2.7.3 I/Q Imbalance

I/Q imbalance results from different amplification in the I and the Q path of the DVB-C modulator. This parameter is calculated by the following equation:

$$I/Q\ \text{IMBALANCE} = \left(\frac{v_2}{v_1} - 1\right)\cdot 100\%$$

where $v_1 = \min(v_I, v_Q)$ and $v_2 = \max(v_I, v_Q)$

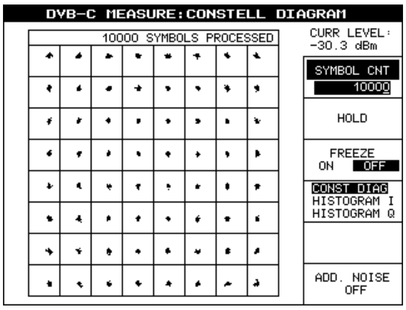


Fig. 2.27 64QAM constellation diagram with 10 % I/Q imbalance

A QAM signal with amplitude imbalance generates a constellation diagram with different spacing of the I/Q value pairs in the horizontal and the vertical direction: in the above example, the spacing is smaller in the horizontal direction. The I/Q value pairs are not located in the center of the decision fields.
Four points representing I/Q value pairs form a rectangle in each case.

2.8.4 I/Q Quadrature Error

If the I and the Q axis are not perpendicular to each other, an I/Q quadrature error is present. This parameter is calculated by the following equation (see also Fig. 2.24):

$$\varphi = \frac{180°}{p}\cdot\left|\overbrace{\arctan\left(\frac{v_Q}{v_I}\cdot\overline{a_Q}\right)}^{j_1} + \overbrace{\arctan\left(\frac{v_I}{v_Q}\cdot\overline{a_I}\right)}^{j_2}\right|$$

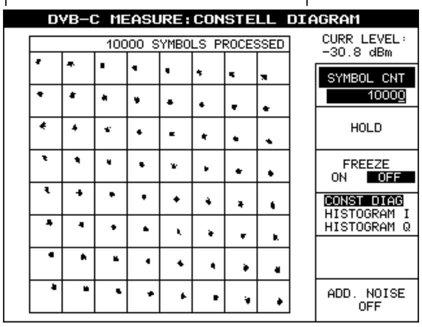


Fig. 2.28 64QAM constellation diagram with 8 ° I/Q quadrature error

A QAM signal with a phase error generates a constellation diagram in which the regression lines through the I/Q value pairs do not run parallel to the lines forming the decision thresholds. Four points representing I/Q value pairs form a rhombus in each case.

2.7.5 Carrier Suppression

DC voltage offset in the I and/or the Q path of the DVB-C modulator results in a residual carrier component. This parameter is calculated by the following equation (see also Fig. 2.24):

$$CS = -10\cdot \lg\left(\frac{P_{rc}}{P_{sig}}\right)$$

P_{rc} = power of residual carrier
P_{sig} = power of DVB-C signal

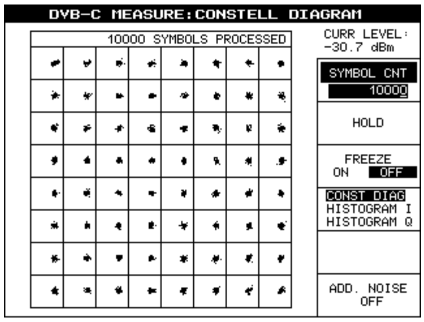


Fig. 2.29 64QAM constellation diagram with 24 dB carrier suppression

A QAM signal with insufficient carrier suppression generates a constellation diagram in which the I/Q value pairs are horizontally or vertically displaced (horizontally in the above example).
The I/Q value pairs are not located in the center of the decision fields. Four points representing I/Q value pairs form a square in each case.

2.7.6 Phase Jitter

In the presence of phase jitter, i.e. with unstable carrier phase, the constellation diagram does not stand still. It rotates back and forth about its center, depending on the jitter amplitude and spectrum.

This parameter is calculated by the following equation (see also Fig. 2.24):

$$PJ = \frac{180^\circ}{\pi} \cdot \arcsin\left(\frac{\sigma_{PJ}}{\sqrt{2}\cdot\left(\sqrt{M}-1\right)\cdot d}\right)$$

$$\sigma_{PJ} = \sqrt{\sigma^2_{PJ+N} - \sigma^2_{N}}$$

where M = 2^m
2d = width/height of decision fields
σ_{PJ} = standard deviation of symbol cloud examined, with noise component deducted

For the calculation, the symbol clouds in the four corners of the diagram are used because it is there where the maximum variation due to jitter occurs.

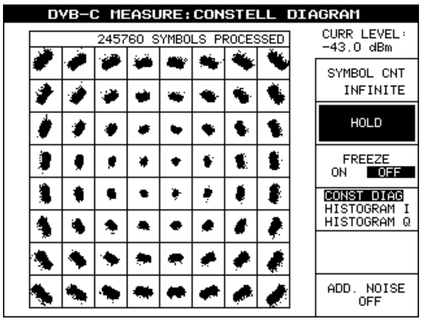


Fig. 2.30 64QAM constellation diagram with 2 ° phase jitter (rms)

A phase jitter of 2 ° (rms) results in a peak-to-peak jitter of 5.7 ° in the case of sinusoidal jitter.

