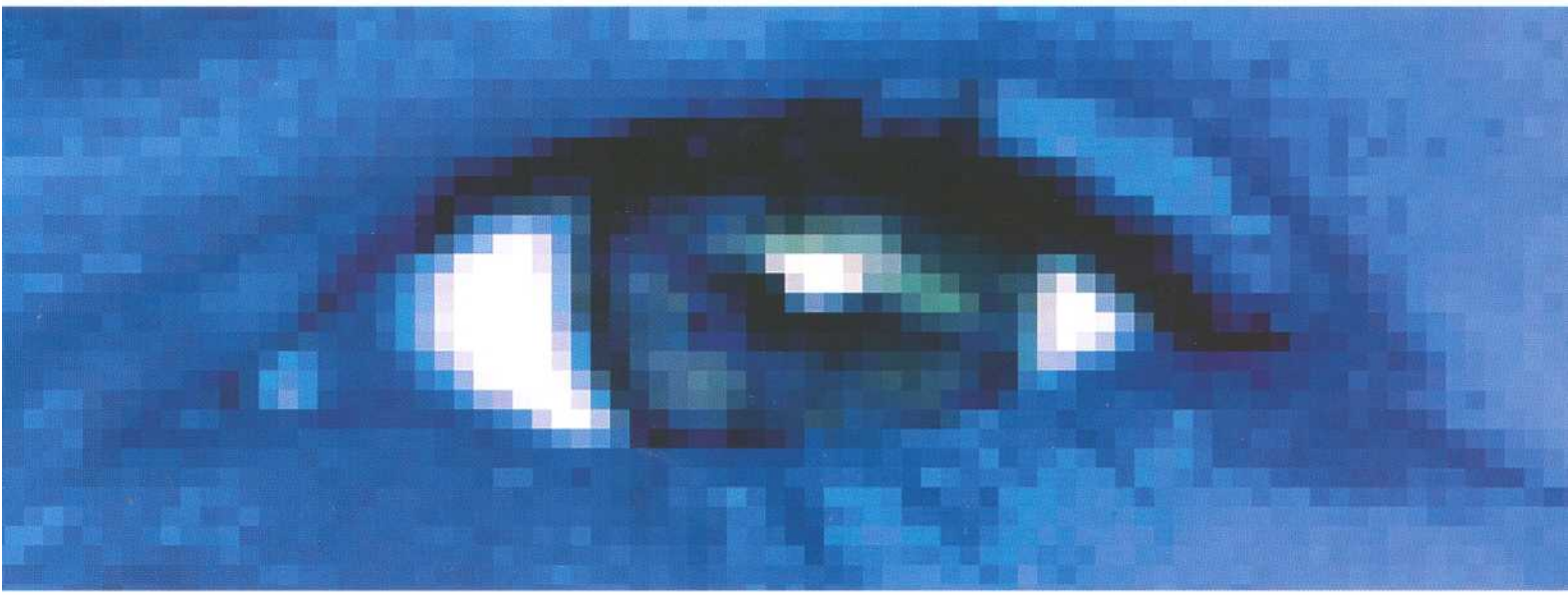


A digital view of the future

Digital Video Component Analyzer VCA

Now with jitter analysis

ROHDE&SCHWARZ

Top programming

The VCA combines the conventional measurement facilities of analog TV waveform monitors with totally new functions that allow monitoring of digital encoding and signal transmission.

Showing the invisible

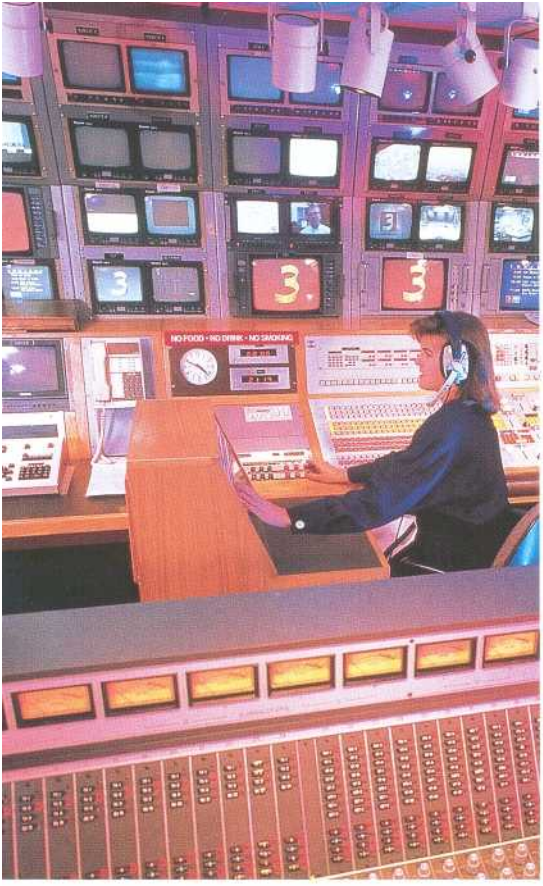
In contrast to analog image transmission, the quality of digital transmission cannot be seen directly. Transmission errors do not lead to a gradual deterioration of the image as in analog systems. The disadvantage – errors can accumulate unnoticed until there is a total system failure. The result – sudden, total loss of image and sound.

