

Fluxgate system / Voltage-output type

F23PxxxS05R SERIES



- [STANDARDS]**
- UL508
  - CSA C22.2 No.14-18
  - EN 62477-1
  - IEC61800-5-1



ABSOLUTE MAXIMUM RATINGS

Parameters	Symbol	Unit	Value	Comment
Supply voltage	Vcc	V	7	
Primary conductor temperature	—	°C	110	
ESD (HBM: Human Body Model)	—	kV	4	C=150pF, R=330 Ω

ISOLATION CHARACTERISTICS

Parameters	Symbol	Unit	Value	Comment
Insulation voltage	Vd	—	AC5000V, for 1minute (Sensing current 0.5mA)	Primary ⇄ Secondary
Insulation Resistance	R <sub>IS</sub>	—	≥ 500M Ω (at DC500V)	Primary ⇄ Secondary
Clearance distance	d <sub>Cl</sub>	—	11.0mm (MIN)	Primary ⇄ Secondary
Creepage distance	d <sub>Cp</sub>	—	12.7mm (MIN)	Primary ⇄ Secondary
Case material	—	—	UL94 V-0	
Comparative Tracking Index : (CTI)	CTI	V	600	

ENVIRONMENTAL AND MECHANICAL CHARACTERISTICS

Parameters	Symbol	Unit	Value			Comment
			MIN	TYP	MAX	
Ambient operating temperature	T <sub>A</sub>	°C	- 40		+ 85	
Ambient storage temperature	T <sub>S</sub>	°C	- 40		+ 85	
Mass	m	g		13		

SPECIFICATIONS

Ta=+25°C, Np=1T, RL=10kΩ, Vcc=+5V

Parameters	Symbol	Unit	Value			Comment
			MIN	TYP	MAX	
Primary nominal current	F23P050S05R	I <sub>PN</sub>	A		50	
	F23P100S05R				100	
Primary current, measuring range	F23P050S05R	I <sub>PM</sub>	A	- 150		+ 150
	F23P100S05R			- 200		+ 200
Supply Voltage	Vcc	V	4.75	5.00	5.25	
Number of primary turns	Np	T	1, 2, 3			
Number of secondary turns	F23P050S05R	Ns	T		1441	
	F23P100S05R				1127	
Consumption current	F23P050S05R	I <sub>CC</sub>	mA		55	
	F23P100S05R				110	

I<sub>CC</sub> = 20 + I<sub>PN</sub> / Ns + Vout / RL

SPECIFICATIONS

Ta=+25°C ,Np=1T, RL=10kΩ, Vcc=+5V

Parameters	Symbol	Unit	Value			Comment	
			MIN	TYP	MAX		
Reference voltage (output)	Vref1	V	2.495	2.500	2.505	Ref OUT mode. at Ip=0A	
Reference voltage (input)	Vref2	V	0		4	Ref IN mode	
Output voltage	Vo	V		Vref1, Vref2		at Ip=0A	
Electrical offset voltage * 1	F23P050S05R	Voe	mV	- 2.5	2.5		
	F23P100S05R						
Electrical offset current referred to primary	F23P050S05R	loe	mA	- 200	200		
	F23P100S05R						- 400
Temperature coefficient of Vref1	TCVref1	ppm/K		± 5.0	± 50		
Temperature coefficient of Vo	F23P050S05R	TCVo	ppm/K		± 3.0	± 10	ppm/K of 2.5V. at Ip=0A, Ta : -40°C~ +85°C.
	F23P100S05R						
Theoretical sensitivity	F23P050S05R	Gth	mV/A		12.5		625mV (at IPN) =   Vref - Vout   / IPN
	F23P100S05R				6.25		
Sensitivity error	εG	%	- 0.7		0.7		
Temperature coefficient of Sensitivity	TCG	ppm/K			± 40	Ta=-40°C~ +85°C	
Linearity error	εL	%	- 0.1		0.1	at Ip = 0A ~ IPN	
External recommended resistance of Vout	RL	kΩ		10			
External recommended capacitance of Vout	CL	pF			500		
Peak to peak output ripple at oscillator frequency	F23P050S05R	—	mV		5	20	RL=1kΩ, f_typ =450kHz
	F23P100S05R						
Reaction time (at 10% of IPN)	F23P050S05R	t <sub>ra</sub>	μs			0.5	RL=1kΩ, di/dt = Ipn or 100A/μs. Whichever is smaller.
	F23P100S05R						
Response time (at 90% of IPN)	F23P050S05R	tr	μs			0.5	RL=1kΩ, di/dt = Ipn or 100A/μs. Whichever is smaller.
	F23P100S05R						
Frequency bandwidth (± 3dB)	BW	kHz		100		RL=1kΩ	
Overall Accuracy (at Ta=25°C)	F23P050S05R	XG	%			1.2	XG= (100× Voe/625) + εG+εL
	F23P100S05R						

