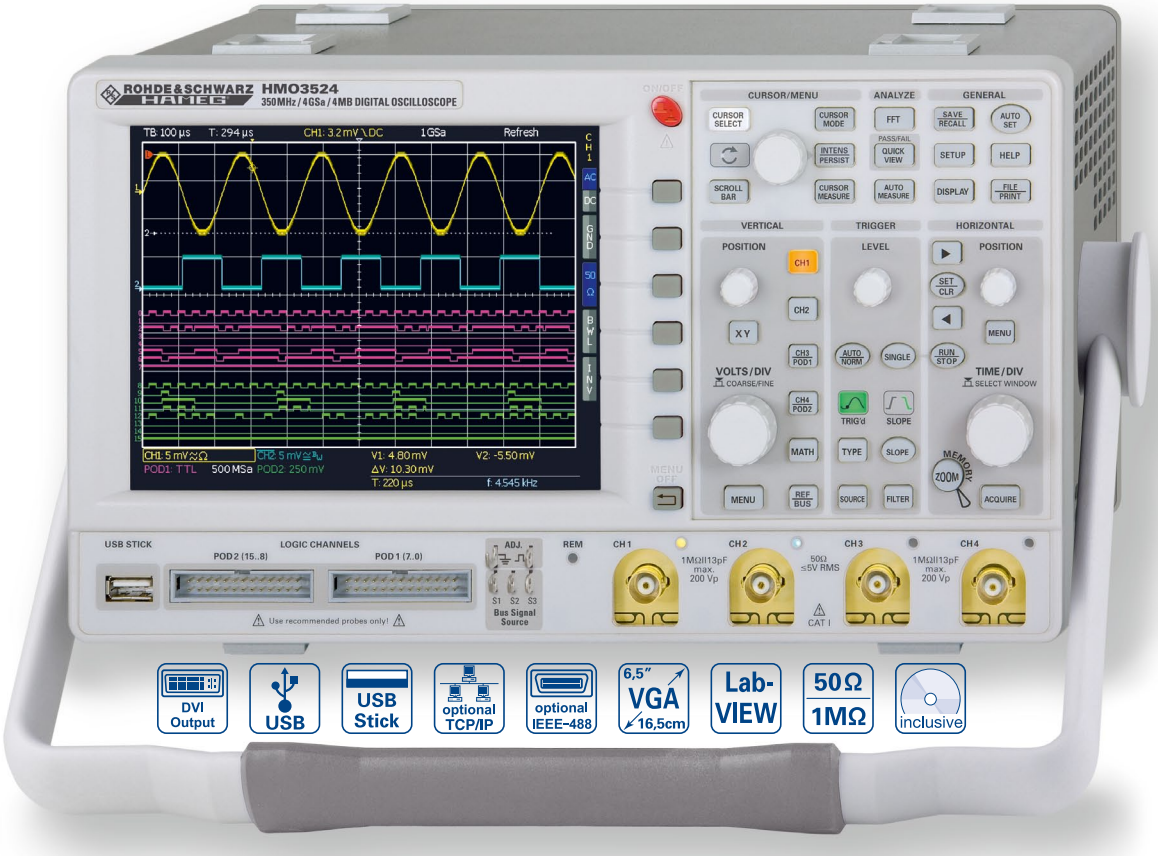
HAMEG Instruments
A Rohde&Schwarz Company

HMO3524

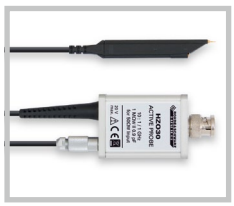
350MHz 2[4] Channel Digital Oscilloscope
HMO3522 [HMO3524]



8 Channel Logic Probe
HO3508

Carrying Case HZ99

Active Probe HZO30



- ☑ **4GSa/s Real Time, 50GSa/s Random Sampling, Low Noise Flash A/D Converter (Reference Class)**
- ☑ **4MPts Memory, Memory Zoom up to 100,000:1**
- ☑ **MSO** (Mixed Signal Opt. HO3508 [HO3516]) with 8 [16] Logic Channels
- ☑ **Serial Bus Trigger** and Hardware accelerated Decode incl. List View. Options: I^2C + SPI + UART/RS-232, CAN/LIN
- ☑ Automatic Search for User defined Events
- ☑ 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
- ☑ 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

