MECHATRONICS LABS SRL

IO-LINK SLAVE MODULE

EVALUATION BOARD

IOLx-E-EVK

IO-Link

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1 INTRODUCTION

1.1 About this Manual

This manual describes the IOLx-E-EVK, the Evaluation Board of IOLx-E.

1.1.1 List of Revisions

Index	Date	Chapter	Revision
1.0	02-11-2017	All	Created
1.1	13-09-2018	All	Update to new hardware version. The functions of the board are same. Add some feature and change dimension of the board.

Table 1.1. *List of revisions*

1.1.2 Reference to Hardware

Hardware	Revision	Part Number
IOLS-E	2.0	IOLS-E-00S

Table 1.2. *Reference to Hardware*

1.2 Other relevant documentation

In additional to this document, the following documents are also relevant for the user of the IOLx-E-EVK Evaluation Board

Manual	Documentation name
Reference Manual of IOLS-E	DOC000001RM11EN.pdf

Table 1.3. *Additional documentation*

2 DESCRIPTIONS AND DRAWINGS

2.1 Description of the IOLx-E-EVK

The IOLx-E-EVK is the Evaluation Board of the component IOLS-E.

It is equipped with a IOLS-E-00S and following features:

- Power supply from different source: USB, IO-Link and direct 3,3V on interface connector.
- Switches for start-up configuration of the module IOLS-E
- Use in simple mode with shift register Input and Output and two analog input on board. On evaluation there are 16 switches IN and 16 LEDs OUT, and potentiometer and temperature analog sensors.
- Use in host mode with external microcontroller interfaced to module IOLS-E. On board there is a STM32F0 family microcontroller with 4 INPUTS and 4 OUTPUTS and 2 ANALOG, already interfaced to microcontroller.
  Is available the demo application that uses toolkit for communication with module.
- ST microcontroller is programmable with JTAG SWD standard connector. Use this for implement your demo application. There are some pin of microcontroller to external interface connector with GPIO, UART, I2C and ANALOG functions.
- USB connector for communication with external application, that communicates with module for configuration and firmware update.
- SPI interface of the module IOLS-E is available to external interface connector for free use. The start-up configuration determines if the module is used in simple or host mode.
- First byte of the input and output shift registers is available to external interface connector
- The 4 inputs and 4 outputs and 2 analogs on ST microcontroller are available to external connector, and they already read and write from demo application.

