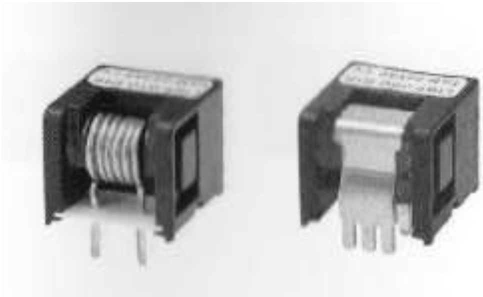
L18P, SL18P Series

Application Manual



■ Overview

The L18P and SL18P series are "built-in coil, built-in bus bar, and onboard" current sensor of an open-loop type. This series has variations in properties such as the power-supply voltage, etc. as shown in Table 1.

Table 1: Variations of L18P, SL18P

Variation name	Power-supply voltage	Rated current	Rated output voltage	Offset voltage Vof	Remarks
L18P□□□D15-OP	±12V ~ ±15V	3 ~ 60A	4.0V	Rated current 3A~30A : 0 ± 0.04V Rated current 40A~60A : 0±0.05V	
SL18P□□□D15					
L18P□□□D15	±15V				
L18P□□□S05	+5V		Vof+1.5V	Vcc/2±0.035V	
L18P□□□S05R			Vof+0.625V	2.5V±0.035V	
L18P□□□S12	+12V		Vof+1.5V		

(Note 1) Numbers in the positions marked by □□□ under the column "Variation name" indicate the rated current value.

Example: L18P003D15-OP has a power-supply voltage of ±15V and rated current of 3A.

(Note 2) Vof under the column "Rated output voltage" indicates the offset voltage.

(Note 3) Vcc under the column "Offset voltage" refers to the power-supply voltage applied to the current sensor.

■ Characteristics

- Compact and with variations of three types of the power-supply voltage.
- Built-in coil type or the built-in bus bar flow of the current to be measured.
- Open-loop-type circuit configuration.
- Onboard type
- Wide range of rated current, 3A ~ 60A.

- The reference point of the output voltage has the variations shown in Table 1.
- Simple structure

Uses

- General-purpose inverter
- Motor drive
- DCDC converter
- Generator
- Detection of low-frequency alternating current

■ Format

Variation name　L18P□□□D15-OP

L18P 003 D 15-OP

Suffix

Power-supply voltage 15: 15V

Power-supply type D: Dual power supply

Rated current 003: 3A
005: 5A
010: 10A
015: 15A
020: 20A
025: 25A
030: 30A
040: 40A
050: 50A
060: 60A

Series name　L18P

Variation name　SL18P□□□D15

SL18P 003 D 15

- Power-supply voltage 15: 15V
- Power-supply type D: Dual power supply
- Rated current 003: 3A
  - 005: 5A
  - 010: 10A
  - 015: 15A
  - 020: 20A
  - 025: 25A
  - 030: 30A
  - 040: 40A
  - 050: 50A
  - 060: 60A
- Series name　SL18P

Variation name L18P□□□D15

L18P 003 D 15

Power-supply voltage: 15: 15V

Power-supply type D: Dual power supply

Rated current
003: 3A
005: 5A
010: 10A
015: 15A
020: 20A
025: 25A
030: 30A
040: 40A
050: 50A
060: 60A

Series name L18P

Variation name　L18P□□□S05

L18P 003 S 05

Power-supply voltage 05: 5V

Power-supply type S: Single power supply

Rated current 003: 3A
005: 5A
010: 10A
015: 15A
020: 20A
025: 25A
030: 30A
040: 40A
050: 50A
060: 60A

Series name　L18P

Variation name　L18P□□□S05R

L18P 003 S 05 R

- Suffix: R
- Power-supply voltage 05: 5V
- Power-supply type S: Single power supply
- Rated current 003: 3A
  - 005: 5A
  - 010: 10A
  - 015: 15A
  - 020: 20A
  - 025: 25A
  - 030: 30A
  - 040: 40A
  - 050: 50A
  - 060: 60A
- Series name　L18P

Variation name　L18P□□□S12

L18P 003 S 12

Power-supply voltage 12: 12V

Power-supply type S: Single power supply

Rated current 003: 3A
005: 5A
010: 10A
015: 15A
020: 20A
025: 25A
030: 30A
040: 40A
050: 50A
060: 60A

Series name　L18P

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

L18P□□□D15-OP

SL18P□□□D15

L18P□□□D15

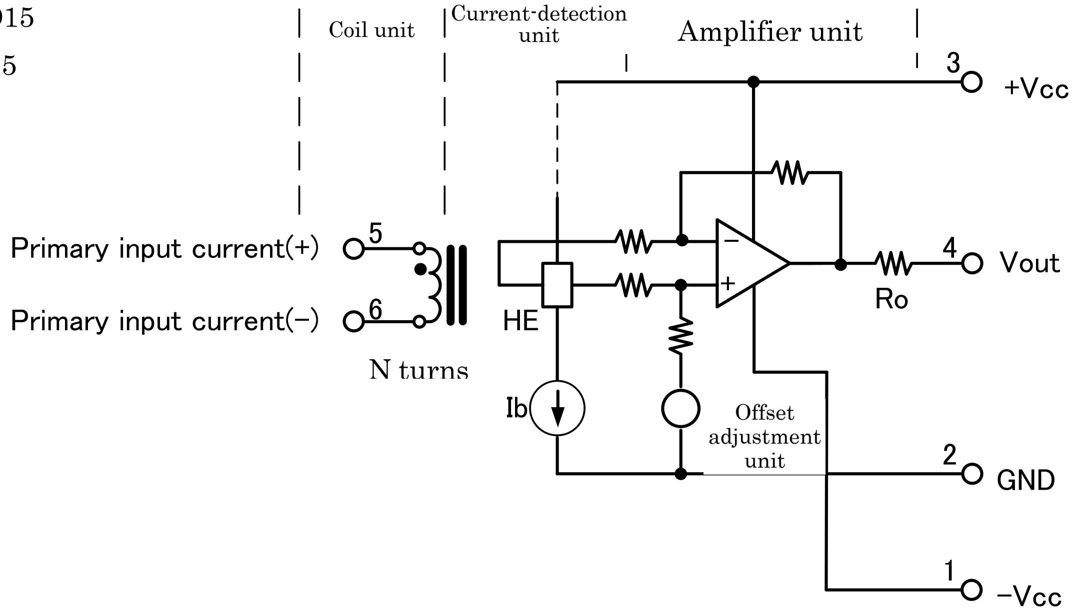


Fig. 1: L18P□□□D15-OP SL18P□□□D15 L18P□□□D15
Internal block diagram

Table 2: L18P□□□D15-OP SL18P□□□D15 L18P□□□D15 Description of terminals

Terminal number	Terminal name	Description	Remarks
1	－Vcc	Negative voltage terminal of power-supply voltage Apply –12V or –15V.	
2	GND	GND terminal GND terminal for power supply	
3	＋Vcc	Positive voltage terminal of power-supply voltage Apply +12V or +15V.	
4	Vout	Output voltage terminal	See *
5	Primary Input current (+)	The plus terminal of the primary current (measured current) When the primary current flows through terminal (5) ⇒ (6), Vout outputs positive voltage.	
6	Primary Input current (–)	The minus terminal of the primary current (measured current)	

* The standard value of output voltage is

$$Vout = G \times I + Vof \quad ; \; G \equiv \frac{4.0V}{If} \quad If: \text{Rated current} \quad Vof: \text{Offset voltage}$$

The offset voltage is the reference voltage of the output voltage and becomes 0V in the case of dual power supply.

