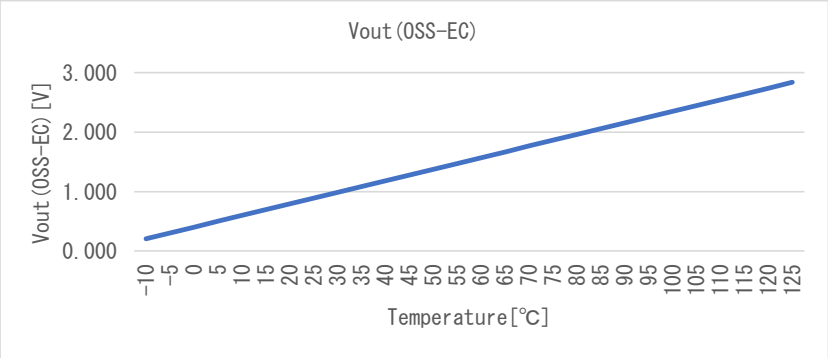
Test Specifications and Results of ADC components

Spec-00000058.pdf

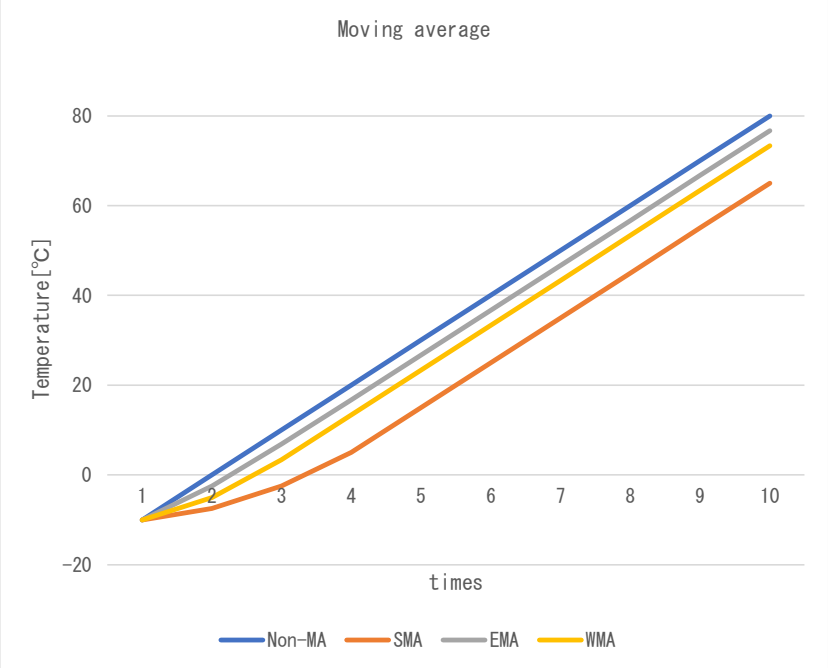
Date	13-Oct-22
Verifier	Red Dragon

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

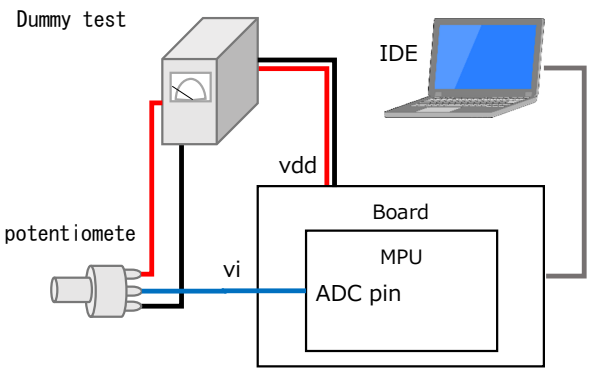
Spec-MCP9701_MCP9701A.pdf		
component data		
x_offset	0.4000	[V]
gain	0.0195	[V/℃]
y_offset	0.0	[℃]
max	125.0	[℃]
min	-10.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



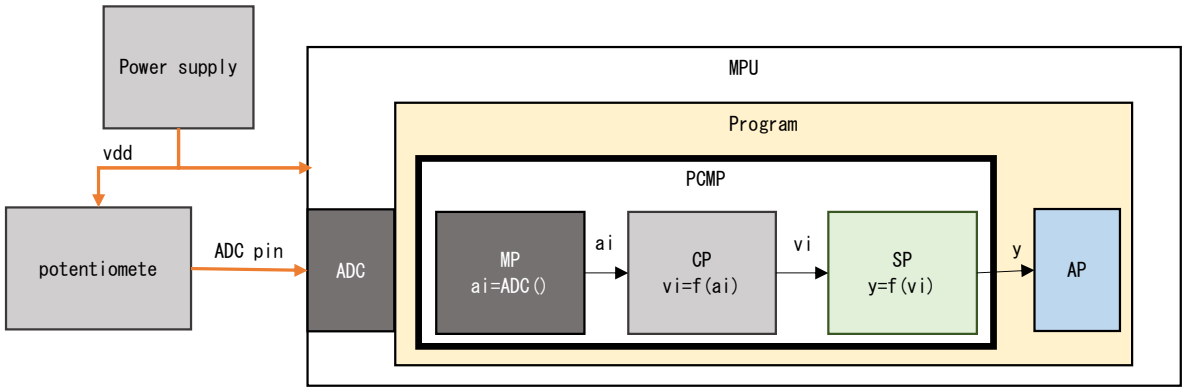
Test environment		
Board	NUCLEO-F401RE	
MPU	STM32F401RE	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	16	[bit]
ADC pin	A0	-
Component	Dummy	



