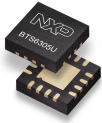


BTS6305U

High linearity pre-driver amplifier with differential input 2.3 GHz - 4.2 GHz

Rev. 9 — 15 June 2023

Product data sheet



1 General description

The BTS6305U is a wideband high linearity pre-driver amplifier with differential input 2.3 GHz - 4.2 GHz for 5G massive MIMO infrastructure applications, with fast on-off switching to support TDD systems. The amplifier is designed to operate between 2.3 GHz and 4.2 GHz. The BTS6305U is housed in a 3 mm x 3 mm x 0.85 mm 16-terminal HVQFN package.

2 Features and benefits

- High saturated output power $P_{o(sat)} = 29$ dBm
- High power-gain $G_p = 39.5$ dB
- High linearity performance ACLR = -42 dBc
- Unconditionally stable
- Fast switching to support TDD systems
- 5 V single supply, quiescent current 100 mA
- Small 16-terminal leadless package 3 mm x 3 mm x 0.85 mm
- ESD protection on all terminals
- Moisture sensitivity level 1

3 Applications

- Wireless infrastructure 5G NR mMIMO
- High linearity pre-driver
- TDD systems



4 Quick reference data

Table 1. Quick reference data

$f = 3.5 \text{ GHz}$; $V_{CC} = 5 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$; input $100 \text{ } \Omega$, and output $50 \text{ } \Omega$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	ON state, $P_o = 15 \text{ dBm}$	-	122	150	mA
		ON state, quiescent	-	100	125	mA
		OFF state	-	1.2	2.5	mA
G_p	power gain	On state	37	39.5	42	dB
		OFF state	-	-49	-47	dB
$P_{o(sat)}$	saturated output power	[1]	26	29	-	dBm
ACLR	adjacent channel leakage ratio	CP-OFDM with 100 MHz channel BW, QPSK modulation, and 60 kHz SCS, fully allocated, $P_o = 15 \text{ dBm}$	-	-42	-	dBc

[1] Connector and Printed-Circuit Board (PCB) losses have been de-embedded, 3 dB gain compression

5 Ordering information

Table 2. Ordering information

Type number	Orderable part number	Package		
		Name	Description	Version
BTS6305U	BTS6305UJ	HVQFN16	3 mm x 3 mm x 0.85 mm, 16 terminals no leads	SOT758-1

