BARIX
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IPAM 10x

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

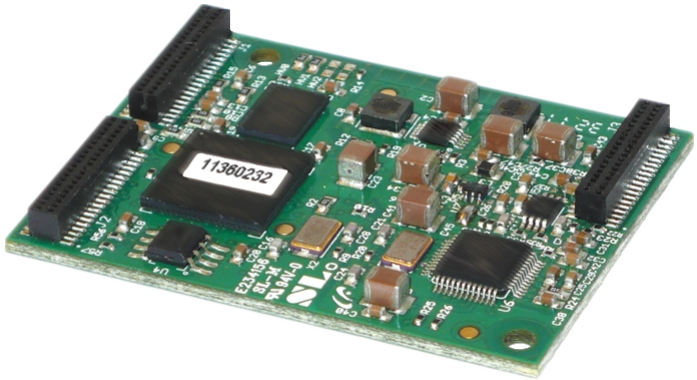
This Preliminary Development Specification aims at giving insight to detailed technical aspects of the Barix IP AUDIO MODULES 101 and 102 and complements the information given in the product sheet.

1.2 Additional documents

As several different ABCL programs and different standard firmware packages can be used with the Barix IP AUDIO MODULES 101 and 102, 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 MODULES 101 and 102

The IP AUDIO MODULES 101 and 102 allow manufacturers of traditional audio devices to add network capabilities to their products.



1.4 Hardware features

The Barix IP AUDIO MODULES 101 and 102 feature:

- High quality, multi standard audio encoding and decoding in formats:
  - G.711, PCM linear, Ogg Vorbis, MP3, AAC+ decoding
  - G.722 (in future firmware release)
  - FLAC, WMA and MP2 can be implemented on OEM request
- Acoustic echo cancellation (AEC) for G.711 and G.722 (in future firmware release)
- Stereo Line in and outputs
- Microphone input (coil, powered or passive capacitive)
- I^2S output (Inter-IC Sound)
- Integrated CPU / MAC / IO controller
- Dual 100Mbit Ethernet ports (1 with PHY, 1 without)
- 2 KB EEprom for configuration store
- 2 MB Flash memory for application and web server content
- 2 TTL level UARTs
- CAN bus interface
- USB1.1 interface
- Dallas 1-wire interface (e.g. for Real Time Clock)
- 11 GPIOs
- Small form factor
- Low Power consumption, runs off a single +5Volt 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 IPAM Carrier PCB for evaluation purposes prior to development of an own carrier board. The IPAM Carrier PCB can be powered by 8 to 30 VDC and features LAN, RS-232 and USB interfaces, microphone and audio in/outputs, a socket for DS1904 iButton Real Time Clock, 4 GPIOs, a reset input and two status LEDs.The Barix IPAM Carrier PCB supports the Barix IP audio module IPAM 100, 101 and 102. For further details please refer to the “IPAM Carrier PCB development specification”.

1.6 Available Applications and Firmware packages

The Barix IP AUDIO MODULES 101 and 102 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
- Fully documented Application Programming Interface (API)
- Highly customizable User Interface (HTML) with development kit
- Special software features in OEM versions on request

