

# Ultralight EME

## The Way

Or

Reflections from Lewis2014

John Worsnop G4BAO



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### The – a very different type of radio club

- The “Social Arm” of the Cambs Repeater Group
- G3PYE, G6PYE, G5PI
- Historical connection to the Pye Telecom Amateur Radio Group
- Close ties to CUWS C&DARC, Raynet, Codgers.
- No Committee, No Clubhouse, No Bullshit
- We welcome “givers”, not “takers”
- Our clubhouse is “the radio”
- Monthly “Pye and Pint” meetings in a local pub
- Annual Fun DXpedition
- Members age from 18 to 80
- Interests from VLF via Sats and Microwaves to Optical comms.





# Camb-Hams Scottish islands activations

- Have become an annual event
- Mainly HF with some VHF
- “Wildcard Activity”
  - Mull 2012
    - Staffa
    - 10GHz – 2 QSOs (with the same station!)
    - 144MHz EME – happened by accident
  - Mull 2013
    - 472 kHz – bit of a failure
    - Optical Comms
    - 144MHz EME – better!
  - Lewis 2014
    - Shiant Islands
    - Ultralight 1.3GHz EME
  - Mull 2015
  - Arran 2016





# Camb-Hams Scottish islands activations

- Objective #1
  - Have fun!





# Why 23cms Portable EME?

- Plenty of activity and big stations on 1296MHz JT modes
- My “buzz” is making things work, not making QSOs!
- Microwave EME is not “easy”
- JT mode makes it a practical proposition
- It is within the grasp of a moderate station
- Great fun!

# Equipment

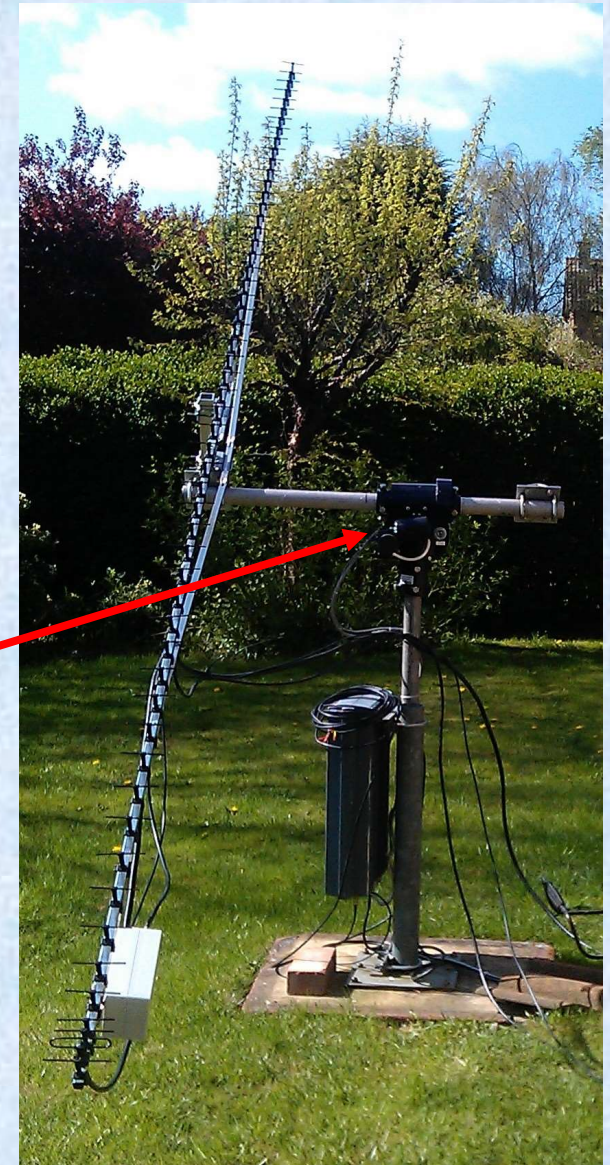
- Antenna
  - Decided to use Yagi(s) not a dish
- Upside
  - Easier to pack and carry
  - Lower windage
    - Important on a Scottish Isle
- Downside
  - Plane polarised not circular
    - 3dB system disadvantage before you start
  - Noisier
    - Sidelobes
  - Lower gain





# Equipment

- Rotor – Az El mount or Polar Mount?
- Chose an Az-EL mount because
  - I already own one
  - The hardware and tracking software is tried at tested at home
- Spid - RAS



