WIFI module specification

For Babynes machine

1 Versions

Version	Date	Editor	Owner	Modifications
0.1	31/07/2012	S. Abdo	SDATAWAY	Initial draft
0.2	06/08/2012	S. Abdo	SDATAWAY	Add EMI test results
0.3	28/05/2013	S. Abdo	SDATAWAY	Major update with release data.
0.4	22/08/2013	S. Abdo	SDATAWAY	Update BOM with alternatives components and FW version update
0.5	29/10/2013	S. Abdo	SDATAWAY	FW version update (Specific routers support)
0.6	20/12/2013	S. Abdo	SDATAWAY	FW version update (new initial setup method)
0.7	06/01/2014	S. Abdo	SDATAWAY	Channels configuration and FW version update for the RT

2 Scope and vision

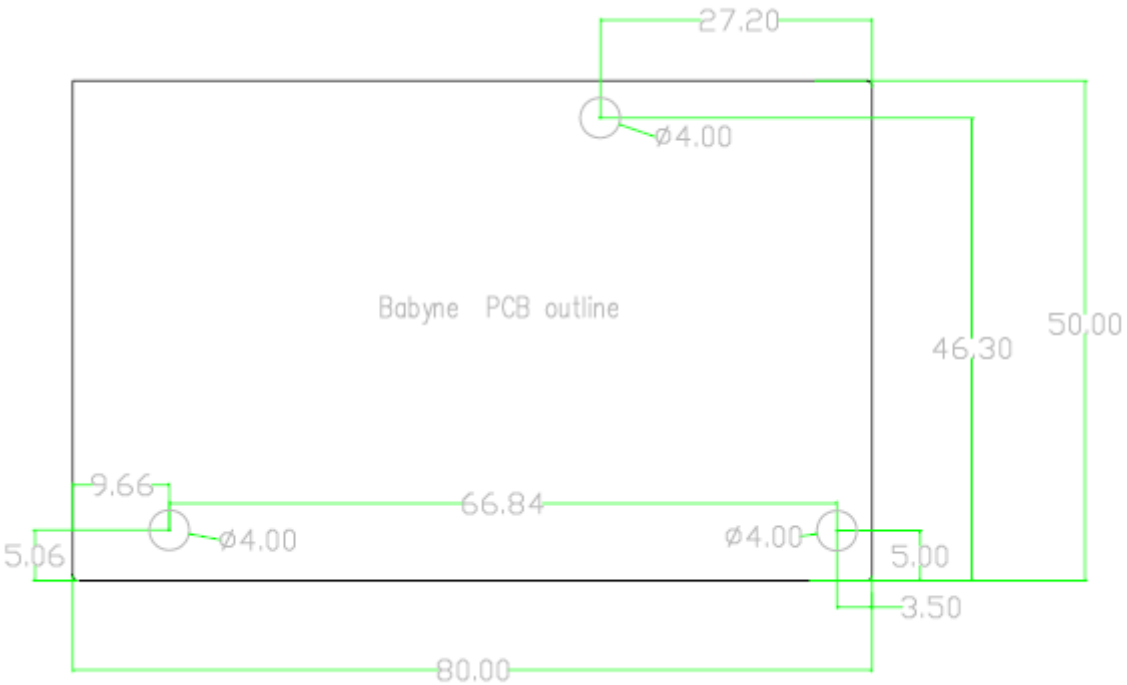
The aim of this document is to specify a WIFI module to be used for sending data over WIFI from a machine toward a web based database.

3 Module specification

3.1 Mechanical specification

This module fit on a 80x50mm PCB. The module must have a couple of holes for fixing with screws or snaps inside a machine. Those 2 holes will also be used for fixing inside a specific plastic case that will ease its installation inside a professional beverage machine.

