



## • DESCRIPTION

Part of the Azimuth family of Frequency converters/combiners, the NTC/2142 is an agile IF to/from L-band/RF frequency-synthesized up down converter. Moreover, the modularity offers the user a wide variety of configuration alternatives. This is ranging from a simple IF to L-band up-converter or an L-band to IF-band down-converter to a more complex simultaneous up- and down-converter with integrated RF up-and down block converter (C-, Ku-, DBS/K-band etc.).

For even more flexibility within a specific application, active L-band splitters and combiners, and/or a conditioner module for outdoor frequency converters and LNB's can be added as well.

The IF to L-band up converter module (NTC/3474) has a frequency input range of +/- 20 MHz for the 70 MHz frequency band and +/- 40 MHz for the 140 MHz frequency band. On the output, the frequency is adjustable between 950 MHz and 1750 MHz.

The down converter module (NTC/3475) is covering the entire L-band for reception, i.e. from 950 MHz to 2150 MHz.

A combination of both modules also allows direct frequency conversion to and from 70 MHz / 140 MHz via the intermediate frequency connectors. Further integration of frequency conversion to or from any RF band is also possible.

The unit characterizes itself by its very low spurious characteristics and a very high 48 Hz resolution. Not only the gain is programmable but also calibrated, giving a flat frequency response over the entire IF-L range. The adjustable down converter gain can be programmed to take into account the coax cable loss.

It's high frequency stability is determined by the 10 MHz reference module (NTC/3462/Ax), which is available in 2 versions (high and very high stability). This module evidently also provides a 10 MHz signal for external devices, as well as the possibility to lock the unit to an external master clock.

For the above-mentioned user-specific applications, the outdoor conditioner/active splitter module NTC/3750/Az offer a wide variety of extension possibilities. Depending on the version chosen (5 versions: see data sheet for further details), one can use this as a simple multiplexer to add a 10 MHz on the same L-band cable (used for e.g. outdoor HPA's with integrated block up converters), or add on top of it an LNB power supply or a 22 KHz frequency.

When the NTC/2142 is used with the Newtec external RF frequency converter (NTC/2505/ZL), the version 3750/AC yields the L-band signal multiplexed with a 100 MHz reference, a 5 MHz bi-directional monitoring and control signal and the unavoidable 24 Volt power supply over the same coax cable. Alternatively, the active 2-input L-band combiner/4-output L-band splitter option (3750/AA) can be selected for situations where e.g. a received signal from 1 or 2 LNB's needs to be distributed to several demodulators or IRD's.

All Control and Monitoring parameters are available locally on the front panel (LCD display & keyboard) and remotely through a web interface (Http) or through the RS-485/232 port or through the 10/100 Base-T Ethernet port. The last two use the RMCPv2 protocol. There is optionally an SNMP + MIB agent.

Another unique feature is its ability to switch from 70 MHz or 140 MHz with or without spectrum inversion, and independently for the Up- and Down converter part.

## • APPLICATIONS

In its basic version, the NTC/2142 is most often used where traditional 70/140 MHz equipment needs to be converted to the more flexible L-band intermediate frequency.

Its simultaneous up- and down-conversion is very often the ideal answer to bi-directional (ESC) satellite links using modems with IF in- and outputs, and which need to be combined with other main carriers.

When used with the integrated or outdoor RF block up converters, the unit becomes an agile RF frequency converter, and which still can be extended with a down converter, a 2-input combiner and/or a splitter (NTC/3650Az).

In case the 4-input active combiner module NTC/2173 is added to the chassis, it transforms this unit to a multi-carrier combiner with agile frequency-synthesized converter (IF to L-band and multiple L-band to RF) with a maximum of 8 L-band inputs.

The presence of the very stable 10 MHz reference module is frequently used as a master reference for other equipment used within the same chain.

