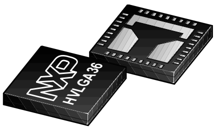


TFF1044HN

Integrated mixer oscillator PLL for satellite quad LNB

Rev. 1 — 10 June 2015
Product data sheet

1. General description

The TFF1044HN is a 10.70 GHz to 12.75 GHz K_u band down converter for use in universal quad and quattro Low Noise Block (LNB) in satellite receiver systems. The device features two RF inputs (two polarizations) and four IF outputs (up to 4 active IF paths). It integrates bias generation and control for the required external LNA stages, image rejection filtering, LO generation, down-conversion mixers, IF amplifier stages, voltage and tone detection on each IF output (for polarization and band selection) and the 4 (IF channels) × 4 (2 polarizations, 2 bands) IF matrix switch. For flexibility, the gain can be controlled in three discrete stages, the polarization of the RF inputs can be swapped and the second stage LNA biasing control can be switched from pHEMT to BJT configuration.

2. Features and benefits

- Low current consumption integrated pre-amplifier, mixer, buffer amplifier and PLL synthesizer
- Integrated pHEMT/BJT bias control for external LNAs
- Flat gain over frequency
- Single 5 V supply pin
- Operates with a low cost 25 MHz crystal
- Crystal-controlled LO frequency generation, alignment free concept
- Dual simultaneously operating LO frequencies (9.75 GHz and 10.6 GHz)
- Adjustable step gain (30 dB, 33 dB and 36 dB)
- Integrated switch matrix
- Integrated voltage and tone detector
- Low phase noise
- Low spurious
- Low external component count
- Alignment-free concept
- 36-terminal leadless plastic thermally enhanced very thin profile land grid array package 5.0 mm × 5.0 mm × 0.72 mm

3. Applications

- Quad LNBs
- Quattro LNBs
- IP LNBs

4. Quick reference data

Table 1. Quick reference data

V_{CC} = 5 V; T_{amb} = 25 °C; f_{LO} = 9.75 GHz or f_{LO} = 10.6 GHz; f_{xtal} = 25 MHz; Z_0 = 50 Ω for RF inputs and Z_0 = 75 Ω for IF outputs unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CC}	supply voltage	IF output AC coupled	[1]	4.3	5	5.6	V
I_{CC}	supply current	IF output AC externally coupled; excluding current for LNAs; single activated IF path	[1]	-	145	-	mA
f_{RF}	RF frequency			10.70	-	12.75	GHz
G_{conv}	conversion gain	f_{IF} = 1450 MHz (low band); single activated IF path					
		low gain mode	[2]	-	30	-	dB
		medium gain mode	[2]	-	33	-	dB
		high gain mode	[2]	-	36	-	dB
NF_{SSB}	single sideband noise figure	high gain mode; f_{IF} = 1450 MHz (low band)	[2]	-	8	-	dB
s_{11}	input reflection coefficient	10.70 GHz ≤ f_{RF} ≤ 12.75 GHz		-	−10	-	dB
s_{22}	output reflection coefficient	950 MHz ≤ f_{IF} ≤ 2150 MHz		-	−10	-	dB
$IP3_o$	output third-order intercept point	high gain mode; carrier power is −10 dBm (measured at IF output)	[2]	-	15	-	dBm

[1] DC values.

[2] See Table 12 for conversion gain selection settings.

5. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
TFF1044HN	HVLGA36	plastic thermal enhanced very thin profile land grid array package; no leads; 36 terminals;	SOT1359-1

6. Functional diagram

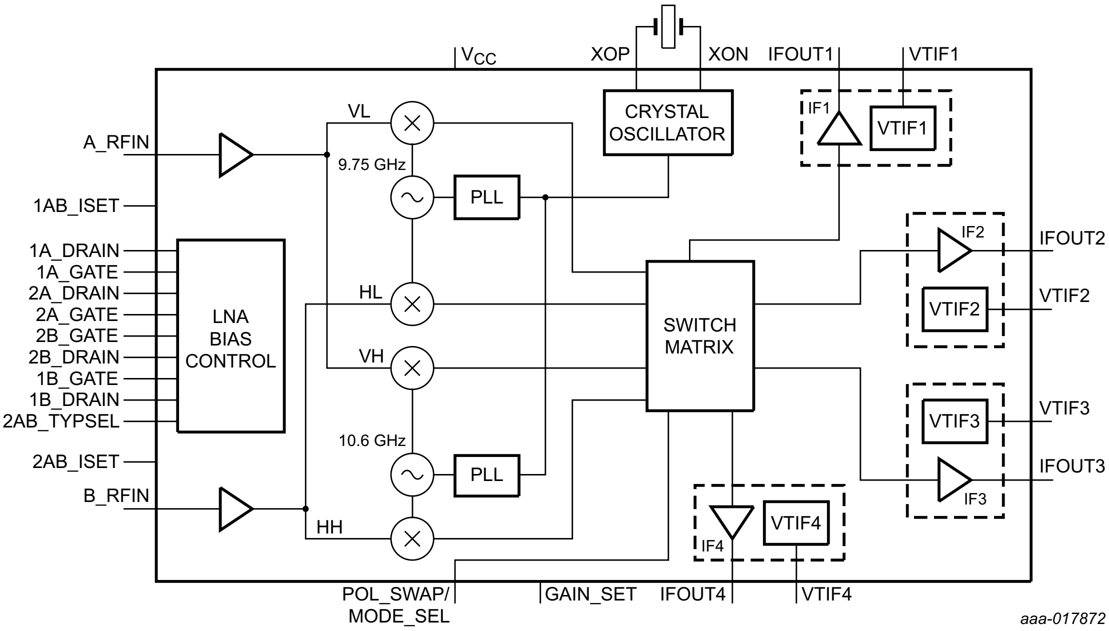


Fig 1. Functional diagram

7. Pinning information

7.1 Pinning

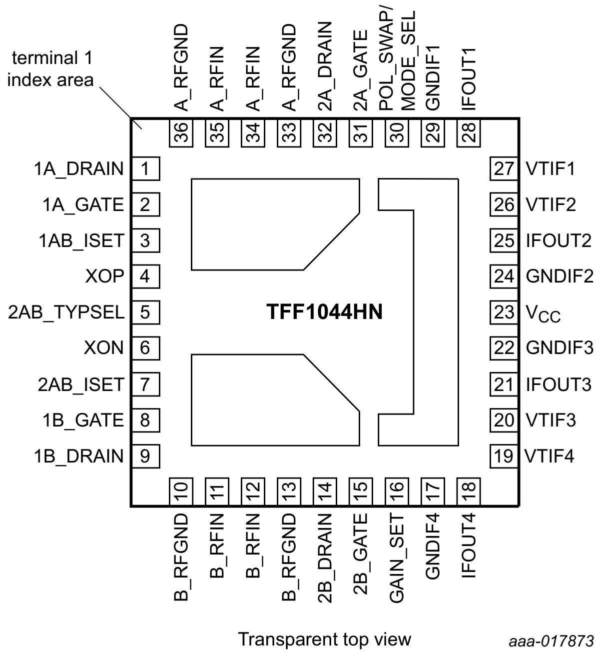


Fig 2. Pin configuration

7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
1A_DRAIN	1	Drain bias for the first stage LNA of RF path A
1A_GATE	2	Gate bias for the first stage LNA of RF path A
1AB_ISET	3	Drain current setting for first stage LNAs
XOP	4	External crystal (Xtal) positive connection. Connect Xtal between this pin and XON (pin 6)
2AB_TYPSEL	5	Second stage LNA type select: BJT/pHEMT
XON	6	External crystal (Xtal) negative connection. Connect Xtal between this pin and XOP (pin 4)
2AB_ISET	7	Drain/collector current setting for second stage LNAs
1B_GATE	8	Gate bias for the first stage LNA of RF path B
1B_DRAIN	9	Drain bias for the first stage LNA of RF path B
B_RFGND	10	RF ground of path B. Connect this pin to the exposed die pad landing and the RF input transmission line
B_RFIN	11	RF input of path B. AC coupled; DC grounded
B_RFIN	12	RF input of path B. AC coupled, DC grounded
B_RFGND	13	RF ground of path B. Connect this pin to the exposed die pad landing and the RF input transmission line

