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UM0376
User manual

STEVAL-IFS002V1
STR9 MEMS extension

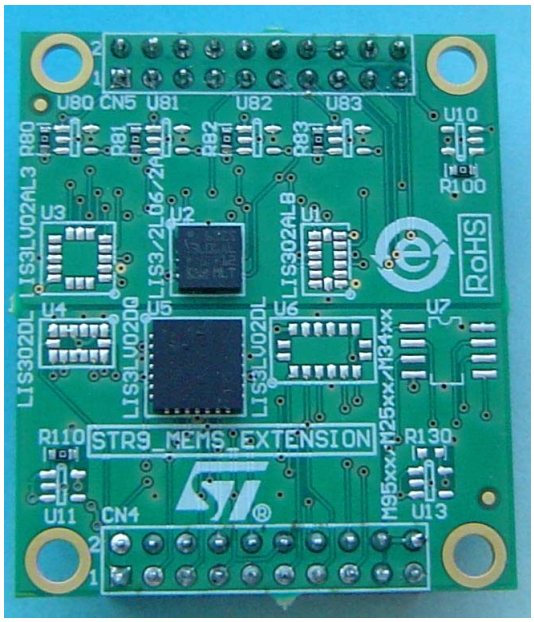
Introduction

This user manual describes the STEVAL-IFS002V1 STR9 MEMS extension hardware. As well as the block diagram and schematics of the extension, a bill of materials and assembly instructions are also included.

The STR9 MEMS extension 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 extension 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 extension



Contents

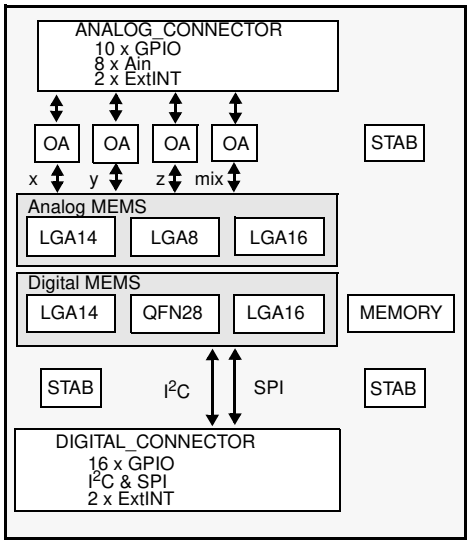
1 STR9 MEMS extension Block diagram

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 memory
  - SO8 (M95xx, M25xx, M34xx)
- Voltage regulator
  - SOT23-5L (LD2980CMxx)
- Operational amplifier
  - SOT23-5L (TS507ILT)

