Test Specifications and Results of ADC components

Date	25-Oct-22
Verifier	Red Dragon

Spec-00000058.pdf

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

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

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

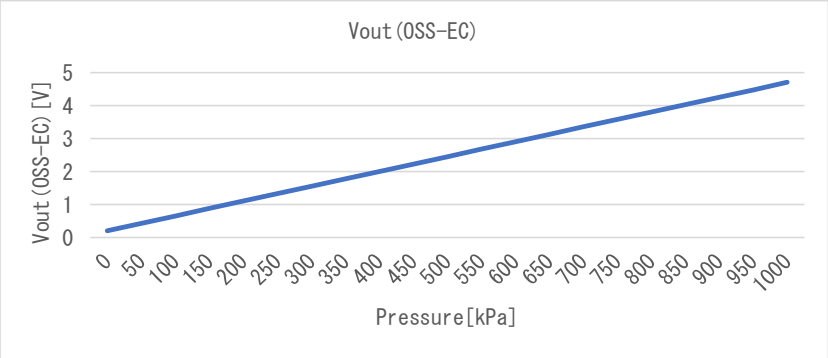
EMA calculation method $phy = (y \times k) + (phy_{n-1} \times (1 - k))$

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

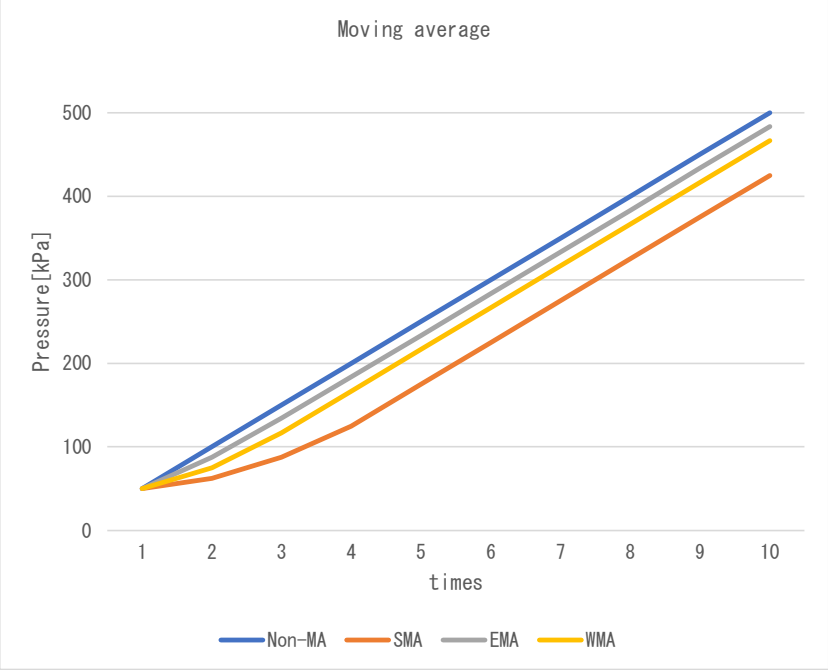
Non-MA calculation method $phy = y$

Spec-MPX5999D.pdf

component data		
x_offset	0.2000	[V]
gain	0.004505	[V/kPa]
y_offset	0.0	[kPa]
max	1000.0	[kPa]
min	0.0	[kPa]

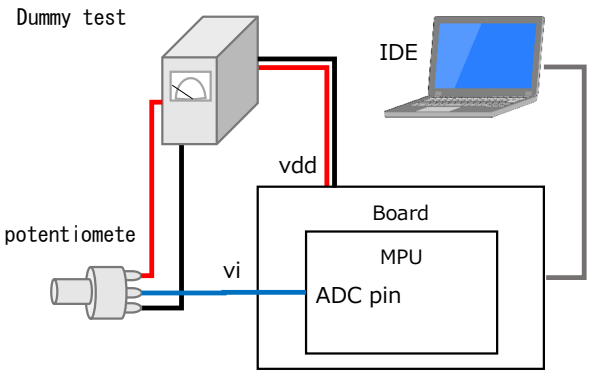


Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



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	

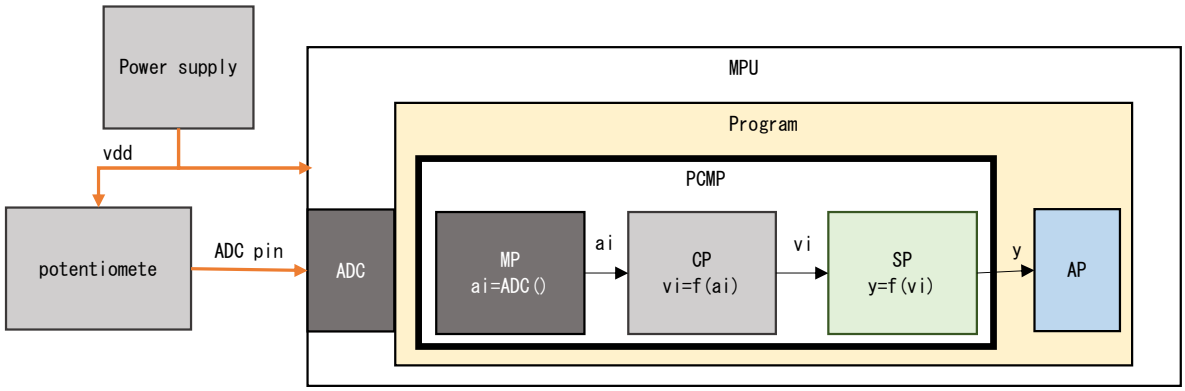
Normal operating voltage		
Vdd	5.0	[V]