A QAM signal with superimposed phase jitter generates a constellation diagram in which the I/Q value pairs appear as circular segments. The segments in the inner part of the diagram are shorter than those in the outer part; the jitter angle is constant. The center points of four segments form a square in each case.

2.7.7 Signal-To-Noise Ratio (SNR)

Noise is generated during any kind of signal processing or signal transmission and superimposed on the original signal. Noise is one of the key parameters in determining the quality of a signal or transmission path. The SNR is calculated from the distribution of the I/Q value pairs (symbols) within the decision fields. Only the four innermost decision fields of the constellation diagram are used in the calculation to minimize potential distortion of the SNR value by the influence of phase jitter.

In the case of the signal shown in Fig. 2.30, there is only minimal distortion of the SNR by phase jitter and other influences. If white noise is superimposed, which is normally the case during signal transmission, the I/Q value pairs have Gaussian (or normal) distribution.

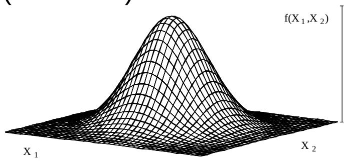


Fig. 2.31 Gaussian distribution of I/Q value pairs

For a DVB-C signal with 30 dB SNR, the following constellation diagram is obtained (with 50 000 symbols evaluated):

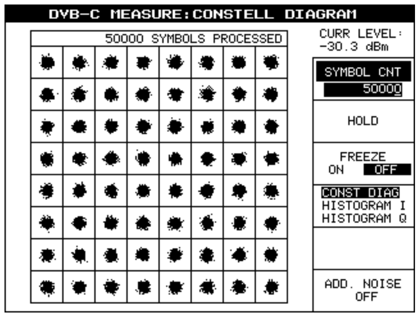


Fig. 2.32 64QAM constellation diagram for a signal with 30 dB SNR

A QAM signal with superimposed noise generates a constellation diagram with the I/Q value pairs in the form of symbol clouds. The center points of four clouds form a square in each case.

2.8 Modulation Error Ratio (MER)

The MER parameter encompasses all the parameters that can be determined by means of the constellation diagram. The MER is, therefore, the most important parameter to be monitored in a DVB system besides the BER. If the MER is within agreed tolerances, all other parameters are likewise within tolerances.

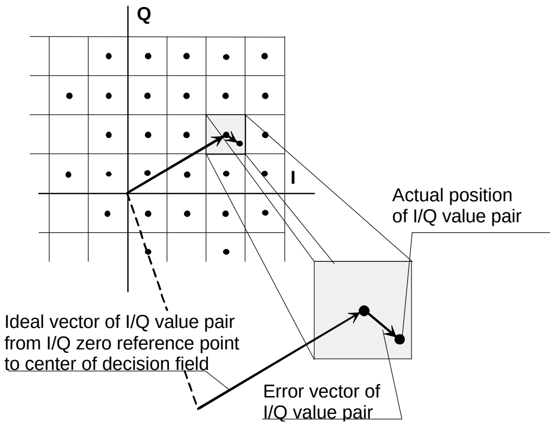


Fig. 2.33 Ideal vector and error vector used in calculating the MER sum parameter

To determine the MER, an error vector is calculated for each I/Q value pair. The length of this vector indicates the offset of the actual position of an I/Q value pair from the ideal position, i.e. the center of the decision field.
Of all error vectors calculated during one second, the sum of the squares is formed. The same is done with the ideal vectors of the decision fields. Then the ratio of the two sums is formed. This value is logarithmized, which yields the MER value in dB. The logarithmic ratio can also be expressed in percent.

The MER, which is defined by ETR290, is a parameter which provides very conclusive information and should therefore always be monitored. As to the MER, empirical data is available describing 64QAM system quality. The limit values stated in Table 2.8 can be used as guide values, although they mean no or only hardly perceptible signal degradation on the TV receiver:

MER Value		Quality	Remarks
% rms	dB		
MER < 1	MER > 40	Very good	Good modulator
1.5 < MER < 2.5	36.5 > MER > 32	Good	Value at output of cable headend
2.5 < MER < 4.0	32 > MER > 28	Normal operation	Servicing was carried out well
4.0 < MER < 5.0	28 > MER > 26	Satisfactory	Service staff should be ready to perform system check
MER > 5.0	MER < 26	Poor	Service staff should perform system check and correct errors immediately

Table 2.8 Limit values for 64QAM DVB-C

Example:
Only if the MER at the output of a cable headend (64QAM DVB-C) falls below 32 dB (2.5 % rms, see Table 2.8) is it necessary to measure the single parameters (see 2.7 "QAM Parameters") so that the cause of this condition can be determined.

2.9 Bit Error Ratio (BER) Measurement

DVB system margins can easily be determined by means of TV Test Transmitter SFQ. System margins will be indicated for each individual quality parameter by deteriorating them to a BER of $2*10^{-4}$, which is the critical limit for system failure. DVB Test Transmitter SFQ helps to find DVB system margins in the laboratory, test shop, in production, quality management and operation.

