Contract on the lease of equipment with the right to its subsequent purchase

(hereinafter referred to as the "contract")

I.
Contracting parties

1. Lessor

Company:	**Teledyne LeCroy Inc.**
Registered office:	700 Chestnut Ridge Rd, Chestnut Ridge, NY 10977
Company No.:	13 250 7777
Tax Registration No.:	13 250 7777
Bank details:	RBS International Trade Services
Account No.:	4008627528
Represented by:	Roberto Petrillo Worldwide Vice President of Sales

(hereinafter referred to as the "**lessor**"), as the first party

and

2. Lessee

Company:	**CESNET, Association of Legal Entities**
Registered office:	Zikova 4, 160 00 Prague 6
Company No.:	63839172
Tax Registration No.:	CZ63839172
Entered in the register of the association of legal entities kept by the civil law section of the Prague City Hall, Mariánské nám. 2, 110 00 Prague 1, under registration number: ZS 22/2/96	
Bank details:	Komerční banka, a. s., Prague 6 branch,
Account No.:	19-8482200297/0100
Represented by:	Ing. Jan Gruntorád, CSc., Association Director

(hereinafter referred to as the "**lessee**"), as the second party

hereby conclude on the day, month and year stipulated below, this contract:

II.
Introductory provisions

1. This contract is concluded on the basis of negotiated procedure without publication for the awarding of a public contract titled "**Lease of equipment for the upgrade of an SDA820 real-time oscilloscope**", which the lessee awarded as part of the implementation of the large

infrastructure project for research, development and innovation titled "CESNET Large Infrastructure", identification code LM2010005, which was approved by the Government of the Czech Republic and is co-financed from the state budget of the Czech Republic. The subsidy provider is the Ministry of Education, Youth and Sports of the Czech Republic, with the subsidy provided on the basis of its Decision made pursuant to the provisions of Section 9 of Act No. 130/2002 Coll., on the Promotion of Research, Experimental Development and Innovation from Public Funds and on Amendments to Certain Related Acts (Act on the Promotion of Research, Experimental Development and Innovation from Public Funds and on Amendments to Certain Related Acts), as amended, and pursuant to Sections 14 and 17 of Act No. 218/2000 Coll., on Budgetary Rules and on Amendments to Certain Related Acts (Budgetary Rules). For this reason, the tender procedure, the performance of the contract and the subsequent control are, besides Act No. 137/2006 Coll., on Public Contracts, also subject and other legislation (e.g. Act No. 320/2001 Coll., on Financial Control in Public Administration, and Act No. 130/2002 Coll., on the Promotion of Research, Experimental Development and Innovation from Public Funds and on Amendments to Certain Related Acts).

III.
Subject of the performance of the contract

1. The subject of the performance of this contract is the delivery of equipment (components) for the upgrade of a LeCroy SDA820 real-time oscilloscope (hereinafter referred to as the "oscilloscope"), in the form of the lease of the components with the right to their subsequently purchase at their residual value.
2. The lessor guarantees that the leased equipment is compatible with the said oscilloscope and is designed, in functional and construction terms, for its upgrade as to enable it to process DP-QPSK signals at 112Gbit/s in at least four channels up to a frequency of 30 GHz.
3. Lessor also provides lessee with 36-month warranty on the delivered goods.
4. A detailed description of the leased components is contained in Appendix No. 1 hereto.

IV.
Duration of the lease and the right to the subsequent purchase of the equipment

1. The lease of the equipment is agreed for a definite period of 36 months from the signing of this contract by the contracting parties.
2. The lessee has the right to purchase the equipment subsequent to the expiry of the agreed lease period for a purchase price of **USD 1,-**.

V.
Deadline, place of delivery, and manner of acceptance of the leased equipment

1. The lessor undertakes to deliver all the leased equipment within five weeks of the effective date of this contract to the lessee's registered office at Zikova 4, 160 00 Prague 6, Czech Republic.
2. A delivery and acceptance protocol shall be executed upon the acceptance and installation of the equipment. The lessee is not entitled to relocate the

contract equipment from the specified address and place without the lessor's prior written consent.

VI.
Use of the contract equipment and its subsequent purchase

1. The lessee may use the contract equipment solely for its own needs and to only entrust its operation to its own employees or to persons in a similar relationship. The lessee is not entitled to sub-lease the contract equipment to a third party without the lessor's prior written consent.
2. The lessee shall use the leased components in accordance with the user manual, which the lessor shall deliver to the lessee together with the leased components, at the latest.
3. The lessee undertakes that the contract equipment shall be operated and managed solely by experienced and trained personnel. The lessee is liable for damage caused by the improper operation or use in violation of the user manual, but its liability for such damage is limited to the rent stipulated in Article VII. hereof.
4. The lessee has a preferential right to purchase the equipment leased under this contract, with this right coming into effect upon the expiry of the lease period under Article IV. hereof. The lessee may exercise this right, provided that it notifies the lessor by not later than 30 days before the expiry of the lease period under Article IV. hereof that it is exercising this right. In this case, the lessee becomes the owner of the subject of the lease (purchase) on the date on which it pays the purchase price set forth in Article VII. hereof (but no earlier than the date following the expiry of the lease period under Article IV. hereof). If the lessee fails to pay the purchase price within 30 days after the expiry of the lease period, its right to purchase shall be forfeited and it shall be obliged to return the subject of the lease to the lessor within 15 days.

VII.
Rent and purchase price

1. The lessee is obliged to pay the lessor rent as consideration for using the components leased under this contract. The total rent is **USD 169 999,-** for the duration of the lease, and shall be paid according to the payment schedule, which is attached hereto as Appendix No. 2.
2. After paying the entire amount of the rent, the lessee has a preferential right to purchase the leased equipment for a purchase price of **USD 1,-**.
3. For the purposes of the payment of VAT and any other fees, the place of delivery shall be the Czech Republic.
4. The rent for the subject of performance may not be increased for the duration of the contract.

VIII.
Payment conditions

1. The rent shall be always paid by the lessee **six months in advance** in accordance with the payment schedule, attached hereto as Appendix No. 2 on the basis of a tax document - invoice (hereinafter referred to as an "invoice"), which the lessor shall issue by the end of the first month of the given lease term.

2. The invoice shall be payable 30 days from the date of its serving to the lessee. The invoice must include all the particulars of a proper accounting and tax document in accordance with the relevant statutory provisions and information that it pertains to a delivery forming part of the implementation by the lessee of a project titled "CESNET Large Infrastructure" and the identification number LM2010005. If the invoice does not contain the said particulars, the lessee shall be entitled to send it back to the lessor by the due date for its supplementation or correction, without becoming in arrears with payment; in such a case the maturity period shall begin to run again as of the re-delivery of the duly supplemented or corrected document.

IX.
Penalty arrangements

1. The lessee is entitled to a penalty of 0.05% of the total rent under Article VII. thereof for each day or part day that the lessor is in delay with the delivery of the subject of the lease to the place of performance after the agreed delivery date in accordance with Article V. hereof.
2. The lessor is entitled to charge the lessee 0.05% interest on the outstanding amount for each day of delay in case of delay in the payment of an invoice.
3. The contracting parties are obliged to charge contractual penalties under this article to the counterparty not later than 60 days from the date of the claim arising, otherwise the claim shall expire. Contractual penalties are payable within 30 days.
4. The lessee has the right to withdraw from this contract should the lessor be more than 45 days in delay with the delivery of the subject of the lease to the place of performance. This shall not prejudice the lessee's right, specified in this contract, to a penalty and compensation for any damage suffered.
5. The lessor has the right to withdraw from this contract should the lessee be in default with the payment of any amount due for more than 45 days. This shall not prejudice the lessor's right, specified in this contract, to a penalty and compensation for any damage suffered.
6. The contracting parties' entitlement to compensation shall not be prejudiced by an agreement on a contractual penalty nor its actual payment.
7. The effects of withdrawal from this contract shall arise upon the serving to the other party of the written manifestation of the manifesting party's will to withdraw from this contract.

X.
Cooperation and mutual communication

1. The contracting parties are obliged to cooperate and provide each other with all information necessary for the proper performance of their obligations. The contracting parties are obliged to notify the other contracting party of any and all facts that are or may be important for the proper performance of the contract and also of every change in the particulars required for mutual communication (e.g. change in telephone numbers, change of an address, bank details, etc.).

2. All notices between the contracting parties, which will apply to the contract or which are to be made under the contract, must be made in writing and served to the other contracting party either personally, by registered mail, fax, courier or e-mail at the address specified in the contract, unless specified or agreed otherwise among the contracting parties.
3. The lessor's correspondence address is: Rue Moïse-Marcinhes 4, P.O. Box 341, 1217 Meyrin 1, Geneva, Switzerland.
4. The lessor's contact e-mail address is: Francesco.Raimondi@lecroy.com.
5. The lessee's correspondence address is: CESNET, Association of Legal Entities, Zikova 4, 160 00 Prague 6.
6. The lessee's contact e-mail address for administrative purposes is josef.vojtech@cesnet.cz.
7. If it is not possible to clearly determine the date on which message was served to the other contracting party, the date of serving shall, in the case of serving being made by:
   - registered mail, be the tenth business day after the date of serving the letter to the postal service.
   - electronic means, the date when the sender of the message receives confirmation of the message being delivered to the recipient.

XI.
Contract validity and effectiveness

1. This contract becomes valid and comes into effect upon its signing by both contracting parties.
2. In the event of termination, the contracting parties are obliged, without undue delay, but not later than 60 days, to settle their mutual obligations and claims arising from this contract in accordance with the law and this contract.

XII.
Sundry and final provisions

1. The lessor acknowledges that:
   a. upon signing this contract it become a party obliged to cooperate during the exercise of financial control in accordance with Section 2(e) of Act No. 320/2001 Coll., on Financial Control in Public Administration, as amended; As part of this control, the lessor will be obliged to permit representatives of the subsidy provider to conduct a control in accordance with the conditions prescribed in the said legislation;
   b. it is obliged to allow representatives of the subsidy provider to access even those parts of the bid, contracts and related documents which are subject to protection under special legislation (such as trade secrets, classified information), provided that the requirements imposed by legal regulations are met [e.g. Section 11(c) and (d), Section 12(2)(f) of Act No. 552/1991 Coll., on State Control, as amended].
   c. it is obliged to contractually ensure that the representatives of the subsidy provider are entitled to control its potential subcontractors in a similar manner.
2. The lessor further undertakes to:
   a) preserve the confidentiality of all facts they become privy to in the performance of the public contract or in connection therewith;

b) refrain from assigning its rights or obligations to any third party without the lessee's written consent;
c) compensate the lessee for any damage caused to it by the lessor's potential subcontractor;
d) arrange for maximum flexibility in performing the subject of the public contract, especially when resolving the lessee's justified needs arising in the duration of the contract;
e) arrange for the protection of personal data in accordance with legal regulations.

3. Unless provided otherwise herein, the legal relations arising from this contract shall be governed by the laws of the Czech Republic and of the European Union, particularly by Act No. 513/1991 Coll., the Commercial Code, as amended, and related regulations.
4. This contract may only be amended by written amendments signed by both contracting parties.
5. The contracting parties have agree that all disputes arising under and in connection with this contract shall be decided with final effect by three arbitrators of the International Court of Arbitration in Vienna under its rules.
6. In the event that one or more provisions of this contract shall be deemed illegal, invalid or unenforceable, such illegality, invalidity or unenforceability shall not affect the other provisions of this contract. The contracting parties agree to replace all illegal, invalid or unenforceable provisions with legal, valid and enforceable provisions most closely resembling the meaning and purpose of the original provisions.
7. This contract is drawn up in two counterparts, with each contracting party receiving one such counterpart.
8. The contracting parties hereby declare that they have read this contract and its appendices properly prior to its signing, that it was concluded according to their free will, certainly, earnestly and clearly, and not in duress under conspicuously disadvantageous conditions. In witness whereof they affix their signatures below.
9. The following appendices form an integral part of this contract:
   - Appendix No.1 - Technical specification of the performance
   - Appendix No. 2 – Rent payment schedule

On behalf of the lessor	On behalf of the lessee
In Meyrin dated 11-08-2012	In Prague dated 02-11-2012
Roberto Petrillo Worldwide Vice President of Sales	Ing. Jan Gruntorád, CSc. Association Director acting under the written authorisation

CESNET
zájmové sdružení právnických osob
160 00 Praha 6, Zikova 4
IČ: 63839172
DIČ: CZ63839172

Appendix No.1 - Technical specification of the performance

LeCroy

LabMaster 10 Zi Series (25 GHz – 65 GHz)
Highest Bandwidth
Modular Oscilloscopes

World's Highest Bandwidth Real-Time Oscilloscope

65 GHz, 160 GS/s

LabMaster 10 Zi modular oscilloscope break bandwidth, sample rate, and channel count barriers – providing more "bandwidth density".

LabMaster 10 Zi provides more bandwidth and more sample rate. The modular design provides the simplest upgrade path in bandwidth and channel count. In one acquisition module, it provides four channels at 36 GHz. Achieve up to 80 channels working precisely together. That's the highest "bandwidth density", and no one else has it.

Operator setup time is minimized with multiple modules and performance is guaranteed. ChannelSync™ ensures precise synchronization of all channels in all acquisition modules using a single-distributed 10 GHz clock and a single trigger circuit. Synchronization performance is identical to that provided with a single, standard oscilloscope package.

Upgradability is designed in. Start with one acquisition module, and add more later, upgrading bandwidth as needed. Spread your capital investments out over time, when you need them.

LabMaster 10 Zi is perfect for developed and emerging 10-12 Gb/s technologies, such as 40/100 GBASE-R Ethernet and SAS12, benefit from 80 GS/s on four (or more) channels at up to 36 GHz. Ultra-high speed technologies, such as CEI-25/28, CEI-56, and optical coherent modulation communication systems (DP-QPSK, 16-QAM, MIMO) benefit from the world's fastest real-time bandwidth (65 GHz) and four or more channels.

A LabMaster 10 Zi oscilloscope that provides two channels at 65 GHz and four channels at 36 GHz. Two 65 GHz or four 36 GHz inputs provide direct

cabled inputs for high-speed differential signals. Add up to twenty additional acquisition modules for 40 channels at 65 GHz or 80 channels at 36 GHz.

