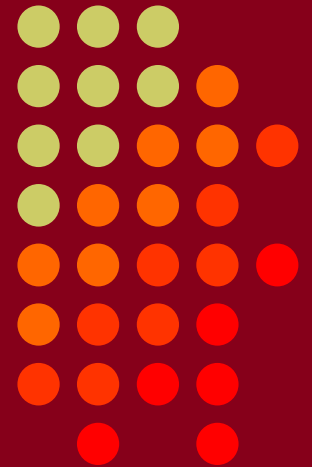


CTU 2023 Presents

RTTY – FT4/8 Digital Contesting

Ed Muns, W0YK & P49X



• CTU •
CONTEST
UNIVERSITY

ICOM®

Digital Contesting is Fun!



- RTTY Contesting → Digital Contesting
- RTTY
 - Operating
 - Setting Up
- FT4/8
 - Operating
 - Setting Up
- 2nd session: *“How to Maximize Your Digital Contest Station and Operation”*

Lots of RTTY Contests

~ two/month



- **Biggies (3) (3 - FT4/8)**

- ARRL RTTY Roundup (1st weekend in Jan)
- CQ WPX RTTY (2nd weekend in Feb)
- **ARRL Int'l Digital (1st weekend in Jun)**
- **WW Digi (last weekend in Aug)**
- CQ WW RTTY (last weekend in Sep)
- **FT Roundup(1st Sat in Dec)**

- **NCJ contests (4)**

- NAQP RTTY (3rd Sat in Feb, 2nd Sat in Jul)
- Sprint RTTY (2nd Sat in Mar & Oct)

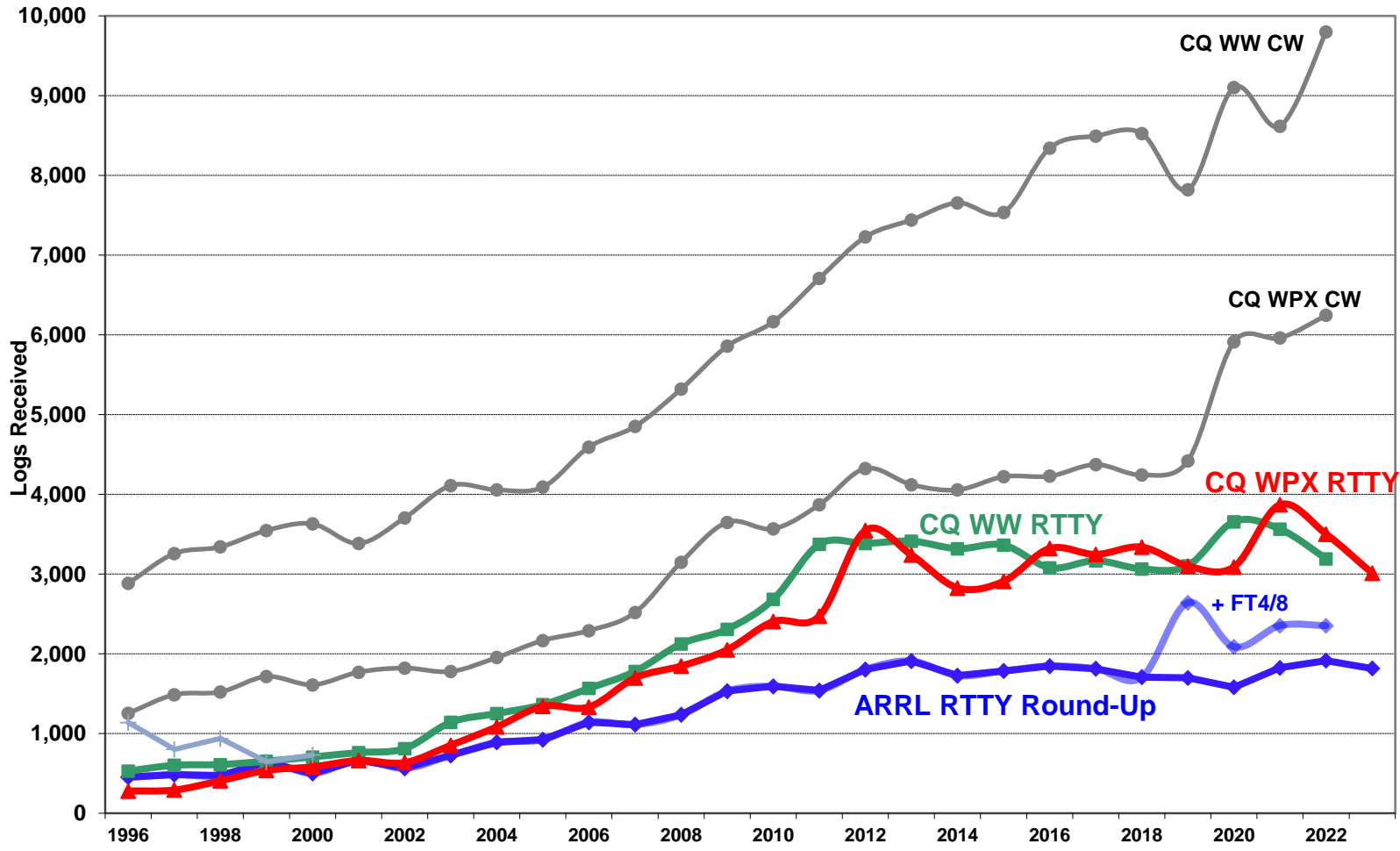
- **Other popular RTTY contests (7)**

- BARTG:
 - Sprint (3rd weekend Jan)
 - HF RTTY (3rd weekend Mar)
 - 75 Baud (3rd weekend Apr)
- WAE RTTY (2nd weekend in Nov)
- JARTS, Makrothen, SARTG (2)

- **NCCC Sprint (52 - every Thursday evening)**

○ CTU ○

Three Largest RTTY Contests



o CTU o

CONTEST
UNIVERSITY

4/96
18 May 2023

ICOM®

What Makes a Great RTTY Contester?



- 1) Contester who happily logs casual callers
- 2) Uses CW & SSB techniques where useful
- 3) Strives to exploit RTTY uniqueness
 - Auto-decode frees operator time ... use it to do things difficult with CW & SSB, e.g., SO3R!
 - Speed is ~2x CW
- 4) Applies learning back to CW & SSB

What is RTTY?

compared to CW



CW

- 1) **One** RF carrier
- 2) Local audio **pitch**
- 3) On **or** off
 - key up is data 0
 - key down is data 1
- 4) **Morse** code
 - typically 25-40 wpm

RTTY

- 1) **Two** RF carriers 170 Hz apart (*Space & Mark; Shift*)
- 2) Local audio **tones**
- 3) One on **and** other off
 - Space is data 0
 - Mark is data 1
- 4) **Baudot** code
 - constant 60 wpm (*or 45.45 Baud*)

What is RTTY?



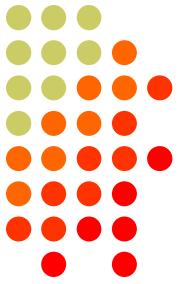
Figures Shift

- 5-bit code → 32 chars.
- 2 sets:
 - Letters set & Figures set
 - 6 common control chars.
 - LTRS (unshifted)
 - FIGS (shifted)
 - Null, Space, LF, CR
- LTRS or FIGS toggle set

Code	Control Characters	
	Letters	Figures ITA2 USTTY
11111	LTRS	
11011	FIGS	
00000	Null	
00100	Space	
01000	LF	
00010	CR	
00011	A	-
11001	B	?
01110	C	:
01001	D	ENQ \$
00001	E	3
01101	F	!
11010	G	&
10100	H	#
00110	I	8
01011	J	BELL '
01111	K	(
10010	L)
11100	M	.
01100	N	/
11000	O	9
10110	P	0
10111	Q	1
01010	R	4
00101	S	' BELL
10000	T	5
00111	U	7
11110	V	;
10011	W	2
11101	X	/
10101	Y	6
10001	Z	"

What is RTTY?

code history



- Bacon's cipher (1605)
- Gauss & Weber (1833)
- Baudot code (1870)
 - Manual bit entry
 - 5-bit ITA1 code
 - Two 32-bit character sets
 - letters
 - figures
- Murray code (1901)
 - Teletype character entry
 - Western Union variation
- **5-bit ITA2 code (1930)**
 - **USTTY variation**
- ASCII (1963)
 - 7-bit ITA5 code

Code	Control Characters		
	Letters	Figures	
		ITA2	USTTY
11111		LTRS	
11011		FIGS	
00000		Null	
00100		Space	
01000		LF	
00010		CR	
00011	A	-	
11001	B	?	
01110	C	:	
01001	D	ENQ	\$
00001	E	3	
01101	F		!
11010	G		&
10100	H		#
00110	I	8	
01011	J	BELL	'
01111	K	(
10010	L)	
11100	M	.	
01100	N	/	
11000	O	9	
10110	P	0	
10111	Q	1	
01010	R	4	
00101	S	'	BELL
10000	T	5	
00111	U	7	
11110	V	;	
10011	W	2	
11101	X	/	
10101	Y	6	
10001	Z	"	



What is RTTY?

Figures Shift



- The *LTRS* and *FIGS* characters do not print
 - The code for the characters “Q” and “1” is the same; which one prints depends on if you are in Letters or Figures set
 - Note that the *LTRS*, *FIGS* and *Space* characters appear in both sets
- Example: “**KI7GUO DE K4GMH**” gets sent as:
 - *LTRS* **K I** *FIGS* **7** *LTRS* **G U O** *Space* **D E** *Space* **K** *FIGS* **4** *LTRS* **G M H**
- Why do we care to understand this?
 - If a burst of static garbles the *LTRS* or *FIGS* character, then what prints after that is from the wrong set until the next *LTRS* or *FIGS* character appears

What is RTTY?

UnShift on Space



- UnShift On Space (USOS or UOS)
 - Increases noise immunity for alpha text
 - Space character forces a shift to the Letters set
- Contest exchanges are alpha and numeric
 - Should UOS be on ~~or off~~?
 - Should Space ~~or Hyphen~~ delimit exchange elements?
 - 599 1079 1079 or 599-1079-1079
- *Recommendation:*
 - *Turn on both RX & TX UOS and use Space delimiters*

What is RTTY?

audio tones



- Space and Mark audio tones
 - Default: 2295 and 2125 Hz (“high tones”)
 - Less fatiguing: 1085 and 915 Hz (“low tones”)
- Analogous to CW pitch
 - Operator choice
 - Each operator can use different tone pairs
 - Transmission is two RF carriers 170Hz apart
- Must be same in radio and decoder/encoder

What is RTTY?

AFSK vs. FSK



Two methods of transmission:

- AFSK (Audio Frequency Shift Keying)
 - keyed audio tones into SSB transmitter via:
 - Mic input, or
 - Auxiliary audio input. e.g., Line In
- FSK (Frequency Shift Keying)
 - on/off keys the transmitter just like CW

Note: Receiving is the same in either case.

What is RTTY?

dial frequency

spots are often wrong



- RTTY RF is independent of local audio tones and whether LSB or USB is used:
 - The higher RF frequency is the Mark (*14090.000 kHz*)
 - The lower RF frequency is the Space (*14089.830 kHz*)
 - The difference between the two is the shift (*170 Hz*)
- FSK displays Mark (*14090.000 kHz*)
- AFSK displays suppressed carrier which varies with local audio tones and sideband used!
 - For Mark tone of 2125 Hz (Space tone of 2295 Hz):
 - LSB (*14092.125 kHz*)
 - USB – Mark & Space tones reversed (*14087.005 kHz*)

What is RTTY?

AFSK vs. FSK



AFSK

- Indirect (*tones → Mic input*)
- Any SSB radio (*esp. legacy*)
- SSB (wide) filtering
- Dial = sup. car. frequency
- VOX
- Audio cable (*a'la FT8, JT65/9, PSK31*)
- Must use high tones

NET (automatic TX tone control)

Less bandwidth (depends on radio)

Easier hook-up; NET

FSK

- Direct (*like CW keying*)
- “Modern” radios
- RTTY (narrow) filtering
- Dial = Mark frequency
- PTT
- COM FSK keying cable
- Can use low tones

No audio level adjust

No disabling speech proc.

No erroneous sound keying

Less pitfalls

What is RTTY?

summary



- Uses 5-bit Baudot (actually, USTTY) code with two sets of 32 characters: Letters and Figures
- Space & Mark frequencies separated by 170 Hz “Shift”
- Local Space & Mark tones analogous to pitch in CW
- Constant 45.45 Baud (60 wpm) asynchronous character stream with 5 data bits and 2-3 sync bits
- Figures Shift & Letters UnShift
 - Use optional UnShift-On-Space (UOS), plus space delimiter
- AFSK vs. FSK transmission (receiving is the same)
 - Radio dial frequency differences
 - 100% duty cycle!

The Cynics Say ...



- “The RTTY decoder/encoder does everything.”
however, this attribute ...
 - frees the operator to improve other skills
 - enables more contest participants
 - provides mode diversity for contest junkies
- “RTTY is a pain to set up and get working.”
... stay tuned, it's really not that difficult!

