Advanced Electronics Labs Inc.,
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High Speed On Board Data Recorder.

Current instructions are written for use with single or multi board OBR configuration.
HS-OBR-12-2G, HS-OBR-9-2G, HS-OBR-6-2G, HS-OBR-3-2G

Ultra-High Speed Shock Hardened Miniature Recorders capture High-speed data for ballistics and explosives testing. **Data recorded during these ultra-fast events, at speeds up to 2MHz per data channel, allow very high precision modeling and analysis of monitored processes.** Model HS-OBR-3-2G is a miniaturized, single board, high shock, solid-state recorder designed to acquire transducer data in shock environments of up to 100,000 G's. Single boards can be easily interconnected providing unlimited data channel capability. **Boards can be configured for a variety of transducer inputs to accommodate testing in harsh environments such as: oil exploration work, automotive crash testing, blast testing, armaments testing and development.** An **Epoxy-encapsulated option is available, as well as single or multi-board configurations**. Low power consumption and use of nonvolatile High Capacity Flash Memory allows **instrumentation** to collect data for long periods of time and to retrieve data any time after the test, even when the power is lost. Data retrieval is accomplished with a simple personal computer. Software supplied with the recorder enables the storage, display, zooming and printing of the data. Firmware upgrades are available with an optional programming connector.

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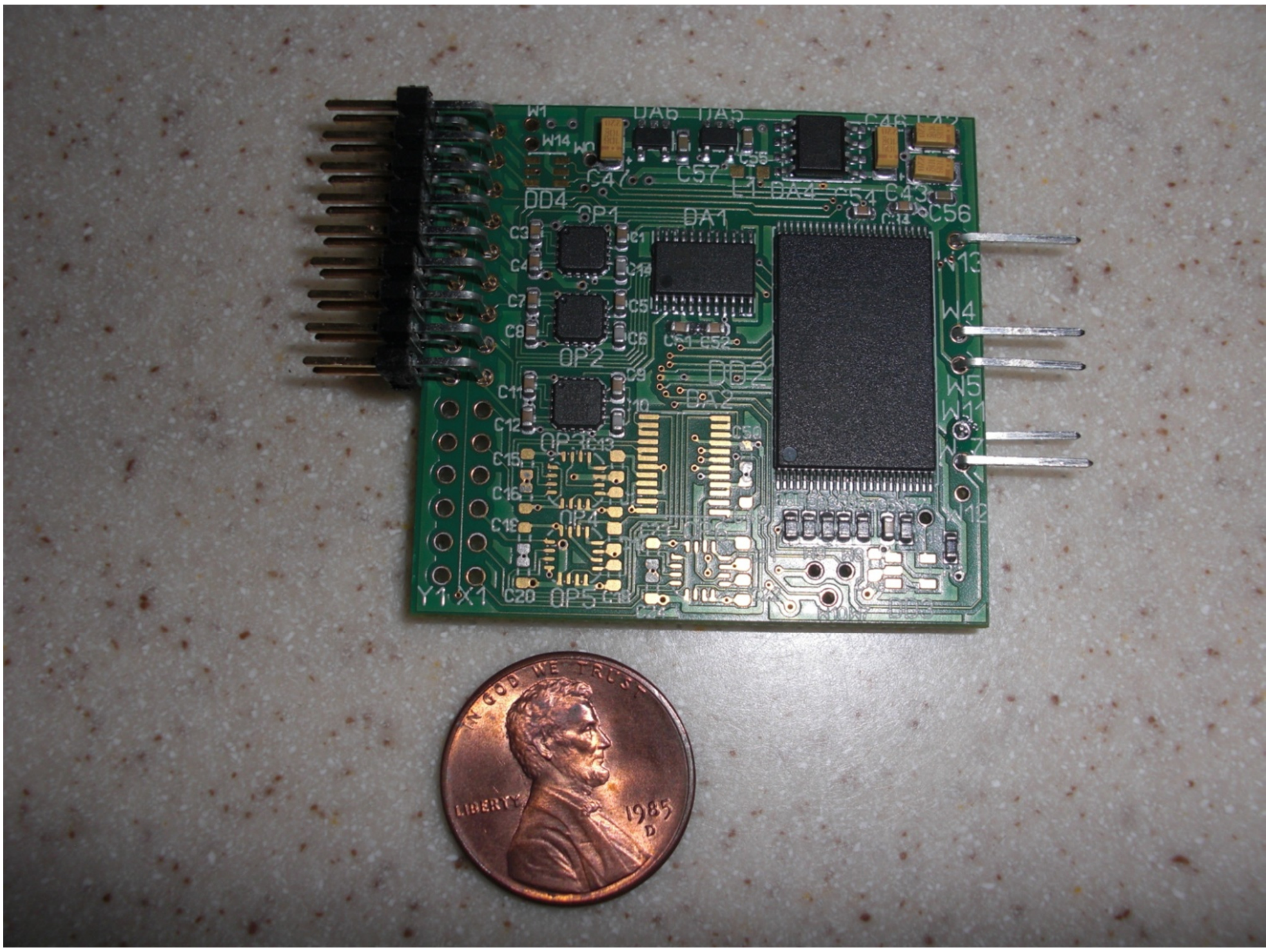

Fully Programmable High Speed Miniature Data Recorder
Single Board configuration (see picture above)

Supply Voltage	**5V regulated (+6V – absolute maximum)**
Supply Current	**50-60mA**
Inputs	**3 analog, Differential**
Filter	**100 KHz Low Pass**
Resolution	**12 Bit**
Sampling Rate	**up to 2 MHz per channel**
Memory	**nonvolatile, Flash 2GByte**
Programmable parameters	**Mode, Delay, Trigger, Bias, Gain, Sampling Rate, Memory Size**
Pre-Trigger data	**4096 samples min.**
Communication	**USB**
Temperature range	**0 to 75 C**
Board size	**1 5/8 x 1 11/16 in. or 41x44mm (without pins)**

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Fig.1. represents the fragment of the boards available for the connections required to operate OBR. Before making any connections with a computer, power supply or sensor, the user must be familiarized with the following instructions of the operation.

Not following the instructions will lead to permanent OBR damage!!!

