DIGTRX 3.11

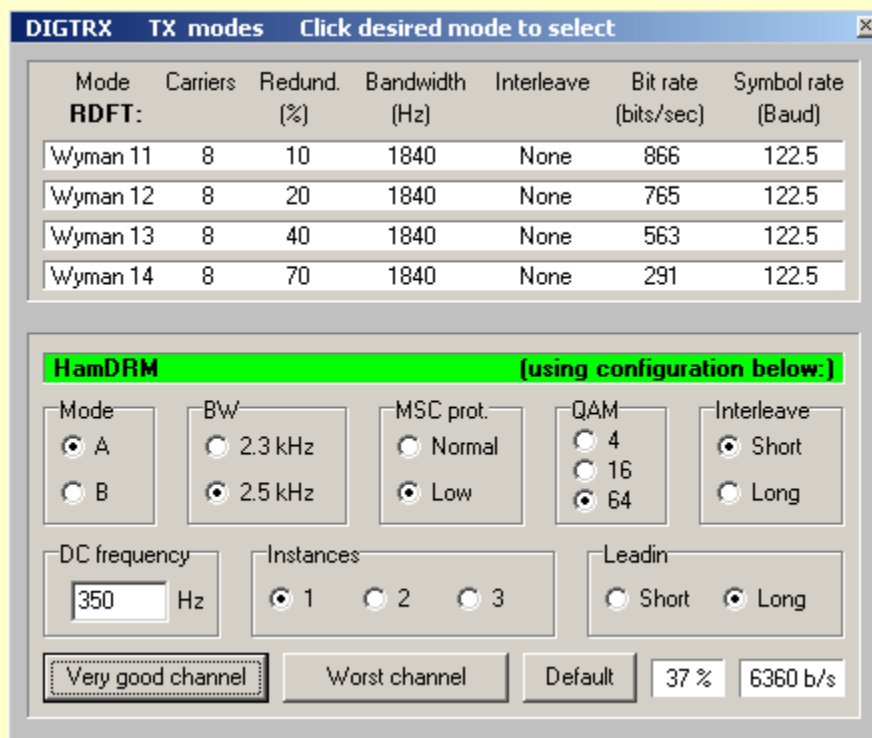**Experimental program with modes RDFT of KB9VAK and HamDRM of HB9TLK.**

The HamDRM mode is compatible with WinDRM, for file transfer, NO VOICE.

HamDRM mode only works on Windows XP or 2000+SP4.
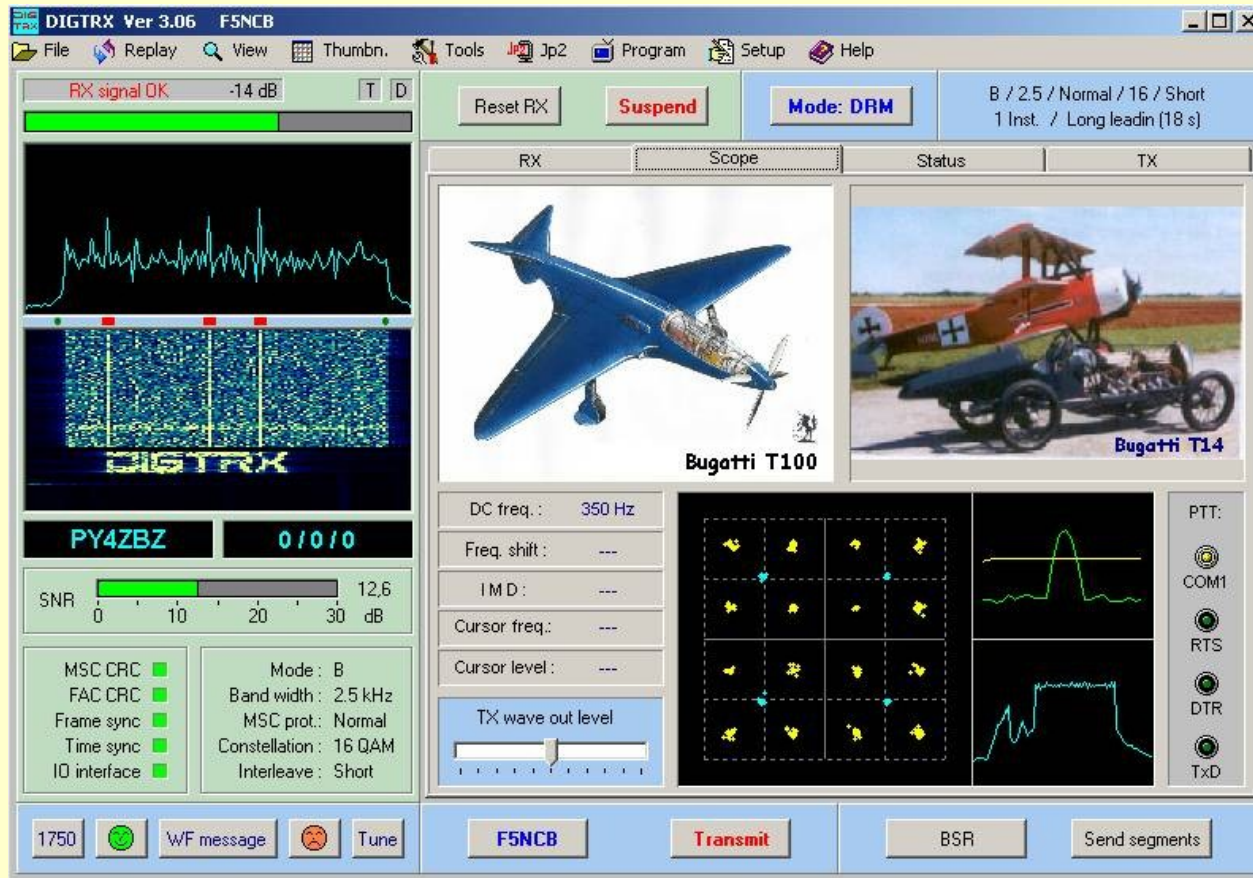
DIGTRX is a program for transfer digital files and which can operate in two different basic modes: the RDFT and HamDRM.

