Test Specifications and Results of ADC components

Spec-00000057.pdf

Date	28-Oct-22
Verifier	Red Dragon

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

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

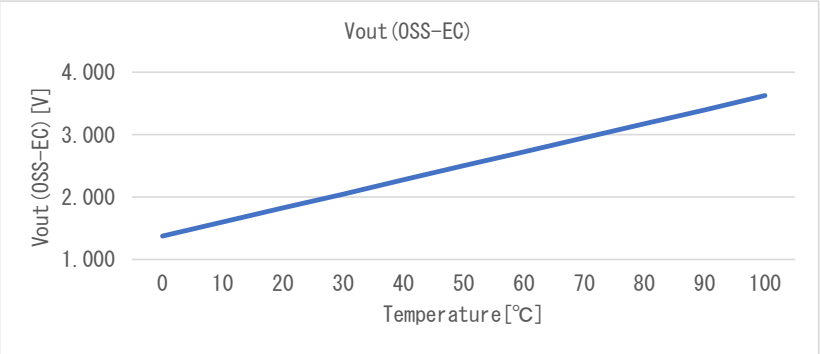
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

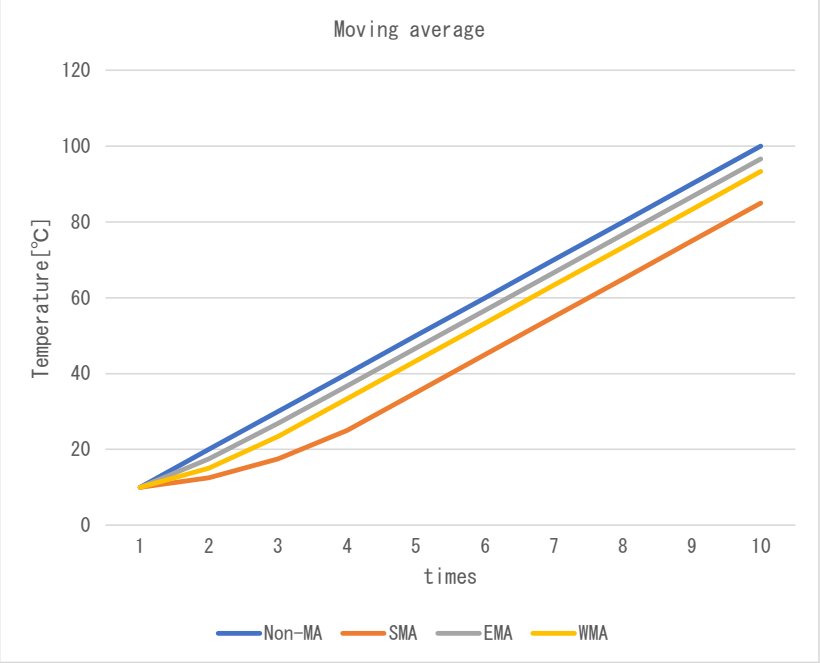
WMA calculation method $phy = ((yn \times n) + (yn-1 \times (n-1)) + \cdots + (y1 \times 1)) / (n + (n-1) + \cdots + 1)$

Non-MA calculation method $phy = y$

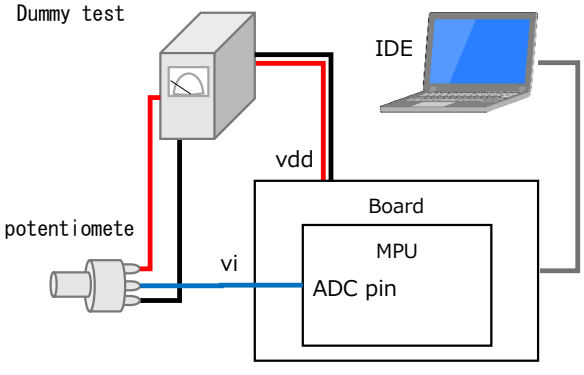
Spec-AD22100K.pdf		
component data		
x_offset	1.3750	[V]
gain	0.0225	[V/℃]
y_offset	0.0	[℃]
max	100.0	[℃]
min	0.0	[℃]



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	

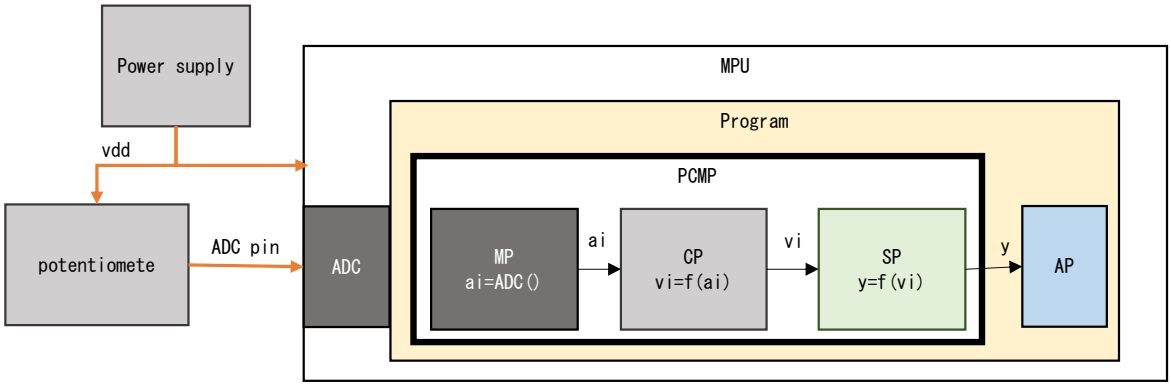


Normal operating voltage		
Vdd	5.0	[V]

