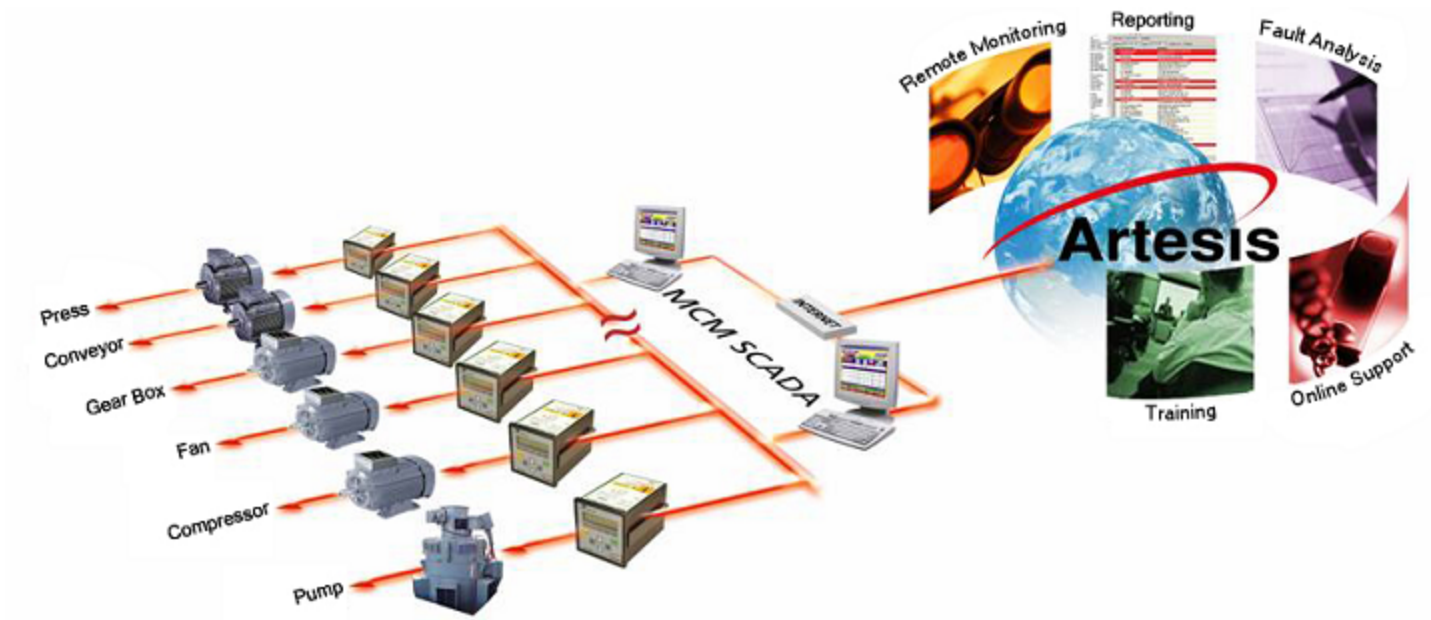


MCMSCADA User's Manual



Motor Condition Monitor (MCM) and MCMSCADA

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1 Introduction

MCMSCADA is a software package for viewing and displaying data from one or more MCM units. With its graphical interface (GUI), MCMSCADA allows the user to obtain and display data in real-time from networked devices, to configure the performance of the devices and to save and subsequently retrieve data for display from its database, in a transparent and intuitive manner. Modern networking procedures permit monitoring of processes on remote machines using TCP/IP protocols over the Ethernet. MCMSCADA harnesses the power afforded by these techniques and allows remote access to the database so that the status of motors monitored by MCM can be viewed from within the local area network.

2 Operational Overview

This section presents an overview of the steps needed to start MCMSCADA for the first time. Please refer to later sections for more detailed information on a particular topic.

MCMSCADA can be started by clicking the program from the MCMSCADA folder from the Programs menu under the Windows Start button, once the installation script on the CD has been run. For details of how to install the package, please refer to section 5 of this manual and to the README file on the installation CD.

Once invoked, the screen shown in Figure 1 can be seen. In keeping with standard practice, the screen has a menu bar along the upper edge, items of which can be selected by placing the mouse cursor over the bar and left clicking. Immediately below the menu bar, is the tool bar containing a selection of icon buttons as short cuts to important and frequently used menu items. If the mouse cursor is placed over one of these icons for a few seconds, a tool tip message will appear outlining the function of the button. If a particular icon is grey, its associated button is not active, and clicking it will have no effect.

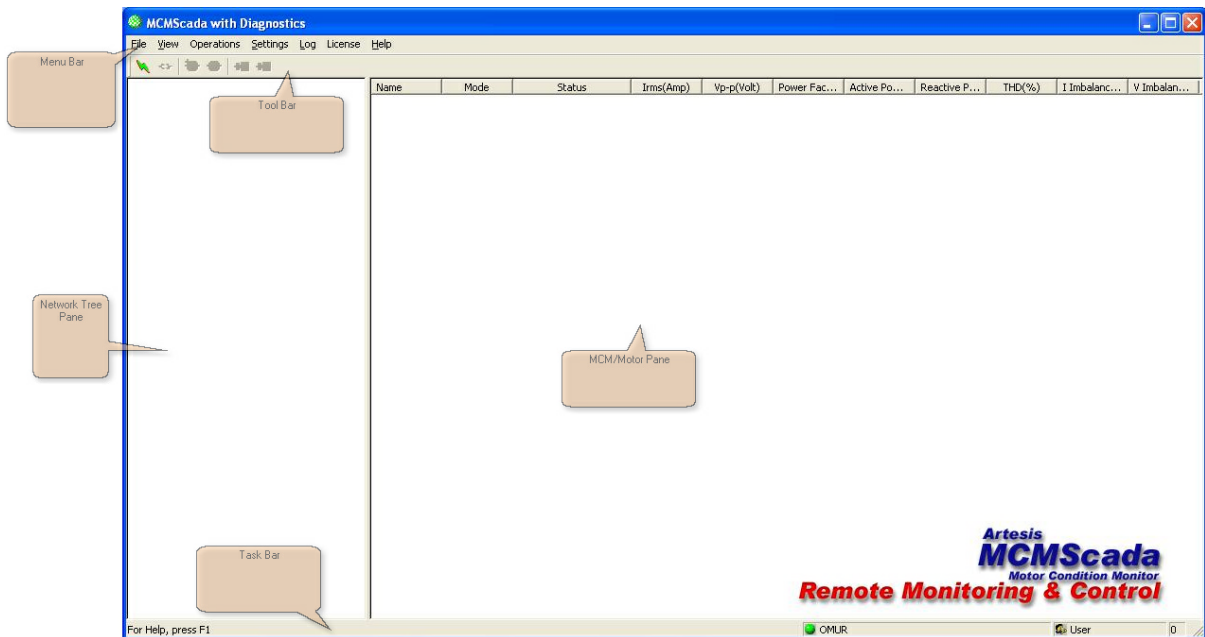


Figure 1: The startup view

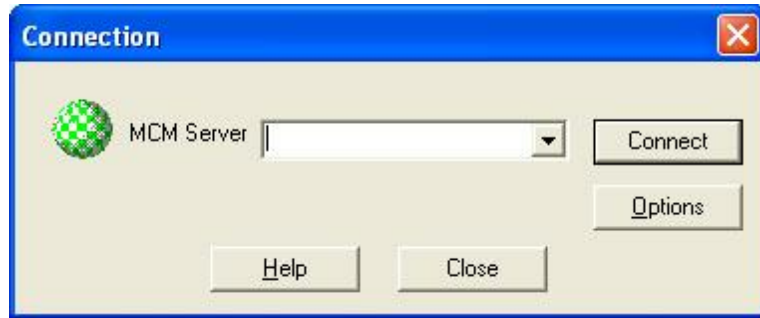


Figure 2: The Connection message box

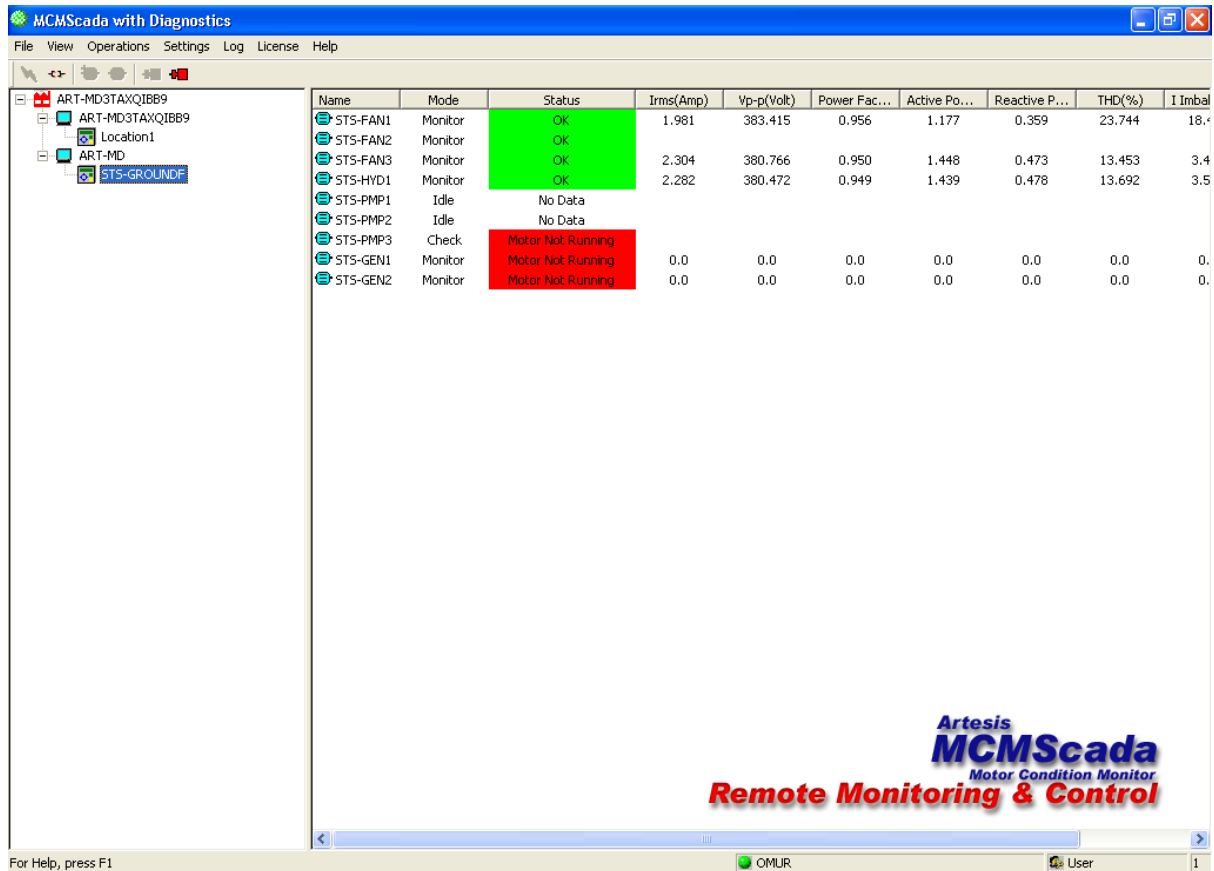


Figure 3: View with MCM devices being monitored

The two windowpanes beneath the tool bar form the bulk of the view. The left pane provides information in the form of a tree describing the network of monitoring PCs and their attached MCM devices. To view the tree a connection must be made to a MCM server, by clicking on the leftmost icon on the toolbar (the only one active at this stage), with the tool tip label **Connect to the Server**. The message box shown in

Figure 2 appears next. Simply pressing the **OK** button will attach the display to the server on the local PC, and display the view seen in Figure 3. In the left hand pane of this view, a tree showing all connected PCs can be seen. The organization of the tree is as follows: The root denoted by the red building like icon, represents the entire MCM network at the user's plant. The network consists of individual PCs (or nodes), each attached to groups of MCM devices. The nodes, represented by PC like icons, come in two flavors: Local (the current machine) or remote (i.e. on another machine on the network). A node can be connected (Turquoise PC), unconnected (Dark blue PC) or disabled (red circle with a diagonal line). If nodes have previously been set up on a PC, they will not be displayed when MCMSCADA is restarted. Pressing the **Connect to the Server** icon at this time will start networking, and these previously unconnected nodes will be shown. Nodes can be disabled in order prevent them from being monitored. Attached to each node are groups of MCM devices arranged according to their physical locations. Each location is represented by an MCM like icon.

Upon connecting to a node, two small icons will appear at the right corner of the windows tray (Figure 4). Double clicking on these icons will reveal a dialog, which shows the list of the connections. In order to close these applications, one should right click on each icon, select exit from the menu, enter the password, and press the OK button. The default password is a blank string. The password should be changed after the installation to prevent unauthorized accesses. Closing these icons while the display is still running will generally cause a system error with unpredictable results. Close icons before running other programmes using the serial port.



Figure 4: MCM main node and node icons on windows tray

Left clicking with the mouse on the tree active points (the + and – symbols) causes the tree to expand or contract. Left clicking on an icon causes the branch of the tree associated with the icon to be selected and any attached label to be highlighted. Right clicking a selected branch causes a context sensitive menu to be displayed from which the user may select a desired action.

When a MCM unit is first installed on a node, only the main node and node icons will be visible. In order to operate the system, the user must first create suitable locations and populate each location with MCM devices.

Adding locations to the local node:

To create a new location, first select the local node by left clicking on the node, and then right click to reveal a context sensitive menu. Select **Add Location** from this menu to reveal the dialog shown in Figure 11. Insert the location name in the appropriate field and if required a short description can be written in the space provided. Finally, click **OK** to create the location.

Adding MCM units to a location:

New MCM units can be added to a location in the following manner: First, left click on the desired location to select it and then right click. From the context sensitive menu that appears select **Add motor**, and the Motor Properties dialog shown in Figure 13 should appear. In this dialog, the Motor name and **Address** fields should be filled in, and the **Update** button pressed. This will retrieve the information needed for the remaining fields from the device itself. Pressing **OK** will close the dialog and update the database with the details of the new motor.

Start monitoring:

Once a node is populated with locations and MCM devices, monitoring should be started by pressing the **Start Serial Communications** button on the toolbar. The software will then search the local area network for MCMSCADA components. The properties of all the devices networked to the node in the right pane of the view, should change as a result of this action, as MCMSCADA starts to interrogate each device on its network and receive status information. This can take some time (up to several

minutes depending on the network). The Serial Communications Indicator on the taskbar will change from red to green when communications are running.

Each MCM device displayed on the motor pane has eight fields of which five are color coded for Monitor, Error, Alarm, Warning and Motor status indications. If a field is green it is functioning normally, but if a red color appears it is an indication of an abnormal condition either in the monitoring device, the motor it is monitoring or in the communication system. A white or neutral color indicates that the field is not applicable at the current time. If MCM detects an abnormal condition in a motor the alarm window will appear giving details of both the node and MCM address. This window cannot be deleted until all conditions return to normal. The Serial Communications Indicator is green when communications are operating normally.

The properties of a specific device can be obtained by first selecting the device by left clicking on the row containing the device on the motor pane and then right clicking the mouse. This will reveal a menu containing the list of actions that can be performed. The first menu group is concerned with actions concerning the device in relation to MCMSCADA. The second group allows the user to obtain and display information from the MCM unit itself, such as the device properties and the measured physical properties of its motor. It also allows reports to be generated detailing the current condition of individual or multiple motors and the plotting of the physical and abstract parameters measured or estimated by the MCM unit.

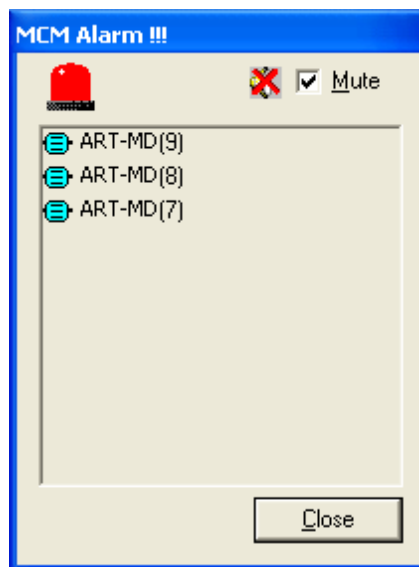


Figure 5: The alarm window

3 Configuring MCMScada

This section describes how MCMSCADA can be configured using the available menu items. Each item is presented with a menu path in the margin using the forward slash as a separator and the word Menu pre-pended to the path. For instance, the menu path:

Menu: Operations / Main node / Connect

would indicate the menu reached by selecting first the Operations menu on the Main Menu, then the Main node item and finally the Connect item from the submenu. Context sensitive menus are indicated by the word Context: pre-pended to the menu path. In most cases a context sensitive menu can also be reached from the toolbar. In such cases, the alternate path is also given.

3.1 Setting and using passwords

MCMSCADA is designed to be used at a number of levels by two different categories of user, Supervisor and User. Someone logged in at Supervisor level has the ability to view and change the data and configuration settings, whilst at User level, only a limited set of data can be viewed and nothing can be changed. This is designed to prevent unauthorized access to the system whilst at the same time allowing maximum usage. The default login level is User and to change to Supervisor, the **Login** item on the Operations menu should be selected. This will display the following dialog. Please note that this operation is only possible after the **Connect to the Server** icon on the toolbar has been pressed.

Menu: Operations / Login



Figure 6: The login dialog

The string supervisor should be written in the **User Name** field. Note that passwords are case insensitive. A password need only be supplied if the default password has been changed, and for first time use is not needed. Pressing the **OK** button will now log the user on at Supervisor level.

