TFF1013HN

Integrated mixer oscillator PLL for satellite LNB

Rev. 1 — 11 September 2013 Product data sheet

1. General description

The TFF1013HN is an integrated downconverter for use in Low Noise Block (LNB) convertors in a 10.7 GHz to 12.75 GHz K_u band satellite receiver system.

2. Features and benefits

- Low current consumption integrated pre-amplifier, mixer, buffer amplifier and PLL synthesizer
- Flat gain over frequency
- Single 5 V supply pin
- Low cost 25 MHz crystal
- Crystal controlled LO frequency generation
- Switched LO frequency (9.75 GHz and 10.6 GHz)
- Low phase noise
- Low spurious
- Low external component count
- Alignment-free concept
- ESD protection on all pins

3. Applications

- K_u band LNB converters for digital satellite reception (DVB-S / DVB-S2)

4. Quick reference data

Table 1. Quick reference data

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CC}	supply voltage	RF input and IF output AC coupled	[1]	4.5	5	5.5	V
I_{CC}	supply current	RF input and IF output AC coupled	[1]	-	52	-	mA
NF_{SSB}	single sideband noise figure			-	9	-	dB
$f_{i(RF)}$	RF input frequency	low band		10.7	-	11.7	GHz
		high band		11.7	-	12.75	GHz
G_{conv}	conversion gain	measured at low band f_{IF} = 1450 MHz and high band f_{IF} = 1625 MHz		-	33	-	dB

Table 1. Quick reference data *...continued*

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
s_{11}	input reflection coefficient	$f_{i(RF)}$ = 10.7 GHz to 12.7 GHz		-	–10	-	dB
s_{22}	output reflection coefficient	$f_{o(IF)}$ = 950 MHz to 2150 MHz; Z_0 = 75 Ω		-	–10	-	dB
$IP3_o$	output third-order intercept point	worst case value of the two measurements is specified	[2]	-	17	-	dBm

[1] DC values.

[2] measurement 1: f_1 = 1733 MHz; f_2 = 1773 MHz; P_i = –46 dBm per carrier; $IP3_o$ measured at 1813 MHz
measurement 2: f_1 = 1893 MHz; f_2 = 1853 MHz; P_i = –46 dBm per carrier; $IP3_o$ measured at 1813 MHz

5. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
TFF1013HN	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads;16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1