There's no need for this to happen now. Use the VCA for monitoring, and you always have your finger on the pulse. You're always fully in the picture about the quality of the video signal. And in the event of errors developing, you can take action to prevent the worst from happening.

Three functions in one unit

The three functions SCOPE (waveform monitor), data frame analyzer and data contents analyzer in one unit make the VCA the analyzer of choice for the following applications in broadcasting technology, service, and the development of digital studio equipment:

- Detection of errors in signal transmission prior to total breakdown of synchronization
- Detection of interference sources
- Display of bit errors
- Checking of the synchronization frame (monitoring of compliance to standards)
- Monitoring of camera signals
- Monitoring of signal generation
- Monitoring of signal distribution in the studio.



Team-player

The VCA is equipped with an RS-232/ 422 interface. This allows the VCA to be controlled remotely – integration into an existing system is no problem. Retro-fit of the remote control option is quick and easy.

Jitter professional

A further option offers professional jitter measurements, spectral measurements of digital signals and a range of other features. This allows you to detect even the most minor error and eliminate it before it becomes a big problem.

VCA delivers the goods

The VCA is versatile. In addition to comprehensive measuring facilities it offers a wide range of features such as display freeze and print-out via a printer for quick and convenient documentation of errors. Or storage of up to nine instrument settings to allow quick measurement type changes.

The Number One

Numeric display is sometimes preferable to graphics. The VCA can switch from Waveform to Numeric Dump allowing errors detected in the graphic display to be quickly and precisely analyzed.

The same with the measurement of Chrominance/ Luminance Gain Delay Error – graphic display shows the big picture, the numeric display shows the exact values.

And now, the technology ...

This has been a brief review of the features and benefits of the VCA. The following pages give a detailed description of features offered by the VCA. And more technical data.

Description

Digital Video Component Analyzer VCA from Rohde & Schwarz solves measurement problems encountered in applications of the new studio technology, in operation and servicing as well as in the development of digital studio equipment.

Combining the characteristics of a waveform monitor and an analyzer and including all conventional display modes, the VCA is suitable for a great variety of measurements and so makes working with digital video signals easy. An optional remote-control unit permits the VCA to be readily integrated into large measuring systems for comprehensive monitoring in the studio. The analyzer has the following notable features:

- Waveform display
- Numeric output of video data
- Analysis of sync frame
- Analysis of data contents
- Timing and level measurements
- Digital transport layer (DTL) analysis including jitter measurements (option)
- Hardcopy of screen via external printer
- To standards CCIR 601/656, SMPTE 125 M/259 M, 8 bits, 10 bits, 625/525 lines
- Remote control (option)

Characteristics

The VCA enables the test engineer in the digital TV studio to perform a fast and in-depth analysis of the data contents and to check for correct syntax of the data frame. The optional digital transport layer (DTL) analysis also allows an assessment of the analog quality of the data stream. All measurement results are clearly displayed on a large-size monitor. For simple documentation of the results, the screen contents can be frozen and output via an external printer.

With the aid of the optional remote-control interface, the VCA can be integrated into automatic test and monitoring systems.

