WLAN FEIC Update

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NXP | SECURE CONNECTIONS FOR A SMARTER WORLD

Agenda

- WLAN FEIC Roadmap

- WiFi 6 (11ax) FEICs

- 5.8GHz KPI

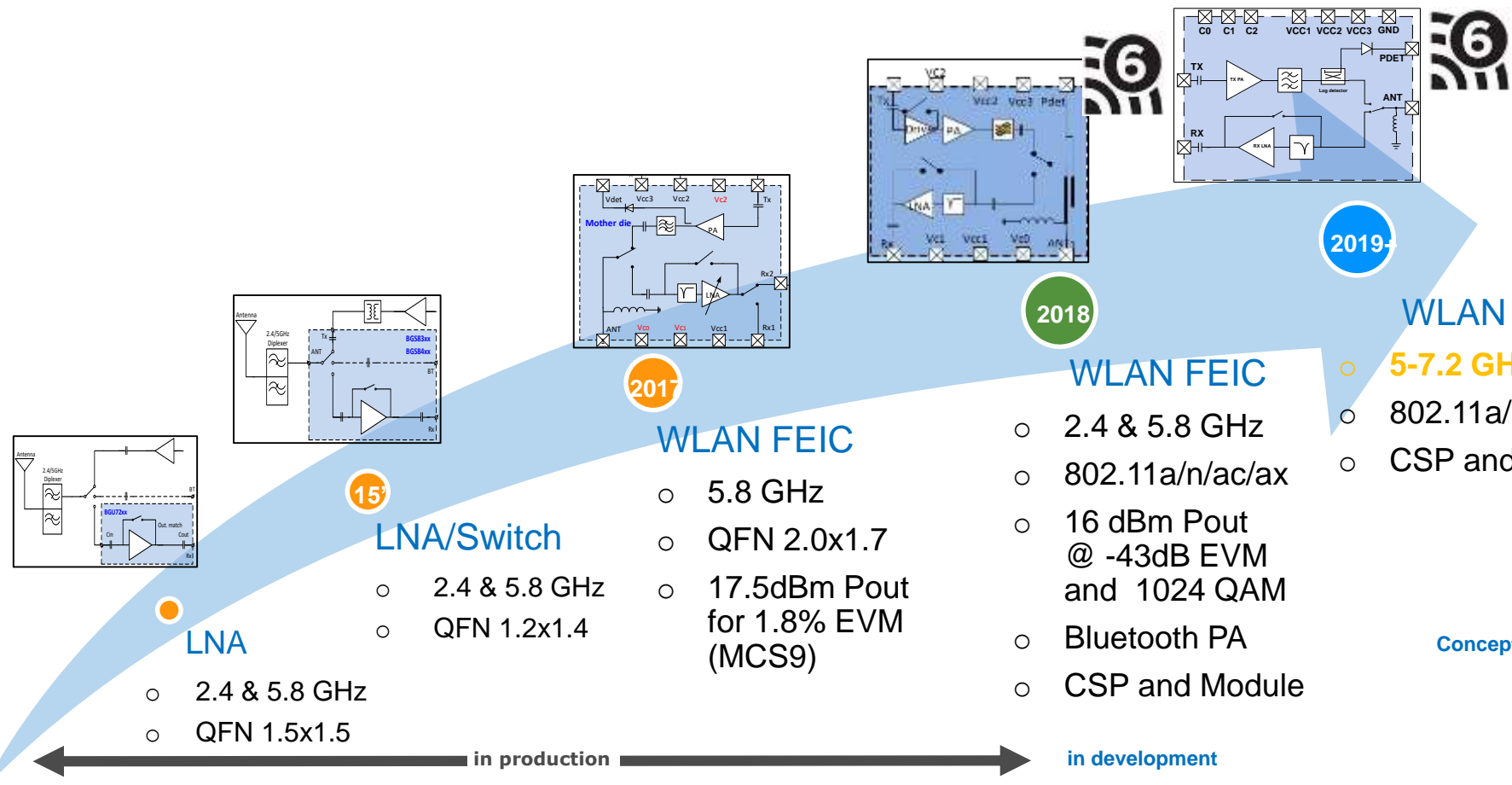- Next Gen FEIC to support 7GHz

- 2.4GHz KPI

- Summary

WLAN FEIC Roadmap

NXP's High Performance Monolithic Solutions for WLAN

NXP offers solutions for all integration levels

RF Performance & Integration

LNA
- o 2.4 & 5.8 GHz
- o QFN 1.5x1.5

15'

