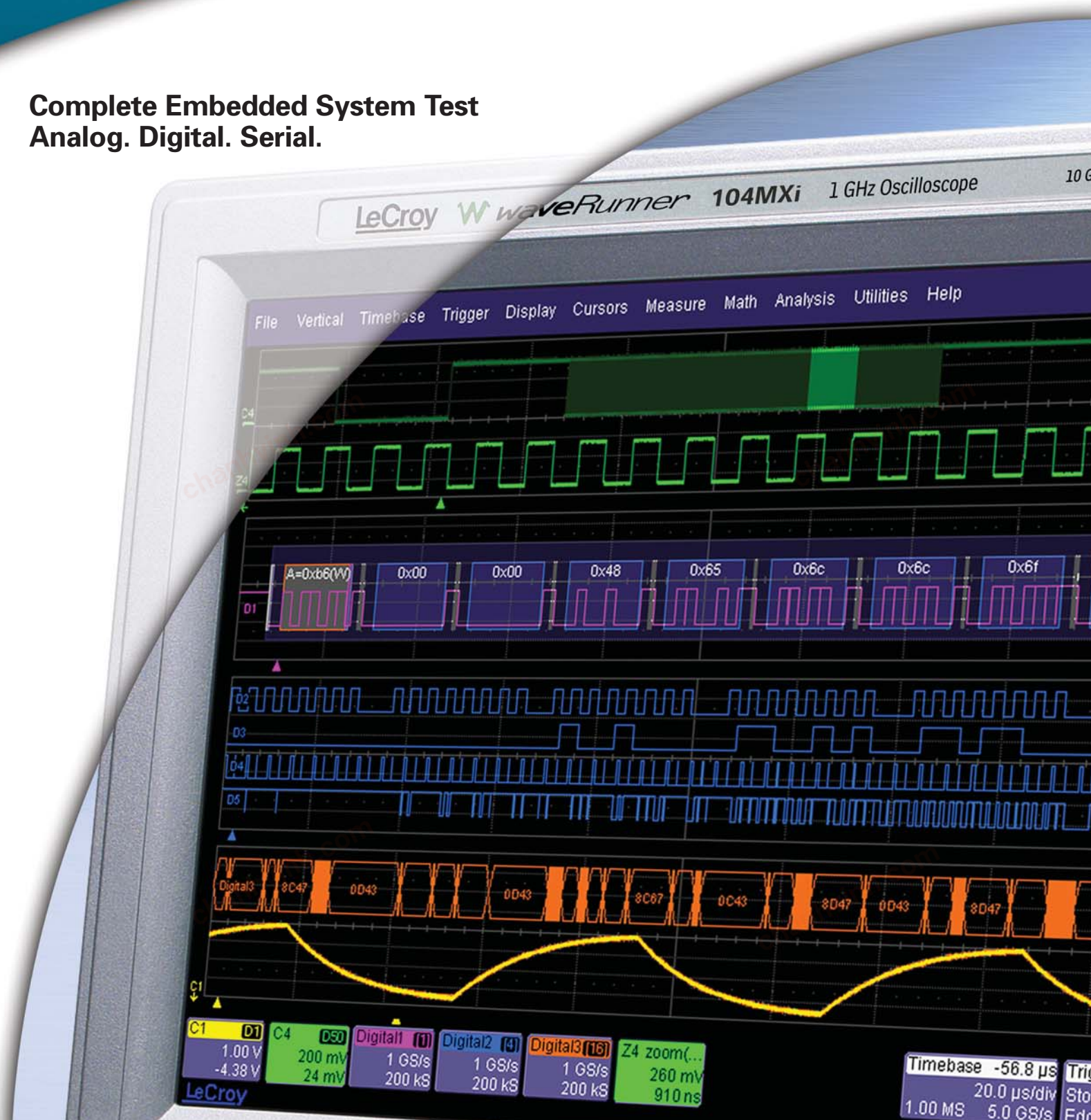
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LeCroy