Changing the password:

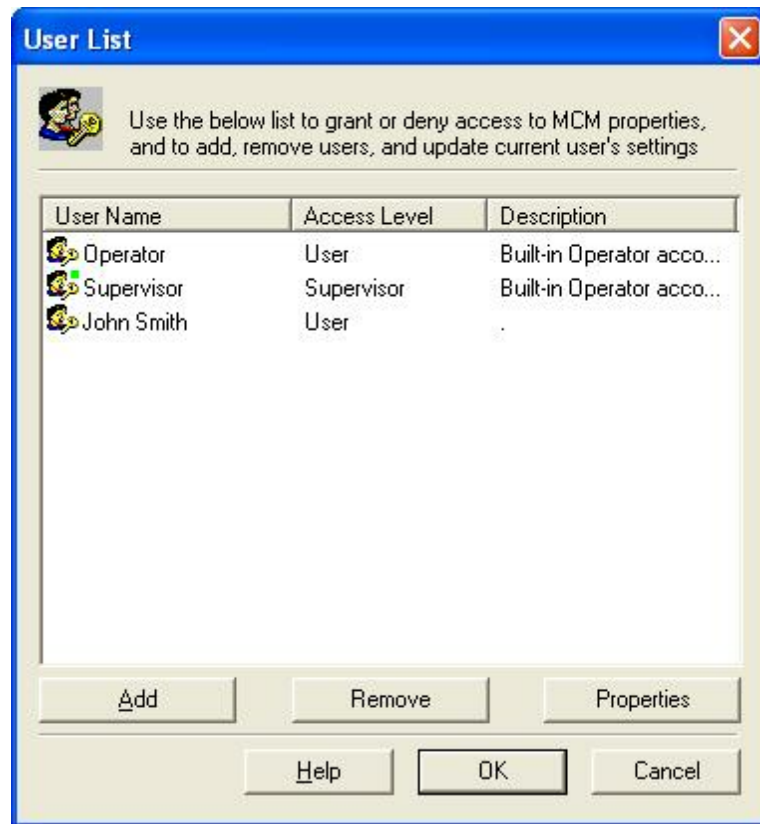


Figure 7: The User List Dialog

It is advised that when logging in for the first time as Supervisor, the password be changed. This can be achieved as follows:

Menu: Settings / User List

From the Settings menu select **User List**. This will display the dialog on left. Select the line containing the user whose settings are to be changed and click on the **Properties** button. The User Properties dialog will then appear in which the new password and any other information can be entered.

Adding new or removing existing users:



Figure 8: The User Properties Dialog

New users can be added in a similar manner. First open the User List dialog and click the **Add User** button. The User Properties dialog will again appear, and the desired user name and access privileges can be entered. A user can be removed by first selecting the user name and then pressing **Remove**.

Menu: Settings / User List

Logging out protects from unauthorized access:

Once a user has finished a session with MCMSCADA, it is important to inform the system using the **Logout** command from the **Operations** menu. This action protects the system from access by unauthorized users who otherwise would have the ability to alter settings and generally interfere with the smooth operation of the monitoring system. It is not possible to log out at user level authority since this level has limited access to system facilities.

Menu: Operations / Logout

3.2 Adding and manipulating remote nodes

A remote node is a connection to another PC on the PC Network running MCMSCADA that has a subnet of MCM devices attached to it. A new remote node can be added to an existing network by selecting the main node icon, right clicking and selecting **Add Node** from the displayed menu. Note that serial communications should be OFF. The view shown in the following figure is then displayed.

Context: Main node Icon / Add node

Menu: Operations / Main node / Add node

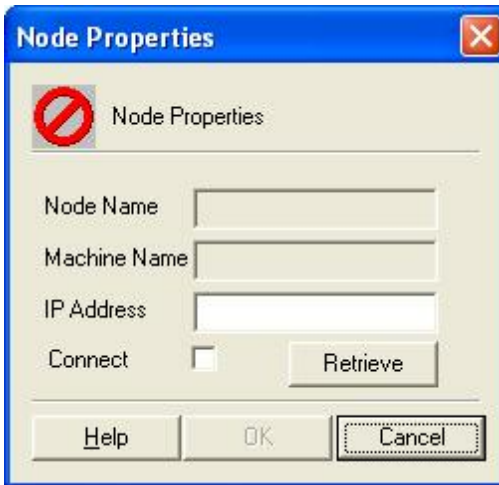


Figure 9: Node Properties Dialog

The network machine name or IP address of the PC forming the node must be provided in the **IP Address** field. If this is not known, the system administrator should be able to provide this information as well as setting any permissions and privileges required by the network. Please note that the selected PC must already be running a correctly configured instance of MCMSCADA. Once the IP address is correctly supplied, the **Retrieve** button may be used to obtain its **Machine Name** and **Node Name**, directly from the selected machine. For automatic connection, the **Connect** box should be checked. Pressing the **OK** button should then display the new node in the tree together with its node name. A tree with multiple nodes is displayed in Figure 10.

The remote PC must be running a correctly configured instance of MCMSCADA prior to remote connection.

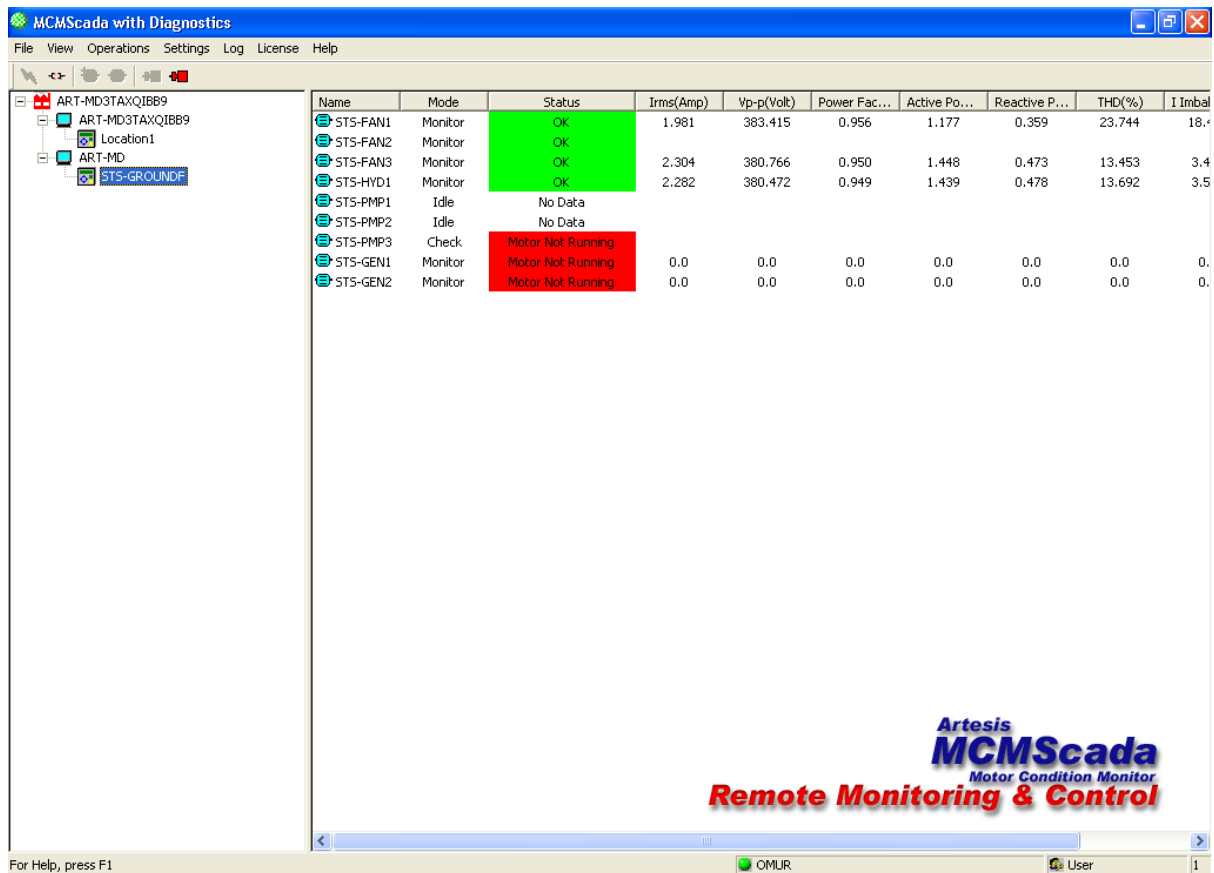


Figure 10: View showing multiple nodes

Once a node has been added to the network tree, various operations can be performed on it. The node can be closed and reopened by selecting the node and clicking **Close node** and **Open node** respectively. Closing a remote node both disconnects the node from the local machine and stops serial communications on the remote node. **Disconnect all nodes** will disconnect all nodes from the local machine and stop communications if the user level is appropriate. Similarly, **Connect all nodes** will restart all the nodes registered on the local machine.

Context: Node / Close node
 Menu: Operations / Node / Close node

Context: Node / Open node
 Menu: Operations / Node / Open node

Context: Main node / Disconnect all nodes
 Menu: Operations / Main node / Disconnect all nodes

The **Open node** command will restart the remote node in background mode i.e. the GUI will not be running.

Context: Node/Edit Node
 Menu: Operations / Node / Edit node

A node can be edited or removed. First the node should be selected, right clicked, and the appropriate option chosen from the displayed menu.

3.3 Adding and removing locations

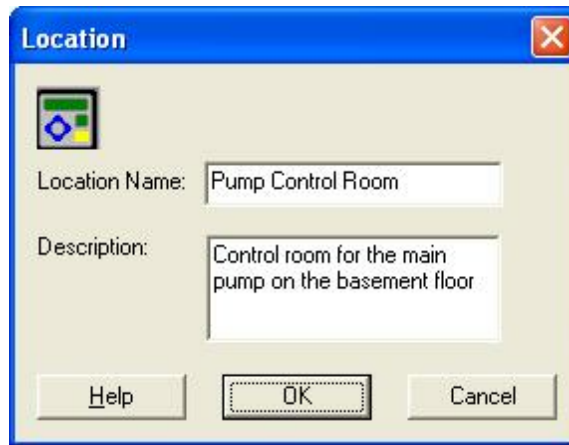


Figure 11: Location Properties Dialog

A convenient collection of several MCM devices grouped together in a single place is called a location. Locations are added, edited or removed when serial communications are OFF, by first selecting the local node and then right clicking. After selecting **Add Location**, the location properties dialog will appear, in which the name of the new location can be entered. Optionally in the **Description** entry, a short description of the new location can be entered. This is for the user's information only and is otherwise not used by the MCMSCADA software.

Context: Location / Add location
Menu: Operations / Node / Add location

Clicking the **OK** button will cause the new location to be added to the tree under the selected node.

The location can be edited or removed by first selecting the location, right clicking and choosing either **Edit Location** or **Remove Location** respectively from the menu.

Context: Location / Edit location
Menu: Operations / Location / Edit location

Context: Location / Remove location
Menu: Operations / Location / Remove location

3.4 Setting the communication parameters

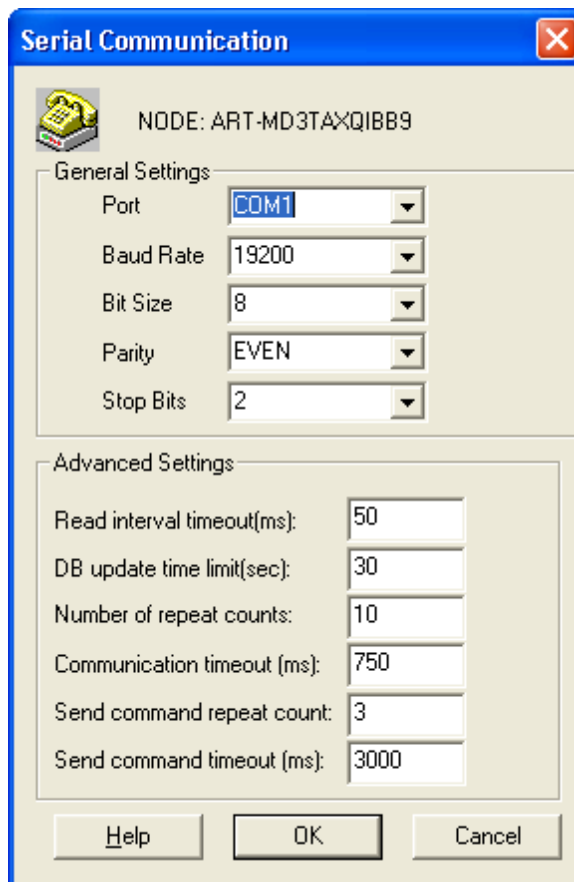


Figure 12: Serial Communications Settings Dialog

Context: Local node/Node Settings / Comm. settings
Menu: Node / Node Setting / Comm. Settings

Before starting any communications using the local node, the communications parameters must be set correctly.

This action includes additional steps if you are using the MCMSCADA-TCPIP version. If this is the case, please refer to the Appendix for additional connection parameters.

Communications settings are displayed by selecting the local node, right clicking and choosing **Comm. Settings** from the displayed menu. The dialog on the left will appear.

The default settings are correct for standard MCM devices and in most cases, only the communication port need be changed. It is important that the settings match with all devices on the subnet, as any discrepancies will result in unpredictable operation. Please refer to the MCM manual for details of how to set the MCM communications settings. Please also note that on any subnet, each device must have a unique address, and that this address must not be 0. If any two devices have the same address, conflicts between the two devices will arise that will prevent communications for the whole subnet.

Once it is established that the communications settings are correct, the **OK** button should be pressed.

Advanced Settings:

Read Interval Timeout is the maximum allowed time between receipt of two characters during serial communications. If this time is exceeded, the driver assumes that the message is complete. This is a critical parameter and the lower its value, the faster the serial communications. Thus on networks with slow responses, a larger value for this parameter might be needed. A general rule of thumb would be to start with a large value, decrease to the point where communications fail, and then add 10 –20% more.

DB Update Time Limit is the timeout value when the MCM test data values are stored into the database. Hence, if test data are available from the MCM units and this timeout period is reached, the data are updated in the database. This value should be less than half the shortest cycle time (approx 60s) of an MCM unit to ensure proper data handling.

Number of Repeat Counts is the number of times the software will attempt to get a response from an MCM unit before deciding that it is not responding, and should be deleted from the list of active devices. When this occurs, the software periodically will try to reestablish contact and if successful will place the device again in the active list.

Communication Timeout is the time period for the MCM Unit to respond.

Send Command Repeat Count is the number of trials to be made when sending a command such as “Idle” etc. to the MCM unit.

Send Command Timeout is the timeout period for sending a command to the MCM unit.

We recommend that the Advanced settings be modified only by qualified personnel.

3.5 Adding and removing MCM devices from a subnet

Motor properties dialog is used to add an MCM device to the network accessible by MCMSCADA.

Context: Location / Add motor

Menu: Operations / Location / Add motor

First ensure that serial communications are OFF and then select the location where the new motor is to be added and right click. Next select **Add motor** and the following dialog will appear.

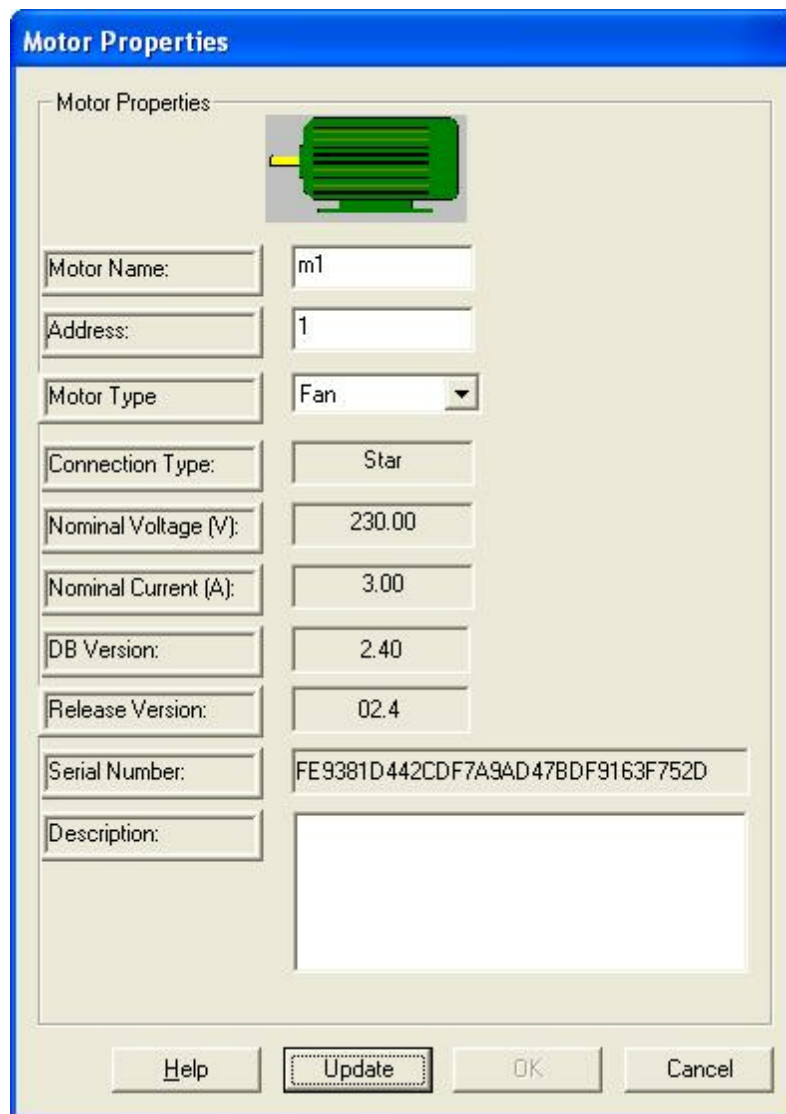


Figure 13: Motor Properties Dialog

The motor name and its subnet address (please refer to the MCM User's manual for details of how to set the device address) must be entered in the **Motor Name** and **Address** fields. An optional description can be added if desired in the **Description** field. Once these items have been entered, pressing the **Update** button will retrieve the remaining information from the MCM unit where they should have been previously set. Pressing the **OK** button will cause the new motor to be added as an entry on the motor pane.


Context: Location / Remove
 Menu: Motor / Remove

A motor can be removed by right clicking on the motor entry in the motor pane and selecting **Remove** from the menu that appears.

3.6 Connecting to remote servers

Pressing the icon labeled **Connect to the server** on the main toolbar brings up the dialog shown in Figure 2. By default, the local machine name should appear in the **MCM Server** field and pressing the **OK** button should cause the display to connect to this machine. Rather than use the local machine, it is also possible to connect to a remote machine and view the status of the devices attached to that machine.