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:

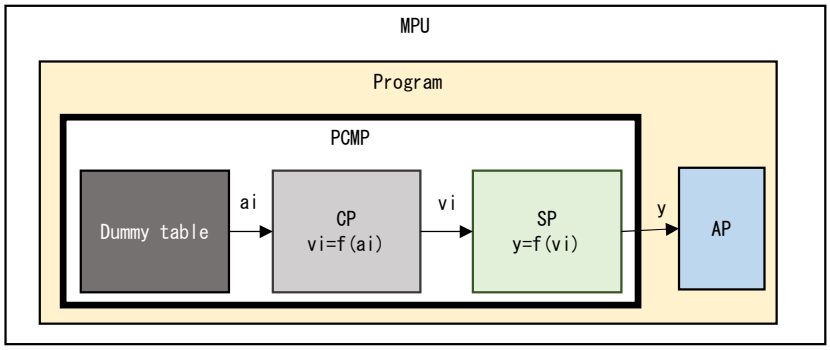


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-20.513	-10.000	4,002	OK
	Measured		0	0.000	-20.513	-10.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.500	29,783	1.500	56.395	56.395	4,000	OK
	Measured		29,799	1.500	56.436	56.436	4,000	
	Difference		-16	-0.001	-0.041	-0.041	0	
3	Expected	2.000	39,719	2.000	82.052	82.052	4,000	OK
	Measured		39,705	1.999	82.016	82.016	4,000	
	Difference		14	0.001	0.036	0.036	0	
4	Expected	3.300	65,536	3.300	148.718	125.000	4,001	OK
	Measured		65,535	3.300	148.715	125.000	4,001	
	Difference		1	0.000	0.003	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	4,073	0.205	-9.995	-9.995	4,000	OK
	Measured	4,073	0.205	-9.995	-9.995	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	4,072	0.205	-9.998	-9.998	4,000	OK
	Measured	4,072	0.205	-9.998	-9.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	4,071	0.205	-10.000	-10.000	4,002	OK
	Measured	4,071	0.205	-10.000	-10.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	4,072	0.205	-9.998	-9.998	4,000	OK
	Measured	4,072	0.205	-9.998	-9.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	56,351	2.837	125.000	125.000	4,000	OK
	Measured	56,351	2.837	125.000	125.000	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	56,352	2.838	125.003	125.000	4,001	OK
	Measured	56,352	2.838	125.003	125.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	56,351	2.837	125.000	125.000	4,000	OK
	Measured	56,351	2.837	125.000	125.000	4,000	
	Difference	0	0.000	0.000	0.000	0	

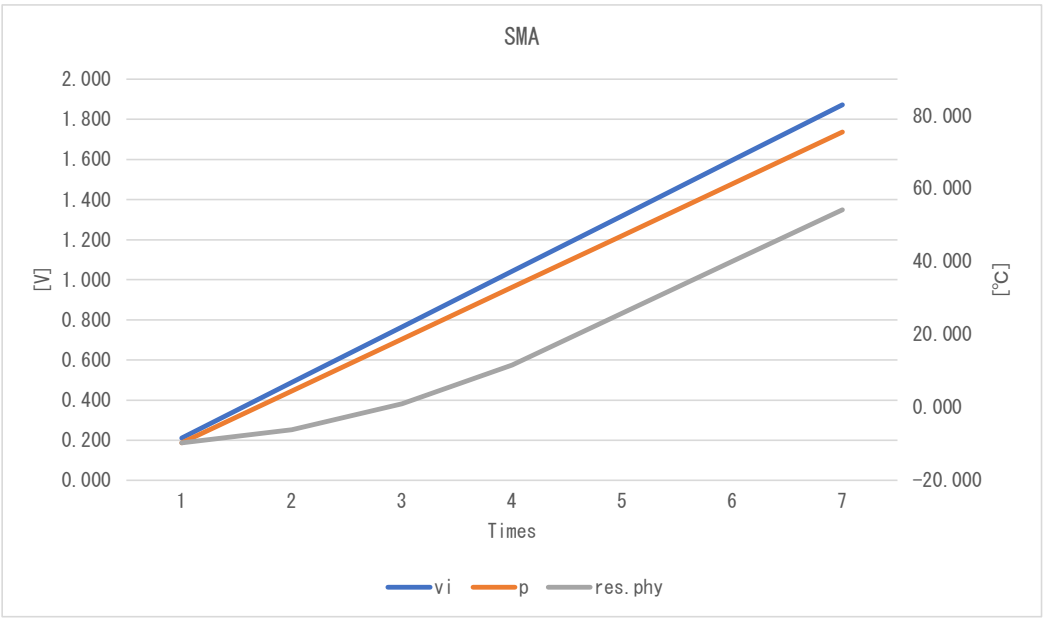
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