# MS Series
# Mixed Signal Oscilloscopes

## Complete Embedded System Test
## Analog. Digital. Serial.



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# The Ultimate Mixed Signal Oscilloscope

**A mixed signal oscilloscope (MSO) is the ideal tool for the design and debug of today's embedded systems providing the only way to see analog, digital and serial data signals simultaneously on one instrument as they occur in real time. Embedded system designers need to view signals into and out of devices such as microcontrollers, DSPs, FPGAs, ADCs, DACs, and transducers while ensuring proper timing and bus traffic.**

## Unmatched Digital Performance

The MS Series offers unmatched digital performance and is available in two models, the MS-500 and MS-250. Designed to capture long records of the fastest digital signals the MS-500 has a maximum input frequency of 500 MHz, while other MSOs are limited to only 250 MHz. The long memory of 50 Mpts/Ch means that these fast signals can be captured for up to 25 ms at up to 2 GS/s sampling rate. On top of this raw performance, the MS-500 supports up to 36 channels —enough for all the ADDR, DATA, control lines and serial data busses. This makes it the perfect tool for embedded systems with 16-bit or 32-bit microcontrollers.

The MS-250 is the ideal tool for testing embedded systems with 8-bit microcontrollers or slower digital signals. With 250 MHz max. input frequency, 18 channels and 10 Mpts/Ch memory the MS-250 is an outstanding value and provides a complete set of tools for embedded system testing.

## Analog Performance Reimagined

A great MSO must be built on a great oscilloscope and the WaveRunner® MXi and WaveSurfer® MXs are two of the best. With bandwidths from 200 MHz to 2 GHz, sampling rates up to 10 GS/s, 12.5 Mpts/Ch available memory, and a wide range of math, measurement and triggering capabilities the WaveRunner MXi and WaveSurfer MXs platforms are powerful and versatile. Both models feature a big, bright 10.4" color touch screen for easy viewing of all your analog and digital signals and both are only 6" deep.

## The Best Serial Data Bus Testing

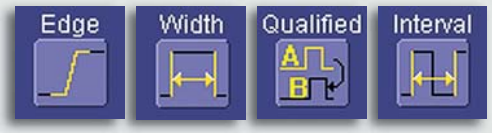
Monitoring serial data busses is a major part of embedded system design and test. The ability to quickly locate and isolate specific messages on these busses is important for efficient testing. With LeCroy's unique color-coded overlay for decoded bus data and powerful, flexible conditional triggering, the MS Series captures all important bus traffic in your system and easily shows important data messages from I²C, SPI, UART, RS-232, and LIN busses.



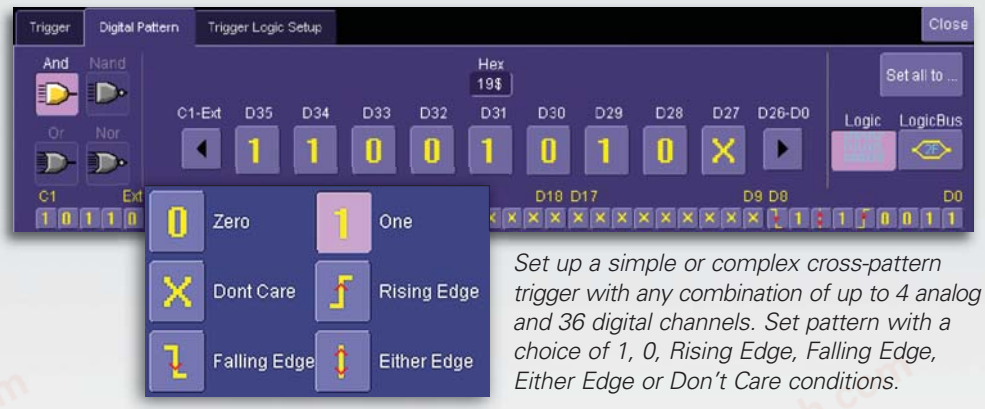
# The Complete Mixed Signal Toolset

## Analog, Digital and Cross-pattern Triggering

The WaveRunner MXi and WaveSurfer MXs oscilloscopes come with an extensive set of triggering capabilities aimed at capturing a wide range of analog signals. With the MS Series this triggering is enhanced, adding analog/digital cross-pattern trigger, analog/digital event triggering and the capability to select any digital channel as the source for an analog trigger.




