Test Specifications and Results of ADC components

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

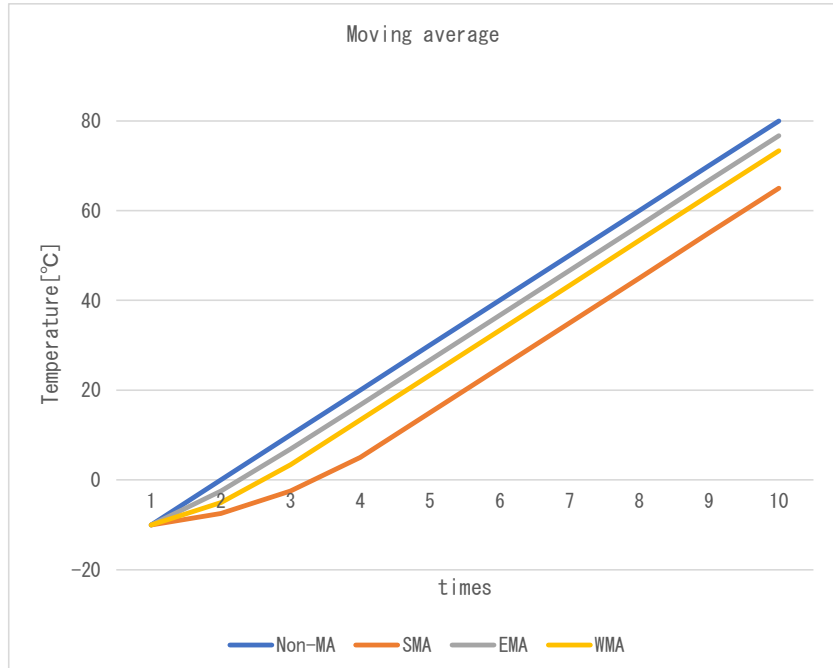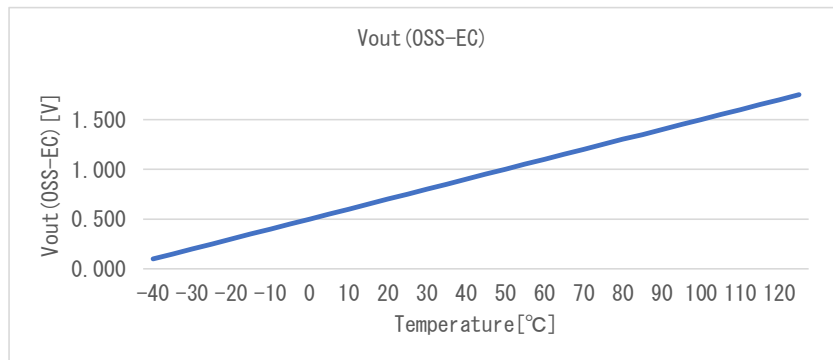| SMA calculation method	$phy = (y_n + y_{n-1} + y_{n-2}) / n$
EMA calculation method	$phy = (y \times k) + (phy_{n-1} \times (1 - k))$
WMA calculation method	$phy = ((y_n \times n) + (y_{n-1} \times (n-1)) + \cdots + (y_1 \times 1)) / (n + (n-1) + \cdots + 1)$
Non-MA calculation method	$phy = y$

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

Vout(OSS-EC)

Moving average

Non-MA   SMA   EMA   WMA

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
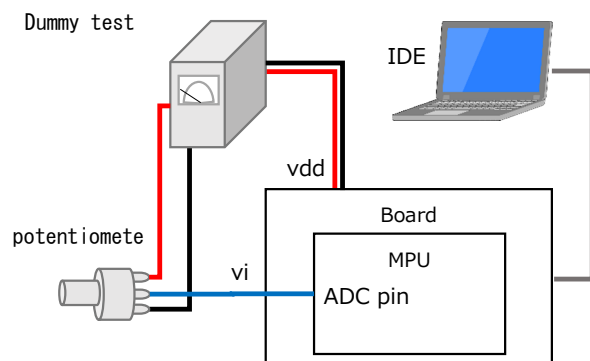
Test Method

