WLAN7001C

WLAN 5 GHz Front-end IC

Rev. 3 — 7 September 2020 Product data sheet

1 General description

The WLAN7001C is a fully integrated RF front-end MMIC for 802.11a/n/ac WLAN standard with up to 80 MHz channel bandwidth. It includes a Low-Noise Amplifier, a Single Pole Double Throw Switch required for TDD operation. The WLAN7001C also includes a TX Power Amplifier and an integrated power detector covering the entire ISM band.

The WLAN7001C integrates harmonic and coexistence filtering. The WLAN7001C has RX by-pass mode for high-power signal handling and low-power TX mode to optimize power efficiency of the PA for low-power levels. Manufactured on QUBiC eighth generation SiGe:C technology of NXP Semiconductors. The WLAN7001C offers best-in-class noise figure, linearity, and power efficiency and low insertion loss CMOS switches with good process stability.

The WLAN7001C has a 1.7 mm × 2.0 mm footprint with HX2SON10 package with 300 µm thickness.

2 Features and benefits

- Full ISM High Band 5150 MHz to 5850 MHz
- Fully integrated RF front end
- Low-noise amplifier (LNA) with bypass mode
- Single Pole Double Throw switch (SPDT)
- Power amplifier (PA) with high linearity and a low-power mode
- Integrated power detector for closed loop control
- Integrated matching for 50 Ω for input & output; DC free input/output ports
- Integrated harmonic and coexistence filtering
- 4 modes of operation (RX Bypass/Stand-by, RX LNA, TX high linearity, TX low power)
- Supply voltage 3.0 V to 4.75 V
- Low supply current of 8 mA in RX mode with optimized performances
- Low RX noise figure = 2.35 dB
- High efficiency: supply current of 185 mA in TX mode at +17 dBm, MCS9
- TX output power of +15 dBm at 1.25 % DEVM (MCS9/VHT80)
- TX output power of +17.5 dBm at 2.0 % DEVM (MCS7/HT40)
- ESD protection on all pins (HBM > 2 kV)
- Small 10-pins leadless package 1.7 mm × 2.0 mm × 0.3 mm; 0.35 mm pitch

3 Applications

- IEEE 802.11a/n/ac WiFi, WLAN
- Smartphones, tablets, netbooks, and other portable computing devices
- Access points, routers, gateways
- Wireless video
- General-purpose ISM applications

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4 Quick reference data

Table 1. Quick reference data

T_{amb} = 25 °C; V_{CC1} = V_{CC2} = V_{CC3} = 3.6 V; V_{IH} = 3.3 V; V_{IL} = 0 V; Z_S = Z_L = 50 Ω; P_i = −30 dBm unless otherwise specified. All measurements done on application board with SMA connectors as reference plane. (DC-decoupling capacitor 100 nF, 470 nF, and 6.8 pF are placed nearby the pin 8, 9 and 4, respectively).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
RF performance at ANT-RX path in RX LNA mode						
I_{CC}	supply current	RX LNA mode	-	8	9.5	mA
G_p	power gain		12	14	16	dB
NF	noise figure	[1]	-	2.35	2.7	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		-	-3	-	dBm
RL_{in}	input return loss		-	12	-	dB
RL_{out}	output return loss		-	10	-	dB
RF performance at ANT-RX path in RX bypass mode						
I_{CC}	supply current	RX bypass mode	-	6	-	µA
G_p	power gain		-8.5	-7	-5.5	dB
RF performance at ANT-TX path in TX high-linearity mode						
I_{CC}	supply current	P_L = +17 dBm, TX high mode [1]	-	185	230	mA
G_P	power gain		26	28	30.5	dB
DEVM	dynamic error vector magnitude	P_{out} = 17.5 dBm, MCS7, HT40	-	2.0	3.0	%
		P_{out} = 15.0 dBm, MCS9, VHT80	-	1.25	1.78	%

