Test Specifications and Results of ADC components

Spec-00000057.pdf

Date	2-Nov-22
Verifier	Red Dragon

vi = (ai × ADC_vdd) / 2^{ADC_bit}

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

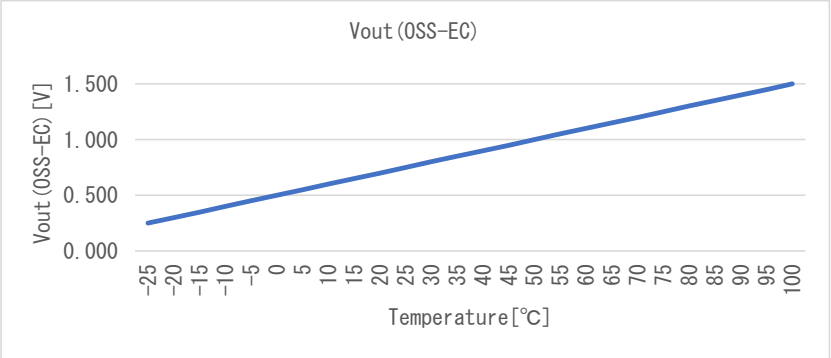
SMA calculation method　　phy = (y_n + y_{n-1} + y_{n-2}) / n

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

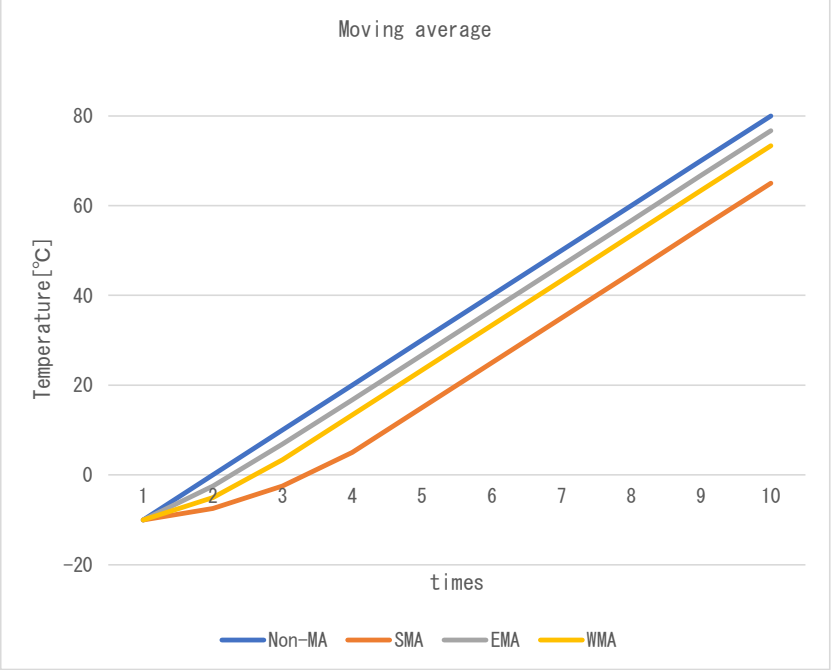
WMA calculation method　　phy = ((yn × n) + (yn-1 × (n-1)) + … + (y 1 × 1)) / (n + (n-1) +…+ 1)

Non-MA calculation method　　phy = y

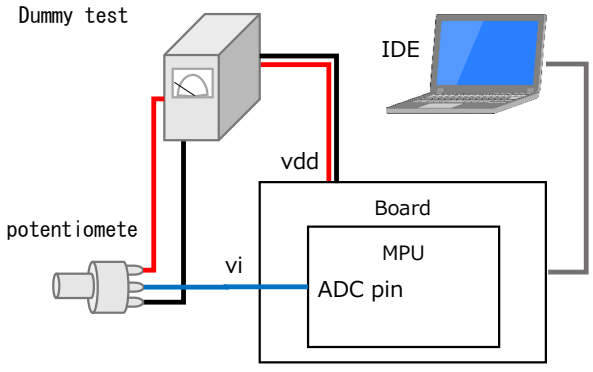
Spec-LM50B.pdf		
component data		
x_offset	0.5000	[V]
gain	0.01	[V/℃]
y_offset	0.0	[℃]
max	100.0	[℃]
min	-25.0	[℃]



