

Voice Recording System VC-MDX

Analogue Interface Board AI24K

Version 2108

1 General

The AI24K interface board is a development of VoiceCollect GmbH (former ATIS Uher). This board is used to receive and record analogue voice signals and signaling data from telephone lines, to convert the signals into VC proprietary format and to save them on storage device

It is connected to passive telephone lines unit and is connected to the telephone lines by using isolated, high impedance analog interfaces. It is equipped with a Motorola MPC875 processor as a core and transfers the audio and signaling data to the recording systems via the PCI bus. The AI24 K interface board provides up to 24 recording channels. The basic board is equipped with 8 recording channel and can be expanded with max 2x 8 channel extension board (piggy-pack).

It performs line supervision, audio capture with Automatic Gain Control, Warning Tone generation, Caller ID detection, real time DTMF signal processing and audio data compression.

The inputs of the board have limited protection against overvoltages (see specifications). So, adapted supplementary protection should be used if the inputs are connected to lines where there is a risk of overvoltage (lightning for example).

2 Applications

Typical applications are the recording from various analogue sources, such as Voice Switches (VCCS), Telephone lines, Radio outputs, Intercom systems and Microphones.

3 Operation

3.1. Functional units - overview

The Figure 2 shows the main building blocks of the AI24KPCI board and the way they are connected. The MPC875 controls all board activity. It fetches stored instructions from the SDRAM. The SDRAM is available to the system host CPU through the PCI bus and locally to the MPC875. The MPC875 controls the interface IC's of the board, all connected to its ports. It also uses the SDRAM for storing program variables. As a main task, the MPC875 transfers audio data to/from the telephone interfaces from/to the SRAM. Line signaling (on/off hook, ringing) is detected by measuring line voltage changes. The system CPU transfers input/output audio data from/to SDRAM visible in the PCI bus memory space. SDRAM is also used to write operating parameters and to read call related data processed by the MPC875. The system CPU uses a set of registers in the PCI bus IO space to control boot operation and audio and control message exchange with the MPC875.

3.2. Analogue Phone Lines

The 8 identical high impedance phone interfaces perform line electrostatic discharge protection, line isolation and monitor the line voltage. Transformers convert from differential to single-ended mode and ensure galvanic isolation. Zener diodes provide tertiary voltage protection.

The audio signal picked at the differential output of a hybrid circuit which attenuates the Warning Tone injected on the line. Signals VIP0 and VIN0 are input to the codec opamp that converts audio to single ended. The analogue signal is converted to digital, companded into A-law or Mu-law and serially processed as part of the

PCM bus on the card. Timing is provided by a 2MHz clock and a 8KHz sync signal, both output by the processor.

The phone line status is supervised by measuring the voltage between line Tip and Ring, each 10ms. The MPC875 software computes the average voltage on the line and, when a drop beyond a settable threshold is detected, the line is declared to be off-hook. When the line is ringing the software detects the presence of 20-25Hz high voltage input. The ringing threshold may also be defined in the recorder application software.

Under software control the card may generate a warning tone into the monitored telephone lines.

Circuits for phone lines 9-16 and 17-24 present on AI24K_EXT #0 and AI24K_EXT #1 respectively are identical.

3.3. DSP

The DSP performs analogue audio input conversion to 16-bit uniform PCM, AGC, compression to G.711 A-law or Mu-law or G.726 or G.723.1, Call Progress Tones and DTMF and Caller ID detection and signal power level computing.

A single DSP chip (Voice Pump) is assigned to all 24 phone lines (including extensions). MPC875 SW polls the DSP each 10ms and whenever the output FIFO is full the control or audio packets are read.

3.4. Alarm Outputs

The circuitry is mounted on the extension board AI8K_EXT.

The extension card provides 4 mechanical relay outputs to be used for driving external alarm devices. The relay status is controlled by signals RLYx# output by MPC875 on PA3-PA0 respectively (x = 0-3). The relay contact signals are RLYxA and RLYxB. Signal RLYxB may be selected by jumpers JP1-4 to be either the Normal Open or the Normal Closed contact of the relays. Fused 12V voltage is connected to a pin of the relays outputs connector P5 to be used if the external alarm circuit is passive. An external current limiting device (resistor, lamp) is mandatory in this case.

