BARIX
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IPAM 302

Preliminary Development Specification

Advanced multiformat audio module with network, USB and serial interface, adding IP based streaming and controlling capabilities to OEM products

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Hardware Rev.	HW 1.2

Table of Contents

1 Introduction

1.1 About this document

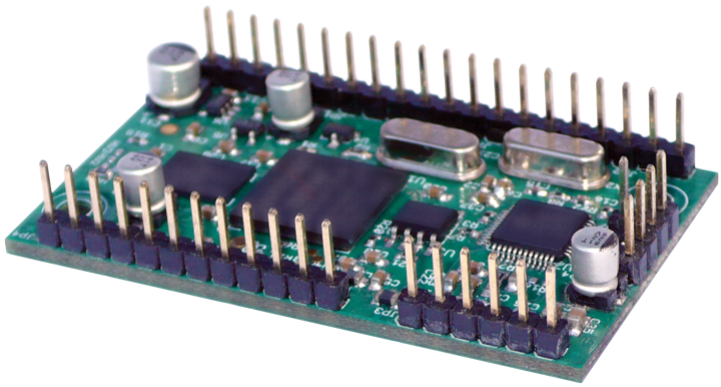
This Preliminary Development Specification aims at giving insight to detailed technical aspects of the Barix IP AUDIO MODULE 302 and complements the information given in the product sheet.

1.2 Additional documents

As several different ABCL programs and different standard firmware packages can be used with the Barix IP AUDIO MODULE 302, the process of loading or updating a software is covered in individual documents.
For information about the loading and configuration of the loaded firmware please refer to the corresponding software user manual and firmware technical documentation.

1.3 About the IP AUDIO MODULE 302

The IP AUDIO MODULE 302 enables manufacturers of traditional audio devices to add network capabilities to their products.



1.4 Hardware features

The Barix IP AUDIO MODULE 302 feature:

- High quality, multi standard audio encoding and decoding in formats:
  - G.711, G.722, PCM linear, Ogg Vorbis, MP3, AAC+ decoding
- Acoustic echo cancellation (AEC) for G.711 and G.722
- Stereo Line in and outputs
- Microphone input (coil, powered or passive capacitive, balanced or unbalanced)
- I^2S output (Inter-IC Sound)
- Integrated CPU / MAC / IO controller
- 10/100Mbit Ethernet port (with PHY)
- 2 KB EEprom for configuration store
- 2 MB Flash memory for application and web server content
- TTL level UART
- USB1.1 interface
- Dallas 1-wire interface (e.g. for Real Time Clock)
- 4 GPIOs
- Small form factor
- Low Power consumption, runs off a single +3.3Volt DC power source
- 2 mounting holes (0.106”/2.7mm) for fixation of IP Audio Module

1.5 Evaluation of the Barix IP Audio Module

Barix recommends the Barix Instreamer for evaluation purposes prior to development of an own carrier board.
The Barix Instreamer can be powered by 5 VDC (standard microUSB) and features LAN and RS-232 interfaces, headphones output and audio inputs, a reset input and two status LEDs.
For evaluating full duplex applications the line inputs and the headphone out can be used.

1.6 Available Applications and Firmware packages

The Barix IP AUDIO MODULE 302 can be loaded with different firmware packages featuring:

- Embedded and robust operating system with fully routable IP stack
- IP standard based protocols (TCP/IP, UDP, HTTP, ICMP, SNMP)
- Supports BootP, DHCP, Auto IP and IPzator
- Integrated web server for configuration, control, update and streaming functions
- Documented Application Programming Interface (API)
- Highly customizable User Interface (HTML) with development kit
- Special software features in OEM versions on request

Standard firmware packages as well as ABCL applications can be downloaded from the Barix website.