350 MHz 2 [4] Channel Digital Oscilloscope HMO3522 [HMO3524]

Firmware: ≥ 4.202

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 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...15 (Logic Channels) with 2 x Option HO3508
Auxiliary input:	Frontside [Rear side]
Function	Ext. Trigger
Impedance	1 MΩ || 13 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):	350 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 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 II 13 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)
Position range:	±10 Divs
Offset control:	
1 mV, 2 mV	±0.2 V
5...50 mV	±1 V
100 mV...5 V	±20 V
Logic Channels:	With Option HO3508
Select. switching thresholds	TTL, CMOS, ECL, 2 x 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 peak detection and trigger level
Min. signal height	0.8 div; 0.5 div typ.
Frequency range	5 Hz...400 MHz
Level control range	From peak- to peak+
Normal (without peak):	
Min. signal height	0.8 div; 0.5 div typ.
Frequency range	0...400 MHz
Level control range	-10...+10 div.
Operating modes:	Slope/Video/Logic/Pulse/Buses optional
Slope:	Rising, falling, both
Sources	CH 1, CH 2, Line, Ext., LCH 0...15 [CH 1...CH 4, Line, Ext., LCH 0...15]
Coupling	**AC:** 5 Hz...400 MHz **DC:** 0...400 MHz **HF:** 30 kHz...400 MHz **LF:** 0...5 kHz **Noise rejection:** 100 MHz LPF 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
Source	CH 1, CH 2, Ext. [CH 1...CH 4]
Logic:	AND, OR, TRUE, FALSE
Source	LCH 0...15, CH 1, CH 2 [CH 1...CH 4]
State	LCH 0...15 X, H, L
Duration	6,4 ns...1.073 s
Pulse:	Positive, negative
Modes	equal, unequal, less than, greater than, within/without a range
Range	min. 16 ns, max. 8.589 s, resolution from 4 ns...1 µs
Sources	CH 1, CH 2, Ext. [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.
Frequency range	0...400 MHz
Level control range	-10...+10 div.
Operating modes	
after time	16 ns...8.589 s, resolution 4 ns...1 µs
after incidence	$1...2^{16}$
Serial Buses:	
Option HO010	I²C/SPI/UART/RS-232 on Logic Channels and Analog Channels
Option HO011	I²C/SPI/UART/RS-232 on Analog Channels
Option HO012	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 100,000:1
Accuracy:	15 ppm
Time Base:	
Refresh operating modes	1 ns/div....20 ms/div.
Roll operating modes	50 ms/div....50 s/div.
Deskew:	-62.0 ns...+61.5 ns
Step size	500 ps

Digital Storage

Sampling rate (real time):	2 x 2 GSa/s, 1 x 4 GSa/s [4 x 2 GSa/s, 2 x 4 GSa/s] Logic Channels: 16 x 1 GSa/s
Sampling rate (random):	50 GSa/s (n/a to Logic Channels)
Memory:	2 x 2 MPts, 1 x 4 MPts [4 x 2 MPts, 2 x 4 MPts]
Operation modes:	Refresh, Average, Envelope, Peak-Detect Roll: free run/triggered, Filter, HiRes
Smallest Peak:	500 ps
Resolution (vertical):	8 Bit (HiRes up to 10 Bit)
Resolution (horizontal):	
Yt Mode	50 Pts./div.
XY Mode	8 Bit
Interpolation:	Sinx/x (CH 1...CH 4), Pulse (LCH 0...15)
Persistence:	Off, 50 ms...∞
Delay pretrigger:	0...2 Million x (1/samplerate)
posttrigger	0...8 Million x (1/samplerate)
Display refresh rate:	Up to 2,500 waveforms/s
Display:	Dots, vectors (interpolation), '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...350 MHz	6 Digit resolution
Accuracy	15 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_{Rise10_90}, t_{Fall10_90}, t_{Rise20_80}, t_{Fall20_80}, 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:	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
Search functions:	Search- and Navigation functions for specfic signal parameter
Interface:	Dual-Interface USB/RS-232 (HO720), USB-Stick (frontside), USB-Printer (rear side) for Postscript Printer, DVI-D for ext. monitor
Optional:	IEEE-488 (GPIB) (HO740), Dual-Interface Ethernet/USB (HO730)

Display functions	
Marker:	up to 8 user definable marker for easy navigation; automatic marker using search criteria
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 hexa-decimal, up to 4 lines; Table view of the decoded data

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	
Probe ADJ Output:	1 kHz/1 MHz square wave signal approx. 1 V_{pp} (ta < 4ns)
Bus Signal Source:	SPI, I^2C, UART, Parallel (4 Bit)
Internal RTC (Realtime clock)**:**	Date and time for stored data
Line voltage:	105...253 V, 50...60 Hz, CAT II
Power consumption:	Max. 70 W at 230 V, 50 Hz
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 220 mm
Weight:	3.6 kg

