S23P Series

Application Manual

S23P Series

■ Overview

The S23P Series is a closed-loop type and built-in bus bar-type current sensor.

The rated current has variations of 50 A and 100 A.

The mounting structure is the on-board type.

Table 1: Outline of S23P series Ta = 25°C Vcc = +15 V (Unless otherwise specified)

Series name	S23P Series			
Model number	S23P50D15M1	S23P100D15M1	S23P50D15M2	S23P100D15M2
Rated current	50 A	100 A	50 A	100 A
Rated output current	50 mA	100 mA	25 mA	50 mA
Maximum current	±226 A (Within 3 seconds) : Vcc = ±12 V RL =7.5 Ω		±110 A (Within 10 seconds) : RL = 71 Ω or less	±160 A (Within 10 seconds) : RL = 25 Ω or less
Number of turns of negative feedback coil N_F	1000 turns		2000 turns	

■Characteristics

- Built-in bus bar-type supply system of the current to be measured.
- The built-in bus bar can be selected from 1 turn to 3 turns depending on the connection method.
- Closed-loop-type circuit configuration.
- Output of on-board-type format with panel mounting structure.
- Power-supply voltage can be used in the range between ±(12 V ±5%) and ± (15 V ±5%).
- Output in the form of current given as output current corresponding to the current to be measured.
- Very high accuracy output current of within ±0.25%.
- Excellent output linearity of within ±0.15%.
- Fast response: Step response (response speed $\frac{di}{dt}$) of less than 0.5 μs.
- Withstand voltage: AC 5000 V for 1 minute
- Satisfies conformity safety standard.

■ Use

- General purpose inverter
- UPS

■ Format

S23P □□□ D 15 □□

- Suffix: Number of turns of negative feedback coil
  - M1: 1000 turns
  - M2: 2000 turns
- Power-supply voltage 15: 15 V
- Power-supply type D: Dual power supply
- Rated current 50: 50 A
  - 100: 100 A
- Series name S23P

