Sigma Series
Transient Oscilloscopes
User's Guide

LDS NICOLET TEST AND MEASUREMENT LLC

Part Number 269-945502 Version 2.1

© LDS Test and Measurement LLC

8551 Research Way, M/S 140

Middleton, Wisconsin USA 53562

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Web: www.lds-group.com

RECEIVING

Unpack the instrument and save the carton and packing material in case the instrument must be shipped to another site or returned to the factory for service.

INSPECTION

Inspect the exterior of the instrument for any visible signs of damage that may have occurred during transit.

If damaged, contact -

LDS Test and Measurement LLC

Customer Service
8551 Research Way, M/S 140
Middleton, Wisconsin USA 53562
Tel: 608-821-6600
Fax: 608-821-6690

Outside the U.S., call your local LDS-Nicolet office or distributor.

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The warranty period for new products is 12 months from the date of invoice.

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Chapter 1: Safety Messages

GROUND / EARTH / PROTECTIVE CONDUCTOR

There is a great deal of inconsistency in the language used to describe the wiring connections necessary to ensure electrical safety of equipment. This inconsistency even extends to international standards whose terminology is at present inconsistent for different standards.

The body of the planet is used as the reference for most power systems and electrical connections made to the soil are referred to as "ground", "earth", and similar terms. Within a building the wiring to this connection is referred to as the protective conductor, the earth wire, the ground wire, the circuit protective conductor, the protective earthing conductor, and similar terms.

Rather than use a multiplicity of terms every time the concept is needed, this manual uses the term "ground" in all places. It is essential for the safe operation of this equipment that there be a definite low impedance connection between the case of the instrument and the circuit protective conductor (ground) of the building. This is provided through the IEC60320 connector on the back of the instrument. It is essential that any plug, or adapter plug, ensure the continuity of this ground connection.

The first WARNING note below is required by the FCC and relates only to the interference potential of this equipment. This message is a direct quotation.

WARNING

The equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart B or Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the user will be required to take whatever measures may be required to correct the interference at their own expense.

The design of this instrument has been verified to EN 61010 for Class I (grounded use).

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be switched on if it is damaged and it should not be used under wet conditions.

For the correct and safe use of this instrument it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

Whenever it is likely that safety protection has been impaired, the instrument must be made inoperative and secured against any unintended operation. Qualified maintenance or repair personnel should be informed. Safety protection is likely to be impaired if, for example, the instrument shows visible damage or fails to operate normally.

This instrument must not be used in life support roles.

GROUNDING

The instrument must be used with a protective ground connected via the conductor of the supply cable.

This is connected to the instrument before the line and neutral connections when the supply connection is made. If the final connection to the supply is made elsewhere, ensure that the ground connection is made before line and neutral.

WARNING

Any interruption of the ground connection inside or outside will make the instrument dangerous. Intentional interruption is prohibited.

Signal connections to the instrument should be connected after the ground is made and disconnected before the ground connection is removed, i.e. the supply lead must be connected whenever signal leads are connected.

Note: *In order to verify the continued safety of this equipment, it is necessary to routinely check the ground / earth bonding and insulation resistance.*

A suitably qualified person should do this.

WARNING

It is recommended that signal grounds always be connected to a local ground. For safety, it is essential that a signal earth be connected whenever voltages greater than 40 V peak are connected. This is to prevent the instrument's case becoming live in the event of a safety ground interruption, which could occur if the supply connector is accidentally disconnected from the rear of the instrument.

It is the responsibility of the user to ensure the safety of any accessories, such as probes, used with the instrument. If the scope probes are connected to a "live system" such that there is current through the scope probe ground leads totaling in excess of 10mA, it is necessary to use a separate protective conductor (earth/ground) connection to the scope in order to prevent the case becoming live if the IEC plug is inadvertently disconnected.

CAUTION

Even low voltage inputs may contain high voltage fast transients (spikes), which could damage the input. For this reason it is not safe, for instance, to make direct connections to an AC line supply.

CAUTION

The outer shells of the input BNC's are connected to the oscilloscope's chassis and therefore to the safety ground.

LIVE PARTS

The covers protect the user from live parts and should only be removed by suitably qualified personnel for maintenance and repair purposes.

The instrument must not be operated with the covers removed.

ENVIRONMENT

The instrument should be operated in a clean, dry environment with an ambient temperature of between 5°C and +40°C.

The instrument will operate with full, specified accuracy between +15°C and 35°C.

The instrument relies on forced air-cooling. Adequate ventilation can usually be achieved by leaving a 75 mm (3" gap) around the instrument. Care should be taken to avoid restricting the airflow around the fan holes at the side and the rear of the instrument.

To clean the DSO, disconnect all power sources and wipe the surfaces lightly with a clean, soft cloth dampened with Water or Isopropyl Alcohol.

POWER AND FREQUENCY REQUIREMENTS

Depending upon the options fitted, the instrument uses between 100 W and 250 W and operates from line voltages of 90 V to 264 V at 47 - 63 Hz.

The power connection is via a standard IEC 60320 connector. The rear panel switch adjacent to the input power connection switches the supply power to the instrument but is not guanteed as a disconnecting device.

The front panel switch on the instrument is a standby power switch. When the instrument is in standby, some power will still be consumed.

TOUCH SCREEN

Do not use the touch screen with a sharp object such as a ballpoint pen. The screen typical activation forces are <25 g with a plastic stylus with 1 mm radius full hemispherical or <50 g with a standard finger.

EMC

EMC stands for Electro-Magnetic Compatibility. The overall intention is that electronic equipment must be able to co-exist with other electronic equipment in its immediate vicinity, thus neither emitting large amounts of electromagnetic energy. There are two distinct requirements for electromagnetic compatibility: Emission and Immunity.

This instrument generates, accepts and can radiate radio frequency energy and, if not installed and used in accordance with this User's Guide, may cause harmful interference to other equipment. However, there is no guarantee that interference will not occur in a particular installation.

Immunity test: All immunity tests are done with the failure criterion being a change of the instrument's control settings. Any of these tests may produce a spurious trigger. Measurements are not valid during and immediately after the immunity tests.

In demanding applications, if this instrument does cause minor harmful interference to other equipment, which can be determined by turning this instrument off and on, the user is encouraged to try to reduce the interference by one or more of the following measures:

- Re-orient or relocate the affected equipment.
- Increase the separation between the instrument and the affected equipment.

- Re-orient or relocate RS 423, IEEE-488 and/or USB interface cables.
- Connect the instrument to an outlet on a different supply circuit than the affected equipment.

Supply cables, interface cables and probes should be kept as short as practical, preferably a maximum of 1 m. Interface cables should be shielded and interface cables longer than 3 m are not acceptable in terms of interference port immunity. The only exception is the network cable, which is not limited in length by EMC requirements.

Note: Use only the USB interfaces for the mouse and keyboard.

FUSE REQUIREMENTS

There is no accessible fusing. If the instrument fails it will need to be serviced by a qualified engineer to ensure there is no internal damage.

Where fused power cord are available, use an approved 3 or 5 Amp fuse.

Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation.

The protection is likely to be impaired if, for example, the apparatus shows visible damage or has been subjected to severe transport stresses.

WARNING

ELECTRICAL SHOCK HAZARD! Do not remove covers. Refer servicing to qualified individuals.

Proper use of this device depends on careful reading of all instructions and labels.

WARNING

This instrument and related accessories are not designed for biomedical experimentation on humans and should not be directly connected to human subjects.

WARNING

This instrument must not be operated in explosive atmospheres.

SYMBOL DESCRIPTIONS

This symbol is used to denote the measurement ground connection. This point is not a safety ground.

This symbol is used to denote a safety ground connection.

Where caution is required, this symbol refers to the User's Guide for further information.

This symbol warns that high voltages are present close to this symbol.

This symbol shows that the switch is a standby switch. When it is pressed, the instrument state toggles between operating and stand by mode. In standby mode some power will be consumed and the instrument is NOT disconnected from the AC supply.

European conformity mark to meet all applicable regulations. In this case, the regulations met are EMC and Safety.

INTERNATIONAL SAFETY WARNINGS

Danske

SIKKERHEDSADVARSEL

Dette instrument skal anvendes med en beskyttelsesjordforbindelse via netkablets jordledning til jordforbindelsen i instrumentets apparatkontakt eller – hvis instrumentet er forsynet dermed – via sikkerhedsjordklemmen. Enhver afbrydelse af sikkerhedsjordforbindelsen vil formentlig gøre instrumentet berøringsfarligt. Bevidst afbrydelse er forbudt. Hvis et indgangssignal overstiger 40 V spidsværdi, skal en ekstra signal jord forbindes.

Dækslerne må ikke fjernes.

Hvis netsikringen springer som følge af en fejl, er det muligt at instrumentets AC netafbryder er blevet beskadiget, hvorfor den bør efterses af en kvalificeret tekniker.

Afbryd instrumentet fra lysnettet ved at fjerne IEC-stikket fra bagpanelet. Dette instruments AC netafbryder er kun beregnet til funktionelle formål. Den er hverken beregnet til eller egnet til afbrydelse af lysnettet.

Nederlands

VEILIGHEIDSWAARSCHUWING

Dit instrument mag uitsluitend worden gebruikt als een beschermende massa (aarde) is aangesloten via de beschermende massageleider van de voedingskabel, of – indien het instrument daarvan is voorzien – via de veiligheids-massa-aansluiting. Als de beschermende massa, binnen of buiten het instrument, wordt onderbroken, dan kan dat hierdoor uitermate gevaarlijk worden. Het opzettelijk onderbreken van de massa, is verboden. Indien er een signaal wordt aangeboden van meer dan 40 V (top-top) dan dient eveneens de signaal aarde aangesloten te zijn.

De deksels nooit verwijderen.

Als de zekering doorbrandt als gevolg van een storing of een defect, dan is het mogelijk dat de wisselstroom-voedingsschakelaar van het instrument beschadigd is. Die schakelaar moet worden gecontroleerd door een deskundig technicus.

Als de IEC-aansluiting op het achterpaneel uit het stopcontact wordt verwijderd, zal het instrument niet langer zijn aangesloten op de wisselstroom-voeding. De wisselstroom-voedingsschakelaar op dit instrument is uitsluitend bestemd voor functionele doeleinden. Die schakelaar mag nooit worden gebruikt om het instrument aan of af te zetten.

Suomi

TURVAOHJEITA

Tätä laitetta käytettäessä sen tulee olla suojamaadoitettu joko verkkojohdon suojajohtimen tai erillisen suojamaadoitusliitännän kautta, mikäli laitteeseen on sellainen asennettu. Suojamaadoituksen katkaiseminen laitteen sisä-tai ulkopuolelta tekevät siitä vaarallisen. Tahallinen katkaisu on kiellettyä. Lisäksi, jos jokin tulosignaaleista ylittää 40 V peak, on signaalimaa kytkettävä.

Älä poista suojakansia.

Mikäli laitteen verkkosulake palaa vian seurauksena, on mahdollista, että laitteen verkkokytkin on vaurioitunut ja se tulee tällöin tarkastuttaa ammattihenkilöllä.

Erottaaksesi tämän laitteen käyttöjännitteestä irrota takapaneelissa oleva IEC-liitin. Tämän laitteen verkkokytkimellä on ainoastaan toiminnallinen tarkoitus. Sitä ei ole tarkoitettu, eikä se sovellu laitteen erottamiseen käyttöjännitteestä.

Français

ATTENTION - DANGER!

Cet appareil doit impérativement être mis à la masse par le conducteur de terre du câble d'alimentation ou, si l'instrument en comporte une, par la borne de terre. Il peut être dangereux en cas de coupure du circuit de terre, que ce soit à l'intérieur ou à l'extérieur de l'instrument. Il est formellement interdit de couper intentionnellement le circuit de terre. De plus, une masse signal doit être connectée si l'un quelconque des signaux d'entrée dépasse 40 V crête.

Ne pas déposer les panneaux de protection.

Le fait que le fusible d'alimentation saute par suite d'une anomalie risque de détériorer l'alimentation secteur de l'instrument; dans ce cas, le faire contrôler par un technicien qualifié.

Pour couper l'alimentation secteur de cet instrument, débrancher le cordon secteur monté à l'arrière. L'interrupteur d'alimentation est purement secteur fonctionnel. Il ne s'agit pas d'un dispositif de coupure du courant, et n'est pas conçu pour cette fonction.

Deutsch

WARNHINWEIS!

Dieses Gerät muß mit einer Schutzerde betrieben werden, die über den Schutzleiter des Speisekabels oder über die Erdungsklemme des Gerätes (falls vorhanden) anzuschließen ist. Bei einer Unterbrechung der Schutzerde außerhalb oder innerhalb des Gerätes kann eine Gefahr am Gerät entstehen! Eine beabsichtigte Unterbrechung ist nicht zulässig. Achtung! Bei Signalspannungen über 40 V muß die Signalmasse angeschlossen sein.

Die Schutzabdeckung nicht entfernen.

Wenn die Sicherung der Versorgung infolge eines Defektes durchbrennt, besteht die Möglichkeit einer Beschädigung des Wechselstromversorgungs-Schalters des Gerätes. Der Schalter muß dann von einem qualifizierten Elektriker geprüft werden.

Zum Trennen des Gerätes von der Wechselstromversorgung den IEC-Stecker von der Rückwand abziehen. Der Wechselstromversorgungs-Schalter dient bei diesem Gerät nur für Funktionszwecke. Er ist nicht als Trennvorrichtung bestimmt bzw. geeignet!

Italiano

AVVISO DI SICUREZZA

Questo strumento deve esser utilizzato con un collegamento protettivo di messa a terra tramite il filo di messa a terra del cavo di alimentazione o tramite il terminale di messa a terra in sicurezza, nel caso in cui lo strumento ne sia dotato. Qualsiasi interruzione della massa a terra protettiva, sia all'interno che all'esterno dello strumento, lo renderà pericoloso. E'vietata qualsiasi interruzione causata intenzionalmente. Inoltre, la connessione di terra deve essere collegata se ad uno qualsiasi degli ingressi viene applicato un segnale superiore a 40 V di picco.

Non aprire lo strumento.

Nel caso in cui il fusibile dell'alimentazione dovesse scattare a causa di un guasto, è possibile che l'interruttore dell'alimentazione a corrente alternata dello strumento possa essere danneggiato e dovrà pertanto essere controllato da un tecnico specializzato e qualificato.

Per disinnestare questo strumento dall'alimentazione a corrente alternata, levare il connettore IEC che si trova sul pannello posteriore. L'interruttore dell'alimentazione a corrente alternata di questo strumento viene fornito esclusivamente per scopi operativi e non viene inteso, né è adatto, per essere utilizzato come dispositivo di disinnesto.

Norsk

ADVARSEL!

Apparatet må tilkoples jordet stikkontakt.

Dette instrumentet må bare anvendes så lenge det er jordet via den beskyttende jordlederen i strømkabelen, eller via jordingsklemmen, hvis instrumentet har en. Eventuelle forstyrrelser i den beskyttende jordingen, inne i eller utenfor instrumentet, vil sannsynligvis gjøre instrumentet farlig. Forsettlig forstyrrelse er forbudt. I tillegg, signal jord må tilkobles dersom inngangs signalet overstiger 40 V spissverdi.

Ikke fjern dekslene

Hvis sikringen springer på grunn av feil som oppstår, er det mulig at instrumentets vekselstrømbryter kan bli skadet – den må derfor kontrolleres av en kvalifisert ingeniør.

Skal instrumentet koples fra vekselstrømtilførselen, kopler man ut IEC-koplingen bak på panelet. Vekselstrømbryteren på dette instrumente tjener kun en funksjonell hensikt. Den er ikke egnet, og må ikke brukes, som skillebryter.

"Apparatet må tilkoples jordet stikkontakt"

Português

Aviso de segurança

Este aparelho deve ser operado com uma ligação terra ligado por um conductor trifásico do cabo principal ou, se o instrumento já tiver um, via um terminal de segurança. Qualquer interrupção do trifásico, dentro ou fora do aparelho, pode tornar o aparelho perigoso. É proibida a interrupção intencional. Nota: O terminal de terra deve ser ligado se o sinal de entrada a medir for superior a 40 V de pico.

Não retire o invólucro/capas.

Se o fusível suplementar queimar por causa de erro, é possivel que o interruptor da fonte AC do aparelho esteja com defeito e deveria ser checado por pessoa autorizada.

Para desconectar este aparelho da fonte AC, retire o conector IEC do painel trazeiro. Neste aparelho, o interruptor da fonte AC existe sómente por razões funcionais. Não deve ser usado e nem é apropriado como dispositivo de desconexão.

Español

ADVERTENCIA SOBRE SEGURIDAD

Este instrumento debe utilizarse conectado a tierra a través del conductor de puesta a tierra del cable de alimentación o de la borna de seguridad, si dicho instrumento estuviera equipado con ella. Cualquier interrupción de esta puesta a tierra, dentro o fuera del instrumento, hará que el manejo del mismo resulte peligroso. Queda terminantemente prohibido dejar en circuito abierto dicha puesta a tierra. Además, debe conectarse una señal de tierra si cualquier señal de entrade sobrepasa los 40 V de pico.

No quite las tapas.

Si se fundiera el fusible de alimentación como consecuencia de una avería, cabe la posibilidad de que el interruptor de encendido del equipo esté dañado y sea necesario comprobarlo por personal técnico especializado y autorizado al efecto.

Para desconectar este instrumento de la red, desenchufe el conector IEC del panel trasero. El interruptor de entrada de CA (encendido) se incluye solo para fines funcionales. No está pensado para utilizarse como medio de desconexión, ni tampoco es adecuado para ello.

Svenska

SÄKERHETSVARNING

Apparaten skall anslutas till jordat uttag.

Detta instrument måste drivas med en skyddande jordledning ansluten via den skyddande jordledaren på matarkabeln eller, om instrumentet har sådan monterad, via det jordade uttaget. Om jordanslutningen störs, inuti eller utanför instrumentet, är det troligt att instrumentet kommer att utgöra en fara. Avsiktlig störning är förbjuden. Dessutom måste en signaljord anslutas om någon av ingångssignalerna överstiger 40 V topp.

Tag ej bort skydden.

Om matarsäkringen smälter på grund av ett fel är det möjligt att strömställaren för växelströmsmatning på instrumentet skadas och den bör då inspekteras av en ingenjör med lämpliga kvalifikationer.

För att koppla bort instrumentet från växelströmstillförseln, tag ut IEC-anslutningen på bakpanelen. Strömställaren för växelströmstillförsel på detta instrument är enbart till för funktionerliga ändamål. Den är inte avsedd som, eller lämplig som, en bortkopplingsanordning.

"Apparaten skall anslutas till jordat uttag"

English

SAFETY WARNING

This instrument must be operated with a protective ground (earth) connected via the protective ground conductor of the supply cable or, if the instrument is fitted with one, via the safety ground terminal. Any interruption of the protective ground, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. In addition, a signal ground must be connected if any input signal exceeds 40 V peak.

Do not remove the covers.

If the supply fuse blows as the result of a fault, it is possible that the instrument's AC supply switch will be damaged and should be checked by a suitably qualified engineer.

To disconnect this instrument from the AC supply, unplug the IEC connector on the rear panel. The AC supply switch on this instrument is provided for functional purposes only. It is not intended as, or suitable as, a disconnecting device.

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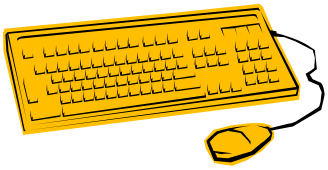
Chapter 2: About This Manual

Symbols Used in This Manual

The following symbols are used throughout this manual to indicate warnings and cautions.

WARNING	**Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
WARNING	**Indicates a fire hazard which, if not avoided, could result in death or serious injury.**
WARNING	**Indicates an electrical shock hazard which, if not avoided, could result in death or serious injury.**
CAUTION	**Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or alerts against unsafe practices, or alerts against actions which could damage the product.**
	**Indicates a mouse and/or keyboard are required to carry out a specific task. While not needed to operate the oscilloscope, a mouse and/or keyboard are required to setup some Windows functions such as: network, printers, time/date, etc. Typical Windows conventions are used for these purposes.**

Manual Conventions

For clarity and convenience, these conventions are used throughout this manual:

- ***Menu names*** and ***commands*** appear in bold, italic lettering.
- **Front Panel** and other **controls** and **control names** appear in bold lettering.

Chapter 3: Introduction

Introducing the Sigma Series Digital Oscilloscopes

Congratulations on your purchase of a Sigma Digital Oscilloscope Workstation. The Sigma is the only DSO (Digital Storage Oscilloscope) in its class to include an integrated, full-featured Windows PC offering acquisition, analysis and connectivity in a single, portable workstation. The Sigma has an extensive range of real-time measurement capabilities or you can load your own third party analysis directly.

Your Sigma incorporates a streamlined "bookshelf" design, maximizing display and front panel space, yet minimizing the impact on valuable bench space. Traditional front panel controls proved a comfortable look and feel. An integrated touch screen provides direct access to all oscilloscope functions, including acquisition, analysis and setup.

A mouse and keyboard are not required to operate your Sigma, even for advanced functions. However a mouse and keyboard can be added to provide another method of control for the ultimate in flexibility.