[1] Guaranteed by device design; not tested in production

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5 Ordering information

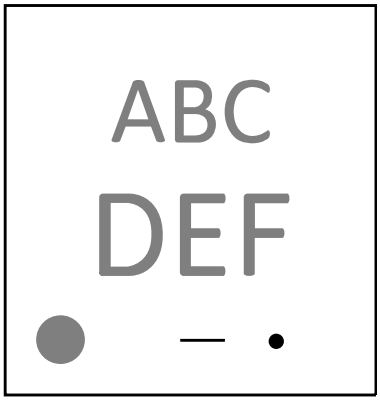
Table 2. Ordering information

Type number	Package		
	Name	Description	Version
WLAN7001C	HX2SON10	plastic, thermal, enhanced super thin small outline package: no leads; 10 terminals: body 2.0 mm × 1.7 mm × 0.30 mm; 0.35 mm	SOT1436

6 Marking

Table 3. Marking code

Lines	Type number	Marking code
Line A (ABC)	WLAN7001C	458
Line B (DEF)	date code	YWW
Line C (H)	assembly center	_.



aaa-026348

Figure 1. Marking code description

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7 Functional diagram

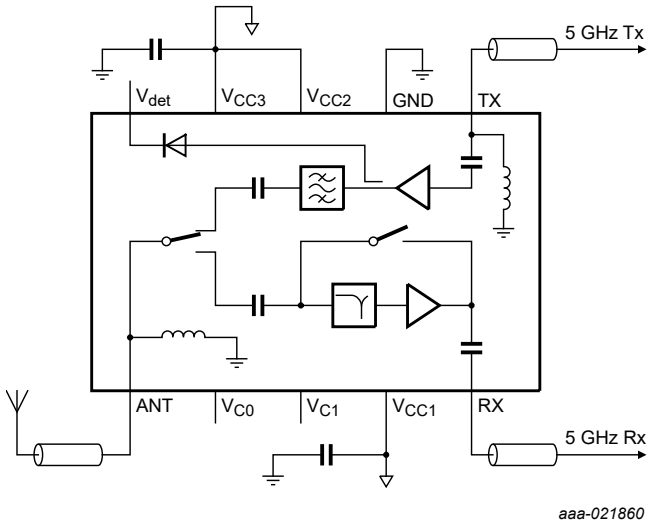

Figure 2. Functional diagram

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8 Pinning information

8.1 Pinning

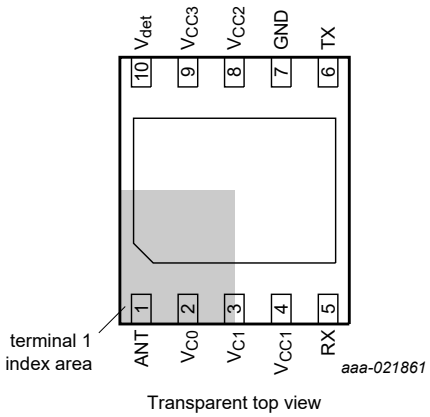

Figure 3. Pin configuration

8.2 Pin description

Table 4. Table 4. Pin description

Symbol	Pin	Description
ANT	1	antenna in/out pin
V_{CO}	2	C_0 control pin
V_{C1}	3	C_1 control pin
V_{CC1}	4	supply voltage (LNA)
RX	5	RX output
TX	6	TX input
GND	7	ground
V_{CC2}	8	supply voltage (PA)
V_{CC3}	9	supply voltage (PA)
V_{det}	10	detection voltage
GND	exposed die pad	ground

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9 Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage	[1]	-0.5	+6	V
$V_{I(C0)}$	input voltage on pin C0	digital control signals for RX, TX modes	-0.5	+4.2	V
$V_{I(C1)}$	input voltage on pin C1	digital control signals for RX, TX, and LNA control signals	-0.5	+4.2	V
$P_{i(ANT)}$	input power-on pin ANT	RX LNA mode; 802.11ac MCS7 signal, +10 dBm [2]	-	10	dBm
		RX bypass mode	-	20	dBm
$P_{i(TX)}$	input power-on pin TX	continuous wave; TX mode; 802.11ac MCS7 signal, +10 dBm [2]	-	10	dBm
T_{amb}	ambient temperature	air temperature	-40	+85	°C
T_j	junction temperature		-40	+155	°C
T_{stg}	storage temperature		-40	+150	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM) according to ANSI/ESDA/JEDEC standard JS-001	-	±2000	V
		Charged Device Model (CDM) according to ANSI/ESDA/JEDEC standard JS-002	-	±500	V