# Equipment

- Rig – Transverter or Multiband?
  - Chose to use the TS2000X
    - Covers 1.3GHz as standard
    - Stable enough (with Fan mods) for JT modes
    - Tried and tested as a transverter driver for 2.3GHz EME
- Preamp
  - G4DDK VLNA23
    - Simply the best, field tested and inexpensive



# Equipment

- Power Amplifier
  - Must be rated for JT modes, Continuous 1 min on, 1 min off cycle
  - Must be reliable.....no standby unit
  - DB6NT 150W unit with large heatsink



## VK3UM EMECalc

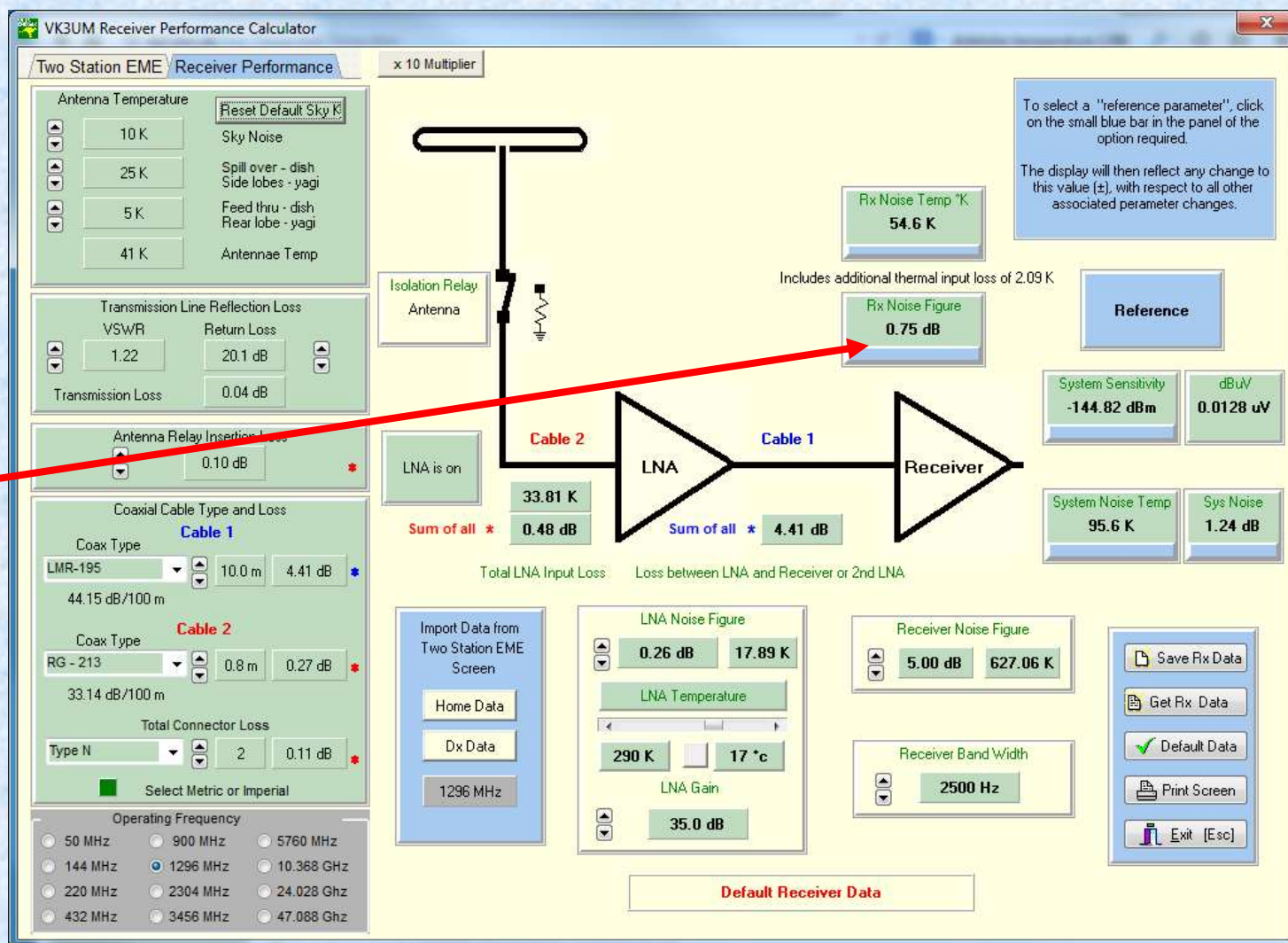
- “Must Have”
- Automates system calculations.
- Used for “What if” analysis of
  - Band
  - Antenna
  - Feed Type
  - Power
  - Receiver performance
  - Moon distance
  - Sun noise