TV Test Transmitter SFQ for DVB-C, DVB-S, DVB-T, ATSC with 8VSB, and the American ITU-T Rec. J.83/B cable standard

If each DVB-C signal parameter is deteriorated to the point the 64QAM transmission system may fail (BER > $2*10^{-4}$), the following general limit values will be found:

Parameter	Value
I/Q imbalance	< 14.0 %
I/Q phase error	< 6.5 °
Carrier suppression	< 6.5 %
SNR	< 24 dB

Table 2.9 Limit values for 64QAM DVB-C

For a BER better than $1*10^{-3}$, QAM Test Receiver EFA can determine the quality parameters listed in Table 2.9, because up to this point an interpretable TS data stream is available due to forward error correction.
Experience has shown that good 64QAM modulators and converters, as used worldwide in DVB-C networks, should not exceed an MER of 1.0 % to 1.3 % rms. Plus, an MER significantly better, i.e. below, 1.5 % rms is not to be expected in public cable networks. The measurement menu below illustrates why this is so:

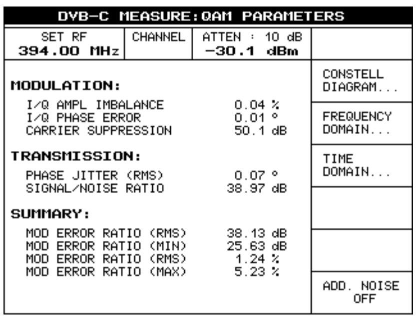


Fig. 2.34 Measurement menu for DVB-C

The good SNR of 38.97 dB alone means an MER of 1.13 % rms assuming that no other QAM parameters affect the MER. The remaining QAM parameters together, therefore, must not deteriorate the MER by more than 0.11 %. For a QAM test receiver this means:
the parameters are to be measured reliably and with very high accuracy. This is indispensable to determine the influence of the single parameters for a sum error as small as that.

The measurement method by which such a high accuracy is achieved is described in section 2.7 "QAM Parameters". The method relies, first, on a high number of symbols being processed per second and decision field and, second, on the phenomenon of noise (which is always present) and its statistical distribution, which allows the center points of the symbol clouds to be exactly determined.

2.10 Equivalent Noise Degradation (END) Measurement

The equivalent noise degradation (END) parameter denotes the deviation of the actual SNR from the theoretical SNR (SNR = 24 dB for 64QAM DVB-C, see Fig. 2.22) for a BER of $1*10^{-4}$.

Two measurements are required to determine the END to prevent that influences from the test equipment invalidate the results.

For the first measurement, the RF signal of a DVB-C modulator is applied to the RF input of TV Test Receiver EFA. EFA superimposes white noise on the signal by means of its internal noise generator, and measures the BER.

Example:
The BER of $1*10^{-4}$ is reached at C/N_1 = 24.8 dB (displayed in the ADD. NOISE field in the menu below). The theoretical SNR for the BER of $1*10^{-4}$ is 24.4 dB. The SNR is converted to C/N as follows:

C/N = SNR + 0.166 = 24.966 dB. The difference of roughly 0.57 dB constitutes the END of the measurement system, in this case consisting of TV Test Transmitter SFQ and TV Test Receiver EFA. Assuming that this value is equally distributed among the two instruments, each unit has an END of only 0.285 dB, which is a very good figure.

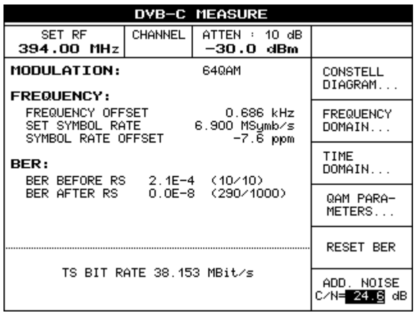


Fig. 2.35 ADD. NOISE on EFA

Note:
The theoretical curves shown in Fig. 2.22 present the BER as a function of the SNR. The following relationship exists for the S/N and the C/N ratio for DVB-C with a roll-off factor of r = 15 %:
$S/N = C/N + k_{roll\text{-}off} = C/N - 0.166$ dB.
With EFA models 20 and 23, the C/N ratio is still referred to the channel bandwidth (e.g. 8 MHz), which is determined by the internal SAW filter. With models 60 and 63, by contrast, the C/N ratio is referred to the symbol rate, i.e. the measurement is independent of the channel bandwidth.

For the second measurement, the RF signal of the DVB-C modulator is applied to the RF input of the device under test (DUT). As in the above measurement, EFA superimposes white noise on the RF signal and measures the BER. The BER of $1*10^{-4}$ is now attained at C/N_2 = 25.2 dB (displayed in the ADD. NOISE field).
The END of the device under test is calculated as follows:
END = C/N_2 – C/N_1 = 25.2 dB – 24.8 dB = 0.4 dB

As the END measurement is a differential measurement, measurement accuracy solely depends on the accuracy of the EFA's attenuator, which is in any case adequate for this purpose.

2.11 DVB-C Spectrum

2.11.1 Amplitude and Phase Spectrum

The european standard EN 300 429 defines in Annex A (preliminarily) the spectrum with amplitude and group delay.

