DVB-H playout
with statistical multiplex and adaptive time slicing

Significant data rate reduction in each TV channel

◆ System with:
 – R&S®AVE264 DVB-H video and audio encoder
 – R&S®AVP264 DVB-H playout base unit
 – R&S®DIP010 DTV IP inserter and generator
◆ Efficient video/audio encoding with variable bit rate

◆ Encoder redundancy
◆ Optimized time slicing for variable data rate
◆ Powerful standards for H.264/AVC video and AAC audio
◆ CA synchronizer for typical encoding systems
◆ File broadcasting with ALC/FLUTE carousel

◆ Fully automatically calculated time slicing
◆ Subchanneling
◆ Complete PSI/SI signaling
◆ Web operation
◆ SNMP for monitoring the statistical multiplex

ROHDE&SCHWARZ

Efficient DVB-H playout

The DVB-H standard for transmitting TV services to small mobile terminals is gaining ground. Rohde & Schwarz offers service and network providers a new DVB-H playout system with a statistical multiplex function and adaptive time slicing. This system allows up to 40 % of the data rate to be saved – without compromising on video quality. As a result, more than 20 (instead of 15) mobile TV programs can be broadcast on a TV channel, for example, ensuring highly efficient use of the limited DVB-H frequency spectrum.

DVB-H playout requires the following instruments:

◆ R&S®DIP010 DTV IP inserter and generator
◆ R&S®AVE264 DVB-H video and audio encoder
◆ R&S®AVP264 DVB-H video and audio playout base unit

As all instruments are designed to work together, their functions ideally complement one another. For the encoder and the playout base unit, Rohde & Schwarz uses software licensed by the Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut (HHI).

Each R&S®AVE264 encodes a program with video and audio information in line with the H.264 and AAC++ standards. The statistical multiplex manager coordinates the variable program-dependent data rates of the encoders for the statistical multiplex and forwards the information about data configuration in the statistical multiplex to the R&S®DIP010. The R&S®DIP010 further processes this information with adaptive time slicing, which is a unique feature. The inserter does this by converting the signal to a burst structure that reduces data rates.

The European Union co-financed the development of the DVB-H playout with statistical multiplex and adaptive time slicing.
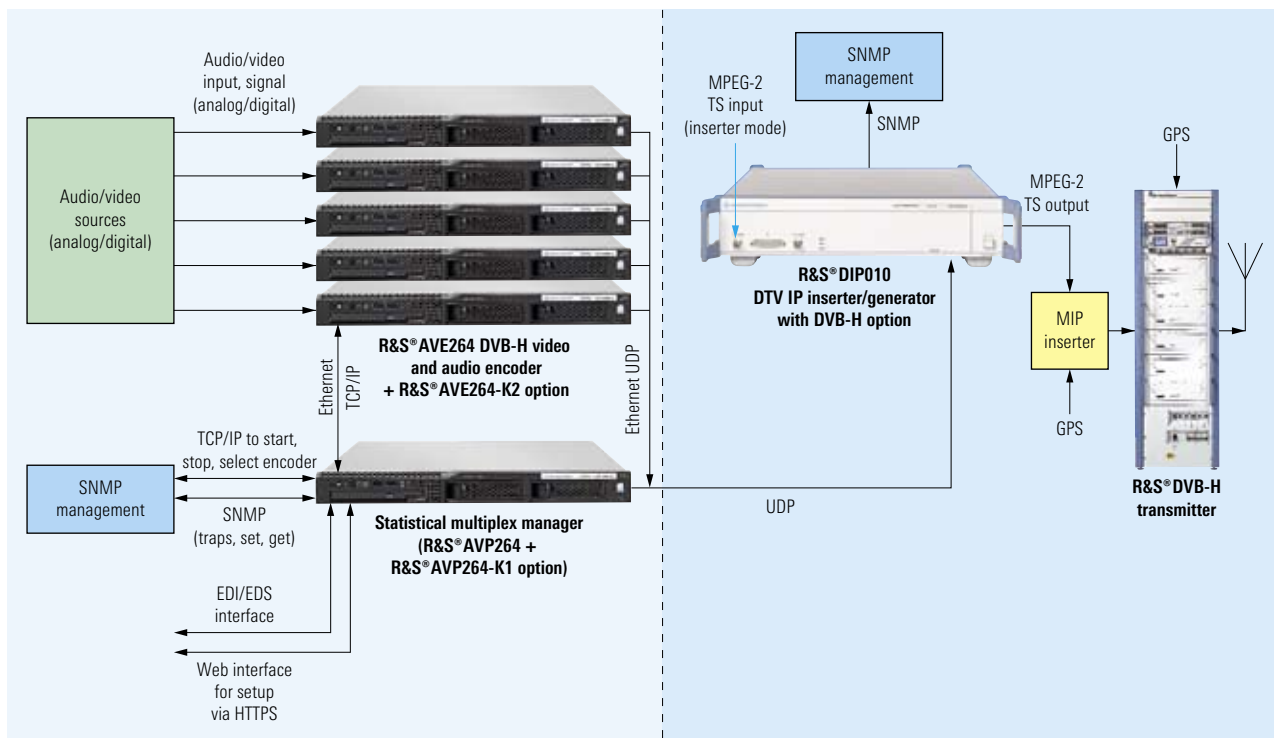
– – – – – Can be separated to different locations

