5.8.5 Carrier Suppression

DC voltage offset in the I and/or the Q path of the ITU-T J.83/B modulator results in a residual carrier component. This parameter is calculated by the following equation:

$CS = -10 * \lg (P_{rc} / P_{sig})$

P_{rc} = power of residual carrier
P_{sig} = power of ITU-T J.83/B signal

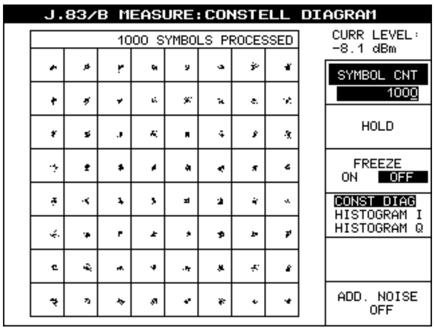

Fig. 5.43 64QAM constellation diagram with 24 dB carrier suppression

A QAM signal with insufficient carrier suppression generates a constellation diagram in which the I/Q value pairs are horizontally or vertically displaced (horizontally and to the right in the above example).
The four corner points of the diagram form a square whose center point is shifted relative to the center point of the diagram.

5.8.6 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:

$$PJ = \frac{180°}{p} \cdot \arcsin\left(\frac{s_{PJ}}{\sqrt{2}\cdot\left(\sqrt{M}-1\right)\cdot d}\right)$$

$$s_{PJ} = \sqrt{s^2_{PJ+N} - s^2_N}$$

where $M = 2^m$
$2d$ = width/height of each decision field
σ_{PJ} = standard deviation of symbol cloud, with noise component excluded

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.

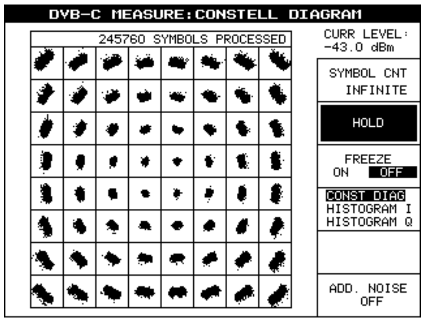

Fig. 5.44 64QAM constellation diagram with 2 ° phase jitter (rms)

A phase jitter of 2 ° (rms) means 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 the four corner segments form a square.

5.8.7 Phase and Amplitude Jitter Spectra

In addition to measuring phase jitter in the time domain, it is now also possible to measure the phase jitter and amplitude jitter spectra using TV Test Receiver R&S EFA model 70 or 73 with firmware version 5.10 or higher. The frequency range is from 1 kHz to 1 MHz.

The jitter spectrum is obtained by comparing the actual positions of a sequence of Rx I/Q data with the ideal positions (in the center of the decision fields). Depending on the measurement selected, the amplitude or phase jitter component is analyzed from the difference between the ideal position and the actual position of the symbols received:

- PHASE JITTER: In this measurement, the ratio of the amplitude of the received I/Q value to the amplitude of the ideal position is assumed to be 1 in each case (the symbols of the decision fields are located on circular segments about the center point of the constellation diagram). The phase jitter is determined by the sequence of phase errors φ(t). This measurement can be used to monitor the phase stability quality of the oscillators used to generate the QAM signal.

- AMPL JITTER: In this measurement, the error in the tangential direction φ(t) is assumed to be zero (the symbols of the decision fields are located on beams originating from the center point of the constellation diagram). The amplitude jitter is determined by the ratio of the amplitude of the received I/Q value to the amplitude of the ideal position in each case. The chronological sequence of amplitude ratios A(t) is processed further. This measurement is useful for checking amplifier control loops in the transmission path.

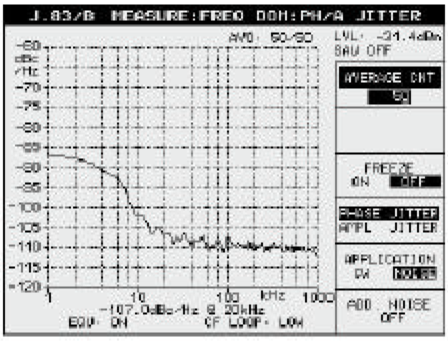

Fig. 5.45 Typical phase jitter spectrum

Depending on whether a noise-like spectrum or a spectrum with discrete interferences is expected, the measurement is performed in the NOISE or CW (continuous wave) mode that can be selected with the APPLICATION softkey.
In the NOISE mode, the frequency characteristic of the phase or amplitude jitter is displayed in dBc/Hz referenced to a bandwidth of 1 Hz. In the CW mode, the result is displayed in dBc, and the reference bandwidth is equal to the resolution bandwidth (RBW, indicated in the upper left of the diagram).
In the example of Fig. 5.46, the RBW is 4.77 kHz.

