

**1. General Description**

This document contains the specifications pertinent to the wireless LAN module, which comply with IEEE802.11a, IEEE802.11b and IEEE802.11g.

ALPS Wireless LAN Module contains complete radio part including base band MAC processor.

**2 Features**

**2.1 2.4GHz Wireless LAN module**

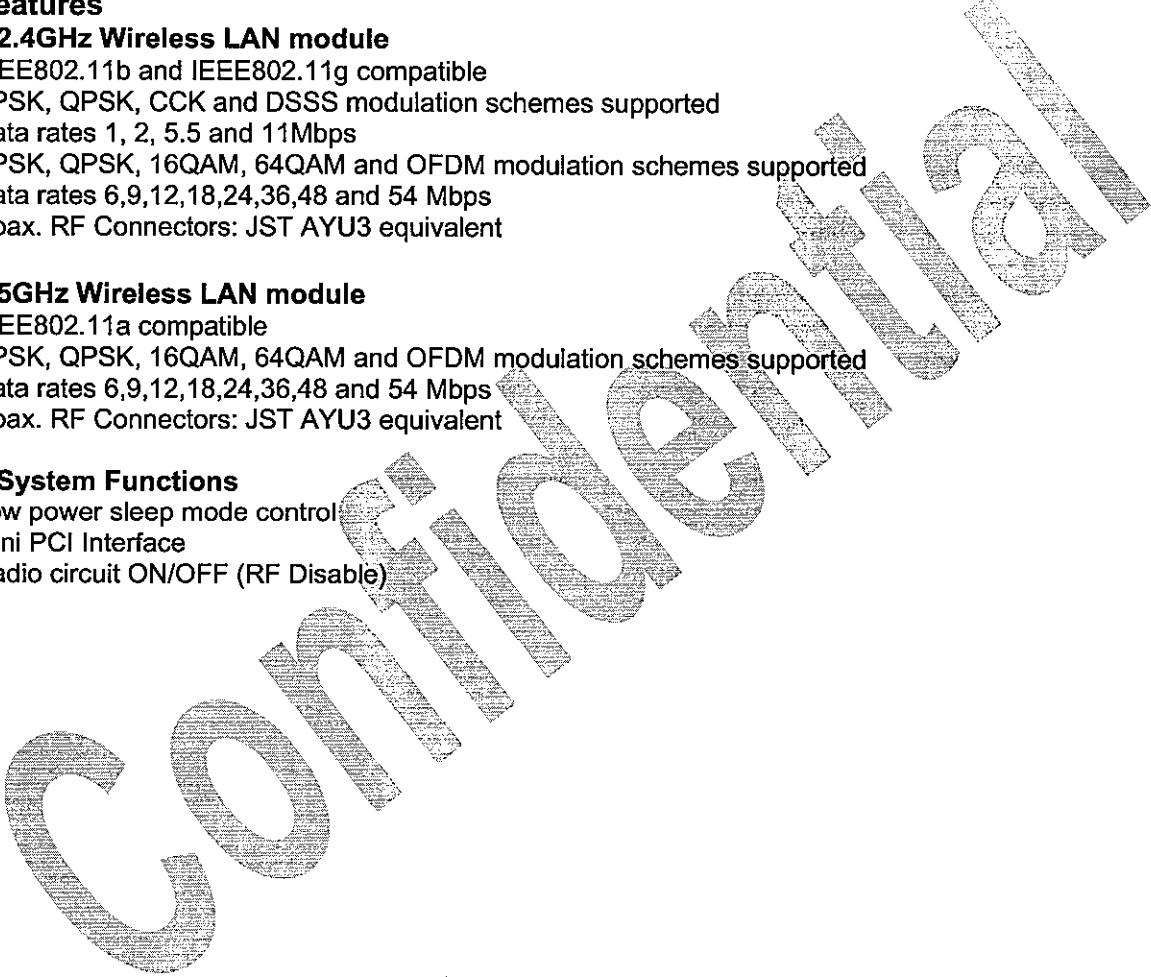
- IEEE802.11b and IEEE802.11g compatible
- BPSK, QPSK, CCK and DSSS modulation schemes supported  
Data rates 1, 2, 5.5 and 11Mbps
- BPSK, QPSK, 16QAM, 64QAM and OFDM modulation schemes supported  
Data rates 6,9,12,18,24,36,48 and 54 Mbps
- Coax. RF Connectors: JST AYU3 equivalent

