

■ Digital ATV – Opening New Horizons

David Crump G8GKQ



■ Dave, G8GKQ

- Active with ATV since 1975
- Not an electronics professional
- Now retired for 7 years
- BATC and Portsdown Project
- QO-100 wideband bandplan lead



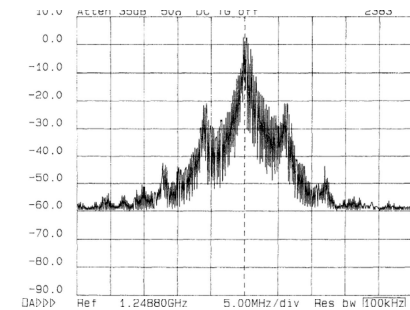
■ Why New Horizons?

- Brief Review of “old” ATV
- Intro to Digital ATV
- Benefits of Digital ATV
- Satellite ATV
- High Definition
- Equipment Options



■ “Old” Amateur TV

- AM on 70cm
- FM on 23cm and 3cm
- Followed broadcast standards
- Wide bandwidth



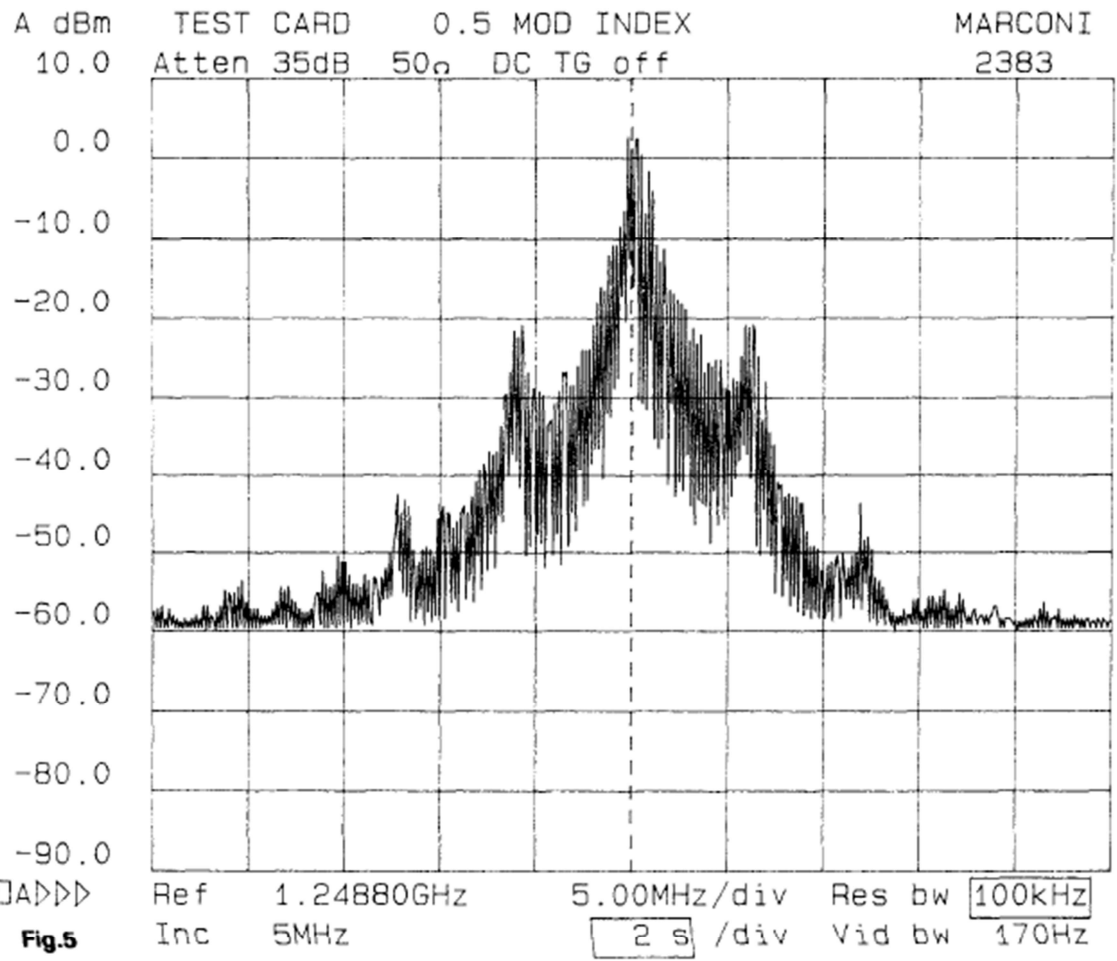
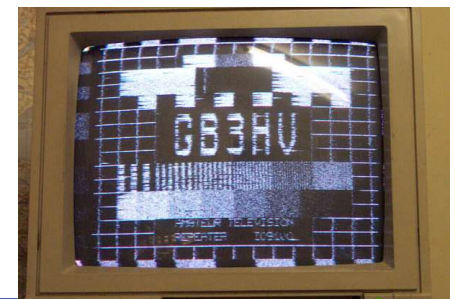
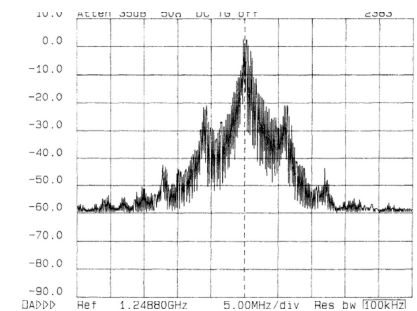


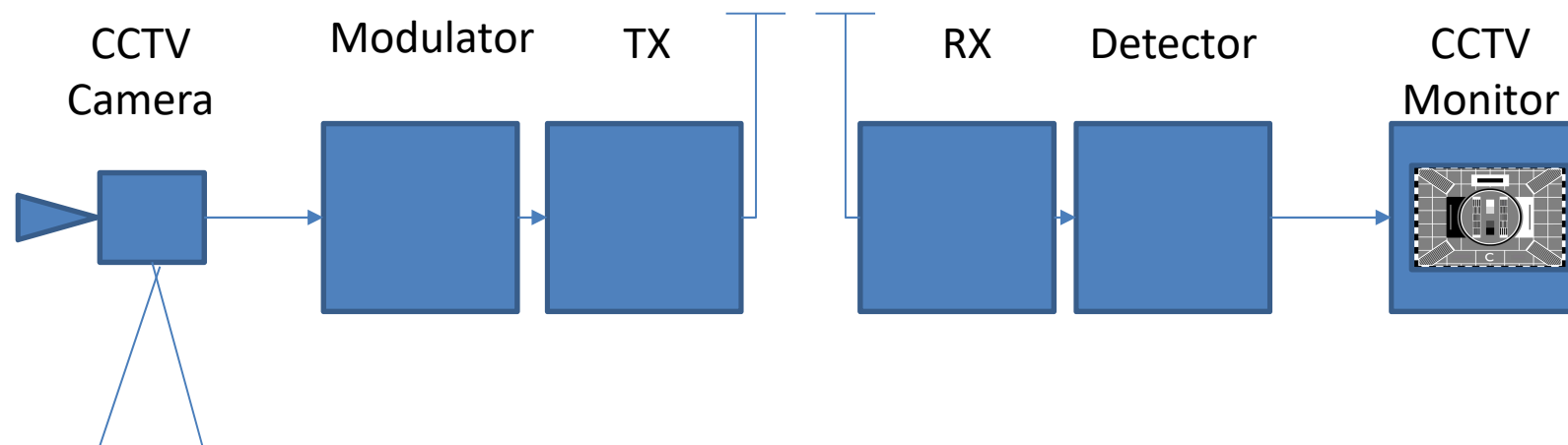
Fig.5

■ “Old” Amateur TV

- AM on 70cm
- FM on 23cm and 3cm
- Followed broadcast standards
- Wide bandwidth
- “Noisy” pictures



