

MAP65 Version 2

A Panoramic, Polarization-
Matching Receiver for JT65

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MAP65: What is it?

- SDR software, works with JT65 signals
- “Big brother” to WSJT
- Rx hardware converts RF to baseband
- Decodes all JT65 signals in 90 kHz BW
- X-Pol: Automatic polarization matching
- Designed for EME on 144, 432, 1296 MHz

JT65 Protocol

- 60 s T/R sequences
- Compact, structured messages
- Modulation: 65-tone FSK, 2.7 baud
- ECC: Reed-Solomon $(63,12)_6$
- Works at 10 to 15 dB below CW limit
- > 1000 EME users on 144 MHz !

Program Comparison

WSJT

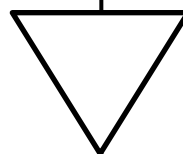
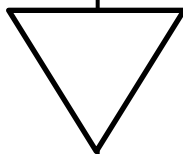
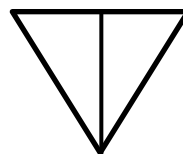
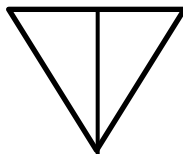
- BW 2-5 kHz
- Many modes
- Decodes one signal
- One polarization

MAP65

- BW 90 kHz
- JT65 only
- Decodes all signals in passband
- All polarizations (avg 3 dB better)
- Automatic Band Map

X

Y



Hardware

RF to Baseband

Software

**Linrad, SDR-Radio
(optional)**

MAP65

**Wide
Graph**

**Astro
Data**

**Main
Window**

Band Map

Messages

MAP65: Version 2 Features

- Supports X-pol and Single-pol systems
- Sub-modes JT65A, B, and C
- Sample rate: 96000 or 95238 Hz
- Optional front-ends: Linrad, SDR-Radio
- Rx hardware: WSE converters, IQ+, Perseus, SDR-IQ, FUNcube Dongle, SoftRock, ...
- QtSDK, C++ for GUI; Fortran for decoder
- Windows, OS X, Linux, ...

Example Receivers



SDR-Radio

SDR-RADIO version 1.5 build 1058

Input Source: Windows Console AF Output Record Tools Help

Options Compact Full Screen

RFspace

Local (This computer) Remote (Via Network) Radio (RFspace) Soundcard, (SoftRock, FUNcube, ...) Play IQ Data File

Radio: - None - Soundcard: Line In (Realtek High Definition Audio) Start Stop Autostart Swap IQ External Options Radio

Frequency: Sample rate: 96.000 kHz

Soundcard (SoftRock, FUNcube, ...)

RX Options

AGC: On Off Fast Med Slow

Knee: -100 dB Slope: 6 dB Hang: 250 ms Decay: 500 ms

AF Output vs AF Input graph

More... Audio Zoom Tune QMB... Filters... AGC ANF CW NB NR Scroll

28.069.262

1.8 3.5 5 7 10 14 18 21 24.5 28/29 NAV ENT... LSB AM... USB DSB CW-L FM... CW-U More...

VFO A

[span] 10:17:50

28.000.000 28.150.000

Radio Not Started

Select 'Input Source' in the ribbon bar, then click 'Start'

Waterfall: Automatic

Audio Spectrum: Filters Show Range kHz CW Shift Width

Audio Spectrum Audio Recorder

Ready Waterfall: 0 lines/s, 40 Hz, 0.0 RBW Mem: 115MB CPU: 0% Speakers AF Gain

Normal Operation at K1JT (2m EME)

1. Turn on Rx, warm up PA
2. Start Linrad and MAP65
3. Click to track Moon
4. Callsigns start to appear on screen
5. Double-click on a CQing callsign
6. Select Tx polarization (H or V)
7. Click “Auto On” to call him

MAP65: Full Screen Display

The screenshot displays the MAP65 software interface, which is used for logging QSOs and monitoring radio signals. The main window is titled "MAP65 v2.3.0, r2466 by K1JT" and features a "Wide Graph" at the top showing a frequency spectrum from 100 to 160 MHz. Below the graph are various control panels and data displays.

Wide Graph: Shows a frequency spectrum from 100 to 160 MHz. The x-axis represents frequency in kHz, ranging from 00 to 2000. The y-axis represents time, with labels for 07:56, 07:57, 07:58, and 07:59. The graph displays a blue background with vertical lines representing signal activity.

Astronomical Data: A window titled "Astronomical..." displays the date and time, along with various astronomical parameters:

```

2012 May 25
UTC: 20:17:03
Az: 164.5
El: 64.7
MyDop: 80
DxAz: 286.5
DxEI: -10.8
DxDop: -141
Dec: 15.8
SunAz: 261.3
SunEl: 43.4
Tsky: 282
MNR: 0.4
Dgrd: -2.9
    
```

QSO Log: A window titled "B..." displays a list of QSOs with columns for Call, Grid, and other parameters:

```

103 *EA3DXU
103 *DK5EW
103 *W3SZ
110 *IW4ARD
110 *WOHP
110 *LX/PA3
110 *AA7A
111 *HB9Q
111 *LZ1DP
114 *IK3MAC
116 *UA9HK
116 *DL8EBW
118 *RA3AQ
122 *I1ANP
123 *SV8CS
123 *R3WVF
123 *NSKDR
124 *K7MAC
125 *EB1DNK
125 *Y09FRJ
125 *W1PKF
126 *RV4AI
126 *UA9FAD
126 *K6MYC
127 *U9SSL
127 *KB8RQ
128 *AA1YN
130 *IK1UWL
131 *F6HVK
    
```

QSO Log Table: A window titled "MAP65" displays a table of QSOs with columns for Freq, DF, Pol, UTC, DT, dB, KV, DS, and TxPol:

Freq	DF	Pol	UTC	DT	dB	KV	DS	TxPol		
110	-67	159	0752	3.2	-17	LX/PA3FPQ IW4ARD	1	0	0	
110	-67	162	0754	3.0	-18	LX/PA3FPQ IW4ARD	1	0	0	
110	-29	107	0755	1.3	-22	IW4ARD LX/PA3FPQ OOO	1	0	0	
111	-115	135	0755	2.3	-13	RRR	0	0	0	
110	-64	158	0756	2.9	-19	FPQ ARD RO	1	0	0	
110	229	99	0756	2.9	-19	LX/PA3FPQ AA7A	1	0	0	
111	-115	135	0757	2.3	-12	73	0	0	0	
110	-64	155	0758	2.9	-18	FPQ ARD 73	1	0	0	
110	-32	104	0759	1.4	-21	AA7A LX/PA3FPQ OOO	1	0	0	
111	-115	137	0759	2.9	-13	CQ HB9Q JN47	1	911	71	V