[1] 6 V is authorized for 250 s over the product life time as transient operational voltage.
[2] Guaranteed by device design; not tested in production

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10 Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Recommended operation						
f_{oper}	operating frequency		5150	-	5850	MHz
V_{CC}	supply voltage	V_{CC1}, operating	3.2	3.6	4.5	V
		V_{CC2}, operating	3.2	3.6	4.5	V
		V_{CC3}, operating	3.2	3.6	4.5	V
V_{IH}	HIGH-level input voltage		1.8	-	3.6	V
V_{IL}	LOW-level input voltage		0	-	0.4	V
T_{oper}	operating temperature	surrounding temperature	-20	+25	+70	°C
Functional operating range [1]						
V_{CC}	supply voltage	V_{CC1}, extended	3.0	3.6	4.75[2]	V
		V_{CC2}, extended	3.0	3.6	4.75[2]	V
		V_{CC3}, extended	3.0	3.6	4.75[2]	V
V_{IH}	HIGH-level input voltage		1.6	-	3.6	V
V_{IL}	LOW-level input voltage		0	-	0.4	V
T_{oper}	operating temperature	surrounding temperature	-20	+25	+85	°C

[1] Functional with reduced performance.
[2] During battery charging only

11 Thermal characteristics

Table 7. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient		65	°C/W

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12 Characteristics

Table 8. Static Characteristics

T_{amb} = 25 °C; V_{CC1} = V_{CC2} = V_{CC3} = 3.6 V; V_{IH} = 3.3 V; V_{IL} = 0 V; Z_S = Z_L = 50 Ω; P_i = -30 dBm, f = 5150 MHz to 5850 MHz. Unless otherwise specified. All measurements done on application board with SMA connectors as reference plane. (DC-decoupling capacitor 100 nF, 470 nF, and 6.8 pF are placed nearby the pin 8, 9 and 4, respectively).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	RX LNA gain mode	-	8	9.5	mA
		RX bypass mode	-	6	-	µA
		RX bypass mode, Vcc1 = Vcc2 = Vcc3 = 4.8 V	-	-	35	µA
		TX high-linearity quiescent	-	145	-	mA
		TX low-power mode quiescent	-	90	-	mA
		TX high-linearity mode at +17 dBm	-	185	230	mA
		TX low-power mode at +12 dBm	-	115	-	mA
I_{ctrl}	control current	internal pull-down resistor, pin C0	-	10	-	µA
		internal pull-down resistor, pin C1	-	10	-	µA

Table 9. Transient Characteristics

T_{amb} = 25 °C; V_{CC1} = V_{CC2} = V_{CC3} = 3.6 V; V_{IH} = 3.3 V; V_{IL} = 0 V; Z_S = Z_L = 50 Ω; P_i = -30 dBm, f = 5150 MHz to 5850 MHz. Unless otherwise specified. All measurements done on application board with SMA connectors as reference plane. (DC-decoupling capacitor 100 nF, 470 nF, and 6.8 pF are placed nearby the pin 8, 9 and 4, respectively).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{on(LNA)}$	LNA turn-on time	from 90 % of control signal to 90 % LNA output level	-	-	300	ns
$t_{off(LNA)}$	LNA turn-off time	from 10 % of control signal to 90 % bypass output level	-	-	400	ns
$t_{on(PA)}$	PA turn-on time	From 90 % of control signal to 90 % PA output level	-	-	500	ns
$t_{off(PA)}$	PA turn-off time	from 10 % of control signal to 90 % bypass output level	-	-	500	ns

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Table 10. Dynamic Characteristics

