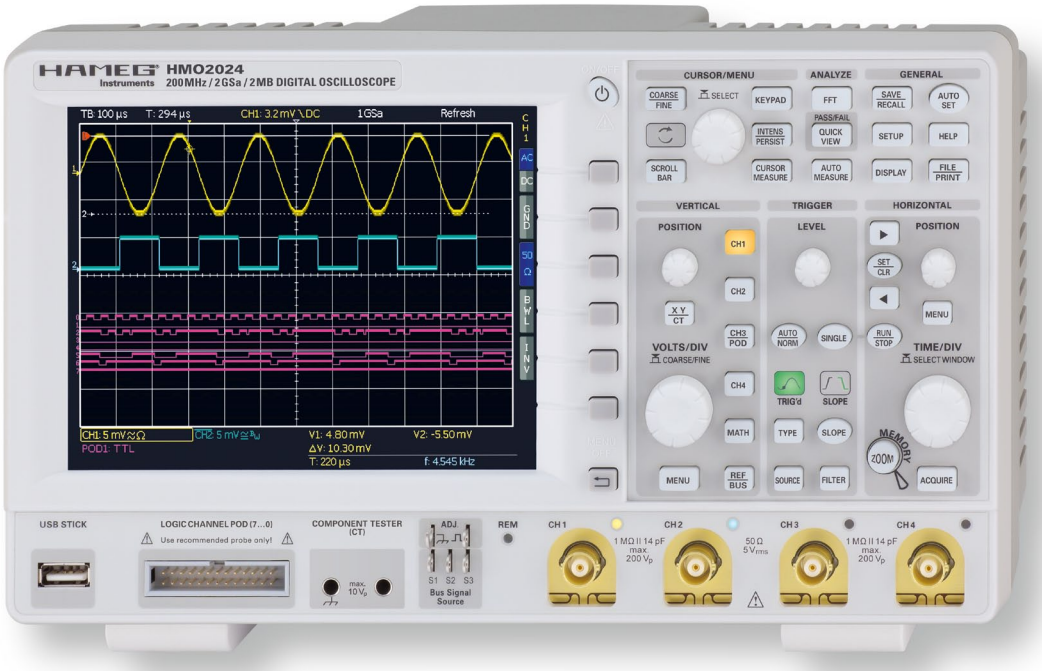
HAMEG Instruments
A Rohde&Schwarz Company

HMO2024

200 MHz 2[4] Channel Digital Oscilloscope
HMO2022 [HMO2024]



DVI Output · USB · USB Stick · optional TCP/IP · optional IEEE-488 · inclusive · 6,5" VGA 16,5cm

2 Channel Version
HMO2022

Side view

8 Channel
Logic Probe HO3508

- ☑ **2GSa/s Real Time, Low Noise Flash A/D Converter (Reference Class)**
- ☑ **2MPts Memory, Memory Zoom up to 50,000:1**
- ☑ **MSO** (Mixed Signal Opt. HO3508) with 8 Logic Channels
- ☑ **Serial Bus** Trigger and Hardware accelerated Decode, I²C, SPI, UART/RS-232 (Opt. HOO10, HOO11)
- ☑ 8 User definable Markers for easy Navigation
- ☑ Pass/Fail Test based on Masks
- ☑ Vertical Sensitivity 1mV/div., Offset Control ±0.2...±20V
- ☑ 12div. x-Axis Display Range, 20div. y-Axis Display Range (**V**irtual**S**creen)
- ☑ Trigger Modes: Slope, Video, Pulsewidth, Logic, Delayed, Event
- ☑ Component Tester, 6 Digit Counter, Automeasurement, Formula Editor, Ratiocursor, FFT for Spectral Analysis
- ☑ Crisp 16.5cm (6.5") TFT VGA Display, DVI Output
- ☑ Lowest Noise Fan
- ☑ 3 x USB for Mass Storage, Printer and Remote Control optional IEEE-488 (GPIB) or Ethernet/USB

200 MHz 2 [4] Channel Digital Oscilloscope HMO2022 [HMO2024]

All data valid at 23 °C after 30 minute warm-up.