LNA/Switch
- o 2.4 & 5.8 GHz
- o QFN 1.2x1.4

2017

WLAN FEIC
- o 5.8 GHz
- o QFN 2.0x1.7
- o 17.5dBm Pout for 1.8% EVM (MCS9)

2018

WLAN FEIC
- o 2.4 & 5.8 GHz
- o 802.11a/n/ac/ax
- o 16 dBm Pout @ -43dB EVM and 1024 QAM
- o Bluetooth PA
- o CSP and Module

2019+

WLAN FEIC
- o **5-7.2 GHz**
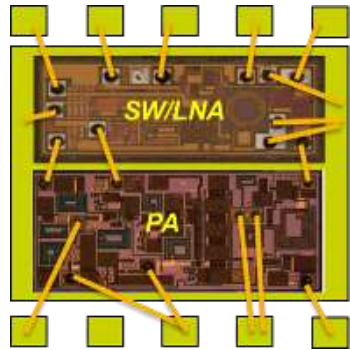- o 802.11a/n/ac/ax
- o CSP and Module

Concept

in production   in development

COMPANY PUBLIC | 3

WLAN RF Front-End Product Families

FEMs	FEICs	RFFEs	SiPs

Wire-bonded FEIC in package (WLAN7001)

CSP FEIC (WLAN7002CC)

Flipped CSP FEIC in package (WLAN7102C)

FEIC

WLAN Chipset

FEICs

IphoneX WLAN SiP Module

FEMs
- FEM = Front-End module (multiple dies)
- 1 die for XLNA
- 1 die for PA
- Wire bonds packaged

FEICs
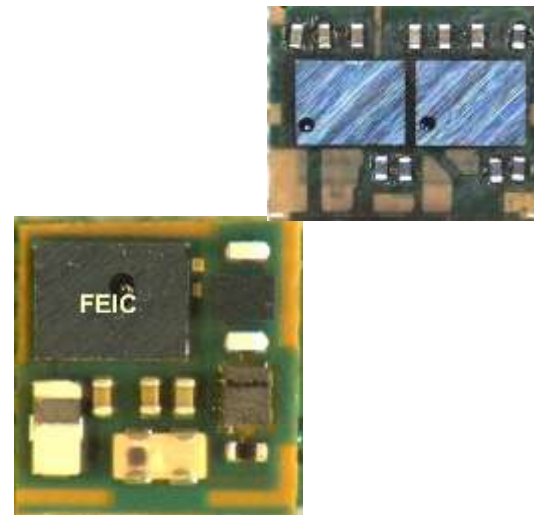- FEIC = Front-End IC (monolithic)
- 1 Monolithic die integrating PA, LNA and Switch
- Wire bond or CSP

RFFEs
- RFFE = RF Front-End
- Module with FEICs or FEMs + SAW/BAW filters and combiners / splitters inside

SiPs
- SiP = System in Package
- Module with FEICs or FEMs, BT PA + WLAN Chipset inside

*with leading RF module partner

WiFi 6 (11ax) FEICs

WLAN7002CC 5GHz
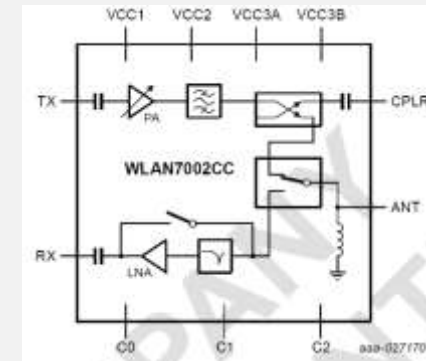## *PA + Switch + LNA WLAN FEIC device*

11ax

Features / Benefits

- ✓ 802.11ac/ax and legacy compliant 5 – 6 GHz FEIC
- ✓ LNA + PA + switch
- ✓ 3 TX gain modes with varying power efficiency and linearity
- ✓ 2 RX gain modes
- ✓ Directional power coupler
- ✓ High linearity @ -47dB EVM levels
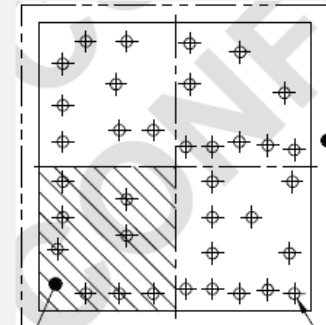- ✓ Version with Power Detector available July 2019

