

**LUDLUM MODEL 375Net-32 Stack Monitor**  
**Part #: 1370-063 Version 1.2.0**

**SOFTWARE MANUAL**  
**Version 1.2.0**

**October 2016**

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## 1. GENERAL

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The model 375-Net software (LMI Part #: 1370-063) monitors and logs the data from up to 32 model 375 instruments connected via RS-232. Additional com ports can be added to a computer via USB to RS-232 converters.

The model 375's output a data message every 2 seconds regardless if it's connected to a computer. The data includes the current radiation readings and the current status of the instrument.

The readings displayed on the screen are updated every 2 seconds. The background color of the reading box changes to indicate the status of the instrument.

<b>COLOR</b>	<b>STATUS</b>
Gray	Offline
Green	Online and OK
Yellow	Low Alarm
Red	High Alarm
Orange	Over Range
Purple	Detector Failure
Cyan	Error

The data is logged to a database at a user-specified time interval and is the average of the readings collected during the log interval time. Readings where the model 375 is alarming, a fail condition is present, or the reading exceeds a user-defined value can be logged at a different rate than the normal logging interval.

The data received from the instruments are logged into a Microsoft™ Access database, and can be viewed, queried, and graphed directly from within the program. Microsoft™ Access can also be used to view the data. At midnight, the software automatically archives the data into a new database file at a user-defined location.

If enabled, the data can also be saved into a comma delimited (.CSV) file for import into a spreadsheet or other program for further manipulation.

The software can monitor data from an air velocity transmitter connected to the computer through a USB data acquisition system. When enabled, the accumulated output is displayed on the status bar of the main screen. The airflow in CFM, the output sample average in pCi, and the accumulated output in pCi are stored in the database.

## 2. FEATURES

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- The logged data can be directly viewed from within the program. The data can be queried in the following ways:
  - All Records
  - Status OK
  - Status Not OK
  - Status Alarm
  - Reading above user defined value
- Display live or archived data as a graph directly from the program.
- Display the minimum, maximum, and average reading for a specific day. Also shows number of alarms, alerts, errors, etc.
- E-mail specific persons based on whether an instrument receives an alarm or failure. Separate e-mail addresses for normal working hours and nighttime.
- A user-defined bitmap can be used to display the readings on the map. The map can be scaled to 25%, 50%, 75%, or 100% size. An editor allows the channel locations to be moved to any point on the map.
- An indicator that under each displayed reading that changes color when data is received from the instrument.
- Labels for each channel are user definable.
- A user-defined comment is available for each channel.
- Alarms can trigger a user-defined .WAV file to play through the computer speakers.
- Data can be logged at different intervals depending on alarm conditions or readings that exceed a user defined value.
- User-defined location of database, .CSV files, and archive location
- Database queries can be saved to create a new database file.
- The logged data is archived automatically at midnight.
- Calculate the accumulated output using an air velocity transmitter and log this information to a database.

### 3. INSTALLATION

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#### Hardware Requirements:

A Windows™ based PC with enough COM ports for every model 375 that is to be connected. If the computer already has enough com ports for the number of 375's then no extra hardware is required.

Digi ([www.digi.com](http://www.digi.com)) makes a USB to RS232 converter that makes it very easy to add 32 com ports to any computer equipped with a USB ports. A USB hub may be required to connect more than 2 converters depending on the number of available USB ports.

#### LMI Part Number

2310687	8 Port USB to RS-232 Converter
4396-310	M 375Net-32 8 Port Kit (includes 8-port USB to RS-232 converter)
22-9423	Air Flow meter 641-12 12"
2312600	NI USB-6008 Bus-Powered Multifunction DAQ USB Device

#### Minimum PC requirements:

1 GHz processor or greater  
 2 GB of memory (4 GB recommended)  
 CD-ROM drive  
 2 GB storage space (More space will allow for more data to be saved)  
 SVGA monitor capable of a resolution of 800x600 or greater.  
 Windows 7 or higher

#### Software Installation:

Insert CD into CDROM drive. If the installation does not start automatically, run "SETUP.EXE" on the CD. The drivers for the USB Data Acquisition module are located on the CD under the "ni-daqmx" folder. Install the drivers before connecting the DAQ to the computer..

#### Hardware Installation:

The software uses Analog input A0 for reading the 4-20mA signal from the air velocity transmitter. See the air velocity transmitter installation and operating instructions for more information. *See version 1.0.0 manual for installation with B&B USB DAQ.*

<i>Air velocity transmitter</i>	<i>USB I/O Module</i>
V+ (RED WIRE)	Pin 2 AI 0 (AI 0+)
V- (BLK WIRE)	Pin 1 GND

The model 375 connection to the computer's RS-232 port requires only two wires (TXD and GND).

	<b>Model 375</b>	<b>PC (9-pin)</b>
<b>TXD</b>	Pin 4	Pin 2
<b>GND</b>	Pin 2	Pin 5

The cable connector has male pins on the model 375 side and female pins on the PC side. The communication parameters for each serial channel are:

2400 bps (baud rate)  
 No parity  
 8 data bits  
 1 stop bit  
 No handshaking

It is possible to setup serial terminal program to verify the data coming from the model 375. To use a terminal program, configure it using the parameters above. Some examples are HyperTerminal, Indigo Terminal, or teraterm.

Every 2 seconds the model 375 sends out 14 bytes with a carriage return and linefeed character ending each message string. The model 375 transmits the data continuously even if no computer is connected to it.

### RS-232 Data Format

BYTE1	0		x
BYTE2	x		x
BYTE3	x	OR	x
BYTE4	x		x
BYTE5	.		.
BYTE6	x		0
BYTE7	Audio Status		1=ON
BYTE8	High Alarm Status		1=ON
BYTE9	Low Alarm Status		1=ON
BYTE10	Over Range Status		1=ON
BYTE11	Monitor Status		1=ON
BYTE12	Error Code		
BYTE13	Carriage Return (ODH)		
BYTE14	Line Feed (0AH)		

### Error Codes

- 0 = No error.
- 1 = Got a negative number.
- 2 = the dtc count exceeded 3 bytes.
- 3 = Addition overflow.
- 4 = Ratemeter exceeded 4 bytes
- 5 = Multiplication Overflow.
- 6 = Division by 0.
- 7 = Accumulator Overflow.
- 8 = Shift Overflow.
- 9 = EEPROM write error.

#### 4. STACK MONITORING

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One channel may be designated for stack monitoring. When stack monitoring is enabled, the software will calculate the airflow in cubic feet/minute (CFM) and the accumulated output in Pico Curies. The duct diameter, calibration constant, and background reading must be input correctly for the calculations to be correct. The designated model 375 must also be set to output its readings in KCPM.