L18P□□□D15-OP SL18P□□□D15 L18P□□□D15 Description of operation

Current-detection unit

The current to be measured (primary input current) is passed through the built-in coil or bus bar. The generated magnetic flux is focused by the core and applied to the magnetic-detection element (Hall element, HE).

The generated magnetic flux is proportional to the product (N×I) of the number of windings N of the built-in coil and the measured current I. The magnetic-detection element outputs a voltage proportional to the magnetic flux, i.e., provides an output voltage proportional to the current to the next-stage amplifier.

The current-detection unit outputs the result without saturation up to current three times as large as the rated current. However, the linearity is guaranteed only up to the rated current. (See also "amplifier unit" for the saturation current.)

Amplifier unit

This block amplifies the output voltage of the magnetic-detection element. Because the output of the magnetic-detection element is of a differential type, the amplifier unit adopts the configuration of a differential amplifier. It outputs the differential output of the magnetic-detection element as the voltage based on the GND. It adopts a circuit configuration that is negligibly affected by fluctuations in the power-supply voltage, and other in-phase signals and can ensure accurate output. The amplifier unit has the maximum output voltage limited by the power-supply voltage. Therefore, the amplifier unit may be saturated even when the current-detection unit of the preceding stage is not. When using the power-supply voltage at ±15V, it can be used without saturation up to three times the rated current. When using the power-supply voltage at ±12 V, the range up to 2.5 times the rated current can be used without saturation.

The voltage gain of the amplifier unit limits the gain at high frequency in order to eliminate noises generated by extraneous noise and high-speed operation of the current to be measured. If the high-speed operation of the current to be measured exceeds the limit determined by factors such as the structure of this product, component performance, etc., the delay of output voltage, for example, can occur. It is recommended to check the operation with an actual waveform.

Because the output voltage of the magnetic-detection element is determined by factors such as the rated current value and the number of windings of the built-in coil, the gain in each product is precisely adjusted in the factory.

Offset adjustment unit

The offset voltage serves as a reference of the output voltage and is given by the output voltage when the current to be measured is 0A. The standard value of the offset voltage is 0V in the case of the current sensor with the dual power supply. Possible deviation in the plus or minus direction owing to an initial deviation and temperature variations should be considered. (Please refer to the specifications table.)

The main origin of the deviation of the offset voltage from the standard value lies in the fact that the Hall element, HE, which is a magnetic sensing element, has an offset voltage. The offset voltage of the Hall element refers to the voltage output from the Hall element, which is minute but nonzero even in the absence of applied magnetic flux. A certain deviation of the offset voltage can arise in the amplifier unit instead of the Hall element. The offset adjustment unit has already been controlled in the factory in such a way that these offsets are globally canceled and fall within a predetermined range of deviation.

Coil unit

In the built-in coil, the number of windings is increased in accordance with the rated current in such a way that accurate measurement can be made even for small current.

For the coil, electric wires of ϕ0.6 ~ ϕ1.6 are used for products with rated current of 3A ~ 30A and the bus bar type (corresponding to one turn) is used for products with rated current of 40A or more.

This unit generates heat due to copper loss (loss due to the coil or bus bar resistance) and iron loss (loss of core) in the presence of current to be measured. Each loss varies depending on conditions such as magnitude, frequency, waveform, etc., of the current to be measured. The loss increases with the effective current value or with the dominant frequency component of the current to be measured.

In the case of direct current, continuous energization operation is possible up to the rated current value. For high-frequency driving, iron loss becomes serious when the frequency of the current to be measured exceeds 1 kHz. When the current contains high-frequency components other than those of the fundamental wave, the iron loss further increases. Therefore, confirmation using an actual current is necessary.

■Block diagram (+5V Single power-supply type)

L18P□□□S05

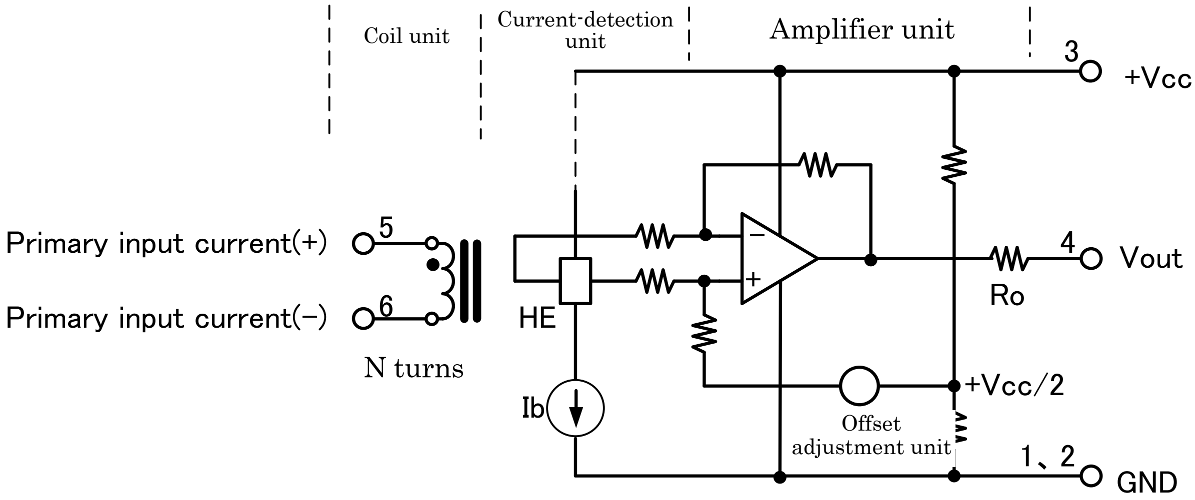


Fig. 2: L18P□□□S05 Internal block diagram

Table 3: L18P□□□S05 Description of terminals

Terminal number	Terminal name	Description	Remarks
1, 2	GND	GND terminal. Connect the minus side of the + 5V power supply.	
3	+Vcc	Positive voltage terminal of power-supply voltage. Apply +5V.	
4	Vout	Output voltage terminal. Output on the basis of Vcc/2.	See *
5	Primary Input current (+)	The plus terminal of the primary current (measured current) When the primary current flows through terminal (5) ⇒(6), Vout outputs positive voltage.	
6	Primary Input current (−)	The minus terminal of the primary current (measured current)	

* The standard value of output voltage:

$Vout = G \times I + Vof$; $G \equiv \frac{1.5V}{If}$ If : Rated current Vof : Offset voltage

The offset voltage is the reference voltage of the output voltage and becomes (Vcc/2)typ in proportion to supply voltage Vcc.