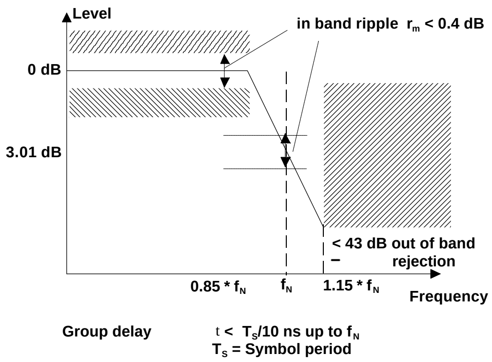


Fig. 2.36 DVB-C spectrum

During transmission of the DVB-C signal, the spectrum is distorted in amplitude and phase as a function of frequency. This is corrected by TV Test Receiver EFA by means of a complex channel correction filter. The result is a spectrum with optimal, flat amplitude and phase frequency response. The filter coefficients represent the inverse channel transfer function, which is then converted to the amplitude and phase frequency response. The spectrum thus calculated is displayed.
From the phase frequency response, the group delay frequency response can be determined by way of differentiation. The amplitude and phase response information can be used to generate a polar plot.

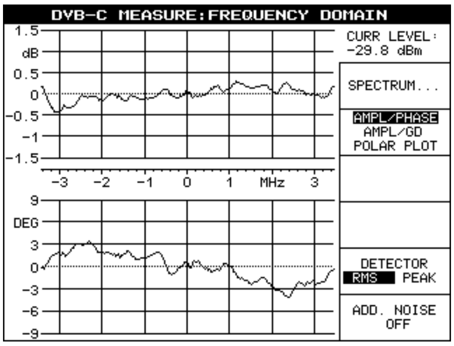


Fig. 2.37 Amplitude and phase frequency response with DVB-C

TV Test Receiver EFA model 60/63 in this way also monitors the effects of the transmission medium on the DVB-C signal.

2.11.2 Spectrum and Shoulder Distance

Calculating channel frequency response by means of a fast Fourier transform (FFT) yields a much higher resolution of level errors than is obtained by evaluation based on the coefficients of a complex channel correction filter as described above. While the FFT method does not offer the high measurement accuracy of a spectrum analyzer, it is sufficiently accurate for evaluating the Tx spectrum of a channel and to determine the out-of-band components.

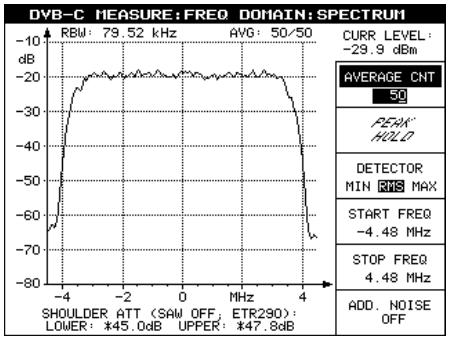


Fig. 2.38 Amplitude frequency response with DVB-C, calculated with an FFT

Maximum level resolution is obtained if only the useful range of the spectrum is analyzed (in this example from -3.45 MHz to +3.45 MHz with a symbol rate of 6.9 Msymb/s). Level resolution is automatically selected as a function of frequency response to a minimum value of 2 dB/div.

To determine the shoulder distance in compliance with ETR290, the largest possible frequency range, i.e. -4.48 MHz to +4.48 MHz, is to be selected. The peak level of the out-of-band components each above and below the useful spectrum is to be measured. The smaller of the two values is the valid shoulder distance.

2.12 Echoes in Cable Channel

Any echoes caused by mismatch in the cable channel can likewise be calculated by means of the coefficients of the channel correction filter. For example, there may be mismatch in the cable system distributing the DVB-C signal to the apartments of a building. Any junction boxes that were manipulated can in this way be accurately identified and located. Points of mismatch are located by means of the echo delay information in µs, or the distance in electrical length in km or miles.

In the example shown in Fig. 2.38, the main pulse is at 0 µs, and the echo follows with an attenuation of 21.0 dB and a lag of 0.29 µs.

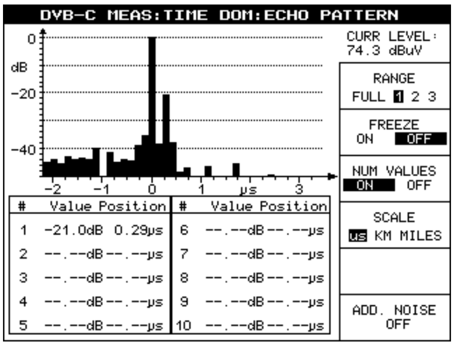


Fig. 2.39 Echo diagram

From the echo delay, the distance from the point of discontinuity causing the reflection is calculated. In the above example, the result is 87 m. The EFA measurement accuracy allows the distance to be displayed with 10 m resolution. For this reason, a distance of 90 m is displayed after switchover to the "KM" scale.

This measurement accuracy is sufficient to locate impedance discontinuity in large cable systems in buildings as described above.

