

# R&S® ETL TV Analyzer Specifications



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# Definitions

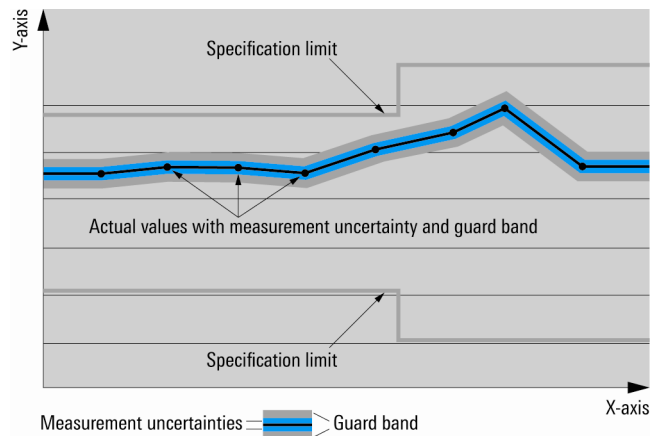
## General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

## Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



## Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

## Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with  $<$ ,  $>$  or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

## Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

## Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

## Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: "parameter: value".

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

# Part 1 – TV analyzer

## Frequency

Frequency range		500 kHz to 3 GHz
Resolution		1 Hz
<b>Reference frequency, internal, nominal</b>		
Aging per year		$1 \times 10^{-6}$
Temperature drift	0 °C to +50 °C	$1 \times 10^{-6}$
<b>Reference frequency, internal, nominal</b> R&S®FSL-B4 OCXO reference frequency option		
Aging per year		$1 \times 10^{-7}$
Temperature drift	0 °C to +50 °C	$1 \times 10^{-7}$
<b>Total reference uncertainty</b>		(time since last adjustment × aging rate) + temperature drift
<b>Spectral purity of SSB phase noise</b> f = 500 MHz		
Carrier offset	1 kHz	typ. -90 dBc (1 Hz)
	10 kHz	< -98 dBc (1 Hz), typ. -103 dBc (1 Hz)
	100 kHz	< -105 dBc (1 Hz), typ. -110 dBc (1 Hz)
	1 MHz	< -125 dBc (1 Hz), typ. -130 dBc (1 Hz)

## Level

<b>Maximum permissible input level</b>		
DC voltage		80 V
CW RF power	preamplifier off	30 dBm (= 1 W)
CW RF power	preamplifier on	20 dBm (= 0.1 W)
Peak RF power	preamplifier off	36 dBm (= 4 W), t < 3 s
Max. pulse voltage		150 V
Max. pulse energy	10 μs	10 mWs
1 dB compression of input mixer	0 dB RF attenuation, f > 200 MHz	+5 dBm (nom.)
<b>Intermodulation</b>		
Third-order intermodulation (TOI)	intermodulation-free dynamic range, level 2 × -20 dBm, reference level -10 dBm, preamplifier = off	
	f < 30 MHz	> 54 dBc (TOI > +7 dBm, typ. +12 dBm)
	f ≥ 30 MHz	> 60 dBc (TOI > +10 dBm, typ. +18 dBm)
Second harmonic intercept (SHI)	f = 20 MHz to 3 GHz	typ. 40 dBm
<b>Immunity to interference</b>		
Image frequency	f + 2 × 48.375 MHz	> 60 dB, typ. 80 dB
	f + 2 × 838.375 MHz	> 60 dB, typ. 80 dB
	f + 2 × 7158.375 MHz	typ. 60 dB
Intermediate frequency	48.375 MHz, 838.375 MHz, 7158.375 MHz	> 60 dB, typ. 80 dB
Spurious response, inherent	f > 30 MHz, without input signal, RF attenuation = 0 dB, RBW < 1 MHz	< -90 dBm
Spurious response	referenced to local oscillators, Δf < 100 kHz	typ. -60 dBc
	referenced to local oscillators, Δf ≥ 100 kHz	< -60 dBc
	referenced to A/D conversion	typ. < -70 dBc
	referenced to subharmonic of first LO (spur at 7158.375 MHz - 2 × f <sub>in</sub> )	typ. -60 dBc
At mixer level < -10 dBm	referenced to harmonic of first LO (spur at f <sub>in</sub> - 3579.1875 MHz)	typ. < -60 dBc
<b>Noise figure</b>		
	preselector (R&S®ETL-B203 option) not installed, 0 dB attenuation, typical values	27 dB (50 MHz to 1.3 GHz, preamplifier off) 15 dB (50 MHz to 1.3 GHz, preamplifier on) 17 dB (1.3 GHz to 2.3 GHz, preamplifier on) 19 dB (2.3 GHz to 3.0 GHz, preamplifier on)
	preselector on	see specifications of R&S®ETL-B203 RF preselector option

<b>Level settings</b>		
Setting range of signal level		-80 dBm to +20 dBm in steps of 0.1 dB
Units of level axis	logarithmic level display	dBm, dBmV, dBμV, dBμA, dBpW
	linear level display	μV, mV, V, μA, mA, A, pW, nW, μW, mW, W
<b>Level measurement uncertainty</b>	95 % confidence level, +20 °C to +30 °C, S/N > 16 dB, 0 dB to -50 dB from reference level, 50 MHz < f ≤ 3 GHz	< 1.0 dB
Attenuator uncertainty		< 0.3 dB
Uncertainty of signal level setting		< 0.1 dB (nom.)

## Analog TV standards and options

Standards		B/G, I, D/K, K1, M, N	
Sound standards	in line with TV standard, see "Channel filter, analog TV"	IRT-A2, NICAM, BTSC, EIA-J, Korea Stereo demodulation: split carrier, intercarrier	
Video bandwidth	in line with TV standard, see "Channel filter, analog TV"	4.0/4.2/5.0/5.2/5.5/5.75/6 MHz	
Group delay correction	see "Channel filter, analog TV"		
<b>Measurements</b>		vision carrier power	
		vision carrier frequency offset	
		vision/sound carrier power ratio	
		vision/NICAM power ratio	
		vision/sound carrier frequency offset	
		video S/N, weighted in line with ITU-R Rec. 567	
		vision modulation depth, residual picture carrier	
		line frequency offset	
		video scope	
		hum modulation	
		in-service, off-service, quiet line	carrier-to-noise power ratio
		off-service	composite triple beat (CTB) ratio
		off-service, quiet line	composite second order (CSO) ratio
		vision detector	synchronous PLL sample, back porch, medium
			synchronous PLL sample, back porch, slow
			synchronous PLL, continuous, fast
	synchronous PLL, continuous, medium		
		synchronous PLL, continuous, slow	
		envelope (ultrafast)	
	with R&S® ETL-B280	TV picture on display	
<b>System performance</b>			
Video SNR	weighted in line with ITU-R Rec. 567 (one channel), nominal and bar	≥ 60 dB	

<b>Channel filter, analog TV</b>				
Standard	Group delay characteristic	Sound system	Bandwidth in MHz ( $f_{\text{passband}} - \text{max}$ )	Residual sideband in MHz
B/G	general	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
	Australia	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
	Denmark	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
	general half	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
	New Zealand	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
	Norway	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
	Sweden	FM 5.5/FM 5.742	5.0	0.75
		FM 5.5/NICAM 5.85	5.0	0.75
		FM 5.5 mono	5.0	0.75
flat	FM 5.5/FM 5.742	5.0	0.75	
	FM 5.5/NICAM 5.85	5.0	0.75	
	FM 5.5 mono	5.0	0.75	
D/K	general (NICAM)	FM 6.5/NICAM 5.85	5.2	0.75
	OIRT GOST 20532-75 OIRT GOST 20532-83	FM 6.5/FM 6.742	6.0	0.75
		FM 6.5/FM 6.258	5.75	0.75
		FM 6.5/NICAM 5.85	5.2	0.75
		FM 6.5 mono	6.0	0.75
	ITU-R Report 308	FM 6.5/FM 6.742	6.0	0.75
		FM 6.5/FM 6.258	5.75	0.75
		FM 6.5/NICAM 5.85	5.2	0.75
		FM 6.5 mono	6.0	0.75
	flat	FM 6.5/FM 6.742	6.0	0.75
		FM 6.5/FM 6.258	5.75	0.75
		FM 6.5/NICAM 5.85	5.2	0.75
FM 6.5 mono		6.0	0.75	
I	flat	FM 6/NICAM 6.552	5.5	0.75
		FM 6 mono	5.5	0.75
K1	K1	FM 6.5/FM 6.742	6.0	0.75
		FM 6.5/FM 6.258	5.75	0.75
		FM 6.5/NICAM 5.85	5.2	0.75
		FM 6.5 mono	6.0	0.75
	flat	FM 6.5/FM 6.742	6.0	0.75
		FM 6.5/FM 6.258	5.75	0.75
		FM 6.5/NICAM 5.85	5.2	0.75
		FM 6.5 mono	6.0	0.75
M/N	FCC	FM 4.5 BTSC	4.0	0.75
		FM 4.5 EIA-J (Japan)	4.0	0.75
		FM 4.5/FM 4.724 (Korea)	4.0	0.75
		FM 4.5 mono	4.0	0.75
	flat	FM 4.5 BTSC	4.2	0.75
		FM 4.5 EIA-J (Japan)	4.2	0.75
		FM 4.5/FM 4.724 (Korea)	4.2	0.75
		FM 4.5 mono	4.2	0.75

Automatic selection depending on selected TV standard and sound system

**Passband amplitude error of channel filter**

Group delay, activated	$f \leq f_{\text{passband-max}}$	$\leq 0.1$ dB
Group delay, flat	$f \leq f_{\text{passband-max}}$	$\leq 0.05$ dB

**Group delay correction**

Standard	B/G							D/K				I	K1	M/N
	general	Australia	Denmark	general half	New Zealand	Norway	Sweden	general NICAM	OIRT GOST 20532-75	OIRT GOST 20532-83	ITU-R Rep. 308			
Freq. in MHz														
	Group delay in ns													
0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.25	-5		-5	-2.5				-5	-5		-5	0	0	0
0.50								0	0	-19	-8	0	0	0
1.00	-53	-30	-53	-26.5				0	0	-40	-40	-53	0	0
1.50								0	0	-70			0	0
2.00	-90	-60	-75	-45				0	0	-90	-80	-85	-87	0
2.25					-60			0	0				0	0
3.00	-75	-40	-75	-37.5	-60			0	0	-75	-80	-92	-85	0
3.50		0											0	0
3.58								0					0	0
3.60						20	0						0	0
3.75	0			0	0				0				0	0
3.80			0										0	0
4.00										-40	-60	-50	0	0
4.18													0	0
4.43	170	170	170	85	170	170	175	170	0	-25	0	0	15	
4.70										0			0	
4.80	400	260	400	200	400	350	400	400					0	
5.00										80		90	0	90
5.25													0	140
5.50											260		0	

**Passband group delay error of channel filter**

	$f \leq f_{\text{passband-max}} - 0.1$ MHz	7 ns
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## R&amp;S® ETL-K202 analog TV video analysis

Measurements	parameter	
	luminance bar amplitude (nominal)	range: -100 % to +100 %, resolution: 0.1 %
	sync amplitude (bar)	range: -50 % to +50 %, resolution: 0.1 %
	burst amplitude (bar)	range: -50 % to +50 %, resolution: 0.1 %
	SNR nominal (weighted in line with ITU-R Rec. 567 (one channel))	range: 30 dB to > 60 dB, resolution: 0.1 dB
	SNR bar (weighted in line with ITU-R Rec. 567 (one channel))	range: 30 dB to > 60 dB, resolution: 0.1 dB
	C/L gain (modulated pulse)	range: -50 % to +50 %, resolution: 0.1 %
	C/L delay (modulated pulse)	range: -500 ns to +500 ns, resolution: 1 ns
	C/L gain (modulated bar)	range: -50 % to +50 %, resolution: 0.1 %
	baseline distortion	range: -40 % to +40 %, resolution: 0.1 %
	line-time distortion	range: -40 % to +40 %, resolution: 0.1 %
	short-time distortion, rising/falling edge	range: -40 % to +40 %, resolution: 0.1 %
	2T pulse amplitude	range: -50 % to +50 %, resolution: 0.1 %
	2T k factor	range: 0 % to +10 %, resolution: 0.1 %
	tilt	range: -40 % to +40 %, resolution: 0.1 %
	C/L intermodulation (pulse)	range: -50 % to +50 %, resolution: 0.1 %
	C/L intermodulation (bar), step 3	range: -50 % to +50 %, resolution: 0.1 %
	C NL gain, peak-peak	range: 0 % to +100 %, resolution: 0.1 %
	C NL phase, peak-peak	range: 0° to +100°, resolution: 0.1°
	luminance NL	range: 0 % to +50 %, resolution: 0.1 %
	differential gain, pos./neg.	range: 0 % to ±50 %, resolution: 0.1 %
	differential phase, pos./neg.	range: 0° to ±50°, resolution: 0.1°
	ICPM, min./max.	range: 0° to ±50°, resolution: 0.1°
	sin x/x amplitude, pos./neg.	range: -100 dB to +100 dB, resolution: 0.01 dB
	sin x/x group delay, pos./neg.	range: -1000 ns to +1000 ns, resolution: 1 ns
	multiburst flag (bar)	range: -100 % to +50 %, resolution: 0.1 %
	multiburst 0.5/1/2/4/4.8/5.8	range: -100 % to +50 %, resolution: 0.1 %
	multiburst (national) flag (bar)	range: -100 % to +50 %, resolution: 0.1 %
	multiburst (national) 0.5/1.5/3.0/4.43	range: -100 % to +50 %, resolution: 0.1 %
	<b>graphics</b>	
	ICPM	bar charts with measured ICPM values for sync pulse base, black level and the five risers of the staircase signal; measured values for luminance NL, differential gain/phase of steps of staircase signal
	sin x/x	signal amplitude and group delay versus frequency
	1T edge over-/undershoot (short-time distortion)	signal sections at rising and falling edge on graticule
	2T pulse	signal section about 2T pulse on graticule

**R&S® ETL-K203 analog multistandard TV video generator**

Color systems		PAL, SECAM, NTSC
Video output (CCVS)	see part 5 (inputs and outputs)	BNC female, 75 $\Omega$
Nominal luminance/chrominance level	B/G, I, D/K, K1	700 mV
	M, N	714 mV
Video signals		color bar 75
		color bar 100
		white
		black
		15 kHz
		250 kHz
		red field
		FuBK
		sin x/x
		gray 50 %
	50 Hz (60 Hz)	

## Digital TV standards and options

### R&S®ETL-B210 digital demodulator for J.83/A/B/C (DVB-C, J.83/B, ISDB-C)

The R&S®ETL-K210 option is required.

Standard	cable TV (e.g. Europe, USA, Korea, China, Japan)	J.83/A/B/C (DVB-C, J.83/B, ISDB-C)
QAM order		4QAM, 16QAM, 32QAM, 64QAM, 128QAM and 256QAM
Bandwidth	digitally filtered, in line with symbol rate	1 MHz to 8 MHz
Symbol rate		1 Msymbol/s to 6.995 Msymbol/s
Measurements	see R&S®ETL-K210 DVB-C/J.83/A/C or R&S®ETL-K213 J.83/B firmware	

### R&S®ETL-B215 digital demodulator for DTMB

Standard	terrestrial TV, China	DTMB
QAM order		4, 4-NR, 16QAM, 32QAM, 64QAM
Guard interval		PN420, PN945 (TDS OFDM) PN595 (single carrier)
Code rate		0.4, 0.6, 0.8
Time deinterleaver		240, 720, off
Modulation		TDS OFDM and single carrier
Bandwidth		7.56 MHz
Measurements	see DTMB	

### R&S®ETL-B216 digital demodulator for J.83/A/B/C (DVB-C, J.83/B, ISDB-C) and DTMB

The R&S®ETL-K210 option is required for J.83/A/C (DVB-C). The R&S®ETL-K213 option is required for J.83/B.

Standard	cable TV (e.g. Europe, China, Japan, USA, Korea)	DVB-C, ISDB-C (QAM)
	terrestrial TV, China	J.83/B (QAM)
QAM order		4QAM, 16QAM, 32QAM, 64QAM, 128QAM and 256QAM (J.83/A/B/C, DVB-C, ISDB-C) 4, 4-NR, 16QAM, 32QAM, 64QAM (DTMB)
Guard interval (DTMB)		PN420, PN945 (TDS OFDM) PN595 (single carrier)
Code rate (DTMB)		0.4, 0.6, 0.8
Time deinterleaver (DTMB)		240, 720, off
Bandwidth	digitally filtered, in line with symbol rate	1 MHz to 8 MHz (J.83/A/B/C, DVB-C) 7.56 MHz (DTMB)
Symbol rate (J.83/A/B/C, DVB-C)		1 Msymbol/s to 6.995 Msymbol/s
Measurements	see DTMB and R&S®ETL-K210 DVB-C/J.83/A/C or R&S®ETL-K213 J.83/B firmware	

## R&S® ETL-K210 DVB-C/J.83/A/C firmware

The R&S® ETL-B210 or R&S® ETL-B216 option is required for DVB-C (J.83/A/C, ISDB-C).

Standard	cable TV (e.g. Europe, China, Japan)	J.83/A/C (DVB-C, ISDB-C)
QAM order		4QAM, 16QAM, 32QAM, 64QAM, 128QAM and 256QAM
Bandwidth	digitally filtered, in line with symbol rate, see subsection "Channel filter"	1 MHz to 8 MHz
Symbol rate		1 Msymbol/s to 6.995 Msymbol/s
Roll-off factor		0.12, 0.13, 0.15, 0.18 (selectable)
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, 64QAM, $f < 1$ GHz, R&S® ETL-B203 preselector not installed)
	carrier frequency offset (in Hz)	
	symbol rate offset (in Hz)	
	modulation error ratio (MER) in dB or %	
	error vector magnitude (EVM) in dB or %	
	bit error ratio (BER) before Reed-Solomon decoder	
	BER after Reed-Solomon decoder	
	packet error ratio or segment error ratio	
	MPEG transport stream rate	
	amplitude imbalance	range: -5 % to +5 %, resolution: 0.01 %
	quadrature error	range: -5° to +5°, resolution: 0.01°
	carrier suppression	range: +20 dB to +60 dB, resolution: 0.1 dB
	phase jitter	range: 0.00° to +2.00°, resolution: 0.1°
signal/noise ratio	range: +20 dB to +50 dB, resolution: 0.1 dB	
<b>Graphical measurements</b>	shoulder attenuation in line with ETSI TR 101290	
	constellation diagram	selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode
	ingress spectrum	within RF $\pm$ symbol rate/2
	MER versus frequency	within RF $\pm$ symbol rate/2
	echo pattern (channel impulse response)	
	amplitude/phase/group delay frequency response	
	CCDF and APD with crest factor	
	MPEG analyzer	with R&S® ETL-B280
	TV picture on display	with R&S® ETL-B280 and R&S® ETL-B281
	<b>Measurement uncertainty (64QAM)</b>	
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Symbol rate offset	referenced to symbol rate	reference uncertainty
Transport stream rate	referenced to stream rate	reference uncertainty
<b>With R&amp;S® FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Symbol rate offset	referenced to symbol rate	reference uncertainty
Transport stream rate	referenced to stream rate	reference uncertainty
<b>With external 10 MHz reference (<math>f \leq 1</math> GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	$\leq 1$ Hz
Symbol rate offset	referenced to symbol rate	$\leq 0.5$ Hz
MPEG transport stream rate	referenced to MPEG transport stream rate	$\leq 1$ Hz
<b>Modulation error ratio (MER)</b>	equalizer on, one channel	
	18 dB to 30 dB	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 40 dB	typ. < 2.0 dB
System performance	signal power > -30 dBm, $f \leq 1.3$ GHz,	$\geq 40$ dB (equalizer on)
	MER	500 MHz, -10 dBm: 46 dB typ. 36 dB (equalizer off, $f \geq 100$ MHz)

Error vector magnitude (EVM)	> 2 % to 8 %	typ. < 6 % of measured value
	> 1.2 % to 2 %	typ. < 11 % of measured value
	> 0.7 % to 1.2 %	typ. < 23 % of measured value
BER before Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-15}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio	$5.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$

**Channel filter for DVB-C firmware (R&S®ETL-K210)**

Channel filter bandwidth	automatic selection of channel filter, in line with selected symbol rate	1.0/2.0/3.0/4.0/5.0/5.4/5.6/5.8/6.0/6.2/6.4/6.6/6.8/7.0/7.2/7.4/7.5/7.6/7.65/7.7/7.75/7.8/8.0/8.2/8.4/9.0 MHz
Passband amplitude error		≤ 0.05 dB
Stopband attenuation		≥ 70 dB
Channel filter shape factor 60 dB:0.1 dB		≤ 1.05

**R&S®ETL-K213 J.83/B firmware**

The R&S®ETL-B210 or R&S®ETL-B216 option is required for J.83/B.

