

A DFS based 23cm Down Converter

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Dallas TX

Introduction

- Part of a beacon Rx monitoring station design
- Adaptable to EME use to support SDR operation
- Exploratory feasibility investigation!

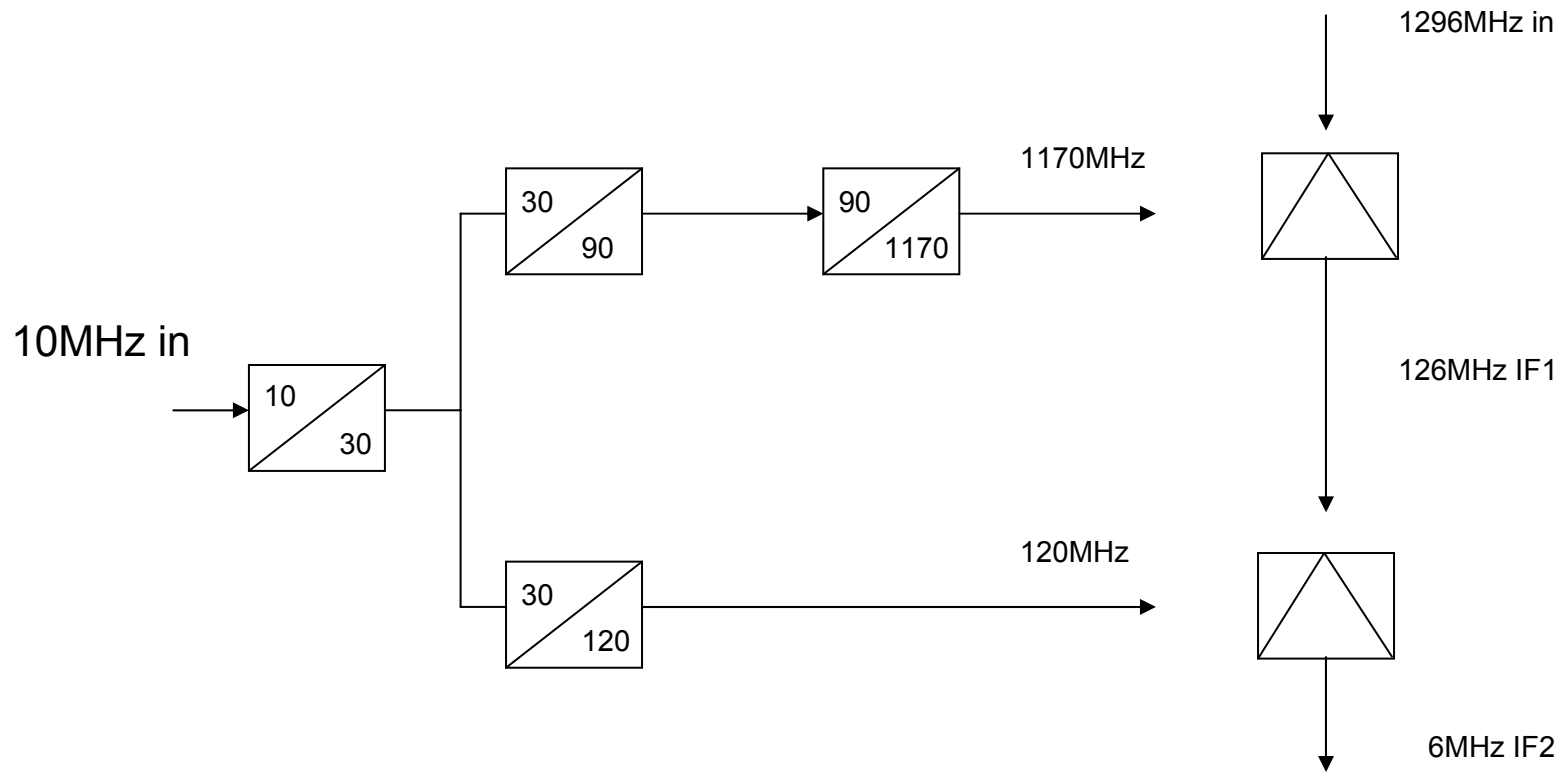
System requirements

- IF output below 30MHz (50MHz)
- Antenna mountable
- Remote power feeding option
- 10MHz reference locked
- No crystals or PLL's

Local Oscillator

- No single conversion solution which meets requirements
- Double conversion possible using 1170MHz and 120MHz
- This gives an IF of 6 – 8MHz for 1296 – 1298MHz RF in
- Both 1170 and 120 can be produced by direct multiplication of 10MHz