DIGTRX   TX modes   Click desired mode to select

Mode RDFT:	Carriers	Redund. (%)	Bandwidth (Hz)	Interleave	Bit rate (bits/sec)	Symbol rate (Baud)
Wyman 11	8	10	1840	None	866	122.5
Wyman 12	8	20	1840	None	765	122.5
Wyman 13	8	40	1840	None	563	122.5
Wyman 14	8	70	1840	None	291	122.5

HamDRM   **(using configuration below:)**

Mode: ⦿ A   ○ B
BW: ○ 2.3 kHz   ⦿ 2.5 kHz
MSC prot.: ○ Normal   ⦿ Low
QAM: ○ 4   ○ 16   ⦿ 64
Interleave: ⦿ Short   ○ Long

DC frequency: 350 Hz
Instances: ⦿ 1   ○ 2   ○ 3
Leadin: ○ Short   ⦿ Long

[Very good channel]   [Worst channel]   [Default]   37 %   6360 b/s

IMPORTANT: IMPORTANT : : : the : the : the : the :

Following a description SIMPLIFY of the HamDRM mode:

HamDRM mode is based on software **Dream,** implementing the modern and efficient **DRM** system**, Digital Radio Mondiale**, used in broadcasting in long, medium and short waves.

HamDRM is a similar digital system the RDFT in some respects (e.g. Reed Solomon code, several carriers, etc.) and totally different from RDFT in other respects:

- **RDFT** (W11 to W14) uses **8** carriers modulated each with **9** different **phases**, fully filtered in form not **to have no spectral overlap**.

- In the current stage, **RDFT** does not coding/simultaneous , i.e. these operations must be made

- **HamDRM** allows **code** information **at the same time** that **transmits** and decodes the information **at the same time as it receives**, in an online way. Therefore, do not need to encode the file before transmitting it and do not need record the received signal after decode it.

HamDRM uses **45 to 51** carriers **ORTHOLOGONALLY** spaced (**OFDM**) and whose spectres overlap, but without mutual interference, because of the orthogonality, which in this case means that each carrier has its frequency central situated in the first spectral zero of the adjacent carrier, or **separation of df frequency** of the carriers is equal to the **inverse** of the **time you of the symbol** : **df ?1/ you**. In addition, the MRM achieves a good discrimination of the distortions caused by propagation in multi-paths thanks to a **tg guard interval** in the domain of time. The following figure shows an example of a carrier in the field of time, i.e. its waveform. Each **transmitted symbol** has duration **ts?tu+tg** and has (but each symbol of a carrier QAM may have different phase and amplitude from the others, see in the picture below, QAM modulation
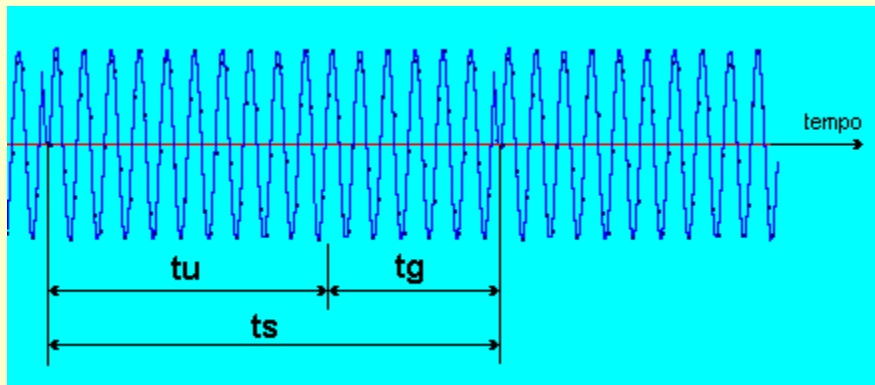
The following figure shows the **spectrum** (domain of frequency) of only five OFDM carriers, being in orange a carrier any **fn,** and four more adjacent carriers (2 above and 2 below) in blue, and after they've been clipping through the **window of integration of the receiver** with duration **you.** Note that the maximum energy of any carrier falls exactly on the null of the others, the so-called orthogonality. Also note that the spectrum of a carrier modulated as in the example above, has the shape of function **senx / x** (orange curve) with nulls at equidisting intervals and equal to **df,** above and below the nominal frequency of the carrier:
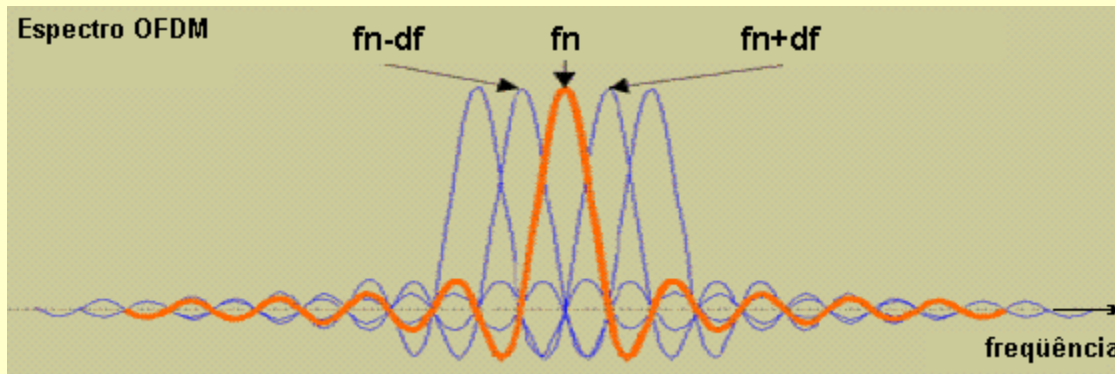
Mode A is a little faster that mode B and should be used when propagation fades selection of despicable. Mode **B** , slower because it uses a time of larger **tg** guard, should be used when propagation has more selective fading due to multi-path propagation

