Test Specifications and Results of ADC components

Spec-00000057.pdf

Date	5-Oct-22
Verifier	Red Dragon

vi = (ai × ADC_vdd) / 2^{ADC_bit}

y = (vi - x_offset) / gain + y_offset　　range min to max

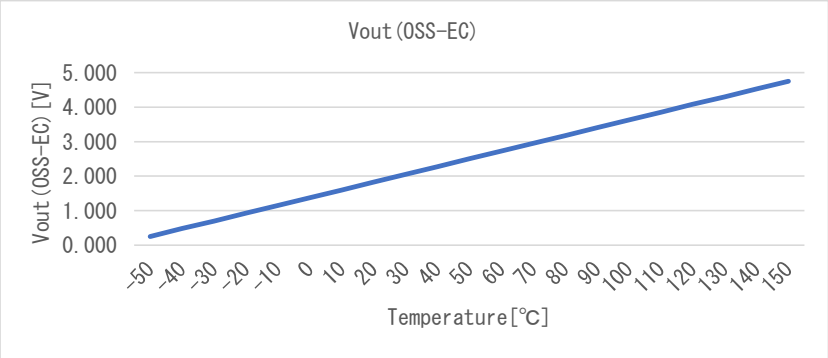
SMA calculation method　　phy = (y_n + y_{n-1} + y_{n-2}) / n

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

WMA calculation method　　phy = ((yn × n) + (yn-1 × (n-1)) + ⋯ + (y 1 × 1)) / (n + (n-1) +⋯+ 1)

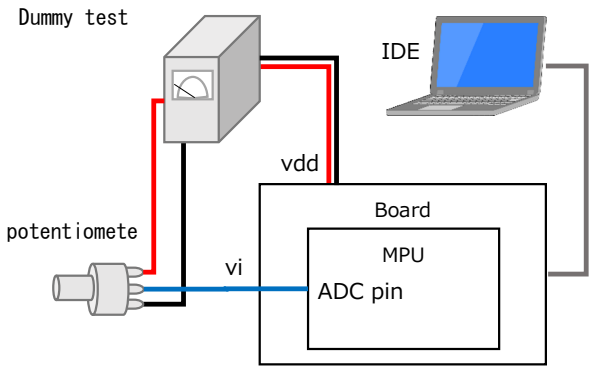
Non-MA calculation method　　phy = y

Spec-AD22100S.pdf		
component data		
x_offset	1.3750	[V]
gain	0.0225	[V/℃]
y_offset	0.0	[℃]
max	150.0	[℃]
min	-50.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3

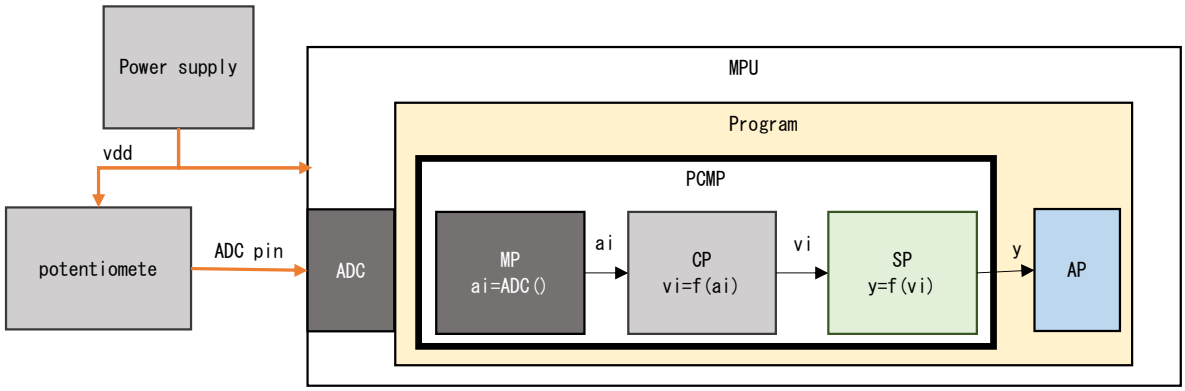
Test environment		
Board	Mega 2560 Rev3	
MPU	ATmega2560	
ComplierVer	avr-gcc 7.3.0	
IDE	Arduino IDE 1.8.19	
Vdd	5.0	[V]
ADC bit	10	[bit]
ADC pin	A0	-
Component	Dummy	



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:

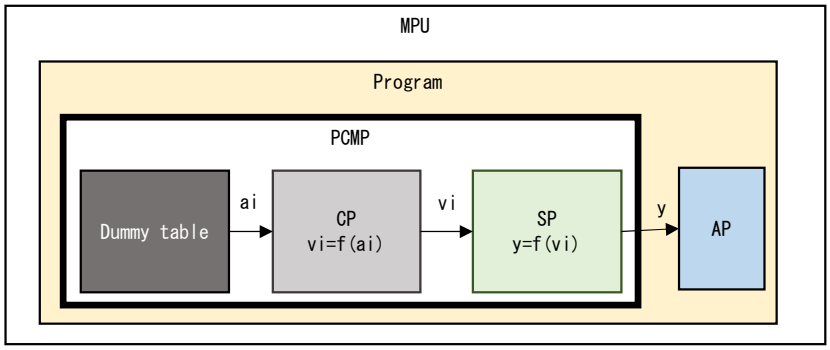


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-61.111	-50.000	4,002	OK
	Measured		0	0.000	-61.111	-50.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.500	307	1.499	5.512	5.512	4,000	OK
	Measured		308	1.504	5.729	5.729	4,000	
	Difference		-1	-0.005	-0.217	-0.217	0	
3	Expected	2.000	410	2.002	27.865	27.865	4,000	OK
	Measured		411	2.007	28.082	28.082	4,000	
	Difference		-1	-0.005	-0.217	-0.217	0	
4	Expected	5.000	1,024	5.000	161.111	150.000	4,001	OK
	Measured		1,023	4.995	160.894	150.000	4,001	
	Difference		1	0.005	0.217	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	53	0.259	-49.609	-49.609	4,000	OK
	Measured	53	0.259	-49.609	-49.609	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	52	0.254	-49.826	-49.826	4,000	OK
	Measured	52	0.254	-49.826	-49.826	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	51	0.249	-50.043	-50.000	4,002	OK
	Measured	51	0.249	-50.043	-50.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	52	0.254	-49.826	-49.826	4,000	OK
	Measured	52	0.254	-49.826	-49.826	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	972	4.746	149.826	149.826	4,000	OK
	Measured	972	4.746	149.826	149.826	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	973	4.751	150.043	150.000	4,001	OK
	Measured	973	4.751	150.043	150.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	972	4.746	149.826	149.826	4,000	OK
	Measured	972	4.746	149.826	149.826	4,000	
	Difference	0	0.000	0.000	0.000	0	

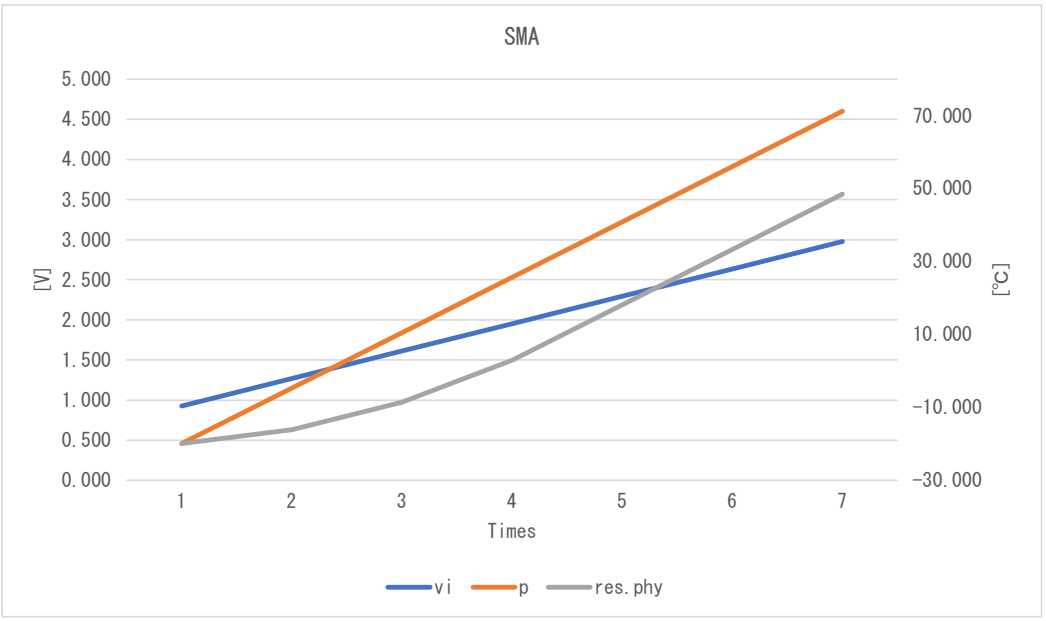
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