Accessories supplied: Line cord, Operating manual, 2 [4] Probes, 10:1 with attenuation ID (HZ350), CD, Software

Recommended accessories:

HO010	Serial bus trigger and hardware accelerated decode, I^2C, SPI, UART/RS-232 on Logic Channels
HO011	Serial bus trigger and hardware accelerated decode, I^2C, SPI, UART/RS-232 on Analog Channels
HO012	Serial bus trigger and hardware accelerated decode, CAN, LIN on Logic Channels and Analog Channels
HO3508	Active 8 Channel Logic Probe
HO3516	2 x HO3508, active 8 Channel Logic Probes
HO730	Dual-Interface Ethernet/USB
HO740	Interface IEEE-488 (GPIB) galvanically isolated
HZ46	4RU 19" Rackmount Kit
HZ99	Carrying Case for protection and transport
HZ355	Slimline Probe 10:1 with automatic identification
HZ355DU	Upgrade from 2 x HZ350 to 2 x HZ355
HZO20	High voltage probe 1,000:1 (400 MHz, 1,000 V_{rms})
HZO30	Active probe 1 GHz (0.9 pF, 1 MΩ, including many accessories)
HZO40	Active differential Probe 200 MHz (10:1, 3.5 pF, 1 MΩ)
HZO41	Active differential Probe 800 MHz (10:1, 1 pF, 200 kΩ)
HZO50	AC/DC Current probe 30 A, DC...100 kHz
HZO51	AC/DC Current probe 100/1,000 A, DC...20 kHz

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HAMEG Instruments
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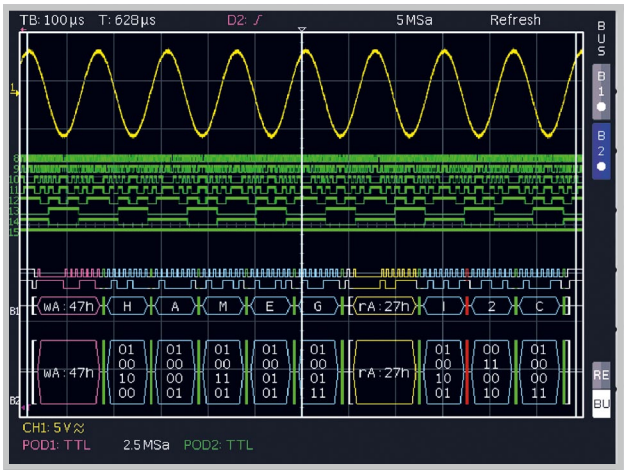
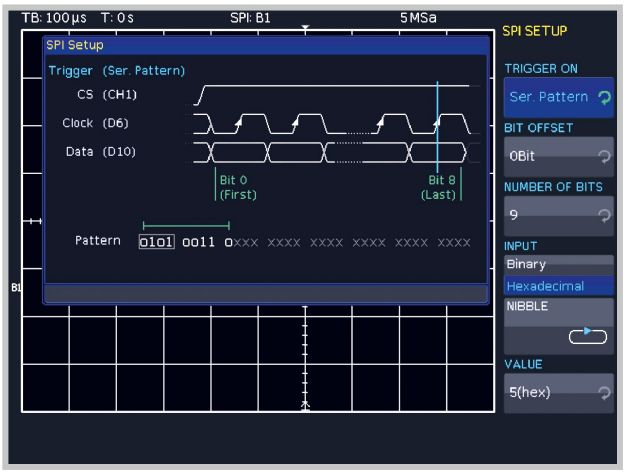
HO010/HO011 Serial Bus