Menu: Operations / Main node / Connect

If either of the two icons  shown is visible on the main window tray, they should be closed as outlined in section 2. Either the machine name or its IP number (obtainable from the network administrator) should be written in the **MCM server** field. If it is desired to make the remote machine the default server, the **Options** button should be pressed and the box checked in the Connection Options dialog that appears.

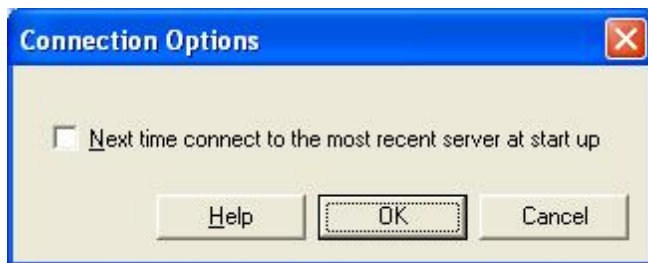


Figure 14: The Connection Options dialog.

3.7 Changing local node properties

By default when a node is established, it takes the name of the machine on which the node resides. This may not be desirable in all cases, and MCMSCADA provides a mechanism to change the node name and other properties. Selecting Local node properties from the Settings menu brings up the dialog on left.

Menu: Settings / Local node properties



Figure 15: Local node properties

When errors occur during execution of MCMSCADA, message boxes are displayed indicating details of the error. By default, the message boxes need to be closed by the user. This property can be changed for a local node using the **Message Box Timer** field. The value of this field (in milliseconds) gives the length of time that a message box will be displayed, after which it is automatically closed. A value of 0

enables the default property of manual closure.

During the connection of a node, it is necessary to synchronize the order of events. With newer, higher speed machines there is unlikely to be much of a problem but with slower ones an error indicating a failure to execute the server can sometimes occur. If this error occurs, the **Server Execution Delay** field on the remote machine should be increased until the error disappears. Under most circumstances, the default value of 1000 milliseconds is suitable.

3.8 Contact list

MCMSCADA holds the list of contacts that it needs to reach in case of particular alarm settings are setup to allow it.

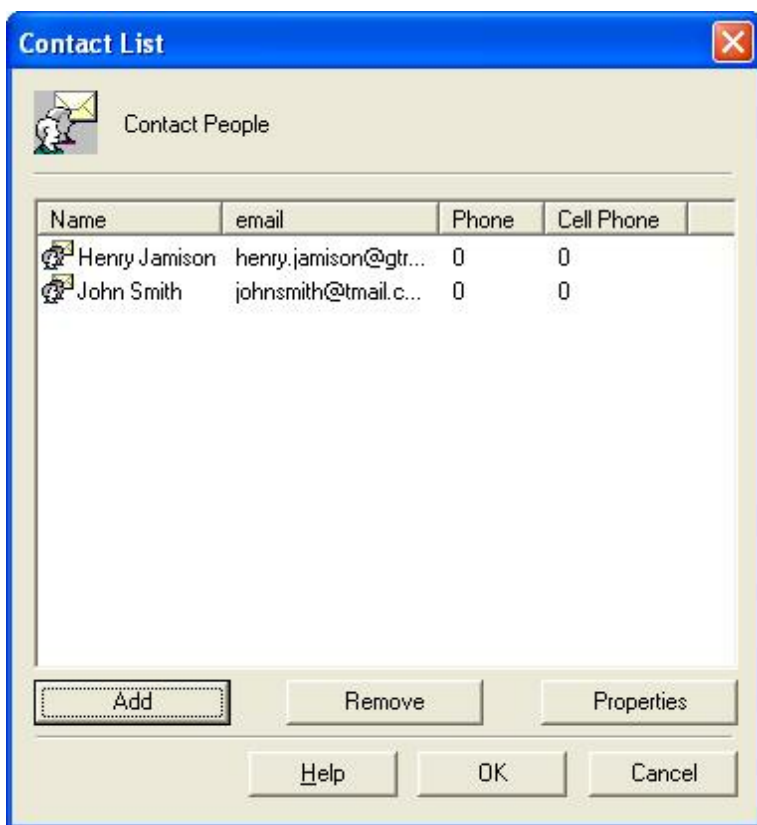


Figure 16: The Contact List Dialog.

MCMSCADA utilizes the features available with modern Internet technology to provide email-messaging capabilities to selected recipients, when one or more MCM units indicate problems with their attached motors. Recipients can be selected using the **Contact List** item from the **Settings** menu on the main menu bar.

Menu: Settings /Contact List

Using the **Add**, **Remove** and **Properties** buttons, it is straightforward to arrange for an email message to be sent to a given address. At this time, neither cellular nor normal telephones are supported.

3.8.1 Adding People to Contact List

The contact person dialog is used to add or modify a contact.

Menu / Settings / Contact List / Add or Properties



Figure 17: The Contact Dialog Box

The **Name** and **email** fields of the Contact dialog displayed by pressing either the **Add** or **Properties** buttons should be filled in and the **Contact** check box enabled as the following figure shows.

3.9 Motor Failure Notification

The second stage in enabling messaging is to select the events that will trigger a message to be sent. This is done using the **Motor Failure Notification** item from the **Settings** menu.



Figure 18: Motor Failure Notification Dialog

Menu: Settings / Motor Failure Notification

Prior to using this facility, Microsoft Outlook must be installed correctly on the server machine. It is advisable to test the connection by pressing the **Settings** button to reveal the dialog box shown in Figure 19 in Mail Server Settings help section.

Before proceeding further, the **Enable Motor Failure Notification** check box must be enabled, otherwise none of the other fields on the dialog will be available for selection. Once this is done, one or more of the available options in the **Notifications** box can be checked. For example if it is required that a message be sent each time MCM indicates an alarm or error condition, the **Alarm** and **Error** boxes should be checked. The button next to Alarm box will be enabled when the **Alarm** box is checked. Pressing this button will reveal the dialog box shown in Figure 20 in the Alarm List help section.

3.9.1 Mail Server Settings

Mail server properties dialog is used to test MCMSCADA's integration with your PC's email capabilities by sending test messages.

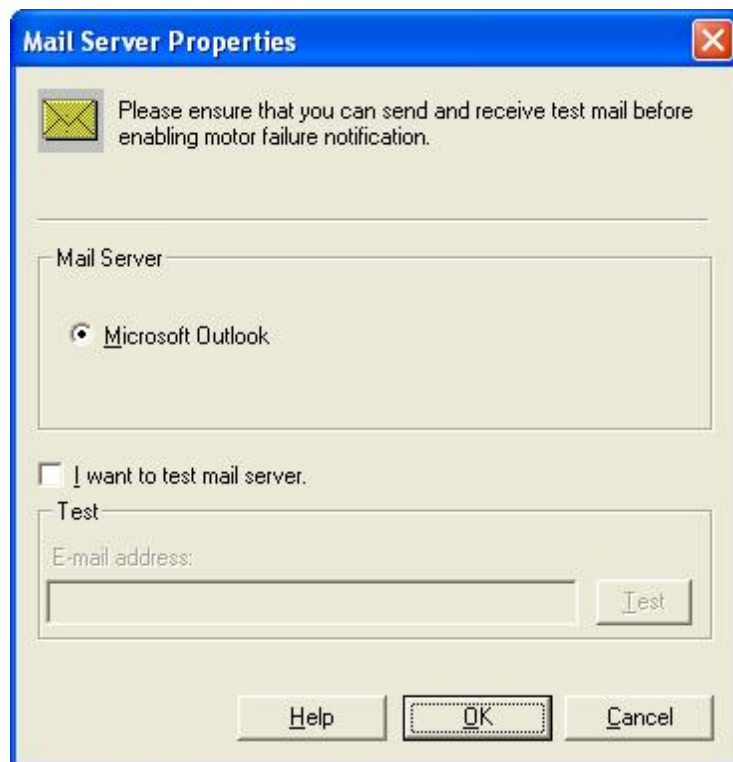


Figure 19: Mail Server Properties

The **I want to test mail server** box should be checked and a valid email address should be supplied in the **E-mail address** field. When the **Test** button is pressed, an email should be sent to the selected address. If this does not occur, please advise your system administrator. Once it is established that the mail system is operating correctly, the **OK** button should be pressed to return to the Motor Failure Notification dialog.

3.9.2 Alarm List

The alarm list dialog is used to indicate which alarm types should be checked when deciding to notify the contacts in the contact list.



Figure 20: Alarm List

Various alarm levels can be selected from this window. MCM status conditions (Watch, Examine 1 etc) can be chosen by first checking **Status** and then selecting the desired level from the **Status** group at the right of the dialog. In this case if **Examine 1** is selected, messages will be sent each time the status of an MCM unit rises to be greater than or equal to the Examine 1 level. Thus all fault levels except Watch would generate a message.

If an instantaneous response is not required, MCMSCADA can be instructed to wait for a given time once the conditions for sending a message are fulfilled. If after this waiting period, the conditions are still appropriate for the message, it will be sent. This time period is set using the **Timeout** field at the bottom left of the dialog.

The content of the MCM Motor Failure Notification Mail will be as shown in Figure 21.

Date: April 18, 2002
 Time: 15:39:48

PLANT	NODE	LOCATION	MOTOR	ADDRESS
MCM-BTL12	MCM-BTL12	Boyahane1	FOSFAT POMPASI	3
MOTOR STATUS		Examine		
OPERATING MODE		Test		
MONITORING STATE		ON		

PLANT	NODE	LOCATION	MOTOR	ADDRESS
MCM-BTL12	MCM-BTL12	Boyahane2	1.2 KONV. MOTORU	30
MOTOR STATUS		Watch		
OPERATING MODE		Test		
MONITORING STATE		ON		

Figure 21: Motor Failure Notification Mail

3.10 Periodic Parameter Report

MCMSCADA can generate and send reports at predetermined intervals set by the user. A report about the current status of each connected device will be sent to the users listed in the Contact List at intervals determined in **Options** pane of the dialog on Figure 22.

Menu: Settings / Parameter Report

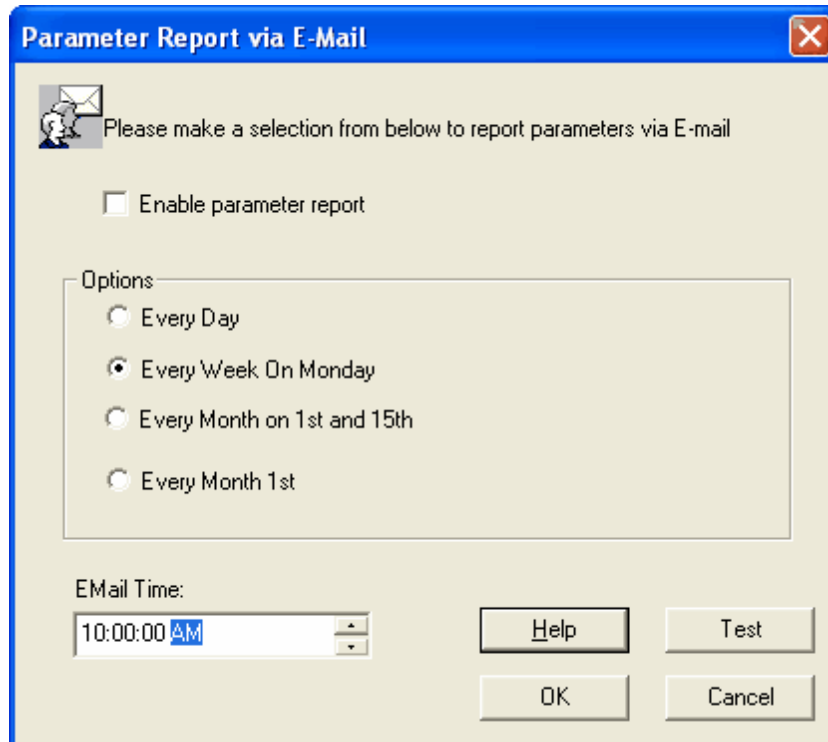


Figure 22: The Parameter Report via E-Mail Dialog.

4 Monitoring Motors with MCMScada

Once the server has been started as described in Section 2, motors added to the motor pane, communications with devices on the subnet should be started by pressing the **Start Serial Communications** icon on the toolbar. This action will cause the software to start data communications with all devices on the subnet.

Control and status information from individual devices can be obtained by first selecting the desired device and then right clicking to display a context sensitive menu with the following entries. Alternative paths via the toolbar are given in the margin.

4.1 Start/Stop motor

Start/stop serial communications with the selected motor. This is useful if a motor has been stopped for some reason and it is desired temporarily to prevent the motor from being monitored by MCMSCADA

Menu: Operations Motor / Start monitor

Menu: Operations Motor / Stop monitor

4.2 Commands

Under normal operation, MCM generally functions in one of the following modes:

- Idle
- Check
- Run
- Resume
- Update

Menu: Operations / Motor / Commands / Idle

Please refer to the MCM User's manual for further details. It is possible to control the mode of operation from MCMSCADA using the items available from this menu.

4.3 Remove

This item will delete permanently the selected MCM device from the motor list.

Menu: Operations / Motor / Remove

4.4 Properties

On selection of this menu item, the Motor properties dialog described in section 3.5 will appear. If desired, the fields can be edited, but the main function is to provide information as to the physical characteristics of the attached motor.

Menu: Operations / Motor / Properties

4.5 Notifications

Warnings, Alarms and Errors:

It is not only important to monitor the state of the motor, but to ensure that the monitoring system itself is functioning properly. MCM provides this information in three categories: Warnings; Alarms and Errors. Warnings are the least serious of the three categories and imply that a condition occurred that MCM has handled but that the user should be aware of. Alarms indicate the presence of motor conditions such as an open circuit phase that could not be handled by MCM and need the user's immediate attention. Errors refer to a malfunction of MCM or its inability to perform its correct function under the current operating conditions. Further details of each category can be found in the MCM User's Manual.

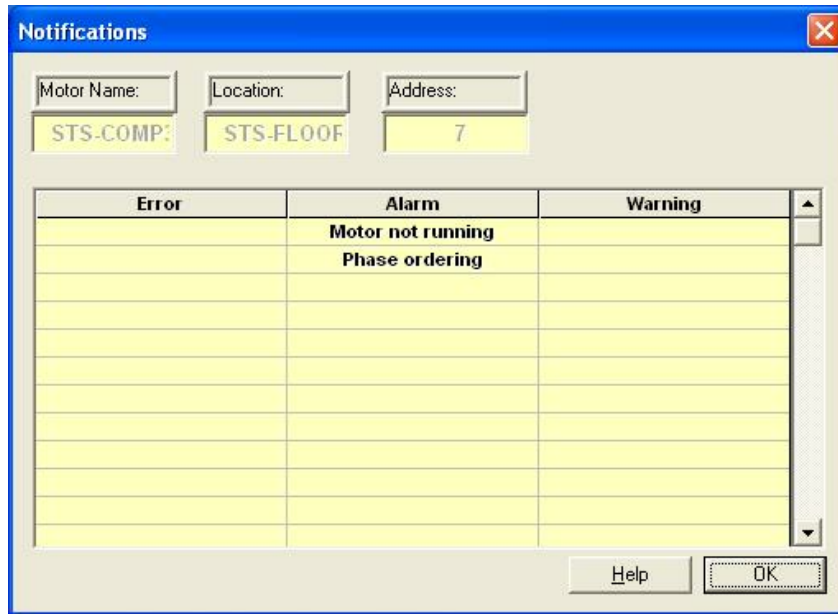


Figure 23: The Notifications Dialog

Menu: Operations / Motor / Notifications

The notification menu displays the following table with a list of the warning, alarm and error conditions reported by the selected MCM unit.

4.6 Information

The information dialog allows the user to see and set parameter values that are obtained from the connected MCM device.

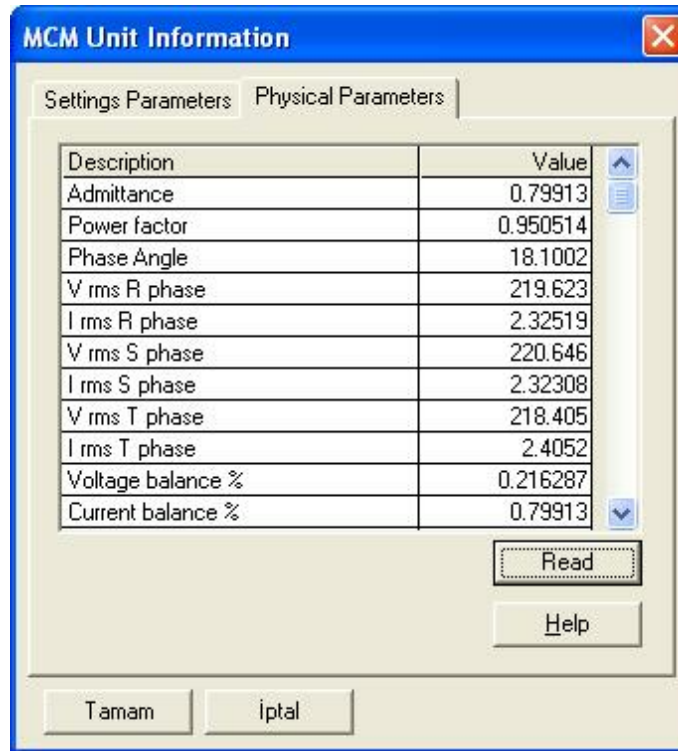


Figure 24: The MCM Unit Information Dialog Showing Physical Parameters

When the Information menu is selected, the user can view the current physical parameters of a motor as measured by its monitoring MCM unit. If the user is logged in with supervisor privileges, it is also possible to view and change the settings of the selected MCM device. Please refer to the MCM User's Manual for further details of both the physical parameters measured by MCM and the settings available to the user.

