

R&S® ETL

TV Analyzer

Specifications

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Definitions

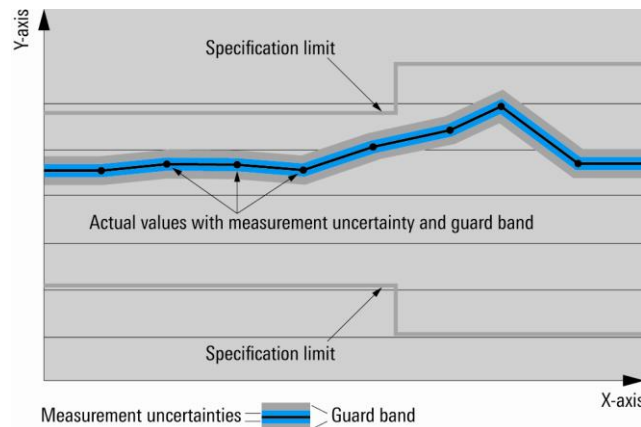
General

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
Reference frequency, internal, nominal		
Aging per year		1×10^{-6}
Temperature drift	0 °C to +50 °C	1×10^{-6}
Achievable initial calibration accuracy		5×10^{-7}
Reference frequency, internal, nominal R&S®FSL-B4 OCXO reference frequency option		
Aging per year		1×10^{-7}
Temperature drift	0 °C to +50 °C	1×10^{-7}
Achievable initial calibration accuracy		5×10^{-8}
Total reference uncertainty		(time since last adjustment × aging rate) + temperature drift + calibration uncertainty
Spectral purity of SSB phase noise 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

Maximum permissible input level		
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.)
Intermodulation		
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
Immunity to interference		
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 – $2 \times f_{in}$)	typ. –60 dBc
	referenced to harmonic of first LO (spur at $f_{in} - 3579.1875$ MHz)	typ. < –60 dBc
At mixer level < –10 dBm		typ. < –60 dBc
Noise figure	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)
	preselector on	19 dB
		(2.3 GHz to 3.0 GHz, preamplifier on)
	see specifications of R&S®ETL-B203 RF preselector option	

Level settings		
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
Level measurement uncertainty	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"	
Measurements		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-B380	TV picture on display
System performance		
Video SNR	weighted in line with ITU-R Rec. 567 (one channel), nominal and bar	≥ 60 dB

Channel filter, analog TV				
Standard	Group delay characteristic	Sound system	Bandwidth in MHz (f _{passband} – 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

B/G (cont.)	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	$f \leq f_{\text{passband}} - \text{max}$	$\leq 0.1 \text{ dB}$
Group delay, flat	$f \leq f_{\text{passband}} - \text{max}$	$\leq 0.05 \text{ dB}$

Group delay correction														
Std.	B/G							D/K				I	K1	M/N
Freq. in MHz	general	Australia	Denmark	general half	New Zealand	Norway	Sweden	general NICAM	OIRT GOST 20532-75	OIRT GOST 20532-83	ITU-R Rep. 308			FCC
	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		0	0	−5	−5		−5	0	0	0
0.50						0	0		−19	−8		0	0	0
1.00	−53	−30	−53	−26.5		0	0	−53	−40	−40	−53	0	0	0
1.50						0	0		−70			0	0	0
2.00	−90	−60	−75	−45		0	0	−90	−80	−85	−87	0	0	0
2.25					−60	0	0					0	0	0
3.00	−75	−40	−75	−37.5	−60	0	0	−75	−80	−92	−85	0	0	0
3.50		0					0					0	0	
3.58							0					0	0	170
3.60						20	0					0	0	
3.75	0			0	0			0				0	0	
3.80			0									0	0	
4.00						50			−40	−60	−50	0	0	293
4.18												0		346
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		
$f \leq f_{\text{passband}} - \max - 0.1 \text{ MHz}$		7 ns

R&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

Measurements (cont.)	parameter	
	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 %
Graphical measurements	multiburst (national) 0.5/1.5/3.0/4.43	range: –100 % to +50 %, resolution: 0.1 %
	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 6 (inputs and outputs)	BNC female, 75 Ω
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-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)

Measurements	parameter	
	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
Graphical measurements	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-B380 and R&S®ETL-K282
	TV picture on display	with R&S®ETL-B380
Measurement uncertainty (64QAM)		
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
With R&S®FSL-B4 OCXO		
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
With external 10 MHz reference ($f \leq 1$ GHz)		
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
Modulation error ratio (MER)	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, MER	≥ 40 dB (equalizer on) 500 MHz, –10 dBm: typ. 46 dB 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	1.0×10^{-3} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio	5.0×10^{-1} to 0.1×10^{-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)
Measurements	parameter	
	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
Graphical measurements	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
	amplitude/phase/group delay frequency response	
	echo pattern (channel impulse response)	
	CCDF and APD with crest factor	
	MPEG analyzer	with R&S®ETL-B380 and R&S®ETL-K282
	TV picture on display	with R&S®ETL-B380
Measurement uncertainty (64QAM)		
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
With R&S®FSL-B4 OCXO		
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
With external 10 MHz reference ($f \leq 1$ GHz)		
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
Modulation error ratio (MER)	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, MER	≥ 40 dB (equalizer on), 500 MHz, –10 dBm: typ. 46 dB
		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	1.0×10^{-3} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio	5.0×10^{-1} to 0.1×10^{-12} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Channel filter for J.83/B firmware (R&S®ETL-K213)		
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-K220 ATSC/8VSB firmware/R&S®ETL-K320/-K322 ATSC Mobile DTV firmware

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

Common specifications for R&S®ETL-K220 ATSC/8VSB firmware and R&S®ETL-K320/-K322 ATSC Mobile DTV firmware		
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
Measurements	parameter	
	level	–55 dBm (preamplifier on) to +10 dBm for quasi-error-free (QEF, f < 1 GHz, R&S®ETL-B203 preselector not installed) typ. –80 dBm
	minimum quasi-error-free input level (R&S®ETL-B203 preselector on, preamplifier on, RF = 500 MHz)	
	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 IEC/IEEE 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	
	MPEG analyzer	with R&S®ETL-B380 and R&S®ETL-K282
	TV picture on display	with R&S®ETL-B380
	ATSC-M/H transmission indicator	

Measurement uncertainty		
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
With R&S®FSL-B4 OCXO		
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
With external 10 MHz reference ($f \leq 1$ GHz)		
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
Modulation error ratio (MER)	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	MER ≥ 40 dB 500 MHz, -10 dBm: typ. 46 dB
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	1.0×10^{-3} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet error ratio	1.0×10^{-1} to 0.1×10^{-12} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Channel selection filter for ATSC firmware (R&S®ETL-K220/R&S®ETL-K320/-K322)		
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
Additional specifications for R&S®ETL-K320/-K322 ATSC Mobile DTV firmware		
Standard	terrestrial TV in line with ATSC A/153	
VSF 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)
Measurements	common parameter	
	legacy TS bit rate	
	main MPEG TS bit rate	
	parade parameter	
	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

Measurements (cont.)	signaling parameter	
	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
	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	FIC header: 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 FIC data of selected parade: 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	M/H service parameter of selected parade: 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
Measurement uncertainty		
Bit rate measurements	referenced to transport stream bit rate	reference uncertainty
With R&S®FSL-B4 OCXO		
Bit rate measurements	referenced to transport stream bit rate	reference uncertainty
With external 10 MHz reference ($f \leq 1$ GHz)		
Bit rate measurements	referenced to transport stream bit rate	≤ 1 Hz
Ensemble BER before Reed-Solomon	1.0×10^{-3} to 0.1×10^{-14} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Ensemble RS packet error ratio	1.0×10^{-1} to 0.1×10^{-10} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Ensemble M/H transport packet error ratio	1.0×10^{-1} to 0.1×10^{-10} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Signaling BER before Reed-Solomon	1.0×10^{-3} to 0.1×10^{-12} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Signaling packet error ratio	1.0×10^{-1} to 0.1×10^{-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&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
Measurements	parameter	
	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 (8 MHz) and ETSI EN 302 296 (8 and 7 MHz)
	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_{symbol} , selectable zero position: main or first echo, absolute or relative display of echo levels

Measurements (cont.)	parameter	
	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-B380 and R&S®ETL-K282
	TV picture on display	with R&S®ETL-B380
Measurement uncertainty (64QAM)		
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
With R&S®FSL-B4 OCXO		
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
With external 10 MHz reference ($f \leq 1$ GHz)		
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
Modulation error ratio (MER)	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	MER ≥ 40 dB (system optimization: stationary fast or stationary slow) 500 MHz, -10 dBm: typ. 46 dB
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	1.0×10^{-3} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio	1.0×10^{-1} to 0.1×10^{-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)
Channel filter for DVB-T/DVB-H firmware (R&S®ETL-K240)		
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&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

Measurements	parameter	
	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 302077
	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_{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
	input of I/Q baseband signal, output of ETI (NI, G.703, HDB3), serial clock/data of selected subchannel	with R&S®ETL-B201
Measurement uncertainty		
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
With R&S®FSL-B4 OCXO		
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

With external 10 MHz reference ($f \leq 1$ GHz)		
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
Modulation error ratio (MER)	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
System performance	signal power > -30 dBm, $f \leq 300$ MHz	MER ≥ 40 dB
Error vector magnitude (EVM)	$> 3\%$ 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	1.0×10^{-2} to 0.1×10^{-14} , 0.0	$0.1 \times 10^{-\text{exponent}}$
BER before Reed-Solomon	1.0×10^{-3} to 0.1×10^{-13} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet error ratio	1.0×10^{-1} to 0.1×10^{-10} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Echo pattern (channel impulse response)	time	≤ 2 ns
	level	≤ 0.5 dB (referred to main path)
Channel filter for T-DMB/DAB firmware (R&S®ETL-K250)		
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&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
Measurements	parameter	
	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)

Measurements (cont.)		
parameter		
	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)
	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_{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-B380
Measurement uncertainty (64QAM)		
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
With R&S®FSL-B4 OCXO		
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

With external 10 MHz reference ($f \leq 1$ GHz)		
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
Modulation error ratio (MER)	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	MER ≥ 40 dB (system optimization: fast or slow) 500 MHz, -10 dBm: typ. 46 dB
BER before Viterbi		
Bit rate/code rate $\times (204/188) > 5$ Mbit/s	1.0×10^{-2} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Bit rate/code rate $\times (204/188) \leq 5$ Mbit/s	1.0×10^{-2} to 0.1×10^{-14} , 0.0	$0.1 \times 10^{-\text{exponent}}$
BER before Reed-Solomon		
Bit rate > 5 Mbit/s	1.0×10^{-3} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
5 Mbit/s $\geq$ bit rate > 500 kbit/s	1.0×10^{-3} to 0.1×10^{-14} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Bit rate ≤ 500 kbit/s	1.0×10^{-3} to 0.1×10^{-13} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Packet/segment error ratio		
Bit rate > 8.16 Mbit/s	1.0×10^{-1} to 0.1×10^{-12} , 0.0	$0.1 \times 10^{-\text{exponent}}$
8.16 Mbit/s $\geq$ bit rate > 816 kbit/s	1.0×10^{-1} to 0.1×10^{-11} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Bit rate ≤ 816 kbit/s	1.0×10^{-1} to 0.1×10^{-10} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Echo pattern (channel impulse response)	time	≤ 2 ns
	level	≤ 0.5 dB (referred to main path)
Channel filter for ISDB-T firmware (R&S®ETL-K260)		
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 line with standard: type 0 and 1
	in manual mode (DVB-T2-base and single PLP only)	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)
Measurements	parameter	
	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
	LDPC iterations	
	BER before LDPC decoder	
	BER before BCH decoder	
	BBFRAME error ratio	
	ESR (errored second 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
		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
	spectrum emission measurement	in line with ETSI EN 300 744 (8 MHz) and ETSI EN 302 296 (8 and 7 MHz)
	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