■ Standard connection diagram

S23P□□□D15□□

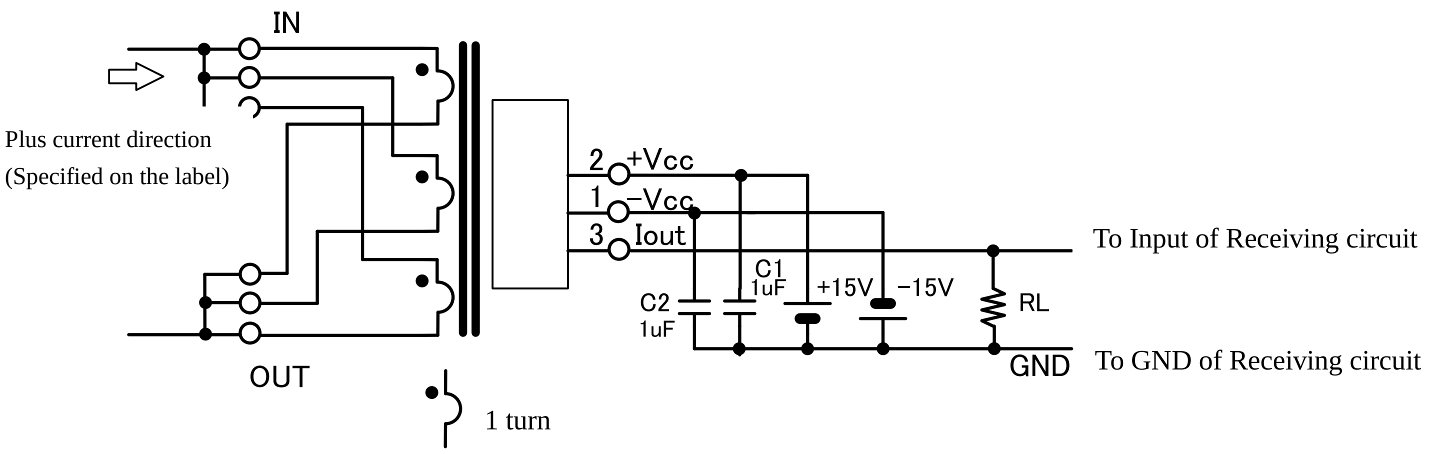

Fig. 1-1: S23P□□□D15□□ Standard connection diagram of 1-turn bus-bar

S23P Series

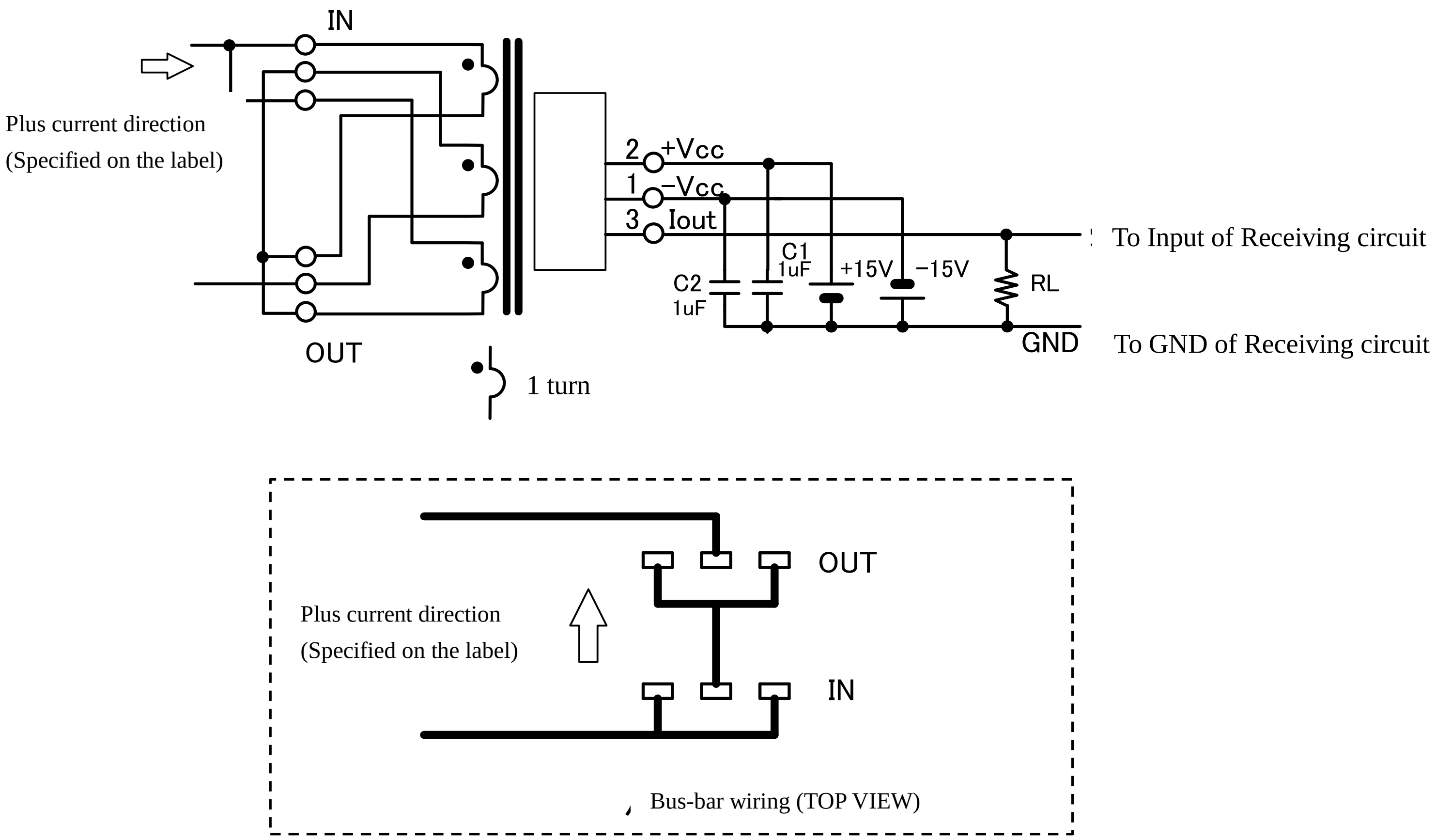

Fig. 1-2: S23P□□□D15□□ Standard connection diagram of 2-turn bus-bar

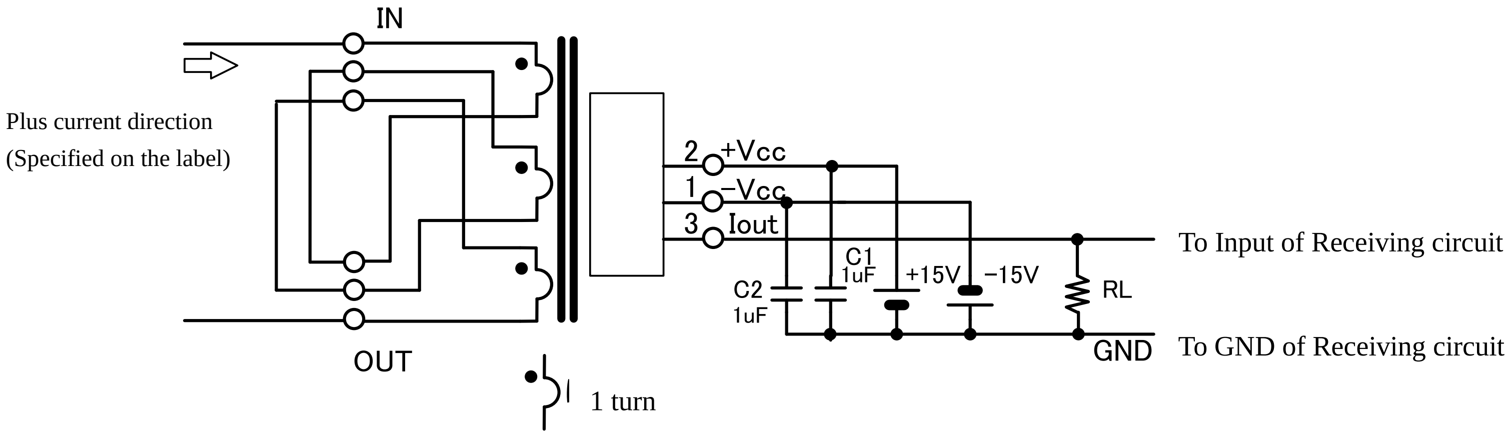

Fig. 1-3: S23P□□□D15□□ Standard connection diagram of 3-turn bus-bar

■Description of input/output terminals: S23P□□□D15□□

Table 2: Description of input/output terminals

Terminal number	Terminal name	Description	Remarks
1	-Vcc	Negative power-supply terminal. Apply -12 V ~ -15 V	
2	+Vcc	Positive power-supply terminal. Apply. +12 V ~ +15 V	
3	Iout	Output terminal. The current output between this terminal and GND is $\frac{1}{N_F}$ of the current to be measured. N_F : Number of turns of negative feedback coil (As shown in Table 1) A resistor can be inserted between this terminal and GND for measuring the voltage corresponding to the current to be measured.	*
IN	Bus bar IN side	On the IN side of the three built-in bus bars Supply the primary current (measured current). When the primary current flows in the direction of the arrow (⇒) on the label, the output current has polarity in the direction from the output terminal (Iout) to GND. Three built-in bus bars are independent of each other and the bus-bar turn number n_{BUS} can be set to be one of three either 1, 2 or 3 depending on conditions.	
OUT	Bus bar OUT side	The minus side of the primary current (measured current).	

* The standard value of the output current $Iout$ is $Iout = \frac{n_{BUS}}{N_F} \times I + Iof$.

I : Current to be measured

Iof : Offset current (=0 A typ)

N_F: Number of windings of negative feedback coil (from Table 1)

n_{BUS}: Number of turns of bus bar

■ Description of basic characteristics

The S23P Series current sensor is used for the measurement of 50 A ~ 100 A class current and outputs $\frac{n_{BUS}}{N_F}$ of the current to be measured from the output terminal. The internal structure is composed of a core (a magnet) penetrating three independent bus bars and an electronic circuit. The electronic circuit is composed of a negative feedback coil constituting a closed loop and a phase compensation circuit for stable operation of the amplifier and the closed loop. Two power-supply voltages are required for both plus and minus. The allowed range of the power-supply voltage is from ±(12 V ± 5%) to ±(15 V ± 5%).

The current to be measured is passed through a bus bar of the sensor. The magnetic flux generated by the current to be measured converges to the built-in core (a magnet), and the built-in amplifier energizes the canceling current to the negative feedback coil in such a way that the generated magnetic flux becomes extremely small, i.e., approximately 0 tesla. That is, a current is supplied to the negative feedback coil so as to cancel the magnetic flux generated by the current to be measured. The magnetic flux of the core (a magnet) is proportional to (current) times (number of turns.) Let the number of turns of the negative feedback coil be N_F. Then, when three bus bars are used as one turn, the magnetic flux at the core (a magnet) is canceled and becomes nearly zero for the current of $\frac{1}{N_F}$ of the measured current passing through the negative feedback coil. The current applied to the negative feedback coil cancels the magnetic flux output from the output terminal. In this case, therefore, the current of $\frac{1}{N_F}$ of the measured current is output. When three bus bars are used as three independent turns, the magnetic flux at the core (a magnet) is canceled and becomes zero for $\frac{3}{N_F}$ of the measured current passing through the negative feedback coil. The current applied to the negative feedback coil for magnetic-flux cancellation is output from the output terminal. Therefore, $\frac{3}{N_F}$ of the current to be measured is always output. The output current can be measured by converting it into a voltage with a measuring resistor connected between the output terminal and GND. The output of the measuring resistor has a plus polarity when the current is supplied in the direction of the arrow described on the main body. In this way, the sensitivity (output current / current to be measured) of the current sensor with the closed-loop configuration becomes (number of bus bar turns) / (number of turns of negative feedback winding). It is not influenced by the fluctuation in the sensitivity of the Hall element or the change in the gain of the AMP. It is determined by the number of turns of the coil and the number of turns of the bus bar. Therefore, the closed-loop-type S23P Series current sensor can achieve high accuracy with an output deviation within ±0.25% and output linearity within ±0.15%.

Because the current output from the output terminal acts as a current source, the sensor is negligibly affected by the wiring resistance from the output terminal of the sensor to the measuring resistor. Therefore, accurate current measurement is possible by paying attention to the influence of the accuracy of the measuring resistor.

This current sensor operates in a manner similar to that of a current transformer so that a sharp change in the current can be measured. When the current to be measured changes stepwise, high-speed response is possible. In fact, when the current to be measured rises at the rate of 100 A/μs, the measured value reaches 90% of the target value within 0.5 μs.

The sensor has an on-board-type structure enabling attachment to a board, and the wiring to the power-supply terminal and the output terminal can be configured in accordance with the pattern on the board.

■**Block diagram (±12V ~ ±15V** Dual power-supply type)

