



# EM3242

## Angle Sensor IC

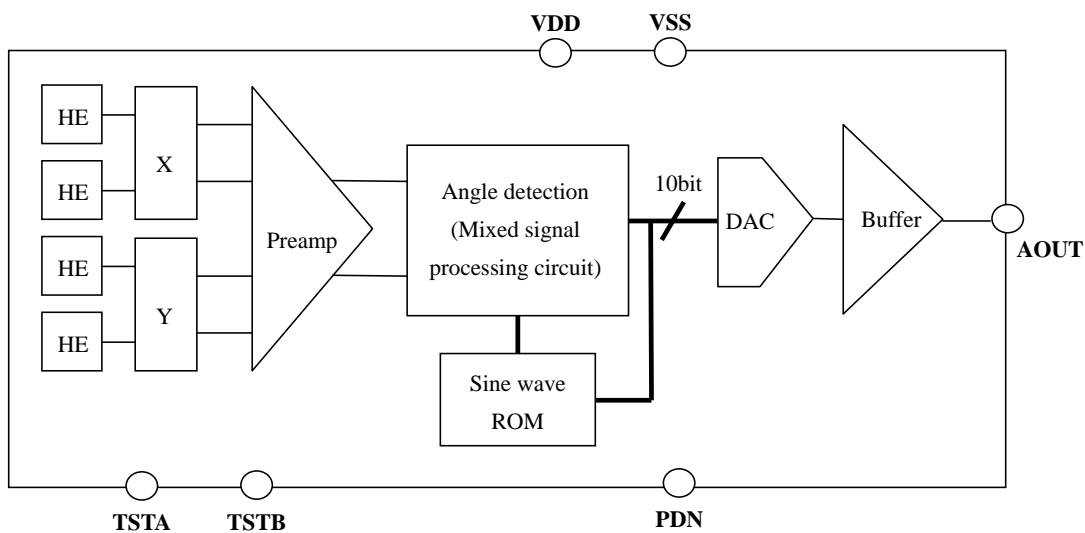
### Applications

- Small absolute rotary encoder
- Small input device (mode selector, volume control, and soon)
- Potentiometer
- Rotary switch

### Features

- Si monolithic rotary position sensor IC with embedded Hall devices
- Contactless rotary position sensor is easily implemented with magnetic disc (radial magnetic) and sensor IC.
- Analog ratiometric output (10% VDD~90% VDD)
- 10 bit Angular Resolution
- 3V single power supply
- Extremely small temperature drift (typ. +/-1.0 degree)
- Ambient operating temperature range: Ta=-40 to 150°C
- Package: SOP6 body size 3.6×3.0×0.95mm

### Block Diagram



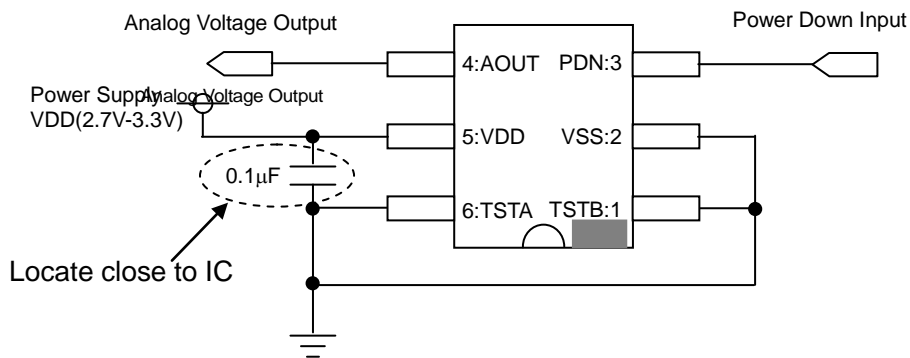
**Functional Blocks**

Block name	Function
HE	Hall Elements. These detect X/Y-compositions of flux which is parallel to the IC package surface by using magnetic concentrator.
PreAmp	This is able to amplify signals from Hall elements.
Angle Detection & Sine Wave ROM	Angle Detection makes digital angle data from signals from Hall Elements using Sine Wave ROM.
DAC	Digital to analog converter for angle output.

