Fluxgate system ／ Voltage-output type

F02P SERIES

TAMURA recommends F02P L series as a succession model.

ABSOLUTE MAXIMUM RATINGS

Parameters	Symbol	Unit	Value	Comment
Supply voltage	Vcc	V	7	
Primary conductor temperature	—	℃	110	
ESD（HBM: Human Body Model）	—	kV	4	C=100pF, R=1.5kΩ

ISOLATION CHARACTERISTICS

Parameters	Symbol	Unit	Value	Comment
Insulation voltage	Vd	—	AC4100V, for 1minute(Sensing current 0.5mA)	Primary ⇔ Secondary
Insulation Resistance	R_{IS}	—	≧ 500MΩ(at DC500V)	Primary ⇔ Secondary
Clearance distance	d_{Cl}	—	7.5mm	Primary ⇔ Secondary
Creepage distance	d_{Cp}	—	7.5mm	Primary ⇔ Secondary
Case material	—	—	UL94 V-0	
Comparative Tracking Index; (CTI)	CTI	V	600	
Application example	—	—	300V, CAT Ⅲ, PD2	Reinforced isolation,non uniform field according to EN62477-1, EN61010
	—	—	600V, CAT Ⅲ, PD2	Simple isolation,non uniform field according to EN50178, EN61010

ENVIRONMENTAL AND MECHANICAL CHARACTERISTICS

Parameters	Symbol	Unit	Value			Comment
			MIN	TYP	MAX	
Ambient operating temperature	T_A	℃	−40		＋105	
Ambient storage temperature	T_S	℃	−40		＋105	
Mass	m	g		12		

SPECIFICATIONS

T_A=+25℃, Np=1T, RL=10kΩ, Vcc=+5V

Parameters		Symbol	Unit	Value MIN	Value TYP	Value MAX	Comment
Primary nominal current	F02P006S05	I_{PN}	A		6		
	F02P015S05				15		
	F02P025S05				25		
	F02P050S05				50		
Primary current, measuring range	F02P006S05	I_{PM}	A	−20		20	
	F02P015S05			−51		51	
	F02P025S05			−85		85	
	F02P050S05			−150		150	
Supply Voltage		Vcc	V	4.75	5.00	5.25	
Number of primary turns		Np	T		1, 2, 3		
Number of secondary turns	F02P006S05	Ns	T		1816		
	F02P015S05				1737		
	F02P025S05				1764		
	F02P050S05				1600		
Consumption current (at I_P)	F02P006S05	Icc	mA		25		Icc=15＋Ip(mA)／Ns
	F02P015S05				30		
	F02P025S05				35		
	F02P050S05				55		
Reference voltage(output)(at I_P=0A)		Vref1	V	2.495	2.500	2.505	Ref OUT mode
Reference voltage(input)		Vref2	V	0		4	Ref IN mode
Output voltage range		Vo	V	0.375		4.625	
Output voltage(at Ip=0A)		Vo	V		Vref1,Vref2		
Electrical offset voltage *1	F02P006S05	Voe	mV	−5.300		5.300	
	F02P015S05			−2.210		2.210	
	F02P025S05			−1.350		1.350	
	F02P050S05			−0.725		0.725	
Electrical offset current referred to primary*1	F02P006S05	Ioe	mA	−51		51	
	F02P015S05			−53		53	
	F02P025S05			−54		54	
	F02P050S05			−58		58	
Temperature coefficient of Vref1		TCVref1	ppm/K		±5.0	±50	
Temperature coefficient of Vo(at Ip=0A)	F02P006S05	TCVo	ppm/K		±6.0	±14	ppm/K of 2.5V
	F02P015S05				±2.3	±6	(−40℃～＋105℃)
	F02P025S05				±1.4	±4	
	F02P050S05				±0.7	±3	
Theoretical sensitivity	F02P006S05	Gth	mV/A		104.2		625mV/I_{PN}
	F02P015S05				41.67		
	F02P025S05				25		
	F02P050S05				12.5		
Sensitivity error		ε_G	%	−0.7		0.7	
Temperature coefficient of Sensitivity(at T_A=−40℃～＋105℃)		TCG	ppm/K			±40	
Linearity error(at I_P)		ε_L	%	−0.1		0.1	
Magnetic offset current referred to primary (at 10×Ip)		I_{OM}	A	−0.1		0.1	

*1 Offset voltage value is after removal of core hysteresis.

