TTC BLE SDK

CC2640 Based Hardware

Characteristic Test

Version: V1.1

Shenzhen Shengrun Technology Co.,Ltd

24th Feb,2017

Version	Revised Date	Revisionist	Reviewer	Modified Content
1.0	2016-12-30	郭高亮/徐凯翔	张眼	First Release
1.1	2017-02-24	郭高亮	张眼	Improved ADC performance testing

Content

1. ADC Relevant Characteristics Test

Test the following main points:

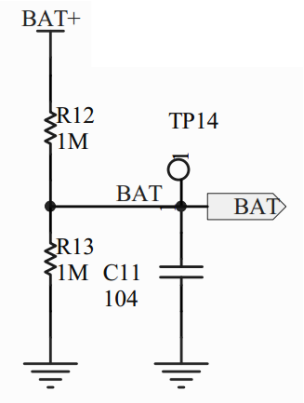
- ADC measurement accuracy when using different reference sources
- Temperature sensor accuracy
- Battery voltage accuracy
- Ambient temperature and the effect of supply voltage on the ADC

1.1 ADC Accuracy

1.1.1 Test Ways Introduction

（1）Peripheral circuits introduction

ADC input pins need to add an RC circuit, collect the voltage through a 104P capacitor connected to the ground. Figure:



（2）software process description

In the program you need to build a periodic event to periodically read the AD value of the voltage, the actual test is 20 times each cycle to collect 20 data and then take the average, and finally the average through the Bluetooth upload to lightblue display, Testers record a number of groups of average, after the completion of data records can draw a chart. In addition, the ADC can use a different internal voltage reference source for software setup, but does not support the use of external reference sources.

（3）Actual operation

The actual test is to use a high-precision DC power analyzer (accurate to 0.0001V) output voltage to the above figure BAT +, adjust the voltage output, with a high-precision multimeter (can be accurate to 0.0001V) measured the voltage at BAT (note, In the adjustment of the voltage after the need to remove the voltmeter table pen, so as not to affect the measurement). And then calculate the theoretical value and the actual value of the difference, with the difference to observe the characteristics of the ADC, each reference voltage are tested again, and ultimately be able to get a complete ADC characteristics table。

Note: ADC test, the analog IO port voltage input to be less than VDDS to ensure the test accuracy!

（4）summary

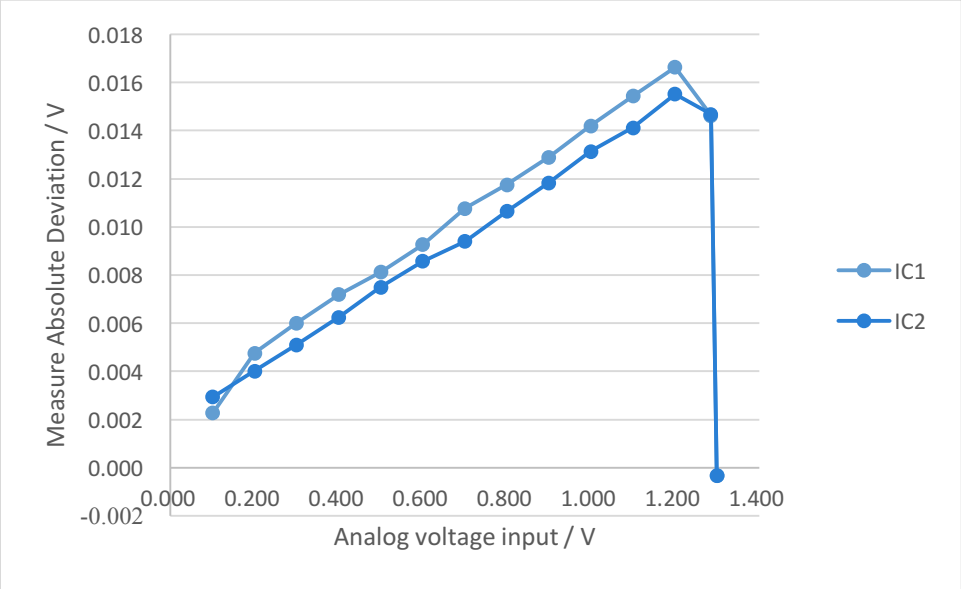
According to the actual test: the use of internal 1.43V voltage as a reference power, ADC measurement accuracy is better (in the 0V ~ 1.43V range, the absolute deviation measured within 2mV). Test the three chips used to measure the absolute error consistency is better. When selecting other reference power, measure the absolute deviation of the increase in amplitude.