Standard	cable TV (e.g. USA, Canada, Korea)	J.83/B
QAM order		64QAM and 256QAM
Deinterleaver	automatic selection	convolutional interleaving depth: I/J = 8/16, 16/8, 32/4, 64/2, 128/1, 128/2, 128/3, 128/4, 128/5
Bandwidth	digitally filtered, in line with symbol rate, see subsection "Channel filter"	1 MHz to 8 MHz
Symbol rate		1 Msymbol/s to 6.995 Msymbol/s
Roll-off factor		0.12, 0.13, 0.15, 0.18 (selectable)
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, 64QAM, f < 1 GHz, R&S®ETL-B203 preselector not installed)
	carrier frequency offset (in Hz)	
	symbol rate offset (in Hz)	
	modulation error ratio (MER) in dB or %	
	error vector magnitude (EVM) in dB or %	
	bit error ratio (BER) before Reed-Solomon decoder	
	BER after Reed-Solomon decoder	
	packet error ratio or segment error ratio	
	MPEG transport stream rate	
	constellation diagram	selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode
	amplitude imbalance	range: -5 % to +5 %, resolution: 0.01 %
	quadrature error	range: -5° to +5°, resolution: 0.01°
	carrier suppression	range: +20 dB to +60 dB, resolution: 0.1 dB
phase jitter	range: 0.00° to +2.00°, resolution: 0.1°	
signal/noise ratio	range: +20 dB to +50 dB, resolution: 0.1 dB	
<b>Graphical measurements</b>	shoulder attenuation in line with ETSI TR 101290	
	constellation diagram	selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode
	ingress spectrum	within RF ± symbol rate/2
	MER versus frequency	within RF ± symbol rate/2
	amplitude/phase/group delay frequency response	
	echo pattern (channel impulse response)	
	CCDF and APD with crest factor	
	MPEG analyzer	with R&S®ETL-B280
TV picture on display	with R&S®ETL-B280 and R&S®ETL-B281	
<b>Measurement uncertainty (64QAM)</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Symbol rate offset	referenced to symbol rate	reference uncertainty
Transport stream rate	referenced to stream rate	reference uncertainty

<b>With R&amp;S®FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Symbol rate offset	referenced to symbol rate	reference uncertainty
Transport stream rate	referenced to stream rate	reference uncertainty
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Symbol rate offset	referenced to symbol rate	≤ 0.5 Hz
MPEG transport stream rate	referenced to MPEG transport stream rate	≤ 1 Hz
<b>Modulation error ratio (MER)</b>	equalizer on, one channel	
	18 dB to 30 dB	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 40 dB	typ. < 2.0 dB
System performance	signal power > -30 dBm, f ≤ 1.3 GHz, MER	≥ 40 dB (equalizer on) 500 MHz, -10 dBm: 46 dB typ. 36 dB (equalizer off, f ≥ 100 MHz)
Error vector magnitude (EVM)	> 2 % to 8 %	typ. < 6 % of measured value
	> 1.2 % to 2 %	typ. < 11 % of measured value
	> 0.7 % to 1.2 %	typ. < 23 % of measured value
BER before Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-15}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio	$5.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
<b>Channel filter for J.83/B firmware (R&amp;S®ETL-K213)</b>		
Channel filter bandwidth	automatic selection of channel filter, in line with selected symbol rate	1.0/2.0/3.0/4.0/5.0/5.4/5.6/5.8/6.0/6.2/6.4/ 6.6/6.8/7.0/7.2/7.4/7.5/7.6/7.65/7.7/7.75/ 7.8/8.0/8.2/8.4/9.0 MHz
Passband amplitude error		≤ 0.05 dB
Stopband attenuation		≥ 70 dB
Channel filter shape factor 60 dB:0.1 dB		≤ 1.05

**DTMB (Chinese terrestrial)**

The R&S®ETL-B215 or R&S®ETL-B216 option is required.

Standard	terrestrial TV, China	DTMB
QAM order	automatic detection or manual selection	4, 4-NR, 16QAM, 32QAM, 64QAM
Bandwidth	digitally filtered, in line with symbol rate, see subsection "Channel filter"	7.56 MHz
Guard interval	automatic detection or manual selection	PN420, PN945 (TDS OFDM) PN595 (single carrier)
Code rate	automatic detection or manual selection	0.4, 0.6, 0.8
Time deinterleaver	automatic detection or manual selection	240, 720, off
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, 64QAM, f < 1 GHz, R&S®ETL-B203 preselector not installed)
	carrier frequency offset (in Hz)	
	bit rate offset (in ppm)	
	modulation error ratio (MER) in dB or %	
	error vector magnitude (EVM) in dB or %	
	bit error ratio (BER) before LDPC decoder	TDS OFDM only
	packet error ratio or segment error ratio	
	MPEG transport stream rate	
	constellation diagram	selectable frame count (1 frame to 999999999 frames + infinite), freeze mode selectable carrier number (carrier 0 to carrier 3779) TPS or payload, selectable
	MER versus frequency	selectable carrier number (carrier 0 to carrier 3779, TPS carriers not shown)
	shoulder attenuation in line with ETSI TR 101290	
	amplitude/phase/group delay frequency response	TDS OFDM only
	CCDF and APD with crest factor	
	echo pattern	TDS OFDM only
MPEG analyzer	with R&S®ETL-B280	
TV picture on display	with R&S®ETL-B280 and R&S®ETL-B281	
<b>Measurement uncertainty</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With R&amp;S®FSL-B4 OCO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Bit rate offset	referenced to MPEG transport stream rate	< 0.2 ppm
MPEG transport stream rate	referenced to MPEG transport stream rate	< 0.2 ppm
<b>Modulation error ratio (MER)</b>	18 dB to 30 dB	typ. < 0.8 dB
	30 dB to 33 dB	typ. < 1.5 dB
System performance	signal power > -30 dBm, f ≤ 1.3 GHz	
	PN420 and PN945 (TDS OFDM)	MER ≥ 34 dB
	PN595 (single carrier)	MER ≥ 34 dB
Error vector magnitude (EVM)	> 2 % to 8 %	typ. < 8 % of measured value
	> 1.4 % to 2 %	typ. < 15 % of measured value
BER before LDPC, PN420, PN945	$1.0 \times 10^{-2}$ to $0.1 \times 10^{-15}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio PN420, PN945	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
<b>Channel filter for DTMB</b>		
Channel filter bandwidth		7.56 MHz
Passband amplitude error		≤ 0.1 dB
Stopband attenuation		≥ 90 dB
Channel filter shape factor 90 dB:0.1 dB		≤ 1.08

**R&S® ETL-K220 ATSC/8VSB firmware/R&S® ETL-K320/-K322 ATSC Mobile DTV firmware**

R&amp;S® ETL-K320 or R&amp;S® ETL-K322 requires the R&amp;S® ETL-B300 or R&amp;S® ETL-B310 option.

<b>Common specifications for R&amp;S® ETL-K220 ATSC/8VSB firmware and R&amp;S® ETL-K320/-K322 ATSC Mobile DTV firmware</b>		
Standard	terrestrial TV in line with ATSC A/53	
VSB order		8VSB
Symbol rate		2.000000 Msymbol/s to 11.000000 Msymbol/s; default: 10.7622378 Msymbol/s
Code rate		2/3
Bandwidth	digitally filtered, in line with channel bandwidth, see subsection "Channel filter"	6 MHz
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, $f < 1$ GHz, R&S® ETL-B203 preselector not installed)
	minimum quasi-error-free input level (R&S® ETL-B203 preselector on, preamplifier on, RF = 500 MHz)	typ. -80 dBm
	carrier frequency offset (in Hz)	
	symbol rate offset (in Hz)	
	modulation error ratio (MER) in dB or %	
	error vector magnitude (EVM) in dB or %	
	bit error ratio (BER) before Reed-Solomon decoder	
	BER after Reed-Solomon decoder	
	packet error ratio or segment error ratio	
	MPEG transport stream rate	
	spectrum emission measurement	in line with IEEE Std 1631-2008
	C/N	selection of noise bandwidth and frequency of measurement
	constellation diagram	selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode
	eye diagram	selectable symbol count (2 symbols to 999999999 symbols + infinite), freeze mode time span: ¼, ½, 1, 2, 3, 4, 5, 6, 7, 8 symbols (selectable)
	pilot value	0.3 to 2.5
	pilot error in dB	-12.4 dB to +6 dB
	data signal/pilot power ratio	5.3 dB to 23.7 dB
	shoulder attenuation in line with FCC	
	SNR (evaluation of low Q samples)	≥ 40 dB
	amplitude/phase/group delay frequency response	
	echo pattern (channel impulse response)	selectable center and time/div, up to 10 echoes shown in a result chart, remote readout of up to 200 echoes, results sorted by level or time/distance, absolute or relative display of echo levels
	CCDF and APD with crest factor	
	with R&S® ETL-B280	MPEG analyzer
	with R&S® ETL-B280 and R&S® ETL-B281	TV picture on display
	ATSC-M/H transmission indicator	
<b>Measurement uncertainty</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Symbol rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With R&amp;S® FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Symbol rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With external 10 MHz reference (<math>f \leq 1</math> GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Symbol rate offset	referenced to MPEG transport stream rate	≤ 0.5 ppm
MPEG transport stream rate	referenced to MPEG transport stream rate	≤ 1 Hz

<b>Modulation error ratio (MER)</b>	18 dB to 30 dB	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 40 dB	typ. < 2.0 dB
System performance	signal power > -30 dBm, f ≤ 1.3 GHz	MER ≥ 40 dB 500 MHz, -10 dBm: 46 dB typ.
Error vector magnitude (EVM)	> 2 % to 8 %	typ. < 6 % of measured value
	> 1.2 % to 2 %	typ. < 11 % of measured value
	> 0.7 % to 1.2 %	typ. < 23 % of measured value
BER before Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-15}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
<b>Channel selection filter for ATSC firmware (R&amp;S® ETL-K220/R&amp;S® ETL-K320/-K322)</b>		
Channel selection filter bandwidth		6.0 MHz
Passband amplitude error		≤ 0.01 dB
Stopband attenuation		≥ 75 dB
Channel filter shape factor 75 dB:0.01 dB		≤ 1.07
<b>Additional specifications for R&amp;S® ETL-K320/-K322 ATSC Mobile DTV firmware</b>		
Standard	terrestrial TV in line with ATSC A/153	
VSB order		8VSB
Symbol rate		2.000000 Msymbol/s to 11.000000 Msymbol/s; default: 10.7622378 Msymbol/s
Frame mode		single frame or dual frame
RS code mode		24 byte (211, 187) 36 byte (223, 187) 48 byte (248, 187)
SCCC code rates		1/2 or 1/4
SCCC block mode		10 SCCC blocks (separated), 5 SCCC blocks (combined)
M/H parades		1 parade to 16 parades (decoding of selected parade)
M/H ensembles		1 ensemble to 32 ensembles (decoding of primary and secondary ensemble of selected parade)
M/H ensembles per parade		1 to 2 (primary and secondary ensemble)
<b>Measurements</b>	<b>common parameter</b>	
	legacy TS bit rate	
	main MPEG TS bit rate	
	<b>parade parameter</b>	
	M/H payload bit rate	
	parade bit rate	
	ensemble bit rate (primary and secondary)	
	BER before RS-CRC (bit error ratio before Reed-Solomon with cyclic redundancy check) decoder	for primary and secondary ensemble of decoded parade
	BER after RS-CRC decoder	for primary and secondary ensemble of decoded parade
	RS packet error ratio (RS PER)	for primary and secondary ensemble of decoded parade
	M/H transport packet error ratio (M/H-TPER)	for primary and secondary ensemble of decoded parade
	<b>signaling parameter</b>	
	TPC signaling bit rate	
	FIC signaling bit rate	
	BER before Reed-Solomon decoder	for TPC and FIC signaling
	BER after Reed-Solomon decoder	for TPC and FIC signaling
	packet error ratio (PER)	for TPC and FIC signaling
	full TPC parameter analysis of selected parade	RS frame mode, RS code mode primary, RS code mode secondary, SCCC block mode, SCCC mode A-D, number of groups, total number of groups, parade repetition cycle, TPC protocol version, FIC version, reserved bits

Measurements (cont.)		signaling parameter (cont.)	
	M/H subframe structure based on TPC	graphical view of occupied M/H slots during the last 7 M/H frames, use of M/H subframe for M/H data	
	full FIC parameter analysis of all transmitted parades/ensembles	<b>FIC header:</b> FIC chunk major protocol version, FIC chunk minor protocol version, FIC chunk header extension length, ensemble loop header extension length, M/H service loop extension length, reserved bit, transport stream ID, number of ensembles <b>FIC data of selected parade:</b> SLT ensemble indicator, GAT ensemble indicator, ensemble protocol version, service signaling channel version, reserved bits, number of services	
	list of M/H-service-based FIC parameters for all parades/ensembles	<b>M/H service parameter of selected parade:</b> ensemble ID, number of services, service ID, multi-ensemble, service status, service protection indicator, reserved bits; if SLT-M/H is transmitted: service name, service category	
	M/H service overview	<b>simultaneous display of all transmitted M/H services:</b> parade ID, ensemble ID, number of services, service ID; if SLT-M/H is transmitted: service name, service category	
	M/H service overview	<b>simultaneous display of all transmitted M/H services:</b> parade ID, ensemble ID, number of services, service ID; if SLT-M/H is transmitted: service name, service category	
<b>Measurement uncertainty</b>			
Bit rate measurements	referenced to transport stream bit rate	reference uncertainty	
<b>With R&amp;S®FSL-B4 OCXO</b>			
Bit rate measurements	referenced to transport stream bit rate	reference uncertainty	
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>			
Bit rate measurements	referenced to transport stream bit rate	≤ 1 Hz	
Ensemble BER before Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-14}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$	
Ensemble RS packet error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-10}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$	
Ensemble M/H transport packet error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-10}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$	
Signaling BER before Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-12}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$	
Signaling packet error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-10}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$	

### R&S® ETL-K221 ATSC SFN frequency offset/R&S® ETL-K321 ATSC Mobile DTV SFN frequency offset

The R&S® ETL-K220, R&S® ETL-K320 or R&S® ETL-K322 option is required.

Frequency offset of echo signal, relative to frequency of main signal	range: ±10 Hz, resolution: 0.01 Hz, accuracy: 0.03 Hz, system optimization: fast	
	echo level requirements (single post-echo)	up to 1 Hz: level ≤ -8 dB
		up to 5 Hz: level ≤ -13 dB
		up to 10 Hz: level ≤ -17 dB
Number of echoes displayed in result chart		up to 10 (including main signal)
Number of echoes available via remote control		up to 200 (including main signal)

## R&amp;S® ETL-K240 DVB-T/DVB-H firmware

Standard	terrestrial TV in line with ETSI EN 30044	DVB-T/DVB-H
FFT mode	automatic detection or manual selection	2K, 4K, 8K
QAM order	automatic detection or manual selection	4QAM, 16QAM, 64QAM
QAM hierarchy	automatic detection or manual selection	none, $\alpha = 1, 2, 4$
Guard interval	automatic detection or manual selection	1/4, 1/8, 1/16, 1/32
Code rate HP, LP	automatic detection or manual selection	1/2, 2/3, 3/4, 5/6, 7/8
Interleaver mode	automatic detection or manual selection	native or in-depth
Bandwidth	digitally filtered, in line with channel bandwidth, see subsection "Channel filter"	5/6/7/8 MHz
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, 64QAM, $f < 1$ GHz, R&S®ETL-B203 preselector not installed)
	minimum quasi-error-free input level (R&S®ETL-B203 preselector on, preamplifier on, RF = 500 MHz, GI = 1/8, QPSK, CR = 2/3)	typ. -90 dBm
	carrier frequency offset (in Hz)	
	bit rate offset (in ppm)	
	modulation error ratio (MER) in dB or %	
	error vector magnitude (EVM) in dB or %	
	bit error ratio (BER) before Viterbi decoder	
	BER before Reed-Solomon decoder	
	BER after Reed-Solomon decoder	
	packet error ratio or segment error ratio	
	MPEG transport stream bit rate	
	constellation diagram	selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode, selectable carrier number (carrier 0 to carrier 6816 in case of 8K FFT)
	MER versus frequency	selectable carrier number (carrier 0 to carrier 6816 in case of 8K FFT)
	amplitude imbalance	range: -5 % to +5 %, resolution: 0.01 %
	quadrature error	range: -5° to +5°, resolution: 0.01°
	carrier suppression	range: -5 dB to +60 dB, resolution: 0.1 dB
	carrier phase	range: -180° to +180°, resolution: 0.1°
	shoulder attenuation	in line with ETSI TR 101290
	spectrum emission measurement	in line with ETSI EN 300 744
	C/N	selection of noise bandwidth and frequency of measurement
	amplitude/phase/group delay frequency response	selectable carrier number (carrier 0 to carrier 6816 in case of 8K FFT)
	echo pattern (channel impulse response)	selectable center and time/div, up to 10 echoes shown in a result chart, remote readout of up to 200 echoes, results sorted by level or time/distance, resolution: 1 ns, extended time range up to $t_{\text{symbol}}$ , selectable zero position: main or first echo, absolute or relative display of echo levels
	CCDF and APD with crest factor	
	TPS information	FFT, QAM order, hierarchy, guard interval, code rate (HP), code rate (LP), interleaver mode, MPE FEC (HP), MPE FEC (LP), time slicing (HP), time slicing (LP), length indicator, cell ID, TPS reserved (frames 1 to 4)
	MPEG analyzer	with R&S®ETL-B280
	TV picture on display	with R&S®ETL-B280 and R&S®ETL-B281

<b>Measurement uncertainty (64QAM)</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With R&amp;S®FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Bit rate offset	referenced to MPEG transport stream rate	≤ 0.5 ppm
MPEG transport stream rate	referenced to MPEG transport stream rate	≤ 1 Hz
<b>Modulation error ratio (MER)</b>		
	18 dB to 30 dB	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 40 dB	typ. < 2.0 dB
System performance	signal power > -30 dBm, f ≤ 1.3 GHz	MER ≥ 40 dB (system optimization: stationary fast or stationary slow) 500 MHz, -10 dBm: 46 dB typ.
Error vector magnitude (EVM)	> 2 % to 8 %	typ. < 6 % of measured value
	> 1.2 % to 2 %	typ. < 11 % of measured value
	> 0.7 % to 1.2 %	typ. < 23 % of measured value
BER before Viterbi or Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-15}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
<b>Echo pattern (channel impulse response)</b>		
	time	≤ 2 ns
	level	≤ 0.5 dB (referred to main path)
<b>Channel filter for DVB-T/DVB-H firmware (R&amp;S®ETL-K240)</b>		
Channel filter bandwidth	5.0/6.0/7.0/8.0 MHz	automatic selection of channel filter, in line with selected channel bandwidth
Passband amplitude error		≤ 0.03 dB
Stopband attenuation		≥ 90 dB
Channel filter shape factor 90 dB:0.03 dB		≤ 1.09

### R&S®ETL-K241 DVB-T/DVB-H SFN frequency offset

The R&S®ETL-K240 option is required.

