15.1.2 Alarm Status Screen Reports

The Alarm Status screen menu bar has a report option (Figure 127). Clicking it reveals two report selections; **Last Measurements** and **Alarms**. Selecting Last Measurements will display a Last Measurements preview screen shown in Figure 128 where the operator can choose to print a report of the last measurement for each sensor assigned to the receiver.
Similarly, selecting the Alarm option presents an Alarm preview screen from which a report can be printed showing the alarm status of each sensor.

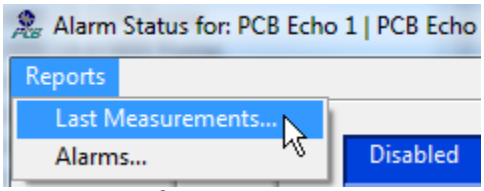
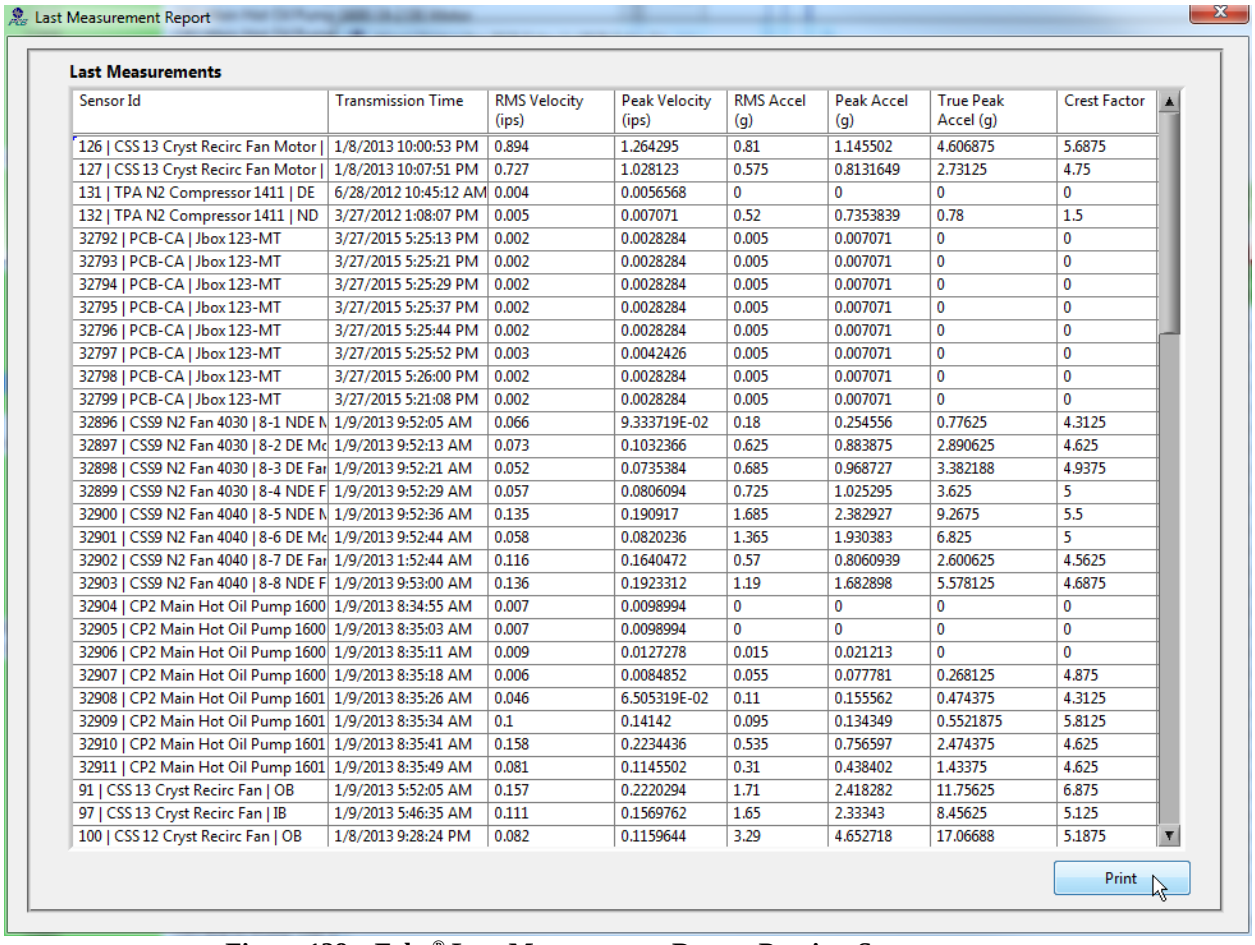


Figure 127 – Echo® Alarm Status Screen Menu Bar

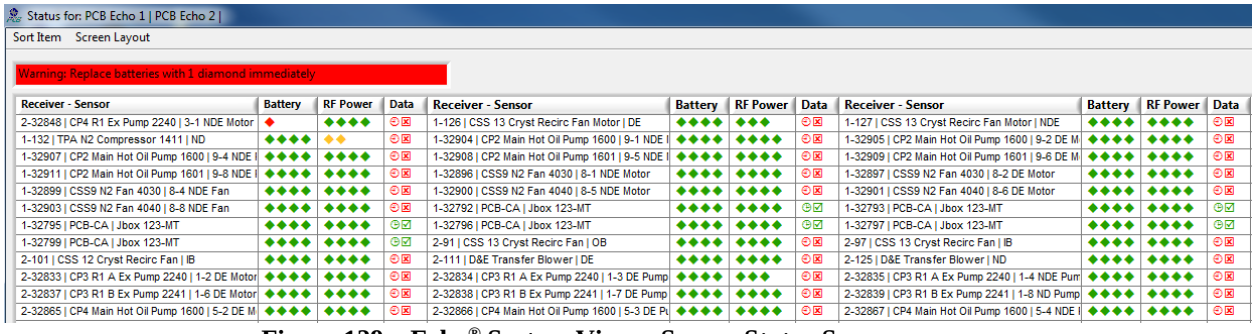


Sensor Id	Transmission Time	RMS Velocity (ips)	Peak Velocity (ips)	RMS Accel (g)	Peak Accel (g)	True Peak Accel (g)	Crest Factor
126 | CSS 13 Cryst Recirc Fan Motor |	1/8/2013 10:00:53 PM	0.894	1.264295	0.81	1.145502	4.606875	5.6875
127 | CSS 13 Cryst Recirc Fan Motor |	1/8/2013 10:07:51 PM	0.727	1.028123	0.575	0.8131649	2.73125	4.75
131 | TPA N2 Compressor 1411 | DE	6/28/2012 10:45:12 AM	0.004	0.0056568	0	0	0	0
132 | TPA N2 Compressor 1411 | ND	3/27/2012 1:08:07 PM	0.005	0.007071	0.52	0.7353839	0.78	1.5
32792 | PCB-CA | Jbox 123-MT	3/27/2015 5:25:13 PM	0.002	0.0028284	0.005	0.007071	0	0
32793 | PCB-CA | Jbox 123-MT	3/27/2015 5:25:21 PM	0.002	0.0028284	0.005	0.007071	0	0
32794 | PCB-CA | Jbox 123-MT	3/27/2015 5:25:29 PM	0.002	0.0028284	0.005	0.007071	0	0
32795 | PCB-CA | Jbox 123-MT	3/27/2015 5:25:37 PM	0.002	0.0028284	0.005	0.007071	0	0
32796 | PCB-CA | Jbox 123-MT	3/27/2015 5:25:44 PM	0.002	0.0028284	0.005	0.007071	0	0
32797 | PCB-CA | Jbox 123-MT	3/27/2015 5:25:52 PM	0.003	0.0042426	0.005	0.007071	0	0
32798 | PCB-CA | Jbox 123-MT	3/27/2015 5:26:00 PM	0.002	0.0028284	0.005	0.007071	0	0
32799 | PCB-CA | Jbox 123-MT	3/27/2015 5:21:08 PM	0.002	0.0028284	0.005	0.007071	0	0
32896 | CSS9 N2 Fan 4030 | 8-1 NDE M	1/9/2013 9:52:05 AM	0.066	9.333719E-02	0.18	0.254556	0.77625	4.3125
32897 | CSS9 N2 Fan 4030 | 8-2 DE Mc	1/9/2013 9:52:13 AM	0.073	0.1032366	0.625	0.883875	2.890625	4.625
32898 | CSS9 N2 Fan 4030 | 8-3 DE Fan	1/9/2013 9:52:21 AM	0.052	0.0735384	0.685	0.968727	3.382188	4.9375
32899 | CSS9 N2 Fan 4030 | 8-4 NDE F	1/9/2013 9:52:29 AM	0.057	0.0806094	0.725	1.025295	3.625	5
32900 | CSS9 N2 Fan 4040 | 8-5 NDE M	1/9/2013 9:52:36 AM	0.135	0.190917	1.685	2.382927	9.2675	5.5
32901 | CSS9 N2 Fan 4040 | 8-6 DE Mc	1/9/2013 9:52:44 AM	0.058	0.0820236	1.365	1.930383	6.825	5
32902 | CSS9 N2 Fan 4040 | 8-7 DE Fan	1/9/2013 1:52:44 AM	0.116	0.1640472	0.57	0.8060939	2.600625	4.5625
32903 | CSS9 N2 Fan 4040 | 8-8 NDE F	1/9/2013 9:53:00 AM	0.136	0.1923312	1.19	1.682898	5.578125	4.6875
32904 | CP2 Main Hot Oil Pump 1600	1/9/2013 8:34:55 AM	0.007	0.0098994	0	0	0	0
32905 | CP2 Main Hot Oil Pump 1600	1/9/2013 8:35:03 AM	0.007	0.0098994	0	0	0	0
32906 | CP2 Main Hot Oil Pump 1600	1/9/2013 8:35:11 AM	0.009	0.0127278	0.015	0.021213	0	0
32907 | CP2 Main Hot Oil Pump 1600	1/9/2013 8:35:18 AM	0.006	0.0084852	0.055	0.077781	0.268125	4.875
32908 | CP2 Main Hot Oil Pump 1601	1/9/2013 8:35:26 AM	0.046	6.505319E-02	0.11	0.155562	0.474375	4.3125
32909 | CP2 Main Hot Oil Pump 1601	1/9/2013 8:35:34 AM	0.1	0.14142	0.095	0.134349	0.5521875	5.8125
32910 | CP2 Main Hot Oil Pump 1601	1/9/2013 8:35:41 AM	0.158	0.2234436	0.535	0.756597	2.474375	4.625
32911 | CP2 Main Hot Oil Pump 1601	1/9/2013 8:35:49 AM	0.081	0.1145502	0.31	0.438402	1.43375	4.625
91 | CSS 13 Cryst Recirc Fan | OB	1/9/2013 5:52:05 AM	0.157	0.2220294	1.71	2.418282	11.75625	6.875
97 | CSS 13 Cryst Recirc Fan | IB	1/9/2013 5:46:35 AM	0.111	0.1569762	1.65	2.33343	8.45625	5.125
100 | CSS 12 Cryst Recirc Fan | OB	1/8/2013 9:28:24 PM	0.082	0.1159644	3.29	4.652718	17.06688	5.1875

Figure 128 – Echo® Last Measurement Report Preview Screen

4.2.15.2 System Sensor Status Screen

A system level view of sensor status can be found by selecting System View | Sensor Status from the main screen menu bar. This screen is identical to the receiver sensor status screen in content but it shows all sensors assigned all receivers for the selected database. Additionally the data can be arranged vertically in a single column like the single receiver screen or horizontally as shown below in a 3 column view. The screen layout menu bar option facilitates this selection.



Receiver - Sensor	Battery	RF Power	Data	Receiver - Sensor	Battery	RF Power	Data	Receiver - Sensor	Battery	RF Power	Data
2-32848 | CP4 R1 Ex Pump 2240 | 3-1 NDE Motor	◆	◆◆◆◆		1-126 | CSS 13 Cryst Recirc Fan Motor | DE	◆◆◆◆	◆◆◆		1-127 | CSS 13 Cryst Recirc Fan Motor | NDE	◆◆◆◆	◆◆◆◆	
1-132 | TPA N2 Compressor 1411 | ND	◆◆◆◆	◆◆		1-32904 | CP2 Main Hot Oil Pump 1600 | 9-1 NDE I	◆◆◆◆	◆◆◆◆		1-32905 | CP2 Main Hot Oil Pump 1600 | 9-2 DE M	◆◆◆◆	◆◆◆◆	
1-32907 | CP2 Main Hot Oil Pump 1600 | 9-4 NDE I	◆◆◆◆	◆◆◆◆		1-32908 | CP2 Main Hot Oil Pump 1601 | 9-5 NDE I	◆◆◆◆	◆◆◆◆		1-32909 | CP2 Main Hot Oil Pump 1601 | 9-6 DE M	◆◆◆◆	◆◆◆◆	
1-32911 | CP2 Main Hot Oil Pump 1601 | 9-8 NDE I	◆◆◆◆	◆◆◆◆		1-32896 | CSS9 N2 Fan 4030 | 8-1 NDE Motor	◆◆◆◆	◆◆◆◆		1-32897 | CSS9 N2 Fan 4030 | 8-2 DE Motor	◆◆◆◆	◆◆◆◆	
1-32899 | CSS9 N2 Fan 4030 | 8-4 NDE Fan	◆◆◆◆	◆◆◆◆		1-32900 | CSS9 N2 Fan 4040 | 8-5 NDE Motor	◆◆◆◆	◆◆◆◆		1-32901 | CSS9 N2 Fan 4040 | 8-6 DE Motor	◆◆◆◆	◆◆◆◆	
1-32903 | CSS9 N2 Fan 4040 | 8-8 NDE Fan	◆◆◆◆	◆◆◆◆		1-32792 | PCB-CA | Jbox 123-MT	◆◆◆◆	◆◆◆◆		1-32793 | PCB-CA | Jbox 123-MT	◆◆◆◆	◆◆◆◆	
1-32795 | PCB-CA | Jbox 123-MT	◆◆◆◆	◆◆◆◆		1-32796 | PCB-CA | Jbox 123-MT	◆◆◆◆	◆◆◆◆		1-32797 | PCB-CA | Jbox 123-MT	◆◆◆◆	◆◆◆◆	
1-32799 | PCB-CA | Jbox 123-MT	◆◆◆◆	◆◆◆◆		2-91 | CSS 13 Cryst Recirc Fan | OB	◆◆◆◆	◆◆◆◆		2-97 | CSS 13 Cryst Recirc Fan | IB	◆◆◆◆	◆◆◆◆	
2-101 | CSS 12 Cryst Recirc Fan | IB	◆◆◆◆	◆◆◆◆		2-111 | D&E Transfer Blower | DE	◆◆◆◆	◆◆◆◆		2-125 | D&E Transfer Blower | ND	◆◆◆◆	◆◆◆◆	
2-32833 | CP3 R1 A Ex Pump 2240 | 1-2 DE Motor	◆◆◆◆	◆◆◆◆		2-32834 | CP3 R1 A Ex Pump 2240 | 1-3 DE Pump	◆◆◆◆	◆◆◆		2-32835 | CP3 R1 A Ex Pump 2240 | 1-4 NDE Pum	◆◆◆◆	◆◆◆◆	
2-32837 | CP3 R1 B Ex Pump 2241 | 1-6 DE Motor	◆◆◆◆	◆◆◆◆		2-32838 | CP3 R1 B Ex Pump 2241 | 1-7 DE Pump	◆◆◆◆	◆◆◆◆		2-32839 | CP3 R1 B Ex Pump 2241 | 1-8 ND Pump	◆◆◆◆	◆◆◆◆	
2-32865 | CP4 Main Hot Oil Pump 1600 | 5-2 DE M	◆◆◆◆	◆◆◆◆		2-32866 | CP4 Main Hot Oil Pump 1600 | 5-3 DE Pu	◆◆◆◆	◆◆◆◆		2-32867 | CP4 Main Hot Oil Pump 1600 | 5-4 NDE I	◆◆◆◆	◆◆◆◆	

Figure 129 – Echo® System View – Sensor Status Screen

4.2.15.3 Echo® System Overview Screen

The Echo® System Overview screen is accessed by selecting System View | Echo System Overview… from the main screen menu bar. This screen is intended for a large display monitor placed in a common area. It has large print and icons making it viewable from a distance. Its purpose is to convey both sensor and machine status at a glance. Each text entry contains the machine name, location and sensor ID. The background color indicates if the machine is operating within established limits (green), in a warning alarm state (yellow) or in a critical alarm state (red).
In addition to the text there are icons for battery status, RF status and Reporting status to indicate whether the sensor is reporting readings on time or is late.
Figure 130 displays a partial shot of this large screen with the available sorting options expanded. The screen is formatted to show 70 measurement points on a single page. If more than 70 points are in the system then the display will page the display every 30 seconds so all points can be seen. The measurement points can be sorted by the various status items to suit the user's preference or the window can be set to cycle through all status items, one at a time, to see the system status from different perspectives. Last Measurement and Alarm reports can also be printed from this screen by selecting the Report menu bar item. The screen is refreshed with data from the database every 5 minutes. The default sort selection is 'Smart Sort'. This organizes the data in an order that lists the most severe problems first. The priority assigned to potential problems is as follows:

1 - Machine critical Alarms
2 - Machine warning alarms
3 - Transmissions Missed
4 - Battery = 0 (dead)
5 - Battery = 1 (poor)
6 - Battery = 2 (ok but consider ordering a new one)
7 - RF=0
8 - RF=1
9 - The rest

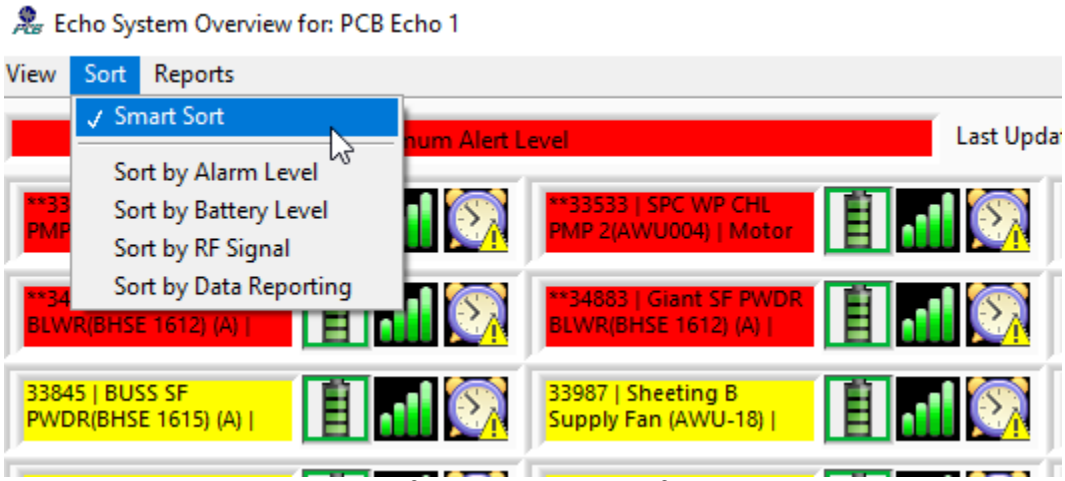


Figure 130 – Echo® System View – Echo® System Overview Screen

In the top right of the screen (Figure 131) is an indication of when the data was last refreshed from the database, how the data is sorted and the number of pages the will be displayed.