Schedule

- ✓ Final samples available now
- ✓ MP Sep 2019

Block Diagram

Package

WLCSP36
1.63 x 1.53 x 0.225

WLAN7002HC 2.4GHz
## *PA + Switch + LNA WLAN FEIC device*

11ax

Features / Benefits

- ✓ 802.11ac/ax and legacy compliant 2.4 GHz FEIC
- ✓ LNA + PA + switch
- ✓ Bluetooth (BT) high-gain / high-efficiency and bypass modes
- ✓ 5 TX gain modes with varying power efficiency and linearity
- ✓ 2 RX gain modes
- ✓ Directional power coupler
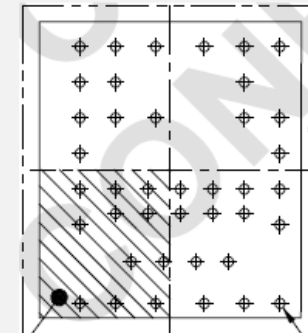- ✓ High linearity @ -47dB EVM levels

Schedule

- ✓ Final samples available May 2019
- ✓ MP Sep 2019

Block Diagram
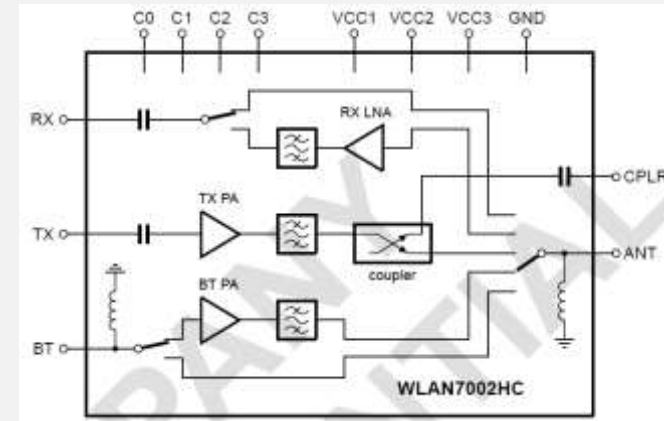
Package

WLCSP40
1.83 x 1.62 x 0.225

Multi-Mode FEICs Optimized for 11ax EVM & Efficiency

FEMs optimized for 11ax, with 3 operating modes as needed:

- Mode 1: High Gain with Low EVM
  - -47 dB EVM for output power up to +16 dBm
  - Used for 11ax when high power is needed.

- Mode 2: High Gain, High Efficiency
  - 2x2 + 2x2 use case.
  - ~ 50% current consumption of High gain low EVM mode.
  - Pout vs. EVM curve is shifted down by 3dB.

- Mode 3: Low Gain with Low EVM
  - -47dB EVM for PA output powers from -15dBm to 4dBm
  - Used for 11ax when RF power requirements are modest
  - Offers much reduced DC power consumption for short links
  - Allows 4x TX to be used for extended durations

SP3T

BT access to 2G WLAN antennas

PA has 3 states:
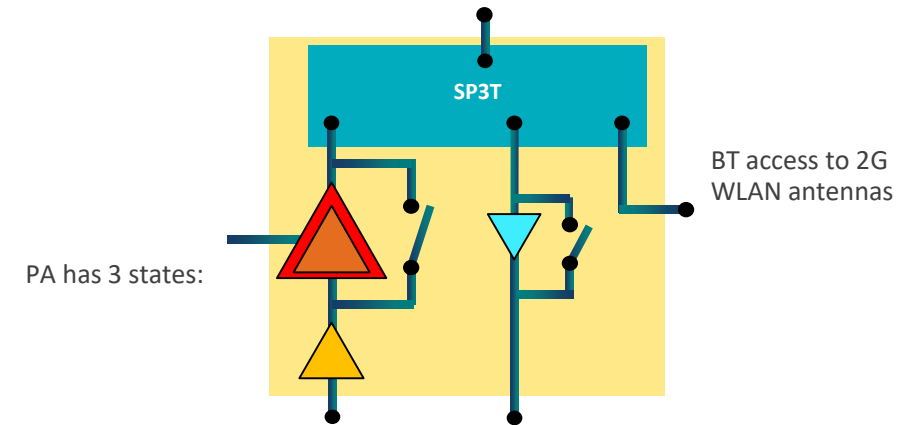
	High Gain Low EVM	High Gain High Efficiency	Low Gain (power save)
Supply Current (mA)	<260 mA	<162 mA	<65 mA
DC Power	~1.0 W	~ 0.62 W	~0.25 W
EVM	<-47dBc @ 16.5 dBm <-20dBc @ 22.5 dBm	<-43dBc @ 16.5 dBm <-20dBc @ 19.5 dBm	<-47dBc @ 4.5 dBm <-20dBc @ 8.5 dBm

