# MO-170 Testing DVB-T & DVBT-H

*The **MO-170** is a multi-purpose DTT modulator providing a complete test suite which can be used to perform measurements at different points on the DVB-T signal chain. The wide selection of test options available in the **MO-170** makes it the perfect companion for anybody interested in checking and validating a variety of critical aspects throughout the DVB-T system.*
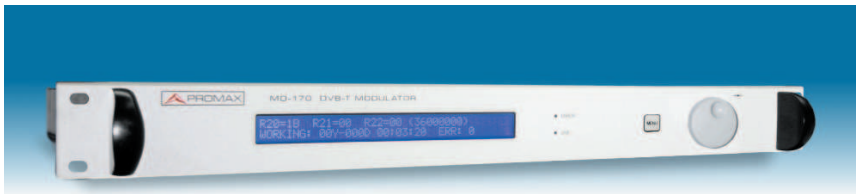
- **6, 7 and 8 MHz channel bandwidths (user-selectable)**
- **2k & 8k modes**
- **Master and slave operation**
- **Hierarchical modes**
- **Frequency agility (1 Hz step)**
- **High MER**

■ In addition to the more common test modes such as:

- Internally generated test TS.
- Carrier blanking.
- Single carrier generation.
- Controlled insertion of errored bits to emulate a given BER before or after the Viterbi decoder.

■ The **MO-170** includes other novel features as an option (**OP-970-E**):

- Addition of white Gaussian noise with selectable C/N.
- Simulation of fixed and mobile multipath channels with up to 6 taps of variable amplitude, delay, phase and Doppler frequency.

■ **DVB-H** is also possible as an option

These and other features present in the **MO-170** simplify the set-up of complex test systems and allows measurements over real conditions without having to spend a fortune.

Test Transport Stream

When out-of-service tests are required the **MO-170** can be used standalone, internally generating a test TS

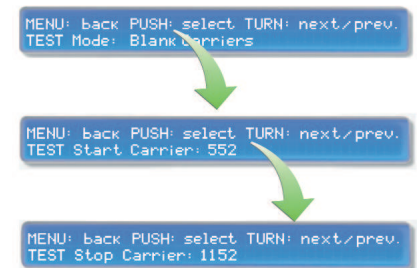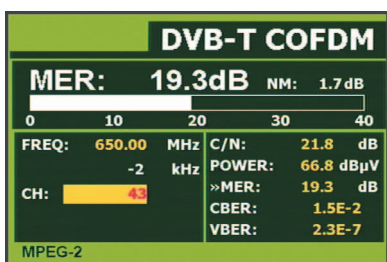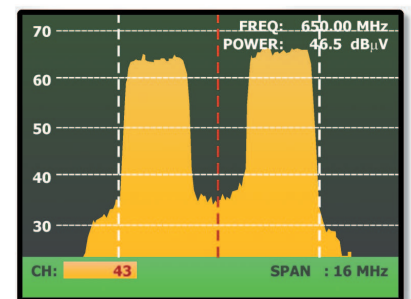*Sample of a test signal with PRBS payload data*

consisting of NULL packets filled up with PRBS payload data. If the tests do not involve displaying a picture on a monitor, no external transport stream input is needed. The MO-170 automatically synthesises the bit rate needed to operate the modulator depending on the DVB-T parameters in use.

In case a moving picture is required the **GV-998** can be used to supply a test pattern through the ASI or SPI input.

Signal level alignment and in-band noise measurements *(OP-170-E option)*

Blanking a set of contiguous carriers within the COFDM spectrum can help in measuring the levels of in-band noise (intermodulation products, Gaussian noise). The **MO-170** allows to vary the width of the spectrum hole as well as its location within the channel.

COFDM signal power is measured by taking the average of the power within the channel. To simplify the process of aligning signal levels across a transmission or reception chain, the **MO-170** can generate a single central carrier whose peak power is 3 dB above the average power of the DTT signal.

Spectrum hole unveilling the presence of intermoduation products within the channel

Getting your Bit Error Ratios right

A **unique feature** of the **MO-170** is the insertion of bit errors in different stages of the DVB-T modulation

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chain. This can help to check the accuracy of the BER estimation algorithms implemented in high-end professional receivers.