Frequency offset of echo signal, relative to frequency of main signal	range	±20 Hz
	resolution	0.01 Hz
	accuracy	0.03 Hz
Number of echoes displayed in result chart		up to 10 (including main signal)
Number of echoes available via remote control		up to 200 (including main signal)

## R&amp;S® ETL-K250 T-DMB/DAB firmware

Standard	digital audio broadcasting in line with ETSI EN 300401 and data broadcasting, MPEG-2 TS streaming in line with ETSI TS 102427	DAB and MPEG-2 TS streaming	
Transmission mode	automatic detection or manual selection	mode I, mode II, mode III, mode IV	
Protection level	automatic detection or manual selection	1, 2, 3, 4, 5, 1-A, 2-A, 3-A, 4-A, 1-B, 2-B, 3-B, 4-B	
Bandwidth	digitally filtered, in line with channel bandwidth, see subsection "Channel filter"	1.536 MHz	
<b>Measurements</b>	<b>parameter</b>		
	level	–65 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, $f < 1$ GHz, R&S®ETL-B203 preselector not installed) –85 dBm (preamplifier on, preselector on, QEF); typ. –92 dBm with protection level 4-A	
	carrier frequency offset (in Hz)		
	bit rate offset (in ppm)		
	modulation error ratio (MER) in dB or %		
	error vector magnitude (EVM) in dB or %		
	bit error ratio (BER) before Viterbi decoder (FIC + MSC)		
	BER before Viterbi decoder (FIC only)		
	BER before Viterbi decoder (MSC only)		
	FIB (fast information block) errors		
	BER before Reed-Solomon decoder for subchannels containing MPEG-2 TS		
	BER after Reed-Solomon decoder for subchannels containing MPEG-2 TS		
	packet error ratio for subchannels containing MPEG-2 TS		
	MPEG transport stream rate for subchannels with MPEG-2 TS		
	constellation diagram	selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode selectable carrier number (carrier –768 to carrier +768 in case of mode I)	
	MER versus frequency	selectable carrier number (carrier –768 to carrier +768 in case of mode I)	
	carrier-to-noise ratio	range: 10 dB to 65 dB, resolution: 0.1 dB (upper limit depending on input level)	
	amplitude/phase/group delay frequency response	selectable carrier number (carrier –768 to carrier +768 in case of mode I)	
	spectrum emission measurement	in line with ETSI EN 302 077	
	C/N	selection of noise bandwidth and frequency of measurement	
	echo pattern (channel impulse response)	selectable center and time/div, up to 10 echoes shown in a result chart, remote readout of up to 200 echoes, results sorted by level or time/distance, resolution: 1 ns, time range: $t_{\text{symbol}}$ selectable zero position: main or first echo	
	CCDF and APD with crest factor		
	subchannel organization	SubChId, data rate, start capacity unit (CU), size CU, protection level	
	ensemble information	ensemble label, time and date (UTC), service labels, service component labels, SubChId, data rate, protection level, start CU, size CU, conditional access flag with R&S®ETL-B201	
	input of I/Q baseband signal, output of ETI (NI, G.703, HDB3), serial clock/data of selected subchannel		

<b>Measurement uncertainty</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With R&amp;S®FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Bit rate offset	referenced to MPEG transport stream rate	≤ 0.5 ppm
MPEG transport stream rate	referenced to MPEG transport stream rate	≤ 1 Hz
<b>Modulation error ratio (MER)</b>		
	8 dB to 30 dB	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 38 dB	typ. < 2.0 dB
<b>System performance</b>		
signal power	> -30 dBm, f ≤ 300 MHz	MER ≥ 40 dB
<b>Error vector magnitude (EVM)</b>		
	> 3 % to 40 %	typ. < 6 % of measured value
	> 1.8 % to 3 %	typ. < 11 % of measured value
	> 1.2 % to 1.8 %	typ. < 23 % of measured value
BER before Viterbi	$1.0 \times 10^{-2}$ to $0.1 \times 10^{-14}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
BER before Reed-Solomon	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-13}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
Packet error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-10}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
<b>Echo pattern</b>		
time		≤ 2 ns
<b>(channel impulse response)</b>		
level		≤ 0.5 dB (referred to main path)
<b>Channel filter for T-DMB/DAB firmware (R&amp;S®ETL-K250)</b>		
Channel filter bandwidth	1.536 MHz	automatic selection of channel filter, in line with selected channel bandwidth
Passband amplitude error		≤ 0.01 dB
Stopband attenuation		≥ 85 dB
Channel filter shape factor 85 dB:0.01 dB		≤ 1.11

### R&S®ETL-K251 T-DMB/DAB SFN frequency offset

The R&S®ETL-K250 option is required.

Frequency offset of echo signal, relative to frequency of main signal	range	±20 Hz
	resolution	0.01 Hz
	accuracy	0.03 Hz
Number of echoes displayed in result chart		up to 10 (including main signal)
Number of echoes available via remote control		up to 200 (including main signal)

## R&amp;S® ETL-K260 ISDB-T firmware

Standard	terrestrial TV in line with ARIB STD-B31	ISDB-T
Mode (FFT)	automatic detection or manual selection	2K, 4K, 8K
Modulation (QAM order)	automatic detection or manual selection	DQPSK, 4QAM, 16QAM, 64QAM
Layer	automatic detection of segments, manual selection of layer	A, B, C
Segments per layer	automatic detection or manual selection	13 in total (layer A + layer B + layer C)
Partial reception	automatic detection or manual selection	
Guard interval	automatic detection or manual selection	1/4, 1/8, 1/16, 1/32
Code rate (all layers)	automatic detection or manual selection	1/2, 2/3, 3/4, 5/6, 7/8
Interleaver mode	automatic detection or manual selection	
	mode 1 (2K FFT)	0, 4, 8, 16
	mode 2 (4K FFT)	0, 2, 4, 8
	mode 3 (8K FFT)	0, 1, 2, 4
Bandwidth	digitally filtered, in line with channel bandwidth, see subsection "Channel filter"	6 MHz
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, 64QAM, f < 1 GHz, R&S® ETL-B203 preselector not installed)
	minimum quasi-error-free input level (R&S® ETL-B203 preselector on, RF = 500 MHz, GI = 1/8, QPSK, CR = 2/3)	typ. -90 dBm
	carrier frequency offset (in Hz)	
	bit rate offset (in ppm)	
	modulation error ratio (MER) in dB or %	total, layer A, layer B, layer C, TMCC, AC
	bit error ratio (BER) before Viterbi decoder	layer A, layer B, layer C (selectable)
	BER before Reed-Solomon decoder	layer A, layer B, layer C (selectable)
	BER after Reed-Solomon decoder	
	packet error ratio or segment error ratio	layer A, layer B, layer C (selectable)
	MPEG transport stream bit rate	layer A, layer B, layer C (selectable)
	constellation diagram	quad screen, layer A, layer B, layer C, selectable carrier types (continual and scattered pilots, TMCC, AC1 and AC2); selectable symbol count (1 symbol to 999999999 symbols + infinite), freeze mode, selectable carrier number (carrier 0 to carrier 5616 in case of 8K FFT)
	MER versus frequency	selectable carrier number (carrier 0 to carrier 5616 in case of 8K FFT)
	amplitude imbalance	range: -5 % to +5 %, resolution: 0.01 %
	quadrature error	range: -5° to +5°, resolution: 0.01°
	carrier suppression	available if layer A is modulated coherently range: -5 dB to +60 dB, resolution: 0.1 dB
	carrier phase	range: -180° to +180°, resolution: 0.1°
	spectrum emission measurement	Japan: ARIB STD-B31 predefined masks for: P ≤ 0.025 W, 0.025 W < P < 0.25 W, P = 0.25 W, 0.25 W < P ≤ 2.5 W, P > 2.5 W Brazil: SBTVD predefined masks for: non-critical, subcritical, critical support of external notch filter selectable noise floor correction
	C/N	selection of noise bandwidth and frequency of measurement
	amplitude/phase/group delay frequency response	selectable carrier number (carrier 0 to carrier 5616 in case of 8K FFT)

<b>Measurements (cont.)</b>	echo pattern (channel impulse response)	selectable center and time/div, up to 10 echoes shown in a result chart, remote readout of up to 200 echoes, results sorted by level or time/distance, resolution: 1 ns, extended time range up to $t_{\text{symbol}}$ selectable zero position: main or first echo, absolute or relative display of echo levels
	CCDF and APD with crest factor	
	TMCC information	signal information: system identification, parameter switching indicator, emergency alarm broadcasting, partial reception, phase shift correction, reserved bits layer information (TMCC current and TMCC next, coupled with parameter switching indicator): modulation (QAM order), code rate, time interleaving, number of segments
	TV picture on display	with R&S®ETL-B280 and R&S®ETL-B281
<b>Measurement uncertainty (64QAM)</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With R&amp;S®FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
MPEG transport stream rate	referenced to MPEG transport stream rate	reference uncertainty
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Bit rate offset	referenced to MPEG transport stream rate	≤ 0.5 ppm
MPEG transport stream rate	referenced to MPEG transport stream rate	≤ 1 Hz
<b>Modulation error ratio (MER)</b>	18 dB to 30 dB	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 40 dB	typ. < 2.0 dB
System performance	signal power > -30 dBm, f ≤ 1.3 GHz	MER ≥ 40 dB (system optimization: fast or slow) 500 MHz, -10 dBm: 46 dB typ.
BER before Viterbi		
Bit rate/code rate × (204/188) > 5 Mbit/s	$1.0 \times 10^{-2}$ to $0.1 \times 10^{-15}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
Bit rate/code rate × (204/188) ≤ 5 Mbit/s	$1.0 \times 10^{-2}$ to $0.1 \times 10^{-14}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
BER before Reed-Solomon		
Bit rate > 5 Mbit/s	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-15}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
5 Mbit/s ≥ bit rate > 500 kbit/s	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-14}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
Bit rate ≤ 500 kbit/s	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-13}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio		
Bit rate > 8.16 Mbit/s	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
8.16 Mbit/s ≥ bit rate > 816 kbit/s	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-11}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
Bit rate ≤ 816 kbit/s	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-10}$ , 0,0	$0.1 \times 10^{-\text{exponent}}$
<b>Echo pattern (channel impulse response)</b>	time	≤ 2 ns
	level	≤ 0.5 dB (referred to main path)
<b>Channel filter for ISDB-T firmware (R&amp;S®ETL-K260)</b>		
Channel filter bandwidth		6.0 MHz
Passband amplitude error		≤ 0.01 dB
Stopband attenuation		≥ 80 dB
Channel filter shape factor 80 dB:0.01 dB		≤ 1.15

## R&S® ETL-K261 ISDB-T SFN frequency offset

The R&S® ETL-K260 option is required.

Frequency offset of echo signal, relative to frequency of main signal	range	±20 Hz
	resolution	0.01 Hz
	accuracy	0.03 Hz
Number of echoes displayed in result chart		up to 10 (including main signal)
Number of echoes available via remote control		up to 200 (including main signal)

## R&S® ETL-K340 DVB-T2 firmware

The R&S® ETL-B300 or R&S® ETL-B310 option is required for DVB-T2.

Standard	terrestrial TV in line with ETSI EN 302755 version 1.3.1: DVB-T2-base, DVB-T2-base lite, DVB-T2-lite	manual selection: T2-lite and T2-base automatic detection: T2-base, T2-base-lite
FFT mode	automatic detection or manual selection (manual selection: for DVB-T2-base only)	1K, 2K, 4K, 8K, 16K, 32K normal or extended carrier mode
Pilot pattern	automatic detection or manual selection (manual selection: for DVB-T2-base only)	PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8 (PP8 for measurements at the transmitter site only)
PLP QAM order	automatic detection or manual selection (manual selection: for DVB-T2-base and single PLP only)	4QAM, 16QAM, 64QAM, 256QAM normal or rotated constellation
Guard interval	automatic detection or manual selection for DVB-T2-base only	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Transmitter mode	automatic detection or manual selection (manual selection: for DVB-T2-base only)	SISO, MISO
PLP Code rate	automatic detection or manual selection (manual selection: for DVB-T2-base and single PLP only)	1/2, 3/5, 2/3, 3/4, 4/5, 5/6 for DVB-T2-base 1/2, 1/3, 2/5, 3/5, 2/3, 3/4 for DVB-T2-lite
FEC type	automatic detection or manual selection (manual selection: for DVB-T2-base and single PLP only)	64K LDPC, 16K LDPC
Time interleaver type	automatic detection in manual mode (DVB-T2-base and single PLP only)	according to standard: type 0 and 1 type 0 only
L1 post scrambling	automatic detection	according to DVB-T2 version 1.3.1
Support of DVB-T2-signals containing FEF (future extension frame)	automatic detection	according to DVB-T2 version 1.3.1
Bandwidth	digitally filtered, in line with channel bandwidth, see subsection "Channel filter"	1.7/5/6/7/8 MHz
Layers	single physical layer pipe (SPLP) multiple physical layer pipe (MPLP)	(selection of layer to be decoded)
<b>Measurements</b>	<b>parameter</b>	
	level	-55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, 64QAM, f < 1 GHz, R&S® ETL-B203 preselector not installed)
	minimum quasi-error-free input level (R&S® ETL-B203 preselector on, preamplifier on, RF = 500 MHz, GI = 1/8, QPSK, CR = 2/3)	typ. < -92 dBm
	carrier frequency offset (in Hz)	
	bit rate offset (in ppm)	
	MER (L1) (modulation error ratio of I/Q cells carrying L1 data) in dB or %	
	MER (PLP) in dB or %	of decoded PLP
	EVM (PLP) in dB or %	of decoded PLP
	BER before LDPC decoder	
	BER before BCH decoder	
	BBFRAME error ratio	
	ESR (errored seconds ratio)	
	TS packet error ratio	if payload type of decoded PLP is "TS" and normal mode (NM) is used
	constellation diagram	constellation of P1 symbols, selectable number of T2 frames constellation before frequency deinterleaver, selectable carrier range, selectable number of OFDM symbols (1 symbol to 999999999 symbols + infinite), selectable start symbol index within T2 frame, freeze mode constellation of I/Q cells of L1-pre signaling or L1-post signaling data after frequency deinterleaver, selectable number of T2 frames

<b>Measurements (cont.)</b>	constellation diagram (cont.)	constellation of selected PLP before time deinterleaver, selectable number of I/Q cells constellation of I/Q cells of selected PLP before and after derotation, selectable number of I/Q cells
	MER versus carrier	selectable carrier range for selected PLP
	shoulder attenuation in line with ETSI TR 101290	
	C/N	selection of noise bandwidth and frequency of measurement
	amplitude imbalance	range: -5 % to +5 %, resolution: 0.01 % (not for MISO signals)
	quadrature error	range: -5° to +5°, resolution: 0.01° (not for MISO signals)
	carrier suppression	range: -5 dB to +60 dB, resolution: 0.1 dB (not for MISO signals)
	carrier phase	range: -180° to +180°, resolution: 0.1° (not for MISO signals)
	amplitude/phase/group delay frequency response	selectable carrier number
	echo pattern (channel impulse response)	selectable center and time/div, up to 10 echoes shown in a result chart, remote readout of up to 200 echoes, results sorted by level or time/distance, resolution: 1 ns, MISO group 1, MISO group 2, MISO group 1 & 2 (dual trace), MISO group 1 & 2 (sum) selectable zero position: main or first echo, absolute and relative display of echo levels
	CCDF and APD with crest factor	
	preamble information (L1-pre signaling) preamble information (L1-post signaling, configurable part)	T2 version, bandwidth extension, guard interval, pilot pattern, transmission system, number of data symbols per T2 frame, number of T2 frames per superframe, L1-post constellation, L1-post size, L1-post info size, L1-post extension, L1-post code rate, L1-post FEC type, L1 repetition, PAPR, type of TX input streams, S1 bits, S2 bits, system ID, cell ID, network ID, TX ID availability, regeneration flag, number of frequencies, current RF index, CRC32 value, L1-post scrambled, T2-base-lite, reserved bits number of PLP, number of subslices per frame, number of auxiliary streams, AUX config RFU, FEF type, FEF interval, FEF length, AUX stream type, AUX private conf, reserved bits information of previewed and decoded PLP (including common PLP): PLP ID, PLP constellation, PLP rotation, PLP FEC type, PLP code rate, PLP type, PLP payload type, time interleaving type, time interleaving length, first frame index, frame interval, max. number of blocks, static flag, static padding flag PLP group ID, first RF index, inband signaling types A and B, PLP mode, reserved bits
	MPEG analyzer	with R&S®ETL-B280
TV picture on display	with R&S®ETL-B280 and R&S®ETL-B281	
<b>Measurement uncertainty</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty

<b>With R&amp;S®FSL-B4 OCXO</b>		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
<b>With external 10 MHz reference (f ≤ 1 GHz)</b>		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Bit rate offset	referenced to MPEG transport stream rate	≤ 0.5 ppm
<b>Modulation error ratio (MER)</b> (32K FFT, bandwidth extension)	20 dB to 30 dB (256QAM), 14 dB to 30 dB (64QAM), 10 dB to 30 dB (16QAM)	typ. < 0.6 dB
	30 dB to 35 dB	typ. < 1.0 dB
	35 dB to 40 dB	typ. < 2.0 dB
System performance	signal power > -30 dBm, f ≤ 1.3 GHz	MER ≥ 40 dB (system optimization: stationary fast or stationary slow) 500 MHz, -10 dBm: 46 dB typ.
Error vector magnitude (EVM)	> 2 % to 20 % (16QAM), > 2 % to 12 % (64QAM), > 2 % to 6 % (256QAM)	typ. < 6 % of measured value
	> 1.2 % to 2 %	typ. < 11 % of measured value
	> 0.7 % to 1.2 %	typ. < 23 % of measured value
BER before LDPC or BCH	$1.0 \times 10^{-3}$ to $0.1 \times 10^{-15}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
BBFRAME error ratio	$1.0 \times 10^{-1}$ to $0.1 \times 10^{-12}$ , 0.0	$0.1 \times 10^{-\text{exponent}}$
Echo pattern (channel impulse response)	time	≤ 2 ns
	level	≤ 0.5 dB (referred to main path)
<b>Channel filter for DVB-T2 firmware (R&amp;S®ETL-K340)</b>		
Channel filter bandwidth	1.7/5.0/6.0/7.0/8.0/10.0 MHz	automatic selection of channel filter, in line with selected channel bandwidth
Passband amplitude error		≤ 0.015 dB (normal carrier mode) ≤ 0.045 dB (extended carrier mode)
Stopband attenuation		≥ 60 dB
Channel filter shape factor	60 dB:0.015 dB	≤ 1.09
	60 dB:0.045 dB	≤ 1.07

### R&S®ETL-K341 DVB-T2 SFN frequency offset

The R&S®ETL-K340 option is required.

