

# TFF1015HN/N1

## Integrated mixer oscillator PLL for satellite LNB

Rev. 1 — 12 September 2011

Product data sheet

### 1. General description

The TFF1015HN/N1 is an integrated downconverter for use in Low Noise Block (LNB) converters 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**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		4.5	5	5.5	V
$I_{CC}$	supply current	RF input and IF output AC coupled	-	52	-	mA
$NF_{SSB}$	single sideband noise figure	measured at low band $f_{IF} = 1450\text{ MHz}$ and high band $f_{IF} = 1625\text{ MHz}$	-	7	-	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 $f_{IF} = 1450\text{ MHz}$ and high band $f_{IF} = 1625\text{ MHz}$	-	39	-	dB



Table 1. Quick reference data ...continued

$V_{CC} = 5\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f_{LO} = 9.75\text{ GHz}$  or  $10.6\text{ GHz}$ ;  $f_{xtal} = 25\text{ MHz}$ ;  $Z_0 = 50\text{ }\Omega$  unless otherwise specified.

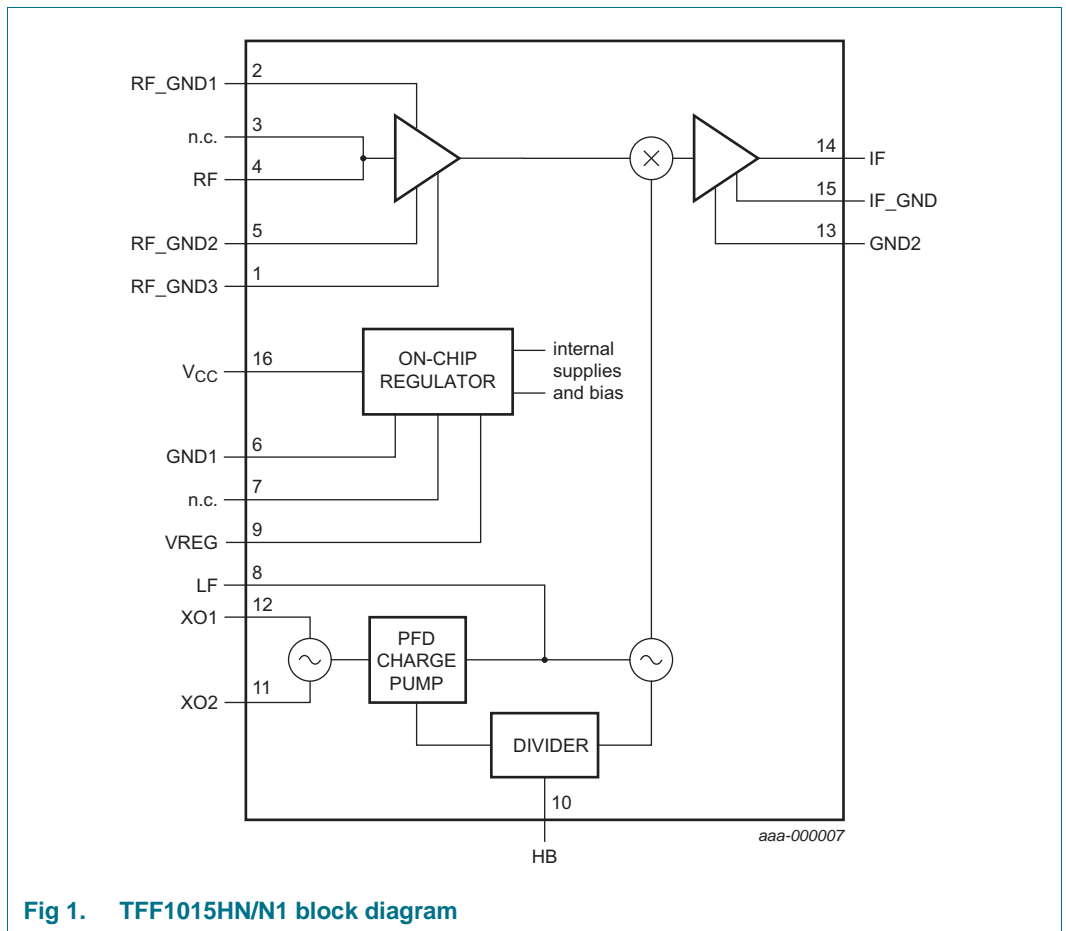
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$S_{11}$	input reflection coefficient	$f_{RF} = 10.7\text{ GHz}$ to $12.7\text{ GHz}$	-	-10	-	dB
$S_{22}$	output reflection coefficient	$f_{IF\_OUT} = 950\text{ MHz}$ to $2150\text{ MHz}$ ; $Z_0 = 75\text{ }\Omega$	-	-10	-	dB
$IP3O$	output third-order intercept point	carrier power is $-10\text{ dBm}$ (measured at output)	-	15	-	dBm