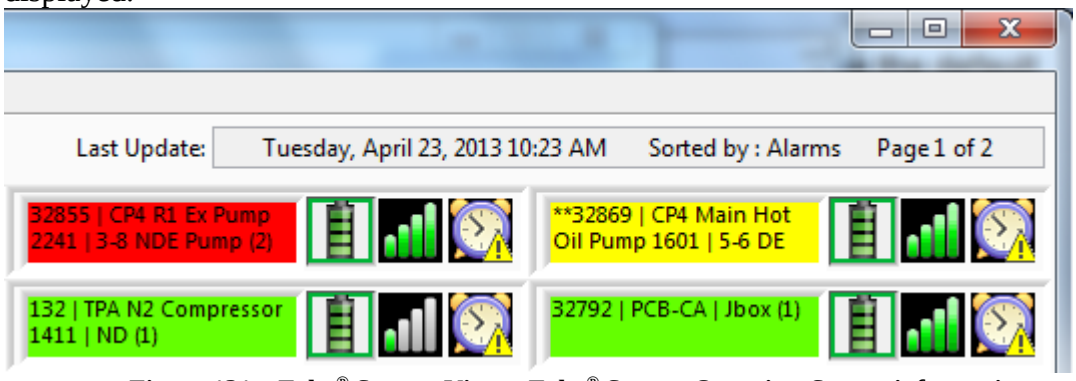
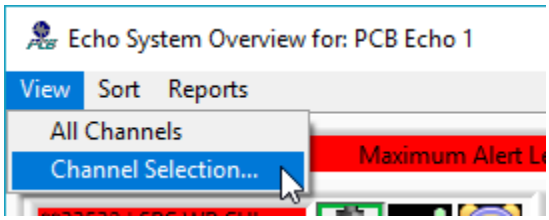


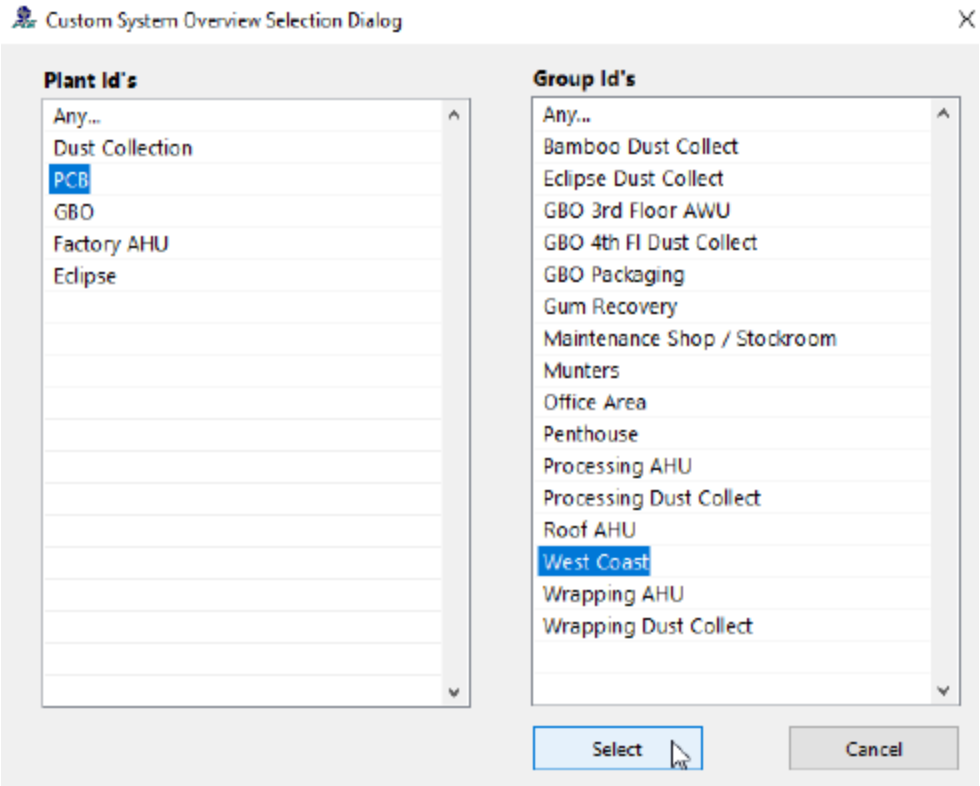
Figure 131 – Echo® System View – Echo® System Overview Screen information

4.2.15.3.1 Customizing the System Overview Channel Selection.

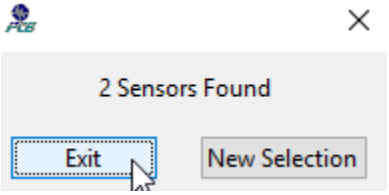
The System Overview screen can be customized to show only the channel groups of interest. Select View | Channel Selection.



This will display the following screen where channels with specific Plant and Group Ids can be selected.



A confirmation screen will appear after the **Select** button is clicked indicating wow many sensors are in the selected group(s).



Selecting **Exit** implements the new overview screen selections.

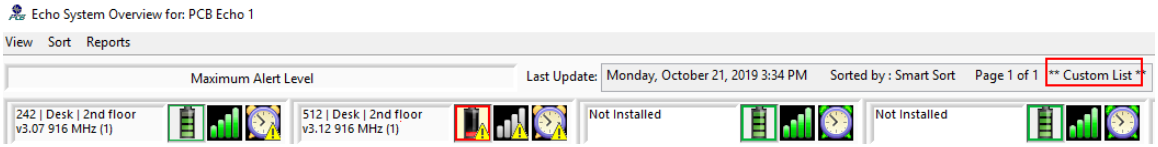


Figure 132 – Echo® System View – Echo® System Overview Custom Channel Selection

To reset the overview screen to all channels select View | All Channels.

4.2.16 Database Merge Utility

If an installation of the Echo® hardware includes the portable receiver and computer component then it will be necessary to use the database merge utility to transfer data collected with the portable unit to a main database which will likely reside on a server. To access the Merge Databases Utility select; Tools | Merge Databases Utility… from the main screen menu bar.

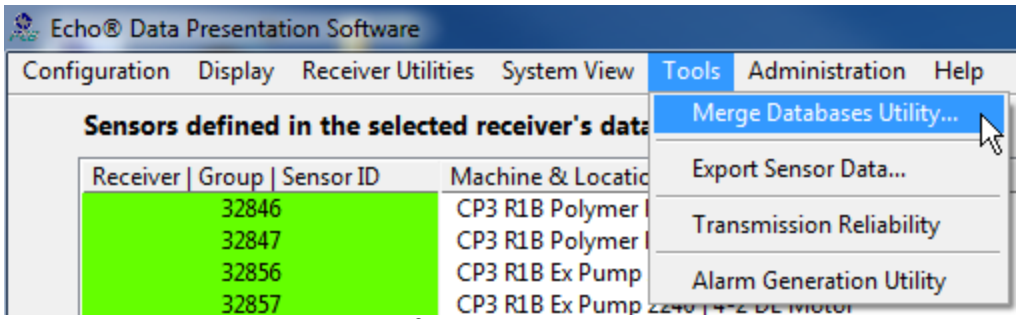


Figure 133 – Echo® Main Screen – Tools menu option

This action will bring up the screen in Figure 134. To run the utility enter the connection (UDL or DSN) file for the main database in the 1st connection field and then the connection file for the remote (portable) database and then click the 'Merge Database' button.

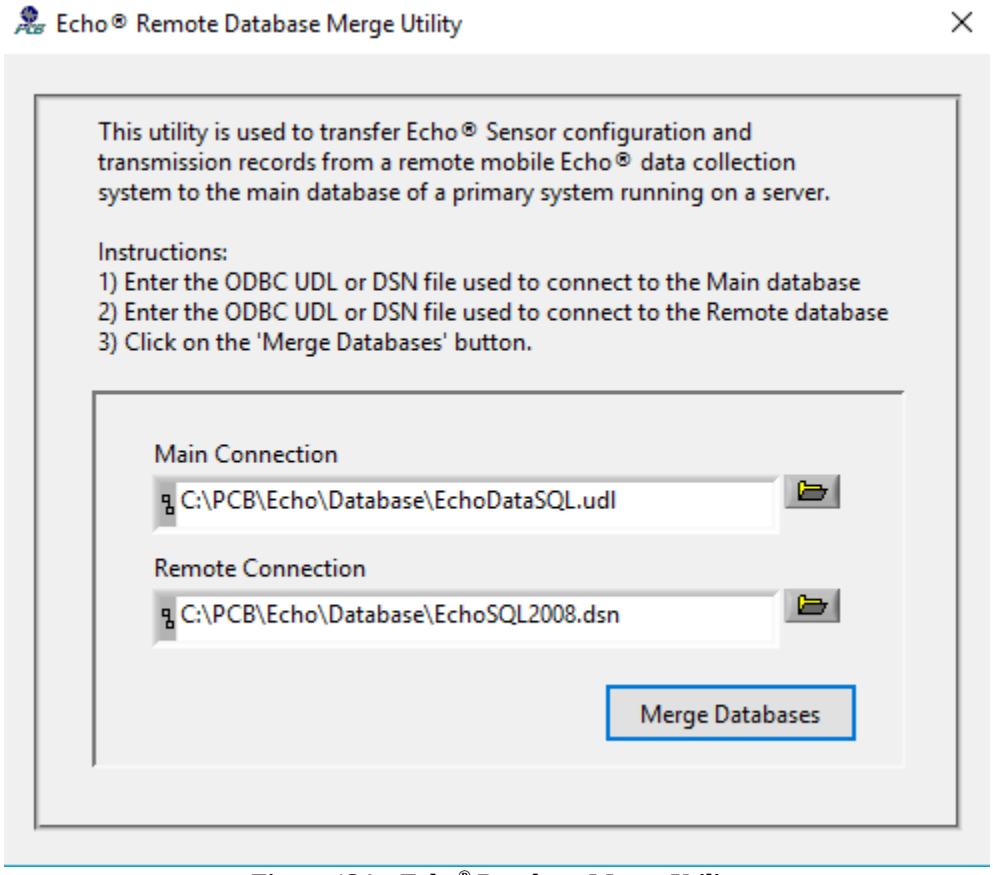


Figure 134 – Echo® Database Merge Utility

This process involves the following steps;

4.2.16.1 Compare Sensor Definitions

The sensor definitions in main and remote databases are compared. If a new or updated sensor is found in the remote database then the operator is prompted (Figure 135) to see if

they want to update the Main database with this new data from the remote database. This dialog will appear for every sensor definition where a difference is found.

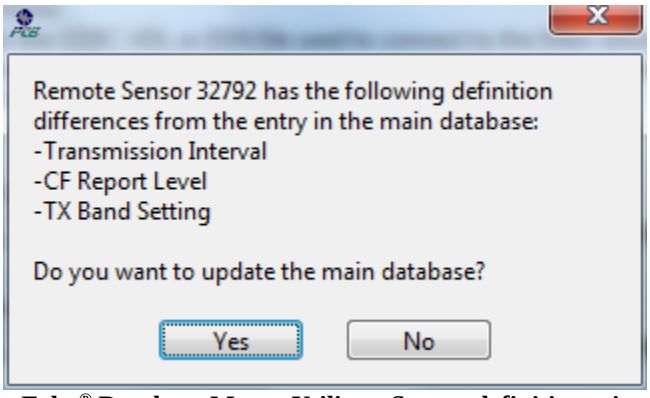
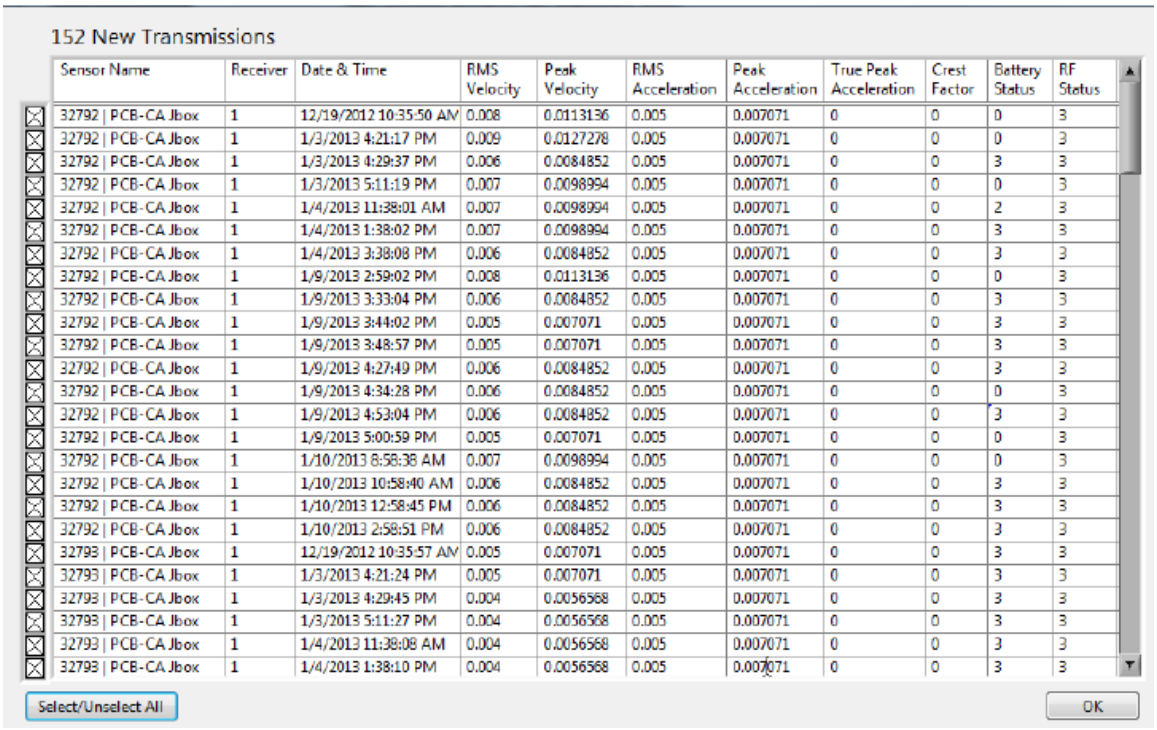


Figure 135 – Echo® Database Merge Utility – Sensor definition mismatch dialog

4.2.16.2 New Transmission Update

Next the utility checks to see if there are transmissions in the remote database that are not in the Master database. If so it lists them in a table (Figure 136) where the user can select which ones they want added to the main database. Check the 'Disable Emails During Import' box to inhibit alarm emails from being sent as part of the merge process.



Sensor Name	Receiver	Date & Time	RMS Velocity	Peak Velocity	RMS Acceleration	Peak Acceleration	True Peak Acceleration	Crest Factor	Battery Status	RF Status
32792 | PCB-CA Jbox	1	12/19/2012 10:35:50 AM	0.008	0.0113136	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/3/2013 4:21:17 PM	0.009	0.0127278	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/3/2013 4:29:37 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/3/2013 5:11:19 PM	0.007	0.0098994	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/4/2013 11:38:01 AM	0.007	0.0098994	0.005	0.007071	0	0	2	3
32792 | PCB-CA Jbox	1	1/4/2013 1:38:02 PM	0.007	0.0098994	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/4/2013 3:38:08 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/9/2013 2:59:02 PM	0.008	0.0113136	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/9/2013 3:33:04 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/9/2013 3:44:02 PM	0.005	0.007071	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/9/2013 3:48:57 PM	0.005	0.007071	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/9/2013 4:27:49 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/9/2013 4:34:28 PM	0.006	0.0084852	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/9/2013 4:53:04 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/9/2013 5:00:59 PM	0.005	0.007071	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/10/2013 8:58:38 AM	0.007	0.0098994	0.005	0.007071	0	0	0	3
32792 | PCB-CA Jbox	1	1/10/2013 10:58:40 AM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/10/2013 12:58:45 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32792 | PCB-CA Jbox	1	1/10/2013 2:58:51 PM	0.006	0.0084852	0.005	0.007071	0	0	3	3
32793 | PCB-CA Jbox	1	12/19/2012 10:35:57 AM	0.005	0.007071	0.005	0.007071	0	0	3	3
32793 | PCB-CA Jbox	1	1/3/2013 4:21:24 PM	0.005	0.007071	0.005	0.007071	0	0	3	3
32793 | PCB-CA Jbox	1	1/3/2013 4:29:45 PM	0.004	0.0056568	0.005	0.007071	0	0	3	3
32793 | PCB-CA Jbox	1	1/3/2013 5:11:27 PM	0.004	0.0056568	0.005	0.007071	0	0	3	3
32793 | PCB-CA Jbox	1	1/4/2013 11:38:08 AM	0.004	0.0056568	0.005	0.007071	0	0	3	3
32793 | PCB-CA Jbox	1	1/4/2013 1:38:10 PM	0.004	0.0056568	0.005	0.007071	0	0	3	3

Figure 136 – Echo® Database Merge Utility – Transmission Update Dialog

Selecting 'OK' will copy the selected transmissions from the remote database to the main database. A confirmation of the transfer will appear when it is complete.

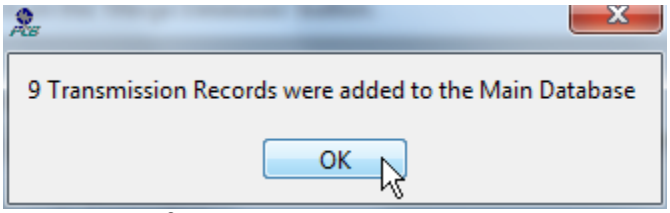


Figure 137 – Echo® Database Merge Utility – Confirmation Dialog

5 Microsoft SQL Server 2008 R2 Express Installation

The Echo® Monitoring Software requires the installation of Microsoft SQL Server to store and retrieve sensor data. This section is provided as an example of an SQL Server Express installation. If you already have SQL Server installed then you can skip this section and attach the Echo® database to the installed version. Depending on the environment this software is being installed into the user may want to override some of the default installation options. Following are screen shots of a successful installation of SQL Express 2008 R2. Echo® Monitoring Software also works with newer versions of SQL Server (e.g. SQL Server 2012 etc.)
This section is not intended to be a tutorial on SQL. If your company already has an SQL database engine running on a server you can simply attach the Echo® database and point the Echo® software to it. If you do decide to install the Express version then these screen shots are meant to show an example of a successful install. The specific settings regarding user authorization will be site specific. To install SQL Express 2008 R2 run the **SQLEXPR_x64_ENU.exe** application and follow these steps.

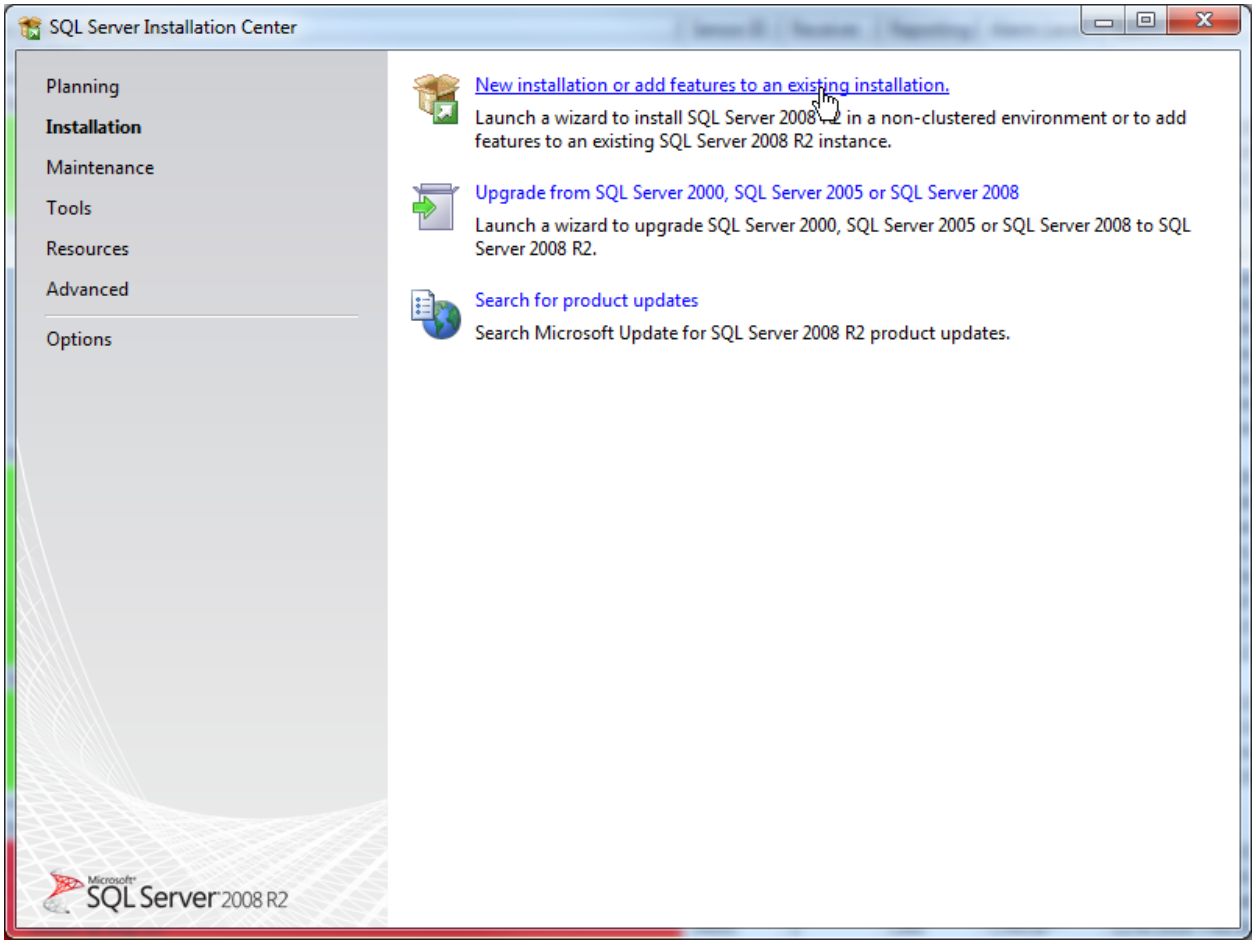


Figure 138 Microsoft SQL 2008 Initial Installation Screen

If you do not already have SQL installed on the computer select the New Installation option.

