

Background and Value

Industrial facilities have hundreds of critical rotating assets such as motors, pumps, gearboxes, and compressors. Unexpected failures result in costly downtime.

An equipment health monitoring (EHM) preventative maintenance solution uses machine learning to identify when assets exceed pre-defined parameters, resulting in:

- **Increased Uptime**—Eliminate unplanned shutdowns by continuously monitoring up to 40 assets with a single system
- **Reduced Maintenance Cost**—Repair prior to failure or extensive collateral damage
- **Effective Maintenance/Parts Scheduling**—Plan for labor and spare parts
- **Ease of Use**—Reduce installation costs and eliminate the complexity of traditional data analysis
- **Improved Asset Selection**—Use data to analyze root cause and reliability
- **IIOT**—Review real-time alerts for better decision-making and remote asset management

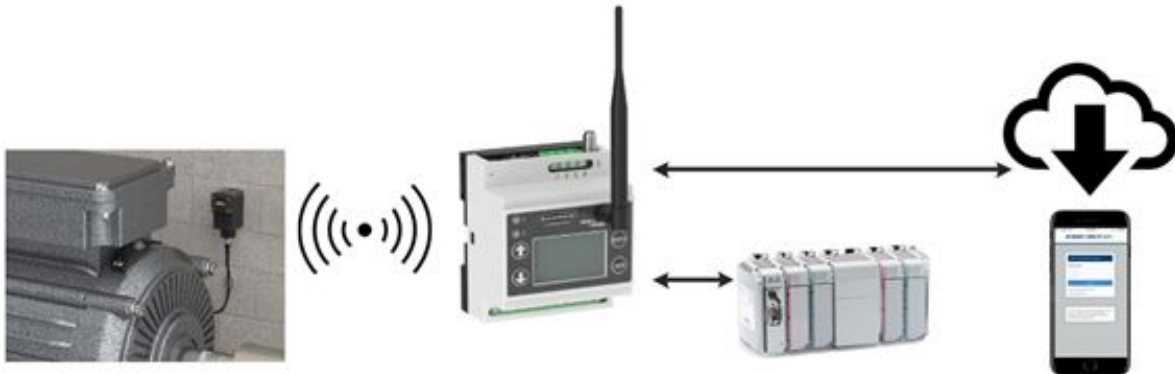


VIBE-IQ® By Banner Engineering Corp:

- Monitors each motor using a machine learning algorithm to baseline values and set control limits for alerts with limited end-user interaction
- Continually monitors RMS Velocity (10-1000Hz), RMS high-frequency Acceleration (1000-4000Hz), and temperature on rotating equipment using Banner's Wireless vibration/temperature sensor
- Determines if motors are running or not and only uses the running data for baselining and alerting
- Collects data for trending and analysis; script defines acute versus chronic issues
- Sends data and alerts to the host control or to the cloud for IIoT connectivity

This Banner solution monitors vibration levels on rotating assets that are the result of:

- Imbalanced/misaligned assets
- Loose or worn components
- Improperly driven or mounted components
- Over-temperature conditions
- Early bearing failure



Guide Features and Benefits

Continuous Vibration Monitoring	Monitors vibration data on up to 40 assets, sensing x- and z-axis RMS velocity and high-frequency RMS acceleration. RMS velocity is indicative of general rotating machine health (unbalance, misalignment, looseness) and high-frequency RMS acceleration is indicative of early bearing wear.
Self-learning Baseline and Thresholds	Prevents users from having to manually generate baselines or alarms; machine learning algorithms create an initial baseline reading and warning/alarm thresholds for each motor individually.
Acute and Chronic Alarms	Generates alarms and warnings for both acute and chronic conditions for each motor. Acute thresholds indicate a short-term condition, such as a motor jam or stall, that crosses the threshold rapidly. Chronic thresholds use a multi-hour moving average of the vibration signals to indicate a long-term condition, such as a wearing/failing bearing or motor.
Temperature Alarms	Each vibration sensor monitors temperature and sends an alarm when the threshold is exceeded.
SMS Text and Email Alerts	Generates email alerts based on individual warnings and/or alarms when used with Banner Cloud Data Services (Banner CDS).
Cloud Monitoring	Push data to Cloud Webserver or PLC (via LAN or Cellular connection) for remote viewing, alerting, and logging.

Solution Components

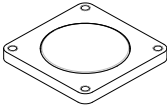
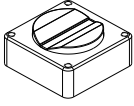
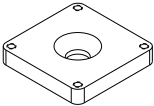
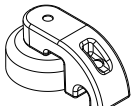
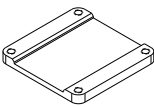


Your solution must include one DXM Controller and up to 40 Q45 All-in-One Sensor Nodes or Q45 Wireless Nodes with vibration sensors (or a combination of both types of Q45s). All Nodes must be operating at the same radio frequency as the DXM Controller.

Sensor	ISM Radio Node	DXM Controller	Description
QM30VT1	Q45VTPD	DXM700-B1R1, DXM700-B1R3, DXM1200-B2R1, DXM1200-B2R3, DXM1000-B1R1, or DXM1000-B1R3	Sure Cross® QM30 VT1 Vibration and Temperature Sensor connected to a Q45VTPD Node; select either a 900 MHz or 2.4 GHz Q45VTPD Node to match the DXM Wireless Controller
Included in Q45VA or Q45VAC	Q45VA or Q45VAC		Q45VA/VAC All-in-One Vibration Sensor Nodes; select either a 900 MHz or 2.4 GHz ISM radio to match the DXM Wireless Controller
QM30VT1	CM1L Condition Monitoring Node		Sure Cross® QMVT1 Vibration and Temperature Sensor connected to a CM1L Condition Monitoring Node; select either a 900 MHz or 2.4 GHz Node to match the DXM Wireless Controller

Mounting Options

The following mounting options are listed from least effective to most effective. In all mounting options, ensure there is no sensor movement because this results in inaccurate information or changes to the time-trended data.