■ Analog ATV Block Diagram

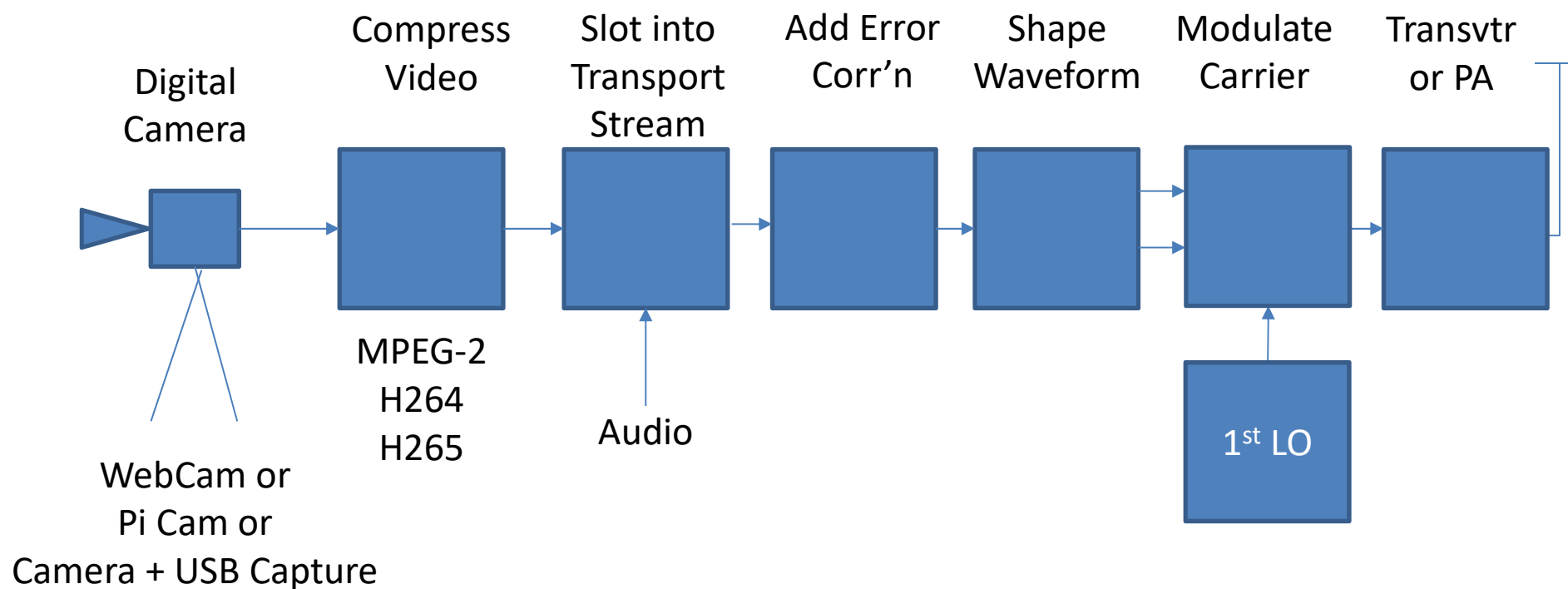


■ Digital TV

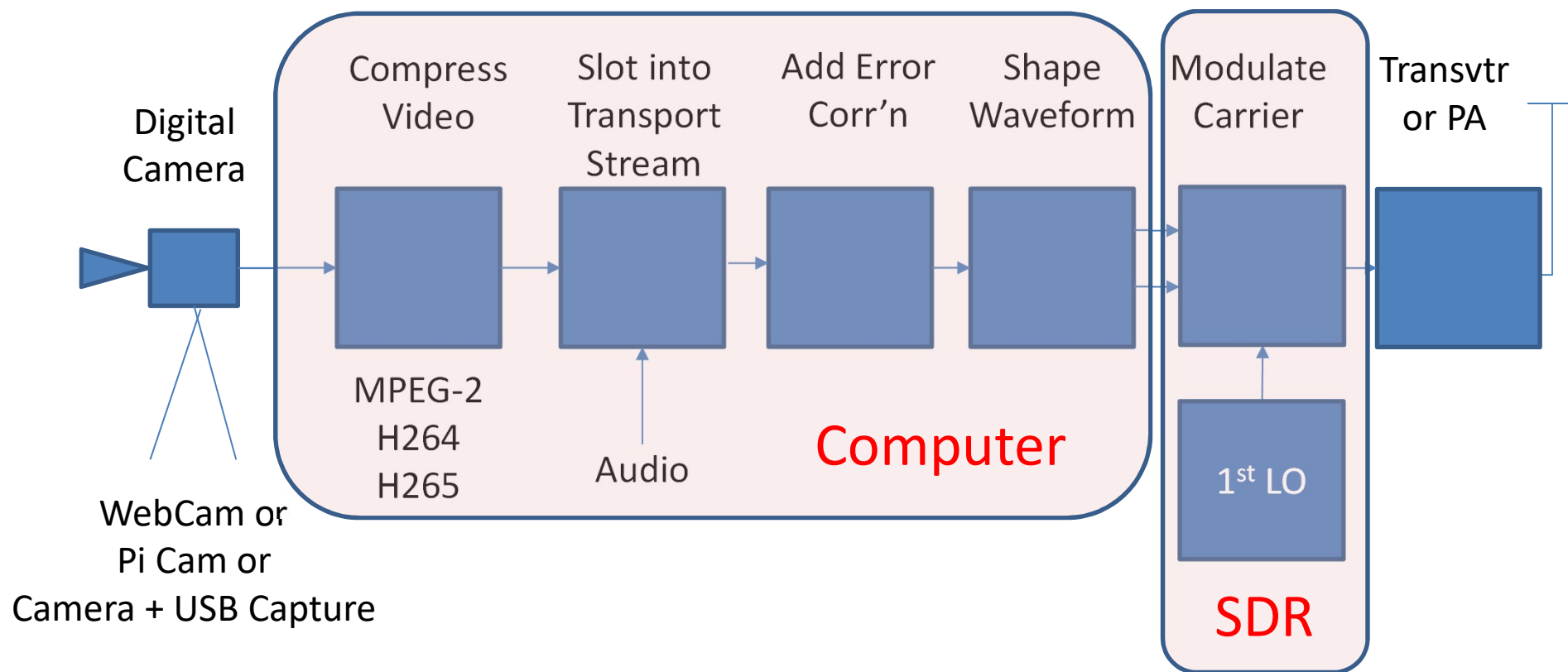
- Adopted by Broadcasters in 1990s
- Relies on lossy compression
- Configurable error correction
- Can fit multiple bits/sec into 1 Hz
- DVB-S and DVB-T variants



