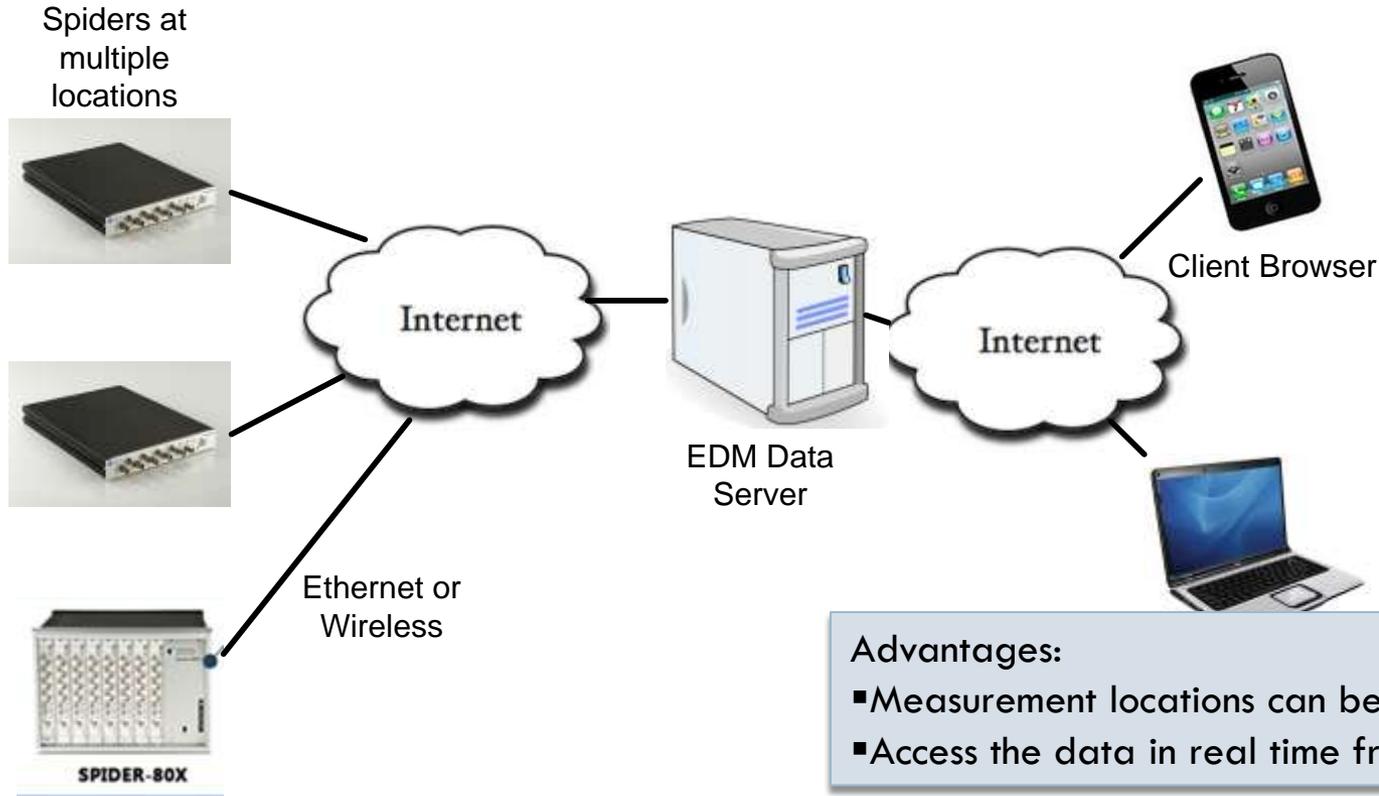


EDM Cloud

Remote Monitoring Solutions

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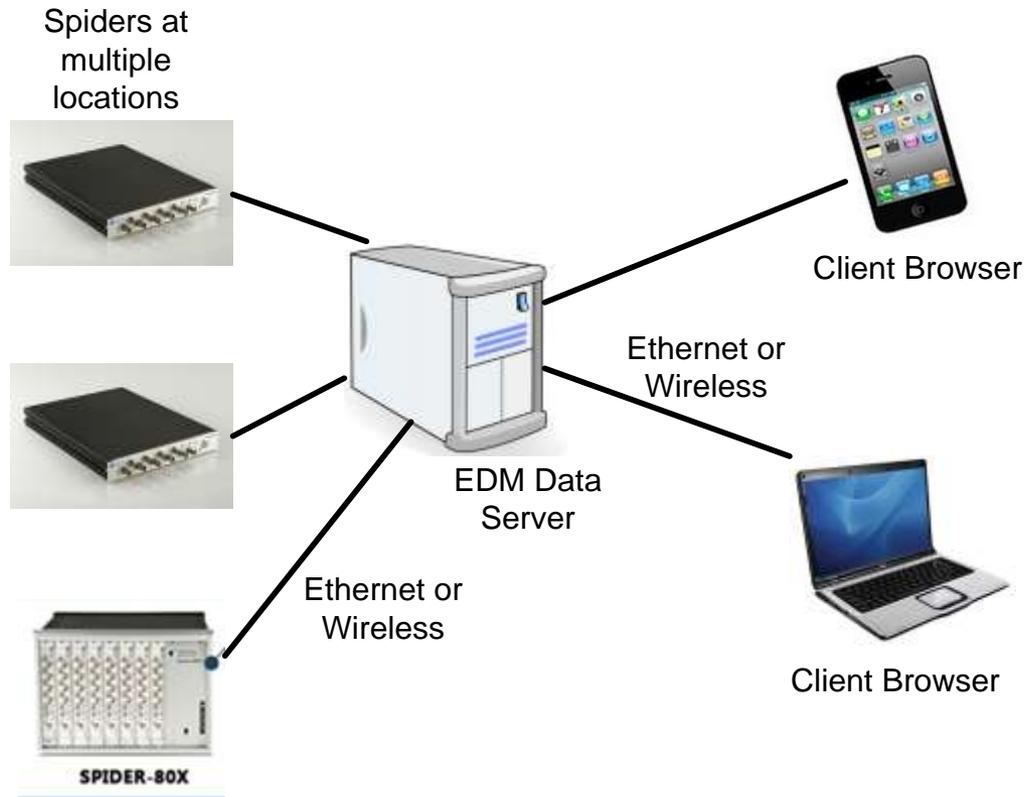
Architecture 1: EDM Cloud runs on the Internet



Advantages:

- Measurement locations can be far away from the users
- Access the data in real time from anywhere

Architecture 2: EDM Cloud runs on a Local Area Network (LAN)



Advantages:

- High speed data access and data transfer.
- Limitation: LAN might be limited by the physical installation

Typical Applications

- Wind Turbine Conditioning Monitoring
- Rotating Machine Monitoring
- Construction Noise
- Cooling Fan Vibration Monitoring
- Airport Noise
- Highway Tunnel, Railway Tunnel Vibration

What Can be Measured with a Spider System

- Vibrations with alarm limits
 - ▣ Time blocks
 - ▣ Long recording signals
 - ▣ RMS or peak levels
 - ▣ Harmonics level
 - ▣ Power spectra
 - ▣ FRF (Frequency response function)
 - ▣ Phase measurement
- Various sound levels with alarm limits
- Temperature, humidity, voltage, strain gage

Access Data and Instruments Anywhere

- Access the instruments and data center with history data online
- Hardware can be offline or online
- Web based client application (no software installation)
- Share online information with your stakeholders via Internet

Unique Hardware Solution

- Spider-80X has extremely compact packaging
 - ▣ Size approximately letter size
 - ▣ Full Ethernet connection
 - ▣ 150dBFS dynamic range: input range selection not needed
 - ▣ Onboard flash memory storage
- Spider-DAQ: Measure strain, high voltage, temperature, humidity
- Input channels expandable