3.5. LED status

The LED shows status during boot, during SDRAM program download and during the normal operation of the card. When card is powered and the MPC875 executes the Flash loader the LED flashes quickly (>5times/second). It flashes once when the firmware is downloaded into the card and then toggles at audio block rate, that is about each 0.5 seconds.

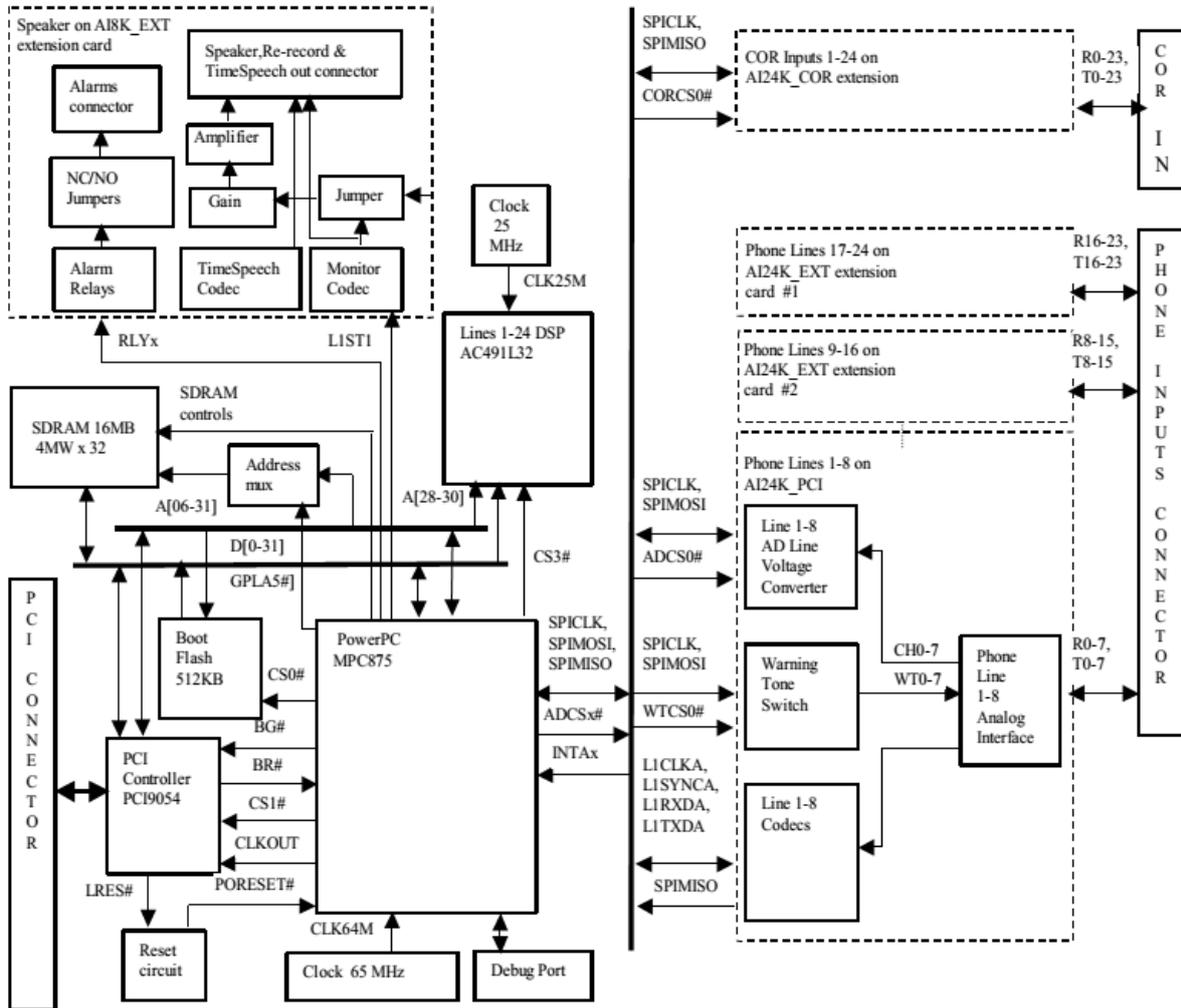


Figure 2-Functional units and Audio flow

4 .Technical data

The **VC-MDx** can be equipped with analogue interface boards developed by VoiceCollect for the purpose of recording from various analogue sources, including Voice Communication Switches (VCS), Telephone lines, Radio outputs, Intercom systems and Microphones.

