10 GHz Booster for the IC-905

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Abstract

This article not only presents a project for the 10 GHz band but also aims to demonstrate how the same concept can be effectively adapted to develop similar systems across all microwave bands supported by the **IC-905**, including the forthcoming **24 GHz band**, soon to be launched by Icom.
Since the release of the new **ICOM IC-905**, many enthusiastic radio amateurs have embraced the opportunity to become active in the **23 cm to 3 cm bands**. However, the transceivers **limited power output**, especially at higher frequencies such as **5.7 GHz** and **10 GHz** presents challenges in achieving reliable long-distance tropospheric communication.
To address this limitation, I set out to design a simple yet effective device that can be easily added to the IC-905's 10 GHz transverter CX-10G. This enhancement requires no modifications to the transceiver itself and is capable of boosting the output power by up to 10 dB, while also improving receiver noise figure.
The concept is straightforward, building on similar systems I have developed in the past for classic 10 GHz transverters. The key idea is to remotely position both the power amplifier and a low-noise preamplifier between the CX-10G and the antenna, minimizing cable losses for optimal performance. One significant feature in this design is the use of the original ACC connector of the CX-10G, configured in a pass through mode inside the booster. This allows the device to intercept the transmit signal, enabling control of the switching circuit within the booster avoiding the need to modify the transceiver. Looking at the picture in Fig. 2 you can easily identify the components of the booster proposed in two different solutions: in the

first one there are two microwave relays for switching the input and output signals. The transmit path include a PA while the receive path consist of a low-noise preamplifier. The relays are controlled from a driver circuit, which controls the two relays, also supplies the TX PA and the RX preamplifier using the SEND signal from the IC-905. The extra loading of the SEND line is less than 1 mA avoiding any possible damage to the SEND line.
An alternative but equally valid approach for RX/TX input switching is to replace the relay with a circulator followed by an isolator (solution 2). The circulator ensures proper RF signal routing, while the isolator, positioned at the preamplifier output, provides additional protection by preventing transmitted RF from damaging the preamplifier. Proper orientation of the circulator and isolator is crucial.
For optimal performance, a high-quality 10 GHz band circulator and isolator with at least 20 dB isolation between reverse ports is recommended. Unfortunately, this configuration is not suitable also for RF output switching due to the circulator's characteristics: in the event of an output mismatch, all output power would be redirected to the preamplifier input port, causing damage. It must be taken into account that the direct path attenuation of this configuration is higher than that of a relay-based setup. However, the available driving power is more than sufficient, and the attenuation in the RX path after the preamplifier causes negligible degradation.