Spider-80X Module



Front View: 8 input channels with control buttons



Back View: Power, Ethernet connector, GND, RS-485, reset button

A 64 channel System consists of Eight Spider-80X

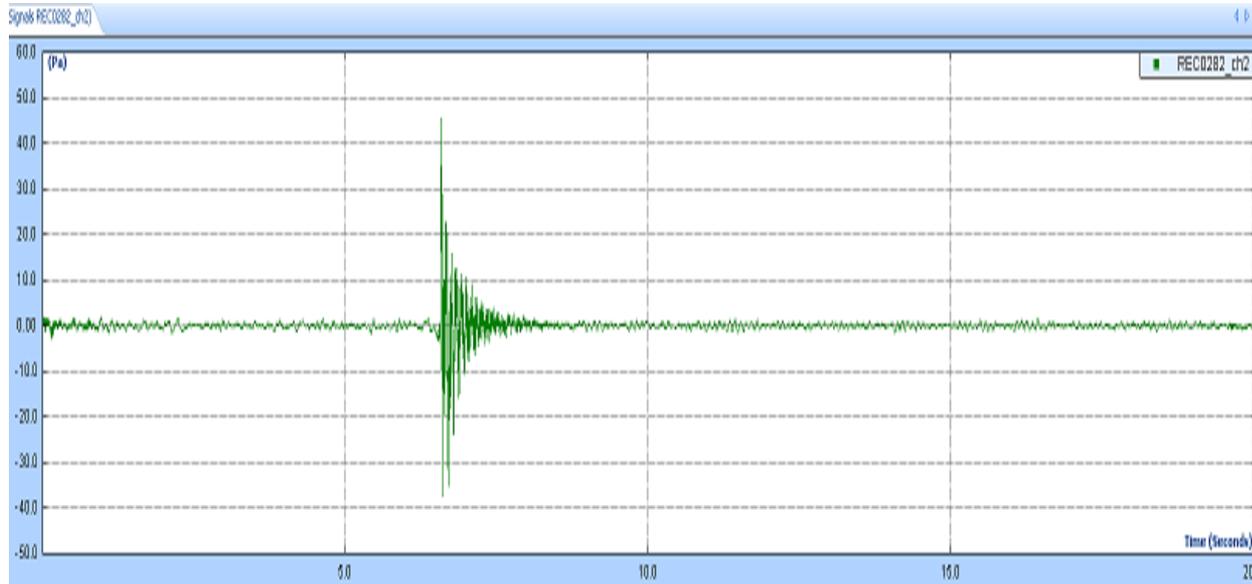


Spider-DAQ Module

- The Spider-DAQ is a module that can either connect to a PC using an Ethernet connection or run without a PC. Using various 8B modules, the Spider-DAQ can measure voltage, strain, current, frequency, temperature, and many more physical quantities.



Dynamic Range is Critical



In machine condition monitoring, one of the biggest challenges is how to measure both large and small signals without changing the input settings

Patented Dual A/D Technology Provides 150 dB Dynamic Range for Input Measurement



US007302354B2

(12) **United States Patent**
Zhuge

(10) **Patent No.:** **US 7,302,354 B2**
(45) **Date of Patent:** **Nov. 27, 2007**

(54) **CROSS-PATH CALIBRATION FOR DATA ACQUISITION USING MULTIPLE DIGITIZING PATHS**

6,970,118 B2 11/2005 Regier 341/118
6,980,134 B2 12/2005 Ely et al. 341/20

OTHER PUBLICATIONS

(75) Inventor: **James Zhuge**, Palo Alto, CA (US)

Anderson, Ole Thorhauge et al., "New Technology Increases the Dynamic Ranges of Data Acquisition Systems Based on 24-bit Technology," *Sound and Vibration*, Apr. 2005, pp. 8-11.

(73) Assignee: **Crystal Instruments Corporation**, Sunnyvale, CA (US)

* cited by examiner

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 49 days.

Primary Examiner—John Barlow

Assistant Examiner—Hien Vo

(74) *Attorney, Agent, or Firm*—Law Offices of Terry McHugh

(21) Appl. No.: **11/392,198**

(22) Filed: **Mar. 28, 2006**

(57)

ABSTRACT

Multi-Level User Administration

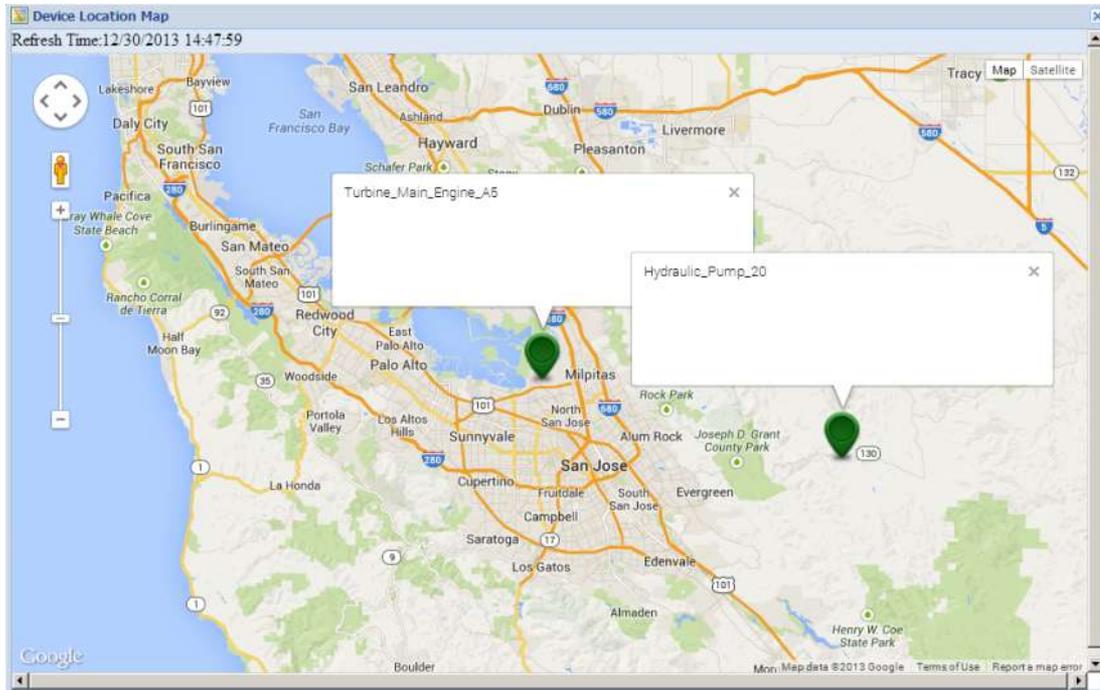
- **Super-Admin**: Has the rights to install, upgrade and configure the server software. Also has the rights of Admin and Users.
- **Admin**: Has the rights to configure the Project, Measurement List, Location of Spiders, Signal List and Runlog. Also has the rights of Users
- **User**: Only has the rights to view or download the measurement data, runlog, events. Does not have rights to change the settings