*Use the oscilloscope triggers with digital channels.*




*Set up a simple or complex cross-pattern trigger with any combination of up to 4 analog and 36 digital channels. Set pattern with a choice of 1, 0, Rising Edge, Falling Edge, Either Edge or Don't Care conditions.*

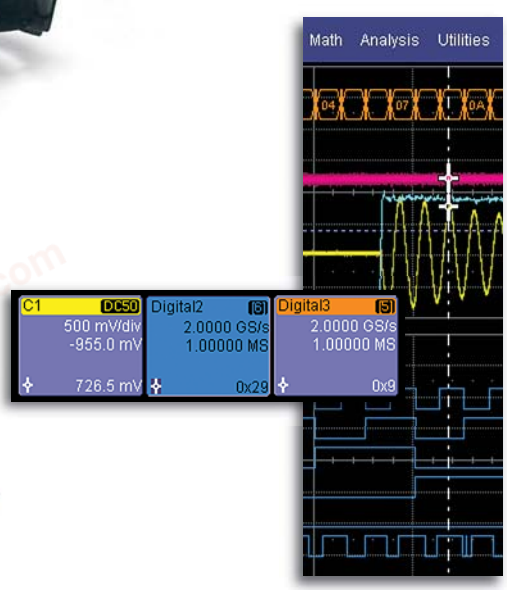


## Easy-to-use Measurement Tools

Cursors and measurement parameters are an important part of any oscilloscope. When using the MS Series these tools measure digital channels as well analog channels.

Cursors read out hexadecimal bus values while parameters make timing measurements on a single digital channel, between two digital channels or even between an analog and a digital channel.