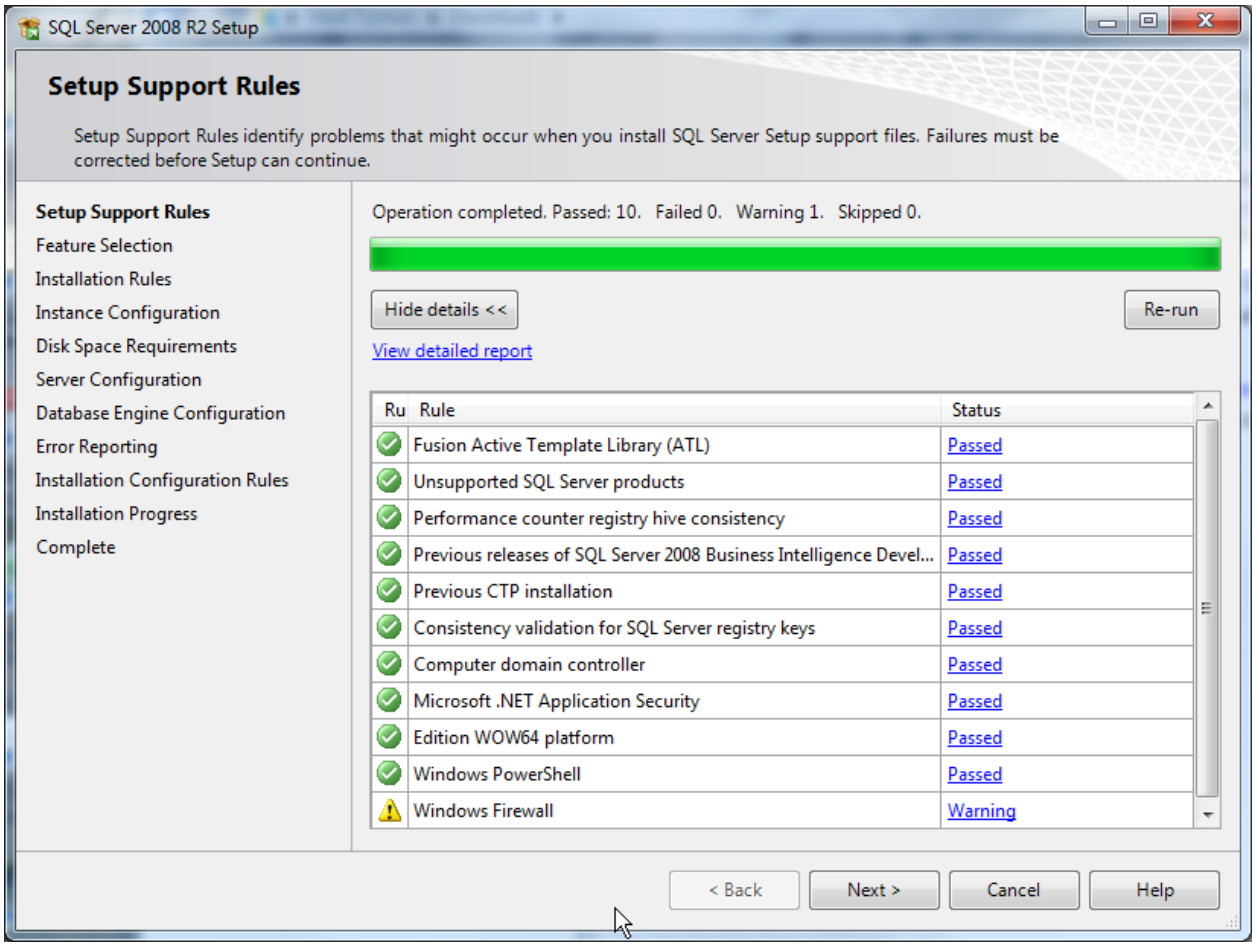


Figure 139 Microsoft SQL Server Setup Support Rules.

- You may or may not see this screen initially. If there are compatibility problems with other components installed on the target PC then you likely will. Click on the status of the offending item to see how to resolve it.

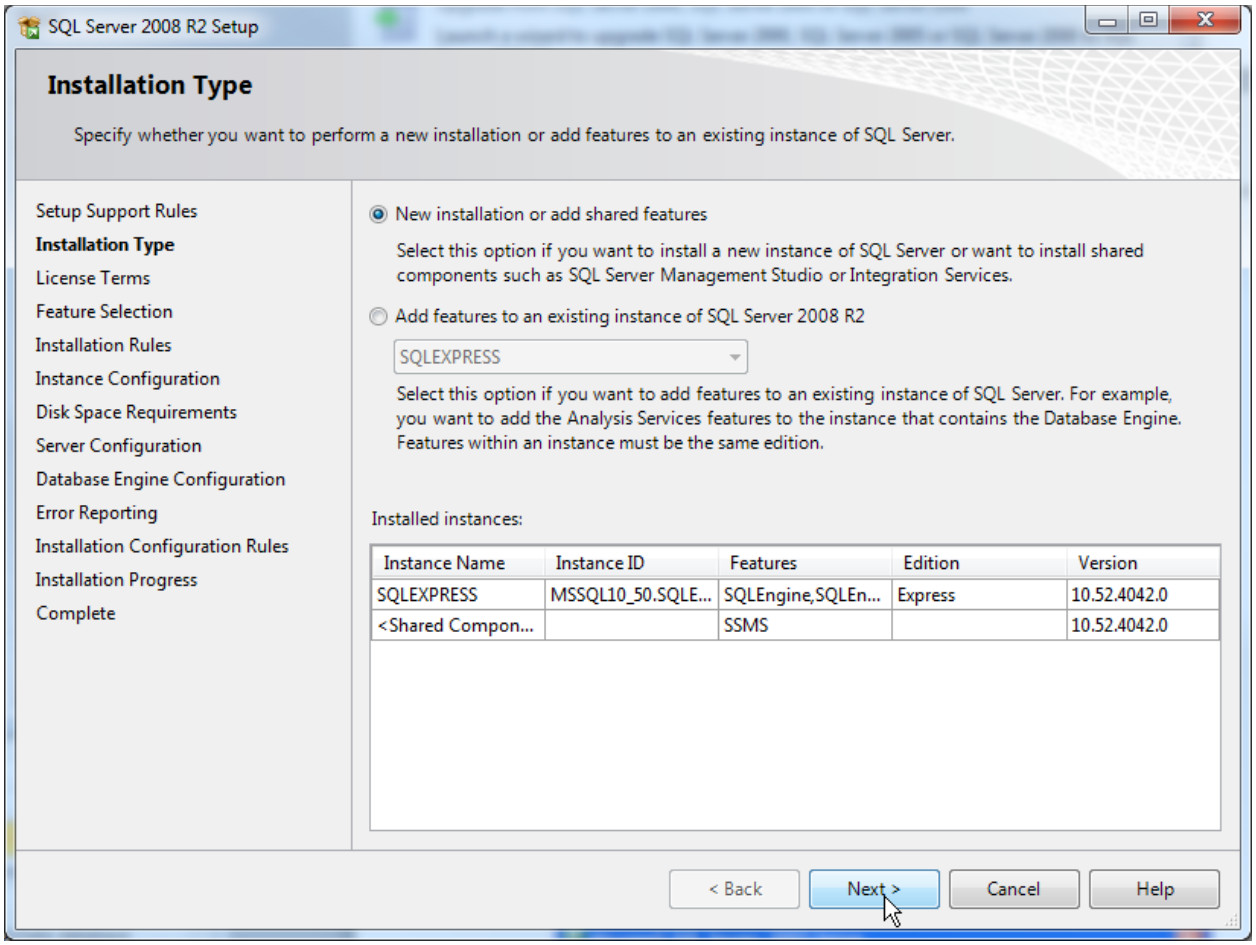


Figure 140 Microsoft SQL Server Component Installation Type

- Select New Installation and then Next.

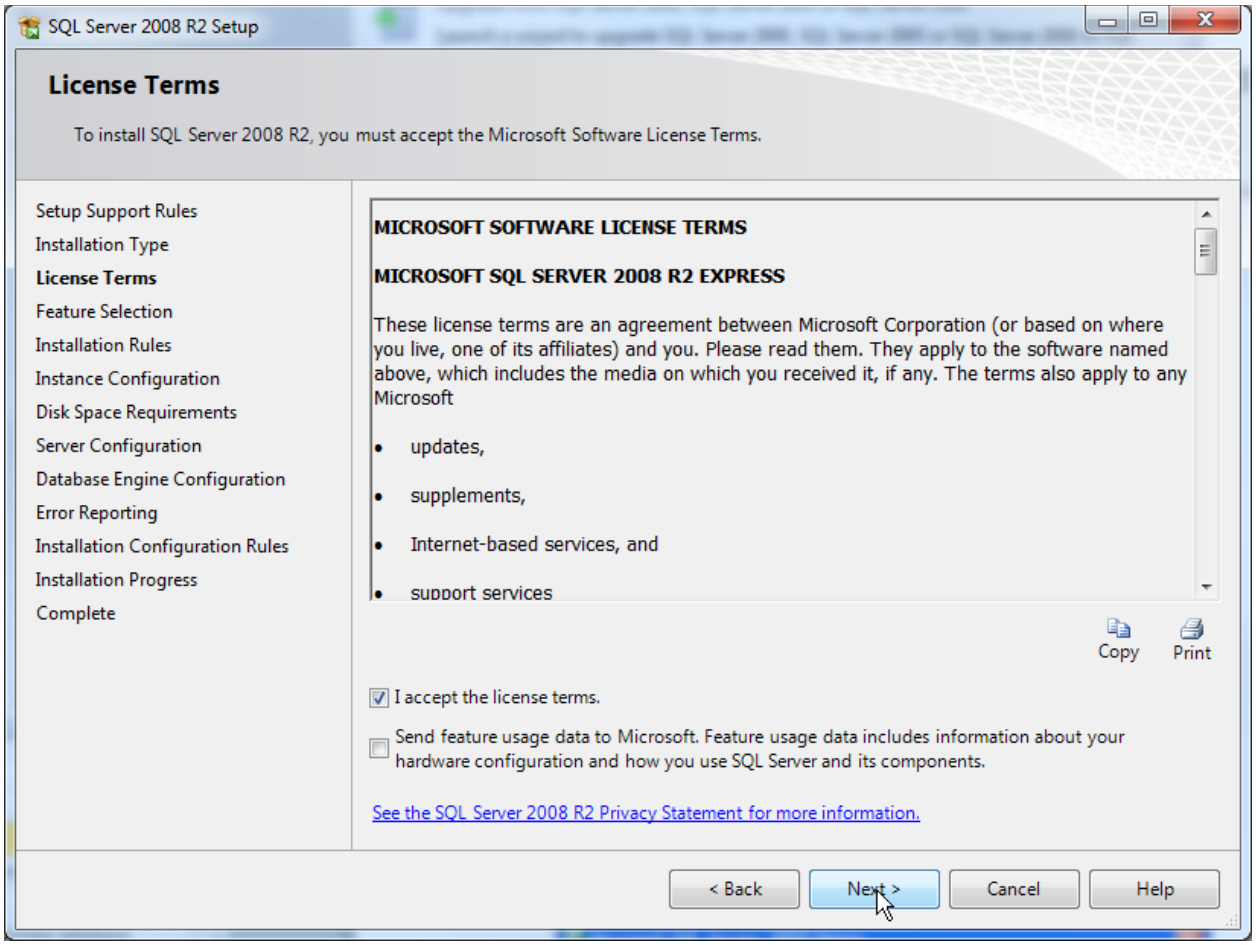


Figure 141 Microsoft Component Installer License Terms

- Click Accept and Next

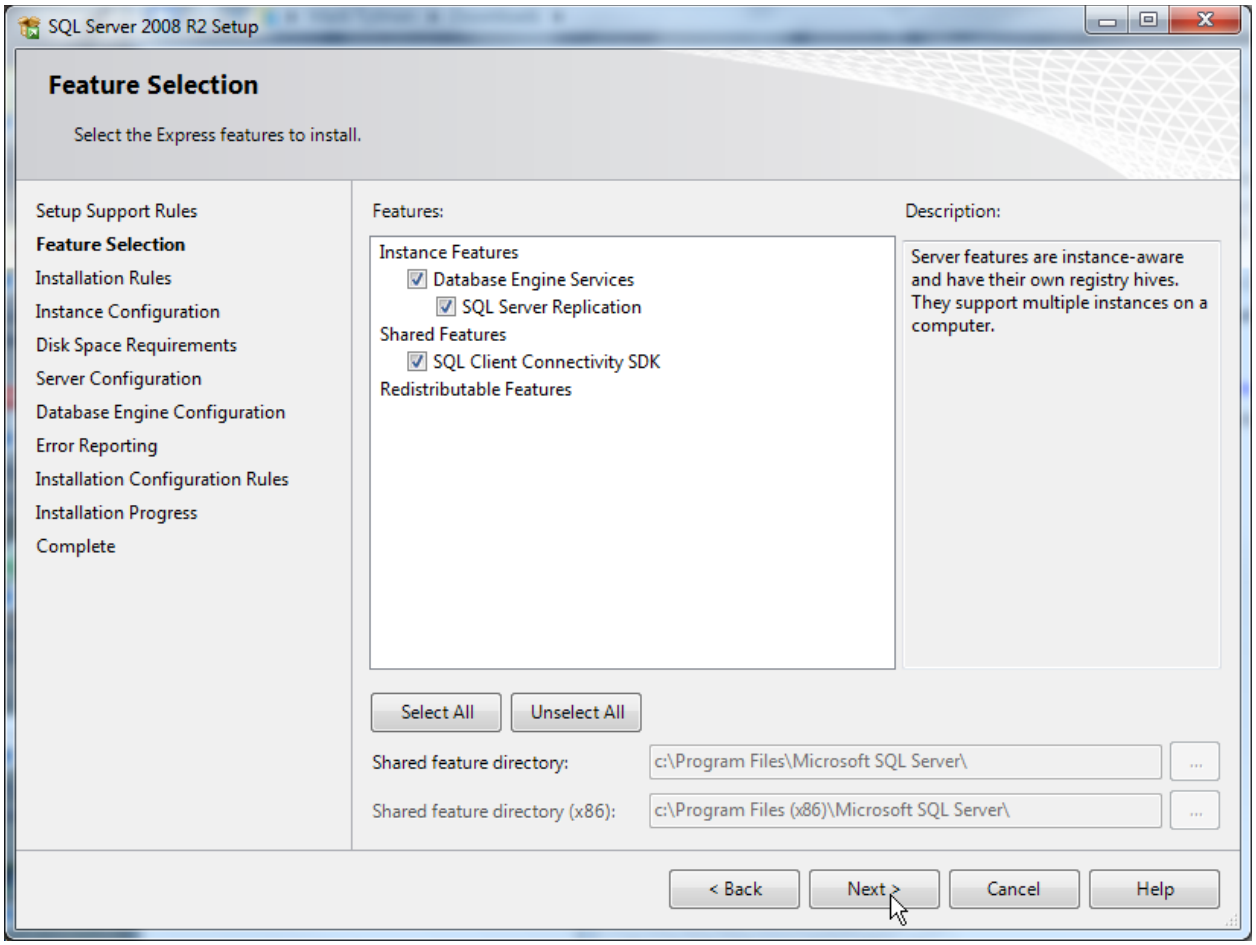


Figure 142 Microsoft SQL Server Installer Feature Selection Dialog

- Click the Select All button and then Next

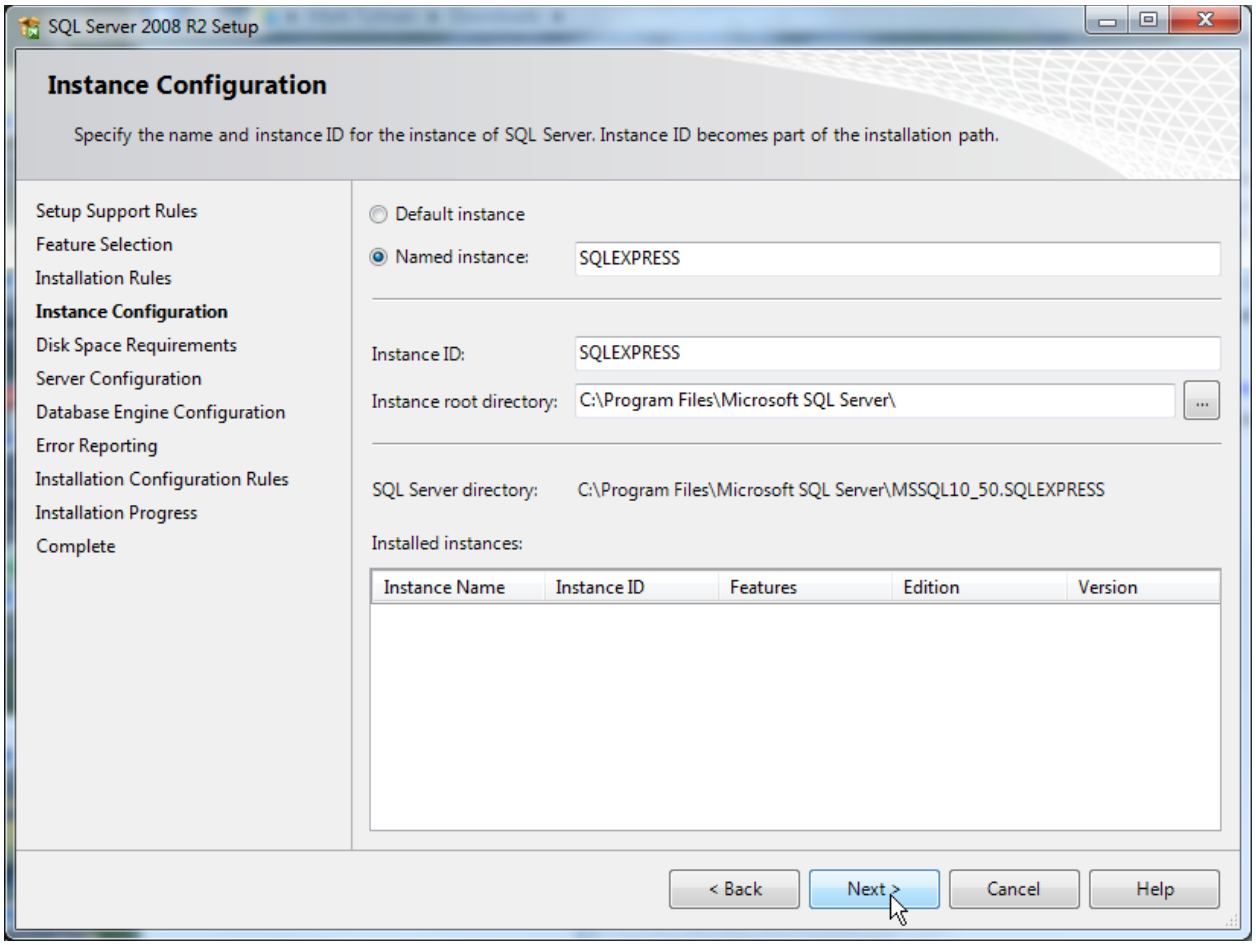


Figure 143 Microsoft SQL Server Installer Instance Configuration

- Select Named instance 'SQLEXPRESS' and then Next.

