Test Specifications and Results of ADC components

Spec-00000058.pdf

Date	26-Oct-22
Verifier	Red Dragon

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

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

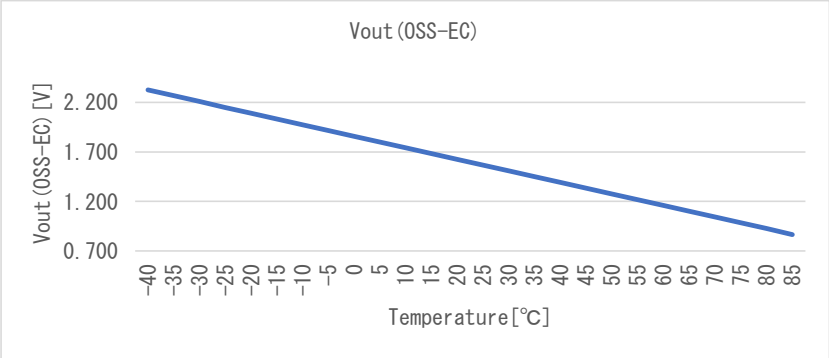
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

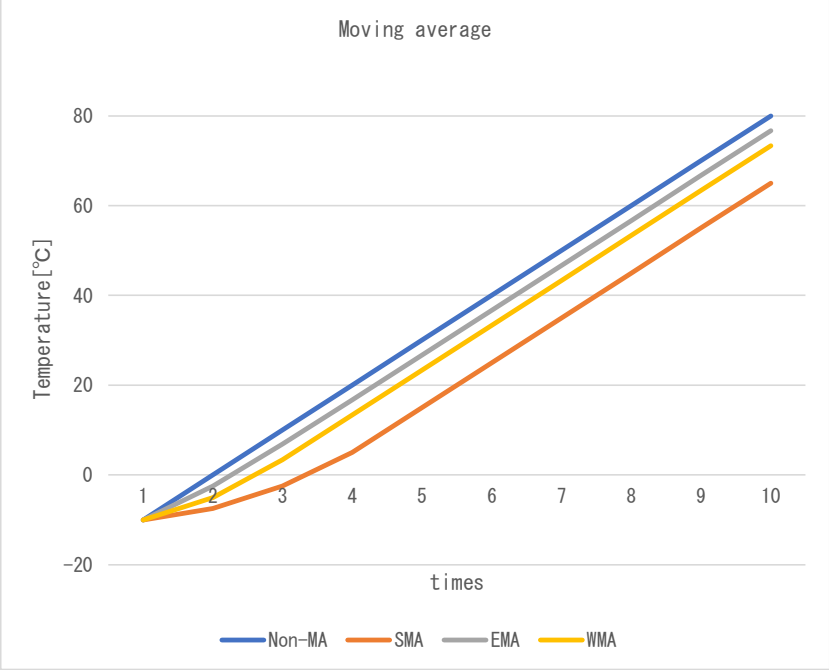
WMA calculation method $phy = ((yn \times n) + (yn-1 \times (n-1)) + \cdots + (y1 \times 1)) / (n + (n-1) + \cdots + 1)$

Non-MA calculation method $phy = y$

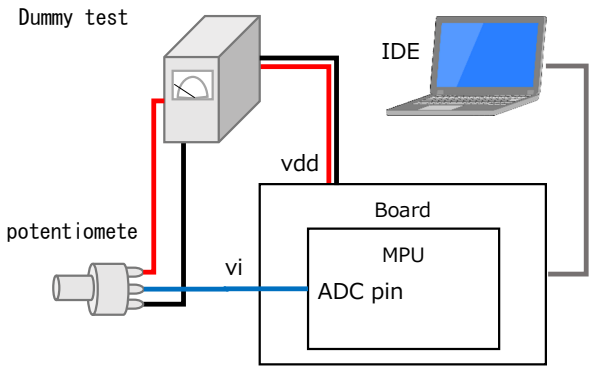
Spec-STLM20DD9F.pdf		
component data		
x_offset	1.8583	[V]
gain	-0.01167	[V/℃]
y_offset	0.0	[℃]
max	85.0	[℃]
min	-40.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



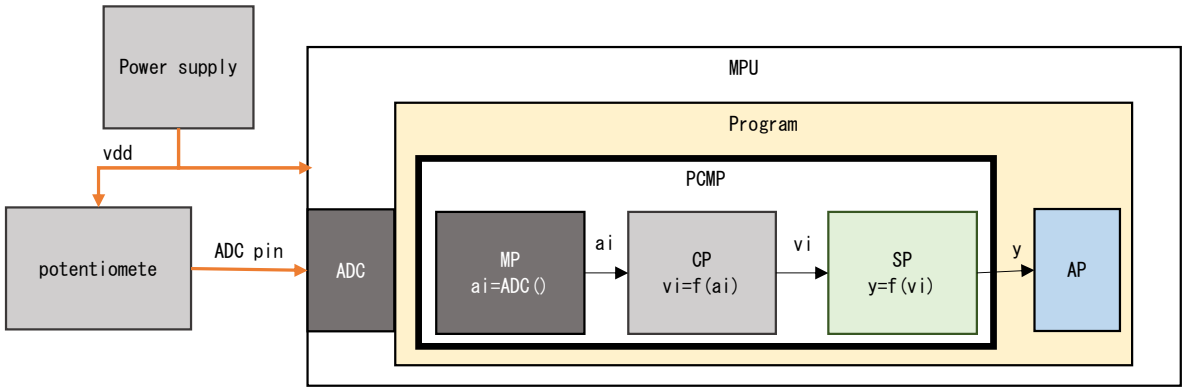
Test environment		
Board	NUCLEO-F401RE	
MPU	STM32F401RE	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	16	[bit]
ADC pin	A0	-
Component	Dummy	