■Block diagram (+5V Single power-supply type)

L18P□□□S05R

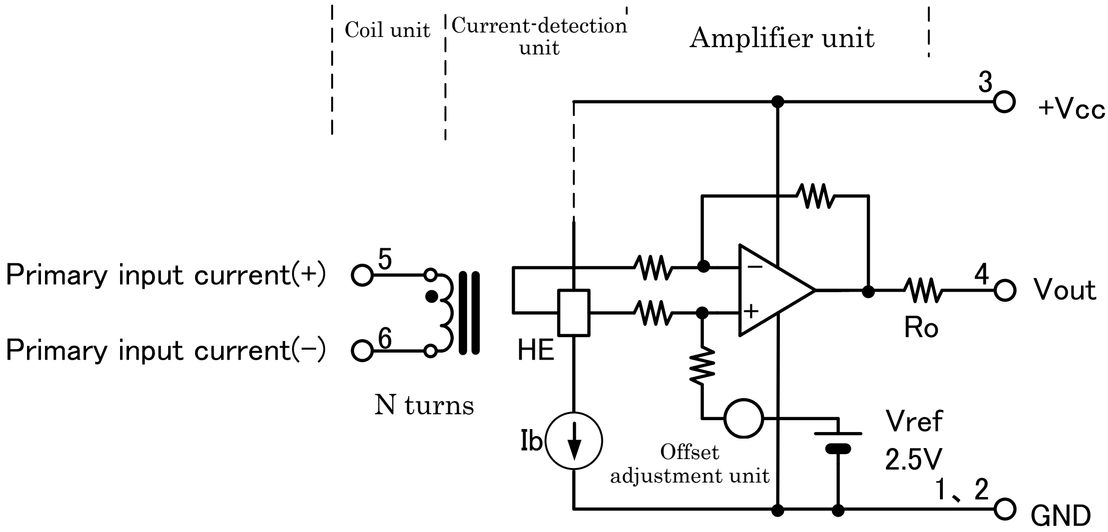


Fig. 3: L18P□□□S05R Internal block diagram

Table 4: L18P□□□S05R Description of terminals

Terminal number	Terminal name	Description	Remarks
1, 2	GND	GND terminal. Connect the minus side of the + 5V power supply.	
3	＋Vcc	Positive voltage terminal of power-supply voltage. Apply +5V.	
4	Vout	Output voltage terminal. Output on the basis of 2.50V.	See *
5	Primary Input current (＋)	The plus terminal of the primary current (measured current) When the primary current flows through terminal (5) ⇒(6), Vout outputs positive voltage.	
6	Primary Input current (－)	The minus terminal of the primary current (measured current)	

* The standard value of output voltage:

$Vout = G \times I + Vof$; $G \equiv \frac{0.625V}{If}$ If :Rated current Vof : Offset voltage

The offset voltage is the reference for the output voltage and is 2.5Vtyp.

L18P□□□S05　L18P□□□S05R　Description of operation

Current-detection unit

The current to be measured (primary input current) is passed through the built-in coil. The generated magnetic flux is focused by the core and applied to the magnetic-detection element (Hall element, HE).

The generated magnetic flux is proportional to the product (N×I) of the number of windings N of the built-in coil and the measured current I. The magnetic-detection element outputs a voltage proportional to the magnetic flux, i.e., it provides an output voltage proportional to the current to the next-stage amplifier. The maximum output voltage of the amplifier unit is limited by the power-supply voltage. Therefore, the amplifier unit may be saturated even when the current-detection unit of the preceding stage is not.

The current detector outputs up to the current value without saturation are given in Table 5 below. However, the linearity is guaranteed up to the rated current value.

Table 5: L18P□□□S05　L18P□□□S05R　Saturation current

Model number	Saturation current	Remarks
L18P□□□S05	1.5 times rated current	
L18P□□□S05R	3 times rated current	

Amplifier unit

This block amplifies the output voltage of the magnetic-detection element. Because the output of the magnetic-detection element is of a differential type, the amplifier unit adopts the configuration of a differential amplifier. It outputs the differential output of the magnetic-detection element as an output voltage based on Vcc/2 or 2.5 V. Table 6 shows the model number of the current sensor and the corresponding offset voltage (reference voltage).

Table 6: L18P□□□S05　L18P□□□S05R　Reference voltage

Model number	Offset voltage (reference voltage)	Remarks
L18P□□□S05	Proportional to supply voltage Vcc: Vcc/2	
L18P□□□S05R	Independent of supply voltage: 2.5V	

It adopts a circuit configuration that is negligibly affected by fluctuations in power-supply voltage and other in-phase signals and can therefore ensure accurate output.

The voltage gain of the amplifier unit limits the gain at high frequency in order to eliminate noise such as extraneous noise and noise generated by high-speed operation of the current to be measured. If the high-speed operation of the current to be measured exceeds the limit determined by factors such as the structure of this product and component performance, etc., problems such as the delay of output voltage, etc., can occur. It is recommended to confirm the operation with an actual waveform.

The output voltage of the magnetic-detection element is determined by factors such as the rated current value and the number of windings of the built-in coil, the gain in each product is precisely adjusted in the factory.

Offset adjustment unit

The offset voltage serves as a reference of the output voltage and is given by the output voltage when the current to be measured is 0A. The standard value of the offset voltage for a single power-supply current sensor is the built-in source of the reference voltage (shown in Table 6). Possible deviation in the plus or minus direction owing to an initial deviation and temperature variations should be considered. (Please refer to the specifications table.)

The main origin of the deviation of the offset voltage from the standard value lies in the fact that the Hall element, HE, which is a magnetic sensing element, has an offset voltage. The offset voltage of the Hall element refers to the voltage output from the Hall element, which is minute but nonzero even in the absence of applied magnetic flux. A certain deviation of the offset voltage can arise in the amplifier unit instead of the Hall element. The offset adjustment unit has already been controlled in the factory in such a way that these offsets are globally canceled and fall within a predetermined range of deviation.

Coil unit

In the built-in coil, the number of windings is increased in accordance with the rated current in such a way that accurate measurement can be made even for small current.

For the coil, electric wires of $\phi 0.6 \sim \phi 1.6$ are used for products with rated current of 3A ~ 30A, and the bus bar (corresponding to one turn) is used for products with rated current of 40A or more.

This unit generates heat due to copper loss (loss due to the coil or bus bar resistance) and iron loss (loss of core) in the presence of current to be measured. Each loss varies depending on conditions such as magnitude, frequency, waveform, etc., of the current to be measured. The loss increases with the effective current value or with the dominant frequency component of the current to be measured.

