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**AMENDMENT HISTORY**

<b>Version</b>	<b>Date</b>	<b>Description</b>
Ver 1.1	February 12, 2003	First issue.
Ver 1.3	July 31, 2003	<ol style="list-style-type: none"><li>1. Add the version code "B" of chip no.</li><li>2. This spec is modified form SNAD01_V1.3</li><li>3. Add standby current more than 50 uA in page 10</li></ol>

**Note:** This document is used to identify the different version "B" & "C" of SNAD01, the most important is standby current and power down setting between version "B" & "C". For the detail please refer to related section.

## 1. GENERAL DESCRIPTION

SNAD01B is a low cost serial 8-bits ADC with 8 individual input channels. Each channel can be independently programmed to a digital or analog input mode. In the analog input mode, this single-ended channel accepts an analog input signal from 0 to  $V_{REF}$  and converts the signal into 12-bit digital codes (with 8-bit accuracy guaranteed). In the digital input mode, the channel can be treated as digital input port and the logic level appears at the channel can be acquired. SNAD01B has a synchronous 3-wires serial interface. Through this interface, the host CPU can easily control SNAD01B.

During A-to-D conversion, the typical current consumption is 500uA at 25kHz throughput-rate and +3V power supply. SNAD01B includes a power-down mode, which reduces maximum current consumption to less than 1uA.

The reference voltage can be varied between 1V and  $+V_{CC}$ , providing a corresponding input voltage range of 0V to  $V_{REF}$ . SNAD01B also has an on-chip 1.17V bandgap reference that can be utilized for constant voltage input (especially for battery monitoring applications). The bandgap reference circuitry consumes 300 $\mu$ A@3v and can be enabled and disabled.

## 2. FEATURES

- ◆ Single Supply: 2.7V ~ 5.25V
- ◆ Eight Analog/Digital Input Channels.
- ◆ Internal 1.17v Bandgap Reference for Battery Monitoring. (Channel 7)
- ◆ Low Power Consumption: typical operating current: 500uA @ 3V, Standby current <1uA.
- ◆ Up to 25kHz Conversion Rate.
- ◆ 8-bits Resolution with (8-bits) No Missing Code.
- ◆ 3-Wire Serial Interface.

## 3. APPLICATIONS

- ◆ Battery-Powered Systems
- ◆ Instrumentation
- ◆ Portable Data Logging
- ◆ Test Equipment
- ◆ Data Acquisition
- ◆ Process-Control Monitoring

- ◆ Digital Input Bus Extender

## 4. BLOCK DIAGRAM

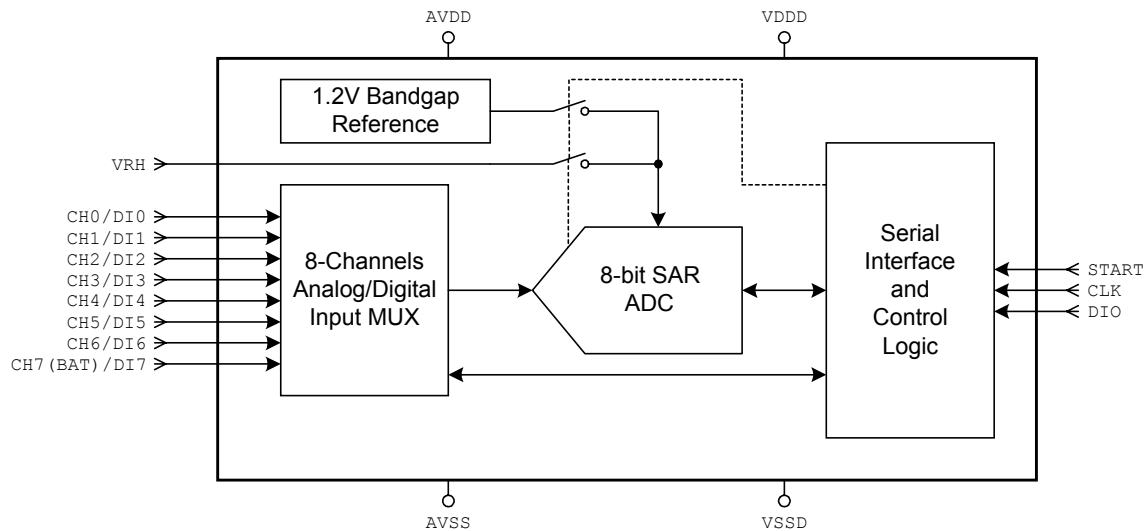


Figure1 Block diagram of ADC.

## 5. PIN ASSIGNMENT

Pin Name	I/O	Description
CH[7] ~ CH[0]	I	Analog input / digital input
REF	I	Reference voltage of analog signal
VDD	I	Positive power
VSS	I	Negative power
AVDD	I	Positive power of analog circuit
AVSS	I	Negative power of analog circuit
START	I	Command initialization signal (from host controller)
CLK	I	Clock of data communication and AD conversion (from host controller)
DIO	IO	Data input and output of data communication

