

This document allows understanding one of the most tricky options of the field strength meter : the constellation diagram. How is it generated? How to use it? And how to understand the results?

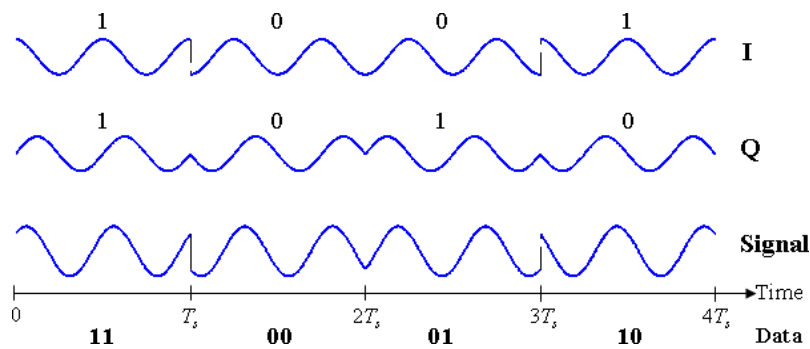
Definition :

The digital data transmission needs the information to be processed. Different modulation types are used in order to transport the information. For the digital TV broadcasting (satellite or terrestrial), the QPSK and QAM modulations are the more used. The term "symbol" is used to define the signals created by these modulations. They can be displayed in the form of graphic thanks to the constellation diagram.

QPSK : Quadrature Phase-Shift Keying

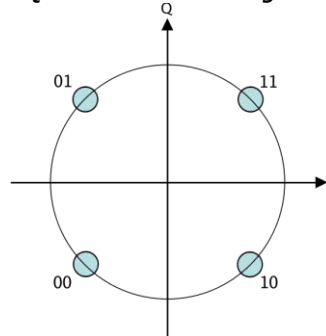
This modulation produces two signals that transport the information, one is sinusoidal (Q) and the other one is cosinusoidal (I). The coding is made according to the phase of these signals. Two phases are possible (180 ° phase difference) for both signal (I and Q), that enables realising 4 different symbols (in the following example, signal/data line).

QPSK temporal diagram - http://fr.wikipedia.org/wiki/Phase-shift_keying



These 4 symbols can be represented in the form of a constellation diagram Q(I).

QPSK constellation diagram

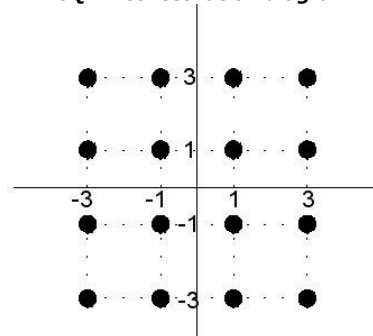


The QPSK modulation is often used in the satellite transmissions because it enables having a signal that is little sensitive to interferences with a correct symbol rate. These characteristics are important, as the signals emitted by the satellite have to cover 36000 km.

QAM : Quadrature Amplitude Modulation

This modulation is another one used for digital signal transmission . In fact, it uses the same phase modulation system but it adds, furthermore, an amplitude modulation. The I and Q signals can take different amplitude values and so increase the transmissible symbol rate. Below, a 16QAM modulation (16 = number of different symbols that can be used with this modulation).

16QAM constellation diagram



The QAM modulation is often used in the terrestrial digital transmission : it enables having a high symbol rate, but it is less resistant to disturbances than the QPSK modulation.


For example : in Europe, the DTV is broadcast with a 64QAM modulation (6 bit per symbol), while in Switzerland, a 16QAM (4 bit per symbol) is used. The 16QAM modulation is more interference-resistant ; thus, the reception is possible in worse conditions. Contrary to the 64QAM, the 16QAM also enables the mobile TV reception (like mobile phone).

