STEVAL-IPP003V1: ST7580 communication module

Introduction

This evaluation board is a tool to evaluate power line communication via a xPSK ST7580 modem and a STM32F general purpose microcontroller which is able to host communication protocol and application software layers.
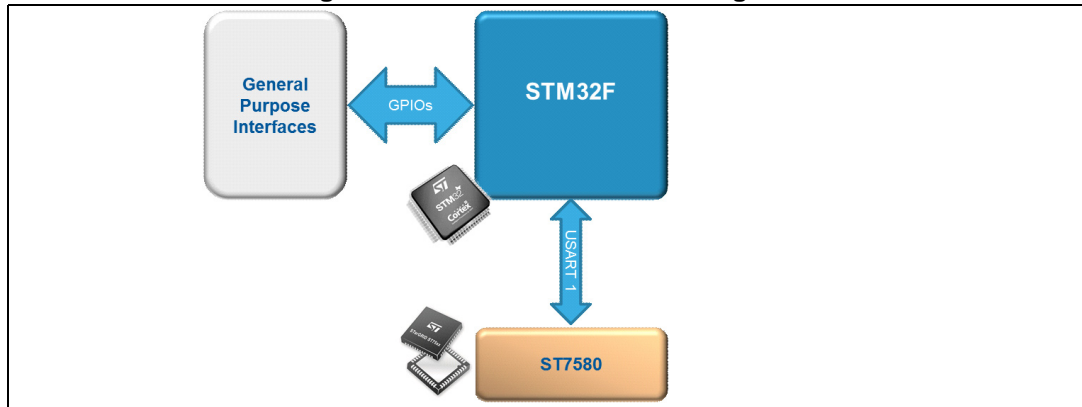
The board is insulated from the high voltage mains by a coupling transformer. The board also includes the following interfaces:

- USB interface
- Dual DC power supply
- Digital interface
- DC or AC insulated bus interface.

The board form factor and interfaces are compatible with the STEVAL-IPP004V1 evaluation board. It can be powered by the EVLALTAIR900-M1 double output SMPS evaluation board based on the ALTAIR04-900 primary controller.

The *Figure 1* shows the module block diagram.

Figure 1. ST7580 module block diagram

Contents

1 Overview

1.1 Recommended reading

This document describes all the parts of the evaluation board. Additional information can be found in the following documents:

- ST device datasheets referenced in this document
- Third party device datasheets

1.2 Safety precautions

The board can be connected to a high voltage AC bus as it offers galvanic insulation to the digital section. This board is strictly intended for use by expert technicians. Due to the high voltage (220 Vac) involved, special care must be taken with regard to personal safety.

There is no protection against accidental human contact with high voltages.

After disconnection of the board from the mains, the live parts must not be touched immediately due to the energized capacitors.

It is mandatory to use a mains insulation transformer to perform any tests on the board in which test instruments such as spectrum analyzers or oscilloscopes are used.

Do not connect any oscilloscope probes to high voltage sections in order to avoid damaging instruments and demonstration tools.

Warning: ST assumes no responsibility for any consequences which may result from the improper use of this tool

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1.3 Getting technical support

Technical assistance is provided free to all customers. For technical assistance, documentation, upgrades and information about products and services, please refer to your local ST distributor/office.

1.4 Package list

The STEVAL-IPP003V1 board package includes the following items:

- The STEVAL-IPP003V1 evaluation board (*Figure 2*)
- A CD-ROM with software and documentation

Figure 2. STEVAL-IPP003V1 evaluation board

2 ST7580 module board components

The board includes a USB interface, a power management unit only enabled for single voltage (12 V) power supply, a microcontroller, an xPSK modem and an insulation section for high voltage coupling.

2.1 Microcontroller

The system is managed by the STM32F103 microcontroller. It is based on the 32-bit ARM Cortex-M3 core with 72 MHz maximum frequency, 768 KB Flash and 96 KB SRAM embedded memories; for further details, please refer to the STM32F103 XL-density performance line family datasheets.

2.2 Debug

Software debug is via a 10-pin JTAG connection; it is possible to use a 10-pin to 20-pin adapter to use standard 20-pin JTAG tools.

Figure 3. STEVAL-IPP003V1 evaluation board

Table 1 shows the pin out of the JTAG connector.

Table 1. JTAG pin out

Pin number	Function
1	3.3V
2	TMS
3	GND
4	TCK
5	GND
6	TDO
7	N.C.
8	TDI
9	GND
10	nRESET

2.3 Reset

The reset sources are:

- Power on reset
- JTAG reset from an in-circuit emulator
- The RESET button (SW5).

2.4 Power supply

The board is powered by two DC voltages (12 V and 3.3 V); the EVLALTAIR900-M1 evaluation board is suitable as the power supply for the necessary voltages. The ST7580 module also includes a linear voltage regulator based on the LK112SM33TR device to optionally supply a single 12 V.

Figure 4. Power supply section
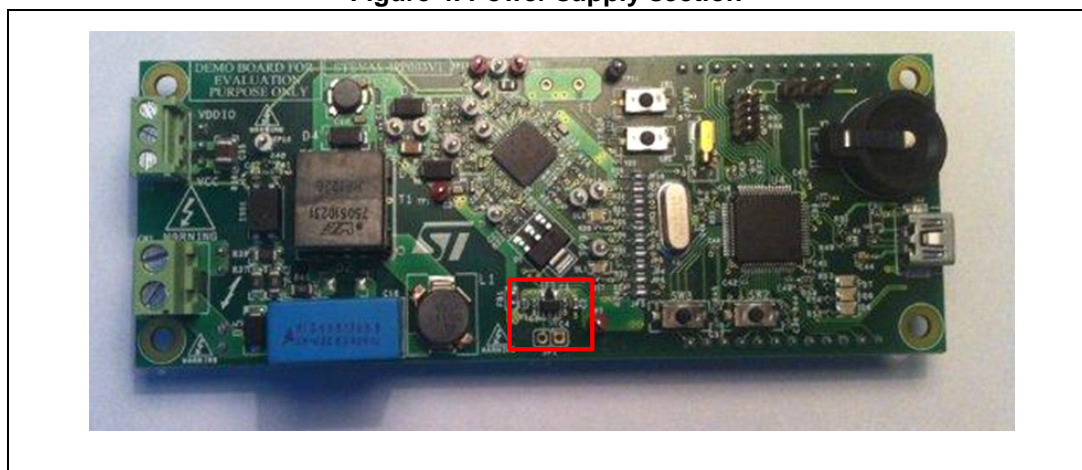
2.5 Power line modem