Premium features include:

- Up to 8 input channels
- Up to 12 bit, 0.25% accuracy at probe tip – the best available at any price!
- Mix and match sample rates and resolutions
- Differential input mode
- Dual Timebase Mode with independent sample rates and memory lengths
- Full featured integrated Windows PC with Windows 2000, Ethernet, USB, and more
- Sophisticated range of real-time measurements including custom analysis
- High resolution 10.4 inch touch-screen display
- IntelliProbe™ interface seamlessly integrates probe ID, scaling and probe power
- Optional direct to disk mode enables ultra-long memories to 1 GS
- Optional dual independent monitor mode
- Optional Synchroscope® Module enables rotational measurements

The Sigma Series of Oscilloscopes includes:

	Number of Channels	Resolution	Maximum Sample Rate	Accuracy	Bandwidth	Input Filter Stages	Input Amplifier Type	Input Range	Number of Timebases
Sigma 30	4	12-bit	10 MS/s	0.25%	5 MHz	500 kHz	Single ended, switchable to 2 ch diff	5 mV– 20 V/div	1
Sigma 60-4	4	8-bit* 10-bit*	200 MS/s 2 MS/s	1% 0.5%	200 MHz 870 kHz	20 MHz, 1 MHz 870 kHz	Single ended	2 mV– 5 V/div	1
Sigma 75-8	8	8-bit	100 MS/s	0.25%	25 MHz	5 MHz, 500 kHz	Single ended, switchable to 4 ch diff	5 mV– 20 V/div	1
Sigma 90-4	4	12-bit* 8-bit*	10 MS/s 100 MS/s	0.25%	5 MHz 25 MHz	500 kHz 5 MHz, 500 kHz	Single ended switchable to 2 ch diff	5 mV– 20 V/div	1
Sigma 90-8	8	12-bit* 8-bit*	10 MS/s 100 MS/s	0.25%	5 MHz 25 MHz	500 kHz 5 MHz, 500 kHz	Single ended, switchable to 4 ch diff	5 mV– 20 V/div	2
Sigma 100-4	4	12-bit* 14-bit*	100 MS/s 1 MS/s	0.25%	25 MHz 435 kHz	5 MHz , 500 kHz 5 MHz , 500 kHz	Single ended, switchable to 2 ch diff	5 mV– 20 V/div	1
Sigma 100-8	8	12-bit* 14-bit*	100 MS/s 1 MS/s	0.25%	25 MHz 435 kHz	5 MHz , 500 kHz 5 MHz , 500 kHz	Single ended, switchable to 4 ch diff	5 mV– 20 V/div	2
Sigma 100HV-4	4	12-bit* 14-bit*	100 MS/s 1 MS/s	0.25%	25 MHz 435 kHz	5 MHz , 500 kHz 5 MHz , 500 kHz	Single ended, switchable to 2 ch diff	5 mV– 20 V/div	1
Sigma 100HV-8	8	12-bit* 14-bit*	100 MS/s 1 MS/s	0.25%	25 MHz 435 kHz	5 MHz , 500 kHz 5 MHz , 500 kHz	Single ended, switchable to 4 ch diff	5 mV– 20 V/div	2

* Software selectable

Sigma Features and Performance

Differential Inputs

Differential inputs offer great benefits over single-ended inputs including:

• Elimination of ground loop errors

• Reduction of noise pickup in long cables

• Direct measurement of floating circuits

• Safe phase to phase power measurements

Your Sigma has a variety of differential measurement options:

• For the highest possible performance, Sigma incorporates the IntelliProbe interface offering better than 0.1% accuracy at the probe tip, plus high CMRR and high voltage differential probes. The IntelliProbe family even includes a current probe and all seamlessly integrate probe identification, scaling and probe power for worry free operation.

• For routine applications that don't require such extreme performance, the Sigma 30, 75, 90 and 100 models offer high accuracy front end amplifiers that allow you to make a quick and accurate differential measurement. A convenient differential menu selection enables you to use two channels to make a differential measurement.

Rotational Measurements

All Sigma models include an External Clock input for synchronization with rotating machinery. But often a convenient clock signal such as 360 or 1024 per revolution is not available. Our optional Synchroscope® module fits inside, utilizing the Sigma's internal PCI slot to solve this common problem. The module provides the ideal solution for monitoring and analysis of engines, pumps, generators or any other application which requires data with respect to angular rotation.

The flexible Synchroscope caters to a wide range of input devices such as shaft encoders, magnetic pickups and pulses from the ECU. It clocks the scope with up to 0.005 degree resolution, plus provides a trigger signal from extra or missing pulses.

The SynchroScope even measures instantaneous speed between each pulse for torsional vibration studies, a uniquely powerful feature available in no other oscilloscope family in the world.

Acquisition

Sigma combines ultra-low noise and ultra-high precision amplifiers, providing better than 0.25% accuracy even at probe tip when using LDS-Nicolet's high performance Intelliprobes. You can choose from several digitizers ranging from high resolution 12-bit models for your physical, mechanical and powerline measurements to a high-bandwidth 200 MHz model for your digital electronics and switched power applications. You can even mix hi-speed and hi-resolution in the same scope for control systems and mechatronics work.

Trigger Features

Sigma's comprehensive range of trigger tools easily isolates changes in amplitude, timing or continuing events. Advanced functions also let you detect more elusive faults such as drop-outs and phantom pulses. But even more importantly, only LDS-Nicolet provides the real-world ability to adjust sensitivity for stable triggers on noisy signals. That means you get a trigger you can trust – consistently.

Flexible Acquisition Memory

Short memories can cost you more than they save. Megaword memories such as those found on Sigma are crucial to capture spurious or transient events for their complete duration without forcing a compromise of horizontal resolution. A unique dual time base in the 8 channel Sigma 90-8 and Sigma 100-8 models allow channels to be acquired at different rates for maximum memory utilization. For rapid bursts of events, Sigma's memory segmentation allows up to 2000 separate triggers to be captured in rapid succession with time stamping and almost no re-arm time.

Traditional DSO memory is augmented by the optional Direct to Disk mode available for all Sigma models. Waveforms can be stored continuously to Sigma's internal hard disk at aggregate speeds up to 200 kS/s. Record lengths of up to 10^9 samples allow literally hours of gap free acquisition at most acquisition rates.

LDS-Nicolet's StatStream™ technology enables ultra-long recordings to be instantly displayed and analyzed. Stored data can be replayed and analyzed using Sigma's extensive analysis suite anywhere on your network using LDS-Nicolet review software.

Ever wonder what led up to a trigger event? Sigma's full disk pre-trigger uses the hard disk as a data buffer, constantly monitoring for a trigger event for permanent storage. When a trigger is received, the full pre-trigger data can be saved and archived automatically. Each segmented sweep includes time stamping and almost no re-arm time Sigma continuously stores data to hard disk.

Analysis Capability

Despite the many advances in DSO technology, most digital oscilloscopes today continue to concentrate only on data capture and display. The actual analysis performed on most DSO's is still relatively simplistic including only basic parametric functions. More extensive analysis often involves a tedious process of file conversion and data transfer to other software.

Flexible Real-Time Analysis

With Sigma, acquired data can be directly analyzed using any combination of unlimited real-time functions. Highly customized measurements can be defined using Sigma's formula editor, with results shown as new traces (FFT, integrate, +, -, x, ÷, filter) or as single values such as min, pk-pk, duty cycle or RMS. Formulas can be stacked to perform even complex analysis in real-time with every trigger.

Windows Analysis and Report Generation

For reporting and printing results, data can automatically be transferred in a variety of formats to MS Word or to LDS-Nicolet's ProView or FlexPro software for customized report layout. And because the Sigma is a full function PC, data and reports can be sent anywhere via network or modem. What could be more simple? Data can also be immediately posted to most popular Windows analysis packages including Excel, MATLAB, DIA-DEM and DADiSP. You can run your favorite programs on the Sigma or use its data files anywhere via wired or wireless Ethernet.

Advanced Display Performance

The large high resolution touchscreen display offers a variety of display options and ample room for readout of current instrument settings. Up to 8 display windows with any number of traces can be viewed simultaneously. Main, zoom and user defined math traces can be viewed independently and scaled to user defined units. Then save in PDF format or print to any Windows printer at the touch of a button.

Connectivity

The real power of Windows operation is connectivity. Sigma incorporates the latest in connectivity including:

- High speed 100 baseT Ethernet provides direct Windows network connection
- USB 2.0 interface enables direct connection to a variety of external storage devices as well as mouse and keyboard
- Any Windows compatible printer

PC Expansion

Sigma's available expansion slot offers the ability to integrate a variety of LDS-Nicolet support cards further enhancing Sigma's vast feature set:

- Optional Synchroscope module enables direct rotational analysis including support for instantaneous RPM measurements.
- Optional Dual Video module allows data to be viewed in real-time on multiple displays. View data on one display and analyze in MATLAB, Excel or LabView on the second.

Sigma Software

To complement the wide-range of Sigma analysis capabilities, LDS-Nicolet offers a range of Windows based products.

ProView Analysis Software

ProView accepts data directly from Sigma, providing lightning fast display, zoom and plotting of data. A formula database lets you define custom calculations with over 100 math functions, updated every time new data is available. And built-in report generation combines your plots, numeric results, test information and even your company logo in professional-looking color reports.

FlexPro Analysis Software

FlexPro accepts data directly from Sigma offering an extended array of time and frequency domain analysis functions. Objects such as 2-D and 3-D plots and result tables can be placed in a report, word processor or on your web site.

DataSentry ™ Remote Monitoring Software

DataSentry ™ offers remote monitoring and control of Sigma for long distance troubleshooting applications. It enables Sigma to be programmed to automatically transmit data or reports based on predetermined measurement criteria. Data can be transmitted via Ethernet or modem, based on a simple trigger event or based on boundary conditions.

Sigma API Programmers Library

ActiveX control library enables complete customization of Sigma for automation and application specific situations. All scope functions and traces are directly accessible through our published DCOM interface.

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Chapter 4: Using Your Sigma

This chapter provides a working map of the main functions of your Sigma DSO. Each section guides you through a different setup or function of the oscilloscope:

- **Acquiring Traces in the Scope Mode**
  Quickly set the Sigma with a repetitive waveform on any one or all channels
  Set the Sigma to provide the optimum settings to suit your application
  Set the display settings
  Select the channels to be displayed and their amplitude and position
  Set the timebase/dual timebase and trace position
  Set the trigger
- **Setting the Timebase and Multi-Shot Capture**
  Set the timebase
  Set up for multi-shot capture
- **Setting Vertical and Horizontal Scaling**
  Set the vertical scaling
  Set the horizontal scaling
- **Setting the Acquisition Functions**
  Set glitch detect, averaging, bandwidth, resolution and external clocking
- **Setting Measurements and Cursors**
  Set a snapshot measurement
  Set up the cursors
  Select traces and bring cursors on screen
  Search for peaks and valleys
- **Transferring Data**
  Set a destination, source, and area for data transfer
  Enable auto transfer and start/add a transfer
- **Saving, Exporting and Recalling a File**
  Save a file
  Export a file
  Recall a file
- **Printing a File**
- **Using the Utilities**

- **Setting Functions for Waveform Analysis**
  Add a function
  About Trace Math functions
  Trace Math – Add, Subtract, Multiply and Divide functions
  Trace Math – Invert, Filter, Integrate, and Differentiate functions
  Trace Math – XY function
  Trace Math – Segment function
  Trace Math – Time Shift function
  About Measurements
  Measurement parameters
  Measurements – changing Measurement parameters
  Measurements – individual descriptions
  FFT
  FFT parameters
  Graphs
  Graph parameters
  Histogram
  Histogram parameters
  Delete a function
  Change the color of a trace
- **Using the Analysis Control Panel**
  Name
  Select Item
  Main Window
  Zoom Window
  Units and Scaling

Once you have worked through these sections, you will be ready to begin using your Sigma.

Acquiring Traces in Scope Mode

1. On the front panel, press the **MODE** button to open the ***Mode*** menu.
2. On the screen, press the Scope button.

To quickly set the Sigma with a repetitive waveform on any one or all channels:

3. Set the Auto Setup function by pressing the front panel **USER** button to open the ***User Function*** menu.
4. Press the ***Start Auto Setup*** button.

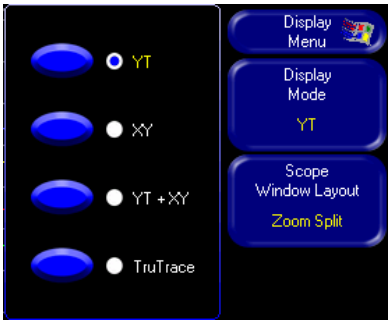
To set the Sigma to provide the optimum settings to suit your application:

5. Setting the Sigma for a specific application consists of setting the display layout, number channels to be used and the type of triggering.

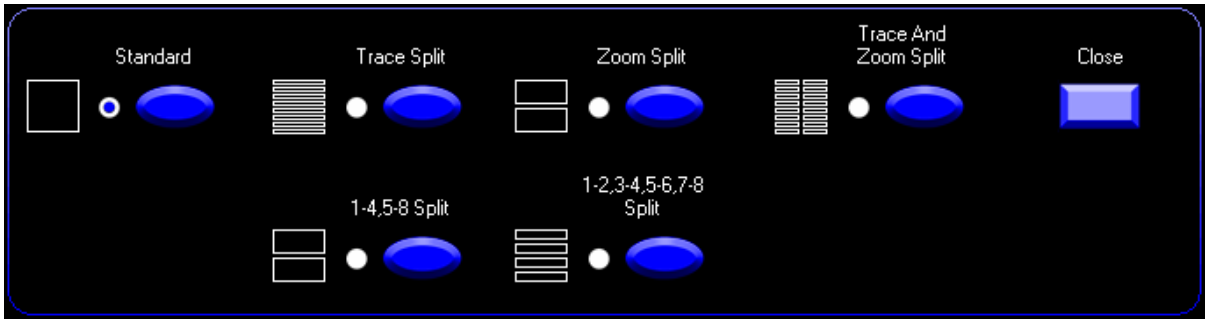
To set the display settings:

6. On the front panel, press the **MENU** button to open the ***Master*** menu. Then press the ***Display*** button.

7. For amplitude versus time waveforms, select YT from the ***Display*** menu. TruTrace® mode works in YT mode only. TruTrace provides an analog variable persistence display trace using single shot. TruTrace is a patented data-compression method which modulates the intensity of a signal based on signal activity. TruTrace operates on each single-shot acquisition, as well as a series of repeated acquisitions.



8. Press the Scope Window Layout button to select way you want your screen to look.



9. Selecting ***Standard*** displays all the traces in one window.

   Trace Split creates four stacked windows with one channel per window. This view has the advantage of showing the waveforms allocating full resolution without overlaying the traces.

   Zoom Split places the entire four channels in the top window and the zoomed only portion in the bottom window.

   Trace and Zoom Split creates four stacked windows with one unzoomed channel per window in the left column and four stacked windows with one corresponding zoomed channel per window in the right column.

Note: *The **Zoom Split** or **Trace and Zoom Split** modes are dependant on the number of channels available on the system, the Main/Zoom settings, such as **Main Window Only**, **Zoom Window Only** or **Both Main and Zoom**.*

10. Press the front panel TRIGGER button, press the front panel **AUTO** button and then press the front panel RUN button. To ensure the Sigma is acquiring data in the Run mode, verify that the ***Acquisition No.*** is incrementing in the bottom right corner of the display.

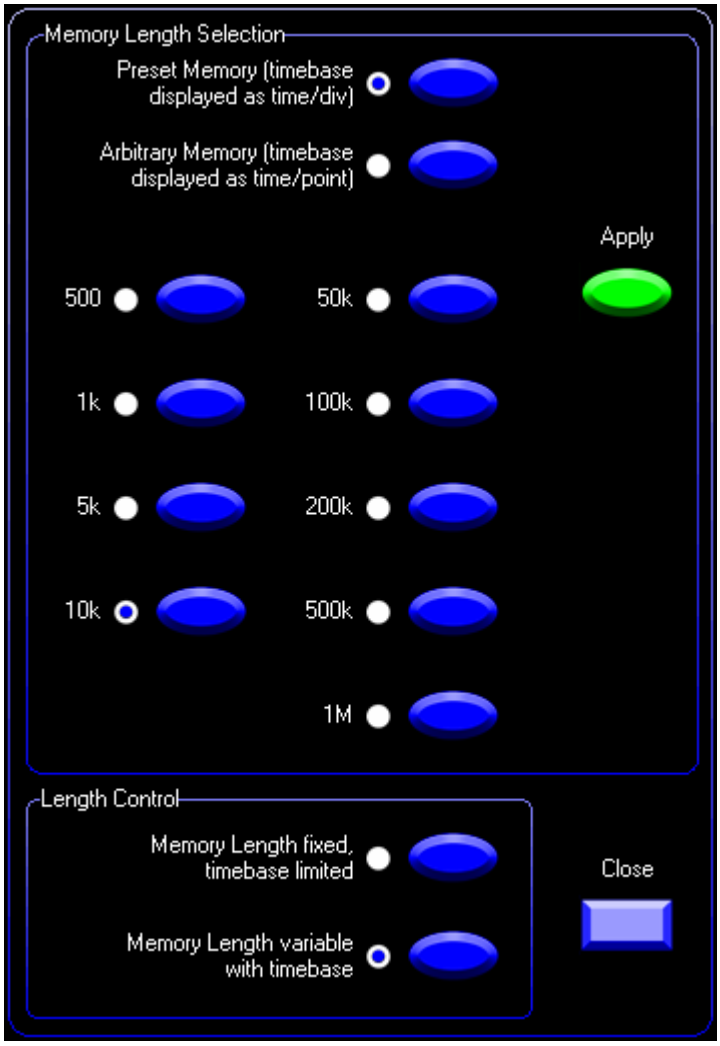
To select the channels to be displayed and their amplitude and position:

11. Press the front panel **CHANNEL** button to open the ***Channel*** menu.
12. Press the ***Channel*** button and choose the channel number from the control panel on the screen. Check the display to make sure the channel you selected is displayed.
13. Press the ***Probe Scaling*** button to select the appropriate scaling for the probe being used. IntelliProbes are set automatically.
14. Press the ***Coupling*** button to select the coupling required. If the signal is off ground AC coupling can be used to eliminate the DC component.
15. The ***More..*** selection enables access to additional parameter settings including ***Channel Name*** and ***Units and Scaling*** settings. Further details on the ***Units and Scaling*** operation are described later in the *Setting Vertical and Horizontal Scaling* section.
16. Use the front panel knobs to adjust the ***Position*** and ***Scale (/DIV)*** ranges for each trace. Note that pressing either knob toggles the selection between the Main trace and the Zoom trace.
17. Repeat Steps 11 through 15 for the other channels.

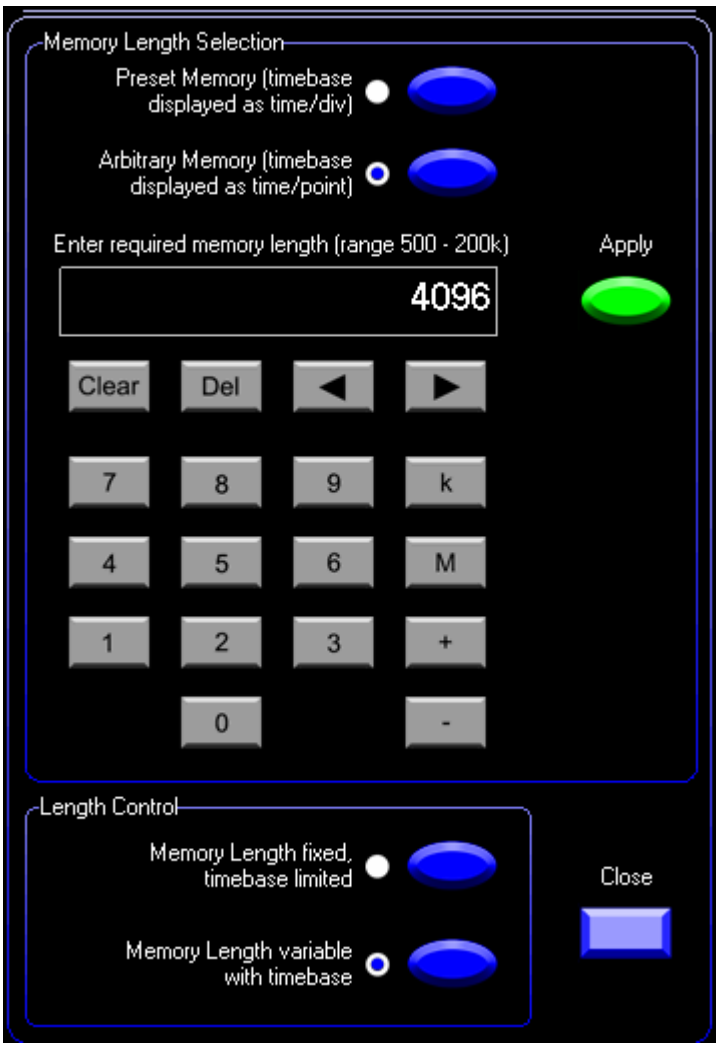
To set the timebase and trace position:

18. Press the front panel **TIMEBASE** button to open the ***Timebase*** menu.

19. Press the ***Memory Length*** button to select a suitable "Preset Memory" length for the required time and sample rate.



