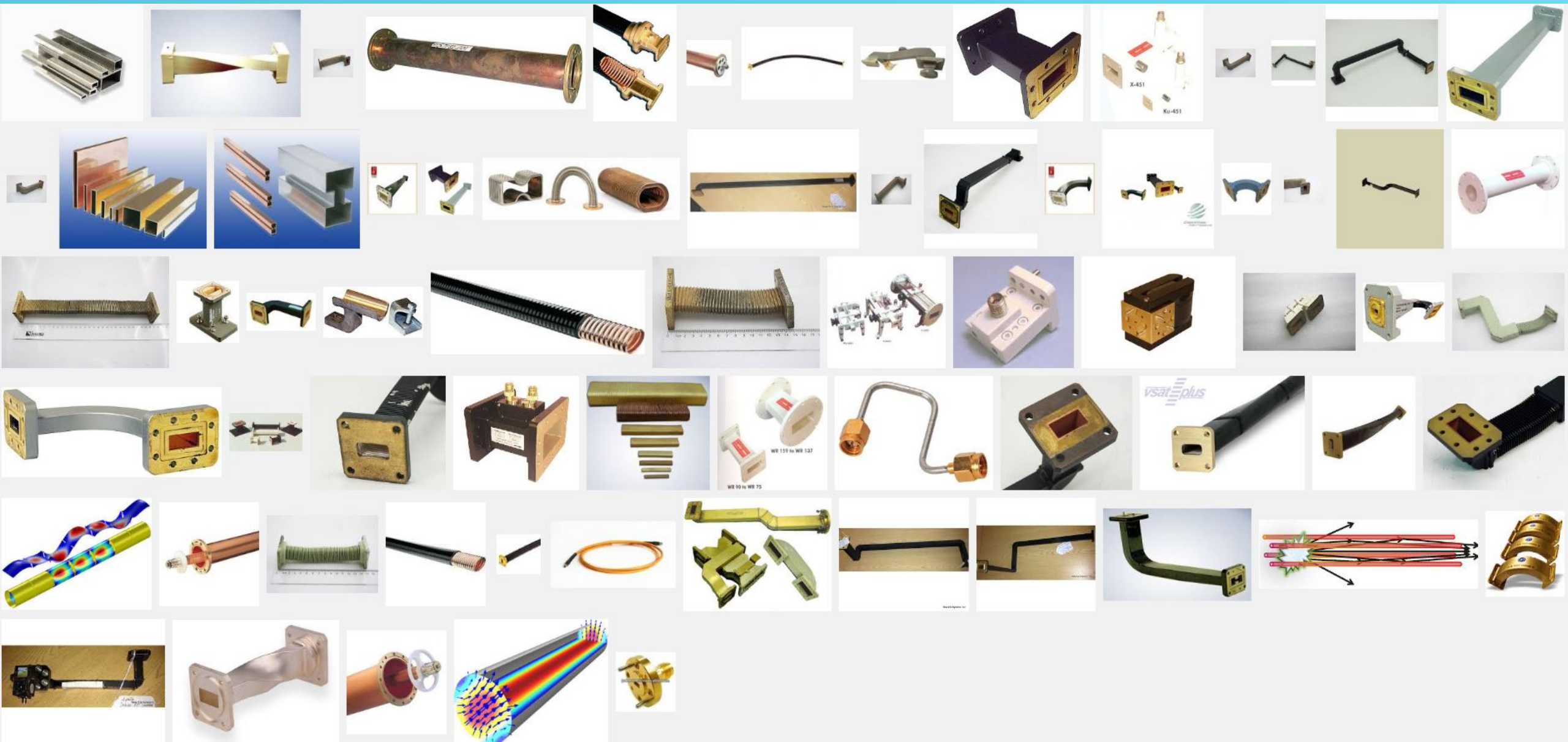
PLUMBING



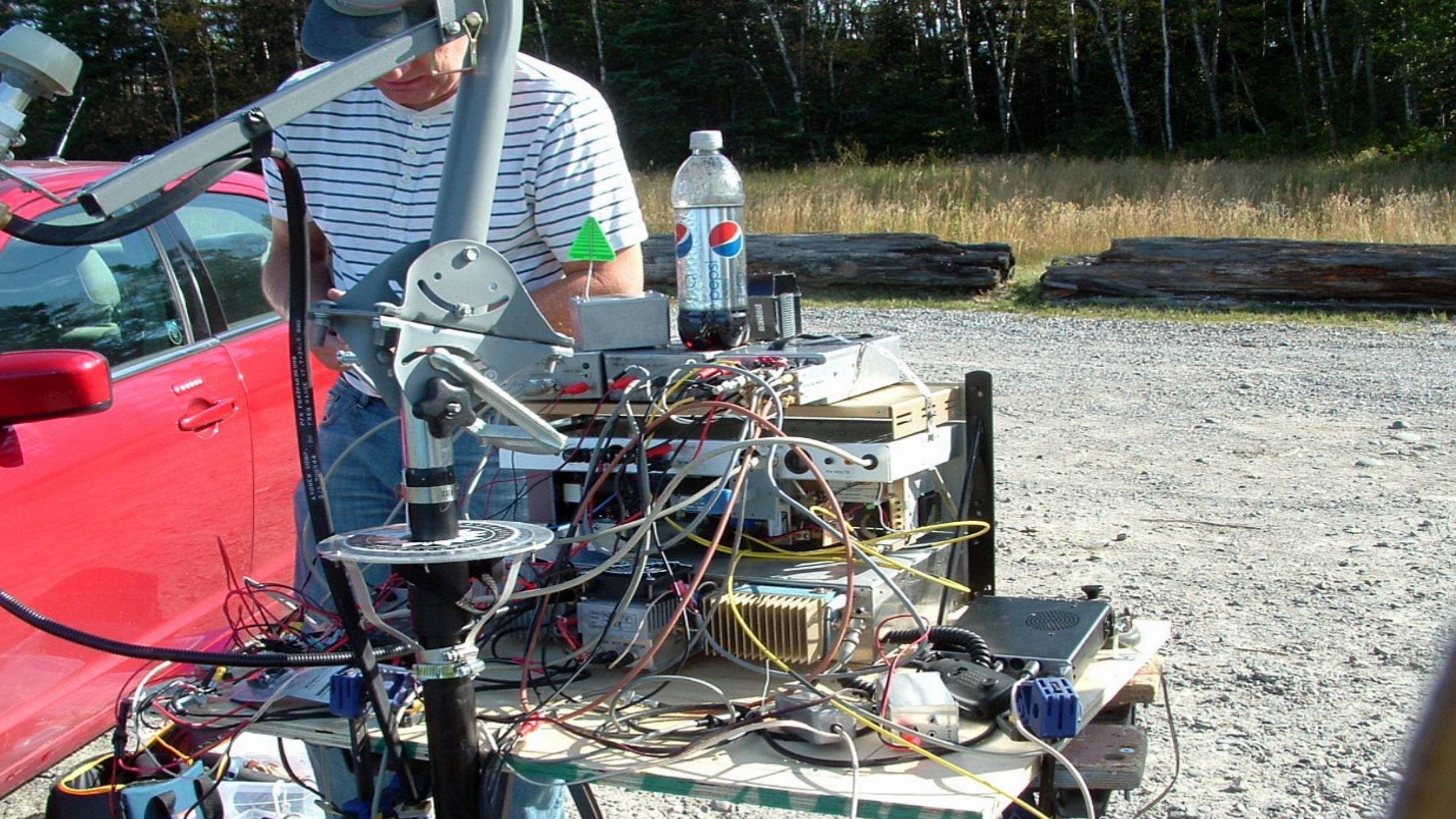
"Getting Onto The Microwave Bands"

