

CUSTOMER : LGE

DATE : 2017.09.06.

the module is to be installed in vehicle only.

SPECIFICATIONS FOR APPROVAL

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

MODEL NAME : RBHP-B213A

CUSTOMER P/N : EAT63433501

APPROVAL	REMARK

APPENDIX

Designed	Checked	Approved	LG Innotek Co., Ltd.	
				
			DOCUMENT No.	RBHP-B213A
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Change History of Revision

Revision	Date	Contents of Revision Change	Remark
0.1	2015.4.23.	Establishment	
0.2	2015.9.15.	Digital I/O Pins IN/OUT Range Spec. changed	△ _a P.29
		Pin configuration was modified	△ _b P.52
		Recommended Land Pattern updated	△ _c P.59
0.3	2016.2.13.	2.4G WiFi power spec. updated	△ _d P18
		5G WiFi power spec. updated	△ _e P22
0.4	2016.4.20.	Model number is changed to RBHP-B213A(PCIe)	
		PCIe power-on timing inserted	△ _f P34
		Pin configuration is modified(PCIe inserted)	△ _g P51
0.5	2016.6.10	Application updated	△ _h P4
		Blockdiagram updated	△ _i P58
		Customer P/N inserted	P1
0.6	2016.9.4	Block diagram updated	△ _j P58
0.7	2016.10.14	Bluetooth, WiFi Radiation performance spec. inserted	△ _k P12,13, 14, 17,18, 22
0.8	2016.10.26	Customer P/N modified	P1
0.9	2017.01.06	ESD spec. modified	△ _l P49
		Antenna Tube color modified	△ _m P6
1.0	2017.02.28	Module Radiation sensitivity spec. modified	△ _n P9
		BT/WiFi core0 5G Antenna tube color changed	△ _o P6
1.1	2017.05.17	Label information updated	△ _p P5
1.2	2017.05.23	Out box label information updated	△ _q P63

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	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
	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				

Change History of Revision

Revision	Date	Contents of Revision Change	Remark
1.3	2017.6.27.	PCIE power-on timing updated	△ _r P35
		PCIE I/O characteristics updated	△ _s P50
		RF performance guarantee min. VBAT voltage updated	△ _t P53
		Application schematic updated	△ _u P63
1.4	2017.7.17.	Bluetooth version updated	△ _v P1
1.5	2017.8.10.	Low temp. operating comment added in Clause 5. (Customer Request)	△ _w P5
1.6	2017.9.06.	Reliability spec. updated	△ _x P58

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	1.6	2017. 09.06.	Rev1.6 Released				

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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-B213A 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-B213A Module assures operating normally at -40 ~ +85℃.

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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-B213A

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7 04 GJ 27 0059

③ ④ ⑤ ⑥ ⑦

EAT63433501

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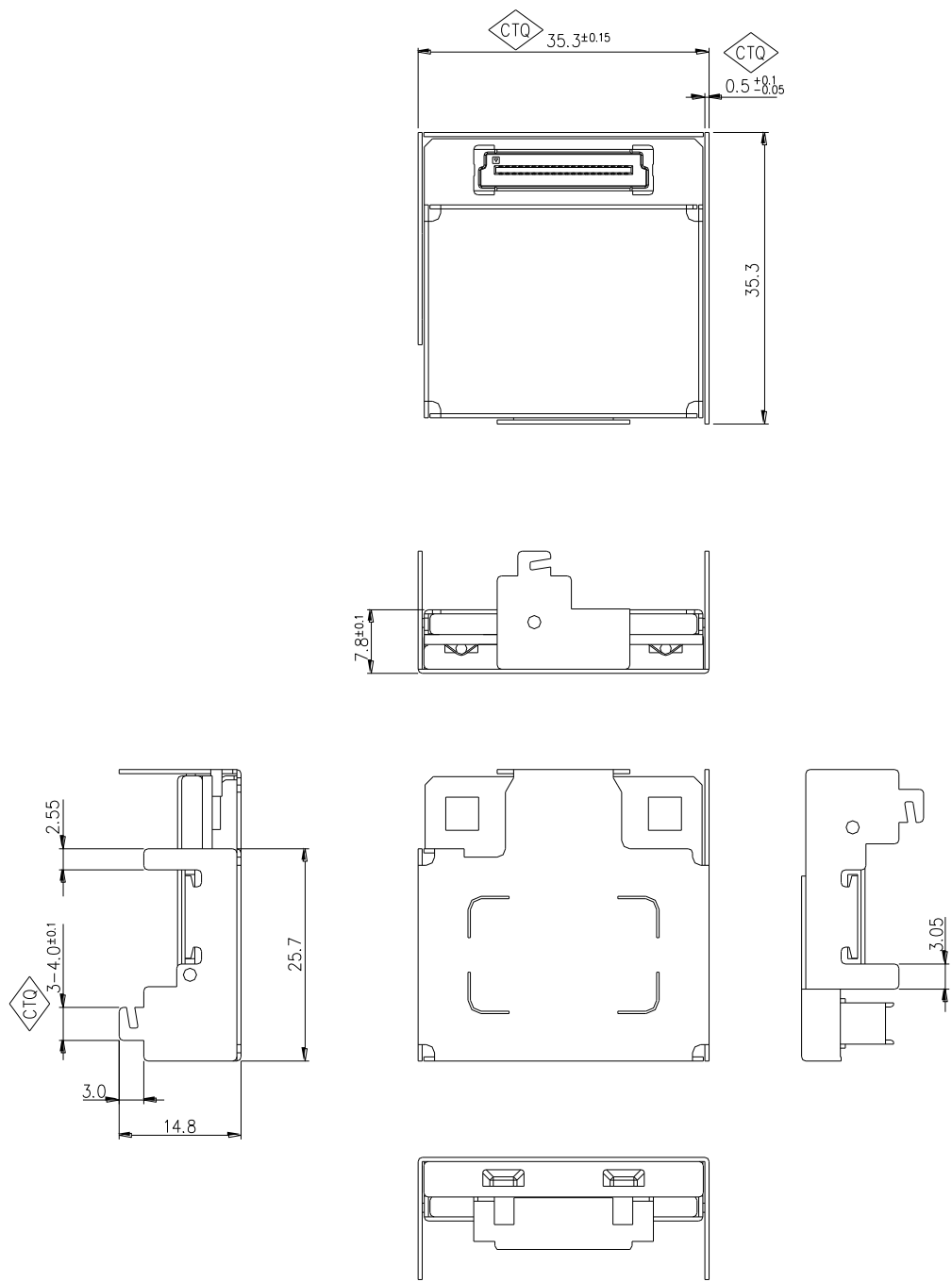
⑨

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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A cross-sectional diagram of a multi-layered structure. It features a central raised section with a flat top surface. Below this, there are two rectangular features, possibly representing solder joints or mounting pads, positioned symmetrically on either side of the center. The entire structure is supported by a base layer.

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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

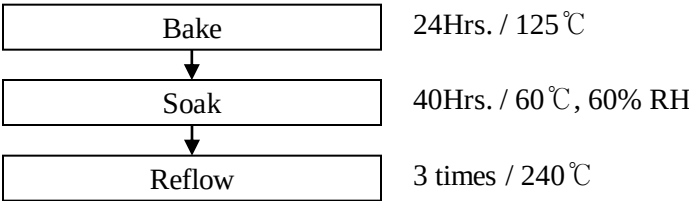
9.3 WLAN

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

10.1 Bluetooth

1) Basic Data Rate - Rx Performance

General Performance

Parameter	Condition	Min	Typ	Max	Unit
Frequency Range		2402		2480	MHz
Impedance	BT_ANT Pin	-	50	-	Ohm

Receiver Performance

Parameter	Condition	Min	Typ	Max	Unit
Sensitivity level (BER≤0.1%) (Radiation performance)	Single slot	-	-	-84 (-75)	dBm
Sensitivity level (BER≤0.1%) (Radiation performance)	Multi slot	-	-	-84 (-75)	dBm
C/I performance ¹⁾ (BER≤0.1%)	C/I _{co-channel} , Input=-60dBm	-	-	11	dB
	C/I _{1MHz} , Input=-60dBm	-	-	0	dB
	C/I _{2MHz} , Input=-60dBm	-	-	-20	dB
	C/I _{≥3MHz} , Input=-67dBm	-	-	-40	dB
	Image radio , Input=-67dBm	-	-	-9	dB
	Image±1 , Input=-67dBm	-	-	-20	dB
Out-of-band Blocking ²⁾ (BER≤0.1%)	30MHz ~ 2000MHz	-10	-	-	dBm
	2000MHz ~ 2400MHz	-27	-	-	dBm
	2500MHz ~ 3000MHz	-27	-	-	dBm
	3000MHz ~ 12.75GHz	-10	-	-	dBm
Intermodulation (BER≤0.1%)	Input=-64dBm, n=5	-39	-	-	dBm
Maximum Input Level (BER≤0.1%)		-20	-	-	dBm

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LG Innotek Co., Ltd

DSGD

CHKD

APPD

RBHP-B213A

DOCUMENT NO.

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10. Electrical Specification

10.1 Bluetooth

2) Basic Data Rate - Tx Performance

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Transmitter Performance					
Parameter	Condition	Min	Typ	Max	Unit
Transmit Power (Radiation performance)	All temperature	-6 (-8)	2	4 (6)	dBm
Power density	All temperature	-	-	20	dBm
Frequency Range	All temperature	2402	-	2480	MHz
20dB bandwidth	All temperature	-	-	1000	KHz
Adjacent channel power ³⁾	±2MHz	-	-	-20	dBm
	±3MHz	-	-	-40	dBm
	±4MHz	-	-	-40	dBm
Out-band Spurious Emission	30MHz ~ 1GHz	-	-	-36	dBm
	1GHz ~ 12.75GHz	-	-	-30	dBm
	1.8GHz ~ 1.9GHz	-	-	-47	dBm
	5.1GHz ~ 5.3GHz	-	-	-47	dBm
Modulation Characteristics	$\Delta F_{1_{avg}}$	140	-	175	KHz
	$\Delta F_{2_{max}}$	115	-	-	KHz
	$\Delta F_{2_{avg}}/\Delta F_{1_{avg}}$	80	-	-	%
Initial Carrier Frequency Tolerance	DH1 packet	-75	-	75	KHz
Carrier Frequency Drift	Five slot packet(DH5)	-40	-	40	KHz

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10. Electrical Specification

10.1 Bluetooth

3) Enhanced Data Rate - Rx Performance

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Enhanced Data Rate Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Sensitivity at 0.01% BER (Radiation performance)	$\pi/4$ DQPSK/8DPSK	-	-	-80 (-75)	dBm
Maximum received signal at 0.1% BER	$\pi/4$ DQPSK	-20	-	-	dBm
	8DPSK	-20	-	-	dBm
C/I co-channel at 0.1% BER	$\pi/4$ DQPSK	-	-	13	dB
	8DPSK	-	-	21	dB
Adjacent channel selectivity C/I $F=F_0+1\text{MHz}$	$\pi/4$ DQPSK	-	-	0	dB
	8DPSK	-	-	5	dB
Adjacent channel selectivity C/I $F=F_0-1\text{MHz}$	$\pi/4$ DQPSK	-	-	0	dB
	8DPSK	-	-	5	dB
Adjacent channel selectivity C/I $F=F_0+2\text{MHz}$	$\pi/4$ DQPSK	-	-	-30	dB
	8DPSK	-	-	-25	dB
Adjacent channel selectivity C/I $F=F_0-2\text{MHz}$	$\pi/4$ DQPSK	-	-	-20	dB
	8DPSK	-	-	-13	dB
Adjacent channel selectivity C/I $F \geq F_0+3\text{MHz}$	$\pi/4$ DQPSK	-	-	-40	dB
	8DPSK	-	-	-33	dB
Adjacent channel selectivity C/I $F \leq F_0-5\text{MHz}$	$\pi/4$ DQPSK	-	-	-40	dB
	8DPSK	-	-	-33	dB
Adjacent channel selectivity C/I $F=F_{\text{image}}$	$\pi/4$ DQPSK	-	-	-7	dB
	8DPSK	-	-	0	dB

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10. Electrical Specification**10.1 Bluetooth****4) Enhanced Data Rate - Tx Performance****Enhanced Data Rate Transmitter Performance**

Parameter	Condition	Min	Typ	Max	Unit
Relative transmit power.		-4	-1	1	dB
$\pi/4$ DQPSK max carrier frequency stability $ \omega_o $		-10	-	10	kHz
$\pi/4$ DQPSK max carrier frequency stability $ \omega_i $		-75	-	75	kHz
$\pi/4$ DQPSK max carrier frequency stability $ \omega_o + \omega_i $		-75	-	75	kHz
8 DPSK max carrier frequency stability $ \omega_o $		-10	-	10	kHz
8 DPSK max carrier frequency stability $ \omega_i $		-75	-	75	kHz
8 DPSK max carrier frequency stability $ \omega_o + \omega_i $		-75	-	75	kHz
$\pi/4$ DQPSK Modulation Accuracy	RMS DEVM	-	-	20	%
	99% DEVM	-	-	30	%
	Peak DEVM	-	-	35	%
8 DPSK Modulation Accuracy	RMS DEVM	-	-	13	%
	99% DEVM	-	-	20	%
	Peak DEVM	-	-	25	%
In-Band spurious emissions	$F > F_0 + 3\text{MHz}$	-	-	-40	dBm
	$F < F_0 - 3\text{MHz}$	-	-	-40	dBm
	$F = F_0 - 3\text{MHz}$	-	-	-40	dBm
	$F = F_0 - 2\text{MHz}$	-	-	-20	dBm
	$F = F_0 - 1\text{MHz}$	-	-	-26	dBm
	$F = F_0 + 1\text{MHz}$	-	-	-26	dBm
	$F = F_0 + 2\text{MHz}$	-	-	-20	dBm
	$F = F_0 + 3\text{MHz}$	-	-	-40	dBm
EDR Differential Phase Encoding (No error)		99	-	-	%

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10. Electrical Specification

