# VibeIQ Mode

Banner's VibeIQ machine learning algorithm simplifies the challenging task of setting up a vibration condition monitoring system.

VibeIQ uses the collected vibration data to determine if an asset is running to generate an initial baseline of the asset and set custom alert thresholds. This custom baseline profile includes specific information, including load and speed variability, asset age, and specific application to create unique thresholds instead of generic ones.

Using VibeIQ can dramatically reduce the time and effort required to establish a predictive maintenance system by removing the knowledge barrier to entry. This results in extended asset life and reduces unexpected downtime by having an early alert system to indicate when maintenance is required. On the same level, this can free up maintenance teams for higher-value work instead of spending time taking vibration readings and monitoring assets that are in good condition.

The QM30VT3 vibration and temperature sensors have this mode built into the sensor and only require a few steps to begin the baselining process. Previously this data had to be collected by a controller and processed at the edge or in the cloud. The configuration registers in 6007-6011 are used to set up the initial parameters that can be used for all future baselines.

*Configuration registers 6007–6011*

| Register | Description |
|---|---|
| 6007 | Number of samples used to generate baseline |
| 6008 | Sample rate for how often a new data point is used towards the baseline (seconds) |
| 6009 | Acute Fault samples, the number of consecutive running samples of vibration data after the baseline is established to trigger an acute fault when above the learned thresholds |
| 6010 | Chronic Fault samples, the number of running samples of vibration data after baseline is established that are used in a moving average to trigger a chronic fault when this moving average crosses the learned thresholds. |
| 6011 | Units (0 = Imperial, 1= Metric) |

The length of the baseline is determined by how often the asset is running, the number of samples used for the baseline, and the sample rate. If you are uncertain how long to collect the baseline data, we recommend about 24 hours of running time or one full load/process cycle that this asset may go through, whichever is longer, to capture all the possible system variability.

The motor is determined to be running using certain defaults limits established by default on the sensor. These thresholds can be adjusted in registers 6012-6017 but typically only require adjustments in unique circumstances. These default parameters are very accurate at determining the running state of a motor and only require adjustment in scenarios where either the sensor is picking up a significant amount of vibration being coupled in from other vibrating sources in the surrounding area, such as a large non-isolated motor, or the sensor is being used on an asset with limited signal output, which can often be corrected by improving the mounting location. In almost all cases, place the sensor as close to the bearing on a cast surface to accurately collect vibration data trends.

After configuration parameters are established, triggering a new baseline only requires sending a value of 1 to register 6001. When the sensor is completing the baseline, the number of remaining samples can be seen in register 6003. After the baseline is finished, baseline and threshold values are placed in registers 6018–6035. This includes a baseline value, warning and alarm threshold for each of the three axes on both the RMS velocity, and high-frequency acceleration data. These values remain constant unless a new baseline is triggered and can be collected for visualizing against the raw vibration data. It is recommended to trigger a new baseline after heavy preventative maintenance or asset replacement is completed.

The VibeIQ mode is focused on trending the RMS Velocity and High-Frequency Acceleration levels. If these values are not increasing beyond the thresholds, nothing beyond standard maintenance should be required. When these parameters begin to trend upward, this can be an early indication of a failure mode appearing.

The RMS Velocity is a parameter taken from the lower frequency area of the sensor's bandwidth (below 1000 Hz). RMS Velocity trending update indicates issues related to imbalance, misalignment, looseness, soft foot, eccentricity, etc.

The RMS High-Frequency Acceleration is a parameter taken from the higher frequency area of the sensor's bandwidth (above 1000 Hz). This parameter and associated faults are indications of early bearing wear, lubrication issues, gear faults in a gearbox, cavitation on a pump, etc.

Temperature is also a critical component of motor monitoring and although the VibeIQ algorithm does not provide baselining or automatic threshold generation, there are registers available for users to set their own thresholds. When the temperature rises above these thresholds, the alert flags will be set for indication.

There are two registers dedicated to providing alert status: 6038 and 6039. These are bit-packed registers where each bit is an indication of a different level or type of fault. There is a warning and alarm level for both RMS Velocity and RMS High-Frequency Acceleration across two types of faults: Acute or Chronic.

Acute faults are triggered when the raw vibration sample data of a running motor rises above the warning or alarm level for multiple samples in a row. The number of samples in a row is based on the user setting in register 6008 (default of 5). An acute fault can be an indication of a quicker developing fault such as a machine jam, belt slip, etc., but due to the volatile nature of vibration signals, some demodulation is necessary to avoid nuisance fault indication. To avoid nuisance fault indications, adjust the acute fault samples register.



© Banner Engineering Corp. All rights reserved.
www.bannerengineering.com

b_51937365
p/n: b_51937365 Rev. A

The Chronic faults are based on a 100-point moving average of running samples. When that trend rises above the warning or alarm thresholds, the chronic alert bits trigger. This type of fault indicates a much longer growing trend upward from asset age/fatigue, spalling within the bearing, etc. A chronic fault could also be an indication that an acute fault was left in that state long enough and it was unable to clear itself.