1. World's Highest Performing Real-Time Oscilloscope — 65 GHz bandwidth, (5.2 ps risetime20 – 80%), 160 GS/s sample rate, up to 80 channels, up to 1024 Mpts of analysis memory
2. Modular — start with four channels and grow your system over time. Spread out your investment as funds permit
3. Wide bandwidth upgrade range (25 - 65 GHz) provides investment protection
4. ChannelSync architecture utilizes a 10 GHz distributed clock for precise alignment of all acquisition systems
5. Single trigger circuit for all modules eliminates additive trigger jitter that occurs with 10 MHz clocking and trigger synchronization of multiple conventional oscilloscopes
6. Simple — connect and acquire — LeCroy has done the hard work for you
7. 325 MB/s data transfer rate from the LabMaster to a separate PC with LeCroy Serial Interface Bus (LSIB) option
8. Server-class multi-core processor combines with X-Stream II streaming architecture for fast acquisition and analysis — 33.6 GHz effective CPU clock rate and 24 GB of RAM standard (expandable to 192 GB)
9. Utilize the built-in 15.3" widescreen (16 x 9) high resolution WXGA color touch screen display — or connect your own with up to WQXGA 2560 x 1600 pixel resolution
10. Lowest Jitter Noise Floor (100 fs_{rms}) and highly stable timebase over long acquisitions
11. Deepest standard toolbox with more measurements, more math, more power
12. SDAIII "CompleteLinQ" options provide four simultaneous eye diagrams and jitter calculations for multi-lane or single-lane, multiple location analysis, noise measurements and crosstalk analysis
13. Eye Doctor™ II and Virtual Probe Signal Integrity Toolsets provide real-time de-embedding, emulation, and equalization on serial data channels
14. 14.1 Gb/s Serial Trigger Option - 80-bit NRZ and 8b/10b Symbol triggering

LabMaster extends its technology leadership with new 36 GHz / 80 GS/s chipset, and delivers 65 GHz / 160 GS/s with xth-generation Digital Bandwidth Interleave (DBI)

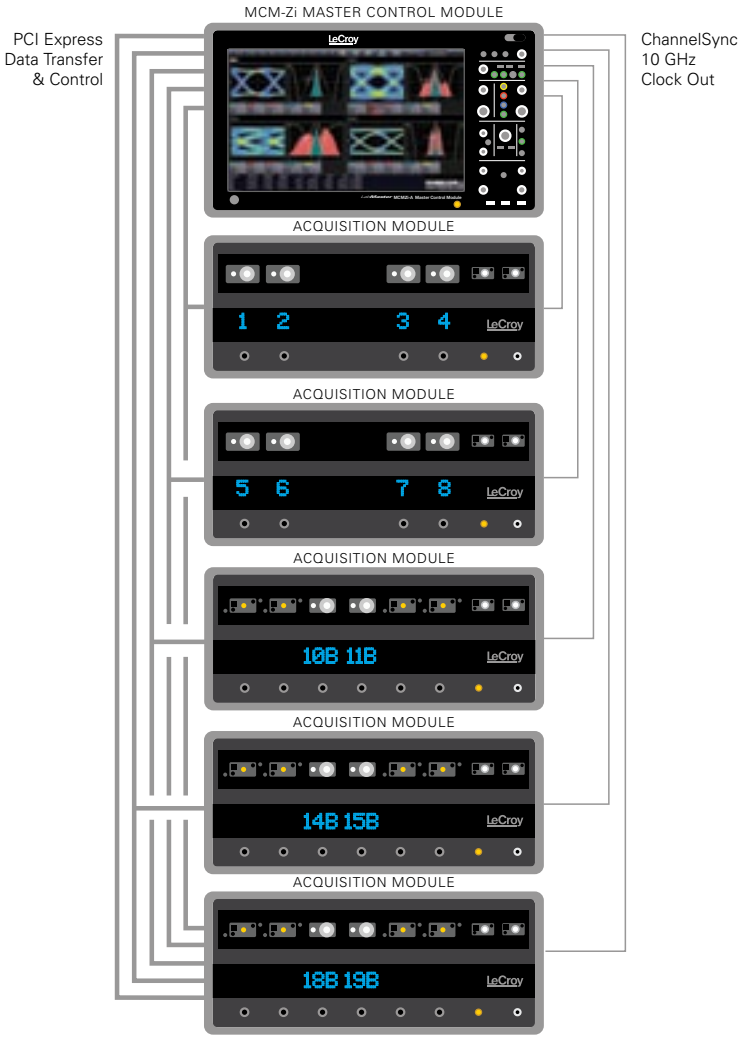
LabMaster 10 Zi leverages the unique LabMaster ChannelSync architecture with next-generation 8HP SiGe chipsets to produce the world's highest bandwidth, four channel oscilloscope – 36 GHz. When combined with LeCroy's patented DBI technology, bandwidth nearly doubles to 65 GHz, with sample rates of 160 GS/s. Truly extraordinary.

The LabMaster class of oscilloscopes are fundamentally better – they are modular, inherently upgradeable, and infinitely flexible while retaining all of the simplicity of operation that you expect from a conventional oscilloscope. LabMaster 10 Zi oscilloscopes can be configured for massive numbers of channels at up to 65 GHz – truly eliminating your technology and test barriers.

LeCroy's ChannelSync architecture ensures precise synchronization of all acquisition modules. ChannelSync ensures precise synchronization of all channels in all acquisition modules by using a single-distributed 10 GHz clock and a single trigger circuit. External clocking is not required, and trigger jitter from multiple trigger circuits is non-existent. Jitter between all channels is an ultra-low <275 fsrms,. Synchronization performance is identical to that provided with a single, standard oscilloscope package, and all captured waveforms and analysis appears on one oscilloscope display.

System

The entire system simply and quickly connects together to create a functional, single oscilloscope package, but without the normal input channel or bandwidth limitations—operation is the same as a conventional oscilloscope. All waveforms are viewable on the built-in 15.3" display or on a variety of optional or user-supplied displays (up to 2560 x 1600 resolution). The entire system design speaks to a level of sophistication and integration not seen before in laboratory equipment.



Master Control Module

The MCM-Zi Master Control Module provides a built-in display, control panel, CPU, and the ChannelSync 10 GHz distributed clock that is the heartbeat of the system and which provides precise synchronization between all oscilloscope channels. High speed multi-lane PCIe connections are made to the Acquisition Modules for control and data transfer. LeCroy has spared no expense by providing a server-class CPU using Intel Xeon™ X5660 processors (33.6 GHz total effective clock speed). 24 GB of RAM is standard (up to 192 GB optionally available). Coupled with LeCroy's proprietary X-Stream II streaming architecture, the CPU muscles its way through the immense amounts of acquisition data made possible by LabMaster 10 Zi.

Additional Acquisition Modules

The LabMaster 10-xx Acquisition Modules are tightly integrated to the Master with the ChannelSync 10 GHz distributed clock and a multi-lane PCI Express connection—From 1 to 20 Acquisition Modules can be configured with a single Master. All acquired data is sent to the server-class CPU for processing. Lighted channel indicators intelligently and dynamically indicate the input channel assignments, depending on the operator setup.

ChannelSync Mainframe Hub

Easily expand beyond 20 channels (5 acquisition modules) with the LabMaster CMH-20Zi ChannelSync Mainframe Hub. This permits capability for up to 80 channels at 20 GHz with the same precise ChannelSync performance as described for the basic system. The ChannelSync Mainframe Hub has inputs for four sets of the ChannelSync 10 GHz clock and PCIe synchronization inputs. It outputs up to 20 identical sets of signals that are connected to up to 20 acquisition modules to provide up to 80 channels at 36 GHz, and up to 40 channels at 65 GHz. Precision between all acquisition modules is maintained identically to the basic system. The ChannelSync Mainframe Hub is populated with one "card" for each acquisition module that is to be connected. These cards can be purchased at any time to minimize the upfront cost.

PERFORMANCE EXCELLENCE & INVESTMENT PROTECTION

The LabMaster 10 Zi platform provides a modular, building block approach to minimizing initial investment while at the same time providing future flexibility. The minimum configuration is four channels at 25 GHz with maximum upgrade to 40 or 80 channels at 36 or 65 GHz respectively with up to 1024 Mpts/ch of analysis memory.

36 GHz, 4 Channel Core Acquisition Module

An 8HP SiGe acquisition system Is operated comfortably within it's 36 GHz bandwidth rating and forms the basic acquisition building block of the LabMaster acquisition modules. Signal fidelity is exceptional, and modules are available at attractive price points down to 25 GHz bandwidth.

Maximum Flexibility

Start with one Master Control Module and one Acquisition Module. Upgrade Acquisition Modules to include more memory or more bandwidth. Add additional acquisition modules at any time without returning equipment to the factory for modification or re-calibration. Spread out your capital investment over a longer period of time, and make only the investments you need when you need them.

Digital Bandwidth Interleave for Upgradeability

As memory and sample rate can be interleaved, so can bandwidth. Using high performance technologies and digital signal processing (DSP), LeCroy provides additional bandwidth on one or two channels with 7th generation Digital Bandwidth Interleaving (DBI). This approach can add 2 channels at 65 GHz to the 36 GHz acquisition building block. Signal fidelity nearly equals that of sampling oscilloscopes, but with none of the acquisition limitations.

4 Channels at 25 GHz

Minimum initial purchase is a LabMaster MCM-Zi Master Control Module and a 10-25Zi Acquisition Module. This provides four channels at 25 GHz and 80 GS/s.

Upgrade to 8 Channels at 36 GHz

Then upgrade the Acquisition Module to a 36 GHz LabMaster 10-36Zi, and add another LabMaster 10-36Zi Acquisition Module.

Upgrade to 8 Channels at 36 GHz 2 Channels at 65 GHz Add More Memory

Then upgrade the Acquisition Module to a 65 GHz model. Increase acquisition memory to 1024 Mpt/Ch. Add an additional 24 GB of RAM to the CPU.

Upgrade to
20 Channels at 36 GHz
10 channels at 65 GHz

Upgrade all Acquisition Modules to 65 GHz maximum bandwidth with 1024 Mpts/Ch acquisition memory. Add three additional 65 GHz Acquisition Modules with maximum memory. Go beyond the limits with a ChannelSync Mainframe Hub for up to 80 total channels!

COMPLETE APPLICATION COVERAGE

25 to 28+ Gb/s SERDES Development

Development and characterization of high-speed 25+ Gb/s SERDES is ongoing. Standards will utilize these high speeds in multiple lanes. Accurate, fast characterization is needed.

Conventional real-time oscilloscopes are limited to ~30 GHz on two channels, limiting them to a single-lane of analysis at a time. More bandwidth and channels are desired; however, sampling oscilloscopes lack the acquisition and analysis capability to understand the root cause of deterministic jitter issues and crosstalk problems.

LabMaster 10 Zi can be configured in a system that provides 2 channels at 65 GHz – ideal for differential high-speed signals. Furthermore, this configuration also provides 4 channels at 36 GHz for testing and debugging of multiple lanes at lower bandwidth. Even more acquisition modules can be easily added to fully leverage LeCroy's SDAIII-CompleteLinQ multi-lane serial data and crosstalk analysis tools.

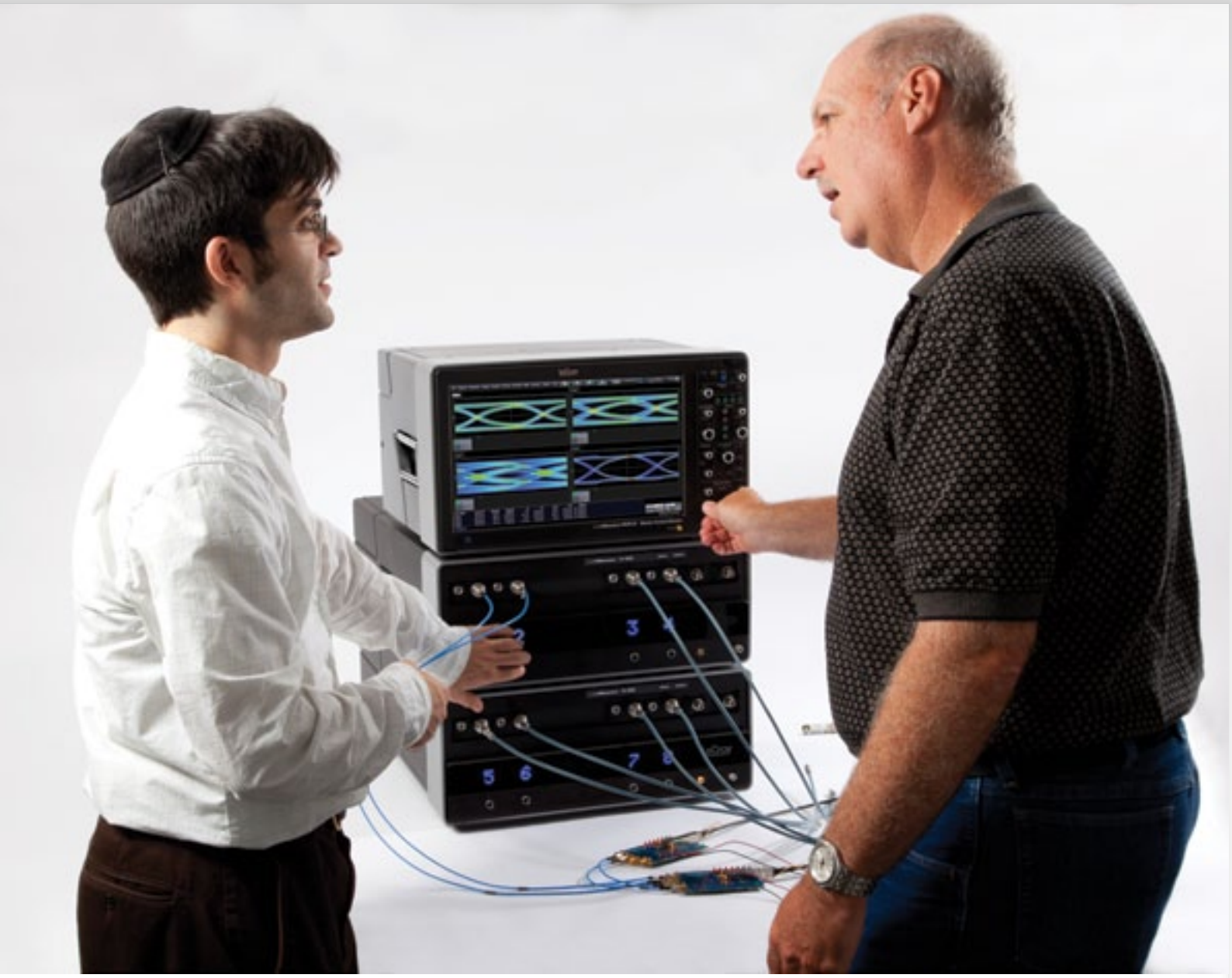
Optical Coherent Modulation Analysis

Cloud computing demands are driving high-speed DP-QPSK and 16-QAM developments, and research is progressing on even faster speeds. For 28 GBaud testing, a LabMaster 10 Zi four channel 36 GHz solution is ideally cost-effective, and also provides an upgrade path to more channels and more bandwidth. LabMaster 10 Zi can be initially configured for 4 channels at up to 65 GHz for those who need more bandwidth, making possible research approaching Terabit/s data rates.

Parallel optical systems, such as frequency-parallel coherent optical super-channels or spatially-parallel coherent optical multiple-input multiple-output (MIMO) systems, have been gaining attention due to their ability to scale fiber capacities and to obtain higher transmission rates with lower speed components. LabMaster 10 Zi systems based on multiple 36 GHz acquisition modules are an effective means to achieve 12 (or more) input channels for high-speed MIMO transmission testing and validation.

Defense and Aerospace Applications

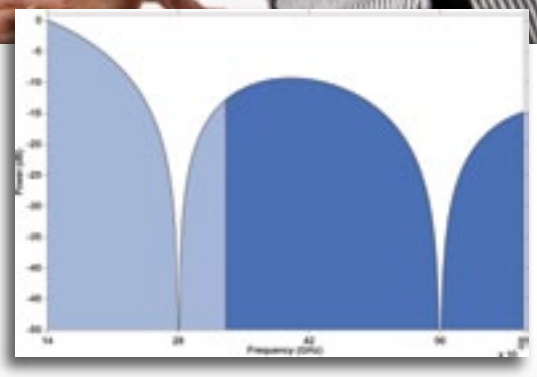
Both high channel counts and high bandwidth are often required in defense and aerospace applications. LabMaster 10 Zi systems can be configured in a variety of channel counts and bandwidth to meet these needs. LeCroy's Serial Interface Bus (LSIB) allows data transfer rates from the oscilloscope to a separate stand-alone PC at speeds up to 325 MB/s and record lengths up to 1024 Mpts/ch. ChannelSync in LabMaster 10 Zi eliminates time spent integrating multiple conventional oscilloscopes into single multi-oscilloscope systems, and provides precise synchronization between all acquisition modules. Customization capabilities permit automated control or user-created math functions and measurement parameters to run in the oscilloscope, enabling the simple deployment of proprietary algorithms from within the oscilloscope user interface.