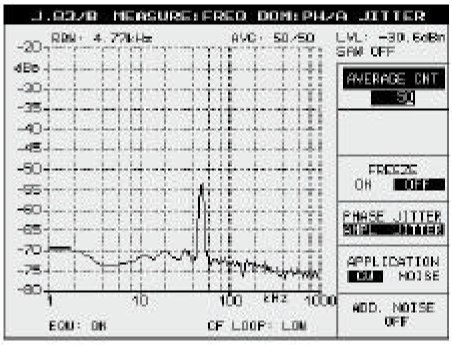

Fig. 5.46 Amplitude jitter spectrum with discrete interferer at about 50 kHz

The TV Test Receivers R&S EFA measure the phase jitter and amplitude jitter spectra in accordance with the ITU-T J.83/A, B and C standards and the DVB-C and ATSC 8VSB standards, thus making it possible to analyze and monitor the quality of the various mixer oscillators and amplifier loops of a transmitter. Jitter analysis can easily be performed during normal operation without switching off the carrier modulation.

Note:
While the phase jitter or amplitude jitter spectrum is being displayed, MER and EVM (ALARM, HISTORY, IEC 625/IEEE 488 bus) cannot be calculated in the background for technical reasons.

5.8.8 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. To minimize potential distortion of the SNR value by the influence of phase jitter, only the four innermost decision fields of the constellation diagram are used in the calculation.

In the case of the signal shown in Fig. 5.44, there is only minimal distortion of the SNR by phase jitter and other influences. If white noise is superimposed, which is normally the case in signal transmission, the I/Q value pairs have Gaussian (or normal) distribution.

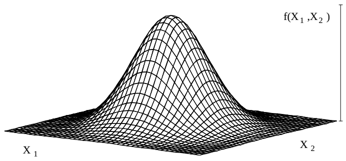

Fig. 5.47 Gaussian distribution of the I/Q value pairs

For an ITU-T J.83/B signal with 30 dB SNR, the following constellation diagram is obtained, with 100 000 symbols evaluated:

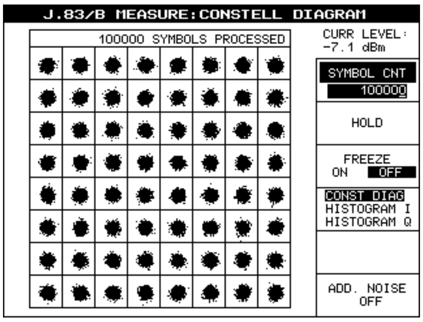

Fig. 5.48 64QAM constellation diagram for a signal with 30 dB SNR

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

5.9 Modulation Error Ratio (MER), Error Vector Magnitude (EVM)

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

To determine the MER/EVM, 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.

To determine the MER, the sum of the squares of all error vectors calculated during one second 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.

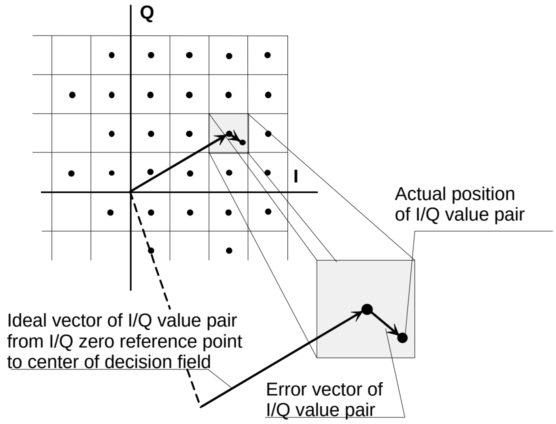

Fig. 5.49 Ideal vector and error vector used in calculating the EVM and MER sum parameters

To determine the EVM, the sum of the squares of all error vectors calculated during one second is formed. Then the ratio of this sum and the square of the longest ideal I/Q vector is determined. This ratio is converted to yield the EVM value in percent.

MER/EVM ratio conversion is performed as follows:

$$EVM_V = \frac{1}{MER_V * V}$$

where V is dependent on the QAM format, see table below.

QAM format	V (= ratio of peak voltage to rms voltage)
16	1.3416
64	1.5275

5.10 Bit Error Ratio (BER) Measurement

ITU-T J.83/B system margins can easily be determined by means of TV Test Transmitter R&S SFQ. System margins will be indicated for each individual quality parameter by deteriorating the parameters to a BER of $7*10^{-5}$ before RS FEC, which is the critical limit for system failure (this value is based on measurements, not derived by way of calculation, criterion is BER → QEF after RS with interleaver 128/1). The TV Test Transmitter R&S SFQ helps to find ITU-T J.83/B system margins in the laboratory, test shop, in production, quality management and during operation.