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

STANDARDS



EN62477-1:2012, EN62477-1:2012/A1:2017 and EN62477-1:2012/A11:2014  
Rated voltage 600V, CAT III, PD2, Reinforced isolation, non uniform field

IEC61800-5-1

Rated voltage 600V, CAT III, PD2, Reinforced isolation, non uniform field



UL508, CSA C22.2 No.14-18 ( CSA FILE No. E243511 )

Rated voltage 600V, PD2

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

Characteristic curve (TYP)

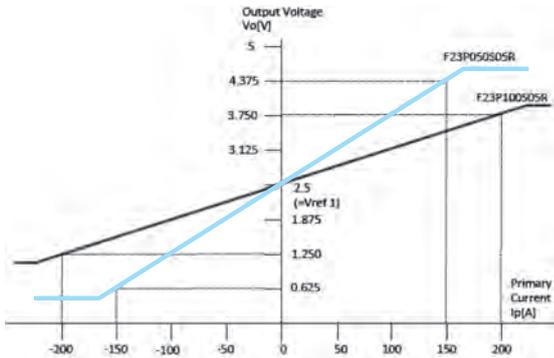


Figure 1 : Linearity curve (Internal reference voltage)  
Measurement condition Ta=+25°C, RL=10kΩ, Vcc=+5V

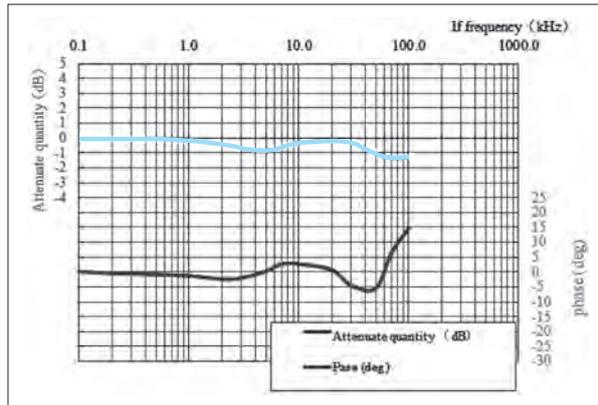


Figure 2 : Frequency response curve  
ex) F23P100S05R  
Measurement condition Ta=+25°C, RL=1kΩ, Ip=3A × 3T, Vcc=+5V

SUPPORT DOCUMENTATION

Maximum continuous DC primary current

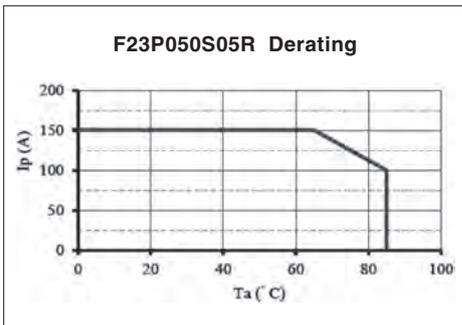


Figure 3 : Ip vs Ta for F23P050S05R

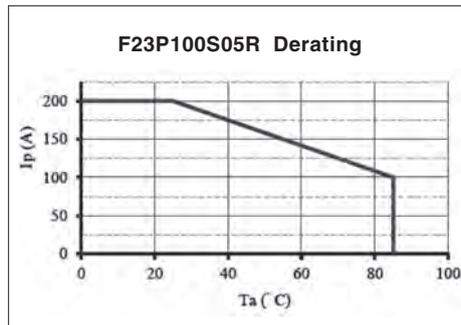


Figure 4 : Ip vs Ta for F23P100S05R  
Measurement condition Vcc=+5V, RL=10kΩ

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

- ①  $I_p < I_{PM}$
- ② Junction temperature  $T_j < 125^\circ\text{C}$
- ③ Resistor power dissipation  $< 0.5 \times$  rated power

Frequency derating

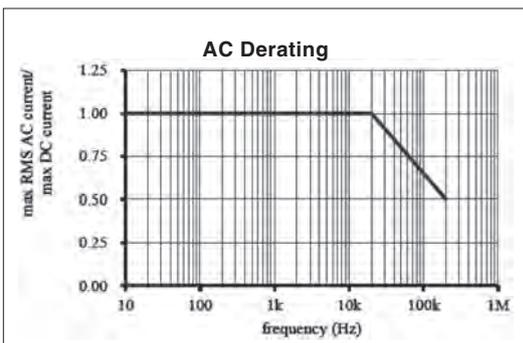


Figure 7 : Maximum RMS AC primary current/maximum DC primary current vs frequency

### Reference voltage

The Ref pin has two modes Ref IN and Ref OUT. If you do not want to use the Ref pin, please unconnected.

