Test Specifications and Results of ADC components

Spec-00000058.pdf

Date	2-Nov-22
Verifier	Red Dragon

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

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

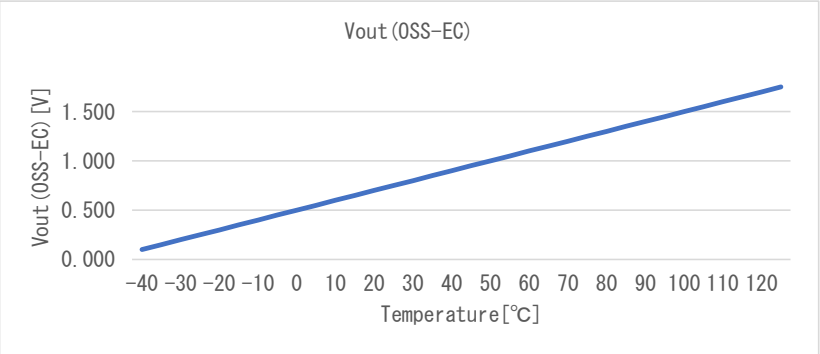
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

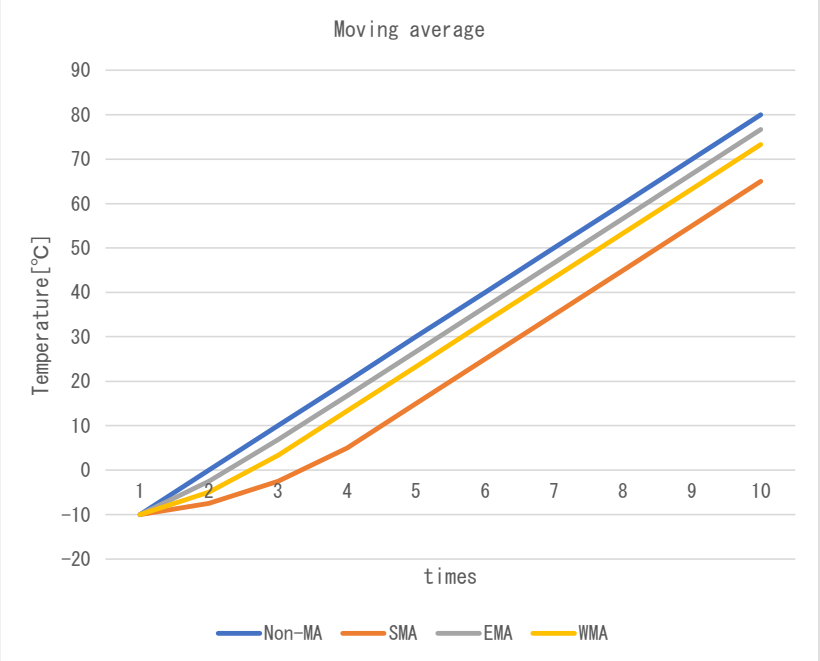
WMA calculation method $phy = ((yn \times n) + (yn-1 \times (n-1)) + \cdots + (y1 \times 1)) / (n + (n-1) + \cdots + 1)$

Non-MA calculation method $phy = y$

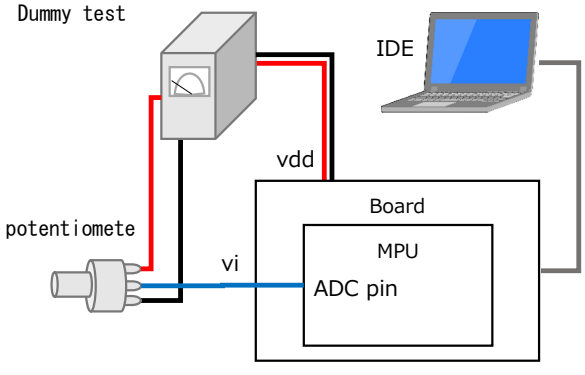
Spec-LM50C_LM50-Q1.pdf		
component data		
x_offset	0.5000	[V]
gain	0.01	[V/℃]
y_offset	0.0	[℃]
max	125.0	[℃]
min	-40.0	[℃]



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	

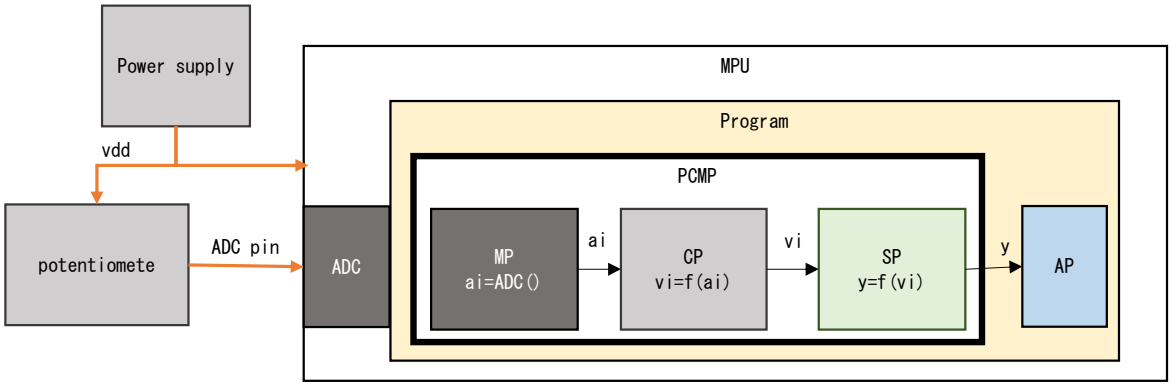


Normal operating voltage		
Vdd	5.0	[V]