Coefficient		
SMA	n	4
EMA	k	0.75
WMA	m	3



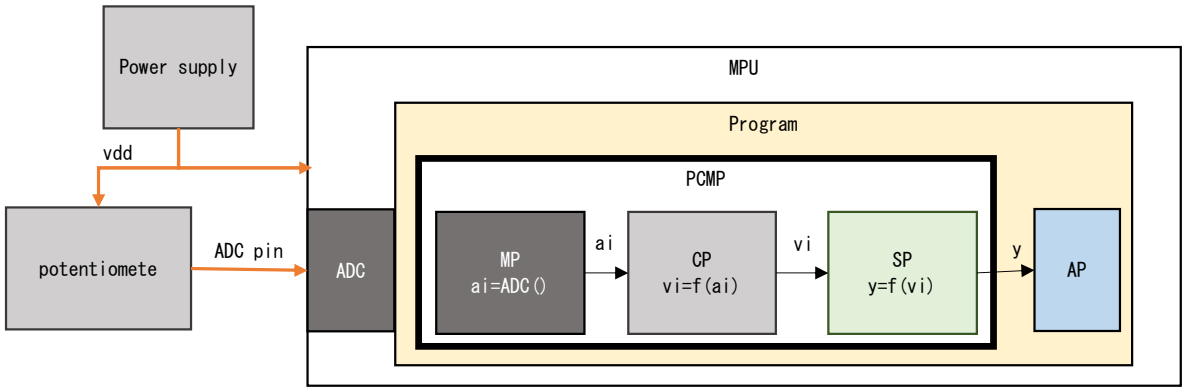
Test environment		
Board	Mega 2560 Rev3	
MPU	ATmega2560	
ComplierVer	avr-gcc 7.3.0	
IDE	Arduino IDE 1.8.19	
Vdd	5.0	[V]
ADC bit	10	[bit]
ADC pin	A0	-
Component	Dummy	



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:

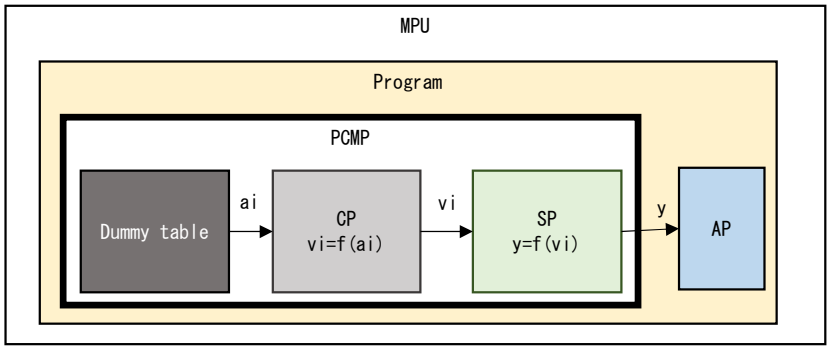


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-50.000	-25.000	4,002	OK
	Measured		0	0.000	-50.000	-25.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.300	266	1.299	79.883	79.883	4,000	OK
	Measured		267	1.304	80.371	80.371	4,000	
	Difference		-1	-0.005	-0.488	-0.488	0	
3	Expected	1.500	307	1.499	99.902	99.902	4,000	OK
	Measured		307	1.499	99.902	99.902	4,000	
	Difference		0	0.000	0.000	0.000	0	
4	Expected	5.000	1,024	5.000	450.000	100.000	4,001	OK
	Measured		1,023	4.995	449.512	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 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	-24.121	-24.121	4,000	OK
	Measured	53	0.259	-24.121	-24.121	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	52	0.254	-24.609	-24.609	4,000	OK
	Measured	52	0.254	-24.609	-24.609	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	51	0.249	-25.098	-25.000	4,002	OK
	Measured	51	0.249	-25.098	-25.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	52	0.254	-24.609	-24.609	4,000	OK
	Measured	52	0.254	-24.609	-24.609	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	307	1.499	99.902	99.902	4,000	OK
	Measured	307	1.499	99.902	99.902	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	308	1.504	100.391	100.000	4,001	OK
	Measured	308	1.504	100.391	100.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	307	1.499	99.902	99.902	4,000	OK
	Measured	307	1.499	99.902	99.902	4,000	
	Difference	0	0.000	0.000	0.000	0	