If an "Arbitrary Memory" length is desired, then selecting this mode within the ***Memory Length Window*** will allow the entry of a custom length. By default, Memory Length varies with changes in the timebase, however if a fixed Memory Length is desired, this selection can be made near the bottom of the ***Memory Length Window.***



20. [For 8 channel units only] Press the ***Dual Timebase*** button to set the Dual Timebase mode, On or Off. When the Dual Timebase mode is set to On, channels 1-4 are dedicated to Timebase A, and channels 5-8 are dedicated to Timebase B. Pressing the ***Timebase*** knob toggles between Timebase A and Timebase B. The Dual Timebase mode allows for independent Timebases and Memory Lengths between channels 1-4 versus channels 5-8 for unique applications.

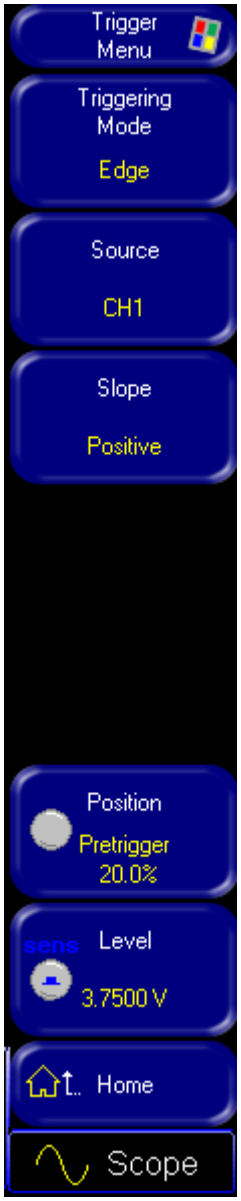
Note: *Some functions may be grayed out when the Dual Timebase mode is set to On.*

21. Press the Main/Zoom button to set the display mode. You can choose ***Main***, ***Main-Zoom*** or ***Zoom***. If the main trace is zoomed, on screen zoom will automatically be selected. (If ***Main-Zoom*** is selected, the zoom trace window will be automatically positioned on the horizontal axis.)

22. Use the **Zoom Position** knob on the front panel to position the trace on the horizontal axis.

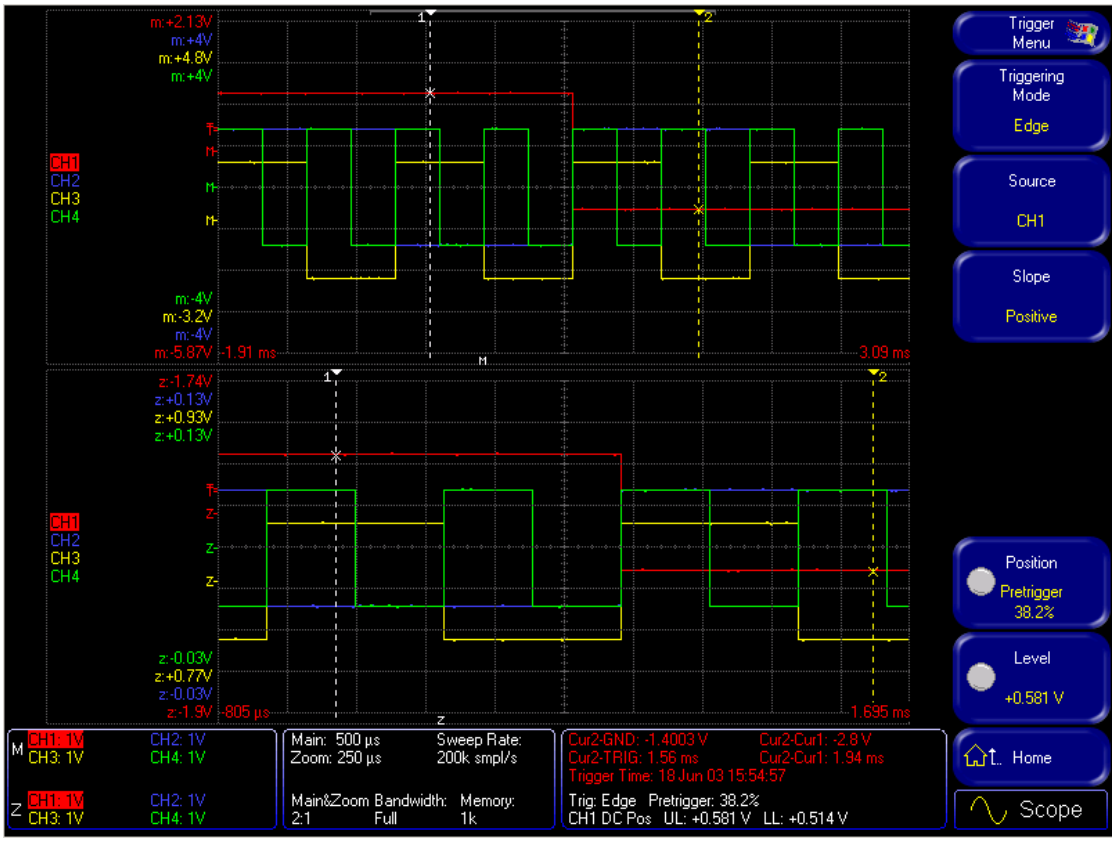
23. Use the **Zoom Timebase** knob on the front panel to adjust the timebase range to the required range.

To set the trigger:



24. Press the front panel **TRIGGER** button to open the ***Trigger*** menu.
25. Press the ***Triggering Mode*** button and select the Edge trigger from the on screen panel. Edge triggers are the most commonly used type of trigger.
26. Press the ***Source*** button to select the channel to be used as the trigger source.
27. Press the ***Slope*** button to select the slope of the signal to define the trigger point.
28. Use the front panel **Level** knob to set the level to obtain a stable trigger. On Sigma Models 30, 90 and 100 ***Trigger Sensitivity*** can also be adjusted. Pressing the **Level** knob toggles between Level and Sensitivity (as shown).
29. Use the front panel **Level** knob to set the level to obtain a stable trigger.

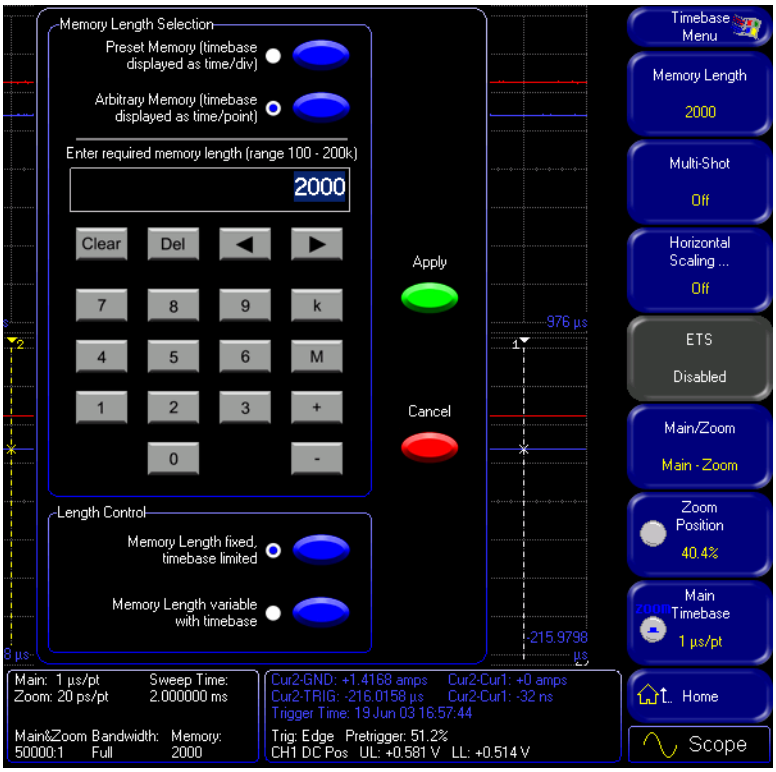
Your screen should now look similar to the one shown here.



Setting the Timebase and Multi-Shot Capture

To set the timebase:

1. Press the front panel **TIMEBASE** button to open the ***Timebase*** menu.
2. Press the ***Memory Length*** button to open the on screen panel where you can select ***Arbitrary Memory*** to display the samples as time per point.
3. Adjust the timebase to set the required sample rate then select the memory length that will enable the system to collect data for the required length of time.
4. Calculate the memory length required from:
   Memory length = segment period/sample per point.
   Enter the memory length (2.000000 ms is shown in this example.)



5. Press ***Apply*** to exit the panel.

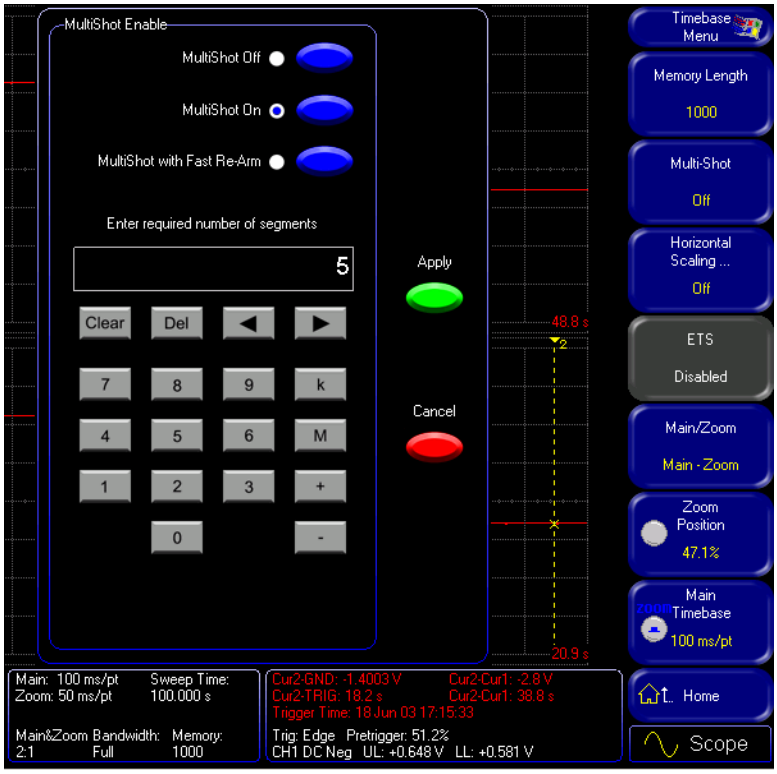
To set up for multi-shot capture:

Multi-Shot captures multiple triggered events by segmenting the memory for each channel. There are two basic modes of operation:

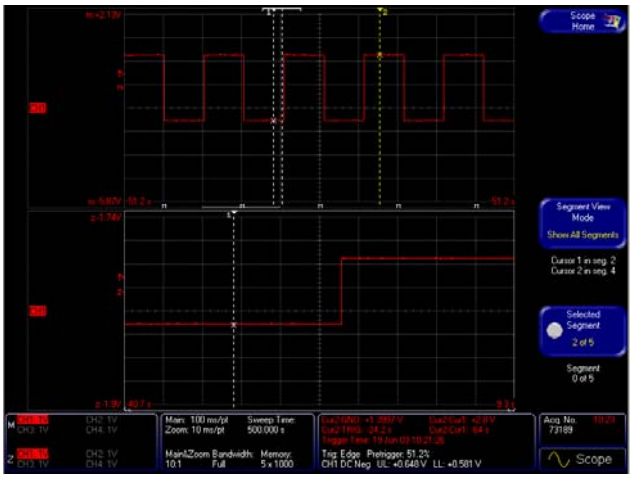
Multi-Shot with Fast Re-Arm which gives priority to the trigger and updates the display after all the segments have been acquired. (nominally 100 µs between triggers)

Multi-Shot On updates the display continuously and hence there will be a longer time between triggers. The time is measured between each segment and will be incorporated into time measurements.

6. Press the ***Multi-Shot*** button to open the on screen panel where you can choose the number of segments required. Each segment is set to use as much memory as required, but the amount actually used is reduced when the maximum store length is reached. In the example shown here the acquisition is set to 5 segments.



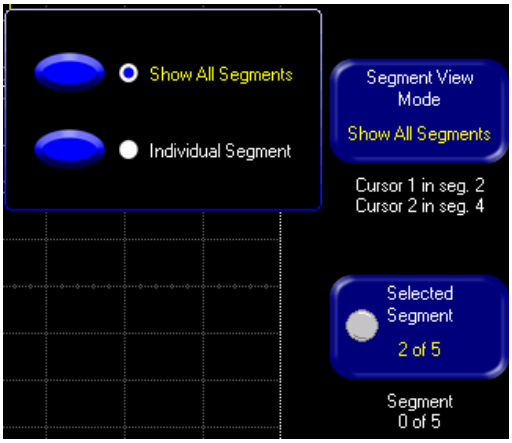
7. The resulting display should look like the following example. (Press the front panel **MODE** button and then press the ***Scope*** button to choose the modes for displaying segments.)



8. There are two modes to choose from when displaying segments:

   Show All Segments. The main trace will show all the segments across the screen and measurements can be made, which includes the time between triggers. Zoom can be applied showing segments or parts of segments.

   Show Individual Segment. The main trace will display a segment chosen using the ***Selected Segment*** button and entering the required number or using the front panel knob to step through the segments.

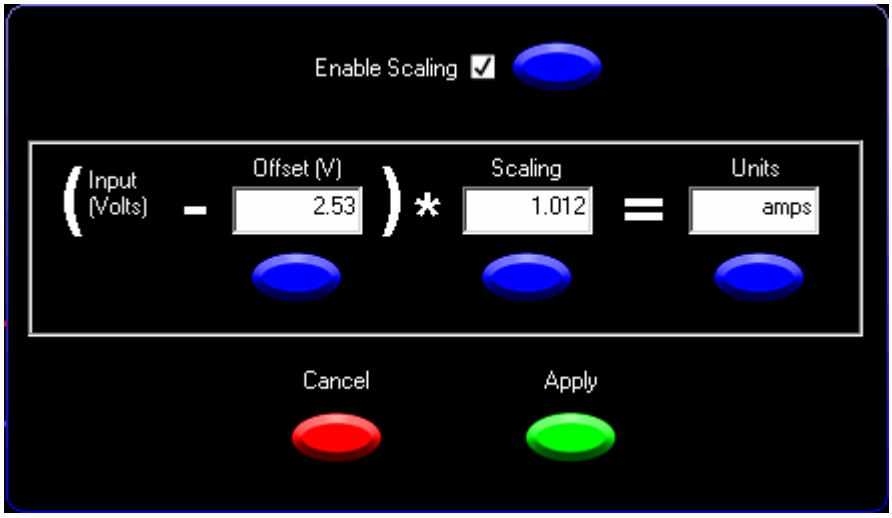


Setting Vertical and Horizontal Scaling

The inputs can be rescaled to cater for engineering units in both amplitude and time.

To set the vertical scaling:

1. Press the front panel **CHANNEL** button to open the ***Channel*** menu.
2. Press the ***More*** button and then the ***Units and Scaling*** button to display the scaling formula on screen.



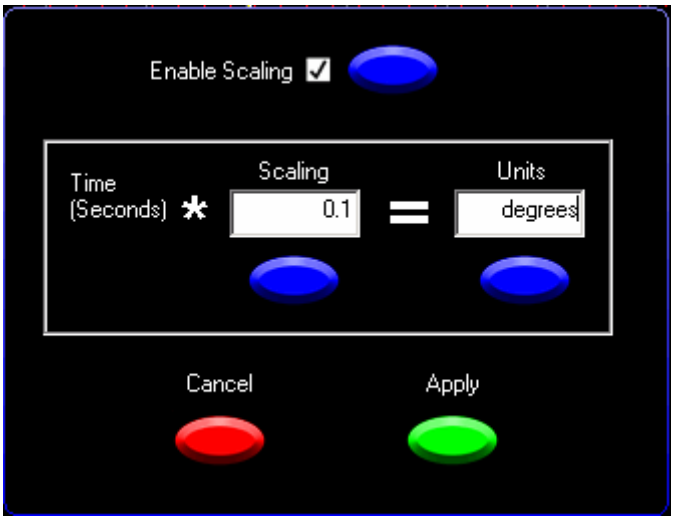
3. At the top of the panel, select ***Enable Scaling***.
4. Enter the parameters required either by opening the on screen keyboard by pressing the blue button below each parameter or by direct entry from an external keyboard.

   Offset removes any live zero.
   Scaling corrects the range calibration slope.
   Engineering Units allows you to change the displayed units.

5. Press ***Apply*** to exit the panel.

To set the horizontal scaling:

6. Press the front panel **TIMEBASE** button to open the ***Timebase*** menu.
7. Press the ***Horizontal Scaling*** button to display the scaling formula on screen.



8. At the top of the panel, select ***Enable Scaling***.
9. Enter the parameters required either by opening the on screen keyboard by pressing the blue button below each parameter or by direct entry from an external keyboard.

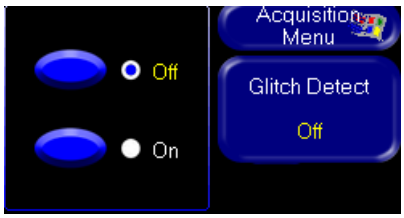
   Scaling corrects the range calibration slope.
   Engineering Units allows you to change the displayed units. For example, the time axis can be displayed in degree rotation or distance.
10. Press ***Apply*** to exit the panel.

Setting the Acquisition Functions

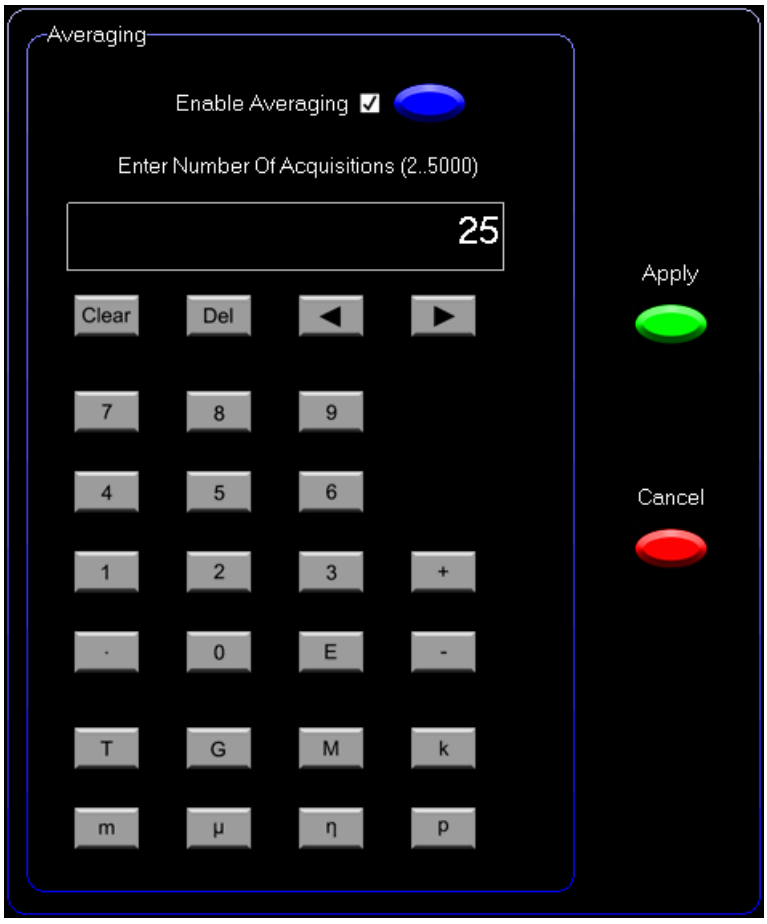
To set glitch detect, averaging, bandwidth, resolution and external clocking:

1. Press the front panel **MENU** button to open the ***Master*** menu.
2. Press the ***Acquisition*** button to display the ***Acquisition*** menu.

3. Press the ***Glitch Detect*** button to turn on/off the Glitch Detect function.



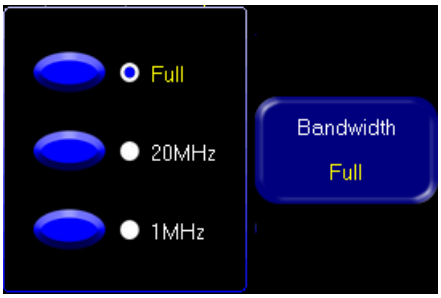
4. Press the ***Average*** button to display the Averaging control panel shown below.



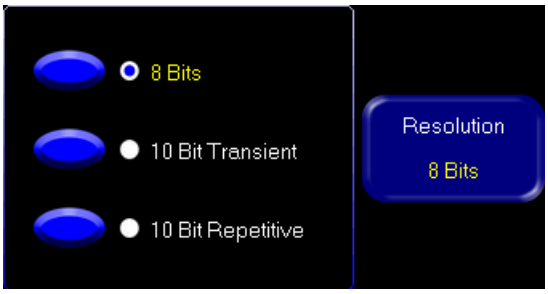
5. Press the ***Enable Averaging*** button to enable the Averaging function and to enable the on screen keyboard to enter an averaging value.

6. Enter the value and press ***Apply*** to close the control panel

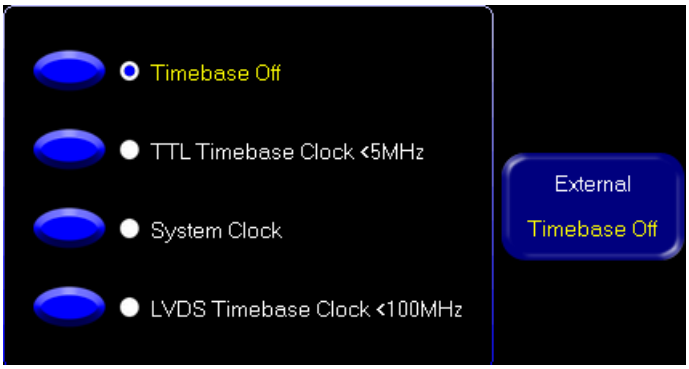
7. Press the ***Bandwidth*** button to select the required bandwidth. The available selections for bandwidth will depend on the Sigma model you are using. The example shown here is for the Sigma 60.



