

# HDMI™

# (high-definition multimedia interface)

HDMI 2.0  
now released  
changes high-  
lighted in green

High-definition multimedia interface (HDMI™) is an interface for transmitting audio and video data between consumer electronics devices. Since its introduction in 2001, it has become the official successor of the analog interfaces in the consumer domain. Since then, HDMI™ LLC and HDMI™ Forum have continuously improved the specifications to include new market requirements and higher resolutions.

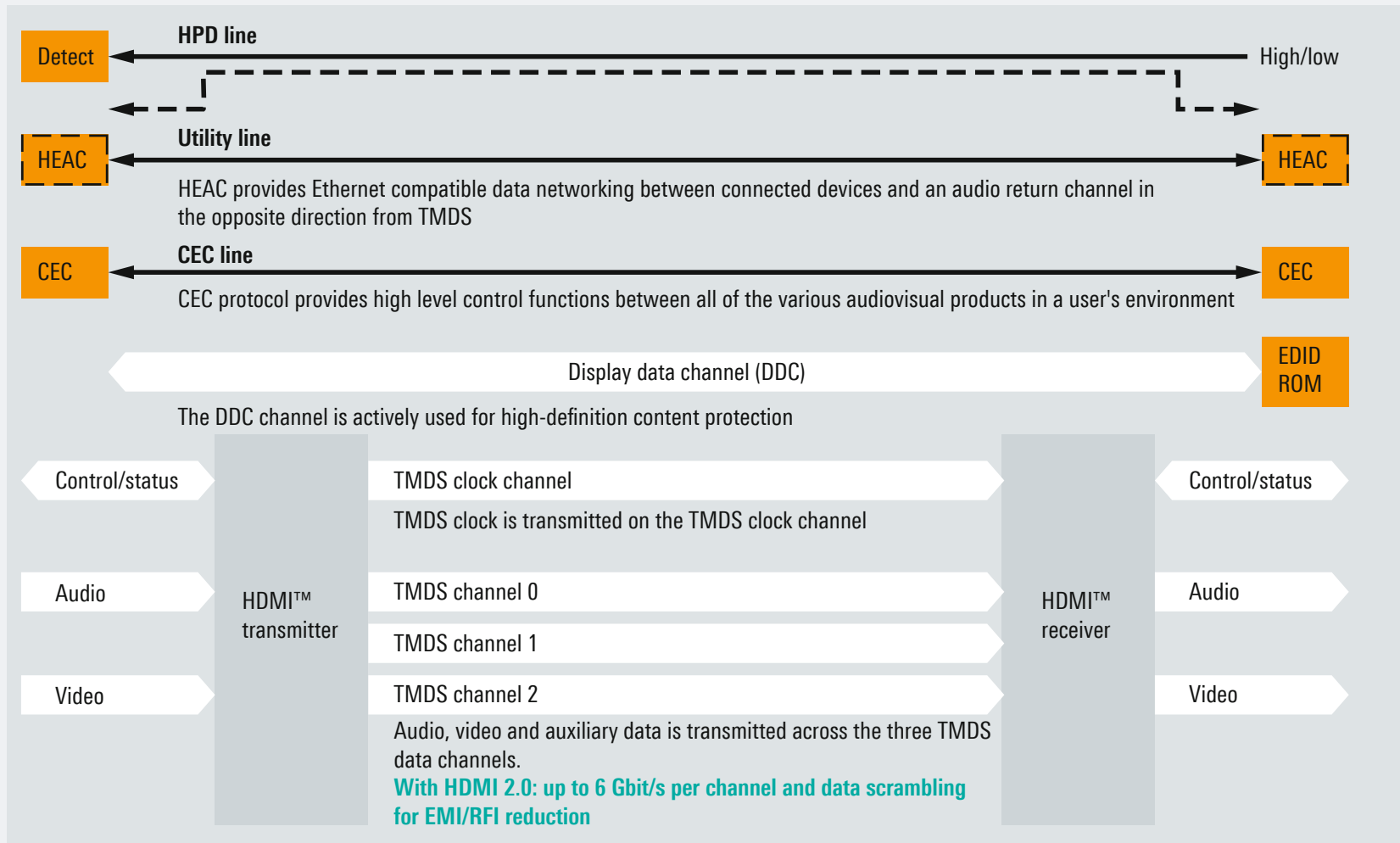
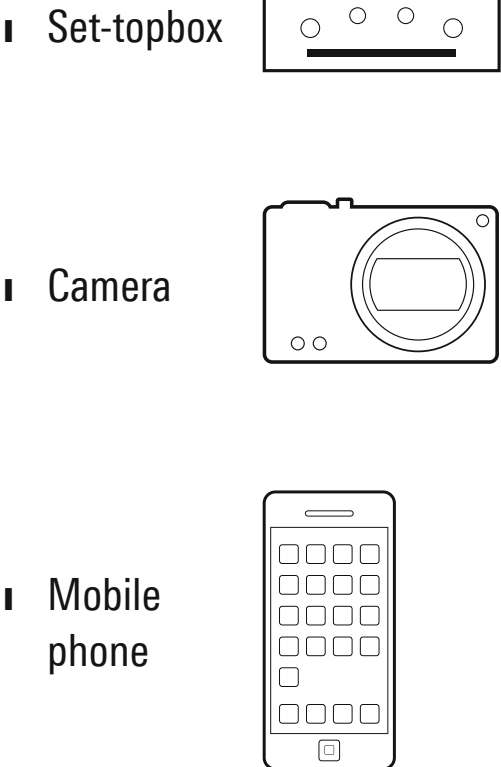
#### Advantages of HDMI™:

- Most common A/V interface with support from more than 3 billion devices
- Uncompressed video with up to 4k resolution
- Eight-channel uncompressed PCM or compressed audio
- High-bandwidth digital content protection (HDCP) to ensure the copyright of transmitted media content

- Consumer electronics control (CEC) for control between interconnected devices
- Ethernet channel (HEC) tunnels IP connections between interconnected devices
- Audio return channel (ARC) replaces additional S/PDIF audio wiring
- Downward-compatible with DVI and previous HDMI™ versions

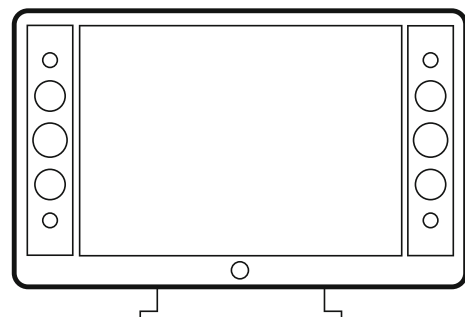
#### Source

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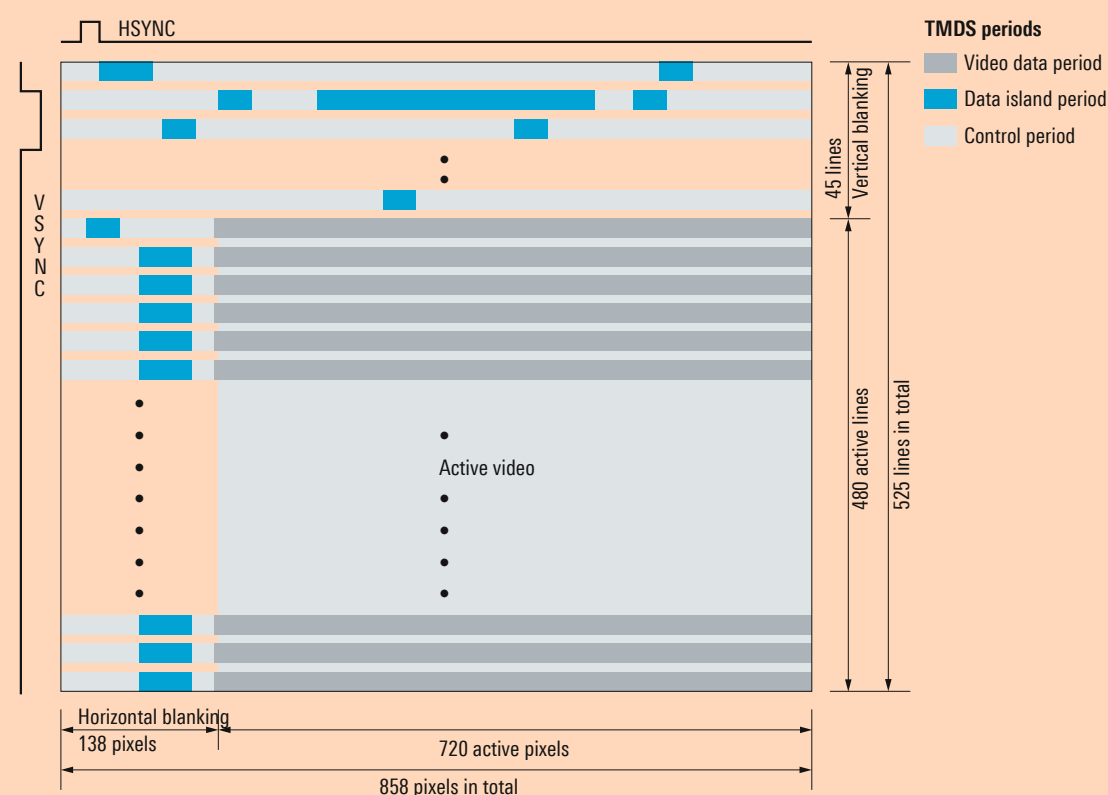


