Test Specifications and Results of ADC components

Spec-00000058.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

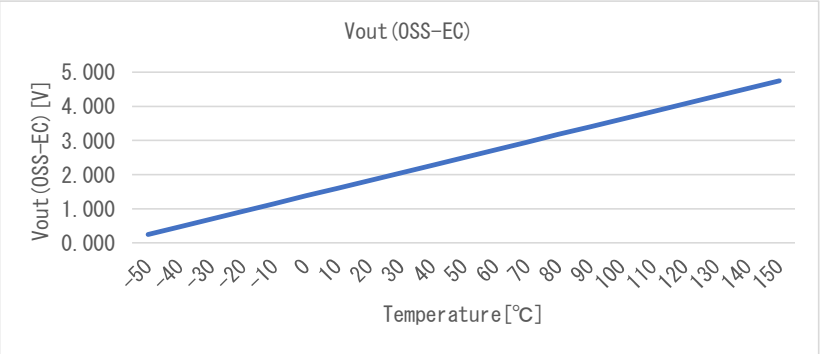
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

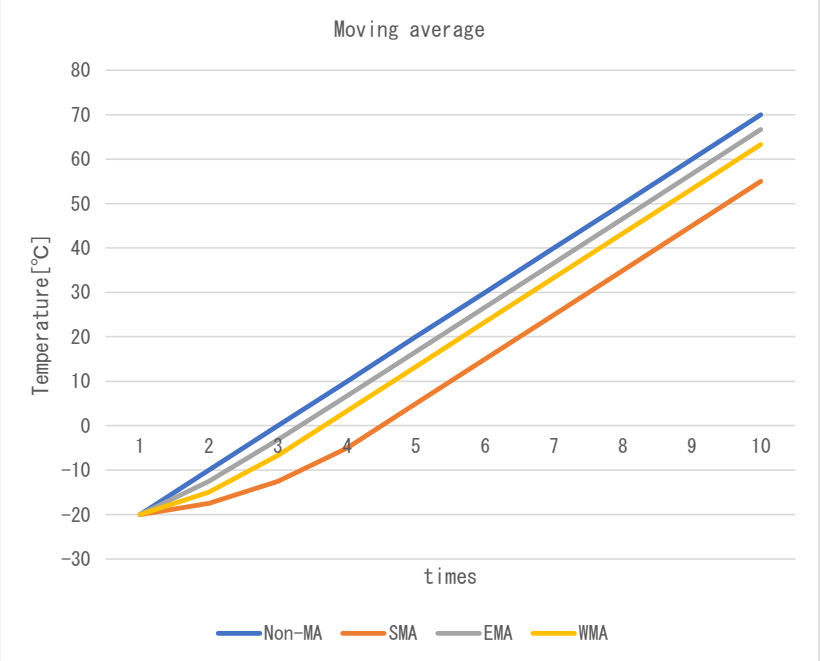
WMA calculation method $phy = ((yn \times n) + (yn-1 \times (n-1)) + \cdots + (y1 \times 1)) / (n + (n-1) + \cdots + 1)$

Non-MA calculation method $phy = y$

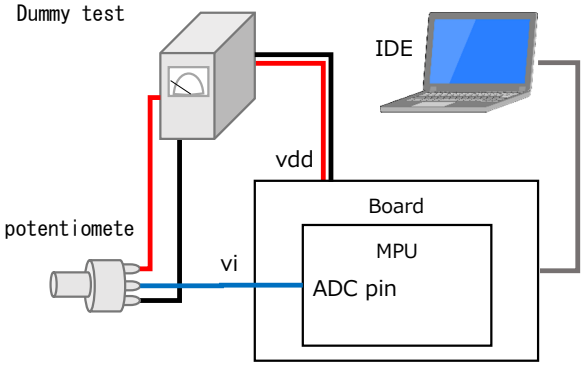
Spec-AD22100S.pdf		
component data		
x_offset	1.3750	[V]
gain	0.0225	[V/℃]
y_offset	0.0	[℃]
max	150.0	[℃]
min	-50.0	[℃]



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	

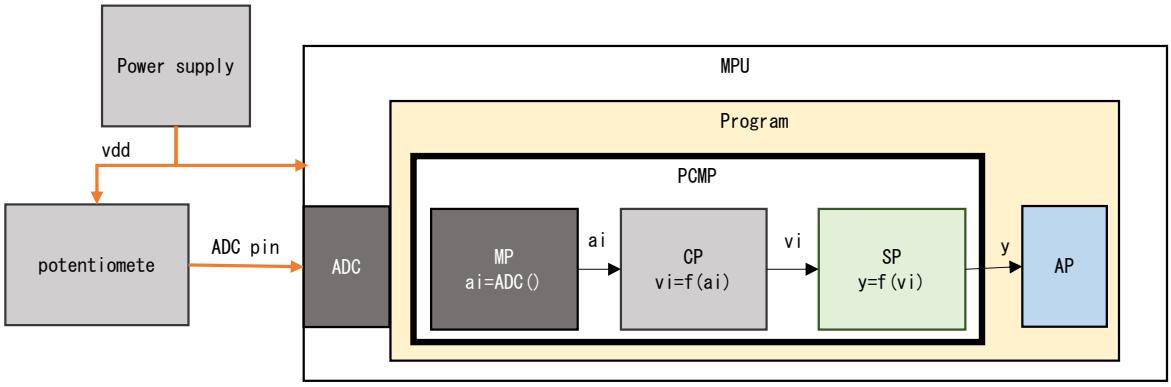


Normal operating voltage		
Vdd	5.0	[V]

