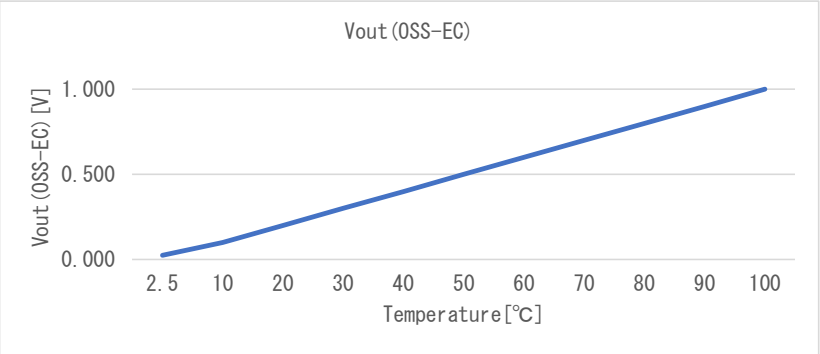
Test Specifications and Results of ADC components

Spec-00000058.pdf

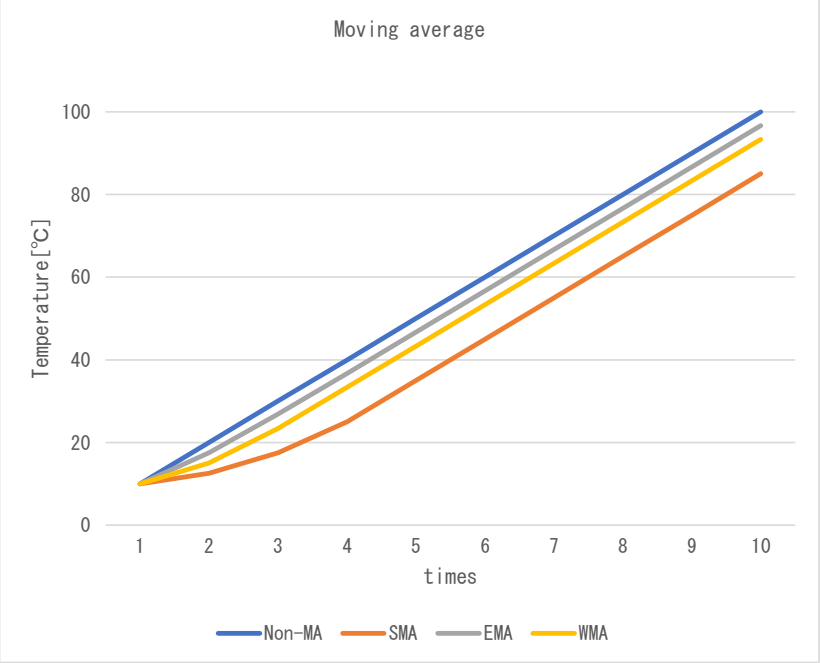
Date	4-Nov-22
Verifier	Red Dragon

vi = (ai × ADC_vdd) / 2^{ADC_bit}
y = (vi - x_offset) / gain + y_offset range min to max
SMA calculation method phy = ($y_n + y_{n-1} + y_{n-2}$) / n
EMA calculation method phy = (y × k) + (phy_{n-1} × (1 - k))
WMA calculation method phy = ((yn × n) + (yn-1 × (n-1)) + ⋯ + (y1 × 1)) / (n + (n-1) +⋯+ 1)
Non-MA calculation method phy = y

Spec-LM45B_LM45C.pdf		
component data		
x_offset	0.0000	[V]
gain	0.01	[V/℃]
y_offset	0.0	[℃]
max	100.0	[℃]
min	2.5	[℃]