8. Press the ***Resolution*** button to select the required resolution. The available selections for resolution will depend on the Sigma model you are using. The example shown here is for the Sigma 60.



9. Press the ***External*** button to select the required External Timebase.



For normal operation, leave the External Timebase ***Off*** and the Sigma will clock the timebase internally.

Setting Measurements and Cursors

To set a snapshot measurement:

1. Press the front panel **MENU** button to open the ***Master*** menu.
2. Press the ***Measurement and Cursors*** button to display the ***Measurement*** menu.

3. Press the ***Snapshot Measurement Setup*** button to display the SnapShot control panel shown below.

4. Press the ***Show SnapShot*** button to enable the SnapShot measurements function. All the possible measurements that can be displayed are sorted into three categories: **Cursor**, **Voltage** and **Time**, as shown in the left column under ***Measurements***. The category currently selected is indicated by the yellow button. Pressing any of these three buttons displays the available measurements for that category in the right columns. Each individual measurement can be toggled on/off. The ***Enable All*** and ***Disable All*** buttons at the bottom turn on all measurements or turn off all measurements for all headings/buttons respectively.
5. Press the ***Close*** button to exit the panel.

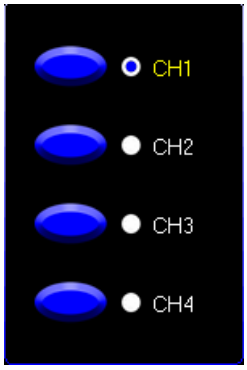
To set up the cursors:

6. Press the ***Cursor Setup*** button to open the Cursor Setup control panel shown below.

7. Under the ***Cursor Enable*** section, press the ***Vertical*** and/or ***Horizontal*** buttons to toggle the vertical and horizontal cursors on/off the screen respectively.
8. Under the ***Cursor Locking*** section, press the ***Locked*** button to have one cursor follow the movement of the other. Press the ***Independent*** button to move each cursor independently of the other.
9. Press the ***Close*** button to exit the panel.

To select traces and bring cursors on screen:

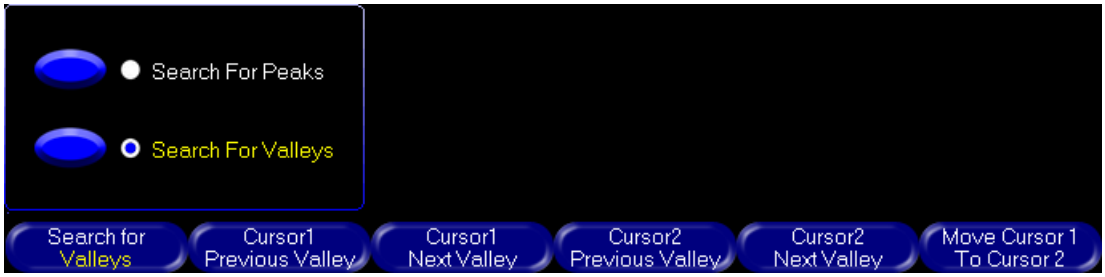
10. Press the ***Cursor Trace Select*** button to select the active trace/channel desired. A control panel opens to show the traces/channels available.



11. Press the ***Bring Cursors On Screen*** button to initially place the cursors on the display.

To search for peaks and valleys:

12. When the ***Measurement and Cursors*** function is selected, a set of buttons appear at the bottom of the display as shown below. The ***Search for Peaks/Valleys*** button (first button on the left) selects the cursor search for Peaks or Valleys. The ***Move Cursor 1 to Cursor 2*** button (on the far right) moves Cursor 1 to Cursor 2. The remaining buttons step either Cursor 1 or 2 to the next or previous peak or valley on the currently selected trace

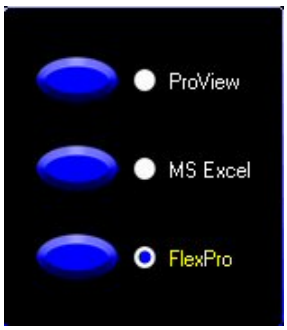


Transferring Data

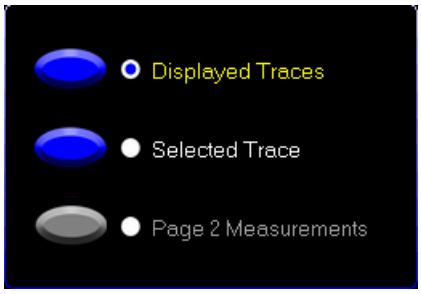
To set a destination, source, and area for data transfer:

1. Press the front panel **MENU** button to open the ***Master*** menu.
2. Press the *Data Transfer* button to display the ***Transfer Setup*** menu.

3. Press the ***Destination*** button to select the application to which the data will be transferred. A control panel opens, showing the available selections.



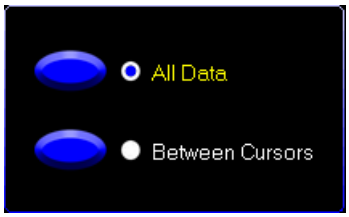
4. Press the ***Source*** button to select the source of the data to be transferred. A control panel opens, showing the available source selections.



Displayed Traces transfers all the traces that are currently displayed.
Selected Trace transfers only the trace that is currently selected.

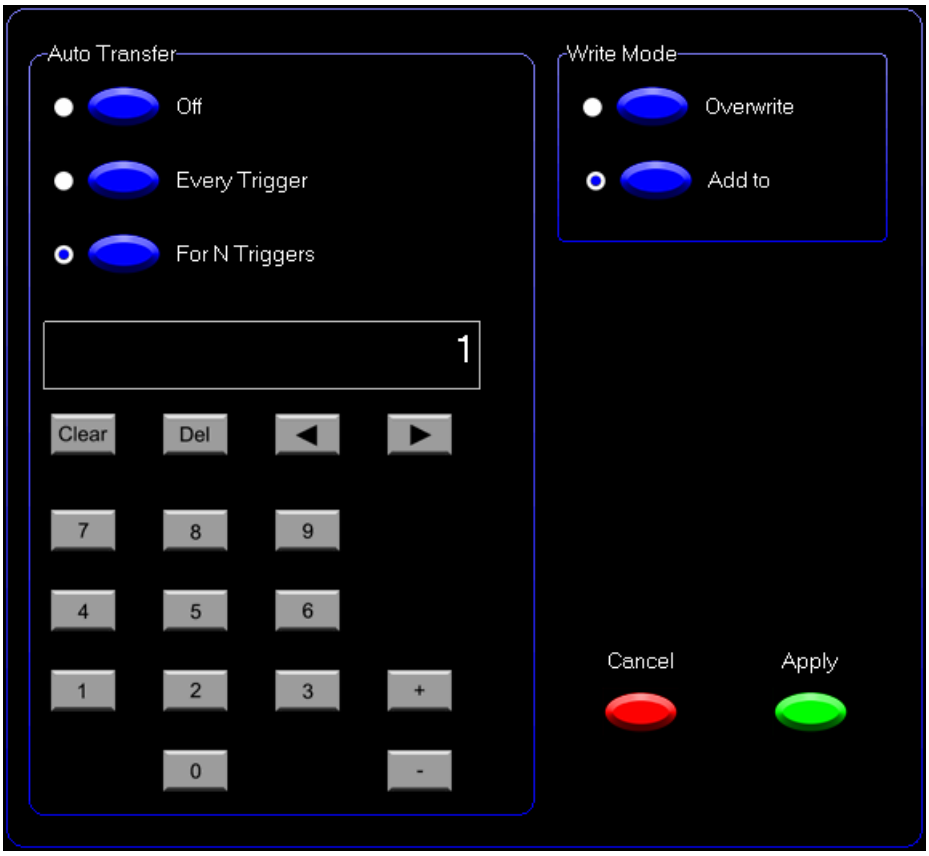
Page 2 Measurements transfer all the measurements that are currently setup in the Page 2 Measurements menu.

5. Press the ***Area*** button to select the area of the trace data to be transferred. A control panel opens, showing the available area selections.



To enable auto transfer and start/add a transfer:

6. Press the **Auto Transfer** button to display Auto Transfer window. A control panel opens, showing the available Auto Transfer selections.



In the ***Auto Transfer*** section of the control panel:
Off disables any automated data transfers.
Every Trigger automatically transfers data after every triggered event.
For N Triggers automatically transfers data for the number of triggers selected and then stops.

In the ***Write Mode*** section of the control panel:
Overwrite overwrites the previous data transferred each time new data is sent.
Add to appends data to the previous data transferred each time new data is sent.

7. Press ***Apply*** to accept the selections for Auto Transfer or press ***Cancel*** to close the control panel without making any changes.
8. Press the ***Start Transfer*** to clear out any previously transferred data and to begin a manual or Auto Transfer.

9. Press the ***Add Transfer*** button to manually add another set of data.

10. Press the ***Home*** button to exit the ***Transfer Setup*** menu.

Saving, Exporting and Recalling a File

To save a file:

1. Press the front panel **MENU** button to open the ***Master*** menu.
2. Press the ***File*** button to display the ***File*** menu.

3. Press the ***Save*** button to display the Save control panel as shown below.

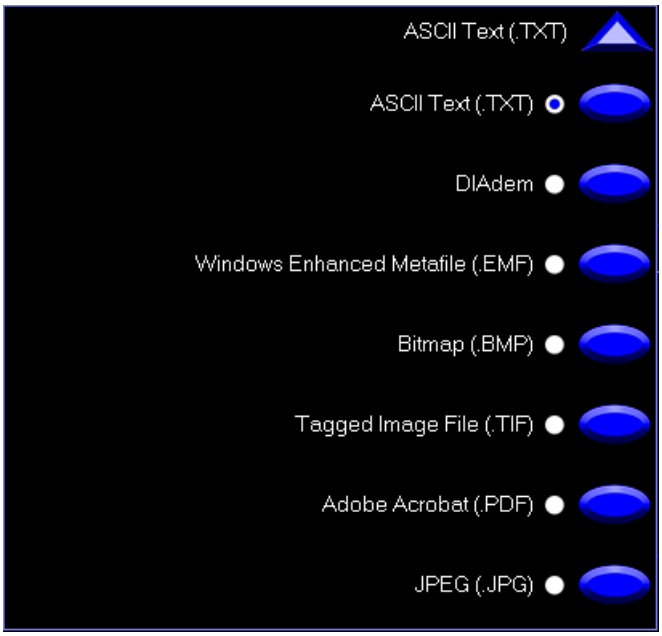
The **Save** control panel contains controls for saving traces and setups in either LDS-Nicolet WFT or Gould DAT formats, plus controls for browsing folders/directories and creating new sub-folder/directories.

To export a file:

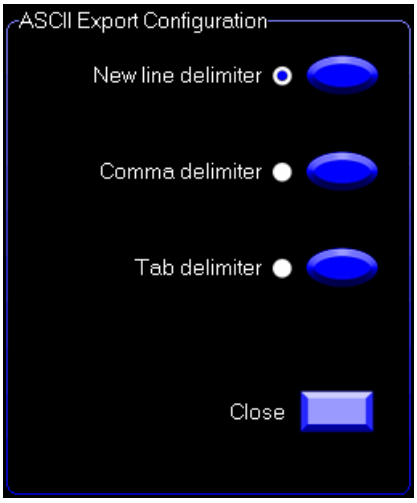
4. Press the **Export** button to display the Export control panel as shown below.

The **Export** control panel contains controls for exporting traces in a wide variety of formats, plus controls for browsing folders/directories and creating new sub-folder/directories.

5. The drop-down menu in the **Export File Format** section displays the wide variety for formats available for exporting as shown below.



6. Press the ***Configure Selected Export Format*** button in the ***Export File Format*** section to display the ASCII Export Configuration selections as shown below.

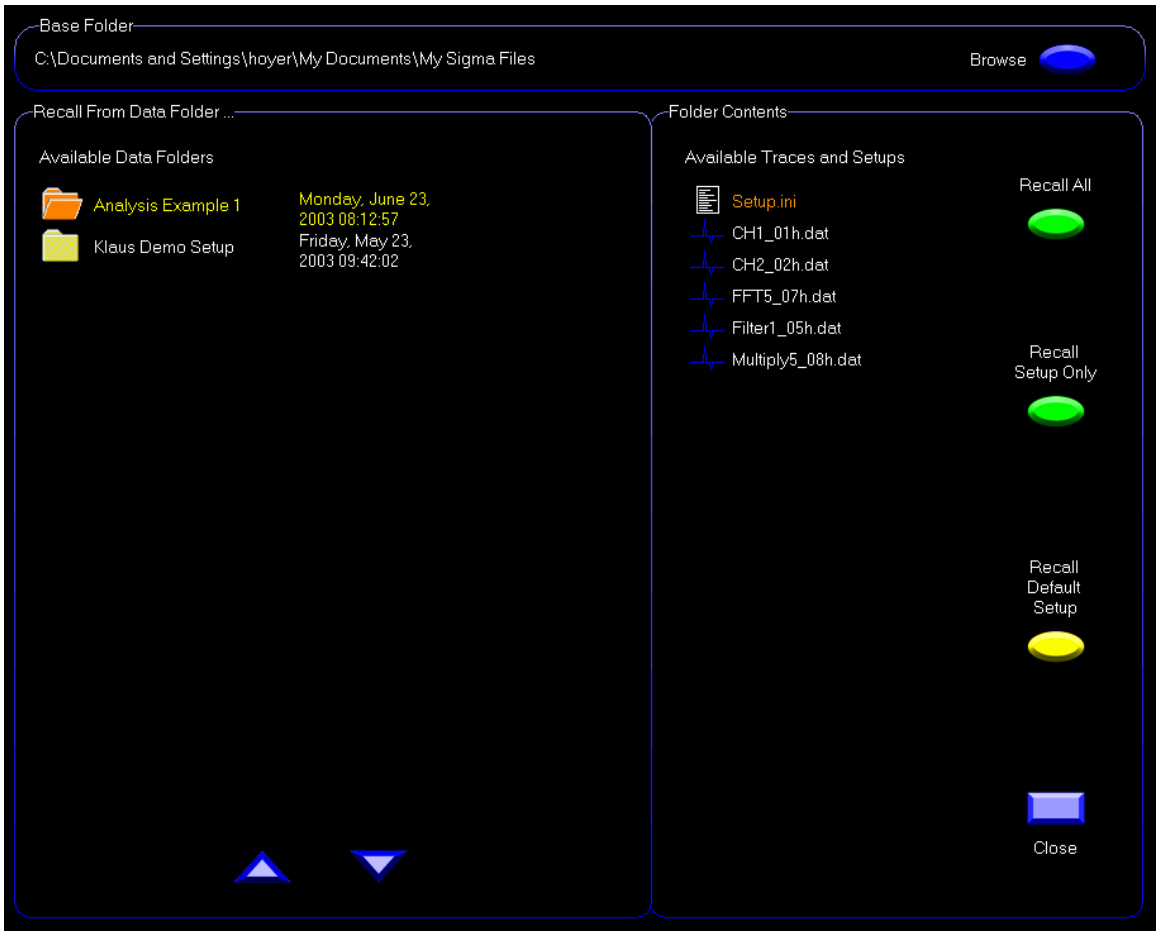


7. Press the ***Export To A New Folder*** button in the ***Auto Numbering*** section to export every data set to a new folder/directory by Auto-Numbering the folder names.

8. Press the ***Export To A Single Folder*** button in the ***Auto Numbering*** section to export all data sets a single folder/directory by Auto-Numbering the trace names.

To recall a file:

9. Press the ***Recall*** button to display the Recall control panel as shown below.



10. The **Recall** control panel contains controls for recalling all (setups and traces), recalling setups only, recalling the default setup, plus controls for browsing folders/directories.

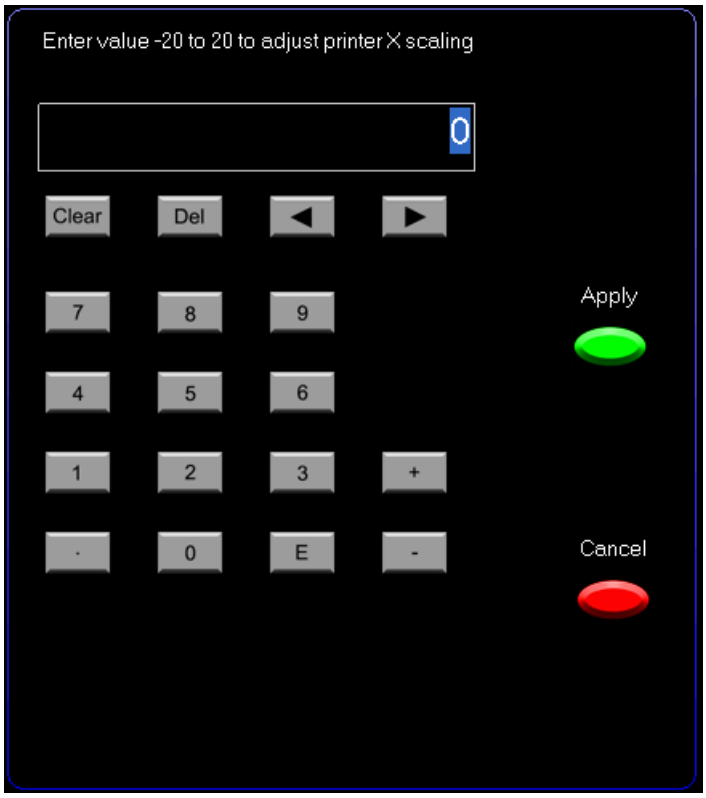
11. Press the ***Home*** button to exit the ***File*** menu.

Printing a File

1. Press the front panel **MENU** button to open the ***Master*** menu.
2. Press the ***Print*** button to display the ***Print*** menu.

3. Press the ***Color*** button to select between mono and color/grey scale modes from the control panel.

4. Press the ***Printer Scale Adjustment*** button to display the Printer Scale control panel as shown below.



5. Press the **Print Screen** button to send a screen print to the default printer.

6. Press the **Home** button to exit the ***Print*** menu.

Using the Utilities

1. Press the front panel **MENU** button to display the ***Master*** menu.
2. Press the ***Utilities*** button to display the ***Utilities*** menu, which contains options for setting up and activating Hardware Options, Calibration and Preferences as shown below.

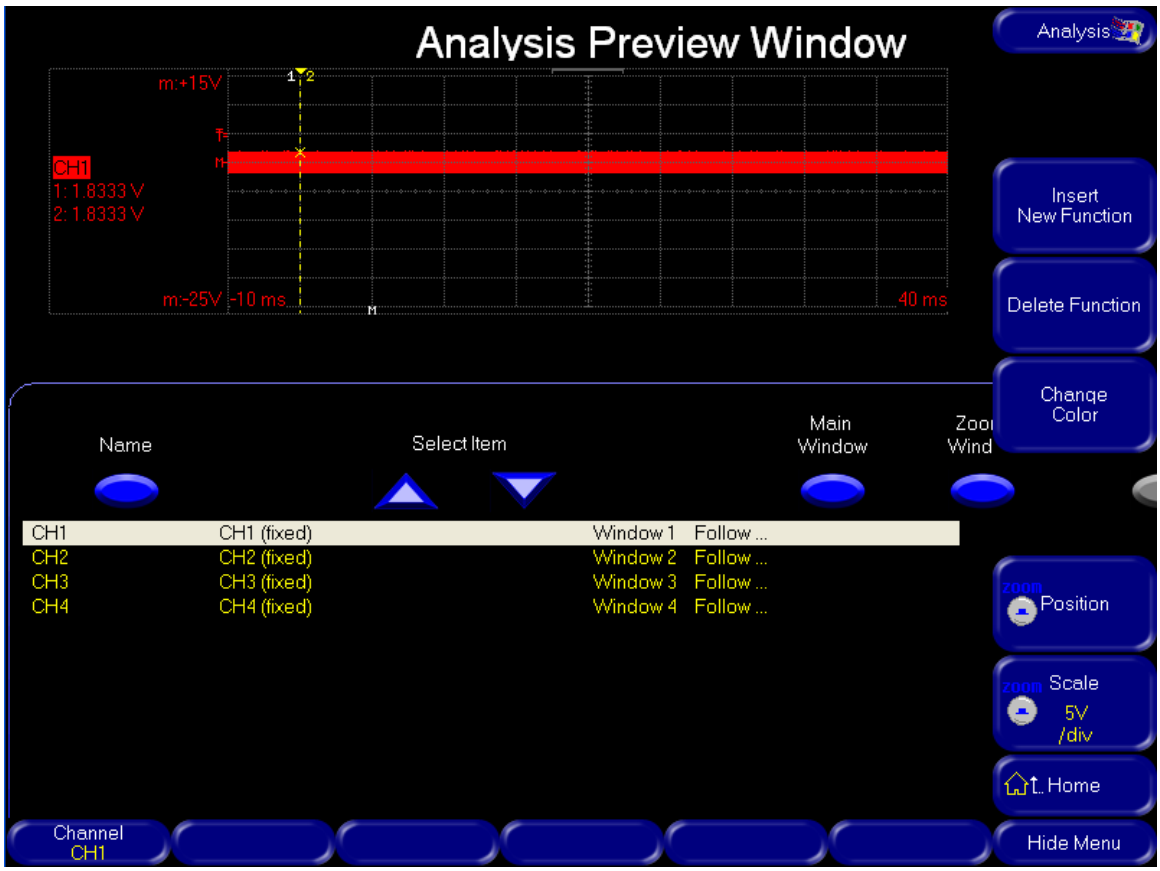
3. Press the ***Home*** button to exit the ***Utilities*** menu.