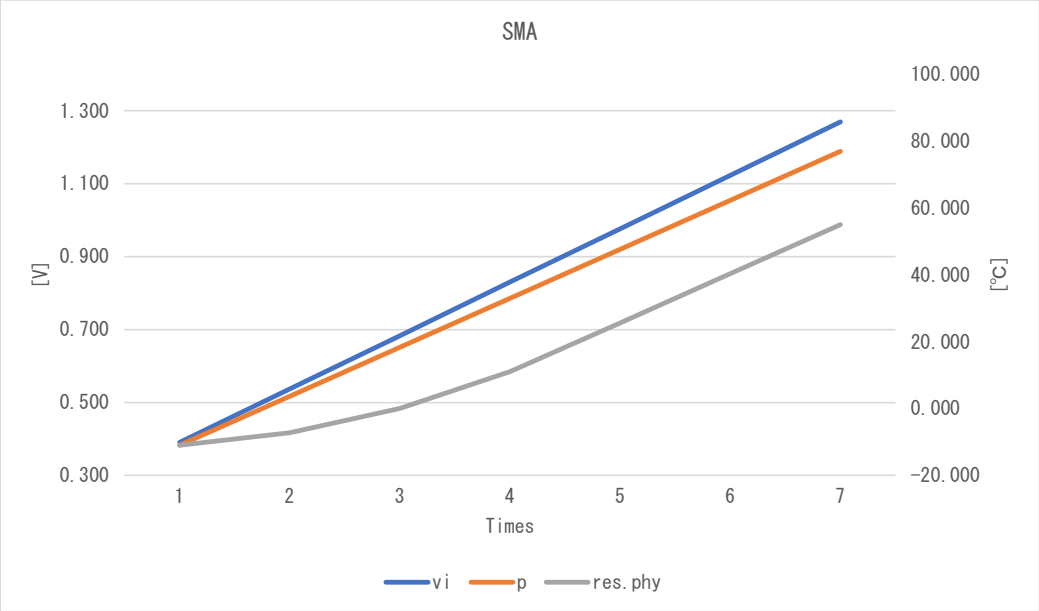
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

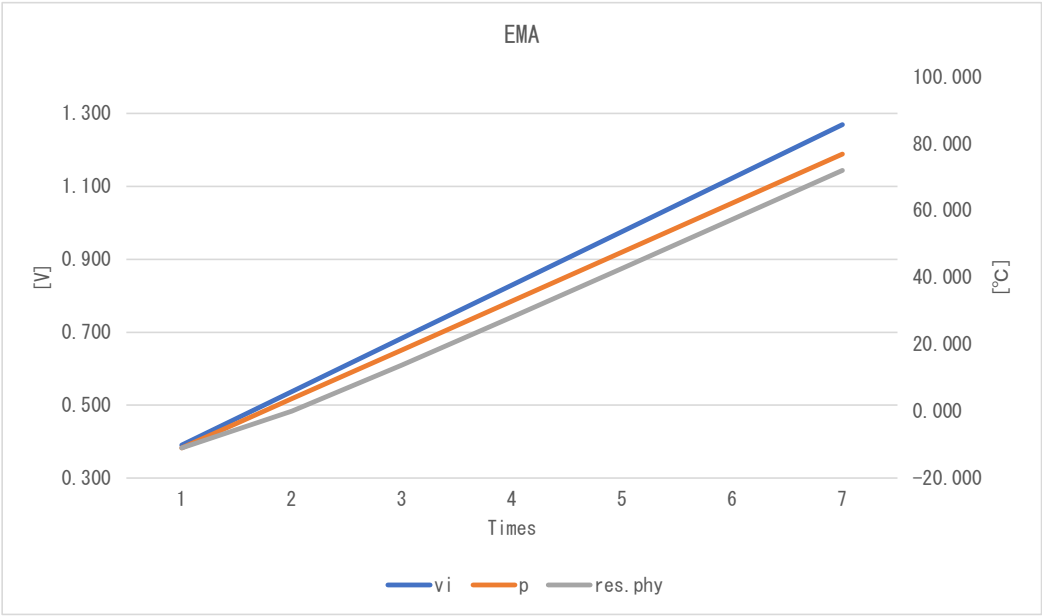
SMA

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	



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	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	-3.613	4,000	OK
	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	8.594	4,000	OK
	Measured	140	0.684	18.359	8.594	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	170	0.830	33.008	23.242	4,000	OK
	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	OK
	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	OK
	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	OK
	Measured	260	1.270	76.953	67.188	4,000	
	Difference	0	0.000	0.000	0.000	0