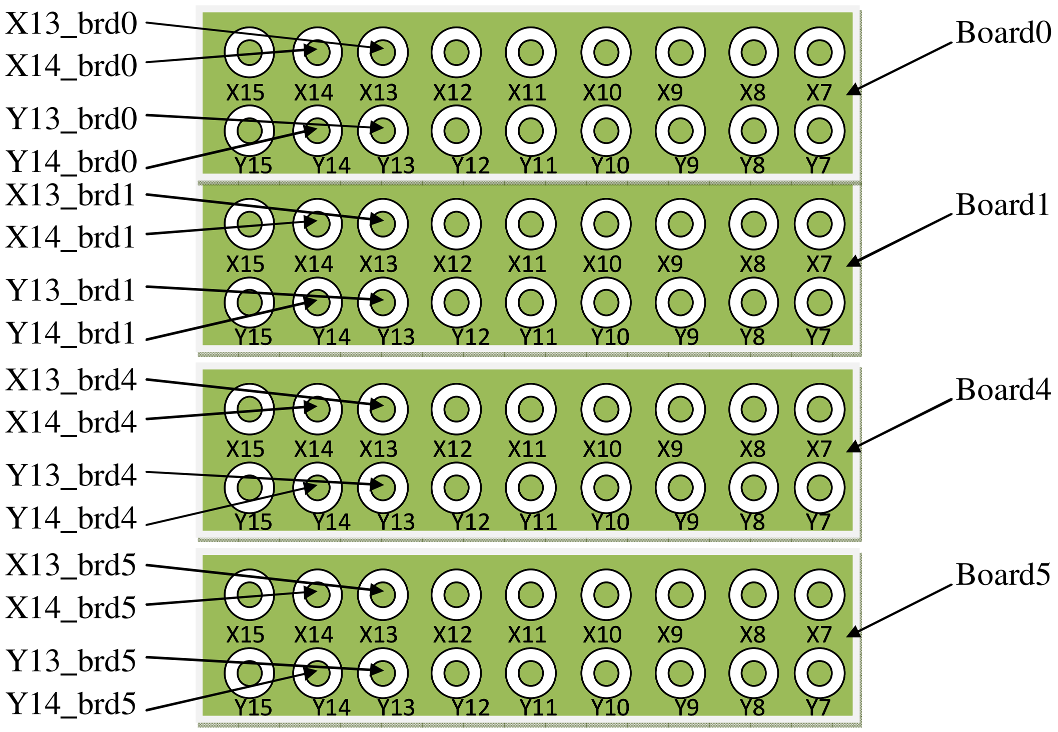

Fig.1

When in multi-board configuration, each OBR board is independent and has its own power connection. All **GND** pads are connected together. For autonomous use (not communicating with a computer that uses a USB power) please follow the instructions below.
To Power the boards set the Power Supply to **5Volts** and make the following connections:

Board 0: Y13 to +V, Y14 to - V
Board 1: Y13 to +V, Y14 to - V
Board 4: Y13 to +V, Y14 to - V
Board 5: Y13 to +V, Y14 to - V

Do NOT exceed absolute maximum of +6V.

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Connect all Y13's together and all Y14's together for a multi-board operation from a single power supply.

To communicate with OBR, to read and write functions contacts from **X row** are used: **X14** and **X13** of each board.

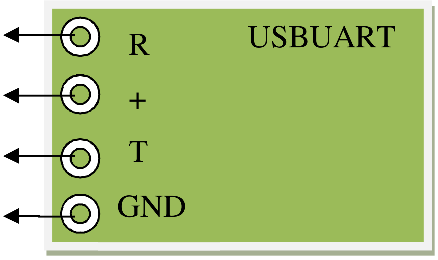

Fig.2

Follow diagram on Fig.2 to establish a communication with each board individually using USBUART. Connect:

Rx to X14,

Tx to X13,

+5 to Y13,

GND to Y14.

Each board of OBR can support up to 3 differential inputs (piezo-resistive accelerometers, pressure sensors, strain gauges and any Wheatstone bridge type sensors). Each analog sensor connection (differential input) is represented with two pads of **Y row** and two pads of **X row**.

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Sensors Connection.

To connect sensors follow the instruction below:

Sensor #1:

X11 to - OUT

X12 to + OUT

Y11 to + Excitation

Y12 to – Excitation

Sensor #2:

X9 to - OUT

X10 to + OUT

Y9 to + Excitation

Y10 to – Excitation

Sensor #3:

X7 to - OUT

X8 to + OUT

Y7 to + Excitation

Y8 to – Excitation

For all boards containing odd numbered pads from group **Y (Y7, Y9 and Y11)** are connected to internal regulated power supplied with **+3.3V** (check this voltage for proper calculations). All even numbered pads **(Y8, Y10 and Y12)** are connected to **GND**. Internal regulated supply will support up to 150 mA. Also, if additional current is needed the user can power up gauges using external regulated power supply. In this case, when powering the sensor, if the power used exceeds more than 3.3V, **DO NOT** allow the output of the gauge to exceed **+/- 3.3V**.

The contact **Y15** can be used as an external G-switch connection (start function). OBR will start data acquisition once this contact is pulled from **GND to +3.3V**.

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Application "Quick Look 3.4."

To establish a communication using Windows Operating System, connect the OBR to the Computer according to Fig. 2. Open the application "**QuickLook 3.4"** or any newer version. The user can download the software application **"QuickLook 3.4"** from the AEL Inc. website and use it without any special installation.

The application **"QuickLook 3.4"** (Fig.3) GUI consists of numerous fields and buttons where user can input data and initiate commands. In the middle portion of the application screen, the white field **"Information Window"** is used to display messages generated by OBR software, providing confirmation of executed commands.

Above the **"Information Window"** – the **"User Window 1/OBR Info"** user can program OBR input required settings for data acquisition and execute various commands. These setting will be applied to all active OBR Channels.

The following commands are currently available:

"Scan" – Locate virtual COM port

"Connect" – Connect Computer to OBR

"Trigger" – Start Data Acquisition/Recording or Arm the OBR

"Trigger Settings" – Select Trigger Mode (Auto, G-switch, Channels)

"Recorder Delay Time" – Time between pressing "Trigger" and Recording starts

"Read Data" – Read Data from OBR Flash Memory into file

"Read Setting" – Read OBR settings

"Save Settings" **– Save OBR settings to Flash Memory**

"Required Memory Size" – Set Flash Memory Size for Data Acquisition

Recorder ID, Firmware and **Software versions** will be displayed in the **Board Info** window after establishing communication.

