Operational Description

Date: 2012/12/27

MB82 can used for WLAN nodes. Every node has a unique network address. Main function is a type of local-area network node that uses high-frequency radio waves rather than wires to communicate between nodes. Use the IEEE 802.11b/g/n (20MHz) network with 11 channels (2412MHz~2462MHz, Space 5MHz), IEEE 802.11n (40MHz) network with 7 channels (2422MHz~2452MHz, Space 5MHz), IEEE 802.11a/n (20MHz) network with 12 channels (5260MHz~5320MHz, 5500MHz~5700MHz, Space 20MHz) and IEEE 802.11n (40MHz) network with 6 channels (5270MHz~5310MHz, 5510MHz~5670MHz, Space 40MHz).

Time base of the transmission frequency:

For IF and RF frequency, Crystal is a clock reference.

Synthesizer:

Synthesizer inside Transceiver. Internal voltage controlled oscillator (VCO) provides the desired LO signal base on the phase-locked loop (PLL) with a relatively wide tuning range for this application.

Transmission:

Base-band Processing (BBP) IC has DSSS (BPSK/QPSK/CCK) and OFDM (BPSK/QPSK/16QAM/64QAM) modulation function, it provides transmission data rate are 1, 2, 5.5, 11 Mbps on DSSS and 6, 12, 18, 24, 36, 48, 54, 300 Mbps on OFDM. Digital data signal will be converted to analog (TX IQ) signals through DAC in BBP IC, TX IQ pass through to low pass filter. TX I/Q signal use direct conversion (zero-IF) architecture converter to generate carrier frequency signal. Transceiver IC and external PA magnify output power.

Receiver:

Reverse direction isolation of LNA inside Transceiver IC suppresses unwanted radiation. Then RF signal will be directly down to IF signal (RX IQ) and high frequency spurious emissions are suppressed by LPF. At last RX IQ signal will be demodulated digital data.

Base band Processing:

1. *Channel Selection:* Channel selection is controlled by BBP IC.

Data Modulation: DSSS (BPSK/QPSK/CCK) and OFDM (BPSK/QPSK/16QAM/64QAM) modulation type is controlled by BBP IC.

2. *Power Control Level:* BBP IC has the power leveling loop table are calibrated by manufacturer, then uses closed-loop power control function to limit RF output power level. Power leveling step accuracy is ± 0.5dB.

Transmit/Receive Switch: EUT has Transmit/Receive Switch and Antenna switch. End user can't select any power setting.

Power Rate: Form host system

Discontinue Transmitting with absence of Data or operational failure states:

"The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met." 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 (ACKs, CTS, PSPoll, etc...) 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 packet. Therefore, the transmitter will be on only while one of the aforementioned packets is being transmitted.

Product Details:

IEEE 802.11n

Items	Description
Product Type	WLAN (1/2TX, 3RX)
Radio Type	Intentional Transceiver
Power Type	From Host System
Modulation	see the below table for IEEE 802.11n
Data Modulation	OFDM (BPSK / QPSK / 16QAM / 64QAM)
Data Rate (Mbps)	see the below table for IEEE 802.11n
Frequency Range	5250 ~ 5350MHz / 5470 ~ 5725MHz
Channel Number	12 for 20MHz bandwidth ; 5 for 40MHz bandwidth
Channel Band Width (99%)	**Ant. 4 :** MCS0 (20MHz): 18.08 MHz ; MCS0 (40MHz): 36.80 MHz ; MCS8 (20MHz): 23.04 MHz ; MCS8 (40MHz): 39.36 MHz **Ant. 5 :** MCS0 (20MHz): 33.12 MHz ; MCS0 (40MHz): 73.28 MHz **Ant. 6 :** MCS0 (20MHz): 18.08MHz ; MCS0 (40MHz): 36.48 MHz ; MCS8 (20MHz): 18.08 MHz ; MCS8 (40MHz): 36.48 MHz **Ant. 10:** MCS0 (20MHz): 31.04 MHz ; MCS0 (40MHz): 61.76 MHz ; MCS8 (20MHz): 31.52 MHz ; MCS8 (40MHz): 58.56 MHz
Conducted Output Power	**<For Band 2>:** **Ant. 4 :** MCS0 (20MHz): 18.77 dBm ; MCS0 (40MHz): 18.47 dBm ; MCS8 (20MHz): 21.86 dBm ; MCS8 (40MHz): 20.70 dBm **Ant. 5 :** MCS0 (20MHz): 20.67 dBm ; MCS0 (40MHz): 20.49 dBm **Ant. 6 :** MCS0 (20MHz): 14.30 dBm ; MCS0 (40MHz): 14.24 dBm ; MCS8 (20MHz): 17.37 dBm ; MCS8 (40MHz): 17.09 dBm **Ant. 10:** MCS0 (20MHz): 22.97 dBm ; MCS0 (40MHz): 22.50 dBm ; MCS8 (20MHz): 23.19 dBm ; MCS8 (40MHz): 22.30 dBm **<For Band 3>:** **Ant. 4 :** MCS0 (20MHz): 18.81 dBm ; MCS0 (40MHz): 18.58 dBm ; MCS8 (20MHz): 21.56 dBm ; MCS8 (40MHz): 21.46 dBm **Ant. 5 :** MCS0 (20MHz): 20.52 dBm ; MCS0 (40MHz): 20.53dBm **Ant. 6 :** MCS0 (20MHz): 14.17 dBm ; MCS0 (40MHz): 14.35 dBm ; MCS8 (20MHz): 17.28 dBm ; MCS8 (40MHz): 17.22 dBm **Ant. 10:** MCS0 (20MHz): 23.13 dBm ; MCS0 (40MHz): 23.27 dBm ; MCS8 (20MHz): 23.09 dBm ; MCS8 (40MHz): 23.08 dBm

IEEE 802.11a

Items	Description
Product Type	WLAN (1/2TX, 3RX)
Radio Type	Intentional Transceiver
Power Type	From Host System
Modulation	OFDM for IEEE 802.11a
Data Modulation	OFDM (BPSK / QPSK / 16QAM / 64QAM)
Data Rate (Mbps)	OFDM (6/9/12/18/24/36/48/54)
Frequency Range	5250 ~ 5350MHz / 5470 ~ 5725MHz
Channel Number	12
Channel Band Width (99%)	**Ant. 5 :** 31.36 MHz
Conducted Output Power	**<For Band 2>:** **Ant. 4 :** 18.61 dBm **Ant. 5 :** 20.70 dBm **Ant. 6 :** 14.09 dBm **Ant. 10:** 22.88 dBm **<For Band 3>:** **Ant. 4 :** 18.80 dBm **Ant. 5 :** 20.57 dBm **Ant. 6 :** 14.30 dBm **Ant. 10:** 23.05 dBm

Antenna & Band width

Antenna	Single (TX)		Two (TX)	
Band width Mode	20 MHz	40 MHz	20 MHz	40 MHz
IEEE 802.11a	V	X	V	X
IEEE 802.11n	V	V	V	V

IEEE 802.11n spec

MCS Index	Nss	Modulation	R	NBPSC	NCBPS		NDBPS		Datarate(Mbps)			
									800nsGI		400nsGI	
					20MHz	40MHz	20MHz	40MHz	20MHz	40MHz	20MHz	40MHz
0	1	BPSK	1/2	1	52	108	26	54	6.5	13.5	7.200	15
1	1	QPSK	1/2	2	104	216	52	108	13.0	27.0	14.400	30
2	1	QPSK	3/4	2	104	216	78	162	19.5	40.5	21.700	45
3	1	16-QAM	1/2	4	208	432	104	216	26.0	54.0	28.900	60
4	1	16-QAM	3/4	4	208	432	156	324	39.0	81.0	43.300	90
5	1	64-QAM	2/3	6	312	648	208	432	52.0	108.0	57.800	120
6	1	64-QAM	3/4	6	312	648	234	486	58.5	121.5	65.000	135
7	1	64-QAM	5/6	6	312	648	260	540	65.0	135.0	72.200	150
8	2	BPSK	1/2	1	104	216	52	108	13.0	27.0	14.444	30
9	2	QPSK	1/2	2	208	432	104	216	26.0	54.0	28.889	60
10	2	QPSK	3/4	2	208	432	156	324	39.0	81.0	43.333	90
11	2	16-QAM	1/2	4	416	864	208	432	52.0	108.0	57.778	120
12	2	16-QAM	3/4	4	416	864	312	648	78.0	162.0	86.667	180
13	2	64-QAM	2/3	6	624	1296	416	864	104.0	216.0	115.556	240
14	2	64-QAM	3/4	6	624	1296	468	972	117.0	243.0	130.000	270
15	2	64-QAM	5/6	6	624	1296	520	1080	130.0	270.0	144.444	300