Setting Functions for Waveform Analysis

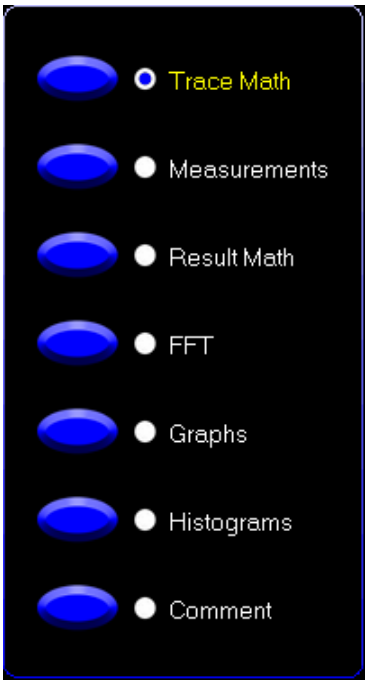
To add a function:

1. Press the front panel **MODE** button to display the ***Mode Select*** menu.
2. Press the ***Waveform Analysis*** button to display the ***Analysis*** menu.

3. Press the ***Analysis and Window Definition*** button to display the Analysis control panel as shown below.



The Analysis control panel contains controls for inserting and deleting analysis functions, plus changing color, position and scale of traces.



4. Press the ***Insert New Function*** button to control panel where you can choose from a wide array of analysis options including Trace Math, Measurements, Result Math, FFT, Graphs, Histograms and Comments.

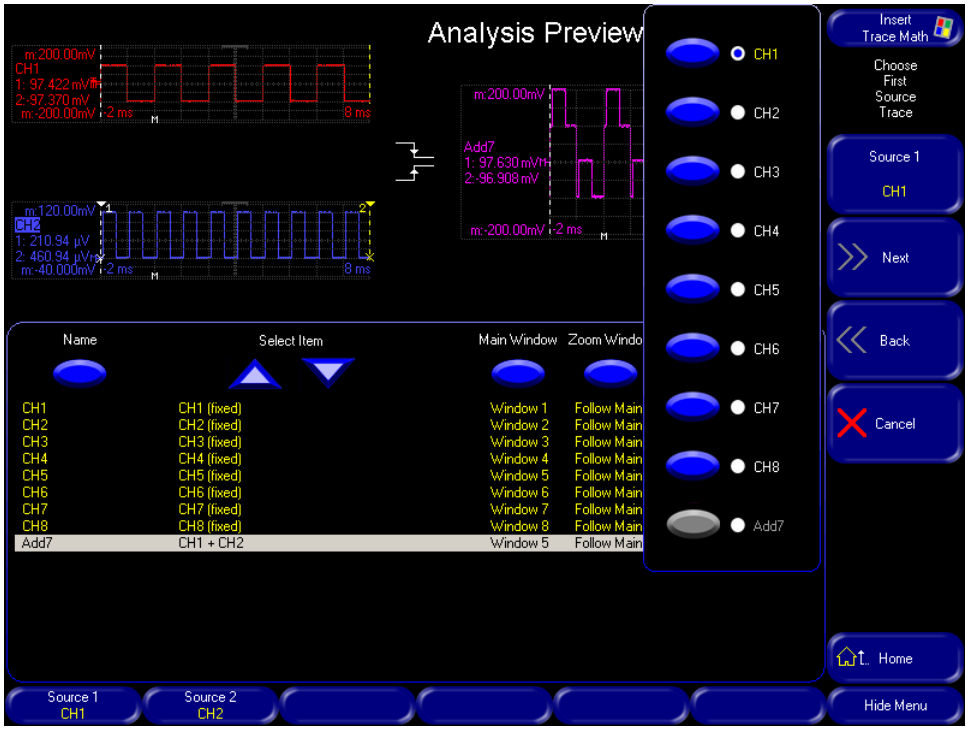
5. Select the analysis function using the appropriate menu button or the **Cursor 2** control. Analysis function choices are as follows:

- ***Trace Math*** – derive a new trace from a mathematical operation performed on one (1) or two (2) traces.
- ***Measurements*** – a long list of measurements offering complete control over source and measure parameters.
- ***Result Math*** – further processing of Measurements, singularly like Square Root, or relationships between two measurements like Delta or Sum.
- ***FFT*** –convert the signal to the frequency domain. The Y axis represents dBV and the X axis is frequency with linear or log scaling.
- ***Graphs*** – plot a Measurement over time.
- ***Histograms*** – give a linear distribution of Measurement values.
- ***Comment*** – adds an on screen message.

6. Select the appropriate analysis option then press the ***Next*** button to proceed with the setup of the analysis function.

Once the analysis function is selected:

- The menu system becomes dynamic, offering the relevant choices in a progressive sequence.
- An **Analysis Preview** window opens. This 'live action' window displays source traces, resultant traces, custom Measurements, XY windows, FFTs, Graphs and Histograms.
- The lower half of the display becomes a resource and definition window. Any of the items in this listing can be edited, renamed, deleted, etc.



About Trace Math Functions

Add - The selected traces are added together. Each point on the resultant trace is the sum of the amplitude from the equivalent time related points on the two source traces.

Subtract - The selected traces are subtracted from each other. Each point on the resultant trace is the difference of the amplitude from the equivalent time related points on the two source traces.

Multiply - The selected traces are multiplied. Each point on the resultant trace is the product of the amplitude from the equivalent time related points on the two source traces.

Divide - The selected traces are divided. Each point on the resultant trace is the division of the amplitude from the equivalent time related points on the two source traces.

Invert - The selected trace is inverted for display purposes (useful for correlating signals that may be out of phase).

Filter – The selected trace is digitally filtered. Several different filter points are available for each filter.

Integrate - The selected trace is integrated, displaying a waveform that represents Volt-seconds (can also define a custom unit).

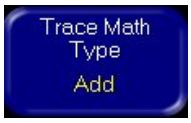
Differentiate - The selected trace is differentiated, displaying a waveform that represents the rate of change.

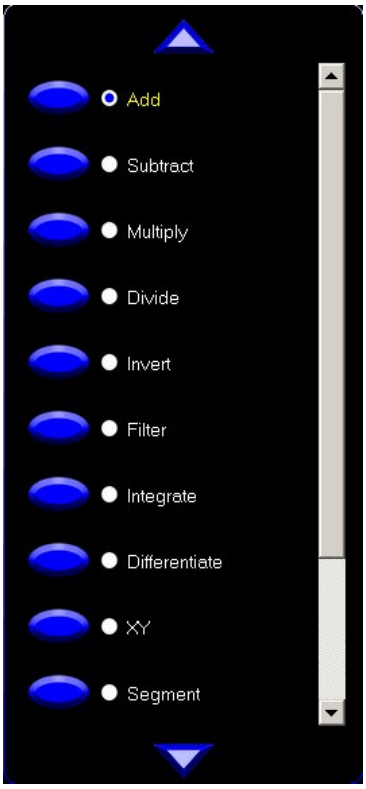
XY - The selected traces are plotted against each other in the two different axis (X and Y). This is different from the XY in Page1 as any signal can be the X axis (in Page1 only Channel 1 is the X axis).

Segment - When operating in Multi Shot mode individual segments can be selected for display allowing segments to be overlaid.

Time Shift – Applies a time shift to a trace used to reposition a trace or correcting phase error.

Trace Math – Add, Subtract, Multiply and Divide Functions



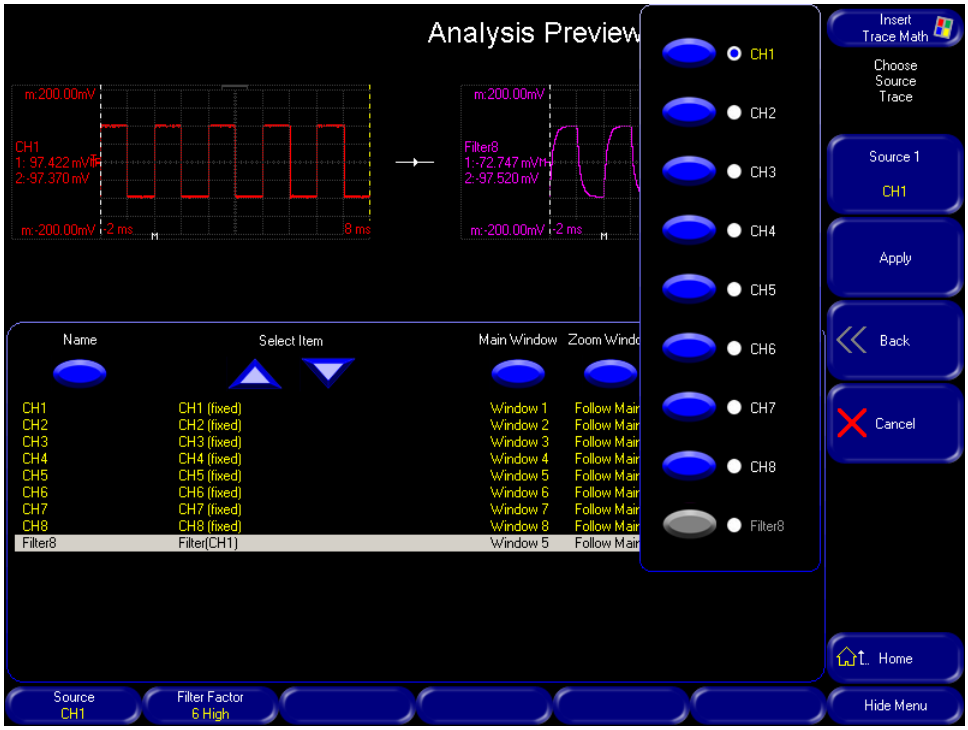


The functions (Add through Time Shift) are set up in a similar fashion. An example of the Add function is presented here.

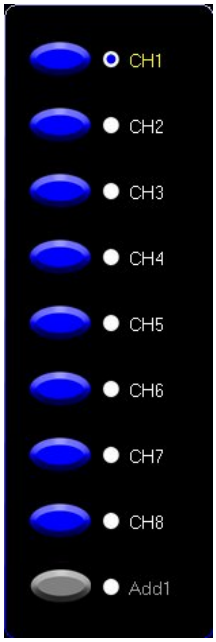
1. Select the Trace Math type using the appropriate menu control or **Cursor 2** (the default is Add). When a Trace Math type is selected, click the ***Next*** button for the next prompt.

2. Once a selection is chosen, the ***Back*** button appears, allowing access to the previous prompt to change the previous selection.

3. Upon choosing **Add**, the Analysis Preview window displays two source windows and a result window.



Note: While in the **Analysis Preview** window, the result waveform can be positioned and scaled with the **Channel 1** front panel controls, **Position** and **Scale.**

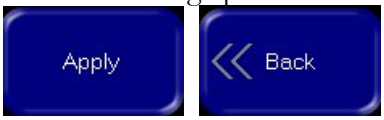


4. Select source 1 from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.

5. When a source 1 is selected, click the ***Next*** button for the next prompt.

6. Select source 2 from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.

7. When a source 2 is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections.



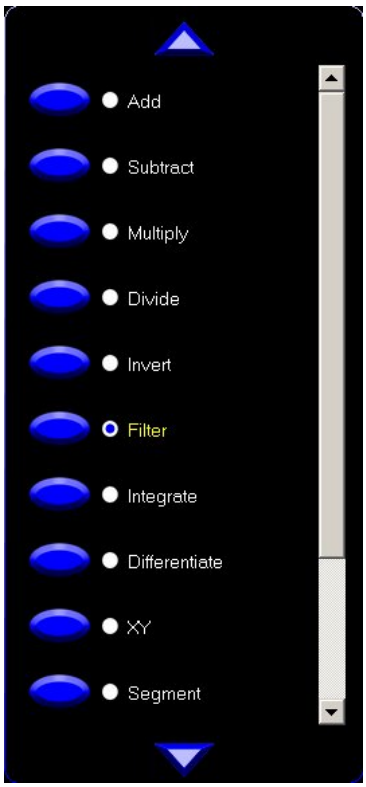
Note: *The source signals can be changed anytime using the parameter bar across the bottom of the screen.*

Use the ***Rename Item / Change Color / Delete Item / Delete All*** button to name, change color or delete the function.

Use the ***Main Window*** and ***Zoom Window*** buttons to select a target window for the function.

Use the ***Units and Scaling*** button to define custom units or scale the function.

Trace Math – Invert, Filter, Integrate, and Differentiate Functions

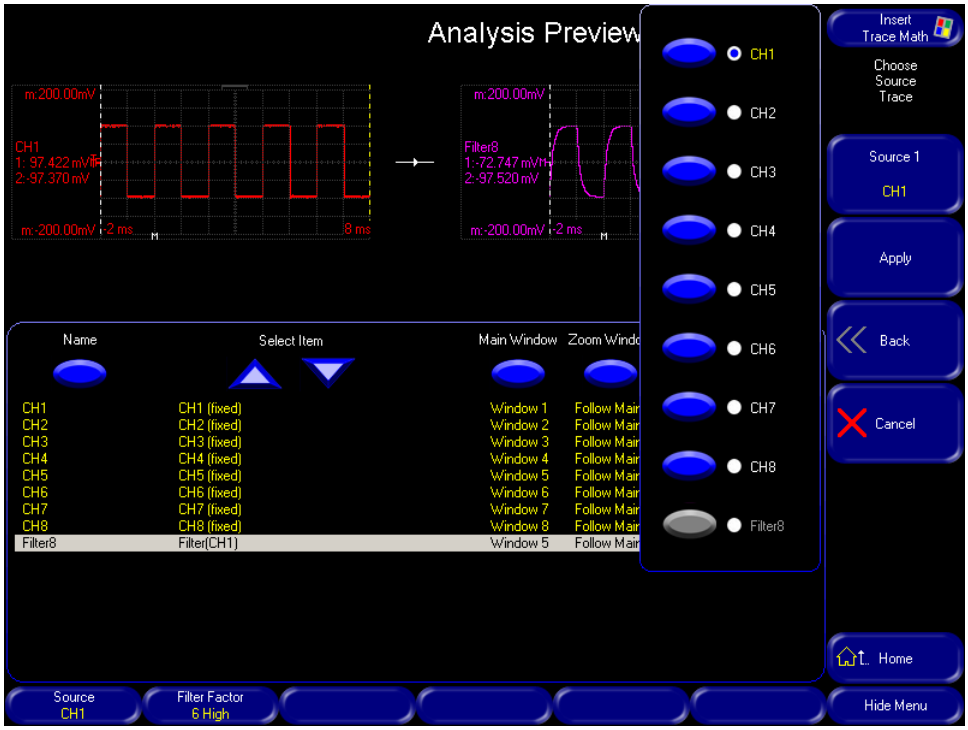


The Invert, Filter, Integrate, and Differentiate functions are set up in a similar fashion. An example of the Filter function is presented here.

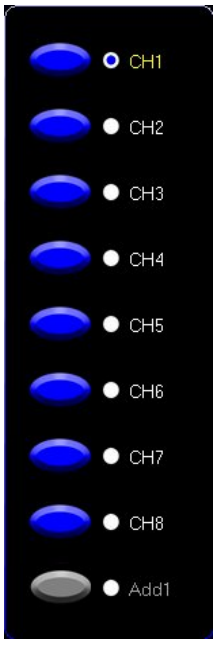
1. Select the Trace Math type using the appropriate menu control or **Cursor 2** (the default is Add). When a Trace Math type is selected, click the ***Next*** button for the next prompt.

2. Once a selection is chosen, the ***Back*** button appears, allowing access to the previous prompt to change the previous selection.

3. Upon choosing **Filter**, the **Analysis Preview** window displays two source windows and a result window.



Note: *While in the* ***Analysis Preview*** *window, the result waveform can be positioned and scaled with the* ***Channel 1*** *front panel controls,* ***Position*** *and* ***Scale.***



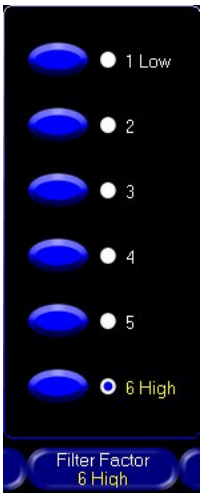
4. Select the source from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.

5. When a source is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections

6. Select source 2 from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.

7. When a source 2 is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections.

Note: *The source signals can be changed anytime using the parameter bar across the bottom of the screen.*



The digital filter function has a Filter Factor parameter located along the lower axis of menu controls. The available factors are relevant to the current timebase. The formula is:

Ff/Timebase = Filter frequency Hz

Where the Ff factors are 5.44, 2.46, 1.15, 0.547, 0.261, 0.124 for 1 to 6 and the timebase is seconds per division giving a result in Hz for the 3 dB point.

e.g. for a timebase of 2 ms/div the first filter frequency will be:

5.44/2e–3 = 2.72 kHz.

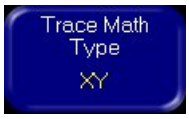
To define other filters, use post-acquisition analysis programs like the FlexPro analysis and report generation software.

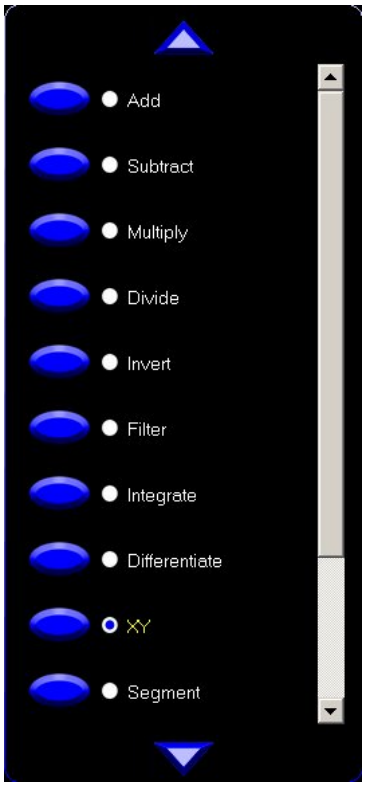
Use the ***Rename Item / Change Color / Delete Item / Delete All*** button to name, color or delete the function.

Use the ***Main Window*** and ***Zoom Window*** buttons to select a target window to display the function.

Use the ***Units and Scaling*** button to define custom units or scale the function.

Trace Math – XY Function





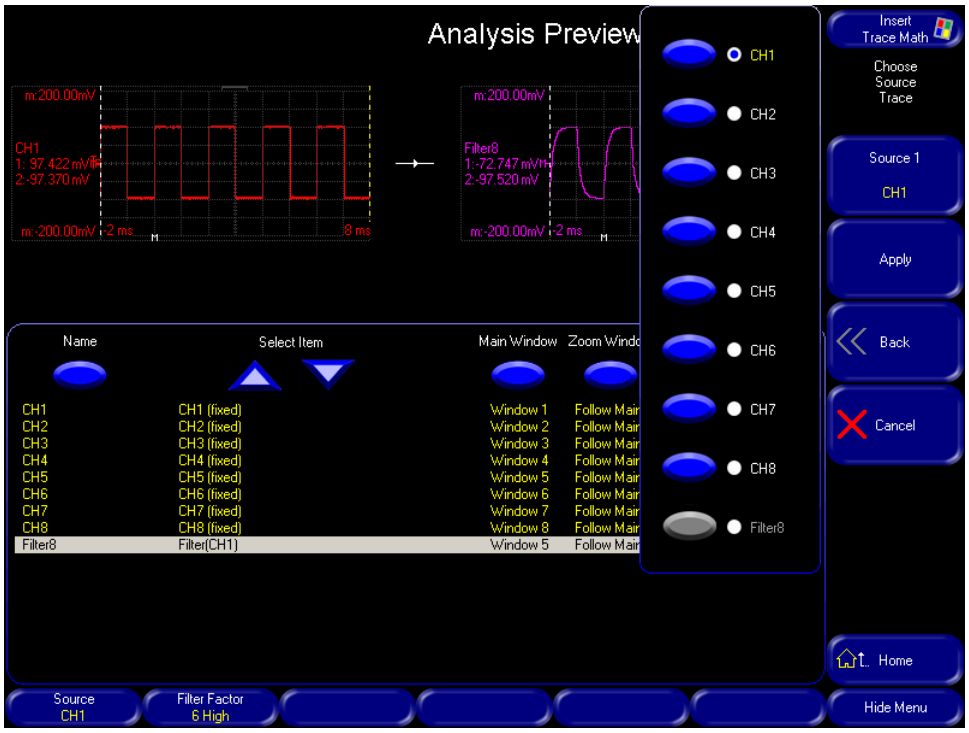
XY in **Page2** analysis is different from XY in **Page1** in a few ways. **Page1** is a simple way to see CH1 as the X axis and CH2, CH3, CH4 as Y axis and is not flexible. The Trace Math function offers complete flexibility. Any channel, or other previously defined waveform (Filter, Integrate, etc) can be either the X or the Y axis.