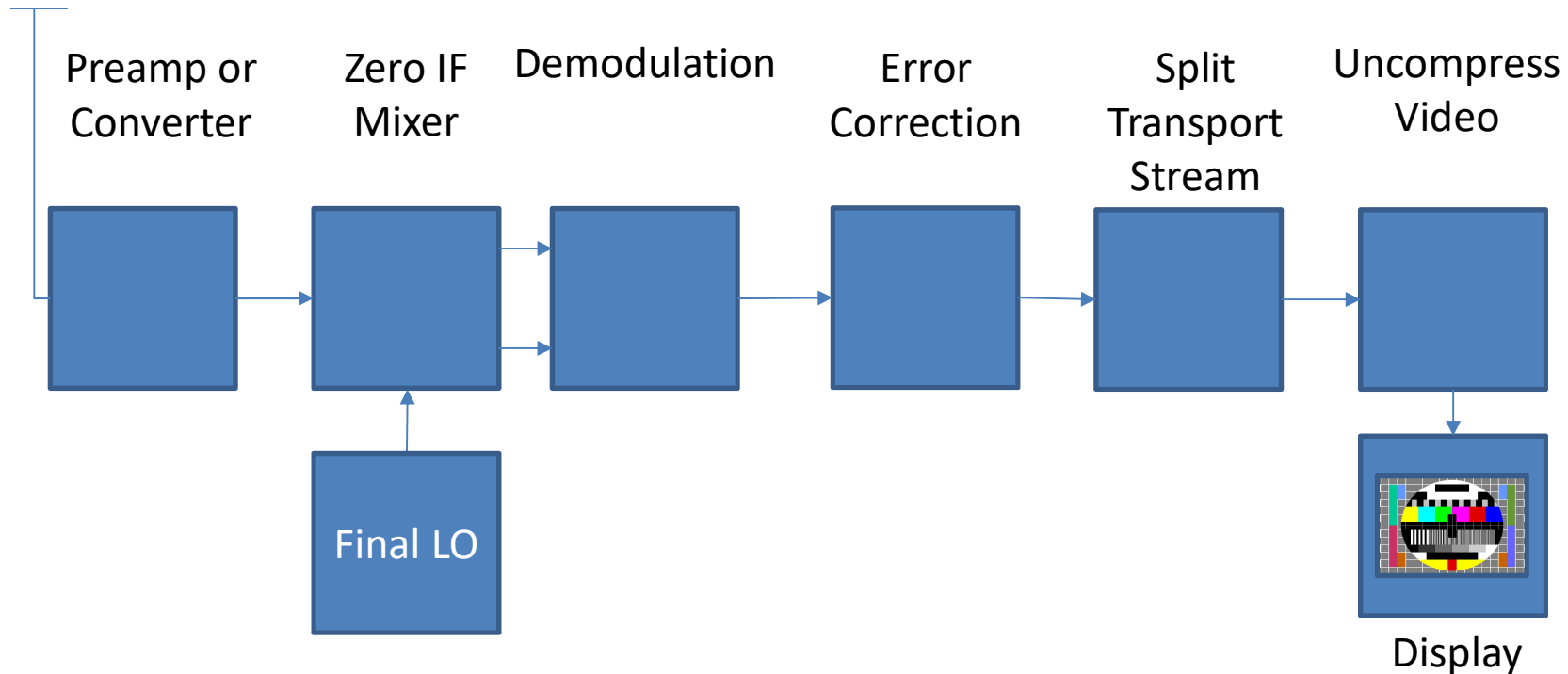
Digital TV Transmitter Block Diagram



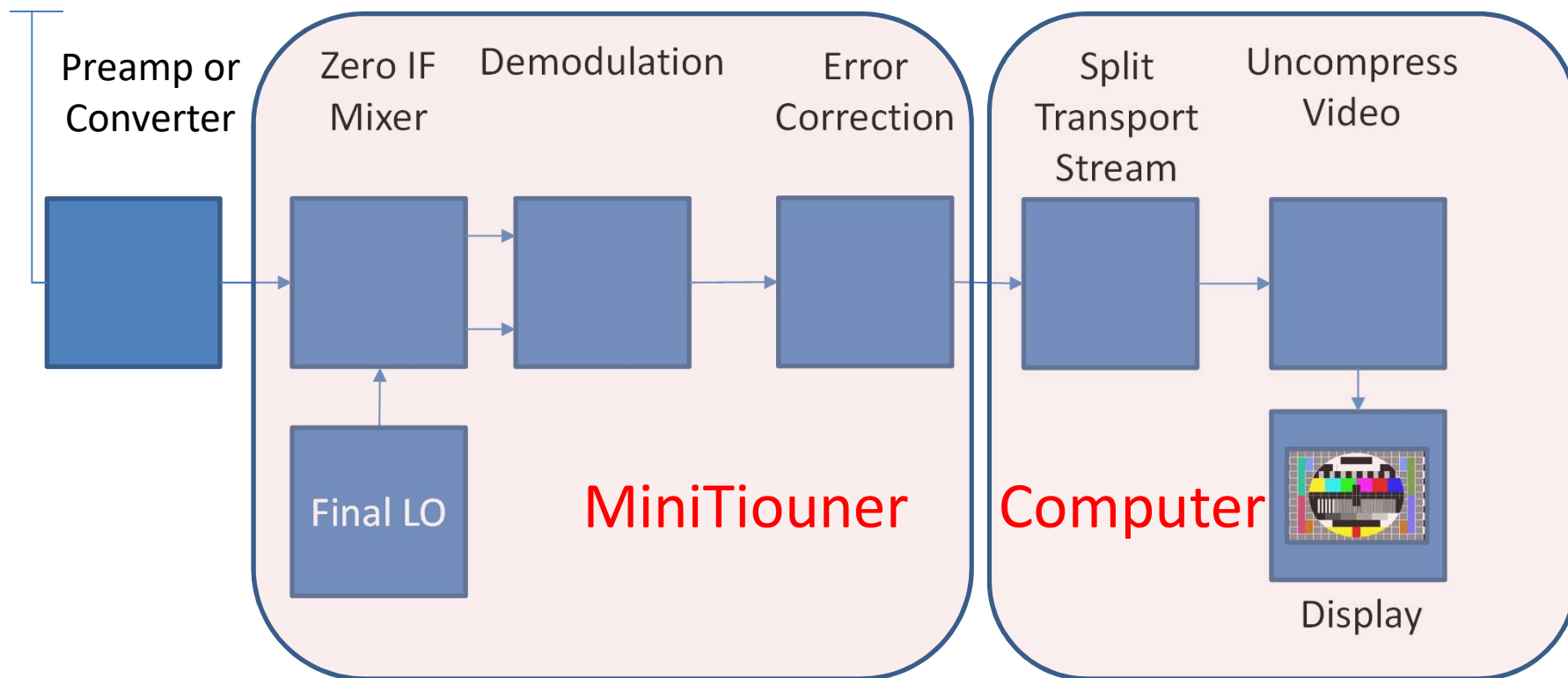
Digital TV Transmitter Block Diagram



Digital TV Receiver Block Diagram



Digital TV Receiver Block Diagram



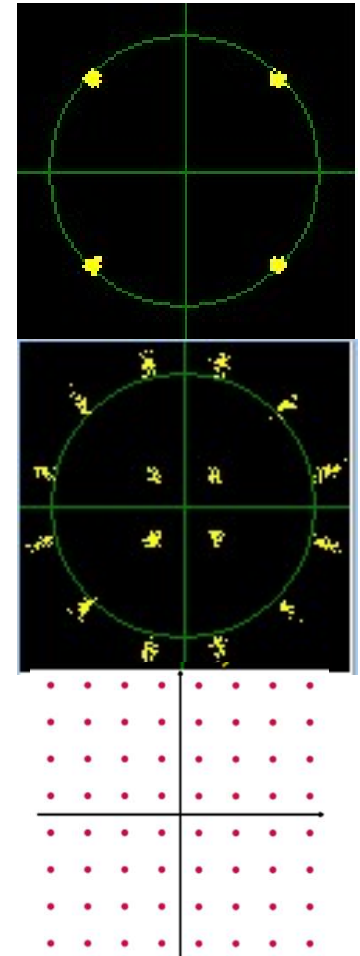
■ Digital TV Compression

- Encoders used to be 12U 19" rack
- Encoding: MPEG-2, H264, H265, AC-1
- Raspberry Pi includes an H264 encoder
- Jetson Nano includes an H265 encoder
- Modern PCs include H264 and H265