RTTY Considerations



Much like CW and SSB, except:

- Non-human decoding implications
 - *serial number repeat, universal “fist” or “voice”*
- Distractions are tempting
 - *watch TV, do email, read, etc.*
- RTTY established practice
 - *‘CQ’ at end of CQ message*
- Whisper-level headphone volume; low tones
 - *just to detect presence & timing*
- Key-down transmission ... 100% duty cycle

◦ CTU ◦

RTTY Sub-Bands



- 10 meters: 28080-28100, during contests 28080-28200
 - JA: 21070-21150
- 15 meters: 21080-21100, during contests 21080-21150
 - JA: 21070-21150
- 20 meters: 14080-14100, during contests 14080-14150
 - JA: 14070-14150
- 40 meters: 7025-7050 & 7080-7100, during contests 7025-7100
 - JA: 7030-7100
- 80 meters: 3580-3600, during contests 3560-3600
 - JA: 3520-3575 and 3599-3612
- 160 meters: 1800-2000
 - No RTTY contesting

◦ CTU ◦

RTTY Messages

CQ WPX RTTY Contest



- Short, as with CW/SSB
- No extraneous info
- 599 (not 5NN) once
- Serial number twice
- Space (not hyphen)
- Omit 'DE'
- RTTY chars
 - %R (CR, LF)
 - %E (drop PTT)
- End with Space

www.rttycontesting.com/tutorials/messages

F02:	%RWPX P49X P49X CQ %0%E
F03:	%R P49X %E
F04:	P49X %E
F05:	%R%C 599 %N2 %N2 %E
F06:	%RTU P49X CQ %0%E
F07:	%RQRV %ZR.1 %E
F08:	%R %C TU .. NOW%L%E
F09:	%RAGN %E
F10:	%RNR? %E
F11:	%R%N3 %E

F02:	%RWPX P49X P49X P49X CQ %0%E
F03:	%RQSL LOTW OR WOYK %E
F04:	%R%C %E
F05:	%RTU 599 %N2 %N2 %L%E
F06:	%RKB %H P49X CQ %L%0%E
F07:	%RQRV %ZS.1 %E
F08:	%R%H %C KB .. NOW%L
F09:	%RQRZ %E
F10:	%RCALL? %E
F11:	? %E

RTTY Messages

formatting



CR/LF

Space

Receive

F02:	%RNPX P49X P49X CQ %C%E
F03:	%R P49X %E
F04:	P49X %E
F05:	%R%C 599 %N2 %N2 %E
F06:	%RTU P49X CQ %O%E
F07:	%RQRV %ZR.1 %E
F08:	%R %C TU .. NOW%L%E
F09:	%RAGN %E
F10:	%RNR? %E
F11:	%R%N3 %E

Super Check Partial

call sign selection



- SCP (Super Check Partial) enables computer to select call signs in receive window
 - Unworked calls (no mult)
 - New mults and double mults
 - Dupes
- Use main SCP from CW/SSB/RTTY contests
 - RTTY SCP is a subset, so use full file

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

N1MM Logger

Super Check Partial

logger differences



XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

- Custom colors
- Highlight option

N1MM Logger

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

WriteLog

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

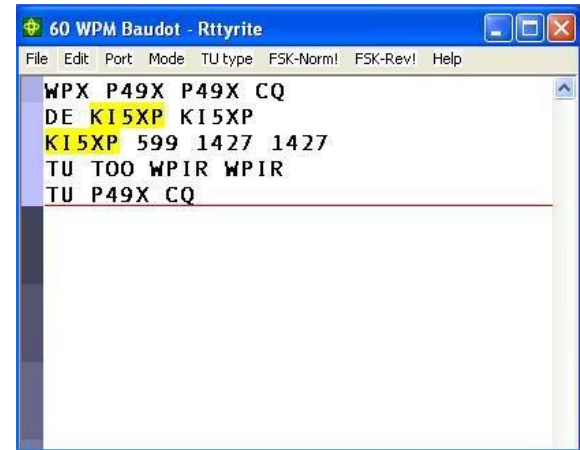
Win-Test

Tips



“All I receive is gibberish!”

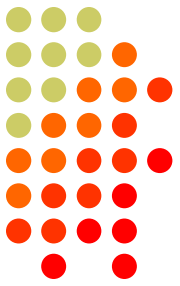
- “Upside-down”
 - Reverse Mark & Space
 - LSB vs. USB
- Figures vs. letters
 - TOO=599, WPIR=2084
 - UOS should be on
 - Shift-click to convert, or look at top two rows
- Audio-In level, tones, flutter
- (Other station’s signal)



○ CTU ○

Tips

“They never answer me!”



- “Upside-down”
 - FSK: polarity switch in radio
 - AFSK: LSB vs. USB; polarity select in software
- Off frequency
 - AFC on with NET (AFSK only) off [recommend RIT instead]
 - AFC & NET on by default in MMTTY
 - changes not sticky; change defaults in USERPARA.INI
- AFSK: Mic & SC levels; speech processor on
- Radio mode, tones, FSK interface

More Tips



- 100% duty cycle ... *caution!*
- Practice
 - During RTTY contests (~ two per month)
 - NCCC Thursday night practices (weekly)
- Multi-Ops

RTTY Operating

summary



- Many casual RTTY contest participants
- RTTY sub-bands; 10-80 only; avoid audio-digital & beacons
- 500 Hz receive filtering; USOS on
- Messages (“macros”)
 - Short, ~~5NN~~, unique exchange twice, Space delimiter
- Common problems
 - “Upside-down” (reversed Space/Mark or LSB vs. USB)
 - Figures vs. Letters
 - Audio:
 - RX audio output level and TX (AFSK only) audio input level
 - Unmuted soundcard inputs and outputs
 - Space and Mark tone consistency between decoder and radio
 - Off-frequency tuning (AFC & NET); band conditions

◦ CTU ◦

CONTEST
UNIVERSITY

26/96
18 May 2023

ICOM®

The Cynics Say ...



- “The RTTY decoder/encoder does everything.”
however, this attribute ...
 - frees the operator to improve other skills
 - enables more contest participants
 - provides mode diversity for contest junkies
- “RTTY is a pain to set up and get working.”
... stay tuned, it's really not that difficult!

How Do I Set it Up?

overview



- **Acquire** and set up hardware and/or software to convert between the RTTY audio tones and text:
 - RTTY *receive* decoder
 - RTTY *transmit* encoder
 - PC-radio interface
- **Configure** decoder/encoder
- **Integrate** decoder/encoder with logger

The rest of the station setup is the same as for CW and SSB

How Do I Set it Up?

RTTY decoder/encoder



- RTTY *receive* decoder converts the two RTTY tones to printed characters.
 - CW decoders seldom used
 - Ears/brain/hands for CW/SSB
- RTTY *transmit* encoder converts typed characters (or messages) into the two tones (AFSK) or on/off keying (FSK).
 - logger *CW keyers and SSB DVKs are also used, similar to RTTY encoders*
 - Otherwise, brain/hands/mouth for CW/SSB

How Do I Set it Up?

decoder/encoder terminology



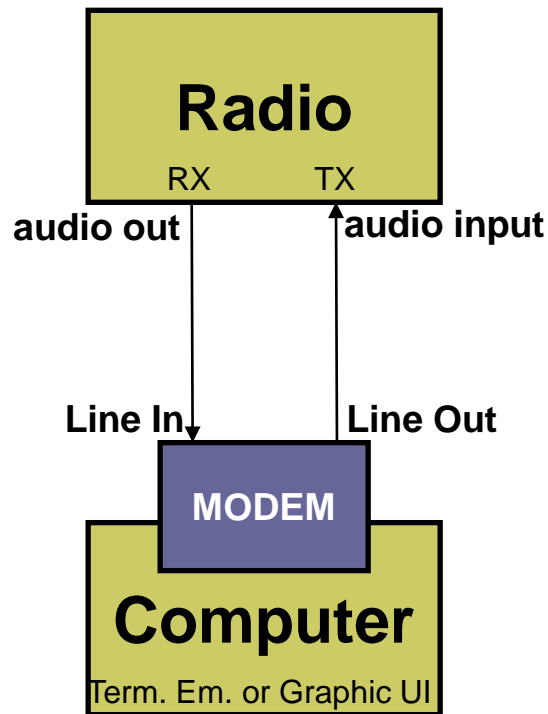
- The RTTY *transmit encoder* and *receive decoder* is sometimes referred to as a MODEM or a TNC:
 - MODEM = MOdulator DEModulator
 - TNC = Terminal Node Controller
- MODEMs can be:
 - a hardware box, or
 - a software application driving a PC soundcard

How Do I Set It Up?

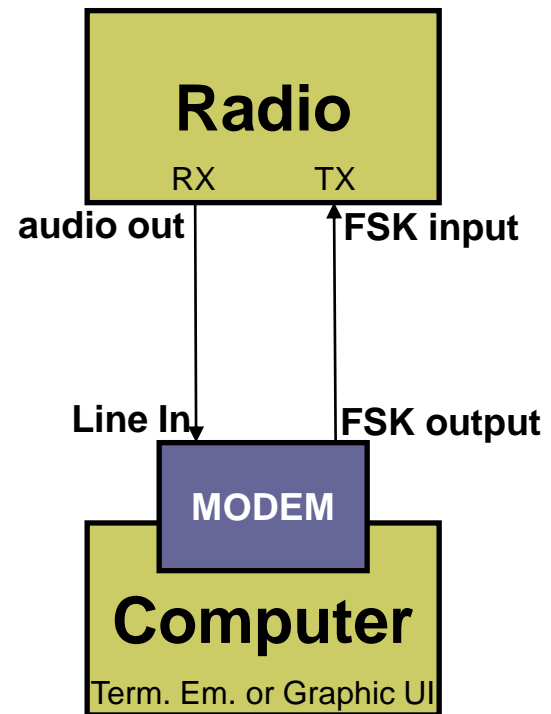
hardware MODEM



AFSK

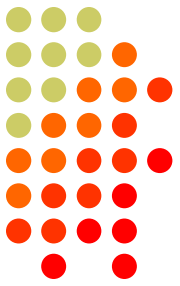


FSK



How Do I Set It Up?

hardware MODEM

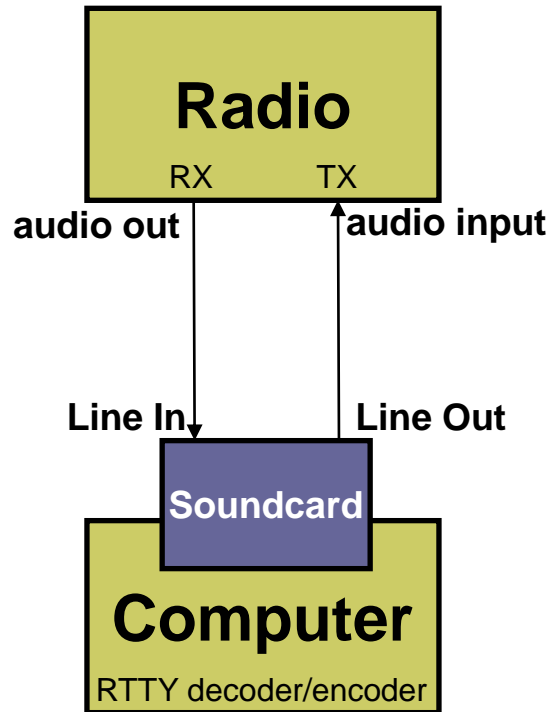


How Do I Set It Up?

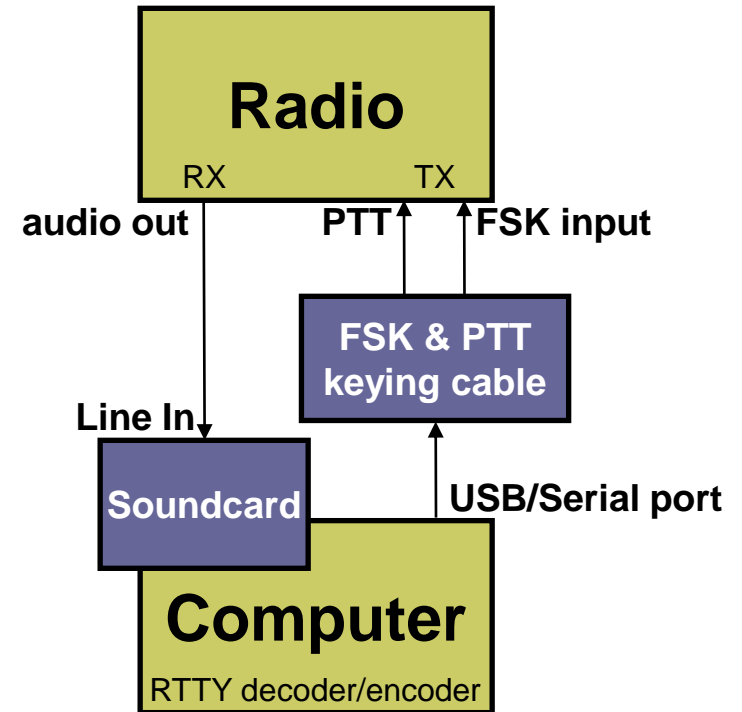
software application & soundcard



AFSK



FSK



How Do I Set it UP?

cables



- Receive:
 - RX audio out to soundcard
 - *Optional DSP filter*
 - 1:1 isolation transformer
 - *JPS NIR-12, or ...*
- Transmit:
 - AFSK: TX audio in from soundcard, or
 - FSK: FSK/PTT keying
 - 1:1 isolation transformer, or
 - Keying interface

How Do I Set It Up?

ground loops

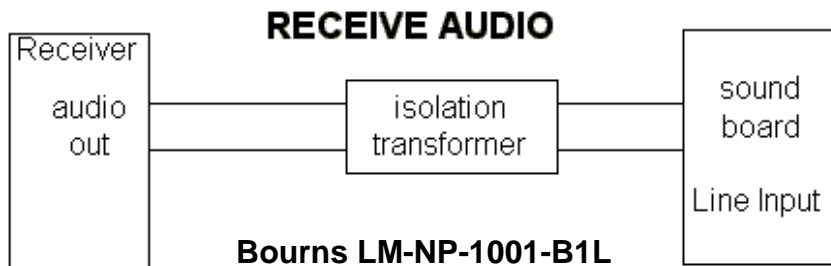


- Eliminate ground loops between radio and PC
- Otherwise insert 1:1 audio isolation transformer on:
 - RX output
 - TX Mic input (*AFSK only*)
- Alternatives:
 - Bourns LM-NP-1001-B1L transformer → homebrew cable
 - Ground loop isolators
 - W2IHY iBox
 - Commercial RTTY interfaces
 - K3 (uses Bourns LM-NP-1001-B1L on LINE IN & OUT)

◦ CTU ◦

How Do I Set It Up?

homebrew audio isolation



\$1.78

-90 dBc 3rd order IMD



How Do I Set It Up?

ground loop isolators



Radio Shack \$19.49 or eBay \$6.99
-64 dBc 3rd order IMD



eBay \$3.35



eBay \$5.50



eBay \$7.45

How Do I Set It Up?