S23P□□□D15□□

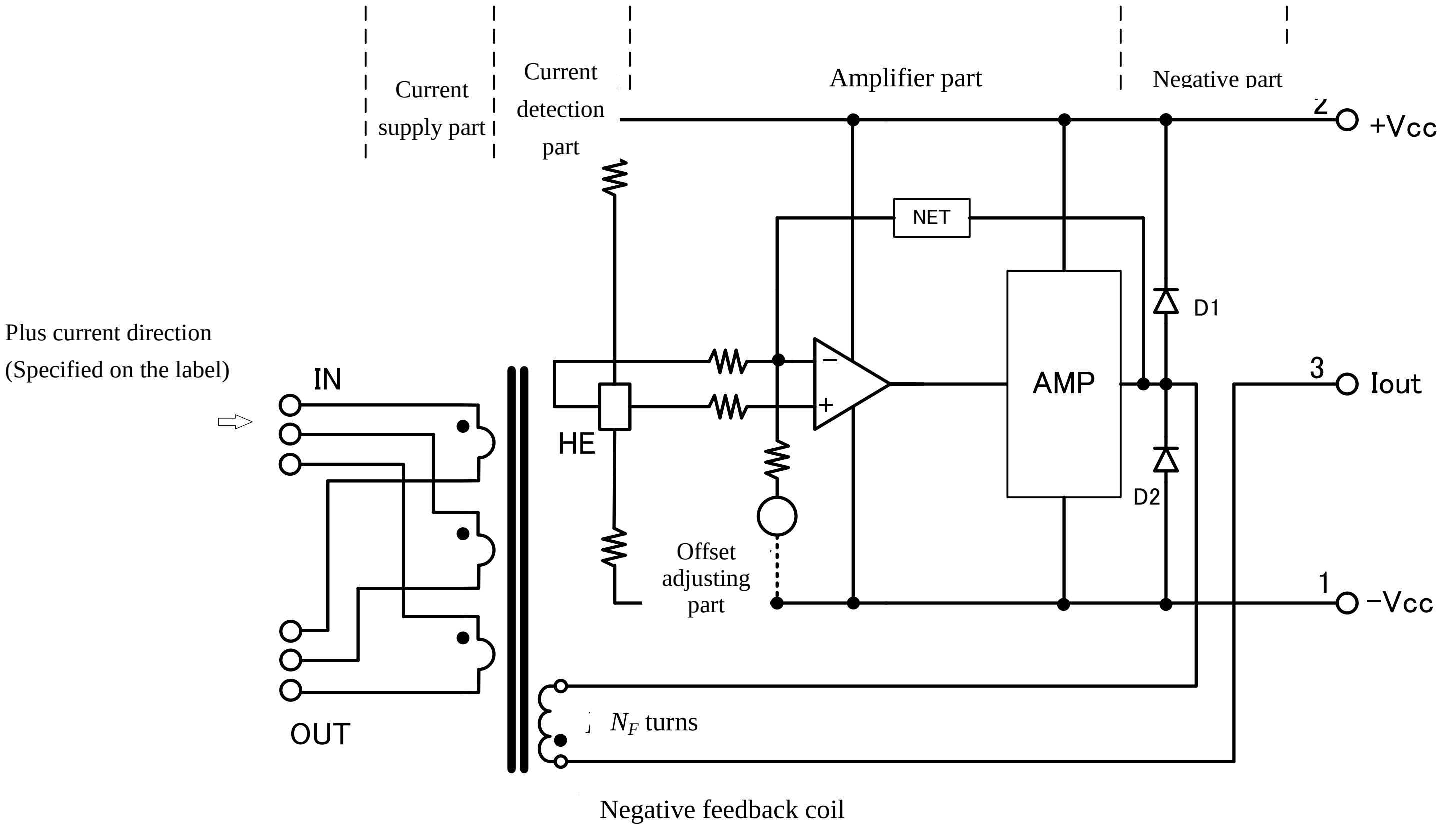

Fig. 2: S23P series: Internal block diagram

■Description of block diagram

Current-flowing unit

The current-flowing part passes the current to be measured through the bus bar built in the main body. Three bus bars are built in and are independent of each other. The three bus bars can be used as one-turn, two-turn, and three-turn bus bars by changing the wiring. The current to be measured is supplied to one bus bar to generate a magnetic flux in the built-in core. The magnetic flux generated by the current to be measured is concentrated on the core of high magnetic permeability. A Hall element, inserted in the core as a magnetic detection element, detects the magnetic flux of the core, and converts the flux into voltage.

The bus bar generates heat due to its own resistance component (copper loss). Even when the ambient temperature is maximum, the maximum value of the current is determined in such a way that the temperature of the sensor does not exceed the specified value.

In addition to the copper loss of the bus bar, heat is generated owing to iron loss (core loss) of the core built into the sensor. Each loss varies depending on various conditions such as the magnitude, frequency, and waveform of the current to be measured. The loss increases with the effective current or with the dominant frequency component of the current to be measured. When the current contains high-frequency components other than those of the fundamental wave, iron loss further increases. Therefore, confirmation using an actual current is necessary.

Current-detection unit

The current to be measured (primary input current) is passed through the bus bar. The generated magnetic flux is focused by the core and applied to the magnetic-detection element (Hall element, HE). When the wiring of the built-in bus bar is one turn, the magnetic flux to be generated in the core by the current to be measured is proportional to the current × 1. On the other hand, approximately $\frac{1}{N_F}$ of the measured current flows through the negative feedback coil and generates a magnetic flux in the direction opposite to the flux generated by the measured current. Because the number of turns of the negative feedback coil is N_F, the magnetic flux of the core is canceled and becomes almost zero. The current flowing through the negative feedback coil has the same value as the output current.

Therefore, when the one-turn bus-bar wiring is used, the output current becomes approximately $\frac{1}{N_F}$ of the current to be measured.

The magnetic detection element (HE) detects a net minute magnetic flux comprising a small current canceled by the current to be measured and the current of the negative feedback coil and converts it into voltage. The converted voltage is sent to the amplifier.

When the two-turn bus-bar wiring is used, the current of the negative feedback coil canceling the magnetic flux generated by the measured current becomes $\frac{2}{N_F}$. For that reason, the output current becomes $\frac{2}{N_F}$ of the measured current. When the three-turn bus-bar wiring is used, the output current becomes $\frac{3}{N_F}$ of the current to be measured by the same mechanism.

Feedback section of amplifier unit

The amplifier circuit amplifies the output voltage of the magnetic-detection element (HE). The current from the amplifier circuit is sent to the feedback circuit. The feedback circuit provides current to the feedback coil. As a result, it constitutes a closed loop consisting of the magnetic-detection element ⇒ amplifier circuit ⇒ feedback circuit ⇒ negative feedback coil ⇒ core magnetic flux ⇒ (magnetic-detection element). See Fig. 3.

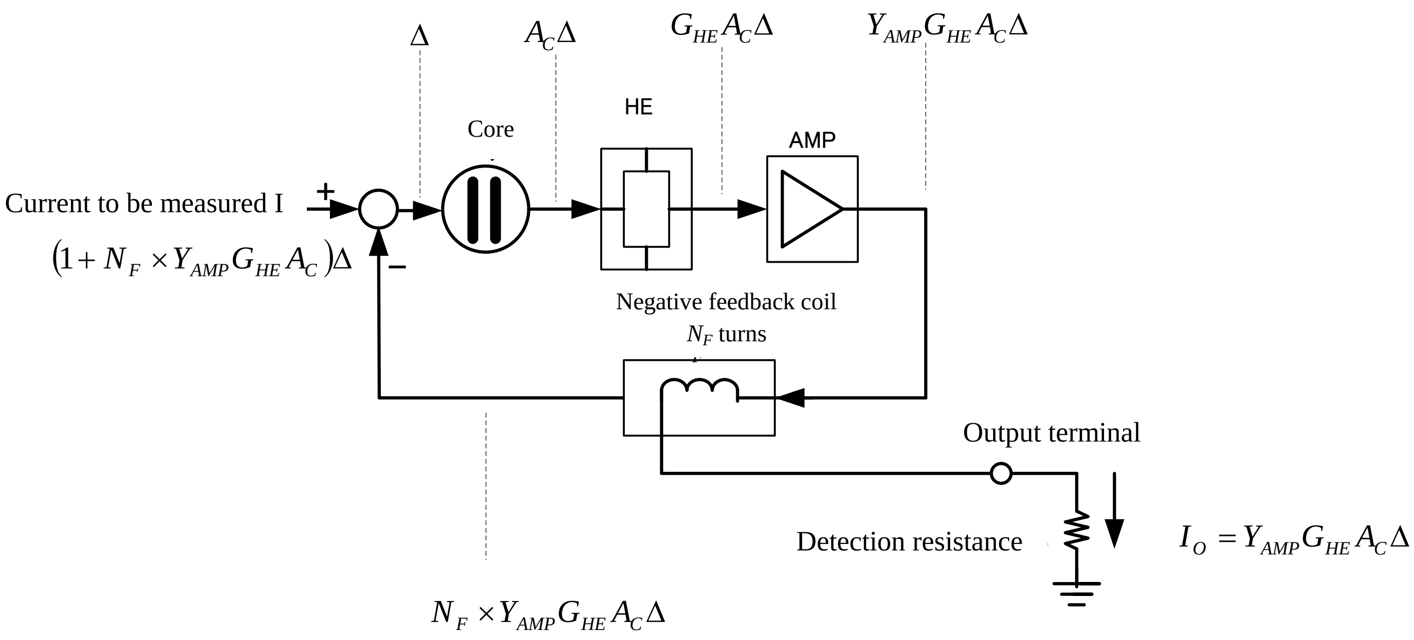

Fig. 3: Closed-loop block diagram (In the case of one-turn bus-bar)

The current I_o flowing in the negative feedback coil multiplied by the number of turns (ampere turn) and the current I to be measured almost cancel each other and their difference becomes the net minute current Δ equivalently exciting the core. The above-mentioned minute current generates small magnetic flux $A_C\Delta$ through the core of high magnetic permeability. The small magnetic flux $A_C\Delta$ is detected by the Hall element (HE) and is converted to voltage $G_{HE}A_C\Delta$. Furthermore, this voltage is amplified by AMP and converted into current $Y_{AMP}G_{HE}A_C\Delta$. The current $Y_{AMP}G_{HE}A_C\Delta$ is output from the output terminal. On the other hand, the same current flows through the negative feedback coil and acts to cancel the current to be measured. Because the negative feedback coil has N_F turns, the ampere turn becomes $N_F \times$ (current flowing through the negative feedback coil). As a result of the cancellation, therefore, the net minute current Δ that excites the core can be written as

$$\Delta = I - N_F \times Y_{AMP}G_{HE}A_C\Delta . \quad \text{Equation 1}$$

On the other hand, the output current is given by

$$I_O = Y_{AMP}G_{HE}A_C\Delta . \quad \text{Equation 2}$$

From Equations 1 and 2, therefore, the relationship between the output voltage and the current to be measured is obtained as

$$\frac{I_O}{I} = \frac{Y_{AMP} G_{HE} A_C \Delta}{\Delta + N_F \times Y_{AMP} G_{HE} A_C \Delta} = \frac{1}{N_F + \frac{1}{\mu}}, \qquad \text{Equation 3}$$

where $\mu \equiv Y_{AMP} G_{HE} A_C$.