Log in anywhere with a Browser



Supports PC, iPod,
Android Phone etc.

Device Location Map



Location of Spider device can be set by their longitude and latitude and then displayed on the Google Map.

Automated Schedule and Limiting Test

- Automated limit test function allows the Spider-80X to conduct automated limit checking for time or frequency signals.
- **Test Signals:** time block signals, auto spectrum, frequency response function, octave spectrum.
- **Limit Signals:** user defined upper or low limit signals. For spectra signal the spectrum type will also be assigned. Limit signals will be bound to testing signals. Maximum segments of each limit signal: 64; Maximum number of limit signals: 64.
- **Testing Schedule:** automatically control the test duration and automates the operation. Multiple testing schedules can be developed and one is executed at a time. Testing schedule event entries: loop/lend-loop, run duration, hold, limit check on, limit check off, start recording, stop recording, save signals, turn signal source on and turn signal source off.
- **Testing Log and Summary Report:** a log file is automatically created for each run of the schedule to record up to 1024 major events. A summary report is provided for the limiting check status for the last schedule run.
- **Limit Check Alarm Events:** beep, screen flashing, add event to testing log, send message to host PC, save signals, and send emails or text messages.

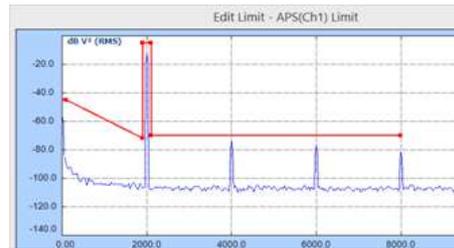
Data Recording with High Reliability

- Acquire time and frequency data continuously up to 102.4 kHz for all channels
- Record up to 4 GB data into internal flash memory
- Large buffers increase reliability
- Reserve power supply recovers data in the event of power loss

How Customized Event Strings work?

Step 1

EDM sets the alarm limit together with a special message string, such as "Exceeding Limit"



Step 2

When alarm event happens, the customized string, "Exceeding Limit" will be sent to the EDM Cloud email service

Step 3

User will receive an alarm email



EDM Cloud Email Service

Reset Spider Devices Remotely

- Provide two ways to reset the Spider hardware devices remotely
 - ▣ A built-in watchdog can be used. In case software failure, watchdog can detect the hung-up and restart the system automatically
 - ▣ As long as the user can “ping” the Spider device remotely, the user can send a special command to the hardware to restart it



Step by Step Configuration



Hardware Configuration: Wired Connection

- The Spider devices are connected to the Ethernet routers
- Routers communicate to the server located on LAN or the Internet



Hardware Configuration: Wireless Connection

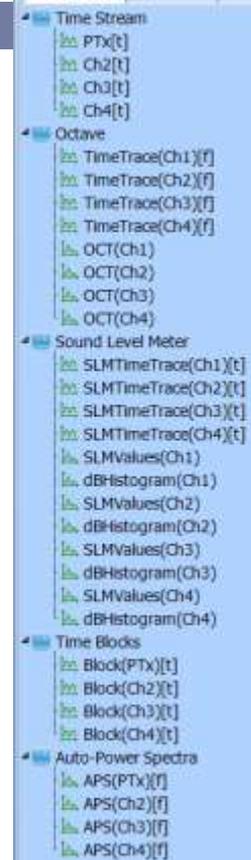
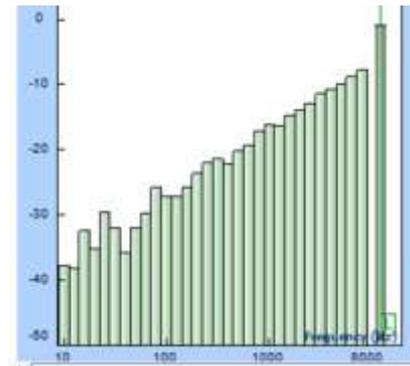
- The Spider devices are connected to the wireless modems
- Wireless modem communicates to the Internet
- Data plan for all major carrier providers are available