## 6. Functional Descriptions

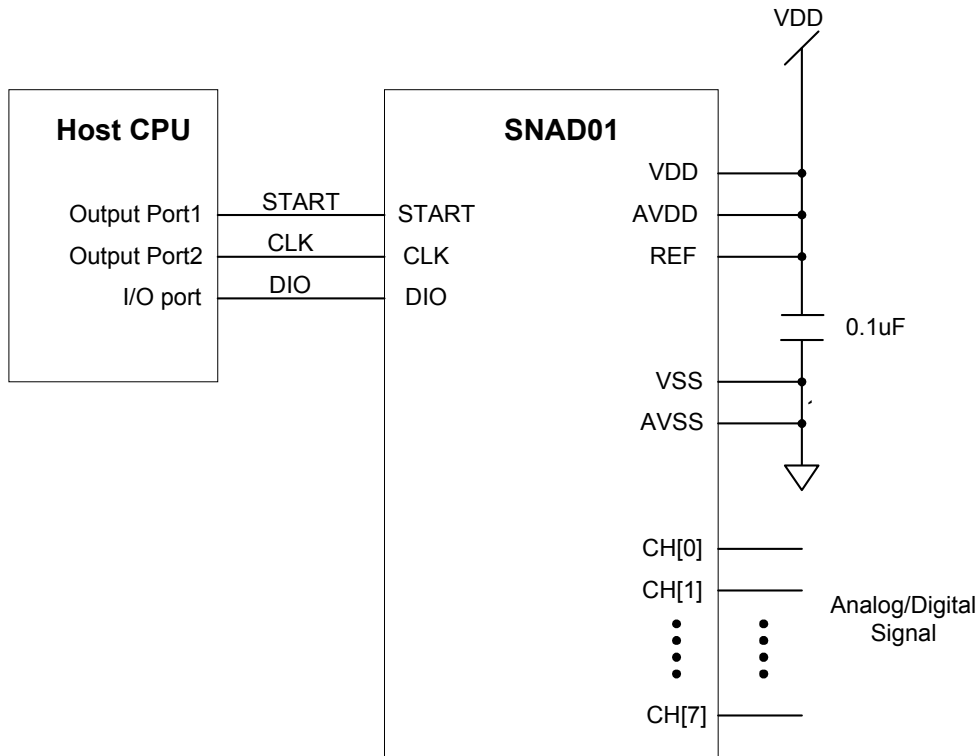


Figure2 Interface with Host CPU

### Interface Format

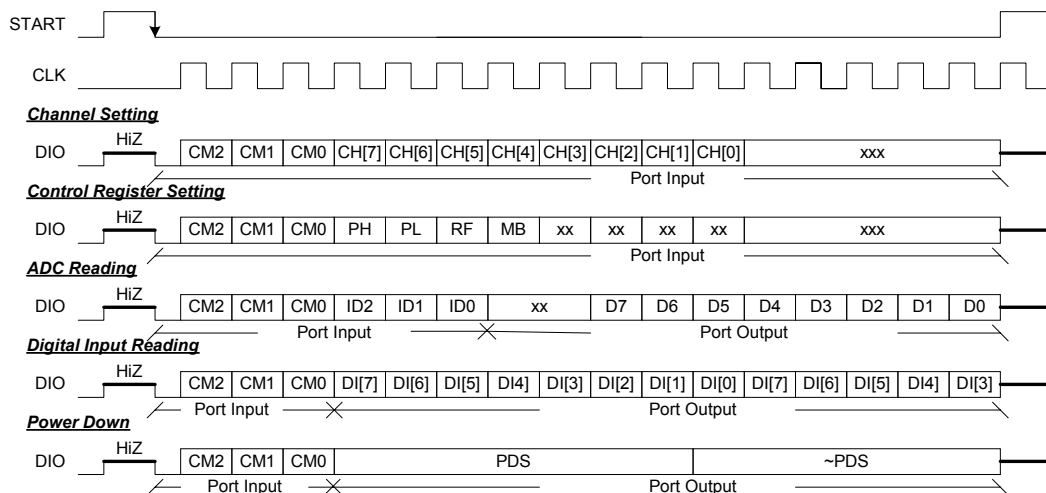


Figure3 Timing Diagram of Whole Commands

1. DIO is HiZ while START is HIGH.
2. The interface logic begins to interpret a command at the falling edge of the START signal.
3. The command ID (sent by Host) is received in the first three clock cycles from DIO.
4. The operations include Channel setting, ADC Reading, Digital Input Reading and Power Down.
5. DIO becomes to HiZ while START returns to HIGH.

Command ID	Operation
000	Power Down (0)
001	Channel Attribute Setting (1:Analog, 0:Digital)
010	Channel Wakeup Function Setting (1:Enable, 0:Disable)
011	Control Register Setting
100	ADC Conversion
101	Digital Input Reading
110	Reserved
111	Power Down (1)

Table1 Command Description Table

1. 000/111: ADC enters into power down after receiving this command.
2. 001: Set the attribute each channel to be an analog or a digital input with the sequence of channel 7 to 0. (1:Analog; 0:Digital)
3. 010: Set the wakeup function of each channel to be enabled or disabled with the sequence of channel 7 to 0. (1:Enable; 0:Disable)
4. 011: Setting the values of control registers.
5. 100: ADC starts to convert the analog signal of the selected channel after receiving this command.
6. 101: ADC starts to read the digital input of every channel with the sequence of channel 7 to 0.
7. 110: ADC enters into testing mode.

### Channel Setting

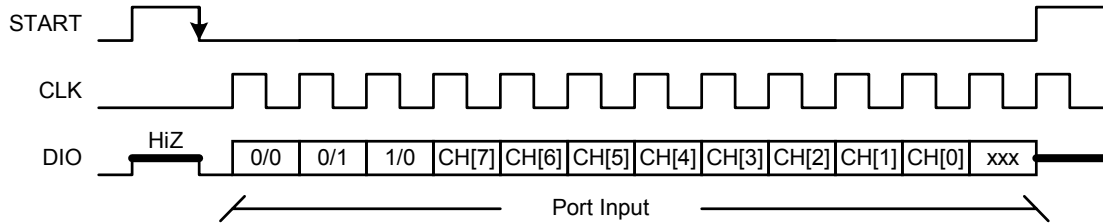


Figure3 The timing diagram of channel attribute/wakeup setting

Command 001: channel attribute setting. Command 010: wakeup function setting.

In attribute setting, “1” means analog and “0” means digital. In wakeup setting, “1” means enable and “0” means disable. After all of the channels are set, the DIO port remains input mode and all the following data are ignored.

### Control Register Setting

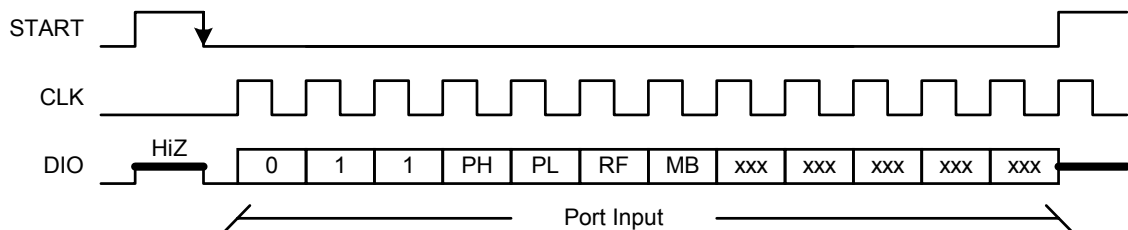


Figure4 The timing diagram of control registers setting

1. Command ID: (011)
2. 4-bit data behind command ID are loaded into control registers with the sequence of PH, PL, RF and MB.
3. The function of each control registers are as Table2.