Because μ of the closed-loop current sensor has a very large value, Equation 4 holds while maintaining high accuracy of the output current within ±0.25%.

$$\frac{I_O}{I} = \frac{1}{N_F} \text{ (In the case of one-turn bus-bar),} \qquad \text{Equation 4}$$

When the bus bars are wired with n_{BUS} turns, the output current becomes $\frac{I_O}{I} = \frac{n_{BUS}}{N_F}$.

Current transformer

When the current to be measured suddenly changes, a current flows through the negative feedback coil in accordance with Lenz's law in such a way that the magnetic-flux change of the core caused by the current to be measured is canceled. This current is $\frac{n_{BUS}}{N_F}$ of the change of the current to be measured, and becomes the output current. When the current to be measured increases as shown by ⇒ in Fig. 4, the current of the negative feedback coil increases in the → direction, is output from the output terminal, flows from the measurement resistor *RL* to GND, and returns from the minus terminal to the negative feedback coil.

Because the output current returns from the power supply terminal to the negative feedback coil via GND, it is necessary to shorten this path. When a transient current of the output current flows, C1 and C2 are recommended to be 10 μF or more.

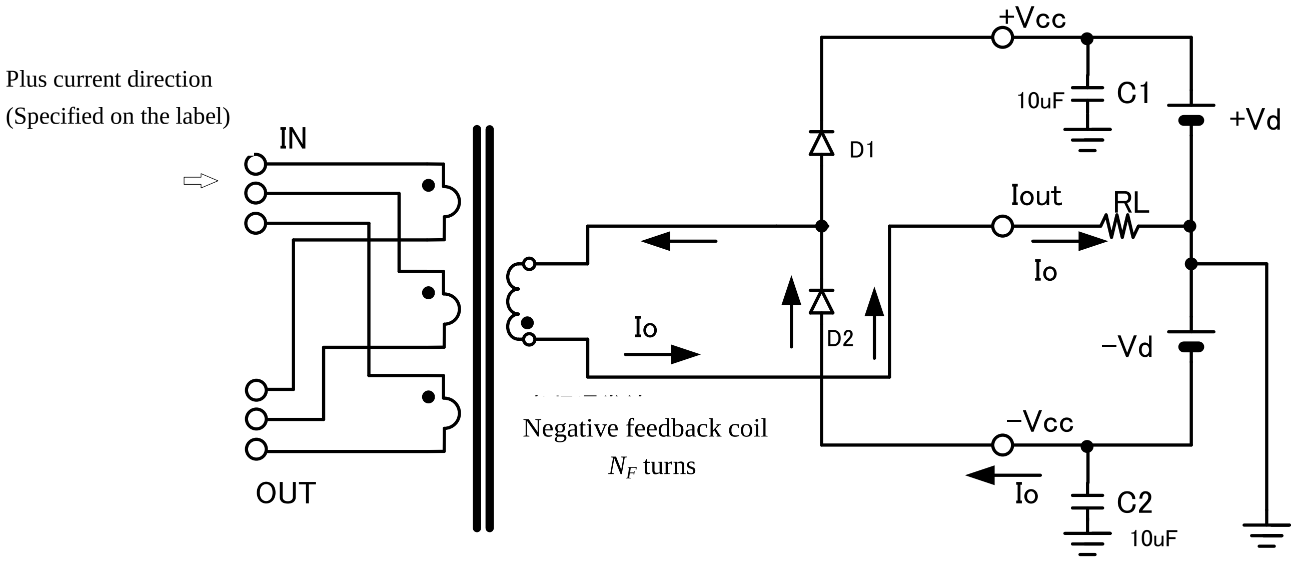

Fig. 4: Equivalent circuit of current transformer operation

Offset adjustment unit

The offset current is a reference of the output current and is an output current when the current to be measured is 0 A. For the S23P Series, the offset current is 0 A.

The main origin of a possible deviation of the offset current from the standard value of 0 A lies in the fact that the Hall element HE, which is the magnetic sensing element, can have an offset voltage. The offset voltage of the Hall element is a minute voltage output even in the absence of applied magnetic flux. A minute output current generated by this offset voltage is the origin of the deviation of the offset current. Deviation of the offset current can also be caused by the amplifier section in addition to the Hall element. Before the product is actually shipped, adjustment is made, using the offset adjusting part, in such a way that the overall offset is comprehensively canceled out and falls within a predetermined deviation.

■Application

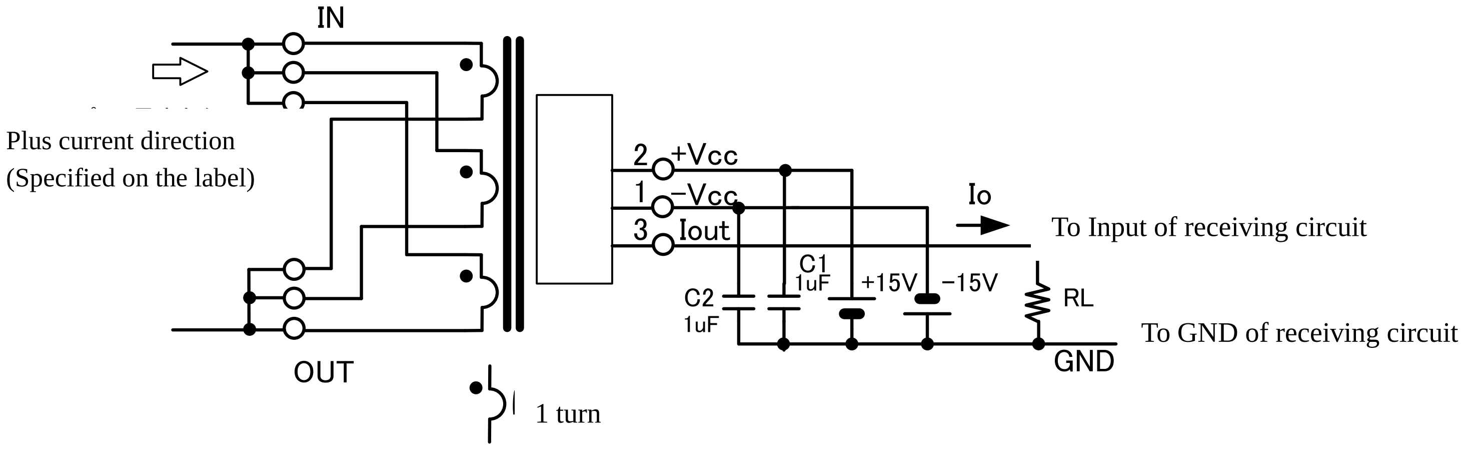

Fig. 5: Application (In the case of one-turn bus-bar)

[Note]

The application shown below is not within the assurance standard of the S23P Series current sensor. In other words, the accuracy of the application and the performance corresponding to the parameter values of the parts shown below are not guaranteed. Therefore, when selecting circuits and component parameters during the design of actual products, sufficient evaluation based on careful consideration of safety and the stability of characteristics is necessary.

Basic operation

This current sensor converts the current to be measured into output current given as $\frac{n_{BUS}}{N_F} = \frac{1}{N_F}$ of the current to be measured. The output current Io in Fig. 5 flows through the measuring resistor RL connected between the output terminal (*Iout*) and GND. First, the voltage across the measuring resistor RL is measured, then the output current Io is calculated, and finally, the current to be measured Iin is obtained as

$$Iin = N_F \times I_O = N_F \times \frac{V_{RL}}{RL}, \qquad \text{Equation 5}$$

where V_{RL} is the voltage between the terminals of the measuring resistor RL.

The output current Io flowing through the measuring resistor RL passes from the positive power supply through the AMP circuit to the measuring resistor RL, and returns to the power supply via GND. Therefore, the ±15 V power supply is required to have sufficient capacity to supply the output current I_O plus the current consumed by the sensor. The current capacity $I_{\pm 15}$ of the ± 15 V power supply is

S23P Series

$$I_{\pm 15} \geq I_{CC} + \frac{I_{MAX}}{N_F},$$

where I_{MAX} is the maximum current to be measured.