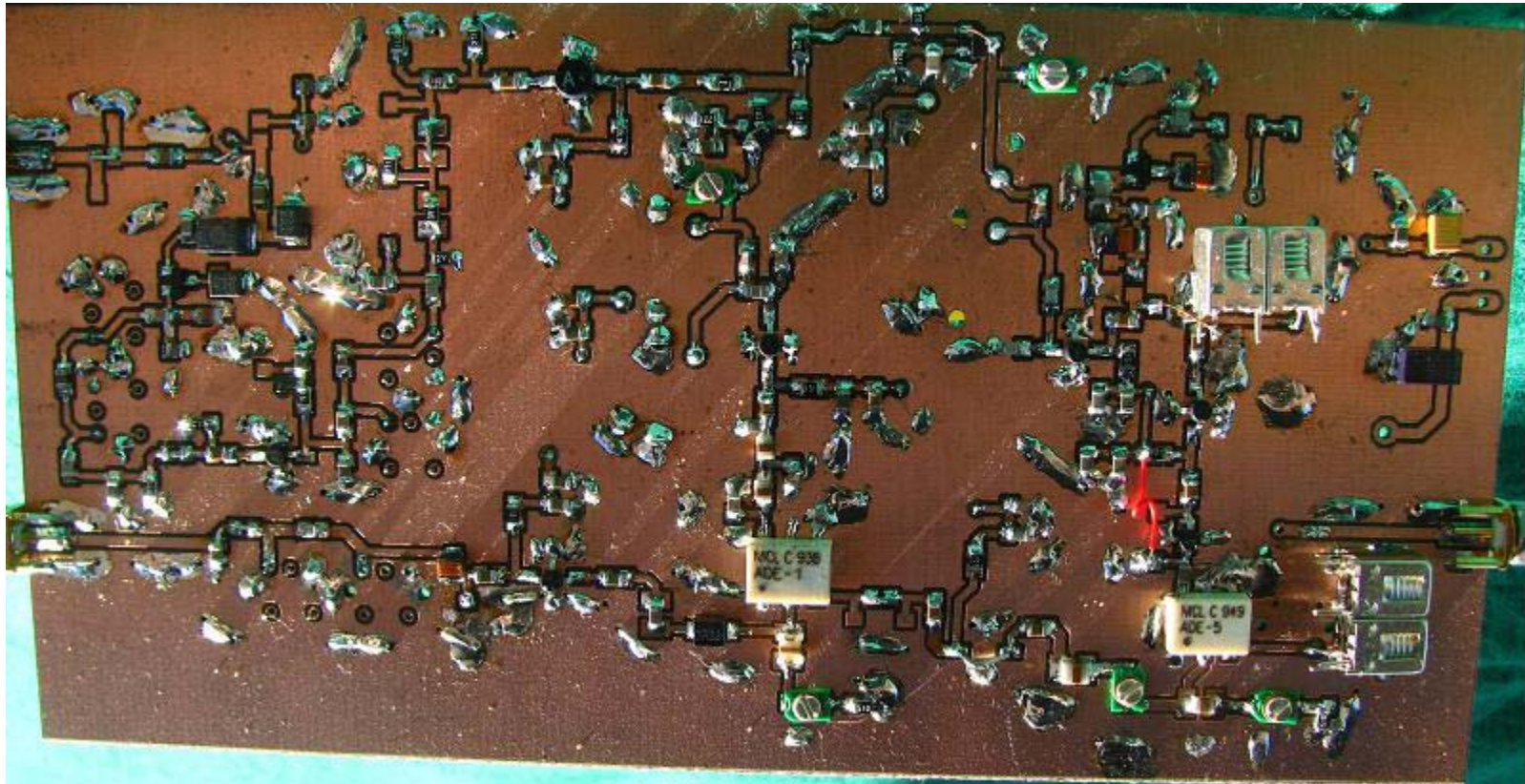
23cm LO generation



LO Rationale

- Other combinations of LO frequencies would also give 6MHz;
eg 1200 and 90,
or 1080 and 210 etc
- But to get these, requires a more complex early stage design for the LO
- Keeping all frequencies based on as high a common multiple of 10MHz as possible gives a cleaner output

Mk1 Rx



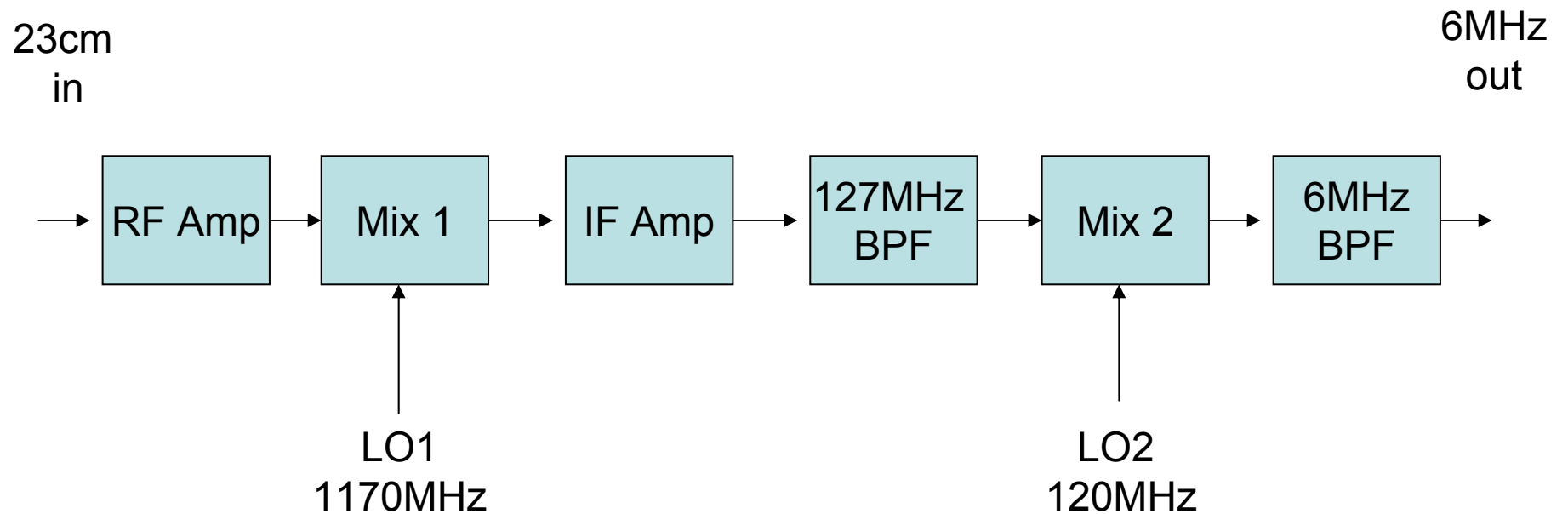
Results

- LO concept proved
- Diode multiplier wasn't successful
- RF path needed more attention
 - gain before 23cm filter
 - better pass band filtering at IF
- Best sensitivity -110dBm for visible trace on SDR-IQ

