VPixx Technologies
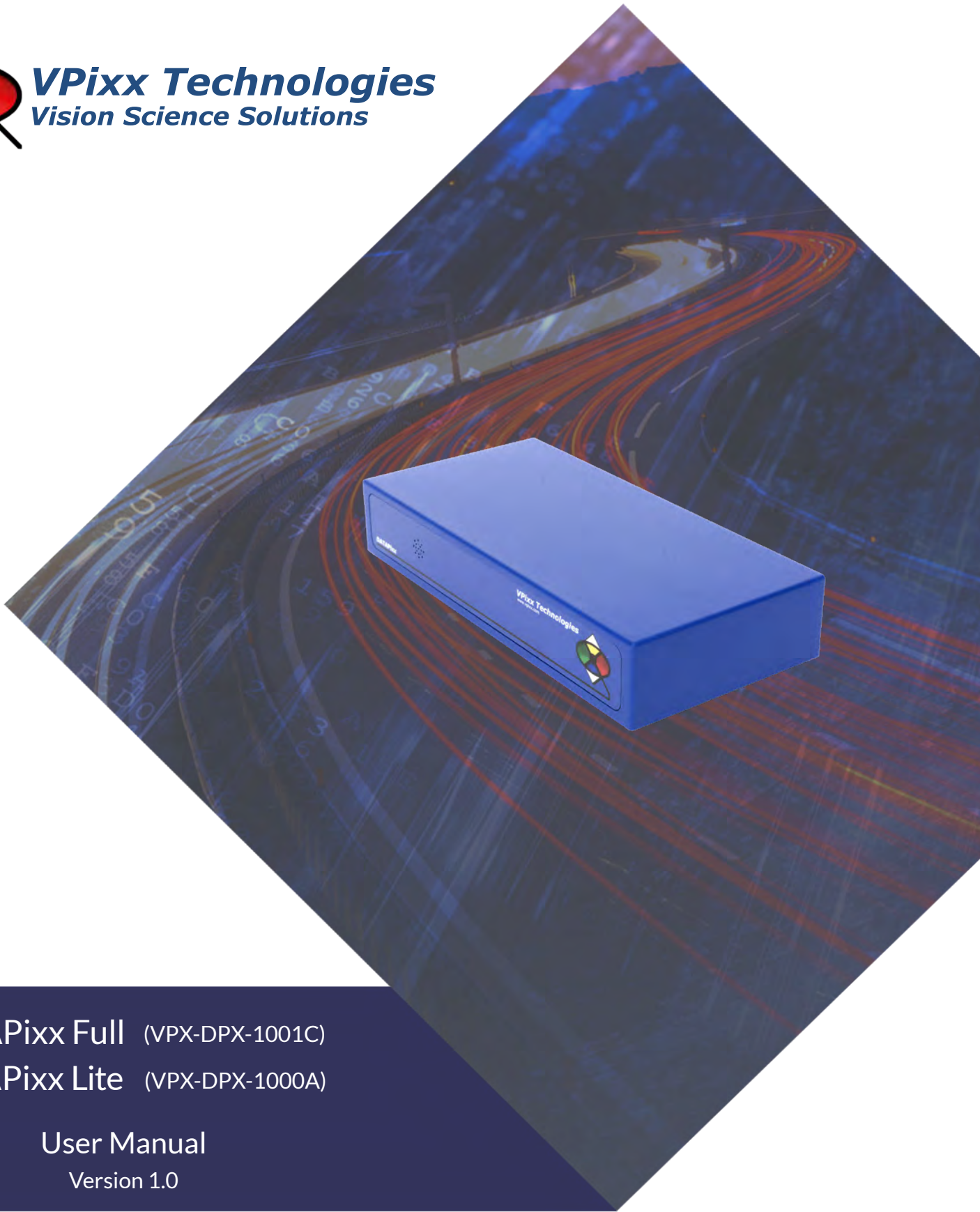## Vision Science Solutions

DATAPixx Full   (VPX-DPX-1001C)
DATAPixx Lite   (VPX-DPX-1000A)

User Manual
Version 1.0

IMPORTANT

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For more information about our company and products, visit our Web site at ***www.vpixx.com***

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Version History of this document

Version Updated to	Date	Author	Reason
1.0	2014/10/30	P.Kakos	v1.0 release

Document Icons

The use of icons emphasizes helpful, caution or warning notes. Below is a list of the icons available.