The current to be measured Iin can be calculated from the voltage V_{RL} across the measuring resistor RL using Equation 5.

Measuring resistance RL

The measuring resistance RL is restricted by Equation 6 for a given power-supply voltage and the maximum current to be measured I_{MAX}. As shown in Fig. 6, the voltage at the output terminal decreases from each supply voltage by a fixed voltage v_{RE}, because of Q1 and Q2 in the sensor, resistors R1 and R2 connected to the emitter, and operational constraints of the preamplifier. Therefore, this voltage difference given by v_{RE} should be properly considered, and the allowable voltage range of the output terminal Iout is within the range of $Vd - v_{RE}$ on the plus side and $-(Vd - v_{RE})$ on the minus side. For such reasons, the maximum value I_{MAX} of the output current and the measuring resistance RL are subject to the constraint given by

$$\left| \frac{I_{MAX}}{N_F}(R_S + RL) + v_{RE} \right| \le Vd \, , \qquad \text{Equation 6}$$

where R_S is the DC resistance of the negative feedback coil (Ω),

v_{RE} is the necessary difference voltage from the power-supply voltage (V),

Vd is the absolute value of the positive and negative power-supply voltage (V),

RL is the measuring resistance (Ω),

and v_{RE} is considered to be about 2.4 V to 4.0V.

Because R_S is the DC resistance of a copper wire, it has temperature characteristics. The resistance $R_S|_{T=t}$ at coil temperature *t* is given by

$$R_S|_{T=t^\circ C} \approx R_S|_{T=25^\circ C} \times \{1 + 0.0043(t - 25)\}. \qquad \text{Equation 7}$$

Using Equation 7, the DC resistance of the negative feedback coils of S23P□□□D15M1 and S23P□□□D15M2 is calculated as shown in Fig. 7.

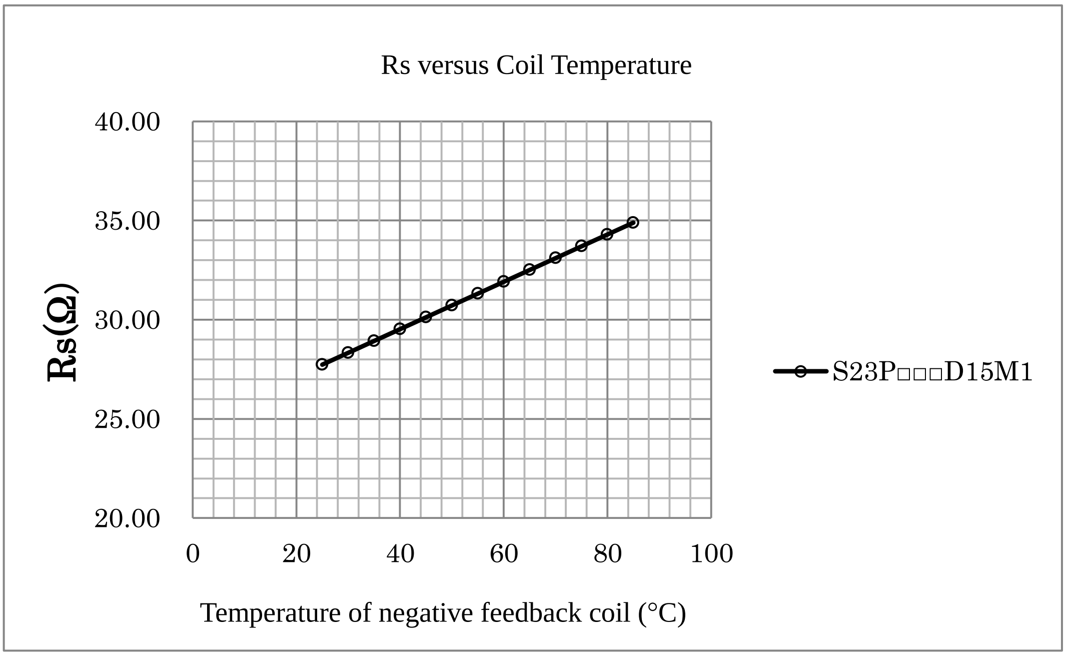

Fig. 7-1: S23P□□□D15M1: Temperature dependence of DC resistance of negative feedback coil

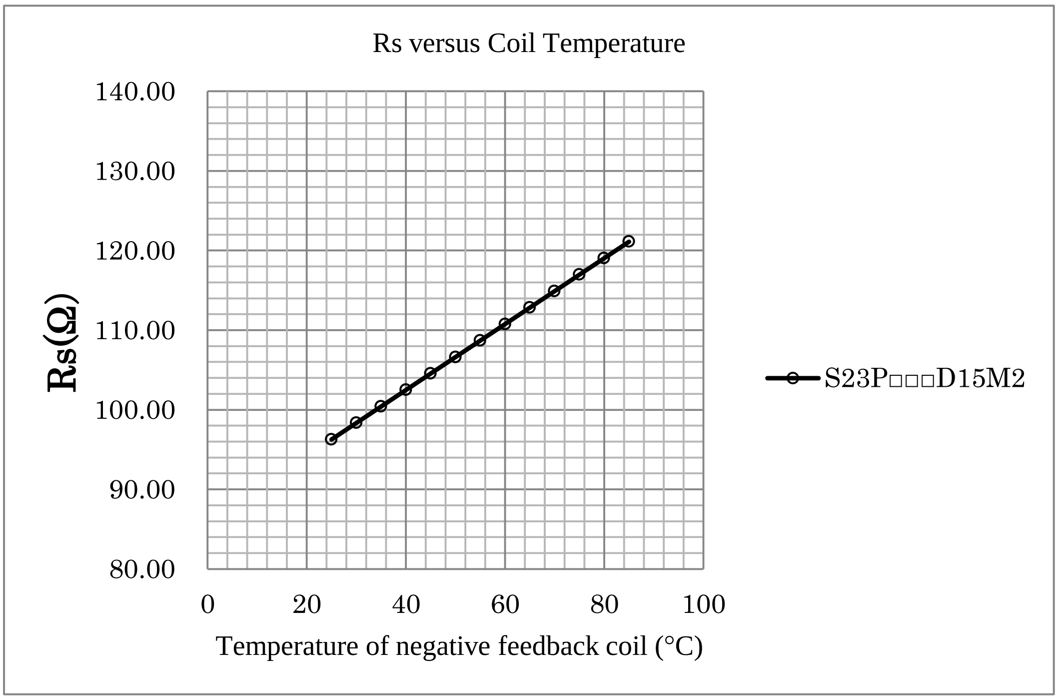

Fig. 7-2: S23P□□□D15M2 Temperature dependence of DC resistance of negative feedback coil

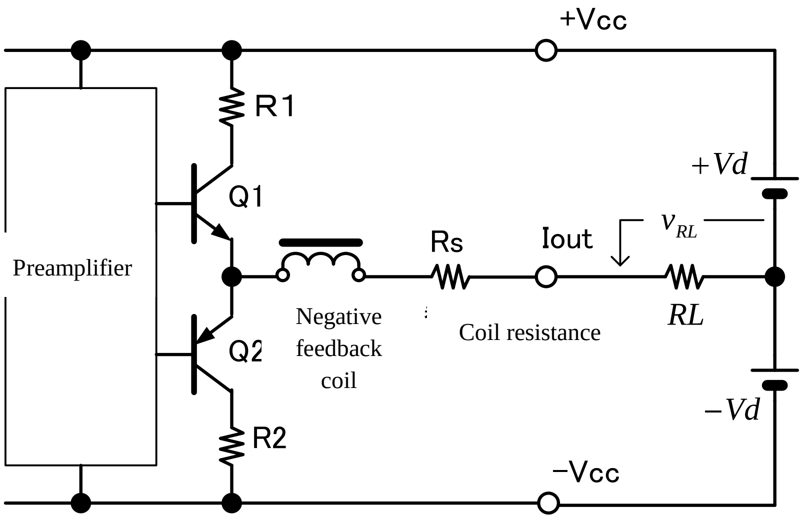

Fig. 6: Equivalent circuit of output circuit

The measuring resistance for S23P□□□D15M1 is shown in Fig. 8 and that for S23P□□□D15M2 is shown in Fig. 9.