Follow Banner's [Vibration Monitoring Sensor Installation Guide](#) (p/n b_4471486) for proper sensor installation help.

Model	Bracket	Application Description
BWA-QM30-FMSS Flat magnet sensor bracket		Highly flexible and reusable, flat magnetic mount for larger diameter surfaces or flat surfaces.
BWA-QM30-CMAL Curved surface magnet bracket		Curved surface magnet mounts are best suited to smaller curved surfaces. Ensure you have positioned the sensor in the correct direction for the strongest mount. Offers flexibility for future sensor placement.
BWA-QM30-FTAL Center mounting bracket, 1/4-28 x 1/2-inch screw mount (ships with sensor)		Flat bracket is permanently epoxied to the motor and the sensor is screwed to the bracket (very effective) or the flat bracket is screwed to the motor and sensor (most effective). Ensures the best sensor accuracy and frequency response. Recommend epoxy designed for accelerometer mounting: Loctite Depend 330 and 7388 activator
BWA-QM30CAB-MAG		Cable management bracket
BWA-QM30-CEAL		Notched aluminum bracket for curved surfaces permanently epoxied to motor and sensor screwed to bracket.
BWA-QM30-FSSSR		Flat surface rapid release stainless steel bracket; circular with a center screw for mounting the bracket to the motor and a side set-screw for quick release mounting of the sensor to the bracket.
BWA-QM30-FSALR		Flat surface rapid-release aluminum bracket; circular with a center screw for mounting the bracket to the motor and a side set-screw for quick-release mounting of the sensor to the bracket.

Configuration Instructions

Follow these basic steps to configure your system.

1. Bind all DX80 Nodes to their Gateway radio and assign Node IDs (see ["Bind a DX80 Node to a DXM and Assign the Node Address" on page 3](#)).
2. Install the vibration sensor (see ["Install the Vibration Sensor" on page 3](#)).
3. Configure the system (see ["Configuration Instructions" on page 2](#)).

4. Save and upload the configuration file (see "[Save and Upload the Configuration File](#)" on page 6).
5. Push information to the cloud (see "[Push Information to BannerCDS](#)" on page 6).

Bind a DX80 Node to a DXM and Assign the Node Address

Binding Nodes to a Gateway ensures the Nodes only exchange data with the Gateway they are bound to. After a Gateway enters binding mode, the Gateway automatically generates and transmits a unique extended addressing (XADR), or binding, code to all Nodes within range that are also in binding mode. The extended addressing (binding) code defines the network, and all radios within a network must use the same code.

1. Apply power to all the devices.
 - Separate radios by two meters when running the binding procedure. Put only one DXM Gateway into binding mode at a time to prevent binding to the wrong Gateway.
2. Enter binding mode on the DXM radio:
 - a. Use the arrow keys to select the **ISM Radio** menu on the LCD and press **ENTER**.
 - b. Highlight the **Binding** menu and press **ENTER**.
3. Assign the Node address to the Node.
 - For Nodes without rotary dials: Use the DXM arrow keys to select the Node address to assign to the DX80 Node about to enter binding mode. The DXM assigns this Node address to the next Node that enters binding mode. Only bind one Node at a time.
 - For Nodes with rotary dials: Use the Node's rotary dials to assign a valid decimal Node Address (between 01 and 47). The left rotary dial represents the tens digit (0 through 4) and the right dial represents the ones digit (0 through 9) of the Node Address. You can leave the DXM "Bind to" address set to 1 because the Node's rotary dials will override that setting.
4. Start binding mode on the DXM radio by pressing **ENTER** on the DXM radio.
5. Enter binding mode on the DX80 Node.
 - For housed radios, triple-click button 2.
 - For board-level radios, triple-click the button.
 - For Nodes without buttons, refer to the Node's datasheet for instructions on entering binding mode.

The left and right LEDs flash alternately and the Node searches for a Gateway in binding mode. After the Node binds, the LEDs stay solid momentarily, then they flash together four times. The Node automatically exits binding mode and reboots.
6. Label the Node with the assigned address number for future reference.
7. Press **BACK** on the DXM to exit binding mode for that specific Node address.

The Node LEDs continue to flash red until the DXM exits binding mode with that Node address.
8. Repeat these steps for as many DX80 Nodes as are needed for your network.
9. When you are finished binding, press **BACK** on the DXM until you return to the main menu.

Install the Vibration Sensor

Correctly mounting the vibration sensor on a motor is important to collect the most accurate readings. There are some considerations when it comes to installing the sensor.

1. Align the vibration sensor's x- and z-axes.

The vibration sensors have an x- and z-axis indication on the face of the sensor. The z-axis goes in a plane through the sensor while the x-axis goes horizontally. The sensor can be installed flat or vertically.