The power line communication is based on the ST7580 narrow-band xPSK modem. It supports coded and non-coded B-PSK, Q-SPK and 8-PSK modulation schemes in order to configure the communication for the best trade-off between data throughput and communication robustness in relation to the condition of the physical layer of the network. The modem supports dual channel operation, allowing automatic message reception on one of the two configured channels. The carrier frequency of the channels can be programmed within the CENELEC frequency bands. The modem coupling circuit for the bus can be configured in order to support coupling to both AC and DC lines.

Figure 5. Power line communication section
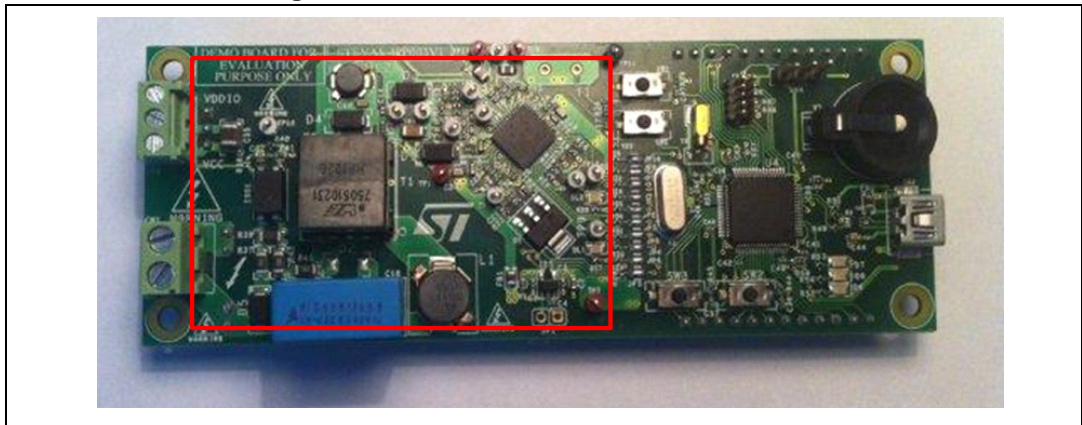
2.6 Status LEDs

Table 2. LED description and STM32W mapping

LED	Function
DL1	PLM receiving activity
DL2	PLM transmitting activity
D6	General purpose (PC5)
D7	General purpose (PC6)
D8	General purpose (PD2)

2.7 Jumpers

2.7.1 Jumper placement

Figure 6. Jumper placement

2.7.2 Jumper position

Figure 7. Jumper position
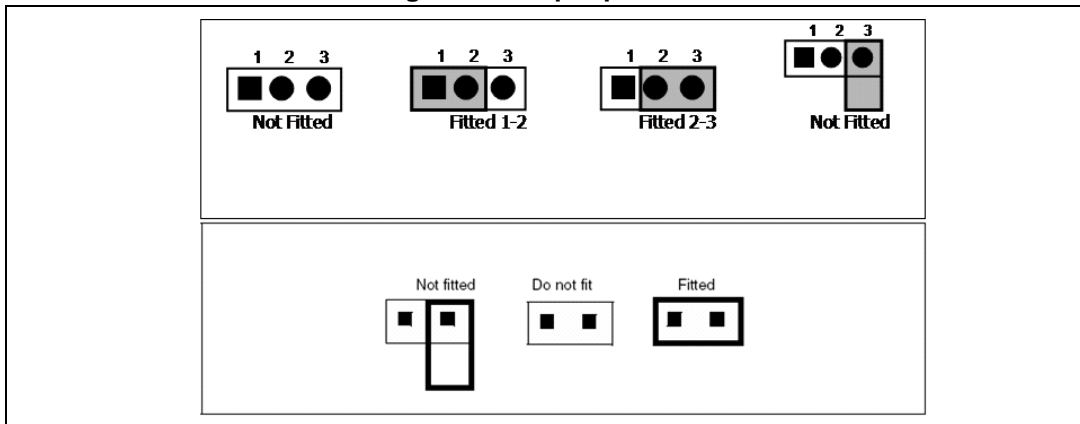
2.7.3 Jumper description and default value

Table 3.

Jumper	Description	Default
JP1	Enable/disable internal 3.3 V regulator: Opened: enable Closed: disable	Open
SW4	Battery/3.3 V connection Position 1-2: 3.3 V connection Position 2-3: Battery connection	2-3

2.8 Pushbutton description

Table 4. Pushbutton description

Button	Description (MCU mapping)
SW5 (RESET)	MCU reset
SW1	ST7580 reset
SW2	General purpose button (PC4)
SW3	General purpose button (PC3)

2.9 Connectors description

2.9.1 Power supply connectors

Figure 8. Power supply connector

Table 5. Power supply connector description

Pin	Description
1	3.3 V (VDDIO)
2	Ground
3	12 V (VCC)