W2IHY iBox audio isolation



How Do I Set It Up?

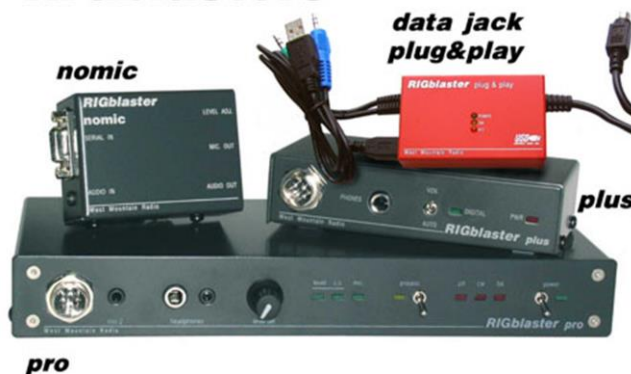
commercial interface audio isolation



Rascal



RIGblasters



How Do I Set It Up?

radio audio isolation



K3: IN - LINE - OUT



How Do I Set It Up?

SDR digital audio isolation



K3S { digital: CODEC (soundcard)
analog: IN - LINE - OUT



How Do I Set It Up

optional radio AF filtering

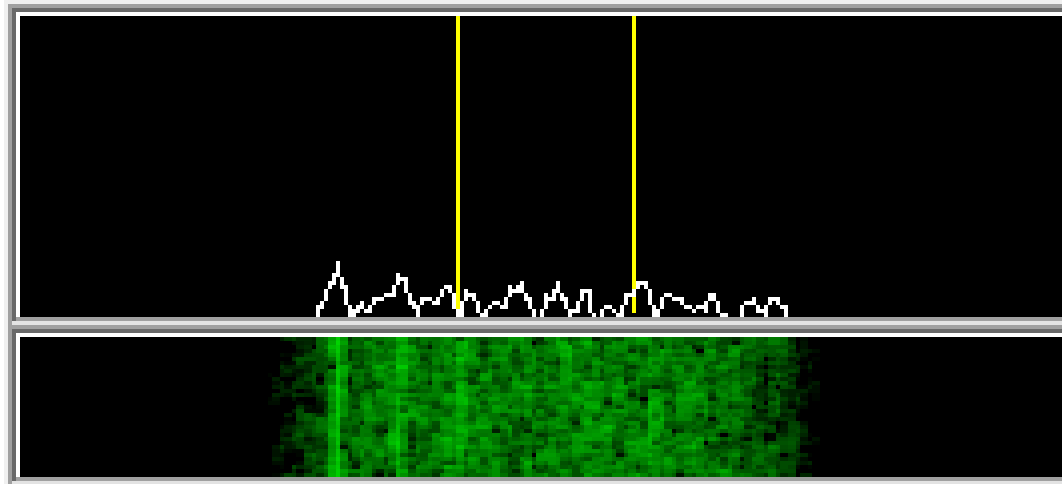


- PC Audio isolation
 - Transformer
 - Commercial interface
 - Some radios (K3, Flex)
- Narrow IF filters (Roofing & DSP)
 - 500 Hz - normal
 - 250 Hz – extreme QRM only
 - Tone filters – don't use
 - Icom Twin Peak Filter
 - K3 Dual-Tone Filter
- Audio filtering
 - JPS NIR-10/12
 - Timewave DSP-599zx
 - Modern DSP rigs



How Do I Set It Up?

adjust RX audio



- Set RX audio level for noise 5% of full-scale
 - Receiver audio out level control, and/or
 - *Windows* Recording Volume Control applet

How Do I Set It Up?

adjust AFSK audio



Insure SSB processor (compression) is Off.

- Adjust:
 - the *Windows* Playback Volume control, and
 - the transmitter Mic (or auxiliary audio input)
- Such that:
 - ALC is just backed off to moderate, and
 - full power output is attained.

How Do I Set It Up?

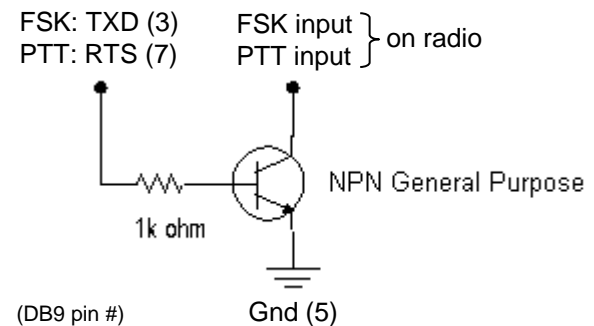
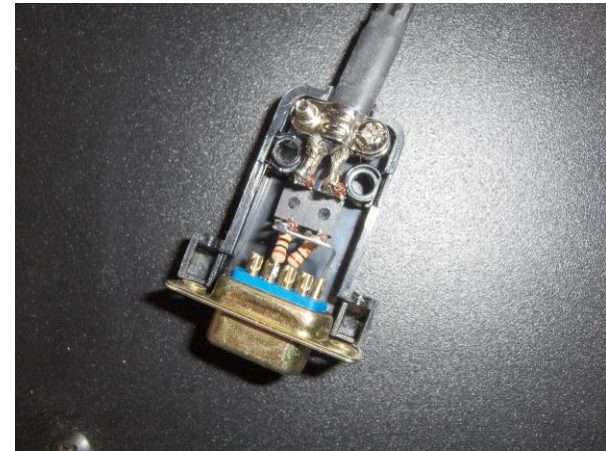
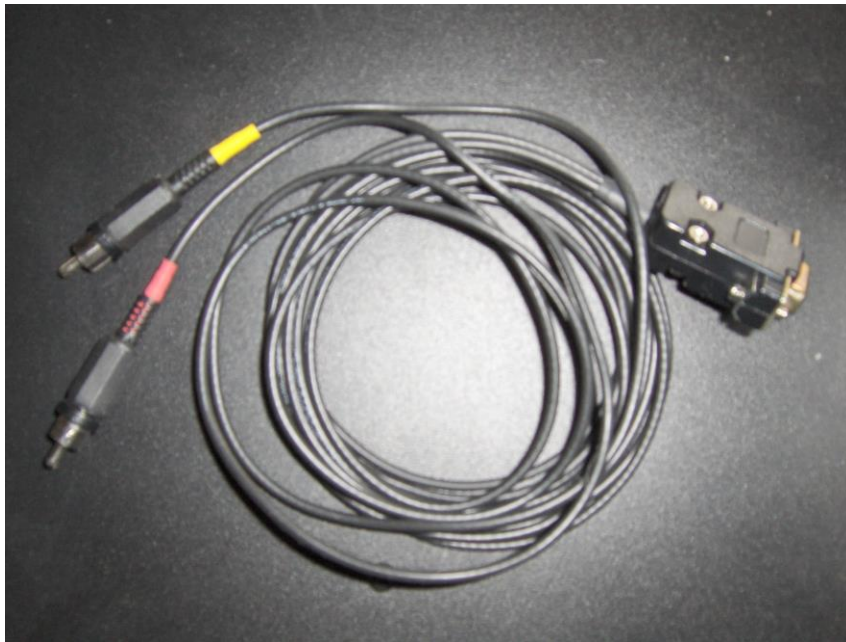
PTT vs. VOX



- AFSK uses VOX or PTT
 - radio Mic input will allow VOX
 - rear panel auxiliary audio input may not; then PTT
 - PTT can usually be keyed via the radio CAT cable
- FSK uses PTT
 - Serial port controls FSK and PTT signals

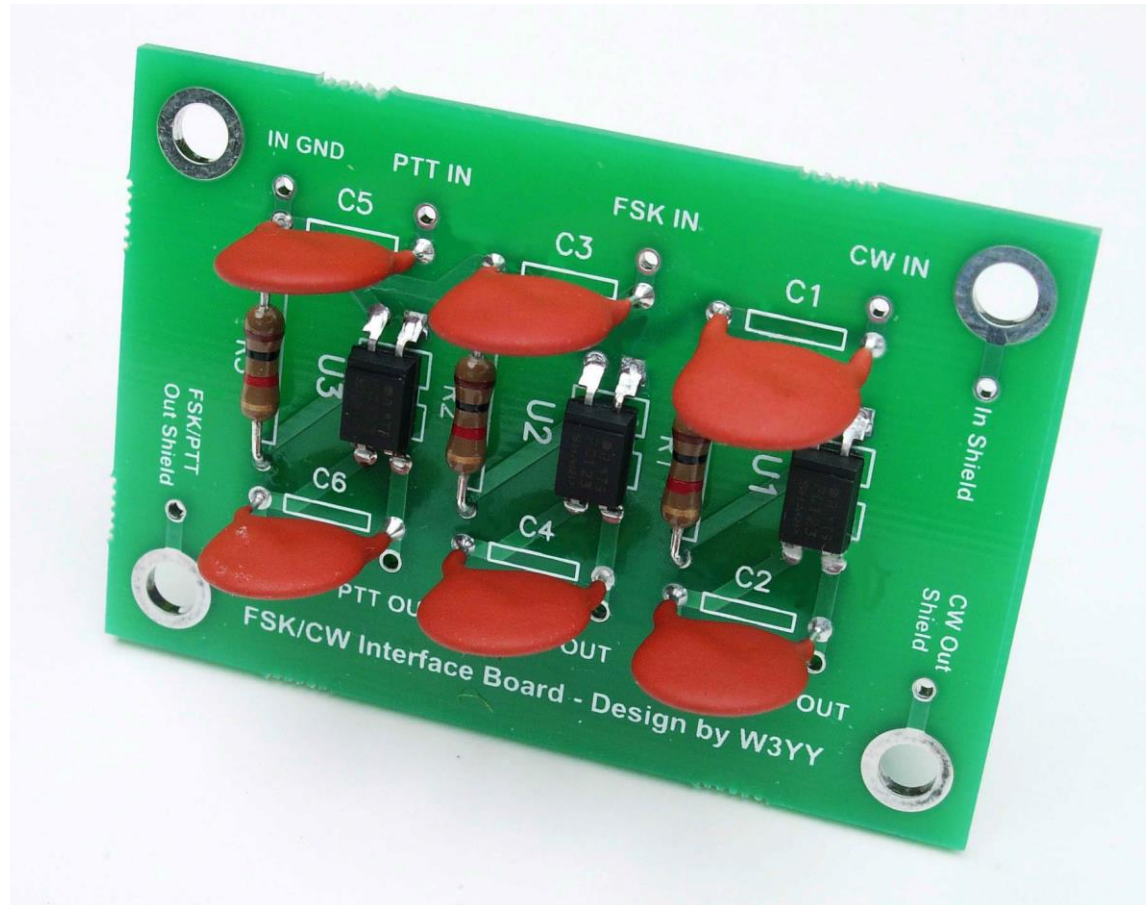
How Do I Set It Up?

homebrew FSK & PTT keying cable



How Do I Set It Up?

W3YY FSK & PTT keying cable



How Do I Set It Up?

Morryty



How Do I Set It Up?

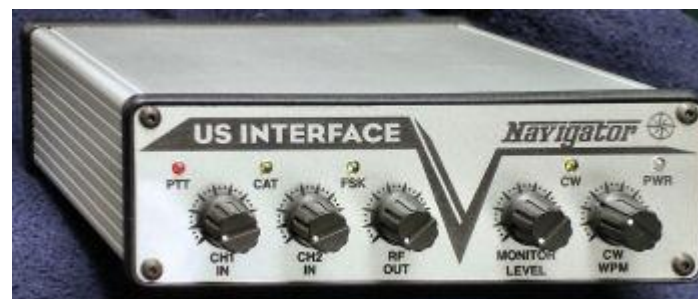
commercial interfaces



RASCAL



RIGblasters



How Do I Set It Up?