Name	Function
PH	Set the pull-up resistor of the channel in digital input mode. 1:ON, 0:OFF.
PL	Set the pull-down resistor of the channel in digital input mode. 1:ON, 0:OFF.
RF	Set the Bandgap reference. 1:ON, 0:OFF.
MB	For testing chip only, always set MB=0 in system power-on initialization routine.

Table2 The function table of control registers

*Note:*

1. The condition of both PH=1 and PL=1 is prohibited.
2. Pull-up and pull-down resistors are not activated while the corresponding channel is set as analog input mode.

### ADC Read Timing

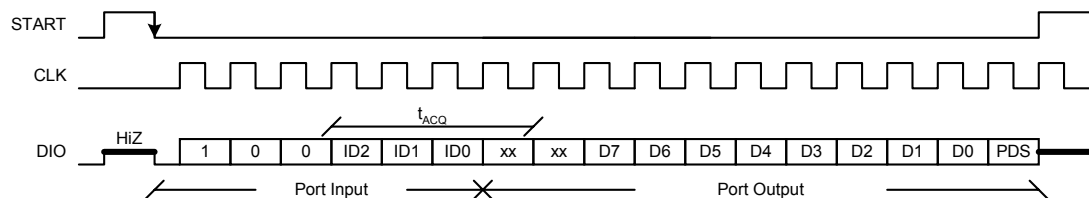


Figure5 The timing diagram of ADC reading

1. Command ID: (100)
2. 3-bit channel number data behind command ID.
3. The analog signal of the selected channel is sampled to ADC. ADC refers the reference voltage and converts the sampled analog signal to digital domain by successive-approximation method.
4. The 8-bit output data (result of conversion) of ADC is sent to DIO port from MSB and is triggered by CLK. The maximum clock frequency is 500kHz @ 2.7v. (Maximum conversion rate=25KHz)



5. After the 8-bits ADC data has been sent out, if the START is kept in LOW and CLK is kept in High/Low transition, then the data with uncertain value are kept appearing on DIO. These data can just be ignored.

Channel ID[2:0]	Selected Channel
000	CH0
001	CH1
010	CH2
011	CH3
100	CH4
101	CH5
110	CH6
111	CH7

Table3 Channel Selection Table.

### Timing of Digital Input Reading

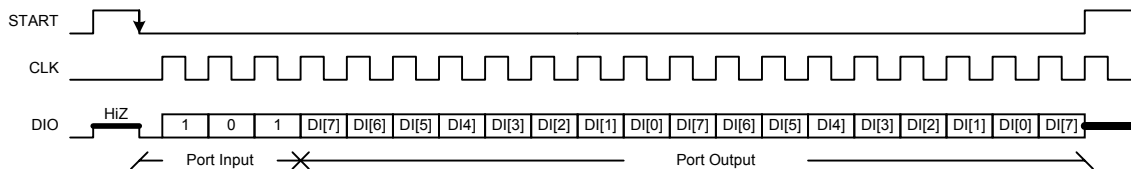


Figure6 The timing diagram of the digital input reading

1. Command ID: (101).
2. The digital data of each channel is sent to the DIO port with the sequence of channel 7 to 0.
3. After all of the channels are read, if the START is kept in LOW and CLK is kept in HIGH/LOW transition, the digital data of each channel is sent to the DIO port again with the sequence of channel 7 to 0 cyclically.
4. Pulling START to HIGH terminates this digital input reading.

*Note: Once a channel is programmed as analog type, the corresponding data is "0" in digital input reading command.*