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

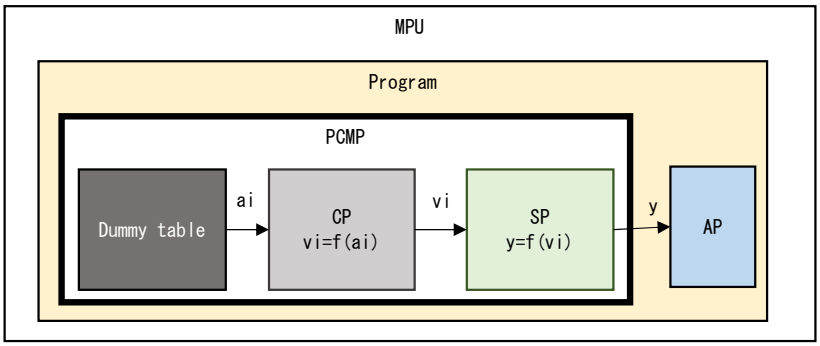
Data with 3.3V board		
x_offset	0.5000	[V]
gain	0.01	[V/℃]
y_offset	0.0	[℃]

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-50.000	-40.000	4,002	OK
	Measured		32	0.002	-49.839	-40.000	4,002	
	Difference		-32	-0.002	-0.161	0.000	0	
2	Expected	1.300	25,817	1.300	79.999	79.999	4,000	OK
	Measured		25,830	1.301	80.064	80.064	4,000	
	Difference		-13	-0.001	-0.065	-0.065	0	
3	Expected	1.500	29,789	1.500	100.000	100.000	4,000	OK
	Measured		29,799	1.500	100.050	100.050	4,000	
	Difference		-10	0.000	-0.050	-0.050	0	
4	Expected	3.300	65,536	3.300	280.000	125.000	4,001	OK
	Measured		65,535	3.300	279.995	125.000	4,001	
	Difference		1	0.000	0.005	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	1,312	0.100	-39.990	-39.990	4,000	OK
	Measured	1,312	0.100	-39.990	-39.990	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	1,311	0.100	-39.998	-39.998	4,000	OK
	Measured	1,311	0.100	-39.998	-39.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	1,310	0.100	-40.005	-40.000	4,002	OK
	Measured	1,310	0.100	-40.005	-40.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	1,311	0.100	-39.998	-39.998	4,000	OK
	Measured	1,311	0.100	-39.998	-39.998	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	22,937	1.750	124.995	124.995	4,000	OK
	Measured	22,937	1.750	124.995	124.995	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	22,938	1.750	125.003	125.000	4,001	OK
	Measured	22,938	1.750	125.003	125.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	22,937	1.750	124.995	124.995	4,000	OK
	Measured	22,937	1.750	124.995	124.995	4,000	
	Difference	0	0.000	0.000	0.000	0	

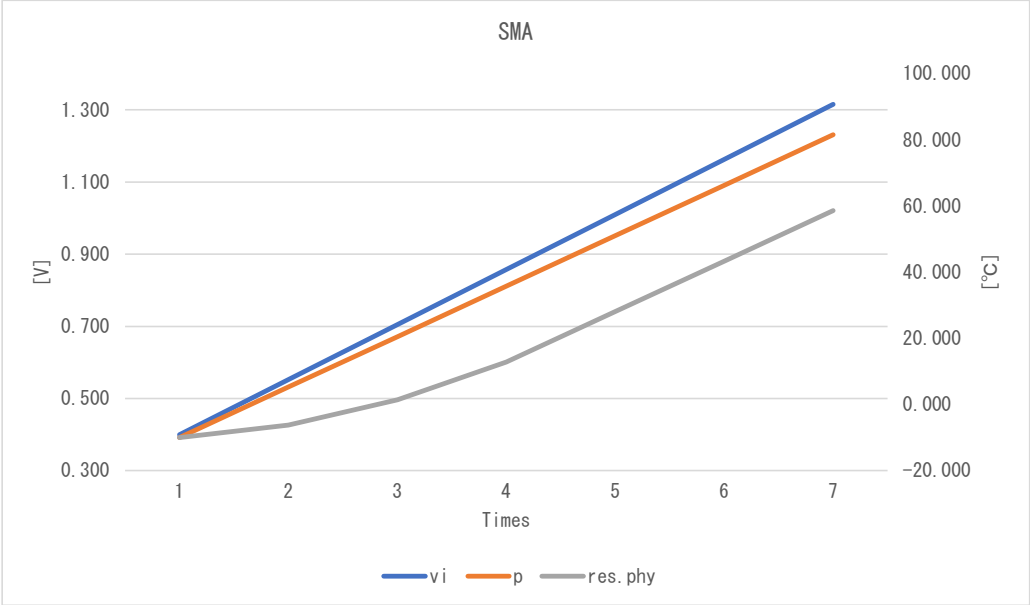
res.sts	4000	Normal
	4001	Max Limiter NG
	4002	Min Limiter NG

