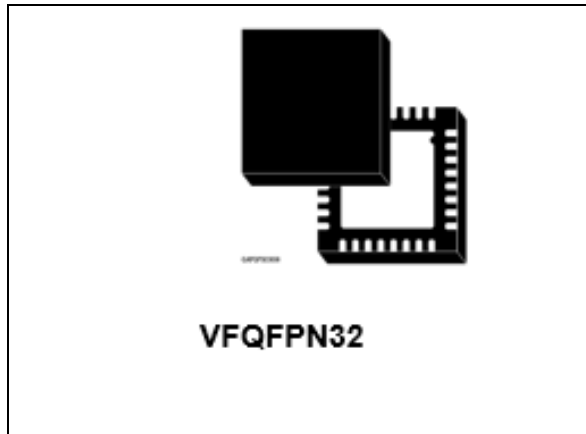



## Automotive Universal GNSS RF Receiver

Datasheet - production data



### Features

- AEC-Q100 qualified 
- Multi GNSS band support (L1/E1, L2C, L5/E5/E6/L6 and L band)
- Programmable IF bandwidth (7 or 13 MHz range)
- 1.62 V to 3.6 V supply voltage range
- Smart digital interface (JESD207-COMPATIBLE)
- Fractional-N synthesizer with embedded loop filter
- SPI interface for full programmability and interface to transmit L-band data bit
- 2 Bit A/D converter
- Operating temperature (-40 °C, 105 °C)
- CMOS040 technology
- QFN5x5 32leads package

### Description

The chip is a fully integrated RF front-end able to support different bands (L1, L2, L5, L6 and L) thanks to a programmable and flexible RF-IF chain driven by a fractional PLL. In particular,

G5RF is able to manage all the GNSS constellations available and planned in the next future like GPS, Galileo, Glonass, BeiDou, IRNSS and QZSS.

The RF\_IF chain is followed from a 2-bit ADC able to convert the IF signal to Sign (SIGN) and Magnitude (MAG) bit. The MAG bit is internally integrated in order to control the variable gain amplifiers. The VGA gain can be also set by the SPI interface.

Further, it is able to manage L-band signal from 1525 to 1559 MHz, in this case a dedicated 10bit ADC is used and the SPI interface to transmit low data rate data in L band support.

A digital interface, JESD207 compliant, is used only to transmit GNSS data and clock to external baseband.

The embedded fractional PLL allows supporting a wide range of reference clocks (10 to 55 MHz) and generates a sampling clock available for the baseband.

The STA5635A embeds two LDOs to supply at 1.1 V the analog and digital cores of the device facilitating requirements to external power supply. A third LDO can be turned-on to supply at 1.8 V external active components as a TCXO.

The chip is manufactured in CMOS040nm Technology and housed in a QFN package.

# Contents

- 1 Pin description ..... 5**
  - 1.1 Block diagram ..... 5
  - 1.2 Pin configuration ..... 6
  - 1.3 STA5635A: pin out ..... 6
  - 1.4 IO configurations ..... 8
  
- 2 Power management and start-up strategy ..... 9**
  
- 3 Antenna sensing ..... 11**
  
- 4 Electrical specifications ..... 12**
  - 4.1 Parameter conditions ..... 12
  - 4.2 Minimum and maximum values ..... 12
  - 4.3 Typical values ..... 12
  - 4.4 Absolute maximum rating ..... 12
  - 4.5 Thermal data ..... 13
  - 4.6 Electrical characteristics ..... 13
  
- 5 Package information ..... 15**
  
- 6 Order codes ..... 18**
  
- Revision history ..... 19**

## List of tables

Table 1.	Pin out. . . . .	6
Table 2.	Digital pin function . . . . .	8
Table 3.	Thresholds when current is rising . . . . .	11
Table 4.	Thresholds when current is falling . . . . .	11
Table 5.	Absolute maximum rating . . . . .	12
Table 6.	Thermal data . . . . .	13
Table 7.	Electrical characteristics (TJ = 25°C unless otherwise noted) . . . . .	13
Table 8.	Device summary . . . . .	18
Table 9.	Document revision history . . . . .	19