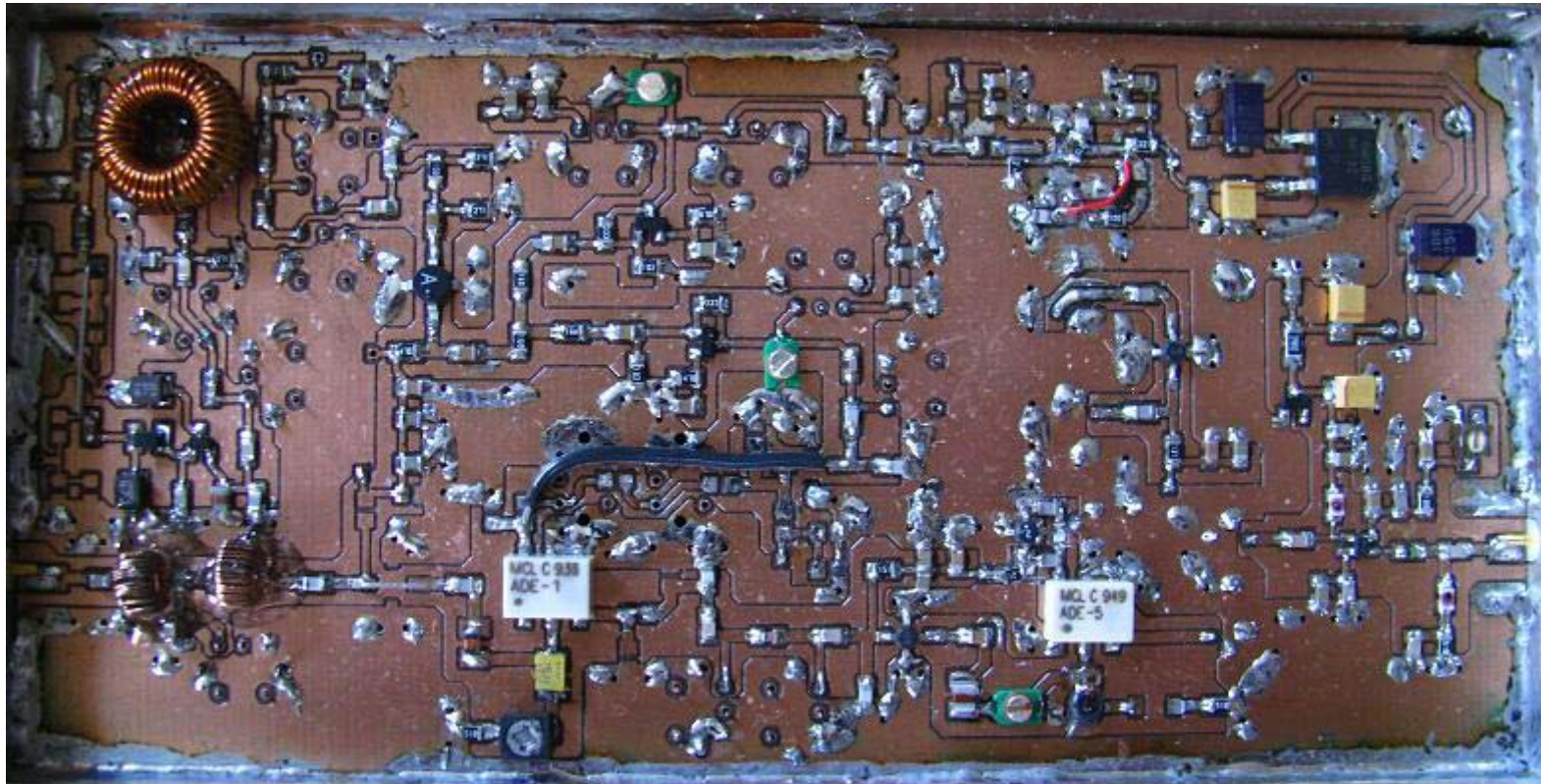
Mk2 Rx

- Transistor multiplier to 1170MHz
- G4DDK MGA71353 gain stage added before 23cm filter
- Interstage filter at 127MHz
- Improved output BPF at 7MHz

Mk2 Rx – RF path



Mk 2 Rx



Experience gained

- LO generation scheme is feasible, even with x13 step
- Inductors wound on toroids give better filter performance than SMD types
- Some gain before the first mixer is very desirable
- MMICs are not good multipliers!

Application

- The converter is presented here as a direct downconverter solution to using an SDR as a panoramic adaptor for 23cm EME
- Design purpose is to provide a 23cm receiver for beacon monitoring, as part of a long term project

Antenna

- Initial testing with big wheel stack
- 4 x WA5VJB
- Signal source is local 23cm Beacon at approx 10km – scattered path

