



# SIGMA2 & SIGMA LOGIC ANALYZERS



## User's Guide

### Features:

- Very large event memory (256 Mb)
- Up to 200 MHz sample speed
- Up to 16 inputs
- Flexible trigger options
- Controlled and powered by USB

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*Note: This document contains hyperlinks pointing to web pages on the Internet. If the links happen to be broken (point to non existing page), please download recent version of this manual from [www.asix.net](http://www.asix.net).*

# 1. SIGMA2 AND SIGMA LOGIC ANALYZERS

SIGMA2 and SIGMA are logic analyzers - development tools designated for tracing and debugging of TTL (and compatible) digital signals.

SIGMA is an original version of the logic analyzer, it was delivered until November 2011. SIGMA2 is a new version which replaces original SIGMA; it has been available since December 2011. SIGMA2 is basically the same as SIGMA, it differs from its predecessor in following:

- new plastic enclosure
- different LED indication
- added a button
- lower price

The SIGMA2 name will be used in the following text for both logic analyzer versions if the features are the same. If there is a difference, the SIGMA2 and SIGMA be will be distinguished.

SIGMA2 is equipped by 256 Mb of memory and provides with up to 16 digital inputs and sampling rates up to 200 MHz. Built-in data compression allows for tracing of long running signals without exhausting the logic analyzer memory. When using all 16 inputs, guaranteed minimum capacity is 14 million samples. SIGMA2 connects to PC through USB (Full-Speed, 12 Mbps) which ensures both data transfer and power delivery with a single cable. No additional power supply is needed.

## 2. INSTALLATION

Install the SIGMA2 software package to your computer. Connect SIGMA2 to a USB port or a USB hub using supplied cable. The operating system detects a new device and asks for a driver. Select option install the driver from specific location and navigate to the folder containing the driver (available on CD or for download at [www.asix.net](http://www.asix.net)). The driver is not digitally signed thus you will be prompted to confirm installation of the driver.

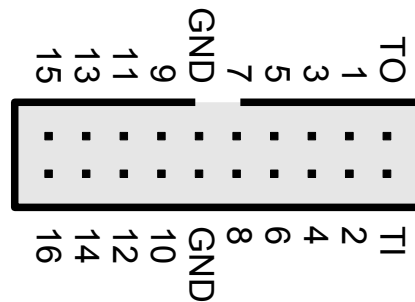
### Driver installation under Windows 7

For Windows 7 use the latest driver from [web](#) or the driver included on the SIGMA2 accessory CD - ROM. Under Windows 7 the driver will not install automatically, it must be installed manually consequently: Open Device Manager and find the connected SIGMA2 logic analyzer there. Open its properties window and select "Update driver". Select a location where the unpacked driver is saved.

## 3. TARGET CONNECTION

The digital inputs are organized as two 8-pin ports (inputs 1 to 8 are connected to port 1, inputs 9 to 16 to port 2). Pin-to-pin skew between inputs on a single

port is relatively low while it may be considerably higher between the ports. Trigger in (TI) may be used to force trigger by external circuitry. Trigger out (TO) indicates a trigger condition to external device (e.g. oscilloscope to measure signal slope in particular conditions).



*Drawing 1: Target connector*

SIGMA2 is equipped by high impedance inputs with TTL logic levels (Low Voltage CMOS with 1 M $\Omega$  pull-down resistor).

Capacitance of probe cables shall be taken into consideration when connecting to the debugged application, otherwise a cross-talk of fast signals may occur. The leads of the supplied cable with individual pins may be split to reduce capacitance between adjacent wires.

## 4. INDICATORS AND BUTTON

### **SIGMA2 (new logic analyzer version only)**

Main panel contains two bi-color LED indicators providing the operator with quick status information.

- ● ONLINE / BUSY (green/yellow LED)
  - *off*: no USB power or USB is in the Sleep mode or no USB driver is installed
  - *green*: SIGMA2 is configured and idle
  - *yellow*: SIGMA2 is acquiring data
- ● TRIGGER STATUS (red/yellow LED)
  - *off*: trigger inactive - no trigger condition detected
  - *red*: SIGMA2 is waiting for trigger condition
  - *yellow*: flashes when trigger condition or trigger pattern is matched

The GO button helps to control the analyzer comfortably by easy cyclical switching between the basic operation states. When pressed in idle state the test is launched. When pressed in running state the trigger is forced. When pressed in triggered state the test is stopped, idle mode is launched and the data transfer from logic analyzer memory to PC is started.

## SIGMA (old logic analyzer version only)

Main panel contains seven LED indicators providing with overall status information at a glance.