In the case of direct current, continuous energization operation is possible up to the rated current value. For high-frequency driving, iron loss becomes serious when the frequency of the current to be measured exceeds 1 kHz. When the current contains high-frequency components other than those of the fundamental wave, the iron loss further increases. Therefore, confirmation using an actual current is necessary.

■Block diagram (+12V Single power-supply type)

L18P□□□S12

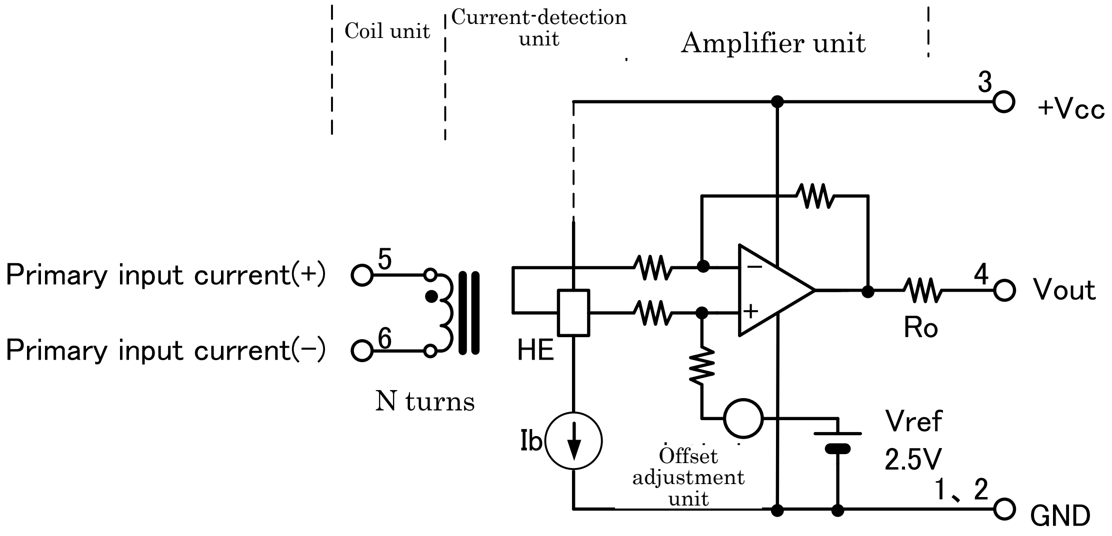


Fig. 4: L18P□□□S12　　　Internal block diagram

Table 7: L18P□□□S12　　Description of terminals

Terminal number	Terminal name	Description	Remarks
1, 2	GND	GND terminal. Connect the minus side of the + 12V power supply.	
3	＋Vcc	Positive voltage terminal of power-supply voltage. Apply +12V.	
4	Vout	Output voltage terminal. Output on the basis of 2.50V.	See *
5	Primary Input current (＋)	The plus terminal of the primary current (measured current) When the primary current flows through terminal (5) ⇒(6), Vout outputs positive voltage.	
6	Primary Input current (－)	The minus terminal of the primary current (measured current)	

* The standard value of output voltage:

$Vout = G \times I + Vof$; $G \equiv \frac{1.5V}{If}$ 　If :Rated current　Vof : Offset voltage

The offset voltage is the reference for the output voltage and is 2.5Vtyp.

L18P□□□S12 Description of operation

Current-detection unit

The current to be measured (primary input current) is passed through the built-in coil or bus bar. The generated magnetic flux is focused by the core and applied to the magnetic-detection element (Hall element, HE).

The generated magnetic flux is proportional to the product (N×I) of the number of windings N of the built-in coil and the measured current I. The magnetic-detection element outputs a voltage proportional to the magnetic flux, i.e., provides an output voltage proportional to the current to the next-stage amplifier.

The current-detection unit outputs the result without saturation up to current 1.25 times as large as the rated current. However, the linearity is guaranteed only up to the rated current.

Amplifier unit

This block amplifies the output voltage of the magnetic-detection element. Because the output of the magnetic-detection element is of a differential type, the amplifier unit adopts the configuration of a differential amplifier. It outputs the differential output of the magnetic-detection element as the voltage based on the 2.5V. Thereby it adopts a circuit configuration that is negligibly affected by fluctuations in the power-supply voltage, and other in-phase signals and can ensure accurate output.

The voltage gain of the amplifier unit limits the gain at high frequency in order to eliminate noises generated by extraneous noise and high-speed operation of the current to be measured. If the high-speed operation of the current to be measured exceeds the limit determined by factors such as the structure of this product, component performance, etc., the delay of output voltage, for example, can occur. It is recommended to check the operation with an actual waveform.

Because the output voltage of the magnetic-detection element is determined by factors such as the rated current value and the number of windings of the built-in coil, the gain in each product is precisely adjusted in the factory.

Offset adjustment unit

The offset voltage serves as a reference of the output voltage and is given by the output voltage when the current to be measured is 0A. The standard value of the offset voltage for a single power-supply current sensor is the built-in source of the reference voltage 2.5V. Possible deviation in the plus or minus direction owing to an initial deviation and temperature variations should be considered. (Please refer to the specifications table.)

The main origin of the deviation of the offset voltage from the standard value lies in the fact that the Hall element, HE, which is a magnetic sensing element, has an offset voltage. The offset voltage of the Hall element refers to the voltage output from the Hall element, which is minute but nonzero even in the absence of applied magnetic flux. A certain deviation of the offset voltage can arise in the amplifier unit instead of the Hall element. The offset adjustment unit has already been controlled in the factory in such a way that these offsets are globally canceled and fall within a predetermined range of deviation.

Coil unit

In the built-in coil, the number of windings is increased in accordance with the rated current in such a way that accurate measurement can be made even for small current.

For the coil, electric wires of ϕ0.6 ~ ϕ1.6 are used for products with rated current of 3A ~ 30A, and the bus bar (corresponding to one turn) is used for products with rated current of 40A or more.

This unit generates heat due to copper loss (loss due to the coil or bus bar resistance) and iron loss (loss of core) in the presence of current to be measured. Each loss varies depending on conditions such as magnitude, frequency, waveform, etc., of the current to be measured. The loss increases with the effective current value or with the dominant frequency component of the current to be measured.

In the case of direct current, continuous energization operation is possible up to the rated current value. For high-frequency driving, iron loss becomes serious when the frequency of the current to be measured exceeds 1 kHz. When the current contains high-frequency components other than those of the fundamental wave, the iron loss further increases. Therefore, confirmation using an actual current is necessary.