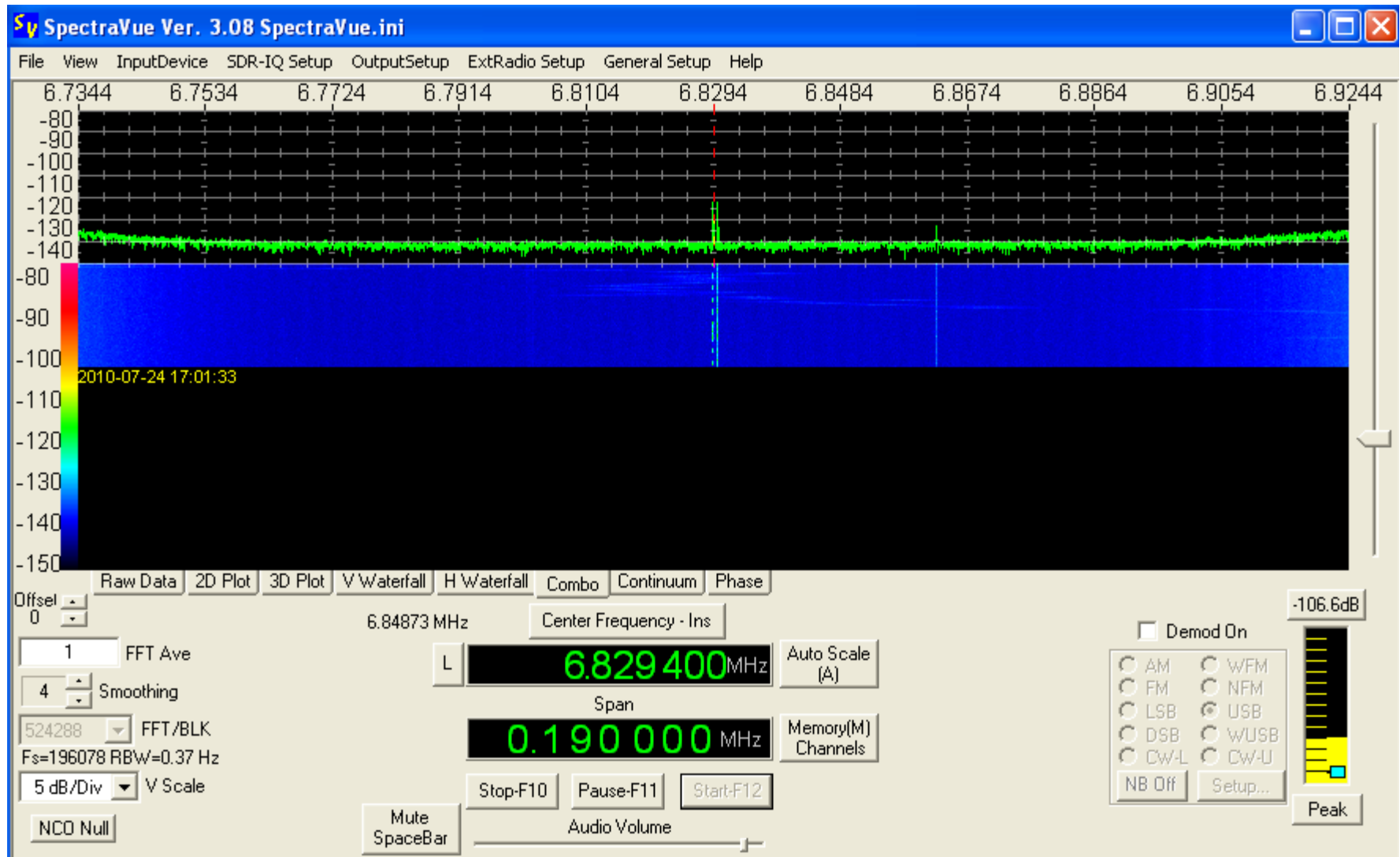
Antenna Construction



Antenna Construction



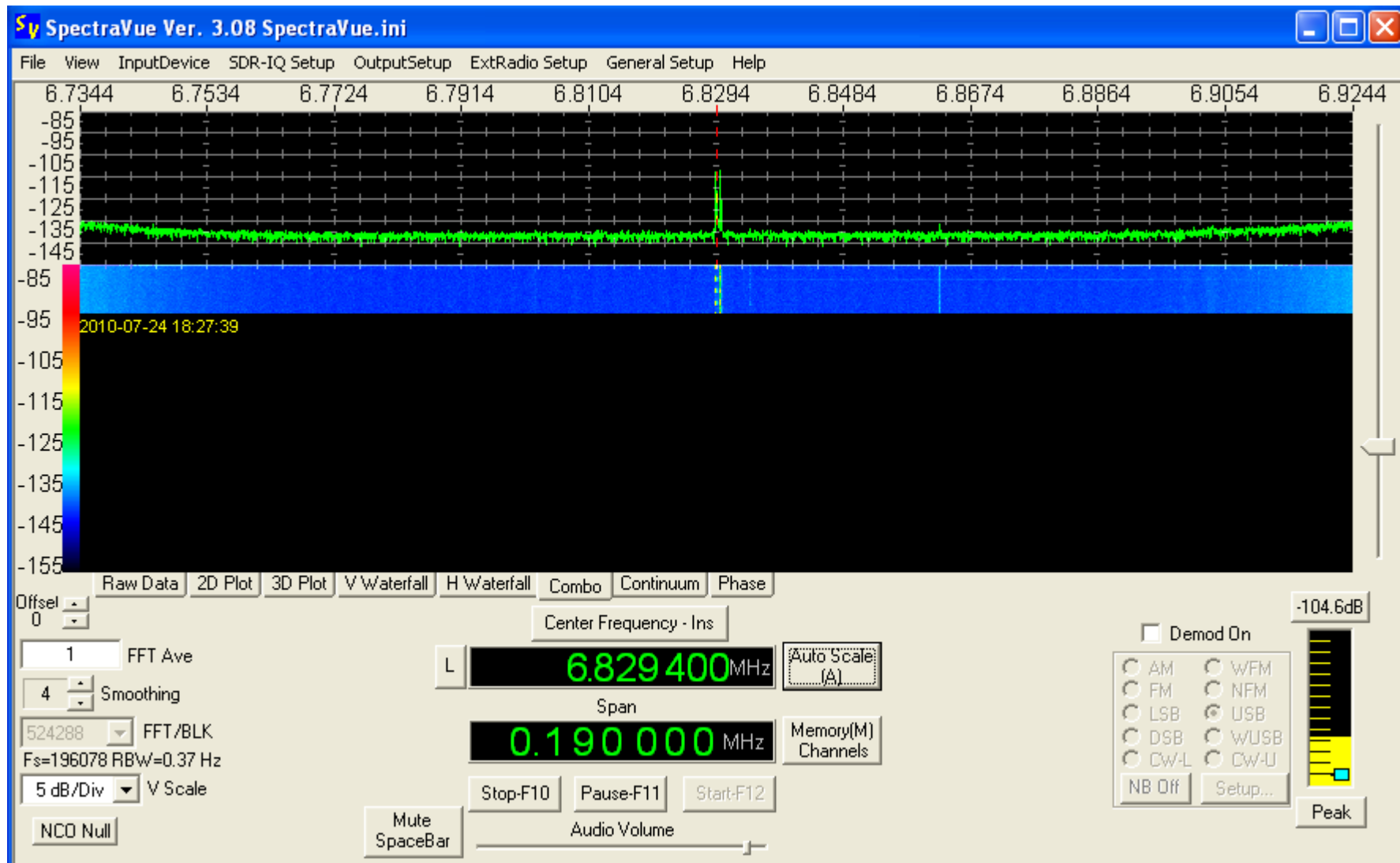
1 Big Wheel Ant



Stage 2... 2 BW's!