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

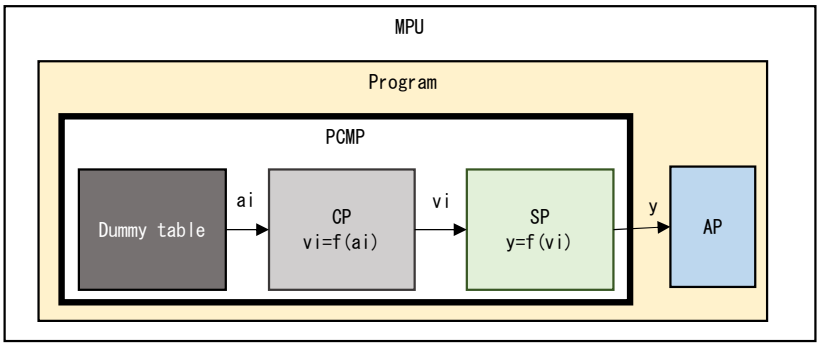
Data with 3.3V board		
x_offset	1.3750	[V]
gain	0.0225	[V/kPa]
y_offset	0.0	[kPa]

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-61.111	0.000	4,002	OK
	Measured		16	0.008	-61.075	0.000	4,002	
	Difference		-16	-0.008	-0.036	0.000	0	
2	Expected	1.500	29,789	1.500	5.555	5.555	4,000	OK
	Measured		29,767	1.499	5.506	5.506	4,000	
	Difference		22	0.001	0.049	0.049	0	
3	Expected	2.000	39,719	2.000	27.778	27.778	4,000	OK
	Measured		39,641	1.996	27.604	27.604	4,000	
	Difference		78	0.004	0.175	0.175	0	
4	Expected	3.300	65,536	3.300	85.556	85.556	4,000	OK
	Measured		65,535	3.300	85.553	85.553	4,000	
	Difference		1	0.000	0.002	0.002	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	18,024	1.375	0.005	0.005	4,000	OK
	Measured	18,024	1.375	0.005	0.005	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	18,023	1.375	0.002	0.002	4,000	OK
	Measured	18,023	1.375	0.002	0.002	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	18,022	1.375	-0.001	0.000	4,002	OK
	Measured	18,022	1.375	-0.001	0.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	18,023	1.375	0.002	0.002	4,000	OK
	Measured	18,023	1.375	0.002	0.002	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	47,513	3.625	99.998	99.998	4,000	OK
	Measured	47,513	3.625	99.998	99.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	47,514	3.625	100.001	100.000	4,001	OK
	Measured	47,514	3.625	100.001	100.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	47,513	3.625	99.998	99.998	4,000	OK
	Measured	47,513	3.625	99.998	99.998	4,000	
	Difference	0	0.000	0.000	0.000	0	

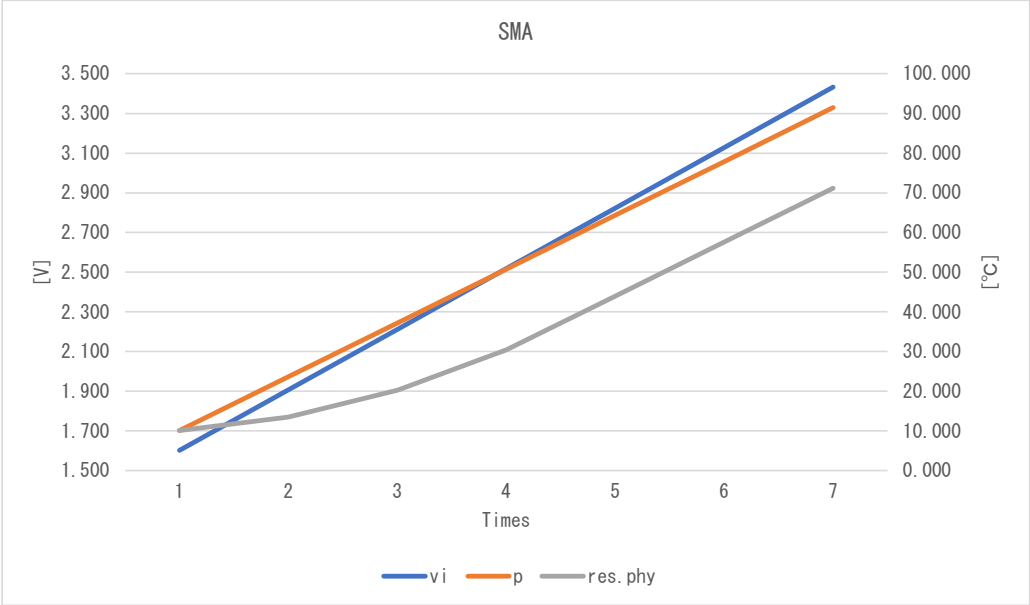
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