2.2 Drawings

2.2.1 Block Diagram

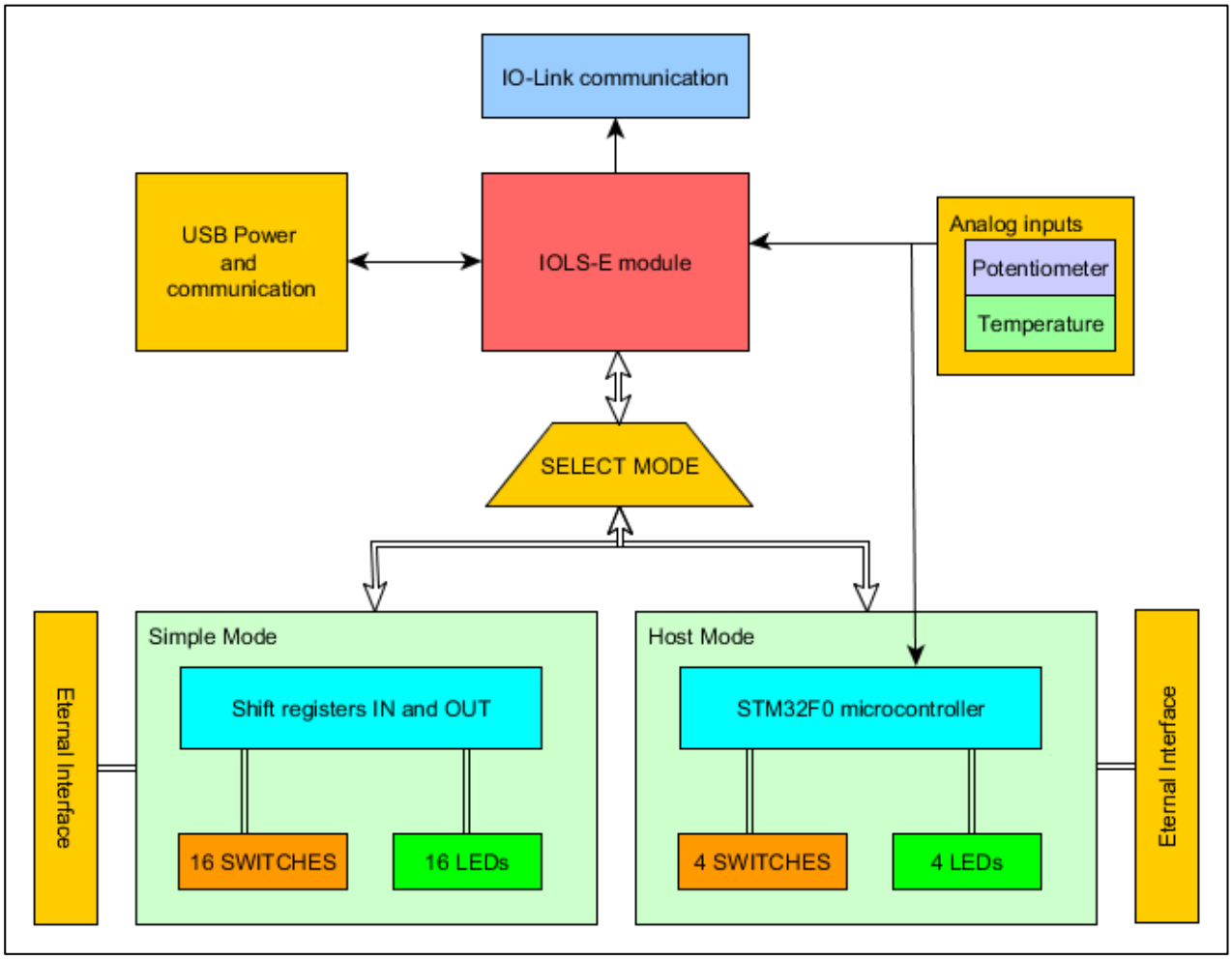


Figure 2.1 . *Diagram block*

2.2.2 Board details

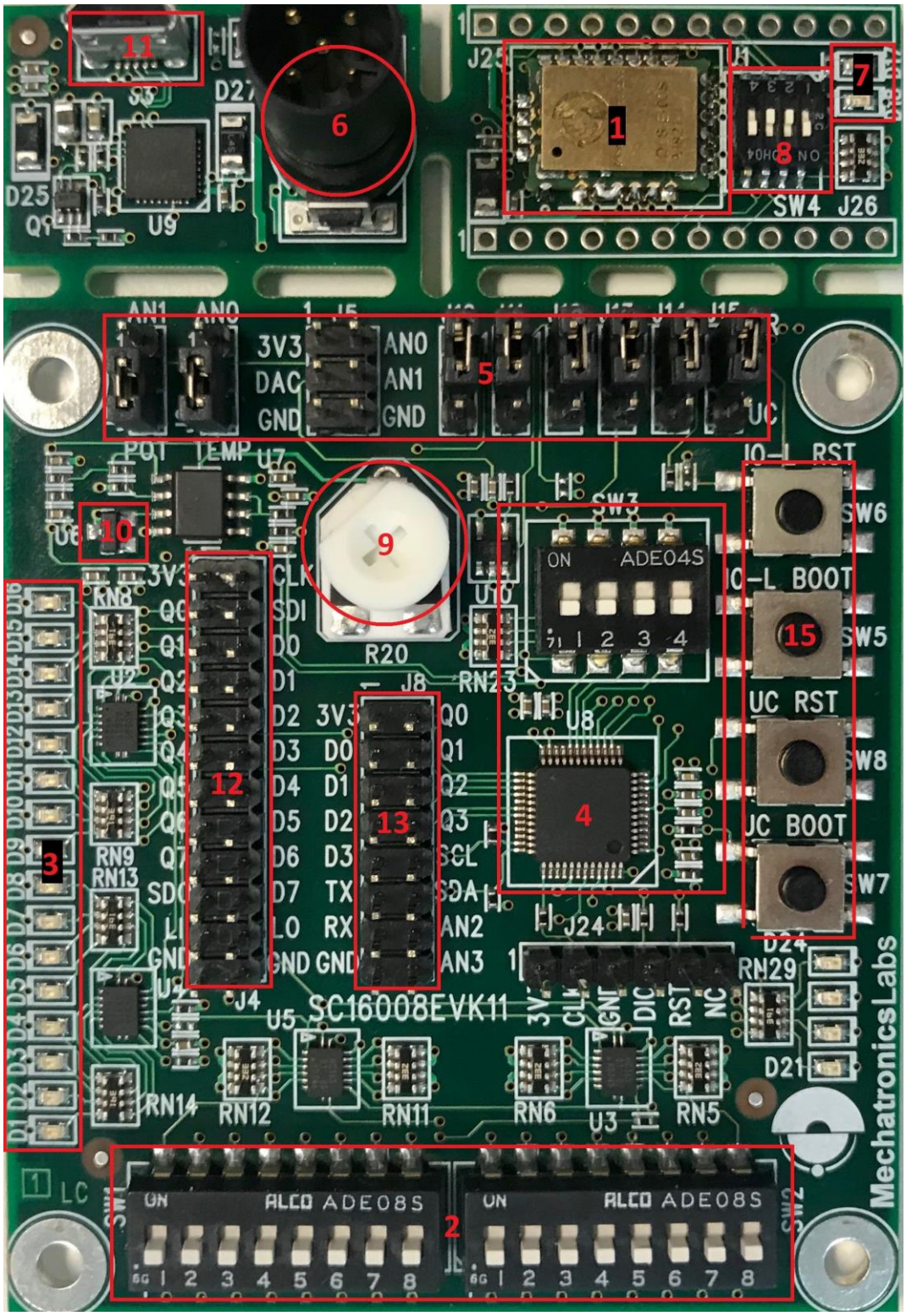


Figure 2.2 . *Board details*

Details number	Description
1	IO-Link Slave Module IOLS-E
2	Simple mode - Shift register Data Input (16 bits)
3	Simple mode - Shift register Data Output (16 bits)
4	Host mode – microcontroller STM32F0 and in/out
5	Jumper for switch selection between simple and host mode
6	IO-Link M12 connector class A port (3 wire)
7	LEDs for IO-Link bus communication status
8	Start-up switch configuration of the module IOLS-E
9	Analog unit – Potentiometer
10	Analog unit – Temperature sensor
11	USB connector – power and communication
12	External interface connector when module is into simple mode configuration
13	External interface connector when module is into host mode configuration
14	External interface connector for direct communication with module. There is SPI interface of the module IOLS-E. Master or slave setting is function of start-up configuration.
15	Push-button for reset and boot selection of the module IOLS-E and ST microcontroller.

Table 2.1. *Board details*

3 FUNCTIONALITY DESCRIPTION

3.1 Start-up configuration

The IOLS-E module can work either in Simple mode or in Host mode. Refer to reference manual of the component.

Selection is done by SW4 according to Table 3.1.

Configuration HW Pin				Module Configuration mode	Configuration parameters	Data image Slave to/from Master IO-Link										
Pin CFGSSIO	Pin CFG2	Pin CFG1	Pin CFG0			B00	B01	B02	B03	B04	B..	B07	B..	B11	B..	B31
0	0	0	0	SIMPLE MODE Autonomous functionality with SSIO (Shift register) and ANALOG channel	4byte ANA; 4byte SSIO (8 PDIN, 4 PDOUT)	AN0	AN0	AN1	AN1	SR0	SR..	SR3	X	X	X	X
0	0	0	1		4byte ANA; 8byte SSIO (12 PDIN, 8 PDOUT)	AN0	AN0	AN1	AN1	SR0	SR..	SR3	SR..	SR7	X	X
0	0	1	0		4byte ANA; 28byte SSIO (32 PDIN, 28 PDOUT)	AN0	AN0	AN1	AN1	SR0	SR..	SR3	SR..	SR7	SR..	SR27
0	0	1	1		4byte SSIO (4 PDIN, 4 PDOUT)	SR0	SR1	SR2	SR3	X	X	X	X	X	X	X
0	1	0	0		8byte SSIO (8 PDIN, 8 PDOUT)	SR0	SR1	SR2	SR3	SR4	SR..	SR7	X	X	X	X
0	1	0	1		32byte SSIO (32 PDIN, 32 PDOUT)	SR0	SR1	SR2	SR3	SR4	SR..	SR7	SR..	SR11	SR..	SR31
0	1	1	0		Reserved for use future	Undefined										
0	1	1	1													
1	0	0	0	HOST MODE Need external host. Module communication IO-Link protocol feature only	Use Serial Modbus host interface*	Host depend - Cyclic Data Exchange registers										
1	0	0	1		Use SPI register access host interface	Host depend - Cyclic Data Exchange registers										
1	0	1	0		Reserved for use future	Undefined										
1	0	1	1													
1	1	0	0													
1	1	0	1													
1	1	1	0													
1	1	1	1													

NOTE: 1 = pull-up resistor; 0 = not mount
* Modbus RTU interface is ever enabled.

***Table 3.1**. Start-up function IOLS-E configuration*

3.2 IOLS-E Simple mode

In Simple mode the SSIO port is used and internal ADC can be enabled.

The IOLS-E can exchange data on SSIO port either with shift registers mounted on the evaluation board and with an external shift register device connected to the SSIO headers up to J4 on J4.2, J4.4, J4.19, J4.21, J4.22 .

Shift registers are then connected to switches SW1, SW2 and to LEDs D1 to D16. Refer to section SCHEMATICS.

If the selection headers J10 to J15 are closed with jumpers, like in Figure 3.1, IOLS-E works in Simple mode and it reads the status of the switches SW1 and SW2 that represent 16-bit input data and set drives the LEDs D1 to D16 writing 16-bit data on the output. The switch 8 of SW2 is the input LSB and the switch 1 of SW1 is the input MSB. D1 and D16 represent the output LSB and MSB respectively.

J4 can be used to connect an external device in alternative to SW1 and LEDs D9 to D16 to exchange 8-bit data. Refer to Table 3.2 for J4 signals.

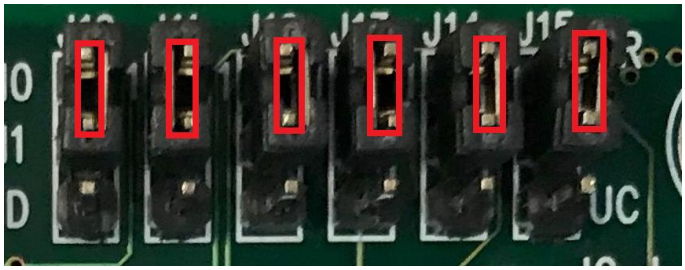


Figure 3.1. *Selection headers J10 to 15 Simple Mode*

SIGNAL	TYPE	FUNCTION
3V3	POWER	It can provide either 3.1V as output or receive 3.3V (3.6V MAX) from an external source
CLK	OUTPUT	Clock signal (from IOLS-E to external device)
Q0 to Q7	OUTPUT	8-bit parallel data output. Outputs and LEDs D9 to D16 are driven simultaneously
SDI	INPUT	IOLS-E serial data input for shift register
D0 to D7	INPUT	8-bit parallel data input. To avoid conflict with SW2 put all SW2 switches in OFF position
SDO	OUTPUT	IOLS-E serial data output for shift register
LI	OUTPUT	Latch-In signal (from IOLS-E to external device)
LO	OUTPUT	Latch-Out signal (from IOLS-E to external device)
GND	GROUND	Signal ground

Table 3.2. *J4 pin signals Simple mode*

If the IOLS-E internal ADC is enabled, the module can read the signal of the temperature sensor (U6) and the voltage value from the potentiometer (R20).

The temperature sensor output is proportional to the temperature according the following equation:

$V_{OUT} = 20mV * T + 1V$ Where: $-40°C \leq T \leq 115°C$.

The potentiometer output can swing from 0V to *3V3* level.

The *3V3* level is also the ADC full-scale value.

Two auxiliary analog inputs are also available on J5 (AN0 and AN1) that can be chosen as alternative to the sensor and the potentiometer. Selection is made by headers J6 and J7 (see Figure 3.2 and Figure 3.3). They are connected direct to input ADC pin signals.

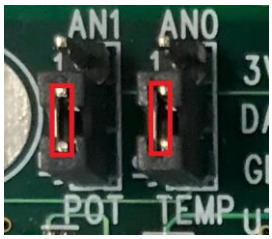


Figure 3.2. *Sensor and pot. Selected J6..J7*

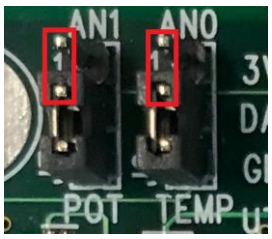


Figure 3.3. *Auxiliary external analog inputs selected J6..J7*

SIGNAL	TYPE	FUNCTION
3V3	POWER	It can provide either 3.1V as output or receive 3.3V (3.6V MAX) from an external source
AN0	INPUT	Analog 0 external input
AN1	INPUT	Analog 1 external input
POT	INPUT	Analog potentiometer signal
TEMP	INPUT	Analog temperature signal
DAC	OUTPUT	Digital Analog output (Reserved for future)
GND	GROUND	Signal ground

Table 3.3. *J5 pin for external analog inputs*

3.3 IOLS-E Host Mode

When the IOLS-E module works in Host mode, it can exchange data on SPI and USB ports. The module internal ADC is always disabled. Module works only for support IO-Link communication. The application runs into host.

If the SPI port is enabled (see Table 3.1) the IOLS-E module can exchange data either with the ST microcontroller mounted on the evaluation board or with external devices connected to the middle pin on the headers J10 to J15 (see Chapter 3.5).

If the selection headers J10 to J15 are closed with jumpers, like in Figure 3.4, the IOLS-E exchanges data with the microcontroller mounted on the evaluation board.