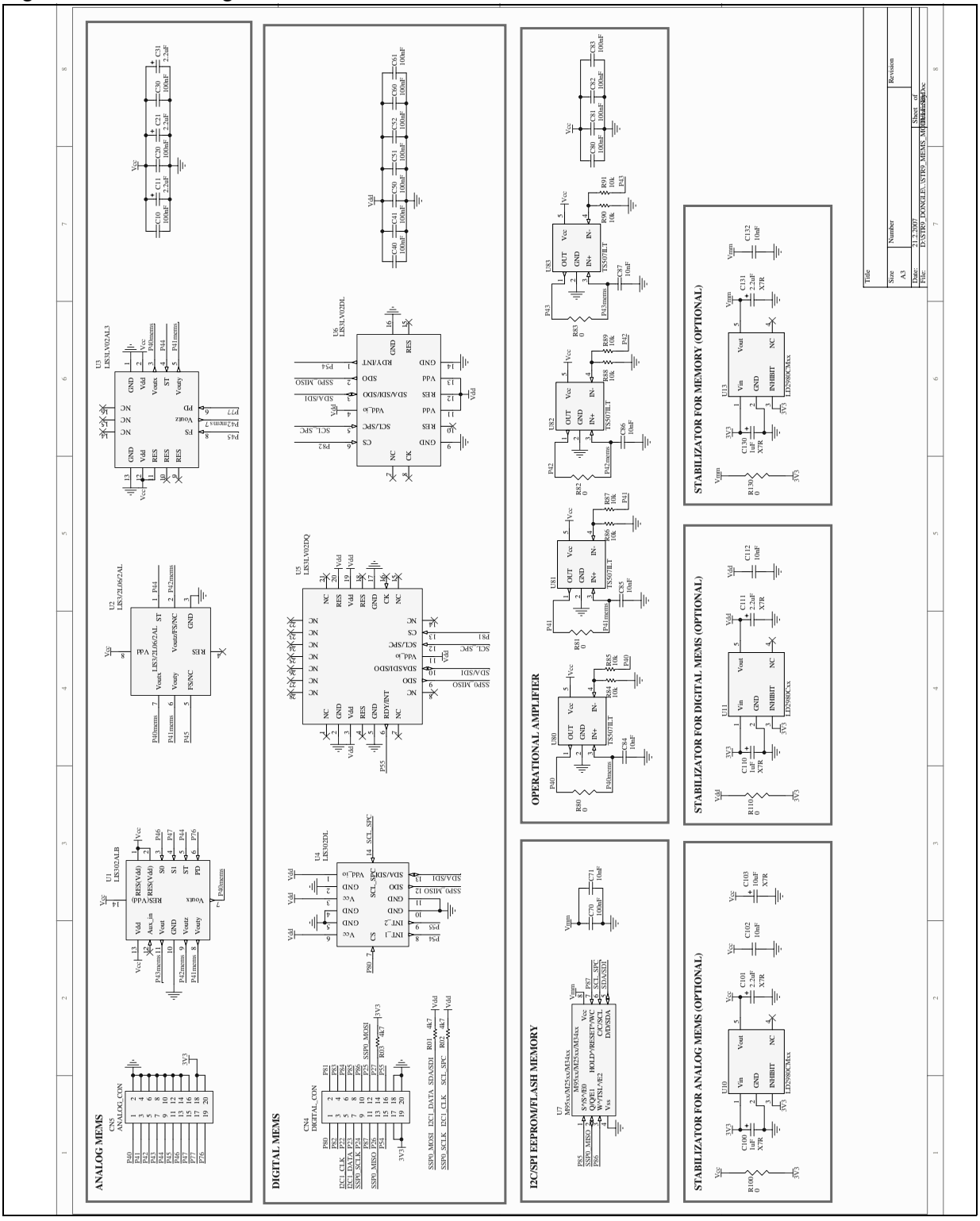
Figure 2 shows the dongle block diagram.

Figure 2. STR9 dongle block diagram



2 Schematics

Figure 3. STR9 dongle schematics



3 MEMS footprints

3.1 LGA8 package

Figure 4. MEMS footprint (LGA8 package)

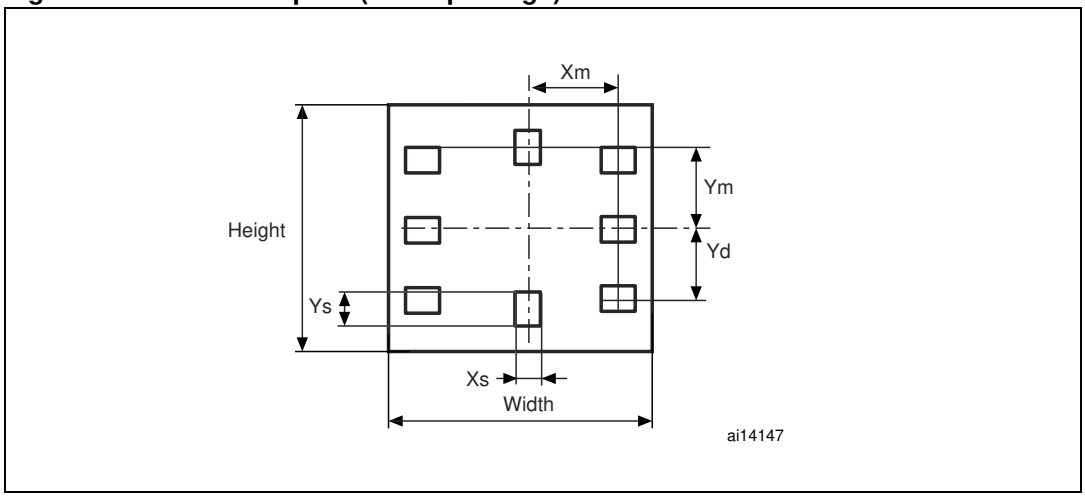


Table 1. Mechanical data

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

3.2 LGA14 package

Figure 5. MEMS footprint (LGA14 package)