6 Marking

Table 3. Marking

Type number	Marking code
BTS6305U	35U

7 Functional diagram

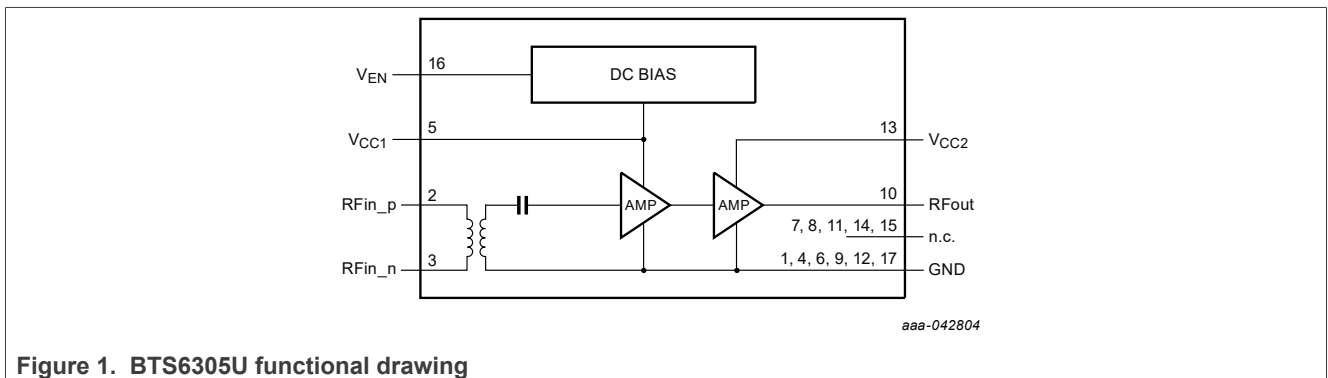


Figure 1. BTS6305U functional drawing

8 Pinning information

8.1 Pin diagram

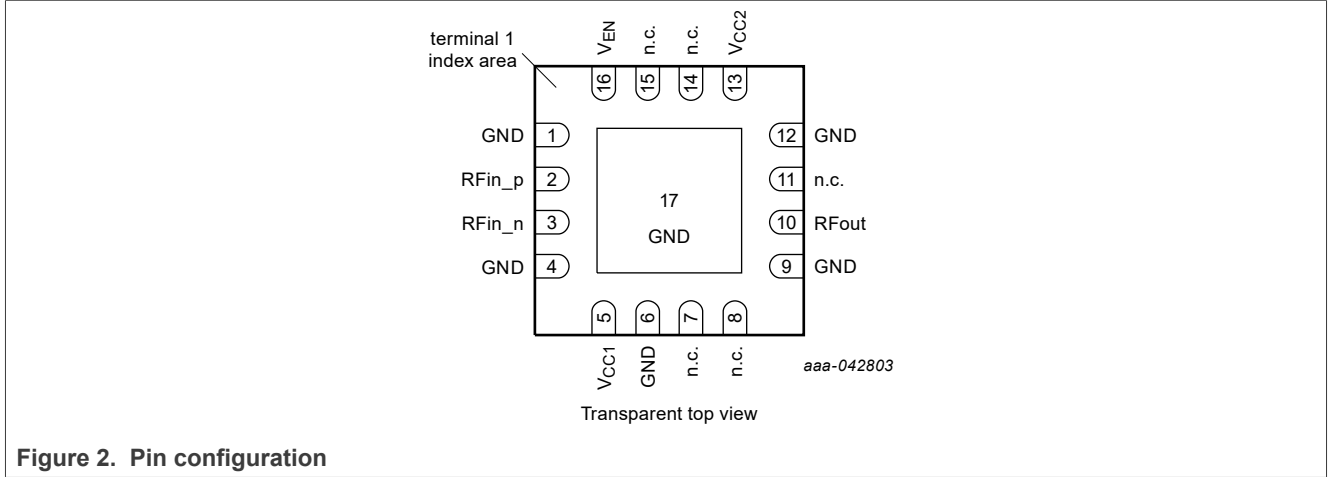


Figure 2. Pin configuration

8.2 Pin description

Table 4. Pin description

Pin	Symbol	Description
1, 4, 6, 9,12, and 17	GND	PCB ground
2	RFin_p	RF input
3	RFin_n	RF input
5	V _{CC1}	supply voltage
7, 8, 11, 14, and 15	n.c.	[1] not connected
10	RF _{out}	RF output
13	V _{CC2}	supply voltage
16	V _{EN}	voltage enable; LOW = OFF state; HIGH = ON state

[1] n.c. means that pin is not connected inside package, and may be left floating in application

9 Functional description

Table 5. Shutdown control

V _{en}	voltage applied at pin V _{en}	[1]	State	Condition
LOW	$0 < V(V_{en}) < V_{IL(max)}$		OFF	bias active, amplifier not active
HIGH	$V_{IH(min)} < V(V_{en}) < V_{I(max)}$		ON	bias active, amplifier active

[1] V_{EN} can only be made HIGH, after supply voltage has been applied to pin V_{CC1}

10 Limiting values

Table 6. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.3	6	V
V _{EN}	enable voltage		-0.3	4	V
P _{I(RF)CW}	continuous waveform RF input power	ON state, OFF state	-	10	dBm
T _{stg}	storage temperature		-50	150	°C
T _j	junction temperature		-	175	°C
V _{ESD}	electrostatic discharge voltage	Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001	-	+/-2	kV
		Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	-	+/-500	V

11 Recommended operating conditions

Table 7. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	supply voltage	[1]	4.75	5	5.25	V
V _{IL}	LOW-level input voltage		0	-	0.6	V
V _{IH}	HIGH-level input voltage		1.2	-	3.6	V
V _{I(max)}	maximum input voltage		-	-	3.6	V
Z ₀	characteristic impedance differential input		-	100	-	Ω
	characteristic impedance output		-	50	-	Ω
T _{case}	case temperature		-40	-	120	°C

[1] supply voltage at V_{CC1} must be applied before, or at the same time as applying supply voltage to pin V_{CC2}

12 Thermal characteristics

Table 8. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
R _{th(j-case)}	junction to case thermal resistance	[1] [2]	50	K/W

[1] case is ground solder pad

[2] thermal resistance determined with device mounted, and device bottom case kept at constant temperature

13 Characteristics

Table 9. Characteristics

$V_{CC} = 5\text{ V}$; $T_{amb} = 25\text{ °C}$; input $100\ \Omega$, and output $50\ \Omega$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{CC}	supply current	ON state, P _o = 15 dBm	-	122	150	mA
		ON state, quiescent	-	100	125	mA
		OFF state	-	1.2	2.5	mA
G _p	power gain	ON state				
		f = 2.6 GHz,	36	38.5	41	dB
		f = 3.5 GHz,	37	39.5	42	dB
		f = 4.2 GHz,	34	36.5	39	dB
		OFF state	-	-49	-47	dB
G _{flat}	gain flatness	f = 2.4 GHz to 2.7 GHz	-	1.4	-	dB
		f = 3.3 GHz to 3.8 GHz	-	1.3	-	dB
		f = 3.8 GHz to 4.2 GHz	-	1.9	-	dB
t _{d(grp)}	group delay time	f = 2.4 GHz to 2.7 GHz	-	0.4	0.5	ns
		f = 3.3 GHz to 3.8 GHz	-	0.4	0.5	ns
		f = 3.8 GHz to 4.2 GHz	-	0.4	0.5	ns
P _{o(sat)}	saturated output power	f = 2.6 GHz ^[1]	-	29	-	dBm
		f = 3.5 GHz ^[1]	26	29	-	dBm
		f = 4.2 GHz ^[1]	-	28.5	-	dBm
P _{L(1dB)}	output power at 1 dB gain compression	f = 2.6 GHz	-	28	-	dBm
		f = 3.5 GHz	-	28.5	-	dBm
		f = 4.2 GHz	-	27.5	-	dBm
IP _{3o}	output third-order intercept point	2-tone; tone spacing = 100 MHz; P _o = 15 dBm	-	33	-	dBm
CMRR	common mode rejection ratio	f = 2.6 GHz	22	28	-	dB
		f = 3.5 GHz	22	31	-	dB
		f = 4.2 GHz	22	31.5	-	dB
RL _i	input return loss	f = 2.6 GHz	10	13	-	dB
		f = 3.5 GHz	10	13.5	-	dB
		f = 4.2 GHz	10	14	-	dB
RL _o	output return loss	f = 2.6 GHz	10	21	-	dB
		f = 3.5 GHz	10	14	-	dB
		f = 4.2 GHz	10	15	-	dB
ISL _r	reverse isolation		-	80	-	dB

