

# TFF1014HN

## Integrated mixer oscillator PLL for satellite LNB

Rev. 2 — 24 November 2011

Product data sheet

### 1. General description

The TFF1014HN/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 $f_{IF} = 1625\text{ MHz}$ | -    | 36  | -     | 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)                         | -   | 14  | -   | dBm  |

## 5. Ordering information

Table 2. Ordering information

| Type number  | Package  |   | Version  |
|--------------|----------|---|----------|
|              | Name     | Description   |          |
| TFF1014HN/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

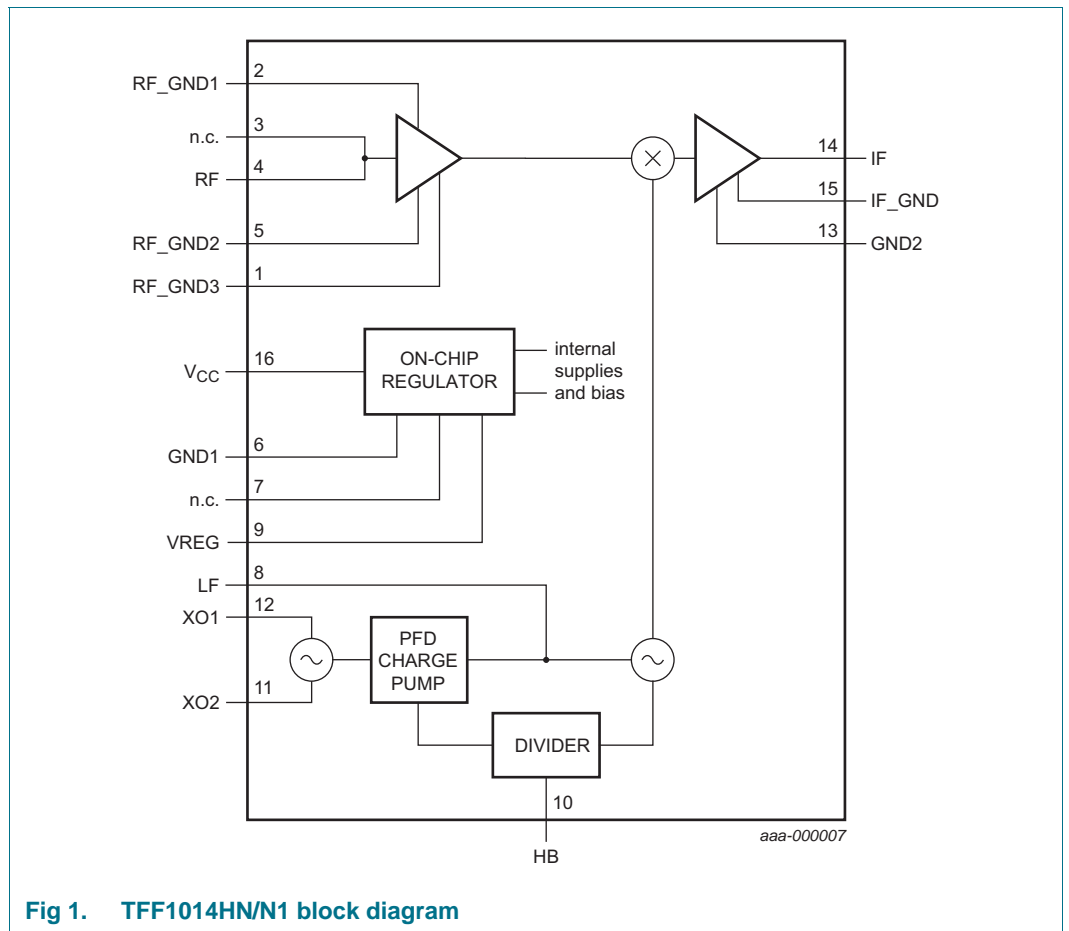
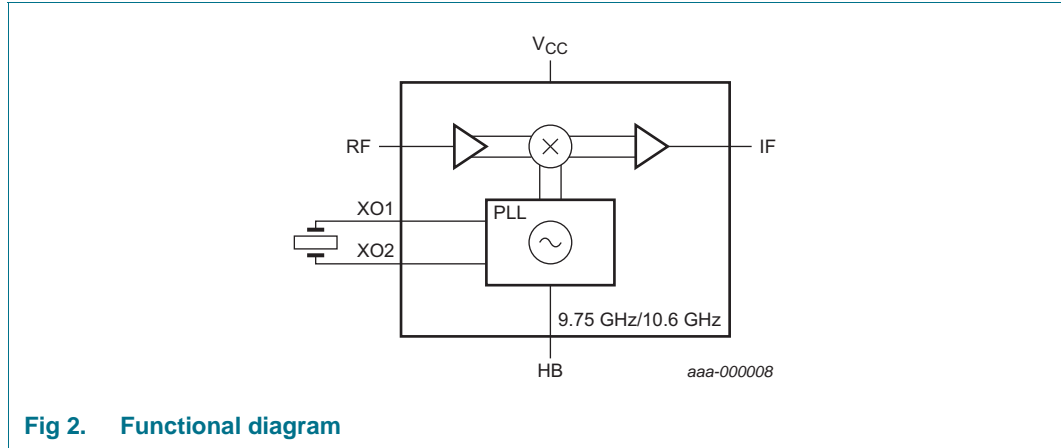