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPSC	Number of coded bits per single carrier
NCBPS	Number of coded bits per symbol
NDBPS	Number of data bits per symbol
GI	guard interval

Table for Filed Antenna:

Ant.	Brand	Model Name	Antenna Type	Connector	Antenna Gain (dBi)	
					2.4GHz	5GHz
1	MOTOROLA	ML-2499-BPNA3-01R	Directional Panel Antenna	N-Type Female	15.5	-
2	MOTOROLA	ML-2499-FHPA9-01R	Dipole Omni Antenna	Type-N-Male	10.5	-
3	MOTOROLA	ML-2499-PNAHD-02R	Patch Antenna	RP-SMAMale	7.5	-
4	MOTOROLA	ML-5299-HPA10-01	Omni-Directional Antenna	N male	-	10.5
5	MOTOROLA	ML-5299-BYGA15-012	Yagi Antenna	N-Type Female	-	10.5
6	MOTOROLA	ML-5299-WPNA1-01R	Directional Panel Antenna	RP-SMAMale	-	14
7	MOTOROLA	ML-2452-PNL9M3-036	3-Port Dual-Band Dir Panel Antenna (2 Vert and 1 Hor ports)	RP-SMAMale x 3	11	10.7
8	MOTOROLA	ML-2452-APAG2A1-01	Omni-Directional Antenna	SMA male RP	2.7	2
9	MOTOROLA	ML-2452-HPA6X6-036	6-Port Omni Patch Array Antenna	Type-N, Male x 6	4	6
10	MOTOROLA	ML-2452-PTA6X6-036	Dual-band MIMO omni patch array, three 2.4G elements, three 5G element Antenna	RP-SMA Male x 6	3	5

Ant.	Loss of External Cable (dB)		True Gain (dBi)		Remark
	2.4GHz	5GHz	2.4GHz	5GHz	
1	0.65	-	14.85	-	2TX, 3RX
2	1.15	-	9.35	-	2TX, 3RX
3	0.65	-	6.85	-	2TX, 3RX
4	-	2.42	-	8.08	2TX, 3RX
5	-	1.42	-	9.08	1TX, 1RX
6	-	1.42	-	12.58	2TX, 3RX
7	0.65	1.42	10.35	9.28	2TX, 3RX
8	0.65	1.42	2.05	0.58	2TX, 3RX
9	1.15	2.42	2.85	3.58	2TX, 3RX
10	0.65	1.42	2.35	3.58	2TX, 3RX

Note: 1. There is no hardware or electrical modification made to the applying modular transmitter itself. Adding ten antennas.

2. Because Ant. 1 and Ant. 7 are the same type antennas, only the higher gain antenna “Ant.1” was tested and recorded in the report.
3. Because Ant. 6 and Ant. 7 are the same type antennas, only the higher gain antenna “Ant.6” was tested and recorded in the report.
4. Because Ant. 8 and original project’s Ant. 4 (Model: ML-2499-HPA3-01R) are the same type antennas, only the higher gain antenna original project’s Ant.4 (Model: ML-2499-HPA3-01R) was tested and recorded in the Sporton project number: FR972826AB.
5. Because Ant. 9 and original project’s Ant. 4 (Model: ML-5299-HPA1-01R) are the same type antennas, only the higher gain antenna original project’s Ant. 4 (Model: ML-5299-HPA1-01R) was tested and recorded in the Sporton project number: FR972826AA.
6. Because Ant. 10 and original project’s Ant. 3 (Model: ML-2499-SD3-01R) are the same type antennas, only the higher gain antenna original project’s Ant. 3 (Model: ML-2499-SD3-01R) was tested and recorded in the Sporton project number: FR972826AB.