#### Sink

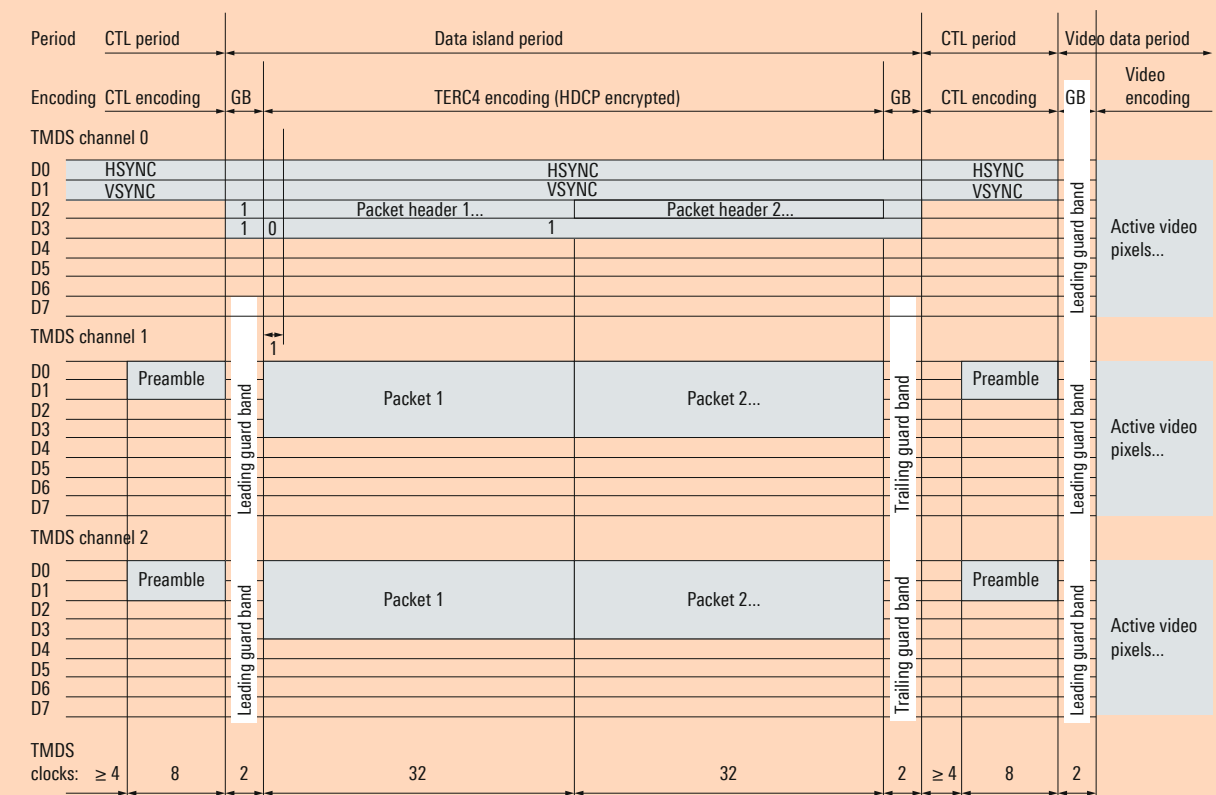
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