

384kHz Stereo Audiophile Performance USB Interface Module

Features

- Support for all PCM sample rates in multiples of 44.1kHz and 48kHz up to 384kHz
- Support for DSD1X, DSD2X and DSD4X
- Support for DoP (DSD1X and DSD2X only)
- I2S output
- Decodes DoP before encoding signals for I2S output
- Supports internal and external master clock operation
- On-board high quality clock generators for 44.1kHz and 48kHz families of sample rates
- No driver required for Mac and Linux platforms.
- Windows driver included.
- Support for I2C communication.
- Requires external power between +6V and +9V.

General Description

The AKUSB module is an audiophile grade USB interface that supports all common sample rates for PCM and DSD up to 12.288MHz. It encodes all audio data received from the USB bus into a standard I2S format that can interface directly with most DAC chips or AKDesign's own converter modules.

The external host can communicate with the module via I2C (other protocols can be supported upon request). The module can generate the necessary sample clock and send it to the external hardware, or it can operate in external master mode where it receives a 512FS clock from its host.

The module is USB Audio Class 2.0 compliant and does not require any driver software for Mac OS and Linux operating systems. For Windows a driver is included. While DSD is supported via DoP, it is also supported natively via the ASIO interface on the Windows platform.

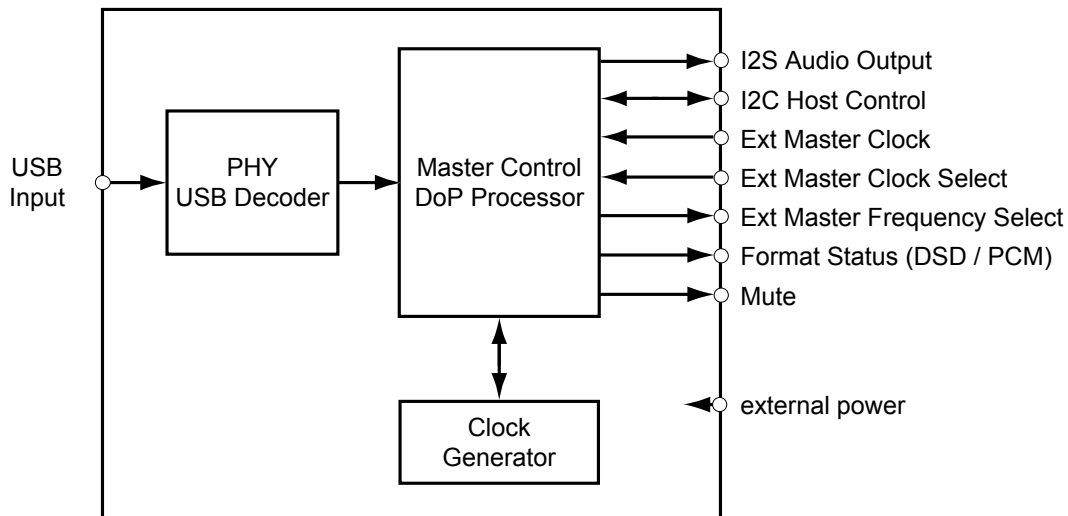


Figure 1

Pinouts

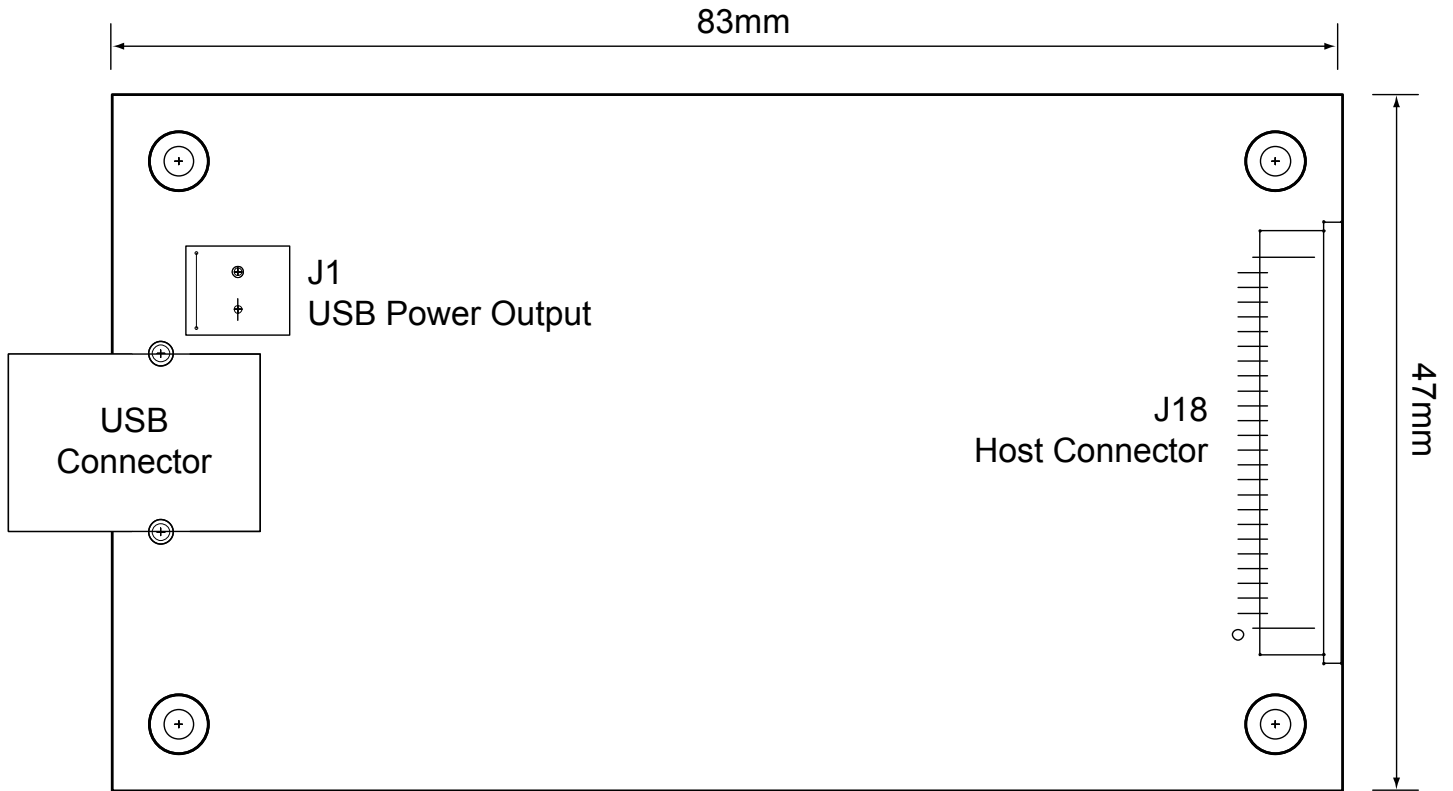


Figure 2

J18 Host Signals

Connector type: FCI SFW24R-2STE1LF

All signal levels are TTL compatible, referenced to 3.3V and **no signal input is 5V tolerant.**

Pin	Signal	Direction	Description
1	DGND		Digital Ground
2	MMCK512	in or out	External master clock (22.5792MHz or 24.576MHz) source or internal master clock output. When SEL_INT=1 then output, else input.
