Test Specifications and Results of ADC components

Spec-00000057.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 $phy = (y_n + y_{n-1} + y_{n-2}) / n$

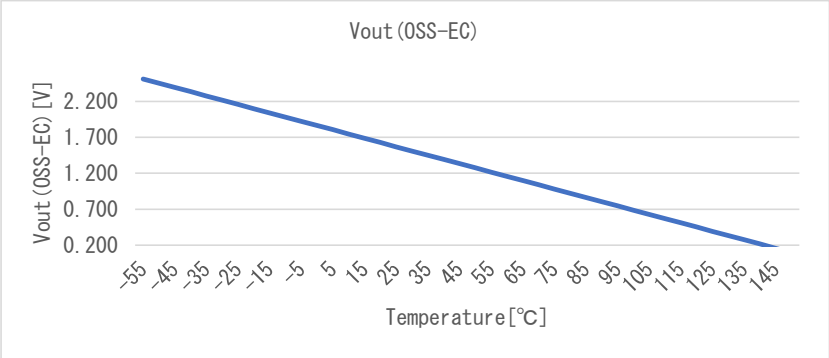
EMA calculation method $phy = (y \times k) + (phy_{n-1} \times (1 - k))$

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

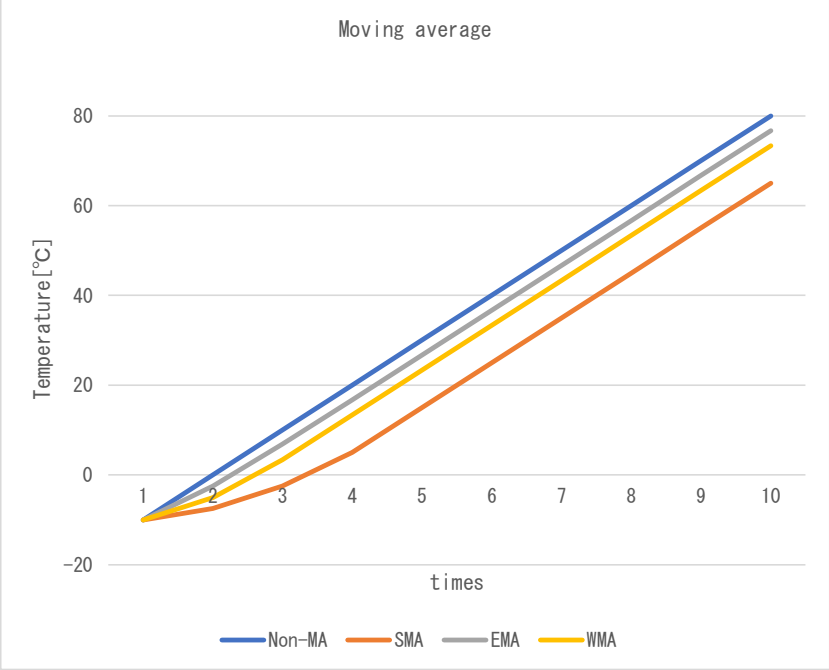
Non-MA calculation method $phy = y$

Spec-TMP9A00.pdf

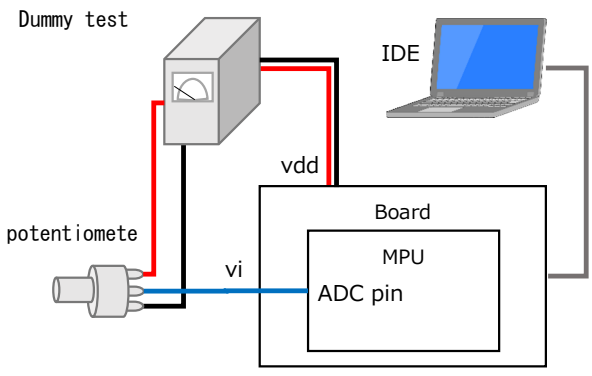
component data		
x_offset	1.8639	[V]
gain	-0.01177	[V/℃]
y_offset	0.0	[℃]
max	150.0	[℃]
min	-55.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



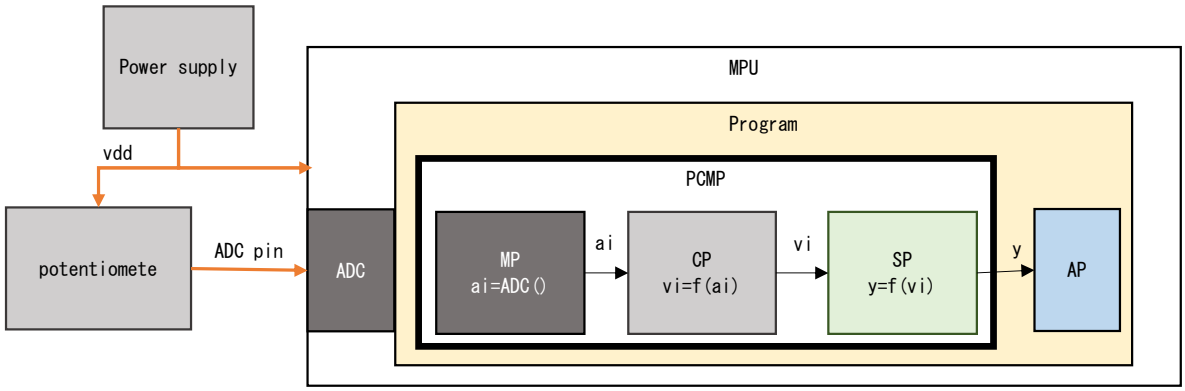
Test environment		
Board	Arduino Pro Mini(3.3V versions)	
MPU	ATmega328P	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	10	[bit]
ADC pin	A0	-
Component	Dummy	