- HamDRM uses **QAM** modulation (4, 16 or 64 QAM). In this case, the carrier suffers **so much modulation of Amplitude and Phase**. Usually, this is achieved by vectorizing two carriers modulated in **A** mplitude only, but situated on orthogonal axes (or in **Q** uadratura), I also have I to ssn a ssn called axes **I and Q** (**I** n phase and in **Q** uadrature), the name **QAM is Q**uadrature **The** mplitude **M** odulation. The following figure, made with my [RZ1 program](#), shows an example of 16QAM, where the resulting carrier may have 16 different vectors (with 3 amplitudes Different and 12 different phases). The **points** that can be occupied by **end** of these **vectors** are a simplified representation of modulation QAM called **CONSTELAO** :
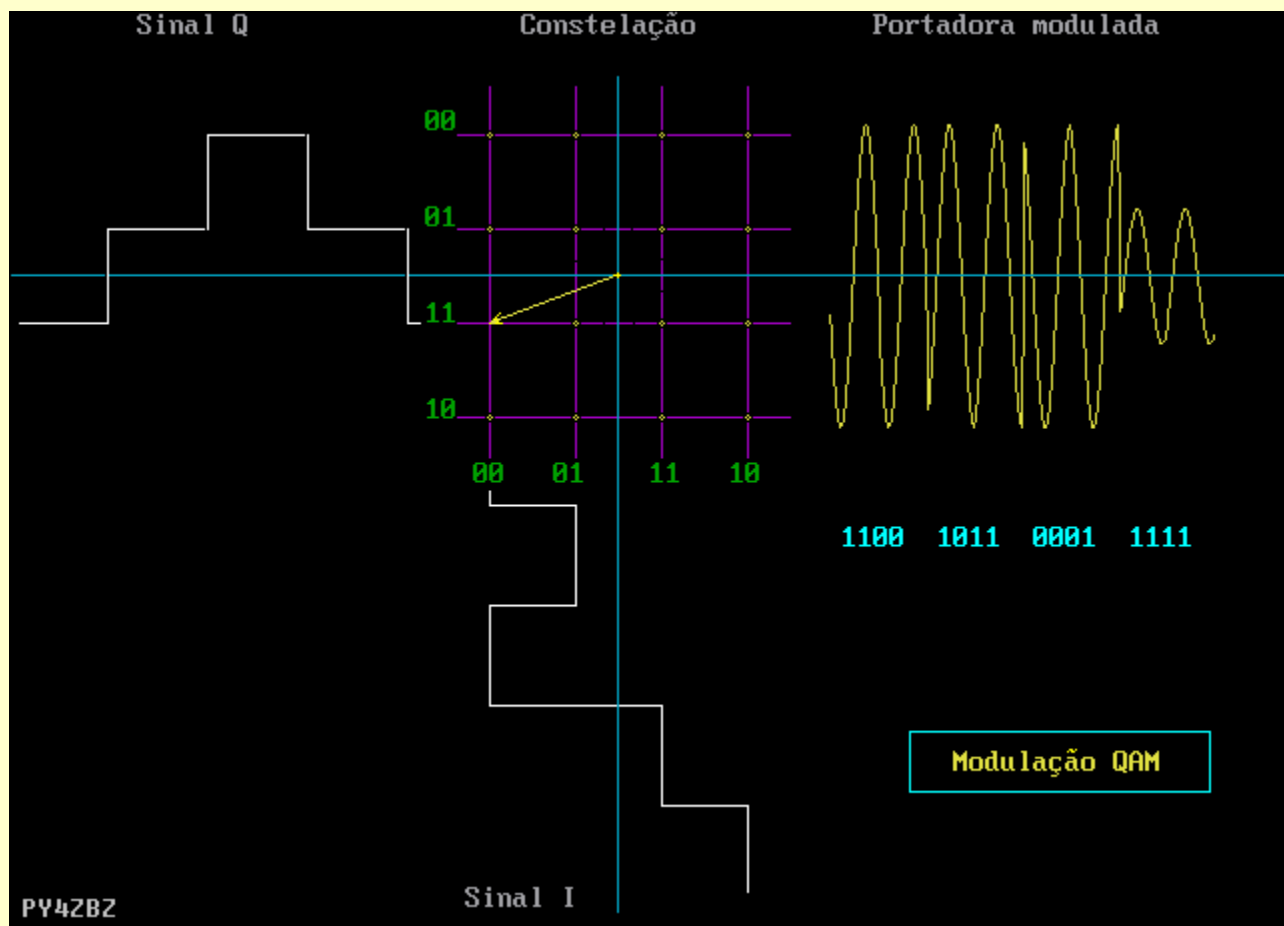
The figure above shows only one of the 16 possible vectors, the others being represented by the yellow dots in the constellation. Each vector "transports" 4 bits of information. For example, the vector of the figure corresponds to code 1100.
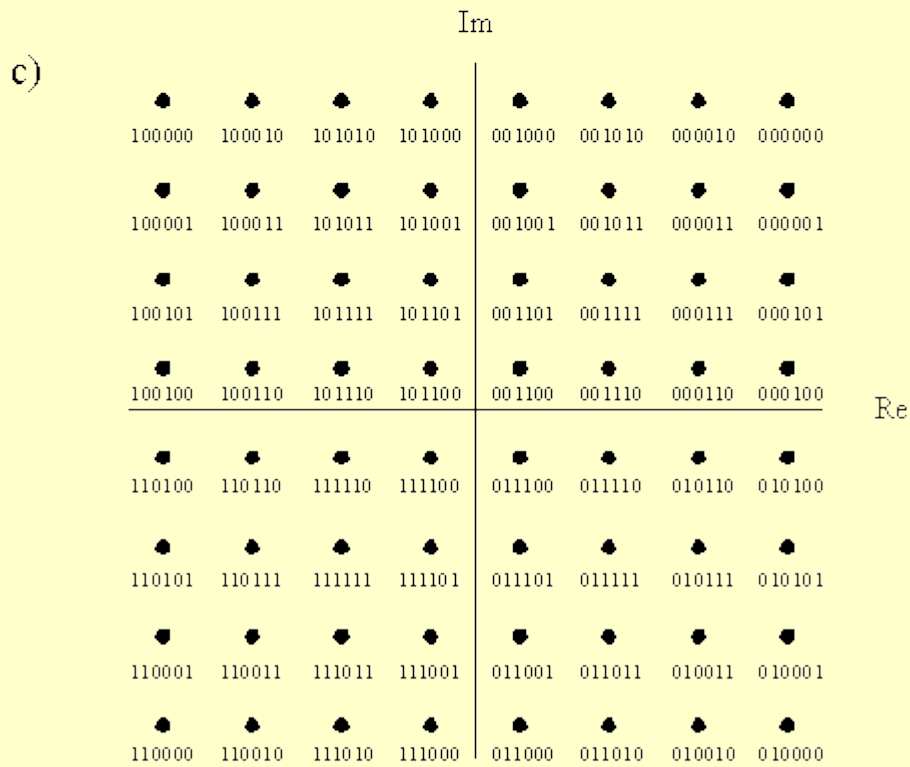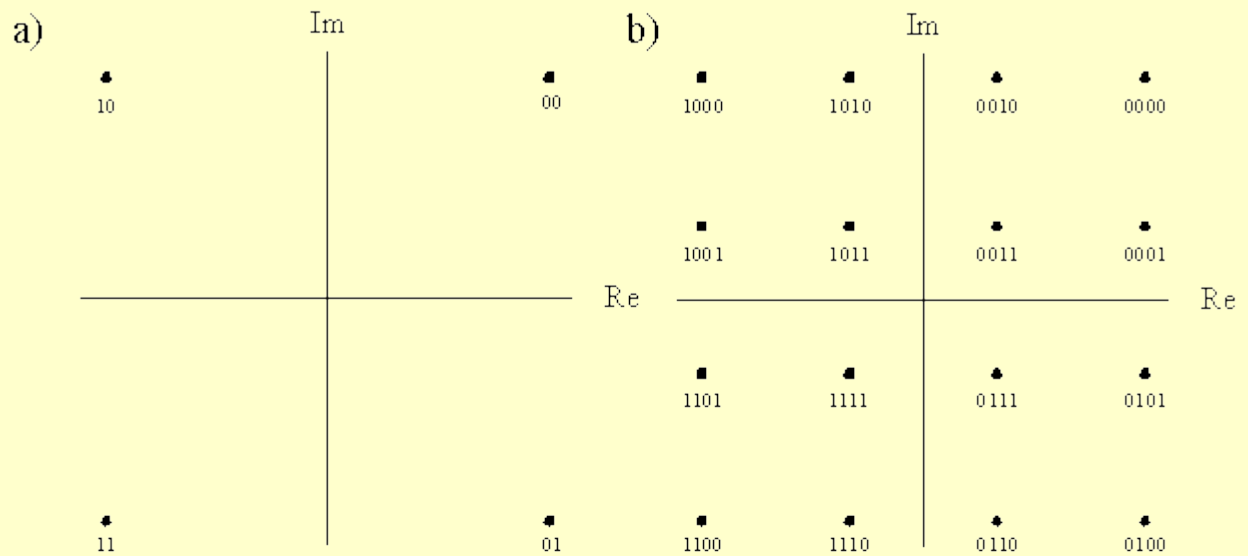
In 4QAM we only have 4 vectors with the same amplitude, each taking only 2 bits, and what is equivalent to modulation QPSK.

