DATA SHEET

GPC11001A

Sound Controller

JUL. 26, 2007

Version 1.2

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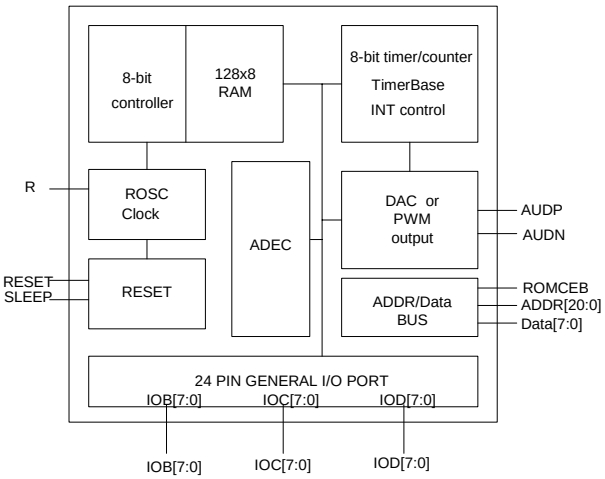
SOUND CONTROLLER

1. GENERAL DESCRIPTION

The GPC11001A, a speech/wavetable synthesizer, is equipped with an 8-bit CMOS microprocessor and a 128-byte working SRAM. Other primary features include two 8-bit Timer/Counters, 24 Software Selectable I/Os, one 8-bit DAC and a pair of PWM outputs. It operates in a wide voltage range of 2.4V - 5.5V. In addition, it has a built-in Clock Stop mode for power savings. The unique power saving mode saves the RAM contents, but freezes the oscillator to stop executing other functions. The maximum CPU frequency can run up to 10MHz and the instruction cycle is two clock cycles (min.) ~ six clock cycles (max.). The GPC11001A is loaded with, not only the latest technology, but also the full commitment and technical support of GENERALPLUS.

2. BLOCK DIAGRAM



3. FEATURES

- 8-bit microprocessor
- ROMless
- **128-byte working SRAM**
- Software-based audio processing
- Wide operating voltage: 2.4V - 5.5V @ 6MHz
  3.6V - 5.5V @ 10MHz
- **Supports ROSC only**
- Max. CPU clock: 6MHz @ 3.0V, 10MHz @ 5.0V
- Standby mode (Clock Stop mode) for power savings.
  Max. 2.0μA @ 5.0V
- 500ns instruction cycle time @ 4.0MHz CPU clock
- **24 general I/Os**
- Two 8-bit timer/counters
- Six INT sources
- Key wake -up function
- IR function
- External feedback input
- Watch dog function
- **One DAC and A pair of PWM output**

4. APPLICATION FIELD

- Intelligent education toys
  Ex. Pattern to voice (animal, car, color, etc.)
  Spelling (English or Chinese)
  Math
- Advanced toy controller
- General speech synthesizer
- Industrial controller

5. SIGNAL DESCRIPTIONS*

Mnemonic	PIN No.	Type	Description
VDD	9, 27, 57	I	Digital Power PAD
VSS	18, 23, 39, 56	I	Digital Ground
PVDD	22	I	PWM Power PAD
PVSS	20	I	PWM Ground
ROSC	26	I	ROSC Resistor input (Resistor must be connected to VDD)
RESETB	25	I	RESET pin, Active low to reset whole system.
TEST	24	I	TEST MODE
AUDP	21	O	Audio OUTPUT1
AUDN	19	O	Audio OUTPUT2
ADDR[14:0]	[41:55]	O	Address Bus
ADDR[20:15]	[71:66]	O	Higher Address Bus
Data[7:0]	[58:65]	I/O	Data Bus
ROMCEB	38	O	External ROM enable (Low Active)
OP	28	I	Watch dog Enable/Disable option
PWMON	29	I	PWM/DAC option
CPUEN	30	I	Internal CPU enable
CKIN	31	I	System clock input
CKOUT	32	O	System clock output
SLEEP	33	O	Sleep signal
RESET	34	O	Reset pin
NMI	35	O	NMI to CPU
IRQ	36	O	IRQ to CPU
RWB	37	O	Read/Write signal
IOB0	72	I/O	Port B is an 8-bit bi-directional programmable Input / Output port with Pull-low. In the input mode, Port B can be in either the Pure or Pull-low states. In the output mode, Port B can be a Buffer.
IOB1	73	I/O	
IOB2	74	I/O	
IOB3	75	I/O	
IOB4	76	I/O	
IOB5	77	I/O	
IOB6	78	I/O	
IOB7	79	I/O	
IOC0	10	I/O	Port C is an 8-bit bi-directional programmable Input / Output port with Pull-low. In the input mode, Port C can be in either the Pure or Pull-low states. In the output mode, Port C can be a Buffer.
IOC1	11	I/O	
IOC2	12	I/O	
IOC3	13	I/O	
IOC4	14	I/O	
IOC5	15	I/O	
IOC6	16	I/O	
IOC7	17	I/O	
IOD0	1	I/O	Port D is an 8-bit bi-directional programmable Input / Output port with Pull-low. In the input mode, Port D can be in either the Pure or Pull-low states. In the output mode, Port D can be a Buffer. (Key change, Wake up I/O)
IOD1	2	I/O	
IOD2	3	I/O	
IOD3	4	I/O	
IOD4	5	I/O	
IOD5	6	I/O	