The following test results are for reference only

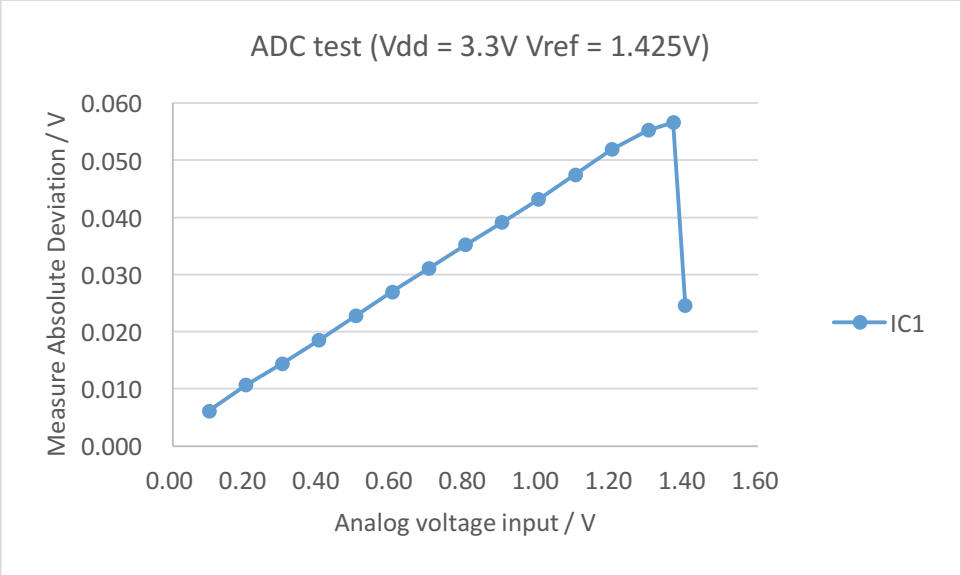
1.1.2 ADC attribute table

（1）Vdd=3.3V Vref = 1.3V

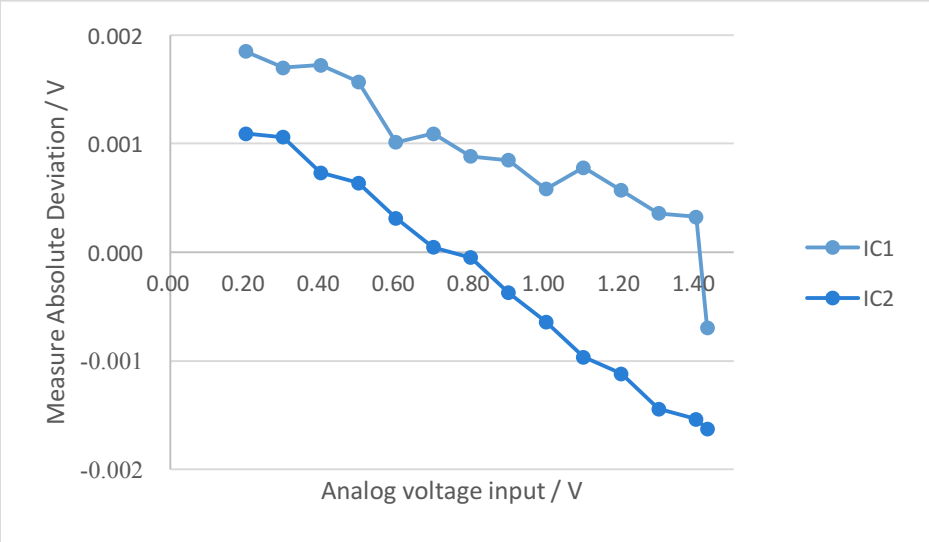
ADC test (Vdd = 3.3V Vref = 1.3V)