TV Test Transmitter R&S SFQ for ITU-T J.83/B cable standard and for DVB-C, DVB-S, DVB-T and ATSC 8VSB standards

If each ITU-T J.83/B signal parameter is deteriorated to the point the 64QAM transmission system may fail (BER > $7*10^{-5}$ before RS FEC), the following limit values will be found:

Parameter	Value
I/Q imbalance	< 18.5 %
I/Q phase error	< 9.5 °
Carrier suppression	< 13.0 %
SNR	< 22 dB

Table 5.8 Limit values for 64QAM ITU-T J.83/B

Here, too, the effect of trellis coding makes itself felt, allowing considerably poorer values for the individual signal parameters compared with DVB-C. For a BER better than $7*10^{-5}$ before RS FEC, the QAM Test Receiver R&S EFA measures the quality parameters listed in Table 5.8 because, up to this point, concatenated forward error correction supplies an interpretable TS data stream. Experience has shown that good 64QAM modulators and converters, as used in ITU-T J.83/B networks, should not exceed an MER of 0.9 % 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:

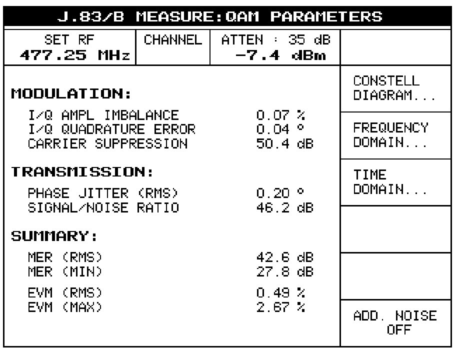

Fig. 5.50 Measurement menu for ITU-T J.83/B

The very positive S/N ratio of 46.2 dB alone means an MER of 0.49 % rms, assuming that no other QAM parameter affects the MER. This means that, in order to reach an MER of 42.6 dB rms (corresponding to 0.74 % rms), the remaining QAM parameters together must not deteriorate the MER by more than 0.25 %. 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 *5.8 "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.

5.11 Equivalent Noise Degradation (END) Measurement

The equivalent noise degradation (END) denotes the deviation of the actual SNR from the empirically determined SNR for a BER of $7*10^{-5}$ (SNR = 22 dB for 64QAM, criterion is BER → QEF after RS with interleaver 128/1).
To prevent influences from the test equipment invalidating results, two measurements are required to determine the END.

For the first measurement, the RF signal of an ITU-T J.83/B modulator is applied to the RF input of TV Test Receiver R&S EFA model 70 or 73. The R&S EFA superimposes white noise on the signal by means of its internal noise generator and measures the BER.
This measurement can also be performed using the test setup described under *5.7 "BER Measurement with R&S SFQ and R&S SFQ-B17 or R&S SFL-J and R&S SFL-K17"*, the noise being superimposed in this case by the noise generator option of the respective test transmitter, i.e. R&S SFQ-B5 or R&S SFL-N.
Example:
The BER of $7*10^{-5}$ is reached at C/N_1 = 22.7 dB (displayed in the ADD. NOISE field of TV Test Receiver R&S EFA). The empirically determined SNR for the BER of $7*10^{-5}$ is 22 dB. The SNR is converted to C/N as follows:
C/N = SNR + 0.2 = 22.2 dB

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Note:
The following relationship exists for the S/N and the C/N ratio for 64QAM ITU-T J.83/B with a roll-off factor of r = 18 % (a = 0.18):
$C/N = S/N - k_{roll\text{-}off} = S/N - (-0.2)$ dB
$k_{roll\text{-}off} = 10 \times \log(1 - a/4)$

With R&S EFA models 70 and 73, the C/N ratio is referenced to the selected symbol bandwidth (= symbol rate, e.g. 5.057 MHz), i.e. the measurement is independent of the channel bandwidth.

The difference (22.7 dB – 22.2 dB) of roughly 0.5 dB is the END of the measurement system itself, in this case of TV Test Transmitter R&S SFQ and TV Test Receiver R&S EFA. Assuming that this value is equally distributed among the two instruments, each unit has an END of only 0.25 dB, which is a very good figure.

For the second measurement, the RF signal of the ITU-T J.83/B modulator is applied to the RF input of the device under test (DUT). As in the first measurement, the R&S EFA superimposes white noise on the RF output signal and measures the BER. The BER of $7*10^{-5}$ is now attained at C/N_2 = 23.1 dB (displayed in the ADD. NOISE field).