**2.2 5GHz Wireless LAN module**

- IEEE802.11a compatible
- BPSK, QPSK, 16QAM, 64QAM and OFDM modulation schemes supported  
Data rates 6,9,12,18,24,36,48 and 54 Mbps
- Coax. RF Connectors: JST AYU3 equivalent

**2.3 System Functions**

- Low power sleep mode control
- Mini PCI Interface
- Radio circuit ON/OFF (RF Disable)



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### 3. Electrical Characteristics

#### 3.1 2.4GHz Connection Characteristics

##### 3.1.1 Absolute Maximum Ratings

Maximum supply voltage Vcc	3.6 V
Storage temperature	-25 to 70deg.C
Humidity	20 to 95%

##### 3.1.2 Recommended Operating Conditions

Operating Temperature	0 deg.C to 60 deg.C
Humidity	20 to 95% (no-condensing)
Supply Voltage Vcc	Nominal : 3.3V Extreme : 3.3V +/-0.3V

#### 3.1.3 Power Consumption

##### 3.1.3.1 DSSS Modulation

Mode	Consumption (mW)		
	Min.	Typ.	Max.
Sleep *1)	—	80	90
Rx Active *1)	—	890	1100
Tx Active *1)*2)	—	1550	1700

Notes: \*1) Power consumption was measured by using the ART ( Atheros Radio Test ) application.

\*2) ART command is Continuous transmit options. (condition : 99 percent duty cycle data mode)

##### 3.1.3.2 OFDM Modulation

Mode	Consumption (mW)		
	Min.	Typ.	Max.
Sleep *1)	—	80	90
Rx Active *1)	—	1000	1200
Tx Active *1)*2)	—	1700	1900

Notes: \*1) Power consumption was measured by using the ART ( Atheros Radio Test ) application.

\*2) ART command is Continuous transmit options. (condition : 99 percent duty cycle data mode)

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**3.1.4 Radio Part Characteristics**

These conditions apply to all AC characteristics: Vcc=3.3V, Temp.=25 deg.C, 2400MHz to 2483.5MHz

**3.1.4.1 Common Physical Layer Specifications**

Operating Frequency	2400MHz to 2483.5MHz	
Operating channel spacing	5MHz	
Channel center Frequency	2412, 2417, 2422, 2427, 2432 2437, 2442, 2447, 2452, 2457 2462, 2467, 2472	
Modulation	DSSS	*1) BPSK
		QPSK
		CCK
	OFDM	*2) BPSK
		QPSK
		16QAM 64QAM
TX to RX turnaround time	10us max.	
RX to TX turnaround time	5us max.	
Slot time	20us max. (including "energy detect time")	
Channel switching settling time	224us max.	
Transmit and receive antenna port impedance	50 ohm typ.	
Transmit and receive in-band and out-of-band spurious emissions	Refer to ARIB STD-T66	

Notes: \*1) Data Rate, Modulation

Data Rate (Mbps)	Modulation
1	BPSK
2	QPSK
5.5	CCK
11	CCK

Notes: \*2) Data Rate, Modulation, and Coding Rate

Data Rate (Mbps)	Modulation and Coding Rate
6	BPSK, 1/2
9	BPSK, 3/4
12	QPSK, 1/2
18	QPSK, 3/4
24	16QAM, 1/2
36	16QAM, 3/4
48	64QAM, 2/3
54	64QAM, 3/4

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**3.1.4.2 Receiver Characteristics**

**3.1.4.2.1 DSSS Modulation**

	Data rate (Mbit/s)	Min.	Typ.	Max.	Unit
Minimum sensitivity *1)	1	—	-95	—	dBm
	2	—	-90	—	
	5.5	—	-90	—	
	11	—	-87	-76	
Adjacent channel rejection *1)	11	35	40	—	dBm
Maximum input level *1)	11	-10	7	—	dBm

