
RTTY Receiving

Optimized RTTY Decoding
to Improve your Contesting

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Technology vs. Brain

- CW (and phone) “decoded” by our brain
- RTTY decoded by software/hardware
 - Very difficult by brain!

Therefore, the receiving and decoding technology is critical for reliable RTTY reception.

This may be the most important system component for the RTTY contester to optimize.

The System

- Antenna
- Receiver
- Modem (decoder)
- PC
- Soundcard
- Inter-connect

The system components interact and each must be considered in the context of the others.

Topics

- Receiver
- Decoder
- Multiple Decoders
- Second Receiver
- Audio Levels

Receiver

- IF Bandwidth
- AGC settings
- Sensitivity and other receiver characteristics

Receiver IF Bandwidth

- ITU recommendation¹
 - $45.\overline{45}$ baud + $(1.2 \times 170 \text{ Hz}) = 249.\overline{45}$ Hz
 - How many signals can fit in a given band width?
 - Ideal conditions: no QRM, QSB, flutter, multi-path, ...
- BUT ... Most decoders work best with a WIDE bandwidth (500 Hz or more)
- BUT ... QRM may dictate a trade-off downward (as low as 200 Hz)

¹ ITU-R SM.1138.2 (10/2008)

Special RTTY Filters

- Icom Twin Peak Filter
- Elecraft Dual Tone Filter
- These special filters treat Mark and Space individually
- ***Do not use these filters!***
 - Narrow filtering degrades the decoder performance

AGC

- **Slow AGC** setting so decoder selective fade algorithms will work effectively

Decoders

- The receive half of a MODEM
- Software MODEMs:
 - RITTY (DOS-based)
 - MMTTY
 - 2Tone
 - MixW (bundled with logging function)
 - WinRtty (native WriteLog RTTY MODEM)
 - CocoaMODEM (Mac-based)
- Hardware MODEMs:
 - PK232
 - Kam
 - Hal DXP38 & P38, 8000 series

Decoders - *recommendations*

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Decoder Design

- “Raised Cosine” filters: RITTY, 2Tone, CocoaMODEM
 - Optimized for 500+ Hz bandwidth
- MMTTY tolerates narrower BW, but starts out with a higher inherent error rate
- Empirically, 500+ Hz bandwidth copies better in all decoders
 - Very weak signals are decoded
 - Flutter, multipath, QSB, QRN, QRM errors are minimized
 - ***UNLESS QRM degrades the receiver***

Multiple Decoders

2013 Ten-Meter RTTY.vl - WriteLog

File Edit View Entry Radio Bands Setup Tools Contest Window Help

JF10PL

80M Mult OK. Need station!
40M Mult OK. Need station!
20M Mult OK. Need station!
15M Mult OK. Need station!
10M 259 2150Z JF10PL 599

Japan
Kanto

Direction 304
Distance 8394
Reverse Bearing 55
LP Direction 124
Sunrise 21:38Z
Sunset 07:28Z

Score: 14,656
QSO Sta Prov Dx
80M 0 0 0 0
40M 0 0 0 0
20M 0 0 0 0
15M 0 0 0 0
10M 229 41 6 17
Total 229 41 6 17

SEQ	DATE	TIME	FREQ	CALL	SNT	RCV	QTH	ML	COUNTRY	C	PREF	TIME
245	2013-12-08	2131	28085	W4FDE	599	599	SC		United States	K		
246		2132	28085	KB0KQA	599	599	MN		United States	K		
247		2132	28085	W4GV	599	599	FL		United States	K		
249D		2142	28085	PU2PZZ	599	599	74		Brazil	PY		
251		2143	28085	W4SDJ	599	599	NC		United States	K		
253		2145	28085	W9CSX	599	599	IN		United States	K		
254		2150	28085	N5UKZ	599	599	LA		United States	K		
255		2150	28085	JF10PL	599	599	065		Japan	JA		