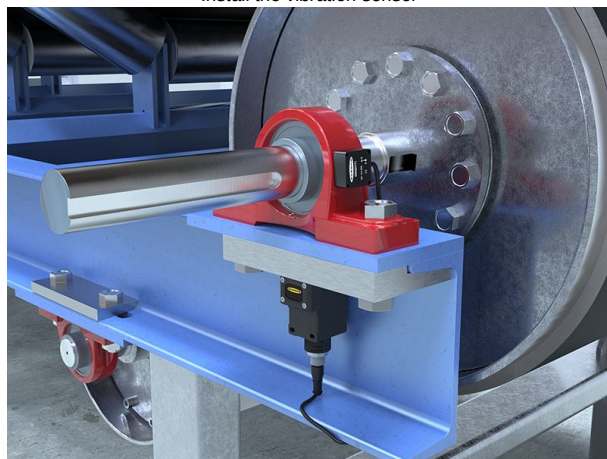
 - Flat installation—Align the x-axis in line with the motor shaft or axially and the z-axis is going into/through the motor.
 - Vertical installation—Align the z-axis so it is parallel with the motor shaft and x-axis is orthogonally vertical to the shaft.
2. Install the sensor as close to the bearing of the motor as possible.

Using a cover shroud or location far from the bearing may result in reduced accuracy or ability to detect certain vibration characteristics.

The mounting type can affect the results of the sensor.

Directly screwing or epoxying a bracket to a motor provides a permanent installation of the bracket to which the sensor can be attached. This more rigid mounting solution ensures some of the best sensor accuracy and frequency response, but is not flexible for future adjustments.

Install the vibration sensor



Magnets are slightly less effective but provide more flexibility for future adjustments and faster installation. Magnet mounts are susceptible to accidental rotation or change in the sensor location if an outside force bumps or moves the sensor. This can lead to a change in the sensor information that differs from the time-trended data from the previous location.

Configure the System

To customize the system to an actual application, make some basic modifications to the template files. There are two files uploaded to the DXM: the XML file sets the DXM's initial configuration and the ScriptBasic file reads vibration data, sets the thresholds for warnings and alarms, and organizes the information in logical and easy-to-find registers in the DXM.

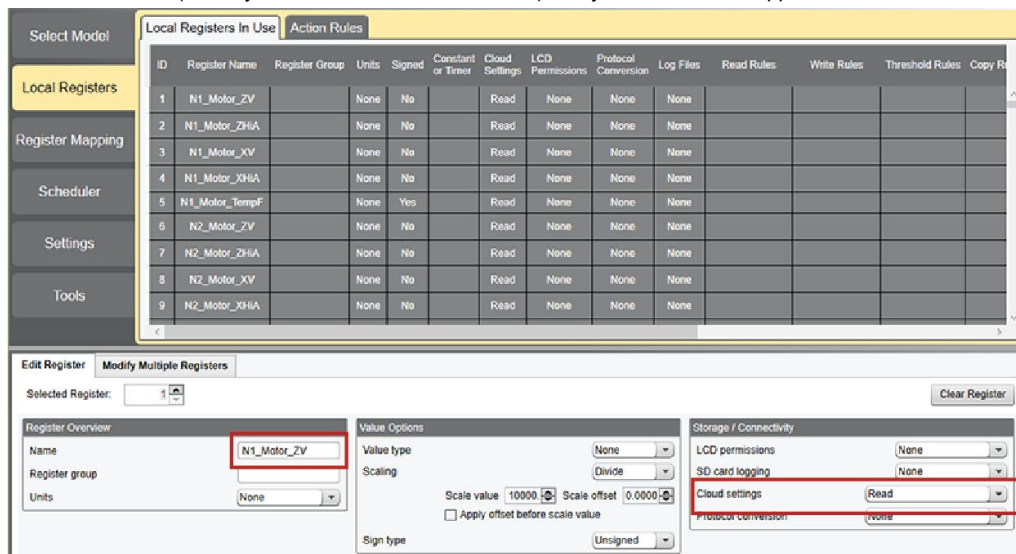
Loading these files and adjusting them requires using Banner's DXM Configuration Software and the Vibration Monitoring files available on www.bannerengineering.com.

1. After binding the radios and assigning the Node IDs, allow the sensors to establish their baseline after they connect to the DXM to avoid recording vibrations generated during installation.
2. Download the preconfigured files from either the DXM series page or the QM30VT sensor series page on bannerengineering.com.
3. Extract the ZIP files into a folder on your computer. Note the location where the files were saved
4. Connect the DXM, using the USB cable supplied with the DXM or an ethernet cable, to a computer containing the [DXM Configuration Software v4](#) or download the software and install it on a computer.
5. Launch the software and select the DXM model.
 - a. In the **Configuration Mode** drop-down list, select **Traditional**.
 - b. Select **Serial** and then select the COM port that the USB cable is plugged into or select **TCP/IP** and enter the correct IP address of the DXM.
 - c. In the **Select DXM Model** drop-down list, select your DXM model.
 - d. Click **Connect**. If you are unsure which COM port to select and multiple ports are listed, attempt to connect to each one of them until you are successful.
6. Load the configuration file by going to **File > Open** and choosing the Vibration Monitoring XML file.
7. Go to the **Settings > Scripting** screen. Click **Upload file** and select the Vibration Monitoring script file (.sb).
8. Go to the **File > Save** menu to save the file. Save the XML file any time the XML has been changed because the software DOES NOT autosave.

Optional Configuration Steps

Customize the XML File

1. Within the configuration software, go to the **Local Registers > Local Registers in Use** screen.
2. Rename the registers for the monitored asset.
 - a. On the **Local Registers > Local Registers in Use** screen, to go the **Edit Register** section near the bottom of the screen.
 - b. In the **Name** field, enter the register name of your monitored asset.
 - c. Because there are five registers per monitored asset, copy and paste names for efficiency.
3. To display the motor vibration data, warnings, and alarms on the Banner CDS website, change the **Cloud settings** to **Read** for each monitored asset's information (velocity, acceleration, alert mask, etc.) that you would like to appear on the website.