2.9.2 Communication bus connector

Figure 9. Communication bus connector
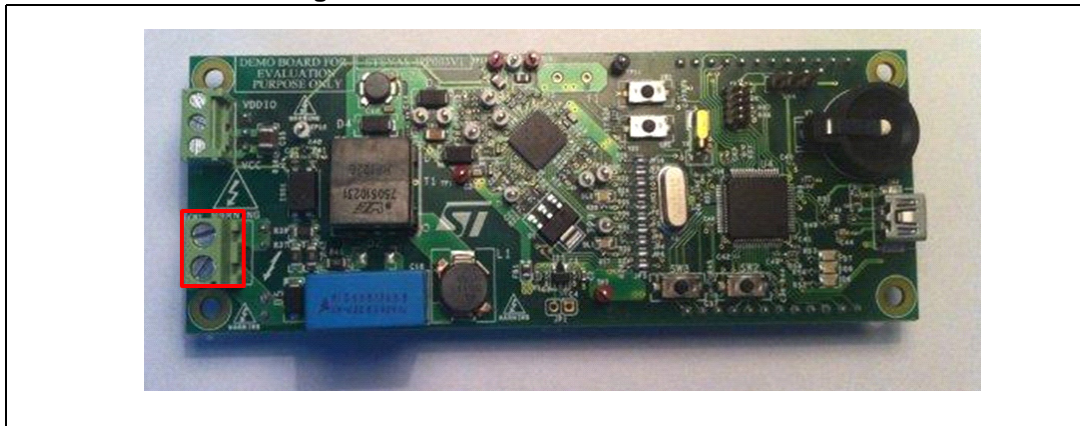
Table 6. Energy meter calibration connector pin description

Pin	Description
1	AC/DC BUS (+)
2	AC/DC BUS (-)

2.9.3 Digital interface connectors

Figure 10. Digital interface
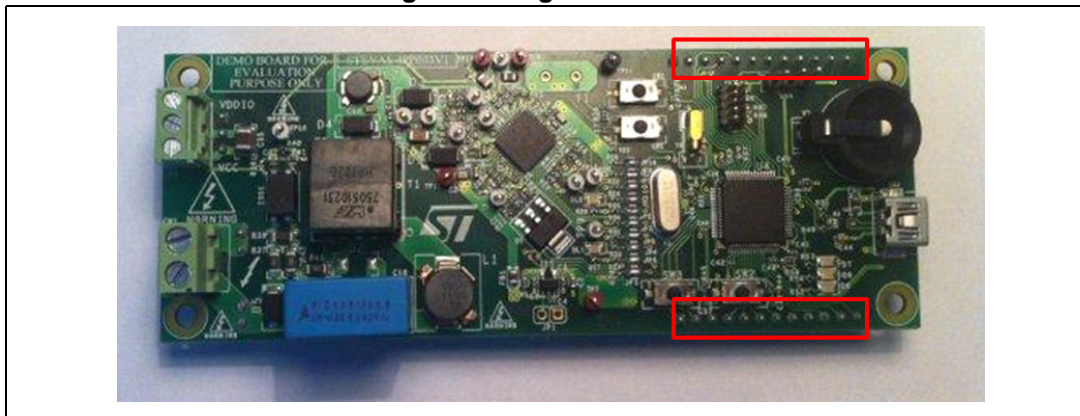
Figure 11. Digital interface connectors description

```
                        J5          J6
         PC0     1                      1        PB5
         PC1     2                      2        PB6
         PC2     3                      3        PB7
     PA4         4                      4        PB8
     PA5         5                      5        PB9
     PA6         6                      6        PB10
     PA7         7                      7        PB11
     PA9         8                      8        PB12
     PA10        9                      9        PB13
         PB0    10                     10        PB14
         PB1    11                     11        PB15
         PB2    12                     12

             Digital_A          Digital_B

    GSPG06112013DI1530
```
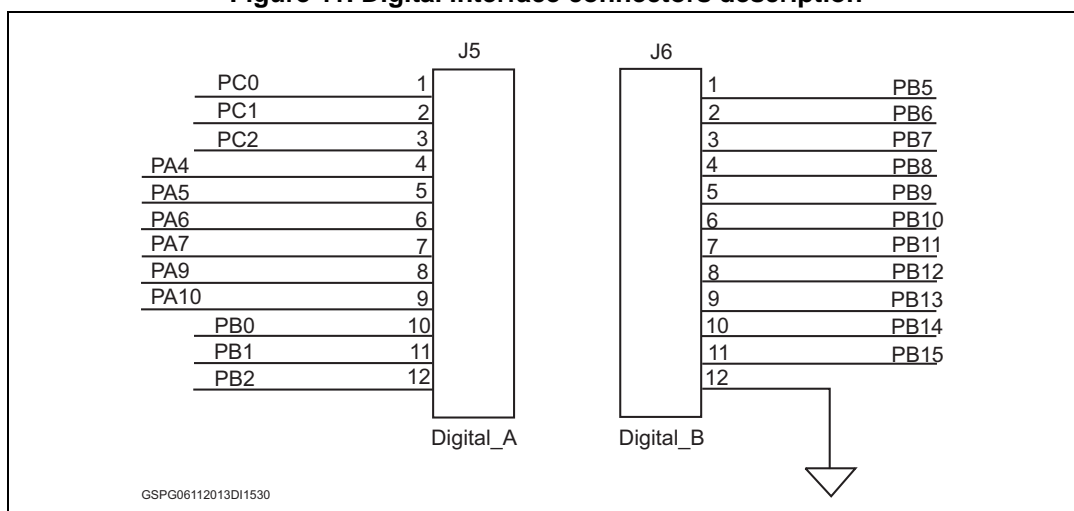
3   ST7580 module operation

The board implements a PLM communication module running the 802.15.4-like MAC over the xPSK physical layer. The firmware also includes an application example that shows how to use the basic MAC-SAP functions. For more details, refer to the document AN4411.

