PalmMicro
Communications, Inc.

AR1688

AR168M VOIP module hardware Manual

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Revision History

Revision	Date	Name	Revision contents
	2007/11/26	*Alanda*	*New Creation*

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1. Introduction

This document introduces the hardware information of AR168M, a voice over IP module of PalmMicro Communications Inc.

AR168M is based on the SOC AR1688 which is the improving version of AR1688, while AR1688 was a fully proved IP phone solution aimed at low cost VOIP market.

AR168M implemented a high quality single channel VOIP processing, supports both SIP and IAX2 protocol. One can easily use AR168M to implement an IP phone without need to understand the complex technical details. It will be helpful to shorten the time to market for most users.

Connection between host and AR168M can be through Universal Asynchronous Receiver/Transmitter (UART) or Serial Peripheral Interface (SPI). It is easy for AR168M to be connected to almost all the embedded MPU host.

AR168M provides fully VOIP features. It supports most popular CODEC algorithm and can meet various requirements for different applications.

1.1. AR168M Features:
- Support SIP or IAX2 protocol
- Support Following Voice Codecs
  - G.711 a-law and mu-law
  - G.729, a, b, ab
  - G.723.1[1] 5.3/6.3k
  - GSM610
  - ILBC
  - Speex
- VAD (Voice Activity Detection)
- CNG (Comfortable Noise Generation)
- G.168 32ms acoustic echo cancel (AEC)
- Standard DTMF tone generation and detection
- Adaptive jitter buffer
- Accord with ITU-T standard signal tone

1.2. AR168M interface:
- Support 3 wire UART (TxD, RxD, GND)
- Support SPI

1.3. AR168M Application:
- IP phone
- Wi-Fi IP phone
- Cordless IP phone
- VOIP door phone
- VOIP Paging
- Echo cancellation application

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[1] Not finished yet.

2. Hardware architecture

2.1. System block architecture and picture

AR168M consists of SOC AR1688, RTL8019, FLASH, LCD connector and interface connector (Figure1). The module size is: 43(mm) x 34(mm). The maximum height of the module is 9.5(mm). Please refer Figure1 to Figure3 for a brief overview.
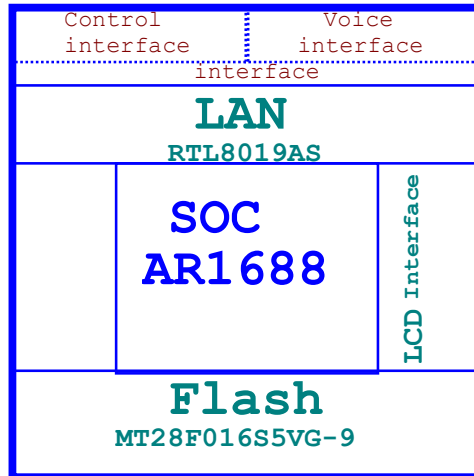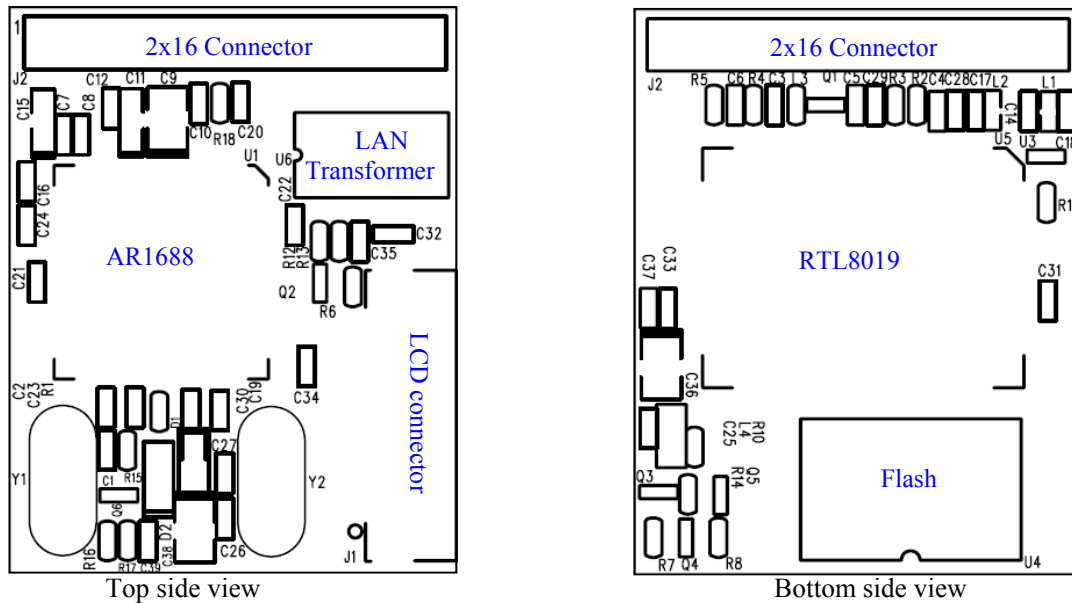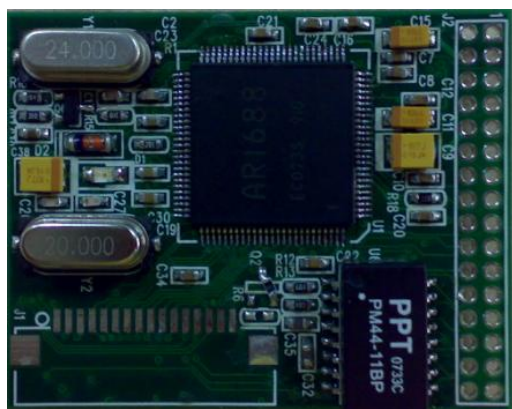

