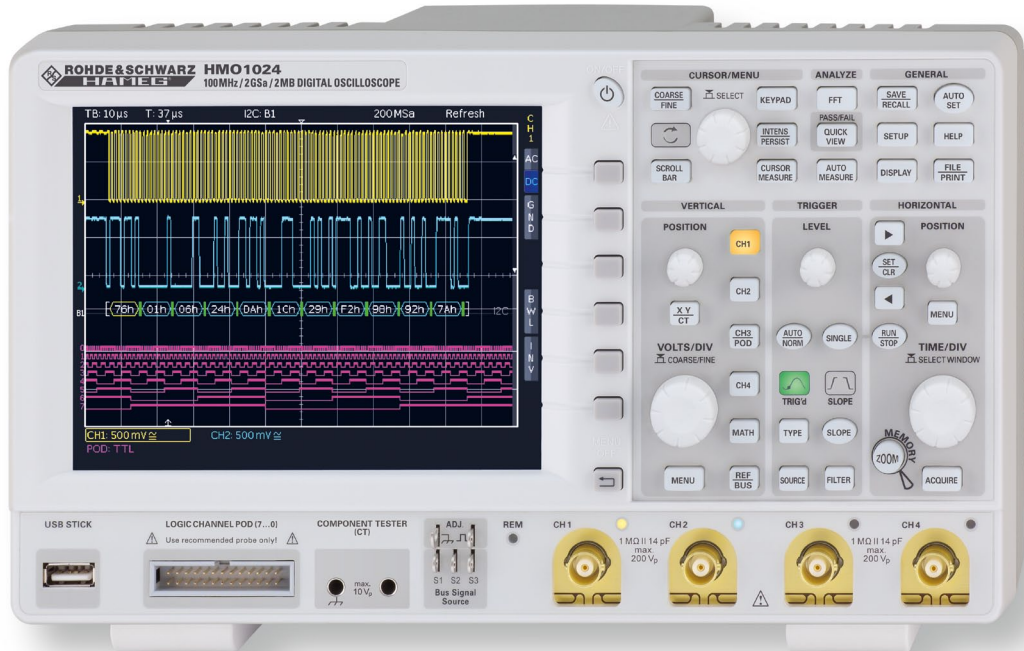


# 100MHz 2[4] Channel Digital Oscilloscope HMO1022 [HMO1024]

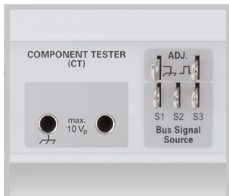
HMO1024



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, Pulsewidth, 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

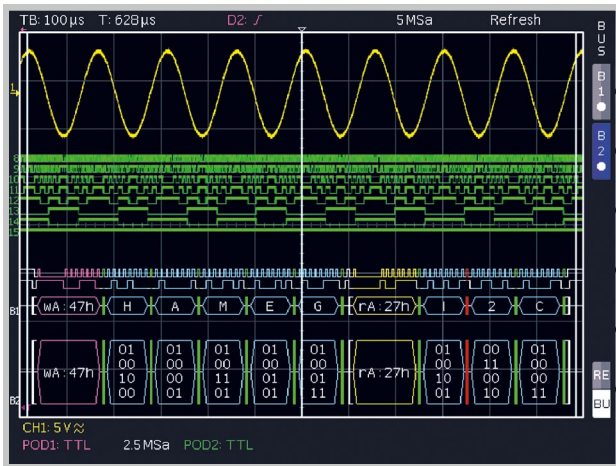
**Accessories supplied:** Line cord, Operating manual, 2 [4] Probes, 10:1/1:1 switchable (HZ154), CD, Software