In 64 QAM, we have 64 different vectors, each taking 6 bits.

Observe which in *M* QAM, *M ? log.base2 of N*, where *N* is the number of **bits per vector**, and *M* the number of **symbols** (or vectors) different.

In QAM, each vector is also called **the SMBOL**, for each symbol equals *N* bits. In the case of 16QAM, if modulars the carrier in order to present for example 1000 vectors by second, we will be transmitting 4000 bits per second, because each vector "transport" 4 bits. Hence the technical name of **Speed or Modulation Rate (or Symbolization)**, expressed in **Baud** (in tribute to the inventor of the telegraph multiplex, Émile Baudot), different from **the Transmission Rate or Speed**, expressed in **Bits by second (bps)**. In this example, the carrier was **modulated with only 1000 baud,** but the corresponding **transmission rate** is **4000 bps**.

The following figure shows examples of constellations QAM (Axis **I** is also called **Re** al and the Aginary **Q Im** axis. a? 4QAM, b?16QAM and c?64QAM):

a)

Im

10   00

Re

11   01

b)

Im

1000	1010	0010	0000
1001	1011	0011	0001

Re

| 1101 | 1111 | 0111 | 0101 |
| 1100 | 1110 | 0110 | 0100 |

c)

Im

| 100000	100010	101010	101000	001000	001010	000010	000000
100001	100011	101011	101001	001001	001011	000011	000001
100101	100111	101111	101101	001101	001111	000111	000101
100100	100110	101110	101100	001100	001110	000110	000100
110100	110110	111110	111100	011100	011110	010110	010100
110101	110111	111111	111101	011101	011111	010111	010101
110001	110011	111011	111001	011001	011011	010011	010001
110000	110010	111010	111000	011000	011010	010010	010000

Re

DIGTRX allows you to view the **constellation QAM received**, and therefore mixed with the **noise** introduced by the medium, screen "Scope". A **noiseless** QAM signal (or with despicable noise) is seen thus:
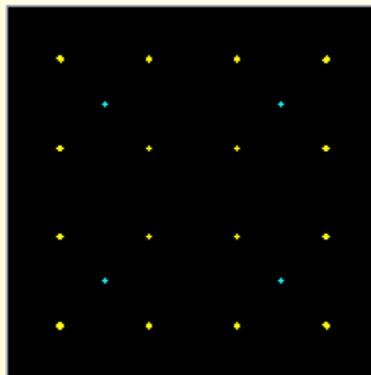

Note that DIGTRX shows two constellations: in **blue** the constellation of the **FAC** signal(information about the DRM signal), which is always in 4QAM, and in **yellow**, the constellation of the **MSC** sign (information or

main data of the DRM signal), which in the image above is at 16QAM.