Part-2: ***Plumbing & Testing***

Instigated by Jim, K0MHZ

Presented by Ben, NO5K

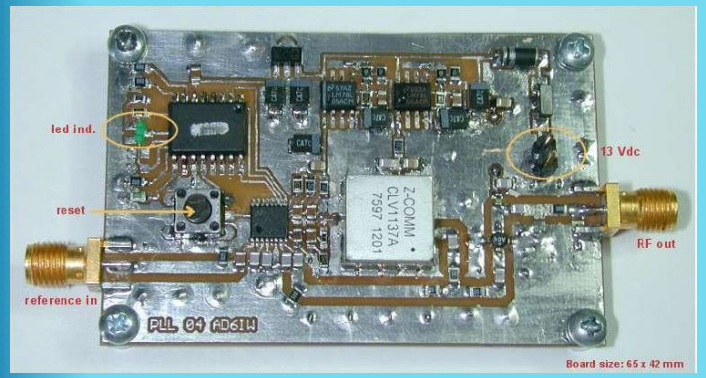
On RMG 3/7/2015


pepsi

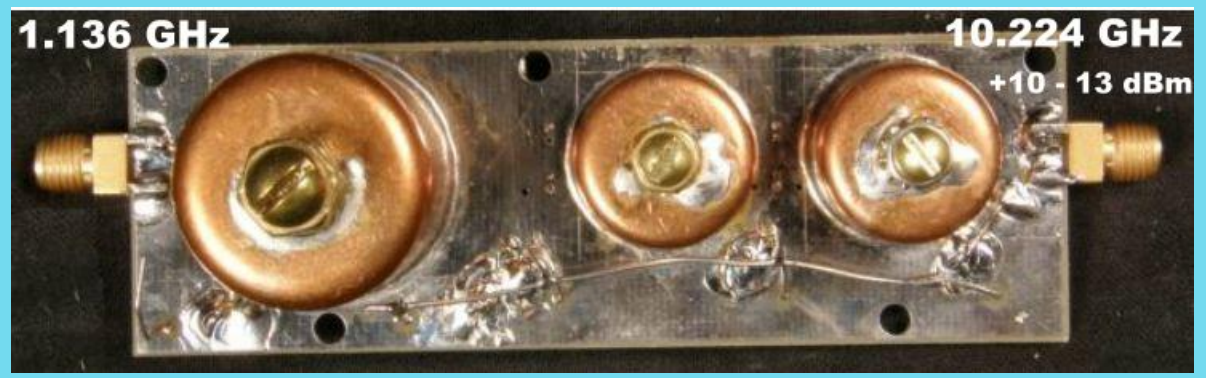
Everything Needs to be Interconnected!

At the Module Level

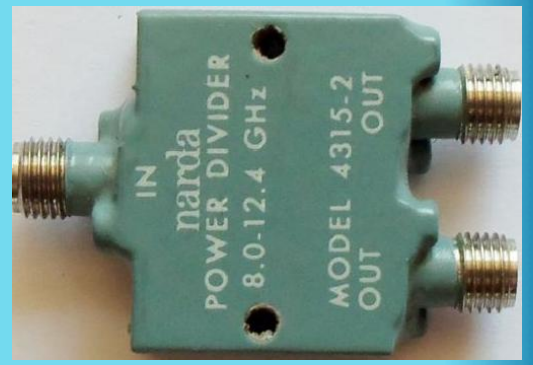
Parts is Parts



ad6lw.com (DUBUS 2006)



PCB W1GHZ, MMIC's MiniCircuit

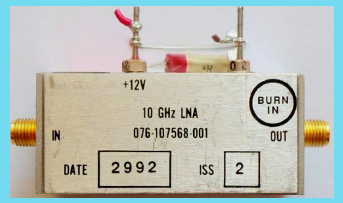


ePay $15 - $35

Two Mixers Tx & Rx

ePay $25 - $200

TRANSCIEVER



ePay $35 Various $100 - 200

ePay ~$35

Free

ePay $50

Difficult to find.

2 Watts Usually too $$$

ePay and uW Swaps.

RDR-Electronics sometimes.

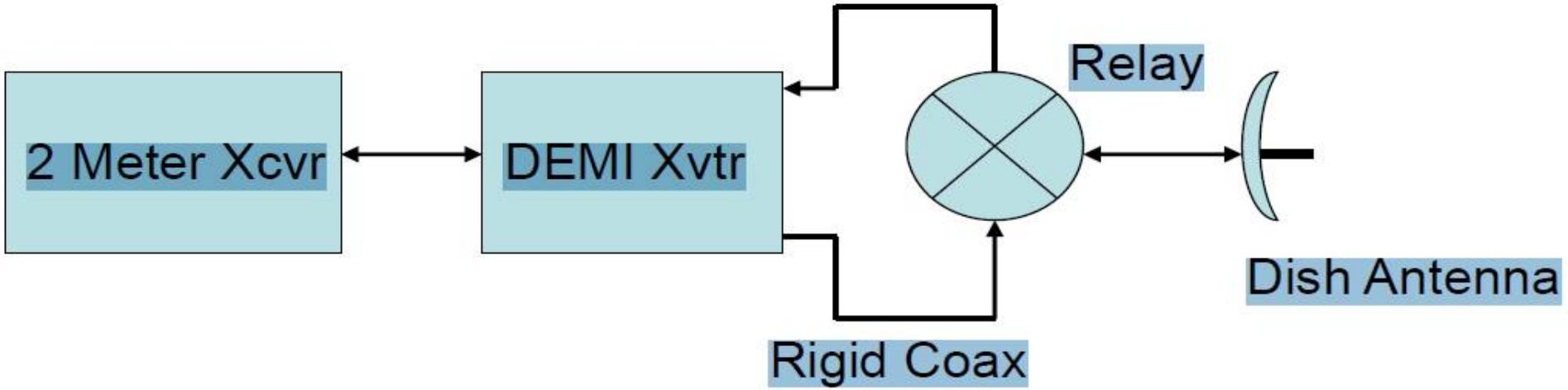
Schematic

One Minute Video

See NTMS for More.