Measurements (cont.)	parameter	
	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 and 2 (dual trace), MISO group 1 and 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 TV picture on display	with R&S®ETL-B380 and R&S®ETL-K282 with R&S®ETL-B380
Measurement uncertainty		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
With R&S®FSL-B4 OCXO		
Carrier frequency offset	referenced to carrier frequency	reference uncertainty
Bit rate offset	referenced to MPEG transport stream rate	reference uncertainty
With external 10 MHz reference ($f \leq 1$ GHz)		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz
Bit rate offset	referenced to MPEG transport stream rate	≤ 0.5 ppm
Modulation error ratio (MER) (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
	signal power > -30 dBm, $f \leq 1.3$ GHz	MER ≥ 40 dB (system optimization: stationary fast or stationary slow) 500 MHz, -10 dBm: typ. 46 dB
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	1.0×10^{-3} to 0.1×10^{-15} , 0.0	$0.1 \times 10^{-\text{exponent}}$
BBFRAME error ratio	1.0×10^{-1} to 0.1×10^{-12} , 0.0	$0.1 \times 10^{-\text{exponent}}$
Echo pattern (channel impulse response)	time level	≤ 2 ns ≤ 0.5 dB (referred to main path)
Channel filter for DVB-T2 firmware (R&S®ETL-K340)		
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 (e.g. 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 and 2 (dual trace), MISO group 1 and 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&S®ETL-K370 DTMB firmware

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

Standard	terrestrial TV, China	GB20600-2006 (DTMB)
QAM order	automatic detection or manual selection	4, 4-NR, 16QAM, 32QAM, 64QAM
Bandwidth	digitally filtered, see subsection "Channel filter"	7.56 MHz ("8 MHz"), 6.615 MHz ("7 MHz"), 5.67 MHz ("6 MHz")
Carrier mode	automatic detection or manual selection	TDS OFDM (C = 3780) single carrier (C = 1)
Frame header	automatic detection or manual selection	420 symbols, 595 symbols, 945 symbols
Sideband position	automatic detection or manual selection	normal, inverted
Code rate	automatic detection or manual selection	0.4, 0.6, 0.8
Time deinterleaver	automatic detection or manual selection	240, 720, off
PN phase	automatic detection	constant, variable
SI power normalization	automatic detection or manual selection	RMS, max
Frame header power boost	automatic detection or manual selection	on/off
Receive conditions for synchronization	minimum input level; preamplifier and preselector on, 500 MHz, 16 QAM, cr = 0.4, system optimization: slow/laboratory, acceptable error free (AEF)	typ. -88 dBm
	0 dB echo attenuation, single echo, system optimization: fast/SFN, acceptable error free (AEF)	frame header 420: up to 19 μ s
		frame header 595: up to 19 μ s frame header 945: up to 38 μ s

Receive conditions for synchronization (cont.)	maximum speed; preamplifier and preselector on, -60 dBm, 500 MHz, 16 QAM, cr = 0.4, fading profile = TU6, system optimization: mobile, acceptable error free (AEF)	typ. 600 km/h
Measurements	parameter	
	level	<-55 dBm (preamplifier on) to +10 dBm for acceptable error free (AEF), 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 (RMS and peak) in dB or %	MER of data carriers
	LDPC iterations	
	bit error ratio (BER) before LDPC decoder	
	bit error ratio (BER) before BCH decoder	
	ESR (errored second ratio)	selectable pipeline length (20/60/300 s)
	TS packet error ratio	
	TS packet errors per second	
	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), data, system information, frame header (selectable)
	MER versus frequency	selectable carrier number (carrier 0 to carrier 3779) including system information carriers (C = 3780)
	shoulder attenuation in line with ETSI TR 101290, GB/T 28435-2012, GB/T 28436-2012	selectable
	amplitude/phase/group delay frequency response	
	CCDF and APD with crest factor	
	echo pattern	
	MPEG analyzer	with R&S®ETL-B380 and R&S®ETL-K282
	TS ASI output	
	TV picture on display (MPEG2, H.264)	with R&S®ETL-B380
Measurement uncertainty		
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
With R&S®FSL-B4 OCXO		
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
With external 10 MHz reference (f ≤ 1 GHz)		
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
Modulation error ratio (MER)	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: typ. 44 dB (C = 3780 with frame header 420 and 945 symbols, or C = 1 with frame header 595 symbols)
Channel filter for DTMB		
Channel filter bandwidth		7.56 MHz, 6.615 MHz, 5.67 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-K371 DTMB SFN frequency offset

The R&S®ETL-K370 option is required.

Frequency offset of echo signal, relative to frequency of main signal	frequency offset range	depends on DTMB system parameterization (bandwidth and frame header length)
	time range	maximum time range of frequency offset measurement depends on DTMB system parameterization (bandwidth and frame header length)
	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-K372 DTMB TX measurements

The R&S®ETL-K370 option is required.

Measurements	parameter	
	image rejection ratio	range: +20 to +80 dB
	amplitude imbalance	range: -5 % to +5 %, resolution: 0.01 %
	quadrature error	range: -5° to +5°, resolution: 0.01°
	carrier suppression	range: +20 dB to +90 dB, resolution: 0.1 dB
	carrier phase	range: -180° to +180°, resolution: 0.1° (for carrier suppression <80 dB)
	amplitude noise	single carrier modulation (C = 1)
	phase noise	single carrier modulation (C = 1)
	MER (system information)	
	MER versus frequency	single carrier modulation (C = 1)
	out of band emissions measurement	in line with GB 20600-2006 (DTMB)
	adjacent channel power measurement	

R&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), DTMB (R&S®ETL-K370), 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:

TV standard	DVB-C (R&S®ETL-K210)	J.83/B (R&S®ETL-K213)	DTMB (R&S®ETL-B215/-B216)	DTMB (R&S®ETL-K370)	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)
Measurement parameter										
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	•	•	•	• ¹	•	•	•	•	•	• (PLP)
MER (peak) in dB	•	•	•	• ¹	•	•	•	•	•	• (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)						•				

Measurement parameters available in the measurement log for R&S®ETL-K110 FM (radio) firmware:

- Input level
- MPX power
- Peak deviation
- RF offset
- Deviation MPX
- Deviation M
- Deviation pilot
- Deviation S
- Deviation RDS
- Deviation SCA
- AM modulation depth
- Pilot frequency offset
- RDS phase
- SCA subcarrier frequency
- SCA subcarrier deviation

¹ MER (RMS, peak) of data, system information (K372) and frame header (K372).

Radio 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, 0 dB attenuation, 10 dBm RF level, weighted in line with ITU-R BS.468-4, quasi-peak detector	≥ 80 dB, typ. 85 dB
Noise density of MPX signal	preselector off, preamplifier off, 0 dB attenuation, 10 dBm RF level, measured at 57 kHz, referred to 20 kHz deviation	≤ -125 dB/√Hz, typ. -130 dB/√Hz
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
Overview measurements	parameter	
	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 %, range: 0 dB to 80 dB, resolution: 0.01 dB, detector: envelope min. and max. peak
	deviation of MPX signal	range: ±150 kHz, resolution: 1 Hz, detector: abs peak
	deviation of L signal	range: ±150 kHz, resolution: 1 Hz, detector: abs peak
	deviation of R signal	range: ±150 kHz, resolution: 1 Hz, detector: abs peak
	deviation of M signal	range: ±150 kHz, resolution: 1 Hz, detector: abs peak
	deviation of S signal	range: ±150 kHz, resolution: 1 Hz, detector: abs peak
	deviation of pilot signal	range: ±75 kHz, resolution: 1 Hz, detector: envelope average
	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, detector: envelope peak
	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, detector: abs peak
	SCA frequency offset	range: ±5 kHz, resolution: 1 Hz
	deviation of SCA subcarrier	range (500 Hz modulation frequency): • ±6 kHz (narrow mode) • ±12 kHz (wide mode) resolution: 1 Hz, detector: envelope peak

Graphical measurements	spectrum	
	RF spectrum with protection ratio masks	in line with ITU-R SM.1268-1, -2 and -3
	level	trace mode: peak hold
	audio scope	
	signals	MPX, AM, L&R, L, R, M&S, M, S, pilot, RDS/DARC subcarrier, SCA, SCA subcarrier
	timebase	10 μ s to 1 s
	markers	4 time markers
	trigger	free run, trace 1, trace 2
	trigger threshold	0 Hz to 150 kHz
	trigger slope	positive, negative
	supplementary measurements	pos. peak, neg. peak, $\pm$ peak/2, RMS value
	audio spectrum	
	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
	markers	4 frequency markers noise marker function marker peak list
	supplementary measurements	SINAD, THD, modulation frequency
	MPX power and peak deviation	
	sampling frequency	1.536 MHz
	update rate	1/s
	MPX power	in line with ITU-R SM.1268-1, -2 and -3
	reference deviation	19 kHz
	range	+18 dB to -32 dB
	integration time	60 s
	peak deviation	absolute peak deviation versus time
	range	0 Hz to 150 kHz
	peak hold time	10 s
	time interval	≥ 60 s, fixed or selectable
	markers	4 time markers
	timer control	start/stop date and time or duration
	supplementary measurements	temporal exceeding of time
	MPX deviation distribution	
	sampling frequency	1.536 MHz
	deviation distribution	in line with ITU-R SM.1268-1, -2 and (with option R&S®ETL-K112) ITU-R SM.1268-3 and ITU-R SM.1268-4
	cumulative deviation distribution	in line with ITU-R SM.1268-1, -2 and (with option R&S®ETL-K112) ITU-R SM.1268-3 and ITU-R SM.1268-4
	deviation resolution	1 kHz
	markers	deviation markers percent marker
	timer control	synchronized with MPX power and peak deviation as well as MPX deviation violation measurement
	MPX deviation violation	
	sampling frequency	1.536 MHz
	deviation violation	in line with ITU-R SM.1268-2 and -3
	deviation limit	range: 0 Hz to 150 kHz, resolution: 1 Hz
	result display	count of total samples count of violation samples ratio of violation samples to total samples in percent
	timer control	synchronized with MPX power and peak deviation as well as deviation distribution measurement