■ Digital TV RF Links

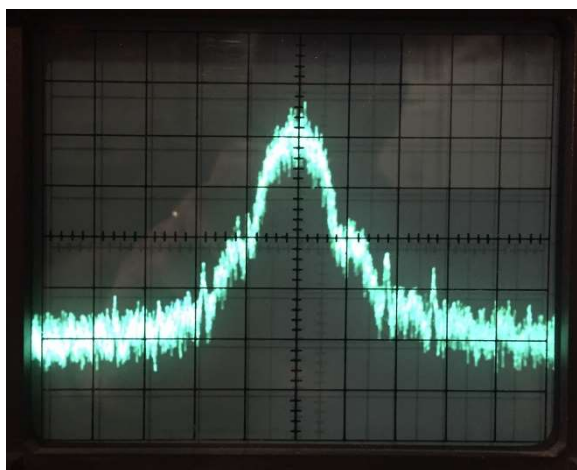
- DVB-S and DVB-S2 use:
 - QPSK, 8PSK, 16APSK or 32APSK
- DVB-T uses:
 - OFDM with 1,705 or 6,817 carriers
 - QPSK, 16QAM or 64QAM on each



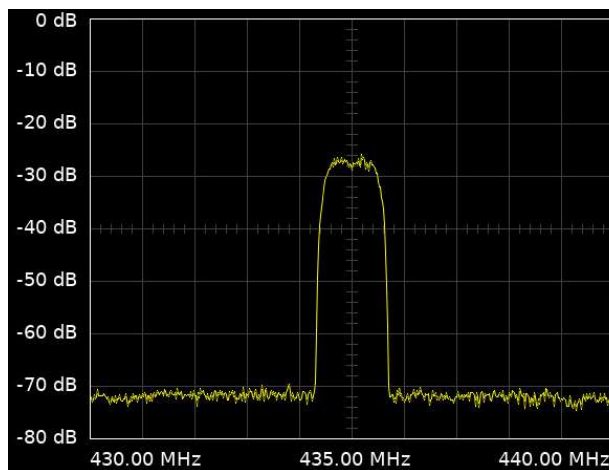
■ Amateur Digital TV

- Commercial DVB-S2 is 30+ MHz wide
- Commercial DVB-T is 8 MHz wide
- Initial DVB-S tests at 4, 2 and 1MS
- Extrapolated standard below 1MS
- Same for DVB-T – custom bandwidth
- Reduced Bandwidth TV (RB-TV)

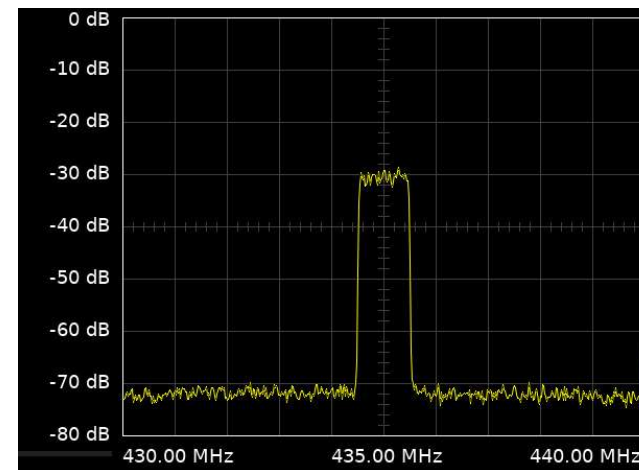
Digital TV Bandwidths



Pre-SDR DVB-S
2Ms @ 2MHz/div
3.5MHz @ 20dB
8MHz @ 40dB



SDR DVB-S2
1Ms @ 1MHz/div
1.4MHz @ 20dB
1.4MHz @ 40dB



SDR DVB-T
1MHz BW @ 1MHz/div
1.0MHz @ 20dB
1.0MHz @ 40dB

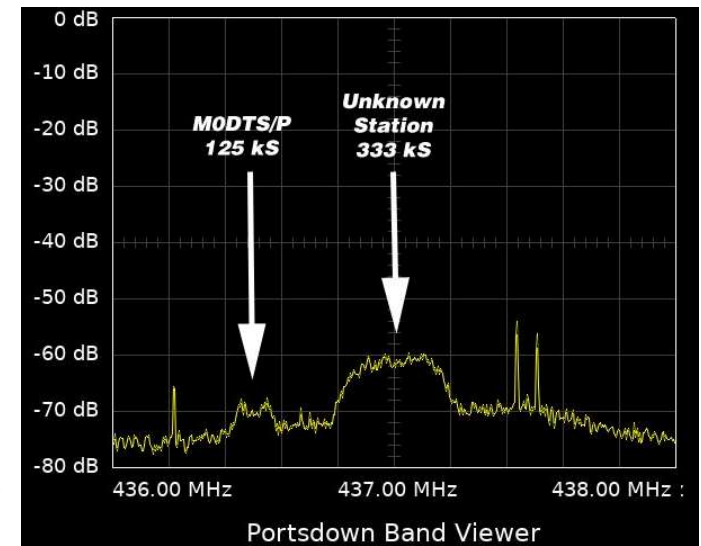
■ Digital TV Error Correction

- DVB uses Forward Error Correction
- Uses proportion of bitstream for FEC
- Signal Content expressed as a fraction
- For example $1/2$, $2/3$, $7/8$ or $9/10$
- Compromise between data and FEC
- Easy to encode, hard to decode



■ Benefits of DATV

- Symbol rate, error correction and modulation can be tailored
- For DX, use low SR and lots of error correction
- For local use higher SR
- Rarely needs more than 1.5 MHz bandwidth



■ Terrestrial DATV

- New repeater standard 1MS FEC 2/3
- Simplex 333kS FEC 2/3
- DX 125kS FEC 2/3 or 1/2
- Use H264 or H265 encoding
- 50 MHz DX 1700km using 125kS
- 122 GHz “DX” 5.9km using 125kS



■ DVB-T vs DVB-S

- DVB-S/S2 easier to generate than DVB-T/T2
- DVB-S/S2 easier to amplify
- DVB-S/S2 locks quicker
- Reduced bandwidth DVB-S/S2 less susceptible to multipath
- Trials suggest DVB-S/S2 is best