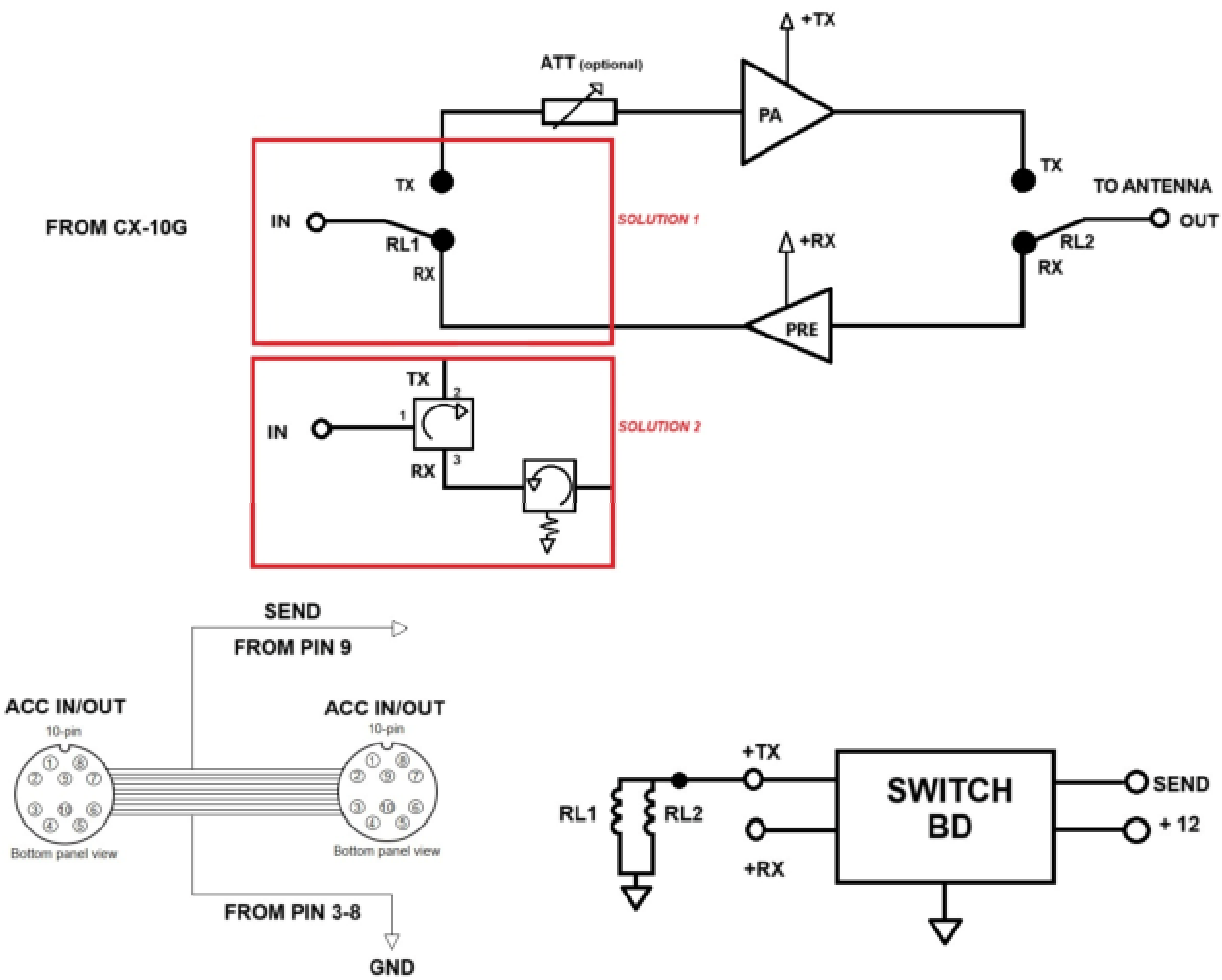

Fig. 1: 10 GHz Booster for IC-905 - block diagram.