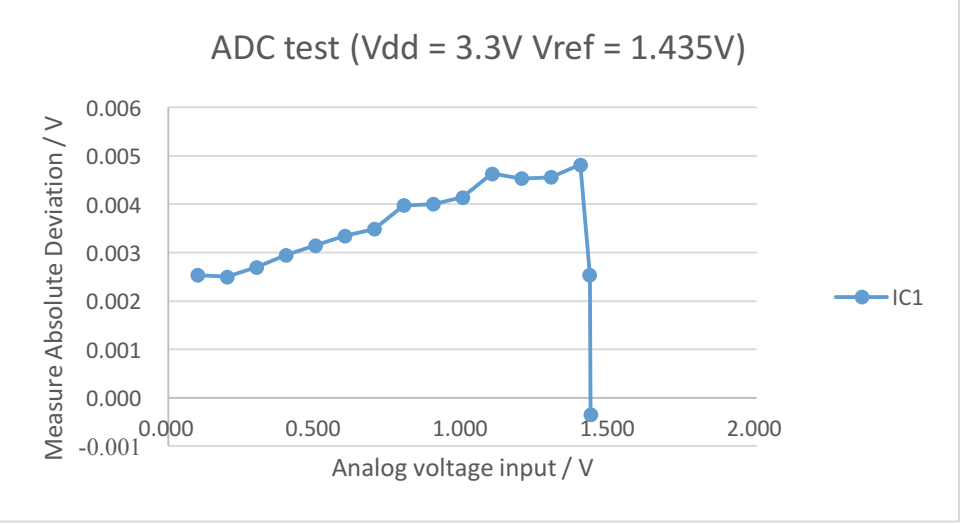
（2）Vdd=3.3V Vref = 1.425V



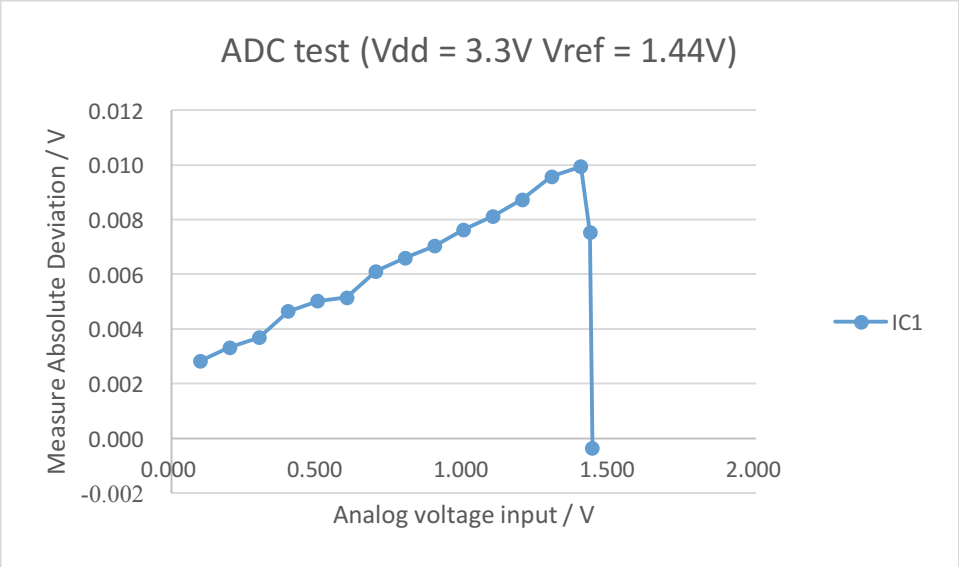
（3）Vdd=3.3V　Vref = 1.43V



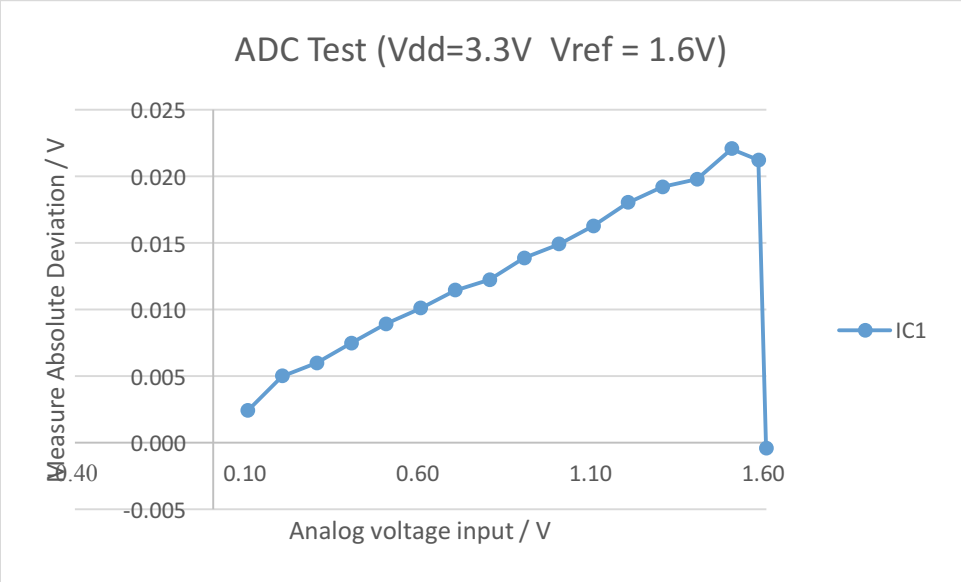
（4）Vdd=3.3V　Vref = 1.435V



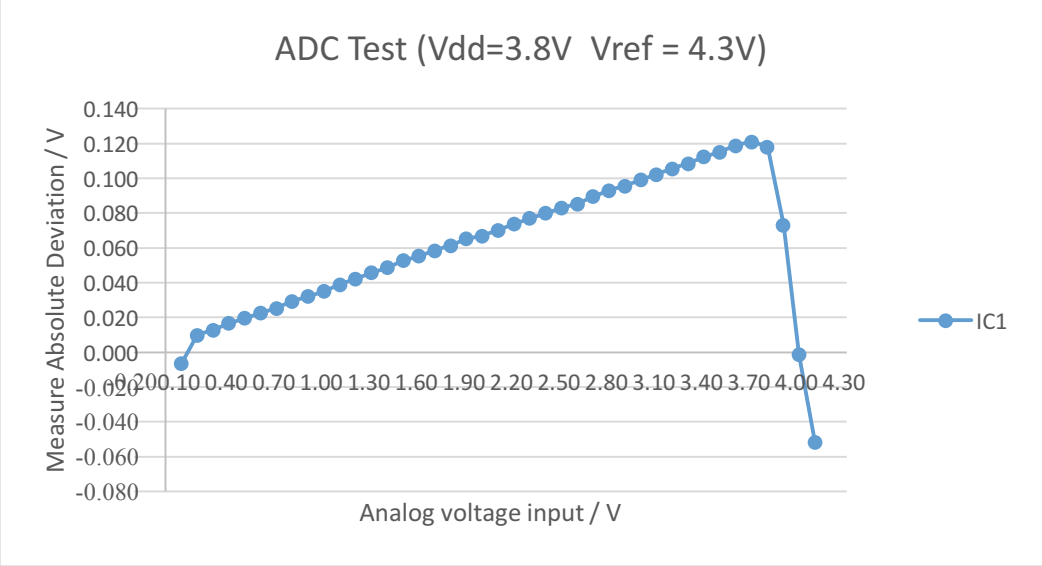
（5）Vdd=3.3V Vref = 1.44V



（6）Vdd=3.3V Vref = 1.6V



（7）Vdd=3.8V Vref = 4.3V



1.2 Temperature Sensor

After testing, in the -40 ℃ ~ +85 ℃ range, the temperature sensor measurement of absolute deviation within 5 ℃, consistent with the datasheet parameters:

Measured on the TI CC2650EM-5XD reference design with T_c = 25°C, V_{DDS} = 3.0 V, unless otherwise noted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Resolution			4		°C
Range		–40		85	°C
Accuracy			±5		°C
Supply voltage coefficient(1)			3.2		°C/V

1.2.1 Test Methods Introduction

（1）Software Process Introduction

In the program you need to build a periodic event to periodically read the temperature value, Measured Results through the Bluetooth upload to the lightblue display, observe the results of five consecutive tests, complete the data recorded after drawing a chart

