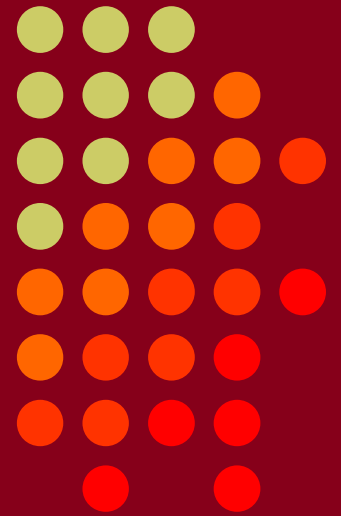


Six Meter BBQ

Austin, TX

Meteor Scatter Utilizing JT Digital Modes

Joel Harrison, W5ZN



• CTU •
CONTEST
UNIVERSITY

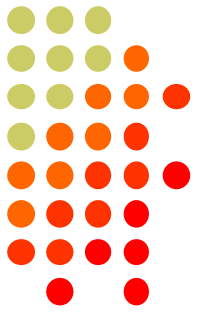
ICOM®

Meteor Scatter



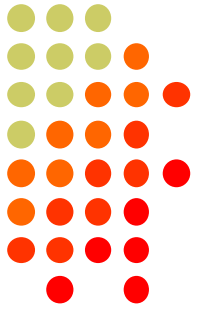
- Meteor scatter is the reflection of radio waves from the ionized trails from meteors burning up in the upper atmosphere.
- Meteors (space debris) burn up in the upper atmosphere at a height of around 65 miles.
- This may be used to make QSOs up to about 1400 miles

Meteor Scatter



- The earth is bombarded by a constant stream of small particles, remnants of comets that when entering the earth's atmosphere can ionize a column of atoms in the E region at approximately 100km (~60 miles) above the surface of the earth which can reflect radio waves in the VHF region of the spectrum

Meteor Scatter



- There are seasonal variations in the number of sporadic meteors
 - Relative rate increases noticeably in May, peaking in July and August then tailing off into October and November.
- There is also an hourly variation in the relative rate of meteors peaking
 - around dawn local time with the minimum late afternoon before the ramp up begins again late evening.
 - The hourly relative rate is due to the fact that the earth's rotation is head on so to speak in the morning into the path of the particles and therefore there is an increase in the relative velocity of a particle entering the earth's atmosphere.

Meteor Scatter



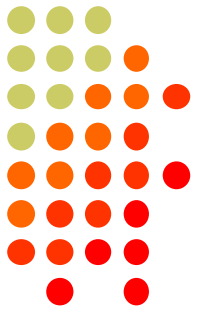
- The length of time of the ionization, or burst duration, is related to meteor velocity and increase in relative velocity results in longer ionization times.