RigExpert Interfaces



How Do I Set It Up?

commercial interfaces



Vendor	Model	Price	PC In'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fc
generic (with K3)	(2) 3.5mm M-M audio cables	\$ 10	-			√					
Buxcomm	Rascal-IIB or -IIIA	\$ 69	-								
Buxcomm	Rascal GLX	\$ 79	Serial	√							
Tigertronics	SL-1+	\$ 80	-	auto							
Tigertronics	USB	\$ 110	USB	auto	√	√					
MFJ	1273B	\$ 60	Serial	√							
MFJ	1275	\$ 110	Serial	√							
MFJ	1279	\$ 140	Serial	√	√						
Mountain Radio	RIGblaster Nomic	\$ 60	Serial/USB	√							
Mountain Radio	RIGblaster Plug & Play	\$ 120	USB	√				√			some
Mountain Radio	RIGblaster Plus II	\$ 160	USB	√			√ or CW	√ or FSK			some
Mountain Radio	RIGblaster Advantage	\$ 200	USB	√	√	√	√ or CW	√ or FSK			√
Mountain Radio	RIGblaster Pro	\$ 300	Serial/USB	√			√	√			√
Navigator	Navigator	\$ 417	USB	√	√	√	√	√	√		√

See May-June 2012 NCJ, "RTTY Contesting" column

How Do I Set It Up?

microHAM interfaces



One Radio



SO2R



How Do I Set It Up?

RigExpert & microHAM interfaces



Vendor	Model	Price	PC In'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fc	SO2R
RigExpert	Tiny	\$ 120	USB	✓	✓			✓		✓	✓	
RigExpert	Standard	\$ 265	USB	✓	✓	✓	✓	✓	✓	✓	✓	
RigExpert	TI-5	\$ 365	USB	✓	✓	✓	✓	✓	✓	✓	✓	
microHAM	USB Interface II	\$ 179	USB	✓				✓			✓	
microHAM	USB Interface III	\$ 225	USB	✓	✓	✓		✓			✓	
microHAM	Digi KEYER II	\$ 369	USB	✓	✓	✓	✓	✓	✓		✓	
microHAM	microKEYER II	\$ 479	USB	✓	✓	✓	✓	✓	✓	✓	✓	
microHAM	micro2R	\$ 369	USB	✓		✓	✓	✓	✓	✓	✓	✓
microHAM	MK2R	\$ 899	USB	✓		✓	✓	✓	✓	✓	✓	✓
microHAM	MK2R+	\$ 999	USB	✓	✓	✓	✓	✓	✓	✓	✓	✓

See May-June 2012 NCJ, "RTTY Contesting" column

How Do I Set It Up?

summary - receive



1. Connect receiver audio output, via isolation, to ...

- MODEM Audio In,
or
- MMTTY via Soundcard Line In (or Mic In with pad):
 - Enable/adjust soundcard Line In (or Mic) input, disable/mute other inputs

2. Optional receive audio filtering

How Do I Set It Up?

summary - AFSK



1. Connect radio's Line In (or, Mic In with pad), via isolation, from:
 - MODEM Audio Out
or ...
 - Soundcard Line Out
2. Speech processor off
3. Enable/adjust SC audio level
 - Disable or mute all other SC outputs

How Do I Set It Up?

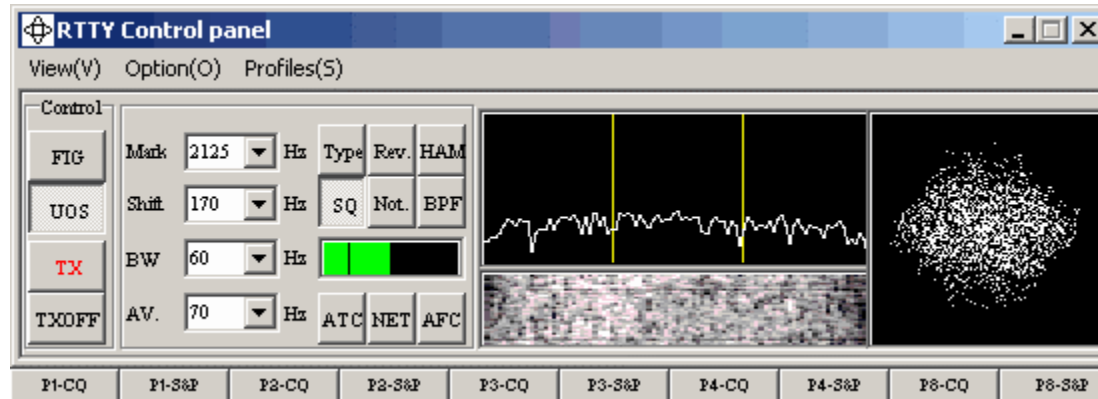
summary - FSK



1. Connect the radio FSK and PTT inputs to:
 - the MODEM FSK and PTT outputs and connect the MODEM Serial port to the PC (USB adapter)
or, if MMTTY ...
 - the RTTY interface FSK and PTT outputs and connect the interface Serial port to PC (USB adapter)
2. If no PC Serial port, then use a USB-Serial adapter.
 - Beware that some won't key FSK properly.
Edgeport USB-Serial adapters are known good.

Decoders

MMTTY



- Dominant soundcard MODEM in use today
- Exceeds performance of most other MODEMs
- Freeware since introduction in 2000
- Written by Mako, JE3HHT

How Do I Set It Up?

MMTTY standalone



Squelch

Messages

Leave UOS on

Don't click inside display

Turn off: NET
AFC

received text

transmitted text

Control: FIG, UOS, TX, TXOFF

Demodulator (IIR): Mark 2125 Hz, Shift 170 Hz, BW 60 Hz, AV 70 Hz

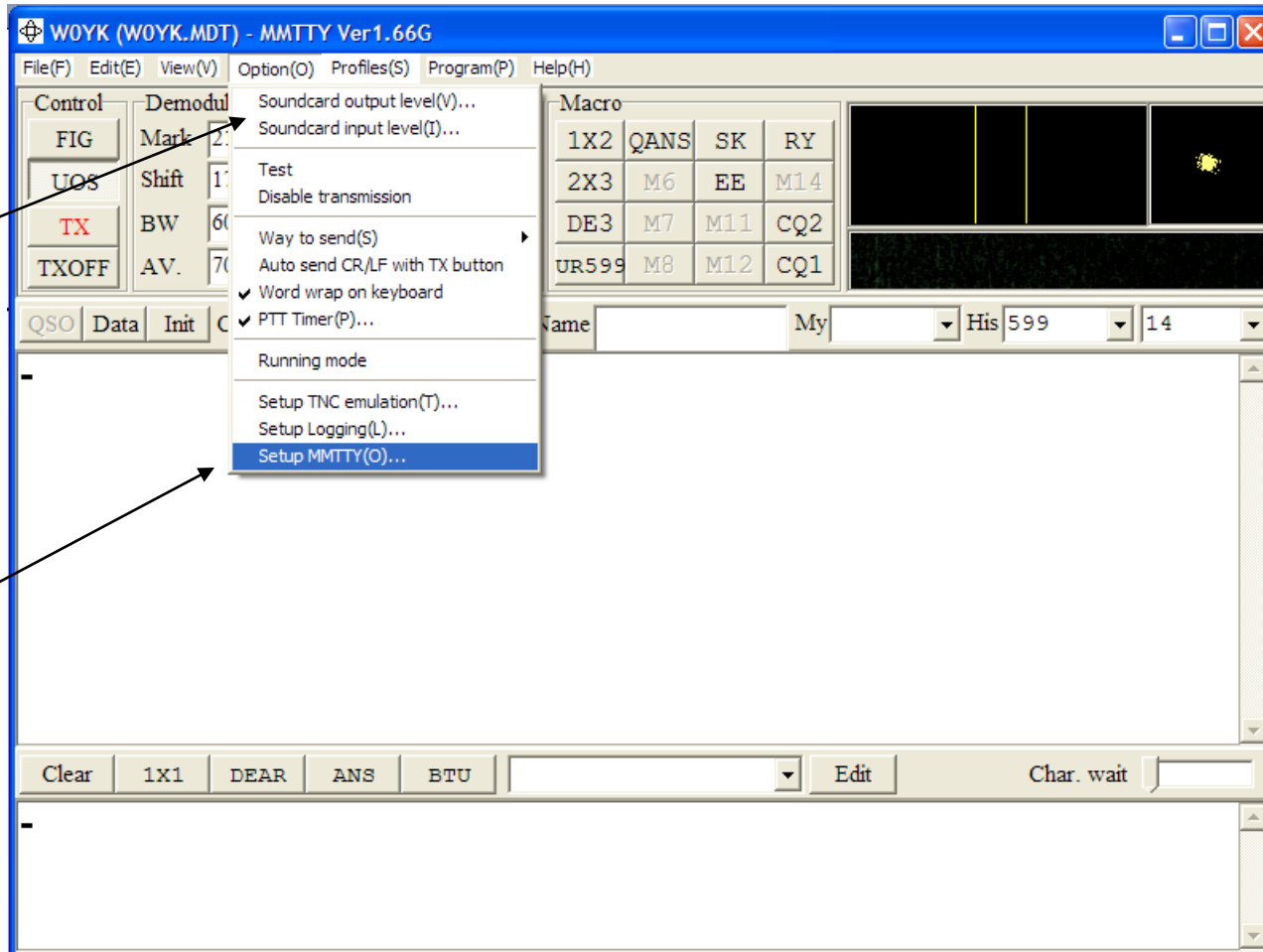
Macro: 1X2, 2X3, DE3, UR599, QANS, M6, DE2, 10M?, SK, EE, M11, M12, RY, M14, CQ2, CQ1

Find: Name, My, His 599, 14

Received text (from macro 1X2):
*1-2)s\$381,(3-0",h"-)-3?0'736.(EWWLEKTHVTQJMCOP
G0XZ2EFPFHCDOHQK GLOE.:24-8598
9) \$S:8
7377-4.h9:9.'5396'1807.,!QHEECQEBBSZ YOWQWTZPPGAYF R OMUXV
WZD
5\$
8hh5
59
:763(Y9(())4HDHTS)87-.,:5 KPWFIEG1 FFFFXGXKUVVRQURSQP WP.CQ 9X0R 9X0R UP QV
UDE W0DD W0DD F:5MQ
DE W0DD W0DD APCV YAABPHYKVVHJUAY
ST(:0/AG3V 5.9 AG3V GVSNYUNAWJUOSDGTVAG3V TU 9X0R UP J
DE W0DD W0DD
DE W0DD W0DD ZSW0DD UP UP UP W0DDQLX VXPFGJQNRDAYQLWB0LDMOM W0LX Me0?-91 W0DD W0DD h.,0: W0DD W0DD QUTM 599 W0LX B27320VYD
QVUGRQJQXKRDJBW0LX TU 9X0R UP CFLECVE17068"4'9h75'!7.\$GHW0LX 599 W0LX QQQ
M0FF2Q0VAPFFF
PUBGHZQ0FII15,3..W0LX TU 9X0R UP DQFPJUU;.BG0WZUMQ0Q9TF 599 N9TF HVXZQCKZQ0ALL0NTH
UVCSKIV
HWFKQ9TF TU 9X0R UP
FUXBQNTXKTF)60'WASCVK 599 WASCVK VUQMVHZXSNUVZMAVW KROEGWASCVK 599 WASCVK BORPKXYQ2(\$23;8
CJ:: 7;6,759.h//827:4\$54\$912("167VFAPJAPCQKQWVHYXh1,/WASCVK TU 9X0R UP MHHK.01:6sZKIGITM7TPV 599 NTPV XKZC
XVCARHG0VUPG0W0s!s8/4HQ ITPV 599 N7WC GNB1XKQVHRRCQSHHM7TP TU 91/R IPB1ZPVZM0HFY:MQVVFZKJ
OR0BF0TU(!/4s0?AXIQ 599 AB4IQ UVAHZU/9TVAB4IQ TU 9X0R UP XNVX
UUUFT
YKTYMZXMPDTS!,5JE 599 W5JE 2/7.1(2::63(8(?1(JLK0R W0DE W0DD 6/.W5JE TU 9X0R UP 9X0R W0DD W0DD WUXNVX 9X0R W0BBN 599-.@BN BU
S3.: 9X0R W0DD W0DD K8BN 599 K8BN K8NUKXh-;013XI
LXSS 9X0R W0VCI
OO K:VXLK 9X0R W0DD W0DD VKP8BN 599 K8BN HALGZM ZCGIFXKAXNXCQ 9X0R 9X0R UP CLPAPQMKC
JGQSHMC:(5:1s:(W0DD 599 W0DD EVVKQCDPYZ/1QVENKLYUFXVVLNMF0W0DD TU 9X0R UP HNUVVB DWUCGTRNV
RUONXNG9C 599 NG_

How Do I Set It Up?

MMTTY Option menu



Soundcard levels

MMTTY setup

How Do I Set It Up?

MMTTY Option/Setup/Demodulator



Discriminator
Type
 IIR resonator
 FIR BPF
 PLL

Mark 2125 Hz
Shift 170 Hz
BW 60 Hz
Show

Limit Amp.
 AGC
 Over Sampling
Gain 200

Smooth LPF
 FIR av. IIR
Freq 70 Hz
f

Pre-Filter
Show
BPF LMS/Notch
 ON
Tap 56
FW 100
 AFC Connection

Reverse
HAM Default 2125 170

HAM Set Default(Demodulator) ? OK Cancel

Set tones
(radio same)

How Do I Set It Up?

MMTTY Option/Setup/TX



TX UOS on

Select LTR

512 Tap, if PC has perf.

FSK/PTT port

Soundcard Line Out level

AFSK PTT

How Do I Set It Up?