Multi-Lane Serial Data

As serial data rates have increased, serial data has also become "parallel" with multiple lanes utilized to achieve higher effective data transfer rates. 100 GbE with up to 4 lanes at 25 or 28 Gb/s each, or multi-lane InfiniBand at 25.78 Gb/s, all using differential signaling, are obvious examples of ultra-high speed systems that present tremendous validation and debug challenges. LabMaster 10 Zi can be configured in up to 80 channels at 36 GHz, or up to 40 channels at 65 GHz. This can be especially helpful for crosstalk analysis or lane skew measurements. For instance, by sending active data over all lanes and utilizing SDAIII-CompleteLinQ Serial Data and Crosstalk Analysis to view up to four simultaneous eye diagrams and jitter measurements, complex lane interactions and "victim/aggressor" behavior can be observed. Lane skew measurements are simple when all of the lanes can be viewed simultaneously. Additionally, two separate oscilloscope channels (with math subtraction) for one differential signal provides better signal fidelity and jitter measurement accuracy compared to using additional differential probes or amplifiers with similar or lower cost, and circuit connection is greatly simplified.

ENABLING HIGH-SPEED SERDES DEVELOPMENTS



How Much Bandwidth is Needed?

Limited oscilloscope bandwidth slows signal rise times and attenuates important high frequency content necessary to properly characterize high-speed SERDES. The use of 65 GHz of oscilloscope bandwidth allows capture of signal content equal to more than four times the fundamental frequency, increasing the capability to accurately measure jitter and otherwise accurately characterize the 28 Gb/s component. The use of a sampling oscilloscope is no solution—sampling oscilloscopes can only be used with repetitive signals, and provide no ability to post-process the data to decompose deterministic jitter and understand root cause.

SERDES data rates are rapidly increasing. 25 – 32 Gb/s speeds are becoming common, and 56 Gb/s speeds are being discussed in committee. Simultaneously, deployments with at least four lanes at these speeds are anticipated to enable equal or higher aggregate data transfer speeds to keep up with increasing network traffic.

LabMaster 10 Zi is uniquely suited to the demands of the high-speed SERDES market. It's ability to provide up to 65 GHz of real-time bandwidth with two or more input channels is beneficial for accurate characterization of 28 – 32 Gb/s signals that have significant power spectral density at >33 GHz. Oscilloscope risetime$_{20-80\%}$ is an impressive 5.2 ps, necessary speed when the unit interval (UI) is a mere 36 ps wide (or less). The 1024 Mpts/Ch acquisition memory provides the ability to capture very long patterns, permitting deterministic jitter (Dj) decomposition on long patterns — something not possible in a sampling oscilloscope. Two input channels provides the ability to input a differential signal pair into the oscilloscope, eliminating the bandwidth, noise, and accuracy constraints inherent in a separate, external differential amplifier.

Multiple Configurations Provide Flexibility

In addition to 2 channels at 65 GHz, a LabMaster 10 Zi system will also provide 4 channels at 36 GHz for testing and debugging of multiple lanes at lower bandwidth. This can be especially useful for crosstalk analysis or lane skew testing when multiple lanes are deployed. Thus, a 65 GHz LabMaster can deployed in a variety of ways and serve many important application needs in the same lab. Multiple MCM-Zi Master Control Modules and Acquisition Modules can even be mixed and matched as needs change, providing more value for your investment in larger labs.

Superior Serial Data/Crosstalk Analysis and Debug Tools

LeCroy's SDAIII-CompleteLinQ Serial Data and Crosstalk Analysis products provide unique capability to simultaneously calculate and display four eye diagrams and jitter measurements from four separate lanes or one lane probed or modeled in four different locations. Measure vertical noise and perform crosstalk analysis, and use 8 and 12-port S-parameters and builtin EyeDrII and VirtualProbe tools to de-embed Crosstalk. Use the optional 14.1 Gb/s true-hardware serial trigger for capturing rare events. A variety of serial decode annotations are available for common encoding schemes, as well as serial protocols. LeCroy's combination of serial decoders and ProtoSync™ protocol analysis views permits link layer debugging on initial SERDES transmissions before protocol analyzer hardware is typically available.

MULTI-LANE SERIAL DATA TESTING

LabMaster 9 Zi-A systems provide unique capability to capture and analyze massive numbers of channels at very high bandwidth—up to 80 channels at 20 GHz or 40 channels at 30 or 36 GHz—with precise synchronization amongst all channels using LeCroy's ChannelSync. This is an ideal solution for serial data standards with many lanes of data at high bit rates, such as 40/100 GbE and PCI Express. Additionally, serial decode, protocol analysis, eye diagram, jitter measurement, and crosstalk analysis tools can be applied for single or multi-lane analysis and system validation.

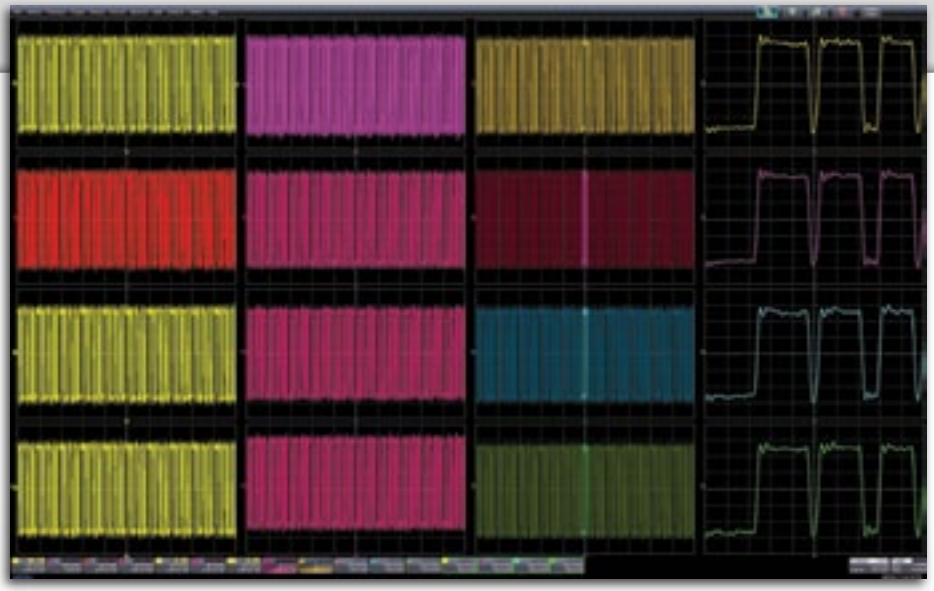
Up to 80 Channels at up to 36 GHz

LabMaster 10 Zi may be configured with 4 to 80 channels and from 25 to 36 GHz of bandwidth. Jitter between all 36 GHz channels is exceptionally low. Signal fidelity is pristine with exceptional rise time, step response, and total and random jitter noise floor. 80 GS/s sample rate is provided on all input channels. For higher speed serial data signals, 2 to 40 channels at up to 65 GHz may be desired.

New Possibilities

Previously, oscilloscopes were limited to 4 channels, and could only be extended beyond that with significant limitations and user effort. LabMaster 10 Zi simplifies everything — it is easy and automatic to configure many channels. Just connect the acquisition modules together, perform a quick and simple deskew procedure, and view all the acquisition data on a single display. In addition, the modular Acquisition Modules minimize incremental channel cost, making it more cost-effective to purchase more oscilloscope channels instead of expensive probes. Furthermore, by cabling signals into the scope instead of using a differential probe or amplifier, noise is decreased by 3 dB or more, with higher user confidence in the overall signal fidelity of the complete measurement system.

ChannelSync Provides Precise Synchronization Between All Acquisition Modules



ChannelSync in LabMaster 10 Zi emulates the architecture of a single oscilloscope package, even though as many as 80 different channels are available for use. A single 10 GHz distributed clock signal is generated and used in the "Master" and also distributed to all Acquisition Modules. The 10 GHz clock frequency—1000 times faster than the 10 MHz reference clocks commonly used to synchronize lab equipment—ensures precise synchronization and high timebase accuracy between all acquisition modules. Additionally, a single trigger circuit for all modules eliminates additive trigger jitter that occurs with 10 MHz clocking and trigger synchronization of multiple conventional oscilloscopes.

Acquisition Modules are automatically identified to the Master Control Module, and a simple and quick ChannelSync calibration corrects for any static acquisition skew between all acquisition modules. The result is up to eighty oscilloscope channels all operating as a single oscilloscope package.

Flexibility, Upgradeability, Investment Protection

LabMaster 10 Zi makes it easy to spread out your capital costs over time and purchase only what you need when you need it. Start with the minimal channel count and bandwidth configuration and add more Acquisition Modules, or upgrade existing Acquisition Modules to a higher bandwidth, as needs change. Acquisition Modules can be mixed together in any combination of bandwidth, so it is possible to configure a system with two channels at 65 GHz for single lane serial data analysis, and eight (or more) channels for multi-lane serial data analysis and crosstalk debug of four (or more) differential signals using cabled inputs.

Unique Multi-Lane SDAIII-CompleteLinQ Test Capability

Only a LabMaster 10 Zi systems provides the capability to simultaneously view four or more differential lanes of serial data traffic with direct cabled inputs, thus increasing the accuracy and signal fidelity compared to using differential probes or external amplifiers, with similar or lower cost. Capture all differential lanes at one time, and use SDAIII-CompleteLinQ Serial Data Analysis software to measure jitter and eye diagrams on up to four lanes, and perform "victim" and "aggressor" crosstalk analysis through direct vertical noise measurements and crosstalk analysis tools.

Simple Multi-Lane System Validation

Multi-lane serial data systems have specifications for allowable lane-to-lane skew. By viewing all lanes simultaneously, and applying serial decoders as necessary, validation of skew tolerance is a fast process.

14.1 Gb/s Serial Trigger Option

Up to 14.1 Gb/s true hardware NRZ serial data pattern, symbol, and primitive trigger. The specially-programmed hardware FPGA triggers the oscilloscope in real-time, vastly simplifying debug of high speed bus systems.

APPROACHING TERABIT/S DATA RATES FOR OPTICAL COHERENT MODULATION ANALYSIS

LabMaster 10 Zi combines the world's fastest real-time bandwidth and four input channels with pristine signal fidelity to meet the advanced research and development requirements for optical coherent modulation analysis on long-haul telecommunication systems.

Four Channels at 65 GHz for DP-QPSK and 16-QAM

A LabMaster 10 Zi four channel 65 GHz system is the ultimate in bandwidth and sample rate for the highest speed characterization of DP-QPSK or 16-QAM optical coherent modulation systems. These systems provide 160 GS/s (2.5x oversampling) on all four channels for accurate capture of in-phase and quadrature-phase modulated signals in two polarizations. ChannelSync ensures high phase stability between all tributaries - at least 2.5 times better than competitive solutions. This ensures the best possible accuracy in constellation diagram analysis. 65 GHz rise time20 – 80% is an astonishing 5.2ps — clearly beneficial when testing 56 to 100 GBaud DP-QPSK or 16-QAM symbol rates utilizing baseband signals with very short unit intervals.

Massive Channel Counts for Parallel Optical MIMO Systems

Parallel optical systems, such as frequency-parallel coherent optical super-channels or spatially-parallel coherent optical multiple-input multiple-output (MIMO) systems, have been gaining attention due to their ability to scale fiber capacities and to obtain higher transmission rates with lower speed components. LabMaster 10 Zi systems based on multiple 36 GHz acquisition modules are an effective means to achieve 12 (or more) input channels for MIMO transmission testing and validation.

Flexible, Upgradeable and Expandable

LabMaster 10 Zi may also be configured as a four channel 36 GHz system and two channel 65 GHz system. While providing lower bandwidth on all four channels, it does provide two channels at 65 GHz for single-polarization characterization. This configuration can later be upgraded to four channels at 65 GHz with the addition of one additional Acquisition Modules, which can be added at any time without returning the other components to LeCroy for calibration or integration. It also provides for the ability to grow the system over time as needs change, and share the system over a wide range of applications.

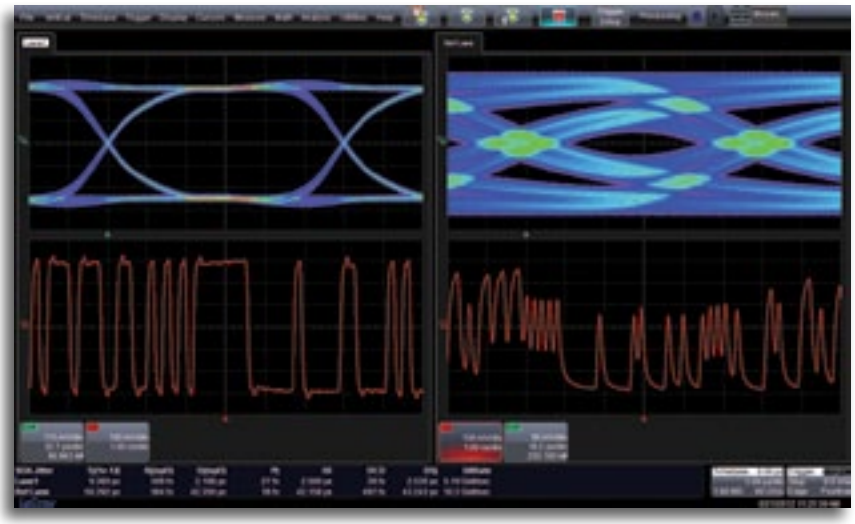
Complete Customization and Fast Data Transfer

All configurations of LabMaster 10 Zi support the needs of researchers with complete customization capability through the use of the XDEV software option. This option provides the ability to integrate a MATLAB, C/C++, Jscript (JAVA) or Visual Basic script into the oscilloscope's processing stream. This capability is ideal for emulating the receiver equalization since it allows proprietary user-generated algorithms to be created and run directly within the oscilloscope operating environment. The result may then be displayed on the oscilloscope in real-time, and computed results may be exported like any channel. The MCM-Zi Master Control Module can also be equipped with LeCroy's Serial Interface Bus (LSIB) to allow acquired data to be transferred to another computer at speeds up to 325 MB/s. The combination of acquisition, customization, processing, and data export capabilities in LabMaster 10 Zi allow it to be used as the single lab data acquisition and processing tool, or leveraged solely as a data acquisition device with fast offload of acquired data to another CPU for further analysis.

28 GBaud Optical Coherent Modulation Analysis Using LabMaster 9 Zi-A

LeCroy's LabMaster 9 Zi-A four channel 20 GHz oscilloscope is an economical alternative to a LabMaster 10 Zi system for characterizing 28 GBaud dual-polarization QPSK, 16-QAM, or lower-speed MIMO coherent modulated signals. This oscilloscope is also modular, and can be upgraded in bandwidth to two channels at 36 GHz for more accurate characterization of a single polarization. Consult LeCroy for more details.

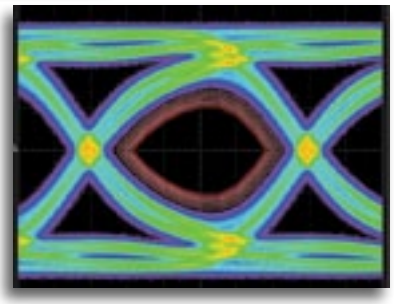
SDAIII-CompleteLinQ SERIAL DATA ANALYSIS PRODUCTS



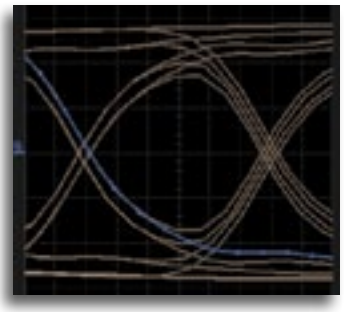
The LeCroy SDAIII-CompleteLinQ Serial Data Analysis products contain multi-lane eye and jitter analysis, LaneScape™ comparison modes, vertical noise measurements, and crosstalk analysis tools. These capabilities provide the deepest insight into the behavior of multi- or single-lane serial data systems.