Meteor Scatter

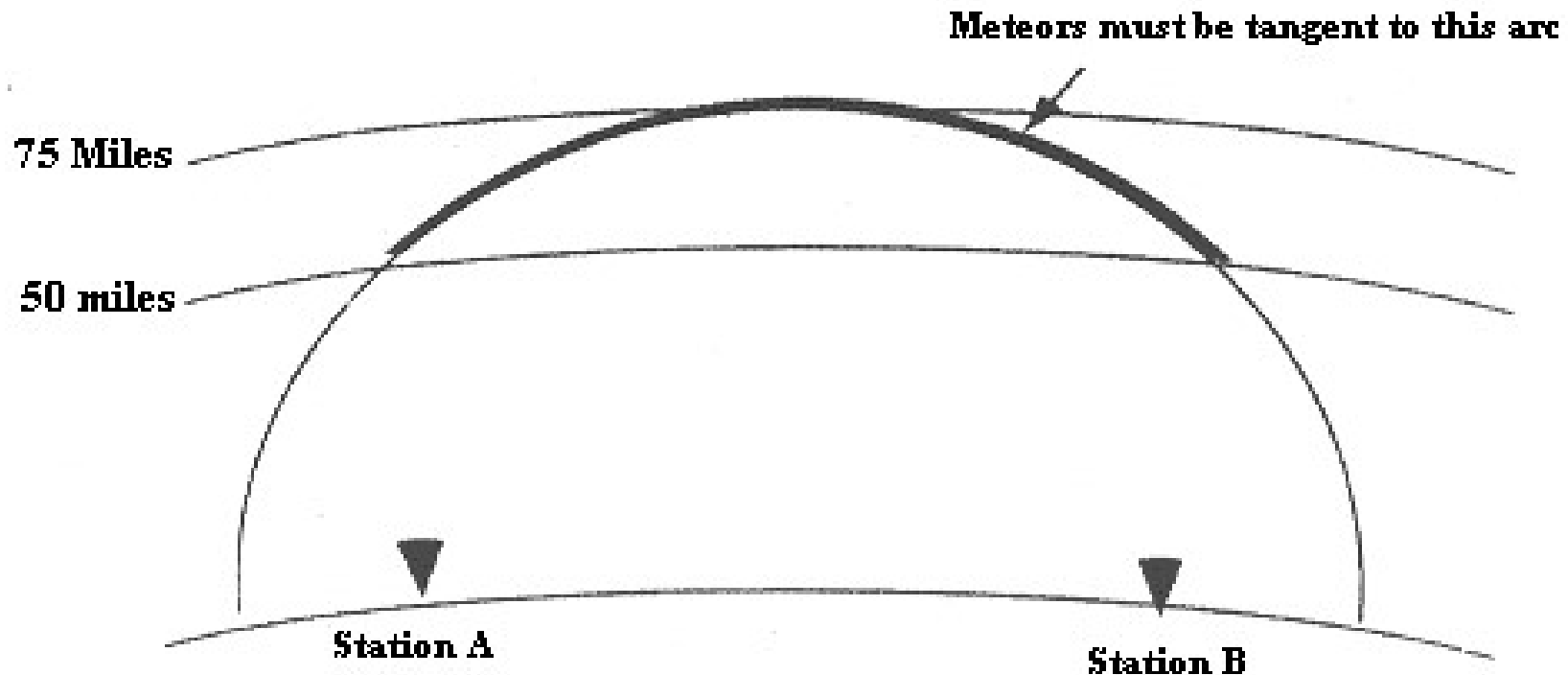


- Most particles entering the earth's atmosphere are the size of a grain of sand resulting in ionization lasting only a fraction of a second
 - much too short to convey any meaningful information using SSB or even high speed CW.
- The digital modes of FSK441 and MSK144 were designed to compress a limited amount of information in a packet and transmit that packet in a very short period of time.
 - In the case of MSK144 the information packet, with a transmission length 0.072 seconds, is repeated over and over again during the duration of the selected transmit interval of 5, 10, 15 or 30 seconds.

Meteor Scatter



Reflection will occur when the trail is oriented as shown

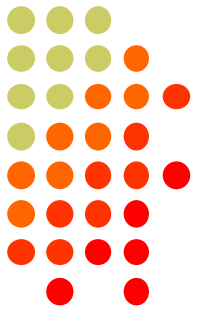


Meteor Scatter



- **Excellent for 50 MHz**
- **Very Predictable Paths**
 - Best times between midnight & approx 9 AM
 - Peak during “showers” – Anytime with high speed procedures like **WSJT**

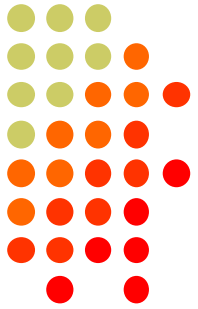
Operating Techniques



K1JT Digital Modes

- **Weak Signal Communication by K1JT (WSJT) offers specific digital protocols optimized for EME and meteor scatter at VHF/UHF**
- **Free open-source programs. Normal usage requires only a standard SSB transceiver and a personal computer with soundcard.**
- **Can Provide Outstanding access to new grid multipliers from moderate stations**