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

2 Hardware

2.1 Mechanical drawing

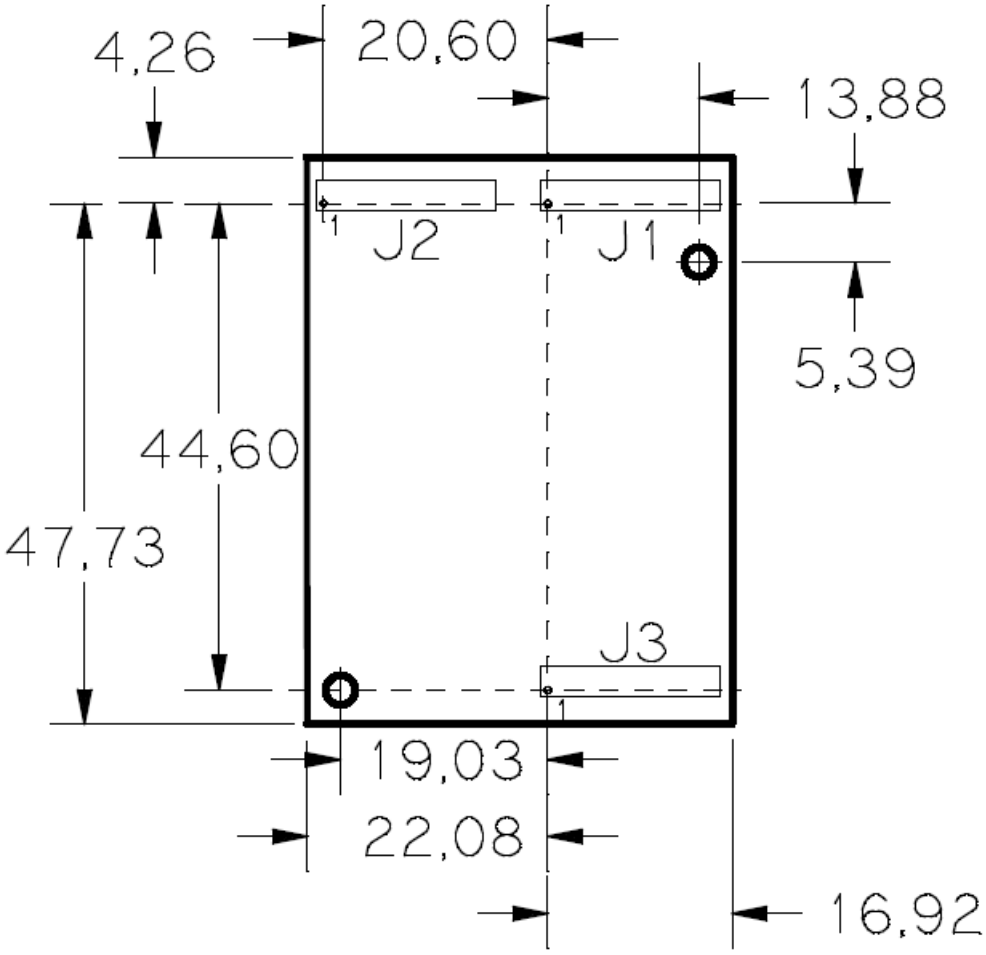
The Barix IP AUDIO MODULES 101 and 102 can be plugged onto the target connector or motherboard using three, high density, 0.8mm spacing, SMT connectors.

The corresponding counterparts (for connectors J1, J2 and J3) to be placed on motherboard are SAMTEC FTE-series header (Part No. FTE-120-02-G-DV).

For mechanical fixation, the board provides two 2.7mm mounting holes for 2.5mm screws.

The total size is 52.2 mm +/-0.2 by 39.3 mm +/-0.2.

Maximum component height is 2.7 mm. The PCB has a thickness of 1.7 mm.Using standard distance bolts of 6 mm a total height of 7.7 mm can be achieved when mounted on a carrier board.