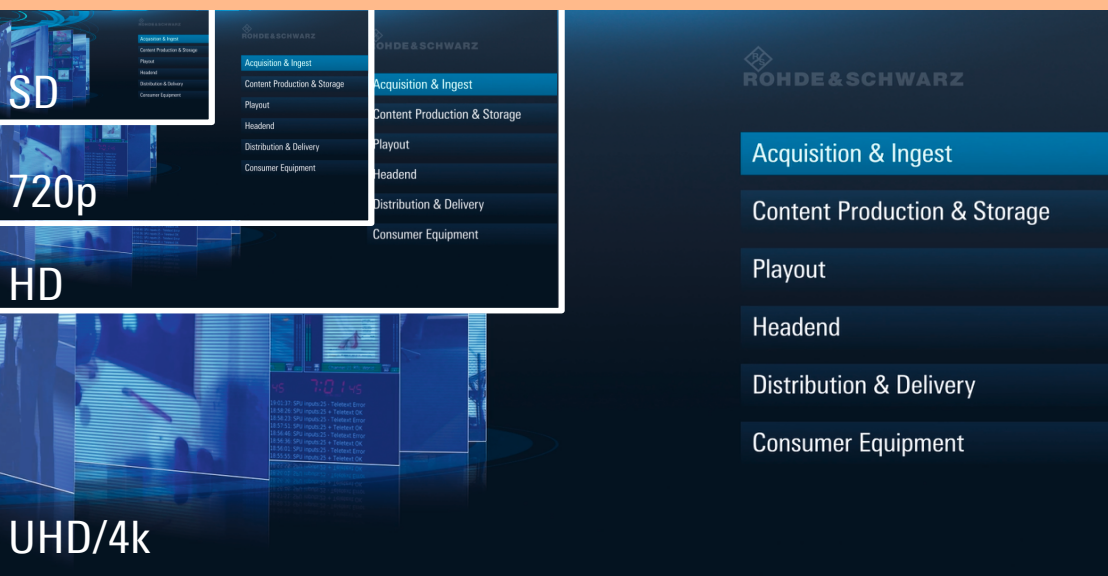
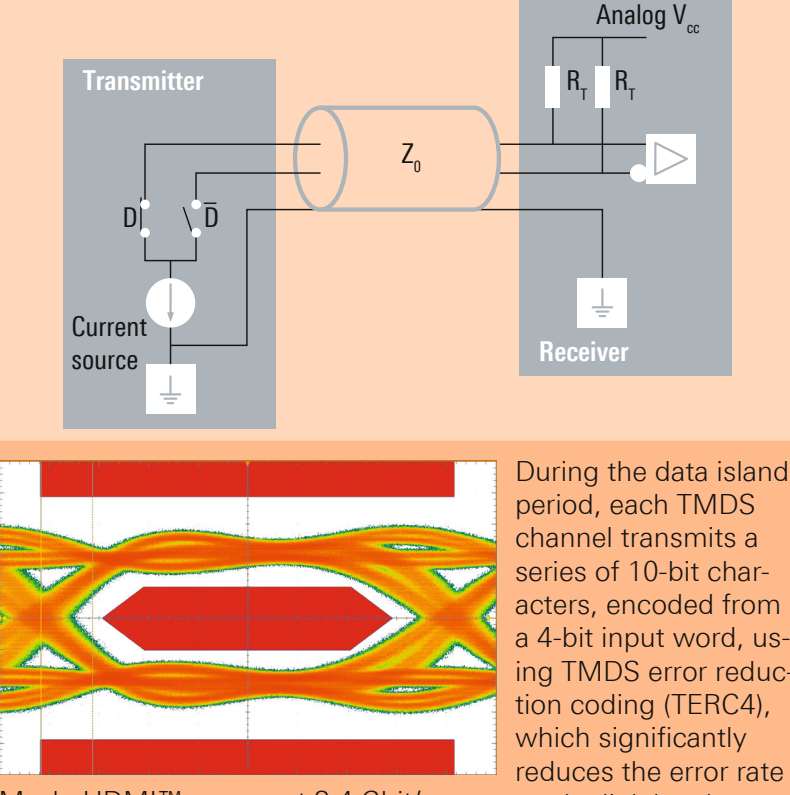
#### TMDS



