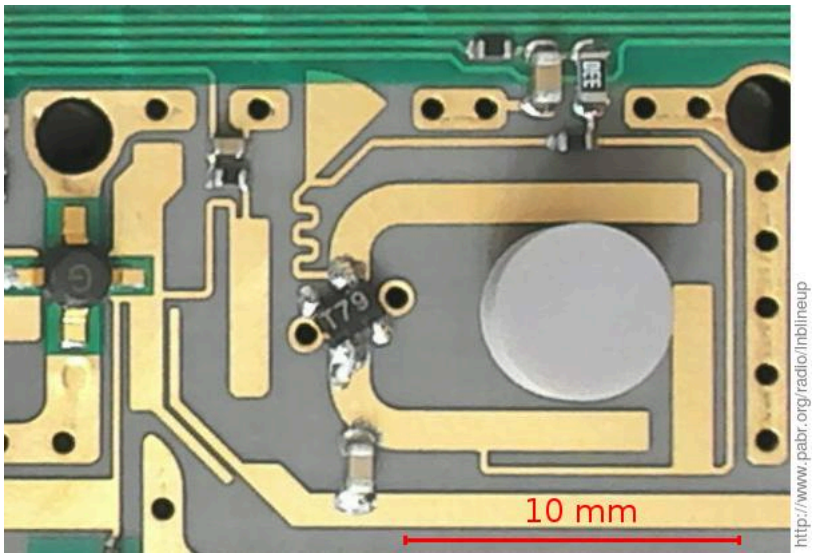
Ku-band LNB line-up

In this article I document the internal construction of several off-the-shelf Ku-band low noise block downconverters (LNB/LNBF) from the perspective of amateur radio applications.



READ THE UP-TO-DATE VERSION ONLINE:
http://www.pabr.org/radio/lnblineup/lnblineup.en.html

Revision History		
1.0	2018-11-01	Initial release.
1.1	2018-12-06	Added UHD414, T304832, LRP04H, PXDL. Notes on power circuits, crystals, supply chain, OSLO 45°.

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1. Motivations

I recently disassembled several inexpensive LNBs in order to select models suitable for specific modifications and applications such as:

- Installing a crystal with a slightly different frequency. This may help receive the amateur 3 cm band with off-the-shelf satellite TV receivers.
- Replacing the crystal with a more accurate TCXO or OCXO. This is convenient for receiving narrow-band transmissions.
- Using an external clock reference. This may be useful for radioastronomy applications.
- Supplying power without a bias tee.
- Mounting several LNBs close together.

These concerns are mostly about mechanical construction and ease of access to key components. RF performance was not considered at all.

Hopefully these notes and pictures will be of interest to others:

- Radio amateurs with unusual requirements may find this information useful to choose among an abundance of models, as the first amateur 3 cm geostationary relays are expected to be deployed soon.
- Those trained in the dark art of microwave engineering may be entertained by the fascinating variety of microstrip patterns found inside these devices.
- Mass-market product designers may find it interesting to identify all the small decisions which ultimately lead to significant price differences between models with mostly identical specifications.

2. Related work

There is a long tradition of adapting mass-market LNBs for amateur radio, starting probably with U.S. C-band TVRO equipment in the late 1970s. Articles can be found in amateur radio journals.

One popular online resource with information about other LNBs is https://uhf-satcom.com/blog/ku-band-pll-lnb-s.

3. Background information on LNBs

3.1. "Universal" LNBs

All LNBs examined here are of the so-called European "Universal" type, i.e. they can receive all four sub-bands resulting from combinations of two polarizations (horizontal / vertical) and two frequency ranges (low / high). In the U.S. they are sometimes called "LNBF" (LNB and Feedhorn), possibly because early C-band equipment had separate horns and LNBs.

Technically their frequency coverage is mostly in X band (8..12 GHz), but the fixed-satellite service in Europe is commonly considered to be an extension of Ku band (12..18 GHz). Hence, these products are marketed as "Ku-band LNBs".

3.2. Single / Twin / Quad / Octo / Quattro

A "Single" LNB is powered through the same F-type coaxial connector that carries its output signal. It provides one of the four sub-bands depending on the DC component and optional overtone in the power supply:

- 13 V selects vertical polarization.
- 18 V selects horizontal polarization.
- No overtone selects the 9.75 GHz LO. This downconverts the low range (10.70..11.70 GHz) to 950..1950 MHz.
- A 22 kHz overtone selects the 10.60 GHz LO. This downconverts the high range (11.70..12.75 GHz) to 1100..2150 MHz.

A "Twin" LNB has two F-type connectors and behaves like two independent "Single" LNBs. If one of the connectors does not receive power, it will not output an IF signal.

A "Quad" LNB is like a "Twin" LNB, except with four independent outputs. Similarly, an "Octo" LNB offers eight independent outputs.

A "Quattro" LNB ouputs all four sub-bands, each on a dedicated connector. As long as at least one connector receives power, all four outputs are active.

3.3. Dimensions

Most LNBs have a 40 mm diameter neck that fits inside a bracket attached to the dish. The LNB can be rotated to account for the polarization skew of satellites that are not exactly South from the receiver location. LNBs with a long neck can also be translated to match the focal length of the reflector.

"Bullet"-style LNBs are intended for multi-satellite setups where two or more horns must be packed tightly in the focal region of a single dish. They typically have a 23 mm diameter neck and a narrow dielectric waveguide instead of a wide horn.

3.4. Local oscillator

Mainstream LNBs generate their LO frequency either with a dielectric resonator oscillator (DRO) or with a crystal-driven phase-locked loop (PLL). PLLs are generally preferred due to their better frequency stability (about 25 kHz vs 250 kHz). However, both technologies exhibit significant temperature-dependent drift.

Crystals are known to age; their resonant frequency can drift by several ppm per year.

One notable feature of DRO designs is that they can be retuned simply by turning a screw that is often accessible without disassembling the sealed cover.

3.5. Noise figure

Most manufacturers claim a N.F. of 0.1 dB, which is commonly regarded as unrealistic.

3.6. Output power

There are reports that some LNBs can output as much as 20 dBm (100 mW) under saturation. This can be a concern when connecting directly to some receivers.

Table 1. Maximum rated input power for popular SDR receivers

PlutoSDR (AD9363)	2.5 dBm
RTL-SDR (R820T)	10 dBm ?
LimeSDR (LMS7002M)	2 dBm ? (0.8 Vpp 50 ohm)

4. General findings

4.1. PLL / DRO

All modern "Single" LNBs turned out to be PLL-based, even those not explicitly advertized as such. No TCXOs were found - only inexpensive crystals.

Surprisingly, many "Twin" and "Quattro" models still use DROs. It is unclear whether there is a technical reason for this, or whether manufacturers are not refreshing their product lines because the market for these models is smaller.

4.2. Crystal frequency

Most PLL models use a 25 MHz crystal. Only those based on RDA chips have a 27 MHz reference, which implies fractional PLL ratios to produce 9750 MHz and 10600 MHz.