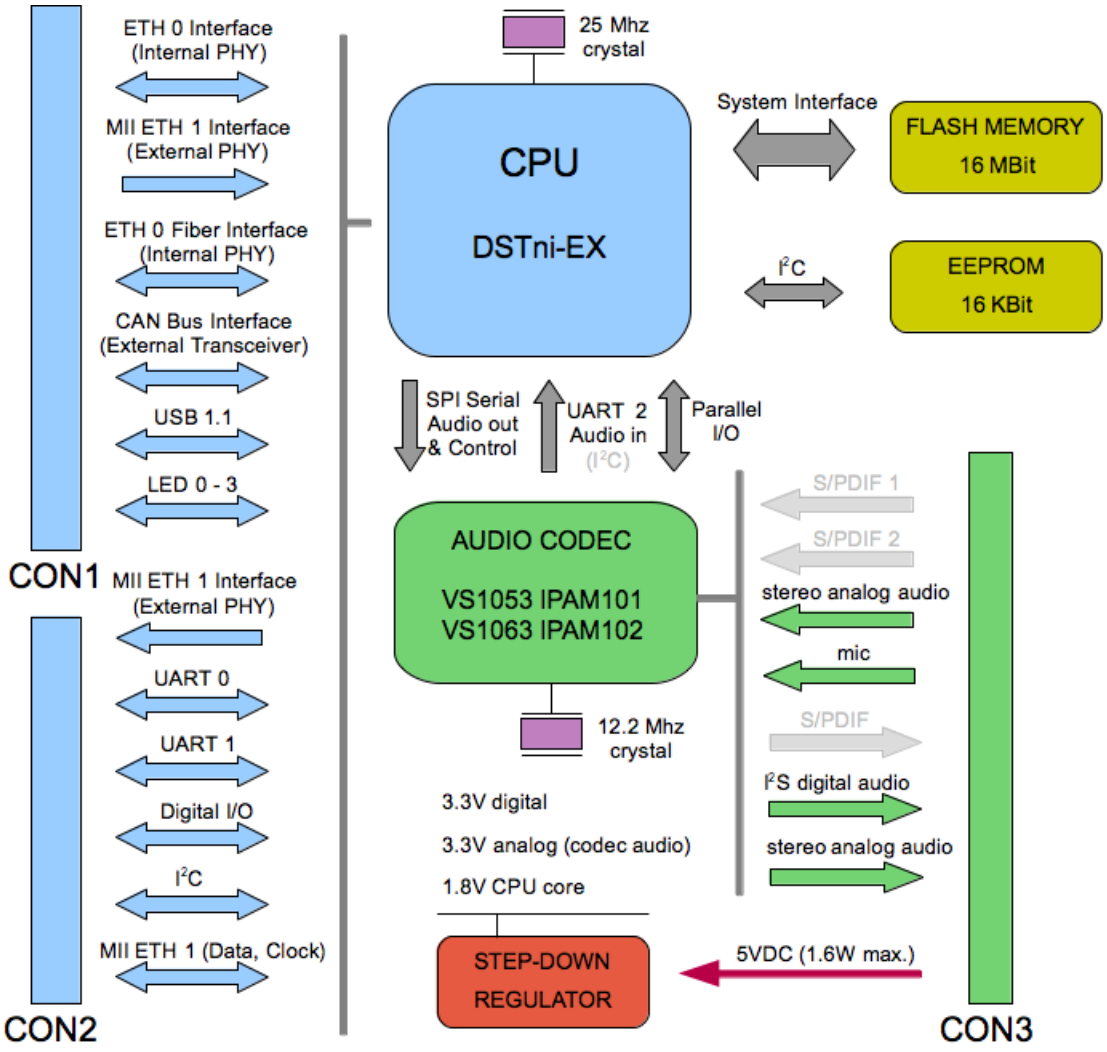
The above drawing shows the component side which faces down onto the carrier PCB.

Dimensions are metric (mm)

Drawing is not to scale

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

2.2 Block diagram



** The S/P DIF interfaces (greyed out), featured in the IPAM 100, are not present any more in the IPAM 101 and 102.*

2.3 Network Interfaces

1 x PHY (TP or FO), 1 x MII

The Barix IP AUDIO MODULES 101 and 102 are equipped with one on-chip physical layer (PHY) Ethernet interface (10/100MBit, full / half duplex, auto negotiation) which supports either a twisted pair port or a fiber optic link. A second Ethernet port can be used by adding a standard PHY chip to the OEM carrier board connected to the MII interface of the Barix IP Audio Module.

2.4 Serial Interfaces

2 x UART (TTL level, TX, RX, RTS, CTS), 1 x CAN-Bus, 1 x USB 1.1

Two separate serial ports 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 3 MBit) can be implemented for OEM firmware versions.
One USB 1.1 standard interface is provided on connector J1 and is supported in Barix drivers.
One CAN-Bus interface is provided on connector J1 and has to be implemented in OEM firmware driver.

2.5 Digital Audio

1 x I^2S

The I^2S digital audio output can be used to connect to I^2S capable devices.

2.6 Analog Audio

1 x Stereo Input (L&R), 1 x Stereo Output (L&R), 1 x Balanced Microphone Input & Bias

Three analog audio interfaces are provided on the Barix IP Audio Module.
The stereo input allows the connection of analog audio sources.
The stereo output can be used to connect to analog amplifiers.

The microphone input can be used either as a balanced (using both input pins: MICP and MICN) or unbalanced input (using MICP only) and allows for use of a wide selection of microphones (dynamic, capacitive). For better performance (frequency response) it is recommended to use a low impedance (< 2 KOhm) microphone.
Bias power is available (on pin MICB) for the use of unbalanced Electret microphones (FET amplified). Phantom powering for balanced microphones requires external circuitry.

2.7 Peripheral I/O

11 x GPIO

Of the eleven 3.3VDC digital general purpose I/Os available on the IP AUDIO MODULES 101 and 102 eight 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)
- During initialization PIO#17 is pulled down for 500 µsec in order to detect 1-wire devices

2.8 Power supply4 x VIN, 4 x SGND

Eight connector pins are provided to power the Barix IP AUDIO MODULES 101 and 102 from a single +5 Volt DC power source. The maximum power consumption is 1.6 Watt.

