



EM3242

Angle Sensor IC

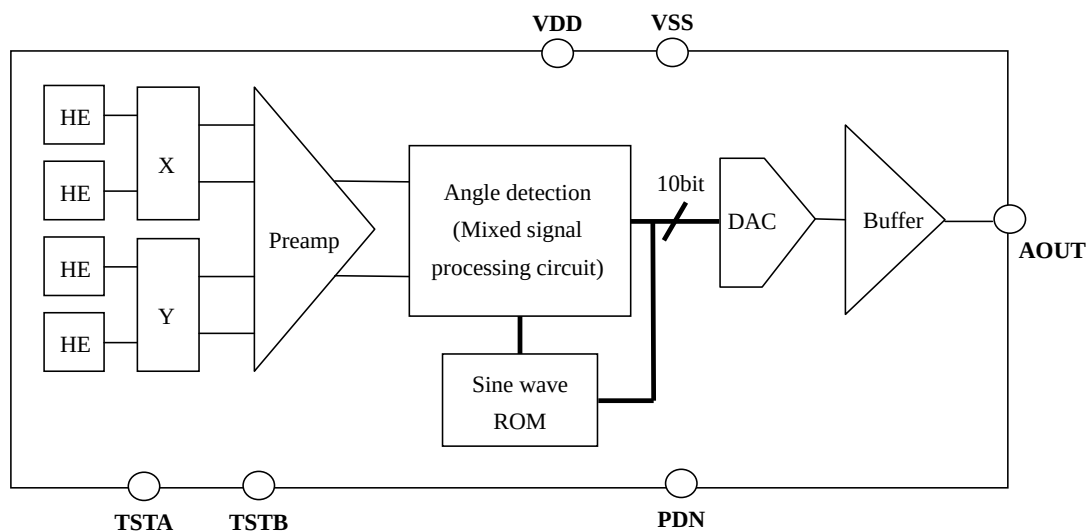
Applications

- ☐ 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= -30 to 85°C
- ☐ Package: SOP6 body size 3.6×3.0×0.95mm

Block Diagram



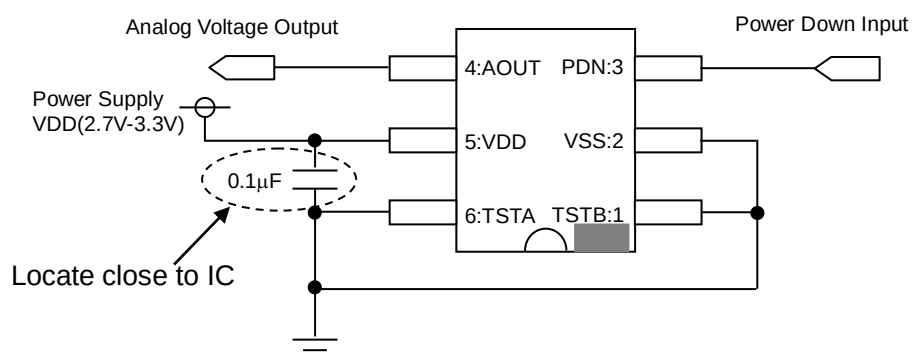
Functional Blocks

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.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	備考
Supply Voltage	V _{DD}	-0.3	6.5	V	
Input Voltage	V _{IN}	-	V _{DD} +0.3	V	PDN terminal
Storage Temperature Range	T _{stg}	-50	+125	°C	

Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply Voltage	V _{DD}	2.7	3.0	3.3	V	
Operating Temperature Range	T _a	-30	-	+85	°C	

Electrical & Magnetic Specifications

Condition is; T_a=25°C, V_{DD}=3.3V if particular notes are not defined.

