

DATA SHEET

GPT8340A

46 TOUCH IO with SPU

Jul 05, 2016

Version 1.3

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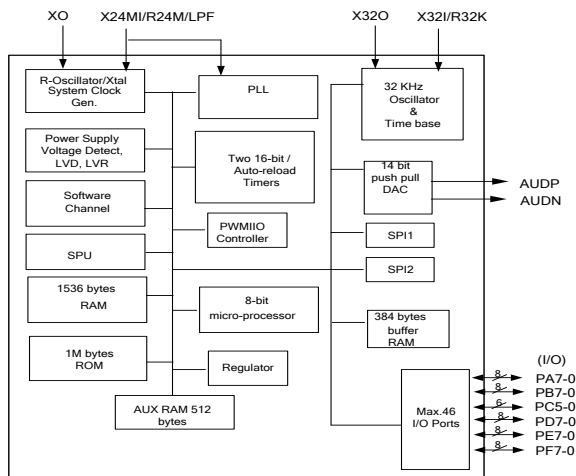
46 TOUCH IO WITH SPU

1. GENERAL DESCRIPTION

The GPT8340A, an 8-bit microprocessor developed by Generalplus, features 1M bytes Mask ROM, 1.5K bytes working RAM, 512 bytes AUX RAM, 22 I/Os, two 16-bit timers, two SPI interfaces, a 14-bit DAC with push-pull amplifier for driving speaker directly. The GPT8340A is designed to operate over a wide voltage, ranging from 2.3V through 5.5V. The Low Voltage Reset function keeps system operating properly when power drops below certain level. The GPT8340A is incorporated a high performance SPU voice engine to implement 8-channel ADPCM/PCM high quality voice and one 14-bit DAC with push-pull amplifier to drive speaker directly. Its large memory area allows user to store both program and audio data in one place. A Serial Peripheral Interface (SPI) controller is also built in GPT8340A to facilitate communication between devices. For more information about GPT8340A's features, please refer to the following section.

2. BLOCK DIAGRAM

2.1. GPT8340A



3. FEATURES

- 8-bit micro-processor
- 1M bytes Mask ROM
- 1.5K bytes SRAM
- 512 bytes AUX RAM
- Operating voltage: 2.3V – 5.5V
- Max. CPU operating speed:
 - 12.0MHz @ 2.7V – 5.5V
 - 8.0MHz @ 2.3V – 3.6V
- Programmable CPU clock: /2, /4, /8, /16, /32, /64 and /128 clock frequency
- Six wake-up sources
- 23 IRQs & 4 NMI Interrupts
- Internal built-in regulator to supply core power (3.3V, for 3-battery application). Also, internal built-in regulator can be turned off and external power is used to supply core power (for 2-battery application).
- SPU(Sound Processing Unit) engine with 8 voice channels
 - Supports 4/5-bit ADPCM and 8/16-bit PCM data format
 - Transform 4/5-bit ADPCM data to 14-bit data to play high quality sound
 - Supports special tag such as Silence Tag, Event tag
- One software channel with noise filter to play high quality sound.
- Low Voltage Detector
 - 8-level (2.3V/ 2.4V/2 .6V/ 2.9V/ 3.0V/ 3.3V/ 3.6V/ 4.0V) voltage detector
- Low Voltage Reset
- Peripherals
 - Dedicated I/Os: PA[7:0], PB[7:0], PC[5:0], PD[7:0], PE[7:0], PF[7:0]
 - Eight I/Os with high sink current for LED application
 - Key wakeup/interrupt function
 - Built-in 32.768KHz oscillator circuit for real time clock function (X'tal or R-osc)
 - Built-in R-oscillator (external resistor is needed) I or PLL for system operating clock
 - Internal time base generator
 - Two 16-bit reloadable timer/counters
 - Watchdog timer
 - 14-bit DAC with push-pull amplifier for driving speaker directly
 - IR output
 - Hardware PWMIO
 - Two SPI serial interface I/Os
- Powerful 8-ch Sound Processing Unit (SPU)
 - Variable tone-color sampling rate: max = 96KHz @ SPU_clock = 24MHz
 - 8-voice polyphony
 - Supports PCM/ADPCM tone-color table

4. APPICATION FIELD

- Handheld game
- Educational toys (Electronic Learning Aids)