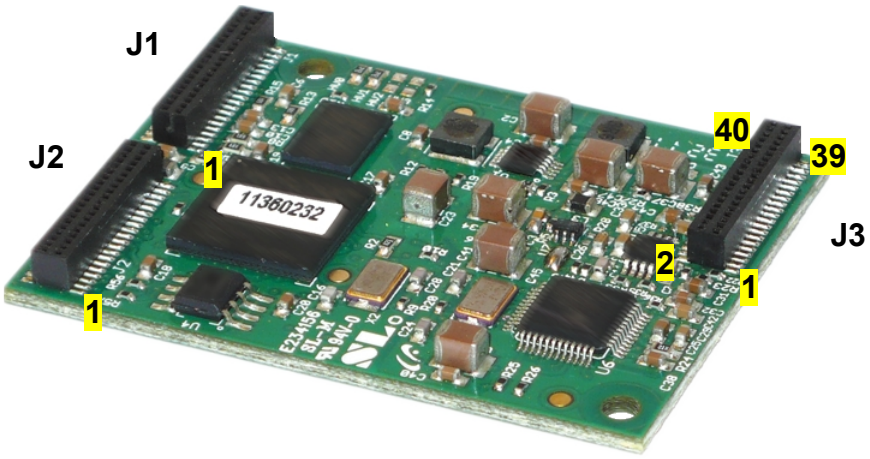
3 Connectors

3.1 Connector placement

The Barix IP AUDIO MODULES 101 and 102 can be plugged onto the target connector or motherboard using three, high density, 0.8mm spacing, 40 pin SMT connectors.

The corresponding counterparts (for connectors J1, J2 and J3) to be placed on motherboard are SAMTEC FTE-series header (Part No. FTE-120-02-G-DV).

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



J1 pin out (Ethernet 1 & 2, Fiber, CAN, USB)

Type columns labeled „T“:
O=Output, I=Input, P=Power, U=USB bus, R=Special function

#	Label	T	Description	#	Label	T	Description
1	TX+	O	PHY level positive Transmit	2	DGND	P	Digital Ground
3	TXCT	R	Trans. Transformer center Tap	4	LED.3	O	see DSTni EX manual
5	TX-	O	PHY level negative Transmit	6	LED.2	O	see DSTni EX manual
7	DGND	P	Digital Ground	8	DGND	P	Digital Ground
9	RX+	I	PHY level positive Receive	10	DGND	P	Digital Ground
11	RXCT	R	Rec. Transformer center Tap	12	LED.1	O	see DSTni EX manual
13	RX-	I	PHY level negative Receive	14	LED.0	O	see DSTni EX manual
15	DGND	P	Digital Ground	16	DGND	P	Digital Ground
17	RXD0	I	2nd MAC receive data 0 (LSB)	18	RXCRS	I	2nd MAC receive carrier sense
19	RXD1	I	2nd MAC receive data 1	20	RXCOL	I	2nd MAC receive collision
21	RXD2	I	2nd MAC receive data 2	22	RXCLK	I	2nd MAC receive clock
23	RXD3	I	2nd MAC receive data 3 (MSB)	24	RXERR	I	2nd MAC receive error
25	FOUT+	O	Fiberoptic Interface TX positive	26	FOUT-	O	Fiberoptic Interface TX negative
27	FIN+	I	Fiberoptic Interface RX positive	28	FIN-	I	Fiberoptic Interface RX negative
29	DGND	P	Digital Ground	30	DGND	P	Digital Ground
31	CANTX	O	CAN-Bus Interface Transmit	32	FSD	I	Fiberoptic Interface input detect
33	CANRX	I	CAN-Bus Interface Receive	34	RESV	R	Fiberoptic current resistor
35	DGND	P	Digital Ground	36	VREF	R	Fiberoptic Interface Voltage ref.
37	DGND	P	Digital Ground	38	DGND	P	Digital Ground
39	USB+	U	USB 1.1 Host Interface positive	40	USB-	U	USB 1.1 Host Interface negative

J2 pin out (GPIO, Ethernet 2, COM 1 & 2, I²C)

Type columns labeled „T“: O=Output, I=Input, B=Bidirectional, P=Power,
C=configurable as input or output, D=Open Drain (pull-up resistor on module)