Below the **"Information Window"** - **"User Window 2/Channel Info"** user can:

Activate/Deactivate **OBR** channels, set the **Gain, Bias** and **Sampling Rate** functions using the corresponding Tab:

Channel 1 for **Sensor #1**

Channel 2 for **Sensor #2**

Channel 3 for **Sensor #3**

In field **"Sampling Rate"** the user selects one of the fixed **Sampling Rates** for each selected active Channel. In the current OBR version the following **Sampling Rates per Channel** are available: **2MHz, 1.1MHz, 750KHz, 440KHz, 301KHz, 240KHz, 190KHz, 61KHz.** Each Channel has built-in Low Pass Filter with the cutoff Frequency of 110 KHz.

In field **"Sensitivity"** user is able to input **Sensor Sensitivity** data and **"Upper range"** and **"Lower Range"** fields will be automatically populated by the application (not available in this version, user can populate these fields for **Sensor/Channel** information purposes only and information will be saved; an automatic field population option will be available in the next software version).

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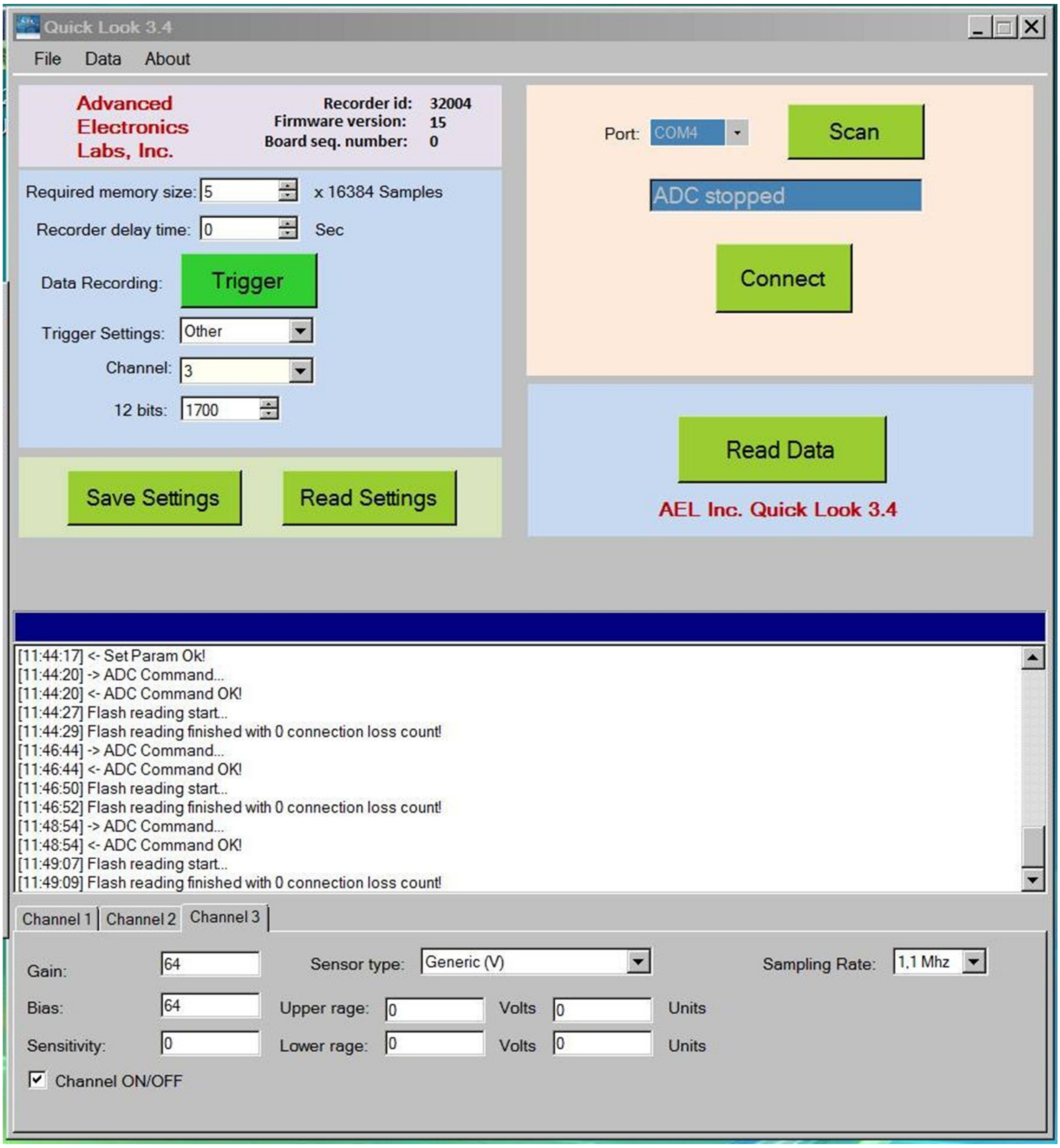

Fig.3

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OBR Operation

To establish a communication with OBR:

Connect to the computer using **USBUART** (Fig.4)

Follow the connection diagram below:

Connect: Rx to X14

Tx to X13

+5 to Y13

GND to Y14

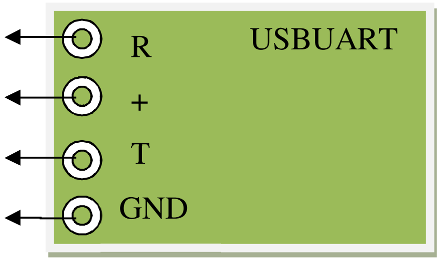

Fig.4

Open the **"QuickLook 3.4"** application and click **"Scan"** to find a virtual COM port.

After receiving a message in the **"Information Window"** confirming that the virtual COM port is found, click the **"Connect"** button.