EDM: Setup the Measurement

Measured signals may include:

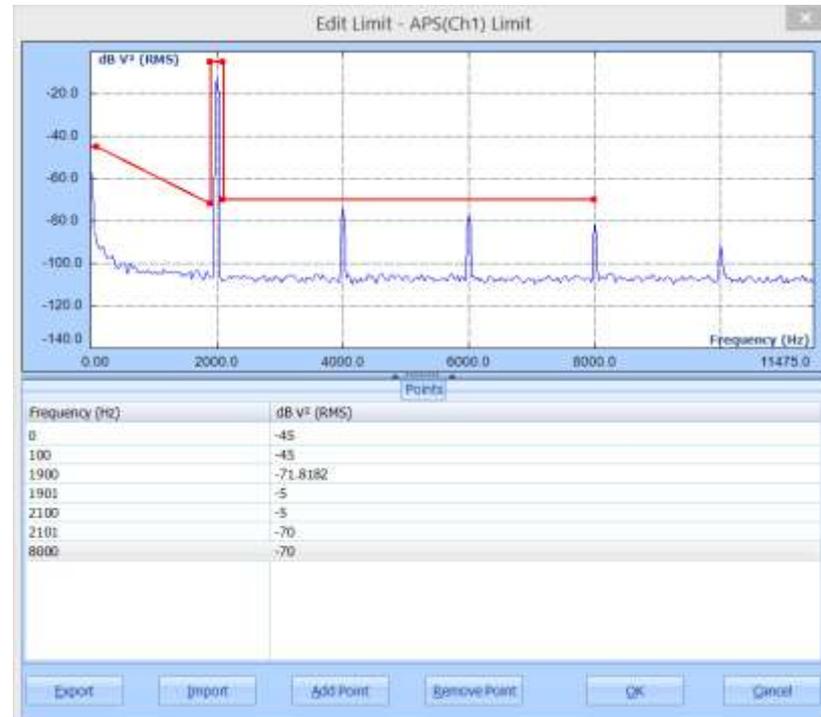
- Time recording signals
- Octave spectra
- Sound level measurement
- Auto-power spectra
- RMS, Peak measurement
- Time blocks



EDM: Set the Alarm Limits

Set up the alarm limits for measurement signals

- ▣ High alarm or low alarm
- ▣ With break points
- ▣ Check the value over the range with percentage



Project, Location, and Signal Setup

New Project

Enter a name for this new project. Check the Spider modules that you would like to include into this project. Click the [OK] button when finished.

Project Name*:

Detected modules

- Turbine_Main_Engine_A5(SN: 2580256)
- Hydraulic_Pump_20(SN: 2583936)

Signal Name Setup

Please enter a unique signal name to identify the physical location that each signal represents (For example "RMS Sensor2" or "Sensor5 Time")

Select a Spider Module

- Detected modules
 - Turbine_Main_Engine_A5(SN: 2580256)
 - Hydraulic_Pump_20(SN: 2583936)

