Type1LV Application Note

Introduction

This Application Note targets HW developers.

It provides how to design the Schematic and Layout, and reference RF performance

For Module specification refer to "type1lv_datasheet-*"

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Murata Manufacturing Co., Ltd.

Revision History

Revision Number	Release Date	Comments
-	2019.3.26	1st issue
2.0	2019.11.21	1.3 Reference Circuit : Updated module Pin layout based on module datasheet.RevL

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1   Module introduction

1.1   Type1LV Introduction

- WLAN(11a/b/g/n/ac-friendly*1)+BT/BLE(BT5.0) combo SIP module with Cypress CYW43012
- The package type is LGA(SM type)
- This module is covered with resin molding and fully shielded with metal
- MAC and BD address are embedded in OTP

*1: IEEE 802.11ac full-compliance requires support for 40 MHz and 80 MHz channel bandwidths. CYW43012 only supports 20 MHz channel bandwidth however it supports 802.11ac's 256-QAM for the 20 MHz channels in the 5GHz band enabling it to offer higher throughput and lower energy per bit than 802.11n only products.

1.2   Block Diagram

Figure-1 shows module internal block diagram.
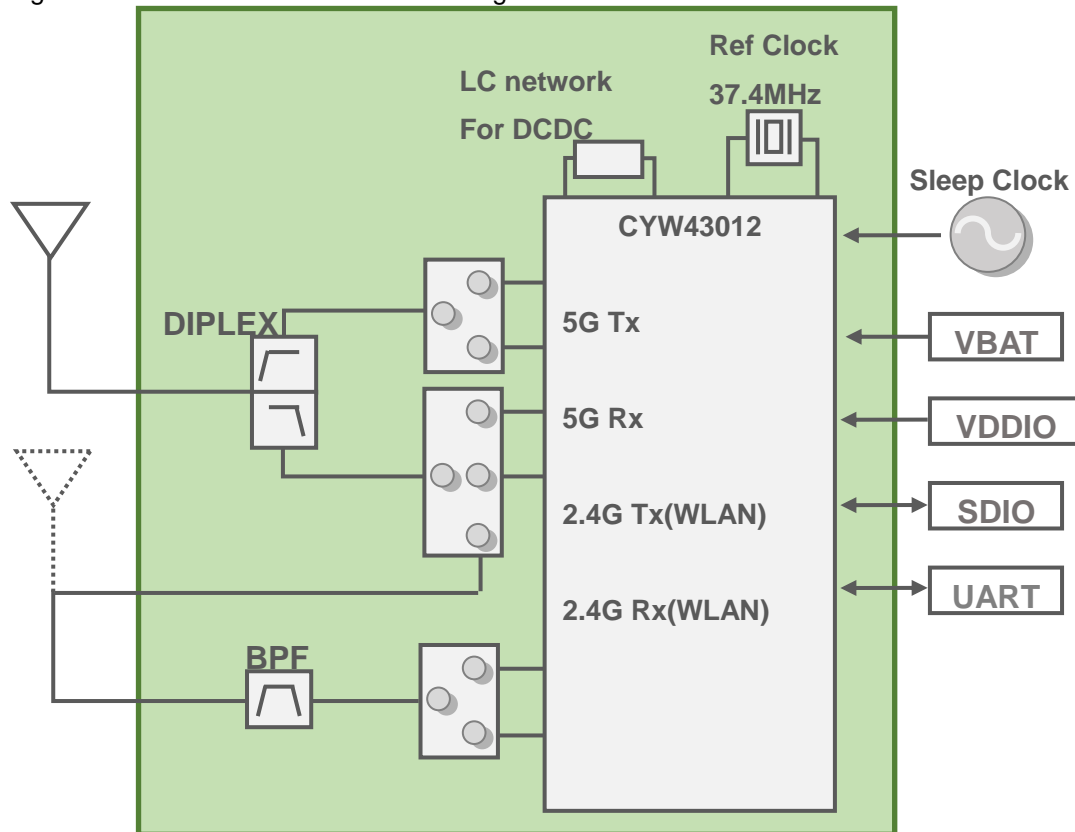
Figure-1, Block diagram

1.3 Reference Circuit

Figure-2 shows the reference circuit of Type1LV module.