● ON-LINE	lit whenever there is a USB connection with PC
● READY	lit when SIGMA is configured and idle
● USB BUSY	indicates data transfer in progress
● TRIGGER WAIT	SIGMA is waiting for trigger condition
● BUSY	SIGMA is acquiring data
● TRIGGER DETECT	flashes when trigger cond. or trigger pattern is matched
● PIN CHANGE	flashes upon change on an input pin

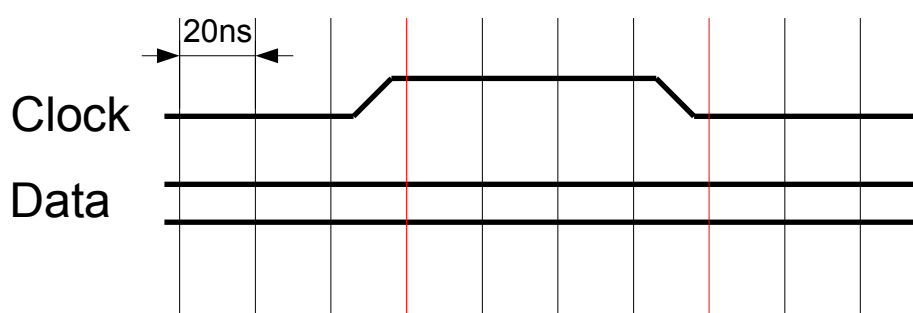
Button is not available at the old SIGMA.

## 5. USING SIGMALOGAN SOFTWARE

### 5.1 Modes of operation

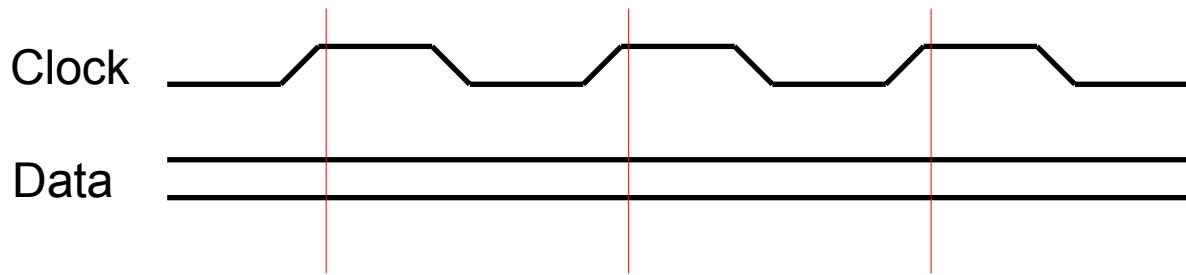
SIGMA2 is able to operate in one of several modes giving possibility to adapt to actual needs of user or the debugged application (all inputs with basic sampling rate or limited number of inputs at higher sampling rates). The mode of operation can be selected in *Settings/Clock source*.

- 16 inputs, 50 MHz (or slower, divided by 2 to 256)
- 8 inputs, 100 MHz, limited to port 1 only
- 4 inputs, 200 MHz, limited to first 4 inputs of port 1 only
- 16 inputs, 50 MHz, sampled only upon change of a given pin (**asynchronous** clock), rising, falling or both edges, max. clock speed ~ 40 MHz with 1:1 duty cycle, the asynchronous mode requires larger amount of the analyzer memory space for saving of a sample, because the sample capture time must be saved as well.



Drawing 2: Sampling with asynchronous clock

- 15 inputs, 1 **synchronous** clock input, only first input on either port may be used as clock, rising or falling edge, max. clock speed 49.9 MHz, the clock signal must be present before start of the test, several last samples will not be contained in the captured test because of pipelining.



*Drawing 3: Sampling with synchronous clock*

Data compression is used in any case, disregarding selected mode of operation, giving possibility to capture long running signals with precise timing. Actual compression ratio depends on characteristics of particular signal.

## 5.2 Input pins

Term **input pin** refers to physical input of SIGMA2. Input pins may be given names for user's convenience in the *Settings/Inputs setup* or using **I** hotkey. The name may consist of letters, numbers and spaces and may be prefixed by hash (#), slash (/) or minus sign (-) to indicate negative polarity. Input names may also be indexed using a number in parenthesis or brackets which is typical for buses.

The *Bus copy* function and the keypresses **Ctrl+↓** or **Ctrl+↑** help to automate the naming process of bus signals. *Fill traces* function may be used to automatically generate traces according to input signal names.


## 5.3 Traces

Term **trace** refers to visualization of acquired data. A trace may be composed of several inputs and otherwise, a single input may be used in multiple traces, e.g. it is possible to visualize several inputs as a bus while still having the possibility to display also the individual signals.

