TV Test Receiver R&S EFA

Eye monitoring for continuous detection of digital TV signals

Rohde & Schwarz presents a new display for the analysis of digitally modulated signals (QAM and 8VSB) to go with the Test Receivers R&S EFA, making a valuable contribution to the evaluation and monitoring of advanced communication systems. This innovative method (patent pending) is based on the classic constellation diagram, expanded by the dimension time. It opens up completely new possibilities for judging quality and errors.

Starting point – the classic constellation diagram

Usually, digitally modulated signals are presented graphically in a constellation diagram, the most important display form for such signals to date. Examples of it are shown in [*]. But this kind of display still has distinct shortcomings. In particular, the constellation diagram lacks sufficient information about the nature of possible interference with time. Periodically occurring interference pulses cannot be detected for instance. Plus, the method shows only a small part of the actually present I/Q data, because it records and displays samples only within a narrow time window. Numerous samples are not detected at all, causing large time gaps (FIG 1).

Eye monitoring – time in the picture

Eye monitoring measures and stores the I/Q data of numerous consecutive constellation diagrams (FIG 2). The I component of each of these diagrams is shifted by 90° and then represented, together with the Q component, in vertical direction. The result is a one-dimensional display (I/Q projection) of the constellation diagram without information loss.

In a second step, the I/Q projections of the consecutive constellation diagrams are represented side by side. Time is thus added as a further dimension, allowing reliable detection of periodic interference for instance.

Continuous I/Q detection

The advanced hardware concept of the Test Receivers R&S EFA makes eye monitoring possible. A large number of detectors operating in parallel are used to permanently monitor the entire range of I/Q samples. When the receiver acquires a specific measured value, the corresponding detector stores the information. This configuration permits the continuous collection of measurement results. Interference with very short pulses of only 10 ns, for instance, is recorded even if just a single symbol is impaired in transmission.

Eye monitoring differs from the familiar eye diagram in its clear time assignment of the measured I/Q samples; redundant information is not displayed. Both dia-

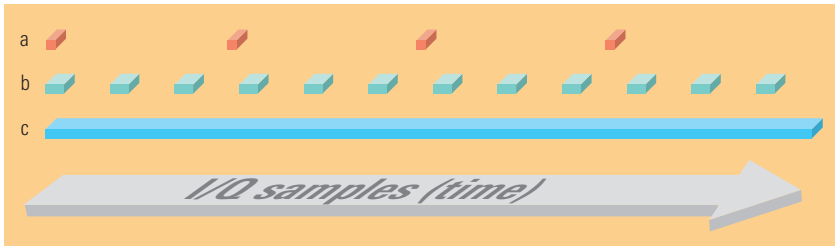

FIG 1
Means of displaying I/Q samples as a function of time: a) other producers (slow screen update with few I/Q samples); b) TV Test Receiver R&S EFA (constellation diagram); c) TV Test Receiver R&S EFA (eye monitoring) with continuous detection of samples