■Standard circuit

L18P□□□D15-OP

SL18P□□□D15

L18P□□□D15

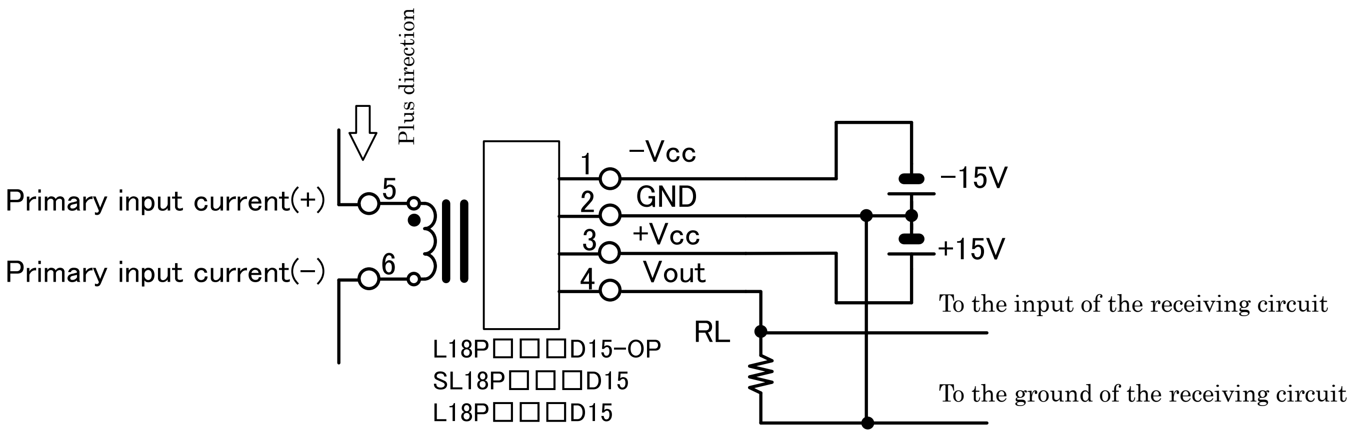


Fig. 5: L18P□□□D15-OP SL18P□□□D15 L18P□□□D15
Standard circuit

□Description of Fig. 5

Basic operation

This current sensor converts measured current into a voltage. The output voltage Vout (4) in Fig. 5 is output on the basis of the GND potential. When the current to be measured is 0, Vout (4) = 0V. When the current to be measured is in the plus direction ((5) ⇒ (6)), Vout (4) becomes + (voltage converted from the measured current). When the current to be measured is in the minus direction ((6) ⇒ (5)), Vout (4) becomes – (voltage converted from the measured current).

The standard value of the output voltage $Vout$ corresponding to the current Iin to be measured is expressed by the following equation.

$Vout = G \times Iin + Vof$; $G \equiv \frac{4.0V}{If}$ If : Rated current Vof: Offset voltage Standard value is 0V

RL = 10 kΩ in Fig. 5 is the equivalent resistance of the receiving circuit of the current sensor output Vout (4). The load resistance between the Vout terminal (4) and the GND potential (2) is a standard one of 10 kΩ.

Effect of offset voltage

The offset voltage Vof is 0 ± 40mV at maximum under the condition of Ta = 25°C. When measuring the rated current, an error within ±1% occurs. The influence of the offset voltage decreases to 1/3 for measured current three times as large as the rated current and the error can be compressed to within ±0.34%. On the other hand, when measuring a current of a half the rated current, the output voltage is 2.0V and the error of the offset voltage ±40mV is within ±2%.

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 higher rated current than necessary is selected, the measurement error due to the offset voltage increases. In selecting the rated current, it is necessary to consider the capability of covering the peak value of the measured current, heat generated by the coil and the core, etc., as well as the above conditions.

■Standard circuit

L18P□□□S05

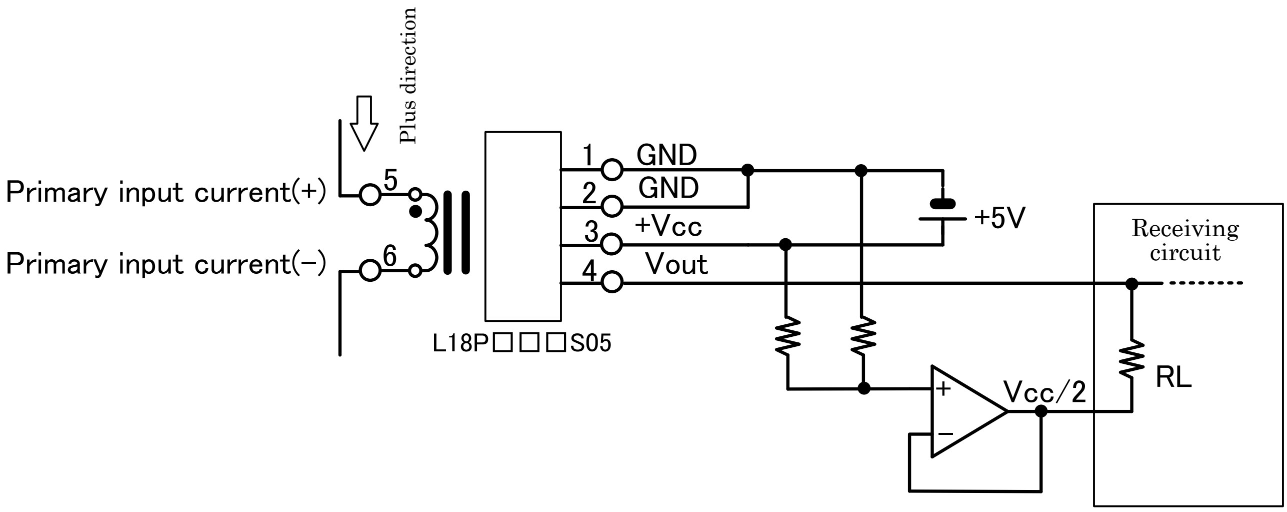


Fig. 6: L18P□□□S05 Standard circuit

□Description of Fig. 6

Basic operation

This current sensor converts measured current into a voltage. The output voltage Vout (4) in Fig. 6 is output on the basis of the Vcc/2 potential. When the current to be measured is 0, Vout (4) = Vcc/2. When the current to be measured is in the plus direction ((5) ⇒ (6)), Vout (4) becomes (Vcc/2) + (voltage converted from the measured current). When the current to be measured is in the minus direction ((6)⇒ (5)), Vout (4) becomes (Vcc/2) – (voltage converted from the measured current).

The standard value of the output voltage *Vout* corresponding to the current *Iin* to be measured is expressed by the following equation.

$Vout = G \times Iin + Vof$; $G \equiv \frac{1.5V}{If}$ If : Rated current Vo : Offset voltage Standard value is $\frac{Vc}{2}$

RL = 10 kΩ in Fig. 6 is the equivalent resistance of the receiving circuit of the current sensor output Vout (4). Connect between Vout terminal (4) and reference potential (Vcc/2).

Effect of offset voltage

The offset voltage Vof is (Vcc/2) ± 35mV at maximum under the condition of Ta = 25°C. An error within ±2.33% occurs when the rated current is measured. The effect of the offset voltage when measuring a current 1.5 times the rated current decreases to ±1.56%. When a current of half the rated current is measured, the output voltage is 0.75V and the error of the offset voltage of ±35mV is within ±4.67%.

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 higher rated current than necessary is selected, the measurement error due to the offset voltage increases. In selecting the rated current, it is necessary to consider the capability of covering the peak value of the measured current, heat generated by the coil and the core, etc., as well as the above conditions.