For a given output frequency, a fractional-N PLL usually has benefits over an integer-N PLL because it allows designers to use a much higher reference frequency. But this is not what's being done in these 27 MHz models; this raises concerns about spurious noise.

4.3. Construction

Most models are very similar in construction. Inside a plastic shell, a cast metal body forms the waveguide and cavities for one or more circuit boards. H and V probes extend from the main PCB into the waveguide, usually one straight and the other with a 90° bend.

Only a few models stand out with conductive mesh gaskets, weatherproof plastic shells, metric screws, or unusual mechanical configurations.

Some models have two layers of shielding: a cast metal cover on the microwave sections of the PCB, and a thin lid for whole electronic cavity. The flexible lid clips between the walls of the chassis. On the one hand, this creates a good continuous RF seal. On the other hand, these lids are hard to remove, even after scrapping the sealing compound.

4.4. RF circuits

Despite a variety of board layouts and dimensions, the circuits are all very similar. The pictures below are scaled to about 40 µm per pixel (click on thumbnails for full size) and oriented so that signals flow generally from left to right. Areas without solder mask are microwave sections. The probe connections are recognizable as large solder blobs in the left half of the pictures. From there, signals go through one, two, or three stages of transistor amplification, and then into a mixer. Mixing is typically done inside the PLL IC; DRO-based models mix with transistors instead. Depending on the LNB type (Single/Twin/Quad/Quattro), one or more IF signals are selected, filtered and output via decoupling capacitors. Solder blobs on the right side lead to the F-type connectors.

Microwave sections are usually surrounded with ground traces that match the inner walls of the cast metal cover. DRO cavities are always heavily shielded.

The unlabeled grey pads in higher-end models are RF absorbers; they prevent self-oscillation and/or improve shielding between sections.

Some models have an IC near the first stage - presumably a bias voltage controller for the FET transistors.

A few models have a crystal with through-hole pins, on the other side of the PCB. Surface-mounted crystals are easier to replace.

The following ICs appear to be popular:

- **"3566".** Found in almost all the low-cost models. 25 MHz PLL.
- **RDA 3565ES.** Found in higher-end models. 27 MHz PLL, mixer, bias controller.
- **Rafael Micro RT320M [https://www.rafaelmicro.com/product/76].** Found in one recent design. 25 MHz PLL, twin mixer.
- **NXP TFF1015HN [https://www.nxp.com/part/TFF1015HN].** A 2011 IC found in one low-cost design. 25 MHz PLL, mixer. Full datasheet available, but EOL.
- **NXP TFF1044HN [https://www.nxp.com/part/TFF1044HN].** A 2015 IC found in recent designs. Dual 25 MHz PLL, quad mixer, Quad/Quattro outputs. Full datasheet and application note available.
- **Rafael Micro RT348M [https://www.rafaelmicro.com/product/76].** Found in one very recent design. Dual 25 MHz PLL, quad mixer.

4.5. Power supply

Power from the coaxial connectors goes through a low-pass filter (thin wiggly line and capacitor) to a voltage regulator. All models use linear regulators, typically 78x06. Only one model was found to run at 3.3 V. Current ratings give an indication about the maximum consumption of the LNB and/or the derating factor that the designers chose to apply:

- 78L06: 100 mA
- 78N06: 300 mA
- 78M06, 78D06: 500 mA

Linear regulators are less noisy than switch-mode converters, but also less efficient. A 6 V 200 mA LNB wastes 1.4 W at 13 V and 2.4 W at 18 V. Only very long, low cost steel core cables would need that much margin to compensate for voltage drop. In controlled conditions, a 9 V supply is often sufficient. However, the extra heat dissipation may be useful in wet weather.

Twin/Quad/Quattro models have either several regulators with diodes downstream, or a single regulator with diodes uptream. The latter option is less expensive but may result in more cross-talk between the IF outputs.

4.6. Band selection

Voltage from the coaxial connectors is tapped upstream of the regulators for sub-band selection. Recent ICs implement 13/18 V and 0/22 kHz detection internally. Older designs use voltage dividers and RC filters.

4.7. Supply chain issues

Examining a large number of LNBs revealed a disturbing practice in the market: Major brands need to build a reputation over several years, but their OEM suppliers tend to renew their product lines much faster than that, typically every year. As a result, several generations of electronic designs end up being sold with the same external appearance, packaging, product name (SKU) and barcode (EAN). The changes can be as drastic as switching from a DRO to a PLL design. While this may be acceptable for mainstream consumers, it can cause headaches for users who need a durable supply of a specific model.

4.8. Concluding remarks

A few circuit boards are obviously derived from the same reference design, which is a good thing considering the expertise that goes into a microstrip board. Still, the variety of designs is surprising for

a class of products with standardized specifications. No two models turned out to be rebranded clones of the same OEM product, at least not within the same geographical market.

In general, sales prices appear to reflect the complexity of the designs. It is intriguing that LNBs can be had for only a few euros, or even 1 USD if you order a whole shipping container. The cost of the LNB is almost negligible in a satellite installation; for most consumers, it is certainly wiser to invest in a quality LNB than to climb on one's roof every few years to replace cheap units.

5. Future work: High-end models

Most of the LNBs tested here sell for 20 EUR or less. Maybe higher-end models use completely different components families and construction techniques.

The following features can be found in more expensive devices:

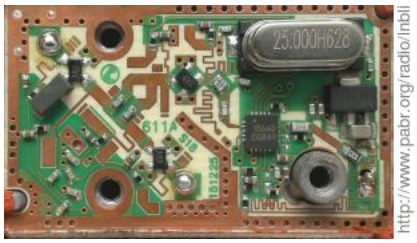
- C120 mounting flange for feedhorns with non-standard F/D ratios
- N or SMA connectors
- Better oscillator (1 ppm) for narrowband signals
- Extended temperature range (-20..+70°C)
- "Wideband" output (downconverting 10.70..12.75 GHz to 300..2350 MHz with a 10.40 or 10.41 GHz LO)
- Fiber optic output
- Input for external clock reference.