Frequency offset of echo signal, relative to frequency of main signal	frequency offset range	depends on DVB-T2 system parameterization (bandwidth, FFT mode, frame length, SISO/MISO...). Maximum possible frequency offset (range) is indicated in measurement display.
	time range	maximum time range of frequency offset measurement depends on selected bandwidth, FFT mode and pilot pattern. Frequency offset calculation is at least possible for echoes within the guard interval.
	resolution	0.01 Hz
	accuracy	0.03 Hz
	SISO/MISO mode	MISO group 1, MISO group 2, MISO group 1 & 2 (dual trace), MISO group 1 & 2 (sum)
Number of echoes displayed in result chart		up to 10 (including main signal)
Number of echoes available via remote control		up to 200 (including main signal)

## R&amp;S® ETL-K208 measurement log

Measurement log for digital TV signals		
Available standards		DVB-C (R&S® ETL-K210) J.83/B (R&S® ETL-K213) DTMB (R&S® ETL-B215/-B216) ATSC (R&S® ETL-K220) DVB-T/DVB-H (R&S® ETL-K240) T-DMB/DAB (R&S® ETL-K250) ISDB-T (R&S® ETL-K260) ATSC-M/H (R&S® ETL-K320/-K322) DVB-T2 (R&S® ETL-K340) FM radio (R&S® ETL-K110)
Time interval		1/2/5/10/20/30 minutes, 1/2/5/10 hours, 1/2/5/10/20/50/100/200/500/1000 days
Auto interval length		on, off
Log detectors		max. min. auto peak average
Traces for measurement log		2
Display of MPEG TS synchronization		always shown at bottom of display (trace 3)

Measurement parameters available in the measurement log for digital TV standards:

Measurement parameter	TV standard								
	DVB-C (R&S® ETL-K210)	J.83/B (R&S® ETL-K213)	DTMB (R&S® ETL-B215/-B216)	ATSC (R&S® ETL-K220)	ATSC-M/H (R&S® ETL-K320/-K322)	DVB-T/DVB-H (R&S® ETL-K240)	T-DMB/DAB (R&S® ETL-K250)	ISDB-T (R&S® ETL-K260)	DVB-T2 (R&S® ETL-K340)
Input level	•	•	•	•	•	•	•	•	•
Carrier frequency offset	•	•	•	•	•	•	•	•	•
Bit rate offset	•	•	•	•	•	•	•	•	•
MPEG TS bit rate	•	•	•	•	•	•	•	•	•
BER before Viterbi						•	•	•	
BER before Viterbi FIC							•		
BER before Viterbi MSC							•		
BER before LDPC			•						•
LDPC iterations									•
BER before Reed-Solomon	•	•		•	•	•	•	•	
BER after Reed-Solomon	•	•		•	•	•	•	•	
BER before BCH									•
BBFRAME error ratio									•
ESR (errored second ratio)									•
MER (RMS) in dB	•	•	•	•	•	•	•	•	• (PLP)
MER (peak) in dB	•	•	•	•	•	•	•	•	• (PLP)
EVM (RMS) in %	•	•	•	•	•	•	•		• (PLP)
EVM (peak) in %	•	•	•	•	•	•	•		• (PLP)
SNR				•	•				
Packet error ratio	•	•	•	•	•	•	•	•	•
Packet errors	•	•	•	•	•	•	•	•	•
FIB errors							•		
None (trace not displayed)	•	•	•	•	•	•	•	•	•
Date/time	•	•	•	•	•	•	•	•	•
GPS data (when NMEA-compliant GPS device is connected): longitude, latitude, altitude, HDOP, number of satellites	•	•	•	•	•	•	•	•	•
ATSC-M/H bit rates (see R&S® ETL-K320/-K322)					•				
ATSC-M/H bit error/packet error measurements (see R&S® ETL-K320/-K322)					•				

## FM/AM options

### R&S®ETL-B110 high SNR FM frontend/R&S®ETL-B310 FPGA extension board, high SNR FM

Frequency range	CCIR and Japan	75 MHz to 110 MHz
Max. input level		20 dBm
Noise figure	preselector on, preamplifier on	typ. 8 dB
	preselector on, preamplifier off	typ. 15 dB
SNR (stereo)	preselector off, preamplifier off, pin = 10 dBm, weighted in line with ITU-R BS.468-4, quasi-peak detector	≥ 80 dB
RF inputs	included in base unit, R&S®ETL-B203 option required	N female, 50 Ω F male, 75 Ω see R&S®ETL-B203

### R&S®ETL-K110 FM (radio) firmware

Standard		FM radio (in line with ITU-R BS.450-3)
Modulation standards		FM mono FM stereo (pilot tone system)
IF filter bandwidth		150/200/250/300/350/400/1000 kHz (selectable)
MPX bandwidth		10 Hz to 100 kHz
FM deviation range		±150 kHz
<b>Measurements</b>	<b>parameter</b>	
	RF level	range: -110 dBm (typ. noise floor) to +20 dBm, resolution: 0.1 dB
	carrier frequency offset	resolution: 1 Hz
	amplitude modulation depth	range: 0 % to 100 %, resolution: 0.01 %
	deviation of MPX signal	range: ±150 kHz, resolution: 1 Hz
	deviation of L signal	range: ±150 kHz, resolution: 1 Hz
	deviation of R signal	range: ±150 kHz, resolution: 1 Hz
	deviation of M signal	range: ±150 kHz, resolution: 1 Hz
	deviation of S signal	range: ±150 kHz, resolution: 1 Hz
	deviation of pilot signal	range: ±75 kHz, resolution: 1 Hz
	pilot frequency offset	range: ±25 Hz, resolution: 0.01 Hz
	pilot phase	range: ±40°, resolution: 0.1°
	deviation of RDS/DARC signal	range: ±75 kHz, resolution: 1 Hz
	RDS frequency offset	range: ±10 Hz, resolution: 0.01 Hz
	RDS phase	range: ±130°, resolution: 0.1°
	deviation of SCA signal	range: ±75 kHz, resolution: 1 Hz
	SCA frequency offset	range: ±5 kHz, resolution: 1 Hz
	deviation of SCA subcarrier	range: ±6 kHz (narrow mode, AF = 500 Hz) resolution: 1 Hz
<b>RDS analysis</b>	basic RDS analysis	RDS BER, program service name, RDS date, RDS local time and RDS UTC, program identification, decoder identification, program type, country, extended country code, TP, TA and MS flags
	extended RDS analysis	radio text and radio text plus, alternative frequencies, enhanced other networks information, group viewer, raw data of open data applications (ODA) and traffic message channel (TMC)
	output of decoded RDS data at the clock/data interface of the R&S®ETL-B201 option	

<b>Graphical measurements</b>	<b>audio scope</b>		
	signals	MPX, AM, L&R, L, R, M&S, M, S, pilot, RDS/DARC subcarrier, SCA, SCA subcarrier	
	timebase	10 $\mu$ s to 1 s	
	marker	time marker	
	trigger	free run, trace 1, trace 2	
	trigger threshold	0 Hz to 150 kHz	
	trigger slope	positive, negative	
	<b>audio spectrum</b>		
	signals	MPX, AM, L&R, L, R, M&S, M, S, pilot, RDS/DARC subcarrier, SCA, SCA subcarrier	
	frequency range	0 Hz to 100 kHz	
	resolution bandwidth	2 Hz to 10 kHz	
	FFT window type	flat top	
	amplitude scaling	linear, logarithmic	
	detector	auto peak, pos. peak, neg. peak, RMS, average, sample	
	marker	frequency marker noise marker marker peak list	
	<b>MPX power and peak deviation</b>		
	MPX power	in line with ITU-R SM.1268-1 and 1268-2	
	integration time	60 s	
	reference deviation	19 kHz	
	peak deviation	peak deviation versus time	
	peak hold time	10 s	
	time interval	$\geq$ 60 s, fixed or selectable	
	marker	time marker	
	timer control	start/stop date and time or duration	
	<b>MPX deviation distribution</b>		
	deviation distribution	in line with ITU-R SM.1268-1 and 1268-2	
	cumulative deviation distribution	in line with ITU-R SM.1268-1 and 1268-2	
	deviation resolution	1 kHz	
	marker	deviation marker percent marker	
	timer control	synchronized with MPX power and peak deviation measurement	
	<b>multipath detection</b>		
	RF frequency response		
	gradient of RF frequency response	in line with ITU-R SM.1268-1 and 1268-2	
	<b>protection ratio</b>		
	mask	in line with ITU-R SM.1268-1 and 1268-2	
	<b>Measurement uncertainty</b>		
	RF level	-100 dBm to +20 dBm (7 dB $\mu$ V to 127 dB $\mu$ V)	$\leq$ 1 dB
	Carrier frequency offset	referenced to carrier frequency	reference uncertainty
	<b>With R&amp;S<sup>®</sup>FSL-B4 OCXO</b>		
	Carrier frequency offset	referenced to carrier frequency	reference uncertainty
	<b>With external 10 MHz reference (f <math>\leq</math> 1 GHz)</b>		
	Carrier frequency offset	referenced to carrier frequency	$\leq$ 1 Hz
	<b>Deviation</b>		
	<b>Inherent noise</b>		
	MPX signal	RF level = -47 dBm	$\leq$ 1.5 kHz
	L, R, M and S signal		$\leq$ 500 Hz
	Pilot signal		$\leq$ 20 Hz
	RDS signal		$\leq$ 300 Hz
	DARC signal		$\leq$ 700 Hz
	SCA subcarrier signal		$\leq$ 700 Hz
	SCA audio signal		$\leq$ 700 Hz

<b>With R&amp;S® ETL-B110/-B310</b>		
MPX signal	preselector = off, attenuation = 0 dB RF level = 0 dBm	≤ 30 Hz
L, R and S signal		≤ 10 Hz
M signal		≤ 2 Hz
Pilot signal		≤ 10 Hz
RDS signal		≤ 10 Hz
DARC signal		≤ 20 Hz
SCA subcarrier signal		≤ 20 Hz
SCA audio signal		≤ 20 Hz
<b>Audio outputs</b>		
Connector	AF signal output of base unit	2 × Lemo Triax, female, balanced (symmetrical to ground), typ. 20 Ω source impedance
Signals		M, L&R, M&S, SCA
Deemphasis	M, L&R, M&S	off, 50 μs, 75 μs
	SCA	off, 100 μs, 150 μs
Output level	level specified for high-impedance load, 600 Ω minimum load	6 dBu (nom.), adjustable for 20 kHz to 160 kHz deviation, max. 12 dBu
Maximum available SNR	with R&S® ETL-B110 or R&S® ETL-B310, 50 μs deemphasis, weighted in line with ITU-R BS.468-4, quasi-peak detector	typ. 70 dB
Headphone	at front panel	3.5 mm mini jack
<b>Auxiliary output</b>		
Connector	video output (CCVS ) of base unit	BNC, 75 Ω
Signals		MPX, AES/EBU, pilot, RDS/DARC subcarrier, SCA subcarrier
Output level	level specified for high-impedance load	1 V/75 kHz deviation, max. 2 V, 75 Ω source impedance
<b>MPX input</b>		
Connector	R&S® ETL-B201 option	BNC

**R&S® ETL-K111 FM (radio) audio analysis/generator**

For the audio generator, the R&amp;S® ETL-B201 option (model .03) is required.

<b>Audio analysis</b>		
<b>Measurements</b>	<b>parameters</b>	
	frequency response	
	response type	amplitude (RMS), amplitude (selective), phase (selective), L-R balance
	signals	MPX, L&R, L, R, M&S, M, S, SCA
	frequency scaling	linear, logarithmic
	crosstalk	
	crosstalk type	linear, nonlinear, linear and nonlinear combined
	signals	L&R, L, R, M&S, M, S, SCA
	frequency scaling	linear, logarithmic
	audio level	
	signals	MPX, L&R, L, R, M&S, M, S, SCA
	detector	
	MPX	selective peak RMS · $\sqrt{2}$
	L&R, L, R, M&S, M, S, SCA	selective peak quasi-peak · $\sqrt{2}$ RMS · $\sqrt{2}$
	mode	absolute, relative (dB, %, $\Delta$ %)
	S/N	
	signals	MPX, AM, L&R, L, R, M&S, M, S, SCA
	filter/detector	
	MPX	flat 100 kHz/RMS
	AM	flat/peak flat 20 kHz/peak flat 20 kHz/quasi-peak ITU-R BS.468-4 weighted/quasi-peak
	L, R, M, S, SCA	flat 15 kHz/RMS flat 15 kHz/quasi-peak ITU-R BS.468-4 weighted/quasi-peak
	THD	
	distortion types	THD, SINAD
	signals	MPX, L&R, L, R, M&S, M, S, SCA
	THD harmonics	d2 to d8
	DFD	
	signals	MPX, L&R, L, R, M&S, M, S
	second-order intermodulation	$f_2 - f_1$ $f_2 - f_1$ and $f_2 + f_1$
	third-order intermodulation	$2 \times f_2 - f_1$ and $2 \times f_1 - f_2$

<b>Audio generator</b>		
Connectors	R&S®ETL-B201 option	3 × BNC, unbalanced
	AF signal output of base unit	2 × Lemo Triax, female, balanced (symmetrical to ground), typ. 20 Ω source impedance
Generator type		analog (R&S®ETL-B201 option) MPX (R&S®ETL-B201 option) AES/EBU (R&S®ETL-B201 option) analog (output of base unit)
Waveforms		single tone dual tone, constant spacing dual tone, independent frequencies
Signals	analog (R&S®ETL-B201 option)	AF, L, R, L = R, off
	MPX (R&S®ETL-B201 option)	L, R, L = R, L = -R, L ≠ R (single tone only), SCA, off
	AES/EBU	L, R, L = R, L = -R, L ≠ R (single tone only), off
	analog (output of base unit)	off
Frequency range	analog (R&S®ETL-B201 option)	10 Hz to 100 kHz
	MPX (R&S®ETL-B201 option)	10 Hz to 100 kHz
	AES/EBU	10 Hz to 24 kHz
	analog (output of base unit)	10 Hz to 15 kHz
Output level	analog (R&S®ETL-B201 option)	max. 18 dBu (specified for high-impedance load, 600 Ω minimum load)
	MPX (R&S®ETL-B201 option)	max. 18 dBu (specified for high-impedance load, 600 Ω minimum load)
	AES/EBU	4 V ( $V_{pp}$ ) into 75 Ω or 110 Ω
	analog (output of base unit)	max. 12 dBu (specified for high-impedance load, 600 Ω minimum load)
Source impedance	analog (R&S®ETL-B201 option)	10 Ω
	MPX (R&S®ETL-B201 option)	10 Ω
	AES/EBU	75 Ω or 110 Ω, selectable
	analog (output of base unit)	20 Ω

### R&S® FSL-K7 AM/FM/φM measurement demodulator

<b>Measurement of analog modulation signals</b>		
Demodulation bandwidth		100 Hz to 6.4 kHz, binary steps 12.5 kHz to 1.6 MHz, binary steps 3/5/8/10/18 MHz
Recording length	maximum	512 ksample
Recording time	demodulation bandwidth	
	100 Hz	3276.8 s
	6.4 kHz	51.2 s
	12.5 kHz	26.6 s
	1.6 MHz	200 ms
	3 MHz	100 ms
	5 MHz	50 ms
	8 MHz	25 ms
	10 MHz	12.5 ms
18 MHz	12.5 ms	
Display	frequency versus time (FM), amplitude versus time (AM), phase versus time (φM), RF power versus time, RF spectrum (FFT), AF spectrum (FFT), table with numeric values for: modulation deviation (peak, RMS), modulation frequency, carrier offset, carrier power (power of unmodulated carrier), THD, SINAD	
<b>AF (modulation frequency)</b>		
Range		≤ 9 MHz max. 0.5 × demodulation bandwidth
Resolution		5 digits
Measurement uncertainty		0.1 %
AF filters	lowpass	3 kHz, 15 kHz, 150 kHz, 5 %, 10 %, 25 % of demodulation bandwidth
	highpass	50 Hz, 300 Hz
	deemphasis	25 μs, 50 μs, 75 μs, 750 μs

<b>AM demodulation</b>		
Measurement range	modulation depth	0 % to 100 %
Modulation depth uncertainty	AF ≤ 1 MHz	< 3 % of measured value + residual AM
Residual AM	demodulation bandwidth ≤ 200 kHz, RMS, RF ≤ 3 GHz, RF input level ≥ (RF attenuation/dB – 30) dBm	0.2 %
Distortion	10 Hz ≤ AF ≤ 100 kHz	0.3 %
FM rejection	AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth	typ. 1 % + residual AM
<b>FM demodulation</b>		
Measurement range	frequency deviation	≤ 9 MHz
Deviation uncertainty	AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth	< 3 % of measured value + residual FM
Residual FM	demodulation bandwidth ≤ 100 kHz, RMS, RF input level ≥ (RF attenuation/dB – 30) dBm	
	RF ≤ 1 GHz	150 Hz
	RF = 3 GHz	200 Hz
Distortion	10 Hz ≤ AF ≤ 100 kHz, deviation < 400 kHz	0.3 %
AM rejection	100 Hz ≤ AF ≤ 1 kHz, modulation depth 50 %	30 Hz
<b>φM demodulation</b>		
AF		≤ 5 MHz, max. 0.5 × demodulation bandwidth
Measurement range	phase deviation	< 1000 rad
Residual φM	demodulation bandwidth ≤ 100 kHz, RMS, RF = 1 GHz, 300 Hz highpass, RF input level ≥ (RF attenuation/dB – 30) dBm	5 mrad
<b>Carrier power versus time</b>		
Display range		noise floor to +20 dBm
Measurement uncertainty	unmodulated carrier, S/N > 16 dB, RF: 50 kHz to 3 GHz	typ. 1 dB
Max. dynamic range	200 kHz demodulation bandwidth	typ. 75 dB
Display linearity	S/N > 16 dB	typ. 0.2 dB
<b>AF spectrum</b>		
Span		≤ 9 MHz
Resolution bandwidth		1 Hz to 10 MHz
<b>RF spectrum</b>		
Span		≤ 18 MHz
Resolution bandwidth		1 Hz to 10 MHz
Shape factor 60 dB:3 dB		2.5 (nom.)
<b>Modulation distortion</b>		
Measurement functions		THD, SINAD
Measurement range		–100 dB to 0 dB
Resolution		0.01 dB
Measurement uncertainty		typ. 0.5 dB
AF frequency range		10 Hz to 5 MHz
<b>Trigger</b>		
Trigger functions		RF level, AM, FM, φM demodulation

## Part 2 – Spectrum analyzer

### Frequency

Range		500 kHz to 3 GHz
Resolution		1 Hz
<b>Reference frequency, internal, nominal</b>		
Aging per year		$1 \times 10^{-6}$
Temperature drift	0 °C to +50 °C	$1 \times 10^{-6}$
<b>Reference frequency, internal, nominal</b> R&S®FSL-B4 OCXO reference frequency option		
Aging per year		$1 \times 10^{-7}$
Temperature drift	0 °C to +50 °C	$1 \times 10^{-7}$
<b>Total reference uncertainty</b>		(time since last adjustment × aging rate) + temperature drift
<b>Frequency readout</b>		with marker or frequency counter
Marker resolution		span/500
Uncertainty		± (marker frequency × reference uncertainty + 2 % × span + 10 % × resolution bandwidth + ½ (last digit))
Frequency counter resolution		1 Hz
Count uncertainty	S/N > 25 dB	± (frequency × reference uncertainty + ½ (last digit))
Frequency span		0 Hz, 10 Hz to 3 GHz
Span uncertainty		3 %
<b>Spectral purity of SSB phase noise</b>		
Carrier offset	1 kHz	typ. -90 dBc (1 Hz)
	10 kHz	< -98 dBc (1 Hz), typ. -103 dBc (1 Hz)
	100 kHz	< -98 dBc (1 Hz), typ. -105 dBc (1 Hz)
	1 MHz	< -115 dBc (1 Hz), typ. -120 dBc (1 Hz)

### Sweep time

Sweep time	10 Hz ≤ span ≤ 3.2 kHz	2.5 ms to 5 × span
	3.2 kHz < span ≤ 1.5 GHz	2.5 ms to 16000 s
	1.5 GHz < span ≤ 3 GHz	5 ms to 16000 s
Uncertainty		3 % (nom.)
	span 0 Hz	1 μs to 5 μs in 125 ns steps 5 μs to 16000 s in 5 % steps

### Resolution bandwidths

<b>Sweep filters</b>		
Resolution bandwidths		300 Hz to 10 MHz (-3 dB) in 1/3 sequence
	with R&S®FSL-B7 zero span	10 Hz to 10 MHz (-3 dB) in 1/3 sequence additionally 20 MHz (-3 dB)
Resolution bandwidth uncertainty		< 3 % (nom.)
Resolution filter shape factor 60 dB:3 dB	Gaussian type filters	< 5 (nom.)
<b>EMI filters</b>		
6 dB bandwidths		9 kHz, 120 kHz, 1 MHz
	with R&S®FSL-B7	200 Hz, 9 kHz, 120 kHz, 1 MHz
Bandwidth uncertainty		< 3 % (nom.)
Shape factor 60 dB:3 dB		< 6 (nom.)
<b>FFT filters</b>		
3 dB bandwidths	analyzer mode	
	with R&S®FSL-B7	300 Hz to 30 kHz in 1/3 sequence 1 Hz to 30 kHz in 1/3 sequence
Bandwidth uncertainty		5 % (nom.)
Shape factor 60 dB:3 dB		2.5 (nom.)
<b>Channel filters</b>		
Bandwidths	300/500 Hz; 1/1.5/2/2.4/2.7/3/3.4/4/4.5/5/6/8.5/9/10/12.5/14/15/16/18 (RRC)/20/21/24.3 (RRC)/25/30/50/100/150/192/200/300/500 kHz; 1/1.228/1.28 (RRC)/1.5/2/3/3.75/3.84 (RRC)/4.096 (RRC)/5 MHz (RRC = root raised cosine)	
	with R&S®FSL-B7	100 Hz, additionally 200 Hz
Video bandwidths	(one-pole lowpass RC filters)	1 Hz to 10 MHz in 1/3 sequence
Demodulation bandwidth		20 MHz (nom.)