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

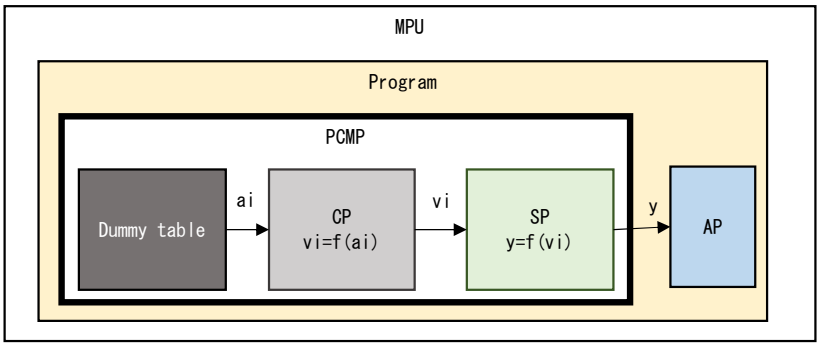
Data with 3.3V board		
x_offset	1.3750	[V]
gain	0.0225	[V/kPa]
y_offset	0.0	[kPa]

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-61.111	-50.000	4,002	OK
	Measured		32	0.002	-61.004	-50.000	4,002	
	Difference		-32	-0.002	-0.108	0.000	0	
2	Expected	1.500	29,789	1.500	5.555	5.555	4,000	OK
	Measured		29,815	1.501	5.614	5.614	4,000	
	Difference		-26	-0.001	-0.058	-0.058	0	
3	Expected	2.000	39,719	2.000	27.778	27.778	4,000	OK
	Measured		39,769	2.003	27.890	27.890	4,000	
	Difference		-50	-0.002	-0.112	-0.112	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	3,278	0.250	-49.996	-49.996	4,000	OK
	Measured	3,278	0.250	-49.996	-49.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	3,277	0.250	-49.999	-49.999	4,000	OK
	Measured	3,277	0.250	-49.999	-49.999	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	3,276	0.250	-50.003	-50.000	4,002	OK
	Measured	3,276	0.250	-50.003	-50.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	3,277	0.250	-49.999	-49.999	4,000	OK
	Measured	3,277	0.250	-49.999	-49.999	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	62,259	4.750	149.999	149.999	4,000	OK
	Measured	62,259	4.750	149.999	149.999	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	62,260	4.750	150.003	150.000	4,001	OK
	Measured	62,260	4.750	150.003	150.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	62,259	4.750	149.999	149.999	4,000	OK
	Measured	62,259	4.750	149.999	149.999	4,000	
	Difference	0	0.000	0.000	0.000	0	

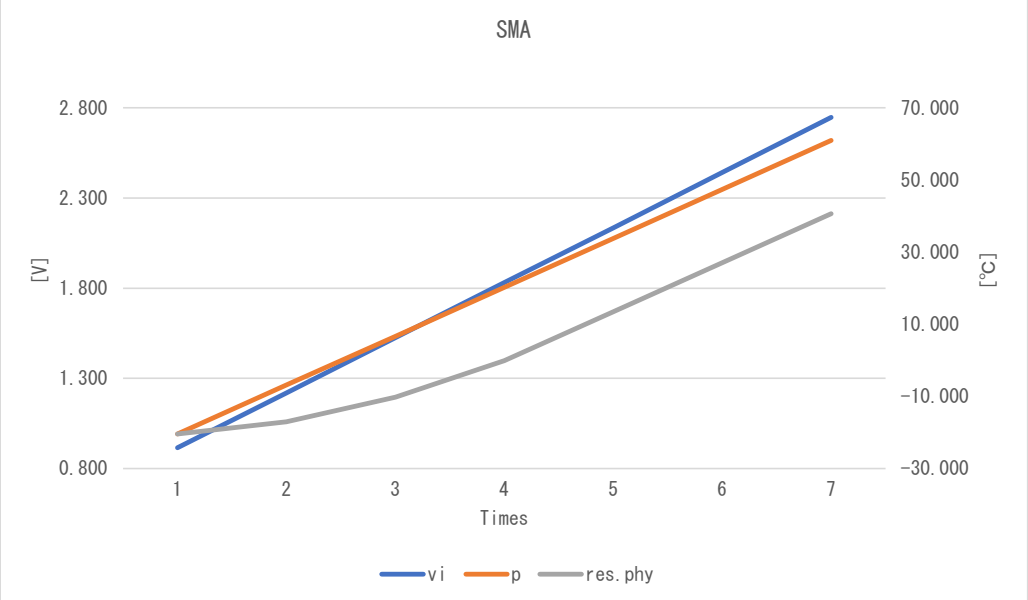
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