DVB-H playout with a statistical multiplex consisting of five programs

R&S®AVE264 DVB-H video and audio encoder

◆ H.264 video encoder
(MPEG-4 AVC, ISO/IEC 14496-10)
◆ AAC audio encoder
(HE AAC, ISO/IEC 14496-3)
◆ Fully configurable encoding
parameters:
– Aspect ratio, frame rate, frame
size, GOP size, bit rate
– Constant bit rate (CBR) and
variable bit rate (VBR) for statistical
multiplex
◆ Video inputs:
– Analog: composite, S-video
– Digital: SDI
◆ Audio inputs:
– Analog: unbalanced (RCA),
balanced (XLR)
– Digital: AES/EBU, embedded SDI
◆ RAID capability
◆ 2 × Ethernet (10/100/1000BaseT)
◆ Graphical user interface for setup
(CBR)

The new R&S®AVE264 DVB-H video and
audio encoder encodes video data in line
with H.264, and audio data in line with
HE AAC and LC AAC, in realtime.

Each instrument encodes one program
with video and audio information and
uses this information to generate an IP
data stream. With a statistical multiplex
of several programs, the R&S®AVP264
statistical multiplex manager configures
and controls the encoders.

The R&S®AVE264 was specially de-
signed for DVB-H; it is fully compatible
with the TS 102 005 DVB-H standard
(DVB-H specification for A/V coding).

The video encoder can be operated in
two different modes – in the constant bit
rate (CBR) mode, and in the variable bit
rate (VBR) mode.

In the CBR mode, the encoded IP data
stream is constant and independent of
the current picture content.

In the VBR mode, however, the variable
output data rate outputs the programs
depending on the amount of picture con-
tent, which varies as a function of time.

With constant bit rate, the encoders can
be operated via a web browser; if the bit
rate is variable, they are operated via the
web interface of the upstream statistical
multiplex manager. The following encod-
ing parameters are fully configurable:

◆ Maximum video data rate in
VBR mode
◆ Constant bit rate in CBR mode
◆ Aspect ratio
◆ Frame rate
◆ Frame size
◆ GOP size
◆ Cropping
◆ Scaling
◆ Qualitative weighting of individual
services

The encoder with a powerful Intel
Pentium processor offers 1024 Mbyte
RAM, two Ethernet interfaces
(10/100/1000BaseT), and an audio/video
grabber card. The RAID hard disk system
increases the memory capacity and
enhances the instrument's failsafety.

The various encoder functions are fully
software-implemented. As a result, the
instrument can be flexibly adapted when
future modifications need to be made.
In networks, the instrument's IP output
signal can be forwarded via Ethernet in
accordance with user-specific require-
ments.