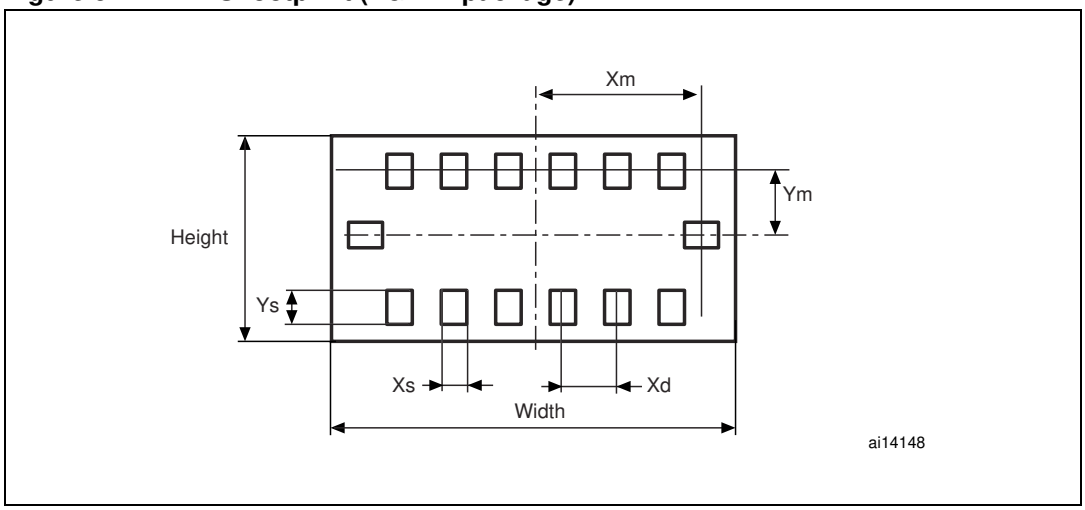


Table 2. Mechanical data

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

3.3 LGA16 (D) package

Figure 6. MEMS footprint (LGA16 (D) package)

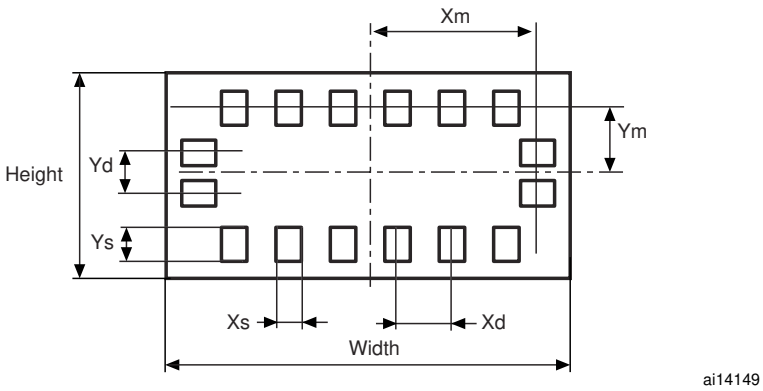


Table 3. LGA16 (D) mechanical data

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

3.4 LGA16 (A) package

Figure 7. MEMS footprint (LAG16 (A) package)

