Open loop L**Series(** is Number)

If the current is applied to the cable, the magnetic field proportional to the current in surroundings of the cable is generated on Ampere's rule. The magnetic core is set in surroundings of the cable to improve the sensitivity. The Magnetic field is converted into the voltage by the linear type - hall element is placed in the gap of the magnetic core. But the output voltage of hall element is several tens of milli-volt, It enlarges it to the output voltage of the product specification (several volts) by the operational amplifier.
The sensor output voltage is linearly proportional to the magnetic flux generated by the measured current. In general, the open loop sensor is voltage output. The characteristic (accuracy, linearity, response, temperature property, and high-frequency current*1, etc.) of the current sensor is not a little better than that of other circuit methods because of the difference of the circuit configuration (magnetic circuit , magnetism-electric conversion and amplification of electrical circuit). However, the size can be reduced and it is lower -cost more than other circuit methods.

We use silicon steel and permalloy in internal magnetic core of the open-loop sensors in order to improve the measurement possible current and hysteresis error. Therefore, at the frequency of the applied current exceeds more than several kHz, there is a possibility that the internal circuit may be damaged by the heat generation of the core loss.

Closed loop S**Series(** is Number)

The closed loop type current sensor measures the applied current on the condition that the magnetic flux density in the magnetic core is extremely zero. Therefore, there is no influence on accuracy by the non-linearity and hysteresis in the core because the flux density in the magnetic core operates in the starting point of the B-H curve in the operation region*1. The characteristic of the closed loop type is better than the open loop type current sensor.
The addition of a secondary winding (1000-5000 turns) on the magnetic core allows feedback current to be supplied in opposition to measured current to compensate or cancel the magnetic flux generated by the measured current. The output of the closed loop sensor is a current output proportional to the measured current divided by the number of secondary winding turns*2.

At the high-frequency current (1-2kHz or more) and the pulse current, current sensor should operate at ACCT (transformer) because the loop gain of the feedback control decreases. Under such a condition, the magnetic flux in the magnetic core is generated .
Output current = (Primary current) / (Secondary winding turns)

Fluxgate system F**Series(** is Number)

The flux-gate current sensor replaces the Hall element with probe coil made of highly saturable material. The magnetic offset of the probe coil does not occur in order to be driven by high-frequency current. The flux-gate utilizes a magnetic balance system to achieve high accuracy, temperature stable current output typically converted to a voltage output with an internal high precision resistor

Applications of Current Sensor

Applications	Series (Example)
 Inverter	L18P L07P L06P L03S L37S L34S LA**P S27S S28S S29S S30S S42S
 Motor control unit	L18P L08P L06P L03S L37S S21S S22S S27S S28S
 PV Inverter	L18P L34S L40S L51S S22P S23P S30S S42S LA**P F**P
 Elevator	L03S L37S L07P L08P S22P S23P S21S S27S F**P
 Robot	L03S L37S L08P L34S S28S S29S
 UPS	L18P L12P F**P S22P S23P S21S S27S S28S S29S
 Welding machine	L03S L37S L08P L06P L34S S21S S27S S28S S29S

