



= Short Datasheet (Preliminary) = AK8963

3-axis Electronic Compass

1. Features

A 3-axis electronic compass IC with high sensitive Hall sensor technology.
Best adapted to pedestrian city navigation use for cell phone and other portable appliance.

Functions:

- 3-axis magnetometer device suitable for compass application
- Built-in A to D Converter for magnetometer data out
- 14-/16-bit selectable data out for each 3 axis magnetic components
 - Sensitivity: 0.6 μ T / LSB typ. (14-bit)
 - 0.15 μ T / LSB typ. (16-bit)
- Serial interface
 - I²C bus interface.
 - Standard mode and Fast mode compliant with Philips I²C specification Ver.2.1
 - 4-wire SPI
- Operation modes:
 - Power-down, Single measurement, Continuous measurement, External trigger measurement, Self test and Fuse access.
- DRDY function for measurement data ready
- Magnetic sensor overflow monitor function
- Built-in oscillator for internal clock source
- Power on Reset circuit
- Self test function with built-in internal magnetic source

Operating temperatures:

- -30°C to +85°C

Operating supply voltage:

- Analog power supply +2.4V to +3.6V
- Digital Interface supply +1.65V to analog power supply voltage.

Current consumption:

- Power-down: 3 μ A typ.
- Measurement:
 - Average power consumption at 8 Hz repetition rate: 280 μ A typ.

Package:

AK8963C	14-pin WL-CSP (BGA):	1.6 mm \times 1.6 mm \times 0.5 mm (typ.)
AK8963N	16-pin QFN package:	3.0 mm \times 3.0 mm \times 0.75 mm (typ.)

2. Overview

AK8963 is 3-axis electronic compass IC with high sensitive Hall sensor technology.

Small package of AK8963 incorporates magnetic sensors for detecting terrestrial magnetism in the X-axis, Y-axis, and Z-axis, a sensor driving circuit, signal amplifier chain, and an arithmetic circuit for processing the signal from each sensor. Self test function is also incorporated. From its compact foot print and thin package feature, it is suitable for map heading up purpose in GPS-equipped cell phone to realize pedestrian navigation function.

AK8963 has the following features:

- (1) Silicon monolithic Hall-effect magnetic sensor with magnetic concentrator realizes 3-axis magnetometer on a silicon chip. Analog circuit, digital logic, power block and interface block are also integrated on a chip.
- (2) Wide dynamic measurement range and high resolution with lower current consumption.

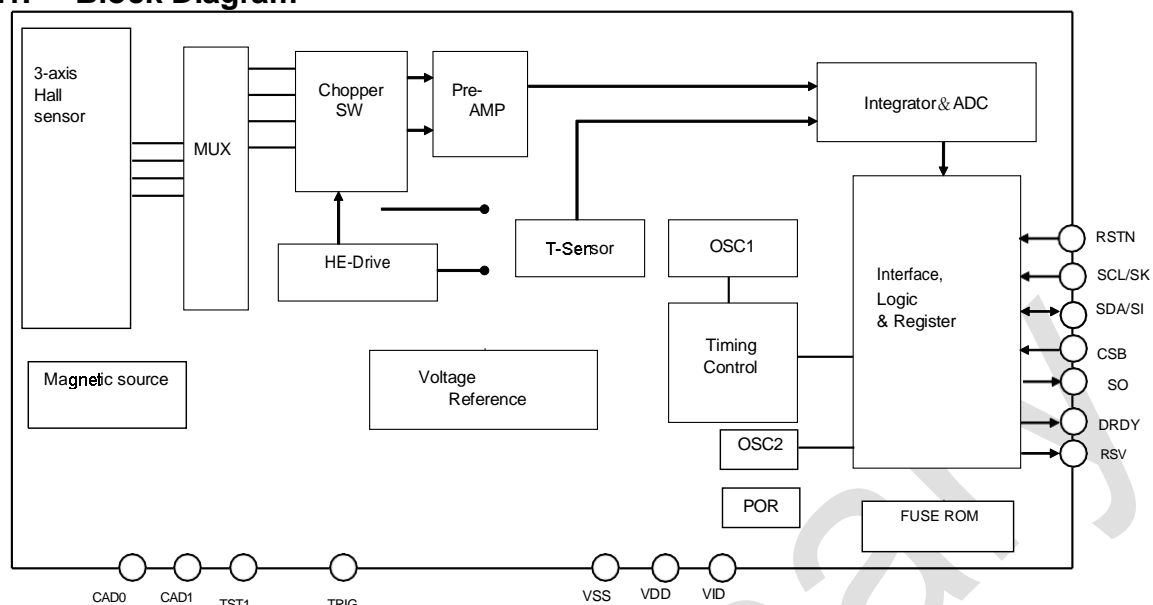
Output data resolution:	14 bit (0.6 μ T/LSB)
	16 bit (0.15 μ T/LSB)
Measurement range:	\pm 4900 μ T
Average current at 8Hz repetition rate:	280 μ A typ.
- (3) Digital serial interface
 - I²C bus interface to control AK8963 functions and to read out the measured data by external CPU. A dedicated power supply for I²C bus interface can work in low-voltage apply as low as 1.65V.
 - 4-wire SPI is also supported. A dedicated power supply for SPI can work in low-voltage apply as low as 1.65V.
- (4) DRDY pin and register inform to system that measurement is end and set of data in registers are ready to be read.
- (5) Device is worked by on-chip oscillator so no external clock source is necessary.
- (6) Self test function with internal magnetic source to confirm magnetic sensor operation on end products.