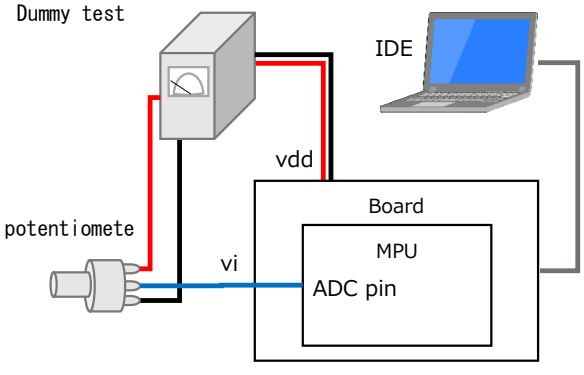


Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



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

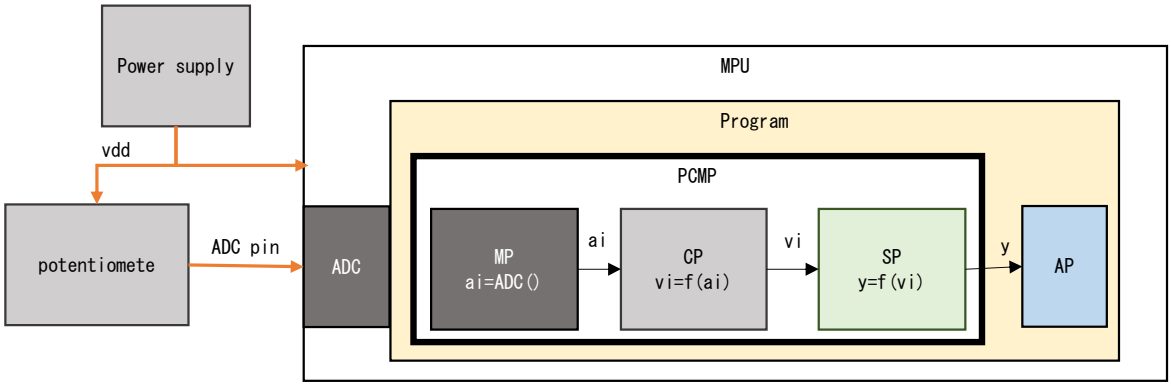
Normal operating voltage		
Vdd	5.0	[V]



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

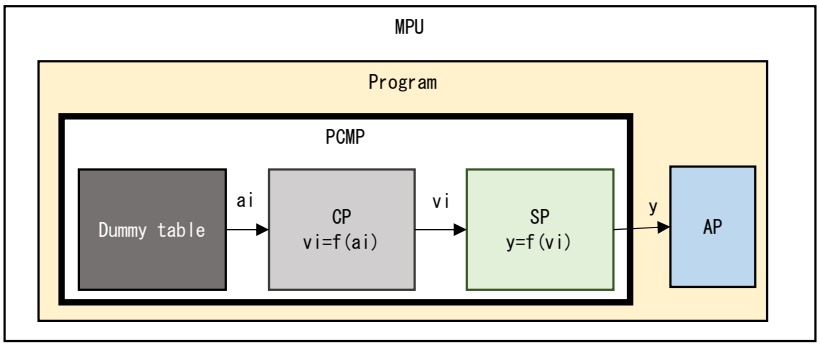
Data with 3.3V board		
x_offset	0.0000	[V]
gain	0.01	[V/℃]
y_offset	0.0	[℃]]

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	0.000	2.500	4,002	OK
	Measured		32	0.002	0.161	2.500	4,002	
	Difference		-32	-0.002	-0.161	0.000	0	
2	Expected	1.300	25,817	1.300	129.999	100.000	4,001	OK
	Measured		25,830	1.301	130.064	100.000	4,001	
	Difference		-13	-0.001	-0.065	0.000	0	
3	Expected	1.500	29,789	1.500	150.000	100.000	4,001	OK
	Measured		29,799	1.500	150.050	100.000	4,001	
	Difference		-10	0.000	-0.050	0.000	0	
4	Expected	3.300	65,536	3.300	330.000	100.000	4,001	OK
	Measured		65,535	3.300	329.995	100.000	4,001	
	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 ai according to Dummy table as shown in the table below, and check Max/Min limiters and diagnostic results. Non-MA mode.

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	329	0.025	2.510	2.510	4,000	OK
	Measured	329	0.025	2.510	2.510	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	328	0.025	2.502	2.502	4,000	OK
	Measured	328	0.025	2.502	2.502	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	327	0.025	2.495	2.500	4,002	OK
	Measured	327	0.025	2.495	2.500	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	328	0.025	2.502	2.502	4,000	OK
	Measured	328	0.025	2.502	2.502	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,107	1.000	99.998	99.998	4,000	OK
	Measured	13,107	1.000	99.998	99.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	13,108	1.000	100.006	100.000	4,001	OK
	Measured	13,108	1.000	100.006	100.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	13,107	1.000	99.998	99.998	4,000	OK
	Measured	13,107	1.000	99.998	99.998	4,000	
	Difference	0	0.000	0.000	0.000	0	

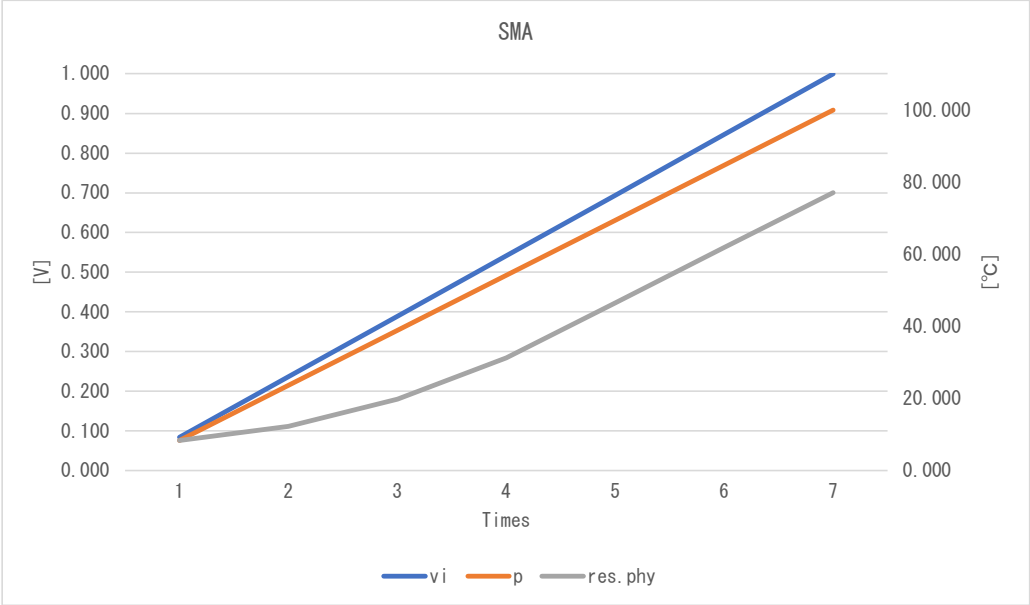
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

