HYCON TECHNOLOGY

DC MEASURE

HY11P12

3 1/2 Low Power Consumption Voltage Measuring

(MAX131 Alternative Plan)

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1. Preface

HYCON's HY11P serial products have high speed measuring and low power consumption characteristics. This article will describe how the chip, under the low consuming current's condition, completes the voltage measuring in the input voltage scope for ±200mV to meet the MAX 130/131 specification demand.

2. Theory Description

Display 2000 count as 200.0mV, the smallest unit will be 100uV. To achieve this condition, the ratio of the internal and external resolutions is suggested to set as 1:6. Hence, the Input RMS Noise must be smaller than or to be equal to 100uV/6 =16uV while selecting the over sampling rate (OSR) as 256 for A/D Output rate that is equal to A/D output frequency 976HZ.

After completion of one measurement through the program setup, it enters into the IDLE MODE. To measure again through awaking WATCH DOG and set the LCD display updating rate to be approximately 1.2HZ.

For network configuraiton, it uses the network cross way that is provided by the product to get the values so that it may eliminate A/D voltage drift rate (A/D Offset) directly. Make the deduction by taking the digital output values from the forward network and the reverse network separately. (INH/INL: the external signal input pin; S+/S-: the internal A/D signal input source;

Forward network digital outputs: ADO1 = +ADO + ADO offset

Reverse network digital outputs: ADO2 = - ADO + ADO offset

The cancelled result of the digital outputs is: (ADO1-ADO2) = 2AD0

…Eliminate the existed AD offset directly.

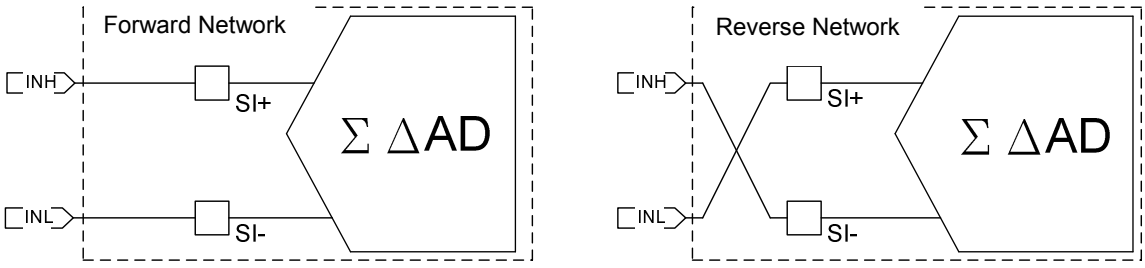

Figure 2-1 A/D Network Cross Diagram

3. Design Plan

3.1. Hardware Description

The simple passive components in the chip itself includes the POWER which is with 4 regulated voltage capacitors (VDD /VLCD /VDDA /ACM), and the Pull high resistor of RST pin itself and the ground capacitor. To match them with the A/D signal input end and the filter capacitor of the reference voltage end that can construct the simple A/D measuring system.

This product provides many available sets of A/D input channels. So in this article, we take AI0/AI1 as the voltage signal input pin and AI2/AI3 as the reference voltage input pin. The application is completed by the simplest circuit. The reference voltage source uses the VDDA differential voltage to input the reference voltage source through AI2/AI3 and calibrates by adjusting the external reference voltage.

The reference point of the voltage input signal source is to take the power ACM (1.2V) as the reference source and connect it to AI1 pin so as to supply the AI0 pin input to measure the +/- signal, just like 2000 counts which its voltage measuring scope can reach ±200mV input signal.