Message Log: A window titled "Messages" displays a list of messages with columns for Freq, DF, Pol, UTC, dB, and CQ Only:

```

Freq DF Pol UTC dB CQ Only
311 90 0754 -18 73
139 74 145 0745 -15 CQ EA6VQ JN19 V
60 135 0755 -18 RRR
60 135 0757 -16 73
54 144 0759 -15 CQ EA6VQ JN19 V
140 -82 90 0746 -20 RO
-82 90 0748 -19 RRR
-85 90 0750 -21 73
-105 101 0752 -24 EA/DJ4UF DH7F
-108 90 0754 -20 RO
-114 90 0756 -21 73
141 157 140 0755 -19 CQ EA3DXU JN11 V
157 135 0757 -16 CQ EA3DXU JN11 V
155 139 0759 -18 CQ EA3DXU JN11 V
152 -38 99 0757 -20 KALVHF DF22C JO30 H
-44 101 0759 -16 KALVHF DF22C JO30 H
179 125 0750 -25 CQ KALVHF EM89 V
179 125 0756 -28 CQ KALVHF EM89 V
155 -263 141 0757 -24 NOAKC TK5JJ JN41 V
97 0 0755 -14 73
440 56 0746 -23 CQ NOAKC EN44 H
437 53 0748 -23 CQ NOAKC EN44 H
437 57 0750 -25 CQ NOAKC EN44 H
440 50 0752 -25 NSKDA NOAKC EN44 OOO H
443 45 0754 -19 RRR
443 42 0758 -26 TK5JJ NOAKC EN44 OOO H
156 -238 101 0755 -6 NOAKC W3SZ FR20 V
-241 102 0757 -5 NOAKC W3SZ FR20 V
    
```

Control Panels: The bottom of the MAP65 window contains several control panels. The "Log QSO" panel includes buttons for "Log QSO", "Stop", "Monitor", "Decode", "Erase", "Auto is OFF", and "Stop Tx". The "DX Call" panel shows "5X1EME" and "KJ60gh" with "Lookup" and "Add" buttons. The "Tx" panel shows "5X1EME K1JT FN20" and "5X1EME K1JT FN20 OOO" with "Tx1" through "Tx6" buttons. The "NB" panel shows "73" and "CQ K1JT FN20" with "Tx1" through "Tx6" buttons. The "Tol" panel shows "1000" and "Tol".

Status Bar: The bottom status bar displays "061111.0759.fh2", "QSO Freq: 111", "QSO DF: -359", "Rx noise: 0.0", "0.0 0.0%", and "JT65B".

Main Window

The screenshot shows the MAP65 software interface. At the top, the title bar reads "MAP65 v2.3.0, r2530 by K1JT". Below it is a menu bar with "File", "Setup", "View", "Mode", "Decode", "Save", and "Help".

The main area is a QSO log table with the following columns: Freq, DF, Pol, UTC, DT, dB, KV, DS, TxPol. The log contains several entries, with the following data:

Freq	DF	Pol	UTC	DT	dB	KV	DS	TxPol
111			0748					
111	305	10	0750	1.7	-24	1	0	91 V
111			0752					
110	277	153	0754	3.0	-17	1	0	0
110	315	114	0755	1.3	-22	1	0	0
111	229	135	0755	2.3	-12	0	0	0
110	280	150	0756	2.9	-18	1	0	0
111	-427	106	0756	2.9	-19	1	0	0
110	315	112	0757	1.3	-22	1	0	0
111	229	135	0757	2.3	-11	0	0	0

Below the log is a control panel with buttons for "Log QSO", "Stop", "Monitor", "Decode", "Erase", "Auto is OFF", and "Stop Tx".

To the left of the control panel is a dB scale from 0 to 60, with a green bar at approximately 25 dB and a pink bar at approximately 28 dB. Below the scale is a yellow box displaying the time "15:43:43".

To the right of the control panel is a "Tx Messages" section with a list of messages and radio buttons for Tx1 through Tx6. The messages are:

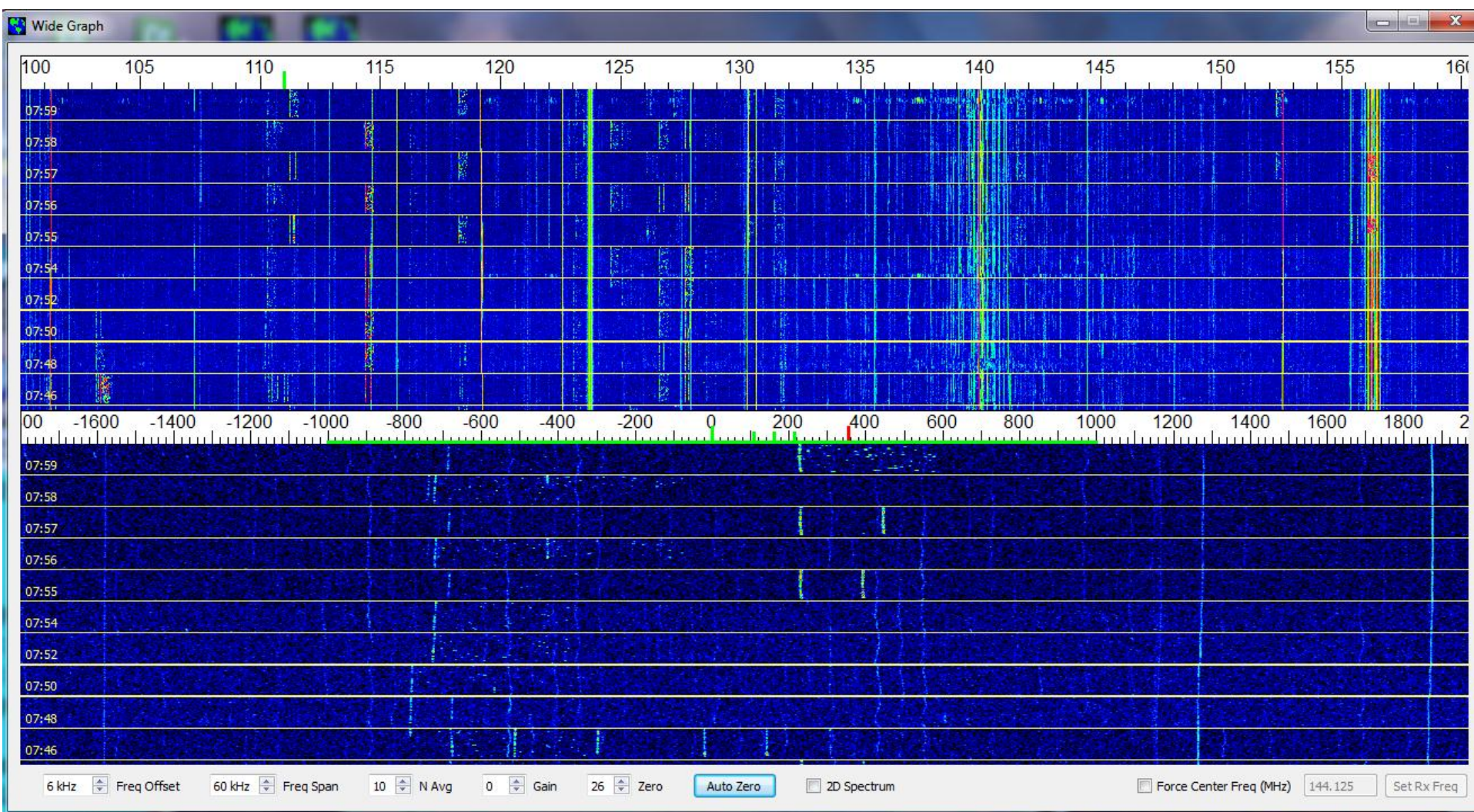
- SV6KRW K1JT FN20 (Tx1 selected)
- SV6KRW K1JT FN20 OOO (Tx2)
- RO (Tx3)
- RRR (Tx4)
- 73 (Tx5)
- CQ K1JT FN20 (Tx6)

At the bottom of the window, there is a status bar with the following information: "061111_0758.tf2", "QSO Freq: 111", "QSO DF: 0", "Rx noise: 26.1 27.7 0.1 %", and "JT65B".