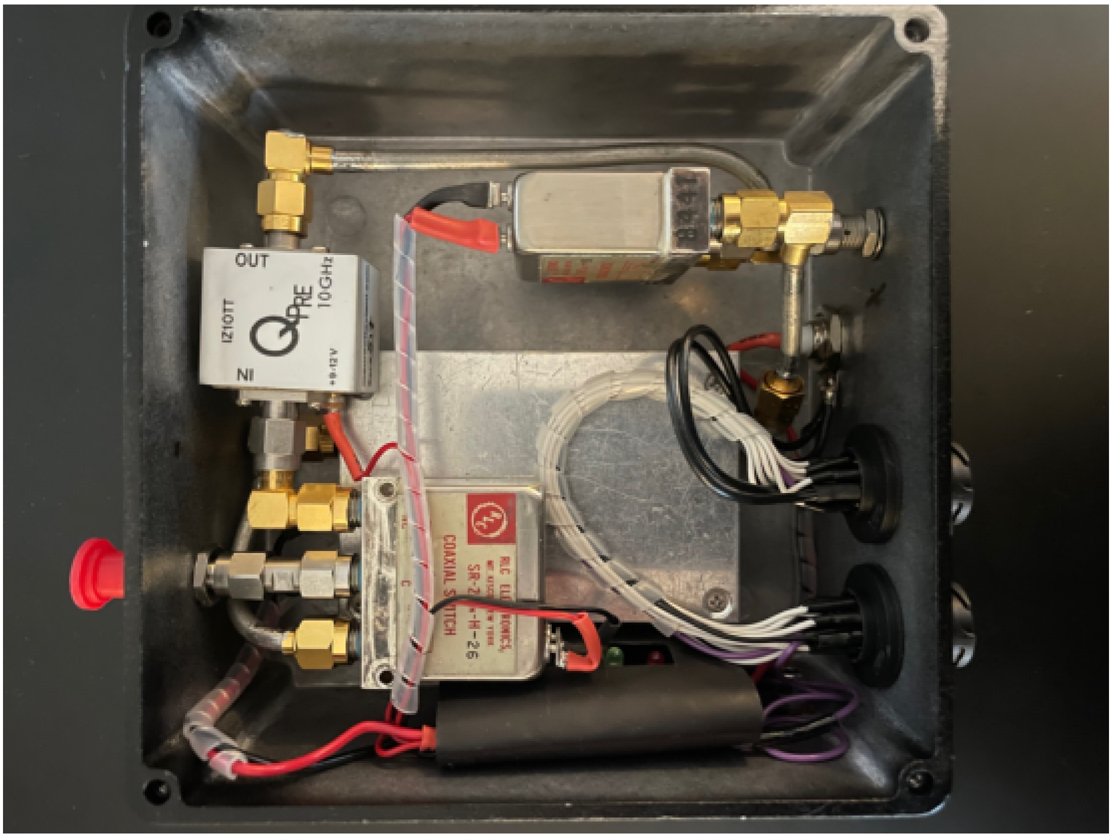

Fig. 2: View into the completed Booster.

Preamplifier

The preamplifier used s based on the well known LNA PCBs sold by RF Microwave of Franco Rota (availability details at the end of the article), see Fig. 4. Using a single stage NE32584, of the 4 available on each PCB, and an appropriate bias circuit (see schematic in Fig. 7), it is possible to achieve gain and noise figures more than adequate for pairing with the CX-10G. Testing has shown that a gain exceeding 15 dB is not required. The resulting gain is approximately 12-14 dB, with an NF around 1 dB. To date, I have assembled around 50 units, also employing different devices such as the CE3520K, see Fig. 5. When the mechanical assembly is performed carefully, consistent performance is guaranteed.

As illustrated in Fig. 3, the mechanical structure consists of two interlocking components made from 1 mm thick metal profiles. The outer casing is in aluminium, with external dimensions of 15x25 mm and a length of 22 mm. The internal section is made from brass, with external dimensions of 22x22 mm and a length of 12 mm.

Using brass for the internal section is crucial, as the PCB needs to be, after being cut to the correct size, soldered along the perimeter of its bottom side to the case for a good ground connection. A 1 pF capacitor must be inserted on both the input and output striplines by cutting the track near the connector. Two-hole male or female SMA connectors are used for input and output. The SMAs can be soldered to the brass body or fixed using two M2 screws. Using a male connector for the input allows the preamplifier to be directly connected to the coaxial relay port due to its compact size, minimizing insertion losses. A feed-through capacitor of suitable size will carry the external power supply to the bias circuit. The bias circuit will deliver the voltages to the LNA PCB through perforations in the PCB itself. Finally, a small M2.5 through screw will join the two parts of the body together.

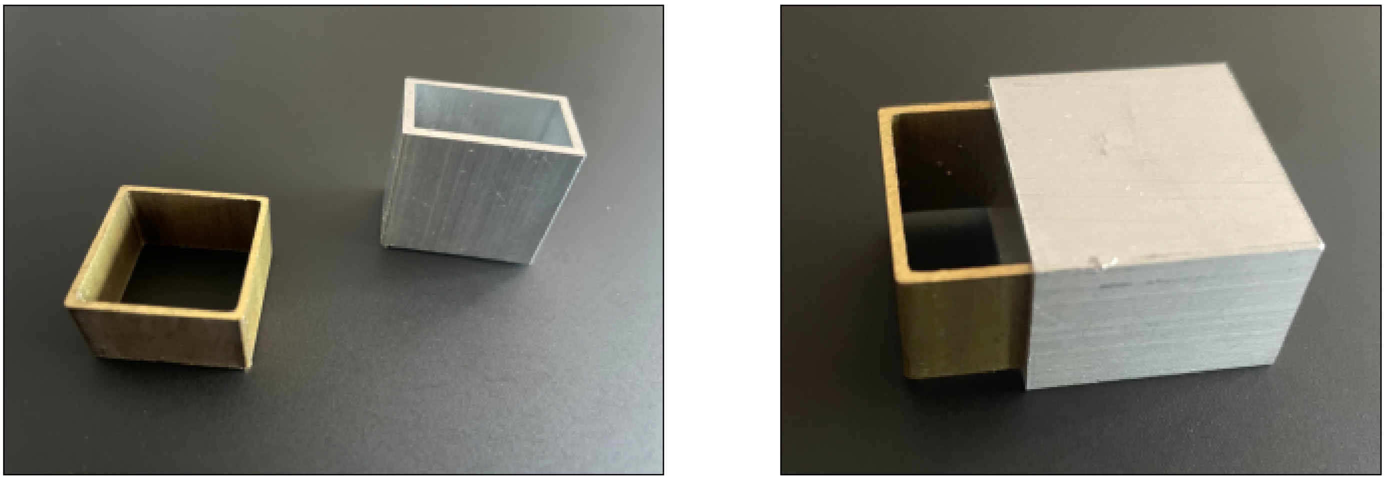

Fig. 3a and 3b: Metal parts for LNA enclosure.

