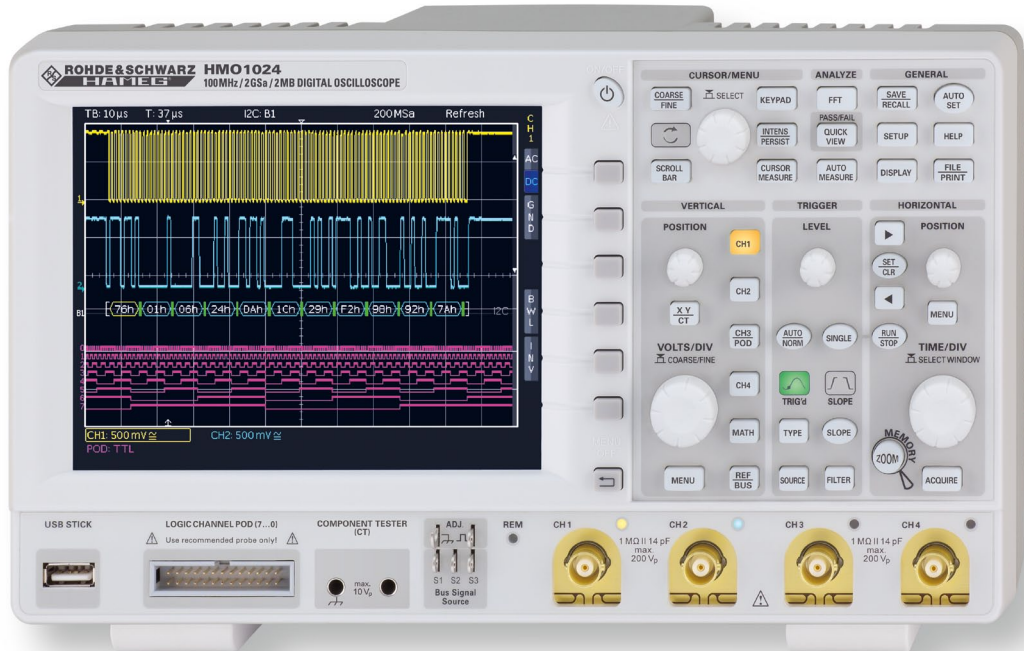


# 100MHz 2[4] Channel Digital Oscilloscope HMO1022 [HMO1024]

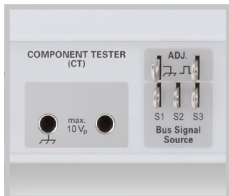
HMO1024



Carrying Case HZ090



Component Tester/Bus Signal Source



Ethernet/USB Dual-Interface H0730 (Option)



- ✓ 2GSa/s Real Time, Low Noise Flash A/D Converter (Reference Class)
- ✓ 2MPts Memory, Memory **Z**oom up to 50,000:1
- ✓ MSO (Mixed Signal Opt. H03508) with 8 Logic Channels
- ✓ Serial Bus Trigger and Hardware accelerated Decode incl. List View. Options: I<sup>2</sup>C + SPI + UART/RS-232, CAN/LIN
- ✓ Automatic Search for User defined Events
- ✓ Pass/Fail Test based on Masks
- ✓ Vertical Sensitivity 1mV/div.
- ✓ 12div. x-Axis Display Range, 20div. y-Axis Display Range (VirtualScreen)
- ✓ Trigger Modes: Slope, Video, Pulswidth, Logic, Delayed, Event
- ✓ Component Tester, 6 Digit Counter, Automeasurement: max. 6 Parameters incl. Statistic, Formula Editor, Ratiocursor, FFT: 64kPts
- ✓ Fan: Silence redefined
- ✓ 3 x USB for Mass Storage, Printer and Remote Control