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4. Circuit Configuration

4.1. Block Diagram



4.2. Block Function

Block	Function
3-axis Hall sensor	Monolithic Hall elements.
MUX	Multiplexer for selecting Hall elements.
Chopper SW	Performs chopping.
HE-Drive	Magnetic sensor drive circuit for constant-current driving of sensor
Pre-AMP	Variable-gain differential amplifier used to amplify the magnetic sensor signal.
Integrator & ADC	Integrates and amplifies pre-AMP output and performs analog-to-digital conversion.
OSC1	Generates an operating clock for sensor measurement. 6.144MHz(typ.)
OSC2	Generates an operating clock for sequencer. 128kHz(typ.)
POR	Power On Reset circuit. Generates reset signal on rising edge of VDD.
Interface Logic	Exchanges data with an external CPU. DRDY pin indicates sensor measurement end and data is ready to be read. I ² C bus interface using two pins, namely, SCL and SDA. Standard mode and Fast mode are supported. The low-voltage specification can be supported by applying 1.65V to the VID pin. 4-wire SPI is also supported by SK, SI, SO and CSB pins. 4-wire SPI works in VID pin voltage down to 1.65V, too.
Timing Control	Generates a timing signal required for internal operation from a clock generated by the OSC1.
Magnetic Source	Generates magnetic field for self test of magnetic sensor.
FUSE ROM	Fuse for adjustment

4.3. Pin Function

QFN Pin No.	WLCSP Pin No.	Pin name	I/O	Power supply system	Type	Function
1	A1	DRDY	O	VID	CMOS	Data Ready output pin. "H" active. Informs measurement ended and data is ready to be read.
2	A2	CSB	I	VID	CMOS	Chip select pin for 4-wire SPI. "L" active. Connect to VID when selecting I ² C bus interface.
3	A3	SCL	I	VID	CMOS	When the I ² C bus interface is selected (CSB pin is connected to VID) SCL: Control data clock input pin Input: Schmidt trigger
		SK				When the 4-wire SPI is selected SK: Serial clock input pin
5	A4	SDA	I/O	VID	CMOS	When the I ² C bus interface is selected (CSB pin is connected to VID) SDA: Control data input/output pin Input: Schmidt trigger, Output: Open drain
		SI	I			When the 4-wire SPI is selected SI: Serial data input pin
15	B1	VDD	-	-	Power	Analog Power supply pin.
4	B3	RSV	O	VID	CMOS	Reserved. Keep this pin electrically nonconnected or connect to VSS.
6	B4	SO	O	VID	CMOS	When the I ² C bus interface is selected (CSB pin is connected to VID) Hi-Z output. Keep this pin electrically nonconnected.
						When the 4-wire SPI is selected Serial data output pin
13	C1	VSS	-	-	Power	Ground pin.
14	C2	TST1	I	VDD	CMOS	Test pin. Pulled down by 100kΩ resistor. Keep this pin electrically nonconnected or connect to VSS.
7	C3	TRG	I	VID	CMOS	External trigger pulse input pin. Enabled only in External trigger mode. Pulled down by 100kΩ resistor. When External trigger mode is not in use, keep this pin electrically nonconnected or connect to VSS.
8	C4	VID	-	-	Power	Digital interface positive power supply pin.
12	D1	CAD0	I	VDD	CMOS (Analog)	When the I ² C bus interface is selected (CSB pin is connected to VID) CAD0: Slave address 0 input pin Connect to VSS or VDD.
						When the 4-wire serial interface is selected Connect to VSS.
11	D2	CAD1	I	VDD	CMOS (Analog)	When the I ² C bus interface is selected (CSB pin is connected to VID) CAD1: Slave address 1 input pin Connect to VSS or VDD.
						When the 4-wire serial interface is selected Connect to VSS.
10	D4	RSTN	I	VID	CMOS	Reset pin. Resets registers by setting to "L". Connect to VID when not in use.

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