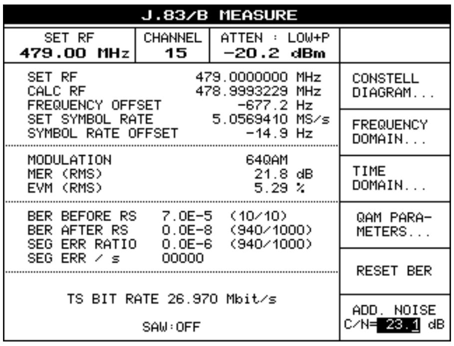


Fig. 5.51 ADD. NOISE on R&S EFA

The END of the device under test is calculated as follows:
END = $C/N_2 - C/N_1$ = 23.1 dB – 22.7 dB = 0.4 dB

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

5.12 ITU-T J.83/B Spectrum

5.12.1 Amplitude and Phase Spectrum

During transmission of the ITU-T J.83/B signal, its spectrum is distorted in amplitude and phase as a function of frequency. TV Test Receiver R&S EFA corrects this by means of a complex channel correction filter. As a result, a spectrum with optimal, flat amplitude and phase frequency response is available for further processing.
An inverse fast Fourier transform (IFFT) covering the coefficients of the channel correction filter yields 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 frequency response information can be used to generate a polar plot.

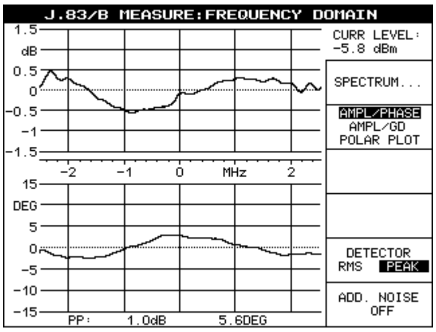


Fig. 5.52 Amplitude and phase frequency response of an ITU-T J.83/B signal

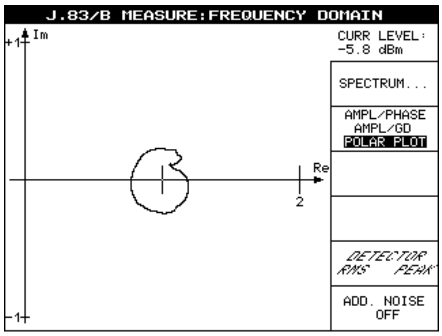


Fig. 5.53 Polar plot of an ITU-T J.83/B signal

Test Receiver R&S EFA model 70/73 in this way also monitors the effects of the transmission medium on an ITU-T J.83/B signal.

5.12.2 Spectrum and Shoulder Distance

Calculating channel frequency response by means of a fast Fourier transform (FFT) yields a much wider dynamic range for level measurements than is obtained by means of 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.

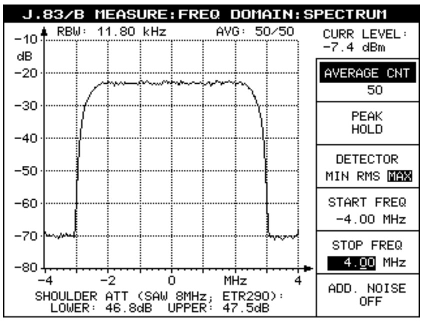


Fig. 5.54 Amplitude frequency response calculated in compliance with TR 101 290

Maximum level resolution is obtained if only the useful range of the spectrum is analyzed (in this example from –2.5 MHz to +2.5 MHz for a symbol rate of 5.056940625 Msymb/s). Level resolution is automatically selected, as a function of the frequency response, to a minimum value of 2 dB/div.
To determine the shoulder distance in compliance with TR 101 290, the 8 MHz SAW filter is to be switched on and the frequency range from –4.0 MHz to +4.0 MHz to be selected.

5.13 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 ITU-T J.83/B 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.

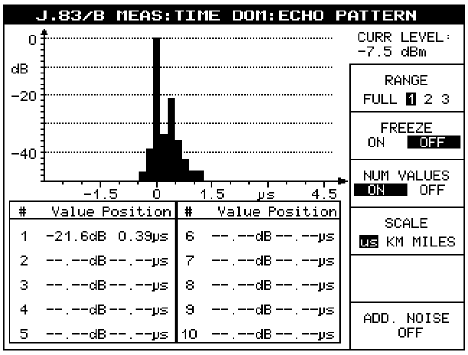


Fig. 5.55 Echo diagram

In the example shown in Fig. 5.55, the main pulse is at 0 µs, and the echo follows with an attenuation of 21.6 dB and a lag of 0.39 µs.

From the echo delay, the distance from the point of discontinuity causing the reflection is calculated. In the above example, the result is 117 m. After switchover to the MILES scale (1 mile = 1.61 km), the R&S EFA displays the distance with 0.07 miles resolution.
This measurement accuracy is sufficient to locate impedance discontinuity in large cable systems in buildings as described above.

5.14 Crest Factor of ITU-T J.83/B Signal

ITU-T J.83/B signals have a structure similar to that of white noise. An important parameter for describing ITU-T J.83/B 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 11.0 dB for 64QAM was measured with TV Test Receiver R&S EFA. The crest factor is displayed here using the complementary cumulative distribution function (CCDF). It can be seen that the amplitude distribution follows exactly the theoretical function (horizontal lines plotted at intervals of 1 dB, indicating the theoretical reference values). From this it can be deduced that there are no limiting effects in the ITU-T J.83/B system under test.