■Standard Circuit

L18P□□□S05R

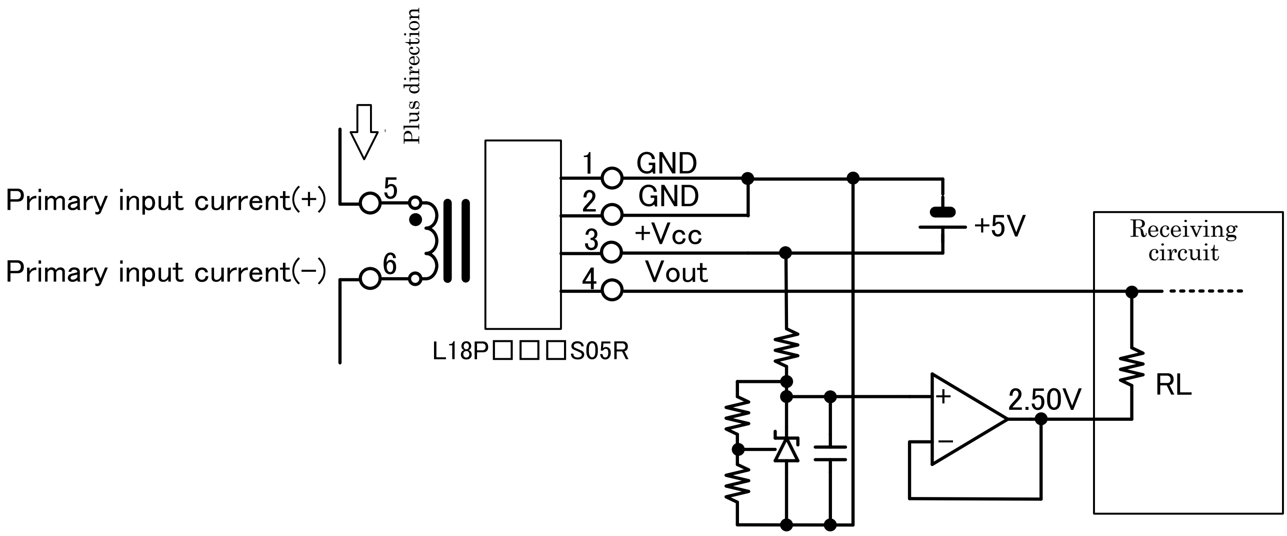


Fig. 7: L18P□□□S05R Standard circuit

☐Description of Fig. 7

Basic operation

This current sensor converts measured current into a voltage. The output voltage Vout (4) in Fig. 7 is output on the basis of the 2.50V potential. When the current to be measured is 0, Vout (4) = 2.50V. When the current to be measured is in the plus direction ((5) ⇒ (6)), Vout (4) becomes 2.50V + (voltage converted from the measured current). When the current to be measured is in the minus direction ((6)⇒ (5)), Vout (4) becomes 2.50V− (voltage converted from the measured current).
The standard value of the output voltage $Vout$ corresponding to the current Iin to be measured is expressed by the following equation.

$$Vout = G \times Iin + Vof \quad ; G \equiv \frac{0.625V}{If}$$

If : Rated current $V\,o$:Offset voltage Standard value is $2.50V$

RL = 10 kΩ in Fig. 7 is the equivalent resistance of the receiving circuit of the current sensor output Vout (4). Connect between Vout terminal (4) and reference potential (2.50V).

Effect of offset voltage

The offset voltage Vof is 2.50V ± 35mV at maximum under the condition of Ta = 25°C. An error within ±5.6% occurs when the rated current is measured. The effect of the offset voltage when measuring a current 1.5 times the rated current decreases to ±3.73%. When a current of half the rated current is measured, the output voltage is 0.3125V and the error of the offset voltage of ±35mV is within ±11.2%.

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 higher rated current than necessary is selected, the measurement error due to the offset voltage increases. In selecting the rated current, it is necessary to consider the capability of covering the peak value of the measured current, heat generated by the coil and the core, etc., as well as the above conditions.

■Standard Circuit

L18P□□□S12

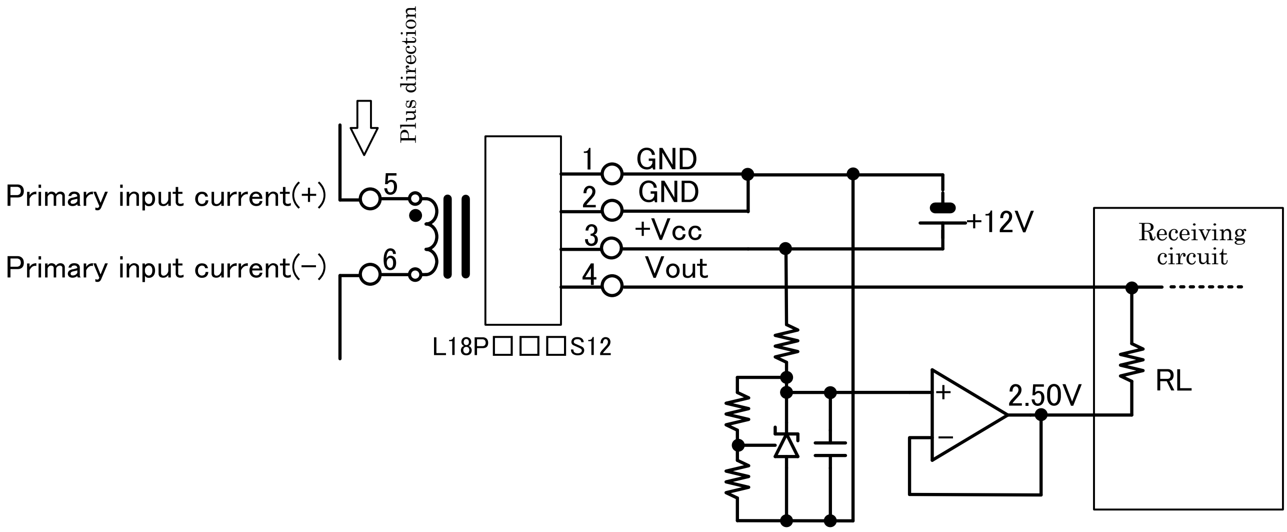


Fig. 8: L18P□□□S12　Standard circuit

☐Description of Fig. 8

Basic operation

This current sensor converts measured current into a voltage. The output voltage Vout (4) in Fig. 7 is output on the basis of the 2.50V potential. When the current to be measured is 0, Vout (4) = 2.50V. When the current to be measured is in the plus direction ((5) ⇒ (6)), Vout (4) becomes 2.50V + (voltage converted from the measured current). When the current to be measured is in the minus direction ((6)⇒ (5)), Vout (4) becomes 2.50V– (voltage converted from the measured current).

The standard value of the output voltage $Vout$ corresponding to the current Iin to be measured is expressed by the following equation.

