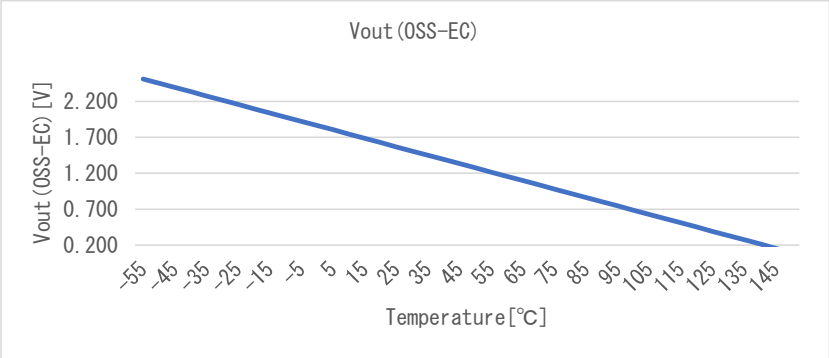
Test Specifications and Results of ADC components

Spec-00000058.pdf

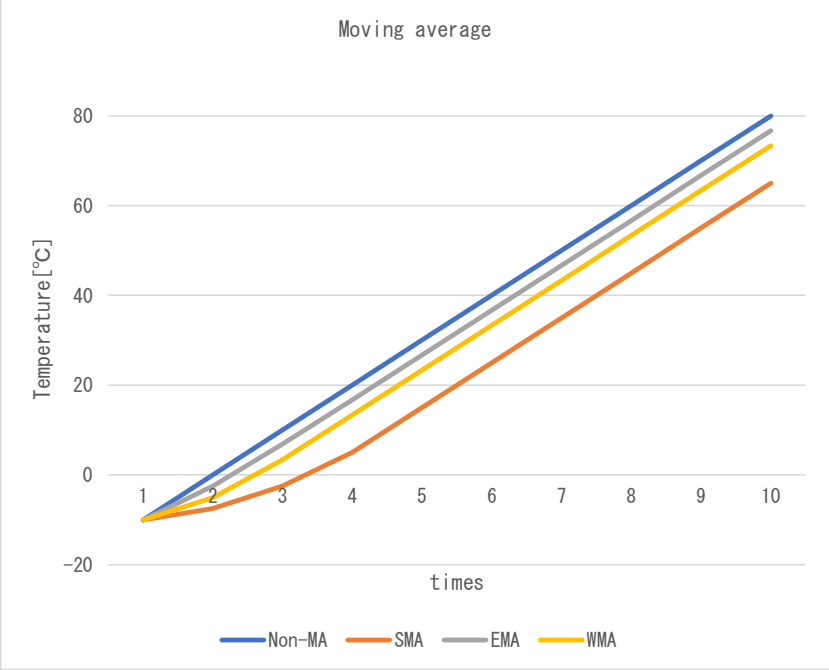
Date	2-Nov-22
Verifier	Red Dragon

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)) + ⋯ + (y 1 × 1)) / (n + (n-1) +⋯+ 1)
Non-MA calculation method　　phy = y

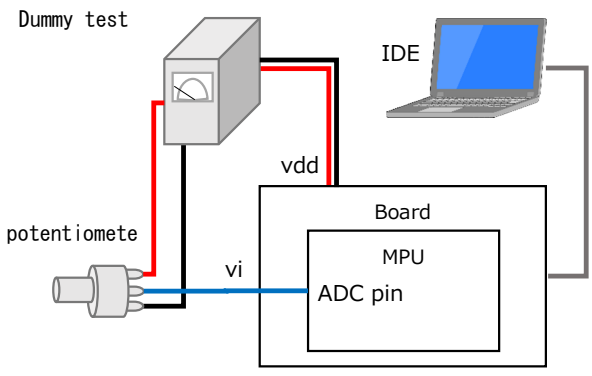
Spec-TMP9A00.pdf		
component data		
x_offset	1.8639	[V]
gain	-0.01177	[V/℃]
y_offset	0.0	[℃]
max	150.0	[℃]
min	-55.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



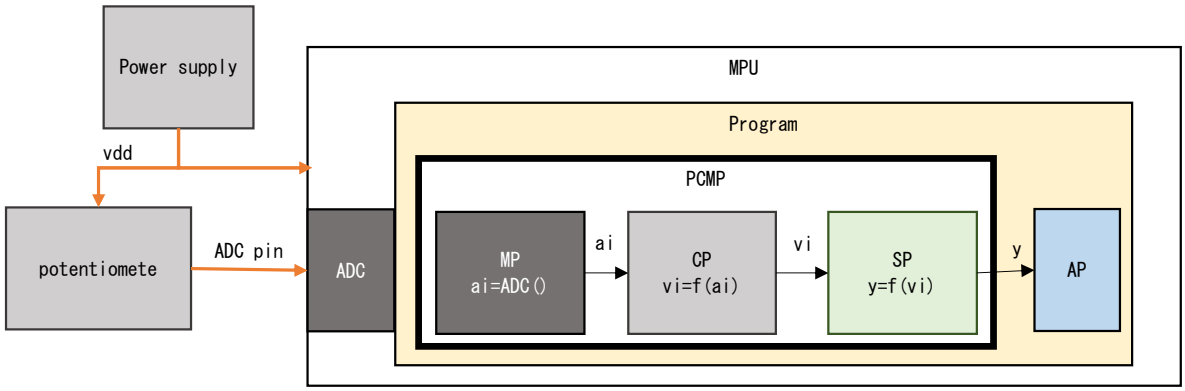
Test environment		
Board	NUCLEO-F401RE	
MPU	STM32F401RE	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	16	[bit]
ADC pin	A0	-
Component	Dummy	