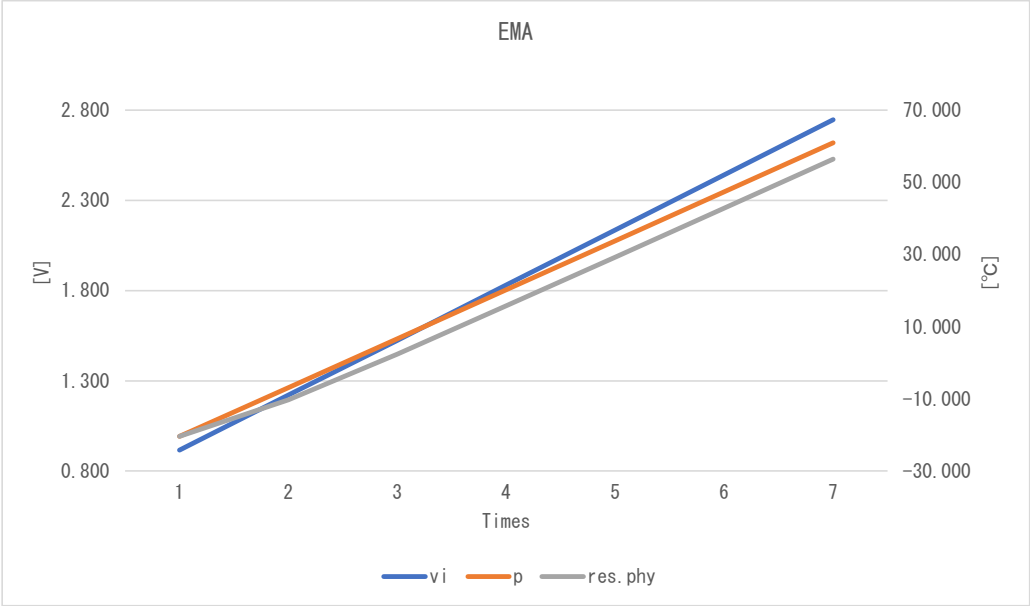
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	12,000	0.916	-20.421	-20.421	4,000	OK
	Measured	12,000	0.916	-20.421	-20.421	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	16,000	1.221	-6.858	-17.030	4,000	OK
	Measured	16,000	1.221	-6.858	-17.030	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20,000	1.526	6.706	-10.248	4,000	OK
	Measured	20,000	1.526	6.706	-10.248	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	24,000	1.831	20.269	-0.076	4,000	OK
	Measured	24,000	1.831	20.269	-0.076	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	28,000	2.136	33.832	13.487	4,000	OK
	Measured	28,000	2.136	33.832	13.487	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	32,000	2.441	47.396	27.051	4,000	OK
	Measured	32,000	2.441	47.396	27.051	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	36,000	2.747	60.959	40.614	4,000	OK
	Measured	36,000	2.747	60.959	40.614	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	12,000	0.916	-20.421	-20.421	4,000	OK
	Measured	12,000	0.916	-20.421	-20.421	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	16,000	1.221	-6.858	-10.248	4,000	OK
	Measured	16,000	1.221	-6.858	-10.248	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20,000	1.526	6.706	2.467	4,000	OK
	Measured	20,000	1.526	6.706	2.467	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	24,000	1.831	20.269	15.819	4,000	OK
	Measured	24,000	1.831	20.269	15.819	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	28,000	2.136	33.832	29.329	4,000	OK
	Measured	28,000	2.136	33.832	29.329	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	32,000	2.441	47.396	42.879	4,000	OK
	Measured	32,000	2.441	47.396	42.879	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	36,000	2.747	60.959	56.439	4,000	OK
	Measured	36,000	2.747	60.959	56.439	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	12,000	0.916	-20.421	-20.421	4,000	OK
	Measured	12,000	0.916	-20.421	-20.421	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	16,000	1.221	-6.858	-13.639	4,000	OK
	Measured	16,000	1.221	-6.858	-13.639	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20,000	1.526	6.706	-2.337	4,000	OK
	Measured	20,000	1.526	6.706	-2.337	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	24,000	1.831	20.269	11.227	4,000	OK
	Measured	24,000	1.831	20.269	11.227	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	28,000	2.136	33.832	24.790	4,000	OK
	Measured	28,000	2.136	33.832	24.790	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	32,000	2.441	47.396	38.354	4,000	OK
	Measured	32,000	2.441	47.396	38.354	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	36,000	2.747	60.959	51.917	4,000	OK
	Measured	36,000	2.747	60.959	51.917	4,000	
	Difference	0	0.000	0.000	0.000	0