6. LNB tear-downs

Table 2. Main characteristics

Brand	Model	Type	Neck	Crystal	PLL/Mixer	Source
			(mm)	(MHz)		(affiliate links)
Octagon	OSLO 1609	Single	40	25	3566Q EQ84	Amazon
McLean	MCTV-668	Single	40	25	JVLB LN5H 8G	Amazon
Opticum	LSP-02G	Single	40	25	3566E NQ819	Amazon
Opticum	Robust	Single	40	25	T1015 04 04 SD522	Amazon
Diesl	Universal Single	Single	40	25	3566E NQ703	Amazon
4TV	4TV HD	Single	40	25	3566E EP547	AliExpress
SuperHDsat	SR-320 v1	Single	40	25	3566E DQ693	AliExpress
Star Com	SR-320 v2	Single	40	25	3566E DQ693	AliExpress
BWEI	BT-180	Single	40	25	3566E EP787	AliExpress
Philips	SX1019	Single	40	(DRO)	Microstrip ? Diode ?	(Obsolete)
HD-Line	HD-BP2	Twin	40	27	RDA 3565ES (x2)	Amazon
Megasat	Multifeed	Twin	23	(DRO)	XH8 (x4)	Amazon
Octagon	OTLSO 1306	Twin	40	27	RDA 3565ES (x2)	Amazon (25/27 MHz random)
Octagon	OTLSO 1609	Twin	40	25	RT320M	Amazon (25/27 MHz random)
Pro-Line	P-40	Quattro	40	(DRO)	XH8 (x4)	Amazon
Venton	EXL-Q	Quattro	23	(DRO)	XH8 (x4)	Amazon
HB-Digital	UHD 414 201612	Quattro	40	(DRO)	XH8 (x4)	Amazon (DRO/PLL random)
HB-Digital	UHD 414 201705	Quattro	40	25 ?	NXP T1044	Amazon (DRO/PLL random) Amazon (possibly GKF-2134Q)
Triax	304832	Quattro	40	25	RT348M	
Opticum	LRP-04H	Quattro	40	25	NXP T1044	Amazon
PremiumX	Deluxe Quattro	Quattro	40	(DRO)	4R S 64 (x2), 4R S 59 (x2)	Amazon

6.1. Octagon OSLO 1609



(Click image to enlarge)

This is an inexpensive model with a simpler design than its "Twin" variant (OTLSO).

Interestingly, the PCB is tilted at 45°. As a result, both probes have identical 45° bends, whereas most LNBs have one straight probe and the other bent at 90°. Maybe this is done to ensure balanced performance between the two polarizations, or to reduce the length of the slits through which the probes enter the waveguide.

Related model . There are reports of an earlier version labeled "1301", identical to the Avenger PLL321S. It uses a RDA3560M and a 27 MHz crystal. Useful links:

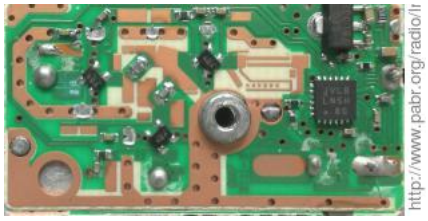
- Analysis of PLL321S: http://f1chf.free.fr/LNBPLL/inside.pdf
- Various mods and measurements: http://www.hb9afo.ch/articles/pll-lnb/10ghz_pll-lnb.htm

Related model . There is also a version labeled "1404" (details unknown).

Table 3. Octagon OSLO 1609 data

Type	Single	
Unit price (approx)	8	EUR,USD
Neck diameter	40	mm
Neck length	30	mm
Aperture diameter	~50	mm
Cap diameter	62	mm
Rated noise factor	0.1	dB
Rated gain	65	dB
Rated flatness/26MHz		dB
PCB size	35x21	mm^2
Stage 1	103 (x2)	
Stage 2	103	
Crystal	25.000H628	
PLL/mixer IC	3566Q EQ84	
Regulator	78N06G	
Screws	3	
RF pads	1	
Labels	CE, WEEE	

6.2. McLean MCTV-668 (GKF-2111-S ?)



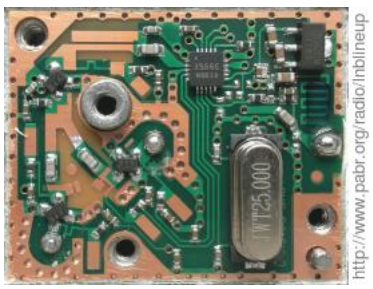
(Click image to enlarge)

This is an intriguing model with an unidentified PLL/mixer IC running at 3.3 V. The through-hole crystal is mounted on the back side.

Table 4. McLean MCTV-668 data

Type	Single	
Unit price (approx)	6	EUR,USD
Neck diameter	40	mm
Neck length	28	mm
Aperture diameter	~47	mm
Cap diameter	53	mm
Rated noise factor	0.1	dB
Rated gain	65	dB
Rated flatness/26MHz	0.5 ?	dB
PCB size	35x19	mm²
Stage 1	V84 (x2)	
Stage 2	V84	
Crystal	25.000M08	
Rated L.O. accuracy	1000 ?	kHz
over temperature range	2000 ?	kHz
PLL/mixer IC	JVLB LN5H 8G	
Regulator	78L33	
Rated current	80 ?	mA
Screws	2	
Labels	CE, WEEE	

6.3. Opticum LSP-02G



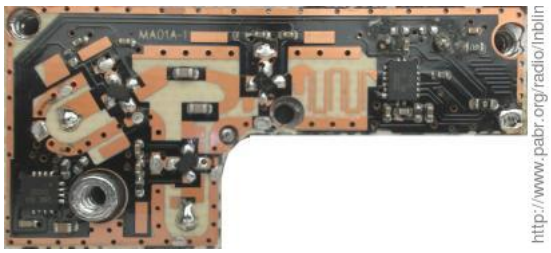
(Click image to enlarge)

This a basic model, compact and inexpensive.

Table 5. Opticum LSP-02G data

Type	Single	
Unit price (approx)	6	EUR,USD
Neck diameter	40	mm
Neck length	30	mm
Aperture diameter	~40	mm
Cap diameter	50	mm
Rated noise factor	0.1	dB
Rated gain	60	dB
Rated flatness/26MHz		dB
PCB size	31x25	mm²
Stage 1	V75 (x2)	
Stage 2	V75	
Crystal	JWT25.000	
PLL/mixer IC	3566E NQ819	
Regulator	78S06M	
Screws	3	
Labels	CE, WEEE	

6.4. Opticum Robust (Amiko L-107)



(Click image to enlarge)

This model has a small non-rectangular circuit board. The through-hole crystal is mounted on the back side.

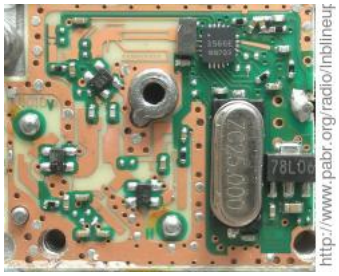
The PLL/mixer is a NXP TFF1015HN.

Related model . Apparently sold as Amiko L-107 in the U.S.A.

Table 6. Opticum Robust data

Type	Single	
Unit price (approx)	6	EUR,USD
Neck diameter	40	mm
Neck length	36	mm
Aperture diameter	~50	mm
Cap diameter	56	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	47x22	mm²
Stage 1	V75 (x2)	
Stage 2	FX	
Crystal	J25F6S8	
PLL/mixer IC	T1015 04 04 SD522	
Regulator		
Screws	3	
Labels	CE, WEEE	

6.5. Diesl Universal Single



(Click image to enlarge)

This is a basic model, compact and inexpensive, but with interesting microstrip patterns.

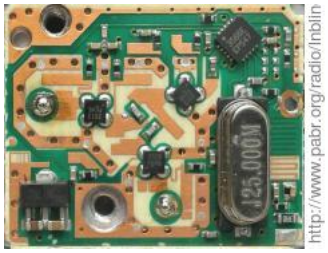
The waveguide has a square cross-section.