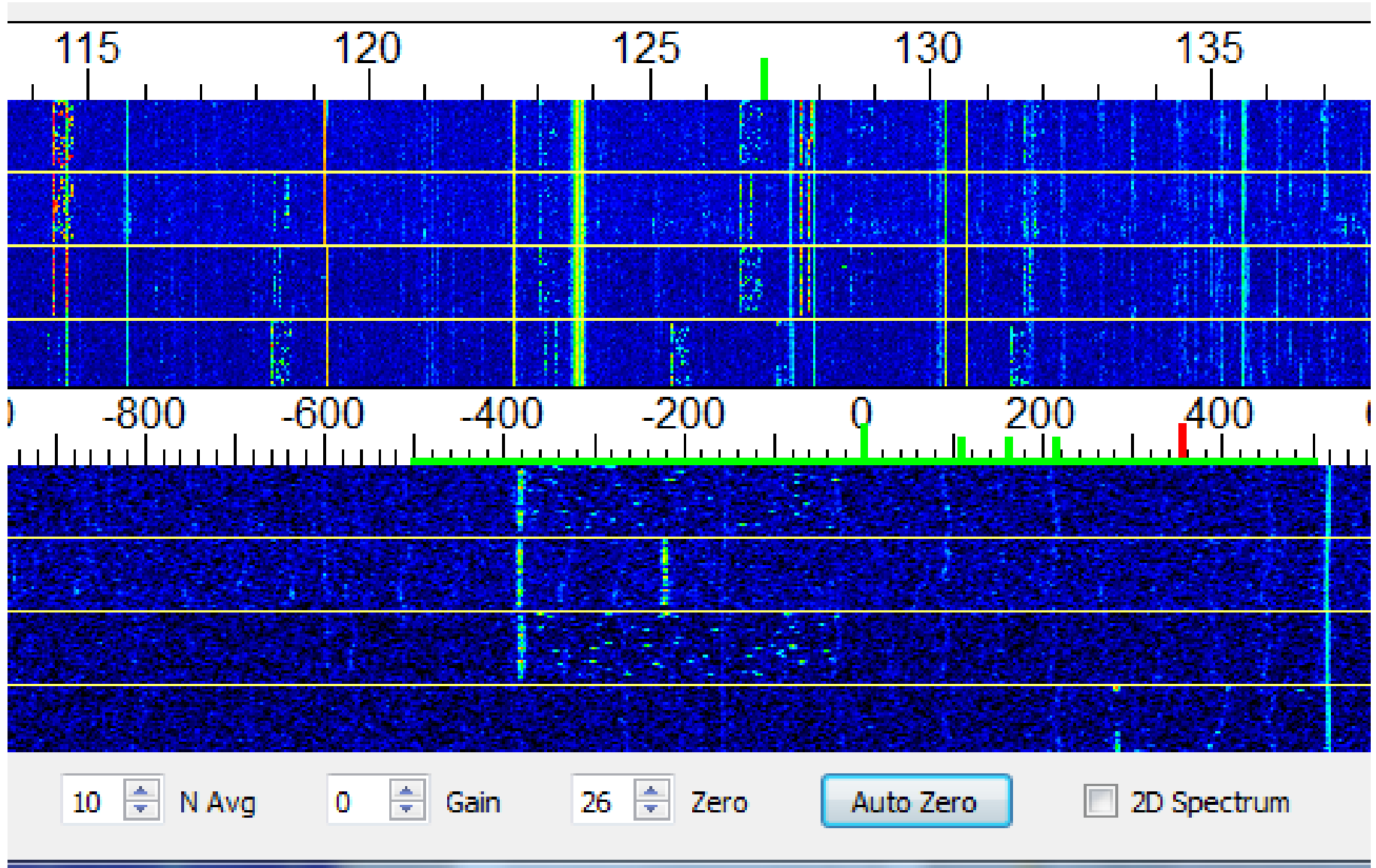
QSO
Window

Tx
Messages

Wide Graph




Wide Graph (detail)



