Sine and cosine output high speed rotary encoder

FEATURES

- Contactless 12-bit resolution rotary encoder
- 12-bit absolute outputs

  --SIN/COS full difference output
- Incremental outputs

  --2V（V_{PP}）
- Angle linearity error < ±0.5°
- Maximum tracking speed: 20krpm
- Wide temperature range: -40℃ to 125℃
- SSOP16 package

APPLICATIONS

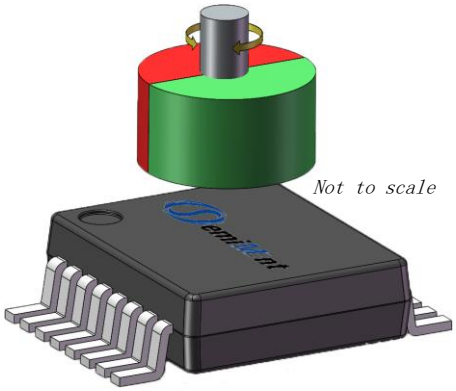
- Contactless rotary position sensing
- Brushless DC motor commutation
- Robotics
- Angular encoder
- Rotational speed control

DESCRIPTION

SC60220 is a non-contact high-speed and high-precision magnetic encoder chip. Hall induction point matrix is built into the center of the chip, which generates sine and cosine position signals through induction of a pair of pole magnets above. The analog to digital conversion circuit inside the chip samples the amplified sine and cosine signals, and the DSP circuit performs Angle calculation, and finally outputs various position signals. The SC60220 is suitable for high precision Angle measurement applications

The chip provides differential sine and cosine signal output with PSIN, NSIN, PCOS and NCOS amplitude of 2.0V. Fully differential sine and cosine signal has high reliability and long transmission distance, which is convenient for ADC sampling.

SC60220 is available in a 16-pin SSOP package, which is lead (Pb) free, with 100% matte tin lead frame plating.



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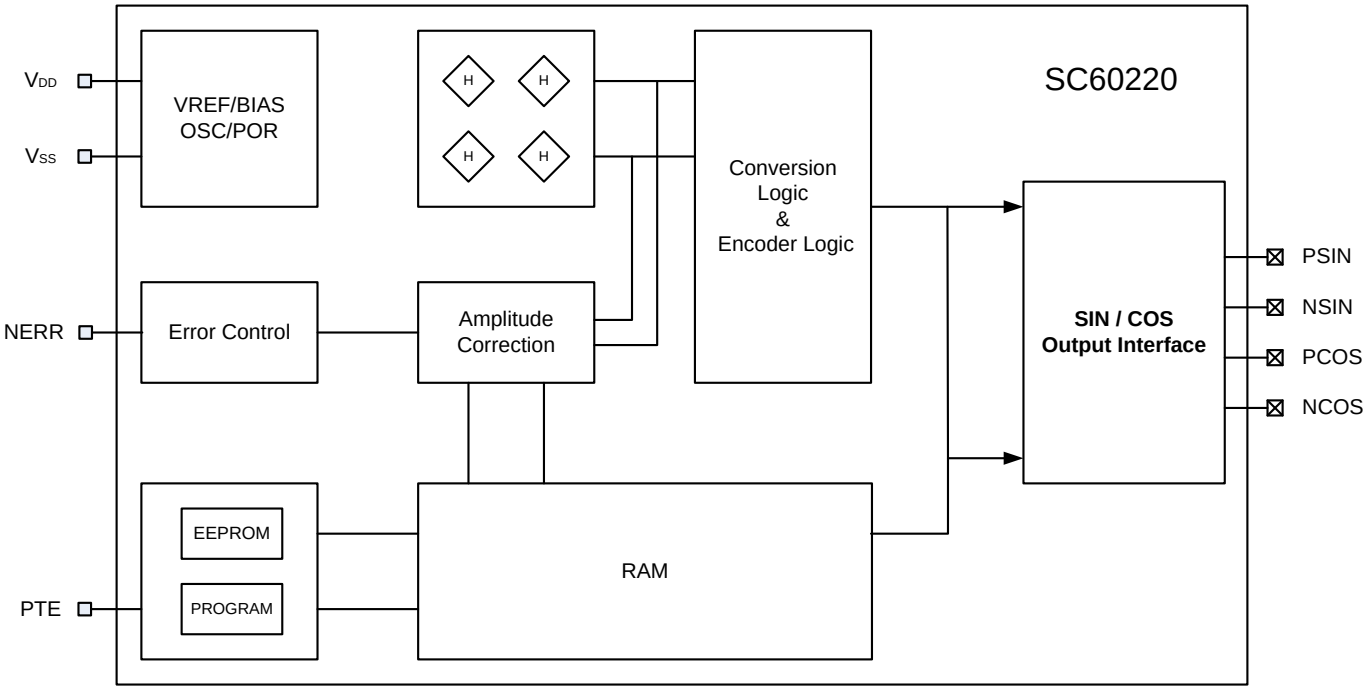
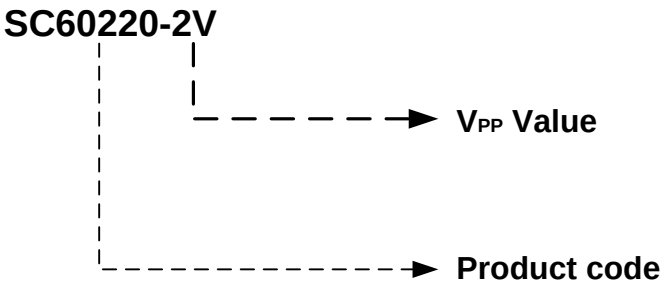
BLOCK DIAGRAM