## 5. Ordering information

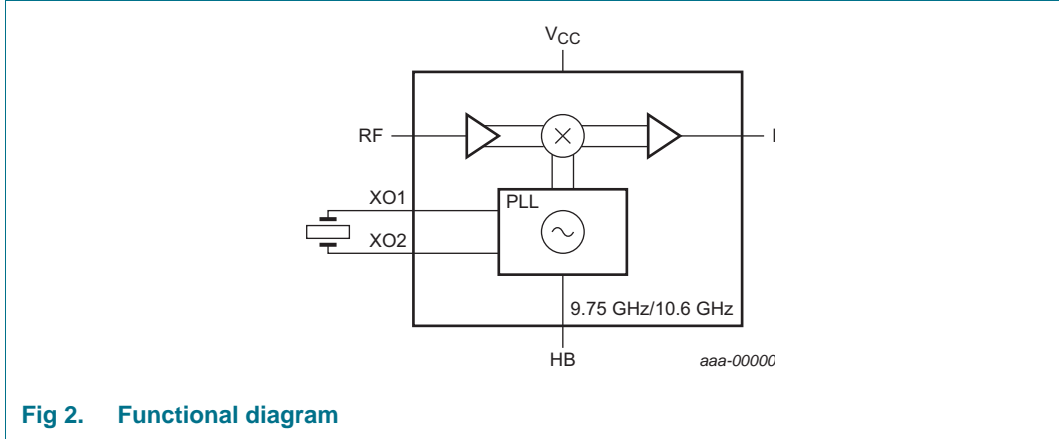
Table 2. Ordering information

Type number	Package		Version
	Name	Description	
TFF1015HN/N1	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body $2.5 \times 3.5 \times 0.85\text{ mm}$	SOT763-1

## 6. Block diagram

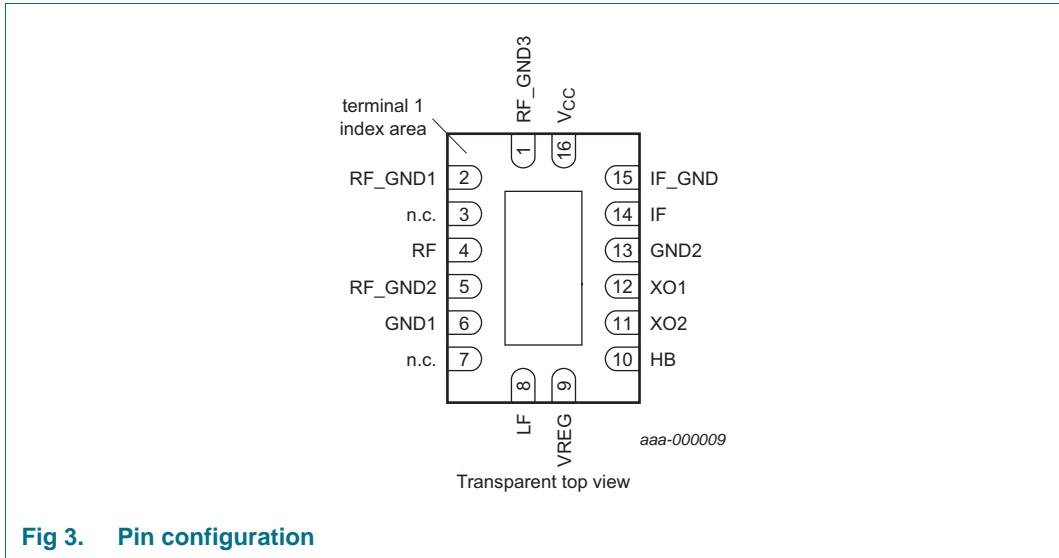


7. Functional diagram



8. Pinning information

8.1 Pinning



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.