4   Schematics

Figure 12. Top
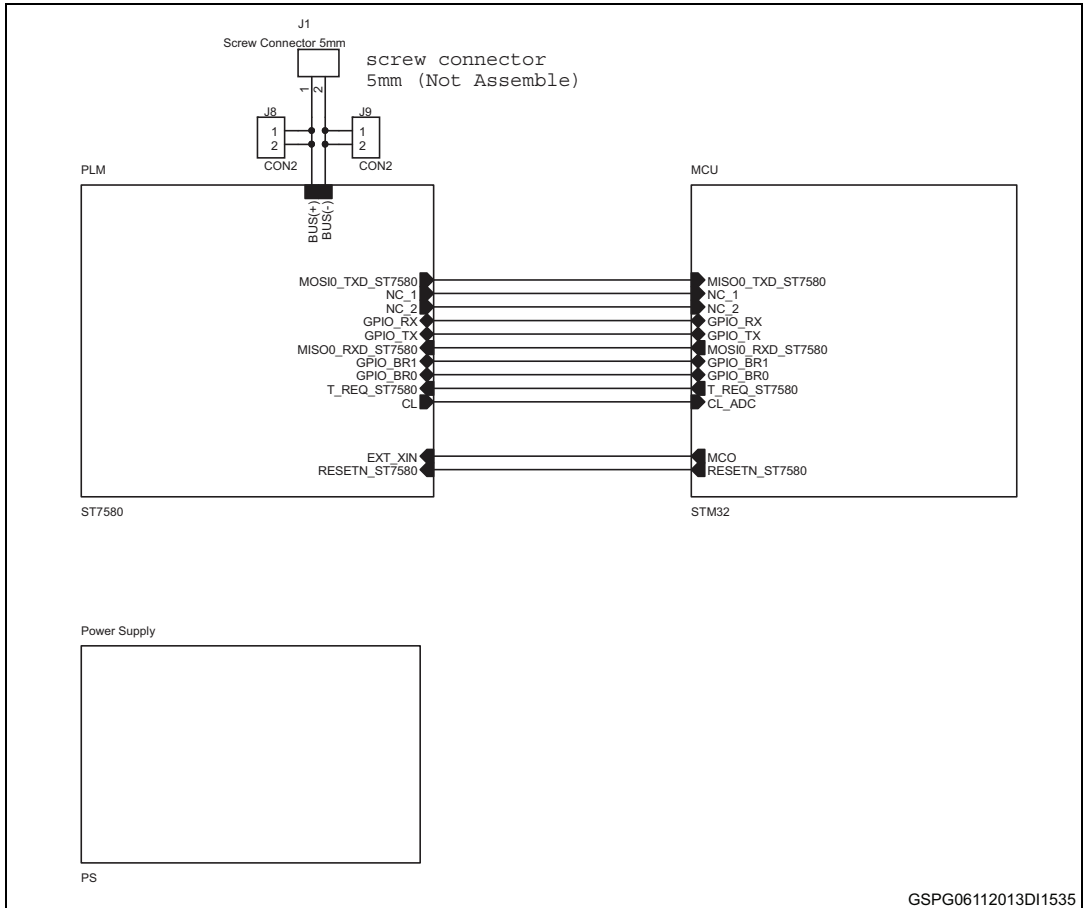
Figure 13. Power management section

GSPG06112013DI1025
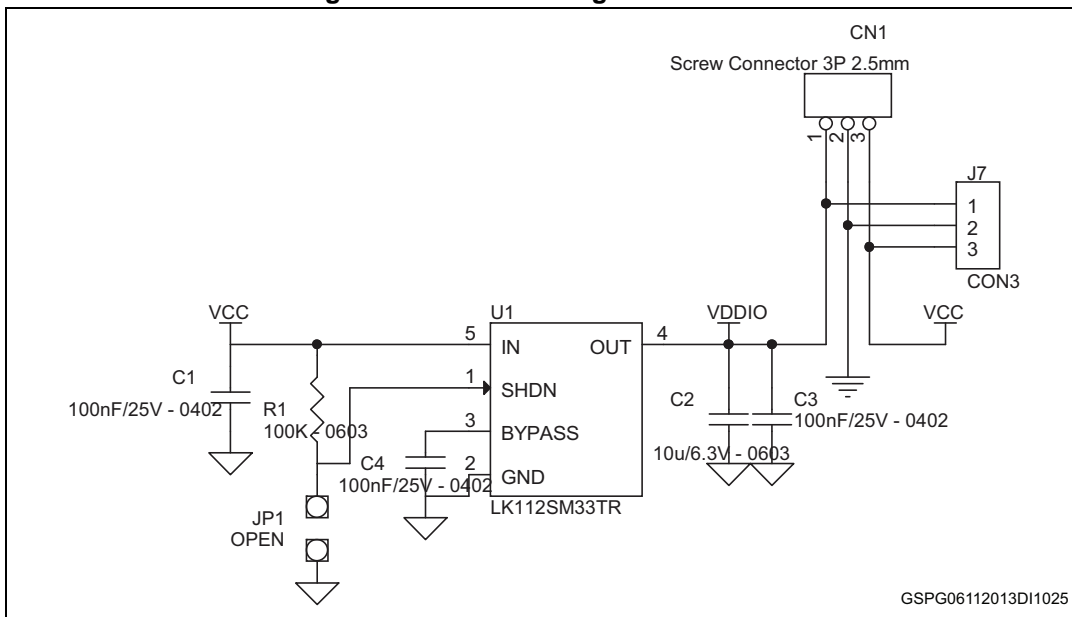
Figure 14. ST7580 reset button (micro-switch)

GSPG06112013DI1030
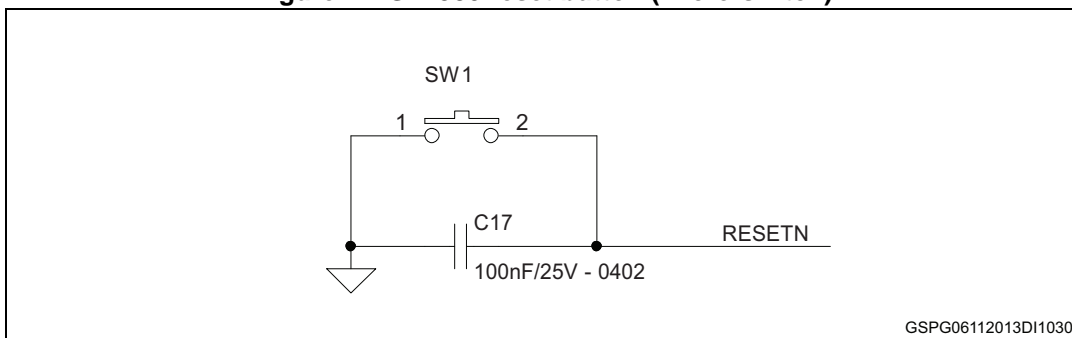
Figure 15. ST7580 UART interface