# 100 MHz 2 [4] Channel Digital Oscilloscope HMO1022 [HMO1024]

Firmware:  $\geq 4.522$

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

## Display

Display:	16.5 cm [6.5"] VGA Color TFT
Resolution:	640 x 480 Pixel
Backlight:	LED 400 cd/m <sup>2</sup>
Display area for traces:	
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 channel:	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, CH 4] with Option HO3508
Auxiliary input:	Frontside [Rear side]
Function	Ext. Trigger
Impedance	1 M $\Omega$    13 pF $\pm$ 2 pF
Coupling	DC, AC
Max. input voltage	100V (DC + peak AC)
XYZ-mode:	All analog Channels on individual choice
Invert:	CH 1, CH 2 [CH 1...CH 4]
Y-bandwidth [-3 dB]:	100 MHz [5 mV...10V]/div. 20 MHz [1 mV, 2 mV]/div.
Lower AC bandwidth:	2 Hz
Bandwidth limiter [switchable]:	approx. 20 MHz
Rise time [calculated]:	<3.5 ns
DC gain accuracy	2%
Input sensitivity:	13 calibrated steps
CH 1, CH 2 [CH 1...CH 4]	1 mV/div...10V/div. [1-2-5 Sequence]
Variable	Between calibrated steps
Inputs CH 1, CH 2 [CH 1...CH 4]:	
Impedance	1 M $\Omega$    14 pF $\pm$ 2 pF
Coupling	DC, AC, GND
Max. input voltage	200V (DC + peak AC)
Measuring circuits:	Measuring Category I [CAT I]
Position range:	$\pm$ 10 Divs
Logic Channels:	With Option HO3508
Select. switching thresholds	TTL, CMOS, ECL, User -2...+8V
Impedance	100 k $\Omega$    <4 pF
Coupling	DC
Max. input voltage:	40V (DC + peak AC)

## Triggering

Analog Channels:	
Automatic:	Linking of peak detection and trigger level
Min. signal height	0.8 div.; 0.5 div. typ. [1.5 div. at $\leq$ 2 mV/div.]
Frequency range	5 Hz...150 MHz [5 Hz...30 MHz at $\leq$ 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 $\leq$ 2 mV/div.]
Frequency range	0 Hz...150 MHz [0 Hz...30 MHz at $\leq$ 2 mV/div.]
Level control range	-10...+10 div.
Operating modes:	Slope/Video/Logic/Pulses/Buses 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...150 MHz DC: 0...150 MHz HF: 30 kHz...150 MHz LF: 0...5 kHz Noise rejection: selectable
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, CH 1, CH 2 [CH 1...CH 4]
State	LCH 0...7 X, H, L
Duration	8 ns...2.147 s, resolution 8 ns

Pulses:	Positive, negative
Modes	equal, unequal, less than, greater than, within/without a range
Range	Min. 32 ns, max. 17.179 s, resolution min. 1 ns
Sources	CH 1, CH 2, Ext. [CH 1...CH 4]
Indicator for trigger action:	LED
Ext. Trigger via:	Auxiliary input 0.3V...10V <sub>pp</sub>
2 <sup>nd</sup> Trigger:	
Slope	Rising, falling, both
Min. signal height	0.8 div.; 0.5 div. typ. [1.5 div. at $\leq$ 2 mV/div.]
Frequency range	0 Hz...150 MHz [0 Hz...30 MHz at $\leq$ 2 mV/div.]
Level control range	-10...+10 div.
Operating modes	
after time	32 ns...17.179 s, resolution 8 ns
after incidence	1...2 <sup>16</sup>
Serial Buses:	
Option H0010	I <sup>2</sup> C/SPI/UART/RS-232 on Logic Channels and Analog Channels
Option H0011	I <sup>2</sup> C/SPI/UART/RS-232 on Analog Channels
Option H0012	CAN/LIN on Logic Channels and Analog Channels

