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WSJT Operation (Meteor Scatter)

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WA5TKU

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History

Meteor Scatter

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- First QST Articles in April 1953, W6QYT & W6POH Was for 15 & 20 meter Operation
- W4AO, W4HHK & W2UK Pioneered 144 MHz Contacts & Procedures
- Contact Procedures Has Changed Little Since
- WSJT Contact Procedures Based on Early Work

The World Above 50 Mc.

CONDUCTED BY EDWARD P. TILTON,* W1HDQ

Nov 1957 *QST*

FOR AN ART that has been known only about four years, v.h.f. meteor-scatter communication has come a long way. When the sharp "ping" of meteor signals was first observed on 144 Mc. back in 1953, many people refused to believe that meteors stirred up enough ionization to reflect signals at so high a frequency. That these were, in fact, signals of meteoric origin took some demonstrating. The work of W4AO, W4HHK, W2UK and other pioneers in this field is a chapter in the history of amateur radio in which we may all take pride.

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Basics

Meteor Trail

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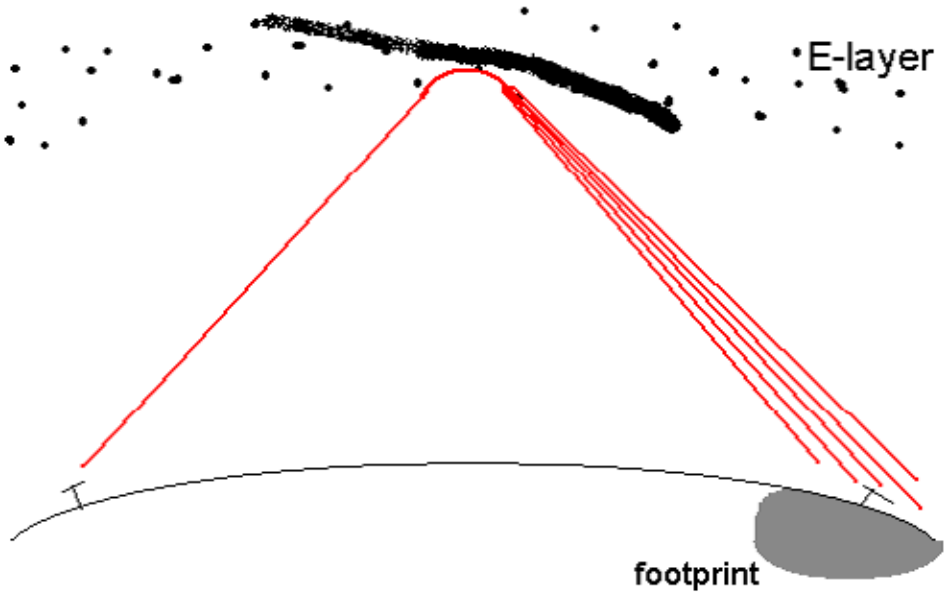
Typical overdense meteor trail
or "blue whizzer"



Meteor Trail

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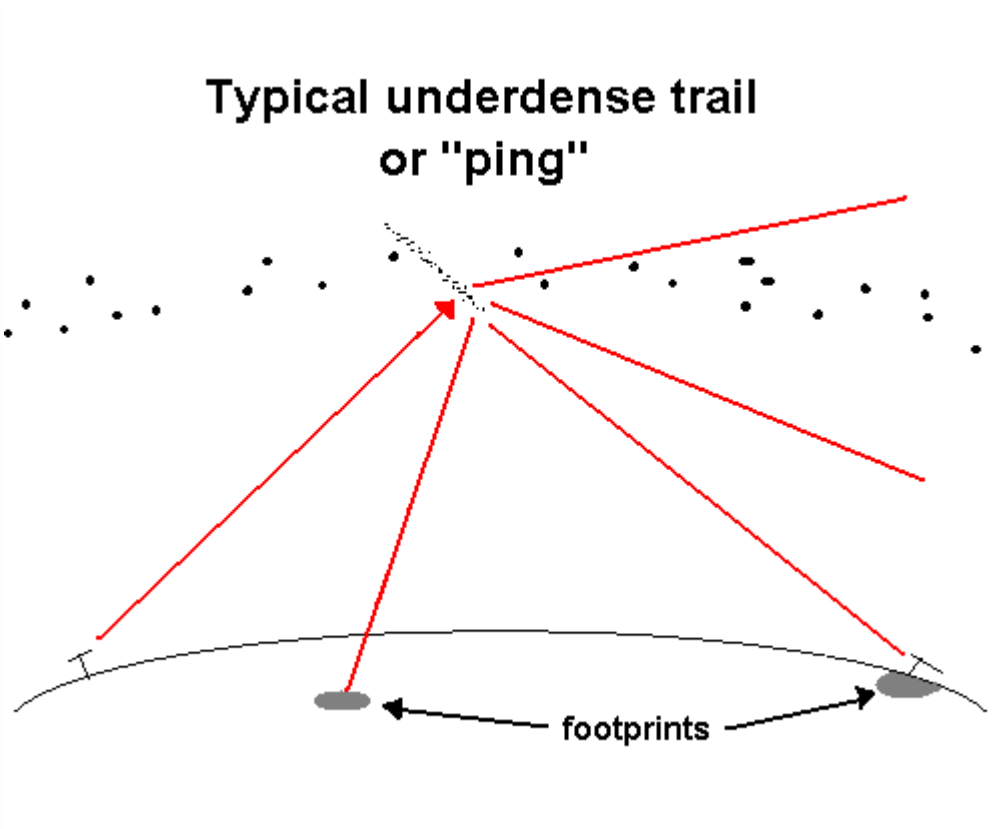

QST April 1953

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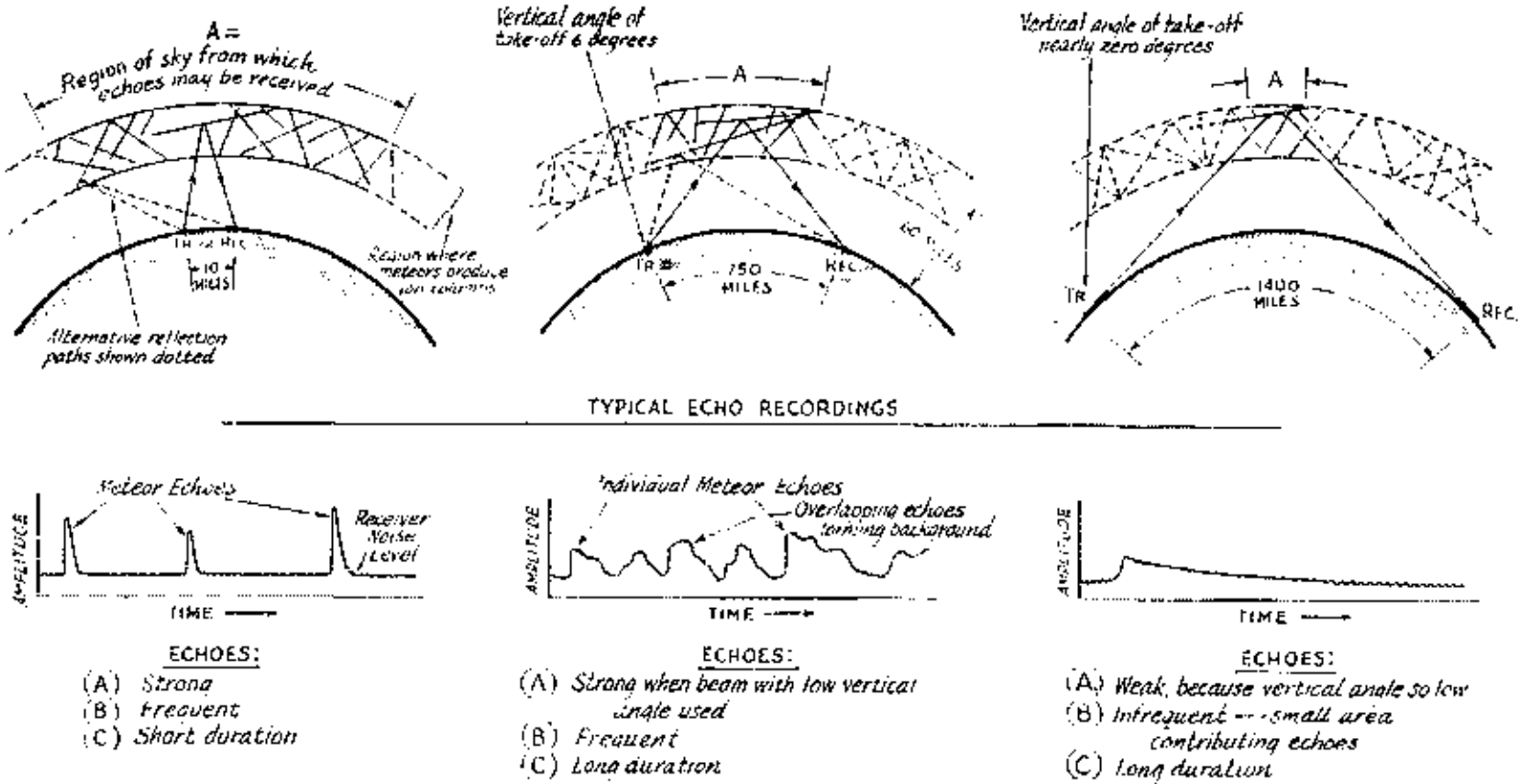