Graphical measurements (cont.)	multipath detection	
	RF frequency response	
	range	0.1 % to 50 %
	resolution	0.1 %
	gradient of RF frequency response	in line with ITU-R SM.1268-1, -2 and -3
	range	0.1 %/kHz to 10.0 %/kHz
RDS analysis	resolution	
	0.1 %	
	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		
Measurement uncertainty		
Overview measurements		
RF level	–100 dBm to +20 dBm (7 dBμV to 127 dBμV)	≤ 1 dB
Frequency and phase measurements		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz + reference uncertainty
Pilot frequency offset	referenced to pilot frequency	≤ 0.01 Hz + reference uncertainty
Pilot phase	referenced to S signal	≤ 0.1 °
RDS frequency offset	referenced to RDS frequency	≤ 0.02 Hz + reference uncertainty
RDS phase	referenced to pilot phase	≤ 0.1 °
SCA subcarrier frequency offset	referenced to SCA subcarrier frequency	≤ 1 Hz + reference uncertainty
With R&S®FSL-B4 OCXO		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz + OCXO uncertainty
Pilot frequency offset	referenced to pilot frequency	≤ 0.01 Hz + OCXO uncertainty
RDS frequency offset	referenced to RDS frequency	≤ 0.02 Hz + OCXO uncertainty
SCA subcarrier frequency offset	referenced to SCA subcarrier frequency	≤ 1 Hz + OCXO uncertainty
With external 10 MHz reference (f ≤ 1 GHz)		
Carrier frequency offset	referenced to carrier frequency	≤ 1 Hz + uncertainty of external reference
Pilot frequency offset	referenced to pilot frequency	≤ 0.01 Hz + uncertainty of ext. reference
RDS frequency offset	referenced to RDS frequency	≤ 0.02 Hz + uncertainty of ext. reference
SCA subcarrier frequency offset	referenced to SCA subcarrier frequency	≤ 1 Hz + uncertainty of ext. reference
AM depth measurement		≤ 0.1 % + residual peak AM
Deviation measurements		
Basic uncertainty		≤ 0.1 % + residual peak FM
Residual peak AM and FM		
	prerequisite A: 0 dBm RF level, 0 dB attenuation, preselector off, preamplifier off, 1 MHz channel bandwidth or prerequisite B: –47 dBm RF level, 0 dB attenuation, preselector on, preamplifier on, 300 kHz channel bandwidth	
AM depth		A: ≤ 0.2 %, typ. ≤ 0.1 % B: ≤ 1 %, typ. ≤ 0.5 %
MPX deviation		≤ 1.5 kHz, typ. ≤ 1.0 kHz
L, R, and S deviation		≤ 700 Hz, typ. ≤ 500 Hz
M deviation		≤ 150 Hz, typ. ≤ 100 Hz
Pilot deviation		≤ 20 Hz, typ. ≤ 10 Hz
RDS deviation		≤ 300 Hz, typ. ≤ 150 Hz
DARC deviation		≤ 700 Hz, typ. ≤ 500 Hz
SCA deviation		≤ 700 Hz, typ. ≤ 500 Hz
SCA subcarrier deviation		≤ 700 Hz, typ. ≤ 500 Hz

Residual peak AM and FM with R&S®ETL-B110/-B310		
	0 dBm RF level, 0 dB attenuation, preselector off, preamplifier off, 1 MHz channel bandwidth	
AM depth		≤ 0.1 %, typ. ≤ 0.05 %
MPX deviation		≤ 30 Hz, typ. ≤ 15 Hz
L, R, and S deviation		≤ 10 Hz, typ. ≤ 5 Hz
M deviation		≤ 2 Hz, typ. ≤ 1 Hz
Pilot deviation		≤ 10 Hz, typ. ≤ 5 Hz
RDS deviation		≤ 10 Hz, typ. ≤ 5 Hz
DARC deviation		≤ 20 Hz, typ. ≤ 10 Hz
SCA deviation		≤ 20 Hz, typ. ≤ 10 Hz
SCA subcarrier deviation		≤ 20 Hz, typ. ≤ 10 Hz
	–47 dBm RF level, 0 dB attenuation, preselector on, preamplifier on, 300 kHz channel bandwidth	
AM depth		≤ 1 %, typ. ≤ 0.5 %
MPX deviation		≤ 300 Hz, typ. ≤ 200 Hz
L, R, and S deviation		≤ 100 Hz, typ. ≤ 50 Hz
M deviation		≤ 20 Hz, typ. ≤ 10 Hz
Pilot deviation		≤ 10 Hz, typ. ≤ 1 Hz
RDS deviation		≤ 50 Hz, typ. ≤ 25 Hz
DARC deviation		≤ 200 Hz, typ. ≤ 100 Hz
SCA deviation		≤ 200 Hz, typ. ≤ 100 Hz
SCA subcarrier deviation		≤ 200 Hz, typ. ≤ 100 Hz
Audio scope		
Basic uncertainty	FM and AM signals via RF input	≤ 0.1 %
	signals via MPX input	≤ 0.1 % + MPX input uncertainty
Audio spectrum		
Basic uncertainty	FM signals via RF input	≤ 0.01 dB
	AM signals via RF input	≤ 0.1 %
	signals via MPX input	≤ 0.1 % + MPX input uncertainty
MPX power and peak deviation		
MPX power	–20 dBr to 12 dBr, –47 dBm to 10 dBm RF level with R&S®ETL-B110/-B310	≤ 0.1 dB (including residual FM)
		≤ 0.01 dB (including residual FM)
Peak deviation	sinusoidal signals	≤ 0.1 % + residual peak FM (see overview measurements)
	pulse peaks	≤ 1 % + residual peak FM
MPX deviation distribution		
Granularity	in line with ITU-R SM.1268-1, -2 and (with option R&S®ETL-K112) ITU-R SM.1268-3 and 1268-4	1 kHz
Deviation uncertainty	sinusoidal signals	≤ 0.1 % + residual peak FM (see overview measurements)
	pulse peaks	≤ 1 % + residual peak FM
MPX deviation violation		
Deviation uncertainty	sinusoidal signals	≤ 0.1 % + residual peak FM (see overview measurements)
	pulse peaks	≤ 1 % + residual peak FM
Multipath detection		
Uncertainty is influenced by spectral properties of used program signal		
	1.92 % reflection, 33.3 µs echo (–34 dB path loss, 10 km echo distance)	
RF frequency response		typ. < 20 % of reading ± 0.1 %
Gradient of RF frequency response		typ. < 20 % of reading ± 0.1 %
Audio outputs		
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
Output level uncertainty	frequency 500 Hz, 40 kHz deviation	≤ 0.2 dB
Balance	frequency 500 Hz, 40 kHz deviation	≤ 0.05 dB
Crosstalk	10 Hz to 15 kHz	≥ 60 dB
Frequency response	referred to 500 Hz	≤ 0.1 dB

THD	frequency 1 kHz, 75 kHz deviation, 50 μ s deemphasis	$\leq 0.1 \%$, typ. 0.01 %
Maximum available SNR	with R&S®ETL-B110 or R&S®ETL-B310, 50 μ s deemphasis, weighted in line with ITU-R BS.468-4, quasi-peak detector, referred to 40 kHz deviation, level adjustment: 6 dBu for 40 kHz deviation	≥ 66 dB, typ. 71 dB
Headphone	at front panel	3.5 mm mini jack
Auxiliary output		
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
Output level uncertainty	frequency 500 Hz, 75 kHz deviation	$\leq 5 \%$
Frequency response	MPX baseband 20 Hz to 100 kHz, referred to 500 Hz	≤ 0.1 dB, typ. ≤ 0.05 dB
Crosstalk	10 Hz to 15 kHz	≥ 60 dB
SNR	MPX baseband 20 Hz to 100 kHz, RMS detector, referred to 500 Hz, 75 kHz deviation	≥ 60 dB, typ. 74 dB
THD	10 Hz to 50 kHz, 75 kHz deviation	$\leq 0.1 \%$, typ. 0.01 %
AES/EBU physical output level	peak-to-peak, terminated with 75 Ω	2 V
AES/EBU output level	frequency 500 Hz, 40 kHz deviation	-12 dBFS
AES/EBU level uncertainty	frequency 500 Hz, 40 kHz deviation	≤ 0.01 dB
AES/EBU frequency response	10 Hz to 15 kHz	≤ 0.01 dB
AES/EBU balance	10 Hz to 15 kHz	≤ 0.01 dB
Crosstalk	10 Hz to 15 kHz	≥ 60 dB
AES/EBU SNR	with R&S®ETL-B110 or R&S®ETL-B310, 50 μ s deemphasis, weighted in line with ITU-R BS.468-4, quasi-peak detector, referred to 40 kHz deviation	≥ 76 dB, typ. 80 dB
AES/EBU THD	10 Hz to 12 kHz, 75 kHz deviation	$\leq 0.01 \%$
MPX input		
Connector	R&S®ETL-B201 option	BNC
Input level range		max. ± 10 V, 100 k Ω impedance
Input level uncertainty	frequency 500 Hz	≤ 0.05 dB
Input frequency range		DC to 100 kHz
Frequency response	20 Hz to 100 kHz, referred to 500 Hz	≤ 0.05 dB
	20 Hz to 60 kHz, referred to 500 Hz	typ. ≤ 0.02 dB
Balance	10 Hz to 15 kHz	≤ 0.01 dB
Crosstalk	10 Hz to 15 kHz	≥ 60 dB
SNR	MPX baseband 10 Hz to 100 kHz, RMS detector, referred to 6 dBu, low impedance source	typ. 60 dB
	decoded L, R, M, or S channel, 50 μ s deemphasis, weighted in line with ITU-R BS.468-4, quasi-peak detector, referred to 6 dBu, low impedance source	≥ 80 dB, typ. 84 dB
THD	MPX baseband 10 Hz to 50 kHz, -6 dBu to 18 dBu	$\leq 0.05 \%$
THD + N	MPX baseband 10 Hz to 50 kHz, 0 dBu to 18 dBu	$\leq 0.1 \%$
DFD	d2, d3, 5 kHz to 100 kHz, -30 dBu to 18 dBu	$\leq 0.05 \%$

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

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

Audio analysis		
Measurements	parameters	
	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 (stereo separation)
	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 $\text{RMS} \cdot \sqrt{2}$
	L&R, L, R, M&S, M, S, SCA	selective peak $\text{quasi-peak} \cdot \sqrt{2}$ $\text{RMS} \cdot \sqrt{2}$
	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 $2 \times f_1 - f_2$
Measurement uncertainty		
Prerequisites		with R&S®ETL-B110 or R&S®ETL-B310, IF filter bandwidth 1 MHz, preselector = off, preamplifier = off, attenuation = 0 dB 0 dBm to 10 dBm RF level
Frequency response		
Amplitude uncertainty	measurement via RF input, MPX signal, 10 Hz to 100 kHz, or L, R, M, or S signal, 10 Hz to 15 kHz	see audio generator uncertainty/ frequency response
	measurement via MPX input	audio generator frequency response + MPX input frequency response
Balance uncertainty		see audio generator uncertainty/balance
Phase uncertainty	MPX signal, 10 Hz to 100 kHz or L, R, M, or S signal, 10 Hz to 15 kHz	$\leq 0.05^\circ$
Crosstalk		
Residual crosstalk	10 Hz to 15 kHz, deviation 40 kHz, deemphasis off	≥ 60 dB

