

## DATA SHEET



### SCA830-D07 1-AXIS INCLINOMETER WITH DIGITAL SPI INTERFACE

#### Features

- 3.3 V supply voltage
- $\pm 1$  g measurement range
- Single axis measurement in Y direction
- $\pm 30$  mg offset accuracy over temp range
- SPI digital interface
- Extensive self-diagnostics features
- Size 7.6 x 3.3 x 8.6 mm (w x h x l)
- Qualified according to AEC-Q100 standard
- Package, pin-out and SPI protocol compatible with Murata's digital accelerometer product family
- RoHS compliant Dual Flat Lead (DFL) plastic package suitable for lead free soldering process and SMD mounting
- Proven capacitive 3D-MEMS technology
- High resolution 16-bit A/D converter

#### Applications

The SCA830-D07 is targeted to applications with high stability requirements. Typical applications include

- Hill Start Aid (HSA)
- Electronic Parking Brake (EPB)
- Roll Over detection
- Suspension control
- Inclinometers
- Motion and position measurements

#### General Description

The SCA830-D07 is a single axis inclinometer component based on Murata's capacitive 3D-MEMS technology. The component integrates high accuracy micromechanical acceleration sensing together with a flexible SPI digital interface. Dual Flat Lead (DFL) housing guarantees reliable operation over product lifetime.

The SCA830-D07 is designed, manufactured and tested for high stability, reliability and quality requirements of automotive applications. The inclinometer has an extremely stable output over wide ranges of temperature, humidity and mechanical noise. The component is qualified to the AEC-Q100 standard and has several advanced self-diagnostics features. The DFL housing is suitable for SMD mounting and the component is compatible with the RoHS and ELV directives.

The SCA830-D07 is a part of Murata's digital accelerometer family and fully compatible with its single axis accelerometers (SCA800 Series) and other multi axis accelerometers (SCA2100 Series and SCA3100 Series).

## Performance Characteristics

Vdd = 3.3 V and ambient temperature unless otherwise specified.

**Table 1.** Performance characteristics of SCA830-D07

| Parameter                              | Condition                             |      |                   |                  |         |
|----------------------------------------|---------------------------------------|------|-------------------|------------------|---------|
|                                        |                                       | Min  | Typ <sup>1)</sup> | Max              | Units   |
| Analog and digital Vdd                 |                                       | 3.0  |                   | 3.6              | V       |
| Current consumption                    | Active mode                           |      | 5                 | 6.3              | mA      |
|                                        | Power down mode                       |      |                   | 0.1              | mA      |
| Measurement range                      | Measurement axis (Y)                  | -1   |                   | 1                | g       |
|                                        |                                       | -90  |                   | +90              | °       |
| Operating temperature                  |                                       | -40  |                   | 125              | °C      |
| Total offset error <sup>2)</sup>       | Temperature range -40 ... +125 °C     | -70  |                   | +70              | mg      |
| Offset stability <sup>3)</sup>         | Temperature range -40 ... +125 °C     | -25  |                   | 25               | mg      |
|                                        |                                       | -1.5 |                   | 1.5              | °       |
| Offset calibration error <sup>4)</sup> | @25°C                                 |      | ±20               |                  | mg      |
|                                        |                                       |      | ±1.1              |                  | °       |
| Offset temperature drift               | Temperature range -40 ... +125 °C     |      |                   | 30 <sup>5)</sup> | mg      |
|                                        | Temperature range -20 ... +85 °C      |      | ±13 <sup>6)</sup> |                  | mg      |
| Sensitivity                            | 16 bit output<br>between ±3°          |      | 32 000            |                  | Count/g |
|                                        |                                       |      | 0.00179           |                  | °/Count |
| Total sensitivity error                | Temperature range -40 ... +125 °C     | -4   |                   | 4                | % FS    |
| Sensitivity calibration error          | @25 °C ±5°C                           |      | ±1.4              |                  | % FS    |
| Sensitivity temperature drift          | Temperature range -40 ... +125 °C     |      | ±0.9              |                  | % FS    |
| Linearity error                        | +1g ... -1g range                     | -20  |                   | 20               | mg      |
| Cross-Axis sensitivity                 |                                       |      | ±2                | ±3.5             | %       |
| Zero acceleration output               | 2-complement                          |      | 0                 |                  | Counts  |
| Amplitude response                     | -3dB frequency                        |      | 6.25              |                  | Hz      |
| Noise                                  |                                       |      | 0.15              |                  | mg RMS  |
| Power on setup time                    |                                       |      |                   | 0.3              | s       |
| Output data rate                       |                                       |      | 125               |                  | Hz      |
| Output load                            |                                       |      |                   | 50               | pF      |
| SPI clock rate                         |                                       |      |                   | 8                | MHz     |
| ESD protection                         | Human Body Model                      |      |                   | 2                | kV      |
|                                        | Charge Device Model                   |      |                   | 1                | kV      |
| Moisture sensitivity level             | IPC/JEDEC J-STD-020C, Level 3         |      |                   |                  |         |
| Mechanical shock                       |                                       |      |                   | 20 000           | g       |
| ID register value                      | Customer readable ID register (27hex) |      | 0A                |                  |         |