Random variations, only from the **Phase** of QAM, cause this deformation (angular variation) of the constellation:
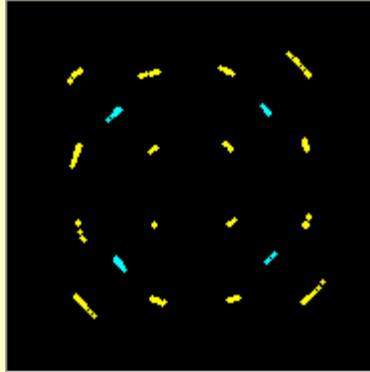

Random variations, only of **Amplitude** of the signal, cause the following deformation (radial variation) in the constellation:
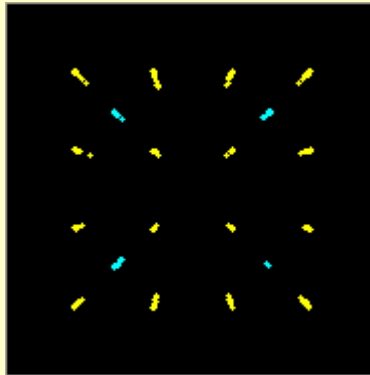
The noise introduced by the means of communication is equivalent to a vector with **amplitude and random phases** that **sum sum** vectors of the constellation and causing the deformation that can be seen in the following figure, spreading and moving away the points of the constellation around the ideal place. If the **signal/noise** ratio **(SNR)** is on the order of **20 dB** (sign 100 times more powerful than noise), the constellation will look like below, and can be demodated without problems:
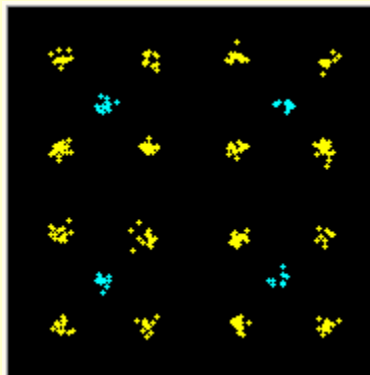
But if the **signal/noise** ratio gets worse much, the noise will cause certain points of the constellation to fall off the **decision limits** of the **demodulator QAM**, (detailed lines in the following figure), causing **decoding errors** :
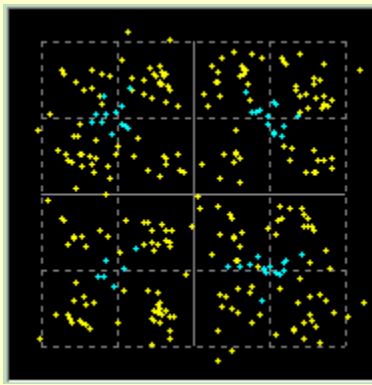
How an FEC system of Error detection and correction (Reed Solomon), up to a certain limit they will be corrected. Above this limit of errors, the signal is no longer usable.

Of the 3 QAM modes of HamDRM, **4QAM** is obviously the one that **supports the most noise**, but of course has the **lowest transmission speed** in bits per second, because each vector only takes 2 bits.

The 64QAM is much **faster**, but in compensation **you need a better noise signal ratio, i.e. a good quality channel.**

The following figure shows the three graphic screens the "scope" screen of the DIGTRX. The largest corresponds to the constellation QAM, in this case is an example of 64QAM, and for ideal conditions:
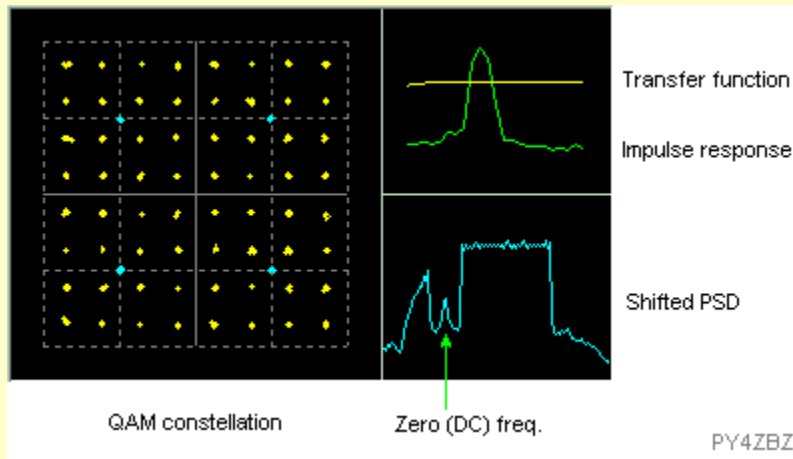

The right and above is a chart that shows, in yellow, the **transfer curve in amplitude** (or response amplitude versus frequency) **of the TX+propagation+RX system,** which ideally it should be flat. In green color is represented the shape of the **wrist of** demodulated **data**. The graph on the right and below shows the **density spectrum power (PSD)** received, **displaced (Shifted)** at frequency, in order to be seen from the frequency of zero. (The left of the frequency zero appears a filtered residue of the spectrum replica, without utility).