R&S®AVP264 DVB-H video and audio playout base unit

◆ Functions:
– Statistical multiplex manager
– SimulCrypt synchronizer
– ALC/FLUTE carousel
◆ Graphical user interface for setting up
a statistical multiplex
◆ RAID capability
◆ 2 × Ethernet (10/100/1000BaseT)

Operating as a statistical multiplex
manager, the R&S®AVP264 controls
and configures the individual encoders
in such a way that their programs are
played out in a statistical multiplex. At
the same time, the R&S®DIP010 is driven
and set to generate the DVB-H signal
with adaptive time slicing.

To play out electronic service guides (ESG) or other file-based content (e.g. a video preview channel), additional services can be configured. Operating as an ALC/FLUTE carousel, the R&S®AVP264 handles the playout of these services; the information is then transmitted in line with the ALC (RFC3450) and FLUTE (RFC3926) standards.

The R&S®AVP264 is operated via a web browser.

The R&S®DIP010 data inserter inserts the IP data stream from the encoder into a DVB-H transport stream. For this purpose, the time slicing function divides the data into short time slices, which are then periodically transmitted. Using adaptive time slicing, the inserter converts the signal from the statistical multiplex into a burst structure that reduces data rates. Adaptive time slicing allows an increased number of programs per channel to be broadcast.

Statistical multiplex and adaptive time slicing

To efficiently transmit multiple TV programs within one channel, the programs are combined in a statistical multiplex. Communication among the encoders as well as between the encoders and the DVB-H playout base unit ensures common compression, as well as data rate control.

The encoder generates a signal with a variable data rate depending on the amount of picture information, which varies as a function of time. To ensure the same quality, video sequences with strongly moving pictures require a higher data rate than picture content that moves less.

R&S®DIP010 DTV IP inserter and generator for DVB-H

◆ MPEG-2 data inserter and generator for DVB-H
◆ Adaptive time slicing to reduce data rates
◆ Handling of services with constant or variable data rate
◆ At least 50 services per channel owing to a hardware-based Reed-Solomon encoder
◆ Dynamic error protection system
◆ Bridging of switching times between bursts by means of additional services with constant data rate
◆ Generation of maximum DVB-H data rate
◆ Additional information for identifying services through PSI/SI signaling
◆ Enabling of service providers to offer fixed data and code rates to content providers
◆ Separate handling of services of different content providers by using hardware and software solutions

The R&S®DIP010 DTV IP inserter and generator is the only instrument on the market that automatically calculates the complex time slicing process with mathematical methods which were specially devised for this purpose.

The data sent in each burst is safeguarded by additional error protection data. In this case, the code rate is the ratio between application data and error protection data in the bursts; automatic puncturing for each burst during the runtime keeps the code rate constant.

For more information about the R&S®DIP010, see the "DTV IP Inserter and Generator R&S®DIP010 for DVB-H" data sheet (PD 0758.0345.32).

The statistical multiplex relies on the fact that still and moving picture content occurs at statistic intervals throughout all programs in a channel. The statistical multiplex manager distributes the available data rate of the DVB-H channel at any given time to the individual programs. Different data rates are assigned to these programs, depending on the current content and its complexity. In turn, the sum of the data rates of all programs is minimized to allow optimum use of the transmission channel without compromising on video quality.

In contrast, limiting a permanently assigned data rate in a system often adversely affects the picture quality of strongly moving pictures. Program providers must therefore find a compromise between transmission capacity and video quality.

The R&S®AVE264 encoder provides the R&S®DIP010 with information about the statistical multiplex of the programs via the R&S®AVP264 playout base unit. The inserter uses this information to determine the parameters of a DVB-H signal with an identical burst data rate for all

programs. Depending on the size and scope of the current program content, the instrument determines the applicable burst duration and the time slice interval down to an accuracy of 1 ms.

Starting each DVB-H burst with an intra-frame (I-frame) ensures fast access to the program and accelerates switchover between individual programs at the DVB-H receiver. The I-frame with the highest amount of data contains all current picture information. It is followed by the predictive frames (P-frames), which contain information about the difference between the current and the preceding I-frame.

