



Getting started Guide

STEVAL-BFA001V1B

Predictive maintenance kit with sensors and IO-Link capability

System Research and Applications

July 2018



STEVAL-BFA001V1B Kit Overview

Setup and programming

Data Monitoring/Logging

How to enable Predictive Maintenance





STEVAL-BFA001V1B Kit Overview

STEVAL-BFA001V1B Kit

What is inside

The **STEVAL-BFA001V1B** is based on 3D digital accelerometer, environmental and acoustic MEMS sensors

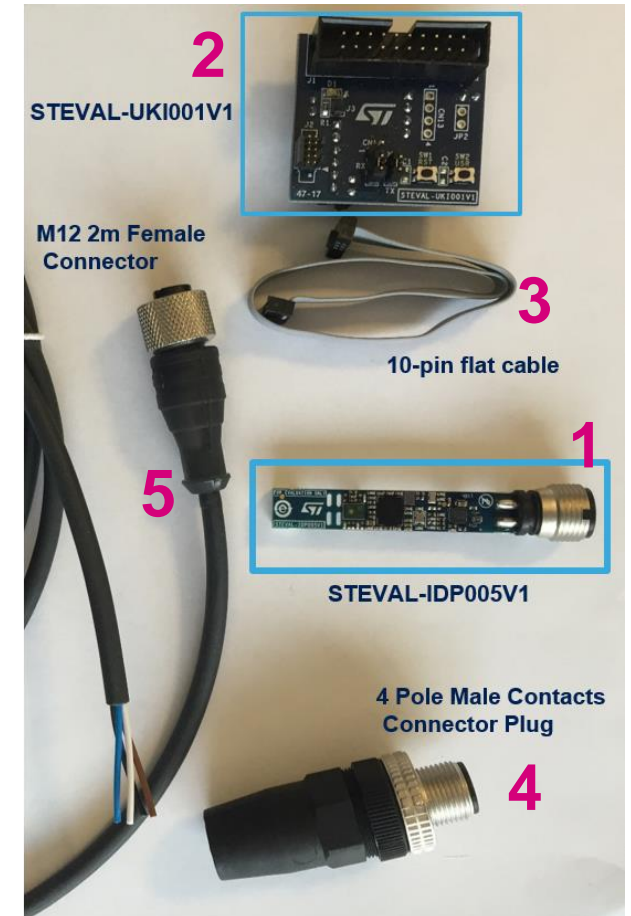
Designed for:

- Condition Monitoring (CM)
- Predictive Maintenance (PdM)

What is inside?

The STEVAL-BFA001V1B includes:

1. STEVAL-IDP005V1- industrial sensor board
2. STEVAL-UKI001V1 - Adapter board for ST-LINK/V2-1
3. 0.050" 10-pin flat cable
4. 4-pole cable mount connector plug, with male contacts
5. M12 female connector with 2m cable

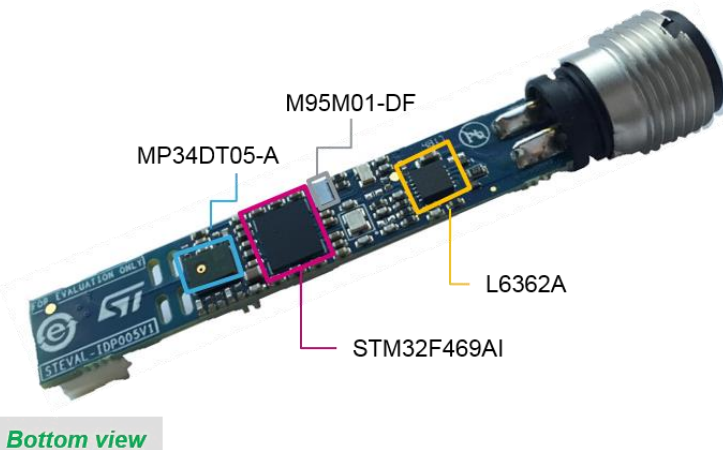
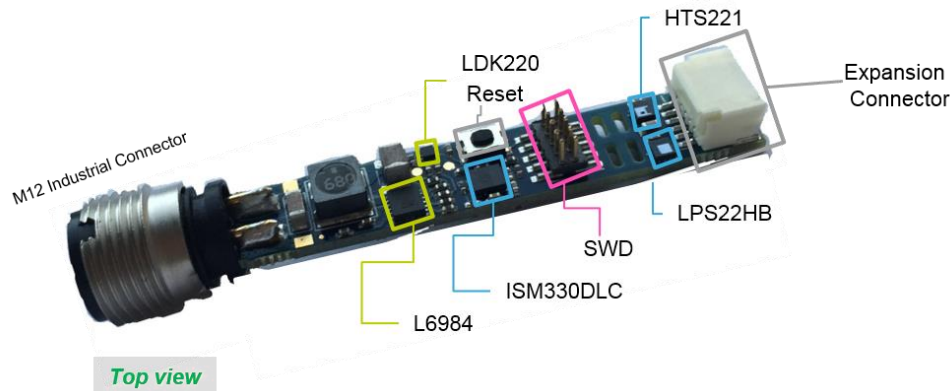


STEVAL-IDP005V1

Hardware Overview

5

The STEVAL-BFA001V1B kit is designed around the STEVAL-IDP005V1



Main supply voltage: 18..32V

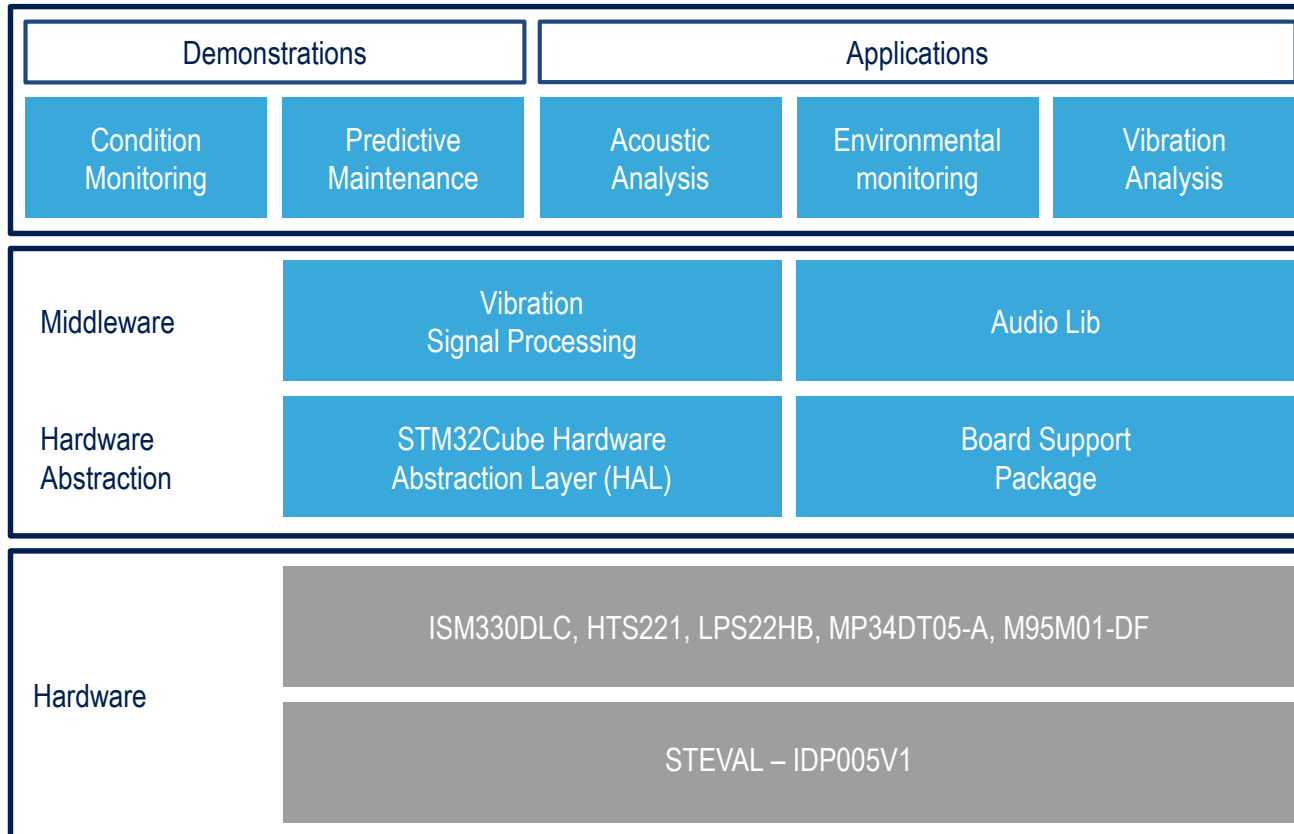
Main components:

- 32-bit ARM® Cortex®-M4 core for signal processing and analysis (STM32F469AI)
- Sensors:
 - iNEMO 6DoF (ISM330DLC- accelerometer and gyroscope)
 - Absolute Digital Pressure (LPS22HB)
 - Relative Humidity and temperature sensors (HTS221)
 - Digital Microphone sensor (MP34DT05-A)
- IO-Link PHY Device (L6362A)
- EEPROM (M95M01-DF) for data Storage
- Step-down switching regulator and LDO regulator (L6984 and LDK220)
- M12 industrial connector
- SWD connector for debugging and programming capability
- Reset button
- Expansion connector with GPIO, ADC, I²C bus

STEVAL-IDP005V1

Software Overview

STSW-BFA001V1 is the software package for the **STEVAL-IDP005V1**



STSW-BFA001V1 architecture

Software Description

Set of firmware examples for CM and PdM based on 3D digital accelerometer (only accelerometer is supported in fw package), environmental and acoustic MEMS sensors.

Key features

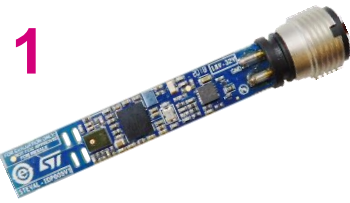
- Developed for STM32F469AI with easy portability across different MCU families
- Middleware including algorithms for advanced time and frequency domain signal processing for vibration analysis:
 - Programmable FFT size (256, 512, 1024, 2048 points)
 - Programmable FFT overlapping
 - Programmable acquisition time window
 - FFT averaging during acquisition time
 - Programmable windowing (Flat Top, Hanning, Hamming)
 - Speed RMS moving average, acceleration max peak.
- Middleware integrating microphone algorithms for:
 - PDM to PCM
 - Sound pressure
 - Audio FFT
- Environmental, acoustic and vibration data monitoring through freely available terminal emulator.
- Example firmware to communicate with STEVAL-IDP004V1 (IO-Link master capable, multi-port evaluation board) and dedicated PC GUI.



Setup and Programming

Hardware prerequisites

Unpack the STEVAL-BFA001V1B ...



1 STEVAL-IDP005V1



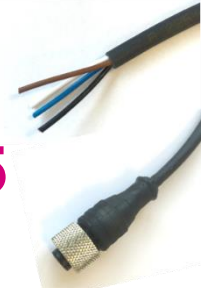
2 STEVAL-UKI001V1



3 10-pin flat cable

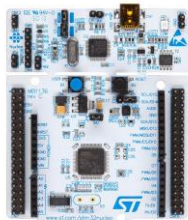


4 4-pole male connector



5 M12 female connector with 2m cable

What do you need more? – not included in the kit –



Any **STM32 nucleo-64** to program debug and interface with PC



USB cable Type-A to Mini B

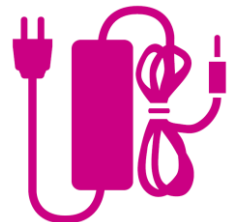


STEVAL-IDP004V1 Master board and generic RS-485/422 USB adapter

(required only to use the GUI)



Laptop



Generic power supply (range 18..32V)

STEVAL-IDP005V1 Demo Setup

Software prerequisites

- **STSW-LINK009**
ST-LINK/V2-1 USB driver
- **STSW-LINK007**
ST-LINK/V2-1 firmware upgrade
- Common freely **Serial line terminal** (i.e. TeraTerm)
- **ST IDP005V1-GUI** (setup included in `.\STSW-BFA001V1\Utilities` folder)
- **Microsoft.net** version 4.5 or higher (this is only to run the GUI)
- **RS-485/USB adapter driver** (this only to use STEVAL-IDP005V1 connected to IO-Link master capable multi port board)

STEVAL-IDP005V1

Power-on

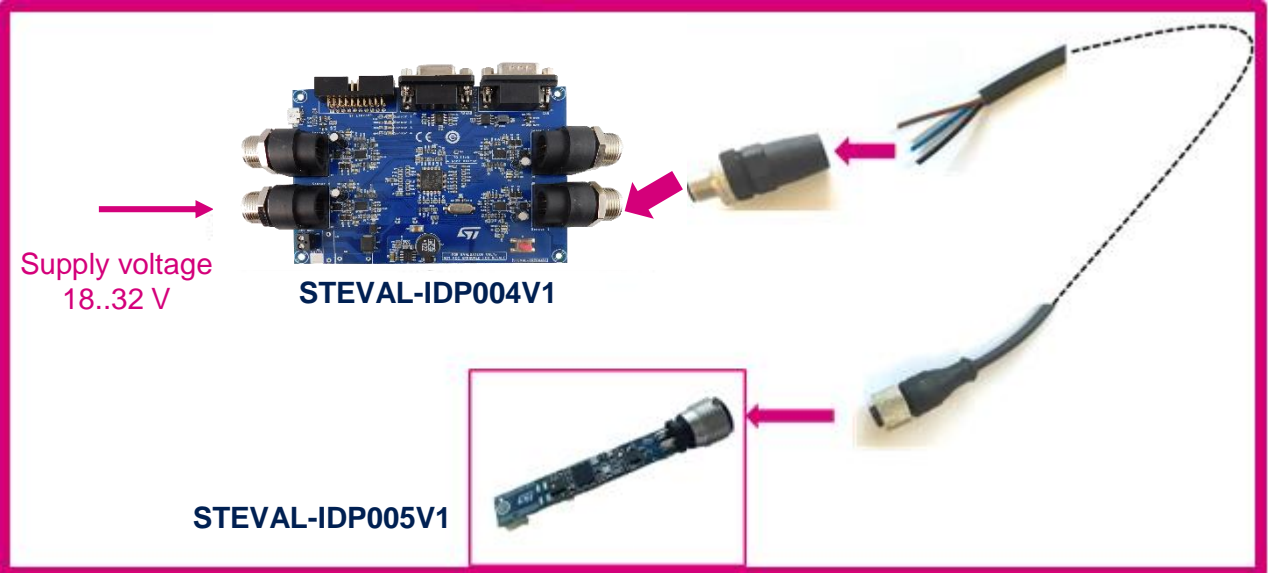
The STEVAL-IDP005V1 can be powered in two ways

Plug the M12 cable onto the STEVAL-IDP005V1 and connect the other end to a power supply 18..32V



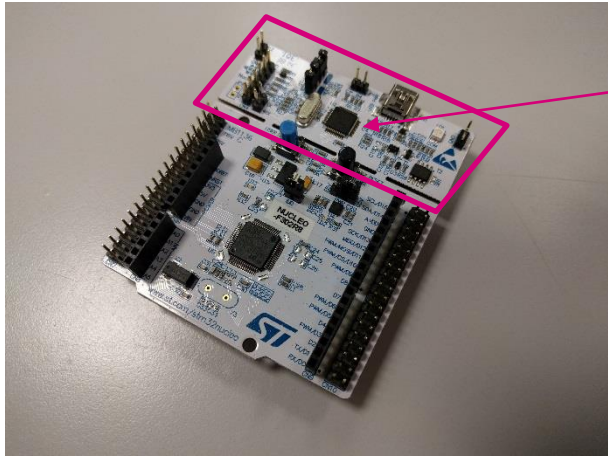
or

If available, use the STEVAL-IDP004V1 to supply the STEVAL-IDP005V1 through the M12 cable