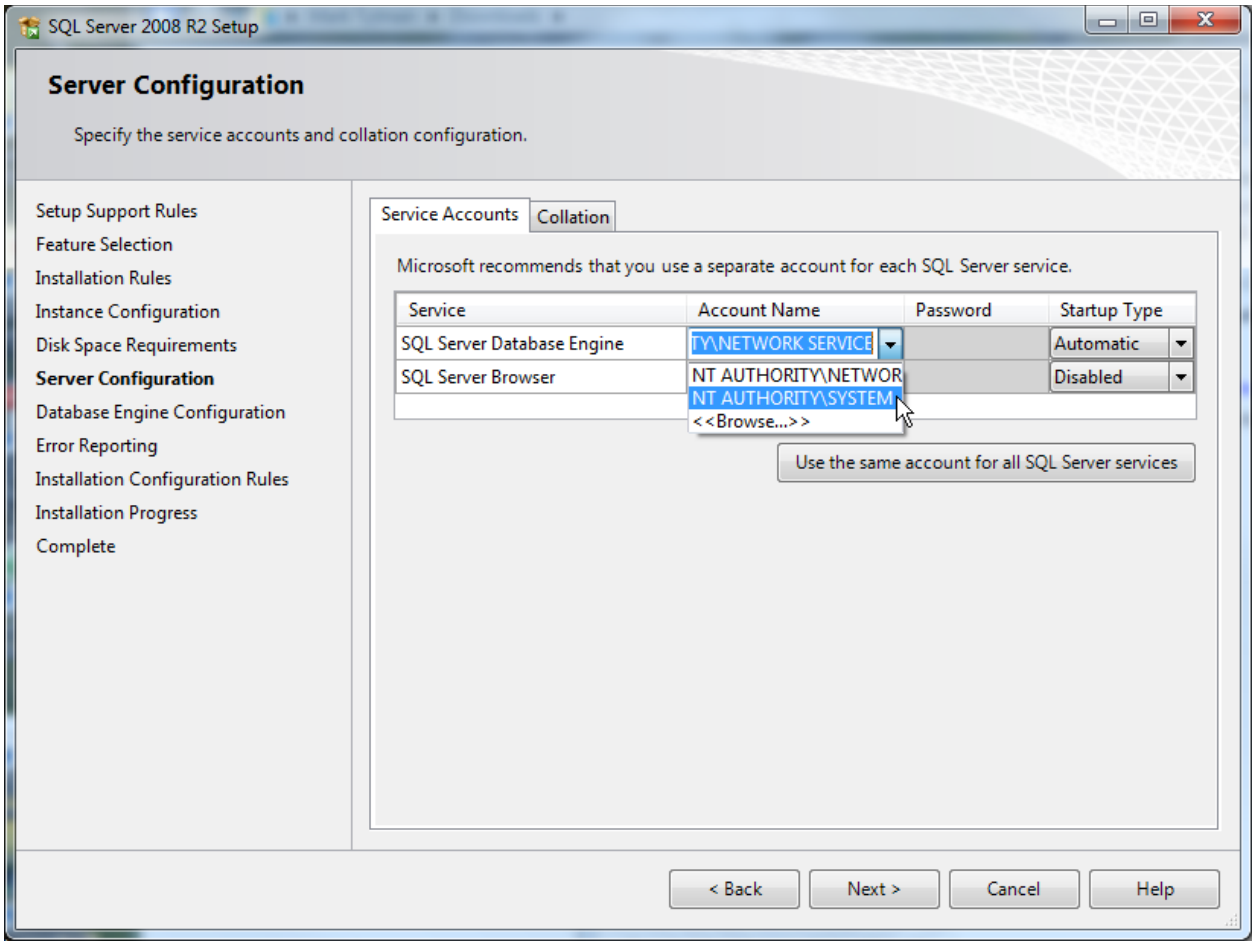


Figure 144 Microsoft SQL Server Configuration Dialog

- Click on the Account Name item of the SQL Server Database Engine row and select the System option. This is appropriate option for a standalone setup. If the SQL Server is located on a remote server consult your IT department or database administrator for the appropriate setting.
- Click Next.

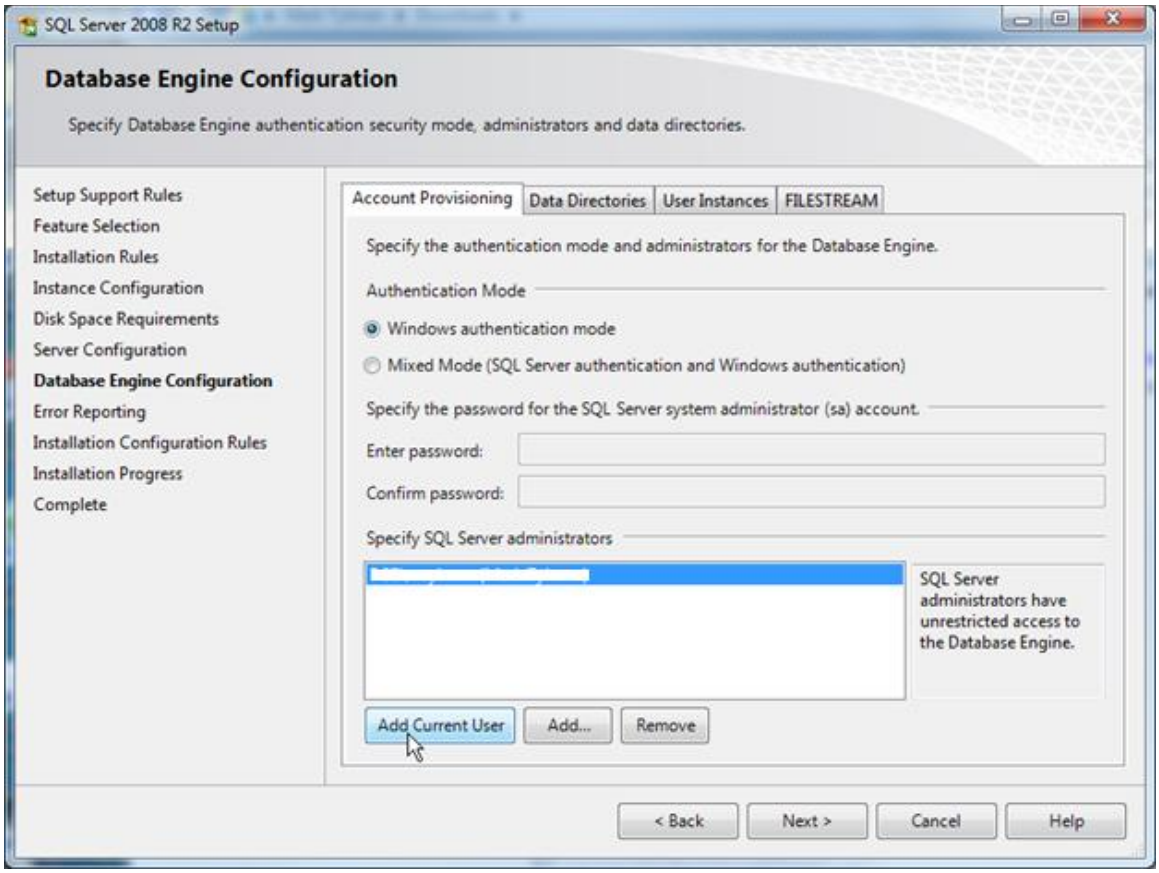


Figure 145 Microsoft SQL Server Feature Selection Dialog

- Select Windows Authentication Mode
- Add the users you want to be administrators for the database. These users will be allowed access to the database engine via the SQL Management Studio tool to 'Attach' the Echo® database and do database maintenance.
- Click Next

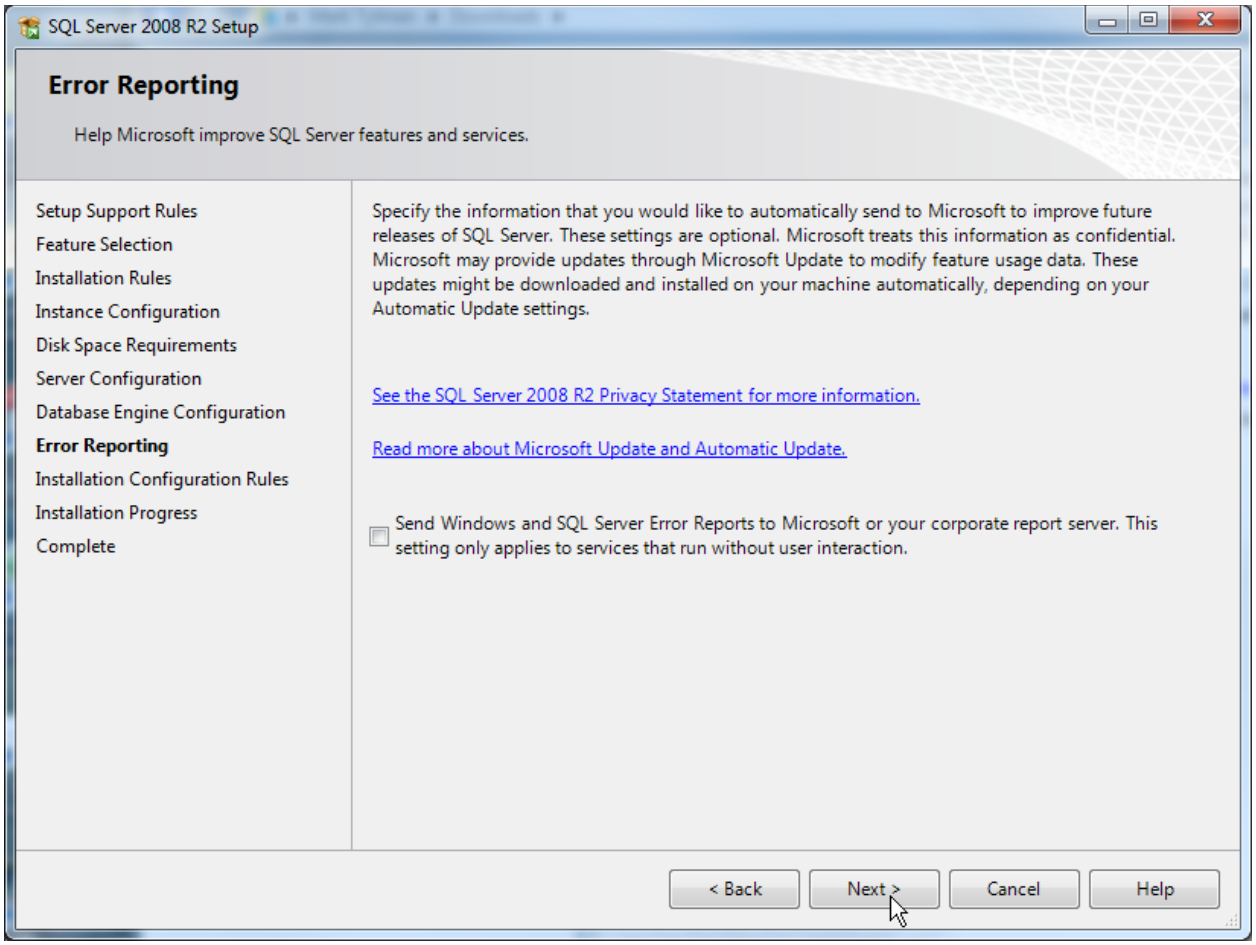


Figure 146 Microsoft SQL Server Authentication Mode Selection Dialog

- Click Next the SQL database server will now be installed

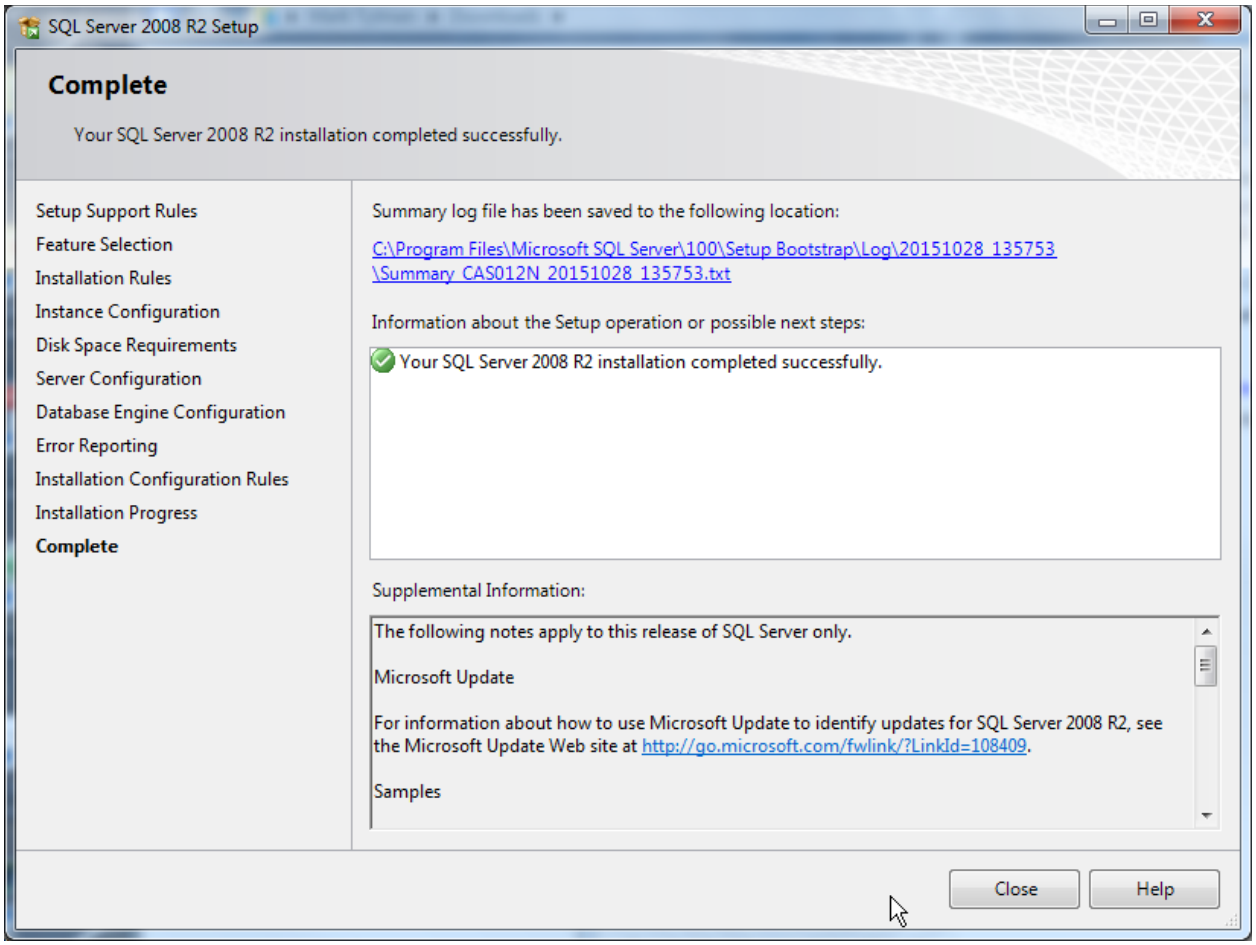


Figure 147 Microsoft SQL Server Successfully installed Dialog

- Click Close
- Then close the SQL Server Installation Center window
- Now install the SQL Server Management Studio application by running the **SQLManagementStudio_x64_ENU.exe** application (Note: x64 installers are for 64 bit operating systems only. If you have a 32 bit system get the x86 files from the Microsoft SQL download site.

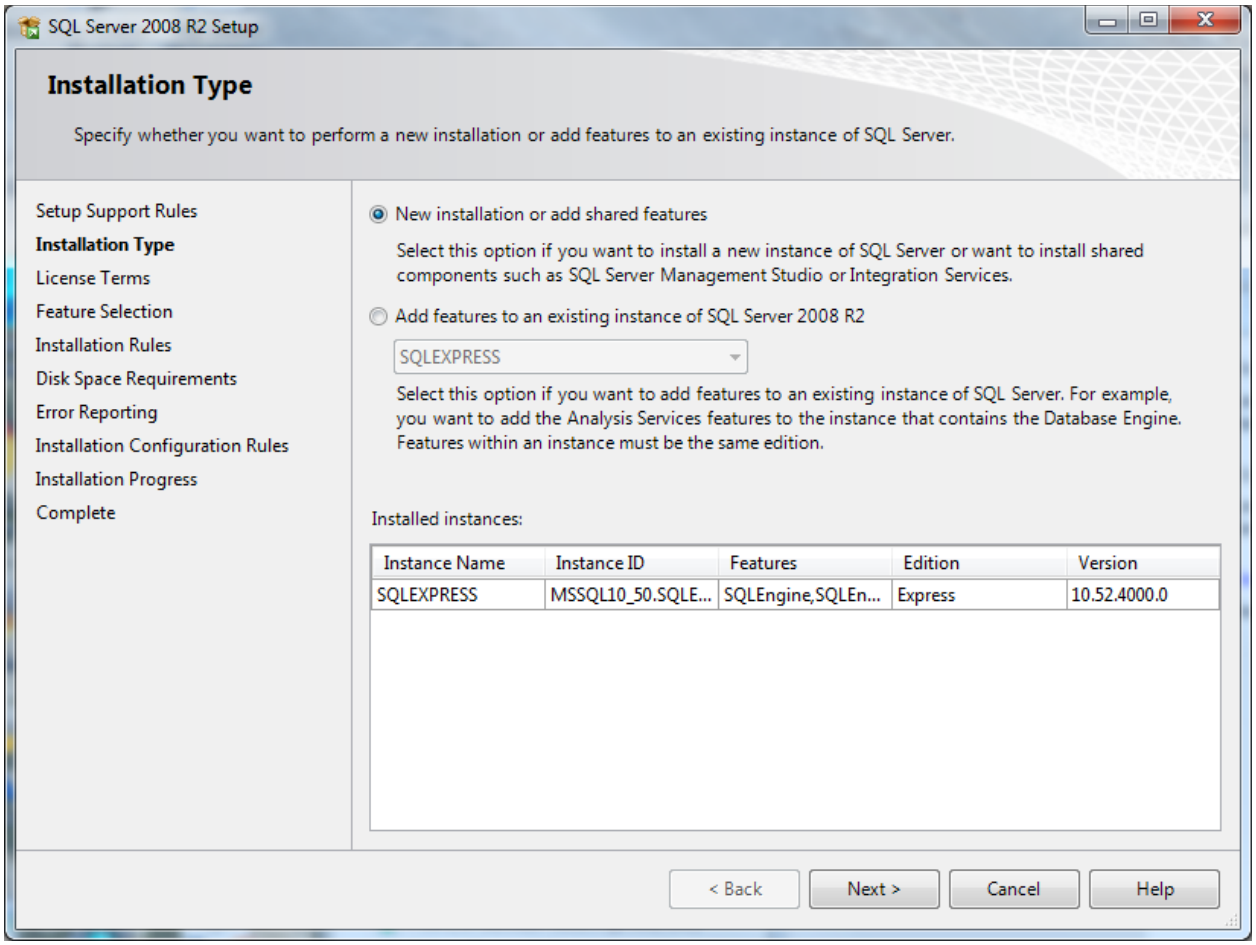


Figure 148 Microsoft SQL Server Management Studio Install Dialog

- This is the initial screen after running the **SQLManagementStudio_x64_ENU.exe** application.
- Select the New Installation or add shared features option
- Click Next.
- The next screen shown is the license agreement. Accept and click Next.

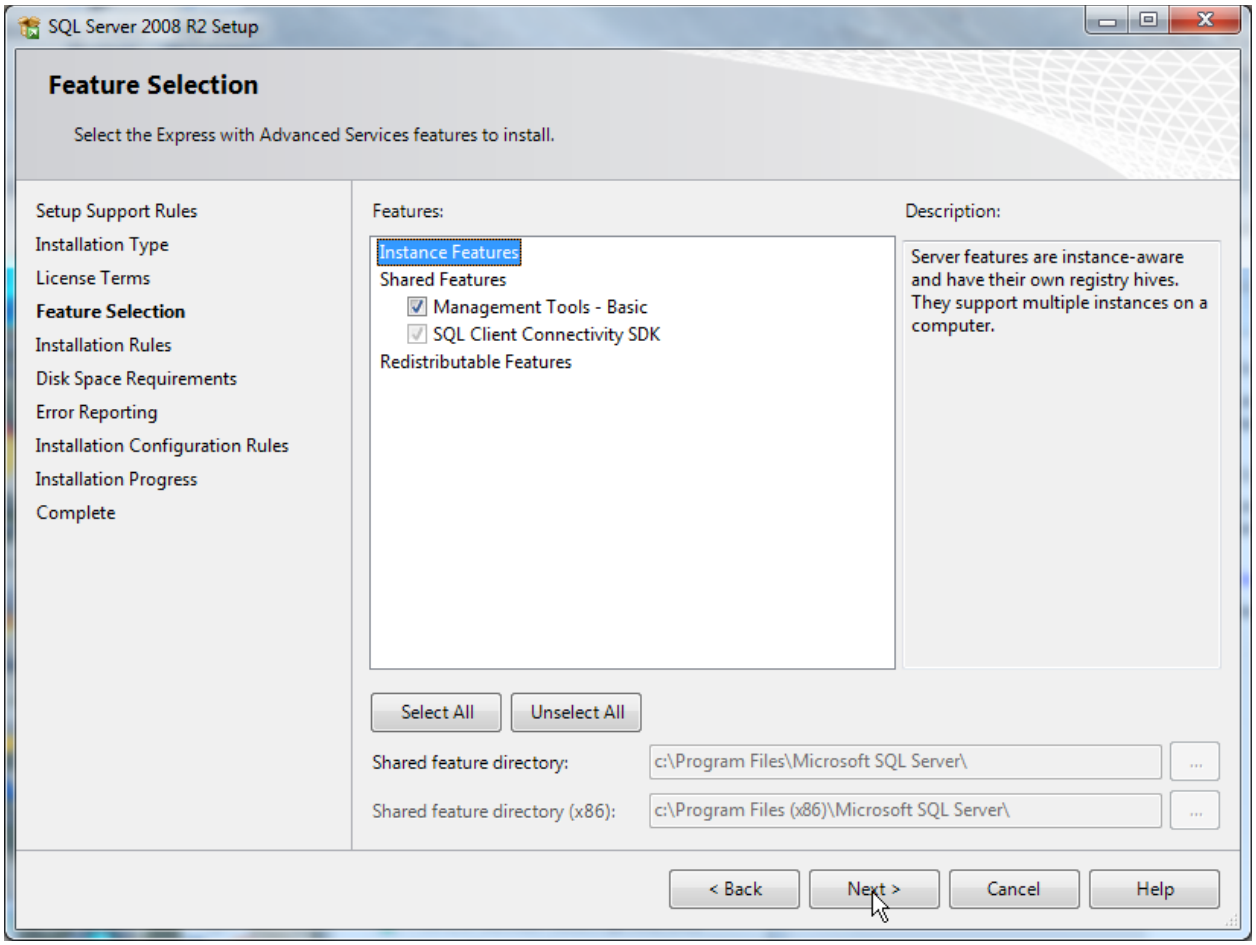


Figure 149 Microsoft SQL Server Management Studio Feature Selection Dialog

- Select All and ensure the Management Tools – Basic gets checked
- Click Next
- Skip the error reporting and click next on the next screen
- The Management tools will now install

5.1 Database Attachment Instructions for Microsoft SQL Server 2008 Express

To attach the Echo® database you must run the SQL Server 2008 R2 Express program. This is accomplished by selecting **Start| All Programs| Microsoft SQL Server 2008 R2 | SQL Server Management Studio** as shown below.

