

CUSTOMER : LGE

DATE : 2017.09.06.

SPECIFICATIONS FOR APPROVAL

PRODUCT NAME : BT(v4.2) + WLAN(802.11a/b/g/n/ac) 2.4G SISO/5G MIMO

MODEL NAME : RBHP-B213B

CUSTOMER P/N : EAT63433501

APPROVAL	REMARK

APPENDIX

Designed	Checked	Approved	LG Innotek Co., Ltd.	
				
			DOCUMENT No.	RBHP-B213B
			PAGE	68

1. Application

△ This specification is applied to LGInnotek Bluetooth (v4.2) and 2.4GHz SISO/5GHz MIMO WLAN(802.11a/b/g/n/ac) Module RBHP-B213B which includes BCM88359

2. Quality

Quality should meet each condition which mentioned on this specification. However, the items which are not mentioned on this specification follow the inspection agreements and standards which are agreed with both companies.

3. Appearance and Characteristics

1) Appearance

Appearance should not be contaminated by harmful materials and should not have cracks etc. Mechanical dimensions should meet the contents of clause 8.

2) Characteristics

Electrical characteristics should meet the contents of clause 10.

4. Application of Bluetooth v4.2 and 2.4GHz/5GHz WLAN(IEEE 802.11.a/b/g/n/ac)

1) Automotive

5. Maximum Rating

NO	ITEM	Rating	UNIT
1	Operating Temperature Range	-40 ~ +85	℃
2	Storage Temperature Range	-40 ~ +105	℃
3	VBAT Voltage Range	-0.5 ~ 6.0	V
4	VIO Voltage Range	-0.5 ~ 3.9	V
5	VBAT Max. Current	700(@3.3V)	mA
6	VIO Max. Current	50(@1.8V)	mA

△ RBHP-B213B Module assures operating normally at -40 ~ +85 ℃.

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	1.5	2017. 08.10.	Rev1.5 Released				
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6. Test

Electrical characteristics are tested for every products. However, if there are any objection in judgments, it should be treated with agreements of companies.

7. Labeling Information



GWANGGAETOH

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RBHP-B213B

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7 04 GJ 27 0059

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EAT63433501

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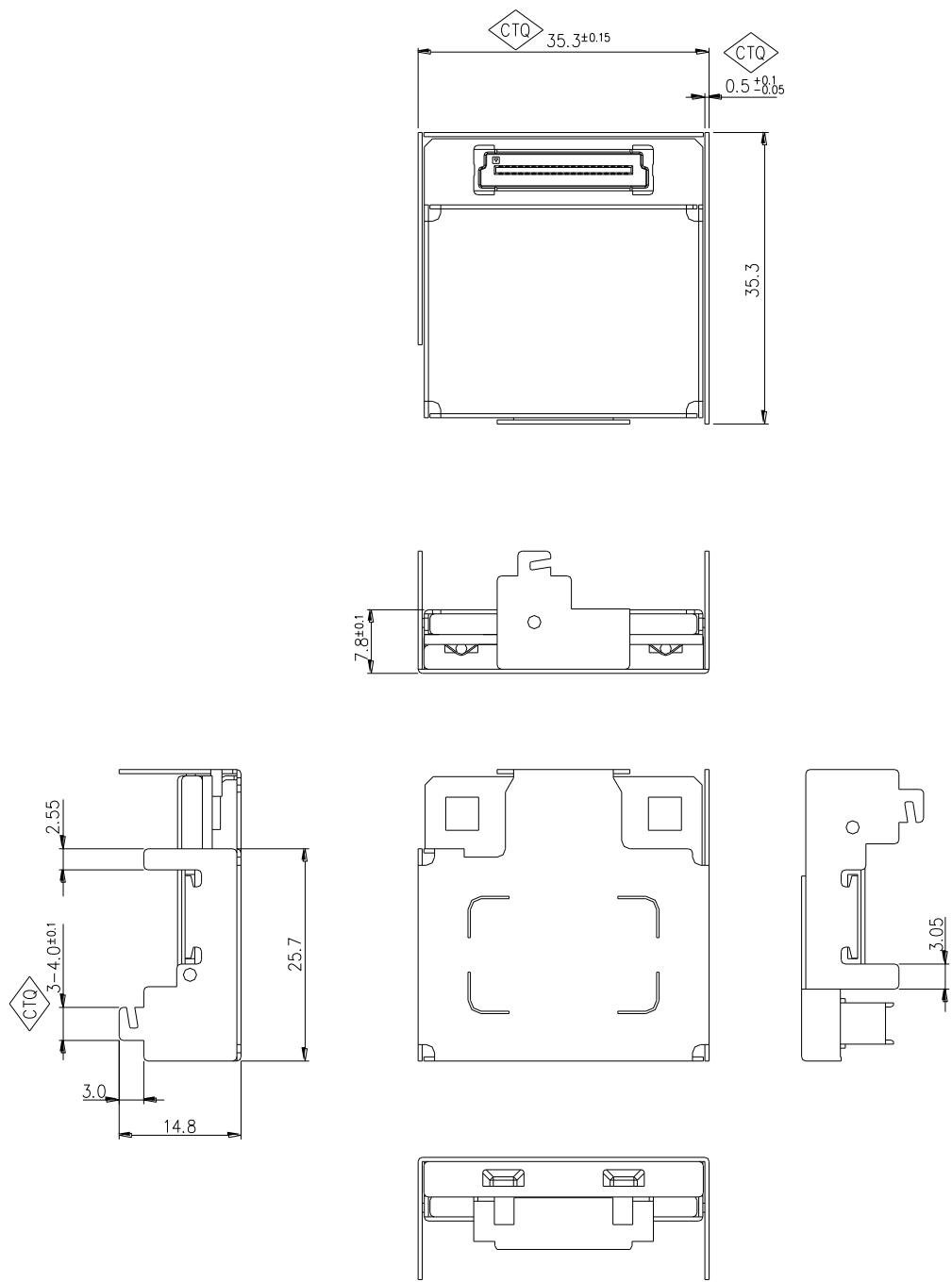
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No.	Index
①	PRODUCT
②	MODEL PART NO.
③	MANUFACTURED YEAR (0~9)
④	MANUFACTURED MONTH(1,2, ...9, A,B,C)
⑤	GwangJu
⑥	MANUFACTURED DATE (1~31)
⑦	MANUFACTURED SERIAL NUMBER(0001~9999)
⑧	Customer P/N
⑨	QR CODE INFORMATION : EAT63433501_704GJ270059

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8. Mechanical Dimension

1) Dimension without Antenna Ass'y

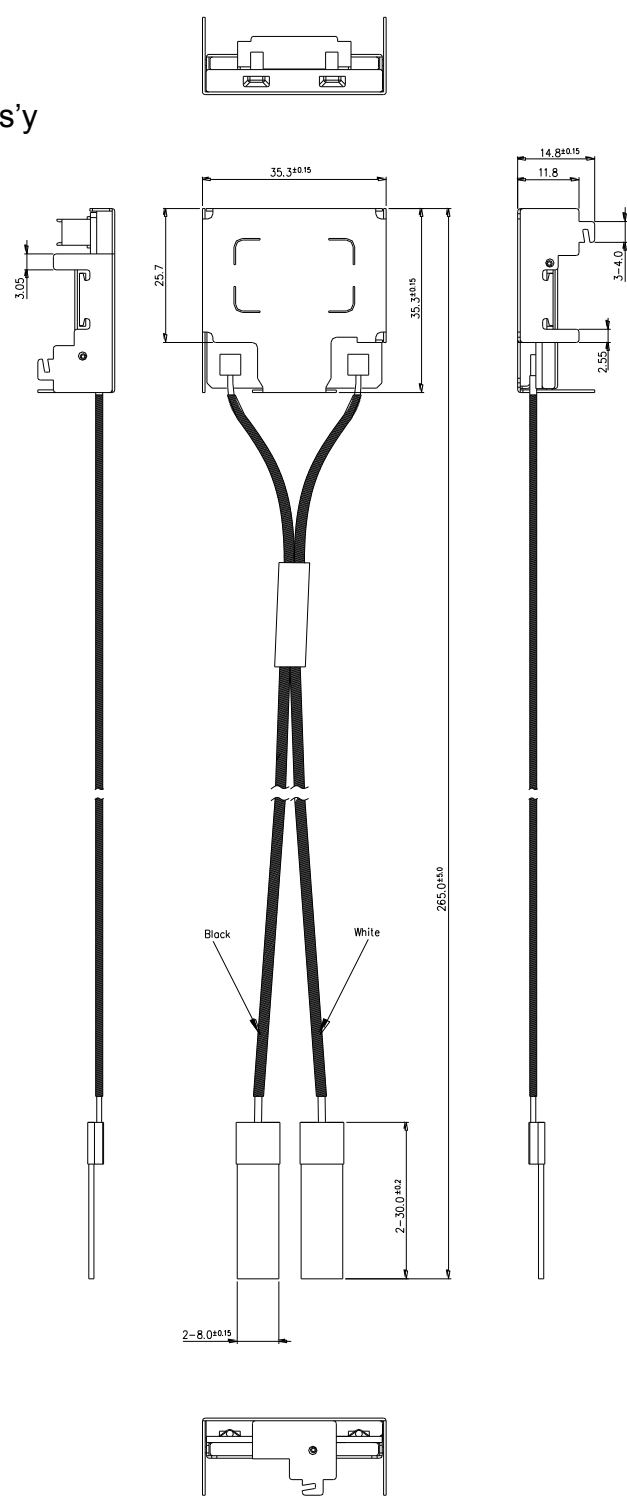


[Unit: mm]

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8. Mechanical Dimension

2) Dimension with Antenna Ass'y



[Unit: mm]

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9. General Features

9.1 BT(v4.2) + 2.4GHz/5GHz WLAN(IEEE 802.11a/b/g/n/ac) 2.4G SISO/5G MIMO

1) Features

- Operation Voltage is 3.3V/1.8V Dual Power Rail
- WiFi Single-stream up to 866 Mbps data rate
- Automotive Module
 - : All components are AEC-Q 100/200 qualified
- Support 2 Antenna port
 - : ANT0 : Bluetooth/5G WLAN, ANT1 : 2.4G/5G WLAN
- Integrated WLAN PA, RF Switch and LNA
- RoHS Compliant
- Size : 35.3 x 35.3 x 7.8 mm³
- Support bandwidth : HT20 / HT40 / VHT80
- HOST Interface : PCIE/SDIO(WLAN), UART(BT), PCM(I2S)
- Package type : Connector type(B to B)

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9. General Features

9.2 Bluetooth(BT v4.2+EDR compliant)

1) Bluetooth Key Features

- Supports key features of upcoming Bluetooth standards
- Fully supports Bluetooth Core Specification version 4.2 + (Enhanced Data Rate)
- EDR features:
 - . Adaptive Frequency Hopping (AFH)
 - . Quality of Service (QoS)
 - . Extended Synchronous Connections (eSCO) – Voice Connections
 - . Fast Connect (interlaced page and inquiry scans)
 - . Secure simple Pairing (SSP)
 - . Sniff Sub rating (SSR)
 - . Encryption Pause Resume (EPR)
 - . Extended Inquiry Response (EIR)
 - . Link Supervision Timeout (LST)
- UART baud rates up to 4 Mbps
- Supports all Bluetooth 4.2 packet types
- Supports maximum Bluetooth data rates over HCI UART
- Multipoint operation with up to seven active slaves
 - . Maximum of seven simultaneous active ACL links
 - . Maximum of three simultaneous active SCO and eSCO connections with scatternet support
- Narrowband and wideband packet loss concealment
- Scatternet operation with up to four active piconets with background scan and support for scatter mode
- High-speed HCI UART transport support
- Channel quality driven data rate and packet type selection
- Standard Bluetooth test modes
- Extended radio and production test mode features
- Full support for power savings modes
 - . Bluetooth clock request
 - . Bluetooth standard sniff
 - . Deep-sleep modes and software regulator shutdown

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9. General Features

9.3 WLAN

1) WLAN RF band & modulation Features

- Dual-band 2.4GHz and 5GHz 802.11 a/b/g/n/ac(802.11ac compliant)
- Up to 866Mbps data rate
- Supports 20, 40 and 80MHz channels with optional SGI(256 QAM modulation)
- Tx and Rx low-density parity check(LDPC)
- Supports IEEE 802.11ac/n beamforming
- Supports PCIe v3.0-compliant interface running at GEN1 speeds
- Supports two antennas with Bluetooth/5G WLAN and 2.4G/5G WLAN antenna
- Supports standard SDIO V3.0 (up to SDR104 mode at 208MHz, 4-bit and 1-bit)
- Backward compatibility with SDIO v2.0 host interface
- WPA and WPA2(Personal) support for powerful encryption and authentication
- AES and TKIP in hardware for faster data encryption and IEEE 802.11i compatibility
- Reference WLAN subsystem provides Wi-Fi protected Setup(WPS)

2) WLAN MAC features

- Enhanced MAC for supporting IEEE 802.11ac features
- Transmission and reception of aggregated MPDUs(A-MPDU) for high throughput(HT)
- Support for power management schemes, including WMM power-save multi-poll(PSMP) and multiphase PSMP operation
- Support for immediate ACK and block-ACK policies
- Inter-frame space timing support, including RIFS
- Back-off counters in hardware for supporting multiple priorities as specified in the WMM specification
- Timing synchronization function(TSF), network allocation vector(NAV) maintenance, and target beacon transmission time(TBTT) generation in hardware
- Hardware offload for AES-CCMP, legacy WPA TKIP, legacy WEP ciphers, WAPI, and support for key management
- Programmable independent basic service set(IBSS) or infrastructure basic service set functionality

