

Test Specifications and Results of ADC components

Spec-00000058. pdf

$$v_i = (a_i \times \text{ADC_vdd}) / 2^{\text{ADC_bit}}$$

$$y = (v_i - x_{\text{offset}}) / \text{gain} + y_{\text{offset}}$$

SMA calculation method

$$\text{phy} = (y_n + y_{n-1} + y_{n-2}) / n$$

range min to max

EMA calculation method

$$\text{phy} = (y \times k) + (\text{phy}_{n-1} \times (1 - k))$$

WMA calculation method

$$\text{phy} = (y_n \times n) + (y_{n-1} \times (n-1)) + \dots + (y_1 \times 1) / (n + (n-1) + \dots + 1)$$

Non-MA calculation method

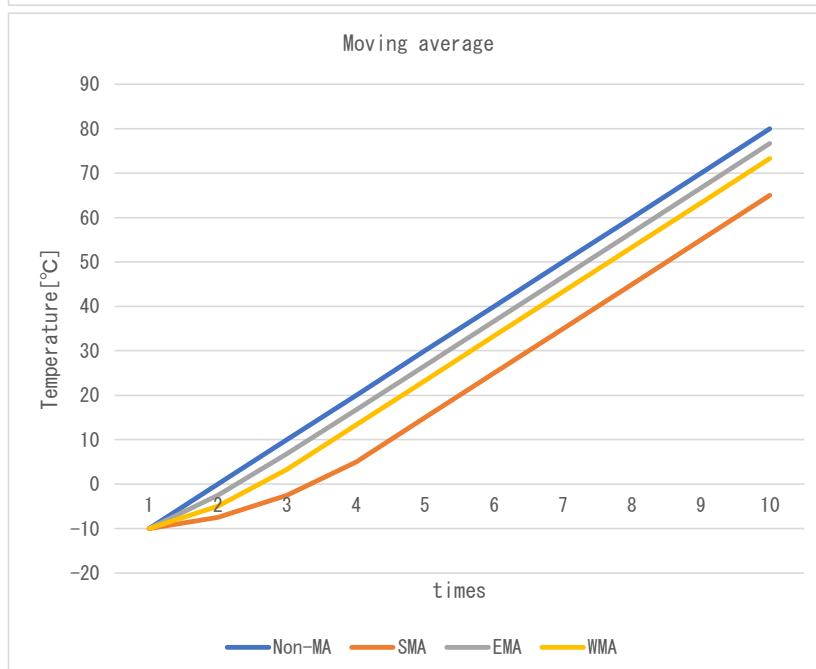
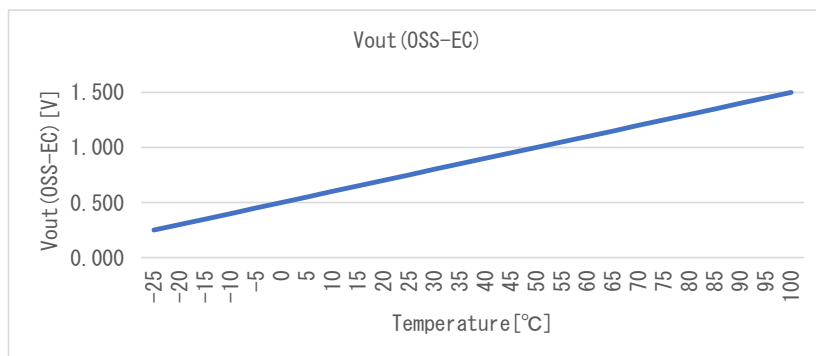
$$\text{phy} = y$$

Date	2-Nov-22
Verifier	Red Dragon

Spec-LM50B. pdf

component data	
x_offset	0.5000 [V]
gain	0.01 [V/°C]
y_offset	0.0 [°C]
max	100.0 [°C]
min	-25.0 [°C]

Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3

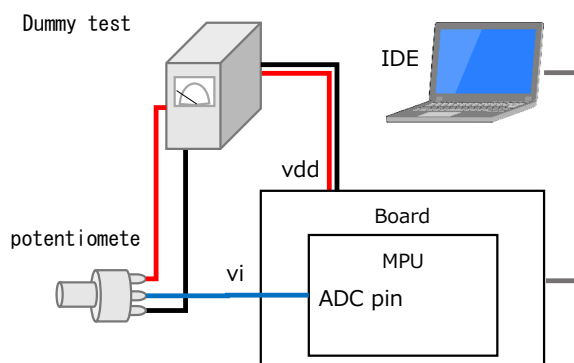


Test environment

Board	NUCLEO-F401RE
MPU	STM32F401RE
CompilerVer	Arm Compiler 6.16
IDE	Mbed Studio 1.4.4
Vdd	3.3 [V]
ADC bit	16 [bit]
ADC pin	A0 -
Component	Dummy

Normal operating voltage

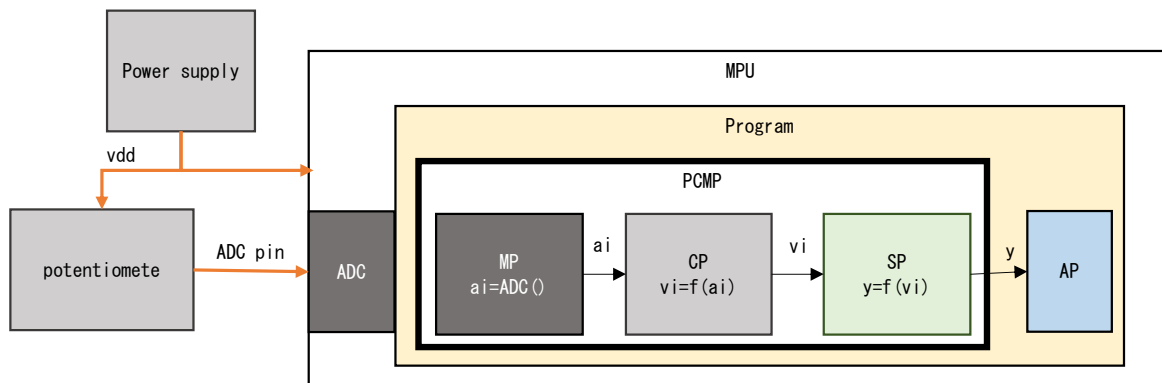
Vdd	5.0 [V]
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Test Method

1. Coupling test with variable resistors

As shown in the figure below, the voltage is varied by a variable resistor to check if the temperature calculation results match the specifications. Non-MA mode:



※Use a 3.3V board instead of a 5V board because we do not have a board with 5V Vdd, although it is a 5V product

Data with 3.3V board

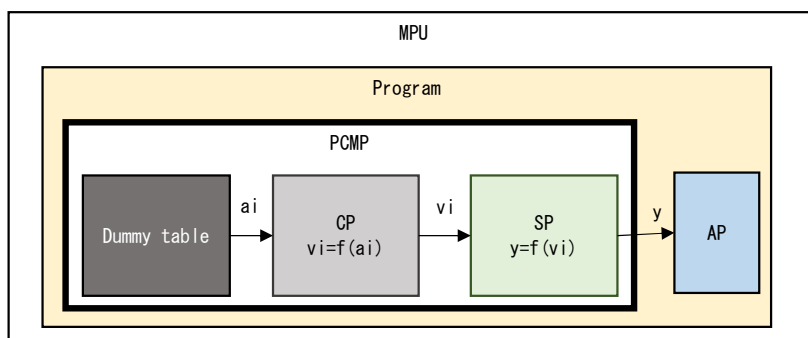
x_offset	0.5000 [V]
gain	0.01 [V/°C]
y_offset	0.0 [°C]

No.	ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	0.000	0	0.000	-50.000	-25.000	4,002	OK
		32	0.002	-49.839	-25.000	4,002	
		-32	-0.002	-0.161	0.000	0	
2	1.300	25,817	1.300	79.999	79.999	4,000	OK
		25,830	1.301	80.064	80.064	4,000	
		-13	-0.001	-0.065	-0.065	0	
3	1.500	29,789	1.500	100.000	100.000	4,000	OK
		29,527	1.487	98.680	98.680	4,000	
		262	0.013	1.319	1.319	0	
4	3.300	65,536	3.300	280.000	100.000	4,001	OK
		65,535	3.300	279.995	100.000	4,001	
		1	0.000	0.005	0.000	0	

res.sts 4,000 Normal
 4,001 Max Limiter NG
 4,002 Min Limiter NG

2. Detail of replacing ADC value test

As shown in the figure below, change the MP layer to the value read from the Dummy table as shown in the test, and perform the following detailed test.