Table 3. Pin description *…continued*

Symbol	**Pin**	**Description**
2B_DRAIN	14	Drain bias for the second stage LNA of RF path B
2B_GATE	15	Gate bias for the second stage LNA of RF path B
GAIN_SET	16	Conversion gain setting pin
GNDIF4	17	Ground connection of IFOUT4. Connect this pin to the exposed die pad landing and the output transmission line ground.
IFOUT4	18	IF output 4
VTIF4	19	Voltage and tone detector input for polarity and band selection of IFOUT4
VTIF3	20	Voltage and tone detector input for polarity and band selection of IFOUT3
IFOUT3	21	IF output 3
GNDIF3	22	Ground connection of IFOUT3. Connect this pin to the exposed die pad landing and the output transmission line ground.
V_{CC}	23	Supply voltage
GNDIF2	24	Ground connection of IFOUT2. Connect this pin to the exposed die pad landing and the output transmission line ground.
IFOUT2	25	IF output 2
VTIF2	26	Voltage and tone detector input for polarity and band selection of IFOUT2
VTIF1	27	Voltage and tone detector input for polarity and band selection of IFOUT1
IFOUT1	28	IF output 1
GNDIF1	29	Ground connection of IFOUT1. Connect this pin to the exposed die pad landing and the output transmission line ground.
POL_SWAP/MODE_SEL	30	Polarity preset for RF inputs and quad/quattro mode selection
2A_GATE	31	Gate bias for the second stage LNA of RF path A
2A_DRAIN	32	Drain bias for the second stage LNA of RF path A
A_RFGND	33	RF ground. Connect this pin to the exposed die pad landing and the RF input transmission line
A_RFIN	34	RF input of path A. AC coupled, DC grounded
A_RFIN	35	RF input of path A. AC coupled, DC grounded
A_RFGND	36	RF ground. Connect this pin to the exposed die pad landing and the RF input transmission line
GND	exposed die pads	Ground; exposed die pads should be connected

8. Limiting values

Table 4. Limiting values

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

Symbol	**Parameter**	**Conditions**	**Min**	**Max**	**Unit**
V_{CC}	supply voltage		–0.5	+7	V
V_{ctrl}	control voltage	[1][2]	–0.5	+24	V
$V_{th(bsel)(p-p)}$	peak-to-peak band selection threshold voltage	$f_{p(ctrl)}$ = 22 kHz [2]	-	2	V
$P_{i(RF)}$	RF input power		-	0	dBm
T_j	junction temperature		-	150	°C

Table 4. Limiting values *…continued*

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

Symbol	Parameter	Conditions	Min	Max	Unit
T_{stg}	storage temperature		–40	+125	°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 JEDEC standard JESD22-C101C	-	±2	kV

[1] DC values.

[2] On VTIF1 (pin 27), VTIF2 (pin 26), VTIF3 (pin 20) and VTIF4 (pin 19).

9. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	IF output AC coupled [1]	4.3	5	5.6	V
V_{ctrl}	control voltage	vertical selection [1][2]	8	-	14	V
		horizontal selection [1][2]	15.5	-	19	V
$V_{th(bsel)(p-p)}$	peak-to-peak band selection threshold voltage	high band; $f_{p(ctrl)}$ = 22 kHz [2]	0.3	0.6	0.8	V
T_{amb}	ambient temperature		–40	+25	+85	°C
Z_0	characteristic impedance	RF inputs	-	50	-	Ω
		IF outputs	-	75	-	Ω
f_{RF}	RF frequency		10.70	-	12.75	GHz
f_{LO}	LO frequency	low band	-	9.75	-	GHz
		high band	-	10.6	-	GHz
f_{IF}	IF frequency		0.95	-	2.15	GHz
$C_{L(xtal)}$	crystal load capacitance		-	16	-	pF
ESR	equivalent series resistance		-	-	40	Ω
f_{xtal}	crystal frequency		-	25	-	MHz

[1] DC values.

[2] On VTIF1 (pin 27), VTIF2 (pin 26), VTIF3 (pin 20) and VTIF4 (pin 19).

10. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	[1]	10	K/W

[1] Simulated using finite element method resembling the device mounted in a typical application

11. Characteristics

Table 7. Characteristics

V_{CC} = 5 V; T_{amb} = 25 °C; f_{LO} = 9.75 GHz or f_{LO} = 10.6 GHz; f_{xtal} = 25 MHz; Z_0 = 50 Ω for RF inputs and Z_0 = 75 Ω for IF outputs unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	IF output AC externally coupled; excluding current for LNAs				
		four activated IF paths [1]	-	190	-	mA
		single activated IF path [1]	-	145	-	mA
I_D	drain current	First stage LNAs				
		R_{set_12} = 22 kΩ connected to 1AB_ISET (pin 3)	8	10	12	mA
		15 kΩ ≤ R_{set_12} ≤ 220kΩ	1	-	15	mA
		Second stage LNAs				
		R_{set_34} = 22 kΩ connected to 2AB_ISET (pin 7)	8	10	12	mA
		15 kΩ ≤ R_{set_34} ≤ 220kΩ	1	-	15	mA
V_D	drain voltage	First stage LNAs [2]				
		R_{set_12} = 22 kΩ	1.8	2	2.2	V
		15 kΩ ≤ R_{set_12} ≤ 220kΩ	1.75	-	2.3	V
		no transistor attached	-	2.7	-	V
		Second stage LNAs (pHEMT) [2][3]				
		R_{set_34} = 22 kΩ	1.8	2	2.2	V
		15 kΩ ≤ R_{set_34} ≤ 220kΩ	1.75	-	2.3	V
		no transistor attached	-	2.7	-	V
V_C	collector voltage	Second stage LNAs (BJT) [2][4]				
		R_{set_34} = 22 kΩ	1.8	2	2.2	V
		15 kΩ ≤ R_{set_34} ≤ 220kΩ	1.75	-	2.3	V
		no transistor attached	-	2.7	-	V
V_O	output voltage	First stage LNAs; I_G = 10 µA [5]	-	–0.9	-	V
		Second stage LNAs [5]				
		second stage LNA = pHEMT; I_G = 10 µA [3]	-	–0.9	-	V
		second stage LNA = BJT; I_B = 50 µA [4]	-	1.4	-	V
G_{conv}	conversion gain	f_{IF} = 1450 MHz (low band); single activated IF path				
		low gain mode [6]	-	30	-	dB
		medium gain mode [6]	-	33	-	dB
		high gain mode [6]	-	36	-	dB
		f_{IF} = 1650 MHz (high band); single activated IF path				
		low gain mode [6]	-	30	-	dB
		medium gain mode [6]	-	33	-	dB
		high gain mode [6]	-	36	-	dB