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

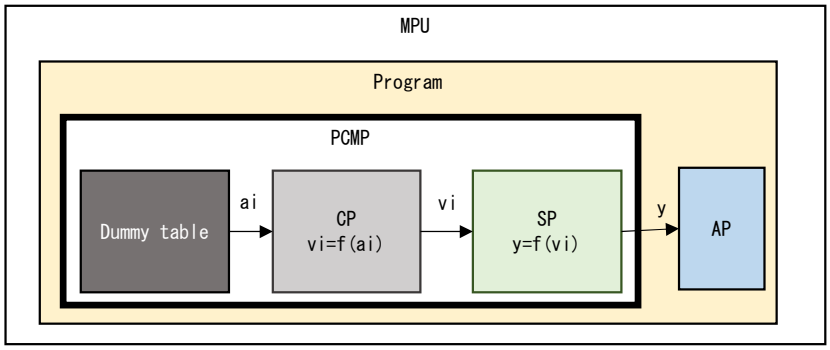
Data with 3.3V board		
x_offset	0.1320	[V]
gain	0.002973	[V/kPa]
y_offset	0.0	[kPa]

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-44.395	0.000	4,002	OK
	Measured		0	0.000	-44.395	0.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.500	29,789	1.500	460.093	460.093	4,000	OK
	Measured		29,799	1.500	460.263	460.263	4,000	
	Difference		-10	0.000	-0.169	-0.169	0	
3	Expected	2.000	39,719	2.000	628.262	628.262	4,000	OK
	Measured		39,705	1.999	628.025	628.025	4,000	
	Difference		14	0.001	0.237	0.237	0	
4	Expected	3.300	65,536	3.300	1065.483	1000.000	4,001	OK
	Measured		65,535	3.300	1065.466	1000.000	4,001	
	Difference		1	0.000	0.017	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	2,623	0.200	0.026	0.026	4,000	OK
	Measured	2,623	0.200	0.026	0.026	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	2,622	0.200	0.009	0.009	4,000	OK
	Measured	2,622	0.200	0.009	0.009	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	2,621	0.200	-0.007	0.000	4,002	OK
	Measured	2,621	0.200	-0.007	0.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	2,622	0.200	0.009	0.009	4,000	OK
	Measured	2,622	0.200	0.009	0.009	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	61,669	4.705	999.994	999.994	4,000	OK
	Measured	61,669	4.705	999.994	999.994	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	61,670	4.705	1000.011	1000.000	4,001	OK
	Measured	61,670	4.705	1000.011	1000.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	61,669	4.705	999.994	999.994	4,000	OK
	Measured	61,669	4.705	999.994	999.994	4,000	
	Difference	0	0.000	0.000	0.000	0	

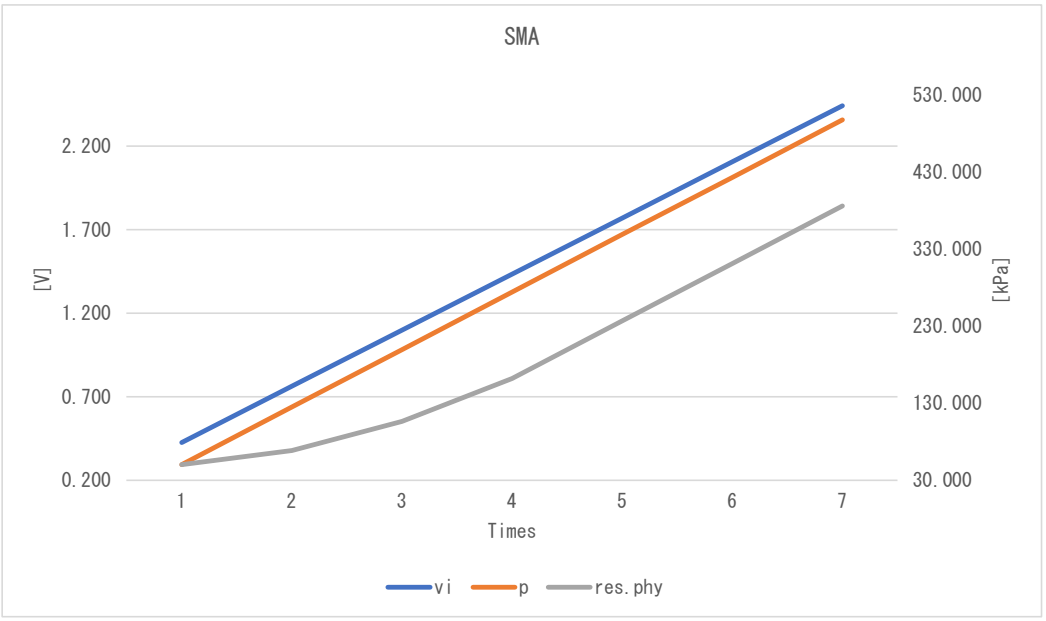
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