Figure1.   AR168M architecture

Figure2.   AR168M main components layout

| Top side view | Bottom side view |

Figure3. AR168M Picture

2.2. SOC AR1688

SOC AR1688 is the kernel part of the AR168M. Its core consists of a Z80 compatible MPU and a 24-bit DSP. It embedded enough memory inside so that no external SDRAM is needed. This reduces the power consumption and the size of the module.

Main features of AR1688:
- Integrated MCU, the instruction set is compatible with Z80
- 24 bits DSP Core，2181-instruction-set compatible DSP co-processor
- DSP Speed up to 72MIPS
- High quality 18bits CODEC on chip.
- One UART port or SPI port
- Maximum voice output: 11mW@16 ohm
- Internal DC/DC converter to produce CORE voltage, eliminate external LDO
- Operating Voltage: IO: 3.3v, Core: 1.8v
- Low Power consumption: <90mW at typical

2.3.Flash

A 2Mbyte 8bit flash is mounted on the AR168M module.

AR168M VOIP module supports both SIP and IAX2protocol. Due to the limitation of the flash capacity, one can upload only one protocol firmware at a time. Changing protocol or upgrading the firmware is possible in future, but specify the correct firmware when ordering the AR168M will be much convenient for user.

2.4. LAN

The LAN unit in the AR168M is implemented with RTL8019AS. It supports 10Mbps. A transformer is already included on the AR168M, so only the network connector needs to be added in the host side.

For most users, LAN port is used to transmit or receive all the voice packets and other protocol information. It is also the port where AR168M upgrading its firmware.

For users who wish to use the LAN interface on host instead of the LAN of AR168M, please write to support@palmmicro.com.cn for detail discussing.

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2.5. LCD interface

A LCD connector is reserved on the AR168M VOIP module. It can be used to connect a dot matrix LCD with a ST7565 compatible controller (To support LCD controller other than ST7565, an extra of development fee will be charged). The LCD should be operated at 3.3V power supply. For detail LCD interface signal definition, please see Table1.

The physical LCD connector is a 16 pins SMT FPC connector in 1mm pitch. It is not mounted on PCB in default. One needs to specify the requirement of LCD connector in his order if he needs it.

Pin Number	Signal Name	Description
1	BL_VCC	LCD Back Light power in, 3.3V
2	GND	Ground
3	VCC	Power in, 3.3V
4	D7	Data bus bit7, MSB
5	D6	Data bus bit6
6	D5	Data bus bit5
7	D4	Data bus bit4
8	D3	Data bus bit3
9	D2	Data bus bit2
10	D1	Data bus bit1
11	D0	Data bus bit0, LSB
12	RD#	LCD read control, low active
13	WR#	LCD write control, low active
14	RS	LCD data/command select input, high for display data, low for command.
15	RST#	LCD reset input, low active
16	CS#	Chip select for LCD, low active

Table1.   LCD interface definition

2.6. Interface Connector

The interface connector is used for the inter-connection of external host and AR168M. The physical connector is in 2mm pitch and the total pin number is 32(2 rows with 16 pin each row). A header or a socket can be mounted for this connector. For the convenient of user's selection of the connector type, AR168M is shipped without the assembly of this connector.

The interface signals include power, network signals, voice signals, UART or SPI signals and GPIOs. Please refer Table2 for detail signal assignment。For more detail of the interface information, please read the following section: "AR168M interface specification".