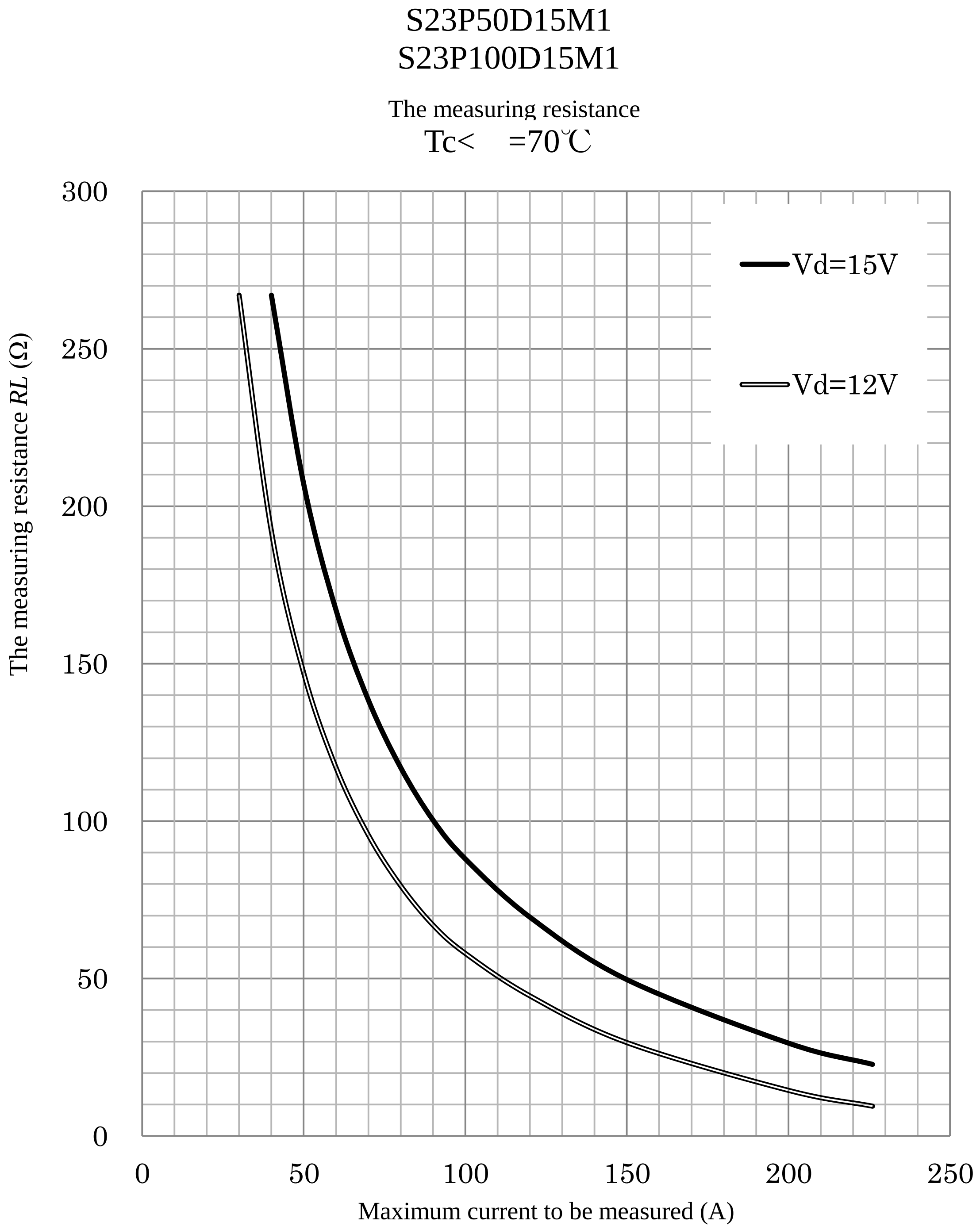

Fig. 8-1: The measuring resistance (when Tc = 70°C or lower)

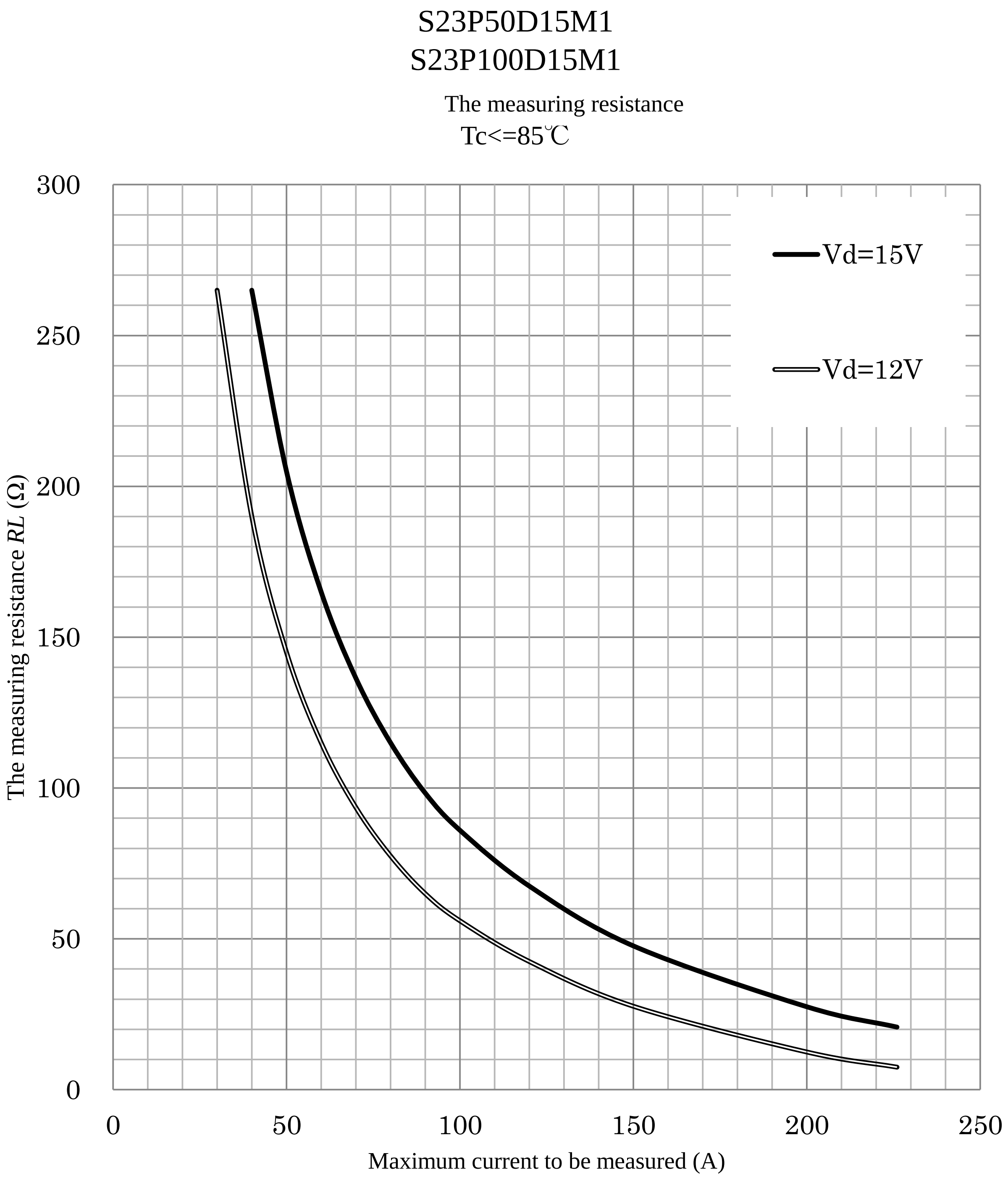

Fig. 8-2: The measuring resistance (when Tc = 85°C or lower)

