RAiO

RA8911

8-Bit
Micro-Controller

Version 1.5

October, 2003

RAiO Technology Inc.

Overview

RA8911 is an 8-bit downloadable micro-controller. Up to 22MHz system clock makes it a perfect choice for high-end device. It contains a 16x16 Multiplier and Accumulator (MAC), which not only greatly reduce programmer's effort, but also shorten development time. RA8911 is embedded 4-channel 10-Bit ADC that can vary your application fields in analog detection, such as temperature, pressure, humidity, etc. Moreover, matched with LCM (LCD Module), 10-bit ADC can be perfectly used in Touch Panel function.

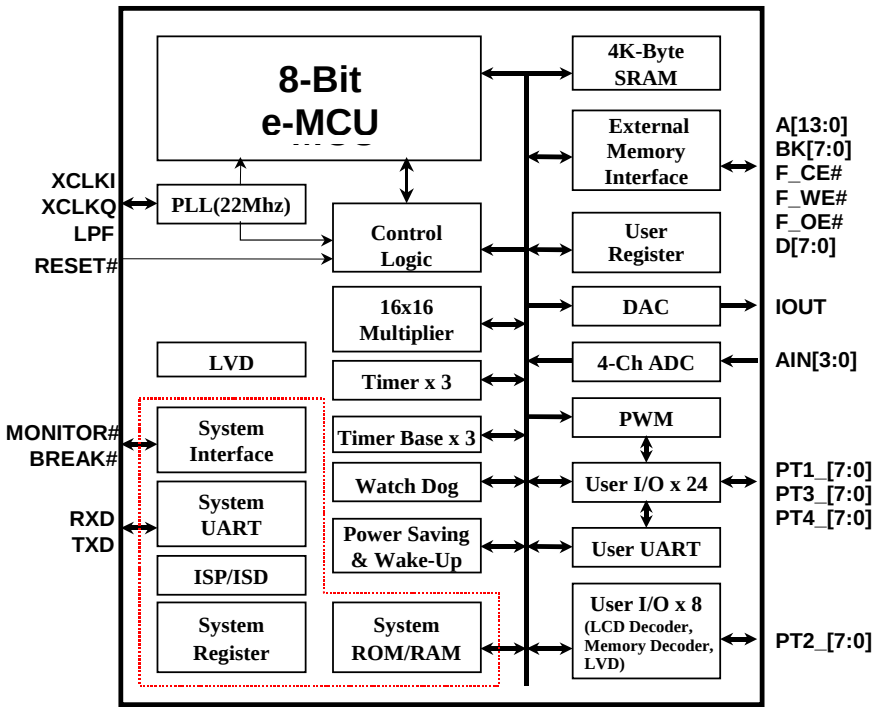
RA8911 is suitable for any downloadable device no matter used by end-users for voice/data download, or used by programmers for S/W program updated. The built-in 4K-byte ROM supports the on-chip RAiO ICE Monitor program, ISP(In-System Programming) and ISD(In-System Debugging), which controls the UART and enables the RS232 connection between the RA8911 and a PC host. Besides that, IrDA application is also allowed to give the device multiple attractive characteristics.

In short, RA8911 supports embedded 4K-byte SRAM, three I/O ports, LCD interface, built in PLL / RC Oscillator, LVD, multiple timer/counter sources, versatile interrupt-handling architecture, built-in one DAC (Digital-to-Analog Converters), 16x16 Multiplier and Accumulator (MAC) and support 4-channel 10-Bit ADC.