Audio level		
Level uncertainty	measurement via RF input	$\leq 0.1 \% + \text{residual FM}$
	measurement via MPX input	$\leq 0.1 \% + \text{MPX input level uncertainty} + \text{MPX input frequency response}$
	additional uncertainty due to internal generator	see audio generator uncertainty / output level and frequency response
Residual FM for level measurements		
MPX signal	selective detector	$\leq 2 \text{ Hz}$
	peak detector	$\leq 30 \text{ Hz}$
	quasi-peak $\cdot \sqrt{2}$ detector	$\leq 20 \text{ Hz}$
	RMS $\cdot \sqrt{2}$ detector	$\leq 10 \text{ Hz}$
L, R, and S signal	selective detector	$\leq 2 \text{ Hz}$
	peak detector	$\leq 10 \text{ Hz}$
	quasi-peak $\cdot \sqrt{2}$ detector	$\leq 5 \text{ Hz}$
	RMS $\cdot \sqrt{2}$ detector	$\leq 5 \text{ Hz}$
M signal	selective detector	$\leq 2 \text{ Hz}$
	peak detector	$\leq 2 \text{ Hz}$
	quasi-peak $\cdot \sqrt{2}$ detector	$\leq 2 \text{ Hz}$
	RMS $\cdot \sqrt{2}$ detector	$\leq 2 \text{ Hz}$
SCA signal	selective detector	$\leq 2 \text{ Hz}$
	peak detector	$\leq 20 \text{ Hz}$
	quasi-peak $\cdot \sqrt{2}$ detector	$\leq 5 \text{ Hz}$
	RMS $\cdot \sqrt{2}$ detector	$\leq 5 \text{ Hz}$
S/N		
MPX signal	via RF input: referred to 40 kHz deviation; via MPX input: referred to 6 dBu input level	
	RMS detector	$\geq 70 \text{ dB}$
AM signal	referred to 100 % modulation depth, without FM modulation, deemphasis off	
	peak detector, without lowpass	$\geq 65 \text{ dB}$
	peak detector, with 20 kHz lowpass	$\geq 70 \text{ dB}$
	quasi-peak detector, unweighted	$\geq 80 \text{ dB}$
	quasi-peak detector, weighted in line with ITU-R BS.468-4	$\geq 75 \text{ dB}$
L, R, and S signal	via RF input: referred to 40 kHz deviation, 50 μs deemphasis; via MPX input: referred to 6 dBu input level, 50 μs deemphasis	
	RMS detector	$\geq 90 \text{ dB}$
	quasi-peak detector, unweighted	$\geq 85 \text{ dB}$
	quasi-peak detector, weighted in line with ITU-R BS.468-4	$\geq 80 \text{ dB}$
M signal	via RF input: referred to 40 kHz deviation, 50 μs deemphasis	
	RMS detector	$\geq 95 \text{ dB}$
	quasi-peak detector, unweighted	$\geq 95 \text{ dB}$
	quasi-peak detector, weighted in line with ITU-R BS.468-4	$\geq 90 \text{ dB}$
	via MPX input: referred to 6 dBu input level, 50 μs deemphasis	
	RMS detector	$\geq 90 \text{ dB}$
	quasi-peak detector, unweighted	$\geq 85 \text{ dB}$
	quasi-peak detector, weighted in line with ITU-R BS.468-4	$\geq 80 \text{ dB}$
SCA signal	via RF input: 7.5 kHz main carrier deviation due to subcarrier; via MPX input: -8.54 dBu subcarrier level	
	narrow mode, 92 kHz subcarrier frequency, 150 μs deemphasis, referred to 2 kHz subcarrier deviation	
	RMS detector	$\geq 65 \text{ dB}$
	quasi-peak detector, unweighted	$\geq 65 \text{ dB}$
	quasi-peak detector, weighted in line with ITU-R BS.468-4	$\geq 65 \text{ dB}$
	wide mode, 67 kHz subcarrier frequency, 100 μs deemphasis, referred to 7 kHz subcarrier deviation	
	RMS detector	$\geq 75 \text{ dB}$
	quasi-peak detector, unweighted	$\geq 75 \text{ dB}$
	quasi-peak detector, weighted in line with ITU-R BS.468-4	$\geq 75 \text{ dB}$

THD		
	via RF input	
MPX signal	1 kHz to 150 kHz deviation 10 Hz to 50 kHz modulation frequency	$\leq 0.01\%$ + distortion of audio generator
L, R, M, and S signal	1 kHz to 150 kHz deviation, 10 Hz to 7.50 kHz modulation frequency, without deemphasis	$\leq 0.01\%$ + distortion of audio generator
SCA signal	7.5 kHz main carrier deviation due to subcarrier, narrow mode: 2 kHz subcarrier deviation, wide mode: 7 kHz subcarrier deviation, 40 Hz to 3 kHz modulation frequency, without deemphasis	$\leq 0.01\%$ + distortion of audio generator
	via MPX input	values above + distortion of MPX input
THD+N		
	via RF input	
MPX signal	40 kHz to 150 kHz deviation 10 Hz to 50 kHz modulation frequency	$\leq 0.02\%$ + distortion of audio generator
L, R, M, and S signal	40 kHz to 150 kHz deviation, 10 Hz to 7.50 kHz modulation frequency, without deemphasis	$\leq 0.02\%$ + distortion of audio generator
SCA signal	7.5 kHz main carrier deviation due to subcarrier, narrow mode: 2 kHz subcarrier deviation, wide mode: 7 kHz subcarrier deviation, 40 Hz to 3 kHz modulation frequency, without deemphasis	$\leq 0.02\%$ + distortion of audio generator
	via MPX input	values above + distortion of MPX input
DFD		
	via RF input	
MPX signal	d2, d3, 1 kHz to 150 kHz deviation 15 kHz to 100 kHz upper frequency, 1 kHz spacing	$\leq 0.01\%$ + distortion of audio generator
L, R, M, and S signal	d2, d3, 1 kHz to 150 kHz deviation, 5 kHz to 15 kHz upper frequency, 1 kHz spacing, without deemphasis	$\leq 0.01\%$ + distortion of audio generator
	via MPX input	values above + distortion of MPX input
Audio generator		
Connectors	R&S®ETL-B201 option AF signal output of base unit	3 × BNC, unbalanced 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) MPX (R&S®ETL-B201 option) AES/EBU analog (output of base unit)	AF, L, R, L = R, off L, R, L = R, L = -R, L ≠ R (single tone only), SCA, off L, R, L = R, L = -R, L ≠ R (single tone only), off
Frequency range	analog (R&S®ETL-B201 option) MPX (R&S®ETL-B201 option) AES/EBU analog (output of base unit)	1 Hz to 100 kHz 1 Hz to 100 kHz 1 Hz to 24 kHz 1 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
Audio generator uncertainty		
Output level		
Analog (R&S®ETL-B201 option)	500 Hz, 6 dBu	≤ 0.05 dB, typ. ≤ 0.02 dB
MPX (R&S®ETL-B201 option)	500 Hz, 6 dBu	≤ 0.05 dB, typ. ≤ 0.02 dB
AES/EBU	500 Hz, -6 dBFS	≤ 0.01 dB
Analog (output of base unit)	500 Hz, 6 dBu	≤ 0.2 dB
Balance		
Analog (R&S®ETL-B201 option)	500 Hz	≤ 0.01 dB
MPX (R&S®ETL-B201 option)	500 Hz	≤ 0.01 dB
AES/EBU	500 Hz	≤ 0.01 dB
Analog (output of base unit)	500 Hz	≤ 0.05 dB
Crosstalk		
MPX (R&S®ETL-B201 option)	10 Hz to 15 kHz	≥ 60 dB
Frequency response		
Analog (R&S®ETL-B201 option)	10 Hz to 100 kHz, referred to 500 Hz	≤ 0.05 dB
	10 Hz to 60 kHz, referred to 500 Hz	typ. ≤ 0.02 dB
MPX (R&S®ETL-B201 option)	10 Hz to 15 kHz, referred to 500 Hz	≤ 0.05 dB, typ. ≤ 0.02 dB
AES/EBU	10 Hz to 24 kHz, referred to 500 Hz	≤ 0.01 dB
Analog (output of base unit)	20 Hz to 15 kHz, referred to 500 Hz	≤ 0.1 dB
SNR		
Analog (R&S®ETL-B201 option)	signal off, referred to 6 dBu, weighted in line with ITU-R BS.468-4, quasi-peak detector	≥ 80 dB
MPX (R&S®ETL-B201 option)	L, R, M, or S channel, signal off, referred to 6 dBu, weighted in line with ITU-R BS.468-4, quasi-peak detector	≥ 70 dB
AES/EBU	signal off, referred to 6 dBu, weighted in line with ITU-R BS.468-4, quasi-peak detector	≥ 90 dB
Analog (output of base unit)	signal off, referred to 6 dBFS, weighted in line with ITU-R BS.468-4, quasi-peak detector	≥ 70 dB
THD		
Analog (R&S®ETL-B201 option)	10 Hz to 50 kHz	
	6 dBu to 18 dBu	≤ 0.05 %
	-30 dBu to 6 dBu	≤ 0.2 %
MPX (R&S®ETL-B201 option)	10 Hz to 7.5 kHz	
	6 dBu to 18 dBu	≤ 0.05 %
	-30 dBu to 6 dBu	≤ 0.2 %
AES/EBU	10 Hz to 12 kHz, -30 dBFS to 0 dBFS	≤ 0.01 %
Analog (output of base unit)	20 Hz to 15 kHz, -12 dBu to 12 dBu	≤ 0.1 %
THD+N		
Analog (R&S®ETL-B201 option)	10 Hz to 50 kHz	
	6 dBu to 18 dBu	≤ 0.1 %
	-12 dBu to 6 dBu	≤ 0.2 %
MPX (R&S®ETL-B201 option)	10 Hz to 7.5 kHz	
	6 dBu to 18 dBu	≤ 0.1 %
	-12 dBu to 6 dBu	≤ 0.2 %
AES/EBU	10 Hz to 12 kHz, -24 dBFS to 0 dBFS	≤ 0.01 %
Analog (output of base unit)	20 Hz to 15 kHz, -12 dBu to 12 dBu	≤ 0.2 %
DFD		
Analog (R&S®ETL-B201 option)	d2, d3, 5 kHz to 100 kHz, spacing 1 kHz	
	-12 dBu to 18 dBu	≤ 0.05 %
	-30 dBu to -12 dBu	≤ 0.2 %

MPX (R&S®ETL-B201 option)	d2, d3, 5 kHz to 15 kHz, spacing 1 kHz	
	–12 dBu to 18 dBu	≤ 0.05 %
	–30 dBu to –12 dBu	≤ 0.2 %
AES/EBU	d2, d3, 5 kHz to 21 kHz, –30 dBFS to 0 dBFS	≤ 0.01 %
Analog (output of base unit)	d2, d3, 5 kHz to 15 kHz, –12 dBu to 12 dBu	≤ 0.1 %

R&S®ETL-K112 FM (Radio) MPX deviation measurement, in line with ITU-R SM.1268-3 and ITU-R SM.1268-4

Extends the deviation distribution measurement and the cumulative deviation distribution measurement of option R&S®ETL-K110 FM (radio) firmware by the measurement method in line with ITU-R SM.1268-3 and ITU-R SM.1268-4. This method uses raw samples instead of 50 ms peak hold samples. The R&S®ETL sampling frequency is 1.536 MHz.

R&S®ETL-K250 T-DMB/DAB firmware

See R&S®ETL-K250 T-DMB/DAB firmware in section Digital TV standards and options on page 16.

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

See R&S®ETL-K251 T-DMB/DAB SFN frequency offset in section Digital TV standards and options on page 18.

R&S®ETL-K470 CDR signal analysis software

The R&S®ETL-K470 CDR signal analysis software requires an Ethernet connection to an external PC/laptop running the application R&S®VSE vector signal explorer.

The specifications of the R&S®ETL-K470 are based on the specifications of the R&S®ETL TV analyzer. They have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are given as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (S/N).

