

# NBEMS for UHF/VHF, Technical stuff

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## MT63 Modes

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### General Description

MT63 is an Orthogonal Frequency Division Multiplexed (OFDM) mode consisting of 64 parallel carriers each carrying part of the transmitted signal. The tones are differential BPSK modulated. MT63 employs a unique highly redundant Forward Error Correction system which contributes to robustness in the face of interference and fading.

The tones have synchronous symbols, and are raised cosine modulated. The mode requires a very linear transmitter. Over-driving leads to excessive bandwidth and poorer reception. The mode is unpopular with some operators because of the bandwidth used.

The mode is very tolerant of tuning, as most software will handle 100Hz mistuning. The mode was designed by Pawel SP9VRC.

Mode	Symbol Rate	Typing Speed <sup>1</sup>	Duty Cycle <sup>2</sup>	Modulation	Bandwidth <sup>3</sup>	ITU Designation <sup>4</sup>
MT63-2000	20 baud	20.0 cps (200 wpm)	80%	64 x 2-PSK	2000 Hz	2K00J2DEN

#### Notes:

1. WPM is based on an average 5 characters per word, plus word space.
2. Transmitter average power output relative to a constant carrier of the same PEP value.
3. This is the "Necessary Bandwidth" as defined by the ITU.
4. A summary of the ITU Designation system can be found at [http://en.wikipedia.org/wiki/Types\\_of\\_radio\\_emissions](http://en.wikipedia.org/wiki/Types_of_radio_emissions)

In addition there are two interleaver options (short and long) which can be set on the **MT63 configuration tab**. The default calling mode is MT63-1000. If the short interleaver is used then one can expect some compromise in robustness. The long interleaver results in somewhat excessive latency (delay between overs) for keyboard chatting. MT63-1000 with the long interleaver has a latency of 12.8 seconds.

### Edited excerpts from Pawel Jalocho's official mt63 code release

The MT63 modem is intended for amateur radio as a conversation (RTTY like) mode where one station transmits and one or more other stations can listen. In short, the modem transmits 64 tones in its baudrate specific bandwidth. The differential bipolar phase modulation is used to encode 10 bits of information per second on each tone. The user data in the form of 7-bit ASCII characters is encoded as a set of 64-point Walsh functions. The bits are interleaved over 32 symbols (3.2 seconds) to provide resistance against both pulse and frequency selective noise or fading. The character rate equals to the symbols rate thus the modem can transmit 10 7-bit characters per second.

This modem can as well run in two other modes obtained by simple time scaling, the possible modes are summarized here:

Bandwidth	Symbol Rate	Character Rate	Interleave / Char.
500 Hz	5 baud	5 char / sec	6.4 or 12.8 sec
1000 Hz	10 baud	10 char / sec	3.2 or 6.4 sec
2000 Hz	20 baud	20 char / sec	1.6 or 3.2 sec

For each mode the interleave factor can be doubled thus each character becomes spread over twice as long period of time.

The MT63 modem is made for single side band operation. The audio generated by the modem (sound card output) is applied to the SSB modulator. On the receiver side, the output of the SSB demodulator is put into the sound card input. The envelope of the MT63 signal is not constant as in other multi-tone systems - it is rather noise-like. One must be careful not to overdrive the transmitter.

The receiver of the MT63 is self-tuning and self-synchronizing thus the radio operator is only required to tune into the signal with +/- 100 Hz accuracy. The modem will tell the actual frequency offset after it is synchronized. The operator **should not** try to correct this offset unless he is able to tune the radio receiver very slowly, because MT63 as a low rate phase modulated system cannot tolerate sudden frequency changes.

The MT63 is a synchronous system and it relies on the sampling rate to be the same at the receiver and the transmitter. At least the sampling rates should not be different by more than  $10^{-4}$ .

If you have calibrated your sound card to **WWV**, then you will meet this requirement.

## Links to advanced usage

Advanced forms templates: <http://hlares.pbworks.com/w/file/54377927/Advanced%20NBEMS.ppt>  
Then click the "Download" tab.

Wrap: [http://www.w6ier.org/images/wa3wsj\\_nbems.pdf](http://www.w6ier.org/images/wa3wsj_nbems.pdf)

FLMSG Users Manual: <http://www.w1hkj.com/flmsg-help/>

Qforms: <http://www.activeham.com/pmwiki.php?n=Main.Downloads>

Qforms, getting started: <http://pengoworks.com/qforms/docs/gettingstarted.htm>

More on Qforms: <http://www.pengoworks.com/index.cfm?action=qForms>

Chat: <http://www.youtube.com/watch?v=Nhcryw1HW0g>