Display

Display:	16.5 cm (6.5") VGA Color TFT
Resolution:	640 x 480 Pixel
Backlight:	LED 400 cd/m²
Display area for curves:	
without menu	400 x 600 Pixel (8 x 12 div.)
with menu	400 x 500 Pixel (8 x 10 div.)
Color depth:	256 colors
Intensity steps per trace:	0...31

Vertical System

Channels:	
DSO mode	CH 1, CH 2 [CH 1...CH 4]
MSO mode	CH 1, CH 2, LCH 0...7 (logic channels) [CH 1, CH 2, LCH 0...7, CH4] with Option HO3508
Auxiliary input:	Frontside [Rear side]
Function	Ext. Trigger
Impedance	1 MΩ || 14 pF ±2 pF
Coupling	DC, AC
Max. input voltage	100 V (DC + peak AC)
XYZ-mode:	All analog channels on individual choice
Invert:	CH 1, CH 2 [CH 1...CH 4]
Y-bandwidth (-3 dB):	200 MHz (5 mV...5 V)/div 100 MHz (1 mV, 2 mV)/div
Lower AC bandwidth:	2 Hz
Bandwidth limiter (switchable)**:**	approx. 20 MHz
Rise time (calculated)**:**	<1.75 ns
DC gain accuracy	2 %
Input sensitivity:	12 calibrated steps
CH 1, CH 2 [CH 1...CH 4]	1 mV/div....5 V/div. (1–2–5 Sequence)
Variable	Between calibrated steps
Inputs CH 1, CH 2 [CH 1...CH 4]:	
Impedance	1 MΩ || 14 pF ±2 pF (50 Ω switchable)
Coupling	DC, AC, GND
Max. input voltage	200 V (DC + peak AC), 50 Ω <5 V_{rms}
Measuring circuits:	Measuring Category I (CAT I), UL 61010B-1
Position range	±10 Divs
Offset control:	
1 mV, 2 mV	±0,2 V - 10 div. x Sensitivity
5...50 mV	±1 V - 10 div. x Sensitivity
100 mV	±2,5 V - 10 div. x Sensitivity
200 mV...2 V	±40 V - 10 div. x Sensitivity
5 V	±100 V - 10 div. x Sensitivity
Logic channels	With Option HO3508
Select. switching thresholds	TTL, CMOS, ECL, User -2...+8 V
Impedance	100 kΩ || <4 pF
Coupling	DC
Max. input voltage	40 V (DC + peak AC)