North Texas NTMS Microwave Society

Basic Components



- Down East Microwave 10 GHz Transverter Kit
- 2 meter I/F transceiver
- Relay and rigid coax
- Dish or Horn antenna

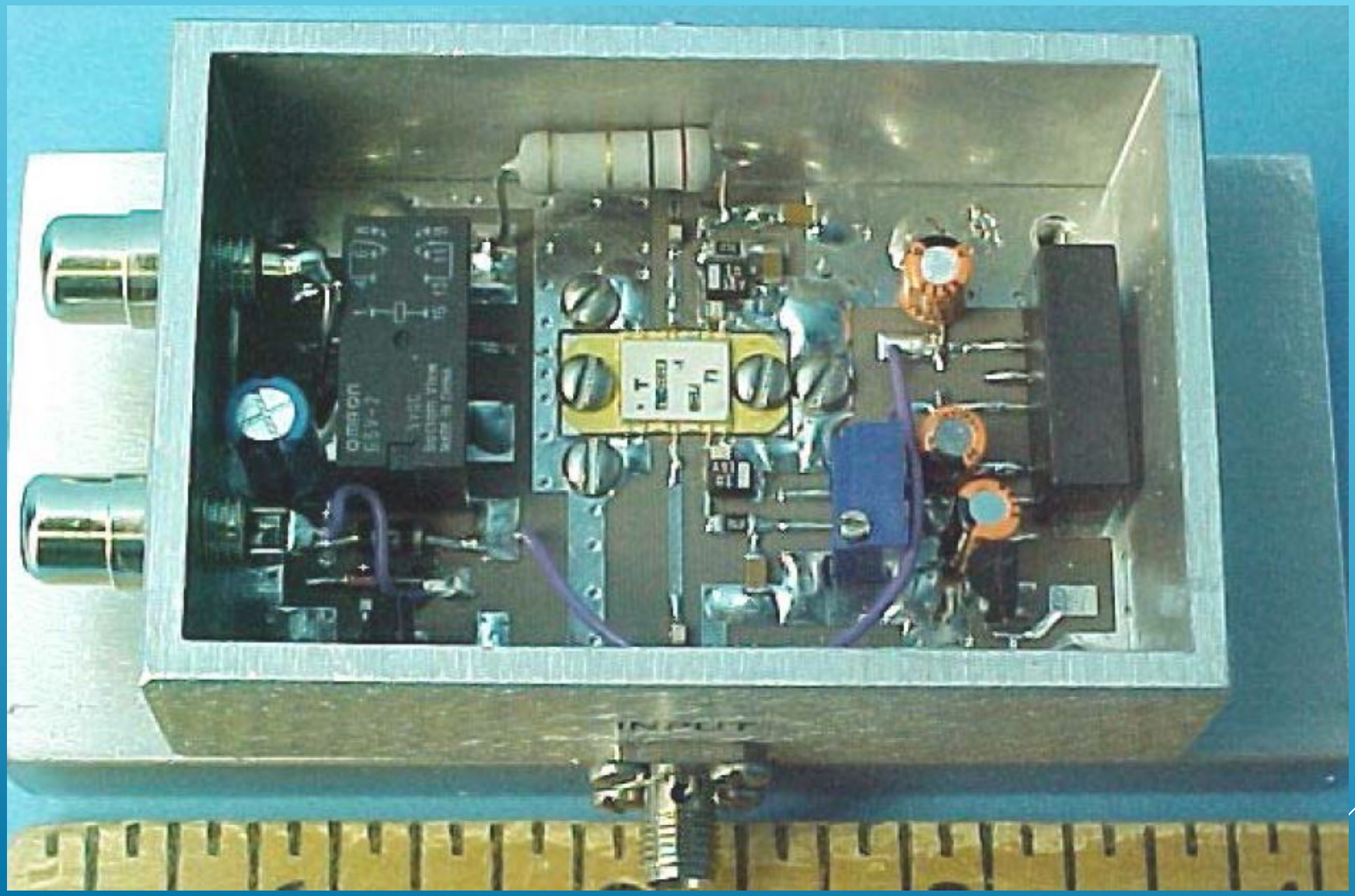
Building 3 Watt DEMI Transverter

DEMI has 2 for 3cm, 10 mW, $400/500 and 3 Watts, $625/775

Use Good Coax and Connectors?

- One 10 GHz Watt Costs ~$110*
  - DEMI 3 Watt @ $325 = $110/watt
  - KUHNE 8 Watt @ 637.4 € = $892 = $112/watt

DEMI 3-3 POWER AMPLIFIER



Typical Component Interconnections

- Analog & Digital Signals:
  - Mic., Speaker, CW key, RIGblaster
- DC Power Distribution: 13.8 & 28 VDC
- Control & Monitoring Signals:
  - PTT, T/R Relay, Voltage, Current, etc.

IF and RF Transmission Lines – next >

Transmission Line Considerations

- Frequency of Use
- Operating Environment
- Mechanical Radius & Flexibility
- Cable Cost versus Attenuation
- Connector Cost & Availability

Transmission Line Types

- LMR Coax — COAXIAL Transmission (Wicki External) — Local Definition
- RG402, .141 Semi Rigid (Solid Cu Outer)
- RG142 RG222 Flexible
- Heliax “Superflex” & “Hard Line”
- Waveguide, Air Dielectric No Center Conductor
- Rigid (Straight Sections only) THIS IS Plumbing !!

