SWS1120
Configurable 24-bit Analog-to-Digital Interface IC for High Performance Capacitive MEMS Gyroscope

General Description

The SWS1120 is a full capacitive detection MEMS gyroscope control IC. The SWS1120 provides a highly configurable plug and play interface solution for MEMS gyroscopes for high performance applications. The SWS1120 offers a high resolution digital output and is supported by proprietary development software and hardware that enables MEMS developers/producers to quickly demonstrate/assess the performance of a MEMS gyroscope.

The SWS1120 is designed as an Application Specific Standard Product (ASSP) that is ready for integration with MEMS sensing elements. The SWS1120 is designed to support a wide variety of MEMS gyroscope designs through OTP configuration only. Capacitive MEMS gyroscopes with various resonance frequencies and sensitivities are supported. Depending on the exact MEMS design and electrical characteristics, differential capacitance resolution down to 50 zF/√Hz or less is achievable.

The SWS1120's capacitive front-end has a trimmable gain and offset to accommodate MEMS process variation during fabrication. SWS1120 requires only a single 5V supply and few passive components.

Features

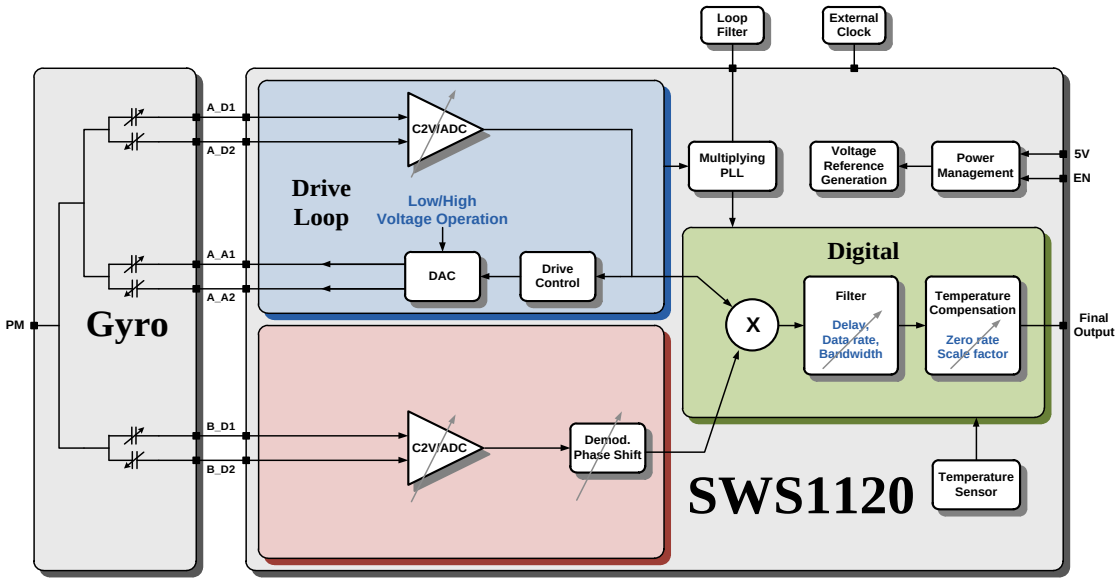
- Ultra low noise capacitive detection front-end with resolution <50zF/√Hz
- Proprietary technology to minimize harmful electrical coupling from sensor actuation signals
- High resolution ADC offering more than 100dB dynamic range in 100Hz BW
- Configurable capacitive front-end to support different sensing element designs
- Charge pump for high voltage actuation option (up to 8V)
- Gyro drive actuation loop with programmable automatic amplitude control (AAC) and tunable frequency range
- Gyroscope Corioilis output demodulation utilizing proprietary accurate phase tuning technique
- Second order scale factor and bias temperature compensation using on chip temperature sensor
- Tunable bandwidth output filter
- On chip clock generation
- Low noise reference voltage
- OTP/MTP for sensor trimming and re-calibration
- Single 5V supply operation with 23mA supply current
- 10Mb/s standard SPI interface in slave mode

Applications

The SWS1120 is targeted at applications with low resolution requirements. Typical applications include:

- Industrial
- Navigation
- Motion and position measurements
- Oil exploration

Block Diagram



Specifications

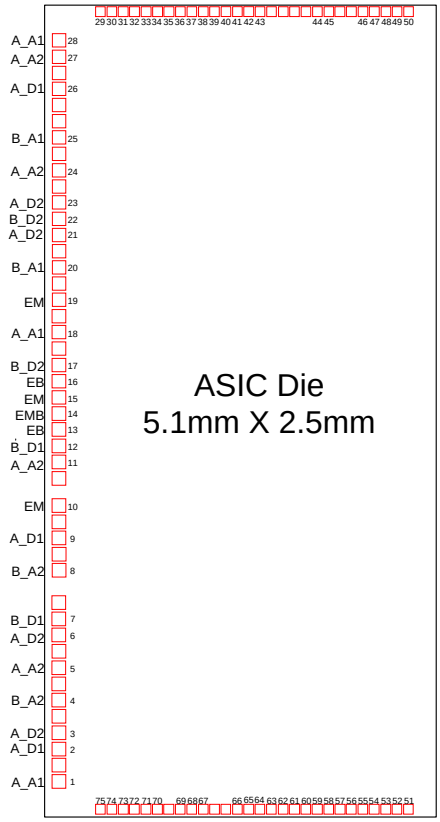
Parameter	Conditions	Min	Typ	Max	Units
Front-End					
Supported Nominal Capacitance		0.25		15	pF
Differential Capacitance Range	Low-voltage operation			1.5	pF
	High-voltage operation			0.85	pF
Input Noise	At max gain setting, parasitic capacitance = 50pF		50		zF/√Hz
Linearity	At maximum voltage output	11			Bit
ADC Dynamic Range	In 100 BW		100		dB
Drive Actuation Voltage		4.4		8	V
Supported Gyro Drive Frequency		1.9		20	KHz
Output					
Bandwidth		4		420	Hz
Group Delay		2		710	Ms
Output Resolution	Two's complement format		24		Bit
Supply Voltage		4.75	5	5.5	V
Supply Current	Low-voltage operation		23		mA
	High-voltage operation		29		mA
Power Down Current			1		µA
Operating Temperature Range		-40		85	°C

Example Gyroscope Performance

The achievable MEMS gyroscope performance is highly dependent on the actual MEMS design and its mechanical and electrical characteristics. As an important reference point; gyro resolutions as low as 0.001 degree/second/√Hz and bias instability around 1 deg/hr have been achieved using SWS1120.

Bare Die and Pad-Out

Die dimensions: 5.1 mm by 2.5 mm and 300µm thickness. Pad opening is 60µm x 60µm with pitch of 70 µm on die north and south sides ball bonding to package pads. MEMS interfacing pads are arranged on one side (left) with pad opening of 80µm x 80µm and a minimum pitch of 100µm. These MEMS side pads are designed to be compatible with both ball and wedge bonding process.



Pad Distribution on Die

MEMS Interface Pad Definitions

As shown in the following table the SWS1120 provides two equivalent interface channels: channel-A and channel-B. For compatibility with different MEMS pad arrangements, each channel can be configured for MEMS gyroscope drive loop interfacing or Coriolis sense detection. Also, signals are represented at the MEMS interface by multiple pads to provide additional flexibility for MEMS pad location.

Pin No.	Name	Description
1	A_A1	Channel A +ve Actuation
2	A_D1	Channel A +ve Detection
3	A_D2	Channel A -ve Detection
4	B_A2	Channel B -ve Actuation
5	A_A2	Channel A -ve Actuation
6	A_D2	Channel A -ve Detection
7	B_D1	Channel B +ve Detection
8	B_A2	Channel B -ve Actuation
9	A_D1	Channel A +ve Detection
10	EM	Proof Mass
11	A_A2	Channel A -ve Actuation
12	B_D1	Channel B +ve Detection
13	EB	MEMS substrate
14	EMB	Inverted Proof Mass
15	EM	Proof Mass
16	EB	MEMS substrate
17	B_D2	Channel B -ve Detection
18	A_A1	Channel A +ve Actuation
19	EM	Proof Mass
20	B_A1	Channel B +ve Actuation
21	A_D2	Channel A -ve Detection
22	B_D2	Channel B -ve Detection
23	A_D2	Channel A -ve Detection
24	A_A2	Channel A -ve Actuation
25	B_A1	Channel B +ve Actuation
26	A_D1	Channel A +ve Detection
27	A_A2	Channel A -ve Actuation
28	A_A1	Channel A +ve Actuation

QFN Package

The main form of delivery of SWS1120 is bare die for integration in a single package with the MEMS sensing element. For applications that require packaged ICs, please contact SWS for QFN packaging options.

Revision History

Revision Date Description 0.1, September 2013

Revision	Date	Description
0.1	9-9-13	Original datasheet created

Contact Information

Cairo Office **(Headquarters)** Si-Ware Systems 3, Khaled Ibn Al-Waleed Street Sheraton, Heliopolis Cairo 11361 Egypt Tel.: +20 2 22 68 47 04 Fax: +20 2 22 68 47 05	**Los Angeles Office** Si-Ware Systems 1150 Foothill Blvd., Suite M La Canada, CA 91011 USA Tel.: +1 818 790 1151