

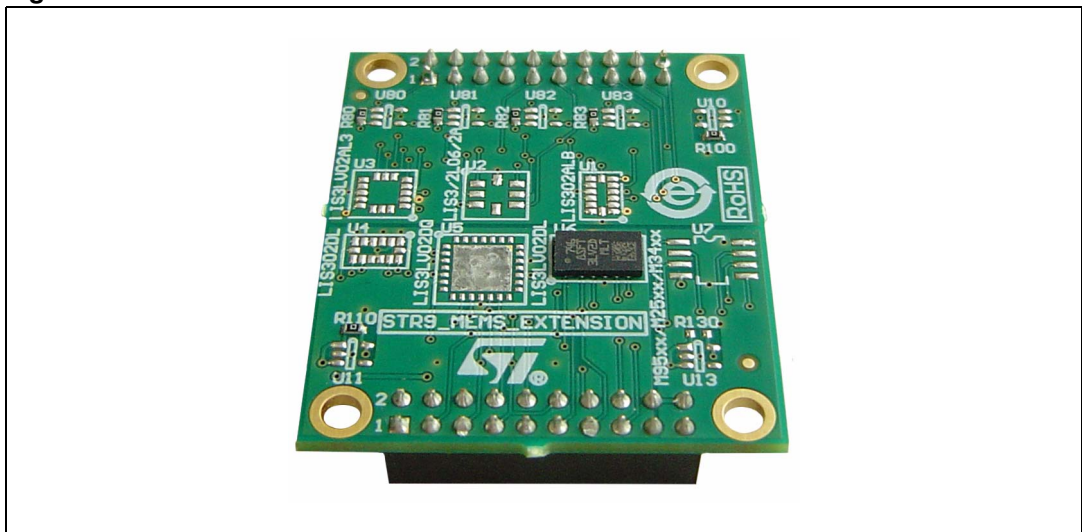
## 1 Introduction

This user manual describes the STEVAL-IFS002V2 STR9 MEMS demonstration board hardware. As well as the block diagram and schematics of the demonstration board, a bill of materials and assembly instructions are also included.

The STR9 MEMS demonstration board provides an STR9 dongle-based application with a MEMS sensor. MEMS (micro-electro-mechanical system) exploits the mechanical properties of silicon to create movable structures that, in the case of MEMS-based motion sensors, are able to sense motion (acceleration or vibration) in distinct directions.

The demonstration board used here can be assembled with several types of digital MEMS sensors as well as analog ones. For data storage, there is assembly space for ST serial Flash. The integration of voltage regulators and operational amplifiers is optional and depends on the intended chip usage.

**Figure 1. STR9 MEMS demonstration board**



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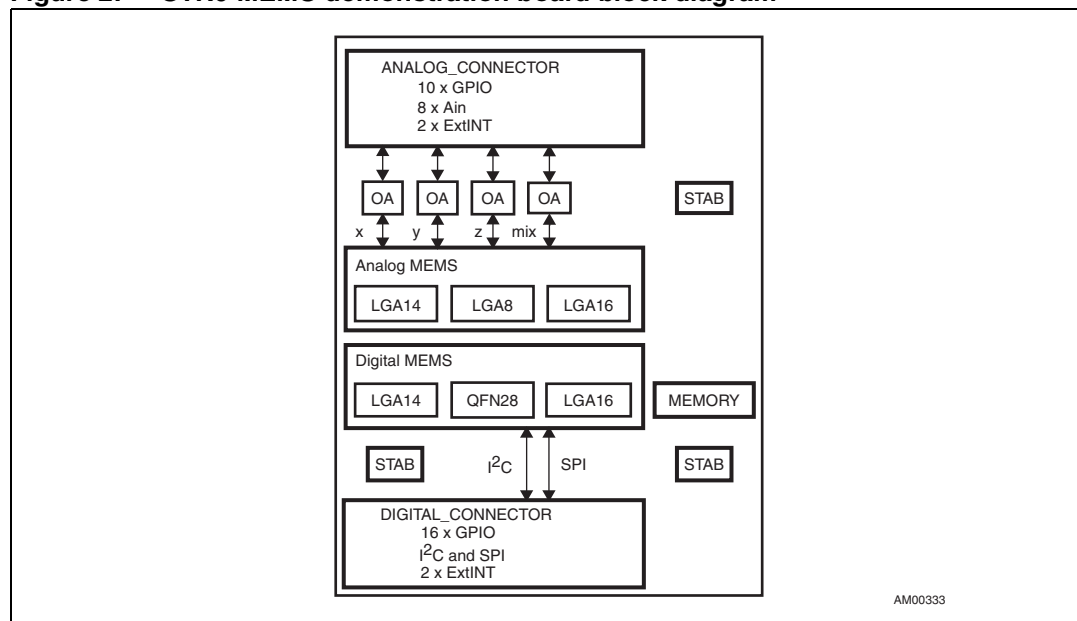
## 2 STR9 MEMS demonstration board block diagram

This board is based on STR9 dongle. The main board features are the following:

- Analog MEMS:
  - LGA8 (LIS2L02AL, LIS2L06AL, LIS3L02AL, LIS3L06AL)
  - LGA14 (LIS302ALB)
  - LGA16 (LIS3L02AL3)
- Digital MEMS:
  - LGA14 (LIS302DL)
  - LGA16 (LIS3LV02DL)
  - QFN28 (LIS3L02DQ, LIS3LV02DQ)
- Serial Flash/EEPROM device
  - SO8 (M95xx, M25xx, M34xx)
- Voltage regulator
  - SOT23-5L (LD2980CMxx)
- Operational amplifier
  - SOT23-5L (TS5071LT)

*Figure 2* shows the STR9 MEMS demonstration board block diagram.