Fig. 5 — Effect of distance on meteor echo behavior, for a given frequency and power.

Major Meteor Showers

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Some Meteor Showers			
Name	**Date of Maximum**	**Meteors / Hour at Max**	**Parent**
Quadrantids	Jan. 4	110	-
Perseids	Aug. 12	68	Comet 1862 III
Orionids	Oct. 21	30	Comet Halley
Leonids	Nov. 17	10	Comet P/Tempel-Tuttle
Geminids	Dec. 14	58	3200 Phaethon

Random Meteors

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- For a north-south path the west side is the most productive from 18H to 06H local and it peaks at 03H.
- The east side of a north-south path is better from 06H to 18H and peaks at 10-11H.
- Max. meteor reflection counts on a north-south path is not at 06H local time!
- For an east-west path the north side is best from 00H to 12H and it peaks at 06H.
- The south side is best from 12H to 24H, but is on a quite even and low level.

Random Meteors

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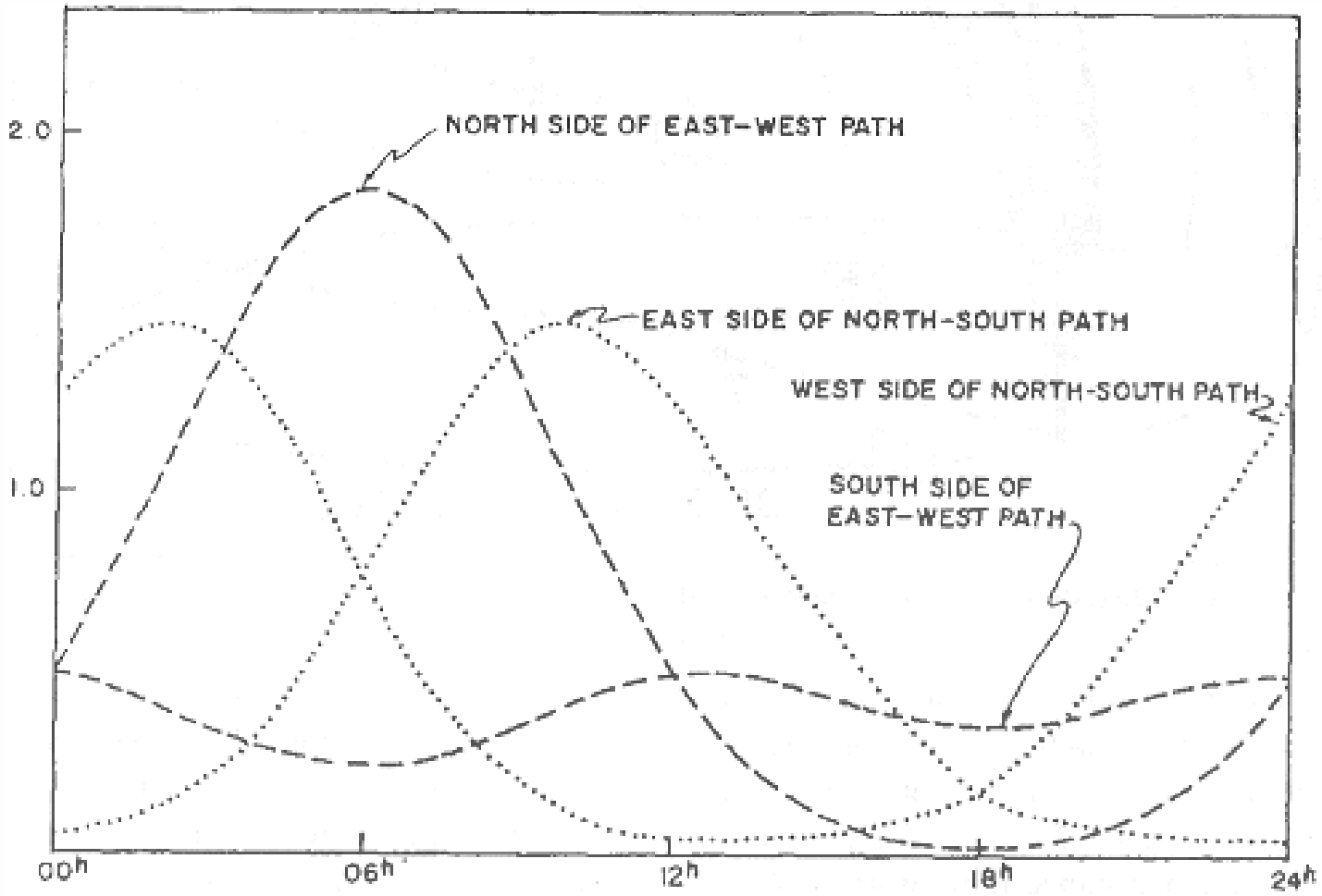
- This drawing shows predicted diurnal variations in random meteor counts for a path length in the order of 1000 km.



Random Meteors

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- The afternoon and early evening has fewer meteors, but the reflections should be longer, as the trails tend to form at lower heights, where the trails persist longer.
- Longer reflections are no disadvantage to making QSO' s, so there is no reason to give up making QSO's in the evening.

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WSJT

WSJT

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- "Weak Signal Joe Taylor" = WSJT
- Developed by Joe Taylor, K1JT
- Current Release is Version 9
- Some People Still Use Version 7
- Both Version Compatible – V9 Has Enhanced FSK441 Decoder & New Mode - ISCAT New to V9 – Replaces JT6M
- Uses Computer Sound Card

WSJT Metor-Scatter QSO

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- Very similar to SSB meteor-scatter operation
- Operators send information based upon what they have copied from the other station.
- QSO is complete when ***both*** stations have received complete callsigns, a piece of information (usually report), and a confirmation that it was received (“roger”).