Notes: \*1) FER < 8% at PSDU length of 1024 bytes

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3.1.4.2.2 OFDM Modulation

	Data rate (Mbit/s)	Min.	Typ.	Max.	Unit
Minimum sensitivity *1)	6	—	-90	-82	dBm
	9	—	-90	-81	
	12	—	-89	-79	
	18	—	-86	-77	
	24	—	-83	-74	
	36	—	-80	-70	
	48	—	-75	-66	
	54	—	-73	-65	
Adjacent channel rejection *1)	6	16	25	—	dB
	9	15	25	—	
	12	13	25	—	
	18	11	23	—	
	24	8	20	—	
	36	4	20	—	
	48	0	17	—	
	54	-1	16	—	
Maximum input level *1)	6	-30	-7	—	dBm
	9		-7	—	
	12		-7	—	
	18		-7	—	
	24		-7	—	
	36		-11	—	
	48		-15	—	
	54		-18	—	
CCA sensitivity	> -76dBm				

Notes: \*1) PER < 10% at PSDU length of 1000 bytes

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**3.1.4.3 Transmitter Characteristics**

	Min	Typ	Max	Unit
Transmit power levels DSSS at 1,2,5,11Mbps *1)	—	17	19	dBm
Transmit power levels OFDM at 6~36Mbps at 48Mbps at 54Mbps	—	17	19	dBm
	—	14	16	
	—	13	15	
	—	13	15	
Transmission spurious at 10 to 2387MHz *3) at 2387 to 2400MHz at 2483.5 to 2496.5MHz at 2496.5 to 8000MHz	—	-40	-26	dBm
	—	-38	-16	
	—	-40	-16	
	—	-48	-26	
Transmit center frequency tolerance *4)	—	+2	+/-25	ppm
Transmit power-on and power-down ramp		1	2	us
Occupied bandwidth *5)		16.6	26	MHz

Notes: \*1)~\*5) These shall be measured in the following conditions

		RBW	VBW
*1)	Transmit power levels	1MHz	3MHz
*2)	Transmit power levels	300kHz	300kHz
*3)	Transmission spurious	1MHz	10kHz
*4)	Transmit center freq. tolerance	1kHz	100Hz
*5)	Occupied bandwidth	300kHz	300kHz

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**3.2 5GHz Connection Characteristics**

**3.2.1 Absolute Maximum Ratings**

Maximum supply voltage Vcc	3.6 V
Storage temperature	-25 to 70 deg.C
Humidity	20 to 95%

**3.2.2 Recommended Operating Conditions**

Qualified temperature	0 deg.C to 60 deg.C
Humidity	20 to 95% (no-condensing)
Supply Voltage Vcc	Nominal : 3.3V Extreme : 3.3V±0.3V

**3.2.3 Power Consumption**

Mode		Consumption (mW)		
		Min.	Typ.	Max.
Sleep	*1)	—	80	90
Rx Active	*1)	—	960	1100
Tx Active	*1)*2)	—	1750	1850

Notes: \*1) Power consumption was measured by using the ART ( Atheros Radio Test ) application.  
 \*2) ART command is Continuous transmit options. (condition : 99 percent duty cycle data mode)

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**3.2.4 Radio Part Characteristics**

These conditions apply to all AC characteristics: Vcc=3.3V, Temp.=25 deg.C, 5.15GHz to 5.85GHz

**3.2.4.1 Common Physical Layer Specifications**

Operating Frequency	5180-5320, 5745-5825MHz
Operating channel numbers	36, 40, 44, 48 52, 56, 60, 64
Channel center Frequency	149, 153, 157, 161, 165 5180, 5200, 5220, 5240MHz 5260, 5280, 5300, 5320MHz
Modulation *1)	5745, 5765, 5785, 5805, 5825MHz BPSK OFDM QPSK OFDM 16QAM OFDM 64QAM OFDM
Error correcting cord	K = 7 (64states) convolutional code
Coding rate	1/2, 2/3, 3/4
Number of subcarriers	52
OFDM symbol duration	4.0us
Guard interval	0.8us (TGI)
Transmit and receive antenna port impedance	50 ohm typ.
Transmit and receive in-band and out-of-band spurious emissions	Refer to ARIB STD-T71
TX RF delay	*2)
Slot time (RX-to-TX turnaround time)	9us