Typically, an acute fault triggers first, but this isn't always the case if the data is bouncing above and below the threshold because each sample below the threshold restarts the acute sample consecutive count. The bit maps for the different alerts in registers 6038 and 6039 are as follows:

*Alert bitmaps for registers 6038 and 6039*

| Register | Bit packed bit location | Description |
|---|---|---|
| 6038 | 0 | X-Axis Velocity Acute Warning |
| | 1 | X-Axis Velocity Chronic Warning |
| | 2 | X-Axis Velocity Acute Alarm |
| | 3 | X-Axis Velocity Chronic Alarm |
| | 4 | X-Axis Hi Accel Acute Warning |
| | 5 | X-Axis Hi Accel Acute Alarm |
| | 6 | X-Axis Hi Accel Chronic Warning |
| | 7 | X-Axis Hi Accel Chronic Alarm |
| | 8 | Y-Axis Velocity Acute Warning |
| | 9 | Y-Axis Velocity Chronic Warning |
| | 10 | Y-Axis Velocity Acute Alarm |
| | 11 | Y-Axis Velocity Chronic Alarm |
| | 12 | Y-Axis Hi Accel Acute Warning |
| | 13 | Y-Axis Hi Accel Acute Alarm |
| | 14 | Y-Axis Hi Accel Chronic Warning |
| | 15 | Y-Axis Hi Accel Chronic Alarm |
| 6039 | 0 | Z-Axis Velocity Acute Warning |
| | 1 | Z-Axis Velocity Chronic Warning |
| | 2 | Z-Axis Velocity Acute Alarm |
| | 3 | Z-Axis Velocity Chronic Alarm |
| | 4 | Z-Axis Hi Accel Acute Warning |
| | 5 | Z-Axis Hi Accel Acute Alarm |
| | 6 | Z-Axis Hi Accel Chronic Warning |
| | 7 | Z-Axis Hi Accel Chronic Alarm |
| | 8 | Temperature Warning |
| | 9 | Temperature Alarm |

| Modbus address (4x holding registers) | Description | I/O range | | Scaling | |
|---|---|---|---|---|---|
| | | Minimum | Maximum | Imperial | Metric |
| 6001 | Baseline trigger | 0 | 1 | - | - |
| 6002 | Baseline acquisition status | 0 | 65535 | - | - |
| 6003 | Baseline samples remaining | 0 | 65535 | - | - |
| 6004 | Velocity threshold comparison mode | 0 | 1 | - | - |
| 6005 | Acceleration threshold comparison mode | 0 | 1 | - | - |
| 6006 | Running threshold options AND vs OR | 0 | 1 | - | - |
| 6007 | Number of baseline samples | 0 | 65535 | - | - |
| 6008 | Sample rate for baselining (seconds) | 0 | 65535 | - | - |
| 6009 | Number of acute fault samples | 0 | 1 | - | - |
| 6010 | Number of chronic fault samples | 0 | 65535 | - | - |
| 6011 | Imperial (0) or metric (1) | 0 | 1 | - | - |

Continued on page 3


© Banner Engineering Corp. All rights reserved.
www.bannerengineering.com

Continued from page 2

| Modbus address (4x holding registers) | Description | I/O range | | Scaling | |
|---|---|---|---|---|---|
| | | Minimum | Maximum | Imperial | Metric |
| 6012 | X-axis RMS velocity running threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6013 | Y-axis RMS velocity running threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6014 | Z-axis RMS velocity running threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6015 | X-axis RMS high-frequency acceleration running threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6016 | Y-axis RMS high-frequency acceleration running threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6017 | Z-axis RMS high-frequency acceleration running threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6018 | X-axis RMS velocity baseline (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6019 | Y-axis RMS velocity baseline (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6020 | Z-axis RMS velocity Baseline (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6021 | X-axis RMS high-frequency acceleration baseline (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6022 | Y-axis RMS high-frequency acceleration baseline (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6023 | Z-axis RMS high-frequency acceleration baseline (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6024 | X-axis RMS velocity warning threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6025 | Y-axis RMS velocity warning threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6026 | Z-axis RMS velocity warning threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6027 | X-axis RMS high-frequency acceleration warning threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6028 | Y-axis RMS high-frequency acceleration warning threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6029 | Z-axis RMS high-frequency acceleration warning threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6030 | X-axis RMS velocity alarm threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6031 | Y-axis RMS velocity alarm threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6032 | Z-axis RMS velocity alarm threshold (in/s or mm/s) | 0 | 65535 | / 10,000 | / 1,000 |
| 6033 | X-axis RMS high-frequency acceleration alarm threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6034 | Y-axis RMS high-frequency acceleration alarm threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6035 | Z-axis RMS high-frequency acceleration alarm threshold (g) | 0 | 65535 | / 1,000 | / 1,000 |
| 6036 | Temperature warning threshold (°F or °C) | -32767 | 32767 | / 100 | / 100 |
| 6037 | Temperature alarm threshold (°F or °C) | -32767 | 32767 | / 100 | / 100 |
| 6038 | Alert flags low word | 0 | 65535 | - | - |
| 6039 | Alert flags high word | 0 | 65535 | - | - |


© Banner Engineering Corp. All rights reserved.
www.bannerengineering.com