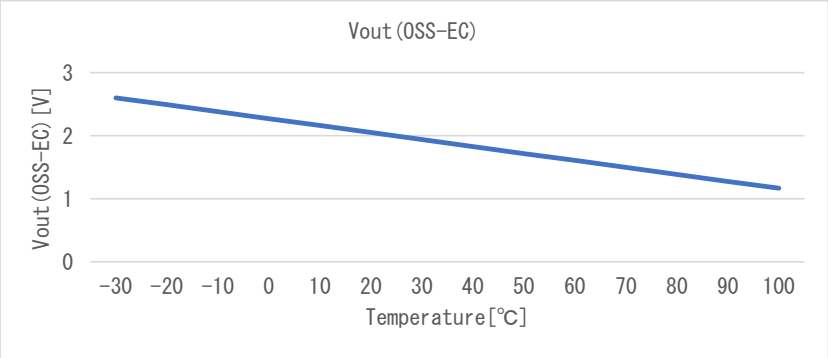
Test Specifications and Results of ADC components

Spec-00000057.pdf

Date	30-Sep-22
Verifier	Red Dragon

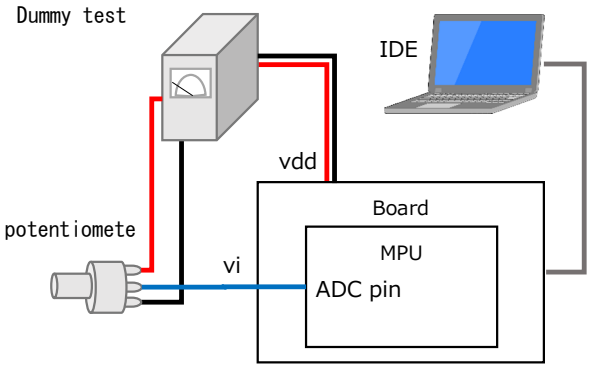
vi = (ai × ADC_vdd) / 2^{ADC_bit}
y = (vi - x_offset) / gain + y_offset range min to max
SMA calculation method phy = ($y_n + y_{n-1} + y_{n-2}$) / n
EMA calculation method phy = (y × k) + (phy_{n-1} × (1 - k))
WMA calculation method phy = ((yn × n) + (yn-1 × (n-1)) + ⋯ + (y 1 × 1)) / (n + (n-1) +⋯+ 1)
Non-MA calculation method phy = y

Spec-S-5813A_5814A.pdf		
component data		
x_offset	1.9400	[V]
gain	-0.01104	[V/℃]
y_offset	30.0	[℃]
max	100.0	[℃]
min	-30.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3

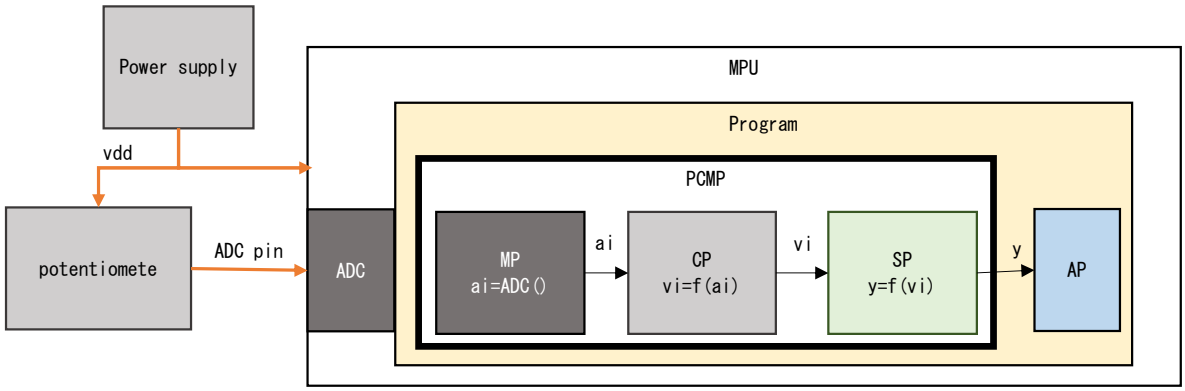
Test environment		
Board	Mega 2560 Rev3	
MPU	ATmega2560	
ComplierVer	avr-gcc 7.3.0	
IDE	Arduino IDE 1.8.19	
Vdd	5.0	[V]
ADC bit	10	[bit]
ADC pin	A0	-
Component	Dummy	



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:

