Test Specifications and Results of ADC components

Spec-00000058.pdf

Date	29-Sep-22
Verifier	Red Dragon

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

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

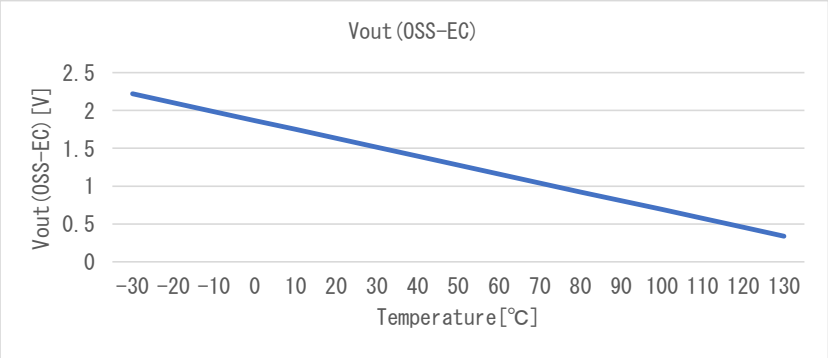
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

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

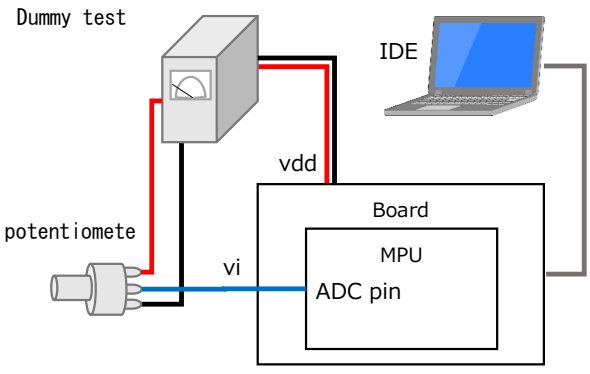
Non-MA calculation method $phy = y$

Spec-S-58LM20A.pdf		
component data		
x_offset	1.5150	[V]
gain	-0.01177	[V/℃]
y_offset	30.0	[℃]
max	130.0	[℃]
min	-30.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3

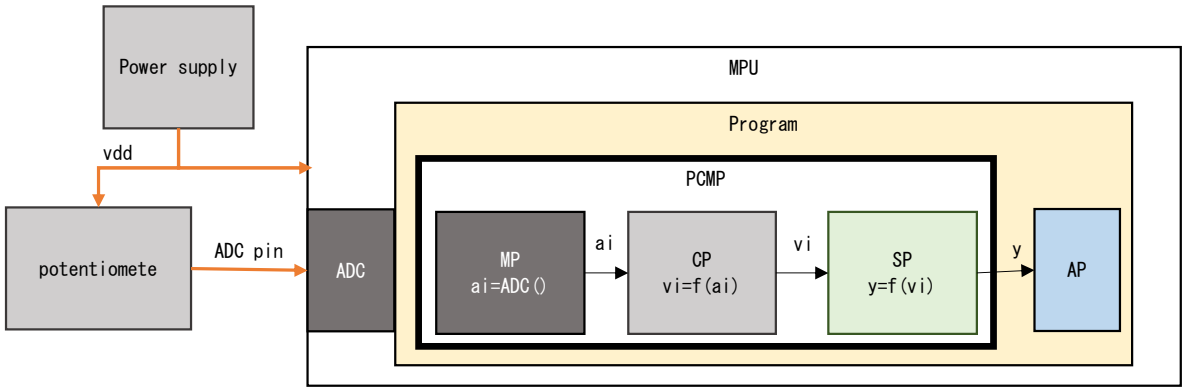
Test environment		
Board	NUCLEO-F401RE	
MPU	STM32F401RE	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	16	[bit]
ADC pin	A0	-
Component	Dummy	



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:

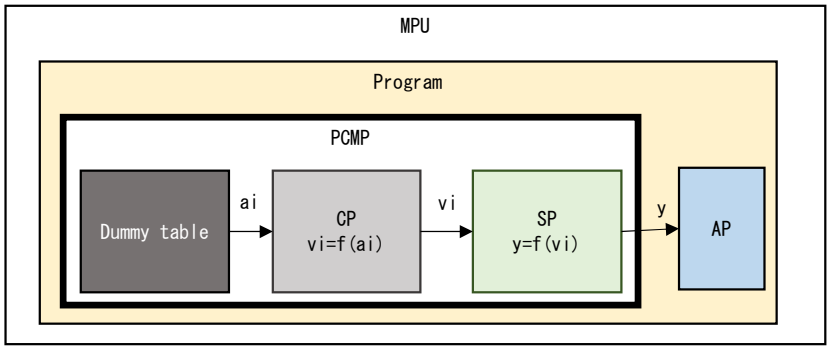


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	158.717	130.000	4,001	OK
	Measured		32	0.002	158.580	130.000	4,001	
	Difference		-32	-0.002	0.137	0.000	0	
2	Expected	1.507	29,926	1.507	30.689	30.689	4,000	OK
	Measured		29,927	1.507	30.684	30.684	4,000	
	Difference		-1	0.000	0.004	0.004	0	
3	Expected	2.038	40,473	2.038	-14.433	-14.433	4,000	OK
	Measured		40,489	2.039	-14.502	-14.502	4,000	
	Difference		-16	-0.001	0.068	0.068	0	
4	Expected	3.300	65,536	3.300	-121.657	-30.000	4,002	OK
	Measured		65,535	3.300	-121.652	-30.000	4,002	
	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	6,714	0.338	129.993	129.993	4,000	OK
	Measured	6,714	0.338	129.993	129.993	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	6,713	0.338	129.998	129.998	4,000	OK
	Measured	6,713	0.338	129.998	129.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	6,712	0.338	130.002	130.000	4,001	OK
	Measured	6,712	0.338	130.002	130.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	6,713	0.338	129.998	129.998	4,000	OK
	Measured	6,713	0.338	129.998	129.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	44,112	2.221	-30.001	-30.000	4,002	OK
	Measured	44,112	2.221	-30.001	-30.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	44,111	2.221	-29.997	-29.997	4,000	OK
	Measured	44,111	2.221	-29.997	-29.997	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	44,112	2.221	-30.001	-30.000	4,002	OK
	Measured	44,112	2.221	-30.001	-30.000	4,002	
	Difference	0	0.000	0.000	0.000	0	

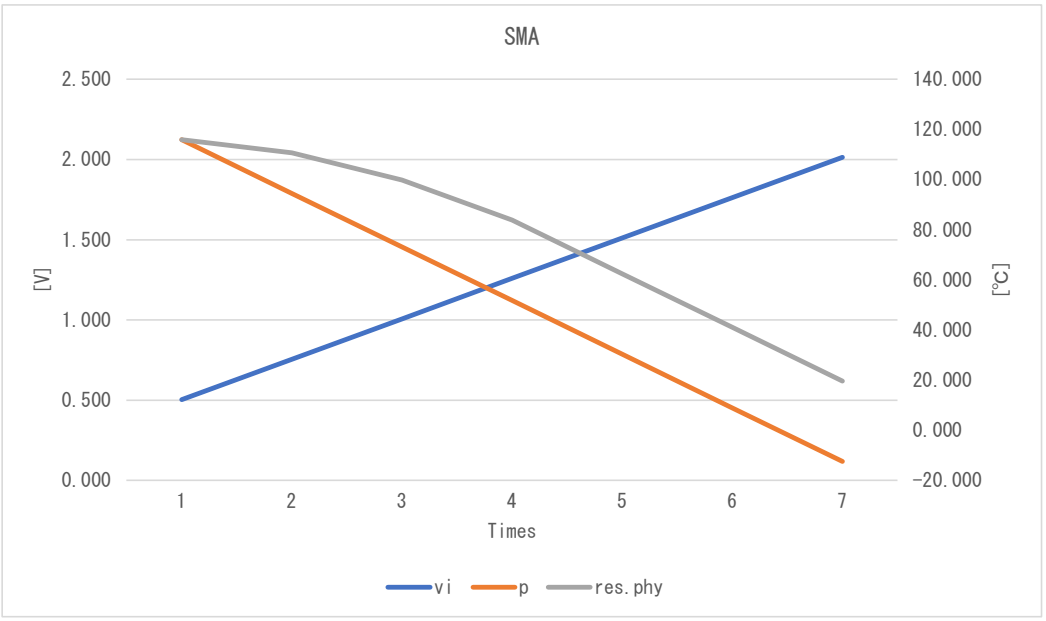
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