<sup>1)</sup> Typical ± values are ±3 sigma variation limits from validation test population.

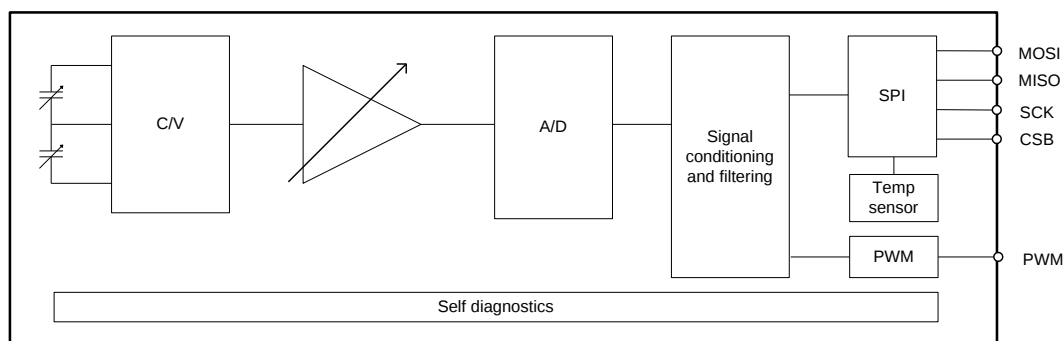
<sup>2)</sup> Includes offset deviation from 0 g value including calibration error and drift over lifetime, temperature and supply voltage.

<sup>3)</sup> **After mounting of the ECU to the application and after offset zero-setting at room temperature. Relevant offset failure due to temperature dependency of offset as well as aging over lifetime**

<sup>4)</sup> Includes offset deviation from 0g value including calibration error and drift over lifetime.