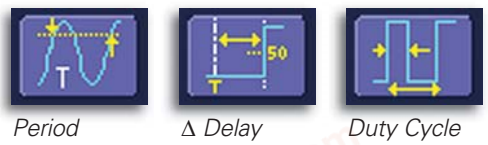








*Frequency* *Delay* *Width*



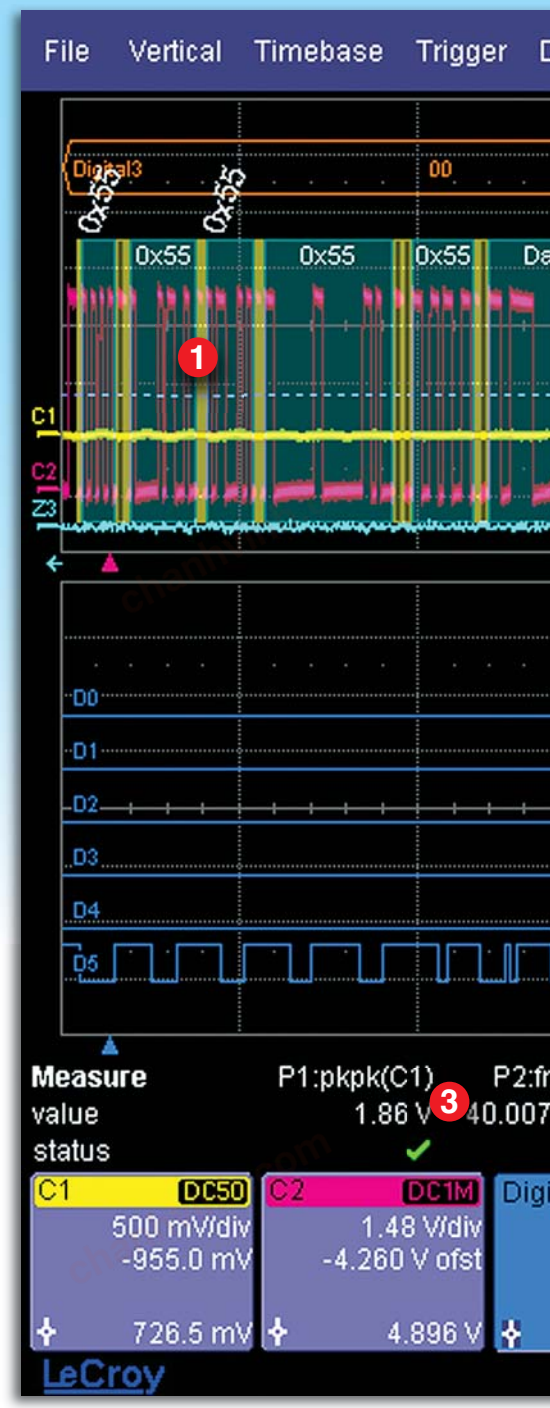

*Period* *Δ Delay* *Duty Cycle*

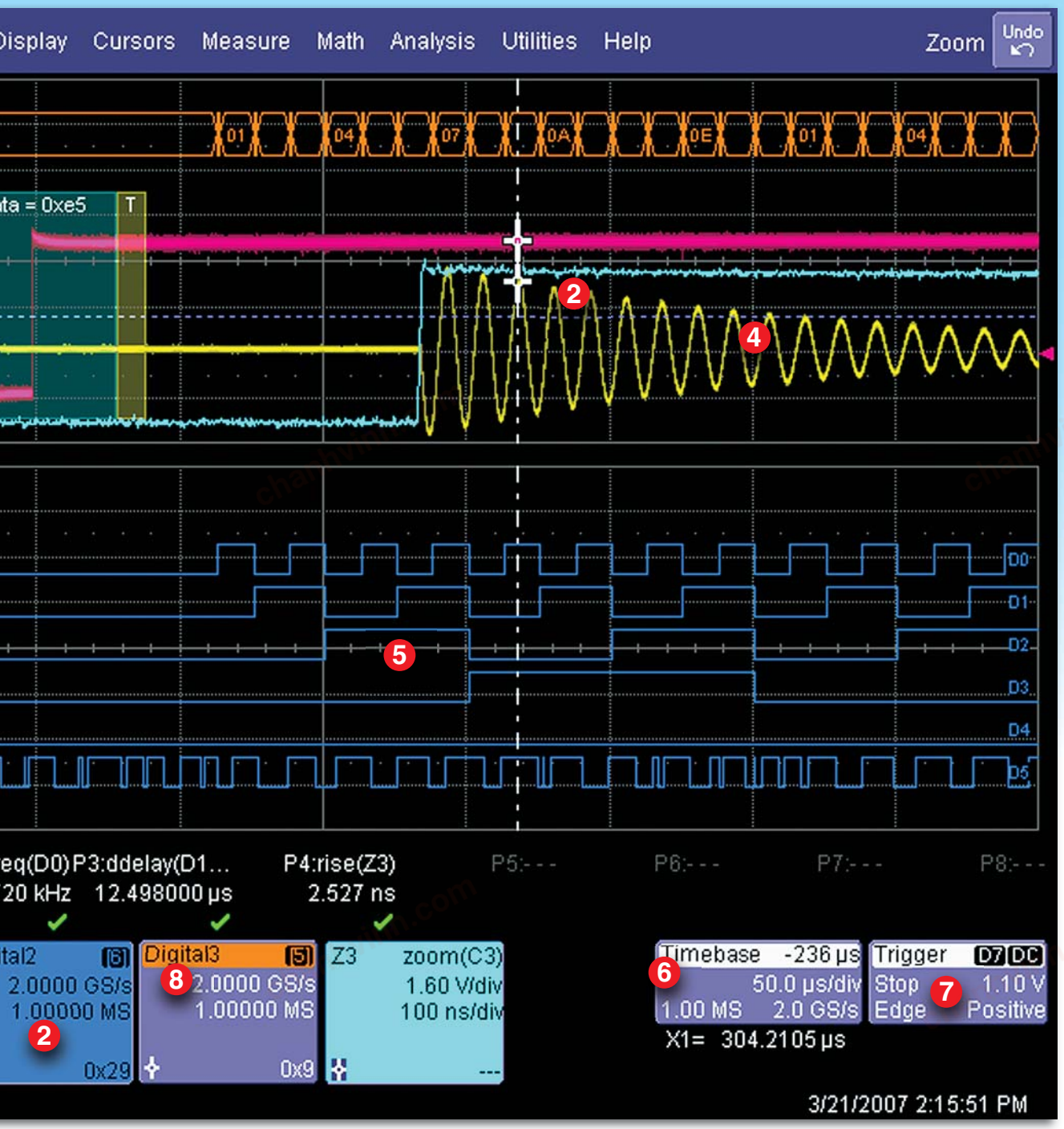
*Use oscilloscope tools like horizontal and vertical cursors along with automatic measurements and statistics to measure analog and digital signals.*