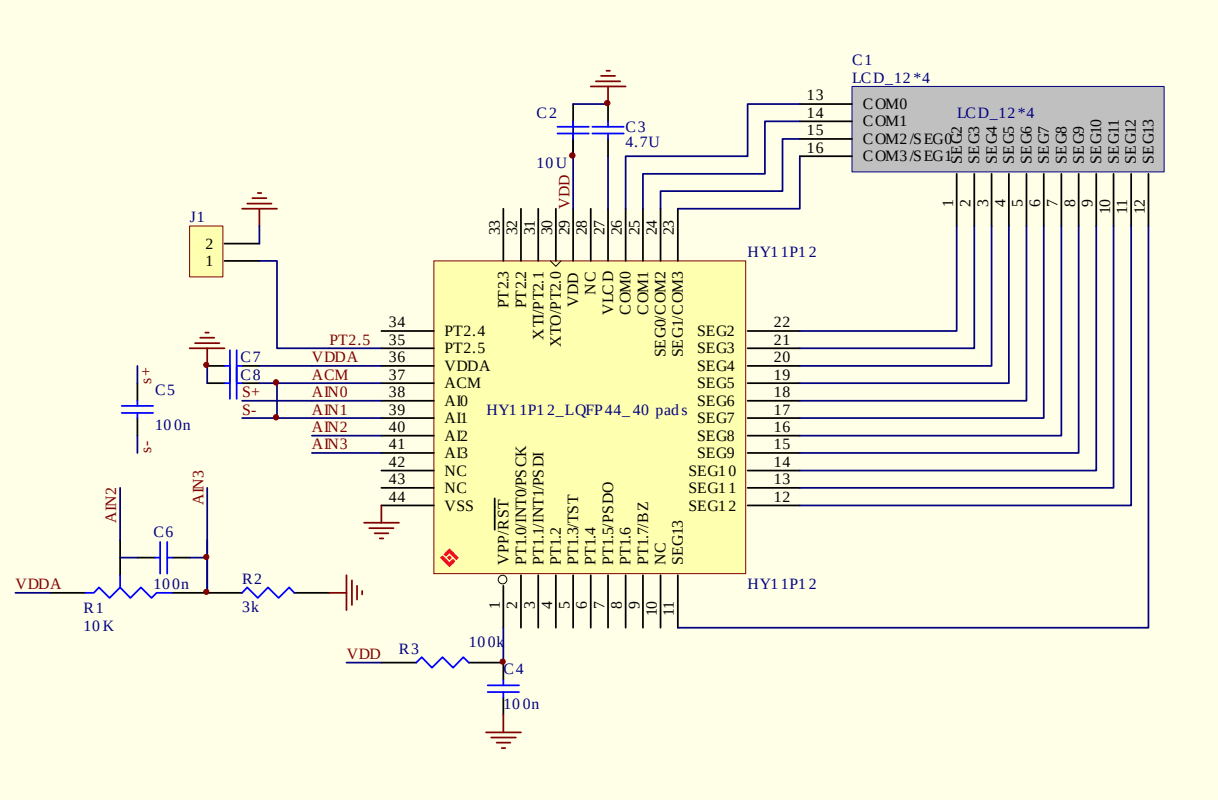

Figure 3-1 Measuring Theory

3.2. BOM List

Table 1

Symbol	Components	Description
HY11P12	LQFP44	U1
C8	0805	47nF
C7	0805	1uF
C2	0805	10uF
C3	0805	4.7uF
C4, C5, C6	0805	100nF
R2	AXIAL-0.4	3K, 1%
R1		10K,1%, Adjustable Resistor
R3	0805	100K
C1	LCD12*4	

3.3. Software Description

Flow chart: For the procedure flow, please refer to Figure 3-2 below.

For the software computing flow in measuring mode, please refer to the chart below that is narrated as follow:

- Switch to the positive network, discard 2 records of ADO, and take 4 records of ADO to average. (Average1)
- Switch to the negative network, discards 2 records of ADO, and take 4 records of ADO to average. (Average2)
- Make the position shift after Average1 subtracting Average2. The computation shows the measuring result.
- Enter IDLE MODE after measuring once, and repeat the above process after the WACHT DOG awaking.
- Select LCD updating frequency to be 1.2HZ or 3.4HZ through I/O PT2.5.