Related model . The Sharp BS1K1EL100A has a similar board layout, but a different PLL/mixer IC.

Table 7. Diesl Universal Single data

Type	Single	
Unit price (approx)	6	EUR,USD
Neck diameter	40	mm
Neck length	26	mm
Aperture diameter	~50	mm
Cap diameter	60	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	28x24	mm²
Stage 1	103 (x2)	
Stage 2	103	
Crystal	ZC25.000	
PLL/mixer IC	3566E NQ703	
Regulator	78L06	
Screws	4	
RF pads	1	
Labels		

6.6. 4TV 4TV HD



(Click image to enlarge)

This is a basic model with the distinguising feature that the cast metal enclosure is not sealed. Instead, the plastic shell is weatherproof (and hard to disassemble). Also, the F-type connector is attached to the cover rather than to the main body.

Table 8. 4TV 4TV HD data

Type	Single	
Unit price (approx)	4	EUR,USD
Neck diameter	40	mm
Neck length		mm
Aperture diameter	~36	mm
Cap diameter	56	mm
Rated noise factor	0.1	dB
Rated gain	60	dB
Rated flatness/26MHz		dB
PCB size	27x22	mm²
Stage 1	3513 FK46 (x2)	
Stage 2	3513 FK46	
Crystal	J25.000M	
PLL/mixer IC	3566E EP547	
Regulator	78L06	
Screws	2	
Labels	CE	

6.7. SuperHDsat SR-320 v1

(Click image to enlarge)

A ultra-low-cost model. The unit I examined had a missing screw hidden by the sealant compound. No CE mark.

Related model . There is a completely different model also branded as "SR-320": Section 6.8, “Star Com SR-320 v2”.

Table 9. SuperHDsat SR-320 v1 data

Type	Single	
Unit price (approx)	3	EUR,USD
Neck diameter	40	mm
Neck length	30	mm
Aperture diameter	~40	mm
Cap diameter	60	mm
Rated noise factor	0.1	dB
Rated gain	65	dB
Rated flatness/26MHz		dB
PCB size	47x15	mm²
Stage 1	10F (x2)	
Stage 2	10F	
Crystal	25.000	
PLL/mixer IC	3566E DQ693	
Regulator	78L06	
Screws	3	
Labels		

6.8. Star Com SR-320 v2

(Click image to enlarge)

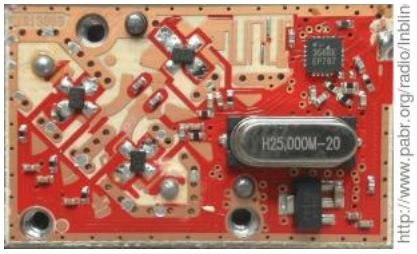
This is a ultra-low-cost model. The through-hole crystal is mounted on the back side. The unit I examined had insufficient sealing. No CE mark.

Related model . There is a completely different model also branded as "SR-320": Section 6.7, “SuperHDsat SR-320 v1”.

Table 10. Star Com SR-320 v2 data

Type	Single	
Unit price (approx)	3	EUR,USD
Neck diameter	40	mm
Neck length	27	mm
Aperture diameter	~48	mm
Cap diameter	61	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	34x14	mm²
Stage 1	10x	
Stage 2	10T	
Crystal	EE25.000M	
PLL/mixer IC	3566E DQ693	
Regulator	78L06	
Screws	2	
Labels		

6.9. BWEI BT-180



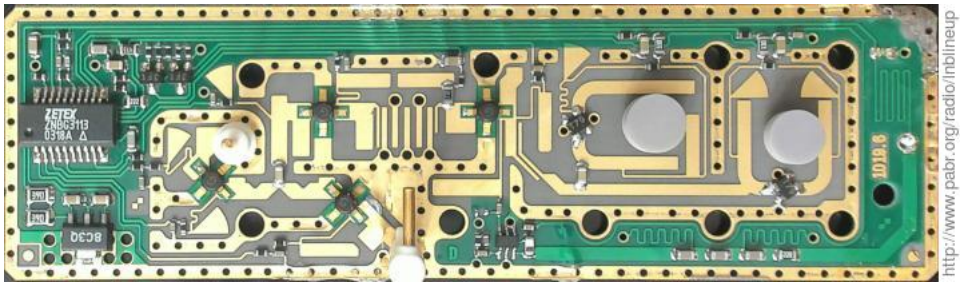
(Click image to enlarge)

This is a ultra-low-cost LNB, with a plain layout but otherwise using the same components as the others. Comes unbranded and without a CE mark.

Table 11. BWEI BT-180 data

Type	Single	
Unit price (approx)	2.5	EUR,USD
Neck diameter	40	mm
Neck length	42	mm
Aperture diameter	~50	mm
Cap diameter	60	mm
Rated noise factor	0.1	dB
Rated gain	58-65	dB
Rated flatness/26MHz		dB
PCB size	35x22	mm²
Stage 1	V75 (x2)	
Stage 2	V75	
Crystal	H25.000M-20	
PLL/mixer IC	3566E EP787	
Regulator	78S06	
Screws	4	
Labels		

6.10. Philips SX1019



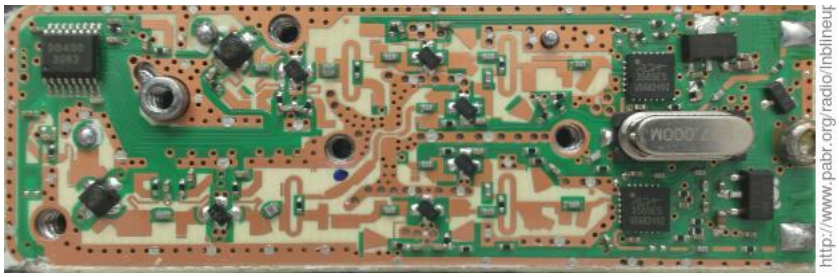
(Click image to enlarge)

This is a historical model made in Germany, possibly in the late 1990s or early 2000s. The plastic shell is weatherproof and welded around the F-type connector. The thin circuit board is riveted between the main body and a backing shield. Probes are apparently gold plated and held in place by PTFE washers. The main IC is a ZNBG3113 bias controller and I.F. switch.