**Buy Now!**



**● FEATURES**

- Simultaneous IF to L-band and L-band to IF frequency agile converter
- Programmable IF : 140 and 70 MHz, switchable
- BW : 70 MHz ± 20 MHz and 140 MHz ± 40 MHz
- IFL : 950-1750 MHz (up converter)  
2150-950 MHz (down converter)
- Calibrated gain frequency response over entire frequency range (up converter)
- Frequency resolution : 48 Hz
- Low spurious response
- Phase noise according to Intelsat IBS / Eutelsat SMS specs
- Adjustable gain / Spectrum inversion
- Ovenized 10.0 MHz reference frequency and external 10.0 MHz reference input and output
- Rx and Tx measured level indication
- Direct RF Freq. read-out
- Up - Down converter, enable/disable
- L-band input/output combiners/splitters in option
- Wide choice of RF frequency ranges in option
- Local & remote M&C access to all menus through a
  - \* web interface (Http protocol)
  - \* RS-485/RS-232 (RMCP v2 protocol)
  - \* 10/100 Base-T Ethernet port (RMCP v2 protocol)
- User-programmable menu structure
- Action Keys (group of commands under single button)
- Real-time clock for alarm occurrence logging
- Internal test-generator and detector (PRBS counter)
- Very compact: 1Ru (height:4.4 cm !)
- CE label
- Dynamic build-up of alarm menu
- Diagnostics generator

**● VERSIONS & OPTIONS (ORDERING INFO)**

The Azimuth family of frequency converters includes a number of alternatives which will fulfill specific application demands.

**1. IF/L-band frequency agile converter modules (choose at least one)**

- NTC/3474/AA.A IF- to L-band frequency agile converter module.
- NTC/3475/AA.A L-band to IF frequency agile down-converter module.

**2. 10 MHz reference board (choose at least one)**

2 types are available. The standard version NTC/3462/AB.A is meant for normal DVB contribution and distribution bandwidths, while the type NTC/3462/AA.A is meant for applications where very low data rates are used (< 1MBaud) with resulting need for very high stability.

- NTC/3462/AB.A 10 MHz OCXO reference Oscillator (normal use)
- NTC/3462/AA.A 10 MHz OCXO High Stability Ref. Oscillator (recommended only with carriers < 1MHz)

**3. L-band outdoor conditioner & active splitter NTC/3750/Ax (optional)**

The NTC/3750/Ax.A is available in 5 different versions:

- NTC/3750/AA: ODU/LNB L-band conditioner & active 2/4 L-band splitter module (Fully equipped version)  
This version contains a selectable circuit for 10 MHz and 100 MHz reference signals, an M&C device for the ODU NTC2505/ZL, and connections for an external power supply to the ODU or LNB. This version also includes an active 2 input/4 output L-band splitter (Power supply and 10 MHz reference board not included \*1)
- NTC/3750/AB: L-band conditioner module for LNB & transceiver  
Version used where one needs to supply a 10 MHz reference signal combined with the L-band signal to i.e. an HPA, or whenever one wants to control an LNB with internal or external reference. (Power supply and 10 MHz reference board not included \*1)
- NTC/3750/AC: L-band conditioner module for ODU NTC/2505/ZL  
Used solely for the Newtec ODU NTC/2505/ZL. It contains the 100 MHz circuit, the M&C circuit and connections for the 24 VDC power supply. (Power supply and 10 MHz reference board not included \*1)
- NTC/3750/AD: L-band conditioner for LNB & transceiver + active 2/4 L-band splitter module  
Version used where one needs to supply a 10 MHz reference on top of the L-band signal to i.e. an HPA, or whenever one wants to control an LNB with internal or external reference. This version also includes an active 2 input/4 output L-band splitter (Power supply and 10 MHz reference board not included \*1)
- NTC/3750/AE: Active 2 inp/4-outp splitter.  
This module version is merely intended for situations where one has to split one or 2 incoming L-band signals (combiner) to 4 independent outputs (splitter). This signal can be coming from i.e. an L-band modulator or an LNB.

\*1): 10 MHz ref. Signal available when NTC/3462/Ax.A installed.  
10 MHz can be used for LNB or HPA with integrated block freq. converter



**4. Frequency Converter Modules NTC/3736, NTC/3750 and 3770-71-series (optional)**

(See also data sheets NTC/3736/xx, NTC/3750/GE and NTC/3770-71)

The field replaceable block up-converter modules convert one or 2 L-band inputs to the required RF-band. They can be installed either within this AZIMUTH chassis, or in the outdoor unit NTC/2505/ZL.