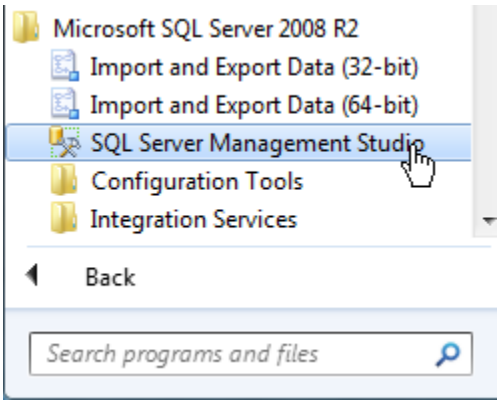


Figure 150 Launch Microsoft SQL Server Management Tools

The first time it runs it will ask you to wait while it configures itself. it will then display the window shown in Figure 151 but the 'Server name' will be < Your PC Name>\SQLEXPRESS

Figure 151 – SQL Server Connection Dialog

Clicking the 'Connect' button will bring up the larger SQL Server application window of which the left pane is shown below. On this pane;

- Right click the **Database** item to reveal the options shown in Figure 152 below
- Select '**Attach**' as shown

- This will bring up the **Attach Databases** dialog shown in Figure 153

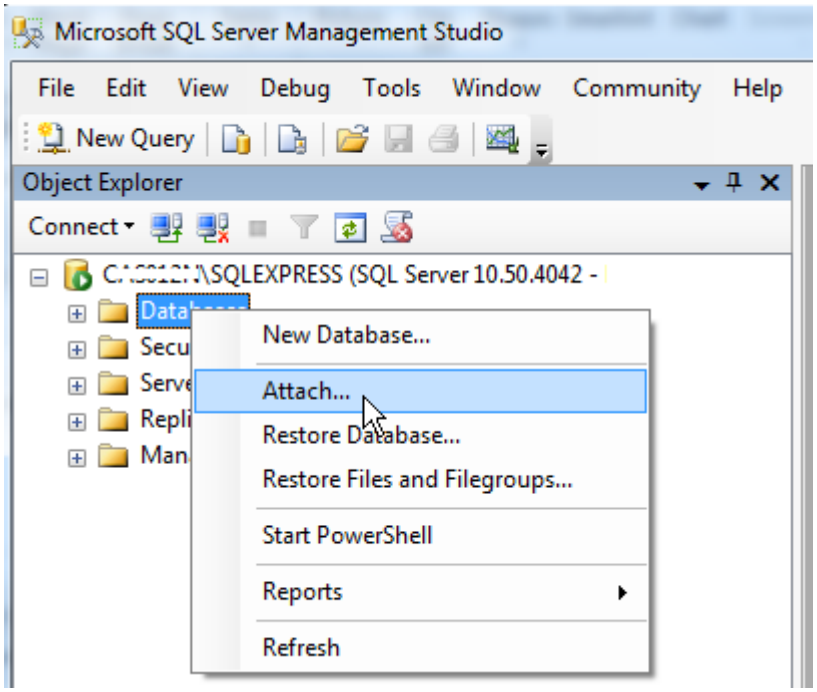


Figure 152 – SQL Server Database Attachment Dialog

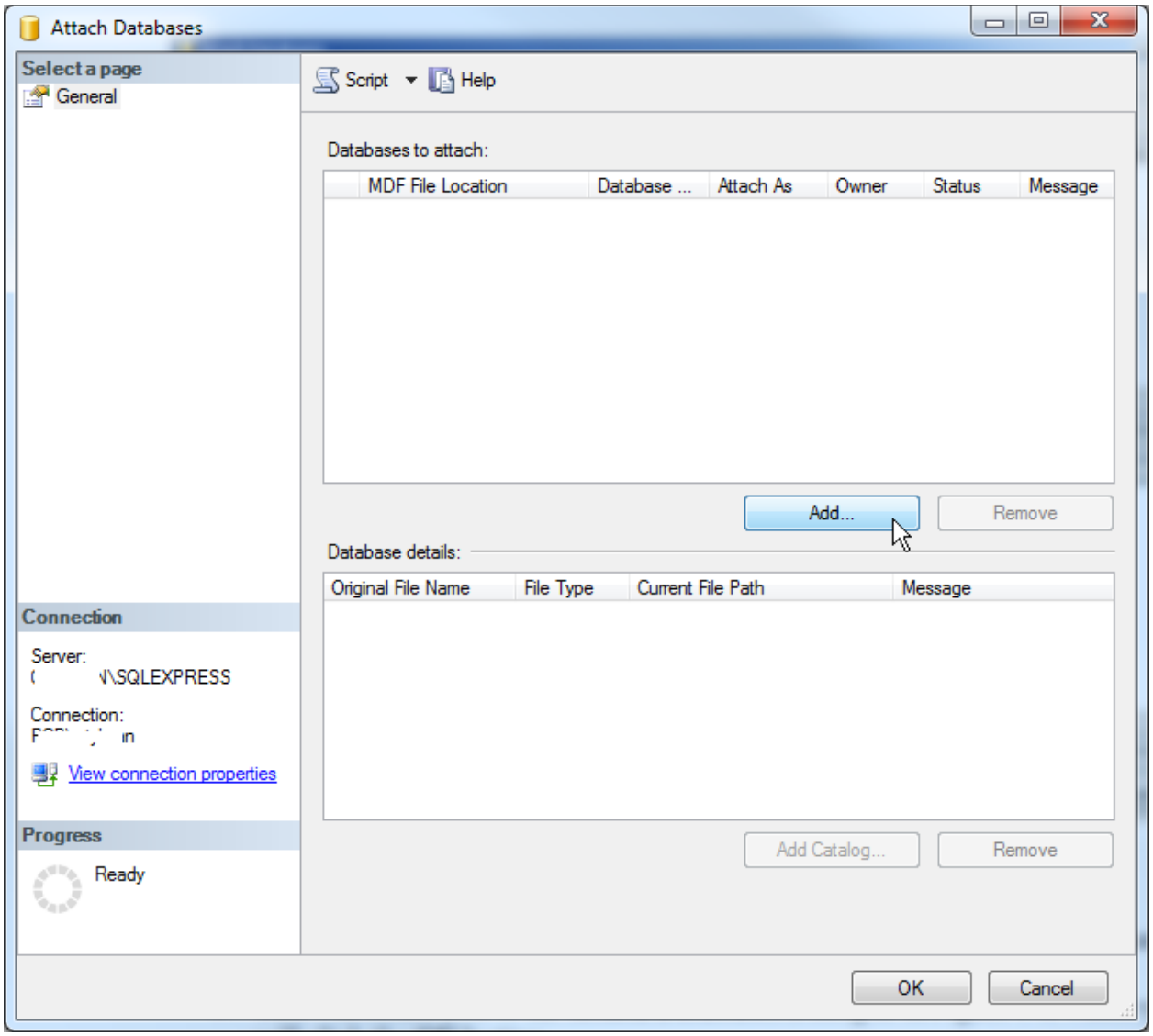


Figure 153 – SQL Server Database File Attachment Screen

- On the **Attach Databases** Dialog Click the '**Add'** button
- On the subsequent File dialog select the Echo® database, EchoSQLData.mdf.
- This will return you to the **Attach Databases** Dialog shown above where you will click the **OK** button

6 Create a File DSN ODBC Connection

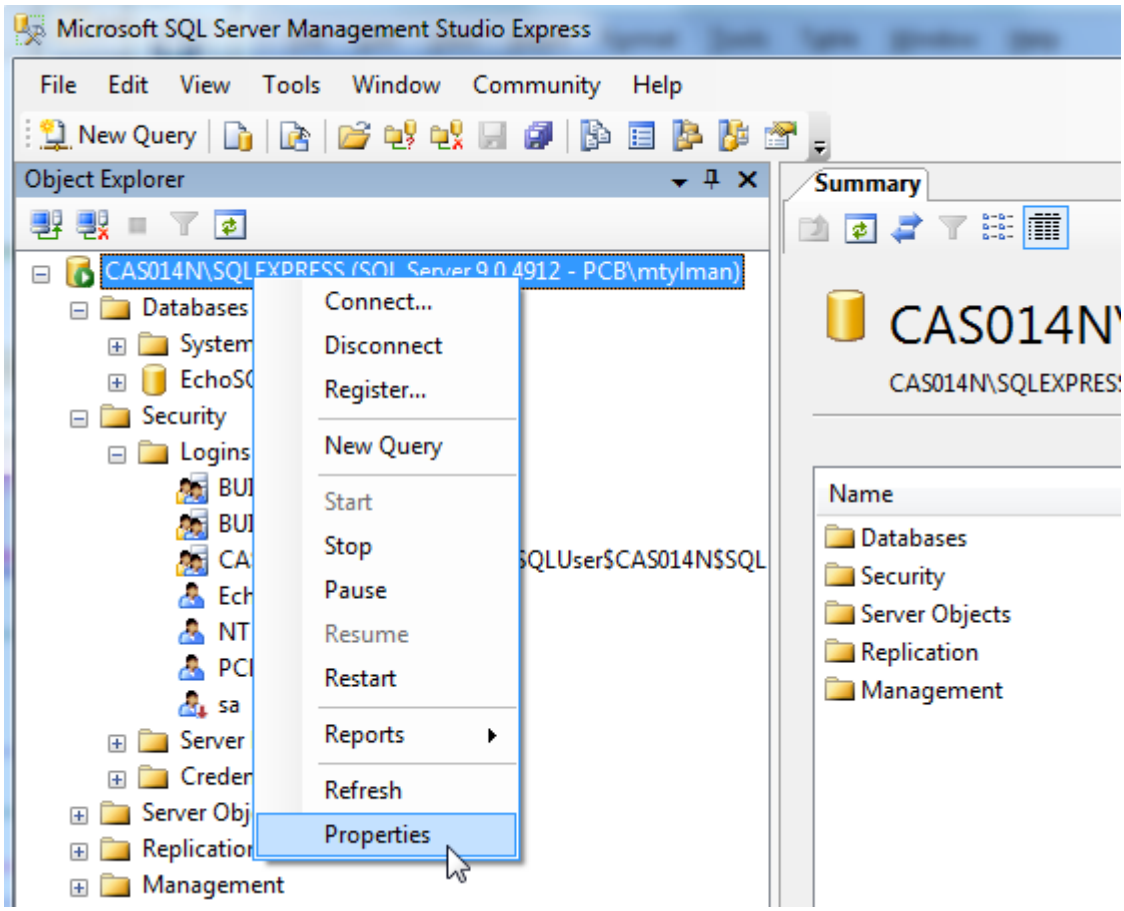
When utilizing the Echo® Monitoring Software in Echo® Data Presentation mode, it is unlikely the user will have the database engine with the Echo® Database installed locally. Therefore a File DSN ODBC connection must be created to provide the software with a path and access rights to the PC or server where the database is loaded. This process occurs in two steps;

1. Create an 'EchoUser' account in the database on the PC that hosts the SQL server
2. Create a File DSN entity in the ODBC Data Source Administrator utility on every PC that is running the Echo® Data Presentation software.

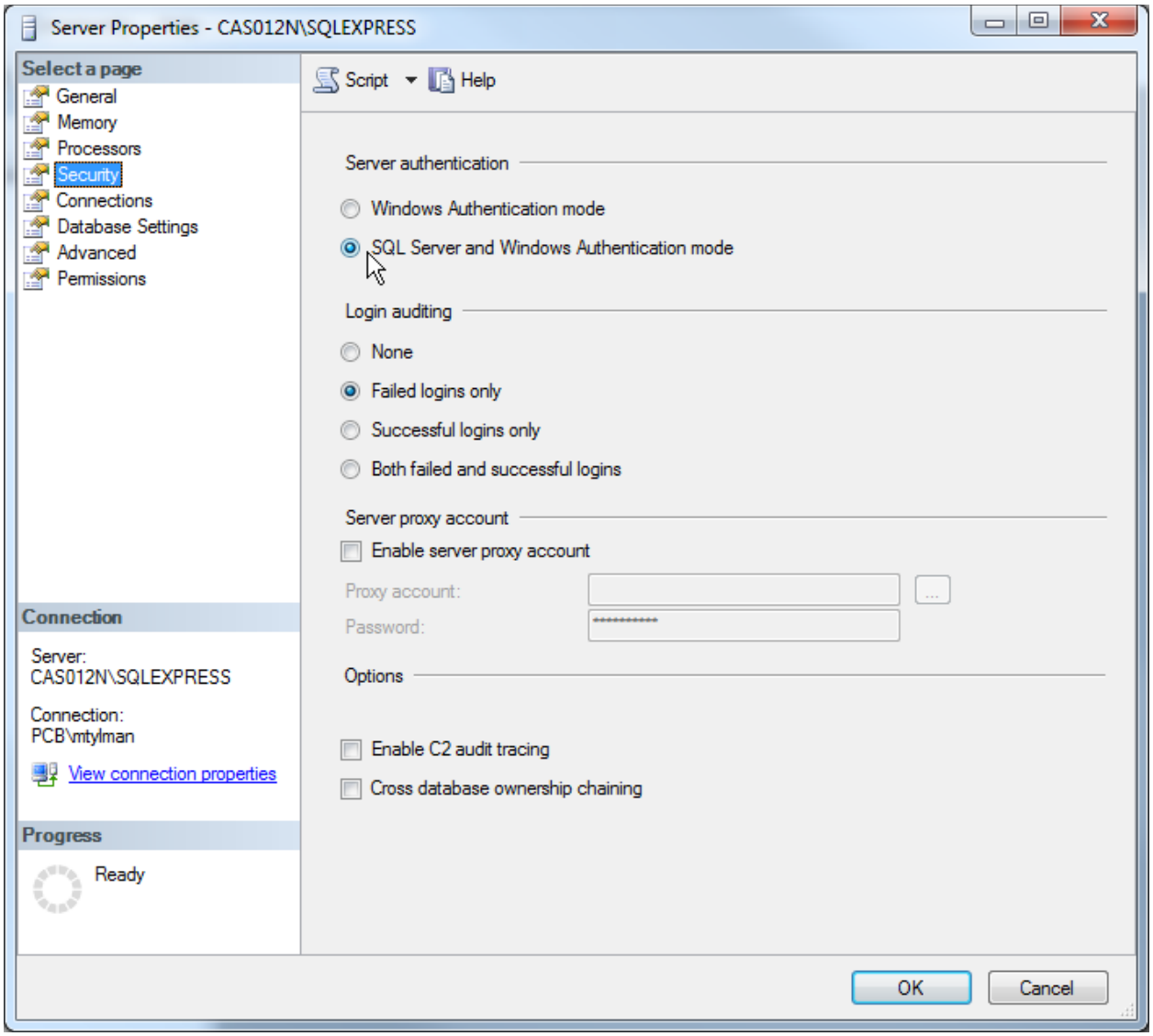
6.1 Create an EchoUser account in the EchoSQLData database

Complete the following steps to create an account compatible with the DSN methodology.

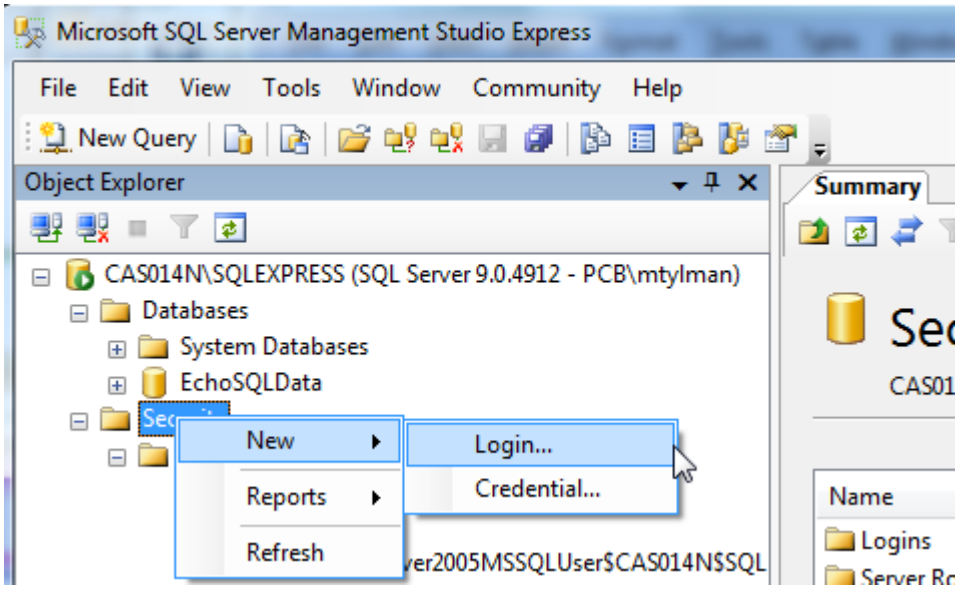
Run the **Microsoft SQL Server Management Studio** program and log into SQL server with normal Windows Authentication.