### Power Down & Channel Wake-Up

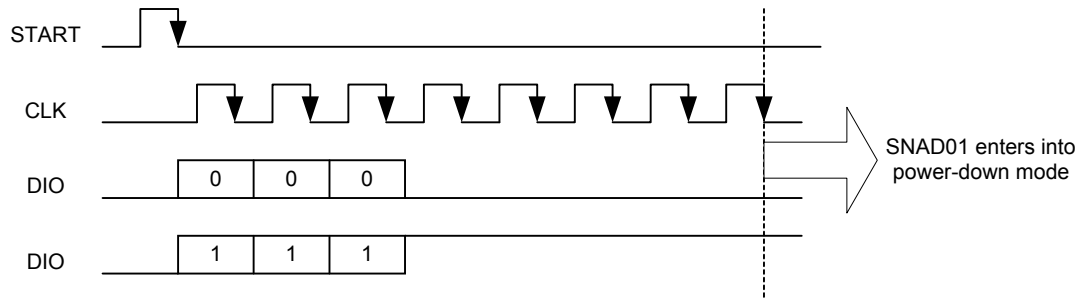


Figure7 The timing diagram of power down command

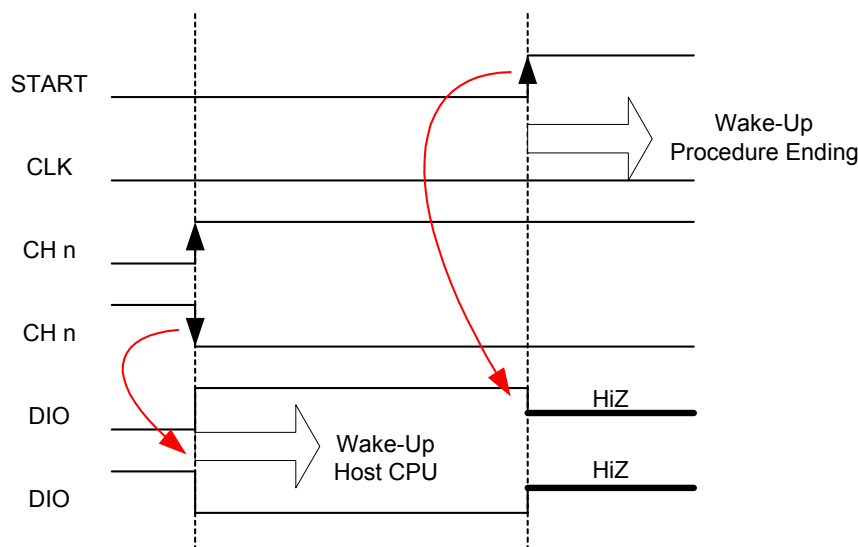


Figure8 The timing diagram of power down command

1. The power down command (000/111) is sent to SNAD01B in the first three cycles, and then SNAD01B enters into power down mode at the 5<sup>th</sup> clock cycle, consuming almost no current (less than 1uA).
2. After SNAD01B enters power down (mode 0: command 000), SNAD01B sends "0" out to DIO until a valid logic transition appears on any wakeup-enabled digital input channel. Once the transition occurs, SNAD01B toggles DIO to "1" to inform host controller. After receiving "1" from DIO, host controller should turn START back to "1" to inform SNAD01B that the power-down stage is over. Otherwise, SNAD01B keeps sending out "1" to DIO and does not recognize any other transitions on any channels.

3. After SNAD01B enters power down (mode 1: command 111), SNAD01B sends “1” out to DIO until a valid logic transition appears on any wakeup-enabled digital input channel. Once the transition occurs, SNAD01B toggles DIO to “0” to inform host controller. After receiving “0” from DIO, host controller should turn START back to “1” to inform SNAD01B that the power-down stage is over. Otherwise, SNAD01B keeps sending out “1” to DIO and does not recognize any other transitions any the channels.

4. The CLK may stop but START ought to remain at LOW level in the whole power down mode.

Note:

1. Wakeup function is only dedicated to the channel which is digital input type AND wakeup-enabled.

2. In SNAD01B version, the standby current will more than 50uA in AD conversion reference voltage use “REF” pin connected external voltage.

**Bandgap reference**

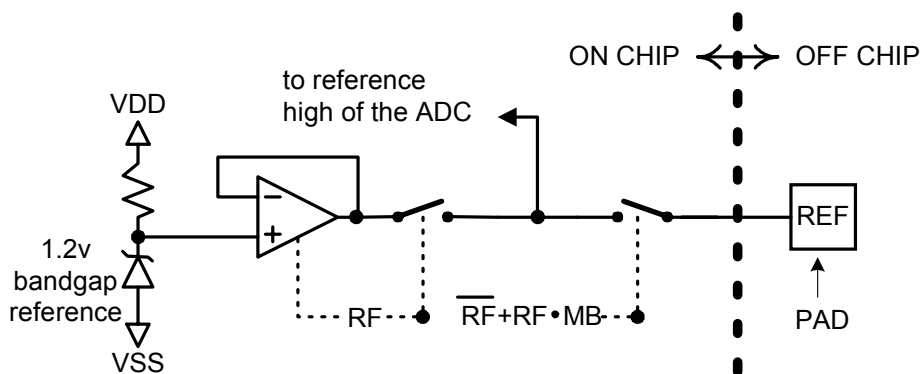


Figure8 Circuit diagram of ADC bandgap reference selection

If the internal bandgap reference is turned ON ( $RF=1$ ), the reference voltage of ADC is supplied by output voltage of the internal bandgap reference circuit. This bandgap consumes about  $300 \mu A$ . The output voltage of bandgap reference is around 1.17V typically.

*Note: MB for chip test only. Always set MB=0 with command (011) in System Power-On Initialization Routine.*

### Input Channel PAD (Channel 0~6)

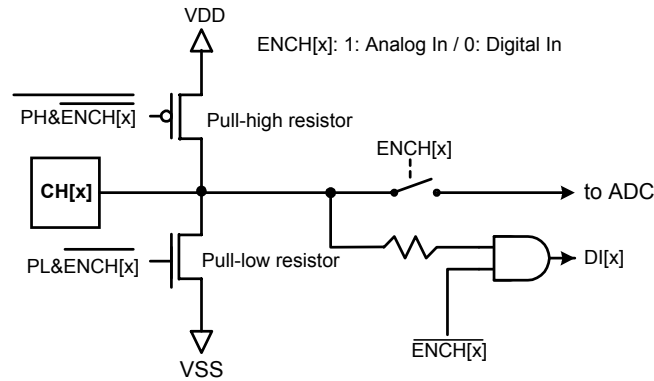


Figure9 Circuit diagram of the Input Channel PAD

1. If a channel is programmed to analog input mode, then the corresponding internal signal, ENCH[x],=1. As in Figure9, pull-high and pull-low are disabled. And the path to digital input is blocked. All digital reading operation of this channel will get the result "0".
2. If a channel is programmed to digital input mode, then the corresponding internal signal, ENCH[x],=0. As in Figure9, the path to ADC is removed.
3. While in digital input mode, this input port can be configured to be floating, weak pull up, or pull down by setting the control register PH and PL as Figure9, where PH&PL=1 is forbidden. The weak pull resistance is about 500KΩ@3v.
4. The default status (digital/analog, pull up/down) of the channels are not defined after power on, so initialization of each channel to define a correct state should be done.
5. Mode of each channel (ENCH[x]) can be set by command 001.

**Battery Monitoring (Channel 7 only)**

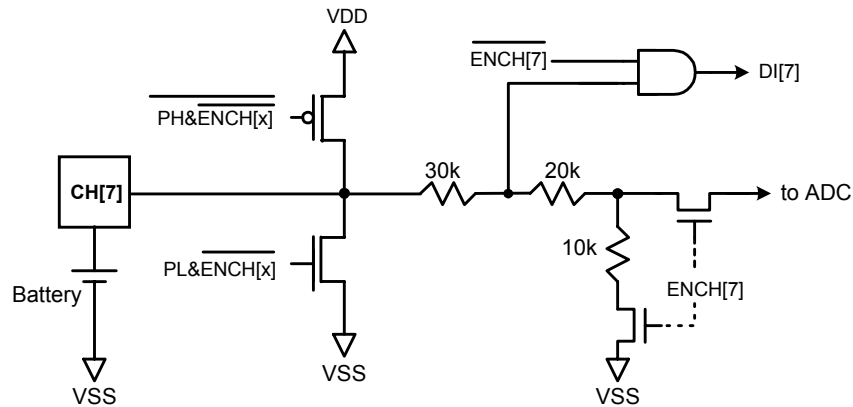


Figure10 The circuit of the Input pad of Channel 7

1. While read ADC command is sent and channel 7 is selected, ADC can be used to monitor the battery voltage.
2. The circuit of battery voltage monitoring is shown in Battery Monitoring (Channel7 only)
3. The battery voltage is six times ADC measuring voltage. Thus, the measured result equals to  $1/6 \times \text{battery voltage}$ .
4. While channel 7 is set to the analog input mode, an input resistor ( $60k\Omega$ ) exists from CH[7] to VSS. To save unnecessary power consumption, CH[7] should be switch to digital input type when CH[7] is not measured.