## 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:	Sin $\pi$ /x, linear, Sample-hold
Persistence:	Off, 50 ms... $\infty$
Delay pretrigger:	0...8 Million x (1/samplerate)
posttrigger	0...2 Million x (1/samplerate)
Display refresh rate:	Up to 2,000 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...150 MHz	6 Digit resolution
Accuracy	50 ppm
Auto measurements:	Amplitude, standard deviation, V <sub>pp</sub> , V <sub>p+</sub> , V <sub>p-</sub> , V <sub>rms</sub> , V <sub>avg</sub> , V <sub>top</sub> , V <sub>base</sub> , frequency, period, pulse count, t <sub>width+</sub> , t <sub>width-</sub> , t <sub>duty</sub> , t <sub>duty+</sub> , t <sub>duty-</sub> , t <sub>Rise10_90</sub> , t <sub>Fall10_90</sub> , t <sub>Rise20_80</sub> , t <sub>Fall20_80</sub> , pos. edge count, neg. edge count, pos. pulse count, neg. pulse count, trigger frequency, trigger period, phase, delay
Measurement statistic:	Min., max., mean, standard deviation, number of measurements for up to 6 Functions
Cursor measurements:	$\Delta V$ , $\Delta t$ , 1/ $\Delta t$ (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
Search functions:	Search- and Navigation functions for specific signal parameter
Interface:	Dual-Interface USB type B/RS-232 [H0720], 2 x USB type A (front- and rear side each 1 x) max. 100 mA, DVI-D for ext. Monitor
Optional:	IEEE-488 (GPIB) [H0740], Dual-Interface Ethernet/USB [H0730]

### Display functions

<b>Marker:</b>	up to 8 user definable marker for easy navigation; automatic marker using search criteria
<b>VirtualScreen:</b>	virtual Display with 20 div. vertical for all Math-, Logic-, Bus- and Reference Signals
<b>Busdisplay:</b>	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; Table view of the decoded data

### Mathematic functions

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

### Pass/Fail functions

<b>Sources:</b>	Analog Channels
<b>Type of test:</b>	Mask around a signal, userdefined tolerance
<b>Functions:</b>	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

<b>Component tester</b>	
<b>Test voltage:</b>	10 V <sub>p</sub> (open) typ.
<b>Test current:</b>	10 mA <sub>p</sub> (short) typ.
<b>Test frequency:</b>	50 Hz/200 Hz typ.
<b>Reference Potential:</b>	Ground (safety earth)
<b>Probe ADJ Output:</b>	1 kHz/1 MHz square wave signal ~1 V <sub>pp</sub> (t <sub>a</sub> < 4 ns)
<b>Bus Signal Source:</b>	SPI, I <sup>2</sup> C, UART, Parallel (4 Bit)
<b>Internal RTC (Realtime clock):</b>	Date and time for stored data
<b>Line voltage:</b>	100...240V, 50...60 Hz, CAT II
<b>Power consumption:</b>	Max. 45 W, typ. 25 W [max. 55 W, typ. 35 W]
<b>Protective system:</b>	Safety class I (EN61010-1)
<b>Operating temperature:</b>	+5...+40 °C
<b>Storage temperature:</b>	-20...+70 °C
<b>Rel. humidity:</b>	5...80 % (non condensing)
<b>Theft protection:</b>	Kensington Lock
<b>Dimensions (W x H x D):</b>	285 x 175 x 140 mm
<b>Weight:</b>	<2.5 kg

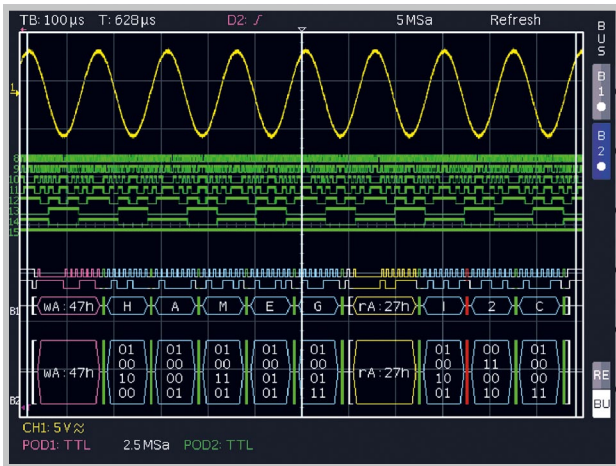
**Accessories supplied:** Line cord, Operating manual, 2 [4] Probes, 10:1/1:1 switchable (HZ154), CD, Software