Figure-2, Reference Circuit

1) Antenna condition for Murata Radio certification

Please add attenuator circuit between Type1LV and antenna matching if you use Murata Radio certification. If your antenna peak gain is higher than Murata application one, please reduce antenna gain by this pi-type attenuator.

Please refer to "Type1LV_Antenna_performance.pdf" about more detail.

2) External 32.768kHz Sleep Clock Specifications

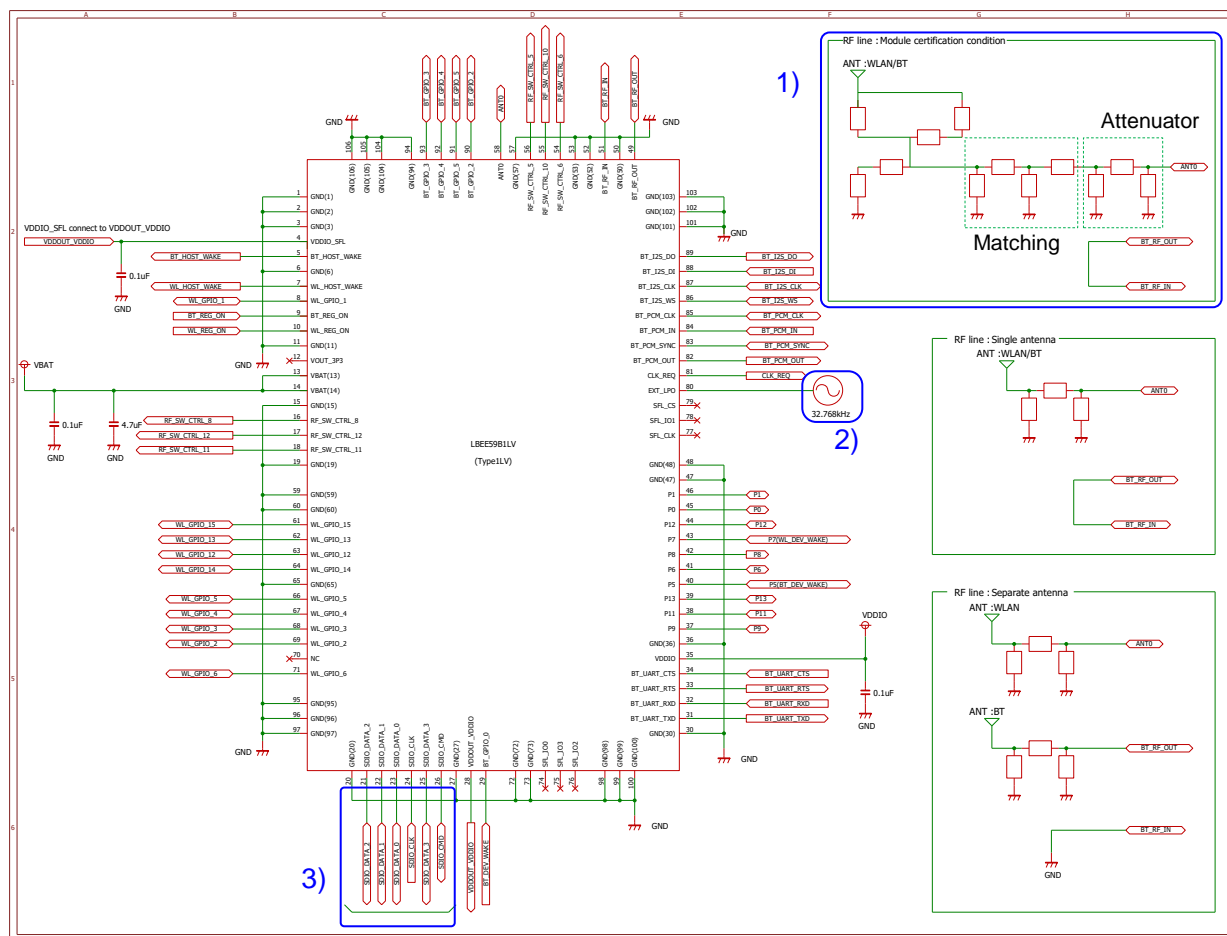Table-1 shows External 32.768 kHz Low-Power Oscillator characteristics for Type1LV.
An external LPO is required.