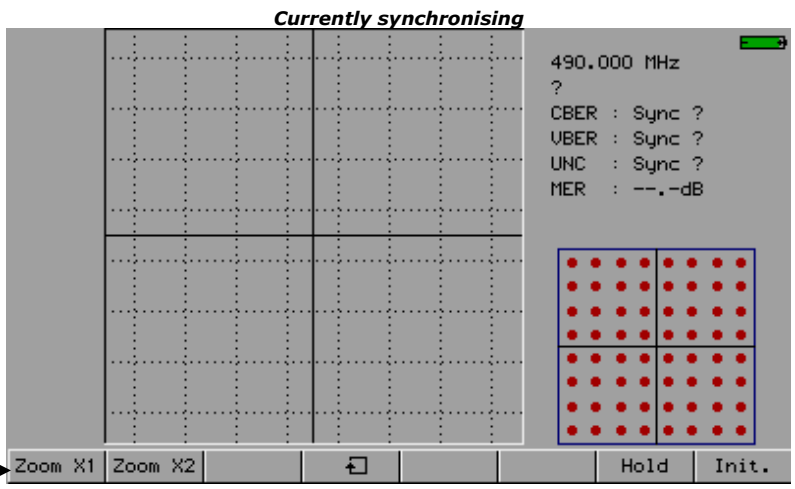
Remark : in DTV , as well as the QAM modulation which is interference-resistant, the COFDM coding is very used because it is well echo-resistant. The principle consists in dividing the information to transmit in several carriers (in 8k mode - 6817 carriers). Each carrier is QAM modulated. In this way, the transmitted signal resists to every perturbation type.

The constellation diagram with the field strength meter :

To display the constellation diagram with the field strength meter :

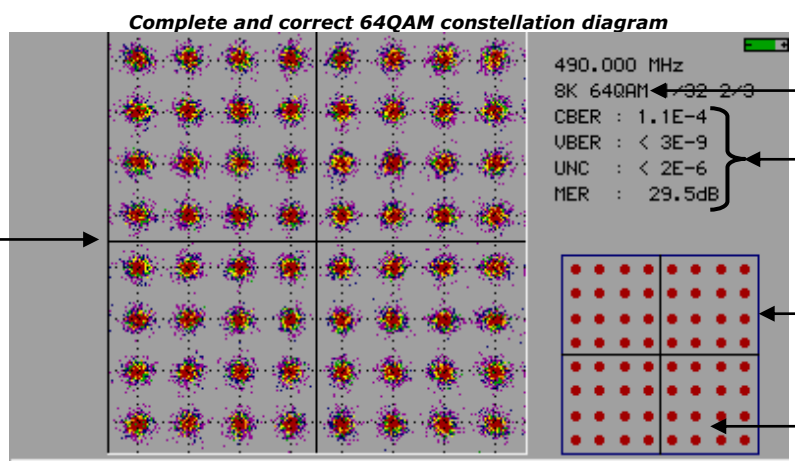
- Select a digital channel. For the example, we have chosen the DTV R2 multiplex

- Press the " Constellation " key :  , the following window appears.



Menu for sensitive keys

When the signal is synchronised, the constellation diagram appears little by little, it has to be as close as possible to the ideal representation given in the bottom right-hand corner of the screen.



Measured constellation diagram

Modulation type : 64QAM

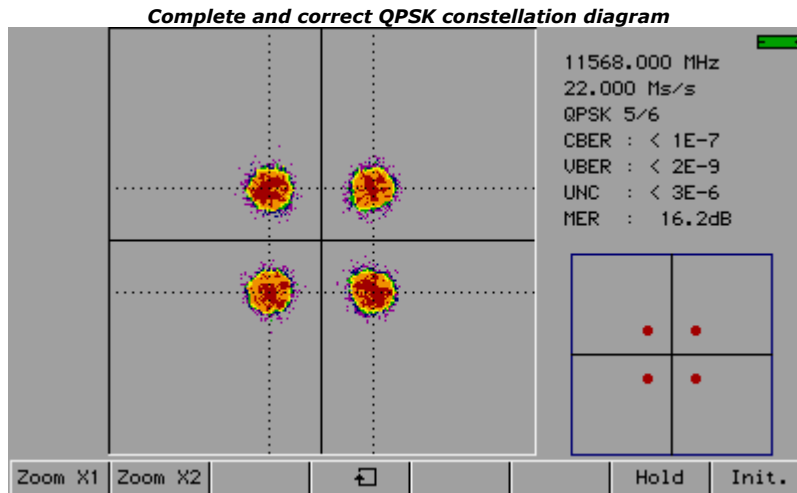
Error rate measures

Blue border : indicates the area seen on the screen

Ideal constellation graph (64QAM)

Many colours are used to indicate the occurrence number on a same point. The more the colour is "warm", yellow and red, the more the occurrence number on this position is high. On the contrary, if the colour is "cold", blue and purple, there are isolated points. For a signal of quality, a maximum of occurrences have to be in a circle which radius is as little as possible.