If additional programs are added to an existing playout system, the system is easily scalable.
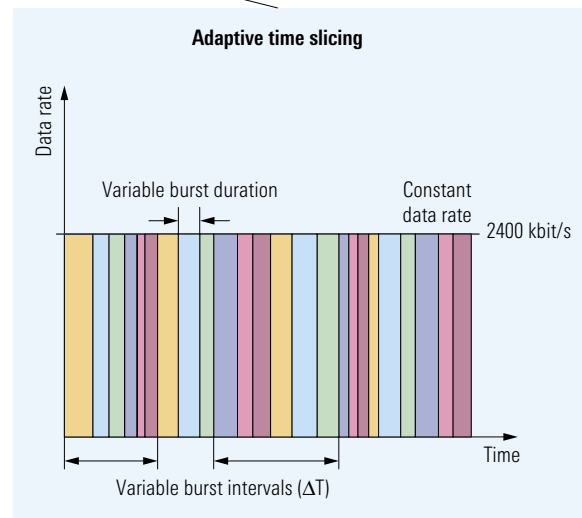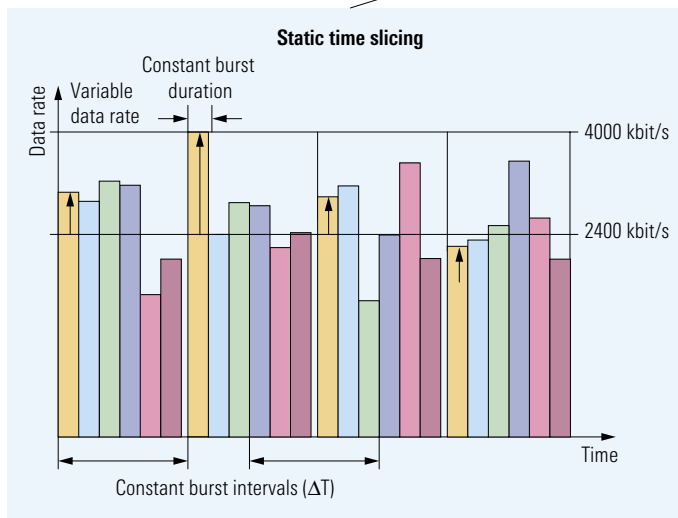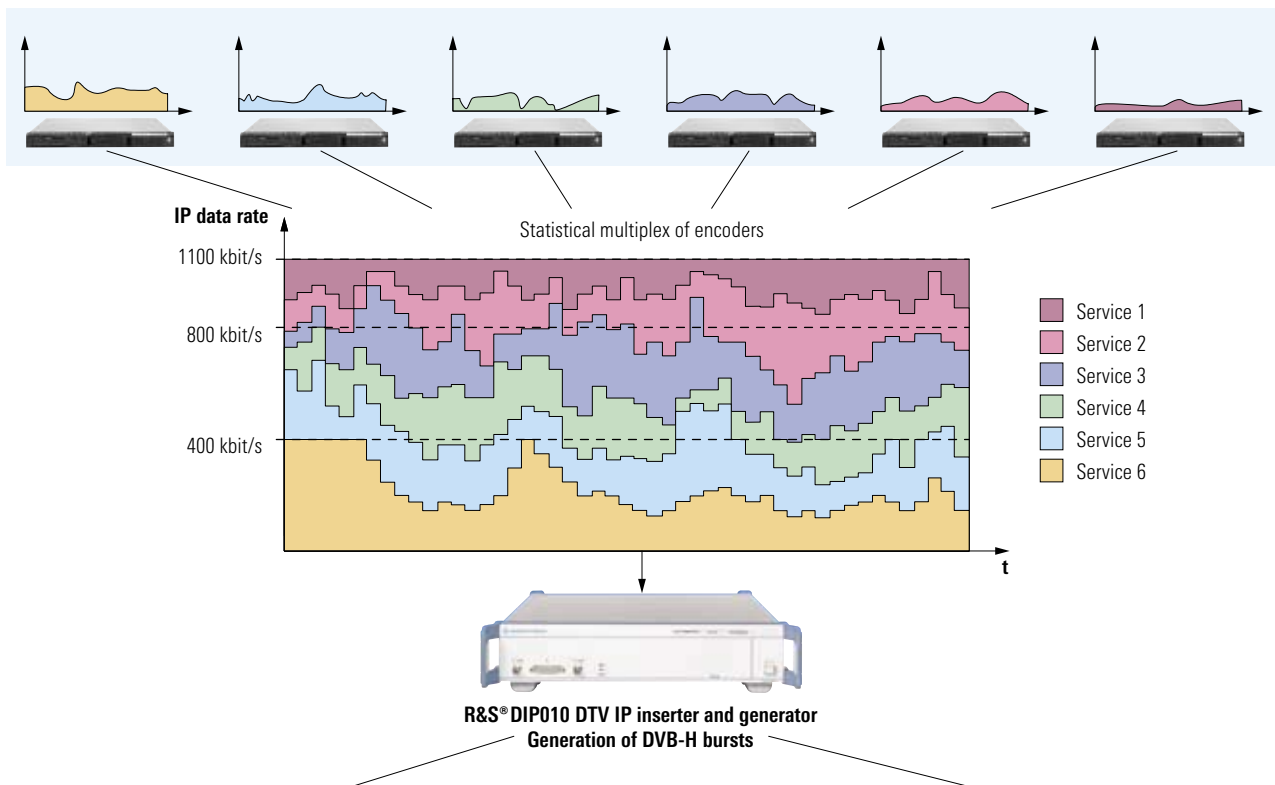
Principle of statistical multiplex with adaptive time slicing

