Simulyzer-RT DIO-1 Card

Hardware version	V1.01_a
Documentation version:	1.2
Created:	(1.0) 03.04.2015
	(1.1) 25.04.2016 Note HF sealing spring
	(1.2) 10.10.2021 Company information edited
Order no.:	1.1002

Safety instructions

To avoid damages to persons and devices the following safety instructions have to be noticed!

- Only qualified personnel are allowed to handle this device!
- Before any handling within the device the current supply has to be switched off!
- During operation the device have to be positioned, that enough air condition is supplied and no small parts can get into the ventilation slots.
- In case of any trouble the system has to be switched de-energized!
- The declared environmental conditions and max. voltage ranges have to be observed!
- To warranty the device remove all dust and dirt in periodically intervals.
- Make sure that the ventilation slots are unobstructed!

Intended use:

The Simulyzer RT DIO-1 card is engineered for measurement and analysis of sensors of a RT proofing system. The field of function of the DIO-1 card is the digital data transfer within the test system (see applications).

- The device is only permitted to use for the intended use.
  Any other use results the deletion of the guarantee!

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Table of contents

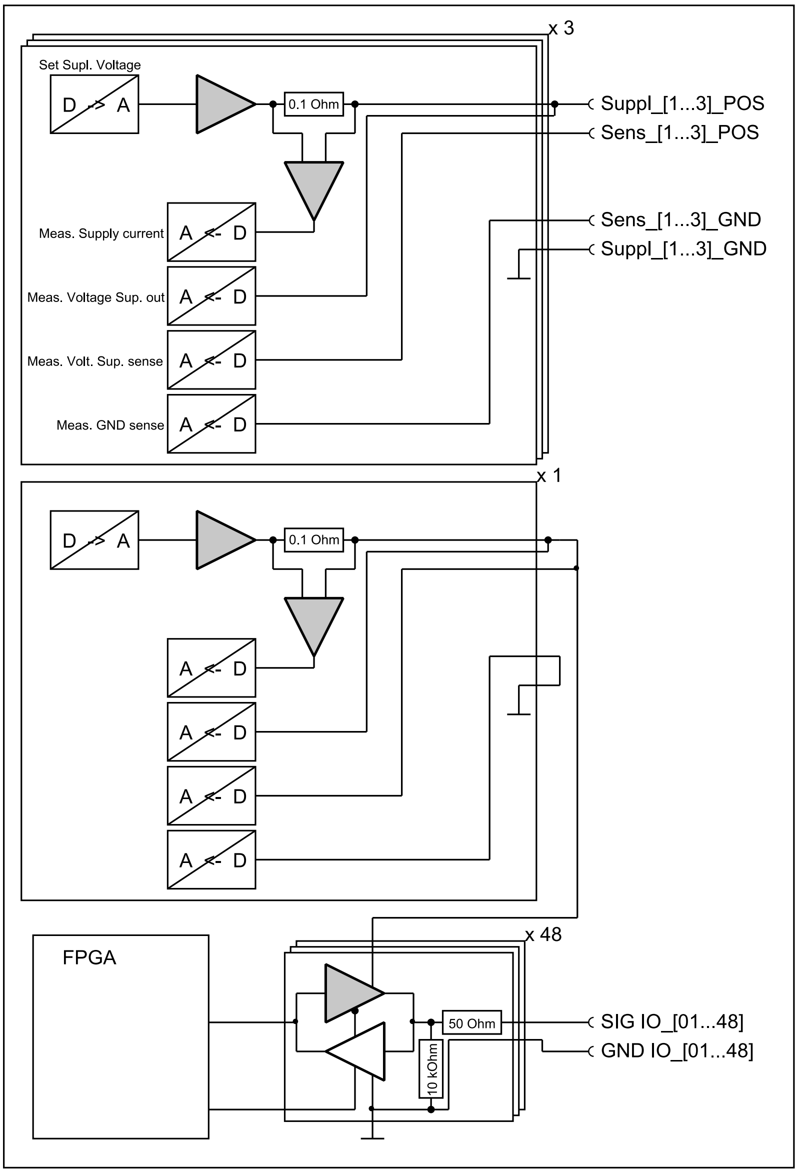
1. Technical data

- Current consumption: 12V / 0,4 A (without external consumers)
- Operating temperature: 0°C … 40°C (32° F … 104°F)
- Rel. Humidity: Max. 85% not condensed
- Weight: 150g
- Dimensions: Single Eurocard, 4 U