SCOPE functions

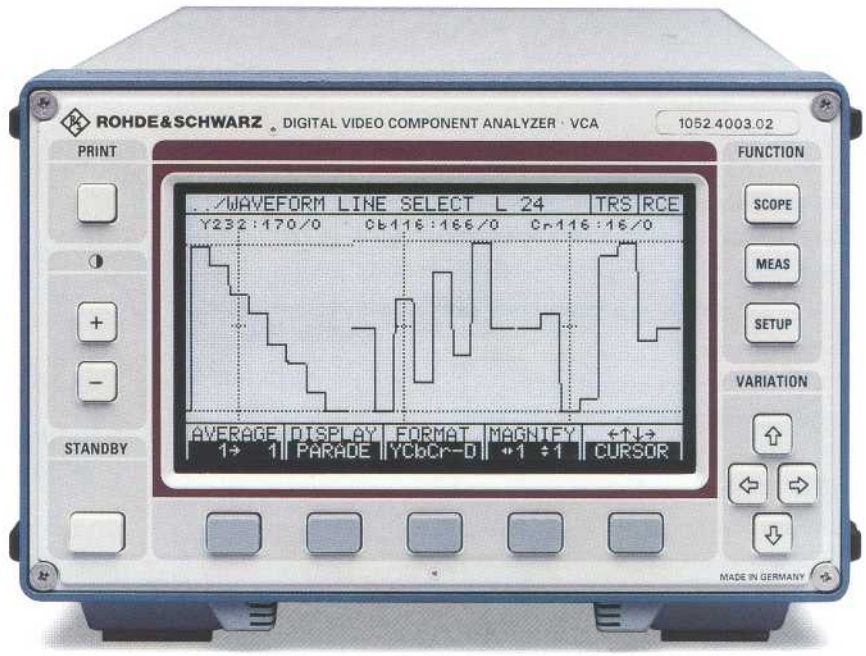
These functions allow waveforms and numerical values of the digital video signal to be analyzed.

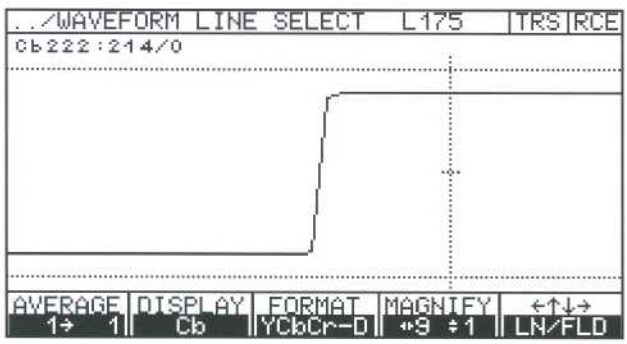
WAVEFORM

The VCA displays the digital video signal without D/A conversion so that all signal irregularities such as errors in the least significant bits that are often lost during D/A conversion are clearly visible. Another feature of the VCA is the qualitative assessment of the analog video signal permitting rise time falling below a minimum level to be detected. This out-of-tolerance condition produces overshoots of the simulated analog signal. Such errors, for instance, are caused by text inserters not operating to standard.

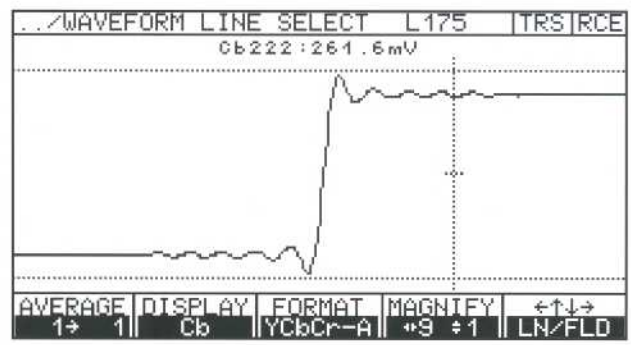
The WAVEFORM functions allow the direct output of the data values: by means of a cursor the precise digital values of the signal components can be read off above the displayed waveform for each sample.

The VCA further provides adjustable averaging to free analog video signals from noise, which can then be measured in the same way as digital signals. With test signals it is thus possible to quickly determine the quality of A/D conversion.





VCA combines the advantages of digital and analog measurements. Digital signal processing enables data storage and subsequent analysis of individual video lines. After switching on a digital filter with analog characteristic



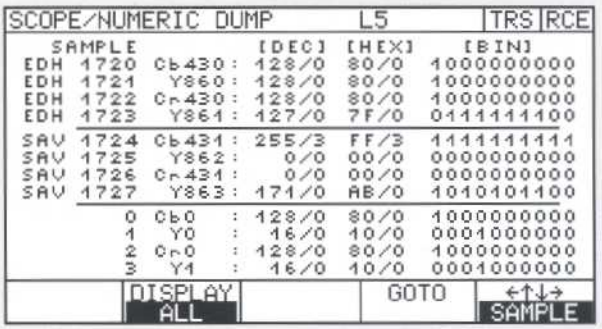
(right), the signal can be assessed and analyzed in detail. The example shows that too low signal rise time produces transients.