10.1 Bluetooth

5) BLE Performance



General Performance					
Parameter	Condition	Min	Typ	Max	Unit
Frequency Range		2402		2480	MHz
Impedance	BT_ANT Pin	-	50	-	Ohm
Sensitivity level (BER≤0.1%) (Radiation performance)	GFSK(1Mbps)	-	-	-87 (-75)	dBm
Transmit Power	-	-6 (-8)	2	4 (6)	dBm
Modulation Characteristics	$\Delta F1_{avg}$	225	-	275	KHz
	$\Delta F2_{avg}$	230	-	-	KHz
	$\Delta F2_{avg}/\Delta F1_{avg}$	80	-	-	%

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10. Electrical Specification

10.2 WLAN

General Performance					
Parameter	Condition	Min	Typ	Max	Unit
Frequency Range	2.4G WiFi	2412		2462	MHz
	5G WiFi	5745		5825	MHz
Impedance	WLAN_ANT Pin	-	50	-	Ohm

1) 2.4GHz DSSS and HR/DSSS (CCK) Transmitter

- IEEE 802.11b DSSS and HR/DSSS modulation

Transmitter Performance					
Parameter	Condition	Min	Typ	Max	Unit
RMS Transmit power (Radiation performance)	11Mbps CCK	13 (8)	16	19 (24)	dBm
RMS EVM	11Mbps CCK	-	-	35	%
Spectral mask, 1 st Sidelobe	11Mbps CCK (fc±11MHz)	-	-	-30	dBr
Spectral mask, 2 nd Sidelobe	11Mbps CCK (fc±22MHz)	-	-	-50	dBr
RF Carrier suppression	Normal/Extreme	15	-	-	dBc
Spurious emissions	30MHz ~ 1GHz (RBW=100kHz)	-	-	-62	dBm
	1GHz ~ 12.75GHz (RBW=1MHz)	-	-	-47	dBm
	1.8GHz ~ 1.9GHz (RBW=1MHz)	-	-	-53	dBm
	5.15GHz ~ 5.3GHz (RBW=1MHz)	-	-	-53	dBm

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	1.6	2017. 09.06.	Rev1.6 Released				

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10.2 WLAN

2) 2.4GHz OFDM Transmitter

- IEEE 802.11g and IEEE 802.11n(HT 20/40 modes MCS0 to MCS7) OFDM modulation

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Transmitter Performance					
Parameter	Condition	Min	Typ.	Max	Unit
RMS Transmit power (Radiation performance)	OFDM, 64-QAM(3/4)	9 (4)	12	15 (20)	dBm
	OFDM, 64-QAM(5/6)	9 (4)	12	15 (20)	dBm
RMS EVM	OFDM, 64-QAM(3/4)	-	-	-25	dB
	OFDM, 64-QAM(5/6)	-	-	-27	dB
Spectral mask	OFDM, 64-QAM(3/4) (fc±11MHz)	-	-	-20	dBr
	OFDM, 64-QAM(3/4) (fc±20MHz)	-	-	-28	dBr
	OFDM, 64-QAM(3/4) (fc±30MHz)	-	-	-40	dBr
	OFDM, 64-QAM(5/6) (fc±11MHz) HT20	-	-	-20	dBr
	OFDM, 64-QAM(5/6) (fc±20MHz) HT20	-	-	-28	dBr
	OFDM, 64-QAM(5/6) (fc±30MHz) HT20	-	-	-45	dBr
Center frequency leakage	Normal/Extreme	-	-	-15	dB
Spurious emissions	30MHz ~ 1GHz (RBW=100kHz)	-	-	-62	dBm
	1GHz ~ 12.75GHz (RBW=1MHz)	-	-	-47	dBm
	1.8GHz ~ 1.9GHz (RBW=1MHz)	-	-	-53	dBm
	5.15GMHz ~ 5.3GHz (RBW=1MHz)	-	-	-53	dBm

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-B213A
	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				

10. Electrical Specification

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3) 2.4GHz DSSS and HR/DSSS (CCK) Receiver

- IEEE 802.11b DSSS and HR/DSSS modulation



Receiver Performance

Parameter	Condition	Min	Typ	Max	Unit
Rx sensitivity (Radiation performance)	1Mbps DSSS ¹⁾	-	-	-89(-81)	dBm
	2Mbps DSSS ¹⁾	-	-	-84(-76)	dBm
	5.5Mbps CCK ¹⁾	-	-	-80(-72)	dBm
	11Mbps CCK ¹⁾	-	-	-76(-68)	dBm
Maximum input level	DSSS ¹⁾	-10	-	-	dBm
	CCK ¹⁾	-10	-	-	dBm
Adjacent channel rejection	DSSS ²⁾	-	-	35	dBr
	CCK ²⁾	-	-	35	dBr

¹⁾ 1024-byte packets, 8% PER
²⁾ 1024-byte packets, 8% PER, 25MHz channel separation.

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-B213A
	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				

10. Electrical Specification**10.2 WLAN****4) 2.4GHz OFDM Receiver**

-. IEEE 802.11g and IEEE 802.11n (HT 20/40 modes MCS0 to MCS7 800ns Guard Interval non-STBC) OFDM modulation

Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Maximum input level ³⁾ (Radiation performance)	Normal/Extreme	-20	-	-	dBm
Rx sensitivity (Radiation performance) (IEEE 802.11g)	6Mbps ¹⁾	-	-	-82(-74)	dBm
	9Mbps ¹⁾	-	-	-81(-73)	dBm
	12Mbps ¹⁾	-	-	-79(-71)	dBm
	18Mbps ¹⁾	-	-	-77(-69)	dBm
	24Mbps ¹⁾	-	-	-74(-68)	dBm
	36Mbps ¹⁾	-	-	-70(-62)	dBm
	48Mbps ¹⁾	-	-	-66(-58)	dBm
Rx sensitivity (Radiation performance) (IEEE 802.11n)	54Mbps ¹⁾	-	-	-65(-57)	dBm
	MCS0 ²⁾ (HT 20)	-	-	-82(-74)	dBm
	MCS1 ²⁾ (HT 20)	-	-	-79(-71)	dBm
	MCS2 ²⁾ (HT 20)	-	-	-77(-69)	dBm
	MCS3 ²⁾ (HT 20)	-	-	-74(-68)	dBm
	MCS4 ²⁾ (HT 20)	-	-	-70(-62)	dBm
	MCS5 ²⁾ (HT 20)	-	-	-66(-58)	dBm
	MCS6 ²⁾ (HT 20)	-	-	-65(-57)	dBm
	MCS7 ²⁾ (HT 20)	-	-	-64(-56)	dBm

1) 1024-byte packets, 10% PER.

2) 4096-byte packets, 10% PER. Applies to both HT-mixed(HT_MF) and HT-greenfield(HT-GF) format packet preamble types.

3) 1024-byte packets OFDM or 4096-byte HT packets, 10% PER.

4) 1024-byte packets, 10% PER, 25MHz channel separation.

5) 4096-byte packets, 10% PER, 25MHz channel separation.

R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			RBHP-B213A
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	
	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				

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Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Adjacent channel rejection (IEEE 802.11g)	6Mbps ⁴⁾	16	-	-	dB
	9Mbps ⁴⁾	15	-	-	dB
	12Mbps ⁴⁾	13	-	-	dB
	18Mbps ⁴⁾	11	-	-	dB
	24Mbps ⁴⁾	8	-	-	dB
	36Mbps ⁴⁾	4	-	-	dB
	48Mbps ⁴⁾	0	-	-	dB
	54Mbps ⁴⁾	-1	-	-	dB
Adjacent channel rejection (IEEE 802.11n)	MCS0 ⁵⁾	16	-	-	dB
	MCS1 ⁵⁾	13	-	-	dB
	MCS2 ⁵⁾	11	-	-	dB
	MCS3 ⁵⁾	8	-	-	dB
	MCS4 ⁵⁾	4	-	-	dB
	MCS5 ⁵⁾	0	-	-	dB
	MCS6 ⁵⁾	-1	-	-	dB
	MCS7 ⁵⁾	-2	-	-	dB

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-B213A
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	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

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10.2 WLAN

5) 5GHz OFDM Transmitter

-. IEEE 802.11a, IEEE 802.11n (HT 20/40 modes MCS0 to MCS7) and IEEE 802.11ac OFDM modulation((VHT 20/40, VHT80 modes MCS0 to MCS9)

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Transmitter Performance					
Parameter	Condition	Min	Typ	Max	Unit
RMS Transmit power (Radiation performance)	OFDM, 64-QAM(3/4)/(5/6)	9 (4)	12	15 (20)	dBm
	OFDM, 256-QAM(3/4)/(5/6)	5 (0)	8	11 (16)	dBm
RMS EVM	OFDM, 64-QAM(3/4)	-	-	-25	dB
	OFDM, 64-QAM(5/6)	-	-	-27	dB
	OFDM, 256-QAM(3/4)	-	-	-30	dB
	OFDM, 256-QAM(5/6)	-	-	-32	dB
Spectral mask	OFDM, 64-QAM(3/4) (fc±11MHz)	-	-	-20	dBr
	OFDM, 64-QAM(3/4) (fc±20MHz)	-	-	-28	dBr
	OFDM, 64-QAM(3/4) (fc±30MHz)	-	-	-40	dBr
	OFDM, 64-QAM(5/6) (fc±11MHz) HT20	-	-	-20	dBr
	OFDM, 64-QAM(5/6) (fc±20MHz) HT20	-	-	-28	dBr
	OFDM, 64-QAM(5/6) (fc±30MHz) HT20	-	-	-45	dBr
	OFDM, 64-QAM(5/6) (fc±21MHz) HT40	-	-	-20	dBr
	OFDM, 64-QAM(5/6) (fc±40MHz) HT40	-	-	-28	dBr
	OFDM, 64-QAM(5/6) (fc±60MHz) HT40	-	-	-45	dBr
	OFDM, 256-QAM(5/6) (fc±11MHz) VHT20	-	-	-20	dBr
	OFDM, 256-QAM(5/6) (fc±20MHz) VHT20	-	-	-28	dBr
	OFDM, 256-QAM(5/6) (fc±30MHz) VHT20	-	-	-40	dBr

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10.2 WLAN

Transmitter Performance					
Parameter	Condition	Min	Typ	Max	Unit
Spectral mask	OFDM, 256-QAM(5/6) (fc±21MHz) VHT40	-	-	-20	dBr
	OFDM, 256-QAM(5/6) (fc±40MHz) VHT40	-	-	-28	dBr
	OFDM, 256-QAM(5/6) (fc±60MHz) VHT40	-	-	-40	dBr
	OFDM, 256-QAM(5/6) (fc±41MHz) VHT80	-	-	-20	dBr
	OFDM, 256-QAM(5/6) (fc±80MHz) VHT80	-	-	-28	dBr
	OFDM, 256-QAM(5/6) (fc±120MHz) VHT80	-	-	-40	dBr
Center frequency leakage	Normal/Extreme	-	-	-15	dB
Spurious emissions	30MHz ~ 1GHz (RBW=100kHz)	-	-	-62	dBm
	1GHz ~ 12.75GHz (RBW=1MHz)	-	-	-47	dBm
	1.8GHz ~ 1.9GHz (RBW=1MHz)	-	-	-53	dBm
	5.15GMHz ~ 5.3GHz (RBW=1MHz)	-	-	-53	dBm

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-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
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10. Electrical Specification

10.2 WLAN

5) 5GHz OFDM Receiver

-. IEEE 802.11a, IEEE 802.11n (HT 20/40 modes MCS0 to MCS7) and IEEE 802.11ac OFDM modulation((HT 20/40, VHT80 modes MCS0 to MCS9)

Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Maximum input level ³⁾ (Radiation performance)	Normal/Extreme	-30	-	-	dBm
Rx sensitivity (Radiation performance) (IEEE 802.11a)	6Mbps ¹⁾	-	-	-82(-74)	dBm
	9Mbps ¹⁾	-	-	-81(-73)	dBm
	12Mbps ¹⁾	-	-	-79(-71)	dBm
	18Mbps ¹⁾	-	-	-77(-69)	dBm
	24Mbps ¹⁾	-	-	-74(-68)	dBm
	36Mbps ¹⁾	-	-	-70(-62)	dBm
	48Mbps ¹⁾	-	-	-66(-58)	dBm
	54Mbps ¹⁾	-	-	-65(-57)	dBm
Rx sensitivity (Radiation performance) (IEEE 802.11n)	MCS0 ²⁾ (HT 20)	-	-	-82(-74)	dBm
	MCS1 ²⁾ (HT 20)	-	-	-79(-71)	dBm
	MCS2 ²⁾ (HT 20)	-	-	-77(-69)	dBm
	MCS3 ²⁾ (HT 20)	-	-	-74(-68)	dBm
	MCS4 ²⁾ (HT 20)	-	-	-70(-62)	dBm
	MCS5 ²⁾ (HT 20)	-	-	-66(-58)	dBm
	MCS6 ²⁾ (HT 20)	-	-	-65(-57)	dBm
	MCS7 ²⁾ (HT 20)	-	-	-64(-56)	dBm

1) 1024-byte packets, 10% PER.
 2) 4096-byte packets, 10% PER. Applies to both HT-mixed(HT_MF) and HT-greenfield(HT-GF) format packet preamble types.
 3) 1024-byte packets OFDM or 4096-byte HT packets, 10% PER.
 4) 1024-byte packets, 10% PER, 25MHz channel separation.
 5) 4096-byte packets, 10% PER, 25MHz channel separation.