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:

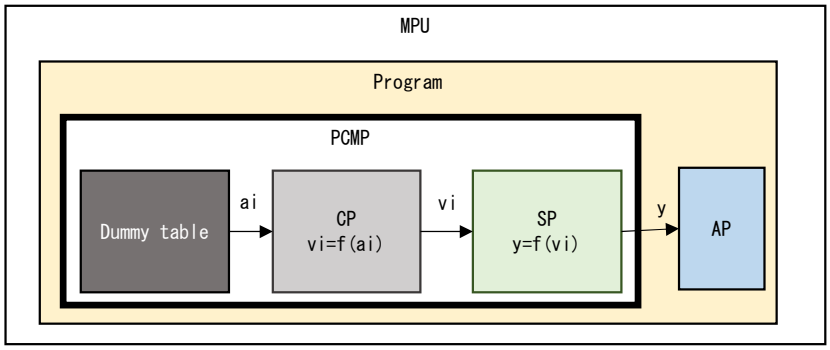


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	158.360	150.000	4,001	OK
	Measured		32	0.002	158.223	150.000	4,001	
	Difference		-32	-0.002	0.137	0.000	0	
2	Expected	1.300	25,817	1.300	47.911	47.911	4,000	OK
	Measured		25,862	1.302	47.718	47.718	4,000	
	Difference		-45	-0.002	0.193	0.193	0	
3	Expected	1.500	29,789	1.500	30.918	30.918	4,000	OK
	Measured		29,751	1.498	31.081	31.081	4,000	
	Difference		38	0.002	-0.163	-0.163	0	
4	Expected	3.300	65,536	3.300	-122.014	-55.000	4,002	OK
	Measured		65,535	3.300	-122.009	-55.000	4,002	
	Difference		1	0.000	-0.004	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	49,870	2.511	-54.992	-54.992	4,000	OK
	Measured	49,870	2.511	-54.992	-54.992	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	49,871	2.511	-54.996	-54.996	4,000	OK
	Measured	49,871	2.511	-54.996	-54.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	49,872	2.511	-55.000	-55.000	4,002	OK
	Measured	49,872	2.511	-55.000	-55.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	49,871	2.511	-54.996	-54.996	4,000	OK
	Measured	49,871	2.511	-54.996	-54.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	1,955	0.098	149.996	149.996	4,000	OK
	Measured	1,955	0.098	149.996	149.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	1,954	0.098	150.001	150.000	4,001	OK
	Measured	1,954	0.098	150.001	150.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	1,955	0.098	149.996	149.996	4,000	OK
	Measured	1,955	0.098	149.996	149.996	4,000	
	Difference	0	0.000	0.000	0.000	0	

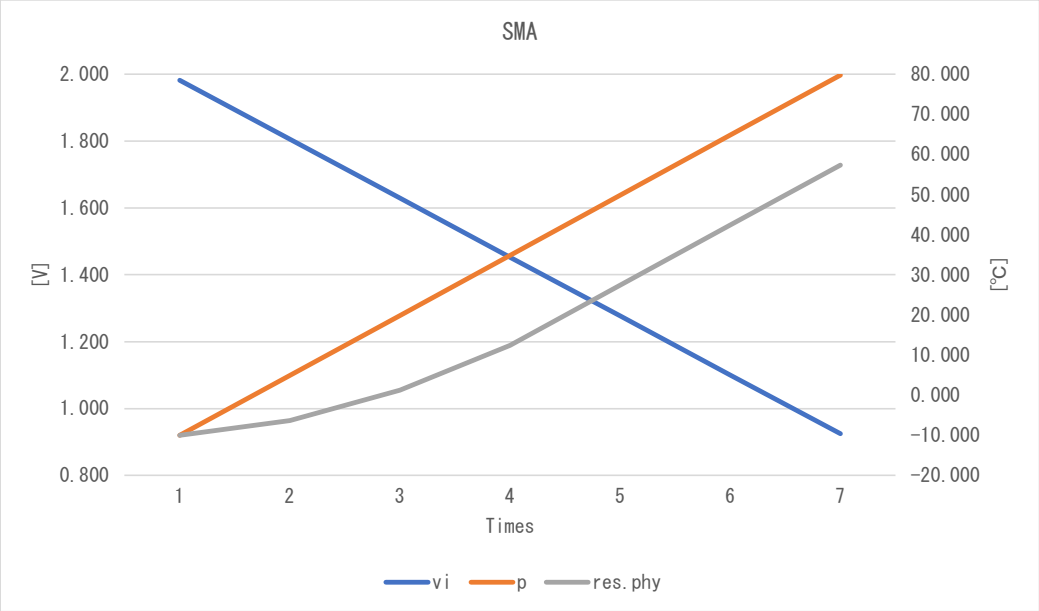
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