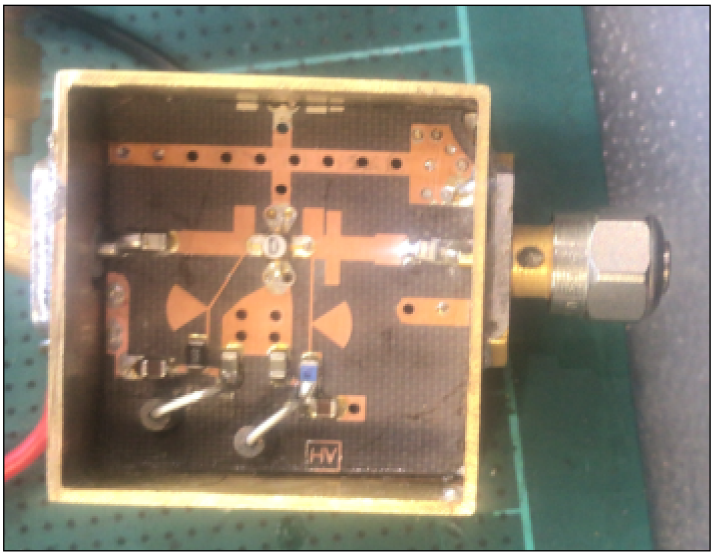

Fig. 4: 10 GHz LNA.

Fig. 5: LNA production at IZ1OTT.

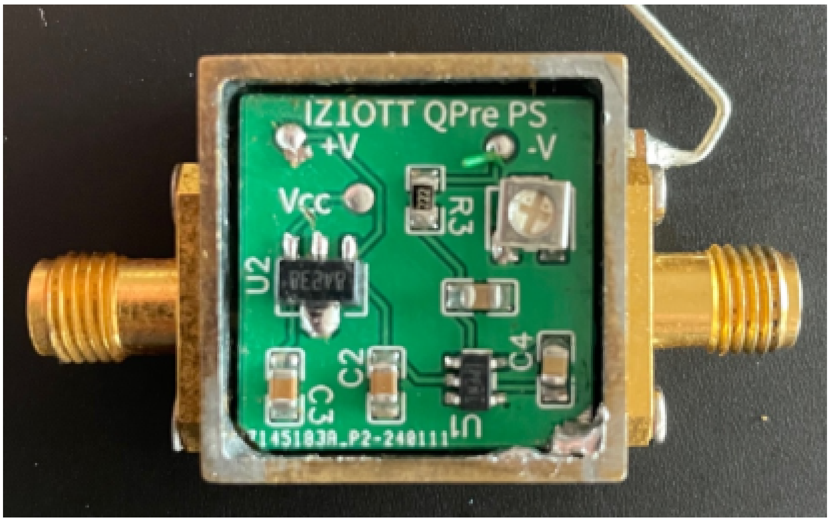

Fig. 6: Power Supply for LNA.