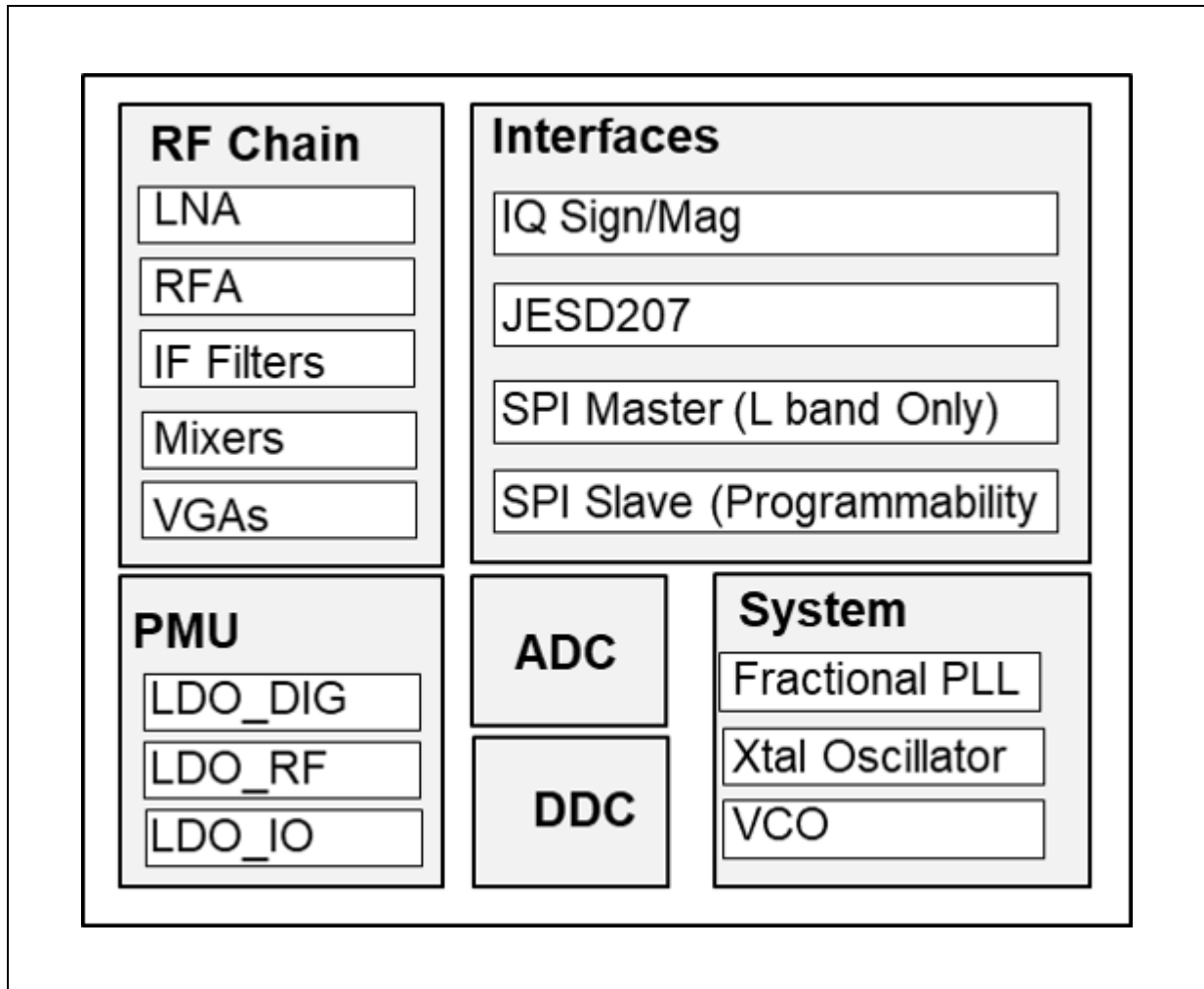
## List of figures

Figure 1.	STA5635A block schematic . . . . .	5
Figure 2.	Pin configuration . . . . .	6
Figure 3.	Power configuration . . . . .	9
Figure 4.	Power up strategy . . . . .	10
Figure 5.	Antenna sensing configuration . . . . .	11
Figure 6.	Package dimensions . . . . .	15
Figure 7.	Top, side and bottom views . . . . .	16
Figure 8.	Details of leads and attached exposed pad . . . . .	17