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-B213A
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	1.6	2017. 09.06.	Rev1.6 Released				

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Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Rx sensitivity (IEEE 802.11n)	MCS0 ²⁾ (HT 40)	-	-	-79(-71)	dBm
	MCS1 ²⁾ (HT 40)	-	-	-76(-68)	dBm
	MCS2 ²⁾ (HT 40)	-	-	-74(-66)	dBm
	MCS3 ²⁾ (HT 40)	-	-	-71(-63)	dBm
	MCS4 ²⁾ (HT 40)	-	-	-69(-61)	dBm
	MCS5 ²⁾ (HT 40)	-	-	-63(-55)	dBm
	MCS6 ²⁾ (HT 40)	-	-	-62(-54)	dBm
	MCS7 ²⁾ (HT 40)	-	-	-61(-53)	dBm
Rx sensitivity (IEEE 802.11ac)	MCS0 ²⁾ (VHT 20)	-	-	-82(-74)	dBm
	MCS1 ²⁾ (VHT 20)	-	-	-79(-71)	dBm
	MCS2 ²⁾ (VHT 20)	-	-	-77(-69)	dBm
	MCS3 ²⁾ (VHT 20)	-	-	-74(-66)	dBm
	MCS4 ²⁾ (VHT 20)	-	-	-70(-62)	dBm
	MCS5 ²⁾ (VHT 20)	-	-	-66(-58)	dBm
	MCS6 ²⁾ (VHT 20)	-	-	-65(-57)	dBm
	MCS7 ²⁾ (VHT 20)	-	-	-64(-56)	dBm
	MCS8 ²⁾ (VHT 20)	-	-	-59(-51)	dBm
	MCS9 ²⁾ (VHT 20)	-	-	-57(-49)	dBm

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Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Rx sensitivity (IEEE 802.11ac)	MCS0 ²⁾ (VHT 40)	-	-	-79(-71)	dBm
	MCS1 ²⁾ (VHT 40)	-	-	-76(-68)	dBm
	MCS2 ²⁾ (VHT 40)	-	-	-74(-66)	dBm
	MCS3 ²⁾ (VHT 40)	-	-	-71(-63)	dBm
	MCS4 ²⁾ (VHT 40)	-	-	-67(-59)	dBm
	MCS5 ²⁾ (VHT 40)	-	-	-63(-55)	dBm
	MCS6 ²⁾ (VHT 40)	-	-	-62(-54)	dBm
	MCS7 ²⁾ (VHT 40)	-	-	-61(-53)	dBm
	MCS8 ²⁾ (VHT 40)	-	-	-56(-48)	dBm
	MCS9 ²⁾ (VHT 40)	-	-	-53(-45)	dBm
Rx sensitivity (IEEE 802.11ac)	MCS0 ²⁾ (VHT 80)	-	-	-76(-68)	dBm
	MCS1 ²⁾ (VHT 80)	-	-	-73(-65)	dBm
	MCS2 ²⁾ (VHT 80)	-	-	-71(-63)	dBm
	MCS3 ²⁾ (VHT 80)	-	-	-68(-60)	dBm
	MCS4 ²⁾ (VHT 80)	-	-	-64(-56)	dBm
	MCS5 ²⁾ (VHT 80)	-	-	-60(-52)	dBm
	MCS6 ²⁾ (VHT 80)	-	-	-59(-51)	dBm
	MCS7 ²⁾ (VHT 80)	-	-	-58(-50)	dBm
	MCS8 ²⁾ (VHT 80)	-	-	-53(-45)	dBm
	MCS9 ²⁾ (VHT 80)	-	-	-51(-43)	dBm

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Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Adjacent channel rejection (IEEE 802.11a)	6Mbps ⁴⁾	16	-	-	dB
	9Mbps ⁴⁾	15	-	-	dB
	12Mbps ⁴⁾	13	-	-	dB
	18Mbps ⁴⁾	11	-	-	dB
	24Mbps ⁴⁾	8	-	-	dB
	36Mbps ⁴⁾	4	-	-	dB
	48Mbps ⁴⁾	0	-	-	dB
	54Mbps ⁴⁾	-1	-	-	dB
Adjacent channel rejection (IEEE 802.11n)	MCS0 ⁵⁾	16	-	-	dB
	MCS1 ⁵⁾	13	-	-	dB
	MCS2 ⁵⁾	11	-	-	dB
	MCS3 ⁵⁾	8	-	-	dB
	MCS4 ⁵⁾	4	-	-	dB
	MCS5 ⁵⁾	0	-	-	dB
	MCS6 ⁵⁾	-1	-	-	dB
	MCS7 ⁵⁾	-2	-	-	dB

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	1.6	2017. 09.06.	Rev1.6 Released				

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Receiver Performance					
Parameter	Condition	Min	Typ	Max	Unit
Adjacent channel rejection (IEEE 802.11ac)	MCS0 ⁵⁾	16	-	-	dB
	MCS1 ⁵⁾	13	-	-	dB
	MCS2 ⁵⁾	11	-	-	dB
	MCS3 ⁵⁾	8	-	-	dB
	MCS4 ⁵⁾	4	-	-	dB
	MCS5 ⁵⁾	0	-	-	dB
	MCS6 ⁵⁾	-1	-	-	dB
	MCS7 ⁵⁾	-2	-	-	dB
	MCS8 ⁵⁾	-7	-	-	dB
	MCS9 ⁵⁾	-9	-	-	dB

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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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	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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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

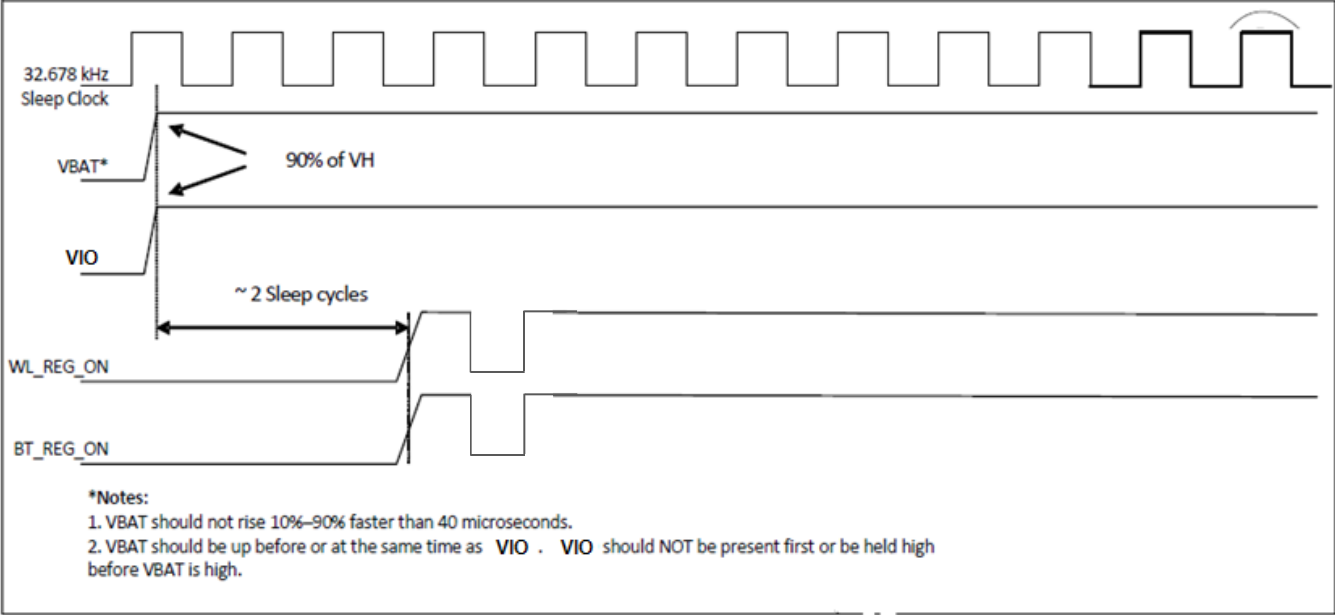
R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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	1.6	2017. 09.06.	Rev1.6 Released				

10. Electrical Specification

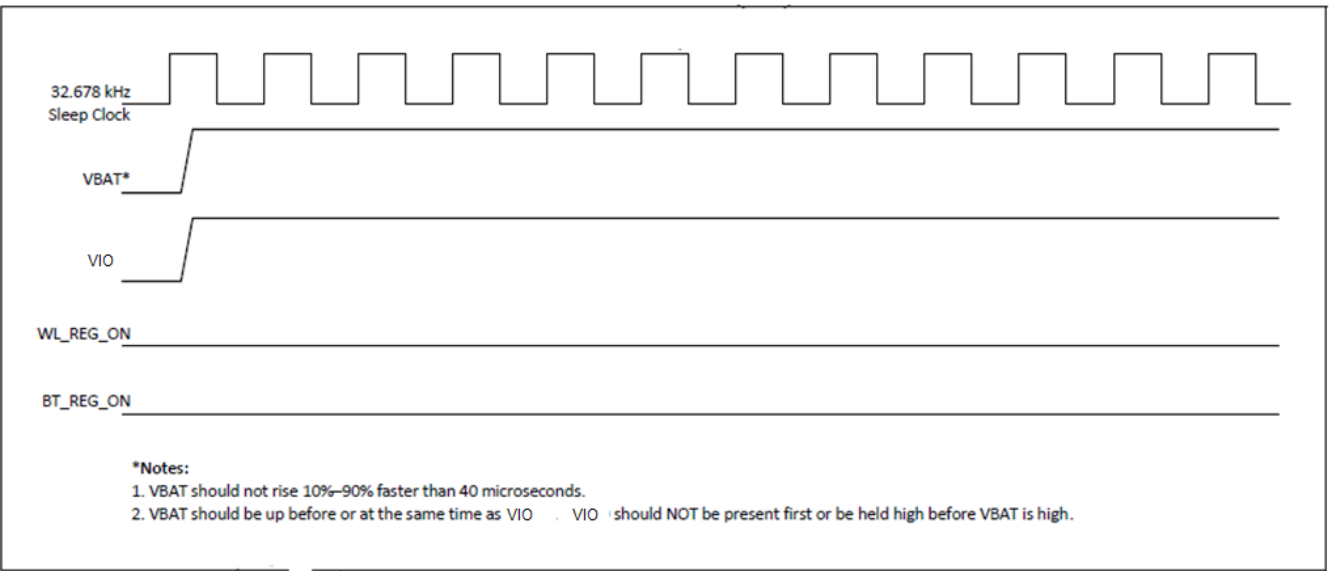
10.3 I/O characteristics

- Control signal timing diagrams

*WLAN =ON, Bluetooth = ON



*WLAN =OFF, Bluetooth = OFF



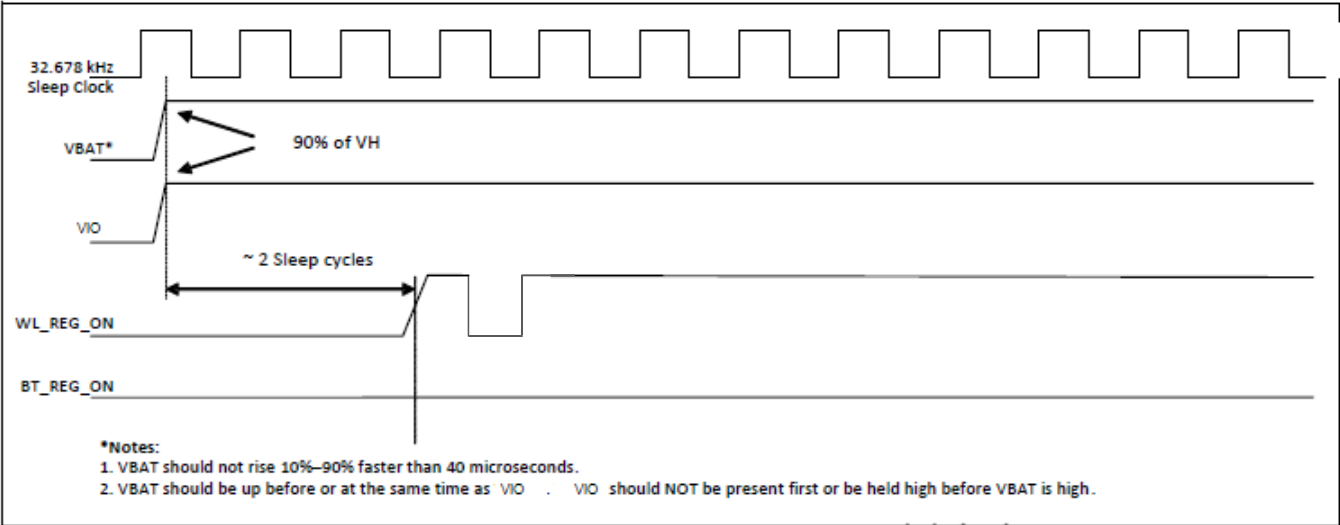
REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