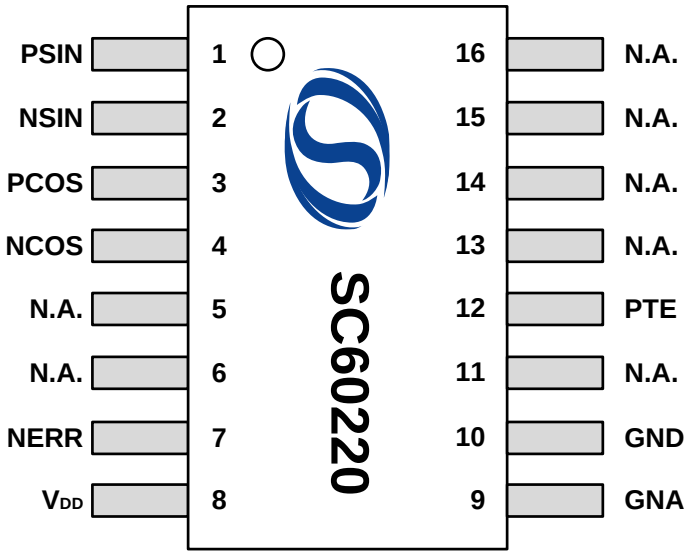
ORDERING INFORMATION

Part Number	Packing	Mounting	Output Type	Marking
SC60220	80 pcs Tube	16-pin SSOP	PSIN, NSIN, PCOS, NCOS	60220



TERMINAL CONFIGURATION

16-Pin SSOP
(Top view)



NO.	Name	I/O	Type	Description
1	PSIN	output	Digital	Sinusoidal output（+）
2	NSIN	output	Digital	Sinusoidal output（-）
3	PCOS	output	Digital	Cosine output（+）
4	NCOS	output	Digital	Cosine output（-）
5	N.A.	-	-	--
6	N.A.	-	-	--
7	NERR	-	Digital	Error output, need exterior pullup resistor (active low)
8	V_{DD}	-	Power	Power Supply PIN
9	GNA	-	GND	Analog Ground PIN
10	GND	-	GND	Digital Ground PIN
11	N.A.	input	-	--
12	PTE	-	Digital	EEPROM Programming Protection PIN
13	N.A.	-	-	--
14	N.A.	-	-	--
15	N.A.	-	-	--
16	N.A.	-	-	--