The USB128A8D converts the 4-20mA reading from the air velocity transmitter into a 12-bit A/D value which is then converted into an air velocity in either feet per minute (FPM) or meters per second (MPS). To calculate the air velocity, it is necessary to specify the full scale reading of the air velocity transmitter in Preferences window and this must match the air velocity transmitters range selection. The transmitter can be configured as:

<b>Feet per Minute</b>	<b>Meters per Second</b>
250	1.25
500	2.5
1000	5
2000	10
3000	15
5000	25
10000	50
15000	75

**NOTE:** See the Installation and Operating Instructions for correct setup of the air velocity transmitter.

The air velocity is calculated as:

$$\text{Air Velocity (FPM)} = \text{Full-Scale} * ((\text{Count} - 819) / 3277)$$

Where:

Full-Scale = air velocity transmitter full scale

Count = 12-bit A/D value read from AD Input Ch0 of USB128A8D

Once the air velocity is calculated, the airflow in cubic feet/minute (CFM) is calculated. The airflow is calculated as:

$$\text{Airflow (CFM)} = (\text{Duct Diameter (in)} / 24 \text{ (in)})^2 * \pi * \text{Air Velocity (FPM)}$$

The air velocity and airflow are calculated every time the model 375 sends a data message which is every two seconds. The airflow is logged to the database in CFM.

The accumulated output is calculated based on the airflow, the current radiation reading, the interval time, and the background and calibration constants. The output sample is calculated every two seconds and added to the accumulated output. The output sample saved to the database is sum based on the number of samples collected and the interval that the software logs the value to the database.

The formula for calculating the output sample is:

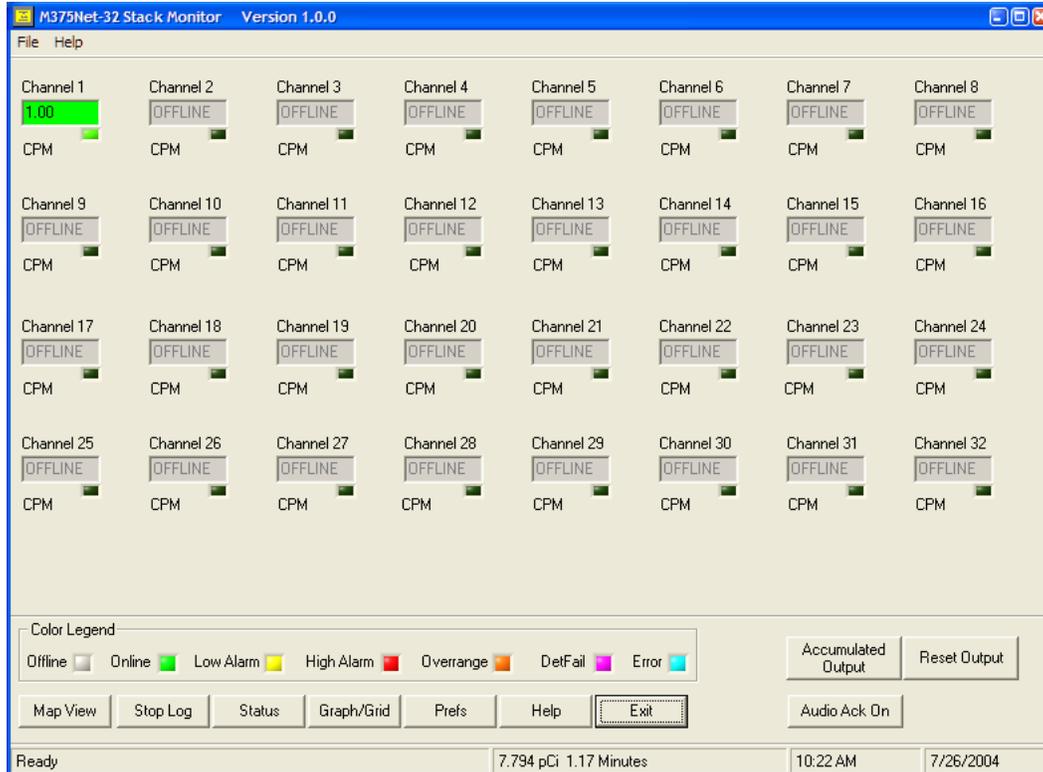
Output Sample (pCi) = (Reading (KCPM) – Background (KCPM)) \* Airflow (CFM) \*  
Sample time (Seconds) \* Calibration Constant (pCi / KCPM · CFM · Secs)

The accumulated output is calculated by adding the output sample every two seconds. The accumulated output is saved to the database in Pico curies. The accumulated output must be manually reset by clicking the “Reset Output” button on the main window or on the “Reset” button on the Accumulated Output window.

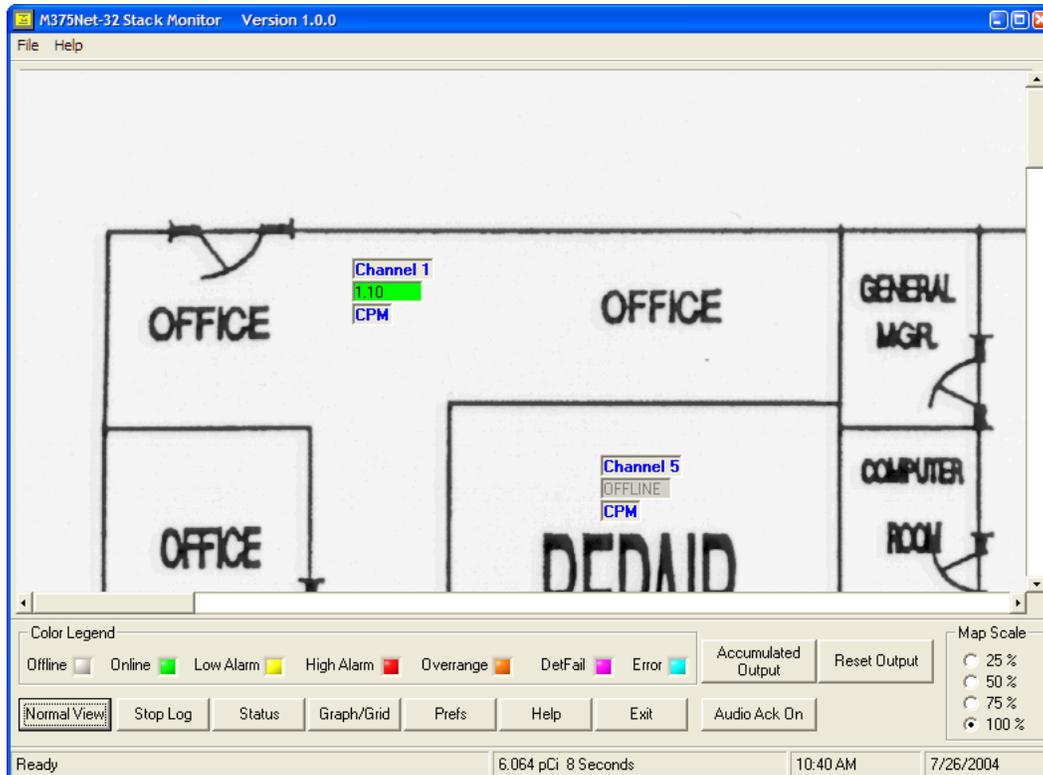
The calibration constant should be determined after installation. The value of the calibration constant will depend on detector efficiency, duct size, and detector placement. The calibration constant is calculated as:

Calibration Constant (pCi / KCPM · CFM · Secs) = pCi / (KCPM \* CFM \* Seconds)

## 5. OPERATION



Main Screen (normal view)



Main Screen (map view)

The main screen consists of a display of 32 channels. Each display is updated when its corresponding model 375 outputs a message. This occurs every 2 seconds and an indicator under each reading box indicates when the software has received data from the model 375. The background color for each channel changes to indicate the status of the channel. The colors are:

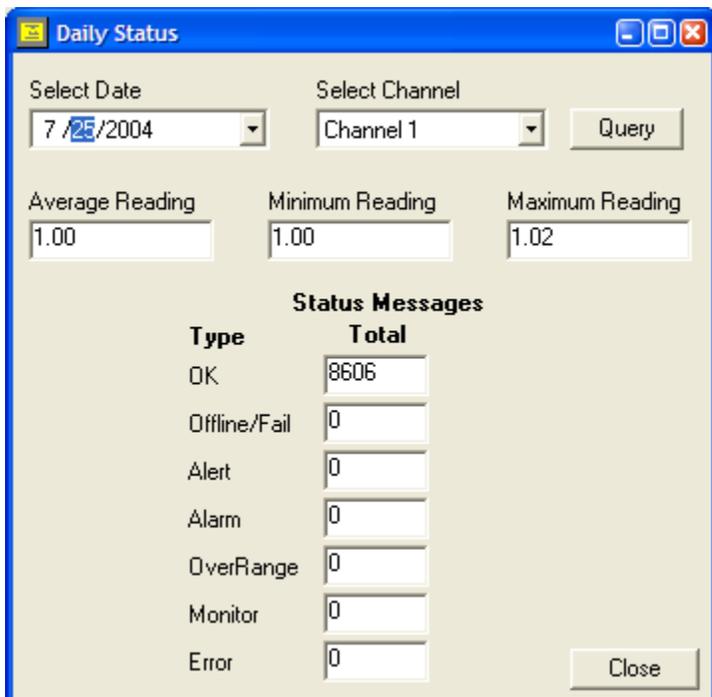
<b>COLOR</b>	<b>STATUS</b>
Gray	Offline
Green	Online and OK
Yellow	Low Alarm
Red	High Alarm
Orange	Over Range
Purple	Detector Failure
Cyan	Error

Above each reading a customizable label is displayed. Below each reading the display units of the model 375 is displayed. Clicking on the reading will bring up the Graph/Grid window with that channel already selected.

**Map View/Normal View:** By selecting the Map View, the display changes to show a user-defined map. The location of the channels can be changed in the location editor in Preferences.

**Stop/Start Log:** Start/Stop logging data to the database and to a comma delimited file. The default is to start logging data as soon as the program is started. The data can be logged at 3 user-defined intervals: Normal Operation, Alarm Condition, or when the Reading exceeds user-defined value. The database stores the channel name, date, time, reading, status, airflow (CFM), output sample (pCi), accumulated output (pCi), and user-defined comment.

**Status:** The status button displays the maximum, minimum, and average reading for the selected day. Also displayed is the total number of each type of status event that occurred for that day.

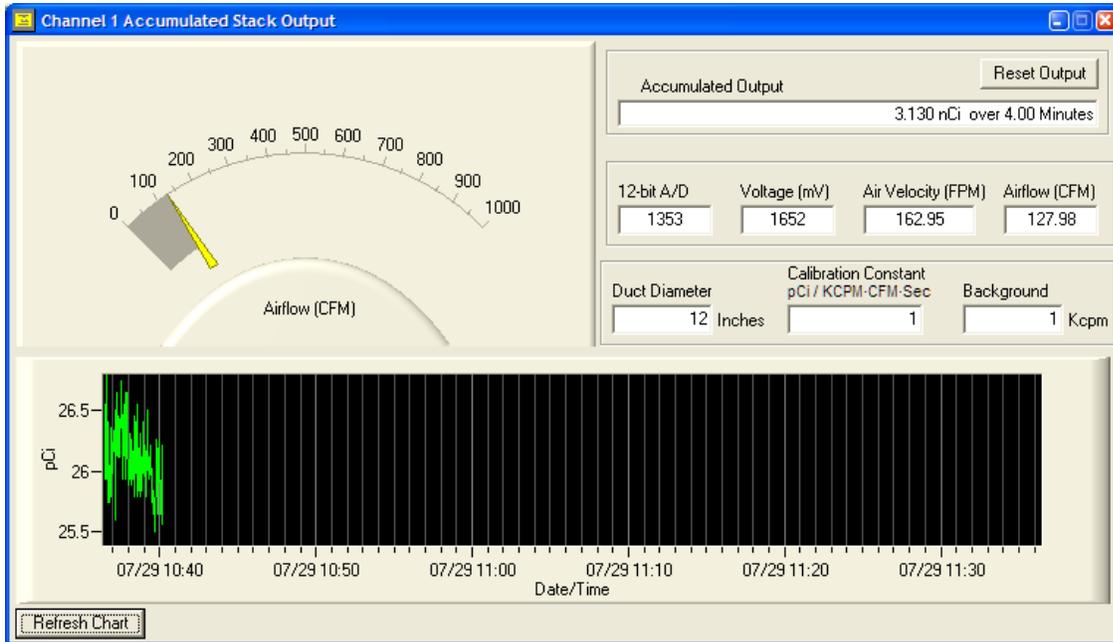


**Graph/Grid:** Displays the Graph/Grid window which allows the data to be viewed either graphically or in a grid. Also, archived data can be viewed here.

**Prefs:** Opens the Prefs window.

**Help:** Displays the help window.

**Accumulated Output:** The Accumulated Output button will display data related to stack monitoring including a meter displaying the current airflow. The output sample chart displays a maximum of two days worth of output samples (86400 samples total).