WSJT Metor-Scatter QSO

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- 30-second sequences are standard.
- Western-most station transmits first. This is in the Western hemisphere.
- DXpeditions usually run all schedules and CQ's on the same frequency and period, regardless of direction.
- "Regular" CQ's can be either first or second period. This eases QRM (contests/showers)

Typical QSO Sequence

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- If you have copied…. Then Send
- Nothing…….. Callsigns Only
- Partial callsigns…….. Callsigns Only
- Both callsigns……. Calls + Report (or Grid)
- Both calls and report... “R” + Report
- “R” + report…… “RRR”
- “RRR”…….. “73” QSO is Complete

FSK441

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- "FSK…" –it uses frequency shift keying. You can think of it as fancy RTTY, however, FSK441 switches among four tones rather than alternating between two.
- Tones: 882Hz, 1323Hz, 1764Hz, 2205Hz.
- "…441" –Each character takes about 2.3ms to send. Each character is composed of three tones. That's 441 baud

FSK441

- Code only supports characters we are interested in sending: callsigns, signal reports, and very short messages.
- Uses the PUA43 alphabet: A-Z, 0-9, space, period, comma, ?, /, #, and $. No formatting characters, such as <CR> or <LF>.
- No stop bits: synchronization achieved with no overhead!

RTTY vs FSK441 Data Format

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RTTY (5-bit)	
A	00011
B	11001
C	01110
Z	10001
6	10101
<SP>	00100

FSK441 (3-bit)		
A	101	
B	102	
C	103	
Z	231	
6	012	
<SP>	033	*

FSK441

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- Each character in the FSK441 code contains at least two different frequencies—no “000” “111” “222” or “333”.
- These characters are reserved for “shorthand” messages: “R26” “R27” “RRR” “73”.
- If one sends one of these messages in a loop, the result is a pure single-frequency carrier. (Hence the name!)

FSK441

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- Space is encoded as “033”.
- No character starts with a “3”.
- All messages contain at least one space. If the user does not enter one, the program will add one to the end of the message.
- When WSJT finds a signal, it “looks” for the sequence “033”. This is the point of synchronization.

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- These messages are shorthand for the most common messages in an FSK441 sked.
- WSJT can use a separate algorithm to look for single-tone messages, which means better S/N than with the multi-tone encoding.
- It *can* occasionally result in false signals.
- You have to use your ham skills: *Listen!*

FSK441

- Four-tone FSK: 882, 1323, 1764, 2205 Hz
- Three tones or “symbols” per character
- Keying rate 441 baud
- Transmission rate 147 cps
- Detection bandwidth 4 × 441 Hz
- Short messages sent repeatedly
- 30s T/R sequences

WSJT FSK441 Window

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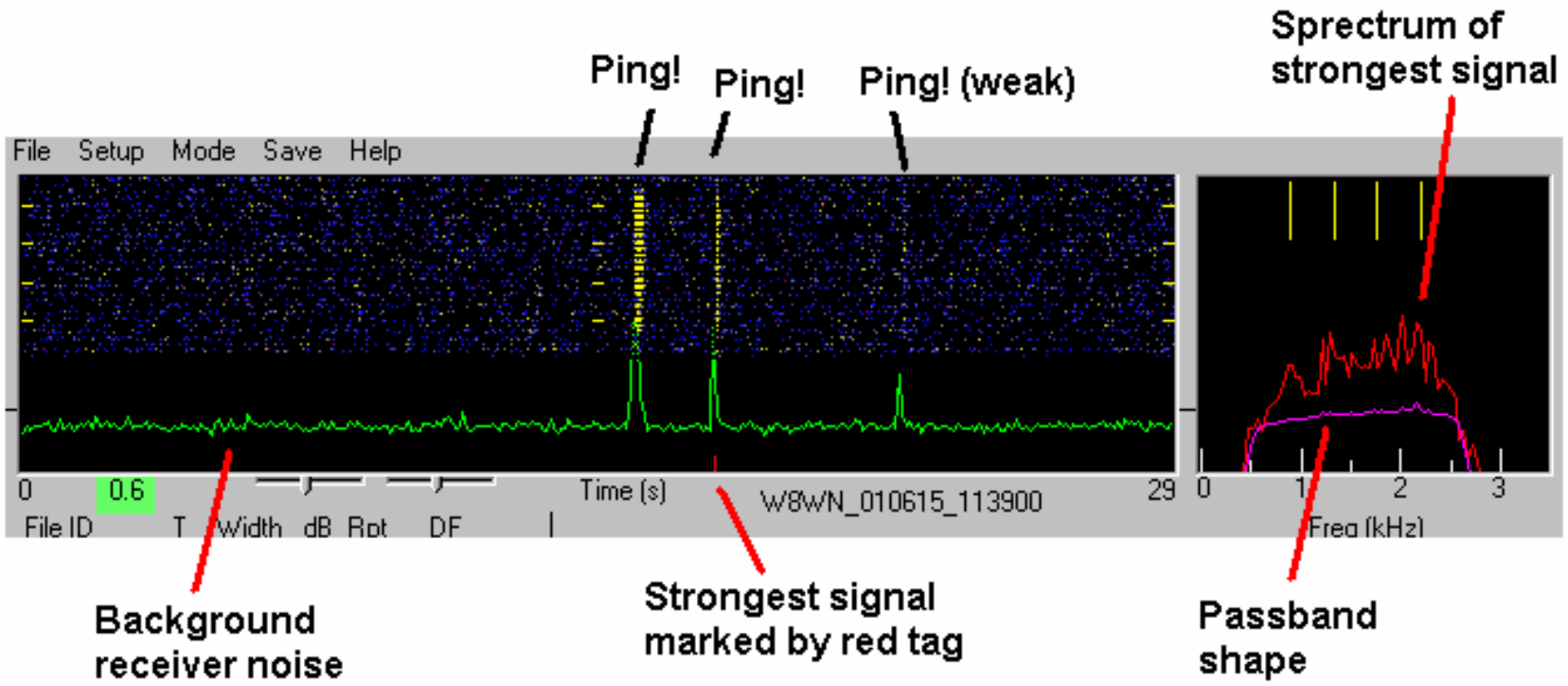