Notes: \*1) Data Rate, Modulation, and Coding Rate

Data Rate (Mbps)	Modulation and Coding Rate
6	BPSK, 1/2
9	BPSK, 3/4
12	QPSK, 1/2
18	QPSK, 3/4
24	16QAM, 1/2
36	16QAM, 3/4
48	64QAM, 2/3
54	64QAM, 3/4

Notes: \*2) The time between "the issuance of a PMD.DATA.request to the PMD" and "the start of the corresponding symbol at the air interface"

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**3.2.4.2 Receiver Characteristics**

	Data rate (Mbit/s)	Min.	Typ.	Max.	Unit
Minimum sensitivity *1)	6	—	-89	-82	dBm
	9	—	-89	-81	
	12	—	-87	-79	
	18	—	-85	-77	
	24	—	-81	-74	
	36	—	-78	-70	
	48	—	-74	-66	
	54	—	-71	-65	
Adjacent channel rejection *1)	6	16	29	—	dB
	9	15	28	—	
	12	13	28	—	
	18	11	26	—	
	24	8	23	—	
	36	4	21	—	
	48	0	19	—	
	54	-1	18	—	
Alternate adjacent channel rejection *1)	6	32	42	—	dB
	9	31	41	—	
	12	29	39	—	
	18	27	37	—	
	24	24	34	—	
	36	20	29	—	
	48	16	29	—	
	54	15	29	—	
Maximum input level *1)	6	-30	7	—	dBm
	9		7	—	
	12		7	—	
	18		7	—	
	24		7	—	
	36		-3	—	
	48		-13	—	
	54		-15	—	
CCA sensitivity	> -82dBm *2)				

Notes: \*1) PER < 10% at PSDU length of 1000 bytes

\*2) If the preamble portion was missed, the receiver shall hold the carrier sense signal busy for any signal 20 dB above the minimum 6 Mbit/s sensitivity (-62dBm).

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**3.2.4.3 Transmitter Characteristics**

	Min	Typ	Max	Unit
Transmit power levels (FCC/5.15~5.25GHz)				dBm
at 6~48Mbps *1)	—	14	16	
at 54Mbps	—	13	15	
Transmit power levels (FCC/5.25~5.825GHz)				dBm
at 6~36Mbps *1)	—	17	19	
at 48Mbps	—	14	16	
at 54Mbps	—	13	15	
Transmit power levels (ETSI)				dBm
at 6~36Mbps *1)	—	17	19	
at 48Mbps	—	14	16	
at 54Mbps	—	13	15	
Transmit spectrum mask				dB
at +/-20MHz *2)	—	-29	-25	
at +/-40MHz	—	-55	-40	
Transmission spurious				dBm
at 10MHz to 5.14GHz *3)	—	-50	-26	
at 5.865 to 16GHz	—	-53	-26	
Transmit center frequency tolerance		+2	+/-20	ppm
Occupied bandwidth		16.7	18.0	MHz

Notes: \*1)~\*5) These shall be measured in the following conditions

		RBW	VBW
*1)	Transmit power levels	300kHz	300kHz
*2)	Transmit spectrum mask	300kHz	300kHz
*3)	Transmission spurious	1MHz	1kHz
*4)	Transmit center frequency tolerance	1kHz	100Hz
*5)	Occupied bandwidth	300kHz	300kHz

Notes: \*3) national regulations

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### 3.3 Baseband Characteristics

These conditions apply to all characteristics: Vcc=3.3V, Temp.=25 deg.C

#### 3.3.1 PCI DC Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Max.	Unit
VIH	High level input voltage	-	0.5Vcc	Vcc+0.5	V
VIL *1)	Low level input voltage	-	-0.5	0.3Vcc	V
VIPU	Input pull-up voltage	-	0.7 Vcc	-	V
IIL *2)	Input leakage current	0<Vin<Vcc	-	+/-10	uA
VOH	High level output voltage	Iout = -500uA	0.9Vcc	-	V
VOL	Low level output voltage	Iout = 1500uA	-	0.1 Vcc	V
CIN *3)	Input Capacitance	-	-	10	pF
CCLK	PCI_CLK pin capacitance	-	5	12	pF
CIDSEL *4)	PCI_IDSEL Pin capacitance	-	-	8	pF
LPIN	Pin Inductance	-	-	20	nH

Notes: \*1) By design. Minimum voltage to which pull-up resistors are calculated to pull a floated network. Applications sensitive to static power utilization must ensure that the input buffer is conducting minimum current at this input voltage.