# Insight into Your Embedded System

**The display of a mixed signal oscilloscope is your view into the analog, digital and serial data signals that drive your embedded system. The big 10.4" color touch screen of the WaveRunner MXi and WaveSurfer MXs simplifies how you use your MSO and makes seeing signal details easier especially when viewing a combination of up to 4 analog and 36 digital channels.**

1. Trigger and decode serial data signals such as I²C, SPI, UART, RS-232, and LIN. The decoded data is presented with a unique color-coded overlay for easy identification. Zoom in closer to see even more data as each individual bit is decoded. Built-in search capability will quickly scan for specific messages on the bus.
2. Use cursors to read hexadecimal bus values or make manual timing measurements.
3. Automatic measurement parameters like period, frequency and duty cycle work on digital lines just as they would on oscilloscope channels. Statistics and Histicons provide detailed measurement information.
4. Analog bandwidths from 200 MHz to 2 GHz with sampling rates up to 10 GS/s.
5. Up to 50 Mpts/Ch digital memory provides very long capture times of all your digital signals, with sampling rates up to 2 GS/s.
6. Long oscilloscope memory enables capturing long records of analog signals while maintaining high sample rate for fast edges.
7. Complete analog/digital cross triggering. Set up a simple or complex pattern using any combination of up to 4 analog and 36 digital channels.
8. Sampling rate of 2 GS/s on digital lines.

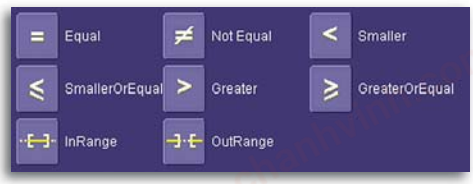



Display Cursors Measure Math Analysis Utilities Help Zoom Undo
01 04 07 0A 0E 01 04
ta = 0xe5 T
2
4
5
D0
D1
D2
D3
D4
D5
eq(D0) P3:ddelay(D1... P4:rise(Z3) P5:- - - P6:- - - P7:- - - P8:- - -
20 kHz 12.498000 µs 2.527 ns
tal2 6
2.0000 GS/s
1.00000 MS
2
0x29
Digital3 5
8
2.0000 GS/s
1.00000 MS
0x9
Z3 zoom(C3)
1.60 V/div
100 ns/div
---
Timebase -236 µs
6
50.0 µs/div
1.00 MS 2.0 GS/s
X1= 304.2105 µs
Trigger D7 DC
Stop 1.10 V
7
Edge Positive
3/21/2007 2:15:51 PM