Turbine_Main_Engine_A5-signals

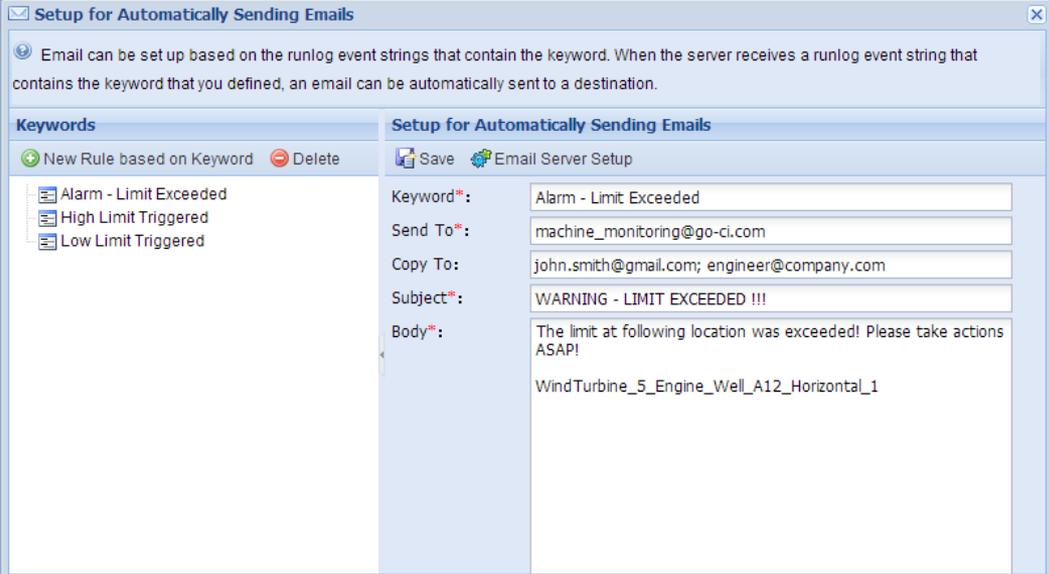
Original Signal	Display Name
Ch1	X1_Accel
Ch2	Y1_Accel
Ch3	Z1_Accel
Ch4	Backup_Vel
Ch5	Loc_12_Vel
Ch6	Loc_16_Vel
Ch7	Not in Use
Ch8	Not in Use
Peak(Ch1)	Peak(X1_Accel)
Peak(Ch2)	Peak(Y1_Accel)
Peak(Ch3)	Peak(Z1_Accel)
Peak(Ch4)	Peak(Backup_Vel)
Peak(Ch5)	Peak(Loc_12_Vel)
Peak(Ch6)	Peak(Loc_16_Vel)
Peak(Ch7)	Peak(Ch7)
RMS(Ch1)	RMS(Ch1)
RMS(Ch2)	RMS(Ch2)

Assign the physical location of each Spider device. They will show up on the map. Press the [Save] button when finished. Physical location is defined by Latitude and Longitude, for example, 37.375998 and -121.967824 in Santa Clara, CA.

Spider Device	Latitude	Longitude
Turbine_Main_Engine_A5	<input type="text" value="37.35"/>	<input type="text" value="-121.57"/>
Hydraulic_Pump_20	<input type="text" value="37.34"/>	<input type="text" value="-121.58"/>

Email Setup at Cloud Server

Users can receive emails that contain the keywords that are preset by the users, for example, “limits exceeded”.



The screenshot shows a configuration window titled "Setup for Automatically Sending Emails". It contains a list of keywords on the left and a form for configuring an email rule on the right.

Keywords:

- Alarm - Limit Exceeded
- High Limit Triggered
- Low Limit Triggered

Setup for Automatically Sending Emails:

Keyword*: Alarm - Limit Exceeded

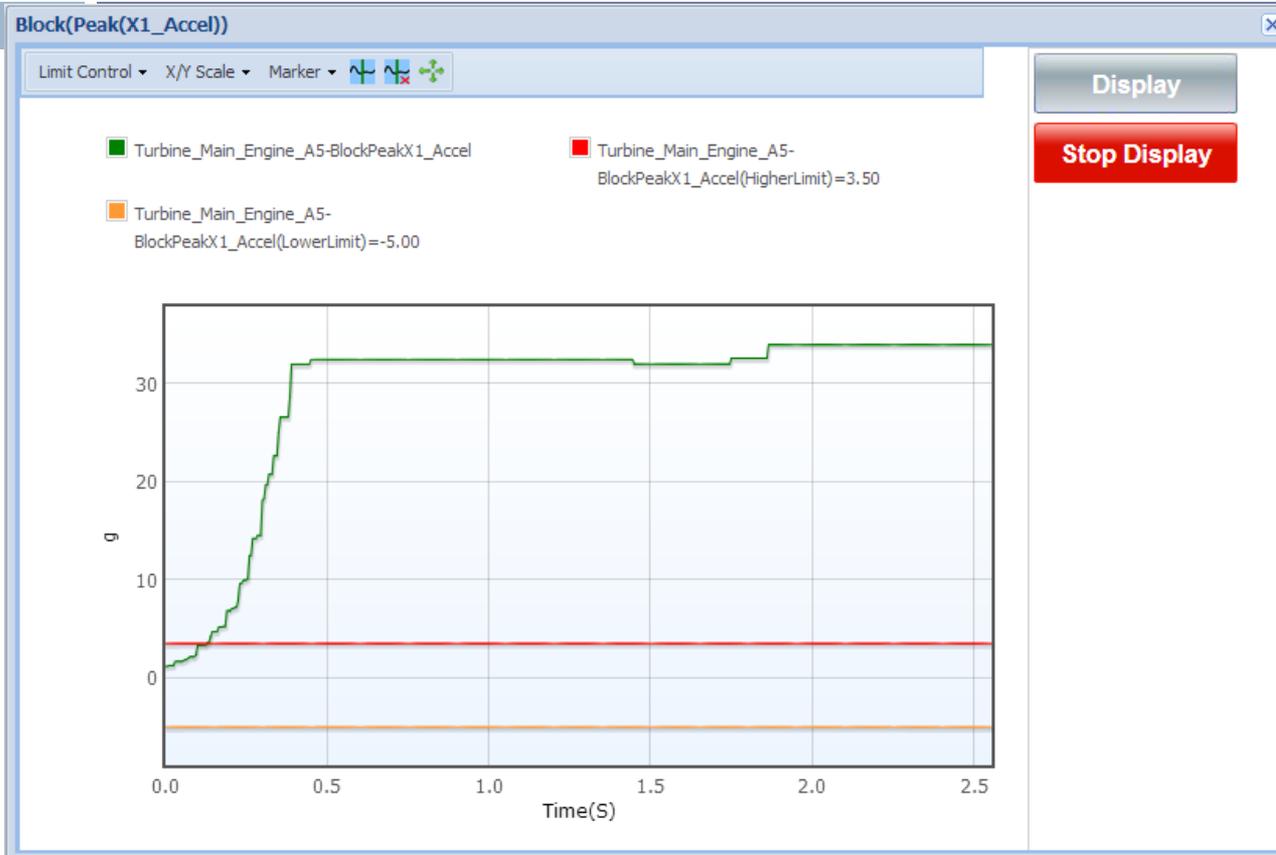
Send To*: machine_monitoring@go-ci.com

Copy To: john.smith@gmail.com; engineer@company.com

Subject*: WARNING - LIMIT EXCEEDED !!!

Body*:
The limit at following location was exceeded! Please take actions ASAP!