Numeric Dump

For localizing digital-specific errors of the digital video signal and for analyzing data words not visible in the picture, it is necessary to display the video signal at the bit level.

This is possible by means of the NUMERIC DUMP function which permits the digital values to be displayed in realtime in hexadecimal, decimal or binary numbers together with the associated sample designation and numbering. This combination allows checking of the digital sync words and of any sound and ancillary data in the blanking interval.

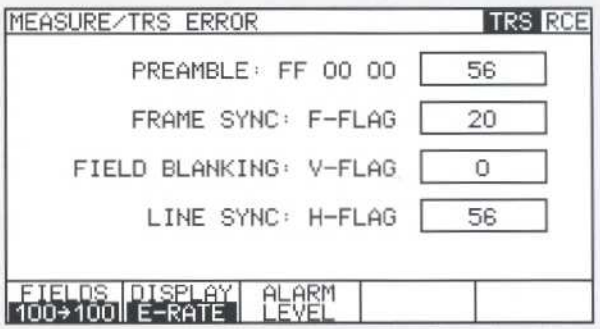
Display of digital signal values in active video and ancillary data range



Waveform level trigger

This function searches for level errors or reserved codes (#FF, #00) in the digital video signal and displays the position and contents of the relevant video data. Any levels of the three video components can be selected as search criteria.

Error measurement of sync information, displayed as error rate



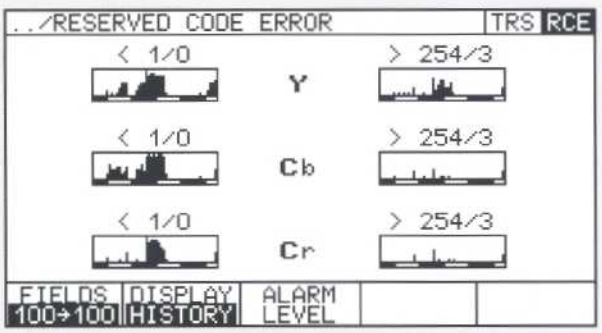
TRS trigger

The VCA uses this function to detect faulty TRS data and display the contents thereof.

Ancillary data status

In addition to the video data proper, ancillary data may be contained in the line blanking intervals of the digital video signal. The VCA checks these data and clearly shows the type of data concerned, eg EDH, digital time code or embedded audio. The contents of the data found can be investigated in detail if required.

Illegal codes in active video, displayed as HISTORY

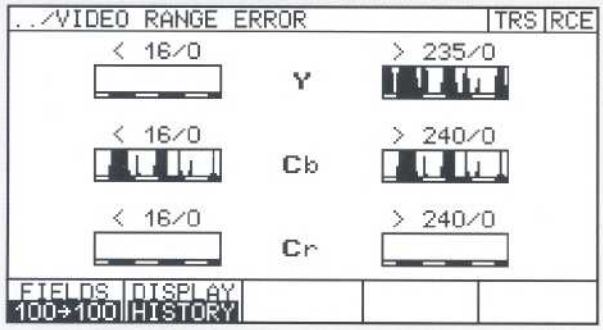


MEASURE functions

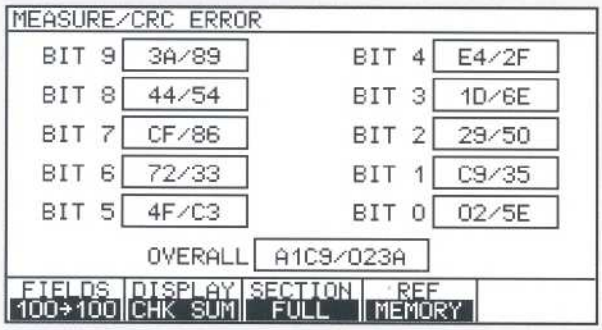
These functions enable realtime measurements of data contents and sync frame of the digital video signal.

The measurement results are displayed as ERROR RATE or can be shown on a new type of HISTORY display.

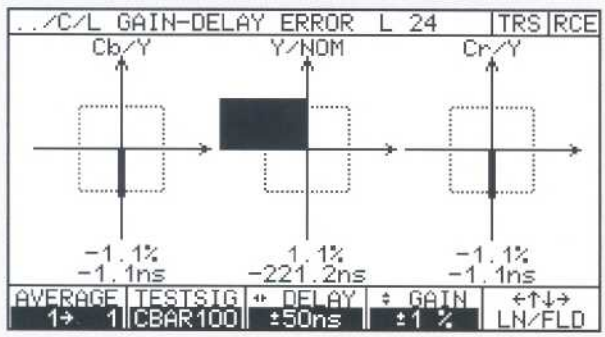
- The ERROR RATE is displayed digitally showing the number of faulty fields occurring at intervals adjustable between 100 and 500 fields.
- The HISTORY display is a graphic representation of all faulty fields occurred during the last 10 seconds. The graphic display is continuously moving over the screen, so indicating the frequency of errors as a function of time. This display greatly facilitates the detection of error sources in digital systems.