1. Select XY using the appropriate menu control or **Cursor 2**. When XY is selected, click the ***Next*** button.

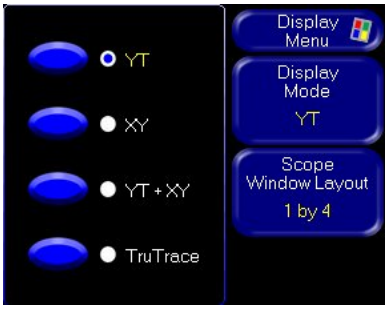
2. Once a selection is chosen, the ***Back*** button appears, allowing access to the previous prompt to change the previous selection.

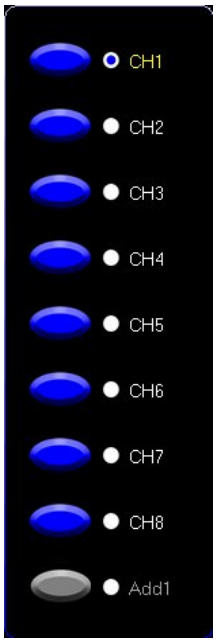
Note: *In the Display menu the Display Mode must be set to include an XY display see the next page.*

3. Upon choosing **XY**, the **Analysis Preview** window displays two source windows and a result window.



Note: *When outside of the* ***Analysis Preview*** *window, the Display Mode must be set to XY mode or XY + YT mode to view the XY relationship. For more information on this, see the Display Menu section of this guide.*





4. Select source 1 from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.
5. When a source 1 is selected, click the ***Next*** button for the next prompt.

6. Select source 2 from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.
7. When a source 2 is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections.

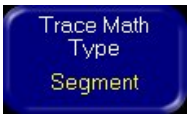
Note: *The source signals can be changed anytime using the parameter bar across the bottom of the screen.*

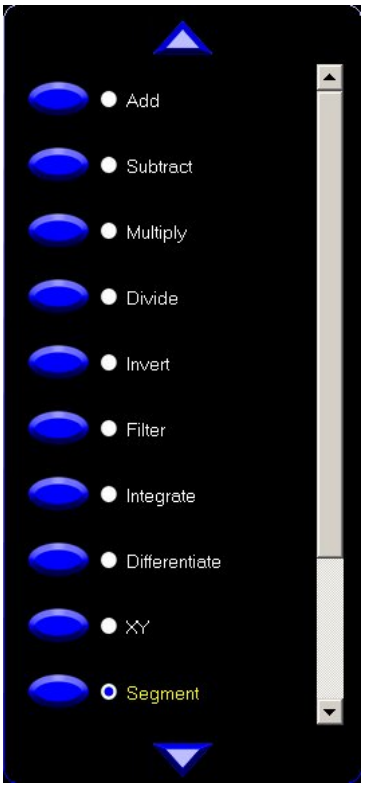
Use the ***Rename Item / Change Color / Delete Item / Delete All*** button to name, change color or delete the function.

Use the ***Main Window*** and ***Zoom Window*** buttons to select a target window for the function.

Use the ***Units and Scaling*** button to define custom units or scale the function.

Trace Math –Segment Function

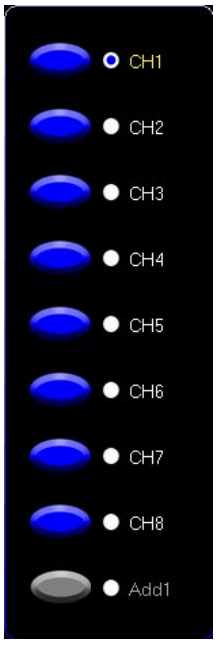




Segment under Trace Math in **Page2** allows individual segments to be selected and displayed in any of the Windows where in **Page1** the display can show either one of the segments or all the segments. The Trace Math segment function offers complete flexibility.

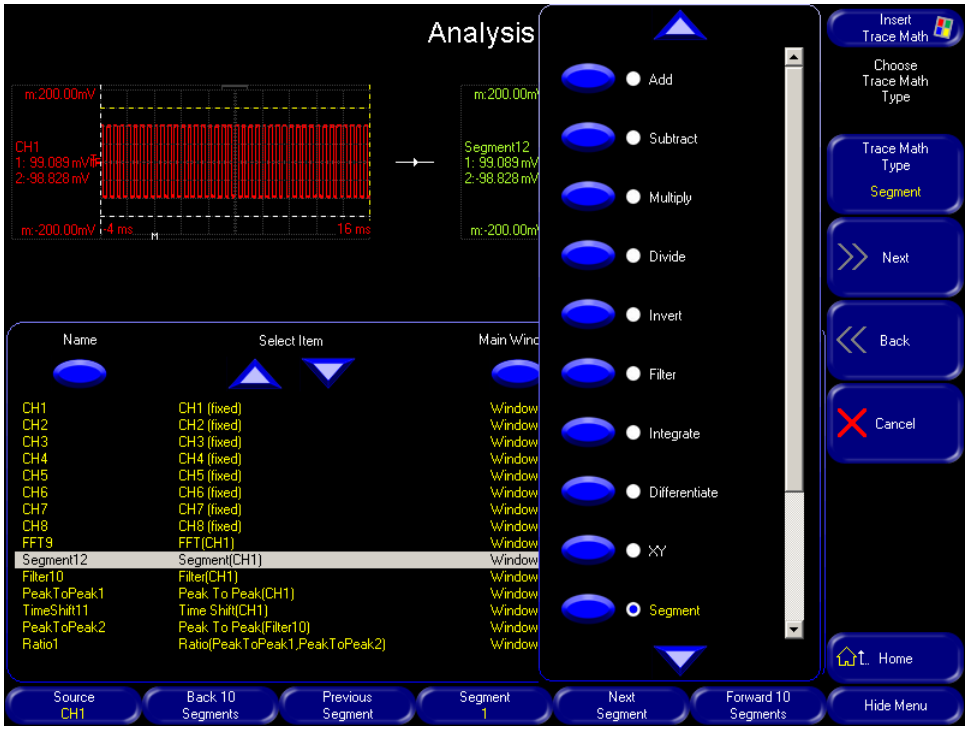
1. Select segment using the appropriate menu control or **Cursor 2**. When segment is selected, click the ***Next*** button.

2. Once a selection is chosen, the ***Back*** button appears, allowing access to the previous prompt to change the previous selection.



3. Select the source from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.
4. When the source is selected, click the ***Apply*** button.

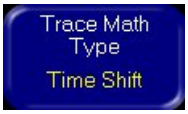
Upon choosing segment, the **Analysis Preview** window displays the source window and a result window. This display shows segment 5 from
channel 1.

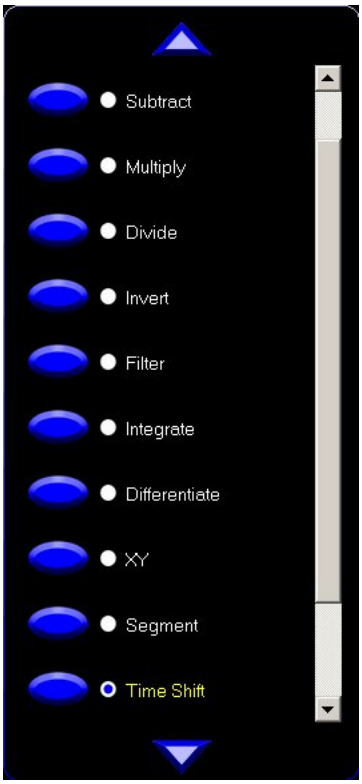


The bar across the bottom allows changes to be made for the source channel, stepping back 10 segments, going to the previous segment, setting the number directly, going to the next segment

or stepping forward 10 segments. These controls enable any of the segments to be displayed in one window or separate windows for comparison.

Trace Math –Time Shift Function

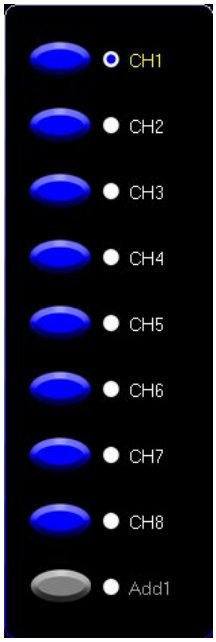




Time Shift under Trace Math in **Page2** allows a waveform to be moved in time to correct for phase errors or to display waveforms that are not coincident in time. The Trace Math Time Shift function can be applied to any channel data and be displayed in any window.

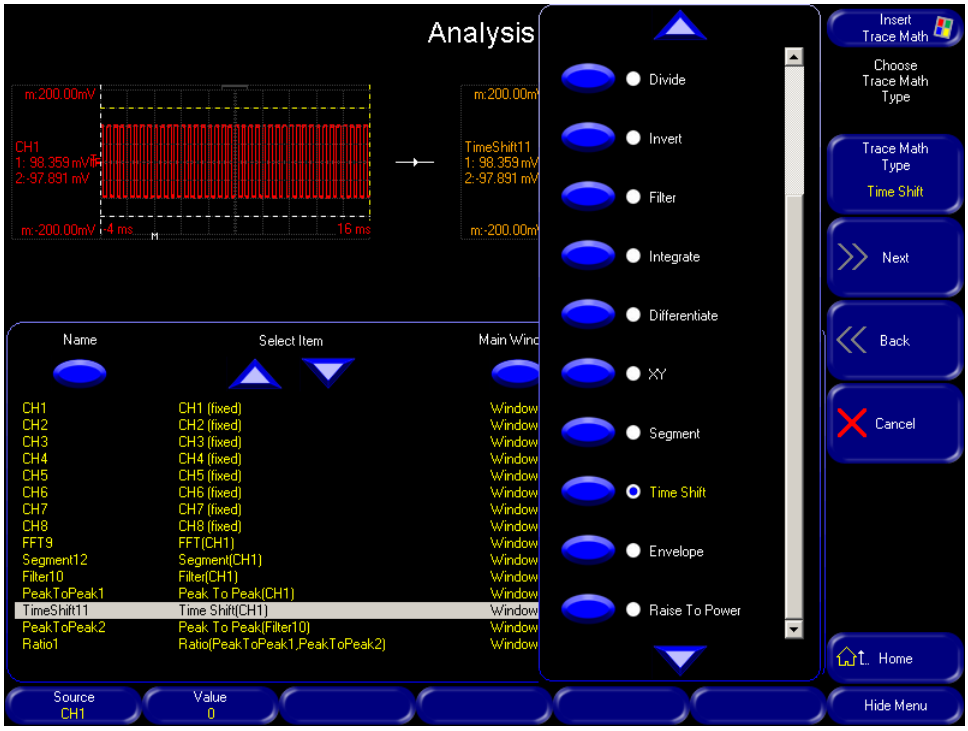
1. Select Time Shift using the appropriate menu control or **Cursor 2**. When Time Shift is selected, click the ***Next*** button.

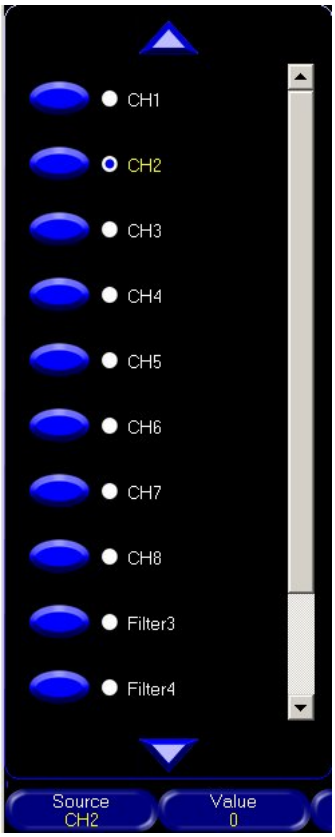
2. Once a selection is chosen, the ***Back*** button appears, allowing access to the previous prompt to change the previous selection.



3. Select the source from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.
4. When the source is selected, click the ***Apply*** button.

Upon choosing Time Shift, the **Analysis Preview** window displays the source window and a result window. This display shows the waveform from channel 1.





The bar across the bottom allows changes to be made for the source channel and the value of time to shift the waveform.

The ***Source*** button opens a menu of all relevant sources for easy selection.

About Measurements

Due to their ability to be completely customized, these analysis Measurements are a very powerful tool. Any parameters that are reasonable to customize can be customized. These parameters include: source, references, boundries, levels absolute, statistical levels, specific crossing number, etc.

Results can be further compounded using simple arithmetic operators in stages to provide complete engineering results. Waveform points are definable on different channels so that measurements can be made on several channels at once. Signal interactions can be exposed comparing points or values across different signals.

When little Measurements mean a lot…

These live and continuous measurements become even more valuable when plotted in a graph or histogram, or used as criteria to initiate an action (fax, email, print, save, etc.) via DATA SENTRY.

The Top and Base levels, for use in such measurements as Rise Time, Amplitude and Overshoot, can be automatically calculated as defined by IEEE standard 181-1977 or can be defined manually by the cursor positions.

A particular waveform transition (among many) can be selected by using boundaries like Trigger, Cursors or other measurements like Max and Min. Further, a particular transition can be isolated by defining a crossing number.

Customized measurements formula based on arithmetic combinations of previous results such as difference in time or voltage, or ratio of voltage/time or time/voltage can be calculated.

Custom measurements can also have a scaling factor and an offset applied, and each measurement can have its units specified and be given a unique name.

Measurement Parameters

Each measurement has a specific set of parameters, some of which are unique to the particular measurement and some of which are drawn from a standard set of parameters. The standard parameters are described here and the unique parameters are described under the appropriate measurement heading.

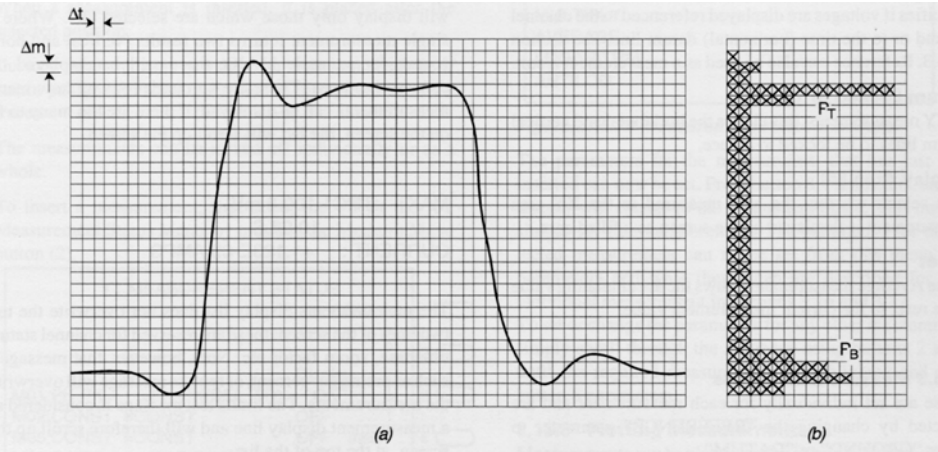
Standard Parameters

Bounds - The horizontal extent over which a trace is measured can be either between cursors, the full trace, or between the two previous crossing type measurements. These can be Max/min, Trigger, Rising/Falling Crossing, Knee, or Dimensioned Constant.

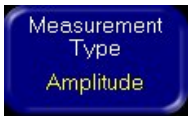
Top/base - The method of determining the top and base levels of a trace can be either the IEEE standard statistical method (IEEE std 181-1977) or simply the values of the trace identified by the cursor horizontal positions.

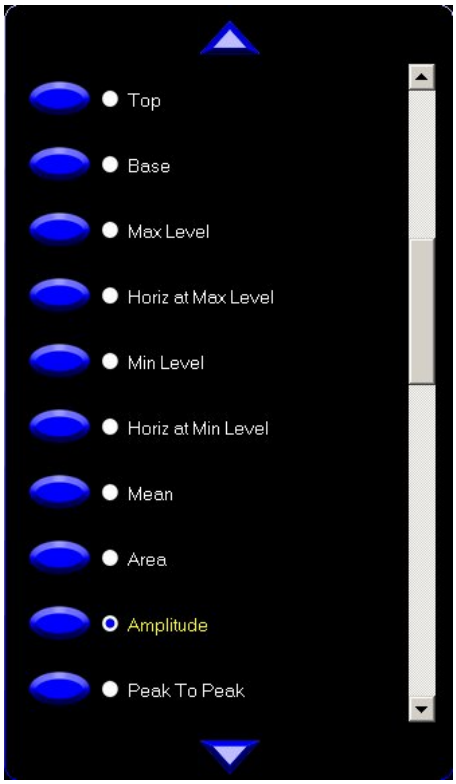
The base principle of the statistical method of analysis achieved as described in IEEE 181-1977, the IEEE Standard on Pulse Measurements and Analysis by Objective Techniques is also described here:

Assume a pulse waveform such as that shown below with a grid superimposed on it where the dimensions Δt and Δm are equivalent to the sample times and the instrument's ADC levels. An occurrence histogram is then produced for each ADC level (Δm) through which the waveform passes.



From this histogram the two peaks corresponding with the Top and the Base of the waveform PT and PB can be identified. The mean of the PT and PB are calculated and taken to be the Top and Base levels respectively. This analysis is best suited to pulse waveforms with bases and tops of significant relative duration. Some waveforms such as a triangular wave to do not produce a suitable histogram with two peaks so the maximum and minimum of the waveform are used. When this is the case, levels can be defined using the cursors.





The setting up of each Measurement is slightly different as each measurement has its own set of parameters: Source type(s), Bounds and References.

This section describes the sequence for setting up a typical Measurement. All Measurement functions are set up in a similar fashion. An example of the Amplitude function is presented here.

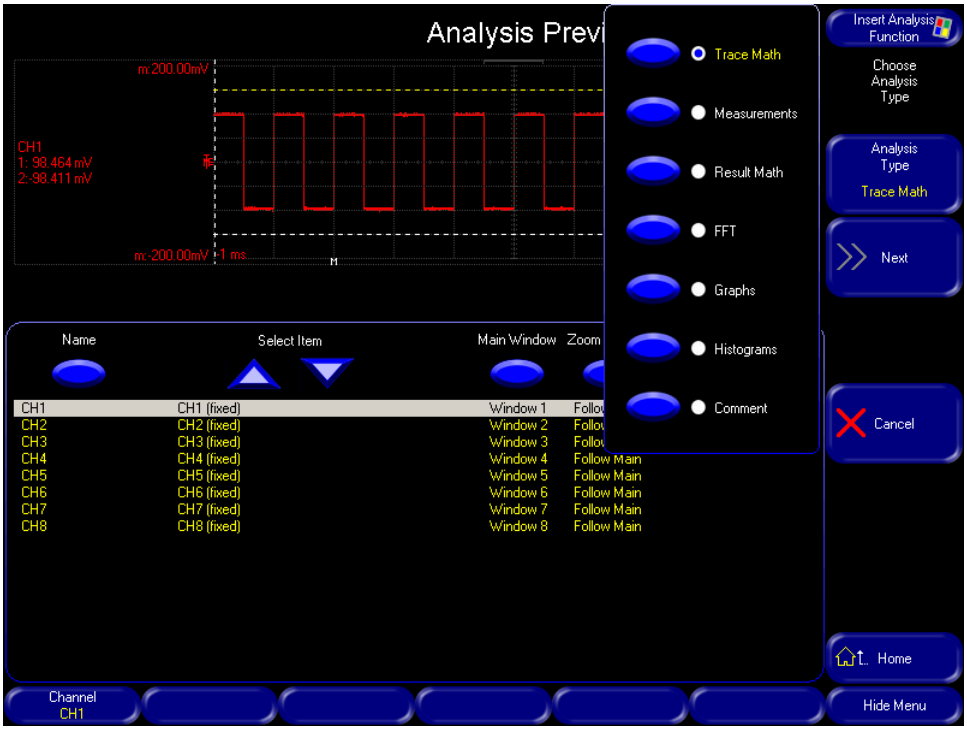
When setting up analysis, an **Analysis Preview** window opens automatically to facilitate the analysis setup process. The **Analysis Preview** window displays the source trace(s) and the resultant trace or measurement. The **Analysis Preview** window is accompanied by another window that lists resources (channels) and definitions (both derived traces and measurements).

1. Select Amplitude using the appropriate menu control or **Cursor 2**.
2. Click the ***Next*** button for the next prompt.

3. Once a selection is chosen, the ***Back*** button appears, allowing access to the previous prompt to change the previous selection.

Once the analysis function is selected:

- The menu system becomes dynamic, offering the relevant choices in a progressive sequence.
- An Analysis Preview window opens. This 'live action' window displays source traces, resultant traces, custom measurements, XY windows, FFTs, graphs and histograms.
- The lower half of the display becomes a resource and definition window. Any of the items in this listing can be edited, renamed, deleted, etc.



Note: *The source signals can be changed anytime using the parameter bar across the bottom of the screen.*

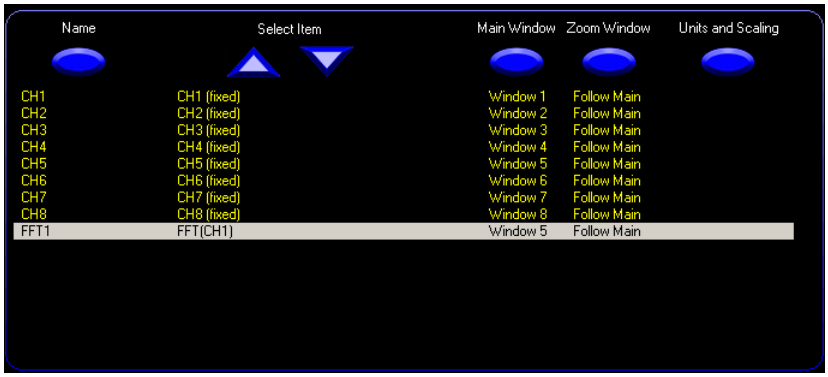
Measurements – Changing Measurement Parameters

The set of Parameters is individual for each Measurement.