Table 7. Characteristics *…continued*

V_{CC} = 5 V; T_{amb} = 25 °C; f_{LO} = 9.75 GHz or f_{LO} = 10.6 GHz; f_{xtal} = 25 MHz; Z_0 = 50 Ω for RF inputs and Z_0 = 75 Ω for IF outputs unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$\Delta G_{conv}/\Delta f$	conversion gain variation with frequency	950 MHz ≤ f_{IF} ≤ 2150 MHz	-	1.0	-	dB
		in every 36 MHz band	-	0.5	-	dB
ΔG_{conv}	conversion gain variation	when switching from single activated IF path to multiple activated IF paths	-	1.5	-	dB
NF_{SSB}	single sideband noise figure	high gain mode [6]				
		f_{IF} = 1450 MHz (low band)	-	8	-	dB
		f_{IF} = 1650 MHz (high band)	-	8	-	dB
s_{11}	input reflection coefficient	10.70 GHz ≤ f_{RF} ≤ 12.75 GHz	-	−10	-	dB
s_{22}	output reflection coefficient	950 MHz ≤ f_{IF} ≤ 2150 MHz	-	−10	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	high gain mode [6]	-	4.5	-	dBm
$IP3_o$	output third-order intercept point	high gain mode; carrier power is −10 dBm (measured at IF output) [6]	-	15	-	dBm
$\varphi_{n\lambda(itg)RMS}$	RMS integrated phase noise density	integration offset frequency = 10 kHz to 13 MHz	-	1.4	-	deg
IRR	image rejection ratio	[7]	-	17	-	dB
$\alpha_{isol(ch-ch)}$	isolation between channels	[7]	-	30	-	dBc
$\alpha_{L(RF)lo}$	local oscillator RF leakage	f_{LO} = 9.75 GHz	-	−48	-	dBm
		f_{LO} = 10.6 GHz	-	−48	-	dBm
$\alpha_{L(IF)lo}$	local oscillator IF leakage	f_{LO} = 9.75 GHz	-	−46	-	dBm
		f_{LO} = 10.6 GHz	-	−46	-	dBm
P_{sp}	spurious output power	at IF outputs within IF band; RBW = 30 kHz				
		in the presence of the signal; carrier power is −10 dBm (measured at IF output)	-	-	−40	dBc
		without RF signal; input terminated with 50 Ω; medium gain mode [6]	-	-	−60	dBm
$f_{p(ctrl)}$	control pulse frequency	[8]	18	22	26	kHz
$V_{th(bsel)(p-p)}$	peak-to-peak band selection threshold voltage	$f_{p(ctrl)}$ = 22 kHz [8]	0.3	0.6	0.8	V
$V_{th(psel)}$	polarity selection threshold voltage	[1][8]	14	14.75	15.25	V
R_{pd}	pull-down resistance	on POL_SWAP/MODE_SEL (pin 30)	70	110	140	kΩ
		on GAIN_SET (pin 16)	70	110	140	kΩ
		on 2AB_TYPSEL (pin 5)	70	110	140	kΩ

[1] DC values.

[2] For first stage LNA on 1A_DRAIN (pin 1) or 1B_DRAIN (pin 9); for second stage LNA on 2A_DRAIN (pin 32) or 2B_DRAIN (pin 14).

[3] 2AB_TYPSEL (pin 5) is connected to GND (pHEMT for second stage LNAs).

[4] 2AB_TYPSEL (pin 5) is floating (BJT transistor for second stage LNAs); first stage LNAs stay in the configuration for pHEMT biasing.

[5] For first stage LNA on 1A_GATE (pin 2) or 1B_GATE (pin 8); for second stage LNA on 2A_GATE (pin 31) or 2B_GATE (pin 15).

[6] See Table 12 for conversion gain selection settings.

[7] Measured at low band (f_{IF} = 1450 MHz) and high band (f_{IF} = 1650 MHz); carrier power is −10 dB m (measured at IF output).

[8] On VTIF1 (pin 27), VTIF2 (pin 26), VTIF3 (pin 20) and VTIF4 (pin 19).

11.1 Impedance information

Table 8. Typical input impedance

For Smith chart see Figure 27.

f	$Z_{i(A\_RFIN)}$	$Z_{i(B\_RFIN)}$
(GHz)	(Ω)	(Ω)
10.70	52.650 + j14.850	37.350 + j18.200
11.20	64.450 + j2.900	41.850 + j19.950
11.70	62.600 – j11.500	49.700 + j16.350
12.20	60.400 – j13.000	59.600 + j7.250
12.75	54.950 – j7.900	69.300 – j10.600

12. Modes of operation

12.1 IF on/off and band/polarization control logic

Activation of the IF paths is determined by the voltage applied at their corresponding VT pins. When the DC voltage applied to any of these pins is lower than the expected minimum value, the corresponding IF path is turned off

Selection between vertical and horizontal polarizations for each path is determined by comparison of the DC voltage V_{ctrl} applied at VTIF pin to a reference threshold voltage.

Selection between high band and low band depends on the presence of a 22 kHz pulse signal applied to the VTIF pin for each IF path. In order to improve the immunity against parasitic signals, the pulse amplitude must be larger than the threshold level for validating the switching to high-band.

In these aspects, TFF1044HN is controlled according to the logic specified in Table 9.

Table 9. IF and band/polarization control

Voltage	Control pulse	IF path	Polarization	Band
$V_{ctrl} < 4$ V	N/A	off	N/A	N/A
8 V < V_{ctrl} < 14 V	no control pulse frequency; $V_{th(bsel)(p-p)} < 100$ mV	on	vertical	low
	$f_{p(ctrl)} = 22$ kHz; 300 mV < $V_{th(bsel)(p-p)}$ < 800 mV	on	vertical	high
15.5 V < V_{ctrl} < 19 V	no control pulse frequency; $V_{th(bsel)(p-p)} < 100$ mV	on	horizontal	low
	$f_{p(ctrl)} = 22$ kHz; 300 mV < $V_{th(bsel)(p-p)}$ < 800 mV	on	horizontal	high

12.2 RF path assignment logic

The vertical and horizontal polarizations are assigned to the RF path A and RF path B inputs according to the logic Table 10. The setting for quattro mode operation is also given in the same table.

Table 10. polarity swap / mode selection settings

connection of POL_SWAP/MODE_SEL (pin 30)	Mode	Polarity	
		RF input path A	RF input path B
GND	quad	horizontal	vertical
float	quad	vertical	horizontal
GND via 100 kΩ pull-down resistor	quattro [1]	N/A	N/A

[1] Quattro mode. See Table 11 for polarization and band attribution to IF ports.

12.2.1 Quattro mode

When grounded via a 100 kΩ resistor, POL_SWAP/MODE_SEL (pin 30) sets the TFF1044HN in quattro mode where the IF outputs are attributed to a given polarization/band, irrespective of the signal applied to the VTIF pins.

Each IF output is assigned to a given polarization/band according to Table 11:

Table 11. IF output assignment

IF output port	Polarization	Band
IFOUT1	A_RFIN	low
IFOUT2	A_RFIN	high
IFOUT3	B_RFIN	low
IFOUT4	B_RFIN	high

12.3 Conversion gain selection logic

The conversion gain shall be determined by the type of termination at GAIN_SET (pin 16) following Table 12.

Table 12. Conversion gain settings

Connection of GAIN_SET (pin 16)	Gain mode
GND	low
float	medium
GND via 100 kΩ pull-down resistor	high

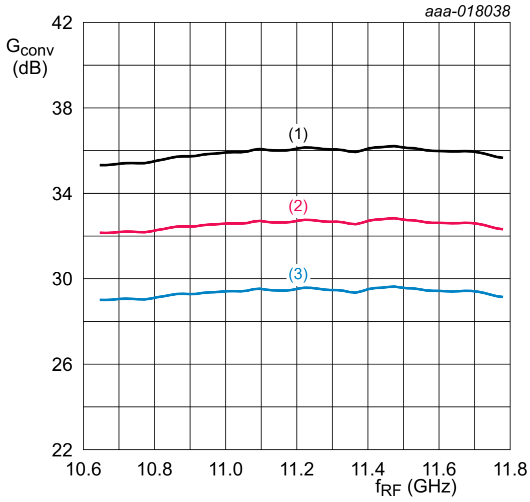
12.4 LNA selection logic

The type of transistor used for the second LNA shall be selected depending on the state of 2AB_TYPSEL (pin 5) according to Table 13.