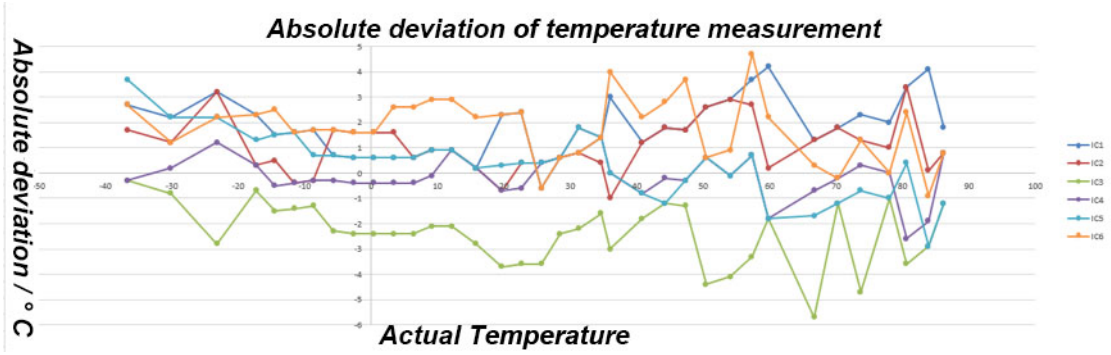
（2）Actual operation

Testing 6pcs of CC2640 5*5 based modules at the same time, 3.3V power on. Put them into the high and low temperature test machine, and use digital thermometer to help record the actual temperature. Set the target temperature of the high and low temperature test in turn, after the temperature is stable, record the temperature of the digital thermometer and lightblue display the measured temperature

1.2.2 Measured Results

The six chips used in the test do not have very good consistency, but

the accuracy of basic within 5 degrees Celsius. See below:



1.3 Battery Monitor

the battery voltage monitoring of the absolute deviation of the measurement within 30mV after testing. The following is the datasheet parameters:

Measured on the TI CC2650EM-5XD reference design with T_c = 25°C, V_{DDS} = 3.0 V, unless otherwise noted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Resolution			50		mV
Range		1.8		3.8	V
Accuracy			13		mV

1.3.1 Test Methods Introduction

（1）Software Process Introduction

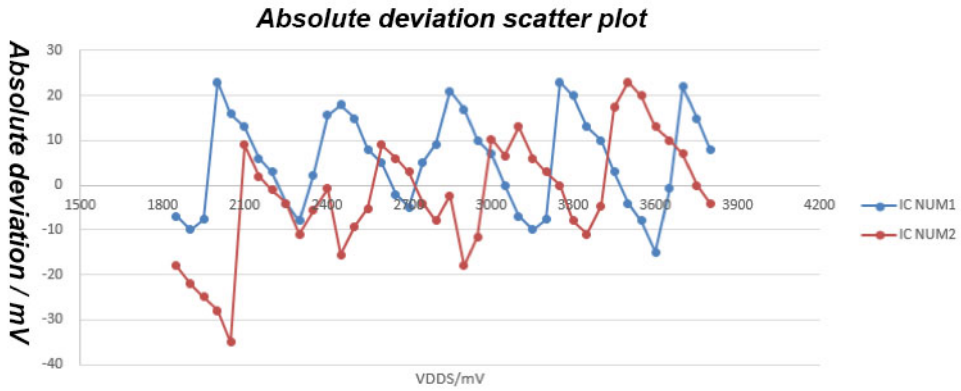
In the program need to build a periodic event to periodically read the battery voltage, Measured Results through Bluetooth to lightblue display, observe the results of five consecutive tests, complete the data recorded after drawing the chart。

（2）Actual operation

Test two CC2640 5 * 5 modules, use the DC power analyzer in the 1.8V ~ 3.8V range of power supply, followed by recording Measured Results.

1.3.2 Measured Results

The following figure contains two CC2640 test results, respectively, with two different colors of the polyline, for reference only. The two chips used in the test do not have very good consistency, but the accuracy of the basic within 30mV.



1.4 Ambient temperature and supply voltage effect on the ADC

1.4.1Power supply Voltage VDDS effects on ADC

(1)Datasheet parameter see as below:

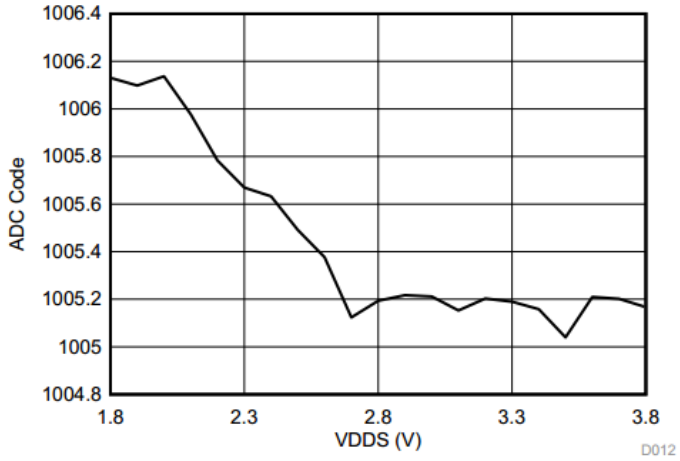


Figure 5-18. SoC ADC Output vs Supply Voltage (Fixed Input, Internal Reference, No Scaling)

(2) Use the internal 1.43V as a reference source, DC power analyzer 1.46v as a fixed input, and with the section1.1.1 mentioned in the voltage divider circuit, range: -40 ℃ ~ +80 ℃, the maximum deviation of the test results of 6LSB (2mV).