Test conditions: Environmental temperature 20°C to 26°C (68°F to 78,8°F)

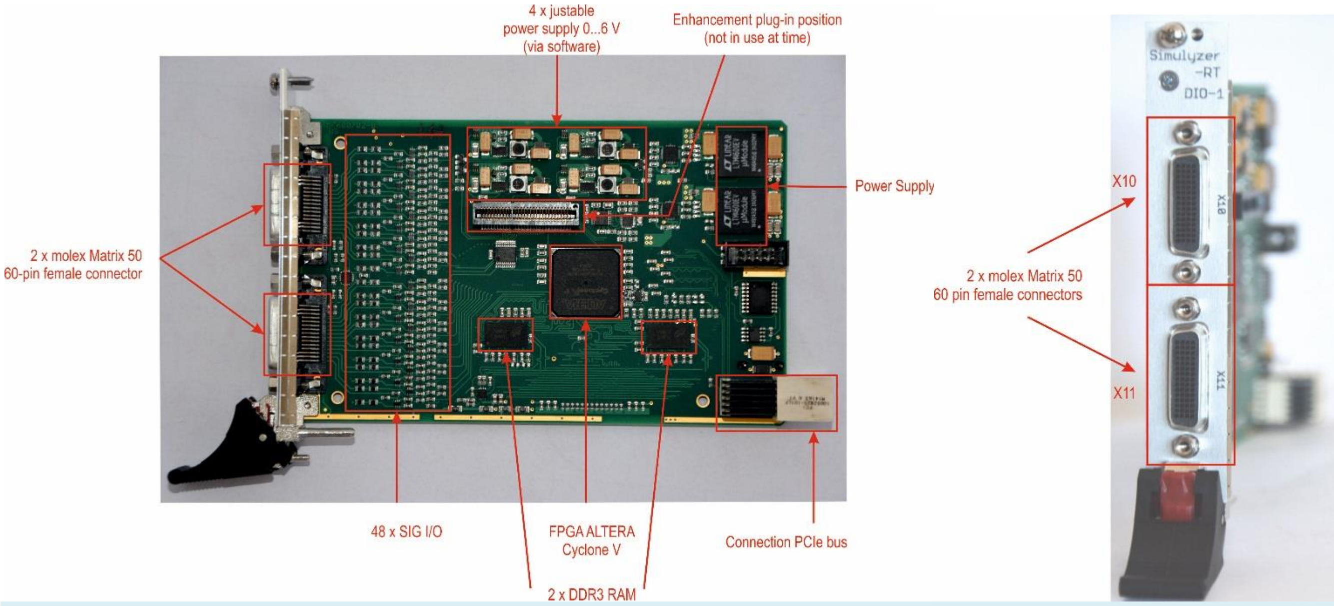
Num	Evaluation	Symbol	typ.	min.	max.	description
1	Permitted voltage range	U_{supp}	12V	11.4V	12.6V	
2	Current consumption	I_{supp}	270mA	-	400mA	Without sensor supply

2. Block diagram



3. Connectors:

- For SPI, FAST-SO
- Connectors to bus: 1 PCIe Lane to CPU-1
  Power supply I2C
  Parallel to all cards for synchronization
- Connectors frontside: 2x molex „Matrix 50“ 60 pin female connector with dig IO + Sensor Power

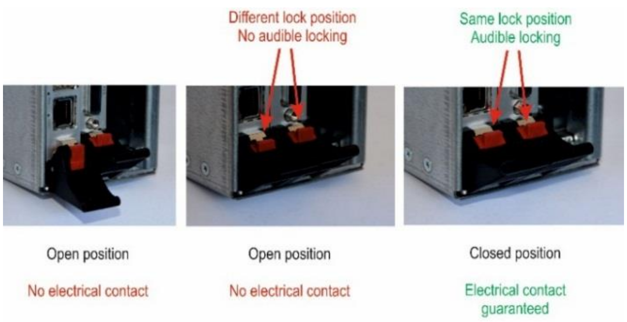


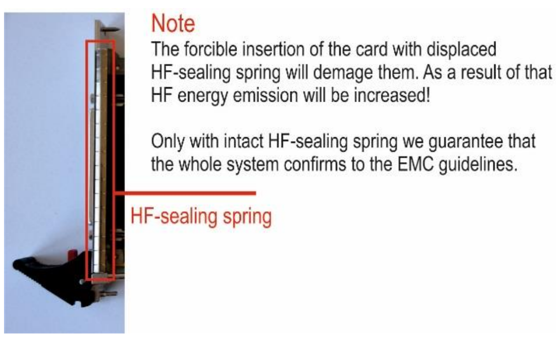
4. Interfaces and FPGA:

- ALTERA FPGA Cyclone V to realize protocolling
- 8 x SPI (MISO, MOSI, CS, CLK) + 16 Reserved DIG IO => 48 Pins
- 16xSPI (16xMISO, 16xMOSI, 8xCS, 8xCLK)/ 48 Pins
- With16 reserved IO it is possible to realize e.g. 4 x Fast-SO
- All DIG IOs bidirectional, level adjustable from 1.2V to 5.5V operating; max. 20MHz
- 3x adjustable PU outputs,
  1.5V to 6.0V, +/- 0.1% of scale final value to supply the sensors,
  current limiting 0..1000mA, +/- 0.1%.
  1x adjustable PU output, 1.5V to 6.0V, +/- 0.1% of scale final value,
  current limiting 0..1000mA +/- 0.1%
  for internal drivers (+ external)
- 50 Ohm Impedance matching for coaxial cable
- Backward measurement of the 4 PU voltages and the 4 currents, accuracy: +/- 0.1% of scale final value

5. Handling card/chassis

Pay attention that the ejection lever of the plug-in card is arrested correctly.
Only the correct position guarantees a justly connection of the bus system and the power supply!

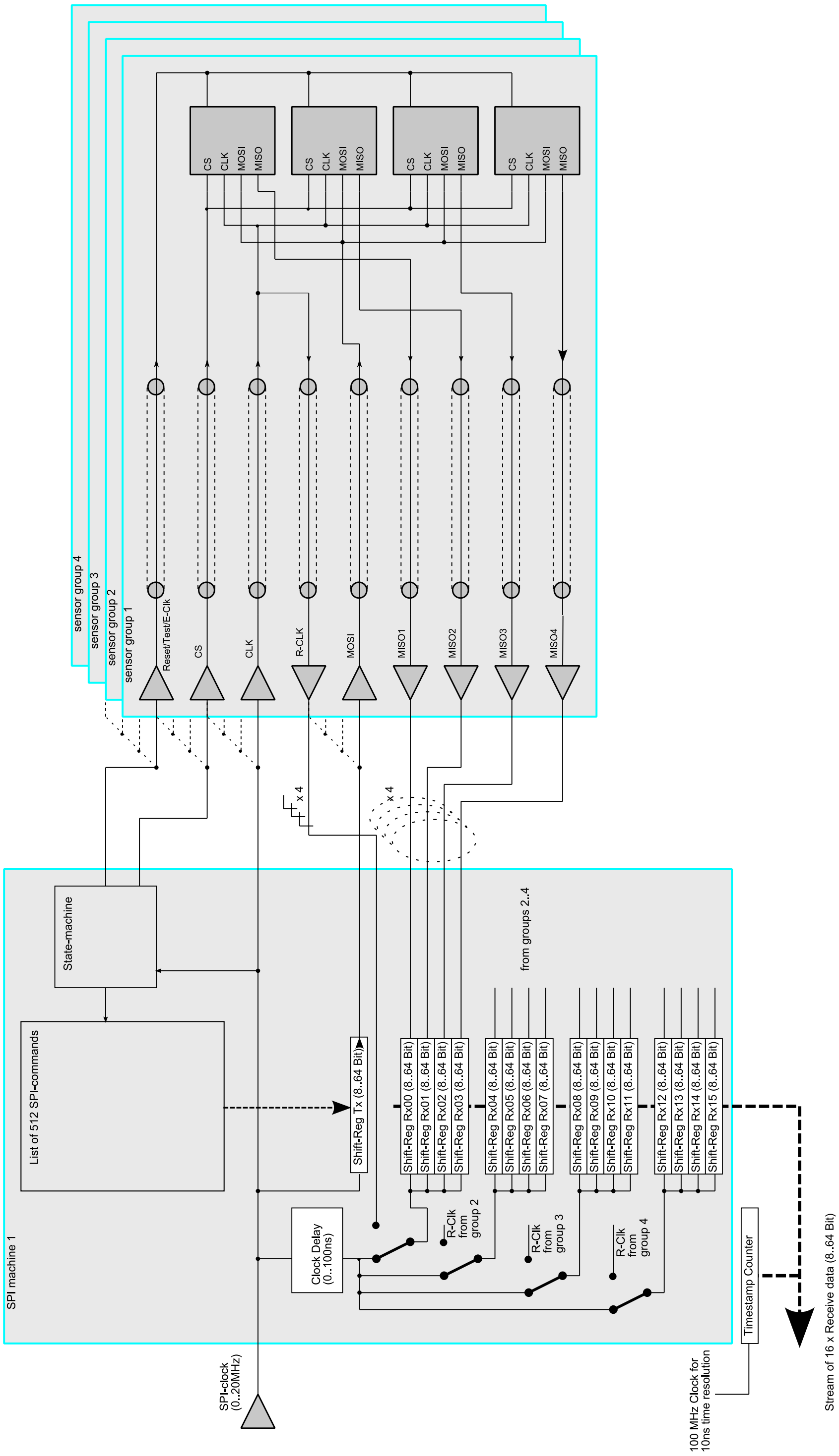




6. Applications – Working modes

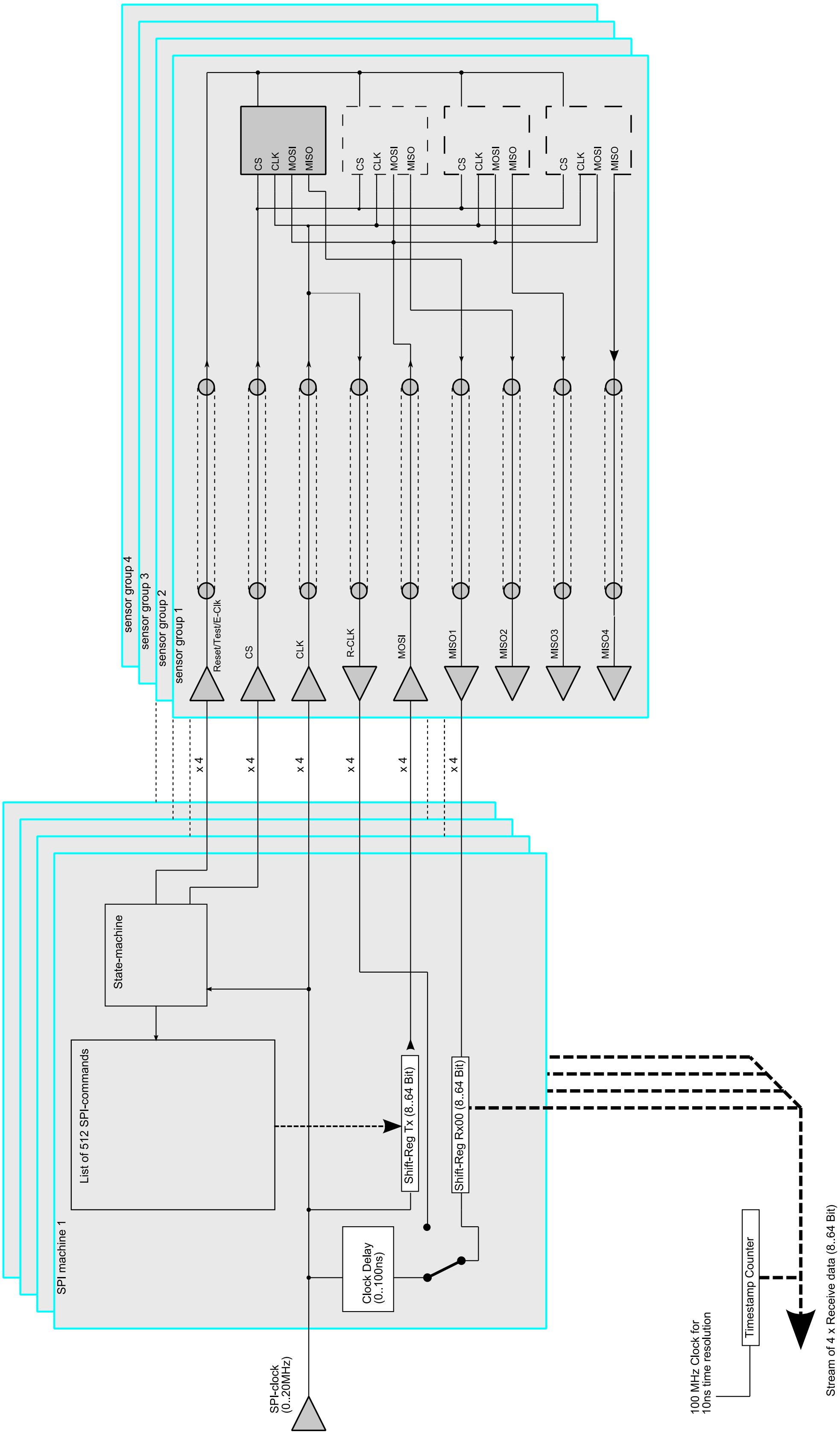
6.1. 16-times highspeed measurement application

