Small 6 cm Transverter

Yet another transverter was built as part of a small 6 cm station.

Objectives:

- Output power > 1 W
- Receive noise figure < 2 dB NF
- Integrated IF and RF transmit/receive switches
- Integrated stable and clean local oscillator

design repository (Gitlab)

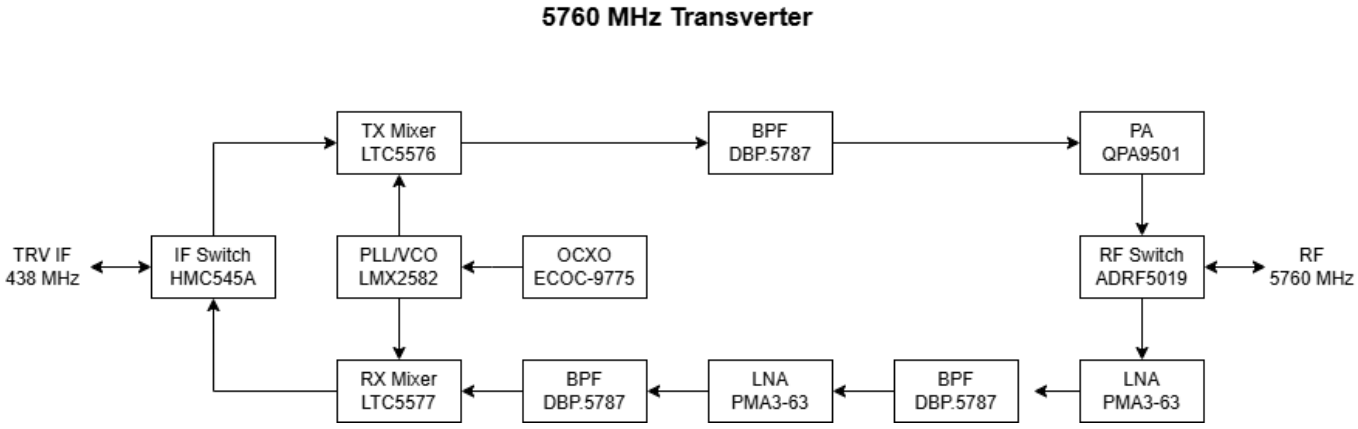
Preface

For many years low-cost LNBs enable people to have very easy access to 10 GHz reception. It's size and ease of use makes it enjoyable to use in many situations. For the 6 cm band no comparable solution is known.

Low-cost and easy to handle components are available to modern radio enthusiasts. An All-in-one transverter combines them with modern PCB technology.

Concept

A block diagram of the transverter is shown in the figure below.



The transverter is designed for an UHF intermediate frequency (IF) and is compatible to the 70 cm all-mode transceiver Yaesu FT817 with 100 mW output power. It handles all the sequencing and transmitter protection through the accessory connector. The local oscillator (LO) uses an ovenized oscillator(OCXO) as stable frequency reference in a small footprint.

Solid-state switches are used for transmit/receive switching. In the transmit chain an up-converter is fed by the attenuated IF signal and LO signal. It's followed by a ceramic filter before reaching the power amplifier. For receiving a dual-stage combination of a low noise amplifier and ceramic band

pass filter is used for high sensitivity and selectivity. The down-converter stage converts the RF signal with a 5322 MHz signal to 438 MHz.

The integrated Power supply handles 6.5 V to 17 V as input voltage. For high efficiency and spectral purity low-noise ultra-low dropout linear regulators are added after filtered DC/DC converters.

An on-board controller is used for managing state transitions of the transverter. After power-up the OCXO will heat-up. All other components are still off until the target temperature is reached and the current consumption went down. The controller measures the current on the power rail and will initialize the local oscillator followed by switching to receive mode after reaching the threshold current. Via the control port the transceiver can request to switch to transmit mode. During initialization and receive mode transceiver's output is blocked by the transmit inhibit signal. After switching to the transmit path the transceiver is allowed to transmit. This guarantees a safe operation for all components.

Implementation

Like in previous projects (10 GHz Multiplier, 10 GHz Beacon) CPWG transmission lines on a four-layer stackup are used. The RF design is based on the well-characterized coaxial/PCB transition and uses a complete coplanar transmission design to interface to all QFN components in GND-signal-GND style for continuous impedance behavior. For the large pads of the bandpass filters an individual footprint was designed and simulated for proper 50 Ohm interfacing on the thin substrate used. As all other components are internally matched no further on-board matching is required.



