"Getting Onto The Microwave Bands" Part-1 TRANSVERTERS Presented by Brian Straup, N5YC On RMG 2/7/2015 For The Current Version Click Here

http://tinyurl.com/kf8ygga

What Is A Transverter And How Does It Work?

Basic Transverter Block Diagram



How Do You Connect It To Your Station?



Down East Microwave 10 GHz Transverter Kit

2 meter I/F transceiver

Relay and rigid coax

Dish or Horn antenna

What Does A Transverter Look Like?

W1GHZ Mini-Transverter Reference



W1GHZ MINI-TRANSVERTER SCHEMATIC



DB9

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Transverter Specifications?

Output Frequencies? – The band you intend to operate on Output Power? Input Frequencies? – The band your Transceiver is operating on □ Input (drive) Power?

Increasing Output Frequencie and Power



Increasing Output Frequencie and Power

W1GHZ Miniverter Transverter □ 144 MHz IF Output Input based on LO Crystal Chosen □ Approximately 1 mW (0 dBm) output DEMI MMIC PC Board with MAR3 □ 12dB Gain, +10dBm @ 1dB Gain compression MiniKits Amplifier Up to 8W Amplifier +39dBm @ 1dB Gain compression □Typically up to 26 dB gain on 2 meters

Typical Power per band

▶ 902 1W to 100+W ▶ 1296 1W to 50W ► 2304 1W to 20W ► 3456 .5W to 40W ► 5726 .2W to 15W ▶ 10368 .01W to 2W

What can I expect with .01W

Many Microwavers started out with 10mW

- ▶ 10 Ghz 5 mW 31 Miles
- ► 2.3 Ghz 1W 929 Miles
- ► 5.7 Ghz 100mW 102 Miles
- ► 1296 1W 275 Miles

Power does help but antenna and location rule the day

A low noise pre-amp is more bang for buck than a power amp

Transverter Specifications cont.?

Local Oscillator? External or Integrated? □ LO Frequency Stability? Receive Noise Figure and Gain? Package, Power and Cooling?

Local Oscillator Frequency Stability?

On the microwave bands your oscillator frequency is multiplied many times. This makes your signal hard to find and track as you drift around the band.

Basic Crystal Oscillator ±10 ppm

Kuhne QH 40A ± 0.2 ppm
ICOM CR-282 TCXO ± 0.5 ppm
OCXO
Rubidium Atomic Reference
GPS Locked Reference





Integrated (built into Transceiver)

External (connected into Transceiver)

Transverter Sources & Cost?

Appliance □ New or Used Kit – enclosure, PCB & parts □ New or Used Kit – PCB only, your parts DIY – Roll your own

TRANSVERTER SOURCES

Built-In, "Integrated" into Transceiver
Designed, Manufactured, Tested, Documented and Supported
Limited to bands supported by your Transceiver Features
Examples: FT-726/736, Flex-5000 U/V & 6700, Elecraft K3 K1444XV

ELECRAFT® K144XV Internal 2-Meter Module for the K3



- Full coverage of the 2-m band (144-148 MHz)
- 8-10 W Output Typical
- -144 dBm System MDS
- 0.15 uV FM Sensitivity
- Separate 2-meter antenna jack on rear panel
- Silent, diode-switched T/R
- 2-meter receive on both main and sub receivers
- Shielded module (1x3x5") FLEX-6700 for the Most Demanding Amateur fits inside K3 even with sub receiver installed



TRANSVERTER SOURCES

External, "Appliance", Plug-and-Go
Designed, Manufactured, Tested, Documented and Supported
End User Integration Required
Examples: W1GHZ, DEMI and KUHNE Transverters
Many available in KIT form









TRANSVERTER SOURCES

External, "DIY", Roll-your-Own

Designs and construction tips may be available from other hams:

* KH6CP, Z.Lau: <u>Home-Brewing a 10 GHz Transverter</u>

* KO4BB: 10 GHz Transverter(s) at KO4BB



10 GHz Transverter With Connectorize Parts





Interesting Transverter Modules Wide Band Frequency Mixers



Mini-Circuits ZX05-14H+ 3700-10000 MHz ~\$50





TR Antenna Relay

SMA Connectors

Low loss at microwave frequencies
When sequenced, will handle >25W
Caution 12V or 28V versions
Most surplus relays are 28V
28V Relays may click at 12V but don't actually engage fhe RF contact

TR Antenna Relay



TRANSCEIVERS For use with Transverters









What To Look For In A Transceiver?