**Figure 2. STR9 MEMS demonstration board block diagram**

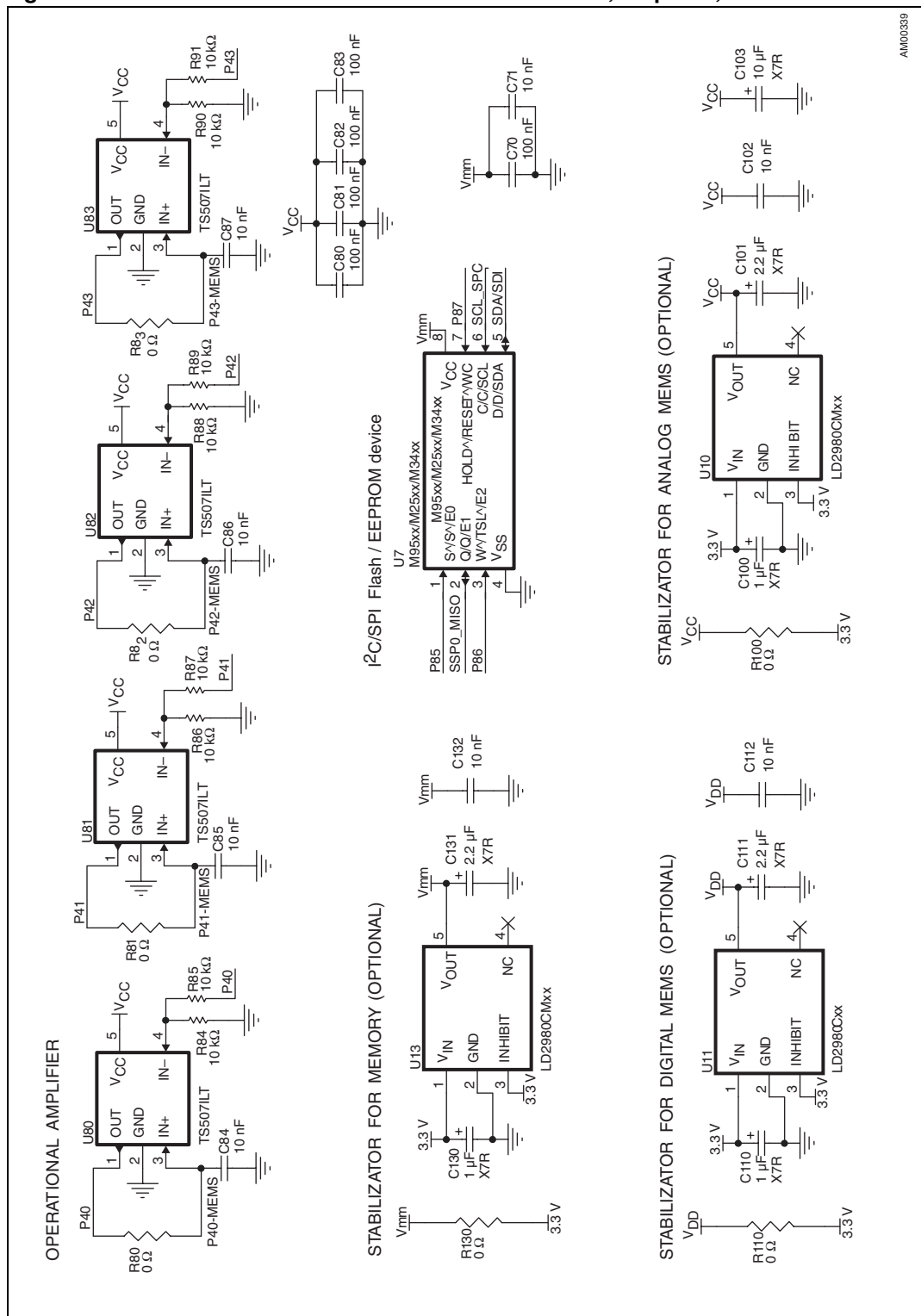


# 3

### Figure 3. Schematics - analog and digital MEMS



**Figure 4. Schematics - I<sup>2</sup>C/SPI Flash/EEPROM device, amplifier, stabilizers**



## 4 MEMS footprints

### 4.1 LGA8 package

Figure 5. MEMS footprint (LGA8 package)