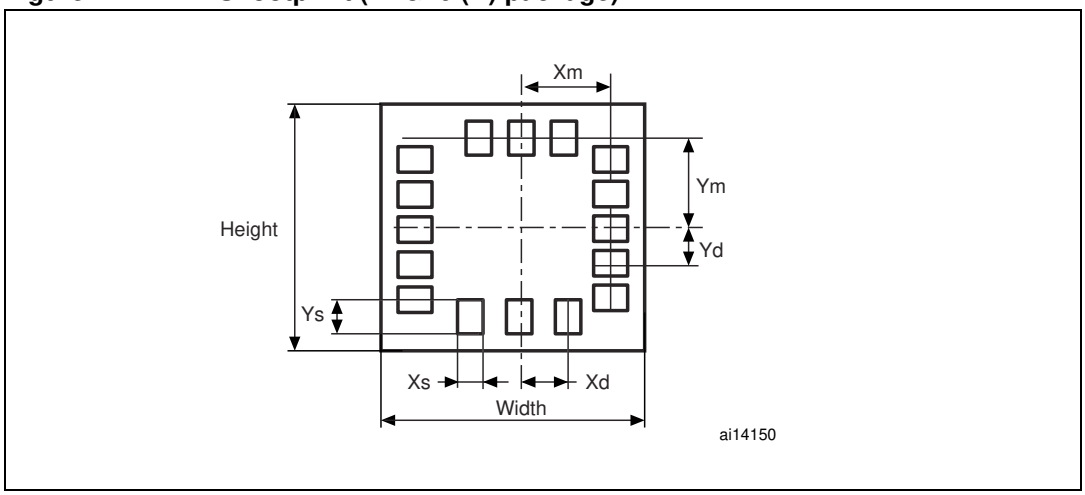
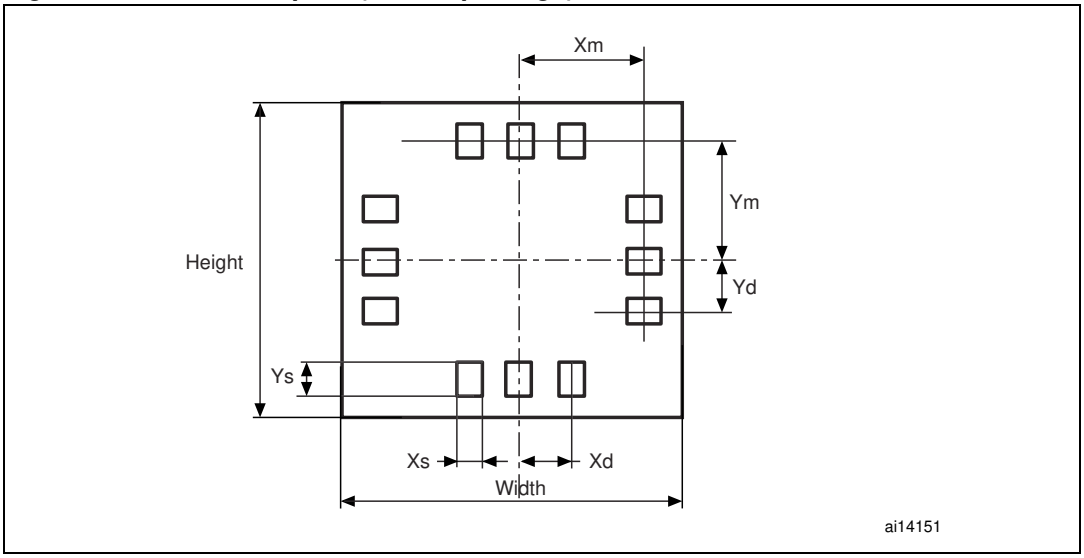


Table 4. Mechanical data

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

3.5 QFN28 package

Figure 8. MEMS footprint (QFN28 package)