#	Label	T	Description	#	Label	T	Description
1	PIO4 *	**C**	PIO #20 (GPIO)	**2**	CTS.0	**I**	UART 0 flow control input
3	PIO8	**C**	PIO #8 (Soft Reset)	**4**	RTS.0	**O**	UART 0 flow control output
5	PIO6 *	**C**	PIO #22 (GPIO)	**6**	RXD.0	**I**	UART 0 receive data
7	PIO7 *	**C**	PIO #23 (GPIO)	**8**	TXD.0	**O**	UART 0 transmit data
9	DGNP	**P**	Digital Ground	**10**	DGND	**P**	Digital Ground
11	PIO16	**C**	PIO #16 (GPIO)	**12**	CTS.1	**I**	UART 1 flow control input
13	PIO17 **	**C**	PIO #17 (GPIO/1-wire **)	**14**	RTS.1	**O**	UART 1 flow control output
15	PIO24	**C**	PIO #24 (Green LED)	**16**	TXD.1	**O**	UART 1 transmit data
17	PIO25	**C**	PIO #25 (Red LED)	**18**	RXD.1	**I**	UART 0 receive data
19	DVCC	**P**	LED return (DVCC)	**20**	DGND	**P**	Digital Ground
21	PIO29	**C**	PIO #29 (GPIO)	**22**	I²CCLK	**C**	I²C Clock (internally used)
23	PIO30	**C**	PIO #30 (GPIO)	**24**	I²CDAT	**C**	I²C Data (internally used)
25	TMR.C	**C**	Timer0 inp./PIO #11 (GPIO)	**26**	-RST	**D**	Low active Reset I/O
27	MDC	**O**	MII Management IF Clock	**28**	MDIO	**B**	MII Management IF Data
29	DGND	**P**	Digital Ground	**30**	DGND	**P**	Digital Ground
31	TXD0	**O**	2nd MAC transmit data 0 (LSB)	**32**	TXCLK	**I**	2nd MAC transmit clock
33	TXD1	**O**	2nd MAC transmit data 1	**34**	TXERR	**O**	2nd MAC transmit error
35	TXD2	**O**	2nd MAC transmit data 2	**36**	TXEN	**O**	F 2nd MAC transmit enable
37	TXD3	**O**	2nd MAC transmit data 3 (MSB)	**38**	RXDV	**I**	2nd MAC receive data valid
39	DGND	**C**	Digital Ground	**40**	DGND	**P**	Digital Ground

** These labels differ from the predecessor IPAM 100. The new internal wiring is remapped in the I/O driver “BCLIO.bin” to guarantee software backward compatibility.*

*** During initialization PIO#17 is pulled down (to GND) for 500 µsec 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).*

J3 pin out (Audio, S/P DIF, I²S, Power)

Type columns labeled „T“: O=Output, I=Input, B=Bidirectional, P=Power, A=Audio Output,
a=Audio Input