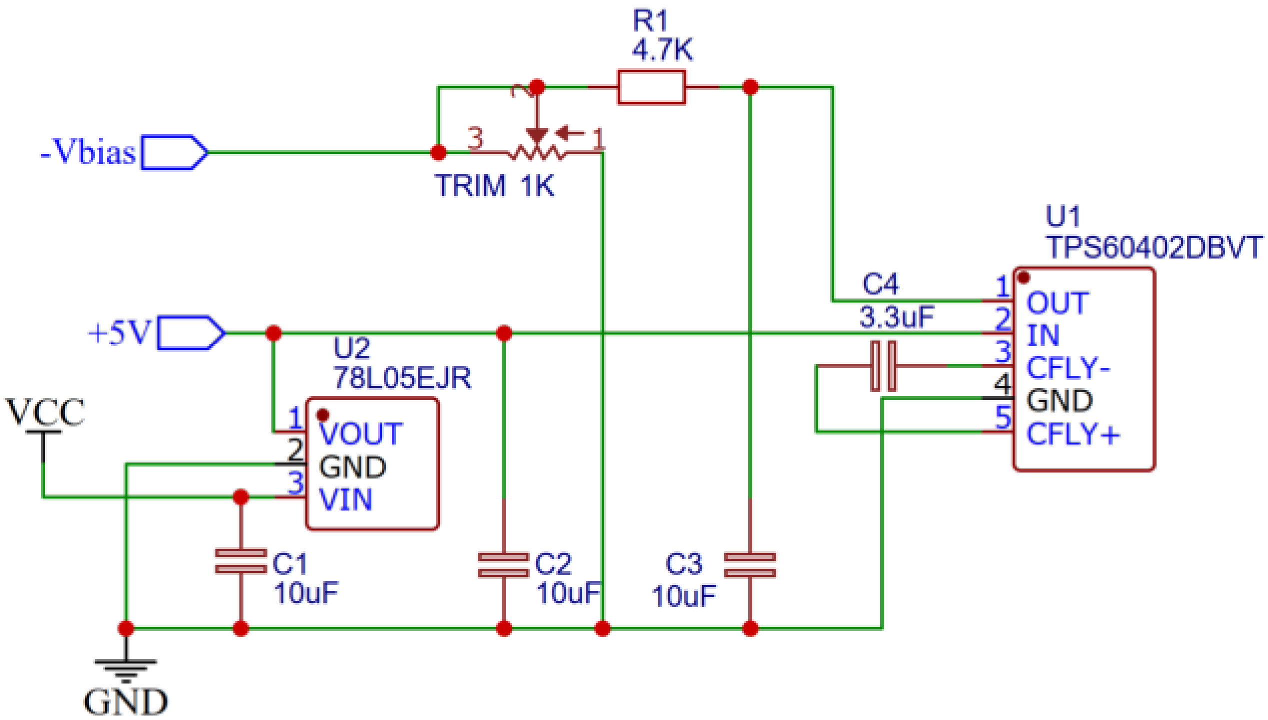

Fig. 7: Circuit diagram LNA Power Supply.

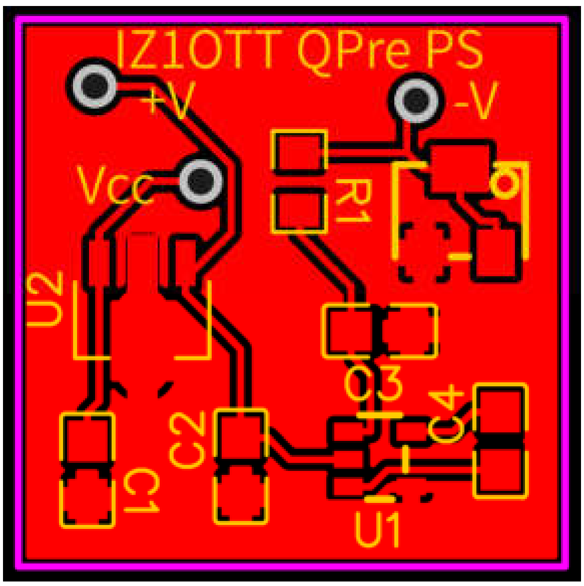

Fig. 8: PCB Power Supply.

Power Amplifier

The PA I adopted is the classic "DB6NT-like" design, employing two stages. The driver consists of Mitsubishi MGF2430 followed by a Toshiba TIM 0910-4 or an equivalent capable of delivering over 4 watts of output power. However, any PA with suitable power specifications can be used provided it meets the required driving conditions and fits within the compact enclosure. For this reason, I refer to specific articles (Dubus 4/1991 and Technik III)) to avoid repeating the PA description.
This PA requires a driving level of 200 mW. Therefore, the maximum output power from CX-10G must be reduced to this level beforehand, or a 3 dB attenuator should be inserted as a precaution. To optimize space, 90° panel mounting female SMA connectors should be used for the PA's input and output. The base of the PA box should be fixed to the case's internal base using a solid aluminium plate of suitable dimensions and a thickness of 5 mm. Alternatively, an external heat sink can be added to the box at the PA base location. This recommendation is particularly useful when the device is used in FM or digital modes.