To realize an application of 16-times parallel measurement technic a SPI machine is implemented at the FPGA, which controls out of a sending shift register the *Slave-In* of the 16 sensors in common.
Chip-Select, *Clock* and optionally *Reset/Test* are also controlled in common.
The 16 *Slave-Out* lines are executed individually, which are connected with 16 receiving shift register.
The commands are send absolutely synchronous, the answer are received individually.



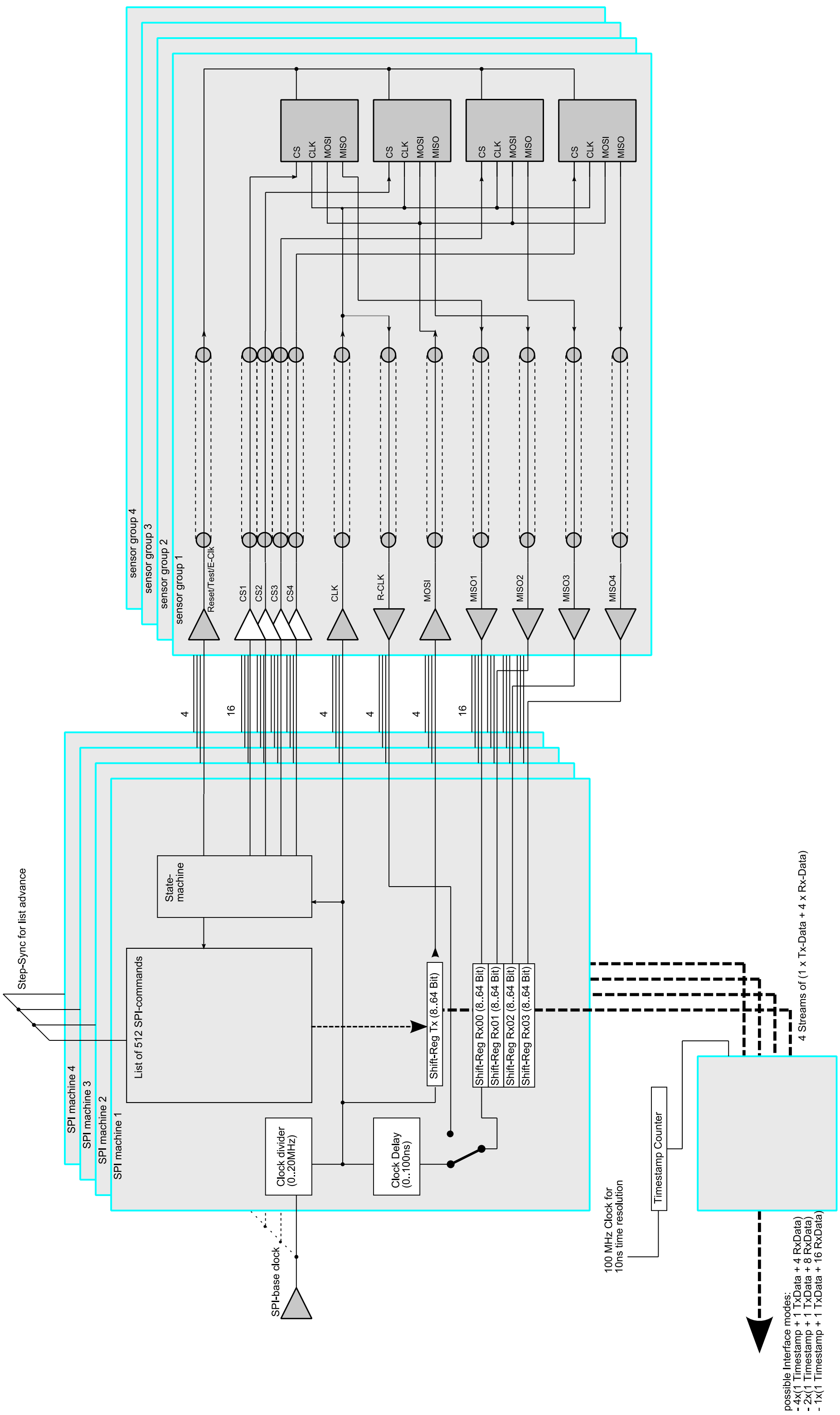
6.2. 4-times comparison application

4 SPI machines each with one own sending- and receiveing shift register.
Each SPI machine serves the first sensor of each 4 times group.
The rest of the three sensors of each group stay unpopulated.



6.3. 16-times high-speed measurement application with different sensors

At the FPGA four SPI machines are implemented, which each controls the *Slave-In* of 4 sensors of a group in common out of its 4 sending shift register. *Clock* and optionally *Reset/Test* are also controlled in common. Individually executed are the 16 *Slave-Out* lines, which are connected to the 4 receiving shift register of the 4 groups.



7. Measurement accuracy

7.1. Time base

