Test Specifications and Results of ADC components

Spec-00000058.pdf

Date	25-Oct-22
Verifier	Red Dragon

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

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

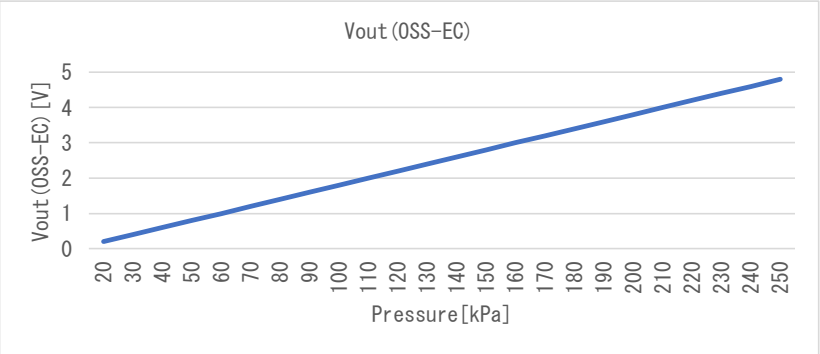
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

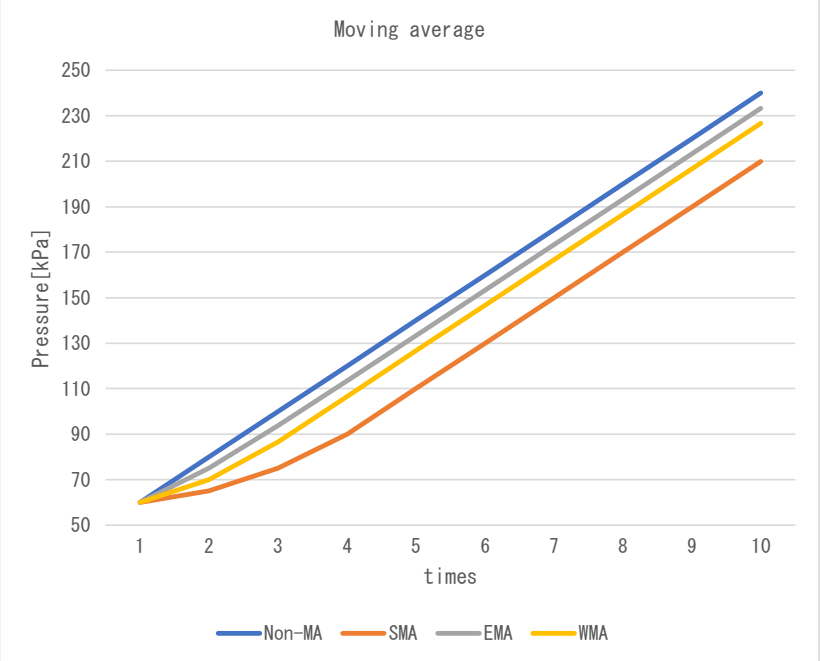
WMA calculation method $phy = ((yn \times n) + (yn-1 \times (n-1)) + \cdots + (y1 \times 1)) / (n + (n-1) + \cdots + 1)$

Non-MA calculation method $phy = y$

Spec-MPXHZ6250A.pdf		
component data		
x_offset	-0.2000	[V]
gain	0.02	[V/kPa]
y_offset	0.0	[kPa]
max	250.0	[kPa]
min	20.0	[kPa]

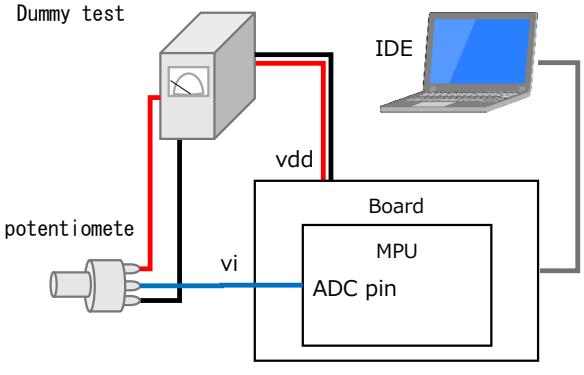


Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



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	

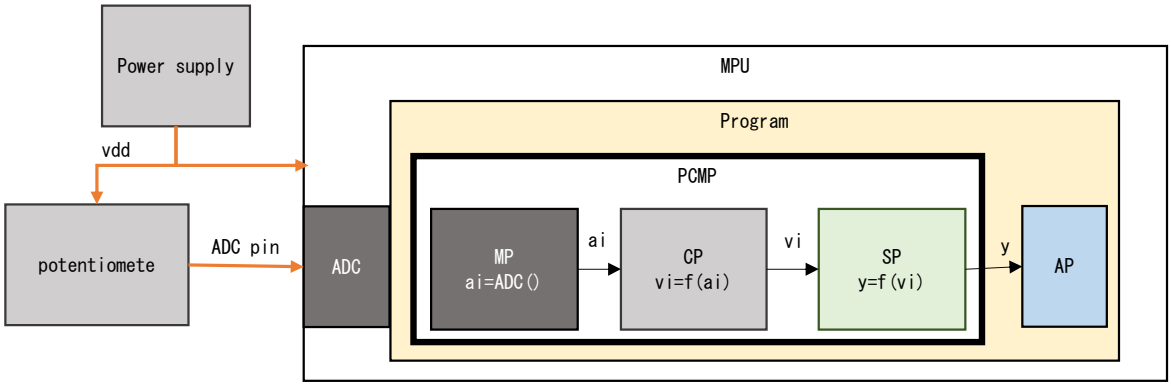
Normal operating voltage		
Vdd	5.0	[V]