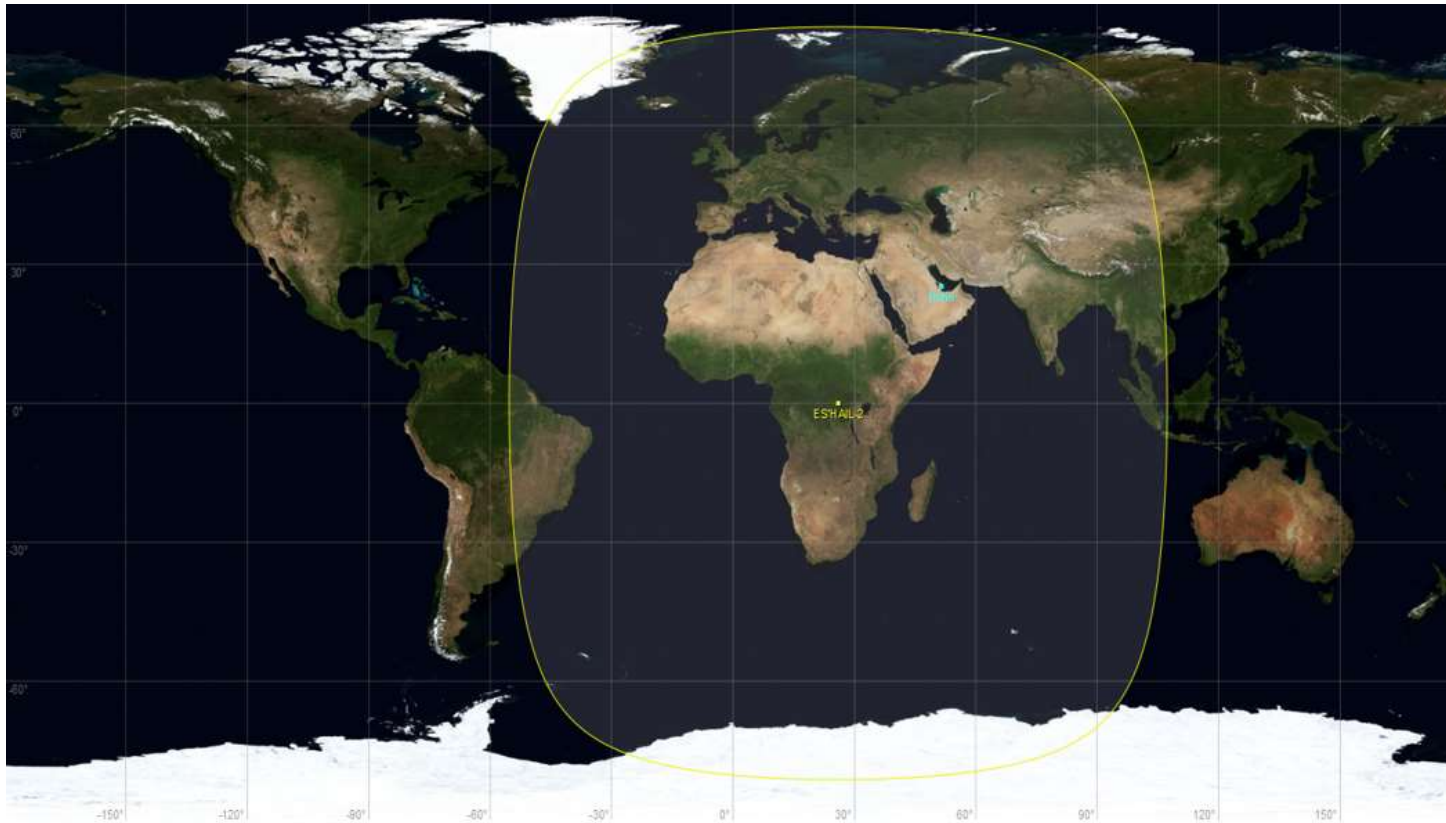
■ QO-100 Wideband

- Es'hail-2 carries 2 transponders
- QO-100 narrowband (500kHz)
- QO-100 wideband (9MHz)
- 2.4GHz up, 10.49GHz down
- Wideband has tighter link budget
- Demo downstairs



Beacon		Wide and Narrow DATV						Narrow DATV				
Beacon		IMS		IMS		IMS		333	333	333	333	333
		333	333	333	333	333	333					
Beacon Only		All DATV modes and SRs		DVB-S/S2 all symbol rates				333 kS and lower				
2401.5	2402.5	2403.5	2404.5	2405.5	2406.5	2407.5	2408.5	2409.5	Uplink (MHz)			
10491.0	10492.0	10493.0	10494.0	10495.0	10496.0	10497.0	10498.0	10499.0	Downlink (MHz)			

■ QO-100 Coverage

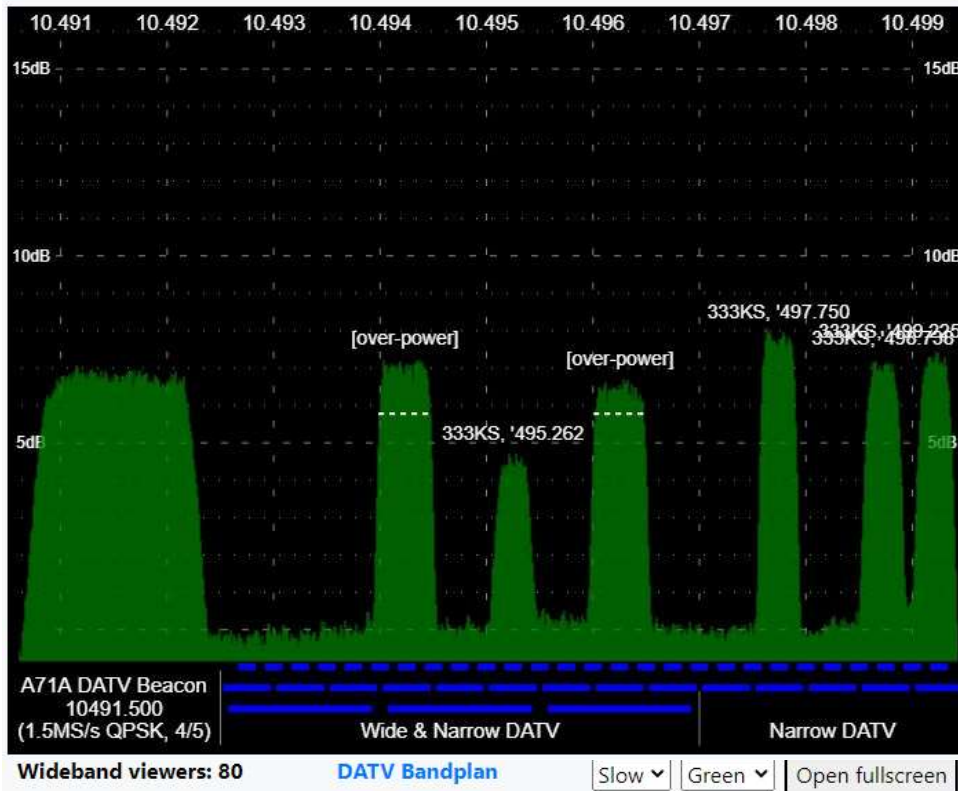


■ QO-100 Utilisation

- Users from Brazil to India
- South Africa to Russia
- Over 250 known users
- In 7MHz available bandwidth



QO-100 Coordination

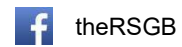


6:11 DB4ZW_Peter gm Poll..	DB4ZW_Peter
6:32 DB4ZW_Peter Poll 73	DB8XO
6:32 PA3BYV Poll 73 all, schönen Tag Peter	Joachim
6:32 DB4ZW_Peter Danke Poll dir auch..	dbrooke
8:30 DD4YR_Robert gm ..	DD4YR_Robert
8:43 DB4ZW_Peter gm Robert..	EA2ARU Jabi
8:46 DD4YR_Robert gm Peter... läuft ... auch im Nebel :-)	F4HSL-Yves
8:46 DB4ZW_Peter ja ich habe es gesehen..	F5NVP René
8:59 Joe - DJ4ZZ DL6BAR musikalisch guter jonter :)	fl_0
8:59 Joe - DJ4ZZ konter	G8GKQ Dave
9:02 Joe - DJ4ZZ Wie heisst dieser track nochmal ?	G8KOE Martin
9:03 Joe - DJ4ZZ synthesizer	Gareth_G4XAT
9:17 Joe - DJ4ZZ OMD Electricity	GW7BZY
9:27 ON1RC Chris Bonjour René D5 9.2 dB	ON1RC Chris
9:28 F5NVP René bonjour Chris	PA2JSA_Jaap
9:28 ON1RC Chris Alors quoi de 9 ?	PA2JSA_Jaap
9:30 F5NVP René 3x3	R0AU Vadim
9:31 ON1RC Chris 7+2	R0AU Vadim
9:31 F5NVP René et toi ???	
9:33 ON1RC Chris dur dur	
10:24 DM2CFL Hartmut Guten Tag an Alle...	