**PIN Description**

No.	Symbol	I/O	Type	Function
1	TSTB	I/O	Analog/Digital	TEST dedicated PIN, which should be connected to the GND in use.
2	VSS	-	Power	Ground PIN.
3	PDN	I	Analog	Power down PIN. IC is active in the case that PDN is High. IC is power down in the case that PDN is Low.
4	AOUT	O	Analog	Analog output PIN for angle data. CL: max.200pF (pull-down)
5	VDD	-	Power	Power Supply PIN. 0.1uF Ceramic Capacitor is required between Vss for stabilization. If Capacitor has magnetism, separate it around 10mm from IC.
6	TSTA	I/O	Analog	TEST dedicated PIN, which should be connected to the GND in use.

Application Circuit



\*Bypass capacitor must be inserted between VDD and VSS.

<b>Absolute Maximum Ratings</b>
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Parameter	Symbol	Min.	Max.	Unit	備考
Supply Voltage	V <sub>DD</sub>	-0.3	6.5	V	
Input Voltage	V <sub>IN</sub>	-	V <sub>DD</sub> +0.3	V	PDN terminal
Storage Temperature Range	T <sub>stg</sub>	-50	+125	°C	

<b>Operating Conditions</b>
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Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply Voltage	V <sub>dd</sub>	2.7	3.0	3.3	V	
Operating Temperature Range	T <sub>a</sub>	-30	-	+85	°C	

<b>Electrical &amp; Magnetic Specifications</b>
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Condition is; T<sub>a</sub>=25°C, V<sub>DD</sub>=3.3V if particular notes are not defined.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Magnetic Flux Density Range	B <sub>RANGE</sub>	20	30	40	mT	@-30~85°C *2
Angle Detection Range	A <sub>RANGE</sub>			360	Deg.	
Angle Resolution	A <sub>RES</sub>		0.36		Deg.	10Bit
Angle error	A <sub>PREC</sub>	-3.0		3.0	Deg.	@25°C *5 *8
Linearity	INL	-0.84		0.84	%FS	FS=360° *5
Angle temperature drift	A <sub>TD</sub>		+/-1.0		Deg.	@-30~85°C (Reference)*1*6
Angle output cycle	T <sub>p</sub>		40		μs	A/D Conversion Cycle *2
Signal delay time	T <sub>d</sub>		140	180	μs	*2
Minimum Output Voltage	V <sub>OUT(min)</sub>	0.095V <sub>DD</sub>	0.1V <sub>DD</sub>	0.105V <sub>DD</sub>	V	@Angle 0° Ratiometric Load Condition *3
Maximum Output Voltage	V <sub>OUT(max)</sub>	0.895V <sub>DD</sub>	0.9V <sub>DD</sub>	0.905V <sub>DD</sub>	V	@Angle 359.64° Ratiometric Load Condition *4
Consumption Current While driving Sensor	I <sub>SUP</sub>		8	12	mA	PDN:H *7
Consumption Current While Power Down	I <sub>PD</sub>			1	μA	PDN:L *7
Startup time	T <sub>PD</sub>		680	850	μs	PDN:L→H *2
Output Current	I <sub>OUT</sub>	-0.3		0.3	mA	*2

\*1) Based on Ambient Temperature = 25°C

\*2) This is a design assurance parameter. And this parameter will not be inspected in mass production.