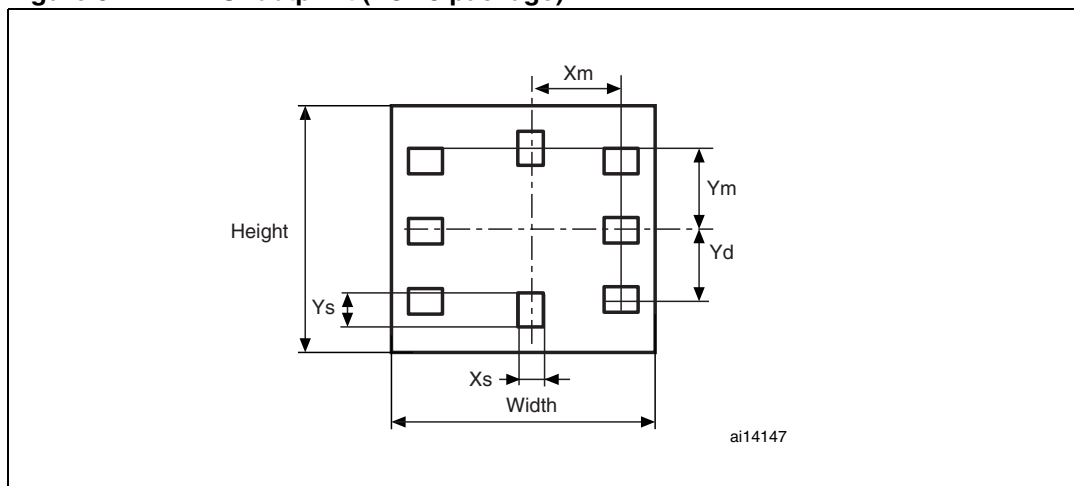


Table 1. Mechanical data (LGA8 package)

| Symbol | Dimension | Unit |
|--------|-----------|------|
| Xs     | 0.79      | mm   |
| Ys     | 1.35      | mm   |
| Xm     | 1.81      | mm   |
| Ym     | 1.81      | mm   |
| Yd     | 1.27      | mm   |
| Height | 5.0       | mm   |
| Width  | 5.0       | mm   |

## 4.2 LGA14 package

Figure 6. MEMS footprint (LGA14 package)

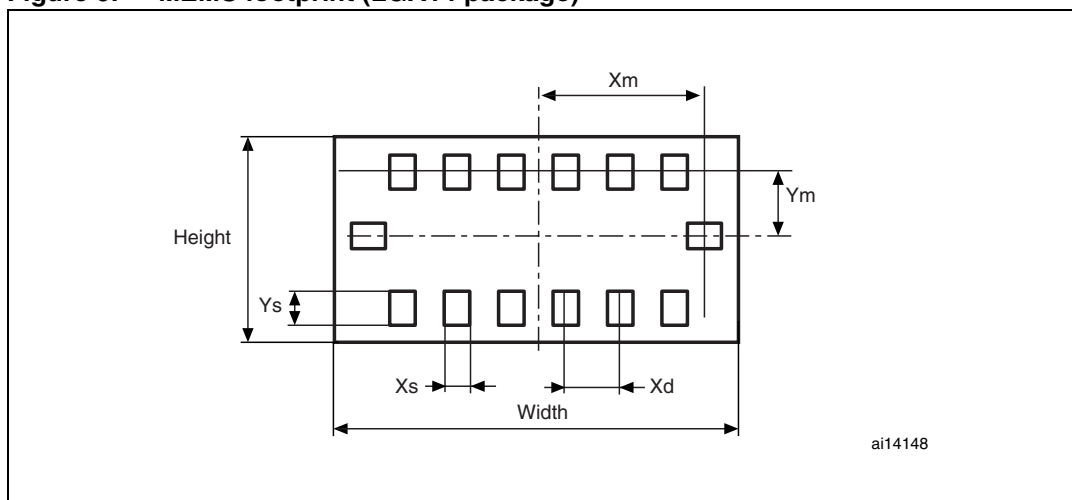


Table 2. Mechanical data (LGA14 package)

| Symbol | Dimension | Unit |
|--------|-----------|------|
| Xs     | 0.64      | mm   |
| Ys     | 0.975     | mm   |
| Xm     | 2.0       | mm   |
| Ym     | 1.0       | mm   |
| Xd     | 0.8       | mm   |
| Height | 3.0       | mm   |
| Width  | 5.0       | mm   |

### 4.3 LGA16 (D) package

Figure 7. MEMS footprint (LGA16 (D) package)