Mnemonic	PIN No.	Type	Description
IOD6	7	I/O	
IOD7	8	I/O	

6. FUNCTIONAL DESCRIPTIONS

6.1. CPU

The microprocessor in the GPC11001A is a high performance 8-bit processor equipped with Accumulator, Program Counter, X and Y Register, Stack pointer and Processor Status Register (identical to the 6502 instruction structure). The maximum CPU speed of 10.0MHz is capable of bringing you cleaner speech, pleasant music as well as achieving the best overall performance.

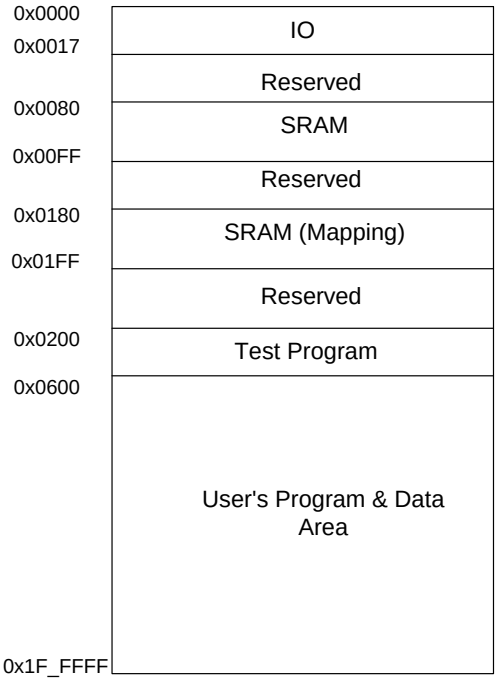
6.2. RAM Area

The total RAM size is 128-bytes (including Stack) starting from address $0080 through $00FF or mapping to $0180 through $01FF.

6.3. Power Saving Mode

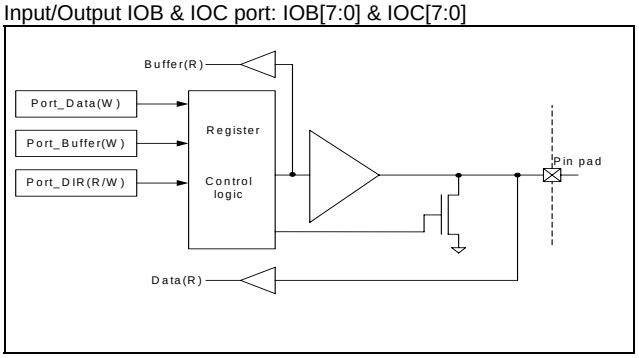
The GPC11001A includes a power saving mode (Standby mode) for those applications that require very low standby current. To enter the standby mode, the Wake-Up Register must be enabled and then the CPU clock stopped by writing to the STOP CLOCK Register. In such a mode, RAM and I/Os will remain in their previous states until being awakened. Port IOD7-0 is the only wake-up source in the GPC11001A. After the GPC11001A is awakened, the internal CPU will go to the RESET state (Tw ≧ 64 x T1) and continue to execute the program. Wakeup Reset will not affect RAM or I/Os.

6.4. Map of Memory and I/Os

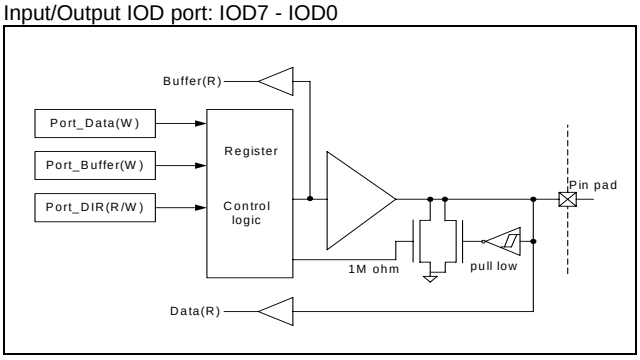


6.5. I/O Port Configuration*

Input/Output IOB & IOC port: IOB[7:0] & IOC[7:0]