W8WN QSO with K1JT

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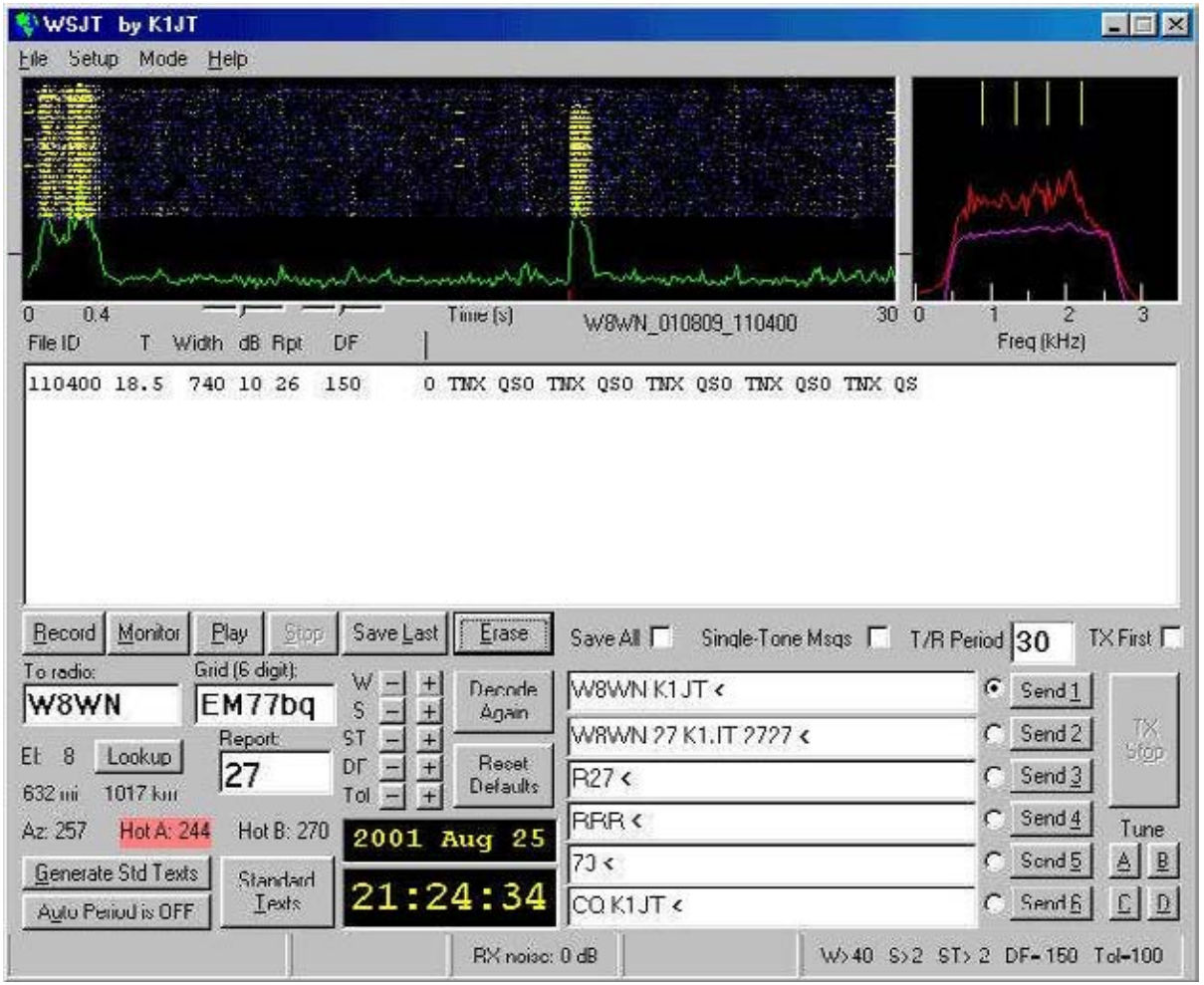

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SETUP

Very Basic Setup Connections

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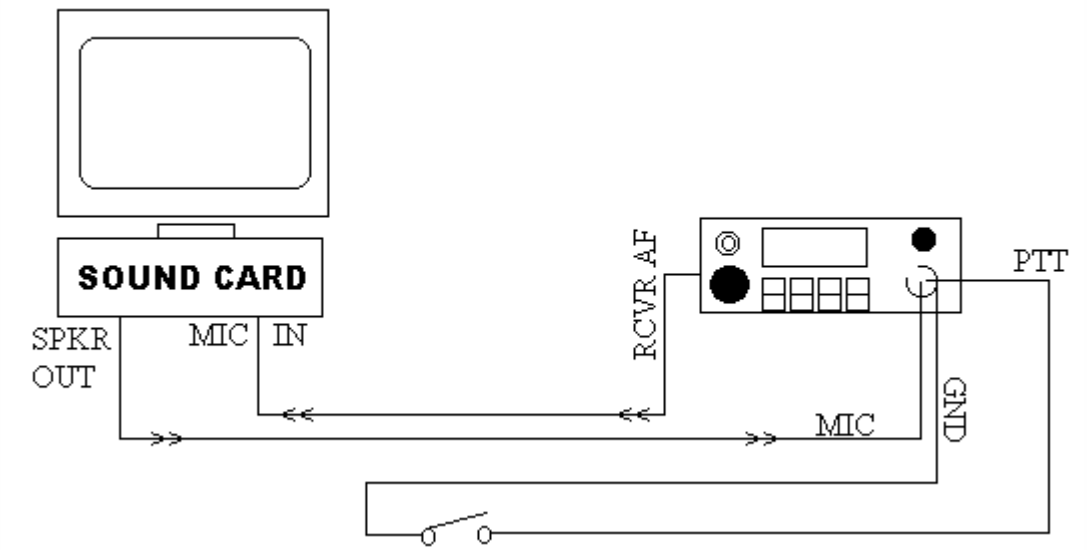
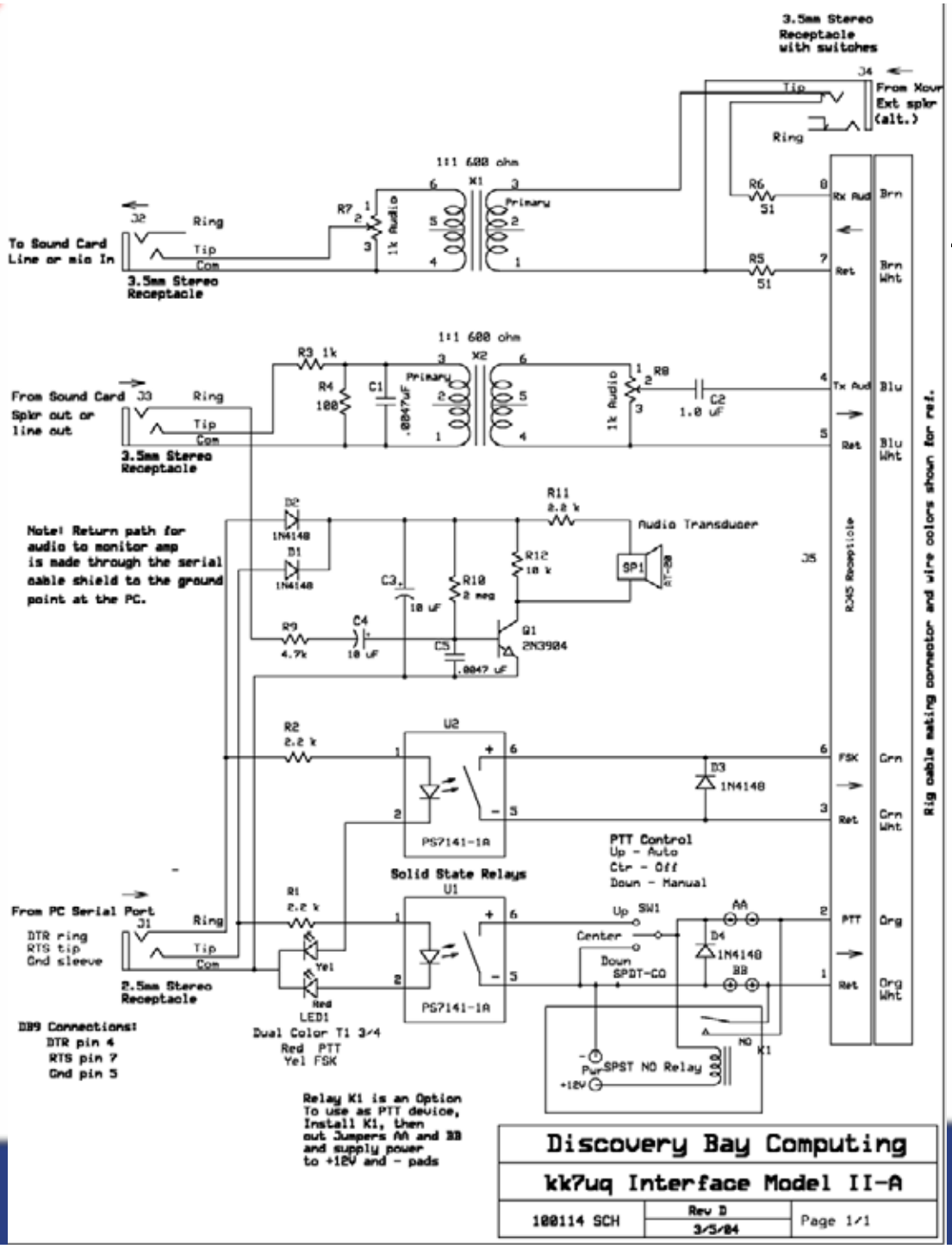