## Level

Display range		displayed noise floor to +20 dBm	
<b>Maximum permissible input level</b>			
DC voltage		80 V	
CW RF power	preamplifier off	30 dBm (= 1 W)	
CW RF power	preamplifier on	20 dBm (= 0.1 W)	
Peak RF power	preamplifier off	36 dBm (= 4 W), $t < 3$ s	
Max. pulse voltage		150 V	
Max. pulse energy	10 $\mu$ s	10 mWs	
1 dB compression of input mixer	0 dB RF attenuation, $f > 200$ MHz	+5 dBm (nom.)	
<b>Intermodulation</b>			
Third-order intermodulation (TOI)	intermodulation-free dynamic range, level $2 \times -20$ dBm, reference level $-10$ dBm, preamplifier = off		
	$f < 30$ MHz	$> 54$ dBc (TOI $> +7$ dBm, typ. $+12$ dBm)	
	$f \geq 30$ MHz	$> 60$ dBc (TOI $> +10$ dBm, typ. $+18$ dBm)	
Second harmonic intercept (SHI)	$f = 20$ MHz to 3 GHz	typ. 40 dBm	
<b>Displayed average noise level</b>			
	0 dB RF attenuation, 50 $\Omega$ termination, RBW = 1 kHz, VBW = 1 Hz, sample detector, log scaling, tracking generator off, normalized to 1 Hz		
R&S <sup>®</sup> ETL-B203 not installed	preamplifier off		
	500 kHz to 1 MHz	$< -100$ dBm (1 Hz)	
	1 MHz to 10 MHz	$< -115$ dBm (1 Hz)	
	10 MHz to 50 MHz	$< -130$ dBm (1 Hz)	
	50 MHz to 3 GHz	$< -140$ dBm (1 Hz)	
	preamplifier on		
	500 kHz to 1 MHz	$< -115$ dBm (1 Hz)	
	1 MHz to 10 MHz	$< -130$ dBm (1 Hz)	
	10 MHz to 50 MHz	$< -145$ dBm (1 Hz)	
	50 MHz to 3 GHz	$< -152$ dBm (1 Hz)	
	preamplifier on, typical values		
	500 MHz	$-162$ dBm (1 Hz)	
	1 GHz	$-160$ dBm (1 Hz)	
	3 GHz	$-158$ dBm (1 Hz)	
With R&S <sup>®</sup> ETL-B203 preselector (bypass)	preamplifier off		
	500 kHz to 1 MHz	$< -92$ dBm (1 Hz)	
	1 MHz to 10 MHz	$< -107$ dBm (1 Hz)	
	10 MHz to 50 MHz	$< -122$ dBm (1 Hz)	
	50 MHz to 3 GHz	$< -128$ dBm (1 Hz)	
	preamplifier on		
	500 kHz to 1 MHz	$< -115$ dBm (1 Hz)	
	1 MHz to 10 MHz	$< -130$ dBm (1 Hz)	
	10 MHz to 50 MHz	$< -145$ dBm (1 Hz)	
	50 MHz to 3 GHz	$< -152$ dBm (1 Hz)	
	With R&S <sup>®</sup> ETL-B203 preselector (filter path, TV mode)	preamplifier off	
		500 kHz to 1 MHz	$< -110$ dBm (1 Hz)
		1 MHz to 10 MHz	$< -125$ dBm (1 Hz)
		10 MHz to 50 MHz	$< -140$ dBm (1 Hz)
50 MHz to 3 GHz		$< -150$ dBm (1 Hz)	
preamplifier on			
500 kHz to 1 MHz		$< -120$ dBm (1 Hz)	
1 MHz to 10 MHz		$< -135$ dBm (1 Hz)	
10 MHz to 50 MHz		$< -150$ dBm (1 Hz)	
50 MHz to 3 GHz		$< -157$ dBm (1 Hz)	

<b>Immunity to interference</b>		
Image frequency	$f_{in} - 2 \times 48.375 \text{ MHz}$	< -80 dBc, typ. -90 dBc
	$f_{in} - 2 \times 838.375 \text{ MHz}$	< -80 dBc, typ. -90 dBc
	$f_{in} - 2 \times 7158.375 \text{ MHz}$	typ. -60 dBc
Intermediate frequency	typ. 48.375 MHz, typ. 838.375 MHz, typ. 7158.375 MHz	< -60 dBc
Intermediate frequency/2	typ. 24.1875	typ. -80 dBc
Spurious response, inherent	$f > 30 \text{ MHz}$ , without input signal, RF attenuation = 0 dB, RBW < 1 MHz	< -90 dBm
Spurious response, referenced to local oscillators	$\Delta f < 100 \text{ kHz}$	typ. -60 dBc
	$\Delta f \geq 100 \text{ kHz}$	< -60 dBc
Spurious response	referenced to A/D conversion	typ. < -70 dBc
Spurious response	referenced to subharmonic of first LO (spur at $7158.375 \text{ MHz} - 2 \times f_{in}$ )	typ. -60 dBc
Spurious response at mixer level < -10 dBm	referenced to harmonic of first LO (spur at $f_{in} - 3579.1875 \text{ MHz}$ )	typ. -60 dBc
<b>Level display</b>		
Logarithmic level axis		10 dB to 100 dB
Linear level axis		0 % to 100 %/10 divisions
Number of traces		4
Trace detectors		max. peak, min. peak, auto peak, sample, RMS, quasi-peak, average
Number of measurement points	default value	501
	range	125 to 16001 in steps of about a factor of 2
Trace functions		clear/write, max. hold, average, min. hold, view
Setting range of reference level	logarithmic level display	-80 dBm to +20 dBm in steps of 2 dB, 5 dB or 10 dB
	linear level display	-80 dBm to +20 dBm, 0 % to 100 %
Units of level axis	logarithmic level display	dBm, dBmV, dB $\mu$ V, dB $\mu$ A, dBpW
	linear level display	$\mu$ V, mV, V, $\mu$ A, mA, A, pW, nW, $\mu$ W, mW, W
<b>Level measurement uncertainty</b>		
95 % confidence level, +20 °C to +30 °C, S/N > 16 dB, 0 dB to -50 dB from reference level	10 MHz < $f \leq 3 \text{ GHz}$	< 0.5 dB
Absolute uncertainty at reference frequency		< 0.3 dB
Frequency response (+20 °C to +30 °C)		< 0.5 dB, typ. 0.3 dB
Attenuator uncertainty		< 0.3 dB
Uncertainty of reference level setting		< 0.1 dB (nom.)
<b>Display nonlinearity</b>		
Logarithmic level display	S/N > 16 dB, 0 dB to -50 dB	< 0.2 dB
Bandwidth switching uncertainty	reference: RBW = 10 kHz	< 0.1 dB (nom.)

## Trigger functions

<b>Trigger</b>		
Trigger source		free run, video, external, IF power
External trigger level		TTL level

## I/Q data

Memory length	output via LAN or GPIB (R&S <sup>®</sup> FSL-B10 option)	max. 512 ksample I and Q
Sample rate		10 kHz to 65.8 MHz
Signal bandwidth	65.833333 MHz sample rate	20 MHz

## Part 3 – Transport stream analysis and monitoring

### R&S® ETL-B280 MPEG processing board

Only for R&S® ETL with serial number > 100500.

<b>Signal inputs</b>		
TS input	number	1 (+ 1 internal)
	connector	BNC
		75 Ω
Mode (user-selectable)	ASI	270 Mbit/s 188/204/208 byte in line with EN 50083-9 (2002)
	SMPTE 310M	19.392658 Mbit/s 188 byte in line with BP 400 SMPTE
Max. cable length		180 m
Max. data rate across all inputs	depending on TS content	128 Mbit/s
<b>Monitoring</b>		
Monitoring engines	R&S® ETL-K282	1 to 2, at least one R&S® ETL-K282 option required for analysis and monitoring
<b>Signal output</b>		
TS output	connector	BNC
		75 Ω
	mode	ASI, SMPTE 310M (user-selectable)
Max. data rate		128 Mbit/s
<b>Video and audio interface</b>		
HDMI	digital	supported by R&S® ETL-B281

## R&S® ETL-K282 MPEG analysis/monitoring

The R&S® ETL-B280 option is required.

<b>Broadcasting standard</b>	independently selectable for every activated signal input	DVB
		ATSC
		SCTE
		ISDB-T
		ISDB-T <sub>B</sub>
<b>Views and function</b>		
Site tree		status overview of all inputs definable site name definable input name
TS tree		tree display of TS structure with event indication in TS tree element
Topology		selectable background display with status display (to be positioned as required) for all enabled signal inputs; TS pie chart can be added
Background image format		GIF
Recommended image size	without pie chart (W × H)	580 × 165 pixel
	with pie chart (W × H)	580 × 380 pixel
Monitoring		realtime TS monitoring
		data rate analysis
		table repetition analysis
<b>Monitoring</b>		
Display of monitoring test results		
Site tree		status indication for all inputs
Input tree		status indication for all TS elements
Statistics counter		error seconds of top-level test parameter
Log view	event description with	time/date
		class (event, alarm, info, system)
		detail information
		PID number
		service number
Bit rate view		bargraph display with peak hold for each section
Table repetition view		bargraph display with peak hold for each section
Size of statistics counter		up to 9999 error seconds
Size of event log	realtime view	1000 lines
	deferred view (log to file)	only limited by space on hard disk
Event class		configurable for each monitoring parameter
		alarm
		warning
		info
		for system events
		system
Limits		configurable for each applicable monitoring parameter
Alarm line		configurable for each monitoring parameter
Log type		transition (new entry by change of status only)
		continuous (new entry every second in case of event)

Log filter	realtime log	system + alarm system + warning system + info
Log to file scheduling		new log file every day new log file every hour new log file after 1 min to 1000 min new log file after 1000 events to 100000 events
<b>Hiding of events</b>		
Number of hidden event definitions		up to 200
Event filter		top-level monitoring parameter PID
Hiding time		0 s to 99999999 s infinite
Monitoring configuration		unlimited number of different configurations import/export feature for quick exchange global assignment (one setting for some or all inputs) single assignment (different settings for each input)

### DVB monitoring measurements

<b>TR 101 290 V1.2.1 – 1st priority monitoring</b>		
TS synchronization	1 packet to 7 packets	loss after packets
	1 packet to 31 packets	lock after packets
Sync byte		single byte invalid successive bytes invalid
PAT	0.1 s to 9999.9 s	upper repetition period
		table ID
		scrambled
Continuity count		discontinuous packet order
		packet occurs more than twice
		packet lost
		incorrect use of discontinuity flag
PMT	0.1 s to 9999.9 s	upper repetition period
		scrambled
PID distance	0.1 s to 9999.9 s	video – upper period
	0.1 s to 9999.9 s	audio – upper period
	0.1 s to 9999.9 s	data – upper period
	“excluding of PID” feature	up to 10 PID numbers
<b>TR 101 290 V1.2.1 – 2nd priority monitoring</b>		
Transport		error indicator
CRC		error in PAT
		error in CAT
		error in PMT
		error in NIT
		error in BAT
		error in SDT
		error in EIT
		error in TOT
		error in SIT
		error in TSMT
		error in MIP
		error in AIT
PCR discontinuity	1 ms to 99999 ms	upper limit
PCR repetition	1 ms to 99999 ms	lower period
	1 ms to 99999 ms	upper period

PCR jitter	10 ns to 999999 ns	upper limit
	profiles	MGF1 (10 MHz)
		MGF2 (100 MHz)
		MGF3 (1 Hz)
test mode	accuracy <sup>1</sup>	
PTS repetition	1 ms to 99999 ms	overall jitter – including packet arrival time
CAT	0.1 s to 9999.9 s	upper period
		missing
		table ID
<b>TR 101 290 V1.2.1 – 3rd priority monitoring</b>		
SI repetition	1 ms to 9999 ms	PAT lower period
	limit is equal to limit of 1st priority PAT	PAT upper period
	1 ms to 9999 ms	CAT lower period
	limit is equal to limit of 1st priority CAT	CAT upper period
	1 ms to 9999 ms	PMT lower period
	limit is equal to limit of 1st priority PMT	PMT upper period
	1 ms to 9999 ms	NIT ACTUAL lower period
	0.1 s to 9999.9 s	NIT ACTUAL upper period
	1 ms to 9999 ms	NIT OTHER lower period
	0.1 s to 9999.9 s	NIT OTHER upper period
	1 ms to 9999 ms	SDT ACTUAL lower period
	0.1 s to 9999.9 s	SDT ACTUAL upper period
	1 ms to 9999 ms	SDT OTHER lower period
	0.1 s to 9999.9 s	SDT OTHER upper period
	1 ms to 9999 ms	BAT lower period
	0.1 s to 9999.9 s	BAT upper period
	1 ms to 9999 ms	EIT ACTUAL PF lower period
	0.1 s to 9999.9 s	EIT ACTUAL PRESENT upper period
	1 ms to 9999 ms	EIT ACTUAL FOLLOWING upper period
	0.1 s to 9999.9 s	EIT OTHER PF lower period
	1 ms to 9999 ms	EIT OTHER PRESENT upper period
	0.1 s to 9999.9 s	EIT OTHER FOLLOWING upper period
	1 ms to 9999 ms	RST lower period
	0.1 s to 9999.9 s	RST upper period
	1 ms to 9999 ms	TDT lower period
	0.1 s to 9999.9 s	TDT upper period
	1 ms to 9999 ms	TOT lower period
	0.1 s to 9999.9 s	TOT upper period
	1 ms to 9999 ms	AIT lower period
	0.1 s to 9999.9 s	AIT upper period
NIT ACTUAL	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
		table ID
NIT OTHER	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
SDT ACTUAL	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
		table ID
SDT OTHER	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
EIT ACTUAL	limit is equal to limit of SI repetition	PF repetition – lower period
	limit is equal to limit of SI repetition	present repetition – upper period
		following repetition – upper period
		table ID
EIT OTHER	limit is equal to limit of SI repetition	PF repetition – lower period
	limit is equal to limit of SI repetition	present repetition – upper period
		following repetition – upper period
EIT PRESENT/FOLLOWING		section missing
RST	limit is equal to limit of SI repetition	lower period
	limit is equal to limit of SI repetition	table ID

<sup>1</sup> Recommended by ETSI TR 101290 for monitoring.

TDT	limit is equal to limit of SI repetition	lower period
	limit is equal to limit of SI repetition	upper period
Unreferenced PID	0.1 s to 9999.9 s	waiting period after change in PMT or CAT
	"excluding of PID" feature	up to 10 PID numbers
<b>Extended checks I – monitoring</b>		
TS	0 bit/s to 128 Mbit/s	lower/upper bit rate
Service	0 bit/s to 128 Mbit/s	lower/upper bit rate
Video	0 bit/s to 128 Mbit/s	lower/upper bit rate
Audio	0 bit/s to 128 Mbit/s	lower/upper bit rate
Other	0 bit/s to 128 Mbit/s	lower/upper bit rate
Null packet	0 bit/s to 128 Mbit/s	lower/upper bit rate
PAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
PMT	0 bit/s to 128 Mbit/s	lower/upper bit rate
CAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
NIT ACTUAL	0 bit/s to 128 Mbit/s	lower/upper bit rate
NIT OTHER	0 bit/s to 128 Mbit/s	lower/upper bit rate
BAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
SDT ACTUAL	0 bit/s to 128 Mbit/s	lower/upper bit rate
SDT OTHER	0 bit/s to 128 Mbit/s	lower/upper bit rate
EIT ACTUAL PF	0 bit/s to 128 Mbit/s	lower/upper bit rate
EIT ACTUAL schedule	0 bit/s to 128 Mbit/s	lower/upper bit rate
EIT OTHER PF	0 bit/s to 128 Mbit/s	lower/upper bit rate
EIT OTHER schedule	0 bit/s to 128 Mbit/s	lower/upper bit rate
TDT	0 bit/s to 128 Mbit/s	lower/upper bit rate
TOT	0 bit/s to 128 Mbit/s	lower/upper bit rate
RST	0 bit/s to 128 Mbit/s	lower/upper bit rate
MIP	0 bit/s to 128 Mbit/s	lower/upper bit rate
AIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
For all bit rate measurements	"excluding of PID" feature	10 PID numbers
	separate measurement profiles for each measurement	MGB1 (payload, 1 s, 1 s) MGB1A (payload, 1 s, 10 s) MGB1B (payload, 1 s, 30 s) MGB2 (payload, 100 ms, 1 s) MGB2A (payload, 100 ms, 100 ms) MGB2B (payload, 100 ms, 500 ms) MGB5 (payload, 1 s, 5 s) MGB5A (payload, 2 s, 60 s) MGB5B (payload, 3 s, 90 s) MGB5C (payload, 4 s, 120 s) MGB5D (payload, 5 s, 150 s) MGB1 (188, 1 s, 1 s) MGB1A (188, 1 s, 10 s) MGB1B (188, 1 s, 30 s) MGB2 (188, 100 ms, 1 s) MGB2A (188, 100 ms, 100 ms) MGB2B (188, 100 ms, 500 ms) MGB5 (188, 1 s, 5 s) MGB5A (188, 2 s, 60 s) MGB5B (188, 3 s, 90 s) MGB5C (188, 4 s, 120 s) MGB5D (188, 5 s, 150 s)

<b>Extended checks II – monitoring</b>		
SFN synchronization		presence – more than one MIP
		presence – megaframe without MIP
		structure – invalid MIP TS header
		structure – inconsistent length field
		structure – setting of max. delay out of range
		structure – synchronization time stamp
		structure – CRC error in MIP
		pointer – does not match location of MIP
		periodicity – unperiodic MIP insertion
		periodicity – MIP pointer not constant
	0.0 $\mu$ s to 5000000.0 $\mu$ s	timing – max. deviation
	0 bit/s to 100000 bit/s	bit rate – inconsistency
TS ID match	0 to 65535	specified TS ID
TS modification		change of TS ID
		additional service
		service disappeared
		additional element
		element disappeared
		change of element stream type
CA alternation		change of PCR PID
		CA flag on
		CA flag off
DVB-H		alternation of key
	0 bit/s to 128 Mbit/s	constant bit rate lower than specified
	0 bit/s to 128 Mbit/s	constant bit rate higher than specified
	0 bit/s to 128 Mbit/s	burst peak bit rate lower than specified
	0 bit/s to 128 Mbit/s	burst peak bit rate higher than specified
	0.0 s to 99.9 s	burst off-time longer than specified
	0 % to 99 %	est. power saving lower than specified
	-9999 ms to +9999 ms	min. delta-T margin lower than specified
-9999 ms to +9999 ms	max. delta-T margin higher than specified	
		IP packet error before MPE FEC