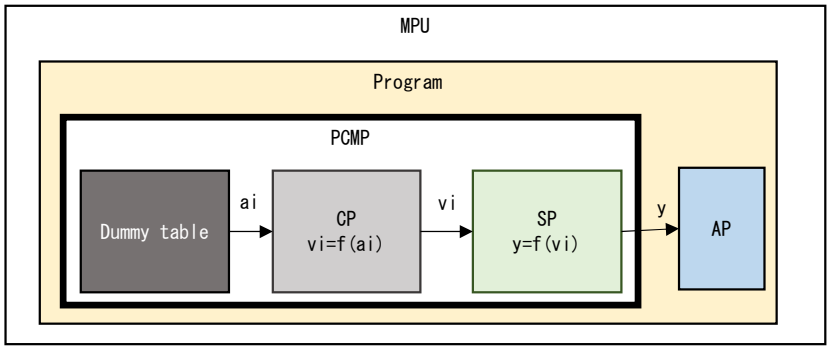


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	205.725	100.000	4,001	OK
	Measured		0	0.000	205.725	100.000	4,001	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.500	307	1.499	69.944	69.944	4,000	OK
	Measured		308	1.504	69.501	69.501	4,000	
	Difference		-1	-0.005	0.442	0.442	0	
3	Expected	2.000	410	2.002	24.388	24.388	4,000	OK
	Measured		410	2.002	24.388	24.388	4,000	
	Difference		0	0.000	0.000	0.000	0	
4	Expected	5.000	1,024	5.000	-247.174	-30.000	4,002	OK
	Measured		1,023	4.995	-246.732	-30.000	4,002	
	Difference		1	0.005	-0.442	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	241	1.177	99.134	99.134	4,000	OK
	Measured	241	1.177	99.134	99.134	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	240	1.172	99.577	99.577	4,000	OK
	Measured	240	1.172	99.577	99.577	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	239	1.167	100.019	100.000	4,001	OK
	Measured	239	1.167	100.019	100.019	4,001	
	Difference	0	0.000	0.000	-0.019	0	
4	Expected	240	1.172	99.577	99.577	4,000	OK
	Measured	240	1.172	99.577	99.577	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	532	2.598	-29.570	-29.570	4,000	OK
	Measured	532	2.598	-29.570	-29.570	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	533	2.603	-30.013	-30.000	4,002	OK
	Measured	533	2.603	-30.013	-30.013	4,002	
	Difference	0	0.000	0.000	0.013	0	
7	Expected	532	2.598	-29.570	-29.570	4,000	OK
	Measured	532	2.598	-29.570	-29.570	4,000	
	Difference	0	0.000	0.000	0.000	0	

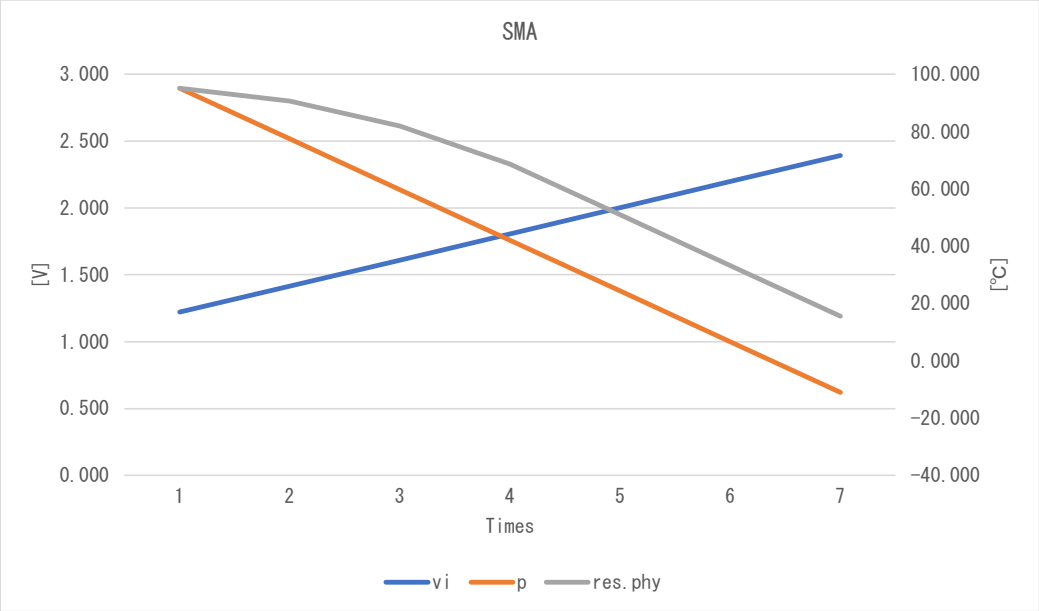
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