4. The most common registers to be sent to the cloud already have their cloud permissions set. To send additional registers or reduce the number of registers being sent if you are using less than 40 sensors, change the cloud permissions.
 - a. On the **Modify Multiple Registers** screen, select **Set** in the drop-down list next to **Cloud settings**.

- b. In the **Cloud settings** drop-down, select **Read** or **None** to turn the register off.
- c. Set the **Starting Register** and the **Ending Register** for the group of registers that need to be changed.
- d. Click **Modify Registers** to complete the modification.

Standard register cloud permissions are shown in the Local Registers table at the end of this document.

5. For systems with up to 40 sensors, warnings and alarms are contained within a single register for each sensor, in Local Registers 201–240.

The registers are labeled “NXX VibMask” where XX is the sensor number. The register value is a decimal form of an 18-bit binary number with a value of 0 or 1 because there can be up to 18 warnings or alarms for each sensor. Velocity alerts are indicative of low frequency motor issues such as unbalance, misalignment, soft foot, looseness, etc. High Frequency Acceleration alerts are indicative of early bearing failure, cavitation, and high side gear mesh, etc. Acute alerts are indicative of a quickly happening issues as they occur after five consecutive (adjustable in register 853) running samples above the thresholds. Chronic alerts are indicative of a long term failure and are based on a 100 point moving average of running samples above the thresholds.

The 18-bit binary masks are broken out as follows:

Bit	Description	Binary Mask
0	Warning – X-Axis – Acute Velocity	$(0/1) \times 2^0$
1	Warning – X-Axis – Acute Acceleration (Hi Freq)	$(0/1) \times 2^1$
2	Warning – Z-Axis – Acute Velocity	$(0/1) \times 2^2$
3	Warning – Z-Axis – Acute Acceleration (Hi Freq)	$(0/1) \times 2^3$
4	Alarm – X-Axis – Acute Velocity	$(0/1) \times 2^4$
5	Alarm – X-Axis – Acute Acceleration (Hi Freq)	$(0/1) \times 2^5$
6	Alarm – Z-Axis – Acute Velocity	$(0/1) \times 2^6$
7	Alarm – Z-Axis – Acute Acceleration (Hi Freq)	$(0/1) \times 2^7$
8	Warning – X-Axis – Chronic Velocity	$(0/1) \times 2^8$
9	Warning – X-Axis – Chronic Acceleration (Hi Freq)	$(0/1) \times 2^9$
10	Warning – Z-Axis – Chronic Velocity	$(0/1) \times 2^{10}$
11	Warning – Z-Axis – Chronic Acceleration (Hi Freq)	$(0/1) \times 2^{11}$
12	Alarm – X-Axis – Chronic Velocity	$(0/1) \times 2^{12}$
13	Alarm – X-Axis – Chronic Acceleration (Hi Freq)	$(0/1) \times 2^{13}$
14	Alarm – Z-Axis – Chronic Velocity	$(0/1) \times 2^{14}$
15	Alarm – Z-Axis – Chronic Acceleration (Hi Freq)	$(0/1) \times 2^{15}$
16	Warning Temperature (> 158°F or 70°C)	$(0/1) \times 2^{16}$
17	Alarm Temperature (> 176°F or 80°C)	$(0/1) \times 2^{17}$

The Vibe Mask Registers display in decimal form and are the sum of the calculations shown in the right column for each Sensor’s mask register. Note that any value greater than zero in registers 201 through 240 indicates a warning or alarm for that particular sensor.

To know the exact warning or alarm, calculate the binary value from the decimal value, which can be done on the Banner CDS site or can be done with a PLC or HMI. Multiple warnings and alarms may trigger on an event depending on severity.

Set Up the Ethernet or Cellular Connection

By default, the DXM with an Ethernet Push interface is configured to push the data registers to a web server. The DXM can also be configured to use a cellular push if the DXM Controller contains a cellular module and data plan. This section is only necessary if you want to receive or display information to more than the DXM Controller’s LCD.

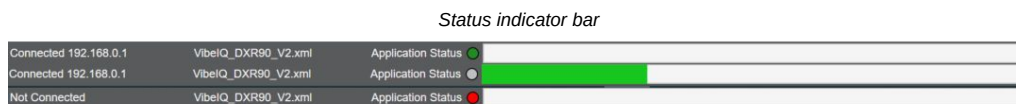
1. On the **Local Registers in Use** screen, set the **Value Type** of register 844 to **Constant** and a value of 1 to enable the data push.
2. If the DXM will push to the cloud web server, set up the push interface.
 - a. Go to the **Settings > Cloud Services** screen.
 - b. From the **Network Interface** drop-down list, select either **Ethernet** or **Cell**. Selecting **Cell** requires a cellular module be installed in the DXM Controller and a wireless plan be set up for sending data.
3. Set the **Cloud Push Interval** to **None**. The script associated with this file establishes the five-minute push interval internally so that it occurs immediately after the sample of the sensors.

Save and Upload the Configuration File

After making any changes to the configuration, you must save the configuration files to your computer, then upload it to the device.

Changes to the XML file are not automatically saved. Save your configuration file before exiting the tool and before sending the XML file to the device to avoid losing data. If you select **DXM > Send XML Configuration to DXM** before saving the configuration file, the software will prompt you to choose between saving the file or continuing without saving the file.