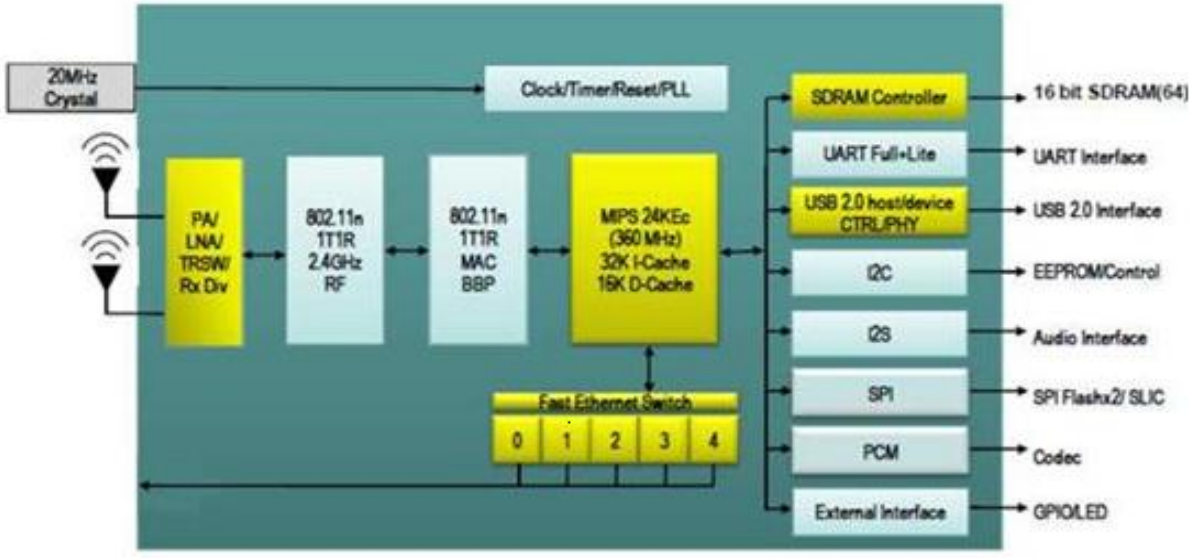
3.1.1 Drawing



3.2 Major internal modules

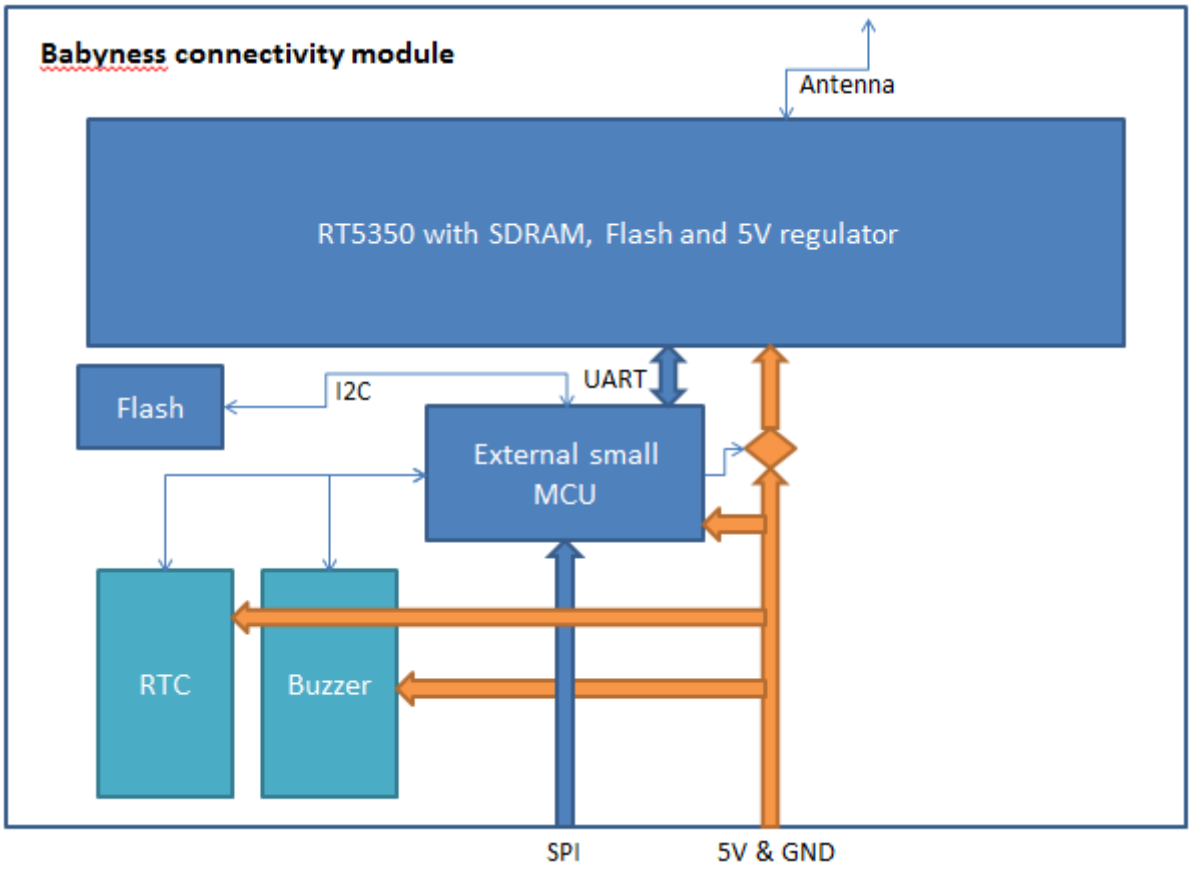
The major functionalities supported are:

1. WIFI chipset:
   - Capable of managing simultaneously an Access point connection and a client connection.
   - 1x1 150Mbps 802.11nMAC/BB
   - A 2.4GHz radio
   - A 360 MHz MIPS® 24K™CPU core with 32KB I-cache/ 16KB D-cache.
   - WEP/TKIP/AES/WPS/WPA/WPA2 engines
   - WIFI Chipset block diagram:



2. A buzzer
3. RTC
4. External MCU and flash: capable of interfacing with the machine main board for data collection and storage before it is sent to the main server.
5. Power management system: providing the required power voltages for internal modules and enabling the module to go in very low consumption mode when the machine is in stand-by mode or when it is in operation.

3.3 Overall module diagram



3.4 Electrical specification

The module is capable of communicating with the main board for gathering data before sending it over WIFI, through an SPI port.

3.4.1 Connection details

3.4.1.1 Connection specification

The module act as an SPI slave

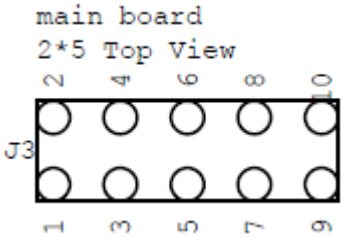
The electrical specification does follow the standard SPI Interface in CMOS logic level.

The SPI interface is powered by 5VDC with a CMOS level.

The interface is driven synchronous with a clock wire. The serial data stream to the WIFI Module is transferred unidirectional over the MOSI line.

3.4.1.2 Connector configuration

Number	Assignment
1	M-MISO
2	VSPI
3	M-SCK
4	M-MOSI
5	Debug
6	VSS_SPI
7	NC
8	NC
9	VSS_SPI
10	EXT_EN0



The cable length is set to XX cm.

3.5 Maximum rating and operating conditions

3.5.1 General parameters

Supply voltage: 5V
Operating temperature conditions: -10 to 55°C

3.5.2 DC electrical characteristics

Parameter	Min	Typ	Max	Unit	Comments
Voltage	4.5	5	5.5	V	
Current		250	900	mA	900mA correspond to peak current consumption

3.6 Functionality description

3.6.1 Initial connection procedure

The initial connection setup is made as follow:

1- The WIFI board start in “Access Point” mode, the customer uses any WIFI enabled device capable of connecting to the board.
2- A wizard will drive the user for inserting the connection details on the board (through WIFI)
3- The WIFI board go to “Client” mode, ready for sending data.