Band Map

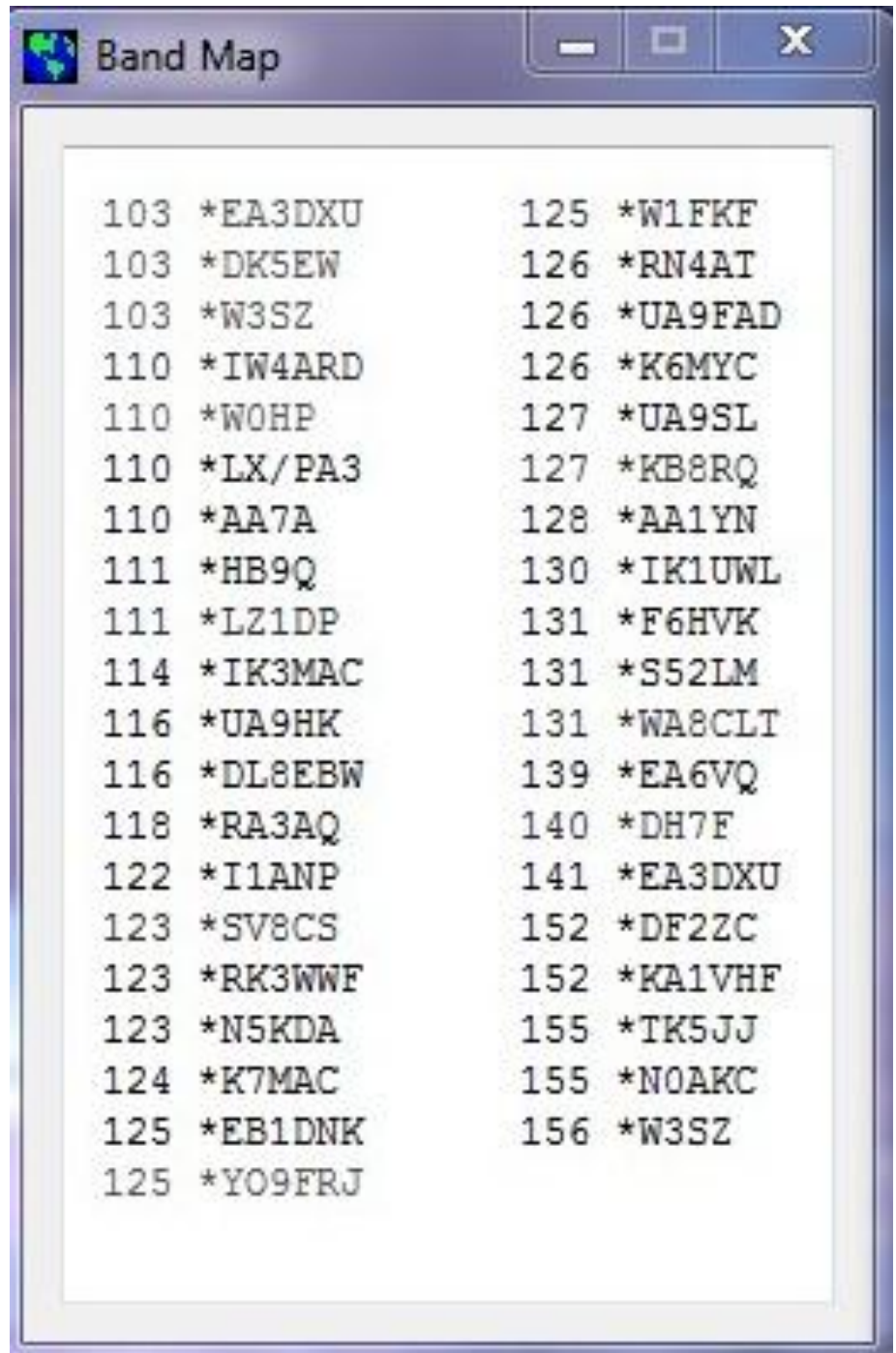
2 × 10-element
Xpol Yagis



The screenshot shows a window titled "Band Map" with a blue background and a list of call signs and frequencies. The list is organized into two columns. The first column contains call signs and frequencies: 103 *EA3DXU, 103 *DK5EW, 103 *W3SZ, 110 *IW4ARD, 110 *WOHP, 110 *LX/PA3, 111 *AA7A, 111 *HB9Q, 111 *LZ1DP, 114 *IK3MAC, 116 *UA9HK, 116 *DL8EBW, 118 *RA3AQ, 123 *I1ANP, 123 *SV8CS, 123 *RK3WWE, 123 *N5KDA, 125 *K7MAC, 125 *EB1DNK, and 125 *YO9FRJ. The second column contains call signs and frequencies: 125 *W1FKF, 126 *RN4AT, 126 *UA9FAD, 127 *K6MYC, 127 *UA9SL, 128 *KB8RQ, 129 *AA1YN, 130 *IK1UWL, 131 *F6HVK, 131 *S52LM, 132 *WA8CLT, 139 *EA6VQ, 140 *DH7F, 141 *EA3DXU, 152 *DF22C, 153 *KA1VHF, 155 *TK5JJ, 156 *NOAKC, and 156 *W3SZ. The call signs are in red and the frequencies are in yellow.

103 *EA3DXU	125 *W1FKF
103 *DK5EW	126 *RN4AT
103 *W3SZ	126 *UA9FAD
110 *IW4ARD	127 *K6MYC
110 *WOHP	127 *UA9SL
110 *LX/PA3	128 *KB8RQ
111 *AA7A	129 *AA1YN
111 *HB9Q	130 *IK1UWL
111 *LZ1DP	131 *F6HVK
114 *IK3MAC	131 *S52LM
116 *UA9HK	132 *WA8CLT
116 *DL8EBW	139 *EA6VQ
118 *RA3AQ	140 *DH7F
123 *I1ANP	141 *EA3DXU
123 *SV8CS	152 *DF22C
123 *RK3WWE	153 *KA1VHF
123 *N5KDA	155 *TK5JJ
125 *K7MAC	156 *NOAKC
125 *EB1DNK	156 *W3SZ
125 *YO9FRJ	

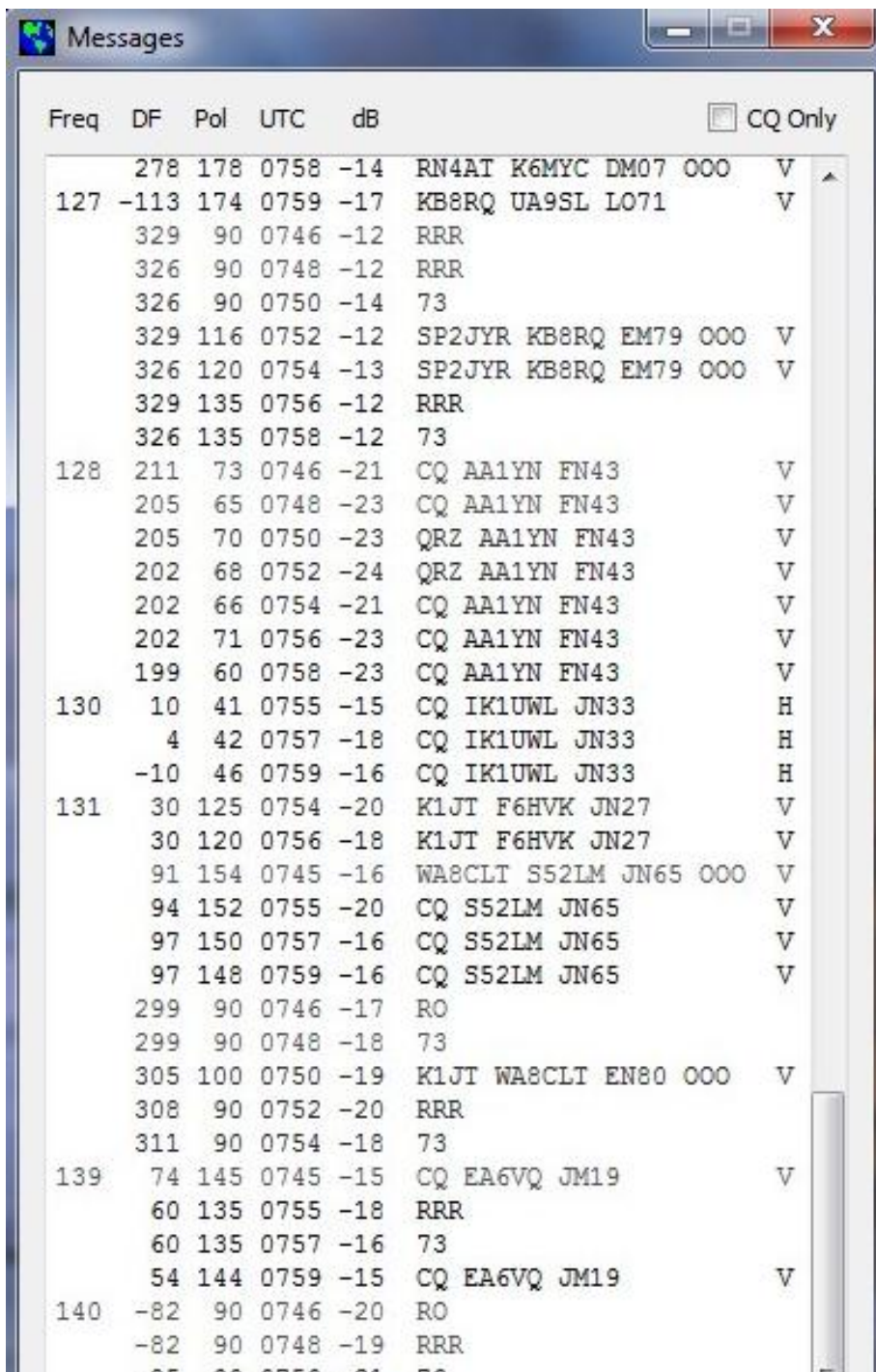
Band Map (grayscale)



A screenshot of a software window titled "Band Map". The window contains a list of call signs and their corresponding frequencies, arranged in two columns. The call signs are preceded by an asterisk. The frequencies range from 103 to 156.