MMTTY Option/Setup/Misc



Soundcard

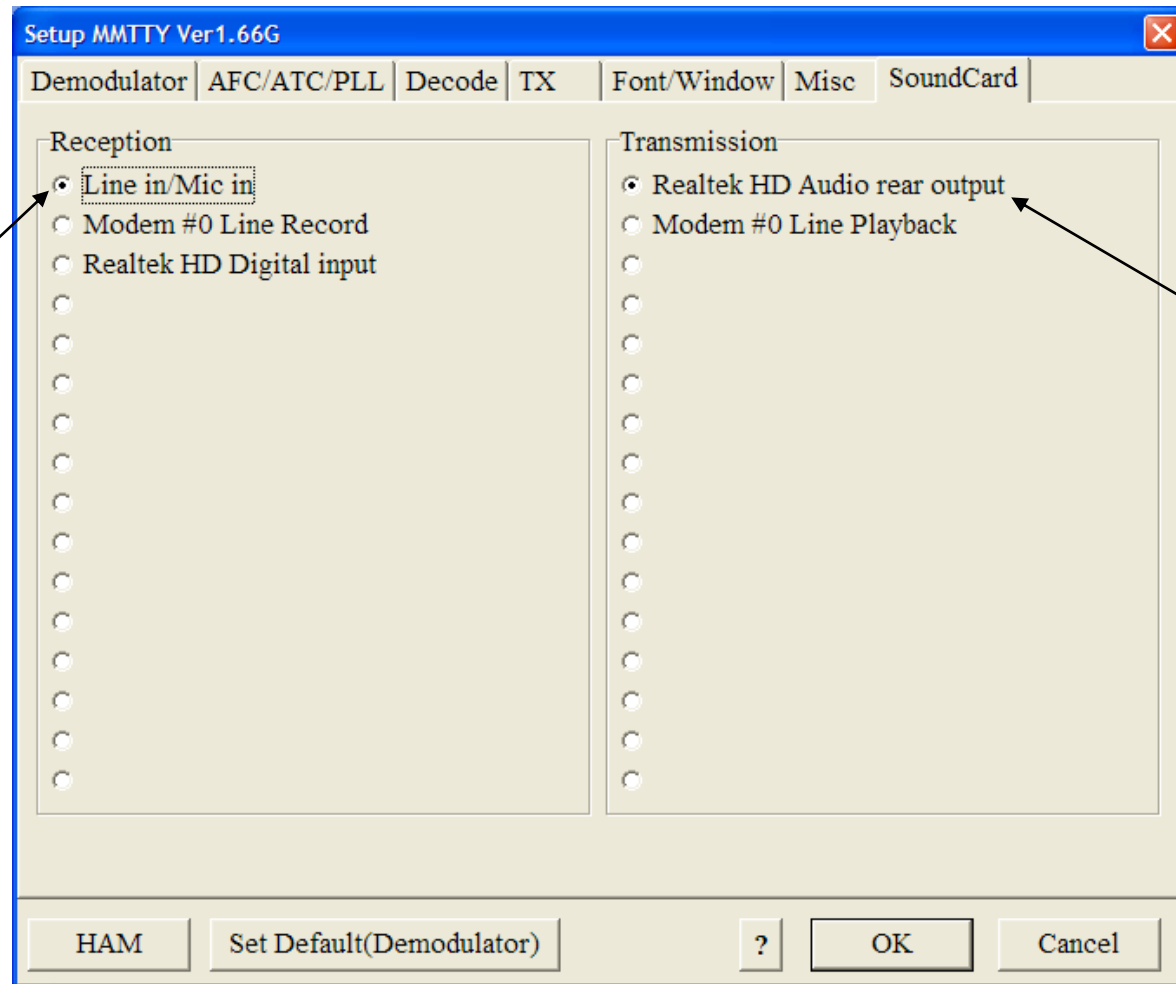
Soundcard Format, 4x

AFSK

FSK

How Do I Set It Up?

MMTTY Option/Setup/SoundCard

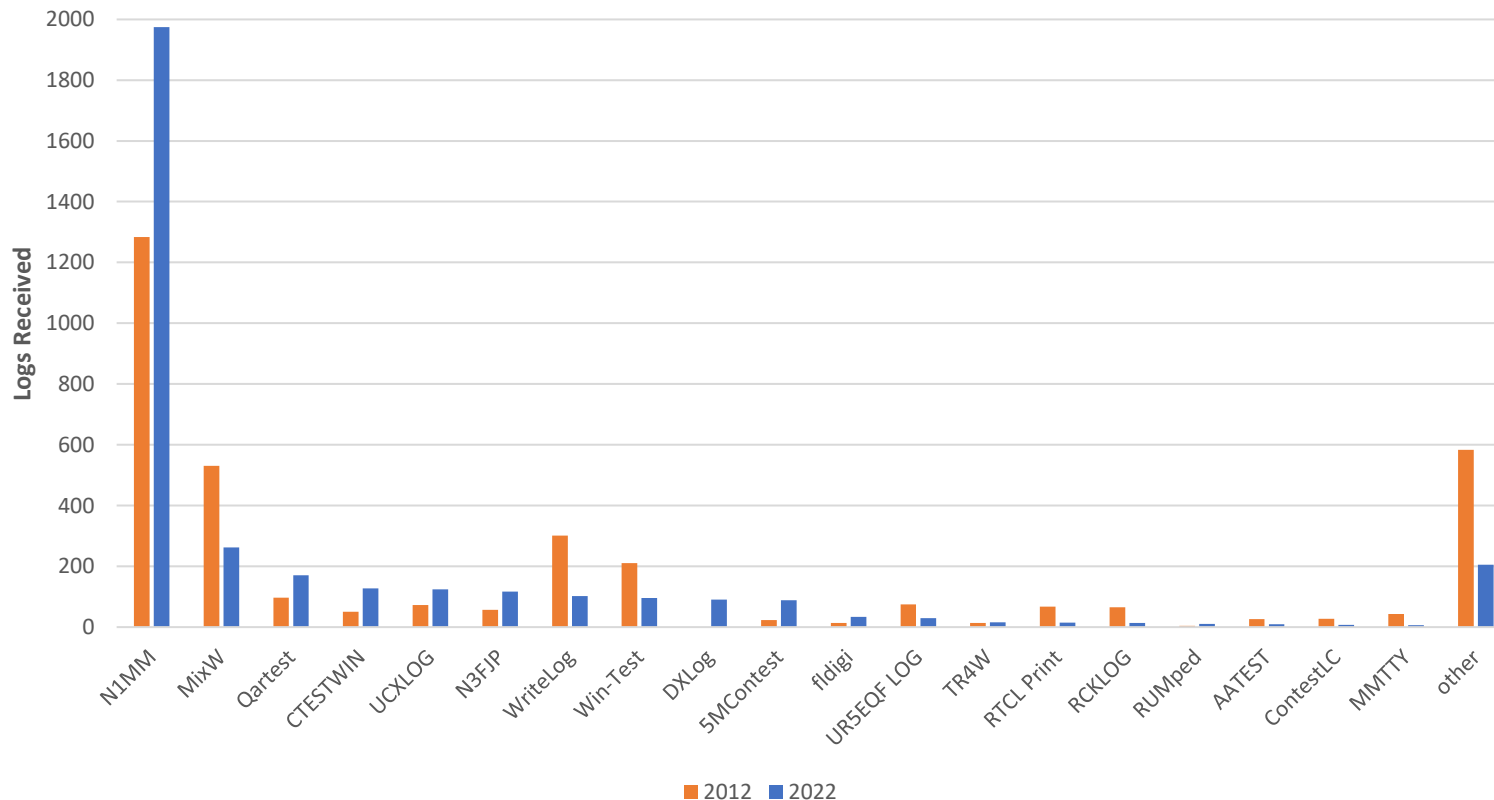


Select receive
Soundcard

Select transmit
Soundcard
(AFSK only)

CQ WPX RTTY

logs received: 2022 vs. 2012



RTTY Contest Loggers



- WriteLog *(1994; created for RTTY)*
 - CW & RTTY came later
 - www.rttycontesting.com/tutorials
- N1MM Logger+ *(2000; dedicated RTTY software designer)*
 - Free
 - www.rttycontesting.com/tutorials
- Win-Test *(2003; RTTY is low priority)*

All three integrate MMTTY & 2Tone and

have similar functionality for basic RTTY contesting.

A Blizzard of Details!

this is fun??



Start Simple, then Enhance

- MMTTY (*free*)
 - get RX working (*std audio cable from radio to PC*)
 - get TX working using either:
 - AFSK (*2nd std audio cable from radio to PC*)
 - FSK (*keying cable or commercial interface*)
- Integrate MMTTY with logging software
- Enhance later
 - Audio isolation (*highly recommended*)
 - 2Tone
 - Higher capability interface (*DIY or commercial*)
 - Advanced setup: SO2V, SO2R, multiple decoders, ...

Resources

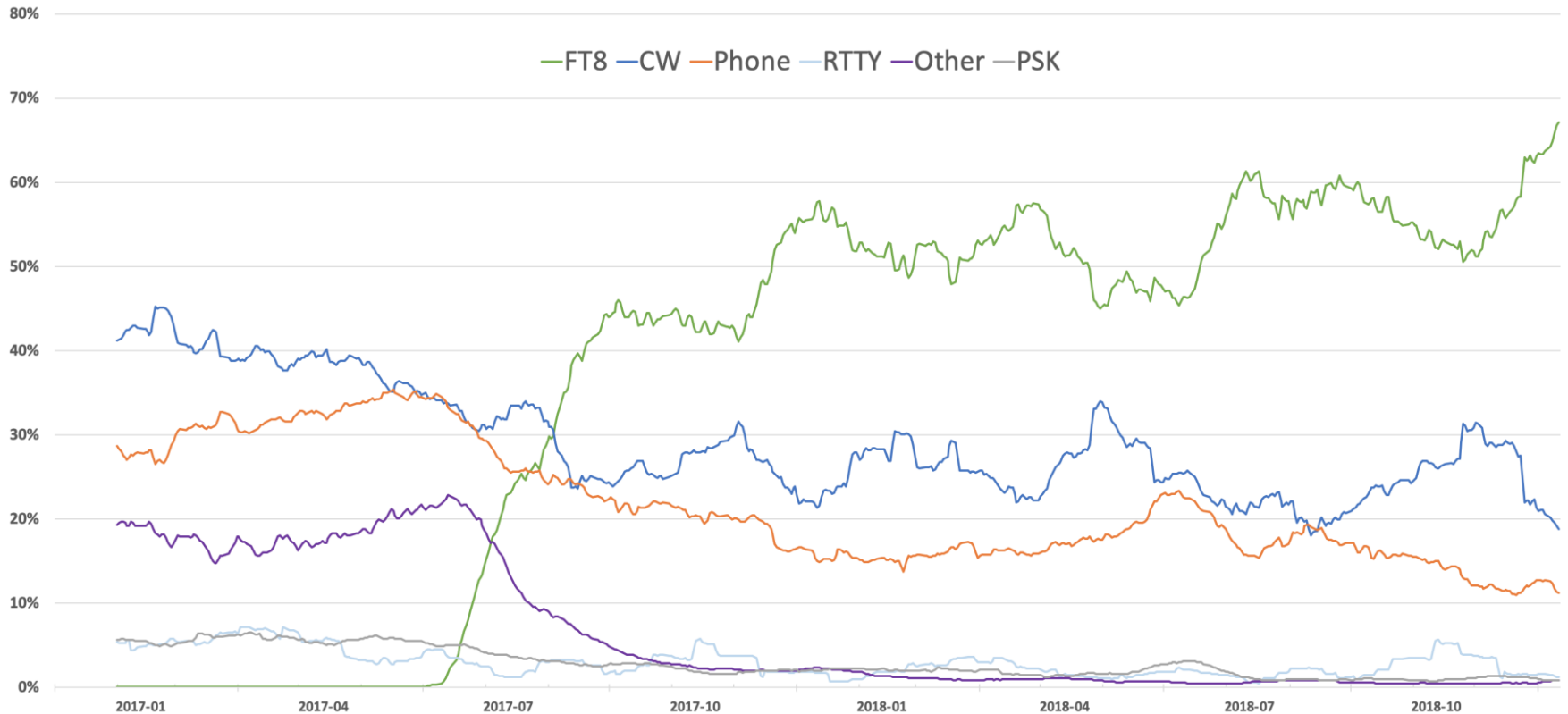


- www.rttycontesting.com premier website
 - Tutorials and resources (beginner to expert)
 - WriteLog, N1MM Logger+ and MMTTY
- rtty@groups.io Email reflector
 - RTTY contester networking
 - Q&A
- Software web sites
 - hamsoft.ca/ (MMTTY)
 - n1mm.hamdocs.com/tiki-index.php (N1MM Logger+)
 - www.writelog.com (WriteLog)
 - www.win-test.com (Win-Test)
- Software Email reflectors
 - mmtty@yahoogroups.com (MMTTY)
 - N1MMLoggerplus@groups.io (N1MM Logger+)
 - Writelog@contesting.com (WriteLog)
 - support@win-test.com (Win-Test)