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

Table 5. Mechanical data

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

4 PCB layout

Figure 9. Top view

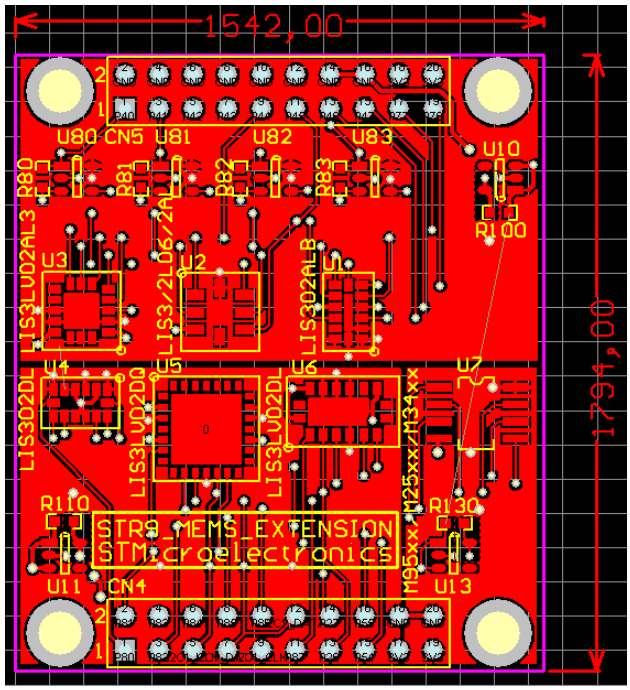
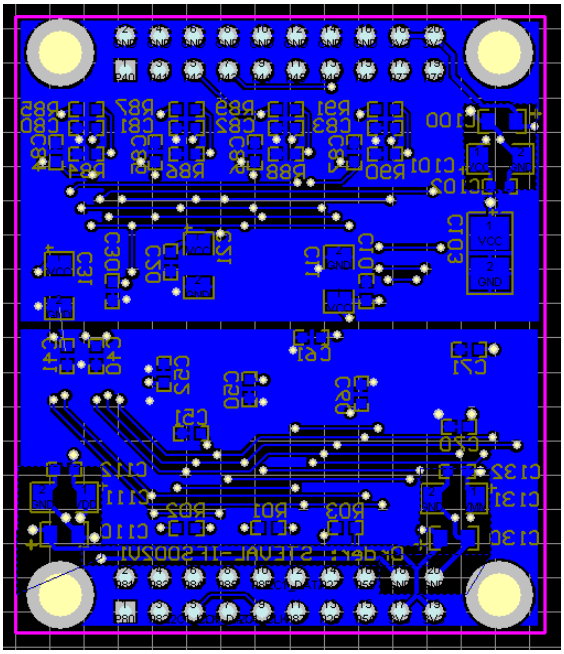


Figure 10. Bottom view



5 Bill of materials and assembly instructions

Table 6 to *Table 15* show the bill of materials, while sections *Section 5.1* to *Section 5.3* provide additional information on assembly.

5.1 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.

5.2 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^2C and SPI are wired.
   a) The unused interface must be selected as floating input or third state.
   b) When using I^2C, it is recommended to have assembled resistors R01 and R02 which are 4.7 kΩ 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^2C and SPI allows more devices to be used simultaneously. Care should be taken, however with the RDY/INT pins, as they are shared.

5.3 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 ST memories:
   M95xx - Serial SPI Bus EEPROM
   M25xx - Serial SPI Bus Flash Memory
   M34xx - Serial I^2C Bus EEPROM

Table 6. Voltage regulator for analog MEMS(1)

Label	Comment	Footprint	Description	Assembled	Order code
U10	LD2980CMxx	SOT23-5L	Voltage regulator	NO	ST: LD2980CMxx
R100	0	0603	Resistor	YES	GM: R0603-0R
C100	1 µF	0805	Pol. Capacitor	NO	Farnell: 422-7086 (X7R)
C101	2.2 µF	1206	Pol. Capacitor	NO	Farnell: 422-7323 (X7R)
C102	10 nF	0603	Capacitor	NO	Farnell: 422-6938 (X7R)
C103	10 µF	3528_AB_REV2	Pol. Capacitor	YES	Farnell: 331-3888 B45196H2106K109

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

Table 7. Voltage regulator for digital MEMS(1)

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

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

Table 8. Voltage regulator for memory(1)

Label	Comment	Footprint	Description	Assembled	Order code
U13	LD2980CMxx	SOT23-5L	Voltage regulator	NO	ST: LD2980CMxx
R130	0	0603	Resistor	YES	GM: R0603-0R
C130	1 µF	0805	Pol. Capacitor	NO	Farnell: 422-7086 (X7R)
C131	2.2 µF	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(1)