This interface board is available in 4, 8, 12, 16 and 24 channel configurations. Channel capacity is controlled by license key.

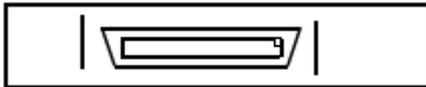
Card size		AI24K_PCI full size PCI (312mm x 108mm)
Input Extension support		2 x A24K_EXT extensions for channels 8-16 and 17-24 (90mm x 70mm, piggy-back)
PCI memory size		16 MB
Input lines		8 + 8 + 8 (base + 2 A24K_EXT extensions), high impedance or 600ohms (solder jumper selectable)
	Connector	Centronics, male, 50 pins
	Max. Voltage	±200V DC continuous ±500V DC for 5 sec.
	AC impedance	high impedance:>30Kohms @ 1000Hz
	DC resistance	high resistance:>10Mohms or 600ohms
	Input Signal	300-3400 Hz ±1dB, +3dBm max. level
	Input level strength	20 mV – 1V (rms)
	Recording Signal Level	-70 dBm to 30 dBm
	Recommended Signal Range	-40 dB to 0dB
	SNR	>60dB @ 1KHz, G711 A-law, 0dB gain
	X-talk	>60dB @ 1KHz, 0dB gain
	Distortion	<3%, G711 A-law, Input Level <3dBm
	Wow and Flutter	<0.1%
Gain	FX:	Adjust range -32dB...+3dB (software adjustable) (default 0dB)
	AGC:	Voice detection Target level -40dBm...0dBm (software adjustable)
Warning Tone		1400 Hz, 1sec on / 14sec off, -20dBm into 300 ohms, per channel selectable
Codec types		1:1 64kHz A-law or M-law (G.711), 2:1 32kHz, 4:1 16kHz (G.726), 10:1 6.3kHz and 12:1 5.3kHz (G723.1)
Phone line signalling detection	Ring detection	2s on/ 4s off cadence, software adjustable threshold
	Caller ID	On-Hook between first and second ring Bellcore or ETSI ETS 200778 compliant
	DTMF	ITU Q.23 and Q.24

Recording Triggers	VOX (Voice Operated Control)	-40 dB - 0 dB
	On/Off Hook recognition	± (24...56)V phone line voltage, per channel adjustable threshold
	Continuous	
Start/Stop timing of recording	Prologue	Selectable prologue time of 1...10 sec.
	Epilogue	Selectable epilogue time of 1...60 sec

5 Mechanical

The AI24K_PCI board is built as full size PCI card. It is a 4-layer board with internal POWER and GROUND planes. Most of the ICs, resistors and capacitors are SMD parts.

On the board front panel a 50-pin connector provides the connection to 8 + 8 + 8 analog telephone lines.