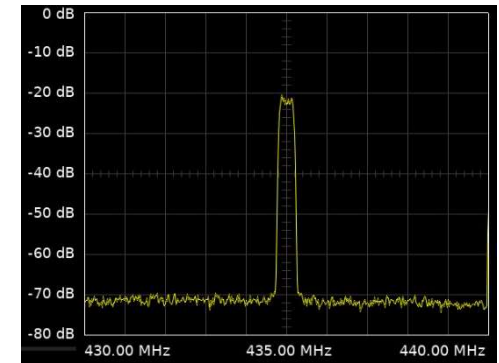
Type a message here and press enter.

[Chat-only webpage](#) [Chat Logs](#)

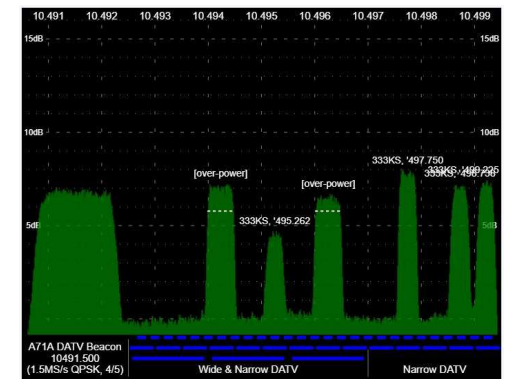
■ QO-100 Net Example



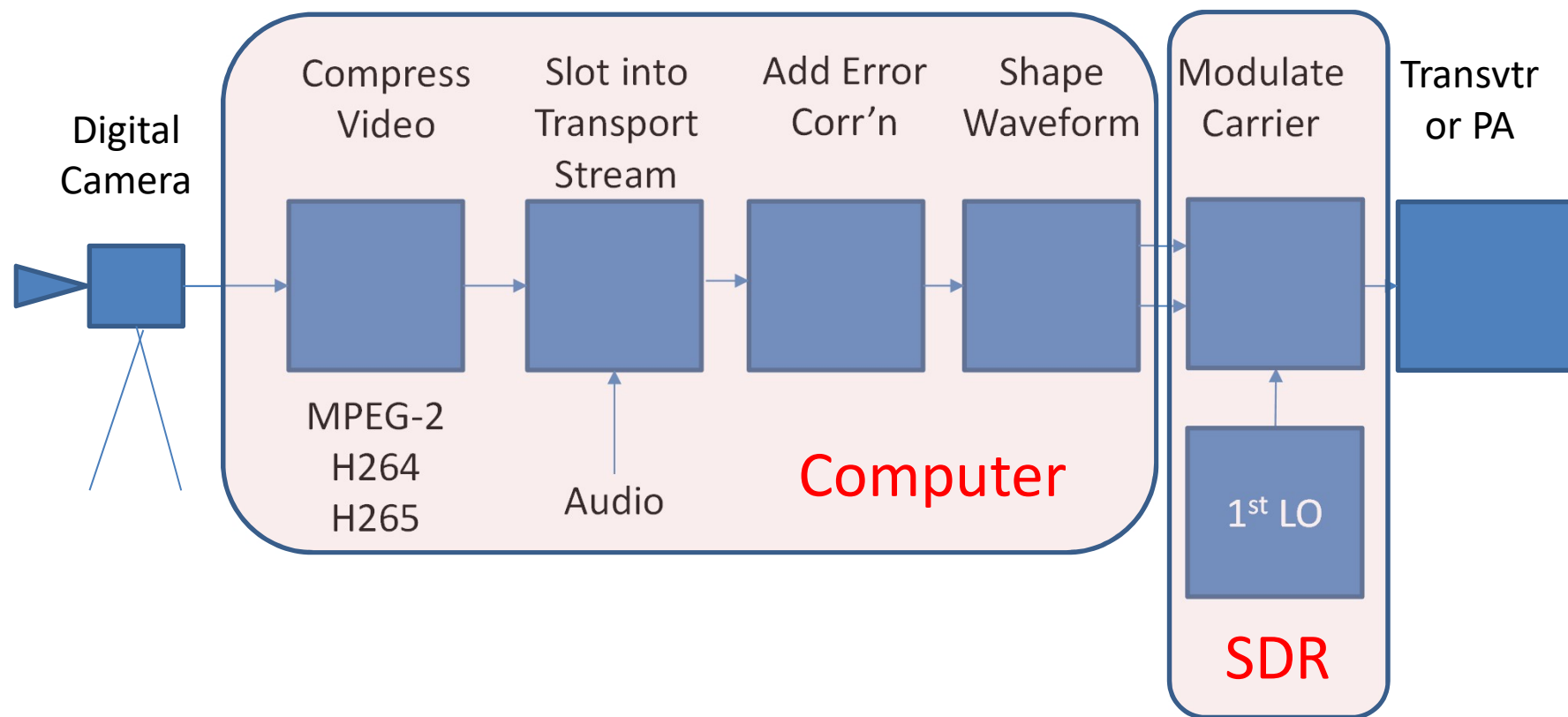
High Definition



1920x1280
in 500kHz



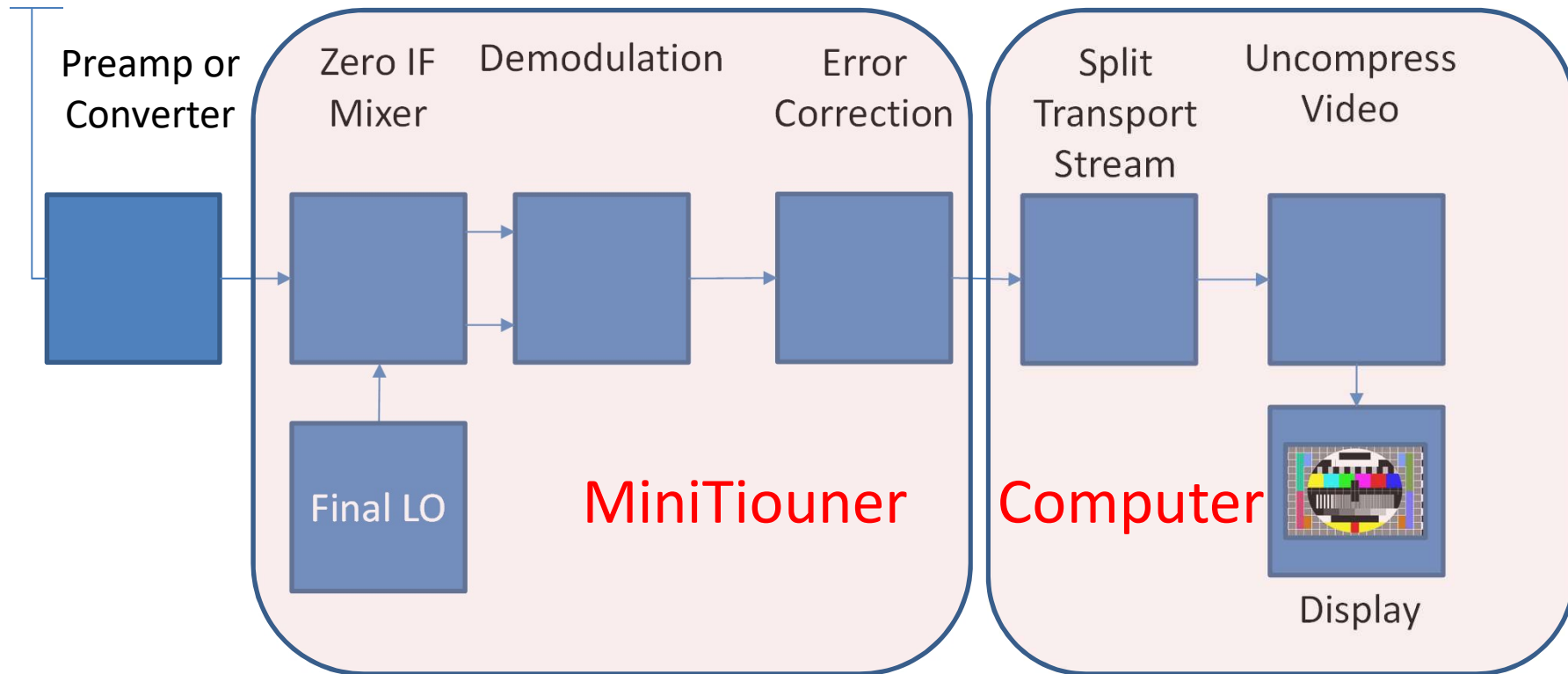
■ Transmission Techniques



Transmission Techniques

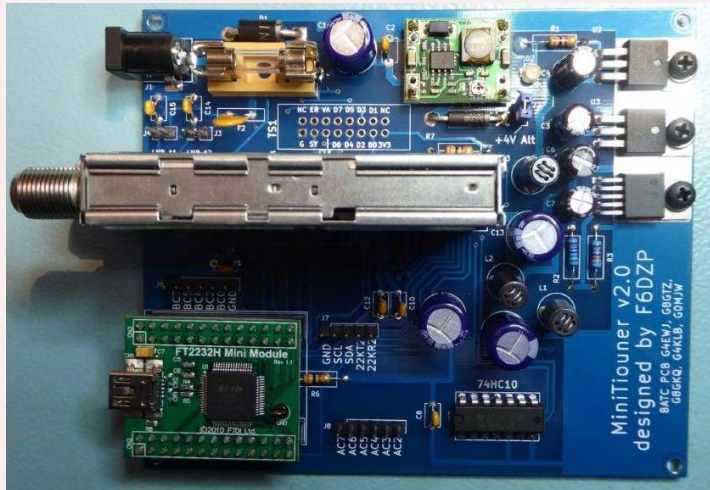


Receive Techniques

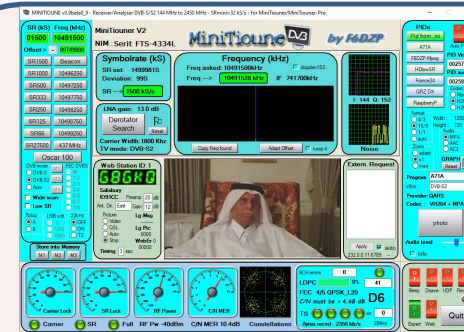


Receive Techniques

Preamp or Converter



MiniTiouner



Computer