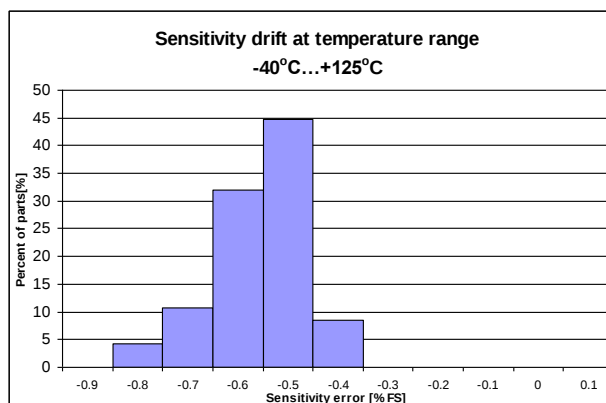
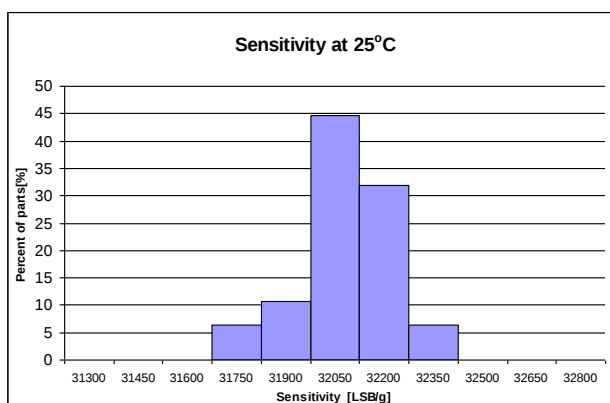
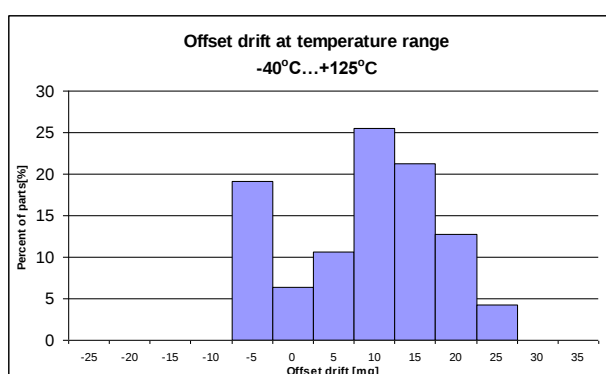
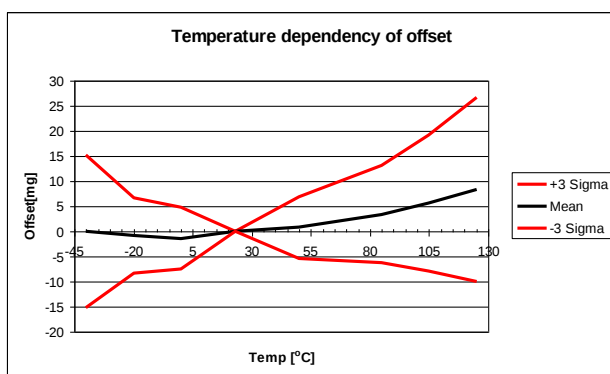
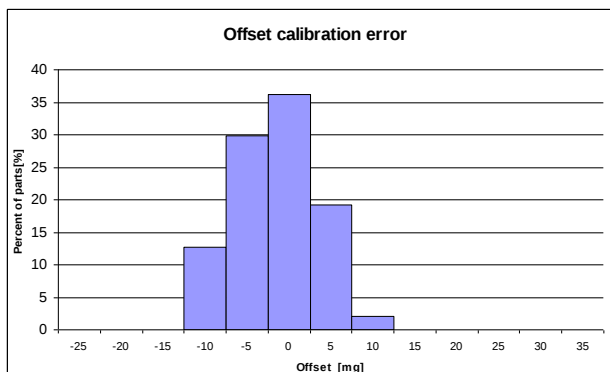
<sup>5)</sup> Offset drift due to temperature. Value is a relative value and has been centered to zero. Error defined as maximum change of offset in temperature range. Offset (max) - Offset (min). 100% tested in production.

<sup>6)</sup> Biggest Change of output from RT value due temperature.