*Note: CH[7] is different from the other 7 channels. The input voltage is reduced to 1/6 before it is sent into ADC.*

## 7. ELECTRICAL CHARACTERISTICS

Typical values apply for  $V_{DD}=V_{REF}=3.0\text{ V}$ ,  $T_{AMB}=25\text{ }^{\circ}\text{C}$  unless otherwise noted.

Symbol	Parameter	min	typ	max	Unit	Conditions
Analog-to-Digital Converter						
$V_{DD}$	Operating voltage	2.7	3.0	5.25	V	
$I_{DD}$	Operating current		400	650	$\mu\text{A}$	Excluding bandgap reference
$I_{PDN}$	Power Down Current		0.1	2	$\mu\text{A}$	
$F_{SMP}$	Conversion Rate (Throughput Rate)		30 40		kHz	$V_{DD}=3.0\text{V}$ $V_{DD}=5.0\text{V}$
DNL	Differential Nonlinearity			$\pm 0.5$	LSB	
INL	Integral Nonlinearity			$\pm 0.5$	LSB	
NMC	No Missing Code	8			Bits	$V_{DD}=2.7\sim 5.25\text{V}$
SINAD	Signal to Noise and Distortion	50			dB	
ENOB	Effective Number of Bits	8			Bits	
Bandgap reference						
VBG	Bandgap reference output voltage	1.14	1.17	1.20	V	
IBG	Operating current of BGR		400		$\mu\text{A}$	
Digital Interface						
	Weak pull up/down resistance		500 k		$\Omega$	$V_{DD}=3\text{V}$
$V_{IL}$	Input low voltage	-0.3		0.8	V	
$V_{IH}$	Input high voltage	$V_{DD}-0.7$		$V_{DD}+0.3$	V	
$V_{OL}$	Output low voltage	0		0.4	V	
$V_{OH}$	Output high voltage	$V_{DD}-0.5$		$V_{DD}$	V	
	Output drive/sink current of DIO		3		mA	$V_{OP}=V_{DD}-0.5\text{V}/V_{SS}+0.5\text{V}$

## 8. APPLICATION CIRCUITS

### Example Circuit: SNAD01B works with Sonix 4-bit Series Controller

CH[0], CH[1], CH[2]: Analog Input

CH[6]: Digital Input

CH[7]: Battery Voltage Detect

REF=VDD+

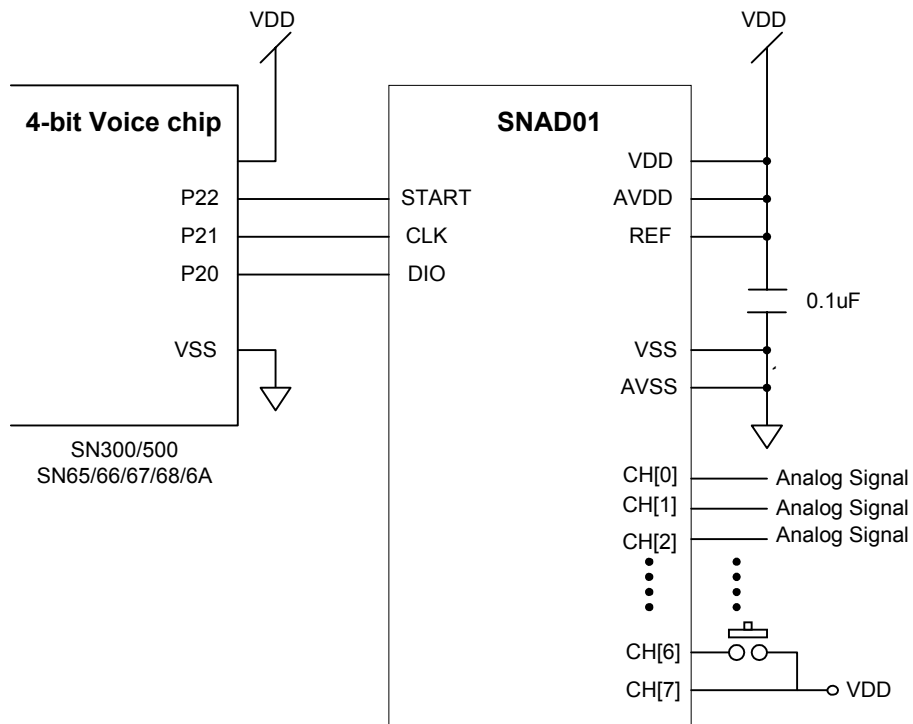


Figure11 SNAD01B works with Sonix 4-bit Series Controller

## 9. Example Programs:

Host Controller: SNC500. Application circuit is identical to Figure11. P22: START.  
P21: CLK. P20: DIO.