SPECIFICATIONS

T_A=+25℃, Np=1T, RL=10kΩ, Vcc=+5V

Parameters		Symbol	Unit	Value			Comment
				MIN	TYP	MAX	
Peak to peak output ripple at oscillator freqency(f typ=450kHz)	F02P006S05	—	mV		40	160	RL=1kΩ
	F02P015S05				15	60	
	F02P025S05				10	40	
	F02P050S05				5	20	
Reaction time(at 10% of I_{PN})	F02P006S05	tra	μs			0.3	RL=1kΩ, di/dt=18A/μs
	F02P015S05					0.3	RL=1kΩ, di/dt=44A/μs
	F02P025S05					0.3	RL=1kΩ, di/dt=68A/μs
	F02P050S05					0.3	RL=1kΩ, di/dt=100A/μs
Response time (at 90% of I_{PN})	F02P006S05	tr	μs			0.3	RL=1kΩ, di/dt=18A/μs
	F02P015S05					0.3	RL=1kΩ, di/dt=44A/μs
	F02P025S05					0.3	RL=1kΩ, di/dt=68A/μs
	F02P050S05					0.3	RL=1kΩ, di/dt=100A/μs
Frequency bandwidth(±1dB)		BW	kHz	200			RL=1kΩ
Frequency bandwidth(±3dB)		BW	kHz	300			RL=1kΩ
Overall Accuracy (at T_A=25℃)	F02P006S05	X_G	%			1.7	X_G=(100×Voe/625)+ε_G+ε_L
	F02P015S05					1.2	
	F02P025S05					1.0	
	F02P050S05					0.9	

STANDARDS

EN50178, EN62477-1, EN61010-1, EN62368-1, UL508(file №E243511)

※Please refer to the another sheet about conditions of UL Recognition.

Characteristic curve(TYP)

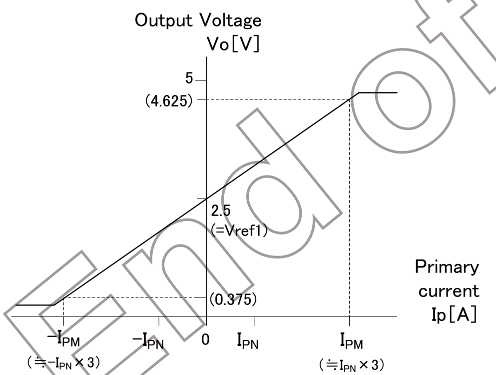


Figure 1:Linearity curve(Internal reference voltage)

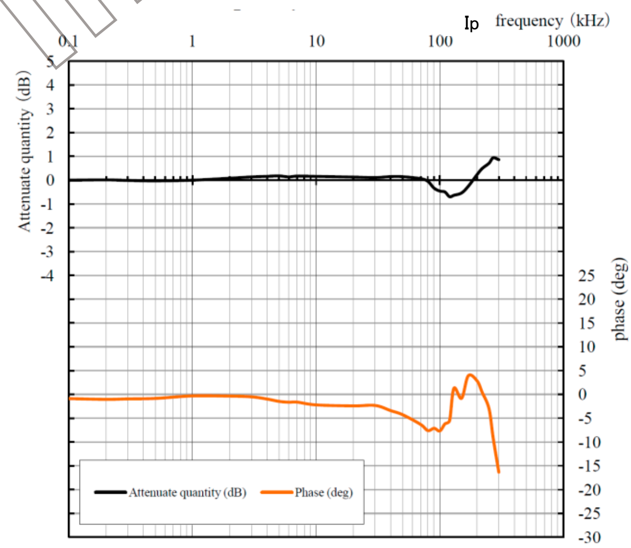


Figure 2:Frequency response curve
ex)F02P025S05
Measurement condition Ta=+25℃, RL=1kΩ, Ip=3A, Vcc=+5V