The following figure shows an example of **bad amplitude response,** at **low frequencies**, of the TX filter or RX, which can be seen both in the transfer curve and in the SPSD. In this case should be tried a transmission with frequency **DC Offset** a little greater : :
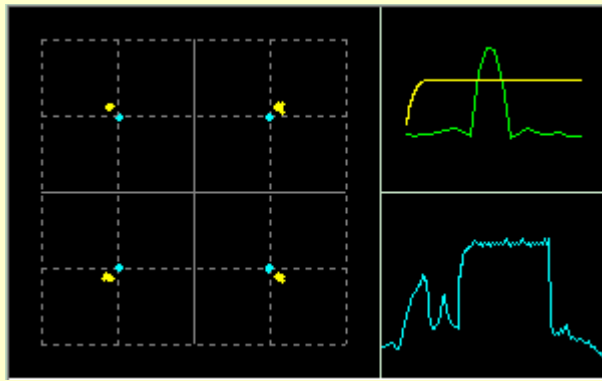
The following figure shows an example of **QSB Selective** caused by multi-path propagation:
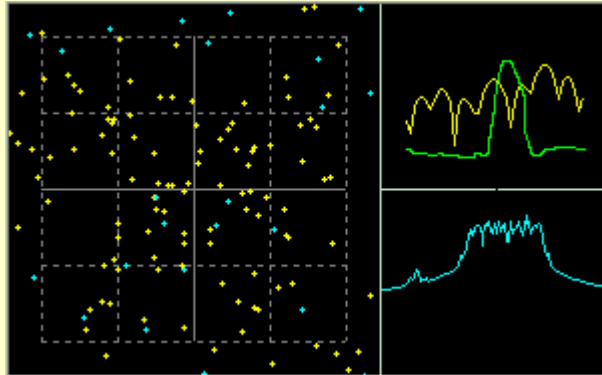
The following figure shows the **spectrum and the spectrogram** of a **HamDRM** signal **with BW-2,5 kHz**, compared to mode RDFT. The **51 bearers** are so close they can't be shown individually on the spectrum. Only **three pilots** stand out, which are carriers with higher level used to facilitate the **timing of the demodulator** and that can also be used as a reference for **tuning of the receptor** (red brands on the frequency scale) :
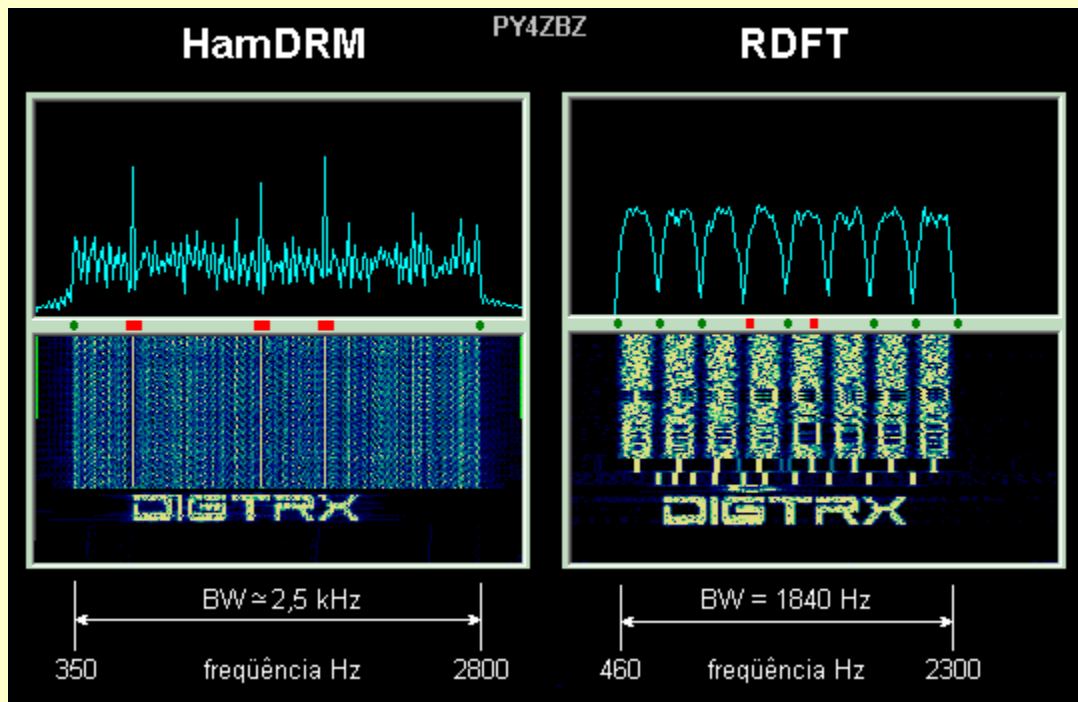
Interleaving consists of interspersing the symbols instead of keeping your natural sequence. The larger, the greater correction of errors with QSB, slow fading, but causes a little longer delay at the reception.

The **occupied BW band** by the HamDRM signal can be **2.3 or 2.5 kHz**. The smallest
is a little slower and should be used [if the equipment filters
SSB TX/RX are narrower](#) or do not have a flat response.

DC frequency simply refers to the lower limit of the band
signal, and should also be chosen depending on the filters through which the signal
go through. go to travel.

Little Glossary HamDRM :

MSC Main Service Channel :main data channel, which can be modulated in 4QAM, 16QAM or 64QAM.

FAC Fast Access Chanel :auxiliary channel always modulated in 4QAM, and which carries the station
prefix and data on the mode used.

QAM Quadrature Amplitude Modulation: vector sum of two square waves and modulated in
amplitude, resulting in a modulated wave simultaneously in phase and amplitude.

COFDM Coded Orthogonal Frequency Division Multiplex: : : the... orthotogonal division
multiplexing of encoded frequency. The one . codification in this case refers to the FEC code.

FEC Forward Error Correction: direct correction of errors. The sslured the sslured The , . The , . The , .
codigo FEC inserts additional information in the transmission that is used in the reception to correct errors
up to a certain limit, without needing repetition.

What is there new: new:

- Fixed some bugs.

WARNING !:

IrfanView is one of the rare free programs for viewing
images that can open corrupt or incomplete files.

Therefore, DIGTRX has the option to use IrfanView to view
corrupt or incomplete file, and also to allow
progressive view of JP2, JPG or BMP files, simply
trying to open the still incomplete time file on time.

But certain corrupt or incomplete files can
cause the IrfanView locking.

Therefore, if the "Progressive RX display" option is enabled,
cases of locking of various instances of IrfanView, may arise,

making the computer extremely slow. In these cases, these
i_view32.exe instances can only be completed through the
Manager of Windows tasks.

Without IrfanView, DIGTRX will show the image file
only at the end of the reception, and only if it is received without error,
but it doesn't risk making the computer too slow.

V 3.10 - Included option "Auto SEND segments" for automatic transmission
segments after receipt of valid BSR.

- Included IMD meter: measures the distortion of the transmitter using the
tuning tones, at the receiving station. It must be greater than 15 dB.

- Included tuning error meter that uses the tuning tones or
the DRM signal in relation to DC frequency.

- Included option to disable automatic change to the screen from
Status every time you see some new status information.

V.3.09- New HamDRM.dll with new E. mode (more resistant to Doppler variations).

V.3.08- New HamDRM.dll with faster timing and best resolution for
texts in the waterfall (hana window).

Although HamDRM mode (and WinDRM or HamDream) already has **identification
CONTINUE** (which no other mode of radio transmission has!),
now another identifier can be included at the beginning of the transmission,
as in DIGTRX RDFT modes, in the setup, under "Use Waterfall ID".

V.3.07- Made small improvements : in the thumb of any; now saves DRM configuration;
suspends or program restores original wave volume and others.
New HamDRM.dll with better spectral resolution and memory reset in case
reception of same file in different mode.

- Fixed some bugs : serial port With or sound card already in use,
problem of Jp2converter with BSR and others.