Recommend Connection of PTT to Computer via Serial Port for Automatic Operation

Sound Card Interface Circuit by KK7UQ



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Audio Interface

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- Top Box - KK7UQ Sound Card Interface
- Bottom Box- 4 Port Data Switch – 15 Pin DB Connectors

Audio Interface

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- Rear View of Sound Card Interface

Sound Card Selection

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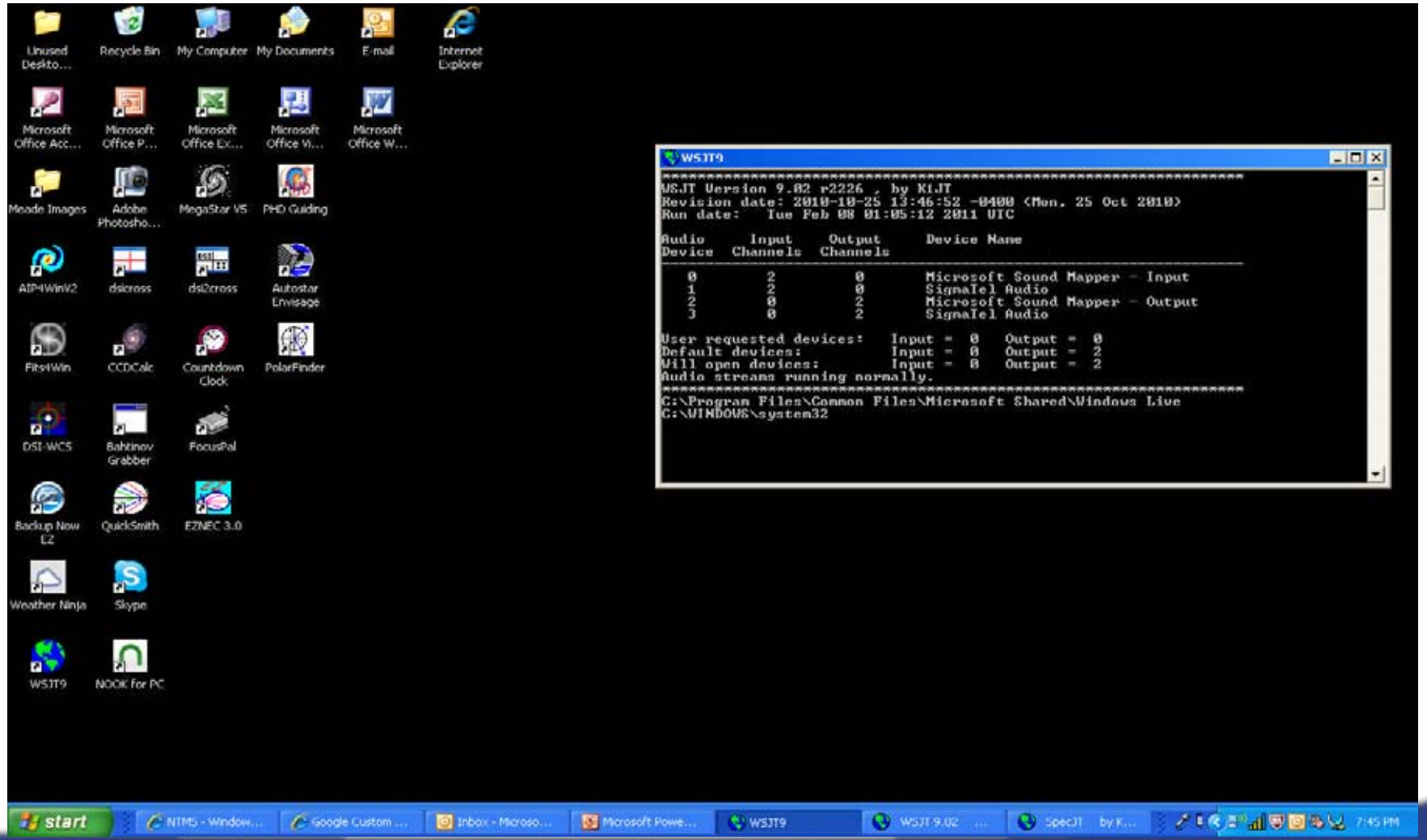

Setting RX Level

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- 4 Possible Locations to Adjust RX Levels
  - Digital Gain Slider in SpecJT Window
  - Options Pull Down in SpecJT Window Opens Sound Card Adjustment Sliders
  - Pot on Sound Card Interface Box
  - If Using Speaker or Headphone as Input Source to Sound Card Interface Box Use Audio Gain on Receiver

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Setting RX Level

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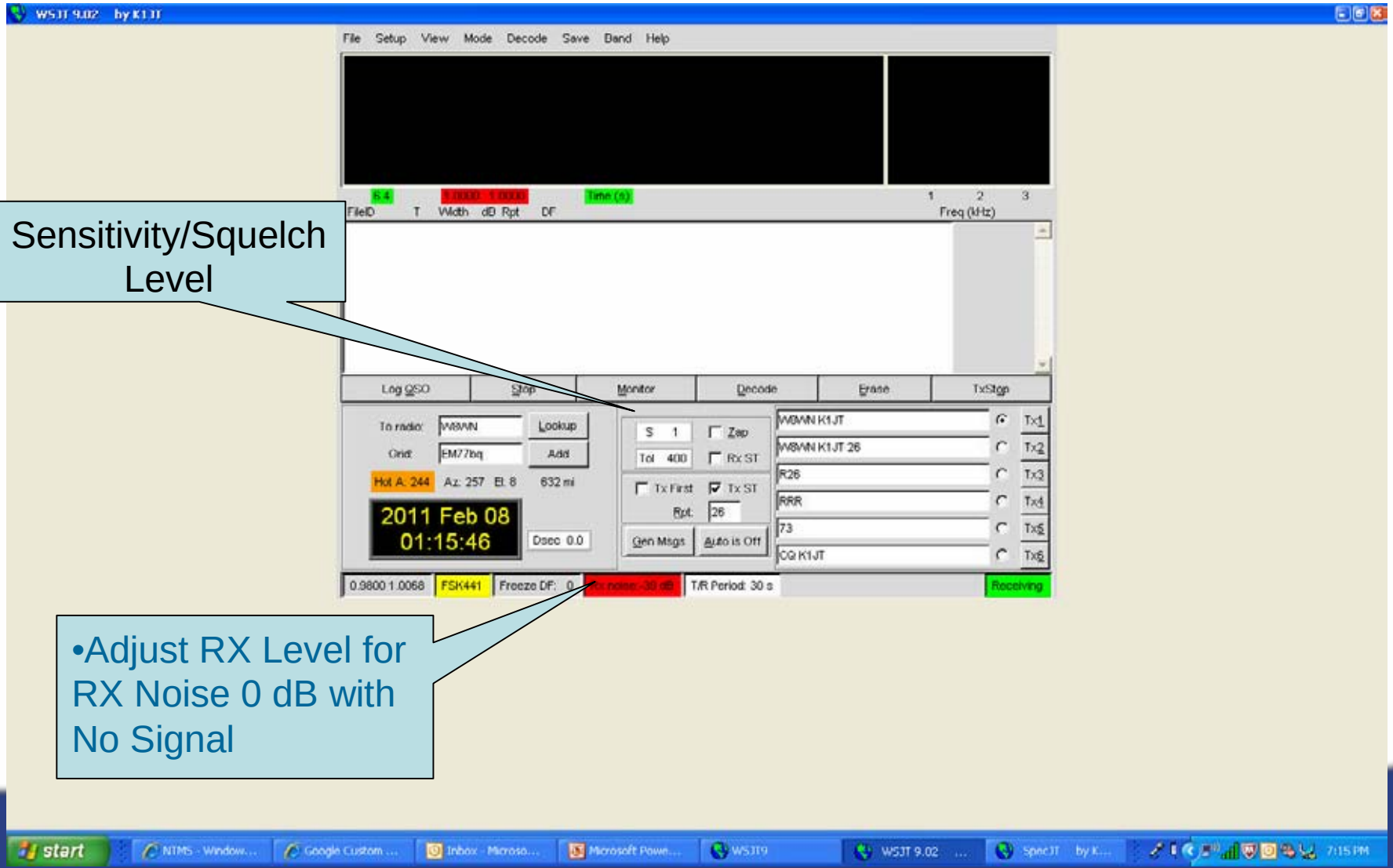