T_{amb} = 25 °C; V_{CC1} = V_{CC2} = V_{CC3} = 3.6 V; V_{IH} = 3.3 V; V_{IL} = 0 V; Z_S = Z_L = 50 Ω; P_i = -30 dBm, f = 5150 MHz to 5850 MHz. Unless otherwise specified. All measurements done on application board with SMA connectors as reference plane. (DC-decoupling capacitor 100 nF, 470 nF, and 6.8 pF are placed nearby the pin 8, 9 and 4, respectively).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
RF performance at ANT-RX path in RX LNA gain mode						
f_{oper}	operating frequency		5150	-	5925	MHz
G_p	power gain		12.5	14	16	dB
$G_{p(flat)}$	power gain flatness	peak-to-peak over any 80 MHz band	-	0.3	-	dB
NF	noise figure	[1]	-	2.35	2.7	dB
$IP2_i$	input second-order intercept point	[1] 1 MHz tone spacing; P_{in} = −13 dBm per tone, f_{in} = 2500 MHz to 2700 MHz	15	-	-	dBm
$IP3_i$	input third-order intercept point	[1] 1 MHz tone spacing; P_{in} = -13 dBm per tone, f_{in} = 1690 MHz to 2000 MHz	0	-	-	dBm
$P_{i(1dB)}$	input power at 1 dB gain compression	in-band	-	-4	-	dBm
$IP3_i$	input third-order intercept point.	[1] 20 MHz tone spacing; P_i = -20 dBm per tone	2.0	4.0	-	dBm
	OOB gain	2400 MHz to 2480 MHz	-	-13	-6	dB
		2480 MHz to 3600 MHz	-	-	11.5	dB
RL_{in}	input return loss		-	-12.5	-10	dB
RL_{out}	output return loss		-	-10.5	-7.5	dB
RF performance at ANT-RX path in RX bypass mode						
f_{oper}	operating frequency		5150	-	5925	MHz
G_p	power gain		-8.5	-7	-5.5	dB
$G_{p(flat)}$	power gain flatness	peak-to-peak over any 80 MHz band	-	0.3	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression	in-band	-	13	-	dBm
$IP3_i$	input third-order intercept point.	[1] 20 MHz tone spacing; P_i = -3 dBm	25	28	-	dBm
RL_{in}	input return loss		-	-10	-7.5	dB
RL_{out}	output return loss		-	-12	-9.5	dB

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
RF performance at ANT-TX path in TX High-Linearity mode						
G_p	power gain		26	28.5	30.5	dB
$G_{p(flat)}$	power gain flatness	peak-to-peak over any 80 MHz band	-	0.5	-	dB
ISL	isolation	measured between ANT and RX ports, while applying signal on TX port in TX mode	33	45	-	dB
SEM	spectral emission mask-compliant maximum power	IEEE mask compliance Figure 7, 11n, MCS0	19	20	-	dBm
RL_{in}	input return loss		-	10	-	dB
α_{2H}	second harmonic level	P_L = 20 dBm; 20; 40; 80 MHz all MCS	-	-31	-26	dBm/ MHz
α_{3H}	third harmonic level	P_L = 20 dBm; 20; 40; 80 MHz all MCS	-	-40	-31	dBm/ MHz
DEVM	dynamic error vector magnitude	P_{out} = 19.5 dBm, 802.11a, 6 Mbp/s	-	4.0	8.75	%
		P_{out} = 18.5 dBm,64 QAM, 54 Mbp/s	-	2.9	4.6	%
		P_{out} = 18.5 dBm MCS7, HT40	-	3.2	5.0	%
		P_{out} = 17.5 dBm, MCS7, HT40	-	2.0	3.0	%
		P_{out} = 17 dBm MCS9, VHT80	-	1.8	2.8	%
		P_{out} = 15 dBm, MCS9, VHT80	-	1.25	1.78	%
		P_{out} = 14 dBm, MCS9, VHT160	-	1.0	1.78	%
	stability, spurious levels.	P_{out} = 19 dBm, MCS7, HT40, 500 MHz to 12 GHz, source/load VSWR ≤ 6:1 [1]	-	-	-42	dBm/ MHz
	ruggedness	V_{CC} = 4.75 V, T_{amb} = -30 °C, + 85 °C, P_{out} is set to ≤ 23 dBm_MCS0 at 50 Ω load and given T_{amb}	-	-	10:1	VSWR
RF performance at ANT-TX path in TX Low-power mode						
G_p	power gain		21	23	26	dB
$G_{p(flat)}$	power gain flatness	peak-to-peak over any 80 MHz band	-	0.2	-	dB
DEVM	dynamic error vector magnitude	P_{out} = 12 dBm, MCS7, HT40 [1]	-	3.2	-	%
α_{2H}	second harmonic level	P_L = 20 dBm; 20; 40; 80 MHz all MCS	-	-35	-	dBm/ MHz
α_{3H}	third harmonic level	P_L = 14 dBm, 20; 40; 80 MHz all MCS	-	-40	-	dBm/ MHz
Power detector at V_{det} pin in TX High-linearity mode						
V_{det}	detection voltage	No RF	0.19	0.22	-	V
		P_L = 21 dBm [2]	-	0.75	0.95	V