NXP

5.8GHz KPI

Key Performance Summary: General

Parameter	Min	Typ	Max	Unit	Conditions
General					
Supply voltage	3.0	3.85	4.8[1)]	V	Designed for direct battery supply 1) Short peak voltage up to 5.25V during charger transitions allowed
Operating temperature	-20		85	C	
Frequency range	5.15		5.95	GHz	
Channel BW	20		80	MHz	
Control IO		1.8		V	Supports 1.8V/2.5V logic
Standby current			20	uA	

Key Performance Summary: RX

Parameter	Min	Typ	Max	Unit	Conditions
RX					
Gain	15	17	19	dB	
Gain flatness		+/-0.5		dB	160MHz channel
NF		2.3	2.9	dB	
IIP3		2		dB	
ICC		11.5		mA	
BYPASS					
Bypass gain		-5		dB	
IIP3 bypass		28		dB	
ICC			20	uA	

Key Performance Summary: TX

Parameter	Min	Typ	Max	Unit	Conditions
TX					
Gain		30		dB	
Gain flatness		+/-0.5		dB	160MHz channel
DEVM					
MCS9 / VHT80		-45	-38	dB	@17.5dBm / 50Ohm / Vnom / high linearity mode
MCS11 / VHT80		-46	-39	dB	@16.5dBm / 50Ohm / Vnom / high linearity mode
MCS11 / VHT80		-48	-41	dB	@14.5dBm / 50Ohm / Vnom / high linearity mode
ICC					
MCS9 / VHT80		245	270	mA	@17.5dBm / 50Ohm / Vnom / high linearity mode

NXP patent-pending technology ensures header, short payload, long payload performance are all identical