High linearity pre-driver amplifier with differential input 2.3 GHz - 4.2 GHz

Table 9. Characteristics...continued

$V_{CC} = 5\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; input $100\ \Omega$, and output $50\ \Omega$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
NF	noise figure	f = 2.6 GHz ^[2]	-	4	-	dB
		f = 3.5 GHz ^[2]	-	4	-	dB
		f = 4.2 GHz ^[2]	-	3.5	-	dB
t _{s(pon)}	power-on settling time	V _{EN} from LOW to HIGH to gain settled within 0.1 dB of final value and phase settled to within 1 degree of final value	-	0.7	0.8	μs
t _{s(poff)}	power-off settling time	V _{EN} from HIGH to LOW to gain settled to be < 5 % of gain in ON state	-	0.05	0.1	μs
K	Rollett stability factor	1 MHz to 15 GHz	1.8	-	-	
ACLR	adjacent channel leakage ratio	CP-OFDM with 100 MHz channel BW, QPSK modulation, and 60 kHz SCS, fully allocated, P _o = 15 dBm	-	-42	-	dBc

[1] Connector and Printed-Circuit Board (PCB) losses have been de-embedded, 3 dB gain compression

[2] Connector and Printed-Circuit Board (PCB) losses have been de-embedded.

14 Graphs

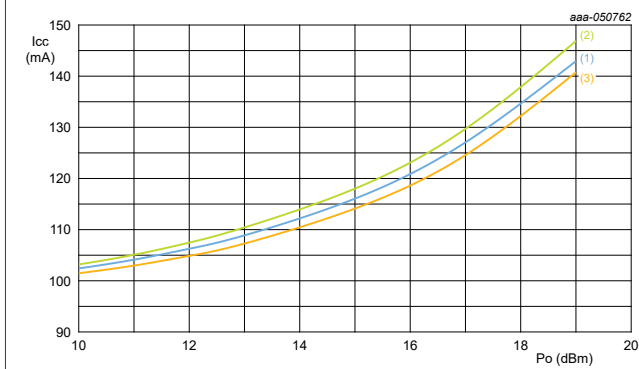


Figure 3. I_{CC} versus P_{out} over frequency at 25 °C
 (1) $f = 2.6$ GHz
 (2) $f = 3.5$ GHz
 (3) $f = 4.2$ GHz

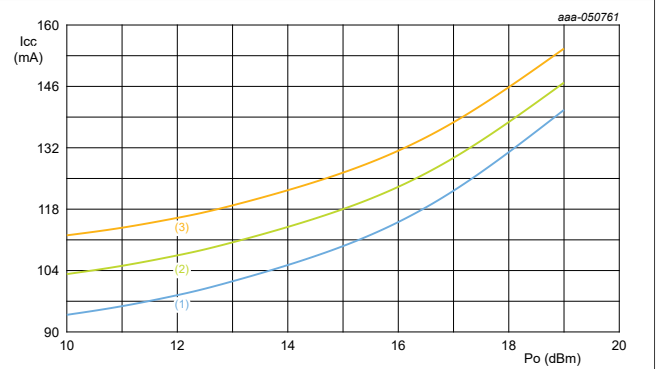


Figure 4. I_{CC} versus P_{out} over temperature at 3.5 GHz
 (1) $T_{case} = -40$ °C
 (2) $T_{case} = 25$ °C
 (3) $T_{case} = 115$ °C