Table 13. Second stage LNA type selection settings

Connection of 2AB_TYPSEL (pin 5)	Type of second stage LNA	
	RF path A	RF path B
GND	pHEMT	pHEMT
float	BJT	BJT

13. Graphs

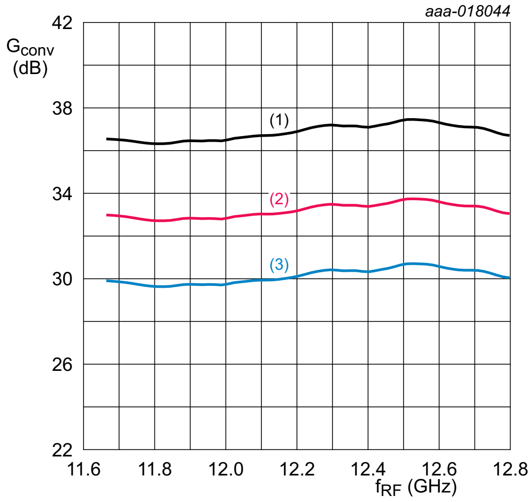


Measured from A_RFIN to IFOUT1.

Low band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode
(2) Medium gain mode
(3) Low gain mode

Fig 3. Conversion gain as a function of RF frequency; typical values

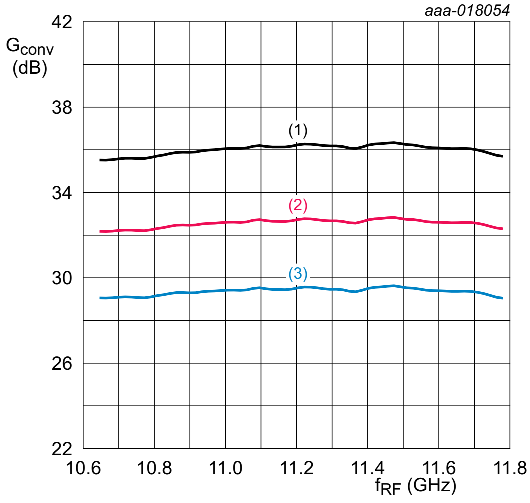


Measured from A_RFIN to IFOUT1.

High band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode
(2) Medium gain mode
(3) Low gain mode

Fig 4. Conversion gain as a function of RF frequency; typical values

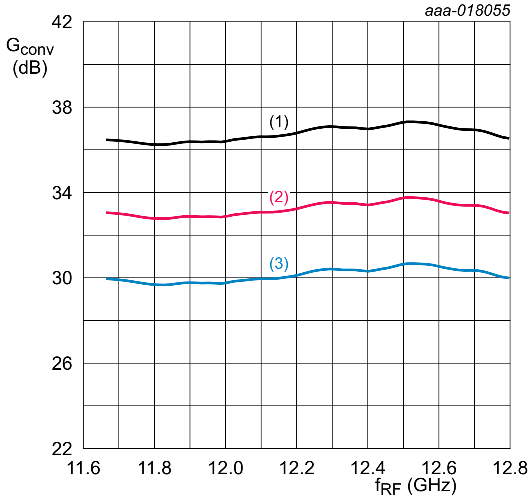


Measured from A_RFIN to IFOUT2.

Low band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode
(2) Medium gain mode
(3) Low gain mode

Fig 5. Conversion gain as a function of RF frequency; typical values

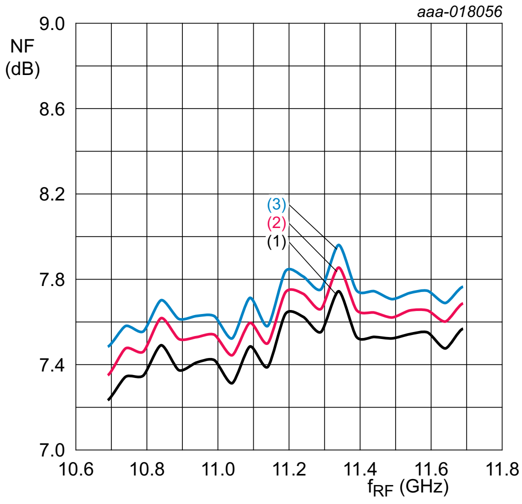


Measured from A_RFIN to IFOUT2.

High band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode
(2) Medium gain mode
(3) Low gain mode

Fig 6. Conversion gain as a function of RF frequency; typical values



Measured from B_RFIN to IFOUT1.

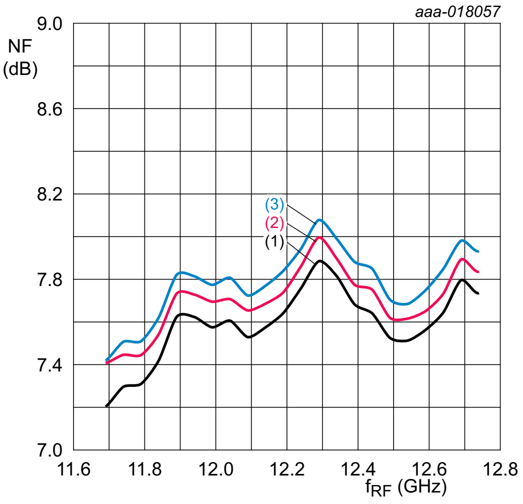
Low band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode

(2) Medium gain mode

(3) Low gain mode

Fig 7. Noise figure as a function of RF frequency; typical values



Measured from B_RFIN to IFOUT1.

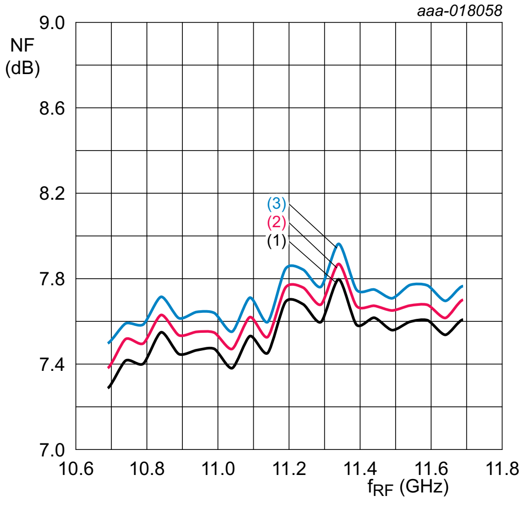
High band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode

(2) Medium gain mode

(3) Low gain mode

Fig 8. Noise figure as a function of RF frequency; typical values



Measured from B_RFIN to IFOUT2.

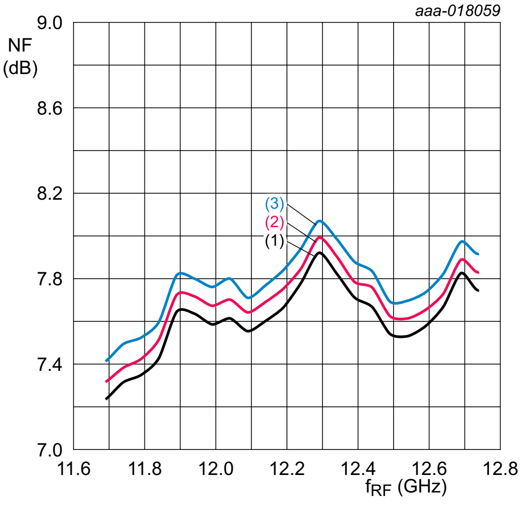
Low band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode

(2) Medium gain mode

(3) Low gain mode

Fig 9. Noise figure as a function of RF frequency; typical values



Measured from B_RFIN to IFOUT2.