SDAIII Core Toolset

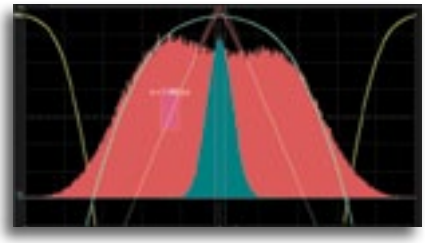
LeCroy provides the most complete toolset in the industry for jitter measurements and eye diagram/jitter analysis. Rj and Dj are separated and Dj is decomposed using one of three dual-Dirac algorithms. Eye diagrams containing all acquired unit intervals are rendered 10-100x faster than competitive systems. Eye diagram analysis tools, such as the extrapolated IsoBER plot, aid insight. Multiple additional tools, such as Tracks, Histograms, and Spectrum waveforms, enhance the understanding of jitter causes. Sophisticated pattern analysis tools, such as Intersymbol Interference (ISI) measurements and plots, provide deep insight into Data Dependent Jitter (DDj) behavior.



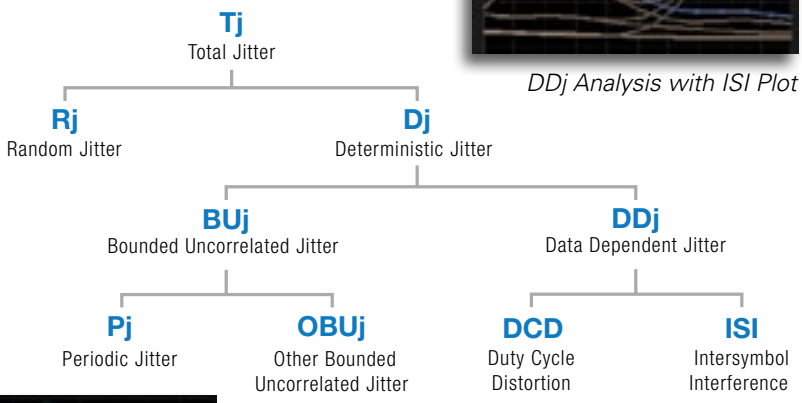
Eye with IsoBER

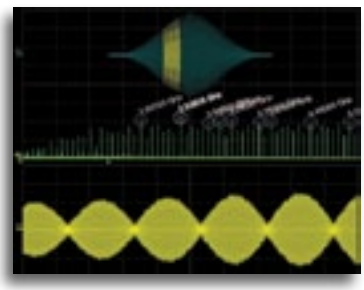


DDj Analysis with ISI Plot



Rj+BUj Analysis



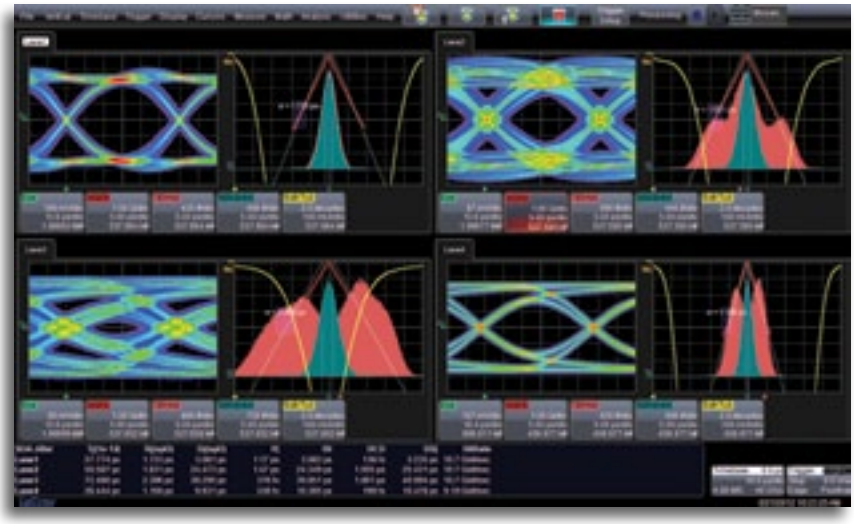


Pj Analysis

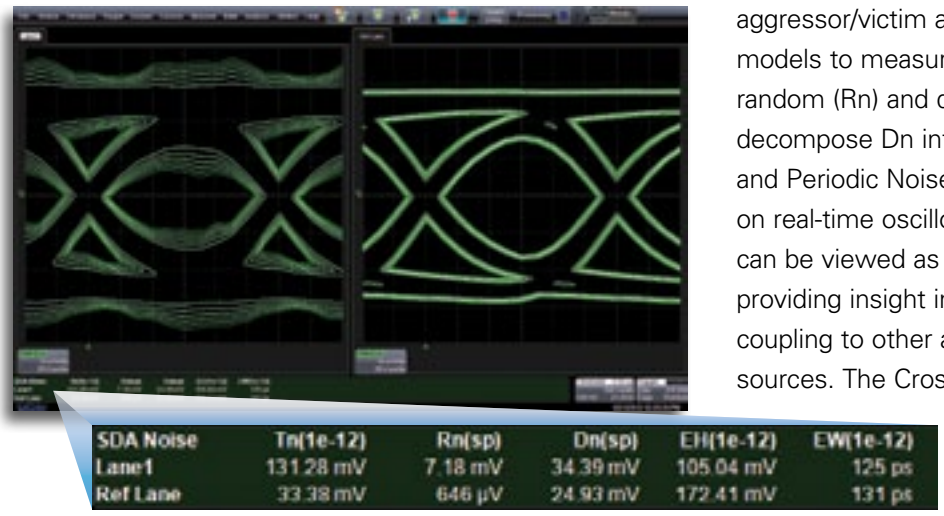
Three Jitter Methodologies

Choose from three dual-Dirac models to separate jitter into total, random and deterministic components (Tj, Rj, Dj). The Spectral Rj Direct method determines Rj directly from the jitter spectrum, and is the most used algorithm. Spectral Rj+Dj CDF Fit follows the FibreChannel MJSQ model. In situations where large amounts of crosstalk/BUj raise the spectral noise floor, the NQ-Scale method will provide more accurate separation of Rj and Dj, and therefore more accurate Tj results.

Measure up to 4 Lanes Simultaneously



"LinQ" products provide extensive multi-lane analysis capabilities. Quickly understand lane-to-lane differences in jitter measurements, eye diagrams, and jitter analysis. Perform aggressor on/off analysis, and see the results from both scenarios simultaneously. Save the analysis of a particular scenario to the Reference Lane, and configure a LaneScape™ Comparison mode to compare the Reference to either one, two or all lanes. Each "lane" can be a different serial data lane, or a different analysis of data from a single serial data lane - ideal for comparing different equalization schemes (using Eye Doctor II option) or examining system behaviors at different locations in the lane (using probes or the VirtualProbe option).



SDA Noise	Tn(1e-12)	Rn(sp)	Dn(sp)	EH(1e-12)	EW(1e-12)
Lane1	131.28 mV	7.18 mV	34.39 mV	105.04 mV	125 ps
Ref Lane	33.38 mV	646 µV	24.93 mV	172.41 mV	131 ps

Vertical Noise and Crosstalk

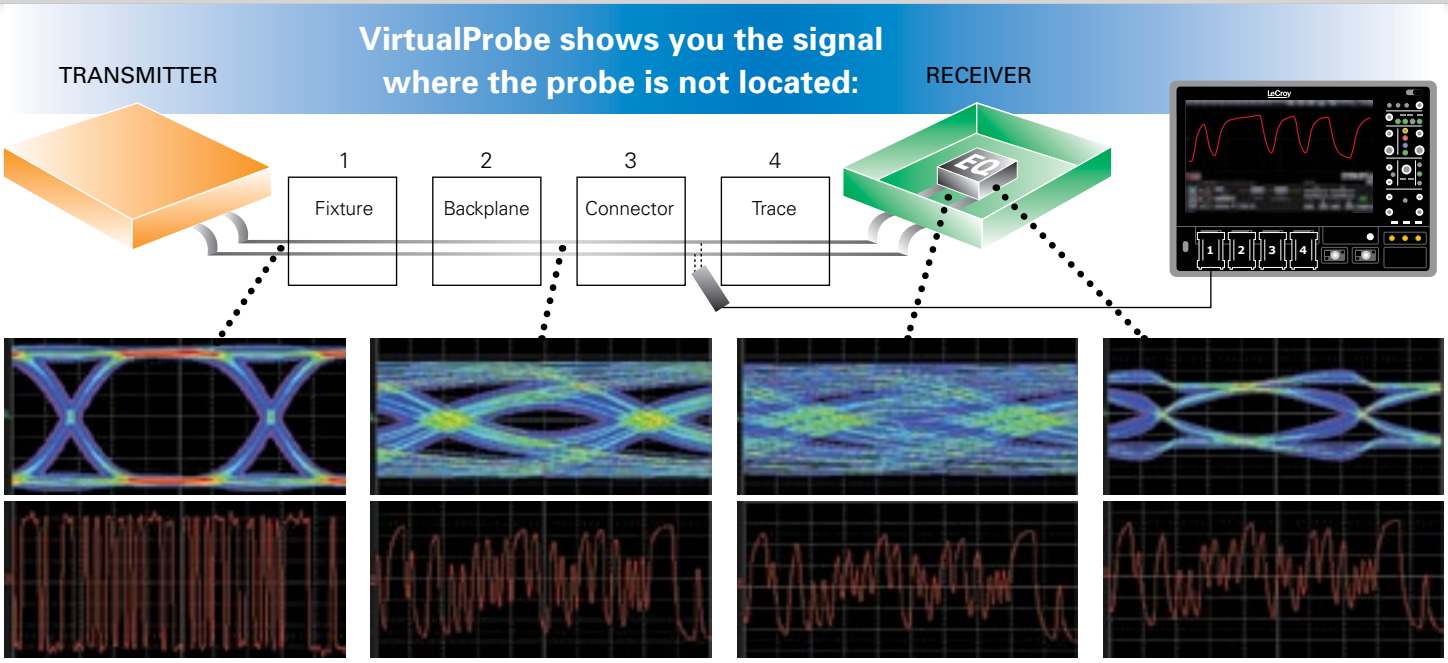
The Crosstalk and CrossLinQ packages provide vertical noise measurements and crosstalk analysis tools for complete aggressor/victim analysis. Use one of three dual-Dirac models to measure and separate noise into total (Tn), random (Rn) and deterministic (Dn) components, and further decompose Dn into Intersymbol Interference Noise (ISIn) and Periodic Noise (Pn). Only LeCroy performs this analysis on real-time oscilloscopes. Similar to jitter analysis, noise can be viewed as a noise track, histogram and spectrum, providing insight into the vertical noise resulting from coupling to other active serial data lanes or other interference sources. The Crosstalk Eye shows the probabilistic extent of noise both inside and outside the eye, quickly showing the impact of excessive noise that is not possible to see in a traditional eye diagram.

CompleteLinQ Does it All

The CompleteLinQ user interface framework provides easy access to all features described above, and also integrates EyeDoctorII and VirtualProbe capabilities for Tx/Rx equalization and fixture/channel de-embedding/emulation. Order SDAIII-CompleteLinQ to equip your oscilloscope with all of LeCroy's Serial Data Analysis and Signal Integrity tools.

Learn More:
www.lecroy.com/SDAIII

EYEDOCTOR™II AND VIRTUALPROBE SIGNAL INTEGRITY TOOLS



Virtually probe the signal at the transmitter with the fixture present, and then de-embed its effects form the measurement.

View the signal between structures to understand losses, ISI and crosstalk caused by backplanes, interconnects and connectors.

See what the eye looks like at the receiver - even if it is not in reach of a differential probe.

Use EyeDoctor to open the eye by modeling CTLE, FFE and DFE equalizers used by your receiver.

As signal speeds and data rates continue to rise, signal integrity effects such intersymbol interference (ISI) and crosstalk become more prevalent and challenging.
Use LeCroy's Advanced Signal Integrity tools to transform your measured signal to include the effects of de-embedding, emulation and equalization algorithms.

De-embed, Equalize and Emulate with EyeDoctorII

Curious to know what your signal would look like without fixture effects? Do you need to understand how ISI and crosstalk of a modeled channel will affect your jitter margin? Or are you seeking to determine which equalization schemes will do the best job of opening a closed eye? The EyeDoctorII package includes easy configuration of basic de-embed/emulation scenarios, CTLE, DFE and FFE equalizers, and transmitter emphasis/de-emphasis.

Advanced De-embedding, Emulation and Virtual Probing

The VirtualProbe package expands the de-embedding and emulation capabilities of EyeDoctorII. Configure a multi-block circuit using modeled S-parameters or measured with a LeCroy SPARQ (or other VNA), and VirtualProbe will build the transfer function that returns the signal as it would appear before or after any block in the circuit. The electrical behavior of a block to reflect and transmit signals can be included, added or removed in order to de-embed or emulate fixtures or channels. Probe loading effects can also be removed. When used in conjunction with the Crosstalk, CrossLinQ or CompleteLinQ SDAIII options, crosstalk between lanes can be modeled using 8 and 12-port S-parameters. Use the LeCroy SPARQ to measure these S-parameters at a fraction of the price of a VNA.

Use EyeDoctorII and VirtualProbe with SDAIII CompleteLinQ products

When using EyeDoctorII and VirtualProbe on oscilloscopes enabled within the SDAIII-CompleteLinQ products, configure de-embedding, emulation and equalization from the same simple flow-chart dialog as all other serial data analysis features. When enabled with the "LinQ" option to enable 4 lanes, users can configure EyeDoctorII and VirtualProbe configurations on each lane, facilitating rapid comparisons of different de-embedding and equalization setups.

Learn More

http://www.lecroy.com/dl/1023
http://www.lecroy.com/vid/M0T6WEC0JYQ
http://www.lecroy.com/dl/1216
http://www.lecroy.com/dl/1136

SPARQ SIGNAL INTEGRITY NETWORK ANALYZER

The SPARQ signal integrity network analyzers connect directly to the device under test (DUT) and to PC-based software through a single USB connection for quick, multi-port S-parameter measurements.

SPARQ is the ideal instrument for characterizing multi-port devices common in signal integrity applications at a fraction of the cost of traditional methods. It is ideal for:

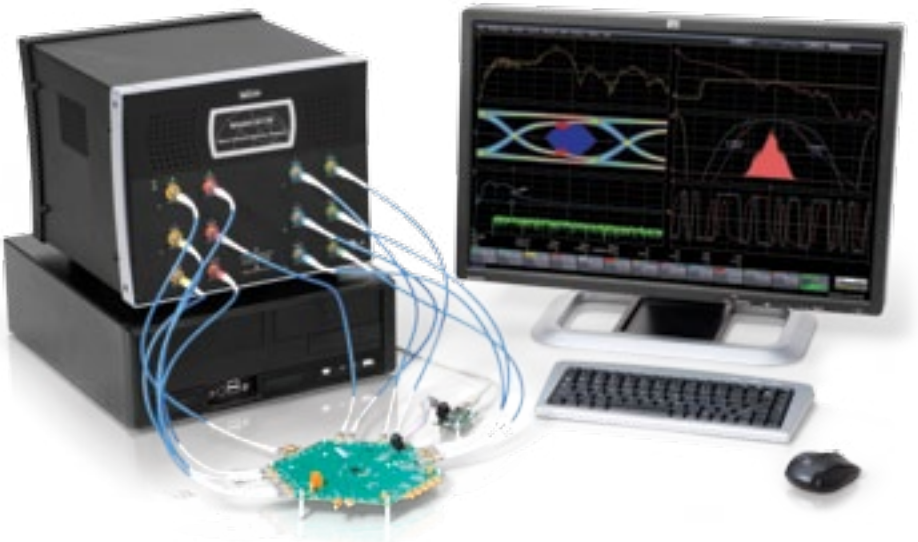
- **Development of measurement-based simulation models**
- **Design validation**
- **Compliance testing**
- **High-performance TDR**
- **PCB testing**
- **Portable measurement requirements**

High-bandwidth, Multi-port S-parameters for the Masses

S-parameter measurements are most often produced by the vector network analyzer (VNA), a difficult instrument that is beyond many budgets. SPARQ is very affordable and simplifies measurements, making S-parameters accessible to all.