Meteor Scatter



Original JT "FSK441" MS Mode

The screenshot displays the WSJT-X software interface for meteor scatter reception. The window title is "WSJT 6 by K1JT". The interface includes a menu bar (File, Setup, View, Mode, Decode, Save, Band, Help), a waterfall plot, a spectrogram, and a time-domain plot. The time-domain plot shows a signal at 11:04:00 with a frequency of 23.0 MHz. The spectrogram shows a signal at 11:04:00 with a frequency of 23.0 MHz. The waterfall plot shows a signal at 11:04:00 with a frequency of 23.0 MHz. The interface also displays a table of received signals, a control panel with buttons for Log QSO, Stop, Monitor, Save, Decode, Erase, Clear Avg, Include, Exclude, and TxStop, and a status bar at the bottom showing "Receiving".

| FileID | T | Width | dB | Rpt | DF | Time (s) | W8WVN_010809_110400 | 1 | 2 | 3 | Freq (kHz) |
|--------|------|-------|----|-----|------|---|---------------------|---|---|---|------------|
| 110400 | 18.5 | 780 | 10 | 26 | -150 | ZS0 TNX QSO TNX QSO TNX QSO TNX QSO TNX | | | | | |

Log QSO Stop Monitor Save Decode Erase Clear Avg Include Exclude TxStop

To radio: W8WVN Lookup
Grid: EM77bq Add
Hot A: 244 Az: 257 El: 8 632 mi
2006 Jul 31 18:33:36

S 2 Zap
Clip 0 NB
Tol 400 Freeze
Defaults AFC
Dsec 0.0

Tx First W8WVN K1JT Tx1
26 Rpt W8WVN 26 K1JT 2626 Tx2
 Sh Msg R26 Tx3
 Sked RRR Tx4
GenStdMsgs 73 Tx5
Auto is Off CQ K1JT Tx6

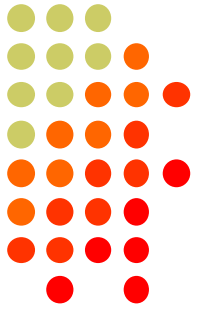
1.0000 1.0000 FSK441 Freeze DF: 0 Rx noise: -2 dB TR Period: 30 s Receiving

Meteor Scatter



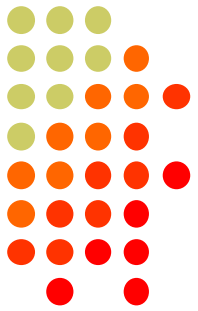
- **New Mode introduced in WSJT-X**
 - Officially released in January 2017
 - Contains 8 new modes
 - **MFSK441 Mode**
 - Calling frequencies 50.280
 - Many new features