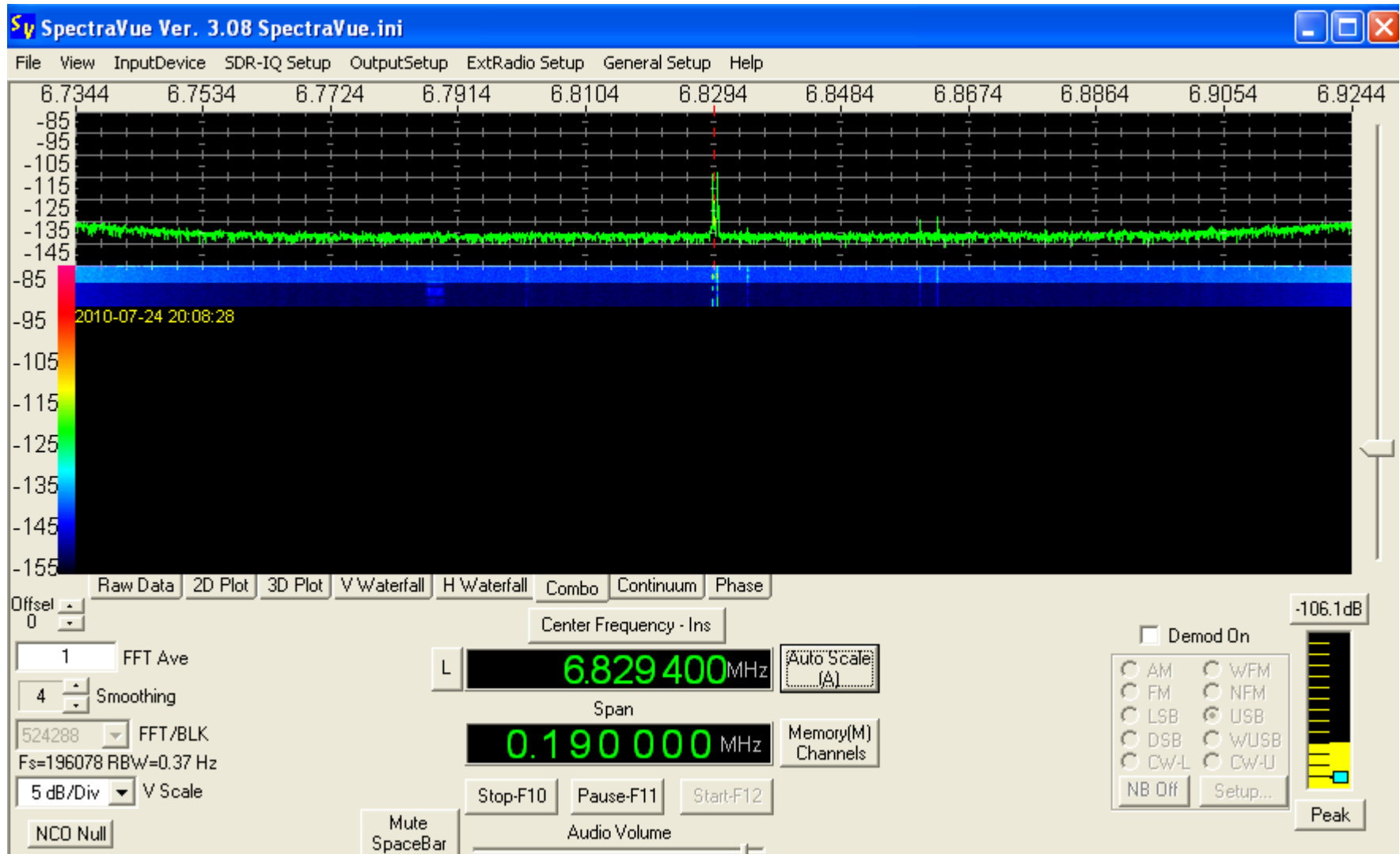
2 Big Wheel Ant



4 Big Wheel Stack



4 Big Wheel Ant



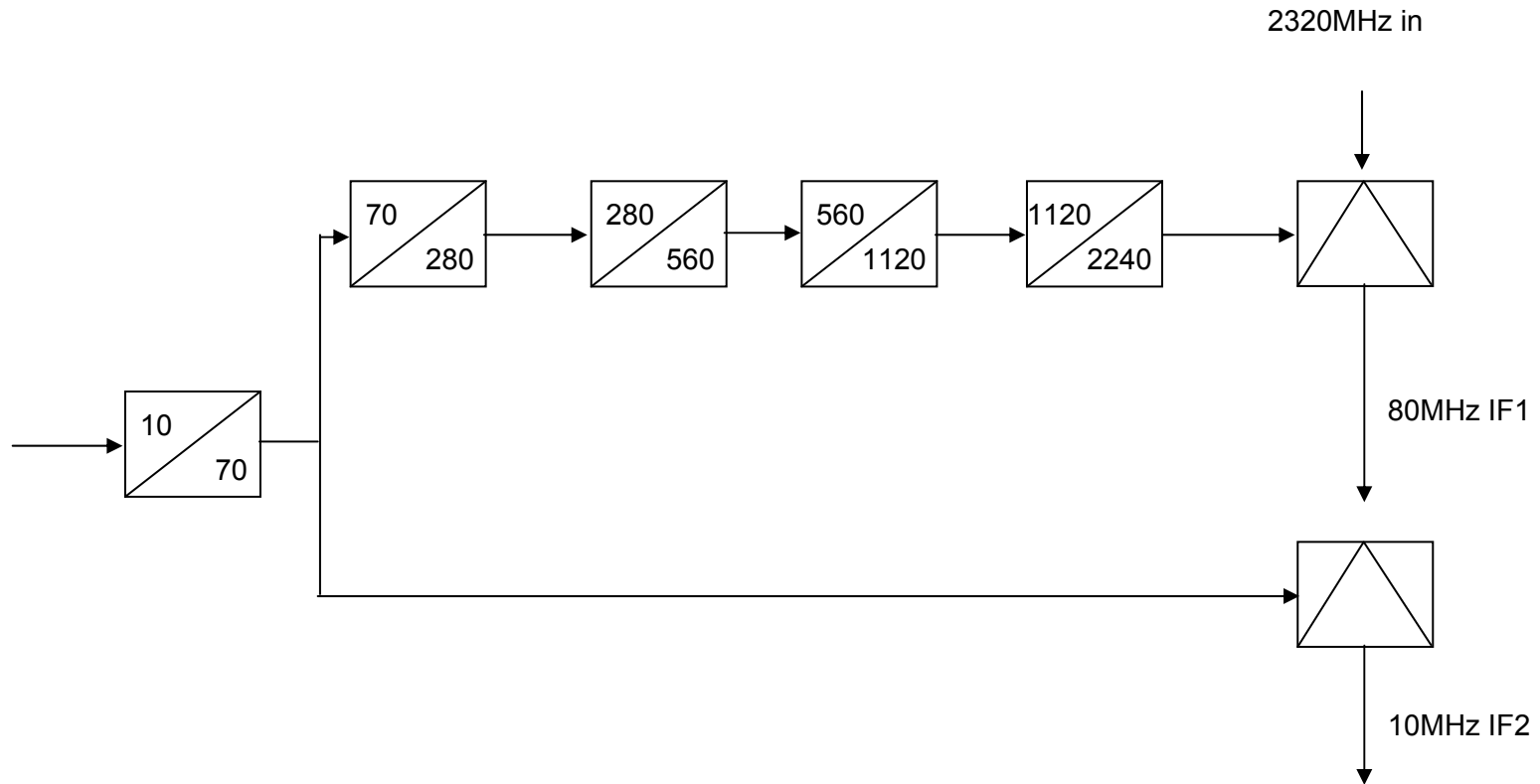
Monitoring solution

- The antenna, converter and single stage G4DDK preamp will mount in a length of 110mm plastic waste pipe
- 10MHz (+DC) and IF out will feed on two separate coaxes to SDR system