GSPG06112013DI1035

Figure 16. DC BUS / AC BUS

BUS(+) OUTPUT(+)

BUS(-) OUTPUT(-)
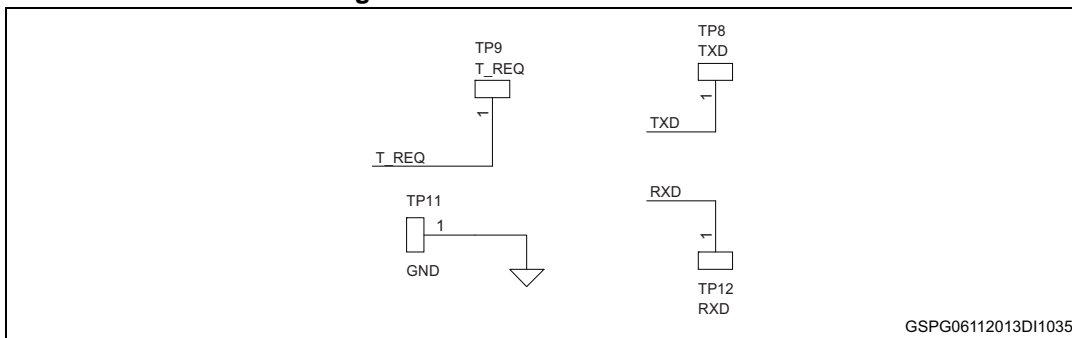
GSPG06112013DI1040
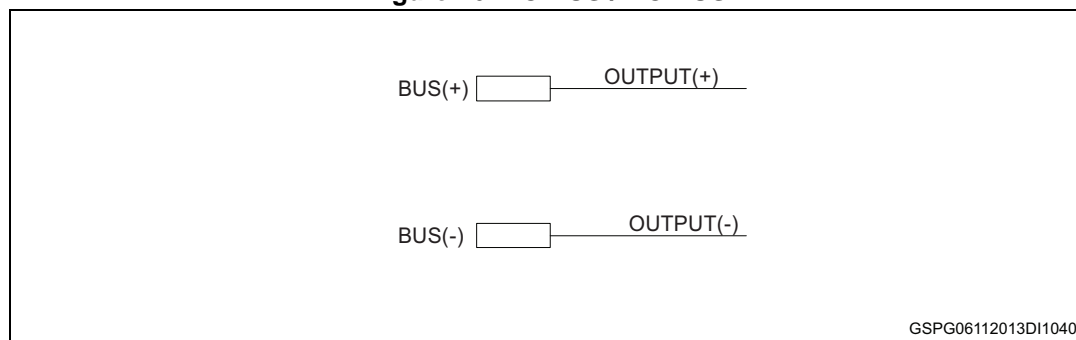
Figure 17. Current limit setting

GSPG06112013DI1045
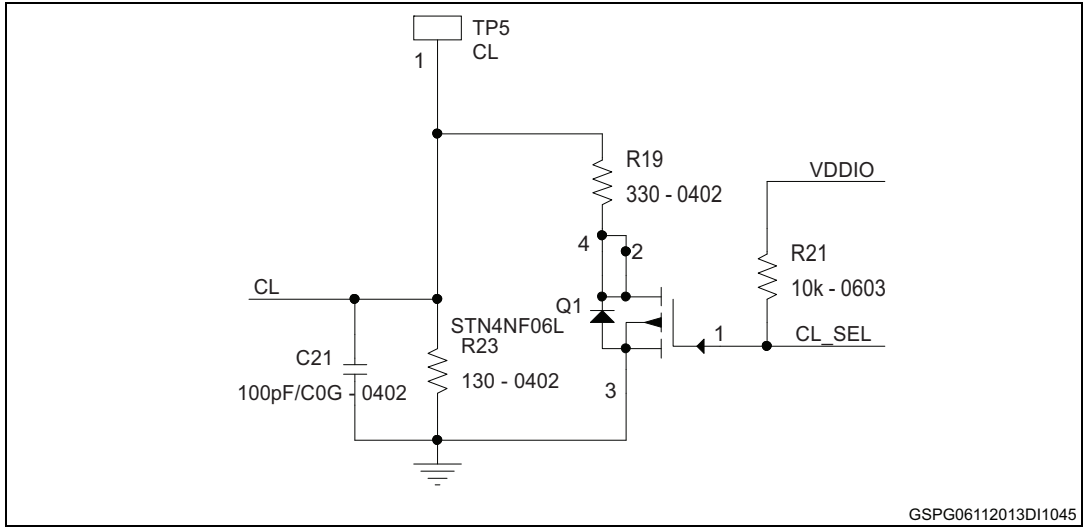
Figure 18. Microcontroller connection