WindTurbine_5_Engine_Well_A12_Horizontal_1

Run the EDM Cloud from Client Side



- View the measurement signals

Run the EDM Cloud from Client Side

Runlog for Each Device

Detected modules

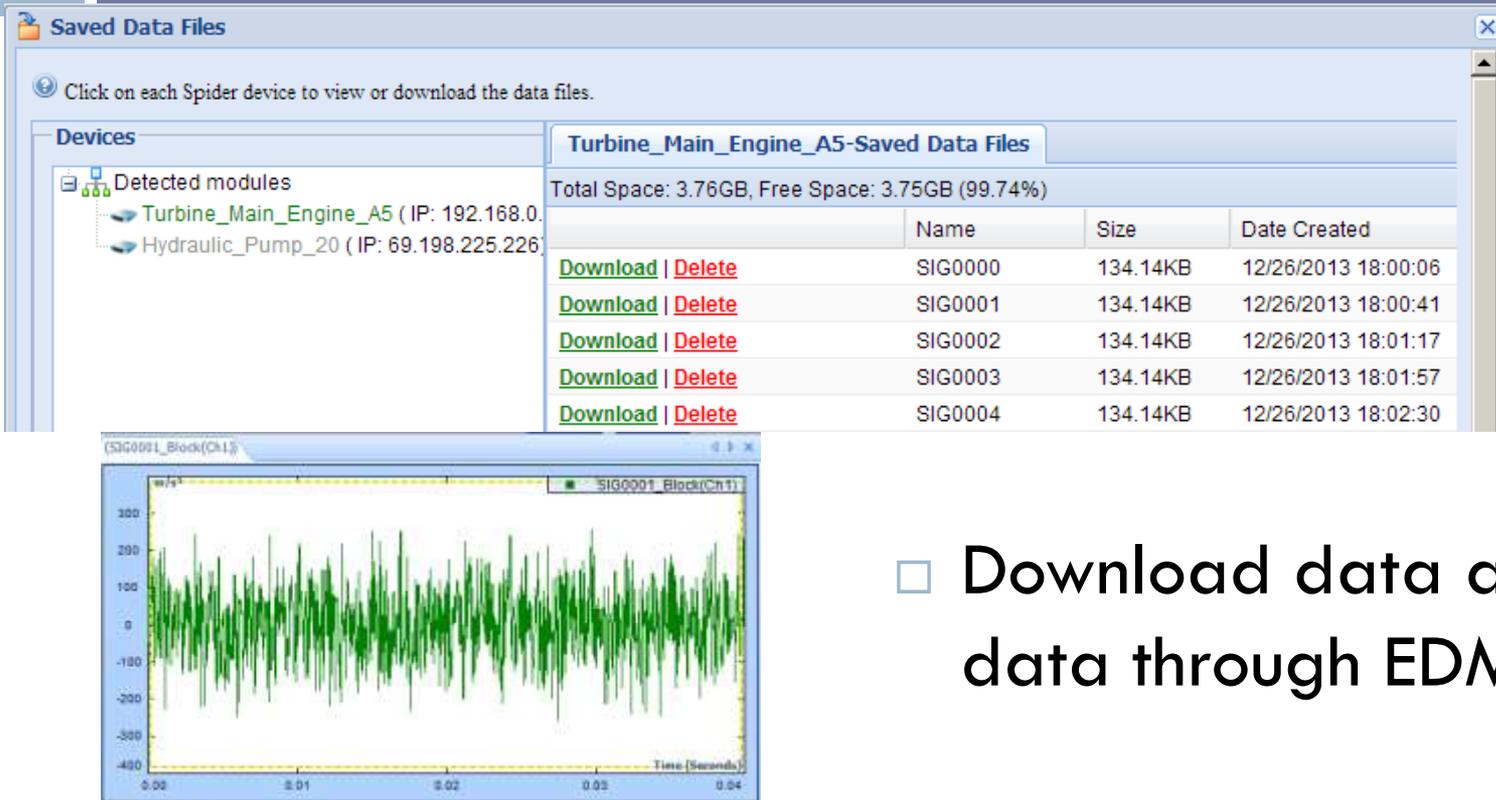
- Turbine_Main_Engine_A5 (IP: 192.168.0.)
- Hydraulic_Pump_20 (IP: 69.198.225.226)