Clublog QSOs by Mode



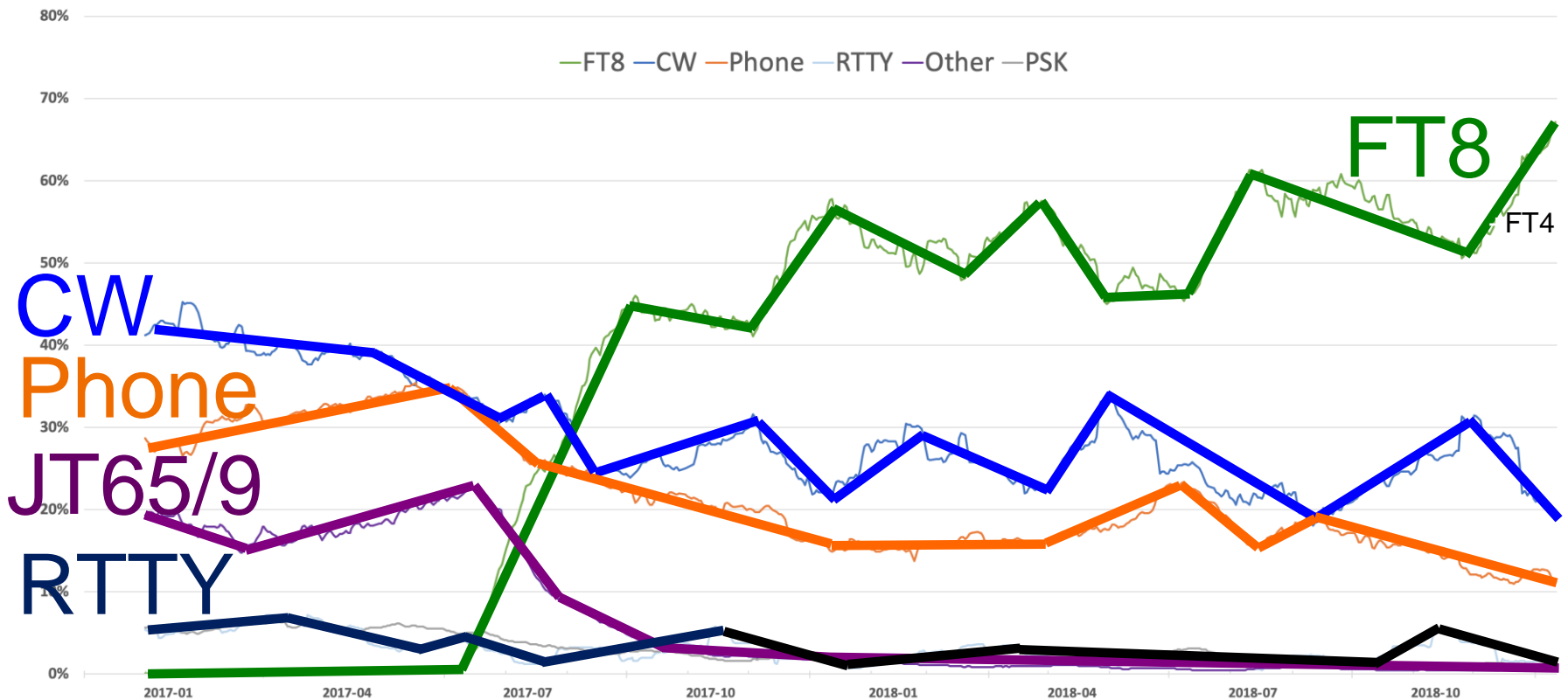
% Share of Modes Stored in Club Log from 2017 to 2019