10. Electrical Specification

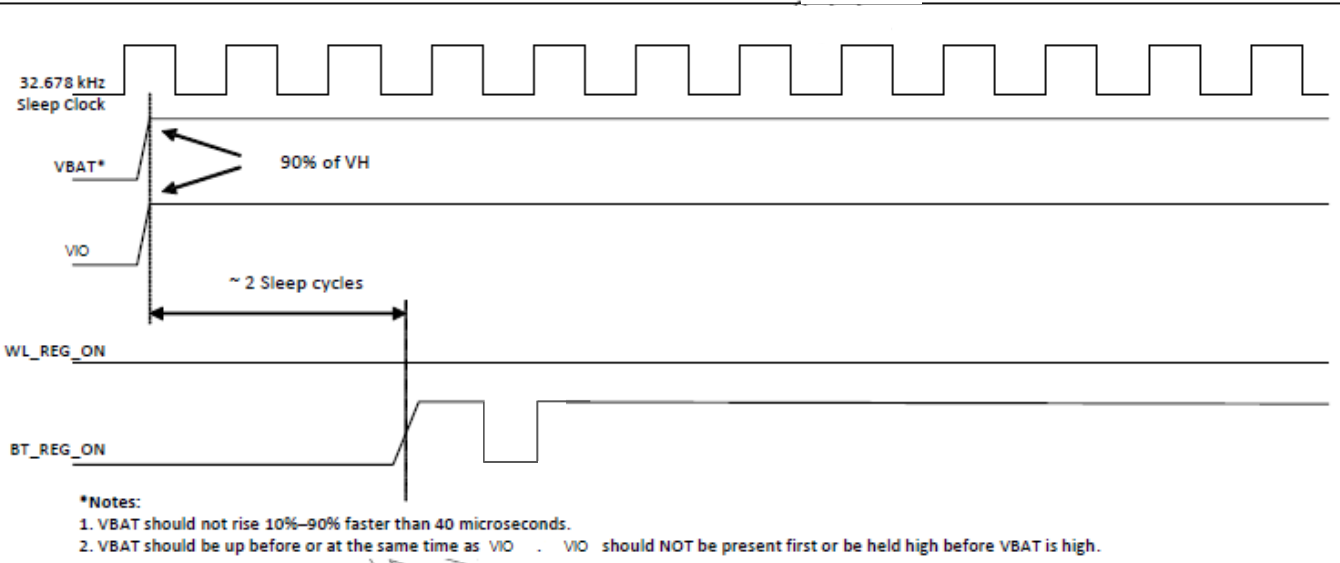
10.3 I/O characteristics

- Control signal timing diagrams

*WLAN =ON, Bluetooth = OFF



*WLAN =OFF, Bluetooth = ON

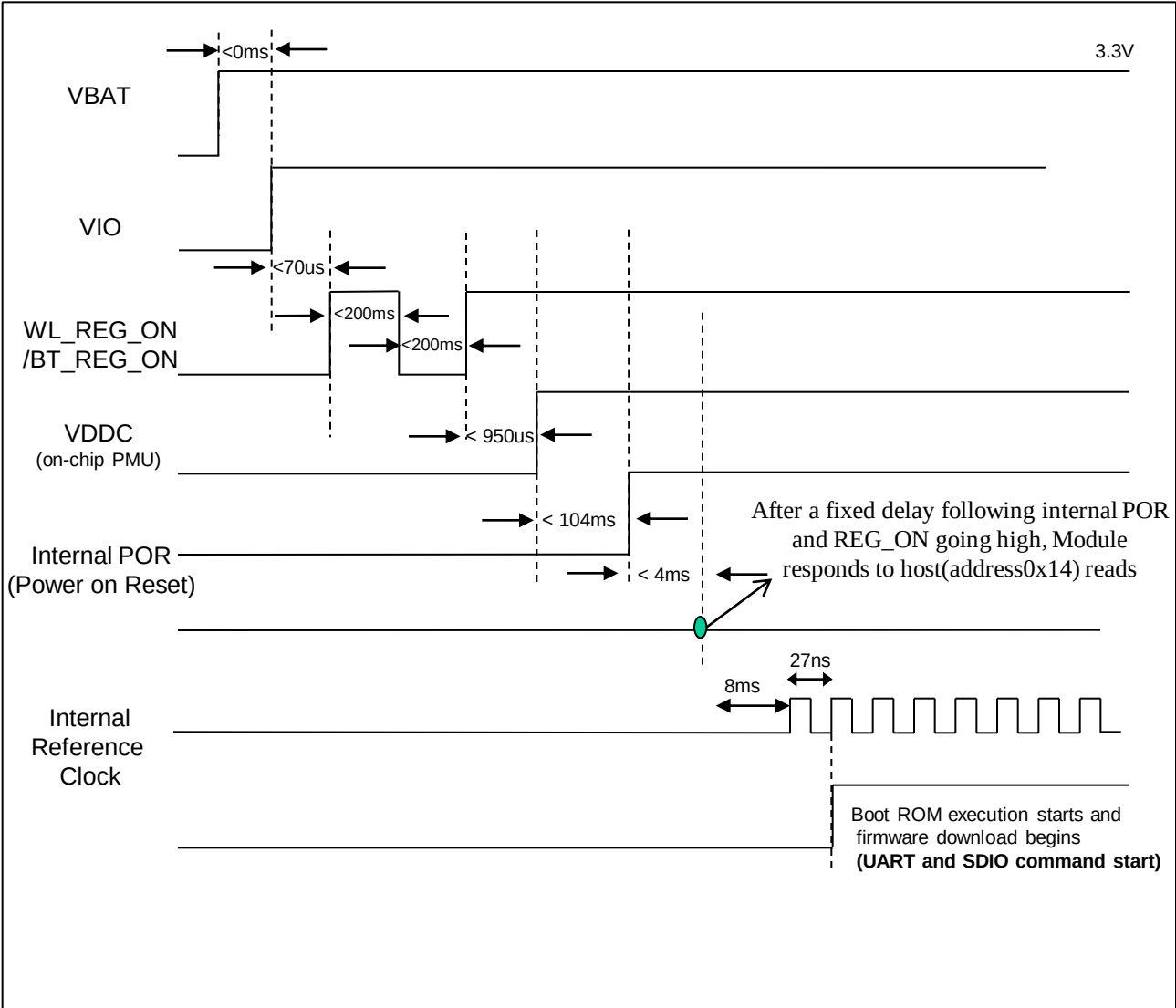


REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
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	1.6	2017. 09.06.	Rev1.6 Released				

10. Electrical Specification

10.3 I/O characteristics

- Boot-Up Sequence and Reset timing



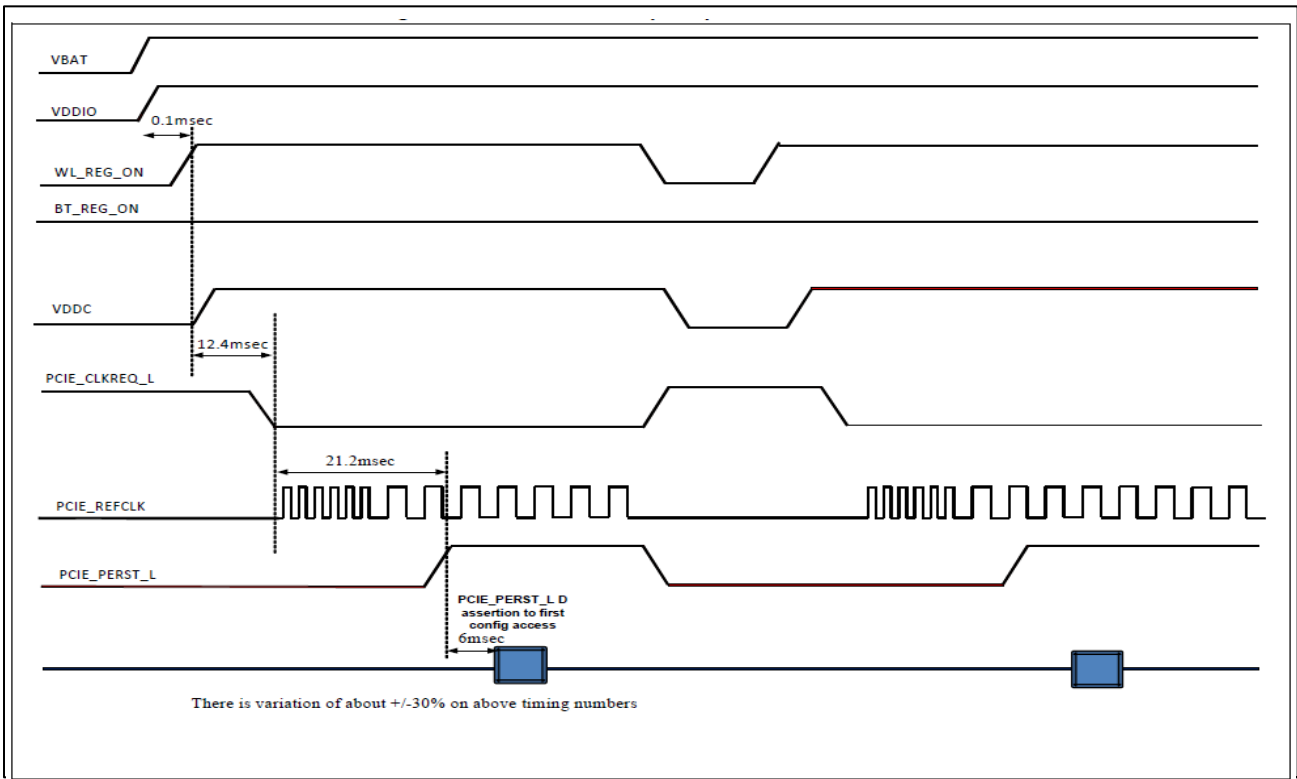
REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

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

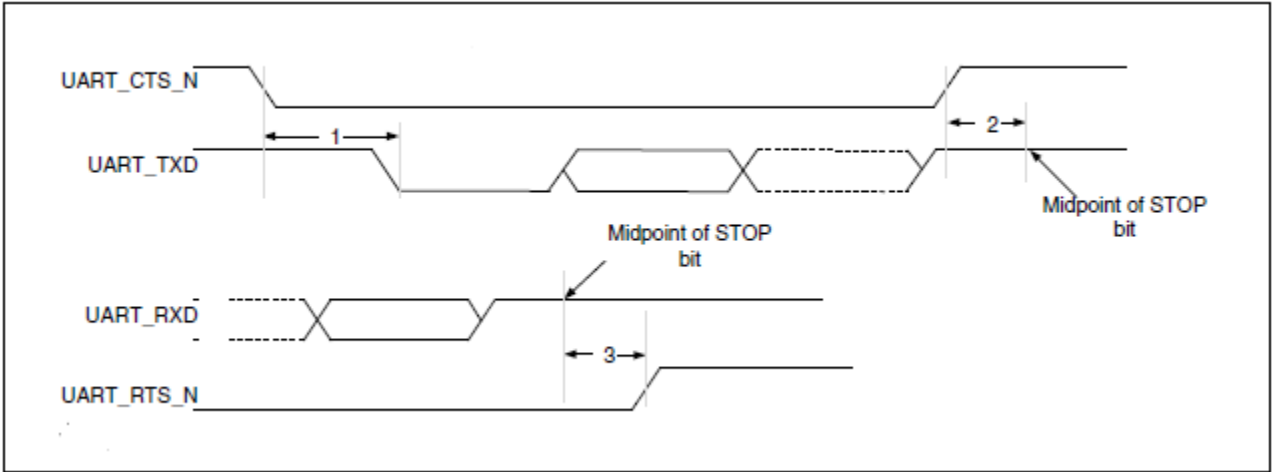
5) UART characteristics

-. 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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	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

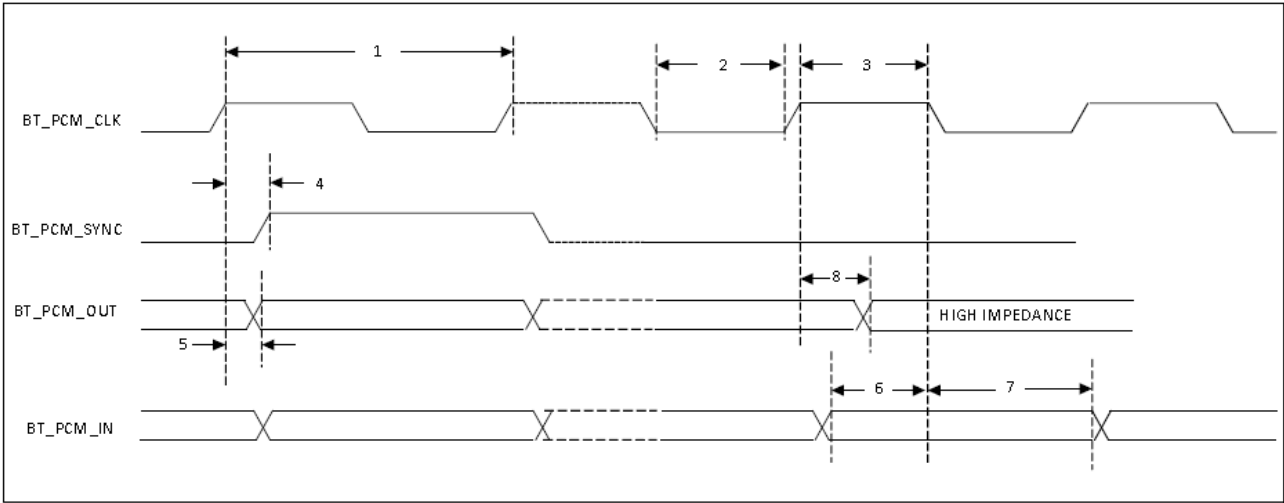
10. Electrical Specification

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

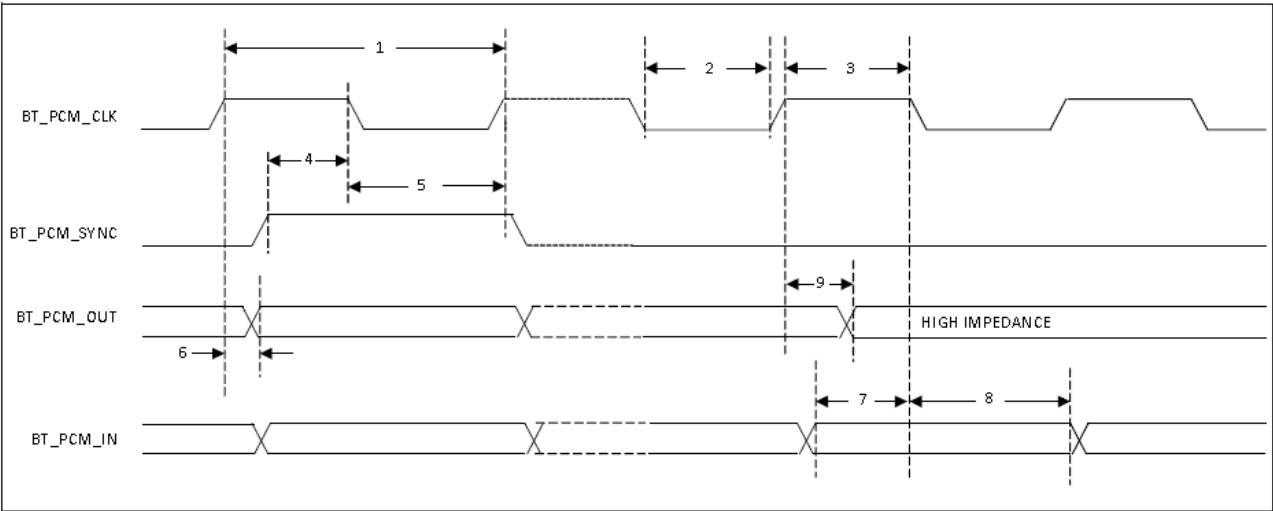
R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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	1.6	2017. 09.06.	Rev1.6 Released				