Andrew

Times Microwave

Heliax

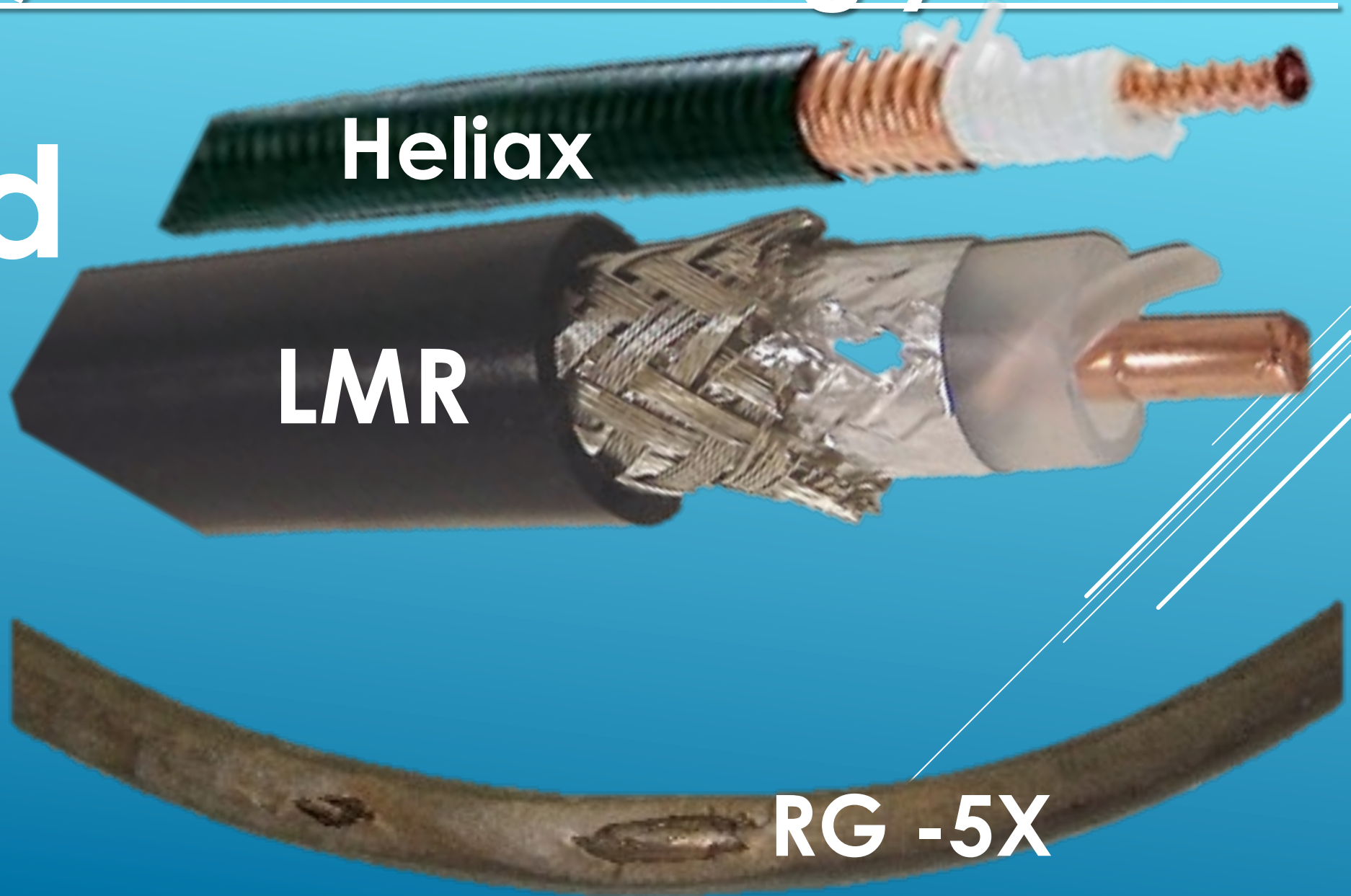
LMR

The Value Of Good Coax Cable?

- What does 10 GHz Coax Cost?
  - Coax Power Loss Cost — Around $0.11 to 0.25 per milliwatt
  - Coax Purchase Cost — Wide variation from different sources.
- Times Micro wave LMR - Data and Calculator
  Link to Times uW Calc.
- Andrew Heliax - Datasheets

The Good, Bad And The Ugly Cables

- Good
- Bad
- Ugly



Some Coax Tooling

LMR400

RF Connector Considerations

- Frequency of Use
- Operating Environment
- Connector Cost & Availability
- Installation Difficulty
- Ability to Test Assemblies


UHF
UHF
N
UHF
N
UHF
BNC
UHF
BNC
UHF
BNC
N
BNC
N
BNC
N
SMA
N
TNC
N
BNC
N
7/16
N
RCA
BNC
TNC
BNC
BNC
BNC
SMA
BNC
SMA
TNC
FME
TNC
FME
SMA
N
N
BNC
N
SMA
N
SMA
BNC
BNC
BNC
BNC
BNC

There are multi-hundred dollar Connectors

This Adapter is a true bargain for a Test Lab and is illustrative of the WIDE range of Specifications and Quality found in ALL Coaxial Components. (Cable, Relays, Loads - everywhere)

Connector Recommendations

- LMR-240 w/N or SMA
- LMR-400 w/N or SMA
- Heliax ¼" Superflex FSJ-1 w/N or SMA
- Heliax ¼" Hard LDF-1 w/N or SMA
- Heliax 3/8" Hard LDF-2 w/N or SMA

Links are to RF Parts Co.
For specific Connectors.

Why test Feed Lines BEFORE ?

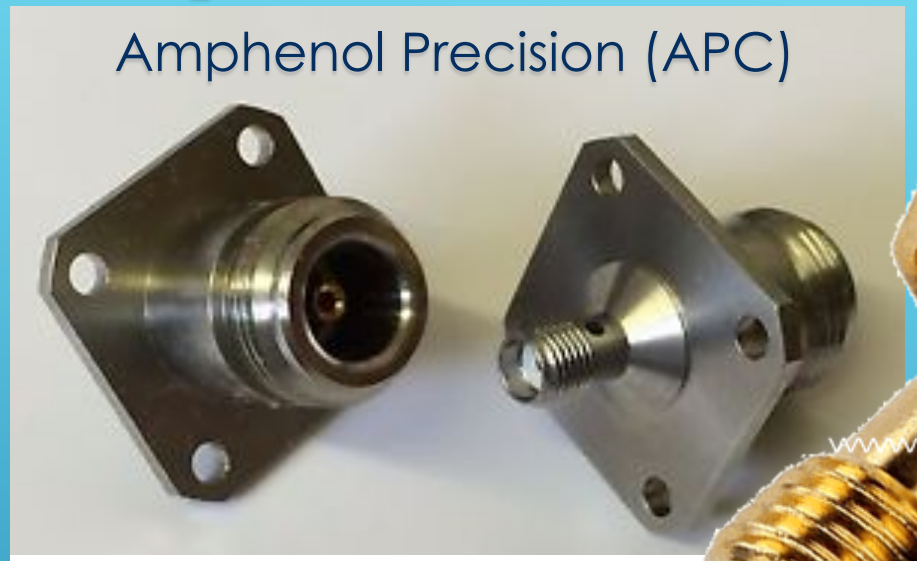
How to Mess Up a Good Setup

- All Adapters Introduce Loss!
- Not all Adapters are the same QUALITY!
  - Chinese E-bay versus Amphenol & Pasternack
- All Connectors have a usage cycle life.
  - Cheap, Gold plated Chinese are the worst!