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9. General Features

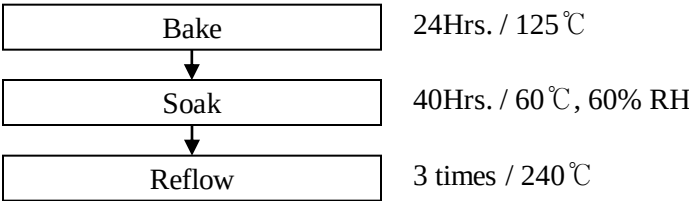
9.3 WLAN

3) WLAN PHY features

- Programmable data rates from MCS0-9 in 20MHz, 40MHz, and 80MHz channels, as specified in IEEE 802.11ac
- Improved performance with channel smoothing and spur canceller support
- Supports Optional short GI and Green field modes in Tx and Rx
- Tx and Rx LDPC for improved range and power efficiency
- Beamforming support
- Supports IEEE 802.11h/k for worldwide operation
- Advanced algorithms for low power, enhanced sensitivity, range, and reliability
- IEEE 802.11a, 11b, 11g, 11n, 11ac single stream PHY standards
- Designed to meet FCC and other worldwide regulatory requirements

9.4 JEDEC MSL (Moisture Sensitivity Level) Test

- MSL 3 Level (Floor Life Time : 168Hrs. / Condition : ≤30 °C, 60% RH)
- Standard : IPC / JEDEC J-STD-020C



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10. Electrical Specification**10.3 I/O characteristics****1) SDIO Interface I/O pins and PCIe out of band signals(PERST_N/PME_L/CLKREQ_N)*****VIO_SD= 1.8V**

Item	Symbol	Min	Typ	Max	Unit
Input high voltage	V _{IH}	1.27	-	-	V
Input low voltage	V _{IL}	-	-	0.58	V
Output high voltage@2mA	V _{OH}	1.40	-	-	V
Output low voltage@2mA	V _{OL}	-	-	0.45	V

***VIO_SD = 3.3V**

Item	Symbol	Min	Typ	Max	Unit
Input high voltage	V _{IH}	0.625xVIO	-	-	V
Input low voltage	V _{IL}	-	-	0.25xVIO	V
Output high voltage@2mA	V _{OH}	0.75xVIO	-	-	V
Output low voltage@2mA	V _{OL}	-	-	1.25xVIO	V

2) Other Digital I/O Pins(UART/PCM/WAKE/REG_ON/STRAP and GPIOs)***VIO = 1.8V**

Item	Symbol	Min	Typ	Max	Unit
Input high voltage	V _{IH}	0.625xVIO	-	VIO+0.1	V
Input low voltage	V _{IL}	-	-	0.35xVIO	V
Output high voltage@2mA	V _{OH}	0.45xVIO	-	-	V
Output low voltage@2mA	V _{OL}	-	-	0.45	V

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10. Electrical Specification**10.3 I/O characteristics**

*VIO = 3.3V

Item	Symbol	Min	Typ	Max	Unit
Input high voltage	V _{IH}	2.00	-	VIO+0.1	V
Input low voltage	V _{IL}	-	-	0.8	V
Output high voltage@2mA	V _{OH}	VIO-0.4	-	-	V
Output low voltage@2mA	V _{OL}	-	-	0.4	V

3) WLAN host interface strap selection

- PCIE_EN, SDIO_DIS, SDIO_PAD

PCIE_EN	SDIO_DIS	SDIO_PAD	Mode
High	High	High	PCIe
Low	Low	High	1.8V SDIO
Low	Low	low	3.3V SDIO

4) Sequencing of reset and regulator control signals

- Description of control signals

***WL_REG_ON**

: Used by the PMU to power up the WLAN section. It is also OR-gated with the BT_REG_ON input to control the internal BCM88359 regulators. When this pin is high, the regulators are enabled and the WLAN section is out of reset. When this pin is low, the WLAN section is in reset. If both the BT_REG_ON and WL_REG_ON pins are low, the regulators are disabled

***BT_REG_ON**

: Used by the PMU(OR-gated with the WL_REG_ON)to power up the internal BCM88359 regulators. If both the BT_REG_ON and WL_REG_ON pins are low, the regulators are disabled. When this pin is low and WL_REG_ON is high, the BT section is in reset

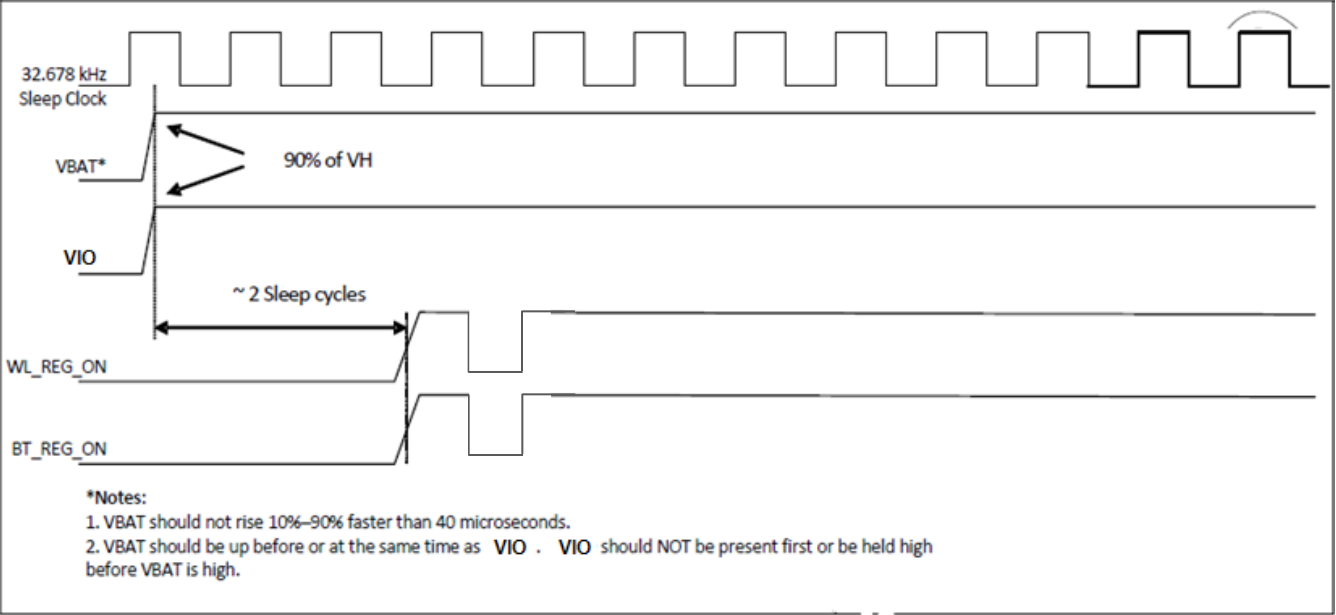
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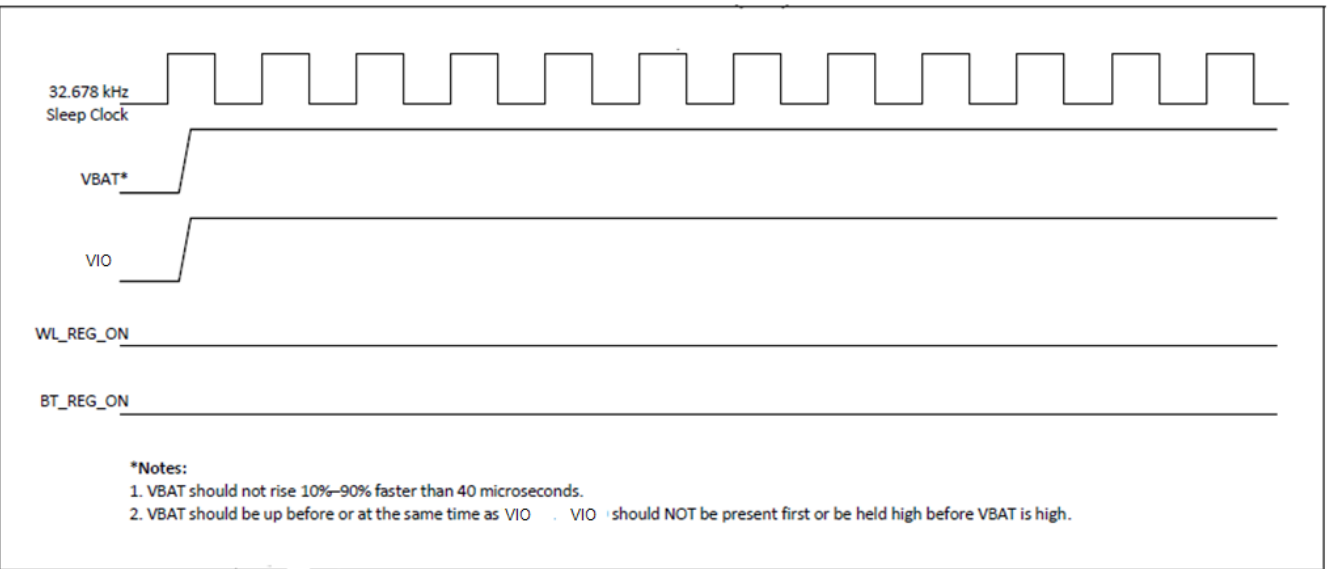
10.3 I/O characteristics

- Control signal timing diagrams

*WLAN =ON, Bluetooth = ON



*WLAN =OFF, Bluetooth = OFF



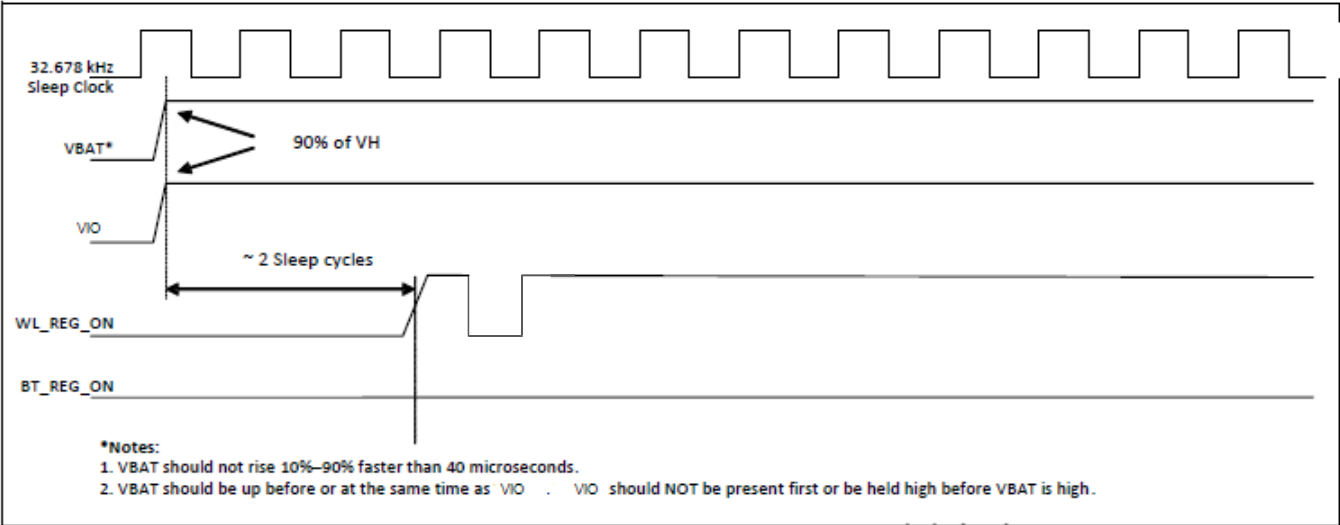
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10. Electrical Specification