Test conditions: Environmental temperature 20°C to 26°C						
Num	**Evaluation**	**Symbol**	**Type**	**Max**	**Unit**	**Comment**
1	Accuracy time base	$\Delta f/f$	±30	±50	ppm	-
2	Aging of time base	$\Delta f/f_A$	±5		ppm/year	-
3	Temperature drift of time base	$\Delta f/f_T$	±0.3	±0.7	ppm/°C	-

7.2. Measurement of the supply voltage

Test conditions: Environmental temperature 20°C to 26°C						
Num	**Evaluation**	**Symbol**	**Type**	**Max**	**Unit**	**Comment**
4	Accuracy of the measured voltage	U_{mea}	±0.3	±0.4	% of scfin. 7.5V	Range 0.5V .. 6.0V
5	Aging of the measured voltage	$U_{A\text{-}mea}$		±0.1	%/year	Range 0.5V .. 6.0V
6	Resolution of the measured voltages		16		Bit	0.. 65535
			0.1144409		mV/LSB	

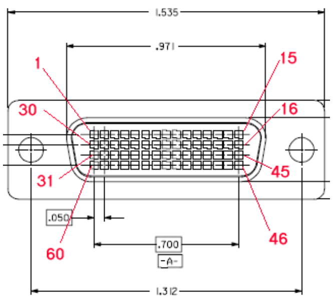
7.3. Measurement of the supply currents

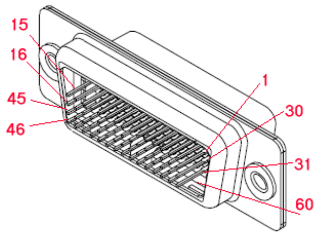
Test conditions: Environmental temperature 20°C to 26°C						
Num	**Evaluation**	**Symbol**	**Type**	**Max**	**Unit**	**Comment**
7	Accuracy of the measured current	I_{mea}	±0.3	±0.4	% of scfin. 1000mA	Range 2mA .. 900mA
8	Aging of the measured current	$I_{A\text{-}mea}$		±0.1	% of scfin. 1000mA / year	Range 2mA .. 900mA
9	Resolution of the measured current		16		Bit	0.. 65535
			15,2587891		µA/LSB	