6. Block diagram

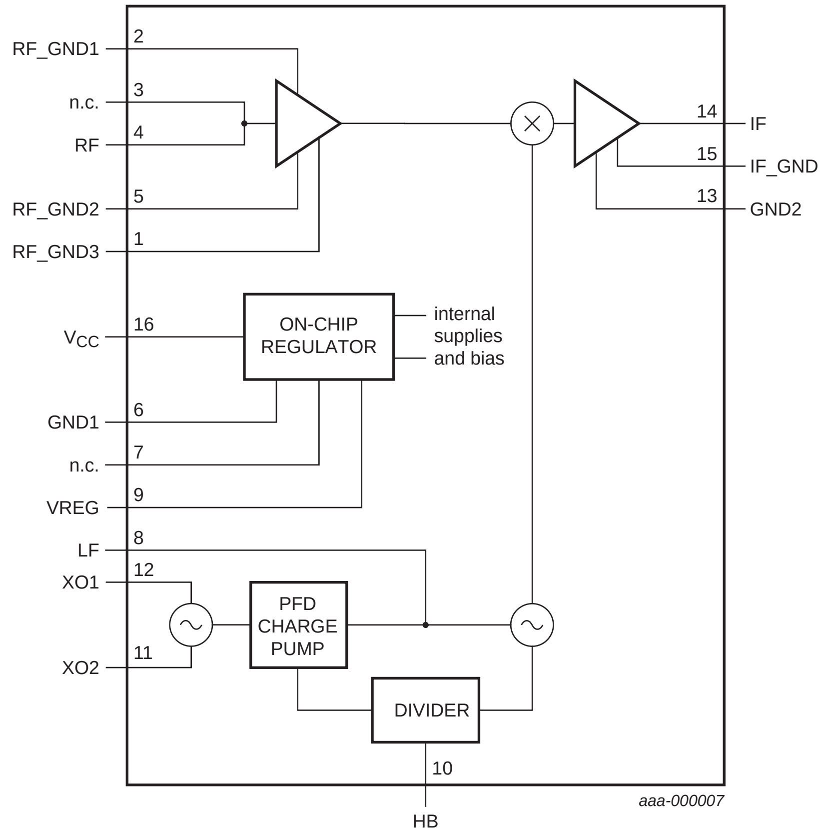


Fig 1. TFF1013HN block diagram

7. Functional diagram

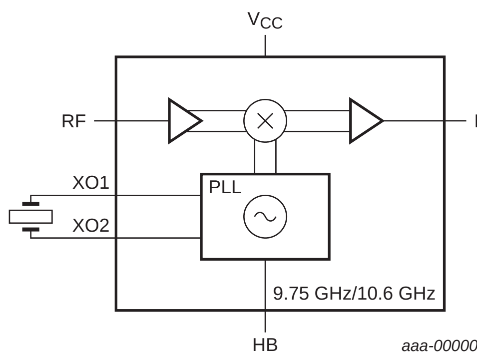


Fig 2. Functional diagram

8. Pinning information

8.1 Pinning

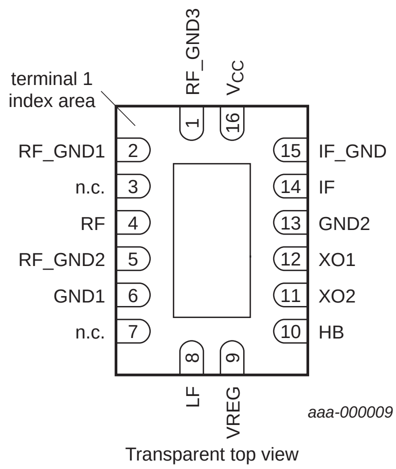


Fig 3. Pin configuration

8.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
GND	0	ground (exposed die pad)
RF_GND3	1	RF ground. Connect this pin to the exposed die pad landing.
RF_GND1	2	RF ground. Connect this pin to the exposed die pad landing and the RF input CPW line.
n.c.	3	not connected. Connect to RF on PCB. [1]
RF	4	RF input.
RF_GND2	5	RF ground. Connect this pin to the exposed die pad landing and the RF input CPW line.
GND1	6	Ground. Connect this pin to the exposed die pad landing and the RF input CPW line.
n.c.	7	not connected. Use this pin to route the ground layer on top of the PCB to the exposed die pad.
LF	8	Loop filter PLL. Connect loop filter between this pin and VREG (pin 9).
VREG	9	Regulated output voltage for PLL loop filter. Connect loop filter to this pin. Decouple against die pad via pin 7.
HB	10	High band / low band selection. Connect this pin to the tone detector or to a logic signal.
XO2	11	Crystal connection 2. Connect crystal between this pin and XO1 (pin 12).
XO1	12	Crystal connection 1. Connect crystal between this pin and XO2 (pin 11).
GND2	13	Ground. Connect this pin to the exposed die pad landing.
IF	14	IF output
IF_GND	15	IF output ground. Connect this pin to the exposed die pad landing and the output transmission line ground.
V_{CC}	16	Supply voltage

[1] The distance between the outer edges of pin 2 and 3 is 740 μm. This gives an optimum transition from a 1.1 mm wide, $Z_0 = 50\ \Omega$ line on RO4223 Printed-Circuit Board (PCB) material of 0.5 mm height to the TFF1013HN.

9. 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	+6	V
$V_{I(HB)}$	input voltage on pin HB		–0.5	+6	V
T_{stg}	storage temperature		–40	+125	°C

10. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.5	5	5.5	V
$V_{I(HB)}$	input voltage on pin HB		0	-	5.5	V
T_{amb}	ambient temperature		–40	+25	+85	°C
Z_0	characteristic impedance		-	50	-	Ω
$f_{i(RF)}$	RF input frequency	low band	10.7	-	11.7	GHz
		high band	11.7	-	12.75	GHz
f_{LO}	LO frequency	low band	-	9.75	-	GHz
		high band [1]	-	10.6	-	GHz
$f_{o(IF)}$	IF output frequency	low band	0.95	-	1.95	GHz
		high band	1.1	-	2.15	GHz
$C_{L(xtal)}$	crystal load capacitance		-	10	-	pF
ESR	equivalent series resistance		-	-	40	Ω
f_{xtal}	crystal frequency		-	25	-	MHz

[1] For a 10.678 GHz LO frequency, select high band and use a crystal with frequency 10.678 GHz / 424 = 25.183962 MHz.

11. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case		35	K/W

12. Characteristics

Table 7. Characteristics

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CC}	supply current	RF input and IF output AC coupled	[1]	-	52	-	mA
$\varphi_{n\lambda(itg)}$	integrated phase noise density	integration offset frequency = 10 kHz to 13 MHz; loop bandwidth = crossover bandwidth		-	1.5	-	°RMS
NF_{SSB}	single sideband noise figure	measured at low band f_{IF} = 1450 MHz and high band f_{IF} = 1625 MHz		-	9	-	dB
G_{conv}	conversion gain	measured at low band f_{IF} = 1450 MHz and high band f_{IF} = 1625 MHz		-	33	-	dB
ΔG_{conv}	conversion gain variation	over whole IF band		-	2.0	-	dB
		in every 36 MHz band		-	0.5	-	dB
s_{11}	input reflection coefficient	$f_{i(RF)}$ = 10.7 GHz to 12.7 GHz		-	−10	-	dB
s_{22}	output reflection coefficient	$f_{o(IF)}$ = 950 MHz to 2150 MHz; Z_0 = 75 Ω		-	−10	-	dB
$IP3_o$	output third-order intercept point	worst case value of the two measurements is specified	[2]	-	17	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression			-	6	-	dBm
$V_{IL(HB)}$	LOW-level input voltage on pin HB			-	-	0.8	V
$V_{IH(HB)}$	HIGH-level input voltage on pin HB			2.0	-	-	V
$R_{pd(HB)}$	pull-down resistance on pin HB			80	110	140	kΩ

[1] DC values

[2] measurement 1: f_1 = 1733 MHz; f_2 = 1773 MHz; P_i = −46 dBm per carrier; $IP3_o$ measured at 1813 MHz
measurement 2: f_1 = 1893 MHz; f_2 = 1853 MHz; P_i = −46 dBm per carrier; $IP3_o$ measured at 1813 MHz