PC-based, Small and Portable

Traditional instruments that produce S-parameters are large and fundamentally stationary. The SPARQ, in contrast, is small and weighs less than 20 lbs. It connects to any standard PC through a USB 2.0 interface, allowing SPARQ to run where computing power is easily upgraded.



S-parameters, Quick

VNA measurements begin with the unpleasant and complex task of calibration. This involves multiple connections that can produce misleading results due to operator error. The SPARQ provides calibrated measurements with a single connection to the DUT and offers simple setup choices. Start and complete the entire measurement with a single button press.

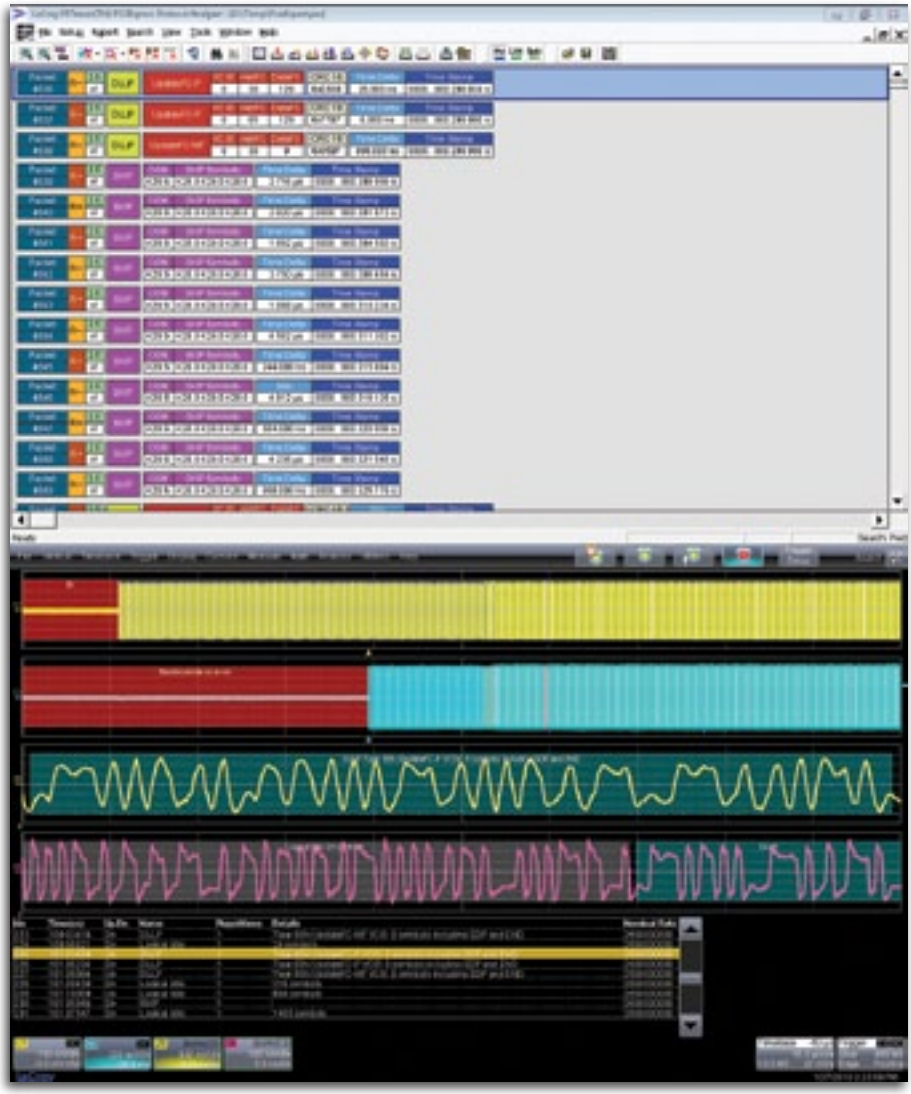
Internal Calibration

SPARQ takes a revolutionary approach to calibration by building in calibration standards. This enables measurements to be made without multiple connection steps and removes the need for additional electronic calibration (ECAL) modules. Calibration proceeds quickly without user intervention, so one can calibrate often without resorting to the use of out-of-date saved calibrations.

Characterize Crosstalk with 8 and 12-port SPARQs

Don't just model crosstalk - measure it. With the 8 and 12 port SPARQs, characterize interconnects with two and three differential lanes in order to obtain S-parameters needed for simulations of aggressor/victim/aggressor topologies.

MOST COMPLETE DEBUG SOLUTION FROM 13–45 GHz



Serial Decode—A Whole New Meaning to Insight

Over 19 different protocols are supported with serial decoders (many with hardware protocol triggers as well). Use ProtoSync with PCIe, USB, SATA, SAS, and Fibre Channel to get a dual-display view of both oscilloscope-generated decode annotations and protocol analyzer software views. Search on protocol data in a table and export table data to an Excel file.

Learn More
http://www.lecroy.com/dl/3005

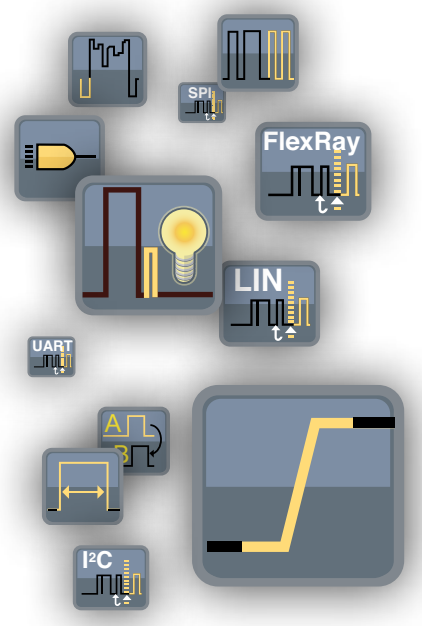
Get more insight with multiple views of your serial data transmissions.

More Trigger Capability Isolates More Problems Quickly

15 GHz Edge trigger, 14.1 Gb/s true-hardware serial trigger (option, available wth 9xxMZi-A Master Acquisition Module only), 10 different SMART triggers, four-stage Cascade™ triggering, Measurement trigger, and TriggerScan™ are all standard and allow you to isolate the problem quickly and begin to focus on the cause. A full range of protocol serial triggers (I^2C, SPI, UART, RS-232, Audio (I^2S, LJ, RJ, TDM), CAN, LIN, FlexRay, MIL-STD-1553 and many others) are also available.

Search and Scan to Understand

Search a captured waveform for hundreds of different measurement parameters or other conditions using WaveScan. Set complex conditions, view search results on the waveform and in a table, and quickly zoom and jump to an entry. "Scan" for events that can't be triggered in hardware.



15 GHz Edge Trigger

DEEP INSIGHT CLARIFIES COMPLEX SIGNALS

All Oscilloscope Tools are not Created Equal

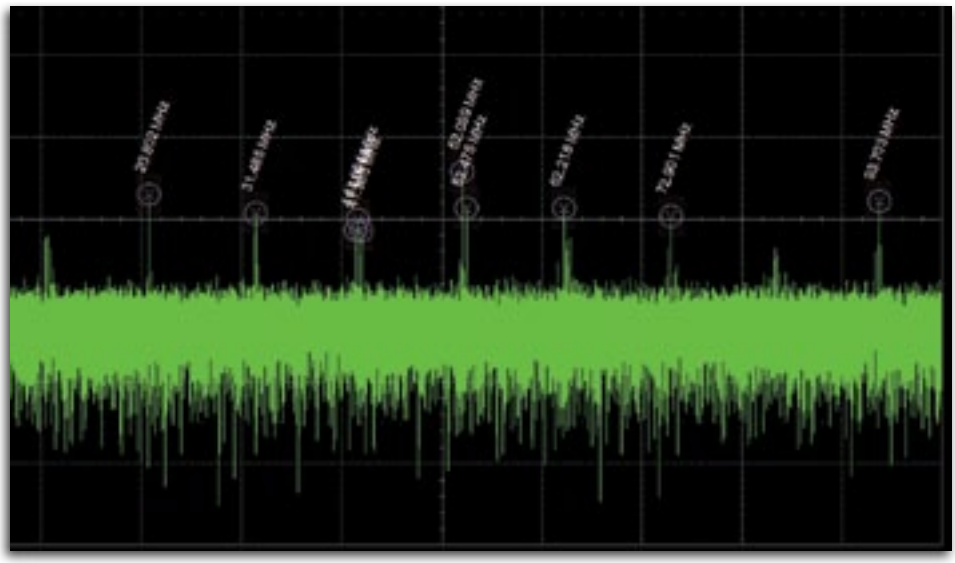
LabMaster 10 Zi has the deepest standard toolbox of any oscilloscope, providing more measure, math, graphing, statistical, and other tools, and more ways to leverage the tools to get the answer faster. While many other oscilloscopes provide similar looking tools, LeCroy allows the most flexibility in applying the tools to any waveform.

Customized Tools

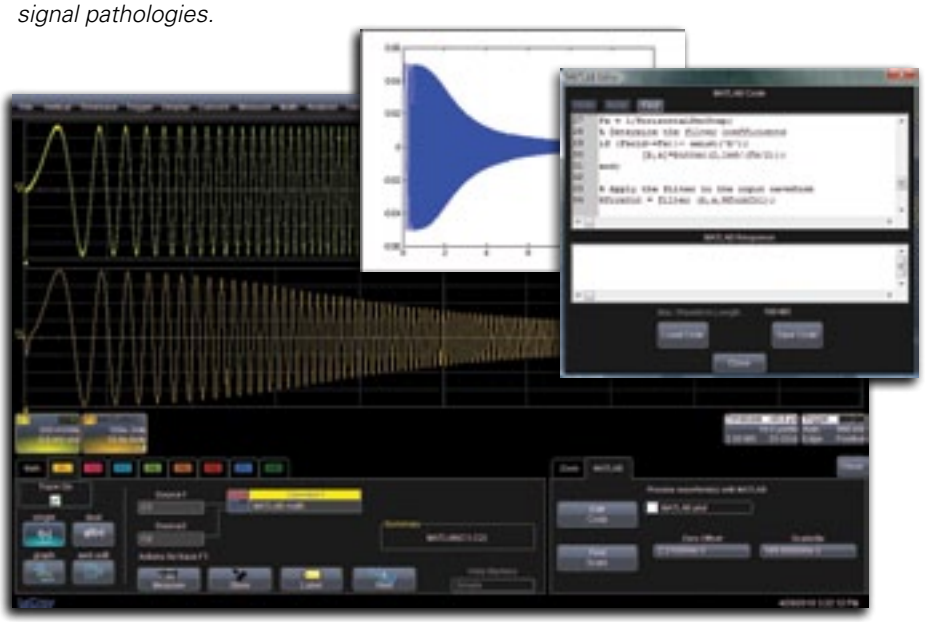
Only LeCroy completely integrates third party programs into the oscilloscope's processing stream by allowing you to create and deploy a new measurement or math algorithm directly into the oscilloscope environment and display the result on the oscilloscope in real-time! There is no need to run a separate program, or ever leave the oscilloscope window. Use C/C++, MATLAB, Excel, JScript (JAVA), and Visual Basic to create your own customized math functions, measurement parameters, or other control algorithms.

Graphical Track, Trend, and Histogram Views

Track plots measurement values on the Y-axis and time on the X-axis to display a measurement change time-correlated to the original channel acquisition—perfect for intuitive understanding of behaviors in frequency modulated (FM) or pulse width modulated (PWM) circuits and jitter measurements, including modu-lation or spikes.

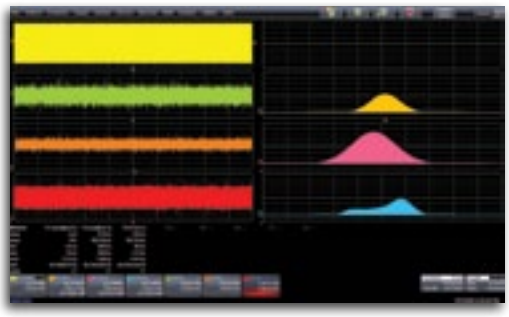


X-Stream II fast throughput streaming architecture makes difficult analysis and deep insight possible. Above, an FFT is applied to a 50 Mpts waveform to determine root cause failure. The high frequency resolution this provides enables deep insight into signal pathologies.



XDEV Customization software package being used to implement a 1 MHz Butterworth filter using MATLAB®.

Histograms provide a visual distribution representation of a large sample of measurements, allowing faster insight. Trends are ideal for plotting slow changes in measurement values.



Capture a single clock channel (yellow) and display Track graphs and Histograms simultaneously of multiple jitter parameters.

HIGH BANDWIDTH PROBING SOLUTIONS

Ultra-wideband Architecture for Superior Signal Fidelity

LeCroy's WaveLink® high bandwidth differential probes utilize advanced differential traveling wave (distributed) amplifier architecture to achieve superior high frequency analog broadband performance.

Highest Bandwidth (25 GHz) Solder-In Lead

Up to 25 GHz Solder-In performance with system (probe + oscilloscope) rise times equal to that of the oscilloscope alone.

Ultra-compact Positioner (Browser) Tip

The most compact positioner tip browser with bandwidth up to 22 GHz makes probing in confined areas easy.

Superior Probe Impedance Minimizes Circuit Loading

Circuit and signal loading is reduced by more than 50% with WaveLink high bandwidth probes compared to competitive probes. In the mid-band frequency range, the difference is even more apparent.

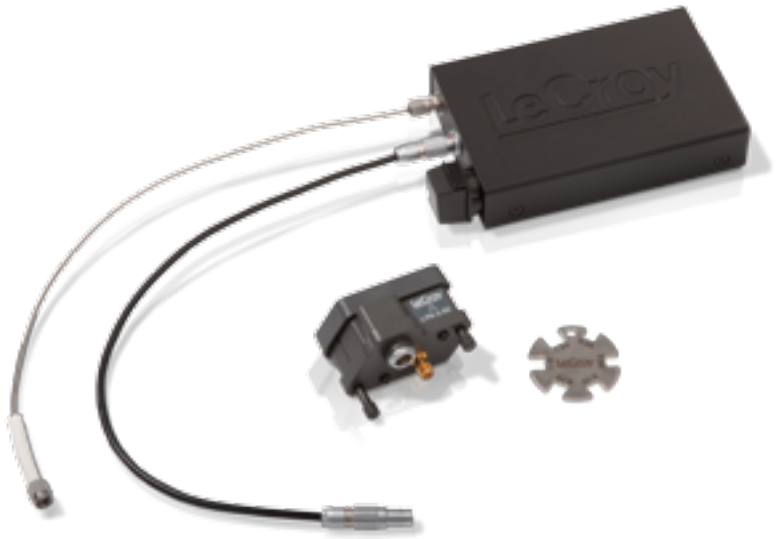
Superior Signal Fidelity and Lowest Noise

WaveLink has exceptional noise performance. In fact, the combination of the probe and the oscilloscope results in measurement performance that is nearly identical to that of a cable input.

D2505-A-PS 25 GHz probe system with Solder-In lead and browser positioner tip.