GSPG06112013DI1050
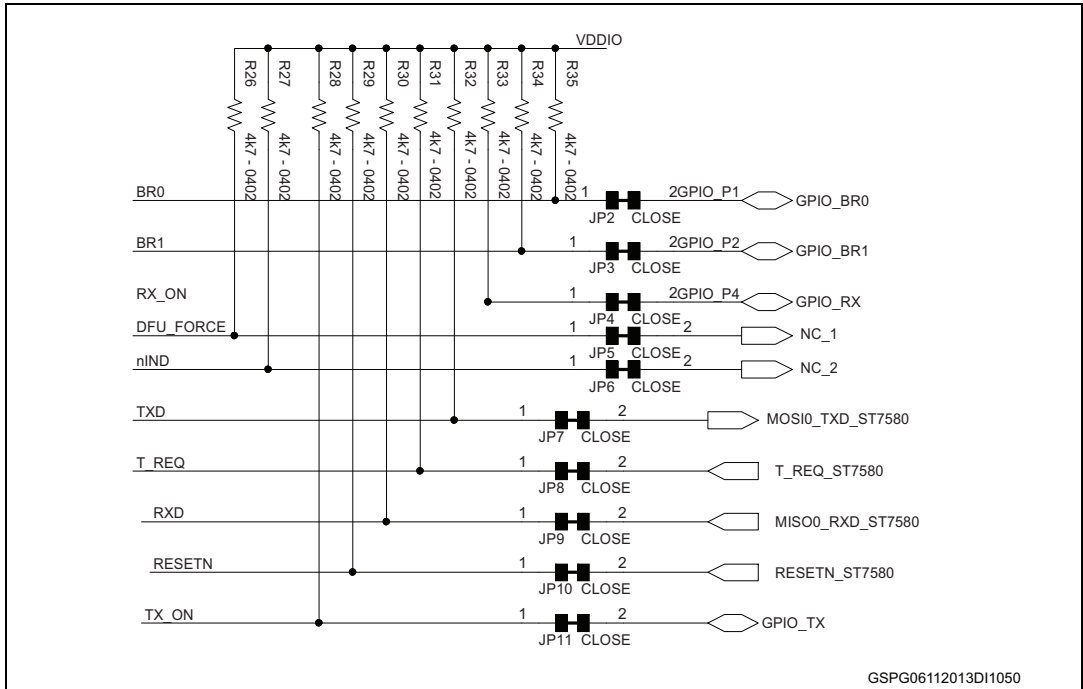
Figure 19. ST7580 module - PLM
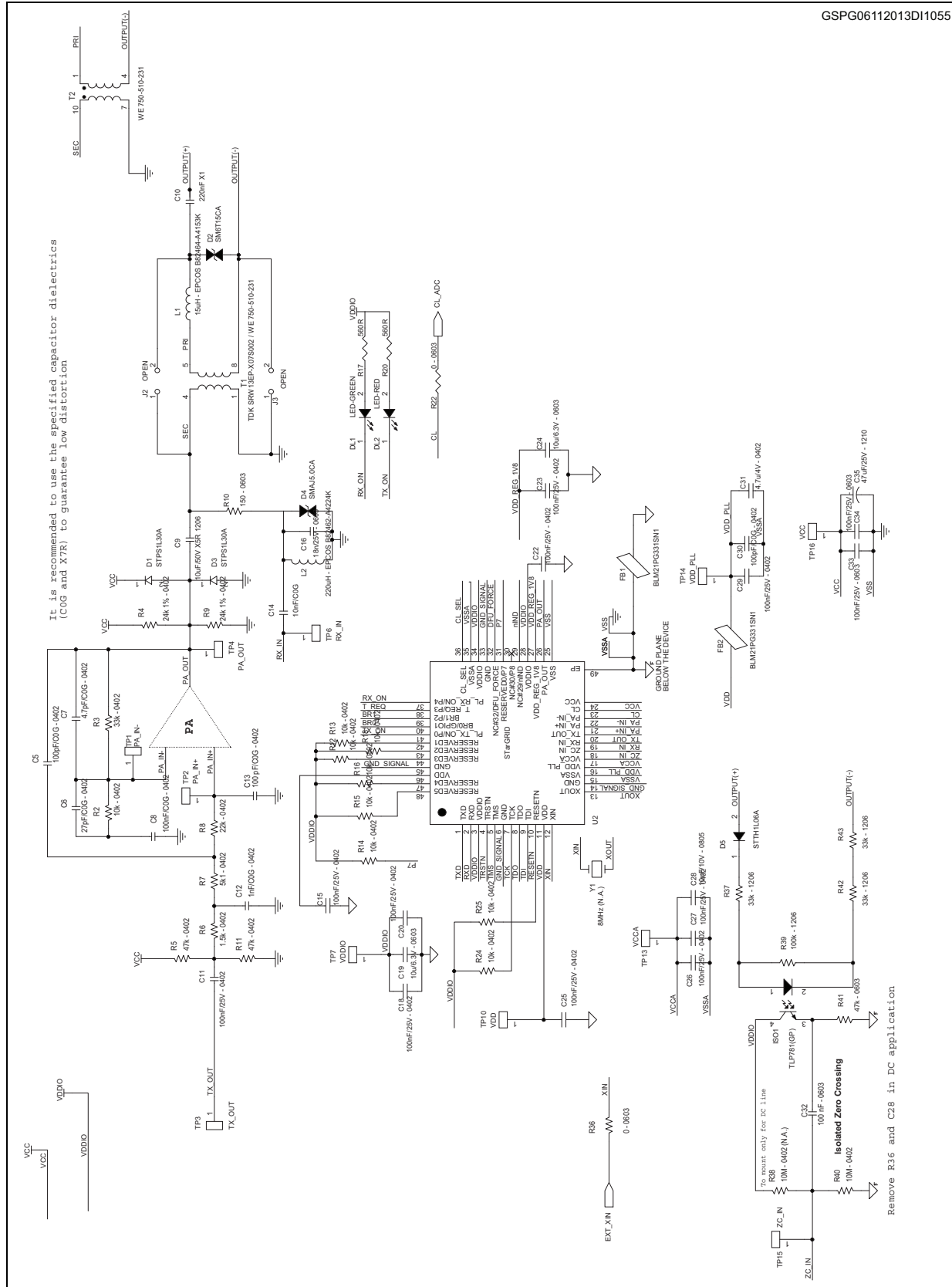
Figure 20. ST7580 module - MCU
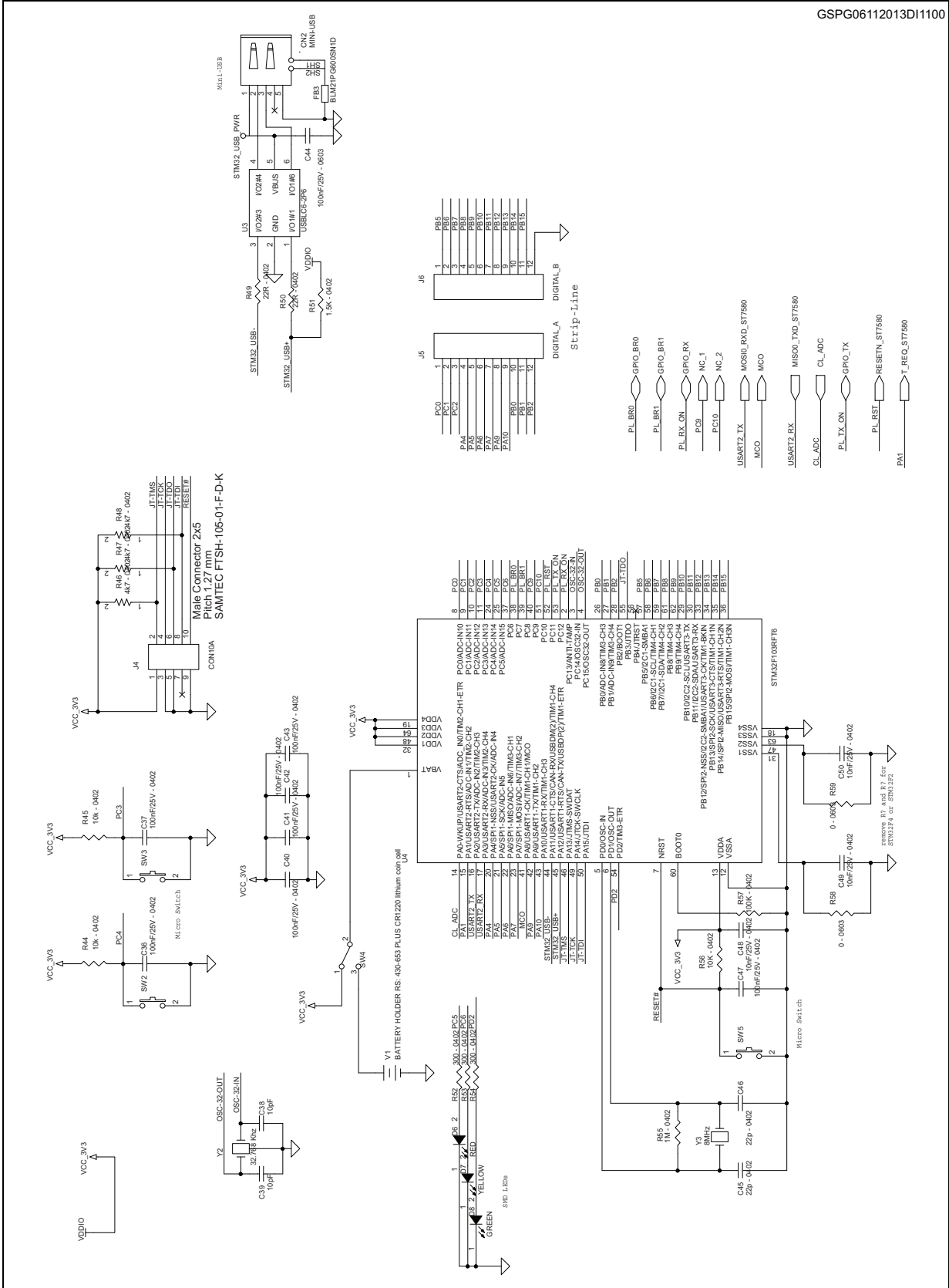
5 Bill of material