**Table 3.** Pin description ...continued

Symbol	Pin	Description
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 <sub>CC</sub>	16	Supply voltage

[1] The distance between the outer edges of pin 2 and pin 3 is 740  $\mu\text{m}$ . 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 TFF1015HN/N1.

## 9. Limiting values

**Table 4.** Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		-0.5	+6	V
V <sub>I(HB)</sub>	input voltage on pin HB		-0.5	+6	V
T <sub>stg</sub>	storage temperature		-40	+125	°C

## 10. Recommended operating conditions

**Table 5.** Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		4.5	5	5.5	V
V <sub>I(HB)</sub>	input voltage on pin HB		0	-	5.5	V
T <sub>amb</sub>	ambient temperature		-40	+25	+85	°C
Z <sub>0</sub>	characteristic impedance		-	50	-	$\Omega$
f <sub>i(RF)</sub>	RF input frequency	low band	10.7	-	11.7	GHz
		high band	11.7	-	12.75	GHz
f <sub>LO</sub>	LO frequency	low band	-	9.75	-	GHz
		high band	[1]	10.6	-	GHz
f <sub>o(IF)</sub>	IF output frequency	low band	0.95	-	1.95	GHz
		high band	1.1	-	2.15	GHz
C <sub>L(xtal)</sub>	crystal load capacitance		-	10	-	pF
ESR	equivalent series resistance		-	-	40	$\Omega$
f <sub>xtal</sub>	crystal frequency		-	25	-	MHz

[1] For a 10.75 GHz LO frequency, select high band and use a crystal with frequency  $10.75 \text{ GHz} / 424 = 25.353774 \text{ MHz}$ .

## 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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC}$	supply current	RF input and IF output AC coupled	-	52	-	mA
$\Phi_{n\lambda}(itg)$	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 $f_{IF} = 1450\text{ MHz}$ and high band $f_{IF} = 1625\text{ MHz}$	-	7	-	dB
$G_{conv}$	conversion gain	measured at low band $f_{IF} = 1450\text{ MHz}$ and high band $f_{IF} = 1625\text{ MHz}$	-	39	-	dB
$\Delta G_{conv}$	conversion gain variation	over whole IF band in every 36 MHz band	-	2.0	-	dB
$S_{11}$	input reflection coefficient	$f_{RF} = 10.7\text{ GHz}$ to $12.7\text{ GHz}$	-	-10	-	dB
$S_{22}$	output reflection coefficient	$f_{IF\_OUT} = 950\text{ MHz}$ to $2150\text{ MHz}$ ; $Z_0 = 75\ \Omega$	-	-10	-	dB
$IP3O$	output third-order intercept point	carrier power is $-10\text{ dBm}$ (measured at the output)	-	15	-	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	k $\Omega$