**Reset Output:** Resets the accumulated output to zero.

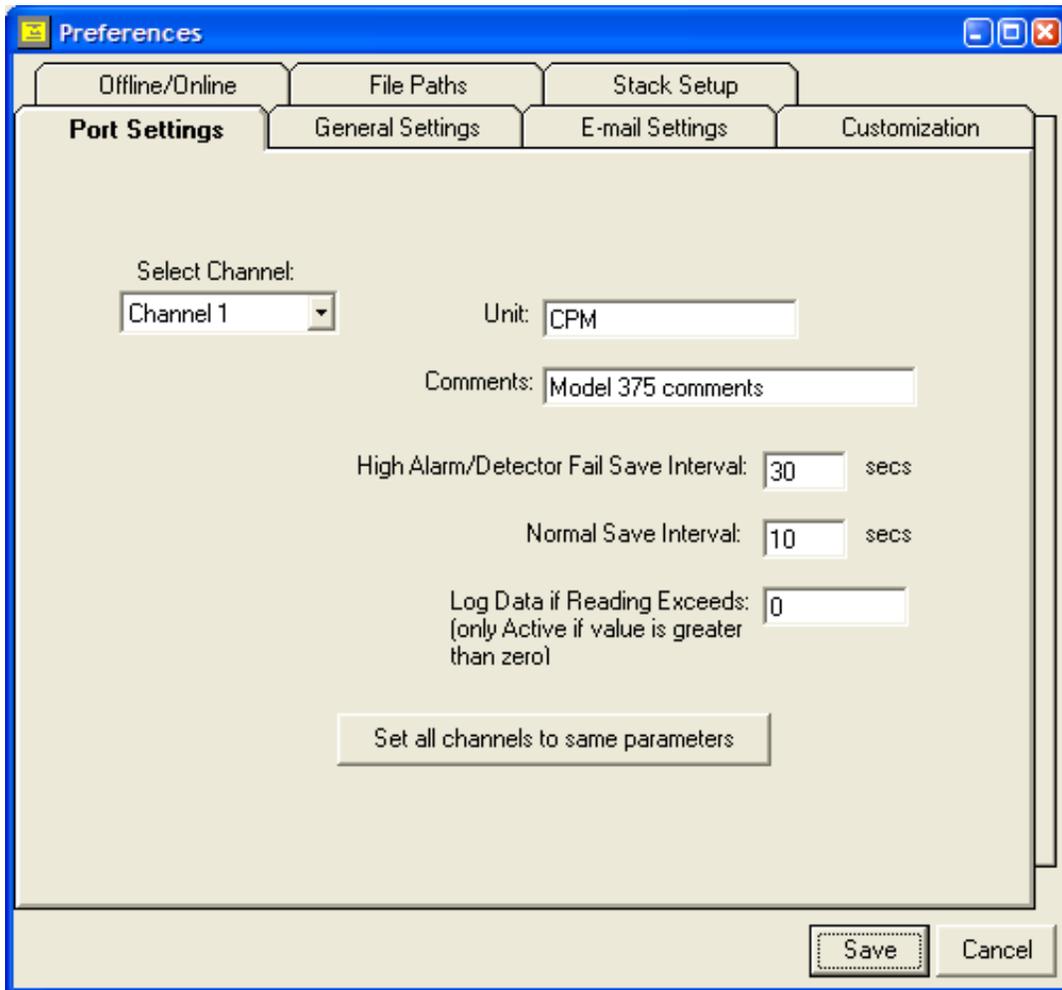
**Audio Ack On/Off:** Acknowledge the audio when an alarm occurs.

**Exit:** Exits the program.

## 6. PREFERENCES

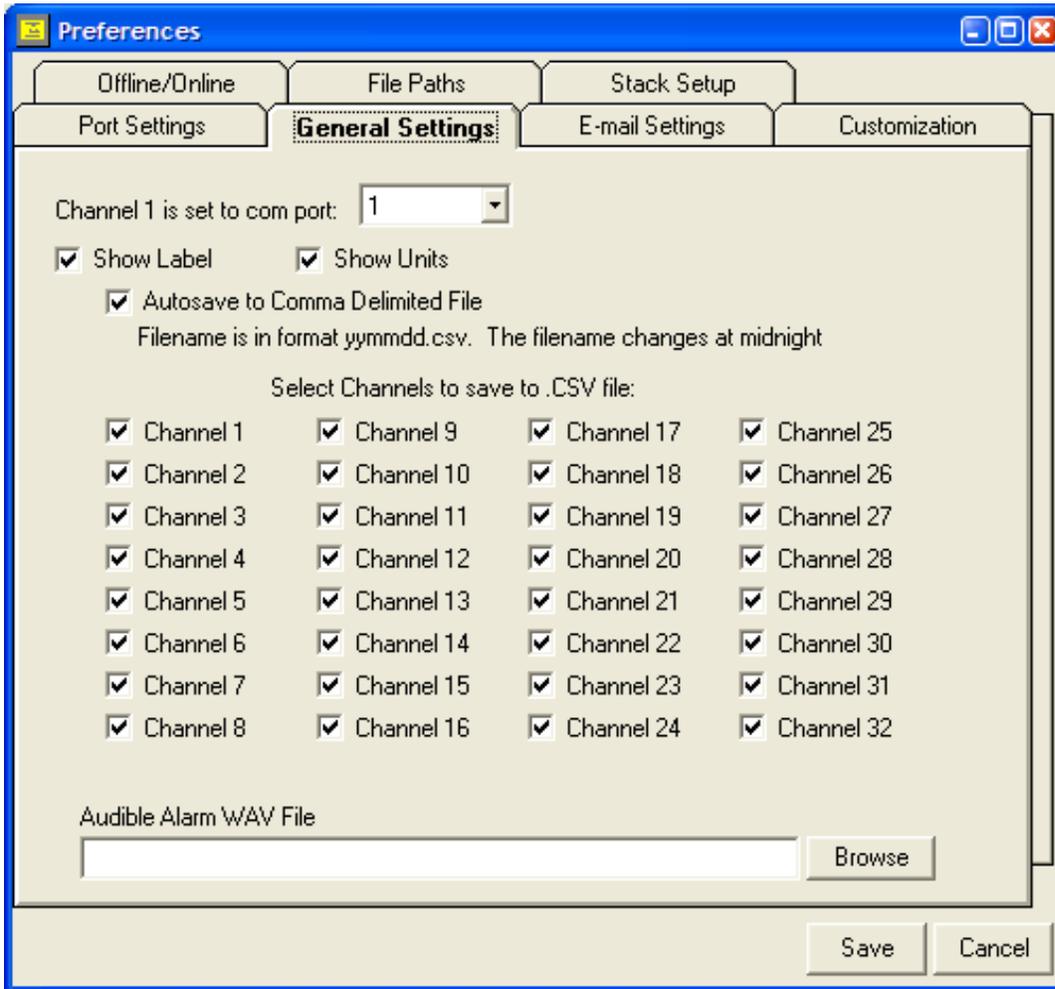
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The Prefs button allows the user to change all of the settings and to edit the location of the channels on the user-defined map. The settings are stored in the M375Net.ini file.



### Channel Settings

Each channel has a user definable Unit, Comment, Normal Log Interval, Alarm save Interval. It is also possible to set all channels to the same unit, comment, and log intervals.



### General Settings

**Channel 1 is set to COM port:** Use this to determine which COM channel, the first channel on the converter will be. The software will look for each 375 starting with this com port.

**AutoSave to Comma Delimited File:** If checked, this will create a comma-delimited file that is updated when the data is logged to the database. The files are stored in the CSV directory specified under the file paths. The filename is "xx-yymmdd.csv" where xx is the channel number and yymmdd is the current date.

**Audible Alarm Wave File:** This is a user-definable wav file that is played when an alarm sounds. The audio acknowledge button on the main screen will silence the alarm.