Icon	Type	Description
	Helpful Hint	*Information to help out during assembly, installation or usage*
	Caution Notice	*Important Information to prevent misuse and/or damage to equipment*
	Warning	***Critical information to prevent damage to equipment and/or personnel***

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Overview

This manual provides installation, usage and maintenance information for VPixx Technologies Inc.'s DATAPixx system.

For technical questions or product support information, do not hesitate to contact the VPixx support team by phone or by sending an E-mail to support@vpixx.com

> By creating your *MyVPixx* account on the VPixx Technologies website, you will have access to additional product documentation, demos, source code examples and the latest firmware and software drivers.

WARNING - SAFETY INFORMATION & PRECAUTIONS

- Use only a power source and connection compatible with this product, as indicated on the label of the power adaptor. Use only the AC adaptor that comes with your DATAPixx. The wrong type of AC adaptor will damage the system and its components

- Be sure that the total ampere rating of the products connected to the outlet does not exceed the current rating of the electrical outlet, and the total ampere rating of the products connected to the power cord does not exceed the rating of the power cord. Look on the power label to determine the ampere rating (Amps or A) for each device.

- Install the DATAPixx near a power outlet that you can easily reach. Disconnect it by grasping the plug firmly and pulling it from the outlet. Never disconnect the device by pulling directly on the cord

General specifications

The DATAPixx is a complete multi-function data and video processing USB peripheral for vision research. In addition to a dual-display video processor, the DATAPixx includes an array of peripherals which often need to be synchronized to video during an experiment, including a stereo audio stimulator, a button box port for precise reaction-time measurement, triggers for electrophysiology equipment, and even a complete analog I/O subsystem. Because we implemented the video controller and peripheral control on the same circuit board, you can now successfully synchronize all of your subject I/O to video refresh with microsecond precision.

As with all VPixx Technologies products, the DATAPixx is field upgradable. If you need a new feature in order to follow some exciting new direction in your research, we can develop the functionality in our labs, then email you an update for your DATAPixx.

Video processing

- DVI input: Dual link on DVI-D connector
- DVI input frequency: 25 MHz to 330 MHz
- VGA output channels: 2 channels on db-15 connectors
- VGA video DAC resolution: 16 bits per RGB gun
- VGA maximum dot rate: 200 MHz (per VGA channel)
- Maximum vertical refresh rate: 200 Hz

Analog to digital converter

- Number of channels: 16 (or 8 differential), on DB-25 connector
- Converter resolution: 16 bits
- Maximum sampling rate: 200 kSPS per channel
- Frequency programming modes:
  - Samples per second
  - Samples per video frame
  - Nanoseconds per sample

- Simultaneous sampling across all channels
- Input range: ±10 V
- Input impedance: $1.6*10^8$ Ω //3 pF
- Absolute maximum input tolerance: ±12 V

*ADC functionalities are available only with DATAPixx full version (VPX-DPX-1001C)

Digital to analog converter

- Number of channels: 4 on DB-25 connector
- Converter resolution: 16 bits
- Maximum sampling rate: 1 MSPS per channel
- Frequency programming modes:
  - Samples per second
  - Samples per video frame
  - Nanoseconds per sample

- Simultaneous output updates
- Output range: ±10 V on 2 ch, ±5 V on 2 ch
- Drive capability: ±25 mA

*DAC functionalities are available only with DATAPixx full version (VPX-DPX-1001C)

Audio CODEC

- Audio line in, microphone in, speaker out, on 3.5 mm jacks
- Stereo microphone input amplifier resistance: 20 kΩ
- Microphone sampling rate: 96 kHz
- Programmable microphone bias voltage range: 2.0 V to 3.1 V
- Stereo DAC sampling rate 96 kHz

*Audio CODEC functionalities are available only with DATAPixx full version (VPX-DPX-1001C)

Digital input

- Number of digital inputs: 24 on db-25 connector
- Input termination: >20 kΩ pullup to 3.3 V
- Input tolerance: 5 V

Digital output

- Number of digital outputs: 24 on db-25 connector
- Output drive stage: 5V through 25 Ω series resistor
- Maximum output current:
  - Source: 15 mA
  - Sink: 12 mA