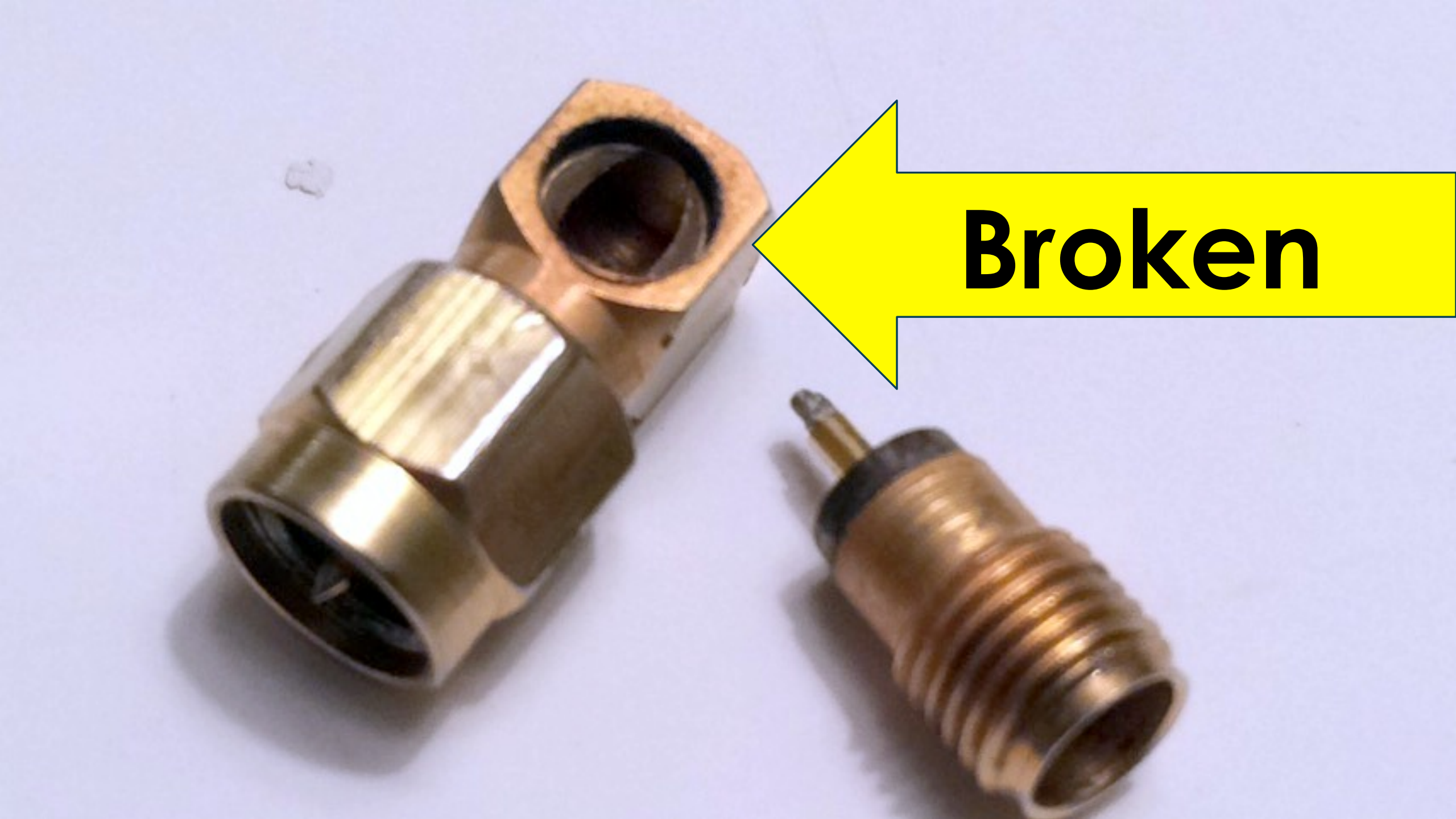
How to Mess Up a Good Setup

- **ADD ADAPTERS!**
  - **Bulkhead**

  - **Inter-series**



1/10th the Cost of APC


Broken

The Good, Bad And The Ugly Adapters

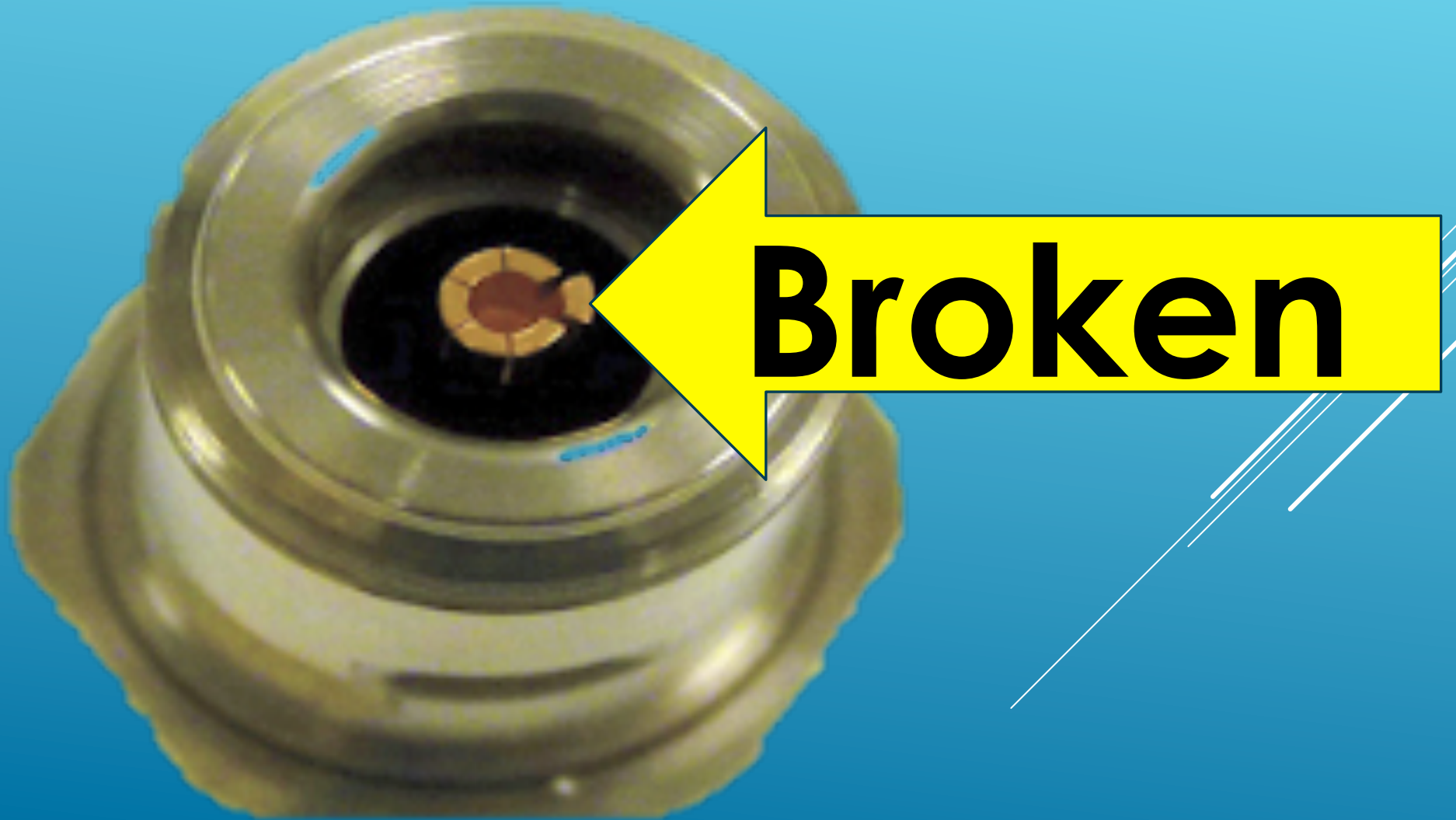
- Good
- Bad
- Ugly

LMR Connector Types

- Good – Crimp
- Bad – Clamp
- Ugly - Solder

How to Mess Up a Good Setup?

- Use Damaged Connectors



Repaired APC

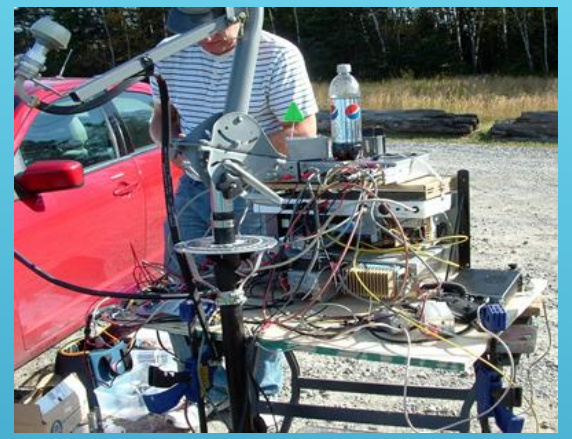
Connector Care

The Value Of Good Coax Connectors?

- What do 10 GHz Connectors Cost?
  - Connector Power Loss Cost
  - Connector Purchase Cost

Typical Interconnection Issues

- RFI Pickup
  - Need for Shielding & Filtering
- Signal Loss
  - Low Loss Cables & Connectors
  - Proper Connector Installation
- Reliability



