

AR1688

AR1688 Hardware Reference Design Manual
(Version 3.0)

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1. Introduction

This document introduces the hardware reference design of PalmMicro's latest IP phone solution: AR1688. The hardware reference design schematic documents are in pdf and orcad formats.

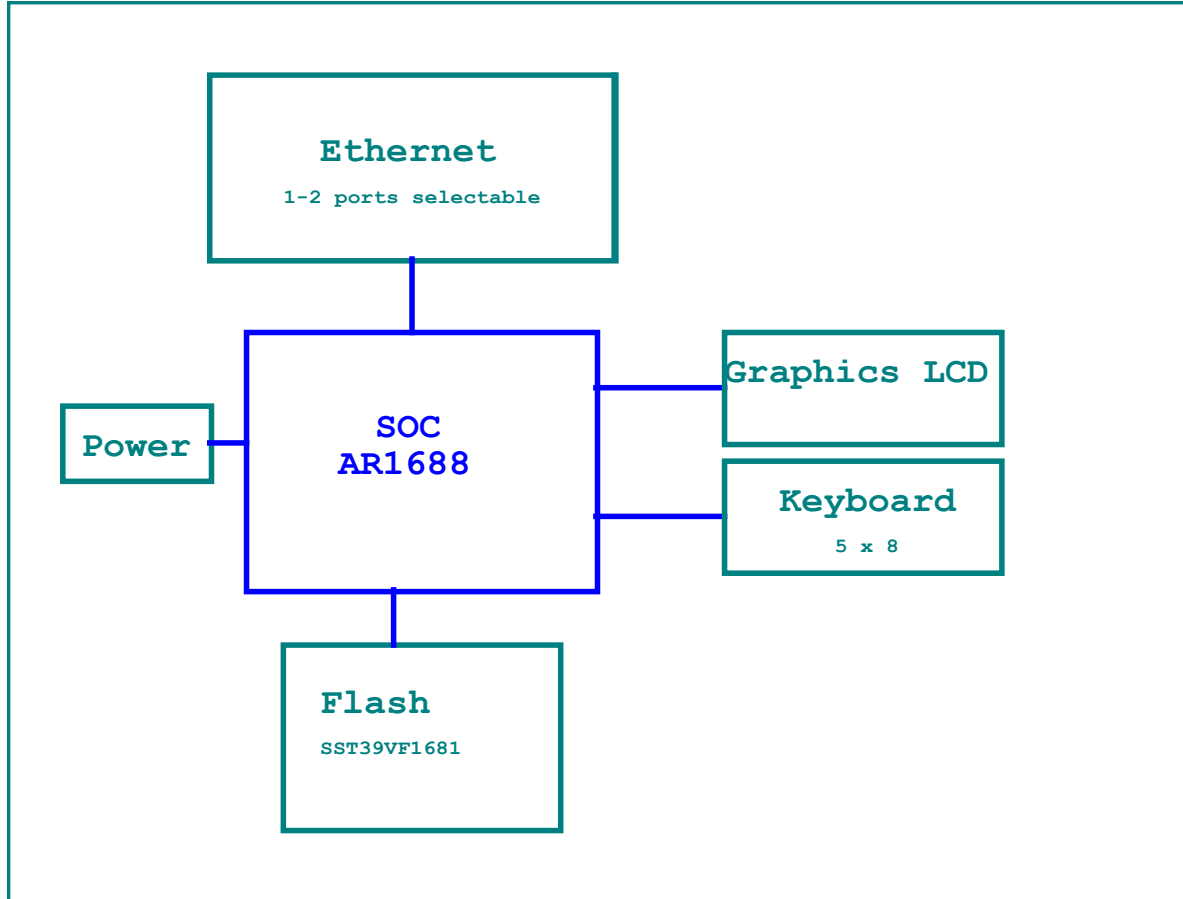
AR1688 is the latest chipset for low cost IP Phone solution. It is a replacement of the well-known PA1688 chipset which is discontinued on May 2006. Compared to PA1688, AR1688 offers better performance and lower cost. It runs at higher speed, yet consumes lesser power. AR1688 has integrated a AD/DA codec and more memory inside the chip, which means no external codec and SDRAM is needed. Besides, the chip has smaller package and offers better voice quality. We believe that AR1688 will be the most competitive solution in the low cost VOIP market.

Users who read this document are suggested to refer the schematics file later than version 8.00.

AR1688 is Rosh compliance SOC, and the key components used in our IP phone reference design are also Rosh compliance.

2. Hardware architecture

2.1. System block diagram



The whole system consists of AR1688 SOC, the network unit, the flash unit, the power unit, the display unit and the keypad unit.

