

Ovation™

Machinery Health Waveform Recorder User Guide



About this manual

Welcome to the Emerson Ovation distributed control system. Ovation is a highly reliable and responsive real-time plant monitoring and process control system that uses commercially available hardware platforms, operating systems, and open network technology.

This manual provides an overview of the Ovation Machinery Health Waveform Recorder, which is a software program enabling you to collect and record high-speed waveform data from the Ovation Machinery Health Monitor.

The information in this manual represents the recommended standards and procedures. If your system requires a different configuration, contact your Emerson service representative or sales office for help with the review of your system.

It is assumed that all installation and maintenance procedures described in this document will be performed by qualified personnel and that the equipment used is only for the purposes described. Using alternate methods of installation or configuration could yield undesirable results.

Summary of Changes

- Made miscellaneous changes and corrections.

Versions and software requirements

The *Machinery Health Waveform Recorder User Guide* is not tied to a specific software release and is updated on a periodic basis. See *Minimum Ovation system requirements [17]*.

Conventions used in this manual

For security purposes, actual IP addresses are not used in Ovation user manuals. The IP addresses used in this manual are for example purposes only and should not be used in an actual system.

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1

Introduction to the Waveform Recorder

Topics covered in this section:

- *Waveform Recorder overview [9]*
- *Waveform Recorder features and functions [11]*
- *Client API functions [12]*
- *AMS Machine Works [13]*
- *Reference terminology [13]*
- *Reference documentation [15]*

1.1

Waveform Recorder overview

The Ovation Machinery Health Waveform Recorder (MHWR) is a software program designed to collect and continuously record high-speed waveform data from the Ovation Machinery Health Monitor (OMHM) for data analysis.

Once data is collected by the Waveform Recorder, the data is sent to AMS Machine Works (AMSMW) for prediction measurement and data analysis.

The acronyms mentioned above are used throughout this document and are described below:

- **MHWR** - refers to the **Machinery Health Waveform Recorder** which is a software program residing on a server-class computer, also may be referred to as OMHMRecorder, Ovation MHM Recorder, MHM Waveform Recorder, or Waveform Recorder.
- **OMHM** - refers to the **Ovation Machinery Health Monitor** which is an Ovation I/O module residing on the Ovation I/O bus typically housed within an Ovation I/O cabinet, also referred to as a module. OMHM(s) interface to Ovation Controllers through the Ovation I/O bus and Ovation network. The module connects to vibration sensors and collects high-speed I/O data required for vibration monitoring and diagnostics.
- **AMSMW** - refers to Asset Management Suite Machine Works which is a suite of products designed to monitor the health of your machinery and to provide advanced prediction and protection capabilities.

Note

Prediction measurements are a function of AMS Machine Works and are used as a means of diagnostic data analysis for machinery health using AMS Machine Works software. Refer to the appropriate [AMS Machine Works User Guide](#) for additional information.

The Waveform Recorder hardware consists of a server class machine with a two-terabyte minimum of free disk space. The Waveform Recorder is connected to OMHM(s) through each module's NIC #2 port.

Depending on the amount of free disk space allocated on the Waveform Recorder, several days of data can be saved. The Waveform Recorder software uses a FIFO (First-In-First-Out) data collection methodology. If the disk is full, the incoming new data is saved and the oldest data is forced out of storage to make room for the incoming data.

Data is collected by the Waveform Recorder at a maximum data rate of two-million samples per second.

Note

Sample rates are directly related to the OMHM channel Fmax setup. Fmax values are determined when configuring the OMHM. Refer to the [*Machinery Health Monitor User Guide*](#) for Fmax configuration. For typical process equipment, it is highly recommended to use Fmax of 2000 Hz or lower.

Higher Fmax values are supported for faster-spinning rotating equipment. Use of Fmax higher than 2000 Hz for typical process equipment provides unnecessary detail and consumes additional disk space.

To accurately determine the recorder quantities and hard disk capacities for your OMHM configuration, you must know the total number of channels required and all Fmax values.

Typically, disk space requirements are determined during the planning and proposal stages of system development. If disk space size needs to be revisited due to performance or other related concerns, contact your Emerson representative for assistance.

The Waveform Recorder can accept connections from up to twenty OMHMs and receives the following types of data:

- OMHM configuration data.
- Raw waveform data.
- Generated parameter data.

The Ovation Machinery Health Client API provides an interface to allow applications to retrieve OMHM waveform, scalar, and configuration data, in a secure manner without direct access to the OMHMs.

Note

The Client API does not support OMHM configuration change requests from the vibration analysis applications; therefore, all OMHM configuration changes are made using the Ovation Developer Studio. Refer to the [*Developer Studio User Guide*](#) and the [*Machinery Health Monitor User Guide*](#) for additional information.

Once the Waveform Recorder software is installed and configured on the Waveform Recorder server, the software runs in the background as a service. Typically, the only user interaction required with the Waveform Recorder is indirect action through AMS Machine Works.

1.1.1 FIFO data storage

The Waveform Recorder uses a FIFO (First-In-First-Out) data storage methodology. The Waveform Recorder receives and stores all raw waveform data in a proprietary data format received from registered OMHM channels into short term FIFO storage.

The amount of data collection capability is limited by the amount of free disk space available on your computer. Emerson recommends a two-terabyte minimum of free disk space to allow for an adequate amount of storage.

Over time, continuous data collection eventually consumes all available storage. Once the maximum amount of storage space has been consumed, the FIFO protocol saves the most recent data and forces older data out of storage.

The FIFO storage location is managed through the Waveform Recorder configuration.

Note

The AMS Machine Works server provides the permanent storage location for the vibration data of interest.

1.2

Waveform Recorder features and functions

The Ovation Machinery Health Waveform Recorder provides the following features and functions:

- Connects directly to the OMHM module's NIC #2 port. Connection can be through a managed switch or through a firewall/router. Can connect indirectly through a data diode in Proxy mode.
- The Waveform Recorder does not require connection to the Ovation network and should not be connected to the Ovation network. The connection is intended to be a separate communication path from Ovation controls.
- Each Waveform Recorder supports up to a total of twenty OMHM modules using the recommended MHWR server with the applicable Ovation part number.
- Collects up to a total of two million samples per second.
- Accepts module registration requests from each OMHM.
- Maintains a database of OMHM module and channel configuration information received from registered modules.
- Captures OMHM configuration data and detects when module configuration changes occur.
- The Client API notifies the client of configuration changes and other important OMHM or Waveform Recorder events.
- The Client API responds to requests from the vibration analysis application to provide OMHM configuration, waveforms, and timestamped parameter data.
- Stores waveform data in exactly the same form as received from the module.

1.3

Client API functions

The Ovation Machinery Health Client API provides an interface to allows software applications to retrieve OMHM waveform, scalar, and configuration data in a secure manner, without having direct access to the OMHM module(s).

Configuration and waveform data from the Waveform Recorder is supplied to client applications through the Client API.

The Client API isolates the calling application from the MHWR details and allows the calling application to be deployed locally to, or remotely from, the server.

For best performance, a local installation of the calling application is recommended.

The Client API supplies the application with the following:

- OMHM configuration information.
- Near real-time raw transient waveforms.
- Bounded raw waveforms from recent history.
- Event notifications.
- Waveform Recorder performance data.

Upon request, the Waveform Recorder provides configuration, bounded, and streaming waveforms to applications through a Client API. The transfer of bounded OMHM waveform data from the Waveform Recorder local history is provided by the Client API.

The Waveform Recorder also receives scalar values from registered OMHM channels, timestamps them and retains them for access through the Client API.

Note

Timestamps are not available from the OMHM; therefore, they must be assigned by the Waveform Recorder.

The Client API does not provide client authentication functionality.

The Client API does not support OMHM configuration change requests from the vibration analysis applications; therefore, all configuration changes are made using the Ovation Developer Studio. Refer to the [*Developer Studio User Guide*](#) for additional information.

Note

Client applications are mainly interested in computed parameters associated with the OMHM channels and do not have access to Ovation.

1.4

AMS Machine Works

Asset Management Suite (AMS) Machine Works is a software program used for analyzing and tracking the mechanical health of plant equipment. AMS Machine Works uses data sent from the Waveform Recorder for vibration diagnostic calculations.

AMS Machine Works software simplifies fault diagnosis and analysis by combining predictive maintenance techniques and comprehensive analysis tools.

Refer to the appropriate [*AMS Machine Works User Guide*](#) for additional information.

1.5

Reference terminology

Table 1. Reference terminology

Term	Description
AMS Asset Management Suite or AMSMW Asset Management Suite Machine Works	A suite of products designed to monitor the health of your assets and maintain them predictively. Provides advanced prediction and protection capabilities. Performs waveform data analysis of the predication waveform produced by the Ovation Machinery Health Monitor.
Application Programming Interface (API)	Software used by the Waveform Recorder to allow other software applications to communicate with one another.
Bounded Waveform	OMHM waveform data sent for a specific time period.
Client API	Receives configuration, waveform data, and events from the Waveform Recorder.
Configurator tool	The Configurator tool (also referred to as the OMHMConfigurator) is used to configure the MHWR and/or MHM Proxy software applications.
Data diode	A networking device allowing data to only travel in one direction. Data diodes are used to isolate and protect networks to guarantee against cyber security intrusions. This device may also be referred to as a unidirectional gateway.
Fast Fourier Transform (FFT)	Used to take time domain waveform data and convert the data to the frequency domain for analysis which allows data to be viewed as it relates to specific frequencies and to the turning speed of the equipment.
Field-Programmable Gate Array (FPGA)	Configurable integrated circuitry located on the OMHM module.
F _{max} Frequency Maximum	The highest or maximum resolvable frequency included in the measurement (low pass filter). Refer to the <i>Machinery Health Monitor User Guide</i> for additional information.

Term	Description
IOD I/O Driver	Interface between the Waveform Recorder (MHWR) and Machine Works.
Machinery Health Client API	The Waveform Recorder client Interface is an API whose purpose is to receive configuration, waveform data, and events from the Waveform Recorder.
Machinery Health Waveform Recorder (MHWR) or (Waveform Recorder)	Software program to collect and continuously record high-speed waveform data from the OMHM(s) for data analysis. Captures waveform, events, and configuration data from OMHMs and serves the data to client applications.
Measurement Parameters	Values related to the channel waveforms, calculated within the OMHM.
<p>Note</p> <p>Parameters available per channel depends on how the channel is configured.</p>	
Module Process Variable (MPV)	Specifies the variable tag name within the OMHM to be mapped to an Ovation point.
Ovation Machinery Health Monitor (OMHM)	Ovation Machinery Health Monitor is an Ovation I/O module used for vibration monitoring. The module is inserted into an Ovation I/O base and used for vibration waveform data collection.
Overalls	Scalar values generated directly from the FPGA processor. Overalls are available per channel depending on how the channel is configured.
Prediction	Measurements used by AMS Machine Works for diagnostic analysis of machinery health.
Protection	Measurements used by Ovation to protect machinery from failure.
Proxy	A software program to manage the transfer of OMHM messages received directly from the OMHM network. Messages are sent unidirectionally from the send-side of a data diode to the receive-side of a data diode. The Proxy software resides on the send-side of the data diode and acts as a interface for the MHWR.
Redundant Array of Independent Disks (RAID)	Data storage technology allowing you to store data in various places on multiple hard disks to protect your data in the event of drive failure.
Scalar values	Used to distinguish a single trend parameter value (such as Overall Acceleration RMS, or 1x Phase) from a more complex block (or bulk) data type (such as a spectrum or time waveform).
Solid State Drive (SSD)	Integrated circuit assemblies used to store data. Typically uses flash memory, and often functions as secondary storage.

Term	Description
Unbounded Waveform or (Transient Waveform)	A continuously supplied data stream of OMHM waveform data.

1.6

Reference documentation

For additional reference information, refer to the following user documents:

[Developer Studio User Guide](#).

[Operator Station User Guide](#).

[Machinery Health Monitor User Guide](#).

[AMS Machine Works User Guide](#).

[Machinery Health Monitor Prediction Waveform Data Collection Guide](#).

[Ports and Services document](#). (This is a password protected document.)

[OMHM AMS and Cybersecurity NERC CIP document](#). (This is a password protected document.)

Note

Contact your Emerson representative to access password protected documentation.

2 Hardware and software requirements

Topics covered in this section:

- *Minimum Ovation system requirements [17]*
- *Software requirements [17]*
- *Hardware requirements [18]*

2.1 Minimum Ovation system requirements

Minimum system requirements:

Ovation 3.6 Feature Pack 4 (with all current applicable patches) and later releases.

2.2 Software requirements

Software required for Machinery Health Waveform Recorder installation is located on the Ovation Data Analysis Product Suite DVD.

Note

Emerson recommends using a standalone server-class machine dedicated specifically for the Waveform Recorder.

The Waveform Recorder software should NOT be loaded on the same machine where Ovation or other software programs reside.

The following software is required:

- Ovation Data Analysis Product Suite DVD - Machinery Health Waveform Recorder license.
- AMS Machine Works.
- Minimum OS - Windows Server 2016.

2.3 Hardware requirements

Access the 5X00852 hardware drawing for current hardware requirements for the Waveform Recorder.

- **5X00852H10** - Server class machine.
 - **5X00852H11** - 2.4TB 10K RPM SAS 12GBPS 512E 2.5 IN. HOT PLUG DRIVE (additional disks).
-

Note

Two servers are required for each standard network configuration.

- One server dedicated for the Waveform Recorder.
- One server dedicated for AMS Machine Works.

For configurations requiring routers:

- One router approved and validated for Ovation systems.

For configurations requiring data diodes:

Typically, three Servers are required for each network configuration using data diodes unless you are employing a Proxy on the data diode.

- Two servers are dedicated for the Waveform Recorder.
- One server is dedicated for AMS Machine Works.
- One data diode approved and validated for Ovation systems.

For MHM Proxy deployment the following hardware requirements apply:

- One server dedicated for the Waveform Recorder.
 - One server dedicated for AMS Machine Works.
 - One data diode with MHM Proxy approved and validated for Ovation systems.
-

The Waveform Recorder must meet the following hardware requirements:

- A dedicated server with a minimum of a two-terabyte hard drive.
- One or more Hard Disk Drives with RAID 0 combining all the disks into one virtual disk, partitioned as follows:
(C:) Used for the Operating System.
(D:) Used for the I/O Driver and the MHWR waveform cache.
- RAID 0 for HDDs or SSDs (Matching Type/Speed/Capacity) [780-BCDL] / 5098869 - (RAID C2).
- RAID 5 for SSDs is optional.
- 16Gb RAM.
- Broadcom 5720 Quad Port 1GbE Base-T - (Network Interface).

Note

For system configurations requiring Switches, Routers, or Data Diodes, refer to the appropriate Emerson drawing for current hardware and cabling recommendations.

3 Deployment planning

Topics covered in this section:

- *Planning your MHWR deployment [21]*
- *What is a Data Diode? [24]*
- *What is the MHM Proxy? [25]*
- *System configurations using data diodes [26]*

3.1 Planning your MHWR deployment

Choosing the appropriate deployment solution for your system depends on your specific system requirements. There are several deployment configurations to transfer waveform data to AMS Machine Works.

The following items should be considered when planning and choosing a deployment option:

- You must have a supported Ovation software version.
- If AMS Machine Works deployment resides inside or outside of the secure DCS environment.
- If you have single or multiple Ovation networks.
- If you have single or multiple OMHM networks.
- The degree of security required.
- The locations of all the OMHM modules to be monitored:
 - The number of modules in each location.
 - Distance to the Ovation network cabinet.
 - (This affects the number of switches required to consolidate NIC2 network traffic from multiple OMHM modules back to the firewall router.)
- The total number of OMHM modules to be monitored.
 - (This affects the number of MHWR and AMS Machine Works servers needed.)
- If you are planning to use an existing SQL license or a stand-alone SQL Express for AMS Machine Works.
 - (This would determine if AMSMW must reside on a level greater than 2.5 on the [Purdue model \[108\]](#) if you want to connect to an existing SQL database.)
- Total network communication throughput requirement across the router and/or data diode.
 - (This affects throughput licensing in the firewall router and in data diode configurations.)
- The total number of OMHM channels and associated Fmax settings:
 - Desired MHWR FIFO buffer maximum length.
 - (This determines the number of additional HDDs needed in each MHWR to support the FIFO buffer length.)

Two deployment approaches are employed when using data diodes with the Waveform Recorder:

- **MHWR Replication** - two MHWRs are required.

Note

Depending on the data diode vendor selected, some parameters may need the default settings changed.

- **MHM Proxy** - one MHWR is required.

Note

The MHM Proxy requires a data diode with proxy software capabilities on the data diode's send-side.

Data diode configuration is unique to each data diode vendor. Typically, configuration varies based on if the diode is for sole usage or shared with other applications.

Refer to the data diode vendor's user documentation for specific configuration requirements and setup procedures.

Note

Be aware, data diode configuration could change depending on the data diode software version. Data diode software revisions change periodically.

Prior to configuring the data diode, make sure the data diode vendor's software version is consistent with the data diode you are using.

The data diode vendor controls the software version of their products and is beyond Emerson's control.

The type of data diode required for your application depends on the deployment approach you choose.

- For MHWR Replication, UDP and TCP connection support is required. Configuration for MHWR Replication depends on the vendor you choose.
- For MHM Proxy, TCP connection support is required.

Note

Some data diode vendors provide data diodes configurable for MHWR Replication only.

Other data diode vendors provide data diodes configurable for either MHWR Replication or MHM Proxy applications.

Refer to the section on [Data Diodes \[24\]](#) or refer to the data diode's vendor documentation for additional information on data diodes.

Refer to [system configuration using data diodes \[26\]](#) for system setup information.

For various system configuration scenarios, refer to the illustrations in the following sections:

- Configurations inside the secure DCS environment, refer to: [*Network deployment configurations inside the Ovation DCS*](#) [115].
- Configurations outside the secure DCS environment and where routers are used, refer to: [*Network configurations using a Firewall/Router*](#) [121].
- Configurations outside the secure DCS environment and where data diodes are used, refer to: [*Network configurations using a Data Diode*](#) [127].

3.2

What is a Data Diode?

In general, a Data Diode is a network communication device providing a means to transfer data securely in one direction between segmented networks. Data diodes are also sometimes referred to as a unidirectional gateway.

As cyber attacks become increasingly concerning for industrial process control, industries search for the best methods to protect network communications. Firewalls are often used as a means to secure data; however, firewalls can be subject to bidirectional data flow. Data diodes provide a unidirectional data transfer which provides a level of security unmatched by typical firewalls.

Data diodes have an array of usage scenarios and are utilized in nearly any application requiring secure unidirectional data transfer.

Data diode hardware and software is designed specifically to provide secure one-way data transfer requirements.

From a hardware perspective, data diodes employ a send-side computer and receive-side computer packaged inside one hardware device. Data diode hardware is physically designed to transmit information in only one direction, from the sender to the receiver.

From a software perspective, data diodes are basically two computers interconnected through a one-way communication link solely housed within one hardware unit.

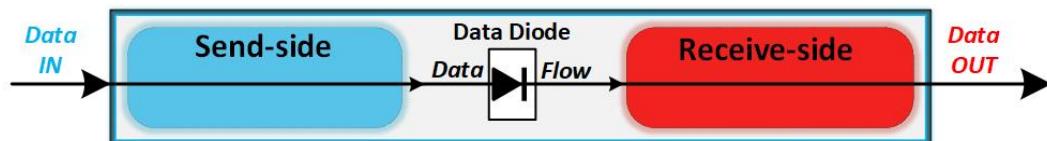
For the OMHM application specifically, the MHWR uses two data transfer methods employing data diodes. Both methods are adequate methods of data transfer and both have advantages and disadvantages to consider. A thorough review of both methods mentioned below is recommended:

- **MHWR Replication** - the data diode receives data from the OMHM Network through an MHWR Server.
- **MHM Proxy** - the data diode receives data directly from the OMHM Network.

The following illustrations show waveform data flow using a data diode:

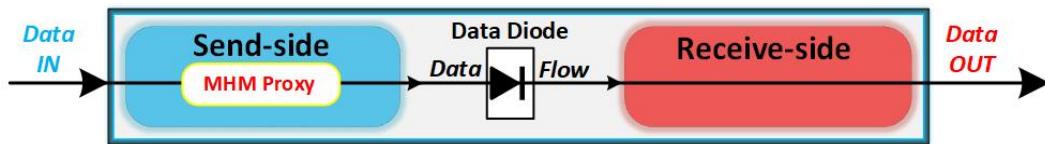
In the MHWR Replication method, the data diode receives data from the MHWR server on the data diode's send-side. Data flows unidirectionally through the data diode to the data diode's receive-side.

Figure 1. Data Diode data flow using MHWR Replication



In the MHM Proxy method, the data diode receives data directly from the MHM Network on the data diode's send-side. Data flows unidirectionally through the data diode's Proxy to the data diode's receive-side.

Figure 2. Data Diode using MHM Proxy

**Note**

MHM Proxy implementation depends on the data diode vendor and deployment approach you decide to use on your system.

Refer to [What is the MHM Proxy? \[25\]](#) for additional information on the MHM Proxy service.

Refer to [System configurations using data diodes \[26\]](#) for additional information on data diode configuration approaches.

3.3

What is the MHM Proxy?

The Ovation Machinery Health Monitor Proxy is a software program intended to reside on the data diode's send-side. Referred to in this manual as the Proxy or MHM Proxy.

The MHM Proxy software manages the transfer of OMHM messages directly from the OMHM network. The Proxy forwards valid waveform messages unidirectionally through the data diode to the receive-side MHWR without the need of a send-side MHWR. In this sense, the software acts as a proxy for a send-side MHWR.

The receive-side MHWR holds the FIFO buffer and sends valid waveform data to AMS Machine Works for processing.

3.4

System configurations using data diodes

The OMHM employs the following two configuration approaches using data diodes.

- **MHWR Replication**
- **MHM Proxy**

The type of data diode you choose to configure on your system determines the appropriate deployment approach. For example:

Approach 1 (MHWR Replication) - Requires two MHWRs. The first MHWR is replicated through the data diode to a second MHWR.

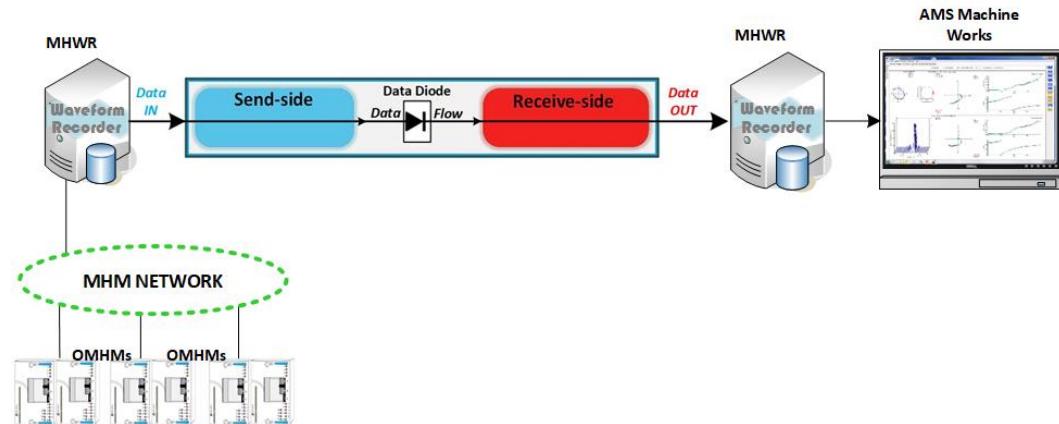
In the MHWR Replication configuration, the data diode receives waveform data from the MHWR server on the data diode's send-side. The data diode's send-side forwards unidirectional data through the data diode to the receive-side. The data diode's receive-side forwards the data to a replicated MHWR server. Then, the replicated server forwards valid waveform data to AMS Machine Works for processing.

The MHWR Replication approach allows for the following considerations:

- Two Waveform Recorders are required.
- Local waveform data buffering is provided.

The following figure illustrates data flow for MHWR replication:

Figure 3. Data Diode configuration with MHWR Replication



Approach 2 (MHM Proxy) - Requires one MHWR. This approach utilizes MHM Proxy software. The MHM Proxy resides on the data diode's send-side and manages the unidirectional transfer of waveform messages from the data diode's send-side to the receive-side.

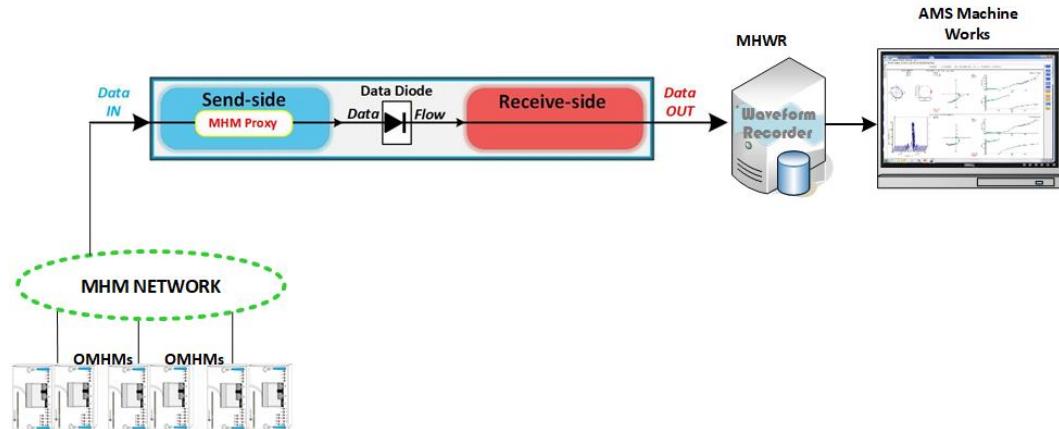
In the MHM Proxy configuration, the MHM Proxy receives waveform data directly from the MHM Network on the data diode's send-side. The data diode's send-side MHM Proxy forwards unidirectional data through the data diode to the receive-side. The data diode's receive-side forwards the data to an MHWR server. Then, the MHWR server forwards valid waveform data to AMS Machine Works for processing.

The MHM Proxy approach allows for the following considerations:

- Saves the expense of one MHWR.
- Local waveform data buffering is not provided.

The following figure illustrates data flow using MHM Proxy software:

Figure 4. Data Diode configuration with MHM Proxy



Note

Some data diode deployment can use either approach depending on the data diode vendor selected.

Emerson supports data diodes approved and validated specifically for Ovation systems.

4

Waveform Recorder installation

Topics covered in this section:

- *Waveform Recorder setup [29]*
- *Licensing requirements [59]*

4.1

Waveform Recorder setup

To begin Waveform Recorder software setup and installation, be sure there is enough free disk space on the drive where you want to install the software.

The preferred location to install Waveform Recorder software to is on the (C:) drive. (Approx. 200 GBytes is recommended for the (C:) partition.)

Typically, the disk drive is partitioned by Emerson. Once you receive the Waveform Recorder, files can then be installed on the (C:) drive.

- The (D:) drive is typically used for the I/O Driver (IOD) and the Waveform Cache. Disk space can be split into two software configurable regions:
IOD Data\Interfaces\ area
MHWR waveform cache

Note

Waveform cache space is a function of sample rate (number of channels and Fmax values) and desired time-range of FIFO storage.

4.1.1

Disk partitioning the Waveform Recorder

Disk partitioning is typically performed by Emerson before you receive your Waveform Recorder. Emerson ensures your server machines are properly configured and have enough disk storage to properly install and run the operating system and the Waveform Recorder software.

If for any reason you have a need to revisit your disk configuration (such as during an operating system reload, first-time setup of unconfigured hardware, or recovering from a hardware failure), the following rules must be followed:

- Ensure you have at least 200 GB of free disk space on the (C:) system partition for operating system installation.
- The (D:) partition contains the remainder of available disk space, which is used for IOD and Waveform Cache data storage.
- Modifying the RAID hardware configuration can jeopardize your RAID protection and is not recommended.
- All hard disks must use the NTFS file system.

Note

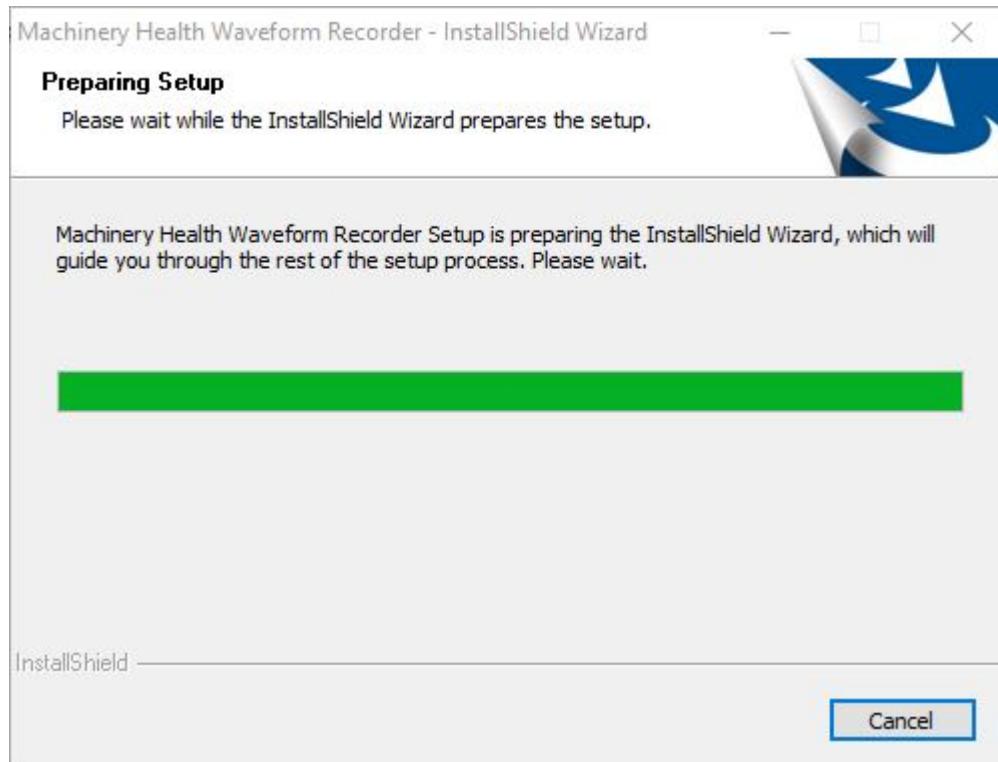
Contact your Emerson representative if you have questions or concerns regarding disk partitioning.

For additional information, refer to the [Software Installation User Guide](#).

4.1.2 To install or reinstall the MHWR

1. Insert the Ovation Data Analysis Products (OvDAP) DVD into the MHWR Server machine's disc drive. Select the MHWR option and enter the license keycode to unlock the MHWR software. The Prepare Setup page appears. The InstallShield Wizard prepares the setup.

Figure 5. Preparing Setup page

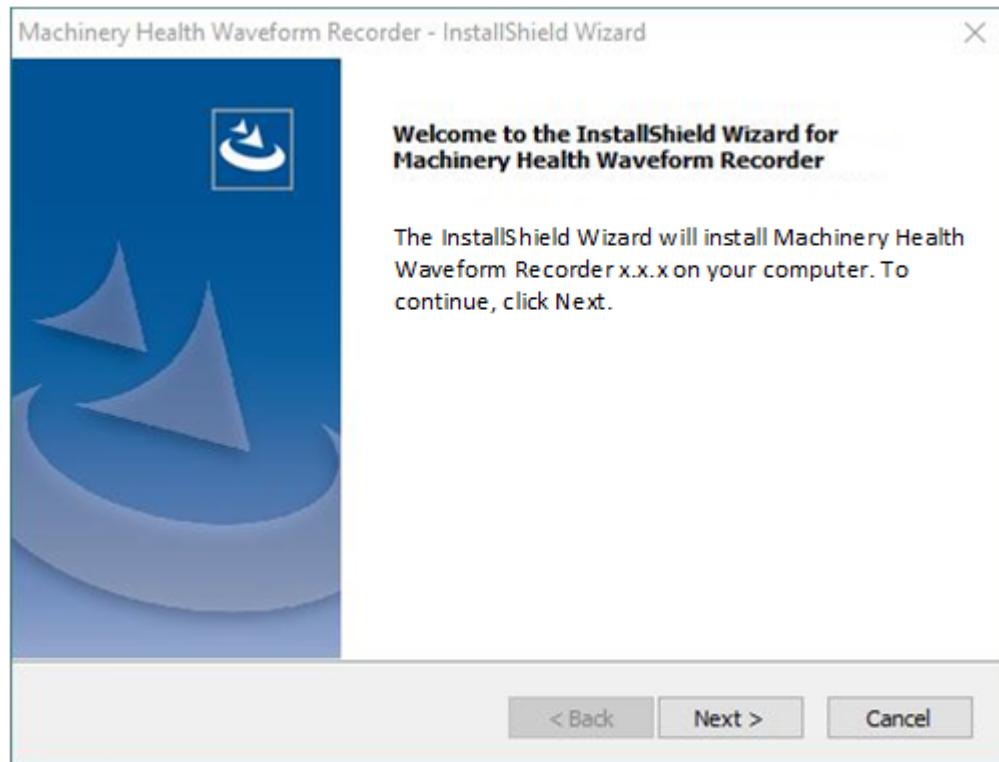


Note

A keycode from Emerson's Software Licensing is required to unlock the MHWR software. If you do not have a keycode, refer to [Licensing requirements \[59\]](#).

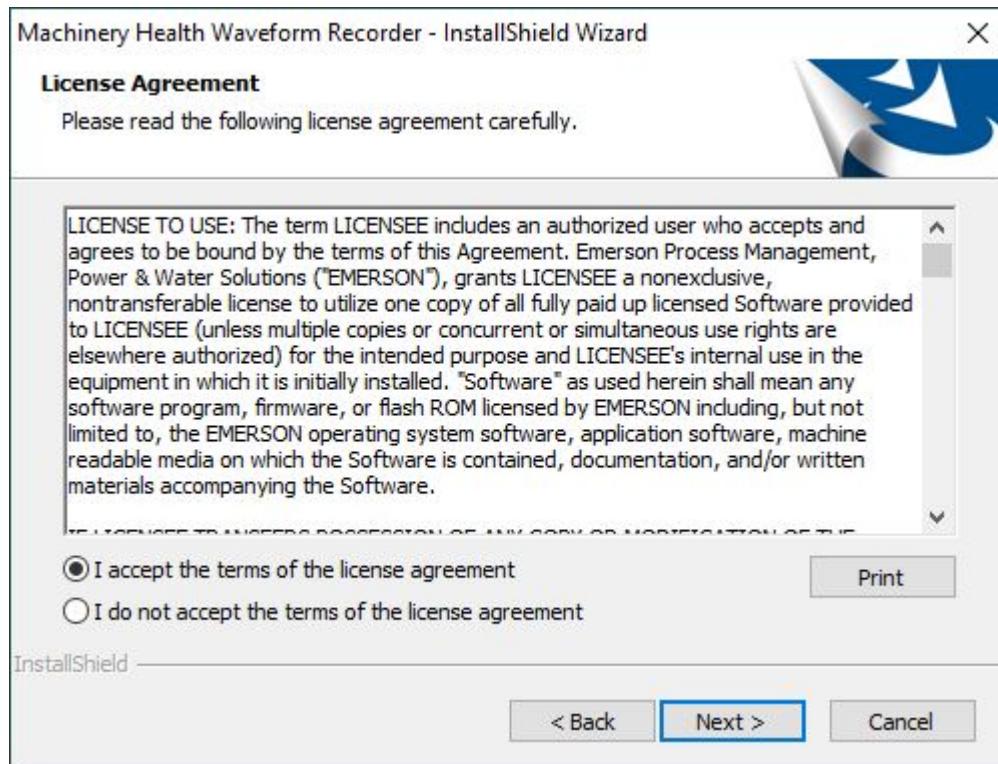
-
2. The InstallShield Wizard Welcome page appears. Click **Next**.