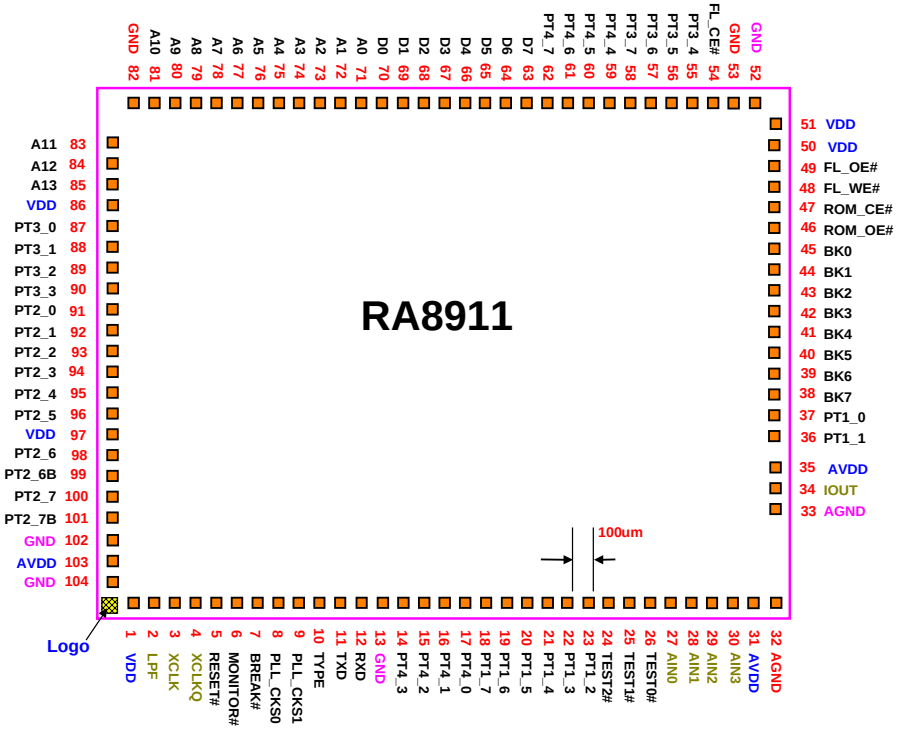
Feature

- 8-bit Micro Processor for Maximum 22MHz
- Internal 4K-Byte SRAM
- Flexible External Flash Support
- Flexible I/O Interrupt & Wake-Up Mode
- Support Wake-Up Reset Mode
- Support LVD(Low Voltage Detector)
- Support External Memory
- Support LCD Interface
- Support PWM Output with 50% or 100% duty select
- Three 8-Bits Programmable I/O Port
- Three 12-Bits Timer
- Six Time-Base Options
- Watch Dog Timer
- One 4 -Level 10-bits Fixed Current Mode DAC
- Support 4-channel 10-bit ADC with Touch Panel Function
- One User's UART with Baud Rate Generator, Up to 115200bps
- UART Provide IrDA/ASK IR/Normal Mode
- Support UART Wakeup
- Support Idle/Sleep/Power Saving Mode
- Support Timer Wake-Up Mode
- Support H/W 16x16 Multiplier with Adder Option
- 1Hz, 2Hz and 1/60Hz Interrupt/Wake up
- Built in PLL, Only need one 32768Hz X'tal or Resistor for Oscillator
- Low Power Consumption
- Operating Voltage: 2.2V ~ 4.5V
- Package: Die Form or PQFP-100Pin