13. Application information

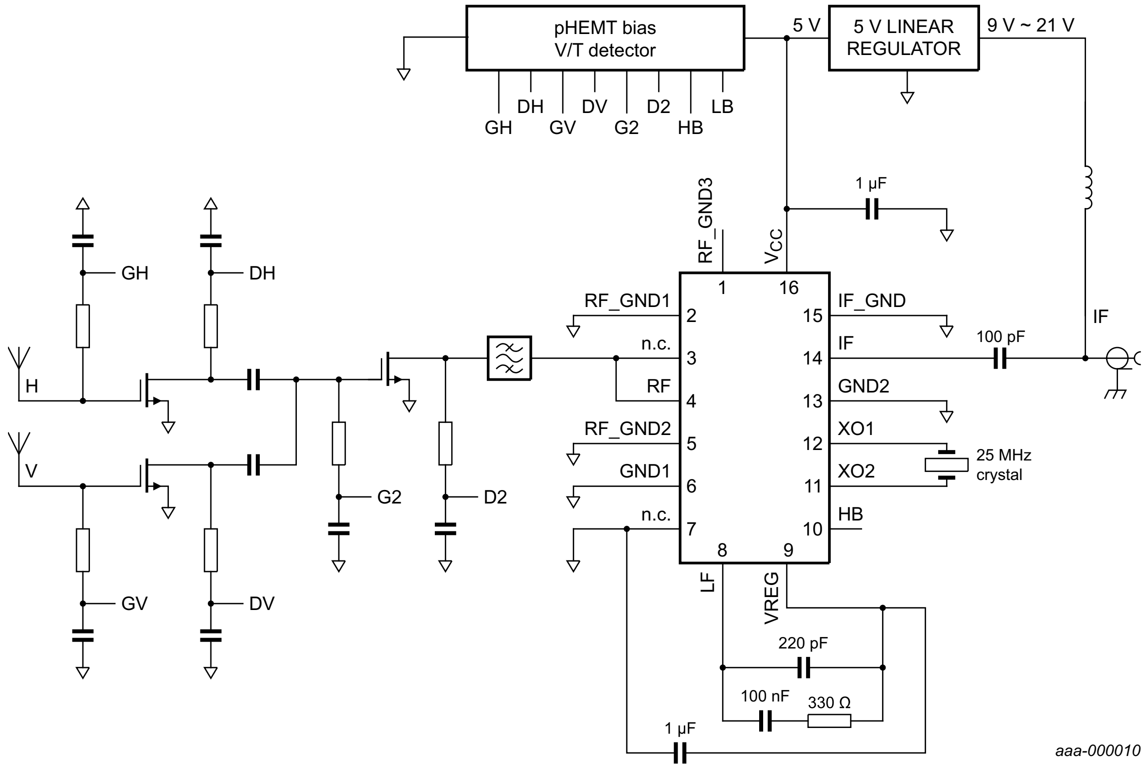


Fig 4. Application diagram of TFF1013HN

Table 8. List of netnames

See Figure 4.

Netname	Description
GH	Gate voltage of 1st stage LNA. Horizontal polarization
DH	Drain voltage of 1st stage LNA. Horizontal polarization
GV	Gate voltage of 1st stage LNA. Vertical polarization
DV	Drain voltage of 1st stage LNA. Vertical polarization
G2	Gate voltage of 2nd stage LNA
D2	Drain voltage of 2nd stage LNA
HB	High band oscillator supply control
LB	Low band oscillator supply control