SUPPORT DOCUMENTATION

Maximum continuous DC primary current

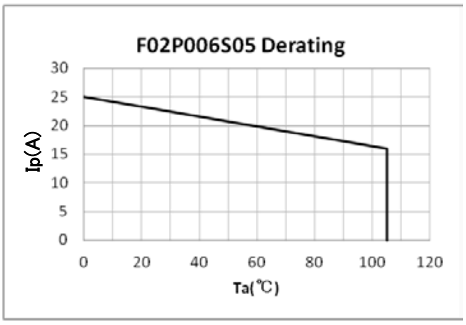


Figure 3:Ip vs Ta for F02P006S05

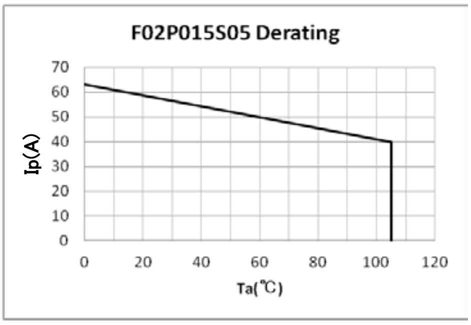


Figure 4:Ip vs Ta for F02P015S05

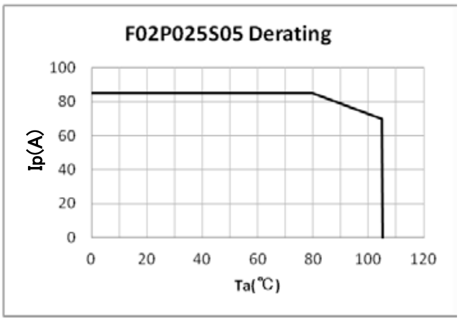


Figure 5:Ip vs Ta for F02P025S05

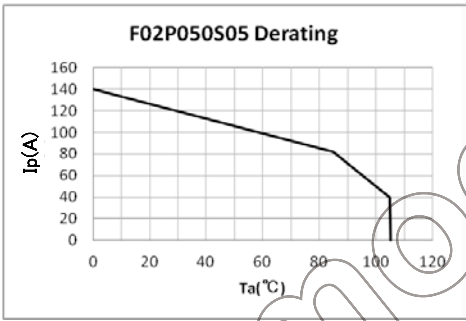


Figure 6:Ip vs Ta for F02P050S05

According to which the following conditions are true the maximum continuous DC primary current plot shows the boundary of the area.

①Ip ＜ Ipmax
②Junction temperature Tj ＜ 125℃
③Resistor power dissipation ＜ 0.5 x rated power

Frequency derating

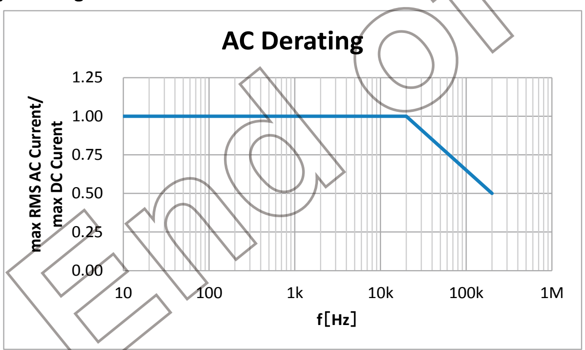


Figure 7:Maximum RMS AC primary current/maximum DC primary current vs frequency

Reference voltage

The Ref pin has two modes Ref IN and Ref OUT:

＜Ref OUT mode＞

The 2.5V internal precision reference is used by the transducer as the reference point for bipolar measurements;

＜Ref IN mode＞

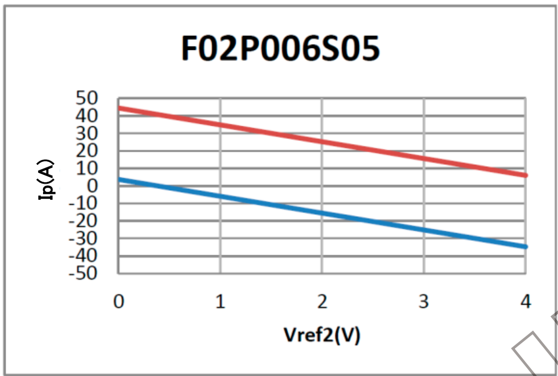
An external reference voltage is connected to the Ref pin; this voltage is specified in the range 0 to 4 V ,

its voltage is used as the reference voltage at the time of measurement.