Block Diagram



PAD Diagram



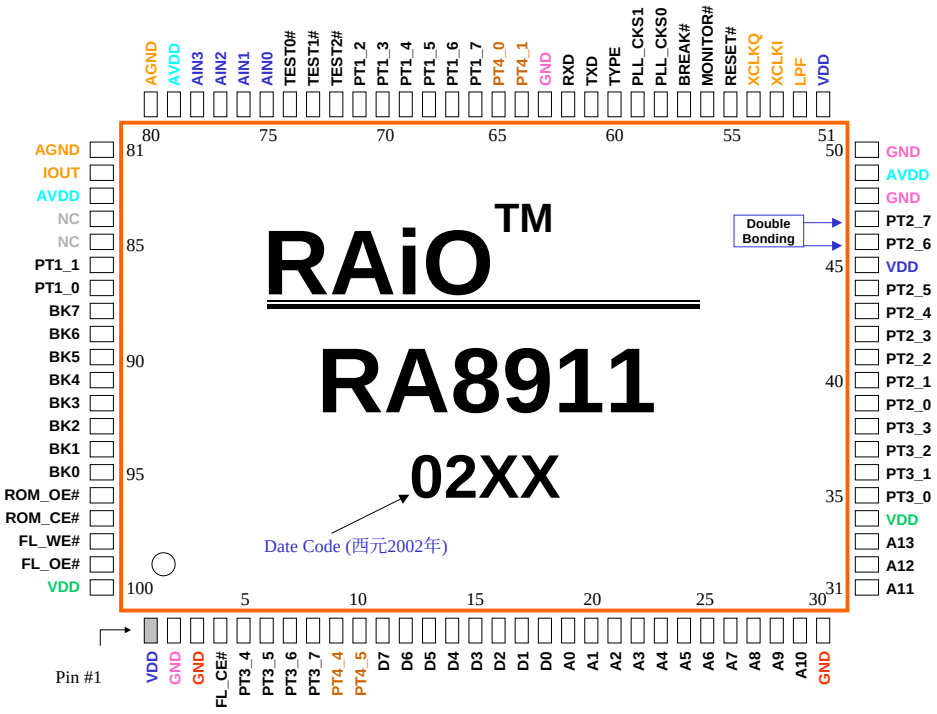
PAD X/Y Coordinate

Pad Order	Text Name	X-axis	Y-axis
83	A11	-1639.35	1050
84	A12	-1639.35	950
85	A13	-1639.35	850
86	VDD	-1639.35	750
87	PT3_0	-1639.35	650
88	PT3_1	-1639.35	550
89	PT3_2	-1639.35	450
90	PT3_3	-1639.35	350
91	PT2_0	-1639.35	250
92	PT2_1	-1639.35	150
93	PT2_2	-1639.35	50
94	PT2_3	-1639.35	-50
95	PT2_4	-1639.35	-150
96	PT2_5	-1639.35	-250
97	VDD	-1639.35	-350
98	PT2_6	-1639.35	-450
99	PT2_6B	-1639.35	-550
100	PT2_7	-1639.35	-650
101	PT2_7B	-1639.35	-750
102	GND	-1639.35	-850
103	VDD	-1639.35	-950
104	GND	-1639.35	-1055
1	VDD	-1550.0	-1166.35
2	LPF	-1449.88	-1166.35
3	XCLK	-1349.88	-1166.35
4	XCLKQ	-1249.88	-1166.35
5	RESET#	-1149.88	-1166.35
6	MONITOR#	-1049.88	-1166.35
7	BREAK#	-949.88	-1166.35
8	PLL_CKS0	-849.88	-1166.35
9	PLL_CKS1	-749.88	-1166.35
10	TYPE	-649.88	-1166.35
11	TXD	-549.88	-1166.35
12	RXD	-449.88	-1166.35
13	GND	-349.88	-1166.35
14	PT4_3	-249.88	-1166.35
15	PT4_2	-149.88	-1166.35
16	PT4_1	-49.88	-1166.35
17	PT4_0	50.12	-1166.35
18	PT1_7	150.12	-1166.35
19	PT1_6	250.12	-1166.35
20	PT1_5	350.12	-1166.35
21	PT1_4	450.12	-1166.35
22	PT1_3	550.12	-1166.35
23	PT1_2	650.12	-1166.35
24	TEST2#	750.12	-1166.35
25	TEST1#	850.12	-1166.35
26	TEST0#	950.12	-1166.35
27	AIN0	1050.62	-1166.35

