Reflex 3.0. The second generation USB transport is designed to transmit digital audio signals from a computer to a digital-to-analog converter (DAC) and from an analog-to-digital converter (ADC) to a computer.

Reflex 3.0 plays audio at a maximum stereo sampling rate of 384 kHz and a maximum resolution of 32-bit PCM.

In single-bit DSD native format, it plays audio with multiples of DSD64, DSD128, DSD256, DSD512. In DoP (DSD over PCM) format, it plays audio with multiplicity up to DSD256.

The module supports Surround sound in the following configurations: 4.0, 3.1, 5.1 and 7.1 in PCM format. As well as multi-channel sound of 12 or 16 channels in TDM format.
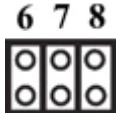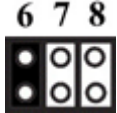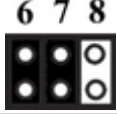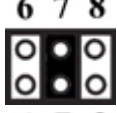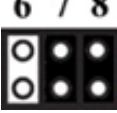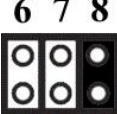
The PC detects the device as a standard USB audio class 2.0 sound card. It works with computers, tablets, smartphones running Win10.11, macOS, Linux, Android and smart TVs with Tizen OS (since 2023). For Win7,8 you can use ASIO drivers.
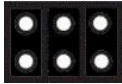
Audio output channel configurations:

Configurations	PCM, kHz										DSD256 DoP up to 11 289,6	DSD512 native up to 22 579,2
	44,1	48,0	88,2	96,0	176,4	192,0	352,8	384,0	705,6	768,0		
2.0	+	+	+	+	+	+	+	+	+	+	+	+
3.1	+	+	+	+	+	+	+	+				
4.0	+	+	+	+	+	+	+	+				
5.1	+	+	+	+	+	+						
7.1	+	+	+	+	+	+						
12.0	+	+	+	+								
16.0	+	+	+	+								

Selecting the audio output channel configuration

The configuration of audio channels is selected by installing jumpers on pins C6, C7, C8.

| Configuration of output channels	Installing of jumpers
2.0	
3.1	
4.0	
5.1	
7.1	
12.0	

16.0	
S/PDIF 2.0	

Data formats.

Data output is possible in I2S, DSD, TDM4 and TDM8 formats.

Configuration of output channels	I2S, active ports		DSD, active ports		TDM4, active ports		TDM8, active ports	
	Output	Input	Output	Input	Output	Input	Output	Input
2.0	1	4	1,2	-	-	-	-	-
3.1	1, 2	4	-	-	1	-	-	-
4.0	1, 2	4	-	-	1	-	-	-
5.1	1, 2, 3	4	-	-	-	-	-	-
7.1	1, 2, 3, 4	-	-	-	1, 2	-	1	-
12.0	-	-	-	-	1, 2, 3	-	-	-
16.0	-	-	-	-	1, 2, 3, 4	-	1, 2	-

The data format is selected by setting jumpers on pins 5 and 9.

Data format	Installing of jumpers
I2S	
DSD	
TDM4	
TDM8	

For the TDM format, the default LR signal is a pulse lasting one BCLK clock cycle. It is possible for LR to be a square wave with a pulse width of 50%, as for I2S. To do this, you need to install a jumper on pin 4.

Sync Modes

The following synchronization modes are possible:

- Master with internal synchronization

- Master with external synchronization

- slave

In «internally clocked master» mode, a crystal resonator mounted on the board is used as a source to generate I2S signals. In the «master with external synchronization» mode, the clock signal from external generators MCLK =

49.152 / 45.1584 kHz is supplied to the "EXT CLK" contact of the module. In the "slave" mode, all clock signals are generated by an external master device connected to Audio Port 1.