Triggering

Analog channels:	
Automatic:	Linking of peakdetection and triggerlevel
Min. signal height	0.8 div.; 0.5 div. typ. (1.5 Div at ≤ 2 mV/Div)
Frequency range	5 Hz...250 MHz (5 Hz...120 MHz at ≤ 2 mV/Div)
Level control range	From peak- to peak+
Normal (without peak)**:**	
Min. signal height	0.8 div.; 0.5 div. typ. (1.5 Div at ≤ 2 mV/Div)
Frequency range	0 Hz...250 MHz (0 Hz...120 MHz at ≤ 2 mV/Div)
Level control range	-10...+10 div from center of the screen
Operating modes:	Slope/Video/Logic/Pulses/Busses (optional)
Slope:	Rising, falling, both
Sources:	CH 1, CH 2, Line, Ext., LCH 0...7 [CH 1...CH 4, Line, Ext., LCH 0...7]
Coupling (Analog Channel):	**AC:** 5 Hz...250 MHz **DC:** 0...250 MHz **HF:** 30 kHz...250 MHz **LF:** 0...5 kHz **Noise rejection:** switchable
Video:	
Standards	PAL, NTSC, SECAM, PAL-M, SDTV 576i, HDTV 720p, HDTV 1080i, HDTV 1080p
Fields	Field 1, field 2, both
Line	All, selectable line number
Sync. Impulse	Positive, negative
Sources:	CH 1, CH 2, Ext. [CH 1...CH 4]
Logic:	AND, OR, TRUE, FALSE
Sources:	LCH 0...7
State	LCH 0...7 X, H, L
Pulses:	Positive, negative
Modes	equal, unequal, less than, greater than, within/without a range
Range	min. 32 ns, max. 10 s, resolution min. 8 ns
Sources:	CH 1, CH 2, [CH 1...CH 4]
Indicator for trigger action:	LED
Ext. Trigger via:	Auxiliary input 0.3 V...10 V_{pp}
2nd Trigger:	
Slope:	Rising, falling, both
Min. signal height	0.8 div.; 0.5 div. typ. (1.5 div at ≤2 mV/div)
Frequency range	0 Hz...250 MHz (0 Hz...120 MHz at ≤2 mV/div)
Level control range	-10...+10 div.
Operating modes:	
after time	32 ns...10 s
after incidence	$1...2^{16}$
Busses (Opt. HO010):	I²C/SPI/UART/RS-232
Sources:	CH 1, CH 2, Ext., LCH 0...7 [CH 1...CH 4, Ext., LCH 0...7]
Busses (Opt. HO011):	I²C/SPI/UART/RS-232
Sources:	CH 1, CH 2, Ext. (for Chip Select at SPI) [CH 1...CH 4, Ext.] (for Chip Select at SPI)
Format	hexadecimal, binary
I²C	Trigger on Start, Stop, Restart, NACK, Adress (7 or 10 Bit), Data, Adress and Data, up to 5 Mb/s
SPI	up to 32 Bit Data, Chip select (CS) pos. or neg., without CS, up to 12,5 Mb/s
UART/RS-232	up to 8 Bit Data, up to 31 Mb/s

Horizontal System

Domain representation:	Time, Frequency (FFT), Voltage (XY)
Representation Time Base:	Main-window, main- and zoom-window
Memory Zoom:	Up to 50,000:1
Accuracy:	50 ppm
Time Base:	2 ns/div....50 s/div.
Roll Mode:	50 ms/div....50 s/div.

Digital Storage

Sampling rate (real time)**:**	2 x 1 GSa/s, 1 x 2 GSa/s [4 x 1 GSa/s, 2 x 2 GSa/s] Logic channels: 8 x 1 GSa/s
Memory:	2 x 1 MPts, 1 x 2 MPts [4 x 1 MPts, 2 x 2 MPts]
Operation modes:	Refresh, Average, Envelope, Peak-Detect Roll: free run/triggered, Filter, HiRes
Resolution (vertical)	8 Bit, (HiRes up to 10 Bit)
Resolution (horizontal)	40 ps
Interpolation:	Sinx/x, linear, Sample-hold
Persistence:	Off, 50 ms...∞
Delay pretrigger:	0...8 Million x (1/samplerate)
posttrigger:	0...2 Million x (1/samplerate)
Display refresh rate:	Up to 2000 waveforms/s
Display:	Dots, vectors, „persistence"
Reference memories:	typ. 10 Traces

Operation/Measuring/Interfaces

Operation:	Menu-driven (multilingual), Autoset, help functions (multilingual)
Save/Recall memories:	typ. 10 complete instrument parameter settings
Frequency counter:	
0.5 Hz...250 MHz	6 Digit resolution
Accuracy	50 ppm
Auto measurements:	Amplitude, standard deviation, V_{pp}, V_{p+}, V_{p-}, V_{rms}, V_{avg}, V_{top}, V_{base}, frequency, period, pulse count, t_{width+}, t_{width-}, $t_{dutycycle+}$, $t_{dutycycle}$, t_{rise}, t_{fall}, pos. edge count, neg. edge count, pos. pulse count, neg. pulse count, trigger frequency, trigger period, phase, delay
Cursor measurements:	ΔV, Δt, 1/Δt (f), V to Gnd, Vt related to Trigger point, ratio X and Y, pulse count, peak to peak, peak+, peak-, mean value, RMS value, standard deviation
Interface:	Dual-Interface USB type B/RS-232 (HO720), 2x USB type A (front- and rear side each 1x) max. 100 mA, DVI-D for ext. Monitor
Optional:	IEEE-488 (GPIB) (HO740), Ethernet/USB (HO730)