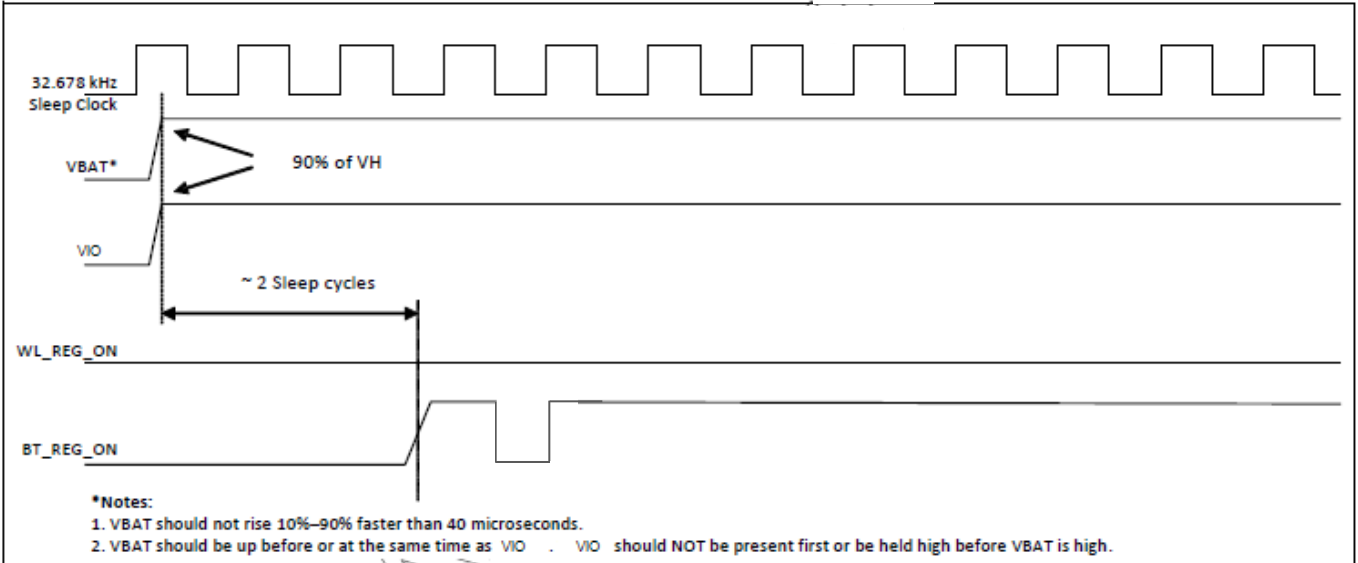
10.3 I/O characteristics

- Control signal timing diagrams

*WLAN =ON, Bluetooth = OFF



*WLAN =OFF, Bluetooth = ON

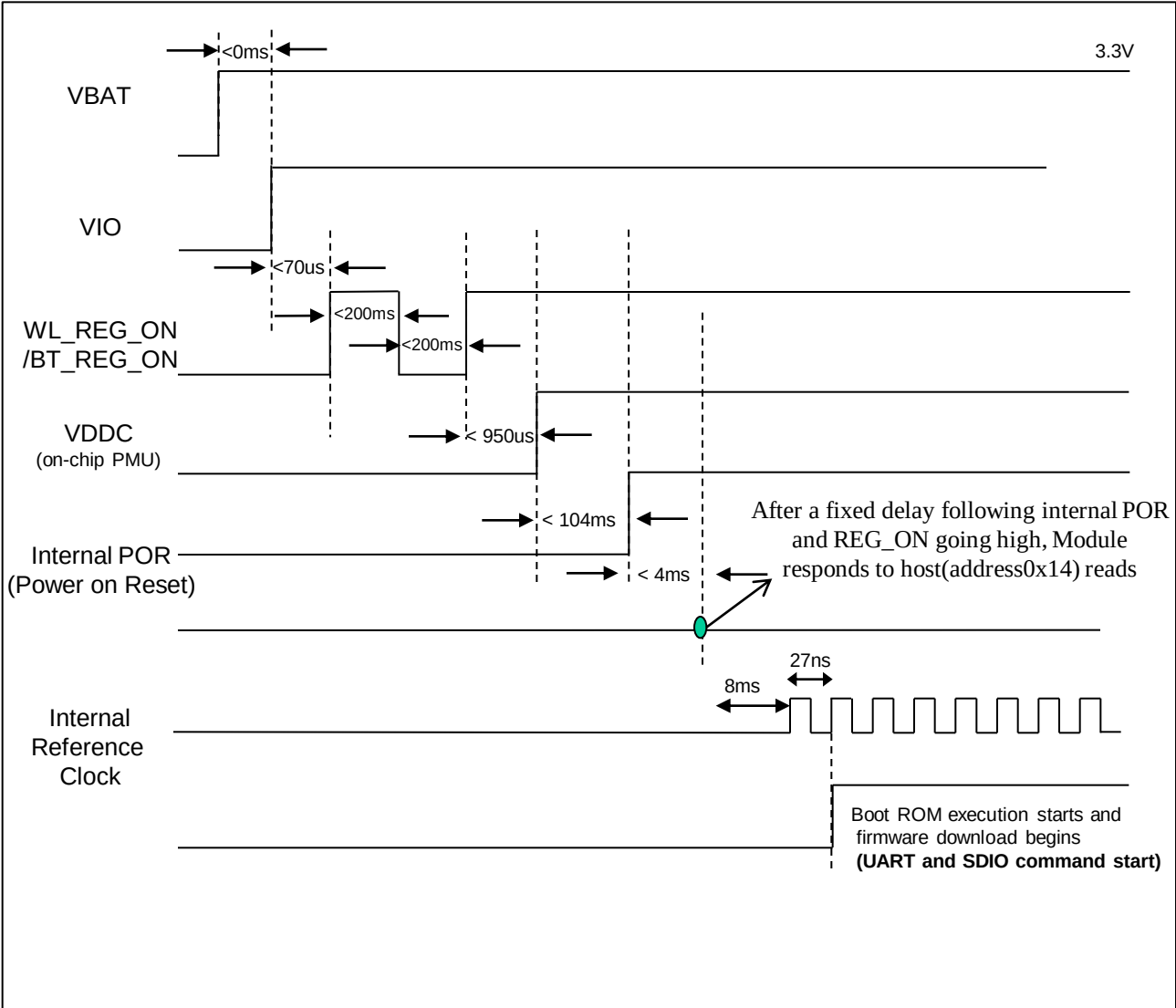


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10. Electrical Specification

10.3 I/O characteristics

- Boot-Up Sequence and Reset timing



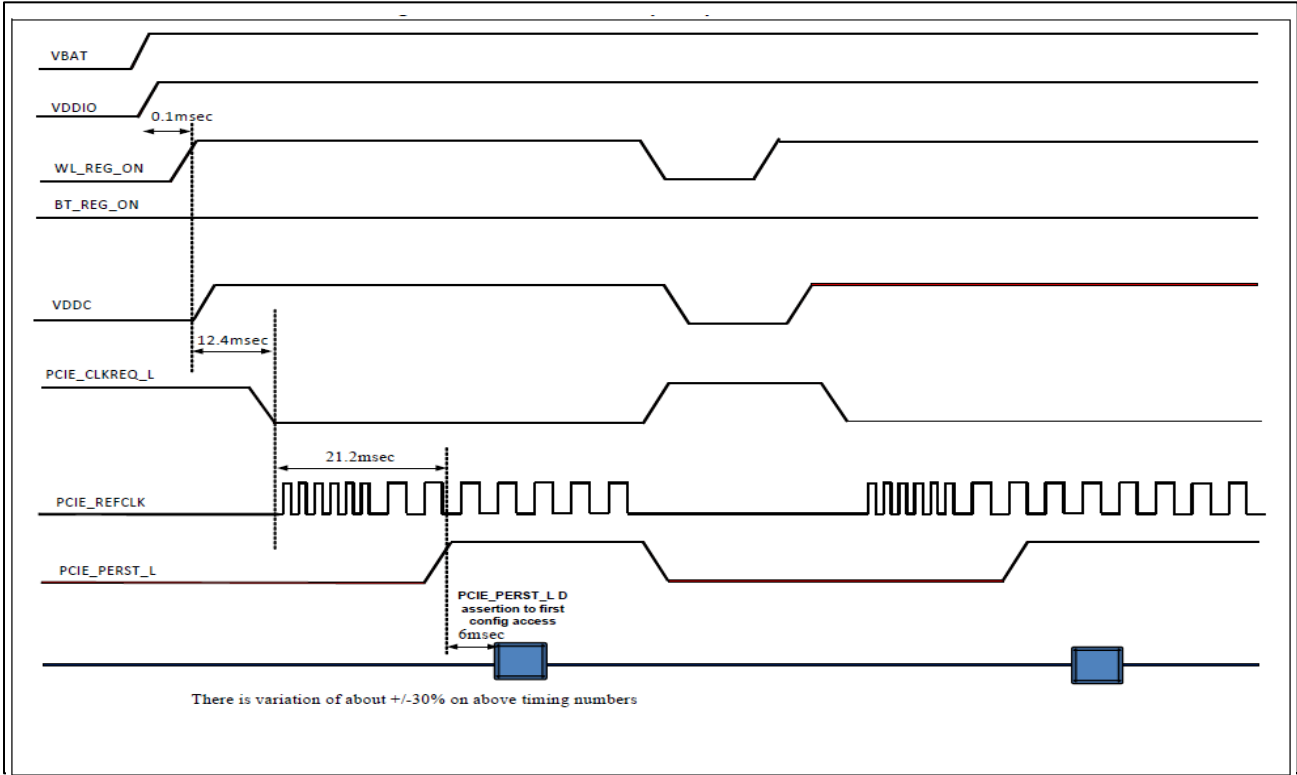
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10. Electrical Specification

10.3 I/O characteristics

 - PCIe Power-on Timing

*Timing Parameter WL_REG_ON)Perst# Deassertion – First Config Access)



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10. Electrical Specification

10.3 I/O characteristics

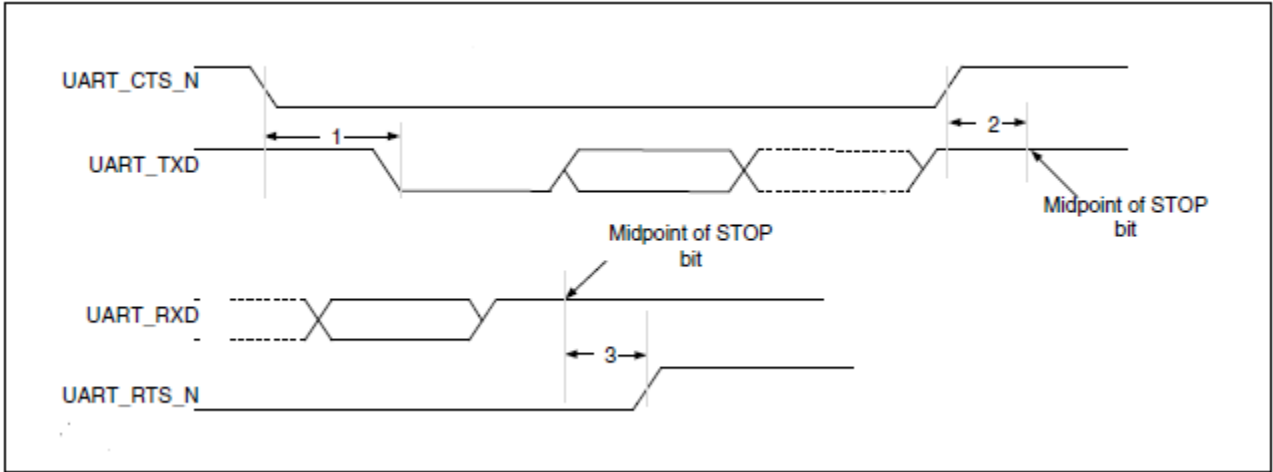
5) UART characteristics

-. UART physical interface is a standard, 4-wire interface(Rx, Tx, RTS, CTS) with adjustable baud rates from 9600 bps to 4Mbps. Normally the UART baud rate is set by a configuration record downloaded after reset or by automatic baud rate detection. LGIT Module supports HCI 3-wire transport(UART H5)

-. UART bus timing specifications

Item	Min	Typ	Max	Unit
Delay time, UART_CTS_N low to UART_TXD valid	-	-	1.5	Bit periods
Setup time, UART_CTS_N high before midpoint of stop bit	-	-	0.5	Bit periods
Delay time, midpoint of stop bit to UART RTS_N high	-	-	0.5	Bit periods
Baud rates range(default rate : 115200bps)	9600	-	4M	bps

-. UART bus timing



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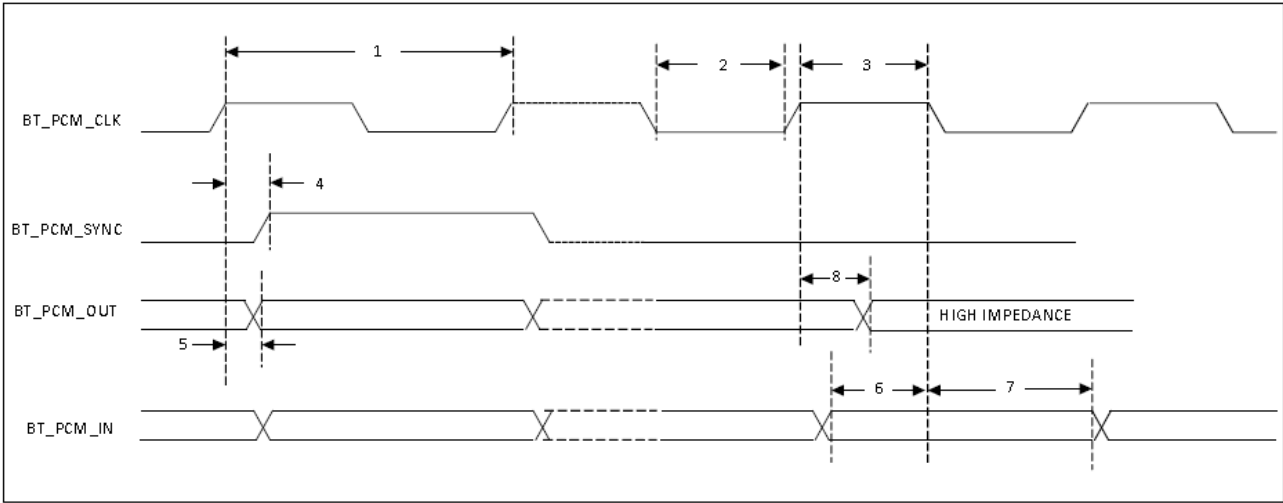
10. Electrical Specification