- Outline plans for other microwave band receivers exist

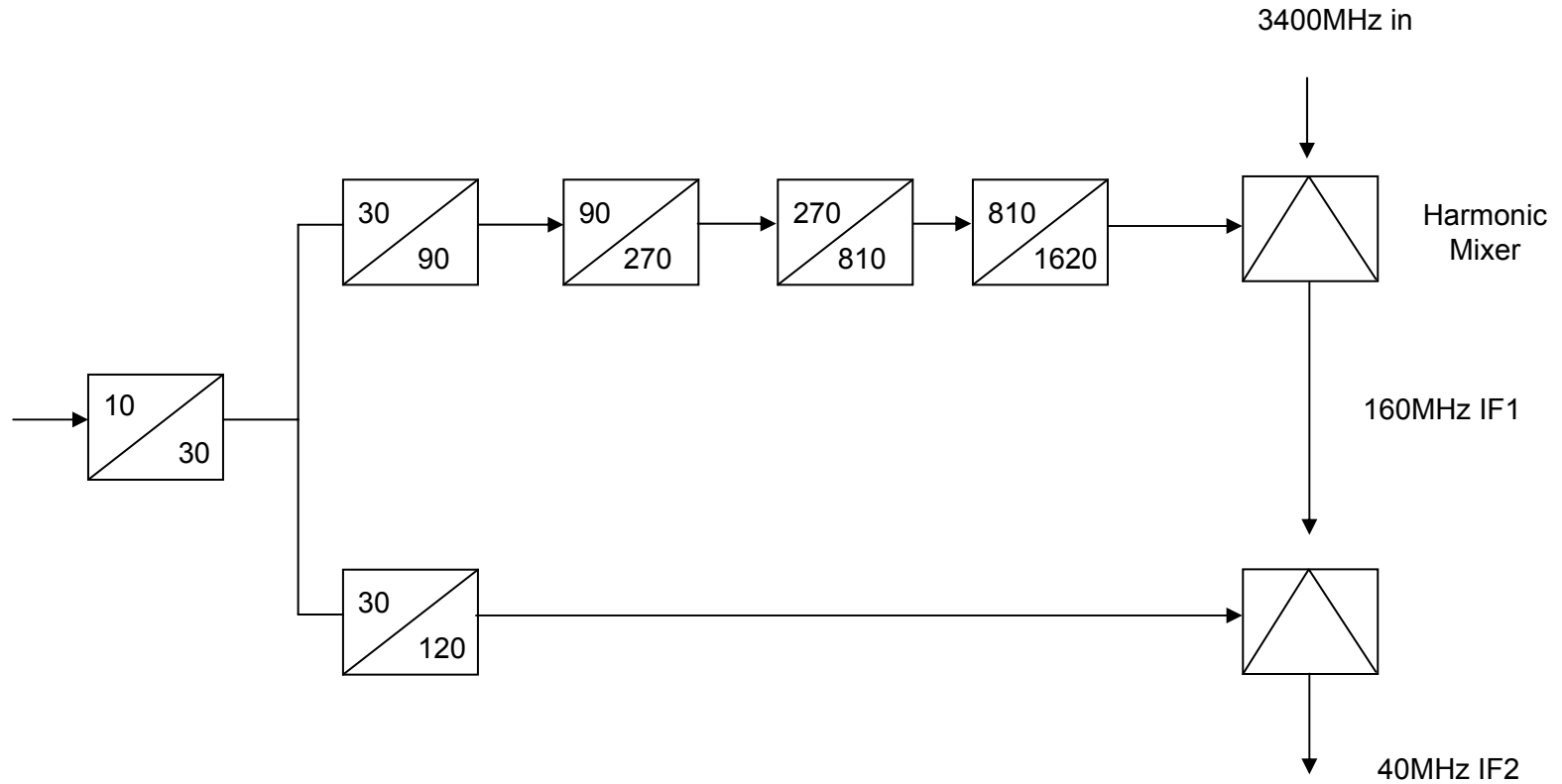
Future Ideas

- The objective of the project is data collection, but 'real time' presentation of band segments via the web is feasible
- All of the European microwave bands can be brought down to IF's below 50MHz using this double conversion approach