## ATSC and SCTE monitoring measurements

<b>MPEG/TS monitoring</b>		
TS synchronization	1 packet to 7 packets	loss after packets
	1 packet to 31 packets	lock after packets
Sync byte		single byte invalid
		successive bytes invalid
Continuity count		discontinuous packet order
		packet occurs more than twice
		packet lost
		incorrect use of discontinuity flag
Transport CRC		error indicator
		error in PAT
		error in CAT
		error in PMT
		error in MGT
		error in VCT
		error in STT
		error in RRT
		error in EIT
		error in ETT
		error in CETT
		error in DET
		error in LTST
		error in DCCT
		error in DCCSCT
PID distance	0.1 s to 9999.9 s	video – upper period
	0.1 s to 9999.9 s	audio – upper period
	0.1 s to 9999.9 s	data – upper period
	“excluding of PID” feature	up to 10 PID numbers
Unreferenced PID	0.1 s to 9999.9 s	waiting period after change in PMT or CAT
	“excluding of PID” feature	up to 10 PID numbers

<b>ATSC/PSIP monitoring</b>		
PSIP basics		base PID
MGT	1 ms to 9999 ms	repetition – lower period
	1 ms to 9999 ms	repetition – upper period
VCT	1 ms to 9999 ms	CVCT repetition – lower period
	0.1 s to 9999.9 s	CVCT repetition – upper period
	1 ms to 9999 ms	TVCT repetition – lower period
	0.1 s to 9999.9 s	TVCT repetition – upper period
STT	1 ms to 9999 ms	repetition – lower period
	0.1 s to 9999.9 s	repetition – upper period
RRT	1 ms to 9999 ms	repetition – lower period
	0.1 s to 9999.9 s	repetition – upper period
ETI	1 ms to 9999 ms	EIT-0 repetition – lower period
	0.1 s to 9999.9 s	EIT-0 repetition – upper period
	1 ms to 9999 ms	EIT-1 repetition – lower period
	0.1 s to 9999.9 s	EIT-1 repetition – upper period
	1 ms to 9999 ms	EIT-2 repetition – lower period
	0.1 s to 9999.9 s	EIT-2 repetition – upper period
	1 ms to 9999 ms	EIT-3 repetition – lower period
	0.1 s to 9999.9 s	EIT-3 repetition – upper period
	1 ms to 9999 ms	EIT-4 to 127 repetition – lower period
	0.1 s to 9999.9 s	EIT-4 to 127 repetition – upper period
ETT	1 ms to 9999 ms	ETT-0 to 127 repetition – lower period
	0.1 s to 9999.9 s	ETT-0 to 127 repetition – upper period
CETT	1 ms to 9999 ms	repetition – lower period
	0.1 s to 9999.9 s	repetition – upper period
DET	1 ms to 9999 ms	DET-0 repetition – lower period
	0.1 s to 9999.9 s	DET-0 repetition – upper period
	1 ms to 9999 ms	DET-1 repetition – lower period
	0.1 s to 9999.9 s	DET-1 repetition – upper period
	1 ms to 9999 ms	DET-2 to 127 repetition – lower period
	0.1 s to 9999.9 s	DET-2 to 127 repetition – upper period
LTST	1 ms to 9999 ms	repetition – lower period
	0.1 s to 9999.9 s	repetition – upper period
DCCT	1 ms to 9999 ms	repetition – lower period
	0.1 s to 9999.9 s	repetition – upper period
DCCSCT	1 ms to 9999 ms	repetition – lower period
	0.1 s to 9999.9 s	repetition – upper period
PAT	0.1 s to 9999.9 s	repetition – upper period
		table ID
CAT	0.1 s to 9999.9 s	scrambled
		missing
		table ID
<b>Services I – monitoring</b>		
PCR repetition	1 ms to 99999 ms	lower period
	1 ms to 99999 ms	upper period
PCR discontinuity	1 ms to 99999 ms	upper limit
PCR jitter	10 ns to 999999 ns	upper limit
		profiles
		MGF1 (10 mHz)
	MGF2 (100 mHz)	
	MGF3 (1 Hz)	
	test mode	accuracy
		overall jitter – including packet arrival time
PTS repetition	1 ms to 99999 ms (700 ms)	upper period
PMT	0.1 s to 9999.9 s	upper period
		scrambled

<b>Services II – bit rate monitoring</b>		
TS	0 bit/s to 128 Mbit/s	lower/upper bit rate
Service	0 bit/s to 128 Mbit/s	lower/upper bit rate
Video	0 bit/s to 128 Mbit/s	lower/upper bit rate
Audio	0 bit/s to 128 Mbit/s	lower/upper bit rate
Other	0 bit/s to 128 Mbit/s	lower/upper bit rate
Null packet	0 bit/s to 128 Mbit/s	lower/upper bit rate
PAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
PMT	0 bit/s to 128 Mbit/s	lower/upper bit rate
CAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
MGT	0 bit/s to 128 Mbit/s	lower/upper bit rate
CVCT	0 bit/s to 128 Mbit/s	lower/upper bit rate
TVCT	0 bit/s to 128 Mbit/s	lower/upper bit rate
STT	0 bit/s to 128 Mbit/s	lower/upper bit rate
RRT	0 bit/s to 128 Mbit/s	lower/upper bit rate
EIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
ETT	0 bit/s to 128 Mbit/s	lower/upper bit rate
CETT	0 bit/s to 128 Mbit/s	lower/upper bit rate
DET	0 bit/s to 128 Mbit/s	lower/upper bit rate
LTST	0 bit/s to 128 Mbit/s	lower/upper bit rate
DCCT	0 bit/s to 128 Mbit/s	lower/upper bit rate
DCCSCT	0 bit/s to 128 Mbit/s	lower/upper bit rate
For any bit rate monitoring	“excluding of PID” feature	10 PID numbers
	separate measurement profiles for each measurement	MGB1 (payload, 1 s, 1 s)
		MGB1A (payload, 1 s, 10 s)
		MGB1B (payload, 1 s, 30 s)
		MGB2 (payload, 100 ms, 1 s)
		MGB2A (payload, 100 ms, 100 ms)
		MGB2B (payload, 100 ms, 500 ms)
		MGB5 (payload, 1 s, 5 s)
		MGB5A (payload, 2 s, 60 s)
		MGB5B (payload, 3 s, 90 s)
		MGB5C (payload, 4 s, 120 s)
		MGB5D (payload, 5 s, 150 s)
		MGB1 (188, 1 s, 1 s)
		MGB1A (188, 1 s, 10 s)
		MGB1B (188, 1 s, 30 s)
		MGB2 (188, 100 ms, 1 s)
		MGB2A (188, 100 ms, 100 ms)
		MGB2B (188, 100 ms, 500 ms)
		MGB5 (188, 1 s, 5 s)
		MGB5A (188, 2 s, 60 s)
		MGB5B (188, 3 s, 90 s)
		MGB5C (188, 4 s, 120 s)
		MGB5D (188, 5 s, 150 s)
<b>Extended monitoring</b>		
TS modification		change of TS ID
		additional service
		service disappeared
		additional element
		element disappeared
		change of element stream type
		change of PCR PID
TS ID match	0 to 65535	specified TS ID
CA alternation		CA flag on
		CA flag off

**ISDB-T and ISDB-T<sub>B</sub> monitoring measurements**

<b>TR 101 290 V1.2.1 – 1st priority monitoring</b>		
TS synchronization	1 packet to 7 packets	loss after packets
	1 packet to 31 packets	lock after packets
Sync byte		single byte invalid
		successive bytes invalid
PAT	0.1 s to 9999.9 s	upper repetition period
		table ID
		scrambled
Continuity count		discontinuous packet order
		packet occurs more than twice
		packet lost
		incorrect use of discontinuity flag
PMT	0.1 s to 9999.9 s	upper repetition period
		scrambled
PID distance	0.1 s to 9999.9 s	video – upper period
	0.1 s to 9999.9 s	audio – upper period
	0.1 s to 9999.9 s	data – upper period
	“excluding of PID” feature	up to 10 PID numbers
<b>TR 101 290 V1.2.1 – 2nd priority monitoring</b>		
Transport		error indicator
CRC		error in PAT
		error in CAT
		error in PMT
		error in NIT
		error in BAT
		error in SDT
		error in H-EIT
		error in M-EITTOT
		error in L-EITSIT
		error in TOT
		error in TSdT
		error in SIT
		error in MIP
		error in AIT
		error in DCT
		error in PCAT
		error in BIT
error in NBIT		
error in LDT		
error in CDT		
error in LIT		
error in ERT		
PCR discontinuity	1 ms to 99999 ms	upper limit
PCR repetition	1 ms to 99999 ms	lower period
	1 ms to 99999 ms	upper period
PCR jitter	10 ns to 999999 ns	upper limit
	profiles	MGF1 (10 MHz)
		MGF2 (100 MHz)
		MGF3 (1 Hz)
test mode	accuracy <sup>2</sup>	
PTS repetition	1 ms to 99999 ms	overall jitter – including packet arrival time
CAT	0.1 s to 9999.9 s	upper period
		missing
		table ID

<sup>2</sup> Recommended by ETSI TR 101290 for monitoring.

## TR 101 290 V1.2.1 – 3rd priority monitoring

SI repetition	1 ms to 9999 ms	PAT lower period
	limit is equal to limit of 1st priority PAT	PAT upper period
	1 ms to 9999 ms	CAT lower period
	limit is equal to limit of 1st priority CAT	CAT upper period
	1 ms to 9999 ms	PMT lower period
	limit is equal to limit of 1st priority PMT	PMT upper period
	1 ms to 9999 ms	NIT ACTUAL lower period
	0.1 s to 9999.9 s	NIT ACTUAL upper period
	1 ms to 9999 ms	NIT OTHER lower period
	0.1 s to 9999.9 s	NIT OTHER upper period
	1 ms to 9999 ms	SDT ACTUAL lower period
	0.1 s to 9999.9 s	SDT ACTUAL upper period
	1 ms to 9999 ms	SDT OTHER lower period
	0.1 s to 9999.9 s	SDT OTHER upper period
	1 ms to 9999 ms	BAT lower period
	0.1 s to 9999.9 s	BAT upper period
	1 ms to 9999 ms	H-EIT ACTUAL PF lower period
	0.1 s to 9999.9 s	H-EIT ACTUAL PRESENT upper period
	1 ms to 9999 ms	H-EIT ACTUAL FOLLOWING upper period
	0.1 s to 9999.9 s	H-EIT OTHER PF lower period
	1 ms to 9999 ms	H-EIT OTHER PRESENT upper period
	0.1 s to 9999.9 s	H-EIT OTHER FOLLOWING upper period
	1 ms to 9999 ms	M-EIT lower period
	0.1 s to 9999.9 s	M-EIT upper period
	1 ms to 9999 ms	L-EIT lower period
	0.1 s to 9999.9 s	L-EIT upper period
	1 ms to 9999 ms	RST lower period
	0.1 s to 9999.9 s	RST upper period
	1 ms to 9999 ms	TDT lower period
	0.1 s to 9999.9 s	TDT upper period
	1 ms to 9999 ms	TOT lower period
	0.1 s to 9999.9 s	TOT upper period
	1 ms to 9999 ms	AIT lower period
0.1 s to 9999.9 s	AIT upper period	
0.1 s to 9999.9 s	PCAT lower period	
1 ms to 9999 ms	PCAT upper period	
0.1 s to 9999.9 s	BIT lower period	
1 ms to 9999 ms	BIT upper period	
0.1 s to 9999.9 s	NBIT(body) lower period	
1 ms to 9999 ms	NBIT(body) upper period	
0.1 s to 9999.9 s	NBIT(ref) lower period	
1 ms to 9999 ms	NBIT(ref) upper period	
NIT ACTUAL	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
		table ID
NIT OTHER	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
SDT ACTUAL	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
		table ID
SDT OTHER	limit is equal to limit of SI repetition	repetition – lower period
	limit is equal to limit of SI repetition	repetition – upper period
H-EIT ACTUAL	limit is equal to limit of SI repetition	PF repetition – lower period
	limit is equal to limit of SI repetition	present repetition – upper period
		following repetition – upper period
		table ID
H-EIT OTHER	limit is equal to limit of SI repetition	PF repetition – lower period
	limit is equal to limit of SI repetition	present repetition – upper period
		following repetition – upper period
H-EIT PRESENT/FOLLOWING		section missing
MH-EIT OTHER	limit is equal to limit of SI repetition	PF repetition – lower period
	limit is equal to limit of SI repetition	present repetition – upper period
		following repetition – upper period

L-EIT	limit is equal to limit of SI repetition	PF repetition – lower period
	limit is equal to limit of SI repetition	present repetition – upper period following repetition – upper period
RST	limit is equal to limit of SI repetition	lower period
	limit is equal to limit of SI repetition	table ID
TDT	limit is equal to limit of SI repetition	lower period
	limit is equal to limit of SI repetition	upper period table ID
Unreferenced PID	0.1 s to 9999.9 s	waiting period after change in PMT or CAT
	“excluding of PID” feature	up to 10 PID numbers
<b>Extended checks I – monitoring</b>		
TS	0 bit/s to 128 Mbit/s	lower/upper bit rate
Service	0 bit/s to 128 Mbit/s	lower/upper bit rate
Video	0 bit/s to 128 Mbit/s	lower/upper bit rate
Audio	0 bit/s to 128 Mbit/s	lower/upper bit rate
Other	0 bit/s to 128 Mbit/s	lower/upper bit rate
Null packet	0 bit/s to 128 Mbit/s	lower/upper bit rate
PAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
PMT	0 bit/s to 128 Mbit/s	lower/upper bit rate
CAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
NIT ACTUAL	0 bit/s to 128 Mbit/s	lower/upper bit rate
NIT OTHER	0 bit/s to 128 Mbit/s	lower/upper bit rate
BAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
SDT ACTUAL	0 bit/s to 128 Mbit/s	lower/upper bit rate
SDT OTHER	0 bit/s to 128 Mbit/s	lower/upper bit rate
H-EIT ACTUAL PF	0 bit/s to 128 Mbit/s	lower/upper bit rate
H-EIT ACTUAL schedule, basic	0 bit/s to 128 Mbit/s	lower/upper bit rate
H-EIT ACTUAL schedule, extended	0 bit/s to 128 Mbit/s	lower/upper bit rate
H-EIT OTHER PF	0 bit/s to 128 Mbit/s	lower/upper bit rate
H-EIT OTHER schedule, basic	0 bit/s to 128 Mbit/s	lower/upper bit rate
H-EIT OTHER schedule, extended	0 bit/s to 128 Mbit/s	lower/upper bit rate
M-EIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
L-EIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
TDT	0 bit/s to 128 Mbit/s	lower/upper bit rate
TOT	0 bit/s to 128 Mbit/s	lower/upper bit rate
RST	0 bit/s to 128 Mbit/s	lower/upper bit rate
AIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
DCT	0 bit/s to 128 Mbit/s	lower/upper bit rate
PCAT	0 bit/s to 128 Mbit/s	lower/upper bit rate
BIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
NBIT(body)	0 bit/s to 128 Mbit/s	lower/upper bit rate
NBIT(reference)	0 bit/s to 128 Mbit/s	lower/upper bit rate
LDT	0 bit/s to 128 Mbit/s	lower/upper bit rate
CDT	0 bit/s to 128 Mbit/s	lower/upper bit rate
LIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
ERT	0 bit/s to 128 Mbit/s	lower/upper bit rate
DCT	0 bit/s to 128 Mbit/s	lower/upper bit rate
LIT	0 bit/s to 128 Mbit/s	lower/upper bit rate
ERT	0 bit/s to 128 Mbit/s	lower/upper bit rate

For all bit rate measurements	“excluding of PID” feature separate measurement profiles for each measurement	10 PID numbers
		MGB1 (payload, 1 s, 1 s)
		MGB1A (payload, 1 s, 10 s)
		MGB1B (payload, 1 s, 30 s)
		MGB2 (payload, 100 ms, 1 s)
		MGB2A (payload, 100 ms, 100 ms)
		MGB2B (payload, 100 ms, 500 ms)
		MGB5 (payload, 1 s, 5 s)
		MGB5A (payload, 2 s, 60 s)
		MGB5B (payload, 3 s, 90 s)
		MGB5C (payload, 4 s, 120 s)
		MGB5D (payload, 5 s, 150 s)
		MGB1 (188, 1 s, 1 s)
		MGB1A (188, 1 s, 10 s)
		MGB1B (188, 1 s, 30 s)
		MGB2 (188, 100 ms, 1 s)
		MGB2A (188, 100 ms, 100 ms)
		MGB2B (188, 100 ms, 500 ms)
		MGB5 (188, 1 s, 5 s)
		MGB5A (188, 2 s, 60 s)
MGB5B (188, 3 s, 90 s)		
MGB5C (188, 4 s, 120 s)		
MGB5D (188, 5 s, 150 s)		
<b>Extended checks II – monitoring</b>		
TS ID match	0 to 65535	specified TS ID
TS modification		change of TS ID
		additional service
		service disappeared
		additional element
		element disappeared
		change of element stream type
CA alternation		change of PCR PID
		CA flag on
		CA flag off
		alternation of key

## R&S® ETL-K283 in-depth analysis

The R&S® ETL-K282 option is required.

Packet interpreter	applicable packet filter (combinations possible): any element of the TS tree payload unit start indicator adaptation field control	display of TS packet in hex and ASCII
		interpretation of TS header
		snapshot or continuous update
Table and PES interpreter	applicable filter: any element of the TS tree for table sections only: table ID, table ID extension, section number	interpretation of table section or PES packet header
		snapshot or continuous update
Header map		display of packet header, PID or symbol for up to 262000 TS packets
		highlighted script for TS packets with corresponding PID by selection of any element of the TS tree
TS list		extended display of the TS in tabular form with 9 columns: group, content, ID, CA, ECM PID, PID, PCR PID, rate (Mbit/s), % bandwidth (continuously updated)
		sorter function in Stop mode
PCR analysis	applicable profiles: MGF1 (10 mHz) MGF2 (100 mHz) MGF3 (1 Hz)	graphical display of PCR overall jitter, PCR accuracy, PCR frequency drift or PCR offset (up to ten minutes)
		graphical display of PCR repetition (up to ten minutes)
		long-term determination of min./max. peak values
PTS analysis		graphical display of PTS/PCR delay (up to ten minutes)
		graphical display of PTS repetition (up to ten minutes)
		long-term determination of min./max. peak values

## R&S® ETL-K284 data broadcast analysis

The R&S® ETL-K282 option is required.

### Analysis of all DVB data broadcast protocols

	Data piping	Data streaming	MPE	Data carousel	Object carousel
<b>Overview</b>	display of descriptors used and name of tables containing the descriptors				
<b>Interpreter</b>	TS header	PES header	section	section (DSI, DII and DDB header)	
<b>Raw data</b>	content of TS packet	content of PES packet	content of section	content of DDB section	
<b>Timing measurements</b>	bit rate of ES	bit rate of PES	bit rate of selected section	bit rate of selected module, DSI, DII section	
	repetition time of payload unit start indicators	repetition time of PES header	repetition time of selected section	repetition time of selected DII, DSI section	

### Analysis of DVB-H services

Only for inputs that are assigned a monitoring configuration in line with DVB.