# Serial Data Bus Validation and Debug

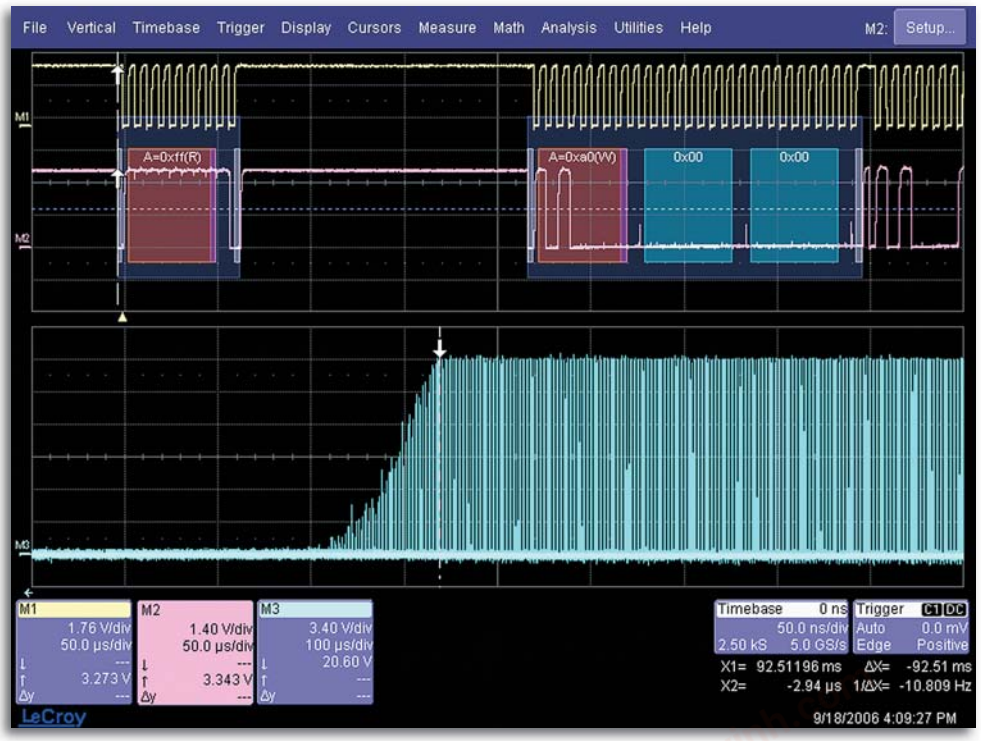
## Complete I²C, SPI, UART, RS-232, LIN, CAN, and FlexRay™ Serial Triggering

Quickly and easily isolate specific serial data events on your embedded controller for better understanding and faster debug. Set up trigger conditions in binary, hexadecimal (Symbolic for CAN) formats. Use the MS-500 or MS-250 to capture serial data busses, keeping the analog oscilloscope channels open for other uses. Trigger on DATA in specific locations of long I²C EEPROM reads. Get complete control of your debug process and finish faster.




## Powerful Conditional Data Triggering

Completely isolate specific message events for better understanding and debug. Use a conditional I²C, CAN, FlexRay,™ UART, RS-232, or LIN DATA trigger to select a range of DATA values to trigger on, not just a single DATA value. Oftentimes, I²C utilizes DATA bytes to specify sub-addresses for accessing memory locations in EEPROMs. Conditional DATA trigger allows triggering on a range of DATA bytes that correspond to reads or writes to specific sub-address memory blocks in the EEPROM.




Conditional DATA triggering can also aid in monitoring DATA outputs from sensors, such as analog-to-digital converters, and triggering when DATA is outside a safe operating range. In both cases, verifying proper operation becomes a simple task.

## Intuitive, Color-coded Decode Overlay

Advanced software algorithms deconstruct the waveform into binary, hex, or ASCII protocol information, then overlay the decoded data on the waveform. Various sections of the protocol are color-coded to make it easy to understand. The decode operation is fast—even with long acquisitions.