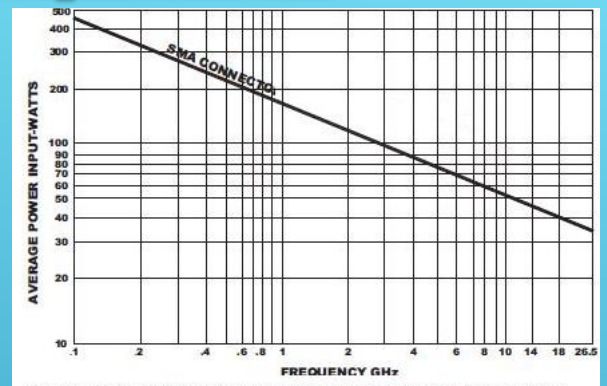
T/R Relay Considerations

- Frequency vs Loss & Isolation
- Relay Type & Voltage
- Connector Type
- Relay Cost & Availability
- Testing RF Relays

T/R Relay Examples

- 12 VDC Latching SMA
- 0.3 dB Loss @ 10 GHz
- 70 dB Isolation @ 10 GHz
- $15-50 on eBay
- Spec. Sheet
- Others

Link to: electricaleequipmentsupplies.com



Consult Factory for derating factor when application does not meet the foregoing referenced conditions.

VSWR	Derating Factor	VSWR	Derating Factor
1.5 : 1	0.96	3.5 : 1	0.70
2.0 : 1	0.88	4.0 : 1	0.64
2.5 : 1	0.84	4.5 : 1	0.60
3.0 : 1	0.75	5.0 : 1	0.56

2S/2SE/2SL/2SLE SERIES
SPDT SWITCH
DC-26.5 GHz ◆ SMA

Ducommun

The ***2S/2SL Series*** features SMA connectors and a frequency range of DC to 18 GHz.