2 Hardware

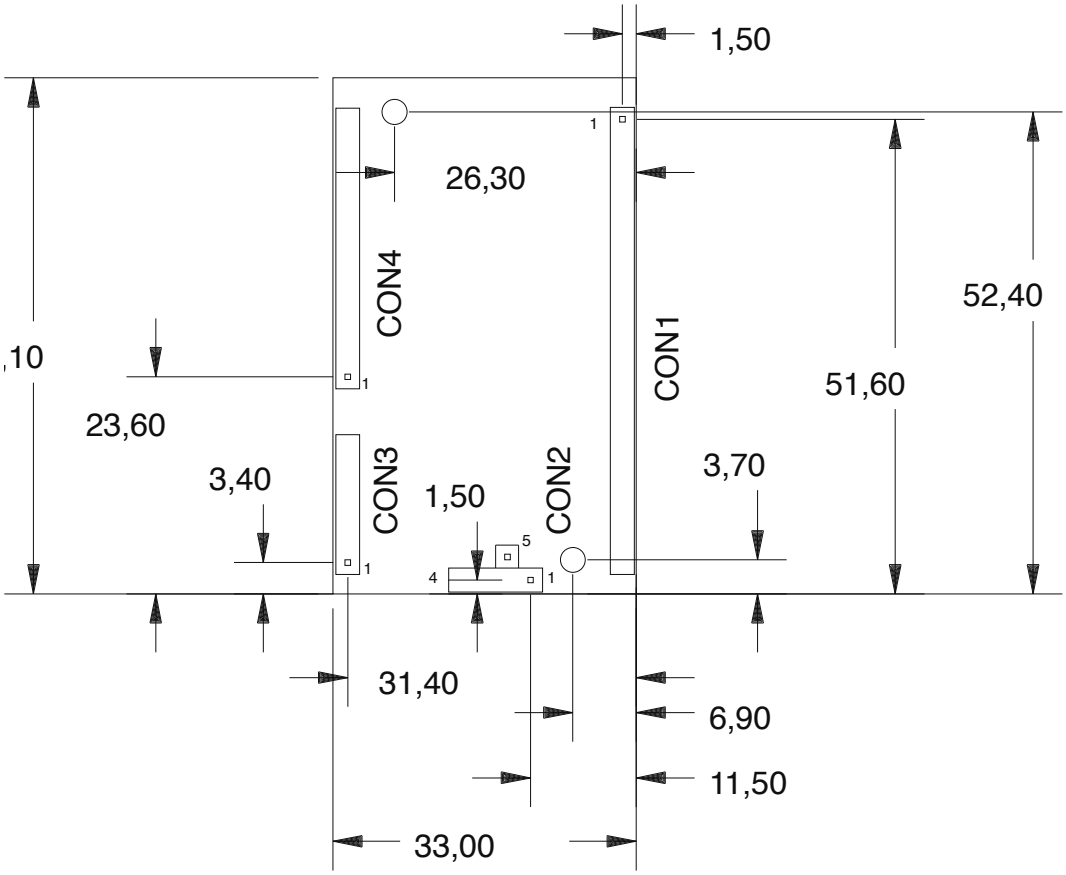
2.1 Mechanical drawing

The Barix IP AUDIO MODULE 302 provides four, standard 2,54mm spacing, single row pin headers and can be therefore plugged onto the target connector or motherboard.

For mechanical fixation, the board provides two 2.7mm mounting holes for 2.5mm screws. The total size is 56.1mm +/-0.2 by 33.0mm +/-0.2.

Maximum component height is 5.6mm. Using standard distance bolts of 6mm a total height of 9mm above the carrier board can be achieved when mounted on a carrier board by means of soldering the pin headers into holes of the carrier board directly.

Using single row female headers (counterpart to pin headers) the height will increase and must be measured by the integrator (our experience in production shows a minimal height of 11.5mm above the carrier board without using distance bolts and 12mm using 9mm distance bolts). Although the total height is increased, the advantage of being able to replace a module should be considered.