This band ranges from 950 MHz up to 18 GHz :

- NTC/3736.DEx.A L-band to 5850-6650 MHz Conv. mod,
- NTC/3736.EEx.A L-band to 12750-13250 MHz Conv. mod
- NTC/3736.EZx.A L-band to 12890-13250 MHz Conv. mod,
- NTC/3736.HCx.A L-band to 17300-17800 MHz Conv. mod,
- NTC/3736.IZx.A L-band to 17700-18100 MHz Conv. mod,
- NTC/3736.KZx.A L-band to 18100-18400 MHz Conv. mod,
- NTC/3750.GE L-band to 13750-14500 MHz Conv. mod
- NTC/3736.TBx.A L-band to 3 x active L-band outputs, G=0 dB
- NTC/3750.AA.A Outdoor Unit/LNB L-band conditioner & active 2/4 L-band splitter module
- NTC/3750.AB.A L-band conditioner module for LNB & transceiver (L-band + 10 MHz ref. on same cable)
- NTC/3750.AC.A L-band conditioner module for ODU NTC/2505/ZL (L-band + 100 MHz + DC + M&C)
- NTC/3750.AD.A L-band conditioner module for LNB & transceiver (L-band + 10 MHz ref. on same cable) + active 2/4 L-band splitter module

In special cases where a higher output level is required, line amplifiers are optionally available:

- NTC/3736.xx.A: +20 dB L-band line amplifier
- NTC/3750.xx.B: +20 dB Ku-band line amplifier
- NTC/3736.xx.C: +20 dB C-band line amplifier
- NTC/3736.xx.E: +18 dB line amplifier (17.3-18.4 GHz)

Following up converters (see above) are fitted with an L-band output and 2 external L-band inputs, allowing the combining and up-conversion of a second L-band source:

NTC/3736.DE-EZ-FZ-HZ-IZ-KZ and NTC/3750/GE

The field replaceable block down-converter modules convert the required RF band to the L-band. They can be installed either within this AZIMUTH chassis, or in the outdoor unit NTC/2505/ZL.

- NTC/3770/AA C-band to L-band PLL block down-converter module
- NTC/3771/AA Low Ku band (10.7-11.7 GHz) to L-band PLL block down converter module
- NTC/3771/AB High Ku band (11.7-12.75 GHz) to L-band PLL block down converter module
- NTC/3771/AC Wide Ku band (10.7-12.75 GHz) to L-band PLL down converter module

**5. Outdoor Power Supply NTC/3337/AC (optional)**

Needed whenever the Newtec ODU (NTC/2505/ZL) or an LNB is used in conjunction with NTC/3750/Ax.

**6. SNMP agent and MIB library**

Needed whenever the unit needs to be controlled over Ethernet via proprietary NMS

**• DATA SUMMARY**

**IF to L-band UPCONVERTER (NTC/3474/AA.A)**

|                             |  |
|-----------------------------|--|
| Connector IF in             | : BNC (F)                                  |
| Connector L-band out        | : SMA (F)                                  |
| IF input impedance          | : 50 Ohm                                   |
| Return loss IF @ 50 Ohm     | : >15 dB                                   |
| L-band output impedance     | : 50 Ohm                                   |
| Return loss L-band @ 50 Ohm | : >15 dB                                   |
| Frequency range IF          | : 70±18 MHz or<br>140± 36 MHz (selectable) |
| Spectrum inversion          | : Switchable                               |
| Frequency range L-band      | : 950 to 1750 MHz                          |

|   |   |
|---|---|
| Frequency step size   | : 48 Hz   |
| Input level IF (typical)  | : +5 to -35 dBm                                   |
| Output level L-band   | : -30 to 10 dBm                                   |
| Output 1dB compression L-band                                       | : +10 dBm   |
| Third order intermod  | : < -60 dBc (P <sub>in/out</sub> :<br>-10/-4 dBm) |
| Third order intercept   | : > +26dBm  |
| Programmable IF gain from input<br>to intermediate freq. @ -10 dBm) | : -15 to 20 dB                                    |
| IF gain step size resolution  | : 0.1 dB  |
| Programmable L-band gain<br>(Intermediate ⇒ L-band)                 | : -20 to 20 dB                                    |
| L-band gain step size   | : 0.1 dB  |