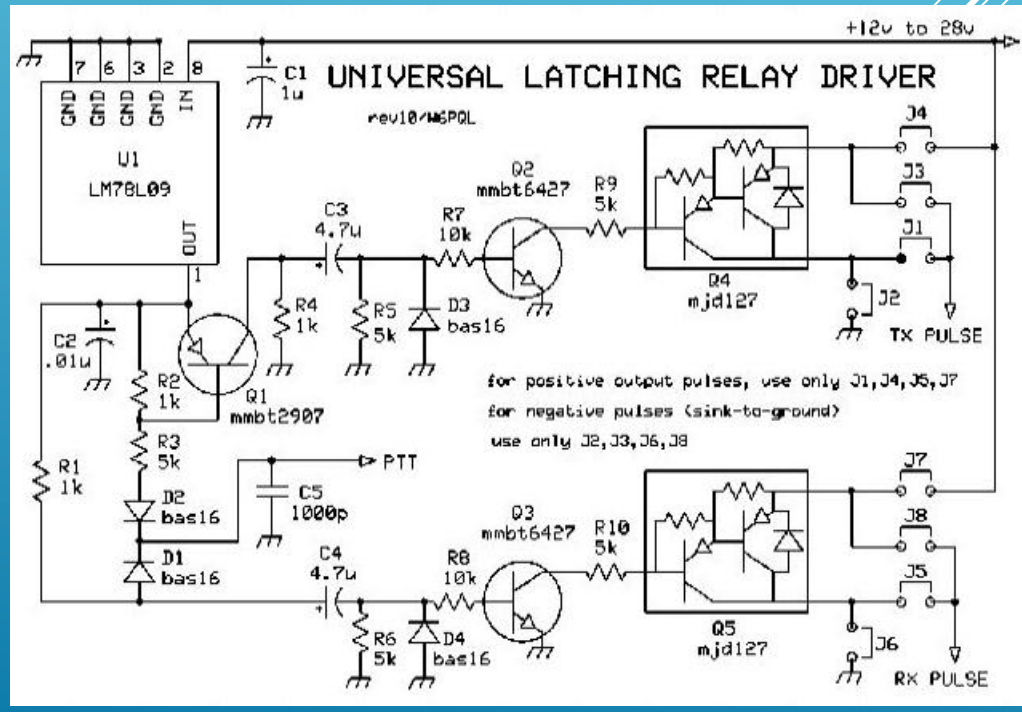
The ***2SE/2SLE Series*** also features SMA connectors and a frequency range of DC to 26.5 GHz.

Both series are available with fail-safe, latching self cut-off, or pulse latching options. The 2SL/2SLE series has in board and out board mounting holes. Please consult Factory for SPST version.

Weight (max.):	2.1 oz
RF Impedance:	50 ohms nominal
Operating Temperature (fail-safe):	-55°C to +85°C ambient
Operating Temperature (latching):	-25°C to +85°C ambient
Operating Life:	1,000,000 cycles min.
Switching Sequence:	Break Before Make

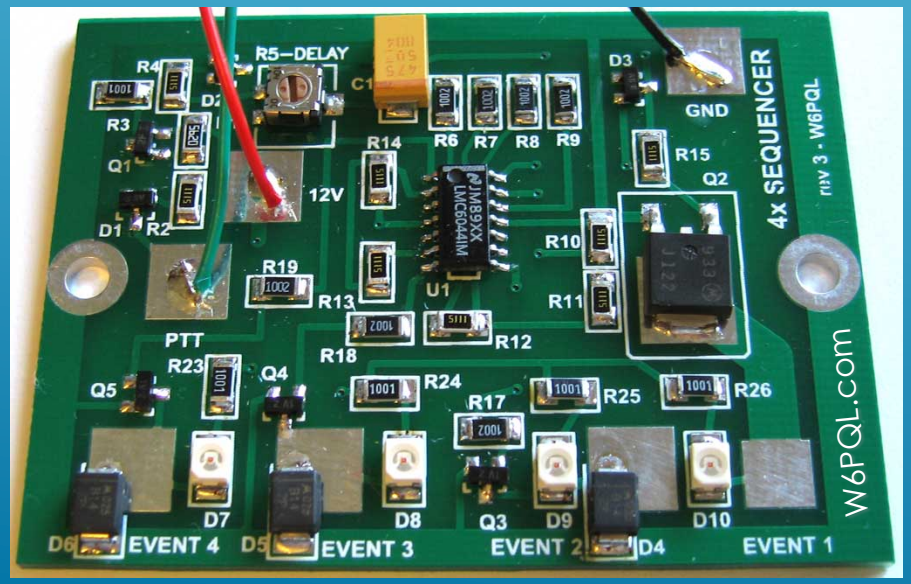
Latching Relay Driver

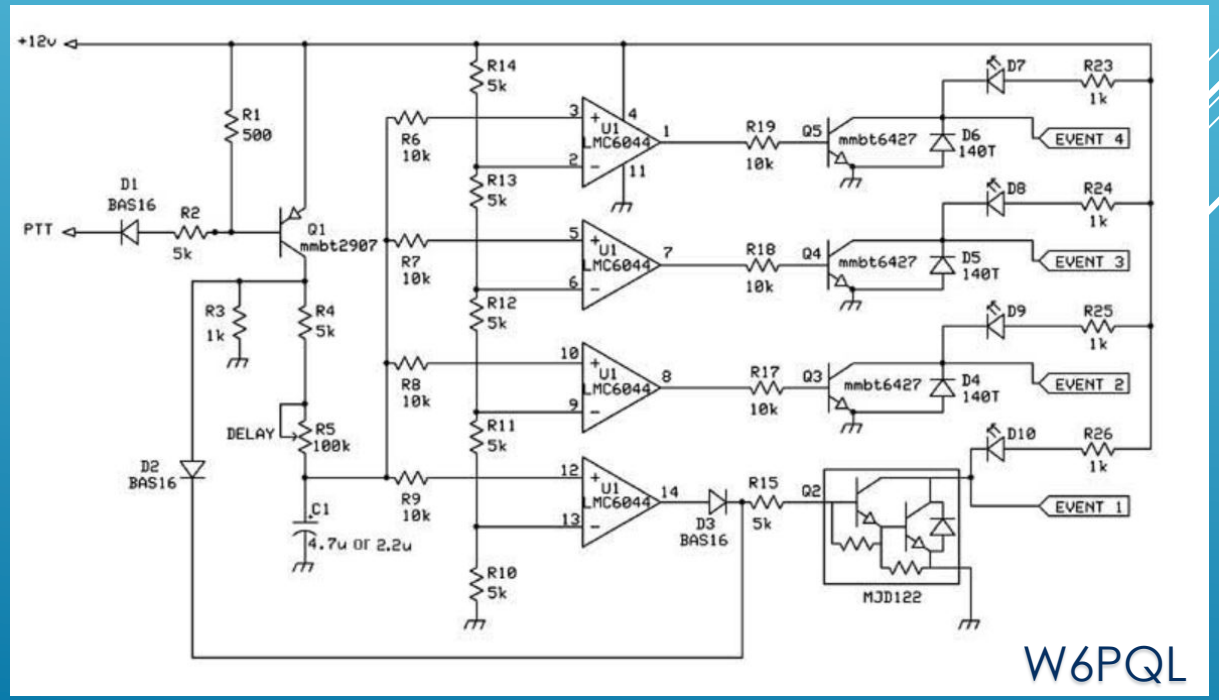
- Drives 12 to 28 VDC Latching Relays
- Kit $15
- Built $25
- **W6PQL URL**



SEQUENCERS

- Sequencers are used in transverters to prevent transmitting into the Rx Pre-Amp, Transmitting with no Load and other items requiring Voltage being applied and removed in a specific order. Sequencing is a critical requirement for systems using Mast Mounted Pre Amps.
- Sequencing starts by the operator issuing the intent to transmit.