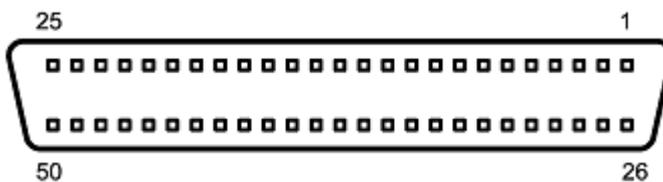
50 Pin / 24 analogue phone ports

6 P1-Phone lines and external contacts input connector

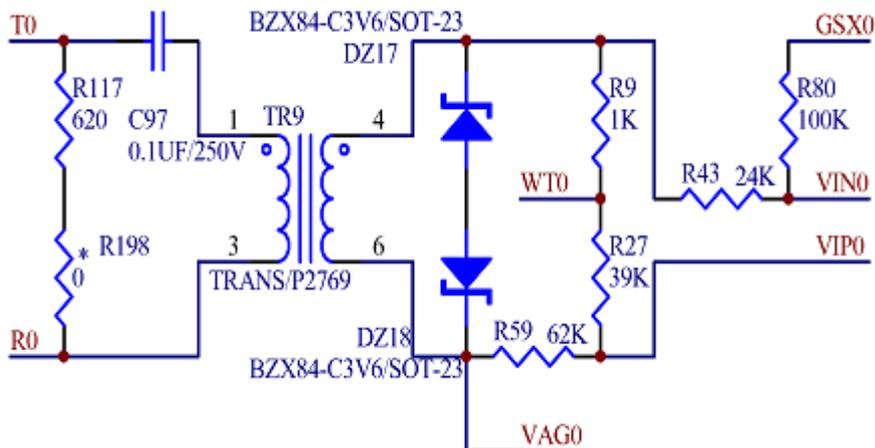
The phone lines input connector has the following pin-out:

Pin	Signal	Description	Pin	Signal	Description
1	R0	Phone line 1 'b' wire	26	T0	Phone line 1 'a' wire
2	R1	Phone line 2 'b' wire	27	T1	Phone line 2 'a' wire
3	R2	Phone line 3 'b' wire	28	T2	Phone line 3 'a' wire
4	R3	Phone line 4 'b' wire	29	T3	Phone line 4 'a' wire
5	R4	Phone line 5 'b' wire	30	T4	Phone line 5 'a' wire
6	R5	Phone line 6 'b' wire	31	T5	Phone line 6 'a' wire
7	R6	Phone line 7 'b' wire	32	T6	Phone line 7 'a' wire
8	R7	Phone line 8 'b' wire	33	T7	Phone line 8 'a' wire
9	R8	Phone line 9 'b' wire	34	T8	Phone line 9 'a' wire
10	R9	Phone line 10 'b' wire	35	T9	Phone line 10 'a' wire
11	R10	Phone line 11 'b' wire	36	T10	Phone line 11 'a' wire
12	R11	Phone line 12 'b' wire	37	T11	Phone line 12 'a' wire
13	R12	Phone line 13 'b' wire	38	T12	Phone line 13 'a' wire
14	R13	Phone line 14 'b' wire	39	T13	Phone line 14 'a' wire
15	R14	Phone line 15 'b' wire	40	T14	Phone line 15 'a' wire
16	R15	Phone line 16 'b' wire	41	T15	Phone line 16 'a' wire
17	R16	Phone line 17 'b' wire	42	T16	Phone line 17 'a' wire
18	R17	Phone line 18 'b' wire	43	T17	Phone line 18 'a' wire
19	R18	Phone line 19 'b' wire	44	T18	Phone line 19 'a' wire
20	R19	Phone line 20 'b' wire	45	T19	Phone line 20 'a' wire
21	R20	Phone line 21 'b' wire	46	T20	Phone line 21 'a' wire
22	R21	Phone line 22 'b' wire	47	T21	Phone line 22 'a' wire
23	R22	Phone line 23 'b' wire	48	T22	Phone line 23 'a' wire
24	R23	Phone line 24 'b' wire	49	T23	Phone line 24 'a' wire
25	R24	Spare input	50	T24	Spare input

Front View of P1 connector (Centronics 50 Poles female)



Schematic of each Line Input (the following picture shows Input 0)



7 Phone input impedance select

Phone input 600 ohms impedance may be selected by soldering 0ohm resistors on AI24K_PCI and AI24K_EXT.

All resistors are 0ohms, can be replaced by soldered shorts.

Resistors OUT = high AC and DC impedance

Resistors IN or shorted = 600ohms DC impedance

Channel	Resistor on AI24K_PCI	Channel	Resistor on AI24K_EXT #0	Channel	Resistor on AI24K_EXT #1
1	R198	9	R193	17	R193
2	R199	10	R192	18	R192
3	R200	11	R191	19	R191
4	R201	12	R72	20	R72
5	R72	13	R201	21	R201
6	R191	14	R200	22	R200
7	R192	15	R199	23	R199
8	R193	16	R198	24	R198

8 P5 Phone Inputs to AI24K_EXT extension #0

This phone inputs connector has the following pin-out.

