Machine Saver

The Solution Before the Problem

4-20 mA Transmitter vs. Machine Saver's VTBNet

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The 4-20 mA Transmitter vs. Machine Saver's VTBNet

OUT WITH THE OLD – IN WITH THE NEW

Protecting and monitoring your plant machinery with a two-wire 4-20 mA vibration transmitter is no different than using a rotary telephone in the age of smartphone technology. This tech note shows how Machine Saver's VTBNet remote vibration and condition monitoring system can provide real-time, actionable information at a lower overall cost. Machine Saver uses Modbus communications protocol, a tried and true tool that uses less wiring while providing the user with useful, actionable information.

HOW IS MACHINE SAVER DIFFERENT THAN THE 4-20 MA TRANSMITTER?

Machine Saver set out to go above and beyond with the VTBNet solution. The Machine Saver development team did not want to be a "me too" solution, but instead a brand new packaged solution that is made up of tried and true technology that is common and familiar across the globe, and applicable in every perceivable manufacturing industry.

Modbus is the most popular industrial protocol used today. Modbus has existed since 1979 – over 35 years – and almost all major instrumentation and automation equipment vendors support Modbus in new products. This protocol is simple, inexpensive, universally understood, and easy to use.

Modbus can run over virtually all communication media, included twisted pair wires, cellular signals, and Ethernet. New PLCs and DCS systems may have a wireless, Ethernet, or fieldbus interface, and Modbus is still the protocol implemented in old and new applications. Simply put, a Modbus connection can be established in a new or existing plant fairly easily, and one growing application for Modbus is in initiating digital communications in older plants by using existing twisted wire pairing.

Essentially, Modbus is a "master-slave" system, whereby the "master" communicates with one or multiple "slaves." The master is typically a PLC, DCS, or a PC. Slave devises on Modbus networks cannot initiate communication; they can only respond… or, they only speak when spoken to. The two versions used today are Modbus RTU and Modbus TCP/IP. There are many differences between these two Modbus configurations.

Modbus RTU data is coded in binary, and requires only one communication byte per data byte. The slaves are often field devices, all of which connect to the network in a multi-drop configuration. When communicating with slaves, device addresses are utilized. When a RTU master (PLC, DCS, or PC) requests information from a device (for example, a VTBNet sensor configured for RS485 RTU), the master sends a message that contains the device's address, the data it needs, and a checksum for error detection. Every other device on the network sees the message, but only the device that is addressed responds. RTU has a limitation of over 247 nodes per network. RTU is ideal for long distances and multi-drop RS485 networks.

Modbus TCP/IP is used over Ethernet, and Modbus packets are encapsulated in standard TCP/IP packets. When communicating with slaves, IP addresses are used. This enables TCP/IP devices to immediately and easily connect and communicate over existing Ethernet networks. Modbus TCP/IP networks can have as many slaves as the physical layer can handle, usually 1,024 slaves. TCP/IP permits the use of multiple Masters, supports gigabyte-level speeds, and allows many more addresses than RS485. Ethernet's rapid adoption within the

process control and automation industry has allowed Modbus TCP/IP to become the most widely used, fastest growing, and supported industrial protocol over Ethernet.

Reliability and vibration data is extremely valuable to maintenance and reliability personnel. Modbus RTU or TCP/IP can be implemented quickly and reliably, all for an affordable price. Once a Modbus system is set up, adding more Machine Saver VTBNet intelligent, Modbus sensors to the data bus is often as simple as a few cut and paste functions. Additionally, other smart sensors for other process variables may also be added to the same bus.

THE TWO WIRE 4-20MA VIBRATION TRANSMITTER

Milliamp (mA) current loop technology was invented and implemented many decades ago, in the late 1890s. Today's current 4-20 mA vibration transmitters were designed in the 1980s, and not much has changed since that time. These transmitters give the end user only one overall value to indicate the condition on one particular axis of vibration on the machine (oppositely, Machine Saver's VTBNet offers data from **three** axes of vibration – plus temperature – from **one** sensor).