Burst timing	burst duration
	burst cycle time
	maximum and minimum of signaled delta-T margin
	burst bit rate
	burst peak bit rate
	constant bit rate
	burst total size
	burst IP payload
	burst duration
FEC analysis	FEC usage
	number of rows
	number of padding columns
	number of puncturing bytes
	burst FEC code rate
	receiver on-time and off-time
	power saving from start
	DVB-H encapsulation overhead
	erroneous rows before and after FEC decoding
	frame error rate (FER)
	MPE frame error rate (MFER)
	correct IP packets before and after FEC
	erroneous IP packets before and after FEC
	IP packet error rate before and after FEC
IP packet error rate before FEC from start	
Decoding	display of DVB-H content via VLC
	zoom function (50 % to 200 %)
	data cache from 0.3 s to 15 s

## R&S® ETL-K285 TS template monitoring

The R&S® ETL-K282 option is required.

Transport stream	0 to 65535	TS ID
	0 to 65535	network ID
	0 to 65535	orig. network ID
	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
EMM	0 to 8191	PID
	mandatory, optional, not allowed	constraint
	0 bit/s to 128 Mbit/s	lower bit rate
User private data	0 bit/s to 128 Mbit/s	upper bit rate
	0 to 8191	PID
	optional, not allowed	constraint
Unreferenced PIDs	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
	0 to 8191	PID
Null packets	optional, not allowed	constraint
	0 bit/s to 128 Mbit/s	lower bit rate
Services	0 bit/s to 128 Mbit/s	upper bit rate
	0 to 65535	service ID
Elementary stream	mandatory, optional, not allowed	constraint
		service name
	0 to 8191	PCR PID
	0 to 8191	PMT PID
	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
	about 50 different types (see below)	type
yes, no	conditional access	
Parental rating <sup>3</sup>	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
ECMs	3 letters	country code
	undefined, age (4 to 18), user-defined (16 to 256)	rating
	0 to 8191	PID
	mandatory, optional, not allowed	constraint
EIT present/following <sup>4</sup>	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
	1 to 999999	upper repetition period
	1 to 999999	upper repetition period
	1 to 999999	upper repetition period
	1 to 999999	upper repetition period
	1 to 999999	upper repetition period
	1 to 999999	upper repetition period
1 to 999999	upper repetition period	

<sup>3</sup> Applicable with DVB, ISDB-T, ISDB-T<sub>B</sub> only.

<sup>4</sup> Applicable with DVB only.

<sup>5</sup> Applicable with ISDB-T, ISDB-T<sub>B</sub> only.

For any bit rate monitoring	separate measurement profiles for each element	MGB1 (payload, 1 s, 1 s) MGB1A (payload, 1 s, 10 s) MGB1B (payload, 1 s, 30 s) MGB2 (payload, 100 ms, 1 s) MGB2A (payload, 100 ms, 100 ms) MGB2B (payload, 100 ms, 500 ms) MGB5 (payload, 1 s, 5 s) MGB5A (payload, 2 s, 60 s) MGB5B (payload, 3 s, 90 s) MGB5C (payload, 4 s, 120 s) MGB5D (payload, 5 s, 150 s) MGB1 (188, 1 s, 1 s) MGB1A (188, 1 s, 10 s) MGB1B (188, 1 s, 30 s) MGB2 (188, 100 ms, 1 s) MGB2A (188, 100 ms, 100 ms) MGB2B (188, 100 ms, 500 ms) MGB5 (188, 1 s, 5 s) MGB5A (188, 2 s, 60 s) MGB5B (188, 3 s, 90 s) MGB5C (188, 4 s, 120 s) MGB5D (188, 5 s, 150 s)
Supported elementary stream types: Video MPEG-1, Video MPEG-2, Audio MPEG-1, Audio MPEG-2, Private Data, PES Private Data, MHEG ISO/IEC 13 522, DMS ISO/IEC 13818-1, ATM Specific ITU-T Rec. H.222.1, DMS_CC ISO/IEC 13818-6 type A, DMS_CC ISO/IEC 13818-6 type B, DMS_CC ISO/IEC 13818-6 type C, DMS_CC ISO/IEC 13818-6 type D, Auxiliary ISO/IEC 13818-1, Audio ADTS ISO/IEC 13818-1, Visual ISO/IEC 14496-2, Audio LATM ISO/IEC 14496-3, PES Flex. Mux. ISO/IEC 14496-1, Section Flex. Mux. ISO/IEC 14496-1, Synchr. Download Protocol ISO/IEC 13818, PES Metadata, Section Metadata, Data Carousel Metadata, Object Carousel Metadata, Synchr. Download Protocol Metadata, IPMP Stream ISO/IEC 13818-11, Video AVC ISO/IEC 14496-10, User Private Stream, VBI Data, VBI Teletext, Subtitling, Audio AC3, Audio Enhanced AC3, AIT, Audio DTS, Audio AAC, Data Piping, Data Asynchronous Streaming, Data Synchronized Streaming, Data Multiprotocol Encapsulation, Data Carousel, Data Object Carousel, Data DVB ATM Stream, Data Higher Protocol, Data System Software Update (UNT), Data IP/MAC Notification (INT), Data MHP Object Carousel, Data MHP Multiprotocol Encapsulation, Data DVB-H		

## R&S® ETL-K382 DVB T2-MI extension

The R&S® ETL-K282 option is required.

The R&S® ETL-K382 option extends the R&S® ETL to include transport streams containing T2-MI streams. The demultiplexing of the T2-MI packets enables measurements and analysis on all three layers (TS, T2-MI, PLP). The new measurement parameters on the T2-MI layer are in line with DVB Document A14-1.

### Features, functions and options applicable to T2-MI streams

Feature	Function	Option
<b>T2-MI monitoring</b>		
Amendment to ETSI TR 101290 for T2-MI (DVB Document A14-1)	T2-MI: monitoring of recommended parameters	R&S® ETL-K282
<b>T2-MI, TS and PLP monitoring</b>		
Bit rate monitoring	monitoring of bit rates	R&S® ETL-K282
<b>TS/PLP monitoring</b>		
TR 101290 priority 1, 2 and 3 monitoring	TS/PLP: monitoring of all TR 101290 priority 1, 2 and 3 parameters	R&S® ETL-K282
Encryption monitoring	monitoring of status and CA alternation	
TS modification	detection of changes in transport stream	
EIT monitoring	monitoring of presence of EIT tables according to signaling in SDT tables and template definitions	
TS template monitoring	comparison of TS characteristics with predefined values	R&S® ETL-K285
<b>T2-MI, TS and PLP analysis</b>		
Interpreter	display of original and interpreted header information and content of T2-MI packets	R&S® ETL-K283
<b>PLP analysis</b>		
PCR analysis	analysis of PCR accuracy, overall jitter, drift, offset and distance	R&S® ETL-K283
PTS analysis	analysis of PTS to PCR difference and PTS distance	
Carousel and MPE analysis	analysis of DVB broadcast protocols	R&S® ETL-K284
<b>Views and displays</b>		
Site tree	status overview of all inputs, input selection	basic functions
T2-MI tree	display of T2-MI elements in tree structure	
	error indication	
	PLP selection	
PLP tree	display of transport stream elements of selected PLP	
	error indication	
	element selection	
Statistics and log	error second counters for top-level monitoring parameters; detailed report entries for monitoring results	
Bit rate	display of bit rates (bargraph displays)	
Table repetition	display of table repetition (bargraph displays)	
PID utilization	visualization of TS packet distribution within TS or selected PLP	
<b>Miscellaneous</b>		
Logging to file	logging of report entries to hard disk (for T2-MI layer or PLP layer)	basic functions, requires an R&S® ETL with serial number $\geq$ 101500 or R&S® ETL-B209 hard disk
Video decode	software decoder (VLC for decoding MPEG-2 SDTV video/audio streams)	

## TS layer

Defined in the amendment to ETSI TR 101290 for T2-MI (DVB Document A14-1: 11.2.5).

TS synchronization	1 packet to 7 packets	loss after packets
	1 packet to 31 packets	lock after packets
Sync byte		single byte invalid
		successive bytes invalid
PAT	0.1 s to 9999.9 s	upper repetition period
		table ID
Continuity count		scrambled
		discontinuous packet order
		packet occurs more than twice
		packet lost
PMT	0.1 s to 9999.9 s	incorrect use of discontinuity flag
		upper repetition period
Transport CRC		scrambled
		error indicator
PCR discontinuity	1 ms to 99999 ms	CRC error in PSI/SI tables PAT, PMT, CAT
		upper limit
PCR repetition	1 ms to 99999 ms	lower period
	1 ms to 99999 ms	upper period
PCR jitter	10 ns to 999999 ns profiles	upper limit
		MGF1 (10 mHz)
		MGF2 (100 mHz)
	MGF3 (1 Hz)	
	test mode	accuracy
		overall jitter – including packet arrival time
Unreferenced PID	0.1 s to 9999.9 s	waiting period after change in PMT
Bit rate	0 bit/s to 128 Mbit/s	TS lower/upper bit rate
	0 bit/s to 128 Mbit/s	T2-MI TS lower/upper bit rate
	0 bit/s to 128 Mbit/s	PID lower/upper bit rate
	0 bit/s to 128 Mbit/s	null packet lower/upper bit rate
	0 bit/s to 128 Mbit/s	PAT lower/upper bit rate
	0 bit/s to 128 Mbit/s	PMT lower/upper bit rate

## T2-MI packet layer

Defined in the amendment to ETSI TR 101290 for T2-MI (DVB Document A14-1).

Packet type	DVB Document A14-1: 11.2.2.1	missing
	DVB Document A14-1: 11.2.2.2	wrong number of BB frames
Packet count	DVB Document A14-1: 11.2.2.3	packet order discontinuity
CRC	DVB Document A14-1: 11.2.2.4	content of T2-MI packet corrupted
Payload	DVB Document A14-1: 11.2.2.5	wrong PLP ID
PLP num blocks	DVB Document A14-1: 11.2.2.6	wrong number of BB frame packets
Transmission order	DVB Document A14-1: 11.2.2.7	wrong order
Timestamp	DVB Document A14-1: 11.2.2.8	different timestamp within superframe
	DVB Document A14-1: 11.2.2.9	discontinuity
Frame length	DVB Document A14-1: 11.2.2.10	longer than 250 ms
Consistency	DVB Document A14-1: 11.2.4.1	bit rate too high for configured parameters
	DVB Document A14-1: 11.2.4.2	wrong leap second value

## PLP layer

Depending on the type of PLP (data PLP in multiple PLP stream, common PLP, data PLP in single PLP stream), all applicable baseband parameters are monitored. See description of R&S®ETL-K282, R&S®ETL-K283 and R&S®ETL-K285.

## Part 4 – Video and audio decoding

The following hardware decoder options allow MPEG-2-coded and H.264-coded SD and HD video signals to be decoded. Audio decoding is also supported. An HDMI interface is available to connect an external display. Using the R&S®ETL-B281 option, the decoded picture and the decoded sound can be output directly on the R&S®ETL.

### R&S®ETL-B281 video and audio hardware decoder

The R&S®ETL-B280 option is required. Decoding of a program selected via the GUI.

Supported video and audio formats		
Video formats	coding method	MPEG-2 (MP@ML) H.264/AVC (MP)
	resolution	480i/576i (standard definition)
Audio formats	coding method	MPEG-1/MPEG-2 layer I

### R&S®ETL-K281 HDTV and Dolby upgrade

The R&S®ETL-B281 option is required.

Additionally supported formats		
Video formats	coding method	MPEG-2 (MP@HL) H.264/AVC (MP)
	resolution	1080i
		720p
		480p/576p
		480i/576i
Audio formats	coding method	Dolby Digital AC-3 Dolby Digital Plus (for up to 6 channels) AAC HE-AAC v2/MPEG-4 Part 3

## Part 5 – Transport stream generation, recording and replay

### R&S® ETL-K280 MPEG TS generator/recorder

The R&S® ETL-B209 option (included in any R&S® ETL with serial number  $\geq 101500$ ) and the R&S® ETL-B280 option are required.

#### Signal inputs for MPEG-2 transport stream recorder function

See R&S® ETL-B280.

#### Signal output for MPEG-2 transport stream generator function

See R&S® ETL-B280.

#### Characteristics of the MPEG-2 transport stream generator for GTS and TRP files

Format		in line with ISO/IEC 1-13818
Number of TS that can be generated simultaneously		1
File format		GTS (Rohde & Schwarz proprietary) TRP (binary)
Storage medium		R&S® ETL system hard disk (serial number $\geq 101500$ ) R&S® ETL-B209 hard disk
Signal set		moving picture sequences and test patterns with test tones for 625 and 525 lines DVB/ATSC/ISDB-T <sub>(B)</sub> systems for detailed information, see the data sheet "Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz"
Supported interface	R&S® ETL-B280	1 × ASI
Sequence length		endless and seamless generation with repetition of video, audio and data contents
Data rate		675 kbit/s to 214 Mbit/s (including null packets)
Useful data rate		max. 90 Mbit/s
Data volume		max. 80 Mbyte useful data
Length of transport stream packets		188/204/208 byte (settable)
PCR jitter	form	sine, rectangle and triangle
	frequency	1 mHz to 100 kHz
	amplitude	0 s to 10 ms
	increment	0.1 $\mu$ s

**TS recorder (TRP) up to 90 Mbit/s**

Format	any bit sequence	8 bit
Number of signals that can be replayed/generated simultaneously		1
File format		TRP (binary)
Storage medium		R&S <sup>®</sup> ETL system hard disk (serial number ≥ 101500) or R&S <sup>®</sup> ETL-B209 hard disk
Buffer		80 Mbyte
Max. data volume		limited only by size of hard disk
Min. data rate		675 kbit/s
Max. data rate	buffer	214 Mbit/s
	hard disk	90 Mbit/s
Replay		
Supported interfaces	R&S <sup>®</sup> ETL-B280	1 × ASI/SMPTE 310M
Determination of data rates	automatically	on the basis of the PCR values obtained
	manually	
Endless replay		frame-exact cut at transition from end of file to beginning of file
Recording		
Supported interface	R&S <sup>®</sup> ETL-B280 selection off	1 × ASI/SMPTE 310M

Several transport streams for testing various DTV receiver, DTV transmitter and decoder STB functions.

For detailed information, see the data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”.

**HDTV sequences (R&S<sup>®</sup>DV-HDTV)****H.264 stream library (R&S<sup>®</sup>DV-H264)****DVB-H stream library (R&S<sup>®</sup>DV-DVBH)****Test card M sequences (R&S<sup>®</sup>DV-TCM)****Japanese ISDB-T transport stream library (R&S<sup>®</sup>DV-ISDBT)****Basic stream library (R&S<sup>®</sup>LIB-K70)****SDTV extended library (R&S<sup>®</sup>LIB-K71)****Extended HDTV library (R&S<sup>®</sup>LIB-K72)****3D TV library (R&S<sup>®</sup>LIB-K73)****Brazilian ISDB-T transport stream library (R&S<sup>®</sup>SFU-K224)****ATSC and ATSC Mobile DTV Streams (R&S<sup>®</sup>SFU-K226)****DVB-T2 MI transport stream library (R&S<sup>®</sup>SFU-K227)****Advanced stream combiner (R&S<sup>®</sup>DV-ASC)**

Comprehensive software tool for generating transport stream files in GTS (Rohde & Schwarz proprietary) or TRP format.

For detailed information, see the data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”.

## Part 6 – Common specifications

### Inputs and outputs

<b>RF input</b>		
Impedance		50 $\Omega$
Connector		N female
VSWR	RF attenuation $\geq 10$ dB	typ. 1.5
Input attenuator		0 dB to +30 dB in 5 dB steps
<b>Additional RF input, 75 <math>\Omega</math></b>		see R&S®ETL-B203 option
<b>Video output (CCVS)</b>		
Connector		BNC female, 75 $\Omega$
Output level, peak-peak	CCVS	1 V
DC position of back porch		0 V
Frequency response error	within video bandwidth	$\leq 0.4$ dB
Group delay response error	within video bandwidth, flat group delay	$\leq 12$ ns
	within video bandwidth, group delay in line with standard	$\leq 20$ ns
2T pulse k factor		$\leq 1$ %
2T pulse amplitude error		typ. $\leq 2$ %
Tilt	bar	$\leq 1$ %
Luminance nonlinearity		$\leq 2$ %
Differential gain		$\leq 2$ %
Differential phase		$\leq 1^\circ$
<b>TS ASI output (digital TV receiver mode)</b>		
Connector		BNC female, 75 $\Omega$
Output level, peak-peak		0.8 V
Data rate		270 Mbit/s
<b>AF signal output</b>		
Connector		2 $\times$ Lemo Triax, female, balanced (symmetrical to ground)
Output impedance		typ. 20 $\Omega$
Output level	600 $\Omega$ load, at 25 kHz deviation	6 dBm
Signals		left/right, sound 1/sound 2, mono
S/N	signal: test pattern, weighted (ITU-R Rec. 468-3) intercarrier method	$\geq 50$ dB
Frequency response	50 $\mu$ s deemphasis, 0.03 kHz to 15 kHz	$\leq 0.5$ dB
Total harmonic distortion (THD)	1 kHz	$\leq 0.1$ %
<b>AF output (headphone)</b>		
Connector		3.5 mm mini jack
Output impedance		$< 100$ $\Omega$
Open-circuit voltage	adjustable in spectrum analyzer mode	up to 1.5 V
<b>Tracking generator (spectrum analyzer mode)</b>		
Tracking generator		N female, 50 $\Omega$
Output level		-20 dBm to 0 dBm in 1 dB steps
Frequency range		1 MHz to 3 GHz
<b>Reverse power</b>		
DC voltage		50 V
CW RF power		30 dBm (= 1 W)
Max. pulse voltage		150 V
Max. pulse energy (10 $\mu$ s)		10 mWs
<b>External reference</b>		
Connector		BNC female, 50 $\Omega$
Input level		0 dBm to +10 dBm
Output level	with R&S®FSL-B4	typ. 0 dBm
Frequency		10 MHz $\pm$ 5 ppm
<b>External trigger/gate input (spectrum analyzer mode)</b>		
Connector		BNC female, 50 $\Omega$
Input level		TTL compatible
<b>USB and remote</b>		
USB interface		2 $\times$ USB 1.1, host for memory stick, mouse, keyboard
Remote interface		LAN
	R&S®FSL-B10	LAN or GPIB

## General data

<b>Remote control</b>		
LAN interface		10/100BaseT, RJ-45
IEC/IEEE bus (GPIB)	R&S®FSL-B10	SCPI 1997.0
<b>Display</b>		
Resolution		640 × 480 pixel
Pixel failure rate		$< 2 \times 10^{-5}$
<b>Mass memory</b>		
Data storage		flash disk (internal), USB memory stick (not supplied)
		> 500 instrument settings and traces
<b>Temperature</b>		
Operating temperature range		0 °C to +45 °C
Permissible temperature range		0 °C to +50 °C
Storage temperature range		-40 °C to +70 °C
Climatic loading		+40 °C at 85 % relative humidity (in line with IEC 60068-2-78)
<b>Mechanical resistance</b>		
Vibration	sinusoidal	IEC 60068-2-6
	random	IEC 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure 1, IEC 60068-2-27
<b>Power supply</b>		
Input voltage range, AC, nominal		100 V to 240 V
AC supply frequency		50 Hz to 60 Hz
Input current, AC		1.8 A to 0.4 A
Power consumption		typ. 95 VA, max. 140 VA with all options
Safety		IEC 61010-1, EN 61010-1, UL 61010-1, CSA C22.2 No. 61010-1
EMC		In line with CISPR 11/EN 55011 group 1 class A (for a shielded test setup). The instrument complies with the emission requirements stipulated by EN 55011 class A. This means that the instrument is suitable for use in industrial environments. In line with EN 61000-6-4, operation in residential, commercial and business areas or in small-size companies is not covered. The instrument may not be operated in residential, commercial and business areas or in small-size companies, unless additional measures are taken to ensure that EN 61000-6-3 is complied with.
Dimensions	W × H × D	
	with handle	408.8 mm × 158.1 mm × 465.3 mm (16.1 in × 6.2 in × 18.3 in)
	without handle	342.3 mm × 158.1 mm × 367.0 mm (13.5 in × 6.2 in × 14.5 in)
Weight	without options	< 9 kg (< 19.8 lb)
<b>Recommended calibration interval</b>		
		12 months
	operation with external reference	24 months

## Hardware options

### R&S® FSL-B5 additional interfaces

<b>User port</b>		
Connector		9-pin D-Sub male
Output		TTL compatible, 0 V/5 V, max. 15 mA
Input		TTL compatible, max. 5 V
<b>Noise source control</b>		
Connector		BNC female
Output		0 V/28 V, max. 100 mA, switchable, supply for noise source
<b>IF/video out</b>		
Connector		BNC female, 50 Ω
Bandwidth	IF and video out	typ. 20 MHz
Output level	video out	typ. 200 mV full scale (open circuit), linear scaling
IF frequency	IF out, TV mode	17.458333 MHz
	IF out, spectrum analyzer mode	typ. 18 MHz
<b>Power sensor</b>		
Connector		6-pin LEMOSA female for supported R&S®NRP-Zxx power sensors

### R&S® ETL-B201 universal DTV, ATV, FM interface

<b>Serial data output/AF GEN R output <sup>6</sup></b>		
Connector		BNC female, 50 Ω
	SER DAT	TTL, R <sub>i</sub> = 50 Ω
	AF GEN R	see R&S®ETL-K111 option
<b>Serial clock output/AF GEN L output <sup>6</sup></b>		
Connector		BNC female, 50 Ω
	SER CLK	
	AF GEN L	see R&S®ETL-K111 option
<b>IF output/CCVS/ETI/AF GEN output <sup>6</sup></b>		
Connector		BNC female, 75 Ω
	IF (DVB-C/J.83/B/ISDB-C and DTMB mode)	4.571428 MHz (DVB-C, J.83/B, ISDB-C) 5.000 MHz (DTMB, 8 MHz channel bandwidth)
	CCVS	max. ±1.0 V
	ETI	±2.37 V into 75 Ω
	AF GEN	see R&S®ETL-K111 option
<b>I signal input</b>		
Connector		BNC female, 50 Ω
Input level	I signal	max. ±0.5 V
<b>Q signal input/MPX input <sup>6</sup></b>		
Connector		BNC female, 50 Ω
Input level	Q signal	max. ±0.5 V
	MPX	max. ±10 V, 100 kΩ impedance

<sup>6</sup> R&S®ETL-K201 model .03 only.