### ◆ Macro Programs: (def.h)

```

p2State    equ    m0
port_l     equ    m1
port_h     equ    m2
ad_out_l   equ    m3
ad_out_h   equ    m4
tmp        equ    m5
tmp1       equ    m6

.....
;;
@ON_START macro          ;;SET START=0
    mov  a    #1011b
    and  a    p2state
    mov  p2state a
    mov  p2    a
endm

.....
;;
@OFF_START macro         ;;SET START=1
    mov  a    #0100b
    or   a    p2state
    mov  p2state a
    mov  p2    a
endm

.....
;;
@CLOCK macro
    mov  a    #0010b    ;;SET CLK L→ H AND H→ L
    or   a    p2state
    mov  p2    a
    mov  a    #1101b
    and  a    p2state
    mov  p2state a
    mov  p2    a
endm

.....
;;
@Send_0 macro
    mov  a    #1110b    ;;HOST SEND 0 → DIO
    and  a    p2state

```





```
    mov  p2state a
    mov  p2  a
    endm

.....
";
@Send_1 macro
    mov  a  #0001b    ;;HOST SEND 1 → DIO
    or   a  p2state
    mov  p2state a
    mov  p2  a
    endm

.....
";
@Send macro data;    ;;HOST SEND 1-BIT CONSTANT (#1 OR #0) → DIO
    mov  tmp data
    mov  a  #1110b
    and  a  p2state
    or   a  tmp
    mov  p2state a
    mov  p2  a
    endm

.....
";
@Read_DIO macro    ;;READ DIO → A.0 (1-BIT)
    mov  a  p2
    mov  tmp #0001b
    and  a  tmp
    endm

.....
";
@P20_Out_Mode macro    ;;SWITCH ALL 4-BIT OF P2 TO OUTPUT MODE
    mov  a  #0000b
    mov  p2s a
    endm

.....
";
@P20_In_Mode macro    ;;SWITCH P2.0 (DIO) TO INPUT MODE
    mov  a  #0001b
    mov  p2s a
    mov  a  #1110b
    and  a  p2state
    mov  p2state a
    mov  p2  a
    endm
```



```
.....  
";  
;; Set Analog/Digital Mode to each channel (1:Analog, 0:Digital) *  
;; y7 → Ch7. y6 → Ch6. y5 → Ch5, ... *  
.....  
";  
@Set_Attrib macro y7,y6,y5,y4,y3,y2,y1,y0  
    @P20_Out_mode    ;; SWITCH P2 TO OUTPUT MODE  
    @ON_START        ;; SET START=0  
  
    @Send_0          ;; SEND COMMAND (001)  
    @Clock  
    @Send_0  
    @Clock  
    @Send_1  
    @Clock  
  
    @Send y7        ;; SEND y7 TO y0  
    @Clock  
    @Send y6  
    @Clock  
    @Send y5  
    @Clock  
    @Send y4  
    @Clock  
    @Send y3  
    @Clock  
    @Send y2  
    @Clock  
    @Send y1  
    @Clock  
    @Send y0  
    @Clock  
  
    @OFF_START      ;; SET START=1  
    @P20_In_mode    ;; SWITCH P2.0 TO INPUT MODE  
endm  
.....  
";  
;; Set Wakeup function Enable/Disable (1:Enable, 0:Disable) *  
;; y7 → Ch7. y6 → Ch6. y5 → Ch5, ... *  
.....  
";  
@Set_Wakeup macro y7,y6,y5,y4,y3,y2,y1,y0  
    @P20_Out_mode    ;; SWITCH P2 TO OUTPUT MODE
```



```
@ON_START      ;; SET START=0
@Send_0        ;; SEND COMMAND (010)
@Clock
@Send_1
@Clock
@Send_0
@Clock

@Send y7       ;; SEND y7 TO y0
@Clock
@Send y6
@Clock
@Send y5
@Clock
@Send y4
@Clock
@Send y3
@Clock
@Send y2
@Clock
@Send y1
@Clock
@Send y0
@Clock

@OFF_START     ;; SET START=1
@P20_In_mode   ;; SWITCH P2.0 TO INPUT MODE
endm

..*****
;;
;; Setup Control Register                *
;; ph: PULL-HIGH register. pl:PULL-LOW register. *
;; rf: BANDGAP reference enable          *
;; mb: Set 0 always                      *
..*****
;;
@Set_Control_Reg macro ph,pl,rf,mb
@P20_Out_mode   ;; SWITCH P2 TO OUTPUT MODE
@ON_START      ;; SET START=0

@Send_0        ;; SEND COMMAND (011)
@Clock
@Send_1
```



```
@Clock
@Send_1
@Clock

@Send ph      ;; SEND ph, pl, rf, mb
@Clock
@Send pl
@Clock
@Send rf
@Clock
@Send mb
@Clock

@OFF_START   ;; SET START=1
@P20_In_mode ;; SWITCH P2.0 TO INPUT MODE
endm

..*****
;;
;; Let SNAD01B Enter Power-Down mode 0          *
;;
..*****
;;

@Power_Down_0 macro
    @P20_Out_mode   ;; SWITCH P2 TO OUTPUT MODE
    @ON_START       ;; SET START=0
    @Send_0         ;; SEND COMMAND (000)
    @Clock
    @Send_0
    @Clock
    @Send_0
    @Clock
    @P20_In_mode   ;; SWITCH P2.0 TO INPUT MODE

    @Clock
    @Clock
    @Clock
    @Clock
    @Clock        ;; SNAD01B ENTERS POWER-DOWN AT THE 8-th CLOCK EDGE.
Endm
```



```
.....
;;
;; Let SNAD01B Enter Power-Down mode 1 *
.....
@Power_Down_1 macro
    @P20_Out_mode    ;; SWITCH P2 TO OUTPUT MODE
    @ON_START        ;; SET START=0

    @Send_1          ;; SEND COMMAND (111)
    @Clock
    @Send_1
    @Clock
    @Send_1
    @Clock
    @P20_In_mode    ;; SWITCH P2.0 TO INPUT MODE

    @Clock
    @Clock
    @Clock
    @Clock
    @Clock          ;; SNAD01B ENTERS POWER-DOWN AT THE 8-th CLOCK EDGE.
endm
.....
;;
;; Read ADC from Channel n (n=n2,n1,n0) *
;; e.g.: Ch 5 (n2, n1, n0= #1, #0, #1) *
;; 8-bit Data → (ad_out_h, ad_out_l) *
.....
@Read_ADC macro n0, n1, n2
    @P20_Out_mode    ;; SWITCH P2 TO OUTPUT MODE
    @ON_START        ;; SET START=0

    @Send_1          ;; SEND COMMAND (100)
    @Clock
    @Send_0
    @Clock
    @Send_0
    @Clock

    @Send n2         ;; SEND CHANNEL NUMBER
    @Clock
    @Send n1
    @Clock
```



```
@Send n0
@Clock

@p20_in_mode ;; SWITCH P2.0 TO INPUT MODE
@Clock      ;; WAIT FOR 2 MORE CLOCKS
@Clock

mov ad_out_l #0
mov ad_out_h #0
*****
;;
@Clock      ;; READ DIO and SAVE 1-bit DATA in ad_out_h.3
mov tmp1#1000b
@Read_DIO
caje #0 @f
mov a ad_out_h
or a tmp1
mov ad_out_h a
@@:
*****
;;
@Clock      ;; READ DIO and SAVE 1-bit DATA in ad_out_h.2
mov tmp1 #0100b
@Read_DIO
caje #0 @f
mov a ad_out_h
or a tmp1
mov ad_out_h a
@@:
*****
;;
@Clock      ;; READ DIO and SAVE 1-bit DATA in ad_out_h.1
mov tmp1 #0010b
@Read_DIO
caje #0 @f
mov a ad_out_h
or a tmp1
mov ad_out_h a
@@:
*****
;;
@Clock      ;; READ DIO and SAVE 1-bit DATA in ad_out_h.0
mov tmp1 #0001b
@Read_DIO
caje #0 @f
```



```
    mov a  ad_out_h
    or a  tmp1
    mov  ad_out_h a
@@:
..*****
;;
    @Clock          ;; READ DIO and SAVE 1-bit DATA in ad_out_I.3
    mov tmp1 #1000b
    @Read_DIO
    caje #0  @f
    mov a  ad_out_I
    or a  tmp1
    mov  ad_out_I a
@@:
..*****
;;
    @Clock          ;; READ DIO and SAVE 1-bit DATA in ad_out_I.2
    mov tmp1 #0100b
    @Read_DIO
    caje #0  @f
    mov a  ad_out_I
    or a  tmp1
    mov  ad_out_I a
@@:
..*****
;;
    @Clock          ;; READ DIO and SAVE 1-bit DATA in ad_out_I.1
    mov tmp1 #0010b
    @Read_DIO
    caje #0  @f
    mov a  ad_out_I
    or a  tmp1
    mov  ad_out_I a
@@:
..*****
;;
    @Clock          ;; READ DIO and SAVE 1-bit DATA in ad_out_I.0
    mov tmp1 #0001b
    @Read_DIO
    caje #0  @f
    mov a  ad_out_I
    or a  tmp1
    mov  ad_out_I a
@@:
..*****
;;
```



```
@Clock
@OFF_START      ;; SET START=1
endm

.....
;; Read Digital Input:          *
;; 8-bit Data -> (port_h, port_l) *
.....

@Read_Port  macro
  @P20_Out_mode  ;; SWITCH P2 TO OUTPUT MODE
  @ON_START      ;; SET START=0

  @Send_1        ;; SET COMMAND (101)
  @Clock
  @Send_0
  @Clock
  @Send_1
  @Clock

  @P20_In_mode  ;; SWITCH P2.0 TO INPUT MODE

  mov  port_l #0
  mov  port_h #0
.....
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_h.3
mov  tmp1  #1000b
@Read_DIO

  caje #0      @f
  mov  a      port_h
  or   a      tmp1
  mov  port_h  a

@@:
.....
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_h.2
mov  tmp1  #0100b
@Read_DIO
  caje #0      @f
  mov  a      port_h
  or   a      tmp1
  mov  port_h  a
```





```
@@:
..*****
;;
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_h.1
mov  tmp1      #0010b
@Read_DIO
caje #0        @f
mov  a         port_h
or   a         tmp1
mov  port_h    a
```

```
@@:
..*****
;;
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_h.0
mov  tmp1      #0001b
@Read_DIO
caje #0        @f
mov  a         port_h
or   a         tmp1
mov  port_h    a
```

```
@@:
..*****
;;
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_l.3
mov  tmp1      #1000b
@Read_DIO
caje #0        @f
mov  a         port_l
or   a         tmp1
mov  port_l    a
```

```
@@:
..*****
;;
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_l.2
mov  tmp1      #0100b
@Read_DIO
caje #0        @f
mov  a         port_l
or   a         tmp1
mov  port_l    a
```

```
@@:
..*****
;;
@Clock          ;; READ DIO and SAVE 1-bit DATA in port_l.1
mov  tmp1      #0010b
@Read_DIO
```



```
caje #0 @f
mov a port_l
or a tmp1
mov port_l a

@@:
.....
;;
@Clock ;; READ DIO and SAVE 1-bit DATA in port_l.0
mov tmp1 #0001b
@Read_DIO
caje #0 @f
mov a port_l
or a tmp1
mov port_l a

@@:
.....
;;
@Clock
@OFF_START ;; SET START=1
endm
.....
;;
```