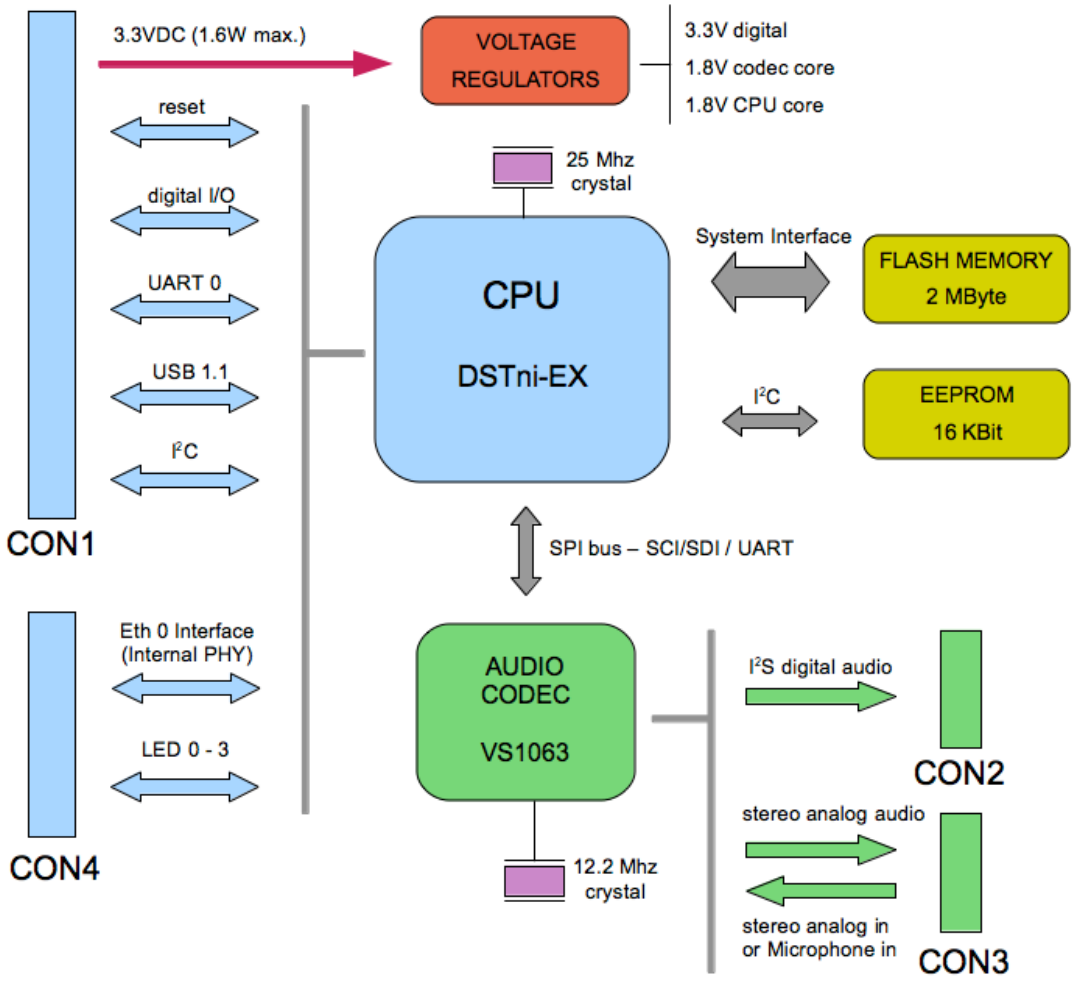
The above drawing shows the component side which faces down onto the carrier PCB.

Dimensions are metric (mm)

Drawing is not to scale

Tolerance of PCB dimension is +-0.2mm, others 0.1mm

2.2 Block diagram



2.3 Network Interfaces

1 x PHY (TP), 2 ETH Status LEDs

The Barix IP AUDIO MODULE 302 is equipped with one on-chip physical layer (PHY) Ethernet interface (10/100MBit, full / half duplex, auto negotiation) which supports either a twisted pair port.