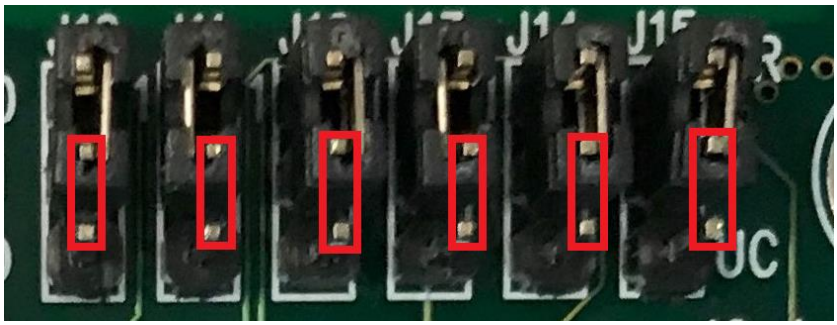


Figure 3.4. *Selection headers J10..15 Host Mode*

3.4 Microcontroller

The microcontroller is STM32F030C8T6 and has four analog inputs:

- temperature sensor
- potentiometer
- two auxiliary analog inputs on connector J8

It can read the status of the switch SW4 and can drive four LEDs: D21 to D24. The demo application reads and exchanges with IOLS-E module all 4 analog inputs and all 8 digital input and output, on board and external interface on J8 connector. More, on J8 are available Serial interface UART and some pin GPIOs have also other functionality, like I2C bus.

The microcontroller can exchange data with a device connected to J8. Refer to Table 3.4 for J8 signals.

SIGNAL	TYPE	FUNCTION
3V3	POWER	It can provide either 3.1V as output or receive 3.3V (3.6V MAX) from an external source
D0 to D3	OUTPUT	4-bit parallel data input
Q0 to Q3	INPUT	4-bit parallel data output; Q3 and Q2 can be configured to SDA and SCL I2C bus signals.
TX	OUTPUT	UART TX (TTL LEVEL)
RX	INPUT	UART RX (TTL LEVEL)
SCL	OUT	I2C Clock Signal
SDA	BIDIR	I2C Data Signal
AN2	INPUT	Analog auxiliary input. The *3V3* level is the ADC full-scale value. Direct to ADC pin signal.
AN3	INPUT	Analog auxiliary input. The *3V3* level is the ADC full-scale value. Direct to ADC pin signal.
GND	GROUND	Signal ground

Table 3.4. *J8 pin signals*

The microcontroller is already programmed, user can anyway write its own firmware on it using the serial wire interface available on J24:

SIGNAL	TYPE	FUNCTION
3V3	OUTPUT	I/O voltage level
CLK	INPUT	SWCLK signal
GND	GROUND	Signal ground
DIO	BIDIR	SWDIO signal
RST	INPUT	Reset signal
NC	---	Not connected

Table 3.5. *J24 pin signals*

3.5 External interface connections

If the selection headers J10 to J15 are left open, IOLS-E exchanges data with an external device connected to the middle pin of J10 to J15, refer to Figure 3.5 and Table 3.7 for signals. IOLS-E can work either in Simple mode and in Host mode while connected with an external device. Remember: You must to connect to any other ground signal on the board while using the J10 to J15 headers.

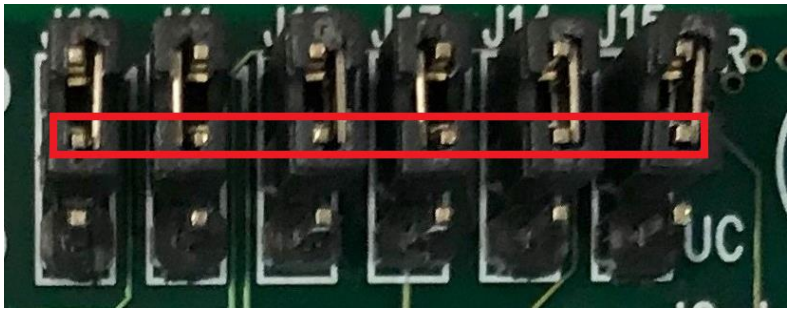


Figure 3.5. *Selection headers J10 to 15 External mode*

SIGNAL	TYPE	FUNCTION
J10.CLK	OUTPUT	Clock signal (from IOLS-E to external device)
J11.MIS	INPUT	IOLS-E serial data input
J12.MOS	OUTPUT	IOLS-E serial data output
J13.LO/CS	OUTPUT	Latch-Out signal (from IOLS-E to external device)
J14.LI/D	OUTPUT	Latch-In signal (from IOLS-E to external device)
J15.RST	NOT CONNECTED	

Table 3.7. *J10 to 15 middle pin signals External mode*

The IOLx-E-EVK board can also be cut in three pieces if the microprocessor and the input sections are not needed, leaving the IO-Link Slave Module detached as shown in Figure 3.6. The remaining Slave Module can be connected with an external device by using J25 and J26 headers. Refer to Table 3.8, 3.9 for J25 and J26 signals.

If you want, you can divide board in only two parts, in this mode you can to use a connector M12 and USB interface, for IO-Link connection and for firmware update from USB.

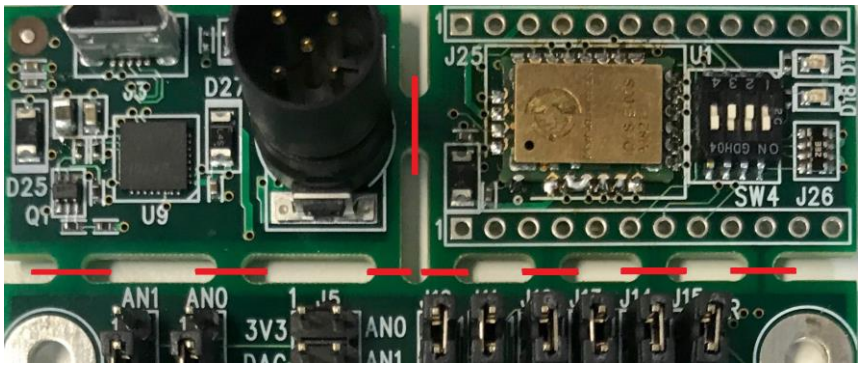


Figure 3.6. *cut the board on the following lines*

SIGNAL	PIN	TYPE	FUNCTION
3V3	1	POWER	Logic 3.3V Voltage. If IO-Link is connected 3.3V is supply from module. Is possible that you have external supply if desired.
N.C.	2	-	
VP	3	POWER	IO-Link Vplus
CQ	4	BI-DIRECTIONAL	IO-Link C/Q signal
VM	5	POWER	IO-Link Ground
N.C.	6	-	
TX	7	OUTPUT	UART Serial transmit data
RX	8	INPUT	UART Serial receive data
RSVD	9	-	
RSVD	10	-	
RSVD	11	-	
GND	12	POWER	Ground signal