# 1 Pin description

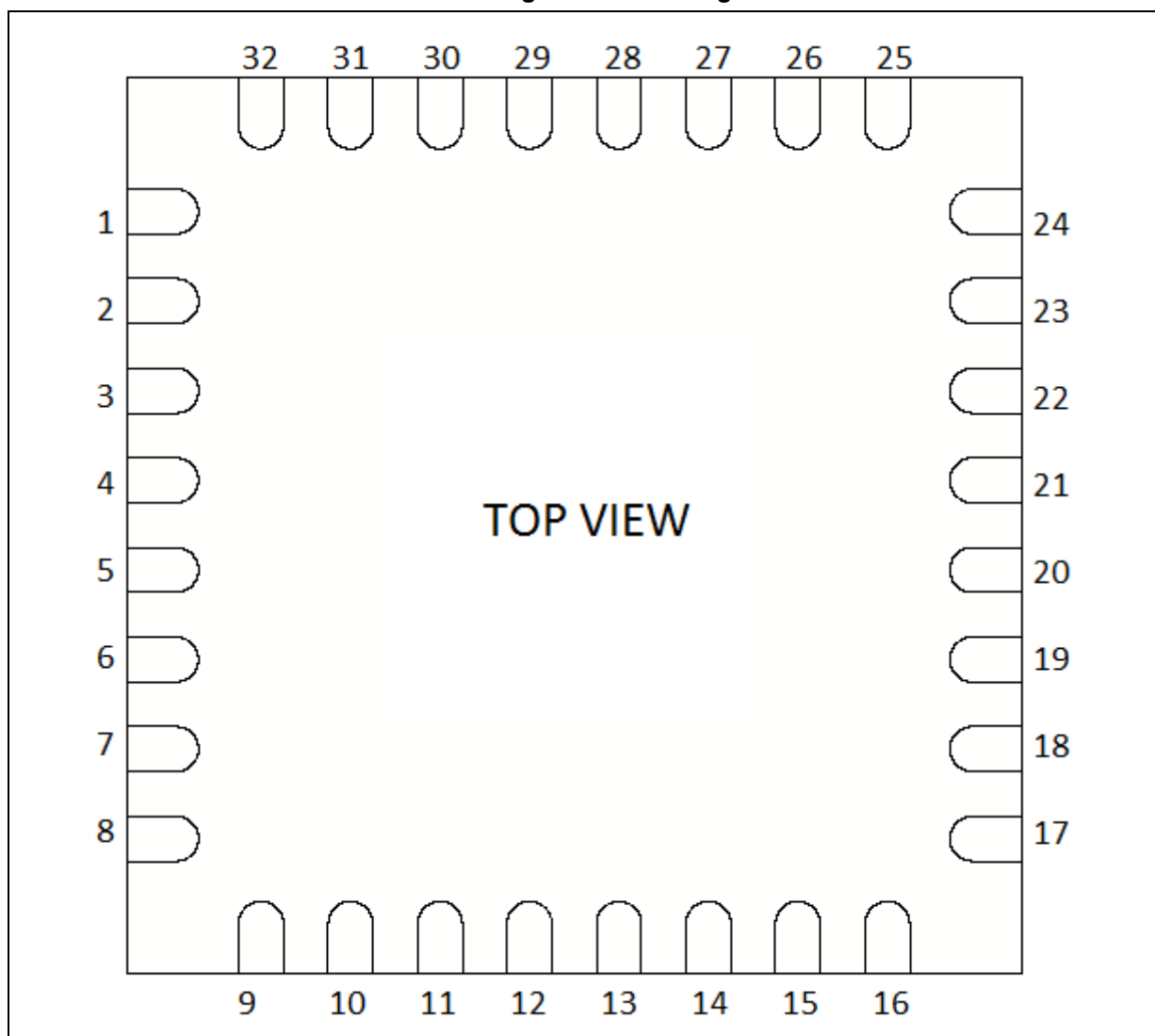
## 1.1 Block diagram

Figure 1. STA5635A block schematic



## 1.2 Pin configuration

Figure 2. Pin configuration



## 1.3 STA5635A: pin out

Table 1. Pin out

#	Name	Description	Supply domain	Type
1	V11_LNA	LNA power supply (1.1 V)	1.1 V	Supply
2	LNA_OUT	LNA output	1.1 V	Analog
3	V11_CHAIN	RF-IF chain power supply (1.1 V)	1.1 V	Supply
4	RFA_IN	RFA input, DC coupled	1.1 V	Analog

Table 1. Pin out (continued)

#	Name	Description	Supply domain	Type
5	TP_IF_P/Sense1 <sup>(1)</sup>	RF/IF receiver chain test positive output/ Antenna Sense1 input	1.8/3.3 V	Analog
6	TP_IF_N/Sense2 <sup>(1)</sup>	RF/IF receiver chain test negative output/ Antenna Sense2 input	1.8/3.3 V	Analog
7	V11_OUT_RF	LDO RF output: supply (1.1 V) for RF section	1.1 V	Supply
8	VCC_RF	Voltage supply 1.62-3.6 V for LDO RF	1.8/3.3 V	Supply
9	V11_PLL	PLL power supply (1.1 V)	1.1 V	Supply
10	TCXO_IN	TCXO input (DC coupled)	1.1 V	Analog
11	NC	Not connected	—	—
12	CHIP_EN	Enable for the whole chip	1.8/3.3 V	Digital
13	V11_OUT_DIG	LDO DIG output: power supply (1.1 V) for digital interface and IO ring	1.8/3.3 V	Supply
14	GND_DIG	Ground for digital	1.8/3.3 V	Ground
15	VCC_IO	Voltage supply 1.62-3.6 V for digital and IO LDOs	1.8/3.3 V	Supply
16	V18_OUT	LDO 1.8V output: supply 1.8 V for external BOM	1.8/3.3 V	Supply
17	TCXO_CLK	TCXO Buffered Output at 1.1 V at VCC_IO	1.8/3.3 V	Analog/Digital
18	GND_IO	I/Os Ground	1.8/3.3 V	Ground
19	Q-sign2	Q-sign of secondary chain	1.8/3.3 V	Digital
20	I-mag2	I-mag of secondary chain	1.8/3.3 V	Digital
21	I-sign2	I-sign of secondary chain	1.8/3.3 V	Digital
22	Q-mag2	Q-mag of secondary chain	1.8/3.3 V	Digital
23	I-mag1	I-mag of main chain	1.8/3.3 V	Digital
24	I-sign1	I-sign of main chain	1.8/3.3 V	Digital
25	Q-sign1	Q-sign of main chain	1.8/3.3 V	Digital
26	Q-mag1	Q-mag of main chain / Interrupt (LBand Mode)	1.8/3.3 V	Digital
27	SPI_CLK	Serial Parallel Interface Clock	1.8/3.3 V	Digital
28	SPI_DI	Serial Parallel Interface Data Input	1.8/3.3 V	Digital
29	SPI_DO	Serial Parallel Interface Data Output	1.8/3.3 V	Digital
30	SPI_NCS	Serial Parallel Interface Chip Select	1.8/3.3 V	Digital
31	LNA_IN	LNA input, DC coupled	1.1 V	Analog
32	LNA_GND	Ground for LNA signal	1.1 V	Ground
EP	GND	Ground		Ground

1. Selectable by SPI programming.

## 1.4 IO configurations

Eight of IO digital pin can have different functions. All functions are described in the [Table 2](#).