Table 7. Bill of material (part 1)

Item	Quantity	Reference	Part / value	Tolerance%	Voltage current	Technology information
1	1	CN1	Screw Connector 3P 2.5mm			
2	1	CN2	MINI-USB			
3	17	C1,C3,C4,C11,C17,C18,C20,C22,C23,C26,C27,C29, C40,C41,C42,C43,C47	100nF/25V - 0402		25V	
4	1	C2	10uF/6.3V0603		6.3V	
5	3	C5,C21,C30	100pF/C0G - 0402		25V	
6	1	C6	27pF/C0G - 0402		25V	
7	1	C7	4.7pF/C0G - 0402		25V	
8	1	C8	100nF/C0G - 0402		25V	
9	1	C9	10uF/50V X5R 1206		50V	
10	1	C10	220nF X1			
11	1	C12	1nF/C0G - 0402		25V	
12	1	C13	100 pF/C0G - 0402		25V	
13	1	C14	10nF/C0G		25V	
14	2	C15,C25	100nF 25V		25V	
15	1	C16	18n/25V - 0603		25V	
16	2	C19,C24	10u/6.3V - 0603		6.3V	
17	1	C28	10uF/10V - 0805		10V	
18	1	C31	4.7u/4V - 0402		4V	
19	1	C32	100 nF - 0603		6.3V	
20	3	C33,C34,C44	100nF/25V - 0603		25V	
21	1	C35	47uF/25V - 1210		25V	
22	2	C36,C37	100nF		25V	
23	2	C38,C39	10pF	5%	50V	
24	1	C45, C46	22p -0402	5%	50V	
26	3	C48,C49,C50	10nF/25V - 0402		25V	
27	1	DL1	LED-GREEN			
28	1	DL2	LED-RED			
29	2	D1,D3	STPS1L30A			
30	1	D2	SM6T15CA			

Table 7. Bill of material (part 1) (continued)