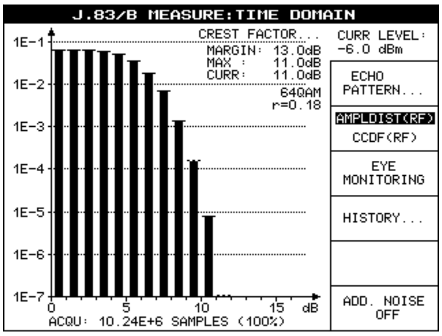


Fig. 5.56 Crest factor of an ITU-T J.83/B signal

Any limitations of the ITU-T J.83/B signal would mean that information is missing, with the consequence of increasing BER. Correct level adjustment of the ITU-T J.83/B system, therefore, helps to avoid an unnecessary reduction of the system's safety margin.

5.15 History

The HISTORY function of TV Test Receiver R&S EFA allows long-term monitoring of an ITU-T J.83/B system for compliance with specified levels, BER before and after RS FEC, non-correctable errors and loss of data without requiring an external PC.
The RF level is continuously monitored. The lower screen can be switched between measuring BER before or after RS FEC and measuring MER (or EVM) in the time domain. In addition, the RF level, the BER before and after RS FEC, and the MER (or EVM) can be output in the form of a list with the average, maximum and minimum values obtained during a given measurement interval.

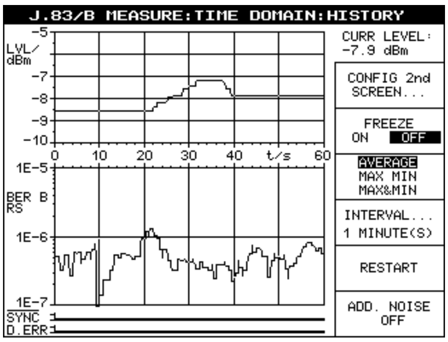


Fig. 5.57 HISTORY display with RF level and BER before RS FEC as a function of time

5.16 Alarm Report

Measurement reports are not only available on site at the cable headend, but can also be queried from a remote control center. System monitoring is very easy using TV Test Receiver R&S EFA model 70/73.

The network operator first chooses the parameters to be monitored. Fig. 5.58 shows a configuration in which all parameters are included in monitoring.

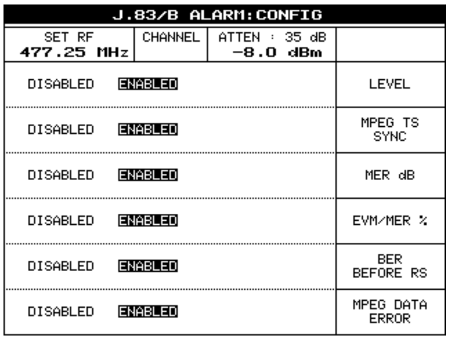


Fig. 5.58 Alarm configuration menu:
all possible parameters are monitored

Table 5.10 lists the parameters (with their short forms) that can be selected in the ALARM:CONFIG menu:

Parameter	Explanation	
LEVEL	Input level below threshold	LV
MPEG TS SYNC	Synchronization of ITU-T J.83/B symbols and MPEG2 transport stream packets	SY
MER dB	MER below threshold	ME
EVM/MER %	EVM (alternatively MER) above threshold	EV
BER BEFORE RS	BER below threshold	BR
MPEG DATA ERROR	Data errors that cannot be corrected by Reed-Solomon forward error correction	DE

Table 5.10

After selecting the ALARM parameters, the alarm thresholds have to be set. Thresholds can be set for LV, ME, EV and BR (see Table 5.10). Since non-correctable data and synchronization failure are absolute events, they are not assigned a threshold.

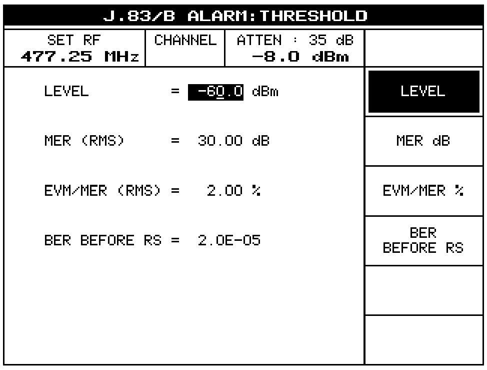


Fig. 5.59 Setting alarm thresholds

The MER alarm threshold can be selected in dB and, same as the error vector magnitude (EVM), also in %. There exist, therefore, two alarm parameters for the MER which may be regarded as an inner and an outer tolerance. The EVM, by contrast, can be expressed in % only and is therefore assigned only one alarm message.