[1] Guaranteed by device design, not tested in production.
[2] Measured at the peak of the preamble of OFDM

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12.1 Graphics

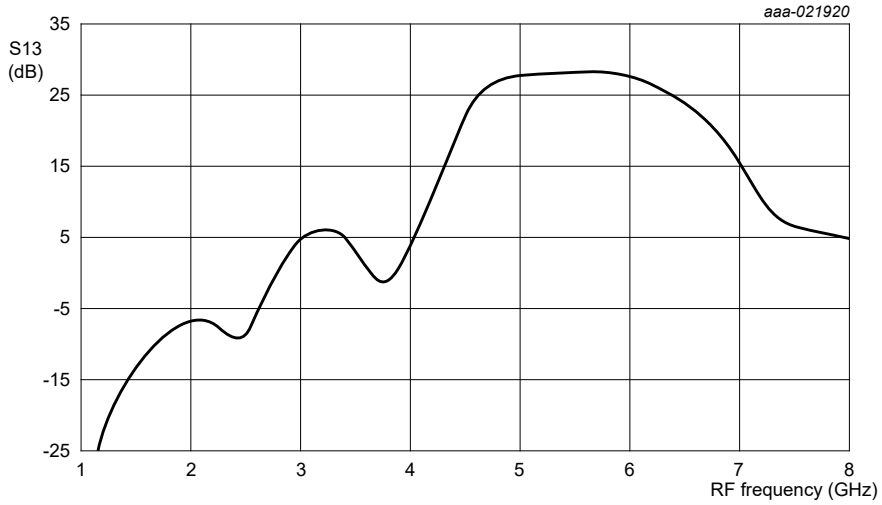

Figure 4. Typical TX high-linearity mode transfer function (S13)

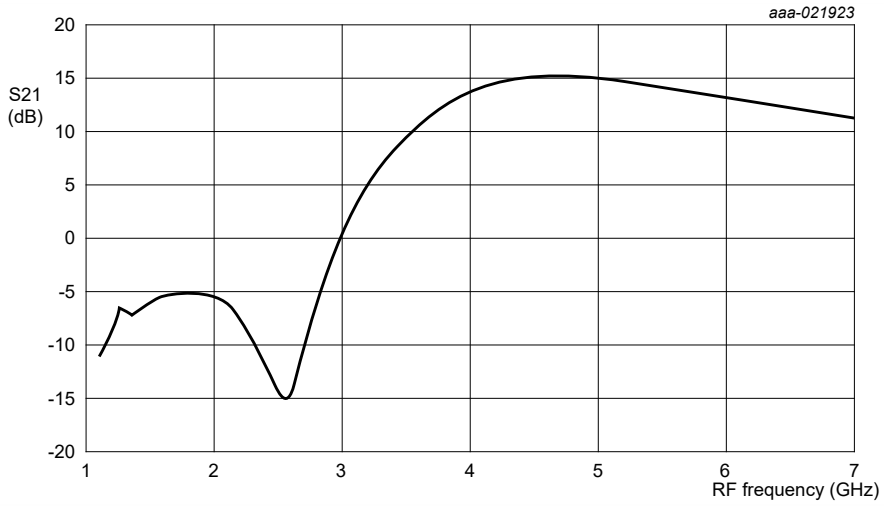

Figure 5. Typical RX transfer function (S21)