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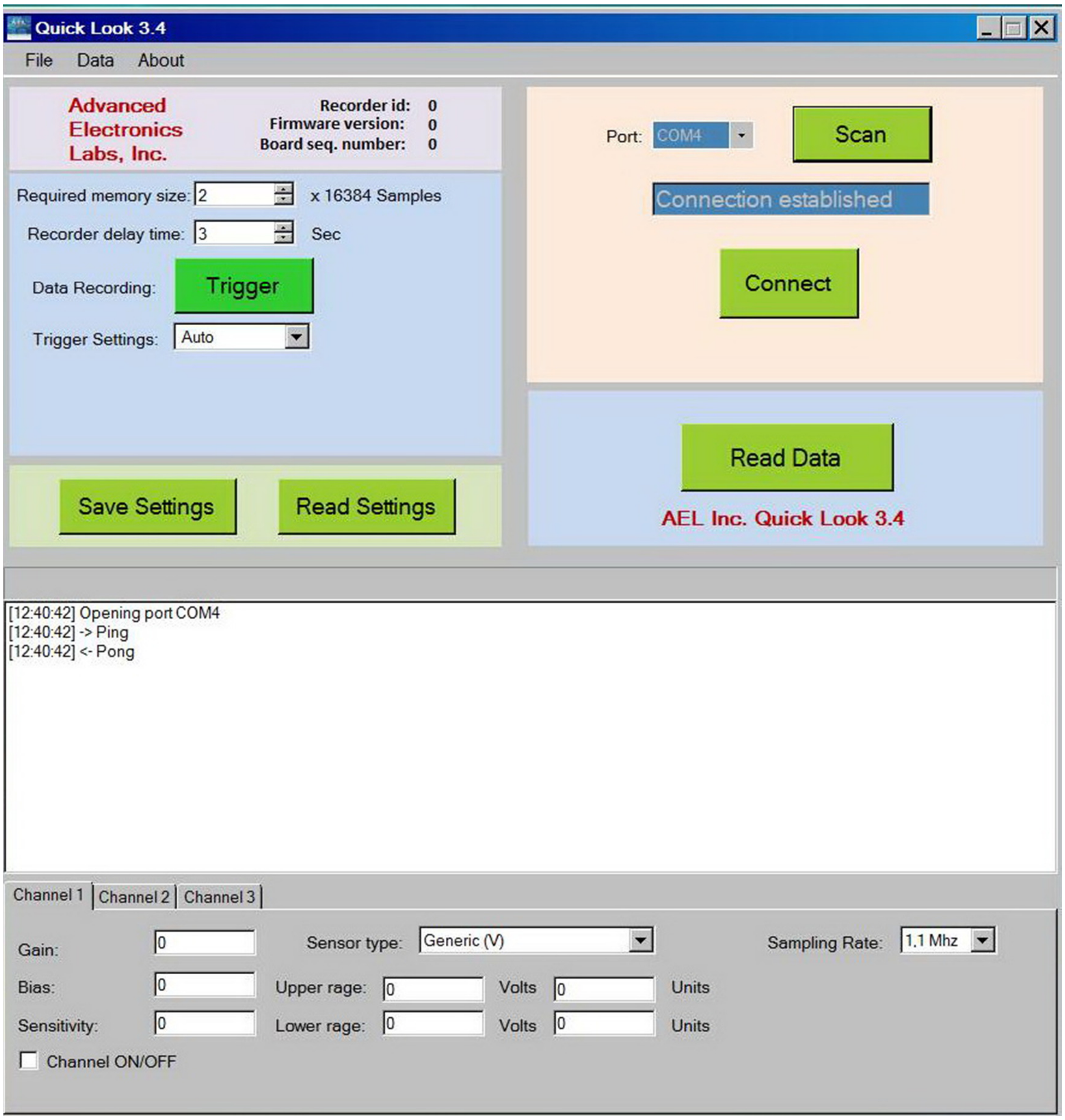

Fig.5

After a successful connection, the words **"Ping and Pong"** will appear to the user in the **"Information Window"** – confirming that Connection has been established. In the case of a failed connection, the user will receive a **"Connection Failed'** message. To fix the problem, check for correct wiring, and repeat the attempt.

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After establishing a communication link with OBR, the user can execute the following commands:

1. Click the **"Read Settings"** button. All fields in the **"User Window 1/OBR Info"** and **"User Window 2/Channel Info"** will be populated with information saved in the Flash Memory. Use this command to verify your settings.
2. Click the **"Save Setting**" button. All the information that the user inputs into fields of the **"User Window 1/OBR Info"** and the **"User Window 2/Channel Info"** will be saved to the **Flash Memory.**
3. Click the **"Trigger"** button. The **OBR** will start recording data from all active channels to the **Flash Memory**. The **OBR** will stop recording when the **"Required memory size"** will be full. During Data acquisition process the **"Trigger"** button, changes to **RED** and all other buttons are inactive. All buttons become active again when recording stops, and memory is full.