Figure 6. Machinery Health Waveform Recorder InstallShield Wizard



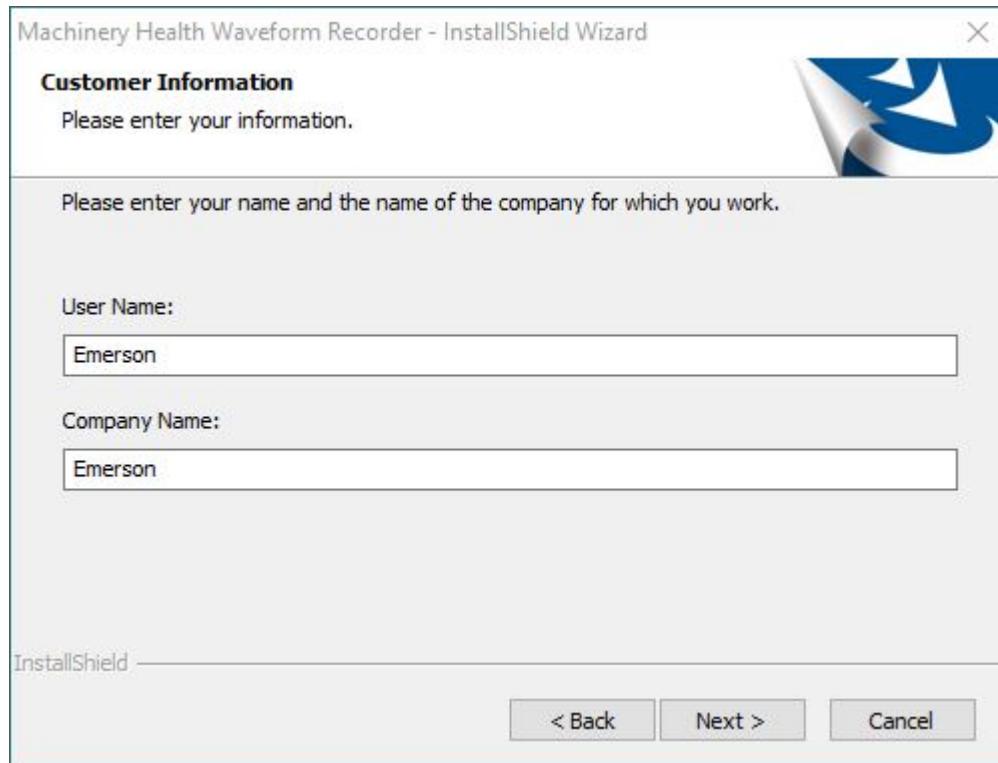
3. The Licensing Agreement page appears. Choose **I accept the terms of the license agreement** and click **Next**.
To print the licensing agreement, click the **Print** button.

Figure 7. Licensing Agreement page



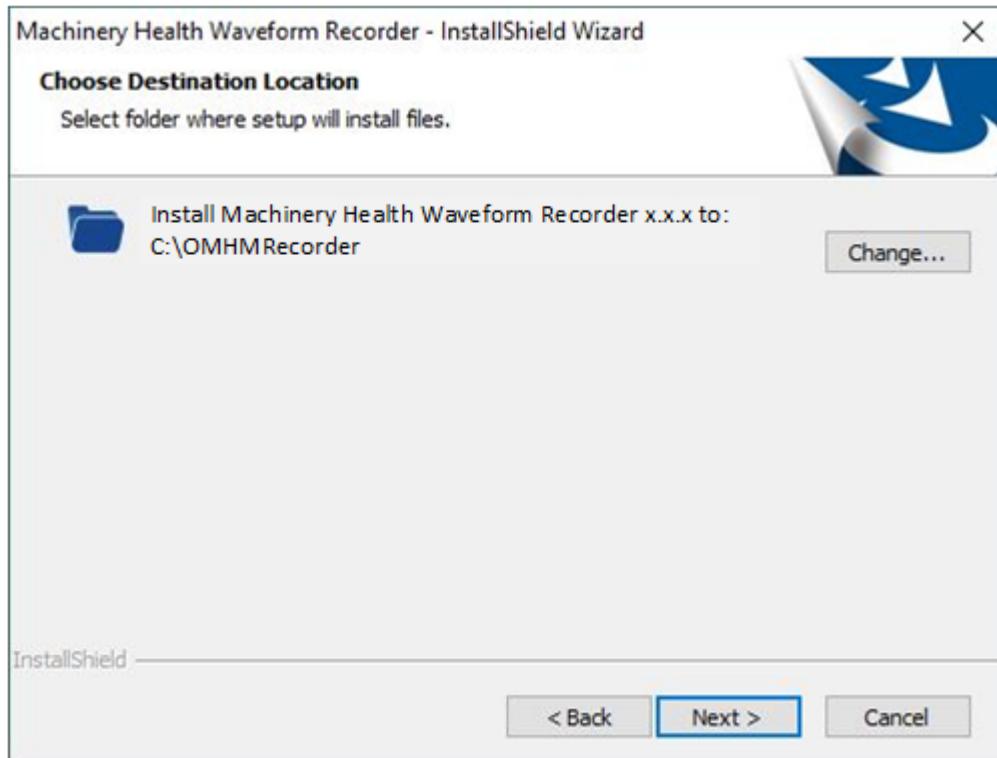
4. The Customer Information page appears. Enter the appropriate **User Name** and **Company Name** in the entry fields and click **Next**.

Figure 8. Customer Information page



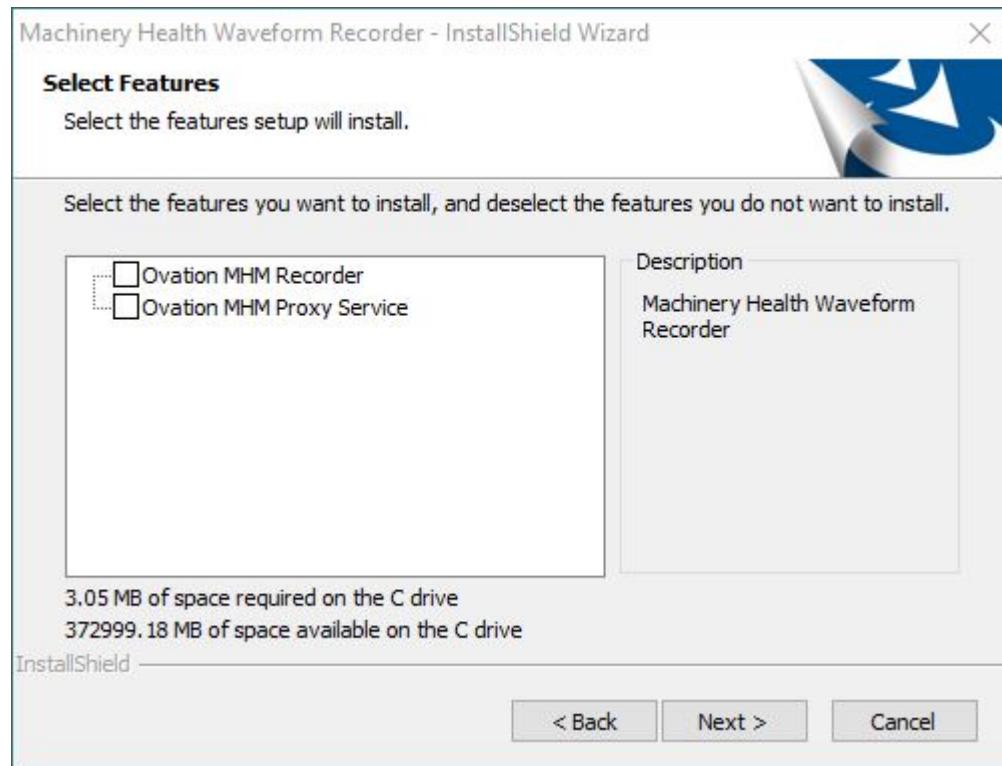
5. The Choose Destination Location page appears.

Figure 9. Choose Destination Location page



- a. Choose the destination where you want the Waveform Recorder files to reside. The location depends on the amount of free disk space available on the drive.
 - b. Typically, the program files are installed on the **(C:) drive**.
 - c. Use the **Change** button to make appropriate file changes.
 - d. Click **Next**.
6. The Select Features page appears.

Figure 10. Select Features page



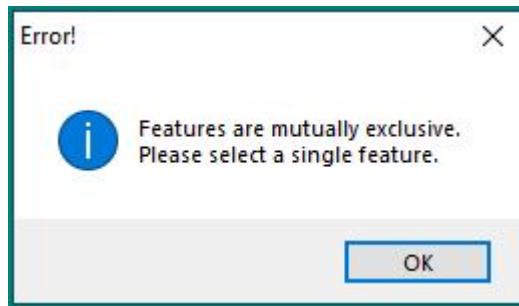
The following two options are presented:

- **Ovation MHM Recorder** - Loads software for the Ovation Machinery Health Waveform Recorder (**MHWR**).
- **Ovation MHM Proxy Service** - Loads software for the Ovation Machinery Health Monitor Proxy Service (**MHM Proxy**). This allows you to use a data diode in conjunction with the MHWR in the Proxy configuration.

CAUTION

Only choose **one** option.

If you select both options and click Next, a message appears stating only to select a single feature. Click **OK** and select a single option.



If you do not select either option and click Next, the following message appears. Click **OK** and select an option.

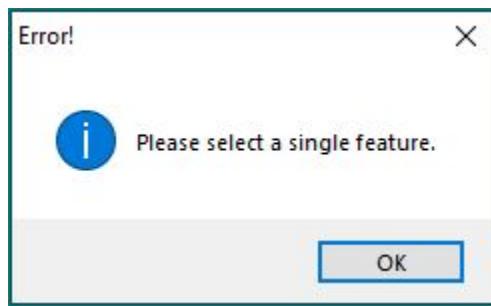
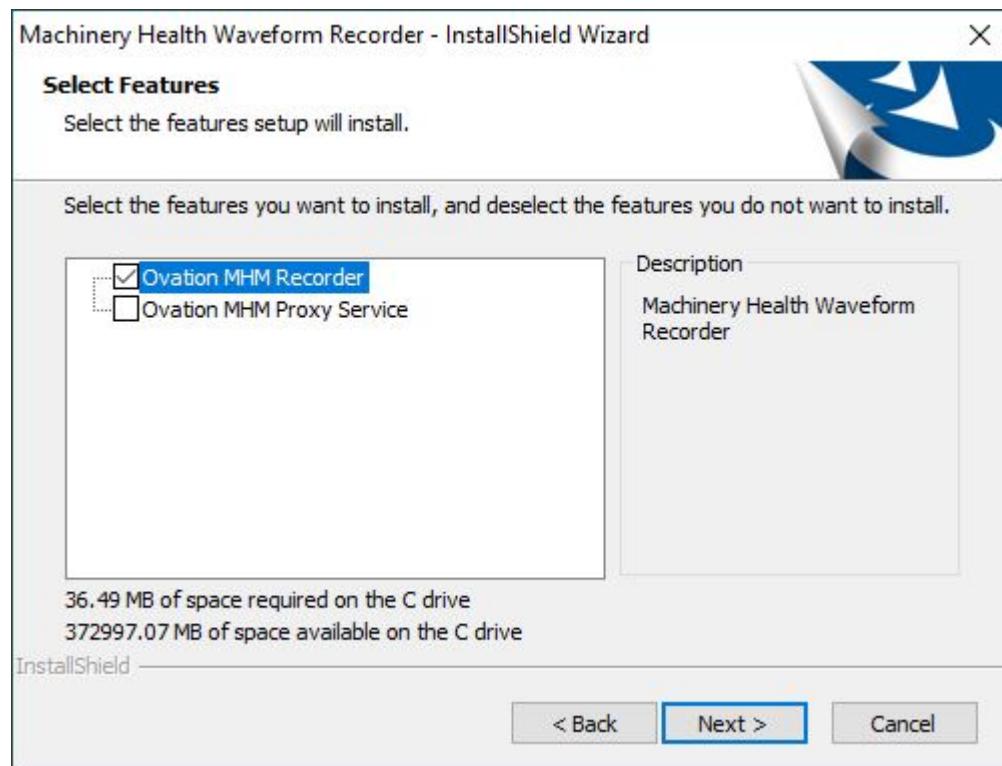


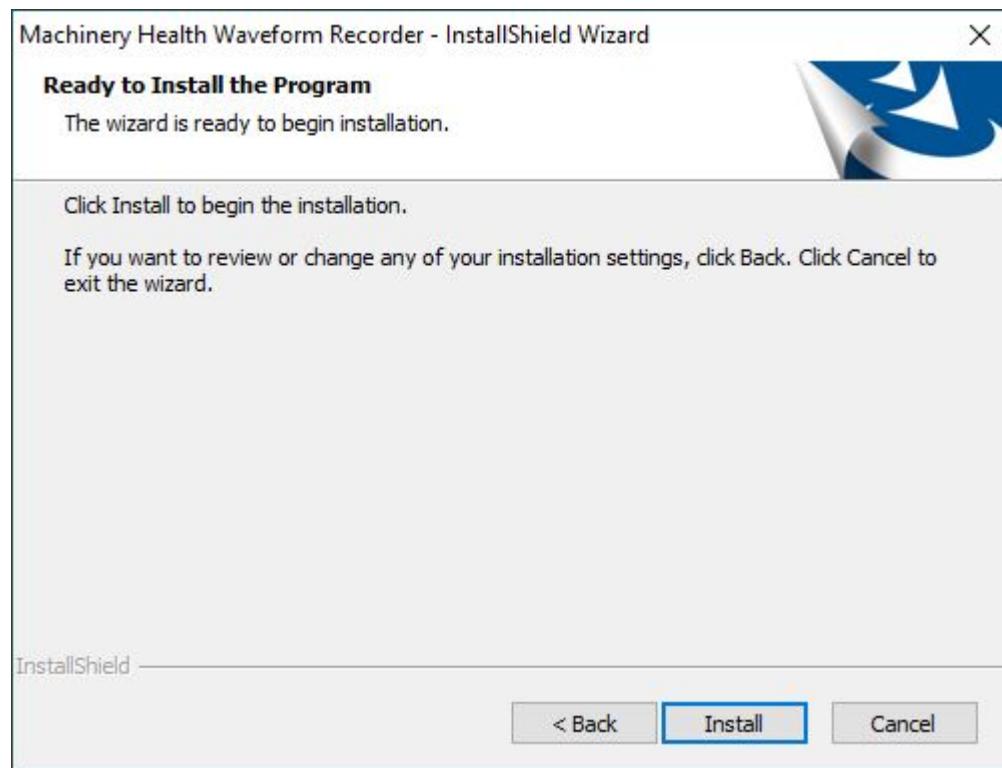
Figure 11. Select Features page with selection checked



For this example, choose the **Ovation MHM Recorder (MHWR)** as shown above and click **Next**.

7. The Ready to Install the Program page appears. Click **Install** to continue the installation.

Figure 12. Ready to Install the Program page



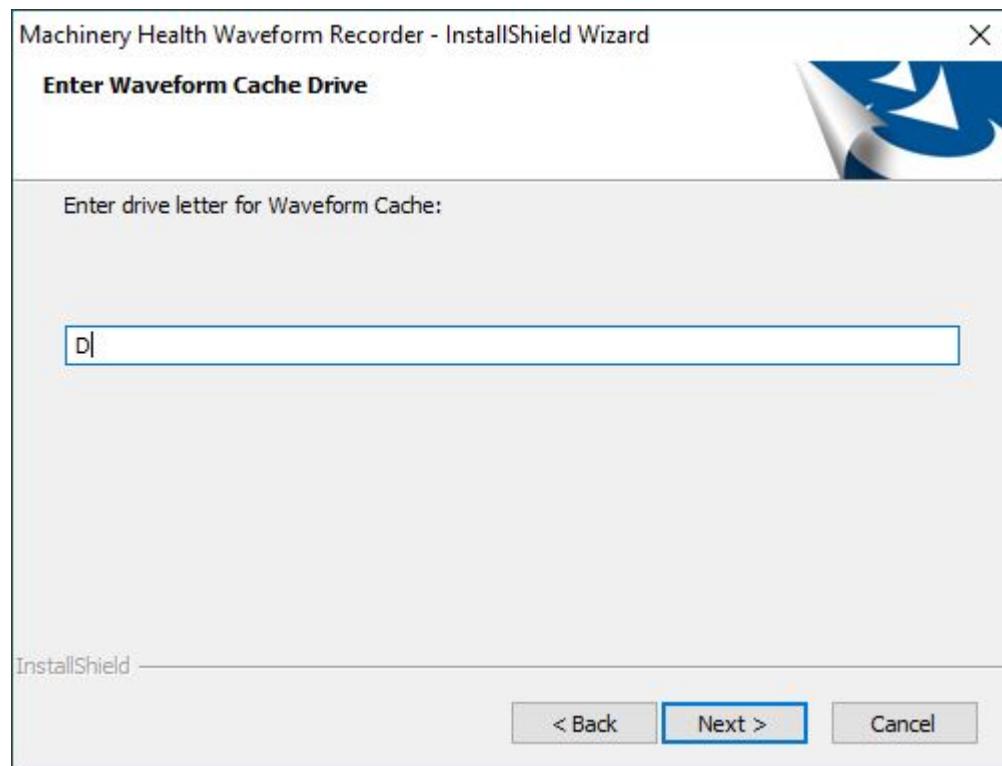
8. The **Enter Waveform Cache Drive** page for the disk drive selection appears. Enter the letter for the disk drive of your preference in the entry field, (enter only the drive letter do not use a colon after the letter). Click **Next**.

Note

The preferred drive location depends on the amount of free disk space available on the drive.

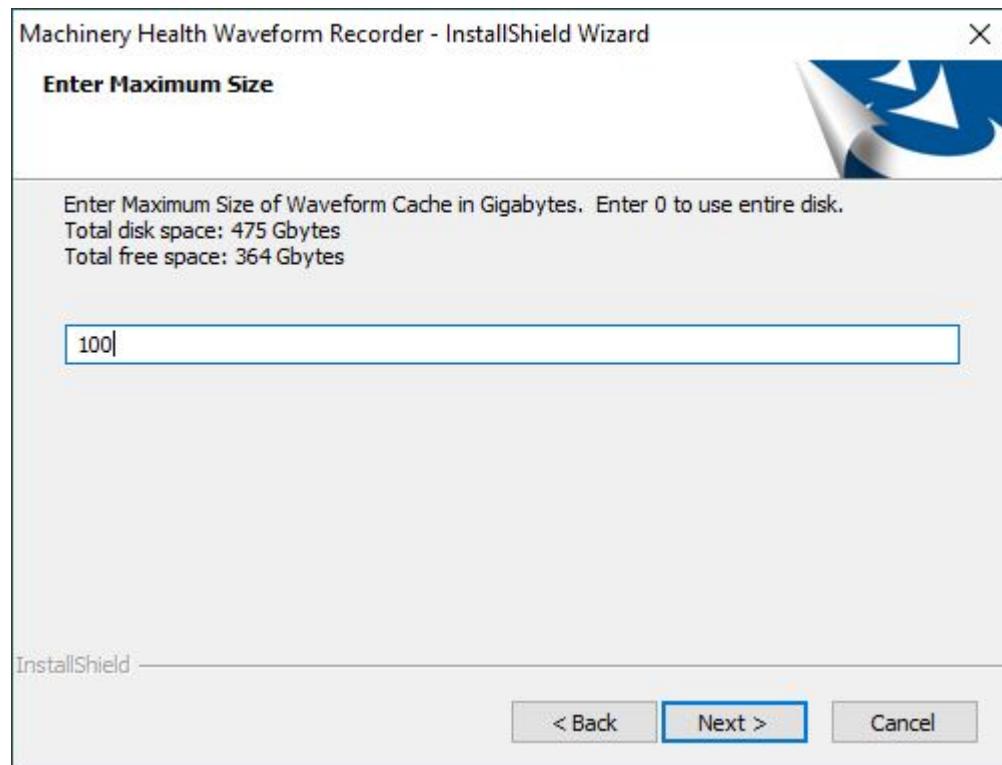
Typically, the IOD and Waveform Cache data files reside on the **(D) drive**.

Figure 13. Enter Waveform Cache Drive page



9. The **Enter Maximum Size** page appears. Enter Maximum Size of Waveform Cache in Gigabytes in the entry field, and click **Next**.

Figure 14. Enter Maximum Size page



- a. The maximum size value determines the maximum amount of waveform data collected before the program begins to remove or (force out) older waveform data.
- b. In this example, a value of 100 GB is selected. Using the FIFO (First-In-First-Out) data collection protocol, data is collected until 100 GB of disk space is consumed before the program is forced to make room for new data.

CAUTION

When a value of 0 (zero) is entered in the Maximum Size field, this informs the MHWR that the entire drive partition is available for waveform data consumption.

A typical installation shares the drive partition with the IOD; therefore, you would NOT want to enter a value of zero in Maximum Size field.

The installation procedure automatically enforces a minimum value of 25-Gigabytes by default; therefore, values 1 through 24 are not valid entries.

The following message displays when values 1 through 24 are entered:



Contact your Emerson representative for guidance on sizing the waveform cache based on the number of OMHM channels, Fmax setting requirements, and desired FIFO buffer length.

- c. When the Maximum Size field is set to zero the following message appears:

Figure 15. Maximum Cache size set to zero message



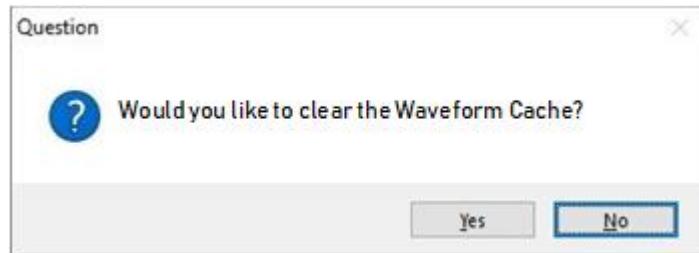
Click **No** and enter a different value, or click **Yes** to confirm your selection and to continue.

Note

Some configurations may have the IOD on one partition and the MHWR on another partition. In this configuration scenario, you may want to choose zero in the Maximum Size field if you want to use the entire drive partition for the MHWR.

A message appears asking you if you want to clear the Waveform Cache.

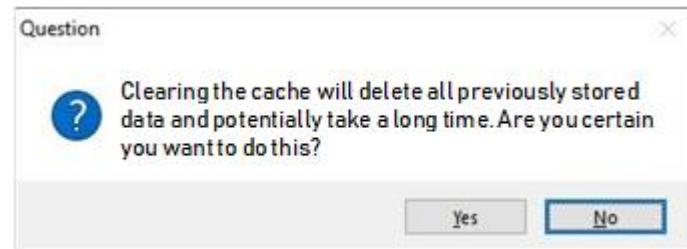
Figure 16. Clearing the Waveform Cache message



Clearing the Waveform Cache removes all previously stored waveform data.

Clearing the Waveform Cache is typically NOT performed or recommended; however, in some situations clearing the Waveform Cache may prove to be useful.

Figure 17. Confirming your selection to clear the Waveform Cache



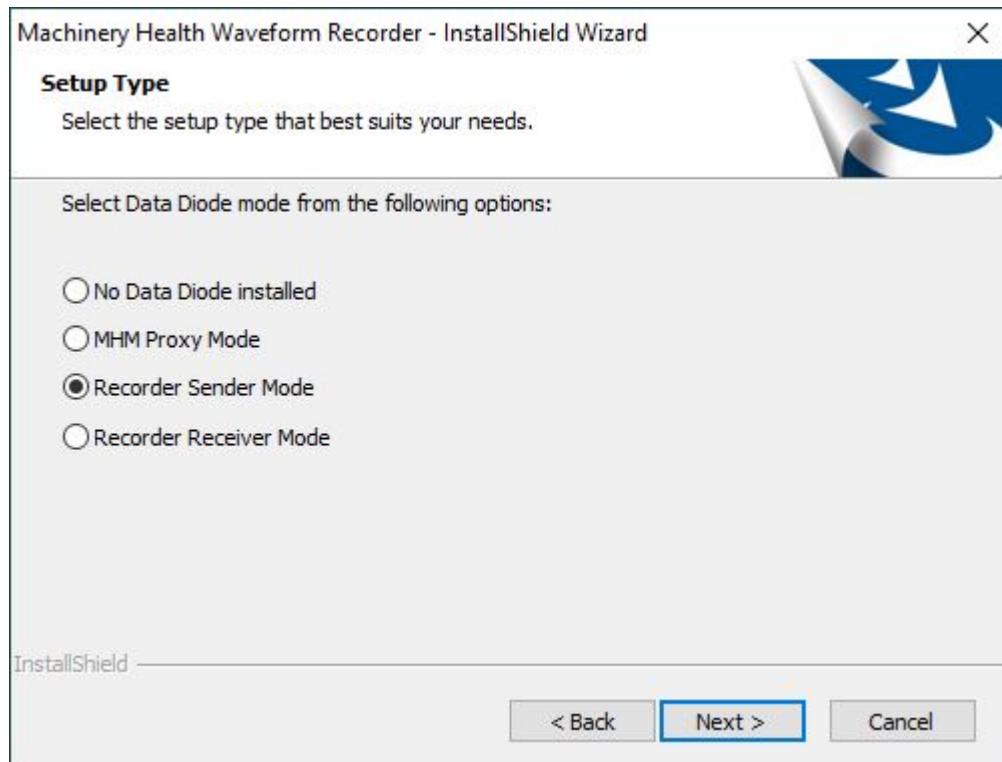
Depending on how much data is stored in the Waveform Cache, clearing all the data could take several minutes. Make sure you want to continue this process before proceeding.

CAUTION

Clearing the Waveform Cache removes all configuration and waveform data.

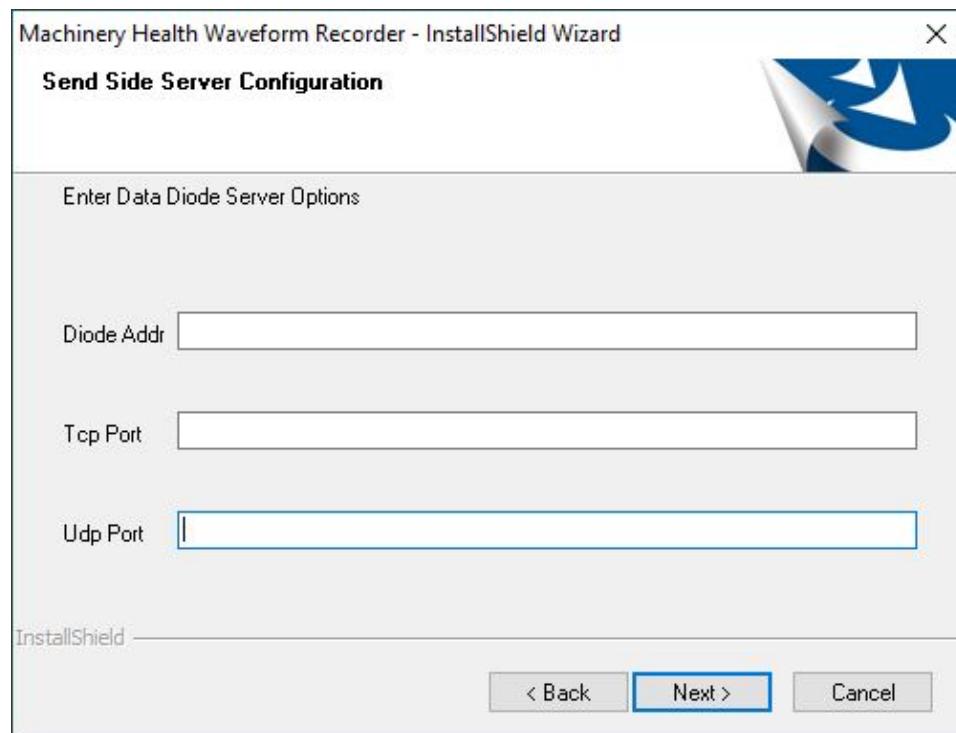
10. The Setup Type page appears. Choose one of the four options shown below and click **Next:**

Figure 18. Setup Type page



- **No Data Diode Installed** - Select this option if a data diode is not installed.
- **MHM Proxy Mode** - Used when a data diode is installed and you want to run in proxy mode.
- **Recorder Sender Mode** - Used when a data diode is installed and the configuration is with two recorders, a sender and a receiver.
If you choose this option the software requires you to enter the **Diode Addr**, and the data diode **TCP and UDP** port numbers. Refer to the figure below.
Enter the required information and click **Next**.

Figure 19. Send Side Server Configuration page



Note

Diode Addr is the data diode's send-side IP address or hostname.

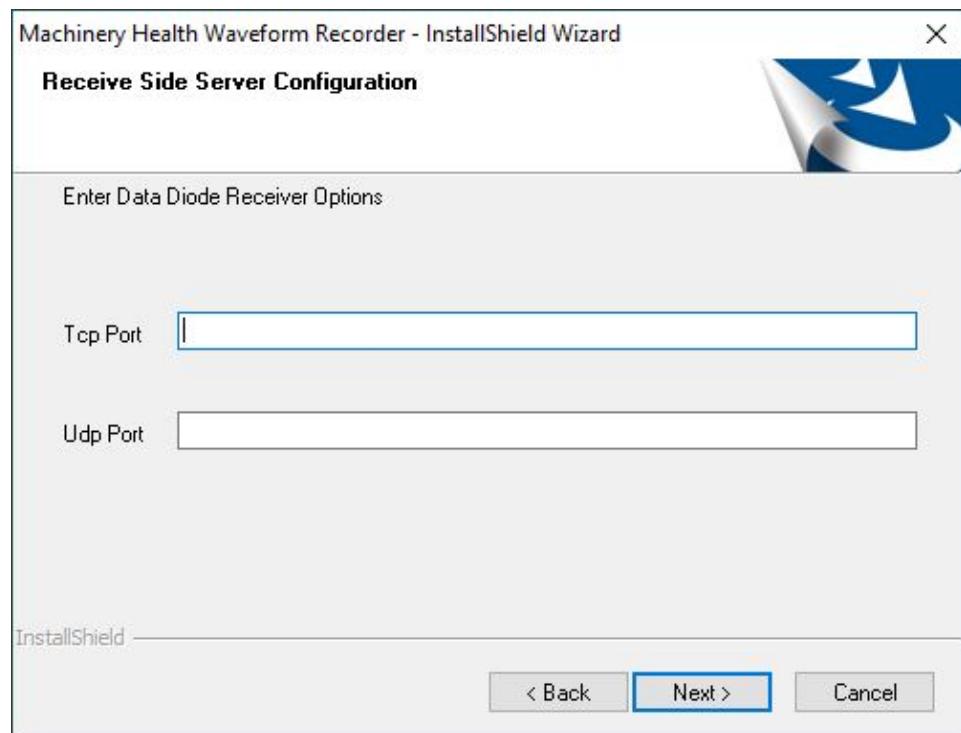
Tcp Port is the TCP port number configured on the data diode for TCP traffic.

Udp Port is the UDP port number configured on the data diode for UDP traffic.

Refer to the [*Ports and Services*](#) documentation for specific port information.

-
- **Recorder Receiver Mode** - Used when a data diode is installed. This option is the same as Recorder Sender Mode, but is used for the receiver.
If you choose this option, the software requires you to enter the **TCP and UDP** port numbers. Refer to the figure below.
Enter the required information and click **Next**.

Figure 20. Receive Side Server Configuration page



Note

Tcp Port is the TCP port number configured on the data diode for TCP traffic.

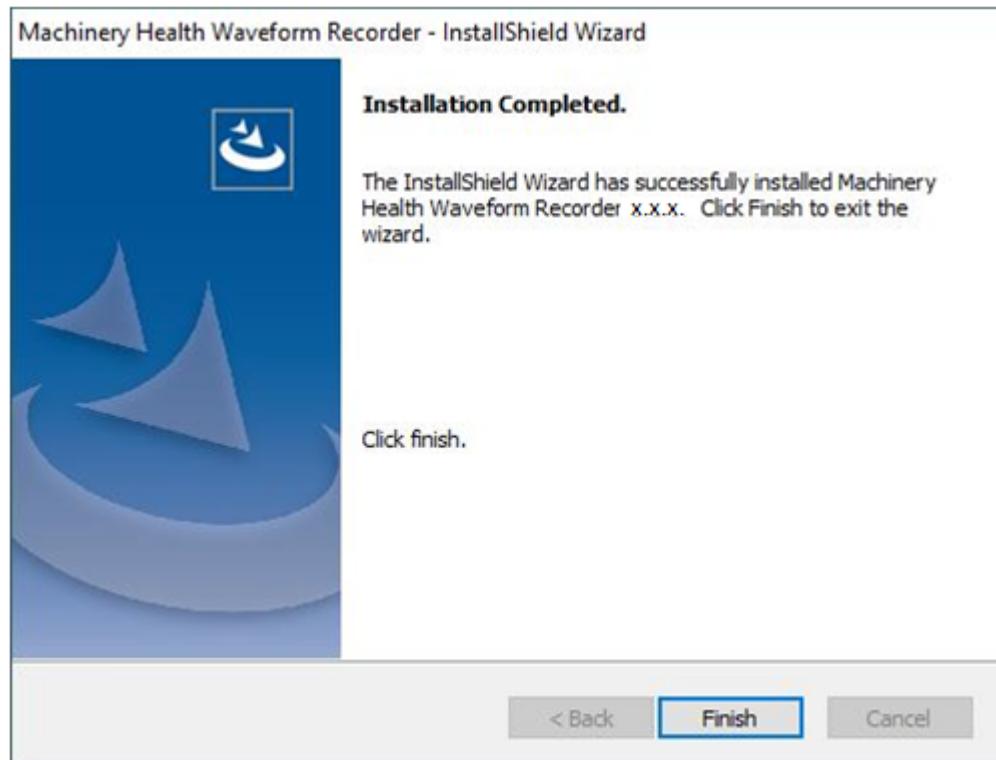
Udp Port is the UDP port number configured on the data diode for UDP traffic.

Refer to the [Ports and Services](#) documentation for specific port information.

11. The installation Completed page appears.

Click **Finish** to complete the Installation.

Figure 21. Installation Completed page



12. Once installation is finished, the Waveform Recorder icon (OMHMRecorder) appears on your desktop as shown below. Double-click the icon to access the Waveform Recorder software program.

Figure 22. Waveform Recorder desktop icon



The OMHMRecorder icon provides a shortcut to the following files:

- [LicenseManager \[59\]](#) - Licenses the Waveform Recorder software.
- [OMHMConfigurator \[91\]](#) - Accesses the OMHMConfigurator tool.
- [OMHMDiag \[76\]](#) - Accesses the Waveform Recorder user interface.