# System calculations

## Receiver parameters

- LNA noise figure 0.26dB
- Preamp > feed loss  
– 0.48dB
- Gain  
– 35dB
- RX feeder loss  
– 4.5dB
- TS2k noise figure  
– 5dB
- RX NF 0.75dB

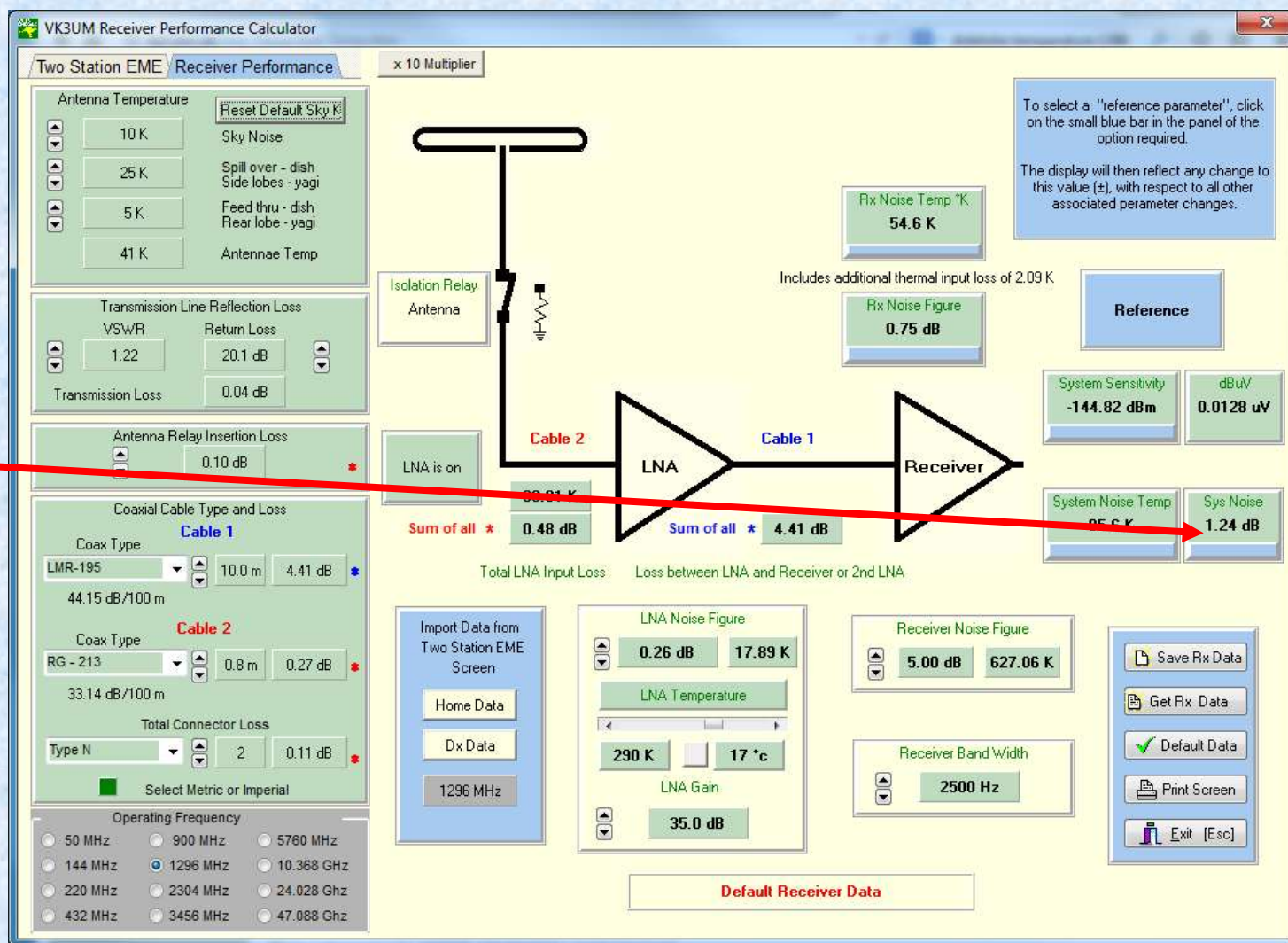




# System calculations

## Antenna parameters

- Antenna gain 21dBi
- Antenna Temp (best guess based on pattern)
  - Sky temp 10K
  - Rear lobes 5K
  - Side lobes 25K
- System NF 1.24 dB
- JT65c 2.5kHz BW



