Test Specifications and Results of ADC components

Spec-00000057.pdf

Date	17-Oct-22
Verifier	Red Dragon

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

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

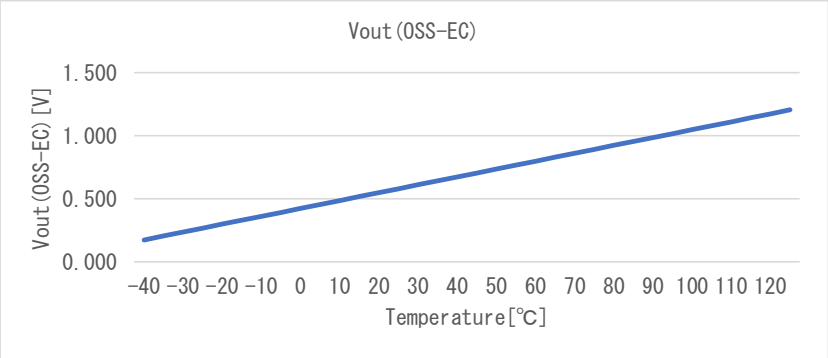
SMA calculation method $phy = (y_n + y_{n-1} + y_{n-2}) / n$

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

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

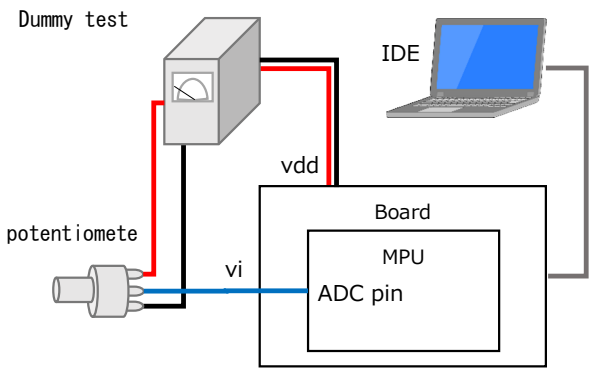
Non-MA calculation method $phy = y$

Spec-TC1046.pdf		
component data		
x_offset	0.4240	[V]
gain	0.00625	[V/℃]
y_offset	0.0	[℃]
max	125.0	[℃]
min	-40.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3

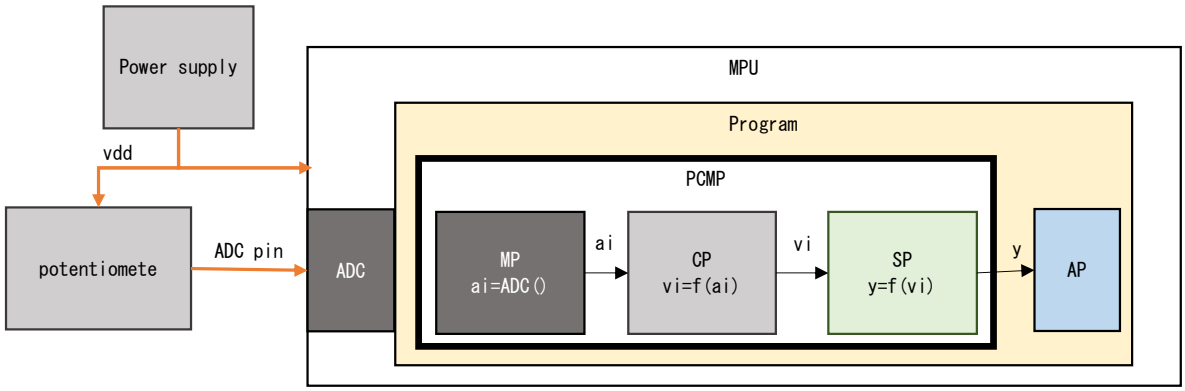
Test environment		
Board	Arduino Pro Mini(3.3V versions)	
MPU	ATmega328P	
ComplierVer	Arm Compiler 6.16	
IDE	Mbed Studio 1.4.4	
Vdd	3.3	[V]
ADC bit	10	[bit]
ADC pin	A0	-
Component	Dummy	



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:

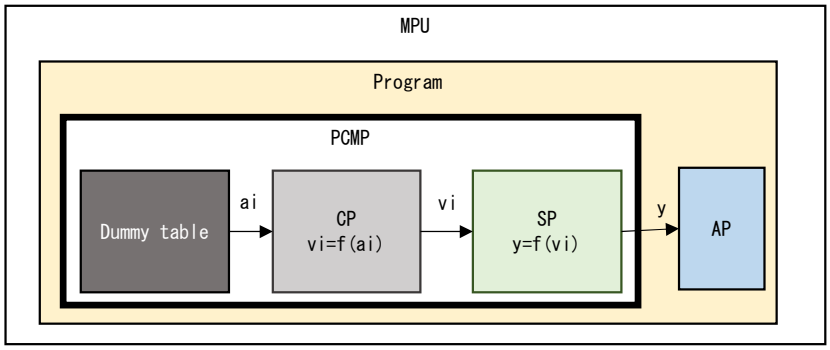


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-67.840	-40.000	4,002	OK
	Measured		0	0.000	-67.840	-40.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.200	372	1.199	123.973	123.973	4,000	OK
	Measured		373	1.202	124.488	124.488	4,000	
	Difference		-1	-0.003	-0.516	-0.516	0	
3	Expected	1.300	403	1.299	139.957	125.000	4,001	OK
	Measured		404	1.302	140.473	125.000	4,001	
	Difference		-1	-0.003	-0.516	0.000	0	
4	Expected	3.300	1,024	3.300	460.160	125.000	4,001	OK
	Measured		1,023	3.297	459.644	125.000	4,001	
	Difference		1	0.003	0.516	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	55	0.177	-39.481	-39.481	4,000	OK
	Measured	55	0.177	-39.481	-39.481	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	54	0.174	-39.996	-39.996	4,000	OK
	Measured	54	0.174	-39.996	-39.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	53	0.171	-40.512	-40.000	4,002	OK
	Measured	53	0.171	-40.512	-40.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	54	0.174	-39.996	-39.996	4,000	OK
	Measured	54	0.174	-39.996	-39.996	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	373	1.202	124.488	124.488	4,000	OK
	Measured	373	1.202	124.488	124.488	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	374	1.205	125.004	125.000	4,001	OK
	Measured	374	1.205	125.004	125.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	373	1.202	124.488	124.488	4,000	OK
	Measured	373	1.202	124.488	124.488	4,000	
	Difference	0	0.000	0.000	0.000	0	

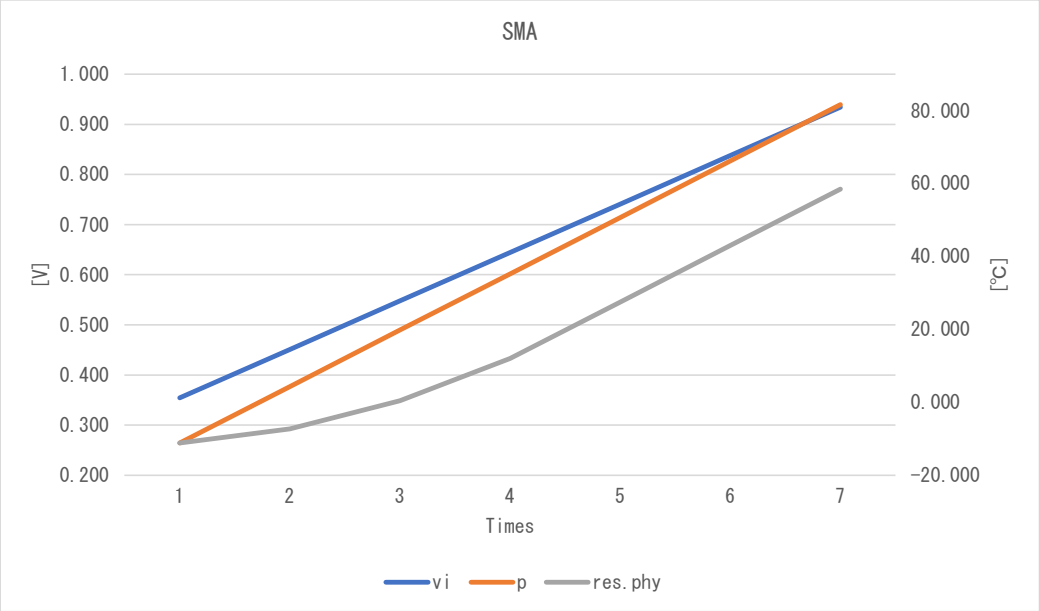
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