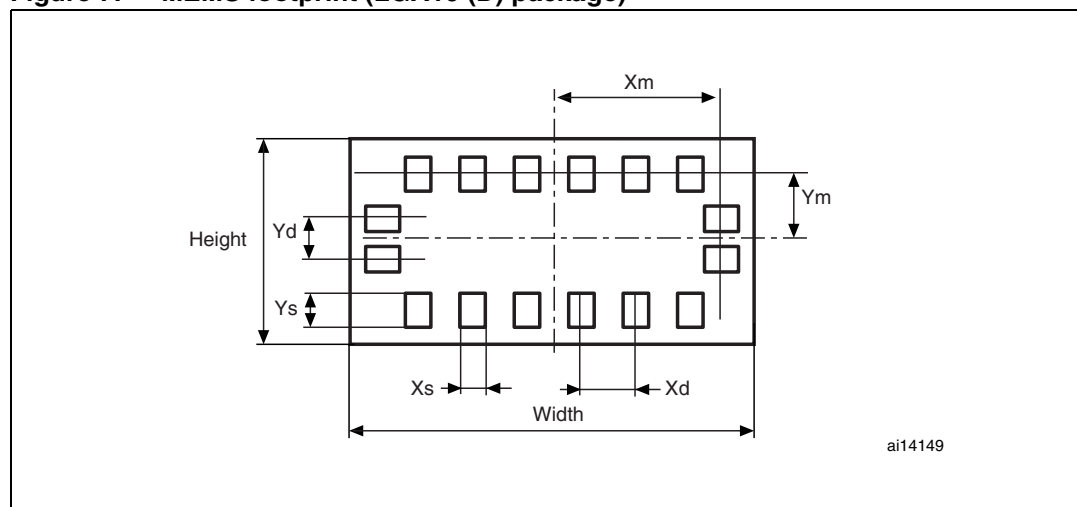


Table 3. Mechanical data (LGA16 (D) package)

| Symbol | Dimension | Unit |
|--------|-----------|------|
| Xs     | 0.65      | mm   |
| Ys     | 0.975     | mm   |
| Xm     | 3.25      | mm   |
| Ym     | 1.7       | mm   |
| Xd     | 1.0       | mm   |
| Yd     | 1.0       | mm   |
| Height | 4.4       | mm   |
| Width  | 7.5       | mm   |

## 4.4 LGA16 (A) package

Figure 8. MEMS footprint (LAG16 (A) package)

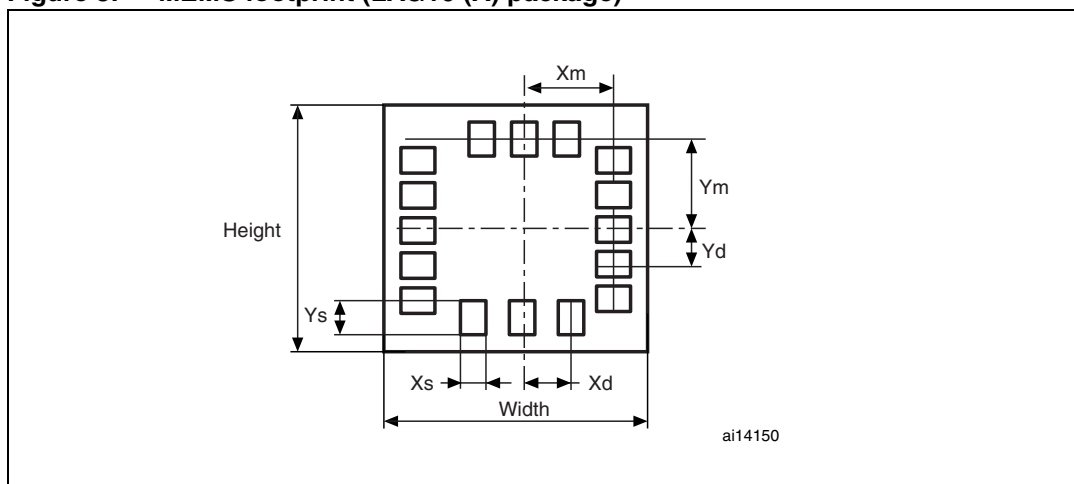
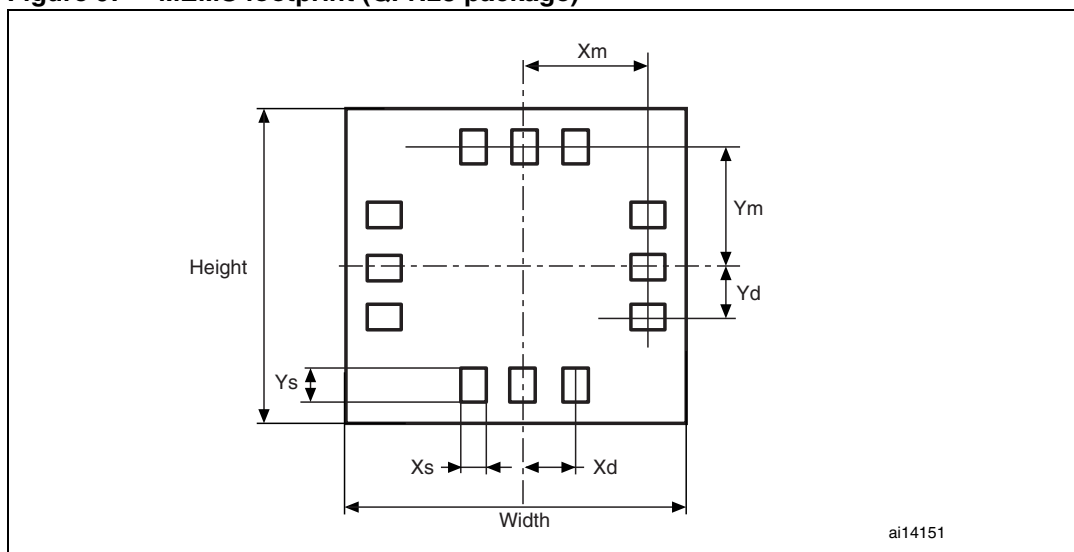