-either to source a typical current of (Vref−2.5)/680,the maximum value will be 2.2mA typ.when Vref2＝4V.

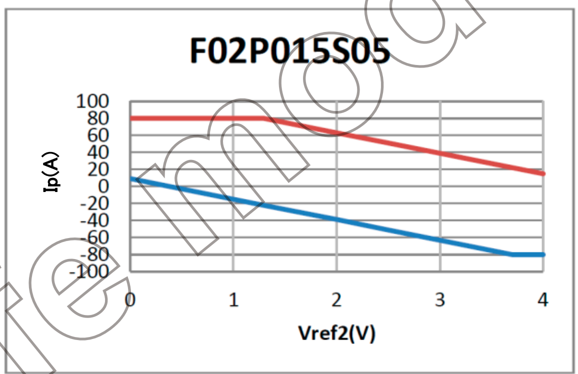
-or to sink a typical current of (2.5−Vref2)/680,the maximum value will be 3.68mA typ.when Vref2＝0V.

The following graphs show how the measuring range of each transducer version depends on external reference voltage value Vref2.



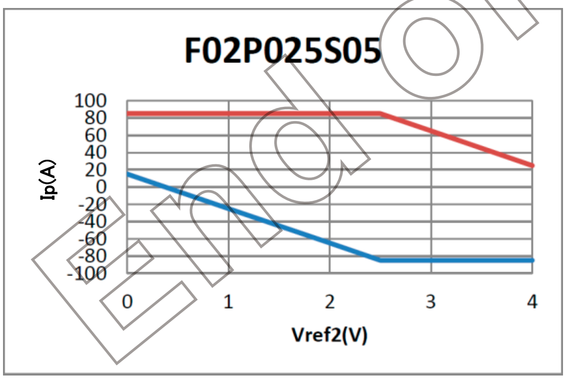
Upper limit：Ip＝−9.6×Vref2＋44.4 (Vref2＝0...4V)

Lower limit：Ip＝−9.6×Vref2＋3.6 (Vref2＝0...4V)



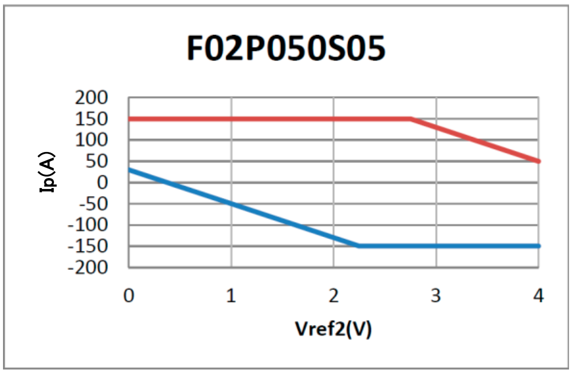
Upper limit：Ip＝80 (Vref2＝0...1.29V)
Ip＝−24×Vref2＋111 (Vref2＝1.29...4V)

Lower limit：Ip＝−24×Vref2＋9 (Vref2＝0...3.7V)
Ip＝−80 (Vref2＝3.7...4V)



Upper limit：Ip＝85 (Vref2＝0...2.5V)
Ip＝−40×Vref2＋185 (Vref2＝2.5...4V)

Lower limit：Ip＝−40×Vref2＋15 (Vref2＝0...2.5V)
Ip＝−85 (Vref2＝2.5...4V)

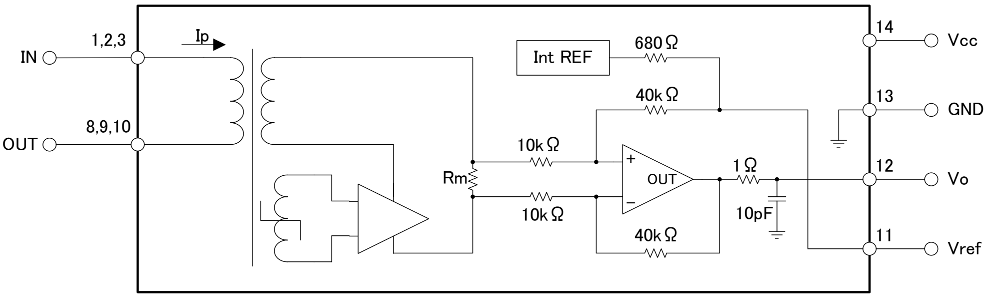


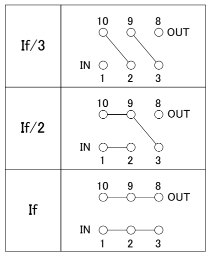
Upper limit：Ip＝150 (Vref2＝0...2.75V)
Ip＝−80×Vref2＋370 (Vref2＝2.75...4V)