## Putting it all together

- Expect -19/-23 JT reports with a 3.5m Dish station running 500W circular

**VK3UM EME Performance Calculator Ver 9:10**

**Two Station EME** | Rx Performance | Source Pos. | Planets | Sky Map | Home Data

**Tx A (Home Station)** G4BAO\_55T

Frequency: 1296 MHz | Path Loss: 270.94 dB | 10 K | 2500 Hz | Diam: 1.00 mm | Mesh: 12.7 mm | Sys Sensitivity: -144.9 dBm | Echo S/N: -31.44 dB

GET IPS SFU DATA | 35.9 K | 17.2 K | 0.2 K | 24 K | 6.201 K | 5.74 dB

144 | 0.48 dB | 0.25 dB | 35.0 dB | 4.5 dB | 5.0 dB | 25 K | 5 K | 5.71 dB

10.7m | LNA Loss | LNA NF | LNA Gain | Coax Loss | Rx NF | Side losses | Rear loss | Sun Y | 0.03 dB

Tx A Output Power: 135 Watts | Transmission Loss: 21.30 dBW | 0.5 dB | 120 Watts | 20.80 dBW | 18.635 W EIRP

RxTK 53.3 K = 0.73 dB | Ground Temperature: 285 K | 12 °C | Tsys 93.3 K = 1.23 dB | System Noise Temperature

**Dx Station as received at Home Station ... -16.55 dB**

**Home Station as received at Dx Station ... -20.20 dB**

**Tx B (Dx Station)** G4BAO\_55T

Frequency: 1296 MHz | Path Loss: 270.94 dB | 10 K | 2500 Hz | Diam: 1.00 mm | Mesh: 8.0 mm | Sys Sensitivity: -146.5 dBm | Echo S/N: -5.41 dB

GET IPS SFU DATA | 10.8 K | 17.9 K | 0.6 K | 24 K | 1.222 K | 7.01 dB

144 | 0.15 dB | 0.26 dB | 35.0 dB | 7.0 dB | 1.5 dB | 24 K | 2 K | 13.82 dB

10.7m | LNA Loss | LNA NF | LNA Gain | Coax Loss | Rx NF | Spillover | Feedthrough | Sun Y | 0.09 dB

Tx B Output Power: 500 Watts | Transmission Loss: 26.99 dBW | 1.0 dB | 397 Watts | 25.99 dBW | 571.836 W EIRP

RxTK 29.3 K = 0.42 dB | Ground Temperature: 290 K | 17 °C | Tsys 65.5 K = 0.88 dB | System Noise Temperature

**Operating Frequency:** 50 MHz | 432 MHz | 2304 MHz | 10.368 GHz | 70 MHz | 144 MHz | 900 MHz | 3456 MHz | 24.048 GHz | 408 MHz | 222 MHz | 1296 MHz | 5760 MHz | 47.088 GHz | 2295 MHz

**Yagi Array 1296 MHz**

Single Yagi Gain in dBd: 19.75 dBd | Number of Yagis: 1 | G/T: N/A | E: 13.20 ° | Beam Width: 13.20 ° | Array Type and Gain: F9FT 1296 55EL

**Parabolic Reflector**

Focal length 0.70 m | Diameter: 1.90 m | Size: Metric | f/D: 0.37 | Efficiency: 52% | Beam Width: 8.52° | Gain: 9155 | Dish Gain: 23.24 dBd | 25.39 dBd | 41.1 Lambda

**Home Station ... Y Factor Calc**

Noise Source (Hot): Sagittarius A, Cassiopeia A, Cygnus A, Centaurus A, Taurus A, Virgo A, Termination, Ground

Noise [hot] Flux: 1775 Jy | Quiet [cold] Sky: 10 K | System TK: 93.3 K

**Point Source Y Factor** 0.02 dB

**Yagi Array 1296 MHz**

Single Yagi Gain in dBd: 15.95 dBd | Number of Yagis: 4 | G/T: N/A | E: 10.61 ° | Beam Width: 10.61 ° | Array Type and Gain: F9FT 1296 23EL

**Parabolic Reflector**

Focal length 1.30 m | Diameter: 3.50 m | Size: Metric | f/D: 0.37 | Efficiency: 64% | Beam Width: 4.63° | Gain: 1446 | Dish Gain: 29.43 dBd | 31.58 dBd | 15.1 Lambda

**Effective Aperture**

TxA: 0.66 M² | TxB: 6.16 M² | Moon Beam Fill Factor: 1.00 x | Sun Beam Fill Factor: 1.00 x | G/T Ratio: 0.00 | Adjust Moon Temp for phase and frequency: 22.07