< Ref OUT mode >

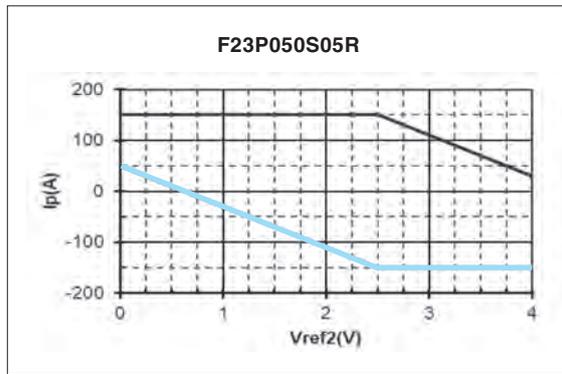
The 2.5V internal precision reference is used by the transducer as the reference point for bipolar measurements;

< Ref IN mode >

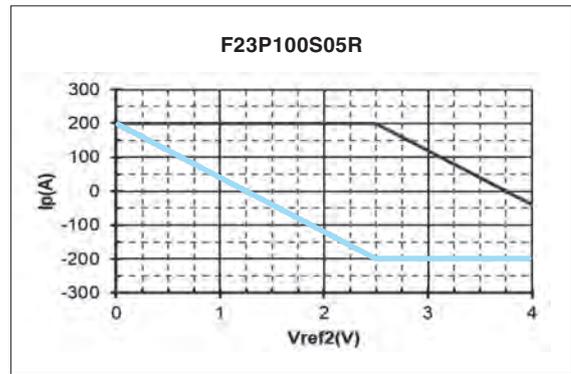
An external reference voltage is connected to the Ref pin; this voltage is specified in the range 0 to 4 V , its voltage is used as the reference voltage at the time of measurement.

- either to source a typical current of  $(V_{ref} - 2.5) / 680$ , the maximum value will be 2.2mA typ. when  $V_{ref2} = 4V$ .
- or to sink a typical current of  $(2.5 - V_{ref2}) / 680$ , the maximum value will be 3.68mA typ. when  $V_{ref2} = 0V$ .

The following graphs show how the measuring range of each transducer version depends on external reference voltage value  $V_{ref2}$ .

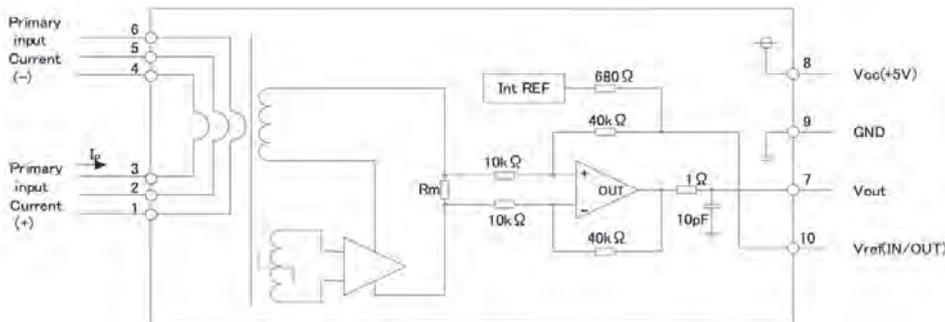


Upper limit :  $I_p = 150$  (Vref2 = 0...2.5V)  
 $I_p = -80 \times V_{ref2} + 350$  (Vref2 = 2.5...4V)  
 Lower limit :  $I_p = -80 \times V_{ref2} + 50$  (Vref2 = 0...2.5V)  
 $I_p = -150$  (Vref2 = 2.5...4V)