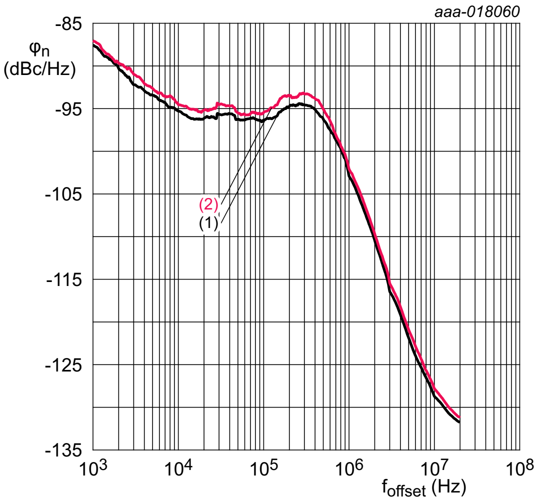
High band; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) High gain mode

(2) Medium gain mode

(3) Low gain mode

Fig 10. Noise figure as a function of RF frequency; typical values

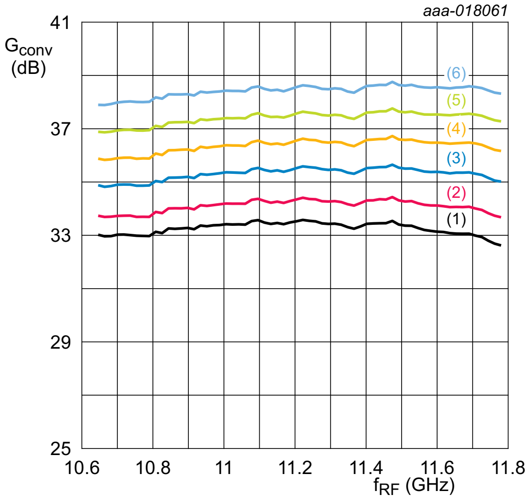


V_{CC} = 5 V; T_{amb} = 25 °C.

(1) Low band

(2) High band

Fig 11. Phase noise as a function of offset frequency; typical values



Measured from A_RFIN to IFOUT1.

High gain mode; low band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

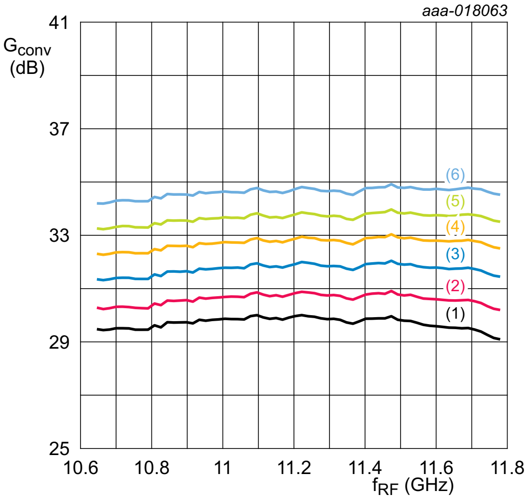
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 12. Conversion gain as a function of RF frequency; typical values



Measured from A_RFIN to IFOUT1.

Medium gain mode; low band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

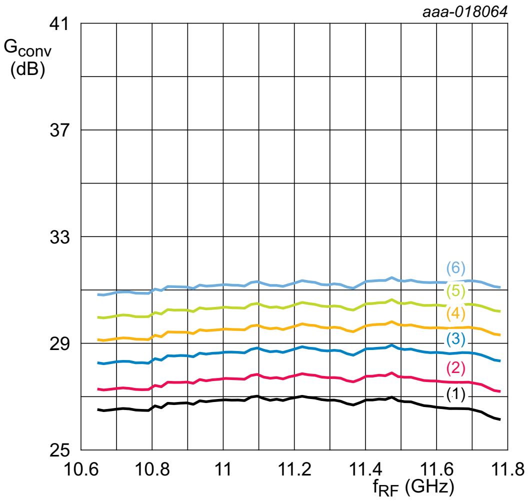
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 13. Conversion gain as a function of RF frequency; typical values



Measured from A_RFIN to IFOUT1.

Low gain mode; low band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

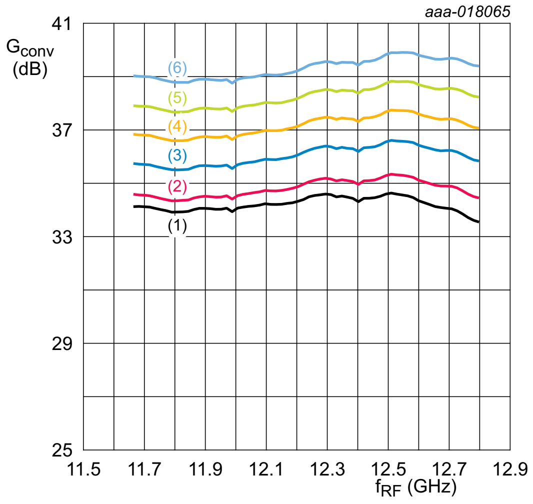
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 14. Conversion gain as a function of RF frequency; typical values



Measured from A_RFIN to IFOUT1.

High gain mode; high band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

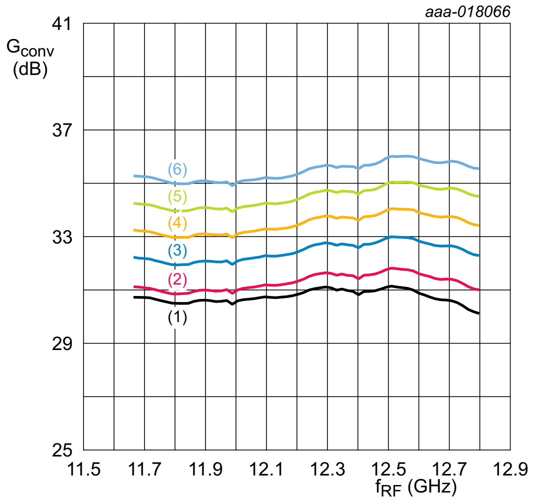
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 15. Conversion gain as a function of RF frequency; typical values



Measured from A_RFIN to IFOUT1.

Medium gain mode; high band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

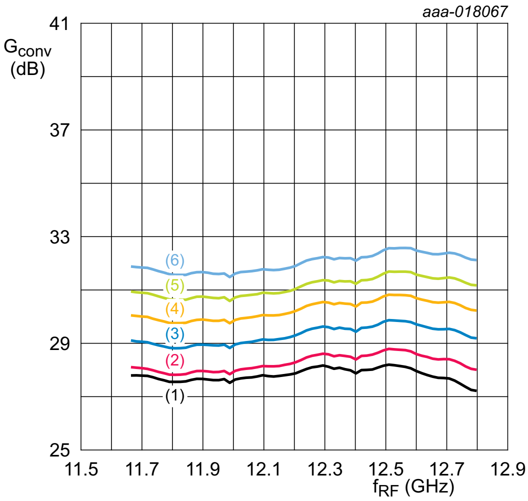
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 16. Conversion gain as a function of RF frequency; typical values



Measured from A_RFIN to IFOUT1.

Low gain mode; high band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

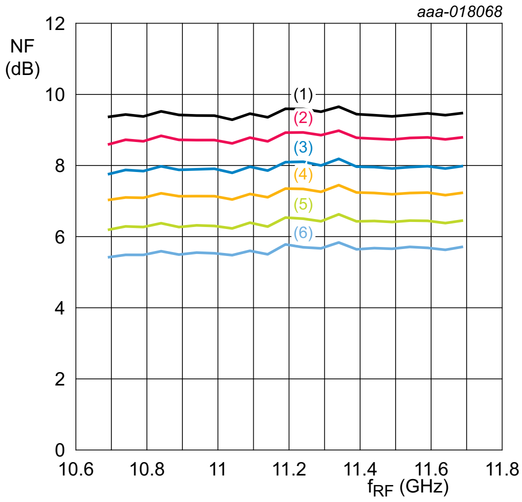
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 17. Conversion gain as a function of RF frequency; typical values



Measured from B_RFIN to IFOUT1.