Synchronization modes	Installing of jumpers C10, C11	Pin assignment
Master with internal synchronization	**10 11**	DATA - output BCLK - output LR - output MCLK - output EXT CLK — not used
Master with external synchronization	**10 11**	DATA - output BCLK - output LR - output MCLK - output EXT CLK - input
Slave	**10 11**	DATA - output BCLK - input (Audio Port 1) LR - input (Audio Port 1) MCLK — not used EXT CLK — not used

Indication of modes.

modes	color
Audio card	green
ChipStudio	blue
Erasing memory	orange
Firmware updateNo app	violet
No app	red

Changes in output states when sample rate and bit depth change.

When changing the sample rate and bit depth in the OS settings, the module changes the states of the outputs: 55 and 57 - for bit depth; 58, 56, 54, 52 - for sample rate. This can be used with external synchronization for oscillator selection or for indication.

State of GPIO lines depending on sample rate.

Sample rate, kHz	Output states		
	FS0 (7)	FS1 (8)	FS2 (9)
44,1	0	0	0
48,0	1	0	0
88,2	0	1	1
96,0	0	1	0
176,4	1	1	1
192,0	1	1	0
352,8	0	0	1
384,0	1	0	1

State of GPIO lines depending on bit depth

Bit depth	Output states	
	RES1 (20)	RES0 (21)
16	0	0
24	0	1
32	1	0

State of GPIO for switching external generators

Gen. select	Output states (19) GENERATOR SELECT
44,1	0
48,0	1

DSD

Connection:

Port1 BCLK = DSD BCLK

Port1 DATA = DSD Left

Port2 DATA = DSD Right

To select the DSD format on the module, you must install jumper C5, selecting configuration 2.0. In this case, the module can only operate in "master" mode. When selecting DSD format, only DoP and DSD Native streams will be played, no system sounds or PCM audio will be played.

In Volumio, and possibly in other Linux builds, to listen to DSD Native (DSD Direct), you need to change the VID/PID of the module so that the VID is from XMOS (0x20B1) or Thesycon (0x152A), because Volumio determines whether the audio card supports DSD Native by looking at the list. You can set other VID/PID.

S/PDIF

Connection:

Port1 DATA = SPDIF DATA

To select the SPDIF format on the module, you need to install jumpers 6,7,8 by selecting the I2S data format and the Master synchronization mode.

USB - HID

GPIO50 - "volume +"

GPIO49 - "volume -"

GPIO48 - "next track"

GPIO47 - "previous track"

GPIO46 - "play/pause"

BCLK/Fs ratio selection (13)

By default, the BCLK/Fs ratio depends on the bit depth. With a 16-bit width, BCLK = 32*Fs in I2S mode; in TDM mode, the slot width is 16 BCLK clocks. With 24 and 32 bits, BCLK = 64*Fs in I2S mode; in TDM mode, the slot width is 32 BCLK clock cycles. If a jumper is installed on pin 13 on the module, the BCLK/Fs ratio will be fixed regardless of the bit width: BCLK = 64*Fs in I2S mode, in TDM mode the slot width will be equal to 32 BCLK clock cycles.

Selection of active edge (polarity) BCLK (3)

By default, the active edge of BCLK is falling. If a jumper is installed on pin 3 on the module, the active edge of BCLK is rising.

ChipStudio.