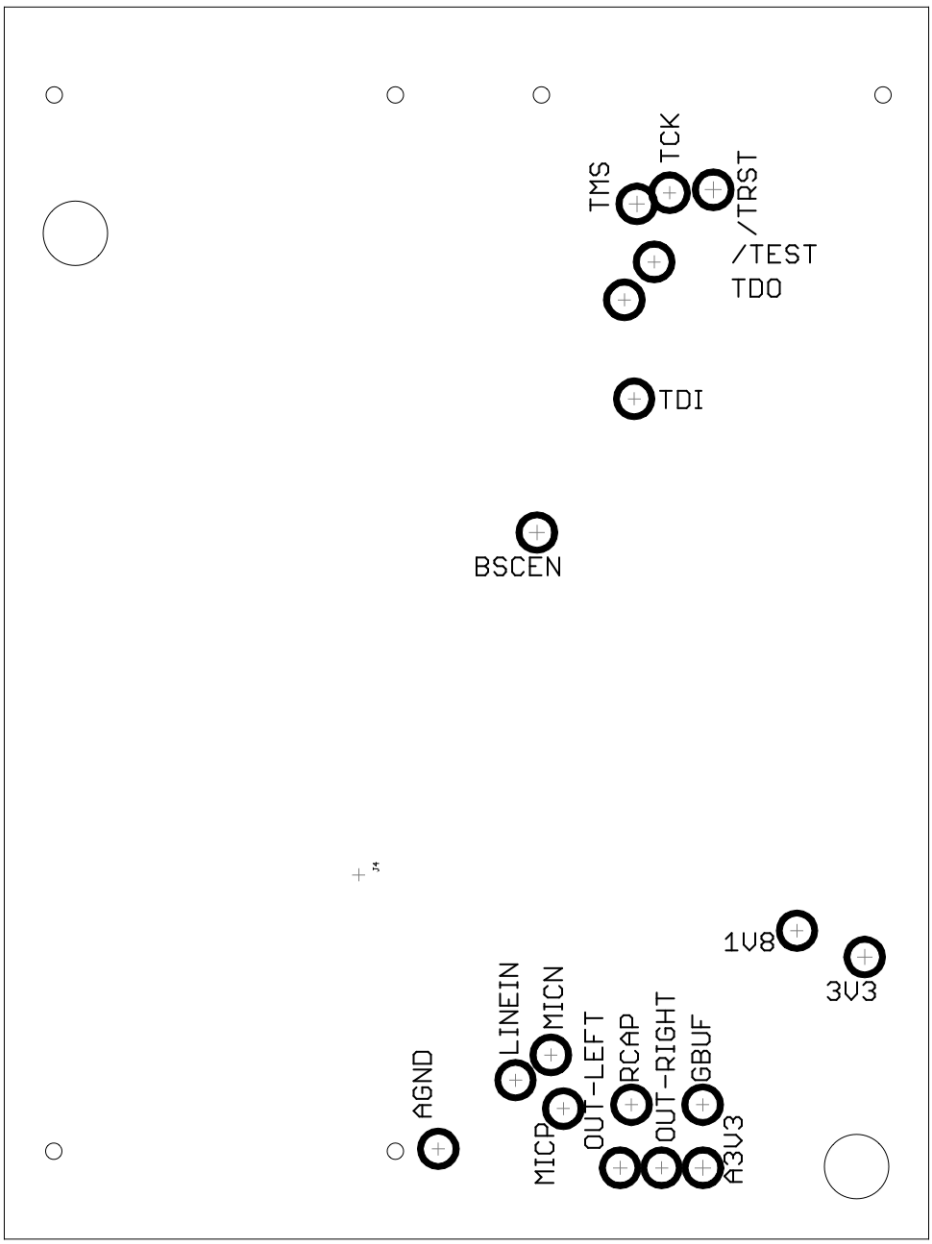
#	Label	T	Description	#	Label	T	Description
1	AGND	**P**	Audio Ground	**2**	OUTL	**A**	Left channel audio output
3	-		reserved	**4**	AGND	**P**	Audio Ground
5	AGND	**P**	Audio Ground	**6**	OUTR	**A**	Right channel audio output
7	-		reserved	**8**	AGND	**P**	Audio Ground
9	AGND	**P**	Audio Ground	**10**	INL	**a**	Left channel audio input
11	-		reserved	**12**	AGND	**P**	Audio Ground
13	-		reserved	**14**	INR	**a**	Right channel audio input
15	AGND	**P**	Audio Ground	**16**	AGND	**P**	Audio Ground
17	AGND	**P**	Audio Ground	**18**	MICBI	**A**	Microphone Bias output
19	AGND	**P**	Audio Ground	**20**	MICP *	**a**	Microphone in positive (MICIN)
21	AGND	**P**	Audio Ground	**22**	MICN *	**a**	Microphone in negative (AGND)
23	DGND	**P**	Digital Ground	**24**	DGND	**P**	Digital Ground
25	MCLK *	**O**	DSP Master Clock (S/P DIF Out)	**26**	SOC	**O**	I²S serial clock output
27	- *		Reserved (S/P DIF Ref)	**28**	SOD	**O**	I²S serial data output
29	- *		Reserved (S/P DIF In 2)	**30**	SOI	**O**	I²S frame indication
31	- *		Reserved (S/P DIF In 1)	**32**	DGND	**P**	Digital Ground
33	SGND	**P**	Supply input Ground	**34**	SGND	**P**	Supply input Ground
35	SGND	**P**	Supply input Ground	**36**	SGND	**P**	Supply input Ground
37	VIN	**P**	Audio module input Voltage	**38**	VIN	**P**	Audio module input Voltage
39	VIN	**P**	Audio module input Voltage	**40**	VIN	**P**	Audio module input Voltage

** These labels differ from to the predecessor IPAM 100 (see previous labels in parenthesis). The microphone input is now differential and S/P DIF interface is gone .*

Test points on PCB bottom

The test points available on the PCB bottom (top when plugged into a carrier PCB) are intended for factory test and debugging purposes.