Table 3.8. *J25 pin signals*

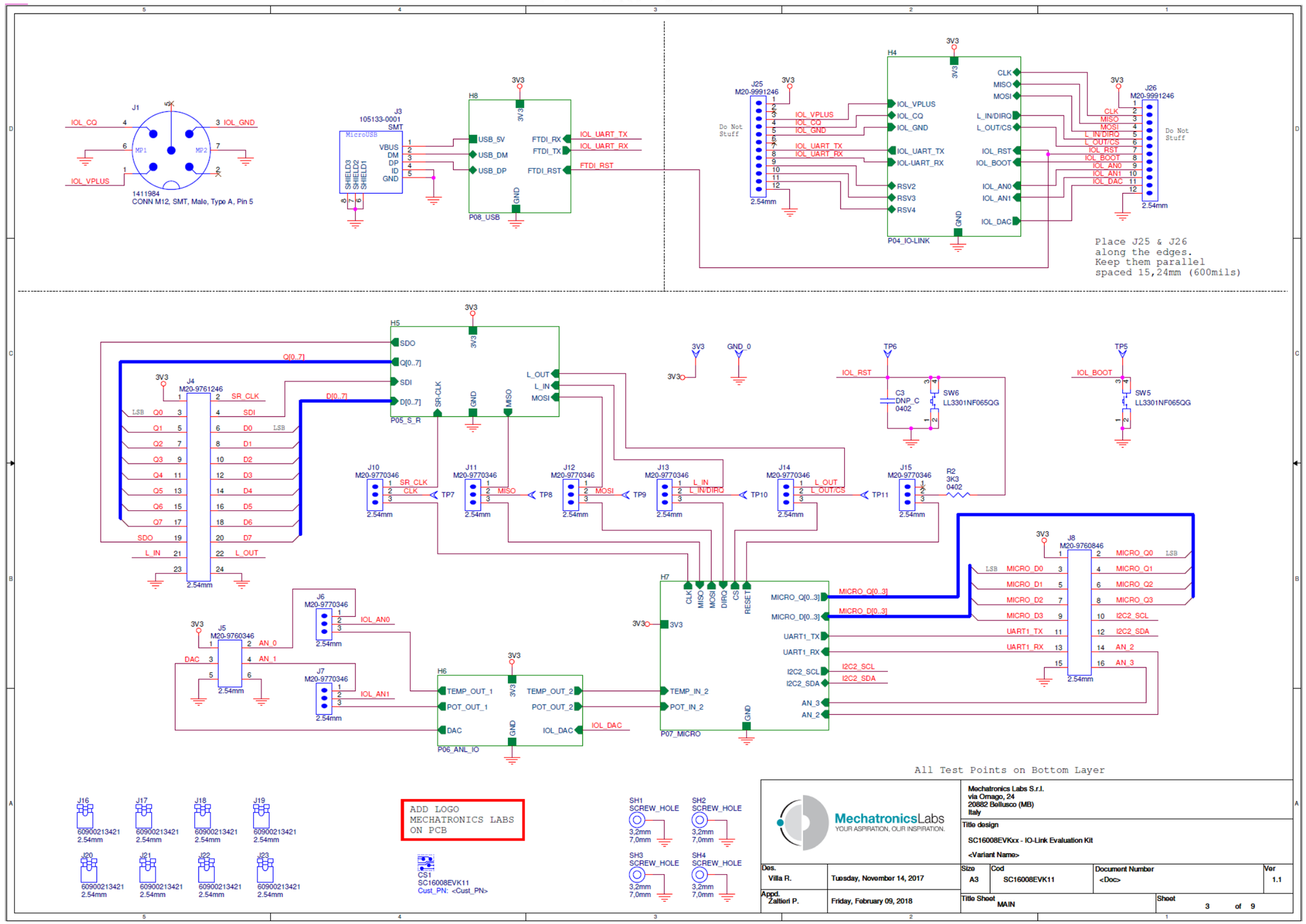
SIGNAL	PIN	TYPE	FUNCTION

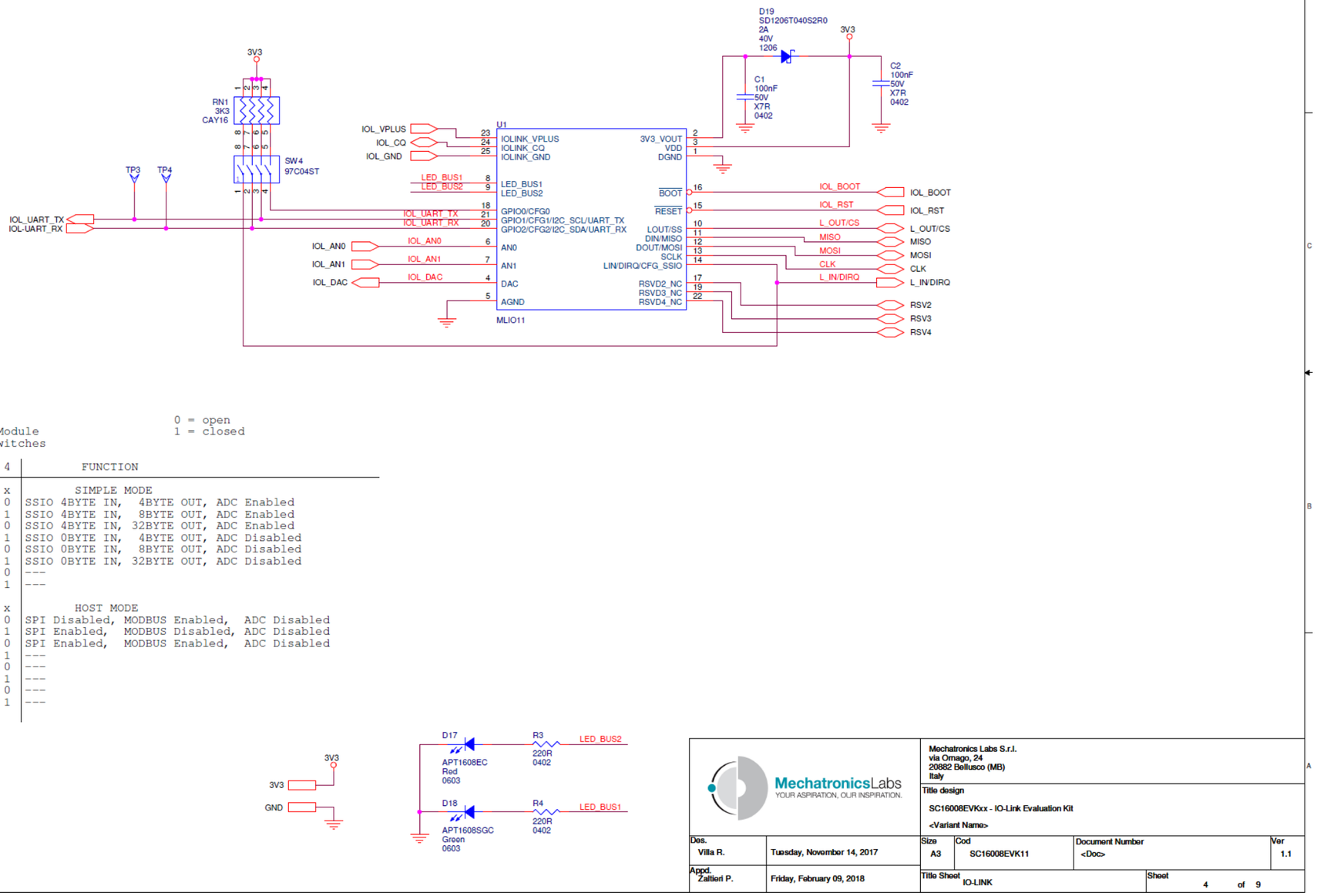
3V3	1	POWER	Logic 3.3V Voltage. If IO-Link is connected 3.3V is supply from module. Is possible that you have external supply if desired.
CLK	2	OUTPUT or INPUT	Clock generation or clock signal input. Is function of the start-up configuration – If Simple mode SPI is master, if Host mode SPI is slave.
MISO	3	OUTPUT or INPUT	SPI Master input or Slave output. Is function of the start-up configuration – If Simple mode SPI is master, if Host mode SPI is slave.
MOSI	4	OUTPUT or INPUT	SPI Master output or Slave input. Is function of the start-up configuration – If Simple mode SPI is master, if Host mode SPI is slave.
LI/D	5	OUTPUT or INPUT	Latch IN or DIRQ - Is function of the start-up configuration – If Simple mode is Latch IN for shift registers, if Host mode is a Data Interrupt Request (DIRQ not yet implement).
LO/CS	6	OUTPUT or INPUT	Latch OUT or Slave Select/Chip Select. Is function of the start-up configuration – If Simple mode is Latch OUT for shift registers, if Host mode is a SPI Slave Select.
RST	7	OUTPUT	Module reset signal. Reset is Low.
BOOT	8	INPUT	Module boot signal – When reset with this pin Low, you start internal boot for firmware update.
AN0	9	INPUT	Analog 0 input. Range 0 - 3.3V.
AN1	10	INPUT	Analog 1 input. Range 0 - 3.3V.
DAC	11	INPUT	Analog Output. Range 0 - 3.3V. (Not yet implement)
GND	12	POWER	Ground signal

Table 3.9. *J26 pin signals*

4 SCHEMATICS

The follow pages, view schematic of the evaluation board, and report Bill of Material.


J1
IOL_CQ
IOL_GND
IOL_VPLUS
1411984
CONN M12, SMT, Male, Type A, Pin 5
J3
105133-0001
SMT
MicroUSB
VBUS
DM
DP
ID
GND
H8
USB_5V
USB_DM
USB_DP
FTDI_RX
FTDI_TX
FTDI_RST
IOL_UART_TX
IOL_UART_RX
P08_USB
J25
M20-9991246
Do Not Stuff
2.54mm
H4
IOL_VPLUS
IOL_CQ
IOL_GND
IOL_UART_TX
IOL-UART_RX
RSV2
RSV3
RSV4
CLK
MISO
MOSI
L_IN/DIRQ
L_OUT/CS
IOL_RST
IOL_BOOT
IOL_AN0
IOL_AN1
IOL_DAC
P04_IO-LINK
J26
M20-9991246
Place J25 & J26
along the edges.
Keep them parallel
spaced 15,24mm (600mils)
H5
SDO
Q[0..7]
SDI
D[0..7]
SR-CLK
MISO
L_OUT
L_IN
MOSI
P05_S_R
J4
M20-9761246
SR_CLK
LSB
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
SDO
L_IN
D0
D1
D2
D3
D4
D5
D6
D7
L_OUT
J10
M20-9770346
SR_CLK
CLK
TP7
J11
M20-9770346
MISO
TP8
J12
M20-9770346
MOSI
TP9
J13
M20-9770346
L_IN
L_IN/DIRQ
TP10
J14
M20-9770346
L_OUT
L_OUT/CS
TP11
J15
M20-9770346
R2
3K3
0402
TP6
IOL_RST
C3
DNP_C
0402
SW6
LL3301NF065QG
TP5
IOL_BOOT
SW5
LL3301NF065QG
J6
M20-9770346
IOL_AN0
J5
M20-9760346
AN_0
AN_1
DAC
J7
M20-9770346
IOL_AN1
H6
TEMP_OUT_1
POT_OUT_1
DAC
TEMP_OUT_2
POT_OUT_2
IOL_DAC
P06_ANL_IO
H7
CLK
MISO
MOSI
DIRQ
CS
RESET
MICRO_Q[0..3]
MICRO_D[0..3]
UART1_TX
UART1_RX
I2C2_SCL
I2C2_SDA
AN_3
AN_2
TEMP_IN_2
POT_IN_2
P07_MICRO
J8
M20-9760846
MICRO_Q0
MICRO_Q1
MICRO_Q2
MICRO_Q3
MICRO_D0
MICRO_D1
MICRO_D2
MICRO_D3
UART1_TX
UART1_RX
I2C2_SCL
I2C2_SDA
AN_2
AN_3
All Test Points on Bottom Layer
J16
J17
J18
J19
J20
J21
J22
J23
60900213421
2.54mm
ADD LOGO
MECHATRONICS LABS
ON PCB
CS1
SC16008EVK11
Cust_PN: <Cust_PN>
SH1 SCREW_HOLE
SH2 SCREW_HOLE
SH3 SCREW_HOLE
SH4 SCREW_HOLE
3,2mm
7,0mm
Mechatronics Labs S.r.l.
via Ornago, 24
20882 Bellusco (MB)
Italy
Title design
SC16008EVKxx - IO-Link Evaluation Kit
<Variant Name>
Dos. Villa R. Tuesday, November 14, 2017
Appd. Zaltieri P. Friday, February 09, 2018
Size A3
Cod SC16008EVK11
Document Number <Doc>
Ver 1.1
Title Sheet MAIN
Sheet 3 of 9