Input/Output IOD port: IOD7 - IOD0



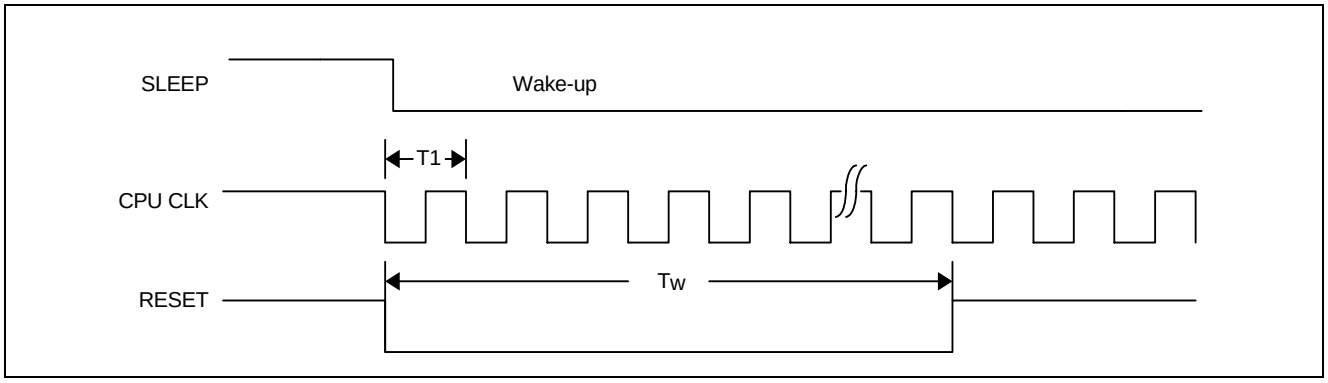


FIG. 1

T1 = 1 / (F_{CPU}), Tw ≧64 x T1

6.6. Timer/Counter

The GPC11001A has two 8-bit timer/counters, TMA and TMB respectively. TMA can be specified as a timer, but TMB can be used as a timer or a counter. In the timer mode, TMA and TMB are re-loaded up-counters. When timer rolls over from $0FFF to $0000, the carry (overflow) signal will cause the user preset value to be loaded into the timer automatically and up-counted again. At the same time, the carry signal will generate an INT signal if the corresponding bit is enabled in the INT ENABLE Register. If TMB is specified as a counter, the user can then reset it by loading #0 into the counter. After the counter has been activated, the value in the counter can also be read at the same time. The read instruction will neither affect the value of the counter nor reset it.

Clock source of Timer/Counter can be selected as follows:

Timer/Counter		Clock Source
TMA	8-BIT TIMER	CPU CLOCK (T) or T/8, T/64, TMB Overflow
TMB	8-BIT TIMER	T, T/65536, EXTCLK, 0, 1

6.7. Speech and Melody

For speech synthesis, the GPC11001A can use NMI for an accurate sampling frequency. The user can store the speech data in ROM and play it back with realistic sound quality. Several algorithms are recommended for high fidelity and compression of sound and they include PCM, LOG PCM, and ADPCM and SACMA3400.

7. ELECTRICAL SPECIFICATIONS

7.1. Absolute Maximum Ratings

Characteristics	Symbol	Ratings
DC Supply Voltage	V_+	< 7.0V
Input Voltage Range	V_{IN}	-0.5V to V_+ + 0.5V
Operating Temperature	T_A	0℃ to +60℃
Storage Temperature	T_{STO}	-50℃ to +150℃

Note: Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

7.2. AC Characteristics (T_A = 25℃)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
OSC Frequency	F_{OSC2}	-	4.0	6.0	MHz	VDD = 2.4V - 3.6V, for 2-battery
		-	6.0	10.0	MHz	VDD = 3.6V - 5.5V, for 3-battery