Pad Order	Text Name	X-axis	Y-axis
28	AIN1	1157.62	-1166.35
29	AIN2	1263.61	-1166.35
30	AIN3	1370.61	-1166.35
31	AVDD	1476.11	-1166.35
32	AGND	1576.11	-1166.35
33	AGND	1639.35	-736.3
34	IOUT	1639.35	-635.8
35	AVDD	1639.35	-536.3
36	PT1_1	1639.35	-432
37	PT1_0	1639.35	-332
38	BK7	1639.35	-232
39	BK6	1639.35	-132
40	BK5	1639.35	-32
41	BK4	1639.35	68
42	BK3	1639.35	168
43	BK2	1639.35	268
44	BK1	1639.35	368
45	BK0	1639.35	468
46	ROM_OE#	1639.35	568
47	ROM_CE#	1639.35	668
48	FL_WE#	1639.35	768
49	FL_OE#	1639.35	868
50	VDD	1639.35	968
51	VDD	1639.35	1068
52	GND	1521.45	1166.35
53	GND	1416.45	1166.35
54	FL_CE#	1316.45	1166.35
55	PT3_4	1177	1166.35
56	PT3_5	1077	1166.35
57	PT3_6	977	1166.35
58	PT3_7	877	1166.35
59	PT4_4	777	1166.35
60	PT4_5	677	1166.35
61	PT4_6	577	1166.35
62	PT4_7	477	1166.35
63	D7	377	1166.35
64	D6	277	1166.35
65	D5	177	1166.35
66	D4	77	1166.35
67	D3	-23	1166.35
68	D2	-123	1166.35
69	D1	-223	1166.35
70	D0	-323	1166.35
71	A0	-423	1166.35
72	A1	-523	1166.35
73	A2	-623	1166.35
74	A3	-723	1166.35
75	A4	-823	1166.35
76	A5	-923	1166.35

77	A6	-1023	1166.35
78	A7	-1123	1166.35
79	A8	-1223	1166.35
80	A9	-1323	1166.35
81	A10	-1423	1166.35
82	GND	-1523	1166.35

Package (PQFP-100Pin)



Pin Description

Signal	I/O	Description
RESET#	IN	**External Hardware Reset, active low.** This pin is used to reset the system.
BREAK#	IN	**User Program Break, active low.** This signal is used to break the user's program from the ISD mode.
MONITOR#	IN	**Monitor Program Select, active low.** This signal is used to select the system boot from monitor program (ROM) or user program (Flash). This signal has to pull low when the user wants to download the data from PC or enter the ISP/ISD mode. Note: Couldn't be floating.
PT1_[7:0]	I/O	**Bit 7~0 of Port 1** These are programmable pins for general-purpose I/O Port 1. The driving current and pull-high or pull-low can be selected by user register.

PT2_7 PWM1	I/O	**Bit-7 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_7 is also as the output of PWM. In PWM mode, the pin is always output and 72mA-driving current is selected.
PT2_6 PWM2	I/O	**Bit-6 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_6 is also as the output of PWM. In PWM mode, the pin is always output and 72mA-driving current is selected.
PT2_5 EXP_WR#	I/O	**Bit-5 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_5 is also as the write control of register $101E. If the write register $101F enabled, the pin is always output except the power saving mode.
PT2_4 FL_CE2#	I/O	**Bit-4 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_4 is also as the secondary external flash chip select. If the secondary flash is enabled, the pin is always output except the power saving mode.
PT2_3 LVD_#	I/O	**Bit-3 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_3 is also as the output of LVD. If the LVD enabled, the pin is always output except the power saving mode.
PT2_2 MEM_WE#	I/O	**Bit-2 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_2 is also as the external memory write enable. If the external memory enabled, the pin is always output except the power saving mode. If REG[1032h] bit6 is set as 1, and then MEM_WE# and FL_WE# can be jointly used.
PT2_1 MEM_OE#	I/O	**Bit-1 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_1 is also as the external memory output enabling. If the external memory enabled, the pin is always output except the power saving mode. If REG[1032h] bit6 is set as 1, and then MEM_OE# and FL_OE# can be jointly used.
PT2_0 MEM_CE#	I/O	**Bit-0 of Port 2** This is a programmable pin for general-purpose I/O Port 2. The driving current and pull-high or pull-low can be selected by user register. The PT2_0 is also as the external memory chip selecting. If the external memory enabled, the pin is always output except the power saving mode.
PT3_7	I/O	**Bit-7 of Port 3** This is a programmable pin for general-purpose I/O Port 3. The driving current and pull-high or pull-low can be selected by user register.