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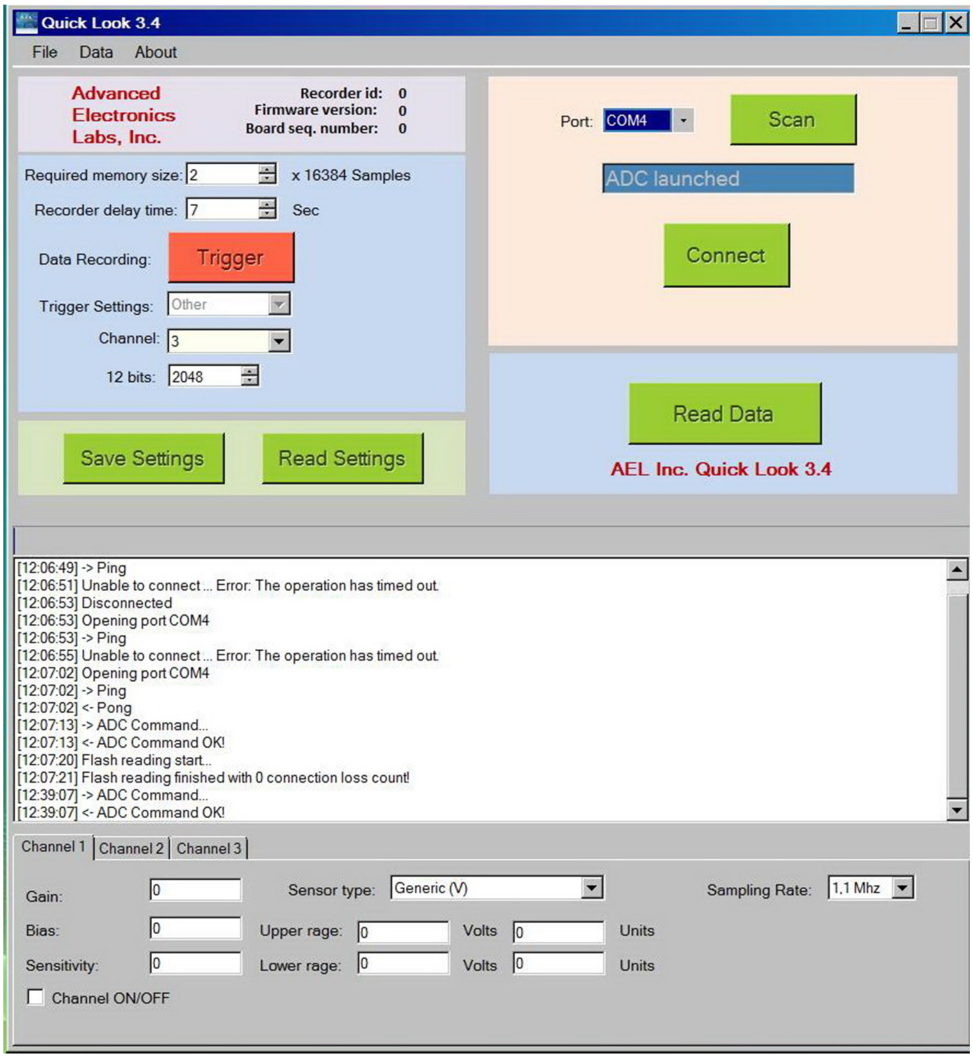

Fig.6

After pressing the "Trigger" button and disconnecting from the computer (when using external power source) the user can confirm that the "OBR" is functioning properly in Trigger waiting mode by connecting an LED between pins X6 and Y6 pins. The LED will emit solid light.

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4. Click the **"Read Data"** button. An additional window will pop up and user will be able to name the **Binary Data File** with a **".sns"** extension and save it to a chosen directory for further data analysis/reduction. The number of data samples in the file will be equal to the (**16384 X "Required Memory size")** input. The file format: first 8KB – input parameters and service info – is NOT visible to the user when the data is graphed, recorded data will follow. **To graph acquired file** for quick data display user can select **"Data"** from the Menu items and then select **"Open measured file…"**

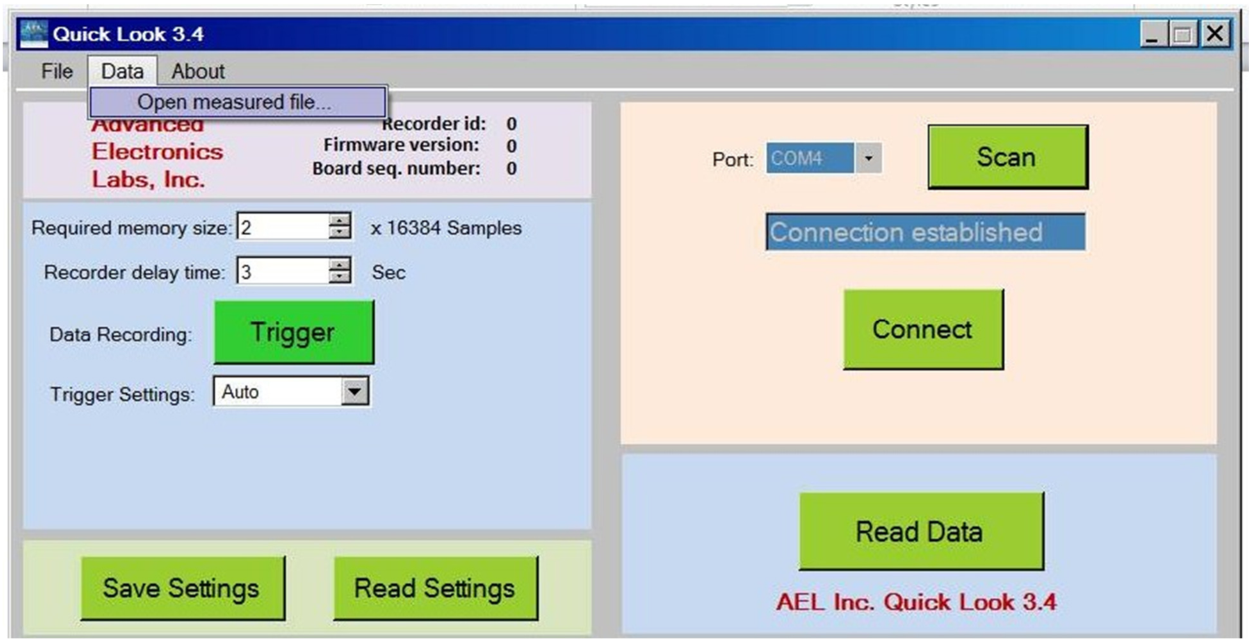

Fig.7

A new window will pop up with the graphical data representation of all active channels.

Here, the user is able to scroll, select and zoom into the data of interest.