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

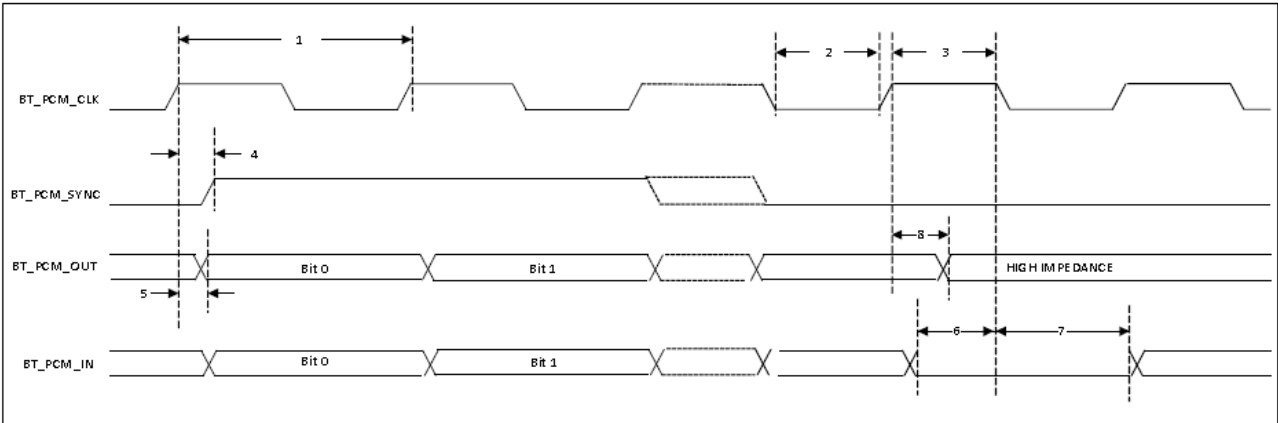
REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

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

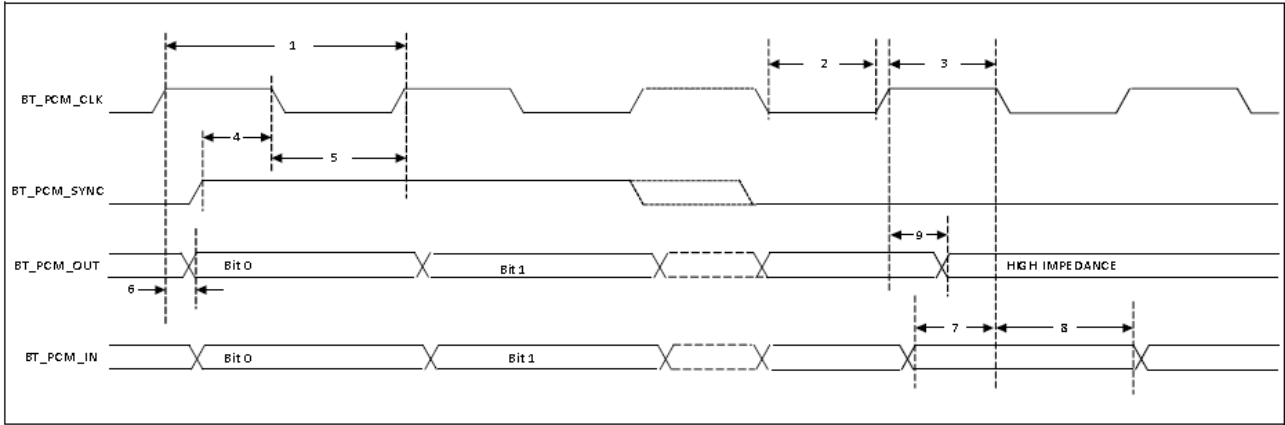
REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
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	1.6	2017. 09.06.	Rev1.6 Released				

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

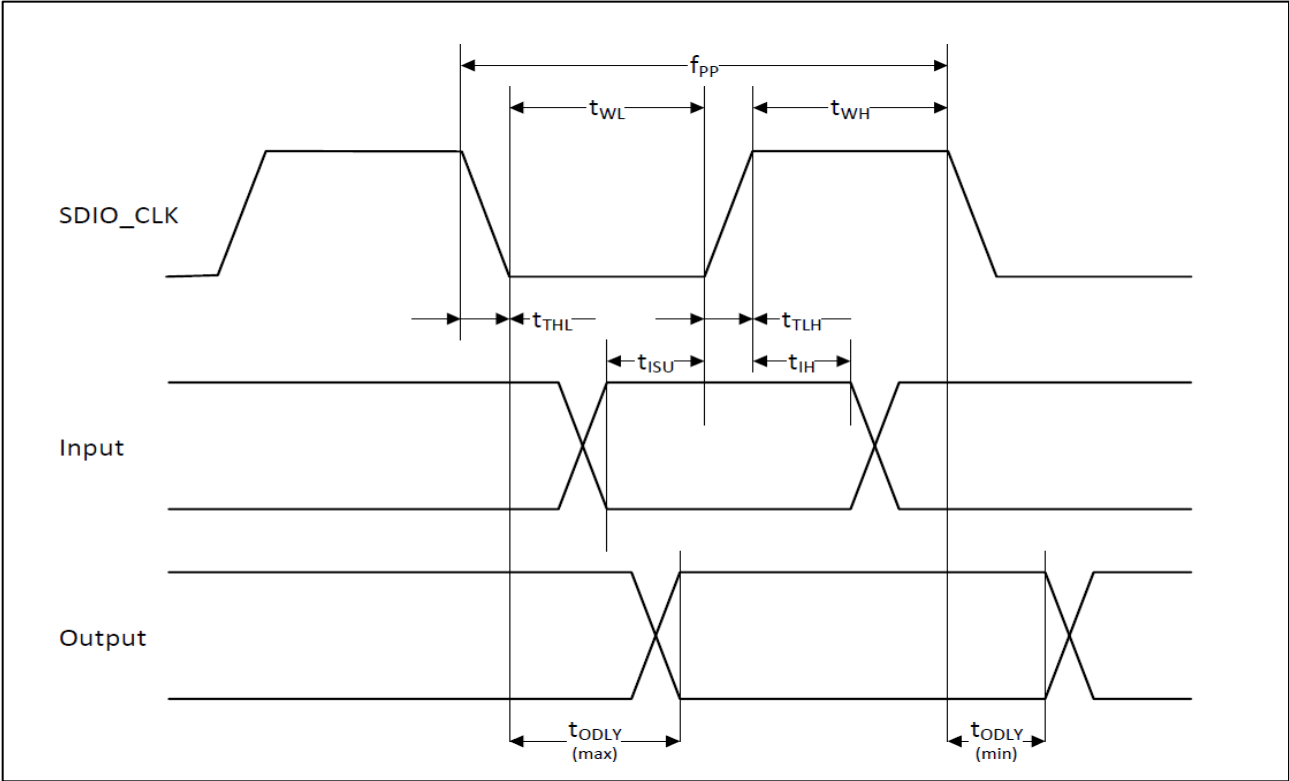
REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
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10. Electrical Specification

10.3 I/O characteristics

7) SDIO characteristics

- RBHP-B213A 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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	1.6	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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1.6	2017. 09.06.	Rev1.6 Released

LG Innotek Co., Ltd

DSGD

CHKD

APPD

RBHP-B213A

DOCUMENT NO.

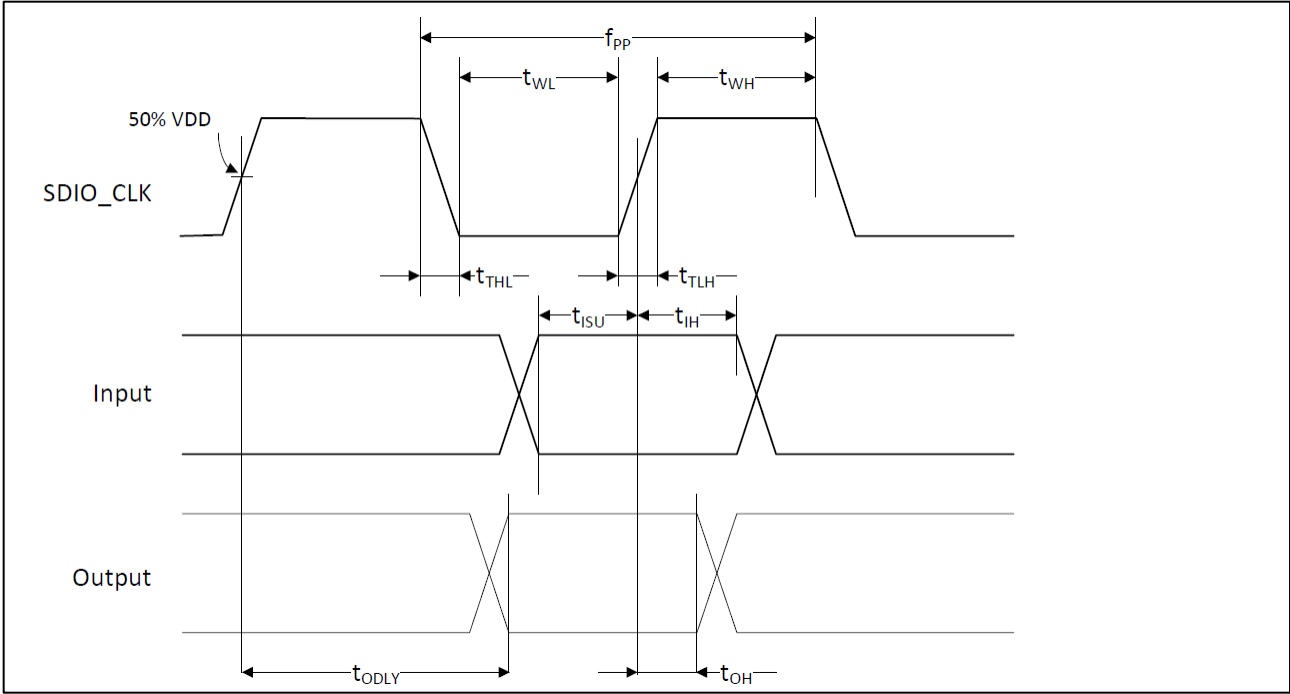
6-3



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

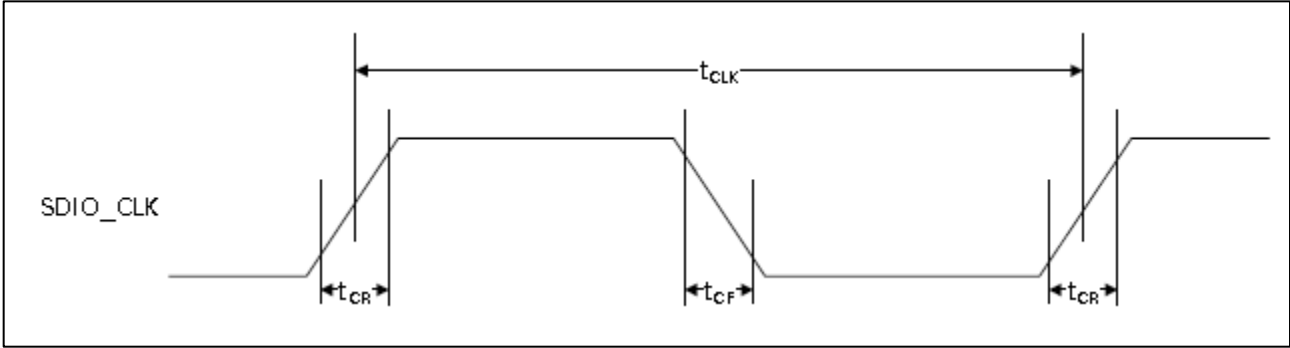
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	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO.
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10. Electrical Specification

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



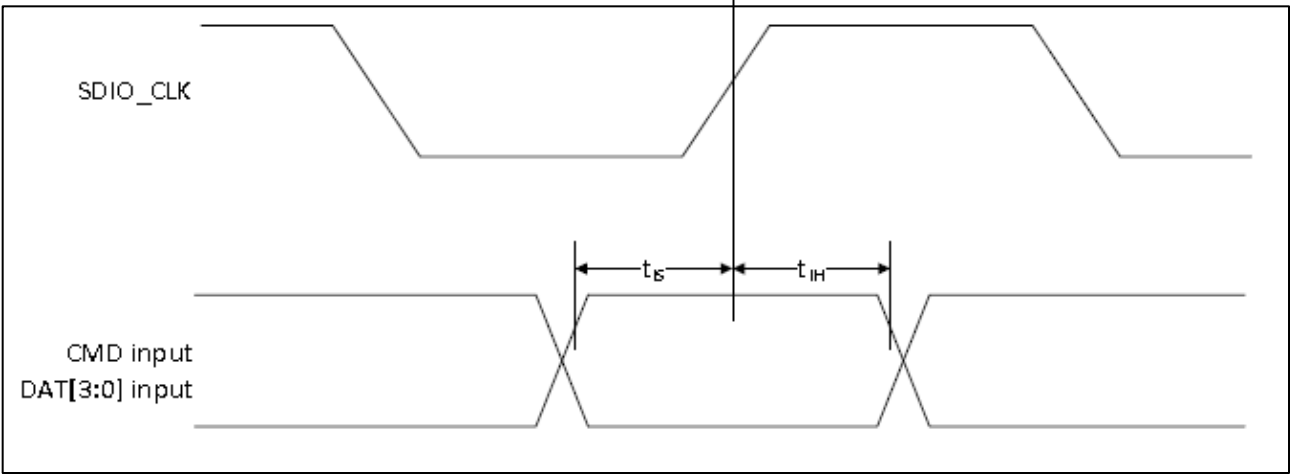
Item	Symbol	Min	Max	Unit	Comments
-	t_{CLK}	40	50	ns	SDR12 mode
		20	400	ns	SDR25 mode
		10	-	ns	SDR50 mode
		4.8	-	ns	SDR104 mode
-	t_{CR}, t_{CF}	-	0.2 $\times t_{CLK}$	ns	$t_{CR}, t_{CF} < 2.0\text{ns(max)}@100\text{MHz}$ $C_{CARD} = 10\text{pF}$ $t_{CR}, t_{CF} < 0.96\text{ns(max)}@208\text{MHz}$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

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-B213A
	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
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10. Electrical Specification