Right-click the server instance in the top left pane as shown above and select Properties

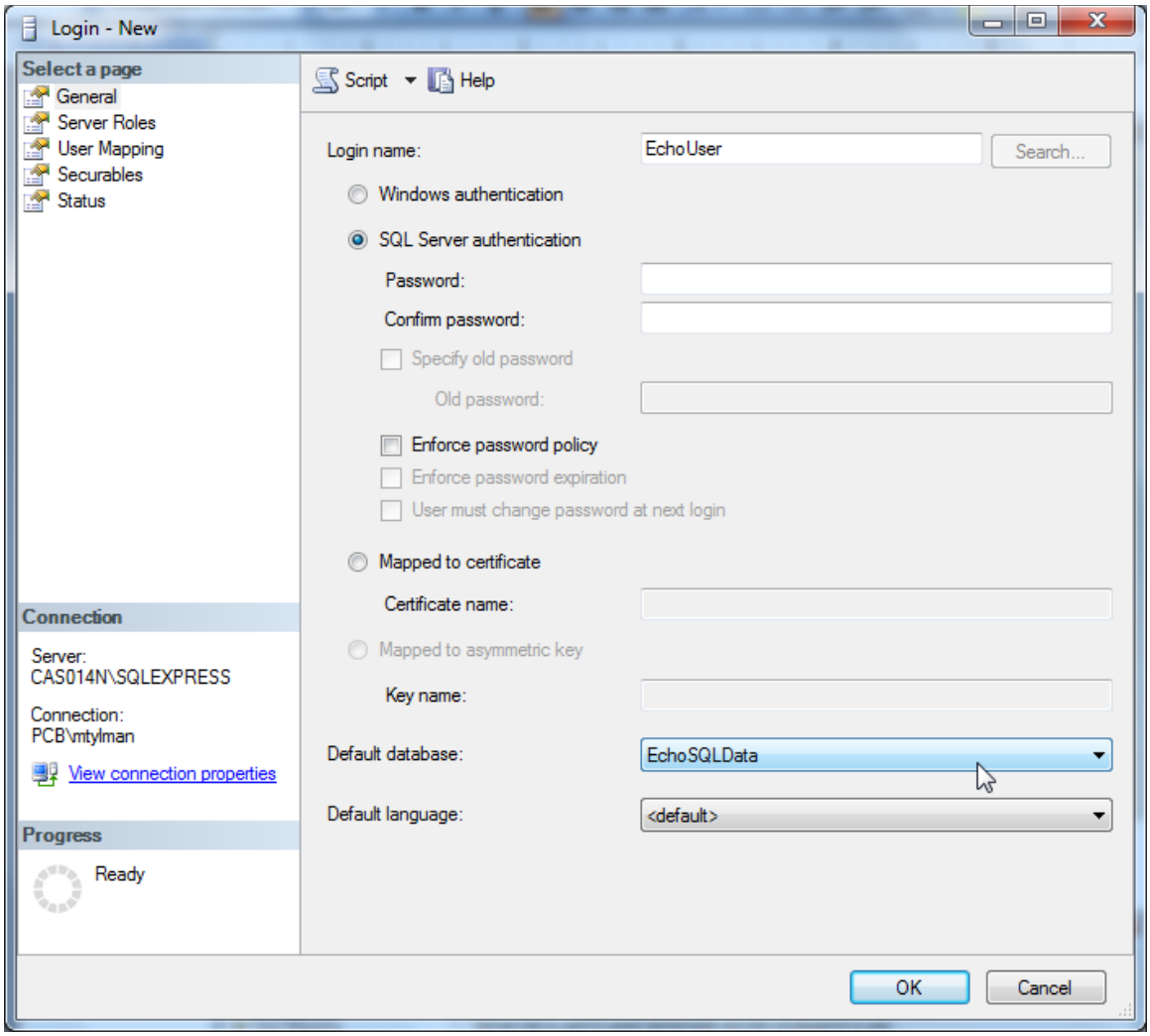


- Select the Security option – make sure "SQL Server and Windows Authentication mode" is selected.
- Click OK to close the window.
- Next select 'Security' and right-click and select 'New | Login…'

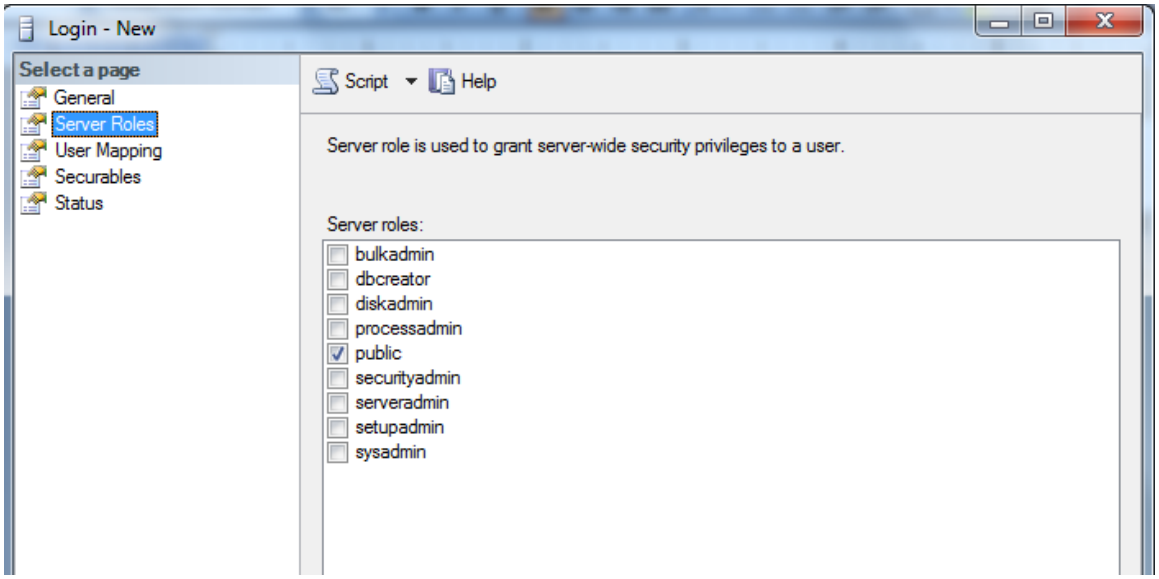


Create a new login account like the one shown below.

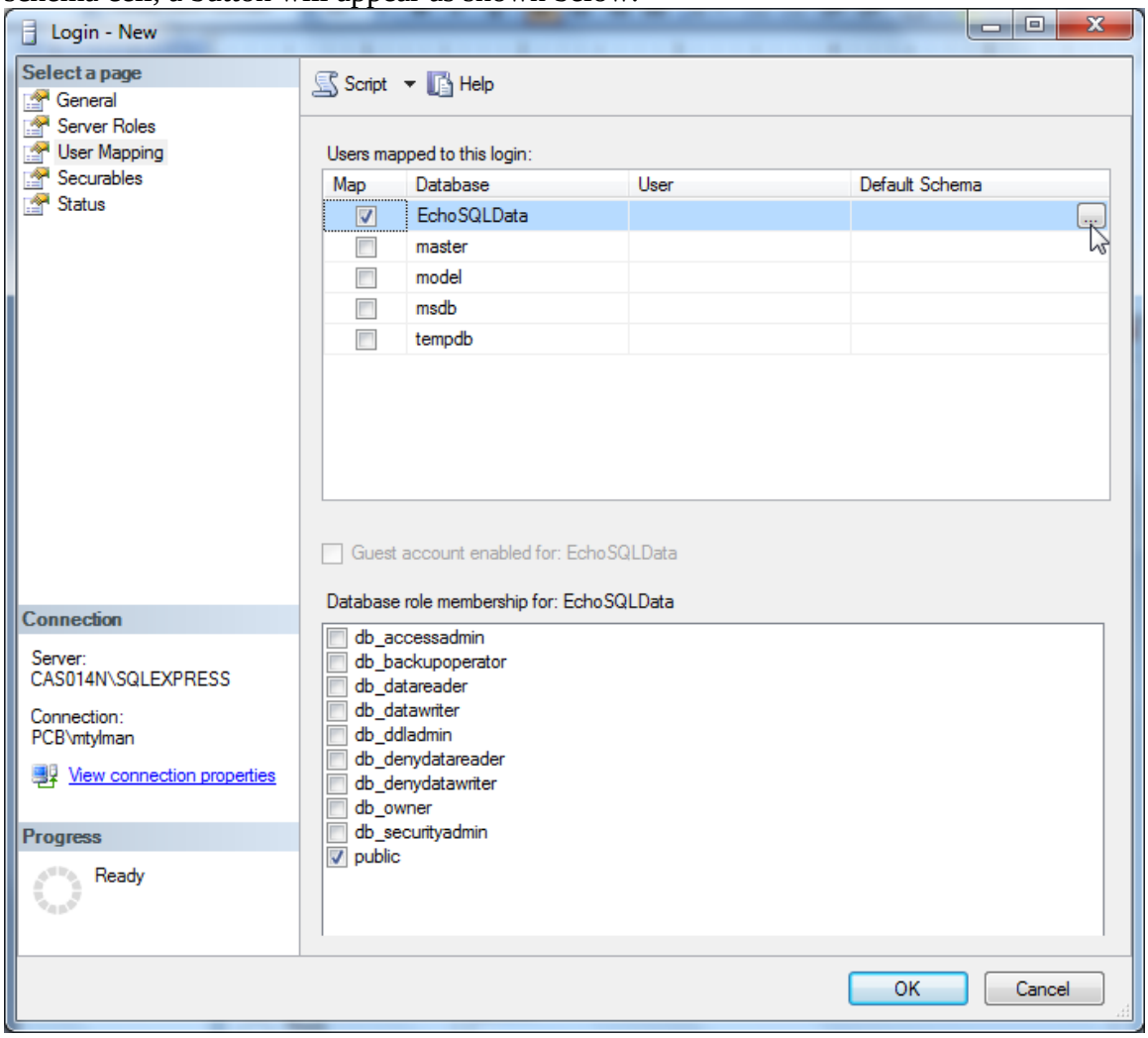
- Enter 'EchoUser' as the login name
- Select SQL Server Authentication
- Make sure Password is blank
- Unselect the Enforce Password Policy if it is selected
- Set the default database to EchoSQLData.
- Remember the login name you will need it later



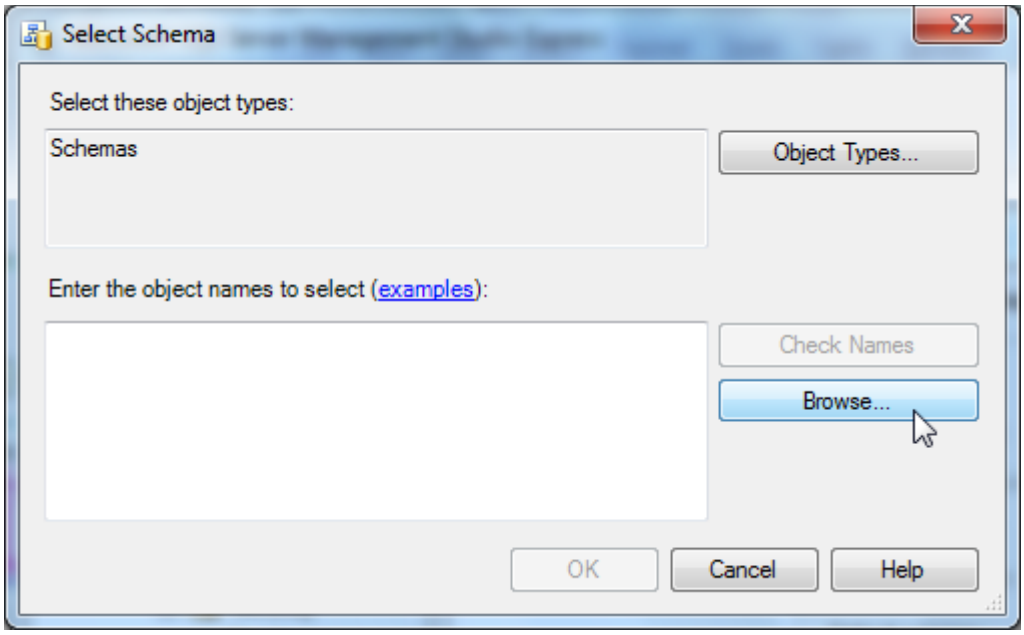
Server Roles screen - select 'public'

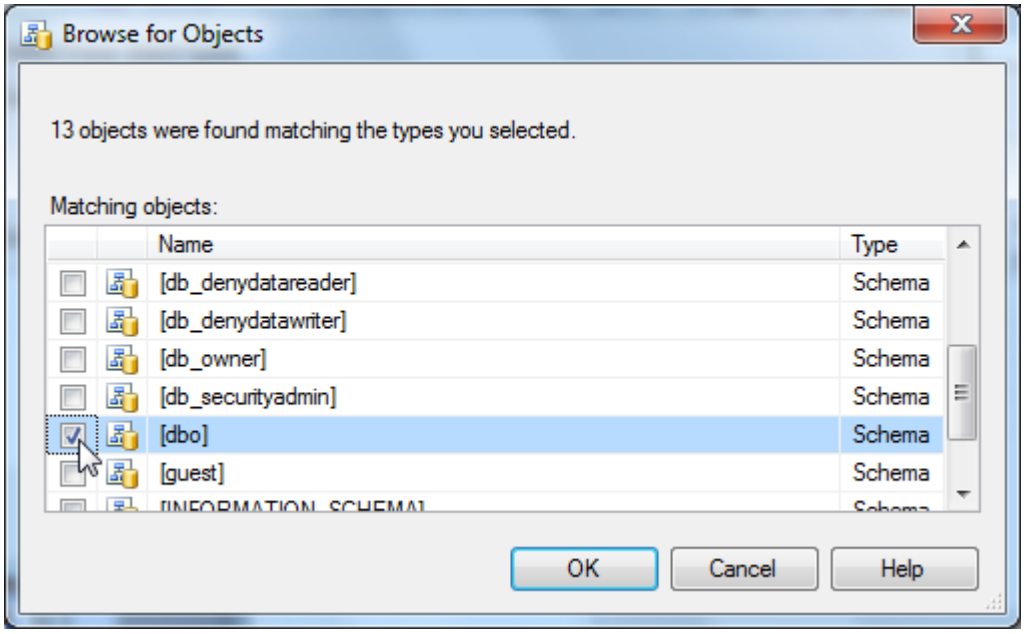


User Mapping Screen – Select EchoSQLData as the database and click in the Default schema cell, a button will appear as shown below.

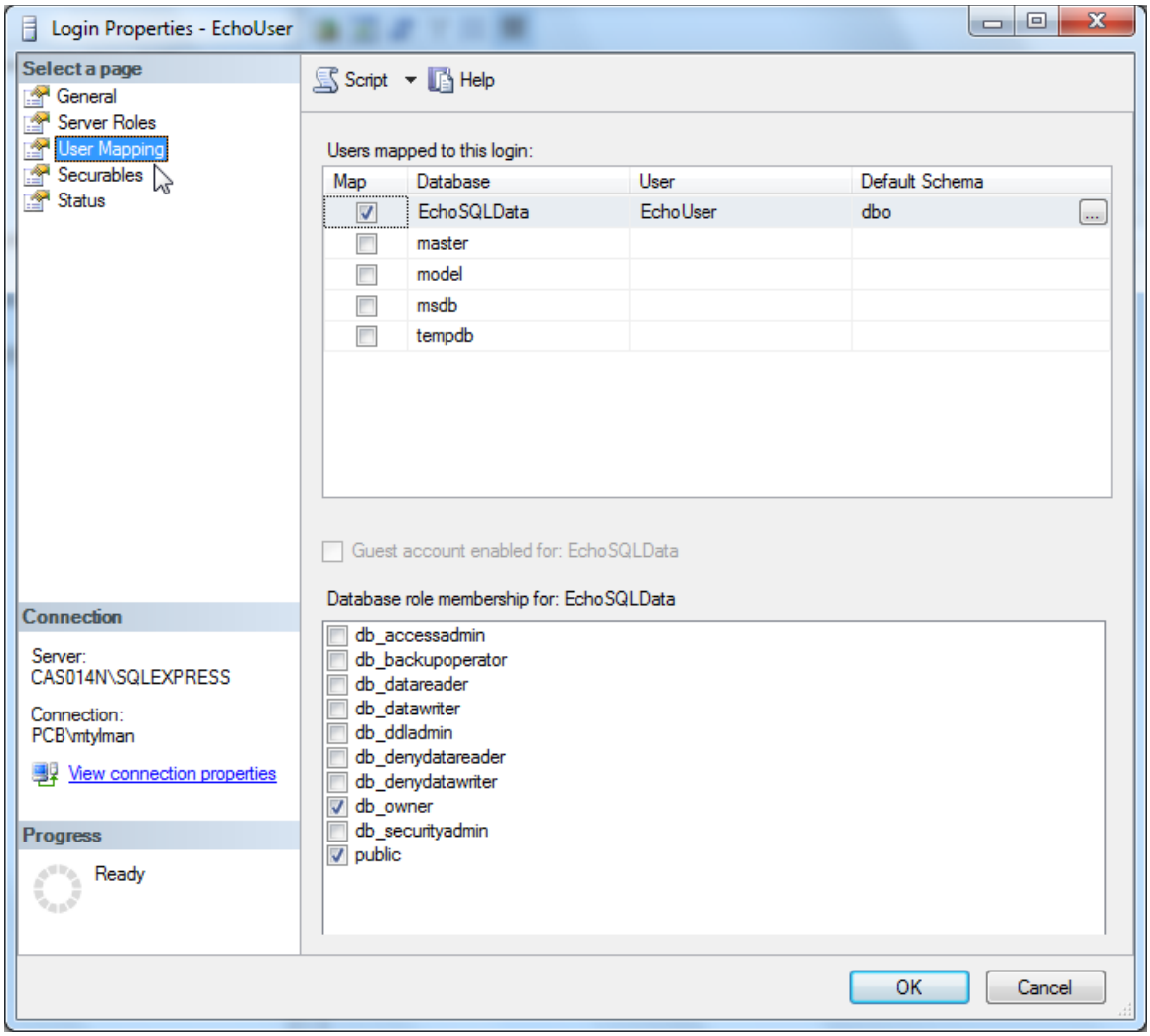


Click the button in the Default schema cell and the 'Select Schema' screen is displayed as shown below. Click the 'Browse button. Next find and select the 'dbo' option and click OK

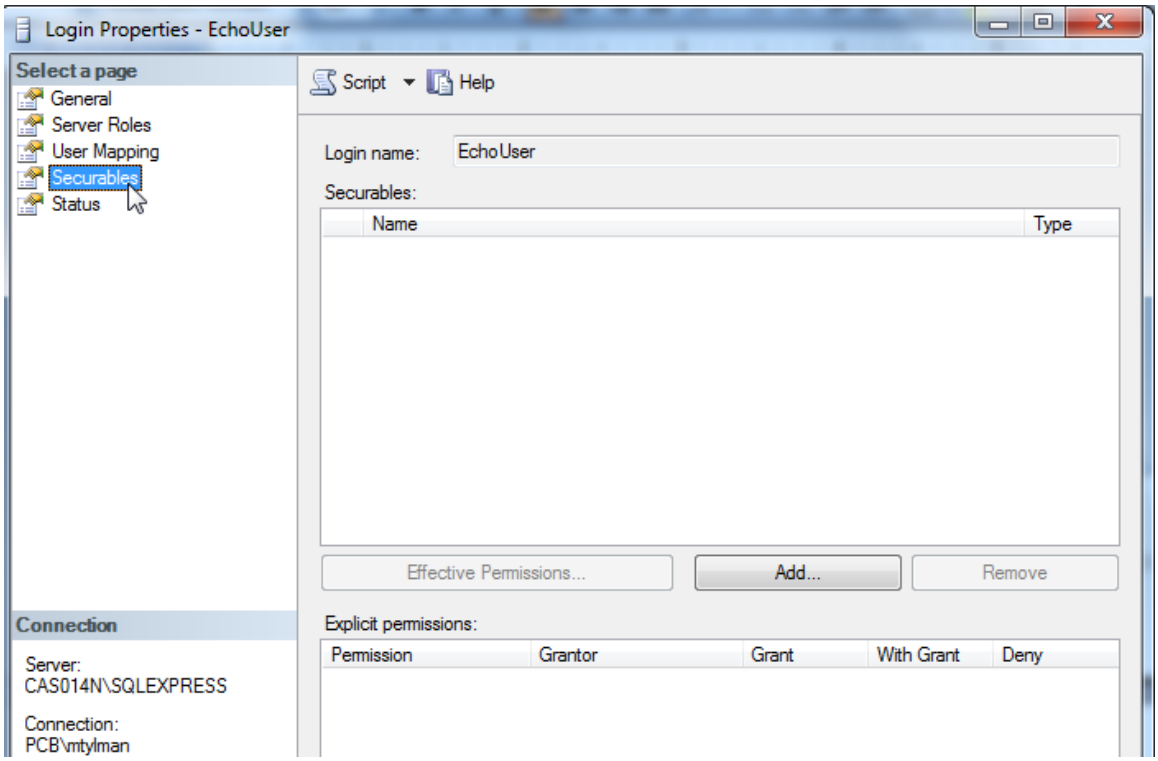


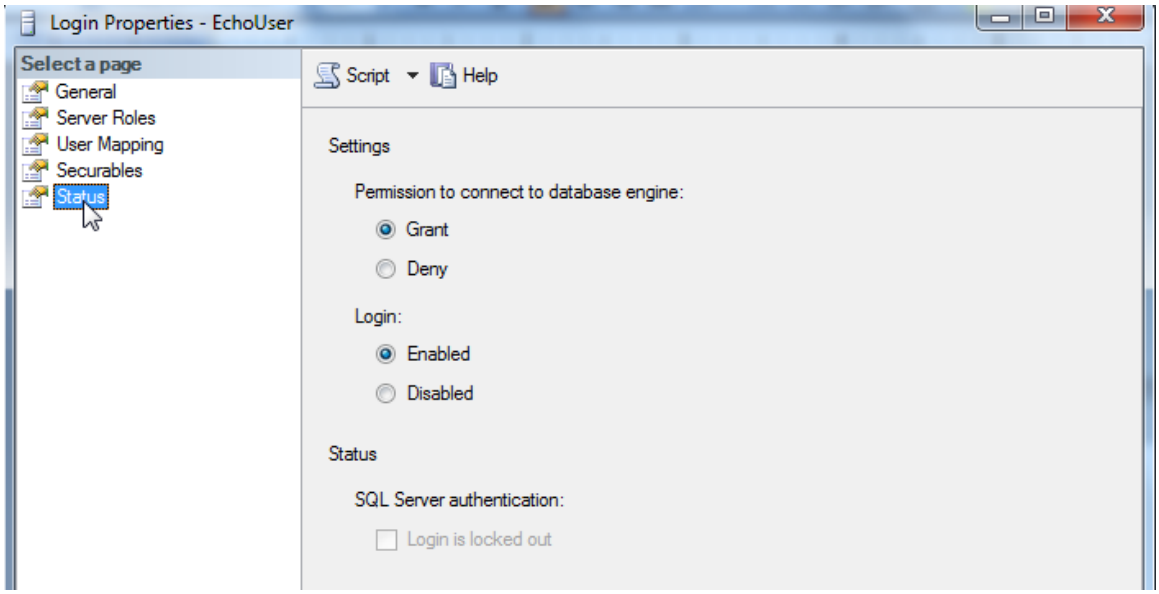


Close out of these screens using the ok buttons and the User Mapping should now appear as shown below. Make sure you select db_owner as indicated in the bottom pane.

