Digitally Trimmed Sensor Signal Conditioner

General Description

The MC01 provides a highly integrated interface for sensors, optimized for resistive bridge sensor calibration and compensation with minimum external components. It provides a 2-bit programmable current source for biasing of external sensors, a 4-bit programmable-gain instrumentation amplifier, two 10-bit Digital-to-Analog converters and an 88-bit EPROM for storing the calibration data and configuring the device. The signal processing tasks performed include 10-bit Analog-to-Digital Conversion, averaging, and compensation of offset, offset temperature coefficient, full-span output, as well as full-span output temperature coefficient. It also performs correction of zero position and sinusoidal nonlinearity -e.g., that of Infineon Giant Magnetoresisive Sensors (GMR)-. Either analog or PWM outputs are provided.

When interfacing the Infineon Giant Magnetoresisive Sensor, the device provides the angular position of a standard magnet centered above the sensor. A programmable range covering up to 110º is divided into 512 steps (9 bits of resolution). In the PWM output configuration the PWM duty cycle limits are programmable, as well as the zero position. The device is insensitive to the peak magnetic field, magnetic offset and displacement of the magnet.

Built-in testability features of the MC01 allow to speed up, automate, and simplify the calibration and compensation of the device.

Although optimized for use with Infineon Giant Magnetoresistive sensors, the MC01 may also be used with other resistive sensors (piezoresistive sensors, accelerometers and strain gauges) with some external components and off-chip linearization (if needed).

Features

- **Accurate Single-Chip Sensor Signal Conditioning**
- **Sensor Deviations Trimmed Using Correction Coefficients Stored in Internal EPROM.**
- **Compensation of Offset, Offset TC, Full-Scale Output, Full-Scale Output TC, and Sinusoidal Nonlinearity**
- **Power Supply selectable:**
  a) 6.5 –30V (40V for 20000 s)
  b) 5V
- **Programmable Current Source (2.5 mA to 4 mA, 4 Steps) for Sensor Biasing**
- **Programmable Analog Gain (18 to 64, 16 Steps)**
- **9 bit Resolution (Higher Resolution Under Development)**
- **Wide Temperature Range.**

Pin Configuration

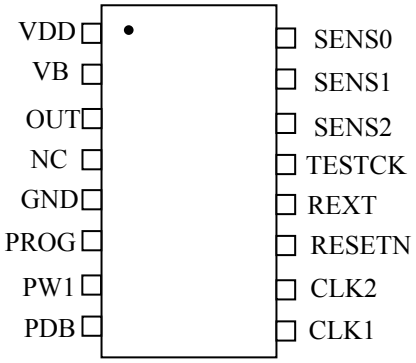

Fig. 1. MC01 pinout

Applications

- When used with the GMR sensor:
  - Contactless potentiometer
  - Absolute position sensor
  - PC mouse
- When used with other resistive sensors:
  - Piezoresistive Pressure and Acceleration Transducers
  - Automotive Systems
  - Hydraulic Systems
  - Strain-Gauge Sensors

TECHNICAL DATA

	MIN	TYP	MAX	UNITS
SUPPLY VOLTAGE				
VB, supply voltage	6.5	12	30	V
VB, supply voltage (5V op. mode)	4.5	5	5.5	V
CURRENT SOURCE				
Bride current range	2.5	3	4	mA
Bridge voltage swing	V_{SS}+1.4		V_{DD} −1.4	V
PROG. GAIN AMPLIFIER				
Gain Range	18.1	25.3	64	
D/A CONVERTERS				
Resolution		10		bits
Differential Nonlinearity		±0.25		LSB
Input Voltage	0.5		4.5	V
COMPENSATION RANGES (for Infineon GMR interfacing)				
Electrical offset correction range	< -50%		>50%	Relative to sensor peak input ampl.
Mechanical offset correction range	-13.75º		13.75º	Relative to ref. position
Digital gain correction range	0		2	
Operating temperature range	-40 to 125 (under validation)			ºC
OUTPUT CHARACTERISTICS (for Infineon GMR interfacing)				
Angular range [a]	16º		110º	Centered on ref. position
Angular resolution		9 bits		
PWM output resolution		0.19%		
PWM duty cycle limits [b]	0%		100%	
PWM frequency	194	200	206	Hz
PWM rise time/fall time [c]	20		30	µs
Analog output resolution		7.8		mV

NOTES:

[a] angular range selectable from 16º to 110º in 1024 steps

[b] PWM duty cycle limits symmetrical: L% to (100-L)%, L selectable from 0%-50% in 256 steps

[c] PWM rise/fall times when slope control option is set

PIN DESCRIPTION (SOIC16 PACKAGE)

PIN	NAME	DESCRIPTION
1	VDD	VDD output from internal voltage regulator. Supply input for 5V applications, where pins 1 and 2 are shorted. Connect a 0.1μF capacitor from VDD to GNG.
2	VB	Battery voltage input
3	OUT	Analog/PWM output. Externally pulled to VB.
4	NC	Leave unconnected
5	GND	Ground Input
6	PROG	PROM Buffered DC Programming Input
7	PW1	Pulse Width Signal for PROM Programming
8	PDB	Power Down for PROM
9	CLK1	Clock for selection of PROM Zener diodes. Must be synchronized with PW1 for programming
10	CLK2	Clock for PROM Zener diode read, or data input for test pattern
11	RESETN	Input for PROM reset and mode selection.
12	REXT	External resistor for internally generating bias currents and clock frequency
13	TESTCK	External test clock
14	SENS2	Negative terminal of differential input
15	SENS1	Positive terminal of differential input
16	SENS0	Bridge voltage/Current bias output

SCHEMATIC DIAGRAM

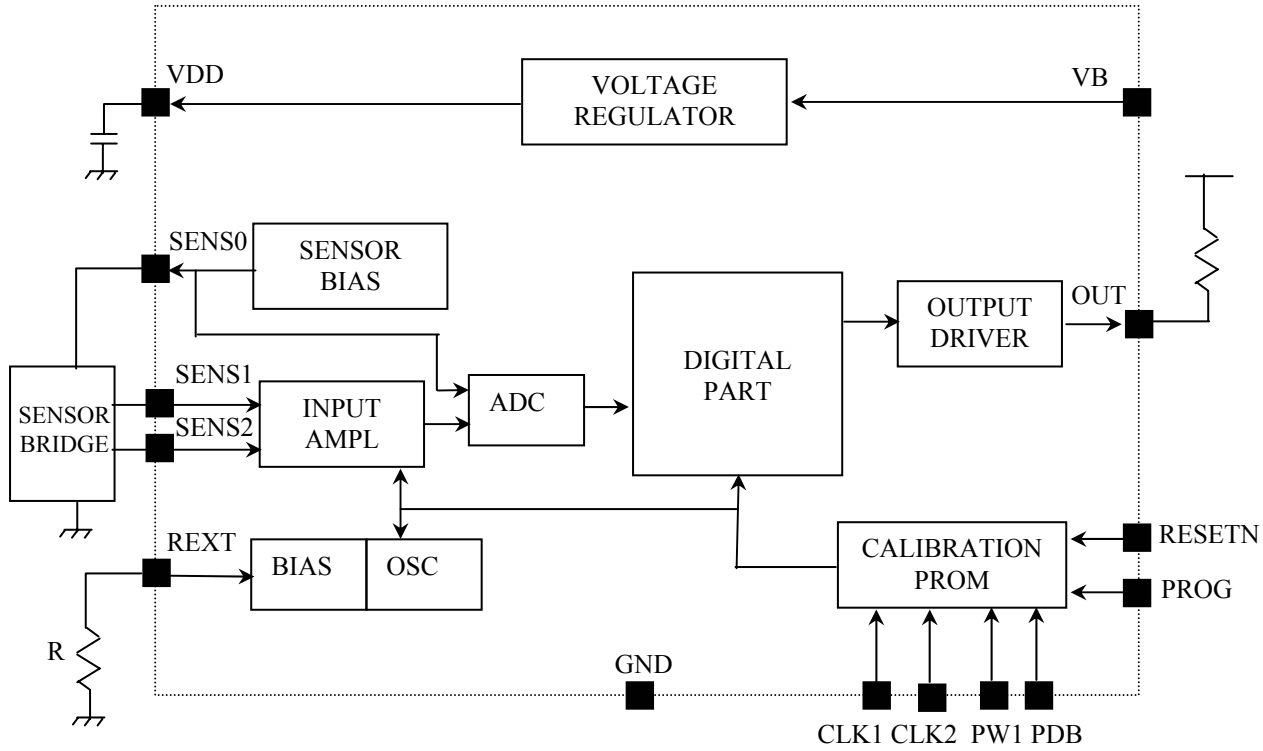

Figure 2. MC01 architecture