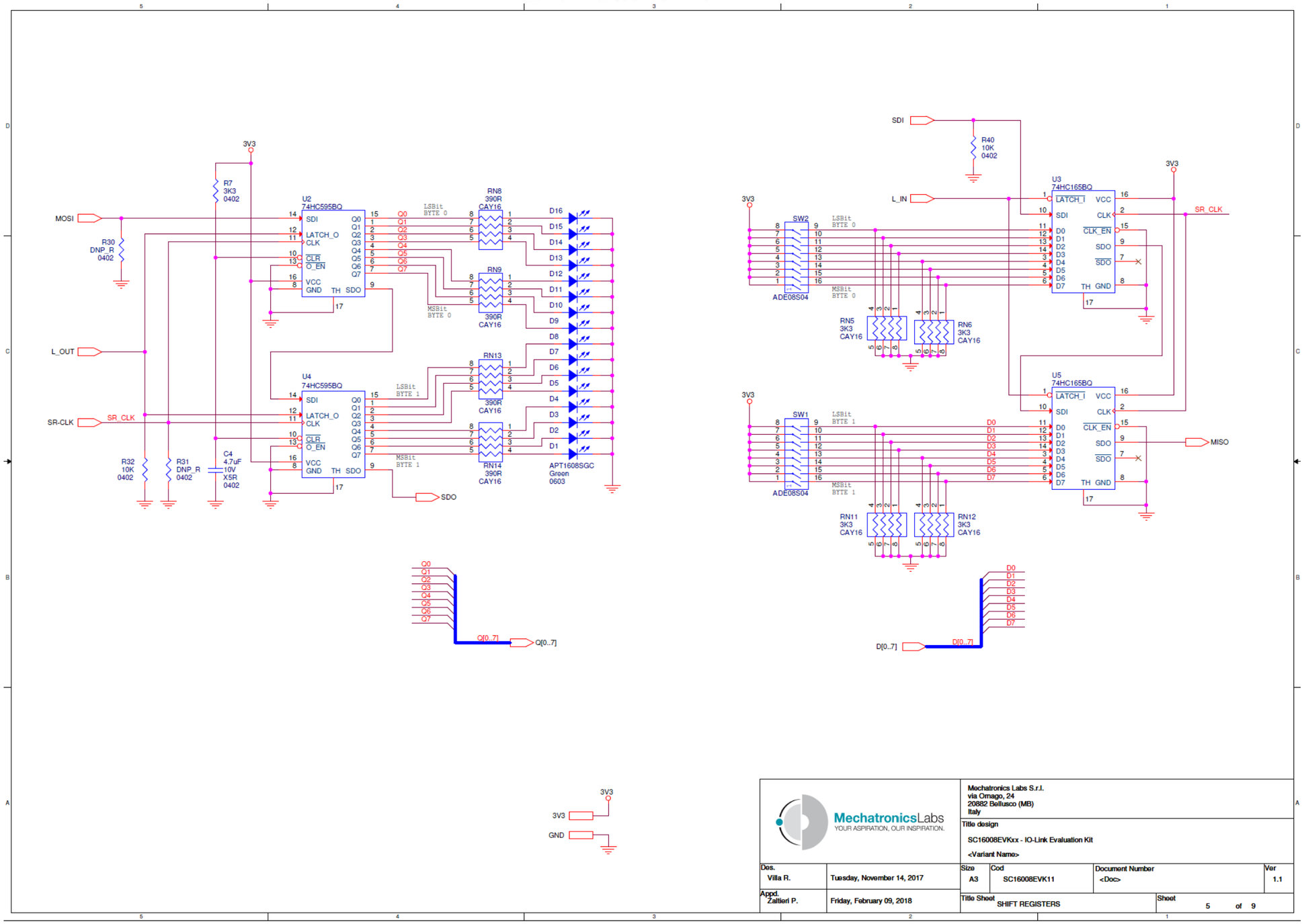



```
SW4                                  0 = open
IO-Link Module                       1 = closed
CONFIG Switches

1  2  3  4  |          FUNCTION
-------------------------------------------------------------
0  x  x  x  |          SIMPLE MODE
0  0  0  0  | SSIO 4BYTE IN,   4BYTE OUT, ADC Enabled
0  0  0  1  | SSIO 4BYTE IN,   8BYTE OUT, ADC Enabled
0  0  1  0  | SSIO 4BYTE IN,  32BYTE OUT, ADC Enabled
0  0  1  1  | SSIO 0BYTE IN,   4BYTE OUT, ADC Disabled
0  1  0  0  | SSIO 0BYTE IN,   8BYTE OUT, ADC Disabled
0  1  0  1  | SSIO 0BYTE IN,  32BYTE OUT, ADC Disabled
0  1  1  0  | ---
0  1  1  1  | ---

1  x  x  x  |          HOST MODE
1  0  0  0  | SPI Disabled, MODBUS Enabled,  ADC Disabled
1  0  0  1  | SPI Enabled,  MODBUS Disabled, ADC Disabled
1  0  1  0  | SPI Enabled,  MODBUS Enabled,  ADC Disabled
1  0  1  1  | ---
1  1  0  0  | ---
1  1  0  1  | ---
1  1  1  0  | ---
1  1  1  1  | ---
```


Mechatronics Labs S.r.l. via Ornago, 24 20882 Bellusco (MB) Italy			
Title design SC16008EVKxx - IO-Link Evaluation Kit <Variant Name>			
Des. Villa R.	Tuesday, November 14, 2017	Size A3	Cod SC16008EVK11
Appd. Zaltieri P.	Friday, February 09, 2018	Title Sheet IO-LINK	Sheet 4 of 9