Settings in ChipStudio

To configure the module in ChipStudio, you need to install the "ChipDip USB device" driver. After installing the driver, you need to install a jumper on pin 12. Now you can connect to the software ChipStudio on your PC. We recommend changing the USB_VID and USB_PID of the device, otherwise after installing the "ChipDip USB device" driver, the module will no longer be detected as a sound card.
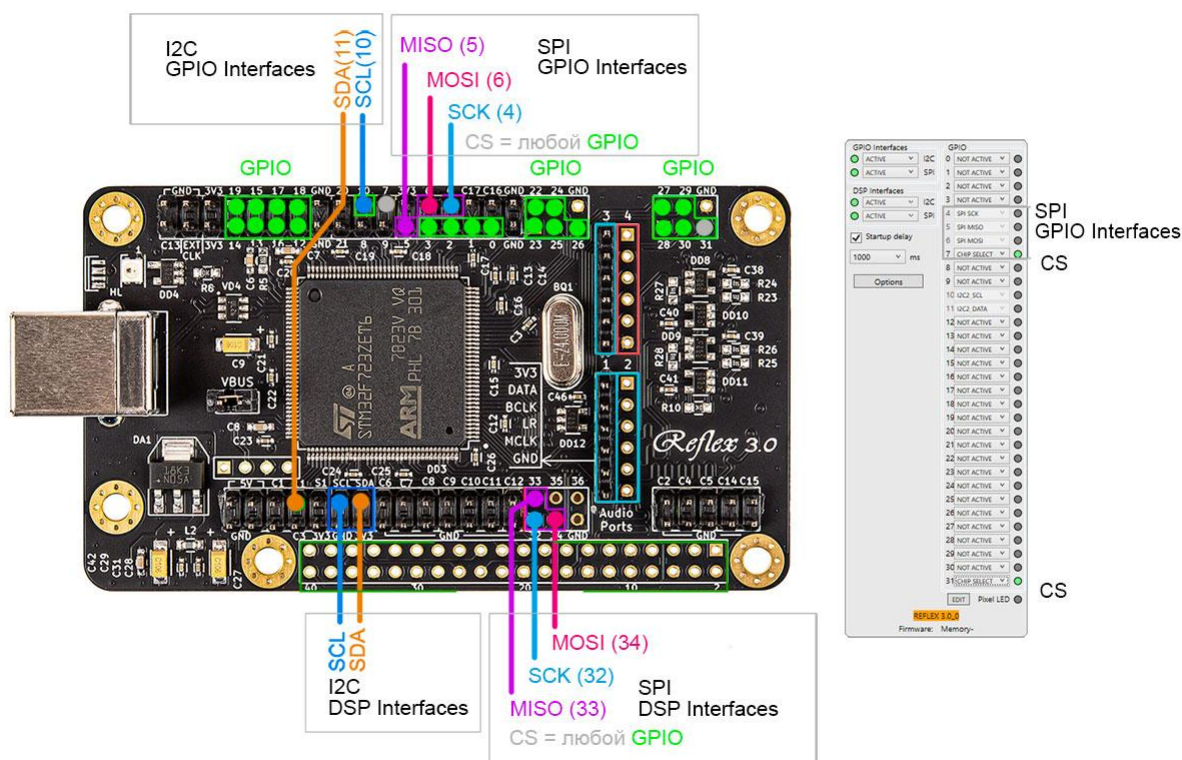
How to connect DSP using I2C or SPI interfaces

Any digital audio processors can be connected to Reflex 3.0 using I2C or SPI interfaces. (depending on DSP) Reflex 3.0 will manage them and configure them the way you want in your SigmaStudio or PurePathStudio project.

DSP can be connected in three ways:

1. DSP Interfaces. Connection via specialized connectors on Reflex 3.0 (Fig. 1) In ChipStudio, activate the necessary interfaces of the Reflex 3.0 controller: I2C, SPI, or two at once.

2. GPIO Interfaces. Connection via GPIO Reflex 3.0 connectors, which are assigned in ChipStudio as I2C or SPI interfaces. In ChipStudio, activate the necessary interfaces of the Reflex 3.0 controller: I2C, SPI, or two at once. In this case, some GPIO connectors will not be able to process signals from external controls. (Fig.1)

3. Combined method DSP Interfaces + GPIO Interfaces. In this case, on the Reflex 3.0 graphics controller in ChipStudio, enable all interfaces or any combination.

Fig.1

How to connect RGB LEDs type WS2812 (Neopixel)

For various indications in your Reflex 3.0 project, you can use addressable RGB LEDs of the Neopixel type. For this, the GPIO18 pin is used. You can connect from one to 255 LEDs in a line to it. You can adjust the color or brightness of each of them depending on the functions they show in ChipStudio. When the Pixel LED function is activated in the settings of the Reflex 3.0 controller, the GPIO18 pin becomes unavailable for connecting adjustments, this means that you connected a ruler or one addressable LED to it. You can connect RGB or RGBW LEDs (with white crystal).

The power for the LEDs can be taken from the +5V connector if there are not very many of them (up to 8 pieces in a line), or you can use a separate power supply.