5. SIGNAL DESCRIPTIONS

5.1. Main Function PIN

Mnemonic	PIN No.	Type	Description
PD7-0	60-53	I/O	bi-directional I/O port
PE7-0	45-52	I/O	bi-directional I/O port
PF7-0	37-44	I/O	bi-directional I/O port
PA0/IRO/EXT1	95	I/O	PA0 is a bi-directional I/O port, which can be software programmed as wakeup I/O and is shared with IRO (IR output) and external interrupt 1.
PA1/EXT2	94	I/O	PA1 is a bi-directional I/O port, which can be software programmed as wakeup I/O and is shared with external interrupt 2.
PA3 - 2	92,93	I/O	PA3-2 is a bi-directional I/O port, which can be software programmed as wakeup I/O.
PA4/ PWMIO0	91	I/O	PA4 is a bi-directional I/O port, which can be software programmed as wakeup I/O and is shared with PWMIO0.
PA5/ PWMIO1	90	I/O	PA5 is a bi-directional I/O port, which can be software programmed as wakeup I/O and is shared with PWMIO1.
PA6/ PWMIO2	89	I/O	PA6 is a bi-directional I/O port, which can be software programmed as wake up I/O and is shared with PWMIO2.
PA7/PWMIO3	88	I/O	PA7 is a bi-directional I/O port, which can be software programmed as wakeup I/O and is shared with PWMIO3.
PB0/SPI2_CSN/IISCKO	86	I/O	PB0 is shared with SPI2_CSN and IISCKO
PB1/ SPI2_SCK/IISDAO	85	I/O	PB1 is shared with SPI2_SCK and IISDAO
PB2/ SPI2_SDO/IISWSO	84	I/O	PB2 is shared with SPI2_SDO and IISWSO
PB3/ SPI2_SDI	83	I/O	PB3 is shared with SPI2_SDI.
PB4/SPI1_CSN/ PWMIO0	81	I/O	PB4 is shared with SPI1_CSN and shared with PWMIO0 and is a high drive IO.
PB5/SPI1_SCK/ PWMIO1/IISCKI	80	I/O	PB5 is shared with SPI1_SCK and IISCKI and shared with PWMIO1 and is a high drive IO.
PB6/SPI1_SDO/ PWMIO2/IISDAI	79	I/O	PB[6:5] is shared with SPI1_SDO and IISDAI and shared with PWMIO2 and is a high drive IO.
PB7/ SPI1_SDI/ PWMIO3/IISWSI	78	I/O	PB7 is shared with SPI1_SDI and IISWSI and shared with PWMIO3 and is a high drive IO.
PC5 -0	96-101	I/O	PC[5:0] is a bi-directional I/O port
R24M/LPF	104	I	ROSC input connected to VDD33V_REGOUT through a resistor, or RC low pass filter connection for PLL(Mask option).
RESETB	110	I	System reset input, low active, internal pull high.
AUDP, AUDN	115,113	O	Audio output of push pull DAC
ACIN	119	I	Audio mixer pad to mix external audio data
X32I/R32K	105	I	32.768KHz crystal input or connects to VDD33V_REGOUT through a resistor (option).
X32O	106	O	32.768KHz crystal output
TEST	111	I	Test input, internal pull low
VDD_REGIN	109	P	Power for Regulator
VSS_REG	108	P	Ground for Regulator
VDD33V_REGOUT	107	P	3.3V power output from regulator (regulator can be off when external 3V is supplied).

Mnemonic	PIN No.	Type	Description
VDD5V	120	P	Power for analog block
VSS	121	P	Ground for analog block
VDD_IO	87	P	Power for PA, PC, PD, PE, PF
VSS_IO	82	P	Ground for PA, PB, PC, PD, PE, PF
VDD_PB	77	P	Power for PB
VDD_DAC	114	P	Power for push pull DAC driver
VSS_DAC	116	P	Ground for push pull DAC driver
AVDD_DAC	118	P	Analog ground for push pull DAC
AVSS_DAC	117	P	Analog power for push pull DAC
NC	1-3,4-30,32-36, 61-76122-130,132- 147,149-153,		Unused pin for user

6. FUNCTIONAL DESCRIPTIONS

6.1. Memories

GPT8340A's memory contains 2048 bytes SRAM, 512 bytes AUX RAM and 1M bytes ROM.

6.2. Operating States

There are three operation modes involved in GPT8340A: standby, halt and operating. The following table shows the differences among these modes.

	Operating	Halt	Standby
CPU	ON	OFF	OFF
32768Hz Oscillator	ON	ON	OFF

6.2.1. Operating Mode

In operating state, all functions (CPU, 32768Hz oscillator, timer/counter...) are activated.

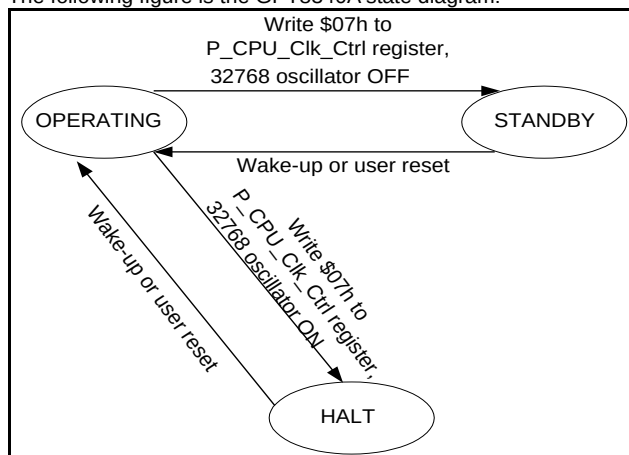
6.2.2. Standby Mode

Turn off 32768Hz oscillator and write "07H" to P_CLK_CPU_Ctrl Register (\$3006) to activate standby mode. The standby mode is a mode that the device is placed in its lowest current consumption state. In standby mode, all functions are turned off; in addition, RAM and I/Os will remain at their previous states.