Table 12. Philips SX1019 data

Type	Single	
Unit price (approx)	?	EUR,USD
Neck diameter	40	mm
Neck length	40	mm
Aperture diameter	47	mm
Cap diameter	59	mm
Rated noise factor	?	dB
Rated gain	?	dB
Rated flatness/26MHz		dB
PCB size	84x25	mm²
Stage 1	"G" (x2)	
Stage 2	"G"	
Stage 3	"G"	
Crystal	DRO + T79 (x2)	
PLL/mixer IC	Microstrip ? Diode ?	
Regulator	8C3Q	
RF pads	2	
Rivets	11	
Labels	CE	

6.11. HD-Line HD-BP2



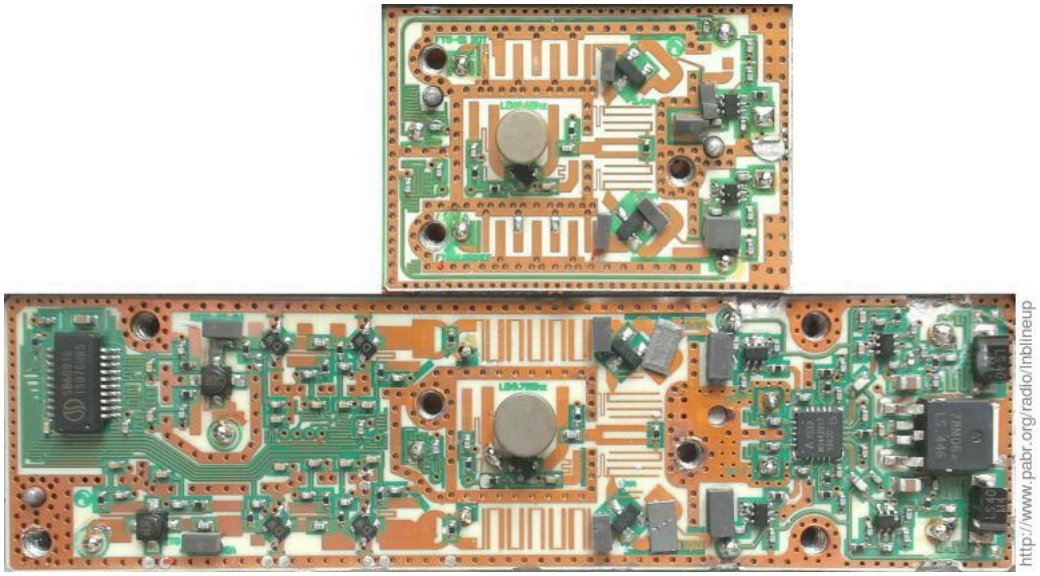
(Click image to enlarge)

This is a sophisticated design with a nice symmetrical board layout. A single crystal apparently drives the two PLL/mixer ICs. There is free space in the enclosure near the gold-plated output connectors.

Table 13. HD-Line HD-BP2 data

Type	Twin	
Unit price (approx)	20	EUR,USD
Neck diameter	40	mm
Neck length	56	mm
Aperture diameter		mm
Cap diameter	59	mm
Rated noise factor	0.1	dB
Rated gain	62	dB
Rated flatness/26MHz		dB
PCB size	73x24	mm²
Stage 1	3Y C A205 (x2)	
Stage 2	V84 (x2)	
Stage 3	t7N (x4)	
Crystal	H27.000M	
PLL/mixer IC	RDA 3565ES (x2)	
Regulator	78S06M (x2)	
Screws	6	
Labels	CE, WEEE	

6.12. Megasat Multifeed



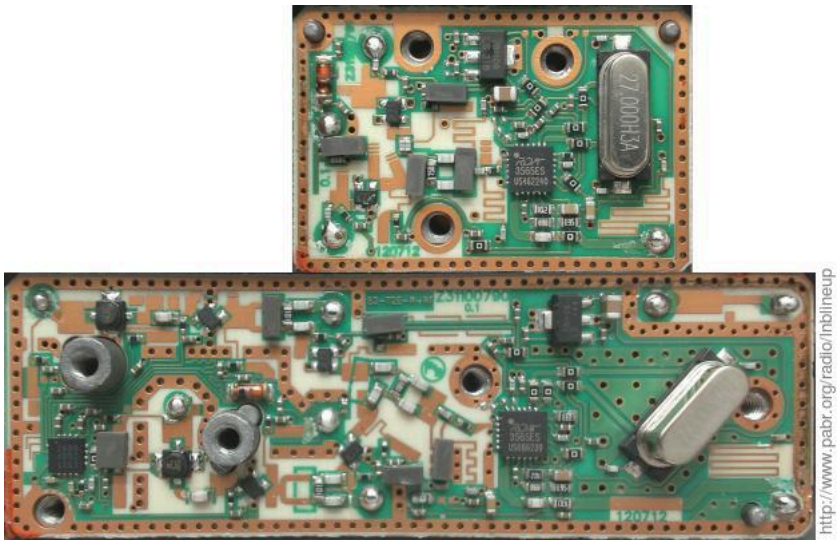
(Click image to enlarge)

This is a "bullet"-style LNB with a narrow head and 23 mm diameter neck followed by a 40 mm diameter section. The two circuit boards are quite sophisticated, but use DROs. Four transistor-based mixers feed into an AMICCOM A7533 switch.

Table 14. Megasat Multifeed data

Type	Twin	
Unit price (approx)	17	EUR,USD
Neck diameter	23	mm
Neck length	31	mm
Aperture diameter		mm
Cap diameter	30	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	91x25 + 37x26	mm²
Stage 1	53 C A042 (x2)	
Stage 2	DW (x2)	
Stage 3	DW (x2)	
Crystal	DRO + NDt (x2)	
PLL/mixer IC	XH8 (x4)	
Regulator	78M06	
Screws	9	
RF pads	20	
Labels	CE	

6.13. Octagon OTLSO 1306 (Amiko L-203)



(Click image to enlarge)

This model is popular in the amateur radio community. The second PLL/mixer is in a dedicated shielded cavity.

Links:

- TCXO mod: http://www.dg0opk.darc.de/Octagon_LNB_mod_March2017.html

- External 27 MHz reference mods: http://www.earf.co.uk/ocxolnb.html, http://www.g4jnt.com/OctagonExtLo.pdf, http://microbandas.es/doku.php?id=microperlas:accesorios:lnb_disciplinado
- Replacement PCB for 10 MHz reference: https://loetlabor-jena.de/doku.php?id=projekte:3cmplllnb:start

Related model . Apparently sold as Amiko L-203 in the U.S.A.

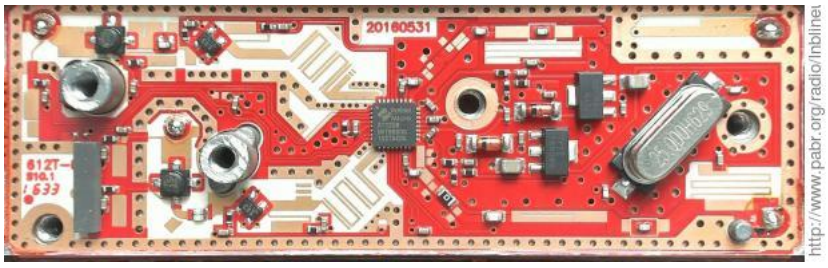
Related model . As of October 2018, this model can still be found in the supply chain, but a completely redesigned variant is being rolled out with the same product name and SKU: Section 6.14, “Octagon OTLSO 1609”. "1306" and "1609" refer to markings near the CE logo on the sticker.

