V9203 Error Calibration

1. Parameter Calculation：

- Calibration coefficients of current RMS, voltage RMS, and power
- Values of the energy accumulation threshold register
- Values of the no-load detection threshold register

2. **Error Calibration：**

- Gain calibration, phase calibration, and low current signal error calibration of active power and inactive power
- Current RMS and voltage RMS calibration

Calibration Example-Parameter calculation

Meter Specifications:

- Rated voltage：220V
- Rated current：5A
- Active/Inactive constant：3200
- Meter type：Three phase, four wire

Parameters of Design:

- Current sampling：10mV
- Current gain：Analog gain：4 ；Digital gain：1
- Voltage sampling：74mV
- Voltage gain：Analog gain：2 ；Digital gain：2

Parameter Calculation

1. Current RMS calibration coefficient ：

Rated current, total current RMS register value (0xE90E, 0xE90F, 0xE910)

$$Value = V_i \times G_i \times K$$
$$= 10 \times 4 \times 2.5 \times 10^6 = 100000000 = 0x5F5E100$$

If the rated current is 5.0000A，displaying 4 decimal places, calibration coefficient:

$$D_i = \frac{100000000}{50000} = 2000$$

Di is the current RMS ratio factor. The user simply divides the value of the register (0xE90E, 0xE90F, 0xE910) by the ratio factor to obtain the current actual total current RMS.

Parameter Calculation

2. Voltage RMS calibration coefficient：

Rated voltage total voltage RMS register value (0xE944, 0xE945, 0xE946)

$$Value = V_v \times G_v \times K$$
$$= 74 \times 8 \times 2.5 \times 10^6 = 1480000000 = 0x58370200$$

If the rated current is 220.0V（ displaying 1 decimal place), calibration coefficient:

$$D_v = \frac{1480000000}{22000} = 672727$$

Dv is the voltage RMS ratio factor. The user simply divides the value of the register (0xE944、0xE945、0xE946) by the ratio factor to obtain the current actual total voltage RMS.

Parameter Calculation

3. Calibration coefficients for active, inactive, and apparent power：

Rated voltage rated current total active power register value（0xE8E8、0xE8E9、0xE8EA）

$$Value = Vi \times Gi \times Vv \times Gv \times K$$
$$= 10 \times 4 \times 74 \times 8 \times 750 = 17760000$$

The rated power is 1.1000Kw and the calibration coefficient is

$$D_w = \frac{10 \times 17760000}{11000} = 16145$$

Dw is the active power ratio factor. The user simply multiply the active power register value by 10, and then divide it by the ratio factor to obtain the actual active power value. The ratio actor of inactive power is the same as that of active power. If bit 13 of register 0xC002 is set to 1, the ratio factor of apparent power is also the same as that of active power.

Parameter Calculation

4. Calibration coefficients for active, inactive, and apparent power：

Rated voltage rated current total active power register value （0xE8E8、0xE8E9、0xE8EA）

$$Value = Vi \times Gi \times Vv \times Gv \times K$$
$$= 10 \times 4 \times 74 \times 8 \times 750 = 17760000$$

The rated power is 1.1000Kw and the calibration coefficient is:

$$D_w = \frac{10 \times 17760000}{11000} = 16145$$

Dw is the active power ratio factor. The user simply multiply the active power register value by 10, and then divide it by the ratio factor, to obtain the actual active power value. The ratio actor of inactive power is the same as that of active power. If bit 13 of register 0xC002 is set to 1, the ratio factor of apparent power is also the same as that of active power.

Parameter Calculation

5. Energy accumulation threshold value：

$$Value = \frac{P \times 3600 \times 1000 \times 6.25}{Const \times Un \times In}$$
$$= \frac{17760000 \times 3600 \times 1000 \times 6.25}{3200 \times 220 \times 5}$$
$$= 113522727$$

P is the value calculated from the power calibration coefficient. Write the calculated value to the energy accumulation threshold register （0xEC1E、0xEC1F）.

Parameter Calculation

6. No-load detection threshold value：

If the start current is 0.2%Ib，the threshold value should be calculated as:

Threshold value upper limit register calculation:

$$Value = 0.7 \times 0.002 \times 17760000 = 24864 = 0x6120$$

Threshold value lower limit register calculation:

$$Value = 0.5 \times 0.002 \times 17760000 = 17760 = 0x4560$$

The calculated values should be written to the upper limit register (0xE8AA) and the lower limit register (0xE8AB) respectively.

Error Calibration

Error calibration flow:

① A、B、C phase active gain calibration
② A、B、C phase active phase compensation
③ A、B、C phase active low current signal error calibration
④ A、B、C phase voltage, current RMS calibration
⑤ A、B、C phase inactive low current signal error calibration

Description：

- After active gain calibration, inactive gain calibration is not required. Just write into the same values.
- Generally, low current signal does not require the calibration.