■ Equipment Options

- MiniTiouner receives 144-2350 MHz
 - But needs prior gain
- SDRs cover 70-3500 MHz
 - But only produce about 1mW
- So we need Preamps, PAs and Transverters

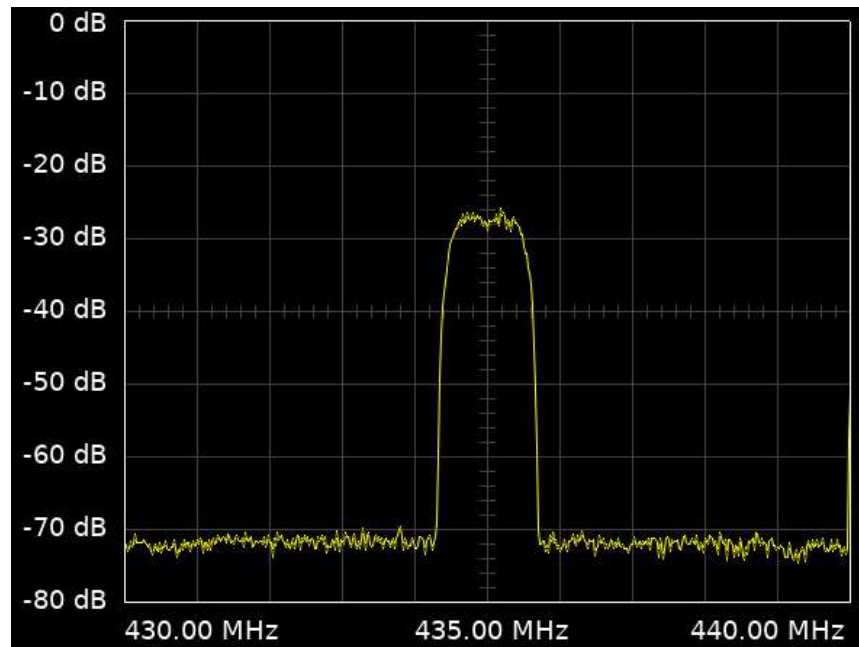


■ Terrestrial Equipment Options

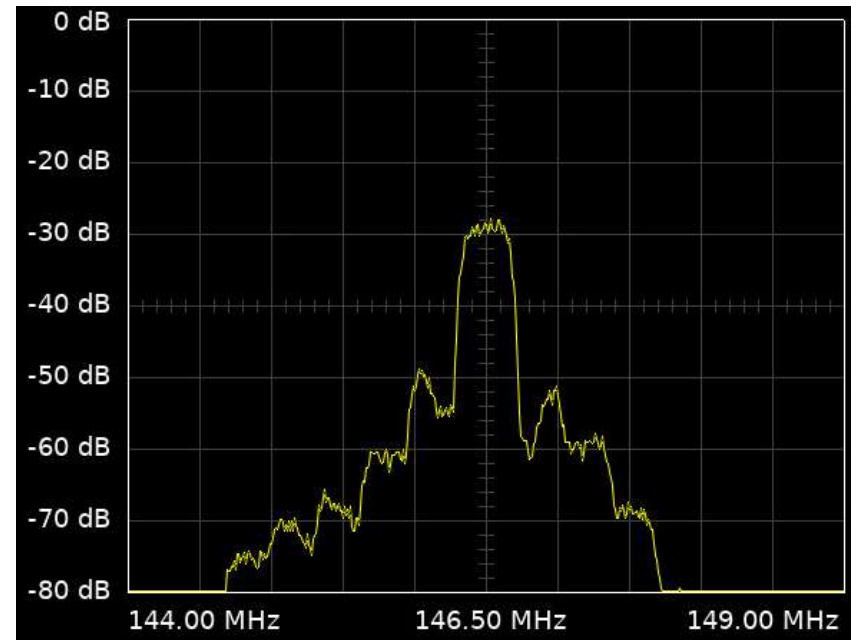
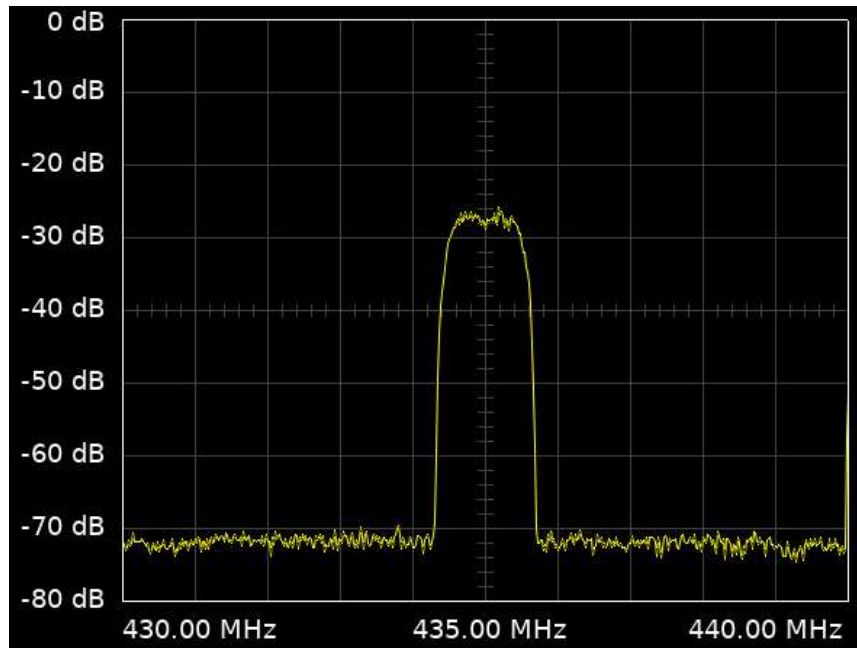
- Receive: as for SSB/FM/CW
 - But aim for 30dB of gain
- Transmit: needs to be very linear
 - Normal SSB PAs not good enough
- Use normal microwave transverters
 - But watch TX linearity