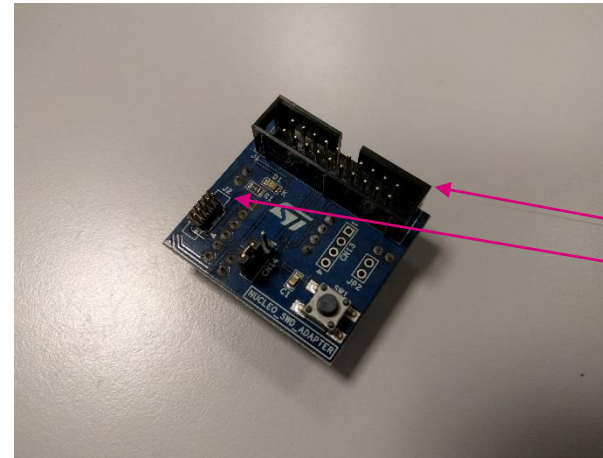
Programming the STEVAL-IDP005V1 1/2

STEVAL-UKI001V1 and ST-LINK/V2-1 overview



STM32 NUCLEO-64 comes with ST-LINK/V2-1

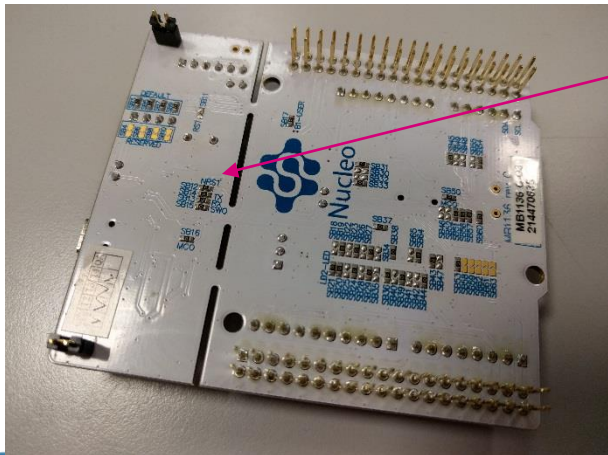
1



STEVAL-UKI001V1 (top view) has two SWD sockets:

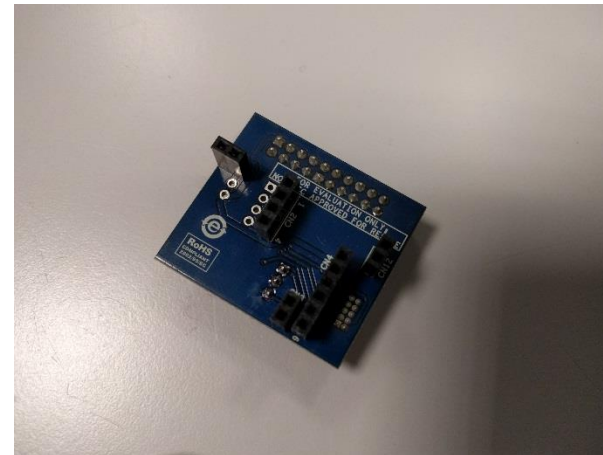
- 20-pin (100 mils)
- 10-pin (50mils)

3



Make sure that SB12 is open

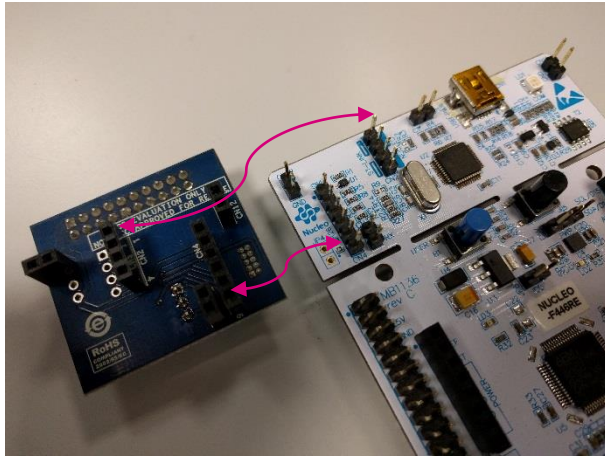
2



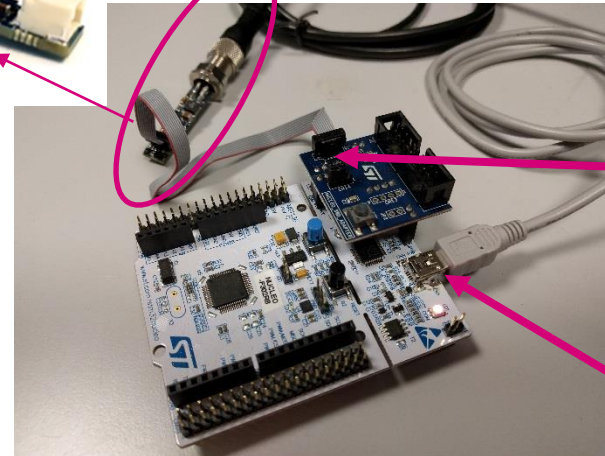
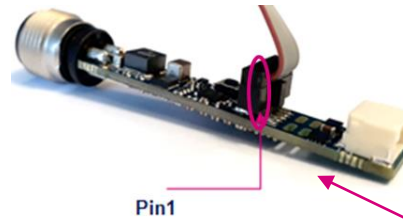
STEVAL-UKI001V1 (bottom view)

4

Programming the STEVAL-IDP005V1 2/2 Setup



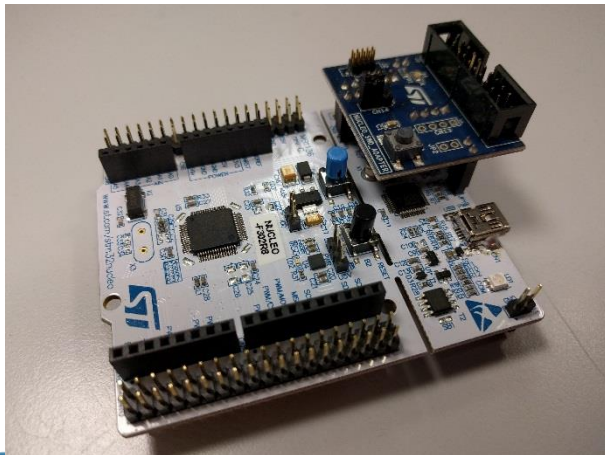
1 Remove all short cap jumpers from the STM32-NUCLEO



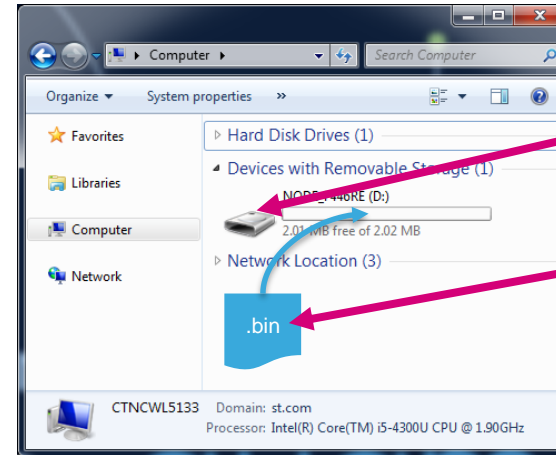
3 Programming steps:

a. Connect the application board to the ST-LINK/V2-1 via the 10-pin flat cable plugged on J2 (on the STEVAL-UKI001V1), then power-on it.

b. Connect the ST-LINK/V2-1 with a PC via an USB cable plugged on CN1.



2 Plug the STEVAL-UKI001V1 on the STM32-NUCLEO respecting the CNx ref.



4

c. The ST-LINK/V2-1 will be recognized as a removable storage.

d. To download the firmware simply copy the .bin file on it.



Data Monitoring / Logging

STSW-BFA001V1

Firmware architecture

The STEVAL-IDP005V1 offers applications and examples as detailed below. All projects allow data monitoring through serial terminal with board connected to PC.