#### Recommended accessories:

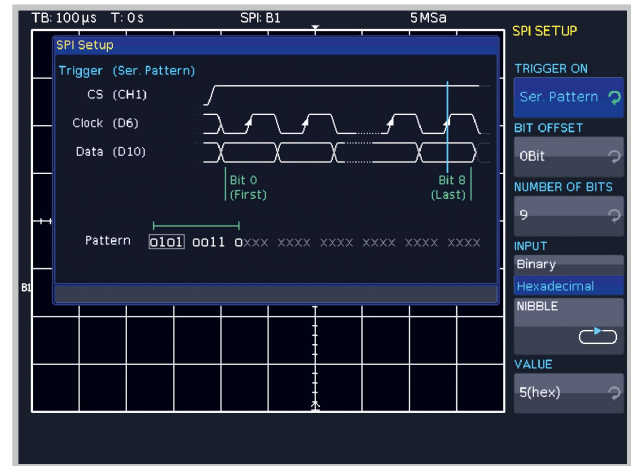
H0010	Serial bus trigger and hardware accelerated decode, I <sup>2</sup> C, SPI, UART/RS-232 on Logic Channels and Analog Channels
H0011	Serial bus trigger and hardware accelerated decode, I <sup>2</sup> C, SPI, UART/RS-232 on Analog Channels
H0012	Serial bus trigger and hardware accelerated decode, CAN, LIN on Logic Channels and Analog Channels
H03508	Active 8 Channel Logic Probe
H0730	Dual-Interface Ethernet/USB
H0740	Interface IEEE-488 (GPIB) galvanically isolated
HZ091	4RU 19" Rackmount Kit
HZ090	Carrying Case for protection and transport
HZ020	High voltage probe 1,000:1 (400 MHz, 1,000 V <sub>rms</sub> )
HZ030	Active probe 1 GHz (0.9 pF, 1 MΩ, including many accessories)
HZ040	Active differential Probe 200 MHz (10:1, 3.5 pF, 1 MΩ)
HZ041	Active differential Probe 800 MHz (10:1, 1 pF, 200 kΩ)
HZ050	AC/DC Current probe 30 A, DC...100 kHz
HZ051	AC/DC Current probe 100/1,000 A, DC...20 kHz