Activated alarms are brought out as single alarms and as a sum alarm at connector X34 (USER PORT) on the rear of the R&S EFA. In addition, alarms can also be triggered via relays. In the event of a sum alarm, the single alarms are queried via the remote control interface.

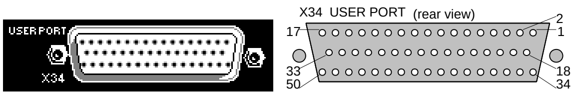


Fig. 5.60 Connector X34 USER PORT

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

Table 5.11 Pin assignment of connector X34 in ITU-T J.83/B mode

Professional monitoring calls for error reports. The R&S EFA not only records the key parameters LV (RF input level below threshold) and SY (loss of synchronization), but also the MER (ME, and additionally the EVM (error vector magnitude, EV)), the BER (BR), as well as non-correctable data errors (DE), the latter indicating the safety margin of an ITU-T J.83/B system. All errors are recorded with date and time.

On pressing the ALARM hardkey on the R&S 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.

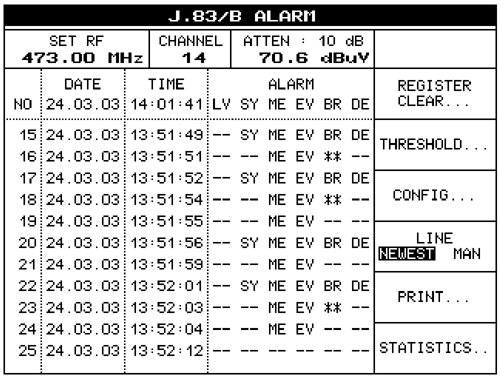


Fig. 5.61 Alarm list

The double asterisk (✳✳) means that the parameter is cleared from the monitoring list. The time and date of clearance are 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.

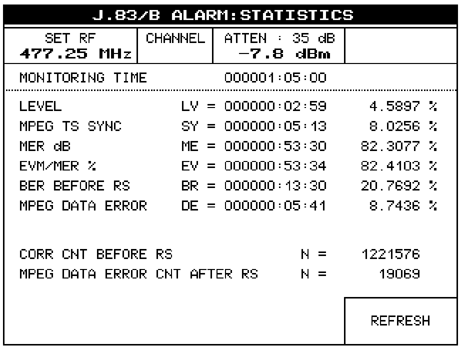


Fig. 5.62 Statistical evaluation of error periods

If errors occur more and more frequently in the alarm report, this indicates instability, and possibly even imminent failure, of the ITU-T J.83/B system.

Operators of digital cable networks know:
If the picture on a TV receiver shows visible degradation, transmission reliability in a DTV 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 R&S EFA, therefore, warns the operator early and reliably of an imminent failure of the ITU-T J.83/B system.

5.17 Options for TV Test Receiver (QAM Demodulator) R&S EFA Model 70/73

5.17.1 RF Preselection Option R&S EFA-B3 (for R&S EFA Model 73)

The ITU-T J.83/B cable 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 R&S EFA-B3 allows channel selection between 5 MHz and 1000 MHz and, in addition, enhances input sensitivity of the R&S EFA front end. The lower frequency limit of 5 MHz makes TV Test Receiver R&S EFA model 73, equipped with R&S EFA-B3, capable of upstream-channel communication.
The minimum input level is lowered to –67 dBm to –70 dBm in the VHF and the UHF range as a function of the RF attenuator setting (Low Noise, Low Distortion, High Adjacent Channel Power).
The RF Preselection option turns the R&S EFA model 73 into a selective test receiver of very high quality capable of demodulation despite low input levels.

5.17.2 Measurements with MPEG2 Decoder Option R&S EFA-B4

The MPEG2 Decoder option R&S EFA-B4 covers part of the functionality of MPEG2 Measurement Decoder R&S DVMD and MPEG2 Realtime Monitor R&S DVRM. The R&S EFA measurement functions are optimized for monitoring the demodulated transport stream at the cable headend.
ITU-T J.83/B uses the same MPEG2 protocol as DVB-C. All MPEG2 measurements are, therefore, identical to those described in Part 2 (DVB-C) of the "Digital TV Rigs and Recipes".

If TV Test Receiver R&S EFA model 70/73 is fitted with option R&S EFA-B4, it alone will suffice to analyze the MPEG2 protocol and the RF characteristics during ITU-T J.83/B transmission.

First, the time limits for the repetition intervals 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 the standards
ISO/IEC 13 818-1 for MPEG2
or
TR 101 290 for DVB
for the parameters defined there.

Parameter name	To DVB		To MPEG	
	MIN	MAX	MIN	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 5.12 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 defined by the user. The largest discrepancy between DVB and MPEG2 is in PCR distance with 40 ms for DVB and 100 ms for MPEG2.