Pin	Signal	Description	Pin	Signal	Description
1	EARTH	Protective Ground	2	EARTH	Protective Ground
3	T24	Spare input	4	R24	Spare input
5	T15	Phone line 16 'b' wire	6	R15	Phone line 16 'a' wire
7	T14	Phone line 15 'b' wire	8	R14	Phone line 15 'a' wire
9	T13	Phone line 14 'b' wire	10	R13	Phone line 14 'a' wire
11	T12	Phone line 13 'b' wire	12	R12	Phone line 13 'a' wire
13	T11	Phone line 12 'b' wire	14	R11	Phone line 12 'a' wire
15	T10	Phone line 11 'b' wire	16	R10	Phone line 11 'a' wire
17	T9	Phone line 10 'b' wire	18	R9	Phone line 10 'a' wire
19	T8	Phone line 9 'b' wire	20	R8	Phone line 9 'a' wire

9 P6- Control Interface to AI24K_EXT extension #0

This Control Interface connector has the following pin-out:

Pin	Signal	Description	Pin	Signal	Description
1	+5VA	Analog +5V power	2	L1RXDA	PCM receive line
3	GND	Analog ground	4	L1TXDA	PCM transmit line
5	+3.3V	+3.3V power	6	RL1CLKA	PCM 2MHz clock
7	GND	Ground	8	LIBCLKA	PCM 256KHz byte clock
9	Spare	-	10	L1ST2	Line 17 8KHz codec sync
11	Spare	-	12	WTCS1#	Warn. Tone 8-15 switch select
13	GND	Ground	14	ADCS1#	Line voltage 8-15 ADC select
15	MULW	Codec Mu-law	16	SPICLK	SPI clock
17	GND	Analog ground	18	SPIMOSI	SPI master output
19	+5VA	Analog +5V power	20	SPIMISO	SPI master input

10 P4- Phone Inputs to AI24K_EXT extension #1

This phone inputs connector has the following pin-out:

Pin	Signal	Description	Pin	Signal	Description
1	EARTH	Protective Ground	2	EARTH	Protective Ground
3	T24	Spare input	4	R24	Spare input
5	T23	Phone line 24 'b' wire	6	R23	Phone line 24 'a' wire
7	T22	Phone line 23 'b' wire	8	R22	Phone line 23 'a' wire
9	T21	Phone line 22 'b' wire	10	R21	Phone line 22 'a' wire
11	T20	Phone line 21 'b' wire	12	R20	Phone line 21 'a' wire
13	T19	Phone line 20 'b' wire	14	R19	Phone line 19 'a' wire
15	T18	Phone line 19 'b' wire	16	R18	Phone line 18 'a' wire
17	T17	Phone line 18 'b' wire	18	R17	Phone line 17 'a' wire
19	T16	Phone line 17 'b' wire	20	R16	Phone line 16 'a' wire

11 P11- Control Interface to AI24K_EXT extension #1

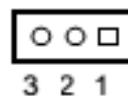
This Control Interface connector has the following pin-out:

Pin	Signal	Description	Pin	Signal	Description
1	+5VA	Analog +5V power	2	L1RXDA	PCM receive line
3	GND	Analog ground	4	L1TXDA	PCM transmit line
5	+3.3V	+3.3V power	6	RL1CLKA	PCM 2MHz clock
7	GND	Ground	8	LIBCLKA	PCM 256KHz byte clock
9	Spare	-	10	SYNC8	Line 9 8KHz codec sync
11	Spare	-	12	WTCS2#	Warn. Tone 8-15 switch select
13	GND	Ground	14	ADCS2#	Line voltage 8-15 ADC select
15	MULW	Codec Mu-law	16	SPICLK	SPI clock
17	GND	Analog ground	18	SPIMOSI	SPI master output
19	+5VA	Analog +5V power	20	SPIMISO	SPI master input