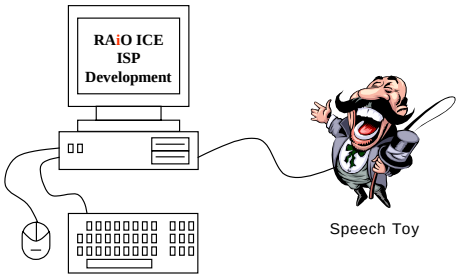
PT3_6	I/O	**Bit-6 of Port 3** This is a programmable pin for general-purpose I/O Port 3. The driving current and pull-high or pull-low can be selected by user register.
PT3_5	I/O	**Bit-5 of Port 3** This is a programmable pin for general-purpose I/O Port 3. The driving current and pull-high or pull-low can be selected by user register.
PT3_4	I/O	**Bit-4 of Port 3** This is a programmable pin for general-purpose I/O Port 3. The driving current and pull-high or pull-low can be selected by user register.
PT3_3 TX	I/O	**Bit-3 of Port 3** The PT3_3 is also as the transmission output of user's UART. In UART mode, the pin is always output except the power saving mode.
PT3_2 RX	I/O	**Bit-2 of Port 3** The PT3_2 is also as the receive input of user's UART. In UART mode, the pin is always input.
PT3_1 LCD_E	I/O	**Bit-1 of Port 3** The PT3_1 is also as the chip enable of external LCD controller. If the external LCD enabled, the pin is always output except the power saving mode.
PT3_0 LCD_RW	I/O	**Bit-0 of Port 3** The PT3_0 is also as the read/write signal of external LCD controller. If the external LCD enabled, the pin is always output except the power saving mode.
PT4_[7:0]	I/O	**Bit 7~0 of Port 4** This is a programmable pin for general-purpose I/O Port 4. The driving current and pull-high or pull-low can be selected by user register.
IOUT	OUT	**DAC Current Output** This pin is the current output of DAC.
AIN[3~0]	IN	**ADC Analog Input** These pins are the analog input of 10-bit ADC for 4-channel. ADC Mode Touch Panel Mode ---------- AIN0 X1 AIN1 X2 AIN2 Y1 AIN3 Y2
ADDR[13:0]	OUT	**14-bit Address Bus.** These signal are used for external memory address bus.
D[7:0]	I/O	**8-bit Data Bus.** These signal are used for external memory data bus.
FL_CE#	OUT	**Flash Chip Select, active low.** This signal is used for external flash.
FL_WE#	OUT	**Flash Write Enable, active low.** This signal is used for external flash. If REG[1032h] bit6 is set as 1, and then FL_WE# and MEM_WE can be jointly used.
FL_OE#	OUT	**Flash Output Enable, active low.** This signal is used for external flash. If REG[1032h] bit6 is set as 1, and then FL_OE# and MEM_OE# can be jointly used.

BK[7:0]	OUT	**Bank Bus.** Register FBANK[1030h] and Ext_SBANK [103Fh] jointly use Bank[7:0] Bus as the output of memory bank register. Normally, they are connected to the higher address of external Flash memory.
RXD	IN	**Receive Data** This is the received data input of system UART. Normally it's connected to the RS232's TX of PC.
TXD	OUT	**Transmit Data** This signal is the transmitted data output of system UART. Normally it's connected to the RS232's RX of PC.
XCLKI	IN	**Oscillator Input.** This is the input signal of external X'tal.
XCLKQ	OUT	**Oscillator Output.** This is the output signal of external X'tal.
LPF	IN	**Low Pass Filter Input.** This signal is connected to the external low pass filter for internal PLL.
PLL[1:0]	IN	PLL Frequency Select These input signals are used to select the PLL speed during the hardware reset. PLL1 PLL0 PLL Clock UART Clock --- 0 0 1.47MHz 368.64KHz 0 1 2.46 MHz 614.4KHz 1 0 7.37 MHz 1.8432MHz 1 1 22.1 MHz 1.8432MHz Note: Couldn't be floating.
TYPE	IN	**PLL Clock Select** This Pin is used to select the clock source of PLL. 0: RC Oscillator 1: 32768 X'tal Note: Couldn't be floating.
TEST0# TEST1# TEST2#	IN	Test Pins are for RAiO's internal testing purpose used in testing IC and ROM status. Normally, users will not use these pins. Therefore, please connect these three pins to VDD when making PCB board.
VDD	PWR	**Power Supply Voltage.**
AVDD	PWR	**Analog Power Supply Voltage.**
GND	PWR	**Ground.**
AGND	PWR	**Analog Ground.**