Table 4. Mechanical data (LAG16 (A) package)

| Symbol | Dimension | Unit |
|--------|-----------|------|
| Xs     | 0.64      | mm   |
| Ys     | 0.975     | mm   |
| Xm     | 2         | mm   |
| Ym     | 2         | mm   |
| Xd     | 0.8       | mm   |
| Yd     | 0.8       | mm   |
| Height | 5.0       | mm   |
| Width  | 5.0       | mm   |

## 4.5 QFN28 package

Figure 9. MEMS footprint (QFN28 package)<sup>(1)</sup>



1. Draft only. Not all the 28 pins are shown.

Table 5. Mechanical data (QFN28 package)

| Symbol | Dimension | Unit |
|--------|-----------|------|
| Xs     | 0.5       | mm   |
| Ys     | 0.725     | mm   |
| Xm     | 3.225     | mm   |
| Ym     | 3.225     | mm   |
| Xd     | 0.8       | mm   |
| Yd     | 0.8       | mm   |
| Height | 7.0       | mm   |
| Width  | 7.0       | mm   |

## 5 PCB layout

Figure 10. Top view

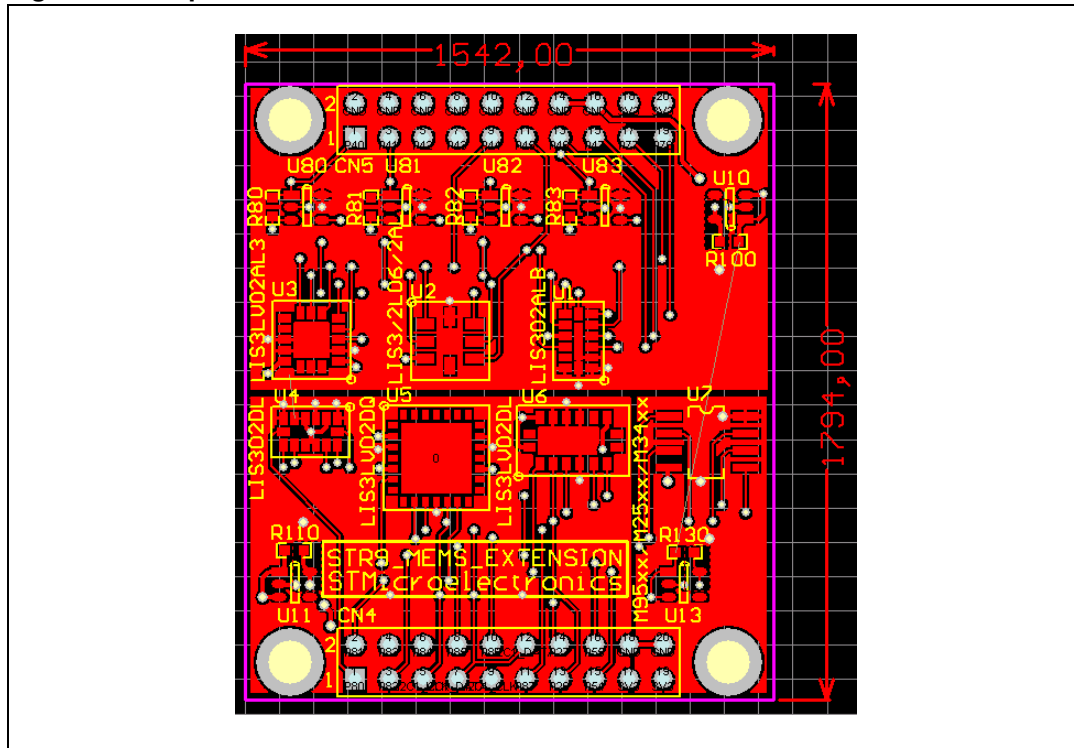
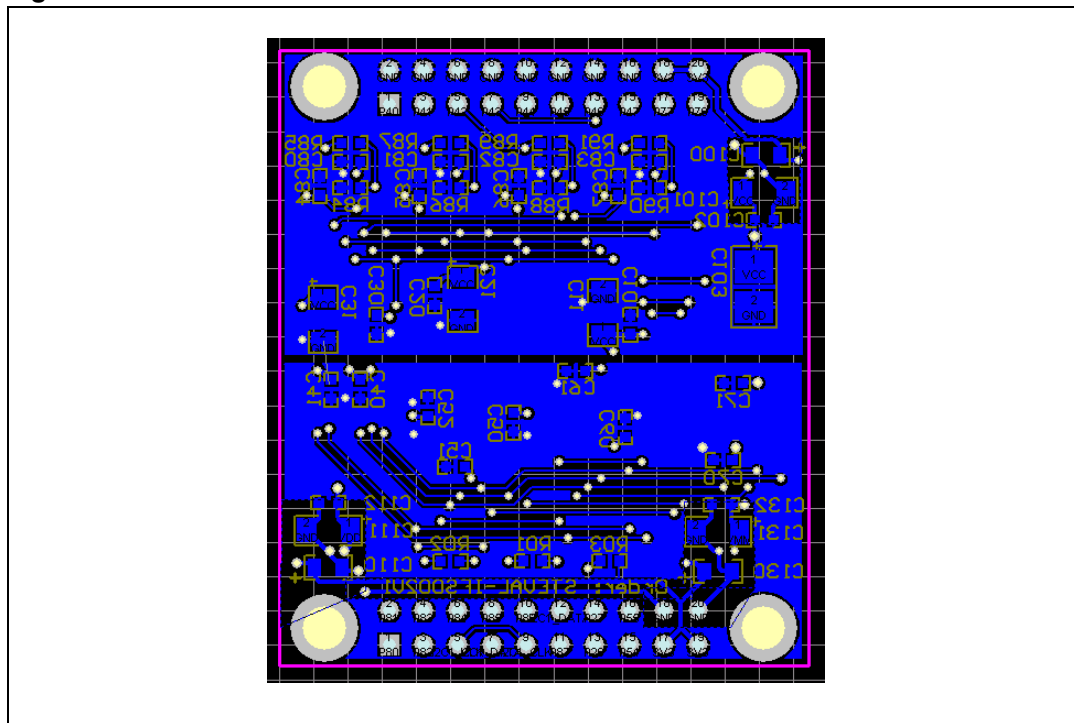