In transmit mode 7.5 watts of heat is dissipated. For proper heat sink the PCB is directly connected to the housing with attached heatsink.


5760 MHz TRANSVERTER
RF I/O



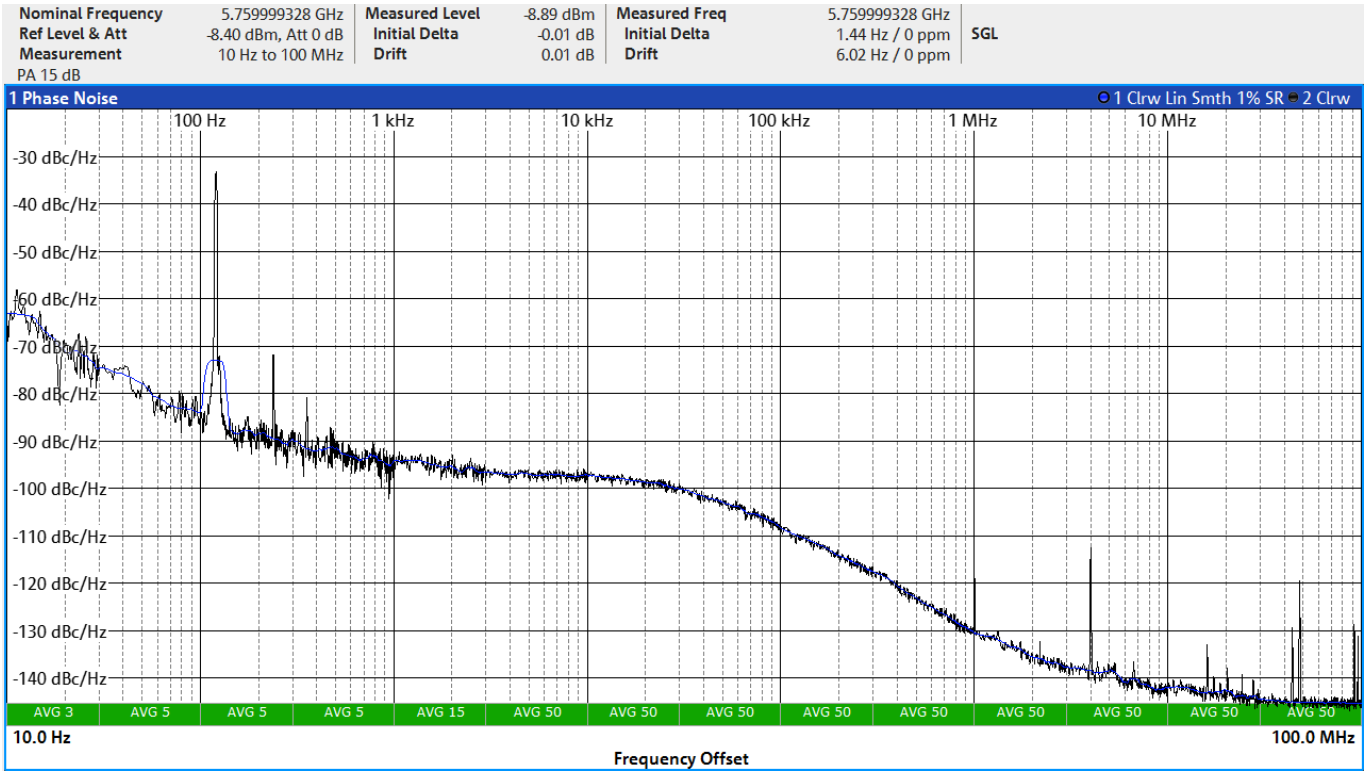
Front and back panels are low-cost PCBs with black solder mask and white silk screen. LEDs are placed on the back panel to show the current state state.

State	RX	TX	HT	PWR
heating	off	off	blinking blink speed depends on OCXO current	off
receiving	on	off	on	all good LO locked and power good
transmitting	off	on	on	high power on for current power above 1 W

Testing

The first prototype was characterized after final assembly. The maximum output power is 29 dBm with 100 mW input power and a noise figure of 3.1 dB is achieved. With 1 dB of switch loss and additional transmission line attenuation the results seem reasonable but noise figure needs some investigation, 1.6 dB was intended.

The phase noise in transmit mode is surprisingly good without any optimization:



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Last update: **2025/12/16 01:35**