Display functions

Marker:	up to 8 user definable marker for easy navigation

VirtualScreen:	virtual Display with 20 div. vertical for all Math-, Logic-, Bus- and Reference Signals
Busdisplay:	up to 2 busses, user definable, parallel or serial busses (option), decode of the bus value in ASCII, binary, decimal or hexadecimal, up to 4 lines
Parallel	logic channels can also be used as source for bus definition
I²C (Opt. HO010, HO011)	color coded Read-, Write Adress, Data, Start, Stop, acknowledge, missing acknowledge, Errors and Trigger condition
SPI (Opt. HO010, HO011)	color coded Data, Start, Stop, Errors and Trigger condition
UART/RS-232 (Opt. HO010, HO011)	color coded Data, Start, Stop, Errors and Trigger condition

Mathematic functions

Number of formula sets:	5 formula sets with up to 5 formulas each
Sources:	All channels and math. memories
Targets:	Math. memories
Functions:	ADD, SUB, 1/X, ABS, MUL, DIV, SQ, POS, NEG, INV, INTG, DIFF, SQR, MIN, MAX, LOG, LN, Low-, High-pass filter
Display:	Up to 4 math. memories with label

Pass/Fail functions

Sources:	Analog channels
Type of test:	Mask around a signal, userdefined tolerance
Functions:	Stop, Beep, screen shot (screen print-out) and/or output to printer for pass or fail, event counting up to 4 billion, including the number and the percentage of pass and fail events

General Information

Component tester	
Test voltage:	10 V_P (open) typ.
Test current:	10 mA_P (short) typ.
Test frequency:	50 Hz / 200 Hz typ.
Reference Potential:	Ground (safety earth)
Probe ADJ Output:	1 kHz/1 MHz square wave signal ~1 V_{pp} (ta <4 ns)
Bus Signal Source	SPI, I²C, UART, Parallel (4 Bit)
Internal RTC (Realtime clock)**:**	Date and time for stored data
Line voltage:	100...240 V, 50...60 Hz, CAT II
Power consumption:	Max. 45 W, typ. 25 W (max. 55 W, typ. 35 W)
Protective system:	Safety class I (EN61010-1)
Operating temperature:	+5...+40 °C
Storage temperature:	-20...+70 °C
Rel. humidity:	5...80 % (non condensing)
Dimensions (W x H x D)**:**	285 x 175 x 140 mm
Weight:	<2.5kg

Accessories supplied: Line cord, Operating manual, 2 [4] Probes, 10:1 with attenuation ID (HZO10), CD

Recommended accessories:

HO010	Serial bus trigger and hardware accelerated decode, I²C, SPI, UART/RS-232 on Logic channels and Analog channels
HO011	Serial bus trigger and hardware acelerated decode, I²C, SPI, UART/RS-232 on Analog channels
HO3508	active 8 Channel Logic Probe
HO730	Dual-Interface Ethernet/USB
HO740	Interface IEEE-488 (GPIB) galvanically isolated
HZO91	4RU 19'' Rackmount Kit
HZO90	Carrying Case for protection and transport
HZO20	High Voltage probe 1000:1 (400 MHz)
HZO30	single ended active probe (1 GHz)
HZO50	AC/DC Currentprobe 20 A, DC...100 kHz
HZO51	AC/DC Currentprobe 1000 A, DC...20 kHz