Gain variation over any 36/72MHz BW: 1.2 dB peak-to-peak

|                       | <b>@ 72 MHz BW</b>         | <b>@ 36 MHz BW</b>       |
|-----------------------|----------------------------|--------------------------|
| Linear group delay    | 0.05 ns/MHz                | 0.03 ns/MHz              |
| Parabolic group delay | 0.0035 ns/MHz <sup>2</sup> | 0.01 ns/MHz <sup>2</sup> |
| Residual group delay  | 1 ns peak-to-peak          | 1 ns peak-to-peak        |

AM/PM conversion : 0.1°/dB max. @ 0 dBm output  
In-band spurious (@ -10 dBm  
intermediate level) : <-65 dBc@-10 dBm output level  
for 200 kbaud and higher rates

Output switching suppression : < -80 dBm

Noise figure : < 20 dB for (in) IF gain > 10 dB  
& (out) L-band gain > 0 dB

|             |           |                |
|-------------|-----------|----------------|
| Phase noise | @ 10 Hz   | : < -50 dBc/Hz |
|             | @ 100 Hz  | : < -70 dBc/Hz |
|             | @ 1 kHz   | : < -80 dBc/Hz |
|             | @ 10 kHz  | : < -85 dBc/Hz |
|             | @ 100 kHz | : < -95 dBc/Hz |

**IF to RF UPCONVERTER (NTC/3474/AA.A and NTC/3736/xx)**

|                         |  |
|-------------------------|--|
| Connector IF in         | : BNC (F)                                  |
| Connector RF out        | : SMA-F                                    |
| IF input impedance      | : 50 Ohm                                   |
| Return loss IF @ 50 Ohm | : >15 dB                                   |
| RF output impedance     | : 50 Ohm                                   |
| Return loss RF @ 50 Ohm | : >12 dB                                   |
| Frequency range IF      | : 70±18 MHz or<br>140± 36 MHz (selectable) |
| Spectrum inversion      | : Switchable                               |

|                    |                     |
|--------------------|---------------------|
| Frequency range RF |                     |
| NTC/3736.DEx.A     | : 5850 - 6650 MHz   |
| NTC/3736.EEx.A     | : 12750 - 13250 MHz |
| NTC/3736.EZx.A     | : 12890 - 13250 MHz |
| NTC/3736.HZCx.A    | : 17300 - 17800 MHz |
| NTC/3736.IZx.A     | : 17700 - 18100 MHz |
| NTC/3736.KZx.A     | : 18100 - 18400 MHz |
| NTC/3750.GE.A      | : 13750 - 14500 MHz |

|   |   |
|---|---|
| Frequency step size   | : 48 Hz   |
| Input level IF (typical)  | : +5 to -35 dBm                                   |
| Output 1dB compression RF   | : >0 dBm  |
| Third order intermod  | : <-60 dBc (P <sub>in/out</sub> :<br>-10/-20 dBm) |
| Third order intercept:  | : > +10 dBm                                       |
| Programmable IF gain from input<br>to intermediate freq. @ -10 dBm) | : -15 to 20 dB                                    |
| IF gain step size resolution  | : 0.1 dB  |
| Programmable RF gain<br>(Intermediate ⇒ RF)                         | : -20 to 20 dB (± 5dB)                            |
| RF gain step size   | : 0.1 dB  |
| L-band monitoring output gain                                       | : same as RF gain                                 |
| Gain variation over any 36/72 MHz BW                                | : 2.6 dB peak-to-peak                             |

|                       | <b>@ 72 MHz BW</b>         | <b>@ 36 MHz BW</b>       |
|-----------------------|----------------------------|--------------------------|
| Linear group delay    | 0.05 ns/MHz                | 0.03 ns/MHz              |
| Parabolic group delay | 0.0035 ns/MHz <sup>2</sup> | 0.01 ns/MHz <sup>2</sup> |
| Residual group delay  | 1 ns peak-to-peak          | 1 ns peak-to-peak        |