#### Data island overview



#### Physical layer of TMDS



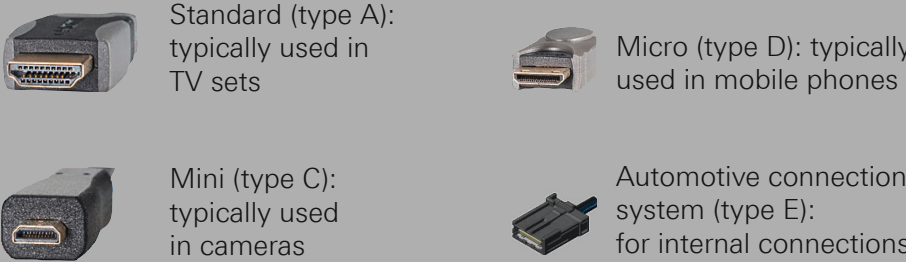
HDMI™ supports nearly all known resolutions for CE instruments such as TV sets or PCs as well as higher resolutions such as 1440p and 4k and 3D up to 1080p. **HDMI 2.0 4k supports more than 30 frames per second.**

Excerpt of commonly used video codes, resolutions and pixel clocks (for detailed timing see CEA-861-D or later version of CEA-861)			
Video code	Resolution	Pixel clock	HDMI 2.0 additions
<b>Standard television SDTV CEA-861 video code</b>			
1	640x480 (VGA), 59.94/60 Hz	25.175 MHz	
2,3	720x480p, 59.94/60 Hz	27.000 MHz	
17,18	720x576p, 50 Hz	27.000 MHz	
6,7	720 (1440)x480i, 59.94/60 Hz	27.000 MHz	
21,22	720 (1440)x576i, 50 Hz	27.000 MHz	
<b>High-definition television HDTV CEA-861 video code</b>			
4	1280x720p, 59.94/60 Hz	74.250 MHz	
19	1280x720p, 50 Hz	74.250 MHz	
5	1920x1080i, 59.94/60 Hz	74.250 MHz	
20	1920x1080i, 50 Hz	74.250 MHz	
16	1920x1080p, 59.94/60 Hz	148.500 MHz	
31	1920x1080p, 50 Hz	148.500 MHz	
34	1920x1080p, 29.97/30 Hz	74.250 MHz	
<b>Ultra high-definition television UHD/4K HDMI™ video code</b>			
0x01	3840x2160p, 29.97/30 Hz	297.000 MHz	
0x02	3840x2160p, 25 Hz	297.000 MHz	
0x03	3840x2160p, 22.98/25 Hz	297.000 MHz	
0x04	4096x2160p, 24 Hz	297.000 MHz	