Interface to the CA encryption system

The programs can be encoded by means of a CA encryption system as needed. DVB-H playout supports the DVB ETSI TS 103 197 V1.4.1 SimulCrypt standard, which is also used by renowned providers of encryption systems.

Two different types of encryption information are available:

◆ Entitlement control messages (ECM)
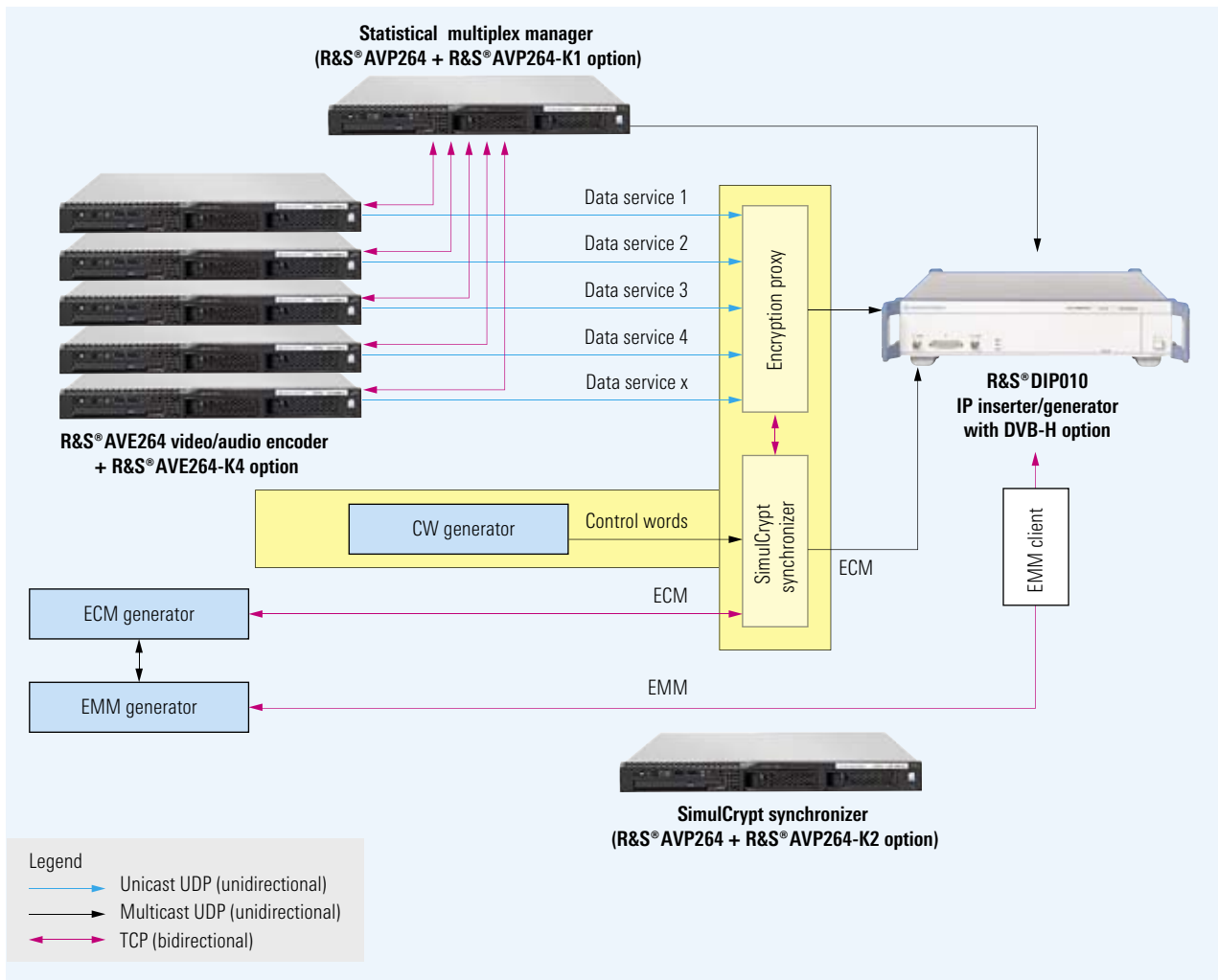◆ Entitlement management messages (EMM)