Four pins (LED.0 to .3) can be used to attach dual color Ethernet status LEDs.

2.4 Serial Interfaces

UART (TTL level, TX, RX, RTS, CTS), 1 x USB 1.1

The serial port UART0 can be used to build serial standard interfaces like RS-232 or RS-485 by attaching external driver chips. Special serial framing (9bit protocols, bi-phase encoding etc) or speeds (up to 1MBit) can be implemented for OEM versions.

One USB 1.1 standard interface is provided on connector J1 for memory use (up to 4 GB, FAT 12 or FAT 16 formatted).

2.5 Digital Audio

I²S output (Inter-IC Sound)

The I²S output interface can be used to drive I²S capable devices.

2.6 Analog Audio

1 x Stereo Output (L&R), 1 x Microphone Input (balanced/unbalanced) or 1 x Stereo Input

Three analog audio interfaces are provided on the Barix IP Audio Module of which two can be used concurrently (audio input can be selected to be either stereo input or microphone input).

The stereo output can be used to connect to analog amplifiers or directly to headphones (30 Ohm). The stereo inputs allow for the connection of analog audio sources with Line level outputs.

The microphone (differential inputs, self-biasing) supports the use of a wide selection of microphones (dynamic, capacitive, FET amplified). The positive microphone input pin is shared with the left line input so either Mic or Line In can be selected at a time.

2.7 Peripheral I/O

7 x GPIO

Of the seven 3.3VDC digital general purpose I/Os available on the IP AUDIO MODULE 302 four can be used freely by OEM software as either input or output while three I/Os are reserved for designated functions (see below). When configured as input (default) the I/O is internally pulled up to 3.3 VDC and tolerate up to 5 VDC Logic Level.
When configured as output the I/O supplies 3.3VDC (4 mA max).

Reserved functions:

- One I/O pin is used as a hardware input for the Reset button
- Two I/O pins serve as a user interface for driving status LEDs (green and red)

2.8 Power supply

1 x VIN, 5 x DGND, 1 x AGND

One connector pins is provided to power the Barix IP Audio Module from a single +3.3 Volt DC power source. One ground pin for power and 4 ground pins for the digital interfaces are provided.

The maximum power consumption is 1.6 Watt.

A separate ground is provided for the audio interfaces.

3 Connectors

3.1 Connector placement

For connector placement (and type) please refer to the mechanical drawing in previous chapter.

3.2 Connector pin out

CON1 pin out (GPIO, UART, USB, I²C)

Pin #	Name	Type	Description (usage)
1	-RST	D	Active low Reset I/O (Hardware reset from power surveillance)
2	TMR.0	I/B	Timer 0 external input / PIO #11 (GPIO)
3	DGND	P	Digital Ground
4	PIO30	B	DSTni EX PIO #30 (GPIO / Relay 1 on Exstreamer 110)
5	PIO29	B	DSTni EX PIO #29 (GPIO)
6	PIO25	B	DSTni EX PIO #25 (Red status LED)
7	PIO24	B	DSTni EX PIO #24 (Green status LED)
8	PIO17	B	DSTni EX PIO #17 (GPIO/1-wire*)
9	PIO8	B	DSTni EX PIO #8 (Button for Reset/Factory defaults/Bootloader)
10	DGND	P	Digital Ground
11	VIN	P	Audio module input Voltage 3.3 VDC
12	CTS.0	I	UART 0 flow control input
13	RTS.0	O	UART 0 flow control output
14	RXD.0	I	UART 0 receive data
15	TXD.0	O	UART 0 transmit data
16	DGND	P	Digital Ground
17	USB-	B	USB 1.1 Host Interface negative
18	USB+	B	USB 1.1 Host Interface positive
19	I2CCLK	B	I²C Clock (Connected internally / Internal testing only)
20	I2CDAT	B	I²C Data (Connected internally / Internal testing only)

Type: O=Output, I=Input, P=Power, B=bidirectional, D = Open Drain (pull-up resistor on module)

* During initialization PIO#17 is pulled down (to GND) for 500usec in order to detect attached 1-wire devices ! Nevertheless it can be used as a push button input (to GND), as a logic input (needs a current limiting resistor) or as an active high logic output (needs a 2K7 pull down resistor).