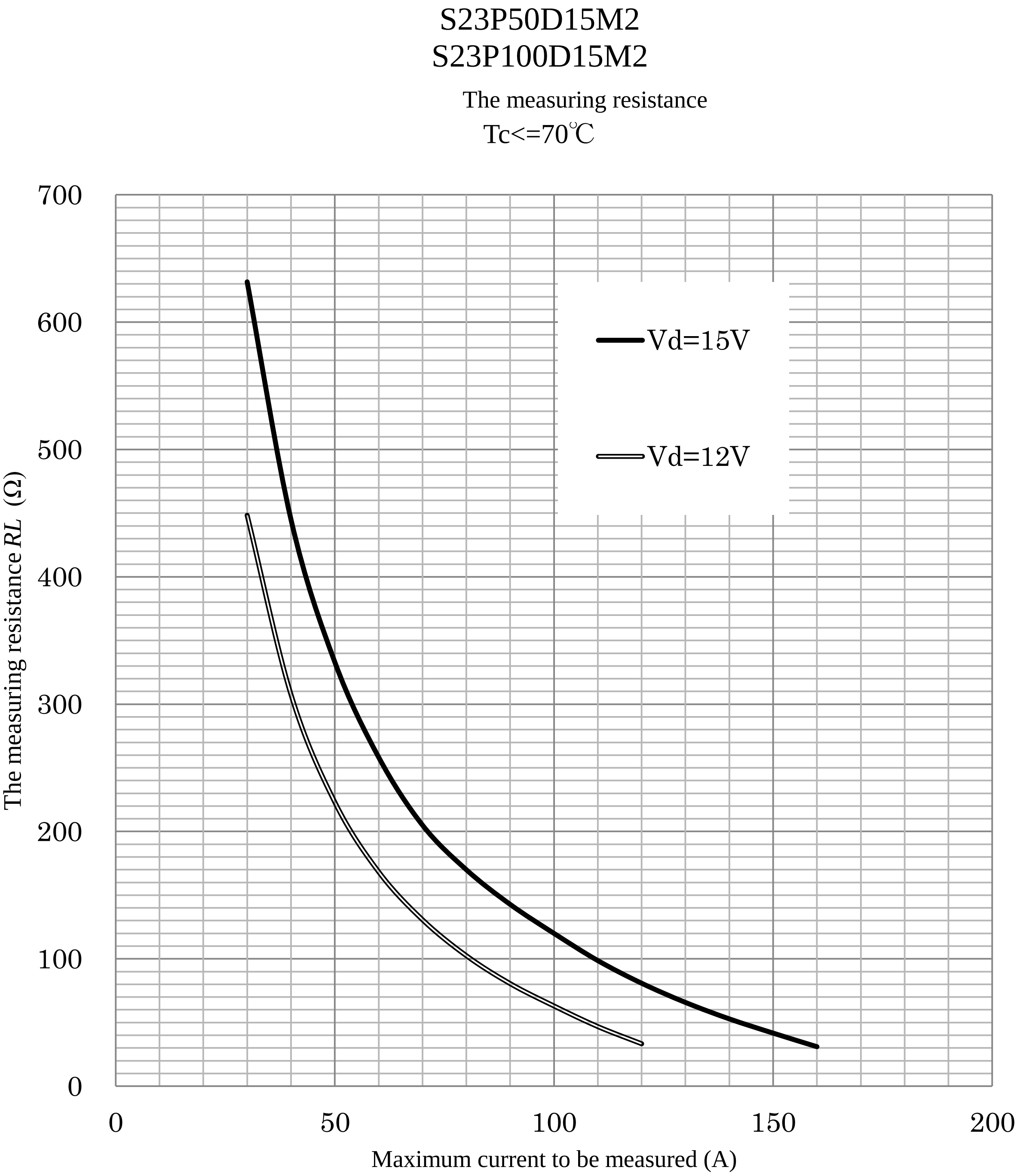

Fig. 9-1: The measuring resistance (when Tc = 70°C or lower)

S23P50D15M2
S23P100D15M2

The measuring resistance
Tc<=85℃

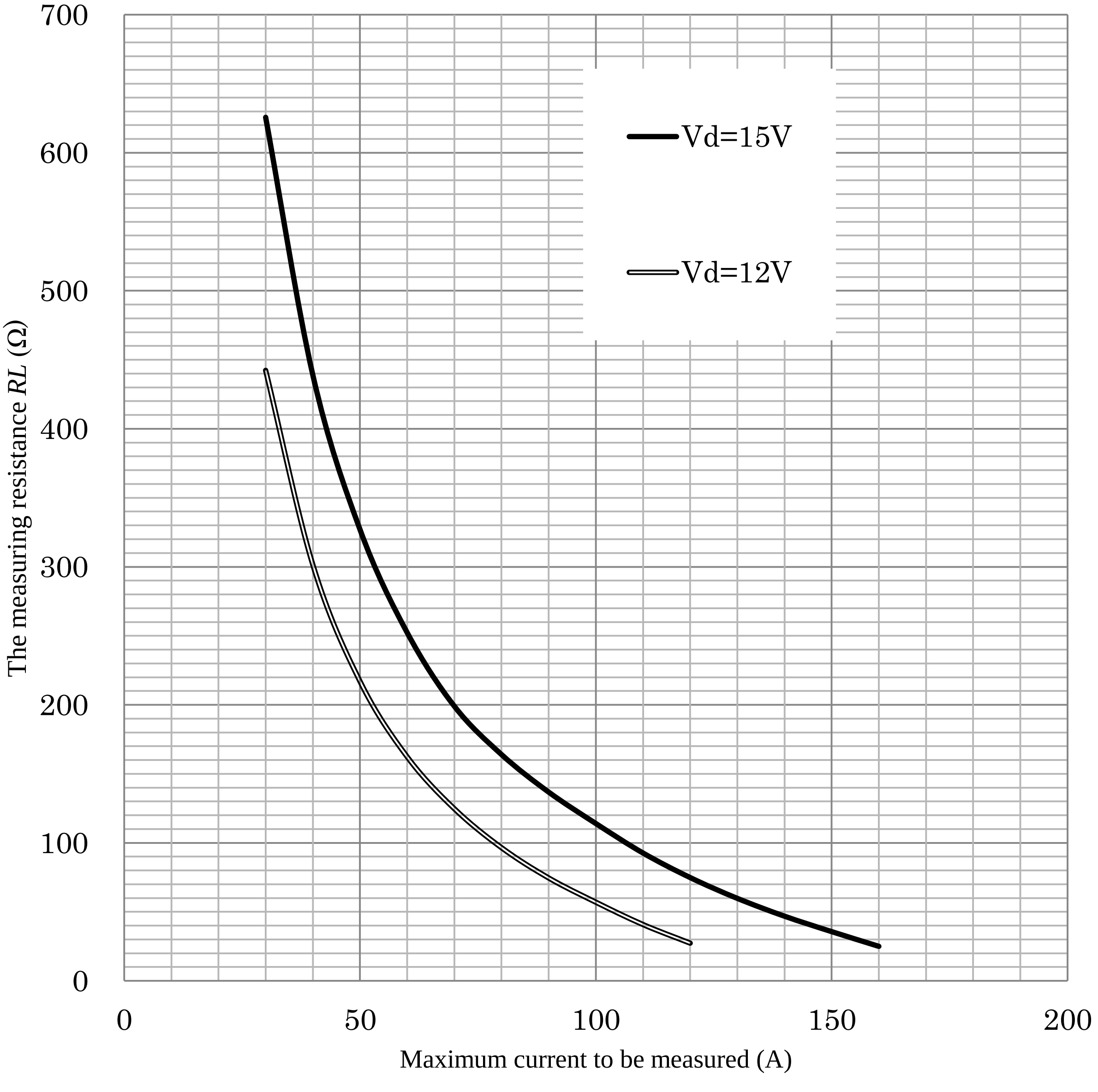

Fig. 9-2: The measuring resistance (when Tc = 85°C or lower)

Minimum measuring resistance RL

The output current passes through each component such as the negative feedback coil and the final stage transistors Q1 and Q2 of AMP. As a result, power loss P_{INT} accompanying the output current shown in Equation 8 occurs inside the sensor.

$$\begin{aligned} P_{INT} &= I_O\{Vd - RL \times I_O\} \\ &\approx Vd \times I_O - RL \times I_O{}^2 \end{aligned}$$

with output current I_O Equation 8

When the output current is constant, the internal loss P_{INT} associated with the output current increases as the power-supply voltage increases and the measurement resistance decreases.

For this series, the minimum value of the measuring resistance for the measurement of the rated current at the ambient temperature of 85°C is shown in Table 3. Note that the magnitude of the current to be measured continuously is limited to the rated current owing to constraints imposed by internal loss.

Table 3-1: S23P□□□M1: Minimum value of measuring resistance

Power-supply voltage	Allowable minimum value of measuring resistance (Ω)	Conditions
±12V	20Ω	Ambient temperature 85 °C
±15V	48Ω	The measured current is rated current (DC)

Table 3-2:S23P□□□M2: Minimum value of measuring resistance

Power-supply voltage	Allowable minimum value of measuring resistance (Ω)	Conditions
±12V	0Ω	Ambient temperature 85 °C
±15V	45Ω	When the measured current is rated current 100 A

* S23P50D15M2: The minimum measuring resistance is 0 Ω when measuring the rated current.

Example of selected measuring resistance RL

In the case of the S23P100D15M1,

Condition: Power-supply voltage Vd , plus side +15 V ±5%, minus side –15 V ±5%

Maximum current to be measured I_{MAX} : 150 A

Maximum ambient temperature Ta: 85°C

Selected result: The measuring resistance $RL = 43\Omega$ from the following (1) and (2).

(1) Maximum measured resistance

Because the detection voltage becomes higher and stronger against noise as the resistance increases, it is recommended to select as high a resistance as possible.