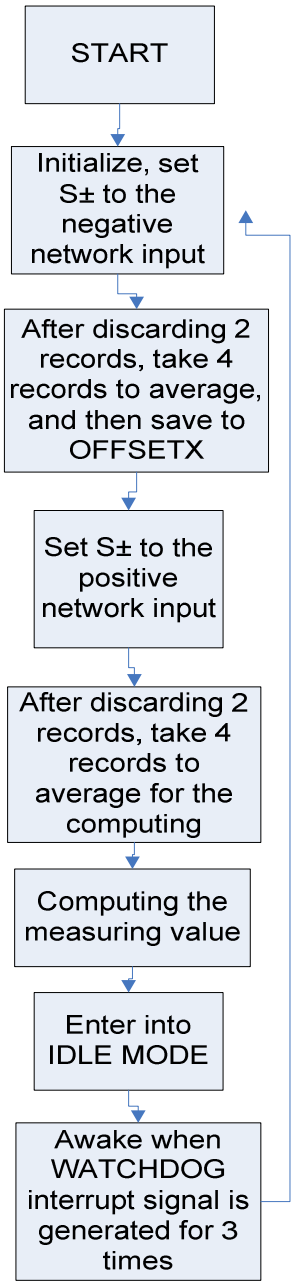

Figure 3-2 Program Flow

3.4. Measuring Wave in The Program

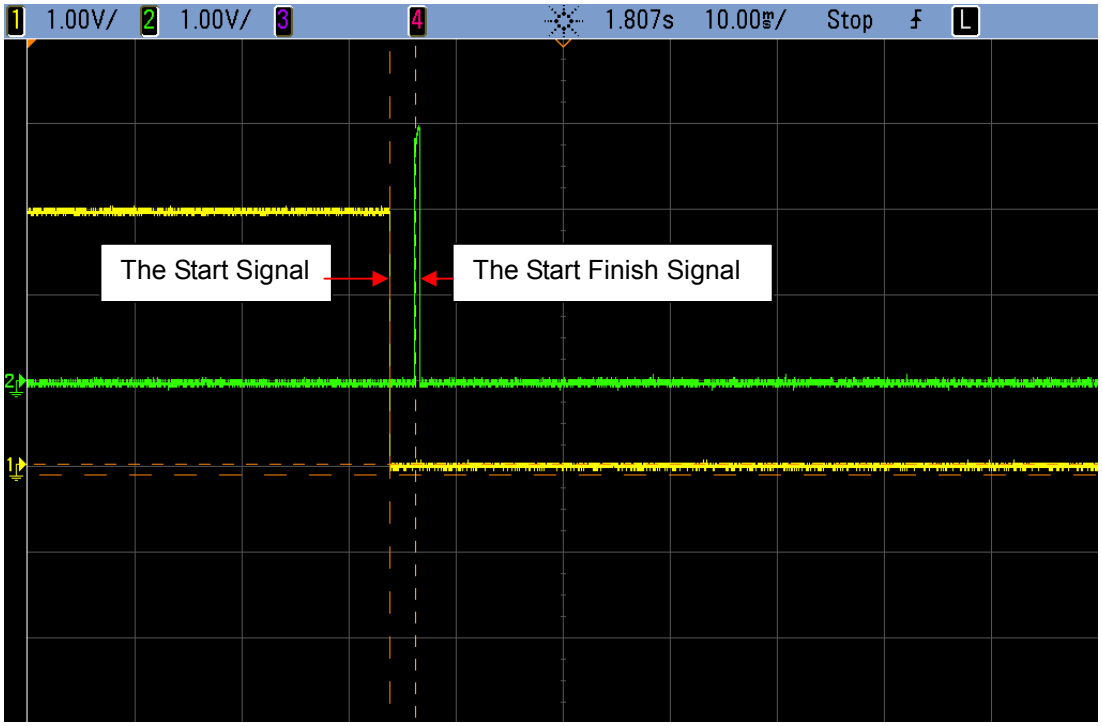

Figure 3-3 The Breaking Wave from IDLE MODE Awaken to Start CPU, △T=2mS