Connectivity

- 1x USB 2.0 type B
- 3x DB-25 female
- 3x 3.5mm stereo jacks
- 1x Dual Link DVI Input
- 2x VGA DB-15 HD
- 1x VESA 3D for shutter goggles
- 1x mini-DIN 8 for serial port
- 1x Power receptacle, power jack 2.5 mm

Power specification

- Power consumption: 20 W max
- Input voltage: 5 Vdc – 4 A
- International AC adaptor input: 100 Vac – 240 Vac (50 Hz – 60 Hz)

Environmental specification

- Operating temperature: 0ºC to 70ºC
- Relative humidity (non-condensing): 0 to 95%

Dimensions

Figure 1 DATAPixx dimensions

Hardware and software requirements

Graphics card

The graphics card should have dual-link DVI outputs, or DisplayPort/Thunderbolt outputs (which can be converted to dual-link DVI through an active dongle).

	All DisplayPort adaptors are not created equal. The limitation is the 320 MHz video bandwidth which your graphics board can transmit over a dual-link DVI video cable. This is enough bandwidth to generate a full 1920x1200 (or 1080) image at 120 Hz.

We strongly recommend using the following adaptor, which can be obtained from VPixx Technologies or ACCEL Cables.

http://www.accellcables.com/collections/adapters/products/ultraav-displayport-or-mini-displayport-to-dvi-d-dual-link-adapter-with-3d-support

USB 2.0

The host computer requires at least one USB 2.0 interface.

Operating system

The DATAPixx is compatible with the following OS: MAC OS X, Windows XP (32bit, 64bit), Windows 7 (32bit, 64bit), Windows 8 (32bit, 64bit) and Linux.

DATAPixx installation

Installation precautions

Make sure the location where you will place the device meets the following requirements:

- The DATAPixx vent is not blocked

- There is enough room behind the DATAPixx to allow for a good airflow

- While manipulating the system, do not drop the DATAPixx or place it on an unstable surface

- Keep the DATAPixx in a well-ventilated area, away from excessive light, heat, or moisture

- For rack-mount installations, refer to the associated user manual and use the optional bracket

- All cables (eg: VGA, DVI, analog or digital interface) should be screwed onto the DATAPixx

Cable installation

1. Connect the USB cable between the DATAPixx and your computer.
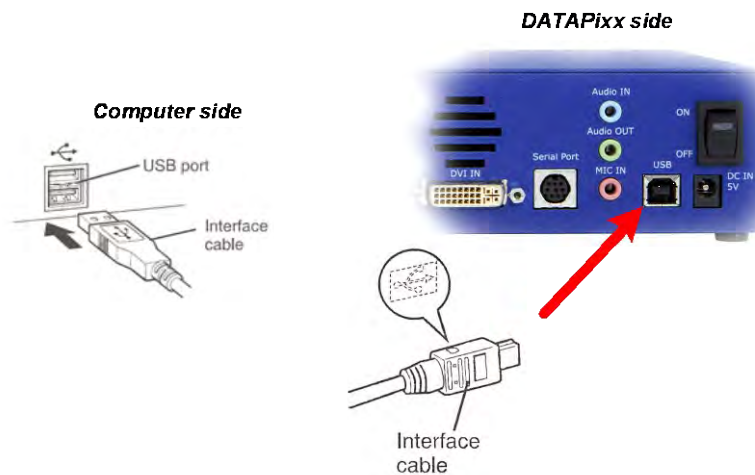
Figure 2 USB cable between DATAPixx and computer

2. Connect the DVI cable between the DATAPixx and your computer.

Figure 3 DVI cable between DATAPixx and computer

Powering the device

Use only the AC adaptor that comes with your DATAPixx.

 The wrong type of AC adaptor will damage the system and its components.

1. Attach the AC adaptor to the DC-IN jack at the rear of the system
2. Plug the AC adaptor into an AC wall outlet
3. Toggle the power switch to the ON position

Figure 4 DATAPixx power up procedure

Device detection

After toggling the DATAPixx power switch to ON, your computer should detect the DATAPixx and prompt you for the installation procedure. On a Mac OS X system, no driver is required; under Microsoft Windows, a driver must be installed for the DATAPixx.

Software installation instructions for Mac OS X

As a first step, ensure that the DATAPixx is turned OFF. Then, insert the CD labeled **"VPixx Technologies Software/Documentation"** in your CD/DVD reader and copy the *Software Tools for MAC* folder into the OS X or Linux user folder.