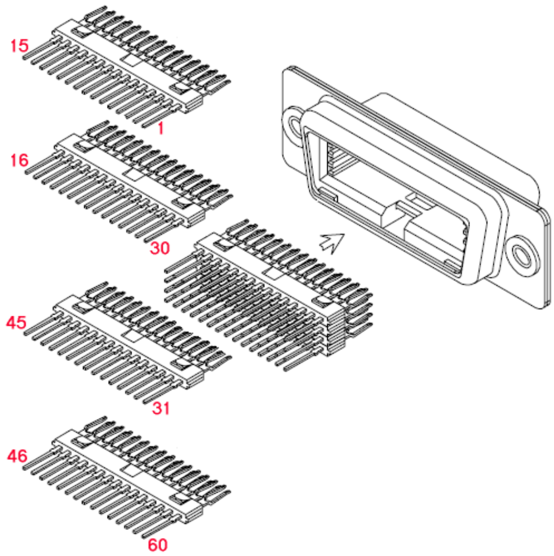
7.4. Generation of the voltages

Test conditions: Environmental temperature 20°C to 26°C						
Num	**Evaluation**	**Symbol**	**Type**	**Max**	**Unit**	**Comment**
10	Accuracy of the created current	U_{mea}	±0.3	±0.4	% of scfin. 6.3V	Range 0.5V .. 6.0V
11	Aging of the created current	U_{mea}		±0.1	% of scfin 6.3V / year	Range 0.5V .. 6.0V
12	Resolution of the created current		16		Bit	0.. 65535
			0,096130371		mV/LSB	

8. Connection diagram X10/X11







Pin		Name X10		Name X11	Cable No.
1		GND IO_01		GND IO_25	K_01
2		SIG IO_01		SIG IO_25	
3		GND IO_02		GND IO_26	K_02
4		SIG IO_02		SIG IO_26	
5		GND IO_03		GND IO_27	K_03
6		SIG IO_03		SIG IO_27	
7		GND IO_04		GND IO_28	K_04
8		SIG IO_04		SIG IO_28	
9		GND IO_05		GND IO_29	K_05
10		SIG IO_05		SIG IO_29	
11		GND IO_06		GND IO_30	K_06
12		SIG IO_06		SIG IO_30	
13	V_{DD} Sesnor	Sens_1_GND	V_{DD} Aux	Sens_3_GND	K_07
14		Suppl_1_GND		Suppl_3_GND	K_08
15		Suppl_1_GND		Suppl_3_GND	
16		Sens_1_POS		Sens_3_POS	K_09
17		Suppl_1_POS		Suppl_3_POS	K_10
18		Suppl_1_POS		Suppl_3_POS	
19		GND IO_07		GND IO_31	K_11
20		SIG IO_07		SIG IO_31	
21		GND IO_08		GND IO_32	K_12
22		SIG IO_08		SIG IO_32	
23		GND IO_09		GND IO_33	K_13

24		SIG IO_09		SIG IO_33	
25		GND IO_10		GND IO_34	K_14
26		SIG IO_10		SIG IO_34	
27		GND IO_11		GND IO_35	K_15
28		SIG IO_11		SIG IO_35	
29		GND IO_12		GND IO_36	K_16
30		SIG IO_12		SIG IO_36	
31		GND IO_13		GND IO_37	K_17
32		SIG IO_13		SIG IO_37	
33		GND IO_14		GND IO_38	K_18
34		SIG IO_14		SIG IO_38	
35		GND IO_15		GND IO_39	K_19
36		SIG IO_15		SIG IO_39	
37		GND IO_16		GND IO_40	K_20
38		SIG IO_16		SIG IO_0	
39		GND IO_17		GND IO_41	K_21
40		SIG IO_17		SIG IO_41	
41		GND IO_18		GND IO_42	K_22
42		SIG IO_18		SIG IO_42	
43	V_{DD} Analog	Sens_2_GND	V_{DD} SPI-Interface		K_23
44		Suppl_2_GND		Suppl_4_GND	K_24
45		Suppl_2_GND		Suppl_4_GND	
46		Sens_2_POS			K_25
47		Suppl_2_POS		Suppl_4_POS	K_26
48		Suppl_2_POS		Suppl_4_POS	
49		GND IO_19		GND IO_43	K_27
50		SIG IO_19		SIG IO_43	
51		GND IO_20		GND IO_44	K_28
52		SIG IO_20		SIG IO_44	
53		GND IO_21		GND IO_45	K_29
54		SIG IO_21		SIG IO_45	
55		GND IO_22		GND IO_46	K_30
56		SIG IO_22		SIG IO_46	
57		GND IO_23		GND IO_47	K_31
58		SIG IO_23		SIG IO_47	
59		GND IO_24		GND IO_48	K_32
60		SIG IO_24		SIG IO_48	