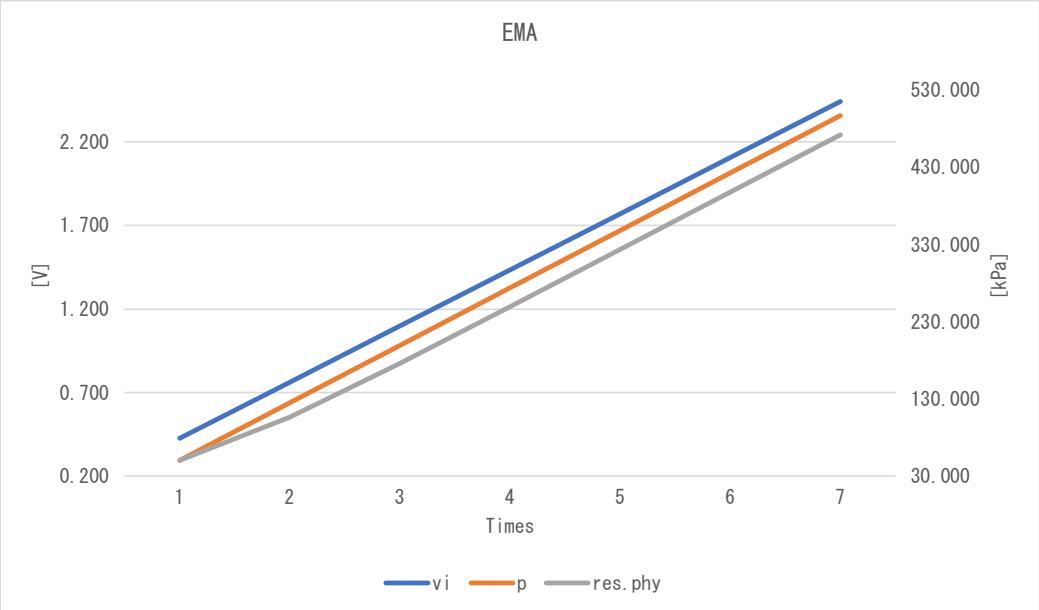
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	5,600	0.427	50.443	50.443	4,000	OK
	Measured	5,600	0.427	50.443	50.443	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	10,000	0.763	124.959	69.072	4,000	OK
	Measured	10,000	0.763	124.959	69.072	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	14,400	1.099	199.475	106.330	4,000	OK
	Measured	14,400	1.099	199.475	106.330	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	18,800	1.434	273.990	162.217	4,000	OK
	Measured	18,800	1.434	273.990	162.217	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	23,200	1.770	348.506	236.732	4,000	OK
	Measured	23,200	1.770	348.506	236.732	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	27,600	2.106	423.022	311.248	4,000	OK
	Measured	27,600	2.106	423.022	311.248	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	32,000	2.441	497.537	385.764	4,000	OK
	Measured	32,000	2.441	497.537	385.764	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	5,600	0.427	50.443	50.443	4,000	OK
	Measured	5,600	0.427	50.443	50.443	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	10,000	0.763	124.959	106.330	4,000	OK
	Measured	10,000	0.763	124.959	106.330	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	14,400	1.099	199.475	176.188	4,000	OK
	Measured	14,400	1.099	199.475	176.188	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	18,800	1.434	273.990	249.540	4,000	OK
	Measured	18,800	1.434	273.990	249.540	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	23,200	1.770	348.506	323.764	4,000	OK
	Measured	23,200	1.770	348.506	323.764	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	27,600	2.106	423.022	398.207	4,000	OK
	Measured	27,600	2.106	423.022	398.207	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	32,000	2.441	497.537	472.705	4,000	OK
	Measured	32,000	2.441	497.537	472.705	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	5,600	0.427	50.443	50.443	4,000	OK
	Measured	5,600	0.427	50.443	50.443	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	10,000	0.763	124.959	87.701	4,000	OK
	Measured	10,000	0.763	124.959	87.701	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	14,400	1.099	199.475	149.797	4,000	OK
	Measured	14,400	1.099	199.475	149.797	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	18,800	1.434	273.990	224.313	4,000	OK
	Measured	18,800	1.434	273.990	224.313	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	23,200	1.770	348.506	298.829	4,000	OK
	Measured	23,200	1.770	348.506	298.829	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	27,600	2.106	423.022	373.345	4,000	OK
	Measured	27,600	2.106	423.022	373.345	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	32,000	2.441	497.537	447.860	4,000	OK
	Measured	32,000	2.441	497.537	447.860	4,000	
	Difference	0	0.000	0.000	0.000	0