	D1305-A, D1305-A-PS	D1605-A, D1605-A-PS	D2005-A, D2005-A-PS	D2505-A, D2505--APS
Bandwidth	**Dxx05-SI and Dxx05-PT Tips** 13 GHz	**Dxx05-SI and Dxx05-PT Tips** 16 GHz	**Dxx05-SI and Dxx05-PT Tips** 20 GHz	**Dxx05-SI Lead** 25 GHz **Dxx05-PT Tip** 22 GHz typical 20 GHz guaranteed
Rise Time (10–90%)	**Dxx05-SI and Dxx05-PT Tips** 32.5 ps (typical)	**Dxx05-SI and Dxx05-PT Tips** 28 ps (typical)	**Dxx05-SI and Dxx05-PT Tips** 20 ps (typical)	**Dxx05-SI Lead** 17.5 ps (typical) **Dxx05-PT Tip** 19 ps (typical)
Rise Time (20–80%)	**Dxx05-SI and Dxx05-PT Tips** 24.5 ps (typical)	**Dxx05-SI and Dxx05-PT Tips** 21 ps (typical)	**Dxx05-SI and Dxx05-PT Tips** 15 ps (typical)	**Dxx05-SI Lead** 13 ps (typical) **Dxx05-PT Tip** 14 ps (typical)
Noise (Probe)	< 14 nV/√Hz (1.6 mV_{rms}) (typical)	< 14 nV/√Hz (1.8 mV_{rms}) (typical)	< 18 nV/√Hz (2.5 mV_{rms}) (typical)	< 18 nV/√Hz (2.8 mV_{rms}) (typical)
Input Dynamic Range	2.0 V_{pk-pk}, ±1 V (nominal)			
Input Common Mode Voltage Range	±4 V (nominal)			
Input Offset Voltage Range	±2.5 V Differential (nominal)			
Impedance (mid-band, typical)	**Dxx05-SI Lead:** 300 Ω at 6 GHz, 525 Ω at 13 GHz, 600 Ω at 16 GHz, 300 Ω at 20 GHz, 120 Ω at 25 GHz **Dxx05-PT Tip:** 160 Ω at 6 GHz, 450 Ω at 13 GHz, 240 Ω at 16 GHz, 210 Ω at 20 GHz			

OPTICAL-TO-ELECTRICAL CONVERTER (OE695G)



OE695G optical-to-electrical converter shown with supplied RF and Power cables

LeCroy's OE695G wide-band optical-to-electrical converter is ideal for measuring optical datacom and telecom signals with data rates from 622 Mb/s to 12.5+ Gb/s. Connection to a real-time LeCroy oscilloscope is through the 2.92mm interface, with a provided adapter to connect to ProLink interfaces.

Built-in Reference Receiver

The OE695G contains built-in software reference receiver filters for common Fiber Channel, Ethernet, and ITU telecom standards. These reference receiver filters provide a 4-pole Bessel Thompson low pass filter response for the combined oscilloscope and optical-to-electrical (O-E) system with the -3dBe (electrical) at 0.75*bit rate. Combined passband response (compared to ideal) is ±1.6dBe (typical). If desired, a custom reference receiver for any bit rate up to 12.5Gb/s can also be applied. Additionally, the OE695G can be operated without any reference receiver applied, providing 9.5 GHz of bandwidth at -3 dB and Tr(10-90%) of approximately 45 ps when used with a LeCroy oscilloscope of ≥ 20 GHz of bandwidth.

Calibration Option for Maximum Accuracy

If guaranteed reference receiver response is required (±0.85 dB max through the passband, with a relaxed requirement through 1.5*bit rate, per the reference receiver requirement), the optional OE695G-REFCAL may be ordered with the OE695G. This will provide a documented calibration response for the various standard reference receivers and up to 12.5Gb/s "custom" reference receiver on all four oscilloscope channels at specific gain ranges (with typical response provided at other gain ranges).

Key Features

- Compatible with LabMaster 10 Zi oscilloscopes
- Frequency range DC to 9.5 GHz (electrical, -3 dB)
- Reference receiver support from 8GFC to 10GFC FEC, or Custom (<12.5Gb/s)
- Full bandwidth mode (no reference receiver applied)
- 62.5/125 µm multi-mode or single-mode fiber input
- Broad wavelength range (750 to 1650 nm)
- +7 dBm (5 mW) max peak optical power
- Low noise (as low as 25 pW/√Hz)
- Ideal for Eye Mask, Extinction Ratio, and Optical Modulation Amplitude (OMA) testing

SPECIFICATIONS

Standard

Math Tools

Display up to 8 math function traces (F1–F8). The easy-to-use graphical interface simplifies setup of up to two operations on each function trace, and function traces can be chained together to perform math-on-math.

absolute value
average (summed)
average (continuous)
correlation (two waveforms)
derivative
deskew (resample)
difference (–)
enhanced resolution (to 11-bits vertical)
envelope
exp (base e)
exp (base 10)
fft (power spectrum, magnitude, phase, up to max Mpts)
floor
integral
interpolate (cubic, quadratic, sinx/x)
invert (negate)
log (base e)
log (base 10)
product (x)
ratio (/)
reciprocal
rescale (with units)
roof
sparse
square
square root
sum (+)
zoom (identity)

Measure Tools

Display any 12 parameters together with statistics, including their average, high, low, and standard deviations. Histicons provide a fast, dynamic view of parameters and wave shape characteristics. Parameter Math allows addition, subtraction, multiplication, or division of two different parameters.

amplitude
area
base
cycles
data
delay
Δ delay
duty cycle
duration
falltime (90–10%, 80–20%, @ level)
frequency
first
last
level @ x
maximum
mean
median
minimum
narrow band phase
narrow band power
number of points
+ overshoot
– overshoot
peak-to-peak
period
risetime (10–90%, 20–80%, @ level)
rms
std. deviation
top
width
median
phase
time @ minimum (min.)
time @ maximum (max.)
Δ time @ level
Δ time @ level from trigger
x @ max.
x @ min.

Pass/Fail Testing

Simultaneously test multiple parameters against selectable parameter limits or pre-defined masks. Pass or fail conditions can initiate actions including document to local or networked files, e-mail the image of the failure, save waveforms, send a pulse out at the front panel auxiliary BNC output, or (with the GPIB option) send a GPIB SRQ.

Basic Jitter and Timing Analysis Tools

This package provides toolsets for displaying parameter values vs. time, statistical views of parameters using histograms, and persistence view math functions. These tools include:

- "Track" graphs of all parameters, no limitation of number
  - Cycle-Cycle Jitter
  - N-Cycle
  - N-Cycle with start selection
  - Frequency @ level
  - Period @ level
  - Half Period
  - Width @ level
  - Time Interval Error @ level
  - Setup
  - Hold
  - Skew
  - Duty Cycle @ level
  - Duty Cycle Error
- Histograms expanded with 19 histogram parameters and up to 2 billion events
- Trend (datalog) of up to 1 million events
- Track graphs of all parameters
- Persistence histogram, persistence (range, sigma)

Standard (cont'd)

Advanced Customization

Provides capability to create a math function or measurement parameter in MATLAB, Excel, C++, JavaScript, or Visual Basic Script (VBS) format and insert it into the oscilloscope's processing stream. All results are processed and displayed on the oscilloscope grid, and are available for further processing. Also permits the creation of customized plug-ins that can be inserted into the scope user interface, control of the scope via Visual Basic scripts embedded in customized functions, and use of LeCroy's Custom DSO capabilities.

Software Options

SDAIII Serial Data Analysis Software (LM10Zi-SDAIII)
(Included in LM9Zi-SDAIII option, Standard on SDA MCM-Zi and DDA MCM-Zi Models)

Total Jitter

A complete jitter measurement and analysis toolset with the SDAIII-CompleteLinQ user interface framework. The CompleteLinQ framework provides a single user interface for "LinQ", "Crosstalk", "EyeDrII" and "Virtual Probe" capabilities (purchased separately).

SDAIII provides complete serial data and clock jitter and eye diagram measurement and analysis capabilities. Eye Diagrams with millions of UI are quickly calculated from up to 512 Mpt records, and advanced tools may be used on the Eye Diagram to aid analysis. Complete TIE and Total Jitter (Tj) parameters and analysis functions are provided. Comparison of eye diagrams and jitter analysis between captured lanes and one "reference" location is provided. Includes:

- Time Interval Error (TIE) Measurement Parameter, Histogram, Spectrum and Jitter Track
- Total Jitter (Tj) Measurement Parameter, Histogram
- Spectrum
- Eye Diagram Display (sliced)
- Eye Diagram IsoBER (lines of constant Bit Error Rate)
- Eye Diagram Mask Violation Locator
- Eye Diagram Measurement Parameters
  - Eye Height
  - One Level
  - Zero Level
  - Eye Amplitude
  - Eye Width
  - Eye Crossing
  - Avg. Power
  - Extinction Ratio
  - Mask hits
  - Mask out
  - Bit Error Rate
  - Slice Width (setting)
- Q-Fit Tail Representation
- Bathtub Curve
- Cumulative Distribution Function (CDF)
- PLL Track

Jitter Decompostion Models

Three dual-dirac jitter decomposition methods are provided for maximum measurement flexibility. Q-Scale, CDF, Bathtub Curve, and all jitter decomposition measurement parameters can be displayed using any of the three methods.

- Spectral, Rj Direct
- Spectral, Rj+Dj CDF Fit
- NQ-Scale

Random Jitter (Rj) and Non-Data Dependent Jitter (Rj+BUj) Analysis

- Random Jitter (Rj) Meas Param
- Periodic Jitter (Pj) Meas Param
- Rj+BUj Histogram
- Rj+BUj Spectrum
- Rj+BUj Track
- Pj Inverse FFT

Deterministic Jitter (Dj) Analysis

- Deterministic Jitter (Dj) Measurement Parameter

SPECIFICATIONS

Software Options (cont'd)

SDAIII Serial Data Analysis Software (continued)

Data Dependent Jitter (DDj) Analysis

- Data Dependent Jitter (DDj) Param
- Duty Cycle Distortion (DCD) Param
- InterSymbol Interference (ISI) Param
- Digital Pattern display
- DDj Plot (by Pattern or N-bit Sequence)
- DDj Histogram
- ISI Plot (by Pattern)

Reference Lane

- Compare current acquisition to Reference with a side-by-side or single (tabbed) display mode

SDAIII "LinQ" Capability
(SDAIII-LinQ, SDAIII-CrossLinQ, and SDAIII-CompleteLinQ Options)

In addition to all SDAIII capabilities, "LinQ" options includes 4 lanes of simultaneous serial data analysis plus the reference lane. If EyeDrII or VirtualProbe are purchased with SDAIII "LinQ" capability, then those capabilities are provided for all four lanes.

Lanescape Comparison Mode

When multiple lanes are enabled for display, Lanescape Comparison Modes is used. Selections for this mode are as follows:

- Single: One lane is displayed at a time.
- Dual: Two lanes are selected for display.
- Mosaic: All enabled lanes are displayed.

SDAIII "Crosstalk" Capability
(Included in SDAIII-Crosstalk and SDAIII-CrossLinQ Options)

In addition to all SDAIII capabilities, "Crosstalk" options add the following noise and crosstalk measurements and analysis tools:

- Total, Random and Deterministic noise (Tn, Rn, Dn) measurements
- Breakdown of Dn into InterSymbol Interference noise (ISIn) and Periodic noise (Pn)
- Noise-based eye height and width: EH(BER) and EW(BER)
- Random noise (Rn) + Bounded Uncorrelated noise (BUn) Noise Histogram
- Q-fit for Noise Histogram
- Rn+Bun Noise Spectrum and Peak threshold
- Pn Inverse FFT Plot
- Rn+Bun Noise Track
- Crosstalk Eye Contour Plot

SDAIII-CompleteLinQ

The ultimate in serial data single or multi-lane link analysis. Provides all the capabilities mentioned above in SDAIII, "LinQ", and "Crosstalk", and also includes EyeDrII and Virtual Probe capabilities.

Eye Doctor II Advanced Signal Integrity Tools (LM10Zi-EYEDRII)

Complete set of channel emulation, de-embedding and receiver equalization simulation tools. Provides capability to emulate a serial data link, de-embed or embed a fixture, cable or serial data channel, add or remove emphasis, and perform CTLE, FFE, or DFE equalization. If purchased with SDAIII, then capabilities are accessed from within the SDAIII-CompleteLinQ user interface framework.

Virtual Probe Signal Integrity Tools (LM10Zi-VIRTUALPROBE)

Provides ability to define a complex serial data channel or topology with up to six circuit elements that may be embedded or de-embedded, allowing "probing" at a location different than the measured position. If purchased with SDAIII and EyeDrII (or with the EYEDRII-VP or CompleteLinQ options), then capabilities are accessed from within the single SDAIII-CompleteLinQ user interface framework.

Software Options (cont'd)

Clock and Clock-Data Timing Jitter Analysis Package (LM10Zi-JITKIT)

Provides convenient setup and four views of jitter (statistical, time, spectrum, and overlaid) for a variety of horizontal, amplitude, and timing parameters. Direct display of jitter measurement values. Supports multiple simultaneous views with fast selection of multiple parameter measurements for fast and easy validation.

Cable De-embedding (LM10Zi-CBL-DE-EMBED)
(Standard on SDA MCM-Ziand DDA MCM-Zi)

Removes cable effects from your measurements. Simply enter the S-parameters or attenuation data of the cable(s) then all of the functionality of the SDA 8 Zi can be utilized with cable effects de-embedded.

8b/10b Decode (LM10Zi-8B10B D)
(Standard on SDA MCM-Zi and DDA MCM-Zi

Intuitive, color-coded serial decode with powerful search capability enables captured waveforms to be searched for user-defined sequences of symbols. Multi-lane analysis decodes up to four simultaneously captured lanes.