Amplification Linearity



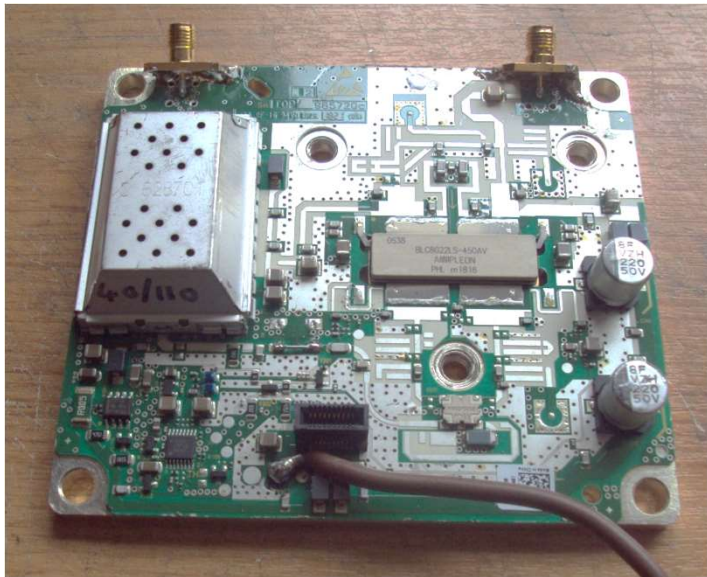
Amplification Linearity



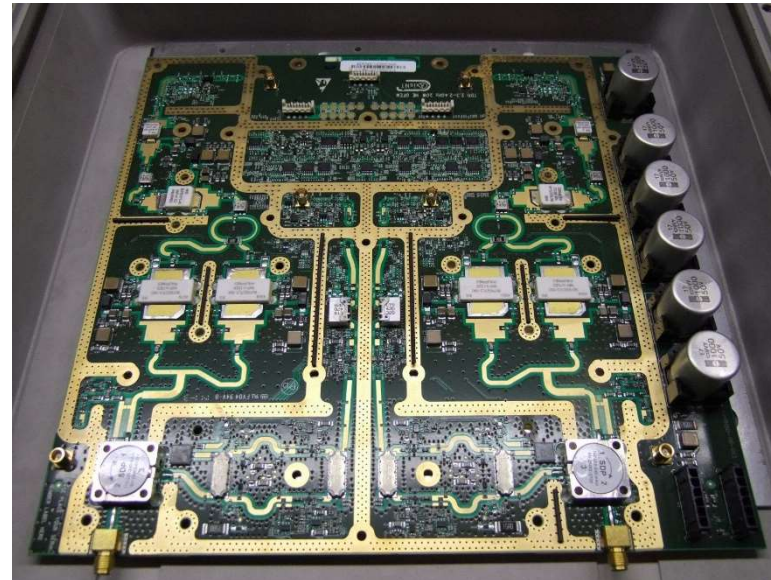
■ QO-100 Equipment



■ QO-100 Power Amplifiers



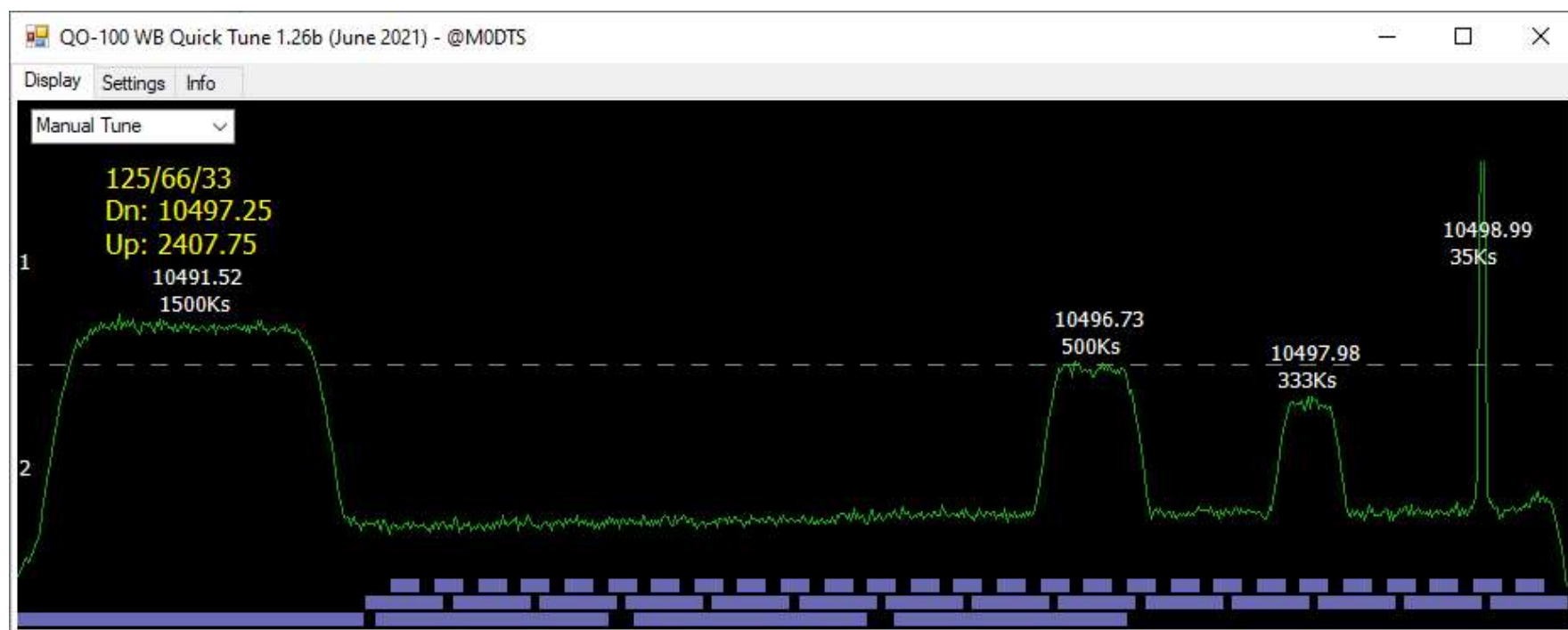
Nokia



AxisNT

Innovation: QuickTune

- Click on Spectrum – Tune RX



■ Innovation: Ryde Receiver

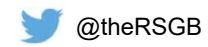
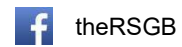
- Set-top box style DATV Receiver
- Uses IR Remote Control
- On-screen Menus
- RF in, HDMI out
- Open source software



■ Why New Horizons?

- Reach – DATV goes further
- QO-100 – Intercontinental DATV
- Equipment – Computer and SDR
- Innovation – through collaboration

Questions



■ Find out more...

<https://wiki.batc.org.uk/>

dave.g8gkq@gmail.com

 BATCOnline

 @BATCOnline

www.rsgb.org