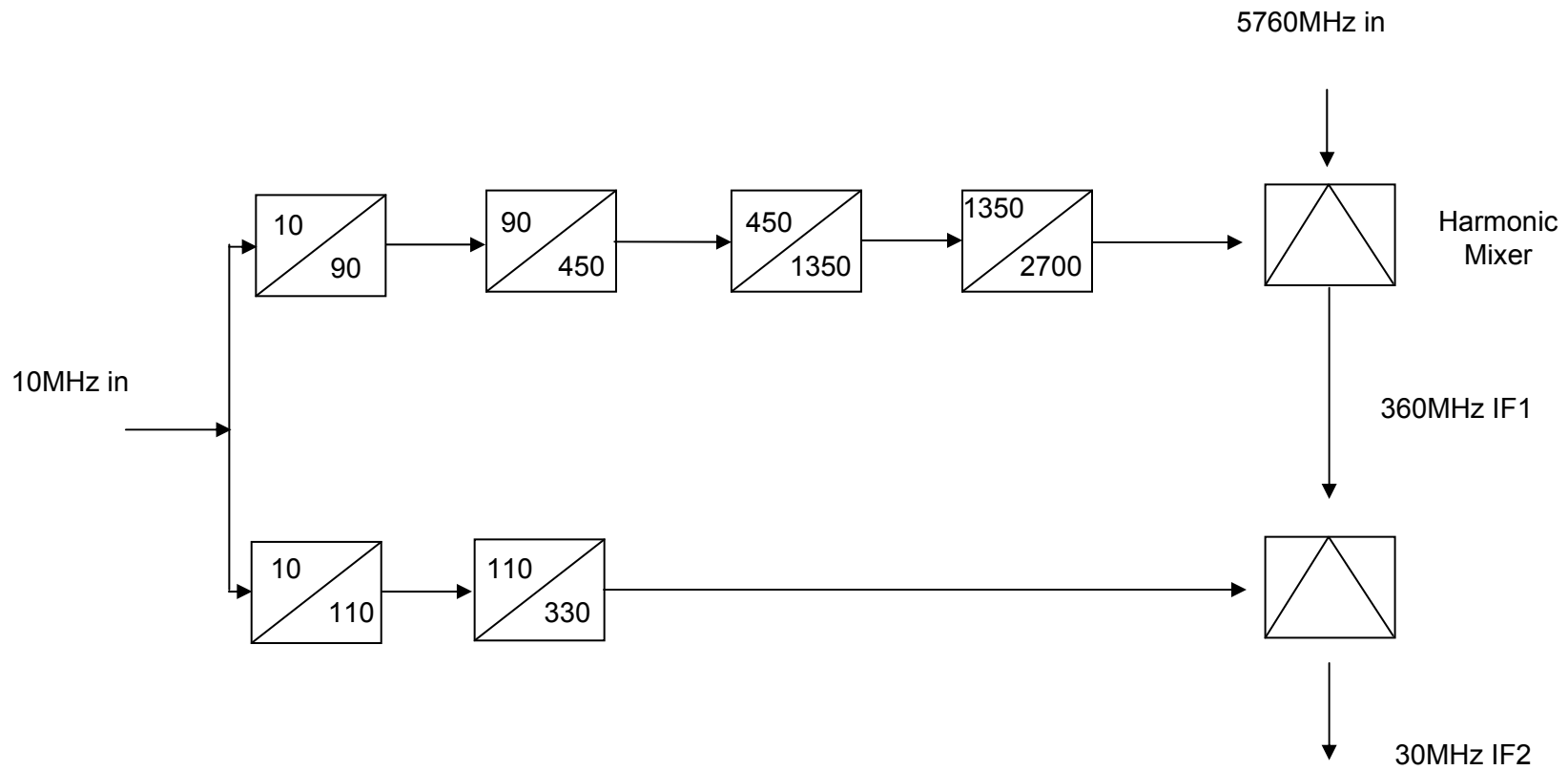
13 cm LO proposal



9cm LO proposal



6cm LO Proposal



IF Management

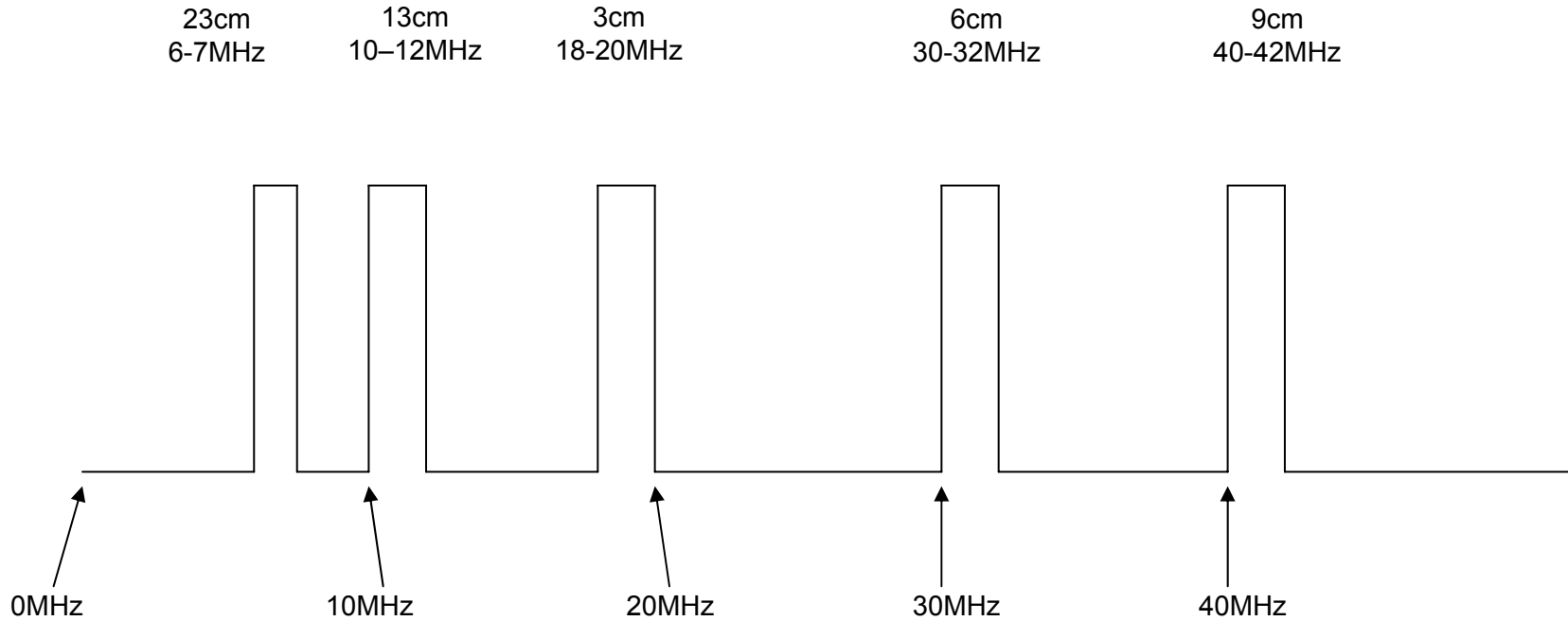
- Two options are possible:
 - a Display both the narrow band and the beacon segments of each band, or
 - b Use only the beacon segment
- Option a would allow an 8 Rx system, eg HPSSDR Mercury, to manage 4 bands
- Option *b* would give 8 bands on the same hardware/software

IF Multiplexing

- Using 6 pole filters at the output of each band converter will give a clean spectrum out
- The outputs of the filters can be summed through a broadband amplifier (5 to 45MHz) to give a composite single feed to the Rx