13. Application information

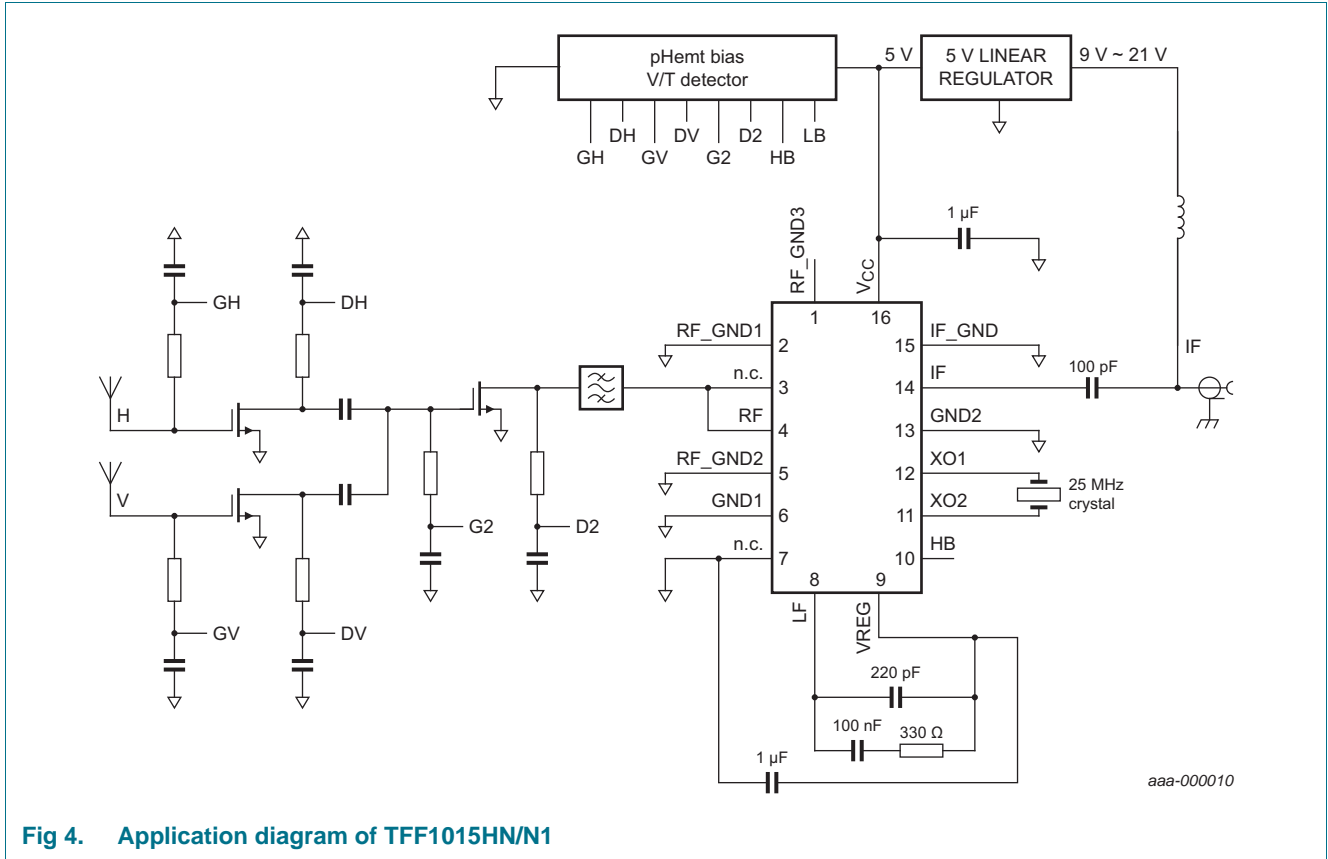


Fig 4. Application diagram of TFF1015HN/N1

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

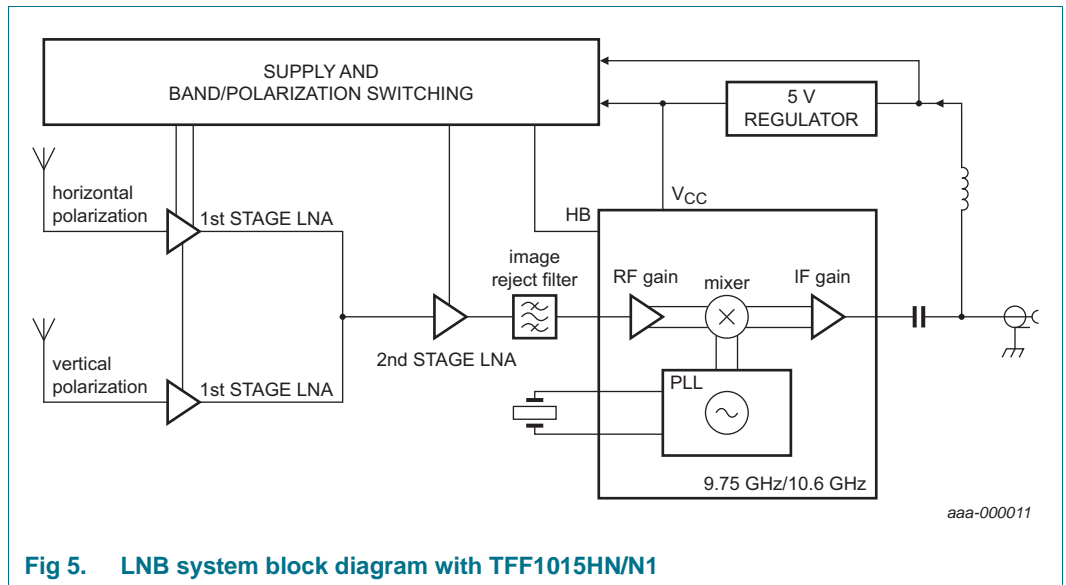


Fig 5. LNB system block diagram with TFF1015HN/N1

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

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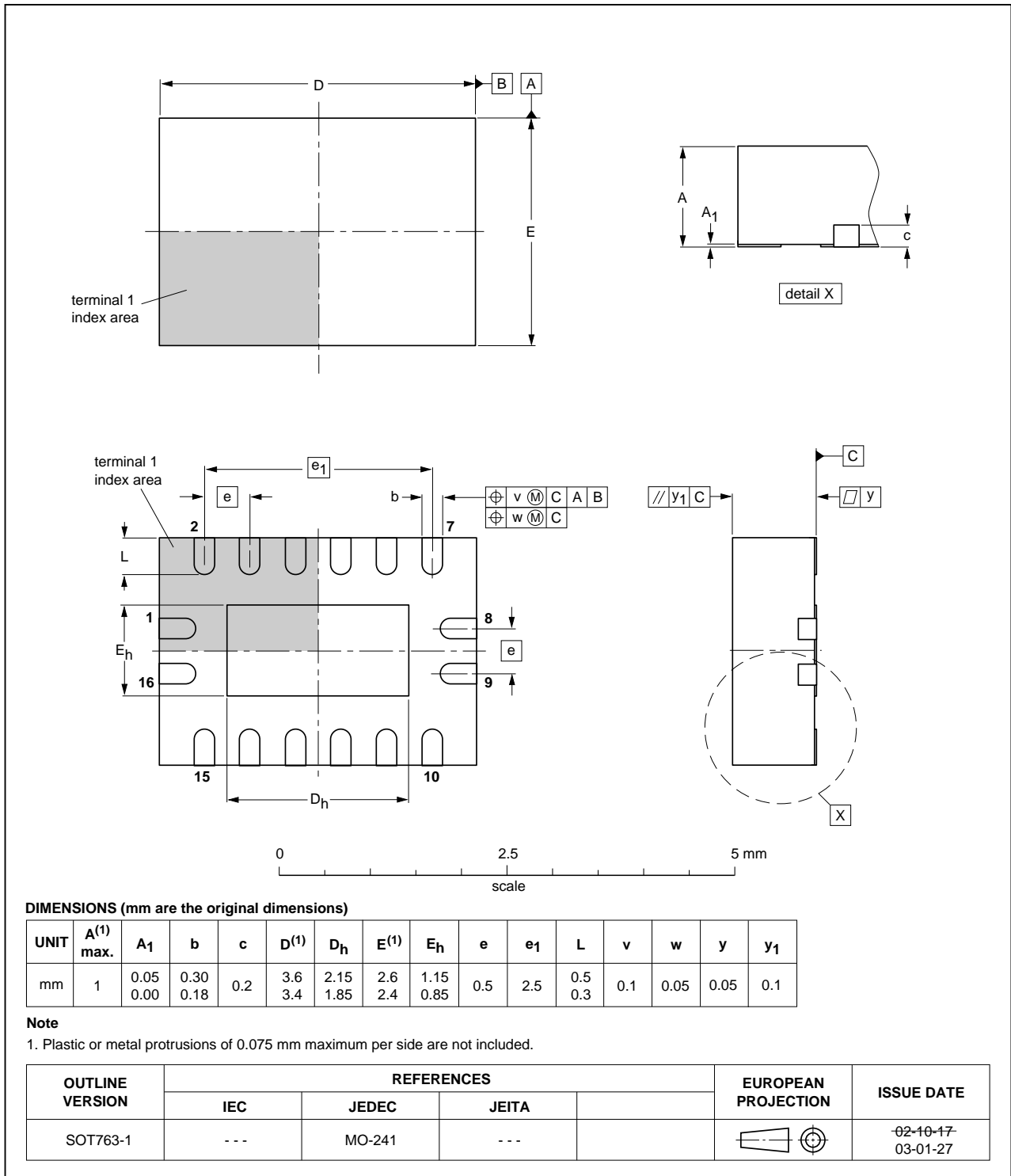


Fig 6. Package outline SOT763-1



## 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
ESD	ElectroStatic Discharge
IF	Intermediate Frequency
K <sub>u</sub> band	K-under band
LO	Local Oscillator
PFD	Phase Frequency Detector
pHemt	pseudomorphic High electron mobility transistor
PLL	Phase-Locked Loop
RF	Radio Frequency
VCO	Voltage-Controlled Oscillator
V/T	Voltage / Tone

## 16. Revision history

**Table 10. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
TFF1015HN_N1 v.1	20110912	Product data sheet	-	-

## 17. Legal information

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Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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[2] The term 'short data sheet' is explained in section "Definitions".

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