Fig. 5.63 shows the menu for setting the limit values on TV Test Receiver R&S EFA fitted with MPEG2 Decoder option R&S EFA-B4. The DEFAULT softkey activates the predefined MPEG2 or DVB values. It is recommended to select the DVB limit values to ensure reproducible and comparable results throughout.

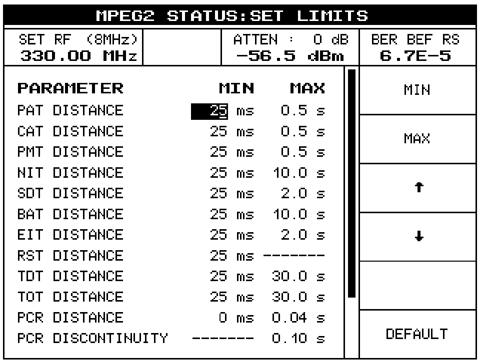


Fig. 5.63 Repetition intervals for tables and time stamps

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 defined by TR 101 290 can be enabled.

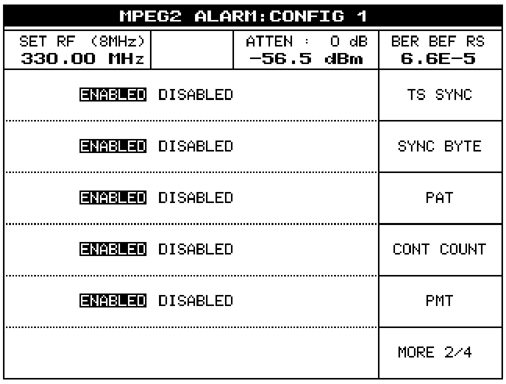


Fig. 5.64 First page of MPEG2 alarm menu

On pressing the ALARM key, the MPEG2 ALARM menu comes up. In this menu, all results exceeding tolerances during the monitoring period are displayed. Disabled parameters are marked by "--" in brackets.

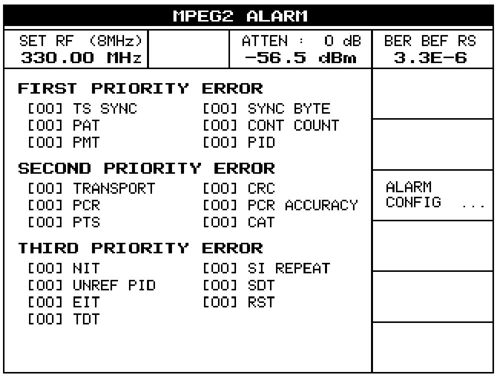


Fig. 5.65 MPEG2 ALARM menu

In the MEASURE menu, the parameters are evaluated in line with TR 101 290 irrespective of the settings made in the ALARM menu. An error counter can be started, stopped and cleared in this menu.

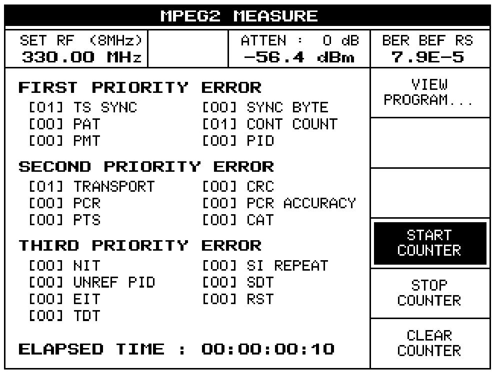


Fig. 5.66 MPEG2 MEASURE menu

Same as in the ITU-T J.83/B mode, the alarms in the MPEG2 mode are brought out at connector X34 of TV Test Receiver R&S EFA. Table 5.13 shows the pin assignment for the MPEG2 mode.

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 5.13 Pin assignment of connector X34 in MPEG2 mode

In the MPEG2 mode, too, alarms can additionally be triggered via relays.

The VIEW PROGRAM COMP... softkey opens the PAT (Program Association Table) 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.

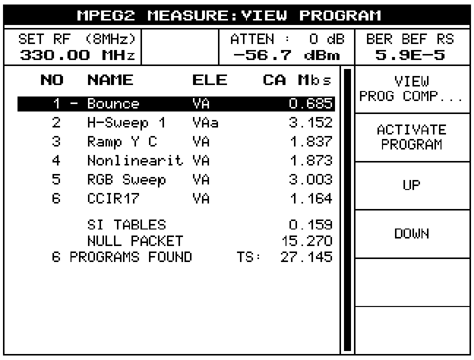


Fig. 5.67 PAT of a transport stream with key parameters

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 including associated PID (Packet IDentifier) numbers. The PID numbers of the PMT and the PCR (Program Clock Reference) are listed too.