10.3 I/O characteristics

-. SDIO SDR mode Device input timing



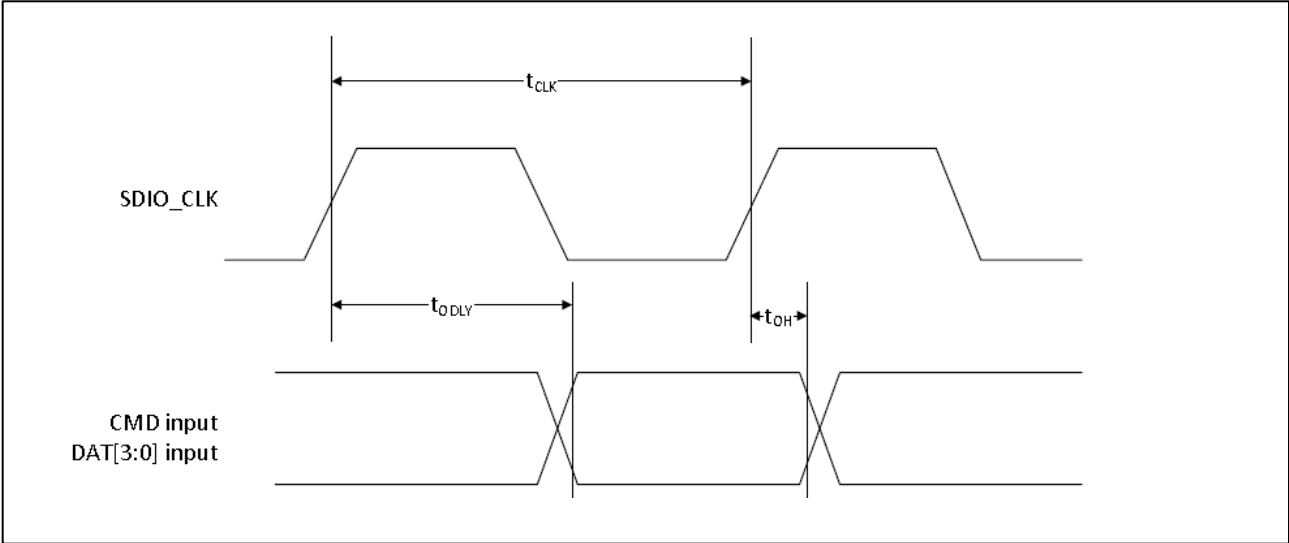
Item	Symbol	Min	Max	Unit	Comments
SDR104 Mode	t _{IS}	1.4	-	ns	C _{CARD} = 10pF, VCT=0.975V
	t _{IH}	0.8	-	ns	C _{CARD} = 5pF, VCT=0.975V
SDR50 Mode	t _{IS}	3	-	ns	C _{CARD} = 10pF, VCT=0.975V
	t _{IH}	0.8	-	ns	C _{CARD} = 10pF, VCT=0.975V

R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
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	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
	1.5	2017. 08.10.	Rev1.5 Released				
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10. Electrical Specification

10.3 I/O characteristics

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



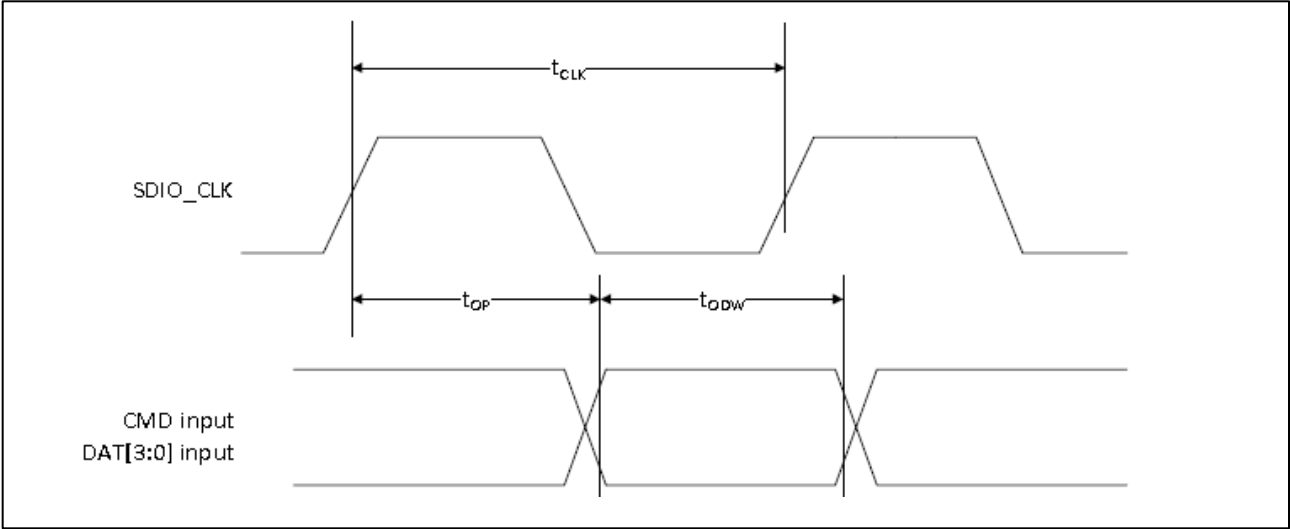
Symbol	Min	Max	Unit	Comments
t _{ODLY}	-	7.5	ns	t _{CLK} > 10ns, CL = 30pF using driver type B for SDR50
t _{ODLY}	-	14.0	ns	t _{CLK} > 20ns, C _L = 40pF using for SDR12, SDR25
t _{OH}	1.5	-	ns	Hold time at the t _{ODLY} (min) C _L = 15pF

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	1.5	2017. 08.10.	Rev1.5 Released				
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10. Electrical Specification

10.3 I/O characteristics

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



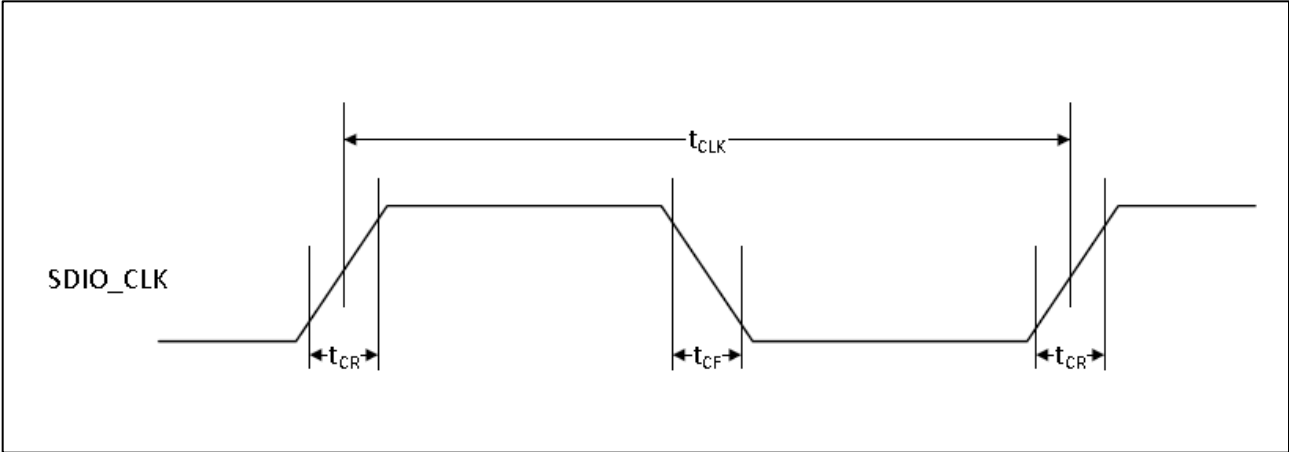
Symbol	Min	Max	Unit	Comments
t _{OP}	0	2	UI	Card output phase
Δt _{OP}	-350	+1550	Ps	Delay variation due to temp. change after tuning
Δt _{ODW}	0.60	-	UI	Δt _{ODW} = 2.88ns @208MHz

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	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				

10. Electrical Specification

10.3 I/O characteristics

-. SDIO DDR50 mode Clock timing



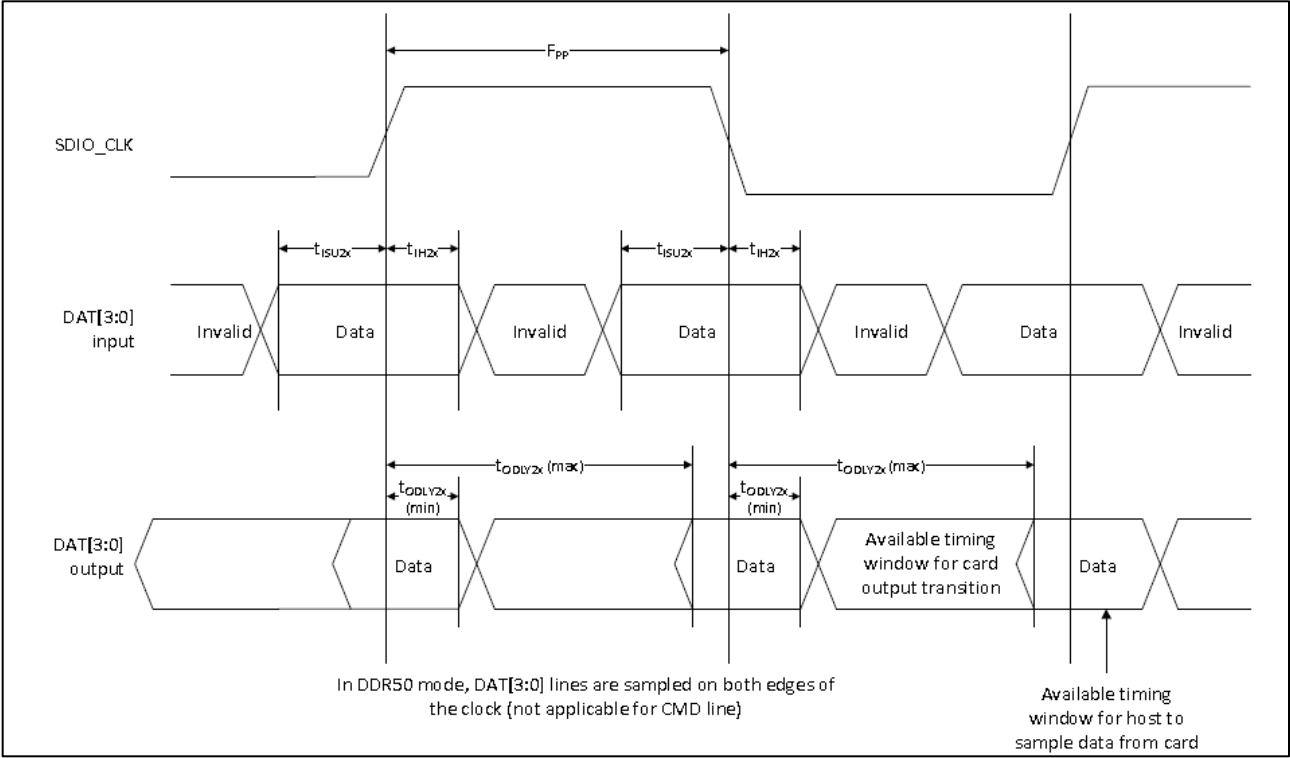
Item	Symbol	Min	Max	Unit	Comments
-	t_{CLK}	20	-	ns	DDR50 mode
-	t_{CR}, t_{CF}	-	$0.2 \times t_{CLK}$	ns	$t_{CR}, t_{CF} < 4.0\text{ns(max)}@50\text{MHz}$ $C_{CARD} = 10\text{pF}$
Clock duty	-	45	55	%	-

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	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
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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	$C_{CARD} < 15pF(1CARD)$

R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
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	1.4	2017. 07.14.	Rev1.4 Released				DOCUMENT NO. 6-3
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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

R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
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	1.6	2017. 09.06.	Rev1.6 Released				

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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	1.6	2017. 09.06.	Rev1.6 Released				

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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	1.6	2017. 09.06.	Rev1.6 Released				

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-B213A 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	

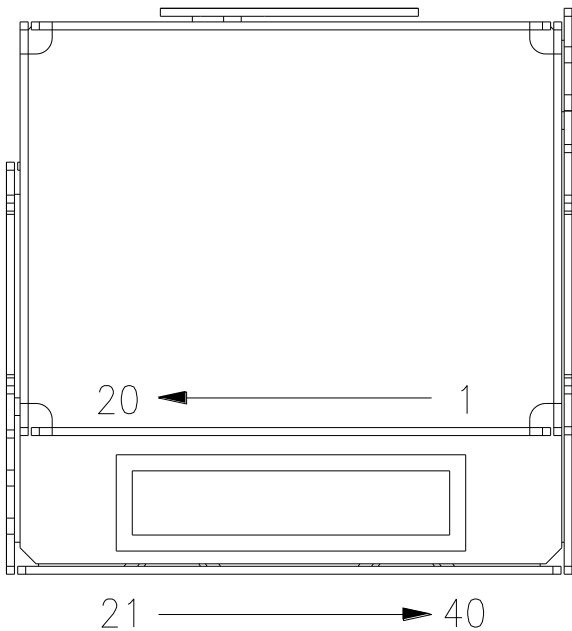
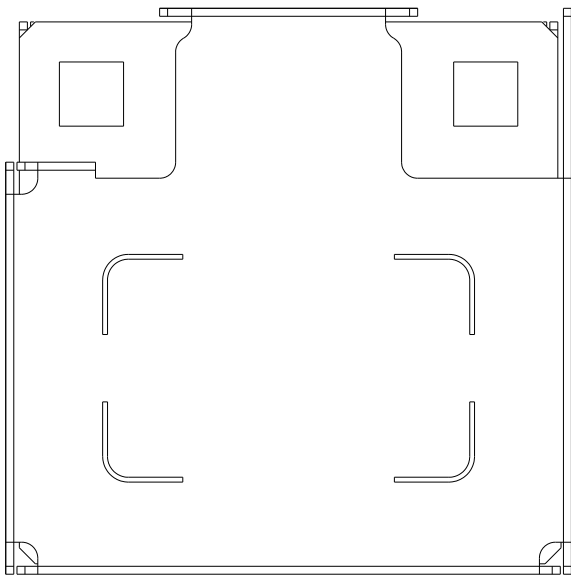
¹⁾ The BCM88359 is functional across this range of voltages.