The screenshot displays the file explorer interface for the STEVAL-IDP005V1 project. The main window shows the following structure:

- Projects (selected)
 - Applications
 - Condition_Monitoring (linked to callout)
 - Predictive_Maintenance
 - Demonstrations
 - Acoustic_Analysis
 - Environmental_Analysis
 - Vibration_Analysis

The callout box contains the text: **Can work also with the STEVAL-IDP004V1 and a dedicated GUI**

Name	Date modified	Type	Size
Acoustic_Analysis	4/26/2018 11:56 AM	File folder	
Environmental_Analysis	4/26/2018 12:29 PM	File folder	
Vibration_Analysis	4/26/2018 12:29 PM	File folder	

STEVAL-IDP005V1 Data Monitoring

STEVAL-IDP005V1 sensor and analysis data can be displayed on PC in two ways

Terminal emulator
(TeraTerm or others freely available)

```
STEVAL-IDP005V1 [Application - Condition Monitoring - FW v.0.2.0]
2018 STMicroelectronics

MCU ID....: 0x004600383035511939383238
MCU SYCLK.: 180000000 Hz
MCU HCLK..: 180000000 Hz
MCU PCLK1.: 45000000 Hz
MCU PCLK2.: 90000000 Hz

Stored STEVAL-IDP005V1 parameters are:
odr=6660 fs=4 hpf=3 size=2048 ovl=75 tacq=5000 tau1=50 tau2=1000 subrng=32 wind=
0 intmtd=0 tdtype=0 tdttime=4

Enter new vibration parameters...
█
```

or

GUI to be used through the STEVAL-IDP004V1 (multiport Master board)



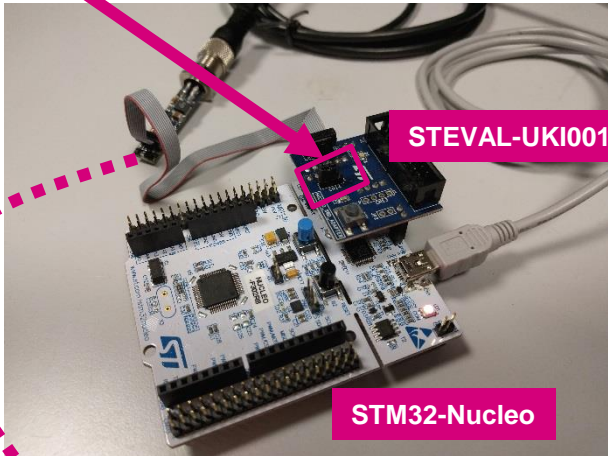
STEVAL-IDP005V1 Data Monitoring

Setup the terminal emulator

1

Plug the STEVAL-UKI001V1 on the STM32-NUCLEO, then connect to the STEVAL-IDP005V1

CN15: closed
CN14: 2-3 position



STEVAL-UKI001V1

STM32-Nucleo

2

Open the terminal emulator



Terminal emulator settings

- Name: COM Port name
- Baud Rate: 230400
- Data: 8
- Parity: None
- Stop Bit: One
- Flow Control: None

3

Push the Reset button on the STEVAL-UKI001V1 (or STEVAL-IDP005V1)

```
COM22 - PuTTY
STEVAL-IDP005V1 [Application - Condition Monitoring - FW v.0.2.0]
2018 STMicroelectronics

MCU ID...: 0x004600383035511939383238
MCU SYSCLK: 180000000 Hz
MCU HCLK..: 180000000 Hz
MCU PCLK1.: 45000000 Hz
MCU PCLK2.: 90000000 Hz

Stored STEVAL-IDP005V1 parameters are:
odr=6660 fs=4 hpf=3 size=2048 ovl=75 tacq=5000 tau1=50 tau2=1000 subrng=32 wind=
0 intmtd=0 tdtype=0 tdtime=4
Enter new vibration parameters...

```

Insert the new parameters or press ENTER

4

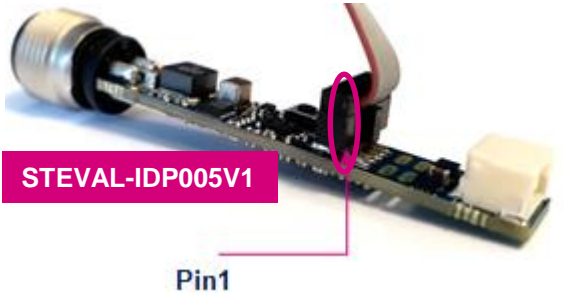
Press Y to start monitoring

5

```
ISM330DLC (Accelerometer): Initialized Ena
ISM330DLC (Accelerometer): real ODR 6645.0

Time Domain Data ***
Speed [mm/s] | RMS (tau1) [mm/s] | RMS (tau2) [mm/s] |
X | Y | Z | X | Y | Z | X | Y | Z |
|-0.015| -0.053| -0.002| 0.028| 0.101| 0.126| 0.027| 0.099| 0.126|
|-0.033| 0.214| 0.211| 0.026| 0.111| 0.131| 0.025| 0.108| 0.130|
|-0.013| 0.174| 0.224| 0.027| 0.149| 0.156| 0.027| 0.143| 0.152|
| 0.013| 0.142| 0.224| 0.025| 0.149| 0.170| 0.025| 0.144| 0.165|
| 0.002| 0.080| 0.057| 0.024| 0.145| 0.170| 0.024| 0.142| 0.166|

```



STEVAL-IDP005V1

Pin1

STEVAL-IDP005V1 Data Monitoring

Parameters Configuration Details

```
COM22 - PuTTY

STEVAL-IDP005V1 [Application - Condition Monitoring - FW v.0.2.0]
2018 STMicroelectronics

MCU ID....: 0x004600383035511939383238
MCU SYSCLK: 180000000 Hz
MCU HCLK..: 180000000 Hz
MCU PCLK1.: 45000000 Hz
MCU PCLK2.: 90000000 Hz

Stored STEVAL-IDP005V1 parameters are:
odr=6660 fs=4 hpf=3 size=2048 ovl=75 tacq=5000 tau1=50 tau2=1000 subrng=32 wind=
0 intmtd=0 tdtype=0 tdttime=4

Enter new vibration parameters...
fs=2 size=1024 ovl=50 ←
New STEVAL-IDP005V1 parameters are:
odr=6660 fs=2 hpf=3 size=1024 ovl=50 tacq=5000 tau1=50 tau2=1000 subrng=32 wind=0 intmtd=0 tdtype=0

Let's go ahead? [y/n]
```

STEVAL-IDP005V1 allows data monitoring using the service UART

The CM application allows data plot and vibration parameters setting (only selected parameters can be changed)

Odr -> Accelerometer ODR in Hz

fs-> accelerometer full scale in g

Hpf -> accelerometer high pass filter

0 - HPF_ODR_DIV_4:

1 - HPF_ODR_DIV_100:

2 - HPF_ODR_DIV_9:

3 - HPF_ODR_DIV_400:

Size -> FFT size (256, 512, 1024, 2048)

ovl -> fft overlapping in % (5 ÷ 95)

Tacq -> acquisition time in ms (0.5 ÷ 60000)

Tau -> time constant for RMS in ms

(25,50,100,150,250,500,1000,1500,2000)

Subrng-> 8, 16, 32, 64 number of spectral subrange

Wind-> 0 (Hanning)

1 (Hamming)

2 (Flat Top)

Tdtype -> 0 Speed RMS

1 Acc RMS

2 Acc RMS and Speed RMS

STEVAL-IDP005V1 Data Monitoring

Data Details (1/3)

```
New STEVAL-IDP005V1 parameters are:
odr=6660 fs=4 hpf=3 size=2048 ovl=75 tacq=5000 tau=500 su

Let's go ahead? [y/n] + Enter
y

ISM330DLC (Accelerometer): Initialized Enabled
ISM330DLC (Accelerometer): real ODR 6638.00 Hz
```

RMS for Acc and/or speed

```
*** Time Domain Data ***
Time | Speed RMS [mm/s]
[ms] | X | Y | Z
647997| 0.009| 0.027| 0.031
648002| 0.012| 0.024| 0.035
648007| 0.015| 0.028| 0.035
648012| 0.015| 0.029| 0.036
648017| 0.016| 0.028| 0.033
648022| 0.016| 0.028| 0.034
648027| 0.015| 0.027| 0.033
648032| 0.017| 0.026| 0.033
648037| 0.017| 0.025| 0.033
648042| 0.017| 0.025| 0.032
648047| 0.017| 0.026| 0.032
648052| 0.017| 0.025| 0.032
```