Box Description

The box used is a **Hammond 1590UFLBK** (RS Code: 8180637), made of die-cast metal, making it lightweight and easy to drill. Its empty weight is **425 grams**, and once fully assembled with all internal components, it slightly exceeds **700 grams**. This makes it ideal for direct installation on the arm of an offset antenna. The external dimensions, excluding the lid flanges, are 120 mm x 120 mm x 60 mm. The box provides **IP55 protection**, which can be upgraded to **IP67** by using a separately purchasable **preformed silicone gasket** for the lid. A key feature of this model is the **two side flanges** on the rear lid, each with two mounting holes, allowing for easy attachment to a plate with brackets for secure installation on the antenna pole, opposite the CX-10G (see photos). This setup saves some additional space. The box is perfectly square, so the flanged lid can be mounted in the preferred orientation. Inside the box, there is sufficient space to accommodate all the components necessary to build the booster (see Fig. 9).

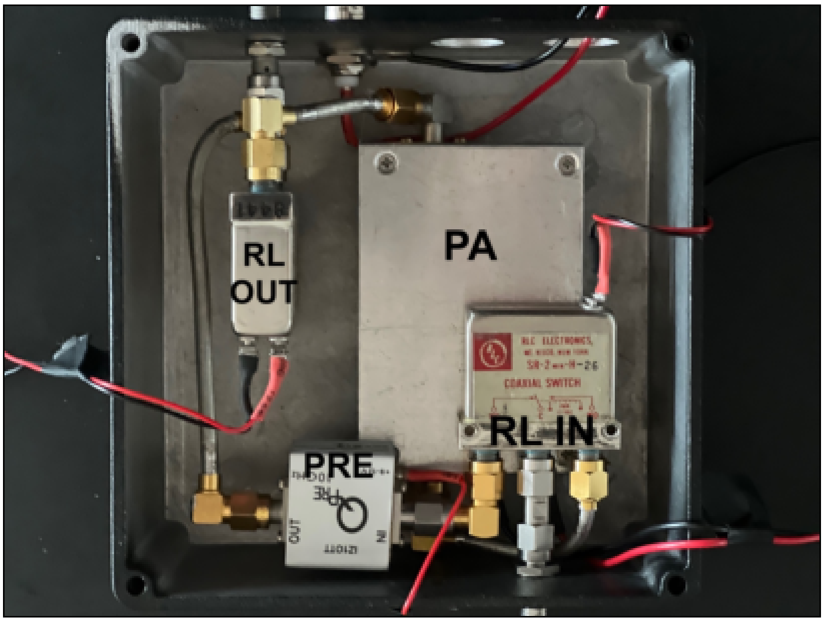

Fig. 9: Photo inside box during construction.

ACC connectors

As previously mentioned, the original connectors used on the CX-10G are replicated on the booster for ease of installation and full cable compatibility. These connectors are manufactured by **ODS Tech** of Taiwan (availability details at the end of the article). The part numbers of the connectors are as follows:
Socket: CCBPM10MBB-KCP7001 (male: 2 pieces mounted on the booster panel)
Plug: CCBDF10FBB-KLS7001 (female: 2 pieces to create the booster-CX-10G connection cable)
A connecting cable between the booster and the CX-10G must obviously be made, terminated with 2 female connectors (one at each end), with a suitable length depending on the chosen installation. For this purpose, it is necessary to use a cable with a diameter of **4.5 - 6.5 mm** that contains **10 conductors**. See Fig. 10.

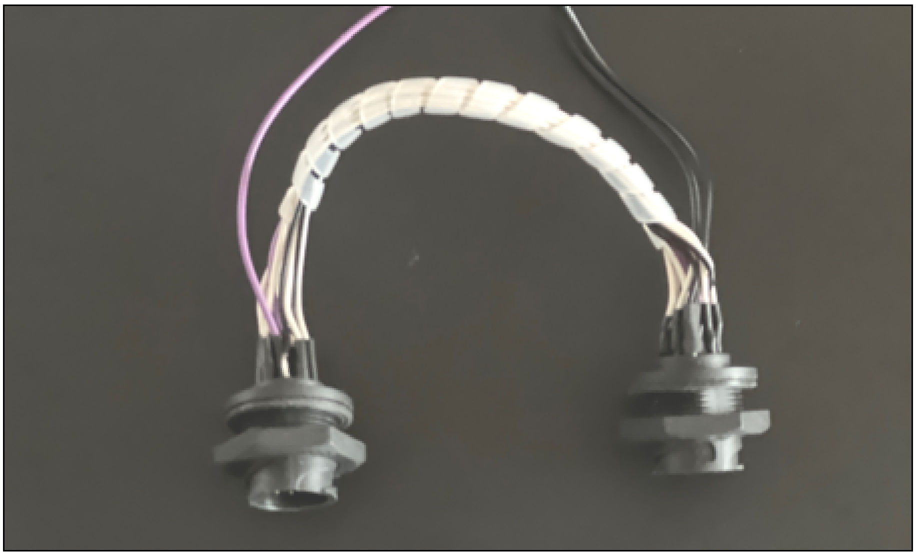

Fig. 10: ACC connector wiring.