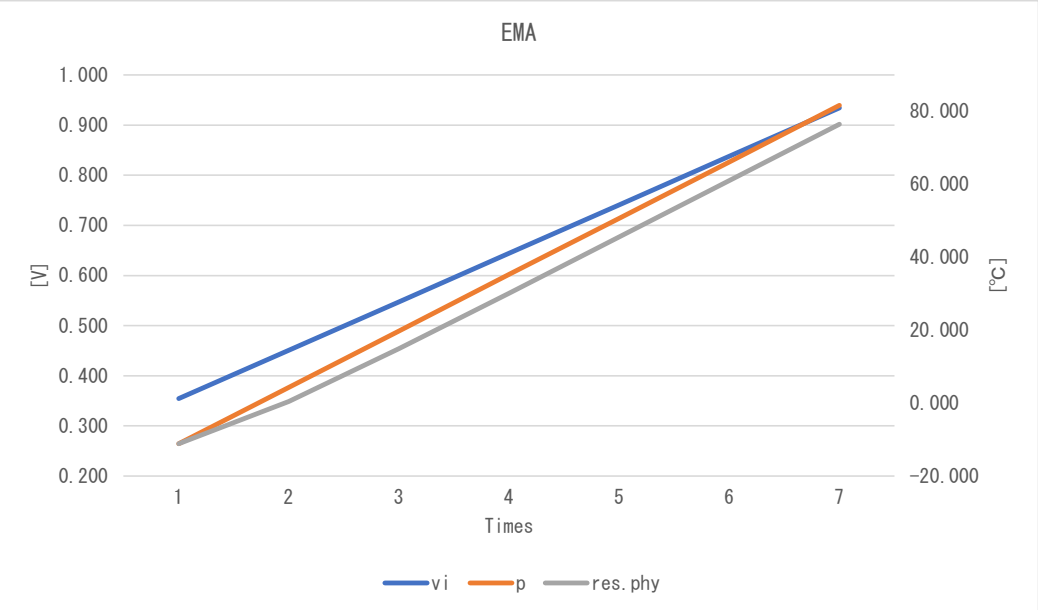
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	110	0.354	-11.121	-11.121	4,000	OK
	Measured	110	0.355	-11.121	-11.121	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	140	0.451	4.348	-7.254	4,000	OK
	Measured	140	0.451	4.348	-7.254	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	170	0.548	19.816	0.480	4,000	OK
	Measured	170	0.548	19.816	0.480	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	200	0.645	35.285	12.082	4,000	OK
	Measured	200	0.645	35.285	12.082	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	230	0.741	50.754	27.551	4,000	OK
	Measured	230	0.741	50.754	27.551	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	260	0.838	66.223	43.019	4,000	OK
	Measured	260	0.838	66.223	43.019	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	290	0.935	81.691	58.488	4,000	OK
	Measured	290	0.935	81.601	58.488	4,000	
	Difference	0	0.000	0.090	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	110	0.354	-11.121	-11.121	4,000	OK
	Measured	110	0.355	-11.121	-11.121	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	140	0.451	4.348	0.480	4,000	OK
	Measured	140	0.451	4.348	0.480	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	170	0.548	19.816	14.982	4,000	OK
	Measured	170	0.548	19.816	14.982	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	200	0.645	35.285	30.209	4,000	OK
	Measured	200	0.645	35.285	30.209	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	230	0.741	50.754	45.618	4,000	OK
	Measured	230	0.741	50.754	45.618	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	260	0.838	66.223	61.071	4,000	OK
	Measured	260	0.838	66.223	61.071	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	290	0.935	81.691	76.536	4,000	OK
	Measured	290	0.935	81.691	76.536	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	110	0.354	-11.121	-11.121	4,000	OK
	Measured	110	0.355	-11.121	-11.121	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	140	0.451	4.348	-3.387	4,000	OK
	Measured	140	0.451	4.348	-3.387	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	170	0.548	19.816	12.082	4,000	OK
	Measured	170	0.548	19.816	9.504	4,000	
	Difference	0	0.000	0.000	2.578	0	
4	Expected	200	0.645	35.285	24.973	4,000	OK
	Measured	200	0.645	35.285	24.973	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	230	0.741	50.754	40.441	4,000	OK
	Measured	230	0.741	50.754	40.441	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	260	0.838	66.223	55.910	4,000	OK
	Measured	260	0.838	66.223	55.910	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	290	0.935	81.691	71.379	4,000	OK
	Measured	290	0.935	81.691	71.379	4,000	
	Difference	0	0.000	0.000	0.000	0