Minimum system requirements for the connected PC/Laptop		
Operating system		Windows 7 64 bit/Windows 10 64 bit
Hard disk space		5 Gbyte
RAM		≥ 4 Gbyte
CPU		min. 1.5 GHz (> 2.5 GHz recommended)
Graphics resolution		≥ 1280 × 1024 pixel
Measuring instrument connection	LAN connection (VXI-11, Hi-Slip), VISA driver	R&S®VISA is provided with the R&S®VSE installer
Frequency		
Frequency range	RF input	same as R&S®ETL base unit
Level		
Level range	RF input	same as R&S®ETL base unit
Signal acquisition		
Input	RF, I/Q file	
Max. carrier frequency offset		± 2 kHz
Sample rate		816 kHz
Capture length	The capture of a complete CDR sub frame (160 ms) is guaranteed.	
	filter deactivated	approx. 641 ms
	filter activated	approx. 320 ms
Trigger modes	RF input	free run, external, IF power
	I/Q file	free run, magnitude
Channel filter	Proper CDR filtering is guaranteed by automatic channel filter configuration based on CDR system configuration.	
	Filter parameters (on/off, 6 dB and 50 dB bandwidth) can also be edited manually.	
High pass filter	Suppression of FM content is guaranteed by automatic filter configuration based on CDR system configuration.	
	Filter parameters (on/off, 6 dB bandwidth) can also be edited manually.	
CDR system configuration		
Settings	spectrum mode index	1, 2, 9, 10, 22, 23
	transmission mode	1, 2, 3
	service description information modulation	QPSK, 16QAM, 64QAM
	service data modulation	QPSK, 16QAM, 64QAM
	service data hierarchical coding	parameterization depends on service data modulation setting: QPSK: α = 1 16QAM or 64QAM: α = 1, α = 2, α = 4

Measurement parameters		
Synchronization	time synchronization	cyclic prefix
	parameter estimation and channel estimation	pilot aided
	modulation detection	defined by configuration file
Tracking/Compensation	phase tracking	on/off
	timing tracking	on/off
	level tracking	on/off
	channel compensation	on/off
MER normalization		RMS pilots and data
		RMS data
		RMS pilots
		peak pilots and data
		peak data
		peak pilots
		none
Result displays		
Result summary		MER all
		MER data
		MER pilot
		frequency error
		sample clock error
		I/Q offset
		gain imbalance
		quadrature error
		frame power
		crest factor
		power versus symbol versus carrier
		power versus carrier
Power		power versus symbol
		magnitude capture
		power spectrum
MER		MER versus symbol versus carrier
		MER versus carrier
		MER versus symbol
Channel		flatness
		group delay
		impulse response
Constellation		constellation diagram
		constellation versus carrier
		constellation versus symbol
Miscellaneous and statistics		CCDF
		signal flow
		allocation matrix as defined in configuration file
Measurement uncertainty		
System performance (MER)	signal level 0 dBm; properly adjusted reference level; center frequency 76 MHz to 108 MHz; phase tracking on; timing tracking on; level tracking off; channel compensation on; MER normalization: RMS pilots and data; In case of spectrum mode index 9, 10, 22, 23 it is ensured by signal generation that no relevant FM spectral parts are located inside the CDR carrier location. CDR power is -14 dB relative to the FM power.	> 40.0 dB, typ. 47 dB (transmission mode 1, 2 and spectrum mode 1, 2)

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

Measurement of analog modulation signals		
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	
AF (modulation frequency)		
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
AM demodulation		
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
FM demodulation		
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
φM demodulation		
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

Carrier power versus time		
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
AF spectrum		
Span		≤ 9 MHz
Resolution bandwidth		1 Hz to 10 MHz
RF spectrum		
Span		≤ 18 MHz
Resolution bandwidth		1 Hz to 10 MHz
Shape factor 60 dB:3 dB		2.5 (nom.)
Modulation distortion		
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
Trigger		
Trigger functions		RF level, AM, FM, ϕ M demodulation

Part 2 – Spectrum analyzer

Frequency

Range		500 kHz to 3 GHz
Resolution		1 Hz
Reference frequency, internal, nominal		
Aging per year		1×10^{-6}
Temperature drift	0 °C to +50 °C	1×10^{-6}
Achievable initial calibration accuracy		5×10^{-7}
Reference frequency, internal, nominal	R&S®FSL-B4 OCXO reference frequency option	
Aging per year		1×10^{-7}
Temperature drift	0 °C to +50 °C	1×10^{-7}
Achievable initial calibration accuracy		5×10^{-8}
Total reference uncertainty		(time since last adjustment × aging rate) + temperature drift + calibration uncertainty
Frequency readout		with marker or frequency counter
Marker resolution		span/500
Uncertainty		$\pm$ (marker frequency × reference uncertainty + 2 % × span + 10 % × resolution bandwidth + $\frac{1}{2}$ (last digit))
Frequency counter resolution		1 Hz
Count uncertainty	S/N > 25 dB	$\pm$ (frequency × reference uncertainty + $\frac{1}{2}$ (last digit))
Frequency span		0 Hz, 10 Hz to 3 GHz
Span uncertainty		3 %
Spectral purity of SSB phase noise		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	< –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

Sweep filters		
Resolution bandwidths		300 Hz to 10 MHz (–3 dB) in 1/3 sequence
	with R&S®FSL-B7	10 Hz to 10 MHz (–3 dB) in 1/3 sequence
	zero span	additionally 20 MHz (–3 dB)
Resolution bandwidth uncertainty		< 3 % (nom.)
Resolution filter shape factor 60 dB:3 dB	Gaussian type filters	< 5 (nom.)
EMI filters		
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.)
FFT filters		
3 dB bandwidths	analyzer mode	300 Hz to 30 kHz in 1/3 sequence
	with R&S®FSL-B7	1 Hz to 30 kHz in 1/3 sequence
Bandwidth uncertainty		5 % (nom.)
Shape factor 60 dB:3 dB		2.5 (nom.)

Channel filters		
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
Maximum permissible input level		
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.)
Intermodulation		
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
Displayed average noise level		
0 dB RF attenuation, 50 Ω termination, RBW = 1 kHz, VBW = 1 Hz, sample detector, log scaling, tracking generator off, normalized to 1 Hz		
R&S®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®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®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)

Immunity to interference		
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
Level display		
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, dBμV, dBμA, dBpW
	linear level display	μV, mV, V, μA, mA, A, pW, nW, μW, mW, W
Level measurement uncertainty		
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.)
Display nonlinearity		
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

Trigger		
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®FSL-B10 option)	max. 512 ksamples I and Q
Sample rate		10 kHz to 65.8 MHz
Signal bandwidth	65.833333 MHz sample rate	20 MHz

Part 3 – Video and audio decoding

R&S®ETL-B380 AV decoder and TS processing

Video and audio decoding		
Playback		internal or external monitor, user-selectable
	internal	video displayed on R&S®ETL screen and output at CCVS output (standard definition), audio output at AF output (headphone) and AF signal output
	on an external monitor	video and audio output at HDMI™ output
Video codecs		H.265/HEVC, H.264/AVC, H.262/MPEG-2, AVS+ (AVS-P16 guangbo profile), AVS (jizhun/baseline profile)
Video resolution		up to 1080/p60 (full HD)
	with R&S®ETL-K381 option	up to 2160/p60 (UHD)
Audio codecs		Dolby® Digital AC-3, Dolby® Digital Plus, MPEG-4 Part 3 (AAC, HE-AAC, HE-AAC v2), MPEG 1 Layer 3 (MP3), MPEG 1 Layer 2 (MP2/MUSICAM)
HDMI™ output		in line with the HDMI™ specification, up to 4k
DVB common interface	conditional access module (CAM) required ²	in line with EN 50221
TS ASI input		
Connector		BNC female, 75 Ω
Interface settings		TS-ASI, T2-MI, SMPTE 310M
Max. cable length	RG 59 cable	180 m
Data rate	TS-ASI, T2-MI	max. 128 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
Data rate across all inputs		max. 128 Mbit/s
TS ASI output		
Connector		BNC female, 75 Ω
Output level		0.8 V (V _{pp})
Data rate		max. 128 Mbit/s
TS over IP interface (R&S®ETL-K386 required)		
Connector		RJ-45
Physical Layer		IEEE 802.3 (1000BaseT)
Link rate		100/1000 Mbit/s
IP transmission protocols		
Version		IPv4
TS over IP encapsulation		in line with Pro-MPEG Code of Practice Release 2 and SMPTE2022-1/2
Signaling		unicast, multicast
Transport of TS packets		UDP and UDP/RTP
Multicast		IGMPv3

² Because of the large number of CAMs and smart card systems on the market, accurate function cannot be ensured in every case.

R&S®ETL-K381 UHD extension

The R&S®ETL-B380 option is required.

Additionally supported formats		
Video resolution	displayed on external monitor via HDMI™	up to 2160/p60 (UHD)
	internal display	downscaled to picture window

R&S®ETL-K386 IP input and output

The R&S®ETL-B380 option is required. IP flows (in) and IP flows (out) cannot be operated simultaneously.

IP flows (in)		
Maximum number of IP flows (in)		2
Maximum bit rate of all IP flows (in) used		up to 128 Mbit/s
Forward error correction (FEC)	2D FEC in line with Pro-MPEG Code of Practice Release 2 and SMPTE2022-1; FEC is automatically applied to IP flow (in) if FEC streams are available	2DFEC, L × D ≤ 100; FEC L: IP flow (in) portnumber + 2; FEC D: IP flow (in) portnumber + 4
IP flows (out)		
Number of simultaneous IP flows (out)		2
TS source		any TS applied to R&S®ETL (ASI, RF, IP)
IP interface		1000BASE-T
Maximum bit rate of all IP flows (out) used		up to 128 Mbit/s
Number of TS per IP packet		1 to 7
Forward error correction (FEC)	2D FEC in line with Pro-MPEG Code of Practice Release 2 and SMPTE2022-1	off, L from 1 to 20, D from 4 to 20
Protocol		UDP or UDP/RTP
Time to live (TTL)		1 to 255
IP monitoring		
Synchronization	1 s to 5 s	loss after number of seconds, lock after number of seconds
Protocol and data type	MPEG-2 TS UDP, MPEG-2 TS UDP/RTP	specified protocol and data type
TS packets in IP packet	1 packet to 7 packets	specified number of TS packets
Data length	0 byte to 99999 byte	upper limit, lower limit
IP bit rate	0 bit/s to 999999999 bit/s	upper limit, lower limit
TS bit rate	0 bit/s to 999999999 bit/s	upper limit, lower limit
Nominal TS bit rate	0 bit/s to 999999999 bit/s (derived from PCR)	upper limit, lower limit
IP bandwidth utilization	percentage of maximum link speed	–
MDI-DF (delay factor)	in line with RFC 4445	upper limit
MDI-MLR (media loss rate)	in line with RFC 4445	upper limit
RTP inter-arrival jitter	in line with RFC 3550	upper limit
IP channel information		
Source IP address		IP address of streaming source
Destination IP address		specified input destination IP address
Destination port		specified input UDP destination port
Forward error correction (FEC)	FEC is applied to IP input stream if available (on)	on, off

Part 4 – Transport stream analysis and monitoring

R&S®ETL-K282 MPEG analysis/monitoring

The R&S®ETL-B380 option is required. Up to 2 R&S®ETL-K282 can be installed.

Broadcasting standard	independently selectable for every activated signal input	DVB ATSC SCTE ISDB-T ISDB-T _B
Views and function		
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
Monitoring		
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
Hiding of events		
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

TR 101290 V1.2.1 – first priority monitoring		
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
PID distance	0.1 s to 9999.9 s	scrambled
	0.1 s to 9999.9 s	video – upper period
	0.1 s to 9999.9 s	audio – upper period
	“excluding of PID” feature	data – upper period
TR 101290 V1.2.1 – second priority monitoring		
Transport		up to 10 PID numbers
CRC		error indicator
		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
		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 ³
PTS repetition	1 ms to 99999 ms	upper period
CAT	0.1 s to 9999.9 s	missing
		table ID

³ Recommended by ETSI TR 101290 for monitoring.