**Table 2. Digital pin function**

Main Name	Description/function	Supply domain	Type
MCLK / Q_Sign2	Digital interface clock (clock decimator filter)	1.8/3.3 V	Digital
	Q-sign data of Secondary main		
Enable / Q_Sign1	Enable for digital interface	1.8/3.3 V	Digital
	Q-sign data of main chain		Digital
Q_Mag1	Q-mag data of main chain	1.8/3.3 V	Digital
D(0) / I_Sign1	I-sign and I-mag data of main chain	1.8/3.3 V	Digital
	I-sign data of main chain		
	Sign data real of main chain		
D(1) / I_Mag1	Q-sign and Q-mag data of main chain	1.8/3.3 V	Digital
	I-mag data of main chain		
	Mag data real of main chain		
D(2) / Q_Mag2	Q-mag data of secondary chain	1.8/3.3 V	Digital
	GNSS Clock (64fo)		
D(3) / I_Sign2	I-sign and I-mag data of secondary chain	1.8/3.3 V	Digital
	I-sign data of secondary chain		
	Sign data real of secondary chain		
D(4) / I_Mag2	Q-sign and Q-mag data of secondary chain	1.8/3.3 V	Digital
	I-mag data of secondary chain		
	Mag data real of secondary chain		
TCXO_CLK	TCXO output buffered signal at VCC_IO	1.8/3.3 V	Digital
	TCXO output buffered signal at 1V1		
	CLK 64f0 (out of H divider) at VCC_IO		
	MCLK at VCC_IO (clock decimator filter)		

Each pin can be configured one by one by using SPI Register #52.



## 2 Power management and start-up strategy

The supply available on board of 3.3 V (or 1V8) have to be applied to VCC\_RF, VCC\_IO and CHIP\_EN (with or without an RC network) pins.

With power supply applied but CHIP\_EN inactive the chip is in stand-by mode consuming just a minimal leakage current. Applying CHIP\_EN High, turns-on the LDOs, immediately after the xtal oscillator and after a delay (td) the rest of the device. On CHIP\_EN pin can be used an optional RC delay to be sure that supply LDOs is set before LDO enable.