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Min.	Max.	Unit
Voltage at V_{DD} , PSIN,NSIN,PCOS,NCOS NERR	$V_{()}$		-0.3	6	V
Current in V_{DD}	$I_{()}$		-10	20	mA
Current at PSIN,NSIN,PCOS,NCOS NERR,	$I_{()}$		-100	100	mA
Current at PTE	$I_{()}$		-10	10	mA
EEPROM Write Cycles				100	cycle
Operating ambient temperature	T_A		-40	125	˚C
Storage temperature	T_{STG}		-65	165	˚C
Operating junction temperature	$T_{J(max)}$			165	˚C

Note: Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD Protection

Human Body Model (HBM) tests according to: standard EIA/JESD22-A114-B HBM

Parameter	Symbol	Limit Values		Units
		Min.	Max.	
ESD-Protection	V_{ESD}	-4	4	kV

OPERATING CHARACTERISTICS

valid through the full operate temperature range, V_{DD}=5V, C_{BY}=0.1uF, unless otherwise specified

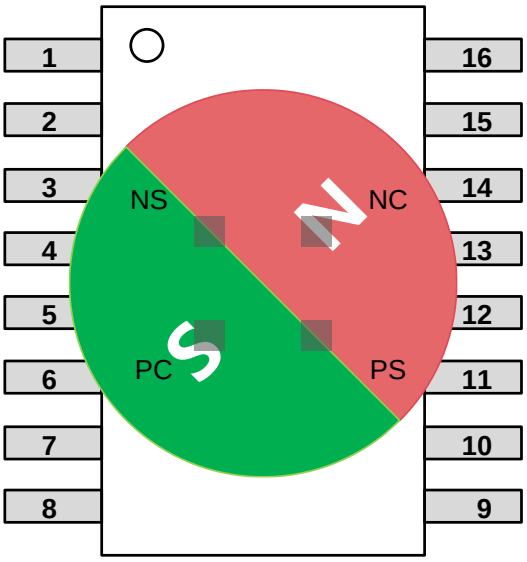
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Electrical Characteristics						
Supply Voltage	V_{DD}		3.0	5.0	5.5	V
Supply Current	I_{DD}	No load, f_{mag}=0 rpm	10	16	22	mA
Bandgap Reference	V_{bg}		1.18	1.25	1.32	V
Reference voltage	Vref		45	50	55	%VDD
Turn-on Threshold	$V_{th(on)}$	Increasing voltage	2.6	2.75	2.9	V
Turn-off Threshold	$V_{th(off)}$	Decreasing voltage	2.4	2.6	2.8	V
Hysteresis	$V_{th(Hys)}$		0.15	--	--	V
Sine/Digital Converter						
Sine/Digital Converter Resolution	$RES_{(sdc)}$		--	12	--	bit
Integral non-linearity	INL_{opt}	V_{DD}=5V,Temp=25℃,D_{in}=1.0mm	-0.5	--	0.5	Deg
Angle Output Delay Time	T_D		--	18.0	45.0	μS
Signal Level Control						
Sine cosine amplitude	V_{pp}		1.6	2.0	2.4	V
Sine and cosine amplitude deviation	OFF_{pp}		-0.1	0.0	0.1	V
Sine and cosine DC level deviation	OFF_{DC}		45	50	55	$\%V_{DD}$
Adjust time	$t_{(on)}$	to ± 10% of final amplitude	--	--	300	μS
Magnetic Input Specification						
Diameter	d_{mag}	ϕ 6mm x 2.5mm for cylindrica Magnets	4.0	6.0	10.0	mm
Thickness	t_{mag}		--	2.5	--	mm
Installation Distance	D_{in}	Recommended magnets	--	1.0	2.0	mm
Field Amplitude	H_{ext}	At chip surface	25	--	125	mT
Rotating Speed of Magnet	rpm		--	--	10	krpm
Lateral Displacement of Magnet Axis to Center of Hall Sensors	x_{dis}		--	--	0.2	mm
Displacement Chip Center to Package Center	x_{pac}		-0.15	--	0.15	mm
Angular Alignment of Chip vs. Package	ϕ_{pac}		-3	--	3	Deg
Displacement of Chip Surface to Package Surface	h_{pac}		--	0.4	--	mm