TR 101290 V1.2.1 – third priority monitoring		
SI repetition	1 ms to 9999 ms	PAT lower period
	limit is equal to limit of first priority PAT	PAT upper period
	1 ms to 9999 ms	CAT lower period
	limit is equal to limit of first priority CAT	CAT upper period
	1 ms to 9999 ms	PMT lower period
	limit is equal to limit of first 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
NIT OTHER	limit is equal to limit of SI repetition	table ID
	limit is equal to limit of SI repetition	repetition – lower period
SDT ACTUAL	limit is equal to limit of SI repetition	repetition – upper period
	limit is equal to limit of SI repetition	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
	limit is equal to limit of SI repetition	following repetition – upper period
	limit is equal to limit of SI repetition	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
	limit is equal to limit of SI repetition	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
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	table ID
	“excluding of PID” feature	waiting period after change in PMT or CAT up to 10 PID numbers
Extended checks I – monitoring		
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 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)
Extended checks II – monitoring		
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 µs to 5000000.0 µs	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
		alternation of key

DVB-H	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

MPEG/TS monitoring		
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
ATSC/PSIP monitoring		
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
		scrambled
CAT	0.1 s to 9999.9 s	missing
		table ID
Services I – monitoring		
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 profiles	upper limit
		MGF1 (10 mHz)
		MGF2 (100 mHz)
		MGF3 (1 Hz)
	test mode	accuracy
PTS repetition	1 ms to 99999 ms (700 ms)	overall jitter – including packet arrival time
PMT	0.1 s to 9999.9 s	upper period
		scrambled
Services II – bit rate monitoring		
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)

For any bit rate monitoring (cont.)	separate measurement profiles for each measurement (cont.)	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)
Extended monitoring		
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_B monitoring measurements

TR 101290 V1.2.1 – first priority monitoring		
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
TR 101290 V1.2.1 – second priority monitoring		
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
PCR jitter	1 ms to 99999 ms	upper period
	10 ns to 999999 ns	upper limit
	profiles	MGF1 (10 MHz)
		MGF2 (100 MHz)
		MGF3 (1 Hz)
	test mode	accuracy ⁴
		overall jitter – including packet arrival time
PTS repetition	1 ms to 99999 ms	upper period
CAT	0.1 s to 9999.9 s	missing
		table ID
TR 101290 V1.2.1 – third priority monitoring		
SI repetition	1 ms to 9999 ms	PAT lower period
	limit is equal to limit of first priority PAT	PAT upper period
	1 ms to 9999 ms	CAT lower period
	limit is equal to limit of first priority CAT	CAT upper period
	1 ms to 9999 ms	PMT lower period
	limit is equal to limit of first 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
		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

⁴ Recommended by ETSI TR 101290 for monitoring.

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
Extended checks I – monitoring		
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	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)
Extended checks II – monitoring		
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
Overview	display of descriptors used and name of tables containing the descriptors				
Interpreter	TS header	PES header	section	section (DSI, DII and DDB header)	
Raw data	content of TS packet	content of PES packet	content of section	content of DDB section	
Timing measurements	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 usage
FEC analysis		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
Decoding		IP packet error rate before and after FEC
		IP packet error rate before FEC from start
		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
	0 bit/s to 128 Mbit/s	upper bit rate
User private data	0 to 8191	PID
	optional, not allowed	constraint
	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
Unreferenced PIDs	0 to 8191	PID
	optional, not allowed	constraint
	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
Null packets	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
Services	0 to 65535	service ID
	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
Elementary stream	0 to 8191	PID
	mandatory, optional, not allowed	constraint
	about 50 different types (see below)	type
	yes, no	conditional access
	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
Parental rating ⁵	3 letters	country code
	undefined, age (4 to 18), user-defined (16 to 256)	rating
ECMs	0 to 8191	PID
	mandatory, optional, not allowed	constraint
	0 bit/s to 128 Mbit/s	lower bit rate
	0 bit/s to 128 Mbit/s	upper bit rate
EIT present/following ⁶	1 to 999999	upper repetition period
EIT schedule (1 to 16) ⁶	1 to 999999	upper repetition period
H-EIT present/following ⁷	1 to 999999	upper repetition period
H-EIT schedule, basic (1 to 8) ⁷	1 to 999999	upper repetition period
H-EIT schedule, extended (1 to 8) ⁷	1 to 999999	upper repetition period
M-EIT present/following ⁷	1 to 999999	upper repetition period
L-EIT present/following ⁷	1 to 999999	upper repetition period

⁵ Applicable with DVB, ISDB-T, ISDB-TB only.

⁶ Applicable with DVB only.

⁷ Applicable with ISDB-T, ISDB-TB 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 Date, 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
T2-MI monitoring		
Amendment to ETSI TR 101290 for T2-MI (DVB Document A14-1)	T2-MI: monitoring of recommended parameters	R&S®ETL-K282
T2-MI, TS and PLP monitoring		
Bit rate monitoring	monitoring of bit rates	R&S®ETL-K282
TS/PLP monitoring		
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
T2-MI, TS and PLP analysis		
Interpreter	display of original and interpreted header information and content of T2-MI packets	R&S®ETL-K283
PLP analysis		
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
Views and displays		
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	
Miscellaneous		
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 ≥ 101 500 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		scrambled
		error indicator
CRC		CRC error in PSI/SI tables PAT, PMT, CAT
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
Unreferenced PID	0.1 s to 9999.9 s	overall jitter – including packet arrival time
Bit rate	0 bit/s to 128 Mbit/s	waiting period after change in PMT
	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 5 – Transport stream generation, recording and replay

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

The R&S®ETL-B380 option is required.

Transport stream generator

Format		in line with ISO/IEC 1-13818
Number of TS that can be generated simultaneously		1
File format		TRP (binary)
Storage medium		R&S®ETL system solid state disk (R&S®ETL units with serial number from 105 000 upwards or equipped with upgrade kit R&S®ETL-U80/-U81/-U82)
Signal set	two SDTV 720 × 576 i50 streams for DVB systems included	one moving picture sequence (diver.trp) and one test pattern (DVTS_2M.trp), both with MPEG2 video and MPEG1 stereo sound
	optional stream libraries for DVB/ATSC/ISDB-T _B systems	see ordering information for overview see also data sheet "Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz" for detailed information, see data sheets of the specific stream libraries
Sequence length		endless and seamless generation with repetition of video, audio and data contents
Data rate		675 kbit/s to 128 Mbit/s
Length of transport stream packets		188/204/208 byte (settable)

Transport stream recorder

Format	any bit sequence	8 bit
Number of signals that can be replayed/generated simultaneously		1
File format		TRP (binary)
Storage medium		R&S®ETL system solid state disk (R&S®ETL units with serial number from 105 000 upwards or equipped with upgrade kit R&S®ETL-U80/-U81/-U82)
Max. data volume		limited only by size of hard disk
Min. data rate		675 kbit/s
Max. data rate		90 Mbit/s
Replay		
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

Part 6 – Software tools

R&S®BCDRIVE broadcast drive test software

The software can be installed on the R&S®ETL or a PC with remote connection to the R&S®ETL. Visualization of the measurement values in Google Earth is possible on a PC using the .kmz file generated by the R&S®BCDRIVE.

Maximum number of instruments in parallel		8
Measurement speed for complete signal quality recording		typ. 1 s
Switchover time during serial measurement of multiple frequencies		4 s to 20 s, depends on broadcast standard and selected measurements
Memory requirements per hour for measurement results	internal format	approx. 10 Mbyte
	.kmz format	approx. 30 Mbyte
	.csv format	approx. 30 Mbyte

Supported standards and measurements

	Receive field strength	Signal synchronization	Modulation error ratio	Bit error ratio	Channel impulse response	Signal/noise ratio	MPX level/peak deviation	RDS bit error ratio
ATSC	●	○	○	○	○			
ATSC Mobile DTV								
DAB / T-DMB	●	●	●	●	●			
DTMB (B215, B216)	●	○	○	○ ⁸	○ ⁸			
DTMB (K370)	●	○	○	○	○			
DVB-T / DVB-H	●	●	●	●	●			
DVB-T2	●	●	●	●	●			
FM (radio)	●						●	○
ISDB-T	●	●	●	●	●			
Analog TV	○					○		

- Mobile measurements. ○...Stationary measurements.

System requirements

Operating system	Windows 10, 8.1, 8, 7, Vista, XP Service Pack 3 or 2 (32 bit or 64 bit)
Rights	administrator rights (for installation)
Processor	Pentium processor or equivalent, 600 MHz or greater
RAM	512 Mbyte
Hard drive	20 Mbyte for program installation, plus a minimum of 500 Mbyte for recording (USB drive can also be used)
Minimum screen resolution	640 × 480 pixel (VGA), 256 colors
Ethernet connection	required for controlling R&S®ETL TV analyzers if the software is not run directly on the R&S®ETL or if additional R&S®ETL analyzers need to be controlled

⁸ For OFDM signals.

R&S®ETL-K950 TVSCAN 2.0 automated measurement of multiple TV channels

Licensing	configuration tool (channel tables, limit values, device settings)	free of charge, no R&S®ETL required
	measurement tool	requires R&S®ETL-K950 option being installed on the R&S®ETL
	visualization tool	free of charge, no R&S®required
Maximum number of R&S®ETL TV analyzers in parallel		unlimited, for each R&S®ETL a new window can be opened
Data base	standard SQLite data base	included in R&S®TVSCAN 2.0
	user-specific data base	supported
Memory requirement for data base	100 scans with 100 channels each	typ. 20 Mbyte
Maximum number of channels		unlimited
Scan of individual channel(s)		yes, selection out of channel list
Time between two scans		immediate or configurable
Duration of scan session		infinite or configurable
Settings that can be individually assigned to each channel	analog TV	video standard, group delay, audio standard, sideband position, vision carrier frequency, frequency offset, reference level, auto level, attenuation, preselector, pre-amplifier, RPC method, RPC line, SNR quiet line, channel name, channel description
	digital TV	TV standard, RF, frequency offset, sideband position, auto level, attenuation, preselector, pre-amplifier, symbol rate, QAM order, roll-off, equalizer, ISDB-T MER/BER layer, DTMB modulation, DTMB frame header, DVB-T2 profile, DVB-T2 PLP, channel name, channel description
Measurement parameters	analog TV	vision carrier level, carrier frequency offset, lock state, lum bar ampl error, lum bar ampl, SN video weighted, SN video weighted nom, FM1 sound carrier, FM2 sound carrier, modulation depth, RPC, FM1 power relative, FM2 power relative, FM1 intercarrier frequency, FM2 intercarrier frequency, HUM
	digital TV	see list below
Visualization for a session		all channel parameters as chart, single channel parameter in time domain (2D graph), single parameter over time and frequency (3D graph), single channel limit violations, all session limit violations
System requirements	32 Bit version for installation on R&S®ETL or PC, visualization tool is not included	operating system: Windows 10, 8.1, 8, 7 or Linux (tested with Ubuntu 16.0.4), administrator rights, dual core processor ≥ 1 GHz, RAM ≥ 2 GByte, 100 MB free memory + memory for the scan results (data base)
	64 Bit version for installation on a PC or laptop, visualization tool is included	operating system 64 Bit: Windows 10, 8.1, 8, 7 or Linux (tested w. Ubuntu 16.0.4), administrator rights, quad core processor ≥ 2 GHz, OpenGL graphics for visualization of 3D diagrams, RAM ≥ 4 GByte, 100 MB free memory + memory for the scan results (data base), network connection to R&S®ETL for measurements