4.1.3 To install or reinstall the MHM Proxy

1. MHM Proxy software is installed on the data diode's send-side. To install the software, use a USB DVD device on the send-side of the data diode or copy the contents of the DVD to the send-side of the data diode.

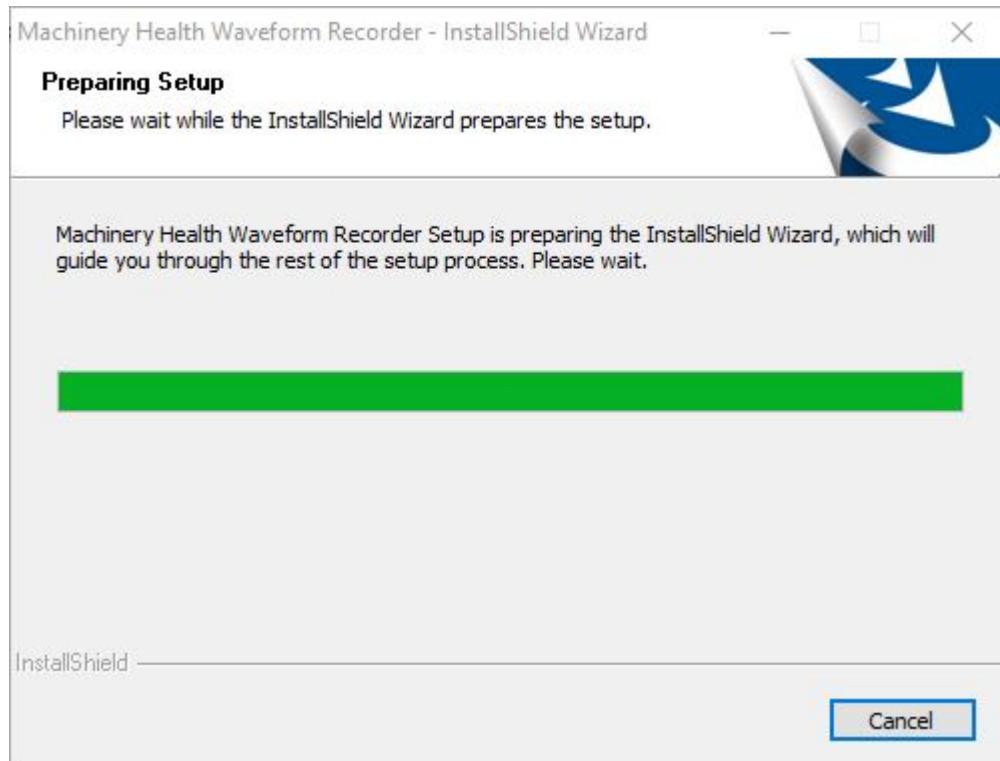
Note

The MHM Proxy software shares a license with the MHWR. Enter the MHWR license keycode to unlock the MHM Proxy software. A license keycode is not necessary to activate the MHM Proxy once the software is unlocked.

Data diode selection must support Proxy software on the send-side of the data diode to load MHM Proxy software.

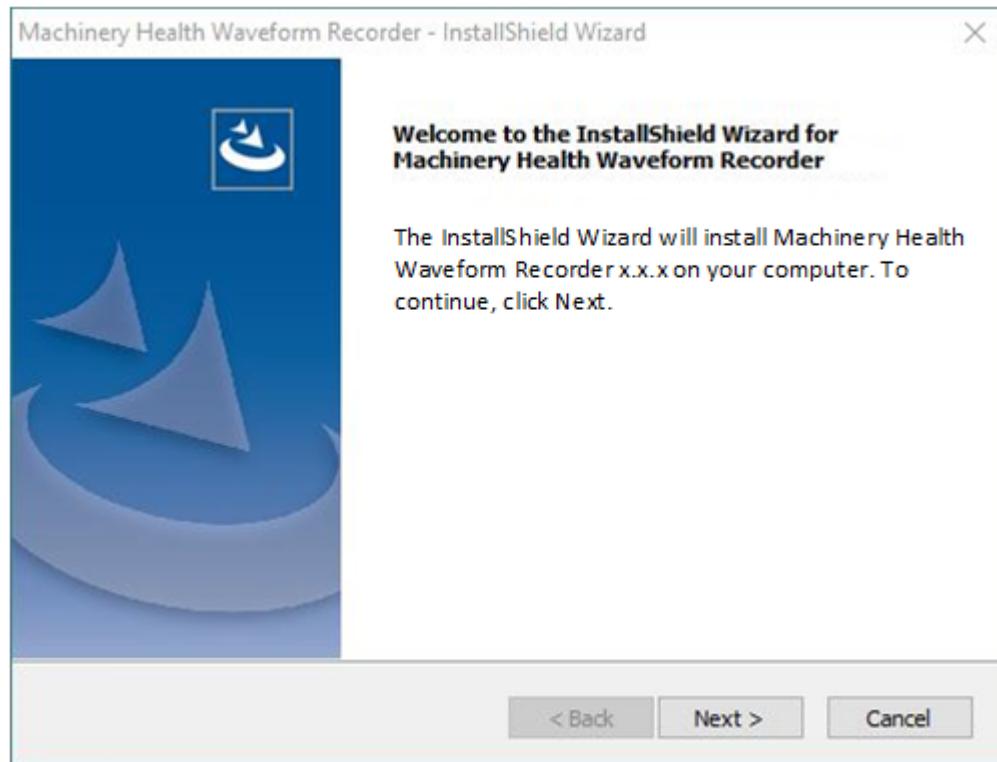
The Prepare Setup page appears. The InstallShield Wizard prepares the setup.

Figure 23. Preparing Setup page



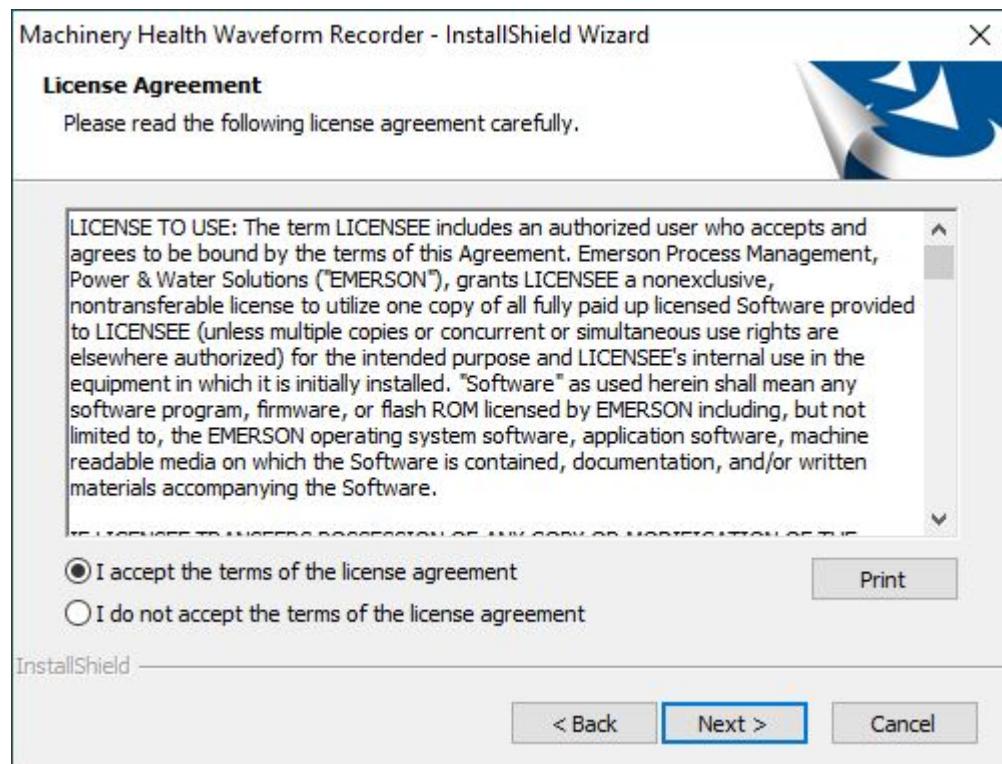
2. The InstallShield Wizard Welcome page appears. Click **Next**.

Figure 24. Machinery Health Waveform Recorder InstallShield Wizard



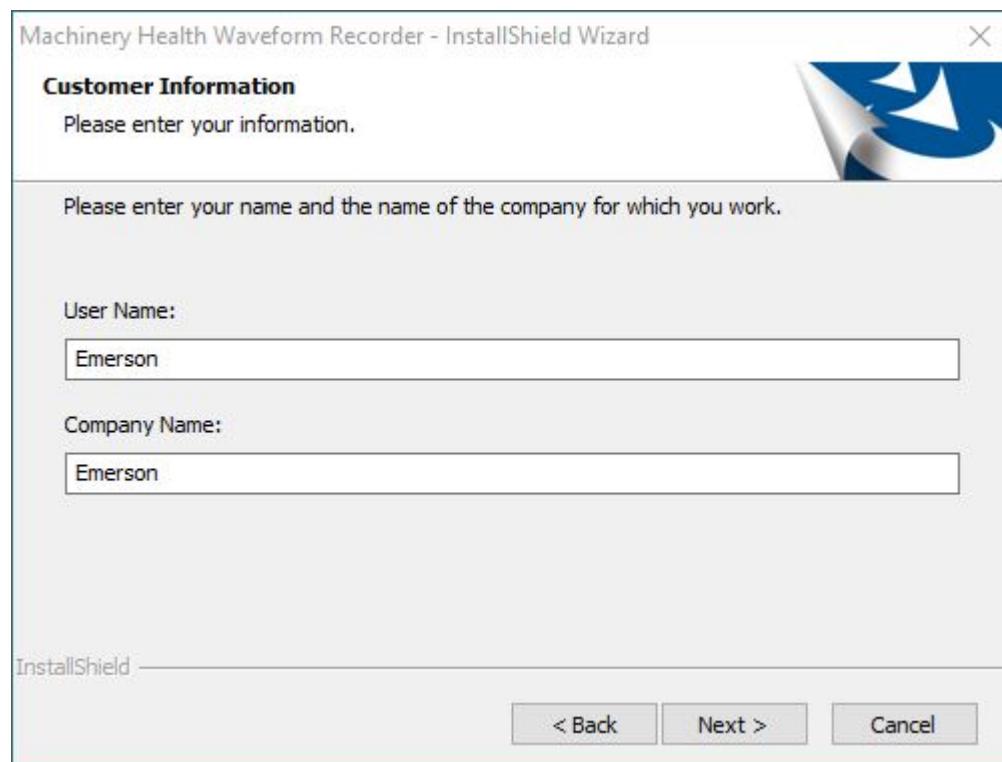
3. The Licensing Agreement page appears. Choose **I accept the terms of the license agreement** and click **Next**.
To print the licensing agreement, click the **Print** button.

Figure 25. Licensing Agreement page



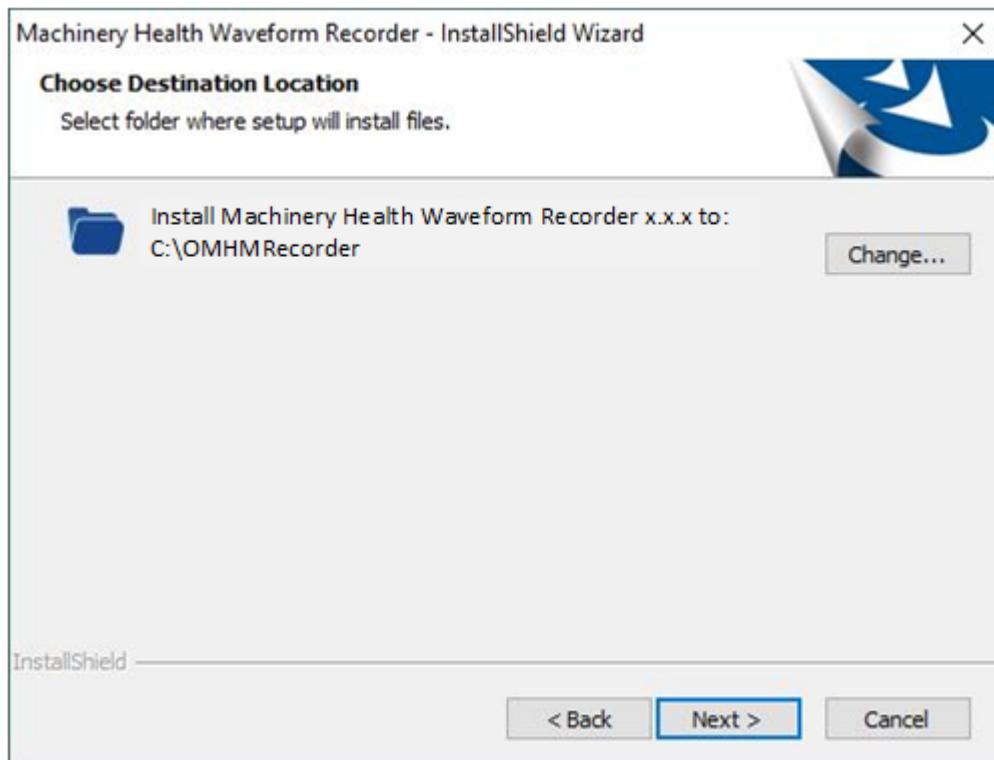
4. The Customer Information page appears. Enter the appropriate **User Name** and **Company Name** in the entry fields and click **Next**.

Figure 26. Customer Information page



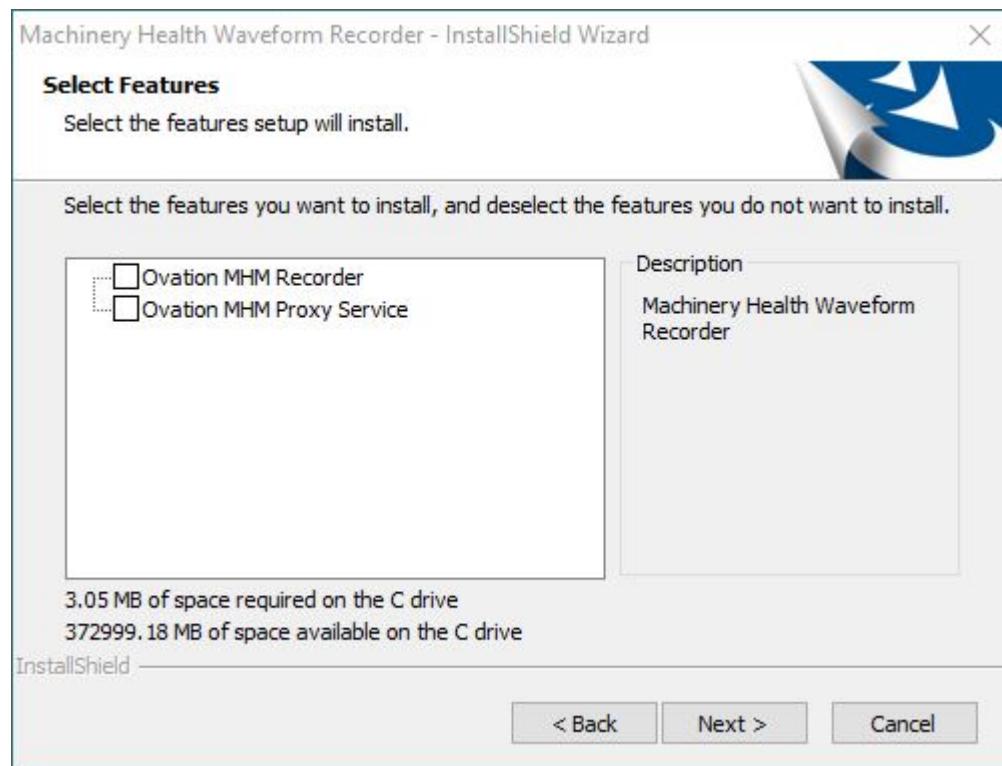
5. The Choose Destination Location page appears.

Figure 27. Choose Destination Location page



- a. Choose the destination where you want the Waveform Recorder files to reside. The location depends on the amount of free disk space available on the drive.
 - b. Typically, the Waveform Recorder program files are installed on the **(C:) drive**.
 - c. Use the **Change** button to make appropriate file changes.
 - d. Click **Next** after you make your selection.
6. The Select Features page appears.

Figure 28. Select Features page



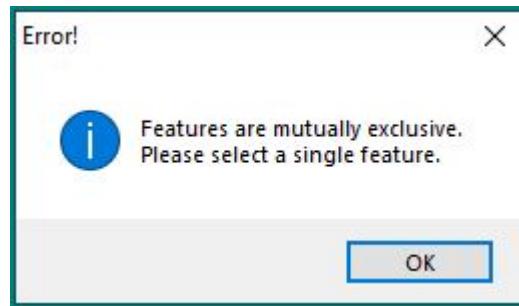
The following two options are presented:

- **Ovation MHM Recorder** - Loads software for the Ovation Machinery Health Waveform Recorder (**MHWR**).
- **Ovation MHM Proxy Service** - Loads software for the Ovation Machinery Health Monitor Proxy Service (**MHM Proxy**). This allows you to use a data diode in conjunction with the Ovation MHM Recorder in the Proxy configuration.

⚠ CAUTION

Only choose **one** option.

If you select both options and click Next, a message appears stating only to select a single feature. Click **OK** and select a single option.



If you do not select either option and click Next, the following message appears. Click **OK** and select an option.

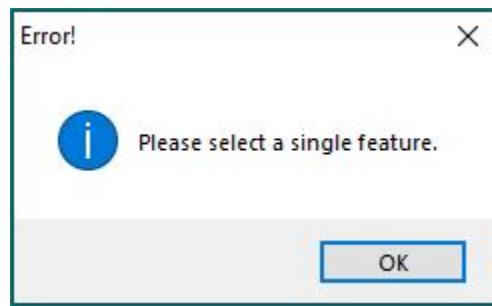
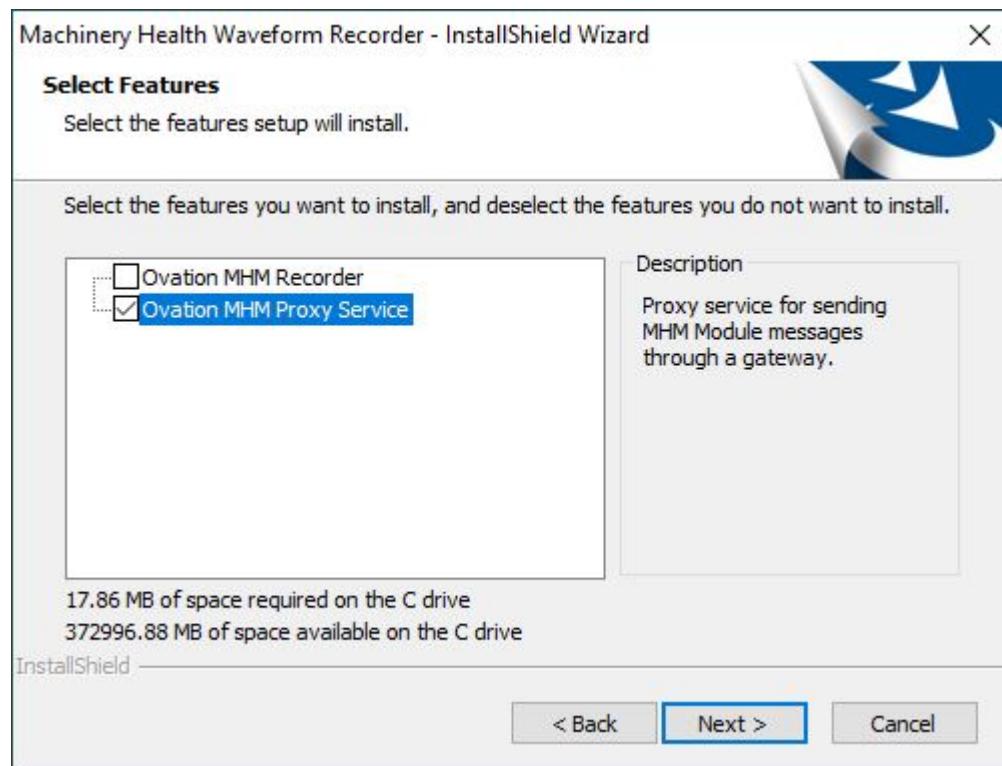


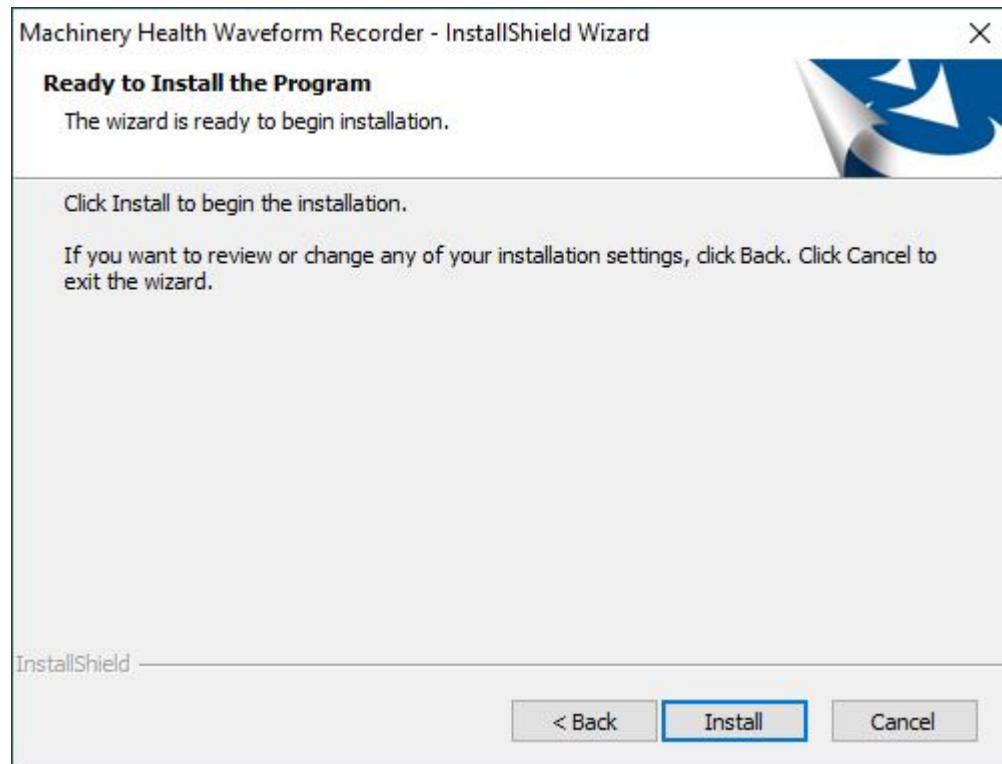
Figure 29. Select Features page with selection checked



For this example, choose the **Ovation MHM Proxy Services** option as shown above and click **Next**.

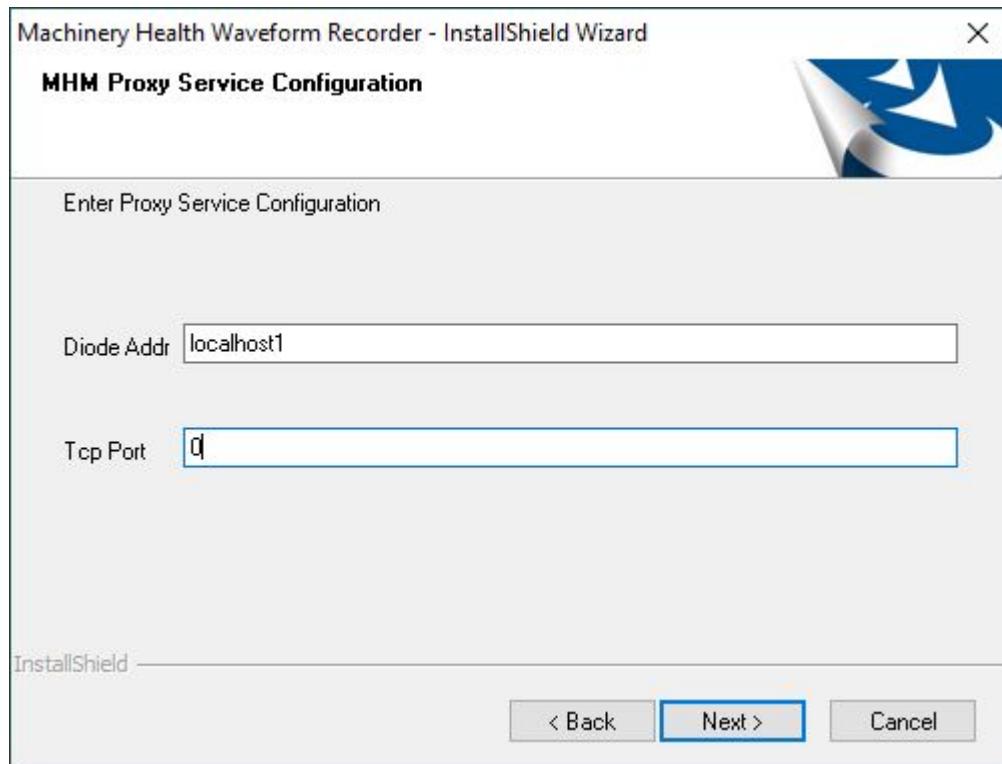
7. The Ready to Install the Program page appears. Click **Install** to continue the installation.

Figure 30. Ready to Install the Program page



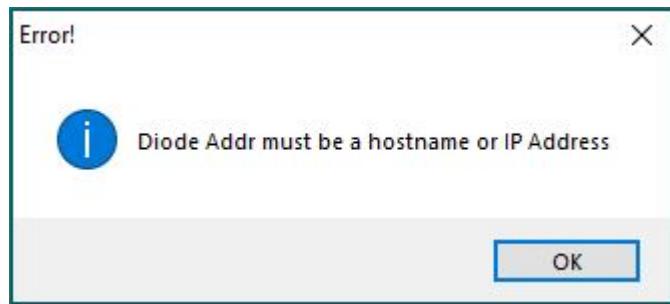
8. The Ovation MHM Proxy Service Configuration page appears.
Enter the **Diode Addr** and the **Tcp Port** values and click **Next**.

Figure 31. MHM Proxy Service Configuration page

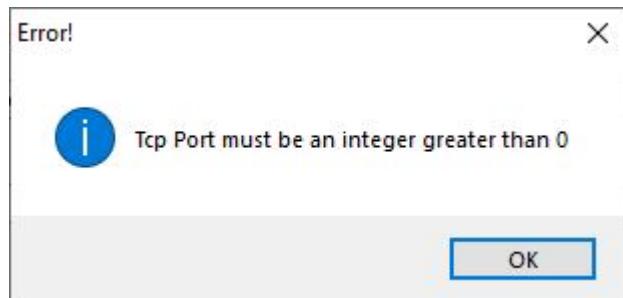


Note

Diode Addr is the data diode's IP address or hostname. The following error occurs if hostname or IP Address is missing. Click **OK** and enter the IP address or hostname.



Tcp Port is the TCP port configured on the data diode for TCP traffic. Port values must be greater than 0 or the error below occurs. Click **OK** and enter a number greater than 0.



Refer to the *Ports and Services* documentation for specific port information.

9. The installation Completed page appears.
Click **Finish** to complete the Installation.

Figure 32. Installation Completed page



10. Once installation is finished, a Waveform Recorder icon appears on your desktop as shown below.

Figure 33. Waveform Recorder desktop icon



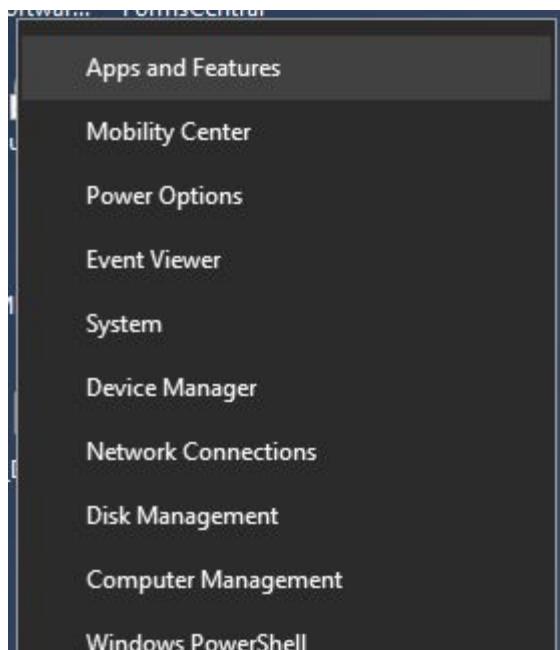
Double-click the icon to access the MHM Proxy software program. The icon provides a shortcut to the following file:

- [OMHMConfigurator \[91\]](#) - Accesses the OMHMConfigurator tool.

4.1.4 To uninstall MHWR or MHM Proxy software

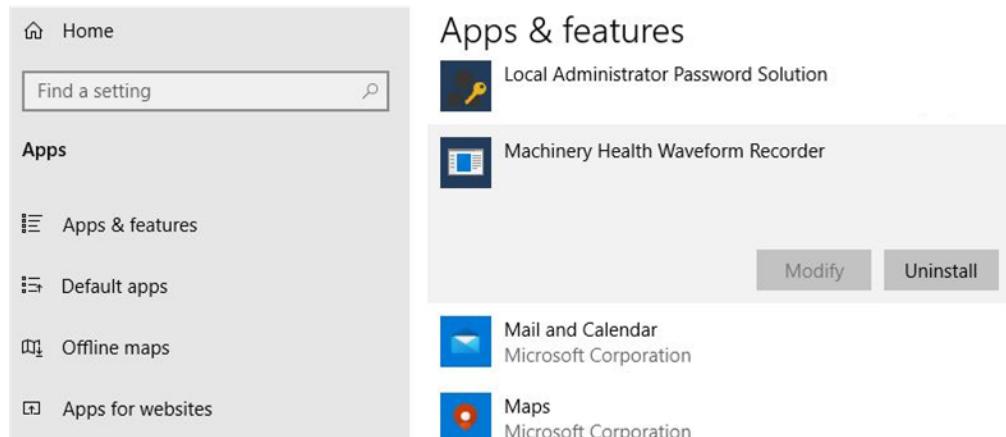
1. Right-click the **Start** icon from the bottom left corner of your screen and select **Apps and Features** from the menu as shown below.

Figure 34. Start menu Apps and Features selection



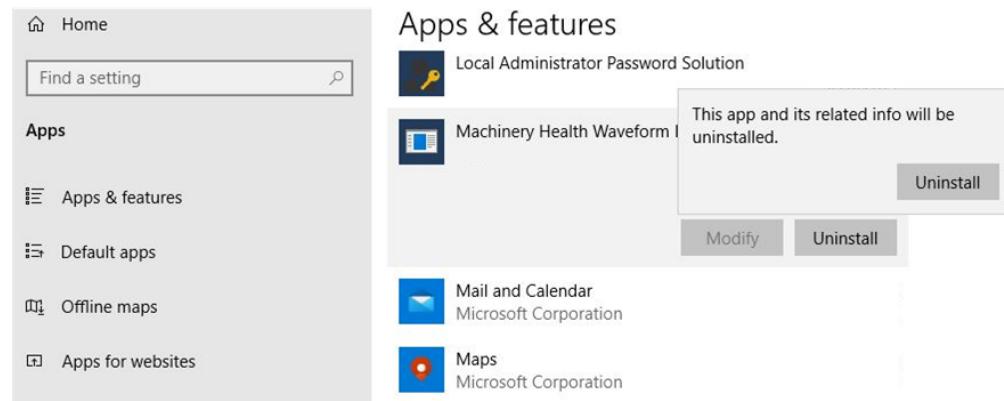
2. A list of Apps and features displays. Scroll the list of Apps & Features and select the Machinery Health Waveform Recorder. Click **Uninstall**.

Figure 35. Apps & features window



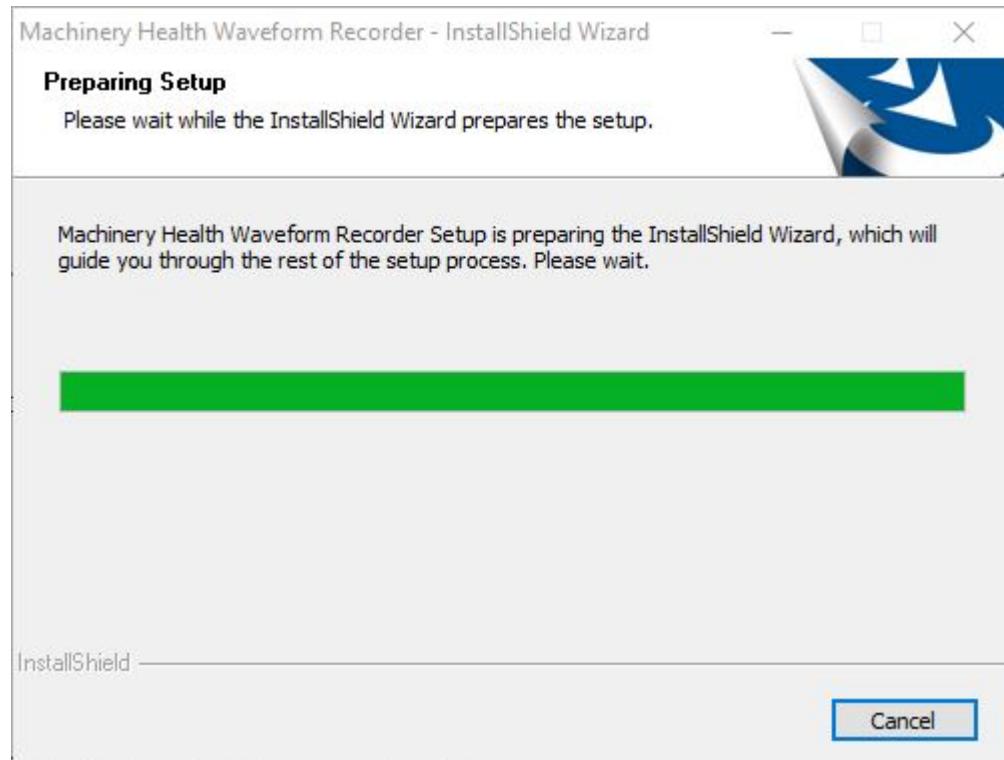
3. A window displays confirming the uninstallation. Click **Uninstall** again from the popup window as shown below.

Figure 36. Apps & features window

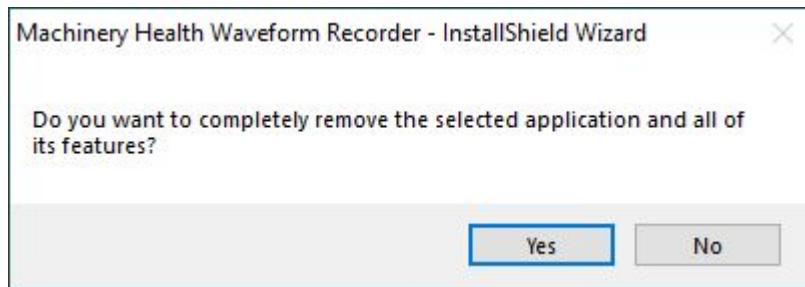


4. The Preparing Setup progress window displays. Continue with the uninstallation or click Cancel to stop the uninstall.

Figure 37. Preparing Setup progress window



5. A prompt displays asking if you want to completely remove the selected application and all of its features.
Click **Yes** to continue to uninstall.