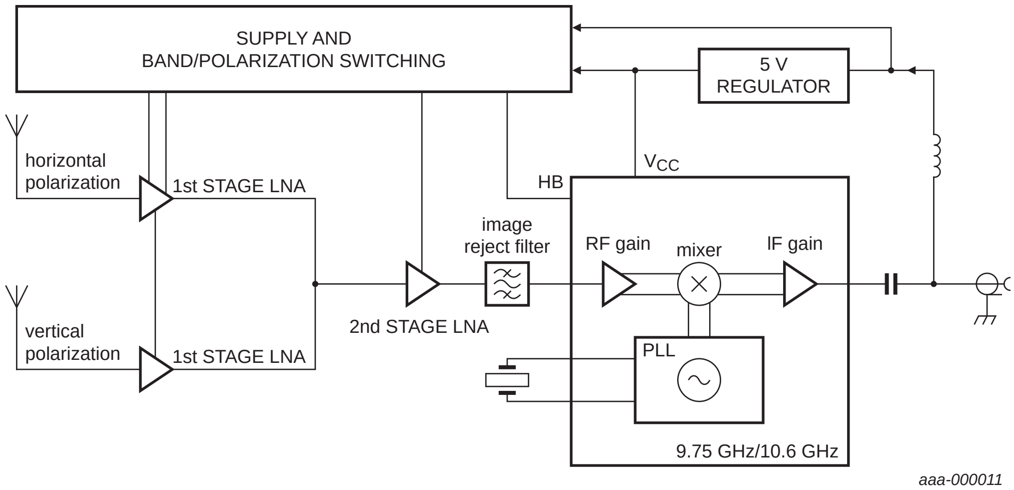
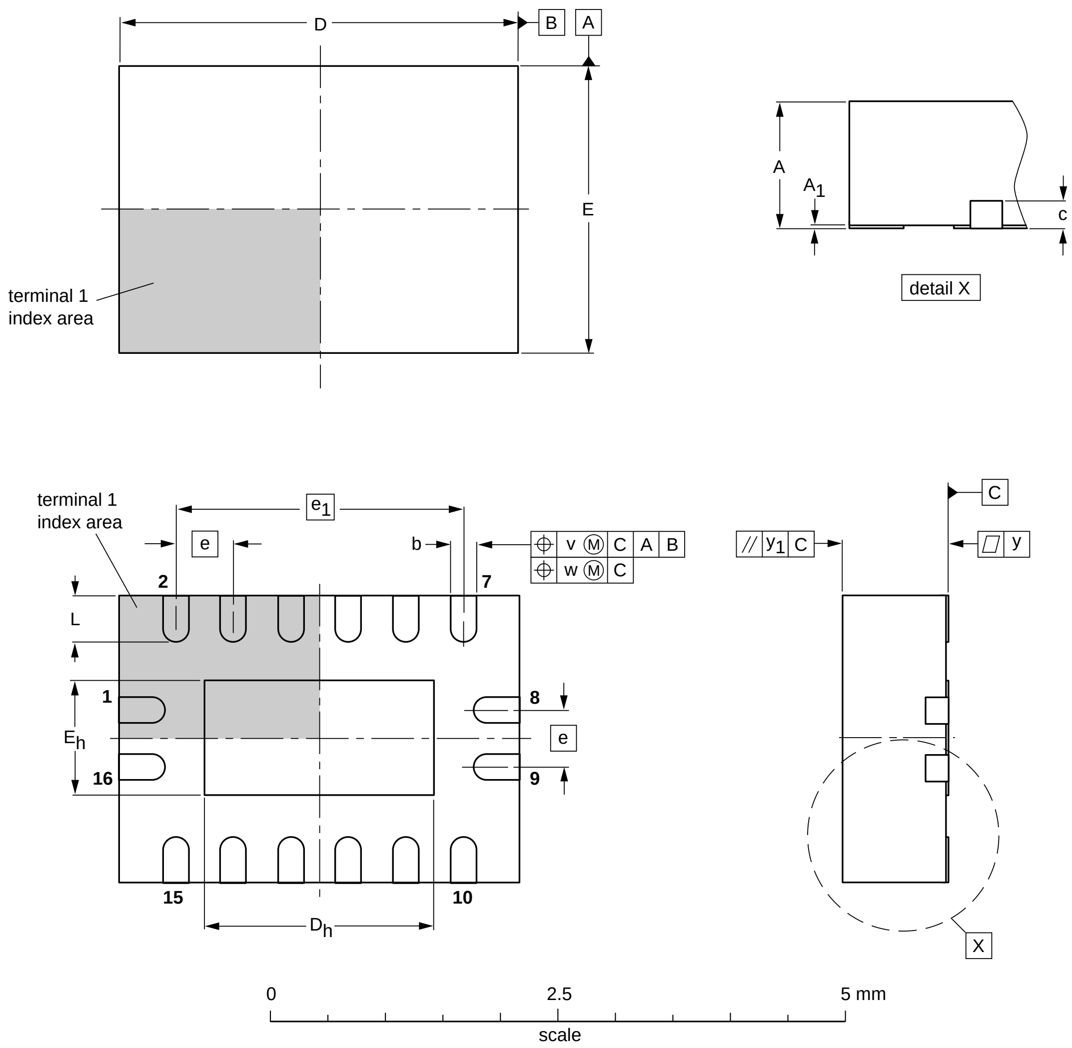


Fig 5. LNB system block diagram with TFF1013HN

14. Package outline

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm **SOT763-1**



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	L	v	w	y	y_1
mm	1	0.05 0.00	0.30 0.18	0.2	3.6 3.4	2.15 1.85	2.6 2.4	1.15 0.85	0.5	2.5	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			
SOT763-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27

Fig 6. Package outline SOT763-1

15. Abbreviations

Table 9. Abbreviations

Acronym	Description
CPW	CoPlanar Waveguide
DVB-S	Digital Video Broadcasting by Satellite
DVB-S2	Digital Video Broadcasting - Satellite - Second generation
IF	Intermediate Frequency
K_u band	K-under band
LO	Local Oscillator
PFD	Phase Frequency Detector
pHEMT	Pseudomorphic High Electron Mobility Transistor
PLL	Phase-Locked Loop
VCO	Voltage-Controlled Oscillator
V/T	Voltage / Tone
XO	Crystal Oscillator

16. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TFF1013HN v.1	20130911	Product data sheet	-	-

17. Legal information

17.1 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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19. Contents

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