WLAN 11ax 5.8GHz Data Summary
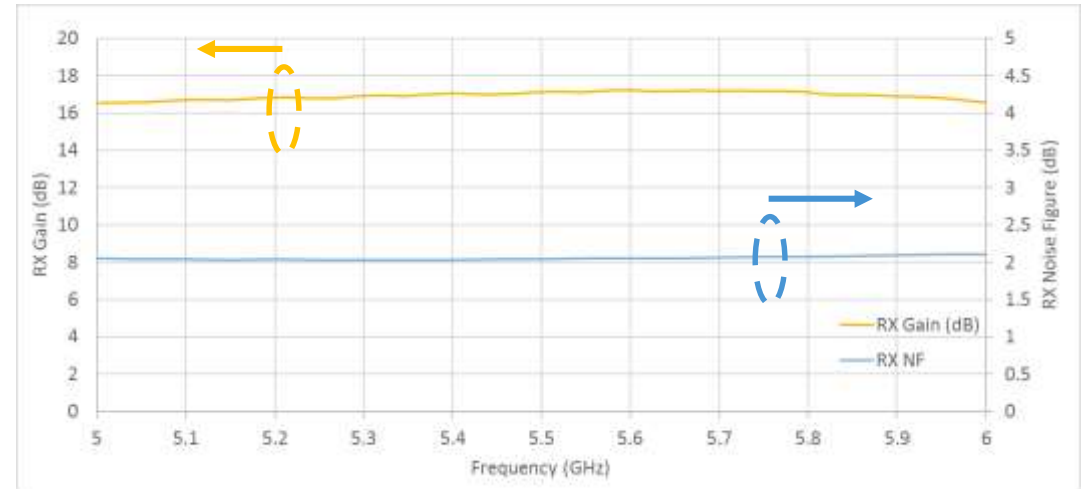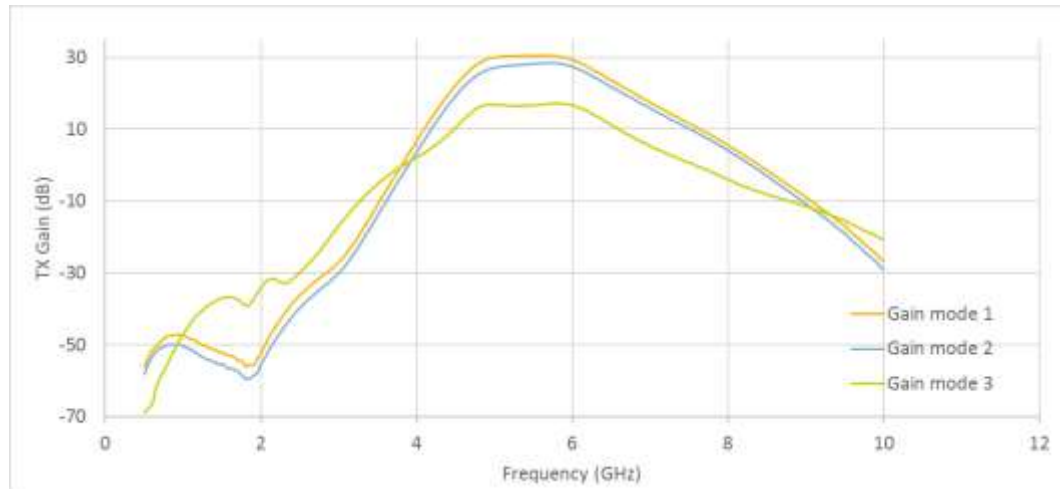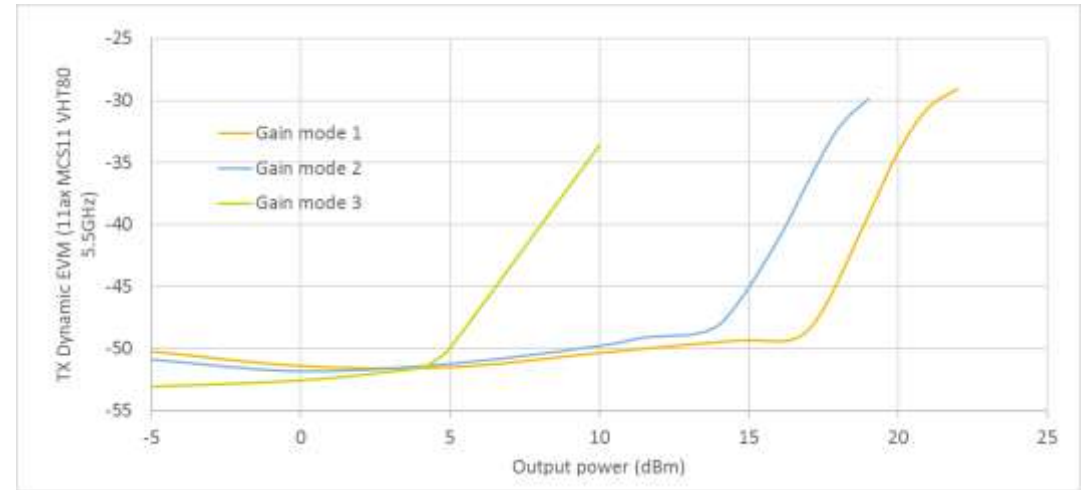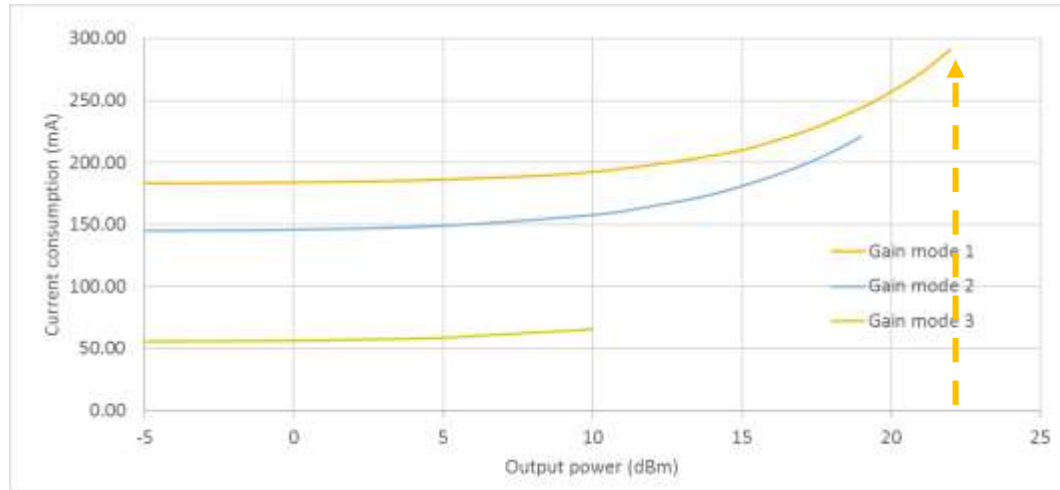
Next Gen FEIC to Support 7GHz