Optimal RF performance specified in the RBHP-B213A approval sheet, however, is guaranteed only for min. 3.2V including VBAT ripple

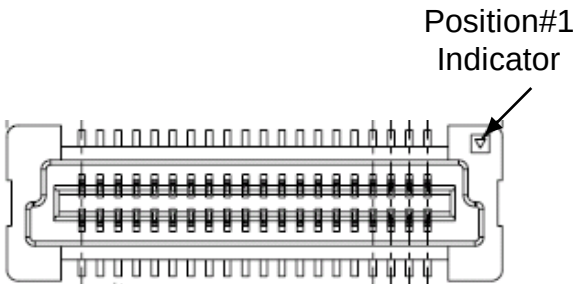
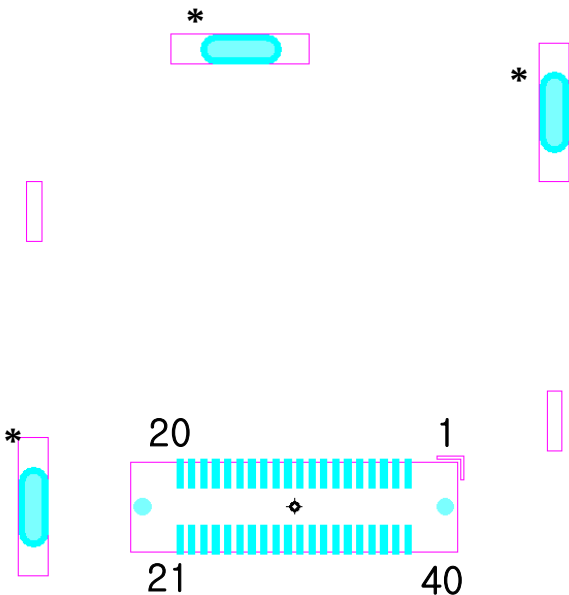
²⁾ MIMO condition

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	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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11. Pin Configuration



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



<FCI 61082-041 >

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11. Pin Configuration



No.	Pin Name	I/O	Description
1	GND	-	Ground
2	BT_UART_RTS	I/O	Bluetooth UART request to send
3	BT_UART_CTS	I/O	Bluetooth UART clear to send
4	BT_UART_TXD	I/O	Bluetooth UART signal output
5	BT_UART_RXD	I/O	Bluetooth UART signal input
6	VIO	I	BT, WLAN VDDIO supply voltage.(3.3V or 1.8V) - BT and WLAN should be same power rail
7	GND	-	Ground
8	SDIO_CLK	I	SDIO clock
9	SDIO_CMD	I/O	SDIO command line
10	SDIO_DATA3	I/O	SDIO data line 3
11	SDIO_DATA2	I/O	SDIO data line 2
12	SDIO_DATA1	I/O	SDIO data line 1
13	SDIO_DATA0	I/O	SDIO data line 0
14	GND	-	Ground
15	GND	-	Ground

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11. Pin Configuration

No.	Pin Name	I/O	Description
16	LPO	I	Low power clock input (32.768KHz, 200~1800mV P-P)
17	GND	-	Ground
18	VBAT	I	Positive supply - Supply voltage : Typical 3.3V.
19	VBAT	I	Positive supply - Supply voltage : Typical 3.3V.
20	VBAT	I	Positive supply - Supply voltage : Typical 3.3V.
21	GND	-	Ground
22	SDIO_DIS	I	SDIO_DISABLE : Low : SDIO Enabled, High : SDIO Disabled
23	PCIE_EN	I	PCIE_ENABLE : Low : PCIE Disabled, High : PCIE Enabled
24	GND	-	Ground
25	BT_PCM_IN	I	PCM data input
26	BT_PCM_OUT	O	PCM data output
27	BT_PCM_CLK	I/O	PCM clock, can be master (output) or slave (input)
28	BT_PCM_SYNC	I/O	PCM sync signal, can be master (output) or slave (input)
29	PCIE_TD_P	O	PCIE Transmitter differential positive
30	PCIE_TD_N	O	PCIE Transmitter differential negative

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11. Pin Configuration

No.	Pin Name	I/O	Description
31	PCIE_CLK_N	I	PCIE differential clock input negative
32	PCIE_CLK_P	I	PCIE differential clock input positive
33	PCIE_RD_N	I	PCIE Receiver differential negative
34	PCIE_RD_P	I	PCIE Receiver differential positive
35	PCIE_CLKREQ	O	PCIE clock request signal
36	PCIE_PERST_N	I	PCIE system reset.
37	PCIE_PME_L	O	PCIE power management event output
38	SDIO_PADVIO	I	SDIO_PADVDDIO :If VIO_SD=1.8V→high, If VIO_SD=3.3V→low
39	BT_REG_ON	I	BT Power on Reset
40	WL_REG_ON	I	WLAN Power on reset - Internal 200KΩ pull-down

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12. Reliability Test Conditions

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

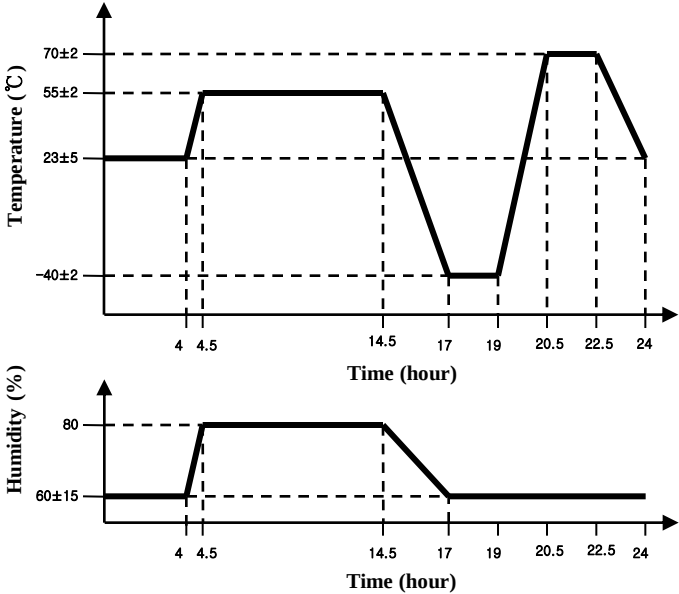


NO	ITEM	Condition	Characteristics
1	High Temp. Load Test	Initial value measured at standard test condition. Test Conditions: 25℃ → 85℃, 100hr(Over for 1hr) Supply Voltage Condition: standard ± 5% In standard test condition, take measurements within 3hr.	- No electrical problem
2	Low Temp. Load Test	Initial value measured at standard test condition. Test Conditions: 25℃ → -40℃, 100hr(Drop for 1 hr) Supply Voltage Condition: standard ± 5% In standard test condition, take measurements within 3hr.	- No electrical problem
3	High Temp. Storage Test	Initial value measured at standard test condition. Test Conditions: 105℃, 168hr In standard test condition, take measurements within 3hr.	- No electrical problem
4	Low Temp. Storage Test	Initial value measured at standard test condition. Test Conditions: -40±3℃, 168hr In standard test condition, take measurements within 3hr.	- No electrical problem
5	Sweep Sine Vibration Test	Initial value measured at standard test condition. Test Conditions: 10~50Hz, 1mm p-p 2hr In standard test condition, take measurements within 3hr.	- No electrical problem
6	Drop Test	Initial value measured at standard test condition. Test Conditions: - Test height: 100 cm - Test times: 10 times Drop the module onto a 10mm thickness plywood. In standard test condition, take measurements within 3hr.	- No mechanical damage
7	Shock Test	Initial value measured at standard test condition. Test Conditions: - Impact acceleration: 50G(m/sec ²) - Impact time: 11 msec - Impact times and direction: 10 times each in 6 directions In standard test condition, take measurements within 3hr.	- No mechanical damage
8	High Temperature Durability	Initial value measured at standard test condition. Test Conditions: - Test Temp.: 85℃ - Test times : 500Hr Supply Voltage Condition: - V min: until 10% of operational cycles - V normal: until 80% of operational cycles - V max: until 10% of operational cycles 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
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°C (1 Hr) -30°C → 25°C, 90%RH (within 1 min) 25°C, 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°C, 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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LG Innotek Co., Ltd

DSGD

CHKD

APPD

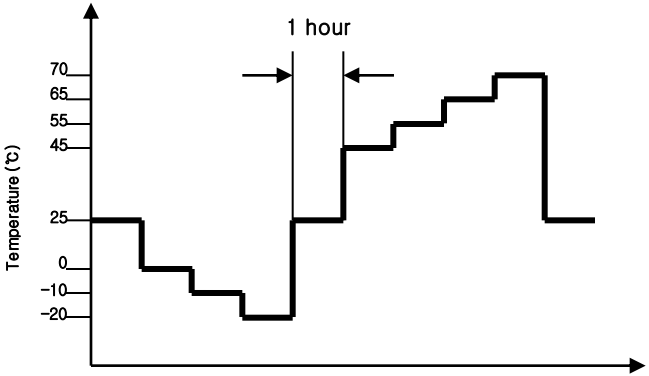
RBHP-B213A

DOCUMENT NO.

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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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	1.6	2017. 09.06.	Rev1.6 Released				

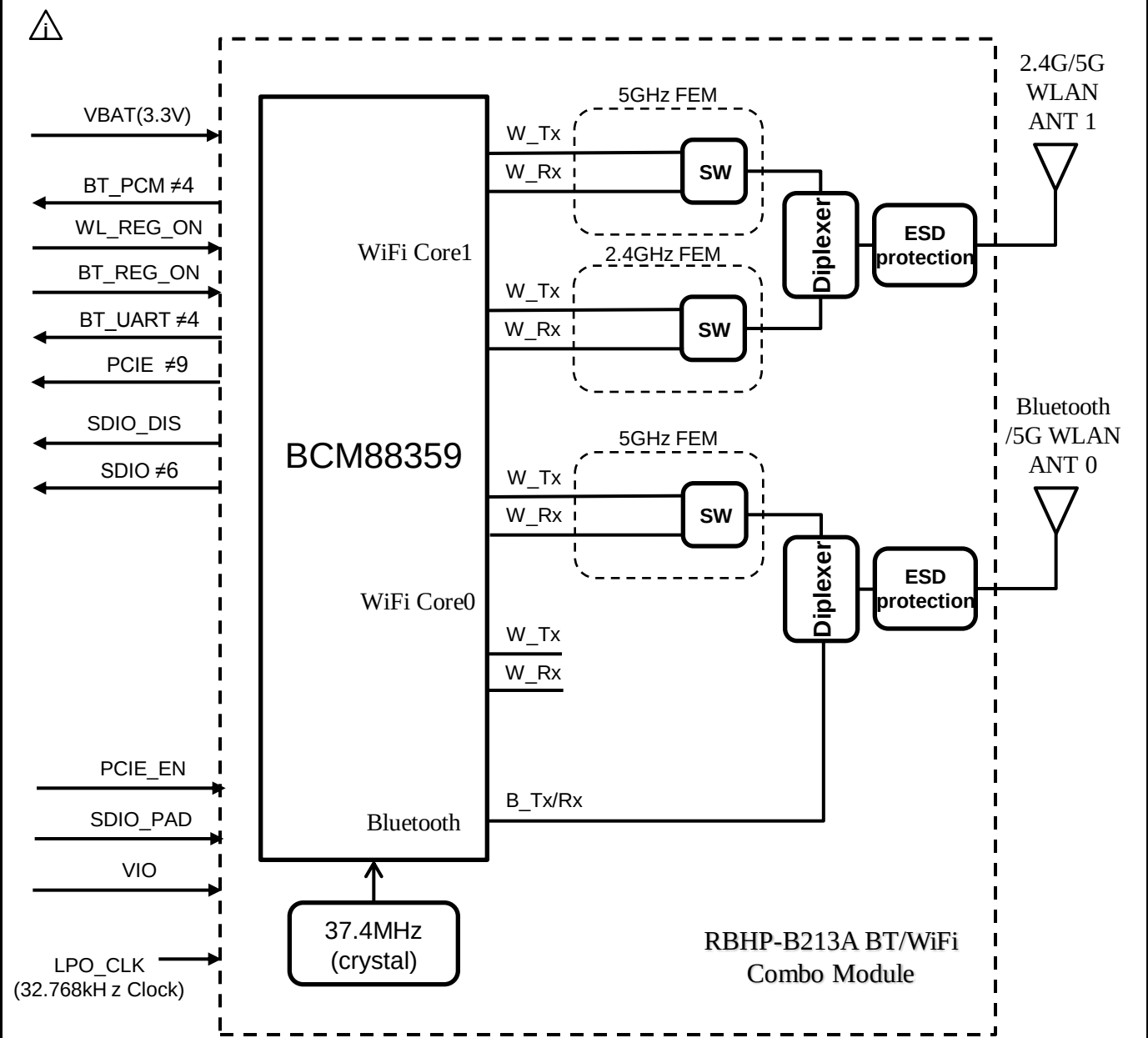
12. Reliability Test Conditions

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.	