To save each channel separately: go to **File - Save to File…** - and you will be able to name and save files to selected directory (there will be three files created: nameaeldata_ch.1, nameaeldata_ch.2, nameaeldata_ch.3)

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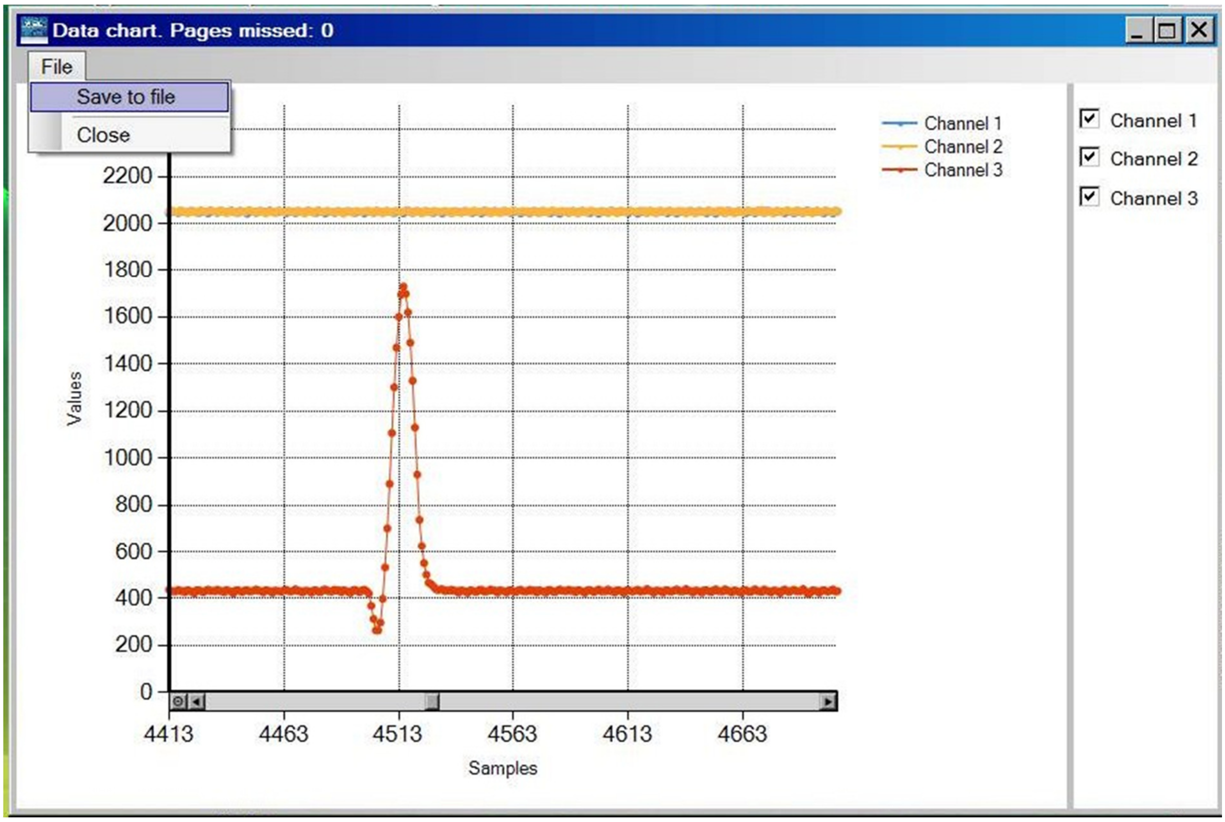

Fig.8 50 KHz pulse capture (at 1.1 MHz sampling rate)

Each channel is represented by a different color. The **X axis** displays the **Sample Number** acquired and the **Y axis** represents a **Sample Value**; the range of **Values** for the **Y** axis range from 0 to **4096**. Step is 3.3V/4096 = .8mV.

To convert the Sample number on the X axis into absolute time: multiply the Sample number by the inverted **"Sampling Rate"** chosen for the current channel.

Example: "S**ampling Rate"** for **Channel 1** is 2 MHz. Then absolute time for sample number 50688 will be:

50688*(1/ 2000000) = 25.344 millisecond

And, if the "S**ampling Rate"** for **Channel 2** was 440 KHz, then the absolute time for sample number
50688 will be:

50688*(1/ 440000) = 115.2 milliseconds.

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In a Graphical representation, Step in absolute time for each active channel depends on selected **"Sampling Rate"** for this Channel.

5. **"Recorder Delay Time" –** the time between activating the **"Trigger"** and the start of recording. When the time is set to "0" recording starts immediately after pressing **"Trigger".** When the Delay Time is set to a value other than "0", clicking the **"Trigger"** will initiate an **"Arm"** mode. Then, start the timer, and data recording will start after the delay time expired. During this time the LED connected to X6, Y6 will emit solid light. User can input a **Delay Time** into the corresponding field between 0 and 7200 Seconds. The maximum Delay Time for the current recorder model is 2 Hours.
6. Click the "**Trigger Setting".** The **Drop down box** appears and the user will select one of the following trigger options: **"Auto", "Other".**

"Auto"– could be used for: data acquisitions, calibrations, sensors checks, parameter readings, memory checks, proper OBR functioning verifications. When the **"Auto"** Mode is selected Data acquisition (recording into Flash Memory) will start by pressing the **"Trigger"** button (user will see the message in **"Information Window"**) and will stop once the selected Memory size is full Use this Mode to start data recording into Flash memory after Delay time expiration.

"Other" – when this mode is selected, drop down text box with Channel option will appear, users will be able to select **"Channel 1, 2, 3 and G-Switch"** to trigger on. In this Mode OBR will start to record data into internal a buffer memory right after Delay Time expiration. This data will be **"Pre-Trigger Data"** and the size will be equal at least to 8096 samples for each active channel.

Data recording into Flash Memory will start after once one of the following conditions is satisfied:

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a. **"G-Switch"** closure. Pin **Y15** could be used for external **G-switch** connection (recording function). The OBR will start the data acquisition once this pin is pulled from the **GND to +1.8 - +3.3V**.

b. If multiple boards are used in the OBR, select **"G-Switch"** on the first board and any trigger option can be selected on all other boards.

c. Exceeding the value entered into the field **"12 Bits"** when the Trigger is on, the Channel is selected. The value range for this window is from **1 to 4096**.

   Step is **3.3V / 4096 = 0.8 mV**.

7. **"Required Memory Size" –** enter desired Flash Memory size for data recording. The value range for this window is between 0 and 65535. Step is 16384 samples. When value of "65535" is entered the entire Flash Memory of 2 Giga Byte will be recorded for all active Channels.

   The total amount of samples will be 1,073,741,824.

   The Memory allocation between channels **will** depend on the amount of active Channels and Sampling Frequency. Example: if two channels are selected and sampling frequency of one channel is twice as fast, then memory allocation for this channel **will be** twice as large.