10.3 I/O characteristics

6) PCM characteristics

-. LGIT Module PCM interface can connect to linear PCM codec devices in master or slave mode. In master mode, the device generates the PCM_CLK and PCM_SYNC signals. In slave mode, these signals are provided by another master on the PCM interfaces as inputs to the devices

-. Short frame sync, master mode timing diagram



-. Short frame sync, master mode interface timing specifications

Item	Min	Typ	Max	Unit
PCM bit clock frequency	-	-	12	MHz
PCM bit clock LOW	41	-	-	ns
PCM bit clock HIGH	41	-	-	ns
PCM_SYNC delay	0	-	25	ns
PCM_OUT delay	-	-	25	ns
PCM_IN setup	8	-	-	ns
PCM_IN hold	8	-	-	ns
Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	-	-	25	ns

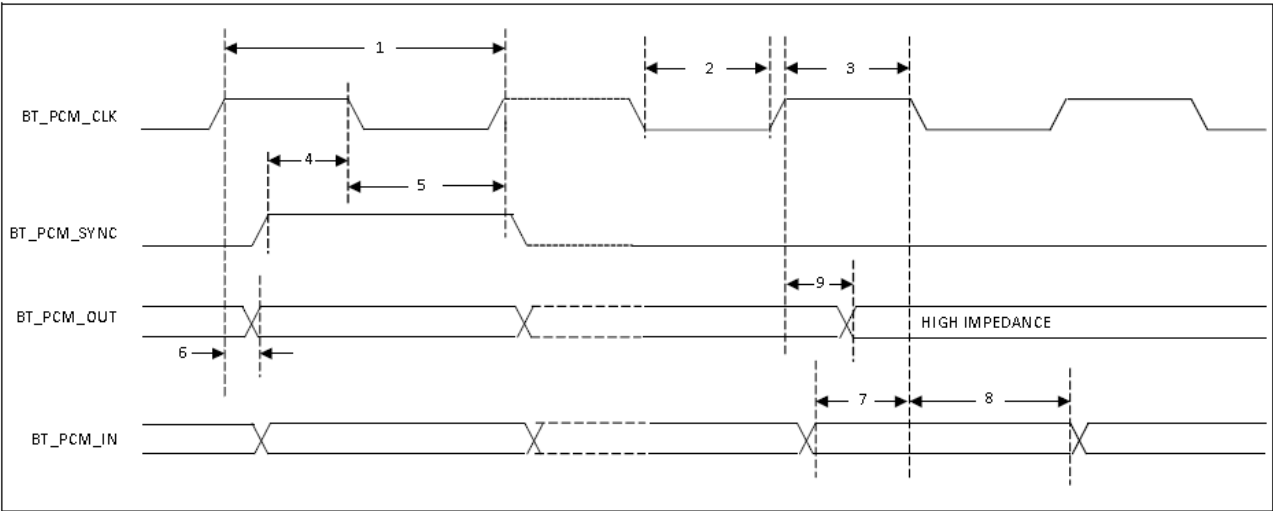
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10. Electrical Specification

10.3 I/O characteristics

6) PCM characteristics

-. Short frame sync, slave mode timing diagram



-. Short frame sync, slave mode interface timing specifications

Item	Min	Typ	Max	Unit
PCM bit clock frequency	-	-	12	MHz
PCM bit clock LOW	41	-	-	ns
PCM bit clock HIGH	41	-	-	ns
PCM_SYNC setup	8	-	-	ns
PCM_SYNC hold	8	-	-	ns
PCM_OUT delay	-	-	25	ns
PCM_IN setup	8	-	-	ns
PCM_IN hold	8	-	-	ns
Delay from rising edge of PCM_CLK during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

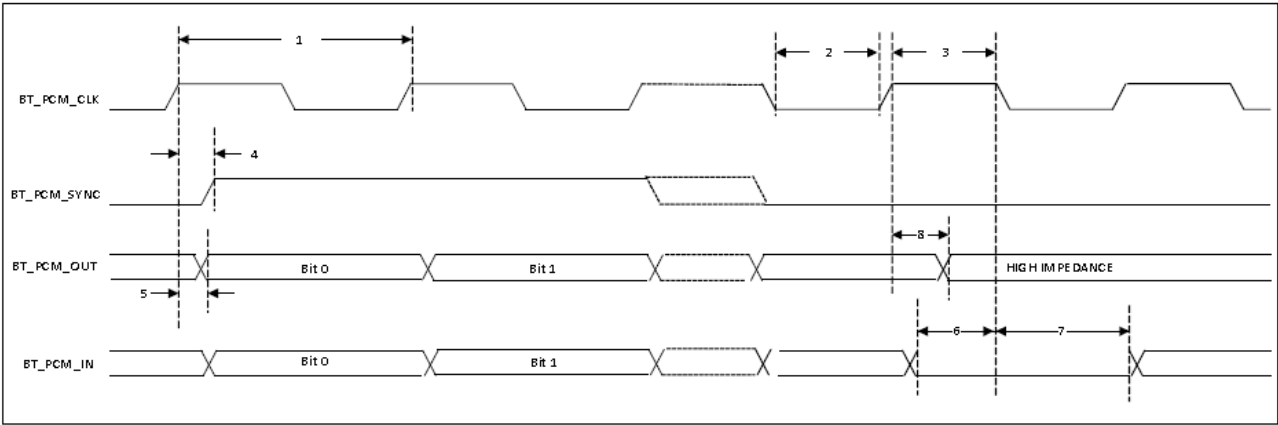
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10. Electrical Specification

10.3 I/O characteristics

6) PCM characteristics

- Long frame sync, master mode timing diagram



- Long frame sync, master mode interface timing specifications

Item	Min	Typ	Max	Unit
PCM bit clock frequency	-	-	12	MHz
PCM bit clock LOW	41	-	-	ns
PCM bit clock HIGH	41	-	-	ns
PCM_SYNC delay	0	-	25	ns
PCM_OUT delay	0	-	25	ns
PCM_IN setup	8	-	-	ns
PCM_IN hold	8	-	-	ns
Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

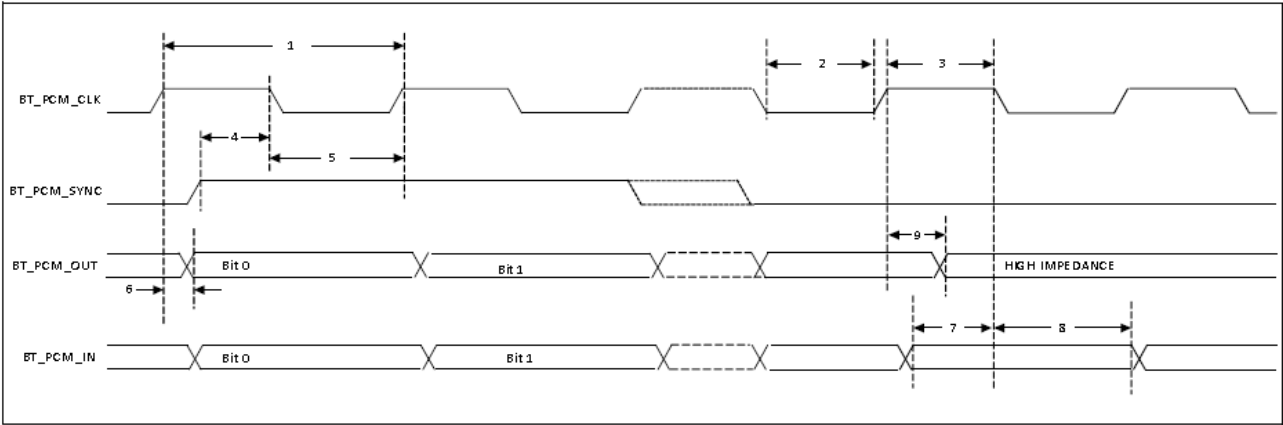
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10. Electrical Specification

10.3 I/O characteristics

6) PCM characteristics

- Long frame sync, slave mode timing diagram



- Long frame sync, slave mode interface timing specifications

Item	Min	Typ	Max	Unit
PCM bit clock frequency	-	-	12	MHz
PCM bit clock LOW	41	-	-	ns
PCM bit clock HIGH	41	-	-	ns
PCM_SYNC setup	8	-	-	ns
PCM_SYNC hold	8	-	-	ns
PCM_OUT Delay	0	-	25	ns
PCM_IN setup	8	-	-	ns
PCM_IN hold	8	-	-	ns
Delay from falling edge of PCM_BCLK or PCM_SYNC during last bit period to PCM_OUT becoming high impedance	0	-	25	ns

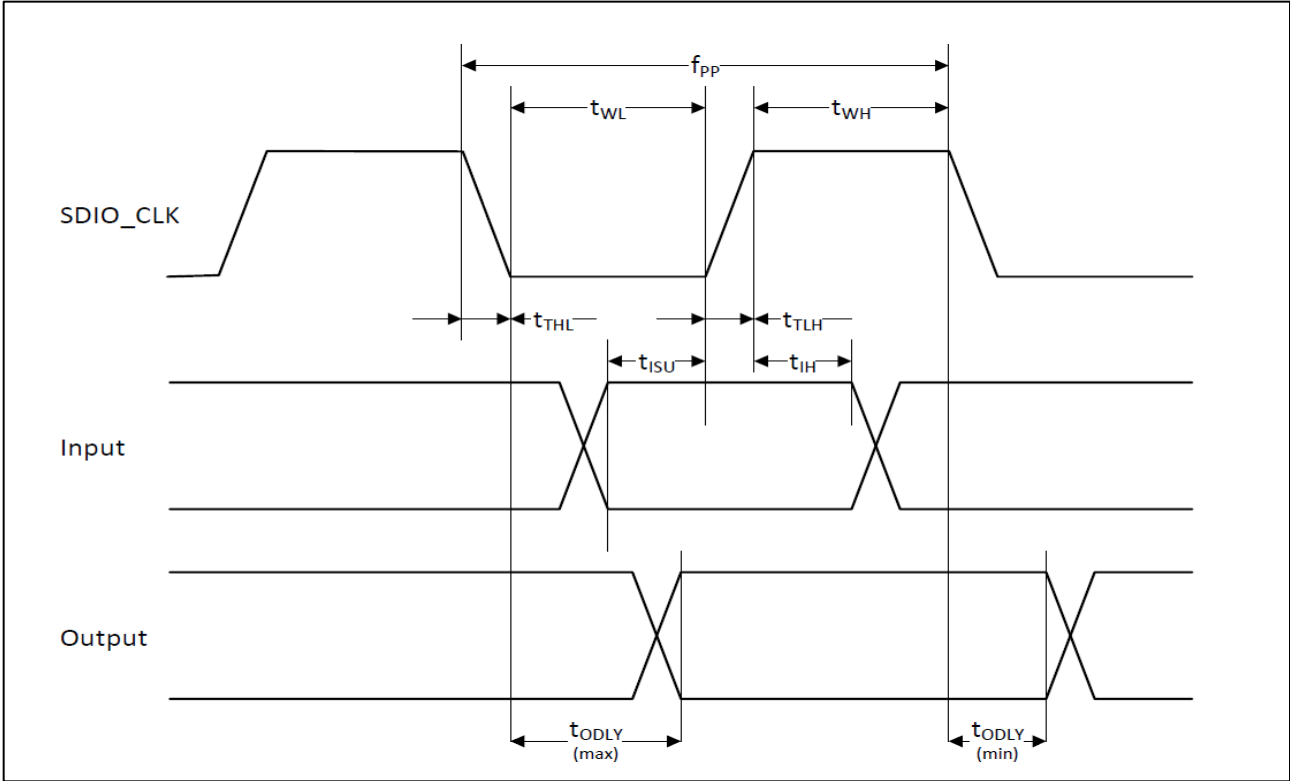
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10. Electrical Specification

10.3 I/O characteristics

7) SDIO characteristics

- RBHP-B213B support up to SDIO 3.0 specification
 - DS : Default speed(DS) up to 25MHz(3.3V signaling)
 - SDR12 : SDR up to 25MHz(1.8V signaling)
 - SDR25 : SDR up to 50MHz(1.8V signaling)
 - SDR50 : SDR up to 100MHz(1.8V signaling)
 - SDR104 : SDR up to 208MHz(1.8V signaling)
 - DDR50 : DDR up to 50MHz(1.8V signaling)
- SDIO default mode timing(min.Vih = 0.7 X VIO, max.Vil = 0.2 x VIO)



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	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO.
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	1.6	2017. 09.06.	Rev1.6 Released				

10. Electrical Specification**10.3 I/O characteristics**

-. SDIO default mode bus timing parameters

Item	Symbol	Min	Typ	Max	Unit
SDIO CLK					
Freq.(data transfer mode)	fPP	0	-	25	MHz
Freq.(identification mode)	fOD	0		400	KHz
Clock low time	tWL	10	-	-	ns
Clock high time	tWH	10	-	-	ns
Clock rise time	tTLH	-	-	10	ns
Clock low time	tTHL	-	-	10	ns
Input : CMD, DAT(referenced to CLK)					
Input setup time	tISU	5	-	-	ns
Input hold time	tIH	5	-	-	ns
Output : CMD, DAT(referenced to CLK)					
Output delay time-data transfer mode	tODLY	0	-	14	ns
Output delay time-data identification mode	tODLY	0	-	50	ns

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LG Innotek Co., Ltd

DSGD

CHKD

APPD

RBHP-B213B

DOCUMENT NO.