for all Oscilloscopes of the HMO Series

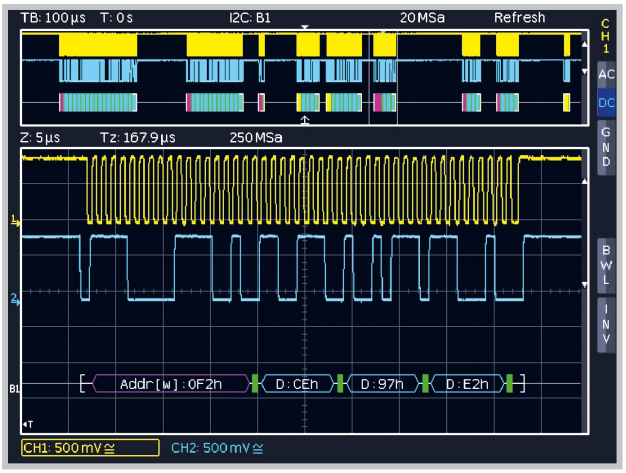
HO010/HO011



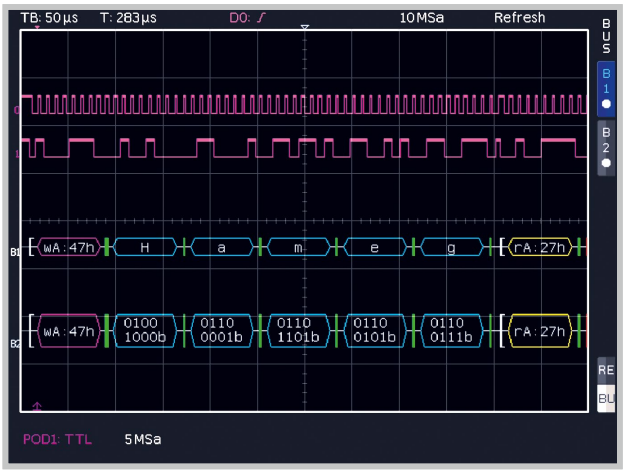
Mixed Signal and Bus Display



SPI Bus Trigger Setup



I²C Bus Hex decoding on the Analog Channel



I²C Bus ASCII and Binary

- ☑ HO010 via Analog Channels and/or Logic Channels, HO011 via Analog Channels
- ☑ I²C, 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

HO010/HO011 I²C, SPI, UART/RS-232 Bus Analysis

	I²C Bus	SPI Bus	UART/RS-232 Bus
Bus Configuration			
Bit/Baud rate	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)
Number of Bit's	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
Polarity	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
Parity	n/a	n/a	none, odd or even
Trigger			
Source	HO010: digital Channels LCH 0...15 (Opt. HO3508) analog Channels CH 1...2 [CH 1...4] HO011: analog Channels CH 1...2 [CH 1...4]	HO010: digital Channels LCH 0...15 (Opt. HO3508) analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4] HO011: analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4]	HO010: digital Channels LCH 0...15 (Opt. HO3508) analog Channels CH 1...2 [CH 1...4] HO011: analog Channels CH 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 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
Input format	Hexadecimal or Binary	Hexadecimal or Binary	Hexadecimal or Binary
Hardware accelerated Decode			
Source	HO010: digital Channels LCH 0...15 (Opt. HO3508) analog Channels CH 1...2 [CH 1...4] HO011: analog Channels CH 1...2 [CH 1...4]	HO010: digital Channels LCH 0...15 (Opt. HO3508) analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4] HO011: analog Channels CH 1...2, external Trigger Entry for Chip Select, [CH 1...4]	HO010: digital Channels LCH 0...15 (Opt. HO3508) analog Channels CH 1...2 [CH 1...4] HO011: analog Channels CH 1...2 [CH 1...4]
Display	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 **up to four lines for decoded values, synchronous display of the Bit lines**	Bus display, color coded for Data: 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 Data: Cyan Start: White Stop: White Error: Red Trigger Condition: Green **up to four lines for decoded values, synchronous display of the Bit lines**
Format	Address ID: hexadecimal Data: ASCII, binary, decimal, hexadecimal	n/a Data: ASCII, binary, decimal, hexadecimal	n/a Data: ASCII, binary, decimal, hexadecimal

