Test Specifications and Results of ADC components

Spec-00000058.pdf

Date	13-Oct-22
Verifier	Red Dragon

$vi = (ai \times ADC\_vdd) / 2^{ADC\_bit}$

$y = (vi - x\_offset) / gain + y\_offset$ range min to max

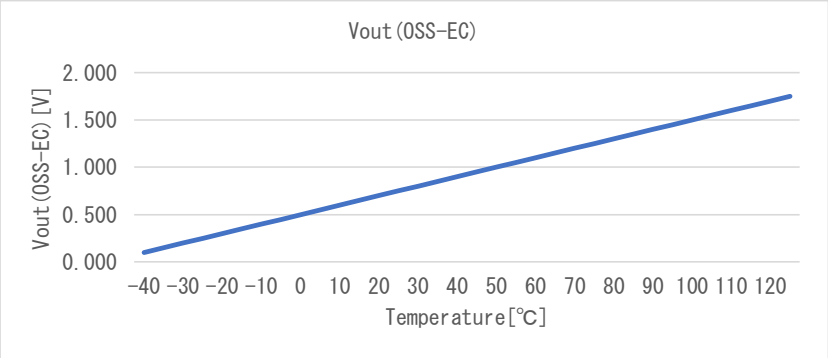
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

WMA calculation method $phy = ((yn \times n) + (yn-1 \times (n-1)) + \cdots + (y1 \times 1)) / (n + (n-1) + \cdots + 1)$

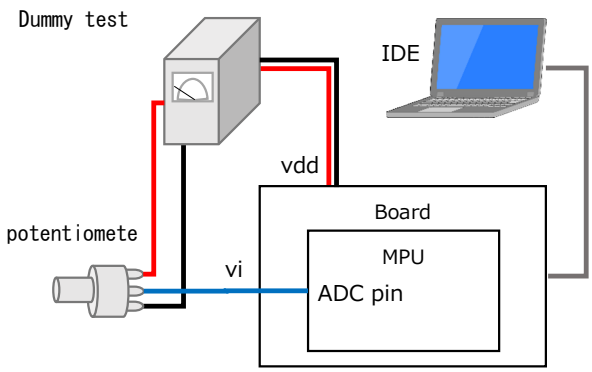
Non-MA calculation method $phy = y$

Spec-MCP9700_MCP9700A.pdf		
component data		
x_offset	0.5000	[V]
gain	0.01	[V/℃]
y_offset	0.0	[℃]
max	125.0	[℃]
min	-40.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3

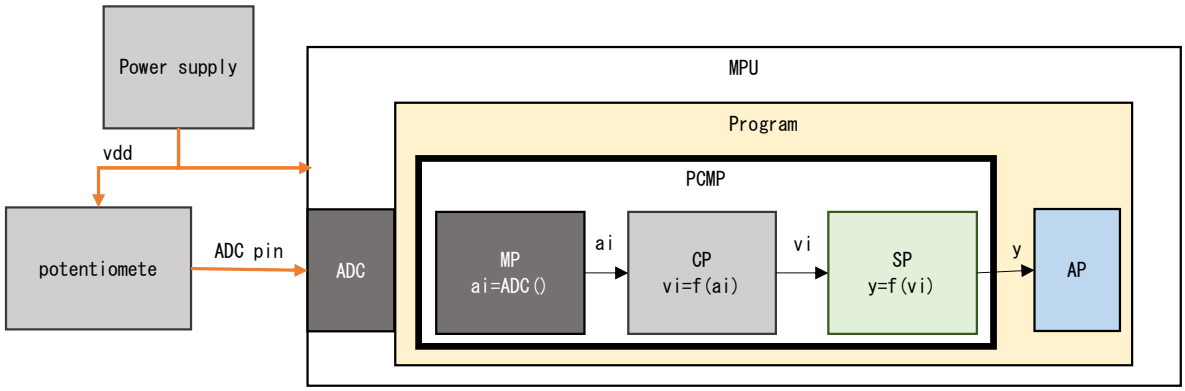
Test environment		
Board	NUCLEO-F401RE	
MPU	STM32F401RE	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	16	[bit]
ADC pin	A0	-
Component	Dummy	



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:

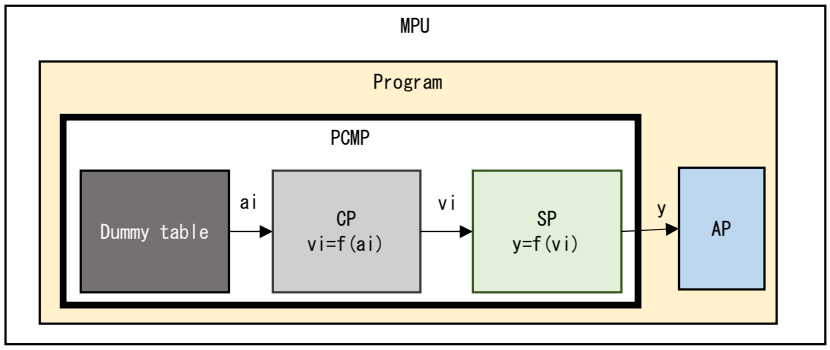


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.002	32	0.002	-49.839	-40.000	4,002	OK
	Measured		32	0.002	-49.839	-40.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.500	29,797	1.500	100.040	100.040	4,000	OK
	Measured		29,799	1.500	100.050	100.050	4,000	
	Difference		-2	0.000	-0.010	-0.010	0	
3	Expected	1.703	33,815	1.703	120.272	120.272	4,000	OK
	Measured		33,816	1.703	120.277	120.277	4,000	
	Difference		-1	0.000	-0.005	-0.005	0	
4	Expected	3.300	65,536	3.300	280.000	125.000	4,001	OK
	Measured		65,535	3.300	279.995	125.000	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	1,987	0.100	-39.995	-39.995	4,000	OK
	Measured	1,987	0.100	-39.995	-39.995	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	1,986	0.100	-40.000	-40.000	4,000	OK
	Measured	1,986	0.100	-40.000	-40.000	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	1,985	0.100	-40.005	-40.000	4,002	OK
	Measured	1,985	0.100	-40.005	-40.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	1,986	0.100	-40.000	-40.000	4,000	OK
	Measured	1,986	0.100	-40.000	-40.000	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	34,753	1.750	124.995	124.995	4,000	OK
	Measured	34,753	1.750	124.995	124.995	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	34,754	1.750	125.000	125.000	4,001	OK
	Measured	34,754	1.750	125.000	125.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	34,753	1.750	124.995	124.995	4,000	OK
	Measured	34,753	1.750	124.995	124.995	4,000	
	Difference	0	0.000	0.000	0.000	0	

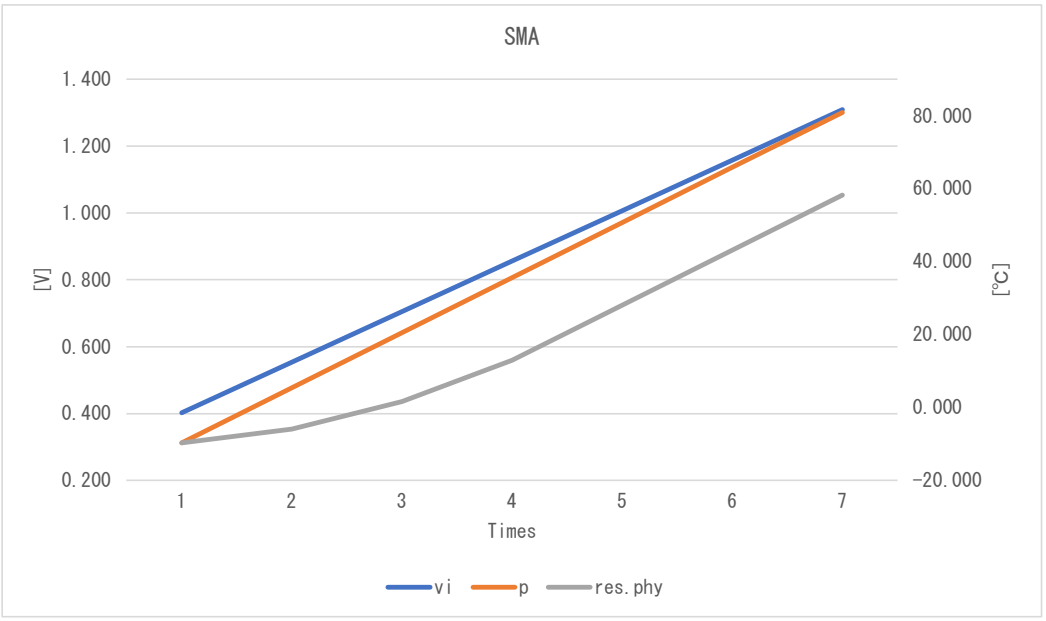
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