Menu: Operations / Motor / Information

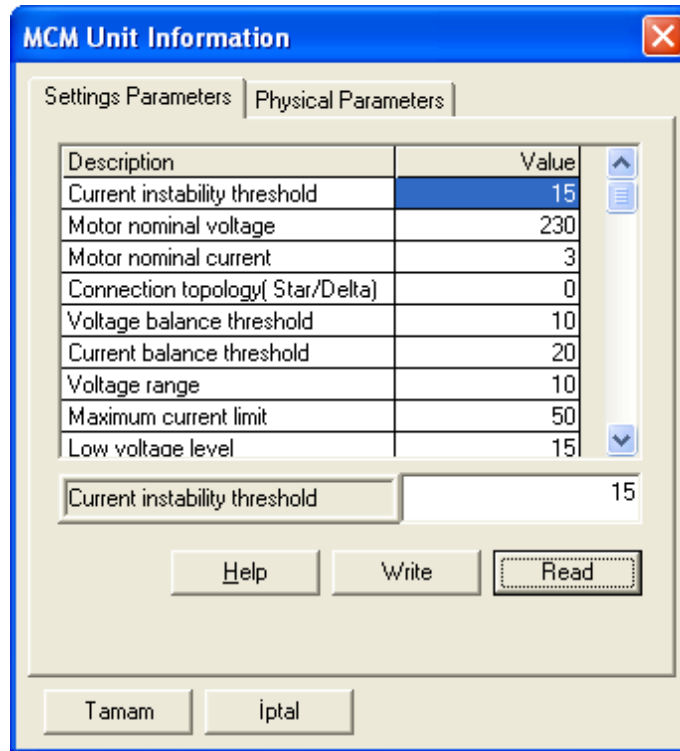


Figure 25: The MCM Unit Information Dialog Showing Settings

The two tables are viewed as pages in a tabbed dialog. When a page is opened, it is necessary to press the **Read** button in order to download the latest information from the MCM unit. In order to change a setting (parameters are read only), the MCM unit must first be sent to **Idle** and the **Read** button pressed. Left clicking on the value to be changed will both highlight the value and cause it to be written into the box underneath the grid, where it can be edited. To update the new value, press **Write**. Once the MCM unit has received the new value MCMSCADA again reads automatically all the settings and displays them in the grid, upon which the newly set value should be displayed. If the MCM unit has rejected the change (usually as a result of not being in the **Idle** state) the value in the grid will remain unchanged.

4.7 Trending

MCMSCADA allows the plotting of values of selected MCM parameters using the Trending facility. Two sets of data are available for plotting: Short term data obtained at every iteration of MCM over the immediate last few days; and Long term data, representing the average of short term data over a windowing period. The properties of both trending types can be set for each local node by selecting the node, right clicking and the selecting **Trend Settings** from the **Node Settings** sub menu.

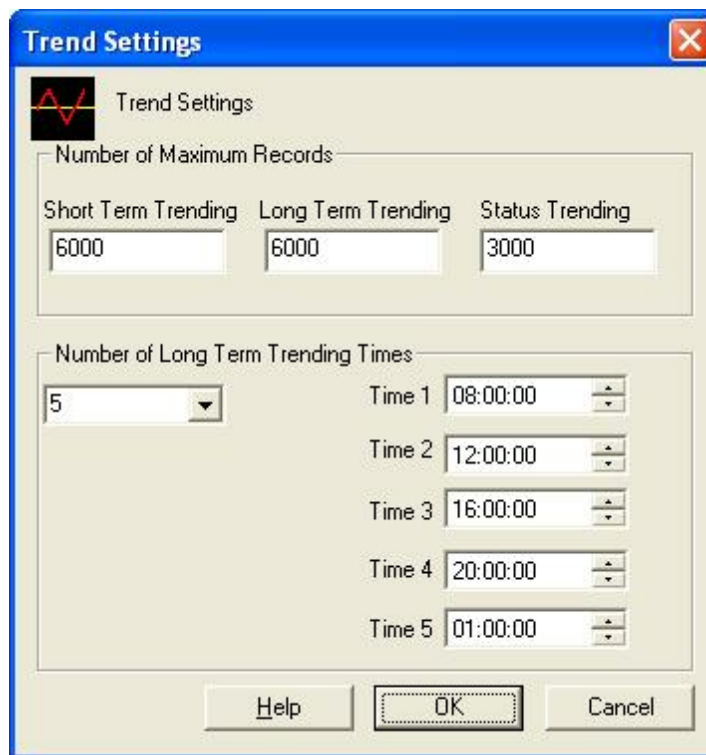


Figure 27: The Trend Settings Dialog

Menu: Operations / Motor / Trending

Menu: Operations / Node / Node settings / Trend settings

The number of records stored in the database for each trending type should be entered in the first two fields. The larger the number of records, the further back in time it will be possible to view. However, the larger the database, the slower the access to each record, and machine performance can seriously degrade.

The number of records for Status Trending is also shown on the Trend Settings dialog. In the database, the status changes such as motor status, alarm, error and warning conditions etc. are logged in the database for the user information.

The lower portion of the Trend Settings dialog shows five selectable times at which long term data will be calculated from the averages of the short term data. The **Number of Times** field gives the actual number of the available times that will be used. For example if this field is set to 1, then long term data will be averaged once a day at the time selected in the **Time 1** field. If the field is set to 2, then the long term data will be calculated twice a day at the times specified in fields **Time 1** and **Time 2**, and so on. This has no effect on the rate at which short-term data are collected as this depends solely on the rate at which each MCM unit operates.

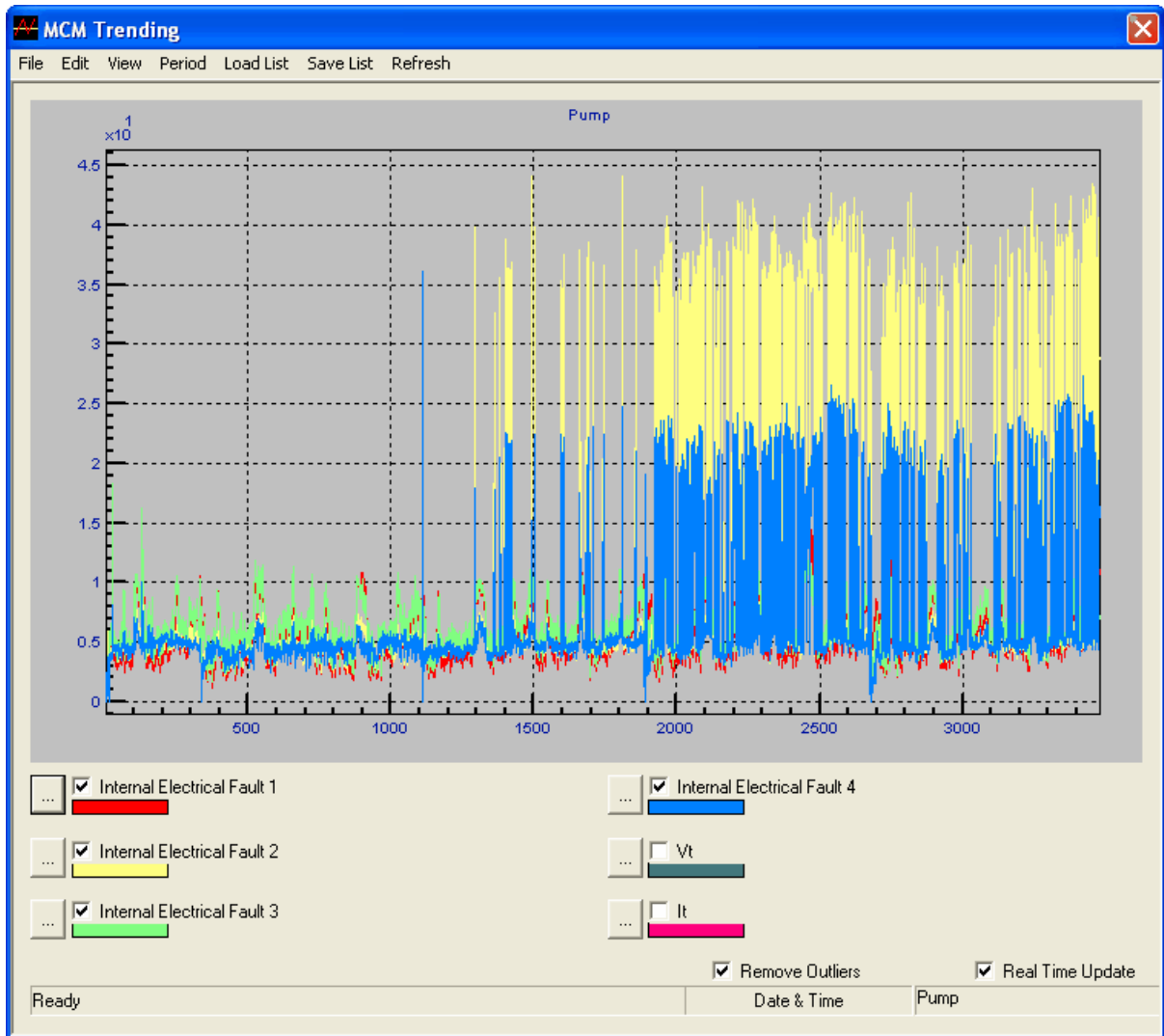


Figure 28: The Trend Window

Once data have been collected, selecting Trending from the motor list pane, displays a plot of the currently selected parameters as in the figure above.

Current settings for the trend can be selected from the various menus along the top of the window. Principally this includes grid selection, drawing and graphic color selection, long or short-term trend selection and whether to save the current settings as default. Along the bottom of the window, is a row of six parameter selection buttons, each with its own check box. Selecting a check box enables that particular channel for drawing. Clicking a particular button enables the parameter represented by the channel to be selected together with its drawing color. Also available is a variable scaling factor or channel multiplier for changing the scale in relation to the other channels. This can be useful in situations where parameters of very different ranges need to be plotted on the same figure.

4.8 Diagnostic

EQUIPMENT STATUS

This section informs the user about the status of operation of equipment as well as maintenance planning information. The status of operation of the equipment is classified as NORMAL, WATCH and EXAMINE. The NORMAL status indicates that the equipment is working as expected. The WATCH

status (WATCH LINE, WATCH LOAD, and WATCH EXISTING FAULTS) alerts the user for possible developing abnormalities. The EXAMINE (EXAMINE 1, EXAMINE 2) status is used to inform the user of the existence of a developing fault. When the statuses is at WATCH or EXAMINE level, maintenance planning and time to failure information is provided together with suggested action. Guidance for diagnostics is provided at the WORK REQUESTS section of the Diagnostic Window.



OK: The equipment is working as expected.




Watch Line: Temporary changes in supply voltage cause this alarm. If alarm is persistent check; harmonic levels, capacitors, isolation of cables, motor connector or terminal slackness, loose contactors.

Watch Load: If the process load has not been altered deliberately, check for leakage, valve & vane adjustment, pressure gauge faults, manometer, dirty filters (fans, compressors). If the process is altered deliberately, MCM/PCM should be updated.

Examine 1: There are developing mechanical and/or electrical fault(s) as shown below. Maintenance should be scheduled within three (3) months.

Examine 2: There are developing mechanical and/or electrical fault(s) as shown below. Maintenance and corrective action should be performed as soon as possible.

Watch Existing Fault(s)   : This sign is an indication of existing fault(s) within acceptable level(s) which are detected during learn mode. These faults should be checked for verification and corrective action at the next scheduled maintenance but no later than six(6) months. Please see the description of the fault below.

EQUIPMENT STATUS 	
Examine	Loose Foundation / Components
Examine	Unbalance/Misalignment/Coupling/Bearing
Examine	Belt/Blade/Trans. Element/Driven Equipment
OK	Bearing
OK	Rotor
OK	  Loose Windings / Stator / Short Circuit
OK	Internal Electrical Fault
OK	External Electrical Fault
OK	Other
OK	Line Status
OK	Load Status
EXAMINE 1	There are developing mechanical and/or electrical fault(s) as shown below. Maintenance should be scheduled within three (3) months.

ELECTRICAL VALUES

This section provides electrical values resulting from the operation of the equipment. If these values are outside of their expected range a WATCH ELECTRICAL VALUES warning is given to alert the user. The user is expected to note and watch to identify the cause. The electrical values, their expected range and possible adverse affects of operation outside of the expected range are explained in the help section. When the parameters are outside of their expected ranges, they are indicated at the WORK REQUESTS section of the Diagnostic Window. ***Voltage and current values of an inverter driven motor can vary in a wide scale in order to control the speed of the motor. Therefore, MCMSCADA does not give alarm from electrical values for inverter driven motors even if they are beyond the thresholds.***

Power Factor: The power factor of an electric motor system is defined as the ratio of the active power flowing to the load to the apparent power, and is a number between 0 and 1. Active power is the capacity of the motor for performing work in a particular time. Apparent power is the product of the current and voltage of the motor. A load with low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. Because of the cost of wasted energy, electrical utilities will usually charge a higher cost to industrial or commercial customers where there is a low power factor. MCMSCADA alerts the user when the power factor goes below a value of 0.8.

Active Power: The actual amount of power being used, or dissipated, by the motor is called actual power (it is also called real power or true power), and it is measured in Watts. Active power of the electrical motor could be obtained by summing output power and losses.

Reactive Power: Reactive loads such as inductors and capacitors dissipate zero power, yet the fact that they drop voltage and draw current gives the deceptive impression that they actually *do* dissipate power. This “phantom power” is called reactive power, and it is measured in a unit called Volt-Amps-Reactive (VAR), rather than Watts. Reactive power makes no contribution to the active power, so it cannot be utilized. The results of reactive power are the costs for the work it involves and transmission losses. Therefore utilities may measure reactive power to financially penalize customers with low power factor loads. This is particularly relevant to customers operating highly inductive loads such as motors at water pumping stations.

Vrms and Irms: The RMS (root mean square) values, Vrms (Volt) and Irms (Amp) are the effective values of a phase voltage and a phase current. It is the equivalent steady DC (constant) value which gives the same effect. MCMSCADA gives the values for the r phase of voltages and the r phase of currents. All three phases are displayed when they are plotted. Operation of a motor at voltage levels above and below the name plate values are not recommended and adversely affect the life of a motor. MCMSCADA alerts the user when the voltage level is 10 % above or 10 % below the nameplate value.


Similarly, operation of a motor at a current level above the nameplate value may cause hot spots which decrease the insulation system rating and its life span. Therefore, motor operation above the nameplate value is not recommended. MCMSCADA+ alerts the user when the current level exceeds 10% of the nameplate value.

Frequency: The rate of changing direction of an alternating voltage or current is called the frequency and it is measured in hertz (Hz) which is the number of forwards-backwards cycles per second. MCMSCADA gives this value for information purposes and there are no upper or lower limits used for this value.

Harmonic Distortion: Harmonic distortion is the change in the waveform of the supply voltage from the ideal sinusoidal waveform. It is caused by the interaction of distorting customer loads. Its major adverse affect for induction motors is the heating in the stator windings. The total harmonic distortion (THD) of the supply voltage is a measurement of the harmonic distortion present and is defined as the ratio of the sum of the powers of all harmonic components to the power of the Fundamental frequency. It is recommended that operation of equipment should be less than 5% THD present in the supply voltage. MCM alerts the user if the THD is greater than 5 %.


Current Unbalance: Current unbalance of an electric motor system is defined as the percentage of the maximum deviation of phase currents from the average current. Current unbalance causes motors to overheat and lose torque. Developing short circuit faults due to the degradation of isolation materials may also cause increasing or decreasing current unbalance over time. Electric motors should not be operated with high current unbalance . MCMSCADA+ alerts the user when the current unbalance exceeds 5%.

Voltage Unbalance: Unbalanced voltage will result in unbalanced currents on the order of 6 to 10 times the voltage unbalance. Consequently, the temperature rise of the motor operating at a particular load and voltage unbalance will be greater than for the motor operating under the same conditions with balanced voltages. In addition, the large unbalance of the motor currents will result in non uniform temperatures in the motor windings. Voltages should be evenly balanced as closely as possible. MCMSCADA alerts the users when the voltage unbalance exceeds 2%.

ELECTRICAL VALUES 		
Watch	Power Factor	0.54
OK	Active Power [kW]	5.5
OK	Reactive Power [kVar]	8.7
OK	Vrms [V]	226
OK	Irms [A]	15
OK	V Imbalance[%]	0.48
OK	I Imbalance[%]	1.8
OK	Frequency [Hz]	50
Watch	THD [%]	11
OK	3th Harmonic [%]	0.77
OK	5th Harmonic [%]	8.9
OK	7th Harmonic [%]	1.2
OK	9th Harmonic [%]	0.08
OK	11th Harmonic [%]	0.32
OK	13th Harmonic [%]	0.65
WATCH ELECTRICAL VALUES	Electrical values are outside of their expected range. They should be noted and watched to identify the cause	

WORK REQUESTS

This section lists the detected abnormalities, possible causes and suggestions for corrective actions when the fault status is at the WATCH or EXAMINE.