5+6GHz Switchable FEIC

PA + Switch + LNA WLAN FEIC device
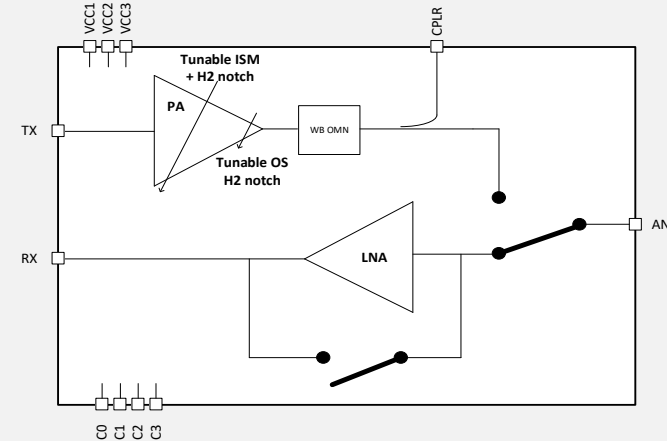
11ax + 6-7GHz

Features / Benefits

- ✓ 802.11ac/ax and legacy compliant 5 – 6 GHz & 6 – 7 Ghz FEIC (band switchable)
- ✓ LNA + PA + switch
- ✓ 3 TX gain modes with varying power efficiency and linearity
- ✓ 2 RX gain modes
- ✓ Directional power coupler/Detector
- ✓ High linearity @ -47dB EVM levels
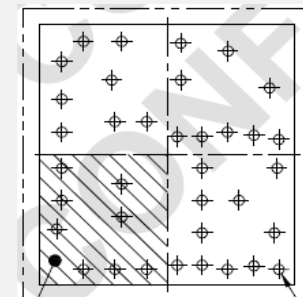- ✓ Industry smallest area and lowest height

Schedule

- ✓ ES – October 2019
- ✓ MP– Q3-2020

Block Diagram

Package

- ✓ WLCSP36
- ✓ 1.63 x 1.63 x 0.225
- ✓ Bump map compatible with WLAN7002CC

2.4GHz KPI

Key Performance Summary: General

Parameter	Min	Typ	Max	Unit	Conditions
General					
Supply voltage	3.0	3.85	4.8[1]	V	Designed for direct battery supply 1) Short peak voltage up to 5.25V during charger transitions allowed
Operating temperature	-20		85	C	
Frequency range	2.4		2.5	GHz	
Channel BW	20		40	MHz	
Control IO		1.8		V	Supports 1.8V/2.5V logic
Standby current			25	uA	

Key Performance Summary: RX

Parameter	Min	Typ	Max	Unit	Conditions
RX					
Gain	13.5	16.5	20	dB	
Gain flatness		+/-0.1		dB	40MHz channel
NF		1.9	2.5	dB	
IIP3		2.5		dB	
ICC		11.5		mA	
BYPASS					
Bypass gain		-5		dB	
IIP3 bypass		40		dB	
ICC			25	uA	