Accelerometer FFT

```
*** FFT Spectral Analysis ***
|bin Freq| Amplitude [m/s2]
| [Hz] | X | Y | Z |
| 0.00| 0.000| 0.000| 0.000|
| 3.25| 0.000| 0.001| 0.000|
| 6.50| 0.000| 0.002| 0.001|
| 9.74| 0.001| 0.003| 0.002|
| 12.99| 0.001| 0.005| 0.005|
| 16.24| 0.002| 0.008| 0.008|
| 19.49| 0.002| 0.008| 0.010|
| 22.74| 0.002| 0.006| 0.009|
| 25.98| 0.002| 0.005| 0.009|
| 29.23| 0.002| 0.004| 0.008|
| 32.48| 0.002| 0.005| 0.008|
| 35.73| 0.002| 0.006| 0.008|
| 38.98| 0.002| 0.005| 0.007|
| 42.22| 0.002| 0.004| 0.005|
| 45.47| 0.002| 0.004| 0.004|
| 48.72| 0.002| 0.005| 0.003|
| 51.97| 0.002| 0.007| 0.003|
| 55.22| 0.002| 0.008| 0.003|
| 58.46| 0.002| 0.008| 0.003|
| 61.71| 0.002| 0.008| 0.003|
| 64.96| 0.002| 0.007| 0.003|
| 68.21| 0.002| 0.006| 0.002|
| 71.46| 0.002| 0.006| 0.002|
| 74.71| 0.002| 0.005| 0.002|
| 77.95| 0.002| 0.004| 0.003|
| 81.20| 0.002| 0.004| 0.003|
```

```
*** FFT SUBRANGE RESULTS ON THREE AXES X-Y-Z ***
| 94.052| 0.002 | 48.647| 0.004 | 25.945| 0.004|
| 119.997| 0.065 | 119.997| 0.097 | 119.997| 0.072|
| 207.563| 0.003 | 285.398| 0.002 | 239.994| 0.003|
| 359.991| 0.003 | 337.289| 0.003 | 337.289| 0.004|
| 470.259| 0.002 | 437.827| 0.002 | 467.016| 0.002|
| 609.715| 0.002 | 548.095| 0.002 | 616.201| 0.002|
| 625.931| 0.002 | 681.064| 0.002 | 645.390| 0.002|
| 752.414| 0.002 | 788.089| 0.002 | 742.685| 0.002|
| 852.952| 0.002 | 914.572| 0.002 | 852.952| 0.002|
| 985.922| 0.002 | 1015.110| 0.002 | 1031.326| 0.002|
| 1125.378| 0.002 | 1044.299| 0.002 | 1047.542| 0.002|
| 1193.484| 0.002 | 1225.916| 0.002 | 1199.971| 0.002|
| 1251.861| 0.002 | 1332.940| 0.002 | 1323.211| 0.002|
| 1439.965| 0.002 | 1358.886| 0.002 | 1439.965| 0.007|
| 1452.938| 0.002 | 1540.503| 0.002 | 1517.801| 0.002|
| 1621.582| 0.002 | 1650.771| 0.002 | 1654.014| 0.002|
| 1741.579| 0.002 | 1666.986| 0.002 | 1696.175| 0.002|
| 1848.604| 0.002 | 1780.497| 0.001 | 1812.929| 0.002|
| 1884.278| 0.002 | 1932.926| 0.002 | 1871.306| 0.001|
| 2023.734| 0.002 | 2004.275| 0.001 | 1981.573| 0.001|
| 2127.516| 0.002 | 2146.975| 0.001 | 2166.434| 0.001|
| 2179.406| 0.002 | 2228.054| 0.001 | 2257.242| 0.001|
| 2283.188| 0.001 | 2361.023| 0.001 | 2292.917| 0.001|
| 2386.969| 0.001 | 2409.671| 0.001 | 2422.644| 0.001|
| 2493.993| 0.001 | 2568.586| 0.001 | 2523.182| 0.001|
| 2646.422| 0.001 | 2597.774| 0.001 | 2607.504| 0.001|
| 2698.313| 0.002 | 2714.528| 0.001 | 2737.230| 0.001|
| 2853.984| 0.002 | 2805.337| 0.001 | 2808.580| 0.001|
| 2905.875| 0.002 | 2938.307| 0.001 | 2951.279| 0.001|
| 3009.656| 0.002 | 3045.331| 0.001 | 3009.656| 0.001|
| 3113.438| 0.001 | 3119.924| 0.000 | 3119.924| 0.000|
| 3217.219| 0.001 | 3217.219| 0.000 | 3217.219| 0.000|
```

Accelerometer Spectral frequency subrange and related amplitude

P, T, rH data

```
*** ENVIRONMENTAL DATA VALUES ***
LPS22HB_T: 35.40 Deg
LPS22HB_P: 1011.75 mBar
HTS221_T: 35.30 Deg
HTS221_H: 28.90 rH

##### Next Measurement #####

Stored STEVAL-IDP005V1 parameters are:
odr=6660 fs=4 hpf=3 size=2048 ovl=75 tacq=5000 tau1=5000

Enter new vibration parameters...
```

```
*** FFT Results ***
FFT AVERAGE Number = 62
Max_Amplitudes -> Xa: 0.065| Ya: 0.097| Za: 0.072|
Bin_Frequencies -> Xf:119.997| Yf:119.997| Zf:119.997|

*** Acceleration Time Domain Max Peak ***
| Xpk: 0.176| Ypk: 0.209| Zpk: 0.182|
```

Frequency and time domain vibration data



STEVAL-IDP005V1 Data Monitoring

Data Details 2/3

```
COM22 - PuTTY
|3308.03| 0.000| 0.000| 0.000|
|3311.27| 0.000| 0.000| 0.000|
|3314.51| 0.000| 0.000| 0.000|
|3317.76| 0.000| 0.000| 0.000|

*** FFT SUBRANGE RESULTS ON THREE AXES X-Y-Z ***
| 94.052| 0.002 | 48.647| 0.004 | 25.945| 0.004|
|119.997| 0.065 |119.997| 0.097 |119.997| 0.072|
|207.563| 0.003 |285.398| 0.002 |239.994| 0.003|
|359.991| 0.003 |337.289| 0.003 |337.289| 0.004|
|470.259| 0.002 |437.827| 0.002 |467.016| 0.002|
|609.715| 0.002 |548.095| 0.002 |616.201| 0.002|
|625.931| 0.002 |681.064| 0.002 |645.390| 0.002|
|752.414| 0.002 |788.089| 0.002 |742.685| 0.002|
|852.952| 0.002 |914.572| 0.002 |852.952| 0.002|
|985.922| 0.002 |1015.110| 0.002 |1031.326| 0.002|
|1125.378| 0.002 |1044.299| 0.002 |1047.542| 0.002|
|1193.484| 0.002 |1225.916| 0.002 |1199.971| 0.002|
|1251.861| 0.002 |1332.940| 0.002 |1323.211| 0.002|
|1439.965| 0.002 |1358.886| 0.002 |1439.965| 0.007|
|1452.938| 0.002 |1540.503| 0.002 |1517.801| 0.002|
|1621.582| 0.002 |1650.771| 0.002 |1654.014| 0.002|
|1741.579| 0.002 |1666.986| 0.002 |1696.175| 0.002|
|1848.604| 0.002 |1780.497| 0.001 |1812.929| 0.002|
|1884.278| 0.002 |1932.926| 0.002 |1871.306| 0.001|
|2023.734| 0.002 |2004.275| 0.001 |1981.573| 0.001|
|2127.516| 0.002 |2146.975| 0.001 |2166.434| 0.001|
|2179.406| 0.002 |2228.054| 0.001 |2257.242| 0.001|
|2283.188| 0.001 |2361.023| 0.001 |2292.917| 0.001|
|2386.969| 0.001 |2409.671| 0.001 |2422.644| 0.001|
|2493.993| 0.001 |2568.586| 0.001 |2523.182| 0.001|
|2646.422| 0.001 |2597.774| 0.001 |2607.504| 0.001|
|2698.313| 0.002 |2714.528| 0.001 |2737.230| 0.001|
|2853.984| 0.002 |2805.337| 0.001 |2808.580| 0.001|
|2905.875| 0.002 |2938.307| 0.001 |2951.279| 0.001|
|3009.656| 0.002 |3045.331| 0.001 |3009.656| 0.001|
|3113.438| 0.001 |3119.924| 0.000 |3119.924| 0.000|
|3217.219| 0.001 |3217.219| 0.000 |3217.219| 0.000|

*** FFT Results ***
FFT AVERAGE Number = 62
Max_Amplitudes -> Xa: 0.065| Ya: 0.097| Za: 0.072|
Bin_Frequencies -> Xf:119.997| Yf:119.997| Zf:119.997|

*** Acceleration Time Domain Max Peak ***
| Xpk: 0.176| Ypk: 0.209| Zpk: 0.182|
```