Table-1, External 32.768kHz Sleep Clock Specifications

Parameter	External LPO Clock	Unit
Nominal input frequency	32.768	kHz
Frequency accuracy	+/-250	ppm
Duty cycle	30-70	%
Input signal amplitude	500 – 1800	mVp-p
Signal type	Square-wave or sine-wave	-
Input impedance*a)	> 100k	ohm

*a) When power is applied or switch off

3) SDIO

Please arrange SDIO lines with 50ohm and put siries-R, shunt-C parts to reject the noise if needed.
10k~100k ohm pull-ups are required on the four DATA lines and the COMD line. This requirement must be met duting all operating states by using external pull-ups. This module doesn not have internal pull-ups on these lines. Please confirm the performance on your board.

4) Guideline for unused pins

All I/O are not needed pull up/down for termination when you don't use below I/O.

P0~13
WL_GPIO
BT_GPIO
FLASH
BT_I2S/PCM
CLK_REQ
RF_SW_CTRL

2   HW Design Guideline

2.1   Underneath of module
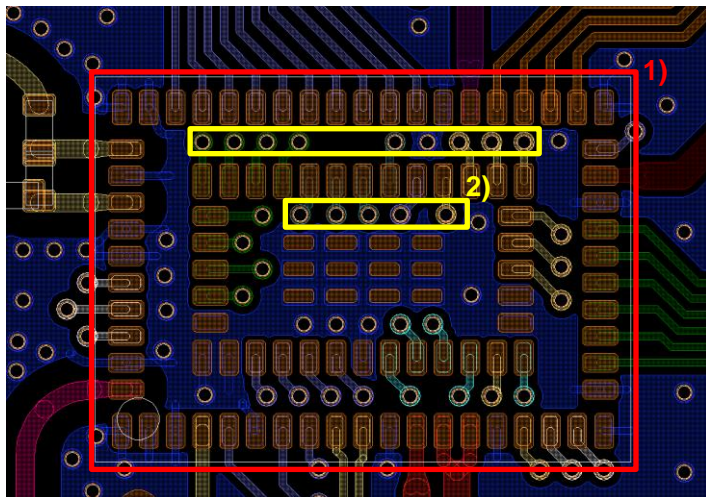
1) Please refer to Murata Datasheet regarding to Dimensions.

   *Murata is preparing DXF file that is module footprint. "Type1LV_footprint.dxf"

2) Via design between outside and inside module pad

   Via Hole Φ250um

   Via Land Φ400um

2.2 Antenna

Antenna line should be 50ohm (*). There should be enough GND via along with Antenna line. Make sure that pi matching circuit is located right before the wifi antenna on the main board.
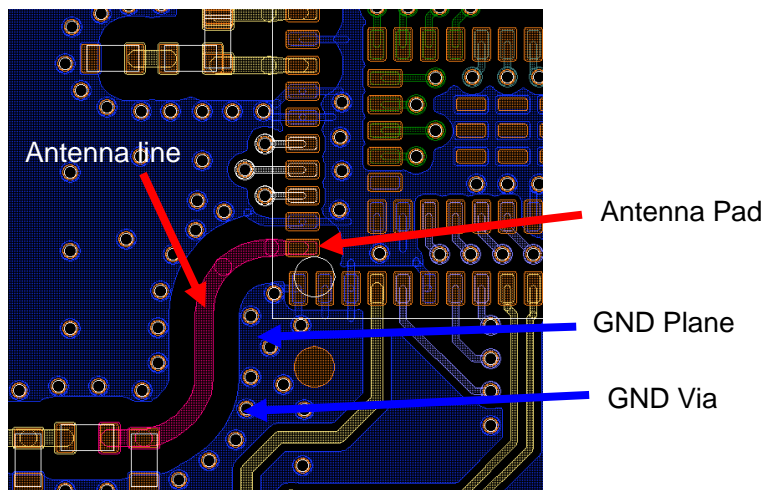
(*) How to make 50ohm line?