1.4.2 Ambient Temperature effects on ADC

The actual Measured Results basically conforms to the parameters given in the specification.

Note: ADC test, the analog IO port voltage input to be less than VDDS to ensure the test accuracy!

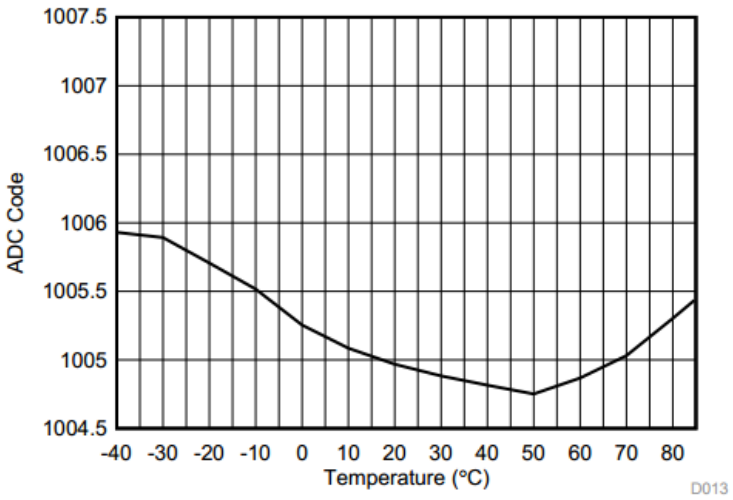


Figure 5-19. SoC ADC Output vs Temperature (Fixed Input, Internal Reference, No Scaling)

2. GPIO Test

Test items are divided into two: input threshold and load capacity test are basically in line with the parameters given by TI, please refer to TI CC2640 data sheet. The following test results are for reference only。

2.1 GPIO Input Threshold Test

1. TI DataSheet Parameter

VIH: ≥0.8*VDDS (Lowest GPIO input voltage reliably interpreted as a «High»)

VIL: ≤0.2*VDDS (Highest GPIO input voltage reliably interpreted as a «Low»)

2. Tested Result

(1) Input IO port setting: Input, no pull-up, no hysteresis

IOID_14 | PIN_GPIO_OUTPUT_DIS | PIN_INPUT_EN | PIN_NOPULL,

VIH: ≥1.51V

VIL: ≤1.49V

Note: There is an unstable interval

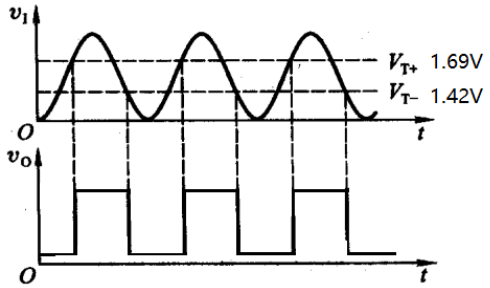
(2) Input IO port setting: Input, no pull-up, there is lag

IOID_14 | PIN_GPIO_OUTPUT_DIS | PIN_INPUT_EN | PIN_NOPULL | PIN_HYSTERESIS,

Positive increasing threshold voltageV_{T+}: 1.69V

Negative decreasing threshold voltageV_{T-}: 1.42V

Note: The intermediate voltage is judged by the direction of voltage change



Note: After PIN_HYSTERESIS is enabled, it is equivalent to adding the Schmitt Trigger function. The Schmitt trigger has a different threshold voltage for both negative and forward increments in two different directions of input.