PIN	Signal	Description	PIN	Signal	Description
1	VCC	Power in, 3.3V	2	VCC3	Power in, 3.3V
3	GND	Ground	4	GND	Ground
5	RST#	Reset in, low active	6	VCC5	Power in, 5.0V
7	AOUTR	Audio output right channel	8	AOUTL	Audio output left channel
9	EMICIN	External Microphone	10	AGND	Analog ground
11	ELINEINR	Line in right channel	12	ELINEINL	Line in left channel
13	ADC1	ADC input channel1	14	ADC2	ADC input channel2

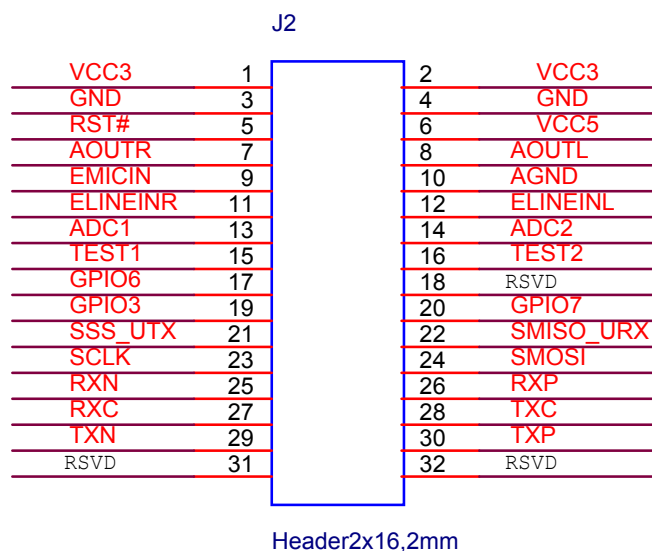| PIN	Signal	Description	PIN	Signal	Description
15	TEST1	For factory test	16	TEST2	For factory test
17	GPIO	General purpose I/O	18	RSVD	Reserved for future use
19	GPIO	General purpose I/O	20	GPIO	General purpose I/O
21	SSS_UTX	SPI slave select or UART TxD.	22	SMISO_URX	SPI master in slave out or UART RxD
23	SCLK	SPI clock signal	24	SMOSI	SPI master out slave in
25	RXN	Ethernet receive data-	26	RXP	Ethernet receive data+
27	RXC	Ethernet receive central tap	28	TXC	Ethernet transmit central tap
29	TXN	Ethernet transmit data-	30	TXP	Ethernet transmit data+
31	RSVD	Reserved for future use	32	RSVD	Reserved for future use

Table2.   AR168M interface definition

Figure4.   Interface connector schematics

2.7.   Module Dimensions

Figure5.   Module Dimensions

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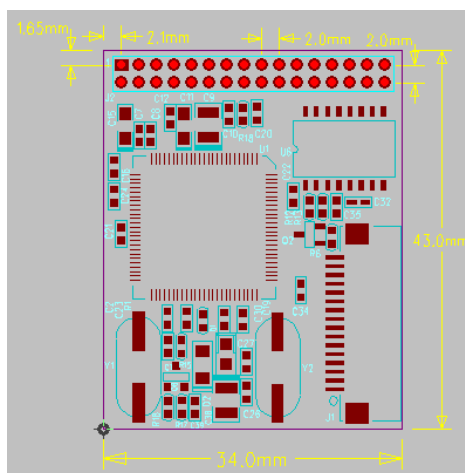
3. AR168M interface specification:

It is necessary for user to understand the interface specification in order to make a correct connection of AR168M and external host. Incorrect connection may cause the AR168M permanent damage.

3.1. POWER

AR168M needs both 5V and 3.3V power input to operate. The 5V is for RTL8019 and the FLASH, while the 3.3V is for AR1688 and other units. An extra of 3.3V for voice analog unit is need for a good voice quality. The power requirements and the appropriate power consumption is listed in the following table:

Voltage	Tolerance	Maximum ripple current (mv)	Rating current (mA)
5V	±5%	<50mV	<60mA
3.3V	±3%	<30mV	<50mA

Warning: No protection circuit inside the AR168M module. Incorrect power exceeds the limitation will cause the permanent damage.