7.3. DC Characteristics (VDD = 5.0V, T_A = 25℃)

Characteristics	Symbol	Limit			Unit	Test condition
		Min.	Typ.	Max.		
Operating Voltage	VDD	3.6	-	5.5	V	-
Operating Current	I_{OP}	-	5.0	-	mA	F_{CPU} = 6.0MHz @ 5.0V, without external memory
		-	21	-	mA	F_{CPU} = 6.0MHz @ 5.0V, with SST flash memory
Standby Current	I_{STBY}	-	-	2.0	μA	VDD = 5.0V
Audio Output Current	I_{AUD}	-	4.5	-	mA	VDD = 5.0V
Input High Level	V_{IH}	3.0	-	-	V	VDD = 5.0V
Input Low Level	V_{IL}	-	-	0.8	V	VDD = 5.0V
Output Source Current (IOC, IOD)	I_{OH}	-4.0	-	-	mA	VDD = 5.0V, V_{OH} = 3.33V
Output Sink Current (IOC, IOD)	I_{OL}	8.0	-	-	mA	VDD = 5.0V, V_{OL} = 0.8V
PWM Output Current	I_{OH}	-	-150	-	mA	VDD = 5.0V, V_{OH} = 4.0V
	I_{OL}	-	200	-	mA	VDD = 5.0V, V_{OL} = 1.0V
Input Resistor (IOC)	R_{IN}	-	85	-	KΩ	VDD = 5.0V, V_{IN} = VDD
Input Resistor (IOD)	R_{IN}	-	85	-	KΩ	VDD = 5.0V, V_{IN} = 0V
Input Resistor (IOD)	R_{IN}	-	770	-	KΩ	VDD = 5.0V, V_{IN} = VDD

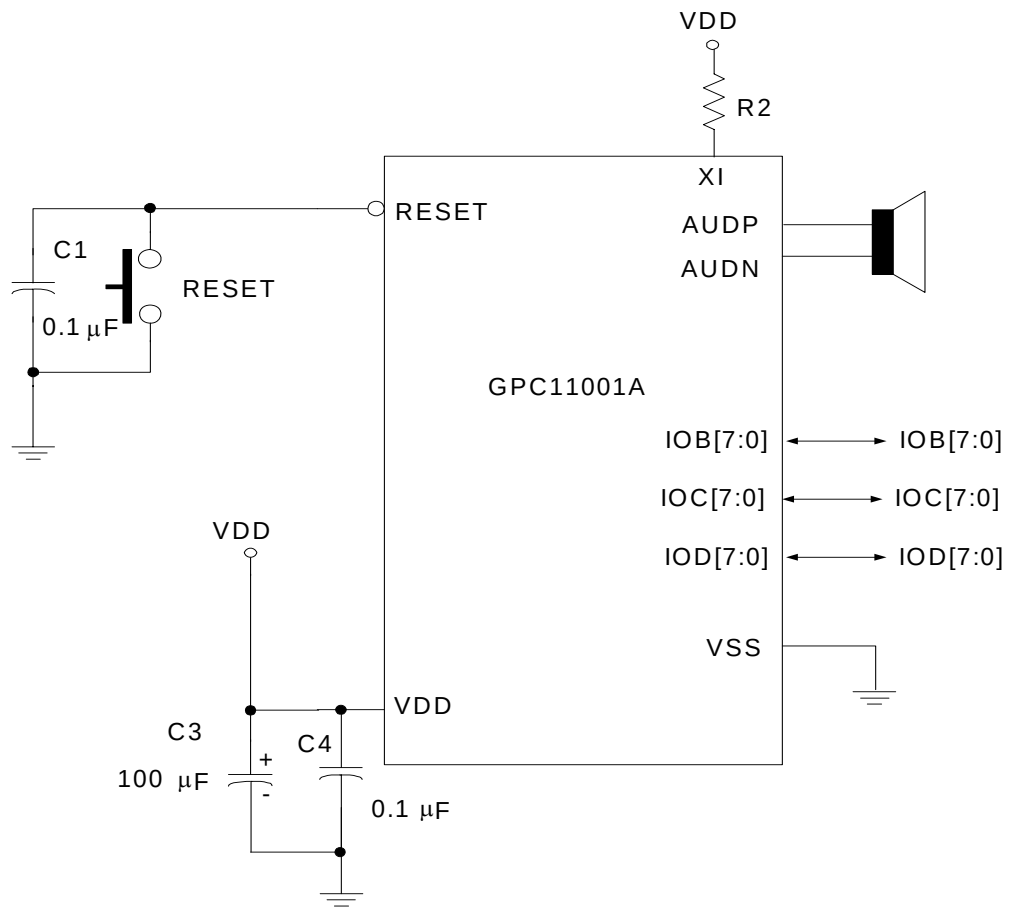
7.4. DC Characteristics (VDD = 3.0V, T_A = 25°C)

Characteristics	Symbol	Limit			Unit	Test condition
		Min.	Typ.	Max.		
Operating Voltage	VDD	2.4	-	3.6	V	-
Operating Current	I_{OP}	-	2.0	-	mA	F_{CPU} = 3.0MHz @ 3.0V, without external memory
		-	8.0	-	mA	F_{CPU} = 3.0MHz @ 3.0V, with SST flash memory
Standby Current	I_{STBY}	-	-	2.0	μA	VDD = 3.0V