2.13 Crest Factor of DVB-C Signal

DVB-C signals have a structure similar to that of white noise. An important parameter for describing DVB-C signals is, therefore, the crest factor, which is defined as the quotient of the peak voltage value and the root-mean-square (rms) voltage value. In the example below, a maximum crest factor of 11.1 dB was measured with TV Test Receiver EFA. The crest factor is displayed using the complementary cumulative distribution function (CCDF). It can be seen that the amplitude distribution follows exactly the theoretical function (vertical lines plotted at intervals of 1 dB). From this it can be deduced that there are no limiting effects in the DVB-C system under test.

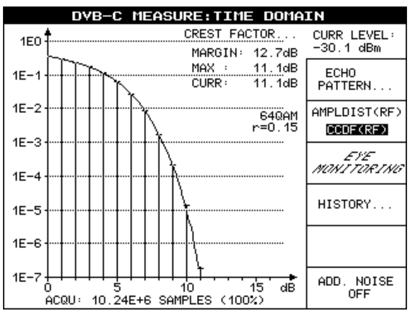


Fig. 2.40 Crest factor of a DVB-C signal

Any limitations of the DVB-C signal would mean that information is missing, with the consequence of increasing BER. Correct level adjustment, therefore, helps to avoid an unnecessary reduction of the system's safety margin.

2.14 Alarm Report

Measurement results are not only displayed on site at the cable headend, but can also queried from a control center via a remote interface. System monitoring is very easy using TV Test Receiver EFA model 60/63.

The network operator first chooses the parameters to be monitored. Fig. 2.40 shows a configuration in which all parameters are included in monitoring.

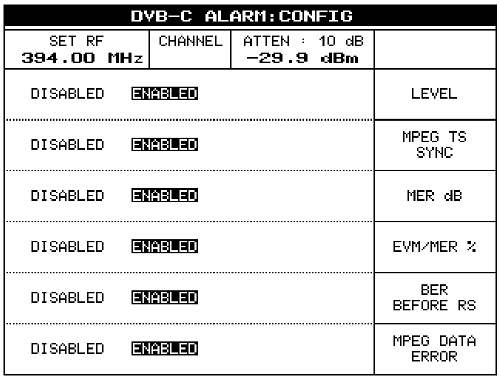


Fig. 2.41 Alarm configuration menu:
all possible parameters are monitored

Table 2.10 lists the parameters (with short forms) selectable in the ALARM:CONFIG menu:

Parameter	Explanation	
LEVEL	Input level below threshold	LV
SYNC	Indicates synchronization of DVB-C symbols and MPEG2 transport stream packets	SY
MER	MER below threshold	ME
EVM	EVM below threshold (alternatively MER)	EV
BER	BER below threshold	BR
MPEG DATA ERROR	Data errors not correctable by Reed-Solomon forward error correction	DE

Table 2.10 Alarm parameters

After selecting the alarm parameters, the alarm thresholds have to be set. Thresholds can be set for LV, ME, EV and BR (see Table 2.10). Non-correctable data and synchronization failure are absolute events and are not assigned a threshold.

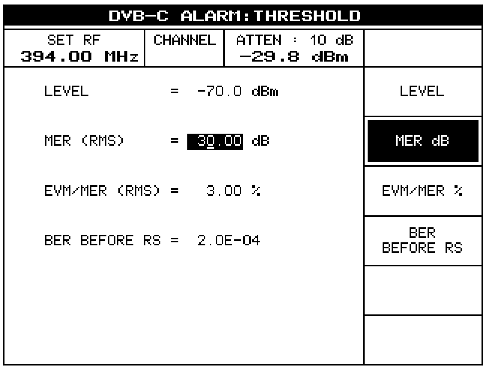


Fig. 2.42 Setting alarm thresholds

The MER can be expressed in dB or, alternatively, as error vector magnitude (EVM) in %. For this reason, there are two alarm parameters for MER, which may be regarded as the inner and outer tolerance. For EVM, by contrast, there exists only one alarm parameter as it can be expressed in % only.

Activated alarms are brought out both as single alarms and as a sum alarm at connector X34 (USER PORT) on the rear of EFA. In the event of a sum alarm, the single alarms are queried via the remote control interface.

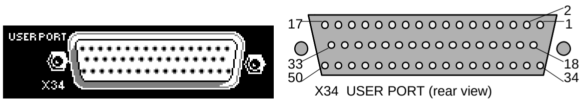


Fig. 2.43 Connector X34 USER PORT

X34 Pin No.	Alarm designation (EFA 60/63)	Alarm designation (EFA 20/23)
1	Sum alarm	Sum alarm
2	Level alarm	Level alarm
3	Sync alarm	Sync alarm
4	MER alarm	BER alarm
5	EVM alarm	Data error
6	BER alarm	
7	Data error	
40 to 48	Ground	Ground
49, 50	+5 V (200 mA)	+5 V (200 mA)

Table 2.11 Pin assignment of connector X34 in DVB-C mode for EFA models 60/63 and 20/23

Professional monitoring calls for error reports. EFA not only records the key parameters LV (input level below threshold) and SY (loss of synchronization), but also the MER (ME, and additionally EVM (error vector magnitude, EV), the BER (BE), and non-correctable data errors (DE), the latter indicating the safety margin of a DVB-C system. All errors are recorded with date and time.