Related model . There are also reports of an earlier, almost identical version labeled "1301", possibly with a RDA3560M instead of the RDA3565ES.

Table 15. Octagon OTLSO 1306 data

Type	Twin	
Unit price (approx)	15	EUR,USD
Neck diameter	40	mm
Neck length	54	mm
Aperture diameter	~50	mm
Cap diameter	62	mm
Rated noise factor	0.1	dB
Rated gain	60..65	dB
Rated flatness/26MHz		dB
PCB size	73x24 + 36x24	mm²
Stage 1	29 C A373 (x2)	
Stage 2	V75 (x2)	
Stage 3	V75 (x4)	
Crystal	27.000 (x2)	
PLL/mixer IC	RDA 3565ES (x2)	
Regulator	78H06 (x2)	
Metric screws	5+3	
RF pads	8+7	
Labels	CE	

6.14. Octagon OTLSO 1609



(Click image to enlarge)

This is a redesign of the OTLSO, identified by "1609" near the CE mark on the sticker. Only two stages of transistor amplification, twin-mixer IC, 25 MHz crystal instead of 27 MHz. The board layout is simple

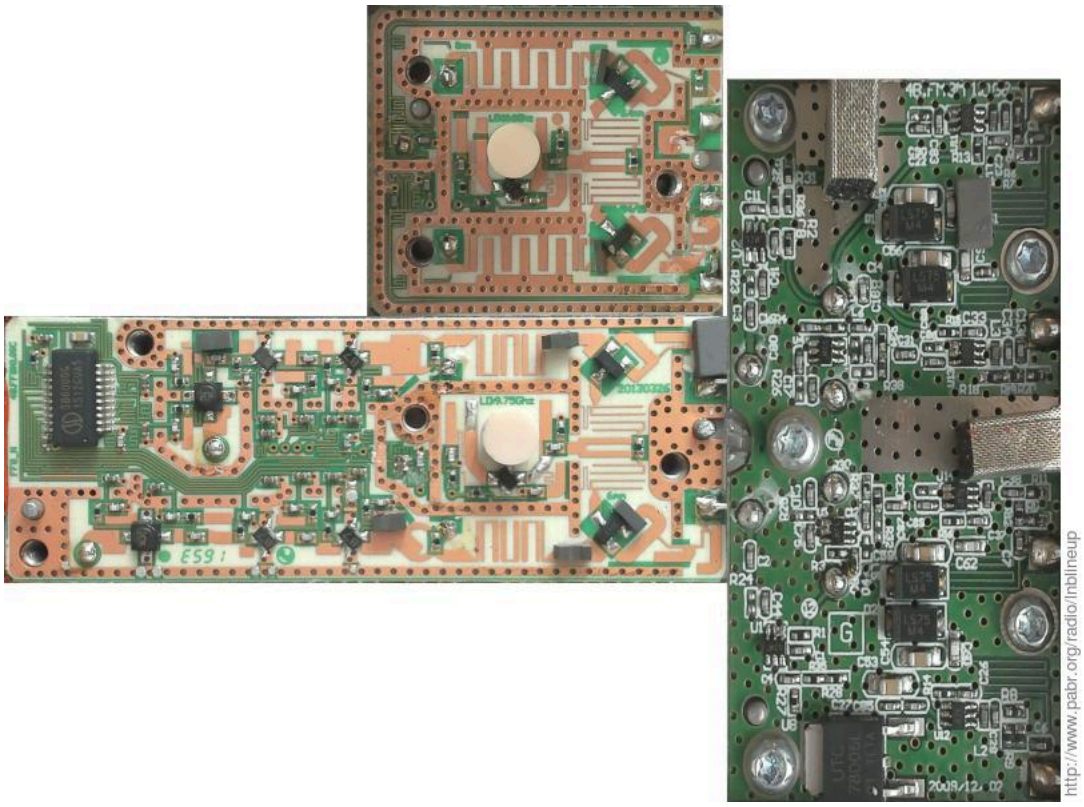
and elegant thanks to the dedicated Rafael Micro IC, although it has obviously been tailored to fit in the same cast metal enclosure as the earlier variant.

Related model . Section 6.13, “Octagon OTLSO 1306 (Amiko L-203)”

Table 16. Octagon OTLSO 1609 data

Type	Twin	
Unit price (approx)	15	EUR,USD
Neck diameter	40	mm
Neck length	54	mm
Aperture diameter	~50	mm
Cap diameter	62	mm
Rated noise factor	0.1	dB
Rated gain	60..65	dB
Rated flatness/26MHz		dB
PCB size	72x23	mm²
Stage 1	FET (x2)	
Stage 2	103 (x2)	
Crystal	25.000H629	
PLL/mixer IC	RT320M	
Regulator	78N06G (x2)	
Metric screws	5	
RF pads	3	
Labels	CE, WEEE	

6.15. Pro-Line P-40



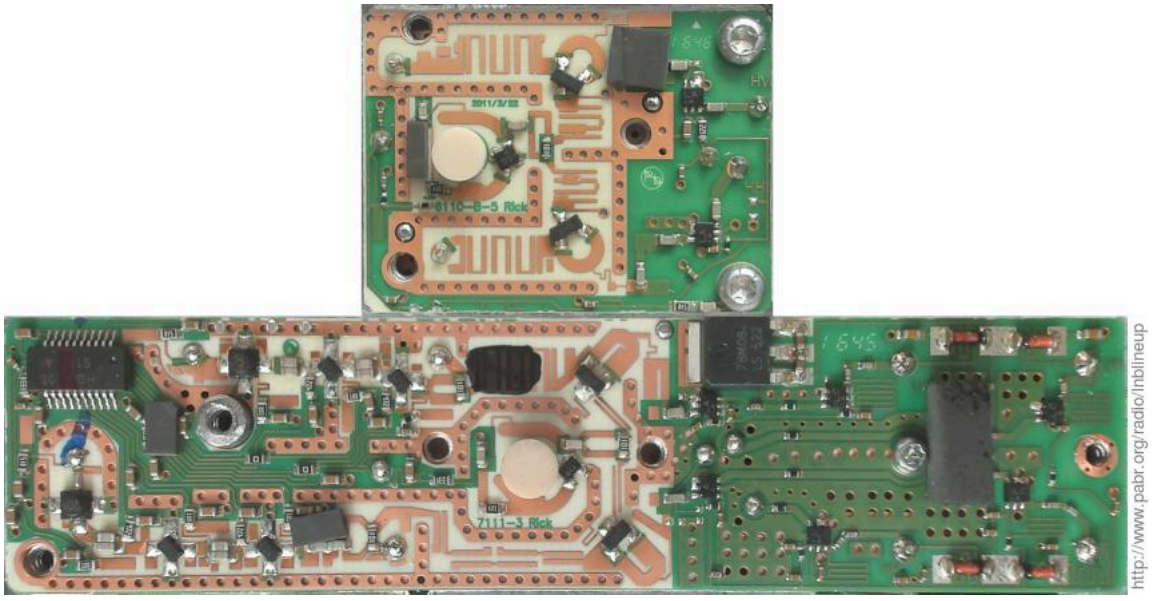
(Click image to enlarge)

A sophisticated design with RF gaskets and two layers of shielding, but with DROs rather than PLLs. Four transistor-based mixers feed into a dedicated PCB with the Quattro outputs.

