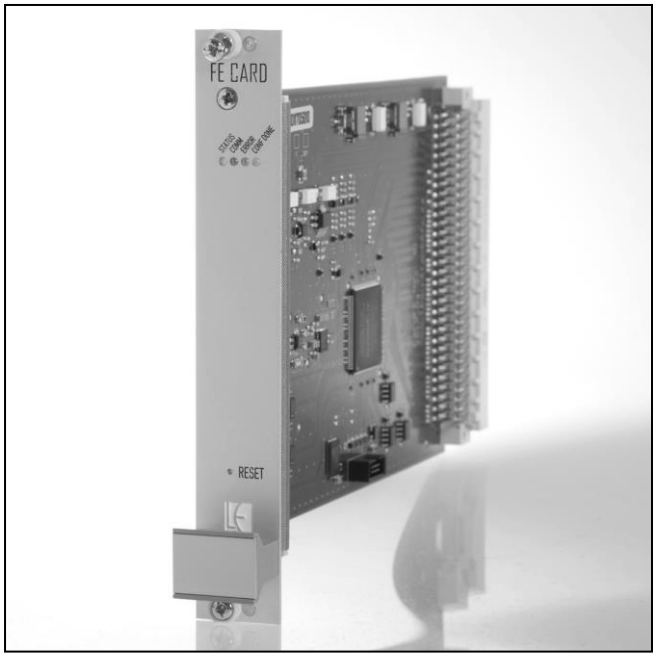
## General Description

The VMS-1301 acquisition card is specially designed to manage high demands of the Blade Tip Timing methods, which is high sampling rate of analog sensor signal, sophisticated multi-threshold settings, and oscilloscope mode for in-depth analysis of every single blade. The selected FPGA technology allows for very fast signal processing at 100 MSa/s that gives us an advantage in comparison with other systems. Moreover, it is possible to process each channel with different trigger methods based on the signal character or sensor type.

VMS-1301 is compatible with all VMS-1XXX series platforms.



*VMS-1301 – Data Acquisition Card*

## Functions and Benefits

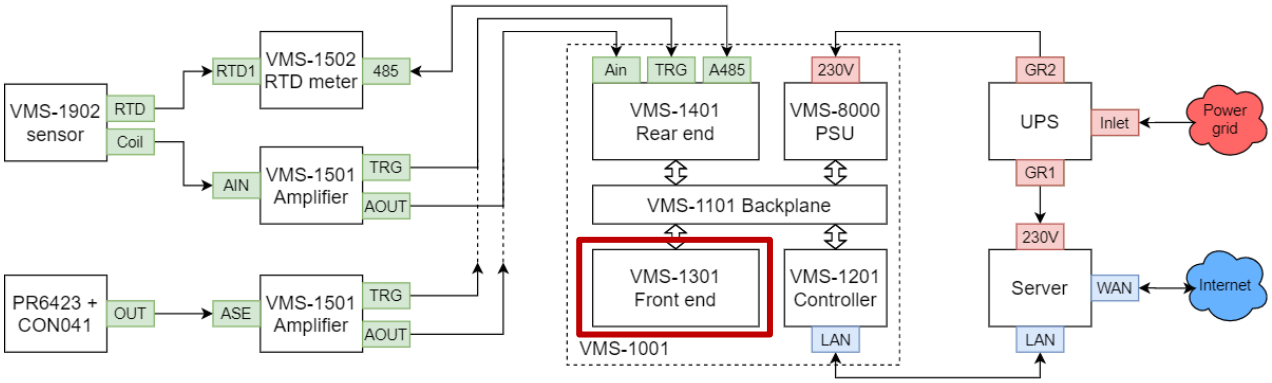
- Analog signal high-speed sampling and processing
- Programmable trigger threshold and hysteresis
- Oscillogram view of raw signal shape
- Programmable trigger signal conditioning
- Digital signal RS-485 trigger input
- Remote firmware update via VMS-1201 Controller