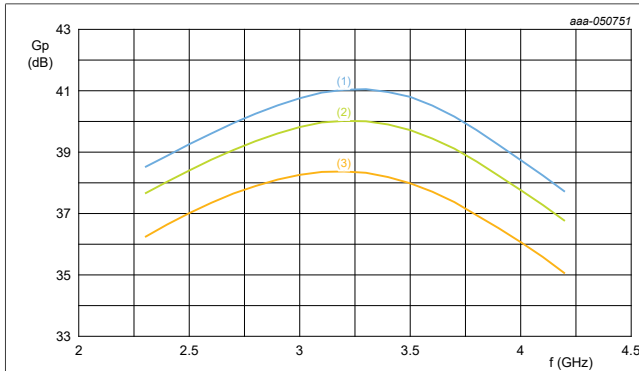


Figure 5. Gain versus frequency over temperature
 (1) $T_{case} = -40$ °C
 (2) $T_{case} = 25$ °C
 (3) $T_{case} = 115$ °C

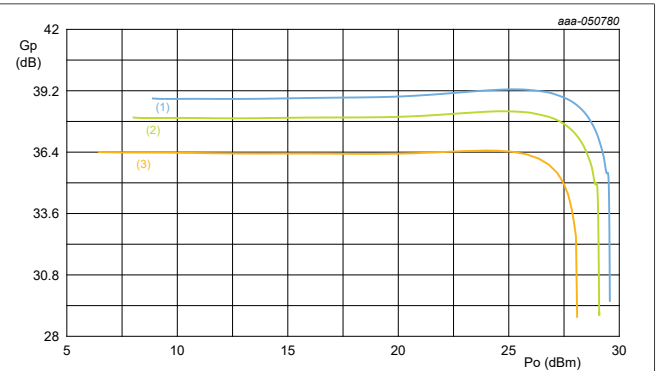


Figure 6. Gain versus P_{out} over temperature at 2.6 GHz
 (1) $T_{case} = -40$ °C
 (2) $T_{case} = 25$ °C
 (3) $T_{case} = 115$ °C

High linearity pre-driver amplifier with differential input 2.3 GHz - 4.2 GHz

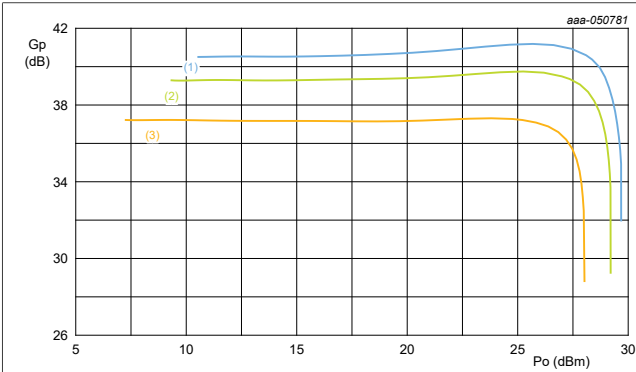


Figure 7. Gain versus P_{out} over temperature at 3.5 GHz
 (1) $T_{case} = -40\text{ °C}$
 (2) $T_{case} = 25\text{ °C}$
 (3) $T_{case} = 115\text{ °C}$

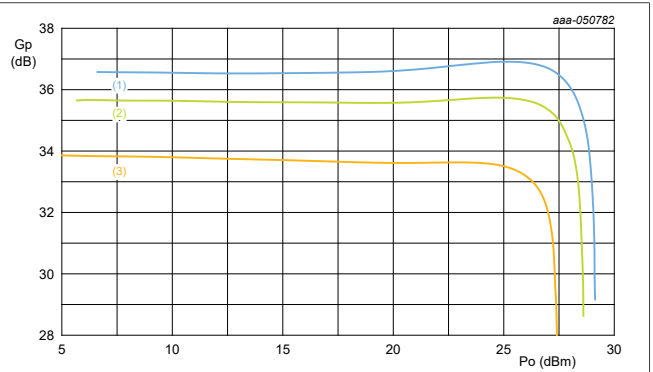


Figure 8. Gain versus P_{out} over temperature at 4.2 GHz
 (1) $T_{case} = -40\text{ °C}$
 (2) $T_{case} = 25\text{ °C}$
 (3) $T_{case} = 115\text{ °C}$

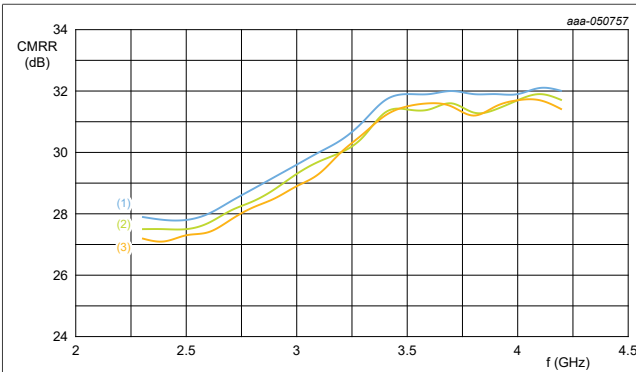


Figure 9. CMRR versus frequency over temperature
 (1) $T_{case} = -40\text{ °C}$
 (2) $T_{case} = 25\text{ °C}$
 (3) $T_{case} = 115\text{ °C}$