Item	Quantity	Reference	Part / value	Tolerance%	Voltage current	Technology information
31	1	D4	SMAJ5.0CA			
32	1	D5	STTH1L06A			
33	1	D6	RED			
34	1	D7	YELLOW			
35	1	D8	GREEN			
36	2	FB1,FB2	BLM21PG331SN1			
37	1	FB3	BLM21PG600SN1D			
38	1	ISO1	TLP781(GP)			
39	3	JP1,J2,J3	Jumper OPEN			
40	10	JP2,JP3,JP4,JP5,JP6,JP7, JP8,JP9,JP10,JP11	Jumper CLOSE			
41	1	J1	Screw Connector 5mm			
42	1	J4	CON10A			
43	1	J5	DIGITAL_A			
44	1	J6	DIGITAL_B			
45	1	L1	15uH - EPCOS B82464- A4153K			
46	1	L2	220uH - EPCOS B82462- A4224K			
47	1	Q1	STN4NF06L			
48	1	R1	100K - 0603			
49	9	R2,R12,R13,R14,R15,R18, R24,R25,R56	10k - 0402			
50	1	R3	33k - 0402			
51	2	R4,R9	24k 1% - 0402			
52	2	R5,R11	47k - 0402			
53	2	R6,R51	1.5K - 0402			
54	1	R7	5k1 - 0402			
55	1	R8	22k - 0402			
56	1	R10	150 - 0603			
57	3	R16,R44,R45	10K			
58	2	R17,R20	560R			
59	1	R19	330 - 0402			
60	1	R21	10k - 0603			

Table 7. Bill of material (part 1) (continued)

Item	Quantity	Reference	Part / value	Tolerance%	Voltage current	Technology information
61	4	R22,R36,R58,R59	0 - 0603			
62	1	R23	130 - 0402			
63	10	R26,R27,R28,R29,R30,R31, R32,R33,R34,R35	4k7 - 0402			
64	3	R37,R42,R43	33k - 1206			
65	1	R38	10M - 0402 (N.A.)			
66	1	R39	100k - 1206			
67	1	R40	10M - 0402			
68	1	R41	47k - 0603			
69	3	R46,R47,R48	4.7k - 0402			
70	2	R49,R50	22R - 0402			
71	3	R52,R53,R54	300 - 0402			
72	1	R55	1M - 0402			
73	1	R57	100K - 0402			
74	1	SW1	ST7580 Reset			
75	3	SW2,SW3,SW5	Rst			
76	1	SW4	Jumper			
77	1	TP1	PA_IN-			
78	1	TP2	PA_IN+			
79	1	TP3	TX_OUT			
80	1	TP4	PA_OUT			
81	1	TP5	CL			
82	1	TP6	RX_IN			SMD
83	1	TP7	VDDIO			SMD
84	1	TP8	TXD			
85	1	TP9	T_REQ			
86	1	TP10	VDD			
87	1	TP11	GND			
88	1	TP12	RXD			SMD
89	1	TP13	VCCA			SMD
90	1	TP14	VDD_PLL			SMD
91	1	TP15	ZC_IN			
92	1	TP16	VCC			

Table 7. Bill of material (part 1) (continued)

Item	Quantity	Reference	Part / value	Tolerance%	Voltage current	Technology information
93	1	T1	TDK SRW13EP-X07S002 / WE 750-510-231			
94	1	U1	LK112SM33TR			
95	1	U2	ST7580			
96	1	U3	USBLC6-2P6			
97	1	U4	STM32F103RFT6			
98	1	V1	BATTERY HOLDER PLUS CR1220 lithium coin cell			
99	1	Y1	8MHz (N.A.)	30 ppm		
100	1	Y2	32.768 KHz	20ppm		
101	1	Y3	8 MHz	30 ppm		

Table 8. Bill of material (part 2)

Item	Package-footprint	Manufacturer	Manufacturer code	RS/ Distrelec /Other code	More info
1	3P 2.5mm				
2					
3	0402				
4	0603				
5	0402				
6	0402				
7	0402				
8	0402				
9	1206				
10		Epcos	B32913A3224M189	RS - 669-0094	
11	0402				
12	0402				
13	0402				
14	0402				
15	0603				
16	0603				
17	0805				

Table 8. Bill of material (part 2) (continued)

Item	Package-footprint	Manufacturer	Manufacturer code	RS/ Distrelec /Other code	More info
18	0402				
19	0603				
20	0603				
21	1210				
22	0603				
23	0402				
24	0402				
26	0402				
27					
28					
29	SMA (JEDEC DO- 214AC)	ST			
30	SMD SMB/DO-214AA	ST			
31	SMA (JEDEC DO-214AC)	ST			
32	SMA	ST			
33					
34					
35					
36			BLM21PG331SN1		
37			BLM21PG600SN1D		
38	DIP-4	Toshiba	TLP781		
39					
40					
41	2P-5mm				
42	Male Connector 2x5 Pitch 1.27 mm		SAMTEC FTSH-105-01-F- D-K		
43	Female Strip 1x12 pitch 2.5mm				To assemble on the bottom side
44	Female Strip 1x12 pitch 2.5mm				To assemble on the bottom side
45		EPCOS	B82464-A4153K		

Table 8. Bill of material (part 2) (continued)

Item	Package-footprint	Manufacturer	Manufacturer code	RS/ Distrelec /Other code	More info
46		EPCOS	B82462-A4224K		
47	SOT-223	ST			
48	0603				
49	0402				
50	0402				
51	0402				
52	0402				
53	0402				
54	0402				
55	0402				
56	0603				
57	0402				
58	0402				
59	0402				
60	0603				
61	0603				
62	0402				
63	0402				
64	1206				
65	0402				
66	1206				
67	0402				
68	0603				
69	0402				
70	0402				
71	0402				
72	0402				
73	0402				
74					
75					
76					
77					
78					
79					

Table 8. Bill of material (part 2) (continued)

Item	Package-footprint	Manufacturer	Manufacturer code	RS/ Distrelec /Other code	More info
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94	SOT23-5L	ST			
95	SMD QFN-48	ST			
96		ST			
97	LQFP64	ST			
98				BATTERY HOLDER RS: 430- 653	
99				RS: 672-0268	
100				RS: 547-6979	
101				RS: 672-0268	

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
04-Jun-2014	1	Initial release.

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