12 AI8K_EXT JP1, JP2, JP3, JP4 - Alarms relays contacts select

The relays Normal (unpowered, deactivated) state is defined as signaling alarms ON.
 JP1, JP2, JP3 select between Normally Open (N.O.) and Normally Closed (N.C.) contacts connected to P8:

Jumper	Pins shorted	Relays contacts connected to P8
JP1	1-2	RLY0A and RLY0B N.O.
JP1	2-3	RLY0A and RLY0B N.C.
JP2	1-2	RLY1A and RLY1B N.O.
JP2	2-3	RLY1A and RLY1B N.C.
JP3	1-2	RLY2A and RLY2B N.O.
JP3	2-3	RLY2A and RLY2B N.C.
JP4	2-3	RLY3A and RLY2B N.O.
JP4	2-3	RLY3A and RLY2B N.C.



13 AI8K_EXT P5 - Speaker output and Alarms outputs connector

The Audio Outputs and Alarms output connector has the following pin-out:

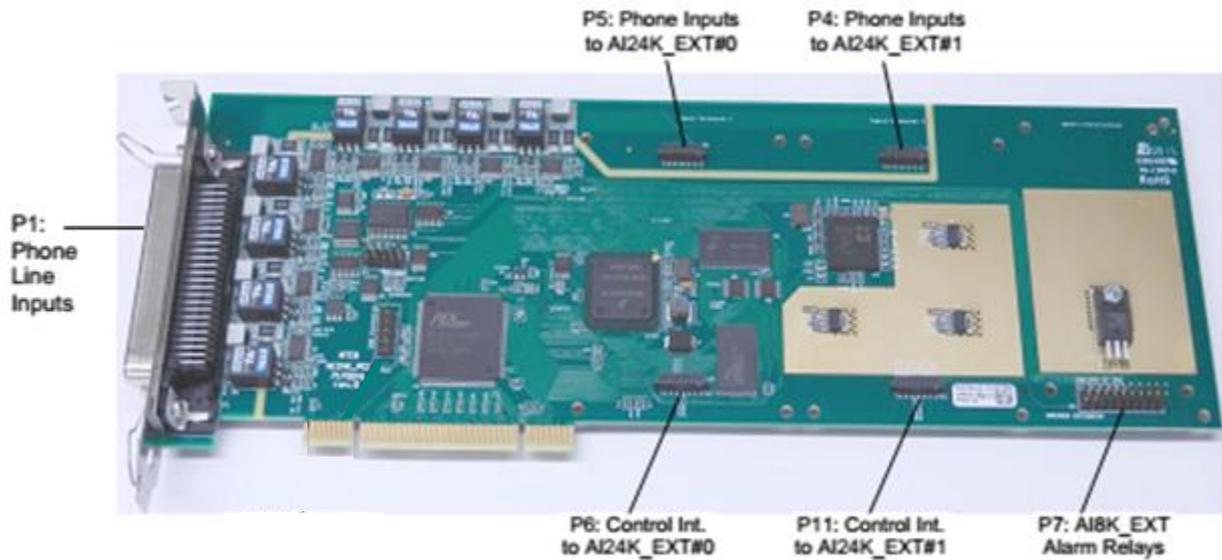
NOTE: Since AI8K_EXT interface audio is not yet implemented Speaker output on this port is unavailable.

Pin	Signal	Description
1	GND	Ground for audio and for alarms (when passive)
2	+12V	fused 12V for passive external alarms
3	GND	Ground for audio and for alarms (when passive)
4	SPKOUT	Speaker output (unavailable)
5	GND	Ground for audio and for alarms (when passive)
6	VOL	External potentiometer output, to wiper
7	RLY3b	Alarm relay 3 contact # 2 (Common)
8	RLY3a	Alarm relay 3 contact # 1 (Normal Open or Normal Close)
9	RLY2b	Alarm relay 2 contact # 2 (Common)
10	RLY2a	Alarm relay 2 contact # 1 (Normal Open or Normal Close)
11	RLY1b	Alarm relay 1 contact # 2 (Common)
12	RLY1a	Alarm relay 1 contact # 1 (Normal Open or Normal Close)
13	RLY0b	Alarm relay 0 contact # 2 (Common)
14	RLY0a	Alarm relay 0 contact # 1 (Normal Open or Normal Close)