V.3.05 and 3.06: - Fixed some bugs and made small improvements.

V.3.04: - Included with a way to join two CAT commands for Icom TRCVR, no
setup of the PTT command. See help PTT setup.

- Included the "Suspend" and "Program" buttons in HamDRM mode.

- Included help files in German by DH1BDU, and Spanish by TI2MAB.

Warning: The Hyper Threading of XP causes crashes in HamDRM! Turn off the HT.

V.3.02: If the option " **Progressive RX picture display** " is tagged (along with "Use IrfanView"), the image will be shown progressively during the reception, **only** for **Jp2** (better) formats, **JPG** and **BMP**. Jp2 is shown with increasing quality. JPG is shown from top to bottom and BMP from the bottom to top up.. Gold image formats do not allow for progressive display. <u>See the example in the figure below.</u>

from 01-05-2003 (337743 on 26-04-2005) (354375 on 17-05-2005)

Download :

DIGTRX311setup.zip

digtrx311updt.zip

Web I's a web I' site in Japanese **Aiuto.zip** Italian help file   **Deutsche Hilphseite**

IMPORTANT: IMPORTANT : : : the : the : the : the : the : the :

The The The adjustment of transmitter power for HamDRM

DIGTRX Old RDFT only version Old version of DIGTRX (RDFT only)

What's new:

- Corrected some bugs.

WARNING: IrfanView is one of the rare free graphic programs is that able to open corrupt or incomplete pictures files.

Please, DIGTRX has the option of using IrfanView to view corrupt or incomplete files, and also to allow progressive display of JP2, JPG or BMP files, simply trying to open the incomplete file at regular intervals before the whole file is received.

But certain corrupt or incomplete files can freeze IrfanView.

Therefore, if the option " Progressive RX display" is enabled, several instances of IrfanView can remain open and not responding, turning the computer extremely slow. In these cases, the instances of i_view32.exe can only be closed using the Window's task manager.

Without IrfanView, DIGTRX will show the image file just

at the end of the reception, and only if this file has in errors,
but without the risk of slowing down the computer.

V 3.10 - Included the option " Auto SEND segments " for automatic requested
transmission segments after receiving a BSR valid.

- Included IMD meter: it measures the transmitter distortion using the
tuning tones, at the receiving station. It should be larger than 15 dB.

- Included tuning error meter using the tuning tones or
the DRM signal related to the DC frequency. programmed in Mode.

- Included option to disable the automatic switch to the Status display
when there is some new status information.

V.3.09- New HamDRM.dll with new mode E. (for channels with high delay and
Doppler spread)

V.3.08- New HamDRM.dll with faster sync and better resolution for texts in the
waterfall (Hanning window).

- In spite of the HamDRM (or WinDRM and HamDream) mode already have
CONTINUOUS identification (the ONLY mode for Hams with this feature !),
now you can include a waterfall ID (or other) at beginning the of the
transmission, like in DIGTRX RDFT modes, in setup," Use waterfall ID ".

V.3.07- Made some improvements: in thumbnails of any; now saving DRM settings;
suspend or program uses original wave out; adjust and other improvements.
New HamDRM.dll with better spectrum; memory reset in case
of same file in different mode.

- Corrected some bugs: with serial With port or sound card already in already use;
with Jp2converter and BSR; and other minor bugs.

V.3.05 and 3.06 : - Corrected some bugs and made small .. improvements.

V.3.04 :- Included a form of joining two CAT commands for Icom TRCVR, in PTT
command setup. See PTT setup help.

- Included the "Suspend" and " Program" buttons in HamDRM mode.

- Included help in German by DH1BDU, and Spanish by TI2MAB.

WARNING : XP with Hyper Threading enabled has problems with HamDRM ! Disable HT for HamDRM.

V.3.02: **Progressive picture display:** If this options is checked (and also Use IrfanView option), then the
received picture will be progressively while receiving, **ONLY** for **Jp2** (best), **JPG** and **BMP** pictures. Jp2 will
be with shown increasing quality. JPG will be shown from top to and bottom and BMP fro bottom to top.
Other picture format don't allow progressive display. See example for Jp2 bellow:

Progressive RX display example   (for Jp2)
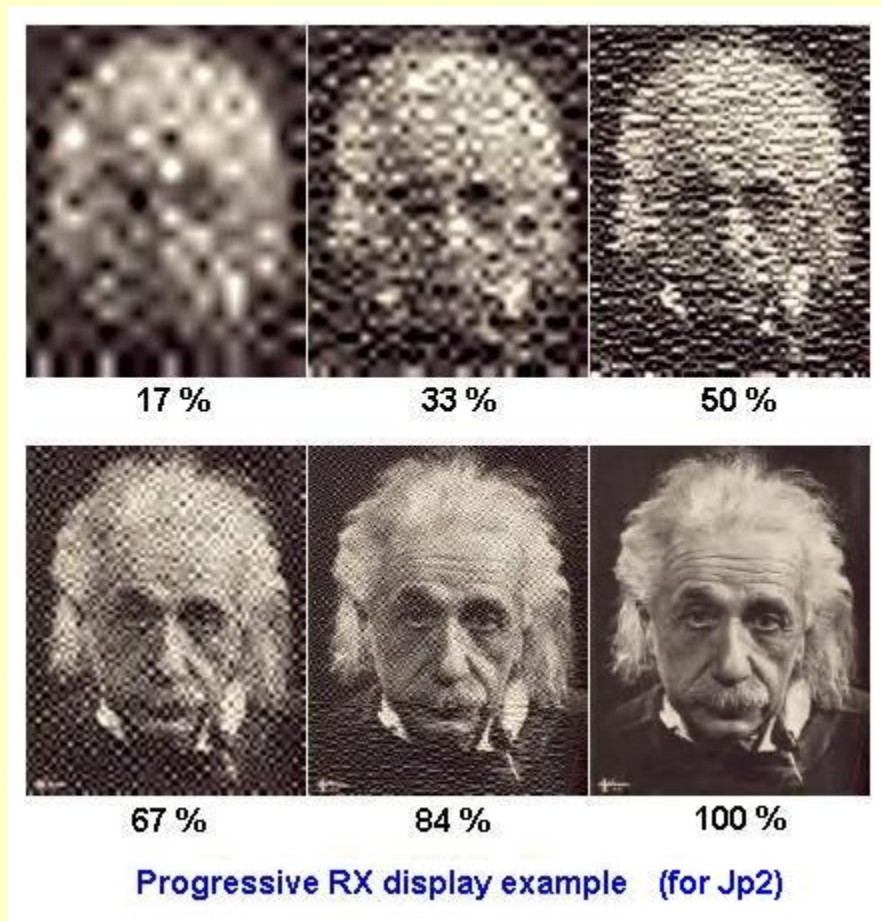
DIGTRX 3.xx Help for HamDRM mode.

