L34S Series

Application Manual

■ Overview

The L34S series comprises open-loop, through-type current sensors.
The rated current varies from 200A to 1500A.

■ Characteristics

- Through-type supply system of the current to be measured.
- Open-loop-type circuit configuration.
- Connector-type input and output can be attached directly to a panel or to a bus bar.
- Simple structure, wide opening.

■ Uses

- Power monitoring for photovoltaic power generation, etc.
- Generator

Format

L34S □□□ D 15

- Power-supply voltage 15: 15V
- Power-supply type D: Dual power supply
- Rated current 200: 200A
  - 300: 300A
  - 400: 400A
  - 500: 500A
  - 600: 600A
  - 800: 800A
  - 1T0: 1000A
  - 1T2: 1200A
  - 1T5: 1500A
- Series name L34S

Table 1: L34S series Specifications of connectors and terminal plating

Model number		Connector specifications		
		Connector manufacturer	Connector product number / (Old product number)	Connector terminal Plating specification
L34S□□□D15	Standard	Molex	22-04-1041 / (5045-04A)	Sn

■Block diagram (+15V Dual power-supply type)

L34S□□□D15

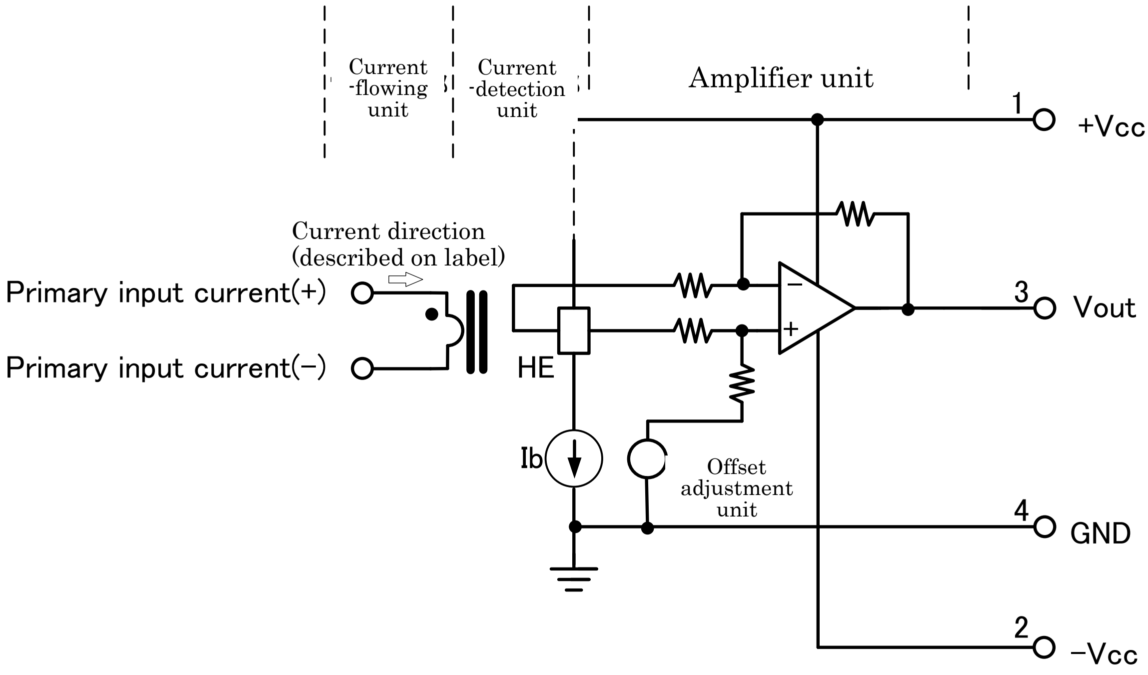


Fig. 1: L34S series Internal block diagram

Table 2: L34S□□□D15 Description of terminal

Terminal number	Terminal name	Description	Remarks
1	+Vcc	Positive power-supply terminal. Apply +15V.	
2	-Vcc	Negative power-supply terminal. Apply −15V.	
3	Vout	Output terminal. Outputs the voltage relative to GND converted from the measured current.	*
4	GND	GND terminal	
	Primary current (+)	The plus side of the primary current (measured current). When the primary current flows in the direction of the arrow (⇒) on the label, the output voltage is output with positive polarity to the output terminal (2).	Through hole
	Primary current (-)	The minus side of the primary current (measured current).	Through hole

* The standard value of the output voltage is $Vout = G \times I + Vof$

; $G \equiv \frac{4.0V}{If}$ If : Rated current Vof : Offset voltage $(= 0Vtyp)$

L34S Description of operation

Current-detection unit

The current to be measured (primary input current) passes through the through-hole. The generated magnetic flux is focused by a core and applied to the magnetic-detection element (Hall element, HE).

The generated magnetic flux is proportional to 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 detector outputs a voltage up to the limit fixed by the rated current without saturation (refer to each catalog value). However, the linearity is guaranteed only up to the rated current value.

Amplifier unit

This block differentially amplifies the output voltage of the magnetic-detection element. The amplifier unit differentially amplifies the output voltage of the magnetic-detection element and outputs the voltage relative to the reference GND (0V) converted from the measured current.