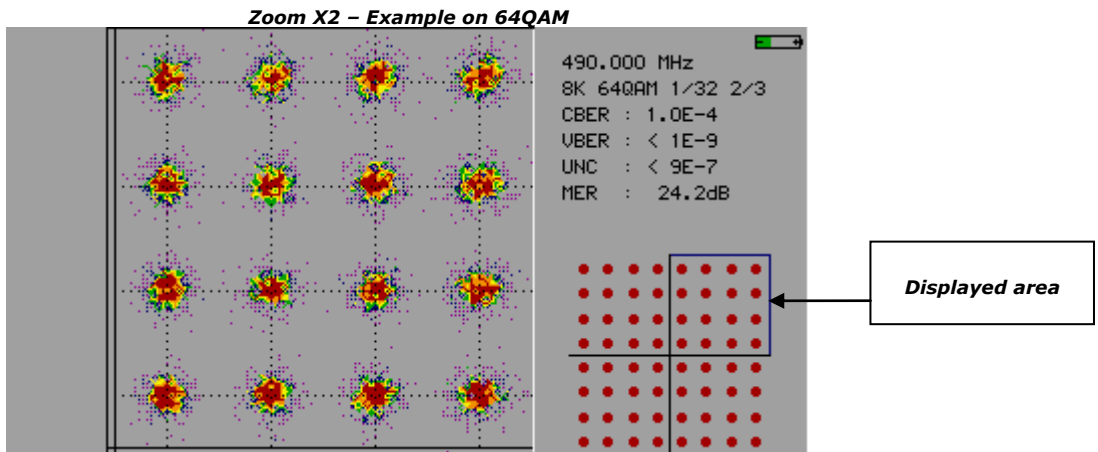
Below, the example of a constellation diagram for a transponder of the ASTRA 19.2°E satellite (QPSK).



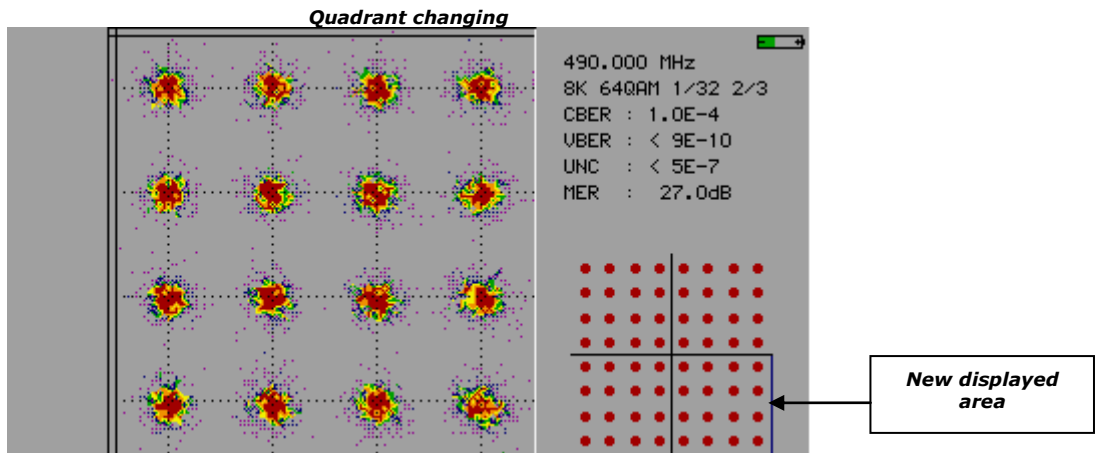
Menu for sensitive keys



- Zoom X1 : restores the complete display
- ZoomX2 : magnifies and centers the picture on one of the constellation diagram 4 quadrants



- The key allows changing the quadrant seen with the "Zoom X2". Thus, it is bordered in blue on the ideal diagram in the bottom right-hand corner of the screen.