Figure 3. Power configuration

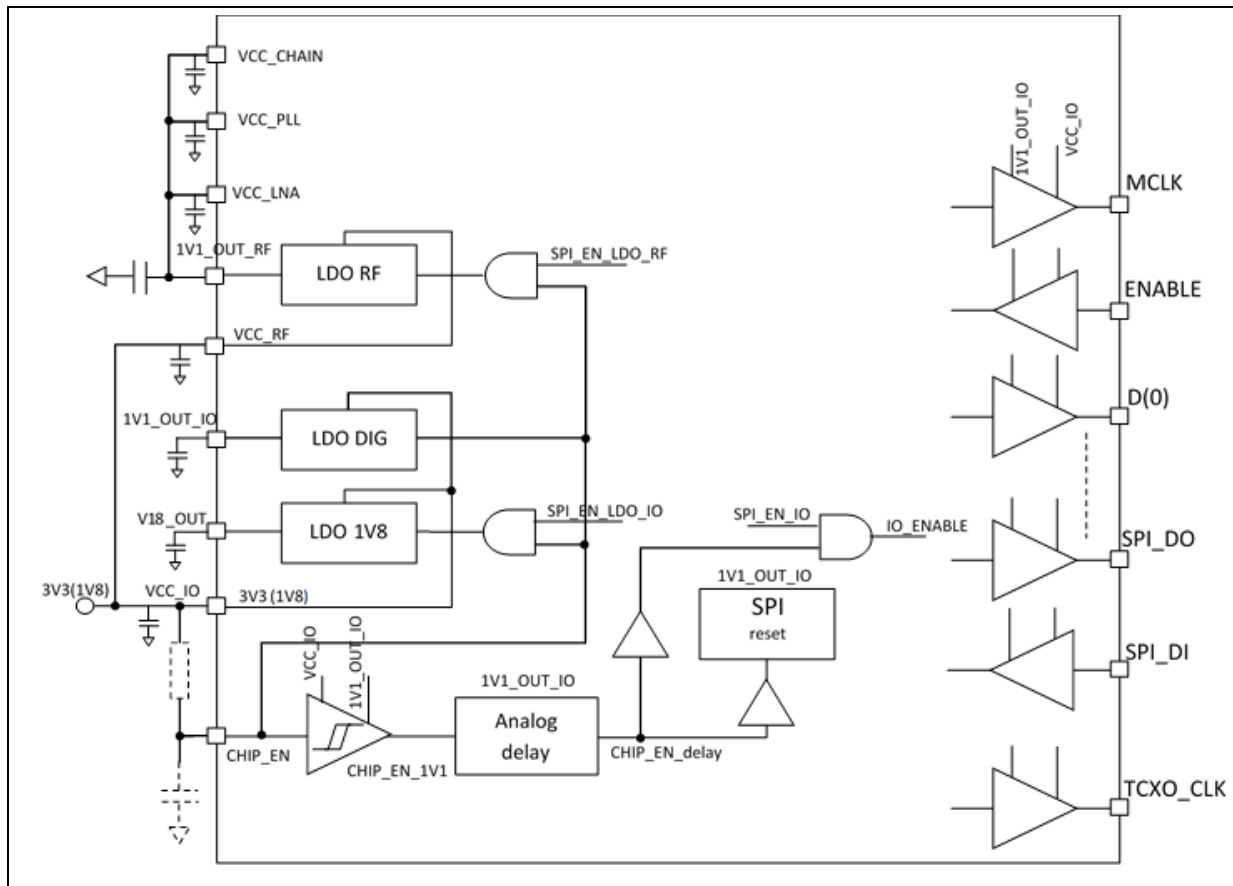
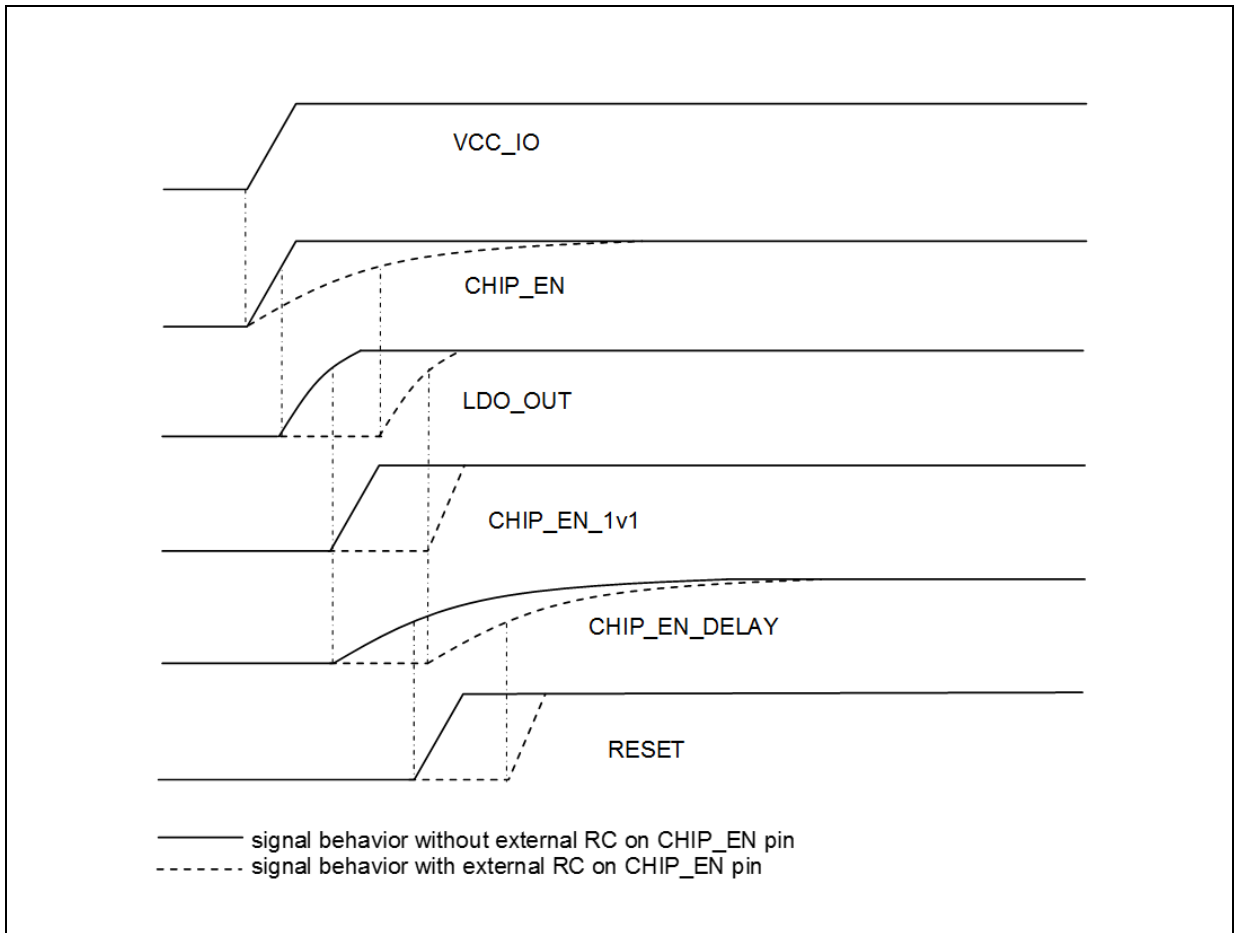


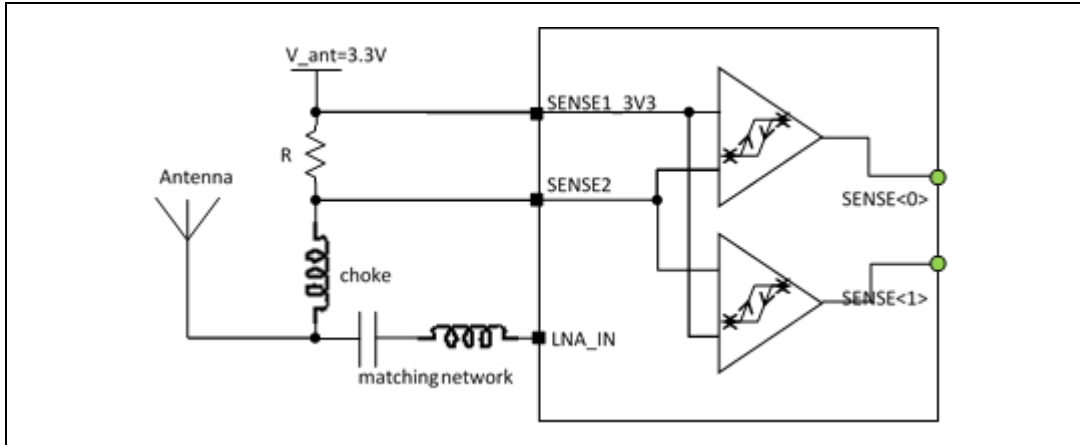
Figure 4. Power up strategy



### 3 Antenna sensing

The *Figure 5* shows how antenna sensing circuit works with 3.3 V Antenna.