## H0010/H0011 Serial Bus

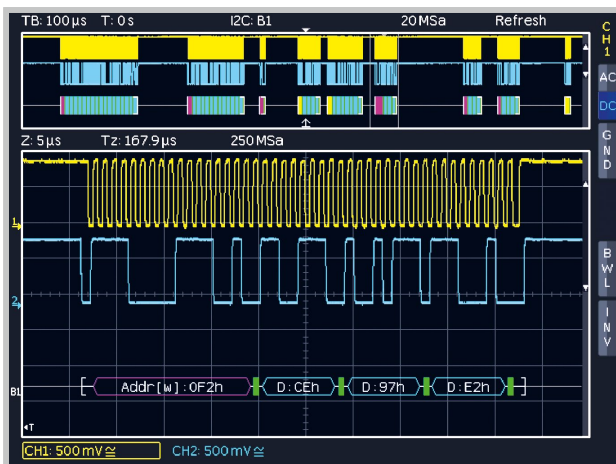
for all Oscilloscopes of the HMO Series



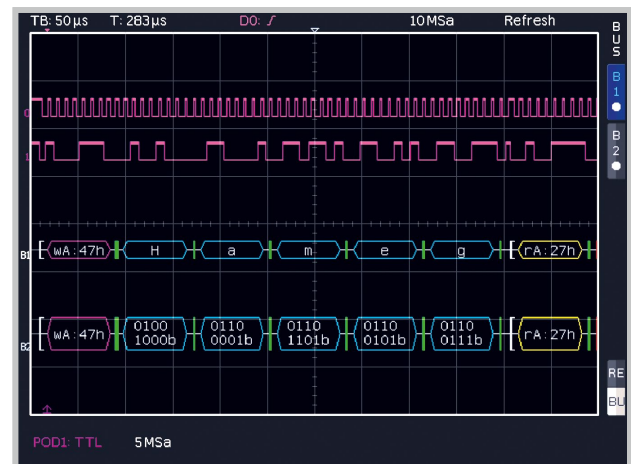
Mixed Signal and Bus Display



SPI Bus Trigger Setup



I<sup>2</sup>C Bus Hex decoding on the Analog Channel



I<sup>2</sup>C Bus ASCII and Binary

- ✓ H0010 via Analog Channels and/or Logic Channels, H0011 via Analog Channels
- ✓ I<sup>2</sup>C, SPI, UART/RS-232 Bus Trigger and Decode
- ✓ Hardware accelerated Decode in Real Time
- ✓ Color Coded Display of the Content for intuitive Analysis and easy Overview
- ✓ More Details of the decoded Values become visible with increasing Zoom Factor
- ✓ Bus Display with synchronous Display of the Data and, if selected, Clock Signal
- ✓ Decode into ASCII, Binary, Hexadecimal or Decimal Format
- ✓ Up to four Lines to comfortably show the decoded Values
- ✓ Powerful Trigger to isolate specific Messages
- ✓ Option for all Oscilloscopes of the HMO Series, retrofittable

H0010/H0011

## H0010/H0011 I<sup>2</sup>C, SPI, UART/RS-232 Bus Analysis

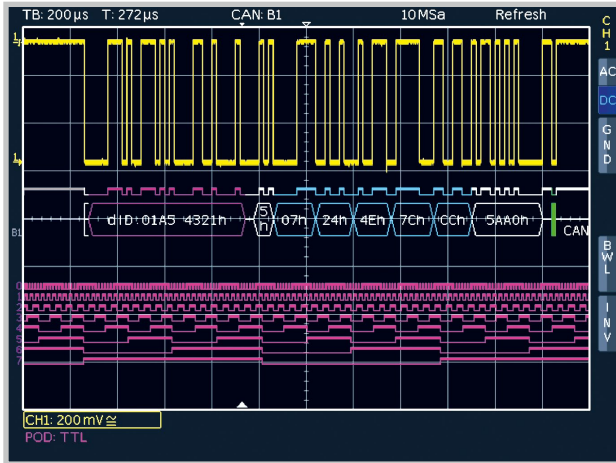
H0010/H0011 I <sup>2</sup> C, SPI, UART/RS-232 Bus Analysis			
	I <sup>2</sup> C Bus	SPI Bus	UART/RS-232 Bus
<b>Bus Configuration</b>			
<b>Bit/Baud rate</b>	up to 10 Mbit/s (HMO352x/2524), up to 5 Mbit/s (HMO72x...202x)	up to 25 Mbit/s (HMO352x/2524), up to 12.5 Mbit/s (HMO72x...202x)	300, 600, 1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 115,200 Baud, up to 62.5 Mbit/s (HMO352x/2524), up to 31 Mbit/s (HMO72x...202x)
<b>Number of Bit's</b>	7 or 10 Bit for Address ID 8 Bit for Data	32 Bit for Data	8 Bit for Data 1, 1.5, 2 Bit for Stop Bit
<b>Polarity</b>	n/a	Chip Select, positive or negative, or without Chip Select (2-wire SPI) Clock rising or falling edge Data High or Low active	High or Low active
<b>Parity</b>	n/a	n/a	none, odd or even
<b>Trigger</b>			
<b>Source</b>	H0010: digital Channels LCH 0...15 [Opt. H03508] analog Channels CH 1...2 [CH 1...4] H0011: analog Channels CH 1...2 [CH 1...4]	H0010: digital Channels LCH 0...15 [Opt. H03508] analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4] H0011: analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4]	H0010: digital Channels LCH 0...15 [Opt. H03508] analog Channels CH 1...2 [CH 1...4] H0011: analog Channels CH 1...2 [CH 1...4]