Characteristics	Symbol	Limit			Unit	Test condition
		Min.	Typ.	Max.		
Audio Output Current	I_{AUD}	-	1.8	-	mA	VDD = 3.0V
Input High Level	V_{IH}	2.0	-	-	V	VDD = 3.0V
Output Source Current (IOC, IOD)	I_{OH}	-2.0	-	-	mA	VDD = 3.0V, V_{OH} = 2.0V
Output Sink Current (IOC, IOD)	I_{OL}	4.0	-	-	mA	VDD = 3.0V, V_{OL} = 0.8V
PWM Output Current	I_{OH}	-	-120	-	mA	VDD = 3.0V, V_{OH} = 2.0V
	I_{OL}	-	200	-	mA	VDD = 3.0V, V_{OL} = 1.0V
Input Resistor (IOC)	R_{IN}	-	170	-	KΩ	VDD = 3.0V, V_{IN} = VDD
Input Resistor (IOD)	R_{IN}	-	170	-	KΩ	VDD = 3.0V, V_{IN} = 0V
Input Resistor (IOD)	R_{IN}	-	1000	-	KΩ	VDD = 3.0V, V_{IN} = VDD

8. APPLICATION CIRCUITS

8.1. Application Circuit - (1)

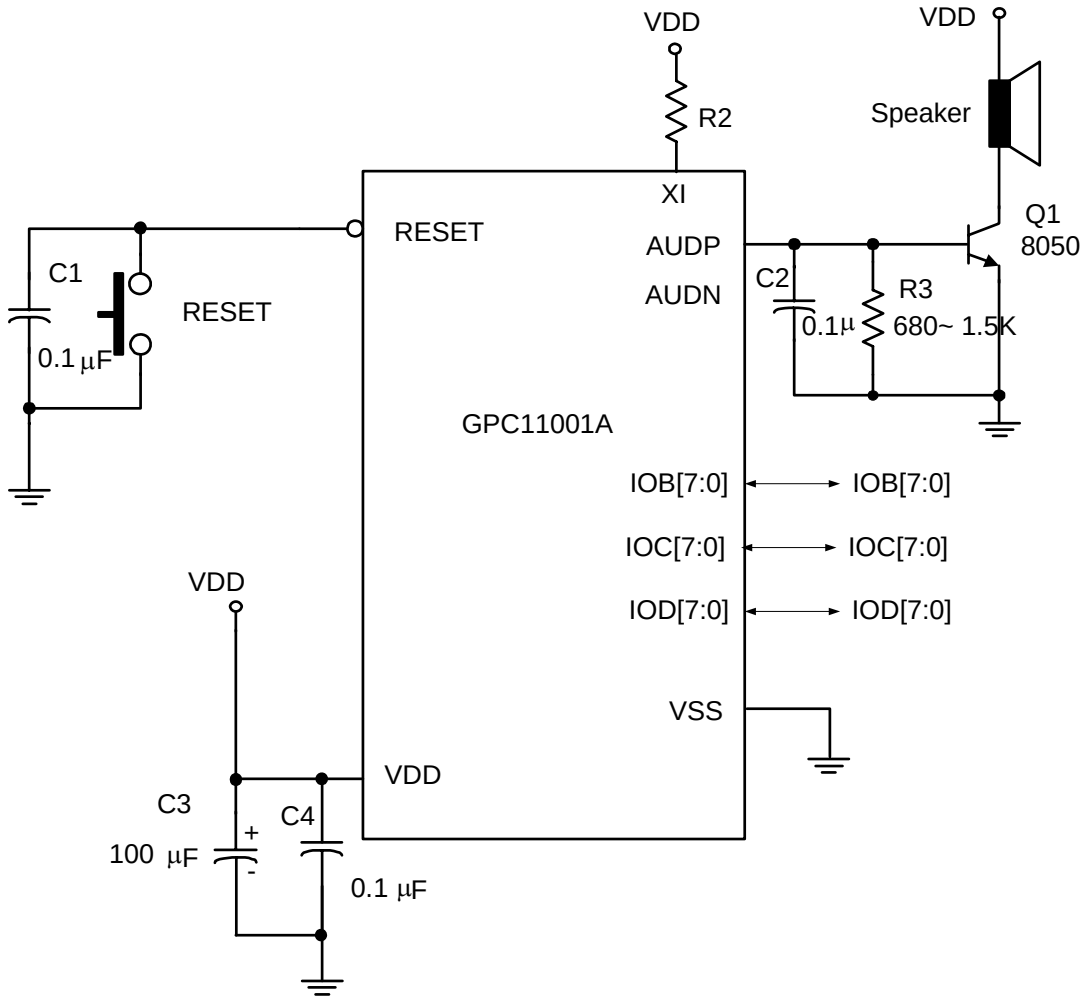


GPC11001A Application circuit

F_{CPU} vs. R2 value

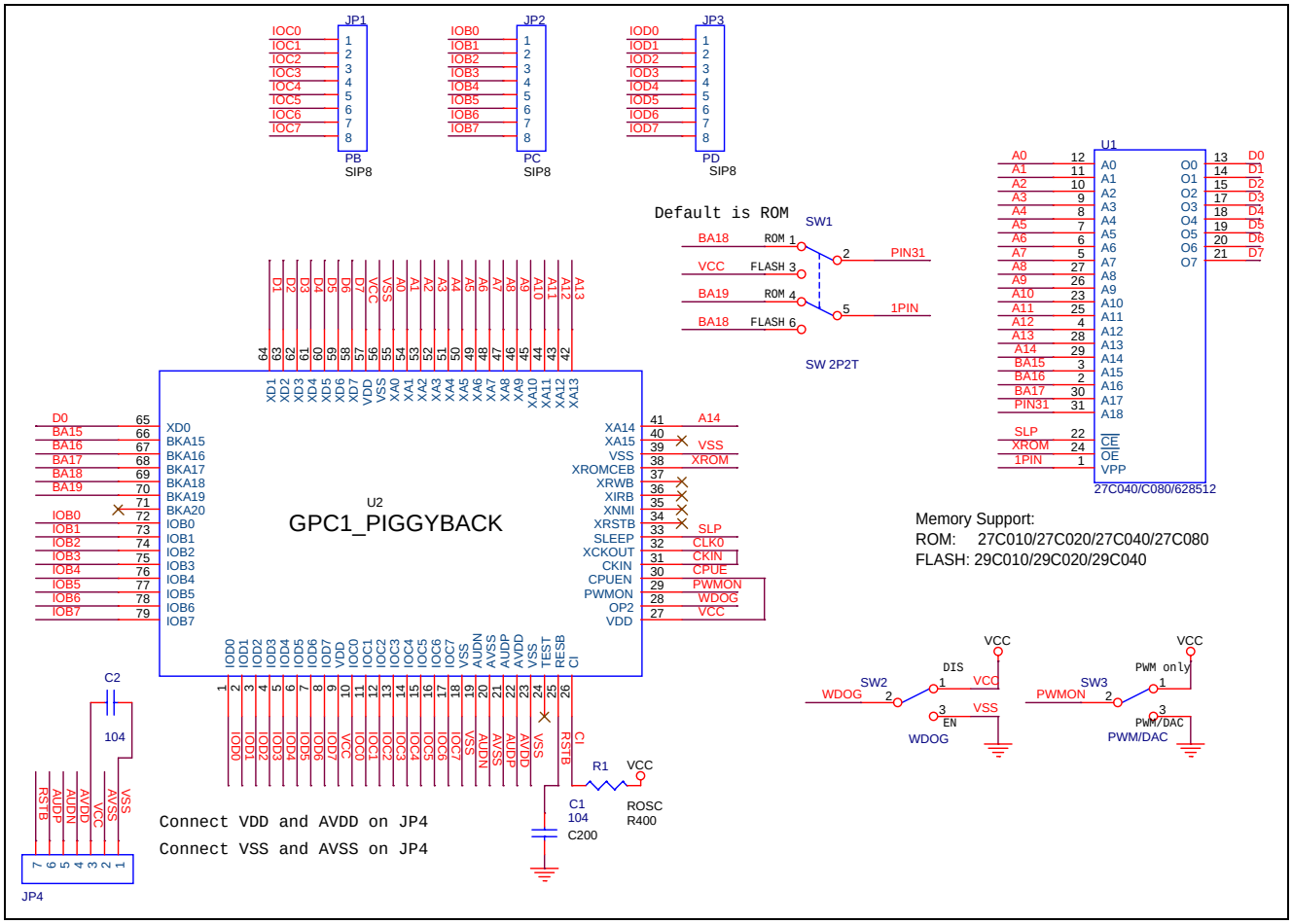
Fcpu	8MHz	7MHz	6MHz	5MHz	4MHz
GPC11001A	38K	44K	52K	63K	82K