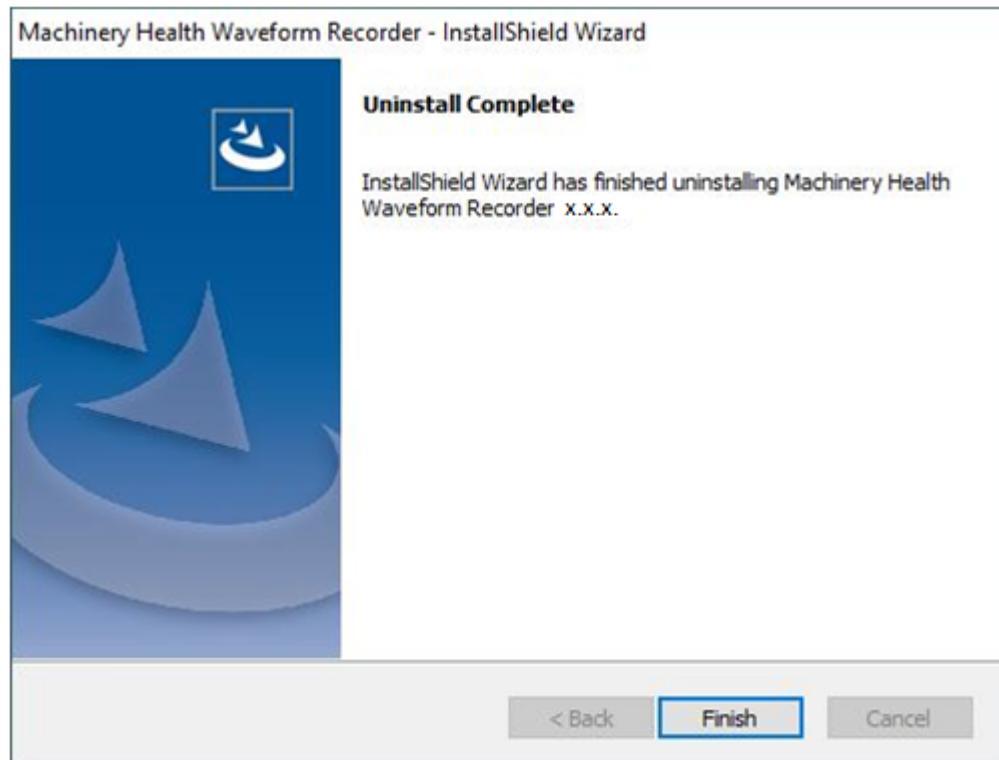


Note

If you click No, the uninstallation stops and returns you to the Apps & features window.

-
6. The Uninstall Complete window displays when the software is successfully removed. Click **Finish**.

Figure 38. Uninstall Complete window



4.2

Licensing requirements

The Machinery Health Waveform Recorder requires a License Code to activate the software.

There are two codes associated with licensing:

- **Locking Code** - Received with your initial software installation.
- **License Code** - Received by contacting Emerson Software Licensing.

A License Code is obtained by performing the following steps:

1. After you have installed the Waveform Recorder software, click the Waveform Recorder desktop icon and access the License Manager to display your Locking Code.
2. Record your Locking Code and send it to Emerson Software Licensing to obtain a License Code.
3. After you receive your License Code from Emerson, share your Locking Code and License Code with your Emerson representative. Your representative could be one of the following:
 - Project engineer.
 - After-market sales representative.
 - Field Service engineer.

Note

Contact Emerson prior to any installation or upgrade to ensure the availability of required codes or licenses.

4. Once the License Code is obtained, enter the **License Code** into the appropriate **Enter License Code** field in the License Manager's Add License window. Then click the **Add License** button.

Note

Continue by following the licensing procedure in [To add a Waveform Recorder license \[59\]](#).

4.2.1

To add a Waveform Recorder license

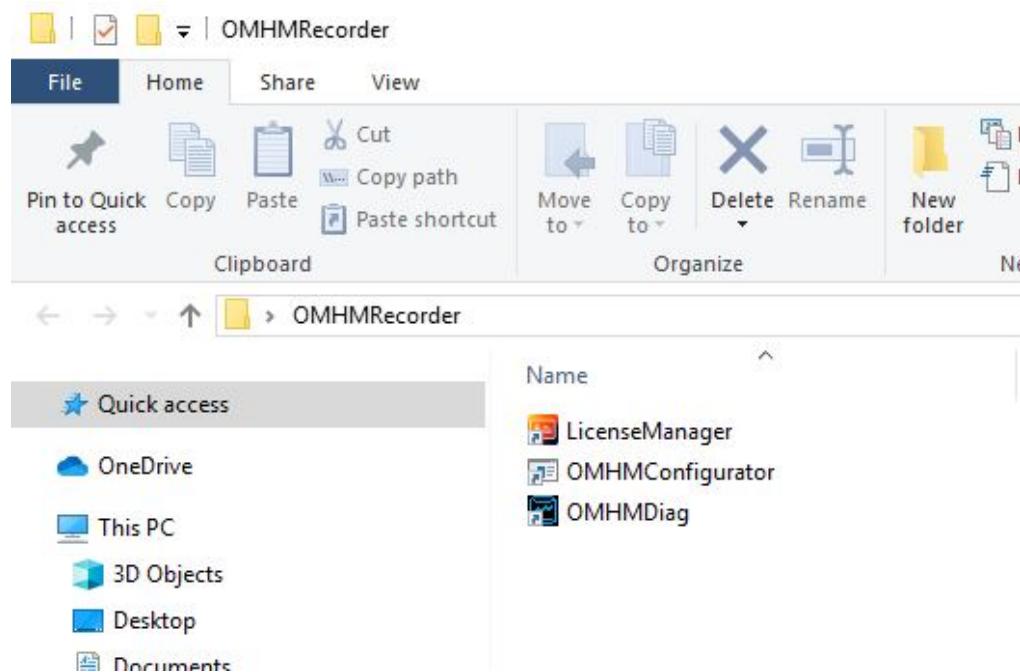
1. After you have loaded the MHW software onto your computer, double click the OMHMRecorder icon from your desktop, shown below.

[Figure 39. Desktop icon](#)



2. The Waveform Recorder files display as shown below. Click the **LicenseManager** file to run the license manager program.

Figure 40. OMHMRecorder files

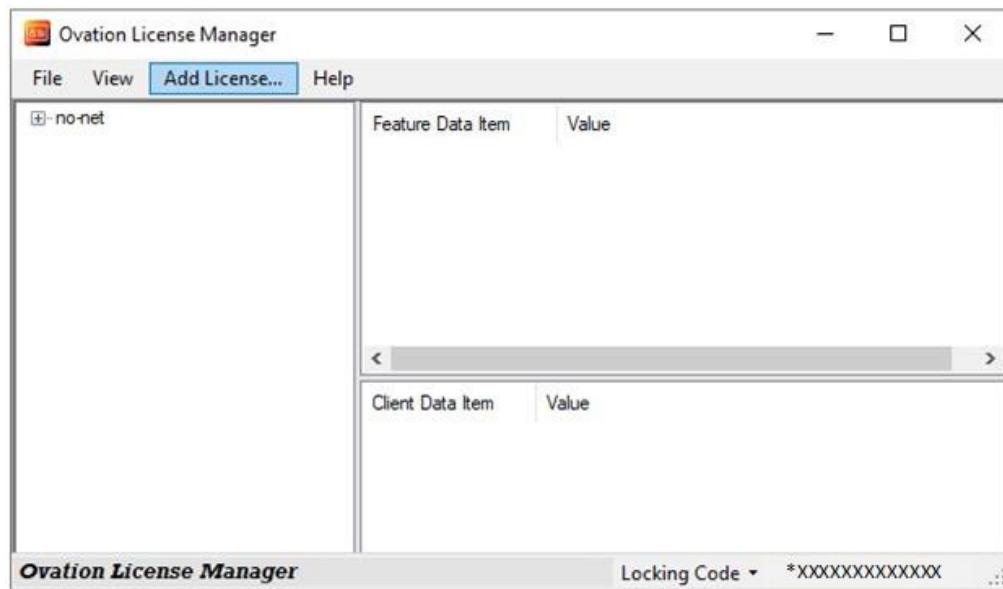


3. The License Manager opens and searches for License Servers and then displays the Ovation License Manager main window. Click **Add License** from the Licensing Manager main window.

Figure 41. Ovation License Manager

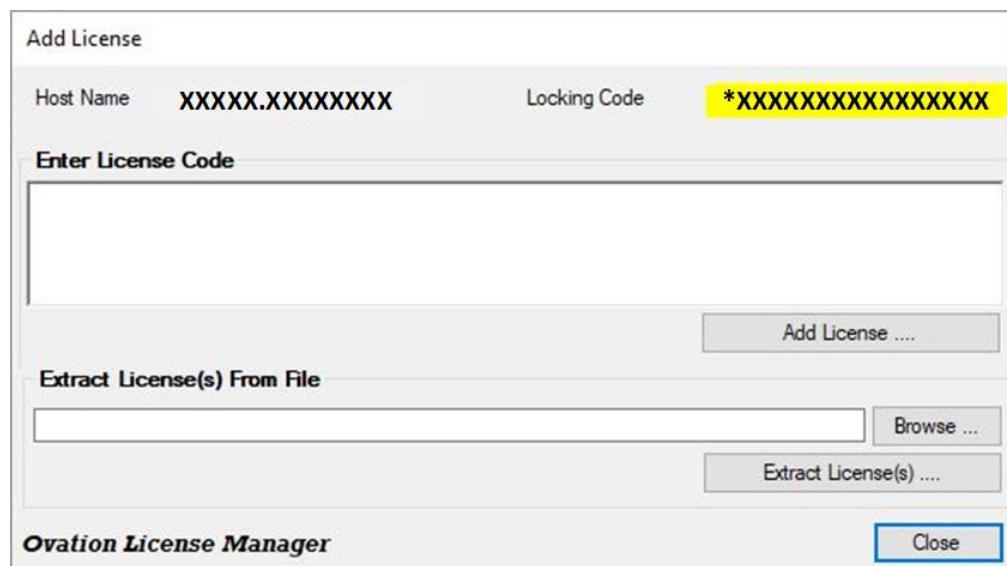


Figure 42. Ovation License Manager main window



4. The Add License window displays showing two licensing options:

Figure 43. Add License window



- Enter a License Code.
- Extract License(s) From File.

To use the Enter License Code option, enter your license code in the **Enter License Code** dialog box and click **Add License**.

Note

You can obtain a License Code by contacting Emerson Software Licensing or by contacting your Emerson representative.

After you receive your License Code from Software Licensing, save the Locking Code and the License Code to a file for future use.

-
5. If your license code is provided in a file, you can use the **Extract License(s) From File** option.

To use this option:

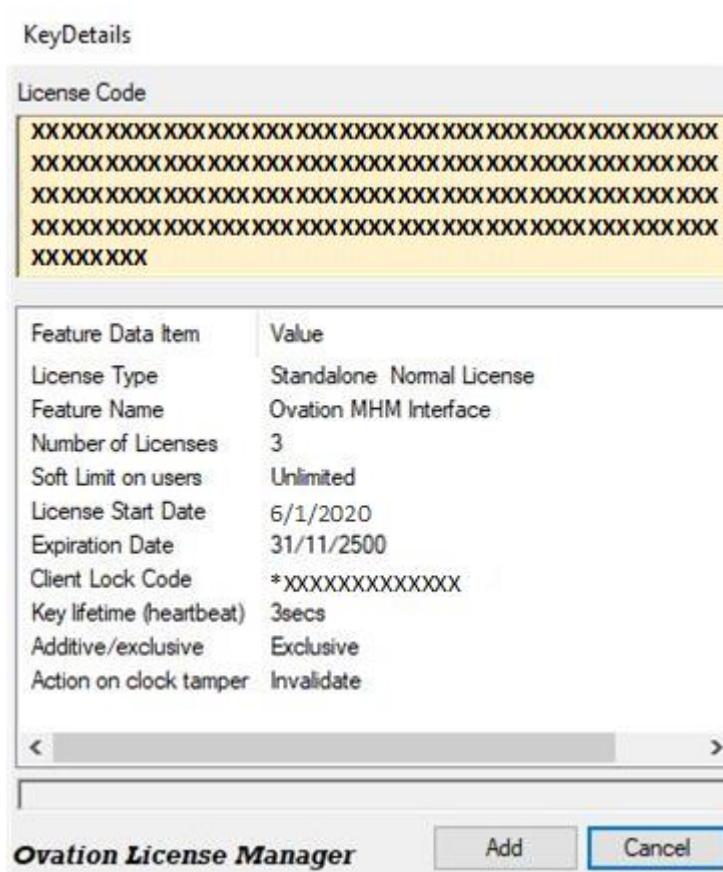
- a. Click **Browse**.
 - b. Navigate to the **text file** containing the license code.
-

Note

The text file path appears in the field adjacent to the Browse button.

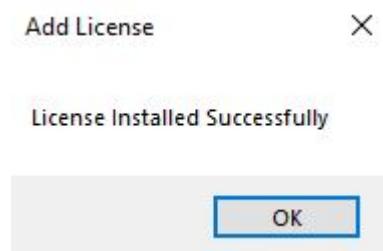
- c. Click **Extract License**.
 - d. The window displays the licenses available from the file. Select the **license code** you want to extract from the file.
 - e. Click **Extract**.
6. The KeyDetails window displays showing your License Code. Verify the license details and click **Add**.

Figure 44. KeyDetails window



7. The Add License window appears stating your 'License Installed Successfully'. Click OK.

Figure 45. Add License window



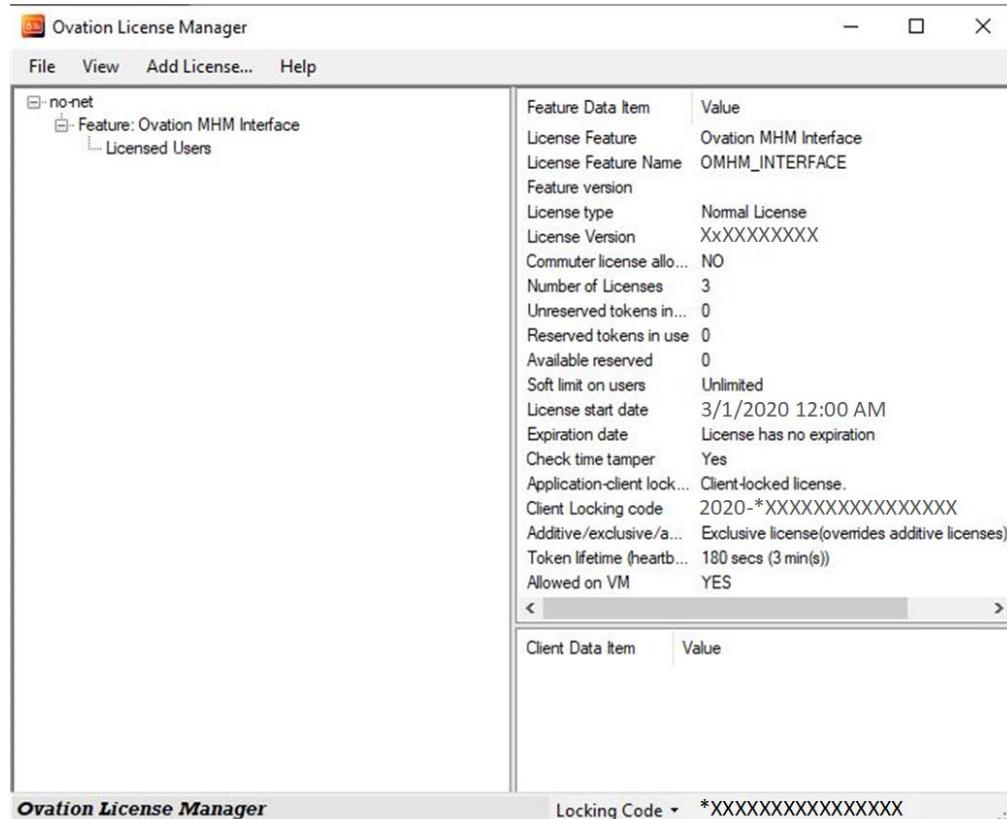
8. The Ovation License Manager updates the license information.

Figure 46. Ovation License Manager



9. The Ovation License Manager main window re-appears populated with license details.

Figure 47. Ovation License Manager main window



10. **Reboot** your computer.

5 Waveform Recorder configuration

Topics covered in this section:

- [Accessing the Developer Studio \[65\]](#)
- [Configuration settings \[65\]](#)
- [MHM sample rate \[66\]](#)
- [Storage rate calculation \[68\]](#)
- [OMHM firmware functions \[69\]](#)

5.1 Accessing the Developer Studio

When the Ovation system is loaded, the Developer Studio icon appears on the desktop. Double-click the icon to access the Developer Studio. For more information, refer to the [*Developer Studio User Guide*](#).

You can also access the Developer Studio from the Operator Station's context menu applications, such as Point Information. For more information, refer to the [*Operator Station User Guide*](#).

Note

Typically, most Developer Studio setup and configuration, including contents and hierarchy, is performed by an Emerson representatives before the system is installed.

OMHM module configuration is performed in the Developer Studio. The Waveform Recorder is dependent on the values configured for each OMHM module.

For example, Fmax values are configured in the Developer Studio and should be carefully considered while configuring the OMHM module since Fmax values affect sample rate.

Emerson recommends using Fmax values 2000 Hz or lower for typical process equipment; however, higher Fmax values are supported for faster spinning rotating equipment. Fmax values higher than 2000 Hz typically provides unnecessary detail and utilizes additional disk space.

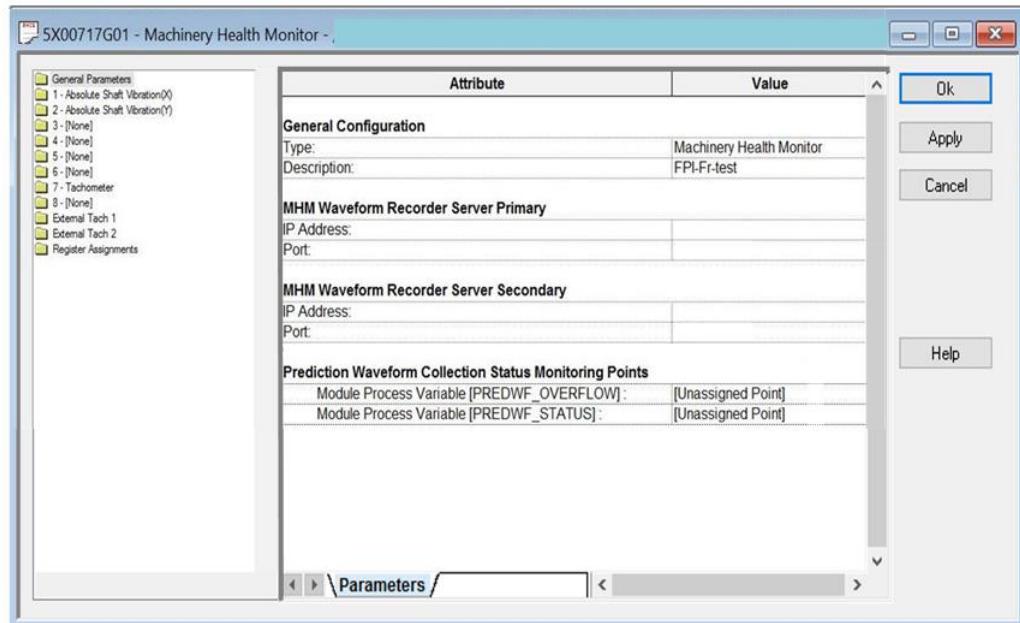
5.2 Configuration settings

The Ovation Machinery Health Monitor configuration settings shown below must be identified to connect to the Waveform Recorder:

- The **MHM Waveform Recorder Server Primary** host NIC #2 is used to identify which Waveform Recorder the OMHM module registers to, and communicates with.
- **MHM Waveform Recorder Server Secondary** (Currently not used).
- **Prediction Waveform Collection Status Monitoring Points** Refer to:
[PREDWF_OVERFLOW Prediction MPV \[73\]](#)
[PREDWF_STATUS Prediction MPV \[72\]](#)

OMHM configuration is performed in the Developer Studio. Access the Developer Studio and navigate to the OMHM module to view all MHM configuration parameters. The following window shows the Machinery Health Monitor configuration window for the OMHM module.

Figure 48. MHM configuration window



Refer to the [Machinery Health Monitor User Guide](#) and the [Developer Studio User Guide](#) for additional information on configuring the OMHM module and connecting to the MHWR.

5.3 MHM sample rate

Fmax values are used to determine the rate at which samples are collected. The following formula is used determine sample rate:

$$\text{Sample Rate} = \text{Fmax} * 2.56$$

Where:

- **Fmax (Frequency maximum)** = Maximum frequency range defined in your vibration analysis.
- **2.56** = This value is used to calculate the adequate sample rate needed to effectively analyze the maximum frequency band desired when performing an FFT.

Note

High Fmax values increase sample rate.

When Fmax values are set too high, less data can be stored in terms of time range.

Refer to [Storage rate calculation \[68\]](#) for additional calculation information.

5.4

Storage rate calculation

Storage Rate is the rate at which samples are collected and stored in Bytes

Fmax values are used to determine the total amount of samples sent through the Waveform Recorder. The following formula can be used as a guide to determine storage rate per channel:

$$\text{Storage Rate} = (\text{Sample Rate} / 8,192) * 42,000$$

Where:

- **Sample Rate = (Fmax * 2.56)**
- **Fmax (Frequency maximum)** = Maximum frequency range defined in your vibration analysis.
- **2.56** = This value is used to calculate the adequate sample rate needed to effectively analyze the maximum frequency band desired when performing an FFT (Fast Fourier Transform).
- **8,192** = Samples per message. (Samples are 4 bytes each).
- **42,000** = Average bytes per message including messaging overhead.

The example below shows Fmax set at 10,000.

where:

- **10,000 * 2.56** = 25,600 samples per second.
- **(25,600 / 8,192)** = messages per second.
- **Messages per second * 42,000** = bytes per second.

Emerson recommends configuring your system with enough disk space to allow for at least a two-hour minimum of data collection from the OMHMs at the expected collection rates.

The amount of storage required for a two-hour data collection period is the sum of the storage rate for all channels over the two-hour period.

For example; 5 modules each module has 8 channels configured with an Fmax value of 10,000 and scaled to Gigabytes:

$$\text{Rate per Channel} = (10,000 * 2.56) / 8192 * 42,000 = 131,250 \text{ bytes per second.}$$

$$\text{Rate Per Module} = \text{Rate Per Channel} * 8 \text{ channels/module} = 1,050,000 \text{ bytes per second.}$$

$$\text{Storage Size} = (2 \text{ hours} * 3,600 \text{ seconds/hour} * 5 \text{ modules} * \text{Rate Per Module}) / 1,024,000,000 = 36.9 \text{ Gigabytes.}$$

Note

If you are employing different Fmax settings on all channels, each channel must be calculated individually and added together to determine an accurate rate per module.

5.5

OMHM firmware functions

The OMHM firmware's main function is to provide protection overall data to the Controller and Ovation points. The OMHM has the following primary functions:

- Provide Low Level Waveform sample collection from configured sensor channels.
- Provide and update Protection Overalls and Parameters to Ovation through I/O bus communications to the Controller.
- Provide continuous Prediction waveform sample data to the Waveform Recorder Server.

Use the Developer Studio to configure the settings in the OMHM module for communication to the Waveform Recorder.

Each OMHM has a network client connection allowing the module to connect (if enabled in the OMHM) to the Waveform Recorder over the Waveform Recorder's Network. The Waveform Recorder must be configured to connect to, and communicate with, the OMHM module. A configuration setting in the Developer Studio identifies this connection.

Note

The Waveform Recorder Network should be outside of the Ovation Control Network.

The following connection settings are made in the Developer Studio:

- Using the **OMHM General Settings Dialog** – Enable the NIC, and set the IP Address and subnet mask for the OMHM module's physical NIC#2 connection.
- Using the **OMHM Engineering Dialog** – Enter the Waveform Recorder Server's IP Address and Port number.

Note

This is the only server IP address the module attempts to connect to during the registration process.

The Ovation Developer Studio settings also provide a method to specify a connection route through a firewall/router network configuration to the Waveform Recorder Server.

Refer to the [*Developer Studio User Guide*](#) and the [*Machinery Health Monitor User Guide*](#) for additional information on configuring the OMHM.

After you have made the required configuration settings in the Developer Studio, the configuration must be provided to the OMHM module by loading the drop for the module. When the drop is loaded, this loads the configuration to the OMHM module for processing. Once the OMHM configuration is loaded, the NIC#2 port on the OMHM module begins communication on the NIC#2 port.

Note

Reboot the module(s) after changes are made for the changes to take effect.

When the connected state is established, the OMHM begins collecting waveform data from active channels and sends the waveform data samples to the Waveform Recorder for storage.

Active MPV values are also sent to and stored by the Waveform Recorder Server. These values are accessed from a Waveform Recorder Server Client through the API.

Note

No other external commands or connections are accepted by the OMHM and only the Waveform Recorder Server can receive this waveform data from the OMHMs.

Additional functions performed by the OMHM firmware are listed below:

- Once a connection is established, MPV's and waveform sample data is provided to the Waveform Recorder Server as follows:
 - Provides Active MPV values (Overall and Parameter Measurements enabled in Ovation) to the Waveform Recorder Server. These values should match Ovation Point Values.
 - Provides gapless waveform sample data for active channels to the Waveform Recorder Server for storage.

Note

The OMHM Module does not send prediction waveform data for a channel when the **collect prediction waveform data** option is deselected in the Ovation OMHM Engineering Tool. However, it continues to send Module Process Variables (MPV's) to the server even when all prediction waveform data channels are deselected.

- Automatically recognizes a disconnection to the Waveform Recorder Server and re-initializes the connection to the Waveform Recorder Server. Waveform Sample data collection is stopped during this process until the connection is re-established.
- Buffers 32,000 waveform data samples per channel in prediction collection to ensure gapless data collection to the waveform data recorder.

Note

These buffers are cleared during a reboot, reconfiguration, or socket disconnection.

- Sends up to 8 channels of gapless raw waveform data at up to 20 kHz Fmax (2 kHz Fmax recommended for majority of process equipment) to the Waveform Recorder Server.

Note

Channels can collect data at 20 kHz Fmax; however, due to throughput concerns the total of all Fmax values should not exceed 175 kHz Fmax maximum per module.

If running a paired/partnered channel collection on any two channels, the Fmax maximum should not exceed 150 kHz maximum per module.

Fmax maximum per module is determined by adding together all Block Data Collection Fmax values along with Prediction Waveform Collection Fmax values, i.e. two possible Fmax settings per channel.

Refer to the [*Machinery Health Monitor Prediction Waveform Data Collection Guide*](#) for additional details.

-
- Sends up to 2 channels of tachometer waveform data per module.
-

Note

Setting channel 7 or 8 to a tachometer type replaces standard waveform measurement on the channel with a tachometer signal; thus, decreasing total vibration measurements available.

5.5.1 PREDWF_STATUS Prediction MPV

The PREDWF_STATUS MPV delivers status bits for the prediction waveform recorder connection and configuration. Provides an overall Prediction Waveform status of the OMHM.

These are 32-bit analog MPV values and can be monitored by an analog point.

Note

Individual bits can be monitored using a control sheet to convert the value to bitwise.

Bits 16 through 32 are reserved.

Bits 0 through 15 are shown in the following table:

Table 2. PREDWF_STATUS

Bit	Description
0	Reserved for future use.
1	Reserved for future use.
2	Reserved for future use.
3	Reserved for future use.
4	Reserved for future use.
5	Reserved for future use.
6	Reserved for future use.
7	Reserved for future use.
8	Reserved for future use.
9	Reserved for future use.
10	Reserved for future use.
11	Reserved for future use.
12	Prediction Waveform configuration status (1 = The Prediction Waveform connection is not configured).
13	Prediction Waveform connection status (1 = The Prediction Waveform socket is not connected).
14	Prediction Waveform overflow status (1 = A Prediction Waveform overflow condition exists for at least one channel).
15	Reserved for future use.

5.5.2 PREDWF_OVERFLOW Prediction MPV

The PREDWF_OVERFLOW MPV delivers overflow bits for the prediction waveform buffers on the module. In the event of an overflow, the channel stops collecting sample data for one minute, and then automatically resumes.

This MPV indicates which OMHM channel is in a Prediction Waveform overflow state (PREDWF_STATUS Bit 14 = 1).

These are 32-bit analog MPV values and are monitored by an analog point.

Note

Individual bits can be monitored using a control sheet to convert the value to bitwise.

Bits 16 through 32 are reserved.

Bits 0 through 15 are shown in the following table:

Table 3. PREDWF_OVERFLOW

Bit	Description
0	Reserved for future use.
1	Reserved for future use.
2	Reserved for future use.
3	Reserved for future use.
4	Reserved for future use.
5	Reserved for future use.
6	Reserved for future use.
7	Reserved for future use.
8	A Prediction Waveform overflow condition exists for Channel 1.
9	A Prediction Waveform overflow condition exists for Channel 2.
10	A Prediction Waveform overflow condition exists for Channel 3.
11	A Prediction Waveform overflow condition exists for Channel 4.
12	A Prediction Waveform overflow condition exists for Channel 5.
13	A Prediction Waveform overflow condition exists for Channel 6.
14	A Prediction Waveform overflow condition exists for Channel 7.
15	A Prediction Waveform overflow condition exists for Channel 8.

6

Waveform Recorder operation

Topics covered in this section:

- *Waveform Recorder process* [75]
- *Waveform Recorder main diagnostics window (OMHMDiag)* [76]

6.1

Waveform Recorder process

Once the initial Machinery Health Waveform Recorder installation is complete, the OMHM module(s) register with the MHWR.

The recording process begins after each OMHM module is configured with valid parameters and loaded through the Developer Studio. The module registers with the Waveform Recorder and the recorder begins to collect configuration, waveform, and parameter data. The data is then sent to the AMS Machine Works server for data analysis.

Note

The Waveform Recorder interfaces directly with the OMHM module(s) NIC 2 port, and does not connect to the Ovation network.

Data is stored on the Waveform Recorder and catalogued on disks to create a short-term FIFO history covering a configurable time period. The server stores the waveform data in the same format as received from the modules.

The Machinery Health Client API on the Waveform Recorder responds to requests from the vibration analysis application to provide OMHM configuration, waveform, and timestamped parameter data.

The Waveform Recorder captures the OMHM module(s) configuration and detects when changes in the configuration occur.

The Client API notifies the client when configuration changes and other important OMHM or Waveform Recorder events have occurred.

When OMHM or MHWR event conditions are detected, the MHWR notifies connected applications.

Conditions include:

- Changes to OMHM or channel configuration.
- Module reboot.
- Waveform Recorder errors.

Client applications are informed through queries or event notifications.

6.2 Waveform Recorder main diagnostics window (OMHMDiag)

The Waveform Recorder's main diagnostics window provides an interface to view important details about the Waveform Recorder. Refer to the following sections for additional information:

- [Server area \[80\]](#)
- [OMHM modules \[85\]](#)
- [Waveform cache \[88\]](#)
- [Notifications \[86\]](#)
- [OptionsDialog \[89\]](#)
- [Server connections \[76\]](#)

Refer to the following section to access the main diagnostics window.

6.2.1 To access the Waveform Recorder main diagnostics window

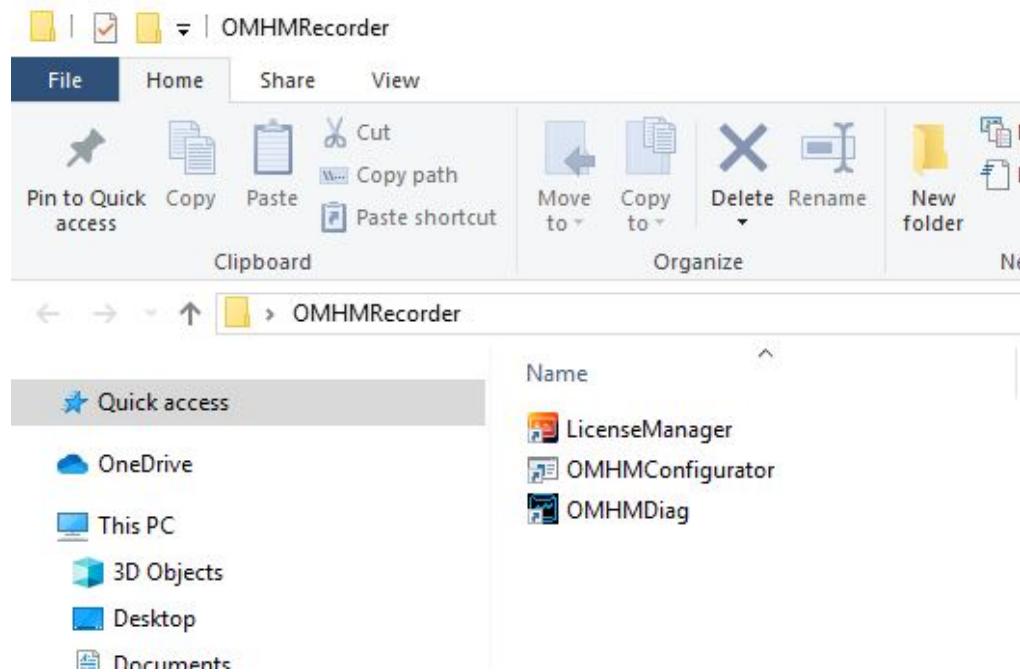
1. Click the **OMHMRecorder** desktop icon to access the Waveform Recorder's program files.

Figure 49. Waveform Recorder desktop icon



2. The Waveform Recorder files display as shown below. Click the **OMHMDiag** file to open the main diagnostic window.

Figure 50. OMHMRecorder files



3. The **OMHMDiag** file displays the Waveform Recorder's main diagnostics window:

Figure 51. Waveform Recorder main diagnostics window

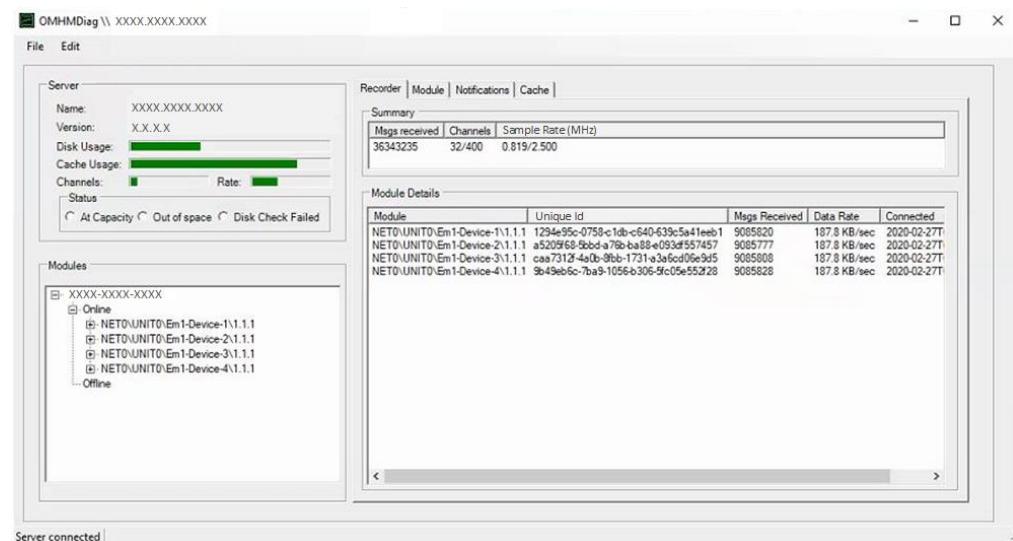
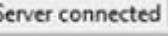
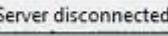


Table 4. Main diagnostics window attributes

Item	Descriptions
File	Save Options - Saves unsaved changes. Exit - Closes the MHWR application.