8. **Tabs "Channel 1", "Channel 2", Channel 3". The** user can activate/deactivate channels by flagging the check box **"Channel ON/OFF"** of corresponding channel. For each active channel, the user can select the following parameters:

   a. **Sampling Frequency –** select one of the values from the drop down box from **61 KHz up to 2 MHz**

   b. **Bias –** select desired bias value from 0 to 255. Step is 3.3V/256 = 13mV

   c. **Gain –** select desired Gain value from 0 to 255. Lowest Gain set at 255 and the highest at 0. Real Gain calculated as **G = 1 + (49400/(39*Gain + 45)).**

   d. The user can input other parameters for information only and they will be saved for use in data post processing.

   e. **For current OBR version scale all the input signals into 2.5Volts.**

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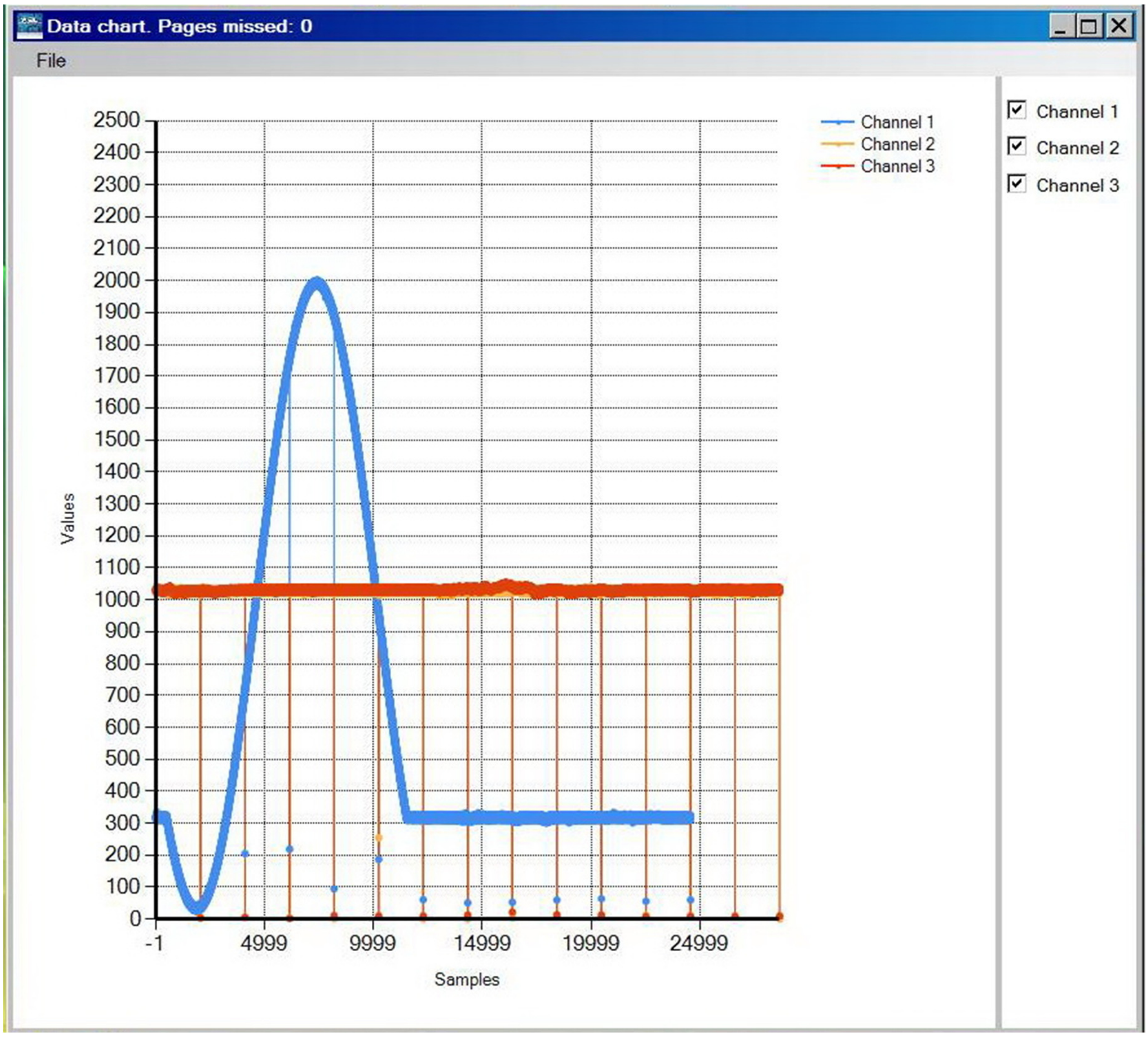