Frequency and max amplitude in subrange on 3 Accelerometer axis

FFT Averaging number. it is fuction of overlapping and acquisition time

Max amplitude at related frequency

Acc peak on 3 axis

STEVAL-IDP005V1 Data Monitoring

Data Details 3/3

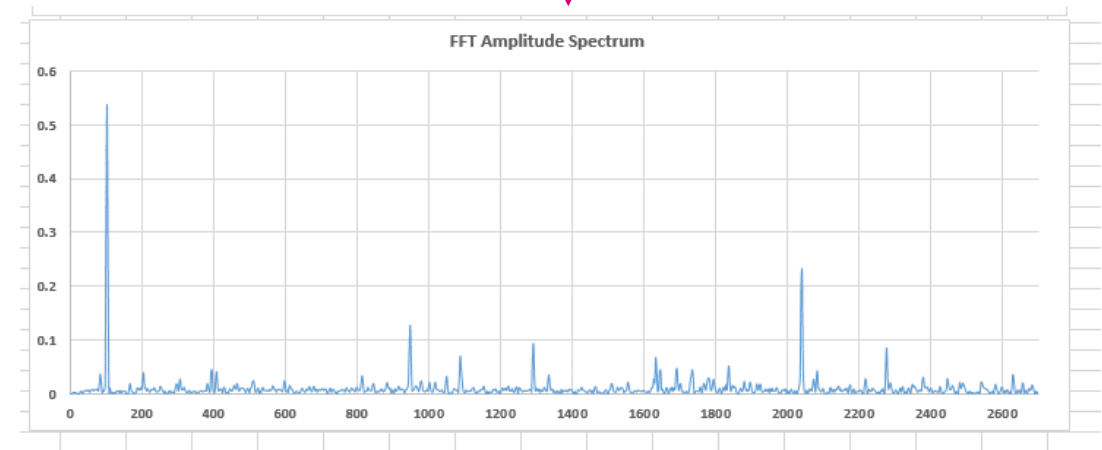
The displayed data can be saved and plotted on external program (i.e. Excel)
Such as the FFT spectral analysis.

```
COM22 - PuTTY
| 0.027| 0.025| -0.029| 0.031| 0.113| 0.094| 0.045| 0.206| 0.209|
| -0.038| 0.019| -0.026| 0.031| 0.108| 0.091| 0.045| 0.205| 0.209|
| 0.037| 0.100| -0.107| 0.030| 0.106| 0.090| 0.045| 0.205| 0.208|
| 0.001| 0.096| -0.061| 0.030| 0.106| 0.091| 0.045| 0.205| 0.208|
| 0.047| 0.034| -0.067| 0.030| 0.103| 0.088| 0.045| 0.204| 0.207|
| -0.016| -0.069| -0.003| 0.029| 0.100| 0.085| 0.045| 0.204| 0.207|
| 0.032| 0.048| -0.029| 0.029| 0.097| 0.082| 0.045| 0.203| 0.207|
| -0.034| 0.079| 0.007| 0.028| 0.096| 0.079| 0.045| 0.203| 0.206|
| 0.005| -0.041| 0.028| 0.029| 0.093| 0.076| 0.045| 0.203| 0.206|

*** FFT Spectral Analysis ***
|bin Freq| Amplitude [m/s2] | | |
| [Hz] | X | Y | Z |
| 0.00| 0.000| 0.000| 0.000|
| 3.25| 0.000| 0.001| 0.000|
| 6.50| 0.000| 0.002| 0.001|
| 9.74| 0.001| 0.003| 0.002|
| 12.99| 0.001| 0.005| 0.005|
| 16.24| 0.002| 0.008| 0.008|
| 19.49| 0.002| 0.008| 0.010|
| 22.74| 0.002| 0.006| 0.009|
| 25.98| 0.002| 0.005| 0.009|
| 29.23| 0.002| 0.004| 0.008|
| 32.48| 0.002| 0.005| 0.008|
| 35.73| 0.002| 0.006| 0.008|
| 38.98| 0.002| 0.005| 0.007|
| 42.22| 0.002| 0.004| 0.005|
| 45.47| 0.002| 0.004| 0.004|
| 48.72| 0.002| 0.005| 0.003|
| 51.97| 0.002| 0.007| 0.003|
| 55.22| 0.002| 0.008| 0.003|
| 58.46| 0.002| 0.008| 0.003|
| 61.71| 0.002| 0.008| 0.003|
| 64.96| 0.002| 0.007| 0.003|
| 68.21| 0.002| 0.006| 0.002|
| 71.46| 0.002| 0.006| 0.002|
| 74.71| 0.002| 0.005| 0.002|
| 77.95| 0.002| 0.004| 0.003|
```

Save log and

plot on .xls format

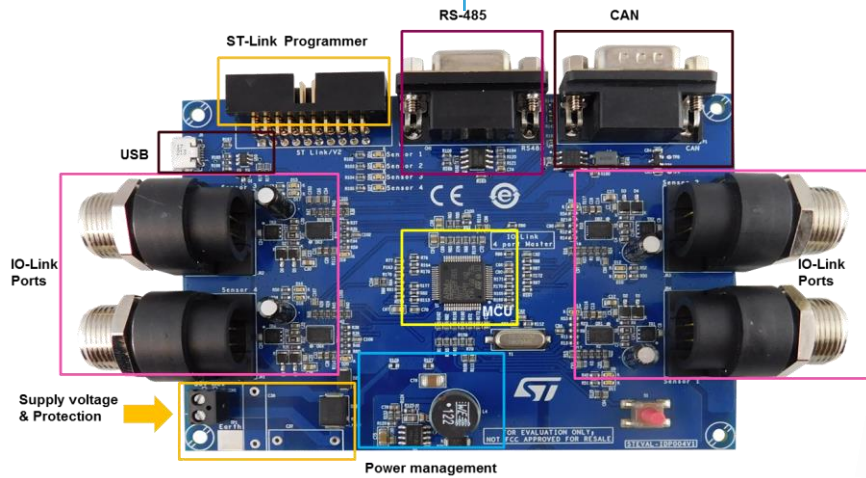
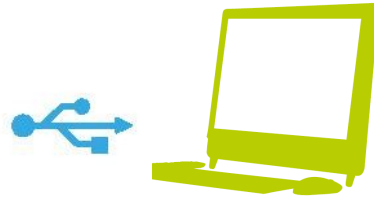


One axis accelerometer FFT

Dedicated GUI trough STEVAL-IDP004V1

STEVAL-IDP005V1 communication based on Master Board

Adapter RS-485 / USB
Optional USB



STEVAL-IDP004V1
STSW-IO-LINK Firmware package



Axel spectrum



STEVAL-IDP005V1

Download the *condition monitoring_ioI* firmware from the STSW-BFA001V1 Demonstration folder