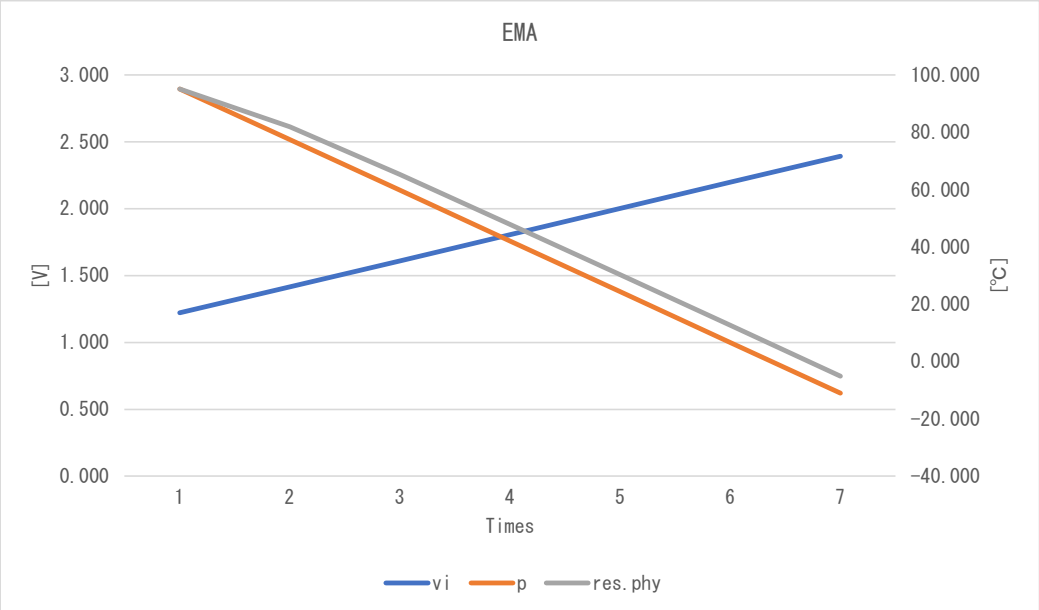
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	250	1.221	95.154	95.154	4,000	OK
	Measured	250	1.221	95.154	95.154	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	290	1.416	77.462	90.731	4,000	OK
	Measured	290	1.416	77.462	90.731	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	330	1.611	59.771	81.885	4,000	OK
	Measured	330	1.611	59.771	81.885	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	370	1.807	42.080	68.617	4,000	OK
	Measured	370	1.807	42.080	68.617	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	410	2.002	24.388	50.925	4,000	OK
	Measured	410	2.002	24.388	50.925	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	450	2.197	6.697	33.234	4,000	OK
	Measured	450	2.197	6.697	33.234	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	490	2.393	-10.994	15.543	4,000	OK
	Measured	490	2.393	-10.994	15.543	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	250	1.221	95.154	95.154	4,000	OK
	Measured	250	1.221	95.154	95.154	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	290	1.416	77.462	81.885	4,000	OK
	Measured	290	1.416	77.462	81.885	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	330	1.611	59.771	65.300	4,000	OK
	Measured	330	1.611	59.771	65.300	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	370	1.807	42.080	47.885	4,000	OK
	Measured	370	1.807	42.080	47.885	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	410	2.002	24.388	30.262	4,000	OK
	Measured	410	2.002	24.388	30.262	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	450	2.197	6.697	12.588	4,000	OK
	Measured	450	2.197	6.697	12.588	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	490	2.393	-10.994	-5.099	4,000	OK
	Measured	490	2.393	-10.994	-5.099	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	250	1.221	95.154	95.154	4,000	OK
	Measured	250	1.221	95.154	95.154	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	290	1.416	77.462	86.308	4,000	OK
	Measured	290	1.416	77.462	86.308	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	330	1.611	59.771	71.565	4,000	OK
	Measured	330	1.611	59.771	71.565	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	370	1.807	42.080	53.874	4,000	OK
	Measured	370	1.807	42.080	53.874	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	410	2.002	24.388	36.183	4,000	OK
	Measured	410	2.002	24.388	36.183	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	450	2.197	6.697	18.491	4,000	OK
	Measured	450	2.197	6.697	18.491	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	490	2.393	-10.994	0.800	4,000	OK
	Measured	490	2.393	-10.994	0.800	4,000	
	Difference	0	0.000	0.000	0.000	0