Pixel encoding	
YC <sub>C</sub> , 4:2:2 (HDMI 2.0 YC <sub>C</sub> , 4:2:0 for 4k resolution)	
YC <sub>C</sub> , 4:4:4	
RGB 4:4:4	
Supported color spaces	
SD: ITU-R Rec. BT.601	
HD: ITU-R BT.709-5	
Additional: sYCC, sYCC601, AdobeYCC601, AdobeRGB, <b>HDMI 2.0: ITU-R BT.2020</b>	
Color depths of 24 (3x8), 30 (3x10), 36 (3x12) and/or 48 (3x16) bit per pixel	
Audio formats	
Uncompressed audio:	8-channel PCM with sample rate of 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz or 192 kHz, <b>HDMI 2.0: up to 32 channels</b>
Compressed audio:	(IEC 61937) Dolby Digital (Plus), DTS (HDI), MPEG, one bit audio (DVD audio, SACD) with a maximum bit rate of 8.144 Mbps (frame rate of 192 kHz), <b>HDMI 2.0: adopt audio formats (HE-AAC, DRC)</b>
Primary 3D video modes	
1280x720p, 50/59.94/60 Hz (frame packing, side-by-side (half), top-and-bottom)	
1280x720p, 23.98/24/25.97/30 Hz (frame packing)	
1920x1080i, 50/59.94/60 Hz (frame packing, side-by-side (half))	
1920x1080p, 23.98/24 Hz (frame packing, side-by-side (half), top-and-bottom), <b>HDMI 2.0: Support of 3D dual-view, 3D OSD display indication</b>	
1920x1080p, 29.97/30 Hz (frame packing, top-and-bottom)	
1920x1080p, 50/59.94/60 Hz (top-and-bottom)	

## Connectors and pin assignment

#### HDMI™ connector types



#### Pin assignment of HDMI™ connectors (type A and E)

Signal	Type A	Type E	Signal	Type A	Type E	Signal
TMDS data2+	pin 1	pin 1	TMDS data5+	pin 12	pin 12	
TMDS data2 shield	pin 2	pin 2	TMDS data5 shield	pin 13	pin 13	
TMDS data2-	pin 3	pin 3	TMDS data5-			
TMDS data1+	pin 4	pin 4	TMDS data4+	pin 14	pin 14	reserved
TMDS data1 shield	pin 5	pin 5	TMDS data4 shield	pin 15	pin 15	SCL (DDC clock)
TMDS data1-	pin 6	pin 6	TMDS data4-	pin 16	pin 16	SDA (DDC data)
TMDS data0+	pin 7	pin 7	TMDS data3+			
TMDS data0 shield	pin 8	pin 8	TMDS data3 shield	pin 17	pin 17	DDC/CEC ground
TMDS data0-	pin 9	pin 9	TMDS data3-	pin 18	pin 18	+5 V (power EDID/DDC)
TMDS clock+	pin 10	pin 10	CEC	pin 19	pin 19	hot plug detect
TMDS clock shield	pin 11	pin 11		standard	automotive	