HamDRM mode is only for Windows XP / 2000+ SP4.

The HamDRM mode is a modern digital transmission mode for HF based on DRM : Digital Radio Mondiale. See more in " About "

It is similar to RDFT in some aspects, but very different in other.

Both use many carriers: RDFT (W11 to W14) uses 8, and HamDRM from 45 to 51 carriers.

Both also use the Reed Solomon FEC code for forward error correction.

The RDFT carriers are modulated in phase with 9 different phases, and they are fully separated in frequency domain.

The HamDRM carriers uses OFDM: orthogonal frequency division multiplex. The modulated carriers are overlapping in frequency domain and are modulated in QAM (amplitude and phase).

In the current state of RDFT, the transmission of a file needs three
separate operations : Coding, Recording (of the transmission) and Decoding,
and this increases the total time of transmittin/receiving.

In HamDRM, a file is codified and transmitted simultaneously.
And it is decoded at the same time in that is received. There is only a
small delay between the end of the transmission and the reception
(some seconds).
To transmit the file needs in the other separate coding and decoding as in RDFT.
Just load the file (if not to big), or use Jp2 converter for adjust the
picture file a suitable size in bytes.

The file is divided in blocks (RDFT) or segments (HamDRM).
The size of segments depends on the mode particularities.

The Mode A is faster than Mode B but it doesn't support negative effects
caused by multi-path propagation as Mode B, which is more robust.

The QAM modulation can be in 4 or 16 or 64 vectors or symbols.
64 QAM is much faster but needs a very good signal noise to noise ratio (SNR),
or a high quality channel.
4 QAM is the slowest but it supports more noise, or smaller SNR.

Interleaving consists of changing the natural symbols sequence.
If long (2 seconds), it allows better error correction with slow fading,
but causes a little larger delay in the reception.
Short interleaving 400 ms.

The occupied band width BW for the HamDRM signal can be set to 2,3 or
2.5 kHz. The smallest is a little slower and it should be used if the
[SSB TX/RX equipments filters are to narrow](#) or have not a flat
transfer function.

The DC frequency simply refers to the lower limit of BW, also and
should be chosen in agreement with the equipments filters.

The amount of instances is the number of times that a file is transmitted
during one transmission. More than 1 instance allows if during the
reception of the first instance some segments were not received, they
will probably be received during the second or third instance,
correcting the received file.

Leadin is just a extra time of initial transmission so that the receiver
can have time to synchronize correctly.

BSR is an adapted system from BBR of DIGTRX and get to do a request

to send only for the missing segments of a received file.

IMPORTANT:

The requested segments should be transmitted with the same mode
configuration to transmit the file for which was made the request.
But the BSR request can be made in a DIFFERENT mode configuration!

The TX mode used by two stations A and B can be DIFFERENT, what allows,
for example, if the station A has a larger local noise, the station B
a more resistant TX mode.

The TX mode is selected by the user (in TX mode) in agreement with
the propagation and reception conditions of the RECEIVING station.

The RX mode is AUTOMATIC and can be DIFFERENT from the TX mode.

SETUP:

The option " TX mode - Last RX mode" sets the transmission mode in
agreement with the last received mode. It should be used carefully.
See the previous important observation.

Show pictures anyway:
If in DIGTRX RDFT mode setup the option " Use IrfanView" is checked
the received image will be shown with missing segments, but only if
IrfanView is able to open it.

The "Mute control " of the " PTT setup also " works in HamDRM mode,
and it acts when MSC CRC is OK (green led).

The option " Ext. /Mix. loopback test " allows to decode the own
transmission.. transmission.. It should only be used for local test.
It should not be used in bilateral contacts.

Some times, the reception routine has some difficulty to synchronize.
The button " Reset RX" allows to restart the routine, what is made
automatically if the option "Auto reset RX" is checked.

Other characteristics of DIGTRX:

A file received in RDFT mode can be retransmited immediately
(replay) in HamDRM mode. A file received in HamDRM mode can be

retransmitted with the function "Replay and reodify..." in RDFT mode.

Since the mean power of RDFT and HamDRM signals are different, DIGTRX
memorizes automatically different settings of " TX wave out level "
adjust for of this two modes.

Small Simplified HamDRM glossary:

MSC MAIN SERVICE CHANNEL: can be modulated in 4QAM, 16QAM or 64QAM.

FAC FAST ACCESS CHANEL: auxiliary channel always modulated in 4QAM.
Transmits the station prefix and data on the used TX mode.

QAM Quadrature Amplitude Modulation: vectorial sum of two waves in
quadrature and modulated in amplitude, what results in a wave
modulated in phase and amplitude.

CONSTELLATION The that points represent the extremity of possible the
vectors of a QAM wave. All the vectors have origin at the center of the center
constellation, or I Q zero coordinates.

COFDM CODED ORTHOGONAL FREQUENCY DIVISION MULTIPLEX Large number of
equaly spaced carriers, with a frequency space between carriers of 1/Tu.
Tu is the useful duration of the impressed symbols on the carriers.
If the receiver integration window time is also Tu, the spectrum of each
modulated carrier will have zero energy on all the other carrier center
, that is the carriers are orthogonal.

FEC FORWARD ERROR CORRECTION The FEC code inserts supplemental
information in the transmitted data, the CRC, that is used in the
reception for direct error correction until a certain limit,
without repetition.

CRC Cyclic Redundancy Check

[DIGTRX Old RDFT only version Old version of DIGTRX (RDFT only)](#)

73, Good luck, Roland PY4ZBZ.