## Parameters

| Parameter | Value | | |
|---|---|---|---|
| | Minimum | Typical | Maximum |
| Mounting | 3U card with DIN41612 connector | | |
| Width | 4 HP | | |
| Number of analog input channels | 1 | | |
| Number of digital input channels | 1 | | |
| Ambient temperature | -40 °C | | 85 °C |
| Analog signal gain | | 0.98 | |
| Analog signal offset | -60 mV | 0 mV | 60 mV |
| Analog signal peak-to-peak noise (0 V input) | 15 mV | 20 mV | 25 mV |
| Analog signal voltage | -10 V | | 10 V |
| Analog signal resolution (1 LSB) | | 4.883 mV | |
| Digital signal speed | | 50 Mbit/s | |
| Power supply consumption at +5 V supply | 3 mA (off) | 200 mA | |
| Power supply consumption at +12 V supply | 1 mA (off) | 20 mA | |
| Power supply consumption at -12 V supply | 1 mA (off) | 15 mA | |
| Input impedance for analog signal | 2 kOhm | | |
| Sampling frequency of AD conversion | 100 MHz | | |

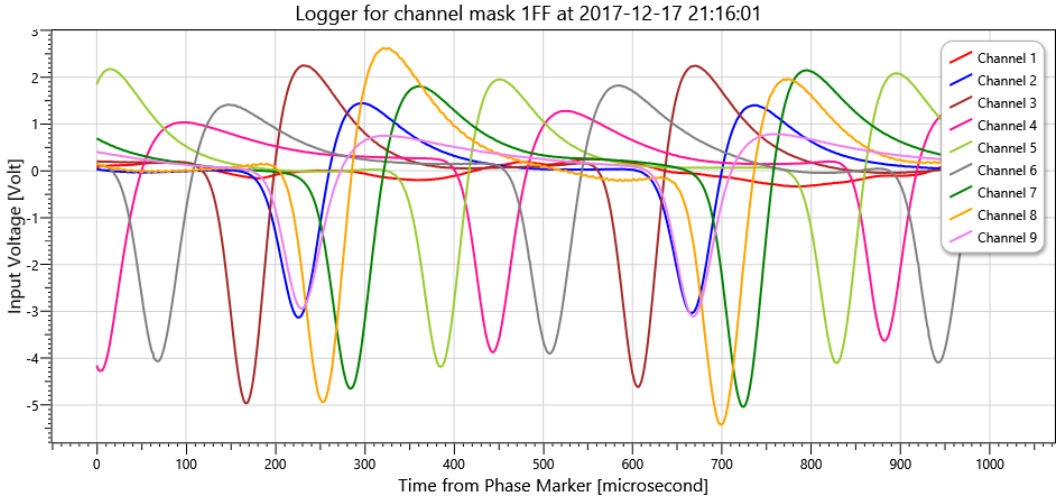
# VMS Platform Overview

The VMS-1301 is an analog front-end part of the VMS platform as highlighted below. This figure represents example of VMS installation based on VMS-1001.
At the very beginning of measuring chain, there is an inductive sensor VMS-1902 that measures response of passing-by blade and returns a voltage signal. This signal is amplified and conditioned by VMS-1501 amplifier and lead to the VMS-1401 rear-end entry point in form of both differential analog and digital (threshold) signals. Note that other sensors (such as eddy current PR6423, magnetic speed sensor PR9376, or isolator P27000) can be used for measurement if they are connected through VMS-1501 amplifier. Inside the VMS-1001 chassis, these signals are connected through VMS-1101 backplane into VMS-1301 front-end card for analog-to-digital conversion and/or digital signal capture.
The set of VMS-1902 (or other sensor), VMS-1501, VMS-1401, and VMS-1301 compose a single measurement channel. The chassis VMS-1001 supports up to 16 independent channels, chassis VMS-1002 supports up to 4 channels.
If the sensor contains RTD temperature detector (PT100 or PT1000), RTD meter VMS-1502 can be used. The VMS-1502 measures 6 RTD sensors at the time, so 6 measurement channels share a single device. It communicates directly with VMS-1201 controller that supports up to 3 RTD meters.
The result of analog conversion and triggering (or capture of digital signal) inside the VMS-1301 is then sent to the VMS-1201 controller by means of LVDS (low-voltage differential signaling) time mark. The VMS-1201 controller gathers time marks from all channels and creates time mark data package upon phase marker arrival. The data package is then sent to the Server for processing and vibration analysis. Server also runs software for complete VMS platform configuration and monitoring.
It is a good practice to have the whole platform connected to an Uninterruptable Power Supply as a sudden power shortage may disrupt consistency of the software.