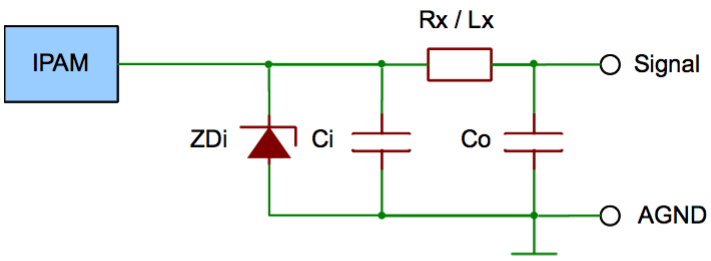
Test point locations are shown in the graphic below (not to scale)



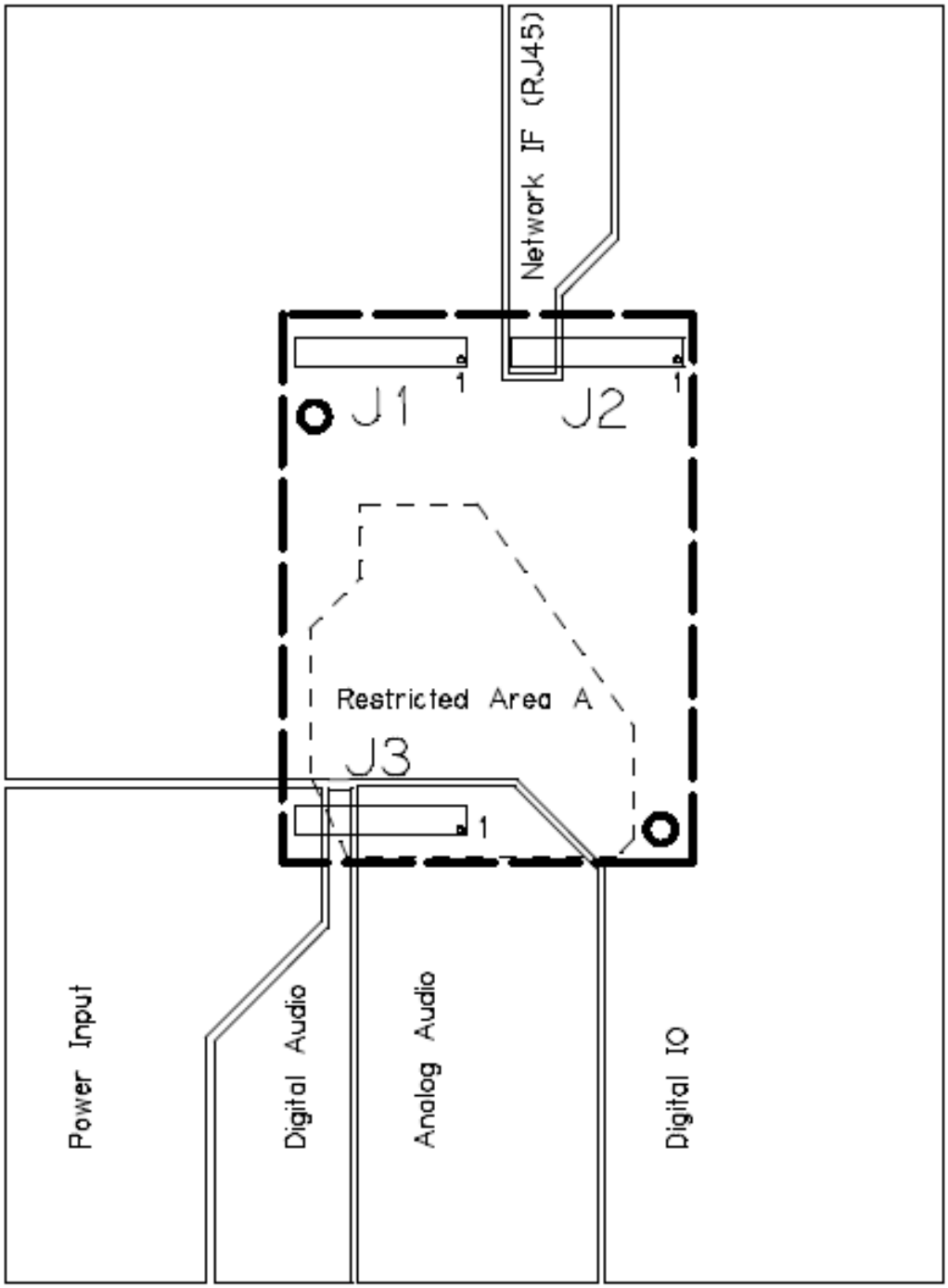
4 Layout Guidelines

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.
- The corresponding counterparts (for connectors J1, J2 and J3) to be placed on motherboard are SAMTEC FTE-series header (Part No. FTE-120-02-G-DV).
- 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 range 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.
- 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 view