R&S®ETL TVSCAN 2.0 supported measurements for Digital TV:

Parameter	DVB-C / J83/A	J83/B	J83/C / ISDB-C	DVB-T	DVB-T2	ATSC	ATSC MDTV	DTMB (K370)	T-DMB/DAB	ISDB-T
Internal reference	•	•	•	•	•	•	•	•	•	•
Preamplifier	•	•	•	•	•	•	•	•	•	•
Attenuation	•	•	•	•	•	•	•	•	•	•
Preselector	•	•	•	•	•	•	•	•	•	•
Power	•	•	•	•	•	•	•	•	•	•
Carrier frequency offset	•	•	•	•	•	•	•	•	•	•
Symbol rate offset	•	•	•			•	•			
Bitrate offset				•	•			•	•	•
Demod lock	•	•	•	•	•	•	•	•	•	•
MPEG lock	•	•	•	•		•	•	•		•
PLP lock					•					
FIC lock									•	
MER RMS in dB	•	•	•	•	• ⁹	•	•	•	•	• ⁹
MER RMS in %	•	•	•	•	• ⁹	•	•	•	•	• ⁹
MER peak in dB	•	•	•	•	• ⁹	•	•	•	•	• ⁹
MER peak in %	•	•	•	•	• ⁹	•	•	•	•	• ⁹
EVM RMS in dB	•	•	•	•	• ⁹	•	•		•	
EVM RMS in %	•	•	•	•	• ⁹	•	•		•	
EVM peak in dB	•	•	•	•	• ⁹	•	•		•	
EVM peak in %	•	•	•	•	• ⁹	•	•		•	
MERL1 RMS in dB					•					
MERL1 RMS in %					•					
MERL1 peak in dB					•					
MERL1 peak in %					•					
BER before Viterbi				•						• ⁹
BER before RS	•	•	•	•		•	•		•	• ⁹
BER after RS	•	•	•	•		•	•			• ⁹
BER before BCH					• ⁹			•		
BER before LDPC					• ⁹			•		
LDPC iteration					• ⁹			•		
Packet errors per second	•	•	•	•		•	•	•	•	• ⁹
Packet error ratio	•	•	•	•	• ⁹	•	•	•	•	• ⁹
Errored seconds ratio					• ⁹			•		
TSRate	•	•	•	•		•	•	•	•	• ⁹
Shoulder attenuation lower	•	•	•	•	•	•	•	•		
Shoulder attenuation upper	•	•	•	•	•	•	•	•		
Phase jitter	•	•	•							
Crest factor current	•	•	•	•	•	•	•	•	•	•
Group delay (pp)	•	•	•	•	•	•	•	•	•	•
Amplitude response (pp)	•	•	•	•	•	•	•	•	•	•
Phase response (pp)	•	•	•	•	•	•	•	•	•	•
IQ imbalance	•	•	•	•	•			• ¹⁰		•
IQ quad error	•	•	•	•	•			• ¹⁰		•
Carrier suppression	•	•	•	•	•			• ¹⁰		•
Carrier phase				•	•			• ¹⁰		•
SN	•	•	•			•	•		C/N	

⁹ ISDB-T: available for layer A or B or C. DVB-T2: for selected PLP.¹⁰ DTMB (K370): requires R&S®ETL-K372.

Part 7 – Common specifications

Inputs and outputs

RF input		
Impedance		50 Ω
Connector		N female
VSWR	RF attenuation ≥ 10 dB	typ. 1.5
Input attenuator		0 dB to +30 dB in 5 dB steps
Additional RF input, 75 Ω		see R&S®ETL-B203 option
Video output (CCVS)		
Connector		BNC female, 75 Ω
Output level	CCVS	1 V (V_{pp})
DC position of back porch		0 V
Frequency response error	within video bandwidth	≤ 0.4 dB
Group delay response error	within video bandwidth, flat group delay	≤ 12 ns
	within video bandwidth, group delay in line with standard	≤ 20 ns
2T pulse k factor		≤ 1 %
2T pulse amplitude error		typ. ≤ 2 %
Tilt	bar	≤ 1 %
Luminance nonlinearity		≤ 2 %
Differential gain		≤ 2 %
Differential phase		$\leq 1^\circ$
TS ASI output (digital TV receiver mode)		
Connector		BNC female, 75 Ω
Output level		0.8 V (V_{pp})
Data rate		270 Mbit/s
AF signal output		
Connector		2 $\times$ Lemo Triax, female, balanced (symmetrical to ground)
Output impedance		typ. 20 Ω
Output level	600 Ω 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	≥ 50 dB
Frequency response	50 μ s deemphasis, 0.03 kHz to 15 kHz	≤ 0.5 dB
Total harmonic distortion (THD)	1 kHz	≤ 0.1 %
AF output (headphone)		
Connector		3.5 mm mini jack
Output impedance		< 100 Ω
Open-circuit voltage	adjustable in spectrum analyzer mode	up to 1.5 V
Tracking generator (spectrum analyzer mode)		
Tracking generator		N female, 50 Ω
Output level		-20 dBm to 0 dBm in 1 dB steps
Frequency range		1 MHz to 3 GHz
Reverse power		
DC voltage		50 V
CW RF power		30 dBm (= 1 W)
Max. pulse voltage		150 V
Max. pulse energy	10 μ s pulse duration	10 mWs
External reference		
Connector		BNC female, 50 Ω
Input level		0 dBm to +10 dBm
Output level	with R&S®FSL-B4	typ. 0 dBm
Frequency		10 MHz $\pm$ 5 ppm
External trigger/gate input (spectrum analyzer mode)		
Connector		BNC female, 50 Ω
Input level		TTL compatible
USB and remote		
USB interface	host for memory stick, mouse, keyboard	2 $\times$ USB 1.1 (serial number $< 105\,000$), 2 $\times$ USB 2.0 (serial number $\geq 105\,000$)
Remote interface		LAN
	R&S®FSL-B10	LAN or GPIB

General data

Operating system	serial number $\geq 105\,000$	Windows 8, embedded
System hard drive		
Type, total capacity	serial number $\geq 105\,000$ serial number $< 105\,000$	SSD, 256 Gbyte HDD, 100 Gbyte (latest instruments)
Available memory for user data	serial number $\geq 105\,000$	> 140 Gbyte
Remote control		
LAN interface		10/100fg, RJ-45
IEC/IEEE bus (GPIB)	R&S®FSL-B10	SCPI 1997.0
Display		
Resolution		640 × 480 pixel
Pixel failure rate		$< 2 \times 10^{-5}$
Temperature		
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
Mechanical resistance		
Vibration	sinusoidal random	in line with IEC 60068-2-6 in line with IEC 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure 1, IEC 60068-2-27
Power supply		
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 without handle	408.8 mm × 158.1 mm × 465.3 mm (16.1 in × 6.2 in × 18.3 in) 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)
Recommended calibration interval		12 months
	operation with external reference	24 months

Hardware options

R&S®FSL-B5 additional interfaces

User port		
Connector		9-pin D-Sub male
Output		TTL compatible, 0 V/5 V, max. 15 mA
Input		TTL compatible, max. 5 V
Noise source control		
Connector		BNC female
Output		0 V/28 V, max. 100 mA, switchable, supply for noise source
IF/video out		
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
Power sensor		
Connector		6-pin LEMOSA female for supported R&S®NRP-Zxx power sensors

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

Serial data output/AF GEN R output ¹¹		
Connector		BNC female, 50 Ω
	SER DAT	TTL, R _i = 50 Ω
	AF GEN R	see R&S®ETL-K111 option
Serial clock output/AF GEN L output ¹¹		
Connector		BNC female, 50 Ω
	SER CLK	
	AF GEN L	see R&S®ETL-K111 option
IF output/CCVS/ETI/AF GEN output ¹¹		
Connector		BNC female, 75 Ω
	IF (DVB-C/J.83/B/ISDB-C and DTMB mode; with R&S®ETL-B210/-B215/-B216 options)	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
I signal input		
Connector		BNC female, 50 Ω
Input level	I signal	max. ±0.5 V
Q signal input/MPX input ¹¹		
Connector		BNC female, 50 Ω
Input level	Q signal	max. ±0.5 V
	MPX	max. ±10 V, 100 kΩ impedance
Available interfaces, depending on selected standard		
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
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

¹¹ R&S®ETL-K201 model .03 only.

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
DTMB mode	R&S®ETL-K370 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 Ω
Connector		F male F female (with F adapter, supplied)
VSWR	RF attenuation ≥ 5 dB	1.5
Input attenuator		0 dB to 55 dB in 5 dB steps
Common data for RF input (50 Ω) and additional RF input (75 Ω)		
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-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 Lithium-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

Base unit

Designation	Type	Order No.
TV Analyzer, 500 kHz to 3 GHz, with tracking generator	R&S®ETL	2112.0004.13
Accessories supplied: power cable and getting started manual		

Standard-specific hardware extensions

Options marked with an asterisk are discontinued options.

Designation	Type	Order No.	Configuration rules
High SNR FM Frontend	R&S®ETL-B110	2112.0233.02	- requires R&S®ETL-B203 model .03 and R&S®ETL-K110 - not with R&S®ETL-B210, -B300, -B310, -B215* or -B216*
Digital Demodulator for Single Carrier	R&S®ETL-B210	2112.0104.02	- requires R&S®ETL-K210 or -K213 - not with R&S®ETL-B110, -B300, -B310, -B215* or -B216*
FPGA Extension Board	R&S®ETL-B300	2112.0385.02	- requires R&S®ETL-K320, -K340 or -K370 - not with R&S®ETL-B110, -B210, -B310, -B215* or -B216* - R&S®ETL with serial number < 102 000 require R&S®ETL-U300
FPGA Extension Board, High SNR FM	R&S®ETL-B310	2112.0340.02	- requires R&S®ETL-B203 model .03 - requires R&S®ETL-K110 and one of the following: R&S®ETL-K320 or -K340 or -K370 - not with R&S®ETL-B110, -B210, -B300, -B215* or -B216* - R&S®ETL with serial number < 102 000 require R&S®ETL-U300

Standard activation and related options

Options marked with an asterisk are discontinued options.