103	*EA3DXU	125	*W1FKF
103	*DK5EW	126	*RN4AT
103	*W3SZ	126	*UA9FAD
110	*IW4ARD	126	*K6MYC
110	*W0HP	127	*UA9SL
110	*LX/PA3	127	*KB8RQ
110	*AA7A	128	*AA1YN
111	*HB9Q	130	*IK1UWL
111	*LZ1DP	131	*F6HVK
114	*IK3MAC	131	*S52LM
116	*UA9HK	131	*WA8CLT
116	*DL8EBW	139	*EA6VQ
118	*RA3AQ	140	*DH7F
122	*I1ANP	141	*EA3DXU
123	*SV8CS	152	*DF2ZC
123	*RK3WWF	152	*KA1VHF
123	*N5KDA	155	*TK5JJ
124	*K7MAC	155	*NOAKC
125	*EB1DNK	156	*W3SZ
125	*YO9FRJ		

Messages



The screenshot shows a window titled "Messages" with a list of communication logs. The window has standard Windows window controls (minimize, maximize, close) in the top right corner. A checkbox labeled "CQ Only" is checked in the top right of the list area. The list is organized into groups by frequency (127, 128, 130, 131, 139, 140). Each entry includes a frequency, a DF value, a polarization (Pol), a UTC time, a dB value, and a call sign or message text. The last column indicates a status, often 'V' for voice or 'H' for hearing.

Freq	DF	Pol	UTC	dB	Message	Status
127	278	178	0758	-14	RN4AT K6MYC DM07 000	V
	-113	174	0759	-17	KB8RQ UA9SL LO71	V
	329	90	0746	-12	RRR	
	326	90	0748	-12	RRR	
	326	90	0750	-14	73	
	329	116	0752	-12	SP2JYR KB8RQ EM79 000	V
	326	120	0754	-13	SP2JYR KB8RQ EM79 000	V
	329	135	0756	-12	RRR	
	326	135	0758	-12	73	
128	211	73	0746	-21	CQ AA1YN FN43	V
	205	65	0748	-23	CQ AA1YN FN43	V
	205	70	0750	-23	QRZ AA1YN FN43	V
	202	68	0752	-24	QRZ AA1YN FN43	V
	202	66	0754	-21	CQ AA1YN FN43	V
	202	71	0756	-23	CQ AA1YN FN43	V
	199	60	0758	-23	CQ AA1YN FN43	V
	130	10	41	0755	-15	CQ IK1UWL JN33
131	4	42	0757	-18	CQ IK1UWL JN33	H
	-10	46	0759	-16	CQ IK1UWL JN33	H
	30	125	0754	-20	K1JT F6HVK JN27	V
139	30	120	0756	-18	K1JT F6HVK JN27	V
	91	154	0745	-16	WA8CLT S52LM JN65 000	V
	94	152	0755	-20	CQ S52LM JN65	V
	97	150	0757	-16	CQ S52LM JN65	V
	97	148	0759	-16	CQ S52LM JN65	V
	299	90	0746	-17	RO	
	299	90	0748	-18	73	
	305	100	0750	-19	K1JT WA8CLT EN80 000	V
140	308	90	0752	-20	RRR	
	311	90	0754	-18	73	
	74	145	0745	-15	CQ EA6VQ JM19	V
	60	135	0755	-18	RRR	
	60	135	0757	-16	73	
140	54	144	0759	-15	CQ EA6VQ JM19	V
	-82	90	0746	-20	RO	
	-82	90	0748	-19	RRR	