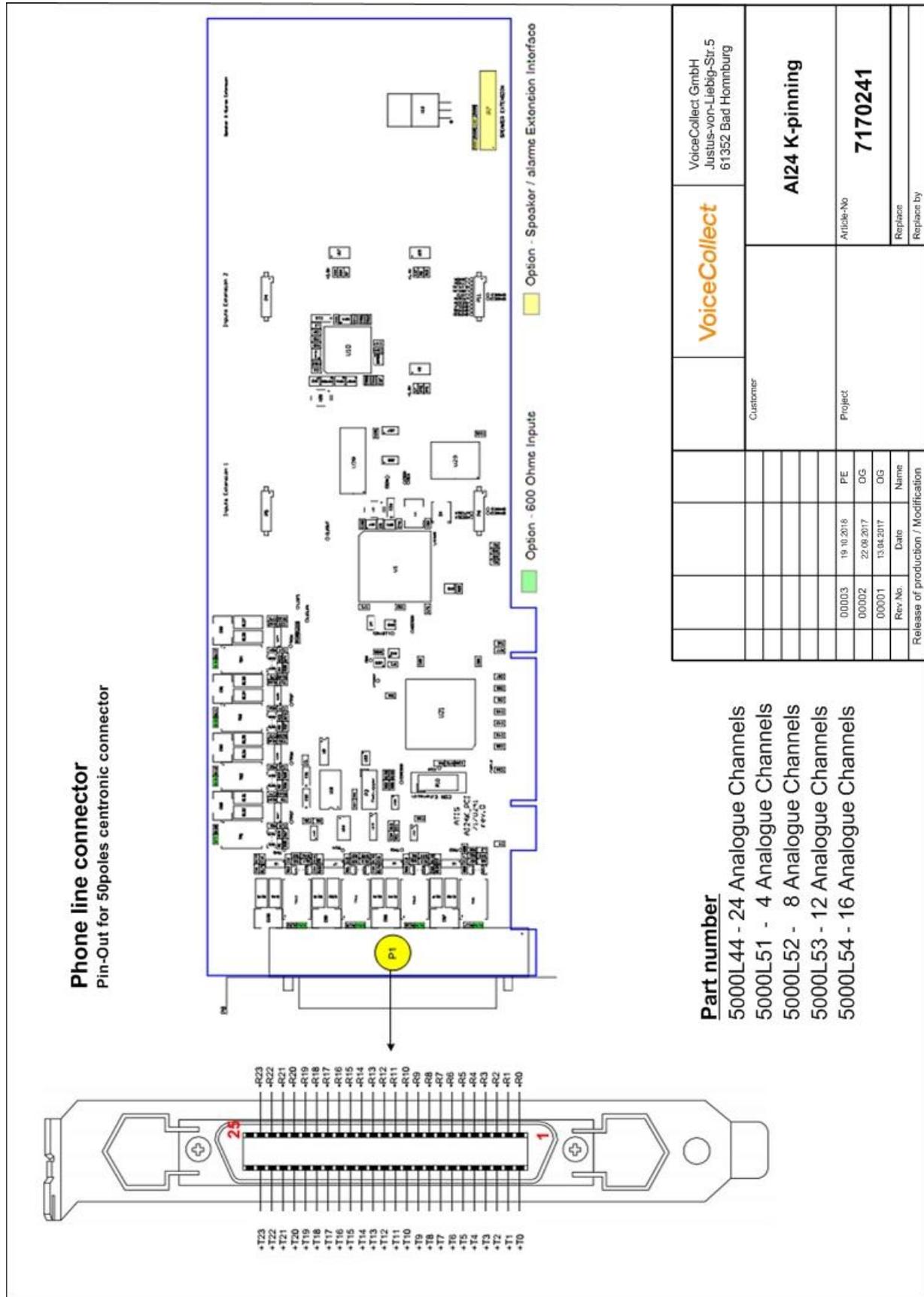
14 Ports location

Main Board AI24K_PCI Top View



Extension Board AI24K_EXT Top View

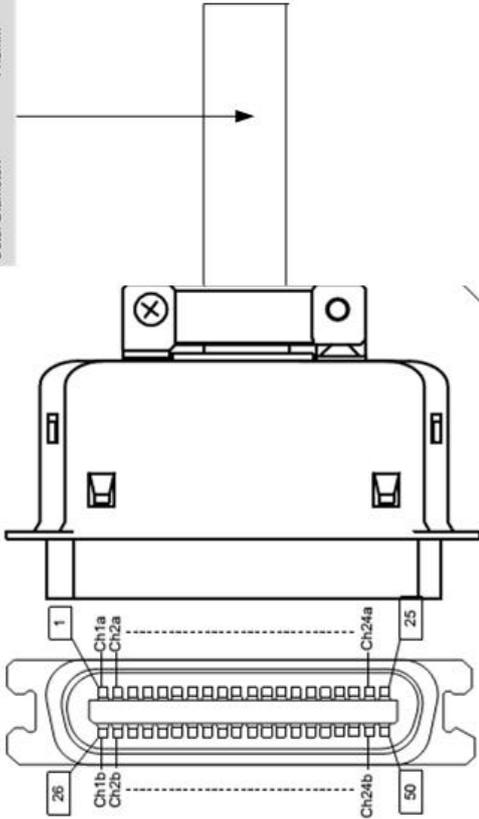




VoiceCollect		VoiceCollect GmbH Justus-von-Liebig-Str.5 61352 Bad Homburg	
		Customer	
AI24 K-pinning		Article-No 7170241	
00003	19.10.2018	PE	Project
00002	22.08.2017	OG	
00001	13.04.2017	OG	
Rev. No.	Date	Name	Release of production / Modification
			Replace by
			Replace by

Cable Product Details:
 Indoor telephone cable, J-V(ST)Y_24*2*0.6
 Pair-twisted wire/Single wire cable (solid wire made from
 blank copper wire, 0.6 mm or 0.8 mm).
 Cross Sectional Area: 0.28 mm²
 Temperature range: -5 °C → +70 °C
 Number of Pairs: 24
 Outer Diameter: 11.5mm

Centronics 50P male connector



Pin No.	Color	Label	Group
1	blue	CH1 a	Group 1
2	yellow	CH2 a	
3	green	CH3 a	
4	braun	CH4 a	
5	black	CH5 a	
6	blue	CH6 a	Group 2
7	yellow	CH7 a	
8	green	CH8 a	
9	braun	CH9 a	
10	black	CH10 a	
11	blue	CH11 a	Group 3
12	yellow	CH12 a	