## Selection of Rohde & Schwarz solutions for HDMI™

Now with support of the new HDMI 2.0 4:2:0 / 21:9 video formats



R&S\*UPP audio analyzer



R&S\*VTS compact video tester



R&S\*VTE video tester



R&S\*VTC video test center

**Glossary:**  
**HDMI** = High-definition multimedia interface; **AV** = Audio/video;  
**PCM** = Pulse code modulation; **HDCP** = High-bandwidth digital content protection; **CEC** = Consumer electronics control; **HEC** = HDMI Ethernet channel; **ARC** = Audio return channel; **S/PDIF** = Sony/Philips digital interconnect format; **DVI** = Digital visual interface; **HPD** = Hot plug detection; **HEAC** = HDMI Ethernet and audio return channel; **TMDS** = Transition minimized differential signaling; **DDC** = Display data channel; **EDID** = Extended display identification data; **CTL** = Control; **TERC** = TMDS error reduction coding; **HSYNC** = Horizontal synchronization; **VS** = Vertical synchronization; **SDTV** = Standard definition television; **HDTV** = High-definition television; **UHD** = Ultra high-definition television; **YC<sub>C</sub>** = Luma (Y), chroma (C<sub>u</sub>, C<sub>v</sub>) components; **RGB** = Red(R), green(G), blue(B) components; **SD** = Standard definition; **HD** = High-definition; **IEC** = International Electrotechnical Commission; **MPEG** = Moving Picture Experts Group; **SACD** = Super audio compact disc; **SCL** = Serial clock; **SDA** = Serial data

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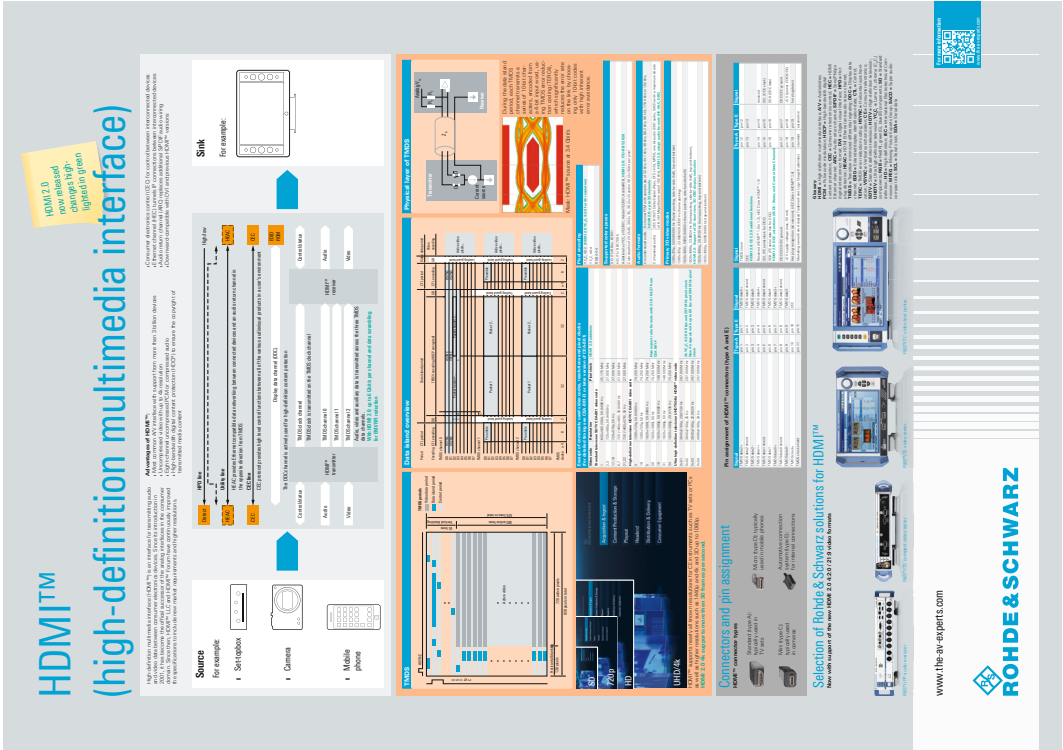


For more information:



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## HDMI™ (high-definition multimedia interface)

### About Rohde & Schwarz

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

### Environmental commitment

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



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**Services that add value**

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- Long-term responsibility