Rx Hardware Interfacing

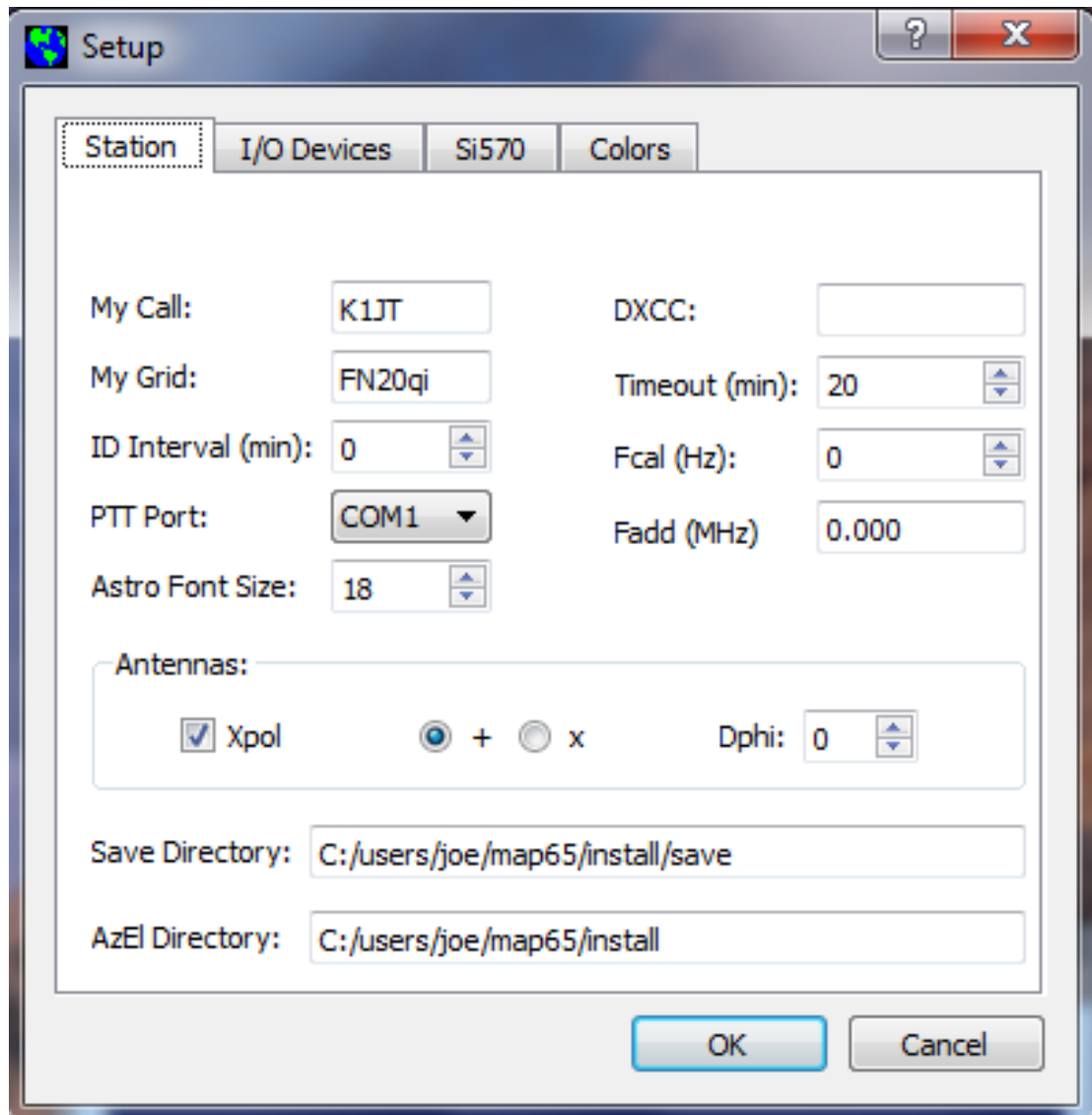
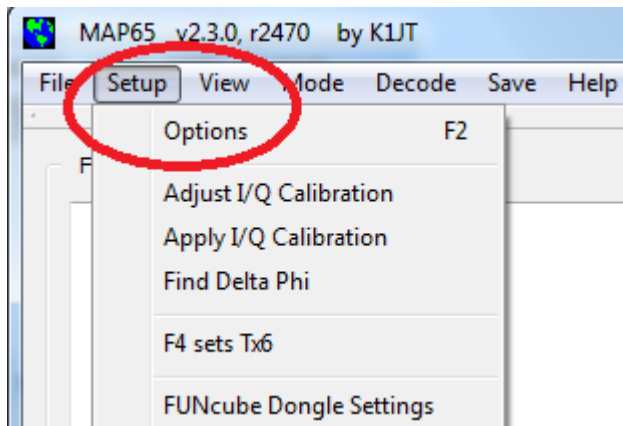
	SoftRock	FUNcube Dongle	SDR-IQ, Perseus	SoftRock × 2	IQ+ VL, V, U	WSE
Input Freq (MHz)	28, 144	144, 432, 1296	28	28, 144	50, 144, 432	144
Polarizations	1	1	1	2	2	2
Soundcard Channels	2	–	–	4	4	4
Digital Interface	USB	USB	USB	USB	USB	Parallel Port
Frequency Control*	L, S, M	L, S, M	L, S	L, M	L, M	L
Front-End Software*	L or S optional	–	L or S required	L optional	L optional	L optional

* L = Linrad, S = SDR-Radio, M = MAP65

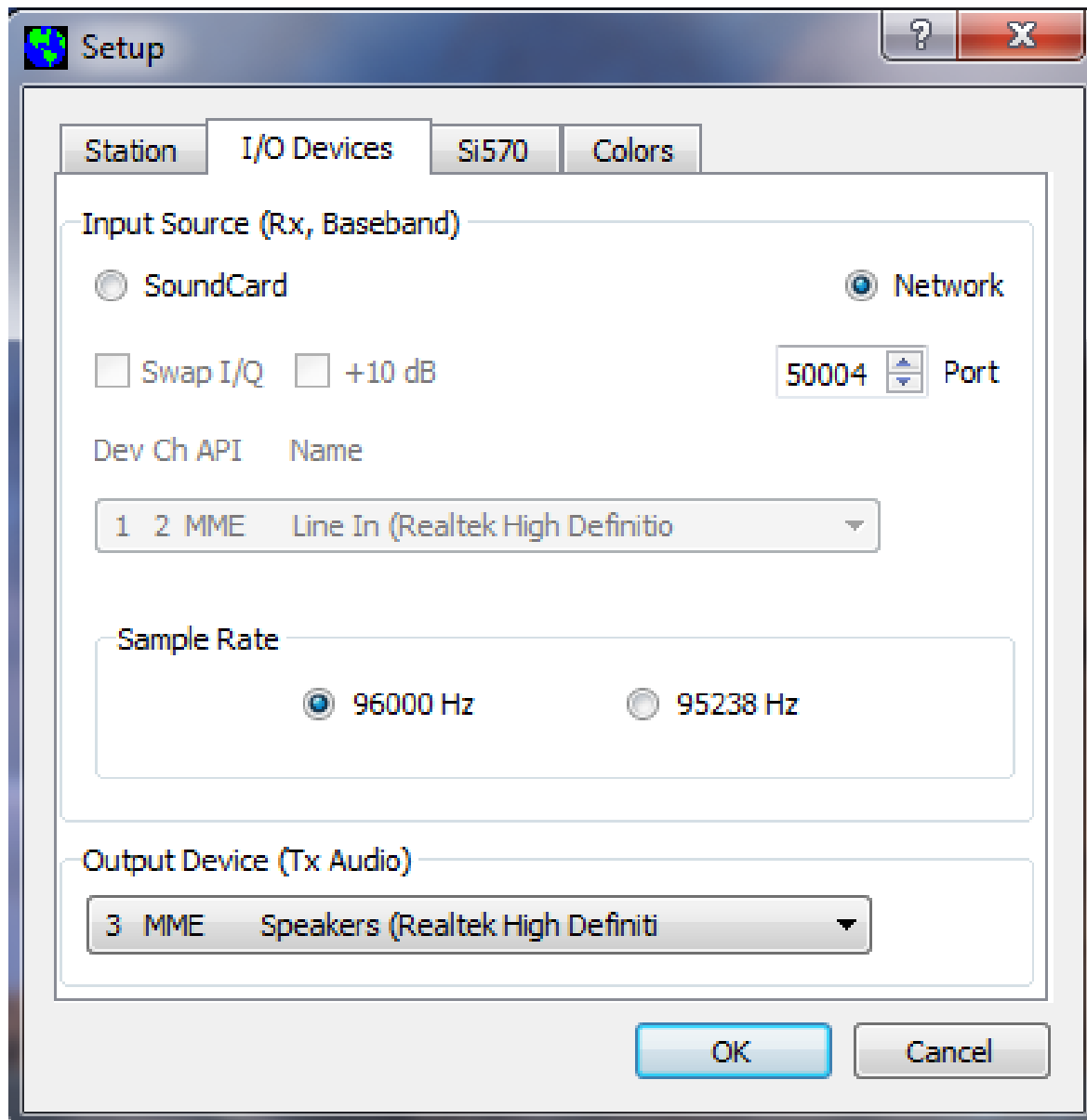
MAP65: Why do you need it?

- Random EME on 144, 432, 1296
(no skeds or logger)
- Superb wideband noise blanker
- Copy all EME signals in band
- Monitor CW as well as JT65
portions of band
- Powerful EME contest operating aid !