Clublog % QSOs by Mode: 2017-2018



% Share of Modes Stored in Club Log from 2017 to 2019



CW
Phone
JT65/9
RTTY

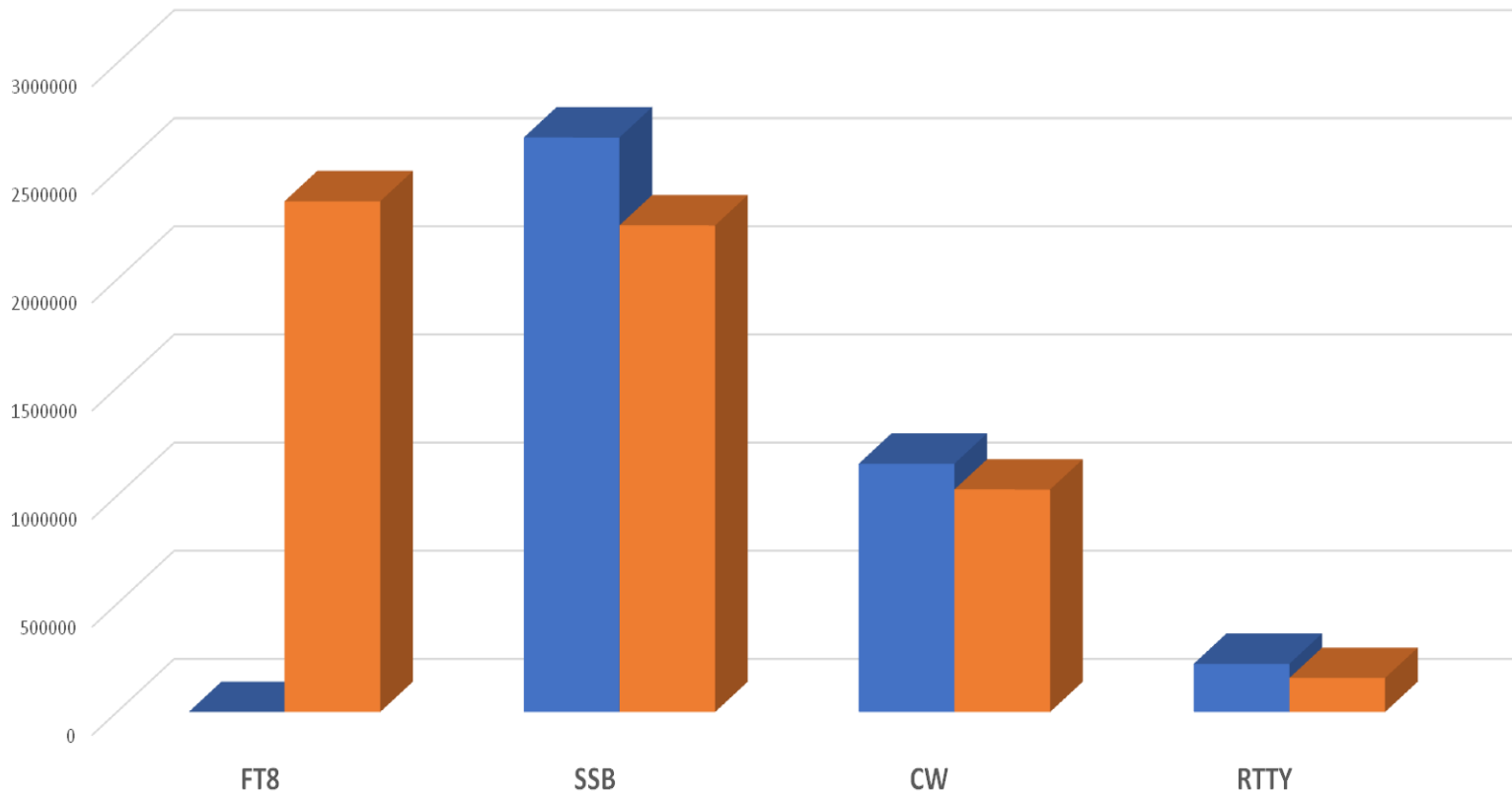
FT8

FT4

The FT8 Explosion



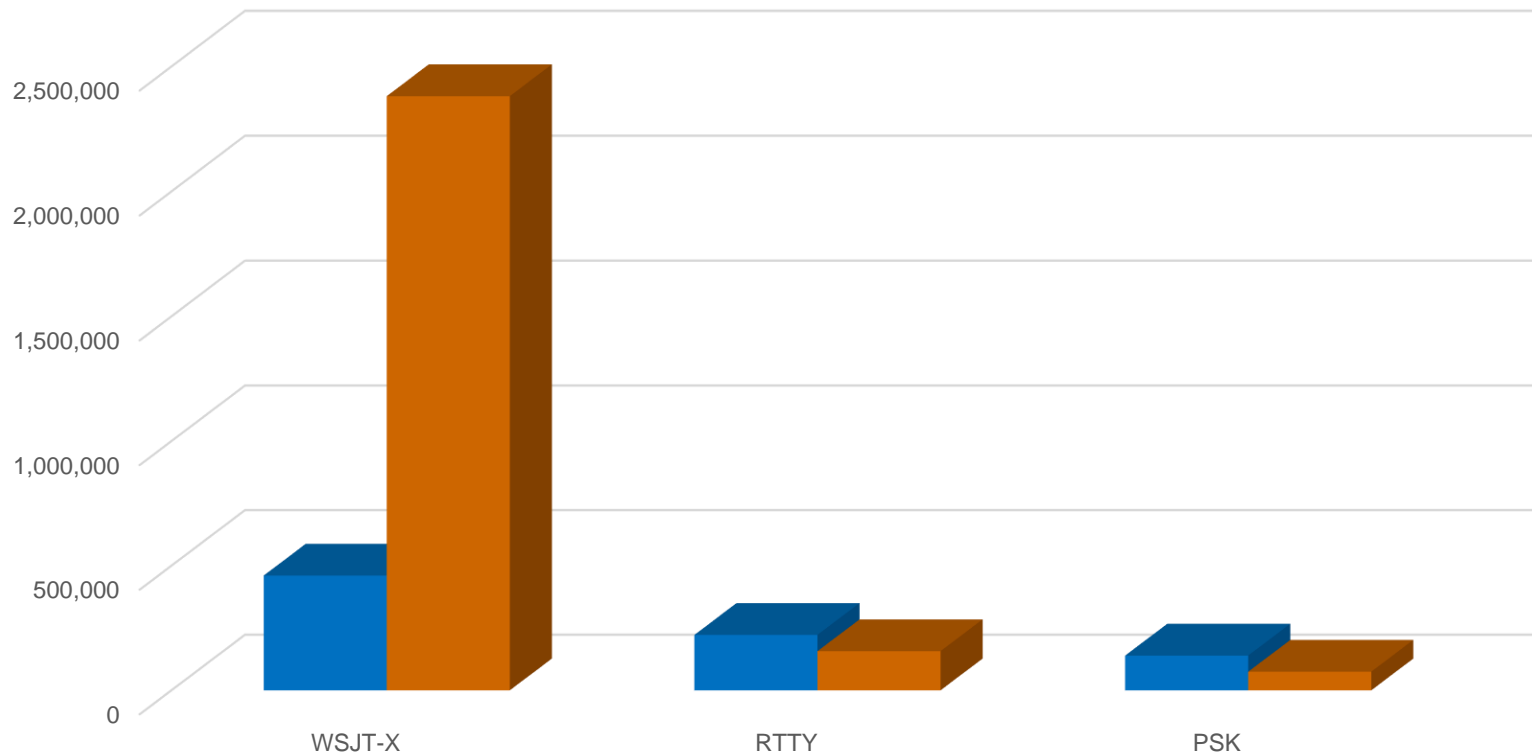
LoTW Uploads by Mode



Digital Mode Trends

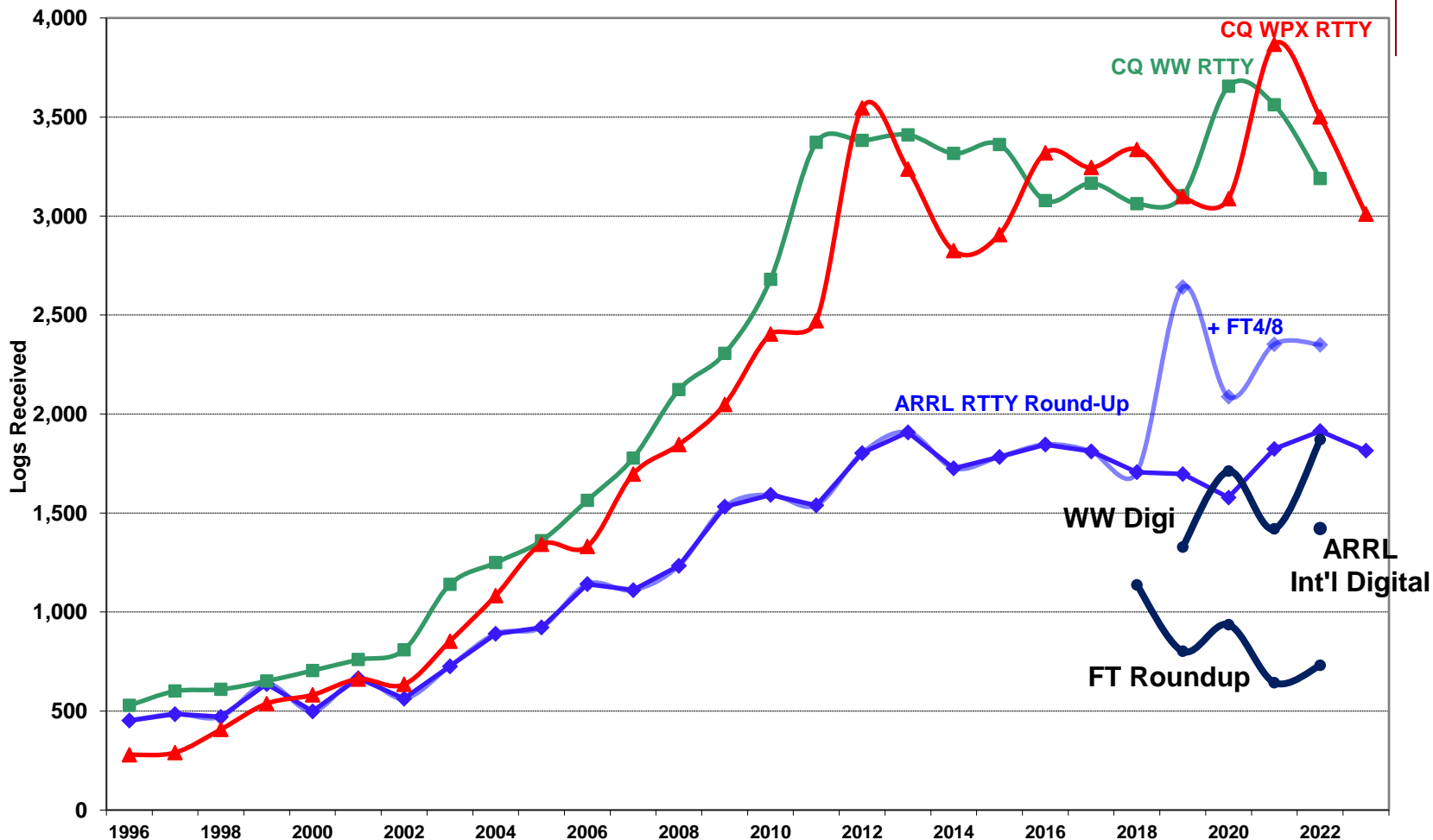


LotW Uploads by Mode



■ 2017 ■ 2018

Three Largest FT4/8 Contests



WSJT & WSJT-X Overview



- **Weak Signal communication by Joe Taylor - eXperimental**
 - Developed for EME; adapted by HF
 - Several modes (JT65, JT9, FT8, etc.)
 - TX/RX cycles synchronous with time servers
-
- + **Multi-channel (external spotting and CQ/S&P irrelevant)**
 - + **Weak signal (inaudible)**
 - + **Longer DX**
 - + **Lower power**
 - + **Compromised antennas and/or QTH**
 - + **Narrow bandwidth (4-176 Hz)**
 - + **“Perfect” copy (SCP irrelevant)**

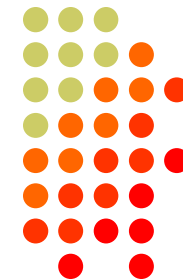
◦ CTU ◦

CONTEST
UNIVERSITY

73/96
18 May 2023

ICOM®

FT8 Multi-Channel Reception



Band Activity

UTC	dB	DT	Freq	Message
023445	3	0.1	1023	~ CQ BG4NN OM96 China
023445	-1	-0.2	1368	~ CQ BG4VR OM93 ~China
023445	-2	-0.2	1575	~ CQ RAOAA NO66 ~AS Russia
023515	0	-0.2	1368	~ JA3YUA BG4VR -13
023515	-2	-0.1	893	~ RD0 JMSJU QN02
023515	-5	0.5	927	~ RD0 BH4TY 73
023515	6	0.1	1023	~ CQ BG4NN OM96 China
023515	-3	-0.1	1576	~ CQ RAOAA NO66 ~AS Russia
023515	-9	0.3	847	~ UA0JG BG5EI FM00
023545	1	-0.2	1367	~ JA3YUA BG4VR RRR
023545	-6	0.3	847	~ UA0JG BG5EI FM00
023545	2	0.1	1023	~ CQ BG4NN OM96 China
023545	-3	0.1	1576	~ CQ RAOAA NO66 ~AS Russia
023615	2	-0.2	1367	~ JA3YUA BG4VR 73
023615	-11	0.3	847	~ UA0JG BG5EI R-18
023615	-5	-0.1	893	~ RD0 JMSJU QN02
023615	5	0.1	1023	~ CQ BG4NN OM96 China
023615	-4	-0.0	1576	~ BH4TY RAOAA -10

Rx Frequency

UTC	dB	DT	Freq	Message
023130	Tx		1023	~ BG4NN JA3YUA 73
023145	4	0.1	1023	~ JA3YUA BG4NN 73
023200	-1	-0.1	927	~ CQ RD0 PN68
023216	Tx		927	~ RD0 JA3YUA PM74
023230	1	-0.1	927	~ JA3YUA RD0 -04
023245	Tx		927	~ RD0 JA3YUA R+01
023300	2	-0.1	927	~ JA3YUA RD0 RRR
023315	Tx		927	~ RD0 JA3YUA 73
023330	-1	-0.1	927	~ JA3YUA RD0 73
023400	1	-0.1	927	~ CQ RD0 PN68
023415	0	0.5	927	~ RD0 BH4TY FM01
023430	0	-0.1	927	~ BH4TY RD0 -05
023445	1	0.5	927	~ RD0 BH4TY R-09
023445	-1	-0.2	1368	~ CQ BG4VR OM93
023501	Tx		1368	~ BG4VR JA3YUA PM74
023515	0	-0.2	1368	~ JA3YUA BG4VR -13
023530	Tx		1368	~ BG4VR JA3YUA R+00
023545	1	-0.2	1367	~ JA3YUA BG4VR RRR
023600	Tx		1368	~ BG4VR JA3YUA 73
023615	2	-0.2	1367	~ JA3YUA BG4VR 73

Annotations:

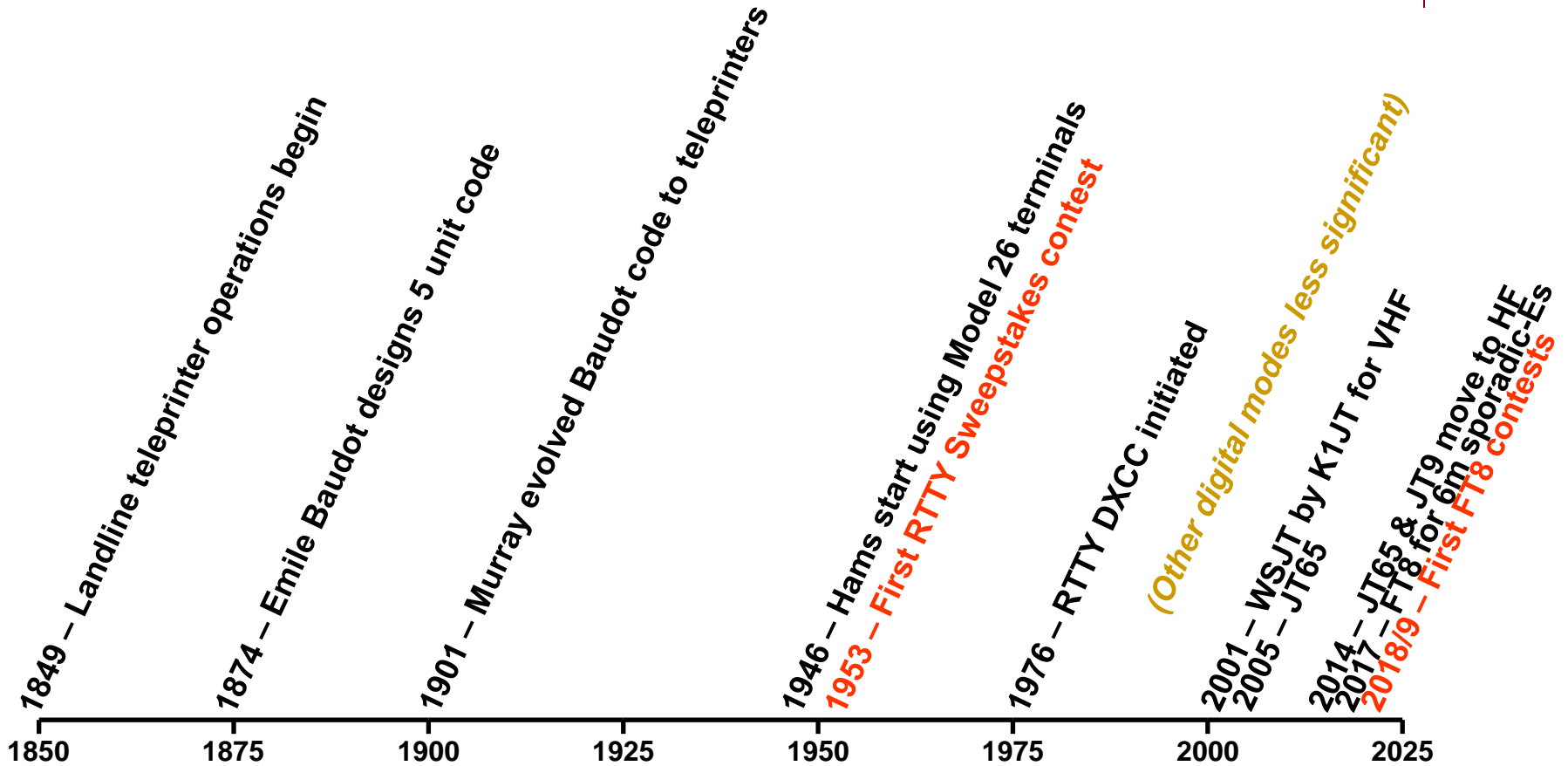
- My Tx:** Points to transmitted signals in the Rx Frequency section, including 023445 (CQ BG4VR OM93), 023501 (BG4VR JA3YUA PM74), 023530 (BG4VR JA3YUA R+00), 023600 (BG4VR JA3YUA 73), and 023615 (BG4VR JA3YUA 73).
- His Tx:** Points to received signals in the Band Activity section, including 023445 (CQ BG4VR OM93), 023515 (JA3YUA BG4VR -13), 023545 (JA3YUA BG4VR RRR), and 023615 (JA3YUA BG4VR 73).

WSJT-X Overview



- + **Multi-channel (external spotting and CQ vs. S&P irrelevant)**
- + **Weak signal (FT8 -13dB & FT4 -10dB compared to RTTY)**
 - + **Longer DX**
 - + **Lower power**
 - + **Compromised antennas and/or QTH**
- + **Narrow bandwidth (4-176 Hz: FT8=50 Hz; FT4=80 Hz)**
- + **“Perfect” copy (SCP irrelevant)**
- **Slow 1-6 minutes/QSO → 30 seconds (FT4)**
- **Limited, fixed messages → fine for contesting**
- **Minimal reaction time → message automation**

RTTY & WSJT History



WSJT & WSJT-X History



- 2001: FSK441 for meteor scatter
- 2002: JT6M for ionospheric scatter
- 2003: JT65 VHF/UHF EME
 - Adopted for QRP HF DXing; 176 Hz bandwidth; 60 sec. transmission
- 2014: JT9 for LF, MF and HF
 - 2 dB more sensitive than JT65; 16 Hz bandwidth
- Jun 2017: FT8 for 6m Es & HF
 - 50 Hz bandwidth; 15 second transmission
- May 2018: Baker Is. DXpedition > 11,000 FT8 HF QSOs
- *Dec 2018: FT8 Roundup (first WSJT-X HF contest)*
- *Jan 2019: ARRL RTTY Roundup (FT8 permitted)*
- *Apr 2019: FT8 DX Contest*
- *Sep 2019: SCC RTTY Championship → WW Digi*
- *Jun 2022: ARRL International Digital*
- *Jan 2023: ARRL RTTY Roundup becomes RTTY-only*

○ CTU ○

CONTEST
UNIVERSITY

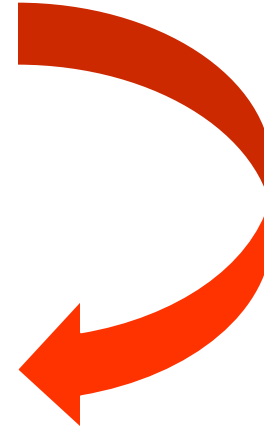
77/96
18 May 2023

ICOM®

Major FT Contests



- ARRL RTTY Roundup [1st weekend in Jan]
 - 2019: FT8 added
 - 2020: FT4 added
 - 2022: RTTY-only or FT-only or Mixed
 - 2023: RTTY-only; no other modes
- ARRL International Digital [1st weekend in Jun]
 - Distance-based scoring
- WW Digi DX Contest [last weekend in Aug]
 - Same as ARRL Int'l Digital
 - plus Grid multipliers
 - minus 160m and 6m
- FT Roundup [1st weekend in Dec]
 - RTTY Roundup rules



o CTU o

FT8 Standard QSO

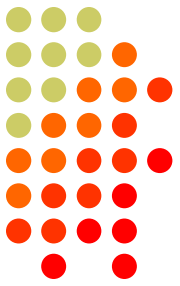
90 sec./QSO



- CQ K1ABC FN42
- W9XYZ K1ABC -11
- W9XYZ K1ABC RRR
- K1ABC W9XYZ EN37
- K1ABC W9XYZ R-09
- K1ABC W9XYZ 73
(superfluous 2nd QSL)

FT8 Short-Cycle QSO

60 sec./QSO



- CQ K1ABC FN42
- W9XYZ K1ABC R-11
- CQ K1ABC FN42
N5DEF K1ABC R-07
- K1ABC W9XYZ -09 (TX2, not TX1)
- K1ABC W9XYZ RR73
K1ABC N5DEF -01

30 sec. rolling QSOs

FT8 DXpedition QSO

75 sec./QSO
60 sec./5 QSOs



QSO period 1
QSO period 2
QSO period 3

- CQ KH1/KH7Z
- K1ABC KH7Z -12
<“CQ” for others>
- K1ABC RR73
W9XYZ KH7Z -08
W0YK KH7Z -13
<“CQ” for others>
- W9XYZ KH7Z RR73
W0YK KH7Z RR73
○ CTU ○
- KH7Z K1ABC FN42
- KH7Z K1ABC R-14
KH7Z W9XYZ EN37
KH7Z W0YK CM97
etc.
- KH7Z W9XYZ R-11
KH7Z W0YK R-15
KH7Z K9YC CM87
KH7Z W6OAT CN87
etc.