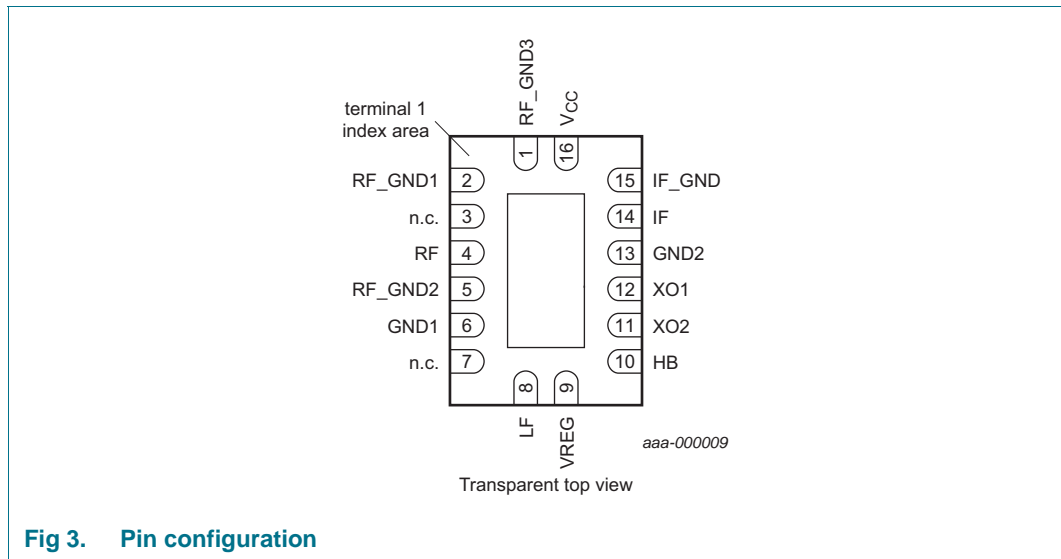
Fig 1. TFF1014HN/N1 block diagram

## 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. <a href="#">[1]</a>                              |
| 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 VCO 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 TFF1014HN/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         |
| $\Phi_{n\lambda(itg)RMS}$ | RMS integrated phase noise density       | integration offset frequency =<br>10 kHz to 13 MHz;<br>loop bandwidth = crossover bandwidth | -   | 1.5 | -   | deg        |
| $NF_{SSB}$                | single sideband noise figure             | measured at low band $f_{IF} = 1450\text{ MHz}$<br>and high band $f_{IF} = 1625\text{ MHz}$ | -   | 7   | -   | dB         |
| $G_{conv}$                | conversion gain                          | measured at low band $f_{IF} = 1450\text{ MHz}$<br>and high band $f_{IF} = 1625\text{ MHz}$ | -   | 36  | -   | dB         |
| $\Delta G_{conv}$         | conversion gain variation                | over whole IF band<br>in every 36 MHz band  | -   | 2   | -   | 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 $2150\text{ MHz}$ ;<br>$Z_0 = 75\ \Omega$                 | -   | -10 | -   | dB         |
| $IP3O$                    | output third-order intercept point       | carrier power is -10 dBm (measured at<br>the output)  | -   | 14  | -   | dBm        |
| $P_{L(1dB)}$              | output power at 1 dB gain<br>compression |   | -   | 4   | -   | 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