**Moon Radar Equ.** 52.80 dB | **Current Moon Distance** 365,073 kms | **Moon Angular Diam** 0.525°.31'30.9" | **Actual Moon Temp** 230 K..0.9 K

**Moon return Loss** 270.94 dB | **Moon Flux 10⁻²²** Sv = 0.0783 | **Moon Declination** Dec. -18.97 ° | **Corrected sfu** 106

Engineering Panel | VK3UM Ver 9:10 | 1296 MHz

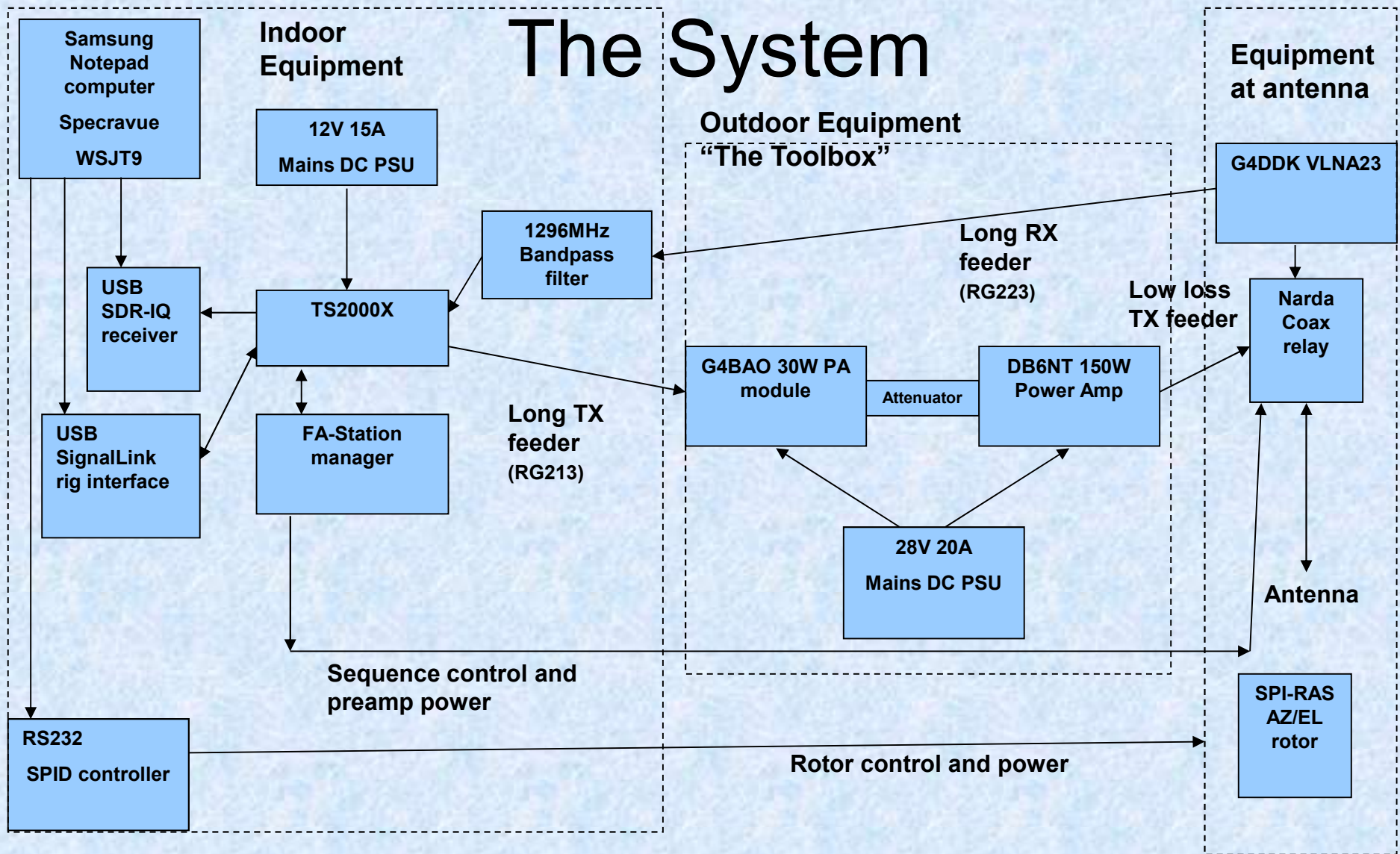


# The Equipment

- There was Lots of it.....