3.6.2 Data gathering and sending to the database

The WIFI board can be in the following states:

1- OFF: This state corresponds to when the machine is not powered.
2- Stand-by: In this mode, the machine is powered and the WIFI board have the WIFI chipset powered down, while it's MCU is running, enabling the board to accept data from the main board and storing it in the board EEPROM.
3- ON: This mode can only be active when the machine is in stand-by. In this mode, the WIFI chipset is turned ON and the board will have the maximum consumption. Therefore, the machine main modules need to be powered down.

The data gathering and sending to the database do follow the below procedure:

1. When the machine is ON, the WIFI board will always be in "Stand-by" mode
2. During an extraction, the machine is ON and the WIFI board remains in "Stand-by" mode
3. Once the extraction is made, the main board sends the corresponding data to the WIFI board. This data will be stored in the dedicated EEPROM on the board.
4. After the extraction, and once the machine goes in "stand-by", the WIFI board goes in ON mode, initiate the connection to the database server and dump the content of the WIFI board EEPROM.
    a. In case of unsuccessful connection to the database server, the connection procedure will be stopped. The data will be kept in the local EEPROM for a later trial.
5. Once the connection procedure is made, the WIFI board goes back again in Stand-by mode, waiting for a new data from the main board.

3.7 FW

The FW verison used in the module is the following:

- ~~V3.0 on the RT5350~~
- ~~V1.8 on the ST MCU~~
- **V5.1 on the RT5350**
- **V5.0 on the ST MCU**

3.8 Channels configuration

For US version, both channels 12 & 13 are disabled.

3.9 Commands

3.9.1 Operating commands

In each defined event, the data will be sent over the interface. So the extraction won't be disturbed.

3.9.1.1 Events

The following table defines the commands (event ID) which are implemented and gives a detail description. Each event has specified parameters. The default parameter is 0x0. So values filled with nulls means that just the event was send

Event ID (1byte)	Description
0x1	Extraction finished (after successful preparation)
0x2	Error
0x3	Descaling
0x4	Connect

3.9.1.2 Event extraction finished

Event ID	Value	Unit	Number of bytes
0x1	Capsule code (6 digits)	Digit	4
	Flow rate in steps of 5ml/min	[ml/min]	2
	Pump extraction time in steps 0.1s	[ms]	2
	Water tank amount before extraction in 5ml steps	[ml]	2
	Temp from MMI in 1° steps	[°C]	1
	Temp water NTC before extraction	[°C]	1
	Number of extracted capsules		2

Example :

Start & event ID	Val1 Capsule code 400060				Val2 Flow rate 350ml/min		Val3 Extraction time 45000ms		Val4 Water tank 950ml	
0x51	0x00	0x06	0x1A	0xBC	0x01	0x5E	0xAF	0xC8	0x03	0xB6

Val5 Temp MMI 37	Val6 Temp water 40	Val7 Capsules extracted 54321		check Check sum
0x25	0x28	0xD4	0x31	0x51

Checksum calculation:

0xC5	(initial)
0x51	Start and eventID
0x00	Value1a
0x06	Value1b
0x1A	Value1c
0xBC	Value1d
0x01	Value2a
0x5E	Value2b
0xAF	Value3a
0xC8	Value3b
0x03	Value4a
0xB6	Value4b
0x25	Value5
0x28	Value6
0xD4	Value7a
0x31	Value7b

0x51	(checksum)
====	

3.9.1.3 Event error mode

Event ID	Value	Unit	Number of bytes
0x2	Capsule code (6 digits)	Digit	4
	Flow rate in steps of 5ml/min	[ml/min]	2
	Pump extraction time in steps 0.1s	[ms]	2
	Water tank amount before extraction in 5ml steps	[ml]	2
	Temp from MMI in 1° steps	[°C]	1
	Temp water NTC before extraction	[°C]	1
	Number of extracted capsules		2
	Number of ultrasonic disconnection		2
	Errorcode in Bit mask		2

3.9.1.4 Error mode bit mask

The error Bit mask is defined as follow

Hex value	Error Description
0x0001	Remove water tank or US disconnection
0x0002	Fill in water during use
0x0004	High water temperature detected by the NTC2
0x0008	Interruption with on/off during preparation
0x0010	Flow is to low (=4s blocked)
0x0020	Extraction duration is to long (>55s):
0x0040	Headmotor timeout while head moves down (Motor error or lower switch faulty)
0x0080	Upper switch faulty (is showed immediatey after start button is pressed)
0x0100	Head Motorcurrent error
0x0200	Needle endswitch error
0x0400	Heater not working

3.9.1.5 Event descaling

Event ID	Value	Unit	Number of bytes
0x3	Descaling mode in Bit mask		1
	Water tank amount before extraction in 5ml steps	[ml]	2

3.9.1.6 Descaling bit mask

Hex value	Error Description
0x00	Descaling finished
0x01	Descaling started (pressed start Button for 5s)
0x02	Rinsing 1 started
0x04	Rinsing 2 started
0x08	Rinsing 3 started
0x10	
0x20	
0x40	Normal rinsing started
0x80	Normal rinsing finished

3.9.1.7 Event connect

Event ID	Value	Unit	Number of bytes
0x4	WLAN demands		1

3.9.1.8 Connect table

The connect Bit mask is defined as follow:

Hex value	Demand
0x01	Connect WLAN Modul
0x02	Disconnect WLAN Modul
0x04	Reset WLAN Modul

3.9.2 Test during module assembly

A set of commands are used over the SPI interface in order to test all blocs and functionalities at the end of the module assembly. This set of commands is detailed below:

ID	Definition	Description
0x10	GET MCU VERSION	This command is sent by the test module. The BabyNes board answers with the current STM8S firmware version.
0x11	GET HW VERSION	This command is sent by the test module. The BabyNes board answers with the current hardware version.
0x12	SET TID	This command is sent by the test module. The BabyNes board store this ID in the internal STM8S EEPROM and answers with an ACK/NACK
0x13	GET TID	This command is sent by the test module. The BabyNes board read the TID stored in EEPROM and answers with the read value.
0x14	PERFORM BUZZER TEST	This command is sent by the test module. The BabyNes board emits a 5 seconds test beep and answers with an ACK.
0x15	PERFORM EEPROM TEST	This command is sent by the test module. The BabyNes board proceeds to an external EEPROM self-test and answers with an ACK/NACK.
0x16	PERFORM RTC TEST	This command is sent by the test module. The BabyNes board proceeds to an external RTC self-test and answers with an ACK/NACK.
0x17	PERFORM RT5350 TEST	This command is sent by the test module. The BabyNes board will be powered up and proceeds to an RT5350 self-test and answers with an ACK/NACK. In addition, the RT5350 give the detected signal level, MAC address and firmware version in the answer.
0x18	TERMINATE RT5350 TEST	This command is sent by the test module. The BabyNes board will shut down the RT5350 and make it going back to normal mode.
0x19	SET TEST FLAG	This command is sent by the test module. The BabyNes board stores this test flag in the internal STM8S EEPROM and answers with an ACK/NACK.
0x1A	GET TEST FLAG	This command is sent by the test module. The BabyNes board read the test flag stored in EEPROM and answers with the read value.
0x1B	J1 PORT TEST	This command is sent by the test module. The BabyNes board proceeds to the external J1 port self-test and answers with an ACK/NACK.

3.9.3 Test during machine assembly

After the assembly of the module inside the machine, a test is performed in order to check its functionality. This test is performed by inserting a specific test barcode in the capsule holder. The details and steps of this test are the following:

1- The machine is powered ON. At this time the WIFI board is in stand-by mode.
2- The test barcode is inserted.

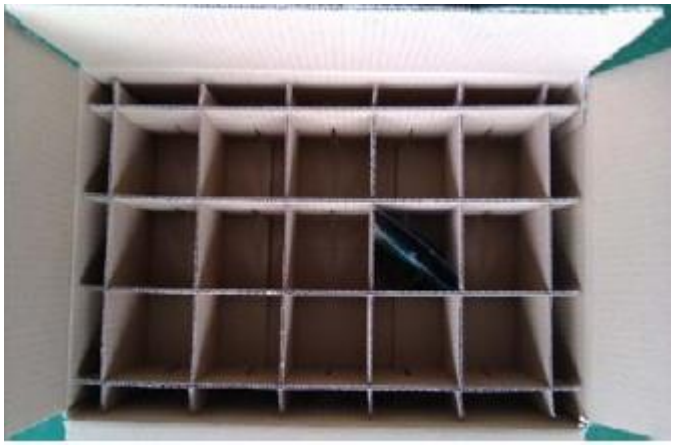
3- The machine is visually switched to stand-by mode providing enough power to the WIFI mode.
4- A “Test WLAN Module” command is sent to the WIFI board as follow:
   a. 0x01 Connect WLAN Modul
   b. 0x02 Disconnect WLAN Modul
   c. 0x04 Reset WLAN Modul
   d. 0x05 Test WLAN Modul
5- A short “Beep” is made by the board to confirm the start of the test.
6- A full test is performed, and the result is communicated to the operator as follow:
   a. A continuous and endless “Beep” means that the test is PASS
   b. A pulsed endless “Beep” means that the test is FAIL.
7- The machine is powered down to exit the test mode.

4 BOM

See annexe 1

5 Packaging

The modules will be packed in a shipper including15 cells per layers. Each of those cells will contain 4 units per cell; therefore there will be 60pcs per carton.
Below is a picture of the shipper packaging.



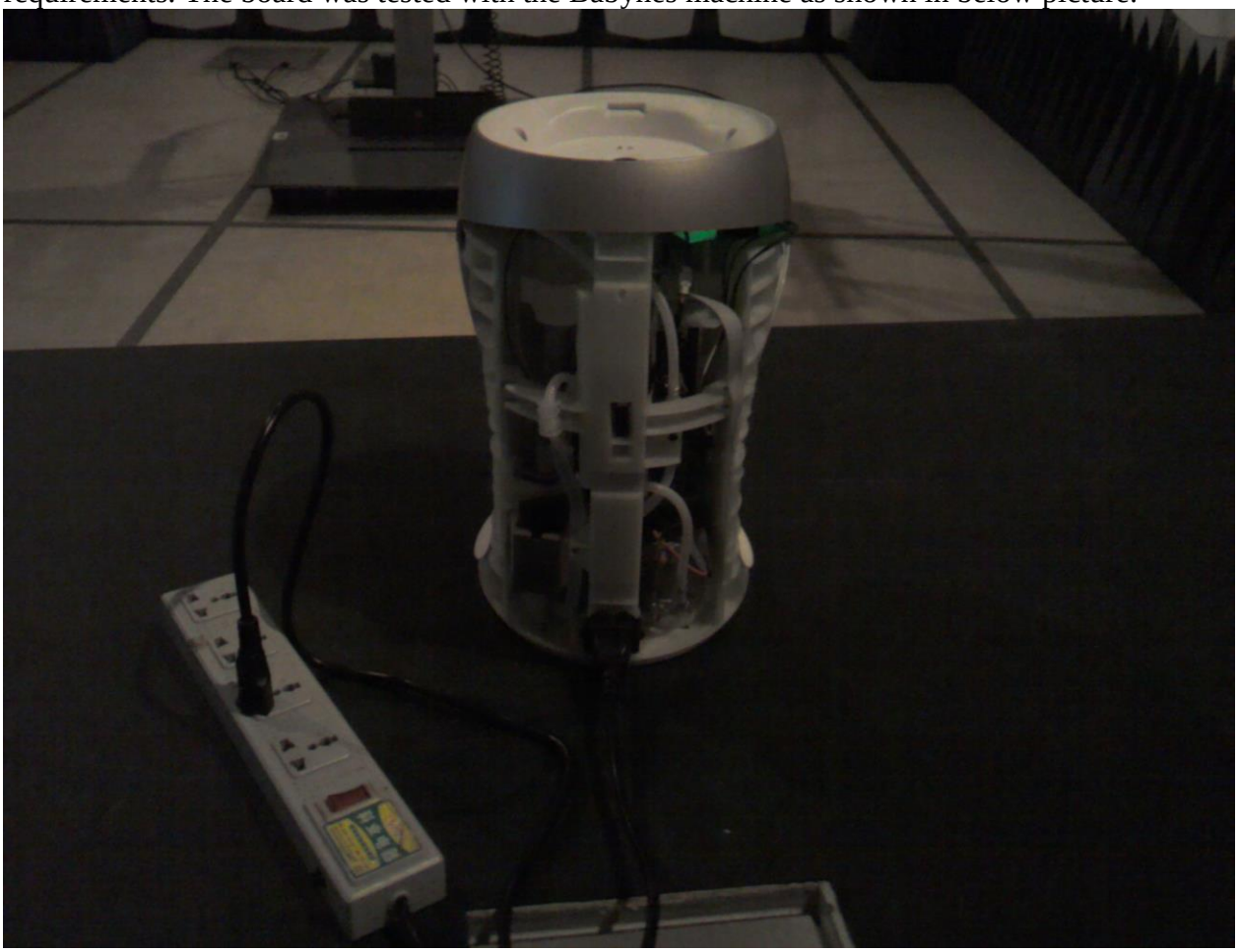
The specification of the packaging is the following:

Pcs/ box	N.W /pcs	N.W/box	G.W/ box	L*W*H/box
60	28.3g	1698g	2050kg	40*27.2*12.5cm

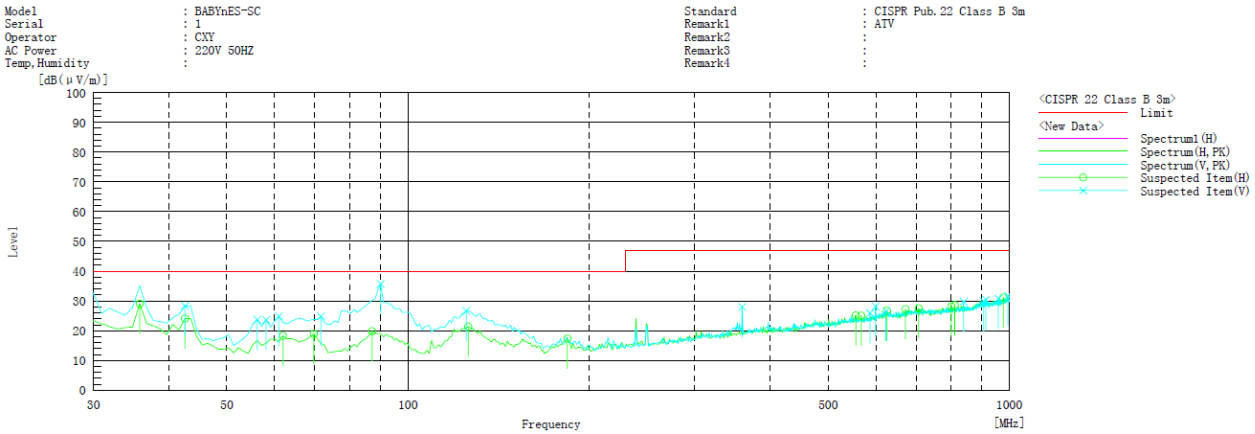
6 Quality and tests

6.1 EMI testing

The WIFI module electromagnet interferences (EMI) are tested toward the CE level requirements. The board was tested with the Babynes machine as shown in below picture:



The result of the test is PASS with the following performances:



Spectrum Selection

No.	Frequency	(P)	Reading	c.f	Result PK	Limit	Margin	Height	Angle
	[MHz]		[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[cm]	[°]
1	90.140	V	26.6	9.1	35.7	40.0	4.3	150.1	334.0
2	35.820	V	20.9	15.4	32.3	40.0	5.0	110.0	163.8
3	35.820	H	13.7	15.4	29.1	40.0	10.9	110.0	163.8
4	42.610	V	16.5	11.8	28.3	40.0	11.7	110.0	20.5
5	125.060	V	18.5	8.2	26.7	40.0	13.3	110.0	268.6
6	61.040	V	17.3	7.5	24.8	40.0	15.2	110.0	272.4
7	71.710	V	17.4	7.4	24.8	40.0	15.2	150.1	250.2
8	995.150	V	6.2	25.5	31.7	47.0	15.3	110.0	79.0
9	977.690	H	5.9	25.3	31.2	47.0	15.8	150.1	201.9
10	42.610	H	12.3	11.8	24.1	40.0	15.9	110.0	350.4
11	959.260	V	5.7	25.1	30.8	47.0	16.2	150.1	12.7
12	56.190	V	16.0	7.7	23.7	40.0	16.3	110.0	228.8
13	58.130	V	16.0	7.6	23.6	40.0	16.4	110.0	84.8
14	914.640	V	5.6	24.8	30.4	47.0	16.6	110.0	313.7
15	906.880	V	5.0	24.9	29.9	47.0	17.1	110.0	176.2
16	839.950	V	6.1	23.7	29.8	47.0	17.2	110.0	128.6
17	811.820	H	5.0	23.6	28.6	47.0	18.4	150.1	260.8
18	126.030	H	13.1	8.2	21.3	40.0	18.7	150.1	259.8
19	801.150	H	4.7	23.5	28.2	47.0	18.8	110.0	350.4
20	599.390	V	7.1	21.1	28.2	47.0	18.9	150.1	135.3
21	359.800	V	11.4	16.6	28.0	47.0	19.0	150.1	324.5
22	707.060	H	4.6	22.9	27.5	47.0	19.5	110.0	189.3
23	672.140	H	4.9	22.4	27.3	47.0	19.7	110.0	303.1
24	87.230	H	11.0	8.9	19.9	40.0	20.2	110.0	90.0
25	626.550	H	4.7	22.0	26.7	47.0	20.3	150.1	85.7
26	623.640	V	4.6	22.0	26.6	47.0	20.4	150.1	351.2
27	69.770	H	11.6	7.4	19.0	40.0	21.0	110.0	16.0
28	586.780	V	5.3	20.6	25.9	47.0	21.1	150.1	220.0
29	62.010	H	10.8	7.5	18.3	40.0	21.7	150.1	189.0
30	555.740	H	5.1	20.1	25.2	47.0	21.9	110.0	264.2
31	567.380	H	4.9	20.2	25.1	47.0	21.9	150.1	127.6
32	184.230	H	6.7	10.7	17.4	40.0	22.6	110.0	115.9