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HAMEG Instruments
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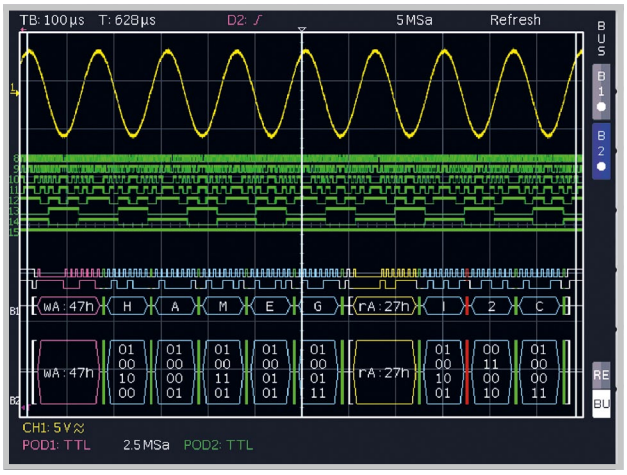
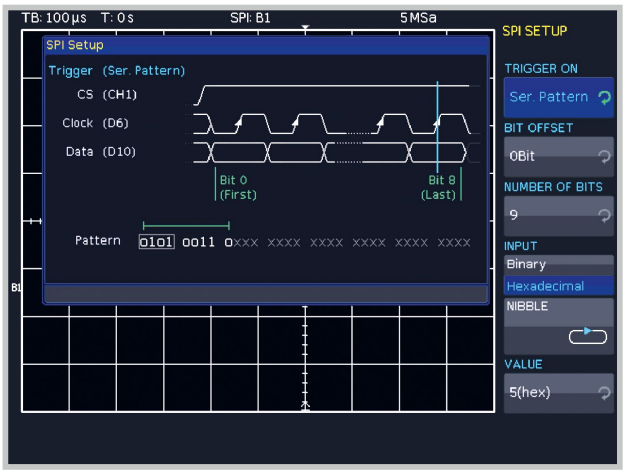
H0010/H0011 Serial Bus

for all Oscilloscopes of the HMO Series

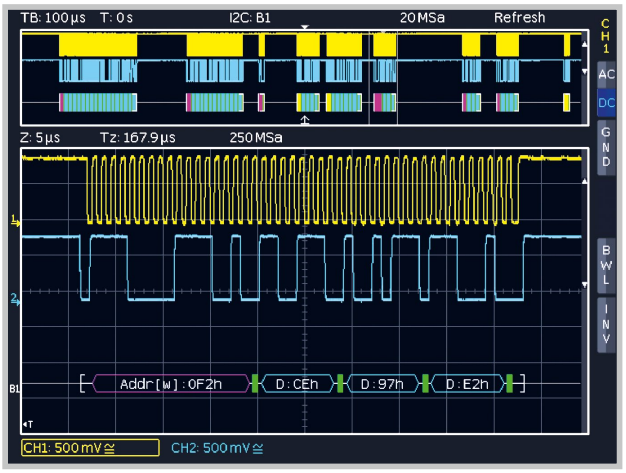
H0010/H0011



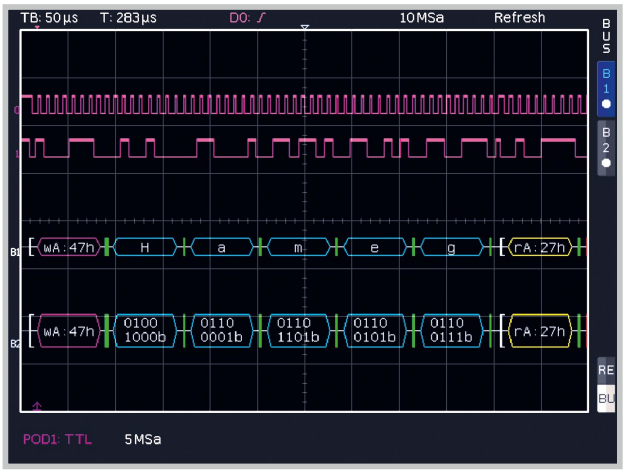
Mixed Signal and Bus Display



SPI Bus Trigger Setup



I²C Bus Hex decoding on the Analog Channel



I²C Bus ASCII and Binary

- ☑ H0010 via Analog Channels and/or Logic Channels, H0011 via Analog Channels
- ☑ I²C, SPI, UART/RS-232 Bus Trigger and Decode
- ☑ Hardware accelerated Decode in Realtime
- ☑ Color Coded Display of the Content for intuitive Analysis and easy Overview
- ☑ More Details of the decoded Values come visible with increasing Zoom Factor
- ☑ Bus Display with synchronous Display of the Data and may be Clock Signal
- ☑ Decode into ASCII, Binary, Hexadecimal or Decimal Format
- ☑ Up to four Lines to show the decoded Values Comfortably
- ☑ Powerful Trigger to isolate specific Messages
- ☑ Option for all Oscilloscopes of the HMO Series, retrofittable