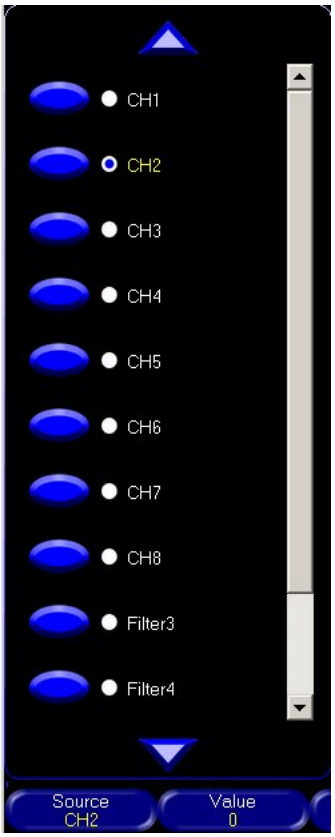
Parameters, in general, are:

- Source(s)
- Bounds
- References

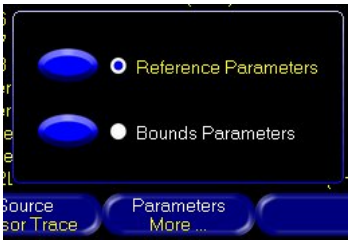
Parameters for any Measurement can be edited after the original Measurement definition is complete. Select the Measurement to be edited from the list of Definitions using the **Cursor 1** control.



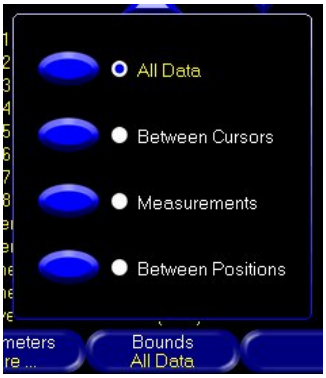
The parameters for the highlighted item appear in the bar along the bottom of the screen. Click on any parameter bar button to adjust the associated parameter.



The ***Source*** button opens a menu of all relevant sources for easy selection.



There can be many different parameters. The ***Parameters More*** button toggles which parameters are presented for adjustment. In this case, Reference and Bounds parameters are available.



Bounds Parameters for this particular Measurement (Amplitude) are:

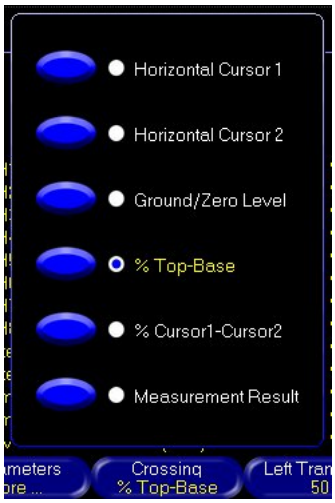
All Data - every data point will be considered.

Between Cursors - a manual boundary adjustment.

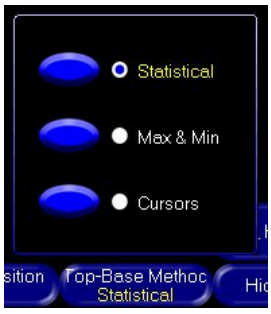
Measurements - a dynamic boundary, such as 2nd Rising Crossing to 3rd Rising Crossing.

Between Positions – a dynamic boundary where starting and ending positions are set as a percentage of the waveform.

The Reference Parameters for Pulse Width, for example, are Crossing level where there are subsections, as shown.



Transitions can be set at a percentage of the crossing amplitude defined by the Crossing selection. The example here shows for percent Top-Base.



Reference parameters for this particular Measurement (Amplitude) are:

Statistical – per IEEE 1977 standards for waveform measurement (Top and Base determination)

Max & Min – a Top or Base is not considered in the measurement

Cursors – use the cursor settings

Measurements – Individual Descriptions

Level at Vertical Cursors

Sources: YT, FFT, Graph, Histogram

References: Horizontal Cursors, Ground(Zero), other Measurement

YT result: Y value at Cursor position. The default unit is Volts but if User Scaling is defined then it will be reflected.

FFT result: Voltage (in Volts or dBV for a log scale)

Graph result: Measurement value at the position of the Cursor on the Graph in units of the measurement

Histogram result: Number of readings (hits) in the bin at Cursor position

Note on Histogram: The total number of readings (hits) is available by defining an "Area" measurement on the Histogram. The percentage of readings in a bin may be calculated by dividing the number of readings in a bin (obtained with a Cursor Measurement) by the total number of readings from the Area Measurement.

HORIZ at Vertical Cursors

This is a time measurement (HORIZontal).

Sources: YT, FFT, Graph, Histogram

References: Start of Data, Vertical Cursors, Trigger Point, other Measurement

YT result: X value at Cursor position. The default unit is Seconds but if User Scaling is defined then it will be reflected (useful for Degrees, Displacement, etc.).

FFT result: Frequency (in Hertz)

Graph result: Will reflect how the Graph was generated (time units or number of acquisitions).

Histogram result: Start and end values of bin at Cursor position

HORIZ at Main Window Start / HORIZ at Main Window End

This is a time measurement (HORIZontal).

Sources: YT, FFT, Graph, Histogram

References: Start of Data, Vertical Cursors, Trigger Point, other Measurement

YT result: Difference in position between the Start / End of the Main Window and the reference position. The default unit is Seconds, but if User Scaling is defined, then it will be reflected (useful for Degrees, Displacement, etc.).

FFT result: Frequency (in Hertz)

Graph result: Will reflect how the Graph was generated (time units or number of acquisitions).

Histogram result: Start and end values of bin at Start / End of Main Window

HORIZ at Zoom Window Start / HORIZ at Zoom Window End

This is a time measurement (HORIZontal).

Sources: YT, FFT, Graph, Histogram

References: Start of Data, Vertical Cursors, Trigger Point, other Measurement

YT result: Difference in position between the Start / End of the Zoom Window and the reference position. The default unit is Seconds, but if User Scaling is defined, then it will be reflected (useful for Degrees, Displacement, etc.).

FFT result: Frequency (in Hertz)

Graph result: Will reflect how the Graph was generated (time units or number of acquisitions).

Histogram result: Start and end values of bin at Start / End of Zoom Window

Level at Horizontal Cursors

Sources: YT, FFT, Graph, Histogram

References: Horizontal Cursors, Ground(Zero), other Measurement

YT result: Y value at Cursor position. The default unit is Volts but if User Scaling is defined then it will be reflected.

FFT result: Voltage (in dBV)

Graph result: Graph value at the position of the Cursor in units of the Measurement

Histogram result: Value of readings (hits) in bin at Cursor position

Top / Base

Sources: YT, Graph

References: Horizontal Cursors, Ground (Zero), other Measurement

Bounds: All Data, Between Cursors, other Measurements

YT result: Statistical Top and Base values will be calculated as defined in IEEE standard 181-1977.

Graph result: Measurement value at point of Top or Base

Max Level / Min Level

Sources: YT, Graph

References: Horizontal Cursors, Ground (Zero), other Measurement

Bounds: All Data, Between Cursors, other Measurements

YT result: Y maximum or Y minimum of a trace in units (default units is Volts but if User Scaling is defined then it will be reflected)

Graph result: Measurement value at point of maximum or minimum

HORIZ at Max Level / HORIZ at Min Level

This is time (HORIZontal) at Max and Min points.

Sources: YT, Graph

References: Horizontal Cursors, Ground (Zero), other Measurement

Bounds: Start of Data, Vertical Trigger, other Measurement

YT result: X value at Y maximum or Y minimum point

Graph result: X value at point of maximum or minimum; will reflect how the Graph was generated (time units or number of acquisitions).

Mean

Sources: YT

References: Horizontal Cursors, Ground (Zero), other Measurement

Bounds: All Data, Between Cursors, other Measurements

YT result: Mean value of the trace in units (default units is Volts but if User Scaling is defined then it will be reflected)

Area

Sources: YT, Graph, Histogram

References: Horizontal Cursors, Ground (Zero), other Measurement

Bounds: All Data, Between Cursors, other Measurements

YT result: Area of a trace either absolute or delta in units-time (default is Volts-time but if User Scaling is defined then it will be reflected)

Graph result: Area of a trace either absolute or delta in Measurements-time (default is whatever Measurement the Graph is based upon)

Histogram result: The total number of samples in the Histogram. When used with a Cursor Measurement, a Result Math Ratio between Area and Cursor values will determine the percentage or time for which that bin accounts.

Amplitude

Sources: YT, Graph

References: Top/Base, Max/Min, Cursor positions

Bounds: All Data, Between Cursors, other Measurements

YT result: A pulse Top minus Base or Max minus Min for selected portion of trace (default unit is Volts but if User Scaling is defined then it will be reflected)

Graph result: The Graph Top minus Base or Max minus Min for the selected portion of the Graph (unit is the Measurement on which the Graph is based)

Peak-to-Peak

Sources: YT, Graph

References: none

Bounds: All Data, Between Cursors, other Measurements

YT result: A pulse Max minus Min for selected portion of trace (default unit is Volts but if User Scaling is defined then it will be reflected)

Graph result: The Graph Max minus Min for the selected portion of the Graph (unit is the Measurement on which the Graph is based)

Pulse Width

Uses the first transition found or within the measurement bounds.

Sources: YT, Graph

References: Horizontal Cursors, Ground(Zero), other Measurement, % between Cursors, % between top and base (defined statistically, by Max & Min, or with Cursors)

Bounds: All Data, Between Cursors, other Measurements

YT result: Time between where the trace crosses two defined levels (default units is time but scaling reflected if used)

Graph result: Time between where the Graph crosses two defined levels (will reflect how the Graph was generated, time units or number of acquisitions)

Period / Frequency / Duty Cycle

Period: Time between at least three crossing points as defined by crossing parameters.

Frequency: The reciprocal of period

Duty Cycle: Ratio of mean time spent above the crossing level to the period waveform. The word AUTO is displayed if the trace does not cross the specified crossing level, indicating that the 50% of the max/min range have been used instead.

Sources: YT

References: Horizontal Cursors, Ground (Zero), other Measurement, % between Cursors, % between top and base (defined statistically, by Max & Min, or with Cursors)

Bounds: All Data, Between Cursors, other Measurements

YT result: Time or frequency between where the trace crosses two defined levels (default units is time but scaling reflected if used)

Rise Time / Fall Time

These measurements use the first transition found within the measurement bounds.

Sources: YT, Graph

References: Horizontal Cursors, Ground (Zero), other Measurement, % between Cursors, % between top and base (defined statistically, by Max & Min, or with Cursors)

Bounds: All Data, Between Cursors, other Measurements

YT result: Time between where a slope crosses two defined levels (default units is time but scaling reflected if used)

Graph result: Time between where the Graph crosses two defined levels (will reflect how the Graph was generated, time units or number of acquisitions)

Rising Crossing / Falling Crossing

This measurement displays the word AUTO if the trace does not cross the specified level, indicating that the 50% of max/min levels have been used instead.

Sources: YT

References: Horizontal Cursors, Ground (Zero), other Measurement, % between Cursors, % between top and base (defined statistically, by Max & Min, or with Cursors)

Bounds: All Data, Between Cursors, other Measurements

YT result: Provides an X and Y value of a particular ("nth") slope (default Y value is Volts and X value time but scaling reflected if used)

***NOTE ON CROSSINGS**:* These measurements are very useful for defining boundaries (Bounds) for other measurements such as Area, Max, Rise Time, Harmonic, etc.

Overshoot / Preshoot

The values are calculated on the first transition.

Sources: YT

References: Top and Base defined statistically, by Max & Min, or with Cursors

Bounds: All Data, Between Cursors, other Measurements

YT result: % value of slope peak / slope Amplitude

Top Knee / Base Knee

This provides a voltage and time of the Knee of a waveform using 30% and 70% crossings and extrapolating to the Top or Base.

Sources: YT

References: Horizontal Cursors, Ground (Zero), other Measurement, % between Cursors, % between top and base (defined statistically, by Max & Min, or with Cursors)

Bounds: All Data, Between Cursors, other Measurements

YT result: X and Y values

AC-RMS / DC-RMS

AC-RMS is the same as Standard Deviation, used to calculate an AC component by taking the Mean of the trace as reference.

Sources: YT

Bounds: All Data, Between Cursors, other Measurements

References: Cursors, Ground (Zero), other Measurement (AC-RMS Reference is only the Mean value of waveform)

YT result: The RMS value of a trace in default units (default units is volts but scaling reflected if used, ie. AMPS)

Count

Sources: YT

Bounds: All Data, Between Cursors, other Measurements

References: Horizontal Cursors, Ground(Zero), other Measurement, % between Cursors, % between top and base (defined statistically, by Max & Min, or with Cursors)

YT result: Provides the number of times a signal has crossed a defined level in either a positive or negative direction.

Level at Trigger

Indicates the Trigger Level in Volts (scaling reflected if used). This is useful when it is desired to setup the Trigger Level at a specific voltage (or User Unit).

Sources: Trigger Source Channel only

References: Cursors, Ground (Zero), other Measurement

Result: Y value in default units (default units is volts but scaling reflected if used)

HORIZ at Trigger

Indicates the time of the Trigger with respect to the beginning of the data. This measurement is very useful when used as part of a boundary (Bounds) for another Measurement (Area, Frequency, etc.) or for making time measurements from other points of interest (Max, Rising Crossing, etc.).

Sources: Arbitrary

Result: X value in time (scaling reflected if used)

Trigger Time: Full date and time (not relative to start of data)

Trigger Time

Indicates the absolute time (date and time) of the Trigger (not relative to the beginning of the data).

Sources: Arbitrary

Result: X value in time (scaling reflected if used)

FFT Harmonic

Sources: FFT

Bounds: Specific Harmonic number is specified within the Parameters

Y Reference (Noise Floor): Cursors, other Measurement, Off

X Reference (Fundamental): Cursors, other Measurement, Auto-Detect

FFT result: Frequency (X value) and level (Y value) in dBV.

SFDR Spurious Free Dynamic Range

Sources: FFT

Bounds: Not used

References: Not used

Result: Level in dBc. (dB with respect to the carrier)

THD+N

This measurement determines the Total Harmonic Distortion + Noise.

Sources: FFT

Bounds: Not used

References: Not used

Result: Level in dB

Result Math

An exclusive feature of the Sigma is that Measurement results can be used in live math formulas. The Page 2 Analysis mode does this with Result Math. Result Math is setup in exactly the same way as Measurements.

The following functions are available to perform functions on a measurement result.

Constant - a numeric value for re-scaling a measurement result in amplitude or in time.

Log - the log of the specified measurement result in amplitude or in time.

Antilog - the antilog of the specified measurement result in amplitude or in time.

Sine - the sine of the specified measurement result in amplitude or in time.

Cosine - the cosine of the specified measurement result in amplitude or in time.

Sum - adds two measurements in amplitude or in time.

Delta - subtracts two measurements in amplitude or in time.

Product - multiplies two specified measurement results in amplitude or in time.

Ratio - divides two specified measurement results in amplitude or in time.

Square - squares the specified measurement result in amplitude or in time.

Square Root - takes the square root of the specified measurement result in amplitude or in time.

Average - averages the specified measurement result in amplitude or in time. Accumulates readings and provides a continuous average, stopping when the acquisition is stopped.

Example 1 - Find the phase between an AC voltage and an AC current

Get a Rising Crossing on the voltage (zero crossing) provides an X value

Get a Rising Crossing on the current (zero crossing) provides another X value

Get the Delta (difference) between the two X values

Get a Period on either signal

Set a Constant to 360

Divide the Period by the Constant to get a factor

Get the Product (multiply) of the factor (Divide result) and the Delta

Set all Measurements to Hidden except the Product

Rename Product to Phase Shift

Phase Shift will repot a live digital value of the phase shift in degrees.

Example 2 - Provide the dBV result from a voltage measurement where dBV = 20 log V/Vreference

Measure a Voltage (in this case, 0.5 Volt)

Set a Constant of 1 (as a 1 Volt reference)

Get the Ratio of the Voltage and Constant (0.5/1=0.5)

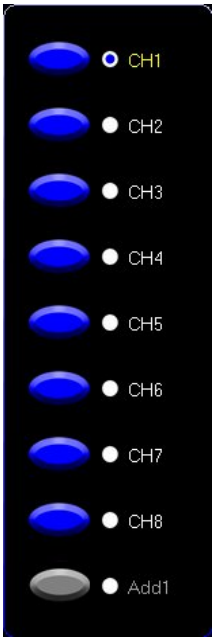
Get Log or the Ratio (= -0.301)

Set Constant of 20

Get the Product of the Ratio and the Constant (= -6.02 dBV)

Set all Measurements to Hidden except the Product.

FFT

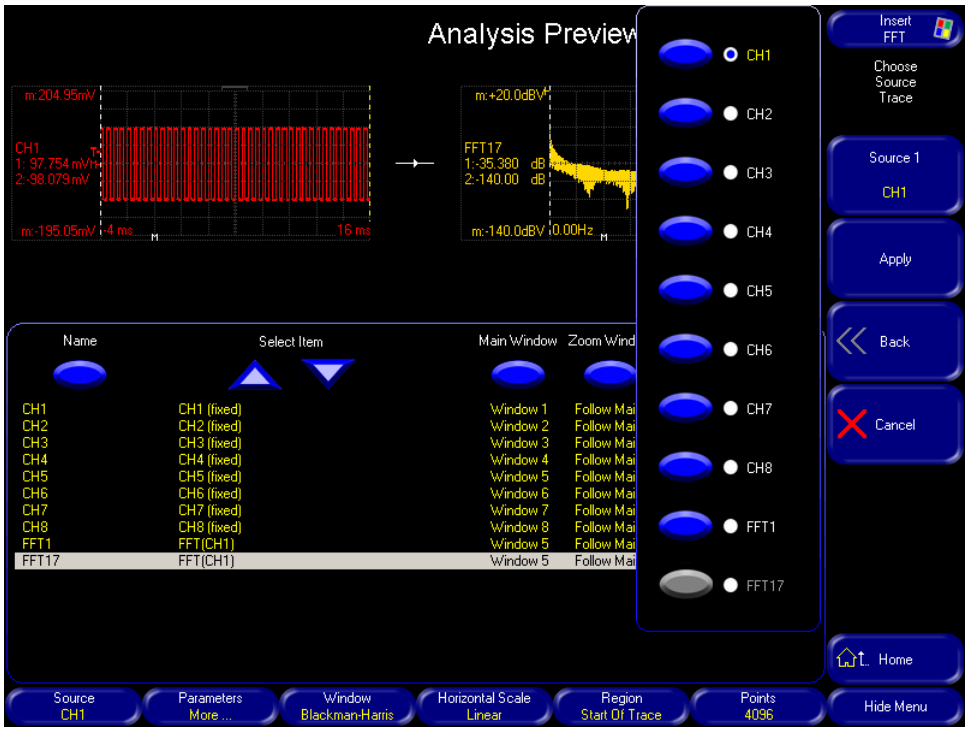


1. Select the source from the list of channels, or other resources that had previously been defined, using the appropriate menu button or the **Cursor 2** control.
2. When a source is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections.

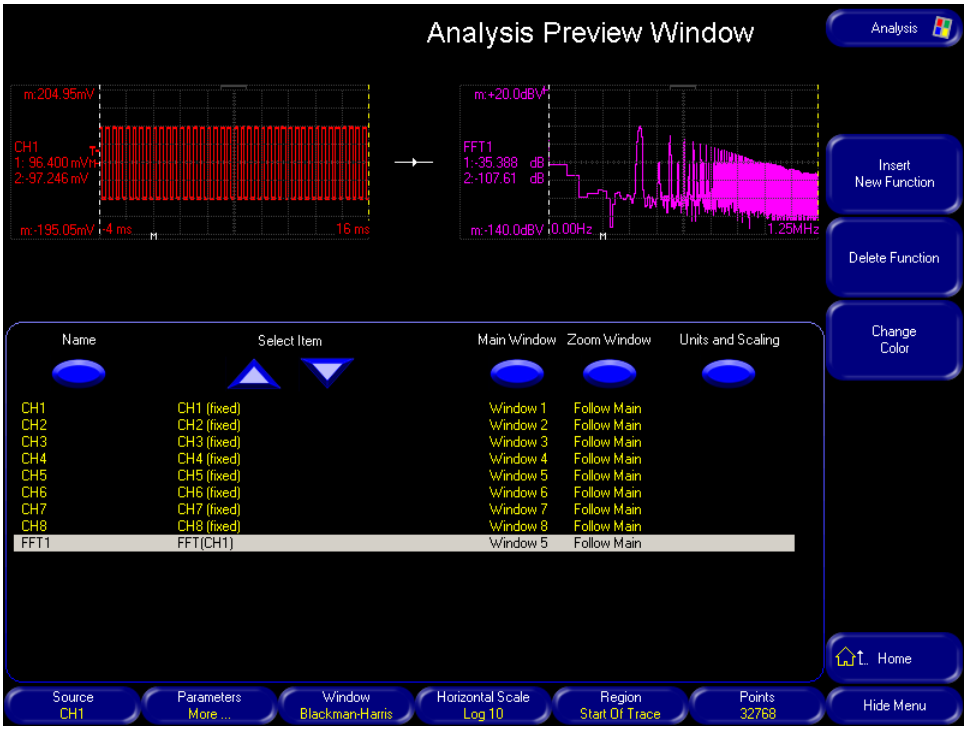
Note: *The source signals can be changed anytime using the parameter bar across the bottom of the screen.*

Once the analysis function is selected:

- The menu system becomes dynamic, offering the relevant choices in a progressive sequence.
- An Analysis Preview window opens. This 'live action' window displays source traces, resultant traces, custom measurements, XY windows, FFTs, graphs and histograms.
- The lower half of the display becomes a resource and definition window. Any of the items in this listing can be edited, renamed, deleted, etc.