High gain mode; low band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

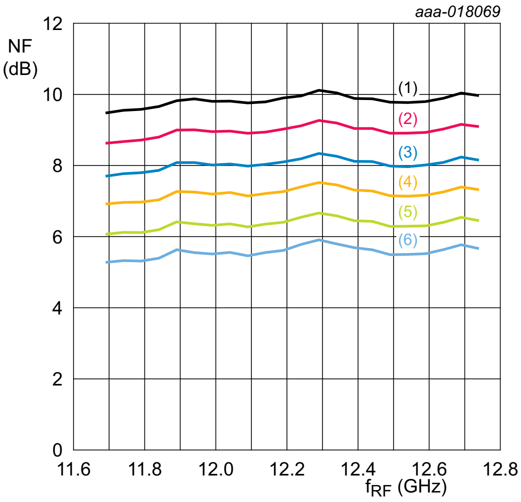
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 18. Noise figure as a function of RF frequency; typical values



Measured from B_RFIN to IFOUT1.

High gain mode; high band; V_{CC} = 5 V.

(1) T_{amb} = +85 °C

(2) T_{amb} = +60 °C

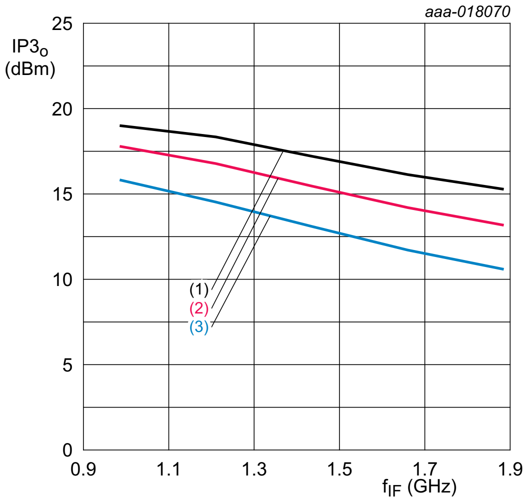
(3) T_{amb} = +35 °C

(4) T_{amb} = +10 °C

(5) T_{amb} = –15 °C

(6) T_{amb} = –40 °C

Fig 19. Noise figure as a function of RF frequency; typical values



Measured from A_RFIN to IFOUT1.

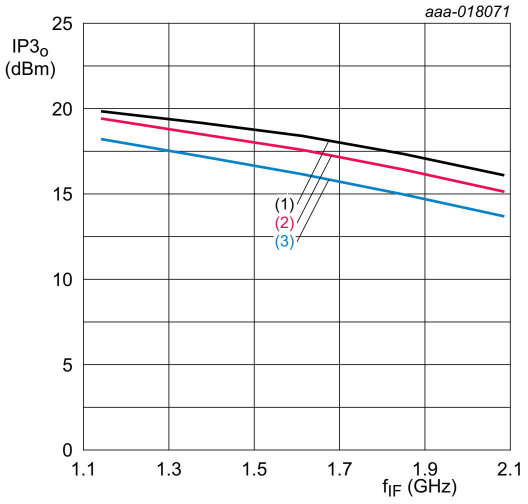
Low band; single activated IF path; V_{CC} = 5 V; T_{amb} = 25 °C; tone separation = 33 MHz.

(1) High gain mode

(2) Medium gain mode

(3) Low gain mode

Fig 20. Output third-order intercept point as a function of IF frequency; typical values



Measured from A_RFIN to IFOUT1.

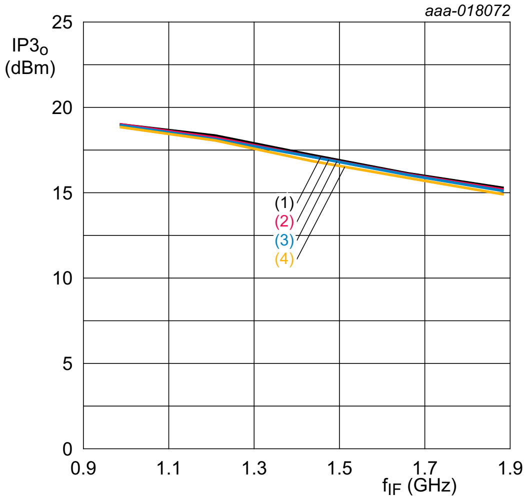
High band; single activated IF path; V_{CC} = 5 V; T_{amb} = 25 °C; tone separation = 33 MHz.

(1) High gain mode

(2) Medium gain mode

(3) Low gain mode

Fig 21. Output third-order intercept point as a function of IF frequency; typical values



Measured from A_RFIN to IFOUT1.

Low band; high gain mode; V_{CC} = 5 V; T_{amb} = 25 °C; tone separation = 33 MHz.

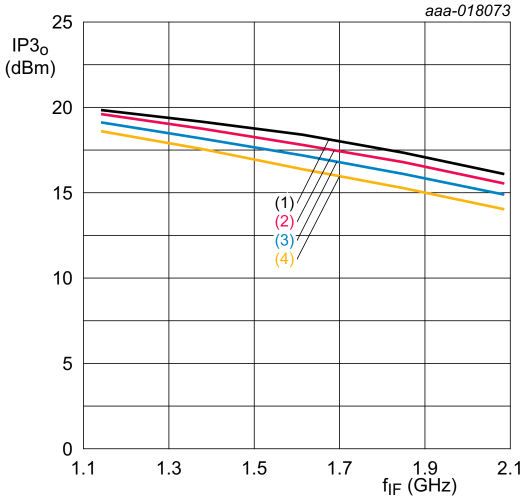
(1) 1 activated IF path

(2) 2 activated IF paths

(3) 3 activated IF paths

(4) 4 activated IF paths

Fig 22. Output third-order intercept point as a function of IF frequency; typical values



Measured from A_RFIN to IFOUT1.

High band; high gain mode; V_{CC} = 5 V; T_{amb} = 25 °C; tone separation = 33 MHz.

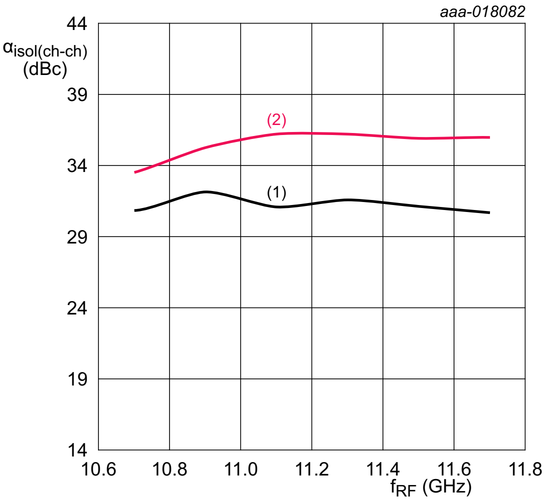
(1) 1 activated IF path

(2) 2 activated IF paths

(3) 3 activated IF paths

(4) 4 activated IF paths

Fig 23. Output third-order intercept point as a function of IF frequency; typical values

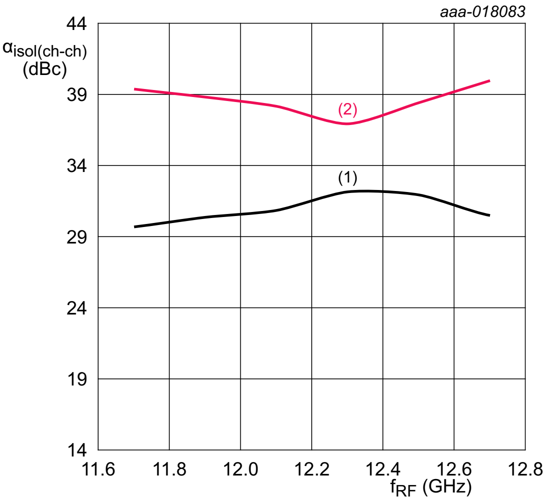


Low band; high gain mode; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) RF input path B to RF input path A

(2) RF input path A to RF input path B

Fig 24. Isolation between channels as a function of RF frequency; typical values

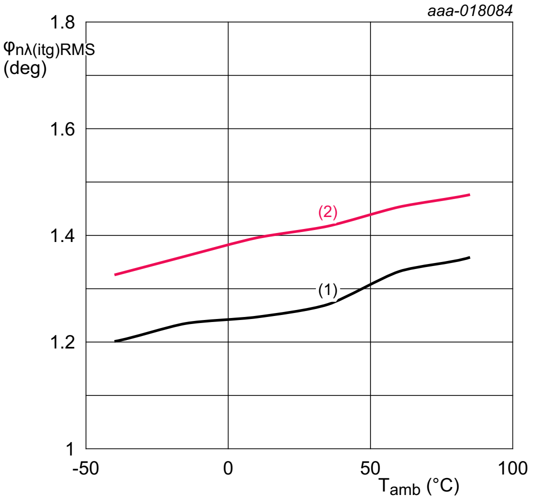


High band; high gain mode; V_{CC} = 5 V; T_{amb} = 25 °C.