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:

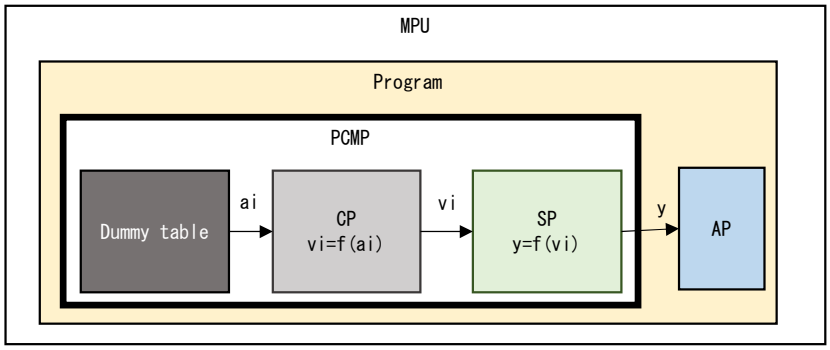


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	158.360	150.000	4,001	OK
	Measured		0	0.000	158.360	150.000	4,001	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.300	403	1.299	48.018	48.018	4,000	OK
	Measured		403	1.299	48.018	48.018	4,000	
	Difference		0	0.000	0.000	0.000	0	
3	Expected	1.500	465	1.499	31.042	31.042	4,000	OK
	Measured		465	1.499	31.042	31.042	4,000	
	Difference		0	0.000	0.000	0.000	0	
4	Expected	3.300	1,024	3.300	-122.014	-55.000	4,002	OK
	Measured		1,023	3.299	-121.740	-55.000	4,002	
	Difference		1	0.001	-0.274	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	778	2.507	-54.658	-54.658	4,000	OK
	Measured	778	2.507	-54.658	-54.658	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	779	2.510	-54.932	-54.932	4,000	OK
	Measured	779	2.510	-54.932	-54.932	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	780	2.514	-55.206	-55.000	4,002	OK
	Measured	780	2.514	-55.206	-55.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	779	2.510	-54.932	-54.932	4,000	OK
	Measured	779	2.510	-54.932	-54.932	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	31	0.100	149.872	149.872	4,000	OK
	Measured	31	0.100	149.872	149.872	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	30	0.097	150.146	150.000	4,001	OK
	Measured	30	0.097	150.146	150.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	31	0.100	149.872	149.872	4,000	OK
	Measured	31	0.100	149.872	149.872	4,000	
	Difference	0	0.000	0.000	0.000	0	

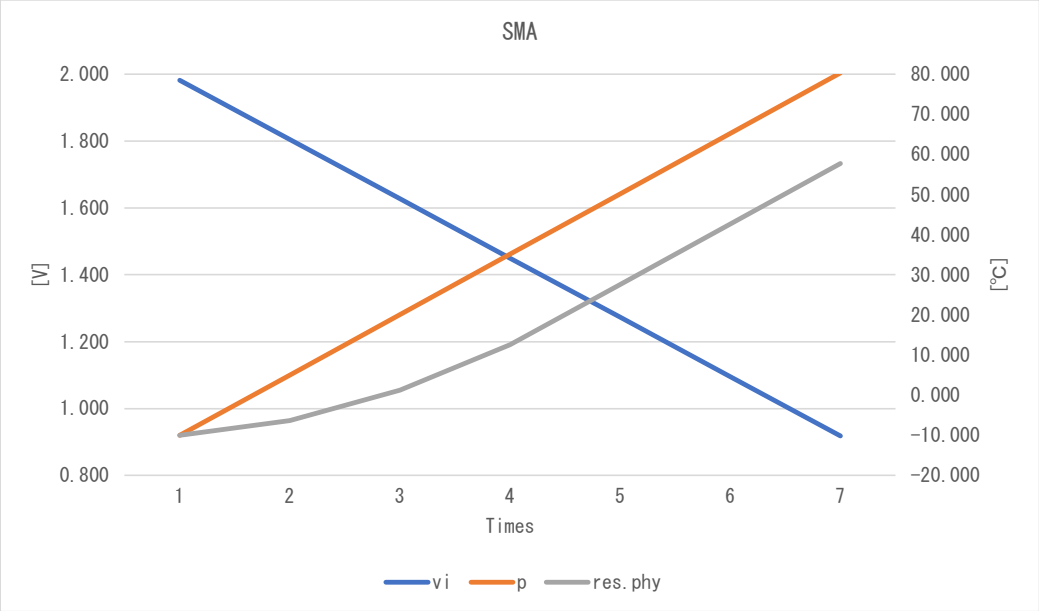
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