Module	Required 1TX Port
2.4G / 5G	Chain 1

Module	Required 2TX Port
2.4G / 5G	Chain 1 and Chain 3

Note: The EUT has can support both 1TX and 2TX functions.

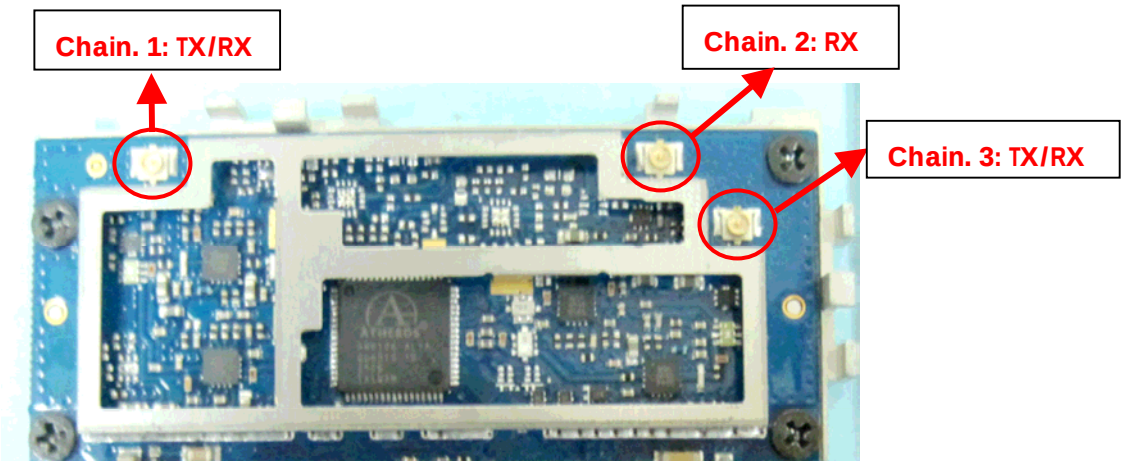
For IEEE 802.11a/n mode (1/2TX, 3RX):

1. For 2TX function:

   Chan. 1 and Chan. 3 could transmit simultaneously, but Chan. 1, Chan. 2 and Chan. 3 could receive simultaneously.

2. For 1TX function:

   Only Chan. 1 can be used as transmitting, but Chan. 1, Chan. 2 and Chan. 3 could receive simultaneously.



(1) DFS Device -- ☒ Master, ☐ Client with Radar detection capability,
☒ Client without radar detection capability, ☐ N/A

(2) Active / Passive Scanning, adhoc mode access point capability

Frequency Band (MHz)	Active Scanning (The device can transmit a probe (beacon))	Passive scanning (Where the device is can listen only with no probes)	Ad Hoc Mode capability	Access point capability
5180 – 5240 MHz	☒ Yes, ☐ No	☒ Yes, ☐ No	☐ Yes, ☒ No	☒ Yes, ☐ No
5190 – 5230 MHz	☒ Yes, ☐ No	☒ Yes, ☐ No	☐ Yes, ☒ No	☒ Yes, ☐ No

(3) Meet 15.202 requirement - ☒ Yes, ☐ No,
pls check below :
☒ A master device is defined as a device operating in a mode in which it has the capability to transmit without receiving an enabling signal. In this mode it is able to select a channel and initiate a network by sending enabling signals to other devices
☒ A client device is defined as a device operating in a mode in which the transmissions of the device are under control of the master. A device in client mode is not able to initiate a network.

(4) For client devices that have software configuration control to operate in different modes (active scanning in some and passive scanning in others) in different bands (devices with multiple equipment classes or those that operate on non-DFS frequencies) or modular devices which configure the modes of operations through software, the application must provide software and operations description on how the software and / or hardware is implemented to ensure that proper operations modes can not be modified by end user or an installer.
☒ Apply, ☐ No Apply,
Reason: The firmware of EUT is set by factory. There is no any software that can be modified by end-user.