

Test Specifications and Results of ADC components

Spec-00000057. pdf

$$v_i = (a_i \times \text{ADC_vdd}) / 2^{\text{ADC_bit}}$$

$$y = (v_i - x_{\text{offset}}) / \text{gain} + y_{\text{offset}} \quad \text{range min to max}$$

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

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

$$\text{WMA calculation method} \quad \text{phy} = ((y_n \times n) + (y_{n-1} \times (n-1)) + \dots + (y_1 \times 1)) / (n + (n-1) + \dots + 1)$$

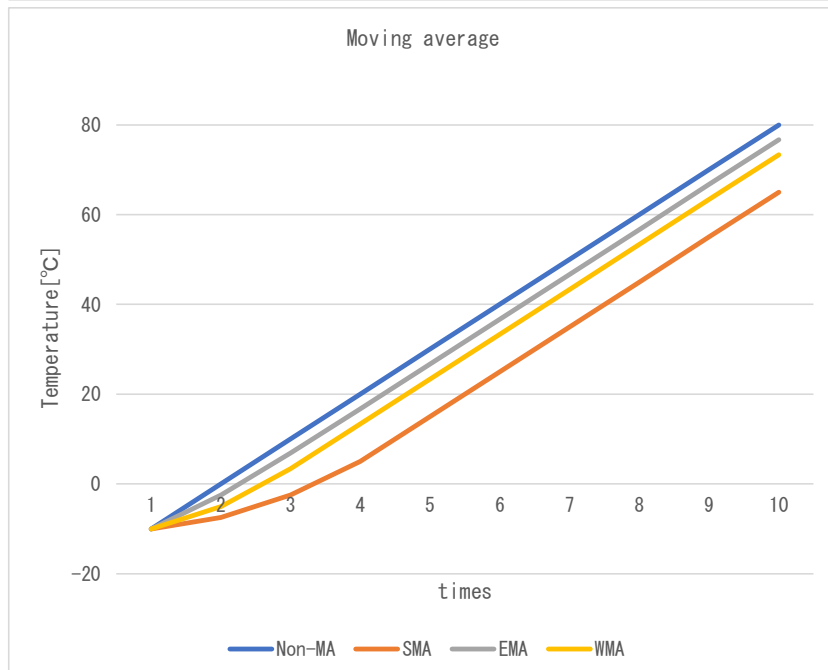
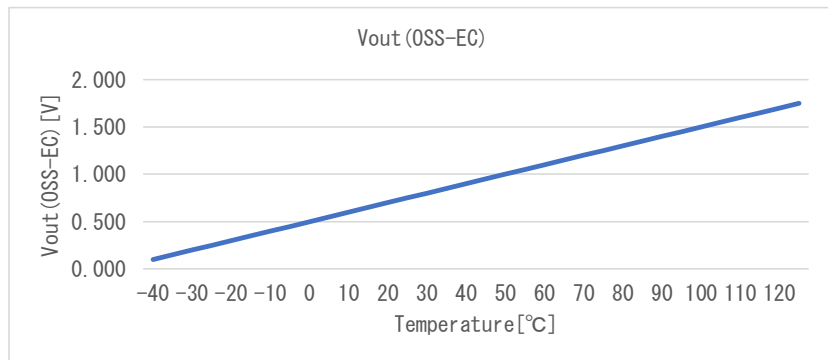
$$\text{Non-MA calculation method} \quad \text{phy} = y$$

Date	13-Oct-22
Verifier	Red Dragon

Spec-MCP9700_MCP9700A. pdf

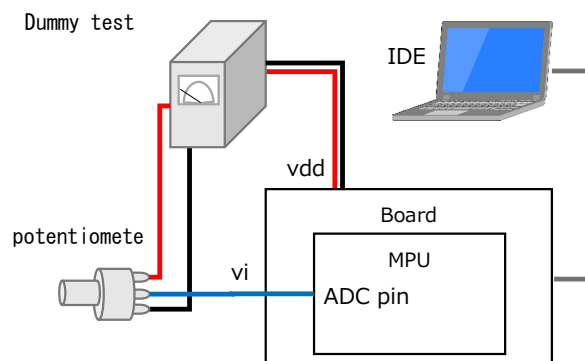
component data	
x_offset	0.5000 [V]
gain	0.01 [V/°C]
y_offset	0.0 [°C]
max	125.0 [°C]
min	-40.0 [°C]

Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



Test environment

Board	Mega 2560 Rev3
MPU	ATmega2560
CompilerVer	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:

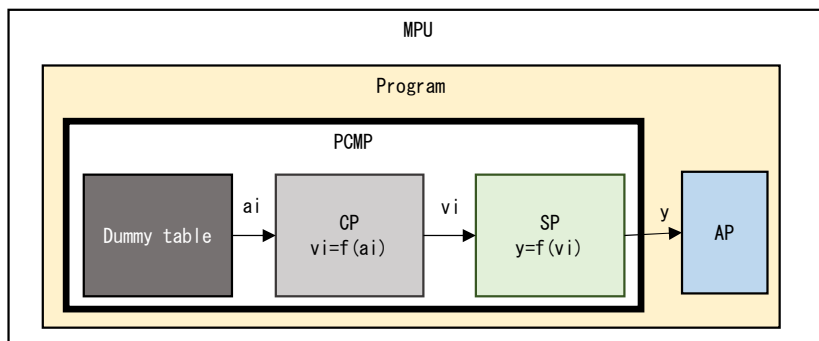


No.		ADC pin	ai	vi	p	res. phy	res. sts	Judgment
1	Expected	0.000	0	0.000	-50.000	-40.000	4,002	OK
	Measured		0	0.000	-50.000	-40.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.500	307	1.499	99.902	99.902	4,000	OK
	Measured		308	1.504	100.391	100.391	4,000	
	Difference		-1	-0.005	-0.488	-0.488	0	
3	Expected	1.700	348	1.699	119.922	119.922	4,000	OK
	Measured		348	1.699	119.922	119.922	4,000	
	Difference		0	0.000	0.000	0.000	0	
4	Expected	5.000	1,024	5.000	450.000	125.000	4,001	OK
	Measured		1,023	4.995	449.512	125.000	4,001	
	Difference		1	0.005	0.488	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 a_i according to Dummy table as shown in the table below, and check Max/Min limiters and diagnostic results. Non-MA mode.

No.		Dummy a_i	v_i	p	res. phy	res. sts	Judgment
1	Expected	22	0.107	-39.258	-39.258	4,000	OK
	Measured	22	0.105	-39.258	-39.258	4,000	
	Difference	0	0.003	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	

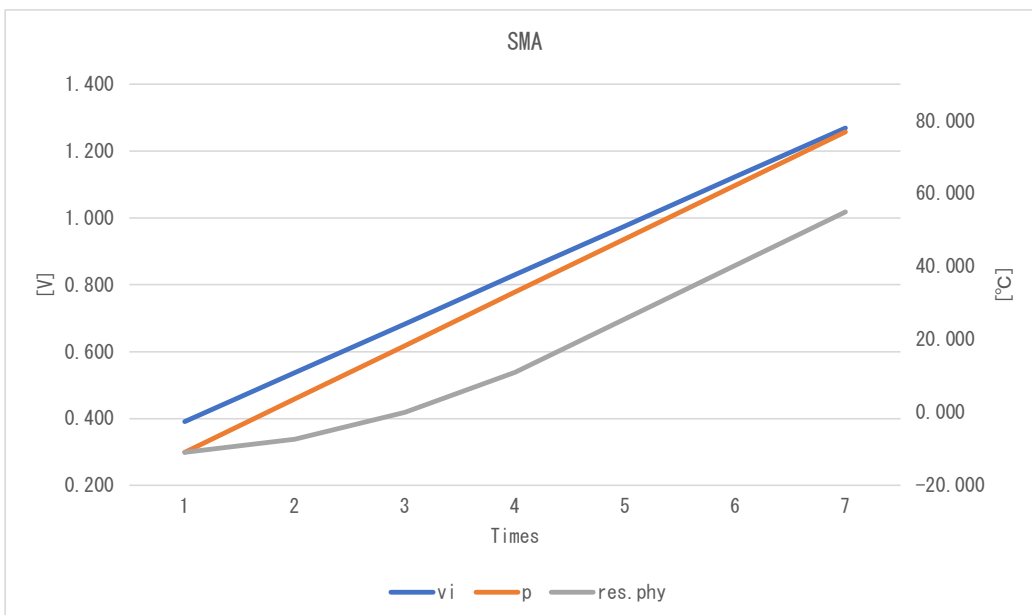
res. sts 4000 Normal
 4001 Max Limiter NG
 4002 Min Limiter NG