Current Sensor / Guide map

Current range	SERIES	Model	Main Specification					UL R/C	Features
			Circuit System	Mounting Configuration	Primary Conductor	Rated Current	Power Voltage		
6A ~ 150A	F01P 	F01PxxxS05L	Fluxgate system	On-board	Built-in bus-bar	6~50A	+5V	●	• Super precision &High stability • F02P & F03P : With reference access • F03P : Longer creepage and clearance distances
	F02P 	F02PxxxS05L							
	F03P 	F03PxxxS05L							
	F23P 	F23PxxxS05R	Fluxgate system	On-board	Built-in bus-bar	50~100A	+5V	●	• Super precision & High stability • With reference access
	F26P 	F26PxxxS05	Fluxgate system	On-board	Through hole □20.5×11	50~150A	+5V	●	• Super precision & High stability • With reference access (Ref_in / Ref_out). * F26P150S12 has only Vref (OUT) function • Suffix - "A" : Improved output voltage waveform distortion
		F26PxxxS05A							
		F26P150S12				150A	+12V		
3A ~ 2500A	L18P 	L18PxxxD15AHV L18PxxxD15-OP	Open loop	On-board	Built-in coil/ bus-bar	3~60A	±15V	●	• Low cost • Compact, high performance • Name end "AHV": Anti-Sulfurated (Coating), Improve dvdt characteristics • Name end "R": Rated voltage change
		L18PxxxS05 L18PxxxS05R					+5V		
		L18PxxxS12					+12V		
	L07P 	L07PxxxD15 L07PxxxD15S	Open loop	On-board	Built-in coil	3~30A	±15V	●	• Low cost • Built-in 2 circuits • Name end "S":Anti-Sulfurated (Coating, Anti-Sulfurated resistance)
		L07PxxxS05					+5V		
	LA17P 	LA17PxxxS05	Open loop	On-board (Discrete)	Built-in bus-bar	10~50A	+5V	●	• Open loop - one chip ASIC model • With reference access • Non ratiometric output (Vout, Voff, Vref)
	L12P 	L12P025D15	Open loop	On-board	Built-in coil	25A	±15V		• Low cost • Compact
	L32P 	L32PxxxS05BFS	Open loop	On-board	Built-in bus-bar	50A, 100A	+5V	●	• Ferrite core is used. • With reference access • Used Anti-Sulfurated resistance
		L32PxxxS05FS			Through hole □15×8	50~400A			
	L08P 	L08PxxxD15IPV/ WIPVW	Open loop	On-board	Through hole φ16	50~500A	±15V		• Wide range of applications • Improve dV/dt characteristics
	L01Z 	L01ZxxxS05	Open loop	On-board	Through hole □15×8	50~600A	+5V		• Wide electrical current range • Compact

Current Sensor / Guide map

Current range	SERIES	Model	Main Specification					UL R/C	Features
			Circuit System	Mounting Configuration	Primary Conductor	Rated Current	Power Voltage		
3A ~ 2500A	LA37S 	LA37SxxxS05M LA37SxxxS05J	Open loop	Connector (MOLEX/JST)	Through hole □20.3×10.3	50~600A	+5V	●	· Succession model of L37SxxxS05 series · Open loop - one chip ASIC model · Rated output voltage : Vof ±800mV or ±625mV · With reference access · Non ratiometric output
		LA37SxxxS05KM LA37SxxxS05KJ							
	L37S 	L37SxxxS05M L37SxxxS05J	Open loop	Connector (MOLEX/JST)	Through hole □20.4×10.4	50~600A	+5V	●	· Design for lower dvdt noise · L37SxxxD15x : Succession model of L03SxxxD15W series · L37SxxxS05x : With reference access · Wide electrical current range · Compact
		L37SxxxD15M L37SxxxD15J				50~ 600(800)A	±15V		
	L03S 	L03SxxxD15	Open loop	Connector (MOLEX)	Through hole □20.5×10.5	50~600A	±15V		· Wide electrical current range · Compact · Name end"W"; Saturation current up, Change position of CN (MOLEX or JST)
		L03SxxxD15WM L03SxxxD15WJ		Connector (MOLEX/JST)		50~800A			
	L31S 	L31SxxxS05FS	Open loop	Connector (MOLEX)	Through hole □20.5×10.5	50~600A	+5V	●	· Wide electrical current range · Ferrite core is used. · With reference access · Used Anti-Sulfurated resistance
	L06P 	L06PxxxS05	Open loop	On-board	Through hole φ22	300~800A	+5V		· Wide range of applications · Single power supply type
	L05Z 	L05Z800S15	Open loop	Connector (JST)	Through hole □20.5×10.5	800A	+15V		· Wide range of applications · Single power supply type
	L34S 	L34SxxxD15	Open loop	Connector (MOLEX)	Through hole □40.5×40.5	200~1500A	±15V	●	· Large aperture · Wide electrical current range · Suffix - "T" ; Wide temperature range (-40 ~ +105℃)
		L34SxxxD15T							
	L40S 	L40SxxxD15M L40SxxxD15J	Open loop	Connector (MOLEX/JST)	Through hole □40.5×30.5	200~1500A	±15V	●	· Succession model of L34SxxxD15T series · High-current (1500A_max) · Large aperture · Suffix - "C":1500V DC system voltage applicable
		L40SxxxD15CM L40SxxxD15CJ							
	L51S 	L51SxxxD15LM L51SxxxD15LJ	Open loop	Connector (MOLEX/JST)	Through hole □64.0×21.0	500~2500A	±15V	●	· High-Current (2500A_max) · Large aperture · Suffix- "(none)":Inner wall height 7mm, Suffix- "L":3.3mm · Suffix- "C":34mm. 1500V DC system voltage applicable
		L51SxxxD15M L51SxxxD15J							
		L51SxxxD15CM L51SxxxD15CJ							
	L55S 	L55SxxxD15	Open loop	Connector (MOLEX)	Through hole □104.5×22.5	1500A, 2000A, 2500A	±15V	●	· High-Current (2500A_max) · Through-hole shape suitable for plate bus bars · 1500V DC system voltage applicable. UL508 Certification : Rated voltage 1000V.