6.2.3. Halt Mode

Write "07H" to P_CLK_CPU_Ctrl Register (\$3006) but still keeps 32768Hz oscillator running to enter halt mode. In halt mode, CPU clock halts and waits for an event (e.g. key press, timer overflow) to wake up. The 32768Hz related functions, such as timer/counter, may remain active in the halt mode.

The following figure is the GPT8340A state diagram:



GPT8340A State Diagram

6.3. Speech and Melody, and DAC

The GPT8340A uses a high performance SPU voice engine to archive 8-channel voice with ADPCM/PCM code. The SPU also supports automatic zero-crossing concatenating function. A hardware multiplier is also embedded in this SPU for software use. The fixed addresses of RAM area \$0000 - \$009F is designed as address pointers and a data buffer for the 8-channel speech/melody generation. Moreover, one 14-bit software channel with noise filter is also supported. There is one 14-bit DAC with push-pull amplifier for direct audio output.

6.4. Hardware PWMIO

Hardware PWMIO supports four LED outputs with 256 brightness levels. The clock source of PWMIO can be opted by users.

6.5. Low Voltage Detection

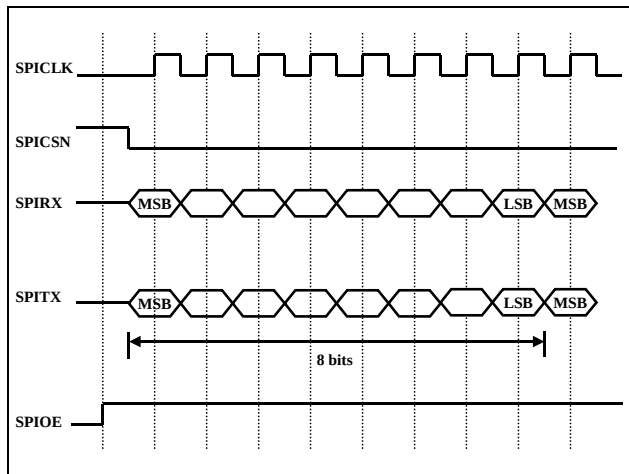
The GPT8340A equips an 8-level (Software programmable) low voltage detector to detect low voltage events. Users can turn on the low voltage detection that monitors VDD_REGIN periodically to check whether it is lower than the given value. In addition, if LV NMI is enabled, a NMI will be issued to notify CPU if power voltage drops below the given value. Also, the voltage detector will generate a system reset if power supply voltage drops extremely low.

6.6. Watchdog Timer (WDT)

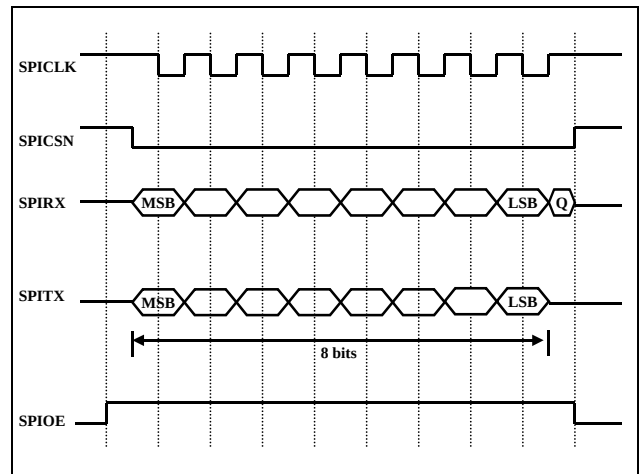
An on-chip watchdog timer is also available in the GPT8340A. The WDT is designed to recover system from unexpected operations. In some cases, if WDT is not cleared within one second, the WDT will generate a system reset to restart system. If WDT is enabled, the WDT should be cleared periodically to avoid accidental reset. The WDT can be cleared through software programming. Note that the WDT works only when 32768Hz clock is activated.

6.7. SPI Controller

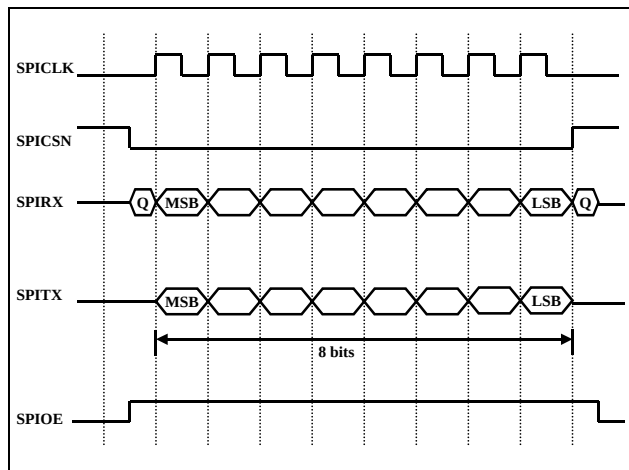
Two Serial Peripheral Interface (SPI) controllers are built-in to enable synchronous serial communication with master/slave peripherals. There are four control signals on SPI including SPICSN, SPICLK (SCK), SPIRX (SDI), and SPITX (SDO). The four signals of SPI1 are shared with PB4, PB5, PB6 and PB7. The four signals of SPI2 are shared with PB0, PB1, PB2 and PB3. While SPI module is enabled by corresponding control bit, these four pins cannot be used as GPIOs and any setting on corresponding GPIO control register will have no effect. Four types of operating modes are supported as follows:



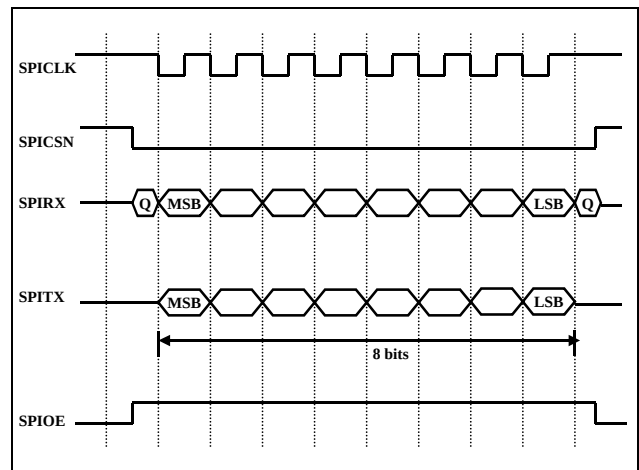
Master Mode, Polarity = 0, Phase=0



Master Mode, Polarity = 1, Phase=0



Master Mode, Polarity = 0, Phase=1



Master Mode, Polarity = 1, Phase=1

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	$0^{\circ}C$ to $+70^{\circ}C$
Storage Temperature	T_{STO}	$-50^{\circ}C$ to $+150^{\circ}C$

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

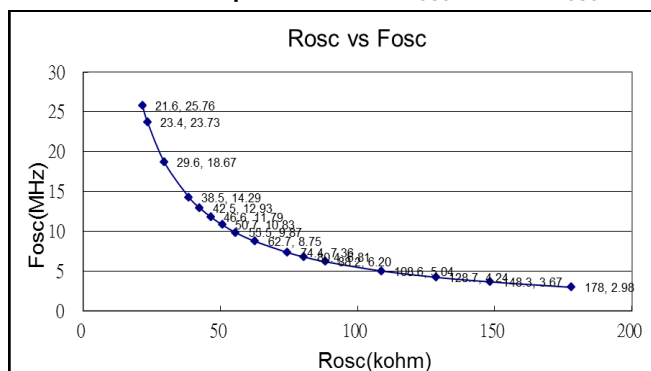
7.2. DC Characteristics (VDD_REGIN=4.5V, for 3-battery Application, Internal Regulator Enabled Output, $T_A=25^{\circ}C$)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
Operating Voltage	VDD_REGIN	2.7	-	5.5	V	For 3-battery
Operating Current	I_{OP1}	-	6	9	mA	$F_{CPU} = 8.0MHz$ @ 5.0V $F_{XTAL} = 16.0MHz$, without loading, DAC disabled.
	I_{OP2}	-	8	12	mA	$F_{CPU} = 12.0MHz$ @ 5.0V $F_{ROSC} = 24.0MHz$, no load, DAC disabled.
Standby Current (Regulator on)	I_{STBYR}	-	5	10	μA	VDD_REGIN = 4.5V, internal regulator on, all off.
Input High Level	V_{IH}	$0.7V_{DD_IO}$	-	V_{DD_IO}	V	$V_{DD_IO} = 4.5V$
Input Low Level(PA/PB/PC) (PD/PE/PF)	V_{IL1} V_{IL2}	0	-	$0.3V_{DD_IO}$	V	$V_{DD_IO} = 4.5V$
Output High Current (I/O) PA/PB4~PB7 PB0~PB3/PC PD/PE/PF	I_{OH1} I_{OH2} I_{OH3}	10.5 7 3.5	15 10 5	19.5 13 6.5	mA	$V_{DD_IO} = 4.5V$, $V_{OH} = 3.15V$
Output Sink Current (I/O) PA4~PA7 PB4~PB7 PA0~PA3/PB0~PB3/PC PD/PE/PF	I_{OL1} I_{OL2} I_{OL3} I_{OL4}	25 17.5 6.3 3.5	50 35 9 5	75 52.5 11.7 6.5	mA	$V_{DD_IO} = 4.5V$, $V_{OL} = 1.35V$
Input Pull-Low Resistor PA(weak pull) PA(strong pull) PB~PF	R_{PL}	100 35 35	150 50 50	200 65 65	K Ω	$V_{IN} = 4.5V$
Input Pull-High Resistor PA(weak pull) PA(strong pull) PB,PC	R_{PH}	100 35 35	150 50 50	200 65 65	K Ω	$V_{IN} = 0V$
OSC Resistor	R_{OSC}	-	23	-	K Ω	$F_{OSC} = 24MHz$ @ 4.5V
OSC32K Resistor	R_{OSC32k}	-	3.1	-	M Ω	$F_{OSC32} = 32768Hz$ @ 4.5V
CPU Clock	F_{CPU}	-	-	12	MHz	$F_{CPU} = F_{OSC}/2$ @ 2.7V