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Sound Card RX Level

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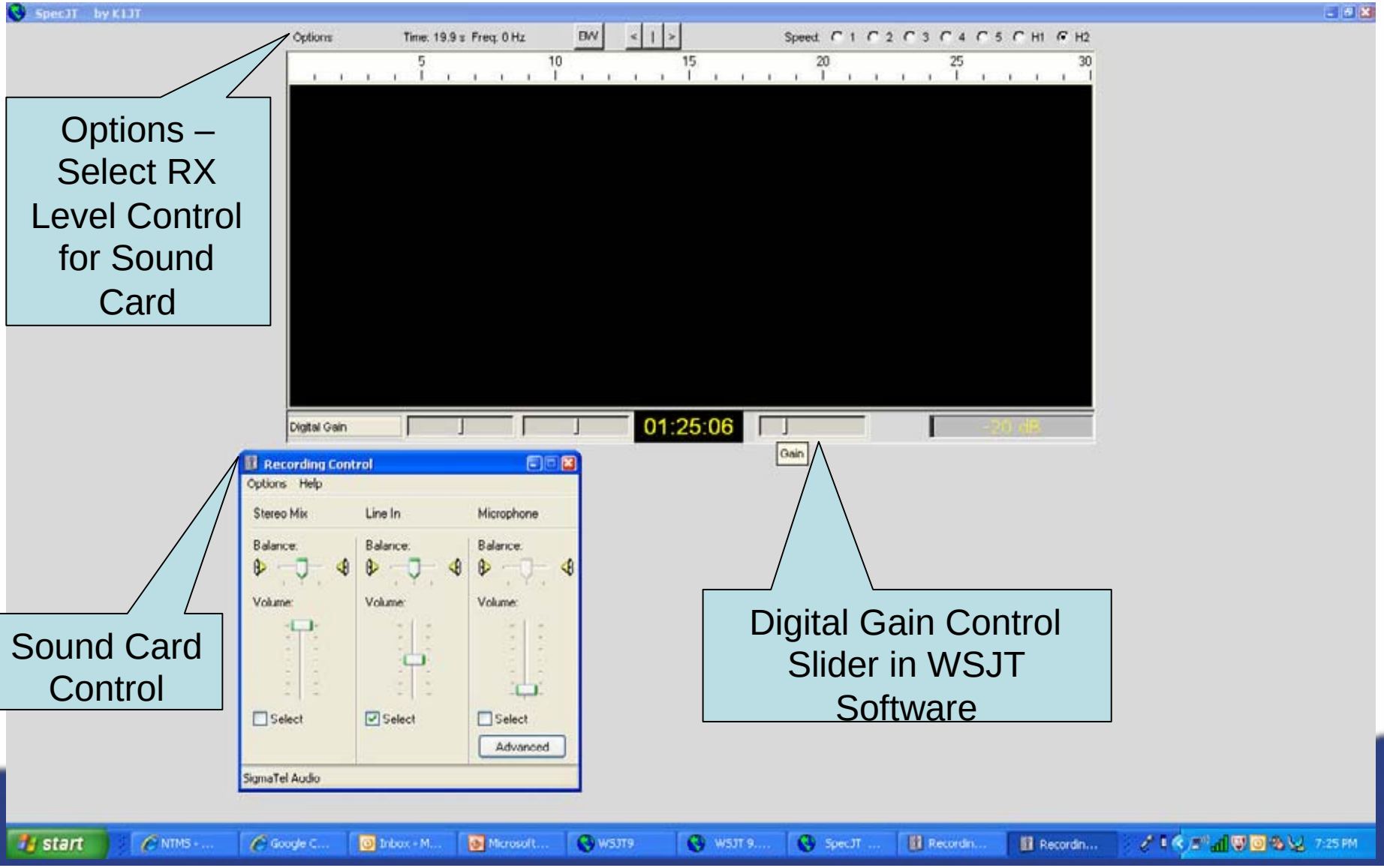

Sound Card TX Level

- 3 Possible Locations to Adjust TX Levels
  - Options Pull Down in SpecJT Window Opens Sound Card Adjustment Sliders
  - Pot on Sound Card Interface Box
  - Mic Gain Control on Radio May Work Depending on Radio and Method of Interfacing Sound Card to Radio

Sound Card TX Level

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Options – Select TX Level Control for Sound Card

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WSJT Setup Options

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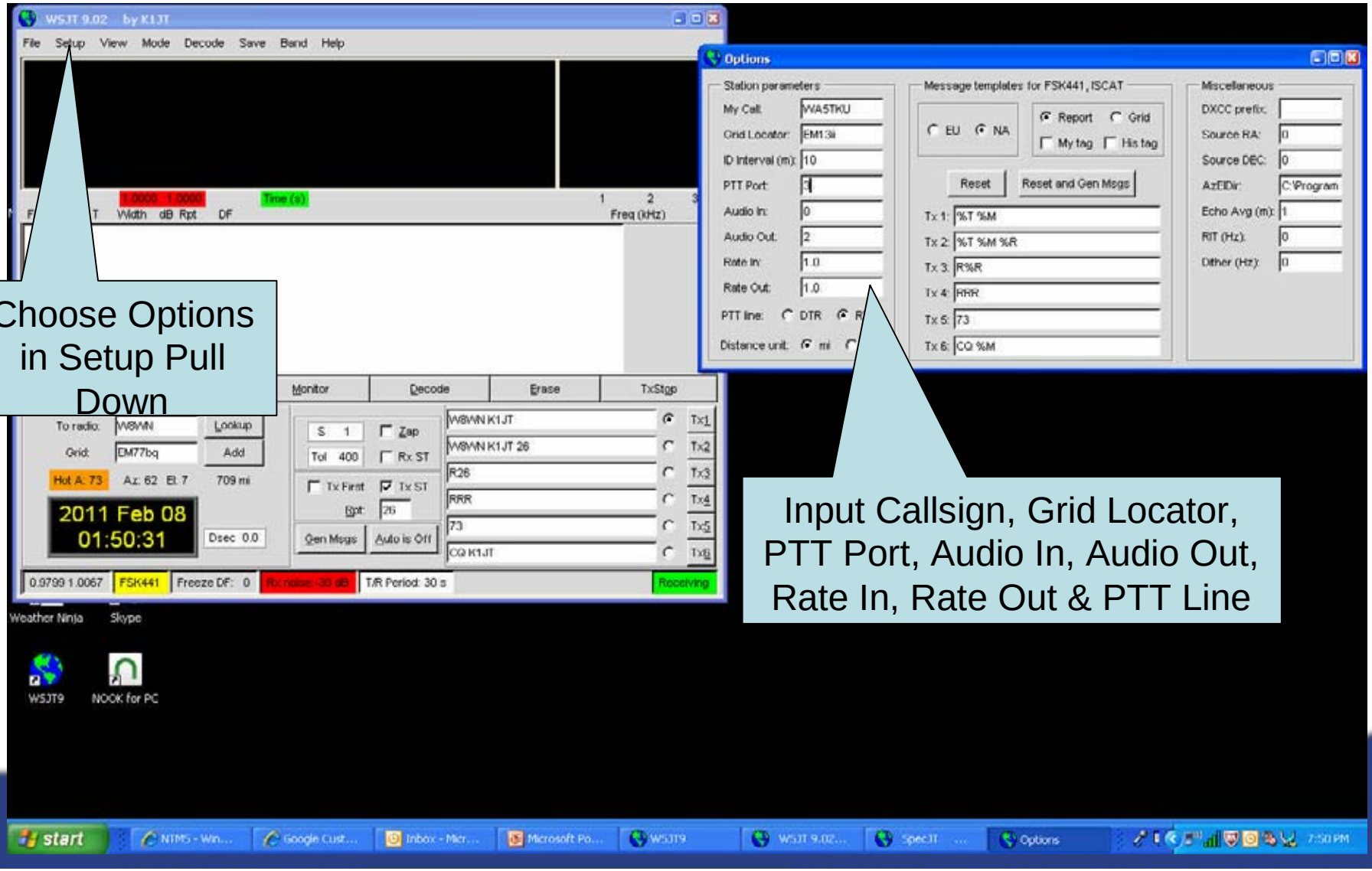