WORK REQUESTS 
<p>EXAMINE 1: There are developing mechanical and/or electrical fault(s) as shown below. Maintenance should be scheduled within three (3) months.</p> <p>1. Looseness / Foundation. Check for loose motor foundation, loose motor components, looseness or excessive tolerances in driven components.</p> <p>2. Misalignment / unbalance. Check for Misalignment, unbalance, bearing, coupling, and motor shaft.</p>

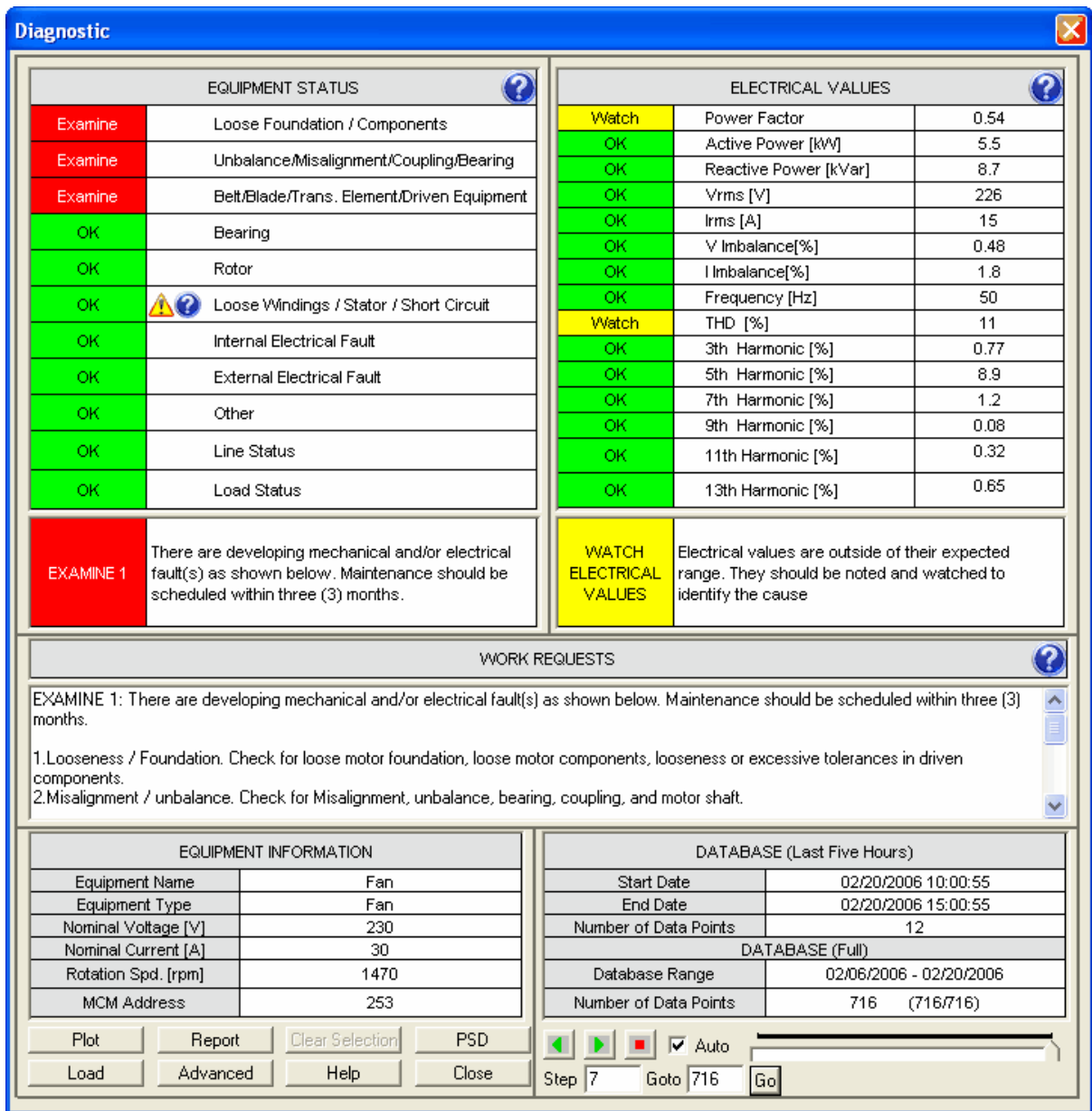


Figure 29: Diagnostic Window

Plot: Diagnostic feature allow the user to plot the selected parameters of MCM. The user can select or unselect any of the parameters of MCM clicking on the colored cells. The selected cells are shown with black back color. After selection of the parameters the user may right click one of the grids and select plot from the popup menu to plot the selected parameters as shown below. Remove Outlier option can be used in order to remove very high values from this plot.

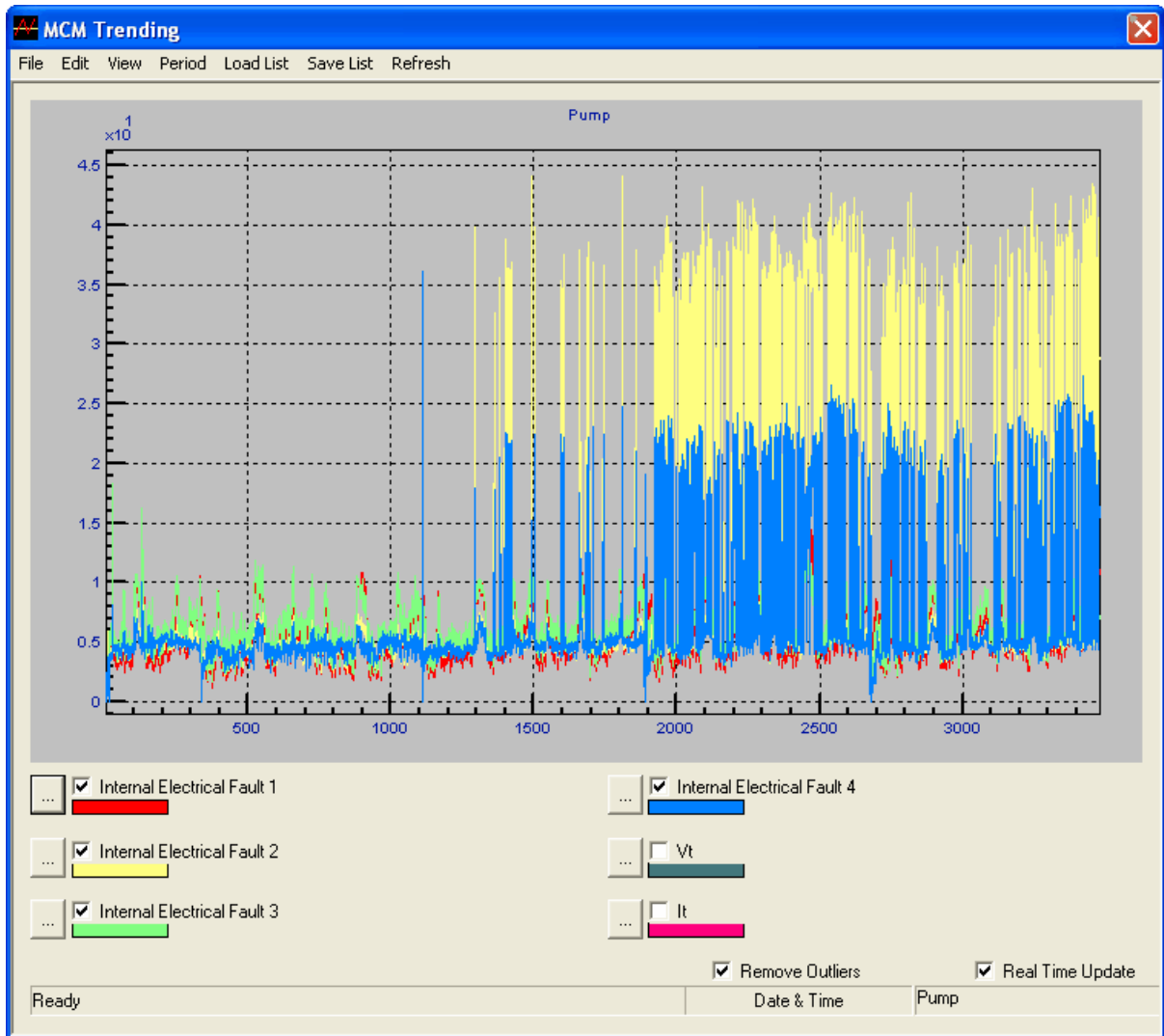


Figure 30: Plot of Mechanical Parameters 10 and 11

Advanced:

Power Spectral Density (PSD) intervals can be seen by pressing the advanced button as shown in below figure. Each mechanical parameter's corresponding minimum and maximum frequency points in Hz are displayed in this window.

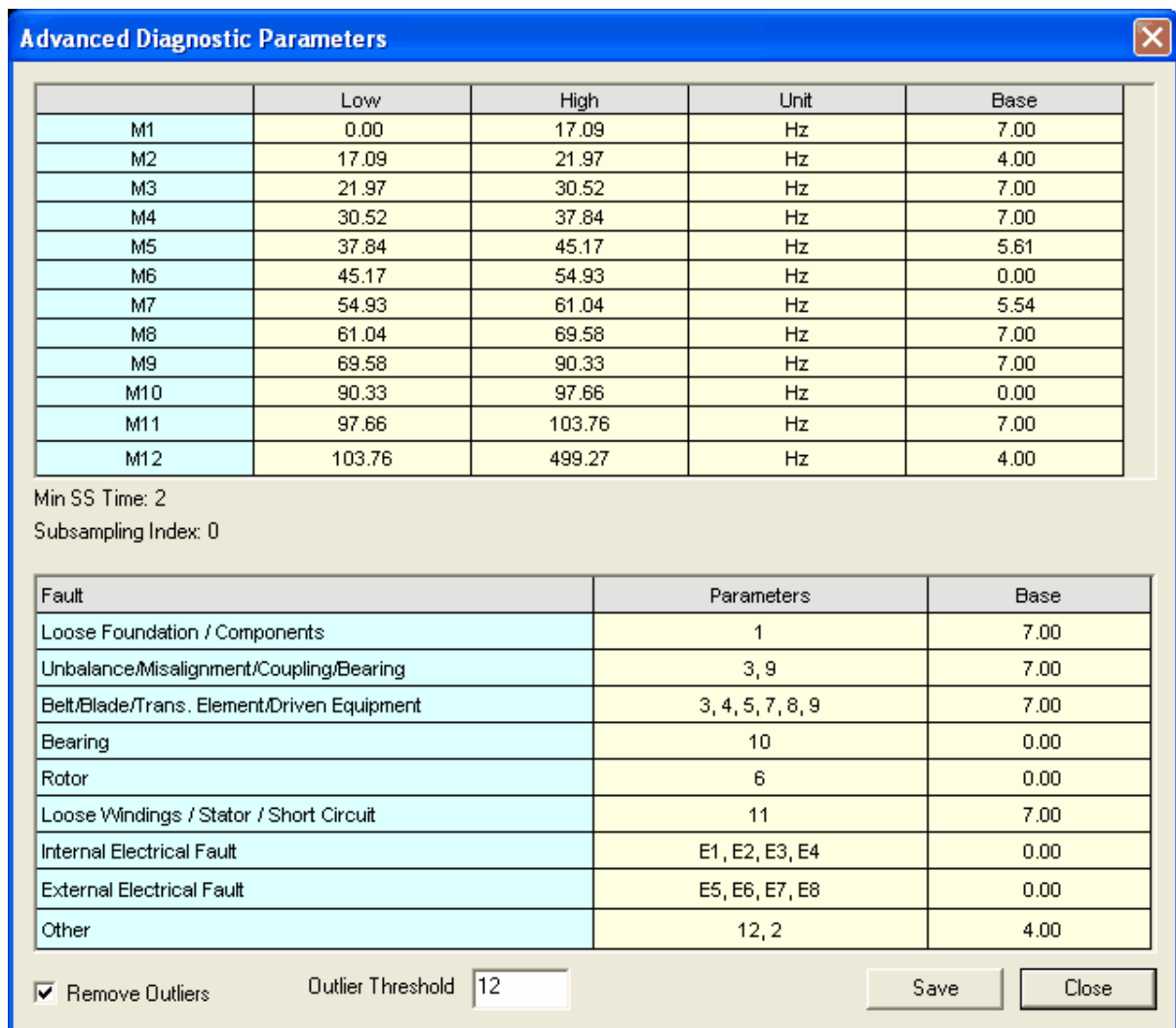


Figure 31: PSD Intervals

Report:

Diagnostic feature can prepare a report for the currently selected MCM. This report can be printed or sent as email attachments to selected recipients by pressing the appropriate buttons on the MCM report window toolbar. Remove outliers is used in order to exclude high peak values from the calculations. The parameters considered as outlier if the parameter value is above $MEAN + Outlier\ Threshold * STD$.

MCM/PCM Report

MCM/PCM declares the existing faults of equipment (MCM Condition Assessment), the weakest areas of equipment which will cause the development of faults in the future (Early Fault Detection), and efficiency of the maintenance action (Verification of Maintenance Action) by a report.

MCM Condition Assessment

MCM first learns equipment it monitors and at the end of the LEARN period provides information about the existing condition of the equipment. During this period MCM automatically determines the weakest areas of equipment which will cause the development of faults in the future. This information can be obtained by pressing the PSD button which shows the frequency spectrum (Power Spectral

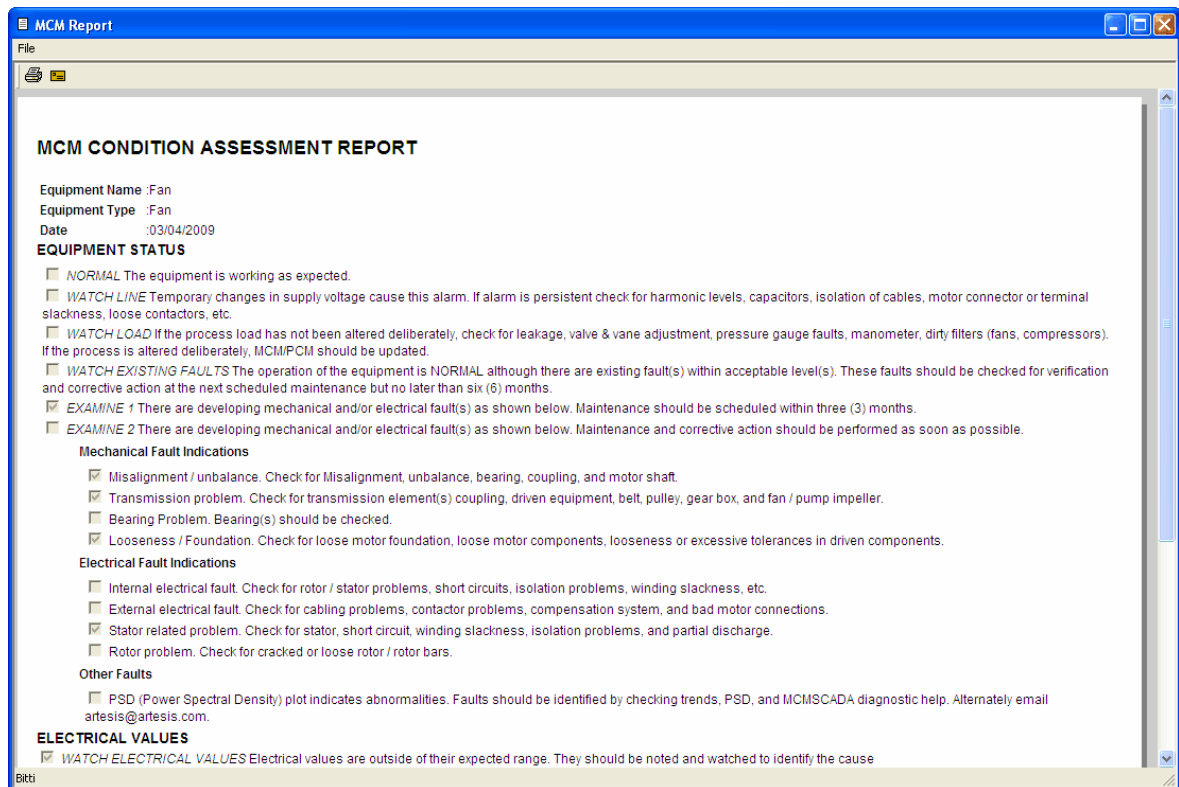
Density) for the equipment. The abnormal peaks in this spectrum and the frequency that they occur indicates the possible faults which are likely to develop which are explained in the HELP section of MCMSCADA & Diagnostics. These weakest areas should be noted by the maintenance team and checked by them during their next planned/periodic maintenance. After the maintenance MCM may be set to LEARN the equipment again to verify the effectiveness of the maintenance action by comparing PSD graph before and after the maintenance.

Early Fault Detection

MCM/PCM detects and reports developing faults a few months in advance before the equipment breaks down by analyzing power spectral density (PSD), characteristic parameters (inductance, resistance, etc...), and variations in motor load and motor supply voltage.

Verification of Maintenance Action

After the maintenance, trending should be checked to determine the effectiveness of the maintenance performed. MCM may be sent to LEARN mode again and a new PSD plot can be obtained and compared with the previous one, to verify that the problems are remedied.



Load:

In order to make analysis on Diagnostics window, Diagnostic information has to be downloaded from MCM. MCM diagnostic information can be downloaded by pressing load button. In order to download Diagnostic information, MCM must be in IDLE mode and learning phase of MCM has to be completed. Otherwise MCMSCADA will not be able to access diagnostic information and it will display below message. Please follow the instructions below to download diagnostic information from the MCM unit.

- 1) Run MCMSCADA software
- 2) Log in as supervisor from Operations > Login menu (Username : supervisor, Password : [blank]). Password section should be left blank.
- 3) Right click on the motor and select Commands > Go Idle to send MCM unit to IDLE mode.
- 4) Right click on the same motor and select "Diagnostic".
- 5) Press "Load" button.
- 6) Once the diagnostic information downloaded diagnostic window will be updated.
- 7) Close the diagnostic window and right click on the motor and select Commands > Go Resume to send MCM unit back to Monitor or Improve mode.



Figure 32: Timeout message

PSD:

Diagnostic feature also allows the user to plot Power Spectral Density (PSD) graphs of the equipment monitored and compare it with low, medium and high threshold levels.