In the *Software Tools for MAC* folder can be found documentation, drivers, libraries and low level C API. By using the vputil application you can configure and operate your device on a basic level.

> *For more information on VPixx software tools, please refer to the **VPixx Software Tools user manual** on MyVPixx.*

Driver and software installation instructions for Windows

These instructions are for Windows 7. Installation under Windows Vista, XP or Windows 8 is similar, but not necessarily identical.

As a first step, ensure that the DATAPixx is turned OFF. Then, insert the CD labeled **"VPixx Technologies Software/Documentation"** in your CD/DVD reader. In *Software Tools for Windows*, run the *setup.exe* application. When the following box appears, click *Next* and follow the instructions.
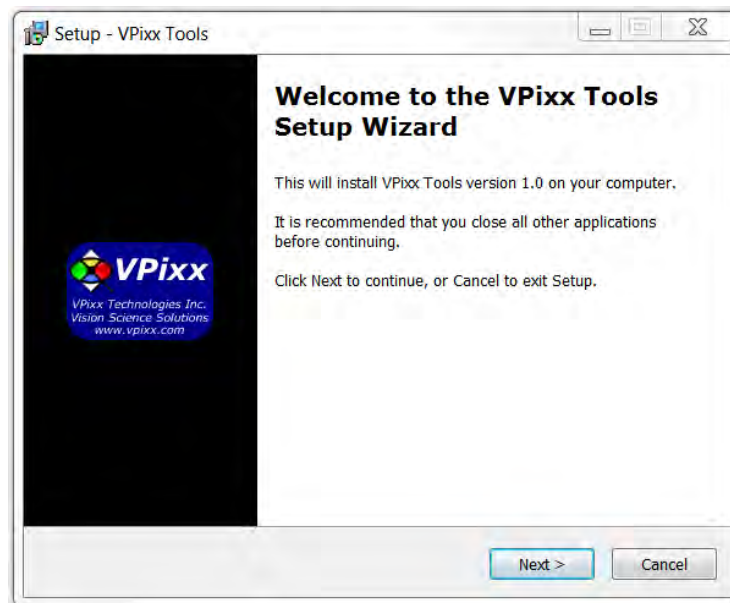
Figure 5 VPixx Tools Setup Wizard

When finished, you can toggle the power switch to the ON position and your device is ready for use.

A shortcut of *vputil.exe* is copied on the *Windows desktop* as well as the *Program Files*, in the *VPixx Technologies* folder; documentation, drivers, libraries and low level C API folders are copied. By using the vputil application you can configure and operate your device on a basic level.

Once the installation is complete, the *VPixx Technologies* folder is located under C:\Program Files\

	*For more information on VPixx software tools, please refer to the **VPixx Software Tools user manual** on MyVPixx.*

I/O connector descriptions

Analog I/O connector

The following table shows the analog I/O pin assignment. If you use the analog breakout cable, refer to the associated user manual interconnection.

*Analog I/O functionalities are available only with DATAPixx full version (VPX-DPX-1001C)

Table 1 Analog I/O pin assignment

Pin	Description	Pin	Description
1	ADC0	14	ADC1
2	ADC2	15	ADC3
3	ADC4	16	ADC5
4	ADC6	17	ADC7
5	ADC8	18	ADC9
6	ADC10	19	ADC11
7	ADC12	20	ADC13
8	ADC14	21	ADC15
9	REF0	22	REF1
10	GND	23	+5 VDC **
11	DAC0	24	DAC1
12	DAC2	25	DAC3
13	GND		Shield *

Connector type: D-SUB, 25 pins
Gender: Female

Pin 1
Pin 14

* Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.
** Current limited (400mA).

VESA 3D connector

Use this interface when using your VESA 3D glasses. The following table shows the VESA 3D pin assignment.

Table 2 VESA 3D pin assignment

Pin	Description
1	+5 VDC **
2	GND
3	VESA_LR (+5 VDC)
Shield *	

Connector type: Mini-DIN, 3 pins
Gender: Female

Pin 3
Pin 2
Pin 1

* Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.
** Current limited (400mA).

Digital output connector

The following table shows the digital output pin assignment.