(3) Pull up without lag

VIH: ≥1.51V

VIL: ≤1.49V

(4) Pull up lag

Positive increasing threshold voltageV_{T+}: 1.67V

Negative decreasing threshold voltageV_{T-}: 1.43V

(5) Pull down without lag

VIH: ≥1.51V

VIL: ≤1.49V

(6) Pull down lag

Positive increasing threshold voltageV_{T+}: 1.67V

Negative decreasing threshold voltageV_{T-}: 1.43V

Tested Result:

Voltage	No lag threshold	Hysteresis threshold
3.8V	1.69V	1.57V/1.91V
3.3V	1.49V/1.51V	1.38V/1.73V
3.0V	1.36V/1.39V	1.27V/1.60V
2.7V	1.24V/1.27V	1.15V/1.47V
2.4V	1.13V/1.16V	1.03V/1.33V
2.0V	0.97V/0.98V	0.85V/1.16V

2.2 Load capacity test (single IO port)

CC2640 high drive capability pins are DIO_3, DIO_4, DIO_5, DIO_6.

Drive capability setting:

```
#define PIN_DRVSTR_MIN    (PIN_GEN|(0x0<<8))  ///< (*) Lowest drive strength
#define PIN_DRVSTR_MED    (PIN_GEN|(0x4<<8))  ///< Medium drive strength
#define PIN_DRVSTR_MAX    (PIN_GEN|(0x8<<8))  ///< Highest drive strength
```

2.2.1 Source current

Test Environment:

CC2640 based transparent transmission module IO port connected to an adjustable resistor down to GND, adjust the resistance value, observe the output of IO port, IO port voltage, respectively, in the different configuration between the two effects.

Note: The module is always linked with lightblue during the test。

VDDS	IO Port	IO Setting	output Current	Actual Voltage	TI parameter value
3.3V	DIO_3 Output high level	PIN_DRVSTR_MAX	15.092 mA	2.32 v	
			10.088 mA	2.68 v	
			8.020 mA	2.80 v	
			4.005mA	3.08 v	
			2.006mA	3.22v	

VDDS	IO port	IO setting	Output Current	Actual Voltage	TI Parameter Value
3.0V	DIO_3 Output high level	PIN_DRVSTR_MAX	15.210 mA	1.92v	
			10.161mA	2.40v	
			8.057mA	2.52v	2.68v
			4.021mA	2.80v	
			2.015mA	2.92v	

VDDS	IO PORT	IO SETTING	Output Current	Actual Voltage	TI PARAMETER VALUE
2.4V	DIO_3 Output high level	PIN_DRVSTR_MAX	15.223 mA	1.40 v	
			10.233 mA	1.80 v	
			8.066 mA	1.92 v	
			4.098 mA	2.20 v	
			2.032mA	2.32 v	

2.2.2 Sink current

Testing Environment:

CC2640 based transparent transmission Module IO PORT Connect an adjustable resistor to VDDS, adjust the resistance value, observe the voltage of the Output Current, IO PORT of IO PORT, and the effect of the difference between the two configurations

VDDS	IO PORT	IO SETTING	Output Current	Actual Voltage	TI PARAMETER VALUE
3.3V	DIO_3 output low level	PIN_DRVSTR_MAX	-15.230 mA	1.160v	
			-10.116 mA	0.680 v	
			-8.093 mA	0.520 v	
			-4.036 mA	0.240 v	
			-2.065mA	0.120 v	

VDDS	IO PORT	IO SETTING	Output Current	Actual Voltage	TI PARAMETER VALUE
3.0V	DIO_3 output low level	PIN_DRVSTR_MAX	-15.131 mA	1.160 v	
			-10.356 mA	0.680 v	
			-8.006 mA	0.520 v	0.33V
			-4.060 mA	0.240 v	
			-2.020 mA	0.120 v	

VDDS	IO PORT	IO SETTING	Output Current	Actual Voltage	TI PARAMETER VALUE
2.4V	DIO_3 output low level	PIN_DRVSTR_MAX	-15.049 mA	1.200v	
			-10.020 mA	0.600 v	
			-8.130 mA	0.440 v	
			-4.033 mA	0.240 v	
			-2.090 mA	0.120 v	

3. Contact Us

深圳市昇润科技有限公司
ShenZhen ShengRun Technology Co.,Ltd.
Tel: 0755-86233846 Fax: 0755-82970906

Website：www.tuner168.com

Alibaba Shop：http://shop1439435278127.1688.com

E-mail: marketing@tuner168.com

地址：广东省深圳市南山区西丽镇龙珠四路金谷创业园 B 栋 6 楼 601-602
ADD: the 6F, BBlock of jingu Pioneer Park, longzhu 4th Road, Nanshan District, Shenzhen, China