Designation	Type	Order No.	Configuration rules
FM (Radio) Firmware	R&S®ETL-K110	2112.0410.02	recommended for high SNR: R&S®ETL-B110 or R&S®ETL-B310
FM (Radio) MPX Deviation Measurement, in line with ITU-R SM.1268-3 and ITU-R SM.1268-4	R&S®ETL-K112	2118.4024.02	requires R&S®ETL-K110
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 -B216*
J.83/B Firmware	R&S®ETL-K213	2112.0504.02	requires R&S®ETL-B210 or -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
ATSC MDTV, ATSC/8VSB Firmware	R&S®ETL-K320	2115.1553.02	requires R&S®ETL-B300 or -B310
ATSC MDTV, ATSC/8VSB SFN Frequency Offset	R&S®ETL-K321	2115.1560.02	requires R&S®ETL-K320 or -K322
DVB-T2 Firmware	R&S®ETL-K340	2112.0527.02	requires R&S®ETL-B300 or -B310
DVB-T2 Frequency Offset	R&S®ETL-K341	2115.1682.02	requires R&S®ETL-K340
DTMB Firmware	R&S®ETL-K370	2118.4047.02	requires R&S®ETL-B300 or -B310
DTMB SFN Frequency Offset	R&S®ETL-K371	2118.4053.02	requires R&S®ETL-K370
DTMB Extended TX Measurements	R&S®ETL-K372	2118.4060.02	requires R&S®ETL-K370
CDR Signal Analysis Software	R&S®ETL-K470	1346.8884.02	requires external PC/laptop

Audio, video and TS related options

Designation	Type	Order No.	Configuration rules
For analog signals			
FM (Radio) Audio Analysis/Generator	R&S®ETL-K111	2112.0427.02	requires R&S®ETL-B201 model .03 and R&S®ETL-K110
Analog TV Video Analysis	R&S®ETL-K202	2112.0433.02	
Analog Multistandard TV Video Generator	R&S®ETL-K203	2112.0440.02	
For digital signals			
AV Decoder and TS Processing	R&S®ETL-B380	2118.4030.02	- requires R&S®ETL with serial number $\geq 100\,500$ - R&S®ETL units with serial numbers $< 105\,000$ require R&S®ETL-U8x - not with R&S®ETL-B235
MPEG TS Generator/Recorder	R&S®ETL-K280	2112.0591.02	- requires R&S®ETL-B380 or -B280 - R&S®ETL units with serial numbers $< 101\,500$ require R&S®ETL-B209 or R&S®ETL-U8x
MPEG Analysis/Monitoring	R&S®ETL-K282	2112.0610.02	requires R&S®ETL-B380 or -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
UHD Extension	R&S®ETL-K381	2118.4253.02	requires R&S®ETL-B380
DVB T2-MI Extension	R&S®ETL-K382	2115.1701.02	requires R&S®ETL-K282
IP Input and Output	R&S®ETL-K386	2118.4260.02	requires R&S®ETL-B380

Further extensions

Designation	Type	Order No.	Configuration rules
R&S®ETL DAkKS (DKD) calibration; contains R&S®ETL-DCV	R&S®ETL-ACA	2112.0010.02	can only be ordered together with an R&S®ETL base unit (In other cases, please contact the Rohde & Schwarz service.)
Universal DTV, ATV, FM Interface	R&S®ETL-B201	2112.0304.03	not with R&S®FSL-B5
RF Preselector	R&S®ETL-B203	2112.0327.03	
DC Power Supply, 11 V to 19 V	R&S®ETL-B230	2112.0256.02	
Lithium-Ion Battery Pack 10 Ah with Battery Charger	R&S®ETL-B235	2112.0262.02	- requires R&S®ETL-B230 - not with R&S®ETL-B380 or -B280
Documentation of R&S®ETL Calibration Values	R&S®ETL-DCV	2082.0490.31	
OCXO Reference Frequency	R&S®FSL-B4	1300.6008.02	
Additional Interfaces	R&S®FSL-B5	1300.6108.02	not with R&S®ETL-B201
GPIO Interface	R&S®FSL-B10	1300.6208.02	
Narrow Resolution Filters	R&S®FSL-B7	1300.5601.02	
AM/FM/PM Measurement Demodulator	R&S®FSL-K7	1301.9246.02	
GPS module	R&S®TSMX-PPS2	1515.7120.02	
SWR Bridge 5 MHz to 3 GHz	R&S®ZRB2	0373.9017.52	
SWR Bridge 40 kHz to 4 GHz, 50 Ω	R&S®ZRC	1039.9492.52	
19" Rackmount Adapter	R&S®ZZA-S334	1109.4487.00	

Software tools

Designation	Type	Order No.	Configuration rules
Broadcast Drive Test Software	R&S®BCDRIVE	2115.1360.02	requires R&S®ETL-K208 and R&S®ETL-B203
R&S®TVSCAN 2.0 Automated measurement of multiple TV channels	R&S®ETL-K950	2112.0479.02	recommended: R&S®ETL-B203

Transport stream libraries

Designation	Type	Order No.	Configuration rules
ISDB-T Transport Streams	R&S®LIB-K54	2116.9393.02	requires R&S®ETL-K280
ATSC-M/H Transport Streams	R&S®LIB-K56	2116.9412.02	requires R&S®ETL-K280
DVB-T2 MI Streams	R&S®LIB-K57	2116.9429.02	requires R&S®ETL-K280
EMC Streams	R&S®LIB-K58	2116.9435.02	requires R&S®ETL-K280
Basic Stream Library	R&S®LIB-K70	2116.9558.02	requires R&S®ETL-K280
Extended SDTV 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 Library	R&S®LIB-K73	2116.9587.02	requires R&S®ETL-K280
HEVC Stream Library	R&S®LIB-K78	2116.9641.02	requires R&S®ETL-K280

Power sensors

Valid for new R&S®ETL units, R&S®ETL units with serial number $\geq 105\,000$ and R&S®ETL units with installed upgrade kits (R&S®ETL-U80/R&S®ETL-U81/R&S®ETL-U82).

Designation	Type	Order No.
Activation of power sensor measurements		
Power Sensor Support	R&S®FSL-K9	1301.9530.02
Recommended power sensors to measure broadcast signals		
R&S®NRP-ZKU/R&S®NRP-ZK6 cable and R&S®FSL-K9 required.		
Three-Path Diode Power Sensor, 10 MHz to 8 GHz, 100 pW to 200 mW, N (m)	R&S®NRP8S	1419.0006.02
Thermal Power Sensor, DC to 18 GHz; 300 nW to 100 mW; N (m)	R&S®NRP18T	1424.6115.02
USB cables		
USB Interface Cable (length: 0.75 m/1.50 m/3.00 m/5.00 m)	R&S®NRP-ZKU	1419.0658.02/03/04/05
Six-pole interface cable (require R&S®FSL-B5)		
Six-Pole Interface Cable (length: 1.50 m/3.00 m/5.00 m)	R&S®NRP-ZK6	1419.0664.02/03/04
Supported power sensors (connection via six-pole cable or USB cable)		
R&S®FSH-Z1, R&S®FSH-Z18, R&S®NRP110T, R&S®NRP18A, R&S®NRP18AN, R&S®NRP18S, R&S®NRP18S-10, R&S®NRP18S-20, R&S®NRP18S-25, R&S®NRP18SN, R&S®NRP18SN-10, R&S®NRP18SN-20, R&S®NRP18SN-25, R&S®NRP18T, R&S®NRP18TN, R&S®NRP33S, R&S®NRP33SN, R&S®NRP33SN-V, R&S®NRP33T, R&S®NRP33TN, R&S®NRP40S, R&S®NRP40SN, R&S®NRP40T, R&S®NRP40TN, R&S®NRP50S, R&S®NRP50SN, R&S®NRP50T, R&S®NRP50TN, R&S®NRP67T, R&S®NRP67TN, R&S®NRP6A, R&S®NRP6AN, R&S®NRP8S, R&S®NRP8SN, R&S®NRPC18, R&S®NRPC18-B1, R&S®NRPC33, R&S®NRPC33-B1, R&S®NRPC40, R&S®NRPC40-B1, R&S®NRPC50, R&S®NRPC50-B1, R&S®NRP-FU, R&S®NRPM3, R&S®NRP-Z11, R&S®NRP-Z21, R&S®NRP-Z211, R&S®NRP-Z22, R&S®NRP-Z221, R&S®NRP-Z23, R&S®NRP-Z24, R&S®NRP-Z27, R&S®NRP-Z28, R&S®NRP-Z31, R&S®NRP-Z32, R&S®NRP-Z37, R&S®NRP-Z41, R&S®NRP-Z51, R&S®NRP-Z52, R&S®NRP-Z55, R&S®NRP-Z56, R&S®NRP-Z57, R&S®NRP-Z58, R&S®NRP-Z61, R&S®NRP-Z71, R&S®NRP-Z81, R&S®NRP-Z85, R&S®NRP-Z86, R&S®NRP-Z91, R&S®NRP-Z92, R&S®NRP-Z96, R&S®NRP-Z98		

Recommended extras

Designation	Type	Order No.
Protective Hard Cover	R&S®EVS-Z6	5201.7760.00
Spare F Adapter, female/female	R&S®FSHTV-Z61	2111.7111.02
Matching Pad 75 Ω , L section, N to BNC	R&S®FSH-Z38	1300.7740.02
Soft Carrying Bag	R&S®FSL-Z3	1300.5401.00
Matching Pad 75 Ω , L section	R&S®RAM	0358.5414.02
Matching Pad 75 Ω , series resistor 25 Ω	R&S®RAZ	0358.5714.02
Lemo Triax Connector (mono) with connecting cable (open)		2067.7451.00
Adapter cable (Lemo Triax – XLR)		2068.9187.00

Options only available for already delivered units

Designation	Type	Order No.	Retro-fittable	Configuration rules
Hard Disk 80 Gbyte	R&S®ETL-B209	2112.0291.02	yes (service)	only for R&S®ETL with serial number 100 500 to 101 500
HDTV and Dolby® Upgrade	R&S®ETL-K281	2112.0604.02		requires R&S®ETL-B281
Mounting Kit for R&S®ETL-B300 and R&S®ETL-B310	R&S®ETL-U300	2112.0379.02	yes (service)	
ATSC MDTV Upgrade	R&S®ETL-322	2115.1576.02		requires R&S®ETL-K220 and (R&S®ETL-B300 or -B310)
Upgrade Kit (SSD with Windows 8, processor board and adapter board)	R&S®ETL-U82	2118.4160.82	yes (service)	for R&S®ETL with serial number from 100 500 to 102 009
Upgrade Kit (SSD with Windows 8 and processor board)	R&S®ETL-U81	2118.4160.81	yes (service)	for R&S®ETL with serial number from 102 010 to 102 999
Upgrade Kit (SSD with Windows 8)	R&S®ETL-U80	2118.4160.80	yes (service)	for R&S®ETL with serial number from 103 000 to 104 999

Discontinued options (for completeness)

Designation	Type	Order No.	Comment
RF Preselector	R&S®ETL-B203	2112.0327.02	new version of preselector: 2112.0327.03
Digital Demodulator for DTMB	R&S®ETL-B215	2112.0156.02	new option for DTMB: R&S®ETL-K370
Digital Demodulator for Single Carrier and DTMB	R&S®ETL-B216	2112.0162.02	- new option for DTMB: R&S®ETL-K370 - option for single carrier alone: R&S®ETL-B210
MPEG Processing Board	R&S®ETL-B280	2112.0362.02	new option for MPEG processing and decoding: R&S®ETL-B380
Video and Audio Hardware Decoder	R&S®ETL-B281	2112.0356.02	included in R&S®ETL-B380 option

Warranty

Base unit		3 years
All other items ¹²		1 year
Options		
Extended Warranty, one year	R&S®WE1	Please contact your local Rohde & Schwarz sales office.
Extended Warranty, two years	R&S®WE2	
Extended Warranty with Calibration Coverage, one year	R&S®CW1	
Extended Warranty with Calibration Coverage, two years	R&S®CW2	
Extended Warranty with Accredited Calibration Coverage, one year	R&S®AW1	
Extended Warranty with Accredited Calibration Coverage, two years	R&S®AW2	

Extended warranty with a term of one and two years (WE1 and WE2)

Repairs carried out during the contract term are free of charge ¹³. Necessary calibration and adjustments carried out during repairs are also covered.

Extended warranty with calibration coverage (CW1 and CW2)

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 ¹³ and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

Extended warranty with accredited calibration (AW1 and AW2)

Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs ¹⁰ and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

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¹² For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

¹³ Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.