

## Test Specifications and Results of ADC components

Spec-00000058. pdf

$$v_i = (a_i \times \text{ADC\_vdd}) / 2^{\text{ADC\_bit}}$$

$$y = (v_i - x_{\text{offset}}) / \text{gain} + y_{\text{offset}} \quad \text{range min to max}$$

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

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

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

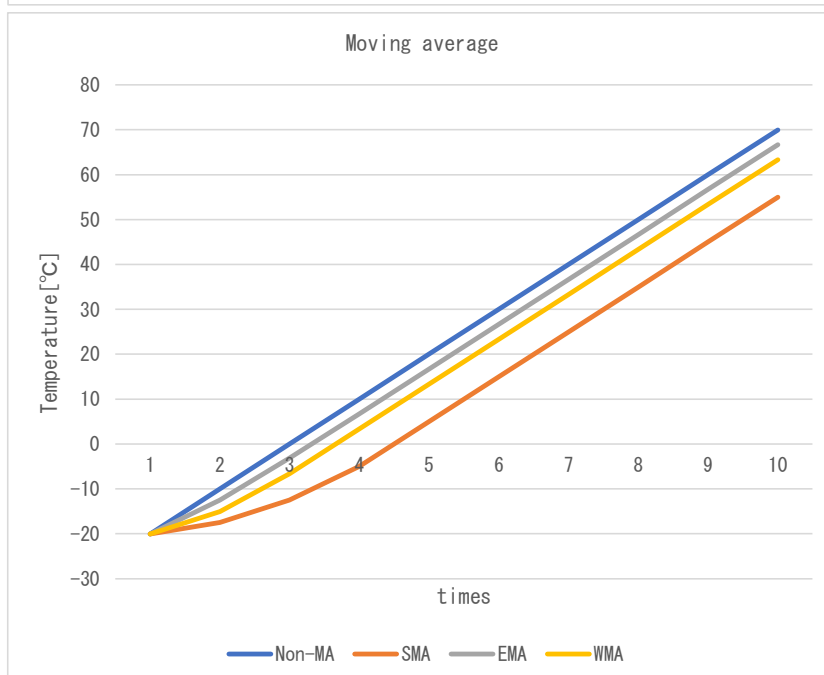
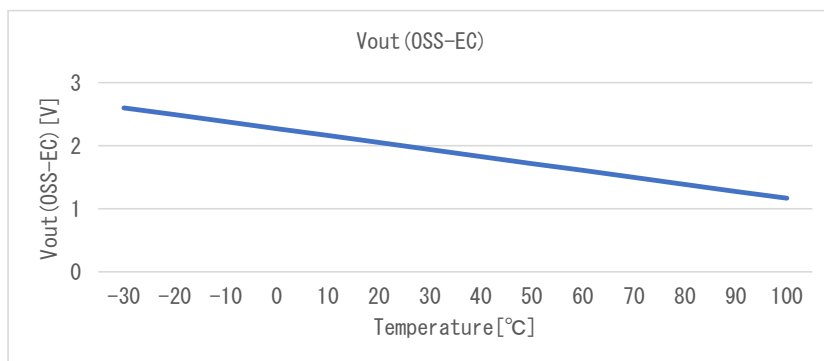
$$\text{Non-MA calculation method} \quad \text{phy} = y$$

Date	30-Sep-22
Verifier	Red Dragon

Spec-S-5813A\_5814A. pdf

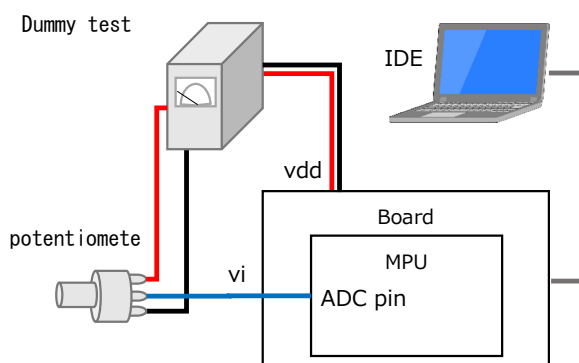
component data		
x_offset	1.9400 [V]	
gain	-0.01104 [V/°C]	
y_offset	30.0 [°C]	
max	100.0 [°C]	
min	-30.0 [°C]	