MOSI
SR-CLK
L_OUT
SR_CLK
SDO
MISO
SDI
L_IN
3V3
GND
U2
U3
U4
U5
74HC595BQ
74HC165BQ
R7 3K3 0402
R30 DNP_R 0402
R31 DNP_R 0402
R32 10K 0402
R40 10K 0402
C4 4.7uF 10V X5R 0402
RN8 390R CAY16
RN9 390R CAY16
RN13 390R CAY16
RN14 390R CAY16
RN5 3K3 CAY16
RN6 3K3 CAY16
RN11 3K3 CAY16
RN12 3K3 CAY16
SW1
SW2
ADE08S04
APT1608SGC Green 0603
LSBit BYTE 0
MSBit BYTE 0
LSBit BYTE 1
MSBit BYTE 1
Q[0..7]
D[0..7]
Mechatronics Labs S.r.l.
via Ornago, 24
20882 Bellusco (MB)
Italy
Title design
SC16008EVKxx - IO-Link Evaluation Kit
<Variant Name>
Des. Villa R.
Tuesday, November 14, 2017
Appd. Zaltieri P.
Friday, February 09, 2018
Size A3
Cod SC16008EVK11
Document Number <Doc>
Ver 1.1
Title Sheet SHIFT REGISTERS
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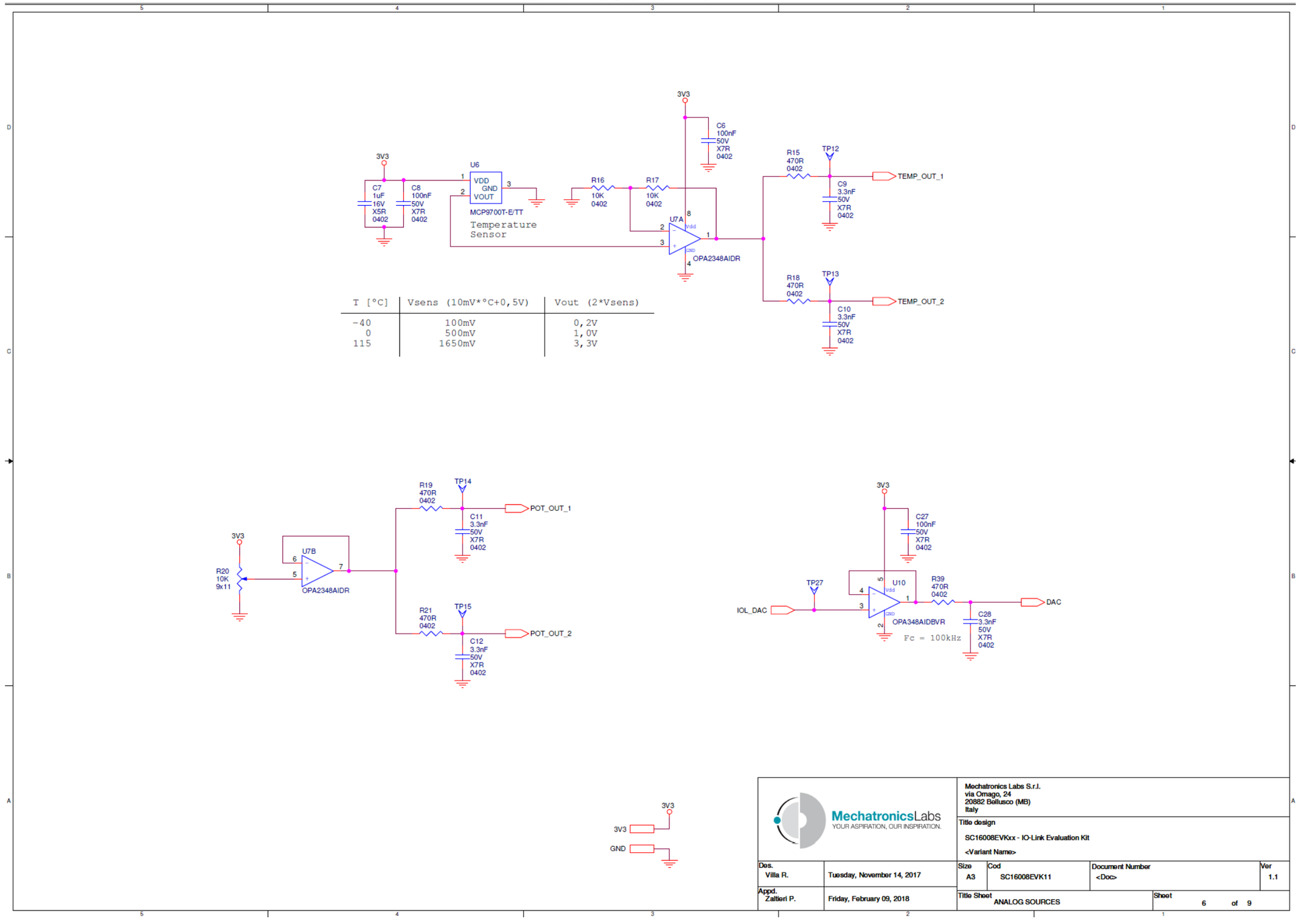
3V3
C6 100nF 50V X7R 0402
U6
VDD
GND
VOUT
MCP9700T-E/TT
Temperature Sensor
C7 1uF 16V X5R 0402
C8 100nF 50V X7R 0402
R16 10K 0402
R17 10K 0402
U7A
OPA2348AIDR
R15 470R 0402
TP12
TEMP_OUT_1
C9 3.3nF 50V X7R 0402
R18 470R 0402
TP13
TEMP_OUT_2
C10 3.3nF 50V X7R 0402
T [°C] | Vsens (10mV*°C+0,5V) | Vout (2*Vsens)
-40 | 100mV | 0,2V
0 | 500mV | 1,0V
115 | 1650mV | 3,3V
R19 470R 0402
TP14
POT_OUT_1
C11 3.3nF 50V X7R 0402
R20 10K 9x11
U7B
OPA2348AIDR
R21 470R 0402
TP15
POT_OUT_2
C12 3.3nF 50V X7R 0402
C27 100nF 50V X7R 0402
TP27
IOL_DAC
U10
OPA348AIDBVR
R39 470R 0402
DAC
C28 3.3nF 50V X7R 0402
Fc = 100kHz
GND
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Cod SC16008EVK11
Document Number <Doc>
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Title Sheet ANALOG SOURCES
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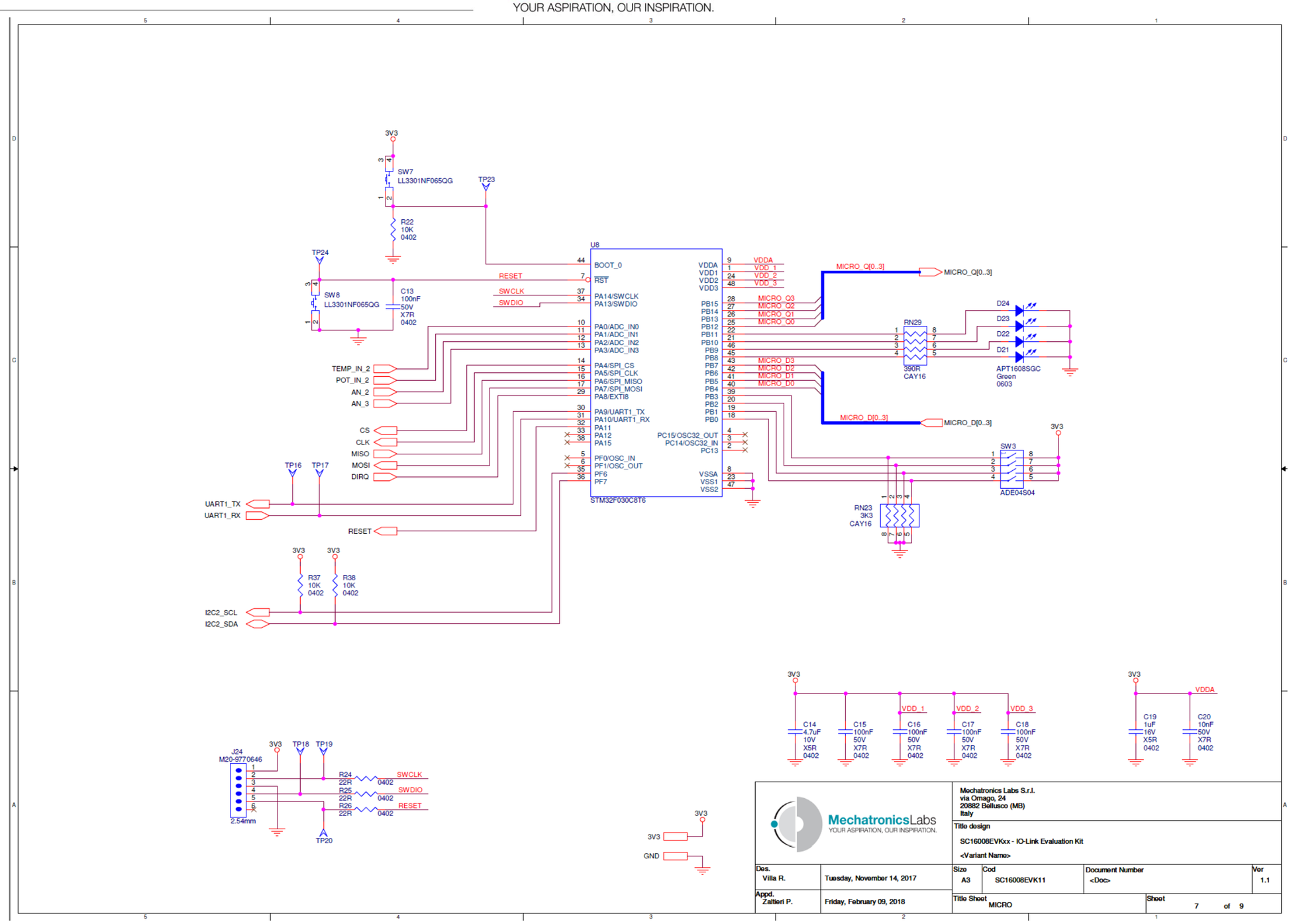
3V3
SW7
LL3301NF065QG
TP23
R22
10K
0402
TP24
SW8
LL3301NF065QG
C13
100nF
50V
X7R
0402
RESET
SWCLK
SWDIO
U8
BOOT_0
RST
PA14/SWCLK
PA13/SWDIO
PA0/ADC_IN0
PA1/ADC_IN1
PA2/ADC_IN2
PA3/ADC_IN3
PA4/SPI_CS
PA5/SPI_CLK
PA6/SPI_MISO
PA7/SPI_MOSI
PA8/EXTI8
PA9/UART1_TX
PA10/UART1_RX
PA11
PA12
PA15
PF0/OSC_IN
PF1/OSC_OUT
PF6
PF7
PC15/OSC32_OUT
PC14/OSC32_IN
PC13
VDDA
VDD1
VDD2
VDD3
VSSA
VSS1
VSS2
STM32F030C8T6
TEMP_IN_2
POT_IN_2
AN_2
AN_3
CS
CLK
MISO
MOSI
DIRQ
TP16
TP17
UART1_TX
UART1_RX
RESET
MICRO_Q[0..3]
MICRO_Q0
MICRO_Q1
MICRO_Q2
MICRO_Q3
MICRO_D[0..3]
MICRO_D0
MICRO_D1
MICRO_D2
MICRO_D3
RN29
390R
CAY16
D24
D23
D22
D21
APT1608SGC
Green
0603
SW3
ADE04S04
RN23
3K3
CAY16
R37
10K
0402
R38
10K
0402
I2C2_SCL
I2C2_SDA
J24
M20-9770646
2.54mm
TP18
TP19
TP20
R24
22R
0402
R25
22R
0402
R26
22R
0402
C14
4.7uF
10V
X5R
0402
C15
100nF
50V
X7R
0402
C16
100nF
50V
X7R
0402
C17
100nF
50V
X7R
0402
C18
100nF
50V
X7R
0402
C19
1uF
16V
X5R
0402
C20
10nF
50V
X7R
0402
GND
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via Ornago, 24
20882 Bellusco (MB)
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Cod SC16008EVK11
Document Number <Doc>
Ver 1.1
Title Sheet MICRO
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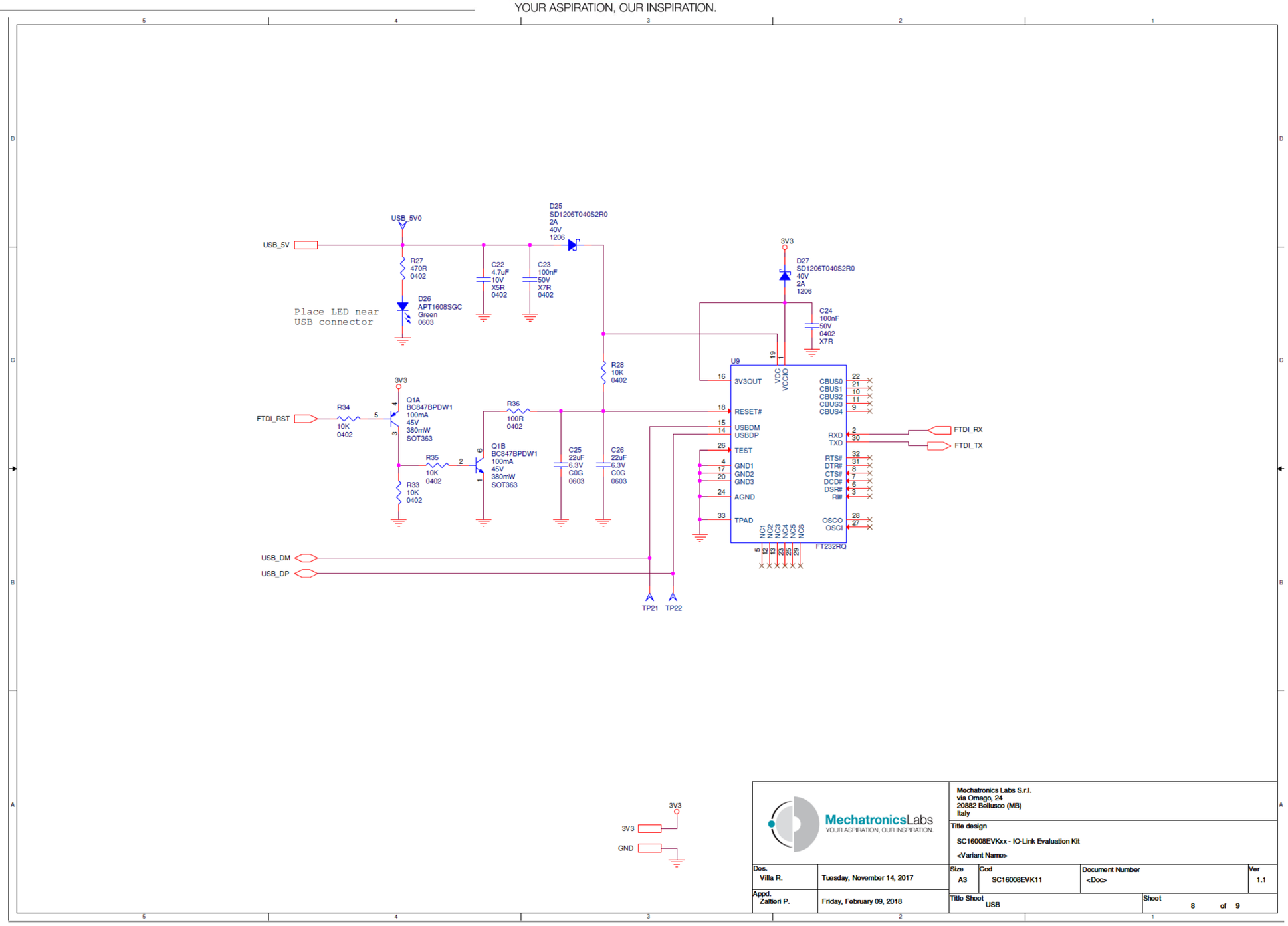
USB_5V0
USB_5V
D25
SD1206T040S2R0
2A
40V
1206
R27
470R
0402
C22
4.7uF
10V
X5R
0402
C23
100nF
50V
X7R
0402
D26
APT1608SGC
Green
0603
Place LED near
USB connector
3V3
D27
SD1206T040S2R0
40V
2A
1206
C24
100nF
50V
0402
X7R
R28
10K
0402
U9
3V3OUT
RESET#
USBDM
USBDP
TEST
GND1
GND2
GND3
AGND
TPAD
VCC
VCCIO
CBUS0
CBUS1
CBUS2
CBUS3
CBUS4
RXD
TXD
RTS#
DTR#
CTS#
DCD#
DSR#
RI#
OSCO
OSCI
NC1
NC2
NC3
NC4
NC5
NC6
FT232RQ
FTDI_RX
FTDI_TX
FTDI_RST
R34
10K
0402
Q1A
BC847BPDW1
100mA
45V
380mW
SOT363
R36
100R
0402
Q1B
BC847BPDW1
100mA
45V
380mW
SOT363
R35
10K
0402
R33
10K
0402
C25
22uF
6.3V
C0G
0603
C26
22uF
6.3V
C0G
0603
USB_DM
USB_DP
TP21
TP22
3V3
GND
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Size
A3
Cod
SC16008EVK11
Document Number
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Ver
1.1
Title Sheet
USB
Sheet
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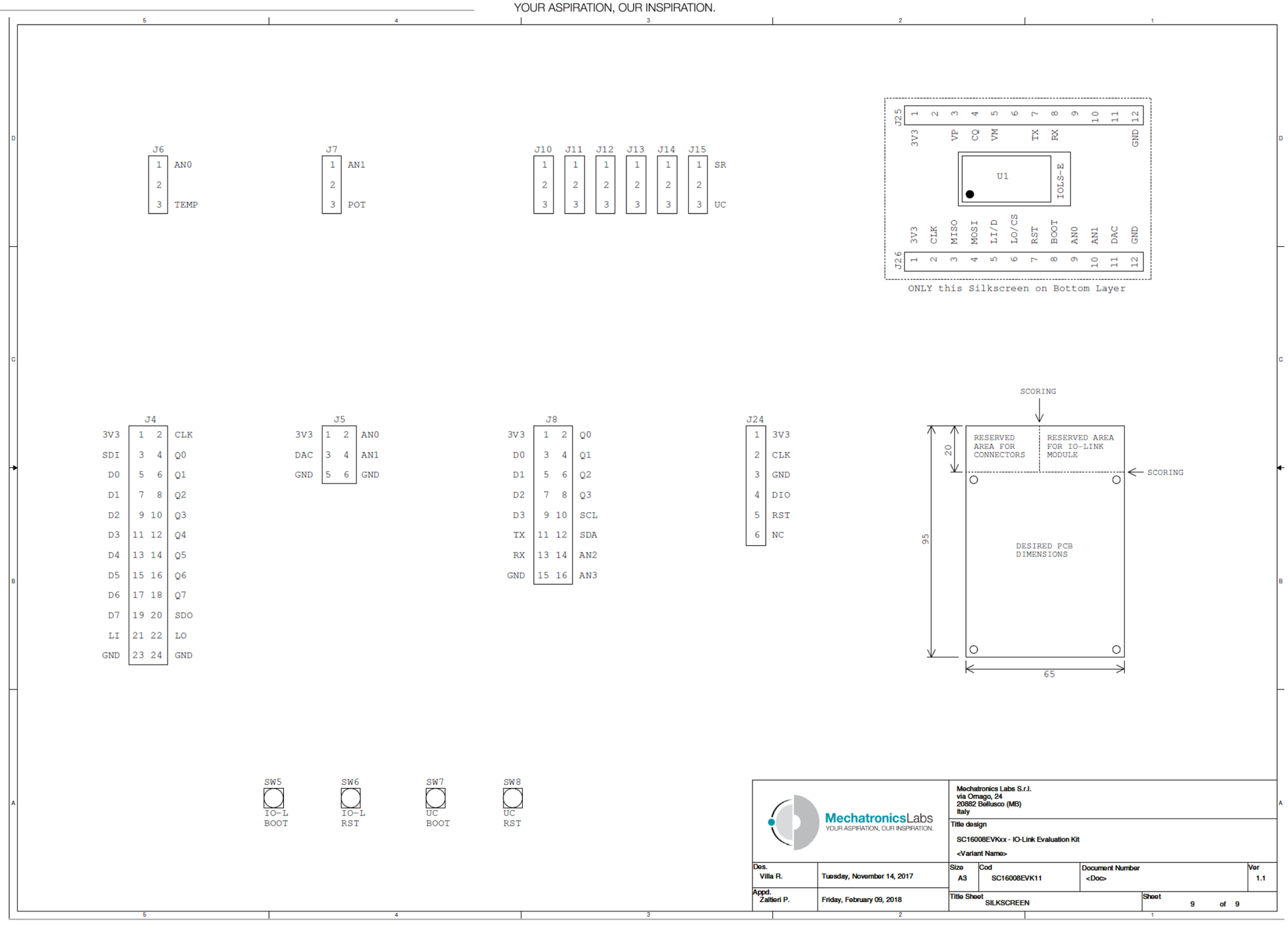
J6
1 AN0
2
3 TEMP
J7
1 AN1
2
3 POT
J10 J11 J12 J13 J14 J15
1 2 3
1 2 3 SR
1 2 3 UC
J25
1 2 3 4 5 6 7 8 9 10 11 12
3V3 VP CQ VM TX RX GND
U1
IOLS-E
J26
1 2 3 4 5 6 7 8 9 10 11 12
3V3 CLK MISO MOSI LI/D LO/CS RST BOOT AN0 AN1 DAC GND
ONLY this Silkscreen on Bottom Layer
J4
3V3 1 2 CLK
SDI 3 4 Q0
D0 5 6 Q1
D1 7 8 Q2
D2 9 10 Q3
D3 11 12 Q4
D4 13 14 Q5
D5 15 16 Q6
D6 17 18 Q7
D7 19 20 SDO
LI 21 22 LO
GND 23 24 GND
J5
3V3 1 2 AN0
DAC 3 4 AN1
GND 5 6 GND
J8
3V3 1 2 Q0
D0 3 4 Q1
D1 5 6 Q2
D2 7 8 Q3
D3 9 10 SCL
TX 11 12 SDA
RX 13 14 AN2
GND 15 16 AN3
J24
1 3V3
2 CLK
3 GND
4 DIO
5 RST
6 NC
SCORING
20
RESERVED AREA FOR CONNECTORS
RESERVED AREA FOR IO-LINK MODULE
SCORING
95
DESIRED PCB DIMENSIONS
65
SW5 IO-L BOOT
SW6 IO-L RST
SW7 UC BOOT
SW8 UC RST
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Size A3
Cod SC16008EVK11
Document Number <Doc>
Ver 1.1
Title Sheet SILKSCREEN
Sheet 9 of 9