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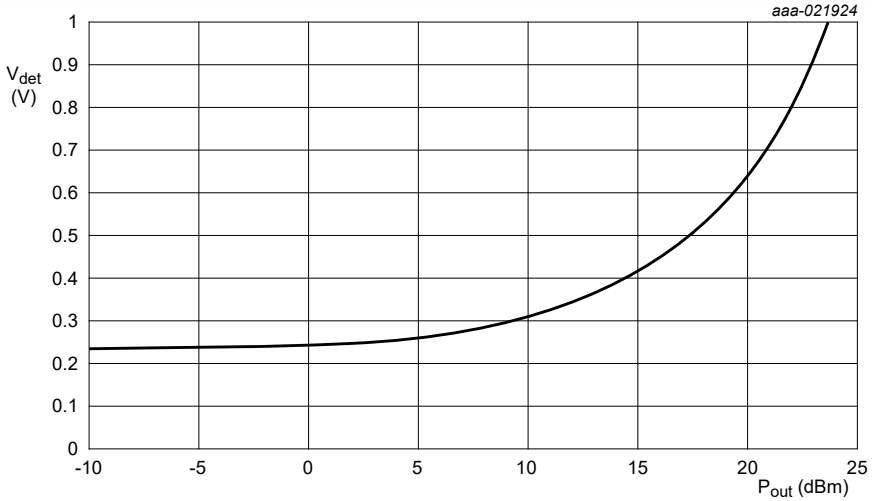

Figure 6. Typical power detector curve

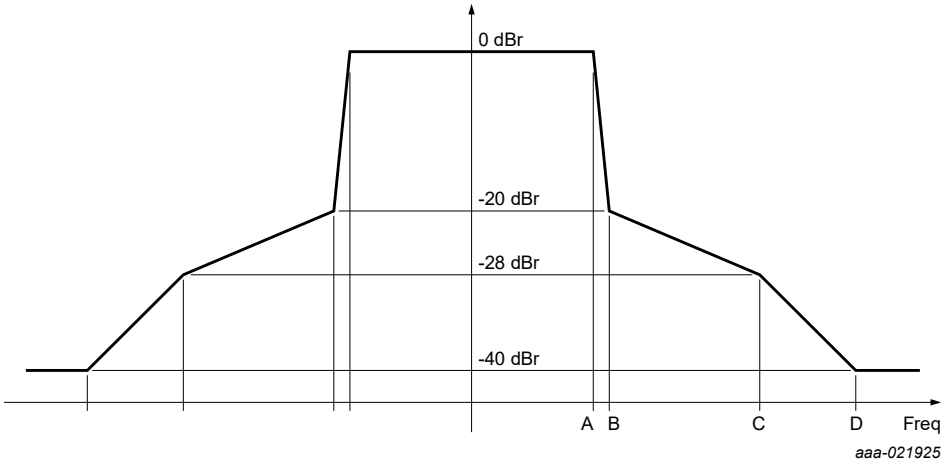

Figure 7. Spectral mask for 802.11 a/n/ac OFDM transmit (RBW = 100 kHz for P_L = 20 dBm, MCS0)

Table 11. Spectral mask distance for 20; 40 MHz bandwidth

Channel size	A	B	C	D	Frequency channel center
20 MHz	9 MHz	11 MHz	20 MHz	30 MHz	5180 MHz to 5825 MHz
40 MHz	19 MHz	21 MHz	40 MHz	60 MHz	5190 MHz to 5795 MHz

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Table 12. Control signal truth table

Pin status		Mode of operation				Mode name
C0	C1	Switch		LNA	PA	
(pin2)	(pin3)	ANT-RX	ANT-TX			
LOW	LOW	ON	OFF	OFF	OFF	RX bypass mode
LOW	HIGH	ON	OFF	ON	OFF	RX LNA
HIGH	LOW	OFF	ON	OFF	ON	TX high-Linearity
HIGH	HIGH	OFF	ON	OFF	ON	TX Low power