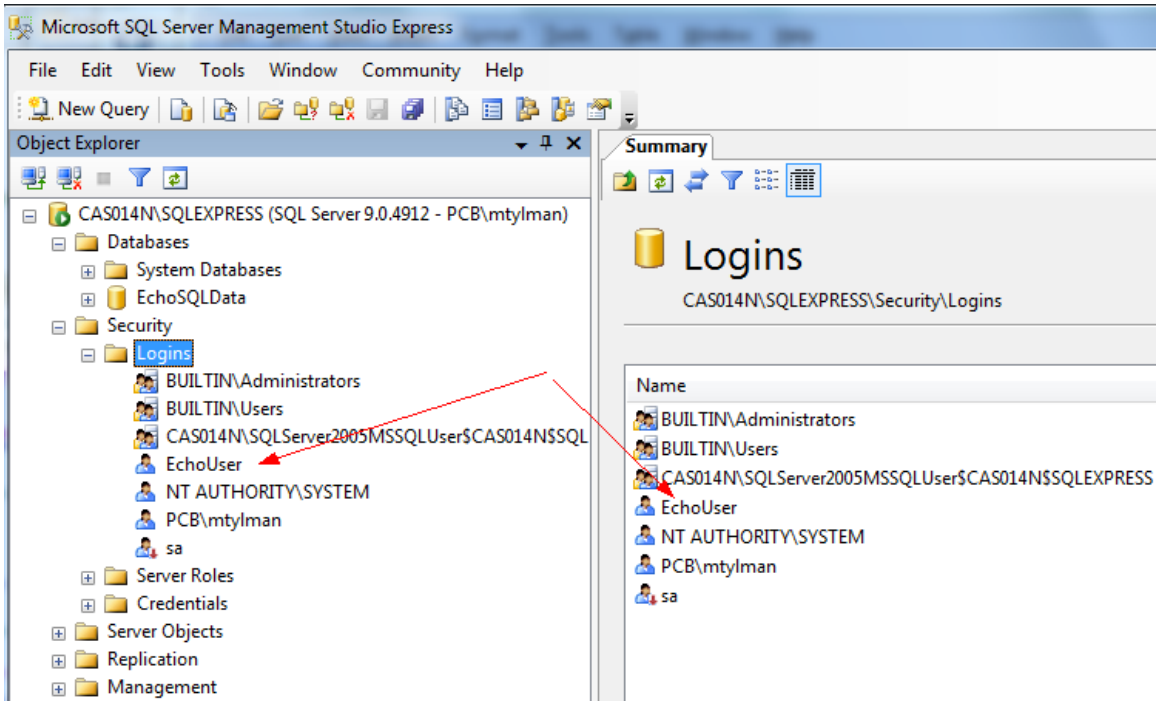


Next ensure the Securables and Status screens look like the one below

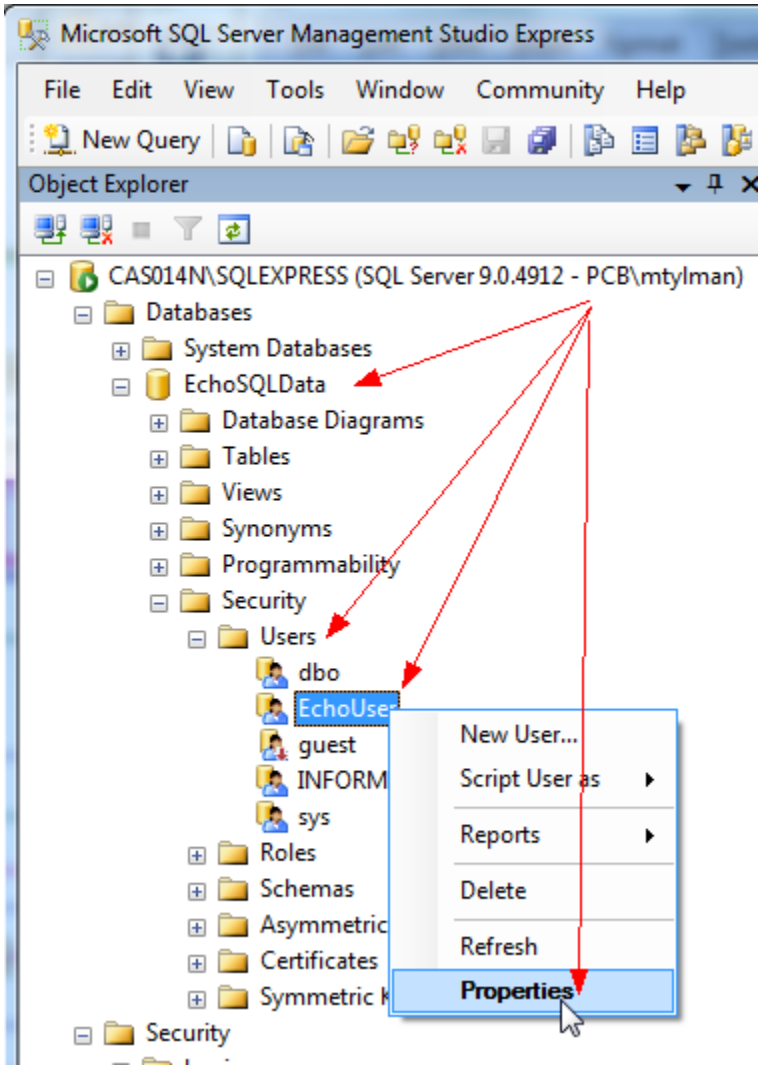


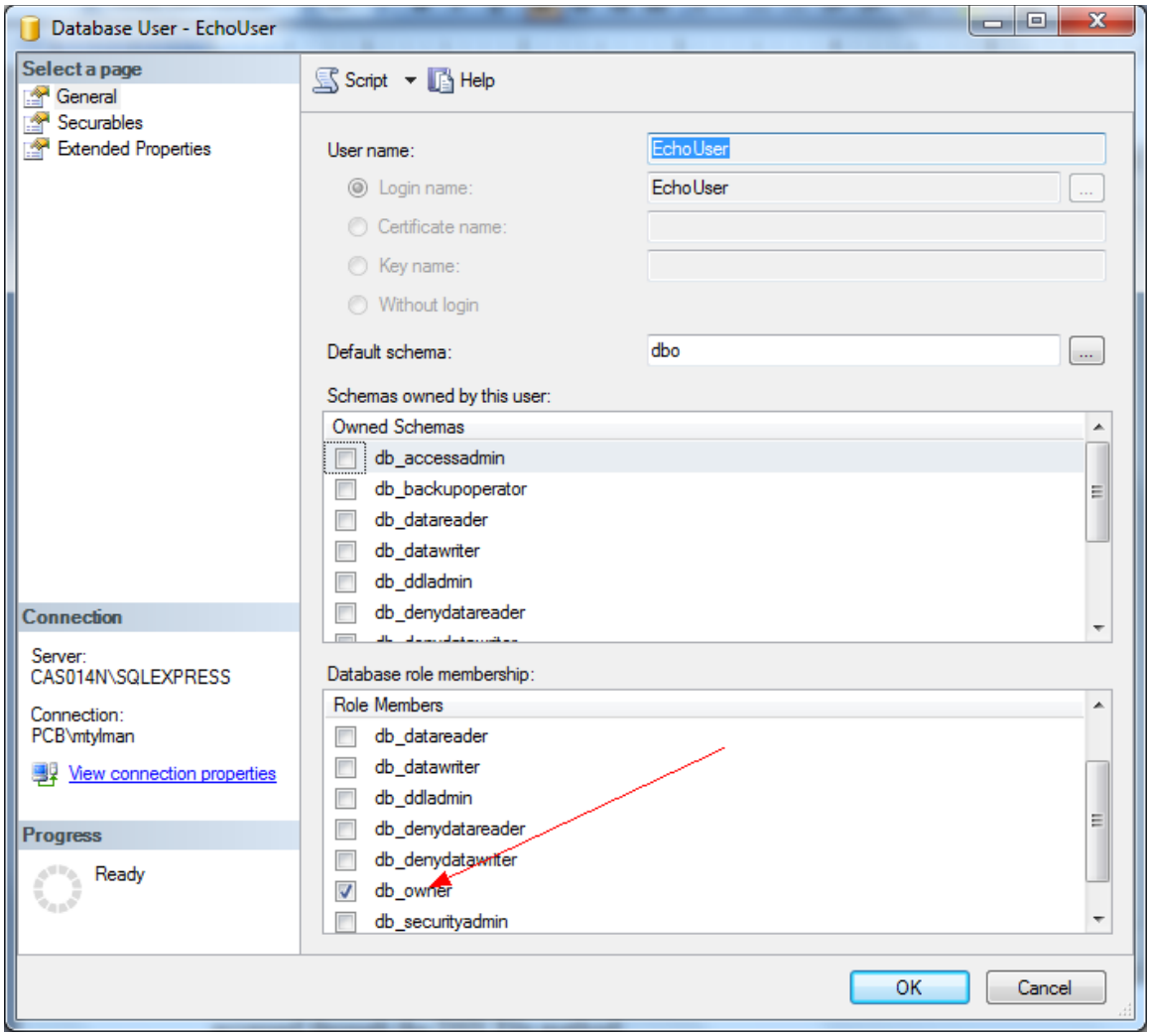


EchoUser should now show up in the logins screen


Microsoft SQL Server Management Studio Express
File Edit View Tools Window Community Help
New Query
Object Explorer
CAS014N\SQLEXPRESS (SQL Server 9.0.4912 - PCB\mtylman)
Databases
System Databases
EchoSQLData
Security
Logins
BUILTIN\Administrators
BUILTIN\Users
CAS014N\SQLServer2005MSSQLUser$CAS014N$SQL
EchoUser
NT AUTHORITY\SYSTEM
PCB\mtylman
sa
Server Roles
Credentials
Server Objects
Replication
Management
Summary
Logins
CAS014N\SQLEXPRESS\Security\Logins
Name
BUILTIN\Administrators
BUILTIN\Users
CAS014N\SQLServer2005MSSQLUser$CAS014N$SQLEXPRESS
EchoUser
NT AUTHORITY\SYSTEM
PCB\mtylman
sa

Next under the EchoSQLData DB select; **Security | Users | EchoUser | Properties**





Make SURE that db_owner is set or messages like the following may occur when it is accessed through the DSN File method:

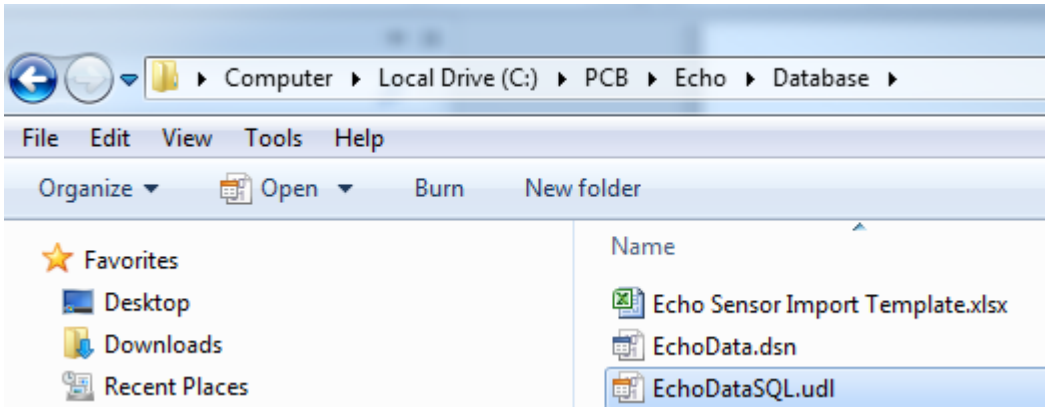
DSN File:
Error -2147217911 occurred at NI_Database_API.lvlib:Conn Execute.vi->DataBase Query.vi->DB Connection Test Dialog.vi

Possible reason(s):
ADO Error: 0x80040E09
Exception occured in Microsoft OLE DB Provider for ODBC Drivers: [Microsoft][ODBC SQL Server Driver][SQL Server]The **SELECT permission was denied on the object** 'Sensor', database 'EchoSQLData', schema 'dbo'. in NI_Database_API.lvlib:Conn Execute.vi->DataBase Query.vi->DB Connection Test Dialog.vi
OR
UDL:
Error -2147217911 occurred at NI_Database_API.lvlib:Conn Execute.vi->DataBase Query.vi->DB Connection Test Dialog.vi
Possible reason(s):
ADO Error: 0x80040E09

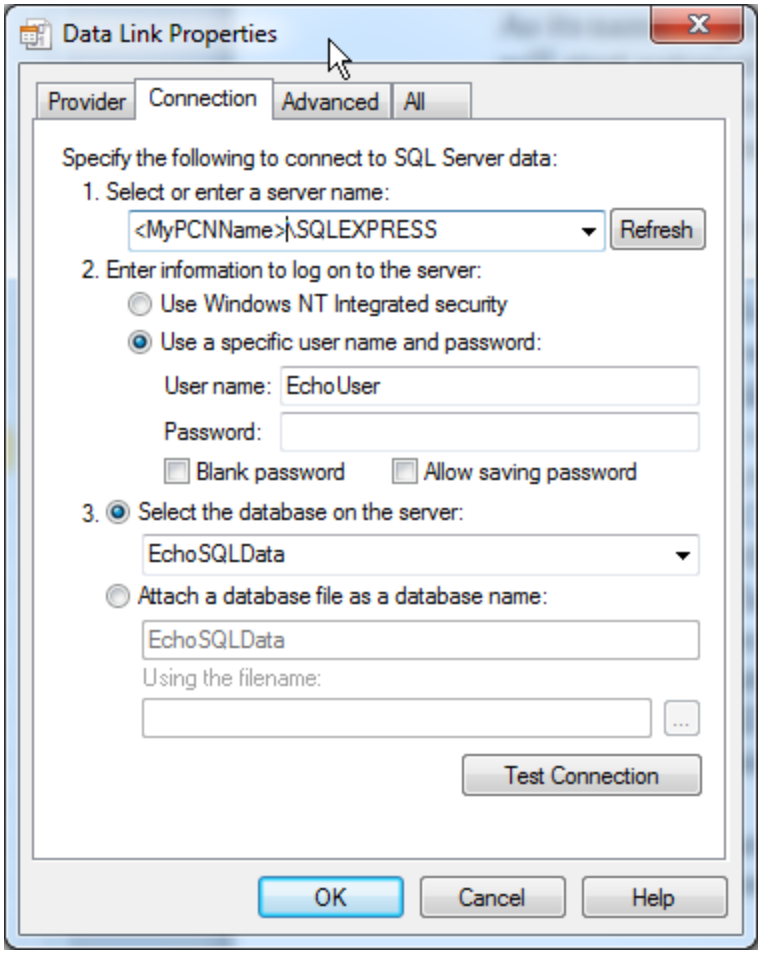
Exception occured in Microsoft SQL Native Client: **The SELECT permission was denied on the object 'S**ensor', database 'EchoSQLData', schema 'dbo'. in NI_Database_API.lvlib:Conn Execute.vi->DataBase Query.vi->DB Connection Test Dialog.vi

6.2 Part 2 – create an ODBC connection file on the client PC

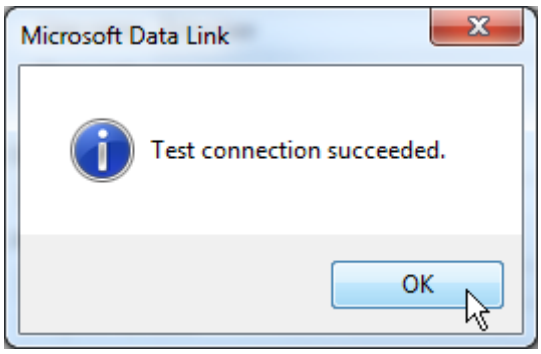
In order to facilitate SQL database access to retrieve Echo® data on a remote PC or server by the Echo® Data Presentation software, an Open Database Connectivity (ODBC) interface needs to be established. The preferred mechanism is configuring a UDL file to do this. You may be able to use the supplied UDL file found in c:\PCB\Echo\Database



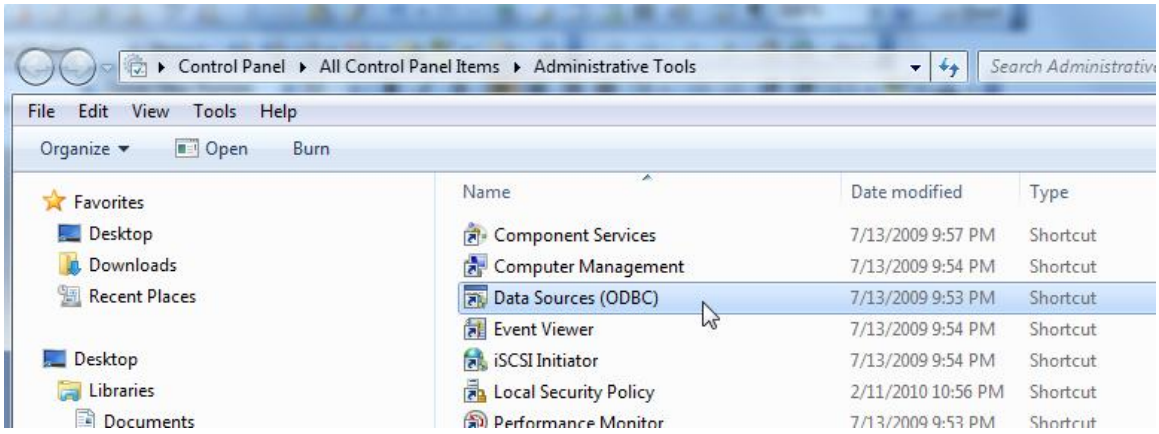
Double click on it to open it



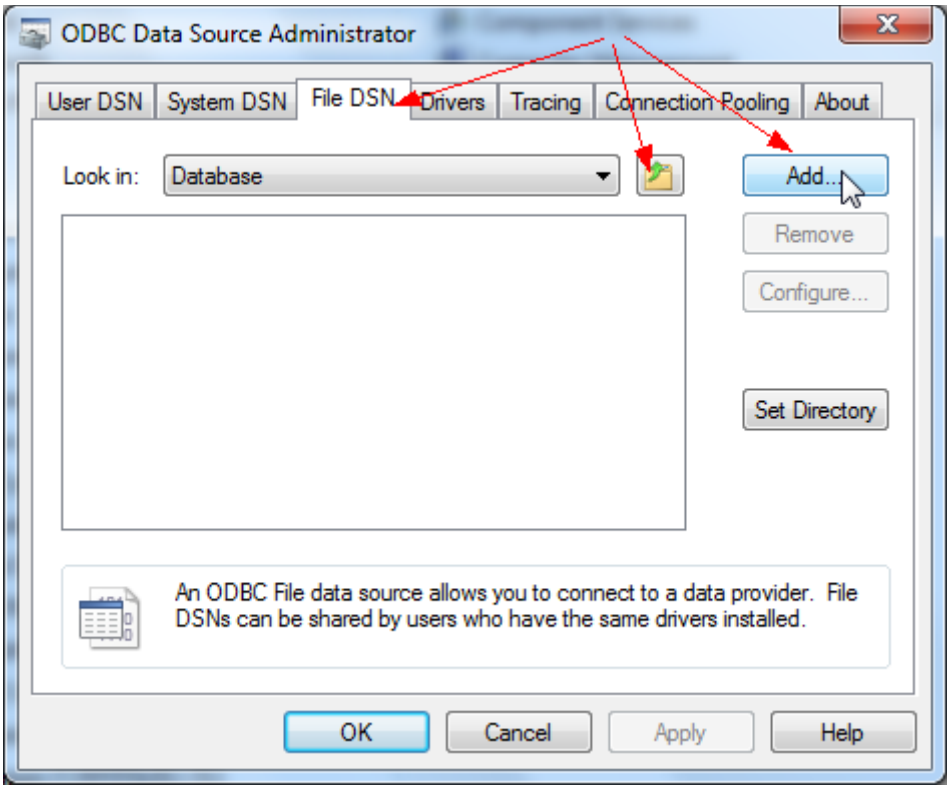
- Change the item 1 to be <your server>
- Change Item 2 to Use a specific user name and password and click 'Blank password'.
- Set item 3 to point to the EchoSQLData database
- Click the Test Connection button and see the following dialog. If the test connect succeeded then your connection file is complete. Use the UDL file in your receiver configuration process.