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:

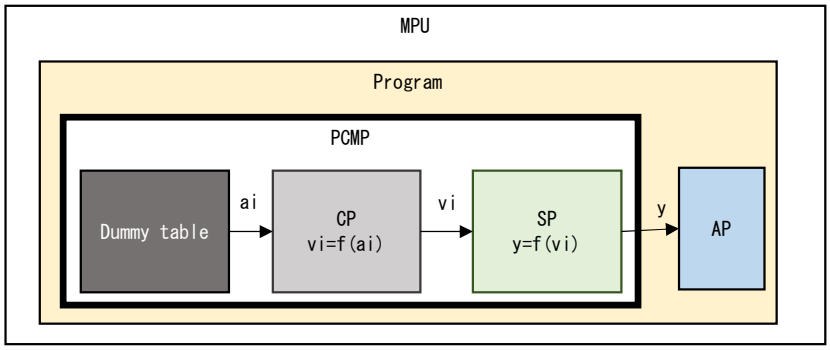


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	159.237	85.000	4,001	OK
	Measured		32	0.002	159.099	85.000	4,001	
	Difference		-32	-0.002	0.138	0.000	0	
2	Expected	1.300	25,817	1.300	47.842	47.842	4,000	OK
	Measured		25,830	1.301	47.785	47.785	4,000	
	Difference		-13	-0.001	0.056	0.056	0	
3	Expected	1.500	29,789	1.500	30.703	30.703	4,000	OK
	Measured		29,783	1.500	30.729	30.729	4,000	
	Difference		6	0.000	-0.026	-0.026	0	
4	Expected	3.300	65,536	3.300	-123.539	-40.000	4,002	OK
	Measured		65,535	3.300	-123.535	-40.000	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	46,174	2.325	-39.995	-39.995	4,000	OK
	Measured	46,174	2.325	-39.995	-39.995	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	46,175	2.325	-40.000	-40.000	4,000	OK
	Measured	46,175	2.325	-40.000	-40.000	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	46,176	2.325	-40.004	-40.000	4,002	OK
	Measured	46,176	2.325	-40.004	-40.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	46,175	2.325	-40.000	-40.000	4,000	OK
	Measured	46,175	2.325	-40.000	-40.000	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	17,206	0.866	84.996	84.996	4,000	OK
	Measured	17,206	0.866	84.996	84.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	17,205	0.866	85.001	85.000	4,001	OK
	Measured	17,205	0.866	85.001	85.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,206	0.866	84.996	84.996	4,000	OK
	Measured	17,206	0.866	84.996	84.996	4,000	
	Difference	0	0.000	0.000	0.000	0	

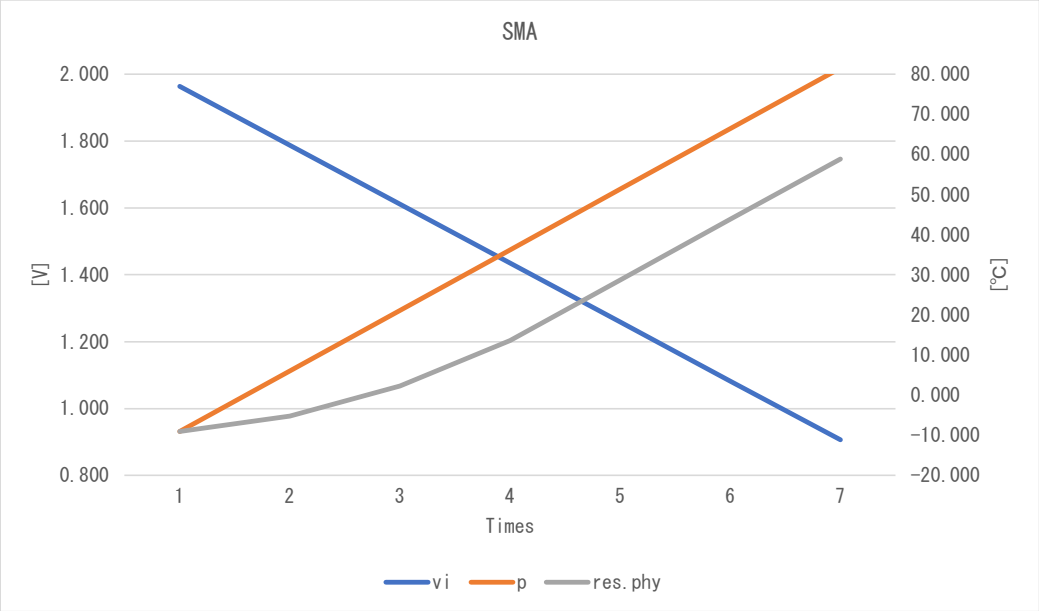
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