Available interfaces, depending on standard selected		
Analog TV mode	R&S®ETL-K203 video generator option not activated	output of sound IF (intercarrier)
	R&S®ETL-K203 video generator option activated	output of sound IF (intercarrier) or output of demodulated video signal, selectable
DTMB mode (R&S®ETL-B215/-B216 options)		input of I/Q baseband signal, output of IF (5.000 MHz)
DVB-C/ISDB-C mode (R&S®ETL-K210 option)		input of I/Q baseband signal, output of IF (4.571428 MHz)
J.83/B mode (R&S®ETL-K213 option)		input of I/Q baseband signal, output of IF (4.571428 MHz)
ATSC mode (R&S®ETL-K220, -K320, -K322 options)		input of I/Q baseband signal, output of serial clock/data after demapper
DVB-T/DVB-H mode (R&S®ETL-K240 option)		input of I/Q baseband signal, output of serial clock/data after demapper
T-DMB/DAB mode (R&S®ETL-K250 option)		input of I/Q baseband signal, output of ETI (NI, G.703, HDB3), output of serial clock/data of selected subchannel
ISDB-T mode (R&S®ETL-K260 option)		input of I/Q baseband signal, output of serial clock/data of selected layer before Viterbi decoder
DVB-T2 mode (R&S®ETL-K340 option)		input of I/Q baseband signal
FM (radio) firmware (R&S®ETL-K110 option)		MPX input
FM (radio) audio analysis/generator mode (R&S®ETL-K111 option)		AF generator L output, R output, AF generator output, AES/EBU output

## R&S®ETL-B203 RF preselector

Additional RF input		
Impedance		75 $\Omega$
Connector		F male
		F female (with F adapter, supplied)
VSWR	RF attenuation $\geq 5$ dB	1.5
Input attenuator		0 dB to 55 dB in 5 dB steps
Common data for RF input (50 $\Omega$ ) and additional RF input (75 $\Omega$ )		
Frequency range		500 kHz to 3 GHz
Noise figure	0 dB attenuation, including spectrum analyzer frontend	15 dB (50 MHz to 1.3 GHz, preamplifier off)
		9 dB (50 MHz to 1.3 GHz, preamplifier on)
		11 dB (1.3 GHz to 2.3 GHz, preamplifier on)
		13 dB (2.3 GHz to 3.0 GHz, preamplifier on)
TOI	0 dB attenuation, preamplifier = off, including spectrum analyzer frontend	
	f < 30 MHz	> -15 dBm
	f $\geq$ 30 MHz	> -5 dBm
Maximum safe input level	DC voltage	80 V
	CW RF power (preamplifier on)	20 dBm
	CW RF power (preamplifier off)	30 dBm

## R&S® ETL-B209 additional hard disk

Only for R&S® ETL with serial number  $\geq 100500$  (included in any R&S® ETL with serial number  $\geq 101500$ ).

Capacity		80 Gbyte
Interface		SATA
Position		internal
Operating conditions		7 × 24 h, extended-service wide-temperature model

## R&S® ETL-B230 DC power supply, 11 V to 19 V

Operating input voltage range		11.0 V to 19.0 V
Maximum input power		120 W
Current consumption		typ. 6 A to 12 A
Input voltage protection, low		typ. 10.0 V
Input voltage protection, high		typ. 20.2 V
Absolute maximum input voltage		20.0 V

## R&S® ETL-B235 Li-ion battery pack, 10 Ah

Battery type		lithium-ion
Capacity		10 Ah
Nominal battery output voltage		14.8 V
Minimum discharge voltage		12.0 V (switchoff auto-protect)
Maximum discharge current		9.5 A (short-circuit-protected)
Operating time with battery	equipped with R&S® ETL-B210, R&S® ETL-B215, R&S® ETL-B216, R&S® ETL-B300 or R&S® ETL-B310, without external USB devices	90 min to 100 min (typ.)
Charge voltage		12 V to 28 V
Charging time	battery outside of the R&S® ETL, with battery charger	typ. 4 h
	R&S® ETL AC powered in shutdown or standby mode	typ. 7 h
	R&S® ETL AC powered in operating mode	typ. 12 h
Accessory (included)		battery charger, 24 V/3 A
Operating temperature range	charging inside of the R&S® ETL	+5 °C to +45 °C
Operating temperature range	charging outside of the R&S® ETL	+5 °C to +45 °C
	discharging	0 °C to +50 °C
Storage temperature range		-20 °C to +50 °C
Maximum charge current		3 A
Dimensions	W × H × D	267 mm × 34 mm × 138 mm (10.5 in × 1.3 in × 5.4 in)
Weight		1.4 kg (3.1 lb)

## Ordering information

Designation	Type	Order No.
TV Analyzer, 500 kHz to 3 GHz, with tracking generator	R&S®ETL	2112.0004.13
<b>Accessories supplied</b>		
Power cable, first steps manual and CD-ROM (with operating manual)		

## Options

Designation	Type	Order No.	Retrofittable	Remarks
High SNR FM Frontend	R&S®ETL-B110	2112.0233.02	yes (service)	requires R&S®ETL-B203 model .02 or model .03, not with R&S®ETL-B210, R&S®ETL-B215, R&S®ETL-B216, R&S®ETL-B300 or R&S®ETL-B310
Universal DTV, ATV, FM Interface	R&S®ETL-B201	2112.0304.03	yes	SER-DAT OUT, SER-CLK OUT, I IN, Q IN, IF OUT/ETI OUT, CCVS OUT, SOUND IF OUT, AF GEN L OUT, AF GEN R OUT, AF GEN OUT, MPX IN, CCVS IN (same slot as R&S®FSL-B5)
RF Preselector	R&S®ETL-B203	2112.0327.03	yes (service)	
Hard Disk 80 Gbyte	R&S®ETL-B209	2112.0291.02	yes (service)	only for R&S®ETL with serial number ≥ 100500; included in any R&S®ETL with serial number ≥ 101500
Digital Demodulator for Single Carrier	R&S®ETL-B210	2112.0104.02	yes (service)	not with R&S®ETL-B110, R&S®ETL-B215, R&S®ETL-B216, R&S®ETL-B300 or R&S®ETL-B310
Digital Demodulator for DTMB	R&S®ETL-B215	2112.0156.02	yes (service)	not with R&S®ETL-B110, R&S®ETL-B210, R&S®ETL-B216, R&S®ETL-B300 or R&S®ETL-B310
Digital Demodulator for Single Carrier and DTMB	R&S®ETL-B216	2112.0162.02	yes (service)	not with R&S®ETL-B110, R&S®ETL-B210, R&S®ETL-B215, R&S®ETL-B300 or R&S®ETL-B310
DC Power Supply, 11 V to 19 V Li-Ion Battery Pack 10 Ah with Battery Charger	R&S®ETL-B230 R&S®ETL-B235	2112.0256.02 2112.0262.02	yes yes	requires R&S®ETL-B230 (same slot as R&S®ETL-B280)
MPEG Processing Board	R&S®ETL-B280	2112.0362.02	yes (service)	only for R&S®ETL with serial number > 100500 (same slot as R&S®ETL-B235) requires R&S®ETL-B280
Video and Audio Hardware Decoder	R&S®ETL-B281	2112.0356.02	yes (service)	
FPGA Extension Board	R&S®ETL-B300	2112.0385.02	yes (service)	not with R&S®ETL-B110, R&S®ETL-B210, R&S®ETL-B215, R&S®ETL-B216 or R&S®ETL-B310
FPGA Extension Board, High SNR FM	R&S®ETL-B310	2112.0340.02	yes (service)	requires R&S®ETL-B203 model .03, not with R&S®ETL-B110, R&S®ETL-B210, R&S®ETL-B215, R&S®ETL-B216 or R&S®ETL-B300
Mounting Kit for R&S®ETL-B300 and R&S®ETL-B310	R&S®ETL-U300	2112.0379.02	yes (service)	only for R&S®ETL with serial number < 102000
OCXO Reference Frequency	R&S®FSL-B4	1300.6008.02	yes	
Additional Interfaces	R&S®FSL-B5	1300.6108.02	yes	video out, IF OUT, noise source control, AUX port, R&S®NRP-Zxx power sensor (same slot as R&S®ETL-B201)
Narrow Resolution Filters	R&S®FSL-B7	1300.5601.02	yes (service)	
GPIO Interface	R&S®FSL-B10	1300.6208.02	yes	

Designation	Type	Order No.	Retrofittable	Remarks
<b>Firmware/software</b>				
FM (Radio) Firmware	R&S®ETL-K110	2112.0410.02		R&S®ETL-B110 or R&S®ETL-B310 for SNR recommended
FM (Radio) Audio Analysis/Generator	R&S®ETL-K111	2112.0427.02		requires R&S®ETL-K110 and R&S®ETL-B201 model .03
Analog TV Video Analysis	R&S®ETL-K202	2112.0433.02		
Analog Multistandard TV Video Generator	R&S®ETL-K203	2112.0440.02		
Measurement Log	R&S®ETL-K208	2112.0579.02		requires at least one digital TV standard or R&S®ETL-K110
DVB-C Firmware	R&S®ETL-K210	2112.0404.02		requires R&S®ETL-B210 or R&S®ETL-B216
J.83/B Firmware	R&S®ETL-K213	2112.0504.02		requires R&S®ETL-B210 or R&S®ETL-B216
ATSC/8VSB Firmware	R&S®ETL-K220	2112.0456.02		
ATSC/8VSB SFN Frequency Offset	R&S®ETL-K221	2112.0462.02		requires R&S®ETL-K220
DVB-T/DVB-H Firmware	R&S®ETL-K240	2112.0556.02		
DVB-T/DVB-H SFN Frequency Offset	R&S®ETL-K241	2112.0562.02		requires R&S®ETL-K240
T-DMB/DAB Firmware	R&S®ETL-K250	2112.0533.02		
T-DMB/DAB SFN Frequency Offset	R&S®ETL-K251	2112.0540.02		requires R&S®ETL-K250
ISDB-T Firmware	R&S®ETL-K260	2112.0485.02		
ISDB-T SFN Frequency Offset	R&S®ETL-K261	2112.0491.02		requires R&S®ETL-K260
MPEG TS Generator/ Recorder	R&S®ETL-K280	2112.0591.02		requires R&S®ETL-B209 (included in any R&S®ETL with serial number $\geq 101500$ ) and R&S®ETL-B280
HDTV and Dolby Upgrade	R&S®ETL-K281	2112.0604.02		requires R&S®ETL-B281
MPEG Analysis/Monitoring	R&S®ETL-K282	2112.0610.02		requires R&S®ETL-B280
In-Depth Analysis	R&S®ETL-K283	2112.0627.02		requires R&S®ETL-K282
Data Broadcast Analysis	R&S®ETL-K284	2112.0633.02		requires R&S®ETL-K282
TS Template Monitoring	R&S®ETL-K285	2112.0640.02		requires R&S®ETL-K282
ATSC MDTV, ATSC/8VSB Firmware	R&S®ETL-K320	2115.1553.02		requires R&S®ETL-B300 or R&S®ETL-B310
ATSC MDTV, ATSC/8VSB SFN Frequency Offset	R&S®ETL-K321	2115.1560.02		requires R&S®ETL-K320 or R&S®ETL-K322
ATSC MDTV Upgrade	R&S®ETL-K322	2115.1576.02		requires R&S®ETL-K220 and R&S®ETL-B300 or R&S®ETL-B310
DVB-T2 Firmware	R&S®ETL-K340	2112.0527.02		requires R&S®ETL-B300 or R&S®ETL-B310
DVB-T2 Frequency Offset	R&S®ETL-K341	2115.1682.02		requires R&S®ETL-K340
DVB T2-MI Extension	R&S®ETL-K382	2115.1701.02		requires R&S®ETL-K282
AM/FM/ϕM Measurement Demodulator	R&S®FSL-K7	1301.9246.02		
Power Sensor Support	R&S®FSL-K9	1301.9530.02		requires R&S®FSL-B5 or R&S®NRP-Z3/-Z4
<b>Software Tools</b>				
Broadcast Drive Test Software	R&S®BCDRIVE	2115.1360.02		requires R&S®ETL-K208 for support of GPS receiver
Automatic TV Channel Scan Software	R&S®TVSCAN	2115.1660.02		

Transport stream libraries for R&S®ETL-K280 MPEG TS generator/recorder			
HDTV Sequences	R&S®DV-HDTV	2085.7650.02	requires R&S®ETL-K280
H.264 Stream Library	R&S®DV-H264	2085.9052.02	requires R&S®ETL-K280
DVB-H Stream Library	R&S®DV-DVBH	2085.8704.02	requires R&S®ETL-K280
Test Card M Sequences	R&S®DV-TCM	2085.7708.02	requires R&S®ETL-K280
Japanese ISDB-T Transport Stream Library	R&S®DV-ISDBT	2085.9146.02	requires R&S®ETL-K280
Basic Stream Library	R&S®LIB-K70	2116.9558.02	requires R&S®ETL-K280
SDTV Extended Library	R&S®LIB-K71	2116.9564.02	requires R&S®ETL-K280
Extended HDTV Library	R&S®LIB-K72	2116.9570.02	requires R&S®ETL-K280
3D TV Library	R&S®LIB-K73	2116.9587.02	requires R&S®ETL-K280
Brazilian ISDB-T Transport Streams	R&S®SFU-K224	2110.4777.02	requires R&S®ETL-K280
ATSC and ATSC Mobile DTV Streams	R&S®SFU-K226	2110.3812.02	requires R&S®ETL-K280
DVB-T2 MI streams and software	R&S®SFU-K227	2115.2120.02	requires R&S®ETL-K280
Advanced Stream Combiner, dongle for USB interface	R&S®DV-ASC	2085.8804.03	

## Recommended extras

Designation	Type	Order No.
Documentation of R&S® ETL Calibration Values	R&S® ETL-DCV	2082.0490.31
19" Rackmount Adapter	R&S® ZZA-S334	1109.4487.00
Lemo Triax connector (mono) with connecting cable (open)		2067.7451.00
Soft Carrying Bag	R&S® FSL-Z3	1300.5401.00
Protective Hard Cover	R&S® EVS-Z6	5201.7760.00
Matching Pad 75 $\Omega$ , L section	R&S® RAM	0358.5414.02
Matching Pad 75 $\Omega$ , series resistor 25 $\Omega$	R&S® RAZ	0358.5714.02
Matching Pad 75 $\Omega$ , L section, N to BNC	R&S® FSH-Z38	1300.7740.02
SWR Bridge 5 MHz to 3 GHz	R&S® ZRB2	0373.9017.52
SWR Bridge 40 kHz to 4 GHz, 50 $\Omega$	R&S® ZRC	1039.9492.52
Spare F Adapter, female/female	R&S® FSHTV-Z61	2111.7111.02

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## Power sensors supported by R&S® FSL-K9

Designation	Type	Order No.
USB Adapter, active (required for using power sensors with the R&S®ETL if the R&S®FSL-B5 option is not installed)	R&S®NRP-Z3	1146.7005.02
USB Adapter, passive (required for using power sensors with the R&S®ETL if the R&S®FSL-B5 option is not installed)	R&S®NRP-Z4	1146.8001.02
Average Power Sensor, 10 MHz to 8 GHz, 200 mW	R&S®NRP-Z11	1138.3004.02
Average Power Sensor, 10 MHz to 18 GHz, 200 mW	R&S®NRP-Z21	1137.6000.02
Average Power Sensor, 10 MHz to 18 GHz, 2 W	R&S®NRP-Z22	1137.7506.02
Average Power Sensor, 10 MHz to 18 GHz, 15 W	R&S®NRP-Z23	1137.8002.02
Average Power Sensor, 10 MHz to 18 GHz, 30 W	R&S®NRP-Z24	1137.8502.02
Average Power Sensor, 9 kHz to 6 GHz, 200 mW	R&S®NRP-Z91	1168.8004.02
Thermal Power Sensor, 0 Hz to 18 GHz, 100 mW	R&S®NRP-Z51	1138.0005.03
Thermal Power Sensor, 0 Hz to 40 GHz, 100 mW	R&S®NRP-Z55	1138.2008.03
Wideband Power Sensor, 50 MHz to 18 GHz, 100 mW	R&S®NRP-Z81	1137.9009.02

## Service options

Service options		
Extended Warranty, one year	R&S®WE1ETL	Please contact your local Rohde & Schwarz sales office.
Extended Warranty, two years	R&S®WE2ETL	
Extended Warranty, three years	R&S®WE3ETL	
Extended Warranty, four years	R&S®WE4ETL	
Extended Warranty with Calibration Coverage, one year	R&S®CW1ETL	
Extended Warranty with Calibration Coverage, two years	R&S®CW2ETL	
Extended Warranty with Calibration Coverage, three years	R&S®CW3ETL	
Extended Warranty with Calibration Coverage, four years	R&S®CW4ETL	

### Extended warranty with a term of one to four years (WE1 to WE4)

Repairs carried out during the contract term are free of charge <sup>7</sup>. Necessary calibration and adjustments carried out during repairs are also covered. Simply contact the forwarding agent we name; your product will be picked up free of charge and returned to you in top condition a couple of days later.

### Extended warranty with calibration (CW1 to CW4)

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs <sup>7</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

For product brochure, see PD 5213.7748.12 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

<sup>7</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

## Service that adds value

- | Worldwide
- | Local and personalized
- | Customized and flexible
- | Uncompromising quality
- | Long-term dependability

## About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

## Environmental commitment

- | Energy-efficient products
- | Continuous improvement in environmental sustainability
- | ISO 14001-certified environmental management system

Certified Quality System  
**ISO 9001**

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