**Figure 5. Antenna sensing configuration**



In the output two bit in 1V1 domain are delivered to SPI and interrupt logic.

In the following tables are showed thresholds when current is rising and when is falling with  $R=1.4 \Omega$  and  $V_{ant}=3.3 V$ .

**Table 3. Thresholds when current is rising**

Current from antenna (when current is rising)	SENSE<1>	SENSE<0>
$I < 24 \text{ mA}$	0	0
$24 \leq I \leq 62 \text{ mA}$	0	1
$I > 62 \text{ mA}$	1	1

**Table 4. Thresholds when current is falling**

Current sunk from antenna (when current is falling)	SENSE<1>	SENSE<0>
$I > 53 \text{ mA}$	1	1
$16 \leq I \leq 53 \text{ mA}$	0	1
$I < 16 \text{ mA}$	0	0

## 4 Electrical specifications

### 4.1 Parameter conditions

Unless otherwise specified, all voltages are referred to GND.

### 4.2 Minimum and maximum values

Unless otherwise specified the minimum and maximum values are guaranteed in the worst conditions of ambient temperature, supply voltage and frequencies by tests in production on 100% of the devices.

STA5635A parts are tested at  $T = -40\text{ °C}$  and  $T = 105\text{ °C}$ .

### 4.3 Typical values

Unless otherwise specified, typical data are based on  $T_{amb} = 25\text{ °C}$ ,  $VCC_{RF}=VCC_{IO}=3.3\text{ V}$ ,  $V11\_OUT\_RF=V11\_OUT\_DIG=1.1\text{ V}$  and  $V18\_OUT=1.8\text{ V}$ .

### 4.4 Absolute maximum rating

Table 5. Absolute maximum rating

Symbol	Parameter	Value		Unit
		Min	Max	
VCC_RF	Supply voltages	-0.3	3.9	V
VCC_IO	Supply voltages	-0.3	3.9	V
V18_OUT	Supply voltages	-0.3	1.98	V
V11_OUT_RF	Supply voltages	-0.3	1.25	V
V11_OUT_DIG	Supply voltages	-0.3	1.25	V
V11_LNA, V11_PLL V11_CHAIN	Supply voltages	-0.3	1.25	V
TJ	Junction operating temperature	-40	125	°C
TS	Storage temperature	-65	150	°C
ESDHBM	Electro static discharge – Human Body Model	-	2	kV
ESDCDM	Electro static discharge – Charge Device Model	-	250	V

### 4.5 Thermal data

Table 6. Thermal data

Symbol	Parameter	Value	Unit
T <sub>AMB</sub>	Ambient operating temperature	-40 to 105	°C
TR <sub>JA</sub>	Thermal Resistance Junction-Ambient	40	°C/W

### 4.6 Electrical characteristics

Table 7. Electrical characteristics (T<sub>J</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
<b>SUPPLY</b>						
VCC_RF	Analog input voltage		1.62	3.3	3.6	V
VCC_IO	Voltage supply for IO, LDO_1V8 and LDO_DIG	If IO pin are supplied at 3.3 V	3.0	3.3	3.6	V
		If IO pin are supplied at 1.8 V (LDO_1V8 must be turned-off)	1.62	1.8	1.98	
ICC	RF current consumption	Vcc=1.1 V, Main/Secondary Chain ON		28		mA
ICC_STBY	Stand-by power consumption	All blocks OFF		TBD		µA
<b>VOLTAGE REGULATOR</b>						
LDO_RF	Regulator output voltage		1.0	1.1	1.2	V
LDO_DIG	Regulator output voltage		1.0	1.1	1.2	V
LDO_1V8	Regulator output voltage		1.62	1.8	1.98	V
<b>LNA</b>						
Gp	Power gain	L1-L band		17		dB
		L2-L5 band		18		
NF	Noise figure <sup>(1)</sup>	L1-L band		1.7		dB
		L2-L5 band		1.7		
P <sub>-1dB</sub>	Input compression point			-18		dBm
<b>RFA - MIXER - IF FILTER - VGA</b>						
GpRFA	RFA voltage gain	Max gain		20		dB
		Min gain		0		dB