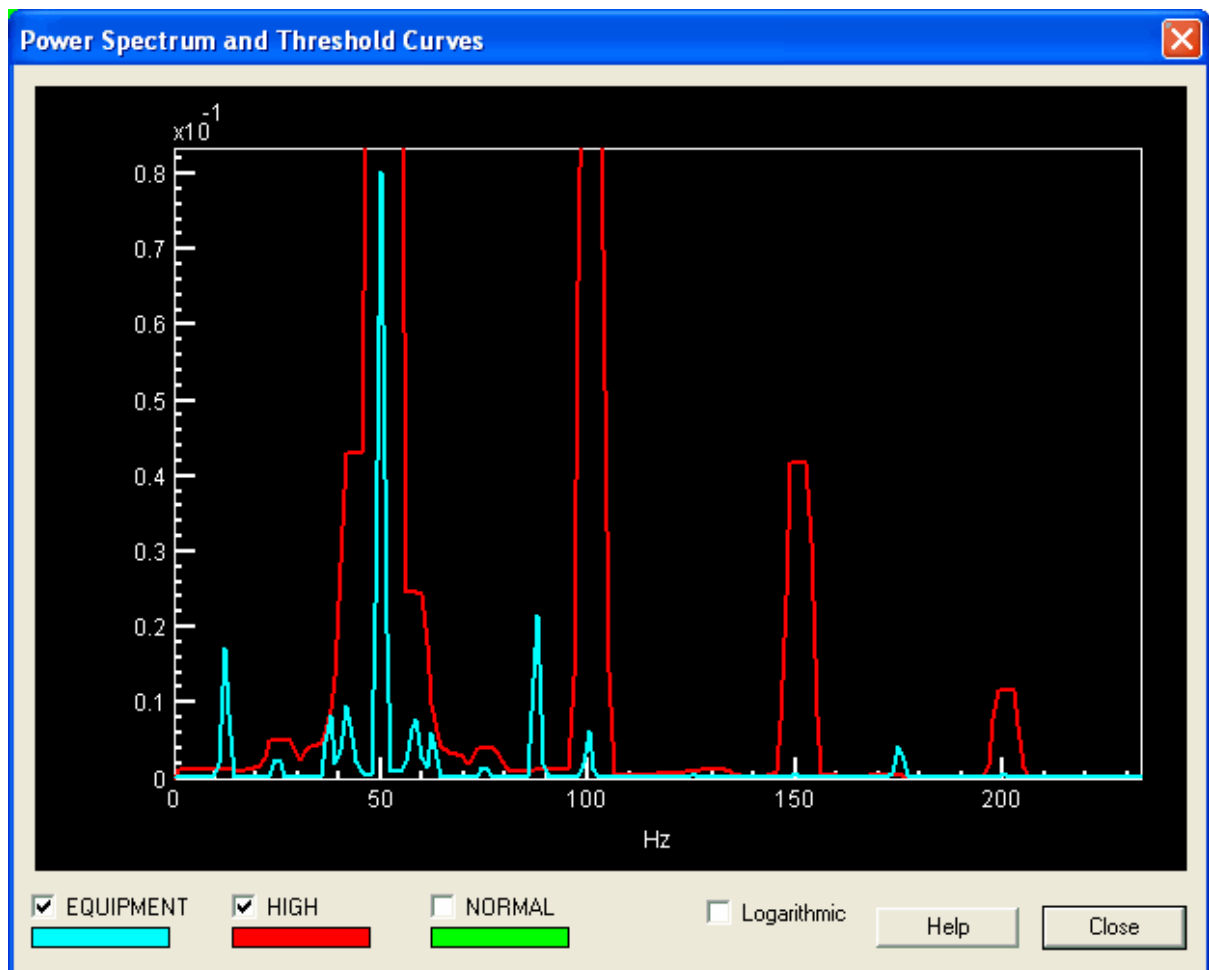


Figure 33: Plot of power spectrum and threshold curves

5 License Management

MCMSCADA has a built in license management system in order to prevent illegal usage of MCMSCADA software. Basic features of MCMSCADA can be used without a license. However in order to use advanced features such as trending, diagnostics, and MCM information, MCMSCADA has to be registered.

5.1 Registering MCMScada

Follow the registration instructions below to activate your license:

- 1) Run MCMSCADA
- 2) Select License > Activation from main menu

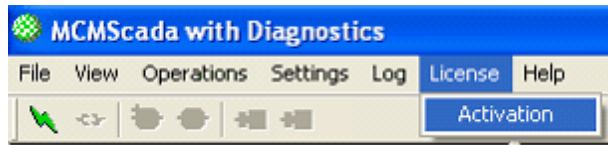


Figure 34: Selecting License->Activation Menu

- 3) Copy Code Entry Number and Computer ID and press keep button leaving Registration Key and Password as zero. Pressing keep button will reveal the same Code Entry Number and Computer ID next time you open the activation window. Otherwise Code Entry Number will be different every time you open the activation dialog.

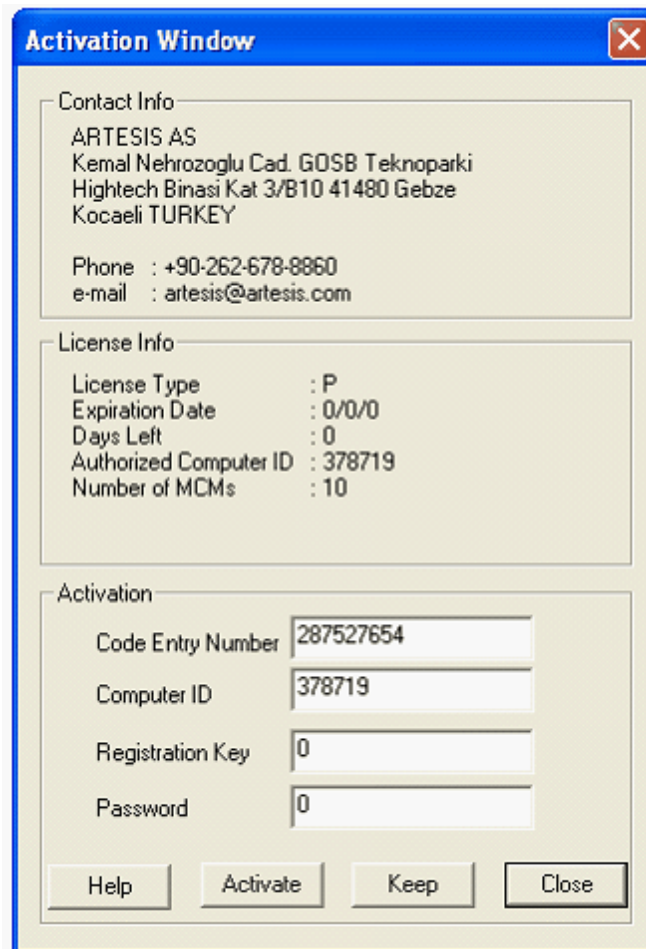


Figure 35: Activation Window Before Registration

- 4) Send Code Entry Number and Computer ID to Artesis. Artesis will generate a Registration Key and Password and send it to you for registration.
- 5) Upon receiving Registration Key and Password, open activation dialog selecting License > Activation from main menu.
- 6) Enter Registration Key and Password.

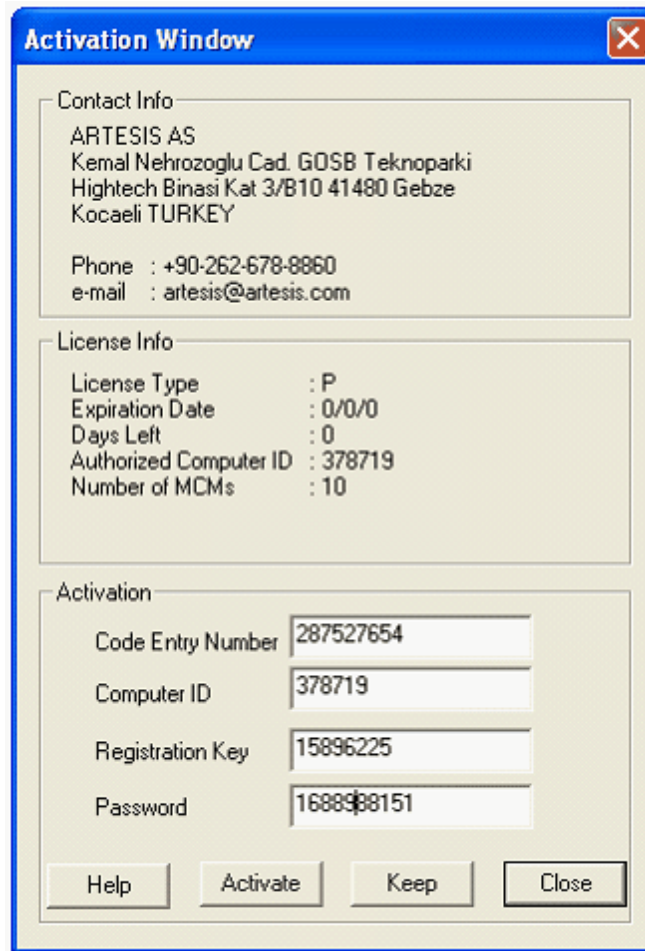


Figure 36: Activation Window During Registration

7) Press Activate button.

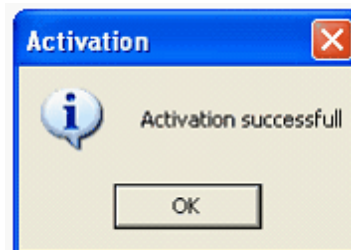


Figure 37: Activation Successful Message

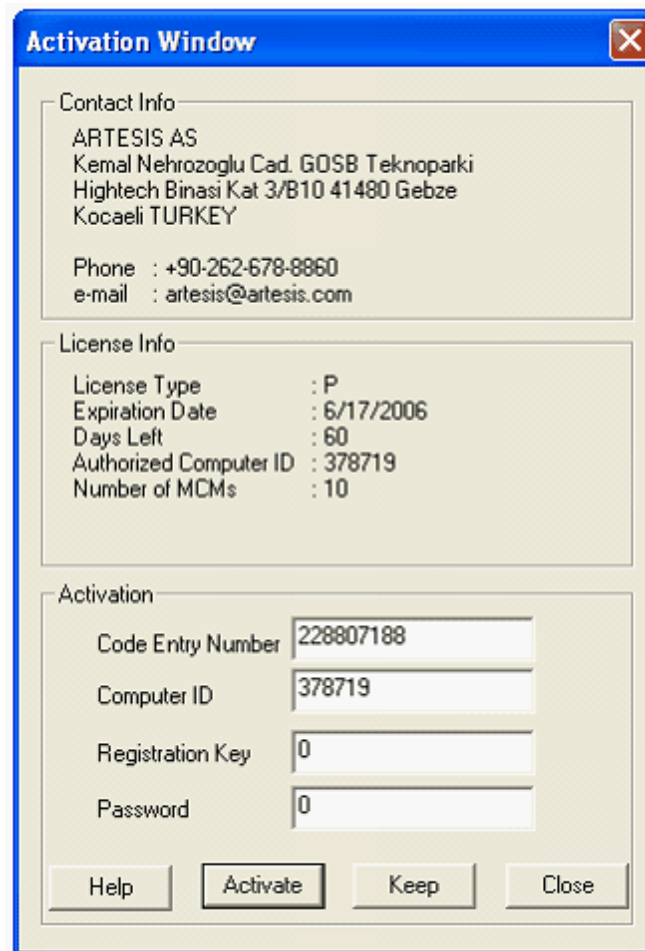


Figure 38: Activation Window After Successful Registration

After registration is completed successfully, MCMSCADA advanced features will be enabled.

6 Installation and Configuration

6.1 Theory of operation

The MCMSCADA software on a node consists internally of a number of interconnecting modules shown diagrammatically in Figure 39.

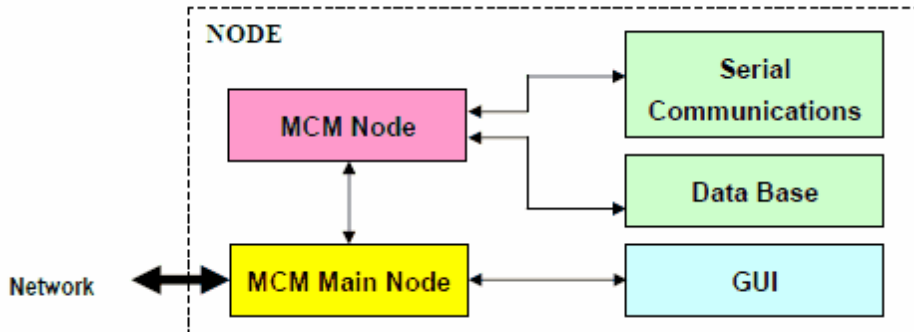


Figure 39: The software modules contained in a node

The MCM Main Node module is responsible for marshalling all messages and events between the other functional units. The Serial Communications and Data Base modules are needed when interfacing to MCM units on a local subnet. The GUI module is needed to allow a user to interact with the system. A PC running an application comprising of these four modules and the MCM node can function as a stand-alone node with no interaction with other nodes in the plant. To achieve operation with multiple nodes and remote access, a single PC on the network must be designated as a server. Through the MCM Main Node module, the server PC is responsible for all communications with the local area network and for sending email messages to designated recipients. Microsoft Outlook needs to be installed on the machine designated as a server if the MCMSCADA email facilities are to be used.

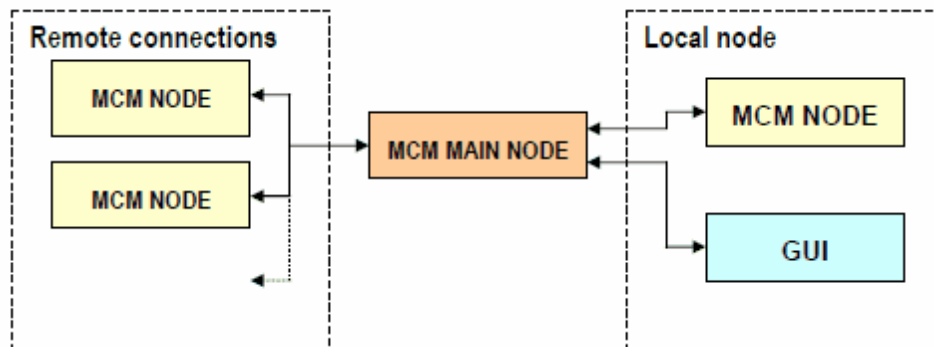


Figure 40: Arrangement of local and remote connections in a network

From Figure 40, it can be seen that all connections on the network are controlled by the MCM Main Node module. It should be noted that a separate machine is not needed to fulfill this function but one of the machines designated as nodes can be used. Since the server machine is responsible for all networking functions, a recent, high performance PC running Windows XP or later is recommended for this function.

MCMScada System Requirements

PC with 300 megahertz or higher processor clock speed recommended

128 megabytes (MB) of RAM or higher recommended

256 megabytes (MB) of available hard disk space

Super VGA (800 x 600) or higher-resolution video adapter and monitor

Keyboard and Microsoft Mouse or compatible pointing device

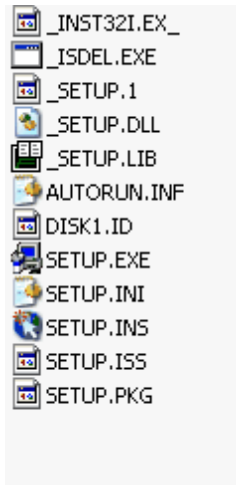
Operating system Windows XP or higher

6.2 Installation Instruction Summary

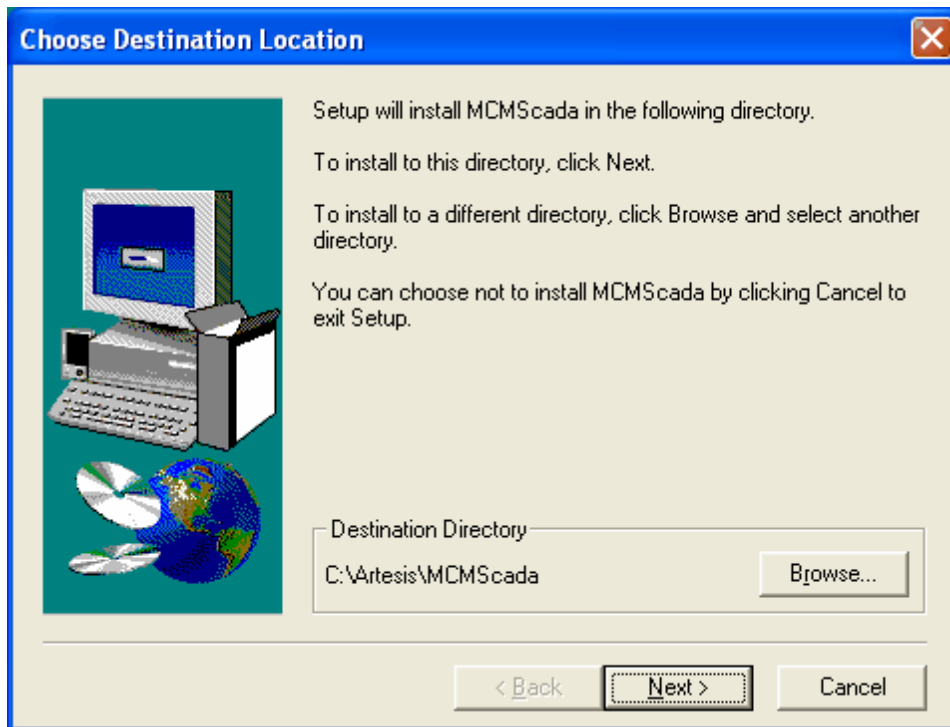
6.2.1 Installing and uninstalling MCMScada on a machine

6.2.1.1 Installation

1. Insert the MCMSCADA CD into the CD-ROM drive. Run **Setup.exe** file located under MCMScada installation folder.



2. On the MCMSCADA installation screen, click **Next** button.



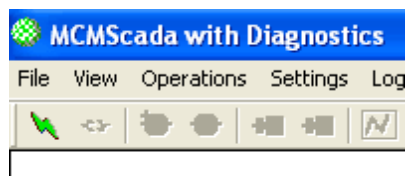
3. Follow the instructions in the installation wizard.
4. Restart your computer.

6.2.1.2 Uninstallation

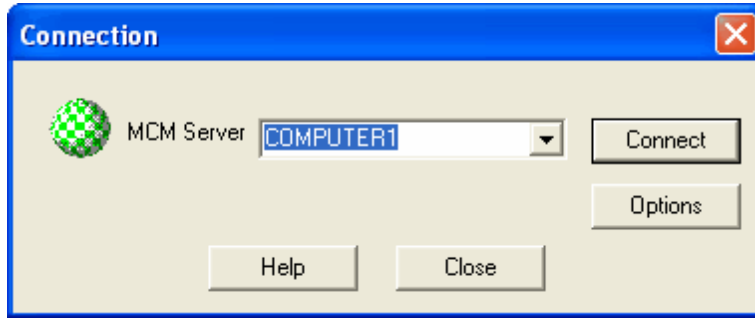
1. On the Windows Taskbar, click Start > Settings > Control Panel
2. Double-click Add/Remove Programs.
3. In the list of installed programs, click MCMSCADA
4. Click Add/Remove.
5. Follow the instruction in the wizard.
6. Restart your computer.

6.3 Configuring MCMScada for Local Access

1. Before running MCMSCADA, make sure that all MCM units are turned on and connected to the one of the serial ports of the computer.
2. On the windows taskbar, click Start>Programs > MCMSCADA > MCMSCADA
3. On the MCMSCADA window, click the **Connect** button (green button on the toolbar).