Figure 11. Bottom view



## 6 Bill of materials and assembly instructions

[Table 6](#) to [Table 15](#) show the bill of materials, while sections [Section 6.1](#) to [Section 6.3](#) provide additional information on assembly.

### 6.1 Assembly information for analog MEMS

1. When U10 LD2980CMxx is not assembled use R100 instead. For low voltage MEMS use a voltage regulator. The maximum supply current is around 1.5 mA per device.
2. Operational amplifiers are optional.
  - a) If they are not necessary, use resistors R80, R81, R82, R83 instead.
  - b) If they are required, use operational amplifiers with the following resistor configuration.  
R80, R81, R82, R83 - not assembled  
R84, R86, R88, R90 - not assembled  
R85, R87, R89, R91 - assembled with 0R.
  - c) To alter the gain of the operational amplifiers, use following resistor configuration.  
R80, R81, R82, R83 - not assembled  
The gain is determined by configuration of R84, R86, R88, R90 and R85, R87, R89, R91.
  - d) In all cases it is recommended to have assembled filtering capacitors C84, C85, C86, C87. Default is 10 nF, but this can be changed according to the required filtering features.
3. Only ONE analog MEMS can be assembled. MEMS analog output pins are shared.

### 6.2 Assembly information for digital MEMS

1. When U11 LD2980CMxx is not assembled, use R110 instead. For low voltage MEMS use a voltage regulator. Maximum supply current is around 1.5 mA per device.
2. Both I<sup>2</sup>C and SPI are wired.
  - a) The unused interface must be selected as floating input or third state.
  - b) When using I<sup>2</sup>C, it is recommended to have assembled resistors R01 and R02 which are 4.7 k $\Omega$  pull-ups.
  - c) When using SPI, each device has its own chip select.
3. The board is designed to have one MEMS assembled on the board although I<sup>2</sup>C and SPI allows more devices to be used simultaneously. Care should be taken, however with the RDY/INT pins, as they are shared.

## 6.3 Assembly information for serial memory

1. When U13 LD2980CMxx is not assembled, use R130 instead. All mentioned memories should be able to operate on 3.3 V. Use a voltage regulator for low voltage memories.
2. U7 supports the following series of STMicroelectronics™ memories:  
 M95xx - Serial SPI Bus EEPROM  
 M25xx - Serial SPI Bus Flash memory  
 M34xx - Serial I<sup>2</sup>C Bus EEPROM

**Table 6. Voltage regulator for analog MEMS<sup>(1)</sup>**

| Label | Comment     | Footprint | Description       | Assembled | Order code                           |
|-------|-------------|-----------|-------------------|-----------|--------------------------------------|
| U10   | LD2980CMxx  | SOT23-5L  | Voltage regulator | No        | ST: LD2980CMxx                       |
| R100  | 0 $\Omega$  | 0603      | Resistor          | Yes       | GM®: R0603-0R                        |
| C100  | 1 $\mu$ F   | 0805      | Pol. capacitor    | No        | Farnell: 422-7086 (X7R)              |
| C101  | 2.2 $\mu$ F | 1206      | Pol. capacitor    | No        | Farnell: 422-7323 (X7R)              |
| C102  | 10 nF       | 0603      | Capacitor         | No        | Farnell: 422-6938 (X7R)              |
| C103  | 10 $\mu$ F  | 3528_AB   | Pol. capacitor    | Yes       | Farnell: 331-3888<br>B45196H2106K109 |

1. By default, the voltage regulator is not assembled.

**Table 7. Voltage regulator for digital MEMS<sup>(1)</sup>**

| Label | Comment     | Footprint | Description       | Assembled | Order code              |
|-------|-------------|-----------|-------------------|-----------|-------------------------|
| U11   | LD2980Cxx   | SOT23-5L  | Voltage regulator | No        | ST: LD2980Cxx           |
| R110  | 0 $\Omega$  | 0603      | Resistor          | Yes       | GM: R0603-0R            |
| C110  | 1 $\mu$ F   | 0805      | Pol. capacitor    | No        | Farnell: 422-7086 (X7R) |
| C111  | 2.2 $\mu$ F | 1206      | Pol. capacitor    | No        | Farnell: 422-7323 (X7R) |
| C112  | 10 $\mu$ F  | 0603      | Capacitor         | No        | Farnell: 422-6938 (X7R) |