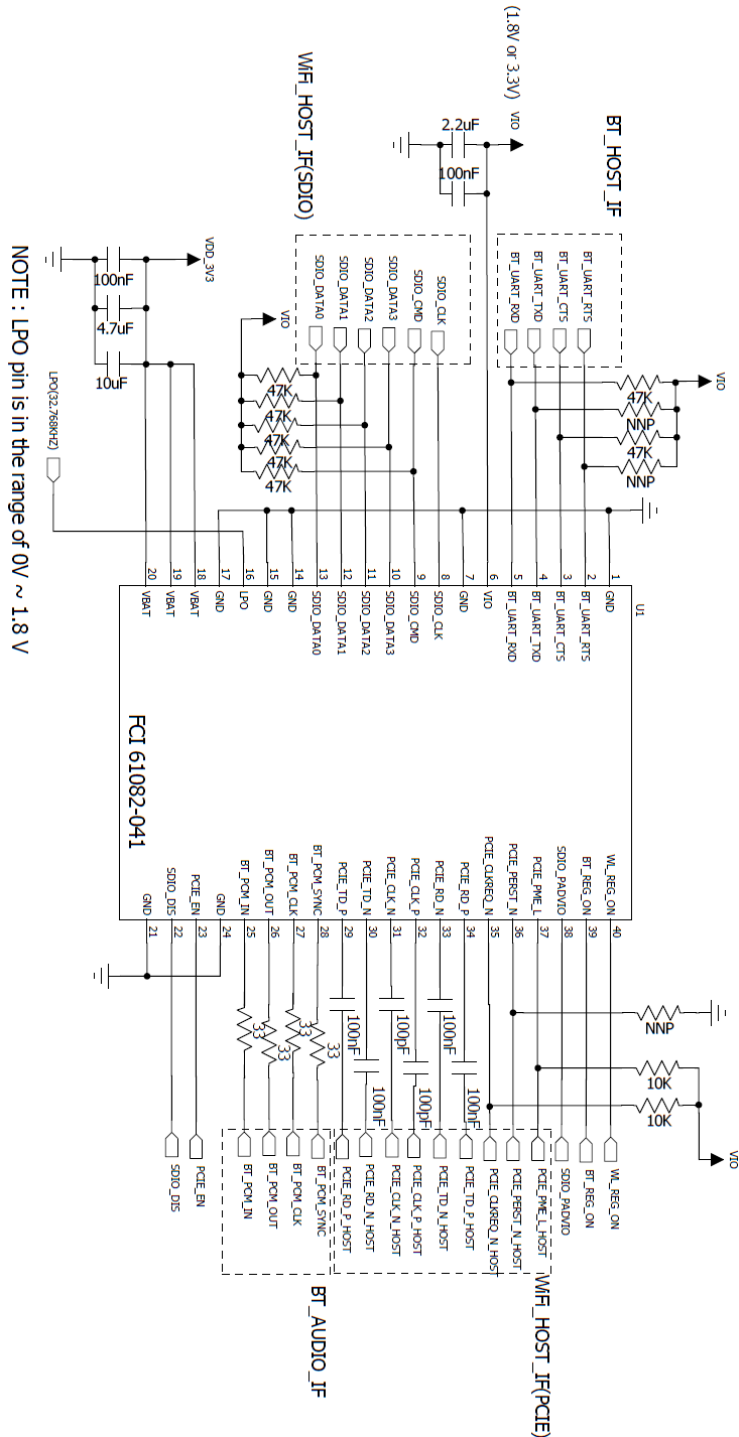
R E V	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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13. Block Diagram



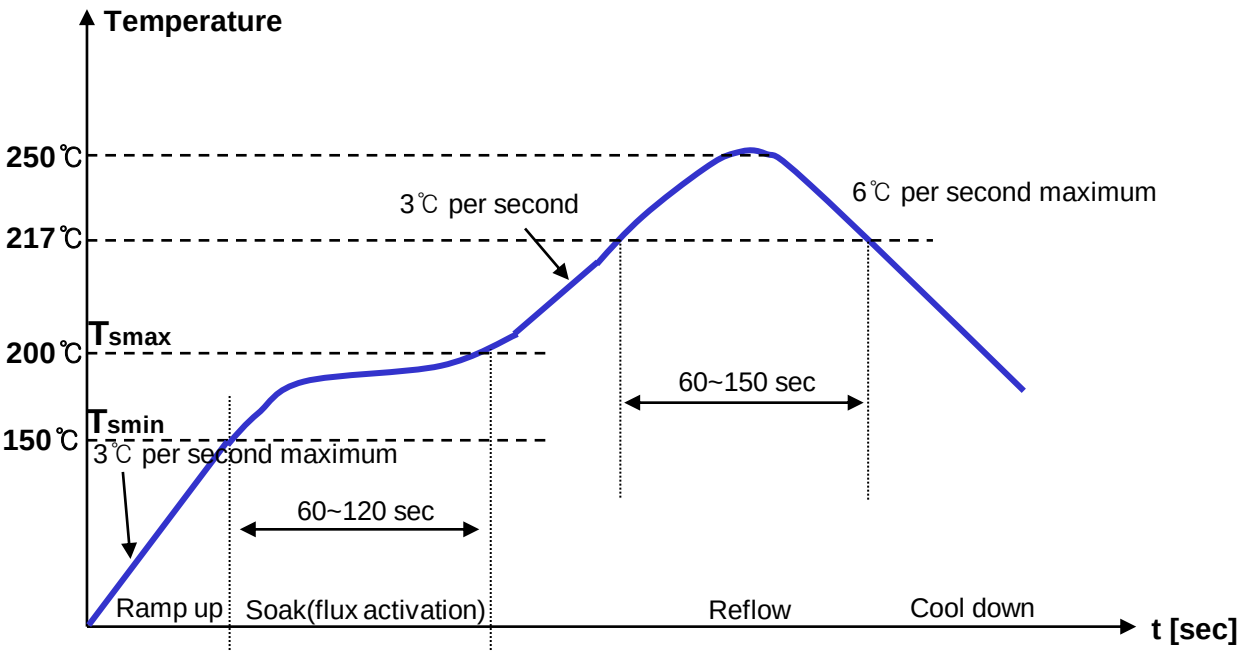
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	1.3	2017. 06.27.	Rev1.3 Released	DSGD	CHKD	APPD	RBHP-B213A
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14. Reference Circuit



REV	1.2	2017. 05.23.	Rev1.2 Released	LG Innotek Co., Ltd			
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15. Reflow Profile

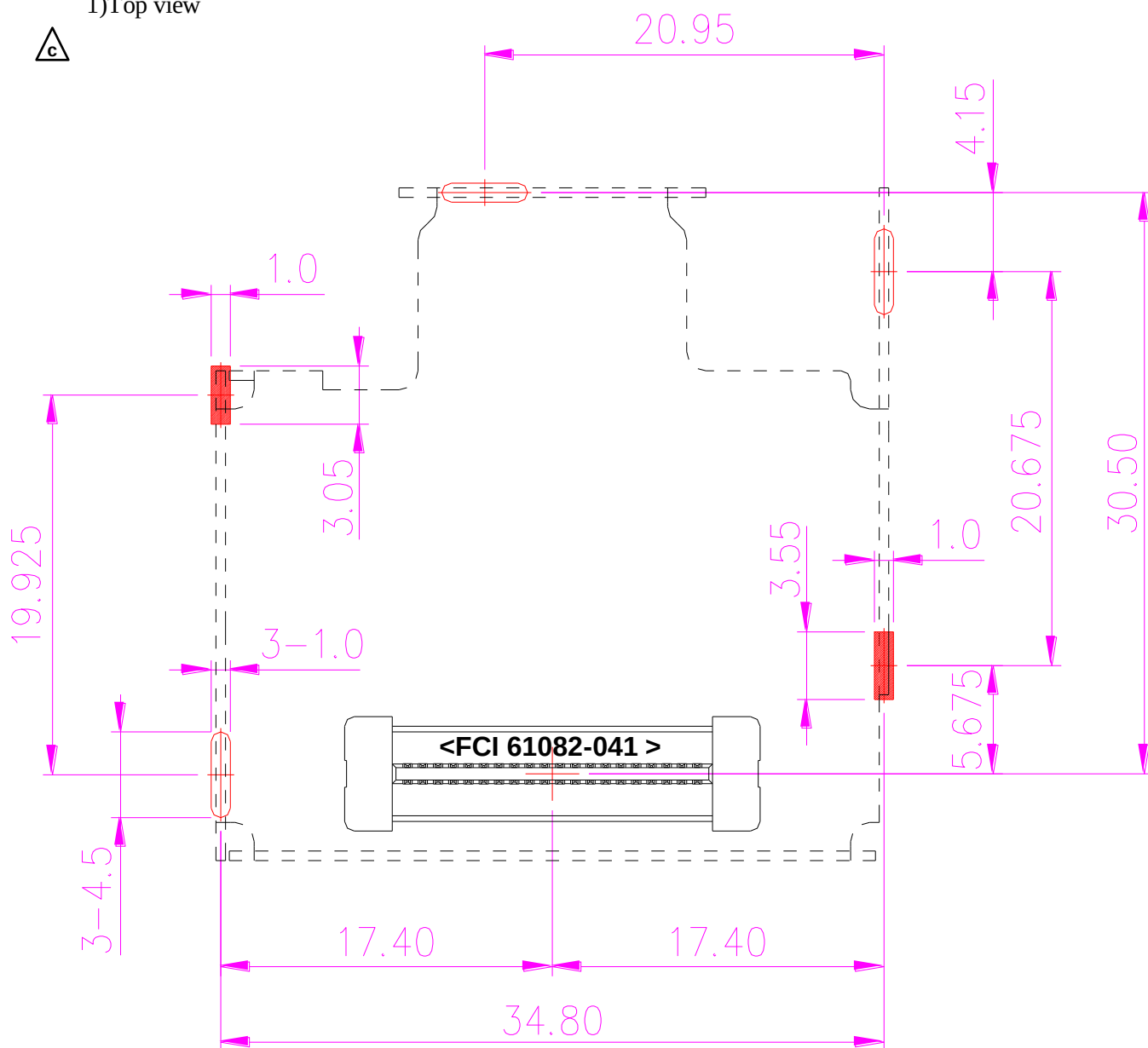


Profile Feature	Pb-free Assembly
Initial ramp-up rate	3°C per second maximum
Preheat	
Temperature minimum(Tsmin)	150°C
Temperature maximum(Tsmax)	200°C
Time(minimum to maximum)	60-120s
Ramp-up rate Tsmax to T _L	3°C per second maximum
Liquidus Temperature(T _L)	217°C
Time above T _L	60-150s
Peak temperature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

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	1.5	2017. 08.10.	Rev1.5 Released				
	1.6	2017. 09.06.	Rev1.6 Released				

16. Recommended Land Pattern

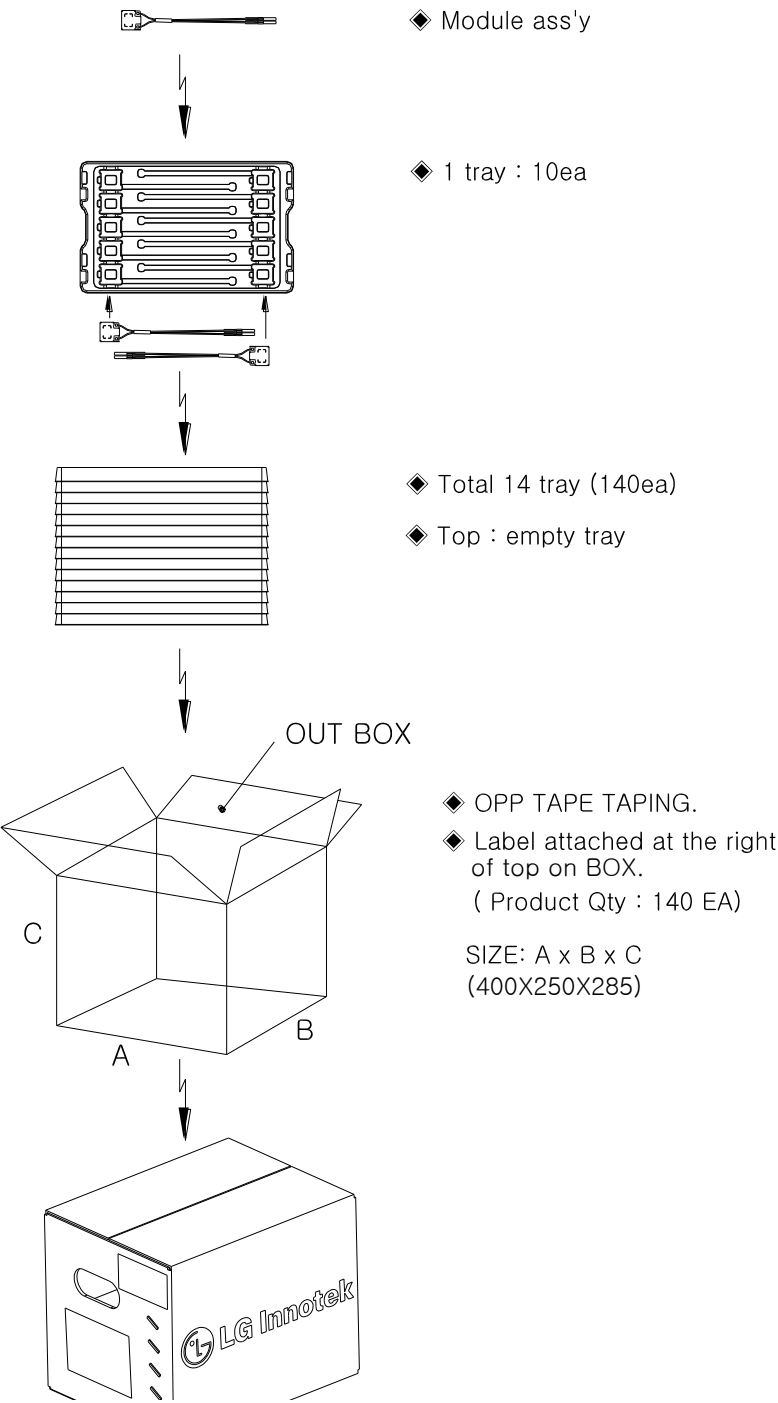
1)Top view



<Unit : mm>

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17. Packing Information



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

17. Packing Information



Item	LGE	v1.0	2016.05.30
EAT63433501	130		
Spec	RBHP-B213A	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-B213A.6530-001.1

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	1.5	2017.08.10.	Rev1.5 Released				
	1.6	2017.09.06.	Rev1.6 Released				

TITLE : Specifications for approval (RBHP-B213A)				REV 1.6 (68 / 68)			
(CUSTOMER P/NO : EAT63433501)							
18. Ordering Information							
R B H P - B 2 1 3 A Product RB Bluetooth Module Type H BT(Class2)+WLAN Host Interface P PCle Chipset Maker B Broadcom Serial Number 213 213 Revision A A Version							
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-B213A
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	1.6	2017. 09.06.	Rev1.6 Released				

LG Innotek Co., Ltd.

(30) - 4021

FCC WARNING STATEMENT

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 interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

Any changes or modifications (including the antennas) to this device that are not expressly approved by the manufacturer may void the user's authority to operate the equipment.

Note : This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. 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 to correct the interference by one or more of the following measures:

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

Modifications not expressly approved by the manufacturer could void your authority to operate the equipment under FCC rules.

FCC RF Radiation Exposure Statement

This equipment complies with FCC RF Radiation exposure limits set forth for an uncontrolled environment. This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Information for OEM integrator

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user manual of the end product.

The user manual which is provided by OEM integrators for end users must include the following information in a prominent location.

"To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter." Label for end product must include "Contains FCC ID: BEJRBHP-B213A, IC: 2703H-RBHP-B213A" or "A RF transmitter inside, FCC ID: BEJRBHP-B213A, IC: 2703H-RBHP-B213A".

IC WARNING STATEMENT

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with IC RF Radiation exposure limits set forth for an uncontrolled environment. This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Cet équipement est conforme aux limites établies par Industrie Canada en matière d'exposition aux radiofréquences dans un environnement non contrôlé. Cet appareil et son antenne ne doivent pas être colocalisés ou fonctionner en conjonction avec tout autre antenne ou émetteur.

Cet équipement doit être installé et utilisé avec une distance minimale de 20cm entre le radiateur et votre corps.