Table 17. Pro-Line P-40 data

Type	Quattro	
Unit price (approx)	18	EUR,USD
Neck diameter	40	mm
Neck length	37	mm
Aperture diameter		mm
Cap diameter	62	mm
Rated noise factor		dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	65x24 + 32x28 + 30x65	mm²
Stage 1	68 C A103 (x2)	
Stage 2	B7 (x4)	
Crystal	DRO + NEt (x2)	
PLL/mixer IC	XH8 (x4)	
Regulator	78D06L	
Screws	4	
Metric screws	6	
Labels	CE	

6.16. Venton EXL-Q



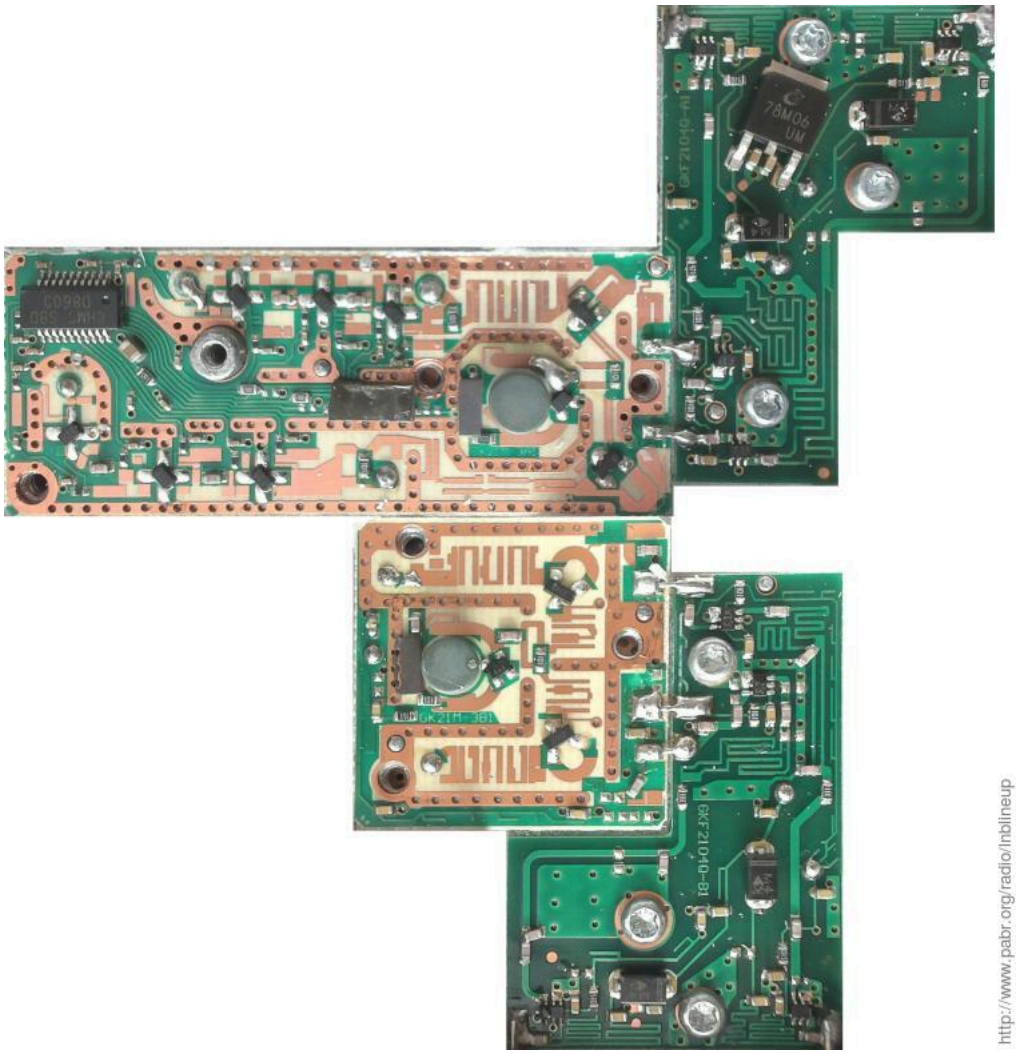
(Click image to enlarge)

A sophisticated "bullet" model with two layers of shielding, but with DROs rather than PLLs. It has a short 23 mm diameter neck followed by a 40 mm diameter section. Interesting use of some kind of ink to tune one microstrip pattern.

Table 18. Venton EXL-Q data

Type	Quattro	
Unit price (approx)	14	EUR,USD
Neck diameter	23	mm
Neck length	22	mm
Aperture diameter		mm
Cap diameter	30	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	101x25 + 37x28	mm^2
Stage 1	61 C A113 (x2)	
Stage 2	V75 (x4)	
Crystal	DRO + T79/GG (x2)	
PLL/mixer IC	XH8 (x4)	
Regulator	78M08	
Screws	9	
RF pads	13	
Labels	CE	

6.17. HB-Digital UHD 414 201612 (Gecen GKF-2104Q ?)



(Click image to enlarge)

The circuit is spread over four boards, presumably to minimize the area of expensive low-loss substrate for the microwave sections.

Related model . There is a more recent version with the same name and SKU but a PLL circuit: Section 6.18, “HB-Digital UHD 414 201705 (Gecen GKF-2134Q ?)”. The four F-type connectors are rotated 180°; there are no other external differences except the serial numbers.

Table 19. HB-Digital UHD 414 201612 data

Type	Quattro	
Unit price (approx)	10	EUR,USD
Neck diameter	40	mm
Neck length	42	mm
Aperture diameter	47	mm
Cap diameter	55	mm
Rated noise factor	0.1	dB
Rated gain	60 ?	dB
Rated flatness/26MHz	0.5 ?	dB
PCB size	89x46 + 44x48	mm²
Stage 1	V75 (x2)	
Stage 2	V75 (x2)	
Stage 3	V75 (x2)	
Crystal	DRO + T79 (x2)	
Rated L.O. accuracy		kHz
over temperature range		kHz
PLL/mixer IC	XH8 (x4)	
Regulator	78M06	
Rated current		mA
Screws	7 + 5	
RF pads	4	
Labels	CE	

6.18. HB-Digital UHD 414 201705 (Gecen GKF-2134Q ?)

(Click image to enlarge)

A modern Quattro PLL model with a clean layout thanks to the dedicated NXP IC. The through-hole crystal is mounted on the back side.

A cut in the top sidewall makes it easy to lift the cover.