HO010/[HO011] Serial Bus

	I²C Bus	SPI Bus	UART/RS-232 Bus
Bus Configuration			
Baud rates	up to 10 Mb/s (HMO352x/2524)*, up to 5 Mb/s (HMO72x...202x)	up to 25 Mb/s (HMO352x/2524)*, up to 12.5 Mb/s (HMO72x...202x)	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud, up to 62.5 Mb/s (HMO352x/2524)*, up to 31 Mb/s (HMO72x...202x)
Number of Bit's	7 or 10 Bit for Adress ID 8 Bit for Data	32 Bit for Data	8 Bit for Data 1, 1.5, 2 Bit for Stop Bit
Polarity	n/a	Chip select, positive or negative, or without Chipselect (2-wire SPI) Clock rising or falling edge Data High or Low active	High or Low active
Parity	n/a	n/a	none, odd or even
Trigger			
Source	HO010: digital Channel LCH 0...15 (Opt. HO3508) analog Channel* LCH 1...2 (CH 1...4) HO011: analog Channel LCH 1...2 [CH 1...4]	HO010: digital Channel LCH 0...15 (Opt. HO3508) analog Channel* LCH 1...2, external Trigger Entry for Chip Select, (CH 1...4) HO011: analog Channel LCH 1...2, external Trigger Entry for Chip Select, [CH 1...4]	HO010: digital Channel LCH 0...15 (Opt. HO3508) analog Channel* LCH 1...2 (CH 1...4) HO011: analog Channel LCH 1...2 [CH 1...4]
Event	7 or 10 Bit Address ID 7 or 10 Bit Address ID with 8 Bit Data Start, Stop, Restart missing Acknowledge Adress ID without Acknowledge	Data packets up to 32 Bit with positive or negative Chip Select or without Chip Select, (2-wire SPI)	Data packets up to 8 Bit
Input format	Hexadecimal or Binary	Hexadecimal or Binary	Hexadecimal or Binary
Hardware accelerated Decode			
Source	HO010: digital Channel LCH 0...15 (Opt. HO3508) analog Channel* LCH 1...2 (CH 1...4) HO011: analog Channel LCH 1...2 [CH 1...4]	HO010: digital Channel LCH 0...15 (Opt. HO3508) analog Channel* LCH 1...2, external Trigger Entry for Chip Select, (CH1...4) HO011: analog Channel LCH 1...2, external Trigger Entry for Chip Select, [CH 1...4]	HO010: digital Channel LCH 0...15 (Opt. HO3508) analog Channel* LCH 1...2 (CH 1...4) HO011: analog Channel LCH 1...2 [CH 1...4]
Display	Bus display, color coded for Read Adress ID: Yellow Write Adress ID: Magenta Date: Cyan Start: White Stop: White ACK/NACK: Green/Red Error: Red Trigger Condition: Green up to four lines for decoded values, synchronous display of the Bit lines	Bus display, color coded for Date: Cyan Start: White Stop: White Error: Red Trigger Condition: Green up to four lines for decoded values, synchronous display of the Bit lines	Bus display, color coded for Date: Cyan Start: White Stop: White Error: Red Trigger Condition: Green up to four lines for decoded values, synchronous display of the Bit lines
Format	Adress ID: hexadecimal Data ASCII, binary, decimal, hexadecimal	n/a Data ASCII, binary, decimal, hexadecimal	n/a Data ASCII, binary, decimal, hexadecimal

*Available for HMO352x/2524 from firmware 3.0

Differences HO010/HO011

Feature	HO010	HO011
Logic channel (LC 0...LC 15) as source for serial bus trigger and decode	x	-
Analog channel (CH 1...CH 4) as source for serial bus trigger and decode	x	x
Time synchronous decode of two serial busses	x	-

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