Item Number	Quantity	Part Reference	Value	Description	Vendor_PN
1	12	C1 C2 C6 C8 C13 C15 C16 C17 C18 C23 C24 C27	100nF	SMT CAP 100nF, 50V, 0402, X7R, ±10%	GCM155R71H104KE02D
2	3	C4 C14 C22	4.7uF	SMT CAP 4.7uF, 10V, 0402, X5R, ±20%	0402ZD475MAT2A
3	2	C7 C19	1uF	SMT CAP 1uF, 16V, 0402, X5R, ±10%	C0402C105K4PACTU
4	5	C9 C10 C11 C12 C28	3.3nF	SMT CAP 3.3nF, 50V, 0402, X7R, ±10%	C0402C332K5RACTU
5	1	C20	10nF	SMT CAP 10nF, 50V, 0402, X7R, ±10%	C0402C103K5RACTU
6	2	C25 C26	22uF	SMT CAP 22uF, 6.3V, 0603, C0G, ±20%	GRM188C60J226MEA0D
7	1	CS1	SC16008EVK11	PRINTED CIRCUIT BOARD SC16008EVK11, 4 LAYERS	
8	22	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D18 D21 D22 D23 D24 D26	APT1608SGC	LED 120°, Green	APT1608SGC
9	1	D17	APT1608EC	LED 120°, Red	APT1608EC
10	3	D19 D25 D27	SD1206T040S2R0	DIODE SCHOTTKY Rectifier, 40V, 2A	SD1206T040S2R0
11	1	J1	1411984	CONN M12, SMT, Male, Type A, Pin 5	1411984
12	1	J3	105133-0001	CONN MICRO USB, SMT, FEMALE, Receptacle, Type B, Vertical, Pin 5	105133-0001
13	1	J4	M20-9761246	CONN HEADER, THT, MALE, 2 ROW, Pitch 2.54mm, Pin 2x12	M20-9761246
14	1	J5	M20-9760346	CONN HEADER, THT, MALE, 2 ROW, Pitch 2.54mm, Pin 2x3	M20-9760346
15	8	J6 J7 J10 J11 J12 J13 J14 J15	M20-9770346	CONN HEADER, THT, MALE, 1 ROW, Pitch 2.54mm, Pin 3	M20-9770346
16	1	J8	M20-9760846	CONN HEADER, THT, MALE, 2 ROW, Pitch 2.54mm, Pin 2x8	M20-9760846
17	8	J16 J17 J18 J19 J20 J21 J22 J23	60900213421	CONN JUMPER, THT, Jumper with Test Point WR-PHD, Pitch 2.54mm, Pin 2	60900213421
18	1	J24	M20-9770646	CONN HEADER, THT, MALE, 1 ROW, Pitch 2.54mm, Pin 6	M20-9770646
19	1	Q1	BC847BPDW1	TRANSISTOR, PNP-NPN, PNP + NPN, 45V, 100mA, 380mW	BC847BPDW1T3G
20	2	R2 R7	3K3	RES 3K3, 0402, ±1%, 50V, 1/16W	CRCW04023K30FKED