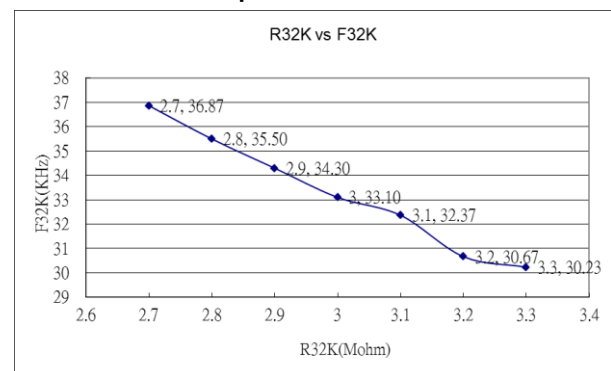
7.3. DC Characteristics(VDD_REGIN= 3.0V, for 2-battery Application, Internal Regulator Output Disabled, T_A=25°C)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
Operating Voltage	VDD_REGIN	2.3	-	3.6	V	For 2-battery
Operating Current	I _{OP1}	-	5	8	mA	F _{CPU} = 8.0MHz @ 3.0V F _{XTAL} = 16.0MHz, no load, DAC disabled.
	I _{OP2}	-	7	10	mA	F _{CPU} = 12.0MHz @ 3.0V F _{ROSC} = 24.0MHz, no load, DAC disabled.
Standby Current (Regulator off)	I _{STBY}	-	1	5	μA	VDD_REGIN = 3.0V, all off
Input High Level(PA/PB/PC) (PD/PE/PF)	V _{IH1} V _{IH2}	0.7VDD_IO	-	VDD_IO	V	VDD_IO = 3.0V
Input Low Level(PA/PB/PC) (PD/PE/PF)	V _{IL1} V _{IL2}	0	-	0.3VDD_IO	V	VDD_IO = 3.0V
Output High Current (I/O) PA/PB4~PB7 PB0~PB3/PC PD/PE/PF	I _{OH1} I _{OH2} I _{OH3}	4.9 3.5 1.75	7 5 2.5	9.1 6.5 3.25	mA	VDD_IO = 3.0V, V _{OH} = 2.1V
Output Sink Current (I/O) PA4~PA7 PB4~PB7 PA0~PA3/PB0~PB3/PC PD/PE/PF	I _{OL1} I _{OL2} I _{OL3} I _{OL4}	13 10 3.5 2.1	26 20 5 3	39 30 6.5 3.9	mA	VDD_IO = 3.0V, V _{OL} = 0.9V
Input Pull-Low Resistor PA(weak pull) PA(strong pull) PB~PF	R _{PL}	100 35 35	150 50 50	200 65 65	KΩ	V _{IN} = 3.0V
Input Pull-High Resistor PA(weak pull) PA(strong pull) PB,PC	R _{PH}	100 35 35	150 50 50	200 65 65	KΩ	V _{IN} = 0V
OSC Resistor	R _{OSC}	-	34	-	KΩ	F _{OSC} = 16MHz @ 3.0V
OSC32K Resistor	R _{OSC32k}	-	3.1	-	MΩ	F _{OSC32} = 32768Hz @ 3.0V
CPU Clock	F _{CPU}	-	-	8	MHz	F _{CPU} = F _{OSC} /2 @ 2.3V

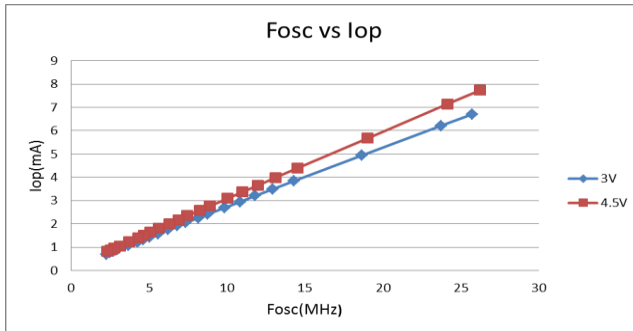
7.4. The Relationship between the R_{OSC} and the F_{OSC}