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13 Application information

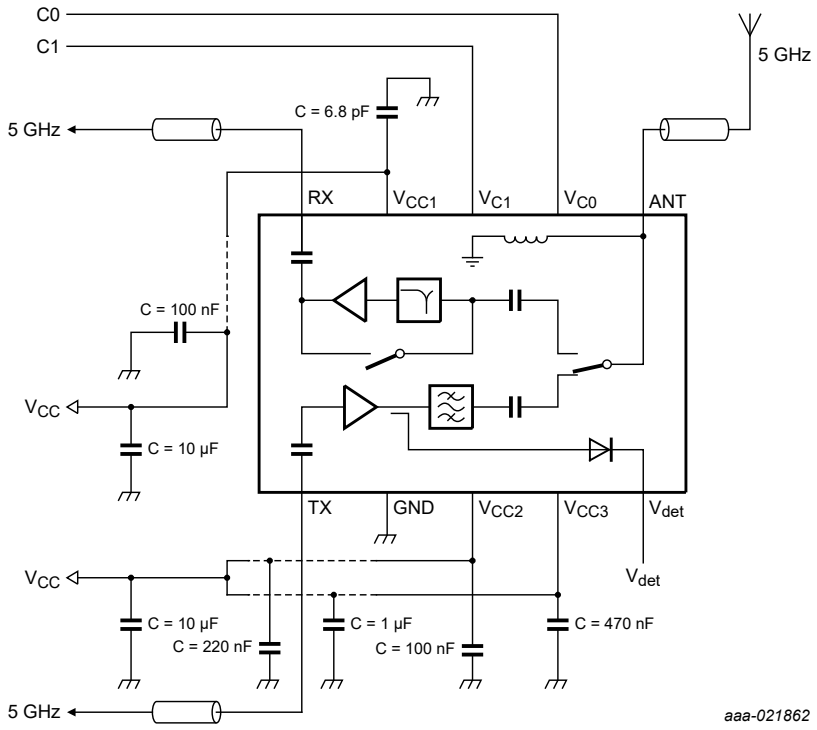

Figure 8. Application diagram

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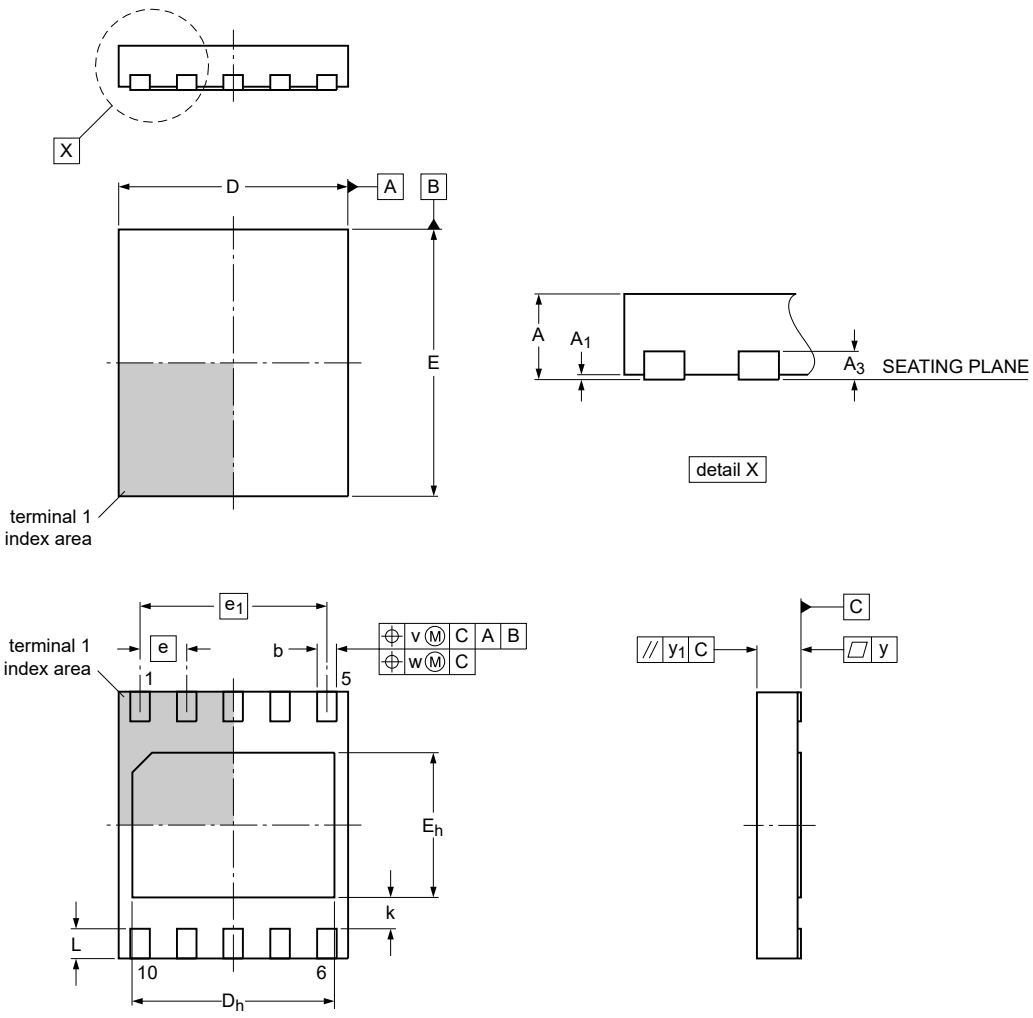
14 Package outline