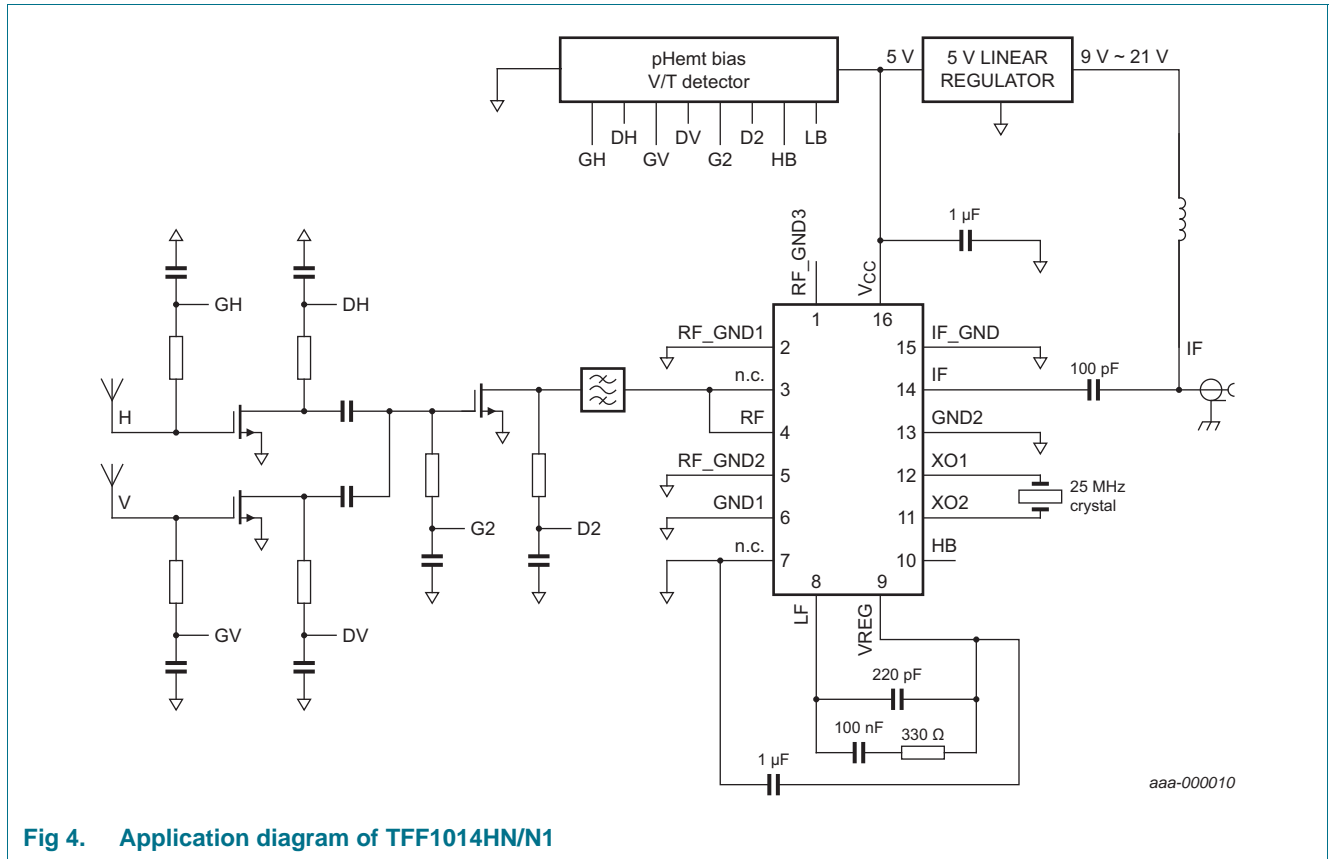
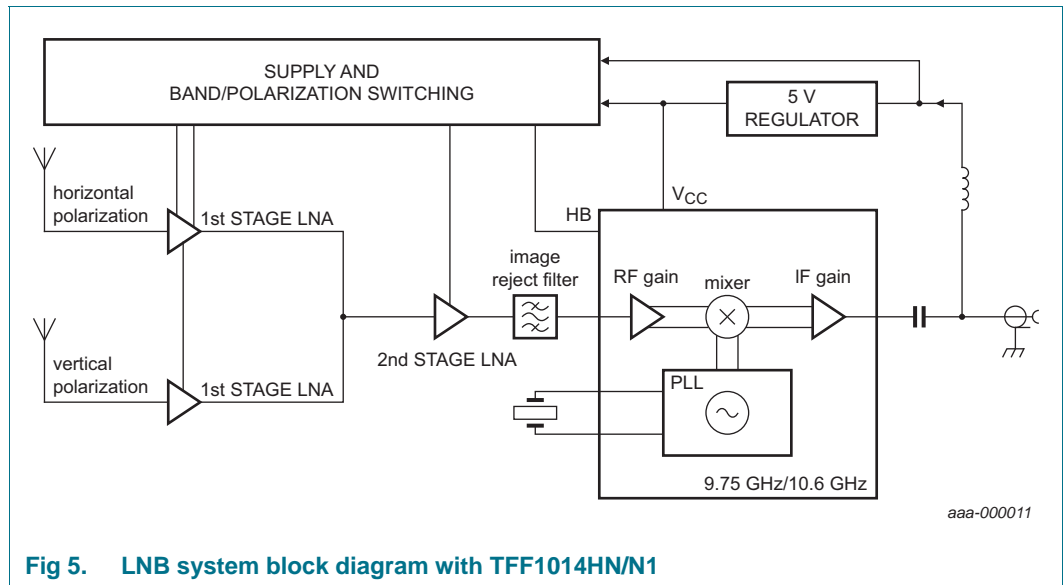