### Email Setup

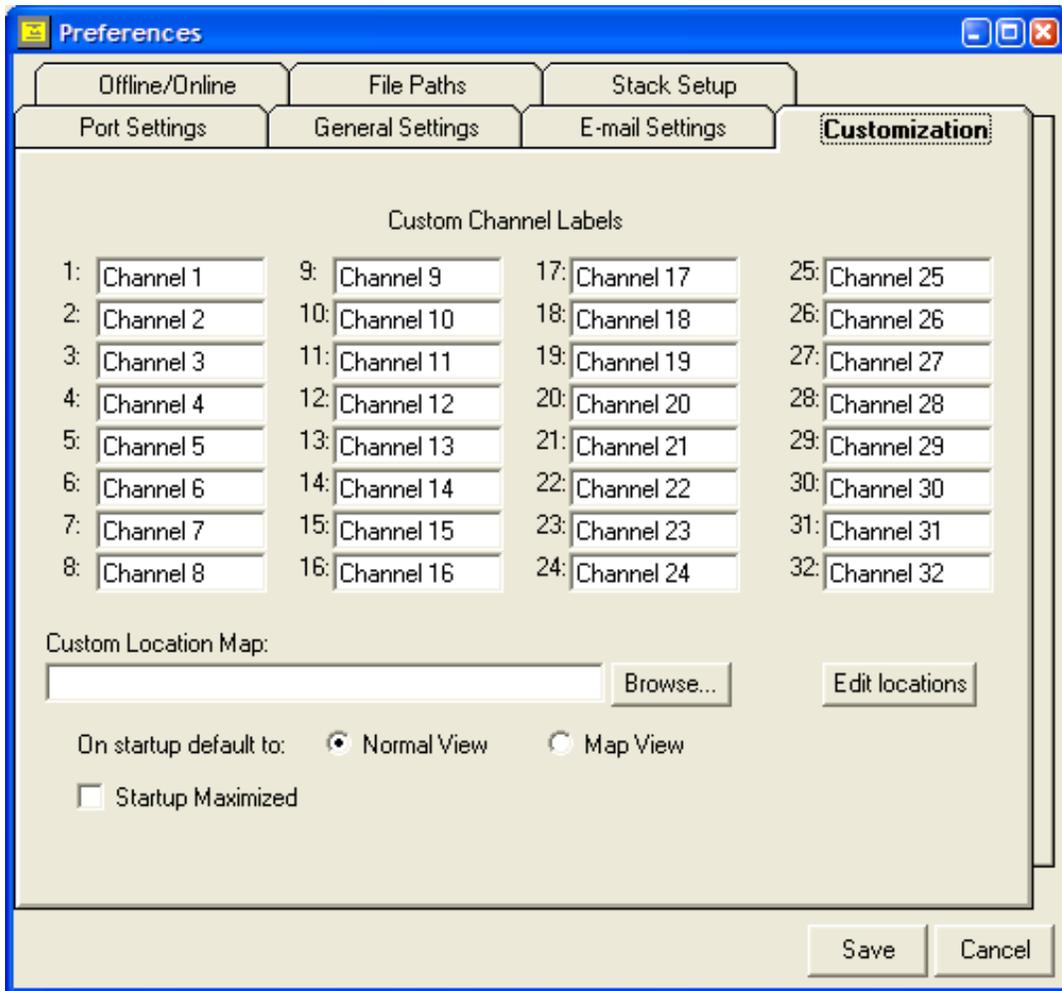
There are 4 separate groups of e-mail addresses with 8 e-mail addresses for each group. The groups are daytime alert/alarm, daytime other event, nighttime alert/alarm, and nighttime other event. The other events include detector failures, errors, offline, and over-range conditions.

To specify the normal business hours check the business hours option and set the start and end hours. If the current time falls between these values then the daytime addresses are used. If the current time falls outside these values then the nighttime addresses are used.

To specify the normal business days check the business day(s) option and click on each day. Days that are not checked are considered to be outside the normal business hours so the nighttime addresses are used.

**Email Subject.** A user-defined field that determines what the subject line of the email will be.

**Custom Message 1 and 2.** Two user-definable fields that are added to the email message when sent.



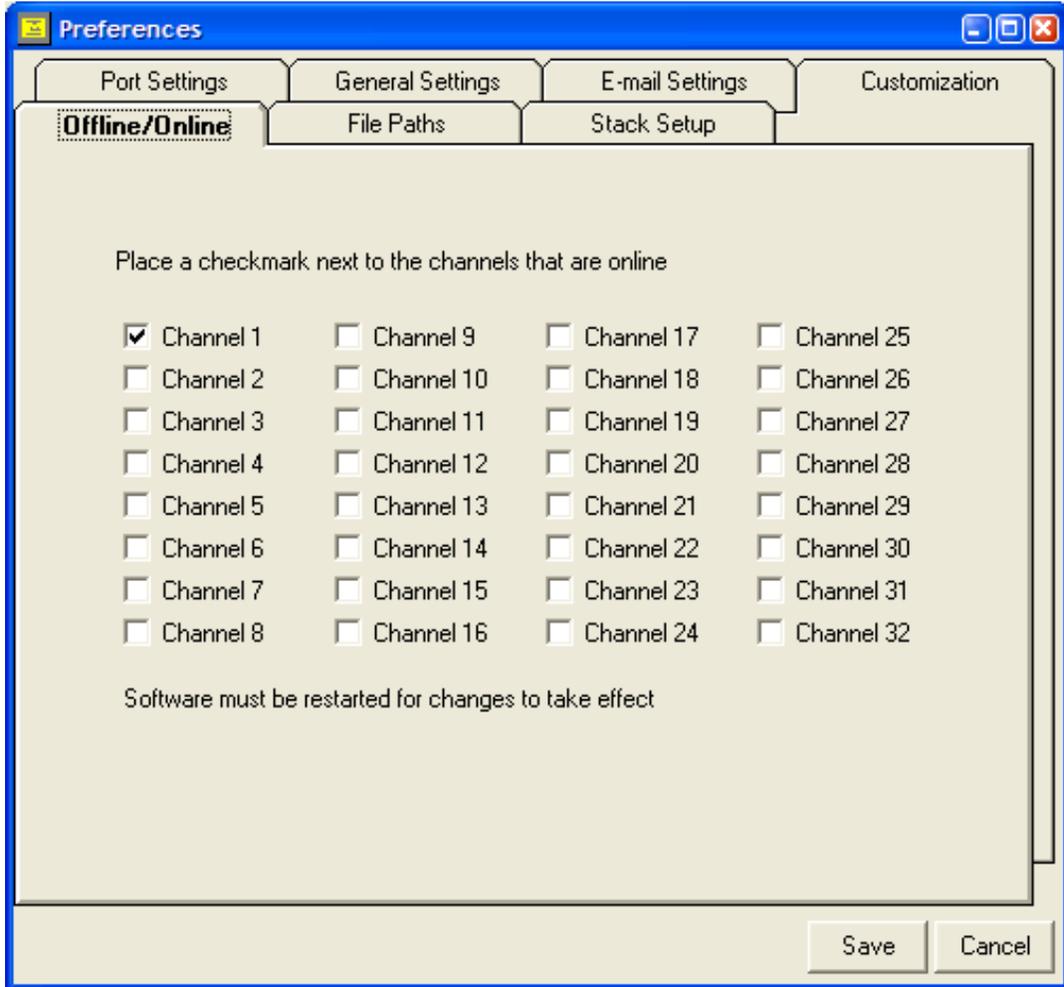
**Customization**

Custom Channel Labels: Each channel can have a custom label name that represents it throughout the program.