Current Sensor / Guide map

Current range	SERIES	Model	Main Specification					UL R/C	Features
			Circuit System	Mounting Configuration	Primary Conductor	Rated Current	Power Voltage		
6A ~ 2000A	S22P 	S22PxxxS05M2 S22PxxxS05P	Closed loop	On-board	Built-in bus-bar	6~25A	+5V	●	• Voltage • output type • Name end"M2"; Backward compatible of normal model, External magnetic field improvement model • Name end "P"; Short lead model of normal model
	S23P 	S23PxxxD15M2 S23PxxxD15M1 S23PxxxD15	Closed loop	On-board	Built-in bus-bar	100A	±15V	●	• High accuracy, High performance • Name end"M2"; Backward compatible, dv/dt improvement type • Name end"M1": Conversion Ration 1:1000 • Conversion Ration • Normal & M2 type are 1:2000
	S21S 	S21S180D15JN	Closed loop	Connector (JST)	Through hole R10	180A	±15V	●	• Semicircle aperture • Conversion Ration 1:4000
	S27S 	S27S300D15Y S27S300D15YM	Closed loop	Connector (MOLEX)	Through hole φ20	300A	±20V	●	• High accuracy, High performance • Conversion Ration 1:2000 • Connector:MOLEX (2 type)
	S28S 	S28S500D24Z S28S500D24ZM S28S500D24ZJ	Closed loop	Connector (MOLEX)	Through hole φ30	500A	±24V	●	• High-current, High accuracy • Conversion Ration 1:5000 • Connector: MOLEX (2 type), JST (1 type)
	S29S 	S29S1T0D24Z S29S1T0D24ZM S29S1T0D24ZJ	Closed loop	Connector (MOLEX/JST)	Through hole φ38.5	1000A	±24V	●	• High-current, High accuracy • Conversion Ration 1:5000 • Connector:MOLEX (2 type), JST (1 type)
	S30S 	S30S2T0D24Z S30S2T0D24ZM S30S2T0D24ZJ	Closed loop	Connector (MOLEX/JST)	Through hole φ61	2000A	±24V	●	• High-current,High accuracy • Conversion Ration 1:5000 • Connector : MOLEX(2 types),JST (1 type)
	S42S 	S42S1T0D24Z S42S1T0D24ZM S42S1T0D24ZJ	Closed loop	Connector (MOLEX/JST)	Through hole φ42	1000A	±24V	●	• High-current,High accuracy • Conversion Ration 1:5000 • Connector : MOLEX(2 types),JST (1 type)