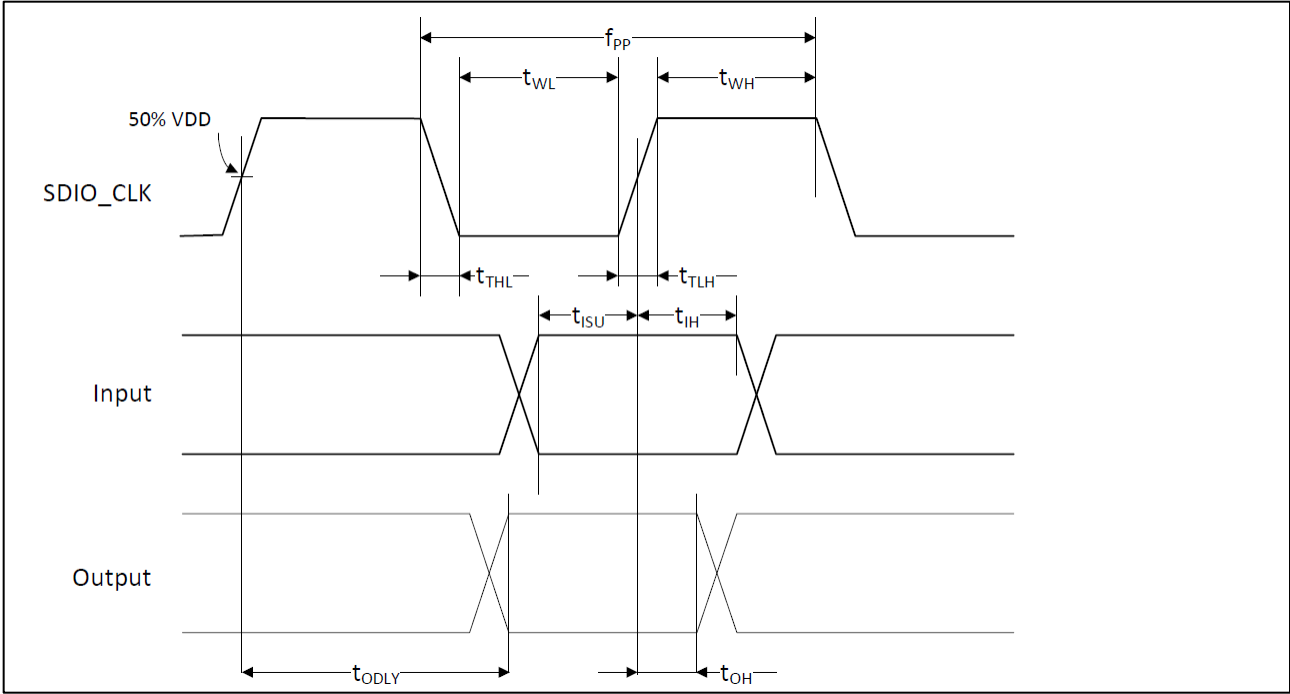
6-3



10. Electrical Specification

10.3 I/O characteristics

-. SDIO high speed mode bus timing(min.Vih = 0.7 X VIO, max.Vil = 0.2 x VIO)



-. SDIO high speed mode bus timing parameters

Item	Symbol	Min	Typ	Max	Unit
SDIO CLK					
Freq.(data transfer mode)	fPP	0	-	50	MHz
Freq.(identification mode)	fOD	0	-	400	KHz
Clock low time	tWL	7	-	-	ns
Clock high time	tWH	7	-	-	ns
Clock rise time	tTLH	-	-	3	ns
Clock low time	tTHL	-	-	3	ns

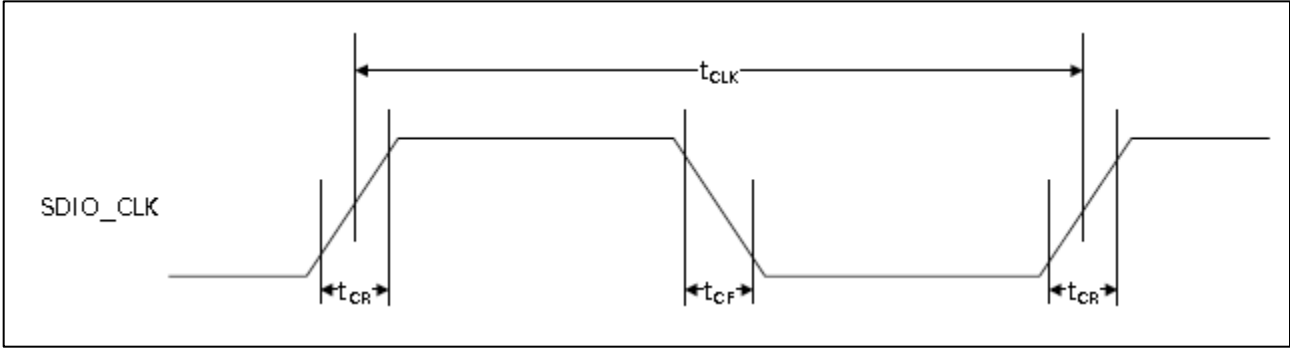
REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213B
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10. Electrical Specification

10.3 I/O characteristics

Item	Symbol	Min	Typ	Max	Unit
Input : CMD, DAT(referenced to CLK)					
Input setup time	tISU	6	-	-	ns
Input hold time	tIH	2	-	-	ns
Output : CMD, DAT(referenced to CLK)					
Output delay time-data transfer mode	tODLY	-	-	14	ns
Output delay time-data identification mode	tODLY	2.5	-	-	ns
Total system capacitance(each line)	CL	-	-	40	pF

- . SDIO SDR mode clock timing



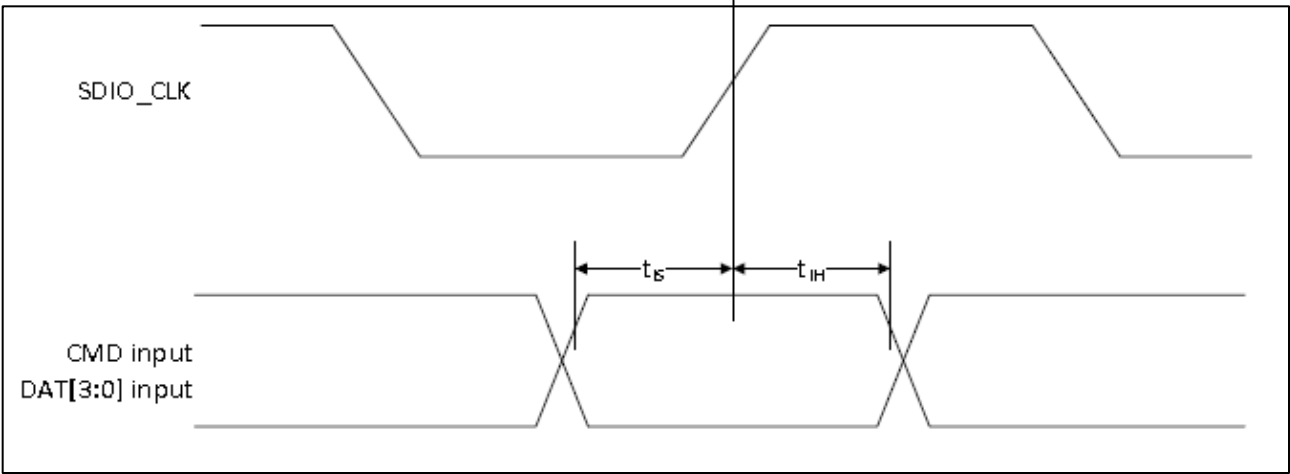
Item	Symbol	Min	Max	Unit	Comments
-	t_{CLK}	40	50	ns	SDR12 mode
		20	400	ns	SDR25 mode
		10	-	ns	SDR50 mode
		4.8	-	ns	SDR104 mode
-	t_{CR}, t_{CF}	-	0.2 $\times t_{CLK}$	ns	$t_{CR}, t_{CF} < 2.0\text{ns(max)}@100\text{MHz}$ $C_{CARD} = 10\text{pF}$ $t_{CR}, t_{CF} < 0.96\text{ns(max)}@208\text{MHz}$ $C_{CARD} = 10\text{pF}$
Clock duty	-	30	70	%	-

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10. Electrical Specification

10.3 I/O characteristics

-. SDIO SDR mode Device input timing



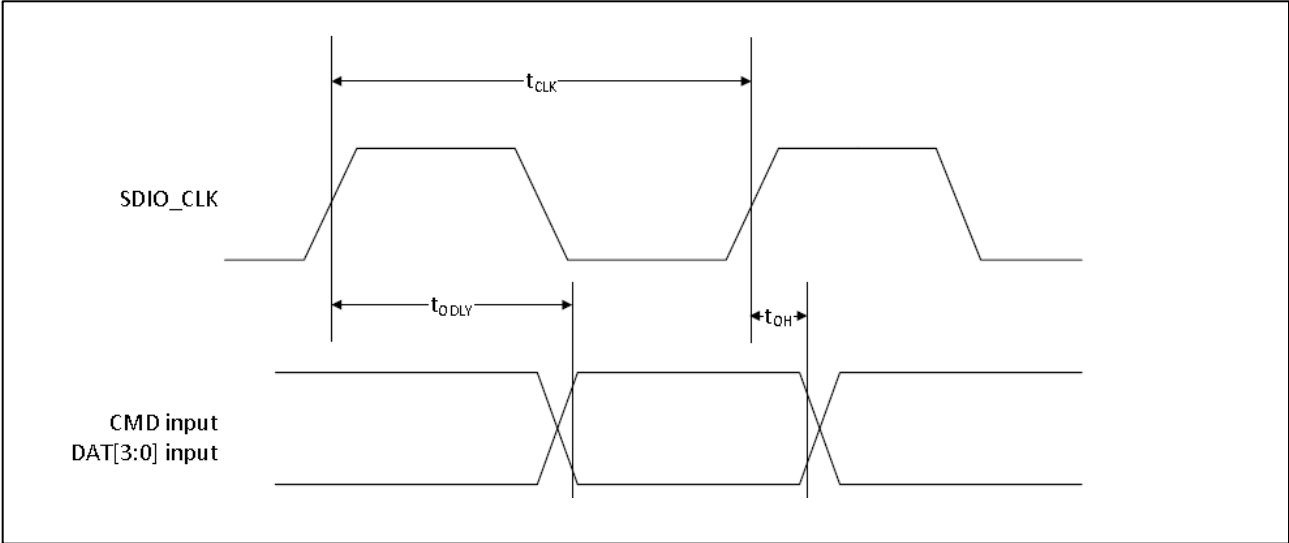
Item	Symbol	Min	Max	Unit	Comments
SDR104 Mode	t_{IS}	1.4	-	ns	$C_{CARD} = 10pF, VCT=0.975V$
	t_{IH}	0.8	-	ns	$C_{CARD} = 5pF, VCT=0.975V$
SDR50 Mode	t_{IS}	3	-	ns	$C_{CARD} = 10pF, VCT=0.975V$
	t_{IH}	0.8	-	ns	$C_{CARD} = 10pF, VCT=0.975V$

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10. Electrical Specification

10.3 I/O characteristics

-. SDIO SDR mode Device output timing(SDR modes up to 100MHz)



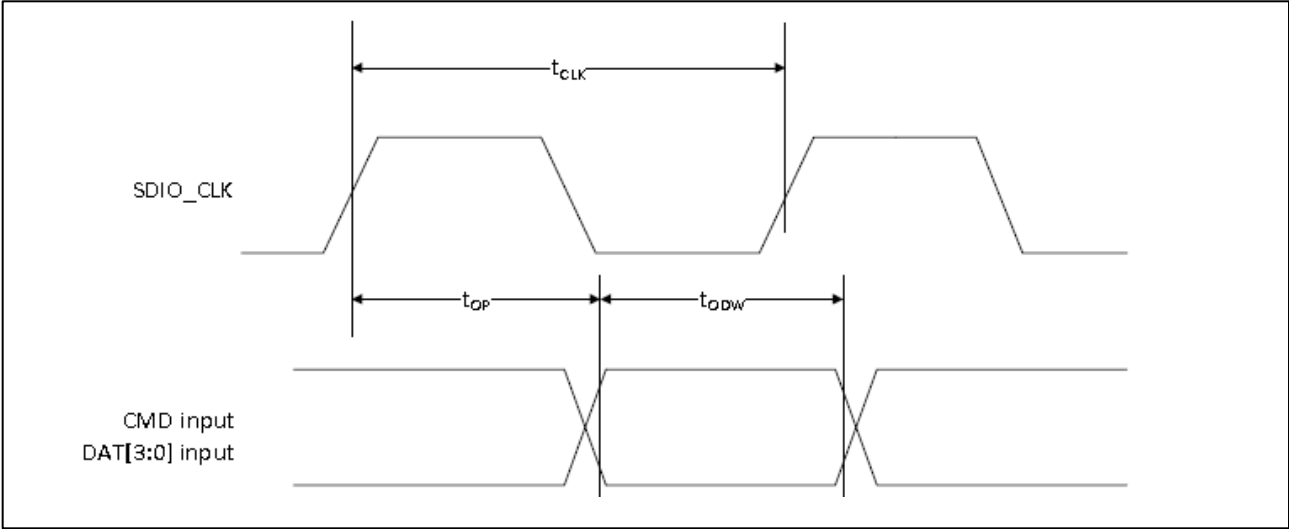
Symbol	Min	Max	Unit	Comments
t_{ODLY}	-	7.5	ns	$t_{CLK} > 10\text{ns}$, $C_L = 30\text{pF}$ using driver type B for SDR50
t_{ODLY}	-	14.0	ns	$t_{CLK} > 20\text{ns}$, $C_L = 40\text{pF}$ using for SDR12, SDR25
t_{OH}	1.5	-	ns	Hold time at the t_{ODLY} (min) $C_L = 15\text{pF}$