On pressing the ALARM hardkey on the EFA front panel, the alarm list is displayed. The list may comprise up to 1000 lines in which each event is entered with its number, date and time and the parameter triggering the alarm. The time indicated is when a parameter first went out of tolerance or returned to tolerance.

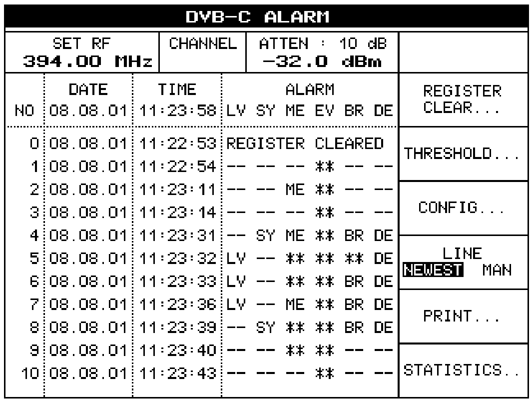


Fig. 2.44 Alarm list

The double asterisk ("✳✳") means that the parameter is cleared from the monitoring list. The time and date of clearance is indicated the first time the sign is displayed for a given parameter.

If more than 1000 events occur during a monitoring period, the initial events are cleared and the current events added at the end of the list.
It may sometimes be necessary, for statistical purposes, to know the duration of the individual errors and the percentage they take up in overall monitoring time. This information is given under STATISTICS.

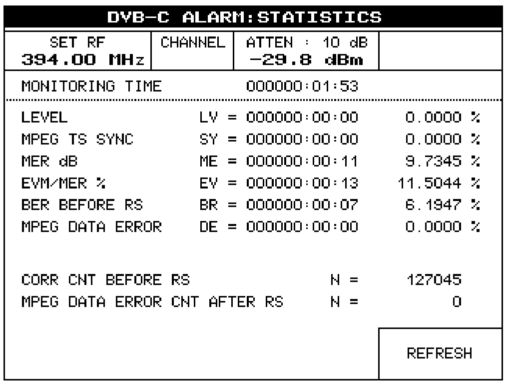


Fig. 2.45 Statistical evaluation of error periods

If errors occur more and more frequently in the alarm report, this indicates instability, and possibly even imminent failure, of the DVB-C system.

Operators of digital cable networks know:

If the picture on a TV receiver already shows visible degradation, transmission reliability in a DVB-C system has fallen far below acceptable limits. As in any digital system, the transition from reliable operation to total failure is a very abrupt one because of forward error correction. TV Test Receiver EFA, therefore, warns the operator early and reliably of an imminent failure of a DVB-C system.

2.15 Options for TV Test Receiver (QAM Demodulator) EFA Model 60/63

2.15.1 RF Preselection EFA-B3 (EFA Model 63)

The DVB-C system does not provide for guard channels. All available channels come one after the other without any guard interval in between. To measure and monitor individual channels of a cable system, the channel of interest has to be selected.
The RF Preselection option EFA-B3 allows channel selection between 5 MHz and 862 MHz and, in addition, enhances input sensitivity of the EFA front end.
The lower frequency limit of 5 MHz makes TV Test Receiver EFA with option EFA-B3 capable of back-channel communication.
The minimum input level is reduced to -67 dBm to -70 dBm in the VHF and the UHF ranges as a function of the RF attenuator setting (Low Noise, Low Distortion, High Adjacent Channel Power).
The RF Preselection option turns EFA model 63 into a selective test receiver of very high quality capable of demodulation despite low input levels.

2.15.2 Measurements with MPEG2 Decoder EFA-B4

The MPEG2 Decoder option EFA-B4 covers only part of the functionality of MPEG2 Measurement Decoder DVMD and MPEG2 Realtime Monitor DVRM. The EFA measurement functions are optimized for monitoring the demodulated transport stream at the cable headend.

If TV Test Receiver EFA 60/63 is fitted with option EFA-B4 to analyze the MPEG2 protocol and the RF characteristics during DVB-C transmission, it alone will suffice to make the necessary measurements.

First, the time limits for the repetition rates of the tables and time stamps in the transport stream have to be set. The limits can be user-defined or selected in conformance with standards

ISO/IEC 13 818-1 for MPEG2
or
ETR290 for DVB

for the parameters defined there.

Parameter name	To DVB MIN	To DVB MAX	To MPEG MIN	To MPEG MAX
PAT distance	25 ms	0.5 s	25 ms	0.5 s
CAT distance	25 ms	0.5 s	25 ms	0.5 s
PMT distance	25 ms	0.5 s	25 ms	0.5 s
NIT distance	25 ms	10 s	---	---
SDT distance	25 ms	2 s	---	---
BAT distance	25 ms	10 s	---	---
EIT distance	25 ms	2 s	---	---
RST distance	25 ms	---	---	---
TDT distance	25 ms	30 s	---	---
TOT distance	25 ms	30 s	---	---
PCR distance	0 ms	0.04 s	0 ms	0.1 s
PCR discontinuity	---	0.1 s	---	---
PTS distance	---	0.7 s	---	---
PID distance	---	0.5 s	---	---
PID unref. Duration	---	0.5 s	---	---

Table 2.11 Limit values for parameters to DVB and MPEG2

In DVB all parameters are predefined, in MPEG2 only a few. Parameters not defined by the standard must be user-defined. The largest discrepancy between DVB and MPEG2 is in PCR distance with 40 ms for DVB and 100 ms for MPEG2.