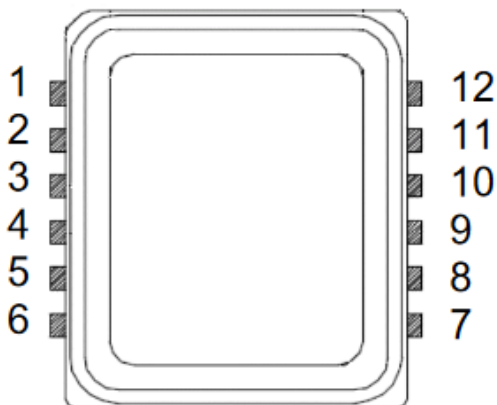


**Figure 1.** SCA830-D07 Block diagram

## Typical Performance characteristics



## Pin Description



**Figure 1.** Component pinout

**Table 2.** Component pinout

| No. | Name     | Type <sup>1)</sup> | PD/PU <sup>2)</sup> | Function                        | Connect |
|-----|----------|--------------------|---------------------|---------------------------------|---------|
| 1   | Reserved |                    |                     | Not used                        | Gnd     |
| 2   | Reserved |                    | PD                  | Factory use                     | Gnd     |
| 3   | AVSS     | AI                 |                     | Negative power supply (analog)  | Gnd     |
| 4   | AVDD     | AI                 |                     | Positive power supply (analog)  | Vdd     |
| 5   | CSB      | DI                 | PU                  | Chip select                     | CSB     |
| 6   | MISO     | ZO                 |                     | Data output                     | MISO    |
| 7   | SCK      | DI                 | PD                  | Serial clock                    | SCK     |
| 8   | MOSI     | DI                 | PD                  | Data input                      | MOSI    |
| 9   | Reserved | ADO                |                     | Pulse width modulation output   | PWM     |
| 10  | DVDD     | AI                 |                     | Positive power supply (digital) | Vdd     |
| 11  | DVSS     | AI                 |                     | Negative power supply (digital) | Gnd     |
| 12  | EGnd     | AI                 |                     | EMC ground                      | Gnd     |

1) A = Analog, D = Digital, I = Input, O = Output, Z = Tristate Output

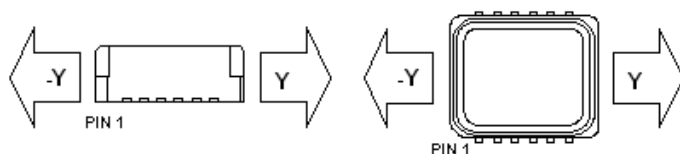
2) PU = internal pullup, PD = internal pulldown

3) PWM pin is driven to '0' after start-up when PWM is disabled. During the mass deflection self-test (STE) PWM pin goes to '1' and returns to '0' when STE is completed. In case of STE failure PWM output will stay at '1'

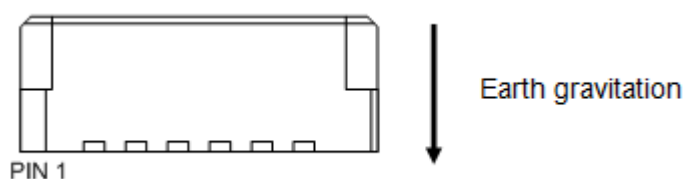
Further description of recommended circuit diagram and PWB layout can be found from company website.