In-band spurious (@ -10 dBm  
intermediate level) : <-65 dBc@-10 dBm output level  
for 200 kbaud and higher rates

Output switching suppression : < -80 dBm  
Disabled converter output suppression: >45 dB (Ext. L-band in)

|             |           |                |
|-------------|-----------|----------------|
| Phase noise | @ 10 Hz   | : < -50 dBc/Hz |
|             | @ 100 Hz  | : < -70 dBc/Hz |
|             | @ 1 kHz   | : < -80 dBc/Hz |
|             | @ 10 kHz  | : < -85 dBc/Hz |
|             | @ 100 kHz | : < -95 dBc/Hz |

**L-band to IF DOWNCONVERTER (NTC/3475/AA.A)**

Connector L-band in : SMA (F)  
 Connector IF out : BNC (F)

L-band input impedance : 50 Ohm  
 Return loss L-band @ 50 Ohm : >15 dB  
 IF output impedance : 50 Ohm  
 Return loss IF @ 50 Ohm : >15 dB

Frequency range L-band : 950 to 2150 MHz

Spectrum inversion : Switchable

Frequency range IF : 70±20 MHz or  
 140±40 MHz (selectable)  
 Frequency step size : 48 Hz

Input level L-band : maximum composite  
 -20 dBm

Output level IF : ≤ 0 dBm typically  
 Output 1dB compression IF : +10 dBm  
 Gain adjust : 0 to 50 dB  
 Gain step size : 0.1 dB  
 Gain variation over any 36/72 MHz : 1.2 dB peak-to-peak

In-band spurious : <-60 dBc@-25 dBm in  
 L-band and 0 dBm out

Output switching suppression : > 80 dB  
 Image rejection : -60 dBc  
 Noise figure : < 15 dB at max. gain

Gain variation over temp (+20 to +40°C) : ± 0.5 dB

|                       | <b>@ 72 MHz BW</b>         | <b>@ 36 MHz BW</b>       |
|-----------------------|----------------------------|--------------------------|
| Linear group delay    | 0.05 ns/MHz                | 0.03 ns/MHz              |
| Parabolic group delay | 0.0035 ns/MHz <sup>2</sup> | 0.01 ns/MHz <sup>2</sup> |
| Residual group delay  | 1 ns peak-to-peak          | 1 ns peak-to-peak        |

AM/PM conversion : 0.1°/dB max. @ 0 dBm output

|             |           |                |
|-------------|-----------|----------------|
| Phase noise | @ 10 Hz   | : < -50 dBc/Hz |
|             | @ 100 Hz  | : < -70 dBc/Hz |
|             | @ 1 kHz   | : < -80 dBc/Hz |
|             | @ 10 kHz  | : < -85 dBc/Hz |
|             | @ 100 kHz | : < -95 dBc/Hz |

**RF to IF DOWNCONVERTER (NTC/3474/AA.A and  
NTC/377x.xx)**

Connector RF In : SMA(F)  
 Connector IF out : BNC (F)

RF input impedance : 50 Ohm  
 Return loss RF in @ 50 Ohm : >17 dB  
 IF output impedance : 50 Ohm  
 Return loss IF @ 50 Ohm : >15 dB

Frequency range RF  
 NTC/3770/AA : 3400-4200 MHz  
 NTC/3771/AA : 10700-11700 MHz  
 NTC/3771/AB : 11700-12750 MHz  
 NTC/3771/AC : 10700-12750 MHz

Spectrum inversion : Switchable

Frequency range IF : 70±20 MHz or  
 140± 40 MHz (selectable)  
 Frequency step size : 48 Hz

Input level RF : max composite -10dBm

Output level IF : ≤ 0 dBm typically  
 Output 1dB compression IF : +10 dBm  
 Gain adjust : -10 to 40 dB  
 Gain step size : 0.1 dB  
 Gain variation over any 36/72 MHz : 1.5 dB peak-to-peak