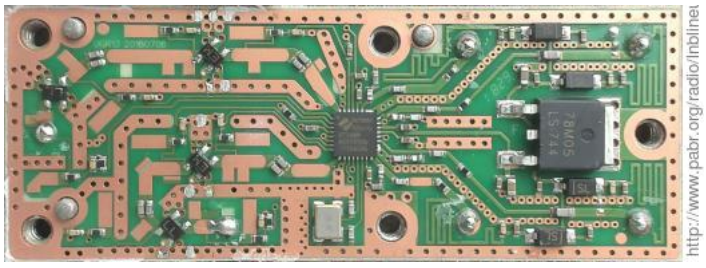
The Low/H output is noisier than the other three. Maybe this is related to the fact that vertical polarization uses a different (better ?) first-stage transistor.

Related model . There is an earlier version with the same name and SKU but a DRO circuit (Section 6.17, “HB-Digital UHD 414 201612 (Gecen GKF-2104Q ?)”). The four F-type connectors are rotated 180°; there are no other external differences except the serial numbers.

Table 20. HB-Digital UHD 414 201705 data

Type	Quattro	
Unit price (approx)	14	EUR,USD
Neck diameter	40	mm
Neck length	42	mm
Aperture diameter	47	mm
Cap diameter	55	mm
Rated noise factor	0.1	dB
Rated gain	60 ?	dB
Rated flatness/26MHz	0.5 ?	dB
PCB size	37x46	mm²
Stage 1	H.B., 3513 116q	
Stage 2	H.B. (x2)	
Crystal	25 ?	
Rated L.O. accuracy	1000 ?	kHz
over temperature range	2000 ?	kHz
PLL/mixer IC	NXP T1044	
Regulator	78H06 (x4)	
Rated current	220 ?	mA
Screws	5	
RF pads		
Labels	CE	

6.19. Triax 304832



(Click image to enlarge)

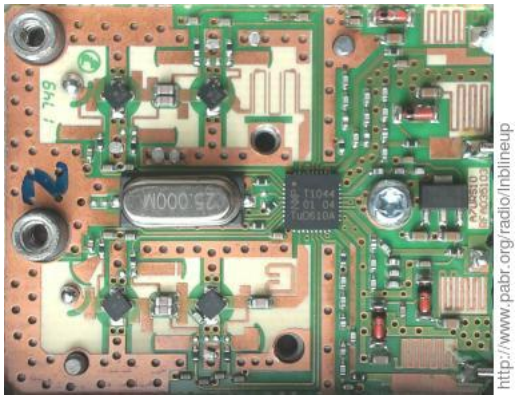
A recent, somewhat expensive model with Quattro outputs in the same form factor as a Single LNB. Beautiful board layout based on the Rafael Micro RT348M.

Its main distinguishing feature is a low-profile SMD crystal.

Table 21. Triax 304832 data

Type	Quattro	
Unit price (approx)	30	EUR,USD
Neck diameter	40	mm
Neck length	32	mm
Aperture diameter	~50	mm
Cap diameter	61	mm
F/D	0.6	
Rated noise factor	0.3	dB
Rated gain	55..65	dB
Rated flatness/26MHz	8 ?	dB
PCB size	61x23	mm²
Stage 1	LL (x2)	
Stage 2	EM (x2)	
Crystal	.25.OY	
over temperature range	1500	kHz
PLL/mixer IC	RT348M	
Regulator	78M05	
Rated current	130? 265?	mA
Screws	5	
Labels	CE	

6.20. Opticum LRP-04H



(Click image to enlarge)

An intriguing model with a heavy inner shield over the microwave section plus a thin cover for the whole electronic cavity. This is usually seen only in DRO designs.

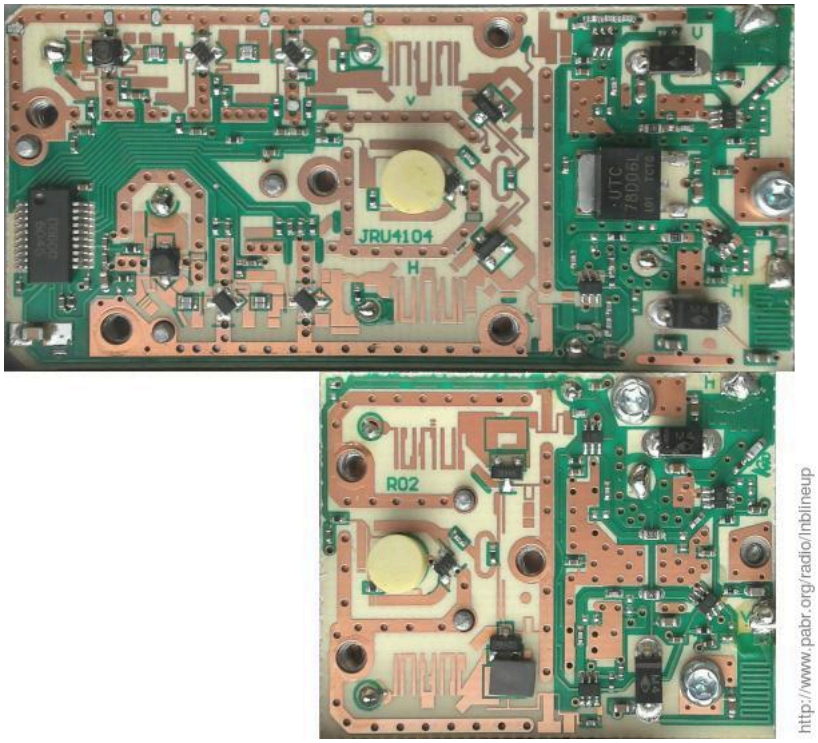
Hard to disassemble.

Elegant layout and modern PLL/mixer IC from NXP, but the crystal is hard to reach because of the shielding.

Table 22. Opticum LRP-04H data

Type	Quattro	
Unit price (approx)	14	EUR,USD
Neck diameter	40	mm
Neck length	32	mm
Aperture diameter		mm
Cap diameter	60	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	44x35	mm²
Stage 1	3513 118n (x2)	
Stage 2	3513 118n (x2)	
Crystal	25.000M	
PLL/mixer IC	NXP T1044	
Regulator	78D05	
Screws	6	
RF pads	3	
Labels	CE	

6.21. PremiumX Deluxe Quattro



(Click image to enlarge)

An expensive Quattro model, well shielded, but using DROs. Very hard to disassemble.

Table 23. PremiumX Deluxe Quattro data

Type	Quattro	
Unit price (approx)	35	EUR,USD
Neck diameter	40	mm
Neck length	32	mm
Aperture diameter		mm
Cap diameter	60	mm
Rated noise factor	0.1	dB
Rated gain		dB
Rated flatness/26MHz		dB
PCB size	71x33 + 43x33	mm^2
Stage 1	62 C A0B3 (x2)	
Stage 2	V75 (x2)	
Stage 3	V75 (x2)	
Crystal	DRO + T79 (x2)	
PLL/mixer IC	4R S 64 (x2), 4R S 59 (x2)	
Regulator	78D06L	
Screws	10	
RF pads	8	
Labels	CE	

7. Terms of use