$Vout = G \times Iin + Vof$; $G \equiv \frac{1.5V}{If}$ If :Rated current $V o$:Offset voltage　Standard value is $2.50V$

RL = 10 kΩ in Fig. 8 is the equivalent resistance of the receiving circuit of the current sensor output Vout (4). Connect between Vout terminal (4) and reference potential (2.50V).

Effect of offset voltage

The offset voltage Vof is 2.50V ± 35mV at maximum under the condition of Ta = 25°C. An error within ±2.3% occurs when the rated current is measured. The effect of the offset voltage when measuring a current 1.25 times the rated current decreases to ±1.8%. When a current of half the rated current is measured, the output voltage is 0.75V and the error of the offset voltage of ±35mV is within ±4.7%.

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 higher rated current than necessary is selected, the measurement error due to the offset voltage increases. In selecting the rated current, it is necessary to consider the capability of covering the peak value of the measured current, heat generated by the coil and the core, etc., as well as the above conditions.

■Application Circuit: Conversion circuit with reference voltage of 2.5V

L18P□□□D15-OP

SL18P□□□D15

L18P□□□D15

– Can be converted to CPU reference voltage (2.5 V) with accuracy being maintained. –

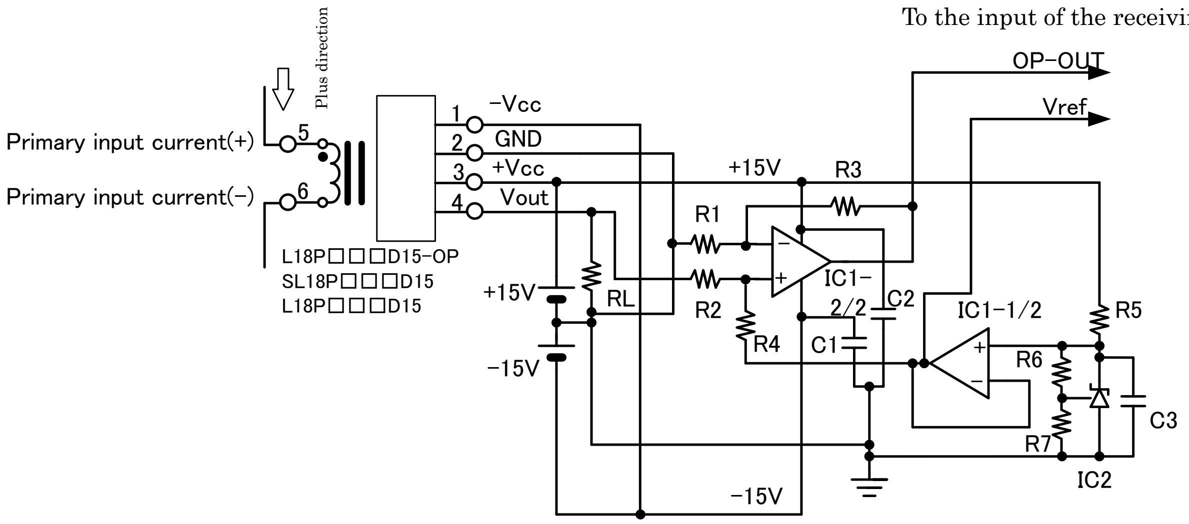


Fig. 9: L18P□□□D15-OP SL18P□□□D15 L18P□□□D15

Conversion circuit with reference voltage of 2.5V

Table 12: Conversion circuit with reference voltage of 2.5V

Symbol	Product name	Model number / Rating	Manufacturer	Remarks
C1, C2, C3	Ceramic capacitor	/0.1uF		
IC1	Integrated circuit	TL082	TI	
IC2	〃	TL431	TI	
R1, R2	Fixed resistor	14.08kΩ		
R3, R4	〃	2.2kΩ		
R5	〃	10kΩ		
R6	〃	22Ω		
R7	〃	10kΩ		

RL	Fixed resistor	33 kΩ		

The output voltage $Vout$ corresponding to the current Iin to be measured, as shown in Fig. 9, is expressed by the following equation.

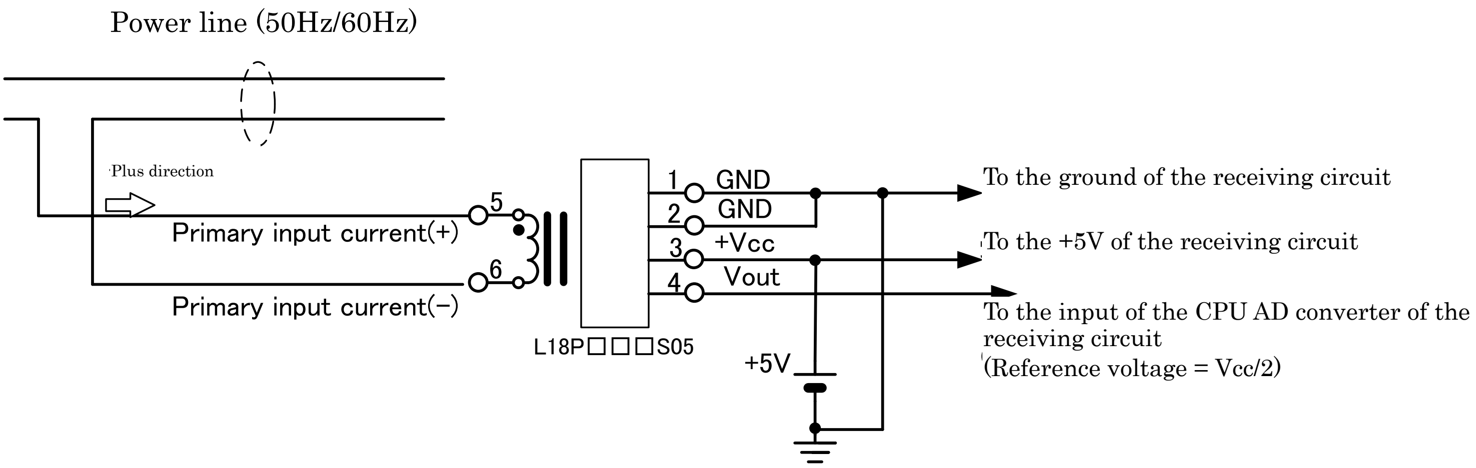
$Vout = G \times Iin + Vof$; $G \equiv \frac{0.625V}{If}$ If : Rated current Vo : Offset voltage Standard value is $2.5V$

■ Application circuit: Current-detection circuit for 50Hz

L18P□□□S05

– More miniaturization possible than current transformer –

Using the same power-supply line as the receiving circuit, the 18P□□□05 sensor can be directly connected to the receiving circuit. The reference voltage of the receiving circuit must be (Vcc/2) of the power-supply voltage Vcc.



The output voltage $Vout$ corresponding to the current Iin to be measured is given by the following equation.