2-1. Max/Min range test

Vary a_i according to Dummy table as shown in the table below, and check Max/Min limiters and diagnostic results. Non-MA mode.

No.		Dummy a_i	v_i	p	res.phy	res.sts	Judgment
1	Expected	3,278	0.250	-24.991	-24.991	4,000	OK
	Measured	3,278	0.250	-24.991	-24.991	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	3,277	0.250	-24.998	-24.998	4,000	OK
	Measured	3,277	0.250	-24.998	-24.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	3,276	0.250	-25.006	-25.000	4,002	OK
	Measured	3,276	0.250	-25.006	-25.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	3,277	0.250	-24.998	-24.998	4,000	OK
	Measured	3,277	0.250	-24.998	-24.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	19,660	1.500	99.994	99.994	4,000	OK
	Measured	19,660	1.500	99.994	99.994	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	19,661	1.500	100.002	100.000	4,001	OK
	Measured	19,661	1.500	100.002	100.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	19,660	1.500	99.994	99.994	4,000	OK
	Measured	19,660	1.500	99.994	99.994	4,000	
	Difference	0	0.000	0.000	0.000	0	

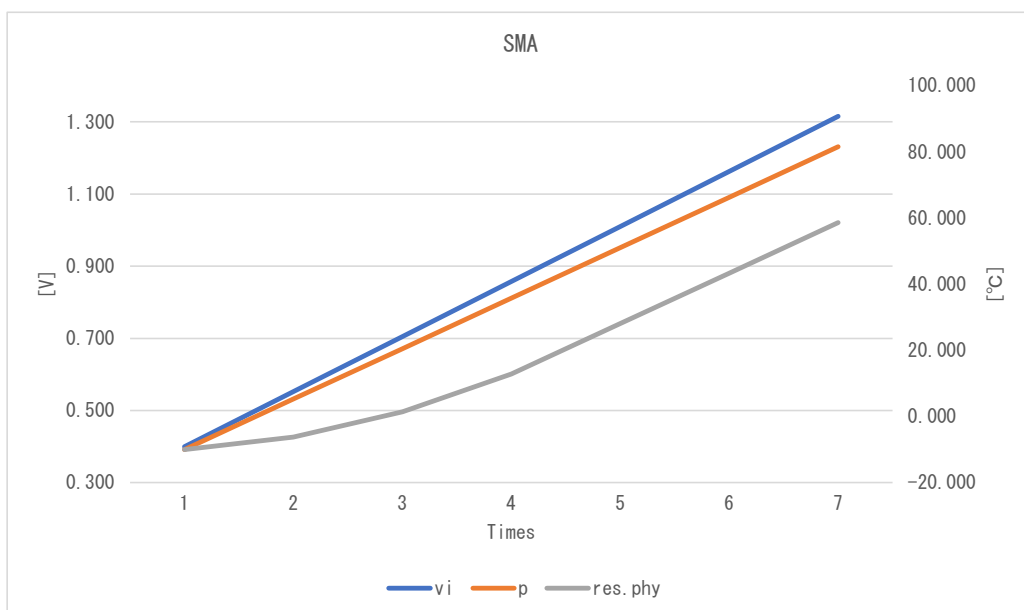
res.sts 4000 Normal
 4001 Max Limiter NG
 4002 Min Limiter NG

2-2. Moving average test

Check each Filter by changing a_i according to the Dummy table as shown in the table below.