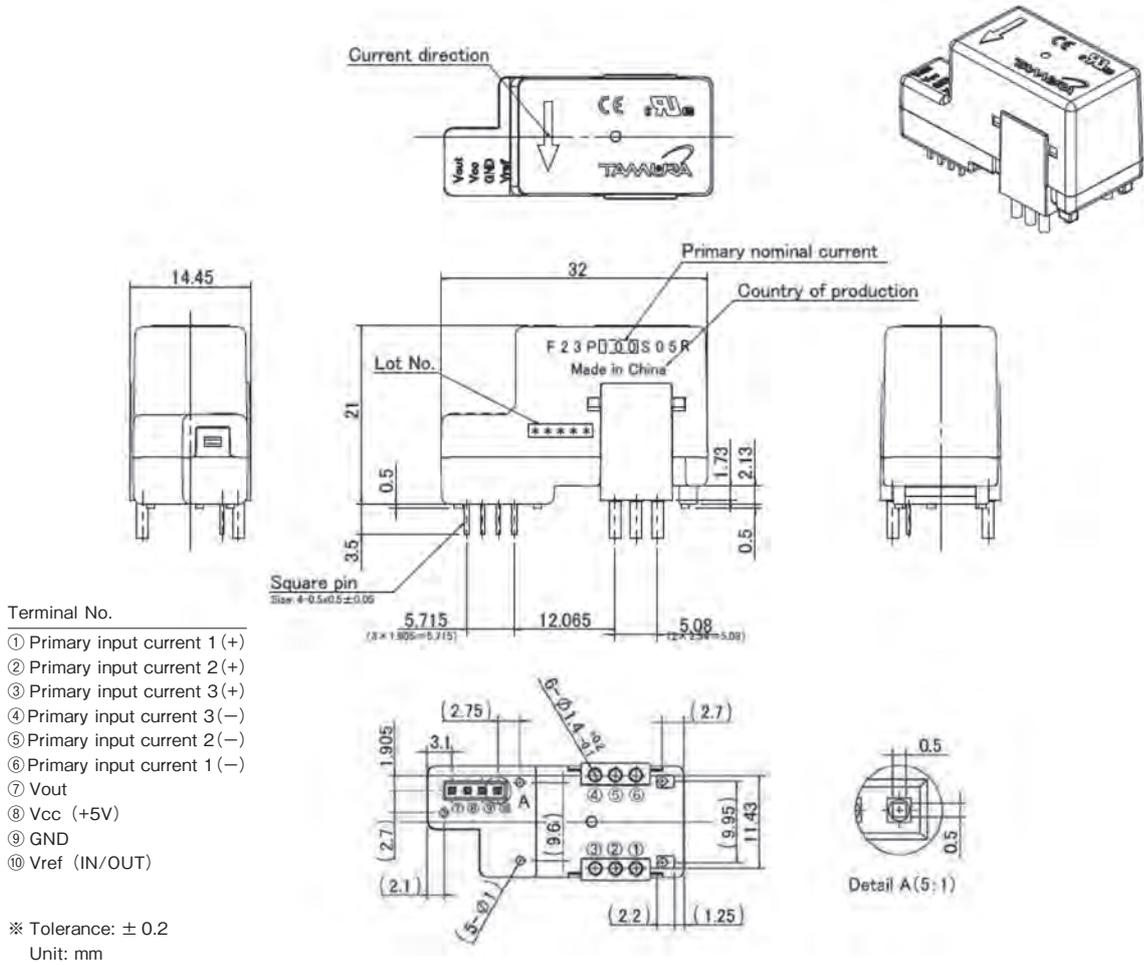
Upper limit :  $I_p = 200$  (Vref2 = 0...2.5V)  
 $I_p = -160 \times V_{ref2} + 600$  (Vref2 = 2.5...4V)  
 Lower limit :  $I_p = -160 \times V_{ref2} + 200$  (Vref2 = 0...2.5V)  
 $I_p = -200$  (Vref2 = 2.5...4V)

### CONNECTION

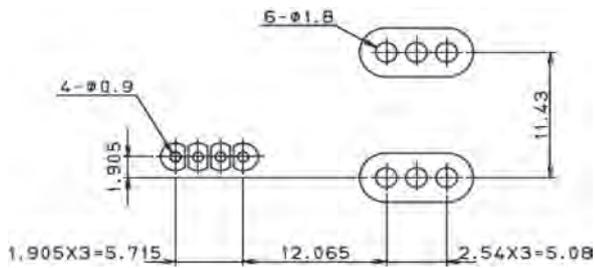


Primary winding Ip	Primary current Ip(A)	wiring	Primary resistance Rp(mΩ)
3	Ip/3		1
2	Ip/2		0.45
1	Ip		0.1

**DIMENSIONS (mm)**



**RECOMMENDED HOLE DIAMETER (mm)**



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1. The content of this information is subject to change without prior notice for the purpose of improvements, etc. Ensure that you are in possession of the most up-to-date information when using this product.
2. This product is intended to be used in general electronics applications (electric home appliances, business equipment, information equipment, communication terminal equipment, measuring devices, industrial equipment, and so on). This product is neither intended nor warranted for use in following equipment or devices:
 

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  - Use in liquids such as water, oil, chemical solutions, or organic solvents, and use in locations where the product will be exposed to such liquids.
  - Use that involves exposure to direct sunlight, outdoor exposure, or dusty conditions.
  - Use in locations where corrosive gases such as sea winds, Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, or NO<sub>2</sub>, 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.