Test Specifications and Results of ADC components

Spec-00000057.pdf

Date	17-Oct-22
Verifier	Red Dragon

vi = (ai × ADC_vdd) / 2^{ADC_bit}

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

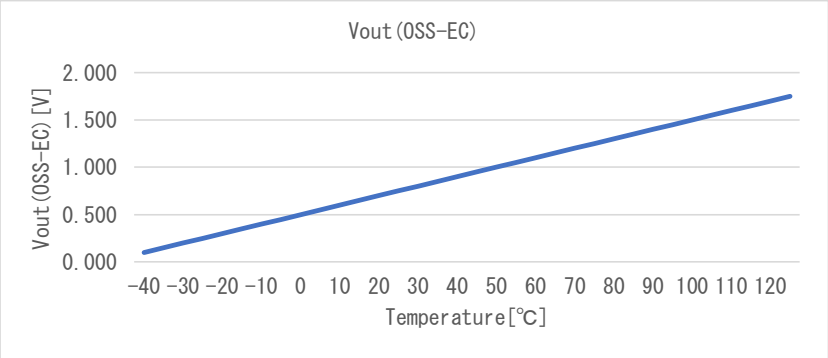
SMA calculation method　　phy = (y_n + y_{n-1} + y_{n-2}) / n

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)

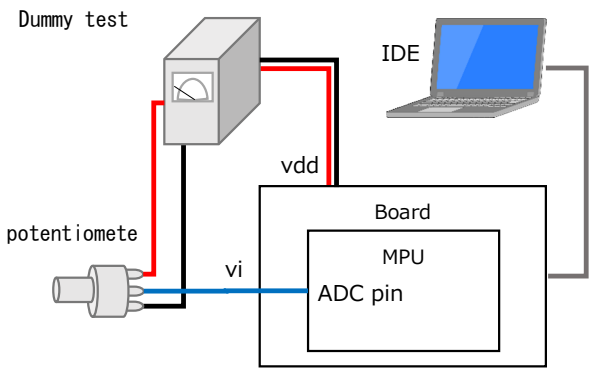
Non-MA calculation method　　phy = y

Spec-TC1047_TC1047A.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

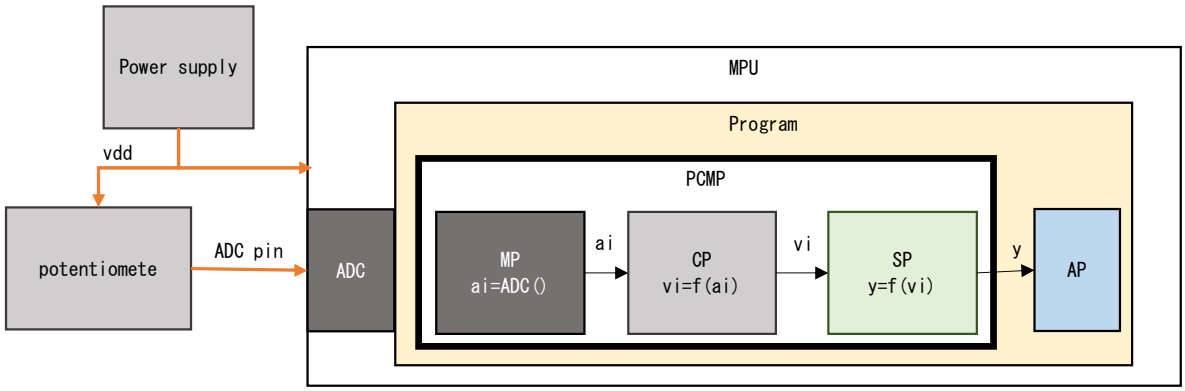
Test environment	
Board	Arduino Pro Mini(3.3V versions)
MPU	ATmega328P
ComplierVer	avr-gcc 7.3.0
IDE	Arduino IDE 1.8.19
Vdd	3.3 [V]
ADC bit	10 [bit]
ADC pin	A0 -
Component	Dummy



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:

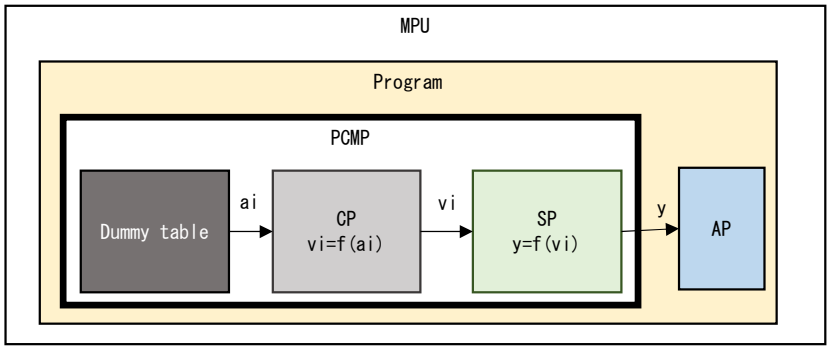


No.		ADC pin	ai	vi	p	res.phy	res.sts	Judgment
1	Expected	0.000	0	0.000	-50.000	-40.000	4,002	OK
	Measured		0	0.000	-50.000	-40.000	4,002	
	Difference		0	0.000	0.000	0.000	0	
2	Expected	1.200	372	1.199	69.883	69.883	4,000	OK
	Measured		373	1.202	70.205	70.205	4,000	
	Difference		-1	-0.003	-0.322	-0.322	0	
3	Expected	1.500	465	1.499	99.854	99.854	4,000	OK
	Measured		467	1.505	100.498	100.498	4,000	
	Difference		-2	-0.006	-0.645	-0.645	0	
4	Expected	3.300	1,024	3.300	280.000	125.000	4,001	OK
	Measured		1,023	3.297	279.678	125.000	4,001	
	Difference		1	0.003	0.322	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	33	0.106	-39.365	-39.365	4,000	OK
	Measured	33	0.106	-39.365	-39.365	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	32	0.103	-39.688	-39.688	4,000	OK
	Measured	32	0.103	-39.688	-39.688	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	31	0.100	-40.010	-40.000	4,002	OK
	Measured	31	0.100	-40.010	-40.000	4,002	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	32	0.103	-39.688	-39.688	4,000	OK
	Measured	32	0.103	-39.688	-39.688	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	543	1.750	124.990	124.990	4,000	OK
	Measured	543	1.750	124.990	124.990	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	544	1.753	125.313	125.000	4,001	OK
	Measured	544	1.753	125.313	125.000	4,001	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	543	1.750	124.990	124.990	4,000	OK
	Measured	543	1.750	124.990	124.990	4,000	
	Difference	0	0.000	0.000	0.000	0	

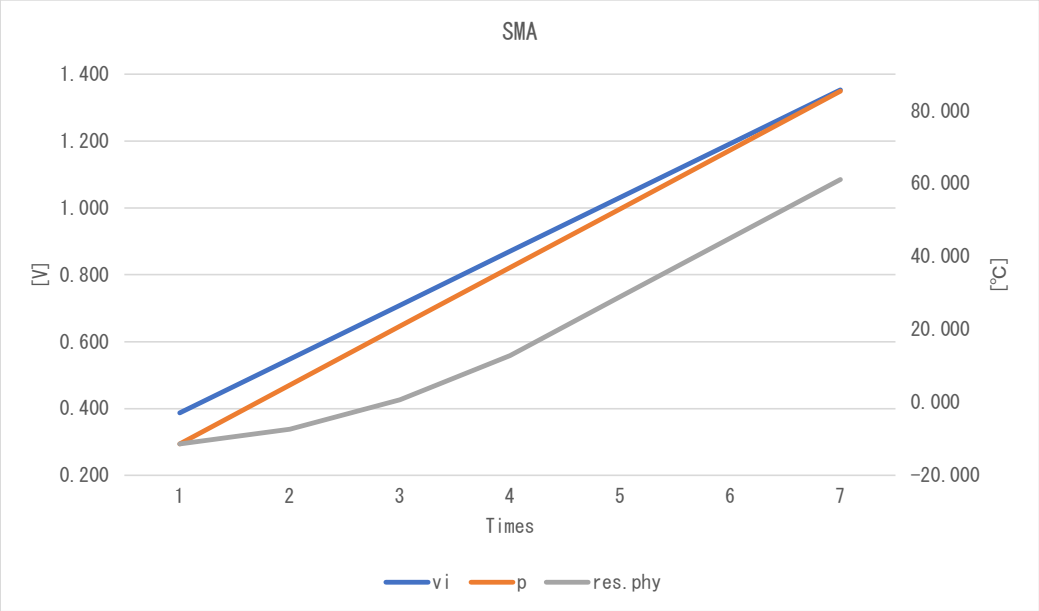
res.sts 4000 Normal
4001 Max Limiter NG
4002 Min Limiter NG