http://www17.plala.or.jp/i-lab/index_e.htm

Here are the conditions of 50ohm lines of evaluation board. (One of example)

- Epsilon : 4.3
- RF trace width(s) : 0.35mm
- GND gap(h) : 0.18mm
- GND gap(w) : 0.5mm

The line impedance is Z0 = **51.8ohm**.

3. RF Measurement Result

3.1 Tx output power level (at module antenna port)

3.1.1. WiFi

Tx output power setting is defined by Murata nvram file.

2.4GHz

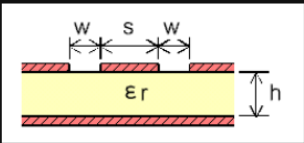| Mode	Data Rate	Output Power[dBm]
11b	1M	17.0
	2M	17.0
	5.5M	17.0
	11M	17.0
11g	6M	17.0
	9M	17.0
	12M	16.0
	18M	16.0
	24M	16.0
	36M	15.0
	48M	15.0
	54M	14.0
11n	MCS0	17.0
	MCS1	17.0
	MCS2	17.0
	MCS3	16.0
	MCS4	15.0
	MCS5	15.0
	MCS6	14.0
	MCS7	13.0

5GHz

Mode	Data Rate	Output Power[dBm]
11a	6M	16.0
	9M	16.0
	12M	16.0
	18M	16.0
	24M	15.0
	36M	15.0
	48M	14.0
	54M	13.0
11n HT20	MCS0	16.0
	MCS1	16.0
	MCS2	16.0
	MCS3	15.0
	MCS4	15.0
	MCS5	14.0
	MCS6	13.0
	MCS7	12.0
11ac VHT20	MCS0	16.0
	MCS1	16.0
	MCS2	16.0
	MCS3	15.0
	MCS4	15.0
	MCS5	14.0
	MCS6	13.0
	MCS7	12.0
	MCS8	10.0

3.1.2. Bluetooth

<Condition>

- VBAT=3.3V, VDDIO=1.8V

- Hcd.file version

    CYW43012C0_003.001.015.0064.0000_Generic_UART_37_4MHz_wlcsp_ref3_sLNA

Frequency[MHz]	Output Power [dBm]		
	DH5	3DH5	BLE
2402	9.4	5.0	5.0
2440	9.4	5.5	5.2
2480	9.1	5.7	5.3

3.2 Rx minimum sensitivity level (at module antenna port)

3.2.1. WiFi

<Condition>

- VBAT=3.3V, VDDIO=1.8V

- FW version:version 13.10.271.111

2.4GHz

Frequency[MHz]	Rx minimum sensitivity level[dBm]					
	11b		11g		11n	
	1Mbps	11Mbps	6Mbps	54Mbps	MCS0	MCS7
2412	-98.8	-89.9	-94.4	-77.7	-94.3	-75.9
2442	-98.7	-89.9	-94.6	-77.8	-94.6	-76.0
2472	-99.0	-89.9	-94.6	-77.7	-94.8	-76.1

5GHz(20MHz band)