CON2 pin out (I²S output)

Pin #	Name	Type	Description (usage)
1	SOC	O	I²S serial clock output
2	SOD	O	I²S serial data output
3	SOI	O	²S frame indication
4	DGND	P	Digital Ground
5	MCLK	O	Digital interface master clock

Type: O=Output, P=Power

CON3 pin out (analog audio input and output)

Pin #	Name	Type	Description (usage)
1	MICI-	AI	Mic balanced negative input (unbal. Mic / line: connect 1uF to GND)
2	MICI+/INL	AI	Mic positive input or Left channel audio input (for line see remark above)
3	AGND	P	Audio Ground
4	INR	AI	Right channel audio input
5	OUTL	AO	Left channel audio output
6	OUTR	AO	Right channel audio output

Type: AI=Audio Input, AG=Audio Ground (centrally connected to DGND), AO=Audio Output

CON4 pin out (network)

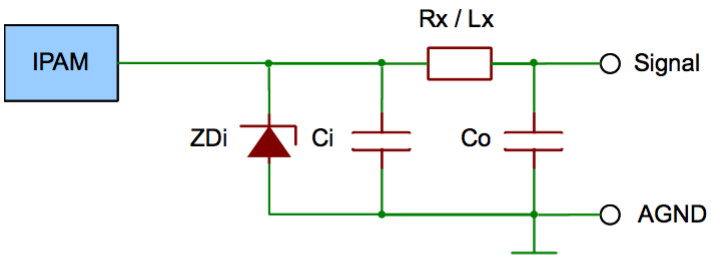
Pin #	Name	Type	Description (usage)
1	TX+	O	PHY level positive Transmit
2	TXCT	R	Transmit Transformer center Tap
3	TX-	O	PHY level negative Transmit
4	DGND	P	Digital Ground
5	RX-	I	PHY level negative Receive
6	RXCT	R	Receive Transformer center Tap
7	RX+	I	PHY level positive Receive
8	DGND	P	Digital Ground
9	LED.3	O	see DSTni EX manual
10	LED.2	O	see DSTni EX manual
11	LED.1	O	see DSTni EX manual
12	LED.0	O	see DSTni EX manual

