

## Test Specifications and Results of ADC components

Spec-00000057. pdf

$$v_i = (a_i \times \text{ADC\_vdd}) / 2^{\text{ADC\_bit}}$$

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

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

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

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

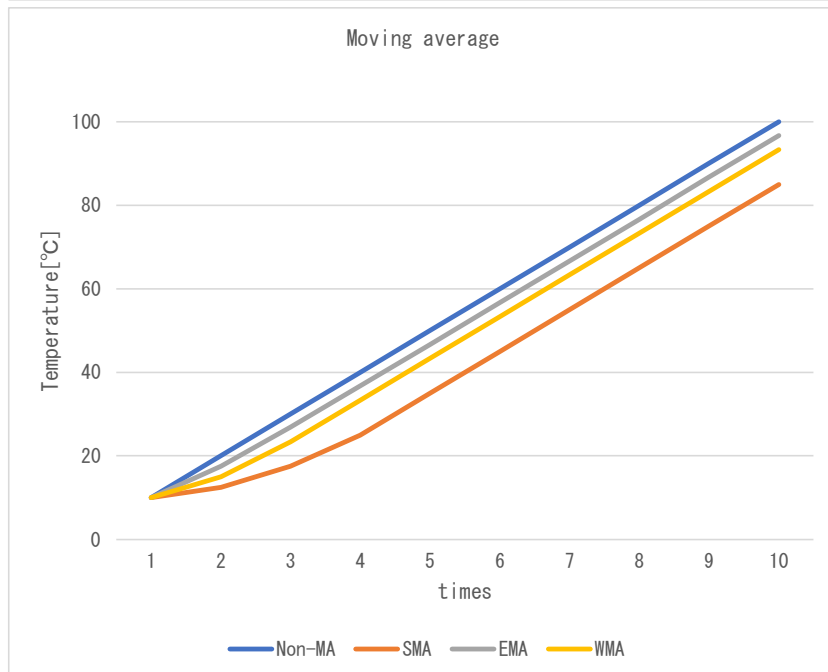
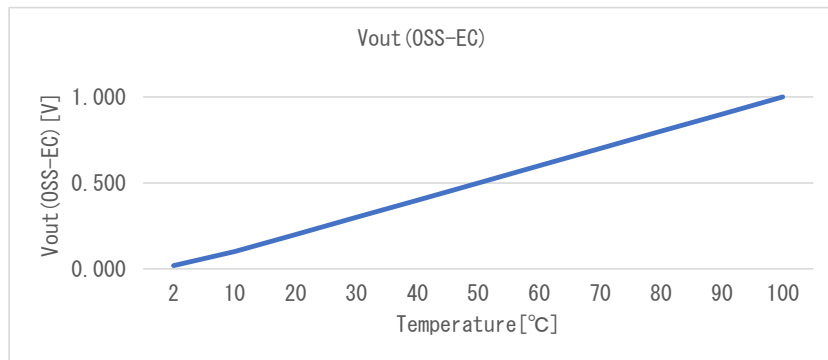
$$\text{Non-MA calculation method} \quad \text{phy} = y$$

Date	4-Nov-22
Verifier	Red Dragon

Spec-LM35D. pdf

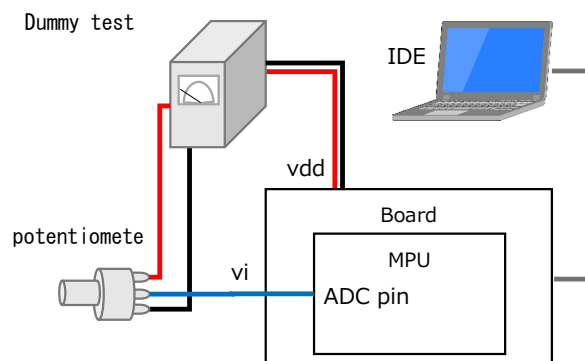
component data	
x_offset	0.0000 [V]
gain	0.01 [V/°C]
y_offset	0.0 [°C]
max	100.0 [°C]
min	2.0 [°C]

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:

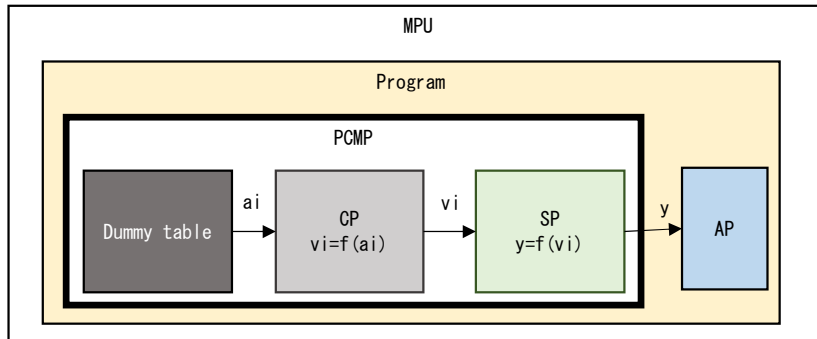


No.		ADC pin	ai	vi	p	res. phy	res. sts	Judgment
1	Expected	0.000	0	0.000	0.000	2.000	4,002	OK
	Measured		0	0.000	0.000	2.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	0.500	102	0.498	49.805	49.805	4,000	OK
	Measured		102	0.498	49.805	49.805	4,000	
	Difference		0	0.000	0.000	0.000	0	
3	Expected	1.500	307	1.499	149.902	100.000	4,001	OK
	Measured		307	1.499	149.902	100.000	4,001	
	Difference		0	0.000	0.000	0.000	0	
4	Expected	5.000	1,024	5.000	500.000	100.000	4,001	OK
	Measured		1,023	4.995	499.512	100.000	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	6	0.029	2.930	2.930	4,000	OK
	Measured	6	0.029	2.930	2.930	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	5	0.024	2.441	2.441	4,000	OK
	Measured	5	0.024	2.441	2.441	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	4	0.020	1.953	2.000	4,002	OK
	Measured	4	0.020	1.953	2.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	5	0.024	2.441	2.441	4,000	OK
	Measured	5	0.024	2.441	2.441	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	204	0.996	99.609	99.609	4,000	OK
	Measured	204	0.996	99.609	99.610	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	205	1.001	100.098	100.000	4,001	OK
	Measured	205	1.001	100.098	100.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	204	0.996	99.609	99.609	4,000	OK
	Measured	204	0.996	99.609	99.610	4,000	
	Difference	0	0.000	0.000	0.000	0	

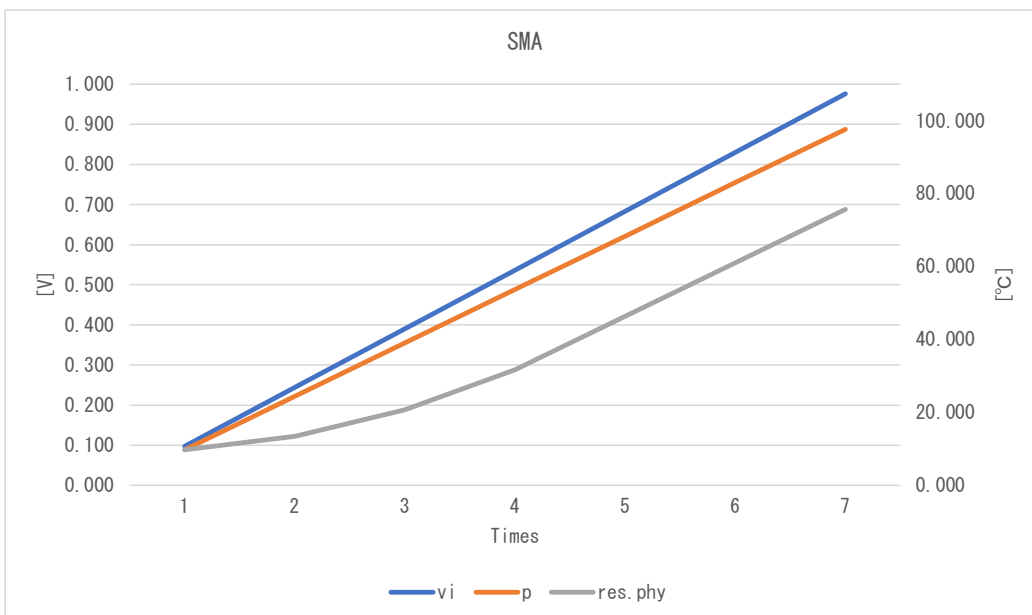
res. sts      4000    Normal  
                  4001    Max Limiter NG  
                  4002    Min Limiter NG