The traces are defined in *Settings/Traces setup* or using **Ctrl+T** hotkey. If a trace is defined as a bus, the value will be displayed according to configurable formatting. Radix from 2 to 36 may be used to format the value as a number using alphabetical characters for digits above 9. There are also special formatting options for displaying data as ASCII characters. Values which do not represent a printable character in selected set are shown as hexadecimal numbers. The output may be prefixed, suffixed, padded with zeros from the left to given width and also digit grouping may be used.

A traces may be also edited by double clicking the trace in the main window. Context menu in the main window may be used to add or remove traces.

## 5.4 Trigger settings

Trigger settings dialog may be invoked from menu by *Settings/Trigger Setup* from menu or using a  hotkey.

Availability of certain trigger settings depends on clock settings. For sample rates of 100 and 200 MHz only basic trigger on edge of selected input signal is available. In other modes either pin trigger or advanced trigger may be used. Advanced trigger allows for precise specification of trigger condition and also precondition which has to precede for the trigger to be activated.

Pin trigger settings define trigger event as combination of desired levels and edges on input pins. The trigger may be immediate (occurs as soon as the defined combination shows up) or delayed by a counter.

Advanced trigger settings define trigger event by a boolean expression. A visual expression builder is used to create or edit the expression. The terms in the expression may be

- simple input or trace a name: `Input0`, `CLK`, `MISO`
- a bus signal: `BUS[0]` or `BUS(0)`
- comparison with a constant:  
`IN5=0`, `BUS=A6`, `BUS=h'a6'`, `BUS=b'10100110'`, `BUS=d'166'`
- optionally prefixed with a negation operator: `!TERM`, `-TERM`, `#TERM`, `/TERM`

An optional precondition may also be defined the same way. The trigger may be immediate, delayed by a counter or set to react on certain event length, time distance of two events, or gap length between events.

Although this approach makes it possible to describe very complex situations a thus to precisely define the moment desired to be captured, there are certain limitations determined by capabilities of the hardware. If the expression is too complex to be implemented in the hardware, exclamation icon appears to indicate this.

Other trigger settings include configurable post-trigger time, style of visual indication of the trigger using the LED, trigger out type (CMOS or open collector output) and trigger in polarity and pull up/down resistor.

## 5.5 Quick start

- 1) Attach SIGMA2 to debugged application and launch the SIGMALOGAN software.
- 2) Use *Settings/Clock source* dialog to select desired sampling rate and mode.

- 3) Open *Settings/Inputs setup* to rename input signals for your convenience (optional step).
- 4) Setup traces in *Settings/Traces setup* dialog to add traces.
- 5) Define trigger condition in *Settings/Trigger setup* dialog.
- 6) Finally run the test using *File/Test* command or simply hit **ENTER** in the main window.

This procedure may be followed automatically by selecting menu item *Settings/Connection wizard*.

## 5.6 Inspecting the data

Navigation in the main window can be controlled by keyboard, mouse or a combination of both.

Sliding left/right along the time axis is controlled by left/right cursor arrows, **PgUp/PgDn** keys mouse scrollwheel, mouse motion while holding down **Ctrl** key or by dragging the horizontal scrollbar.

Zooming is controlled by **+** and **-** keys, rotating scrollwheel while holding down **Ctrl** key. The **\*** key zooms to 1:1 (every sample visible) while the **/** key zooms out to preview all available data at once. Highlighting part of the screen by dragging the mouse zooms to selected region.

## 5.7 Plugins

The SIGMA2 software features modular design to add functionality according to users needs. This modularity is achieved by using **plugins**.

Plugins are dynamically loadable libraries (DLL files) located in the main program folder. Individual plugins may be enabled or disabled in *Settings/Plugins* dialog and configured in *Settings/Plugin Settings* (if applicable). Several plugins are part of the SIGMA2 software package by default.

Some plugins (UART, SPI, I<sup>2</sup>C) decoded data can be inserted among captured signals as virtual track in the *Settings/Traces Setup menu*. After the track name is clicked, the plugin can be chosen in the ComboBox on the right.

### Bookmarks (dll\_bookmarks.dll)

This plugin provides with possibility to define up to 10 bookmarks for convenient navigation in the data. Press **Ctrl+Shift+0** to **Ctrl+Shift+9** to place or remove a bookmarks. To navigate to an existing bookmark, press **Ctrl+0** to **Ctrl+9**. To use the bookmarks a plugin providing cursor (e.g. `dll_mousecursor.dll`) has to be enabled.



#### Edge search (dll\_edgeseach.dll)

Enables easy motion over the signal edges. Press **Alt+←** or **Alt+→** to jump to nearest previous or next edge of the selected trace.