Type: O=Output, I=Input, P=Power, R = Reference level

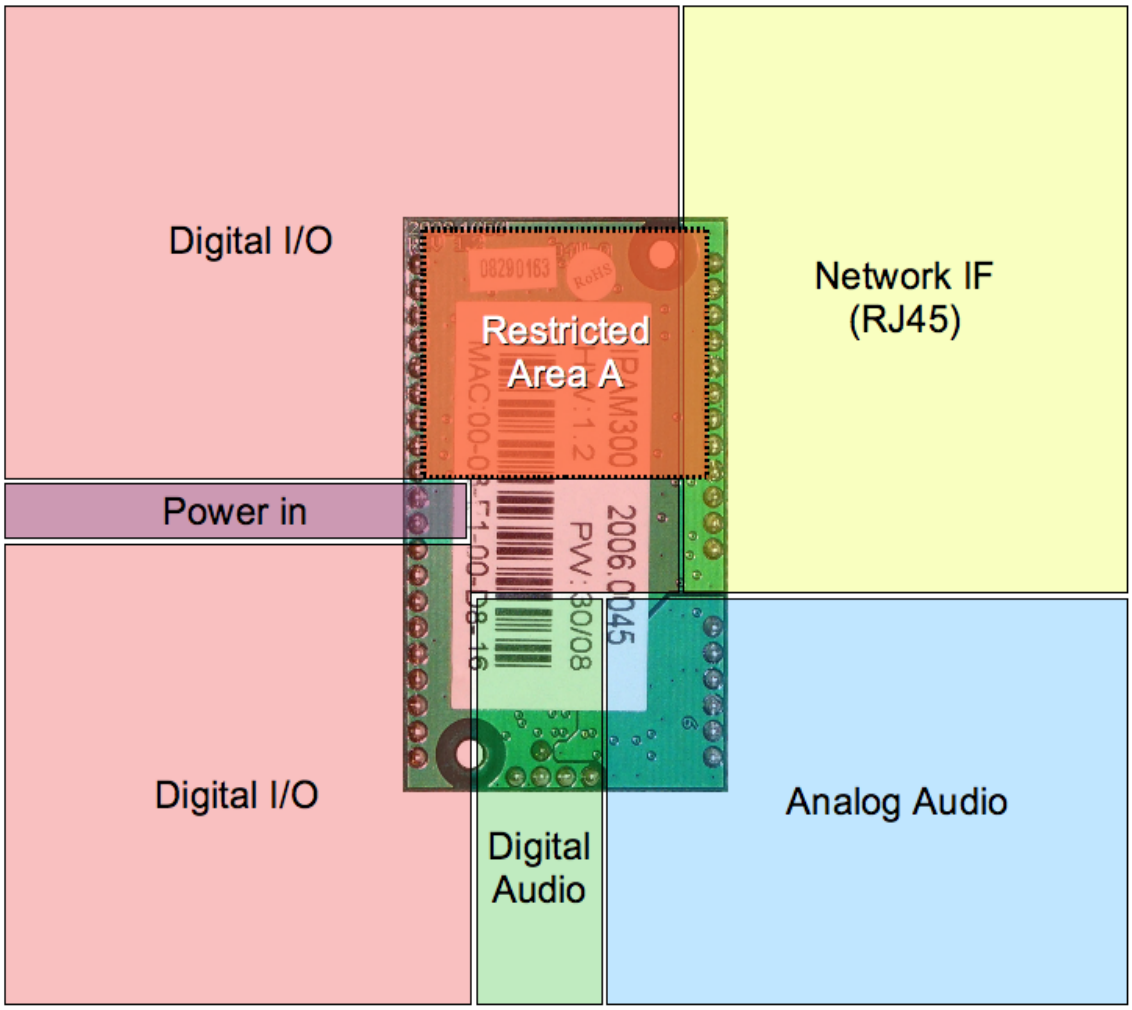
4 Layout Guidelines

4.1 General rules

- A low ESR Capacitor of 10uF to 47uF in parallel to a low loss ceramic 100nF capacitor is recommended as power supply bypass close to the Barix Audio Module's power supply pins.
- All available ground pins of the Barix Audio Module should be attached to their respective ground domain.
- Avoid any connection of ground domains on the Carrier PCB as the ground interconnection exists centrally on the Barix Audio Module already.
- Avoid signal trace routing crossing domain borders (see graphic on next page).
- Restricted Area A must not contain any high current switching circuitry nor any components creating magnetic flux (see graphic on next page).
- Flood unused PCB areas with copper and connect those planes to it's respective ground.
- Designers should use good PCB layout techniques suited for high speed bidirectional data bus design when the USB signal run is more than a few cm in length
- The USB signal lines should be of equal electrical length and track width for their entire length
- The USB signal lines include provision for termination resistors (to DGND).
  The exact value of the terminations may need to be checked or confirmed by a designer and are in the vicinity of 15 Kilo-Ohms (+/- 5%). These termination resistors should be close to either the USB socket or the IPAM connector.
- A more complex (capacitive) termination may be needed under some circumstances.
- Any unused pins can be left open to save power consumption (no pull-up or pull-down needed).
- Any unused audio pins can be left open. Only exception is the need of a 1uF capacitor on MICI- (CON3 pin 1) to ground when using as unbalanced Mic input or when using Line in.
- When planning on variations of carrier PCBs consider a filter consisting of a resistor/ inductivity and a capacitor (close to the target devices connector) for audio inputs and outputs:
  - For audio inputs always place a filter capacitor (Ci, see schematic below) to ground just after the above mentioned resistor/ inductivity (towards the IPAM connector).
    For unused audio connectors inputs simply do not populate the resistor/inductivity.
    Calculate the values for this R-C filter according to your use (desired cut-off frequency versus impedance).
  - For audio outputs always place a filter capacitor (Co, see schematic below) to ground just after the above mentioned resistor/ inductivity (towards the IPAM connector) and populate the resistor/inductivity. Calculate the values for this R-C filter according to your use (desired cut-off frequency versus impedance).
- Although all audio inputs are DC-decoupled consider the use of current limiting resistors in the audio signal path close to the devices connectors. It is a good procedure to also limit the max input voltage to 3.3 volts using zener diodes (ZDi) right after the resistor.