Beginner Test Capability

- Multi-function, Multi-meter
- 3 cm Beacons, local & Distant
- Power and SWR Monitor
- Weak Signal Sources

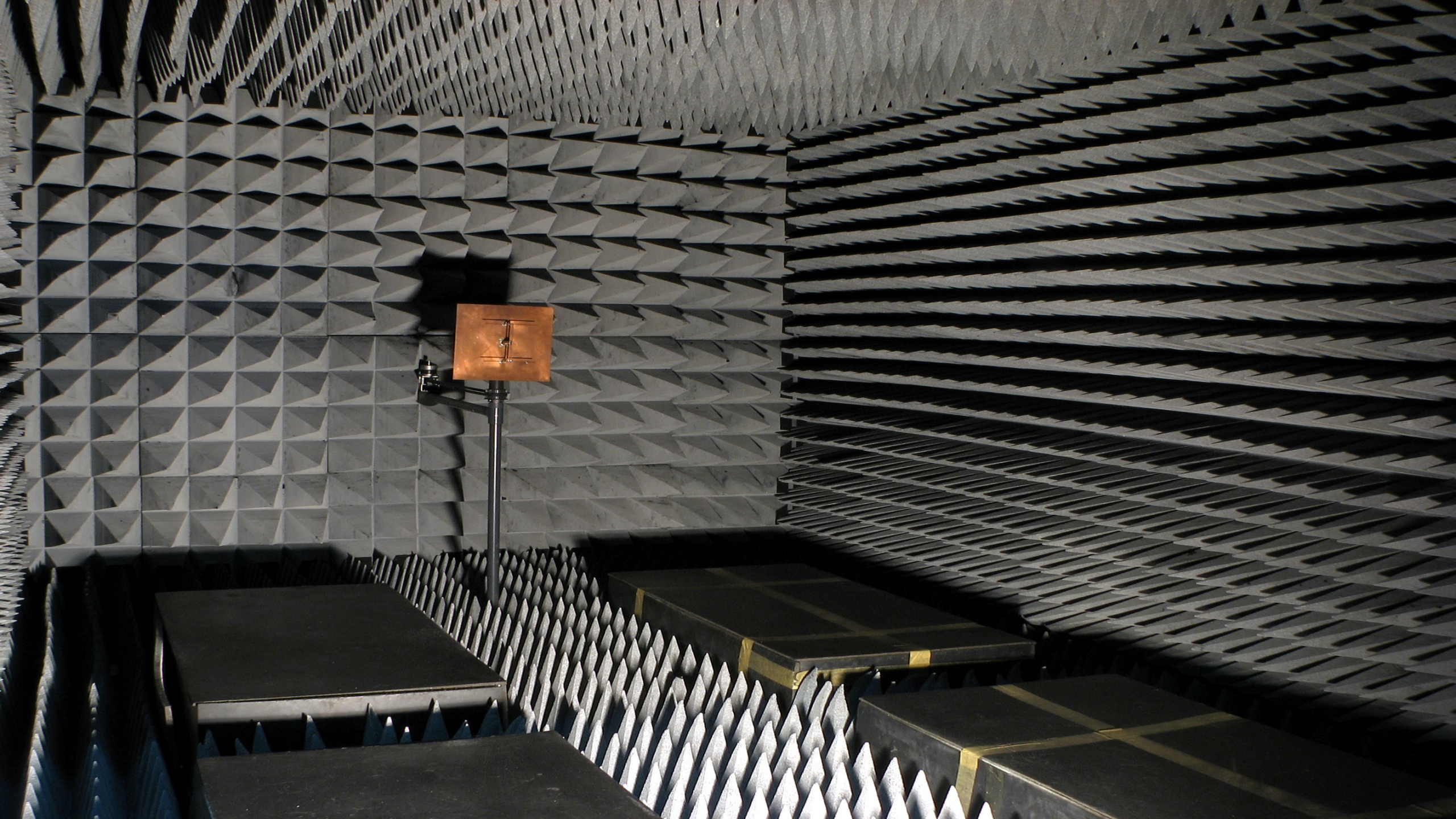
Intermediate Test Capability

- Analog Power Meter
- Spectrum Analyzer
- Solar Noise Monitor

Advanced Test Capability

- Digital Power Meter
- Spectrum Analyzer
- Network Analyzer
- Noise Figure Meter $ About $1K

Add $2.5K To 26.5 GHz + $1K Source $10K NFA To 3.5 GHz + $3K Source $75 Basic NFM + SOURCE



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: http://en.wikipedia.org/wiki/Transverter
- RMG Website : http://k5rmg.com/
- RMG Build Status Spreadsheet: http://tinyurl.com/k46o565
- NTMS – Ward & Gormley: http://tinyurl.com/o4wnc4j
- AD6IW – PLL LO (L-Band): http://www.ad6iw.com/
- K04BB: http://ko4bb.com/ham_radio/10GHz_transverters/
- W6BY: http://50mhzandup.org\Amateur_Radio_Microwave.pdf
- N2CEI: http://01895fa.netsolhost.com/PDF/MUDpaper.PDF
- DEMI: http://tinyurl.com/nxk2eah
- Wikipedia: http:/Crystal Oven Comparison

References cont.:

- KUHNE: http://tinyurl.com/pmdpjrj
- W1GHZ: Mini-Transverter
- W1GHZ: Sequencer for Transverters
- WA5VJB: Low Cost PCB Antennas
- VK3XDK: 10GHz V2 3cm Transverter kit
- WA3IAC: A transverter for 10.368 MHz Good Basic Tech.
- VE3HHT: White Box Transverter
- DEMI: Interfacing DEMI Transverters
- KUHNE: PTT Control of DB6NT Transverters

"Getting Onto The Microwave Bands"

Part-3: *Antennas & Feeds*

Tom, K5VH

Part-4: *Operating a Microwave Station*

John, W0JT/5