Table 7. Electrical characteristics (TJ = 25°C unless otherwise noted) (continued)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
GC	Conversion gain (from RF <sub>Ain</sub> to ADC input)	VGA & RFA at max gain		95		dB
		VGA & RFA at min gain		45		
$\Delta_{VGA}$	VGA dynamic range			50		dB
P <sub>-1dB</sub>	RF-IF-VGA Input Compression Point	In band RFA max VGA max		-105		dBm
		In band RFA max VGA min		-55		dBm
NF <sub>RF-IF</sub>	RF-IF-VGA noise figure <sup>(1)</sup>	VGA & RFA at max gain in L1-L2-L5-L band		5		dB
BW	-1dB high freq corner IF Filter	Set corner #1		13		MHz
		Set corner #2		7.5		
ATT	Aliasing frequency rejection	F = 52 MHz (corner #1)	20			dB
		F = 12 MHz (corner #2)	20			
<b>CRYSTAL OSCILLATOR- FRACTIONAL SYNTHESIZER – VCO</b>						
F <sub>XTAL</sub>	XTAL frequency		10		55	MHz
P <sub>XTAL_IN</sub>	Reference input signal sensitivity	XTAL_IN pin DC blocked requested. Without crystal XTAL_OUT load <5 pF.	-20			dBm
R <sub>DIV</sub>	Reference divider range		1		63	-
N <sub>DIV</sub>	Loop divider range		56		2047	-
Frac	PLL fractionality			18		bit
F <sub>LO</sub>	LO operating frequency		2300		3300	MHz
<b>Digital Input-Output DC characteristics</b>						
V <sub>IH_1V8</sub>	CMOS input high level	V <sub>CC_IO</sub> =1.8 V	0.75*V <sub>CC_IO</sub>		0.3+V <sub>CC_IO</sub>	V
V <sub>IL_1V8</sub>	CMOS input high level	V <sub>CC_IO</sub> =1.8 V	-0.3		0.25*V <sub>CC_IO</sub>	V
V <sub>IH_3V3</sub>	CMOS input high level	V <sub>CC_IO</sub> =3.3 V	2.5		0.3+V <sub>CC_IO</sub>	V
V <sub>IL_3V3</sub>	CMOS input high level	V <sub>CC_IO</sub> =3.3 V	-0.3		0.6	V
V <sub>OH</sub>	CMOS output high level		V <sub>CC_IO</sub> -0.4			V
V <sub>OL</sub>	CMOS output low level				0.4	V

1. Not tested in production.

## 5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com).

ECOPACK is an ST trademark.

Figure 6. Package dimensions

**TITLE: VFQFPN 5x5x1.0 32L PITCH 0.50 – with wettable flank (half cut leads)**  
**PACKAGE TYPE: Plastic no-lead**  
**PACKAGE CODE: B03N**  
**JEDEC REFERENCE NUMBER: No reference**

**PACKAGE DIMENSIONS**

DRAWING				
SYMBOL	MIN.	NOM.	MAX.	NOTE
A	0.80	0.85	0.90	12
A1	0.00	-	0.05	9, 12
A2	0.2 REF.			
A3	0.12			12
b	0.22	0.25	0.28	5, 6, 7, 12, 13
D	5.00 BSC			4, 12
D2	3.55	3.60	3.65	10, 12
e	0.50 BSC			12
E	5.00 BSC			4, 12
E2	3.55	3.60	3.65	10, 12
L	0.35	0.40	0.45	12, 13
k	0.20			
N	32			8

SYMBOL	TOLERANCE OF FORM AND POSITION	
	DRAWING	
aaa	0.15	
bbb	0.10	
ccc	0.10	
ddd	0.05	
eee	0.08	
fff	0.10	
NOTE	1,12	
REF		