2-2. Moving average test

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

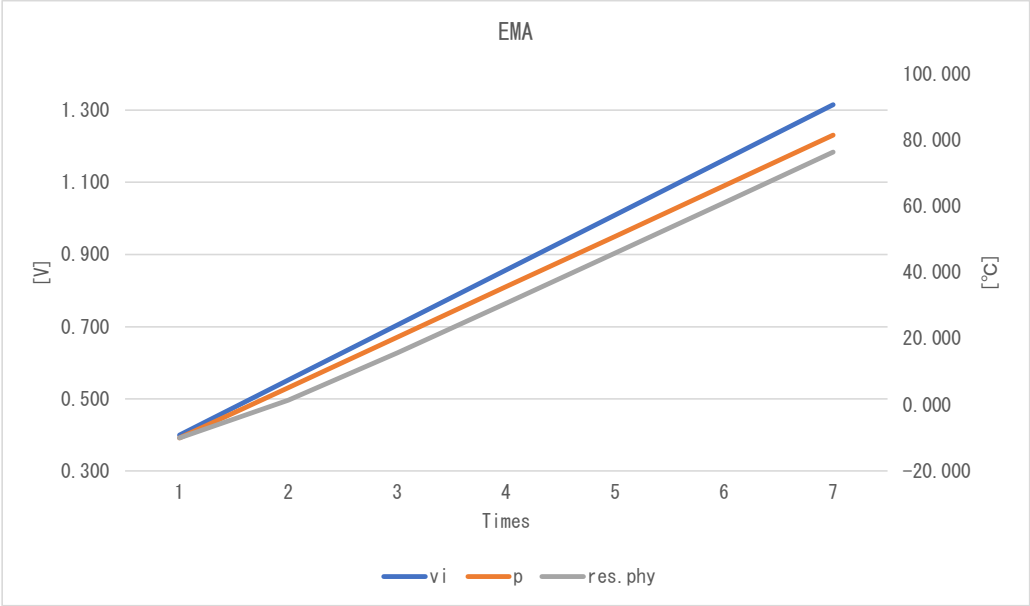
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	5,240	0.400	-10.022	-10.022	4,000	OK
	Measured	5,240	0.400	-10.022	-10.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	7,240	0.552	5.237	-6.207	4,000	OK
	Measured	7,240	0.552	5.237	-6.207	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	9,240	0.705	20.496	1.422	4,000	OK
	Measured	9,240	0.705	20.496	1.422	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	11,240	0.858	35.754	12.866	4,000	OK
	Measured	11,240	0.858	35.754	12.866	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,240	1.010	51.013	28.125	4,000	OK
	Measured	13,240	1.010	51.013	28.125	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	15,240	1.163	66.272	43.384	4,000	OK
	Measured	15,240	1.163	66.272	43.384	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,240	1.315	81.531	58.643	4,000	OK
	Measured	17,240	1.315	81.531	58.643	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	5,240	0.400	-10.022	-10.022	4,000	OK
	Measured	5,240	0.400	-10.022	-10.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	7,240	0.552	5.237	1.422	4,000	OK
	Measured	7,240	0.552	5.237	1.422	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	9,240	0.705	20.496	15.727	4,000	OK
	Measured	9,240	0.705	20.496	15.727	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	11,240	0.858	35.754	30.748	4,000	OK
	Measured	11,240	0.858	35.754	30.748	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,240	1.010	51.013	45.947	4,000	OK
	Measured	13,240	1.010	51.013	45.947	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	15,240	1.163	66.272	61.191	4,000	OK
	Measured	15,240	1.163	66.272	61.191	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,240	1.315	81.531	76.446	4,000	OK
	Measured	17,240	1.315	81.531	76.446	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	5,240	0.400	-10.022	-10.022	4,000	OK
	Measured	5,240	0.400	-10.022	-10.022	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	7,240	0.552	5.237	-2.393	4,000	OK
	Measured	7,240	0.552	5.237	-2.393	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	9,240	0.705	20.496	10.323	4,000	OK
	Measured	9,240	0.705	20.496	10.323	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	11,240	0.858	35.754	25.582	4,000	OK
	Measured	11,240	0.858	35.754	25.582	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	13,240	1.010	51.013	40.841	4,000	OK
	Measured	13,240	1.010	51.013	40.841	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	15,240	1.163	66.272	56.099	4,000	OK
	Measured	15,240	1.163	66.272	56.099	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	17,240	1.315	81.531	71.358	4,000	OK
	Measured	17,240	1.315	81.531	71.358	4,000	
	Difference	0	0.000	0.000	0.000	0