2-2. Moving average test

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

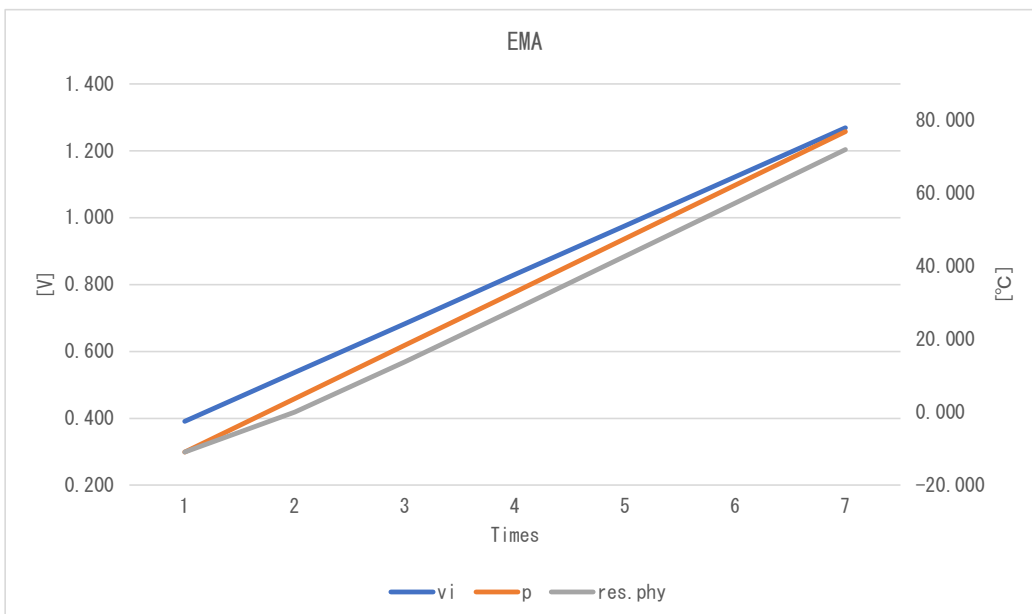
SMA

	No.	Dummy a_i	v_i	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	



EMA

	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	0.049	4.000	OK
	Measured	110	0.537	3.711	0.049	4.000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	140	0.684	18.359	13.782	4.000	OK
	Measured	140	0.684	18.359	13.782	4.000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	170	0.830	33.008	28.201	4.000	OK
	Measured	170	0.830	33.008	28.201	4.000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	200	0.977	47.656	42.793	4.000	OK
	Measured	200	0.977	47.656	42.793	4.000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	230	1.123	62.305	57.427	4.000	OK
	Measured	230	1.123	62.305	57.427	4.000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	260	1.270	76.953	72.072	4.000	OK
	Measured	260	1.270	76.953	72.072	4.000	
	Difference	0	0.000	0.000	0.000	0	



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
	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
	Difference	0	0.000	0.000	0.000	0
3	Expected	140	0.684	18.359	11.035	4,000
	Measured	140	0.684	18.359	8.594	4,000
	Difference	0	0.000	0.000	2.441	0
4	Expected	170	0.830	33.008	23.242	4,000
	Measured	170	0.830	33.008	23.242	4,000
	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
	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
	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
	Difference	0	0.000	0.000	0.000	0