\*3) AOUT Maximum Load Condition is CL=200pF (pull-down), AOUT Load Condition in Vout (min.) test: RL=9kΩ (pull-up), CL=200pF (pull-down)

\*4) AOUT Maximum Load Condition is CL=200pF (pull-down), AOUT Load Condition in Vout (max.) test: RL=9kΩ (pull-down), CL=200pF (pull-down)

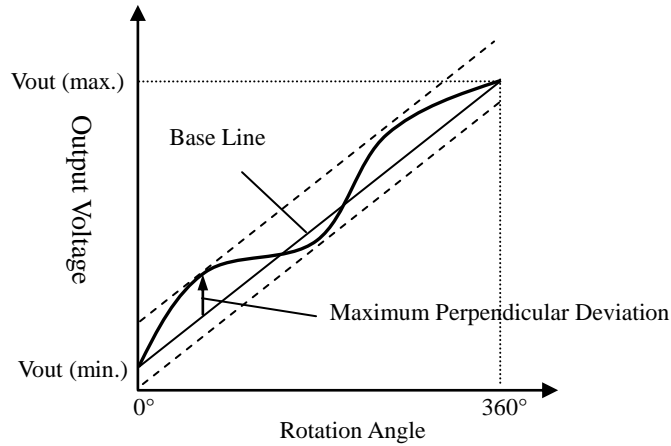
\*5) Angle error

Angle Error is defined as below formula.

$$\text{Angle Error } [^\circ] = 360^\circ \times \text{Maximum Perpendicular Deviation} / (\text{Vout (max.)} - \text{Vout (min.)})$$

Linearity is defined as below formula.

$$\text{Linearity } [\% \text{FS.}] = \text{Maximum Perpendicular Deviation} / (\text{Vout (max.)} - \text{Vout (min.)}) \times 100 \quad [\% \text{FS.}]$$

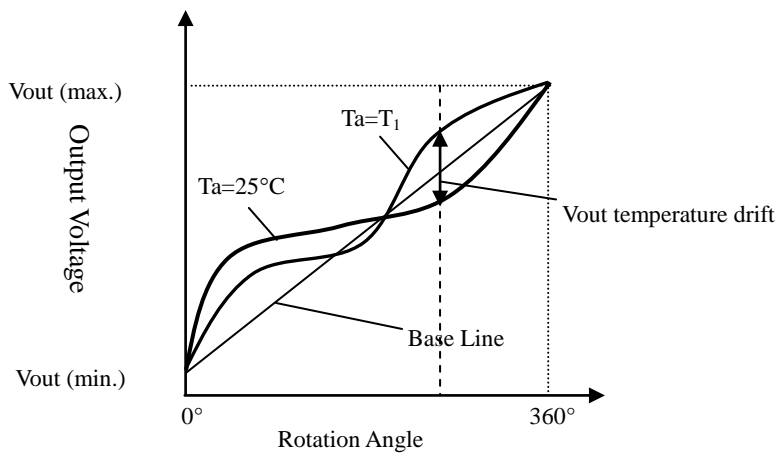


\*6) Angle temperature drift

Vout temperature drift means temperature drift of output voltage at the same rotation angle.

Angle temperature drift is defined as below formula.

$$\text{Angle temperature drift } [^\circ] = 360^\circ \times \text{Vout temperature drift} / (\text{Vout (max.)} - \text{Vout (min.)})$$

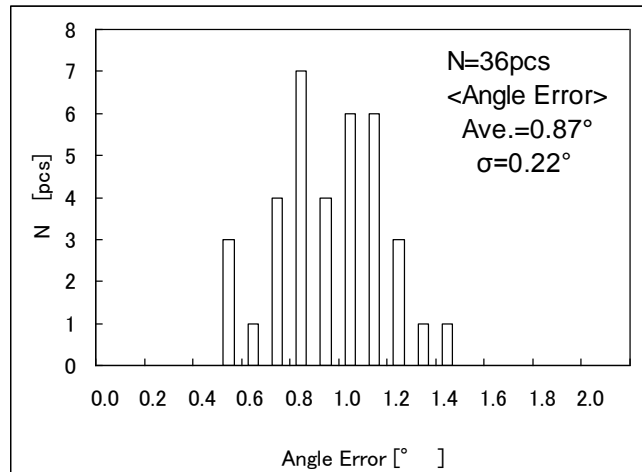


\*7) No Load

\*8) Reference (Angle Error)