Axel Peak

Speed RMS

P, T, H parameters



STEVAL-IDP005V1 GUI

Vibration Analysis



Frequency domain parameters

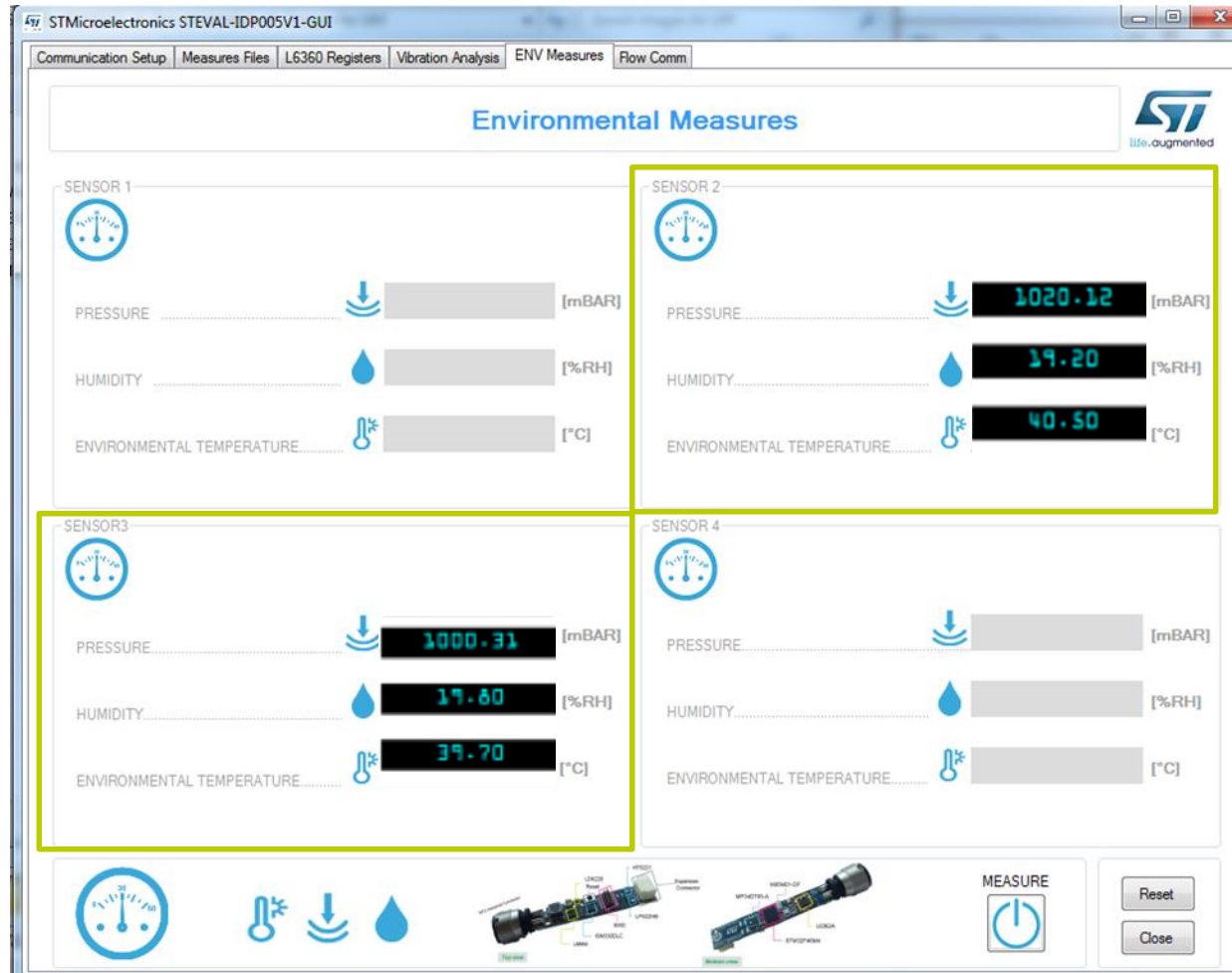


Time domain parameters

Plot related to nodes 2 and 3 in this example

STEVAL-IDP005V1 GUI

Environmental Monitoring



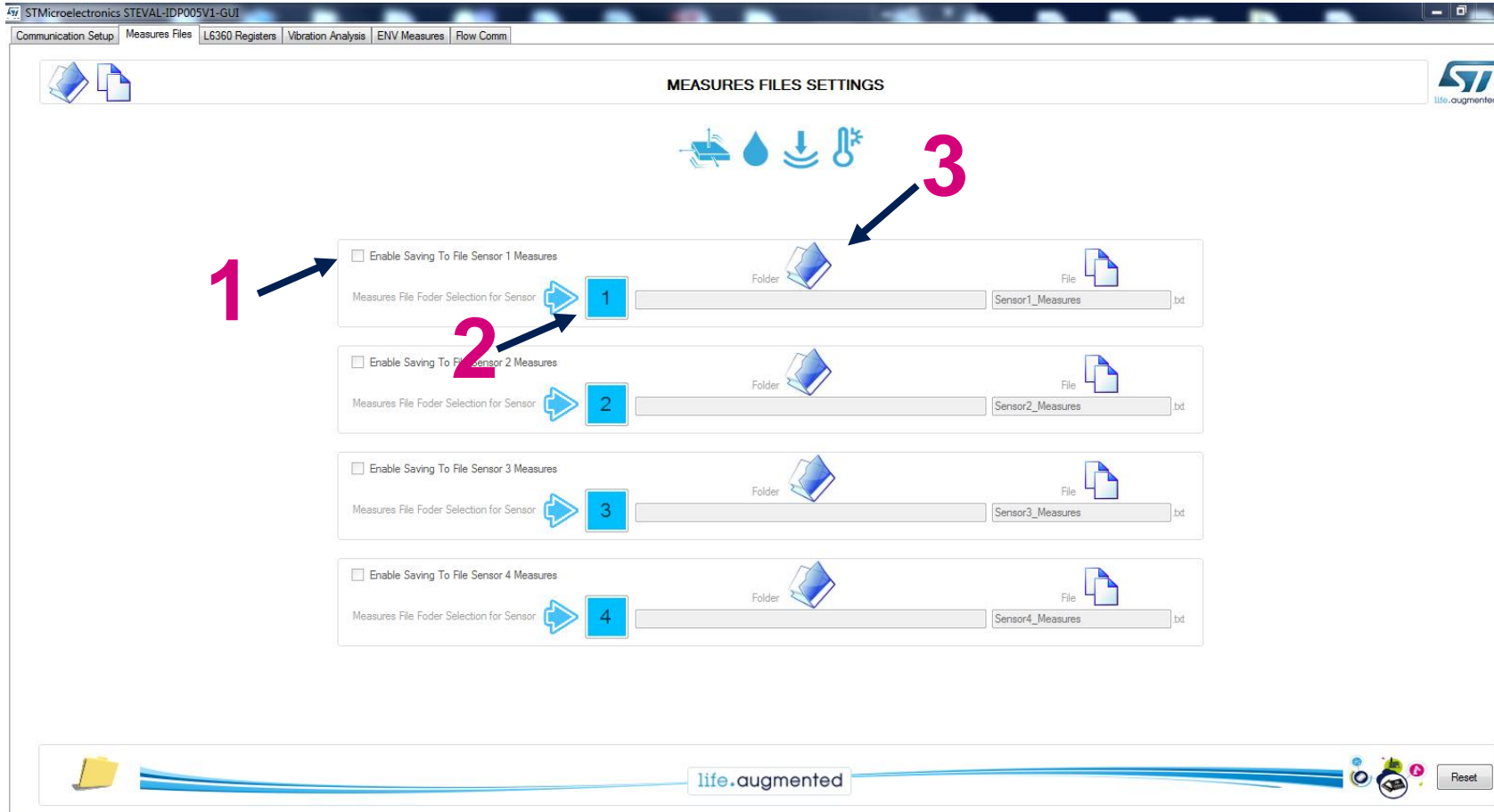
- Pressure
- Relative Humidity
- Temperature

Nodes 2 and 3 in this example

STEVAL-IDP005V1 GUI

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Save data log



1. Check the box “ Enable Saving To File Sensor X Measures”

2. Click the related square blue button

3. Select the folder path where store the file, and choose the file name



How to enable Predictive Maintenance

Predictive Maintenance Demonstration FW

The Predictive Maintenance demonstration project (PredMaint_SVR), inside STSW-BFA001V1\Projects\Demonstrations\Predictive_Maintenance folder, allows programmable vibration thresholds and give, in output, motor status details coming from **time** and **frequency** vibration analysis.

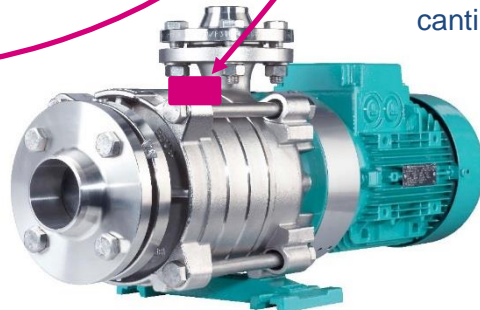
The motor status are:

- Good
- Warning
- Alarm

PC connection through service UART



Fix STEVAL-IDP005V1 very close to equipment. It is recommended not use cantilever board fixing.