HX2SON10: plastic, thermal enhanced super thin small outline package; no leads; 10 terminals; body 2.0 x 1.7 x 0.3 mm **SOT1436-1**



Dimensions (mm are the original dimensions)

Unit	A	A_1	A_3	b	D	D_h	E	E_h	e	e_1	k	L	v	w	y	y_1
max	0.33	0.05		0.20	1.75	1.55	2.05	1.13				0.26				
mm nom	0.30	0.02	0.1	0.15	1.70	1.50	2.00	1.08	0.35	1.4		0.21	0.07	0.05	0.08	0.1
min	0.28	0.00		0.10	1.65	1.45	1.95	1.03			0.2	0.16				

Note
1. Plastic or metal protrusions of 0.05 mm maximum per side are not included.

sot1436-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1436-1	- - -	- - -	- - -			~~15-03-04~~ 15-05-21

Figure 9. Package outline SOT1436

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15 Handling information

15.1 Moisture sensitivity

Table 13. Moisture sensitivity level

Test methodology	Class
JESD-22-A113	1

15.2 ESD information

CAUTION

This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20, IEC/ST 61340-5, JESD625-A* or equivalent standards.

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16 Abbreviations

Table 14. Abbreviations

Acronym	Description
ATM	automated teller machine (cash dispenser)
CDM	charge device model
CMOS	complementary metal oxide semiconductors
CW	continuous wave
DEVM	dynamic error vector magnitude
ESD	electrostatic discharge
EVM	error vector magnitude
HBM	human body model
IEEE	institute of electrical and electronics engineers
ISM	industrial scientific medical
LNA	low-noise amplifier
MCS	modulation & code scheme
MMIC	monolithic microwave-integrated circuit
MSL	moisture sensitivity level
PA	power amplifier
RX	receiver
SiGe:C	silicon germanium carbon
SPDT	single pole double throw
TDD	time duplex division
TX	transmitter
VHT	very high throughput
VSWR	voltage standing wave ratio
WLAN	wireless local area network

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17 Revision history

Table 15. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
WLAN7001C v.3	20180907	Product data sheet	-	WLAN7001C v.2
Modification	• Changed status from Company confidential to Public • updated the ESD condition on CDM with the correct description of the used ESD standard			
WLAN7001C v.2	20180815	Product data sheet	-	WLAN7001C v.1
Modification	Put extra condition at Dynamic characteristics DEVM: P_{out} = 14 dBm			
WLAN7001C v.1	20180213	Product data sheet	-	-

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18 Legal information

18.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

18.2 Definitions

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