Radio: SEQ CALL RCV QTH

28085 KHz FSK

28086 KHz FSK R 256 VK4UC 599

New Station

WriteLog for Windows 35 WPM 35 WPM AUTO CQ APRL RTTY Bound Up

10RY WOYK WOYK CQ
MPPEWIREAT
HM BOAGVIKIYQXJNLTJWSJV
\$7#(54989775;.33\$';
10RY WOYK WOYK CQ

2Tone

10RY WOYK WOYK CQ W
TU WOYK
EVMVRRSW
FMUZLCVJQ701.
62\$/
10RY WOYK WOYK CQ LUVKSP

LMMTY

TU WOYK CQ TJERVYQJON
TH W OWVZ
10RY WOYK WOYK CQ OQWFMQPORV
10RY WOYK WOYK CQ TJ
10RY WOYK WOYK CQ EPLFBNPVE TRG
JF10PL 599 CA
J737QKSSM YBWAMSFTO UPMNVSSKWIDA

G3YD 2Tone

LMP W
10RY WOYK WOYK CQ
10RY WOYK WOYK CQ
IU2(';
7095 F
CHIP)-&'.'-;'07'17' JIOTWVKW

DXP38

28060
28070
28080
28090
28100
28110

NABMG
N6RO
K6HGF
VA7AM
WE6EZ
JF10PL
N5UKZ
VK4UC
K700
W4FDE
KT0DX
W4TZX
W5PF
N2BJ
W5AP
WS7V
NC7Q
NX8G/5
K5WW
YV5AX
W4UK
VA2UP

Multiple Decoders

- Supported by both N1MM Logger & WriteLog
- 5% of the time only one will decode properly
 - MMTTY, 2Tone or DXP38 prevails about equally
- One may be superior in a given situation
 - Early 2Tone versions superior in most W0YK contesting
 - Later 2Tone versions not so much
 - MMTTY often superior in P49X contesting
 - DXP38 decodes further off-frequency (advantage)
 - 2Tone delays the first few characters (disadvantage)

Multiple decoders give clear copy more of the time.

Second Receiver

- More useful for RTTY due to decoder technology (vs. brain!)
- A “real” second receiver, not a second VFO
- Applications:
 - S&P on same band while running
 - Efficient “leapfrog” S&P
 - Split operation
 - Alternate CQing, high and low in the band

Second Receiver

Main
Sub

The screenshot displays the Ten-Ten software interface. At the top, a log table shows the following data:

SEQ	DATE	TIME	FREQ	CALL	SNT	RCV	QTH	ML	COUNTRY	C	PREF	TIME
245	2013-12-08	2131	28085	W4FDE	599	599	SC		United States	K		
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254		2150	28085	N5UKZ	599	599	LA		United States	K		
255		2150	28085	JF10PL	599	599	065		Japan	JA		

Below the log table, the radio controls show a frequency of 28085 kHz FSK. A call sign '256 VK4UC' is entered in the 'CALL' field. The 'Radio' section also shows '28086 kHz FSK' and 'New Station'.

Two waterfall plots are visible on the right side, labeled 'Main' and 'Sub'. The 'Main' plot shows a signal at 28085 kHz, with a call sign 'VK4UC' highlighted. The 'Sub' plot shows a signal at 28085 kHz, with a call sign 'VK4UC' highlighted. A red circle highlights the 'Main' plot, and a green circle highlights the 'Sub' plot.

At the bottom of the interface, several windows are open, including '2Tone', 'MMTTY', and 'DXP38'. The '2Tone' windows show a signal at 28085 kHz, and the 'MMTTY' and 'DXP38' windows show a signal at 28085 kHz. A red circle highlights the '2Tone' windows, and a green circle highlights the 'MMTTY' and 'DXP38' windows.