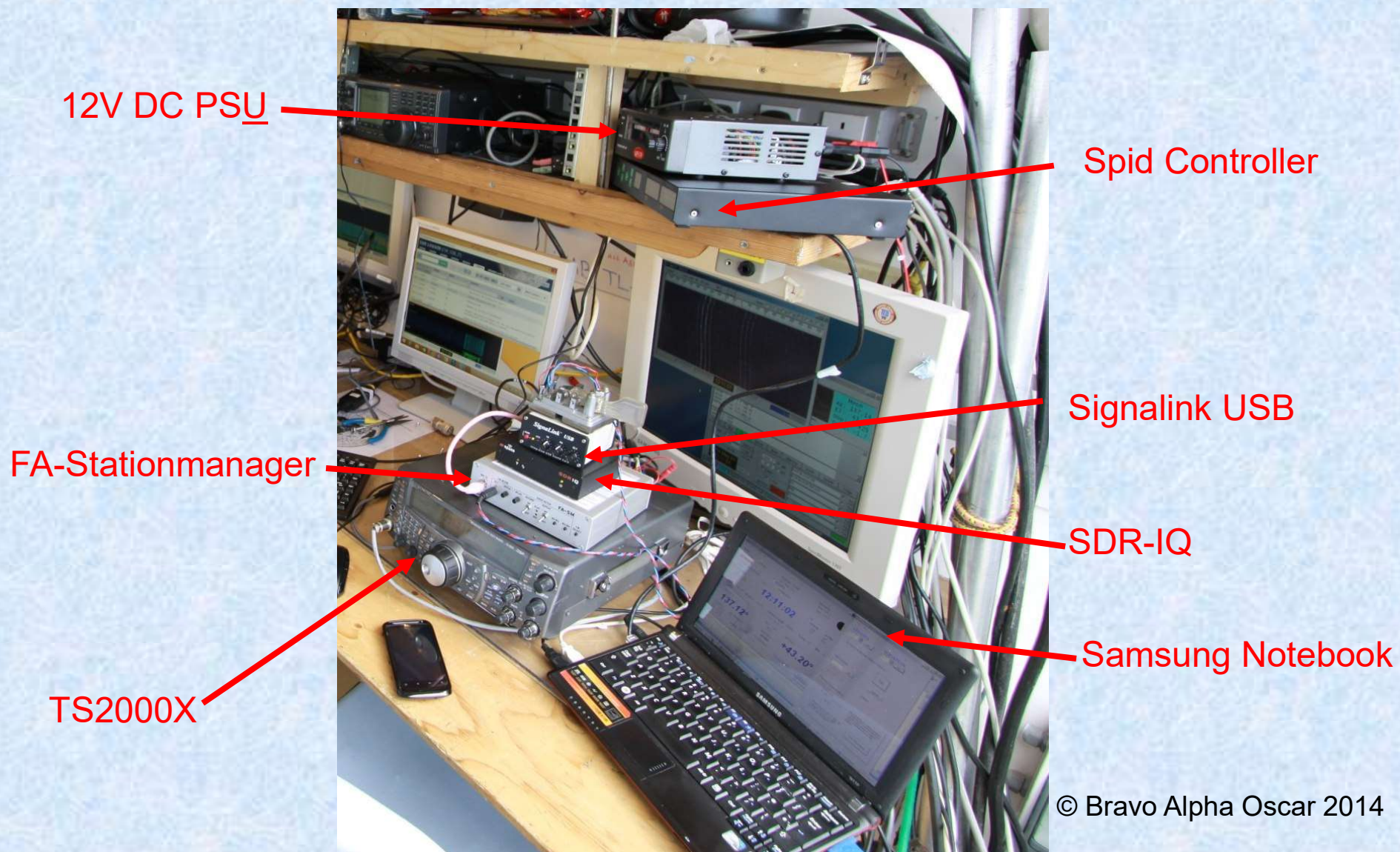


## The System





# Indoor equipment

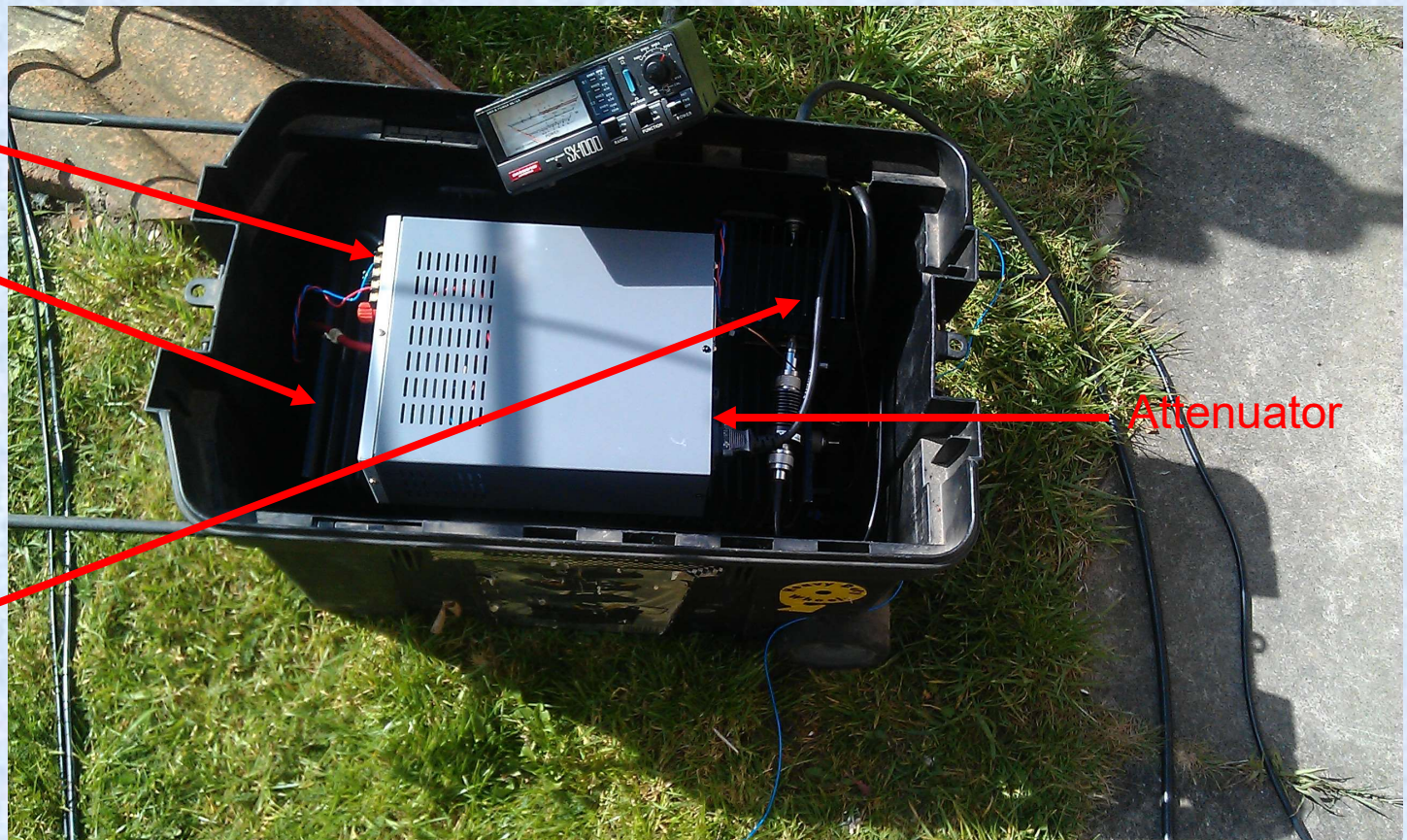




# Outdoor equipment “The toolbox”

28V DC PSU  
on top of  
DB6NT PA

Driver Amp  
tucked down  
here



Attenuator

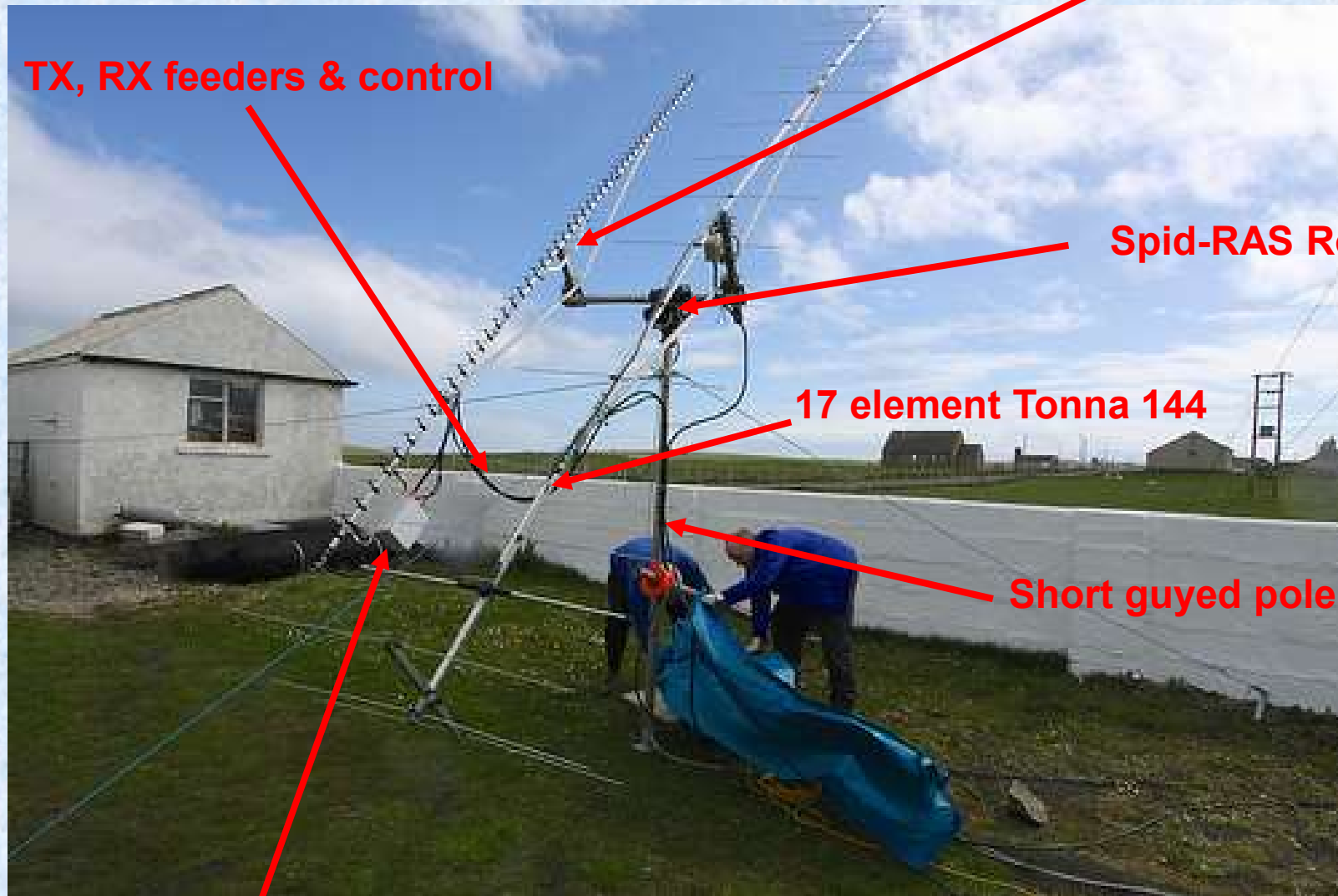


# The Antenna

- We didn't use this antenna.... But pictures like this are compulsory for EME talks
- ☺
- Moving on.....



# The Antenna



55 element Tonna 1296

TX, RX feeders & control

Spid-RAS Rotator

17 element Tonna 144

Short guyed pole with stay

G4DDK VLNA23 and relay