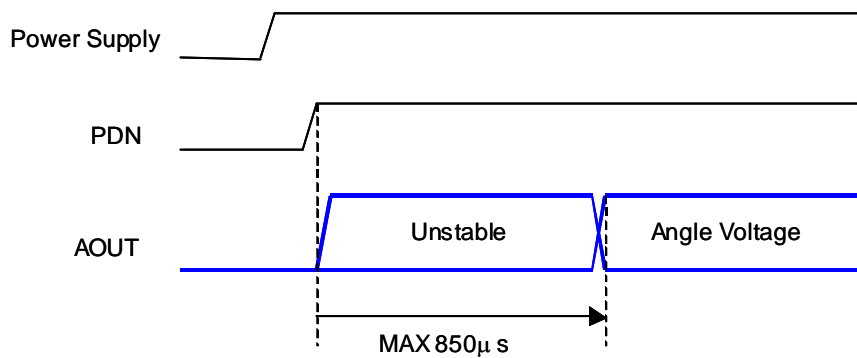
<Measurement conditions>

1. Magnet:  $\phi 7.0 \times t 2.0$ mm (Neodymium magnet:  $B_r=1250$ mT)
2. Distance between the magnet and the package: Gap=4.0mm  
(This Gap is the distance where the magnetic flux density at the sensor becomes 30mT)
3. Rotation angle of magnet: 0 to 360° (step: 1deg.)
4. Power Supply:  $V_{dd}=3.3$ V
5. Bypass Capacitor:  $C=0.1 \mu F$  (Distance from IC to Bypass Capacitor:  $d=15$ mm)



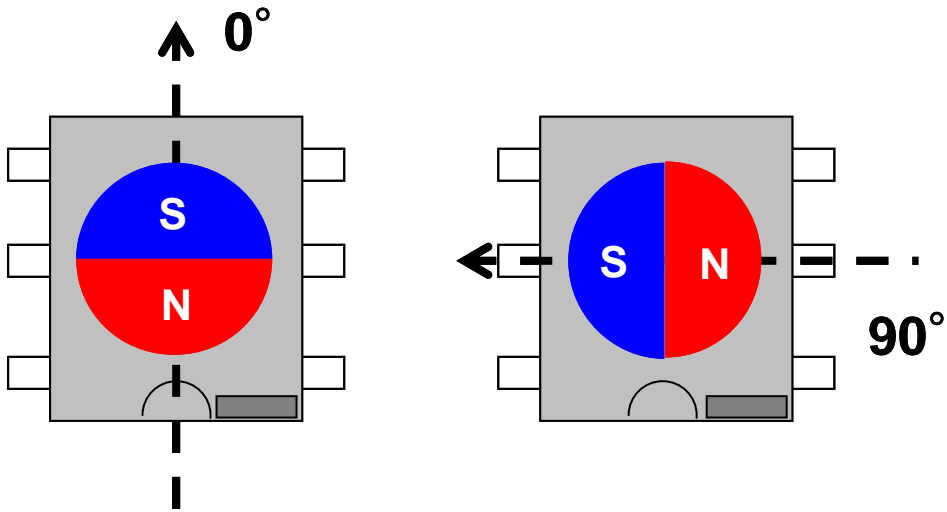
In this measurement conditions, Maximum of Angle Error (Ave.+5σ) is smaller than +/-2°