4.2 Carrier PCB Power and Signal Domains



Relevant excerpt from previous chapter “General Rules”:

- All available ground pins of the Barix Audio Module should be attached to their respective ground domain.
- Avoid any connection of ground domains on the Carrier PCB as the ground interconnection exists centrally on the Barix Audio Module already.
- Avoid signal trace routing crossing domain borders (see graphic above).

5 Technical data

5.1 Power supply input

Parameter	Min	Max	Unit
Supply voltage (Nominal)	3.2	3.4	VDC
Supply voltage (Absolute Maximum Ratings)	3.14	3.47	VDC
Power consumption max.		1.6	W

5.2 CPUs / Memory

Parameter	Details
Central processor unit	Lantronix DSTni-EX, 256 KB zero wait state static RAM
Firmware & Application Memory	2MB Flash ROM (approx. 1700KB free for user data, varying depending on loaded firmware)
Configuration Memory	2KB EEprom

5.3 Network Interfaces

Parameter	Details
Ethernet type	10/100 Base (integrated PHY)
Functionality	10/100 Mbit, full / half duplex, auto negotiation
Status display	Link / Activity LED
Protocols	TCP/IP, UDP, RTP, SIP, DHCP

5.4 Serial Interfaces

Parameter	COM 1 (UART 0)
Signals	RxD, CTS both TTL 3.3 VDC, TxD, RTS both TTL 3.3VDC (VH min. 2.4 VDC @ 2 mA max.), GND
Baud rates	300 .. 230400
Data bits	7 or 8
Parity	No, Even, Odd
Stop bits	1 or 2
Flow control	No, XON/XOFF

5.5 Peripheral I/O Interfaces

Parameter	Min	Max	Unit
VIL Input Low Voltage	-0.3	0.8	VDC
VIH Input High Voltage	2.0	5.5	VDC
VOL Output low voltage @IOL max 4 mA	0	0.4	VDC
VOH Output high voltage @IOH max 4 mA	2.4	3.3	VDC

5.6 Audio Interfaces

Audio Processor (Codec) Decoding features

Format	Sampling rate / Bit rate & type
PCM 16bit linear	8..48 kHz
PCM 8bit logarithmic (µLaw / aLaw)	8..48 kHz
G.722	16 kHz
Ogg Vorbis	48 kHz / 500 kbps
MPEG1 & MPEG2 Layer 3 (MP3)	8 to 48 kHz / 32..320 kbps, constant bitrate (CBR) and variable bit rate (VBR)
HE-AAC v2 (AAC+) [1]	8 to 48 kHz / up to 576 kbps, with or without Spectral Band Replication (SBR), with or without Parametric Stereo (PS)

[1] requires separate licensing by OEM

Audio Processor (Codec) Encoding features

Format	Sampling rate / Bit rate & type
PCM 16bit linear	8..48 kHz
PCM 8bit logarithmic (µLaw / aLaw)	8..48 kHz
G.722	16 kHz
Ogg Vorbis [1]	48 kHz / 500 kbps
MPEG1 & MPEG2 Layer 3 (MP3) [1]	8 to 48 kHz / 32..192 kbps, constant bit rate (CBR) and variable bit rate (VBR)