Second Receiver

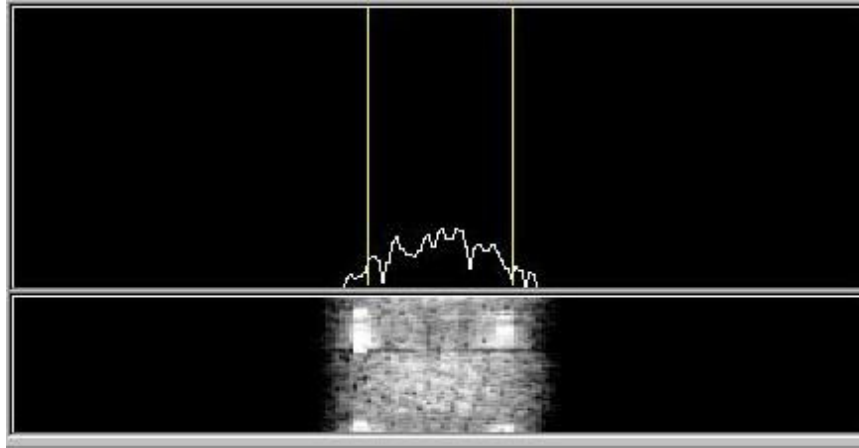
The screenshot displays the Ten-Ten RTTY software interface. The main window shows a log of stations with columns for SEQ, DATE, TIME, FREQ, CALL, SNT, RCV, QTH, ML, COUNTRY, C, PREF, and TIME. A station with call sign VK4UC is highlighted in the log. Below the log, there are radio controls for two receivers, with the second receiver (RX) currently set to 28086 kHz FSK. To the right, two waterfall plots are shown, labeled 'Main' and 'Sub'. The 'Main' plot shows a signal at 28086 kHz, and the 'Sub' plot shows a signal at 28086 kHz. A red arrow points from the 'Main' plot to the 'Sub' plot, indicating the signal path. A green arrow points from the 'Sub' plot to the 'Main' plot, indicating the signal path. A white arrow points from the 'Sub' plot to the VK4UC entry in the log. A red circle highlights the 'Call' button in the radio controls, and a red circle highlights the 'Work stn' button. A red circle highlights the 'Move back to main RX' button.

1. Click call
2. Work stn
3. Move back to main RX

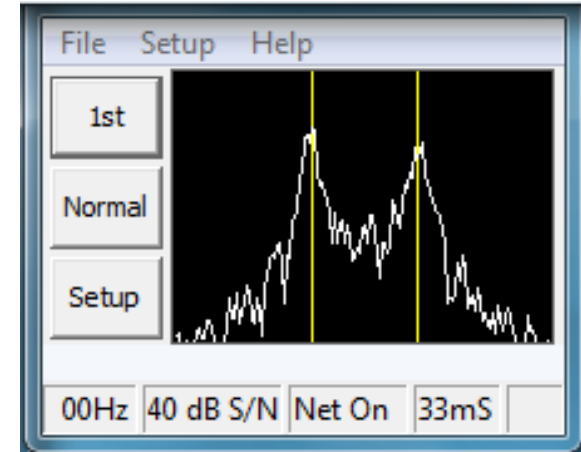
Audio Level

- Optimize the system dynamic range
 - Decode the weakest and strongest signal
 - Set the noise floor to 5-10% of full scale in MMTTY, or
 - Set the strong signal peak to 90% of full scale in 2Tone
- Don't saturate isolation transformers
 - If used for ground loops/Pin-1 problems
 - e.g., keep K3 LINE OUT level below '10'
 - Increase soundcard level (after the transformer) to achieve desired level in MMTTY or 2Tone

Setting the Audio Level



MMTTY



2Tone

- Adjust MMTTY noise floor to 5-10% full scale
- Adjust 2Tone strong signal to 90% full scale
 - 2Tone AGC will compensate for wide range of signal strengths

Summary

- Maintain as wide a receiver IF bandwidth as possible
 - QRM will force a narrower bandwidth
- Use slow AGC or none at all
- Do not use special RTTY filters, e.g., Twin Peak Filter
- Deploy multiple decoders for signal diversity
- Use the second receiver
- Optimize audio dynamic range
 - Noise floor at 5-10% full scale in MMTTY
 - Strong signal at 90% full scale in 2Tone
- Don't saturate audio transformers
 - Run low levels through them