Figure 7. Top, side and bottom views

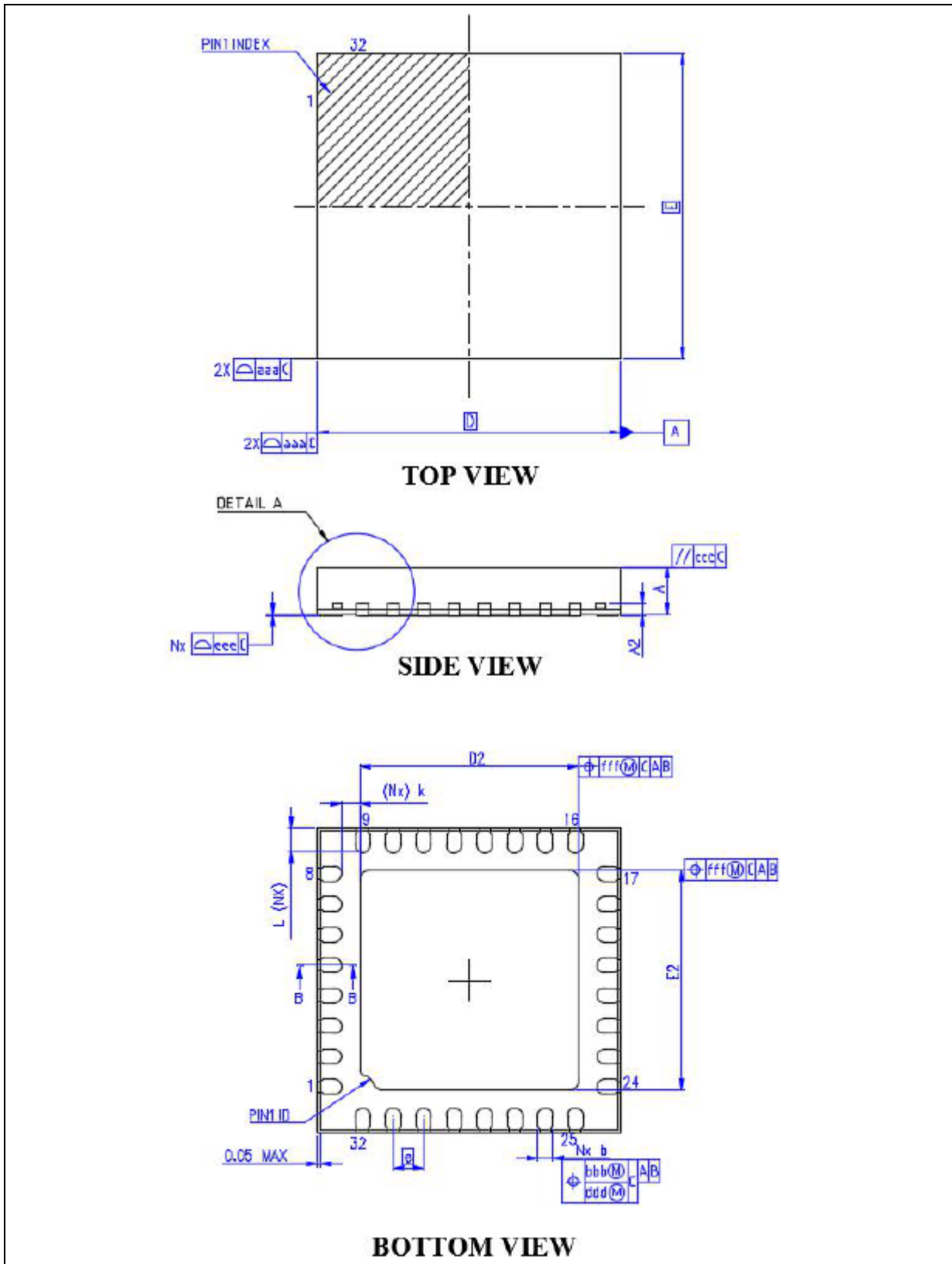
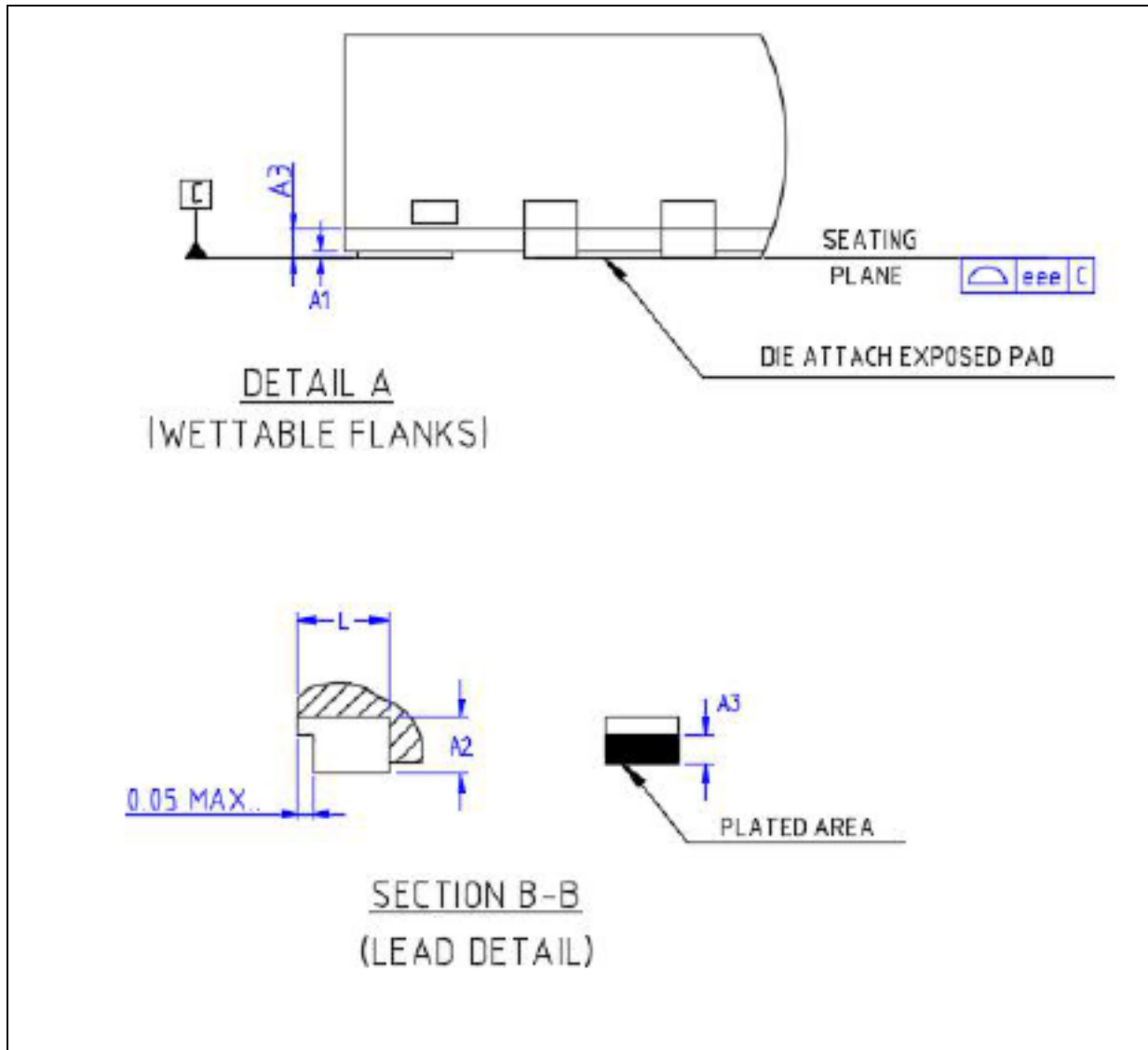




Figure 8. Details of leads and attached exposed pad



## 6 Order codes

Table 8. Device summary

Package	Order codes	
	Tray	Tape and reel
VQFN32	STA5635A	STA5635ATR

## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
26-Mar-2019	1	Initial release.
02-Dec-2020	2	Rpn in production data. Updated <a href="#">Figure 1</a> . Deleted old chapter 2, 3, 4, 5, and Appendix.

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