Table 3 Digital output pin assignment

Pin	Description	Pin	Description
1	Digital Out 0	14	Digital Out 1
2	Digital Out 2	15	Digital Out 3
3	Digital Out 4	16	Digital Out 5
4	Digital Out 6	17	Digital Out 7
5	Digital Out 8	18	Digital Out 9
6	Digital Out 10	19	Digital Out 11
7	Digital Out 12	20	Digital Out 13
8	Digital Out 14	21	Digital Out 15
9	Digital Out 16	22	Digital Out 17
10	Digital Out 18	23	Digital Out 19
11	Digital Out 20	24	Digital Out 21
12	Digital Out 22	25	Digital Out 23
13	GND		Shield *

Connector type: D-SUB, 25 pins
Gender: Female

Pin 1

Pin 14

* Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.

Digital input connector

The following table shows the digital input pin assignment.

Table 4 Digital input pin assignment

Pin	Description	Pin	Description
1	Digital In 0	14	Digital In 1
2	Digital In 2	15	Digital In 3
3	Digital In 4	16	Digital In 5
4	Digital In 6	17	Digital In 7
5	Digital In 8	18	Digital In 9
6	Digital In 10	19	Digital In 11
7	Digital In 12	20	Digital In 13
8	Digital In 14	21	Digital In 15
9	Digital In 16	22	Digital In 17
10	Digital In 18	23	Digital In 19
11	Digital In 20	24	Digital In 21
12	Digital In 22	25	Digital In 23
13	GND		Shield *

Connector type: D-SUB, 25 pins
Gender: Female

Pin 1

Pin 14

* Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.

Audio In / MIC In / Audio Out

Audio equipment may be connected through these jacks with standard 1/8" (3.5mm) stereo plugs. The following table shows the audio pin assignment for each jack.

*Audio IN, MIC In and Audio Out functionalities are available only with DATAPixx full version (VPX-DPX-1001C)

Audio In

Table 5 Audio In pin assignment

Pin	Description
TIP	Audio In left
Ring	Audio In Right
Sleeve	GND
Shield *	

Connector type: Stereo 1/8" (3.5mm)

Gender: Jack (female)

*   Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.

Audio Out

Table 6 Audio Out pin assignment

Pin	Description
TIP	Audio Out left
Ring	Audio Out Right
Sleeve	GND
Shield *	

*   Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.

MIC In

Table 7 MIC In pin assignment

Pin	Description
TIP	MIC In left
Ring	MIC In Right
Sleeve	GND
Shield *	

*   Shield is tied to the GND by a 0 Ohm resistor inside the DATAPixx system.

Software support

Your DATAPixx includes a full set of I/Os and can be accessed through the DATAPixx toolbox in our VPixx Software Tools libraries.

VPixx Software Tools include a low-level ANSI C API as well as Psychtoolbox MATLAB / Octave and Python libraries for Mac OS X, Windows XP, Windows 7, Windows 8 and Linux. In addition, the DATAPixx is directly supported by the VPixx high-level application.

With the VPixx Software Tools, you can:

- Acquire data on analog IO;
- Acquire an analog signal and convert it to digital;
- Set up audio playback, feedback and stream;
- Set up voltage outputs, synchronize and generate audio using digital to analog convertors;
- Record, monitor and synchronize with a RESPONSEPixx or any digital signal;
- Set up a Gaze Contingent display using a DATAPixx;
- Show 3D Stimuli with perfect synchronization;
- Display stimuli using high-bit precision;
- Record a microphone input;
- Display stimuli at 440 and 1440 Hz using a PROPixx;
- Set up a touchscreen using a TOUCHPixx;
- And much more !

We strongly recommend you create your MyVPixx account by visiting:

http://vpixx.com/register/

By registering, you will have access to the latest software versions, demos and user manuals to support all your VPixx products.

Psychtoolbox

All DATAPixx I/Os can be accessed through the DATAPixx toolbox library included with the Psychtoolbox. The DATAPixx hardware toolbox is fully supported by the Psychophysics Toolbox (PTB) using Matlab or GNU/Octave under OS X, Windows and Linux.

Once the PTB has been installed, there are several paths to getting information on using the DATAPixx within the PTB. From Mario Kleiner: "All special graphics display functions (stereo, multi-display, mirroring, high precision color and luminance display) are supported via PsychImaging, e.g., demonstrated in BitsPlusCSFDemo, AdditiveBlendingForLinearSuperpositionTutorial and ImagingStereoDemo. The Timestamping functionality and other convenience functions, as well as audio capture and voice keys are available via PsychDataPixx, DatapixxAudioKey and PsychPortAudioDatapixxTimingTest. Refer to the *Help* section of the DatapixxToolbox for more information. All low-level features are supported via the Datapixx mex file driver".