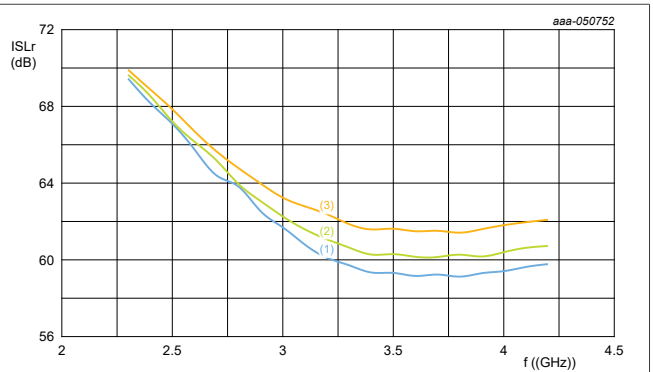


Figure 10. Isolation versus frequency over temperature
 (1) $T_{case} = -40\text{ °C}$
 (2) $T_{case} = 25\text{ °C}$
 (3) $T_{case} = 115\text{ °C}$

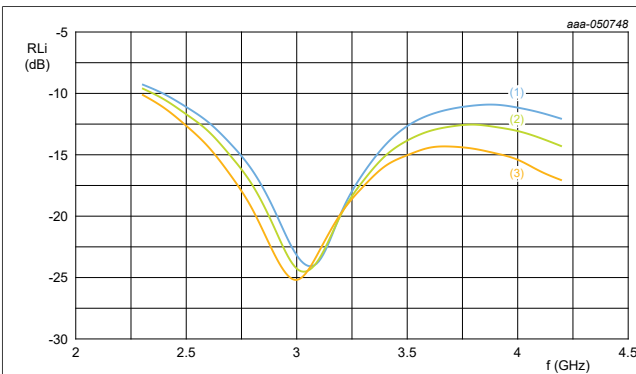


Figure 11. S_{11} versus frequency over temperature
 (1) $T_{case} = -40\text{ °C}$
 (2) $T_{case} = 25\text{ °C}$
 (3) $T_{case} = 115\text{ °C}$

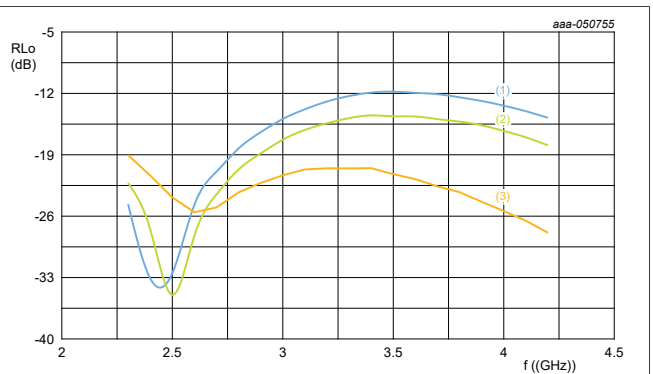


Figure 12. S_{22} versus frequency over temperature
 (1) $T_{case} = -40\text{ °C}$
 (2) $T_{case} = 25\text{ °C}$
 (3) $T_{case} = 115\text{ °C}$

High linearity pre-driver amplifier with differential input 2.3 GHz - 4.2 GHz

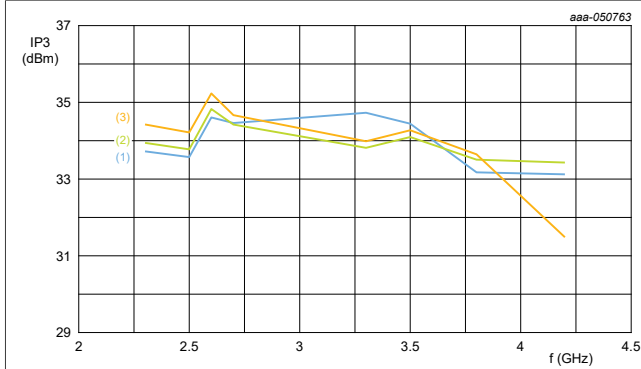


Figure 13. IP3 versus frequency over temperature

- (1) $T_{case} = -40\text{ °C}$
- (2) $T_{case} = 25\text{ °C}$
- (3) $T_{case} = 115\text{ °C}$

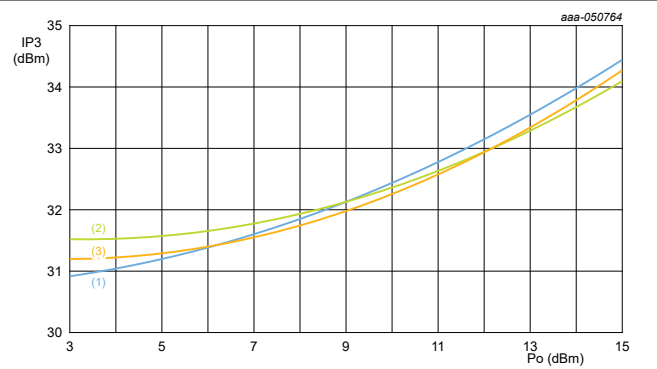


Figure 14. IP3 versus P_{out} over temperature at 3.5 GHz

- (1) $T_{case} = -40\text{ °C}$
- (2) $T_{case} = 25\text{ °C}$
- (3) $T_{case} = 115\text{ °C}$