3. Function description

3.1. The AR1688 SOC and the audio unit

The AR1688 SOC is the kernel of the whole IP phone system, it controls all the other function units. The AR1688 SOC has the following functions:

- Memory and IO interface: It consists of address bus, data bus, read/write control, and chip select control signals.
- The clock source: The system clock source of the AR1688 SOC.
- ADC input: There are two 8bit ADC channels available for AR1688.
- UART: It is a standard UART port without hardware flow control. The UART port is used as GPIO for IP phone design, and used as communication port in the VOIP module design.
- GPIOs: For various control of the system, such as keypads, LCD, led etc.
- DC/DC: It produces the core voltage for the AR1688 SOC.
- Voice interface: Integrated an AD/DA codec interface for external audio unit.

The audio unit of AR1688 IP phone is almost the same as that in AR1688. It includes handset interface, microphone, speaker power amplifier and side-tone circuit. The AR1688 IP phone can play voice in two modes: one is through handset, the other is through speaker. During the conversation, user can switch between these two modes. It should be noticed that the system can only works at one mode at any moment. In the speaker mode, user can hear voice from speaker as soon as he switch in speaker mode even if he picks up the handset.

Audio unit for AR1688 IP phone system was made some modification, in order to get a better performance than AR1688 IP phone system.

3.2. Flash

A SST Rosh compliance flash is used in the AR1688 IP phone reference design system. So it is easy for user to implement a Rosh compliance IP phone with AR1688 solution.

The flash should be programmed before assembly on the PCB. The AR1688 do not support ISP.

Palmmicro provided flash accompany with AR1688, users are not recommended to buy flash buy themselves, blank flash is not useable for AR1688 IP phone solution.

Before shipped, all the flash will be programmed with an initial firmware in the factory.

User should ensure not to power off the system during firmware upgrading. Otherwise, you may need to recover the system firmware from “safe mode”. And an unsuccessful upgrading of page0 may corrupt the phone and can only be restored by returning it to the factory.

3.3. Power

The main power supply for AR1688 IP phone is 5V DC. All the other voltages are obtained from this 5V supply through DC/DC converter or LDO. The total current consumed of the whole IP phone system is listed in below table:

Condition(Without LCD display)	Total consumed current of 5V (mA)
Single LAN port	90
Double LAN ports	260
Notes: The current was measured at standby state. It is not the maximum current needed of the whole system.	

According to the different external power input, user should implement different power unit in the AR1688 IP phone system:

- Use a 5V DC external power system. This is the simplest way for the power unit of AR1688 IP Phone system. No DC/DC for 5V power is needed in this situation.

- Use an AC or DC power higher than 5V. In this case, a DC/DC(or AC/DC) unit is needed in the AR1688 IP phone system to produce the 5V voltage.
- Use POE for external power system. A DC/DC for POE power device system is needed in the AR1688 IP phone system.

There are two power schemes implemented in the schematics: one can accept 5V DC power input, and the other can accept DC input of 6-15V. Please select what you wished.

The power system in the reference design is for reference only. Users can implement their own power solution for the system. Since the power system is very important to the system reliability and voice quality, we suggest user to make detail test and evaluation before accept it. User should notice:

- Keep enough power margin. We suggest the rating current at least should be 120% of the maximum current need of the system, and the peak current should be twice the maximum current needed.
- The quality of power system will affect the IP phone voice quality. Please choose the power system with low noise.
- Any power system will reduce its power output as the temperature rising, user should make sure the power system can fulfill the requirement at the maximum temperature allowed.

3.4.Network

There are two network options in the AR1688 IP phone reference design documents, one is single LAN port and the other is double LAN ports, user can select one of them in their final product.

Due to the different structure of the two options, there is little network behavior difference between them. The link speed of the single LAN port is 10 Mbps, while the double LAN ports is in 100 Mbps.

Two LED are used for network status indication, here is the function:

LNK0#/LNKACT0#: It has no meaning in single LAN option and acts the LINK+ACTIVITY of port 0 in double LAN option.

ACT0_LNKACT#1: It is the ACTIVITY indication in single LAN option and the LINK+ACTIVITY of port 1 in double LAN option.

The BOM for these two options are different. Please refer to the BOM documents for further information.

Notes:

Good PCB layout is the guarantee of network performance and reliability. We suggest user to keep the differential signals lines as short as possible, and minimize the VIA number also. Besides, decoupling and bypass of the power supply for the network chip is also important.

3.5.Reset circuit

Reset circuit is used to reset the AR1688 IP phone while the system is powered on. This circuit will keep the RESET# at low for about 20ms.

3.6.Safe Mode

The safe mode (also called page0 mode) is a special mode of the AR1688 system. It is only used for firmware recovery when the phone's firmware was corrupted.

By picking the handset at the power on stage, the AR1688 system will enter safe mode. To exit the safe mode, you can simply reset the system. For example, reboot the phone.