7 Annex1: BOM

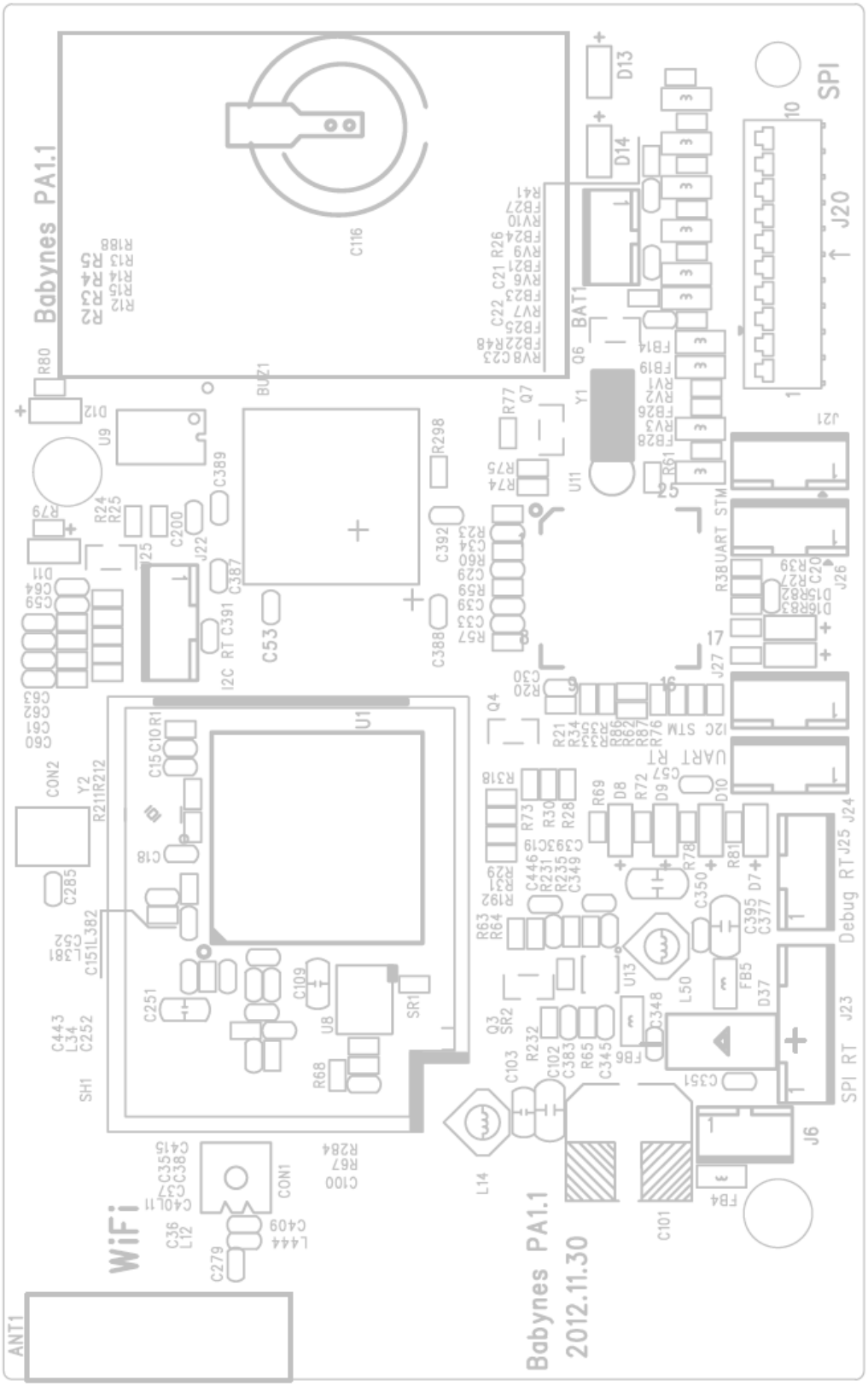
Item	Description	QTY	Brand	ID
1	BabyNes Shield, Fe/Ni	1	xinhongmeng	SH1
	BabyNes Shield, Fe/Ni	1	DaTai	SH1
2	10 pin connector,2651-28#-2.54/1.5-10P-225mm	1	hongchang	J20
	10 pin connector,2651-28#-2.54/1.5-10P-225mm	1	chaohong	J20
3	Capacitor,EECSOHD224H,0.22F,5.5V,±30%,Φ10.5*6	1	PANASONIC	C116
	Capacitor,0.22F,5.5V,±30%,Φ10.5*6	1	Lilong	C116
4	Corona EVA/3*6*0.5mm	1	Xinhongjing	
	Corona EVA/3*6*0.5mm		XinYilong	
5	Crystal,1TD125BFNS004,32.768K,±10ppm,12.5pF,2.0*6.0mm	1	KDS	Y1
6	Capacitor,GRM1555C1H1R2BA01D,0402,1.2pF,50V,±0.1pF,COG	2	Murata	C36,C40
	Capacitor,1.2pF,50V,±0.1pF,COG	2	AVX	C36,C40
	Capacitor,1.2pF,50V,±0.1pF,COG	2	Kemet	C36,C40
7	Capacitor,0402,0.01uF,16V,±10%,X5R/X7R	3	Free	C4,C393,C446
8	Capacitor,0402,0.1uF,16V,±10%,X5R/X7R	36	Free	C9,C16,C24,C28,C30,C31,C32,C33,C34,C39,C43,C53,C54,C55,C56,C59,C92,C98,C104,C108,C110,C113,C114,C200,C345,C348,C349,C351,C383,C387,C388,C389,C390,C391,C414,C422
9	Capacitor,0402,1uF,6.3V,±10%,X5R/X7R	5	Free	C1,C8,C14,C29,C111
10	Capacitor,0402,27pF,50V,±5%,NPO	1	Free	C15
11	Capacitor,0402,100pF,50V,±5%,NPO	11	Free	C7,C10,C57,C58,C60,C61,C62,C63,C64,C117,C395
12	Capacitor,0402,1000pF,50V,±10%,X5R/X7R	5	Free	C19,C20,C21,C22,C23
13	Capacitor,0603,4.7uF,10V,±10%,X5R	7	Free	C2,C42,C84,C93,C109,C112,C251
14	Resistor,0402,9.1KΩ,±1%,1/16W	1	Free	R50
15	Resistor,0402,16.9KΩ,±1%,1/16W	1	Free	R70
16	Resistor,0402,2.7pF,±0.25pF,50V,NPO	2	Free	C35,C38
17	Resistor,0402,0.022uF,50V,±10%,X5R	1	Free	C18