FUNCTIONAL DESCRIPTION

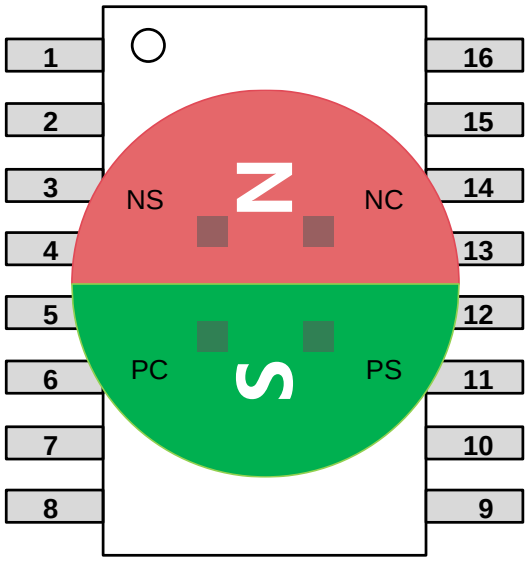
Position of the Hall Sensors

The Hall sensors are placed in the center of the package at a 90° angle to one another and arranged in a circle.

The zero-angle position of the magnet is reached when the value of V_{PCOS}-V_{NCOS} is at a maximum. This is the case when the South Pole of the magnet is exactly above the PCOS sensor and the North Pole is above sensor NCOS. When the magnet is rotated counterclockwise, the angle is increasing, as shown in the figure below.