<b>Event</b>	7 or 10 Bit Address ID 7 or 10 Bit Address ID with 8 Bit Data Start, Stop, Restart missing Acknowledge Address 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
<b>Input format</b>	Hexadecimal or Binary	Hexadecimal or Binary	Hexadecimal or Binary
<b>Hardware accelerated Decode</b>			
<b>Source</b>	H0010: digital Channels LCH 0...15 [Opt. H03508] analog Channels CH 1...2 [CH 1...4] H0011: analog Channels CH 1...2 [CH 1...4]	H0010: digital Channels LCH 0...15 [Opt. H03508] analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4] H0011: analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4]	H0010: digital Channels LCH 0...15 [Opt. H03508] analog Channels CH 1...2 [CH 1...4] H0011: analog Channels CH 1...2 [CH 1...4]
<b>Display</b>	Bus display, color coded for  Read Address ID:           Yellow Write Address ID:       Magenta Data:                       Cyan Start:                     White Stop:                      White ACK/NACK:               Green/Red Error:                     Red Trigger Condition:       Green  <b>up to four lines for decoded values, synchronous display of the Bit lines</b>	Bus display, color coded for  Data:                       Cyan Start:                     White Stop:                      White  Error:                     Red Trigger Condition:       Green  <b>up to four lines for decoded values, synchronous display of the Bit lines</b>	Bus display, color coded for  Data:                       Cyan Start:                     White Stop:                      White  Error:                     Red Trigger Condition:       Green  <b>up to four lines for decoded values, synchronous display of the Bit lines</b>
<b>Format</b>	Address ID: hexadecimal Data:        ASCII, binary, decimal, hexadecimal	n/a Data:        ASCII, binary, decimal, hexadecimal	n/a Data:        ASCII, binary, decimal, hexadecimal