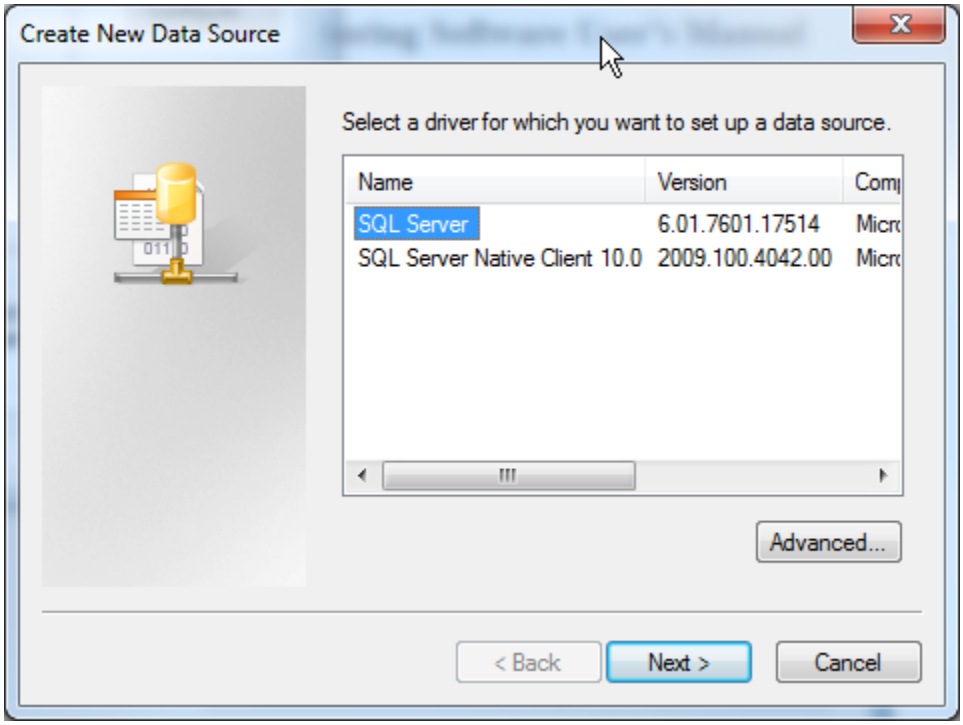
Alternatively an ODBC Data Source Name (DSN) file can be created. Following are the steps to create a DSN file in Windows 7; however, Windows 10 is very similar.



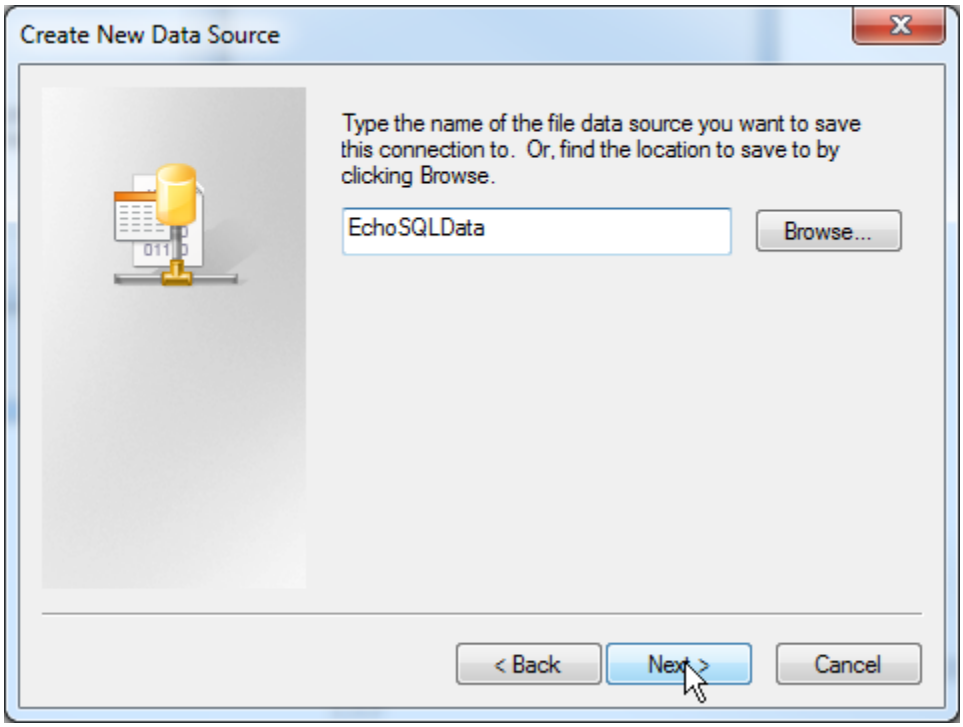
Start | Control Panel | Administrative Tools and open Data Sources (ODBC).



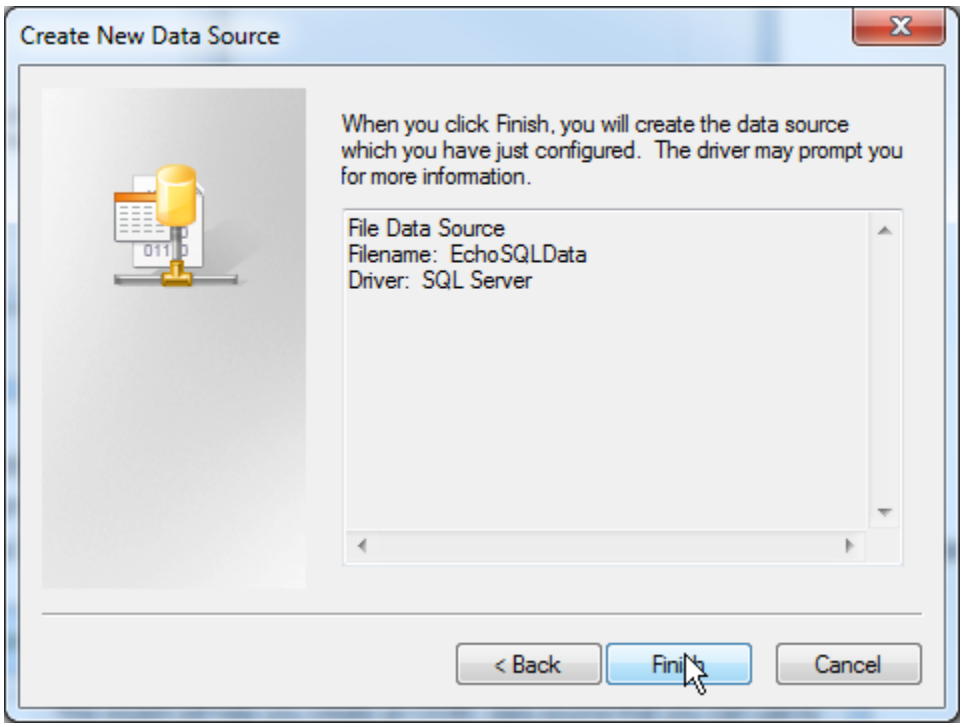
- Select the File DSN Tab
- Use the browse button to find the c:\PCB\Echo Monitoring\Database directory
- Select Add



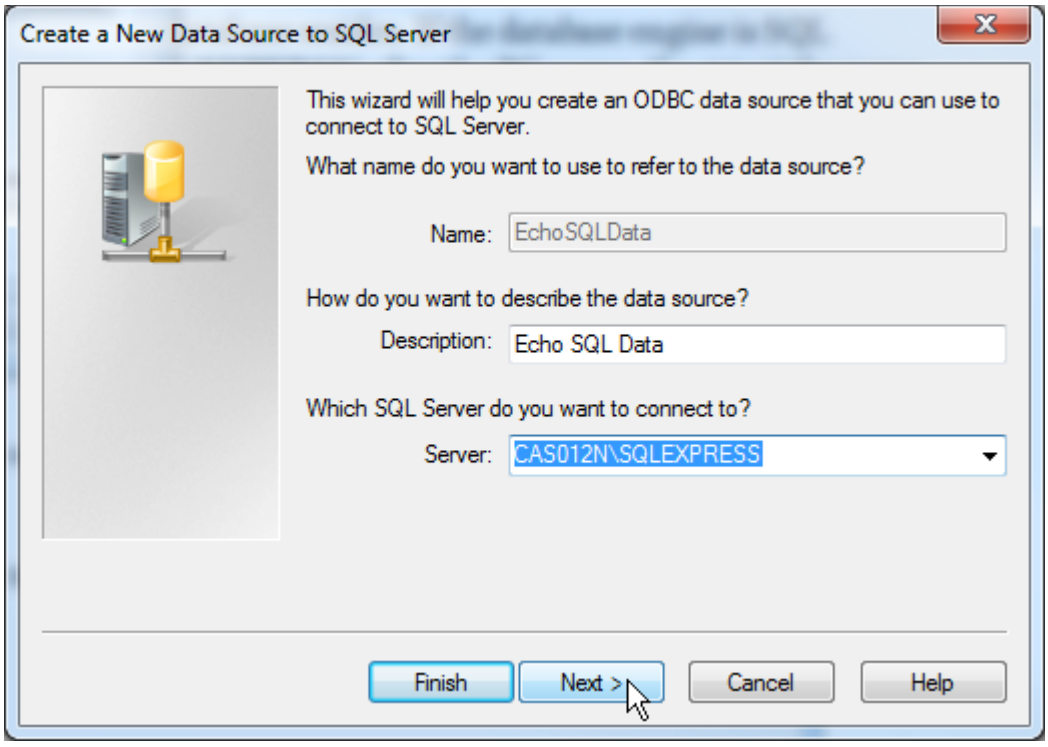
- Select SQL Server as the driver and click Next



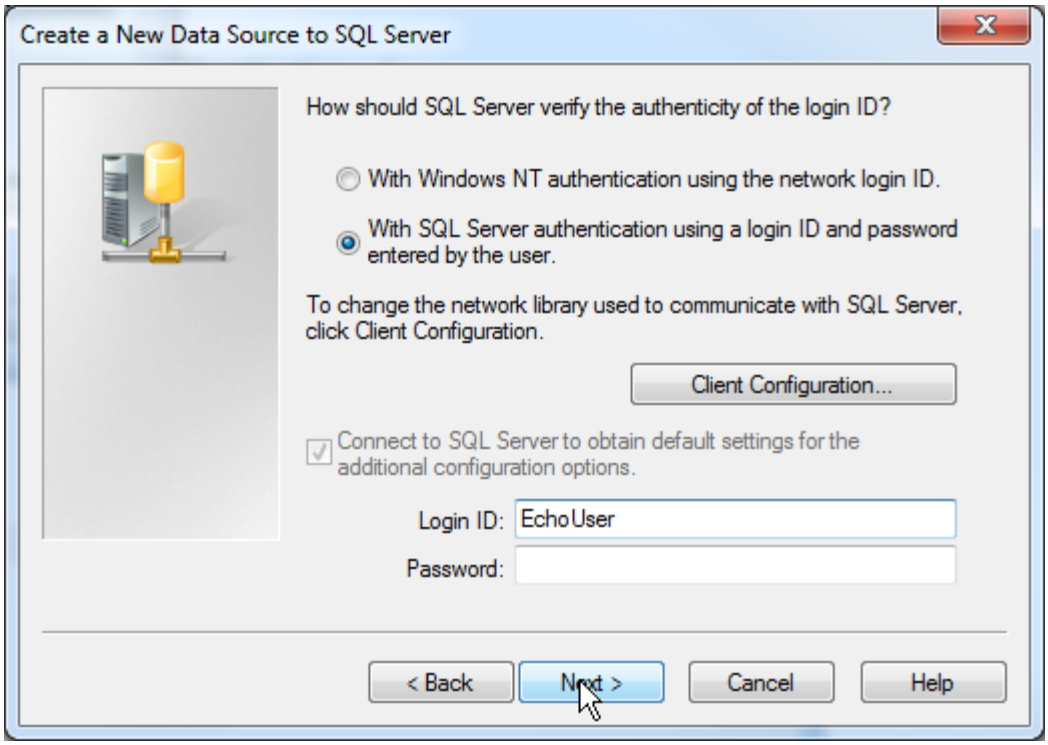
- Enter a name for the file you are creating and click Next



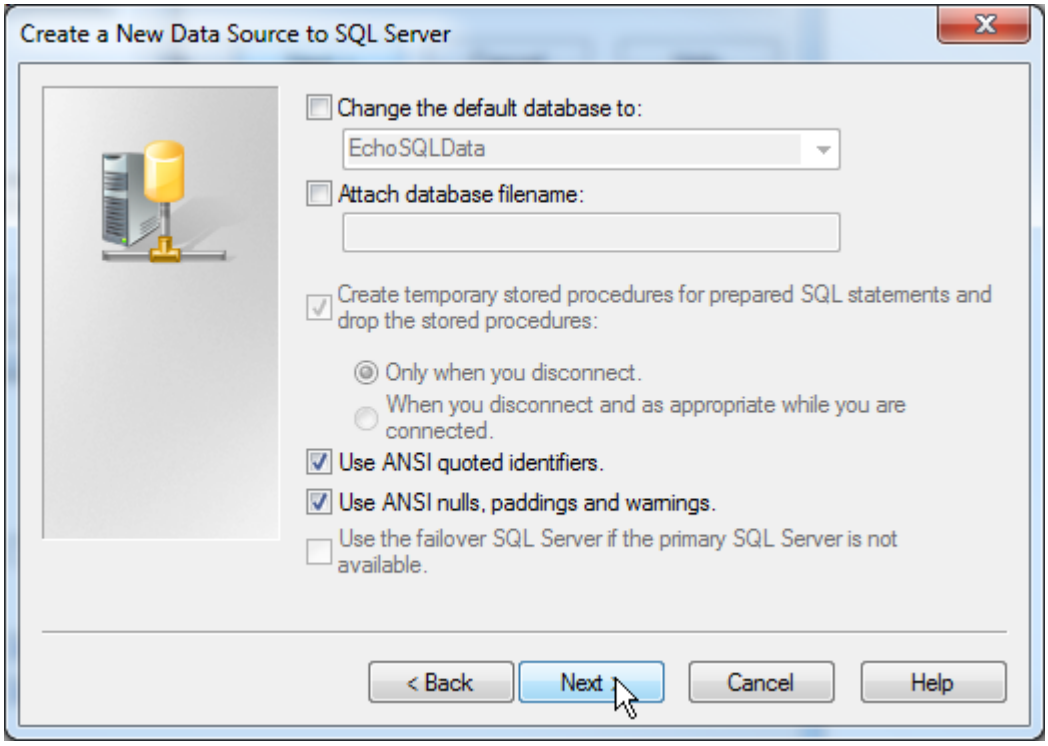
- Click the finish button



- Enter a description
- Enter the Server where the database resides. If the database engine is SQL Express then be sure to add '\EXPERSS' after the PC name, if not just the name is correct.

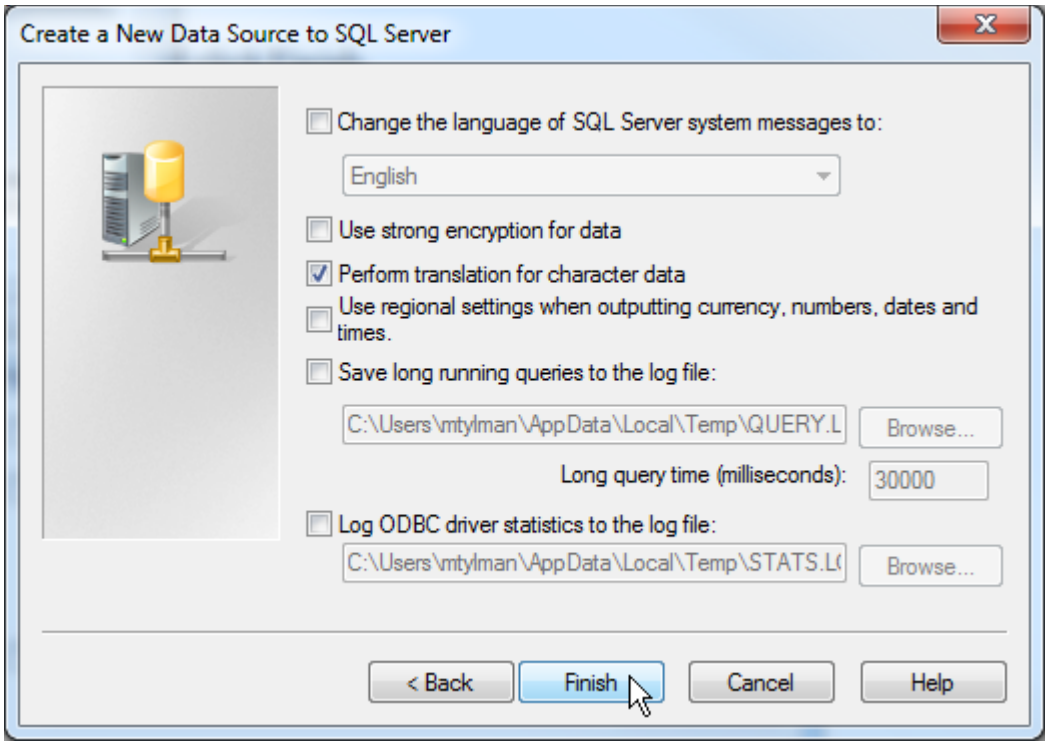


- Select 'With SQL Server authentication…'
- Enter EchoUser and the Login ID and leave the password blank
- Click the Next button

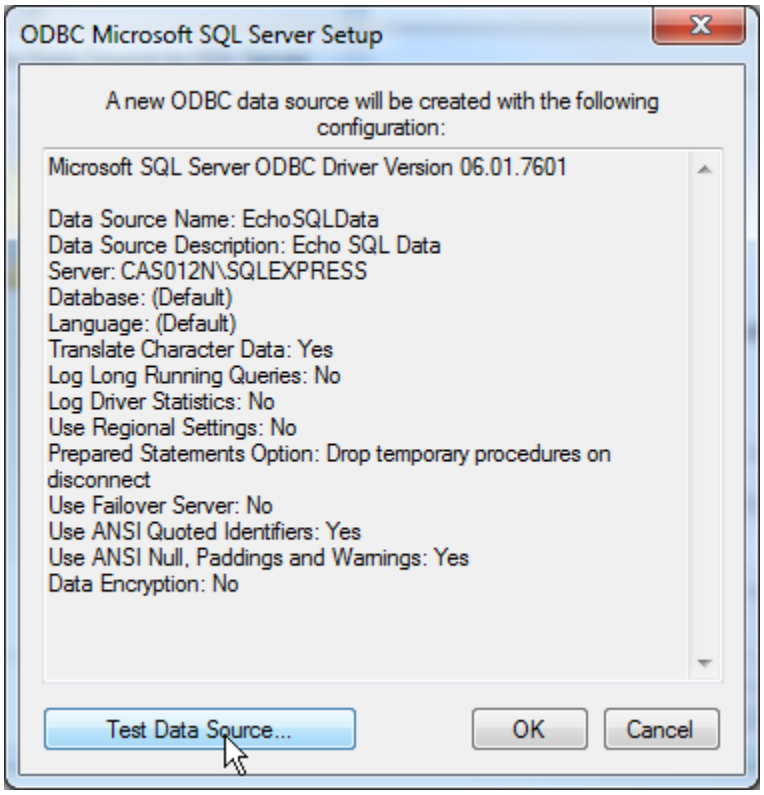


Getting to this screen indicates a connection to the server has been established

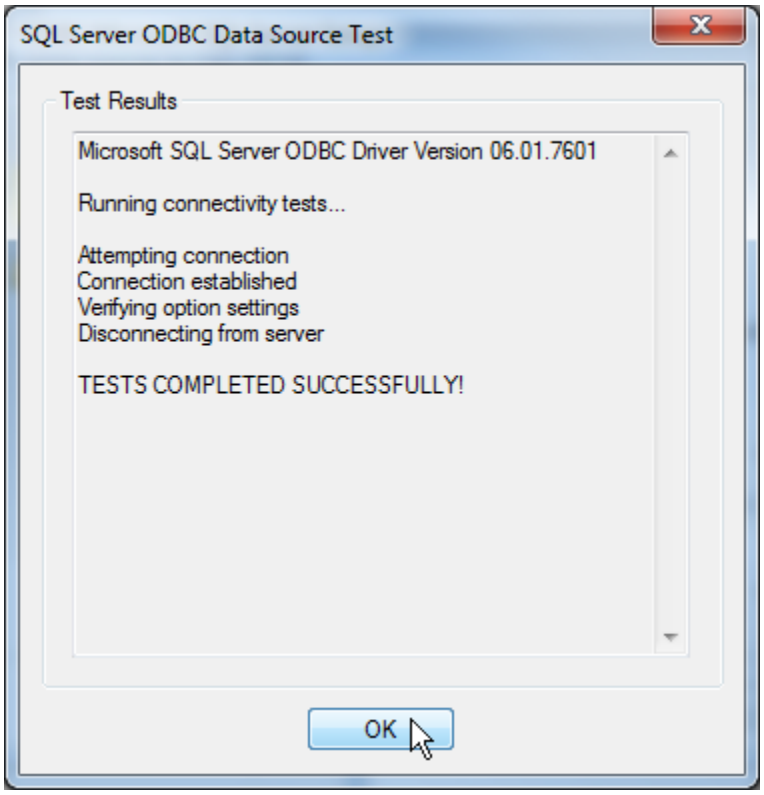
- Leave this screen as it is and click Next.



- Leave this screen as it is and click Finish.



- When this screen appears click 'Test Data Source'



This screen indicates a successful connection to the database has been established. The Echo® Monitoring should now be able to access data in it.