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# Log of stations worked

**14 “initials” in 11 DXCCs on 4 continents**

<b>Date</b>	<b>Time</b>	<b>Callsign</b>	<b>DX Station Details</b>
27/04	12:29	I1NDP	10m Prime focus dish 500W
27/04	12:35	UA4HTS	6m Prime focus dish 700W
27/04	12:47	UA3PTW	3.7m Prime focus dish 300W
27/04	13:05	W1AW/2	9m Prime focus dish 500W
27/04	13:07	K2UYH	9m Prime focus dish 500W
28/04	12:36	PA0BAT	3m Prime focus dish 500W
28/04	12:57	HB9Q	10m Prime focus dish 1kW
30/04	09:56	OH2DG	8m Prime focus dish 500W
30/04	12:56	DF3RU	6m Prime focus dish 500W
01/05	09:12	JA6AHB	7m Prime focus dish 500W
01/05	09:20	OE5JFL	11.2m Prime focus dish 1kW
01/05	16:34	PY2BS	5.1m Prime focus dish 500W
01/05	16:37	PI9CAM	20m “Dwingeloo” Dish
01/05	16:45	OK1KIR	10m Prime focus dish 1kW

# Acknowledgements

- The Camb-Hams.
  - A very different type of radio club
- Sam, G4DDK for the loan of his 150W PA
- Steve M1ACB for some of the photos



Sunset on Lewis



## Acknowledgements

- Pete and Louise
- The owners of “The Decca” Isle of Lewis



# The Decca

B&B, self-catering, restaurant  
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