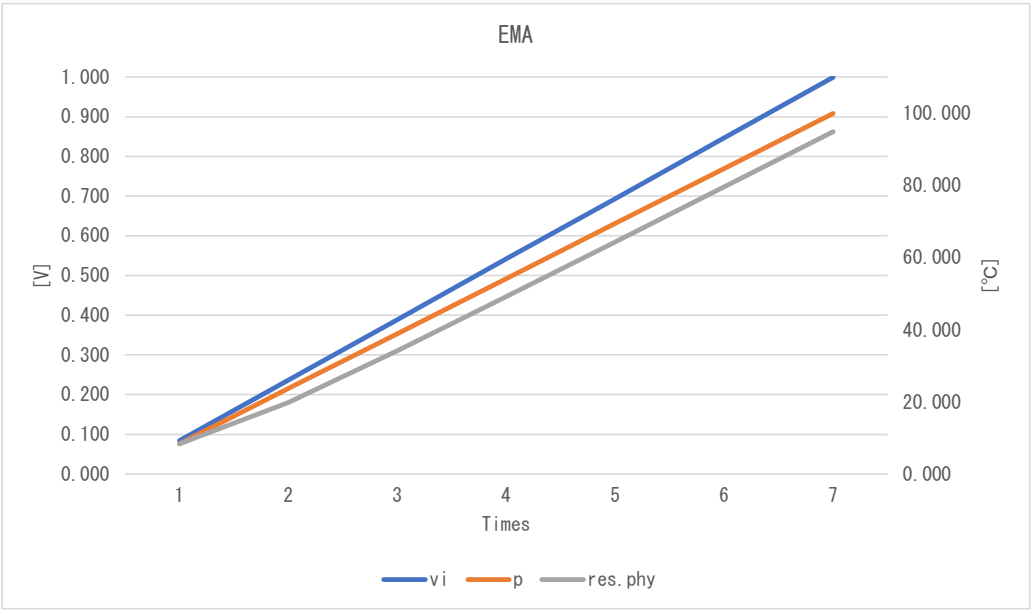
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	1,100	0.084	8.392	8.392	4,000	OK
	Measured	1,100	0.084	8.392	8.392	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	3,100	0.237	23.651	12.207	4,000	OK
	Measured	3,100	0.237	23.651	12.207	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	5,100	0.389	38.910	19.836	4,000	OK
	Measured	5,100	0.389	38.910	19.836	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	7,100	0.542	54.169	31.281	4,000	OK
	Measured	7,100	0.542	54.169	31.281	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	9,100	0.694	69.427	46.539	4,000	OK
	Measured	9,100	0.694	69.427	46.539	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	11,100	0.847	84.686	61.798	4,000	OK
	Measured	11,100	0.847	84.686	61.798	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	13,100	0.999	99.945	77.057	4,000	OK
	Measured	13,100	0.999	99.945	77.057	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	1,100	0.084	8.392	8.392	4,000	OK
	Measured	1,100	0.084	8.392	8.392	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	3,100	0.237	23.651	19.836	4,000	OK
	Measured	3,100	0.237	23.651	19.836	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	5,100	0.389	38.910	34.142	4,000	OK
	Measured	5,100	0.389	38.910	34.142	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	7,100	0.542	54.169	49.162	4,000	OK
	Measured	7,100	0.542	54.169	49.162	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	9,100	0.694	69.427	64.361	4,000	OK
	Measured	9,100	0.694	69.427	64.361	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	11,100	0.847	84.686	79.605	4,000	OK
	Measured	11,100	0.847	84.686	79.605	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	13,100	0.999	99.945	94.860	4,000	OK
	Measured	13,100	0.999	99.945	94.860	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	1,100	0.084	8.392	8.392	4,000	OK
	Measured	1,100	0.084	8.392	8.392	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	3,100	0.237	23.651	16.022	4,000	OK
	Measured	3,100	0.237	23.651	16.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	5,100	0.389	38.910	28.737	4,000	OK
	Measured	5,100	0.389	38.910	28.737	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	7,100	0.542	54.169	43.996	4,000	OK
	Measured	7,100	0.542	54.169	43.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	9,100	0.694	69.427	59.255	4,000	OK
	Measured	9,100	0.694	69.427	59.255	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	11,100	0.847	84.686	74.514	4,000	OK
	Measured	11,100	0.847	84.686	74.514	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	13,100	0.999	99.945	89.773	4,000	OK
	Measured	13,100	0.999	99.945	89.773	4,000	
	Difference	0	0.000	0.000	0.000	0