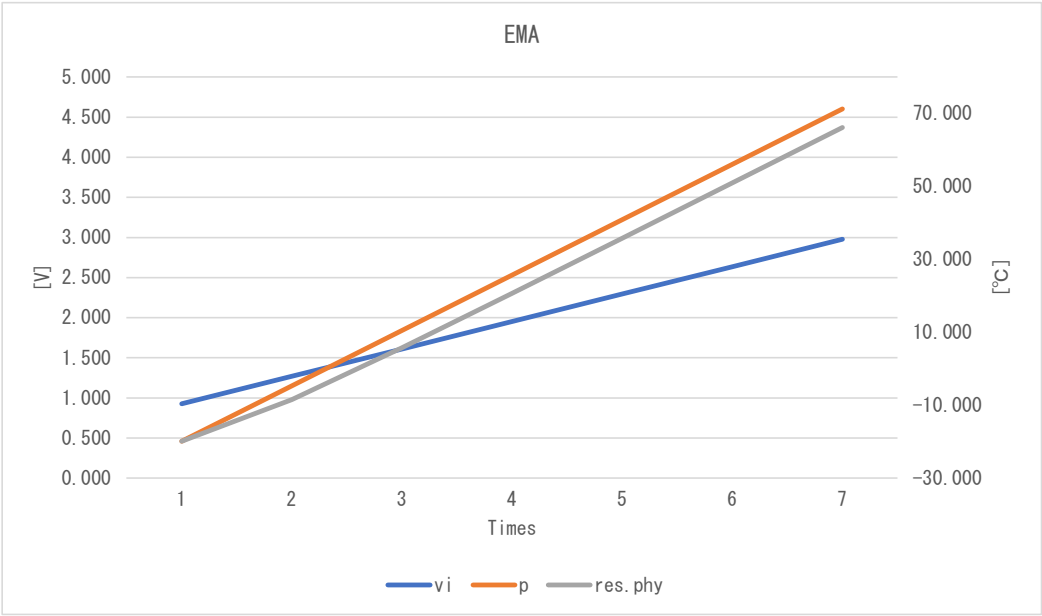
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	190	0.928	-19.878	-19.878	4,000	OK
	Measured	190	0.928	-19.879	-19.879	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	260	1.270	-4.688	-16.081	4,000	OK
	Measured	260	1.270	-4.688	-16.081	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	330	1.611	10.503	-8.485	4,000	OK
	Measured	330	1.611	10.504	-8.485	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	400	1.953	25.694	2.908	4,000	OK
	Measured	400	1.953	25.694	2.908	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	470	2.295	40.885	18.099	4,000	OK
	Measured	470	2.295	40.885	18.099	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	540	2.637	56.076	33.290	4,000	OK
	Measured	540	2.637	56.076	33.290	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	610	2.979	71.267	48.481	4,000	OK
	Measured	610	2.979	71.267	48.481	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	190	0.928	-19.878	-19.878	4,000	OK
	Measured	190	0.928	-19.879	-19.880	4,000	
	Difference	0	0.000	0.000	0.001	0	
2	Expected	260	1.270	-4.688	-8.485	4,000	OK
	Measured	260	1.270	-4.688	-8.485	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	330	1.611	10.503	5.756	4,000	OK
	Measured	330	1.611	10.504	5.756	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	400	1.953	25.694	20.710	4,000	OK
	Measured	400	1.953	25.694	20.710	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	470	2.295	40.885	35.842	4,000	OK
	Measured	470	2.295	40.885	35.842	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	540	2.637	56.076	51.018	4,000	OK
	Measured	540	2.637	56.076	51.018	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	610	2.979	71.267	66.205	4,000	OK
	Measured	610	2.979	71.267	66.205	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	190	0.928	-19.878	-19.878	4,000	OK
	Measured	190	0.928	-19.879	-19.879	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	260	1.270	-4.688	-12.283	4,000	OK
	Measured	260	1.270	-4.688	-12.283	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	330	1.611	10.503	0.376	4,000	OK
	Measured	330	1.611	10.504	0.376	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	400	1.953	25.694	15.567	4,000	OK
	Measured	400	1.953	25.694	15.567	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	470	2.295	40.885	30.758	4,000	OK
	Measured	470	2.295	40.885	30.758	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	540	2.637	56.076	45.949	4,000	OK
	Measured	540	2.637	56.076	45.949	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	610	2.979	71.267	61.140	4,000	OK
	Measured	610	2.979	71.267	61.140	4,000	
	Difference	0	0.000	0.000	0.000	0