Development

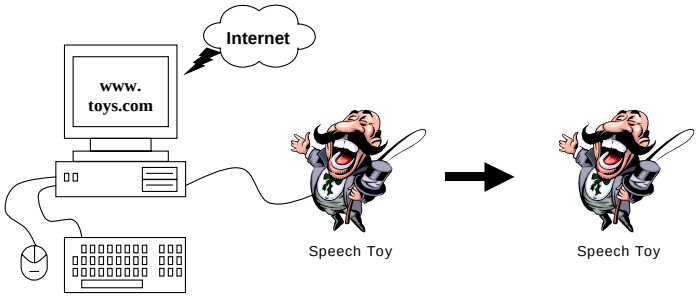
The RA8911 support the ISP (In-System Programming) and ISD (In-System Debugging) functions for customer to develop their system. Users can download their programs as well as data from a PC host to the external Flash ROM.

-ISP/ISD Mode is entered when the MONITOR# pin having been pulled down to ground voltage level. The on-chip Monitor program together with RAiO's ICE (RICE-2000) Utility Program running on a PC will be executed to support ICE debugging and ISP download of user programs from the PC Host.



Develop Program from ISP Mode
(Customers)

-***User Mode*** is entered when the MONITOR# pin has been pulled up to logic high voltage level. User application programs can be executed only in this mode. The end-user can download the application program or data from the customer's website through the PC interface. Because the program/data was stored in the flash so the application device of customer (such as speech toy) will operate independent that after disconnect with the PC.



Down load from Internet
(End-Users)

A Portable Speech Toy

RICE-2000 (RICE for short) is a full-completed environment developed by RAiO especially for RA89XX series. The major reason for developing RICE is give fully convenience to program designers who are using RA89XX IC, and let them enjoy consistent and friendly design environment at planning, designing and debugging. In RICE environment, it saves a great deal of developing time by not only providing Editor for users to do direct coding, but also providing many Hot-Key functions for users to do direct compiling, linking, and downloading. Since RA89XX series carry 8-bit micro-processor and a framework of ISP (In-System-Programming), ISD (In-System Debugging), then this simple and reliable environment of RICE can let program designers to proceed design and debug in Real Chip. Moreover, the mass-production ICs are ready for clients to do planning and designing directly without diverse traits happened between developing time and mass production period.

In the meanwhile, in order to support integrated speech interface, RICE provides a solution of 32K-bps ADPCM for programmers to easily combine programs and speech files. If you want to have more information and program design skills of RA8911, please refer to the user manual of RICE-2000.

Application

The following block diagram is the basic application circuit of RA8911. We also give three examples on the user manual of RICE-2000 to let users have more understanding of RA8911 and the develop environment of RICE-2000, and then start to proceed program designing and product developing. The examples have one simple I/O control and two speech samples. Please refer to the user manual of RICE-2000 if you needed.

Application Field	
Simple I/O Controller	General Propose Controller
Speech Controller	Internet Download (Speech/Voice Toy, Sound Book, Voice-Prompted Controller...)
Low-Grade Product	LCD Game, Calculator, Calendar, ... Internet Download (educational toy or household appliance…)
High-Grade Product	SMS Controller, Low-end PDA Controller and Internet Download Device Function