21	2	R3 R4	220R	RES 220R, 0402, ±1%, 50V, 1/16W	CRCW0402220RFKED
22	6	R15 R18 R19 R21 R27 R39	470R	RES 470R, 0402, ±1%, 50V, 1/16W	CRCW0402470RFKED
23	11	R16 R17 R22 R28 R32 R33 R34 R35 R37 R38 R40	10K	RES 10K, 0402, ±1%, 50V, 1/16W	CRCW040210K0FKED
24	1	R20	10K	RES 10K, TRIMMER THT, ±25%, 20V, 20mW	3319P-1-103
25	3	R24 R25 R26	22R	RES 22R, 0402, ±1%, 50V, 1/16W	CRCW040222R0FKED
26	1	R36	100R	RES 100R, 0402, ±1%, 50V, 1/16W	CRCW0402100RFKED
27	6	RN1 RN5 RN6 RN11 RN12 RN23	3K3	RES 3K3, CAY16, ±5%, 50V, 1/16W	CAY16-332J4LF
28	5	RN8 RN9 RN13 RN14 RN29	390R	RES 390R, CAY16, ±5%, 50V, 1/16W	CAY16-391J4LF
29	2	SW1 SW2	ADE08S04	SWITCH DIP SWITCH SMT, Extended Actuator, Pin 8, 2.54mm	ADE08S04
30	1	SW3	ADE04S04	SWITCH DIP SWITCH SMT, Extended Actuator, Pin 4, 2.54mm	ADE04S04
31	1	SW4	97C04ST	SWITCH DIP SWITCH SMT, Low Profile, Half-pitch, Pin 4, 1.27mm	97C04ST
32	4	SW5 SW6 SW7 SW8	LL3301NF065QG	SWITCH PUSH BUTTON SMT, Pin 4	LL3301NF065QG
33	1	U1	MLIO11	IC IO-Link Slave Controller	IOLS-E
34	2	U2 U4	74HC595BQ	IC 8bit serial-in, serial/parallel-out SHIFT REGISTER, tri-state output, Package: DHVQFN16	74HC595BQ,115
35	2	U3 U5	74HC165BQ	IC 8bit parallel-in, serial-out SHIFT REGISTER, Package: DHVQFN16	74HC165BQ,115
36	1	U6	MCP9700T-E/TT	IC Low-power Linear Active Thermistor (10mV*°C, +/-2°C)	MCP9700T-E/TT
37	1	U8	STM32F030C8T6	IC Entry-level ARM Cortex-M0 Value line MCU with 64 Kbytes Flash, 48 MHz CPU	STM32F030C8T6
38	1	U9	FT232RQ	IC USB to serial UART interface QFN32	FT232RQ
39	1	U10	OPA348AIDBVR	IC Rail-to-Rail OPA, Single Supply +2.1V to 5.5V	OPA348AIDBVR
40	1	U7	OPA2348AIDR	IC Rail-to-Rail OPA, Single Supply +2.1V to 5.5V	OPA2348AIDR

Table 4.1. *Bill of Material*

5 ELECTRICAL CHARACTERISTICS

The Evaluation Board can be powered in three ways:

- Connecting an IO-Link Master to J1 or J2
- Providing 5V on the USB connector
- Providing 3.3V on *3V3* pins of J4, J5, J8 connectors

If the Evaluation Board is powered either by IO-Link Bus or by USB connector, the Board can provide 3.1V (typically) on *3V3* pins of J4, J5, J8 connectors using its internal LDOs.

The Evaluation Board can be supplied also applying a voltage greater than 3.1V on *3V3* pins of J4, J5, J8 connectors. In this way the internal LDOs are inhibited.

PARAMETER	DESCRIPTION	CONDITION	Min	MAX	UNIT
IO-Link VPLUS (V+)			-40	+40	V
IO-Link CQ			-40	+40	V
USB Vcc			-0.5	+6	V
USB DP & DM			-0.5	+3.8	V
3V3 (Vin)		No power supply applied neither to IO-Link Bus nor to USB connector	-0.3	4	V
I/O Vin	Input voltage on any digital or analog pin		-0.3	4	V
I/O Iout	Output current source by any digital pin			25	mA

Table 5.1. *Absolute maximum ratings*

PARAMETER	DESCRIPTION	CONDITION	Min	Typ.	MAX	UNIT
IO-Link VPLUS (V+)	Operating supply Voltage		5	24	30	V
IO-Link Icc	Operating supply Current	No power supply applied to USB connector, No devices connected to J4, J5, J8		2		mA
IO-Link CQ			-10		VPLUS + 10	V
USB Vcc	Operating supply Voltage		4		5.25	V
USB Icc	Operating supply Current	No power supply applied to IO-Link Bus, No devices connected to J4, J5, J8		25		mA
USB Voh	Output (High)		2.8		3.6	
USB Vol	Output (Low)		0		0.3	V
USB Vse	Single ended Rx Threshold		0.8		2.0	V
USB Com	Differential common Mode		0.8		2.5	V
USB Vdif	Differential input Sensitivity		0.2			V
USB DrvZ	Driver output Impedance		26	29	44	Ω
3V3 Vout	LDOs output Voltage	Supplied either by IO-Link bus or by USB	2.8	3.1	3.4	V
3V3 Iout	LDOs output Capability	Supplied either by IO-Link bus or by USB	50			mA

Table 5.2. *Normal Operating conditions*

6 Order information

Type number	Package style	Package MOQ
IOLx-E-EVK	Box	1

***Table 6.1**. Order information*

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