7.5. The Relationship between the R32K and the F32K



7.6. The Relationship between the FCPU and the IOP



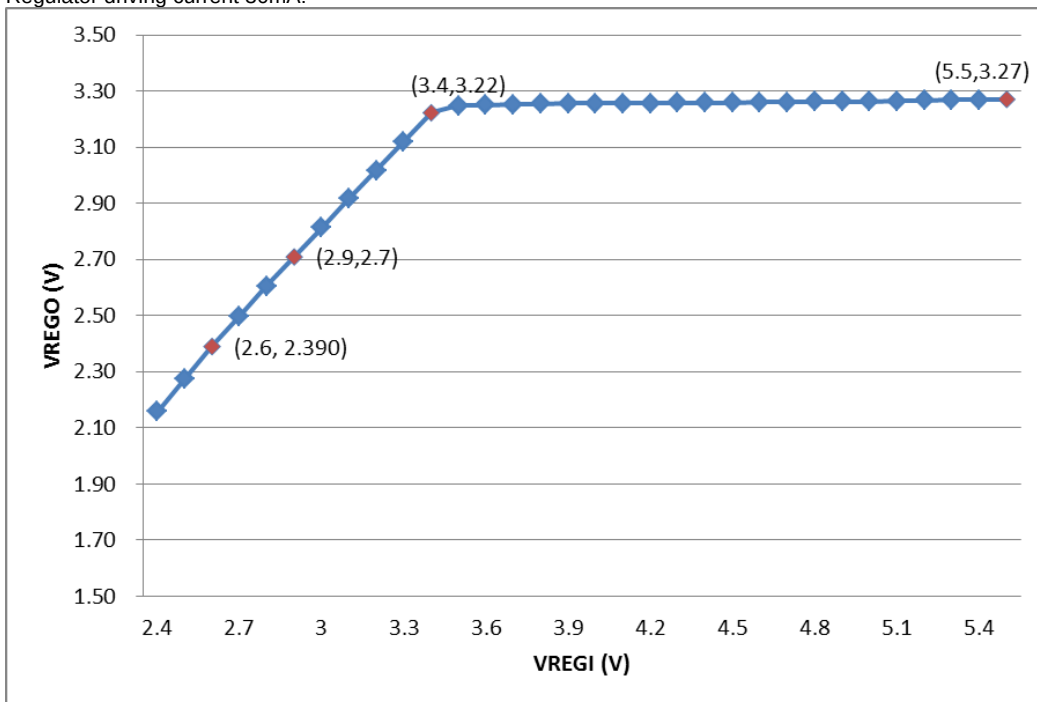
7.7. DAC Characteristics (VDD_REGIN = 5.0V, TA = 25°C)

Characteristics	Symbol	Limit			Unit
		Min.	Typ.	Max.	
DAC Resolution	RESO	-	-	14	bit
THD+n (5V@0.45W)	-	-	0.1	-	%
Noise at No Signal	-	-	-65	-	dBr A
Dynamic Range(-60dB)	-	-	-65	-	dBr A

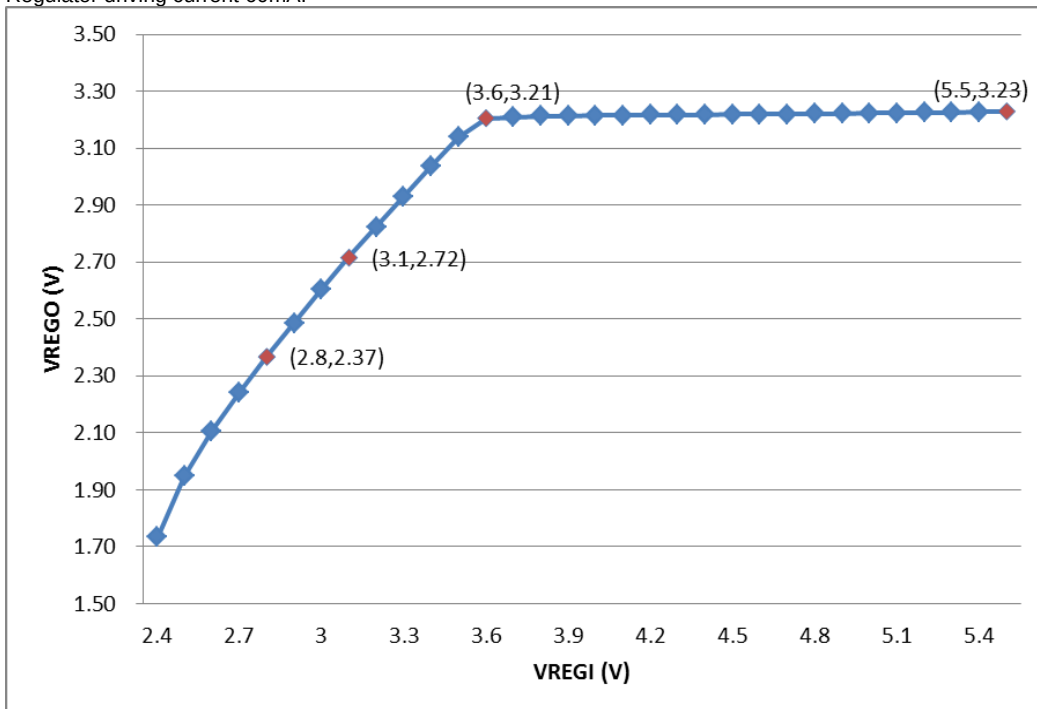
7.8. Regulator Characteristics (TA = 25°C)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
Input Voltage	VREGI	2.3	-	5.5	V	
Maximum Current Output	IREGO ₄₅	-	-	60	mA	VDD5V (Regulator in)= 4.5V, Δ VDD (Regulator out) <100mV
Maximum Current Output	IREGO ₃₀	-	-	60	mA	VDD5V (Regulator in)= 3.0V, Δ VDD (Regulator out) <300mV
Output Voltage	VREGO	3.135	3.3	3.465	V	VREGI > 3.5V
Standby Current	IRGES	-	2.5	-	uA	No load