1. By default, the voltage regulator is not assembled.

**Table 8. Voltage regulator for memory<sup>(1)</sup>**

| Label | Comment     | Footprint | Description       | Assembled | Order code              |
|-------|-------------|-----------|-------------------|-----------|-------------------------|
| U13   | LD2980CMxx  | SOT23-5L  | Voltage regulator | No        | ST: LD2980CMxx          |
| R130  | 0 $\Omega$  | 0603      | Resistor          | Yes       | GM: R0603-0R            |
| C130  | 1 $\mu$ F   | 0805      | Pol. capacitor    | No        | Farnell: 422-7086 (X7R) |
| C131  | 2.2 $\mu$ F | 1206      | Pol. capacitor    | No        | Farnell: 422-7323 (X7R) |
| C132  | 10 nF       | 0603      | Capacitor         | No        | Farnell: 422-6938 (X7R) |

1. By default, the voltage regulator is not assembled.

**Table 9. Analog MEMS<sup>(1)</sup>**

| Label | Comment       | Footprint  | Description    | Assembled | Order code                              |
|-------|---------------|------------|----------------|-----------|-----------------------------------------|
| CN5   | ANALOG_CON    | HDR2X10STD | Header 10X2    | Yes       | GM: S2G20                               |
| U1    | LIS302ALB     | LGA14AD    | Analog MEMS    | No        | ST: LIS302ALB                           |
| C10   | 100 nF        | 0603       | Capacitor      | No        | Farnell: 422-6859 (X7R)                 |
| C11   | 2.2 $\mu$ F   | 1206       | Pol. capacitor | No        | Farnell: 422-7323 (X7R)                 |
| U2    | LIS3/2L06/2AL | LGA8A      | Analog MEMS    | No        | ST: LIS3/2L06/2AL<br>(LIS3L06AL for MP) |
| C20   | 100 nF        | 0603       | Capacitor      | No        | Farnell: 422-6859 (X7R)                 |
| C21   | 2.2 $\mu$ F   | 1206       | Pol. capacitor | No        | Farnell: 422-7323 (X7R)                 |
| U3    | LIS3LV02AL3   | LGA16A     | Analog MEMS    | No        | ST: LIS3LV02AL3                         |
| C30   | 100 nF        | 0603       | Capacitor      | No        | Farnell: 422-6859 (X7R)                 |
| C31   | 2.2 $\mu$ F   | 1206       | Pol. capacitor | No        | Farnell: 422-7323 (X7R)                 |

1. By default, the LIS3/2L06/2AL is assembled.

**Table 10. Digital MEMS<sup>(1),(2)</sup>**

| Label | Comment        | Footprint  | Description  | Assembled              | Order code              |
|-------|----------------|------------|--------------|------------------------|-------------------------|
| CN4   | DIGITAL_CON    | HDR2X10STD | Header 10X2  | Yes                    | GM: BL220G              |
| U4    | LIS302DL       | LGA14AD    | Digital MEMS | Yes                    | ST: LIS302DL            |
| C40   | 100 nF         | 0603       | Capacitor    | Yes                    | Farnell: 422-6859 (X7R) |
| C41   | 100 nF         | 0603       | Capacitor    | Yes                    | Farnell: 422-6859 (X7R) |
| U5    | LIS3LV02DQ     | QFN28D     | Digital MEMS | No                     | ST: LIS3LV02DQ          |
| C50   | 100 nF         | 0603       | Capacitor    | No                     | Farnell: 422-6859 (X7R) |
| C51   | 100 nF         | 0603       | Capacitor    | No                     | Farnell: 422-6859 (X7R) |
| U6    | LIS3LV02DL     | LGA16D     | Digital MEMS | No                     | ST: LIS3LV02DL          |
| C60   | 100 nF         | 0603       | Capacitor    | No                     | Farnell: 422-6859 (X7R) |
| C61   | 100 nF         | 0603       | Capacitor    | No                     | Farnell: 422-6859 (X7R) |
| R01   | 4.7 k $\Omega$ | 0603       | Resistor     | Yes (I <sup>2</sup> C) | GM: R0603-4k7           |
| R02   | 4.7 k $\Omega$ | 0603       | Resistor     | Yes (I <sup>2</sup> C) | GM: R0603-4k7           |
| R03   | 4.7 k $\Omega$ | 0603       | Resistor     | Yes (SPI)              | GM: R0603-4k7           |

1. By default, the I<sup>2</sup>C interface is used.

2. By default, the LIS3LV02DL is assembled.

**Table 11. Memory<sup>(1)</sup>**

| Label | Comment               | Footprint | Description            | Assembled | Order code              |
|-------|-----------------------|-----------|------------------------|-----------|-------------------------|
| U7    | M95xx/M25xx/<br>M34xx | SO8       | Serial<br>Flash/EEPROM | No        | ST: M95xx/M25xx/M34xx   |
| C70   | 10 nF                 | 0603      | Capacitor              | No        | Farnell: 422-6859 (X7R) |
| C71   | 10 nF                 | 0603      | Capacitor              | No        | Farnell: 422-6938 (X7R) |