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:
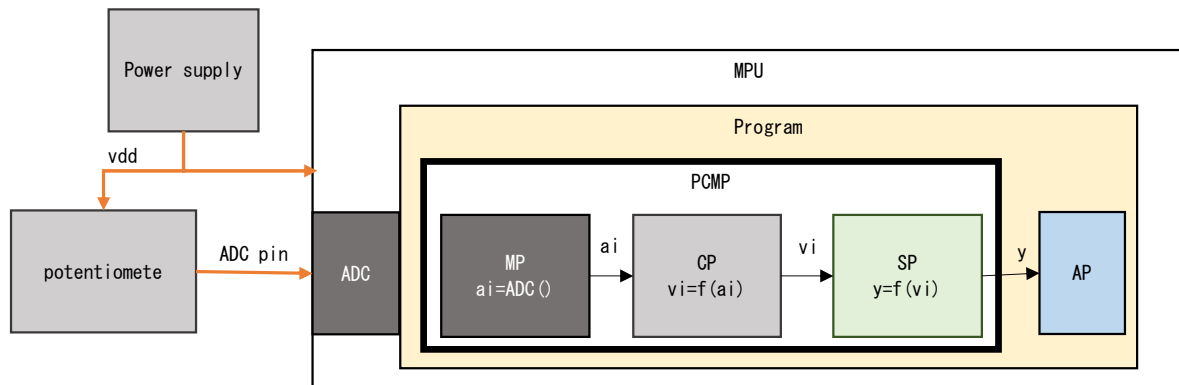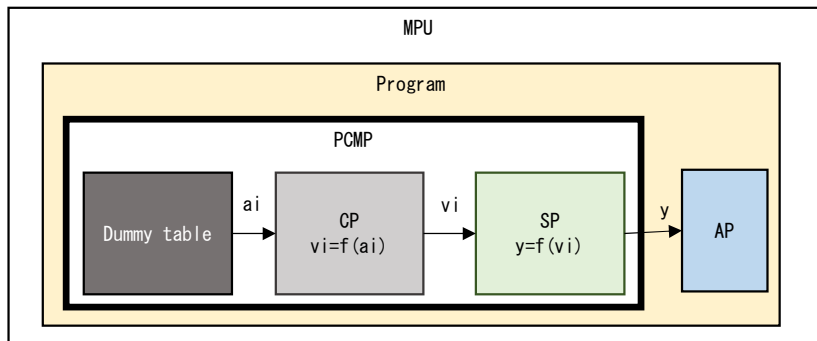

No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected		0	0.000	−50.000	−40.000	4,002	
	Measured	0.000	0	0.000	−50.000	−40.000	4,002	OK
	Difference		0	0.000	0.000	0.000	0	
2	Expected		266	1.299	79.883	79.883	4,000	
	Measured	1.300	267	1.304	80.371	80.371	4,000	OK
	Difference		−1	−0.005	−0.488	−0.488	0	
3	Expected		307	1.499	99.902	99.902	4,000	
	Measured	1.500	307	1.499	99.902	99.902	4,000	OK
	Difference		0	0.000	0.000	0.000	0	
4	Expected		1,024	5.000	450.000	125.000	4,001	
	Measured	5.000	1,023	4.995	449.512	125.000	4,001	OK
	Difference		1	0.005	0.488	0.000	0	

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res.sts    4,000    Normal
           4,001    Max Limiter NG
           4,002    Min Limiter NG
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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.

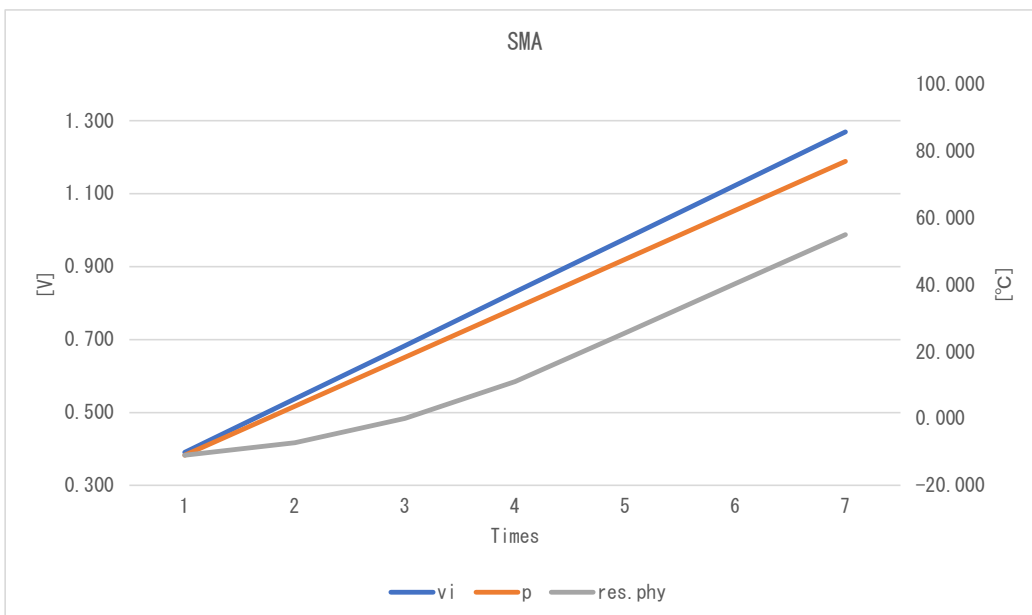| No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	22	0.107	-39.258	-39.258	4,000	OK
	Measured	22	0.107	-39.258	-39.258	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	21	0.103	-39.746	-39.746	4,000	OK
	Measured	21	0.103	-39.746	-39.746	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	20	0.098	-40.234	-40.000	4,002	OK
	Measured	20	0.098	-40.234	-40.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	21	0.103	-39.746	-39.746	4,000	OK
	Measured	21	0.103	-39.746	-39.746	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	358	1.748	124.805	124.805	4,000	OK
	Measured	358	1.748	124.805	124.805	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	359	1.753	125.293	125.000	4,001	OK
	Measured	359	1.753	125.293	125.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	358	1.748	124.805	124.805	4,000	OK
	Measured	358	1.748	124.805	124.805	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