Meteor Scatter

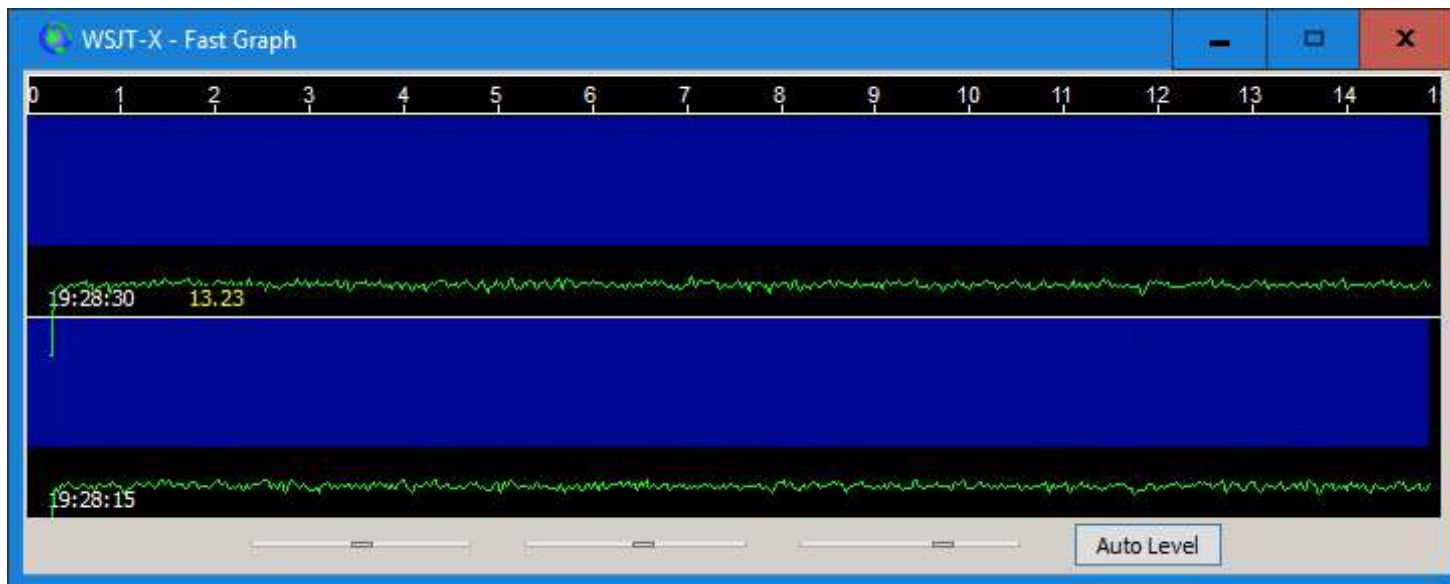


- Focussed toward contest style operation that include:
 - a machine human interface that facilitates rapid population of QSO specific information
 - shorter TX and RX periods than FSK441
 - auto sequencing that reduces human error and improves operator efficiency important considerations during contest operation

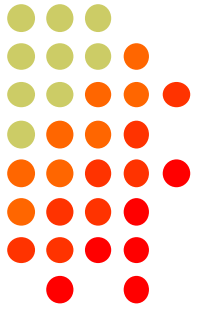
Meteor Scatter



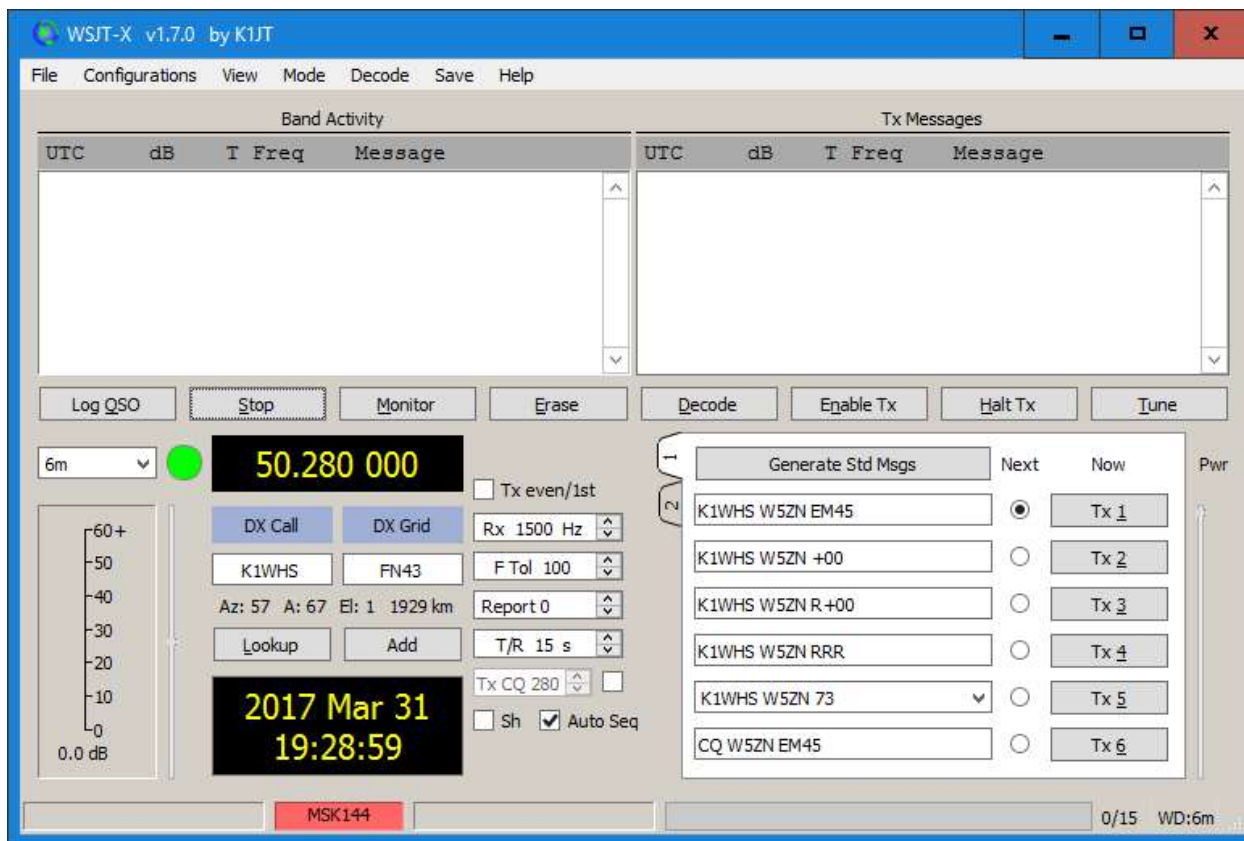
Graph still exists but in a separate window called “Fast Graph”