1. By default, the memory is not assembled.

**Table 12. Operational amplifier X-axis for analog MEMS<sup>(1)</sup>**

| Label | Comment       | Footprint | Description              | Assembled | Order code              |
|-------|---------------|-----------|--------------------------|-----------|-------------------------|
| U80   | TS507ILT      | SOT23-5L  | Operational<br>amplifier | No        | ST: TS507ILT            |
| R80   | 0 $\Omega$    | 0603      | Resistor                 | Yes       | GM: R0603-0R            |
| R84   | 10 k $\Omega$ | 0603      | Resistor                 | No        | GM: R0603-10k           |
| R85   | 10 k $\Omega$ | 0603      | Resistor                 | No        | GM: R0603-10k           |
| C80   | 100 nF        | 0603      | Capacitor                | No        | Farnell: 422-6859 (X7R) |
| C84   | 10 nF         | 0603      | Capacitor                | No        | Farnell: 422-6938 (X7R) |

1. By default, the amplifier is not assembled.

**Table 13. Operational amplifier Y-axis for analog MEMS<sup>(1)</sup>**

| Label | Comment       | Footprint | Description              | Assembled | Order code              |
|-------|---------------|-----------|--------------------------|-----------|-------------------------|
| U81   | TS507ILT      | SOT23-5L  | Operational<br>amplifier | No        | ST: TS507ILT            |
| R81   | 0 $\Omega$    | 0603      | Resistor                 | Yes       | GM: R0603-0R            |
| R86   | 10 k $\Omega$ | 0603      | Resistor                 | No        | GM: R0603-10k           |
| R87   | 10 k $\Omega$ | 0603      | Resistor                 | No        | GM: R0603-10k           |
| C81   | 100 nF        | 0603      | Capacitor                | No        | Farnell: 422-6859 (X7R) |
| C85   | 10 nF         | 0603      | Capacitor                | No        | Farnell: 422-6938 (X7R) |

1. By default, the amplifier is not assembled.

**Table 14. Operational amplifier Z-axis for analog MEMS<sup>(1)</sup>**

| Label | Comment       | Footprint | Description              | Assembled | Order code              |
|-------|---------------|-----------|--------------------------|-----------|-------------------------|
| U82   | TS507ILT      | SOT23-5L  | Operational<br>amplifier | No        | ST: TS507ILT            |
| R82   | 0 $\Omega$    | 0603      | Resistor                 | Yes       | GM: R0603-0R            |
| R88   | 10 k $\Omega$ | 0603      | Resistor                 | No        | GM: R0603-10k           |
| R89   | 10 k $\Omega$ | 0603      | Resistor                 | No        | GM: R0603-10k           |
| C82   | 100 nF        | 0603      | Capacitor                | No        | Farnell: 422-6859 (X7R) |
| C86   | 10 nF         | 0603      | Capacitor                | No        | Farnell: 422-6938 (X7R) |

1. By default, the amplifier is not assembled.

**Table 15. Operational amplifier XYZ-axes for analog MEMS<sup>(1)</sup>**

| Label | Comment       | Footprint | Description           | Assembled | Order code              |
|-------|---------------|-----------|-----------------------|-----------|-------------------------|
| U83   | TS507ILT      | SOT23-5L  | Operational amplifier | No        | ST: TS507ILT            |
| R83   | 0 $\Omega$    | 0603      | Resistor              | Yes       | GM: R0603-0R            |
| R90   | 10 k $\Omega$ | 0603      | Resistor              | No        | GM: R0603-10k           |
| R91   | 10 k $\Omega$ | 0603      | Resistor              | No        | GM: R0603-10k           |
| C83   | 100 nF        | 0603      | Capacitor             | No        | Farnell: 422-6859 (X7R) |
| C87   | 10 nF         | 0603      | Capacitor             | No        | Farnell: 422-6938 (X7R) |

1. By default, the amplifier is not assembled.

## 7 Revision history

**Table 16. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21-Apr-2008 | 1        | Initial release.                                                                                                                                                                                                                                                                                                                                                         |
| 17-Oct-2008 | 2        | Updated <a href="#">Figure 1</a> , <a href="#">Figure 2</a> , <a href="#">Figure 3</a> and added <a href="#">Figure 4</a> (reformatted previous <a href="#">Figure 3</a> into <a href="#">Figure 3</a> and <a href="#">Figure 4</a> ), updated (reformatted) <a href="#">Table 6</a> to <a href="#">Table 15</a> .                                                       |
| 05-Mar-2009 | 3        | Renamed “extension board” to demonstration board”, updated <a href="#">Section 2</a> , renamed title of <a href="#">Figure 2</a> and <a href="#">Section 3</a> , <a href="#">Table 1</a> to <a href="#">Table 5</a> and <a href="#">Table 15</a> , updated <a href="#">Figure 3</a> and <a href="#">Figure 4</a> , <a href="#">Table 6</a> and <a href="#">Table 9</a> . |

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