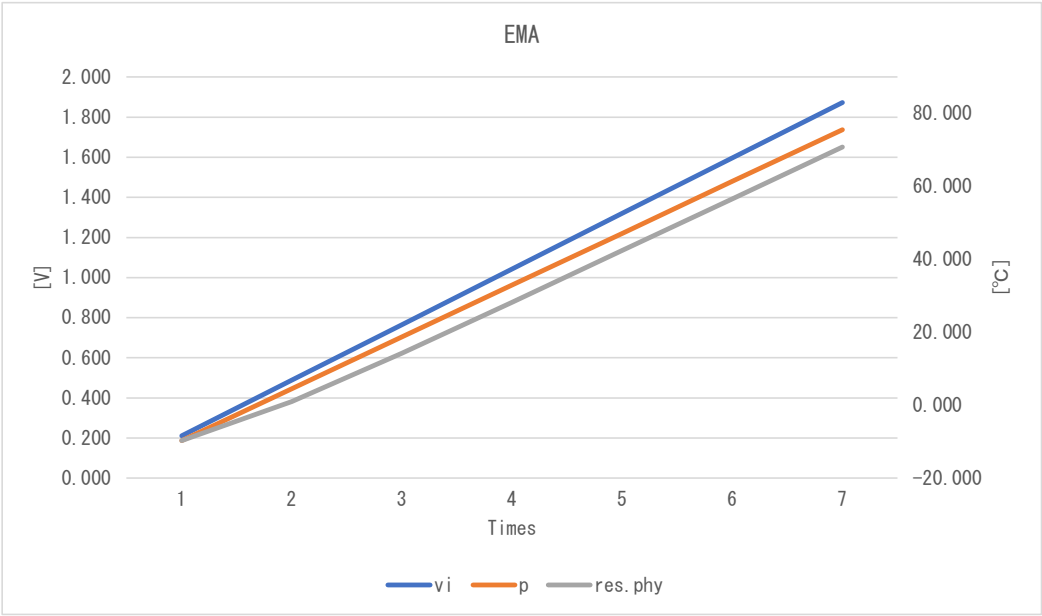
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	4,200	0.211	-9.667	-9.667	4,000	OK
	Measured	4,200	0.211	-9.667	-9.667	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	9,700	0.488	4.535	-6.117	4,000	OK
	Measured	9,700	0.488	4.535	-6.117	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	15,200	0.765	18.737	0.984	4,000	OK
	Measured	15,200	0.765	18.737	0.984	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	20,700	1.042	32.940	11.636	4,000	OK
	Measured	20,700	1.042	32.940	11.636	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	26,200	1.319	47.142	25.839	4,000	OK
	Measured	26,200	1.319	47.142	25.839	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	31,700	1.596	61.345	40.041	4,000	OK
	Measured	31,700	1.596	61.345	40.041	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	37,200	1.873	75.547	54.244	4,000	OK
	Measured	37,200	1.873	75.547	54.244	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	4,200	0.211	-9.667	-9.667	4,000	OK
	Measured	4,200	0.211	-9.667	-9.667	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	9,700	0.488	4.535	0.984	4,000	OK
	Measured	9,700	0.488	4.535	0.984	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	15,200	0.765	18.737	14.299	4,000	OK
	Measured	15,200	0.765	18.737	14.299	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	20,700	1.042	32.940	28.280	4,000	OK
	Measured	20,700	1.042	32.940	28.280	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	26,200	1.319	47.142	42.427	4,000	OK
	Measured	26,200	1.319	47.142	42.427	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	31,700	1.596	61.345	56.615	4,000	OK
	Measured	31,700	1.596	61.345	56.615	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	37,200	1.873	75.547	70.814	4,000	OK
	Measured	37,200	1.873	75.547	70.814	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	4,200	0.211	-9.667	-9.667	4,000	OK
	Measured	4,200	0.211	-9.667	-9.667	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	9,700	0.488	4.535	-2.566	4,000	OK
	Measured	9,700	0.488	4.535	-2.566	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	15,200	0.765	18.737	9.269	4,000	OK
	Measured	15,200	0.765	18.737	9.269	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	20,700	1.042	32.940	23.472	4,000	OK
	Measured	20,700	1.042	32.940	23.472	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	26,200	1.319	47.142	37.674	4,000	OK
	Measured	26,200	1.319	47.142	37.674	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	31,700	1.596	61.345	51.876	4,000	OK
	Measured	31,700	1.596	61.345	51.876	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	37,200	1.873	75.547	66.079	4,000	OK
	Measured	37,200	1.873	75.547	66.079	4,000	
	Difference	0	0.000	0.000	0.000	0