3	SEL_INT	in	Pulled high, set to 0 to select external clock master mode
4	NC		do not connect
5	NC		do not connect
6	NC		do not connect
7	DGND		Digital Ground
8	I2C_SDA	in/out	SDA of host I2C host bus, 3V3 pull-up resistor on module, not 5V tolerant
9	I2C_SCL	out	SCL of host I2C host bus, 3V3 pull-up resistor on module, not 5V tolerant
10	xINIT	in	Reset input, active low, 3V3 pull-up resistor on module, not 5V tolerant
11	DGND		Digital Ground
12	VDD	in	Digital supply voltage
13	VDD	in	Digital supply voltage
14	DGND		Digital Ground
15	xMUTE	out	Mute signal for external hardware, active low (muted)
16	SEL_44	out	only used during external master clock mode 1 selects 44.1kHz based external master clock 0 selects 48kHz based external master clock
17	NC		do not connect
18	NC		Do not connect
19	I2S_DAT	out	When SEL_DSD=0 then PCM data output, else DSD left channel data
20	DGND		Digital Ground
21	I2S_LRCK	out	When SEL_DSD=0 then L/R clock, else DSD right channel data
22	I2S_BCK	out	I2S bit clock input
23	SEL_DSD	out	PCM / DSD indicator for I2S interface: 1 indicates DSD, 0 indicates PCM
24	DGND	in	Digital Ground

J1 USB Bus Power Output

Connector type: no connector stuffed

This connection can be used to access the USB bus power. It is not used on the module

Pin	Signal	Direction	Description
1	VBUS		+5V
2	DGND		Digital Ground

RECOMMENDED OPERATING CONDITIONS

Description	Symbol	Min.	Typ.	Max.	Units
Digital power supply	VD	+6	+7	+8	V
Ramp up time from GND to VD	VD			100	ms
All digital signal input levels (TTL compatible)			3.3	3.75	V
Digital supply current	I _{VD}		200	300	mA
Ambient temperature	T _A	-10		+45	°C

SWITCHING CHARACTERISTICS

Description	Min.	Typ.	Max.	Units
MMCK512 Frequency		512		FS ¹⁾
Host I2C Bus				
SCL Clock Frequency		0.5		FS
SDA setup time before postive edge of SCL	100			ns
SDA hold time after negative edge of SCL		0		ns

1) FS=44.1kHz or 48kHz.