Lower limit：Ip＝−80×Vref2＋30 (Vref2＝0...2.25V)
Ip＝−150 (Vref2＝2.25...4V)

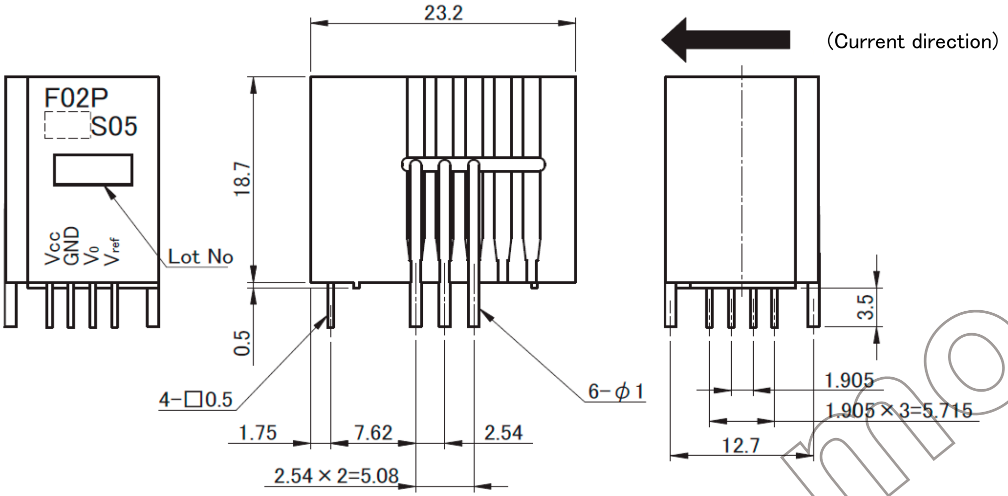
If you do not want to use the Ref pin, please unconnected.

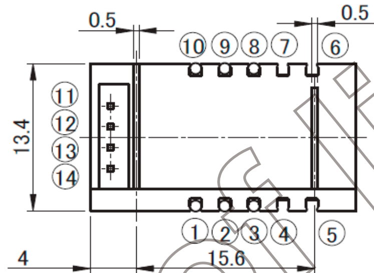
CONNECTION





DIMENSIONS(mm)

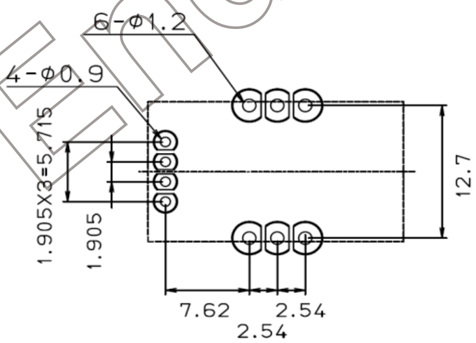




(Terminal No.)
①②③: INPUT
⑧⑨⑩: OUTPUT
⑪: Vref
⑫: Vo
⑬: GND
⑭: Vcc

※ (Unless otherwise specified tolerances shall be ±0.5

RECOMMENDED HOLE DIAMETER(mm)



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   - *Use in locations where corrosive gases such as sea winds, Cl_2, H_2S, NH_3, SO_2, or NO_2, are present. (Some product improves durability)*
   - *Use in environments with strong static electricity or electromagnetic radiation.*
   - *Use that involves placing inflammable material next to the product.*
   - *Use of this product either sealed with a resin filling or coated with resin.*
   - *Use of water or a water soluble detergent for flux cleaning.*
   - *Use in locations where condensation is liable to occur.*

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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.