#### Recommended accessories:

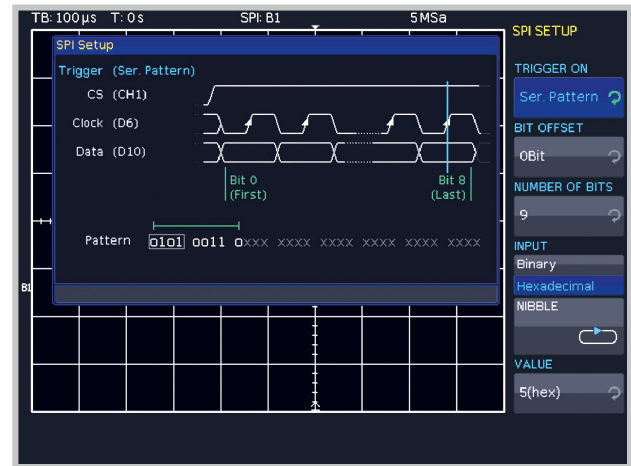
H0010	Serial bus trigger and hardware accelerated decode, I <sup>2</sup> C, SPI, UART/RS-232 on Logic Channels and Analog Channels
H0011	Serial bus trigger and hardware accelerated decode, I <sup>2</sup> C, SPI, UART/RS-232 on Analog Channels
H0012	Serial bus trigger and hardware accelerated decode, 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

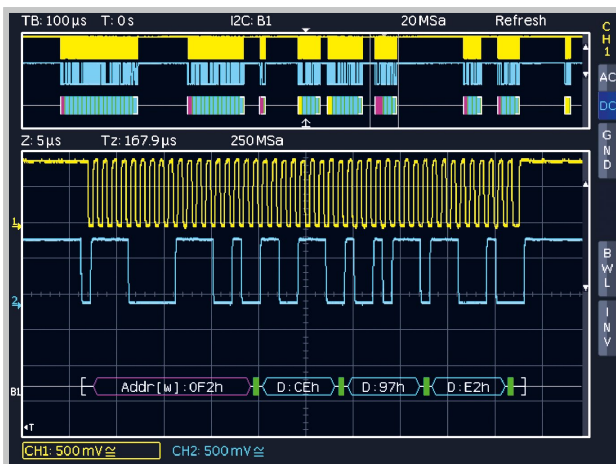
for all Oscilloscopes of the HMO Series



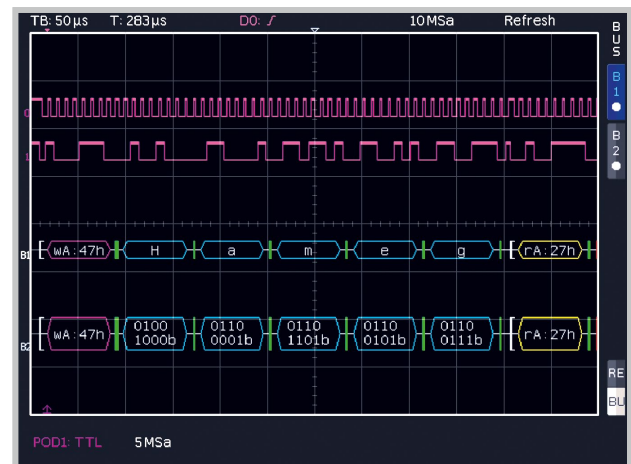
Mixed Signal and Bus Display



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

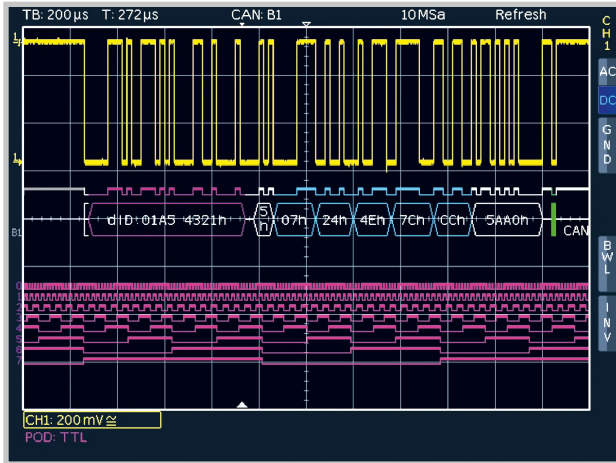
H0010/H0011 I <sup>2</sup> C, SPI, UART/RS-232 Bus Analysis			
	I <sup>2</sup> C Bus	SPI Bus	UART/RS-232 Bus
<b>Bus Configuration</b>			
<b>Bit/Baud rate</b>	up to 10 Mbit/s (HMO352x/2524), up to 5 Mbit/s (HMO72x...202x)	up to 25 Mbit/s (HMO352x/2524), up to 12.5 Mbit/s (HMO72x...202x)	300, 600, 1,200, 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 10Bit for Address ID 8Bit for Data	32Bit for Data	8 Bit for Data 1, 1.5, 2Bit 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 10Bit Address ID 7 or 10Bit Address ID with 8Bit Data Start, Stop, Restart missing Acknowledge Address ID without Acknowledge	Data packets up to 32Bit with positive or negative Chip Select or without Chip Select, (2-wire SPI)	Data packets up to 8Bit
<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