### Program 1: Set Configuration of SNAD01B

```
;; Setup Configuration of SNAD01B
;;
;; With Pull-Low, Bandgap ON. (PH=0, PL=1, RF=0,MB=0)
;;
;;
;;           CH7 CH6 CH5 CH4 CH3 CH2 CH1 CH0
;; Analog/Digital: B  A  A  D  D  D  A  A  :B, battery detect
;; Wakeup:       X  X  X  NO YES YES X  X
;;
```

```
SNC520
program
include  def.h
```

#### START:

```
mov     a      #1111b
mov     p2s    a
mov     a      #0000b
mov     p2     a
mov     p2State #0

@Set_Control_Reg #0, #1, #0, #0      ;; Set Control Registers
@Set_Attrib  #0, #1, #1, #0, #0, #0, #1, #1  ;; Set Chan Analog/Digital
@Set_Wakeup  #0, #0, #0, #0, #1, #1, #0, #0  ;; Setup Wakeup function
```

### Program 2: Read ADC result from Channel 1

```
;; Inherit from program 1
;; 8-bit ADC result of channel 1 in ( ad_out_h, ad_out_l)

@Read_ADC #0, #0, #1      ;;get ADC result from Ch1 in ( ad_out_h, ad_out_l)
...
...
```

**Program 3: Read Digital Input data from Ch4, Ch3, CH2**

```
;; Inherit from program 1
;; After Reading,
;; Port_h.0 = Input of Ch4
;; Port_l.3 = Input of Ch3
;; Port_l.2 = Input of Ch2

@Read_Port    ;;get ADC result in ( ad_out_h, ad_out_l)
...
...
```