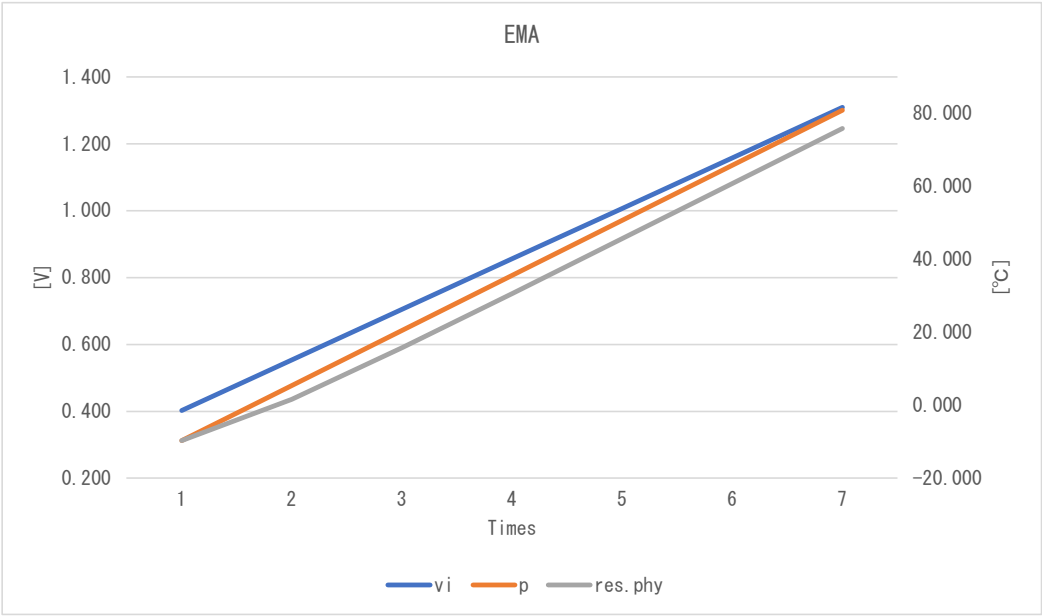
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	8,000	0.403	-9.717	-9.717	4,000	OK
	Measured	8,000	0.403	-9.717	-9.717	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	11,000	0.554	5.389	-5.940	4,000	OK
	Measured	11,000	0.554	5.389	-5.940	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	14,000	0.705	20.496	1.613	4,000	OK
	Measured	14,000	0.705	20.496	1.613	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	17,000	0.856	35.602	12.943	4,000	OK
	Measured	17,000	0.856	35.602	12.943	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	20,000	1.007	50.708	28.049	4,000	OK
	Measured	20,000	1.007	50.708	28.049	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	23,000	1.158	65.814	43.155	4,000	OK
	Measured	23,000	1.158	65.814	43.155	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	26,000	1.309	80.920	58.261	4,000	OK
	Measured	26,000	1.309	80.920	58.261	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	8,000	0.403	-9.717	-9.717	4,000	OK
	Measured	8,000	0.403	-9.717	-9.717	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	11,000	0.554	5.389	1.613	4,000	OK
	Measured	11,000	0.554	5.389	1.613	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	14,000	0.705	20.496	15.775	4,000	OK
	Measured	14,000	0.705	20.496	15.775	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	17,000	0.856	35.602	30.645	4,000	OK
	Measured	17,000	0.856	35.602	30.645	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	20,000	1.007	50.708	45.692	4,000	OK
	Measured	20,000	1.007	50.708	45.692	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	23,000	1.158	65.814	60.784	4,000	OK
	Measured	23,000	1.158	65.814	60.784	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	26,000	1.309	80.920	75.886	4,000	OK
	Measured	26,000	1.309	80.920	75.886	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	8,000	0.403	-9.717	-9.717	4,000	OK
	Measured	8,000	0.403	-9.717	-9.717	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	11,000	0.554	5.389	-2.164	4,000	OK
	Measured	11,000	0.554	5.389	-2.164	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	14,000	0.705	20.496	10.425	4,000	OK
	Measured	14,000	0.705	20.496	10.425	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	17,000	0.856	35.602	25.531	4,000	OK
	Measured	17,000	0.856	35.602	25.531	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	20,000	1.007	50.708	40.637	4,000	OK
	Measured	20,000	1.007	50.708	40.637	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	23,000	1.158	65.814	55.743	4,000	OK
	Measured	23,000	1.158	65.814	55.743	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	26,000	1.309	80.920	70.850	4,000	OK
	Measured	26,000	1.309	80.920	70.850	4,000	
	Difference	0	0.000	0.000	0.000	0