	/X7R			
18	Resistor,0402,6800pF,50V,±10%,X5R/X7R	1	Free	C100
19	Resistor,0402,1500pF,50V,±10%,X5R/X7R	1	Free	C105
20	Resistor,0402,68pF,50V,±5%,NPO	1	Free	C106
21	IC-RT5350F,TFBGA-196,Ralink	1	RALINK	U1
22	IC-MX25L3206EM2I-12G,SOP-8,MXIC	1	MXIC	U6
23	IC-TPS62290DRV,SON-6,TI	1	TI	U13
24	MOS,VIC1333DL,N/PType,SOT23-6L	1	victech	U8
	MOS,FDC6420C,N/P Type	1	Fairchild	U8
25	PCB,BabyNes PA1.1,4layer,FR4,1.6mm	1	FCF	
	PCB,BabyNes PA1.1,4layer,FR4,1.6mm	1	Guanhong	
	PCB,BabyNes PA1.1,4layer,FR4,1.6mm	1	Yongheyu	
26	IC-STM8S005K6T6C,LQFP-32,ST	1	ST	U11
27	MCP7940N-I/MS,MSOP-8,Microchip	1	MICROCHIP	U36
28	Resistor,0402,0Ω,±5%,1/16W	13	Free	R20,R21,R57,R59,R73,R75,R280,R309,L16,L17,L34,L53,L671
29	Resistor,0402,33Ω,±5%,1/16W	1	Free	R300
30	Resistor,0402,1KΩ,±5%,1/16W	13	Free	R13,R14,R15,R18,R69,R72,R78,R79,R80,R81,R82,R83,R212
31	Resistor,0402,100Ω,±5%,1/16W	2	Free	R34,R35
32	Resistor,0402,4.7KΩ,±5%,1/16W	21	Free	SR2,R24,R25,R32,R33,R36,R63,R64,R71,R94,R95,R107,R118,R119,R142,R144,R150,R154,R293,R308,R318
33	Resistor,0402,10KΩ,±5%,1/16W	8	Free	R12,R19,R23,R76,R87,R298,R48,R77
34	Resistor,0402,100KΩ,±5%,1/16W	4	Free	R41,R60,R74,R232
35	Resistor,0402,1MΩ,±5%,1/16W	2	Free	R22,R211
36	Resistor,0402,12KΩ,±1%,1/16W	3	Free	R1,R26,R27
37	Varitor,0402,VZ0402M090AGT,9V,190pF	7	Walsin	RV1,RV2,RV3,RV6,RV7,RV8,RV10
38	Resistor,0402,22Ω,±5%,1/16W	8	Free	SR1,R30,R31,R40,R58,R61,R188,R37
39	Inductance,HI1005-1C2N2SMT,2.2±0.3nH,0.3A,0402	1	Free	L11
40	Resistor,0402,1.8KΩ,±1%,1/16W	1	Free	R235
41	Resistor,0402,8.2KΩ,±1%,1/16W	2	Free	R8,R231
42	Resistor,0402,1.5pF,50V,±0.25pF,NPO	1	Free	C37
43	Resistor,0402,10pF,50V,±0.5pF,NPO	3	Free	C6,C17,C443