Fig. 11: Connectors in the Booster box.

Relay and cabling

The SMA relays used for input and output must have a **12-Volt coil**, be **low-loss**, and be rated for a frequency of **10 GHz or higher**. The control for both relays will come from the switching circuit on the same line as the power supply for the power amplifier (PA). All cabling (**Input Connector - Relay - Preamp - PA - Output**

Relay - Output Connector) must be made using **semi-rigid UT141 cable** and terminated with **straight or 90° SMA connectors**, depending on the available space inside the box (see Fig. 9).
The **Input and Output connectors** are **SMA-to-SMA panel transitions** to ensure compatibility with the original installation. Alternatively, **N-type panel connectors** can be used. In this case, the preparation of RF interconnection cables must account for this change.
The two 10-pin ODS socket connectors inside the booster must be directly connected pin-to-pin. Additionally, the SEND signal (pin 9) should also be connected to the switch circuit, while the ground pins (pins 3 and 8) should also be connected to the metal body of the enclosure for proper grounding. For detailed information on the ACC connector, refer to Section 13 of the IC-905 user manual.
Any kind of waterproof connector can be used to carry the 12 V supply to the unit. In my prototype I used a female panel BNC. Alternatively, using a **multipole connector** would allow additional functionality, such as such as taking the detector voltage of the PA out of the booster. Since the SEND signal from the ACC connector remains active across all conditions and bands, it is recommended to disconnect the 12 V power supply to the booster when the 10 GHz band is not in use. Failure to do so may result in unnecessary power consumption, heat generation, and potential wear on the booster. Additionally, note that once the booster is installed, the 10 GHz band will operate exclusively through it, as no bypass system is available.

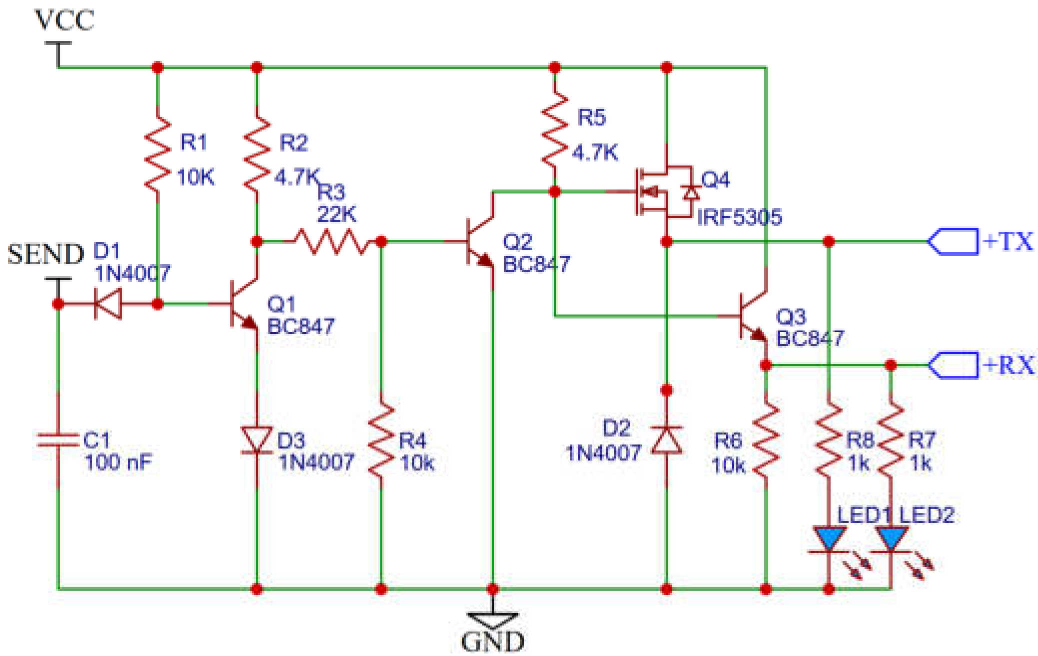

Fig. 12: Circuit diagram switch.