Item	Descriptions
Edit [89]	<p>Accesses the OptionsDialog [89] window Edit options.</p> <p>Update Rate = Rate in seconds updates occur - (range is 0 to 60 seconds). Typically, this does not need to be changed.</p> <p>Display Local Time checkbox = When checked, displays the Local Time and Date of the system running the OMHMDiag program.</p> <p>Hide When Minimized checkbox = When checked, hides the window when the window is minimized.</p> <p>Server = Waveform Recorder Server name. (Typically, this does not need to be changed).</p> <p>Port = The port over which communications occur. (Typically, this does not need to be changed).</p>
 OptionsDialog	A blue OptionsDialog icon = Displays when the Options window is open.
Server area [80]	Displays information pertaining to the Waveform Recorder server and server capacities.
Modules area [81]	Displays the number of MHM modules registered with the Waveform Recorder online and offline. Online module information can be displayed by right-clicking the module name.
Recorder tab [84]	Shows Waveform Recorder status and an overview of all items displayed within all windows.
Module tab [85]	Shows information pertaining to all registered OMHM module(s).
Notifications tab [86]	Displays important notices recognized by the Waveform Recorder server.
Cache tab [88]	Summary of all collected waveform data.
Module Details area	Displays information about the OMHM module(s). Specifically, displays the Module name, Unique Id value, number of Messages received, Data Rate in KB/sec, and a time when the module Connected.
 OMHMDiag \\U	A green icon displays in your tray during normal operation.
 OMHMDiag \\local...	A red icon displays in your tray when a disconnection problem occurs with the server.
Server connection area	<p>Displays MHWR Server connection status messages in the main diagnostics window's lower left corner.</p> <ul style="list-style-type: none"> • Server connected message. • Server disconnected message. • Licensing messages.
 Server connected	Displays when the MHWR Server has established a connection. Located in the main diagnostics window's lower left corner.
 Server disconnected	Displays when the MHWR Server is not connected. Located in the main diagnostics window's lower left corner.

Item	Descriptions
Server not licensed	<p>Server not licensed: Feature 330 not licensed: License query error (18) [Unable to locate a License Server for requested Feature.]</p> <p>When applicable, a license message displays in main diagnostics window's lower left corner indicating the server is not licensed.</p> <hr/> <p>Note</p> <p>A 10 day trial license is provided with your software. After the trial period you must license the software through Emerson's Software Licensing. Refer to Licensing requirements [59].</p> <hr/>

6.2.2 Server information area

Waveform Recorder Server area is shown in the main diagnostics window's upper-left corner. The Server area displays information and capacities specifically about the Waveform Recorder Server.

The Server area is shown in the following illustration:

Figure 52. Server area

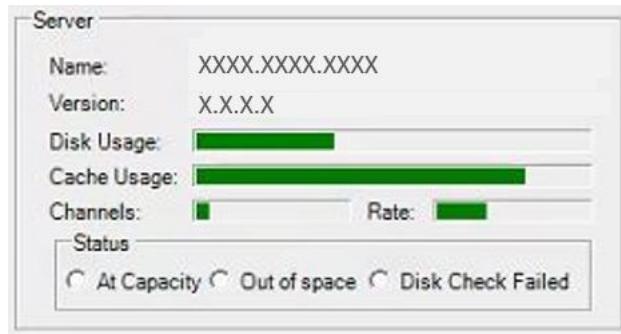


Table 5. Server area descriptions

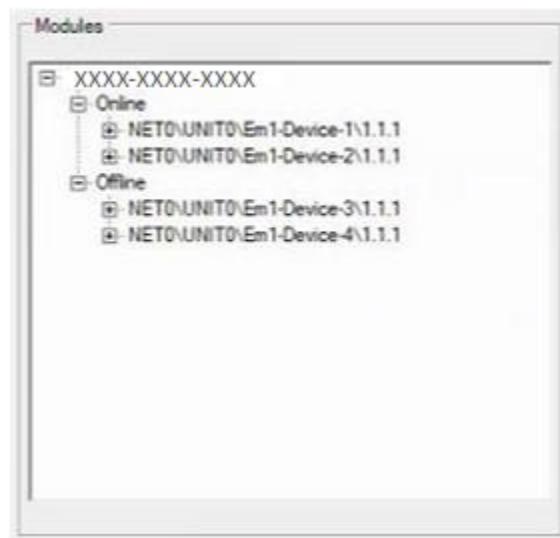
Item	Description
Server area	Displays information about the Waveform Recorder server.
Name	Displays the name assigned to the server.
Version	Shows the Waveform Recorder's software version.
Disk Usage	Capacity bar graph illustrating the total storage usage to date and shows the remaining disk space available.
Cache Usage	Capacity bar graph illustrating the total storage usage to date, and shows the remaining Cache storage available.
Channels	Bar graph illustrating the total channel usage currently being used. Range = 1 to a maximum of 400 channels for all modules online.
Rate	Bar graph representing samples per second in millions. Maximum limit = 2.5 million samples per second.
Status area	Displays server disk status.
At Capacity	Lit when the maximum capacity is reached. Maximum = 400 channels or when you are collecting samples at 2.5 million samples per second.
Out of space	Lit when you are out of disk space.
Disk Check Failed	Lit if the disk check feature is unable to determine how much space is used on the disk.

6.2.3 Modules area

The Modules section shows the number of OMHM modules registered with the Waveform Recorder online and offline.

The following figure shows a navigation tree of all online and offline OMHM modules in the Modules area:

Figure 53. Modules area



Note

If the module list is blank, use the Ovation Controller Diagnostics utility and check if the OMHM firmware is up to date, check the network connections, and check the network settings in the OMHM and MHWR.

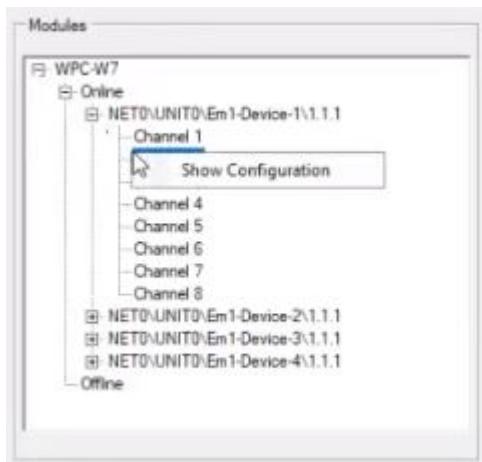
Device configuration information about on-line OMHM modules is available by right-clicking the module name to display Device Configuration Information as shown in the figure below:

Figure 54. Device Configuration information window



You can display information about module channels by expanding each module to show channel configuration as illustrated below:

Figure 55. List of configured channels



Click the desired channel to view Channel Configuration information as shown in the following figure.

Figure 56. Channel Configuration information window



6.2.4 Recorder tab

The Recorder tab shows the Waveform Recorder status and is an overview of all items displayed within all windows.

The following figure illustrates the Recorder tab:

Figure 57. Recorder Tab

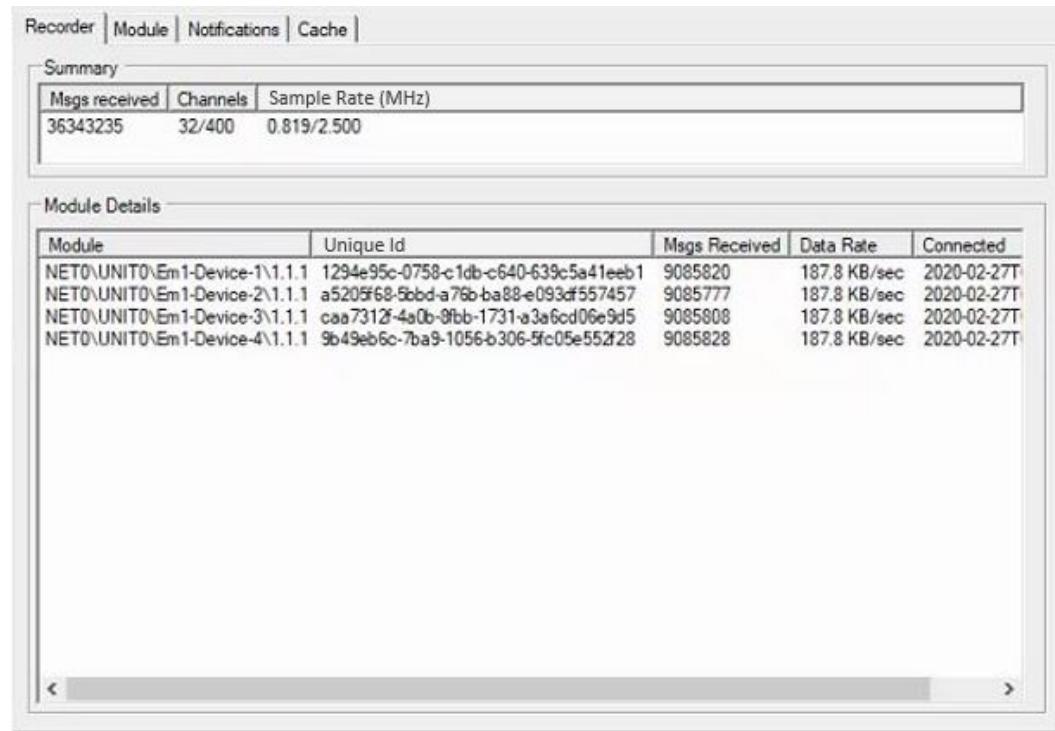


Table 6. Recorder tab descriptions

Item	Description
Summary area	Summarizes all waveform messages received.
Msgs received	Displays the total number of all waveform messages received.
Channels	Shows channel capacities currently configured.
Sample Rate (MHz)	Displays sample rate capacities currently configured in MHz.
Module Details area	Displays a list of all online modules.
Module	Network unit device and I/O location originally configured in the Developer Studio.
Unique Id	Id value unique across all modules.
Msgs Received	Total number of waveform messages received.
Data Rate	The rate at which the module is sending data in kilobytes per second (KB/sec.).
Connected	Timestamp when the module came online.

6.2.5 Module tab

The Module tab displays detailed information about the registered OMHM module(s). Open the module tab and click one of the modules to display info in the modules area.

The following illustration shows the Module tab:

Figure 58. Module tab

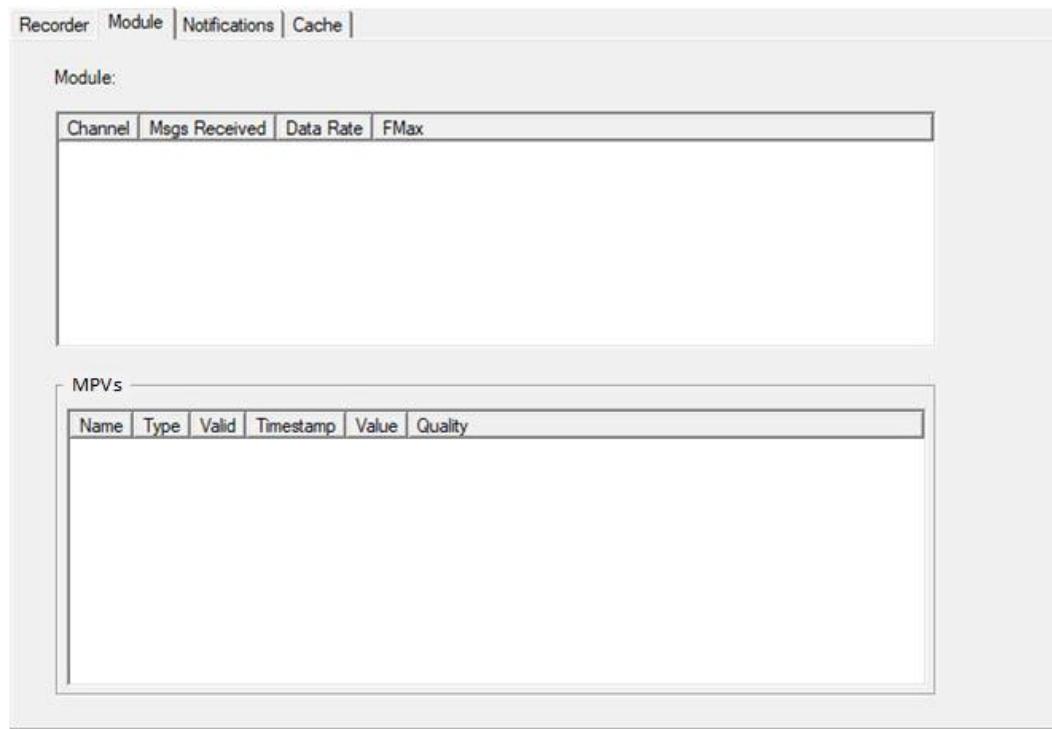


Table 7. Module tab descriptions

Item	Description
Channel	Displays the channels for the MHM module.
Msgs Received	Displays messages received.
Data Rate	Rate at which data is received.
Fmax	Fmax value selected when the module was configured.
MPVs	The calculated variables originally configured in the Developer Studio.
Name	Name assigned to the point.
Valid	True = Valid. False = Not valid.
Timestamp	Time the value was received.
Value	Floating point number.
Quality	Shows point quality: Good - Bad - Fair - Poor.

6.2.6 Notifications tab

Notifications are important messages to let you know an important event has occurred in the application requiring your attention.

Notifications also provide a way for you to track changes while you are away from the system.

For example, the following messages could be a notification:

- Modules connecting and disconnecting.
- Connecting to the MHWR.
- Losing connection with the MHWR.
- Disk at capacity or Disk out of space.

The following illustration shows the Notifications tab:

Figure 59. Notifications tab

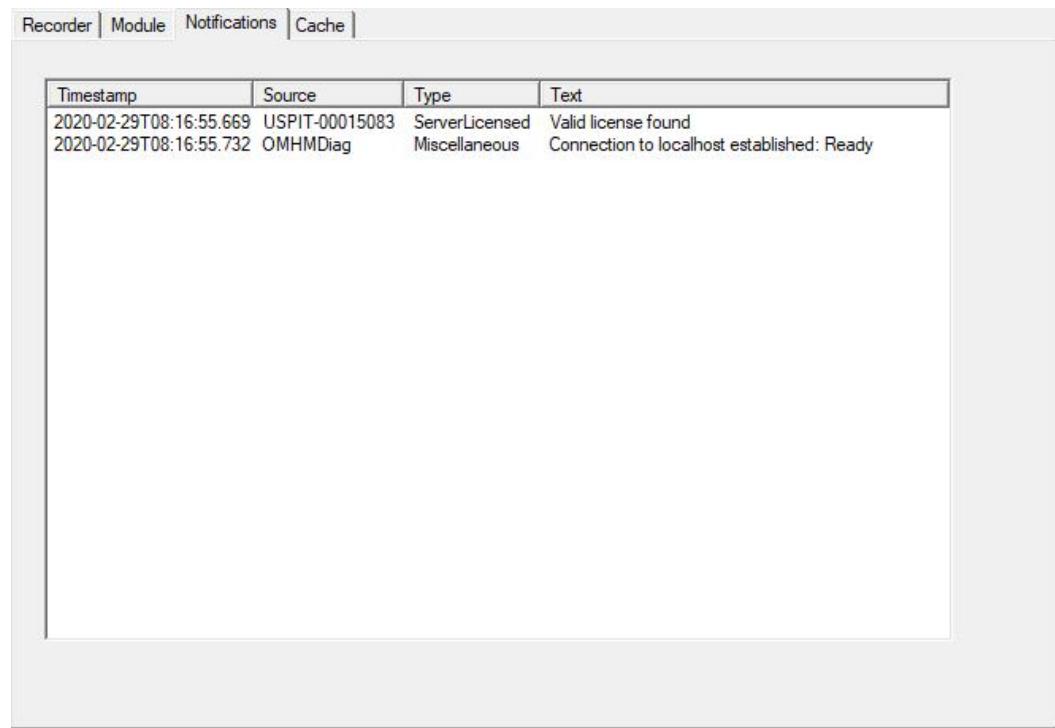


Table 8. Notifications tab descriptions

Item	Description
Timestamp	Time when the notification was received.
Source	Shows the source of where the notification was generated.

Item	Description
Type	Lists the type of notification received, for example: <ul style="list-style-type: none">• Server licensed or Server not licensed.• Miscellaneous notifications.• Module notifications.
Text	Displays a text message about the notification.

6.2.7 Cache tab

The Cache tab is the summary of all waveform data collected.

The following illustration shows the Cache tab:

Figure 60. Cache tab

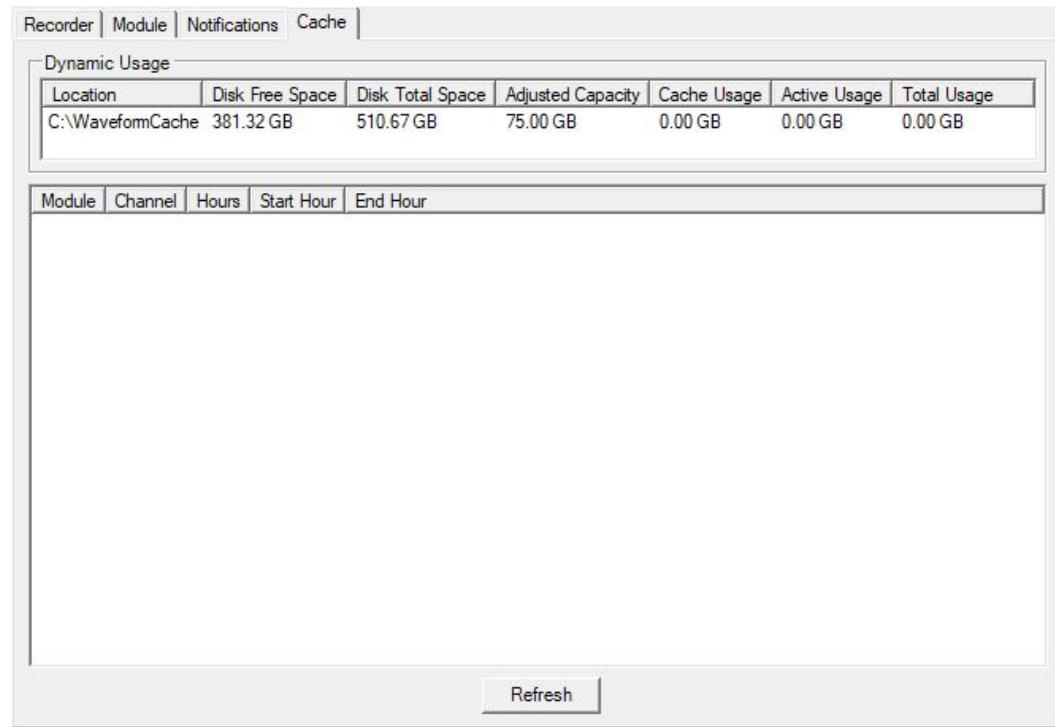


Table 9. Cache tab descriptions

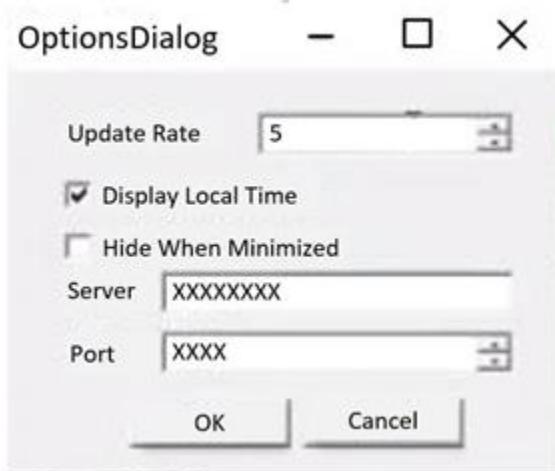
Item	Description
Location	Displays the waveform Cache location.
Disk Free Space	Total amount of free disk space - (GB).
Disk Total Space	Total amount of disk space - (GB).
Adjusted Capacity	Represents the waveform cache capacity, as configured by the user, minus space used for internal operations (approximately 15% of the configured capacity).
Cache Usage	Amount of cache space used.
Active Usage	Amount of active space used.
Total Usage	Sum of active and cache usage.
Module	Summary of all the modules and their channels and how much data has been stored for each. Use the Refresh button to update values.
Channel	Lists the number of channels.
Hours	Total number of hours of the recording.
Start Hour	Time when the recording began.

Item	Description
End Hour	Time when the recording ended.
Refresh	Updates the current values. Information in the Cache page's module area is not dynamic; therefore, you must refresh the page to update the values.

6.2.8 OptionsDialog window

The OptionsDialog window is accessed from the **Edit** button on the [main diagnostics \[76\]](#) window.

Figure 61. OptionsDialog window



Displays the following OptionsDialog Edit configuration options:

Table 10. OptionsDialog window attributes

Item	Description
Update Rate	Rate in seconds updates occur - (range is 0 to 60 seconds). Typically, this does not need to be changed. Default = 5 seconds. To disable, select 0.
Display Local Time checkbox	When checked, displays the Local Time and Date of the system running the OMHMDiag program. Local Time displays time in your local time zone. UTC - Date and Time displays in UTC (Universal Coordinated Time) when unchecked. UTC is a standard fixed time protocol synchronized across all time zones world-wide. UTC does not observe daylight savings time. All dynamic timestamps change between Local and UTC depending on your selection. Default = Checked (Displays Local Time)

Item	Description
<input type="checkbox"/> Hide When Minimized checkbox	<p>When checked, hides the window when the window is minimized.</p> <p>To un-minimize: Double-click the icon or right-click Restore to reopen the window.</p> <p>Right-click Exit to close the program.</p> <p>Default = Unchecked.</p>
	<p>Note</p> <p>When the application is minimized its icon appears in the system tray (located on task bar's right side). By default Windows hides this icon.</p> <p>Taskbar icons are selectable. If you want the icon to always appear in the tray, use the Windows/TaskBarSettings/NotificationArea Select Which Icons Appear on the TaskBar/System Tray.</p> <p>When set, the icon displays in the tray and appears either red or green.</p>
Server	<p>Waveform Recorder Server name. (Typically, this does not need to be changed).</p> <p>Default = Local Host.</p>
Port	<p>The port over which communications occur. (Typically, this does not need to be changed).</p> <p>Note</p> <p>Selections can be saved when prompted. The program commits your changes to memory when saved.</p> <p>If changes are not saved, all values return to the default values the next time the program is started. Changes made but not saved are used in the current execution of the OMHMDiag process.</p> <p>Refer to the <i>Ports and Services</i> documentation for specific port information.</p>
 OptionsDialog	<p>A blue OptionsDialog icon = Displays when the OptionsDialog window is open.</p>

7 OMHM Configurator

Topics covered in this section:

- [OMHM Configurator tool \[91\]](#)
- [MHWR tab \[93\]](#)
- [MHM Proxy tab \[97\]](#)

7.1 OMHM Configurator tool

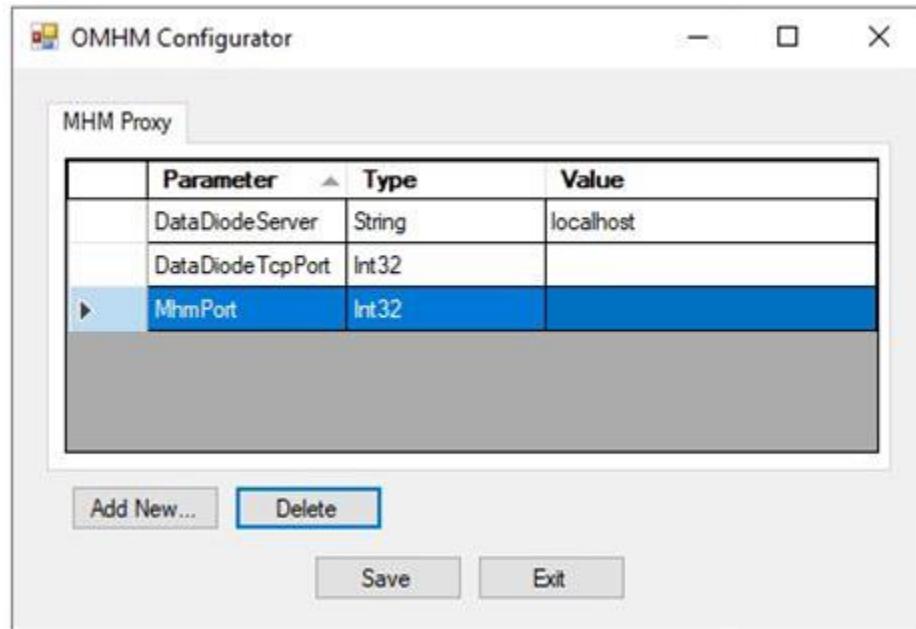
The OMHM Configurator tool allows you to configure attributes of either the MHWR server or the MHM Proxy programs.

Depending on the software installation option you selected during the initial OMHM Configurator installation, the Configurator tool displays one of the windows shown below when the Configurator tool is accessed:

If you selected the **Ovation MHM Proxy Service** option during initial software installation, the MHM Proxy tab appears in the OMHM Configurator tool's window as shown below:

Refer to the [MHM Proxy tab \[97\]](#).

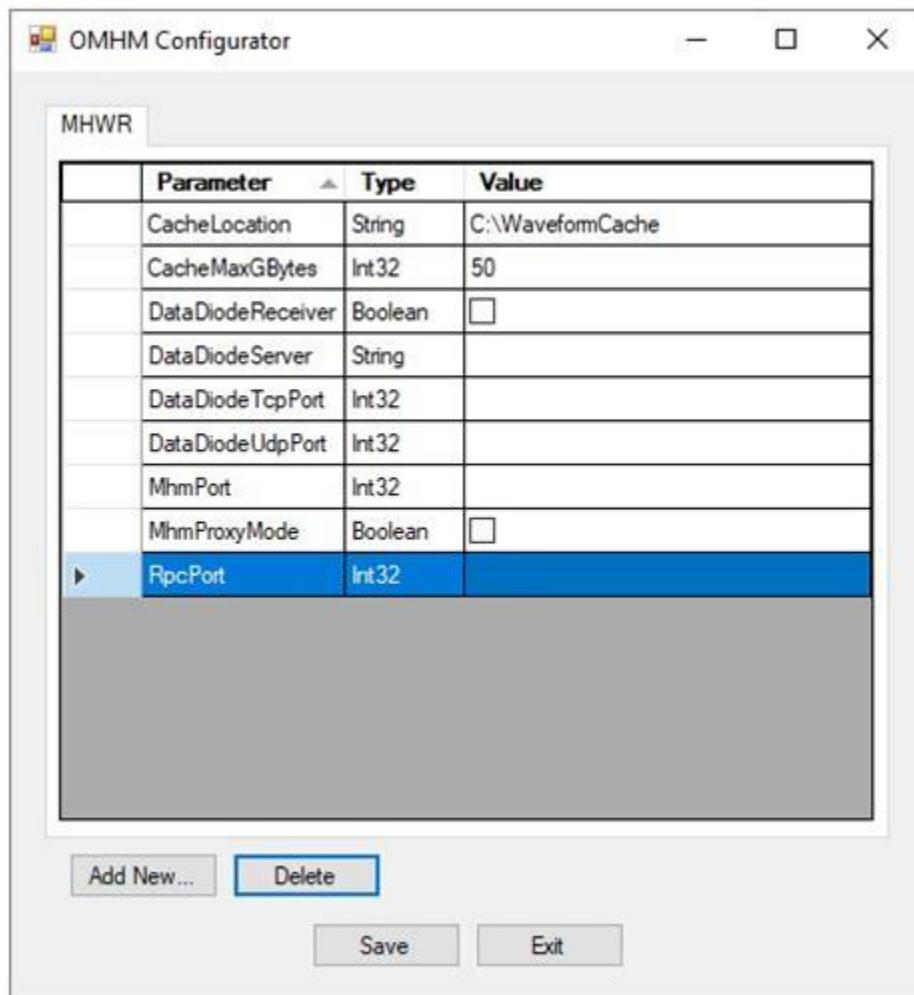
Figure 62. OMHM Configurator window (MHM Proxy tab)



If you selected the **Ovation MHM Recorder** option during initial installation, the MHWR tab appears in the OMHM Configurator tool's window as shown below:

Refer to the [MHWR tab \[93\]](#).

Figure 63. OMHM Configurator window (MHWR tab)



Note

See [To install or reinstall the MHWR \[31\]](#) for additional information on installation options.

7.2 MHWR tab

The MHWR tab displays when the OMHM Configurator tool is accessed and when your software installation is configured for the **Ovation MHM Recorder**.

Note

Software configuration occurs in the initial software installation setup process.

See [To install or reinstall the MHWR \[31\]](#) for software installation information.

The MHWR tab displays a list of pre-configured parameters in the Parameters column. The parameters listed provide user-configurable settings associated with the MHWR.

In this window you can perform the following actions:

- Add and delete new parameters
- Configure values of existing parameters
- Activate or deactivate parameters

The following illustration shows the MHWR tab's pre-configured parameters:

Figure 64. MHWR tab

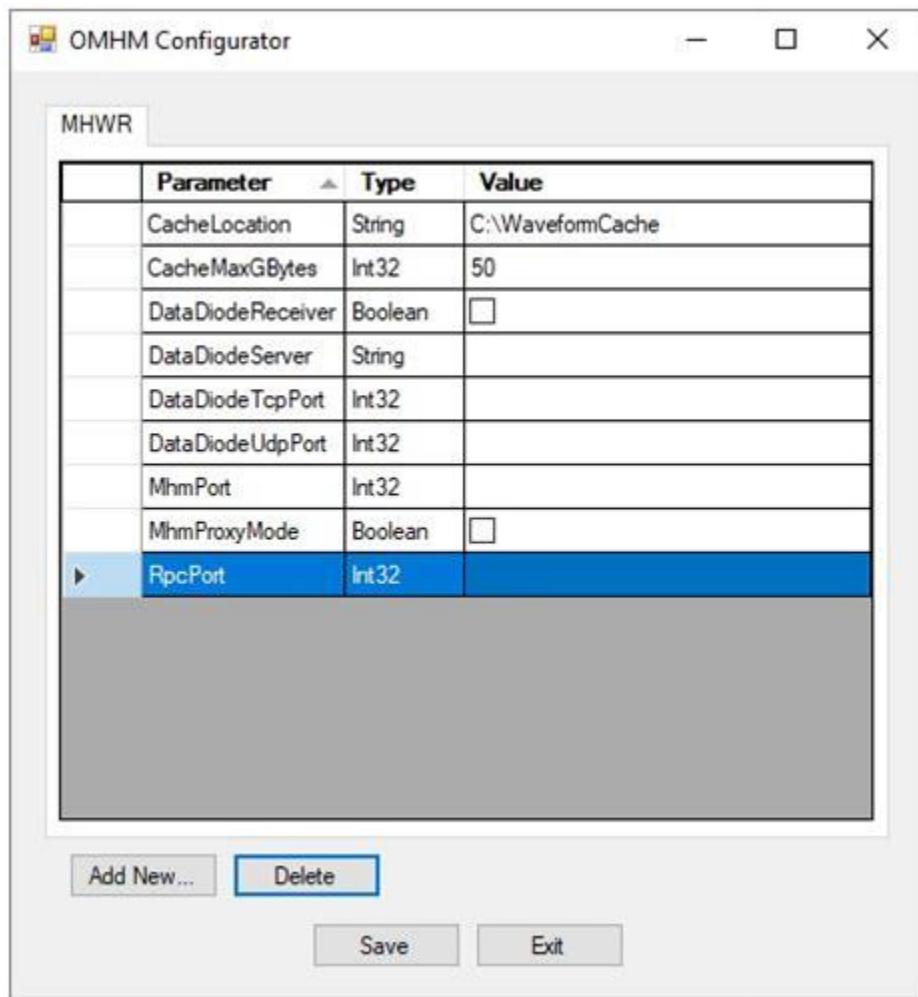


Table 11. MHWR tab configurator attributes

Item	Description
Parameter column	The parameter column displays a list of configuration parameters. During initial installation this column only displays pre-configured parameters. After new entries are added and saved, they are listed in this column. Choosing the dropdown arrow arranges the entries alphabetically in ascending or descending order.
CacheLocation	Directory of the cache.
CacheMaxGBytes	Maximum size of cache in Gigabytes.

Item	Description
DataDiodeReceiver	<p>Checkbox indicating this installation is running on Data Diode Recorder Receiver mode.</p> <ul style="list-style-type: none"> • Checked = True (configured) • Unchecked = False (not configured) • Default = False
DataDiodeServer	<p>Hostname or IP Address of Data Diode send server.</p> <p>Valid for Data Diode Recorder sender mode.</p>
DataDiodeTcpPort	<p>Port used for TCP traffic through the data diode.</p> <p>Valid for Data Diode Recorder sender or receiver mode.</p>
DataDiodeUdpPort	<p>Port used for UDP traffic through the Data Diode.</p> <p>Valid for Data Diode Recorder sender or receiver mode.</p>
MhmPort	<p>The TCP port the recorder listens on to receive module messages and is valid whenever the recorder is receiving module messages which is every configuration option except Diode Receive Mode.</p> <p>Note When in Proxy mode, this port must match the receive side TCP port configuration of the data diode.</p> <p>This value must match the configuration value of the modules.</p> <p>Note Refer to the <i>Ports and Services</i> documentation for specific information on Port numbers.</p>
MhmProxyMode	<p>Checkbox indicating the installation is operating in proxy mode.</p> <ul style="list-style-type: none"> • Checked = True (configured) • Unchecked = False (not configured) • Default = False <p>Note This should be set only when there is an MHM Proxy server configured.</p>
RpcPort	<p>TCP port the Recorder uses to respond to clients, AMS Machine Works, and OMHM Diag.</p> <p>Note Refer to the <i>Ports and Services</i> documentation for specific information on Port numbers.</p>

Item	Description
Parameters appearing in the Add New Entry dropdown list:	
MinimumFreeGBytes	<p>The minimum amount of free space kept on the waveform cache disk, even if the cache is not full.</p> <p>Default = 10 GBytes</p>
UseCompression	<p>Compresses the waveform cache files on the disk.</p> <p>Enabling compression can potentially increase cache storage but at the expense of processor cycles since it takes processor cycles to perform the compression.</p> <p>Default = True</p>
DataDiodeRetryFailedFiles	<p>In Data Diode Recorder Sender mode, retries sending waveform files if the data diode is unresponsive.</p> <p>Changing this field is not recommended.</p> <p>Default = True</p>
DynamicCacheEqualSpace	<p>Manages the waveform cache for each channel by allocating the same amount of disk space instead of hours.</p> <p>Default = False</p>
Type column	<p>Displays the type of parameter. Types are:</p> <ul style="list-style-type: none"> String Boolean Int32
Value column	Displays the default or configured value for the specific parameter.
Value checkbox	<p>Active or inactive when the check box is selected or deselected.</p> <p>Checked = True (active)</p> <p>Unchecked = False (inactive)</p>
Add New	<p>Opens the Add New Entry window. New parameters are entered and configured using this window.</p> <p>See To add a new entry [100].</p>
Delete	<p>Removes the selected parameter from the list.</p> <hr/> <p>Note</p> <p>Required parameters cannot be deleted. You are prompted with an error message when attempting to delete required parameters.</p> <p>See To delete an entry [103].</p> <hr/>
Save	Commits the current configuration selections to memory.
Exit	Closes the OMHM Configurator.