3.7.UART

The UART pins are used as GPIOs in the AR1688 IP phone system.

3.8.LCD interface

AR1688 IP phone can support graphics LCD with resolution up to 128x64. LCD back light is also supported.

The LCD interface of AR1688 is in 16 pins. It can directly connect to the LCD module with ST7565 LCD controller. Graphics LCD with other LCD controller is also possible with extra LCD driver. Please contact Palmmicro for further information.

If the LCD is operating at 3.3V power supply, the AR1688 can directly drive the LCD without extra bus transceiver. If the LCD is operating at 5V, the bus transceiver is suggested to be kept.

Character LCD is not supported for the moment.

LCD interface:

PIN NUMBER	PIN SIGNAL	DESCRIPTION
1	CS#	LCD chip select, low active
2	RESET#	LCD reset, low active
3	RS	LCD input control, low for instruction, high for data
4	WR#	LCD write control, low active
5	RD#	LCD read control, low active
6-13	D[0:7]	Data bus
14	PWR	LCD power input, 3.3V
15	GND	Ground
16	BLPWR	LCD back light power input, 3.3V.

3.9.LED

There are total 8 LEDs available in the AR1688 IP phone system. These LEDs can be used to as state indication in the final product or as troubleshooting purpose during manufacture. Users are allowed to select what they needed. All the LED control signals are active low.

The LED current in the reference design is about 6 mA. User should ensure the LEDs can get enough current as their datasheet mentioned. Please adjust the current constrain resistor value if necessary. If you mount two LEDs (eg: one on the board, the other on the outside case) for the same LED control signal, you should double the LED current.

LED function table:

REF	LED SIGNAL NAME	FUNCTION	BEHAVIOR
D5	PWRLED#	Power	On when power on. Off when power off.
D6	SPKLED#	Speaker	On when is in speaker mode.
D7	MUTELED#	Mute/DND	During voice talk, on when the MIC is muted, off when the MIC is not muted; During standby, on when in DND (Do Not Disturb) mode, off when in normal mode.
D8	HOLDLED#	Hold	On when is in Hold state.
D9	MSGLED#	Message	Flash when there is unread message. Off when no any unread message.
D10	TRANSLED#	Reserved.	Reserved
D11	LNK0# LNKACT#0	Network indication	For single LAN option, unused. For double LAN option, on when the first LAN port is linked, off is not linked and flash is in TX/RX activity.
D12	ACT0# LNKACT#1	Network indication	For single LAN option, Flash=TX/RX activity, ON= no TX/RX activity.

REF	LED SIGNAL NAME	FUNCTION	BEHAVIOR
			For double LAN option, on when the second LAN port is linked, off is not linked and flash is in TX/RX activity.

3.10. Keypad

The keypad for AR1688 IP Phone system supports maximum of 40 keys.

All the key functions are defined in the schematic file, please chose the needed key and layout the PCB according the schematics. User is allowed to omit unused keys.

Keypad and its function table:

KEYPAD NUMBER	FUNCTION ASSIGNMENT	DESCRIPTION
K1	1	Digital key
K2	2	Digital key
K3	3	Digital key
K4	Call	Call key
K5	Mem1	Quick dial key
K6	4	Digital key
K7	5	Digital key
K8	6	Digital key
K9	Redial	Redial key
K10	Mem2	Quick dial key
K11	7	Digital key
K12	8	Digital key
K13	9	Digital key
K14	Speaker	Speaker key
K15	Mem3	Quick dial key
K16	*	Digital key
K17	0	Digital key
K18	#	Digital key
K19	Flash	Flash key
K20	Mem4	Quick dial key
K21	Hold	Hold key
K22	Message	Message key
K23	Transfer	Transfer key
K24	Mute	Mute key. It acts as mute function during voice talking, and DND(do not disturb) during standby.
K25	Mem5	Quick dial key
K26	Left	Left key
K27	Right	Right key
K28	Vol+/Up	Volume up or UP key
K29	Vol-/Down	Volume down or down key
K30	Menu	Menu key
K31	OK	OK Key
K32	Cancel	Cancel key
K33	Reserved	Reserved for future use
K34	Reserved	Reserved for future use
K35	Reserved	Reserved for future use
K36	Mem6	Quick dial key

KEYPAD NUMBER	FUNCTION ASSIGNMENT	DESCRIPTION
K37	Mem7	Quick dial key
K38	Mem8	Quick dial key
K39	Mem9	Quick dial key
K40	Mem10	Quick dial key

3.10.1. Keypad back light

Keypad back light can be implemented if one really needed. Please use the LCD back light control signal to control the keypad back light.

3.10.2. Hook state detect

Hook state is detected by a GPIO of AR1688. This is different from the early version of AR1688 IP phone system.