1. Save the XML configuration file to your hard drive by going to the **File > Save As** menu.
2. Go to the **DXM > Send XML Configuration to DXM** menu.



- If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the cable and reconnect the DXM to the software.
- If the Application Status indicator is green, the file upload is complete.
- If the Application Status indicator is gray and the green status bar is in motion, the file transfer is in progress.

After the file transfer is complete, the device reboots and begins running the new configuration.

Push Information to BannerCDS

The DXM Wireless Controller can connect to the Web via Ethernet or an internal cell module. The controller pushes data from the DXM to be stored and displayed on a website.

The Banner platform for storing and monitoring the system's data is <https://bannercds.com>. The Banner Cloud Data Services website automatically generates dashboard content for the application that is populated onto the Dashboard. Email alerts can be configured using the Alarms screen.

To push data to the cloud, change register 844 to one (1).

For more information on creating accounts on and using the Banner Cloud Data Services (CDS) system, please refer to the Banner CDS Quick Start Guide (p/n 201126).

Create a New Gateway

After you log into the Banner Cloud Data Services website, the **Overview** screen displays. Follow these steps to create a new monitoring site.

1. Click on **New Gateway** (top right corner of the **Overview** screen).
Create a new Gateway for each DXM Controller that sends data to the web server.
A **New Gateway** prompt appears.
2. Verify **Traditional** is selected for the **Gateway Type**.
3. Enter a **Gateway Name**.
4. Select the **Company** from the drop-down list.
5. Copy the **Gateway ID** number located within the prompt window to your computer's clipboard.
The **Gateway ID** number created by the web server is a required parameter in the configuration of the DXM. The **Gateway ID** is the address the webserver uses to store the data pushed from the DXM.
6. Click **Submit** to close the prompt window.

Configure the DXM to Push Information to the Cloud

IMPORTANT: Do not adjust the Cloud Push Interval. The push frequency is controlled by the script. Adjusting the cloud push interval through this configuration may result in excessive amounts of data being pushed to Banner CDS.

1. Within the DXM Configuration Software, go to the **Local Registers in Use** screen.
2. Set the **Value Type** of register 844 to **Constant** and a value of 1 to enable the data push.
3. Go to the **Settings > Cloud Services** screen.
4. Set the **Server name/IP** to push.bannercds.com.
5. In the **Web Server** section, paste the **Gateway ID** copied from the BannerCDS configuration screen into the appropriate field.
6. Use the **File > Save** menu to save the XML file to your hard drive.
7. Send the updated XML to the DXM Controller using the **DXM > Send XML Configuration to DXM** menu.

Upload the XML Configuration File to the Website

To upload an XML configuration file to the website, follow these instructions.

1. On the BannerCDS website, select **Gateways** on the **Overview** screen.
2. On the row displaying your **Gateway**, click the **Details** under **View**.
3. Select **Edit Gateway**.
The **Edit Gateway** prompt appears.
4. Click **Select File** under **Update XML**.
5. Select the file that was just updated to the DXM and click **Open**.
After the XML file is loaded into the webserver, the webserver uses the register names and configurations defined in the configuration file. The same XML configuration file is now loaded on both the DXM and the Website. After some time, the data should be seen on the website.
6. To view the data from the Gateway's screen, click on the **Details** link for each **Gateway**.
The Gateway **Details** screen lists the **Sensor** objects and default **Alarms** for that gateway. You may view the individual register information by selecting **Registers**.

Completing these steps creates continuity between the **Gateway** created on the website with the DXM used in the field. The DXM pushes data to the website, which can be viewed at any time.

Register Glossary and Options

Acute Samples

Non-Volatile Register 853

Set to a default value of five (5) consecutive samples before triggering an acute alert. User adjustable to any value one (1) or greater for the number of consecutive samples above a warning or alarm threshold before triggering an acute alert.

Baseline Samples

Non-Volatile Register 852

Set to a default value of 300 samples for a baseline. User adjustable to any number of five-minute samples used to generate baseline, warning, and alarm thresholds.

Baseline, Warning and Alarm Levels

Local Registers 5181–5660

Each Node has a baseline, warning, and alarm level for each of the four vibration characteristics stored in these registers. Set to push once per day. Use for graphing with raw vibration data for comparison.

Cloud Push

Local Register 844

Set to a value of one (1) to enable cloud pushing from the script.

Motor Run Flag On/Off (0/1)

Local Registers 241–280

The script determines whether or not a motor is running and only uses data from a running motor for trending, alerts, and baselining. These registers could be used to track run time or ON/OFF count with action rules.

Node Connection Status

Local Registers 281–320

A value of one (1) in the 8th bit (decimal 128) indicates a Node is in sync with its client radio. Any other value indicates a Node is no longer in sync with its client radio. This could be due to radio interference or low battery.

OR'd Warnings and Alarms

Local Registers 570–578

All registers here provide a value of zero (0) or one (1) to indicate if the value is false or true. These indicate a warning or error on any of the 40 Nodes based on the description of the register. Some are for vibration acute or chronic warnings or alarms, some for temperature, and some for the radio connection.

Sensor Vibration and Temperature Data

Local Registers 1–200

Each Node has five registers, two for RMS velocity, two for RMS High Frequency Acceleration, and one for Temperature. The data is unscaled for easier viewing.

In English units (in/s), the velocity = Register value ÷ 10000.

For metric (mm/s), the velocity = Register value ÷ 1000.

For either unit, acceleration (g) = Register value ÷ 1000. For example, a velocity register value of 500 = 0.05 in/s and an acceleration register value of 15 = 0.015 g.