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10. Electrical Specification

10.3 I/O characteristics

-. SDIO SDR mode Device output timing(SDR modes 100MHz to 208MHz)



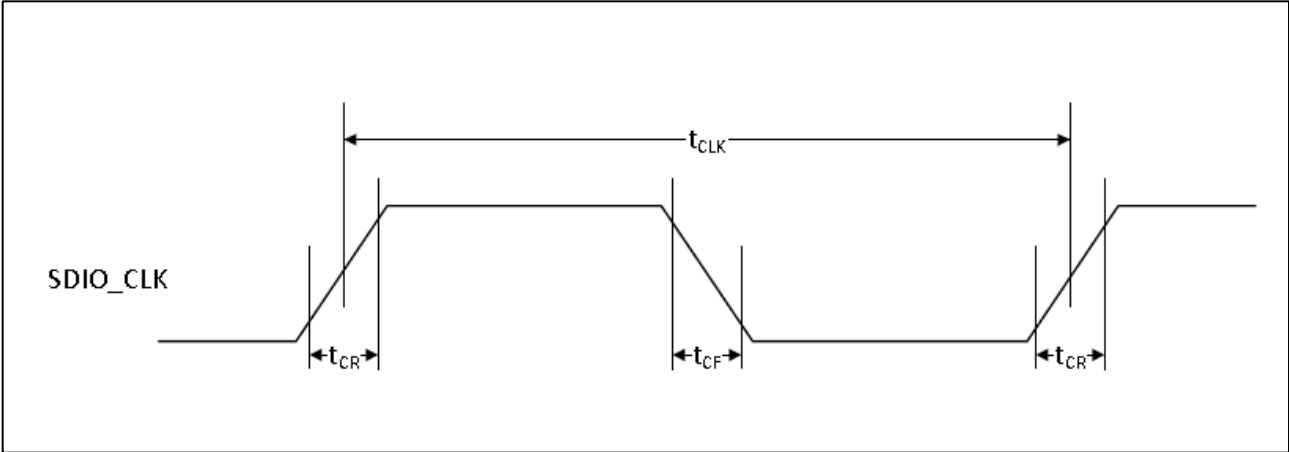
Symbol	Min	Max	Unit	Comments
t_{OP}	0	2	UI	Card output phase
Δt_{OP}	-350	+1550	Ps	Delay variation due to temp. change after tuning
Δt_{ODW}	0.60	-	UI	$\Delta t_{ODW} = 2.88ns @208MHz$

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10. Electrical Specification

10.3 I/O characteristics

-. SDIO DDR50 mode Clock timing



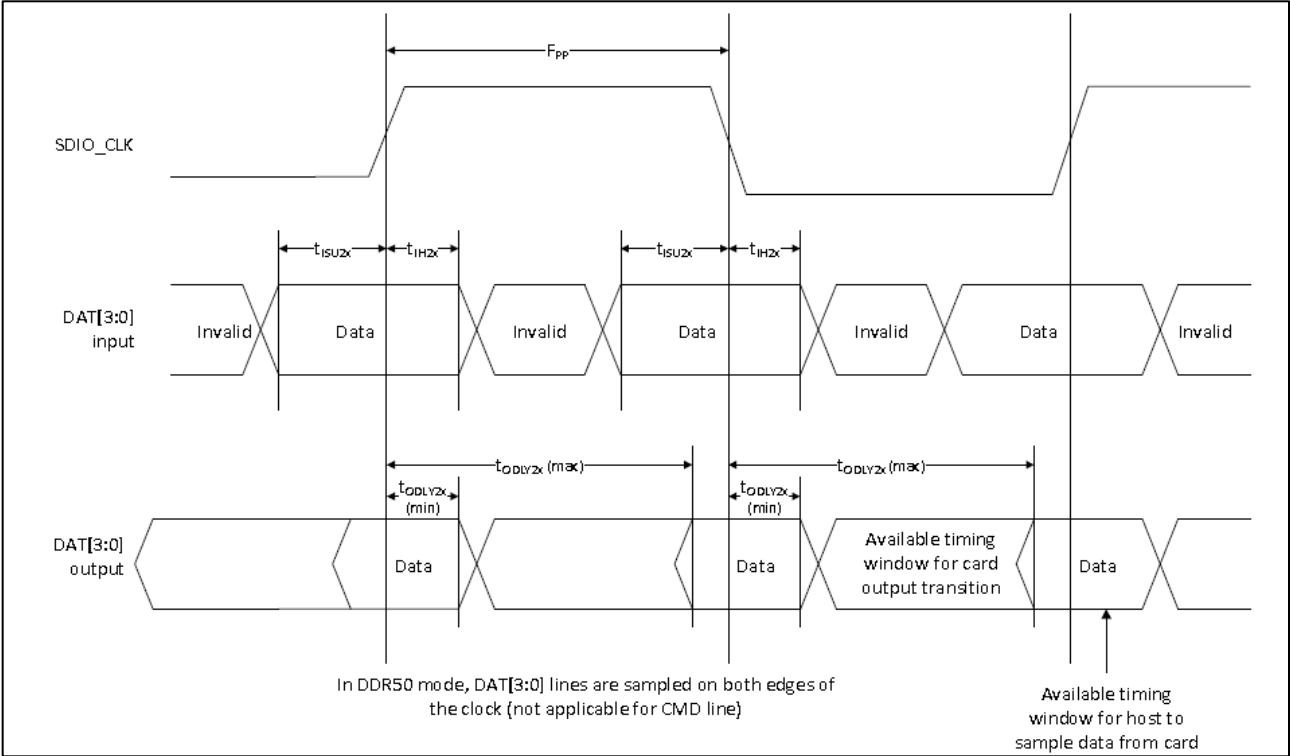
Item	Symbol	Min	Max	Unit	Comments
-	t_{CLK}	20	-	ns	DDR50 mode
-	t_{CR}, t_{CF}	-	$0.2 \times t_{CLK}$	ns	$t_{CR}, t_{CF} < 4.0\text{ns(max)}@50\text{MHz}$ $C_{CARD} = 10\text{pF}$
Clock duty	-	45	55	%	-

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10. Electrical Specification

10.3 I/O characteristics

- SDIO DDR50 mode Data timing



	Item	Symbol	Min	Max	Unit	Comments
Input CMD	Input Setup time	t_{ISU}	6	-	ns	$C_{CARD} < 10pF(1CARD)$
	Input Hold time	t_{IH}	0.8	-	ns	$C_{CARD} < 10pF(1CARD)$
Output CMD	Output delay time	t_{ODLY}	-	13.7	ns	$C_{CARD} < 30pF(1CARD)$
	Output hold time	t_{OH}	1.5	-	Ns	$C_{CARD} < 15pF(1CARD)$
Input DAT	Input Setup time	t_{ISU2X}	3	-	ns	$C_{CARD} < 10pF(1CARD)$
	Input Hold time	t_{IH2X}	0.8	-	ns	$C_{CARD} < 10pF(1CARD)$
Output DAT	Output delay time	t_{ODLY2X}		7.5	ns	$C_{CARD} < 25pF(1CARD)$
	Output holdtime	t_{ODLY2X}	1.5	-	Ns	$C_{CARD} < 15pF(1CARD)$

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10. Electrical Specification**10.3 I/O characteristics**

8) PCI Express characteristics

△_s -. PCI Express Reference CLK

Parameters	Symbol	Comments	Min.	Typ.	Max	Unit
Baud rate	BPS	-	-	2.5	-	Gbaud
Reference clock amplitude	Vref	LVPECL, AC coupled	1.0	-	-	V

-. PCI Express Receiver

Parameters	Symbol	Comments	Min.	Typ.	Max	Unit
Differential termination	ZRX-DIFF-DC	Differential termination	80	100	120	Ω
DC impedance	ZRX-DC	DC common-mode impedance	40	50	60	Ω
Powered down termination(POS)	ZRX-HIGH-IMP-DC-POS	Power-down or RESET high Impedance	100k	-	-	Ω
Powered down termination(NEG)	ZRX-HIGH-IMP-DC-NEG	Power-down or RESET high Impedance	1k	-	-	Ω
Input voltage	VRX-DIFFp-p	AC coupled, differential(p-p)	175	-	-	mV
Jitter tolerance	TRX-EYE	Minimum receiver eye width	0.4	-	-	UI
Differential return loss	RLRX-DIFF	Differential return loss	10.0	-	-	dB
Common-mode return loss	RLRX-CM	Common-mode return loss	6	-	-	dB
Unexpected electrical idle enter detect threshold integration time	RX-IDEL-DET-DIFFENTERTIME	An unexpected electrical idle must be recognized no longer than this time to signal an unexpected idle condition.	-	-	10.0	ms
Signal detect threshold	VRX-IDLE-DET-DIFFpp	Electrical idle detect threshold	65.0	-	175	mV

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10. Electrical Specification**10.3 I/O characteristics****8) PCI Express characteristics****- . PCI Express Transmitter**

Parameters	Symbol	Comments	Min.	Typ.	Max	Unit
Output voltage	VTX-DIFFp-p	Differential p-p, programmable in 16 steps	0.8	-	1200	mV
Output voltage rise time	VTX-RISE	20% to 80%	0.125 (2.5 GT/s) 0.15 (5 GT/s)	-	-	UI
Output voltage fall time	VTX-FALL	80% to 20%	0.125 (2.5 GT/s) 0.15 (5 GT/s)	-	-	UI
RX detection voltage swing	VTX-RCV-DETECT	The amount of voltage change allowed during receiver detection.	-	-	600	mV
TX AC peak common-mode voltage(5 GT/s)	VTX-CM-AC-PP	TX AC common mode voltage (5 GT/s)	-	-	100	mV
TX AC peak commonmode voltage(2.5 GT/s)	VTX-CM-AC-P	TX AC common mode voltage (2.5 GT/s)	-	-	20.0	mV
Absolute delta of DC common-model voltage during L0 and electrical idle	VTX-CM-DC-ACTIVE-IDLE-DELTA	Absolute delta of DC common-model voltage during L0 and electrical idle.	0	-	100	mV
Absolute delta of DC common-model voltage between D+ and D-	VTX-CM-DC-LINE-DELTA	DC offset between D+ and D-	0	-	25.0	mV
Electrical idle differential peak output voltage	VTX-IDLE-DIFF-AC-p	Peak-to-peak voltage	0	-	20.0	mV

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10. Electrical Specification

10.3 I/O characteristics

8) PCI Express characteristics

Parameters	Symbol	Comments	Min.	Typ.	Max	Unit
TX short circuit current	ITX-SHORT	Current limit when TX output is shorted to ground.	-	-	90.0	mA
DC differential TX termination	ZTX-DIFF-DC	Low impedance defined during signaling (parameter is captured for 5.0 GHz by RLTX-DIFF)	80.0	-	120	Ω
Differential return loss	RLTX-DIFF	Differential return loss	10 (min) for 0.05: 1.25 GHz	-	-	dB
Common-mode return loss	RLTX-CM	Common-mode return loss	6.0	-	-	dB
TX eye width	TTX-EYE	Minimum TX eye width	0.75	-	-	UI

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10. Electrical Specification**10.4 Operating Conditions****1) Recommended operation conditions**

Parameter	Min	Max	Unit
Operating Temperature Range	-40	+85	°C
Supply Voltage : VBATT (3.3V)	3.0 ¹⁾	3.6	V
Supply Voltage : VIO (1.8V)	1.62	1.98	V

2) Current consumption

Parameter	Average	Unit
Stand-by (BT & WLAN)	10	mA
WLAN Continuous Rx	180	mA
WLAN Continuous Tx ²⁾	420	mA
Bluetooth Connection	20	mA

3) ESD Precautions

RBHP-B213B is classified as a JESD22-A114(HBM) class 1C(1kV) product. Apply ESD static handling precautions during manufacturing.

4) External 32.768KHz low-power oscillator(LPO)

External 32.768KHz precision oscillator is required.