- IF Frequency?
- Output Power Level (IF Drive) Control?
- Power "Spiking"?
- PTT Sequencing (to Transverter)?
- IF Frequency Stability?
- Band Scope Capability?

Power Drain and Portability (if necessary)?

2 Meter IF for 902 on Up

- Look For Low Power Option IW is the right level for most Transverters Ultra Sensitivity not Required Noise floor is set by transverter Disconnect the High/Low power button Band Scope Capability?
- Power Drain and Portability (if necessary)?

How To Kill Your Transverter?

- IF Overdrive One of the most "popular" ways to blow out the Transverter TX IF input circuitry.
- IF key-ON "Spike" Initial RF power surge when Transceiver is keyed On.
- Over or Reverse Voltage Higher voltage isn't necessary better!
- <u>Over Heating</u> Check out heat sink temperature and add cooling fan if necessary.
 - Digital Modes and/or integrated power amplifier

How To Kill Your Transverter cont.?

► <u>T/R Relay Performance:</u>

□ <u>SWR (return loss) or relay</u>

□ **Poor RF isolation while transmitting**

Maximum of 1 mW input RF (Kuhne)

Poor isolation while switching

□ Failure of 24-28 VDC "booster" driver

How To Kill Your Transverter cont.?

Improper PTT sequencing:

- PTT OFF while transmitting may damage the RX IF circuitry.
- PTT turns ON too late insufficient delay between PTT ON and RF arriving from Transceiver.
- PTT turns OFF too early insufficient delay between RF ending and PTT turning OFF.
- □ Noise on PTT control while transmitting.

Testing Transverters?

What can be tested? What test equipment is required? Who's available to help?

Adjusting "No-Tune" Transverters What can be adjusted? Output power level □ Receive gain PTT options (Low, High, IF, etc.) Internal *sequencer settings Internal *ALC level

References:

- Wikipedia: <u>http://en.wikipedia.org/wiki/Transverter</u>
- RMG Website : <u>http://k5rmg.com/</u>
- RMG Build Status Spreadsheet: <u>http://tinyurl.com/k46o565</u>
- NTMS Ward & Gormley: <u>http://tinyurl.com/o4wnc4j</u>
- K04BB: <u>http://ko4bb.com/ham_radio/10GHz_transverters/</u>
- W6BY: http://<u>50mhzandup.org/Amateur_Radio_Microwave.pdf</u>
- N2CEI: <u>Future Designs of Microwave Transverters</u>
- DEMI: <u>http://tinyurl.com/nxk2eah</u>
- Wikipedia: <u>Crystal Oven Comparison</u>

<u>References cont.</u>:

- KUHNE: <u>http://tinyurl.com/pmdpjrj</u>
- ► W1GHZ: <u>Mini-Transverter</u>
- ► W1GHZ: <u>Sequencer for Transverters</u>
- VK3XDK: <u>10GHz V2 3cm Transverter kit</u>
- WA3IAC: <u>A transverter for 10.368 MHz</u>
- VE3HHT: <u>White Box Transverter</u>
- **DEMI:** Interfacing DEMI Transverters
- KUHNE: <u>PTT Control of DB6NT Transverters</u>

"Getting Onto The Microwave Bands"

Part-2: Antennas & Feeds Tom, K5VH Part-3: Microwave Plumbing & Testing Ben, NO5K Part-4: Operating a Microwave Station John, W0JT/5