## Table Summary and Search/Zoom

Turn your oscilloscope into a protocol analyzer with the Table display of protocol information. Customize the table, or export Table data to an Excel file. Touch a message in the table and automatically zoom in for detail. Search for specific address or data values in the acquisition.

| Idx | Time | Addr Length | Address | R/W | Length | Data |
|---|---|---|---|---|---|---|
| 8 | 240.494 ms | 7 | 0x21 | 1 | 2 | 0xff 00 00 |
| 9 | 360.555 ms | 7 | 0x21 | 0 | 1 | 0x08 |
| 10 | 360.698 ms | 7 | 0x21 | 1 | 2 | 0x49 00 00 |
| 11 | 481.865 ms | 7 | 0x21 | 0 | 1 | 0x0a |
| 12 | 482.007 ms | 7 | 0x21 | 1 | 2 | 0x00 00 00 |
| 13 | 606.294 ms | 7 | 0x20 | 0 | 3 | 0x01 36 00 |
| 14 | 721.235 ms | 7 | 0x20 | 0 | 1 | 0x00 |
| 15 | 721.377 ms | 7 | 0x20 | 1 | 2 | 0x12 36 00 |
| 16 | 841.266 ms | 7 | 0x20 | 0 | 1 | 0x02 |

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# Analog Bandwidths from 200 MHz to 2 GHz

## WaveSurfer MXs



Designed for those requiring a basic oscilloscope for signal viewing and performing basic timing measurements.

| | |
|---|---|
| **Bandwidth Range** | 200 MHz – 1 GHz |
| **# of Analog Channels** | 2 or 4 |
| **Analog Sample Rate** | Up to 5 GS/s |
| **Analog Memory** | 10 Mpts/Ch |
| **Application Packages** | Electrical Telecom |
| **Serial Data Trigger and Decode** | I²C, SPI, UART, RS-232, LIN, CAN |
| **Display** | 10.4" Color Touch Screen |
| **Operating System** | Windows® XPe |

## WaveRunner MXi



Higher performance and advanced capabilities with longer standard and optional memory are intended for fast processing of long records, advanced analysis and some application based measurements.

| | |
|---|---|
| **Bandwidth Range** | 400 MHz – 2 GHz |
| **# of Analog Channels** | 2 or 4 |
| **Analog Sample Rate** | Up to 10 GS/s |
| **Analog Memory** | 12.5 Mpts/Ch, 25 Mpts/Ch Interleaved |
| **Application Packages** | PowerMeasure, EMC, Jitter and Timing, Digital Filter, Serial Data Mask, USB, Ethernet, Electrical Telecom, Disk Drive Measurements |
| **Serial Data Trigger and Decode** | I²C, SPI, UART, RS-232, LIN, FlexRay, CAN |
| **Display** | 10.4" Color Touch Screen |
| **Operating System** | Windows® XP Pro |

**PK400-1 Microgripper Set**

Large gripper probe set for 0.10 inch (2.54 mm) pin pitch, includes 10 probes with color-coded leads.



**PK400-2 Microgripper Set**

Medium gripper probe set for 0.04 inch (1.0 mm) pin pitch, includes 10 probes with color-coded leads.



**PK400-3 Microgripper Set**

Small gripper probe set for 0.008 inch (0.2 mm) pin pitch, includes 10 probes with color-coded leads.



*The MS Series is compatible with WaveRunner MXi, WaveRunner Xi, WaveSurfer MXs and WaveSurfer Xs oscilloscopes featuring the LeCroy Bus connection.*

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# Specifications and Ordering Information