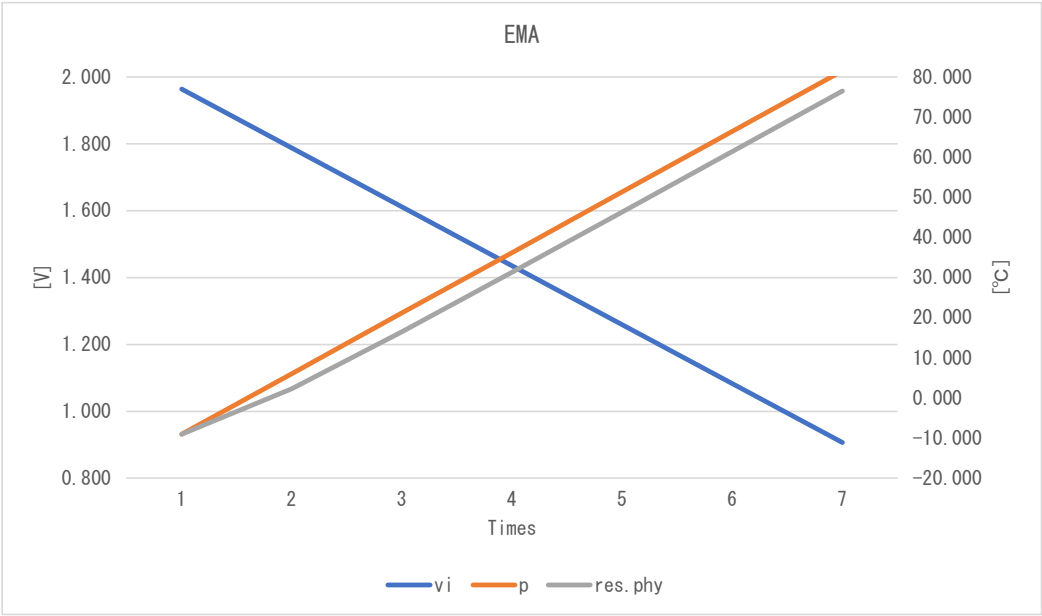
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	39,000	1.964	-9.041	-9.041	4,000	OK
	Measured	39,000	1.964	-9.041	-9.041	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	35,500	1.788	6.061	-5.265	4,000	OK
	Measured	35,500	1.788	6.061	-5.265	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	32,000	1.611	21.163	2.286	4,000	OK
	Measured	32,000	1.611	21.163	2.286	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	28,500	1.435	36.265	13.612	4,000	OK
	Measured	28,500	1.435	36.265	13.612	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	25,000	1.259	51.367	28.714	4,000	OK
	Measured	25,000	1.259	51.367	28.714	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	21,500	1.083	66.469	43.816	4,000	OK
	Measured	21,500	1.083	66.469	43.816	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	18,000	0.906	81.571	58.918	4,000	OK
	Measured	18,000	0.906	81.571	58.918	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	39,000	1.964	-9.041	-9.041	4,000	OK
	Measured	39,000	1.964	-9.041	-9.041	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	35,500	1.788	6.061	2.286	4,000	OK
	Measured	35,500	1.788	6.061	2.286	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	32,000	1.611	21.163	16.444	4,000	OK
	Measured	32,000	1.611	21.163	16.444	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	28,500	1.435	36.265	31.310	4,000	OK
	Measured	28,500	1.435	36.265	31.310	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	25,000	1.259	51.367	46.352	4,000	OK
	Measured	25,000	1.259	51.367	46.352	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	21,500	1.083	66.469	61.440	4,000	OK
	Measured	21,500	1.083	66.469	61.440	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	18,000	0.906	81.571	76.538	4,000	OK
	Measured	18,000	0.906	81.571	76.538	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	39,000	1.964	-9.041	-9.041	4,000	OK
	Measured	39,000	1.964	-9.041	-9.041	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	35,500	1.788	6.061	-1.490	4,000	OK
	Measured	35,500	1.788	6.061	-1.490	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	32,000	1.611	21.163	11.095	4,000	OK
	Measured	32,000	1.611	21.163	11.095	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	28,500	1.435	36.265	26.197	4,000	OK
	Measured	28,500	1.435	36.265	26.197	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	25,000	1.259	51.367	41.299	4,000	OK
	Measured	25,000	1.259	51.367	41.299	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	21,500	1.083	66.469	56.401	4,000	OK
	Measured	21,500	1.083	66.469	56.401	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	18,000	0.906	81.571	71.503	4,000	OK
	Measured	18,000	0.906	81.571	71.503	4,000	
	Difference	0	0.000	0.000	0.000	0