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

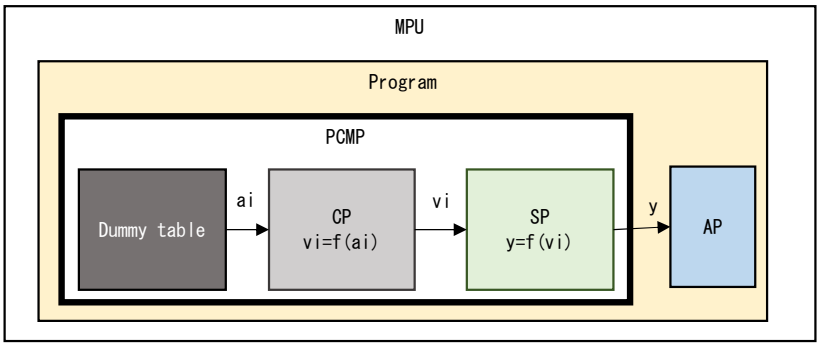
Data with 3.3V board		
x_offset	-0.1320	[V]
gain	0.0132	[V/kPa]
y_offset	0.0	[kPa]

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	10.000	20.000	4,002	OK
	Measured		32	0.002	10.122	20.000	4,002	
	Difference		-32	-0.002	-0.122	0.000	0	
2	Expected	1.500	29,789	1.500	123.636	123.636	4,000	OK
	Measured		29,799	1.500	123.674	123.674	4,000	
	Difference		-10	0.000	-0.038	-0.038	0	
3	Expected	2.000	39,719	2.000	161.516	161.516	4,000	OK
	Measured		39,785	2.003	161.768	161.768	4,000	
	Difference		-66	-0.002	-0.252	-0.252	0	
4	Expected	3.300	65,536	3.300	260.000	250.000	4,001	OK
	Measured		65,535	3.300	259.996	250.000	4,001	
	Difference		1	0.000	0.004	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	20.006	20.006	4,000	OK
	Measured	2,623	0.200	20.006	20.006	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	2,622	0.200	20.002	20.002	4,000	OK
	Measured	2,622	0.200	20.002	20.002	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	2,621	0.200	19.998	20.000	4,002	OK
	Measured	2,621	0.200	19.998	20.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	2,622	0.200	20.002	20.002	4,000	OK
	Measured	2,622	0.200	20.002	20.002	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	62,914	4.800	249.998	249.998	4,000	OK
	Measured	62,914	4.800	249.998	249.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	62,915	4.800	250.002	250.000	4,001	OK
	Measured	62,915	4.800	250.002	250.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	62,914	4.800	249.998	249.998	4,000	OK
	Measured	62,914	4.800	249.998	249.998	4,000	
	Difference	0	0.000	0.000	0.000	0	

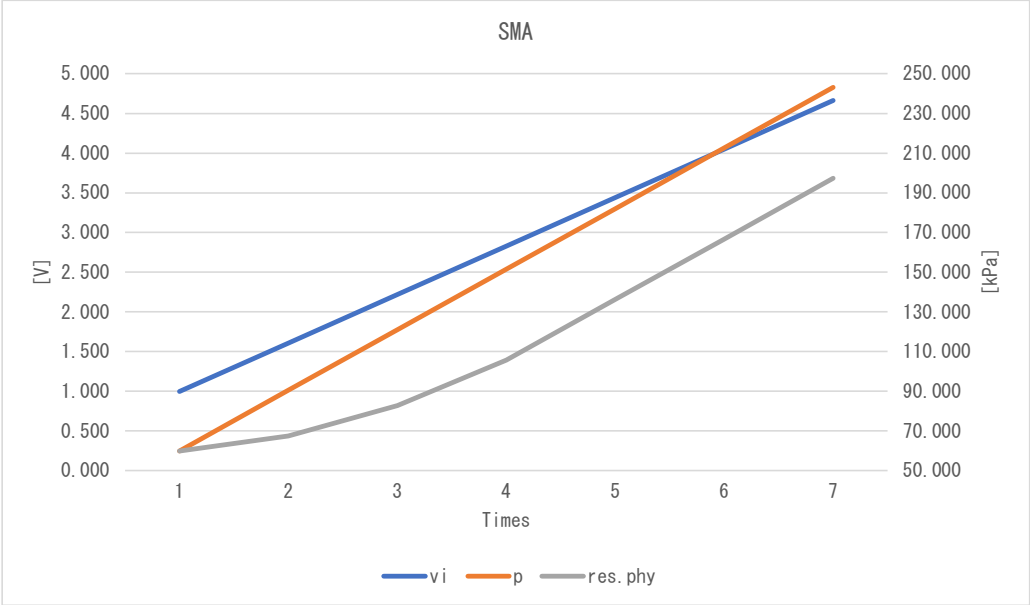
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

