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

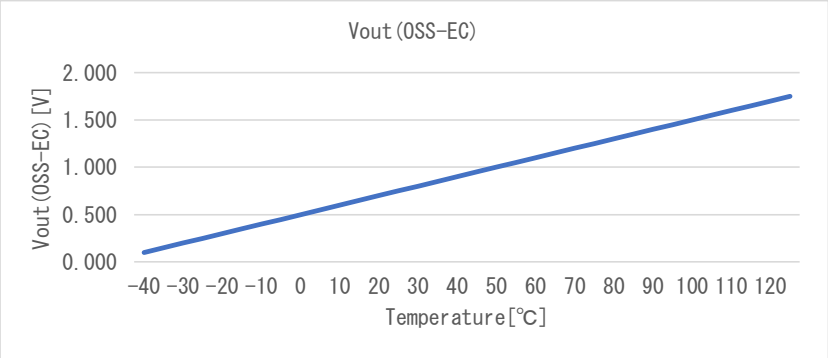
SMA calculation method phy = (y_n + y_{n-1} + y_{n-2}) / n

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)

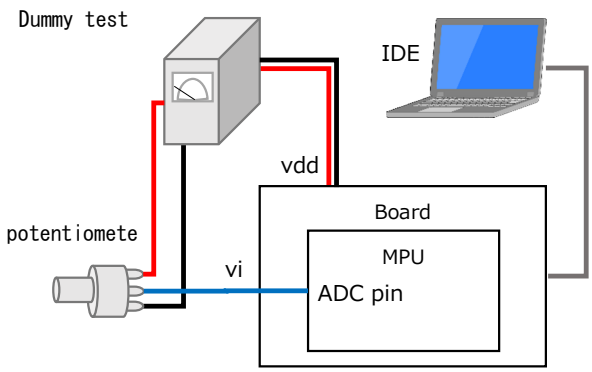
Non-MA calculation method phy = y

Spec-TC1047_TC1047A.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

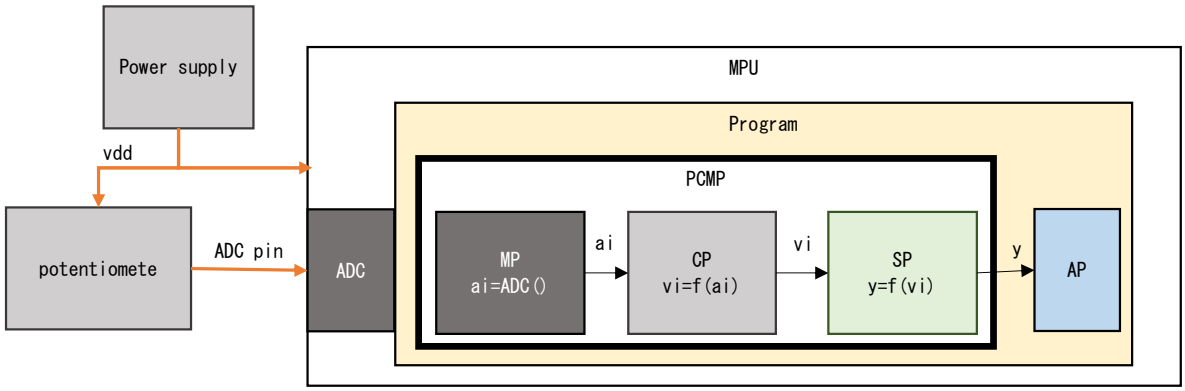
Test environment		
Board	NUCLEO-F401RE	
MPU	STM32F401RE	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	16	[bit]
ADC pin	A0	-
Component	Dummy	



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:

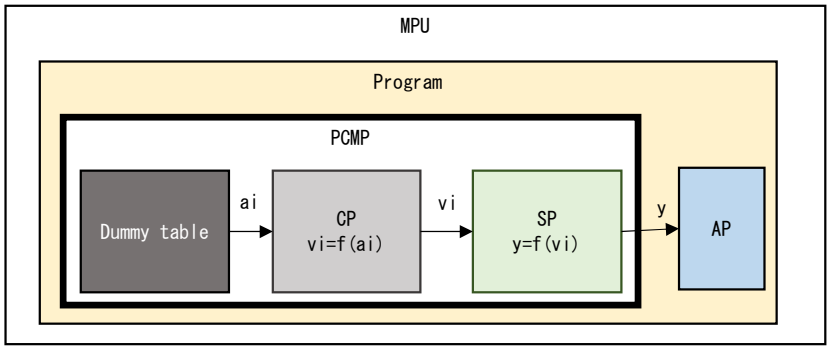


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-50.000	-40.000	4,002	OK
	Measured		0	0.000	-50.000	-40.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.206	23,956	1.206	70.628	70.628	4,000	OK
	Measured		23,957	1.206	70.633	70.633	4,000	
	Difference		-1	0.000	-0.005	-0.005	0	
3	Expected	1.500	29,789	1.500	100.000	100.000	4,000	OK
	Measured		29,799	1.500	100.050	100.050	4,000	
	Difference		-10	0.000	-0.050	-0.050	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	

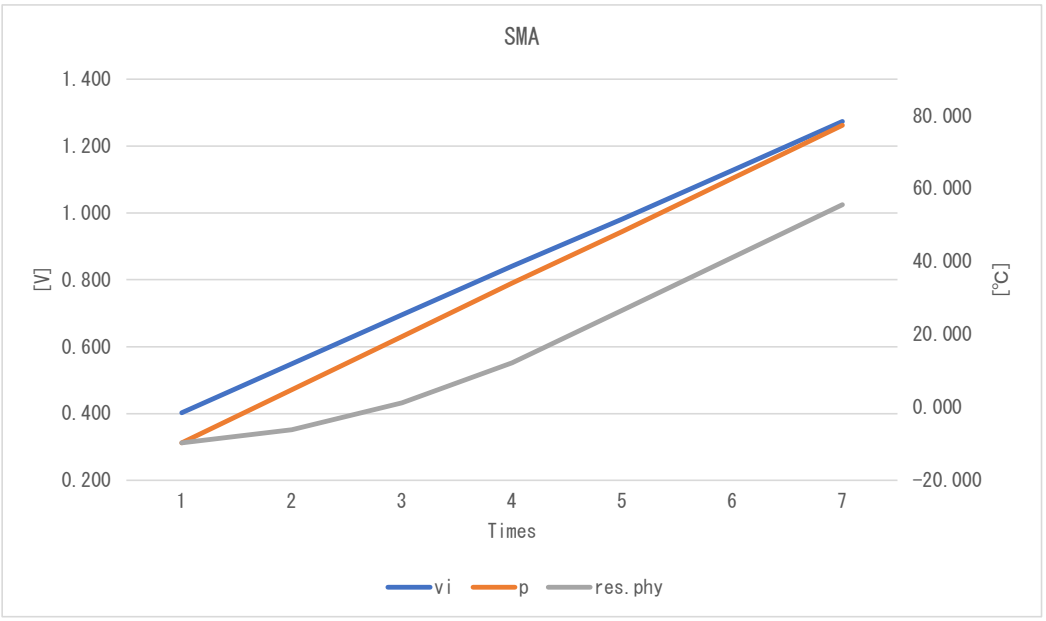
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