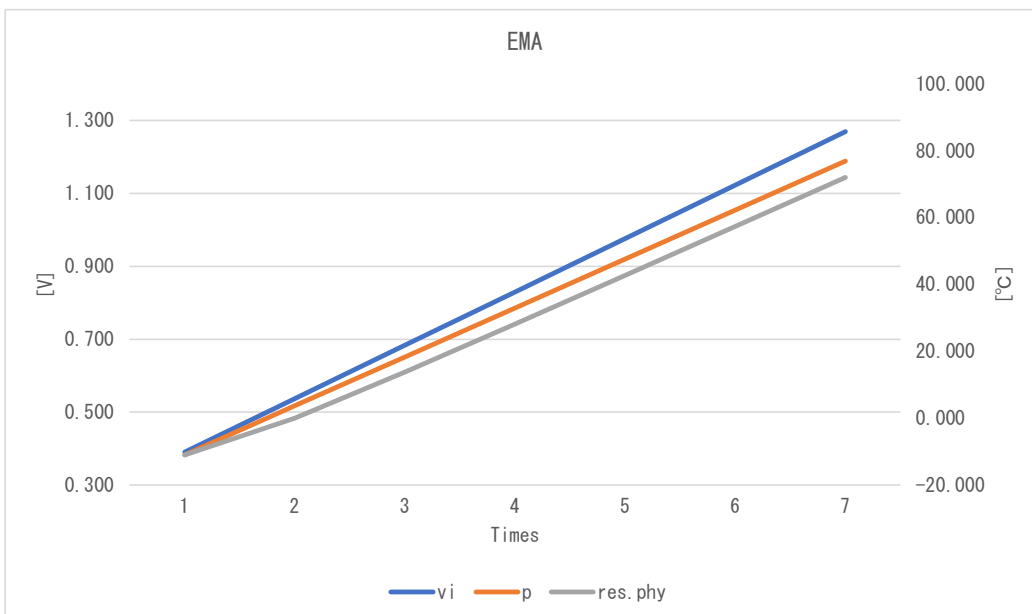Check each Filter by changing ai according to the Dummy table as shown in the table below.

SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	80	0.391	-10.938	-10.938	4,000	OK
	Measured	80	0.391	-10.938	-10.938	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	110	0.537	3.711	-7.275	4,000	OK
	Measured	110	0.537	3.711	-7.275	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	140	0.684	18.359	0.049	4,000	OK
	Measured	140	0.684	18.359	0.049	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	170	0.830	33.008	11.035	4,000	OK
	Measured	170	0.830	33.008	11.035	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	200	0.977	47.656	25.684	4,000	OK
	Measured	200	0.977	47.656	25.684	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	230	1.123	62.305	40.332	4,000	OK
	Measured	230	1.123	62.305	40.332	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	260	1.270	76.953	54.980	4,000	OK
	Measured	260	1.270	76.953	54.981	4,000	
	Difference	0	0.000	0.000	0.000	0	

SMA

EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	80	0.391	−10.938	−10.938	4,000	
	Measured	80	0.391	−10.938	−10.938	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
2	Expected	110	0.537	3.711	0.049	4,000	
	Measured	110	0.537	3.711	0.049	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
3	Expected	140	0.684	18.359	13.782	4,000	
	Measured	140	0.684	18.359	13.782	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
4	Expected	170	0.830	33.008	28.201	4,000	
	Measured	170	0.830	33.008	28.201	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
5	Expected	200	0.977	47.656	42.793	4,000	
	Measured	200	0.977	47.656	42.793	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
6	Expected	230	1.123	62.305	57.427	4,000	
	Measured	230	1.123	62.305	57.427	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
7	Expected	260	1.270	76.953	72.072	4,000	
	Measured	260	1.270	76.953	72.072	4,000	OK
	Difference	0	0.000	0.000	0.000	0	

EMA

WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	80	0.391	−10.938	−10.938	4,000	
	Measured	80	0.391	−10.938	−10.938	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
2	Expected	110	0.537	3.711	−3.613	4,000	
	Measured	110	0.537	3.711	−3.613	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
3	Expected	140	0.684	18.359	8.594	4,000	
	Measured	140	0.684	18.359	8.594	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
4	Expected	170	0.830	33.008	23.242	4,000	
	Measured	170	0.830	33.008	23.242	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
5	Expected	200	0.977	47.656	37.891	4,000	
	Measured	200	0.977	47.656	37.891	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
6	Expected	230	1.123	62.305	52.539	4,000	
	Measured	230	1.123	62.305	52.539	4,000	OK
	Difference	0	0.000	0.000	0.000	0	
7	Expected	260	1.270	76.953	67.188	4,000	
	Measured	260	1.270	76.953	67.188	4,000	OK
	Difference	0	0.000	0.000	0.000	0	

WMA