Fig. 2.45 shows the menu for setting the limit values on TV Test Receiver EFA fitted with MPEG2 Decoder option EFA-B4. The DEFAULT softkey activates the predefined MPEG2 or DVB values. To ensure reproducible and comparable results, it is recommended to select the DVB limit values.

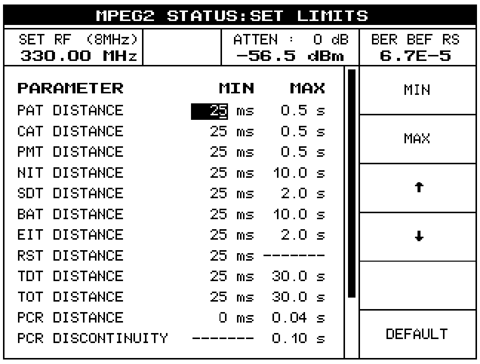


Fig. 2.46 Repetition rates for tables and time stamps

After defining the time limits, the parameters to be monitored for the MPEG2 alarm report have to be enabled. All parameters of the three priorities as defined by ETR290 can be enabled.

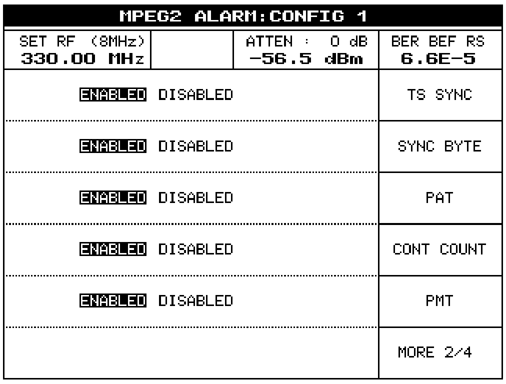


Fig. 2.47 First page of MPEG2 alarm menu

On pressing the ALARM key, the MPEG2 ALARM menu appears. In this menu, all results exceeding tolerances during the monitoring period are displayed. For disabled parameters, "--" is indicated in brackets.

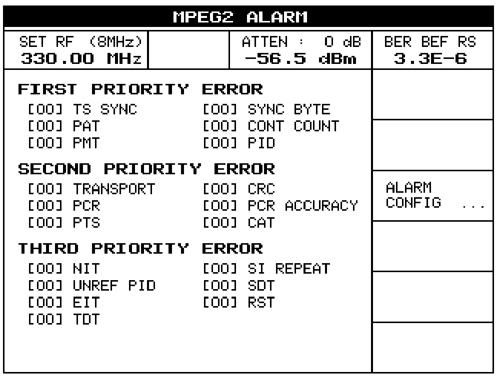


Fig. 2.48 MPEG2 ALARM menu

In the MEASURE menu, the parameters are evaluated in line with ETR290 irrespective of the settings made in the ALARM menu. An error counter can be started, stopped or cleared in this menu.

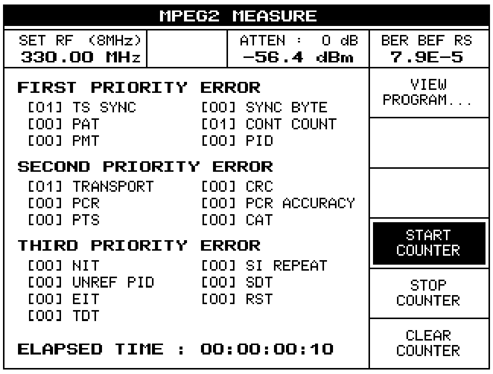


Fig. 2.49 MPEG2 MEASURE menu

Name	Output (pin No.)
Sum alarm	1
First priority alarm (sum)	2
Second priority alarm (sum)	3
Third priority alarm (sum)	4
Ground	40 to 48
+5 V (200 mA)	49, 50

Table 2.12 Pin assignment of connector X34 (alarm lines) for MPEG2 mode

Connector X34 of TV Test Receiver EFA is assigned alarm lines both for the DVB-C mode and the MPEG2 mode. Table 2.12 shows the pin assignment for the MPEG2 mode.

The VIEW PROGRAM COMP... softkey opens the PAT of the received transport stream listing the programs transmitted. The data rates of the overall transport stream, the individual programs, the tables and the null packets of the transport stream are displayed as well

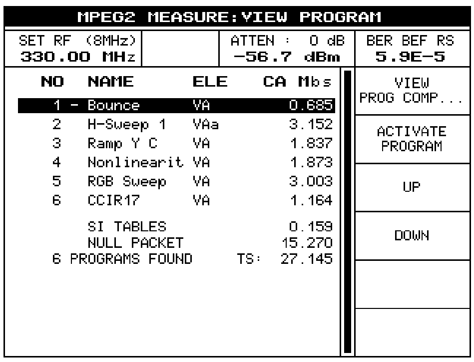


Fig. 2.50 PAT of a transport stream with key parameters

ACTIVATE PROGRAM opens the PMT (program map table) of the selected program with information on the number of video, audio, data and "other" data streams of the program including associated PID (packet identifier) numbers. The PID numbers of the PMT and the PCR (program clock reference) are listed too.