9. Connection diagram X10/X11 as a 4x4 SPI Master Machine

Pin		Neutral name X10	4x4 SpiMaMa Name X10		Neutral name X11	4x4 SpiMaMa Name X11	Cable no.
1		GND IO_01			GND IO_25		K_01
2		SIG IO_01	CLK_G1		SIG IO_25	CLK_G3	
3		GND IO_02			GND IO_26		K_02
4		SIG IO_02	R_CLK_G1		SIG IO_26	R_CLK_G3	
5		GND IO_03			GND IO_27		K_03
6		SIG IO_03	MOSI_G1		SIG IO_27	MOSI_G3	
7		GND IO_04			GND IO_28		K_04
8		SIG IO_04	RES_TEST_E_G1		SIG IO_28	RES_TEST_E_G3	
9		GND IO_05			GND IO_29		K_05
10		SIG IO_05	CS_G1_S1		SIG IO_29	CS_G3_S1	
11		GND IO_06			GND IO_30		K_06
12		SIG IO_06	CS_G1_S2		SIG IO_30	CS_G3_S2	
13	V_{DD} Sesnor	Sens_1_GND		V_{DD} Aux	Sens_3_GND		K_07
14		Suppl_1_GND			Suppl_3_GND		K_08
15		Suppl_1_GND			Suppl_3_GND		
16		Sens_1_POS			Sens_3_POS		K_09
17		Suppl_1_POS			Suppl_3_POS		K_10
18		Suppl_1_POS			Suppl_3_POS		
19		GND IO_07			GND IO_31		K_11
20		SIG IO_07	CS_G1_S3		SIG IO_31	CS_G3_S3	
21		GND IO_08			GND IO_32		K_12
22		SIG IO_08	CS_G1_S4		SIG IO_32	CS_G3_S4	
23		GND IO_09			GND IO_33		K_13
24		SIG IO_09	MISO_G1_S1		SIG IO_33	MISO_G3_S1	
25		GND IO_10			GND IO_34		K_14
26		SIG IO_10	MISO_G1_S2		SIG IO_34	MISO_G3_S2	
27		GND IO_11			GND IO_35		K_15
28		SIG IO_11	MISO_G1_S3		SIG IO_35	MISO_G3_S3	
29		GND IO_12			GND IO_36		K_16
30		SIG IO_12	MISO_G1_S4		SIG IO_36	MISO_G3_S4	
31		GND IO_13			GND IO_37		K_17
32		SIG IO_13	CLK_G2		SIG IO_37	CLK_G4	
33		GND IO_14			GND IO_38		K_18
34		SIG IO_14	R_CLK_G2		SIG IO_38	R_CLK_G4	
35		GND IO_15			GND IO_39		K_19
36		SIG IO_15	MOSI_G2		SIG IO_39	MOSI_G4	

37		GND IO_16			GND IO_40		K_20
38		SIG IO_16	RES_TEST_E_G2		SIG IO_0	RES_TEST_E_G4	
39		GND IO_17			GND IO_41		K_21
40		SIG IO_17	CS_G2_S1		SIG IO_41	CS_G4_S1	
41		GND IO_18			GND IO_42		K_22
42		SIG IO_18	CS_G2_S2		SIG IO_42	CS_G4_S2	
43	V_{DD} Analog	Sens_2_GND		V_{DD} SPI-Interface			K_23
44		Suppl_2_GND			Suppl_4_GND		K_24
45		Suppl_2_GND			Suppl_4_GND		
46		Sens_2_POS					K_25
47		Suppl_2_POS			Suppl_4_POS		K_26
48		Suppl_2_POS			Suppl_4_POS		
49		GND IO_19			GND IO_43		K_27
50		SIG IO_19	CS_G2_S3		SIG IO_43	CS_G4_S3	
51		GND IO_20			GND IO_44		K_28
52		SIG IO_20	CS_G2_S4		SIG IO_44	CS_G4_S4	
53		GND IO_21			GND IO_45		K_29
54		SIG IO_21	MISO_G2_S1		SIG IO_45	MISO_G4_S1	
55		GND IO_22			GND IO_46		K_30
56		SIG IO_22	MISO_G2_S2		SIG IO_46	MISO_G4_S2	
57		GND IO_23			GND IO_47		K_31
58		SIG IO_23	MISO_G2_S3		SIG IO_47	MISO_G4_S3	
59		GND IO_24			GND IO_48		K_32
60		SIG IO_24	MISO_G2_S4		SIG IO_48	MISO_G4_S4	

10. Connection cable

K_01 .. K_07, K_09, K_11 .. K_23, K_25, K_27 .. K_32	Coaxial cable, 1,3mm diameter
K_08, K_10, K_24, K_26	Litz wire 0,75mm² 2mm diameter
All cable length =2m, end open