GENERAL DESCRIPTION

Power-up and Reset

At power-up the module automatically loads the software from an internal flash memory. This process takes about 700ms from the time the digital power supply reached its nominal value. An internal integrator keeps the internal reset signal low until initialization is complete. The external xINIT can be pulsed to reset the module. Upon release the internal integrator will cause a delay of about 1s.

I2S transmitter

The I2S transmitter generates the standard signals for PCM up to 384kHz and for DSD up to 12.2MHz.

All signals are generated directly from the 512FS master clock, either from internal or external source.

The 3 signal lines (I2S_DAT, I2S_BCK, I2S_LRCK) also double as DSD outputs, where I2S_DAT becomes the data output for the left channel, the I2S_LRCK becomes the data output for the right channel and I2S_BCK is the 64FS, 128FS or 256FS bit clock. The SEL_DSD signal indicates the format (1 for DSD, 0 for PCM).

For PCM outputs the I2S_BCK always has 2 times 32 cycles per sample.

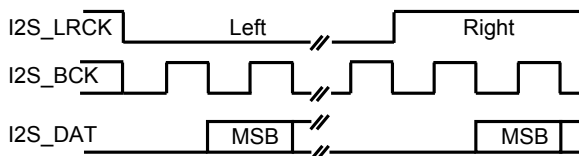


Figure 3

Timing for I2S transmitter in PCM mode

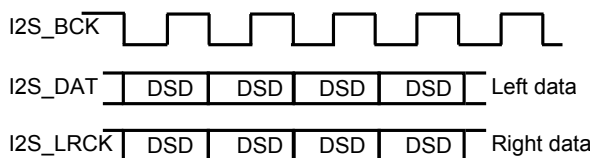


Figure 4

Timing for I2S transmitter in DSD mode

DSD-over-PCM (DoP)

DoP is an open industry standard that was created to allow the transmission of DSD data over standard PCM interfaces such as AES/EBU, I2S or USB etc. For this 16 DSD bits are packed into a 24-bit PCM frames. The remaining 8 bits in the frame are used as a marker to signal the compliant receiver that the contained data is DSD. Details of the standard can be found in the

standard which can be downloaded from our website: www.akdesigninc.com.

The standard is supported on the USB receiver side and then decoded into DSD signals on the I2S output.

Internal Clock Generator

For applications that do not provide the generation of a 512FS master clock frequency, the module has an internal high quality clock generator. In such a case no external audio clock generator is required.

The MMCK512 signal is bi-directional and can be selected as either input or output. The signal input SEL_INT selects internal clock generation and sets MMCK512 as output when set to high (default through internal pull-up resistor).

Driver Software

No driver software is required for the Mac OS and Linux platforms as the USB implementation is USB Audio Class 2.0 compliant. For the Windows platform AKDesign offers a free driver software. For a fee it can be customized with your company name, product name and VID/PID.

LED indicators

The module has 4 red LED's D1, D2, D3, D5. With D5 being the most significant bit and D1 the least significant bit these 4 LED's indicate the detected sample rate as follows:

- 0000: no USB connection
- 0001: 44.1kHz
- 0010: 48kHz
- 0011: 88.2kHz
- 0100: 96kHz
- 0101: 176.4Hz
- 0110: 192kHz
- 0111: 352.8kHz
- 1000: 384kHz
- 1001: DSD 1x
- 1010: DSD 2x
- 1011: DSD 4x

I2C BUS DEFINITIONS

The AKUSB module communicates various states and controls via I2C. The module is bus master and sends information automatically whenever one of the registers changes in value. By default the module sends data to the device address 0xAA, but other custom addresses can easily be programmed.

The transmission is always with 2 data bytes. The first byte contains the register address and the second the register contents.

Register Descriptions

Audio Status (address 00000001)

7	6	5	4	3	2	1	0
xMUTE	reserved	reserved	reserved	AudioStat(3)	AudioStat(2)	AudioStat(1)	AudioStat(0)

xMUTE: 0 when active mute signal received from USB host application

The 4-bit AudioStat word indicates the detected sample rate:

- 0000: no lock, no signal
- 0001: 44.1kHz
- 0010: 48kHz
- 0011: 88.2kHz
- 0100: 96kHz
- 0101: 176.4kHz
- 0110: 192kHz
- 0111: 352.8kHz
- 1000: 384kHz
- 1001: DSD
- 1010: DSD 2X
- 1011: DSD 4X

Firmware Version (address 00000010)

7	6	5	4	3	2	1	0
FW_V(7)	FW_V(6)	FW_V(5)	FW_V(4)	FW_V(3)	FW_V(2)	FW_V(1)	FW_V(0)

This byte contains the firmware version in binary form. This byte is only sent once after power-up or after asserting the xInit signal.

REVISION HISTORY

2014/07/22	Release
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