Custom Location Map: This is the bitmap that is used for the Map View.

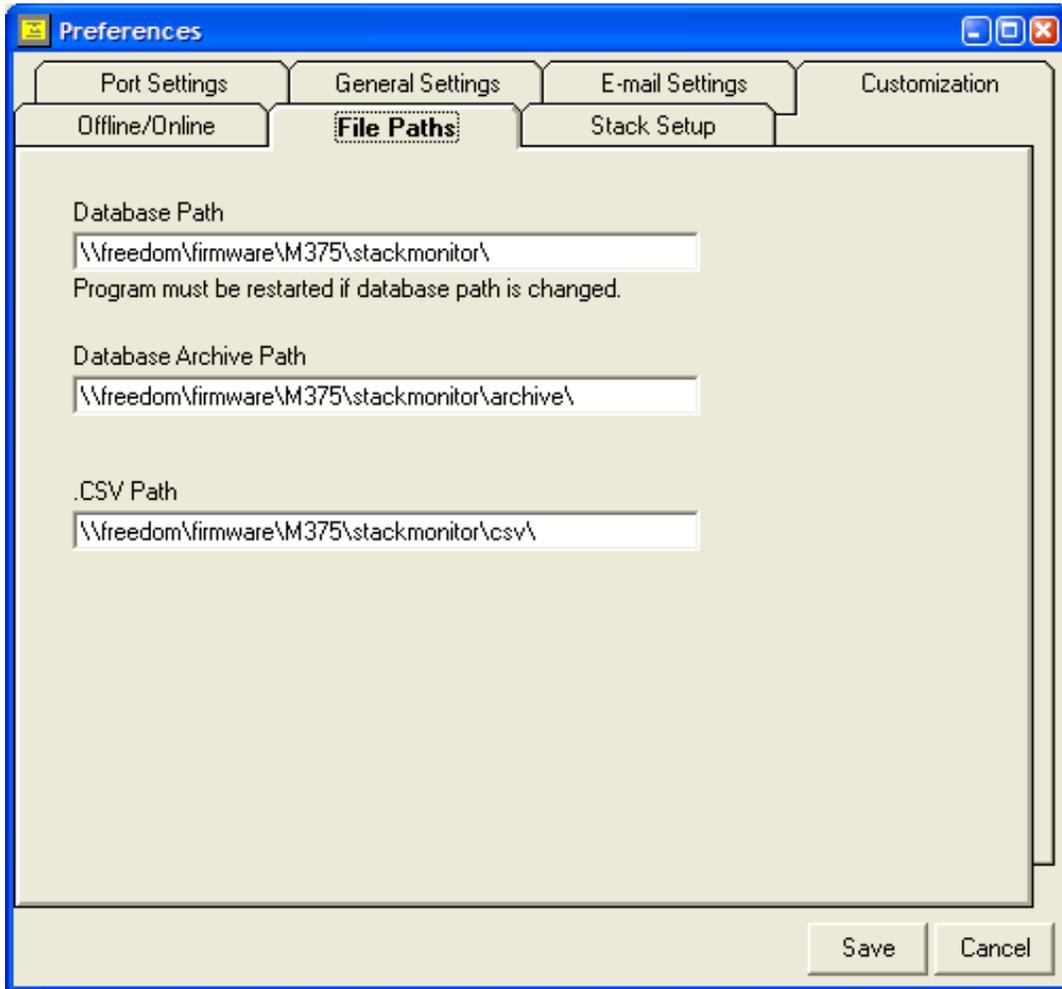
Default View Mode: The default view at startup can either be Normal or Map View.

Edit Locations: This brings up the Location Editor that allows for the channels to be placed onto the map.



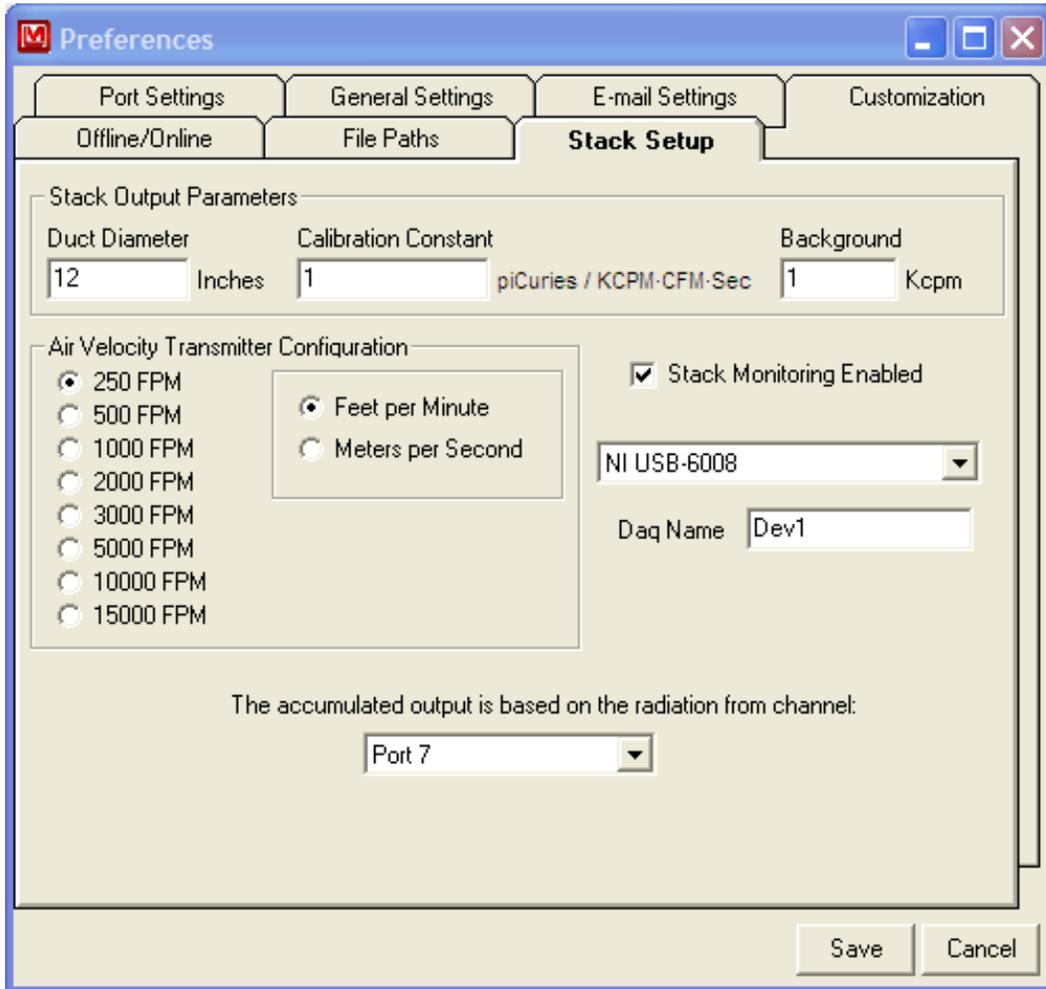
**Offline/Online**

Channels with a checkmark are considered online and will be polled for data. Unchecked channels will not be checked for data.