Spectrum Analyzer Mode (LM10Zi-SPECTRUM)

This package provides a new capability to navigate waveforms in the frequency domain using spectrum analyzer type controls. FFT capability added to include:

- Power averaging
- Power density
- Real and imag components
- Freq domain parameters
- FFT on up to 128 Mpts

Disk Drive Measurements Package (LM10Zi-DDM2)
(Standard on DDA MCM-Zi)

This package provides disk drive parameter measurements and related mathematical functions for performing disk drive WaveShape Analysis. Disk Drive Parameters are as follows:

- amplitude assymetry
- local base
- local baseline separation
- local maximum
- local minimum
- local number
- local peak-peak
- local time between events
- local time between peaks
- local time between troughs
- local time at minimum
- local time at maximum
- local time peak-trough
- local time over threshold
- local time trough-peak
- local time under threshold
- narrow band phase
- narrow band power
- overwrite
- pulse width 50
- pulse width 50 –
- pulse width 50 +
- resolution
- track average amplitude
- track average amplitude –
- track average amplitude +
- auto-correlation s/n
- non-linear transition shift

SPECIFICATIONS

Vertical System

	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
Analog Bandwidth @ 50 Ω (-3 dB) (1.85mm Inputs)				50 GHz (≥10 mV/div)	60 GHz (≥10 mV/div)	65 GHz (≥10 mV/div)
Analog Bandwidth @ 50 Ω (-3 dB) (2.4/2.92 Inputs)	25 GHz (≥10 mV/div)	30 GHz (≥10 mV/div)	36 GHz (≥10 mV/div)			
Rise Time (10–90%, 50 Ω) (test limit, flatness mode)	16.0 ps	13.3 ps	12.0 ps	8.4 ps	7.5 ps	6.9 ps
Rise Time (20–80%, 50 Ω) (flatness mode)	12.0 ps	10.0 ps	9.0 ps	6.3 ps	5.6 ps	5.2 ps
Input Channels	Up to 80, depending on configuration selected. (Any combination of up to 80 2.92mm input channels)			Up to 40, depending on configuration selected. Up to 80 @ 36 GHz.		
Bandwidth Limiters	Hardware Bandwidth Limiters: 5 GHz Software Bandwidth Limiters: User selected in 1 GHz increments up to full bandwidth rating					
Input Impedance	2.92mm Inputs: 50 Ω±2%			2.92mm Inputs: 50 Ω±2% 1.85mm Inputs: 50 Ω±2%		
Input Coupling	50 Ω: DC, GND					
Maximum Input Voltage	2.92 mm Inputs: ±2 Vmax @ <80mV/div, 5.5Vrms @ ≥80mV/div			2.92 mm Inputs: ±2 Vmax @ <80mV/div, 5.5Vrms @ ≥80mV/div 1.85 mm Inputs: ±2 Vmax @ ≤80mV/div		
Vertical Resolution	8 bits; up to 11 bits with enhanced resolution (ERES)					
Sensitivity	50 Ω (2.92mm): 2 mV–1 V/div, fully variable (2-9.9 mV/div via zoom)			50 Ω (2.92mm): 2 mV–1 V/div, fully variable (2-9.9 mV/div via zoom) 50 Ω(1.85mm): 10 mV–80mV/div, fully variable		
DC Vertical Gain Accuracy (Gain Component of DC Accuracy)	±1% F.S. (typical), offset at 0V; ±1.5% F.S. (test limit), offset at 0V					
Offset Range	50 Ω (2.92mm): ±500 mV @ 2–79 mV/div ±4 V @ 80 mV/div -1 V/div			50 Ω (1.85 mm): ±500 mV @ 10–80 mV/div 50 Ω (2.92mm): ±500 mV @ 2–79 mV/div ±4 V @ 80 mV/div -1 V/div		
DC Vertical Offset Accuracy	±2% F.S. (typical), offset at 0V; ±1.5% F.S. (test limit), offset at 0V					

SPECIFICATIONS

	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
Horizontal System						
Timebases	Internal timebase with 10 GHz clock frequency common to all input channels. Single, distributed 10 GHz clock for all channels ensures precise synchronization with timing accuracy between all channels identical to that provided within a single, conventional oscilloscope package.					
Time/Division Range	For ≤36 GHz Mode: 10 ps/div–64 s/div (Real-Time Mode: 10 ps/div - 64 s/div; RIS mode: 10 ps/div - 10 ns/div, user selectable at ≤10ns/div)			For >36 GHz Mode: Real-Time Mode, 10 ps/div - 320 µs/div, depending on memory length For ≤36 GHz Mode: 10 ps/div–64 s/div (Real-Time Mode: 10 ps/div - 64 s/div; RIS mode: 10 ps/div - 10 ns/div, user selectable at ≤10ns/div)		
Clock Accuracy	< 1 ppm + (aging of 0.5ppm/yr from last calibration)					
Time Interval Accuracy	< 0.06 / SR + (clock accuracy* Reading) (rms)					
Trigger and Interpolator Jitter	< 0.1 ps_{rms} (typical, software assisted), 2 ps_{rms} (typical, hardware)					
Channel-Channel Deskew Range	±9 x time/div. setting or 25 ns max. (whichever is larger), each channel					
External Timebase Reference (Input)	10 MHz; 50 Ω impedance, applied at the rear input of MCM-Zi Master Control Module					
External Timebase Reference (Output)	10 MHz; 50 Ω impedance, output at the rear of MCM-Zi Master Control Module					

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	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
Acquisition System						
Single-Shot Sample Rate/Ch	80 GS/s on each channel.			160 GS/s on each channel in >36 GHz Mode. 80 GS/s on each channel in ≤36 GHz Mode.		
Random Interleaved Sampling (RIS)	200 GS/s for repetitive signals (10 ps/div to 10 ns/div)			For >36 GHz Mode: Not Applicable For ≤36 GHz Mode: 200 GS/s for repetitive signals (10 ps/div to 10 ns/div)		
Maximum Trigger Rate	1,000,000 waveforms/second (in Sequence Mode, up to 4 channels)					
Intersegment Time	1 µs					
Standard Memory (4 Ch / 2 Ch / 1Ch) (Number of Segments)	20 M / 20 M / 20M (2000)			40 M / 40 M / 40M (In ≤36 GHz Modes, reference memory specification for 36 GHz LabMaster 10 Zi) (1000)		
Memory Options (4 Ch / 2 Ch / 1 Ch for ≤ 20 GHz Models, 2 Ch / 1 Ch for 30 and 36 GHz Models, 1 Ch for 45 GHz Model) (Number of Segments)	S-32 Option: 32M / 32M / 32M (7,500) M-64 Option: 64M / 64M / 64M (15,000) L-128 Option: 128M / 128M / 128M (15,000) VL-256 Option: 256M / 256M / 256M (15,000) XL-512 Option: 512M / 512M / 512M (15,000)			S-32 Option: 64M / 64M / 64M (3,500) M-64 Option: 128M / 128M / 128M (7,500) L-128 Option: 256M / 256M / 256M (15,000) VL-256 Option: 512M / 512M / 512M (15,000) XL-512 Option: 1024M / 1024M / 1024M (15,000) (In ≤36 GHzModes, reference memory specification for 36 GHz LabMaster 10 Zi)		
Acquisition Processing						
Averaging	Summed averaging to 1 million sweeps; continuous averaging to 1 million sweeps					
Enhanced Resolution (ERES)	From 8.5 to 11-bits vertical resolution					
Envelope (Extrema)	Envelope, floor, or roof for up to 1 million sweeps					
Interpolation	Linear or Sin x/x					

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	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
Triggering System						
Modes	Normal, Auto, Single, and Stop					
Sources	Using 9xxMZi-A Master Acquisition Module: any input channel, Aux, Aux/10, Line, or Fast Edge on 9xxMZi-A, or any input channel (Edge trigger only) on 9xxSZi-A Acquisition Modules. Using MCM-Zi Master Control Module: Any Ch 1-4 of the first 9xxSZi-A Acquisition Module input, or Fast Edge of the MCM-Zi module, or any input channel (Edge trigger only) on additional 9xxSZi-A Acquisition Modules Slope and level unique to each source except line trigger.					
Coupling Mode	DC, AC, HFRej, LFRej					
Pre-trigger Delay	0–100% of memory size (adjustable in 1% increments of 100 ns)					
Post-trigger Delay	0–10,000 divisions in real time mode, limited at slower time/div settings					
Hold-off by Time or Events	From 2 ns up to 20 s or from 1 to 99,999,999 events					
Internal Trigger Range	±4.1 div from center					
External Trigger Sensitivity, (Edge Trigger)	For any LabMaster 10xx-Zi Acquisition Module: 2 div @ < 1 GHz, 1.5 div @ < 500 MHz, 1.0 div @ < 200 MHz, (for DC coupling)					
Max. Trigger Frequency, SMART Trigger	For Ch 1-4 of a LabMaster 10xx-Zi Acquisition Module: 2.0 GHz @ ≥ 10 mV/div (minimum triggerable width 200 ps)					
External Trigger Input Range	For any LabMaster 10xx-Zi Acquisition Module: Aux (±0.4 V); Aux/10 (±4 V)					
Basic Triggers						
Edge	Triggers when signal meets slope (positive, negative, or either) and level condition.					
Window	Triggers when signal exits a window defined by adjustable thresholds					
TV-Composite Video	Triggers NTSC or PAL with selectable line and field; HDTV (720p, 1080i, 1080p) with selectable frame rate (50 or 60 Hz) and Line; or CUSTOM with selectable Fields (1–8), Lines (up to 2000), Frame Rates (25, 30, 50, or 60 Hz), Interlacing (1:1, 2:1, 4:1, 8:1), or Synch Pulse Slope (Positive or Negative)					

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	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
SMART Triggers™						
State or Edge Qualified	Triggers on any input source only if a defined state or edge occurred on another input source. Holdoff between sources is selectable by time or events					
Qualified First	In Sequence acquisition mode, triggers repeatably on event B only if a defined pattern, state, or edge (event A) is satisfied in the first segment of the acquisition. Holdoff between sources is selectable by time or events					
Dropout	Triggers if signal drops out for longer than selected time between 1 ns and 20 s					
Pattern	Logic combination (AND, NAND, OR, NOR) of 5 inputs (4 channels and external trigger input). Each source can be high, low, or don't care. The High and Low level can be selected independently. Triggers at start or end of the pattern					
SMART Triggers with Exclusion Technology						
Glitch	Triggers on positive or negative glitches with widths selectable as low as 200ps to 20 s, or on intermittent faults					
Width (Signal or Pattern)	Triggers on positive, negative, or both widths with widths selectable as low as 200ps to 20 s, or on intermittent faults					
Interval (Signal or Pattern)	Triggers on intervals selectable between 1 ns and 20 s					
Timeout (State/Edge Qualified)	Triggers on any source if a given state (or transition edge) has occurred on another source. Delay between sources is 1 ns to 20 s, or 1 to 99,999,999 events					
Runt	Trigger on positive or negative runts defined by two voltage limits and two time limits. Select between 1 ns and 20 ns					
Slew Rate	Trigger on edge rates. Select limits for dV, dt, and slope. Select edge limits between 1 ns and 20 ns					
Exclusion Triggering	Trigger on intermittent faults by specifying the expected behavior and triggering when that condition is not met					
Cascade (Sequence) Triggering						
Capability	Arm on "A" event, then Trigger on "B" event. Or Arm on "A" event, then Qualify on "B" event, and Trigger on "C" event. Or Arm on "A" event, then Qualify on "B" then "C" event, and Trigger on "D" event					
Types	A, B, C, or D event: Edge, Glitch, Width, Window, Dropout, Interval, Runt, Slew Rate, or Pattern (analog)					
Holdoff	Holdoff between A and B, B and C, C or D, or any is selectable by time or number of events					
Reset	Reset between A and B, B and C, C and D, or any combination is selectable in time or number of events					
High-speed Serial Protocol Triggering (Optional)						
Data Rates	Option LM10Zi-14GBIT-80B-8B10B-TD: 600 Mb/s to 14.1 Gb/s, Channel 4 input only					
Pattern Length	80-bits, NRZ or eight 8b/10b symbols					
Clock and Data Outputs	No Clock and Data Recovery outputs provided					

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	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
Color Waveform Display						
Type	On LabMaster MCM-Zi Master Control Module: Color 15.3" flat panel TFT-Active Matrix LCD with high resolution touch screen					
Resolution	WXGA; 1280 x 768 pixels					
Number of Traces	Display a maximum of 40 traces. Simultaneously display channel, zoom, memory and math traces					
Grid Styles	Auto, Single, Dual, Quad, Octal, X-Y, Single + X-Y, Dual + X-Y, Twelve, Sixteen, Twenty					
Waveform Representation	Sample dots joined, or sample dots only					
Integrated Second Display						
Type	Color 15.3" flat panel TFT-Active Matrix LCD with high resolution touch screen.					
Resolution	WXGA; 1280 x 768 pixels					
High-Speed Digitizer Output (Option)						
Type	Option LSIB-2. Installs in LabMaster MCM-Zi Master Control Module and uses one available PCIe slot normally used by a LabMaster 10-xxZi Acquisition Module.					
Transfer Rates	Up to 325 MB/s (typical)					
Output Protocol	PCI Express, Gen 1 (4 lanes utilized for data transfer)					
Control Protocol	TCP/IP					
Command Set	Via Windows Automation, or via LeCroy Remote Command Set					
Processor/CPU						
Type	In LabMaster MCM-Zi Master Control Module: Intel® XeonTM X5660 2.8 GHz (or better). There are two processors in each CPU, and each processor has 6 cores for a total of 12 cores and an effective processor speed of 33.6 GHz.					
Processor Memory	24 GB standard. Up to 192 GB optionally available					
Operating System	Microsoft Windows® 7 Professional Edition (64-bit)					
Oscilloscope Operating Software						
Real Time Clock	Date and time displayed with waveform in hardcopy files. SNTP support to synchronize to precision internal clocks					
Setup Storage						
Front Panel and Instrument Status	Store to the internal hard drive, over a network, or to a USB-connected peripheral device					
Interface						
Remote Control	Via Windows Automation, or via LeCroy Remote Command Set					
Network Communication Standard	VXI-11 or VICP, LXI Class C (v1.2) Compliant					
GPIB Port (optional)	Supports IEEE – 488.2. Installs in LabMaster MCM-Zi Master Control Module and uses one available PCIe slot normally used by a LabMaster 10-xxZi Acquisition Module.					
LSIB Port (optional)	Supports PCIe Gen1 x4 protocol with LeCroy supplied API. Installs in LabMaster MCM-Zi Master Control Module and uses one available PCIe slot normally used by a LabMaster 10-xxZi Acquisition Module.					
Ethernet Port	Supports 10/100/1000Base-T Ethernet interface (RJ45 port)					
USB Ports	LabMaster MCM-Zi Master Control Module: minimum 2 total USB 2.0 ports on rear of unit to support Windows compatible devices LabMaster MCM-Zi Master Control Module: minimum 3 total USB 2.0 ports on front of unit to support Windows compatible devices					
External Monitor Port	Dual Link DVI compatible to support internal display on MCM-Zi Master Control Module (1280 x 768 pixel resolution) and customer-supplied monitor with up to WQXGA (2560 x 1600 pixel) resolution using extended desktop mode.					

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	25 GHz LabMaster (SDA/DDA)	30 GHz LabMaster (SDA/DDA)	36 GHz LabMaster (SDA/DDA)	50 GHz LabMaster (SDA/DDA)	60 GHz LabMaster (SDA/DDA)	65 GHz LabMaster (SDA/DDA)
Power Requirements						
Voltage	LabMaster 10-xxZi Acquisition Module: 100–240 VAC ±10% at 45-66 Hz; 100-120 VAC ±10% at 380-420 Hz; Automatic AC Voltage Selection, Installation Category II LabMaster MCM-Zi Master Control Module: 100–240 VAC ±10% at 45-66 Hz; Automatic AC Voltage Selection, Installation Category II					
Max. Power Consumption	LabMaster 10-xxZi Acquisition Module - 1300 W / 1300 VA. LabMaster MCM-Zi Master Control Module - 450 W / 450 VA. Each Module and the CPU has a separate power cord.			LabMaster 10-xxZi Acquisition Module - 1350 W / 1350 VA. LabMaster MCM-Zi Master Control Module - 450 W / 450 VA. Each Module and the CPU has a separate power cord.		
Environmental						
Temperature (Operating)	+5 °C to +40 °					
Temperature (Non-Operating)	–20 °C to +60 °C					
Humidity (Operating)	5% to 80% relative humidity (non-condensing) up to +31 °C Upper limit derates to 50% relative humidity (non-condensing) at +40 °C					
Humidity (Non-Operating)	5% to 95% relative humidity (non-condensing) as tested per MIL-PRF-28800F					
Altitude (Operating)	Up to 10,000 ft. (3048 m) at or below +25 °C					
Altitude (Non-Operating)	Up to 40,000 ft. (12,192 m)					
Random Vibration (Operating)	0.5 g_{rms} 5 Hz to 500 Hz, 15 minutes in each of three orthogonal axes					
Random Vibration (Non-Operating)	2.4 g_{rms} 5 Hz to 500 Hz, 15 minutes in each of three orthogonal axes					
Functional Shock	20 g_{peak}, half sine, 11 ms pulse, 3 shocks (positive and negative) in each of three orthogonal axes, 18 shocks total					
Physical Dimensions						
Dimensions (HWD)	LabMaster MCM-Zi Master Control Module - 10.9" x 18.2" x 15.6" (277 x 462 x 396 mm), LabMaster 10-xxZi Acquisition Module - 8.0" x 18.2" x 26" (202 x 462 x 660 mm)					
Weight	LabMaster 10-xxZi Acquisition Module -53 lbs. (24 kg) LabMaster MCM-Zi Master Control Module - 47 lbs. (21.4 kg)			LabMaster 10-xxZi Acquisition Module -58 lbs. (24 kg) LabMaster MCM-Zi Master Control Module - 47 lbs. (21.4 kg)		
Shipping Weight	LabMaster 10-xxZi Acquisition Module -53 lbs. (24 kg) LabMaster MCM-Zi Master Control Module - 47 lbs. (21.4 kg)			LabMaster 10-xxZi Acquisition Module -58 lbs. (24 kg) LabMaster MCM-Zi Master Control Module - 47 lbs. (21.4 kg)		
Certifications						
	CE Compliant, UL and cUL listed; conforms to EN 61326, EN 61010-1, UL 61010-1 2nd edition, and CSA C22.2 No. 61010-1-04					
Warranty and Service						
	3-year warranty; calibration recommended annually. Optional service programs include extended warranty, upgrades, and calibration services					