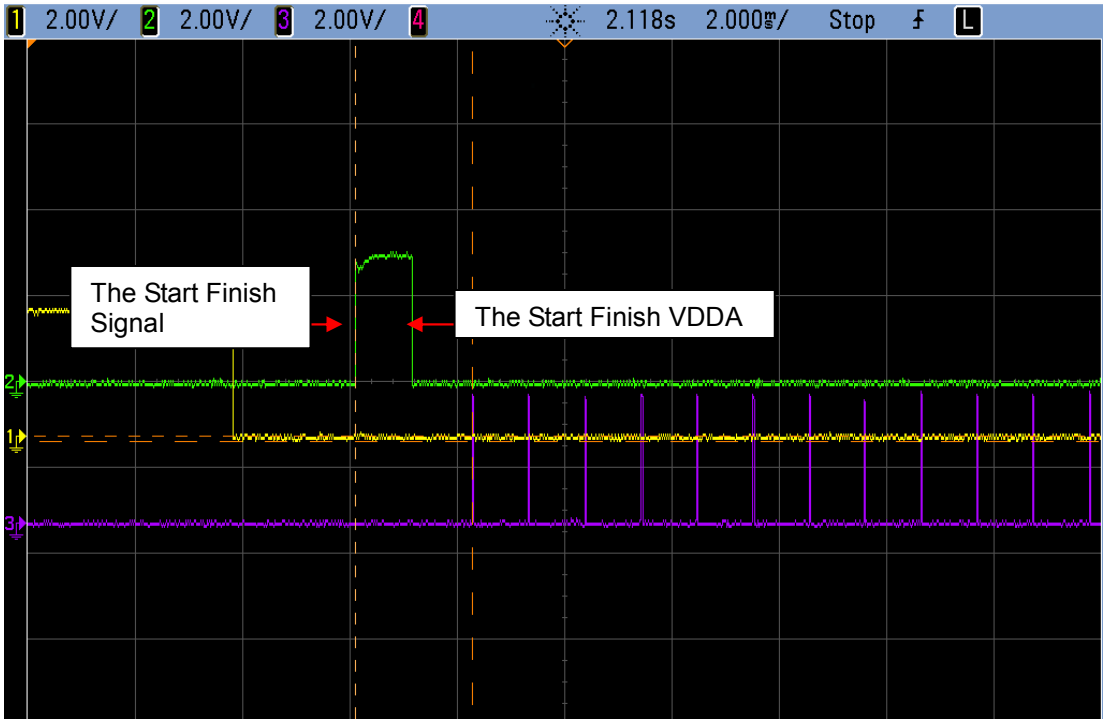

Figure 3-4 VDDA Start Delay Is About 0.5mS

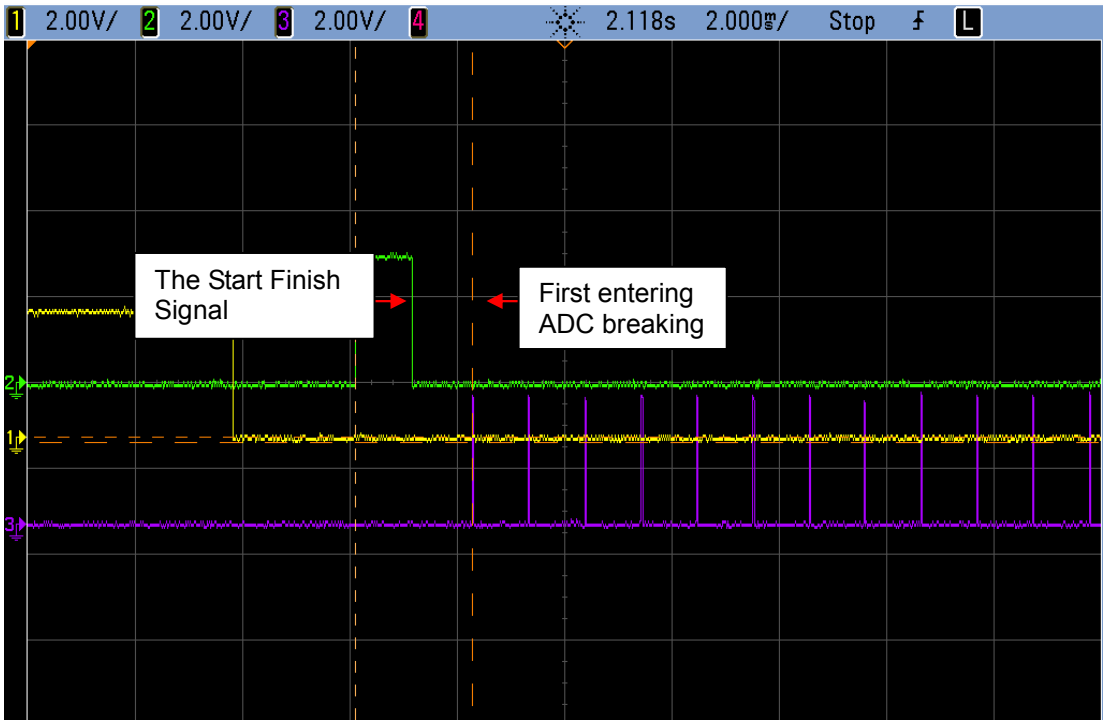

Figure 3-5 The time of the first time entering the ADC breaking after CPU starting, △T=1.52mS