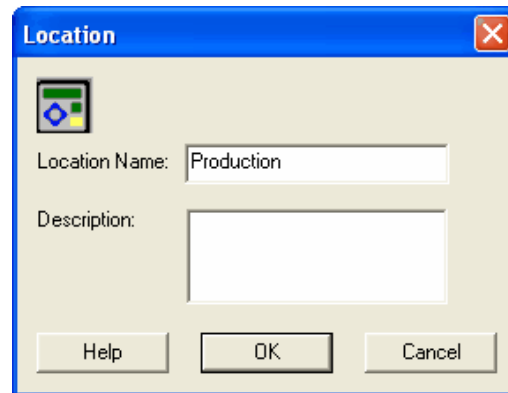
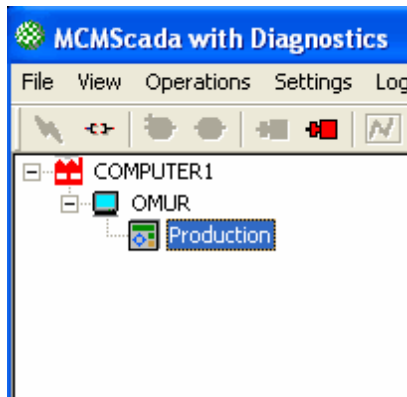
4. Enter either The network machine name or IP address and click the **OK** button.



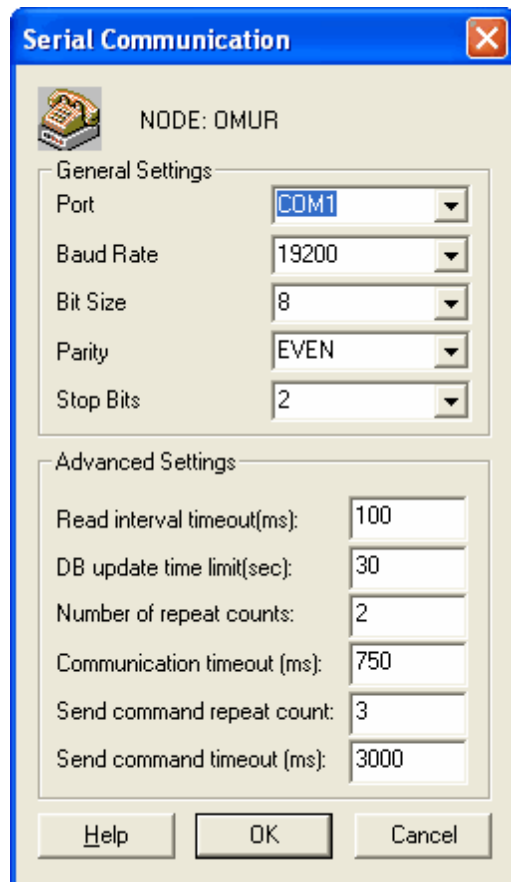
5. MCMSCADA will connect to local Main node and node Both the Main node icon and the node icon should appear on the system tray at the right of the Taskbar.



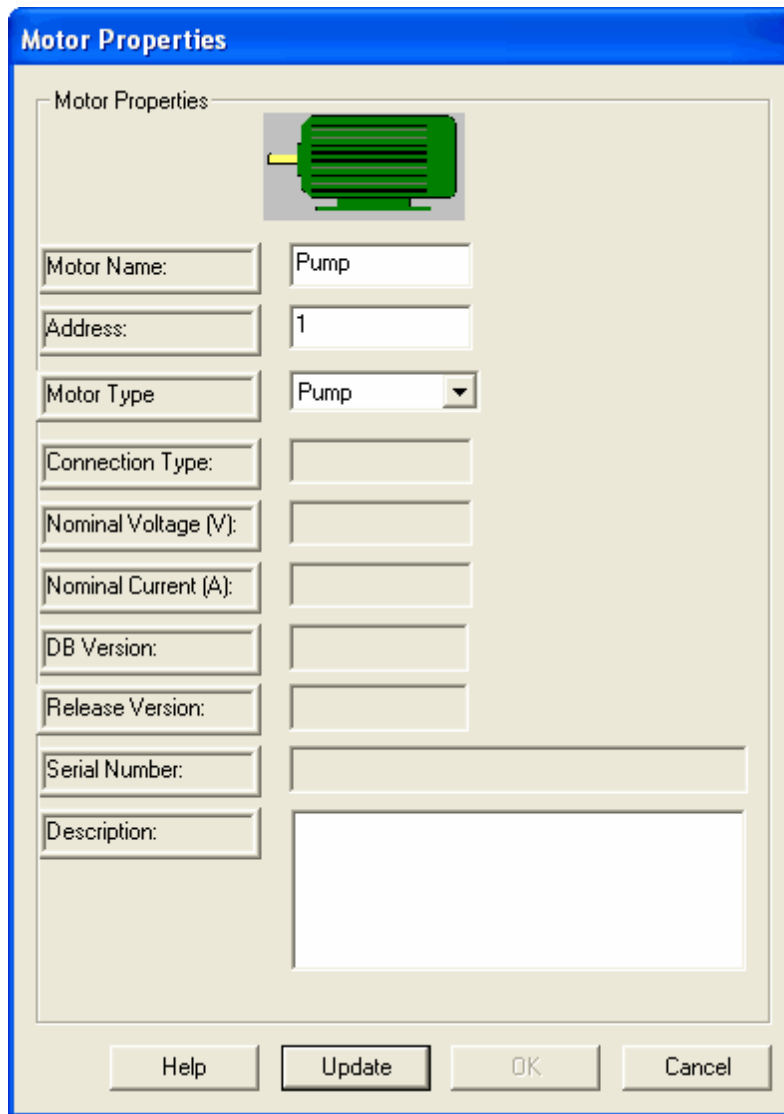
6. The default location “Location1” will appear under the local node. In order to rename the location name, right click on location, select **Edit Location**, enter an appropriate name for this location, and press **OK**.



7. Right click on the node and select **Comm settings**. Make sure that the communication settings are the same as those of the MCM units and the selected communication port is the port that MCM units are connected to.



8. Right click on **location** and select **Add Motor**.



Motor Properties

Motor Name: Pump

Address: 1

Motor Type: Pump

Connection Type:

Nominal Voltage (V):

Nominal Current (A):

DB Version:

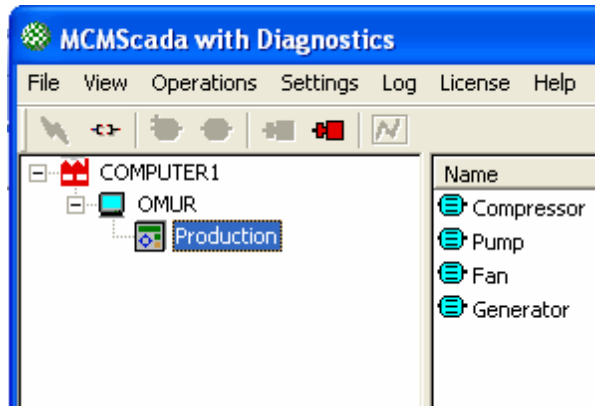
Release Version:

Serial Number:

Description:

Help Update OK Cancel

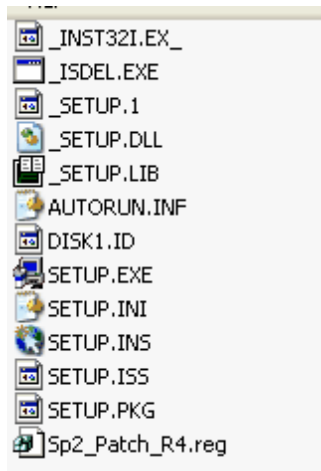
9. On the motor properties window, enter the motor name, address, description and press the **Update** button. MCMSCADA will retrieve the motor information from the MCM unit and update the motor properties window. Press **OK** to add this motor to the selected location.
10. Click on **location name** and click the **start serial communications** button on the toolbar.



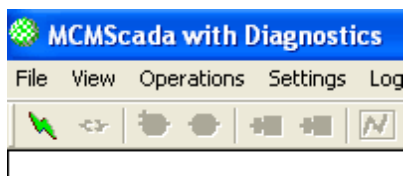
6.4 Configuring MCMScada for Remote Access

6.4.1 Configuring the Host machine

1. Install the MCMSCADA software as detailed above in "Configuring MCMSCADA for Local Access" section on the host machine.
2. Run SP2_Patch_R4.reg file which is located in both installation directory of MCMScada and installation CD of MCMScada software.



3. Run MCMScada Software from Start>Programs > MCMSCADA > MCMSCADA.
4. On the MCMSCADA window, click the **Connect** button (green button on the toolbar).

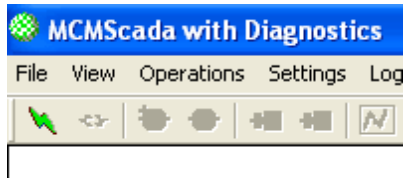


5. Make sure that both the MCM Main node and the MCM Node are running (two small icons should appear in the system tray on the Taskbar at the bottom right hand corner of the monitor screen.)

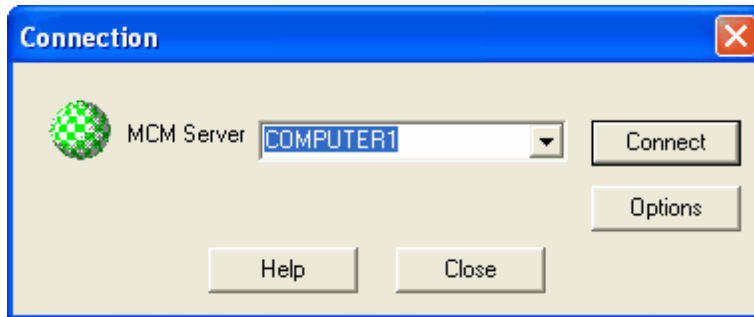


6.5 Connecting to a Local Machine

1. Before connecting to the local machine, MCMSCADA should be installed and configured.
2. Press connect button on the toolbar.



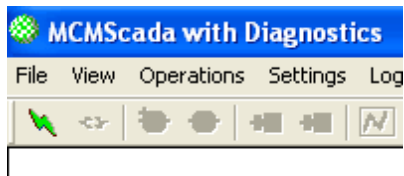
3. Enter either The network machine name or IP address.



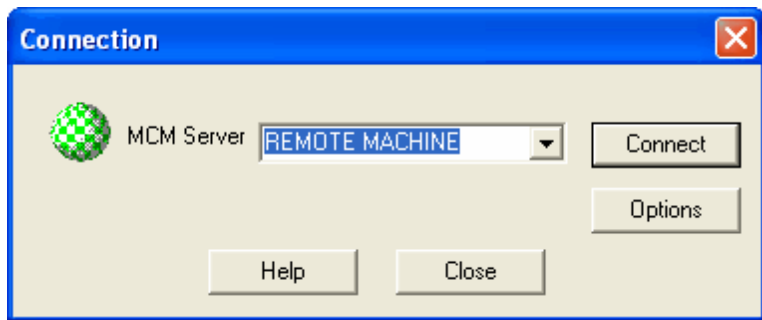
4. Press the **Connect** button.

6.6 Connecting to a Remote Machine

1. Before connecting to a remote machine, MCMSCADA should be installed and configured on both the remote and local machines.
2. Press the **Connect** button on the toolbar.



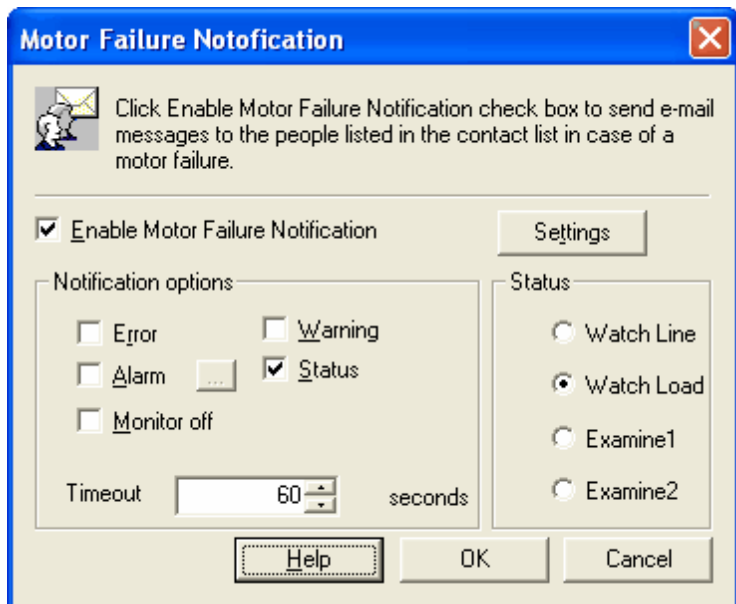
3. Enter either IP number or network computer name of the **remote machine**.

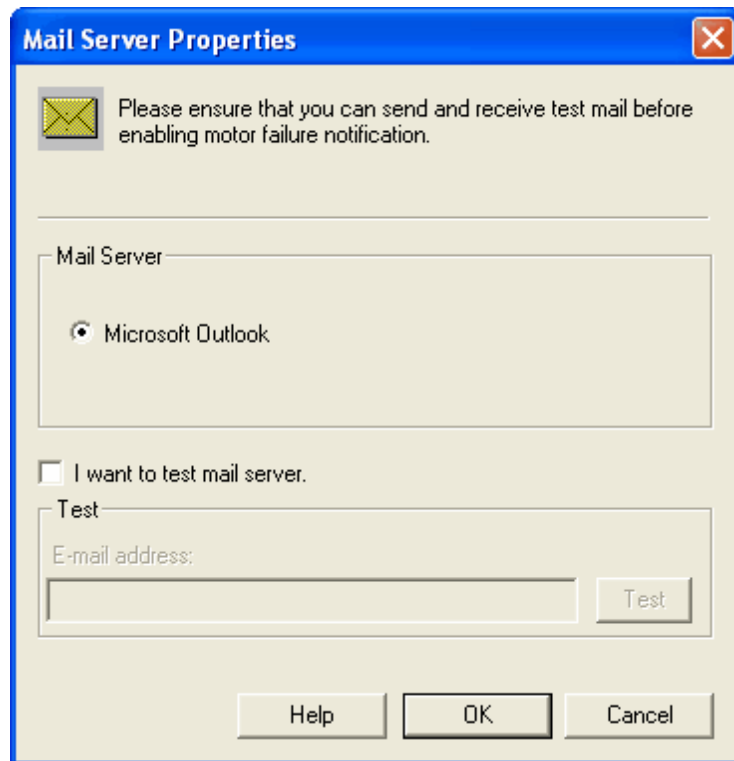


4. Press the **Connect** button.

6.7 Configuring Motor Failure Notification

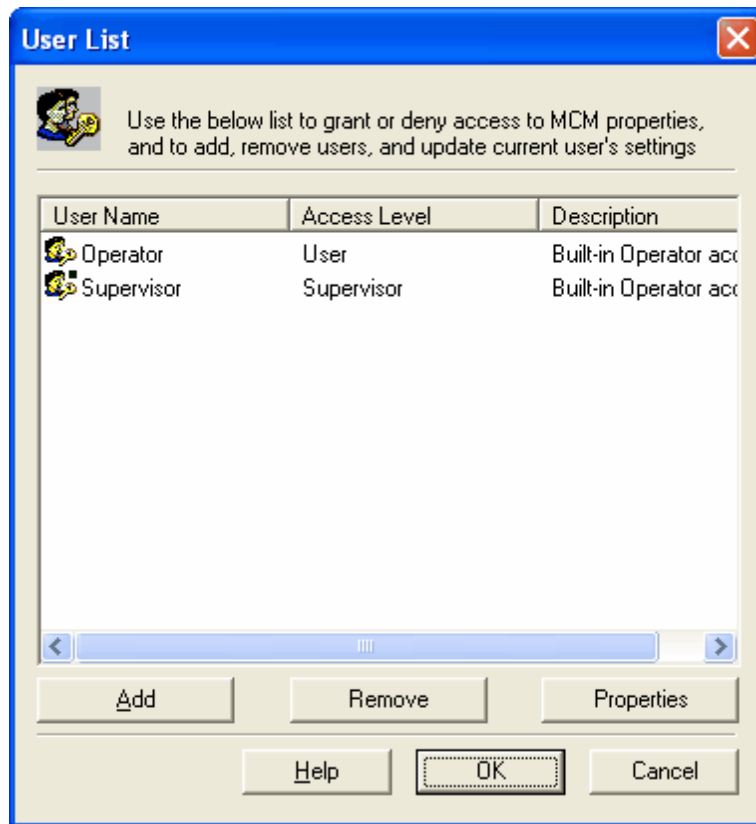
1. Motor Failure Notification configuration is required only for the MCM Main Node on the server machine
2. Install and configure Microsoft Outlook. Make sure that you can send and receive mail.
3. Run MCMSCADA.
4. Click Settings > Motor Failure Notification.
5. On the Motor Failure Notification window, click the **Settings** button.
6. On the Mail Server Properties window, click **I want to test mail server**
7. Type your e-mail address and press the **Test** button. If you cannot send and receive test mail, you should check the Outlook configuration.
8. Close the Mail Server Properties window.
9. On the Motor Failure Notification window, click Enable Motor Failure Notification
10. Select Notification Options as you wish.
11. Press **OK**.
12. On the MCMSCADA window, click Settings>Contact List.
13. Add the contact person's name, e-mail address, and phone numbers. You can add up to 20 contacts.
14. Press **OK**.





6.8 Configuring the User List

1. In order to edit user list, you should login at least at supervisor level. A built-in account is provided by default. You should change the Supervisor password as soon as you install the MCMSCADA.
2. User Name: Supervisor
3. Password:
4. Access Level: Supervisor
5. Login as Supervisor
6. Click Settings > User List
7. Add new users to the list. You can add up to 20 users.



7 Appendix 1 - Connecting MCM to a Network

Connecting MCM to a network

Introduction

MCM devices can be connected in a network to a host pc and viewed using the MCMSCADA software. This section presents a short overview of the connection techniques required to obtain optimum use from networked MCM devices.