WSJT Setup Options

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- Options Pull Down Window
  - Input Your Callsign
  - Input Your Grid Square (6 digit)
  - Input PTT Port – Look in Device Manager for Port Information
  - Set Audio In & Out to Match WSJT Sound Card Window for Sound Card of Choice
  - Rate In & Out – See WSJT Manual
  - PTT Line Selection Depends on Interface Box Design
    - My Box has DTR & RTS Diode ORed

Station Requirements

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- Radio with Short Term Stable Frequency
- PC with Sound Card
- Radio to Sound Card Interface
- Ability to Sync PC Clock to Stable Source
  - Short Term Stability Most Important ie < 200 Hz/Hour

Dimension 4

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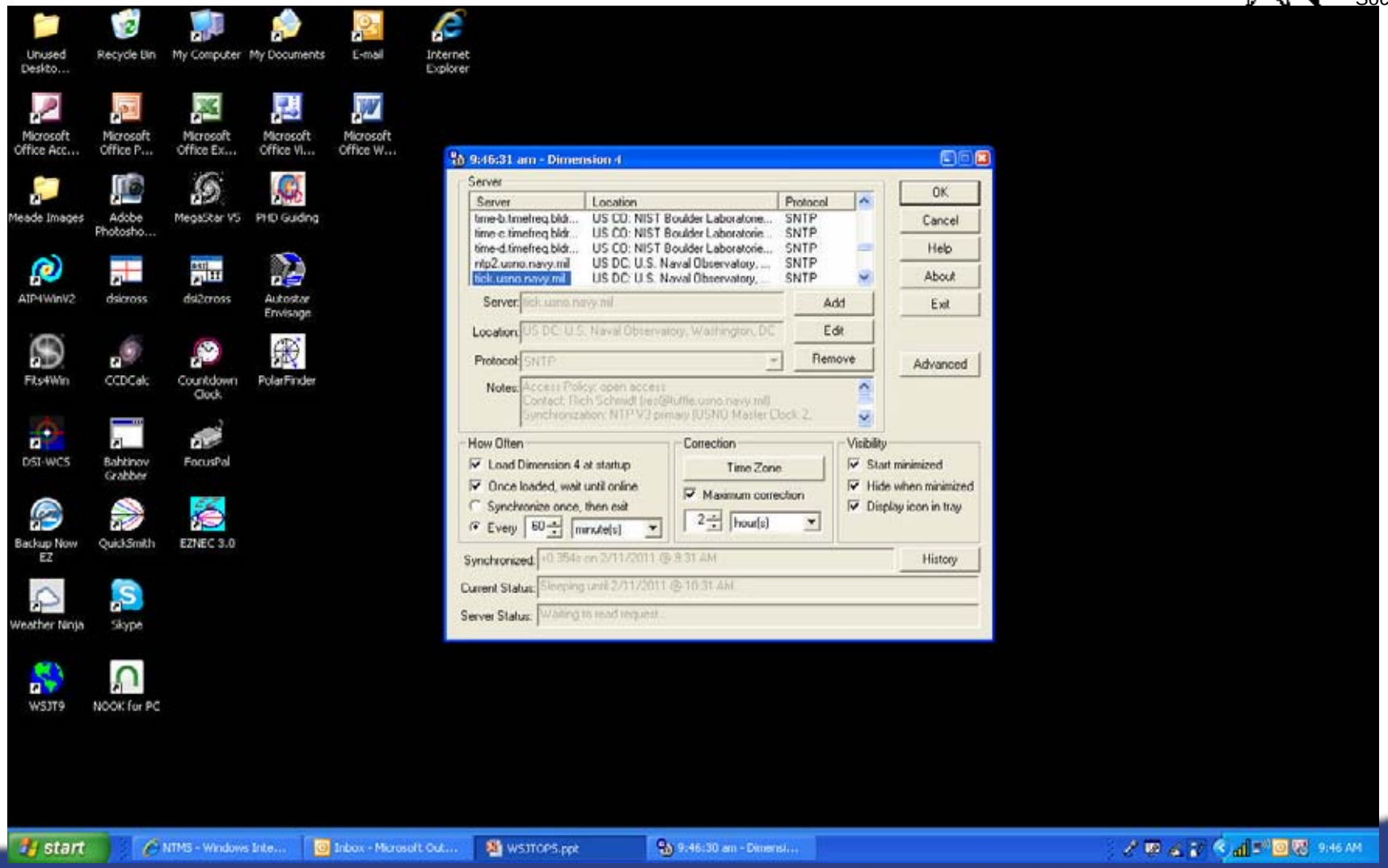

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Operation

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N0UK Reflector for Coordination