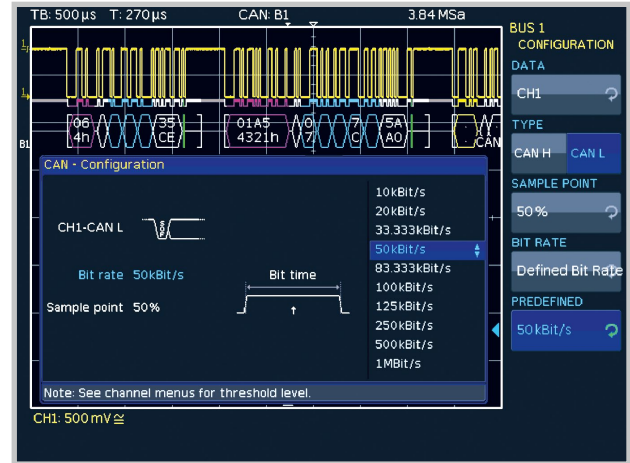
Feature	H0010	H0011
Logic Channels (LCH 0...LCH 15) as source for serial bus trigger and decode	x	-
Analog Channels (CH 1...CH 4) as source for serial bus trigger and decode	x	x
Time synchronous decode of two serial busses	x	-

## H0012 CAN/LIN Bus Analysis

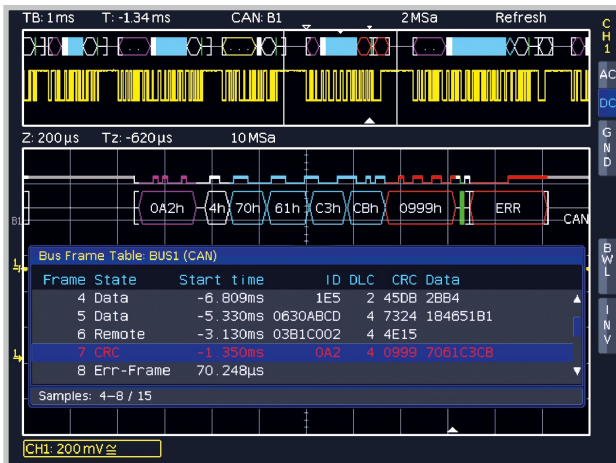
for all Oscilloscopes of the HMO Series



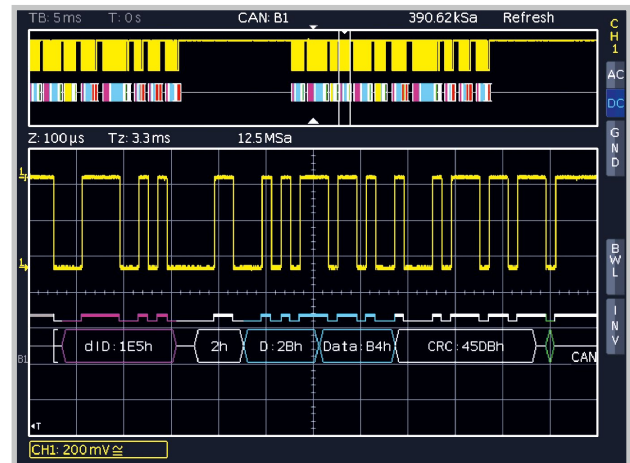
Mixed Signal and Bus Display



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

# 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