(1) RF input path B to RF input path A

(2) RF input path A to RF input path B

Fig 25. Isolation between channels as a function of RF frequency; typical values

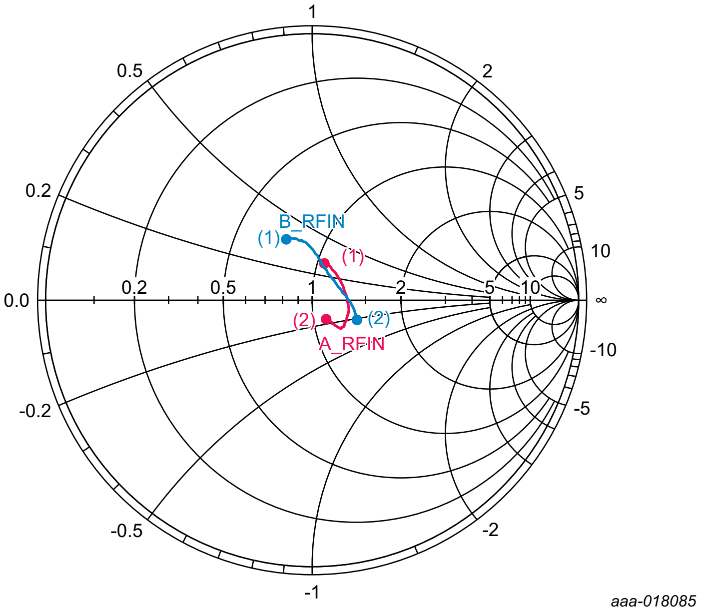


V_{CC} = 5 V.

(1) Low band

(2) High band

Fig 26. RMS integrated phase noise density as a function of ambient temperature; typical values

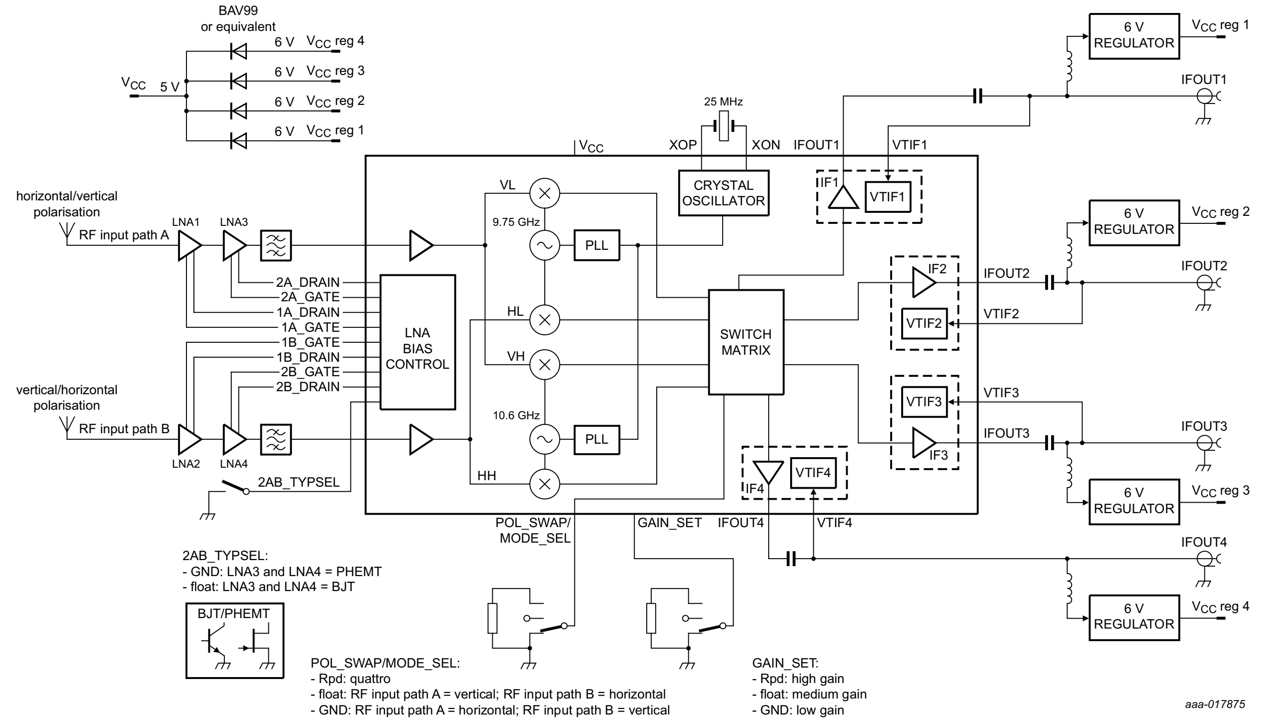


(1) f_{RF} = 10.70 GHz

(2) f_{RF} = 12.75 GHz

Fig 27. Input reflection coefficient (S_{11}); typical values

14. Application information



2AB_TYPSEL:
- GND: LNA3 and LNA4 = PHEMT
- float: LNA3 and LNA4 = BJT

POL_SWAP/MODE_SEL:
- Rpd: quattro
- float: RF input path A = vertical; RF input path B = horizontal
- GND: RF input path A = horizontal; RF input path B = vertical