7.3 MHM Proxy tab

The MHM Proxy tab displays when the Configurator tool is accessed and when your software installation is configured for the **Ovation MHM Proxy Service**.

Note

Software configuration occurs in the initial software installation setup process.

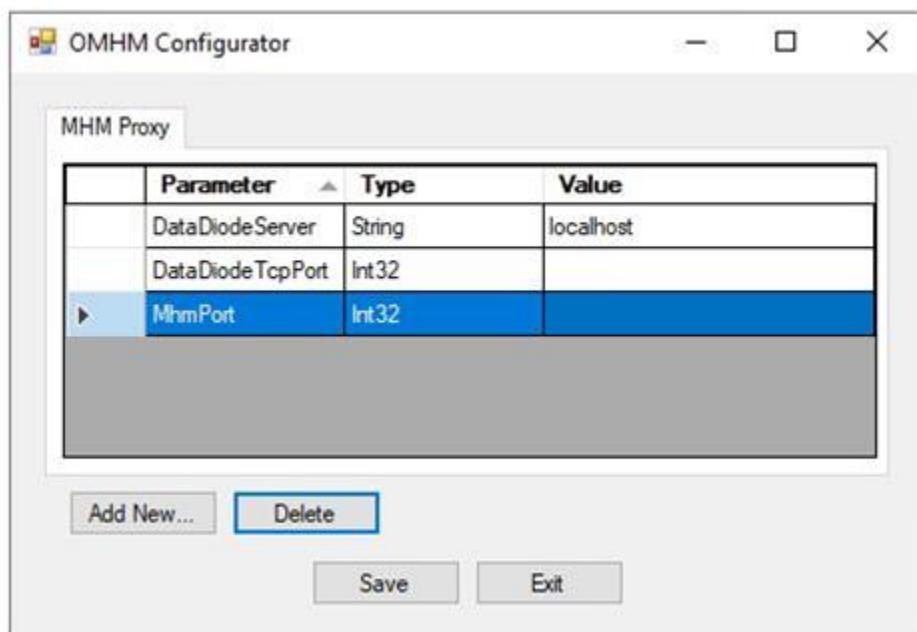
See [To install or reinstall the MHM Proxy \[46\]](#) for software installation information.

The MHM Proxy tab displays a list of pre-configured parameters in the Parameters column. These parameters provide user-configurable settings associated with the MHM Proxy Service and can perform the following actions:

- Add and delete new parameters
- Configure values of existing parameters

The MHM Proxy tab is shown in the following figure:

Figure 65. MHM Proxy tab



Note

The MHM Proxy setup requires Data diode configuration.

Emerson supports data diodes approved and validated specifically for Ovation systems.

Refer to: [What is a Data Diode? \[24\]](#) for additional information on data diodes.

Table 12. MHM Proxy tab

Item	Description
Parameter column	Displays a list of configuration parameters. During initial installation this column only displays pre-configured parameters. After new parameters are entered and configured they appear in this column. Parameters are listed alphabetically in ascending or descending order by choosing the dropdown arrow located at the top of the column.
DataDiodeServer	The data diode's send-side IP address or host name. Since the proxy is expected to be installed on the data diode itself, this value is typically localhost
DataDiodeTcpPort	The TCP Multi Connector port configured on the data diode's send side to receive proxy messages. Refer to the Ports and Services document for specific information on ports.
MhmPort	The TCP port the Proxy connects to in order to receive MHM module messages. This value must match the configuration value of the modules.

Item	Description
	Refer to the <i>Ports and Services</i> document for specific information on ports.
Add New	Opens the Add New Entry window. New parameters are added using this window. See To add a new entry [100] .
Delete	Removes the selected parameter from the list. Note Pre-configured parameters are required parameters and cannot be deleted. You are prompted with an error message when attempting to delete required parameters. See To delete an entry [103] .
Save	Commits the current configuration selections to memory.
Exit	Closes the OMHM Configurator.

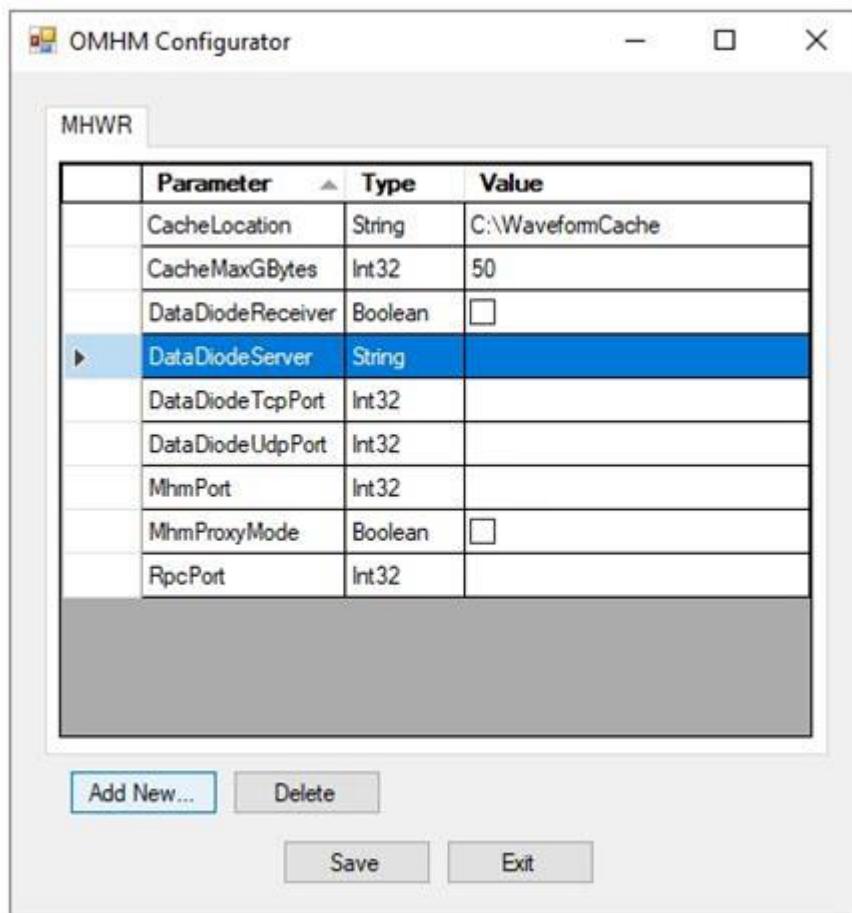
7.3.1 To add a new entry

1. Open the **OMHM Configurator** tool.

Depending on the software option you selected during the initial software installation, either the **MHWR** tab or the **MHM Proxy** tab appears. The process to add a new entry is the same for either software selection.

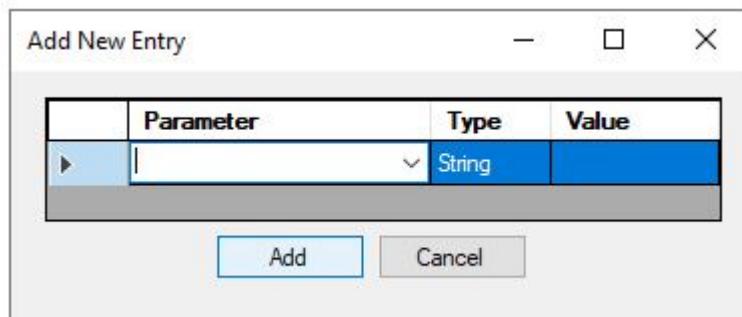
For this example, the **MHWR** tab is shown below:

Figure 66. MHWR tab



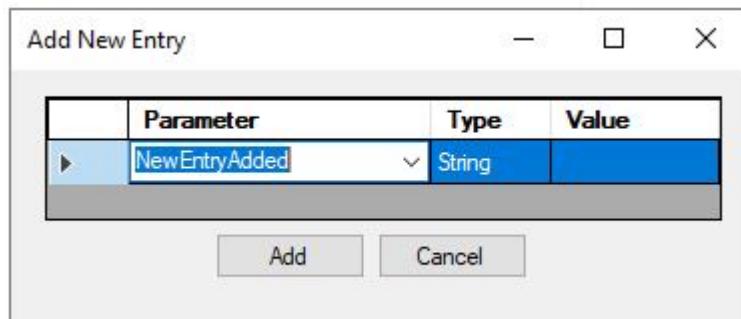
2. Click the **Add New** button located at the bottom of the window. The Add New Entry window appears.

Figure 67. Add New Entry window



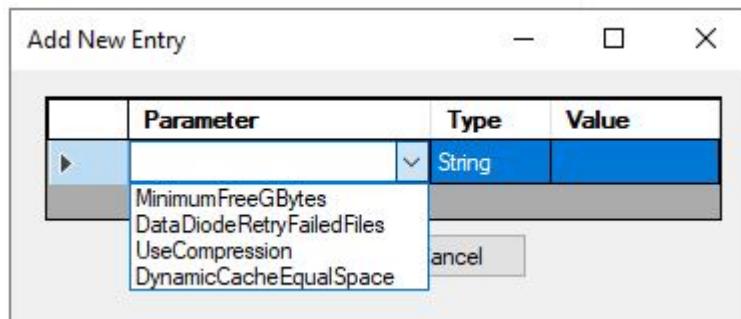
3. The Add New Entry window has two options to add entries:
Option 1 - You can enter a newly created entry in the Parameter name field.

Figure 68. Add New Entry window (option 1)



Option 2 - You can choose one of the pre-configured options from the dropdown menu in the Parameter field.

Figure 69. Add New Entry dropdown choices (option2)



Option 1 is used for this example:

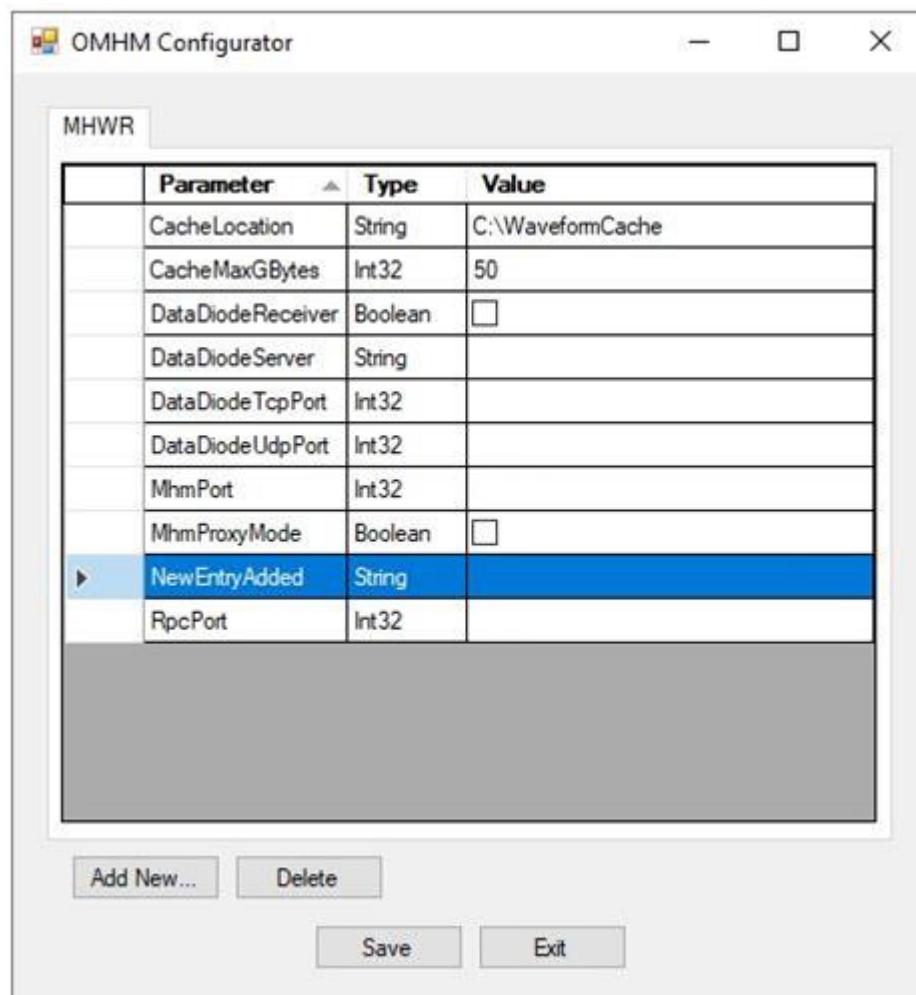
Enter the name of the new entry in the Parameter name field. In this example a new entry is created named **NewEntryAdded**. Click the **Add** button.

Option 2 - If you choose to enter one of the pre-configured parameters, the options are:

- **MinimumFreeGBytes** - The minimum amount of free space kept on waveform cache disk, even if cache is not full.
- **DataDiodeRetryFailedFiles** - In Data Diode Recorder Sender mode, retries sending waveform files if the data diode is unresponsive.
- **UseCompression** - Compresses the waveform cache files on disk. Enabling this parameter can potentially increase cache storage but at the expense of processor cycles since it takes processor cycles to perform the compression.
- **DynamicCacheEqualSpace** - Manages the waveform cache for each channel by allocating an equal amount of disk space versus number of hours.

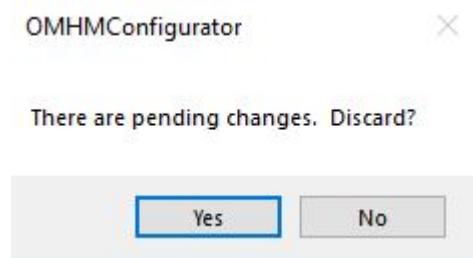
4. Once the entry is added, the new entry displays in the Parameter column. Click the **Save** button on the OMHM Configurator window to commit the changes to memory.

Figure 70. OMHM Configurator window with new entry



5. After you save the new entry, the entry appears in the list of parameters in the Parameter column as shown above.
If you add an entry and do not save the entry, you are prompted with the following message:

Figure 71. Pending changes notification window



Click **Yes** to save the changes or click **No** to discard the changes.

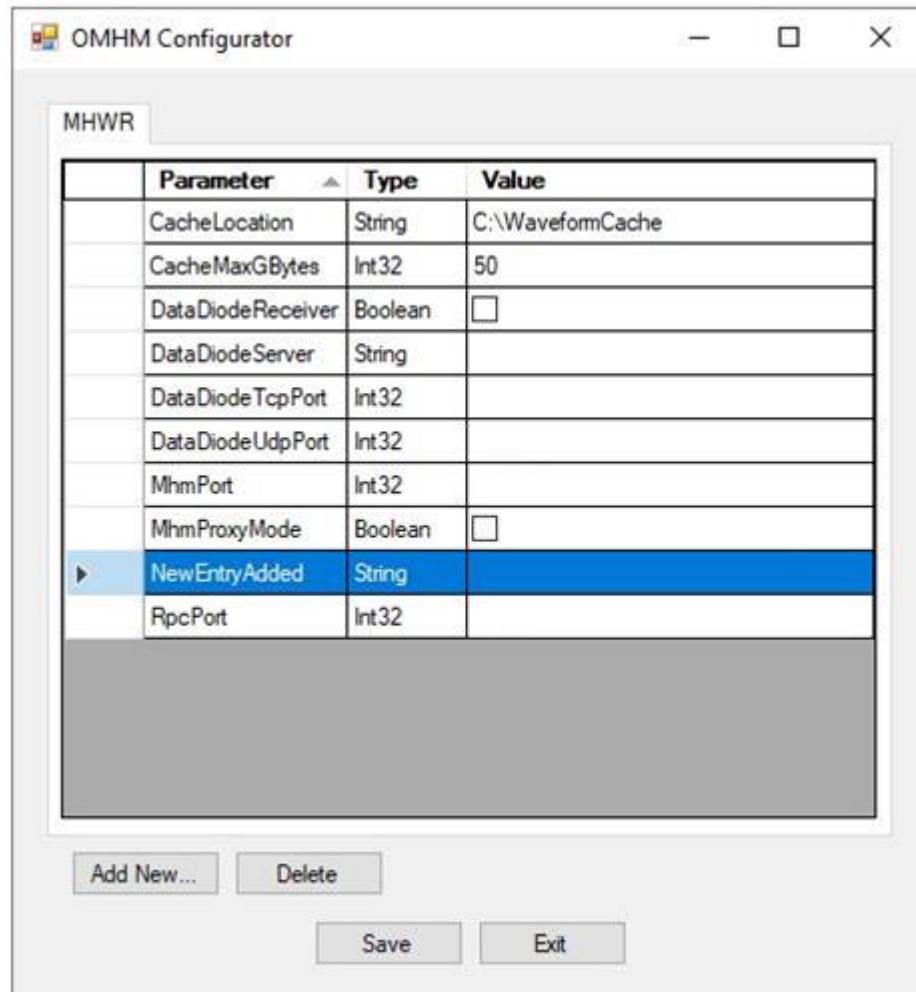
7.3.2 To delete an entry

1. Open the **OMHM Configurator** tool.

Depending on the software option you selected during the initial software installation, either the **MHWR** tab or the **MHM Proxy** tab appears. The process to delete an entry is the same for either option.

For this example, the **MHWR** tab is shown below:

Figure 72. MHWR tab



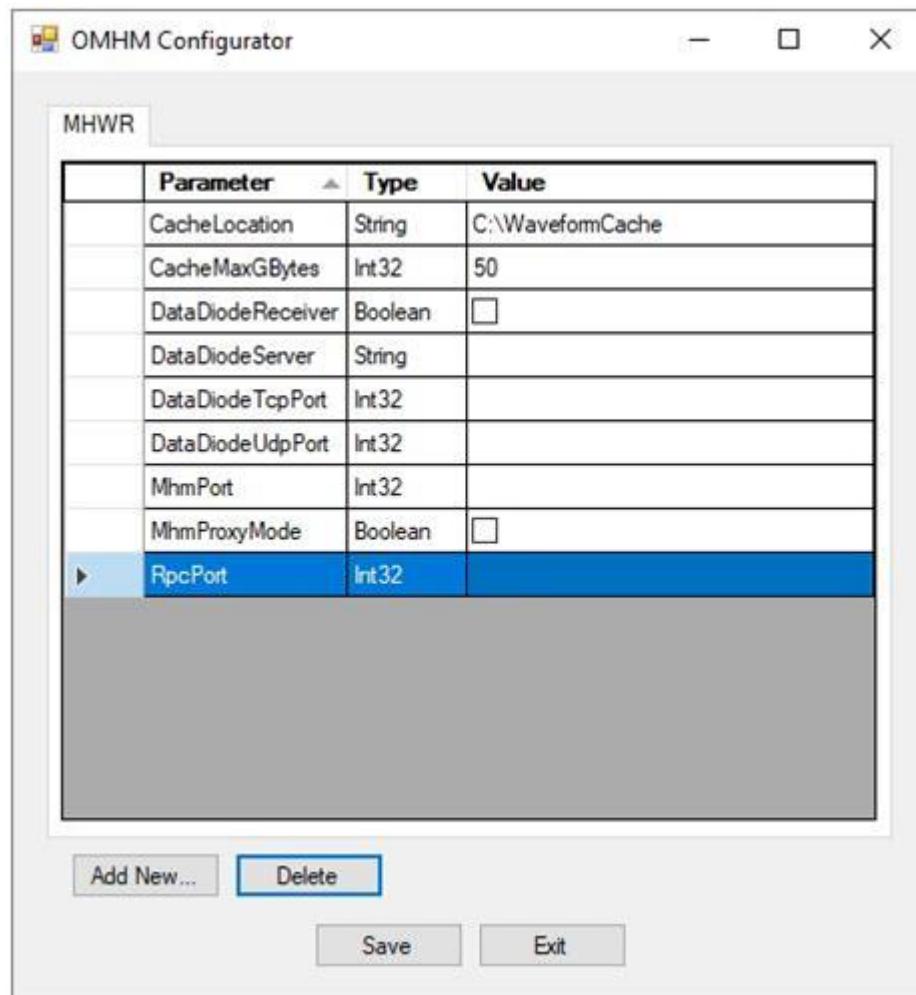
2. Select the parameter you want to delete. The **NewEntryAdded** parameter is selected in this example.

Note

Required parameters cannot be deleted. The software program only allows you to delete parameters you have added.

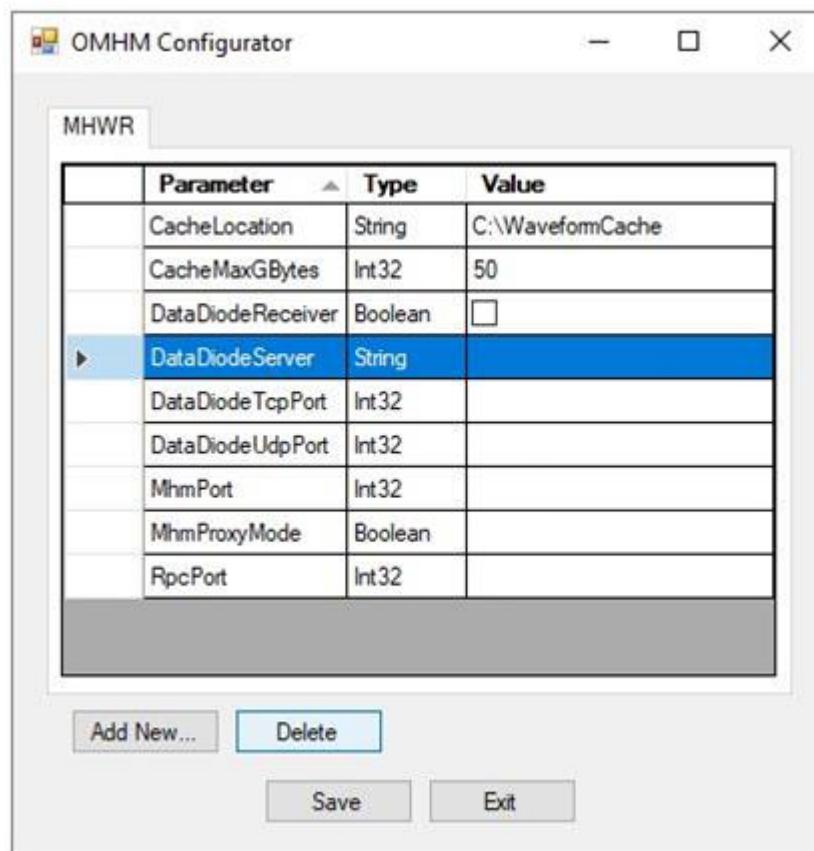
Click the **Delete** button. The parameter is removed from the list as shown in the following figure.

Figure 73. Deleted parameter removed



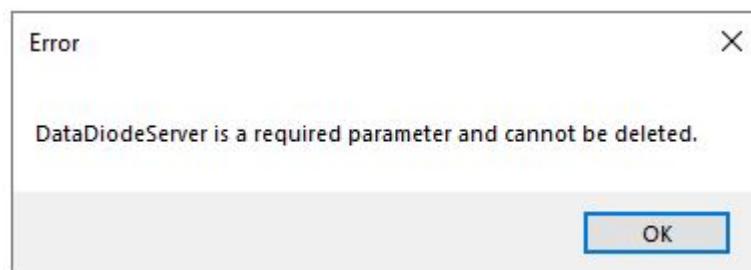
The figure below shows the **DataDiodeServer** selected. DataDiodeServer is a required parameter and cannot be deleted.

Figure 74. Required parameter selection



If you attempt to delete a required parameter an error occurs. The following figure shows an error message explaining the **DataDiodeServer** cannot be deleted.

Figure 75. Error message



3. Click the **OK** button to continue.

8 Network deployment scenarios

Topics covered in this section:

- *Purdue Enterprise Reference Architecture Model [108]*
- *System Network example [110]*
- *Network deployment configurations [110]*

8.1

Purdue Enterprise Reference Architecture Model

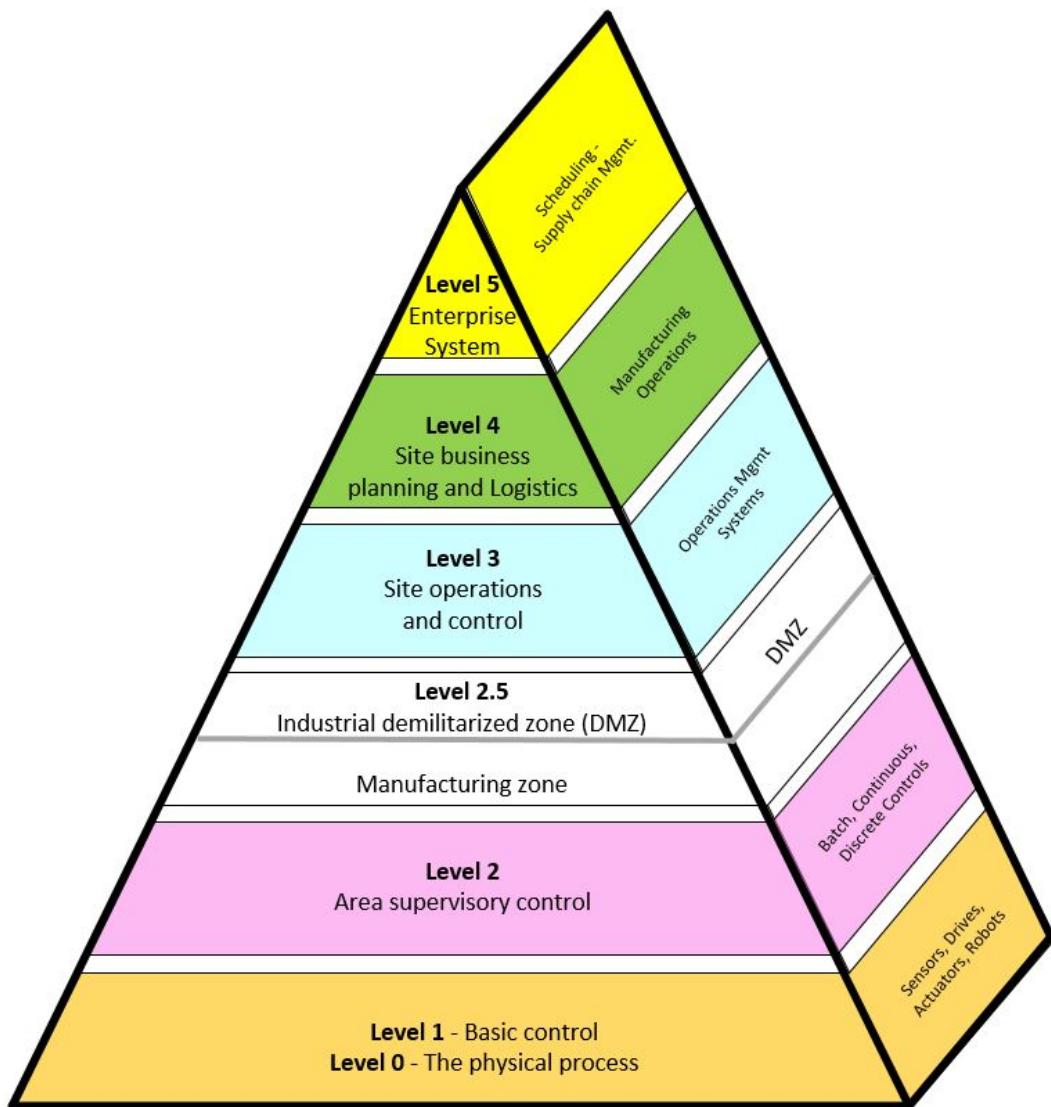
Emerson's system network architecture is based on the Purdue Enterprise Reference Architecture Model (PERA).

The Purdue Model is a widely used architectural model designed to structure Industrial control system network segmentation. The model is a good resource to begin the process of laying out your system networking architecture.

Understanding the Purdue Enterprise networking model should help you understand the networking configurations illustrated in this section.

The diagram below illustrates the Purdue Model hierarchy:

Figure 76. Purdue model example



The following list describes a high-level overview of the Purdue modeling structure:

Purdue model descriptions:

Level 0 - The Process - The physical process - Defines the actual physical processes of the plant. (For example, sensors, drives, actuators, robots).

Level 1 - Basic control equipment - Intelligent devices - Sensing and manipulating the physical processes. Process (sensors, analyzers, actuators and related instrumentation).

Level 2 - Area supervisory control - Control Systems - (Batch control - Continuous control - Discrete control) Supervising, monitoring and controlling the physical processes. Real-time controls and software; DCS, human-machine interface (HMI); supervisory and data acquisition (SCADA) software.

Level 2.5 - Industrial demilitarized zone (DMZ) and Manufacturing zone

Level 3 - Site operations and control - Manufacturing operations systems - Managing production work flow to produce the desired products. Batch management; manufacturing execution/operations management systems.

Level 4 - Site business planning and Logistics - Business logistics systems - Managing business-related activities of manufacturing.

Level 5 - Enterprise network - The enterprise zone is where business systems typically reside. Scheduling and supply chain management tasks are typically performed at this level.

Note

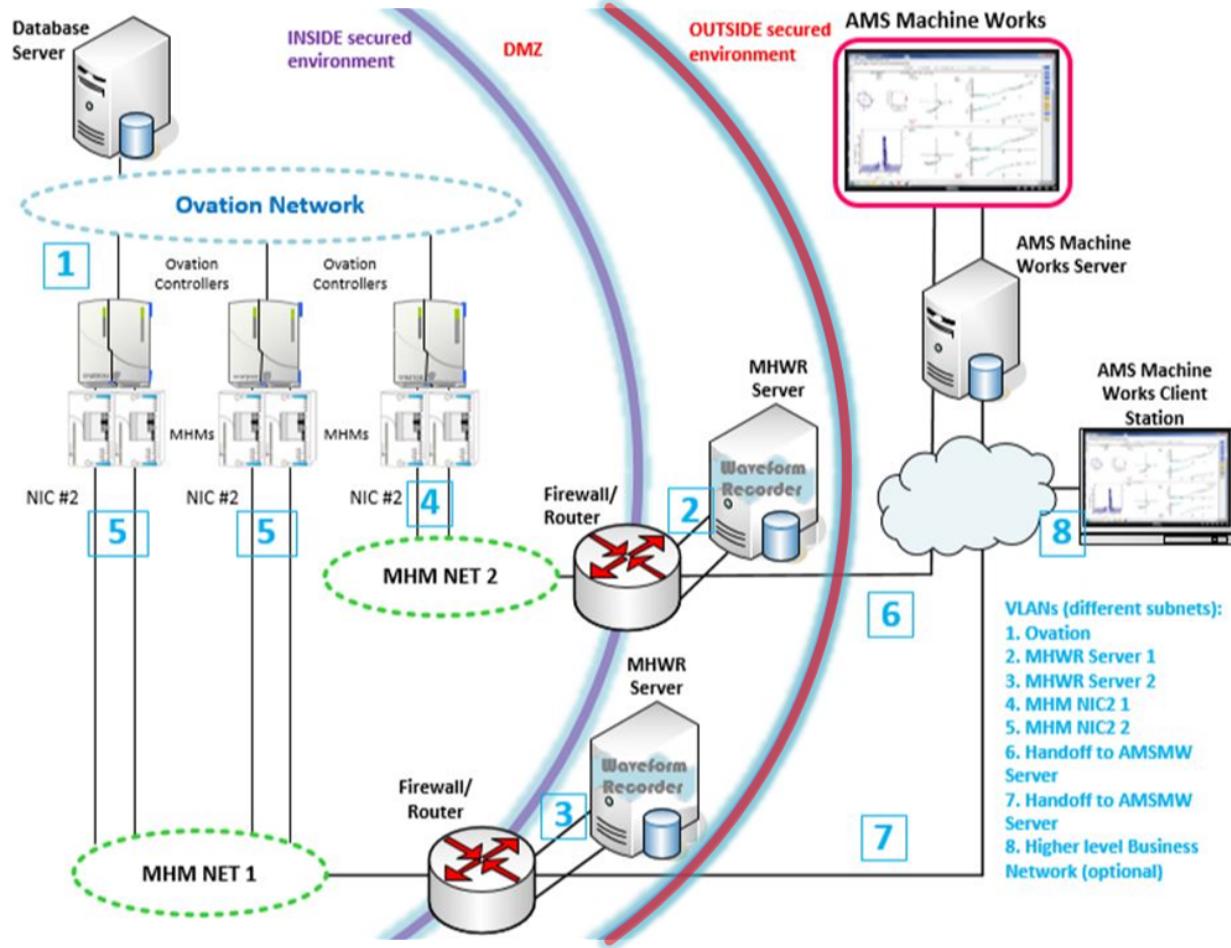
Refer to the following website for additional information:

https://en.wikipedia.org/wiki/Purdue_Enterprise_Architecture

8.2 System Network example

The following figure illustrates an example of a system network structure using the Purdue Enterprise Reference Architecture Model:

Figure 77. System network example



8.3

Network deployment configurations

Deployment configuration scenarios for the Waveform Recorder require a dedicated network of sufficient capacity between the OMHM modules and the Waveform Recorder.

A Firewall/Router or a Data Diode must be in place for deployments where OMHM modules from more than one Ovation system connects using the same Waveform Recorder located **outside** the secure Ovation DCS environment.

A Firewall/Router or a Data Diode must be in place for deployments where AMS Machine Works data is to be accessible above Level 2 of the [Purdue model \[108\]](#).

Networking design plays a key role in achieving secure data transfer results. Emerson recommends contacting your Emerson representative for advice and guidance on the most effective and efficient networking setup for your system requirements.