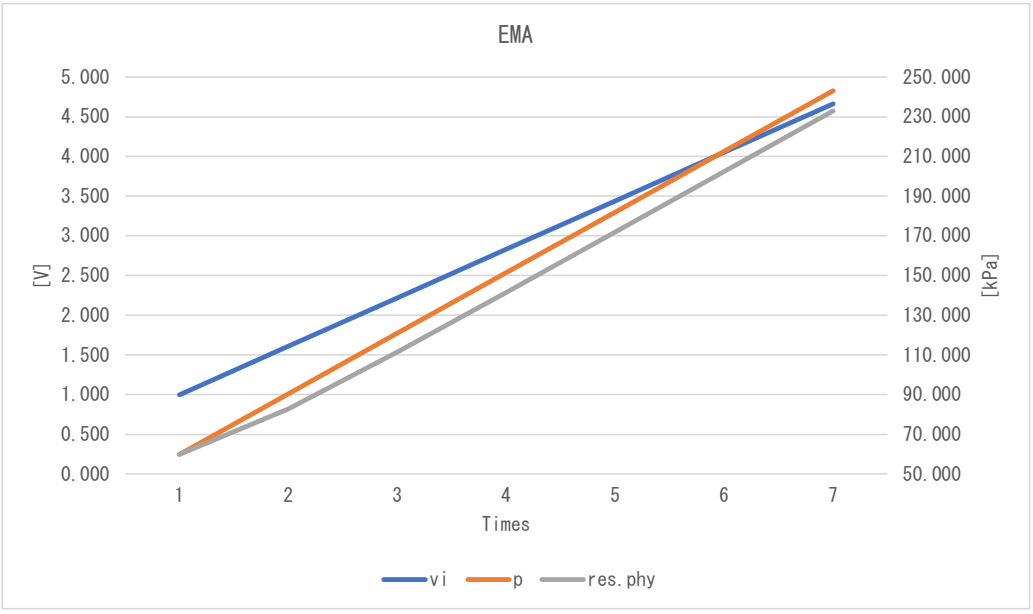
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	13,100	0.999	59.973	59.973	4,000	OK
	Measured	13,100	0.999	59.973	59.973	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	21,100	1.610	90.490	67.602	4,000	OK
	Measured	21,100	1.610	90.490	67.602	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	29,100	2.220	121.008	82.861	4,000	OK
	Measured	29,100	2.220	121.008	82.861	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	37,100	2.831	151.525	105.749	4,000	OK
	Measured	37,100	2.831	151.525	105.749	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	45,100	3.441	182.043	136.266	4,000	OK
	Measured	45,100	3.441	182.043	136.266	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	53,100	4.051	212.560	166.784	4,000	OK
	Measured	53,100	4.051	212.560	166.784	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	61,100	4.662	243.078	197.302	4,000	OK
	Measured	61,100	4.662	243.078	197.302	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	13,100	0.999	59.973	59.973	4,000	OK
	Measured	13,100	0.999	59.973	59.973	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	21,100	1.610	90.490	82.861	4,000	OK
	Measured	21,100	1.610	90.490	82.861	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	29,100	2.220	121.008	111.471	4,000	OK
	Measured	29,100	2.220	121.008	111.471	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	37,100	2.831	151.525	141.512	4,000	OK
	Measured	37,100	2.831	151.525	141.512	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	45,100	3.441	182.043	171.910	4,000	OK
	Measured	45,100	3.441	182.043	171.910	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	53,100	4.051	212.560	202.398	4,000	OK
	Measured	53,100	4.051	212.560	202.398	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	61,100	4.662	243.078	232.908	4,000	OK
	Measured	61,100	4.662	243.078	232.908	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	13,100	0.999	59.973	59.973	4,000	OK
	Measured	13,100	0.999	59.973	59.973	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	21,100	1.610	90.490	75.231	4,000	OK
	Measured	21,100	1.610	90.490	75.231	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	29,100	2.220	121.008	100.663	4,000	OK
	Measured	29,100	2.220	121.008	100.663	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	37,100	2.831	151.525	131.180	4,000	OK
	Measured	37,100	2.831	151.525	131.180	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	45,100	3.441	182.043	161.698	4,000	OK
	Measured	45,100	3.441	182.043	161.698	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	53,100	4.051	212.560	192.215	4,000	OK
	Measured	53,100	4.051	212.560	192.215	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	61,100	4.662	243.078	222.733	4,000	OK
	Measured	61,100	4.662	243.078	222.733	4,000	
	Difference	0	0.000	0.000	0.000	0