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 µF	1206	Pol. Capacitor	NO	Farnell: 422-7323 (X7R)
U2	LIS3/2L06/2AL	LGA8A	ANALOG MEMS	YES	ST: LIS3/2L06/2AL (LIS3L06AL for MP)
C20	100 nF	0603	Capacitor	YES	Farnell: 422-6859 (X7R)
C21	2.2 µF	1206	Pol. Capacitor	YES	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 µF	1206	Pol. Capacitor	NO	Farnell: 422-7323 (X7R)

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

Table 10. Digital MEMS(1)(2)

Label	Comment	Footprint	Description	Assembled	Order code
CN4	DIGITAL_CON	HDR2X10STD	Header 10X2	YES	GM: BL220G
U4	LIS302DL	LGA14AD	DIGITAL MEMS	NO	ST:LIS302DL
C40	100 nF	0603	Capacitor	NO	Farnell: 422-6859 (X7R)
C41	100 nF	0603	Capacitor	NO	Farnell: 422-6859 (X7R)
U5	LIS3LV02DQ	QFN28D	DIGITAL MEMS	YES	ST: LIS3LV02DQ
C50	100 nF	0603	Capacitor	YES	Farnell: 422-6859 (X7R)
C51	100 nF	0603	Capacitor	YES	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 kΩ	0603	Resistor	YES (I^2C)	GM: R0603-4k7
R02	4.7 kΩ	0603	Resistor	YES (I^2C)	GM: R0603-4k7
R03	4.7 kΩ	0603	Resistor	YES (SPI)	GM: R0603-4k7

1. By default, the I^2C interface is used.
2. By default, the LIS3LV02DQ is assembled.

Table 11. Memory(1)

Label	Comment	Footprint	Description	Assembled	Order code
U7	M95xx/M25xx/ M34xx	SO8	Serial 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-axe for analog MEMS(1)

Label	Comment	Footprint	Description	Assembled	Order code
U80	TS507ILT	SOT23-5L	Operational amplifier	NO	ST: TS507ILT
R80	0	0603	Resistor	YES	GM: R0603-0R
R84	10 kΩ	0603	Resistor	NO	GM: R0603-10k
R85	10 kΩ	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-axe for analog MEMS(1)

Label	Comment	Footprint	Description	Assembled	Order code
U81	TS507ILT	SOT23-5L	Operational amplifier	NO	ST: TS507ILT
R81	0	0603	Resistor	YES	GM: R0603-0R
R86	10 kΩ	0603	Resistor	NO	GM: R0603-10k
R87	10 kΩ	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-axe for analog MEMS(1)

Label	Comment	Footprint	Description	Assembled	Order code
U82	TS507ILT	SOT23-5L	Operational amplifier	NO	ST: TS507ILT
R82	0	0603	Resistor	YES	GM: R0603-0R
R88	10 kΩ	0603	Resistor	NO	GM: R0603-10k
R89	10 kΩ	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-axe for analog MEMS(1)

Label	Comment	Footprint	Description	Assembled	Order code
U83	TS507ILT	SOT23-5L	Operational amplifier	NO	ST: TS507ILT
R83	0	0603	Resistor	YES	GM: R0603-0R
R90	10 kΩ	0603	Resistor	NO	GM: R0603-10k
R91	10 kΩ	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.

6 Revision history

Table 16. Document revision history

Date	Revision	Changes
19-Jan-2007	1	Initial release.
24-May-2007	2	*Figure 3: STR9 dongle schematics*, *Figure 9: Top view* and *Figure 10: Bottom view* updated. Stabilisator replaced by voltage regulator in the whole document. MEMS footprint figures updated in*Section 3* to add height and width. Bill of materials updated and reorganized in *Section 5*.
12-Nov-2007	3	Added extension board root part number. Updated STR9 MEMS extension board photo in *Figure 1: STR9 MEMS extension*. Updated R01, R02 and R03 assembling status and *Note 1* in *Table 10: Digital MEMS*.