Measurement of standard-level infringements: display of too high levels (right) and too low levels (left)



Display of CRC checksums for every single bit and for complete data words



Level and delay measured with colour bar signal. Signal shown in example is three clocks too early (approx. 222 ns), luminance level is 1.1% above nominal value

TRS error

The timing reference signal (TRS) includes a preamble as well as a protected code word containing all synchronizing data. The VCA continuously checks this information to ensure that the data remain in compliance with valid standards.

Reserved code error

This monitoring function searches for data words #00 and #FF which are reserved for the preambles of the TRS and the ancillary data.

Video range error

This measurement function ensures that the level of the digital video signal is not too high or too low. Deviations from the standard level point to a malfunction of the measured signal source.

CRC error

This measurement function continuously calculates the cyclic redundancy checkword (CRC) of the video data by obtaining a checksum from the transmitted data words and comparing it with a reference value. With digitally generated test patterns, such as produced by TV Generators SAF or SFF with CCIR601 option, this checksum is specific for every test pattern. Differences or changes of the video data at the end of the link are due to a faulty transmission.

One of the VCA's special features is the individual monitoring of all ten bits. In conjunction with the HISTORY display, the bit activity can thus be easily monitored. This allows the detection of sporadic errors (eg due to loose contacts) in the parallel lines of the transmission link and of faults in picture processing equipment, recording units, frame stores and mixers.

Chrominance/luminance gain/delay error

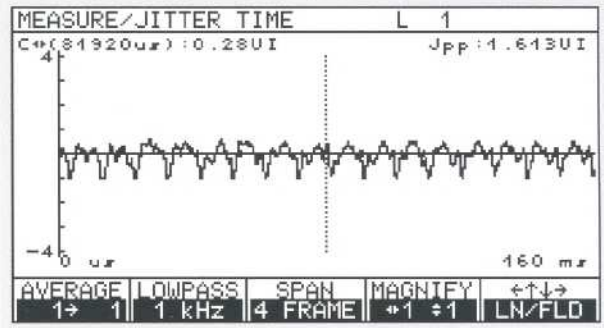
As in analog measurements, the colour bar signal is used to measure delay and level inequalities as chrominance/luminance gain/delay error.

Compared to the purely visual assessment with an oscilloscope, the VCA is able to provide precise measured values. A graphic display facilitates the evaluation of the test results. It shows the chrominance/luminance ratio as well as the departure of the luminance level from the standard signal. The timing of the signal referred to the TRS (sync frame) is also measured. This allows the dynamic range and timing of A/D and D/A converters and of analog processors to be checked as well as clock errors to be detected.

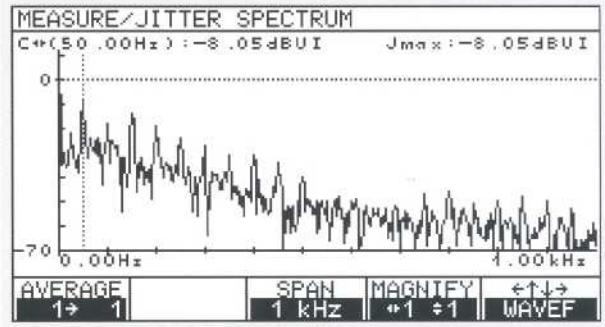
DTL analysis option

While the VCA basic unit checks the data contents of the digital video signal, the optional DTL Analysis VCA-B11 (digital transport layer) allows to search for the physical causes of data errors in serial-digital video signals, with signal jitter playing an important role in this respect. The VCA performs jitter measurements according to the demodulator method and also supports measurements to the clock extractor method.