The R&S®DIP010 inserter places the ECM at the beginning of each burst of the services. Thus, the data is immediately decoded when the burst is received, allowing quick video access. The EMM, in turn, are transmitted in separate slices.

The SimulCrypt synchronizer and special options of the DVB-H video and audio encoders implement the encryption function.

Powerful standards

The H.264 standard, also referred to as MPEG-4 part 10 AVC (advanced video coding), complies with ISO/IEC 14496-10 and is a powerful standard for video compression.

Audio data is encoded in compliance with the ISO/IEC 14496-3 audio compression standard, advanced audio coding (AAC) with HE AAC (high efficiency) and LC AAC (low complexity).

Statistical multiplex manager
(R&S®AVP264 + R&S®AVP264-K1 option)

Data service 1
Data service 2
Data service 3
Data service 4
Data service x

Encryption proxy

**R&S®AVE264 video/audio encoder
+ R&S®AVE264-K4 option**

**R&S®DIP010
IP inserter/generator
with DVB-H option**

CW generator — Control words

SimulCrypt synchronizer

ECM generator

ECM

ECM

EMM client

EMM generator

EMM

**SimulCrypt synchronizer
(R&S®AVP264 + R&S®AVP264-K2 option)**

Legend
→ Unicast UDP (unidirectional)
→ Multicast UDP (unidirectional)
→ TCP (bidirectional)

DVB-H playout with statistical multiplex and encryption

Specifications

R&S®AVE264 DVB-H video and audio encoder, R&S®AVP264 DVB-H video and audio playout base unit