In-band spurious : <-60 dBc@-15 dBm in RF  
 and 0 dBm out

Output switching suppression : > 80 dB  
 Image rejection : 60 dBc  
 Noise figure : < 25 dB at max. gain

|                       | <b>@ 72 MHz BW</b>         | <b>@ 36 MHz BW</b>       |
|-----------------------|----------------------------|--------------------------|
| Linear group delay    | 0.05 ns/MHz                | 0.03 ns/MHz              |
| Parabolic group delay | 0.0035 ns/MHz <sup>2</sup> | 0.01 ns/MHz <sup>2</sup> |
| Residual group delay  | 1 ns peak-to-peak          | 1 ns peak-to-peak        |

|             |           |                |
|-------------|-----------|----------------|
| Phase noise | @ 10 Hz   | : < -50 dBc/Hz |
|             | @ 100 Hz  | : < -70 dBc/Hz |
|             | @ 1 kHz   | : < -80 dBc/Hz |
|             | @ 10 kHz  | : < -85 dBc/Hz |
|             | @ 100 kHz | : < -90 dBc/Hz |

**INTERNAL REFERENCE FREQUENCY (see NTC/3462/Ax)**

AA version : stability :  $\pm 2 \times 10^{-9}$  over 0°C to 65°C  
ageing :  $\pm 0.5$ ppb/day  
 $\pm 500$ ppb/10year

AB version : stability :  $\pm 5 \times 10^{-8}$  over 0°C to 70°C  
ageing :  $\pm 15$  ppb/day  
 $\pm 300$  ppb/year

**EXTERNAL 10.0 MHz REFERENCE**

Input level : -3 dBm up to +7 dBm  
Output level : +7 dBm  
connector : BNC (F) – 50

**MONITOR & CONTROL INTERFACES**

- a) protocol : Http (via web-browser)  
connector : RJ-45  
electrical : Ethernet 10 base-T
- b) protocol : RMCP **version 2 only**  
connector : 9 pin sub-D female  
electrical : RS-485 / RS-232
- c) protocol : RMCP **version 2 only** over TCP-IP or UDP, SNMP  
connector : RJ-45  
electrical : Ethernet 10 base-T

**ALARM INTERFACE**

connector : 9 pin sub-D (F)  
electrical : dual switch-over contacts

**MECHANICAL**

19" sub rack, height: 1RU, weight 6 kg

**POWER SUPPLY**

90-130/180-260V, 105VA, 47-63 Hz

**TEMPERATURE**

operational : 0° up to +40°C  
storage : -40° up to +70°C

**CONTROL**

**COMMON**

- 10 MHz source
- Outdoor unit control (optional)
- Outdoor unit reference (optional)
- LNB control (optional)

**UPCONVERTER**

- Output on/off
- 70 or 140 MHz input frequency band
- Selectable 40/80 MHz BW for 140 MHz IF
- Output frequency
- Input gain IF
- Output gain L-band
- Spectrum inversion

**DOWNCONVERTER**

- Output on/off
- 70 or 140 MHz output frequency band
- Selectable 40/80 MHz BW for 140 MHz IF
- Input frequency
- IF Gain
- Spectrum inversion

**ALARM**

**COMMON**

- ODU alarm (optional)
- 10 MHz alarm
- Power supply alarm
- Temp. alarm

**UPCONVERTER**

- Synthesizer out-of-lock
- Input Overload warning (no Tx switch-off) (adjustable & selectable threshold)
- Input under load alarm (adjustable & selectable threshold)

**DOWNCONVERTER**

- Synthesizer out-of-lock
- Input Overload warning (no Rx switch-off) (adjustable & selectable threshold)
- Input under load alarm (adjustable & selectable threshold)