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

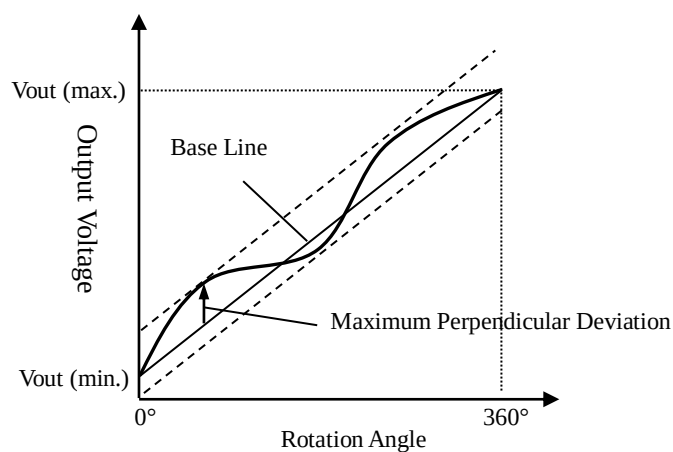
*5) Angle error

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.

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

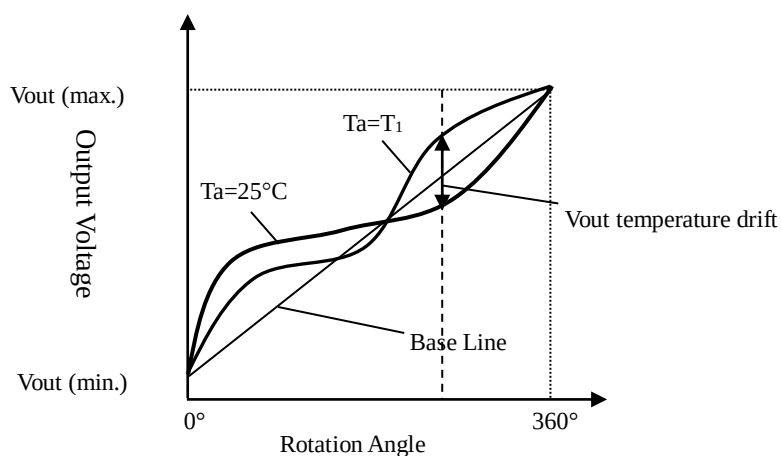


*6) Angle temperature drift

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

Angle temperature drift is defined as below formula.

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

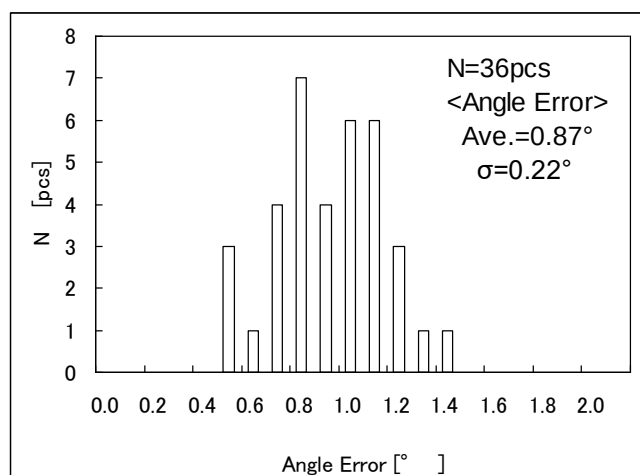


*7) No Load

*8) Reference (Angle Error)

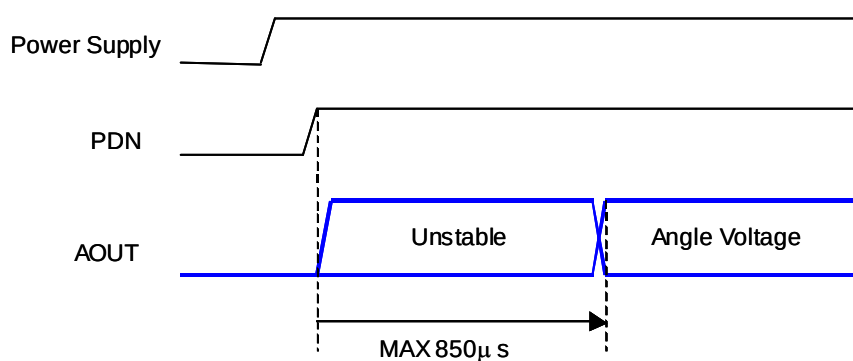
<Measurement conditions>

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)