Coding video	
Format	H.264 in line with ISO/IEC 14496-10
Bit rate	variable bit rate (VBR) 40 kbit/s to 384 kbit/s
Range	user-selectable in steps of 1 kbit/s
Resolution	specified in ETSI TS 102 005 V01.02.01
Frequency	
NTSC	30 Hz
PAL	25 Hz
Capability classes	
A/B/C	in line with ETSI TS 102 005 V01.02.01
Features	context-based adaptive variable length code (CAVLC), noise reduction, deinterlace, cropping, scaling, valid input detection, prioritization of services
Output interfaces	
Network connector	Ethernet (8-pin RJ-45 connector, bandwidth 1000/100/10 Mbit/s, level 2 V V_{pp}) , in line with IEEE 802.3
Platform hardware	
Server	IBM X306M
Processor	Intel Pentium 4 HT, 3.2 GHz or later
RAM	1024 Mbyte
Drives	CD/DVD
Hard disk	>32 Gbyte SATA (RAID1 for redundancy)
Network	standard: 2 × Broadcom NetXTreme Gigabit Ethernet
Power supply	100 V to 127 V or 200 V to 240 V AC autosensing
Frequency	50/60 Hz
Power consumption	max. 550 VA
Cooling	air-cooled with six fans
Air temperature	
Active	+10 °C to +35 °C
Inactive	−40 °C to +60 °C
Relative humidity	8 % to 80 %
Dimensions (W × H × D)	440 mm × 43 mm × 559 mm (max. 711.4 mm) (17.32 in × 1.70 in × 22.01 in (max. 28.00 in)) (19" cabinet, 1 height unit)
Weight	max. 12.7 kg (28.00 lb)
MTBF	>3 years
Noise emissions	max. 65 dB(A)

EMC
  Emissions
  Immunity
  Harmonic current emissions
  Voltage changes, voltage fluctuations, and flicker
	in line with EMC Directive 2004/108/EC
	in line with EN 55022, class A
	in line with EN 55024
	in line with EN 61000-3-2:2000
	
	in line with EN 61000-3-3:1995 + A1:2001

Safety	in line with Low Voltage Directive 73/23/EC, EN 60950-1 in line with Battery Directive 91/157/EC, 93/86/EC, 98/101/EC

R&S®AVE264 DVB-H video and audio encoder only

Platform software	
Operating system	Windows XP Embedded
SNMP	SNMP subagent
Content encryption (CAS)	
System	ISMACryp 1.1 in line with RFC 3640 for audio, RFC 3984 for video SimulCrypt in line with ETSI TS 103 197 digital video broadcasting (DVB); headend implementation of DVB SimulCrypt
Audio input interfaces	
Analog	RCA (chinch) – unbalanced (impedance 600 Ω, level 5 V V_{pp}) XLR – balanced (impedance 600 Ω, level 5 V V_{pp})
Digital	AES/EBU (impedance 110 Ω, level 1 V to –3.5 V V_{pp}, resolution 16 bit to 24 bit) in line with AES/EBU3-1992/2003 and AES/EBU11-1997/2003 embedded SDI in line with SMPTE 272M-A
Coding	
Format	advanced audio coding (AAC) in line with ISO/IEC 14496-3 (HE AAC v1/v2)
Bit rate	32 kbit/s to 128 kbit/s for capability class B, max. 320 kbit/s for multichannel
Range	user-selectable in steps of 1 kbit
Resolution	12500, 24000, 32000, 44100, 48000
Modes	mono, stereo, joint stereo
Platform hardware	
Grabber card	Viewcast Osprey-530
Video input interfaces	
Analog	composite (BNC, impedance 75 Ω, unbalanced, bandwidth 3.5 MHz at 3 dB, level 1 V V_{pp} ±0.3 dB) in line with PAL: ITU-R BT.407; NTSC: ITU-R BT.470-6 Y/C (S-video 4-pin mini DIN (Hosiden), impedance 75 Ω, unbalanced, bandwidth 5 MHz at 3 dB, level 1 V V_{pp}) in line with PAL: ITU-R BT.407; NTSC: ITU-R BT.470-6
Digital	serial digital interface (SDI, BNC connector, impedance 75 Ω, unbalanced, bandwidth 270 Mbit/s), in line with SMPTE 259M-C, ITU-R BT.601

Ordering information

Selection of instruments and options in accordance with the requirements placed on the DVB-H playout system