## Main Features

The most important role of VMS-1301 in the VMS platform is to capture amplified analog signal, convert it to digital form and apply configurable trigger condition to obtain time marks. In order to achieve very high resolution in time, high-end analog to digital converter with 100 million samples per second is used. Thanks to used FPGA technology, the VMS-1301 evaluates trigger condition every 10 ns that results in measurement with exceptional resolution. The most common trigger parameters are edge type, threshold voltage and hysteresis voltage. However, more complex conditions may be integrated if needed in the future.
The sampled signal can also be logged into an internal buffer and sent to the server to get an oscillogram waveform view of the input analog signal. Along with measured moving minimum and maximum values, such an insight view is very beneficial during system commissioning, monitoring, and maintenance. Capture on all independent channels can be synchronized by phase marker or external trigger. The figure below shows captured logger of 9 channels in VMS Setup software tool.




## Pin Description

The VMS-1301 has no connector for external wiring.

## Backplane Interface

The VMS-1301 communicates with the rest of the VMS-100X platform via backplane connector including the following signals.

| Name | Description |
|---|---|
| EMIF | Parallel 16-bit multiplexed address and data memory interface. |
| LVDS-A | Primary low-voltage differential signals for time measurement. |
| LVDS-B | Secondary low-voltage differential signals for time measurement. |
| Power | Power supply +5 V, +12 V, -12 V. |
| Address | Position within the backplane. |
| Analog | Analog raw signal connected through VMS-1401 from rear end. |
| Digital | Digital trigger signal connected through VMS-1401 from rear end. |
| RS-485 A | Primary RS-485 bus for Modbus RTU communication. |
| RS-485 B | Secondary RS-485 bus used for time synchronization. |

## Wiring and Power-up

The VMS-1301 has no connector that allows for any wiring. It can be used only when plugged into VMS-110x backplane using VMS-100x chassis that assures signal integrity and prevents from any misuse.
Recommended power-up sequence when manipulating with VMS-1301:

1. Assure that given channel is turned-off in configuration software
2. Power down whole system by main power switch on back side of VMS-100x
3. Plug in the VMS-1301
4. Power up whole system by main power switch on back side of VMS-100x
5. Turn on the channel in configuration software
6. Configure related parameters

## Led Indication

For simple behavior indication, the VMS-1301 is equipped with four indicating LED diode on the front panel. From left to right they have the following meaning

| Label | Color | Meaning |
|---|---|---|
| STATUS | Green | Firmware status. This LED should blink at 1 Hz when all systems are working |
| COMM | Green | Communication with controller. This LED blinks when there is ongoing backplane communication on memory interface, e.g., when logger is retrieved or when some parameter changes. |
| ERROR | Red | Error that prevents this device to operate correctly. Mainly hardware malfunction. |
| CONF DONE | Red | Configuration of FPGA NOT done. If this LED shines, FPGA is not able to load configuration from external memory. Firmware is probably corrupted, and the device is not working. |

## Pinhole Button

There is a pinhole reset button at the bottom of the front panel. Press of this button causes the firmware to reset its state, which is supposed to be used in special cases of channel malfunction. This button does NOT perform power reset NOR FPGA firmware reconfiguration.

## Device Limitations

### Heat-up

High-precision, low-noise operational amplifier and high-speed ADC used in this device work with higher bias current and have higher power consumption. These parts may self-heat up to 20 °C above ambient temperature. The used industrial-grade parts should however withstand such temperatures over the whole recommended ambient temperature range.

## Norm Compliance

This product was developed and manufactured with the compliance of following European norms (EN):

- EN 61000-4
- EN 55032
- EN 50581:2013

CE

## Document revisions

| Revision number | Date | Remarks |
|---|---|---|
| Rev 01.0 | 06/2017 | Document release |
| Rev 02.0 | 09/2020 | Add block diagram and description. New parameters table.<br>Relevant for SN 1301-2008-0001 and newer |