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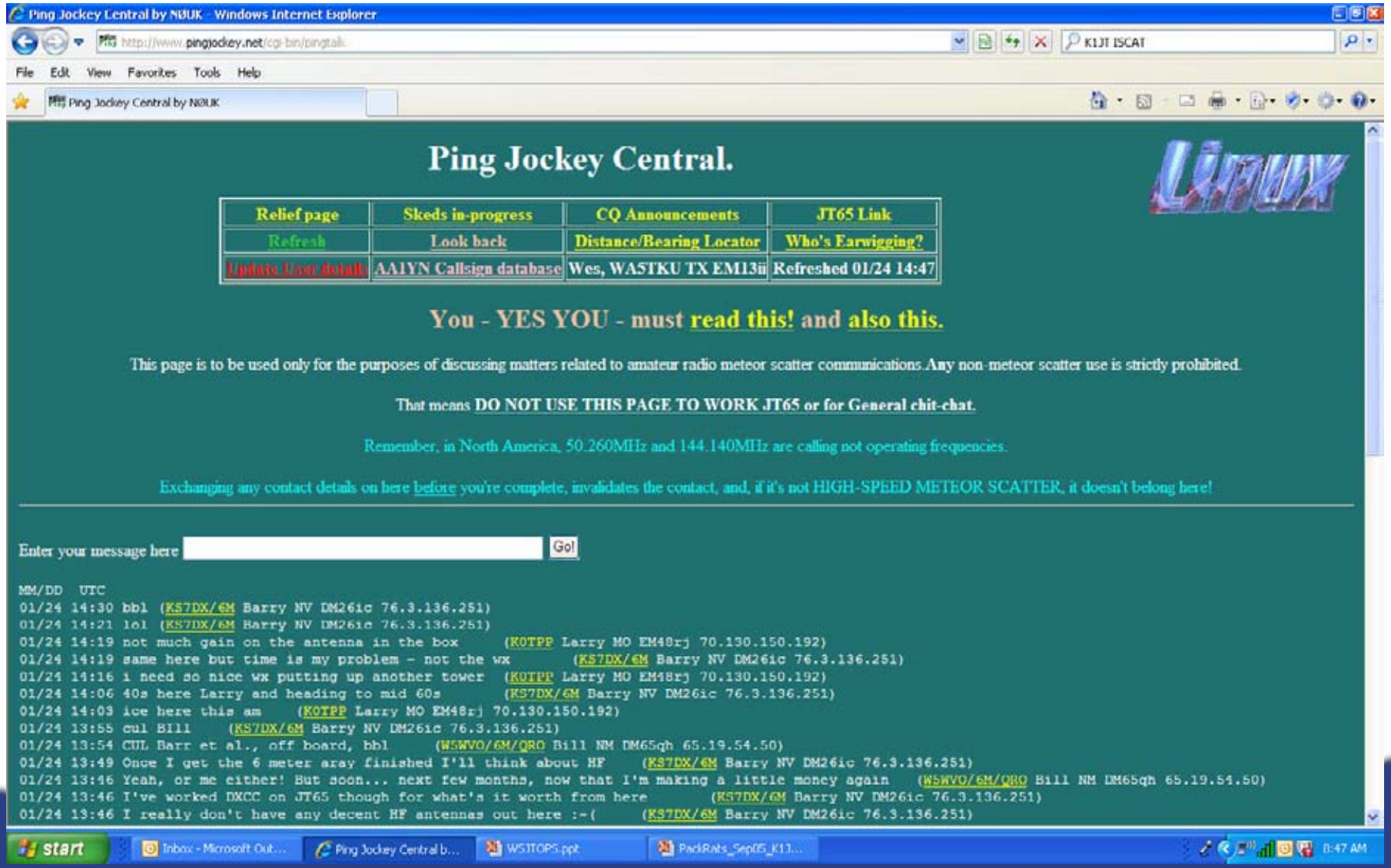

Logger Etiquette

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- Statements Best Not Used
  - • Are you sending single tones now?
    • I can hear you now
    • I have up to 10db burst no decodes
    • Just got a big one!
    • Keep going
    • Your DF is 102
    • Leave your antenna there!
    • Not hearing anything, moving to Hot A
    • I am getting some single tone, is that you?
    • Wow! You hit me hard, 13db!
    • Keep going we are almost finished.
    • There is 500 watts out have anything yet?

2011 Major Meteor Showers

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Quadrantids (QUA)	**Jan 01-Jan 10**
Lyrids (LYR)	**Apr 16-Apr 25**
Eta Aquarids (ETA)	**Apr 28-May 21**
Delta Aquarids (SDA)	**Jul 21-Aug 23**
Perseids (PER)	**Jul 13-Aug 26**
Orionids (ORI)	**Oct 04-Nov 14**
Leonids (LEO)	**Nov 07-Nov 28**
Geminids (GEM)	**Dec 04-Dec 16**
Ursids (URS)	**Dec 17-Dec 23**

Calling Frequencies & Modes

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Band	Call Freq.	Modes (WSJT 9)
Six Meters	50.260	FSK441, JT6M or ISCAT
Two Meters	144.140	FSK441
222	222.085	FSK441

Calling CQ – Offset Method

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- " Knowing how to properly call CQ is just as important as knowing where to call CQ" According to WA5UFH
- CQ 280 WA5UFH not CQ U20 WA5UFH
  - Recent Change in Offset Calling Procedure
- Station Calling CQ listens on 50.280
- When Answering Station is Heard Calling Station Shifts TX from 50.260 to 50.280
- Continue Normal Contact Procedure

Answering CQ – Offset Method

- Answer Station Replies to CQ on Offset Frequency (Above Example would be 50.280)
- Answering Station Sends Both Calls
- CQing Station will Shift His TX Frequency to 50.280 to Continue Normal QSO Procedure

Contact Time

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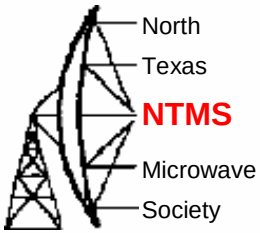
- Contacts Can Take a Few Minutes
- Contacts Can Take Hours
- Patience is Needed for Long Distance QSO
- Common Mistake of New Comer is to Give Up if QSO is Not Quick

My Experience



- Have Made Contacts in a Few Minutes
- Have Taken Over an Hour for Contact
- Rox's Availability Major Contributor
- WA5TKU Max 144 MHz DX is 1203 Miles
  - 100 watts – FT-847 – 13 Element Yagi @ 70 feet

DX Records

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- **Known & verified HSMS Records:**
- 222 MHz AF6O & W7XU 222MHz 1270 mi / 2043 km Aug 12,2007 15:22 Perseids
- 144 MHz K2DRH & N6RMJ 144MHz 1572 mi / 2530 km Aug 13,2009 06:50 Perseids
- 50 MHz VE3CDX & N8JX 50MHz 1627 mi / 2618 km May 16,2008 15:22 eta Aquarids

WA5TKU Station

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- 50 MHz
  - FT-920 – 100 watts
  - 5 Element Yagi @ 50 Feet
  - No External Preamp
- 144 MHz
  - FT-847 – Mirage Amp – 100 watts
  - 13 Element Yagi @ 70 Feet
  - Preamp Internal to Mirage Amp
  - Added Fan to Mirage Amp a MUST!!!

WA5TKU Station

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- PC – 1.6 GHz Processor – 2 Gig Ram
- External Sound Card
- Use D4 to Sync PC Clock
- Sound Card Interface Box
- Radio to Sound Card Interface Selector
- Connection to Interface Box Via Back of Radios – Levels Out of Radio Constant

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FSK441 DEMO


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ISCAT

ISCAT

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- ISCAT Introduced Summer 2010 in WSJT v8.x
- Results of Testing – ISCAT Replaced JT6M in WSJT v9.x
- Like JT6M Best Used for Tropo & E's
- Improved Signal Decode for Strong Long Burst Signals Like Tropo & E's
- Most North American Stations Now Using ISCAt
- EU Stations Have Not Adopted ISCAT to Date
- May Cause Problem During this Summer E's Season – Keep WSJT 7 on PC

ISCAT

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- Options
  - Possible to Run 30 sec or 15 sec Sequences
    - Right Click T/R Period for 15 sec
    - Left Click T/R Period Return to 30 sec

Mode Comparison

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	FSK441	JTMS_2	JT6M	ISCAT_2
T/R period (s)	30	30	30	30
Modulation type	4-FSK	MSK*	44-FSK	41-FSK
Keying rate (baud)	441	1378	21.5	43.1
Characters/s	147	197	14.3	32.3
Bandwidth (Hz)	1764	1378	947	1809

*MSK stands for "minimum shift keying", a technique that allows faster keying while minimizing bandwidth

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ISCAT DEMO

Summary

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- Meteor Scatter
  - Showers
  - Random
  - FSK441
- Scatter
  - ISCAT or JT6M
- E Skip
  - ISCAT or JT6M
- Fun to Operate

References

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