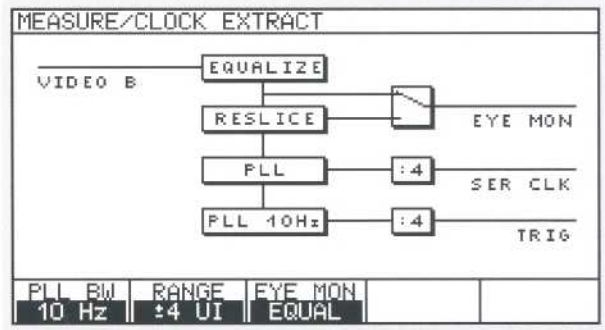
Display of jitter versus time, in example shown over a range of four frames



Jitter display in frequency spectrum, in example shown up to 1 kHz



Output signals switched for jitter measurement to clock extractor method



Jitter/time

This measurement yields a continuous display of the jitter versus time within a selected time interval, with synchronization being possible to any line, frame or four frames. All signal-dependent jitter effects, such as line-dependent jitter, can be clearly detected and suitable measures taken to reduce such jitter effects.

Jitter/spectrum

The result of this measurement is the spectral display of the jitter frequencies in the range from 10 Hz to 8 MHz. Since not all the jitter frequencies cause malfunctioning of an instrument or system, the display of the jitter spectrum is an important evaluation aid before initiating further measurement or service action.

Clock extract

This function enables jitter measurements according to the socalled clock extractor method, with an eye pattern of the serial digital signal being displayed on an external oscilloscope. The VCA provides all output signals required for this measurement. The signal for displaying the eye pattern is derived after a cable equalizer. A comparator for level regeneration can additionally be switched into the signal path. A special operating mode allows the clock jitter to be displayed in a range of up to four clock cycles.

Amplitude spectrum

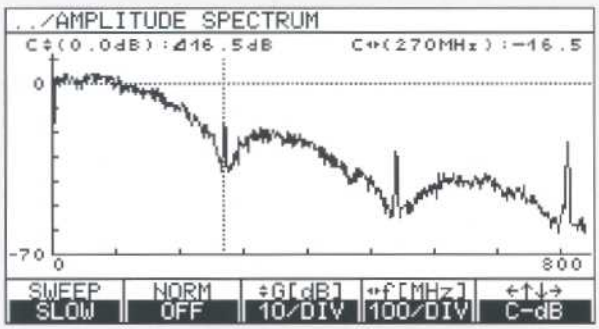
The VCA allows the amplitude spectrum of the serial-digital video signal to be measured in a range up to 800 MHz. With the aid of the amplitude spectrum it is easy to detect faulty line terminations, open-ended feeder cables, defective cables and faulty line drivers. Impermissible spectral components caused by active interference sources are revealed at once.

Return loss

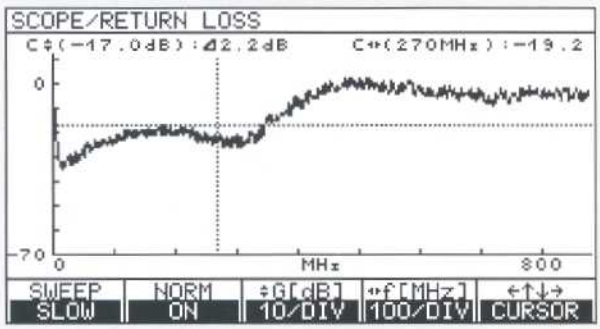
The VCA can be used to measure return loss of serial interfaces up to 800 MHz. An external SWR bridge offered as an accessory is required for this measurement. The VCA contains a broadband noise generator as a signal source. The amplitude spectrum of the signal at the output of the SWR bridge is displayed for evaluation. Too low a return loss may be the cause of faulty signal transmission. The spectral display of the return loss allows easy detection of out-of-tolerance deviations.

Signal delay

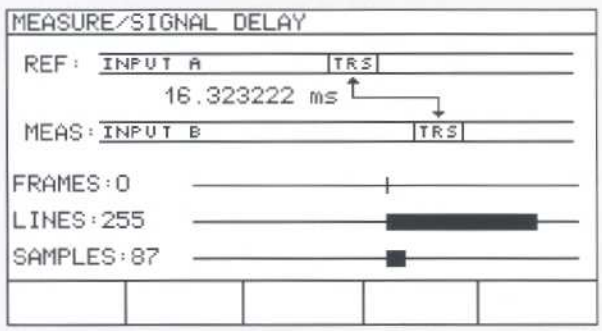
The VCA allows extremely simple measurement of the time delay between two serial digital signals without the need for additional measuring instruments.



Display of amplitude spectrum up to approx. 8 MHz



Frequency-dependent measurement of return loss using external SWR bridge



Measurement of delay between two signals over ±8 frames

Remote-control option

This option provides the VCA with full remote-control capability via the built-in RS-232/422 interface so that it can ideally be integrated into automatic measuring and monitoring systems in the studio.