[1] in a future firmware release

Line Input and A/D Conversion typical values

Parameter	Value	Unit
Input clipping level (input gain set to 0 dB)*	0.78 2.21 0.06	V_{RMS} V_{PP} dBu
Analog input impedance	2000	Ω
Frequency response (-3dB) @ 48 kHz sample rate PCM	20..22750	Hz
Signal-to-noise ratio (SNR)	87	dB
Dynamic Range (16 bit theoretical)	96	dB
Total Harmonic Distortion (THD @ -3dBFS)	0.02	%
Interchannel Isolation (Stereo Cross Talk)	-87	dB

** Software selectable input gain from -3db to +19.5dB in 1.5 dB steps*

Microphone Input and A/D Conversion typical values

Parameter	Value	Unit
Input clipping level (at input gain 0 dB and microphone gain 21dB)*	0.111 -26.9	V_{PP} dBu
Analog input impedance (differential)	18	kΩ
Frequency response (-3dB) @48 kHz sample rate PCM	21..22'750	Hz
Analog line input signal-to-noise ratio (SNR)	-73	dB
Dynamic Range (16 bit theoretical)	96	dB
Input Total Harmonic Distortion (THD @ -3dBFS)	0.018	%

** Software selectable input gain from -3db to +19.5dB in 1.5 dB steps in series with a software selectable microphone gain from +21db to +43.5dB in 1.5 dB steps*

Line Output and D/A Conversion typical values

Parameter	Value	Unit
Full Scale Output Voltage (Peak-to-peak) unloaded *	2.39 0.844 0.745	V_{PP} V_{RMS} dBu
Analog output impedance	16	Ω
Frequency response (-3dB) @ 48 kHz sample rate PCM	20..21500	Hz
Output signal-to-noise ratio (SNR)	94	dB
Dynamic Range (16 bit theoretical)	96	dB
Output Total Harmonic Distortion (THD @ -3dBFS)	0.029	%
Interchannel Isolation (Stereo Cross Talk)	-66	dB

** Output level (software controllable) set to max.*

5.7 Mechanical

Weight

14 grams / 0.494 oz. Min. 950 000h acc. to MIL217F at 40°

Dimensions

Parameter	Length	Height	Width	Unit
Complete Printed Circuit Board	56.1 2.2	11.44 0.45	33.0 1.3	mm inch
Printed Circuit Board only		1.27 0.05		mm inch
Connector height above PCB component side		8.9 0.35		mm inch
Connector height above PCB rear side		1.27 0.05		mm inch
Component height max above PCB		5.6 0.22		mm inch

5.8 MTBF Calculations

Parameter	Value	Unit
MTBF calculated according to	MIL217F	-
Calculated Supply Voltage	3.3	VDC
Calculated Temperature (ambient)	25 77	° C ° F
Calculated Temperature (inside device, e.g. Barix Instreamer)	40 104	° C ° F
Calculation for Ground Mobile Device	TBD	hours
Calculation for Ground Fix Device	950000	hours

5.9 Environmental

Parameter	Value	Unit
Operating Temperature Range	0..+60 32..140	° C ° F
Operating Humidity Range (non-condensing)	0..70	%
Storage Temperature Range	0..+70 32..158	° C ° F
Storage Humidity Range (non-condensing)	0..70	%

5.10 Certifications / Compliances

Complies with RoHS

6 Ordering Information

IPAM 302	**2012.9129**

Sold in quantities of 10, 200 and 1000.

Instreamer EU package	**2012.9121**
Instreamer US package	**2012.9123**
Instreamer UK package	**2012.9124**
Instreamer noPSU package	**2012.9125**

7 Legal Information

Newest information about our devices is available via download from our website, www.barix.com.

We explicitly reserve the right to change and improve the product without notice.

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