ORDERING INFORMATION

Product Description	Product Code
LabMaster 10 Zi Series Master Control Modules	
LabMaster Master Control Module with 15.3" WXGA Color Display.	LabMaster MCM-Zi
SDA Master Control Module with 15.3" WXGA Color Display (provides add'l standard software and 32 Mpt/Ch memory)	SDA MCM-Zi
DDA Master Control Module with 15.3" WXGA Color Display (provides add'l standard software and 32 Mpt/Ch memory)	DDA MCM-Zi
LabMaster 10 Zi Series Acquisition Modules	
25 GHz, 80 GS/s, 4 Ch, 20 Mpts/Ch LabMaster 10 Zi Acquisition Module with 50 Ω input	LabMaster 10-25Zi
30 GHz, 80 GS/s, 4 Ch, 20 Mpts/Ch LabMaster 10 Zi Acquisition Module with 50 Ω input	LabMaster 10-30Zi
36 GHz, 80 GS/s, 4 Ch, 20 Mpts/Ch LabMaster 10 Zi Acquisition Module with 50 Ω input	LabMaster 10-36Zi
50 GHz, 160 GS/s, 2 Ch, 40 Mpts/Ch LabMaster 10 Zi Acquisition Module with 50 Ω input (36 GHz, 80 GS/s, 4 Ch, 20 Mpts/Ch)	LabMaster 10-50Zi
60 GHz, 160 GS/s, 2 Ch, 40 Mpts/Ch LabMaster 10 Zi Acquisition Module with 50 Ω input (36 GHz, 80 GS/s, 4 Ch, 20 Mpts/Ch)	LabMaster 10-60Zi
65 GHz, 160 GS/s, 2 Ch, 40 Mpts/Ch LabMaster 10 Zi Acquisition Module with 50 Ω input (36 GHz, 80 GS/s, 4 Ch, 20 Mpts/Ch)	Labmaster 10-65Zi

Included with LabMaster MCM-Zi Standard Configuration

Power Cable for the Destination Country, Optical 3-button Wheel Mouse USB 2.0, Printed Getting Started Manual, Anti-virus Software (Trial Version), Microsoft Windows 7 License, Commercial NIST Traceable Calibration with Certificate, 3-year Warranty

Included with LabMaster 10-xxZi Standard Configuration

2.92mm Connector Saver: Qty. 4, 1.85mm Adapter: Qty. 2 (50-65 GHz units only), PCIe x 8 cable, 2m long, PCIe x 4 cable, 2m long, Power Cable for the Destination Country, ChannelSync 10 GHz clock cable, 2m long, Commercial NIST Traceable Calibration with Certificate, 3-year Warranty

ChannelSync Expansion Products

ChannelSync Mainframe Hub to permit LabMaster expansion to up to 20 acquisition modules	LabMaster CMH20-Zi
Expansion ChannelSync module card for ChannelSync Mainframe Hub. One required per connected acquisition module	LabMaster CMH-1ACQMODULE-Zi

Product Description	Product Code
Memory Options	
20 Mpts/Ch Standard Memory for LabMaster 10 Zi Acquisition Module	LM10Zi-STD
32 Mpts/Ch Standard Memory for LabMaster 10 Zi Acquisition Module. Used with SDA MCM-Zi	SDA10Zi-STD
32 Mpts/Ch Standard Memory for LabMaster 10 Zi Acquisition Modules. Used with DDA MCM-Zi	DDA10Zi-STD
32 Mpts/ch Memory Option for LabMaster 10 Zi Acquisition Module	LM10Zi-S-32
64 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules	LM10Zi-M-64
64 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with SDA MCM-Zi	SDA10Zi-M-64
64 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with DDA MCM-Zi	DDA10Zi-M-64
128 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules	LM10Zi-L-128
128 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with SDA MCM-Zi	SDA10Zi-L-128
128 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules Used with DDA MCM-Zi	DDA10Zi-L-128
256 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules	LM10Zi-L-256
256 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with SDA MCM-Zi	SDA10Zi-L-256
256 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with DDA MCM-Zi	DDA10Zi-L-256
512 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules	LM10Zi-XL-512
512 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with SDA MCM-Zi	SDA10Zi-XL-512
512 Mpts/Ch Memory Option for LabMaster 10 Zi Acquisition Modules. Used with DDA MCM-Zi	DDA10Zi-XL-512

ORDERING INFORMATION

Product Description	Product Code
CPU, Computer and Other Hardware Options for LabMaster MCM-Zi Master Control Module	
Additional 500 GB Hard Drive for MCM-Zi	MCM-Zi-500GB-RHD-02
48 GB RAM Upgrade for MCM-Zi	MCM-Zi-24-UPG-48GBRAM
96 GB RAM Upgrade for MCM-Zi	MCM-Zi-24-UPG-96GBRAM
192 GB RAM Upgrade for MCM-Zi	MCM-Zi-24-UPG-192GBRAM
GPIB Option for MCM-Zi	GPIB-2
Serial Data and Crosstalk Analysis	
Bundle - Multi-Lane SDA LinQ Framework, including Eye, Jitter, Noise, Crosstalk Measurements, with EyeDrII and VirtualProbe	LM10Zi-SDAIII-CompleteLinQ SDA10Zi-SDAIII-CompleteLinQ DDA10Zi-SDAIII-CompleteLinQ
Multi-Lane Serial Data Analysis LinQ Framework, Eye, Jitter, Noise and Crosstalk Measurements	LM10Zi-SDAIII-CrossLinQ SDA10Zi-SDAIII-CrossLinQ DDA10Zi-SDAIII-CrossLinQ
Multi-Lane Serial Data Analysis LinQ Framework, Eye and Jitter Measurements	LM10Zi-SDAIII-LinQ SDA10Zi-SDAIII-LinQ DDA10Zi-SDAIII-LinQ
Single-Lane Serial Data Analysis Framework, Eye, Jitter, Noise and Crosstalk Measurements	LM10Zi-SDAIII-Crosstalk SDA10Zi-SDAIII-Crosstalk DDA10Zi-SDAIII-Crosstalk
Single-Lane Serial Data Analysis Framework, Eye and Jitter Measurements	LM10Zi-SDAIII
Signal Integrity Toolkits	
Advanced De-embedding, Emulation and Virtual Probing Toolkit	LM10Zi-VIRTUALPROBE
Signal Integrity Toolkit - Channel & Fixture De-embedding/Emulation, Tx/Rx Equalization	LM10Zi-EYEDRII
Bundle - EyeDrII and VirtualProbe Toolkits	LM10Zi-EYEDRII-VP
Cable De-embed Option	LM10Zi-CBL-DE-EMBED

Product Description	Product Code
Serial Data Compliance	
QualiPHY Enabled 10GBase-KR Software Option	QPHY-10GBase-KR
QualiPHY Enabled LPDDR2 Software Option	QPHY-LPDDR2
QualiPHY Enabled DDR3 Software Option	QPHY-DDR3
QualiPHY Enabled DisplayPort Software Option	QPHY-DisplayPort
QualiPHY Enabled HDMI Software Option	QPHY-HDMI†
QualiPHY Enabled PCIe 3.0 Software Option	QPHY-PCIe3
QualiPHY Enabled PCIe Gen1 Software Option	QPHY-PCIe
QualiPHY Enabled SATA Software Option	QPHY-SATA-TSG-RSG
QualiPHY Enabled SAS-2 Software Option	QPHY-SAS2
QualiPHY Enabled SFI Software Option	QPHY-SFI
QualiPHY Enabled SuperSpeed USB Transmitter/ Receiver Compliance Software Option	QPHY-USB3-Tx-Rx

† TF-HDMI-3.3V-QUADPAK required.

PCI Express, SuperSpeed USB (USB 3.0) and SATA Complete Hardware/Software Test Solutions are available. Consult Factory.

Serial Data Test Fixtures	
HDMI Test Fixture Set (TPA-P-SE, TPA-P-DI)	TF-HDMI
HDMI Pull-Up Terminator Quad Pack — For Use with the Efficere ET-HDMI-TPS-P Plug Test Adapter	TF-HDMI-3.3V-QUADPAK
SATA 1.5 Gb/s, 3.0 Gb/s and 6.0 Gb/s Compliance Test Fixture	TF-SATA-C
SATA 1.5 Gb/s, 3.0 Gb/s and 6.0 Gb/s Compliance Test Fixture Measure Kit	TF-SATA-C-KIT
SuperSpeed USB Compliance Test Fixture	TF-USB3
100 ps Rise Time Filter	RISE-TIME-FILTER-100PS
150 ps Rise Time Filter	RISE-TIME-FILTER-150PS
20 dB SMA Attenuators	20DB-SMA-ATTENUATOR

ORDERING INFORMATION

Product Description	Product Code
Serial Data Triggers and Decoders	
600 Mb/s to 14.1 Gb/s 80-bit NRZ and 8b/10b Serial Trigger. Also includes 8b/10b Decode.	LM10Zi-14GBIT-80B-8B10B-TD
64b/66b Decode Annotation Option	LM10Zi-64b66b D
8b/10b Decode Decode Annotation Option	LM10Zi-8B10B D
Ethernet 10G Decode Option	LM10Zi-ENET10Gbus D
PCI Express Decode Annotation Option	LM10Zi-PCIEbus D
USB 3.0 Decode Annotation Option	LM10Zi-USB3bus D
USB 2.0 Decode Annotation Option	LM10Zi-USB2bus D
USB2-HSIC Decode Option	LM10Zi-USB2-HSICbus D
SATA Decode Annotation Option	LM10Zi-SATAbus D
SAS Decode Annotation Option	LM10Zi-SASbus D
Fibre Channel Decode Annotation Option	LM10Zi-FCbus D
D-PHY Decode Option	LM10Zi-DPHYbus D
DigRF 3G Decode Option	LM10Zi-DigRF3Gbus D
DigRF v4 Decode Option	LM10Zi-DIGRFv4bus D
Audiobus and Decode Option for I^2S, LJ, RJ, and TDM	LM10Zi-Audiobus D
Audiobus, Decode, and Graph Option for I^2S, LJ, RJ, and TDM	LM10ZiAudiobus DG
MIPI D-PHY Decode Annotation Option	LM10Zi-DPHYbus D
MIPI D-PHY Decode and Physical Layer Test Option	LM10Zi-DPHYbus DP
MIPI M-PHY Decode An-notation Option	LM10Zi-MPHYbus D
MIPI M-PHY Decode Annotation and Physical Layer Test Option	LM10Zi-MPHYbus DP
I^2C Bus and Decode Option	LM10Zi-I2Cbus D
SPI Bus and Decode Option	LM10Zi-SPIbus D
LIN and Decode Option	LM10Zi-LINbus D
UART and RS-232 and Decode Option	LM10Zi-UART-RS232bus D
FlexRay and Decode Option	LM10Zi-FlexRaybus D
FlexRay, Decode, and Physical Layer Test Option	LM10Zi-FlexRaybus DP
CAN and Decode Option	LM10Zi-CANbus D
CAN, Decode and Measure/Graph Option	LM10Zi-CANbus DM
MIL-STD-1553 Decode Option	LM10Zi-1553 D
ARINC 429 Symbolic Decode Option	LM10Zi-ARINC429bus DSymbolic
PROTObus MAG Serial Debug Toolkit	LM10Zi-PROTObus MAG
Decode Annotation and Protocol Analyzer Synchronization Software Option	LM10Zi-ProtoSync
Decode Annotation and Protocol Analyzer Synchronization Software + Bit Tracer Option	LM10Zi-ProtoSync-BT
General Purpose and Application Specific Software Options	
Spectrum Analyzer and Advanced FFT Option	LM10Zi-SPECTRUM
Digital Filter Software Package	LM10Zi-DFP2
Serial Data Mask Software Package	LM10Zi-SDM
Disk Drive Measurements Software Package	LM10Zi-DDM2
Disk Drive Analyzer Software Package	LM10Zi-DDA
Advanced Optical Recording Measurement Package	LM10Zi-AORM
EMC Pulse Parameter Software Package	LM10Zi-EMC
Clock Jitter Analysis with Four Views Software Package	LM10Zi-JITKIT

Product Description	Product Code
High Speed Output Accessories	
High-speed PCIe Gen 1 x4 Digitizer Output	LSIB-2
PCI Express x1 Express Card Host Interface for Laptop Express Card Slot	LSIB-HOSTCARD
PCI Express x1 Host Interface Board for Desktop PC	LSIB-HOSTBOARD
PCI Express x4 3-meter Cable with x4 Cable Connectors Included	LSIB-CABLE-3M
PCI Express x4 7-meter Cable with x4 Cable Connectors Included	LSIB-CABLE-7M
Miscellaneous	
MCM-Zi Rackmount Kit	MCM-Zi-RACKMOUNT
LabMaster 10 Zi Acquisition Module Rackmount Kit	LM10Zi-ACQMOD-RACKMOUNT
LabMaster MCM-Zi Softcase	MCM-Zi-SOFTCASE
LabMaster 10 Zi Acquisition Module Soft Carrying Case	LM10Zi-ACQMOD-SOFTCASE
Removable Front Panel with 4 Independent Channel Controls.	Zi-FRONTPANEL-4CH
Integrated 2nd Touch Screen Display (Top-mounted, Fully Integrated 15.3" WXGA with Touch Screen Display, Including all Cabling and Software)	Zi-EXTDISP-15
Probes and Probe Accessories	
WaveLink 13 GHz, 2.0 Vp-p Differential Probe System	D1305-A-PS
WaveLink 16 GHz, 2.0 Vp-p Differential Probe System	D1605-A-PS
WaveLink 20 GHz, 2.0Vp-p Differential Probe System	D2005-A-PS
WaveLink 25 GHz, 2.0 Vp-p Differential Probe System	D2505-A-PS
Optical-to-Electrical Converter, DC to 9.5 GHz, 785 to 1550 nm	OE695G

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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labmaster10zi-ds-03july12
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Appendix No. 2

to the Contract on the lease of equipment with the right to its subsequent purchase

Rent payment schedule

Lease of equipment for the upgrade of an SDA820 real-time oscilloscope

Subject of the lease:
- LabMaster MCM-Zi + LabMaster 10-30Zi

Total rent of **$ 169,999** will be paid for 36 months according to the following payment schedule:

Months	**Monthly fee**	**N. of Months**	**SubTotal**	**Balance of the Lease**
1 to 4	$ 30,000	4	$ 120,000	$ 49,999
5 to 8	$ 10,000	4	$ 40,000	$ 9,999
9 to 12	$ 1,000	4	$ 4,000	$ 5,999
13 to 35	$ 250	23	$ 5,750	$ 249
36	$ 249	1	$ 249	**$ 0**
Total	**-**	**36**	**$ 169,999**	**-**
Purchase price	**$ 1**	**-**	**$ 1**	**-**

After paying the entire amount of the rent price, the lessee has a preferential right to purchase the leased equipment for a purchase price of **$ 1**.