Parameter	LPO clock	Unit
Nominal input frequency	32.768	KHz
Frequency accuracy	±200	ppm
Single input amplitude	200 ~ 1800	mV, p-p
Signal type	Square-wave or sine-wave	

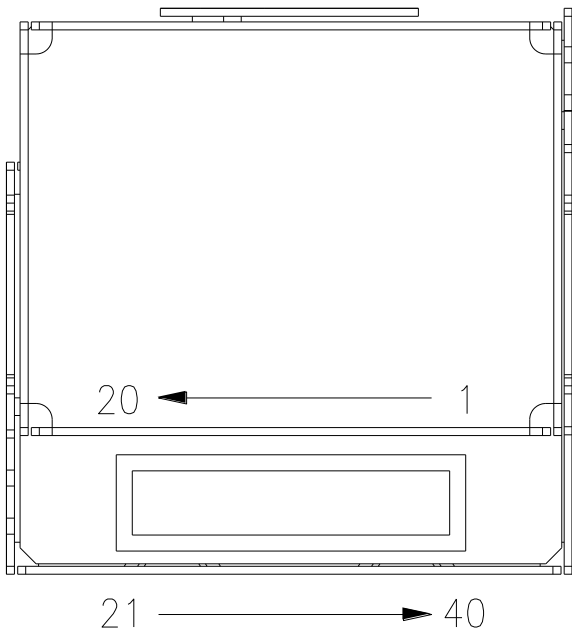
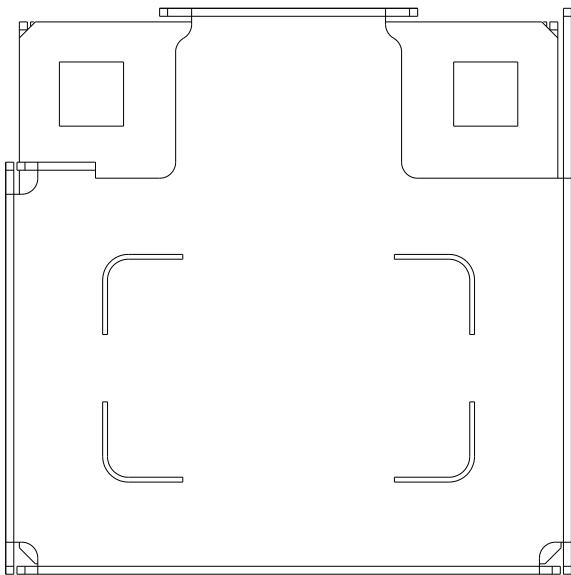
¹⁾ The BCM88359 is functional across this range of voltages.

Optimal RF performance specified in the RBHP-B213B approval sheet, however , is guaranteed only for min. 3.2V including VBAT ripple

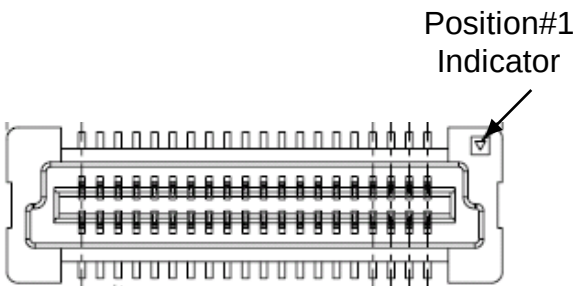
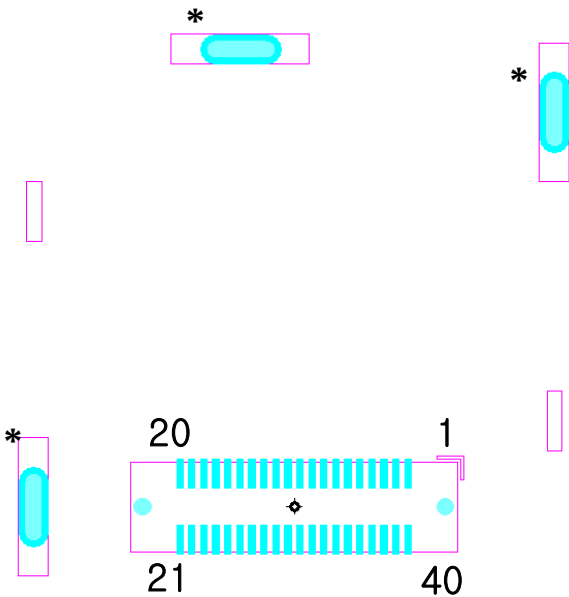
²⁾ MIMO condition

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11. Pin Configuration



< Opposite (Host) Pin Map (Top View) >

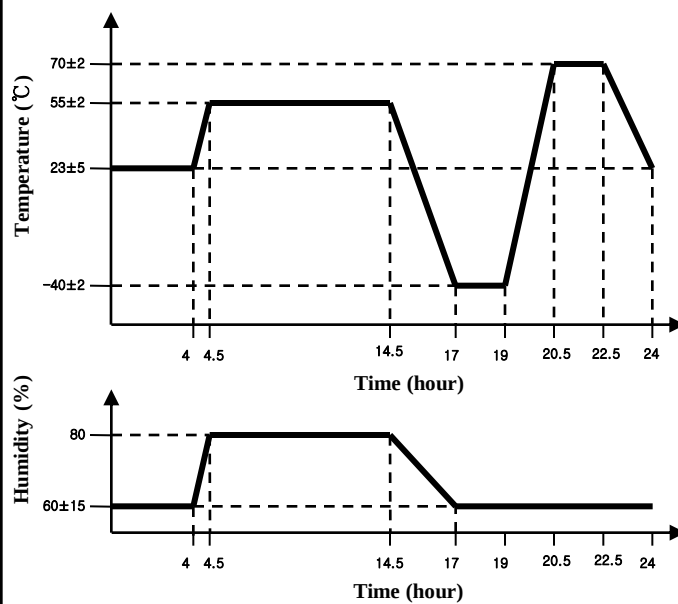


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12. Reliability Test Conditions

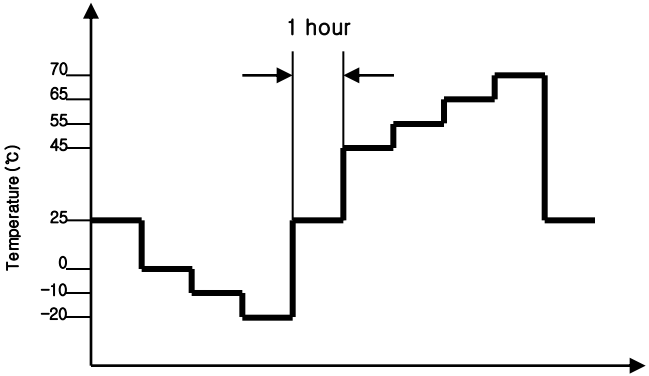
12.1 Items related with Non-Solderability(ES96100-02)

NO	ITEM	Condition	Characteristics
9	Against flux	Initial value measured at standard test condition. Test Conditions -Soak 5 seconds in a I.P.A and let waiting condition for 35 seconds. After then test.	- No electrical problem
10	Temperature and Humidity Cycling	Initial value measured at standard test condition. Test Conditions: 3 cycle condition.  In standard test condition, take measurements 2hr after.	- No electrical problem
11	Dew Condensation test	Initial value measured at standard test condition. Test Conditions: 3 cycle condition. -30℃ (1 Hr) -30℃ → 25℃, 90%RH (within 1 min) 25℃, 90%RH (1 Hr) - On : 15 min / Off : 15 min In standard test condition, take measurements 2hr after.	- No electrical problem
12	High humidity and Temp. load test	Initial value measured at standard test condition. Test Conditions: 60℃, 80%, 48hr In standard test condition, take measurements within 3hr.	- No electrical problem
13	Dust	Initial value measured at standard test condition. Test Conditions: JIS Z 8901, 5kg In standard test condition, take measurements within 3hr.	- No electrical problem

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12. Reliability Test Conditions

12.1 Items related with Non-Solderability(ES96100-02)

NO	ITEM	Condition	Characteristics
14	Temperature Drift Test	Initial value measured at standard test condition. <u>Test Conditions:</u>  Take measurements sustaining each temperature.	- No electrical problem
15	Dust	Initial value measured at standard test condition. <u>Test Conditions:</u> JIS Z 8901, 5kg In standard test condition, take measurements within 3hr.	- No electrical problem
16	Complex Environment	Initial value measured at standard test condition. <u>Test Conditions:</u> -20℃~60℃, 10~50Hz, 1G In standard test condition, take measurements within 3hr.	- No electrical problem
17	Operation Durability	Initial value measured at standard test condition. <u>Test Conditions:</u> 25±5℃ 60±20%, 1500Hrs In standard test condition, take measurements within 3hr.	- No electrical problem
18	ESD	Initial value measured at standard test condition. <u>Test Conditions:</u> ±1KV 5time 150pF/330Ω In standard test condition, take measurements within 3hr.	- No electrical problem

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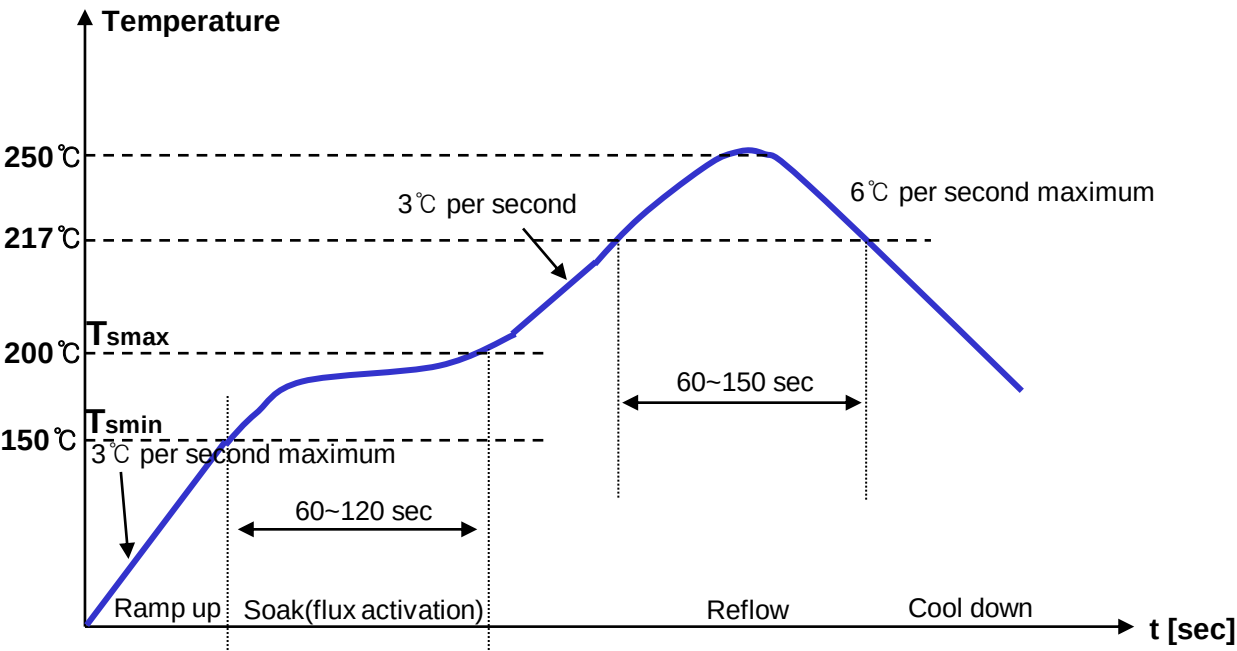
12. Reliability Test Conditions

12.2 Items related with Solderability(ES90000-04)

NO	ITEM	Condition	Characteristics
1	High Temperature and Humidity Load Test	Initial value measured at standard test condition. Test Conditions: 85±3℃, 85±5%RH, 1000hr In standard test condition, take measurements within 3hr.	- Whisker, No electrical problem
2	Thermal Shock	Initial value measured at standard test condition. Test Conditions: -40℃ (10 min) -40℃ → 85℃, (within 10 min) 85℃ (10 min) 85℃ → -40℃, (within 10 min) - Test cycle : 1000 cycles - Test Times : 667 Hr In standard test condition, take measurements within 3Hr.	- No Whisker, Bond strength, section inspection, electrical problem
3	Power and Temperature Cycling	Initial value measured at standard test condition. Test Conditions: 100 cycle condition - Test Times : 100 Hr Supply Voltage Condition: standard ± 5% Power Condition: -35℃ (10 min) -35℃ → 75℃, (Temp. variation velocity : over 6℃/min) 75℃ (10 min) 75℃ → -35℃, (Temp. variation velocity : over 6℃/min) - On: 300 sec , Off: 300 sec In standard test condition, take measurements within 3Hr	
4	Random Vibration test With operation	Initial value measured at standard test condition. Test Conditions: - Frequency : 10 ~ 1000Hz - Power spectrum density : 0.0296 ~ 9.63 (m/s ³) ² /Hz - Direction : X/Y/Z, 8hr/Axis In standard test condition, take measurements 2hr after.	