Fig.9 Data sample

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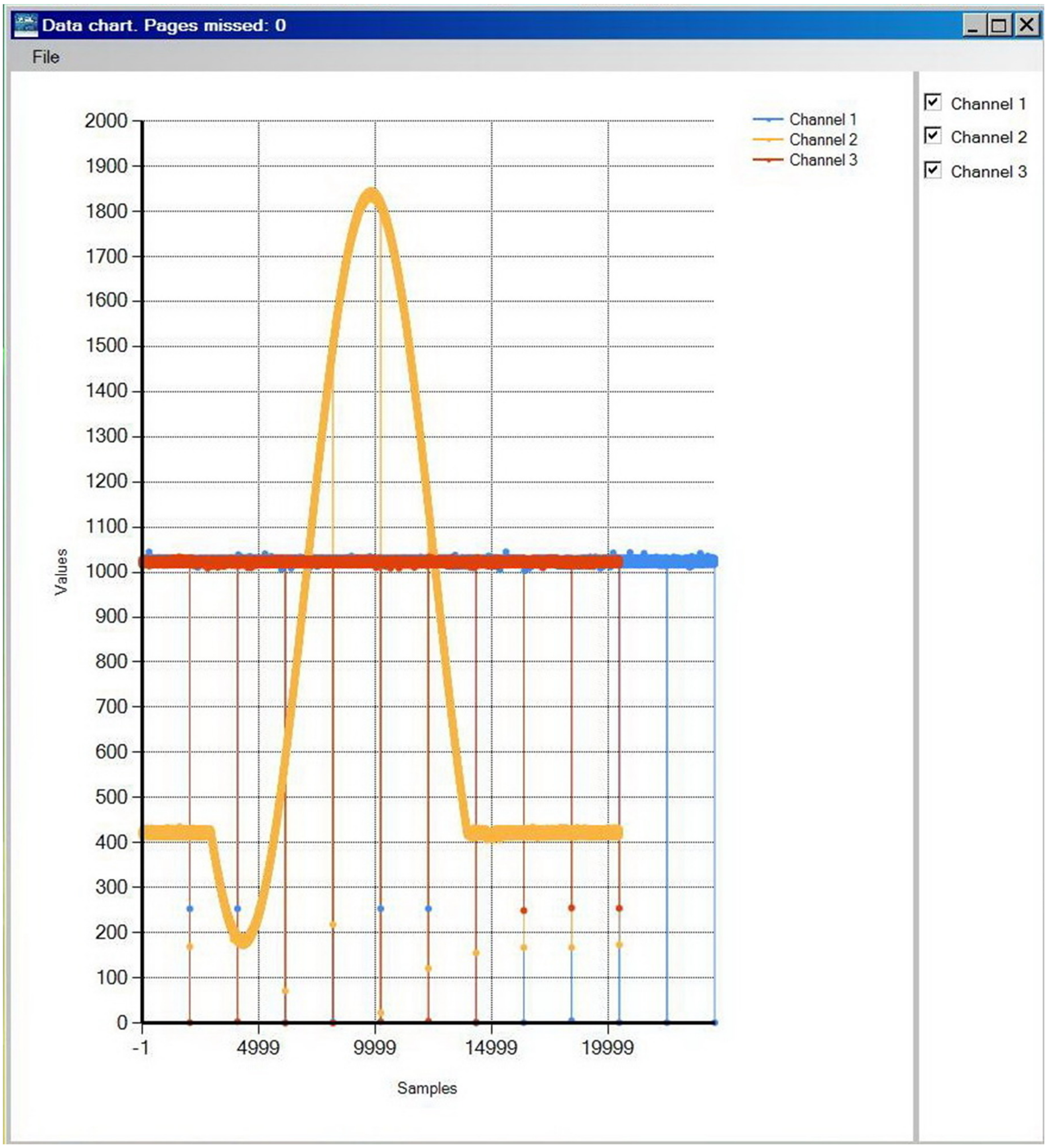

Fig.10 Data sample

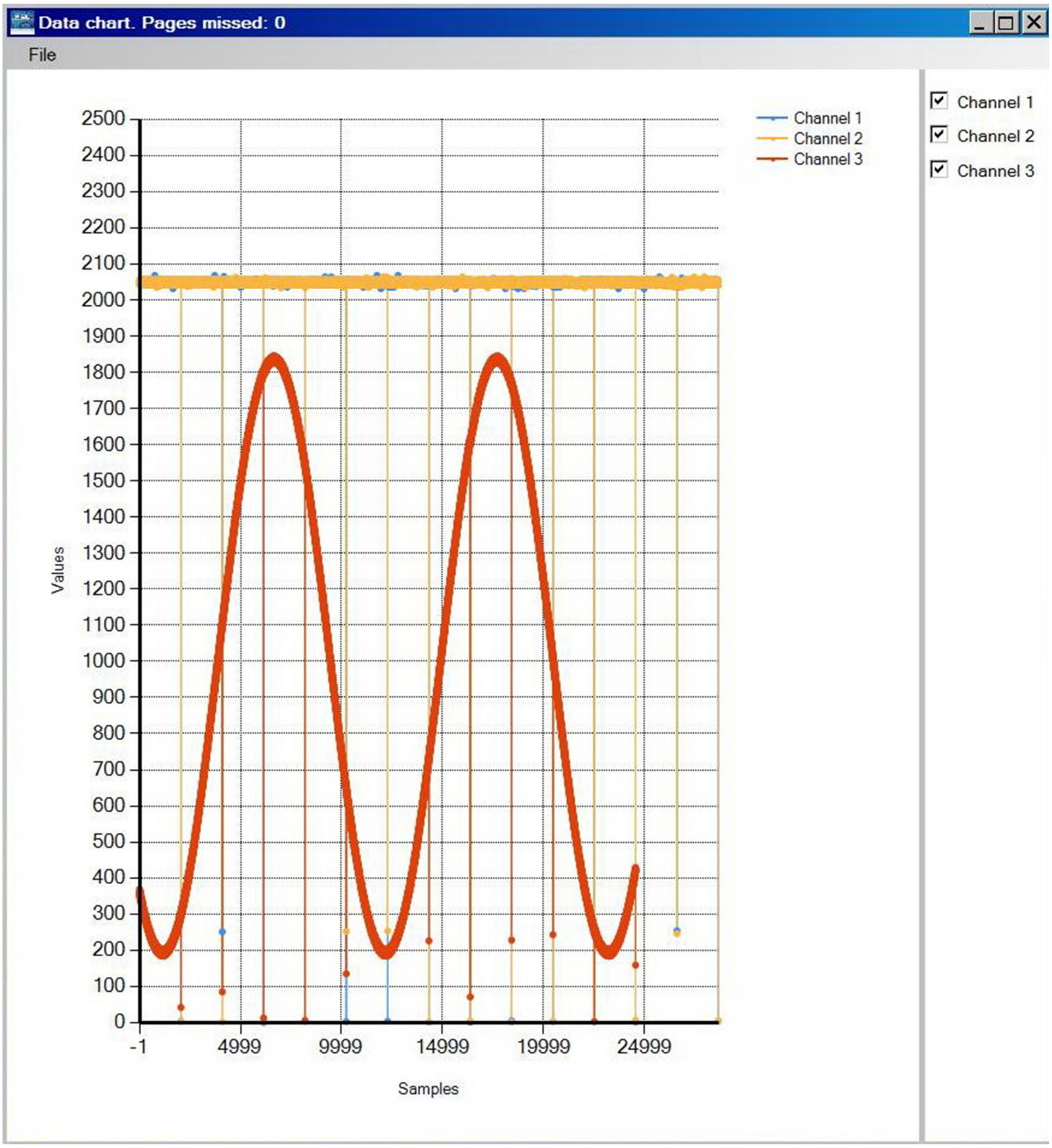

Fig. 11 Data sample