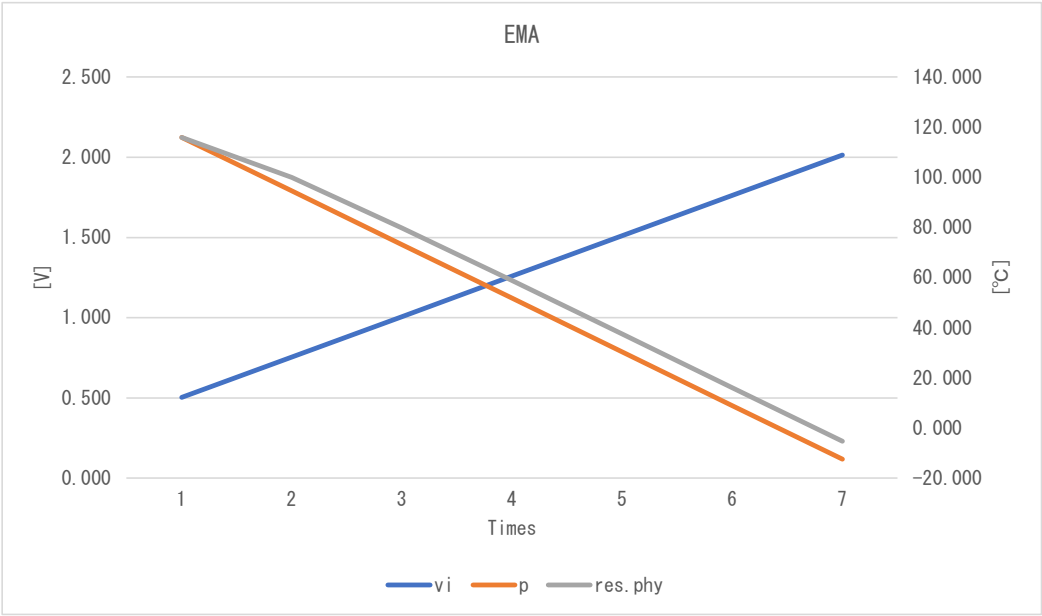
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	10,000	0.504	115.935	115.935	4,000	OK
	Measured	10,000	0.504	115.935	115.935	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	15,000	0.755	94.545	110.588	4,000	OK
	Measured	15,000	0.755	94.545	110.588	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20,000	1.007	73.154	99.892	4,000	OK
	Measured	20,000	1.007	73.154	99.892	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	25,000	1.259	51.763	83.849	4,000	OK
	Measured	25,000	1.259	51.763	83.849	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	30,000	1.511	30.372	62.458	4,000	OK
	Measured	30,000	1.511	30.372	62.458	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	35,000	1.762	8.981	41.068	4,000	OK
	Measured	35,000	1.762	8.981	41.068	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	40,000	2.014	-12.410	19.677	4,000	OK
	Measured	40,000	2.014	-12.410	19.677	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	10,000	0.504	115.935	115.935	4,000	OK
	Measured	10,000	0.504	115.935	115.935	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	15,000	0.755	94.545	99.892	4,000	OK
	Measured	15,000	0.755	94.545	99.892	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20,000	1.007	73.154	79.838	4,000	OK
	Measured	20,000	1.007	73.154	79.838	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	25,000	1.259	51.763	58.782	4,000	OK
	Measured	25,000	1.259	51.763	58.782	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	30,000	1.511	30.372	37.475	4,000	OK
	Measured	30,000	1.511	30.372	37.475	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	35,000	1.762	8.981	16.105	4,000	OK
	Measured	35,000	1.762	8.981	16.105	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	40,000	2.014	-12.410	-5.281	4,000	OK
	Measured	40,000	2.014	-12.410	-5.281	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	10,000	0.504	115.935	115.935	4,000	OK
	Measured	10,000	0.504	115.935	115.935	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	15,000	0.755	94.545	105.240	4,000	OK
	Measured	15,000	0.755	94.545	105.240	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20,000	1.007	73.154	87.414	4,000	OK
	Measured	20,000	1.007	73.154	87.414	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	25,000	1.259	51.763	66.023	4,000	OK
	Measured	25,000	1.259	51.763	66.024	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	30,000	1.511	30.372	44.633	4,000	OK
	Measured	30,000	1.511	30.372	44.633	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	35,000	1.762	8.981	23.242	4,000	OK
	Measured	35,000	1.762	8.981	23.242	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	40,000	2.014	-12.410	1.851	4,000	OK
	Measured	40,000	2.014	-12.410	1.851	4,000	
	Difference	0	0.000	0.000	0.000	0