## Specifications

| | MS-500* | MS-500-36 | MS-250 |
|---|---|---|---|
| **Acquisition System** | | | |
| Maximum Input Frequency | 500 MHz | 250 MHz (500 MHz) | 250 MHz |
| Sample Rate | 2 GS/s | 1 GS/s (2 GS/s) | 1 GS/s |
| Acquisition Memory (per Channel) | 50 Mpts/Ch† | 25 Mpts/Ch (50 Mpts/Ch) | 10 Mpts |
| **Digital Channels** | | | |
| Number of Channels | 18 | 36 (18) | 18 |
| Threshold Groupings | D0–D8, D9–D17 | D0–D8, D9–D17, D18–D25, D26–D35 | D0–D8, D9–D17 |
| Threshold Levels | TTL, ECL, CMOS (2.5 V, 3.3 V, 5 V), PECL, LVDS or User Defined | | |
| **Trigger** | | | |
| Trigger Types | Edge, Width, Pattern, Glitch, Interval, Dropout | | |
| Serial Data Triggers (Optional) | I²C, SPI, UART, RS-232, LIN | | |
| Trigger Sources | C1–C4, D0–D17, EXT | C1–C4, D0–D35, EXT | C1–C4, D0–D17, EXT |
| **Physical Dimensions** | | | |
| Dimensions (W x L x D) | 4.25" x 8.375" x 1.5" (10.8 x 21.3 x 3.8 cm) | | |
| Net Weight | 1.7 lbs. (.775 kg) | | |
| Lead Set Length | 16" (40.65 cm) | | |

*MS-500 supports 36 channels with use of second lead set (MSO-DLS-36).
†10 Mpts/Ch max. memory when used with WaveSurfer Xs and WaveSurfer MXs.

## Ordering Information

| Description | Product Code |
|---|---|
| 500 MHz, 2 GS/s, 18 Ch, 50 Mpts/Ch Mixed Signal Oscilloscope Option | MS-500 |
| 250 MHz, 1 GS/s, 36 Ch, 25 Mpts/Ch (500 MHz, 18 Ch, 2 GS/s, 50 Mpts/Ch Interleaved) Mixed Signal Oscilloscope Option | MS-500-36 |
| 250 MHz, 1 GS/s, 18 Ch, 10 Mpts/Ch Mixed Signal Oscilloscope Option | MS-250 |

### Hardware Options and Accessories

| | |
|---|---|
| 18 Channel Lead Set Replacement (D0–D17) | MSO-DLS-18 |
| 18 Channel Lead Set (D18–D35) Enables 36 Channels on MS-500 | MSO-DLS-36 |
| Large Gripper Probe Set for 0.10" (2.54 mm) Pin Pitch, Includes 10 Color Coded Probes | PK400-1 |
| Medium Gripper Probe Set for 0.04" (1.0 mm) Pin Pitch, Includes 10 Color Coded Probes | PK400-2 |
| Small Gripper Probe Set for 0.008" (0.2 mm) Pin Pitch, Includes 10 Color Coded Probes | PK400-3 |
| Ground Extender for Square Pin Header | MSO-GND-EXTEND |
| Flexible Ground Lead | MSO-GND-LEAD |
| 36 Channel Mictor Connector for MS Series (Includes 1 MSO-MICTOR-SHROUD) | MSO-MICTOR |
| 18-pin 3M Interface Cable (Mates with 3M Part Number 2520-6002) | MSO-3M |
| Replacement LeCroy Bus Cable | MSO-LBUS |
| Shroud for Mictor Connector, Kit of 3 | MSO-MICTOR-SHROUD |

### Included with Standard Configuration

- Mixed Signal Oscilloscope Module
- 18 Channel Digital Lead Set (1 with MS-500 and MS-250, 2 with MS-500-36)
- LeCroy Bus and USB2.0 Cables (1.3 m)
- Ground Extenders (20 with MS-500 and MS-250, 40 with MS-500-36)
- Flexible Ground Leads (5 with MS-500 and MS-250, 10 with MS-500-36)
- Carrying Case
- Operator's Manual (English)
- Quick Reference Guide (English)
- CE Conformance Certificate Contained in Manual

### Customer Service

LeCroy oscilloscopes and probes are designed, built, and tested to ensure high reliability. In the unlikely event you experience difficulties, our digital oscilloscopes are fully warranted for three years, and our probes are warranted for one year.

This warranty includes:

- No charge for return shipping
- Long-term 7-year support
- Upgrade to latest software at no charge

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**Local sales offices are located throughout the world.**
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