3.2. Network signals

Network signals are from LAN transformer (Figure6). There are totally six of them. Those name start with Rx are input signals of AR168M, while with Tx signals are the output.
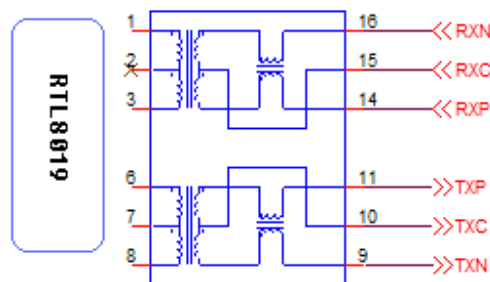

Figure6.   Network signals schematics

3.3. UART

The UART of AR168M is a three-wire port, include: RxD, TxD, GND. The voltage level of these signals is 3.3V for high and 0V for low. RxD is 5V compatible.

The data structure of UART consists of one start bit, one stop bit, one parity check bit, 5-8 bit data. Start bit is always low and the stop bit is always high. LSB is transmitting first. UART supports baud rate from 600 to 115200bps. For good hardware design, higher baud rate is possible under the extra software support.

One should set the exact same parameters for the UART of AR168M and host in order to make a successful communication. The AR168M shipped with the default UART parameters as follows:
Baud rate=9600bps, one start bit, one stop bit, eight data bit and no parity.

Warning: If the level of UART exceeds range of 0-5V，It will damage the AR168M！！！
      SPI and UART share same signal pin, so one can't select SPI and UART at the same time.

3.4. SPI interface

The SPI interface of AR168M can operate at master or slave mode. When it works at master mode, SCLK is outputted from AR168M, and a slave selection control signal SSS_UTX is also outputted for slave device selection. If the SPI interface of AR168M operates at slave mode, external SPI master device should provide SCLK to AR168M. The SSS_UTX is not used in this mode.
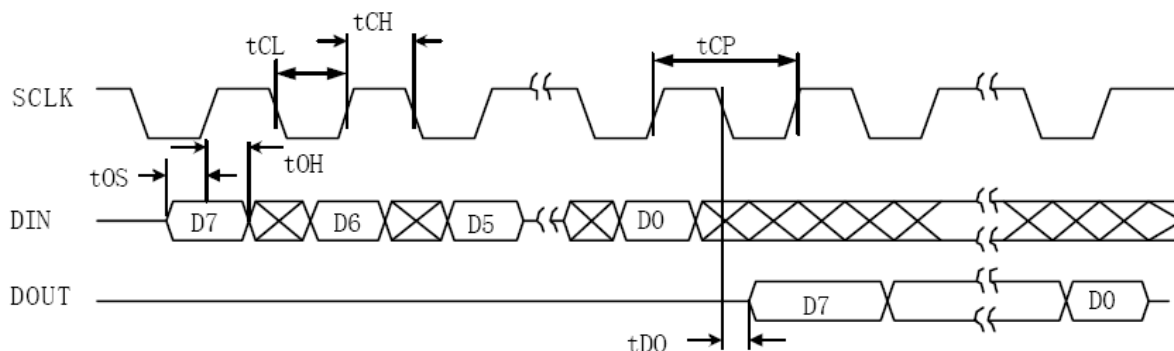
Figure7 is the waveform of SPI interface.

Figure7.   SPI interface diagram

3.5. GPIO

GPIO of AR168M are reserved for future use, they are not necessary in the IP phone application. If anyone hopes to use those GPIOs for special use, please write to support@palmmicro.com.cn to enquire for further information.

GPIO7 at pin 20 is used to control the AR168M boot mode. It should be pulled up to 3.3V with a 10k resistor externally. By pulling this pin to ground at the power up will make the AR168M enter safe mode.

3.6. ADC

Two 8-bit ADC channels are included in AR168M, they are also reserved for future use.

3.7. Voice signals

Voice signals include input and output group. Microphone and line in are both acceptable for voice input.

3.7.1. EMICIN

This is the input of external microphone. Since the microphone bias circuit and a coupling capacitor are already included inside AR168M, one can simply connect the positive lead of microphone with this signal.

Compare to line in, microphone input has much higher gain inside the AR1688 chip.

3.7.2. ELINEINR，ELINEINL

They are line in of external voice signals. Although the line in is in stereo input, but AR168M takes as mono-channel for VOIP application. Please connect them together outside. These signals are ac-coupling.

The line in input can't connect to the microphone directly. If you don't use them, please connect them to analog ground.

3.7.3. AOUTR，AOUTL

They are right and left channel voice output of AR168M. In the application of VOIP, the output of AOUTR and AOUTL are exact the same.

These outputs can directly drive a 32ohm headphone, but not enough to drive a speaker. An external power amplifier is necessary in case to drive speaker. The voice output signals are dc coupling with a dc bias of 1.5V.