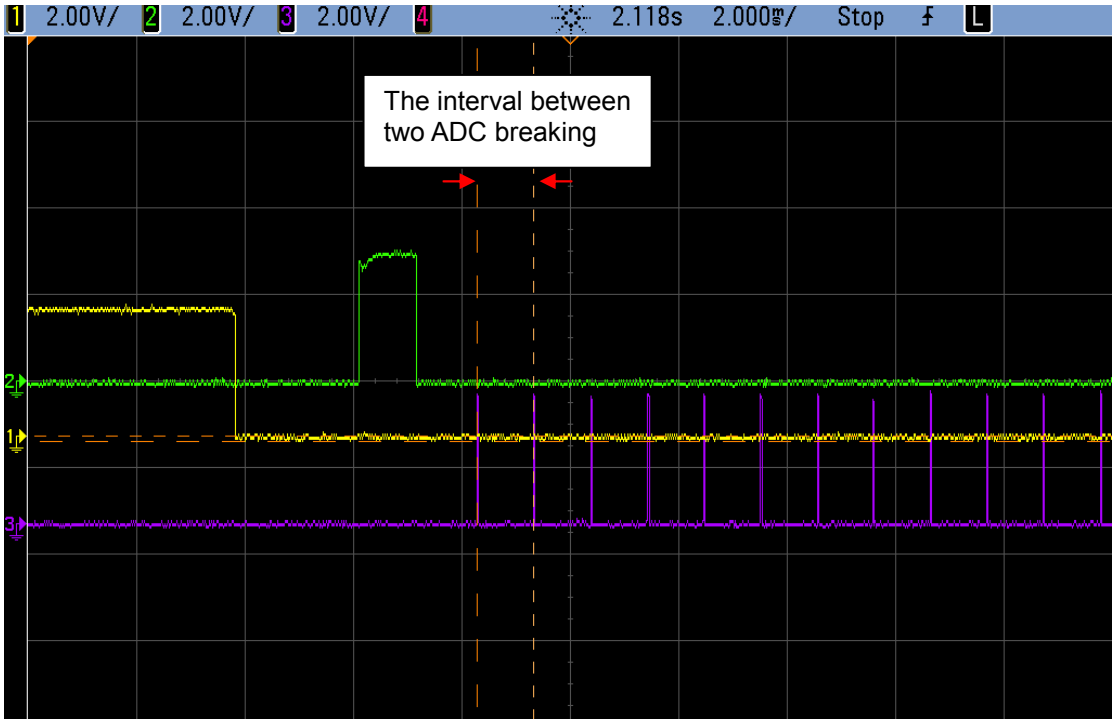

Figure 3-6 The Interval of Every ADC Value Producing, △T=1.02mS

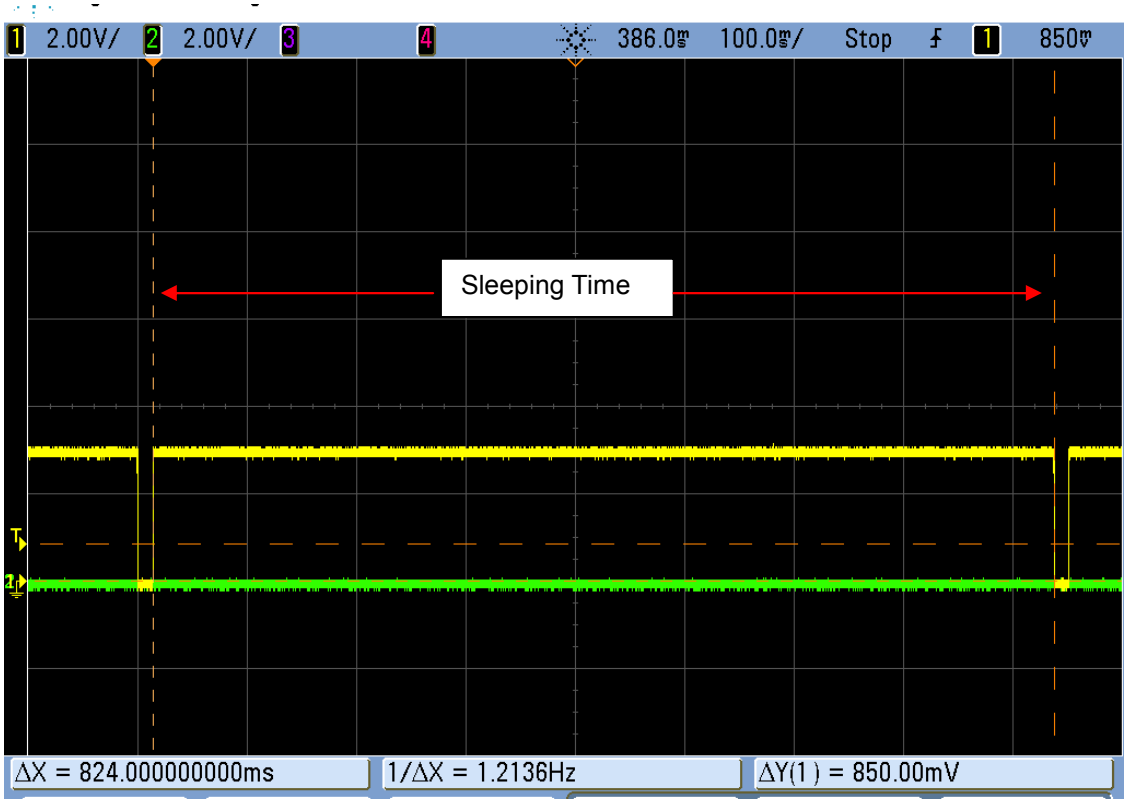

Figure 3-5 The Sleeping Time After Measuring Once, △T=824mS

4. Technical Specification

Operating Voltage: 2.4V~3.6V.

Power Consuming: 0.03mA ~ 0.08mA.

Resolution: Voltage: 1uV ~ 10uV; Temperature: 0.1℃.

Display Speed (Hz): 1.2HZ

Display Value: ±200.00mV

Table 2: T=25℃ ，VDD=3V，unless other noted

parameters	Test conditions	Min	TYP	max	units
Zero input reading	Vin=0.0v,fullscale=200mV	-000.0	000.0	+000.0	Counts
Ratiometric Reading	Vin=Vref, Vref=200mV	199.9	200.0	200.1	Counts
Rollover Error (difference in reading for equal positive and negative reading near full scale)	-Vin=+Vin=200mV	-1	±2	+1	Counts
Linearity	Full scale =200.0mV	-1	±2	+1	Counts
Common mode rejection ratio	Vacm=0.7 to 1.7V,Vin=0V Full scale=200mV		75		DB
Noise	Vin=0V, full scale=200mV		1.85		uV
Input leakage current	Vin=0V,		0.1		μA
Zero reading drift	Vin=0V		0.5		μV
Scale factor temperature coefficient	Vin=199.0mV		2.22		ppm/℃

5. Power Consuming Estimation

To calculate with 3.4 Measuring Wave in The Program, the measuring time to finish one measurement is approximately 14.74mS, the sleeping time is approximately 824mS, and the LCD updating frequency is approximately 1.2HZ.