Differences HO010/HO011

Feature	HO010	HO011
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	-

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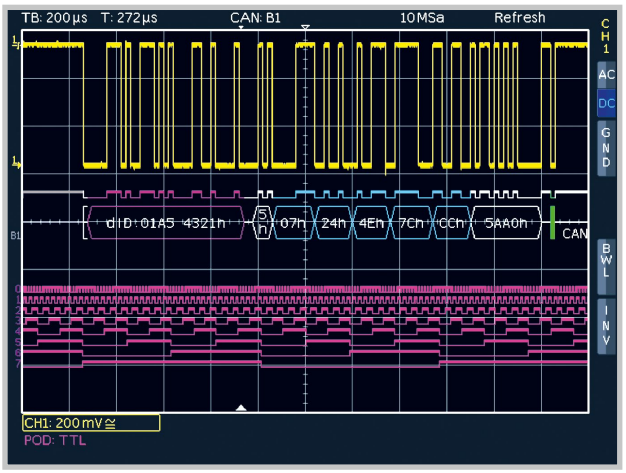
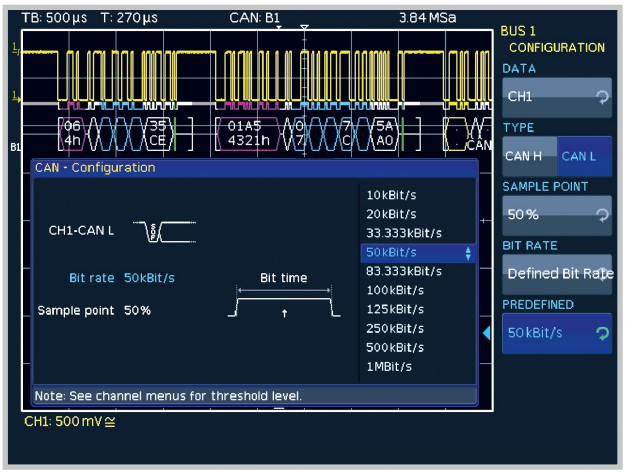
H0012 CAN/LIN Bus Analysis

for all Oscilloscopes of the HMO Series

H0012

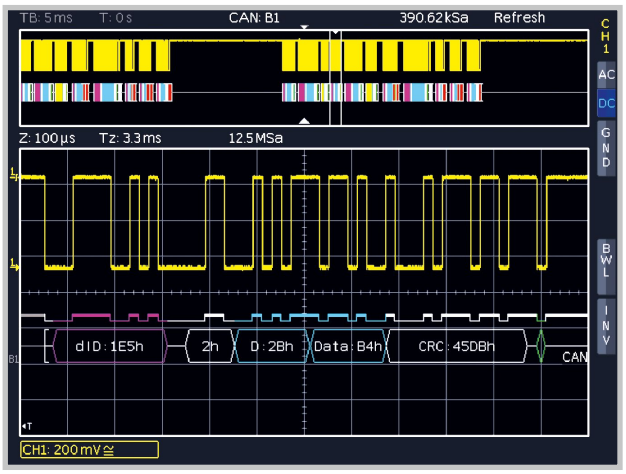


Mixed Signal and Bus Display



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

HO012 CAN/LIN Bus Analysis

	CAN Bus	LIN Bus
Bus Configuration		
Bit rates	Pre-Defined or User-Select, 100 Bit/s...4 Mb/s (HMO352x/2524), 100 Bit/s...2 Mb/s (HMO72x...202x)	Pre-Defined or User-Select, 100 Bit/s...4 Mb/s (HMO352x/2524), 100 Bit/s...2 Mb/s (HMO72x...202x)
Signal Type	CAN-L or CAN-H, Single Ended or Differential Probe (Analog Channels only)	n/a
Sample Point Range	25...90 %	n/a
Threshold	Pre-Defined or User-Select	Pre-Defined or User-Select
Polarity	n/a	High or Low Active
Protocol Version	n/a	1.x, 2.x, J2602, 1.x or 2.x
Trigger		
Source	digital Channel LCH 0...15 (Opt. HO3508), analog Channel CH 1...2 [CH 1...4]	digital Channel LCH 0...15 (Opt. HO3508), analog Channel CH 1...2 [CH 1...4]
Event	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 =, ≠, <, >
Input format	Hexadecimal or Binary	Hexadecimal or Binary
Hardware accelerated Decode		
Source	digital Channel LCH 0...15 (Opt. HO3508), analog Channel CH 1...2 [CH 1...4]	digital Channel LCH 0...15 (Opt. HO3508), analog Channel CH 1...2 [CH 1...4]
Display		
Bus	**color coded for** 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 **up to four lines for decoded values, synchronous display of the Bit lines**	**color coded for** Start and End of Frame: White brackets Break: Magenta, Synchronisation: White Identifier: Yellow, Parity: Green, Data: Cyan Checksum: White, Error: Red, Wake Up: Magenta **up to four lines for decoded values, synchronous display of the Bit lines**
Table	**Display of Bus 0 or 1** Frame Number State (Frame Type or Error Description) Start Time, Identifier, DLC, CRC, Data	**Display of Bus 0 or 1** Frame Number State (Frame Type or Error Description) Start Time, Identifier, Length, Checksum, Data
Format	Identifier & other: hexadecimal Data: ASCII, binary, decimal, hexadecimal	Identifier & other: hexadecimal Data & Checksum: ASCII, binary, decimal, hexadecimal

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