Because the output voltage of the magnetic-detection element is determined by factors such as the rated current, etc., the gain of the amplifier in each product has been precisely adjusted in the factory.

Offset adjustment unit

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

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-detection 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 appear 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.

Current-flowing unit

The current-flowing part is used by passing a bus bar or electric wire through the through-hole in the main body. The current to be measured is supplied to the bus bar or the electric wire passing through the through-hole. The bus bar or electric wire generates heat owing to its own resistance component (copper loss). Choose either a bus bar or electric wire in such a way that the temperature of the sensor does not exceed the specified value even when the ambient temperature is the allowable maximum value.

In addition to the copper loss caused by the penetrated bus bar and electric wire, heat is generated owing to iron loss (core loss) of the core built in the sensor. Each loss varies depending on conditions such as the 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. 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.

■Standard circuit 1

L34S□□□D15

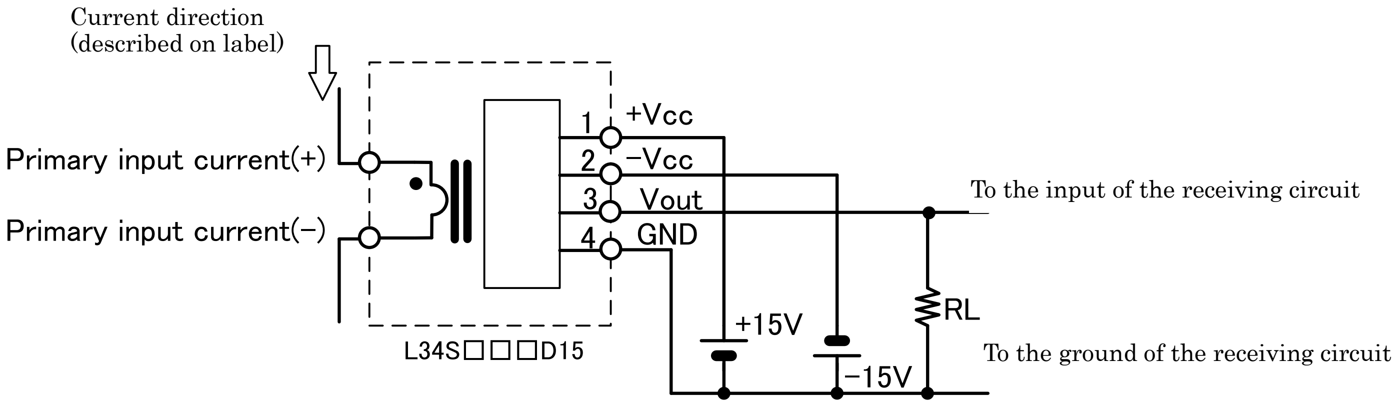


Fig. 2: L34S Standard circuit

□Description of Fig. 2

Basic operation

This current sensor converts a measured current into a voltage. The output voltage Vout (3) in Fig. 2 is output on the basis of the GND potential. When the current to be measured is 0, Vout (3) = 0Vtyp. When the current to be measured is in the plus direction (direction ⇒ of the label), Vout (3) becomes 0V + (voltage converted from the measured current). When the current to be measured is in the minus direction (direction opposite to ⇒ of the label), Vout (3) becomes 0V – (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.

$$Vout = G \times Iin + Vof$$

; $G \equiv \dfrac{4.0V}{If}$ If :Rated current $V\ o$; Offset voltage $(= 0V\ t\ y)$

RL = 10 kΩ in Fig. 2 is the equivalent resistance of the receiving circuit of the current sensor output Vout (3). The load resistance between the Vout terminal (3) and the GND potential (4) is standard 10 kΩ.

Effect of offset voltage

The offset voltage Vof is 0 ± 20mV at maximum in the case of L34S under the condition of Ta = 25°C. An error within ±0.5% occurs when measuring the rated current. When measured current is three times the rated current, the influence of the offset voltage decreases to 1/3 and the error is compressed to within

±0.17%. On the other hand, when the measured current is half the rated current, the error of the offset voltage ±20mV is within ±1% because the output voltage is 2.0V.

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 bus bar, and the core built in the sensor, etc. as well as the above conditions.

Application Circuit: Reference-voltage conversion circuit (convert from GND to 2.5 V)