The following table lists a few examples of possible network deployment configurations:

Table 13. Network deployment configuration examples

Networking Configuration Scenario	MHM network	Waveform Recorder quantity	AMS Machine Works Deployment	Router or Data Diode requirement
Single Ovation network [116] . Waveform Recorder and AMS Machine Works deployment within the DCS environment.	Single	Single	Inside	No
Single Ovation network [117] . Waveform Recorder and AMS Machine Works deployment within the DCS environment.	Multiple	Multiple	Inside	No
Multiple Ovation networks [118] . Waveform Recorder and AMS Machine Works deployment inside the DCS environment.	Single	Single	Inside	No
Multiple Ovation networks [119] . Waveform Recorder and AMS Machine Works deployment inside the DCS environment.	Multiple	Single	Inside	No
Single Ovation network [122] . Waveform Recorder accessed through a firewall/router. MHWR and AMS Machine Works deployment outside the DCS environment.	Single	Single	Outside	Router required
Single Ovation network [123] . Waveform Recorder accessed through a firewall/router. MHWR and AMS Machine Works deployment outside the DCS environment.	Multiple	Multiple	Outside	Router required
Multiple Ovation networks [124] . Waveform Recorder accessed through a firewall/router. MHWR and AMS Machine Works deployment outside the DCS environment.	Single	Single	Outside	Router required

Networking Configuration Scenario	MHM network	Waveform Recorder quantity	AMS Machine Works Deployment	Router or Data Diode requirement
Multiple Ovation networks [125]. Waveform Recorder accessed through a firewall/router. MHWR and AMS Machine Works deployment outside the DCS environment.	Multiple	Single	Outside	Router required
Multiple Ovation Networks [125]. Waveform Recorder accessed through a firewall/router. MHWR and AMS Machine Works deployment outside the DCS environment.	Multiple	Multiple	Outside	Router required
Single Ovation network [128]. Waveform Recorder data replication through a Data Diode. The replicated MHWR and AMS Machine Works deployment are outside the DCS environment.	Single	Single	Outside	Data Diode required
Single Ovation network [130]. Waveform Recorder data replication through a Data Diode. The replicated MHWR and AMS Machine Works deployment are outside the DCS environment.	Multiple	Multiple	Outside	Data Diode required
Multiple Ovation networks [131]. Waveform Recorder data replication through a Data Diode. The replicated MHWR and AMS Machine Works deployment are outside the DCS environment.	Single	Single	Outside	Data Diode required

Networking Configuration Scenario	MHM network	Waveform Recorder quantity	AMS Machine Works Deployment	Router or Data Diode requirement
<p>Multiple Ovation networks [132].</p> <p>Waveform Recorder data replication through a Data Diode.</p> <p>The replicated MHWR and AMS Machine Works deployment are outside the DCS environment.</p>	Multiple	Single	Outside	Data Diode required
<p>Single Ovation network [129].</p> <p>Waveform Recorder data replication through a Data Diode.</p> <p>The replicated MHWR and AMS Machine Works deployment are outside the DCS environment.</p>	Single	Single	Outside	Data Diode required using a Proxy
<p>Multiple Ovation networks [133].</p> <p>Waveform Recorder data replication through a Data Diode.</p> <p>The replicated MHWR and AMS Machine Works deployment are outside the DCS environment.</p>	Multiple	Multiple	Outside	Data Diode(s) required

9 Network deployment configurations inside the secure Ovation DCS

Topics covered in this section:

- *Network configurations inside the secure DCS environment [115]*

9.1 Network configurations inside the secure DCS environment

For waveform analysis client applications residing within the secure Ovation DCS environment, the OMHM interface supports local client applications located within the secure Ovation DCS.

Refer to the illustrations in this section show various networking configurations where MHWR and AMS Machine Works deployment is inside the secure Ovation DCS.

- Single Ovation network - Single MHM network - Single MHWR [116]
- Single Ovation network - Multiple MHM networks Multiple MHWRs [117]
- Multiple Ovation networks - Single MHM network Single MHWR [118]
- Multiple Ovation networks - Multiple MHM networks Single MHWR [119]

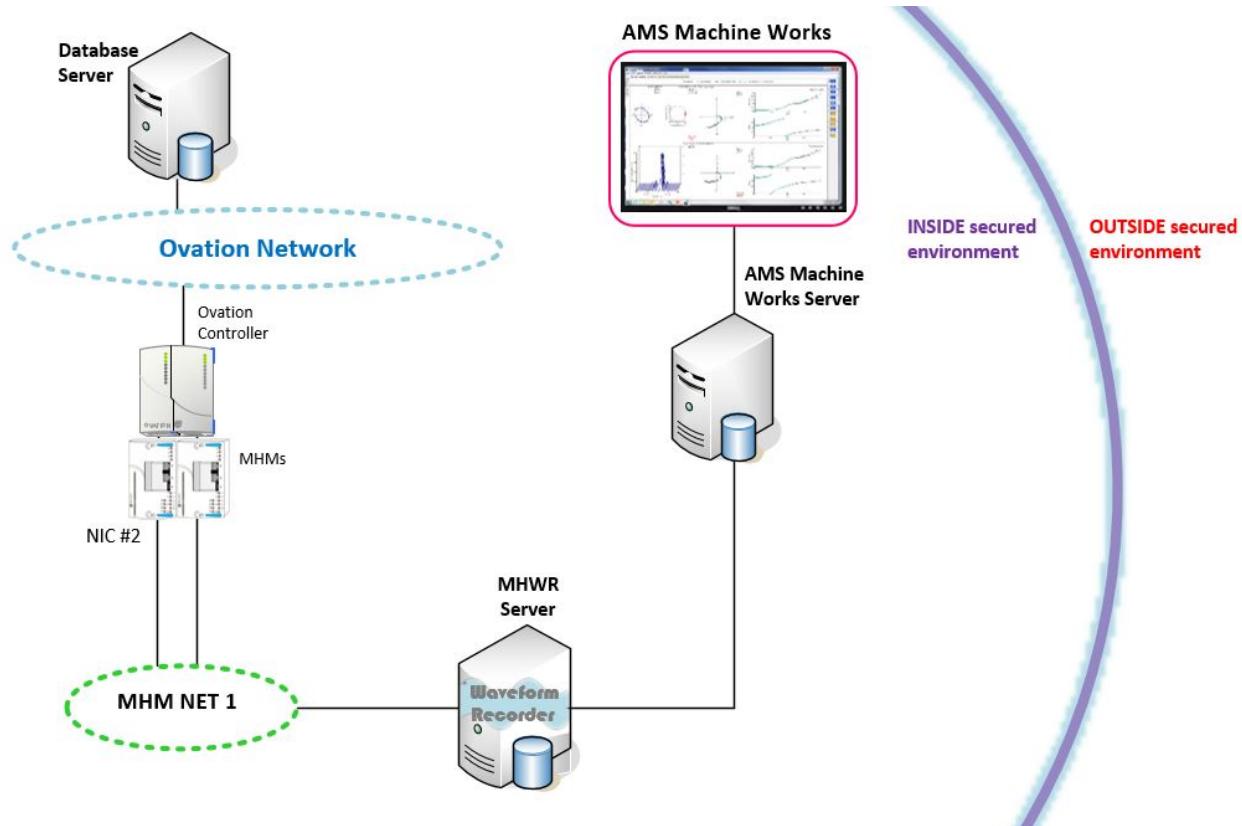
9.1.1 Single Ovation network - Single MHM network - Single MHWR

The following illustration shows a **Single** Ovation network with a **Single** MHM network and a **Single** MHWR.

Note

MHWR and AMS Machine Works deployment is **inside** the secure DCS environment.

Figure 78. Single Ovation network - Single MHM network - Single MHWR



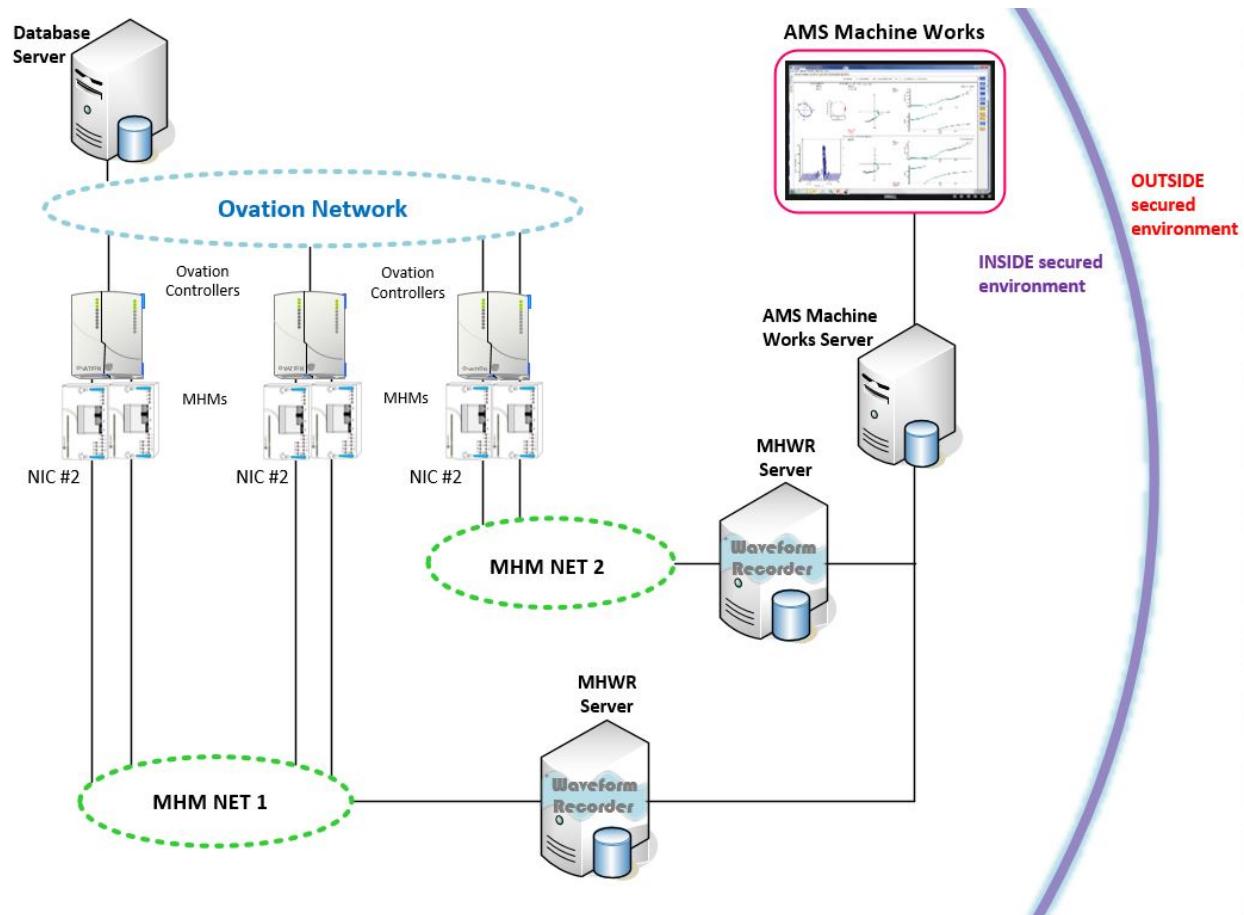
9.1.2 Single Ovation network - Multiple MHM networks - Multiple MHWRs

The following illustration shows a **Single Ovation network** with **Multiple MHM networks** and **Multiple MHWRs**.

Note

MHWR and AMS Machine Works deployment is **inside** the secure DCS environment.

Figure 79. Single Ovation network - Multiple MHM networks - Multiple MHWRs



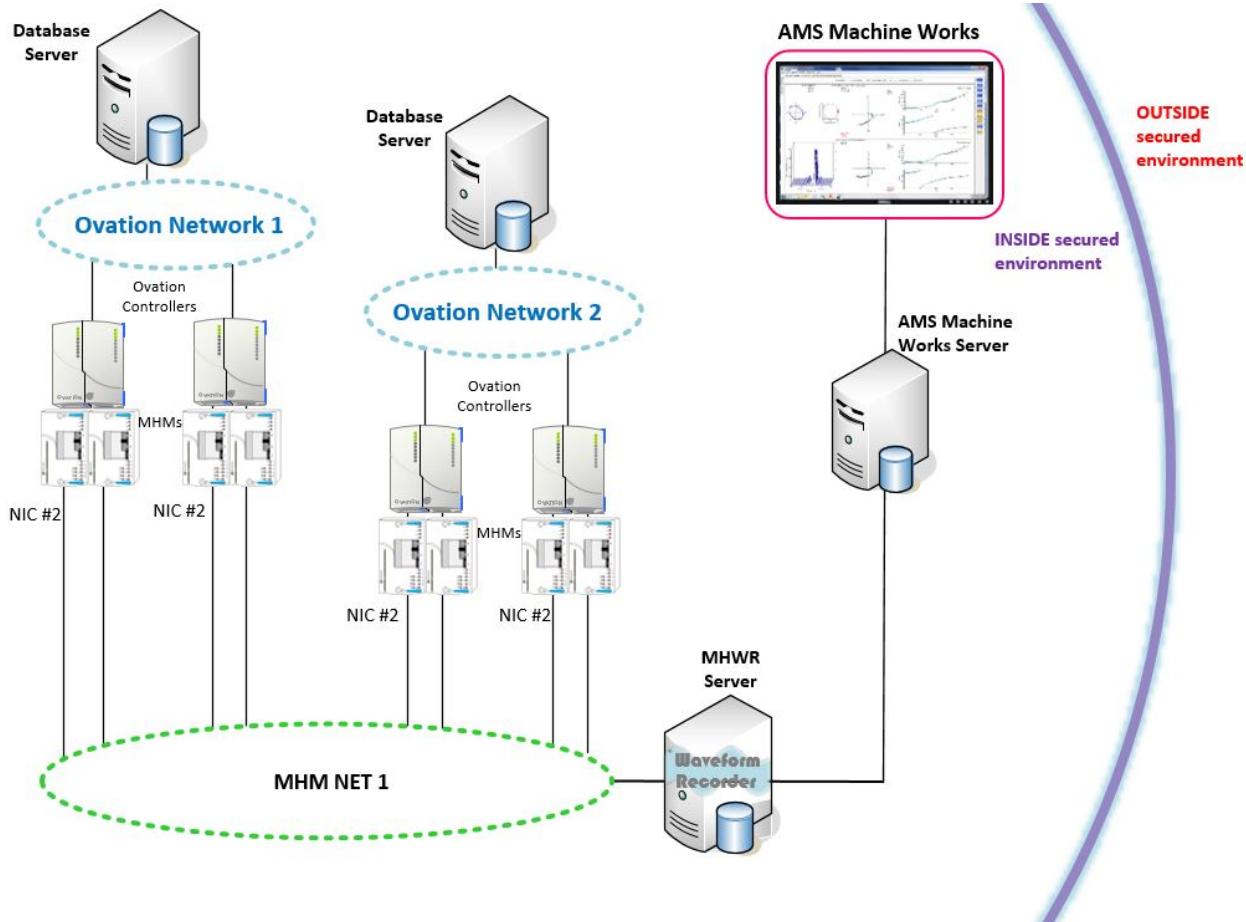
9.1.3 Multiple Ovation networks - Single MHM network - Single MHWR

The following illustration shows **Multiple Ovation networks** with a **Single MHM network** and a **Single MHWR**.

Note

MHWR and AMS Machine Works deployment is **inside** the secure DCS environment.

Figure 80. Multiple Ovation networks - Single MHM network - Single MHWR



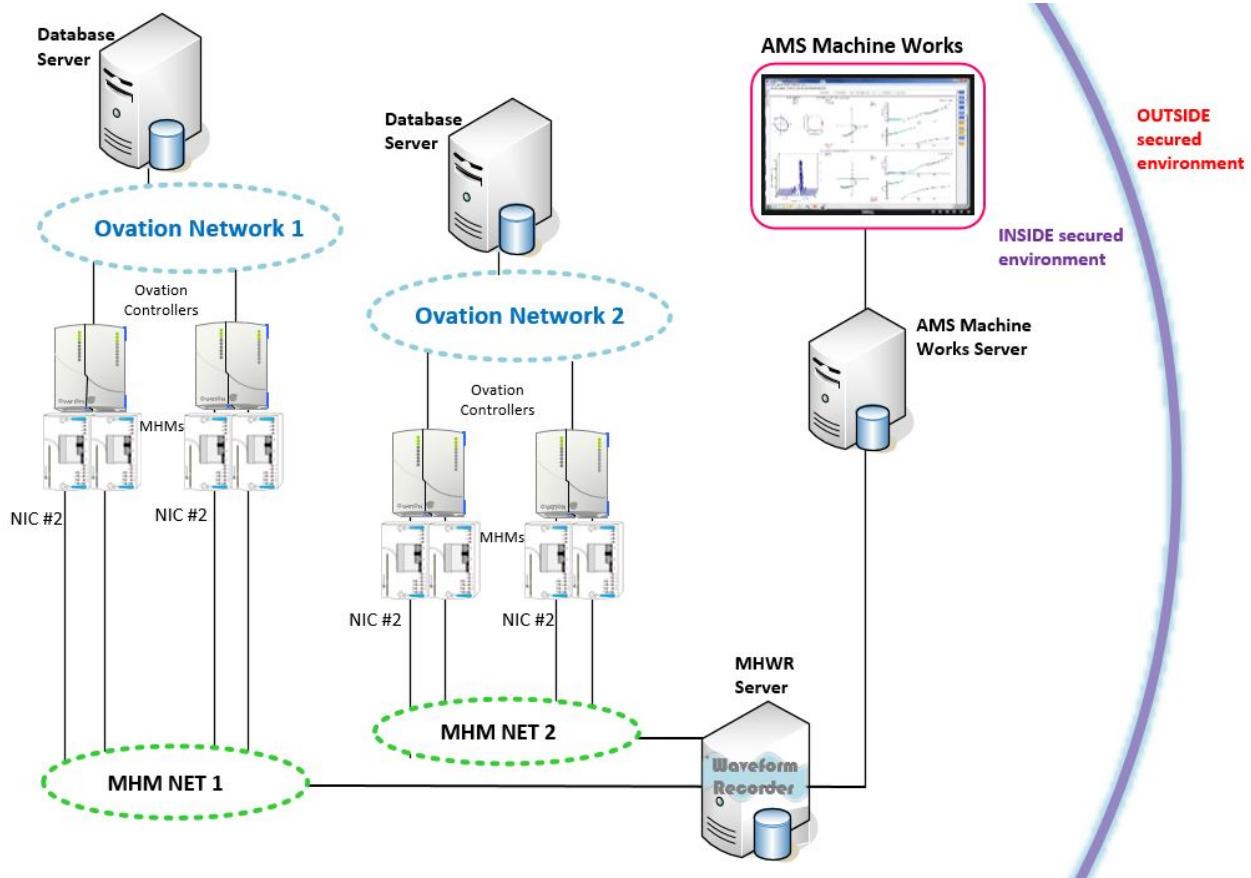
9.1.4 Multiple Ovation networks - Multiple MHM networks - Single MHWR

The following illustration shows **Multiple Ovation networks** with **Multiple MHM networks** and a **Single MHWR**.

Note

MHWR and AMS Machine Works deployment is **inside** the secure DCS environment.

Figure 81. Multiple Ovation networks - Multiple MHM networks - Single MHWR



10 Network deployment using a Firewall/Router

Topics covered in this section:

- *Network configurations using a Firewall/Router [121]*

10.1 Network configurations using a Firewall/Router

Client applications can be located within your enterprise network while providing communication through a firewall/router to protect against cyber threats to the Ovation DCS.

Refer to the Illustrations in this section to show networking configuration examples where MHWR and AMS Machine Works deployment is OUTSIDE the secure Ovation DCS environment and communication is through a Firewall/Router.

[Single Ovation network - Single MHM network - with Single MHWR \[122\]](#)

[Single Ovation network - Multiple MHM networks - with Multiple MHWRs \[123\]](#)

[Multiple Ovation networks - Single MHM network - with Single MHWR \[124\]](#)

[Multiple Ovation networks - Multiple MHM network - with Single MHWRs \[125\]](#)

[Multiple Ovation networks - Multiple MHM network - with Multiple MHWRs \[125\]](#)

10.1.1 Single Ovation network - Single MHM network - Single MHWR using a Firewall/Router

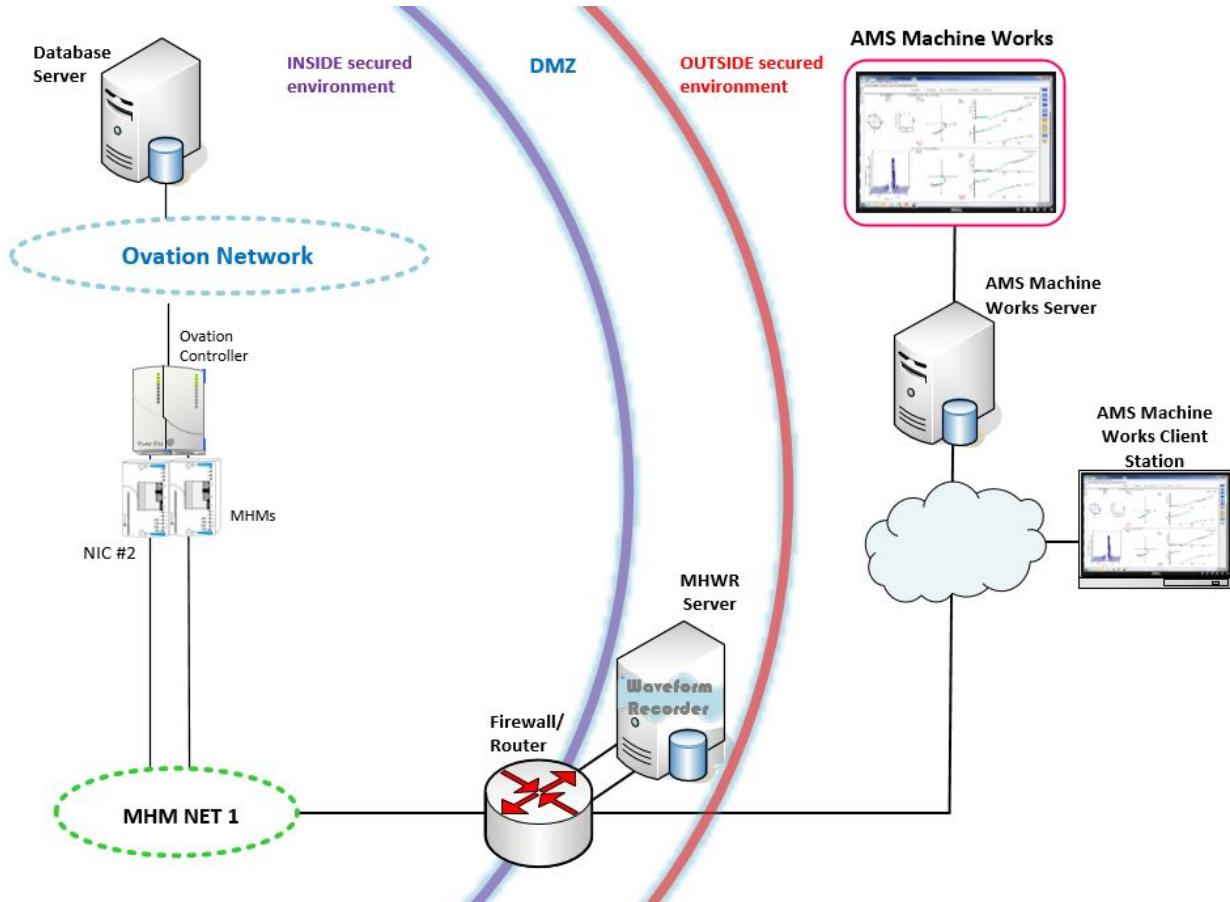
The following illustration shows a **Single** Ovation network with a **Single** MHM network and a **Single** MHWR communicating with AMS Machine Works through a Firewall/Router.

Note

Depending on your system requirements, the MHWR can reside either inside or outside the secure DCS environment when using a firewall/router.

The illustration below shows the MHWR and AMS Machine Works deployment **outside** the secure DCS environment.

Figure 82. Single Ovation network - Single MHM network - Single MHWR using a Firewall/Router



10.1.2 Single Ovation network - Multiple MHM networks - Multiple MHWRs using a Firewall/Router

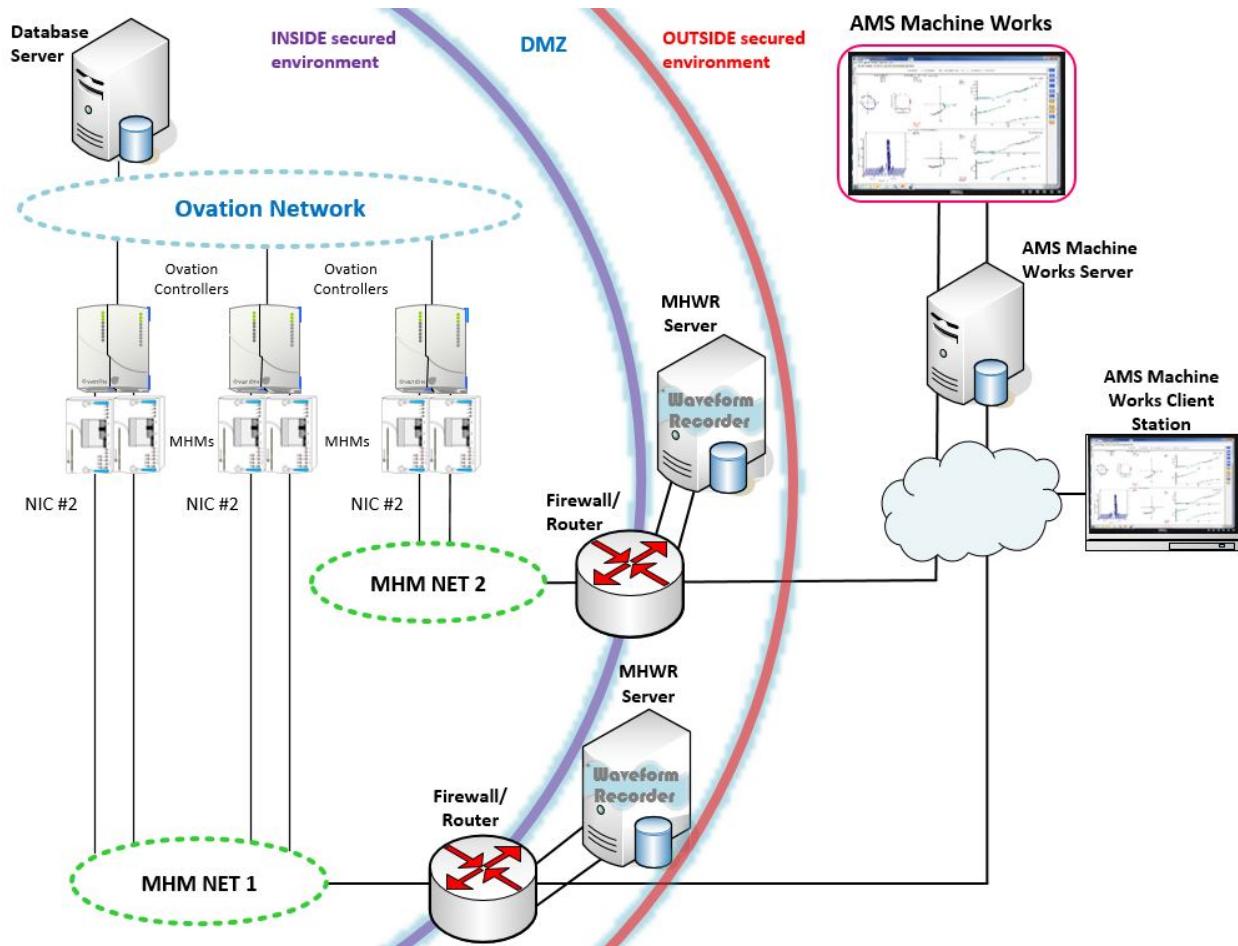
The following illustration shows a **Single** Ovation network with **Multiple** MHM networks and **Multiple** MHWRs communicating with AMS Machine Works through a Firewall/Router.

Note

Depending on your system requirements, the MHWR can reside either inside or outside the secure DCS environment when using a firewall/router.

The illustration below shows the MHWR and AMS Machine Works deployment **outside** the secure DCS environment.

Figure 83. Single Ovation network - Multiple MHM networks - Multiple MHWRs using a Firewall/Router



10.1.3 Multiple Ovation networks - Single MHM network - Single MHWR using a Firewall/Router

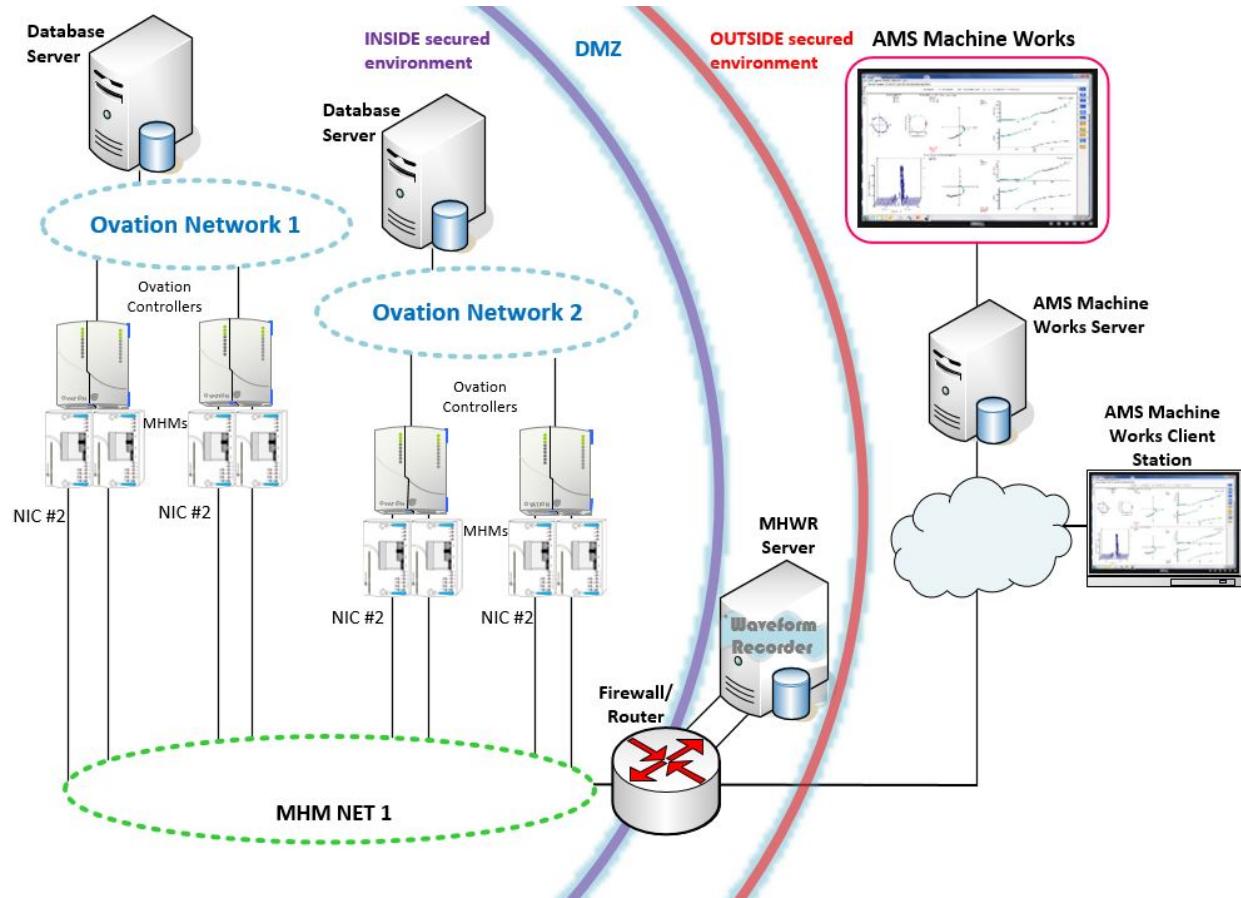
The following illustration shows **Multiple Ovation networks** with a **Single MHM network** and a **Single MHWR** communicating with AMS Machine Works through a Firewall/Router.

Note

Depending on your system requirements, the MHWR can reside either inside or outside the secure DCS environment when using a firewall/router.

The illustration below shows the MHWR and AMS Machine Works deployment **outside** the secure DCS environment.

Figure 84. Multiple Ovation networks - Single MHM network - Single MHWR using a Firewall/Router



10.1.4 Multiple Ovation networks - Multiple MHM networks - Single MHWR using a Firewall/Router

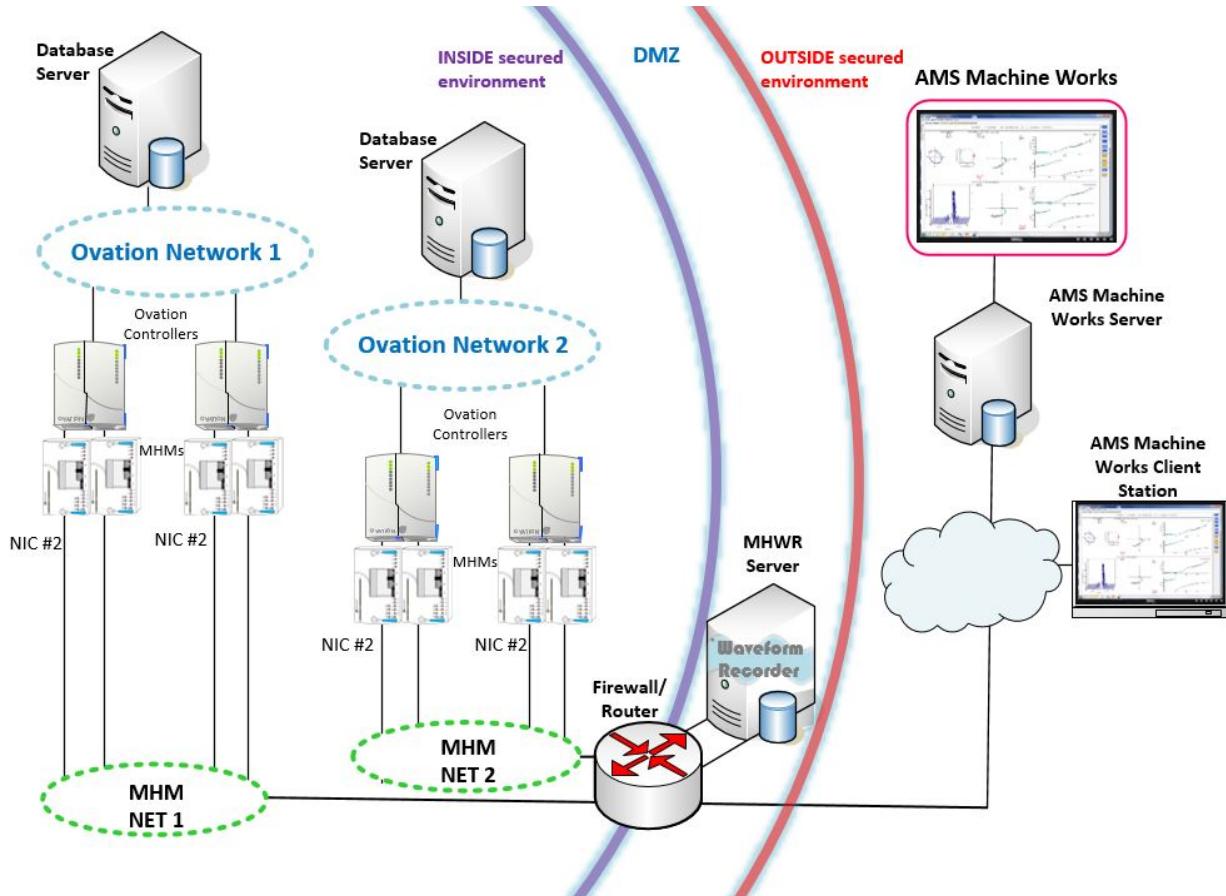
The following illustration shows **Multiple** Ovation networks with **Multiple** MHM networks and a **Single** MHWR communicating with AMS Machine Works through a Firewall/Router.

Note

Depending on your system requirements, the MHWR can reside either inside or outside the secure DCS environment when using a firewall/router.

The illustration below shows the MHWR and AMS Machine Works deployment **outside** the secure DCS environment.