Today, many plants still use these outdated 4-20 mA analog transmitters, and they are often provided by an OEM. Even with this equipment installed at the time of production, maintenance staffs are often unfamiliar with the capabilities and limitations of the 4-20 mA transmitter. In the end, the owners and operators of the process machines must bear the plant's diminished output and revenue losses when processes are not protected against excessive and destructive forces, such as:

- Misalignment
- Out of balance or looseness situations
- Impending bearing wear/failure conditions

4-20 mA loops are relatively easy to install and program, although the information they provide is extremely limited. A two-wire vibration transmitter does not have the capability to communicate the vibration fault frequency or other vibration data – which is vital to understanding why a machine is failing. The transmitter can only "see" one axis of vibration; bear in mind that machine vibration is always orbital, and vibration movement occurs in all three axes at the same time. So, one 4-20 mA transmitter can only give you a third of the data one needs to properly care and diagnose equipment.

MACHINE SAVER AND Modbus – A WINNING COMBINATION

Machine Saver manufactures and installs cutting edge vibration monitoring solutions for reliable machine protection and condition monitoring. Centered around a smart, addressable tri-axial sensor, the digital, Modbus-enabled Machine Saver sensor permits reliability engineers and maintenance professionals to easily monitor balance of plant equipment. The sensor is suitable for rotating machine applications such as motors, fans, engines, centrifuges, and cooling towers, as well as reciprocating machines like compressors and pumps.

The sensor provides overall vibration level outputs for the X, Y, and Z axes in acceleration and velocity, in addition to temperature output. Machine Saver's sensor has a programmable low-pass, high-pass, or band-pass filter capability.

Up to 250 sensors can be daisy-chained together (reducing wiring and installation costs) and can be connected to the plant PLC or DCS. The

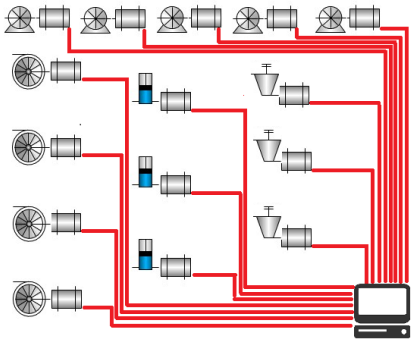
sensors communicate through a cellular gateway, and do not interfere with other wireless equipment you may already be using.

Machine Saver's web portal provides remote monitoring capabilities such as: text message/email upon alarms, historical trends, dynamic data (Time Waveform, Acceleration FFT, Velocity FFT), and expert remote vibration monitoring assistance.

PROS AND CONS OF THE 4-20 MA TRANSMITTER

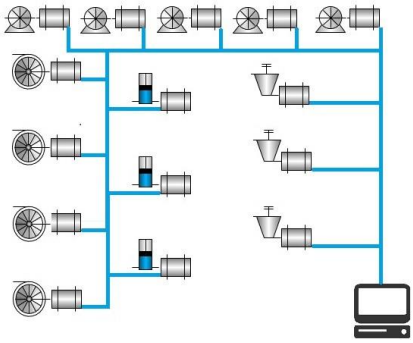
+ Simplest option to connect and configure
+ Not sensitive to background electrical noise
+ Effective for long-distance connections, as the current does not degrade
– Can only detect vibration in one axis, which only gives 1/3rd of the needed information
– One current loop can only transmit one process variable – transmitted information, therefore, is limited to one parameter
– No spectrum or time waveform data collection system available for condition monitoring, and NO advanced warning for a deteriorating machine's condition
– 4-20 mA analog output no longer a viable standard, as more plants transition to digital networks
– Susceptible to direct and indirect two-way radio interference
– No field accessible calibration adjustments – simply a pass/fail, disposable unit
– Calibration verified with a time-consuming and cumbersome process involving a portable shaker table… but transmitters cannot be recalibration to improve performance
– More wiring used for milliamp current loops than with Modbus wiring, which leads to higher costs and installation mistakes. Installation, labor, and conduit cost typically costs 30% or more than single cable installation for Modbus data bus.

MORE CAPABILITIES WITH LESS WIRE



4-20 mA information provided:

- Velocity overall X axis
- Out of range or fault



Modbus information provided:

- Velocity overall for X, Y and Z axes
- Acceleration overall for X, Y, and Z axes
- Bearing temperature
- Sensor OK status
- High alarm status
- High High alarm status
- Dynamic spectrum acceleration (FFT)
- Dynamic spectrum velocity (FFT)
- Time waveform
- Kurtosis
- Crest factor
- Mechanical looseness (impact) count
- Power supply voltage
- System error messages