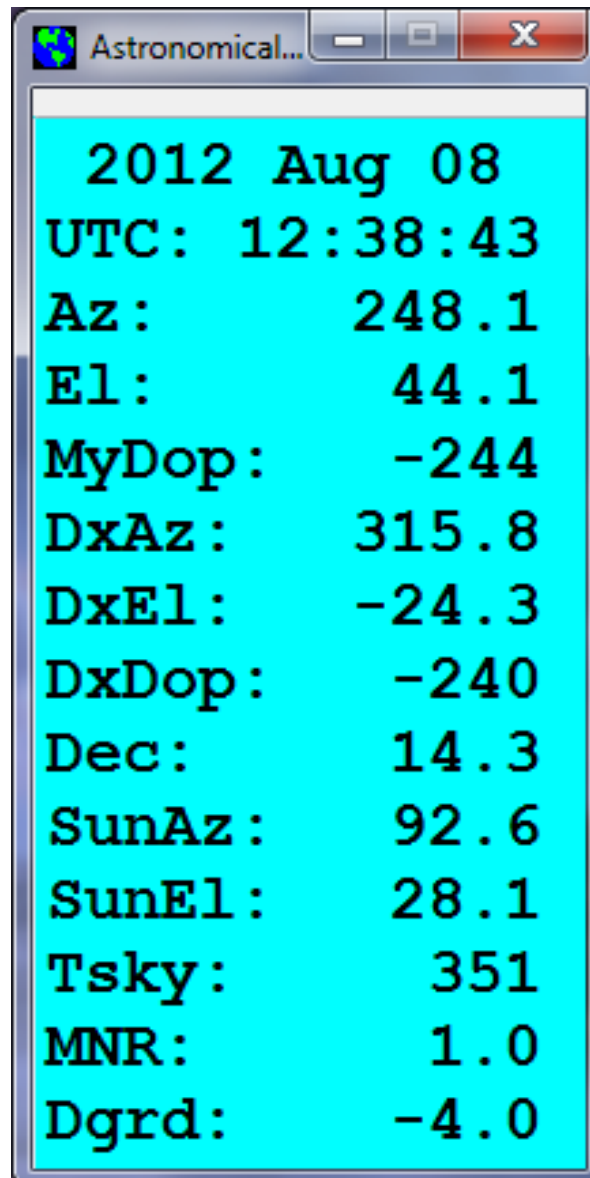
Setup | Options – Station tab



Setup | Options – I/O Devices



Astronomical Data



A screenshot of a software window titled "Astronomical..." with a globe icon. The window contains a list of astronomical data points on a cyan background. The data is as follows:

2012 Aug 08	
UTC:	12:38:43
Az:	248.1
El:	44.1
MyDop:	-244
DxAz:	315.8
DxEl:	-24.3
DxDop:	-240
Dec:	14.3
SunAz:	92.6
SunEl:	28.1
Tsky:	351
MNR:	1.0
Dgrd:	-4.0

Station Control at K1JT

Station by K1JT

144.115.000

Band									
1.8	3.5	5.3	7	10	14	18	21	24	28
50	144	222	432	903	1.2	2.3	3.4	5.7	10.3

HF Ant
 Vert 160/80 Doublet Mosley

RoverLog

Pointing
 Manual Moon Sun RoverLog W3CCX/B Service Stow

Offset

9.0

211 64

File azel.dat

13:01:28,211.3, 64.1, Moon
13:01:28, 98.3, 33.9, Sun
144, 162, Doppler
115,0, fQSO