A Channel BER (CBER or BER before the Viterbi decoder) ranging between 7.6×10^{-6} and 1.25×10^{-1} is generated by modifying the sequence of bits at the input to the constellation mapper. Analogously, the **MO-170** is able to generate a Viterbi BER (VBER or BER after Viterbi) going from 3.7×10^{-9} to 6.2×10^{-2} by properly processing the bits at the output of the Reed-Solomon encoder. The main advantage of this technique when compared with varying the C/N to get the desired CBER or VBER, is its high resolution and unparalleled accuracy.
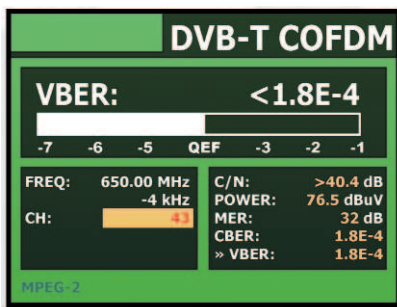
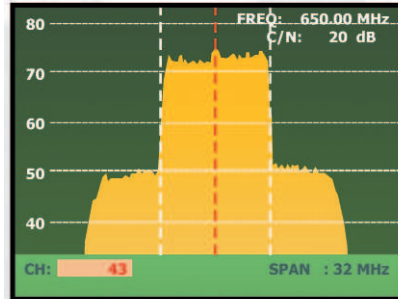*QEF VBER insertion in the MO-170 and BER measured by the TV EXPLORER*

Start making noise

(OP-170-E option)

A traditional set-up for measuring DVB-T performance versus C/N typically includes a source of wideband white Gaussian noise, an RF power meter plus selective channel filter or a spectrum analyser, and a varying number of high-precision variable attenuators and directional couplers. The C/N generation function available in the **MO-170** makes this kit no longer required and allows a much simpler configuration.

In the **MO-170**, white Gaussian noise

with twice the bandwidth of the DVB-T signal is digitally added to the

*QEF VBER insertion in the **MO-170** and BER measured by the **TV EXPLORER***

COFDM signal. C/Ns between 3 and 40 dB in steps of 0.1dB can be selected. In addition, the RF signal level (COFDM and noise combined) can be further attenuated from 0 to 60 dB in 1 dB steps. This provides the means to either keep the signal power constant whilst varying the C/N (e.g. to plot the BER vs. C/N of a demodulator), or to keep the C/N constant whilst varying the signal power (e.g. to find the sensitivity of a receiver).

The DVB-T signal may be switched off while the noise is still on, and vice versa. This way, noise and signal average powers can be measured externally using the appropriate equipment so as to verify the selected C/N reading. The fact that both noise and signal are digitally synthesised has the added benefit of generating C/Ns **with a precision that is difficult to achieve in a traditional assorted test set-up**.

Fixed/mobile multipath channels, SFN/MFN simulation and more *(OP-170-E option)*

COFDM was the modulation chosen for digital terrestrial TV broadcasting because of its superior performance in dynamic and static multipath channels.

A **novel feature** in the **MO-170** is the possibility of simulating channels with up to 5 echoes (plus the main path) of variable attenuation (0 to 40 dBc in 0.1 dB steps), delay (0 to 445 ms), phase (0º to 359.9º with resolution of 0.1º) and Doppler frequency (zero for fixed channels and ranging between -830 Hz and + 830 Hz in 0.1 Hz steps for mobile channels).
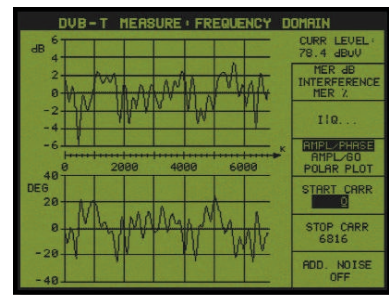
*Amplitude and phase of fixed Ricean channel F1 simulated with the **MO-170***

Among other applications, the channel simulator can be successfully used to simulate the following scenarios:

- Pre-echoes in a SFN or, in general, any power delay profile found in practice in single (MFN) & multiple transmitter (SFN) networks.

- Static channels corresponding to roof-top fixed and portable reception. In particular, good 6-ray approximations can be generated for the F1 and P1 channels defined in Appendix B of document ETSI EN 300 744. Other 6-path profiles are those defined in Appendix K.2 of document ETSI TR 101 290.

- Mobile channels with pure Doppler shift. An example of this is the 0 dB echo profile proposed in Appendix K.3 of document ETSI TR 101 290.

The channel simulator may be used in conjunction with the C/N generator to evaluate the performance of a DVB-T system for a pre-defined multipath channel as a function of the amount of additive noise present in the channel.