Turbine_Main_Engine_A5-Runlog

Absolute Time	Event Type	Event Data	Event Source
12/26/2013 17:42:35	Run Limit Duration	30	Schedule
12/26/2013 17:42:35	Turn Signal Source Off	0	Schedule
12/26/2013 17:42:34	Save Signals to Internal Memory	0	Action
12/26/2013 17:42:29	Run Limit Duration	5	Schedule
12/26/2013 17:42:29	Turn Signal Source On	0	Schedule
12/26/2013 17:42:29	Limit Check On	0	Action
12/26/2013 17:42:29	Limit Check Off	0	Action
12/26/2013 17:42:01	Send E-Mail	4115	Action
12/26/2013 17:42:01	Exceed Limit Warning(High)	Block(RMS(Ch1))	Action
12/26/2013 17:42:01	Exceed Limit Warning(High)	Block(Peak(Ch1))	Action
12/26/2013 17:41:59	Run Limit Duration	30	Schedule
12/26/2013 17:41:59	Turn Signal Source Off	0	Schedule
12/26/2013 17:41:58	Save Signals to Internal Memory	0	Action
12/26/2013 17:41:53	Run Limit Duration	5	Schedule
12/26/2013 17:41:53	Turn Signal Source On	0	Schedule
12/26/2013 17:41:53	Limit Check On	0	Action
12/26/2013 17:41:53	Limit Check Off	0	Action
12/26/2013 17:41:25	Send E-Mail	4115	Action
12/26/2013 17:41:25	Exceed Limit Warning(High)	Block(RMS(Ch1))	Action
12/26/2013 17:41:25	Exceed Limit Warning(High)	Block(Peak(Ch1))	Action
12/26/2013 17:41:23	Run Limit Duration	30	Schedule
12/26/2013 17:41:23	Turn Signal Source Off	0	Schedule

- View the RunLog Events

Run the EDM Cloud from Client Side



Click on each Spider device to view or download the data files.

Devices

Detected modules

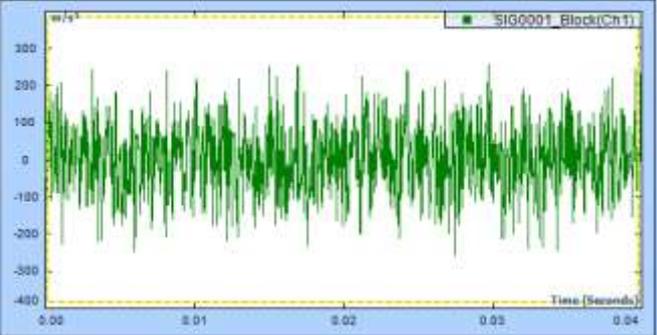
- Turbine_Main_Engine_A5 (IP: 192.168.0.1)
- Hydraulic_Pump_20 (IP: 69.198.225.226)

Turbine_Main_Engine_A5-Saved Data Files

Total Space: 3.76GB, Free Space: 3.75GB (99.74%)

	Name	Size	Date Created
Download Delete	SIG0000	134.14KB	12/26/2013 18:00:06
Download Delete	SIG0001	134.14KB	12/26/2013 18:00:41
Download Delete	SIG0002	134.14KB	12/26/2013 18:01:17
Download Delete	SIG0003	134.14KB	12/26/2013 18:01:57
Download Delete	SIG0004	134.14KB	12/26/2013 18:02:30

(SIG0001_Block(Ch1))



- Download data and view data through EDM