User Adjustable Temperature Warning and Alarm Levels

Non-Volatile Registers 7681–7760

Set to a default of 158 °F (70 °C) for warning and 176 °F (80 °C) for alarm. Enter in the required level for each Node.

User Adjustable Vibration Warning and Alarm Levels

Non-Volatile Registers 7001–7320

level is zero (0) to use automatically generated values. Users can adjust the level manually by entering a value for any warning or alarm level on any vibration characteristic.

In English units (in/s), the velocity = Register value ÷ 10000.

For metric (mm/s), the velocity = Register value ÷ 1000.

For either unit, acceleration (g) = Register value ÷ 1000. For example, 0.05 in/sec = register value of 500.

Vibration Alerts Mask

Local Registers 201–240

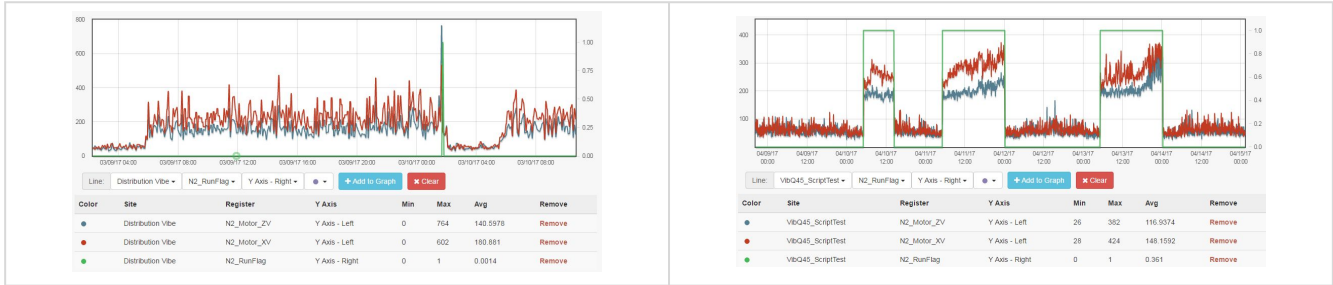
Each Node has one register in this grouping where all the vibration and temperature alerts are bitpacked into a single register. Any value greater than zero (0) indicates a warning or alarm condition and can be used for setting up notifications via email or SMS from within the Banner Cloud Data Services (Banner CDS) platform.

Additional Information

Adjust the Velocity Thresholds for the Run Flag

The script included in this application guide automatically generates baselines and standard deviations by recognizing when a motor is running and collecting data.

If a motor has a very low RMS velocity and acceleration when running, it can be very difficult to distinguish. To ensure the system is working properly, look at the Run Flag and X/Z RMS velocity over time. The data graphics show when a motor is running or off. If the Run Flag doesn't turn on (1) when the motor turns on, decrease the Running Motor RMS Velocity threshold. To determine this, look at the data over time.



On the left, sensor 2 is between 150 and 425 for RMS velocity when the motor is running and below 100 when the motor is not running. The Run Flag (green line) indicates the motor is running at one point in time when the velocity has a spike. In comparison, if we look at the RMS velocities for sensor 2 on the right, we can see the Run Flag (green line) clearly indicates when the motor is running and not running even if the velocities are low. This means the acceleration is high enough to distinguish when the motor is running.

To adjust for this, reduce the Running RMS Velocity Thresholds for the X and Z axis to a level that is above the off state but below the lowest data collected while the motor was running. In this case a value of 100 would be the appropriate value. This value varies depending on the motor and should be assessed for each motor. To change the Run Velocity thresholds, follow these steps.

1. On the DXM Configuration Software, go to the **Local Registers > Local Registers in Use** screen.
2. Click on the X Velocity Run threshold in registers 661–700 (labeled **NX_RunThres_XV** and where X is the motor ID number) and change the value in the **Constant** field to a more accurate value for that motor.
3. Click on the Z Velocity Run threshold in registers 701–740 (labeled **NX_RunThres_ZV** and where X is the motor ID number) and change **Constant** to a more accurate value for that motor.
4. If you are configuring other similar motors, use the **Modify Multiple Registers** screen to save time.
5. After you have configured these thresholds for each motor, see ["Save and Upload the Configuration File" on page 6](#).
6. Re-baseline your motor (see ["Baselining a Motor" on page 8](#)).

Baselining a Motor

The script included with this guide uses the first 300 running data points (user adjustable by changing register 852) of a motor to generate a baseline and the statistics for determining warning and alarm threshold levels.

Create a new baseline when significant changes are made to the motor or vibration sensor, including performing heavy maintenance, moving the sensor, installing a new motor, etc. This ensures that the system is running as accurately as possible. Re-baselining a motor can be done from the DXM Configuration Software, from the Banner CDS website, or from a connected host system.

Baseline a Motor Using the DXM Configuration Software

1. Go to the **Local Registers > Local Registers in Use** screen.
2. Use the arrows to select **Registers**.
The registers are labeled **NX_Baseline** (where X is the sensor number you want to baseline).
3. Select the appropriate register to reset and click **Enter**.
4. Change the value to 1, then click **Enter** three times.
The reset register value automatically returns to zero after the baseline is complete.

Baseline a Motor from the Banner CDS Website

1. On the **Dashboard** screen, select the appropriate **Dashboard** that was automatically created for your gateway
2. Within the **Dashboard**, click on the appropriate motor icon for the asset you would like to baseline.
3. Click **View Item** within the prompt that appears.
4. Scroll down within the tray that appears at the bottom of the screen, then click the **Baseline** switch to **ON**.
This automatically turns off after the baseline is complete.
5. Repeat these steps for each sensor that needs to be baselined.