Documentation: **SCA8X0 21X0 3100 Product Family Specification**

## Measurement Directions

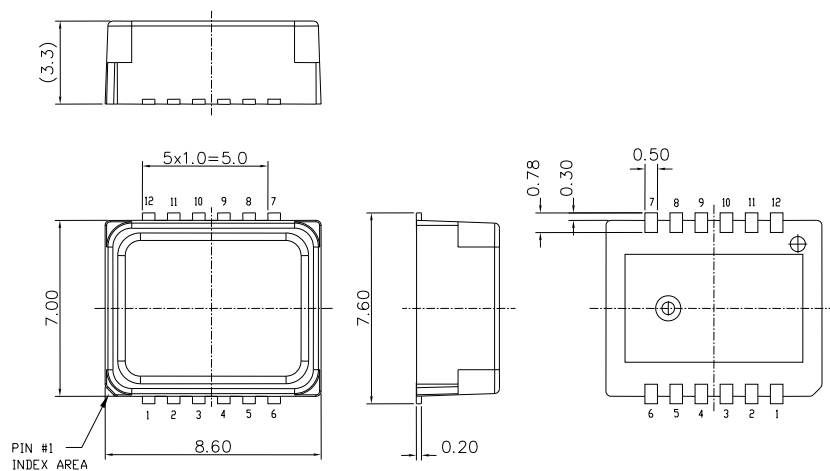


**Figure 3.** Accelerometer measuring directions



**Figure 2.** Zero acceleration output position

## Housing Dimensions



**Figure 4.** Housing dimensions

## Application Note for Acceleration Output Reading (16 bit output sensitivity)

This is addition to SCA8X0\_21X0\_3100 Product Family Specification chapter 3.1.

### DOUT\_LSB

Address: 4h

| Bits | Mode | Initial Value | Name | Description                                                            |
|------|------|---------------|------|------------------------------------------------------------------------|
| 7:0  | R    | 00h           | DATA | Acceleration data LSB frame<br>Read always DOUT_MSB prior to DOUT_LSB. |

### DOUT\_MSB

Address: 5h

| Bits | Mode | Initial Value | Name | Description                                                               |
|------|------|---------------|------|---------------------------------------------------------------------------|
| 7:0  | R    | 00h           | DATA | Acceleration data MSB frame<br>Reading of this register latches DOUT_LSB. |

The bit level description of acceleration data from DOUT\_LSB ... DOUT\_MSB registers is presented below.  
The acceleration data is presented in 2's complement format. At 0 g acceleration the output is ideally 0000h.

| +/-1g product | DOUT_MSB bits(7:0) |       |       |       |      |      |      |     | DOUT_LSB bits(7:0) |      |      |      |      |      |      |      | 16b   |             |
|---------------|--------------------|-------|-------|-------|------|------|------|-----|--------------------|------|------|------|------|------|------|------|-------|-------------|
| Bit number    | 15                 | 14    | 13    | 12    | 11   | 10   | 9    | 8   | 7                  | 6    | 5    | 4    | 3    | 2    | 1    | 0    | [-]   | Bits (15:0) |
| SCA8xx        | s                  | 512,0 | 256,0 | 128,0 | 64,0 | 32,0 | 16,0 | 8,0 | 4,00               | 2,00 | 1,00 | 0,50 | 0,25 | 0,13 | 0,06 | 0,03 | [mg]  | [Dec]       |
| +1g position  | 0                  | 1     | 1     | 1     | 1    | 1    | 0    | 1   | 0                  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1000  | 32000       |
| -1g position  | 1                  | 0     | 0     | 0     | 0    | 0    | 1    | 1   | 0                  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | -1000 | -32000      |
| +Full-scale   | 0                  | 1     | 1     | 1     | 1    | 1    | 1    | 1   | 1                  | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1023  | 32767       |
| -Full-scale   | 1                  | 0     | 0     | 0     | 0    | 0    | 0    | 0   | 0                  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | -1024 | -32768      |

Acceleration bits can be converted to mg acceleration (Acc) using following equation

$$Acc[mg] = -\frac{1}{32}s \cdot 2^{15} + \frac{1}{32} \sum_{n=0}^{14} b_n 2^n$$

where s is the bit number 15 (sign), and bn is the bit number n between 0 and 14.

## Order information

**Table 3.** Order codes for SCA830-D07

| Order code     | Description                                                                                                                                                      | Measurement Range (g) | Packing | Qty      |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------|----------|
| SCA830-D07-004 | 1-axis inclinometer with digital SPI interface                                                                                                                   | ±1 g                  | Bulk    | 4 pcs    |
| SCA830-D07-1   | 1-axis inclinometer with digital SPI interface                                                                                                                   | ±1 g                  | T&R     | 100 pcs  |
| SCA830-D07-10  | 1-axis inclinometer with digital SPI interface<br><i>This order code is used for automotive customers after customer has approved the product for production</i> | ±1 g                  | T&R     | 1000 pcs |

*Murata reserves all rights to modify this document without prior notice*