Key Performance Summary: TX WLAN

Parameter	Min	Typ	Max	Unit	Conditions
TX					
Gain		30		dB	
Gain flatness		+/-0.2		dB	40MHz channel
DEVM					
MCS9 / VHT40		-42	-35	dB	@19dBm / 50Ohm / Vnom / high linearity mode
MCS11 / VHT40		-49	-41	dB	@16.5dBm / 50Ohm / Vnom / high linearity mode
MCS11 / VHT40		-49	-43	dB	@14.5dBm / 50Ohm / Vnom / high linearity mode
ICC					
MCS9 / VHT80		285	310	mA	@19dBm / 50Ohm / Vnom / high linearity mode

NXP patent-pending technology ensures header, short payload, long payload performance are all identical

Key Performance Summary: TX BT

Parameter	Min	Typ	Max	Unit	Conditions
TX					
Gain		20		dB	
DEVM					
EDR / 8DPSK (rms)			2	%	
EDR / 8DPSK (peak)			5	%	
ICC					
GFSK		85	95	mA	@16.5dBm / 50Ohm / Vnom
		100	110	mA	@18.5dBm / 50Ohm / Vnom
		120	130	mA	@20.5dBm / 50Ohm / Vnom

WLAN 11ax 2.4Ghz Data Summary
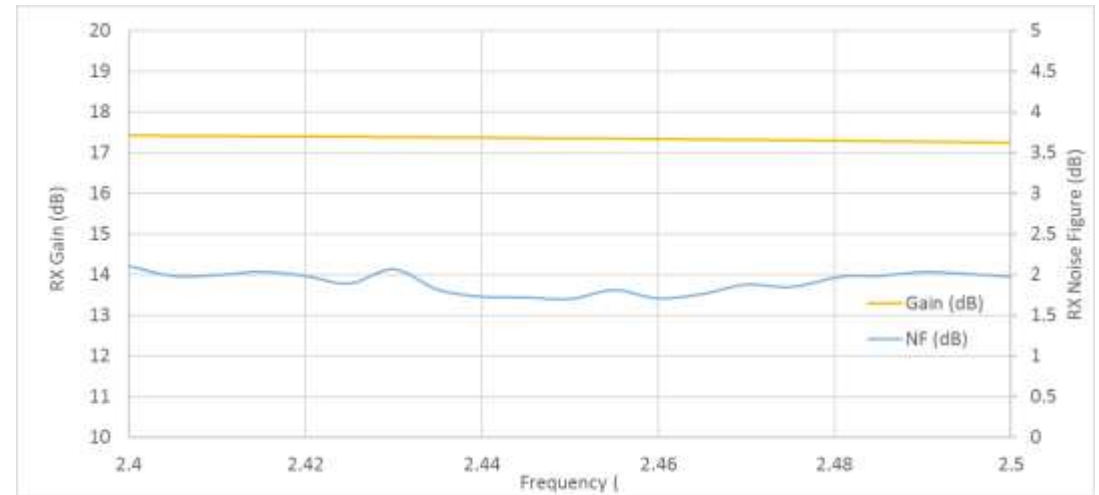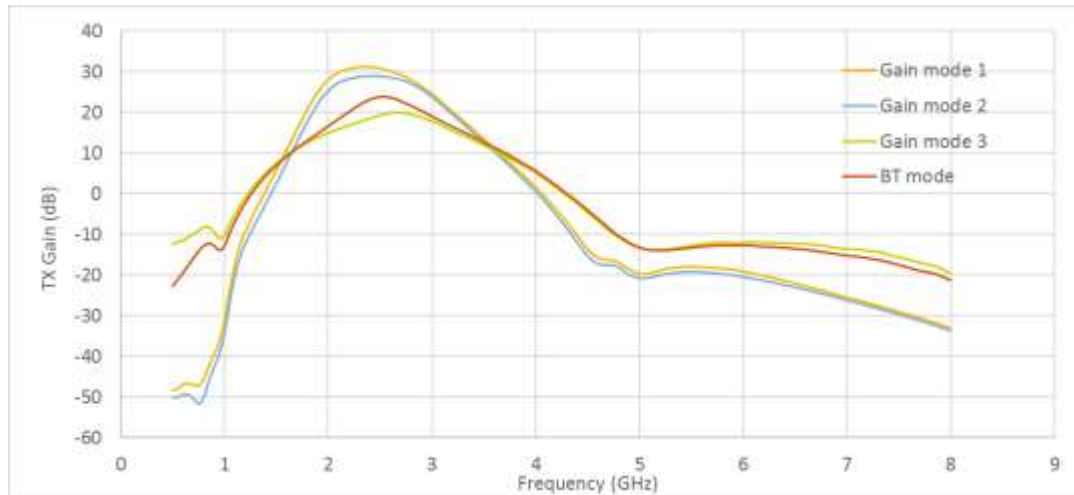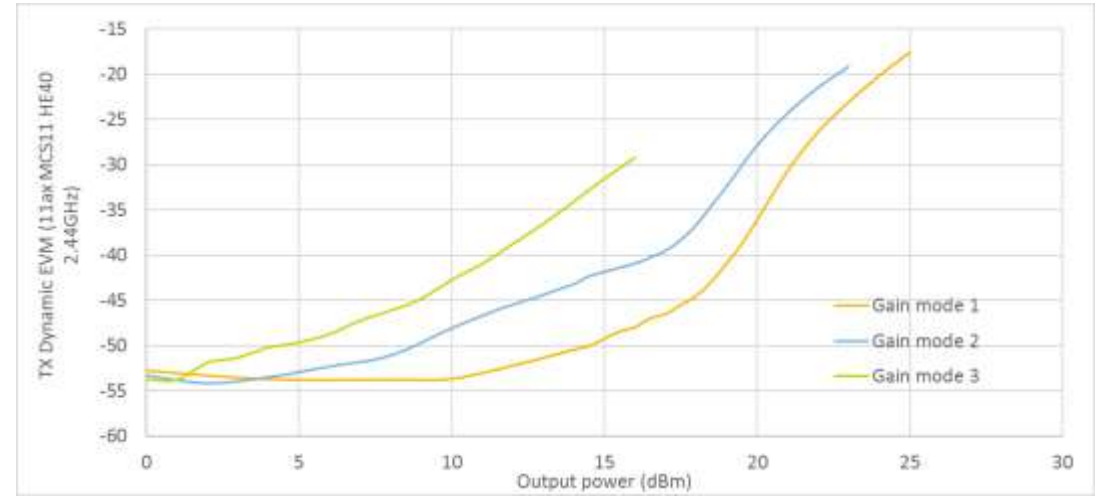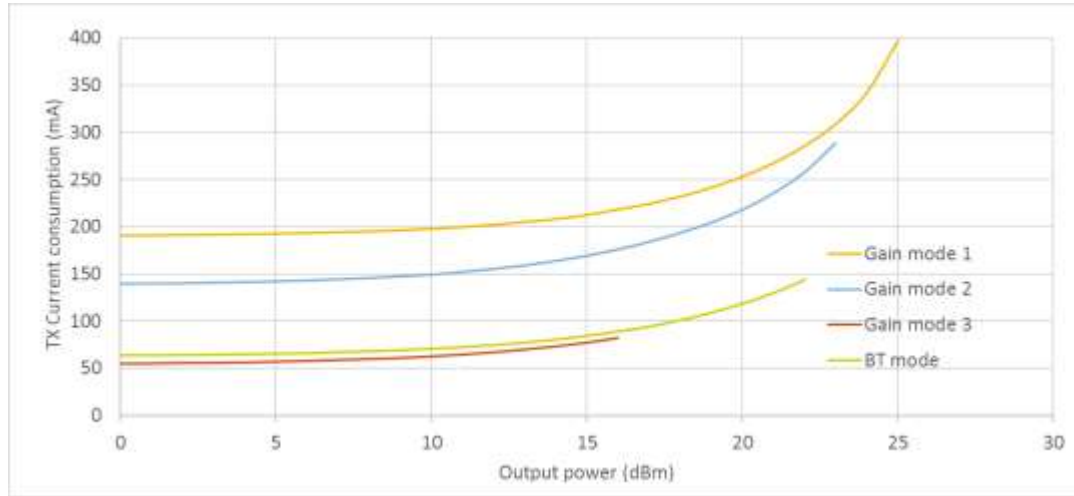
Summary

- NXP WLAN 11AX (WIFI 6) FEIC are best in class
- Qualified on QCOM Hastings platform (QCA6390/91)
- Suitable for smartphones, handheld devices, mobile devices etc.

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