The reference signal is applied to input A of the VCA and the test signal to input B. The VCA displays the delay between the two signals both in terms of time and in terms of frames, lines and sampling values. Normally, the measurement range covers one frame. Special test signals even enable measurement over 16 frames. This function is especially important for setting up studios since signal delays of a few frames as may well occur with complex studio equipment cannot be ignored.

Signal margin

This function enables relative measurement of the signal margin, a quantity by which the signal quality may become poorer before an error-free decoding is no longer possible. A noise signal with adjustable amplitude is superimposed on the received data signal by the VCA which then indicates the noise level at which the signal cannot be decoded any more. This value is a measure of the signal margin still available. In the case of unknown serial signals, this measurement enables a fast first assessment of the signal quality.

Measurement functions

Waveform monitor (SCOPE)

Functions of basic unit

WAVEFORM LINE SELECT	display of digitized video signal: Y, C_B, C_R as original digital data, Y, C_B, C_R and G, B, R analog simulation
Display	parade, overlay or single, cursor measurement with position and value of sample, average function, magnify function (expansion, zoom), line selection
WAVEFORM LEVEL TRIGGER	same as WAVEFORM LINE SELECT, but with selectable trigger threshold
WAVEFORM	same as WAVEFORM LINE SELECT, but with overlay of active video lines
NUMERIC DUMP	binary, decimal and hexadecimal display of all data words with sample numbering and data type designation (Y, C_B, C_R, EAV, SAV or ANC), possibility of branching to cursor position, SAV, EAV and EDH position, line selection
TRS TRIGGER	same as NUMERIC DUMP, but with trigger to TRS error
ANCILLARY DATA STATUS	status display of ancillary data contained in video signal

Additional functions with option VCA-B11

AMPLITUDE SPECTRUM	measurement of frequency-dependent signal level; 3 measurement speeds, normalize function, magnify function, cursor measurements, consideration of cable lengths
Frequency range	5 to 800 MHz (RBW = 4 MHz)
Measurement range	–50 to +5 dB (referred to nominal level of serial signal)
Amplitude-frequency response (referred to 50 MHz)	5 to 300 MHz: ±2.5 dB 300 to 800 MHz: ±4 dB
Linearity	±1.5 dB
RETURN LOSS	measurement of return loss (external SWR bridge required); 3 measurement speeds, normalize function, magnify function, cursor measurements
Frequency range	5 to 800 MHz (RBW = 4 MHz)
Attenuation measurement range	up to –30 dB (referred to broadband noise of –10 dBm)

Analyzer (MEASURE)

Functions of basic unit

TRS ERROR	sync word monitoring with respect to preamble, frame sync flag, line sync flag, field blanking flag; ERROR RATE and HISTORY display; background monitoring with adjustable limit values and insertion of warning (TRS) in other displays
VIDEO RANGE ERROR	data word monitoring in active video range for checking data range (standard level), separately for Y, C_B, C_R, ERROR RATE and HISTORY display
RESERVED CODE ERROR	data word monitoring with respect to TRS preamble (#FF, #00) in active video range, ERROR RATE and HISTORY display, background monitoring with adjustable limit values and insertion of warning (RCE) in other displays
CRC ERROR	monitoring of all data bits in a field by means of cyclic redundancy check, single bit and data word analysis, CHECK SUM, HISTORY and ERROR RATE display
C/L GAIN/DELAY ERROR	
Luminance/nominal level diff.	display in 0.1% steps, resolution 1 LSB
Luminance/nominal delay diff.	measurement range: –2.5 to +2.5 µs, resolution 0.1 ns
Chrominance/luminance level diff.	display in 0.1% steps, resolution 1 LSB
Chrominace/luminance delay diff.	measurement range: –1 to +1 µs, resolution 0.1 ns, test signals: 100% and 75% colour bar, average function, magnify function

Additional functions with option VCA-B11

SIGNAL DELAY	measurement of delay difference between two serial-digital signals
Measurement range	±1 field with standard signal, ±16 fields with test signal sequence
Resolution	1 sample (37 ns)
JITTER TIME/JITTER SPECTRUM	jitter measurement either in time or in frequency domain; 3 time or frequency windows, average function, magnify function, cursor measurements
Measurement range for discrete jitter frequencies	10 Hz to 200 kHz: 0.01 to 8 UI_{pp} [1] 200 kHz to 8 MHz: 0.01 to 8 UI_{pp} [1] x (0.2 MHz/jitter frequency [MHz])
CLOCK EXTRACT	clock extraction with selectable division factor 1/1 or 1/4; trigger signal with same division factor; extractor band limits 10 Hz, 1 kHz
SIGNAL HEADROOM	adjustable superimposed noise) of signal from input B to output SUP IMP

[1] Data jitter measured in unit intervals (UI). One UI corresponds to the period of one bit = 3.7 ns.