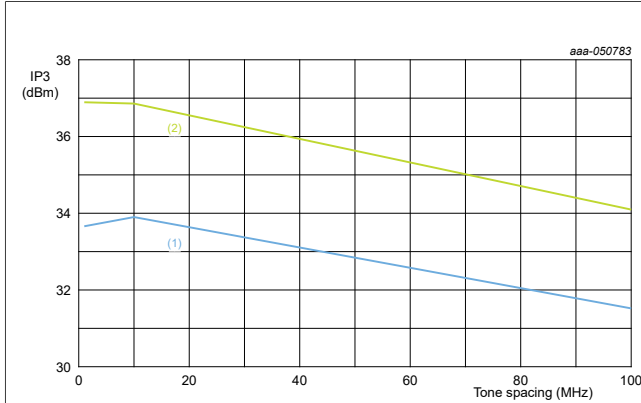


Figure 15. IP3 versus tone spacing over P_{out}

- (1) $P_o = 3\text{ dBm}$
- (2) $P_o = 15\text{ dBm}$

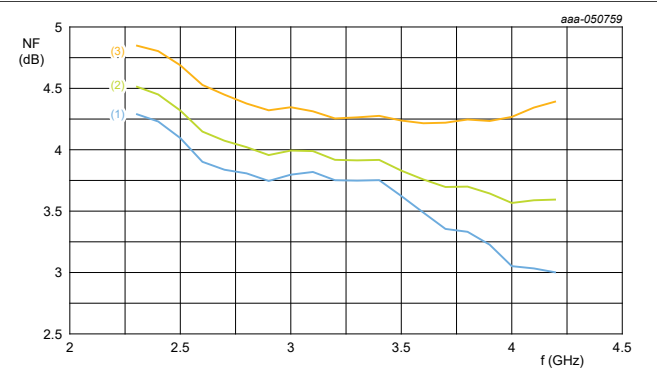


Figure 16. NF versus frequency over temperature

- (1) $T_{case} = -40\text{ °C}$
- (2) $T_{case} = 25\text{ °C}$
- (3) $T_{case} = 115\text{ °C}$

15 Application information

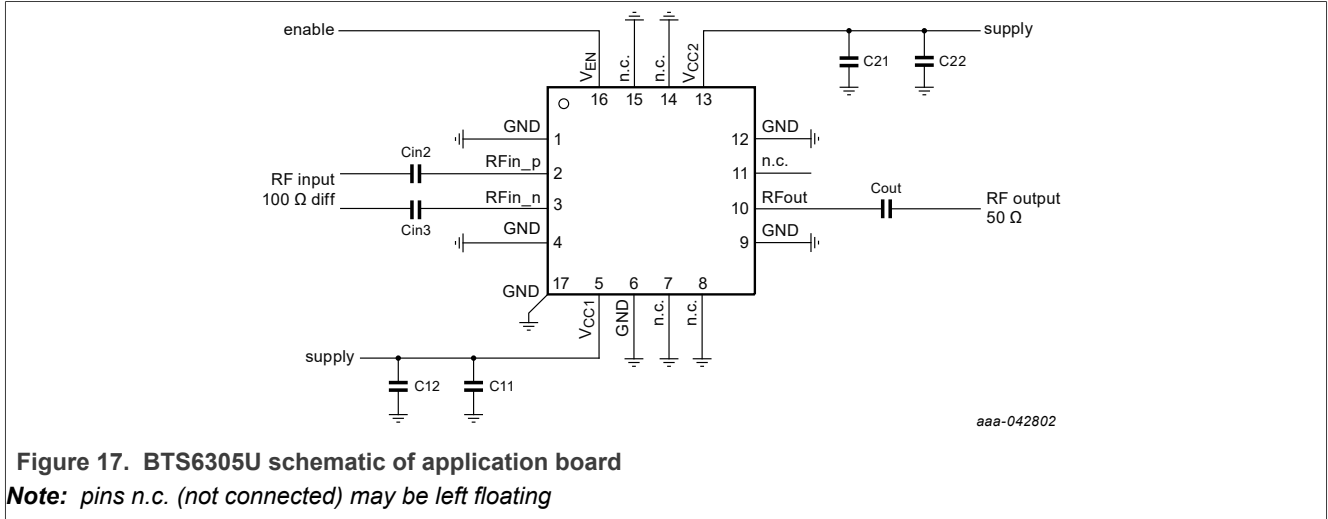


Figure 17. BTS6305U schematic of application board
Note: pins n.c. (not connected) may be left floating