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



## 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:

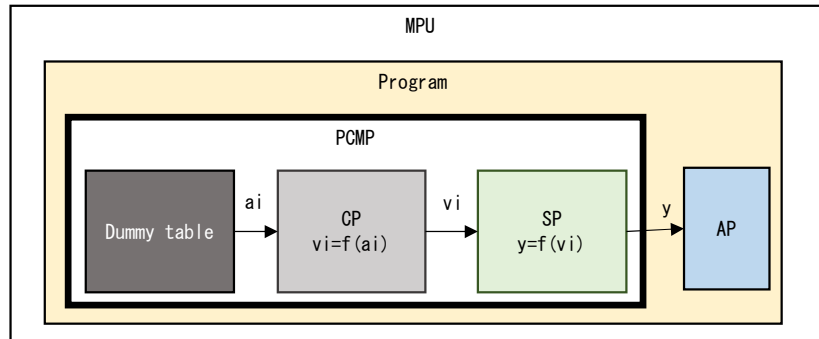


No.		ADC pin	ai	vi	p	res. phy	res. sts	Judgment
1	Expected	0.000	0	0.000	205.725	100.000	4,001	OK
	Measured		0	0.000	205.725	100.000	4,001	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.505	29,878	1.504	69.450	69.450	4,000	OK
	Measured		29,879	1.505	69.445	69.445	4,000	
	Difference		-1	0.000	0.005	0.005	0	
3	Expected	2.024	40,185	2.023	22.439	22.439	4,000	OK
	Measured		40,201	2.024	22.366	22.366	4,000	
	Difference		-16	-0.001	0.073	0.073	0	
4	Expected	3.300	65,536	3.300	-93.188	-30.000	4,002	OK
	Measured		65,535	3.300	-93.184	-30.000	4,002	
	Difference		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	23,181	1.167	99.995	99.995	4,000	OK
	Measured	23,181	1.167	99.995	99.995	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	23,180	1.167	99.999	99.999	4,000	OK
	Measured	23,180	1.167	99.999	99.999	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	23,179	1.167	100.004	100.000	4,001	OK
	Measured	23,179	1.167	100.004	100.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	23,180	1.167	99.999	99.999	4,000	OK
	Measured	23,180	1.167	99.999	99.999	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	51,682	2.602	-30.000	-30.000	4,000	OK
	Measured	51,682	2.602	-30.000	-30.000	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	51,683	2.602	-30.004	-30.000	4,002	OK
	Measured	51,683	2.602	-30.004	-30.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	51,682	2.602	-30.000	-30.000	4,000	OK
	Measured	51,682	2.602	-30.000	-30.000	4,000	
	Difference	0	0.000	0.000	0.000	0	

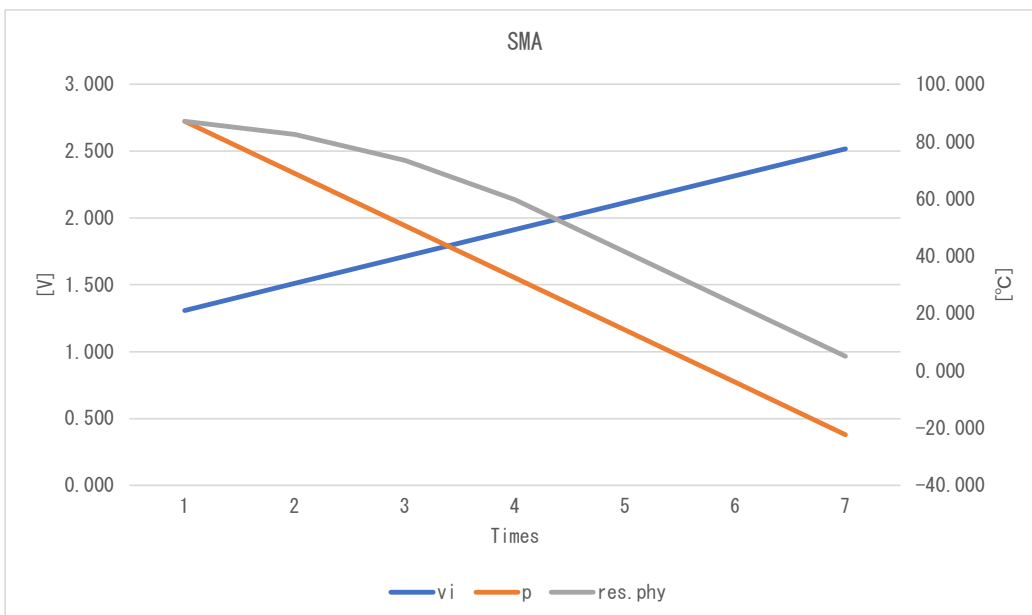
res. sts      4000    Normal  
                  4001    Max Limiter NG  
                  4002    Min Limiter NG