DX Call: SV6KRW Grid: KM09

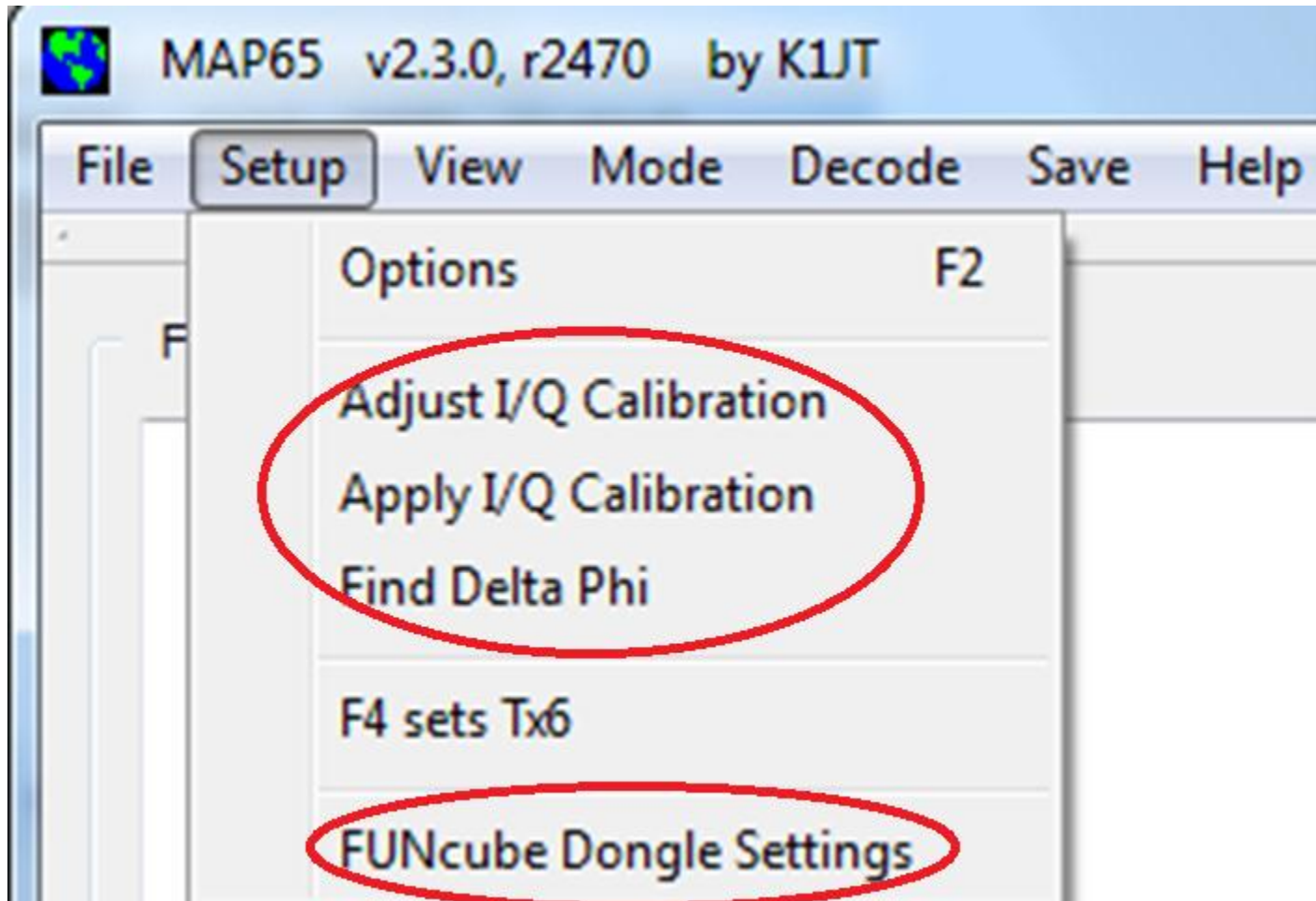
Tx first

NB

500 Tol

13:01:28

More Setup Features

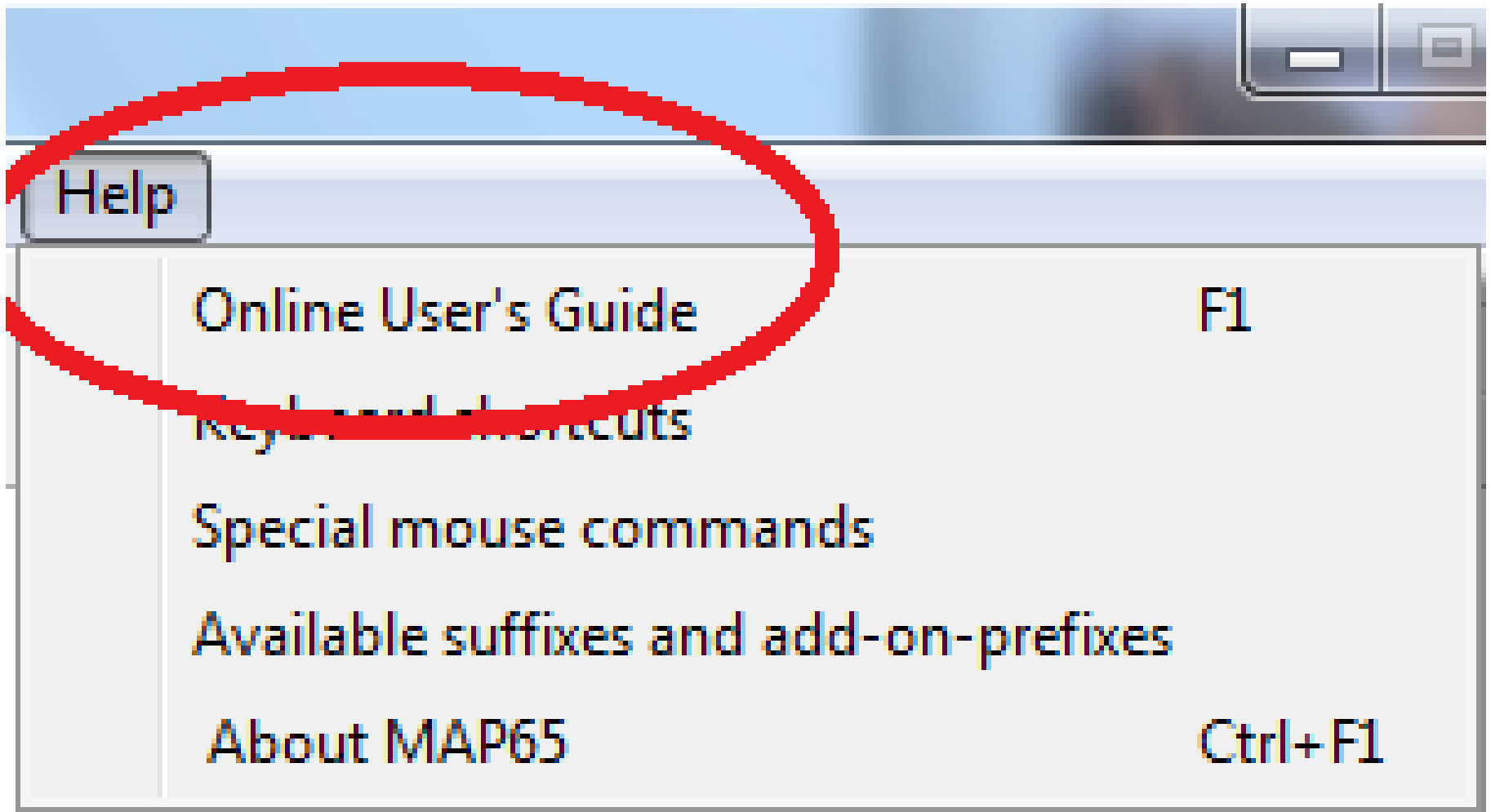


Setup Utility for FUNcube Dongle

The screenshot displays the 'FUNcube Dongle Controller' software interface. At the top, the title bar reads 'FUNcube Dongle Controller' with standard window controls. Below the title bar is a menu bar with 'File', 'Tools', and 'Help'. A toolbar contains icons for file operations and a waveform. The main interface is divided into several sections:

- Frequency:** A large green box displays '89,102,000 Hz'. Below it are navigation buttons (< and >) and a green frequency input field showing '20.000'. A 'Corr' field is set to '-120 ppm'.
- Correction:** A section with four spinners: 'DC I' (0.00015), 'Gain' (1.00000), 'DC Q' (-0.00116), and 'Phase' (0.00000).
- Firmware:** A section with four buttons: 'Bootloader', 'Upload', 'Application', and 'Verify'.
- Status:** 'PLL Locked' checkbox is checked, and 'IF RSSI' is shown as a bar graph with a value of '0'.
- Signal Flow Diagram:** A block diagram showing the signal path: LNA → RF Filter → Mixer → Mixer Filter → IF Amp 1 → IF RC Filter → IF Amp 2 → IF Amp 3 → IF Amp 4 → IF Filter → IF Amp 5 → IF Amp 6.
- Configuration Parameters:** A row of dropdown menus for: LNA gain (+20.0dB), RF Filter (509MHz LPF), Mixer gain (12dB), Mixer filter (1.9MHz), IF gain 1 (+6dB), IF RC filter (1.0MHz), IF gain 2 (0dB), IF gain 3 (0dB), IF gain 4 (0dB), IF filter (2.15MHz), IF gain 5 (+3dB), and IF gain 6 (+3dB).
- Advanced Settings:** 'LNA enhance' (Off), 'Band' (VHF II), 'Bias current' (11 V/U band), and 'IF gain mode' (Linearity).
- Buttons:** A 'Defaults' button and a red status bar at the bottom right that reads 'No FCD detected'.

Online User's Guide



432 and 1296 MHz

- “Best” EME bands
- Much smaller T_{sys}
- Much smaller antennas are “enough”
- Hear your own echoes with:
 - 432: 4 x 6m yagis, 250 W
 - 1296: 3m dish, 150 W
- MAP65 is great for JT65 and CW !
- Use Xpol Yagis on 432
- Single pol'n (RHC/LHC) on 1296

Possible Future Modes?

JT65B2, JT65C2

- 2 × speed, for EME contesting
- 30 s T/R sequences → up to 20 QSOs per hour !
- Sensitivity: 3 dB less
- Presently available in WSJT (only)
- Possible problems ...
 - QRM? Sub-band plan? Switching between modes?