Application notes

<General Considerations>

1. The sensor uses polar electronic components. When the polarity of the power supply is mistaken, the sensor is damaged.
2. Static electricity or excessive voltage can increase an offset voltage in the Hall element, and cause offset voltage to change. Please exercise care in handling and application.
3. In order to prevent the influence of noise, the use of twisted cable or shielded cable for the output line is recommended
4. If using this device within a magnetic field generated by other devices, the specified accuracy may not be obtainable.
5. Our products (several models are excluded) are adjusted with the trimming method by the measurement condition (Load resistance, Power supply voltage) of specification sheets. Therefore, characteristics (Offset, Output, etc.) and its deviation may be changed in different circuit conditions from the measurement condition. All change characteristic items are not indicated on specification sheets.
6. The performance of current sensors with through-hole (aperture) is dependent on the position of the primary conductor. Tamura specifications are based on a primary conductor completely filling the through-hole (aperture) area.
7. The current sensor rated current in DC Amps.
8. Please use mating connector with equivalent terminal plating material to insure proper operation and avoid possibility of 'galvanic corrosion' .
9. Please do not store in high-temperature and high-humidity storage environment. Please use it after confirming soldering when it is kept for six months or more. (product soldered with substrate)
10. We recommend performing a zero offset adjustment by measuring the offset voltage at startup. In continuously operation for a few months, or at change of ambient temperature or humidity is large, we recommend regularly performing a zero offset adjustment at being idling (it is clear that the current is not apply) .
11. The current sensor doesn't have built-in protection circuit (devices and fuses, etc.). As a failure mode of the sensor, there is a short circuit and open state. In the case of a short-circuit state, the abnor-mal temperature rise of the internal parts is assumed, and there is a possibility to smoke and to ignite. If it is used in safety critical circuit blocks, please take appropriate measures by protection devices, protection circuits, etc. For closed loop -type sensors and flux gate (closed loop type) sensors, the consumption current of the secondary power supply varies in proportion to the measurement current.

<Open loop>

1. High frequency primary current may result in excessive heating in iron magnetic core and cause damage to internal circuitry; for high frequency applications select current sensor with ferrite core material.
2. If the measured current exceeds the rated current, magnetic core saturation will occur and the output voltage signal will not be linearly proportional to the measured current.

<Closed Loop>

1. For closed loop current sensors please insure the power supply voltage is balanced, symmetrical, and, applied simultaneously to avoid potential increase in DC offset error.
2. Maximum rated current measurement duration is timedependent. Maximum rated current applied in excess of the time limit can result in damage to internal electronic circuitry; please consult Tamura for assistance.
3. When using a measurement resistor to convert current output to voltage output select a resistor with stable temperature characteristic to insure accuracy of the output voltage.
4. Compensation current supplied to the secondary winding varies in proportion to the measured current based on the conversion ratio. (If/KN; KN = secondary turns) Please insure the PSU has required current capacity to supply compensation current to the secondary winding.

<Flux-Gate>

1. Compensation current supplied to the secondary winding varies in proportion to the measured current. Please insure the PSU has required current capacity to supply compensation current to the secondary winding.
2. There is 450kHz ripple voltage present on the output and reference output voltage signals . An external capacitor maybe added if necessary.

Part numbering system

Outlines

Ex)

L03 S *** D 15 □□□□

S22 P *** S 05 □□□□

❶ ❷ ❸ ❹ ❺ ❻

❶ Model (3 figures or 4 figures)

L ** : Open loop system (Magnetic Proportion System)
S ** : Closed loop system (Servo system)
F ** : Fluxgate system
LA ** : Open loop system + One chip ASIC

❷ Mounting configuration (1 figure)

P : Through Hole Mounting Device
M : Surface Mount Device
S : Bolt-on Device

❸ Rated current (3 figures)

Ex)

2R5 : 2.5A 005 : 5A
050 : 50A 500 : 500A
1T0 : 1000A

❹ Control power supply type (1 figure)

S : Single supply D : Dual supply

❺ Power supply voltage (2 figures)

15 : 15V 05 : 5V

❻ Special specification (4 figures_MAX.)

Ex)

Figures	Special specification
B	With a busbar
C	With a cover
J	Connector Maker : JST
M	Connector Maker : Molex
W	Saturation current is increased.
X	Secondary coil :1000 Turns
Z	Secondary coil : 5000 Turns
Y	Secondary coil : 2000 Turns