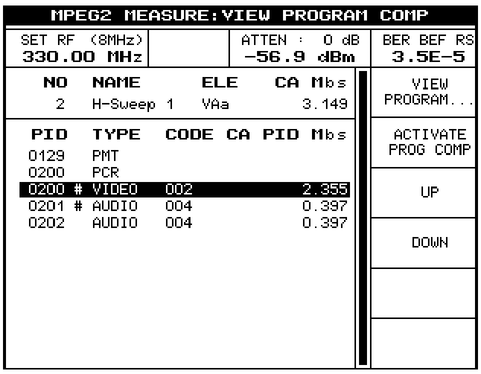


Fig. 5.68 PMT of a program with key parameters

TV Test Receiver R&S EFA model 70/73 with MPEG2 Decoder option R&S 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.

5.17.3 SAW Filters
2 MHz R&S EFA-B14, 6 MHz R&S EFA-B11 8 MHz R&S EFA-B13

The ITU-T J.83/B standard does not define the channel bandwidth, so the complete VHF and UHF range is available for transmission.
The preferred channel bandwidths are 2 MHz, 6 MHz and 8 MHz, i.e. those defined for the analog standards. For upstream-channel communication in interactive television, 2 MHz is commonly used. To ensure that each operator has the bandwidth configuration matching their application, the SAW filters for TV Test Receiver R&S EFA are available as options. The desired filter should, therefore, always be specified when placing an order.
One SAW filter should always be fitted. Two more SAW filters can be installed optionally.

2 MHz SAW Filter R&S EFA-B14

Expands the R&S EFA functionality to include an ITU-T J.83/B upstream channel. The option supports a 2 MHz channel bandwidth. Various symbol rates are possible.

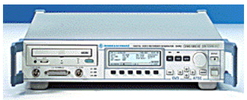
2MHz SAW Filter R&S EFA-B11
6 MHz SAW Filter R&S EFA-B12
8 MHz SAW Filter R&S EFA-B13

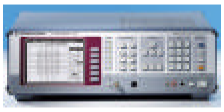
One of these filters can be inserted in the third SAW slot. The 6 MHz filter supports the channel bandwidths defined by Standard M, the 7 MHz filter either VHF channels or the UHF channel bandwidths used in Australia. The 6 MHz SAW filter is the filter most frequently used in ITU-T J.83/B.

The filters fitted are displayed in the status menu.

The 8 MHz SAW filter plays a very important role also in ITU-T J.83/B, although the 6 MHz filter is most commonly used there, because it is needed for automatic shoulder distance measurement.

5.18 Overview of ITU-T J.83/B Measurements

Instrument, Test Point	Test Parameter
At input of cable headend, TS source for production MPEG2 MEASUREMENT GENERATOR R&S DVG  DTV RECORDER GENERATOR R&S DVRG  MPEG2 MEASUREMENT DECODER R&S DVMD  MPEG2 REALTIME MONITOR R&S DVRM  DIGITAL VIDEO QUALITY ANALYZER R&S DVQ 	Test signal generator for reproducible MPEG2 measurements, various test sequences Test signal generator for reproducible MPEG2 measurements, various test sequences, recording of user-defined transport streams, recording of error events Realtime MPEG2 transport stream protocol analysis Realtime MPEG2 transport stream protocol monitoring Measurement of signal quality after MPEG2 coding and decoding
At test transmitter/ cable headend, in production  SPECTRUM ANALYZER R&S FSEx  SPECTRUM ANALYZER R&S FSP  SPECTRUM ANALYZER R&S FSU	LO harmonics ITU-T J.83/B spectrum Shoulder distance Roll-off factor Crest factor (via signal envelope) Output power

Instrument, Test Point	Test Parameter
At test transmitter/ cable headend  **Power Meter R&S NRVS with Thermal Power Sensor R&S NRV-Z51**	High-precision thermal measurement of output power
Monitoring receiver at cable headend **Test receiver in production**  ITU-T J.83/B TEST RECEIVER R&S EFA Model 70/73 with option R&S EFA-B4	**Basic unit** Order of QAM Symbol rate ITU-T J.83/B amplitude, phase and group-delay spectrum Output power END, BER, MER Crest factor Shoulder distance (to TR 101 290) Frequency offset Echo diagram Constellation diagram QAM I/Q parameters Alarm report **Option R&S EFA-B4** Measurements to TR 101 290: parameters of the three priorities Alarm report PAT and PMT
Simulation of ITU-T J.83/B cable headend  TV TEST TRANSMITTER R&S SFQ Options: NOISE GENERATOR FADING SIMULATOR	C/N setting for END measurement Simulation of defined receive conditions and impedance discontinuities Simulation of transmitter defects
ITU-T J.83/B test transmitter for production  TV TEST TRANSMITTER R&S SFL-J	Test transmitter for production Simulation of transmitter defects for testing set-top boxes in production

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