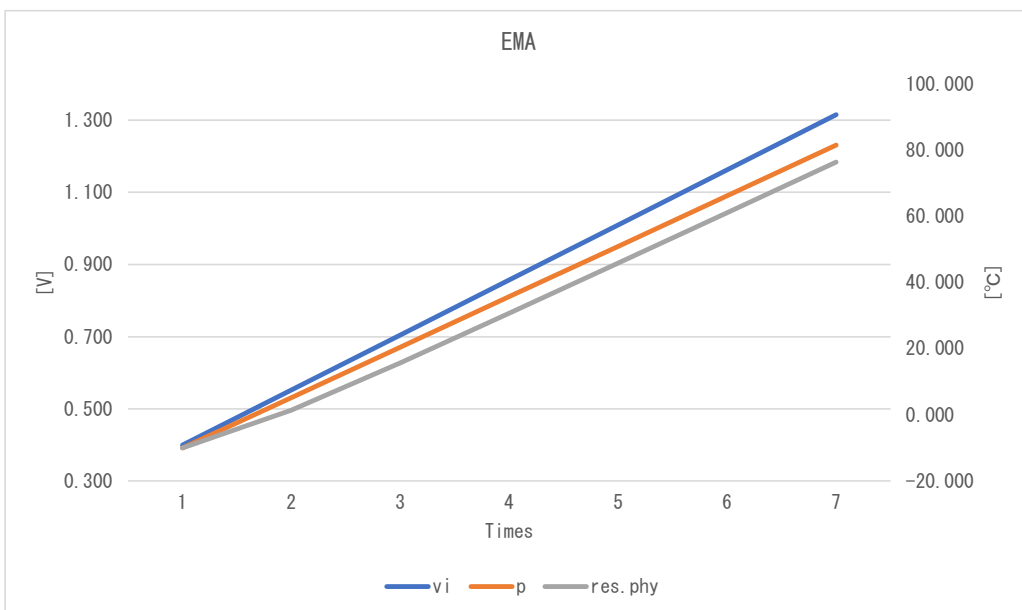
SMA

No.		Dummy a_i	v_i	p	res. phy	res. sts	Judgment
1	Expected	5,240	0.400	-10.022	-10.022	4,000	OK
	Measured	5,240	0.400	-10.022	-10.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	7,240	0.552	5.237	-6.207	4,000	OK
	Measured	7,240	0.552	5.237	-6.207	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	9,240	0.705	20.496	1.422	4,000	OK
	Measured	9,240	0.705	20.496	1.422	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	11,240	0.858	35.754	12.866	4,000	OK
	Measured	11,240	0.858	35.754	12.866	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,240	1.010	51.013	28.125	4,000	OK
	Measured	13,240	1.010	51.013	28.125	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	15,240	1.163	66.272	43.384	4,000	OK
	Measured	15,240	1.163	66.272	43.384	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,240	1.315	81.531	58.643	4,000	OK
	Measured	17,240	1.315	81.531	58.643	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

	No.	Dummy ai	vi	p	res. phy	res. sts	Judgment
1	Expected	5,240	0.400	-10.022	-10.022	4,000	OK
	Measured	5,240	0.400	-10.022	-10.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	7,240	0.552	5.237	1.422	4,000	OK
	Measured	7,240	0.552	5.237	1.422	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	9,240	0.705	20.496	15.727	4,000	OK
	Measured	9,240	0.705	20.496	15.727	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	11,240	0.858	35.754	30.748	4,000	OK
	Measured	11,240	0.858	35.754	30.748	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,240	1.010	51.013	45.947	4,000	OK
	Measured	13,240	1.010	51.013	45.947	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	15,240	1.163	66.272	61.191	4,000	OK
	Measured	15,240	1.163	66.272	61.191	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,240	1.315	81.531	76.446	4,000	OK
	Measured	17,240	1.315	81.531	76.446	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

	No.	Dummy ai	vi	p	res. phy	res. sts	Judgment
1	Expected	5,240	0.400	-10.022	-10.022	4,000	OK
	Measured	5,240	0.400	-10.022	-10.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	7,240	0.552	5.237	-2.393	4,000	OK
	Measured	7,240	0.552	5.237	-2.393	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	9,240	0.705	20.496	10.323	4,000	OK
	Measured	9,240	0.705	20.496	10.323	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	11,240	0.858	35.754	25.582	4,000	OK
	Measured	11,240	0.858	35.754	25.582	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,240	1.010	51.013	40.841	4,000	OK
	Measured	13,240	1.010	51.013	40.841	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	15,240	1.163	66.272	56.099	4,000	OK
	Measured	15,240	1.163	66.272	56.099	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,240	1.315	81.531	71.358	4,000	OK
	Measured	17,240	1.315	81.531	71.358	4,000	
	Difference	0	0.000	0.000	0.000	0	