## 2-2. Moving average test

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

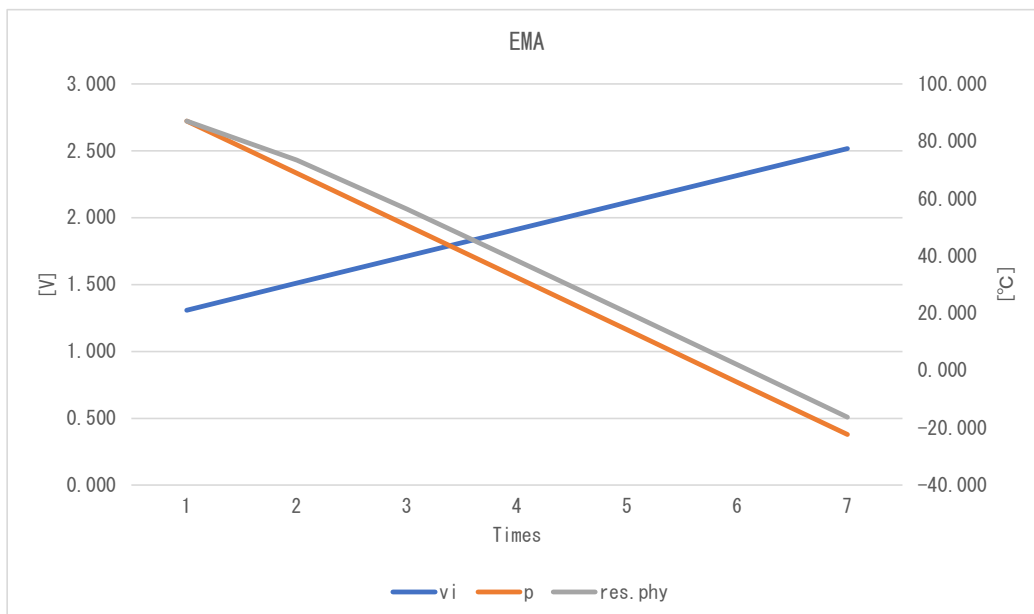
SMA

	No.	Dummy $a_i$	$v_i$	$p$	res. phy	res. sts	Judgment
1	Expected	26,000	1.309	87.137	87.137	4,000	OK
	Measured	26,000	1.309	87.137	87.137	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	30,000	1.511	68.893	82.576	4,000	OK
	Measured	30,000	1.511	68.893	82.576	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	34,000	1.712	50.649	73.454	4,000	OK
	Measured	34,000	1.712	50.649	73.454	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	38,000	1.913	32.405	59.771	4,000	OK
	Measured	38,000	1.913	32.405	59.771	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	42,000	2.115	14.160	41.527	4,000	OK
	Measured	42,000	2.115	14.160	41.527	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	46,000	2.316	-4.084	23.283	4,000	OK
	Measured	46,000	2.316	-4.084	23.283	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	50,000	2.518	-22.328	5.038	4,000	OK
	Measured	50,000	2.518	-22.328	5.038	4,000	
	Difference	0	0.000	0.000	0.000	0	



# EMA

	No.	Dummy ai	vi	p	res. phy	res. sts	Judgment
1	Expected	26.000	1.309	87.137	87.137	4.000	OK
	Measured	26.000	1.309	87.137	87.137	4.000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	30.000	1.511	68.893	73.454	4.000	OK
	Measured	30.000	1.511	68.893	73.454	4.000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	34.000	1.712	50.649	56.350	4.000	OK
	Measured	34.000	1.712	50.649	56.350	4.000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	38.000	1.913	32.405	38.391	4.000	OK
	Measured	38.000	1.913	32.405	38.391	4.000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	42.000	2.115	14.160	20.218	4.000	OK
	Measured	42.000	2.115	14.160	20.218	4.000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	46.000	2.316	-4.084	1.992	4.000	OK
	Measured	46.000	2.316	-4.084	1.992	4.000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	50.000	2.518	-22.328	-16.248	4.000	OK
	Measured	50.000	2.518	-22.328	-16.248	4.000	
	Difference	0	0.000	0.000	0.000	0	



# WMA

	No.	Dummy ai	vi	p	res. phy	res. sts	Judgment
1	Expected	26.000	1.309	87.137	87.137	4.000	OK
	Measured	26.000	1.309	87.137	87.137	4.000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	30.000	1.511	68.893	78.015	4.000	OK
	Measured	30.000	1.511	68.893	78.015	4.000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	34.000	1.712	50.649	62.812	4.000	OK
	Measured	34.000	1.712	50.649	62.812	4.000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	38.000	1.913	32.405	44.567	4.000	OK
	Measured	38.000	1.913	32.405	44.568	4.000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	42.000	2.115	14.160	26.323	4.000	OK
	Measured	42.000	2.115	14.160	26.323	4.000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	46.000	2.316	-4.084	8.079	4.000	OK
	Measured	46.000	2.316	-4.084	8.079	4.000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	50.000	2.518	-22.328	-10.165	4.000	OK
	Measured	50.000	2.518	-22.328	-10.165	4.000	
	Difference	0	0.000	0.000	0.000	0	