#### Show time at mouse pointer (dll\_hinttime.dll)

Shows time position of the cursor location as a tooltip.

#### Other derived inputs (dll\_inv.dll)

Adds virtual input signals which are inversions of real inputs.

#### Mouse Cursor (dll\_mousecursor.dll)

Draws a vertical line under mouse cursor position. Also provides with magnetic edges and snapping to grid.

#### Disallow multiple instances (dll\_mutex.dll)

This plugin simply watches that no more than a single instance of the SIGMALOGAN software is running at a time.

#### Show already downloaded from SIGMA2 (dll\_sig0.dll)

SIGMALOGAN displays a raw preview of the performed test as soon as data is captured, there is no need to wait for complete test to be downloaded from SIGMA2. The detailed data is then being downloaded in the background with areas of user's interest first (i.e. when zooming in). This plugin visually indicates portions of data which are yet to be downloaded (these are drawn on shaded background).

#### Simple marker (dll\_simplemarker.dll)

Allows user to place a single mark at the cursor position by pressing spacebar. This is particularly useful for measuring time distance between two points (place the mark to one location, move the cursor to the other one and watch the tooltip).

#### UART Plugin (dll\_uart.dll)

Decodes one or more captured UART signals and displays data as ASCII, decimal or hexadecimal value.

#### SPI Bus Analyzer Plugin (dll\_spibus.dll)

Decodes captured signals as SPI and displays as hexadecimal value.

### I2C Bus Analyzer Plugin (dll\_i2cbus.dll)

Decodes captured signals as I<sup>2</sup>C and shows start bits, stop bits, addresses, acknowledges (ACK) and data as hexadecimal values.

### USB 1.1 Plugin (dll\_usb.dll)

Decodes captured signals as USB 1.1 signals. First a new decoder must be added in the *Settings/Plugin Settings/USB Plugin Configurations* menu using *Add New Decoder* button and the captured signals traces to be decoded must be chosen. After the OK button is pressed, a decoded data window is opened. The data decoding is started on menu *Other/Decode Now!* click or on the **F9** key press. The communication can be decoded automatically after the data are downloaded from the analyzer. if in the settings there is „*Decode protocol automatically upon data download*“ checked.

After decoding the communication is displayed in a tree structure where all the packets are listed. The decoded packets can be itemized on the bits level. After clicking the decoded packet or some its part, the appropriate part of the captured tracks is highlighted. After right mouse button clicking a *Zoom* function from the local menu can be used, it shows the chosen section captured signals over all the width of the screen. The *Search/Find* function of the main menu provides various possibilities how to search in the decoded data.

**It is required that a licence is bought for the USB plugin functionality. The licence is assigned to the logic analyzer hardware.** With the USB plugin licence a through probe is supplied. It is equipped with two USB A connectors (plug and receptacle) and pins for the logic analyzer connection. The logic analyzer can be connected either directly to the USB signals or to the buffered USB signals. On the USB cable there must be found a suitable position for the probe, where the captured signals are the best quality.

Additional plugins may be provided in the future.

Source codes of some plugins are released under GPL, thus users are free to modify or create plugins.

## **6. FREQUENCY MEASURING**

A utility for measuring frequency on up to 4 inputs is provided as part of the SIGMA2 software package. Filtering and averaging may be selected for each measured input individually.

*Please note, that the frequency measuring and SIGMALOGAN cannot be used simultaneously, an exclusive access to SIGMA2 is required.*

## 7. TECHNICAL SPECIFICATION

	<i>min.</i>	<i>typ.</i>	<i>max.</i>	
V <sub>IL</sub> input low voltage			0.8	V
V <sub>IH</sub> input high voltage	2.0			V
V <sub>IN</sub> absolute rating, inputs 1..16	-0.3		5.5	V
V <sub>IN</sub> absolute rating, trigger I/O	-0.3		3.6	V
t <sub>sksp</sub> single port <sup>1)</sup>		1		ns
t <sub>skbp</sub> between ports <sup>2)</sup>		4.8		ns
Δf/f <sub>typ</sub> internal clock precision		50		ppm
T <sub>A</sub> ambient temperature <sup>3)</sup>	0		50	°C

1) t<sub>sksp</sub> is skew between pins which belong to the same port

2) t<sub>skbp</sub> is skew between pins belonging to different ports

3) indoor use only

## 8. PACKAGE CONTENTS

- SIGMA2 logic analyzer
- Target cables:
  - 20 individual pins (SIGMACAB)
  - one-to-one 20 pins (SIGCAB20)
  - one-to-one 10 pins (SIGCAB10)
- USB cable (A-B)
- CD-ROM (software, drivers)

## 9. CONTACT INFORMATION

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