Error Calibration

1. Active Gain Calibration：

Take A-phase for example, when the current is 1.0 Ib, A-phase before calibration is as below:

Standard meter power value	Power value displayed on energy meter	Error displayed on calibration meter
1.1001Kw	1.0862KW	-1.23%

Calculation formula:

$$S = 2^{31} \times \left(\frac{1}{1+e} - 1 \right) \times S_1 \times \left(\frac{1}{1+e} \right)$$

Description：

e indicates the current error, which can be displayed on the calibration meter. It can be calculated through the displayed power of energy meter and standard meter:

$$e = \frac{1.0862 - 1.1001}{1.1001} \times 100\% = -1.26\%$$

S1 is the initial value of A-phase gain register（0xE95A/B/C）.

Error Calibration

A-phase active power gain register value calculation:

$$S = 2^{31} \times \left(\frac{1}{1-0.0123} - 1 \right) \times 0 \times \left(\frac{1}{1-0.0123} \right)$$

$$= 26742987 = 0x19810CB$$

Description：

S1 is 0，which indicates that the initial value of gain register is 0. Write the calculated value to the A-phase active gain register （0xE95A/B/C）and A-phase inactive gain register （0xE965 ）

If the calculated value is negative, please write in the complement. The calibration of B-phase and C-phase is the same as that of A-phase.

Error Calibration

2、 Active Phase Compensation：

Take A-phase for example, when the current is 0.5L Ib, A-phase before calibration is as below:

Standard meter power value	Power value displayed on energy meter	Error displayed on calibration meter
0.5502Kw	0.5481KW	-0.36%

Calculation formula: $N = \frac{3011}{2} \times \frac{f_{ADC}}{819200} \times e$

Description：

e is the current error, which can be displayed directly on the calibration meter. It can also be calculated by the displayed power of the energy meter and the standard meter. $e = \frac{0.5481 - 0.5502}{0.5502} \times 100\% = -0.38\%$

The value of fadc is determined by the bit [19:18] of register 0x8003. The default value is 819200.

Error Calibration

A-phase active power phase register value calculation ：

$$N = \frac{3011}{2} \times \frac{819200}{819200} \times -0.0036 = -5.52 \approx -5$$

Description：

Write 5 to bit [6: 0] of the phase compensation register 0xE954. Because it is negative, write 1 to bit[7].

The calibration method for B-phase is the same as A-phase. The calibration value and the symbol are written in bit [15: 8].

The calibration method for C-phase is the same as A-phase. The calibration value and the symbol are written in bit [23:16].

If the phase segment calibration is forbidden, write the same values to 0xE955 / 6/7/8.

Error Calibration

3、Active Offset calibration :

Take A-phase for example, when the current is 0.05Ib， A-phase before calibration is as below：

Standard meter power value	Power value displayed on energy meter	Error displayed on calibration meter
0.0551Kw	0.0547KW	-0.81%

Calculation formula:

$$\Delta P = -e \times k \times P$$

Description :

e is the current error, which can be displayed directly on the calibration meter. It can also be calculated by the displayed power of energy meter and the standard meter.

$$e = \frac{0.0547 - 0.0551}{0.0551} \times 100\% = -0.73\%$$

K indicates the current while calibrating. In this case, it is 0.05.

P represents the active power value of Ib. The previously calculated value is 17760000

Error Calibration

A-phase active offset compensation register value (0xE98E) calculation :

$$\Delta P = 0.05 \times 17760000 \times 0.0081 \approx 7192 = 0x1C18$$

Description:

If the calculated value is negative, please write in the complement.

The calibration of B-phase and C-phase is the same as that of A-phase.

Error Calibration

4、Inactive offset compensation ：

Reactive power does not require the gain calibration, and only requires the low current signal offset compensation.

Calculation formula: $\Delta P = e \times k \times P$

Description:

The inactive offset compensation is the same as the active offset compensation. Only the e is positive.

P is the value of each phase inactive power register （0xE8F0/1/2） when the current is 1.0Ib. In the actual applications, the value is the same as the value of active power register（0xE8E8/9/A ）.

Error Calibration

A-phase inactive offset compensation register value (0xE991) calculation ：

When the current is 0.05Ib, A-phase inactive power before calibration is as below：

Standard meter power value	Power value displayed on energy meter	Error displayed on calibration meter
0.0549KVar	0.0546KVar	-0.51%

$$\Delta P = -0.0051 \times 0.05 \times 17760000 \approx -4528 = 0xFFFFEE50$$

Error Calibration

5、Gain Calibration of Current RMS and Voltage RMS ： The RMS gain calibration formula is the same as the power gain calibration formula. Just the error e in the formula can only be calculated by the displayed value and the value of the standard meter.

The A-phase current RMS calibration is taken as an example：

Current RMS of Standard Meter	Current RMS displayed on energy meter
5.0001A	5.0762A

$$e = \frac{4.9762 - 5.0001}{5.0001} \times 100\% = 1.52\%$$

$$S = 2^{31} \times \left(\frac{1}{1 + 0.0152} - 1\right) \times 0 \times \left(\frac{1}{1 + 0.0152}\right)$$

$$\approx -32153025 = 0x\mathrm{FE15623F}$$

Single-Point Error Calibration

Single-point calibration：

When the current is Ib, voltage is Un, and power factor is 0.5L, the single-point calibration is used for one-time calibration active, reactive power gain calibration, phase calibration, and voltage RMS, current RMS.

Please refer to the file “Single-point Calibration”.