Therefore, we estimate the average consuming current of the whole measurement to be as the follow:

- ✓ The consuming current for the start delay is approximately: 0.667 uA/S.
- ✓ The consuming current for the VDDA setup delay is approximately: 0.166 uA/S.
- ✓ The consuming current for the measurement and computation of the positive and negative network is approximately: 15.465 uA/S.
- ✓ LCD drive current is: 15 uA/S.
- ✓ The consuming current in IDLE MODE is: 1.65 uA/S.

The average current per second is about 0.667 +0.166＋15.465＋15＋1.65uA ≒ 32.848 uA.

If the updating rate is 3.4HZ per second, the estimation of its consuming current is as follow:

- ✓ The consuming current for the start delay is approximately: 2 uA /S
- ✓ The consuming current for the VDDA setup delay is approximately: 0.5uA/S
- ✓ The consuming current for the measurement and computation of the positive and negative network is approximately: 46.395 uA/S
- ✓ LCD drive current is: 15 uA/S
- ✓ The consuming current in IDLE MODE is: 1.65 uA/S

The average current per second is about 2 +0.5＋46.395＋15＋1.65uA ≒65.545 uA.

6. The Comparison of HY11P12 and MAX131

6.1. The Comparison of Power Consumption

Table 3

	HY11P12 low power DC measure			Max131			
	Min	Typ	Max	Min	Typ	Max	units
Supply voltage	2.7	3	3.6		15		V
Supply current		65			60	100	uA
Power		0.195			0.9		mW

6.2. The Comparison of Chip Type

Table 4

Item	HY11P12 low power DC measure	MAX131
Chip type	OTP	ASIC

Note: The OTP chip can meet the different functional need flexibly through the programming, and simultaneously, it can also carry out the lower power consumption, but ASIC is unable to be revised.

6.3. The Comparison of ADC Characteristics

Table 5

Item		HY11P12 low power DC measure			MAX131			
Parameters	Test conditions	Min	TYP	max	Min	TYP	max	units
Zero input reading	Vin=0.0v,fullscale=200mV	-000.0	000.0	+000.0	-000.0	000.0	+000.0	Counts
Radiometric Reading	Vin=Vref, Vref=200mV	199.9	200.0	200.1	199.9	200.0	200.1	Counts
Rollover Error (difference in reading for equal positive and negative reading near full scale)	-Vin=+Vin=200mV	-1	±2	+1	-1	±2	+1	Count
Linearity	Full scale =200.0mV	-1	±2	+1	-1	±2	+1	Count
Common mode rejection ratio	Vacm=1.0V, Vin=0V Full scale=200mV		75			106		DB
Noise	Vin=0V, full scale=200mV		2.87			10		μV
Input leakage current	Vin=0V,		100			1	10	pA
Zero reading drift	Vin=0V		0.25			0.2		μV
Scale factor temperature	Vin=199.0mV		2.22			1		ppm/℃

Coefficient								
Supply current			62			60	100	uA

7. Conclusion

To take the actual test on the HY11P12 chip of HYCON, we found that it can achieve the measuring purpose only by the combination of few passive components for the chip, and it can further reduce greatly the signal distortion that caused by the external noise disturbance. The author tested actually the dialing and receiving by Nokia6300 handset (the GSM 900/1800 system) and found that the signal amplifying system of the external connection OPAMP line is very easy to be disturbed by the handset signal if use other chips and the measuring results are unusual. However, HY11P12 chip is hardly affected in its testing result. The actual result of it on the external display is ±1 count inaccuracy at most.

In this article, we used HY11P12 chip only to proceed with the A/D application measurement that it is mainly for the demonstration of its performance, stability and low power consumption. The overall performance of HY11P12 can definitely substitute MAX131.

8. Attachment

Example Program:

APD-HY11P12001-V01_SC V0.1.rar

9. Reference Documents

1: MAX131DATSHEET - http://www.maxim-ic.com.cn/quick_view2.cfm/qv_pk/1288

2: HYCON's Product Datasheet: HY11P12- http://www.hycontek.com/page2.html