R&S® DVB-H playout requirements	Video and audio encoder (for each program)					Statistical multiplex manager (for each multiplex)		SimulCrypt synchronizer		ALC/FLUTE carousel		DTV IP inserter and generator	
	R&S® AVE264 instrument	R&S® AVE264-K1 option	R&S® AVE264-K2 option	R&S® AVE264-K3 option	R&S® AVE264-K4 option	R&S® AVP264 instrument	R&S® AVP264-K1 option	R&S® AVP264 instrument	R&S® AVP264-K2 option	R&S® AVP264 instrument	R&S® AVP264-K3 option	R&S® DIP010 instrument	R&S® DIP-H option
Constant bit rate													
Constant bit rate	1	1										1	1
Constant bit rate + encryption	1		1					1	1			1	1
Constant bit rate + ALC/FLUTE	1	1								1	1	1	1
Constant bit rate + encryption + ALC/FLUTE	1		1					1	1	1	1	1	1
Statistical multiplex													
Statistical multiplex	1			1		1	1					1	1
Statistical multiplex + encryption	1				1	1	1	1	1			1	1
Statistical multiplex + ALC/FLUTE	1			1		1	1			1	1	1	1
Statistical multiplex + encryption + ALC/FLUTE	1				1	1	1	1	1	1	1	1	1

Designation	Type	Order No.
DTV IP Inserter and Generator MPEG-2 in, MPEG-2 out, as generator or inserter, 54 Mbit/s IP throughput, including DBC WebCarousel™, DBC MediaRouter	R&S®DIP010	3540.9254.20
Options		
DVB-H option for DTV IP inserter and generator, supports time slicing, FEC, PSI/SI, including ALC/FLUTE	R&S®DIP-H	3542.0060.00
SSU UpdateCarousel, playout of set-top box firmware, carousel with SSUStreamer	R&S®SSUCAR	3540.9890.00
Accessories		
Rack Adapter, 2 height units, 19"	R&S®ZS800R1	3539.5620.00
DVB-H Video and Audio Encoder Base unit for one program with video and audio[1] Input video: SDI digital input, composite PAL/NTSC analog input Input audio: embedded SDI, digital AES/EBU, analog L/R Video encoding: H.264/AVC baseline profile Audio encoding: HE AAC (LC AAC) Output: IP/RTP[1]	R&S®AVE264	5301.8000.12
Options		
CBR Video Encoder H.264 Allows constant bit rate (CBR) for video in one encoder	R&S®AVE264-K1	5301.8039.13
VBR Video Encoder H.264 Allows variable bit rate (VBR) for video in one encoder for statistical multiplex	R&S®AVE264-K2	5301.8039.14
CBR Video Encoder H.264 with encryption Allows constant bit rate (CBR) for video in one encoder, in combination with SimulCrypt synchronizer (R&S®AVP264 and R&S®AVP264-K2 option)	R&S®AVE264-K3	5301.8039.15
VBR Video Encoder H.264 with encryption Allows variable bit rate (VBR) for video in one encoder for statistical multiplex, in combination with SimulCrypt synchronizer (R&S®AVP264 and R&S®AVP264-K2 option)	R&S®AVE264-K4	5301.8039.16
Statistical multiplex manager		
For one statistical multiplex per subchannel (in combination with R&S®AVE264 encoder and R&S®AVE264-K2 or R&S®AVE264-K4 option), consisting of:		
DVB-H Video and Audio Playout Base Unit, based on industrial 19" PC, licensed by Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut (HHI)	R&S®AVP264	5301.8000.02
Statistical Multiplex Manager Software	R&S®AVP264-K1	5301.8039.03
SimulCrypt synchronizer		
Allows encryption for one multiplex (in combination with R&S®AVE264 encoder with R&S®AVE264-K3 or R&S®AVE264-K4 option), consisting of:		
DVB-H Video and Audio Playout Base Unit, based on industrial 19" PC, licensed by Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut (HHI)	R&S®AVP264	5301.8000.02
SimulCrypt Synchronizer Software	R&S®AVP264-K2	5301.8039.04
ALC/FLUTE carousel		
Allows playout of ESG files, for one multiplex consisting of:		
DVB-H Video and Audio Playout Base Unit, based on an industrial 19" PC, licensed by Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut (HHI)	R&S®AVP264	5301.8000.02
ALC/FLUTE Carousel Software	R&S®AVP264-K3	5301.8039.05

[1] Only in combination with one of the options.

Certified Quality System
ISO 9001
REG. NO CERT-11180-2001-AQ-ESN-TGA

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

More information at
www.rohde-schwarz.com
(search term: DVB-H playout)

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