\*2) Input leakage currents include hi-Z output leakage for all bi-directional buffers with tri-state outputs.

\*3) Absolute maximum pin capacitance for a PCI input is 10pF(except for PCI\_CLK).

\*4) Lower capacitance on this input-only pin allows for nonresistive coupling to PCI\_AD[XX].

#### 3.3.2 AC Specification for 3.3V signaling

AC Specifications for all PCI Signaling except GLK

Symbol	Parameter	Conditions	Min. *1)	Max. *1)	Unit
slewr	PCI output rise slew rate *2)	0.2Vcc - 0.6 Vcc	1	4	V/ns
slewf	PCI output fall slew time *2)	0.6Vcc - 0.2 Vcc	1	4	V/ns
Ic1	Low clamp current	-3 < Vin < -1	-25+(Vin+1)/0.015	-	mA
IcH	High clamp current	Vcc+4 > Vin > Vcc+1	25+(Vin- Vcc-1)/0.015	-	mA

Notes: \*1) Based on the minimum capacitive load a driver will see (10pF)

\*2) The cumulative edge rate across the specified range, rather than the instantaneous rate at any point without the transition range. Rise slew rate does not apply to open outputs.

#### 3.3.3 PCI Clock Specifications

Table. PCI Interface Clock Specifications

Symbol	Parameter	Min.	Max.	Unit
tcyc	CLK cycle time	30	*1)	ns
thigh	CLK high time	11		ns
tlow	CLK low time	11		ns
	CLK slew rate*2)	1	4	V/ns

Notes: \*1) The host interface must operate at frequency of 33 MHz unless otherwise specified.

\*2) The slew rate specification must be met across the minimum p-to-p portion of the clock waveform.

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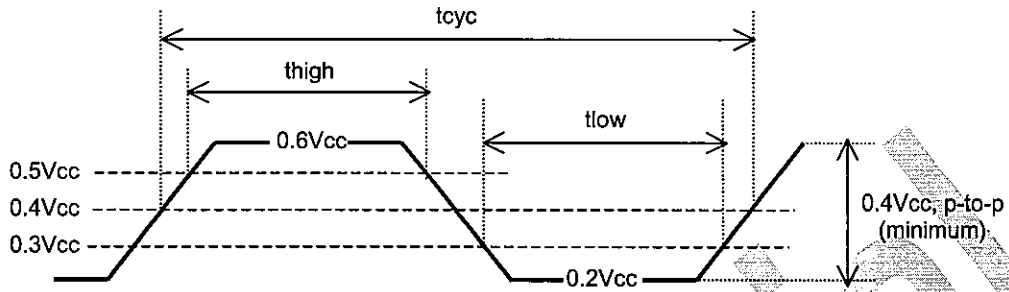


Figure 2. PCI Interface Clock Waveform

### 3.3.4 PCI Interface Timing Parameters

Table. PCI Interface Timing Parameters

Symbol	Parameter	Min.	Max.	Unit
tval	PCI_CLK to signal valid delay *1)*2)	-	11	ns
tval(ptp)	PCI_CLK to signal valid delay *1)*2)	-	12	ns
tsu	Input setup time to PCI_CLK *1) *2)	7	-	ns
Tsu(ptp)	Input setup time to PCI_CLK *1) *2)	10,12	-	ns
th	Input hold time from PCI_CLK *1)	2	-	ns

Notes: \*1) Refer to the PCI specifications for measurement conditions, assumed 35pF load.

\*2) PCI\_REQ # and PCI\_GNT# are point-to-point signals and have different output valid delay and input setup times than bused signals. PCI\_GNT# has a setup of 10; PCI\_REQ# has a setup of 12. All other signals are bused.

Note : Other Electrical specifications of PCI Bus are compliant to the PCI2.2.

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1) Compliance with FCC requirement 15.407(c)

Data transmission is always initiated by software, which is then passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. Several special packets are initiated by the MAC.

These are the only ways the digital baseband portion will turn on the RF transmitter, which it then turns off at the end of the packets.

Therefore, the transmitter will be on only while one of the aforementioned packets is being transmitted. In other words, this device automatically discontinues transmission in case of either absence of information to transmit or operational failure.