Meteor Scatter



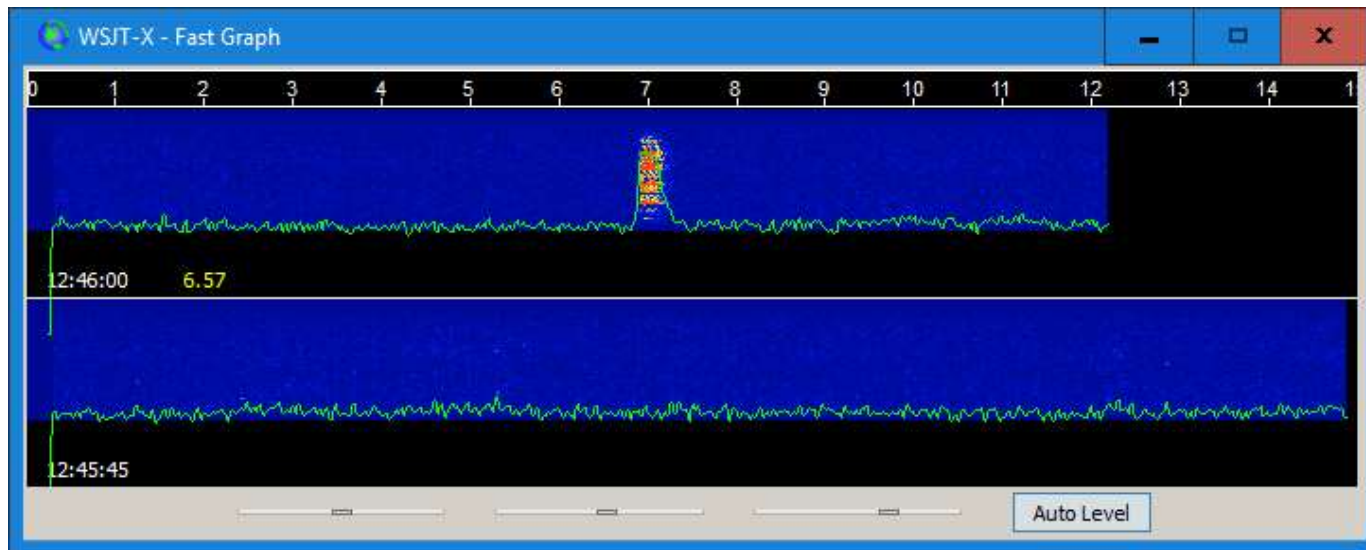
MSK144 Window is different from previous FSK441 Window”



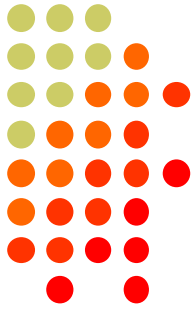
Meteor Scatter



Signal bursts still appear in the “Fast Graph”



Meteor Scatter

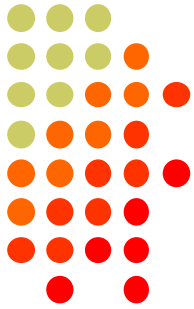


The screenshot displays the WSJT-X v1.7.0 software interface. The main window is titled "WSJT-X v1.7.0 by K1JT" and has a menu bar with "File", "Configurations", "View", "Mode", "Decode", "Save", and "Help".