13	green	CH13 a	
14	braun	CH14 a	
15	black	CH15 a	
16	blue	CH16 a	Group 4
17	yellow	CH17 a	
18	green	CH18 a	
19	braun	CH19 a	
20	black	CH20 a	
21	blue	CH21 a	Group 5
22	yellow	CH22 a	
23	green	CH23 a	
24	braun	CH24 a	
25	Not connected		
26	CH2 b	red	Group 1
27	CH3 b	white	
28	CH4 b	white	
29	CH5 b	white	
30	CH6 b	white	
31	CH7 b	white	Group 2
32	CH8 b	white	
33	CH9 b	white	
34	CH10 b	white	
35	CH11 b	white	
36	CH12 b	white	Group 3
37	CH13 b	white	
38	CH14 b	white	
39	CH15 b	white	
40	CH16 b	white	
41	CH17 b	white	Group 4
42	CH18 b	white	
43	CH19 b	white	
44	CH20 b	white	
45	CH21 b	white	
46	CH22 b	white	Group 5
47	CH23 b	red	
48	CH24 b	red	
49	CH24 b	white	
50	Not connected		

VoiceCollect		VoiceCollect GmbH Justus-von-Liebig-Str.5 61352 Bad Homburg	
Customer		Cable 10m 24AI-K	
Project		Article-No 7147110	
00003	31.10.2016	PE	Release of production / Modification
00002	22.09.2017	OG	
00001	13.04.2017	OG	
Rev.No	Date	Name	Replace
			Replace by

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