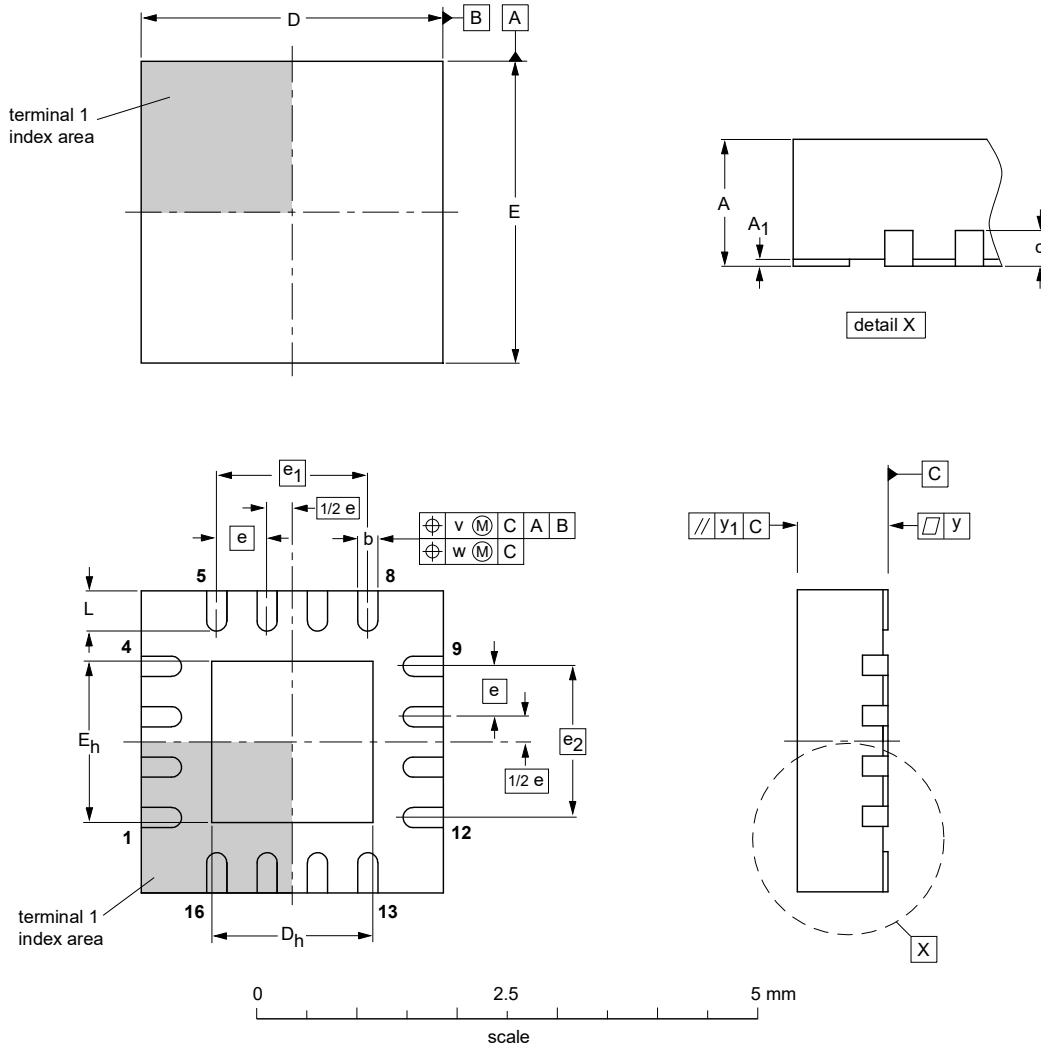
Table 10. List of components

Component	Description	Value	Remarks
Cin2, and Cin3	capacitor	18 pF	in a 50 Ω PCB track
C _{out}	capacitor	3.9 pF	in a 50 Ω PCB track
C11, and C21	capacitor	10 nF	recommended
C12, and C22	capacitor	1 μF	optional

16 Package outline

HVQFN16: plastic thermal enhanced very thin quad flat package; no leads;
16 terminals; body 3 x 3 x 0.85 mm

SOT758-1



DIMENSIONS (mm are the original dimensions)

UNIT	A ⁽¹⁾ max.	A ₁	b	c	D ⁽¹⁾	D _h	E ⁽¹⁾	E _h	e	e ₁	e ₂	L	v	w	y	y ₁
mm	1	0.05 0.00	0.30 0.18	0.2	3.1 2.9	1.75 1.45	3.1 2.9	1.75 1.45	0.5	1.5	1.5	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT758-1	---	MO-220	---		-02-03-25- 02-10-21

Figure 18. Package outline SOT758-1 (HVQFN16)