Time domain

```

*** TIME DOMAIN SPEED RMS THRESHOLDS STATUS X-Y-Z ***
GOOD | GOOD | GOOD |
0.325 | 2.649 | 0.597 |
GOOD | GOOD | GOOD |
1529.62 | 0.010 | 884.72 | 0.028 | 936.57 | 0.015 |
*** TIME DOMAIN ACC PEAK THRESHOLDS STATUS X-Y-Z ***
GOOD | GOOD | GOOD |
1769.43 | 0.004 | 1892.58 | 0.005 | 1659.25 | 0.008 |
GOOD | ALARM | ALARM |
3.144 | 17.187 | 7.279 |
                
```

Frequency domain

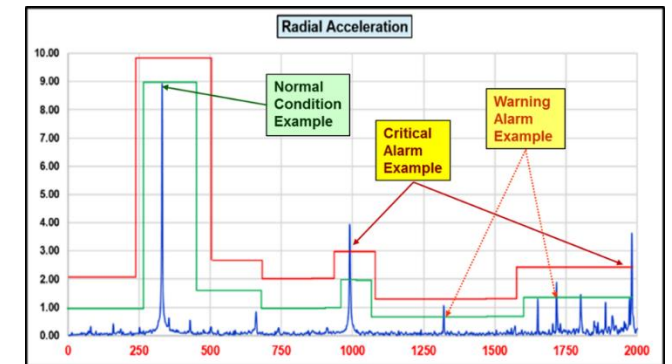
```

*** FREQUENCY DOMAIN THRESHOLDS STATUS ON SUBRANGE vs X-Y-Z ***
GOOD | GOOD | GOOD |
64.81 | 0.053 | 29.17 | 0.373 | 45.37 | 0.076 |
GOOD | GOOD | GOOD |
777.77 | 0.010 | 567.13 | 0.031 | 576.85 | 0.016 |
GOOD | GOOD | GOOD |
891.20 | 0.010 | 884.72 | 0.028 | 936.57 | 0.015 |
GOOD | GOOD | GOOD |
1529.62 | 0.005 | 1335.18 | 0.011 | 1442.12 | 0.018 |
GOOD | GOOD | GOOD |
1769.43 | 0.004 | 1892.58 | 0.005 | 1659.25 | 0.008 |
GOOD | GOOD | GOOD |
2446.75 | 0.003 | 2449.99 | 0.002 | 2099.99 | 0.002 |
GOOD | GOOD | GOOD |
2748.13 | 0.003 | 2874.52 | 0.002 | 2495.36 | 0.002 |
GOOD | GOOD | GOOD |
2903.69 | 0.003 | 3030.08 | 0.002 | 2910.17 | 0.001 |

***** TIME DOMAIN STATUS *****
-----> ALARM <-----
***** FREQUENCY DOMAIN STATUS *****
-----> GOOD <-----

***** Next Measurement *****
                
```

General motor status



Predictive Maintenance Demonstration FW

Threshold settings

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User can modify the alarm and warning thresholds for Speed RMS, Acc peak and spectral band. It is done in precompiling phase on **MotionSP_Threshold.h** file. Spectral band can be subdivided in 8, 16, 32 or 64 subrange.

*Open the PredMaint_SVR project from STSW-BFA001V1\Projects\Demonstrations\Predictive Maintenance folder**

```
Workspace
PredMaint_SVR
Files
STEVAL_IDP005V1 - PredMaint_SRV
Application
EWARM
User
data_communication_srv.c
main.c
MotionSP_Manager.c
MotionSP_Threshold.h
stm32f4xx_hal_msp.c
stm32f4xx_it.c
Drivers
Middlewares
Output

main.c MotionSP_Threshold.h
82  * "THE USER CAN CHANGE THESE VALUES TO ADAPT THE ANALYS
83  */
84  static const sTimeDomainThresh_t TDSpeedRMSThresh =
85  { /* Value in mm/s */
86  5.65f,    /*!< SPEED_RMS_THR_WARN_AXIS_X
87  5.65f,    /*!< SPEED_RMS_THR_WARN_AXIS_Y
88  5.65f,    /*!< SPEED_RMS_THR_WARN_AXIS_Z
89  9.65f,    /*!< SPEED_RMS_THR_ALARM_AXIS_X
90  9.65f,    /*!< SPEED_RMS_THR_ALARM_AXIS_Y
91  9.65f,    /*!< SPEED_RMS_THR_ALARM_AXIS_Z
92  };
93
94  /**
95  * @brief Values inserted considering the value for Accel
96  * and using an ideal shaker @60 Hz for the WARNING for
97  */
98  static const sTimeDomainThresh_t TDAccPeakThresh =
99  { /* Value in m/s^2 */
100  3.5f,     /*!< THR_WARN_AXIS_X
101  3.5f,     /*!< THR_WARN_AXIS_Y
102  3.5f,     /*!< THR_WARN_AXIS_Z
103  6.5f,     /*!< THR_ALARM_AXIS_X
104  6.5f,     /*!< THR_ALARM_AXIS_Y
105  6.5f,     /*!< THR_ALARM_AXIS_Z
106  };
107

main.c MotionSP_Threshold.h
103  6.5f,     /*!< THR_ALARM_AXIS_X
104  6.5f,     /*!< THR_ALARM_AXIS_Y
105  6.5f,     /*!< THR_ALARM_AXIS_Z
106  };
107
108  /******
109  /*- WARNING and ALARM THRESHOLDS with SUBRANGE = 8 -*/
110  /******
111
112  static const float FDWarnThresh_Sub8[8][3] = {
113  /* -X- -Y- -Z- */
114  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 1 */
115  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 2 */
116  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 3 */
117  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 4 */
118  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 5 */
119  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 6 */
120  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 7 */
121  {1.5f, 2.5f, 3.5f}, /* Warn Thr Subrange 8 */
122  };
123
124  static const float FDAlarmThresh_Sub8[8][3] = {
125  /* -X- -Y- -Z- */
126  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 1 */
127  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 2 */
128  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 3 */
129  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 4 */
130  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 5 */
131  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 6 */
132  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 7 */
133  {4.5f, 5.5f, 6.5f}, /* Alarm Thr Subrange 8 */
134  };
135  };
```

— Threshold values for Warning
— Threshold values for Alarm



(*) to change thresholds and recompile firmware it is necessary install one of the supported IDEs

Predictive Maintenance Demonstration FW

Terminal Emulator Data Output

PC Data output displayed are detailed below:

Time domain Motor Status details for each axes

```

*** TIME DOMAIN SPEED RMS THRESHOLDS STATUS X-Y-Z ***
GOOD | GOOD | GOOD |
0.325 | 2.649 | 0.597 |

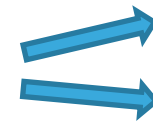
*** TIME DOMAIN ACC PEAK THRESHOLDS STATUS X-Y-Z ***
GOOD | ALARM | ALARM |
3.144 | 17.187 | 7.279 |
    
```

Status on spectral band for each axes in 8 subranges

```

*** FREQUENCY DOMAIN THRESHOLDS STATUS ON SUBRANGE vs X-Y-Z ***
GOOD | GOOD | GOOD |
64.81 | 0.053 | 29.17 | 0.373 | 45.37 | 0.076 |
GOOD | GOOD | GOOD |
777.77 | 0.010 | 567.13 | 0.031 | 576.85 | 0.016 |
GOOD | GOOD | GOOD |
891.20 | 0.010 | 884.72 | 0.028 | 936.57 | 0.015 |
GOOD | GOOD | GOOD |
1529.62 | 0.005 | 1335.18 | 0.011 | 1442.12 | 0.018 |
GOOD | GOOD | GOOD |
1769.43 | 0.004 | 1892.58 | 0.005 | 1659.25 | 0.008 |
GOOD | GOOD | GOOD |
2446.75 | 0.003 | 2449.99 | 0.002 | 2099.99 | 0.002 |
GOOD | GOOD | GOOD |
2748.13 | 0.003 | 2874.52 | 0.002 | 2495.36 | 0.002 |
GOOD | GOOD | GOOD |
2903.69 | 0.003 | 3030.08 | 0.002 | 2910.17 | 0.001 |
    
```

General Motor Status in Time and in Frequency domain



```

##### TIME DOMAIN STATUS #####
-----> ALARM <----- |
##### FREQUENCY DOMAIN STATUS #####
-----> GOOD <----- |
##### Next Measurement #####
    
```



Thank you