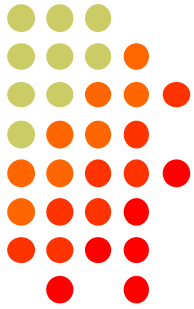
The interface is divided into several sections:

- Band Activity:** A table with columns "UTC", "dB", "T", "Freq", and "Message". It shows four entries, with the first one highlighted in green: "123930 -1 14.5 1437 & CQ WA8CLT EN80".
- Tx Messages:** An empty table with columns "UTC", "dB", "T", "Freq", and "Message".
- Control Panel:** Includes buttons for "Log QSO", "Stop", "Monitor" (highlighted in green), "Erase", "Decode", "Enable Tx", "Halt Tx", and "Tune".
- Frequency and Mode:** Shows "6m" mode and a frequency of "50.280 000".
- Call and Grid:** Shows "DX Call" as "K1WHS" and "DX Grid" as "FN43".
- Antenna Data:** Shows "Az: 57 B: 47 El: 1 1929 km".
- Time and Date:** Shows "2017 Apr 02 12:41:41".
- Message Queue:** A list of messages with "Next" and "Now" columns. The first message "K1WHS W5ZN EM45" is selected.
- Status Bar:** Shows "Receiving 15%", "MSK144", "Last Tx: TUNE", and "11/15 WD:6m".

Meteor Scatter



Meteor Scatter



The screenshot displays the WSJT-X v1.7.0 interface. The 'Band Activity' table shows several entries, with the top one highlighted in green:

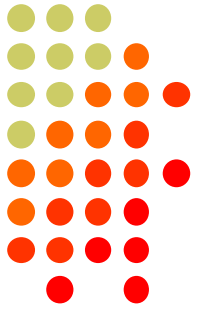
| UTC | dB | T | Freq | Message |
|--------|----|------|------|----------------------|
| 123930 | -1 | 14.5 | 1437 | & CQ WA8CLT EN80 |
| 123945 | -2 | 7.3 | 1433 | & WA8CLT VE2DFO FN25 |
| 123945 | -1 | 7.4 | 1432 | & WA8CLT VE2DFO FN25 |
| 123945 | 1 | 8.2 | 1433 | & WA8CLT VE2DFO FN25 |

The 'Tx Messages' table shows the current transmission and a previous one:

| UTC | dB | T | Freq | Message |
|--------|----|------|------|--------------------|
| 123930 | -1 | 14.5 | 1437 | & CQ WA8CLT EN80 |
| 124215 | Tx | | 1500 | & WA8CLT W5ZN EM45 |

The interface also shows a frequency display of 50.280 000 MHz, a date and time of 2017 Apr 02 12:42:28, and a list of messages to be transmitted, including 'WA8CLT W5ZN EM45' and 'CQ W5ZN EM45'.

K8ZR Test Results



- **Contest QSO Non-Contest QSO**

- **Tx Time:**

- 15 sec. CQ N8JX EN64
- 15 sec. N8JX K8ZR EN91
- 15 sec. K8ZR N8JX R EN64
- 15 sec. N8JX K8ZR RRR
- 15 sec. K8ZR N8JX 73
- Total time: 75 seconds

- **Non-Contest QSO**

- **Tx Time:**

- 15 sec. CQ WB4JWM EM83
- 15 sec. WB4JWM K8ZR EN91
- 15 sec. K8ZR WB4JWM +05
- 15 sec. WB4JWM K8ZR R+07
- 15 sec. K8ZR WB4JWM RRR
- 15 sec. WB4JWM K8ZR 73
- Total time: 90 seconds