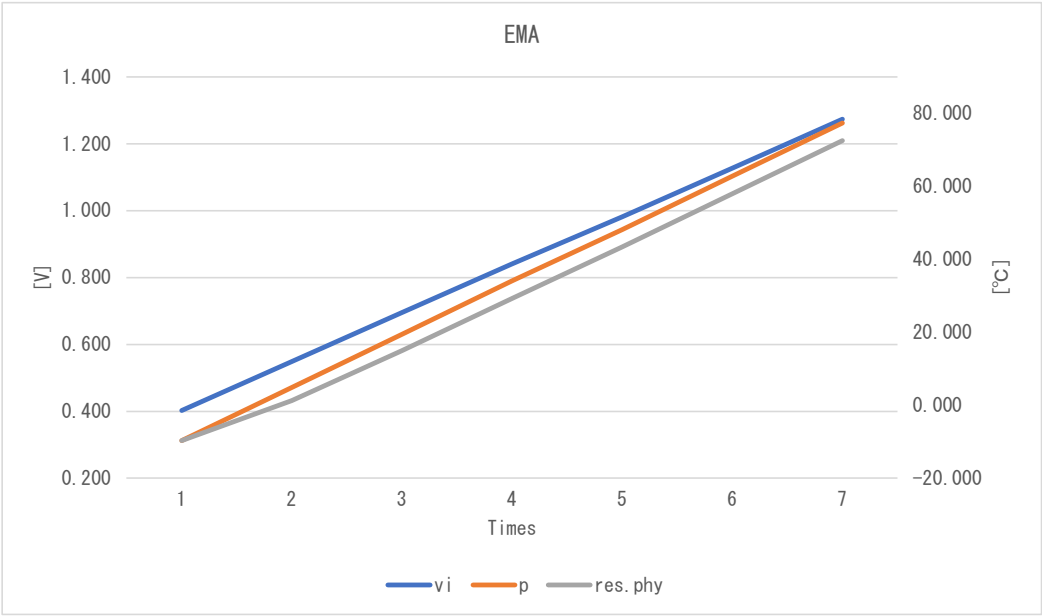
SMA

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	10,900	0.549	4.886	-6.066	4,000	OK
	Measured	10,900	0.549	4.886	-6.066	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	13,800	0.695	19.489	1.235	4,000	OK
	Measured	13,800	0.695	19.489	1.235	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	16,700	0.841	34.091	12.187	4,000	OK
	Measured	16,700	0.841	34.091	12.187	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	19,500	0.982	48.190	26.664	4,000	OK
	Measured	19,500	0.982	48.190	26.664	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	22,400	1.128	62.793	41.141	4,000	OK
	Measured	22,400	1.128	62.793	41.141	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	25,300	1.274	77.396	55.618	4,000	OK
	Measured	25,300	1.274	77.396	55.618	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	10,900	0.549	4.886	1.235	4,000	OK
	Measured	10,900	0.549	4.886	1.235	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	13,800	0.695	19.489	14.925	4,000	OK
	Measured	13,800	0.695	19.489	14.925	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	16,700	0.841	34.091	29.300	4,000	OK
	Measured	16,700	0.841	34.091	29.300	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	19,500	0.982	48.190	43.468	4,000	OK
	Measured	19,500	0.982	48.190	43.468	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	22,400	1.128	62.793	57.962	4,000	OK
	Measured	22,400	1.128	62.793	57.962	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	25,300	1.274	77.396	72.537	4,000	OK
	Measured	25,300	1.274	77.396	72.537	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	10,900	0.549	4.886	-2.415	4,000	OK
	Measured	10,900	0.549	4.886	-2.415	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	13,800	0.695	19.489	9.753	4,000	OK
	Measured	13,800	0.695	19.489	9.753	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	16,700	0.841	34.091	24.356	4,000	OK
	Measured	16,700	0.841	34.091	24.356	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	19,500	0.982	48.190	38.707	4,000	OK
	Measured	19,500	0.982	48.190	38.707	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	22,400	1.128	62.793	53.142	4,000	OK
	Measured	22,400	1.128	62.793	53.142	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	25,300	1.274	77.396	67.661	4,000	OK
	Measured	25,300	1.274	77.396	67.661	4,000	
	Difference	0	0.000	0.000	0.000	0