Figure 85. Multiple Ovation networks - Multiple MHM networks - Single MHWR using a Firewall/Router



10.1.5 Multiple Ovation networks - Multiple MHM networks - Multiple MHWRs using a Firewall/Router

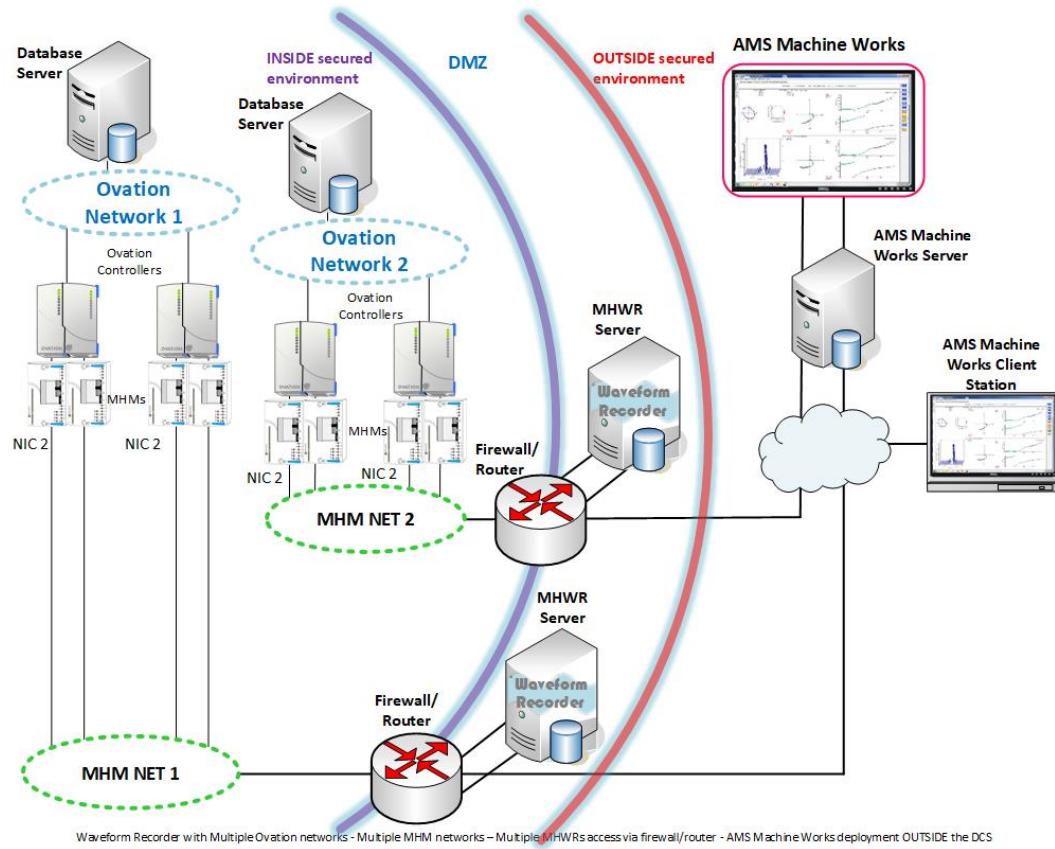
The following illustration shows **Multiple** Ovation networks with **Multiple** MHM networks and **Multiple** MHWRs communicating with AMS Machine Works through a Firewall/Router.

Note

Depending on your system requirements, the MHWRs can reside either inside or outside the secure DCS environment when using a firewall/router.

The illustration below shows the MHWRs and AMS Machine Works deployment **outside** the secure DCS environment.

Figure 86. Multiple Ovation networks - Multiple MHM networks - Multiple MHWRs using a Firewall/Router



11 Network deployment configurations using Data Diodes

Topics covered in this section:

- *Network configurations using a Data Diode [127]*

11.1 Network configurations using a Data Diode

For Client applications located within your enterprise network but where the use of a firewall/router may not provide the level of security protection desired, data diodes can be an alternative to protect from potential cyber threats.

The Ovation DCS can be secured against cyber threats by utilizing unidirectional data communications outside of the DCS environment in data diode deployment configurations. Commercially available data diode products are used to provide unidirectional data flow.

Refer to the illustrations in this section to show network configuration examples using data diodes.

[Single Ovation network - Single MHM network - with Single MHWR \[128\]](#)

[Single Ovation network - Single MHM network - with Single MHWR using a Proxy \[129\]](#)

[Single Ovation network - Multiple MHM networks - with Multiple MHWRs \[130\]](#)

[Multiple Ovation networks - Single MHM network - with Single MHWR \[131\]](#)

[Multiple Ovation networks - Multiple MHM networks - with Single MHWR \[132\]](#)

[Multiple Ovation networks - Multiple MHM networks - with Multiple MHWRs \[133\]](#)

11.1.1 Single Ovation network - Single MHM network - Single MHWR using a Data Diode

The following illustration shows a **Single** Ovation network with a **Single** MHM network and a **Single** MHWR communicating with AMS Machine Works through a Data Diode.

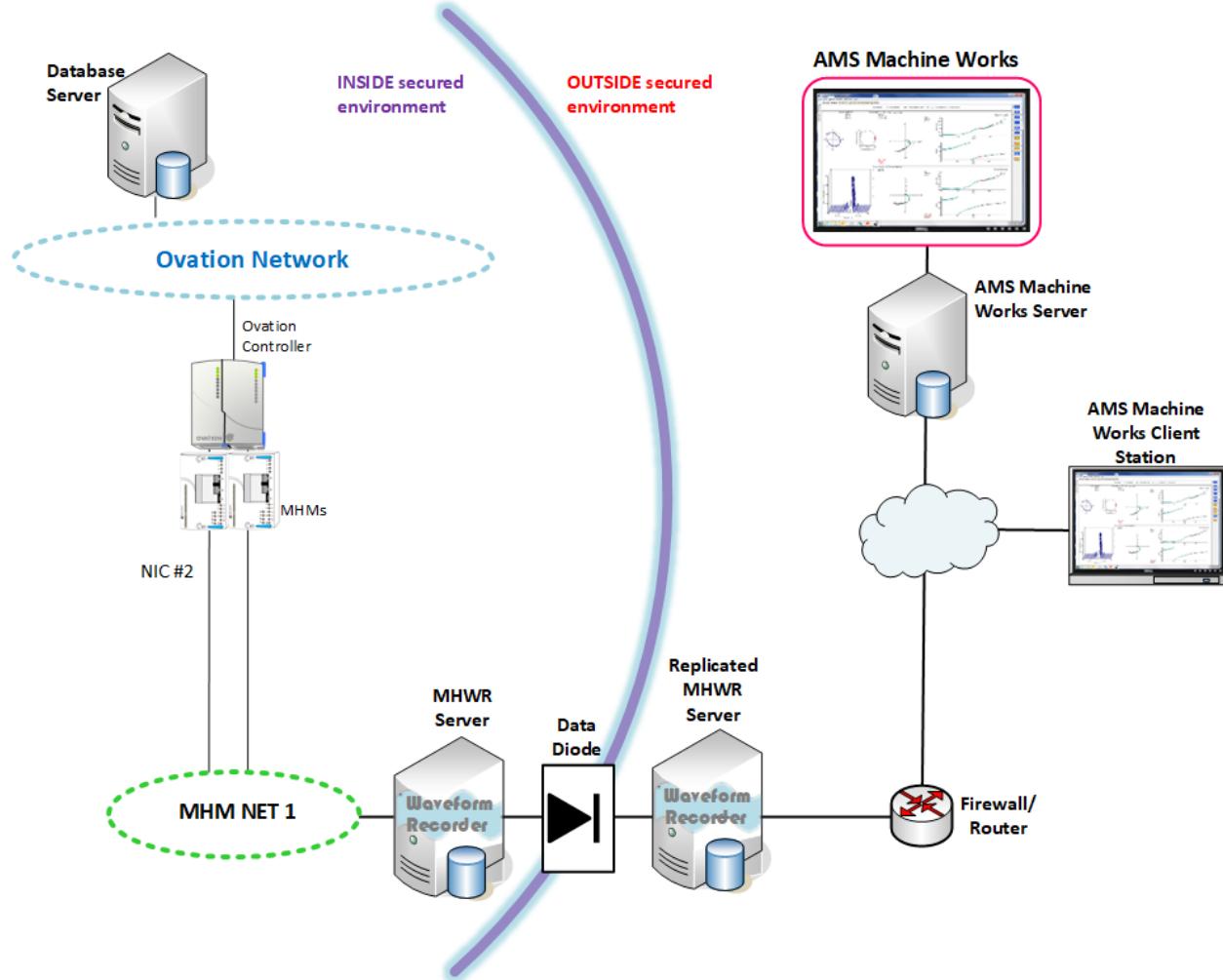
Note

The replicated MHWR and AMS Machine Works deployment is **outside** the secure DCS environment.

Similarly, the MHM Proxy is another data transfer deployment method using data diodes. Refer to the illustration for [data diodes using the MHM Proxy \[129\]](#).

Emerson recommends installing a firewall/router between the MHWR and AMS Machine Works for additional protection.

Figure 87. Single Ovation network - Single MHM network - Single MHWR - using a Data Diode



11.1.2 Single Ovation network - Single MHM network - Single MHWR using a Data Diode with MHM Proxy

The following illustration shows a **Single** Ovation network with a **Single** MHM network and a **Single** Data Diode communicating with AMS Machine Works through a Data Diode Proxy.

Note

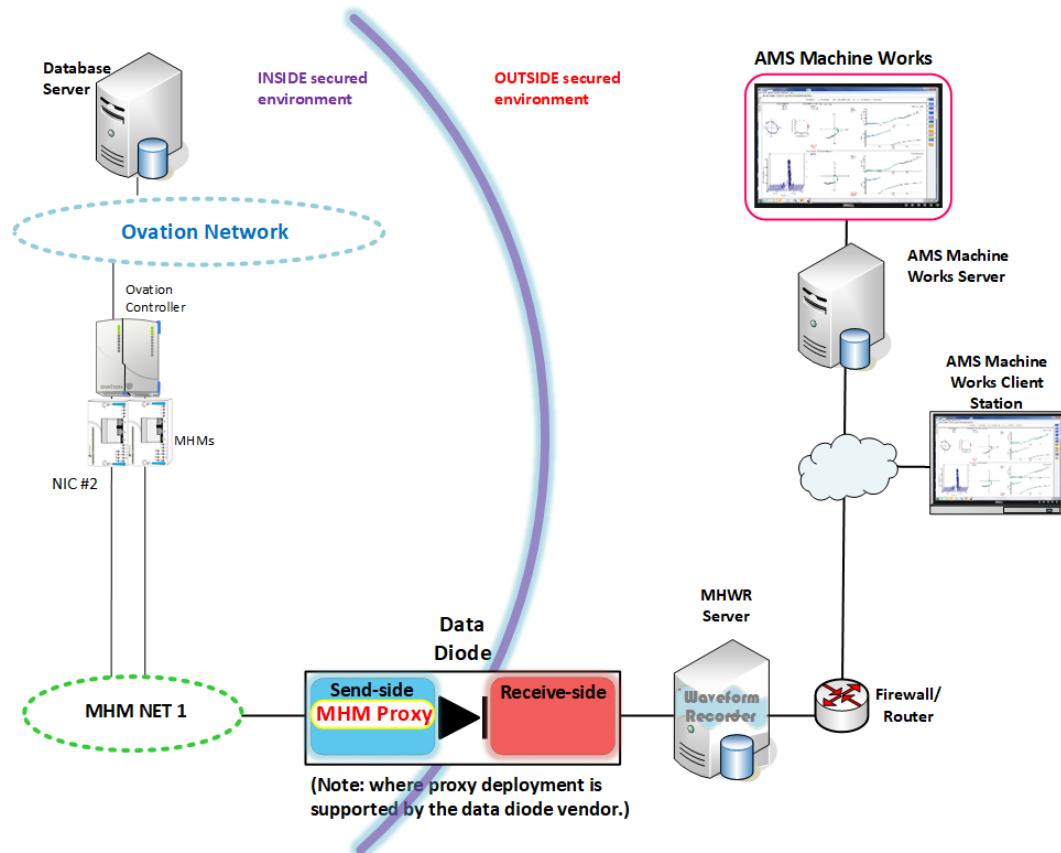
The replicated MHWR and AMS Machine Works deployment is **outside** the secure DCS environment.

Similarly, the MHWR Replication is another data transfer deployment method using data diodes. Refer to the illustration for [data diode setup using MHWR Replication \[128\]](#).

The MHM Proxy can be used where proxy deployment is supported by the data diode vendor.

Emerson recommends installing a firewall/router between the MHWR and AMS Machine Works for additional protection.

Figure 88. Single Ovation network - Single MHM network - Single MHWR using a data diode with Proxy capabilities



11.1.3 Single Ovation network - Multiple MHM networks - Multiple MHWRs using Data Diodes

The following illustration shows a **Single** Ovation network with **Multiple** MHM networks and **Multiple** MHWRs communicating with AMS Machine Works through Data Diodes.

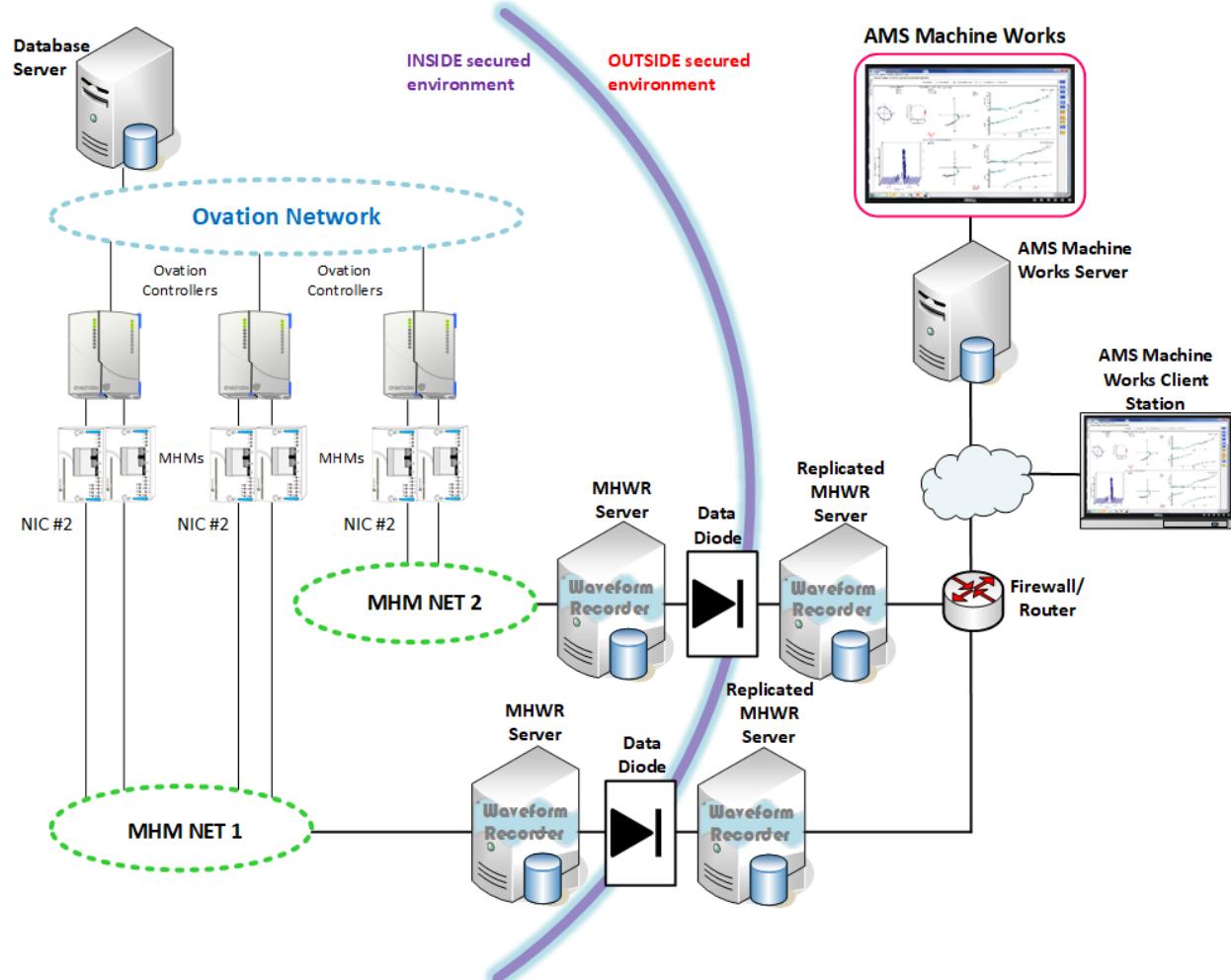
Note

The replicated MHWRs and AMS Machine Works deployment are **outside** the secure DCS environment.

Similarly, the MHM Proxy is another data transfer deployment method using data diodes. Refer to the illustration for [MHM Proxy data diode setup \[133\]](#).

Emerson recommends installing a firewall/router between the MHWR and AMS Machine Works for additional protection.

Figure 89. Single Ovation network - Multiple MHM networks - Multiple MHWRs using Data Diodes



11.1.4 Multiple Ovation networks - Single MHM network - Single MHWR using a Data Diode

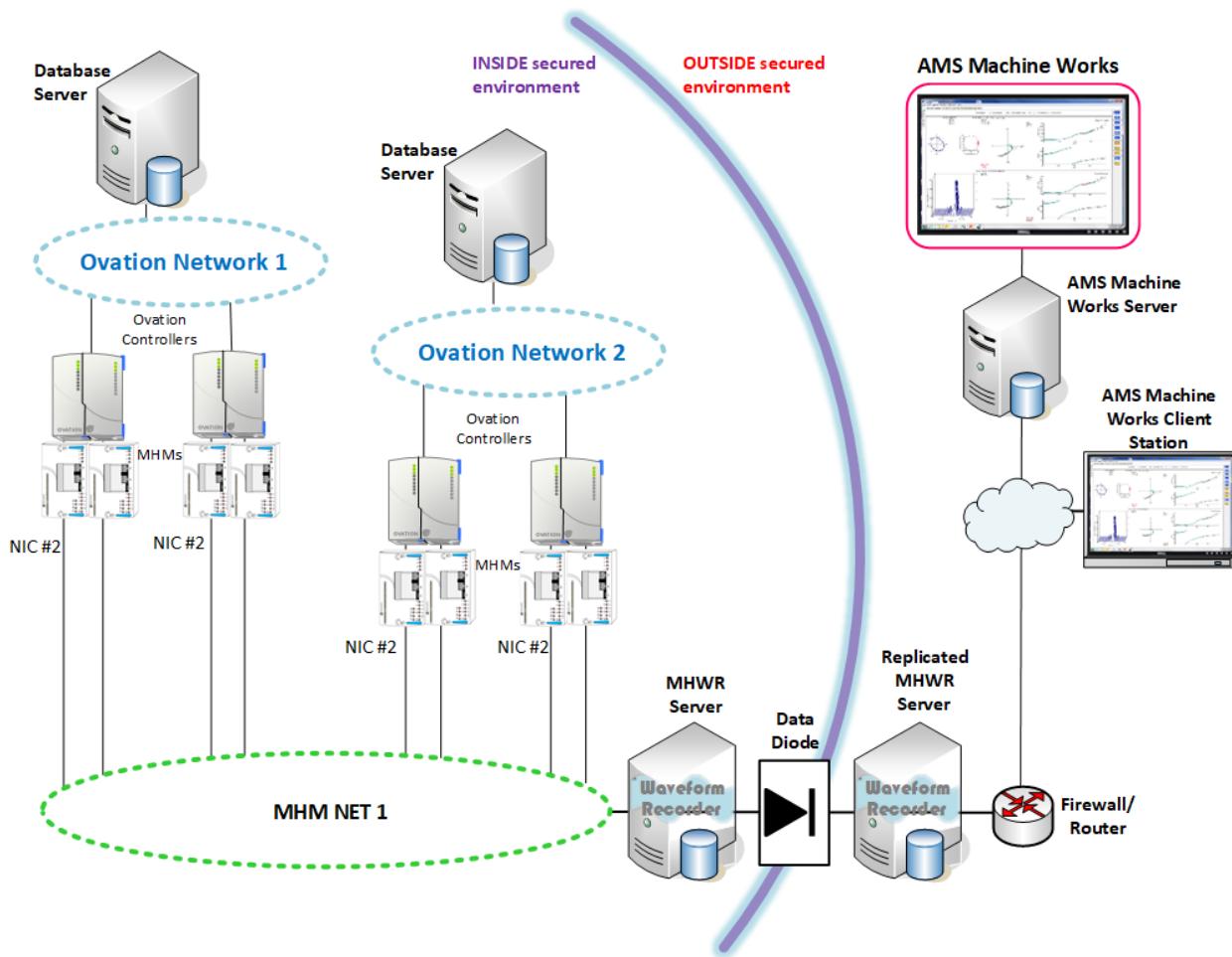
The following illustration shows **Multiple** Ovation networks with a **Single** MHM network and a **Single** MHWR communicating with AMS Machine Works through a Data Diode.

Note

The replicated MHWR and AMS Machine Works deployment is **outside** the secure DCS environment.

Emerson recommends installing a firewall/router between the MHWR and AMS Machine Works for additional protection.

Figure 90. Multiple Ovation networks - Single MHM network - Single MHWR using a Data Diode



11.1.5 Multiple Ovation networks - Multiple MHM networks - Single MHWR using a Data Diode

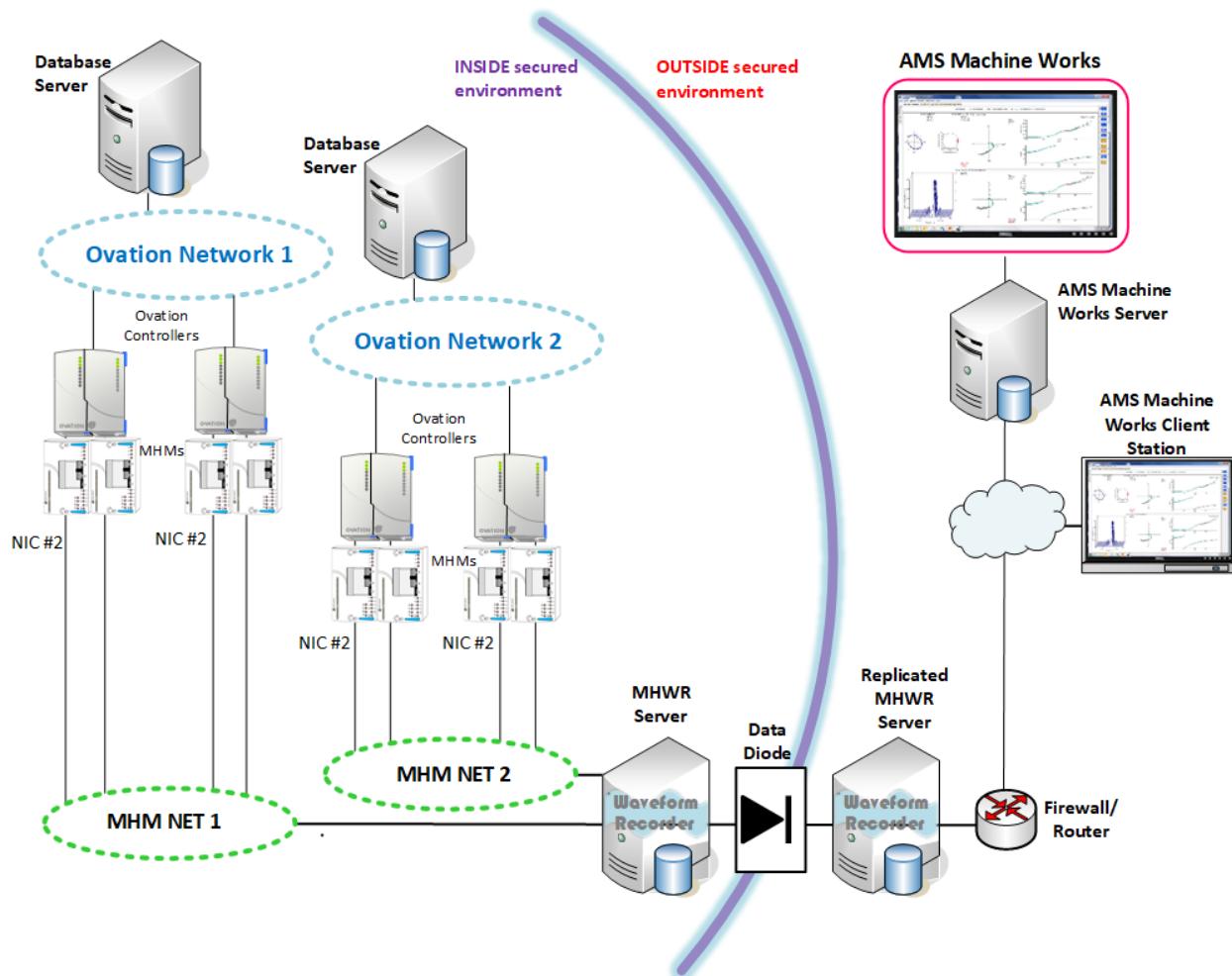
The following illustration shows **Multiple** Ovation networks with **Multiple** MHM networks and a **Single** MHWR communicating with AMS Machine Works through a Data Diode.

Note

The replicated MHWR and AMS Machine Works deployment is **outside** the secure DCS environment.

Emerson recommends installing a firewall/router between the MHWR and AMS Machine Works for additional protection.

Figure 91. Multiple Ovation networks - Multiple MHM networks - Single MHWR using a Data Diode



11.1.6 Multiple Ovation networks - Multiple MHM networks - Multiple MHWRs using Data Diodes

The following illustration shows **Multiple** Ovation networks with **Multiple** MHM networks and **Multiple** MHWRs communicating with AMS Machine Works through Data Diodes.

The illustration below shows two MHM Networks using data diode's with the MHM Proxy. Data is sent directly from the MHM Network through a data diode Proxy.

Note

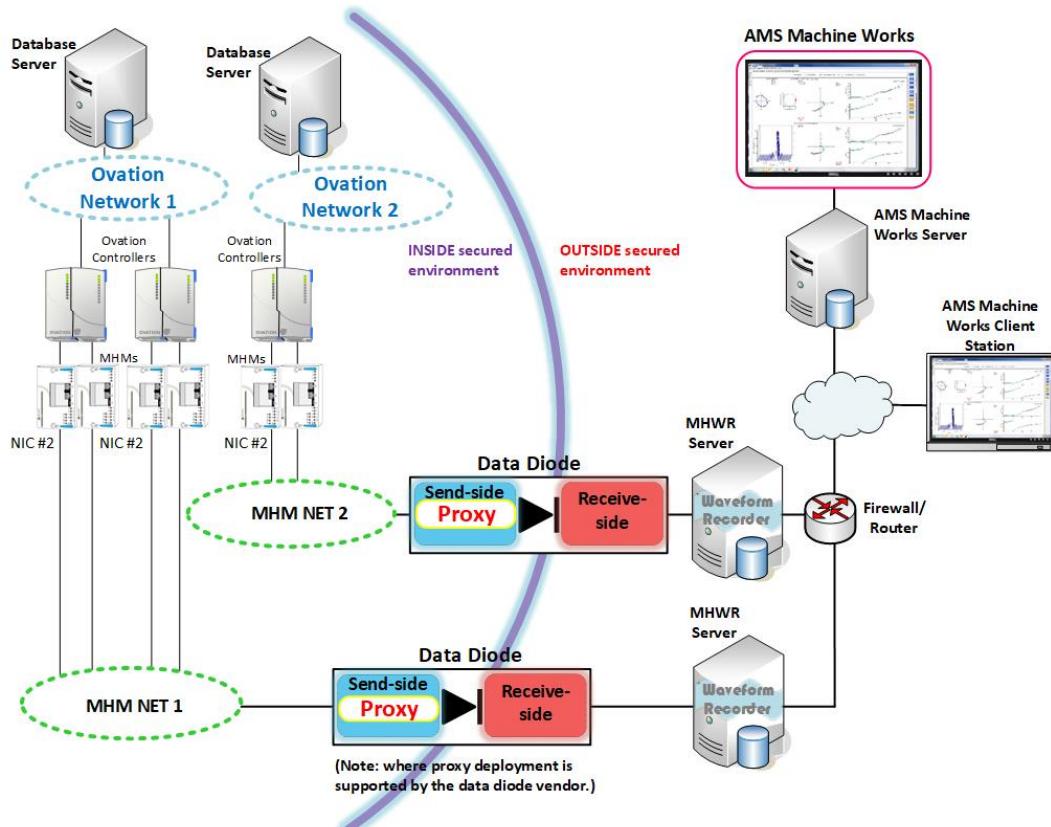
The replicated MHWRs and AMS Machine Works deployment are **outside** the secure DCS environment.

Similarly, the MHWR Replication is another data transfer deployment method using data diodes. Refer to the illustration for [MHWR Replication data diode setup \[130\]](#).

The MHM Proxy method can be used where proxy deployment is supported by the data diode vendor.

Emerson recommends installing a firewall/router between the MHWR and AMS Machine Works for additional protection.

Figure 92. Multiple Ovation networks - Multiple MHM networks - Multiple MHWRs using data diodes



12

Specifications for the Waveform Recorder

Topics covered in this section:

- *Specifications [135]*

12.1

Specifications

The following table lists specifications associated with the Waveform Recorder:

Table 14. Specifications for the Waveform Recorder

Description	Quantity
<p>Minimum number of servers required for each standard network configuration:</p> <ul style="list-style-type: none"> • One MHWR server. • One AMS Machine Works Server. 	2 total
<p>Minimum number of servers required for each network configuration when using data diodes:</p> <p>Using the MHWR Replication approach:</p> <ul style="list-style-type: none"> • Two MHWR servers. • One AMS Machine Works Server. <p>Refer to System configurations using data diodes [26].</p>	3 total (2 total when using MHM Proxy on supported data diodes.)
<p>Minimum number of servers required for each network configuration when using data diodes with MHM Proxy support:</p> <p>Using the MHM Proxy approach:</p> <ul style="list-style-type: none"> • One MHWR server. • One AMS Machine Works Server. <p>Refer to System configurations using data diodes [26].</p>	2 total
Minimum amount of free disk space required.	2 terabytes
Maximum number of OMHM modules per MHWR.	20
Maximum number of MHWR per AMS Machine Works server.	4
Maximum number of tach channels per module.	2 channels
Maximum number of channels per OMHM module, tach channels included.	8 channels
Maximum number of channels across all on-line modules.	400 channels
Maximum of all Fmax values totaled per module.	175 kHz

Specifications

Description	Quantity
Maximum of all Fmax values totaled per module when using a paired/partner collection on any channel.	150 kHz
Maximum number of samples per second.	2 million

13 Troubleshooting

Topics covered in this section:

- *Troubleshooting MHWR problems [137]*
- *Introducing new MPVs from the OMHM and Ovation [138]*

13.1 Troubleshooting MHWR problems

Below is a list of common problems and resolutions associated with the MHWR:

- Not using a supported software version or applicable patches. - Check the software version and the patches required for your system.
- Forgetting to install Ovation patches and to update OMHM firmware in each module during MHWR and AMS Machine Works installation. - Check all software patches required for your system.

Note

Contact your Emerson representative or Emerson Software Licensing for help with your software version and required patches.

-
- License expiration - a 10-day free trial license is initially applied. After this period a license must be obtained by Emerson's Software Licensing.
 - Not enough disk space. - Setting Fmax values higher than necessary may be consuming too much storage.
 - The module's IP Address was changed but new values did not update. - When the module's IP Addresses are changed in the Developer Studio, the module(s) must be rebooted to apply the new values.

Note

When changing an OMHM module's IP Addresses, a reboot is required.

-
- Modules are not displaying as online in the OMHMDiag window.
 - Make sure the port configured on the MHMs match the MHM port configured on the MHWR.
 - Forgetting to update the firmware in each OMHM module.
The Developer Studio Engineer tool for the OMHM shows the settings for sending prediction waveform data to the MHWR. If the firmware is not updated in each OMHM, the OMHM ignores the additional settings from the Developer Studio Engineer tool.

Note

Firewall issues could also prevent communication but is unlikely since the install should permit MHWR traffic through the firewall.

- Modules continually move from online to offline - Fmax settings for the prediction waveform collection may be set too high for the module's processing capability to maintain the flow of waveform data.
(For example, Fmax on 8 channels is set to 20000 Hz).
- The tachometer channel is not sending a value. If a channel is configured for a tachometer but the tach is not sending a value, the module may appear to be online but is not sending data.
If a tachometer is assigned to the channel, the waveform data is triggered by the first tach mark to align the waveform with the tachometer. If the tach signal is bad or the machine is off, the waveform data does not send.

Note

Once a tach signal is received and a data stream is established, the data stream continues.

If the machine is running, investigate the tachometer signal.

If the machine is stopped, wait until the machine is re-started to capture data.

13.2

Introducing new MPVs from the OMHM and Ovation

The OMHM module and Ovation allows you to create and assign Module Process Variables (MPVs).

MPVs are created when a measurement type is selected in the Developer Studio. When selected, the measurement is calculated and placed in an MPV for transport to Ovation. An Ovation point can be assigned to these variables for monitoring in the Ovation Database. These include overall measurements and analysis parameters.

Overall variables include:

- RMS
- Peak
- Peak-To-Peak
- DC along with the other types of measurements available, including eccentricity and displacement.

Analysis Parameters are secondary variables and include Peak/Phase, and Energy.

All MPVs calculated are also communicated to the MHWR through the secondary network. These values are recognized by the MHWR as MPVs and are held in memory for retrieval by AMS Machine Works.

Note

The MHWR has knowledge of the type of variable, whether it is an overall variable or an analysis parameter.

These MPVs are viewed from the MHWR diagnostics program and are shown in a list per channel and displays the variable value, quality, and type. These values must agree with values viewed in Ovation.

AMS Machine Works consumes these MPV variables either by request or at regular intervals.

Note

Be aware, the MPV values may or may not be stored in an historian.

When the OMHM module is updated with new measurement calculations, additional MPVs are added to the firmware and Ovation to support these measurement calculations.

Emerson recommends when you are updating OMHM module firmware and Ovation to implement new measurement calculations, update the MHWR software and AMS Machine Works to be sure all MPVs are updated and recognized by the system.

AMS Machine Works software and MHWR software must be updated any time OMHM module firmware is updated in order to take advantage of any newly introduced MPVs from OMHM in the AMS Machine Works software.

If new MPVs are present and the MHWR is not updated, the following behavior is expected:

Newly created MPVs are unrecognized by the MHWR; therefore, no classification of Overall or Analysis Parameter is known. The MHWR reads these MPVs along with the value and quality. If viewed in the Diagnostic program, these unrecognized MPVs appear at the end of the MPV list below all known MPVs for each channel. Scroll to the bottom of the list to display the unrecognized MPV's quality and value.

If AMS Machine Works is not updated, it may not request the new MPVs or have a displayable location for them.

The recommend best practice is to update AMS Machine Works and the MHWR to implement all newly introduced MPVs from the OMHM(s) and Ovation.

Twitter: twitter.com/ovationusers
LinkedIn: linkedin.com/groups?gid=4179755
Ovation Users' Group: www.ovationusers.com

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