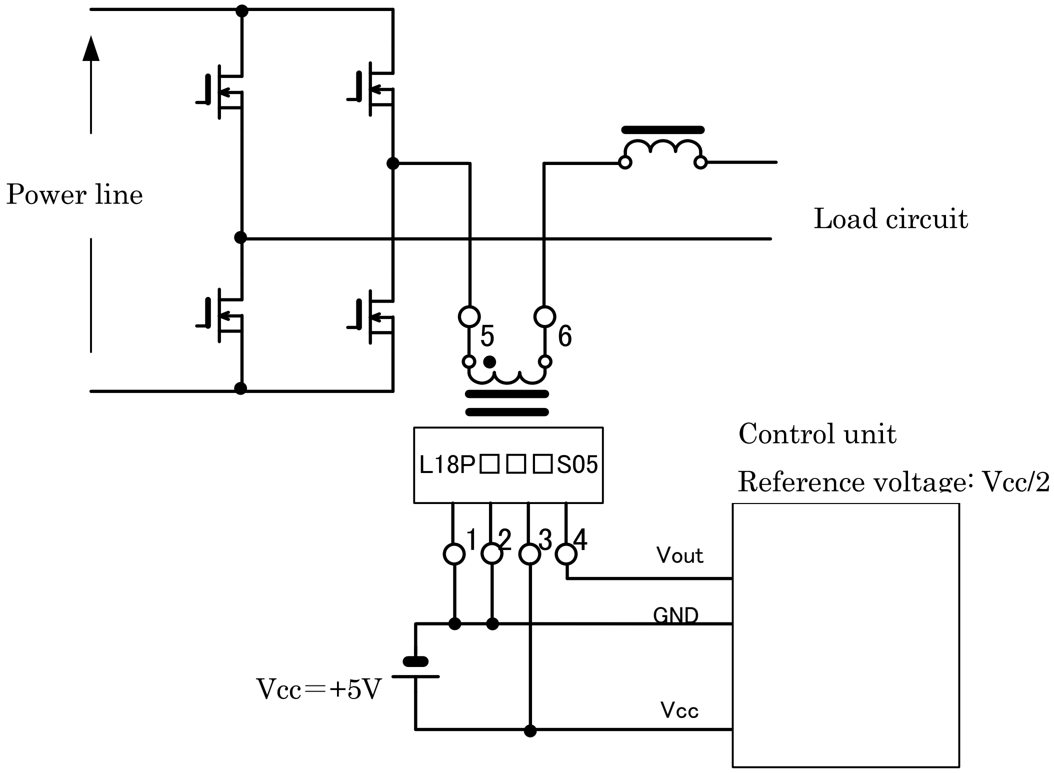
$Vout = G \times Iin + Vof$; $G \equiv \frac{1.5}{If}$ If : Rated current Vof : Offset voltage Standard value is $\frac{Vc}{2}$

Fig. 10: L18P□□□S05 Current-detection circuit for 50Hz/60Hz

(Note) Use L18P□□□05R, when the reference voltage of the receiving circuit is fixed at 2.5V (independent of Vcc).

■Application circuit: Inverter current-detection circuit

L18P□□□S05



The output voltage $Vout$ corresponding to the current Iin to be measured is given by the following equation.

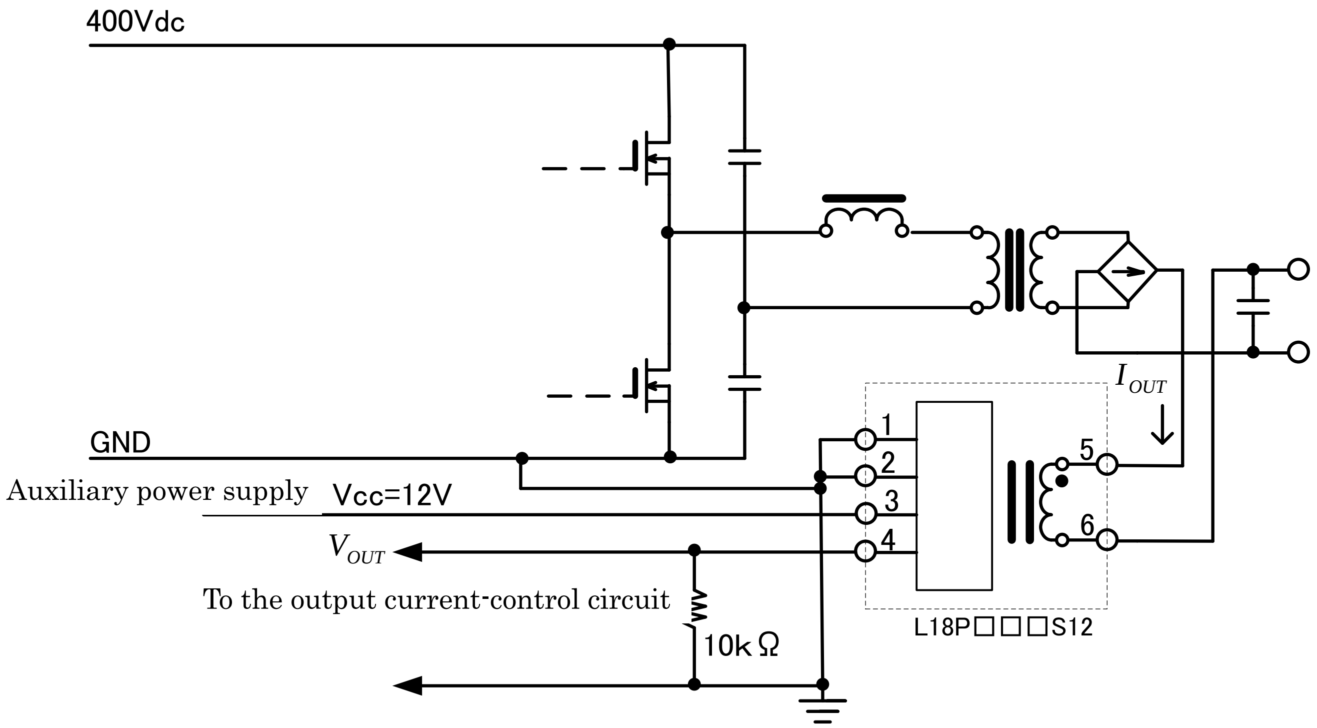
$Vout = G \times Iin + Vof$; $G \equiv \frac{1.5}{If}$ If : Rated current Vof : Offset voltage   Standard value is $\frac{Vcc}{2}$

(Note) Use L18P□□□05R, when the reference voltage of the receiving circuit is fixed at 2.5V (independent of Vcc).

Fig. 11: L18P□□□S05 Inverter current-detection circuit

■Application circuit: Overcurrent detection circuit

L18P□□□12



The value of the output current I_{OUT} is detected as voltage V_{OUT} between 10 kΩ terminals.

$$Vout = G \times I_{OUT} + Vof$$

However, $G \equiv \frac{1.5V}{If}$ If : Rated current Vo :Offset voltage Standard value is $2.50V$

Fig. 12: L18P□□□S12 Current-detection circuit for 50Hz/60Hz