8.2. Application Circuit - (2)



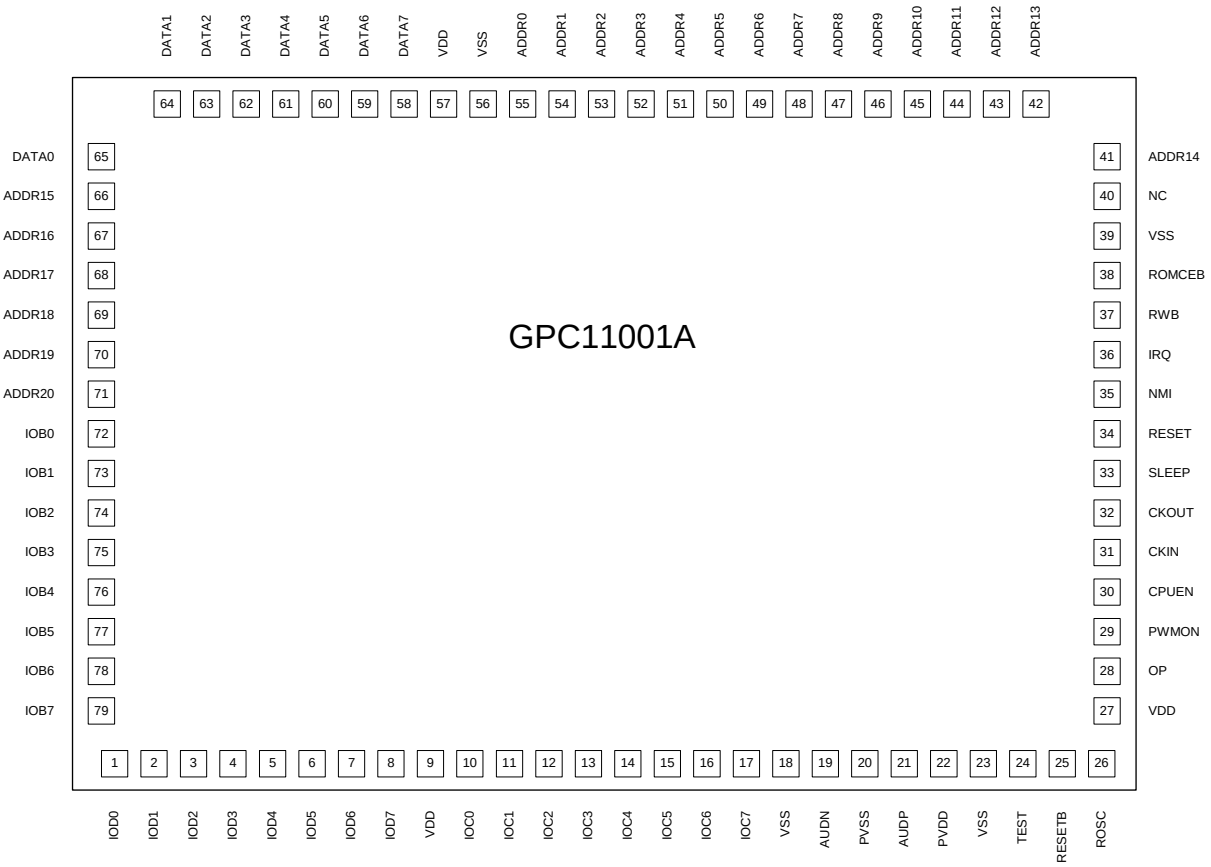
GPC11001A Application circuit(DAC Output)

8.3. GPC1 PIGGYBACK



9. PACKAGE/PAD LOCATIONS

9.1. PAD Assignment



The IC substrate should be connected to VSS

Note1: To ensure that the IC functions properly, please bond all of VDD and VSS pins.

Note2: The 0.1μF capacitor between VDD and VSS should be placed to IC as close as possible.