5 Technical data

5.1 Power supply input

Parameter	Min	Max	Unit
Supply voltage (Nominal)	4.8	5.2	VDC
Supply voltage (Absolute Maximum Ratings)	4.0	5.5	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	1 x 10/100 Base (integrated PHY for twisted pair or fiber optic link), 1x 10/100 Base MII port (needs PHY chip on OEM carrier board to connect to RJ45 socket)RJ-45 female socket
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)	COM 2 (UART 1)
Signals	RxD, CTS both TTL 3.3 VDC, TxD, RTS both TTL 3.3VDC (VH min. 2.4 VDC @ 2 mA max.), GND	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	300 .. 230400
Data bits	7 or 8	7 or 8
Parity	No, Even, Odd	No, Even, Odd
Stop bits	1 or 2	1 or 2
Flow control	No, XON/XOFF	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 [1]	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+) [2]	8 to 48 kHz / up to 576 kbps, with or without Spectral Band Replication (SBR), with or without Parametric Stereo (PS)

[1] IPAM 102 only, [2] requires separate licensing by OEM

Encoding features:

Format	Sampling rate / Bit rate & type
PCM 16bit linear	8..48 kHz
PCM 8bit logarithmic (µLaw / aLaw)	8..48 kHz
G.722 [1, 3]	16 kHz
Ogg Vorbis [1, 3]	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] IPAM 102 only, [2] requires separate licensing by OEM, [3] in a future firmware release

Line Input and A/D Conversion

Line Input path and A/D conversion (VLSI VS1053 & VS1063) 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)	0.009	%
Interchannel Isolation (Stereo Cross Talk)	-87	dB

Electret Microphone Input and A/D Conversion

Microphone input path and A/D conversion (VLSI VS1053 & VS1063) typical values:

Parameter	Value	Unit
Bias Voltage (Electret capsule minimal Bias voltage)	2.0 .. 3	VDC
Bias current max.	2	mA
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

Line Output path and D/A conversion (VLSI VS1053 & VS1063) typical values:

Parameter	Value	Unit
Full Scale Output Voltage (Peak-to-peak) unloaded *	0.844 2.39 0.745	V_{RMS} V_{PP} dBu
Analog output impedance	16	Ω
Frequency response (-3dB) @ 48 kHz sample rate PCM	1..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

11.2 grams / 0.395 oz.

Dimensions

Parameter	Length	Height	Width	Unit
Complete Printed Circuit Board	52.2 2.06	5.08 0.2	39.3 1.55	mm inch
Printed Circuit Board only		1.7 0.07		mm inch
Connector height above PCB		3.38 0.13		mm inch
Component height max above PCB		2.7 0.1		mm inch

5.8 MTBF Calculations

Parameter	Value	Unit
MTBF calculated according to	MIL217F	-
Calculated Supply Voltage	5	VDC
Calculated Temperature (ambient)	25 77	° C ° F
Calculated Temperature (inside device)	40 104	° C ° F
Calculation for Ground Mobile Device	TBD	hours
Calculation for Ground Fix Device	900'000	hours

5.9 Environmental

Parameter	Value	Unit
Operating Temperature Range	-20..+60 -4..140	° C ° F
Operating Humidity Range (non-condensing)	0..70	%
Storage Temperature Range	-40..+85 -40..185	° C ° F
Storage Humidity Range (non-condensing)	0..70	%

5.10 Certifications / Compliances

Complies with RoHS

6 Ordering Information

IPAM 101	**2010.0075**
IPAM 102	**2011.0078**

Sold in quantities of 10, 200 and 1000.

IPAM 102 Evaluation Kit	**2011.9114**

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.

Barix AG
Seefeldstrasse 303
8008 Zürich
SWITZERLAND

T +41 43 433 22 11
F +41 44 274 28 49

www.barix.com
sales@barix.com
support@barix.com