2-2. Moving average test

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

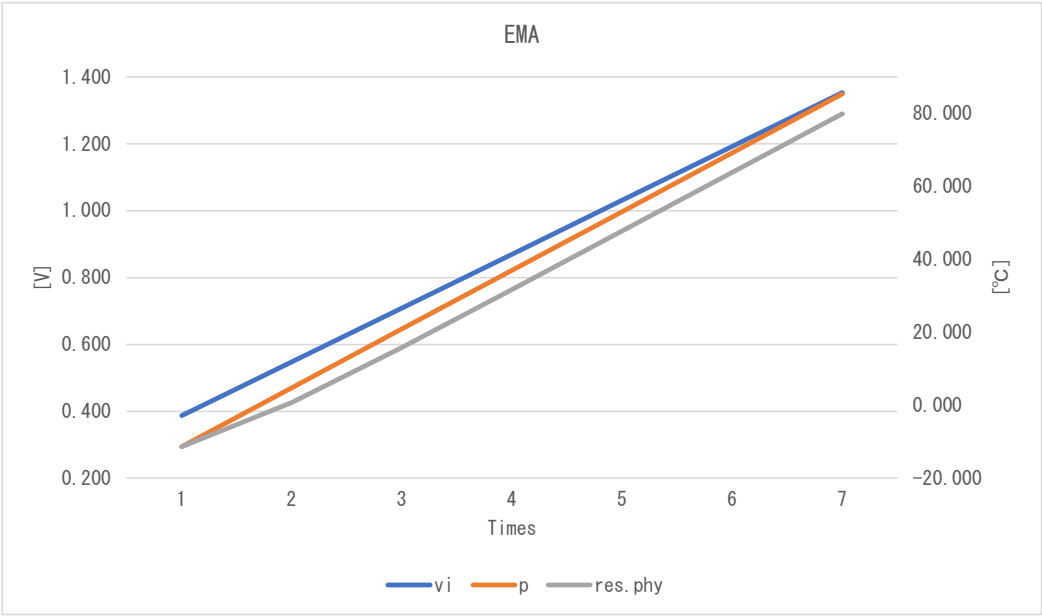
SMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	120	0.387	-11.328	-11.328	4,000	OK
	Measured	120	0.387	-11.328	-11.328	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	170	0.548	4.785	-7.300	4,000	OK
	Measured	170	0.548	4.785	-7.300	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	220	0.709	20.898	0.757	4,000	OK
	Measured	220	0.709	20.898	0.757	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	270	0.870	37.012	12.842	4,000	OK
	Measured	270	0.870	37.012	12.842	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	320	1.031	53.125	28.955	4,000	OK
	Measured	320	1.031	53.125	28.955	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	370	1.192	69.238	45.068	4,000	OK
	Measured	370	1.192	69.238	45.068	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	420	1.354	85.352	61.182	4,000	OK
	Measured	420	1.354	85.352	61.182	4,000	
	Difference	0	0.000	0.000	0.000	0	



EMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	120	0.387	-11.328	-11.328	4,000	OK
	Measured	120	0.387	-11.328	-11.328	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	170	0.548	4.785	0.757	4,000	OK
	Measured	170	0.548	4.785	0.757	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	220	0.709	20.898	15.863	4,000	OK
	Measured	220	0.709	20.898	15.863	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	270	0.870	37.012	31.725	4,000	OK
	Measured	270	0.870	37.012	31.725	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	320	1.031	53.125	47.775	4,000	OK
	Measured	320	1.031	53.125	47.775	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	370	1.192	69.238	63.872	4,000	OK
	Measured	370	1.192	69.238	63.872	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	420	1.354	85.352	79.982	4,000	OK
	Measured	420	1.354	85.352	79.982	4,000	
	Difference	0	0.000	0.000	0.000	0	



WMA

No.		Dummy ai	vi	p	res.phy	res.sts	Judgment
1	Expected	120	0.387	-11.328	-11.328	4,000	OK
	Measured	120	0.387	-11.328	-11.328	4,000	
	Difference	0	0.000	0.000	0.000	0	
2	Expected	170	0.548	4.785	-3.271	4,000	OK
	Measured	170	0.548	4.785	-3.272	4,000	
	Difference	0	0.000	0.000	0.000	0	
3	Expected	220	0.709	20.898	10.156	4,000	OK
	Measured	220	0.709	20.898	10.156	4,000	
	Difference	0	0.000	0.000	0.000	0	
4	Expected	270	0.870	37.012	26.270	4,000	OK
	Measured	270	0.870	37.012	26.270	4,000	
	Difference	0	0.000	0.000	0.000	0	
5	Expected	320	1.031	53.125	42.383	4,000	OK
	Measured	320	1.031	53.125	42.383	4,000	
	Difference	0	0.000	0.000	0.000	0	
6	Expected	370	1.192	69.238	58.496	4,000	OK
	Measured	370	1.192	69.238	58.496	4,000	
	Difference	0	0.000	0.000	0.000	0	
7	Expected	420	1.354	85.352	74.609	4,000	OK
	Measured	420	1.354	85.352	74.609	4,000	
	Difference	0	0.000	0.000	0.000	0