### File Paths

Change the locations of the live database file, archive path, and .CSV path. The program must be restarted if the location of the live database file is changed. The default location for the data is in ProgramData\Ludlum Measurements, Inc\Model 375 Stack Monitor.



### Stack Setup

**Duct Diameter:** The diameter of the duct where the air velocity transmitter is mounted in inches.

**Calibration Constant:** The calibration constant is used to calibrate the accumulated output and is expressed as Pico Curies / CFM · KCPM · Sec.

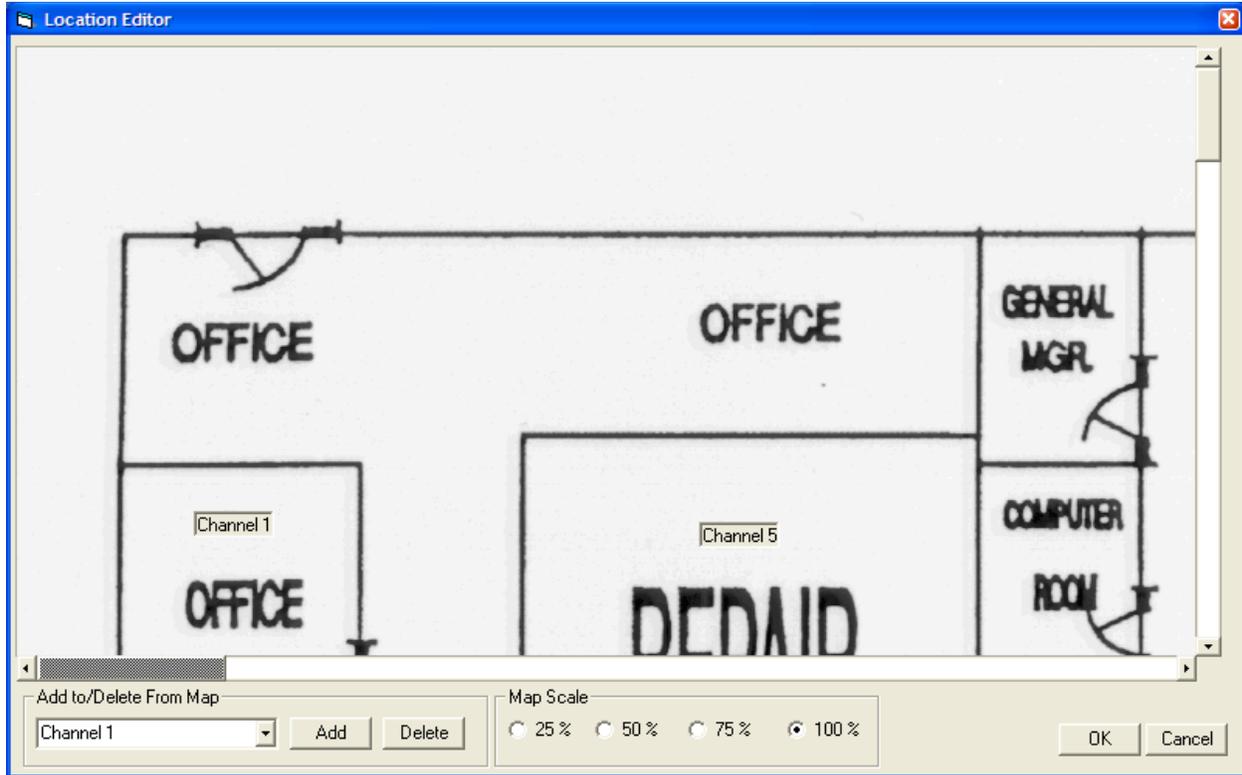
**Background:** The background reading of the model 375 used in stack monitoring and will be subtracted from the current reading when calculating the output.

**Air Velocity Transmitter Configuration:** The full scale reading of the transmitter. This must match the configuration of the transmitter.

**Stack Monitoring Enabled:** Enables or disables the stack monitoring option. There are two types of supported data acquisition modules: NI USB-6008 and B&B UD128A8D. The B&B unit is obsolete but is still supported. When selecting the NI DAQ, the name must of the unit must be specified. The default is “Dev1”.

**Channel:** Specify the designated channel for stack monitoring.

## 7. LOCATION EDITOR



### Overview

The Location Editor allows for the placement of the channels onto the map. Select the specific channel in the list box. Click Add to add to the map and delete to delete from the map. Use the mouse to drag the channel around the map.

The map file name must be in bitmap (.bmp) format. The user can scan in a blueprint/map of the area and save in bitmap format. Each map is composed of 4 files with each file representing a scale of 100%, 75%, 50% and 25%.

### Creating Map Files

The files must be located in the same directory with filenames corresponding to the following:

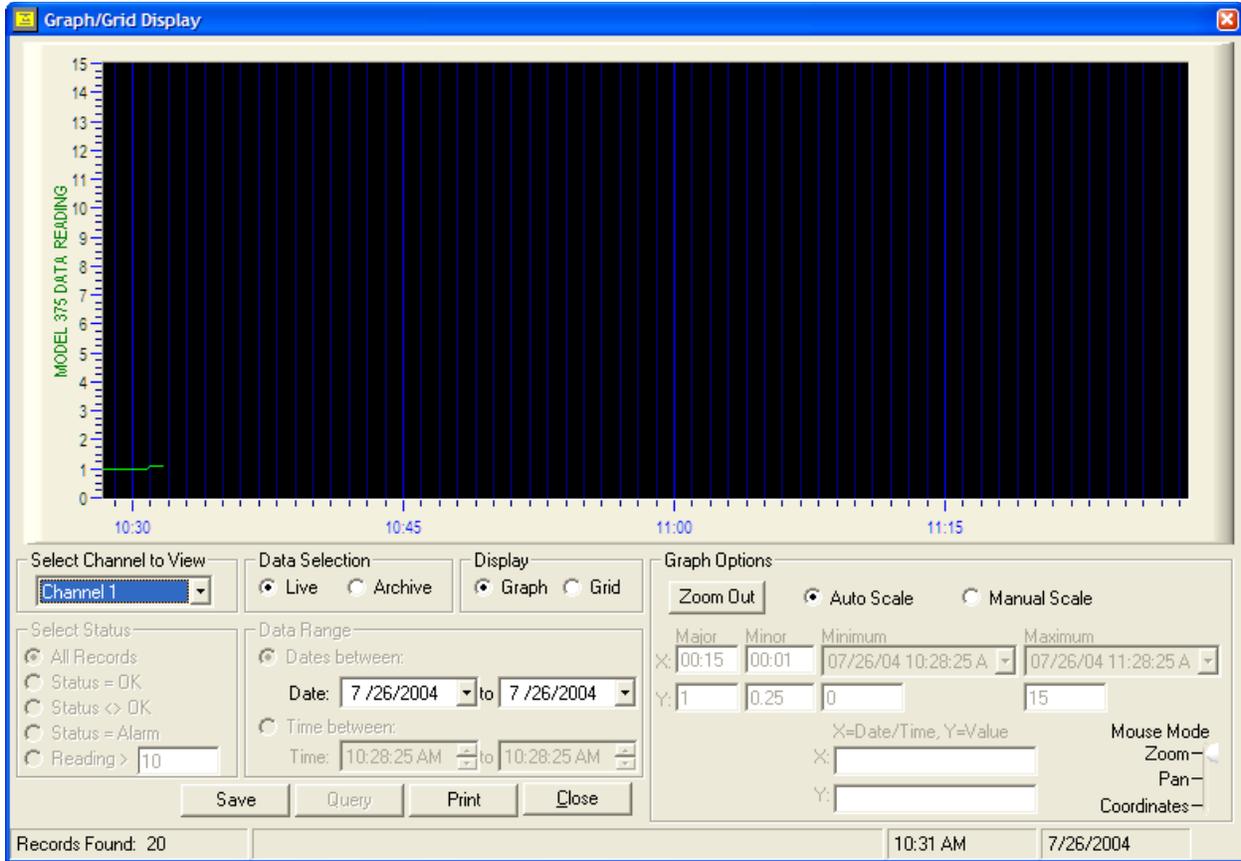
C:\LMI.BMP	(100% scale)
C:\LMI-25.BMP	(25% scale)
C:\LMI-50.BMP	(50% scale)
C:\LMI-75.BMP	(75% scale)

In the preferences for location map you will select C:\LMI.BMP as the filename.

To make the 25% scaled versions of the bitmap start Paint (Start / Programs / Accessories / Paint).

1. Open the bitmap to be used for 100%.
2. Select Image / Stretch/Skew from the pull-down menu.
3. Under the Stretch section change both values to 25%.
4. Save the file as NAME-25.BMP where NAME is the original filename. Repeat steps for the 50, and 75 percent bitmaps.

## 8. VIEWING DATA



**Graph/Grid Display**

Port	Date	Time	Status	Reading	Units	Airflow (CFM)	Output Sample	Accum Output	Note
Channel 1	7/26/2004	10:33:30 AM	OK	1.10	CPM	4.07	2.183 pCi	224.542 pCi	Model 37
Channel 1	7/26/2004	10:33:20 AM	OK	1.10	CPM	8.63	2.278 pCi	213.627 pCi	Model 37
Channel 1	7/26/2004	10:33:10 AM	OK	1.10	CPM	10.31	2.215 pCi	202.238 pCi	Model 37
Channel 1	7/26/2004	10:33:00 AM	OK	1.10	CPM	3.12	0.844 pCi	191.165 pCi	Model 37
Channel 1	7/26/2004	10:32:48 AM	OK	1.10	CPM	4.55	1.930 pCi	186.104 pCi	Model 37
Channel 1	7/26/2004	10:32:38 AM	OK	1.10	CPM	15.10	3.280 pCi	176.455 pCi	Model 37
Channel 1	7/26/2004	10:32:28 AM	OK	1.10	CPM	10.79	1.983 pCi	160.056 pCi	Model 37
Channel 1	7/26/2004	10:32:18 AM	OK	1.10	CPM	15.34	3.902 pCi	150.144 pCi	Model 37
Channel 1	7/26/2004	10:32:08 AM	OK	1.10	CPM	17.26	3.628 pCi	130.634 pCi	Model 37
Channel 1	7/26/2004	10:31:58 AM	OK	1.10	CPM	12.22	2.035 pCi	112.496 pCi	Model 37
Channel 1	7/26/2004	10:31:48 AM	OK	1.10	CPM	7.19	2.468 pCi	102.320 pCi	Model 37
Channel 1	7/26/2004	10:31:38 AM	OK	1.10	CPM	13.18	2.900 pCi	89.982 pCi	Model 37
Channel 1	7/26/2004	10:31:28 AM	OK	1.10	CPM	9.11	2.552 pCi	75.482 pCi	Model 37
Channel 1	7/26/2004	10:31:18 AM	OK	1.10	CPM	6.95	2.921 pCi	62.722 pCi	Model 37
Channel 1	7/26/2004	10:31:08 AM	OK	1.10	CPM	9.35	1.835 pCi	48.116 pCi	Model 37
Channel 1	7/26/2004	10:30:58 AM	OK	1.08	CPM	9.83	2.188 pCi	38.942 pCi	Model 37
Channel 1	7/26/2004	10:30:48 AM	OK	1.00	CPM	13.42	0.277 pCi	28.003 pCi	Model 37
Channel 1	7/26/2004	10:30:38 AM	OK	1.00	CPM	10.79	0.147 pCi	26.618 pCi	Model 37

Select Channel to View: Channel 1

Data Selection:  Live  Archive

Display:  Graph  Grid

Select Status:  All Records  Status = OK  Status <> OK  Status = Alarm  Reading > 10

Data Range: Dates between: 7/25/2004 to 7/25/2004

Records Found: 31

Done

10:33 AM 7/26/2004

### **Grid/Graph View**

This screen displays the data as either a grid or a graph. If “Live” is selected then the data viewed is the live data coming from the channel. If “Archive Data” is selected then the records from the database are used.

When viewing “Live” data the grid and graph are updated according to the log interval set in preferences screen. The grid data is updated with the newest data appearing at the top of the grid and the oldest data appearing at the bottom of the grid.

The graph can be printed by clicking the “Print” button. The "Save" button will save the current query into a new database file.

### **Select Channel to View**

Select which channel to display.

### **Data Selection**

Live data show the current data coming from the instruments, archive data works with previously saved data in the database.

### **Graph Options**

The graph options determine how the grid is displayed by allowing the user to specify automatic or manual scale mode. Automatic scale mode uses information about the current data to automatically adjust the minimum and maximum values of the graph. Manual scale mode allows the user to specify the minimum and maximum values. Changing the Mouse mode allows the mouse to zoom in on the graph, pan the graph display or show the coordinate values where the mouse cursor is located.

### **Select Status**

This determines which records are displayed from the database. Choices are All records, Status is OK, Status is Not OK, Status = Alarm, and Reading exceeds user-defined value.

### **Date Range**

This allows the data to be searched according to a date and/or time range.