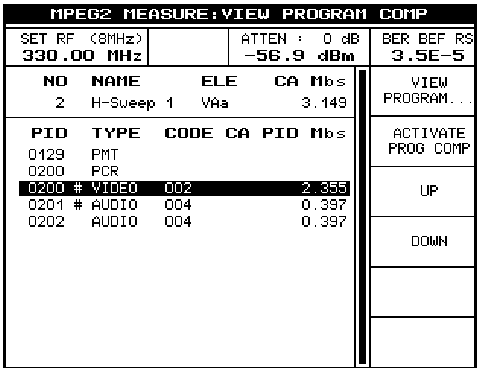


Fig. 2.51 PMT of a program with key parameters

TV Test Receiver EFA model 60/63 with MPEG2 Decoder option EFA-B4 offers functionality optimized for MPEG2 monitoring at the output of a cable headend. The outputs for analog CCVS video and analog audio allow aural and visual monitoring of the programs fed into the cable network.

2.15.3 SAW Filters
2 MHz EFA-B14, 6 MHz EFA-B11
7 MHz EFA-B12, 8 MHz EFA-B13

The DVB-C standard does not define the channel bandwidth, so the complete VHF and UHF range is available for signal transmission.
The preferred channel bandwidths are 6 MHz, 7 MHz and 8 MHz, i.e. those defined for the analog standards. For back-channel communication in interactive television, 2 MHz are commonly used. To ensure that each operator has the bandwidth configuration matching his application, the SAW filters for TV Test Receiver EFA are available as options. The desired filter should, therefore, always be specified when placing an order.
One SAW filter must always be fitted. Two more SAW filters can be installed optionally.

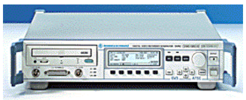
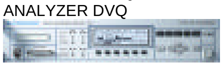
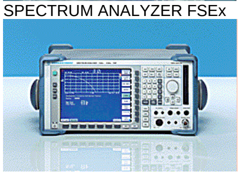
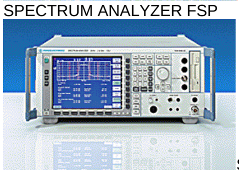
2 MHz Filter EFA-B14
Expands the EFA functionality to include a DVB-C back channel as defined by EN 300 800 Summary (Upstream) Table 7. The option supports 2 MHz channel bandwidth. Various symbol rates are possible.

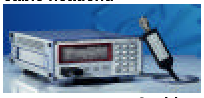
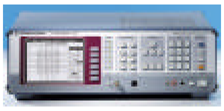
6 MHz Filter EFA-B11, 7 MHz Filter EFA-B12, 8 MHz Filter EFA-B13

One of these filters can be inserted in the third SAW slot. The 6 MHz filter supports the channel bandwidths defined by Standard M, the 7 MHz filter either VHF channels or the UHF channel bandwidths used in Australia. The 8 MHz SAW filter is the filter most frequently used in DVB-C.

The filter(s) fitted are displayed in the status menu.

2.16 Overview of DVB-C Measurements

Instrument, Test Point	Test Parameter
At input of cable headend **TS source for production** MPEG2 MEASUREMENT GENERATOR DVG 	Test signal generator for reproducible MPEG2 measurements, various test sequences
DTV RECORDER GENERATOR DVRG 	Test signal generator for reproducible MPEG2 measurements, various test sequences; recording of user-defined transport streams, recording of error events
MPEG2 MEASUREMENT DECODER DVMD 	Realtime MPEG2 transport stream protocol analysis
MPEG2 REALTIME MONITOR DVRM 	Realtime MPEG2 transport stream protocol monitoring
DIGITAL VIDEO QUALITY ANALYZER DVQ 	Measurement of signal quality after MPEG2 coding and decoding
At test transmitter/ **cable headend** **Analyzers for production**  SPECTRUM ANALYZER FSEx  SPECTRUM ANALYZER FSP  S SPECTRUM ANALYZER FSU	LO harmonics DVB-C spectrum Shoulder distance Roll-off factor Crest factor Output power

Instrument, Test Point	Test Parameter
At test transmitter/ **cable headend**  **Power Meter NRVS with** **Thermal Power Sensor NRV-Z51**	High-precision thermal measurement of output power
Monitoring receiver **at cable headend** **Test receiver in production**  EFA Models 60/63 DVB-C TEST RECEIVER with option EFA-B4	**Basic unit** Order of QAM Symbol rate DVB-C amplitude and phase spectrum Output power END, BER, MER Frequency offset Echo diagram Constellation diagram I/Q parameters in QAM Alarm report **Option EFA-B4** Measurements to ETR290: parameters of the three priorities Alarm report PAT and PMT
Simulation of **DVB-C cable headend**  TV TEST TRANSMITTER SFQ Options NOISE GENERATOR FADING SIMULATOR	C/N setting for END measurement Simulation of defined receive conditions and impedance discontinuities Simulation of transmitter defects
DVB-C test transmitter for production  SFL-C TV TEST TRANSMITTER	Test transmitter for production Simulation of transmitter defects for testing set-top boxes in production