WW Digi QSO

- CQ WW K1ABC FN42
- W9XYZ K1ABC R-FN42
(implicit “CQ” for others)
- W0YK K1ABC R-FN42
(implicit “2nd QSL” for W9XYZ)
(implicit “CQ” for others)
- P49X K1ABC R-FN42
(implicit “2nd QSL” for W0YK)
- P49X K1ABC 73
(superfluous 2nd QSL)

○ CTU ○

CONTEST
UNIVERSITY

60-75 sec./QSO
30 sec./rolling QSO



- K1ABC W9XYZ EM05
- K1ABC W9XYZ RR73
K1ABC W0YK CM97
- K1ABC W0YK RR73
K1ABC P49X FK52
- K1ABC P49X RR73

QSO period 1
QSO period 2
QSO period 3

← K1ABC W9XYZ RR73

← K1ABC W0YK RR73

WW Digi QSO

60-75 sec./QSO
30 sec./rolling QSO



QSO period 1
QSO period 2
QSO period 3

- CQ WW K1ABC FN42
- W9XYZ K1ABC R-FN42
(implicit "CQ" for others)
- W0YK K1ABC R-FN42
(implicit "2nd QSL" for W9XYZ) ← W9XYZ may want 73
(implicit "CQ" for others)
- P49X K1ABC R-FN42
(implicit "2nd QSL" for W0YK) ← W0YK may want 73
- P49X K1ABC 73
(superfluous 2nd QSL)
- K1ABC W9XYZ EM05
- K1ABC W9XYZ RR73
K1ABC W0YK CM97
- K1ABC W0YK RR73
K1ABC P49X FK52 ← K1ABC W9XYZ RR73
- K1ABC P49X RR73 ← K1ABC W0YK RR73

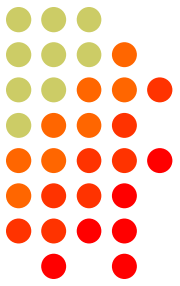
◦ CTU ◦

CONTEST
UNIVERSITY

83/96
18 May 2023

ICOM[®]

Setting Up for FT8



- **Download/install WSJT-X**
 - **Alternatively MSHV or DigiRite (WriteLog only)**
- **Hardware (radio and PC) same as AFSK**
- **Study the:**
 - **Quick Start Guide to WSJT-X 2.0, and**
 - **the WSJT-X User Guide**

Time Synchronization

mandatory for reliable QSOs



- Windows Internet Time Sync
 - Weekly updates
 - Can be unreliable
- Alternatives
 - Meinberg NTP (recommended by K1JT)
 - NetTime (recommended by W0YK)
 - Dimension 4
 - Atomic Clock Sync

Sub-Band Choices

Int'l Digi, WW Digi, FT RU



- Suppressed-Carrier dial frequency
 - FT4: 14080
 - FT8: 14090
- Use receiver's maximum BW: 2.5-4 kHz
- QSO partner > 3 kHz ... call above 3 kHz
- Move dial frequency up in 3 kHz increments

Split Transmit



WSJT-X v2.2.0-rc1 by K1JT, G4WJS, and K9AN

File Configurations View Mode Decode Save Tools Help

Band Activity				Rx Frequency					
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message

CQ only Menus

20m ● **14.074 000** Tx even/1st
Tx 1500 Hz Hold Tx Freq
Rx 1500 Hz
Report -15
 Auto Seq Call 1st
WW DIGI

Generate Std Msgs	Next	Now	Pwr
AA5AU W0YK CM97	<input type="radio"/>	<input checked="" type="radio"/> Tx 1	<input type="range"/>
AA5AU W0YK CM97	<input type="radio"/>	<input type="radio"/> Tx 2	<input type="range"/>
AA5AU W0YK R CM97	<input type="radio"/>	<input type="radio"/> Tx 3	<input type="range"/>
AA5AU W0YK RR73	<input type="radio"/>	<input type="radio"/> Tx 4	<input type="range"/>
AA5AU W0YK 73	<input type="radio"/>	<input type="radio"/> Tx 5	<input type="range"/>
CQ WW W0YK CM97	<input checked="" type="radio"/>	<input type="radio"/> Tx 6	<input type="range"/>

Receiving WW Digi FT8 5/15 WD:2m

Deep Decode



The screenshot shows the WSJT-X v2.2.0-rc1 software interface. The 'Decode' menu is open, with 'Deep' selected and highlighted by a red circle. The main window displays two columns for decoding data, with headers 'UTC', 'dB', 'DT', 'Freq', and 'Message'. Below the main window, there are various controls including a frequency display showing '14.074 000', a signal strength meter showing '24 dB', and a list of messages for transmission. The 'Monitor' button is highlighted in green.

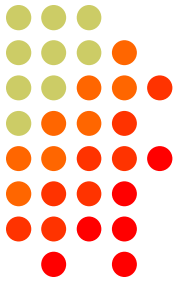
Utilize Odd/Even Cycles



The screenshot shows the WSJT-X v2.2.0-rc1 interface. The main window is titled "WSJT-X v2.2.0-rc1 by K1JT, G4WJS, and K9AN". The interface is divided into several sections:

- Band Activity and Rx Frequency:** Two large empty tables with columns for UTC, dB, DT Freq, and Message.
- Control Panel:** Includes buttons for "CQ only", "Log QSO", "Stop", "Monitor" (highlighted in green), "Erase", "Decode", "Enable Tx", "Halt Tx", "Tune", and "Menus".
- Frequency and Mode:** Shows "20m" mode and a frequency of "14.074 000". A red circle highlights the "Tx even/1st" checkbox, which is currently unchecked.
- Call Sign and Grid:** Fields for "DX Call" (AA5AU) and "DX Grid".
- Time and Date:** Displays "2020 May 12 05:09:20".
- Message Queue:** A table with columns "Generate Std Msgs", "Next", and "Now". It lists several messages like "AA5AU W0YK CM97" and "CQ WW W0YK CM97".
- Status Bar:** Shows "Receiving", "WW Digi", "FT8", and "5/15 WD:2m".

WW Digi DX Contest



The screenshot shows the WSJT-X v2.2.0-rc1 interface. The main window displays a Band Activity waterfall plot and a control panel with a frequency of 14.074 000 MHz and a date/time of 2020 May 12 04:56:23. The Settings dialog box is open, showing the 'Advanced' tab. The 'Special operating activity' checkbox is checked, and the 'WW Digi Contest' radio button is selected. The interface also shows a 'Receiving' status bar at the bottom.

Minimizing NILs in WW Digi



- FT contest NILs are high
 - RTTY is 1-2%, FT is 5-6%
- QSO partners disagree on QSO completion
 - One doesn't log, the other logs (and, gets a NIL)

CQ W0YK CM97

W0YK AA5AU EL92

← AA5AU answers with exch

AA5AU W0YK R CM97

← W0YK QSLs with exch

W0YK AA5AU RR73

← AA5AU QSLs

AA5AU W0YK 73

← W0YK QSLs AA5AU's QSL!



← when does it end?

◦ CTU ◦

**CONTEST
UNIVERSITY**

91/96
18 May 2023

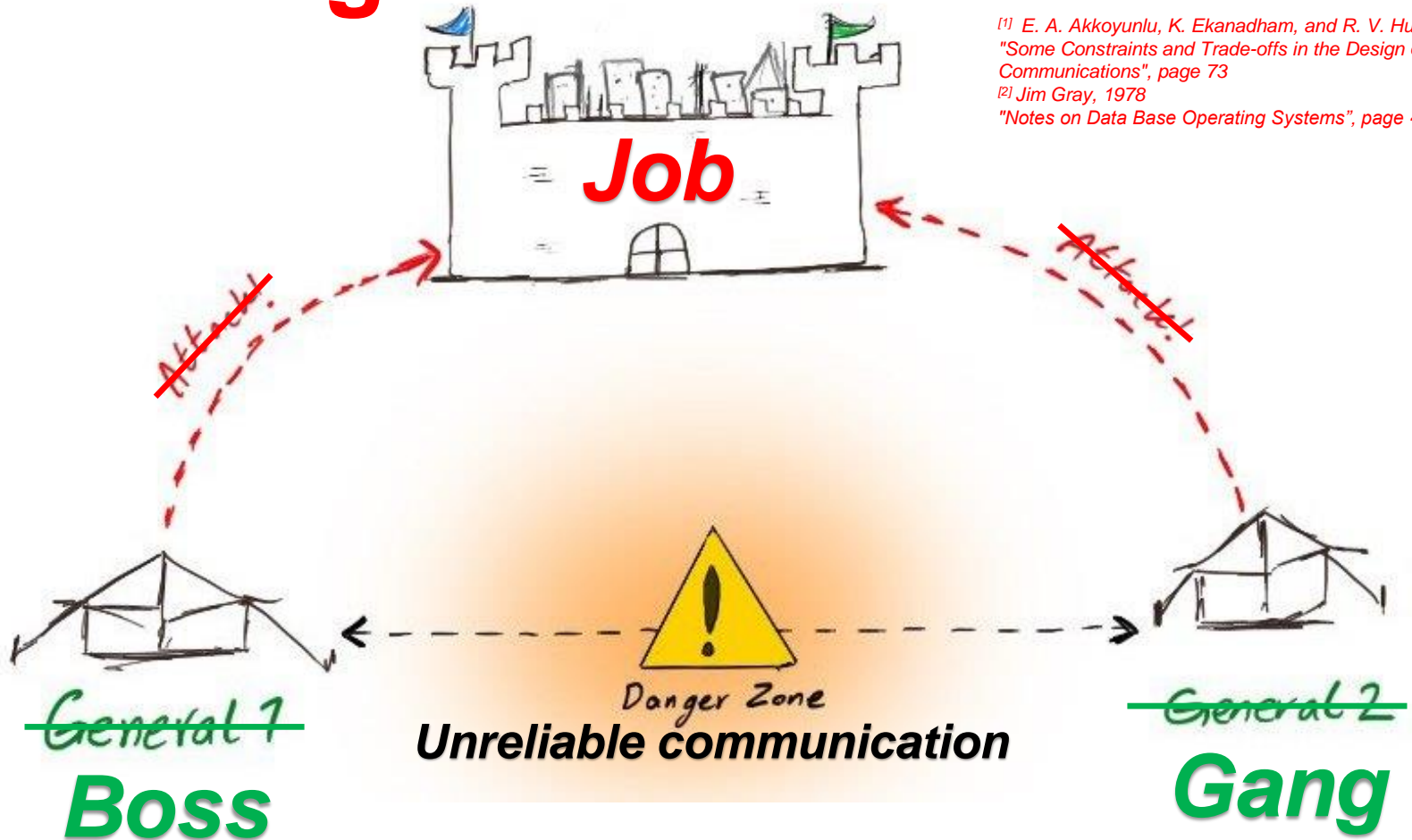
ICOM

~~Two Generals Paradox~~ [1,2] The Gangsters



[1] E. A. Akkoyunlu, K. Ekanadham, and R. V. Huber, 1975
"Some Constraints and Trade-offs in the Design of Network Communications", page 73

[2] Jim Gray, 1978
"Notes on Data Base Operating Systems", page 465



FT Repeat Protocol



CQ W0YK CM97

W0YK AA5AU EL92

←AA5AU calls with exch

AA5AU W0YK R CM97

← W0YK QSL's with exch

W0YK AA5AU RR73

←AA5AU QSL's

AA5AU W0YK R CM97

← W0YK missed QSL msg

W0YK AA5AU RR73

←AA5AU repeats QSL

Minimizing NILs

Recommendation



- Develop skill to dynamically change message
 - e.g., use the Alternate F1-F6 keys in WSJT-X
- Always log the QSO when receiving a RRR, RR73 or 73 message.
- Always log the QSO when sending RRR, RR73 or 73 message.
 - Look for a clue that your message was not received, e.g., your QSO partner re-sends his report.

FT8 vs. FT4 Strategy



- FT4 is faster; FT8 decodes better
 - Intrinsic vs. extrinsic speed
 - FT4 is intrinsically 2x the speed of FT8
 - FT8 is more likely to decode
 - Either might be extrinsically faster at a given time
 - Dynamically use the mode with highest QSO rate
- New stations & multipliers in each mode

Resources



- Software web sites
 - physics.princeton.edu/pulsar/K1JT/wsjitx.html (WSJT-X)
 - n1mm.hamdocs.com/tiki-index.php (N1MM Logger+)
 - <https://writelog.com/digirite> (DigiRite)
 - www.writelog.com (WriteLog)
- Software Email reflectors
 - wsjt-devel@lists.sourceforge.net (WSJT-X)
 - n1mmloggerplus@groups.io (N1MM Logger+)
 - digirite@groups.io (DigiRite)
 - writelog@contesting.com (WriteLog)
- Tutorials for WW Digi DX Contest
 - rttycontesting.com/tutorials/n1mm/operating-ww-digi-with-n1mm/ N1MM+/WSJT-X
 - rttycontesting.com/tutorials/writelog3/digirite/ WriteLog/DigiRite