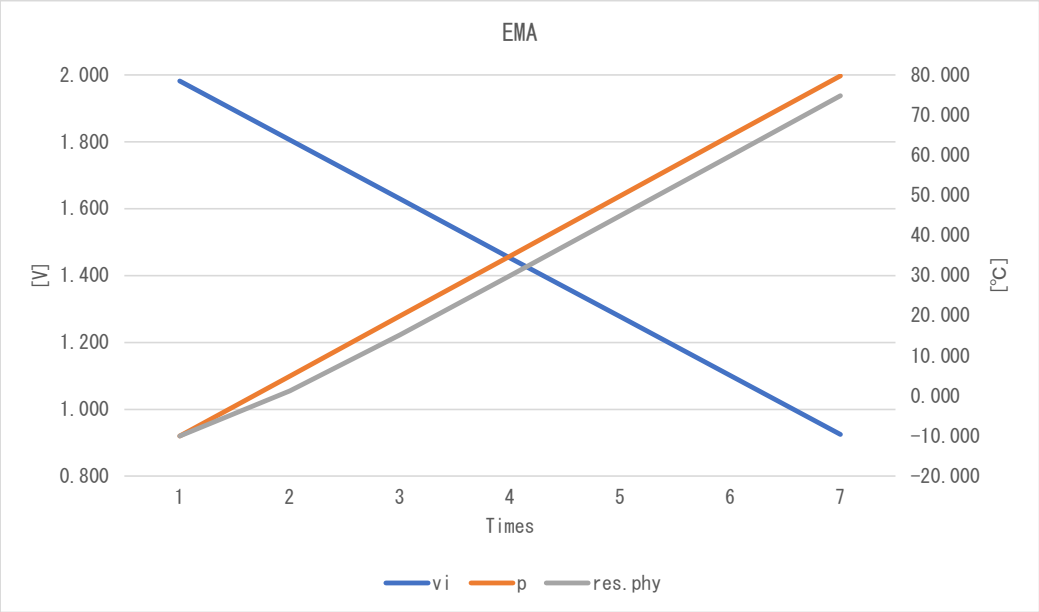
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	39,360	1.982	-10.028	-10.028	4,000	OK
	Measured	39,360	1.982	-10.028	-10.028	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	35,860	1.806	4.945	-6.285	4,000	OK
	Measured	35,860	1.806	4.945	-6.285	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	32,360	1.629	19.919	1.202	4,000	OK
	Measured	32,360	1.629	19.919	1.202	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	28,860	1.453	34.892	12.432	4,000	OK
	Measured	28,860	1.453	34.892	12.432	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	25,360	1.277	49.866	27.406	4,000	OK
	Measured	25,360	1.277	49.866	27.406	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	21,860	1.101	64.840	42.379	4,000	OK
	Measured	21,860	1.101	64.840	42.379	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	18,360	0.924	79.813	57.353	4,000	OK
	Measured	18,360	0.924	79.813	57.353	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	39,360	1.982	-10.028	-10.028	4,000	OK
	Measured	39,360	1.982	-10.028	-10.028	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	35,860	1.806	4.945	1.202	4,000	OK
	Measured	35,860	1.806	4.945	1.202	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	32,360	1.629	19.919	15.240	4,000	OK
	Measured	32,360	1.629	19.919	15.240	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	28,860	1.453	34.892	29.979	4,000	OK
	Measured	28,860	1.453	34.892	29.979	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	25,360	1.277	49.866	44.894	4,000	OK
	Measured	25,360	1.277	49.866	44.894	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	21,860	1.101	64.840	59.853	4,000	OK
	Measured	21,860	1.101	64.840	59.853	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	18,360	0.924	79.813	74.823	4,000	OK
	Measured	18,360	0.924	79.813	74.823	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	39,360	1.982	-10.028	-10.028	4,000	OK
	Measured	39,360	1.982	-10.028	-10.028	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	35,860	1.806	4.945	-2.542	4,000	OK
	Measured	35,860	1.806	4.945	-2.542	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	32,360	1.629	19.919	9.936	4,000	OK
	Measured	32,360	1.629	19.919	9.936	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	28,860	1.453	34.892	24.910	4,000	OK
	Measured	28,860	1.453	34.892	24.910	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	25,360	1.277	49.866	39.884	4,000	OK
	Measured	25,360	1.277	49.866	39.884	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	21,860	1.101	64.840	54.857	4,000	OK
	Measured	21,860	1.101	64.840	54.857	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	18,360	0.924	79.813	69.831	4,000	OK
	Measured	18,360	0.924	79.813	69.831	4,000	
	Difference	0	0.000	0.000	0.000	0