9.2. Ordering Information

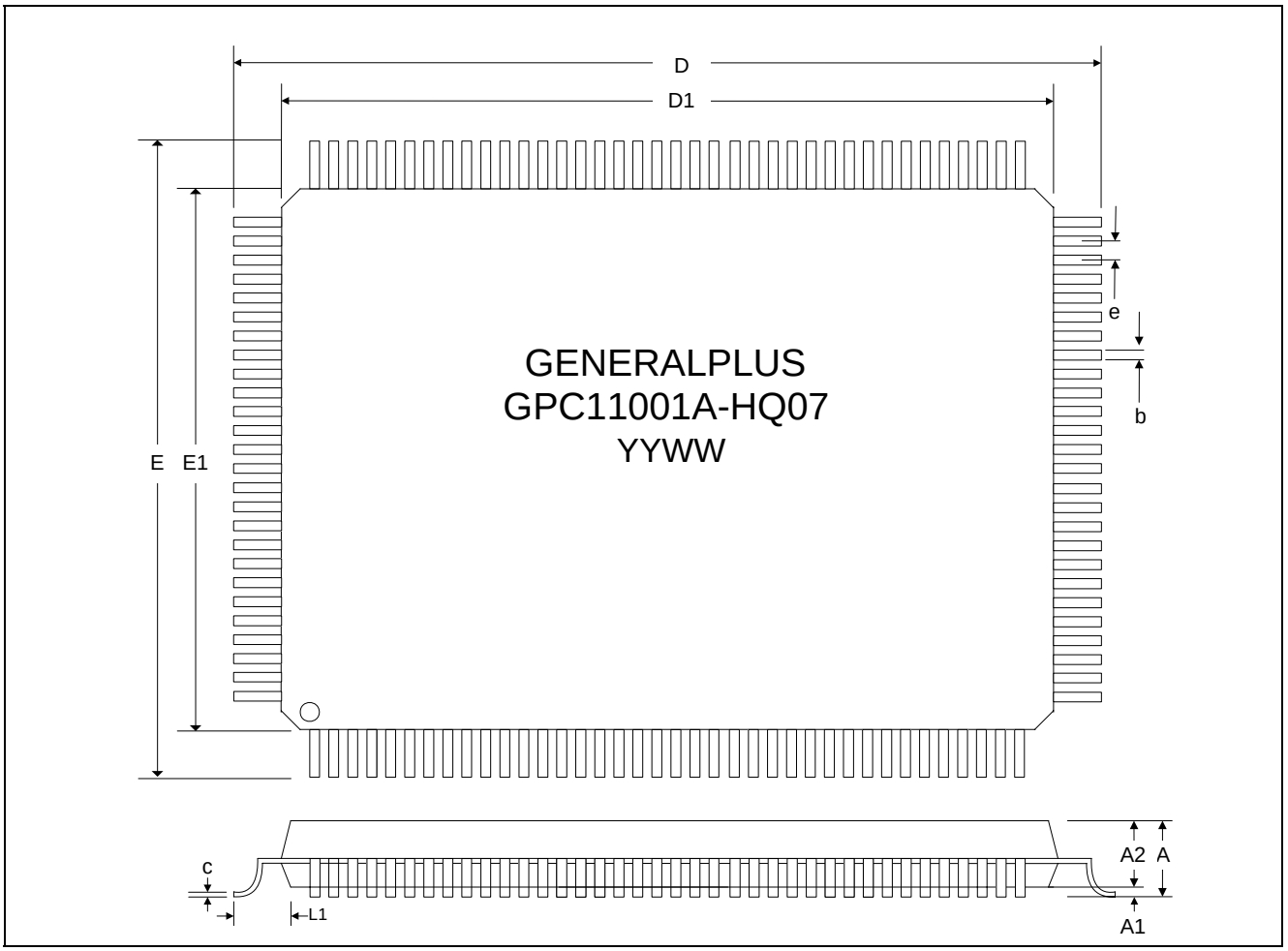
Product Number	Package Type
GPC11001A - NnnV - C	Chip form
GPC11001A - NnnV - HQ07x	Green Package - QFP 128L

Note1: Code number is assigned for customer.

Note2: Code number (N = A - Z or 0 - 9, nn = 00 - 99); version (V = A - Z).

Note3: Package form number (x = 1 - 9, serial number).

9.3. Package Information



Symbol	Min.	Nom.	Max.	Unit
A	-	-	3.40	Millimeter
A1	0.25	-	-	Millimeter
A2	2.73	2.85	2.97	Millimeter
b	0.17	0.22	0.27	Millimeter
c	0.09	-	0.20	Millimeter
D	23.00	23.20	23.40	Millimeter
D1	19.90	20.00	20.10	Millimeter
E	17.00	17.20	17.40	Millimeter
E1	13.90	14.00	14.10	Millimeter
e	0.5 BSC.			Millimeter
L1	1.60 BSC.			Millimeter

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11. REVISION HISTORY

Date	Revision #	Description	Page
JUL. 26, 2007	1.2	1. Modify the “DC Characteristics (VDD = 5.0V, T_A = 25℃)” in section 7.3. 2. Modify the “DC Characteristics (VDD = 3.0V, T_A = 25°C)” in section 7.4.	8 8
FEB. 15, 2006	1.1	1. Add the DC Characteristics (VDD = 5.0V, T_A = 25°C) to section 7.3. 2. Modify the DC Characteristics (VDD = 3.0V, T_A = 25°C) in section 7.4.	8 8
OCT. 11, 2005	1.0	Original Note: The GPC11001A data sheet v1.0 is a continued version of SPC11001A data sheet v0.1	16