## Differences H0010/H0011

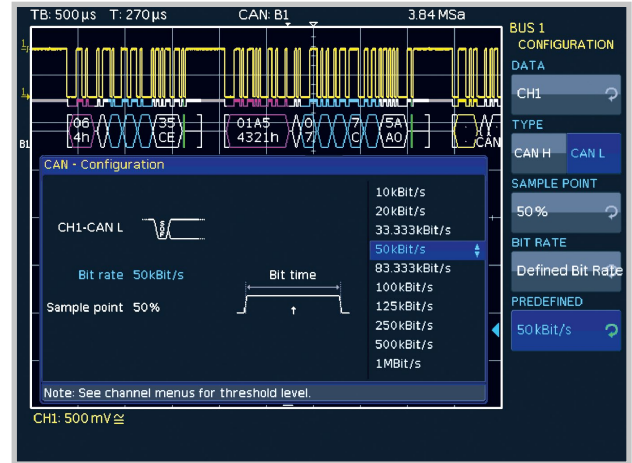
Feature	H0010	H0011
Logic Channels (LCH 0...LCH 15) as source for serial bus trigger and decode	x	-
Analog Channels (CH 1...CH 4) as source for serial bus trigger and decode	x	x
Time synchronous decode of two serial busses	x	-

## H0012 CAN/LIN Bus Analysis

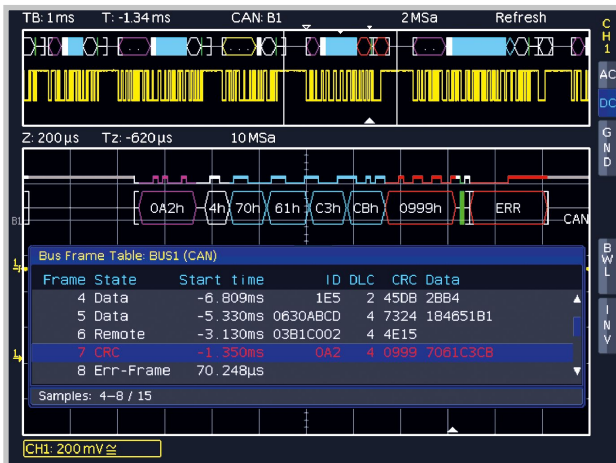
for all Oscilloscopes of the HMO Series



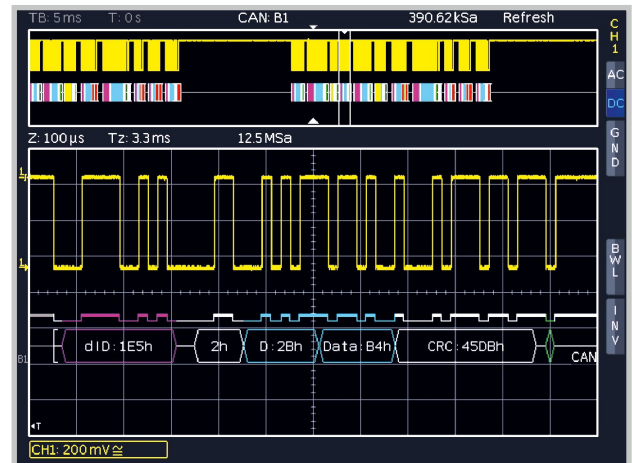
Mixed Signal and Bus Display



CAN Bus Configuration



CAN Bus list display



CAN Bus HEX

- ☑ CAN, LIN Bus Trigger and Decode
- ☑ Hardware accelerated Decode in Real Time
- ☑ 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 and List Display with synchronous Display of the Data
- ☑ Decode into ASCII, Binary, Hexadecimal or Decimal Format
- ☑ Up to four Lines to show the decoded Values
- ☑ Powerful Trigger to isolate specific Messages
- ☑ Option for all Oscilloscopes of the HMO Series, retrofittable

# H0012 CAN/LIN Bus Analysis

CAN Bus		LIN Bus
<b>Bus Configuration</b>		
<b>Bit rates</b>	Pre-Defined or User-Select, 100 Bit/s...4 Mb/s (HM0352x/2524), 100 Bit/s...2 Mb/s (HM072x...202x)	Pre-Defined or User-Select, 100 Bit/s...4 Mb/s (HMO352x/2524), 100 Bit/s...2 Mb/s (HMO72x...202x)
<b>Signal Type</b>	CAN-L or CAN-H, Single Ended or Differential Probe (Analog Channels only)	n/a
<b>Sample Point Range</b>	25...90%	n/a
<b>Threshold</b>	Pre-Defined or User-Select	Pre-Defined or User-Select
<b>Polarity</b>	n/a	High or Low Active
<b>Protocol Version</b>	n/a	1.x, 2.x, J2602, 1.x or 2.x
<b>Trigger</b>		
<b>Source</b>	digital Channel LCH 0...15 [Opt. H03508], analog Channel CH 1...2 [CH 1...4]	digital Channel LCH 0...15 [Opt. H03508], analog Channel CH 1...2 [CH 1...4]
<b>Event</b>	Start of Frame (SOF), End of Frame (EOF) Error Frame Error condition: Stuff Bit Error, CRC Error, Not Acknowledge, Form Error Overload Frame Data Frame (11 or 29 Bit ID) Remote Frame (11 or 29 Bit ID) Identifier: 0, 1, X (Don't Care) Pattern, Trigger when =, ≠, <, > Identifier and Data: ID and 64 Bit data pattern (0, 1, X), trigger when =, ≠, <, >	Start of Frame (SOF), Wake Up Frame Error Frame Error condition: Checksum Error, Parity Error Synchronisation Error Identifier: 0, 1, X (Don't Care) Pattern, Trigger when =, ≠, <, > Identifier and Data: ID and 64 Bit data pattern (0, 1, X), trigger when =, ≠, <, >
<b>Input format</b>	Hexadecimal or Binary	Hexadecimal or Binary
<b>Hardware accelerated Decode</b>		
<b>Source</b>	digital Channel LCH 0...15 [Opt. H03508], analog Channel CH 1...2 [CH 1...4]	digital Channel LCH 0...15 [Opt. H03508], analog Channel CH 1...2 [CH 1...4]
<b>Display Bus</b>	<b>color coded for</b>  Start and End of Frame: White brackets Data ID: Magenta, Remote ID: Yellow DLC: White, Data: Cyan, CRC: White ACK: Green, Overload: White, Error: Red  <b>up to four lines for decoded values, synchronous display of the Bit lines</b>	<b>color coded for</b>  Start and End of Frame: White brackets Break: Magenta, Synchronisation: White Identifier: Yellow, Parity: Green, Data: Cyan Checksum: White, Error: Red, Wake Up: Magenta  <b>up to four lines for decoded values, synchronous display of the Bit lines</b>
<b>Table</b>	<b>Display of Bus 0 or 1</b>  Frame Number State (Frame Type or Error Description) Start Time, Identifier, DLC, CRC, Data	<b>Display of Bus 0 or 1</b>  Frame Number State (Frame Type or Error Description) Start Time, Identifier, Length, Checksum, Data
<b>Format</b>	Identifier & other: hexadecimal Data: ASCII, binary, decimal, hexadecimal	Identifier & other: hexadecimal Data & Checksum: ASCII, binary, decimal, hexadecimal