Regulator driving current 30mA:

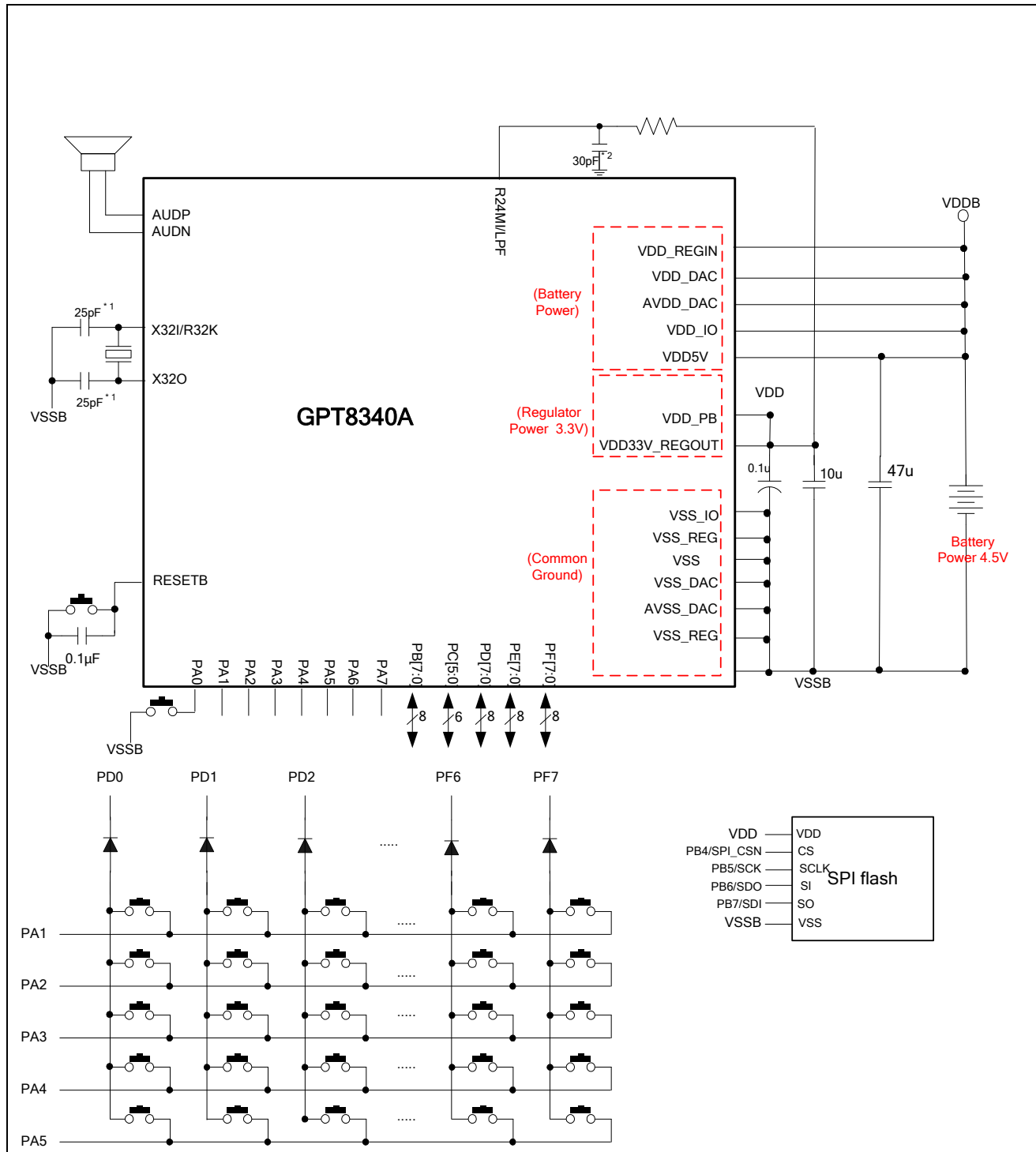


Regulator driving current 60mA:



8. APPLICATION CIRCUITS

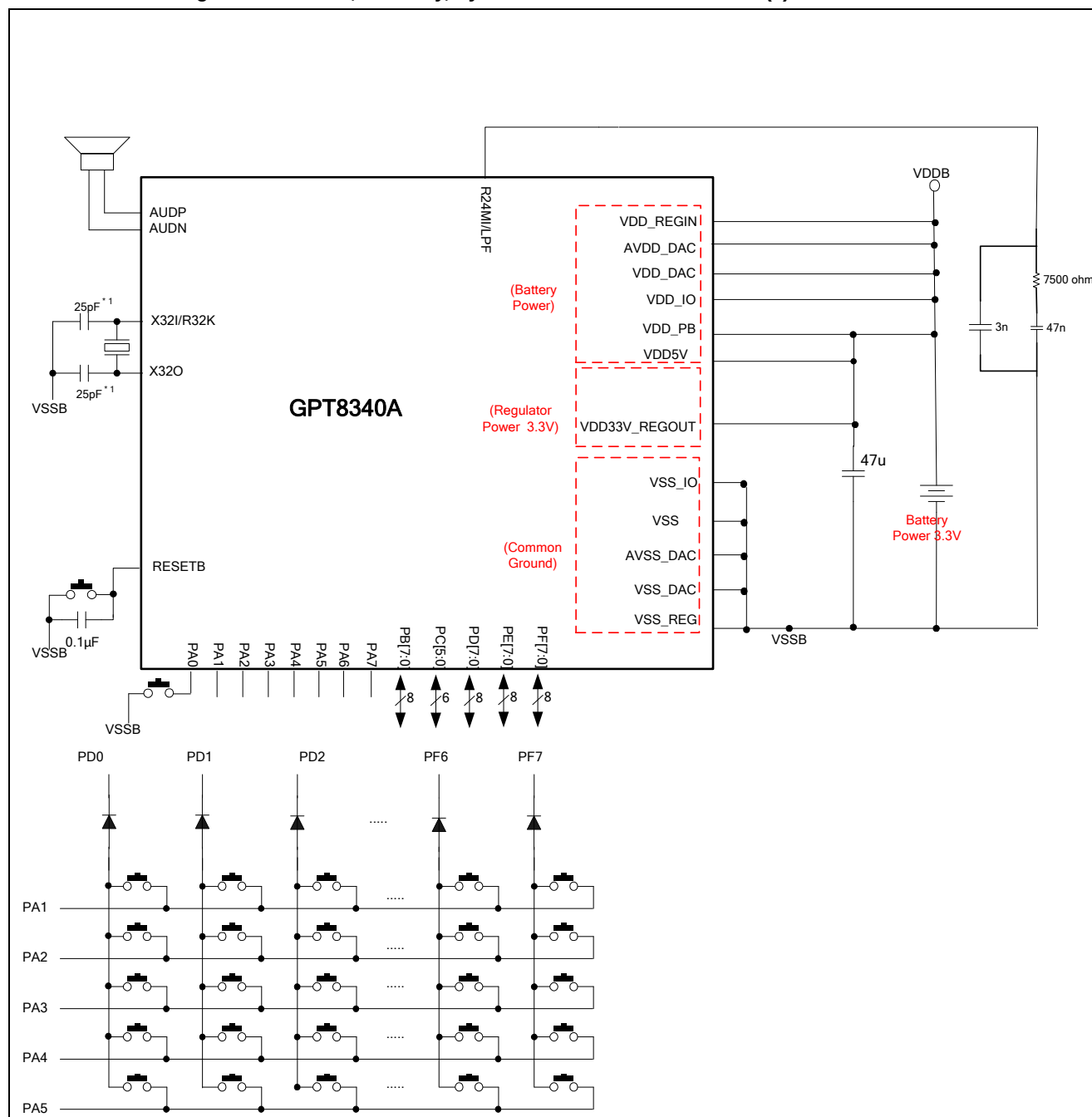
8.1. 3-battery, Internal 3.3V Regulator enabled, ROOSC24M XTAL32K selected, PB[4:7] connected to 3.3V SPI Flash using Internal 3.3V Regulator Power - (1)



Note*1: These capacitor values are for design guidance only. The recommended 32K XTAL features are ESR=11.2~60K and CL1=CL2 =26~36pF (including PCB parasitic loading, for example, user should apply additional 20~30pF on X32I and X32O if PCB parasitic loading is 6pF).

Note*2: This capacitor can be removed if this node is immune from noise.

8.2. Internal 3.3V Regulator disabled, 2-battery, System PLL XTAL32K selected - (2)



Note*1: These capacitor values are for design guidance only. The recommended 32K XTAL features are ESR=11.2~60K and CL1=CL2 =26~36pF (including PCB parasitic loading; for example, user should apply additional 20~30pF on X32I and X32O if PCB parasitic loading is 6pF).

9. ORDERING INFORMATION

Product Number	Package Type
GPT8340A - NnnV - C	Chip form

Note1: Code number is assigned for customer.

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

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11. REVISION HISTORY

Date	Revision #	Description	Page
Jul. 05, 2016	1.3	update Ioh/Iol variation range	9, 10
Jul. 31, 2014	1.2	update DC and regulator characteristic and its application circuit.	
Aug 13, 2013	1.1	update VDD_IO/VSS_IO description, update application circuit for 32K xtal	
Nov 09, 2012	1.0	Original	16