## 2-2. Moving average test

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

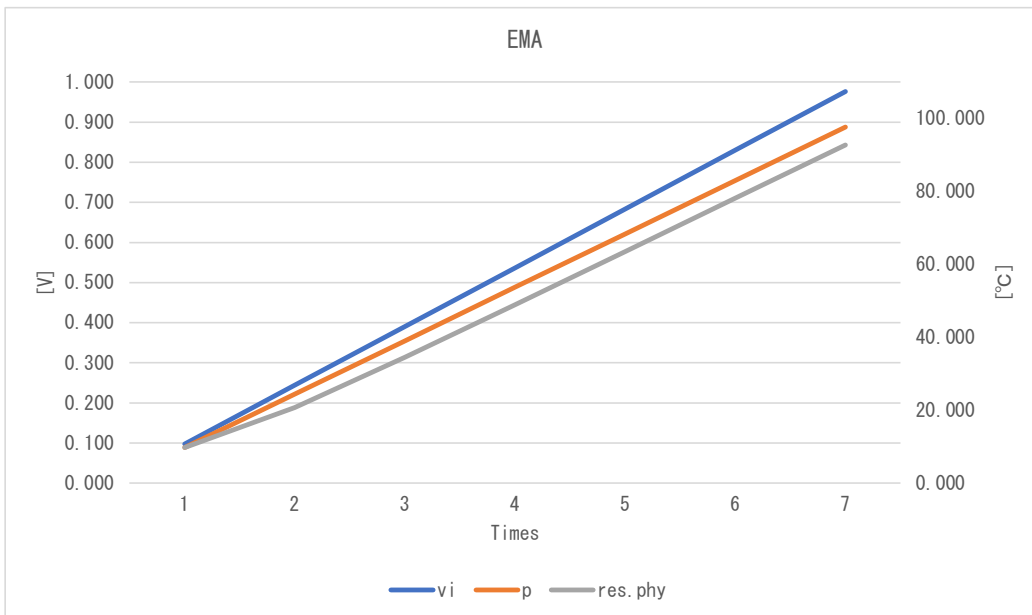
SMA

No.		Dummy $a_i$	$v_i$	$p$	res. phy	res. sts	Judgment
1	Expected	20	0.098	9.766	9.766	4.000	OK
	Measured	20	0.098	9.766	9.766	4.000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	50	0.244	24.414	13.428	4.000	OK
	Measured	50	0.244	24.414	13.428	4.000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	80	0.391	39.063	20.752	4.000	OK
	Measured	80	0.391	39.063	20.752	4.000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	110	0.537	53.711	31.738	4.000	OK
	Measured	110	0.537	53.711	31.738	4.000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	140	0.684	68.359	46.387	4.000	OK
	Measured	140	0.684	68.359	46.387	4.000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	170	0.830	83.008	61.035	4.000	OK
	Measured	170	0.830	83.008	61.035	4.000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	200	0.977	97.656	75.684	4.000	OK
	Measured	200	0.977	97.656	75.684	4.000	
	Difference	0	0.000	0.000	0.000	0	



# EMA

	No.	Dummy ai	vi	p	res. phy	res. sts	Judgment
1	Expected	20	0.098	9.766	9.766	4.000	OK
	Measured	20	0.098	9.766	9.766	4.000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	50	0.244	24.414	20.752	4.000	OK
	Measured	50	0.244	24.414	20.752	4.000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	80	0.391	39.063	34.485	4.000	OK
	Measured	80	0.391	39.063	34.485	4.000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	110	0.537	53.711	48.904	4.000	OK
	Measured	110	0.537	53.711	48.904	4.000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	140	0.684	68.359	63.496	4.000	OK
	Measured	140	0.684	68.359	63.496	4.000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	170	0.830	83.008	78.130	4.000	OK
	Measured	170	0.830	83.008	78.130	4.000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	200	0.977	97.656	92.775	4.000	OK
	Measured	200	0.977	97.656	92.775	4.000	
	Difference	0	0.000	0.000	0.000	0	



# WMA

	No.	Dummy ai	vi	p	res. phy	res. sts	Judgment
1	Expected	20	0.098	9.766	9.766	4.000	OK
	Measured	20	0.098	9.766	9.766	4.000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	50	0.244	24.414	17.090	4.000	OK
	Measured	50	0.244	24.414	17.090	4.000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	80	0.391	39.063	29.297	4.000	OK
	Measured	80	0.391	39.063	29.297	4.000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	110	0.537	53.711	43.945	4.000	OK
	Measured	110	0.537	53.711	43.945	4.000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	140	0.684	68.359	58.594	4.000	OK
	Measured	140	0.684	68.359	58.594	4.000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	170	0.830	83.008	73.242	4.000	OK
	Measured	170	0.830	83.008	73.242	4.000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	200	0.977	97.656	87.891	4.000	OK
	Measured	200	0.977	97.656	87.891	4.000	
	Difference	0	0.000	0.000	0.000	0	