In addition, the DatapixxDemos folder contains a collection of low-level DATAPixx functional starting points for all of the basic functionalities.

DatapixxToolbox questions may be emailed to support@vpixx.com. General questions whose answers may be useful to other DATAPixx users should be posted on the PTB forum.

⚠️	*For more information on PsycToolbox, please refer to the* **DATAPixx Toolbox for MATLAB user manual** *on MyVPixx.*

Python

pypixxlib uses the object-oriented approach and strengths of Python. With pypixxlib, you can get information to and from your devices while using your preferred python packages for stimulus generation. pypixxlib converts your physical device into python objects with attributes matching the subsystems included in VPixx devices. This guarantees everything you attempt is executed on the subsystem you intended. We also offer a functional approach with the versatility of Python; pypixxlib includes a wrapper for our ANSI C API.

Complete with full documentation and demos, pypixxlib is therefore very easy to use.

⚠️	*For more information on Python, please refer to the* **DATAPixx Toolbox for Python user manual** *on MyVPixx.*

Low-level ANSI C API

Insert the CD labeled **"VPixx Technologies Software/Documentation"** in your CD/DVD reader and browse it. The **"Low Level C API\libdpx\src"** folder in the **Software** folder contains the ANSI C APIs, which are compatible with Windows, MAC OS X and Linux. Do not forget that I/Os are named as DATAPixx I/Os.

⚠️	*For more information on low level ANSI C API, please refer to the* **DATAPixx Toolbox low level ANSI C API user manual** *on MyVPixx.*

DATAPixx firmware update

For a firmware update, log on to your MyVPixx account and select the proper software tools package for your operating system under the UPDATES tab.

For Windows :

Download and install the *setup.exe* application and follow the instructions. When finished, run the *vputil.exe* application located under the following path C:\Program Files\VPixx Technologies\Software Tools\vputil\bin\win32\

At the command line prompt, type fw_update. Your DATAPixx will be updated with the latest firmware.

For MAC OS X or Linux :

Download the *VPixx Software Tools package* and copy the *Software Tools for Mac* folder into the OS X or Linux user folder. When finished, run the *vputil.app* application located under the following path in your user folder: VPixx_Software_Tools/vputil/bin/macosx/

At the command line prompt, type fw_update. Your DATAPixx will be updated with the latest firmware.

	*For more information on firmware updates, please refer to the **VPixx Software Tools user manual**.*

Theory of operation

Video pipeline

A video signal contains all the pixels for every frame. The resolution determines the amount of pixels: for example, 1920 x 1080 means 1920*1080 pixels on your screen. Each of these pixels contains the color information it will show on screen.

Colors are described using the RGB (Red-Green-Blue) format. For every video frame, each pixel has access to 24 bits of color information (8 bits per color). This means, for example, that red can take values from 0 to 255 and consequently that 256 different shades of red are possible. Red 0 signifies no red, while red 255 signifies 100% red color. All of the three colors (RGB) have 8 bits, which creates 16 777 216 different possible colors. RGB colors are usually represented as (R,G,B), where R, G and B are the respective color values [0-255].

A color is usually described with 8 bits of information. 8-bit information can be seen as $R_7R_6R_5R_4R_3R_2R_1R_0$, which is a binary representation of the color (in this example, R for Red). Every bit (R_i) can take the value 0 or 1, and the final value will be a sum:

$$Red = \sum_{i=0}^{i=7} 2^i * R_i$$

The color red 255 would be represented as 0b11111111, whereas red 16 would be 0b00010000. Since 255 represents every bit at a value of 1, it is the maximum value for an 8-bit number.

Video processing

The DATAPixx video subsystem converts a dual-link DVI digital video input from the host computer (or laptop), into VGA analog video outputs. The VGA outputs feature full 16-bit video DACs for ultimate precision in very low contrast stimuli. A second VGA output head can show the tester a mirror of the primary display; or alternatively, the left/right halves of a wide DVI input image can be split onto the two VGA displays, ensuring perfect frame synchronization between the left/right displays. To further support stereo applications, the DATAPixx also includes a standard VESA mini-DIN-3 connector for interfacing with stereo goggles.