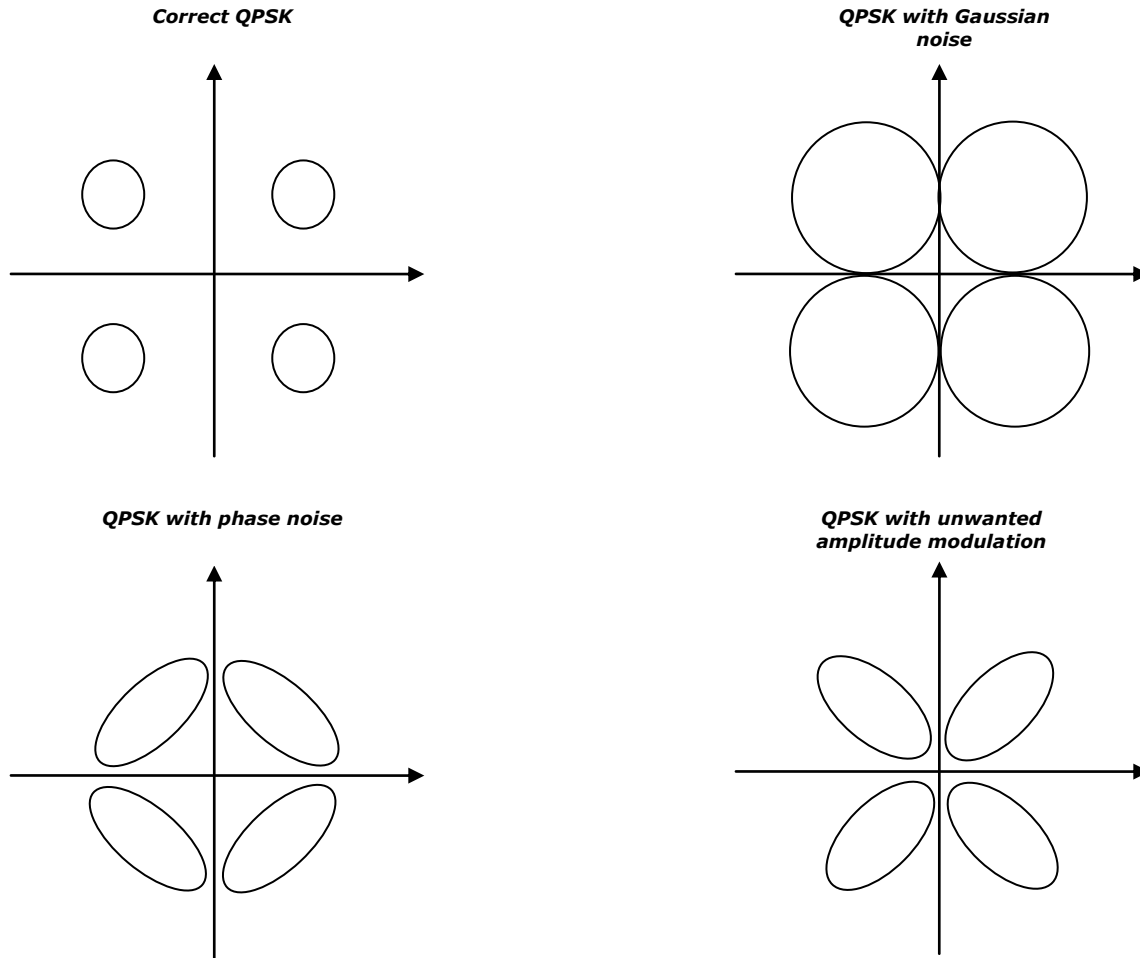


- **Hold** : stops the measurement (fixed picture) / restarts the measurement
- **Init.** : deletes the current diagram and starts a new measurement

Identify a defect

The constellation diagram changes according to the signal. If the signal is perturbed, the constellation diagram is distorted. In accordance with the distortion, it is possible to identify the type of interferences that pollute the information.

Example on a QPSK signal :



Identifying the defect type allows determining what channel element is concerned.

- **Gaussian noise** : too high attenuation (bad antenna adjustment, dispersion in the cables, defective amplifier).
- **Phase noise** : bad modulation equipment adjustments (local oscillator).
- **Amplitude noise** : defective amplification equipment.

Product link : http://www.sefram.com/wwwFR/F_quick_search.asp?st=7861