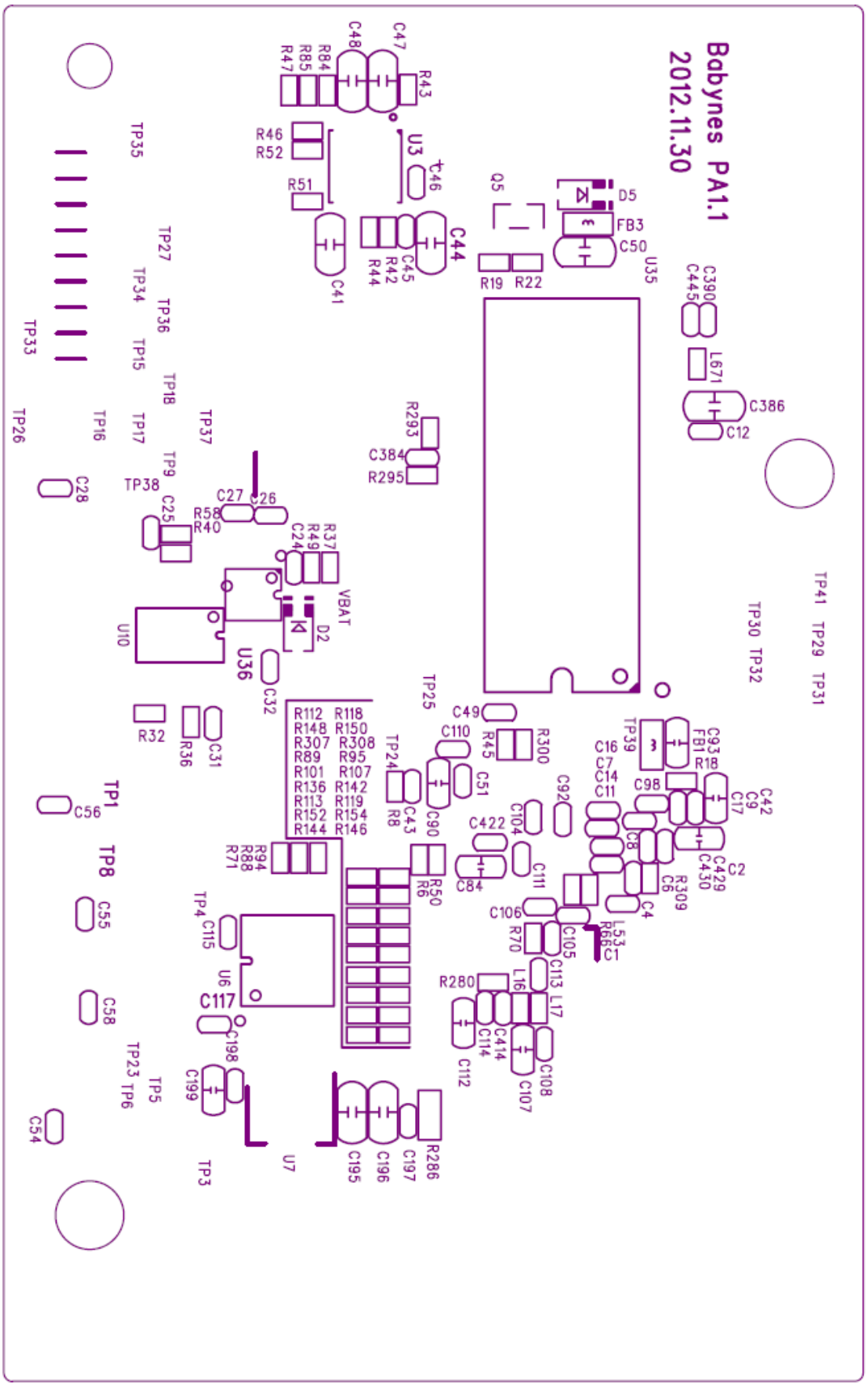
44	Capacitor,GJM1555C1HR50BB01D,0402,0.5pF,50V,±0.1pF,NPO	1	Free	L444
45	Antenna Connector,MM8430-2610B	1	Free	CON1
46	Inductance,CDRH2D14NP-4R7NC,4.7uH,±30%,1A	1	Xianjin	L14
47	Inductance,CDRH2D14NP-3R3NC,3.3uH,±30%,1A	1	Xianjin	L50
48	IC-AT24C256C-SSHM-T,SOIC-8,ATMEL	1	ATMEL	U10
49	Resistor,0805,10uF,10V,-20%~+80%,Y5V	4	Free	C50,C102,C350,C377
50	IC-APX809-26SAG-7,SOT-23,Diodes	1	Diodes	U25
51	Resistor,0402,47Ω,±5%,1/16W	1	Free	R68
52	Inductance,HK1005 1N8S-T,1.8nH,±0.3nH,0.4A,0402	1	Free	L12
53	Diode,1N4148WSST,SOD-323	2	Free	D5,D2
54	IC-W9825G6JH-6,TSOP Ⅱ-54,Winbond	1	Winbond	U35
	IC-NT5SV16M16CS-6K,TSOP Ⅱ-54,NANYA	1	NANYA	U35
55	Capacitor,CDVS,220uF,16V,±20%,ϕ6.3*7.7mm	1	Free	C101
56	Resistor,0402,18pF,50V,±5%,NPO	2	Free	C26,C27
57	Ferrite,HCB1608KF-121T20,0603,120Ω,2A	8	Free	FB1,FB3,FB4,FB5,FB6,FB24,FB25,FB28
58	Crystal,X3S020000BA1H-V,20MHz,±10ppm,10pF,3225	1	Huaxin	Y2
59	Ferrite,HCB1608KF-601T10,0603,600Ω,1A	7	Free	FB21,FB22,FB23,FB27,FB14,FB19,FB26
60	Buzzer,8.5*8.5*4mm,85dB	1	Xinruisheng	BUZ1
	Buzzer,8.5*8.5*4mm,85dB	1	Handeli	BUZ1
61	MOS,2N7002K,NType,SOT-23	5	Free	Q3,Q4,Q5,Q6,Q7
62	Inductance,LQG15HS5N1S02D,5.1nH,±0.3nH,0.3A,0402	1	Free	C279
63	Resistor,0402,49.9Ω,±1%,1/16W	4	Free	R2,R3,R4,R5
64	Resistor,0402,2KΩ,±1%,1/16W	2	Free	R67,R284

8 Annex1: Components placement

Top face :



Bottom face :


Babynes PA1.1
2012.11.30
C48
C47
R43
R84
R85
R47
R46
R52
U3
R51
C46
C44
C45
R42
R44
C41
Q5
D5
FB3
C50
U35
R19
R22
C390
C445
L671
C386
C12
TP35
TP27
TP34
TP36
TP33
TP15
TP18
TP26
TP16
TP17
TP37
R293
C384
R295
TP9
TP38
C28
C25
C27
C26
R58
R40
R37
R49
C24
VBAT
D2
U10
U36
C32
TP25
C49
R45
R300
C110
C51
TP24
R8
C43
C90
R112
R118
R148
R150
R307
R308
R89
R95
R101
R107
R136
R142
R113
R119
R152
R154
R144
R146
R32
R36
C31
TP1
C56
TP8
C55
C58
TP4
C115
U6
C117
C198
C199
TP23
TP5
TP6
C54
TP3
U7
C195
C196
C197
R286
R94
R88
R71
R50
R6
C84
C422
C104
C111
C106
R70
C105
C113
L16
L17
R280
C414
C114
C112
C108
C107
C16
C7
C14
C11
C92
C98
TP39
C93
FB1
R18
C42
C9
C17
C8
C429
C430
C2
C6
R309
C4
L53
R66
C1
TP41
TP29
TP31
TP30
TP32