Specifications

Signal standard selectable video standards: 525 lines/60 Hz and 625 lines/50 Hz, 8 and 10 bits

Display LC, illuminated, 240 x 128 pixels, intensity and contrast adjustable, visible area 134 mm x 76 mm

Instrument setups

SAVE/RECALL CONFIGURATION storage and recall of 9 instrument setups

PRINTER suitable printers: Epson RX80/FX80, HP Deskjet/Laserjet, Rohde & Schwarz PUD3 and PDN

Printout hardcopy of screen via RS-232/RS-422 interface

Signal inputs/outputs

Return loss of serial inputs >25 dB into 75 Ω (5 to 270 MHz)
Return loss of serial outputs >17 dB into 75 Ω (5 to 270 MHz)

Signal inputs of basic unit

Serial (270 Mbit x 1) to SMPTE 259M
Parallel (27 Mbit x 10) to CCIR 601/656 and SMPTE 125M

Signal inputs with option VCA-B11

Serial A and serial B (270 Mbit x 1) to SMPTE 259M
Parallel (27 Mbit x 10) to CCIR 601/656 and SMPTE 125M

Signal outputs of basic unit

Serial (270 Mbit x 1) signal of serial input to SMPTE 259M with reclocking

Parallel (27 Mbit x 10) signal of selected input to CCIR 601/656 and SMPTE 125M with reclocking

Signal outputs with option VCA-B11

Serial A (270 Mbit x 1) signal of serial input A to SMPTE 259M with reclocking

Serial B (270 Mbit x 1) signal of serial input B to SMPTE 259M with reslicing

Parallel (27 Mbit x 10) signal of selected input to CCIR 601/656 and SMPTE 125M with reclocking

MONITOR (270 Mbit x 1) signal of input to SMPTE 259M selected for measurement

SUP IMP (270 Mbit x 1) signal of input B to SMPTE 259M with superimposed noise

EYE MON (270 Mbit x 1) signal of input B after cable equalization or after digitization (reslicing); V_{pp} = approx. 700 mV into 75 Ω

SER CLK clock of signal input B (270 MHz or 67.5 MHz) with jitter bandwidth <8 MHz; V_{pp} = approx. 800 mV into 75 Ω

TRIG clock of signal input B (270 MHz or 67.5 MHz) with jitter bandwidth <10 Hz; V_{pp} = approx. 800 mV into 75 Ω

NOISE broadband noise of typ. –90 dBm/Hz (5 MHz to 1 GHz)

General data

Rated temperature range +5 to +40°C (guaranteed specs; operational from 0 to +50°C)

Storage temperature range –40 to +70°C

Mechanical load

Sinewave vibration 5 to 150 Hz, max. 2 g at 55 Hz, 0.5 g from 55 to 150 Hz, satisfies IEC 68-2-6, IEC 1010-1, MIL-T-28800D class 5

Random vibration 10 to 300 Hz, 1.2 g_{rms}

Shock 40 g shock spectrum, satisfies MIL-STD-810C and MIL-T-28800D classes 3 and 5

Climatic load +25°C/+40°C, cyclic at 95% relative humidity, satisfies IEC 68-2-30

Electromagnetic compatibility satisfies EU EMC directives (89/336) and German EMC law

Power supply 100/230 V, –10/+15%, 120/220 V, –15/+10%, 47 to 63 Hz

Power consumption basic unit: 60 VA, with option VCA-B11: 140 VA

Electrical safety satisfies EN 61010-1

Dimensions (W x H x D) 220 mm x 148 mm x 461 mm

Weight

Basic unit 6.4 kg

With option VCA-B11 7.7 kg

Ordering information

Order designation	Digital Video Component Analyzer VCA	1052.4003.02
Accessories supplied	power cable, operating manual	
Options		
Remote Control via RS-232/RS-422 interface	VCA-B1	1052.5600.02
DTL Analysis	VCA-B11	1052.5800.02
Recommended extras		
SWR Bridge 75 Ω, BNC, 5 to 850 MHz, for return loss measurement	VCA-Z1	1052.5900.02
Service manual		1052.6493.24

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