**Program 4: Power-down SNAD01B and Host, and Wake-up**

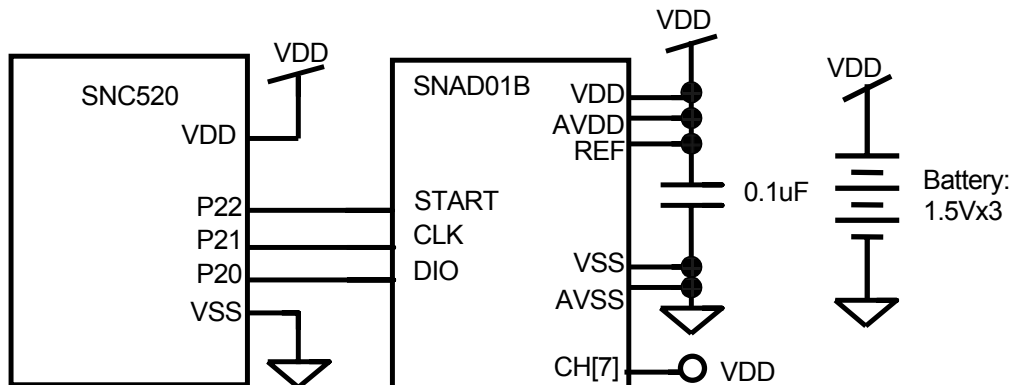
```
;; Inherit from program 1
;; Enter Power-down Mode (0)

@Power_Down_0    ;;SNAD01B enters power-down Mode (0)

end              ;; HOST (SNC520) enter power-down
...
...

TRIGGER:
@OFF_START      ;; SET START=1
...
@Read_Port      ;; READ Trigger condition or Debounce Procedure starting from here
...
...
```

**Program 5: Battery Low Detection**



An application uses three 1.5V batteries for power supply. During operation, the power of batteries keeps consumed and the voltage of battery keeps going down. Now, voltage lower than 3.6V is treated as “Battery Low”. The ADC and bandgap reference circuit in SNAD01B can be utilized to detect “Battery Low”. The voltage through channel 7 to ADC is reduced to  $1/6 \cdot VDD$  (Figure10). Thus, when  $VDD=3.6V$ , the voltage into ADC is around 0.6V. And bandgap is chosen for reference voltage (approximately 1.17V within the whole operation voltage range). The value acquired from ADC is about  $(0.6/1.17) \cdot 256=131$ . For simplification consideration, we choose “ADC’s readout < 128” as “Battery Low” condition.

```
;; Inherit from program 1
;; Enter Power-down Mode (0)
```

CheckBattery:

```
@Set_Control_Reg #0, #1, #1, #0 ;; Set rf=1, turn-on bandgap
@Set_Attrib #1, #1, #1, #0, #0, #0, #1, #1 ;; Switch Ch7 to Analog
```

```
mov m15 #0
```

CheckAgain:

```
@Read_ADC #1, #1, #1 ;; Read Ch7
mov a #1000b
and a ad_out_h
caje #1000b Battery_Low_No ;; if (Value>=128) then Not Battery Low
mov a m15
inca
mov m15 a
caje #3 Battery_Low_Yes ;; if (Value<128) for 3 times, then
jmp CheckAgain ;; battery low.
```

Battery\_Low\_Yes:

```
mov m14 #1
```

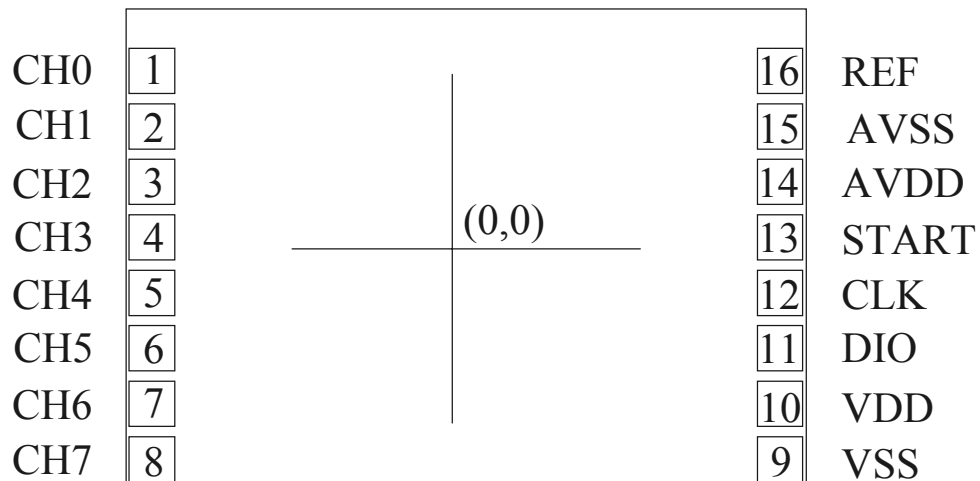
Battery\_Low\_No:

```
@Set_Control_Reg  #0, #1, #0, #0      ;; Set rf=0, turn-off bandgap
@Set_Attrib      #0, #1, #1, #0, #0, #1, #1  ;; Switch Ch7 to Digital
                                                    ;; To save operating current
```

## 10. PAD DIAGRAM

### Dice Form

NO	PAD NAME	X(um)	Y(um)	NO	PAD NAME	X(um)	Y(um)
1	CH0	-623.50	352.50	9	VSS	623.50	-417.50
2	CH1	-623.50	242.50	10	VDD	623.50	-307.50
3	CH2	-623.50	132.50	11	DIO	623.50	-197.50
4	CH3	-623.50	22.50	12	CLK	623.50	-87.50
5	CH4	-623.50	-87.50	13	START	623.50	22.50
6	CH5	-623.50	-197.50	14	AVDD	623.50	132.50
7	CH6	-623.50	-307.50	15	VSS	623.50	242.50
8	CH7	-623.50	-417.50	16	REF	623.50	352.50



CHIP SIZE=1350 x 950um

## SNAD01B

Note: The substrate MUST be connected to Vss in PCB layout

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