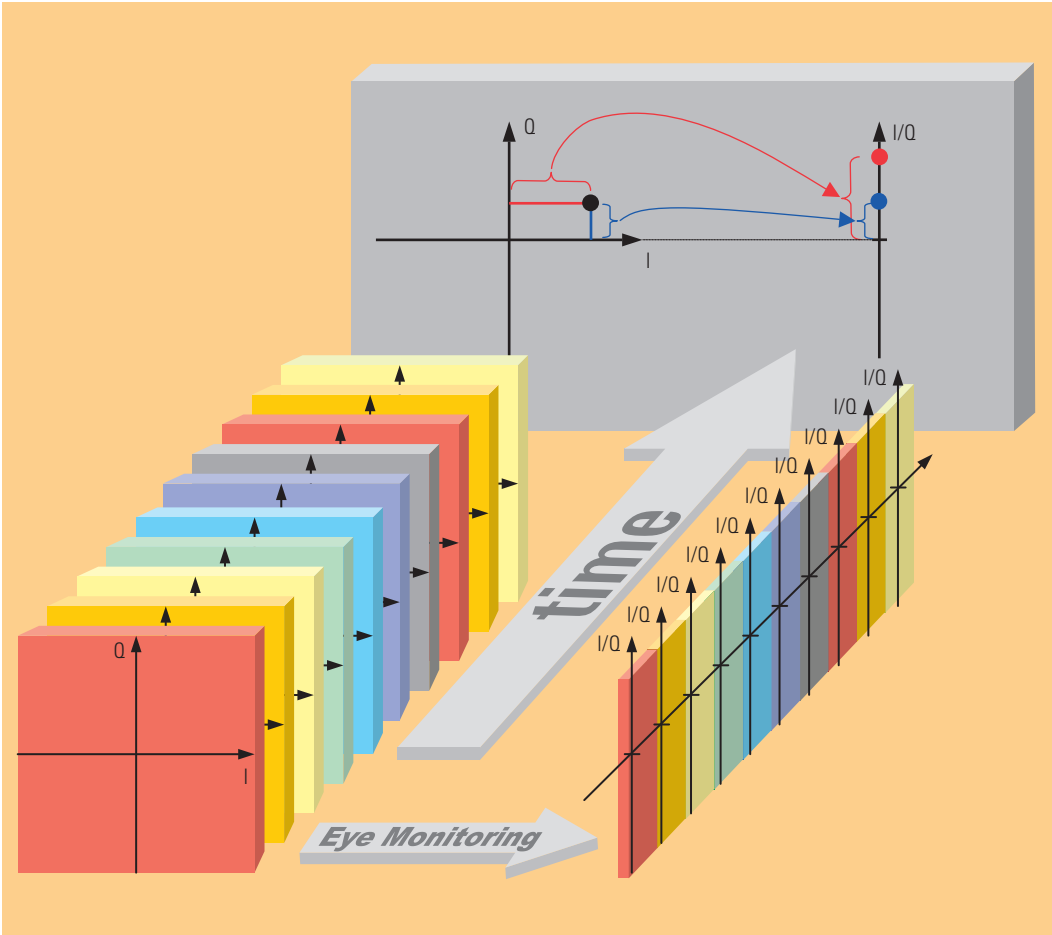

FIG 2
Eye monitoring: consecutive constellation diagrams are each reduced by one dimension (projection of I axis onto Q axis) and then graphically displayed as a function of time.

grams graphically display the eye height, but only eye monitoring permits continuous detection. It can consequently be interpreted as a follow-on development of the eye diagram.

Flexible result display

The required time window can be configured within wide limits. The user defines a time window (e.g. one hour), and measurement starts in the narrowest window (20 s). Once this has been monitored, the instrument automatically keeps switching to the next highest window (40 s, etc) until the total time required is displayed. The display then changes to scroll mode, where new samples are added at the right display edge and the oldest ones at the left edge are deleted. The entire specified time window is thus visible on the display with the current values at any time. A maximum of 1000 days can be displayed. Of course, this mode too ensures continuous collection of results.

Examples

In the new eye monitoring function, Rohde & Schwarz presents a method of monitoring and displaying measurement results that is unique worldwide. Two examples, recorded for 64QAM and 6.9 Msymb/s, illustrate this. The first shows a section of 20 s that was impaired by very short pulses (25 ns) from a pulse generator exactly every 2 s. The measurement (FIG 3) clearly indicates the regular interference; the red markers at the pulse times illustrate this. All occurring pulses are continuously detected and displayed.

The second example shows monitoring over a four-day interval (FIG 4). You can clearly recognize the periodicity of increasing and decreasing interference, depending on the time of day. This may be due to EMC problems (man-made noise) or differences in temperature, for instance.

Backed by forward-looking hardware

Eye monitoring shows up to advantage compared to other methods. Unlike bit error ratio measurement, a problem is perceived before limits are violated. And the short pulse interference is reliably detected whereas modulation error ratio measurement (MER) does not detect it because of the rare appearance of the pulses. What is more, short interference pulses would not significantly contribute to the effective MER value.