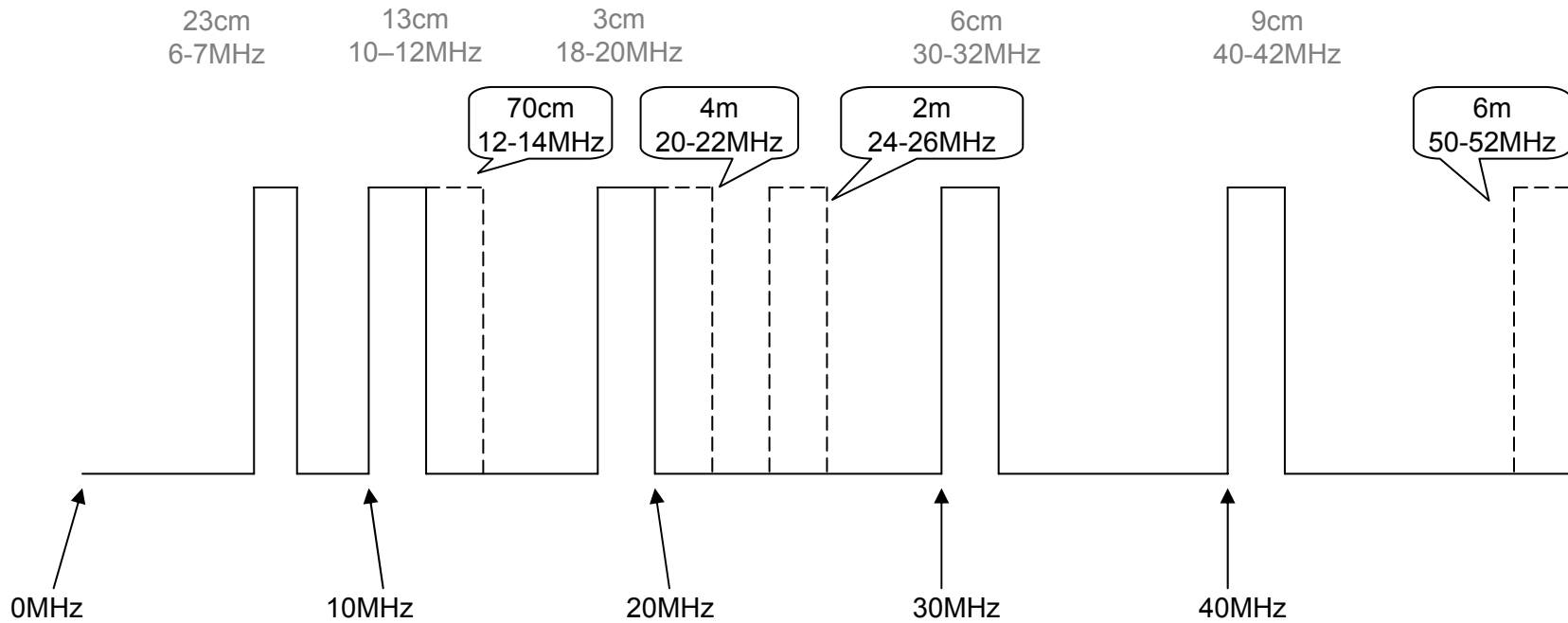
IF Spectrum

Microwave only option



IF Spectrum

>50MHz option



Conclusions

- LO generation using direct 10MHz multiplication is feasible for all microwave bands
- IF's of less than 50MHz can be delivered by double conversion
- Multiplexing IF's will allow multiband reception

References

- <http://www-users.cs.york.ac.uk/~fisher/lcfilter/>
- Jewell G4DDK (2006) 23cm preamp Microwave Projects
2 pp RSGB, London
- Micrometals 2005 Catalogue
- Big Wheel PCB antennas - <http://www.wa5vjb.com/>