□First, the measuring resistance becomes 48 Ω from the solid curve of the power-supply voltage of 15 V in Fig. 8-2.

□Next, consider a 5% reduction in the power-supply voltage.

Equation 6 gives

$$RL = Vd \times \frac{1000}{I_{MAX}} - v_{RE} \times \frac{1000}{I_{MAX}} - R_S .$$

Because $RL = 48$,

$$48 = 15 \times \frac{1000}{150} - v_{RE} \times \frac{1000}{150} - R_S .$$

Let Δr be the influence of a 5% reduction in the power-supply voltage on the allowable maximum measuring resistance. Then,

$$48 - \Delta r = 14.25 \times \frac{1000}{150} - v_{RE} \times \frac{1000}{150} - R_S .$$

The subtraction of the left and right sides of both expressions gives

$$\Delta r = 0.75 \times \frac{1000}{150.} = 5\Omega .$$

Therefore, the measuring resistance becomes

$$RL = 48\Omega - 5\Omega = 43\Omega .$$

Offset current

The offset current Vof is the output current when the measured current is 0 A. Although the standard value of the offset current is 0 mA, in the case of the S23P100D15M1, it has a deviation of ±0.3 mA. When measuring the rated current of 100 A, the deviation may cause error within ±0.3%. The influence of the offset current when measuring a current of 200 A decreases and the error can be compressed to within ±0.15%. On the other hand, when half of the rated current is measured, the output current is 50 mA, and the error of the offset current ±0.3 mA increases to a value within ±0.6%.

In order to minimize the error, it is necessary to select a sensor with a rated current suitable for the measured current.

If a sensor with a rated current higher than necessary is selected, the measurement error due to the offset current increases.

Output linearity

The output linearity is the difference between a straight line approximating the input/output characteristics of the sensor and the sensor output, and the ratio (%) of the difference to the absolute value is defined as output linearity ε_L. The formula for calculating the output linearity of the measurement point J in Fig. 10 is

$$\varepsilon_L\big|_J = \frac{\Delta_J}{I_O} \times 100 \quad (\%), \qquad \text{Equation 9}$$

where

I_O : Rated output current (V),

Δ_J : Difference of sensor output current at measured current I_J from approximate linear line (V),

I_f : Rated current (A),

I_J : Measured current at measurement point J (A).

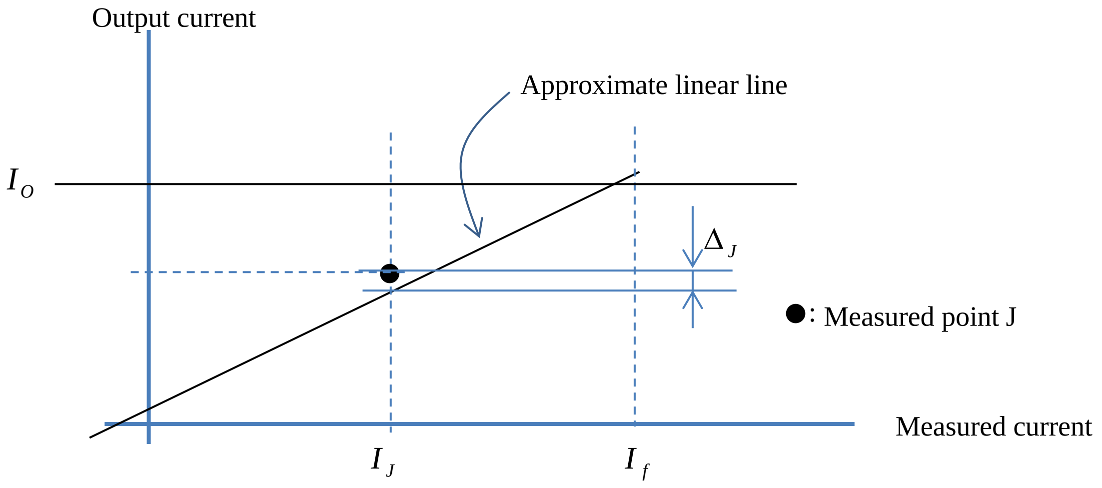

Fig.10: Output linearity

Hysteresis error

Hysteresis error is caused by the hysteresis characteristic of the core. When the current to be measured is increased from 0 A to the rated current and then returned to 0 A, a maximum difference of ±0.3 mA with respect to the original value arises in the output current. This difference is called hysteresis error.

When the current to be measured increases or decreases during operation, this hysteresis error occurs. The amount of error is related to the amount of change of the current to be measured. The hysteresis error becomes larger when the width of the change increases.

<u>Overall detection accuracy</u> $\Delta_{TOTAL}\big|_{t1\leftrightarrow t2}^{Iin}$

For the measured current of the sensor, Iin, when the ambient temperature is between $t1$ (°C) and $t2$ (°C), the overall detection accuracy of the sensor is determined by the error given by Equation 10 where the ambient temperature is 25°C.

$$\Delta_{TOTAL}\big|_{t1\leftarrow t2}^{Iin} = X_G + \{TcI_O \times \Delta T\} + \left(\frac{\Delta Iof + TcIof\big|_{t1\leftrightarrow t2} + I_{OH}}{I_{OUT}}\right) \times 100, \qquad \text{Equation 10}$$

where

$\Delta T = t1 - 25$ or $\Delta T = t2 - 25$,

$\Delta_{TOTAL}\big|_{t1\leftrightarrow t2}^{Iin}$: Overall detection accuracy at ambient temperature between $t1$°C and $t2$°C for the current to be measured, based on the ambient temperature of 25°C (%),

I_{OUT} : Output current corresponding to measured current Iin (A),

ΔIo : Deviation of offset current at 25°C (A), Table 4 No. 2,

I_{OH} : Hysteresis error (A), Table 4 No. 4,

TcI : Temperature coefficient of output current (%/°C), Table 4 No. 5,

$TcIof\big|_{t1\leftrightarrow t2}$: Maximum variation of offset current deviation in the temperature range from $t1$°C to $t2$°C (A) Table 4 No. 6.

Table 4: S23P Series: List of deviations determining the accuracy of the output current (Unless otherwise specified) Ta = 25°C

No	Item	Symbol	Standard value (max)		Remarks
			S23P□□□D15M1	S23P□□□D15M1	
1	Output current accuracy	X_G	Within ±0.25%	Within ±0.25%	
2	Deviation of offset current	ΔIof	Within ±0.0003 A	Within ±0.00015 A	
3	Output linearity	ε_L	Within ±0.15%	Within ±0.15%	
4	Hysteresis error	I_{OH}	Within ±0.0003 A	Within ±0.0003 A	
5	Temperature coefficient of output current	$TcIo$	±0.01%/°C	±0.01%/°C	Excluding fluctuation of offset current
6	Temperature coefficient of offset current	$TcIof\big|_{-40\leftrightarrow+85}$	±0.8mA max (-25°C ~ 85°C)	±0.5mA (-25°C ~ 85°C)	

(1) Overall detection accuracy for measurement of rated current

The overall detection accuracy, when measuring the current to be measured I_f , is given in Table 5 using items in Table 4 and Equation 10.

Table 5: Overall detection accuracy for measurement of rated current

Ambient temperature	Accuracy Δ_{TOTAL}			
	S23P50D15M1	S23P100D15M1	S23P50D15M2	S23P100D15M2
25°C	±1.5%	±0.9%	±2.1%	±1.2%
-25°C	±3.6%	±2.2%	±4.6%	±2.7%
+85°C	±3.7%	±2.3%	±4.7%	±2.8%

(2) Overall detection accuracy for measurement of half of rated current $\frac{I_f}{2}$

The overall detection accuracy, when measuring the current to be measured $\frac{I_f}{2}$, is given in Table 6 using items in Table 4 and Equation 10.

Table 6: Overall detection accuracy for measuring of half of rated current

Ambient temperature	Accuracy Δ_{TOTAL}			
	S23P50D15M1	S23P100D15M1	S23P50D15M2	S23P100D15M2
25°C	±2.7%	±1.5%	±3.9%	±2.1%
-25°C	±6.4%	±3.6%	±8.4%	±4.6%
+85°C	±6.5%	±3.7%	±8.5%	±4.7%

Power supply

The plus or minus power supply provides an output current in addition to that consumed by the sensor. Therefore, sufficient capacity of the power supply is necessary to take care of all of them.

When operating as a current transformer, the output current is supplied from the negative feedback coil built into the sensor and passes through each of the plus and minus power supplies. Therefore, the output capacitor of the power supply must be 10 μF or more. Insert a ceramic capacitor of about 10 μF between the +Vcc terminal and GND and between the –Vcc terminal and GND, if necessary.