The new eye monitoring function is now included in models 50/53 (ATSC), 60/63 (DVB-C), 70/73 (J.83/B) and option EFA-B20 of the TV Test Receiver R&S EFA. Instruments already in use can be upgraded with a firmware update. This is possible because the advanced hardware concept of the receivers featured the field-programmable gate arrays needed to implement eye monitoring right from the start.

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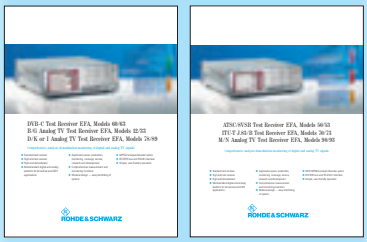
More information and data sheets at www.rohde-schwarz.com (search term: EFA)



Various data sheets on the R&S EFA family can be downloaded.

REFERENCES

[*] TV Test Receiver R&S EFA: Digital multistandard platform for the analysis of QAM-modulated signals. News from Rohde & Schwarz (2001) No. 172, pp 34–37

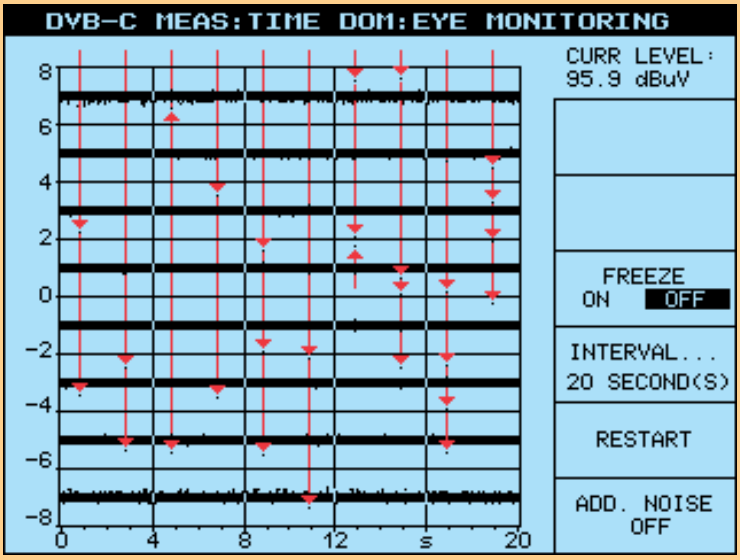


FIG 3 Eye monitoring with 20 s display time: pulses of 25 ns cause interference of the 64QAM signal every 2 s (red markers). The Test Receiver R&S EFA continuously monitors all pulses. At least two impaired test points (I and Q components) are visible for each pulse, depending on whether just one or two symbols were impaired.

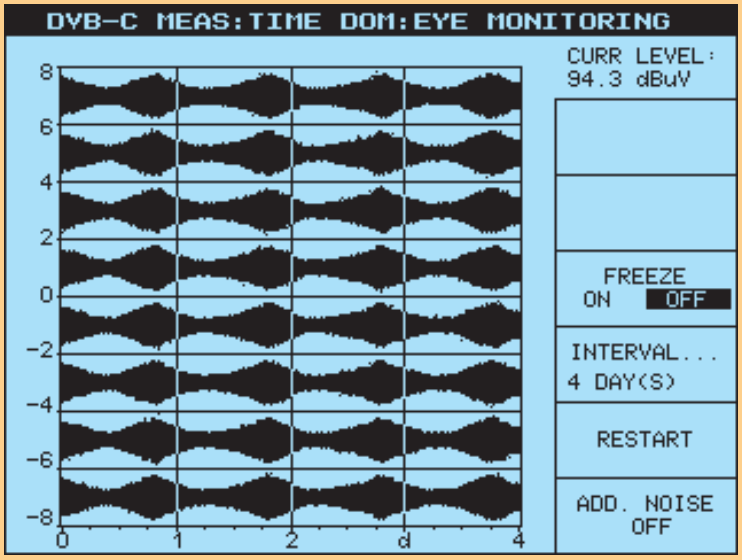


FIG 4 Eye monitoring over four-day interval: periodic interference of 64QAM signal