Conclusion

The 10 GHz IC-905 Booster effectively enhances the IC-905's performance by boosting power and improving receiver sensitivity without requiring modifications. Its compact, weather-resistant design ensures easy integration and minimal losses, while the adaptable concept extends to other microwave bands, including the upcoming 24 GHz band. This project provides a practical solution for advancing amateur radio communication.

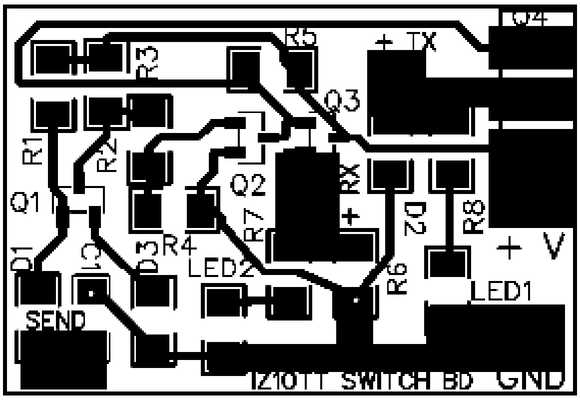

Fig. 13: PCB switch.

A special showcase will take place near the Advantec stand (Italian Icom distributor) at the Electronics Fair in Montichiari (Brescia, Italy) on Saturday, March 8, and Sunday, March 9, 2025.

Safety Notice

Microwave frequency output power may pose potential risks. Users must take all necessary precautions to ensure safe operation.

Disclaimer

The author assumes no responsibility for any damage or harm resulting from the use of this project. Proceed at your own risk.

References

Ready-to-use boosters or components for this project may soon be available directly from the author. For more information on this project and other devices or parts, please visit my webpage at mauroottaviani.com or contact me via email at mauroottaviani@ymail.com. For ODS connectors, which are available exclusively to professional buyers, please contact **Neumüller Elektronik GmbH**, Gewerbegebiet Ost 7, D-91085 Weisendorf, Deutschland / Germany, Ph.: + 49 9135 73666-0, Fax: + 49 9135 73666-60, info@neumueller.com
For LNA PCB contact Rf-Microwave.com - Part name SU-02

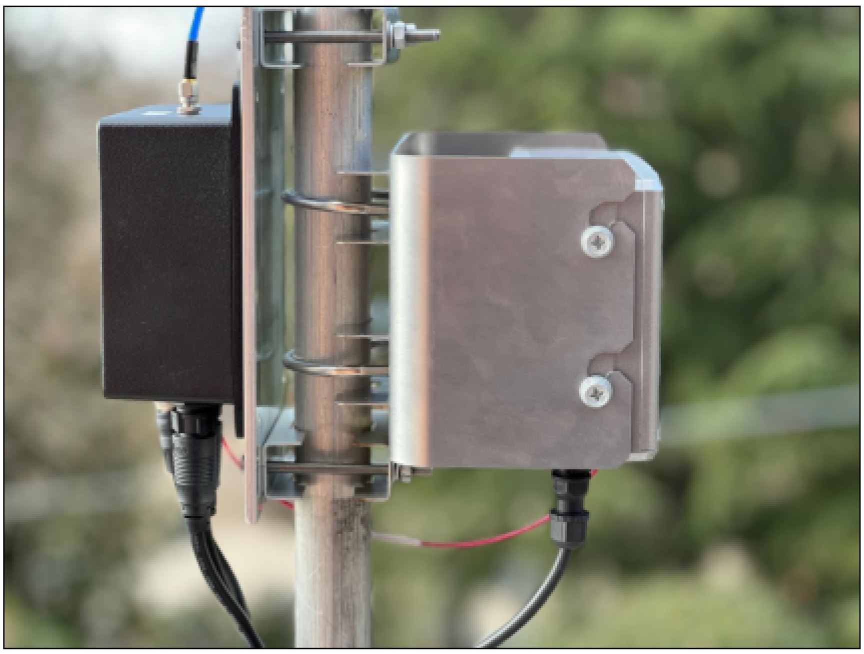

Fig. 14: Booster and TVTR on pole.