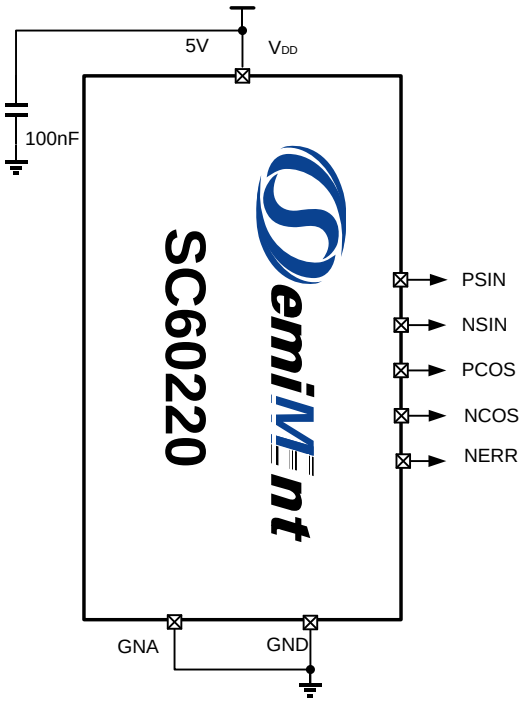


Angle = 0°



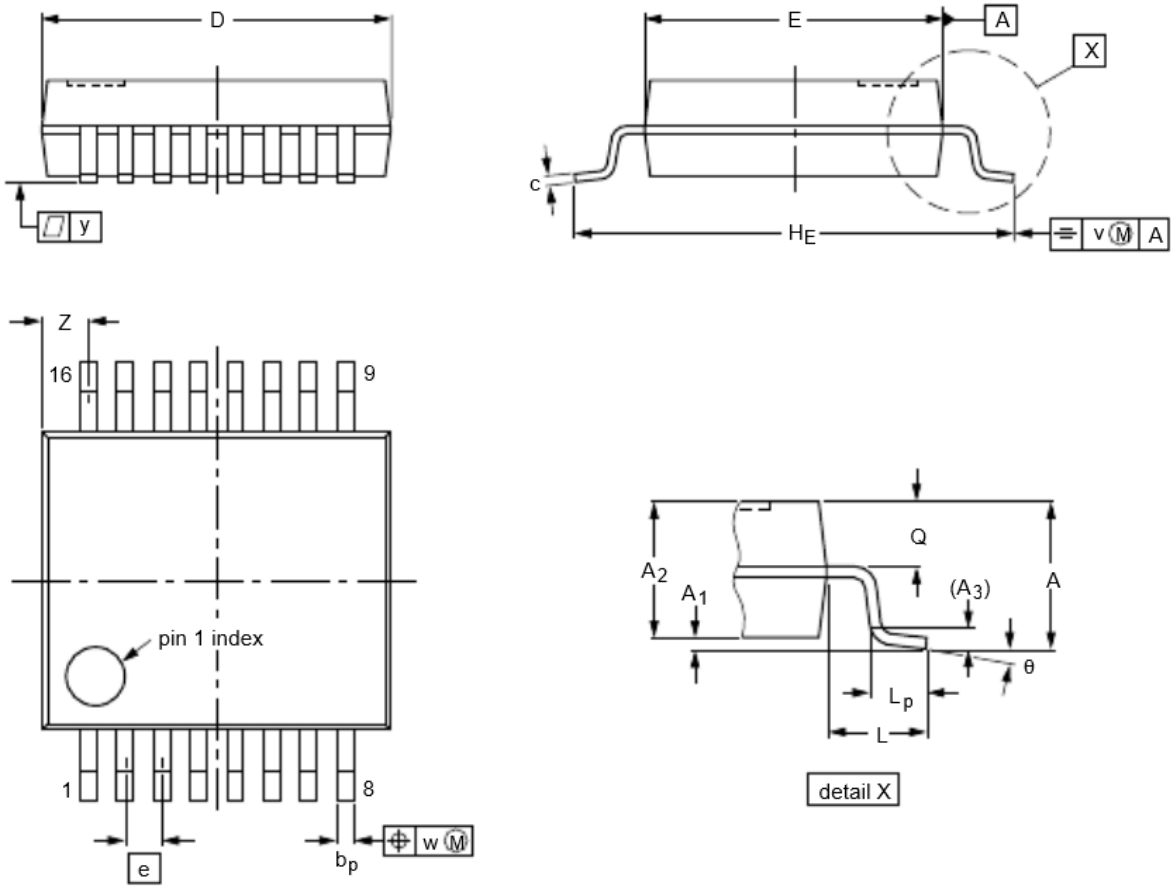
Angle = 45°

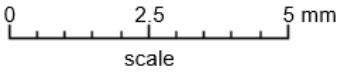
TYPICAL APPLICATION



A decoupling capacitor of 100nF is recommended in V_{DD} pin.

PACKAGE INFORMATION





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_P	Q	v	w	y	$Z^{(1)}$	θ
mm	2	0.21 0.05	1.85 1.65	0.25	0.38 0.22	0.25 0.09	6.4 6.0	5.6 5.0	0.65	8.2 7.4	1.25	0.95 0.55	0.9 0.7	0.2	0.13	0.1	1.00 0.55	8 0

Note

1. Plastic or metal protrusions of 0.25mm maximum per side are not included.

Revision History

Revision	Date	Description
RevA1.0	2019-04-05	Initial release
RevA1.1	2019-07-16	Update typical application circuit
RevA1.2	2020-05-31	Add version history
RevA/1.0	2020-11-17	Update format