GAIN_SET:
- Rpd: high gain
- float: medium gain
- GND: low gain

For more information see application note *AN11640*

Fig 28. LNB system block diagram with TFF1044HN

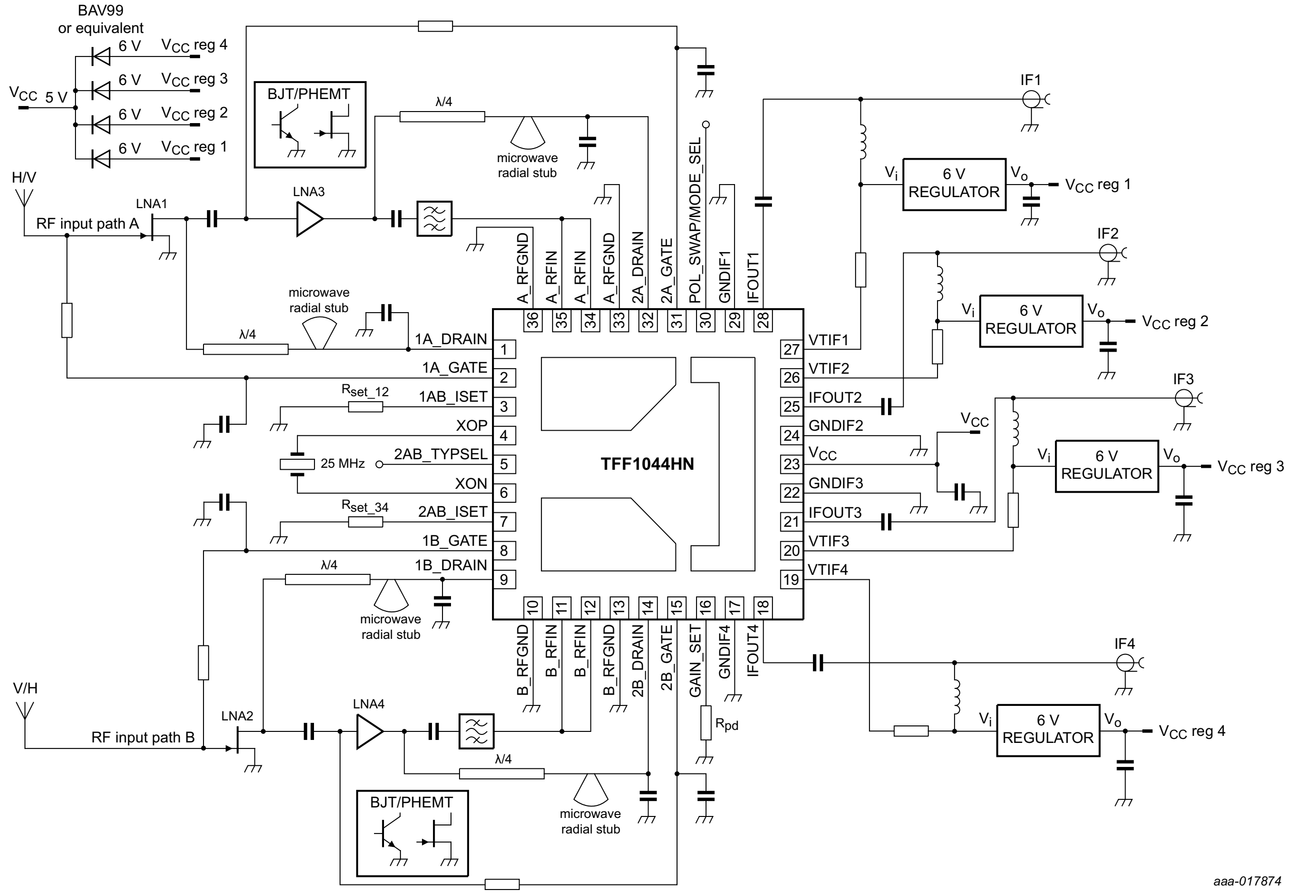
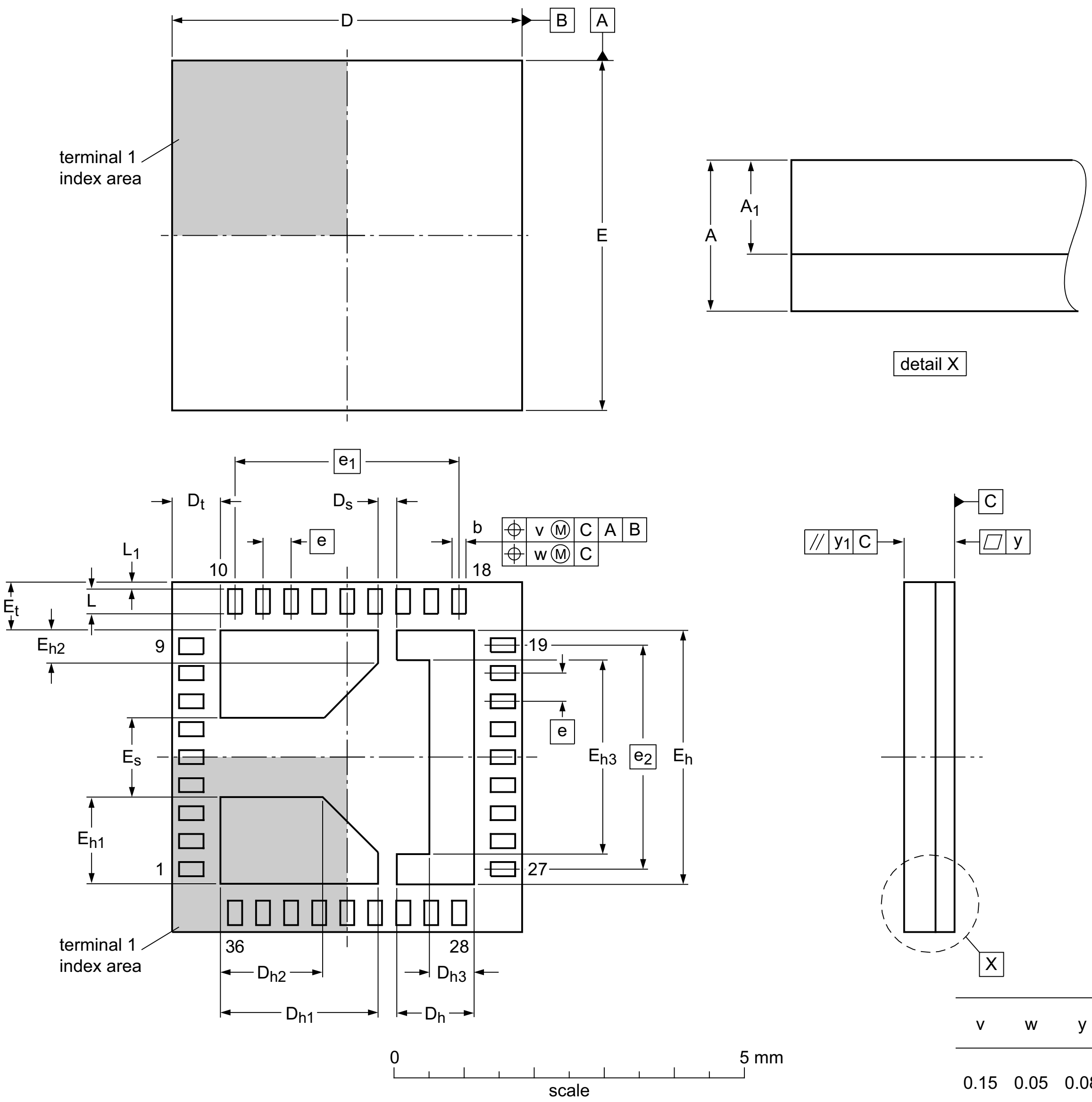


Fig 29. Application diagram of TFF1044HN

15. Package outline

HVLGA36: plastic thermal enhanced very thin profile land grid array package; no leads; 36 terminals; **SOT1359-1**



v	w	y	y_1
0.15	0.05	0.08	0.1

Dimensions (mm are the original dimensions)

Unit		A	A_1	b	D	D_h	D_{h1}	D_{h2}	D_{h3}	D_s	D_t	E	E_h	E_{h1}	E_{h2}	E_{h3}	E_s	E_t	e	e_1	e_2	L	L_1
mm	max	0.82	0.50	0.25	5.1	1.15	2.30	1.53	0.67	0.32	0.74	5.1	3.68	1.30	0.52	2.82	1.19	0.74				0.40	0.15
	nom	0.72	0.45	0.20	5.0	1.10	2.25	1.48	0.62	0.27	0.69	5.0	3.63	1.25	0.47	2.77	1.14	0.69	0.4	3.2	3.2	0.35	0.10
	min	0.62	0.40	0.15	4.9	1.05	2.20	1.43	0.57	0.12	0.64	4.9	3.58	1.20	0.42	2.72	1.09	0.64				0.30	0.05

sot1359-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1359-1						~~14-10-22~~ 15-01-27

Fig 30. Package outline SOT1359-1 (HVLGA36)

16. Abbreviations

Table 14. Abbreviations

Acronym	Description
BJT	Bipolar Junction Transistor
HH	Horizontal High band
HL	Horizontal Low band
IF	Intermediate Frequency
IP	Internet Protocol
K_u band	K-under band
LNA	Low Noise Amplifier
LNB	Low Noise Block
LO	Local Oscillator
pHEMT	pseudomorphic High Electron Mobility Transistor
PLL	Phase-Locked Loop
RBW	Resolution BandWidth
VH	Vertical High band
VL	Vertical Low band
VT	Voltage Tone

17. Revision history

Table 15. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TFF1044HN v.1	20150610	Product data sheet	-	-

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”.

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20. Contents

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Date of release: 10 June 2015
Document identifier: TFF1044HN

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