16.1 Footprint and solder information

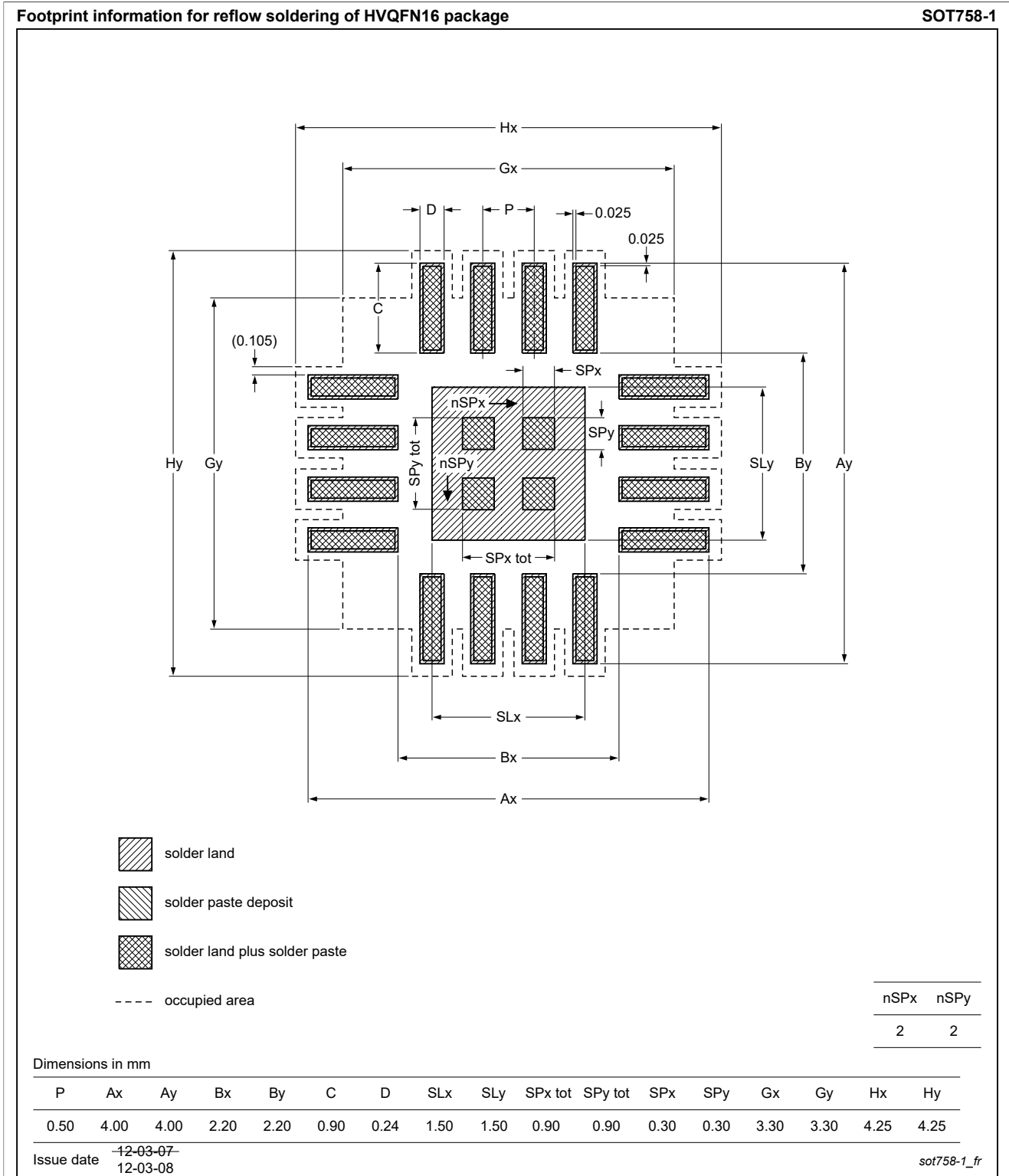


Figure 19. Footprint information

17 Handling 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.

18 Abbreviations

Table 11. Abbreviations

Acronym	Description
5G NR	5 th generation new radio
ACLR	adjacent channel leakage ratio
CP-OFDM	cyclic prefix orthogonal frequency division multiplexing
CMMR	common mode rejection ratio
ESD	electrostatic discharge
mMIMO	massive multiple-input multiple-output
PA	power amplifier
RF	radio frequency
TDD	time-division duplexing

19 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BTS6305U v.9	20230615	Product data sheet	-	BTS6305U v.8
modification	• Changed max case temperature from 115°C to 120°C			
BTS6305U v.8	20230321	Product data sheet	-	BTS6305U v.7
modification	• Updated table 4 pin description			
BTS6305U v.7	20230315	Product data sheet	-	BTS6305U v.6
modification	• Updated min value storage temperature			
BTS6305U v.6	20230310	Product data sheet	-	BTS6305U v.5
modification	• Updated graphs			

20 Legal information

20.1 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>.

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High linearity pre-driver amplifier with differential input 2.3 GHz - 4.2 GHz

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Security — Customer understands that all NXP products may be subject to unidentified vulnerabilities or may support established security standards or specifications with known limitations. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately.

Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP.

NXP has a Product Security Incident Response Team (PSIRT) (reachable at PSIRT@nxp.com) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

20.4 Trademarks

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