**Startup time**

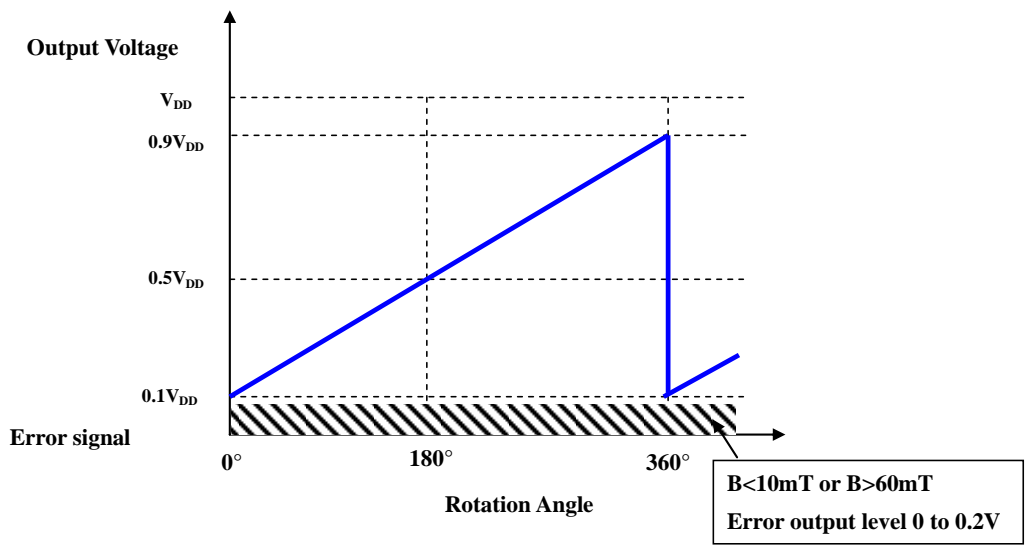


- 1) Please be noted that there is a certain period that the angle output voltage is unstable when EM-3242 goes to the operation from power down (PDN) mode, as shown above.
- 2) “Power Up Voltage” should be applied to PDN pin after applying “Power Supply Voltage” to VDD pin.

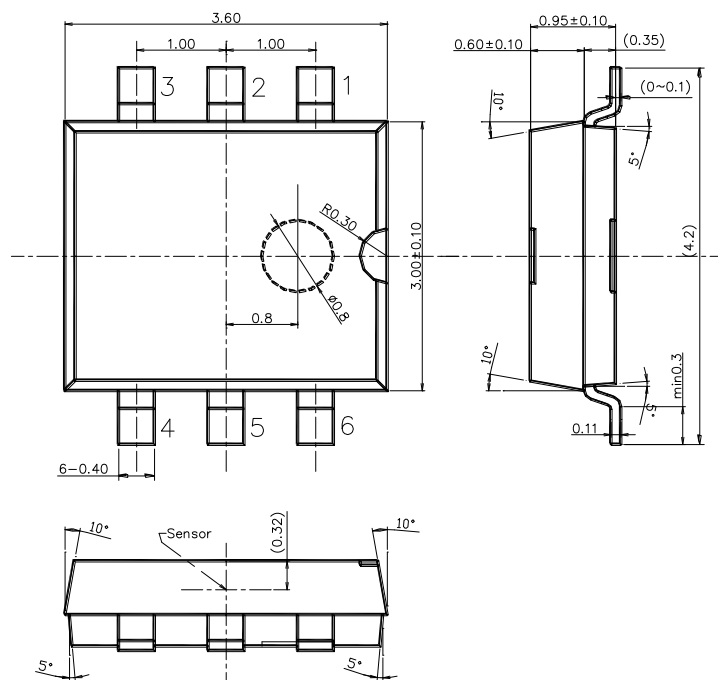
Magnet Direction and Output Voltage



Marking side defines the N polar as 0°, the Output Voltage (AOUT) increases as the magnet rotates counterclockwise. In other words, it decreases as the magnet rotates clockwise.



<b>Package and Terminals</b>
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Material of the terminals; Cu  
 Material of the plating; Sn  
 Thickness of the plating; 10 $\mu$ m (Typ.)  
 Weight; 24.3mg  
 \*This product is a Pb-Free Product.

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