Baseline a Motor from a Connected Host System

Example host systems may be a PLC or HMI.

1. Determine the sensor number X, where X is the sensor number 1–40 (sensor ID 11-50) to be re-baselined.
2. Write a value of 1 to register 320 + X.

Adjusting Warning and Alarm Thresholds

These values are stored in non-volatile local registers so they remain through a power outage.

Temperature—The default temperature settings are 158 °F (70 °C) for warnings and 176 °F (80 °C) for alarms. Temperature thresholds may be changed from the DXM Configuration Software, from the Banner CDS website, or from a connected host system.

Vibration—After baselining is complete, warning and alarm thresholds are set for each vibration characteristic on each axis automatically. To view those values, check registers 5181–5660 (12 registers per sensor). To adjust those thresholds, use registers 7001–7320 (8 registers per sensor). Triggering a new baseline returns these user-defined registers to zero.

Adjust the Thresholds Using the Configuration Software

1. Using the DXM Configuration Software, connect to the DXM Controller running the Vibration Application Guide.
2. Go to the **Tools > Register View** screen.
 - **Temperature**—The temperature warning and alarm thresholds are in registers 7681–7760 and are labeled **NX_TempW** or **NX_TempA**, where X is the Sensor ID.
 - **Vibration**—The vibration warning and alarm thresholds are in registers 7001–7320 and are labeled **User_NX_XVel_Warning** or **User_NX_XVel_Alarm**, etc., where X is the Sensor ID.
3. Use the right column and enter the starting register to change and the value to write to the register.
4. Click **Write Registers**.
5. Repeat steps 3 and 4 for any additional thresholds to change.
6. To modify up to 40 thresholds at a time, adjust the **Number of registers** underneath the starting register. Enter a value for each register and click **Write Registers** when you are finished.
7. To return to using an original baseline value for a particular sensor:
 - **Vibration**— Set the user-defined register (7001–7320) back to 0.

Adjust the Threshold from the Banner CDS Website

1. On the **Dashboard** screen, select the appropriate **Dashboard** that was automatically created for your gateway.
2. Within the **Dashboard**, click on the appropriate motor icon for the asset you would like to adjust thresholds.
3. Click **View Item** within the prompt that appears.
4. Below the graphs, enter the values for the thresholds and click **Update**.
The Banner CDS updates the system's settings the next time the Controller pushes to the cloud.
5. Scroll down within the tray that appears at the bottom of the screen and enter your desired values for the thresholds into the respective numeric fields.
6. Click **Update**.
Banner CDS updates the system settings the next time the gateway controller pushes to the cloud.
7. Repeat these steps for each sensor threshold.
8. For the vibration thresholds, set the threshold back to 0 to return to using the original baseline values for a particular sensor.

Adjust the Thresholds from a Connected Host System

Example host systems may be a PLC or HMI.

1. Write the appropriate value into the register where x is the Sensor ID.
 - **Temperature**—Value in °F or °C to registers 7680 + x for the temperature warning or 7720 + x for the temperature alarm.
 - **Vibration**—Write to the following registers.

Register	Description	Register	Description
7000 + (x - 1) × 8	X-Axis Velocity Warning	7004 + (x - 1) × 8	X-Axis Acceleration Warning
7001 + (x - 1) × 8	X-Axis Velocity Alarm	7005 + (x - 1) × 8	X-Axis Acceleration Alarm
7002 + (x - 1) × 8	Z-Axis Velocity Warning	7006 + (x - 1) × 8	Z-Axis Acceleration Warning
7003 + (x - 1) × 8	Z-Axis Velocity Alarm	7007 + (x - 1) × 8	Z-Axis Acceleration Alarm

2. For the Vibration values, to return to using an original baseline value for a sensor, set the user-defined register (7001–7320) back to 0.

Enable Current Monitoring

When using the CM1L Condition Monitoring Node, there is an option to use the included 20 Amp or 150 Amp current transformers for current monitoring. Follow these directions to turn on current monitoring and thresholds when using the CM1L Node with your Vibe-IQ predictive maintenance system.

1. Using the DXM Configuration Software, connect to the DXM Controller running the Vibe-IQ Application.
2. Go to **Tools > Register View** screen.
3. Enable current measurements.
 - a. In the **Write Registers** section, select register 854 in the **Starting Register** field.
 - b. Enter a 1 in the **Value** field.
 - c. Click **Write registers**.
4. Set your warning and alarm thresholds.

This value is based on your specific application. Since there is no automatic baselining for current, each application's warning and alarm levels will be different. Enter a warning value for your application that indicates your condition is not normal.

 - a. In the **Write Registers** section, select register 7761 (through 7840) in the **Starting Register** field.
 - b. Enter your thresholds for warnings (registers 7761–7800) and alarms (registers 7801–7840) by entering your value in Amps multiplied by 100. For example, if you want a warning value of 50 A, enter 5000 for that register.
 - c. Click **Write registers**.
5. Read the current reading (A) from registers 6061 through 6100 and the Current Alerts mask from registers 6101 through 6140.

The Current Alerts mask is a one (1) for a warning and a two (2) for an alarm.

Local Registers

The Applications Guide files are shared by Banner Solutions Kits. Some registers described as Solutions Kit functionality are only relevant for systems using the Banner Solutions Kits that use an HMI screen. The variable N represents the Node number 1–40 (equivalent to sensor ID 11–50).