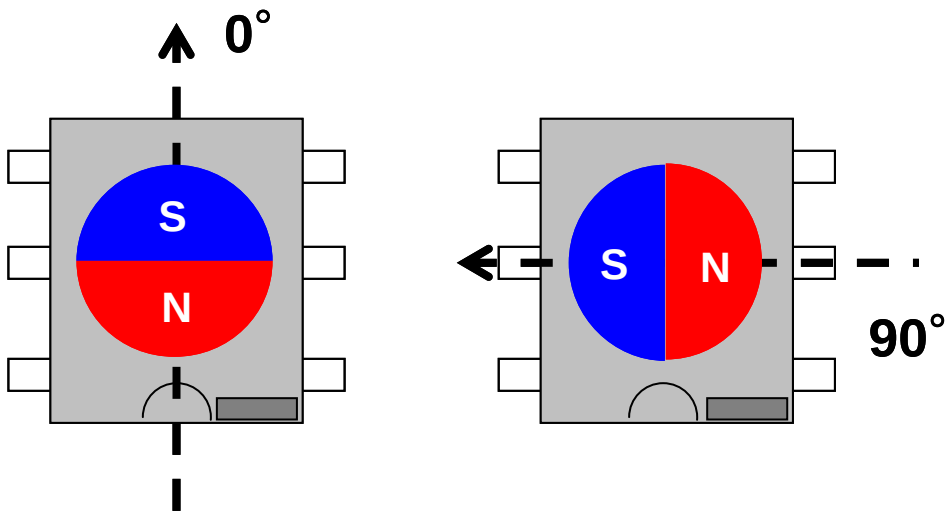
In this measurement conditions, Maximum of Angle Error (Ave. $+5\sigma$) is smaller than $\pm 2^\circ$

Startup time

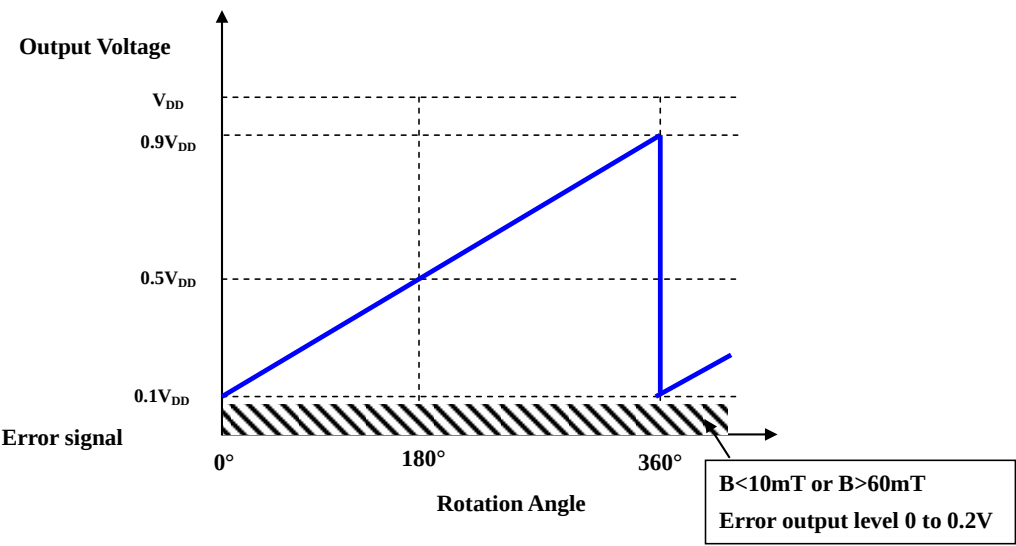


- 1) Please be noted that there is a certain period that the angle output voltage is unstable when EM-3242 goes to the operation from power down (PDN) mode, as shown above.
- 2) “Power Up Voltage” should be applied to PDN pin after applying “Power Supply Voltage” to VDD pin.

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.



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