**LED INDICATIONS**

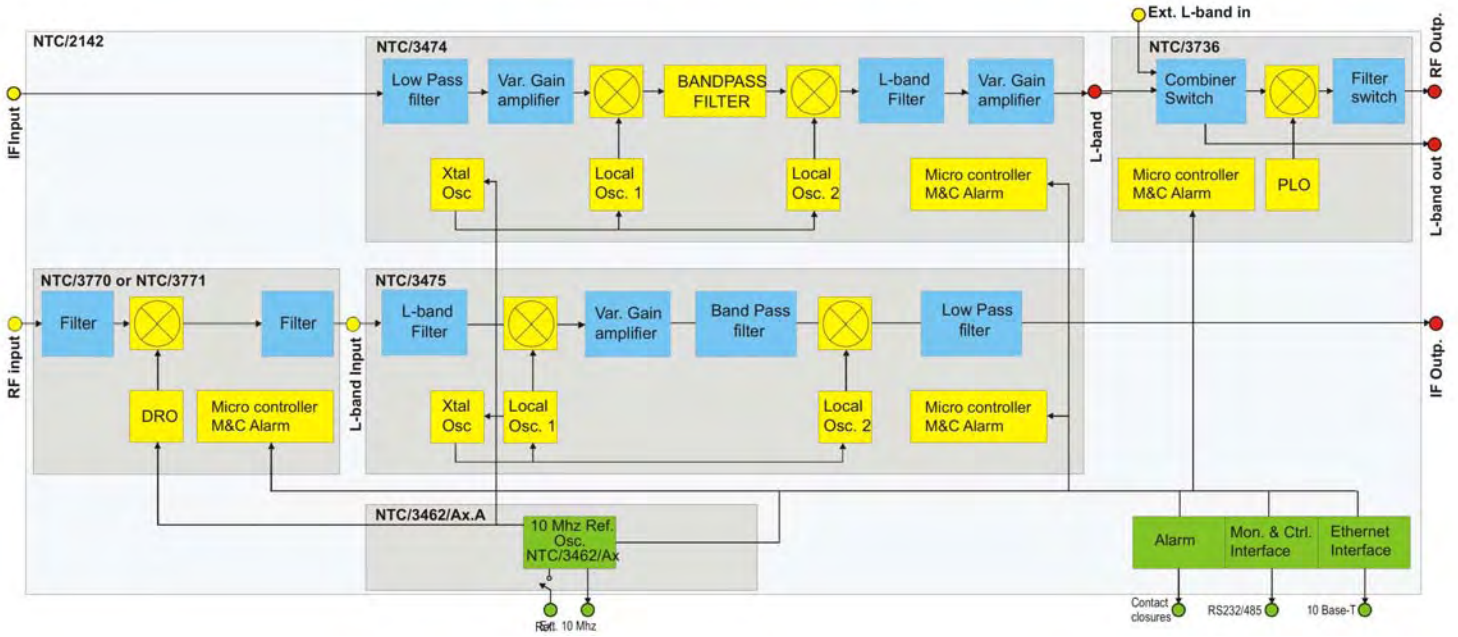
- IF out, L-band out, RF out, Active alarm, memorized alarm, test mode/DC to outdoor on

**MONITORING**

All control parameters, alarms (active and memorized), power supply voltages, internal temperature, outdoor equipment (optional), etc.

• BLOCK DIAGRAM

IF TO/FROM L-BAND/RF AGILE FREQUENCY CONVERTER NTC/2142/xx  
BLOCK DIAGRAM



• TECHNICAL LITERATURE & REFERENCES (ALSO AVAILABLE ON OUR WEBSITE)

Other related products

- AZIMUTH
- AZIMUTH
- NTC/3474/AA.A
- NTC/3475/AA.A
- NTC/2173/xx
- NTC/2505/ZL
- NTC/3462/Ax
- NTC/3736
- NTC/3750/xx
- NTC/3750/Ax
- NTC/3770-71

- Product families
- Frequency converter Family
- IF to L-band Frequency Agile Converter Module
- L-band to IF Frequency Agile Converter Module
- Stand-alone indoor 2, 4 or 8 L-band input Combiner / Frequency Converter
- L-band Output Frequency Converter Unit
- 10 MHz Reference Frequency module
- Field replaceable convertor modules
- L-band Block Frequency Converters to C-, Ku- and K-band
- L-band Outdoor Conditioner & Active Splitter
- RF down converter

Application notes

- NTC/2042/APN01
- NTC/2042/APN02
- NTC/2142/APN01

- IF/IFL Converter - NTC/2042 applications
- Insertion of communication carriers into DTV uplink earth stations
- IF and L-band conversion applications

Technical publications

December 1996

Performance considerations of multiphase and multilevel digital modulation techniques