Fig 4. Application diagram of TFF1014HN/N1

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                      |



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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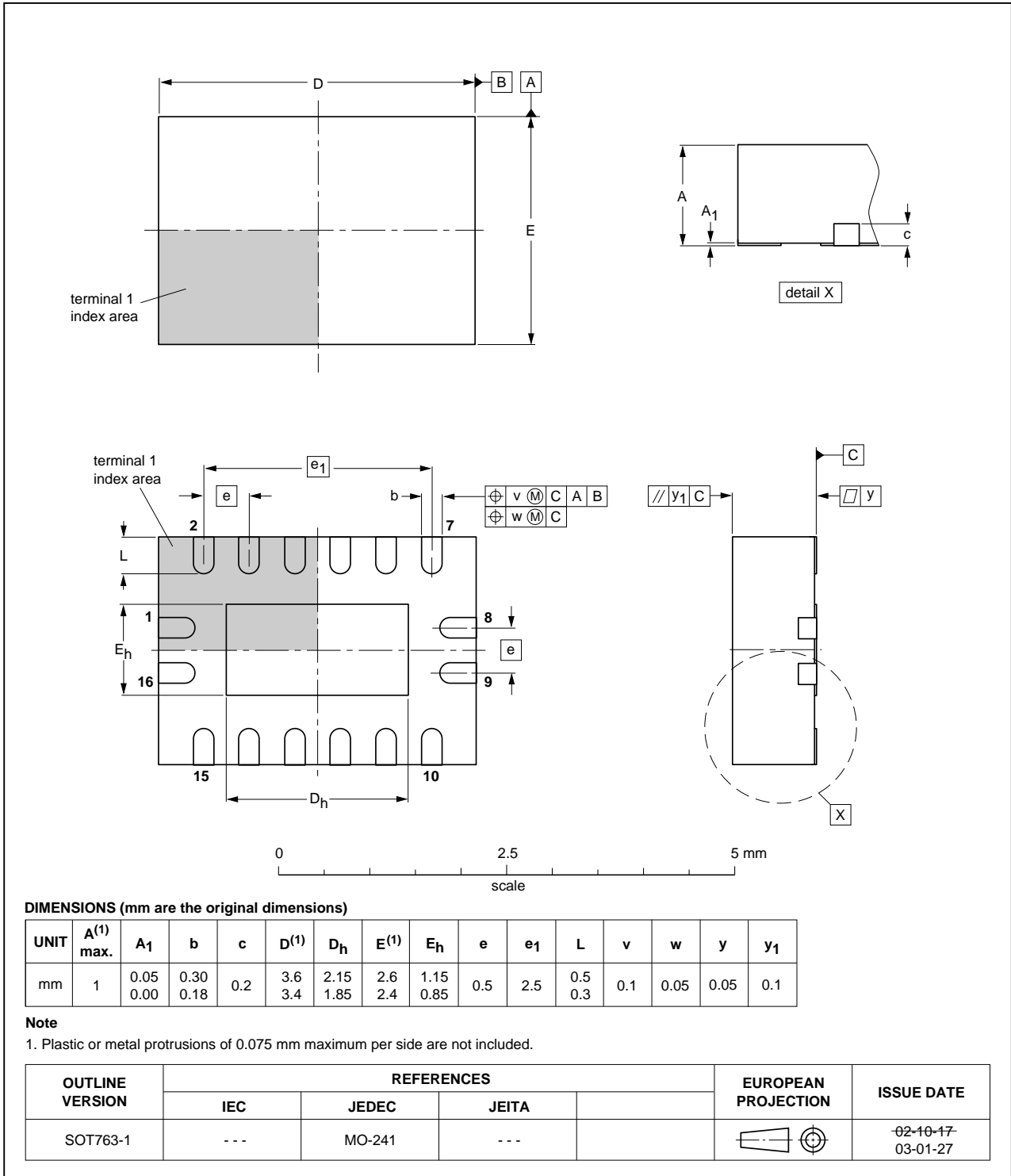


Fig 6. Package outline SOT763-1



## 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       |
|------------------|--|----------------------|---------------|------------------|
| TFF1014HN v.2    | 20111124   | Product data sheet   | -             | TFF1014HN_N1 v.1 |
| Modifications:   | <ul style="list-style-type: none"> <li>The status of this data sheet has been changed to Product data sheet</li> </ul> |                      |               |                  |
| TFF1014HN_N1 v.1 | 20110912   | Objective data sheet | -             | -                |

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|-----------------------------------|-------------------------------|---|
| 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.                                     |

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