TCPIP Version Connection Settings

In this version, the MCM device network can be setup as a separate network independent of the TCP network. This way, the user is able to connect to a distant MCM network from a remote PC without any additional software. Follow the steps below for setting up the TCPIP network:

1) Open the TCPIP Server Dialog shown below by following Main Menu -> Settings -> TCPIP Servers.

TCP/IP Servers

Number of TCPIP Converters: 2

TCPIP Converter: Converter 2

TCP/IP Configuration

IP/URL: 192.168.55.226

Port: 4001

Extra Byte: 0

MCM Device Count: 1

MCM Device Addresses

1.	4	6.	0	11.	0
2.	0	7.	0	12.	0
3.	0	8.	0	13.	0
4.	0	9.	0	14.	0
5.	0	10.	0	15.	0

Configurations Summary

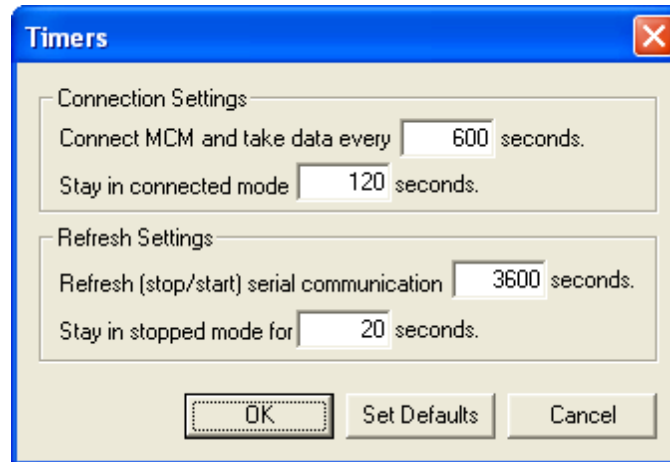
Converter 1:
 IP:192.168.55.225
 Port:4001
 Extra Bytes:0
 Number of MCMs:3
 Addresses: 1, 2, 3

Converter 2:
 IP:192.168.55.226
 Port:4001
 Extra Bytes:0
 Number of MCMs:1
 Addresses: 4

Save Cancel

- 2) Adjust the number of TCPIP Converters that are acting as gateways between MCM Networks and TCPIP according to your setup.
- 3) Choose the converter you want to setup, and enter required information in the TCP/IP configuration box as shown below:
 - a) The IP address of the converter in the IP/URL section
 - b) "4001" for the port number
 - c) "0" for the Extra Byte
 - d) Number of devices in the MCM Device Count section. When you enter the device count

- information, MCM Device Addresses box will enable as many input boxes for further entry.
- e) The MCM network addresses for each of the MCM devices connected to the local MCM network accessed by this particular converter.
- 4) Validate the changes you have made to the settings on the Configurations Summary pane. To add, delete or modify any converters, follow the steps above.
 - 5) Open the Timers dialog shown below by following Main Menu -> Settings -> Timers.



- 6) Click "Set Defaults" button and observe the default settings filled in the appropriate boxes. If you experience difficulties using the default settings, you may follow steps 7 and 8 to optimize the timers for your setup.
- 7) In the "Connection Settings" box, input the connection frequency and connection time of MCMSCADA to the MCM's in the first and second boxes respectively.
- 8) In the "Refresh Settings" box, input the refresh rate of the serial communication and duration of stopped mode time in the first and second boxes respectively.

Note: After the TCP/IP settings are changed as shown by the steps above, the standart version connection settings below must be followed.

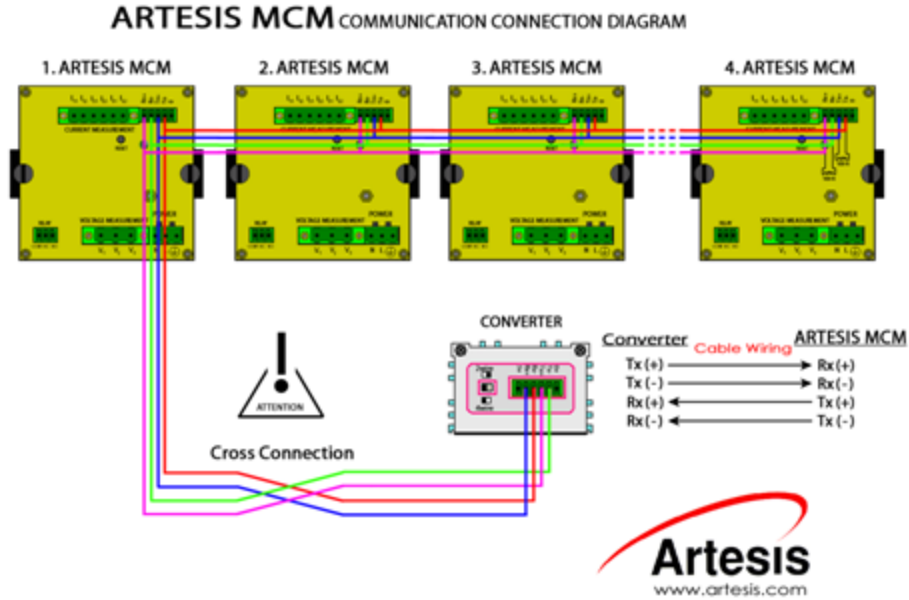
Standart Version Connection Settings

Setting up a network

MCMSCADA uses Industry standard RS 485 serial interfacing to connect devices to the serial port of a standard pc. MCM uses a linear four-wire topology with two sets of screened, twisted pair cables for transmission and reception. RS 485 requires the use of differential transmission/reception to achieve high data throughput rates over long distances (up to about 1km). Including the host pc, a maximum of 31 other devices may be connected to a single network node provided that the total length of cables is less than the permitted maximum, without the need of external repeaters. With repeaters, these constraints apply to each segment (ie segment cable length less than the maximum and total number of transceivers less or equal to 32 including the repeaters)

When setting up a network within a plant, high quality screened cable consisting of two sets of twisted pairs and a ground return should be used. The cable should be laid in ducts away from power lines or other potential sources of noise and EMI. Only one end of each cable shield should be connected directly to ground; connecting both ends can allow ground currents to flow and induce noise in the cable. The grounding point is arbitrary and can be any convenient point on the network. Alternatively, each section of the network can be grounded separately, but in this case it must be ensured that the shields on each section are not connected directly as this would allow currents to flow in the shields. If required,

a series capacitor and resistor can be used to connect the free end of the shield to the local ground on the MCM unit. This will give the desired high impedance at dc whilst allowing noise inducing, high frequency signals to short to ground. In a linear topology network, the connection of termination resistors between the two sets of terminals of the last device on the network, is highly recommended and can significantly improve frequency response and noise rejection capabilities. The resistor should have a value corresponding to the characteristic impedance of the cable, typically around 120 Ω. Please consult the cable manufacturer's specifications for more details.



Connection to the host pc should be made using a standard RS 485 – RS 232 converter to the selected serial port. For best results in noisy environments especially when inverters are used to drive the motors, the converter should be an optically isolated type such as Artesis part no. ART-MCM 0001. This will ensure that communication problems resulting from electrically induced noise will be minimized.

The network cables should be connected to the screw terminals on the rear of each MCM unit. The last unit in the network (at the far end of the network from the pc) should be fitted with termination resistors between the + and – terminals of the transmit and receive branches.

Guidelines for establishing RS485 networks

In order to minimize problems with the use of RS485 networks, a number of points should be considered. An excellent discussion of the subject can be found in the National Semiconductor Application note: "Ten ways to bullet proof RS-485 interfaces" AN012882.

Cable properties and topologies:

There are many ways a network consisting of n points can be connected. The high cost of cabling often influences cabling layouts that minimize cost at the expense of network performance. In all cases high quality, twisted-pair cable should be used with known line impedance. As signals move along a cable, the characteristic line impedance determines the speed at which they travel. When a signal reaches the end of a cable it can be reflected back along the cable and interfere with the original signal. Multiple reflections from free ends can degrade the signal sufficiently to make it impossible to determine the

voltage level and data will be lost. These effects become much more apparent with longer cables and higher transmission frequencies, but can be present under all conditions. The simple expedient of placing termination resistors at each free end, of a value equal to the characteristic line impedance, can drastically reduce reflections by absorbing the transmitted energy. As in all things, this action requires a trade-off somewhere. The termination resistances act as loads to the active RS485 driver and since the resistors appear as parallel loads, their combined effect is to increase the current that the driver has to supply in order to maintain the required voltage levels. The RS485 standard specifies a maximum of two termination resistances, one at each end of a linear cable. Above this load, the driver's performances are not guaranteed. The consequences of this are:

1. The cable must be laid out in a linear, daisy-chain manner so that each device on the network is visited by the cable as in Figure a
2. Stubs used to join devices to the network should be as short as possible in order to minimize the time delay between the signal and its inevitable reflection (the time delay will be equal to twice the stub length divided by the propagation speed). Thus the longer the stub length, the larger the time delays. It is recommended that a stub length of no more than a few centimeters should be used.
3. Star configurations such as that shown in Figure c should be avoided at all costs. This configuration is often the cheapest in terms of cabling costs as it can minimize the total cabling length. It can even be made to work by trial and error, but is inherently unstable, and some devices may behave erratically. The topology is basically that of a linear network with stub lengths equal to the network length. The question will always arise as to where to place the termination resistances as the stubs are of equal importance to the network.

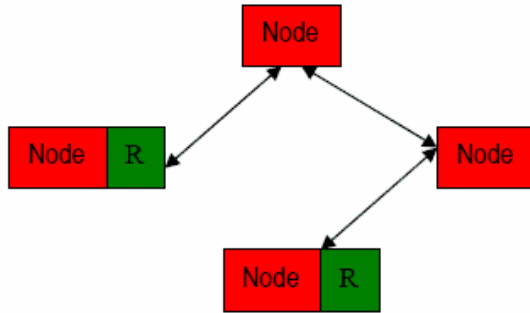


Figure a: Ideal linear daisy-chain topology network with terminating resistor at each end (denoted by the R blocks)

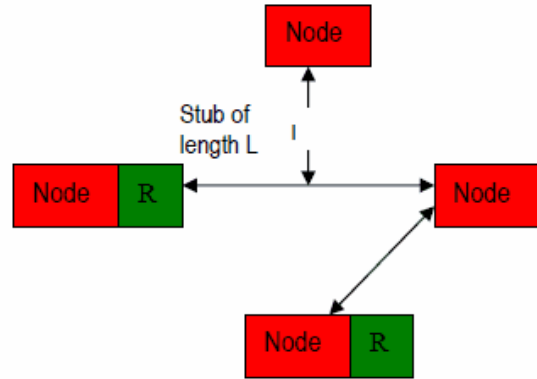


Figure b: Linear topology network with a stub. L should be as short as possible

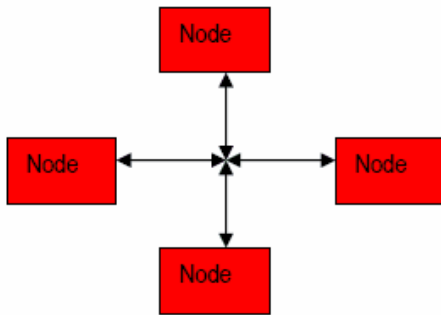


Figure c: Star topology network. Where should the terminations be placed?

Grounding and return paths:

Ground is usually denoted as a reference point for voltage measurements. It is often implicitly assumed that two points at ground are at the same potential. Whilst this may be approximated in a single device, as the physical separation between two locations becomes large, ground potentials may vary considerably. Networks by definition connect separate locations together with electrical signals needing a well-defined return path. If the return path is via the ground, the impedance may be high and noise may be coupled to the signals. On the other hand, connecting two locations directly via a return wire may cause high currents to flow as a result of the potential difference between the grounds at the separate locations. An alternative is to connect the return via a small (100 W) resistor to the cable. This will ensure both low current flow and a well-defined return path for signal currents. MCM has internal resistors connected between ground and the common terminal (0) on the communications port for this purpose.

All cabling should be screened with the screen grounded at a suitable point.

Summary

- Use good quality screened, twisted pair cable with an extra wire for the return signal.
- Ground the cable screen at one point. Never allow it to carry current.
- Ground each node on a network and provide a low impedance return path for signals.
- Use a linear daisy-chain topology for connecting nodes on the network. Never use a star configuration.
- Keep the inevitable stubs created when attaching a node to the network as short as possible.

- Terminate both ends of the network with resistors equal to (or slightly greater than) the characteristic line impedance. Note that Artesis RS232-485 converters contain termination resistors.
- Use repeaters to extend the distance or number of devices on the network.

8 Appendix 2 - Vista Troubleshooting

Known Issues with Vista

Installation on Windows Vista operating system is supported by MCMSCADA, but there are certain issues that need your attention.

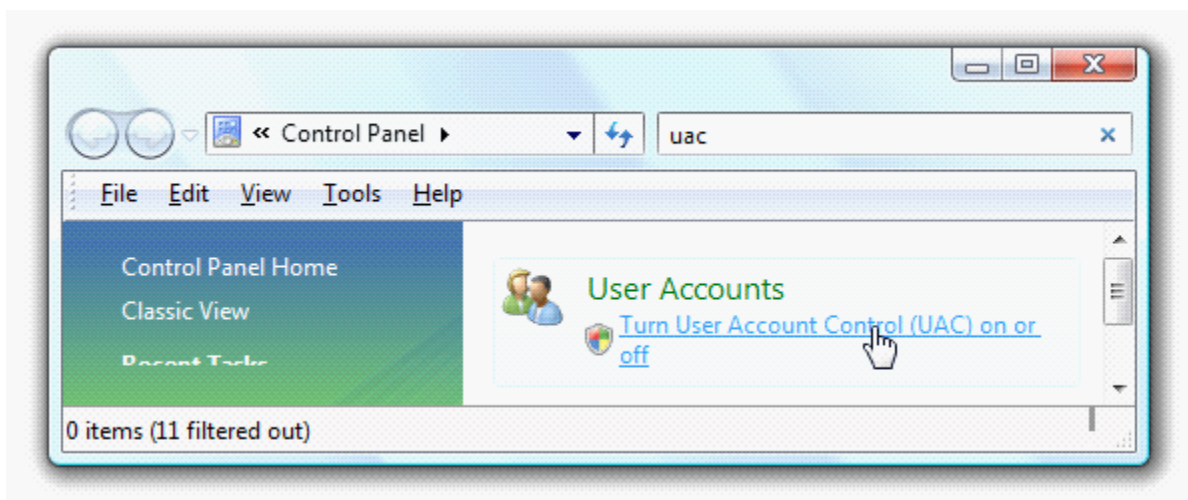
Turning of User Control

Starting with Windows Vista, Microsoft OS's ask the user for permission when certain applications try to issue system level commands. MCMSCADA has been known to generate such information during its use. You can turn off this dialog in Vista. This will stop the operating system from displaying messages related to user control completely, thus enabling MCMSCADA to work without interruptions.

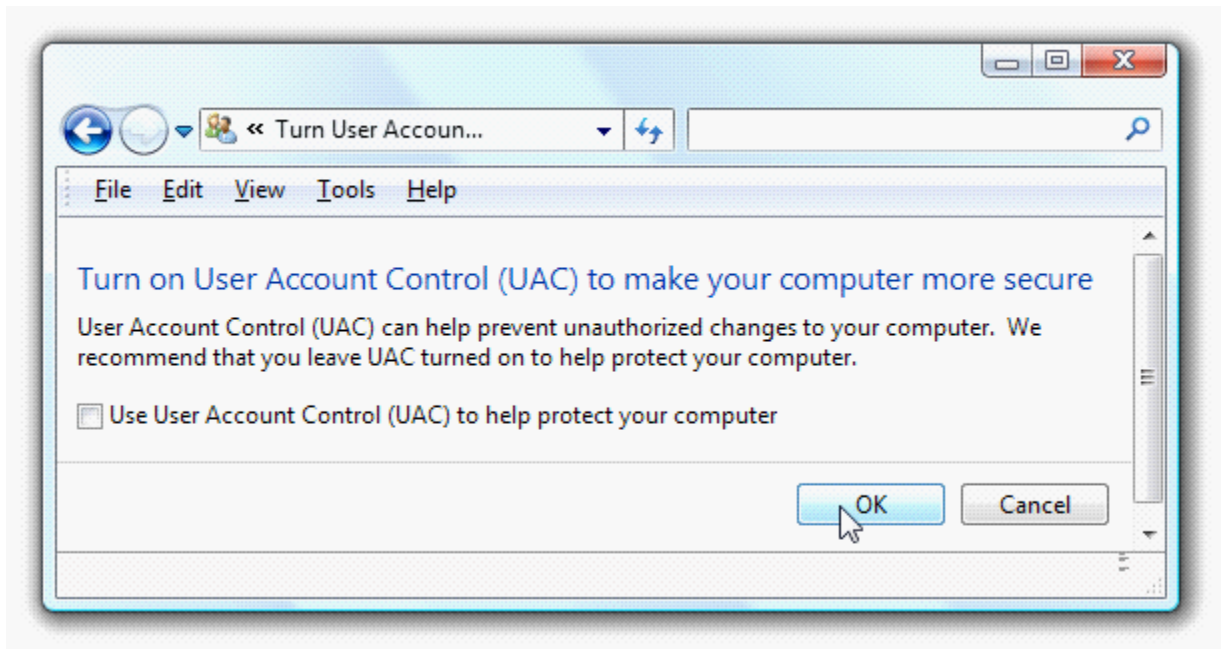
Note: Turning off user control is not required for MCMSCADA to function properly, and will also turn off other applications' related messages.

You can follow the steps below to turn of user control:

1. Open up Control Panel, and type in "UAC" into the search box. You will see a link for "Turn User Account Control (UAC) on or off":



2. On the next screen you should **uncheck** the box for "Use User Account Control (UAC)", and then click on the OK button.



3. You will need to reboot your computer before the changes take effect

Opening Help

MCMSCADA uses Winhelp, a help system that was present on previous Windows versions by default. If you have trouble starting help, then you will need to follow the link below to install a patch for your Vista system that was released by Microsoft.

[Download Microsoft Vista Winhelp32 Patch](#)