Name	Register	Range	Description	Cloud Push Default
Vibration Data	$1 + (N - 1) \times 5$	1–200	Z-axis velocity (Scaled + 10000)	✓
	$2 + (N - 1) \times 5$		Z-axis high frequency acceleration (Scaled + 1000)	✓
	$3 + (N - 1) \times 5$		X-axis velocity (Scaled + 10000)	✓
	$4 + (N - 1) \times 5$		X-axis high frequency acceleration (Scaled + 1000)	✓
	$5 + (N - 1) \times 5$		Temperature (Scaled + 20) (Signed Reg)	✓
Vibration Mask	$201 + (N - 1)$	201–240	Bit-packed alarm message	✓
Run Flag	$241 + (N - 1)$	241–280	Motor running flag (0/1)	
Sensor Status	$281 + (N - 1)$	281–320	Connection status of radio (128 = Connected)	✓
Baseline	$321 + (N - 1)$	321–360	Indication of baseline and trigger to re-baseline a Sensor Node (0/1)	Read/Write
Raw Register Data	$1 + (N - 1) \times 5$	361–560	Placeholder registers for script	
	$2 + (N - 1) \times 5$			
	$3 + (N - 1) \times 5$			
	$4 + (N - 1) \times 5$			
	$5 + (N - 1) \times 5$			
Warning/Alarm Masks		561–574	OR'd Alarm registers	
Temp OR		575–576		
Status Radio OR		577–578		
Temperature Warning	$581 + (N - 1)$	581–620	Individual temperature warning registers (0/1)	
Temperature Alarm	$621 + (N - 1)$	621–660	Individual temperature alarm registers (0/1)	
Run Thresholds Constants	$661 + (N - 1)$	661–700	Threshold constant for motor run determination	
	$701 + (N - 1)$	701–740		
	$741 + (N - 1)$	741–780		
	$781 + (N - 1)$	781–820		
Site Survey		821–823	Solutions Kit functionality	

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Name	Register	Range	Description	Cloud Push Default
Binding		824		
Alert Warning Lights		825–830	Trigger for lights on DXM related to alerts/alarms	
Sample Count		831	One second timer count up to 300 between samples	
Read Rule Enable		832	System function to trigger read rules when sample count hits 300	
Set Up Nodes		833	Register to trigger Node configuration setup (0/1); controlled by the script	
Sample Time		834	Placeholder registers for script	
Push Count		835		
Nodes 1-10 Status		836	Solutions Kit Functionality	
Nodes 11-20 Status		837		
Nodes 21-30 Status		838		
Nodes 31-40 Status		839		
Fast Sample Trigger		843		
Cloud Push Enable		844	Enable or disable cloud pushing (0/1)	
First Run		851	Solutions Kit functionality (0/1, set to 0 to reinitialize settings)	
Baseline samples		852	Set number of samples for a baseline (default 300)	
Acute Sample		853	Number of samples in a row for acute fault (default 5)	
CT Enable		854	Set to 1 to enable CT measurements (0/1)	
Chronic Fault Trends 100 Point Moving Average	$5021 + (N - 1) \times 4$	5021–5180	Z velocity trend	
	$5022 + (N - 1) \times 4$		Z acceleration trend	
	$5023 + (N - 1) \times 4$		X velocity trend	
	$5024 + (N - 1) \times 4$		X acceleration trend	
Visible Baseline and Alarms	$5181 + (N - 1) \times 12$	5181–5660	Baseline and thresholds being used for alarms (Selected from Learned or User Defined)(X Velocity(3), Z Velocity(3), X Acceleration(3), Z Acceleration (3). (Scaling = Velocity ÷ 10000, Acceleration ÷ 1000)	Push once a day at UTC 00:00
Learned Thresholds	$5661 + (N - 1) \times 8$	5661–5980	Calculated baseline and thresholds from algorithm (used in 5181-5660 if equivalent user thresholds in 7001-7320 are set to 0)(X Velocity(3), Z Velocity(3), X Acceleration(3), Z Acceleration (3) (Scaling = Velocity ÷ 10000, Acceleration ÷ 1000)	
Scaled Temp Reading	$5981 + (N - 1)$	5981–6020	Placeholder registers for script	
User Selected Nodes	$6021 + (N - 1)$	6021–6060	Solutions kit functionality	
Current (A) Reading	$6061 + (N - 1)$	6061–6100	Current reading in amps from CM node if used (Scaled ÷ 100)	✓
Current Alerts Mask	$6101 + (N - 1)$	6101–6140	Current alerts mask (bit 1 warning, bit 2 alarm)	✓
User Defined Thresholds	$7001 + (N - 1) \times 8$	7001–7320	User-defined vibration thresholds (will override learned thresholds) (X Velocity(2), Z Velocity(2), X Acceleration(2), Z Acceleration (2) (Scaling = Velocity ÷ 10000, Acceleration ÷ 1000)	
Saved Count/Mean/StdDev	$7321 + (N - 1) \times 9$	7321–7680	Solutions Kit functionality	
Temp Warning Thresholds	$7681 + (N - 1)$	7681–7720	User-defined temperature thresholds (unscaled)	Push once a day at UTC 00:00 / Write
Temp Alarm Thresholds	$7721 + (N - 1)$	7721–7760		
Current Warning Thresholds	$7761 + (N - 1)$	7761–7800	User-defined current thresholds (scaled ÷ 100)	
Current Alarm Thresholds	$7801 + (N - 1)$	7801–7840		
Current Scale	$7841 + (N - 1)$	7841–7880	Current scale (read from DIP switches but user-adjustable for non-standard CTs) (unscaled)	

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