Analog output interface

The DATAPixx analog subsystem contains 4 DAC (Digital-to-Analog-Converter) channels, with 16-bit precision and ±10 V output swings. The maximum update rate is 1 MSPS, and all 4 channels update simultaneously. DAC update rate can be specified in samples per second, samples per video frame, or nanoseconds per sample, and waveform onset can be synchronized to video refresh with microsecond precision.

Analog input interface

The DATAPixx analog subsystem includes 16 ADC (Analog-to-Digital Converter) channels, with 16-bit precision and ±10 V input range. The maximum sampling rate is 200 kSPS, and all 16 channels are simultaneously sampled for evoked potential and other applications sensitive to sampling phase. ADC sample rate can be specified in samples per second, samples per video frame, or nanoseconds per sample, and sampling can be synchronized to video refresh with microsecond precision.

Digital interface

The DATAPixx contains 24 TTL inputs and 24 TTL outputs. Inputs are pulled up, so simple response boxes can be read with no additional hardware. TTL input transitions are timetagged enabling response-time calculation with microsecond precision. Similarly TTL outputs can be scheduled to transition at a specified point within a video frame, enabling simple triggering of external testing hardware.
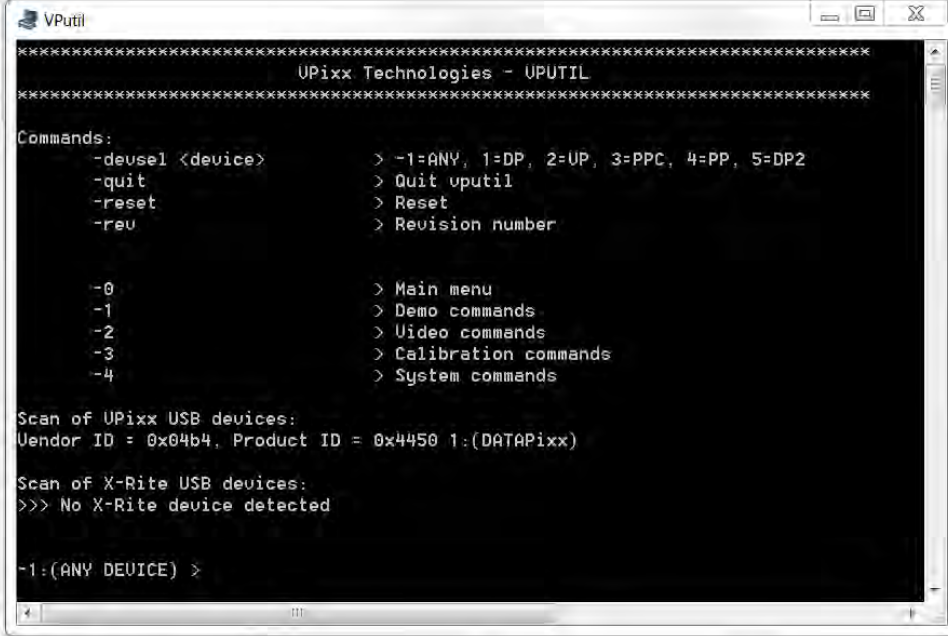
Audio interface

The DATAPixx contains a stereo audio CODEC which can bias and convert a stereo microphone input. The CODEC can also drive a 96 kSPS audio stimulus directly into headphones. Stimulus phase between audio-left, audio-right, and video refresh, can be controlled with microsecond precision for cross-modal research.

vputil software tool

The vputil tool can be run from the main VPixx Technologies directory under the "Software Tools\vputil\bin" folder. This utility allows the user to control some of the VPixx equipment features. It can also be used for generating built-in test patterns from the equipment.

1. Toggle the power switch to the ON position
2. Run the vputil application

Figure 6 vputil application main screen

The vputil tool automatically detects all VPixx Technologies hardware connected to the computer. The main menu of the application can be displayed by using the help command.

(!)	*For more information on vputil software tools, please refer to the **VPixx Software Tools user manual** on MyVPixx.*

Maintenance

The DATAPixx does not require periodic calibration activities.

Cleaning the DATAPixx

Clean the surface of your DATAPixx as required and depending on usage.

	Do not use cleaners that contain any petroleum-based materials such as benzene, thinner, or any volatile substance

Warranty

The DATAPixx device is warranted against manufacturing defects in materials and workmanship for two years for parts and labor from the date of purchase.