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15. Reflow Profile

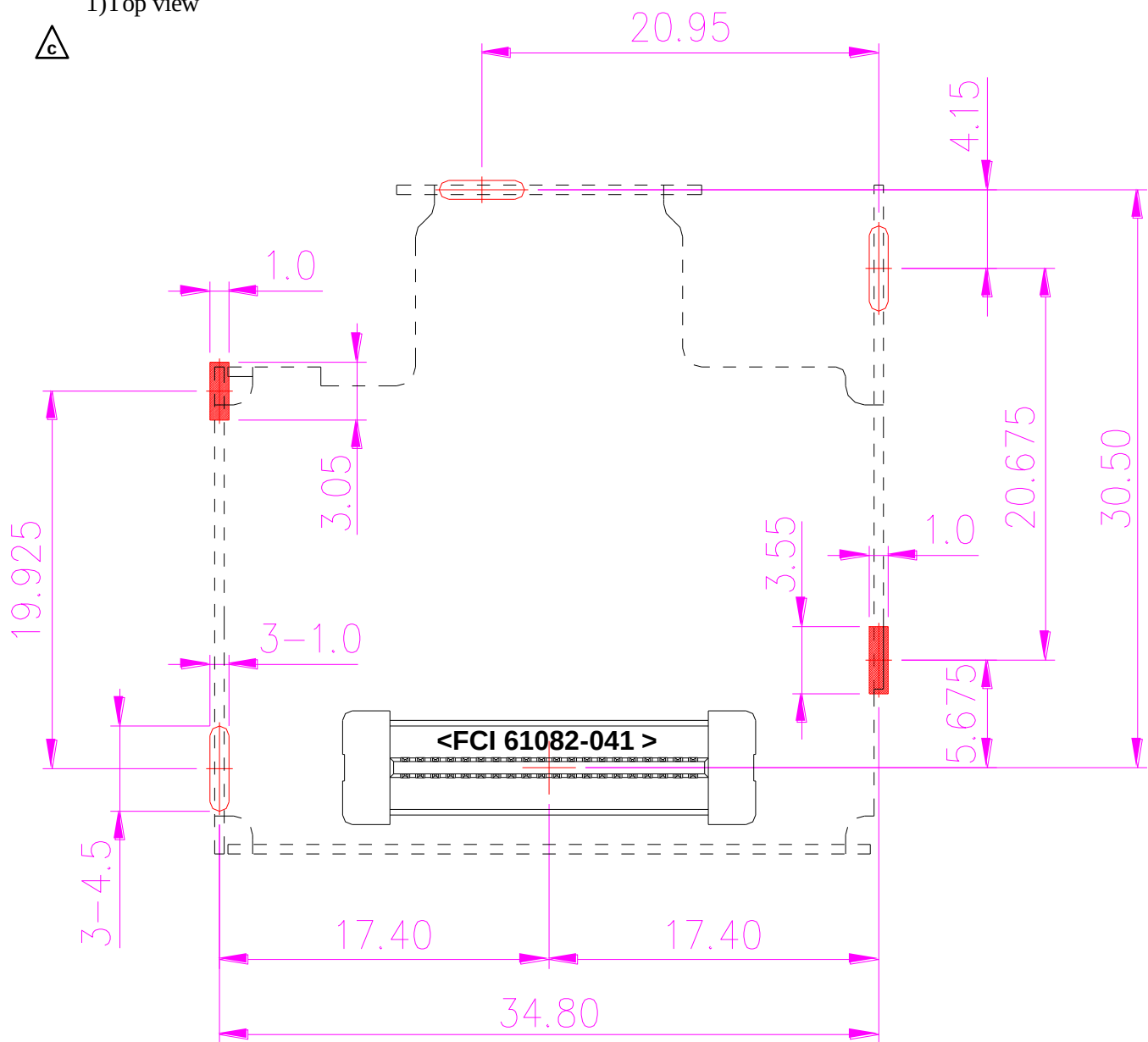


Profile Feature	Pb-free Assembly
Initial ramp-up rate	3°C per second maximum
Preheat	
Temperature minimum(Tsmin)	150°C
Temperature maximum(Tsmax)	200°C
Time(minimum to maximum)	60-120s
Ramp-up rate Tsmax to TL	3°C per second maximum
Liquidus Temperature(TL)	217°C
Time above TL	60-150s
Peak temperature	250°C maximum
Time within 5°C of actual peak	10s
Ramp-down rate	6°C per second maximum

R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213B
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

16. Recommended Land Pattern

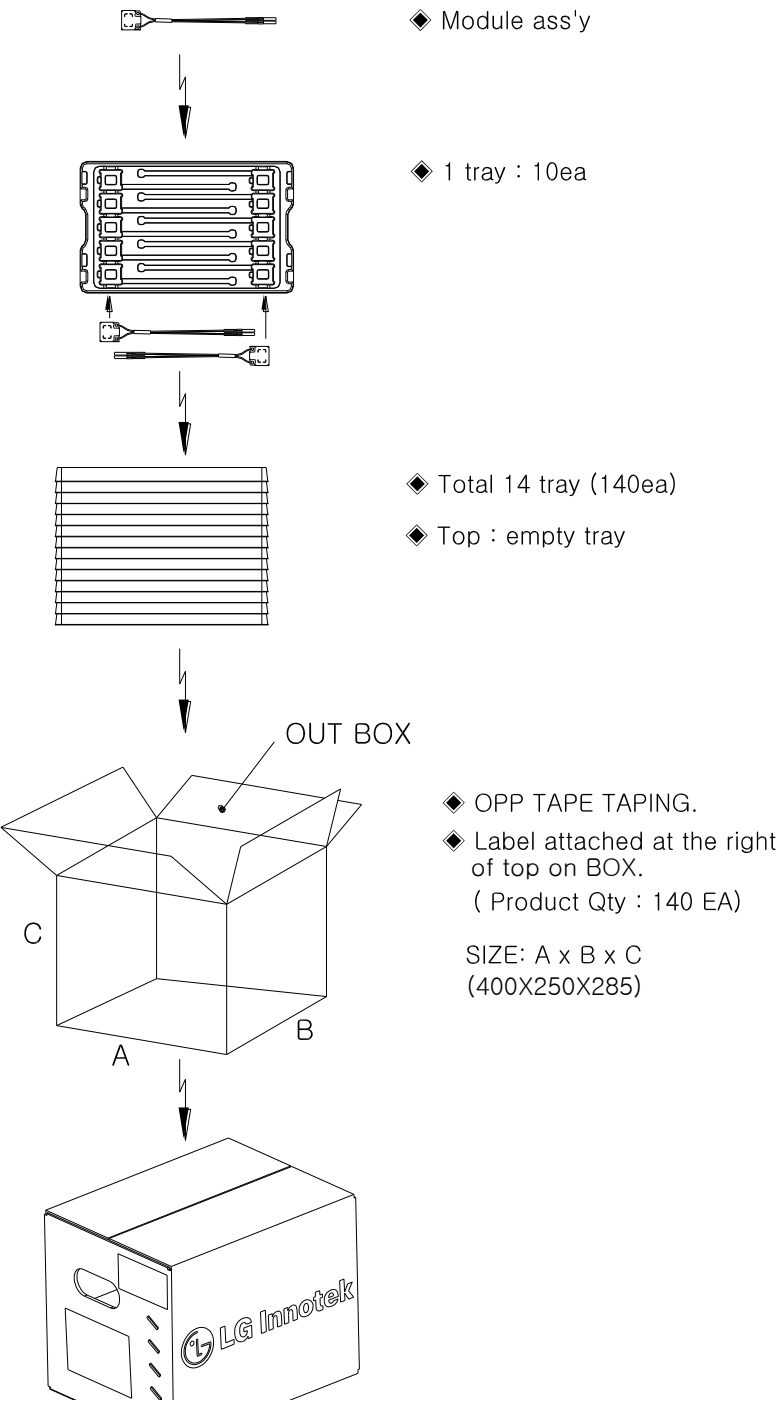
1)Top view



<Unit : mm>

REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213B
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

17. Packing Information



REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213B
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

(CUSTOMER P/NO : **EAT63433501**)

17. Packing Information

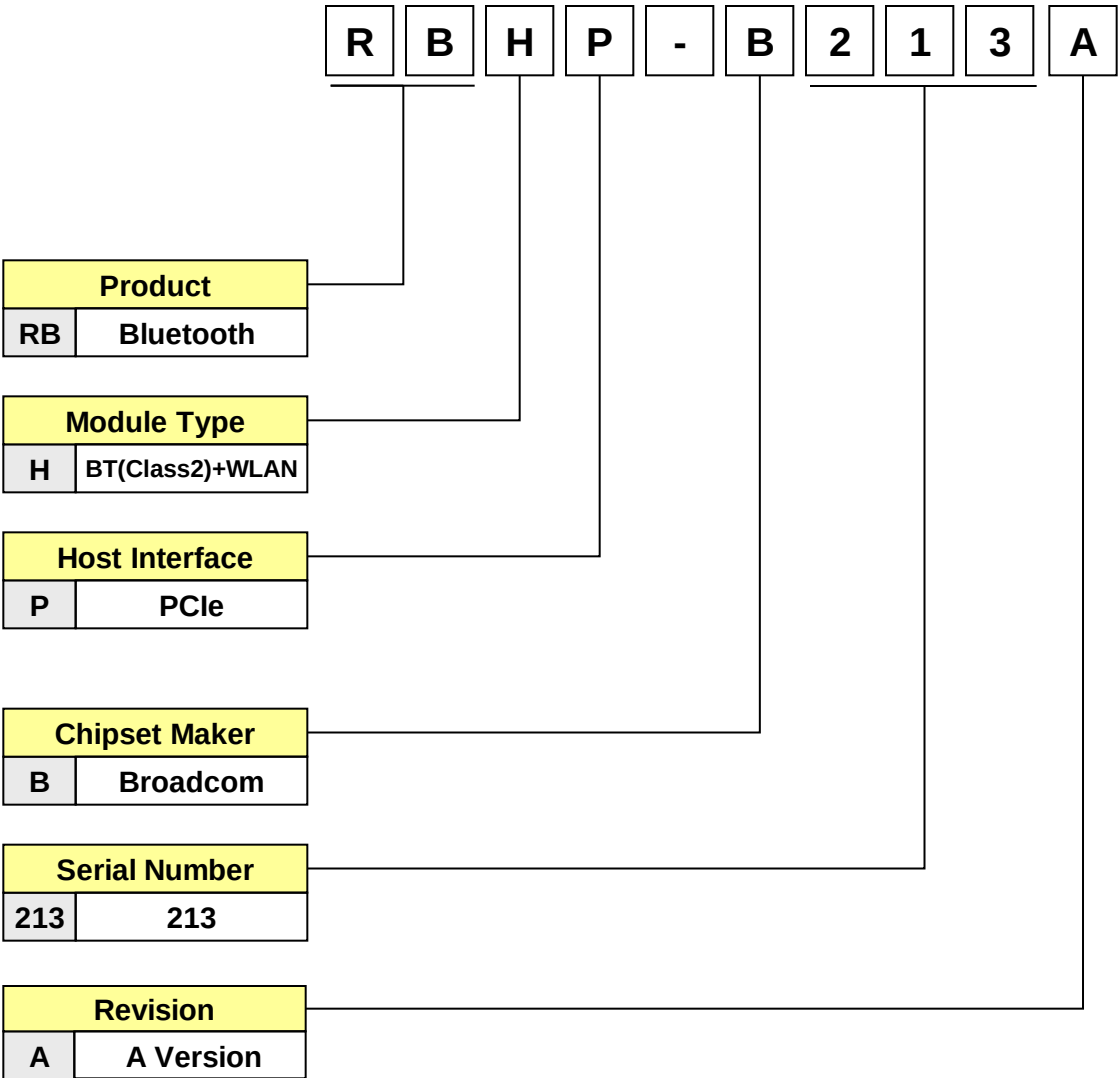


Item	LGE	v1.0	2016.05.30
EAT63433501	130		
Spec	RBHP-B213B	LotNo	6530 - 001

No.	Index
①	POSITION (ITEM / OUTBOX)
②	CUSTOMER
③	FIRMWARE VERSION (vX.X)
④	SHIPPING DATE (YYYY.MM.DD)
⑤	BARCODE (Customer P/N, Quantity) Ex) EAT63433501 130
⑥	CUSTOMER P/N
⑦	QUANTITY
⑧	MODEL P/N
⑨	LOT NUMBER
⑩	BARCODE (Lot No.) Ex) 6530-001
⑪	BARCODE (Model P/N, Lot No.1) Ex) RBHP-B213B.6530-001.1

REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213B
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

18. Ordering Information



REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213B
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

FCC Information

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions :

- (1) This Device may not cause harmful interface, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for CLASS B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try correct the interference by one or more of the following measures:

- 1.1. Reorient or relocate the receiving antenna.
- 1.2. Increase the separation between the equipment and receiver.
- 1.3. Connect the equipment into an outlet on a circuit different from that to which receiver is connected.
- 1.4. Consult the dealer or experienced radio/TV technician for help.

WARNING

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

“CAUTION : Exposure to Radio Frequency Radiation.

Antenna shall be mounted in such a manner to minimize the potential for human contact during normal operation. The antenna should not be contacted during operation to avoid the possibility of exceeding the FCC radio frequency exposure limit.

IC Information

This device complies with Industry Canada license-exempt RSS standard(s). Operation in subject to The following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme avec Industrie Canada RSS standard exempts de licence(s), Son utilisation est soumise à Les deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférences et (2) cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

Information for OEM Integrator

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

End product labelling

The label for end product must include

“Contains FCC ID: BEJRBHP-B213B, Contains IC: 2703H-RBHPB213B”.

“ CAUTION: Exposure to Radio Frequency Radiation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20cm between the radiator and your body. This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users.”

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.³

Explanation: This module meets the requirements of FCC part 15C(15.247).

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT has a PCB Antenna, , and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design,, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: BEJRBHP-B213B.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a PCB Antenna, , and the antenna use a permanently attached antenna which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: BEJRBHP-B213B

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Topband can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.