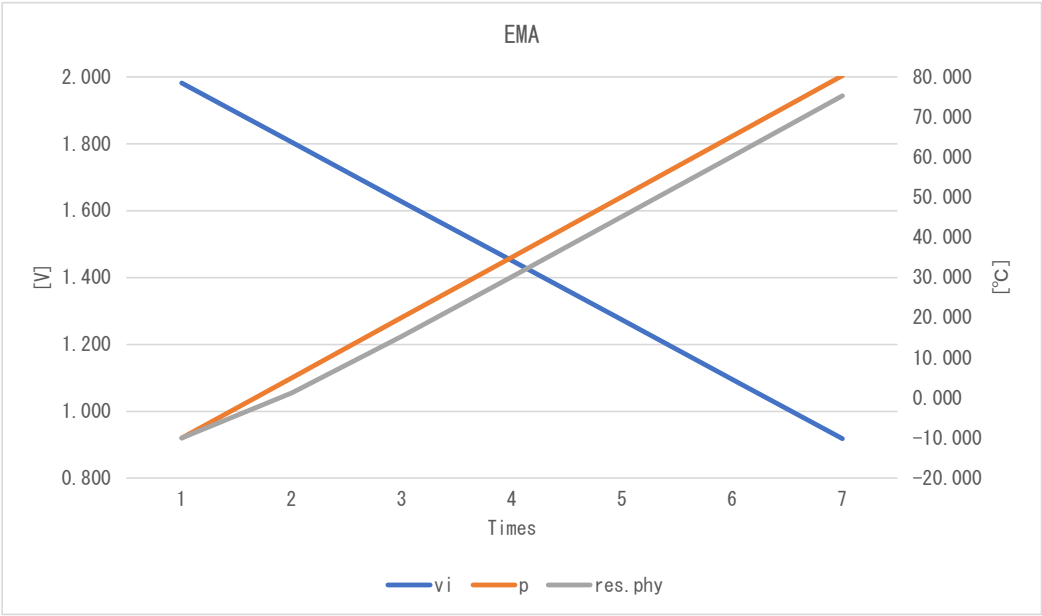
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	615	1.982	-10.028	-10.028	4,000	OK
	Measured	615	1.982	-10.028	-10.028	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	560	1.805	5.031	-6.264	4,000	OK
	Measured	560	1.805	5.031	-6.264	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	505	1.627	20.090	1.266	4,000	OK
	Measured	505	1.627	20.090	1.266	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	450	1.450	35.149	12.560	4,000	OK
	Measured	450	1.450	35.149	12.560	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	395	1.273	50.208	27.620	4,000	OK
	Measured	395	1.273	50.208	27.620	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	340	1.096	65.267	42.679	4,000	OK
	Measured	340	1.096	65.267	42.679	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	285	0.918	80.327	57.738	4,000	OK
	Measured	285	0.919	80.327	57.738	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	615	1.982	-10.028	-10.028	4,000	OK
	Measured	615	1.982	-10.028	-10.028	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	560	1.805	5.031	1.266	4,000	OK
	Measured	560	1.805	5.031	1.266	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	505	1.627	20.090	15.384	4,000	OK
	Measured	505	1.627	20.090	15.384	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	450	1.450	35.149	30.208	4,000	OK
	Measured	450	1.450	35.149	30.208	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	395	1.273	50.208	45.208	4,000	OK
	Measured	395	1.273	50.208	45.208	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	340	1.096	65.267	60.253	4,000	OK
	Measured	340	1.096	65.267	60.253	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	285	0.918	80.327	75.308	4,000	OK
	Measured	285	0.919	80.327	75.308	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	615	1.982	-10.028	-10.028	4,000	OK
	Measured	615	1.982	-10.028	-10.028	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	560	1.805	5.031	-2.499	4,000	OK
	Measured	560	1.805	5.031	-2.499	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	505	1.627	20.090	10.051	4,000	OK
	Measured	505	1.627	20.090	10.051	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	450	1.450	35.149	25.110	4,000	OK
	Measured	450	1.450	35.149	25.110	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	395	1.273	50.208	40.169	4,000	OK
	Measured	395	1.273	50.208	40.169	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	340	1.096	65.267	55.228	4,000	OK
	Measured	340	1.096	65.267	55.228	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	285	0.918	80.327	70.287	4,000	OK
	Measured	285	0.919	80.327	70.287	4,000	
	Difference	0	0.000	0.000	0.000	0