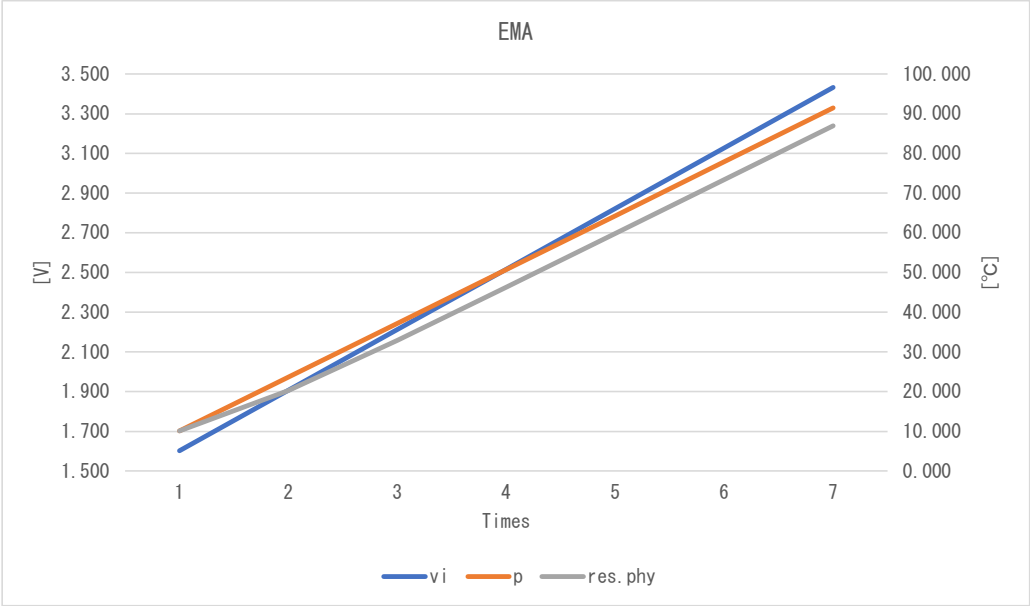
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	21,000	1.602	10.097	10.097	4,000	OK
	Measured	21,000	1.602	10.097	10.097	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	25,000	1.907	23.660	13.487	4,000	OK
	Measured	25,000	1.907	23.660	13.487	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	29,000	2.213	37.223	20.269	4,000	OK
	Measured	29,000	2.213	37.223	20.269	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	33,000	2.518	50.787	30.442	4,000	OK
	Measured	33,000	2.518	50.787	30.442	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	37,000	2.823	64.350	44.005	4,000	OK
	Measured	37,000	2.823	64.350	44.005	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	41,000	3.128	77.913	57.568	4,000	OK
	Measured	41,000	3.128	77.913	57.568	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	45,000	3.433	91.477	71.132	4,000	OK
	Measured	45,000	3.433	91.477	71.132	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	21,000	1.602	10.097	10.097	4,000	OK
	Measured	21,000	1.602	10.097	10.097	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	25,000	1.907	23.660	20.269	4,000	OK
	Measured	25,000	1.907	23.660	20.269	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	29,000	2.213	37.223	32.985	4,000	OK
	Measured	29,000	2.213	37.223	32.985	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	33,000	2.518	50.787	46.336	4,000	OK
	Measured	33,000	2.518	50.787	46.336	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	37,000	2.823	64.350	59.847	4,000	OK
	Measured	37,000	2.823	64.350	59.847	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	41,000	3.128	77.913	73.397	4,000	OK
	Measured	41,000	3.128	77.913	73.397	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	45,000	3.433	91.477	86.957	4,000	OK
	Measured	45,000	3.433	91.477	86.957	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	21,000	1.602	10.097	10.097	4,000	OK
	Measured	21,000	1.602	10.097	10.097	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	25,000	1.907	23.660	16.878	4,000	OK
	Measured	25,000	1.907	23.660	16.878	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	29,000	2.213	37.223	28.181	4,000	OK
	Measured	29,000	2.213	37.223	28.181	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	33,000	2.518	50.787	41.744	4,000	OK
	Measured	33,000	2.518	50.787	41.744	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	37,000	2.823	64.350	55.308	4,000	OK
	Measured	37,000	2.823	64.350	55.308	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	41,000	3.128	77.913	68.871	4,000	OK
	Measured	41,000	3.128	77.913	68.871	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	45,000	3.433	91.477	82.435	4,000	OK
	Measured	45,000	3.433	91.477	82.435	4,000	
	Difference	0	0.000	0.000	0.000	0