K8ZR Test Results



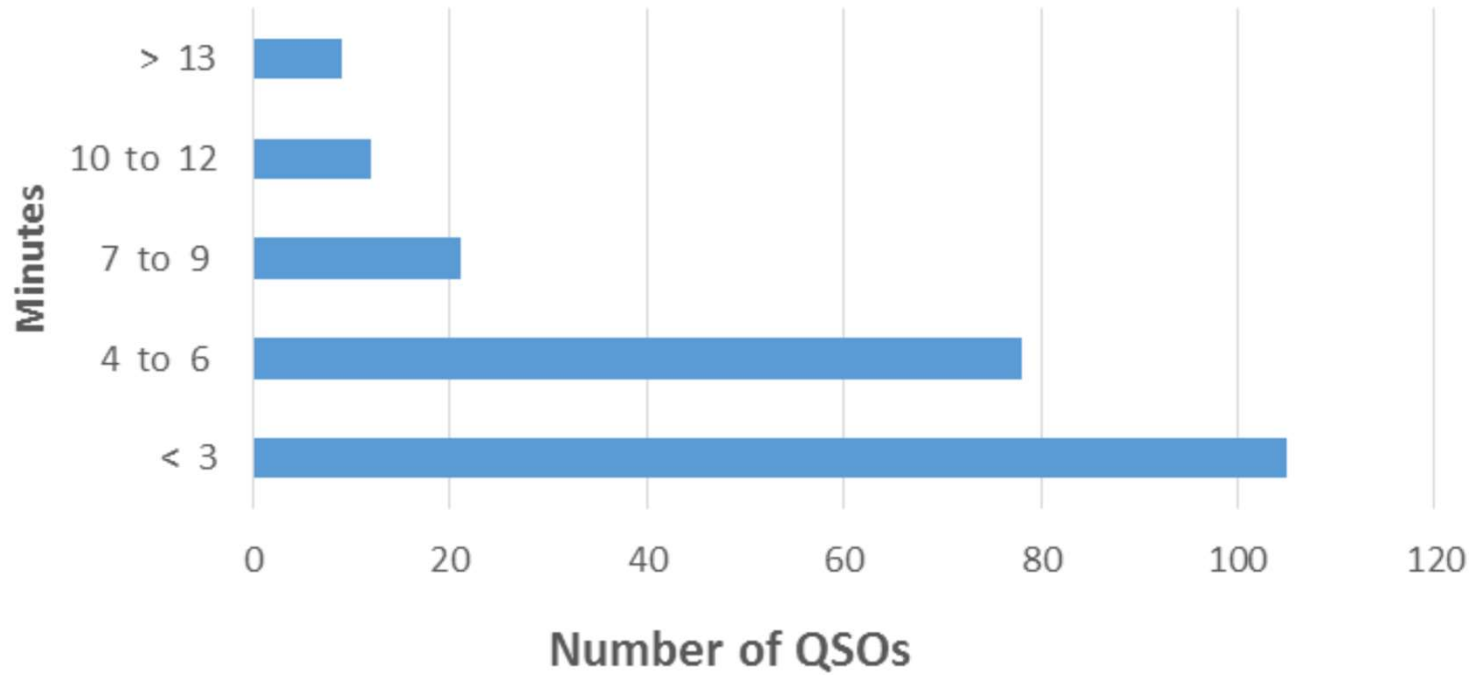
50 MHz MSK144 QSO Summary

- Period January 23rd- March 13th: 50 days
- Number of 50 MHz MSK144 QSOs: 225
- Average number of minutes to complete a QSO: 4.6
- Number of unique callsigns worked: 50
- Number of unique callsigns decoded: 98
- Number of States worked: 22
- Number of unique Grids worked: 42
- Number of 90 second QSOs: 10
- Best DX K5DOG EM00wh: 1,223 miles

K8ZR Test Results



Table 2.
Time to Complete



Acknowledgement



- Thanks to Tony, K8ZR (x-WA8RJF) for supplying additional information on Meteor Scatter