L34S□□□D15

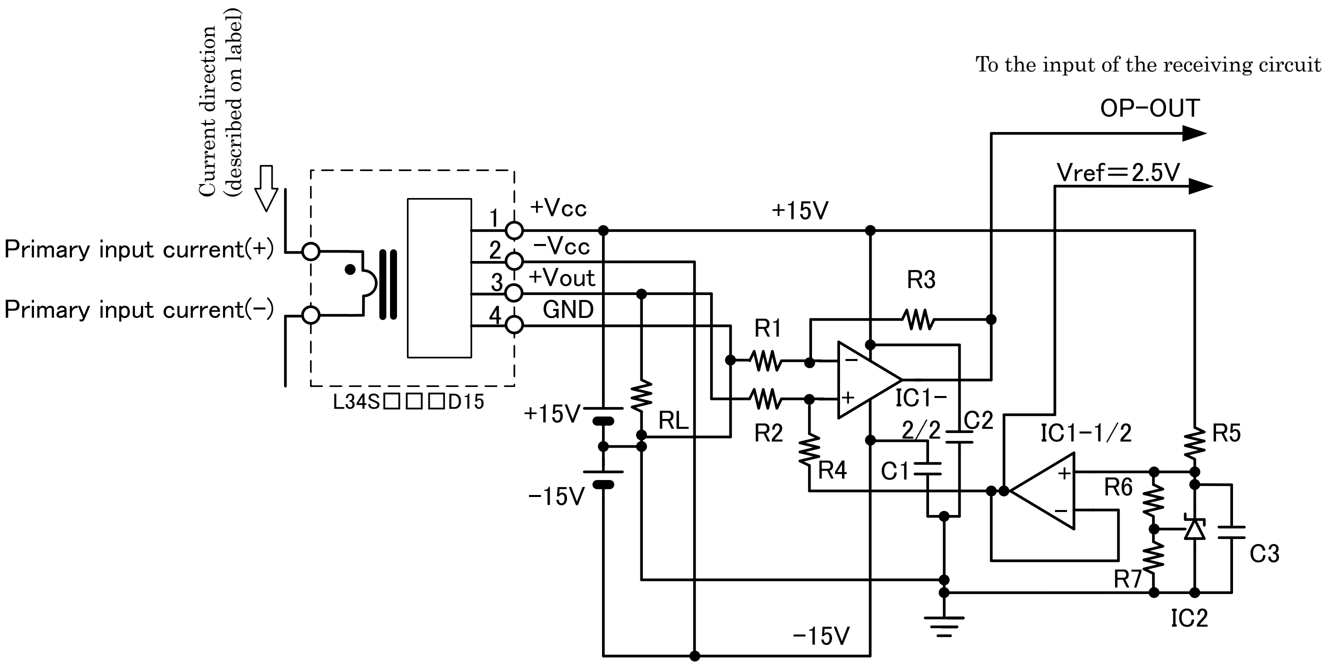


Fig. 3: L34S　　Reference-voltage conversion circuit

Table 4: L34S Reference-voltage conversion circuit

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	33kΩ		

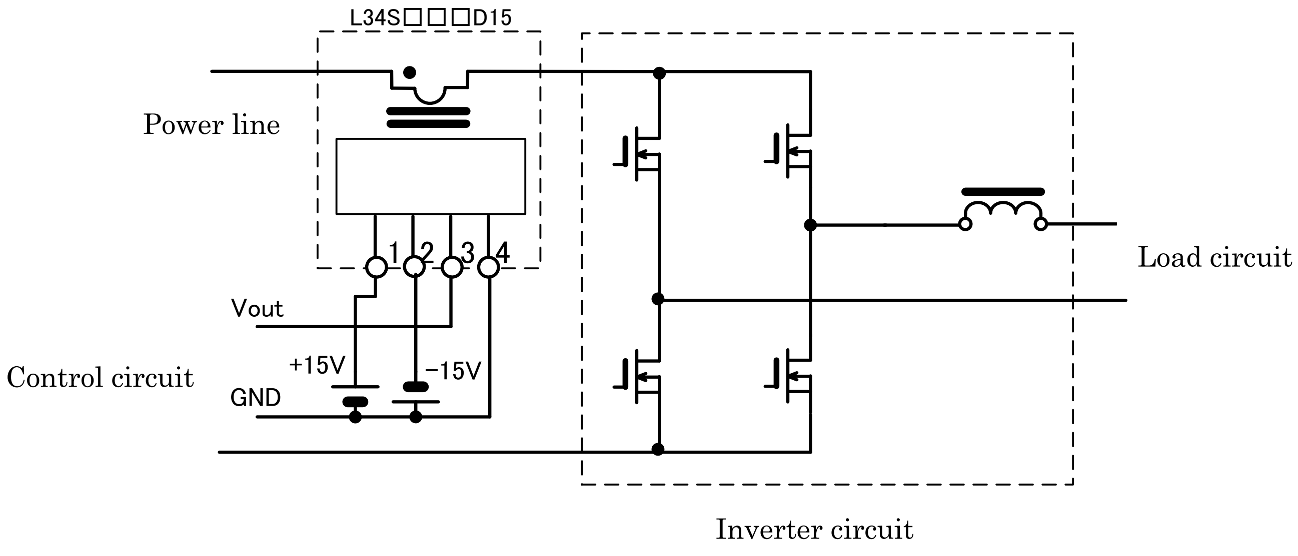
The standard value of the output voltage OP_OUT corresponding to the current Iin to be measured, as shown in Fig. 3, is expressed by the following equation.

$$OP\_OUT = G \times Iin + Vof$$

; $G \equiv \frac{0.625V}{If}$ If : Rated current Vof : Offset voltage Standard value is $2.5V$

Inverter: Detection of Input DC current

L34S□□□D15



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 $Vof = 0Vtyp$ (Offset voltage)

Fig. 4: Inverter current-detection circuit