Frequency[MHz]	Rx minimum sensitivity level[dBm]					
	11a		11n(HT20)		11ac(VHT20)	
	6Mbps	54Mbps	MCS0	MCS7	MCS0	MCS8
5180	-92.2	-75.1	-92.1	-73.4	-91.8	-71.0
5500	-91.2	-75.4	-91.2	-73.7	-91.1	-71.0
5825	-90.2	-75.6	-90.3	-73.7	-90.7	-71.1

3.2.2. Bluetooth

<Condition>

- VBAT=3.3V, VDDIO=1.8V

- Hcd.file version
  CYW43012C0_003.001.015.0064.0000_Generic_UART_37_4MHz_wlcsp_ref3_sLNA

Frequency[MHz]	Rx minimum sensitivity level[dBm]		
	DH5	3DH5	BLE
2402	-92.8	-90.8	-97.3
2440	-93.0	-90.4	-97.4
2480	-93.0	-90.3	-97.3

4. Current consumption

4.1 WiFi

4.1.1. Tx/Rx current consumption

\<Condition>

- VBAT=3.3V, VDDIO=1.8V
- WL_REG_ON:ON, BT_REG_ON:ON
- FW version:version 13.10.271.111

2.4GHz

Mode	Rate	Tx current		Rx current[mA]*b)
		setting power	Tx current[mA]*a)	
11b	1Mbps	17.0	200	20
	11Mbps	17.0	200	
11g	6Mbps	17.0	195	20
	54Mbps	14.0	150	
11n	MCS0	17.0	195	20
	MCS0	13.0	140	

*a) Setting value: 1024byte, 20usec interval.

*b) Carrier sense when no carrier present.

5GHz

Mode	Rate	Tx current		Rx current[mA]*b)
		setting power	Tx current[mA]*a)	
11a	6Mbps	16.0	300	20
	54Mbps	13.0	230	
11n(HT20)	MCS0	16.0	300	20
	MCS7	12.0	210	
11ac(VHT20)	MCS0	16.0	300	20
	MCS8	10.0	190	

*a) Setting value:1024byte, 20usec interval.

*b) Carrier sense when no carrier present.

4.1.2. Sleep current consumption

<Condition>

- VBAT=3.3V, VDDIO=1.8V
- WL_REG_ON:ON, BT_REG_ON:OFF
- FW_version: 13.10.271.57

Band	Mode	VBAT(3.3V) mA	VDDIO(1.8V) uA
-	IEEE Power save, Inter Beacon*a)	0.024	120
2.4GHz	IEEE Power Save:DTIM1*b)	0.479	119
	IEEE Power Save:DTIM3	0.149	119
	IEEE Power Save:DTIM5	0.099	119
5GHz	IEEE Power Save:DTIM1	0.368	119
	IEEE Power Save:DTIM3	0.113	119
	IEEE Power Save:DTIM5	0.077	119

*a). Idle, not associated, or inter-beacon.

*b). Beacon Interval = 100ms

4.2 Bluetooth

4.2.1. BLE current consumption

<Condition>

- VBAT=3.3V, VDDIO=1.8V
- WL_REG_ON:OFF, BT_REG_ON:ON
- Hcd.file version: CYW43012C0_003.001.015.0064.0000_Generic_UART_37_4MHz_wlcsp_ref3_sLNA.hcd

Mode	VBAT(3.3V) uA	VDDIO(1.8V) uA
BLE Scan *a)	121	44
BLE Adv-Uncounnectable 1.00sec	30	39
BLE connected 1sec	29	44

*a) No devices present. A 1.28 second interval with a scan window of 11.25ms.

5. Throughput performance

<Condition>

- VBAT=3.3V, VDDIO=1.8V
- WL_REG_ON:ON, BT_REG_ON:ON
- FW_version: 13.10.271.138

2.4GHz

11n_HT20_MCS7	Tx[Mbps]	Rx[Mbps]
TCP	51.2	47.8
UDP	57.2	56.9

5GHz

11ac_VHT20_MCS8	Tx[Mbps]	Rx[Mbps]
TCP	60.8	66.8
UDP	68.9	69.7

(END)