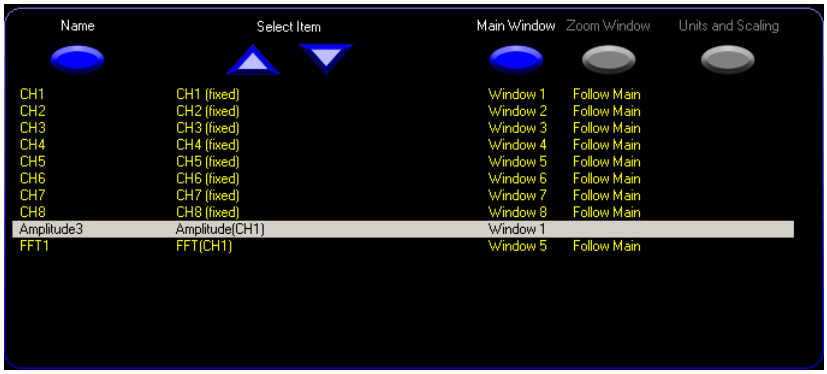


Upon choosing FFT, the Analysis Preview window displays the selected source and result window.



FFT Parameters

Parameters for any Measurement can be edited after the original Measurement definition is complete. Select the Measurement to be edited from the list of Definitions using the Cursor 1 control.



The parameters for the highlighted item appear in the bar along the bottom of the screen. Click on any parameter bar button to adjust the associated parameter.

The Parameters for FFT are:

- Source
- Window (Rectangular, Hamming, von Hann/Hanning, Blackman, Black-Harris, Windowed-Sinc and Flat-Top)
  A "rectangular window" means no window function is applied. For a 12-bit data acquisition system, it is recommended that Blackman-Harris or windowed-sinc functions are used. The remaining filters have been provided for backwards compatibility. Data that is not windowed correctly can produce very poor spurious free dynamic range.
- Horizontal Scale (Linear or Log 10) / Vertical Scale (dBV or Volts)
- Region (Start of Trace, Middle of Trace, End of Trace)
- Number of Points (in power of 2 sequence)

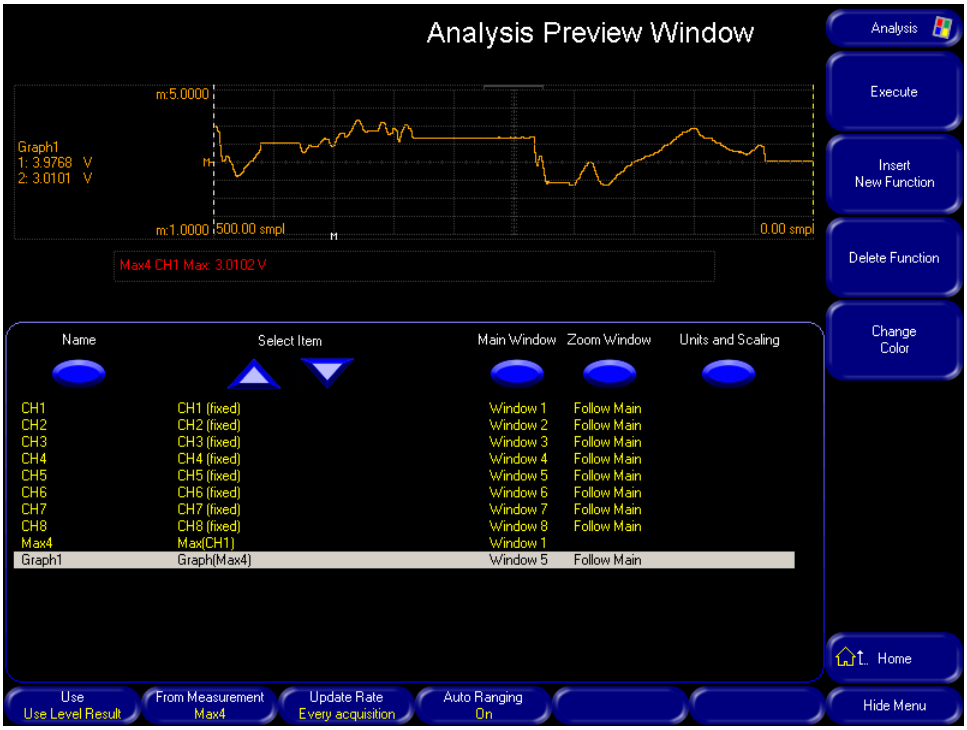

Caution

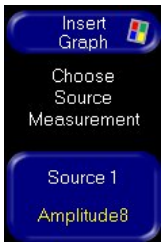
The FFT length is the maximum FFT that will be allowed. If the acquisition store length is set to a lower value than the FFT length, the FFT will be smaller. There will be no indication that this has occurred as there is no interlock between the acquisition length and the FFT length. It is recommended that the minimum FFT size be 4096 points, with 8192 and higher being preferable. It is understandable that the FFT size can be effectively limited by the maximum sampling rate and the resulting acquisition store length. A longer FFT provides more resolution in terms of frequency and a lower noise floor.

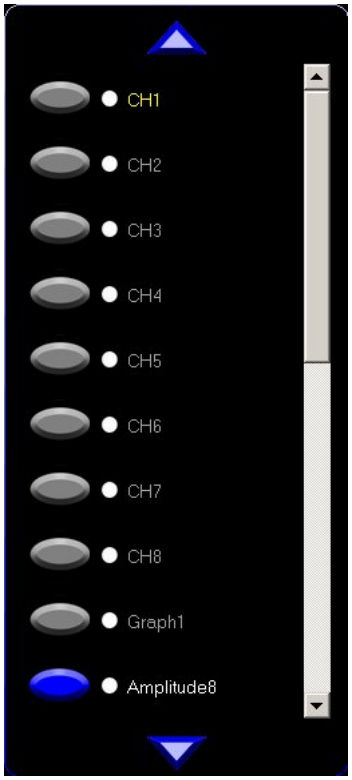
- Averaging (very useful for suppressing aberrant noise) (Available for Vertical parameters only.)

Graphs

The Graphs function provides a means of live trending of a particular Measurement over time. Graphs can update periodically or with each new acquisition. Any Measurement can be graphed.

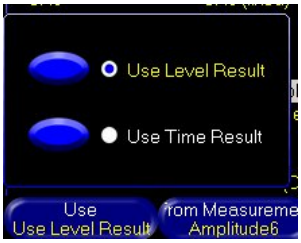






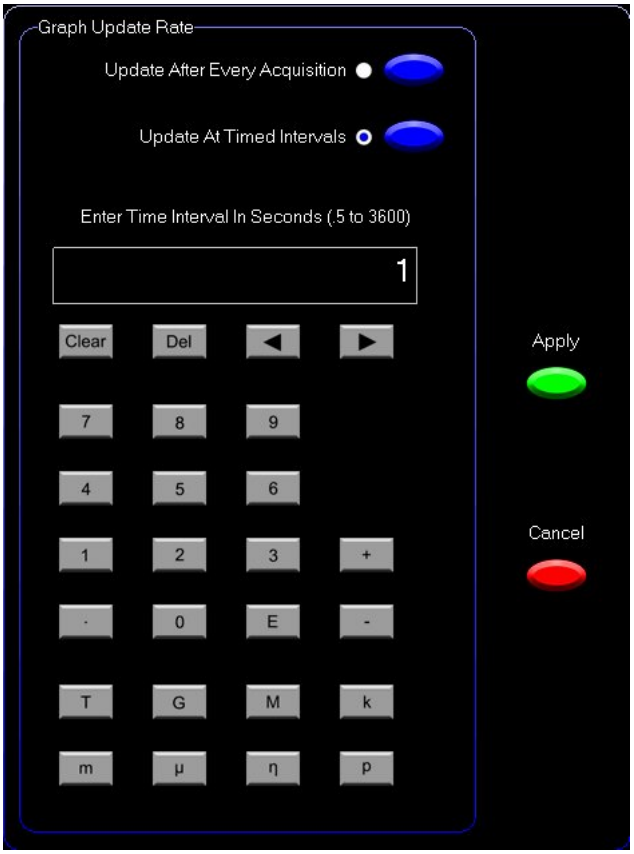
1. Select the Measurement to be graphed from the list of resources. Only Measurements are available in this list. Traces cannot be graphed and are grayed out. Use the appropriate menu button or the **Cursor 2** control to select the Measurement.
2. When a source is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections.

Note: *The source Measurements can be changed anytime using the parameter bar across the bottom of the screen.*



In some cases there is a level measurement and a time value and therefore the Use selection allows either to be selected for graphing.

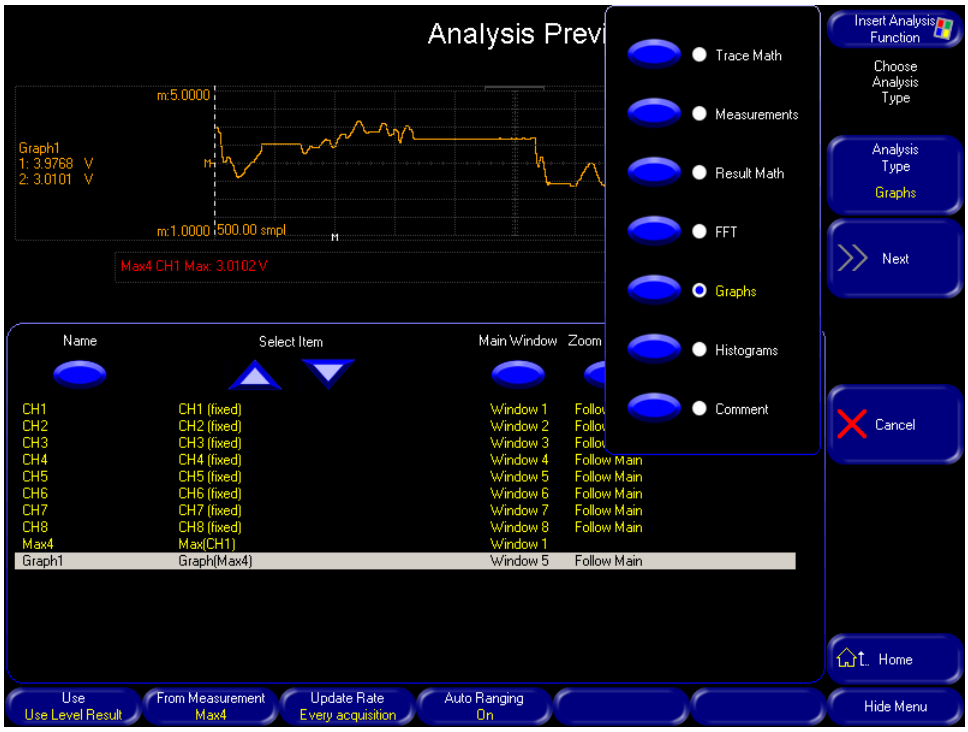
The update rate is set using the Update Rate button in the parameter bar.



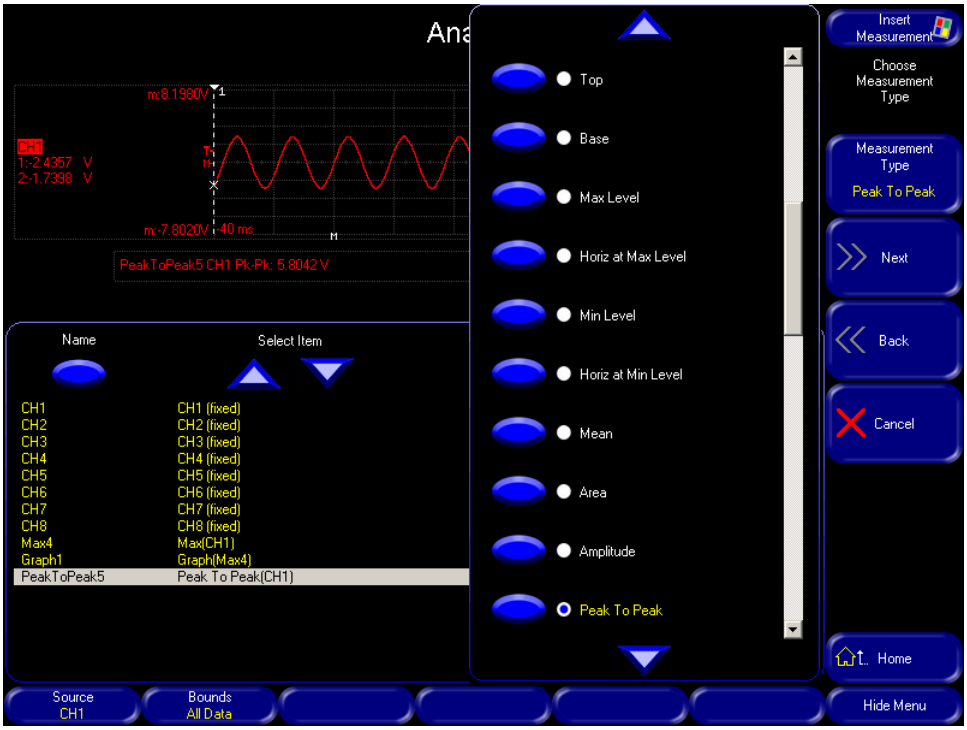
Auto Ranging can also be turned on or off using the button in the parameters bar.

Once the analysis function is selected:

- The menu system becomes dynamic, offering the relevant choices in a progressive sequence.
- An Analysis Preview window opens. This 'live action' window displays source traces, resultant traces, custom measurements, XY windows, FFTs, graphs and histograms.
- The lower half of the display becomes a resource and definition window. Any of the items in this listing can be edited, renamed, deleted, etc.

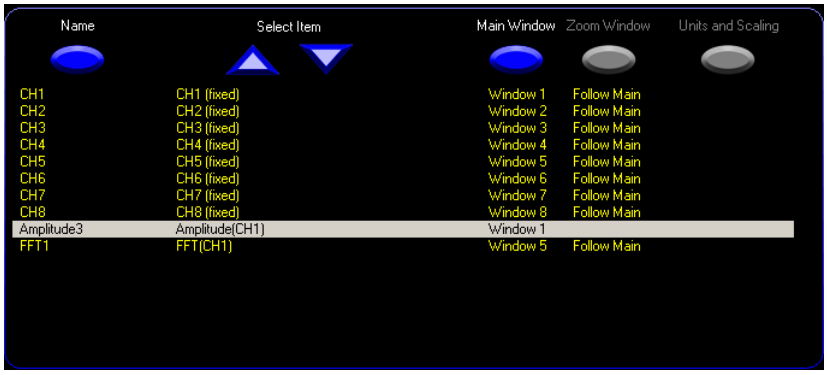


Upon choosing Graph, the Analysis Preview window displays the selected source and result window.



Graphs Parameters

Parameters for any Measurement can be edited after the original Measurement definition is complete. Select the Measurement to be edited from the list of Definitions using the Cursor 1 control.



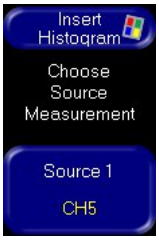
The parameters for the highlighted item appear in the bar along the bottom of the screen. Click on any parameter bar button to adjust the associated parameter.

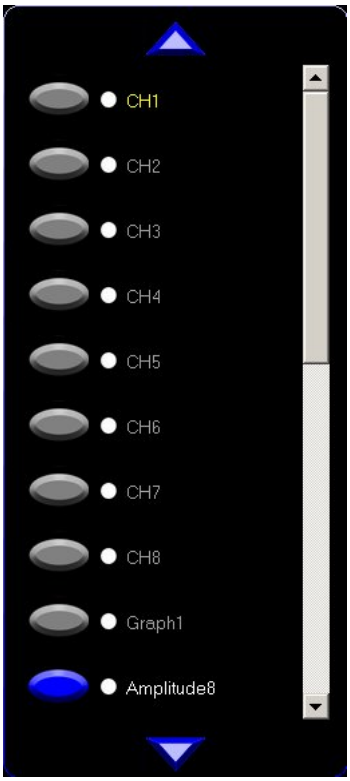
The Parameters for Graphs are:

- ***Use Time Result*** or ***Use Level Result*** - many Measurements result in X and Y values
- ***From Measurement*** - allows changing of Measurement to be Graphed
- ***Ranging*** - turn Auto Ranging on or off (manually set the upper and lower levels with Range Min and Range Max)
- ***Update Rate*** - update rate from Every Acquisition to every 300s

Histogram

The Histograms function provides a live distribution analysis of a particular Measurement. Histograms can update periodically or with each new acquisition. Nearly any Measurement can be histogrammed.



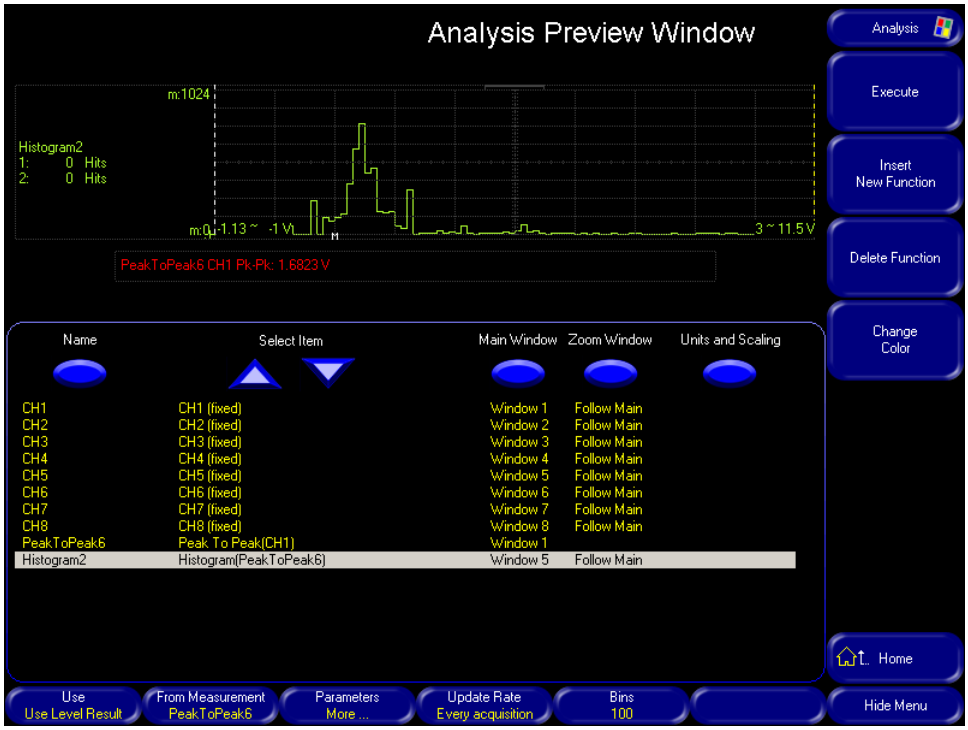


1. Select the Measurement to histogram from the list of resources. Only Measurements are available in this list. Traces cannot be put in a histogram and are grayed out. Use the appropriate menu button or the **Cursor 2** control to select the Measurement.
2. When a source is selected, click the ***Apply*** button or use the ***Back*** button to change previous selections.

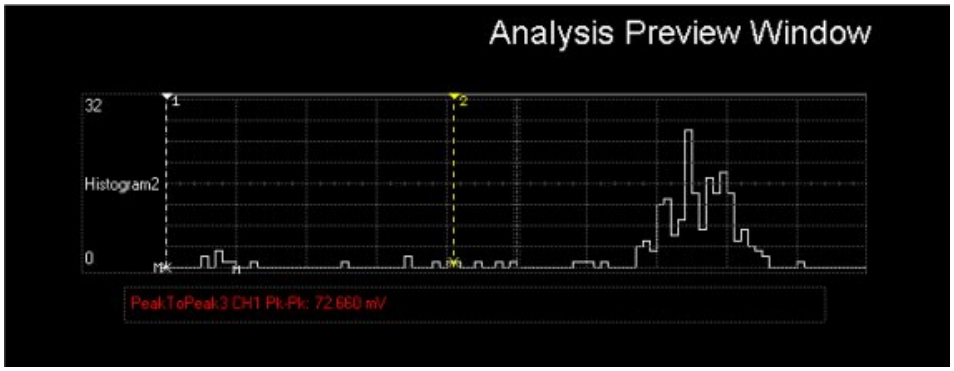
Note: *The source Measurements can be changed anytime using the parameter bar across the bottom of the screen.*

Once the analysis function is selected:

- The menu system becomes dynamic, offering the relevant choices in a progressive sequence.
- An Analysis Preview window opens. This 'live action' window displays source traces, resultant traces, custom measurements, XY windows, FFTs, graphs and histograms.
- The lower half of the display becomes a resource and definition window. Any of the items in this listing can be edited, renamed, deleted, etc.

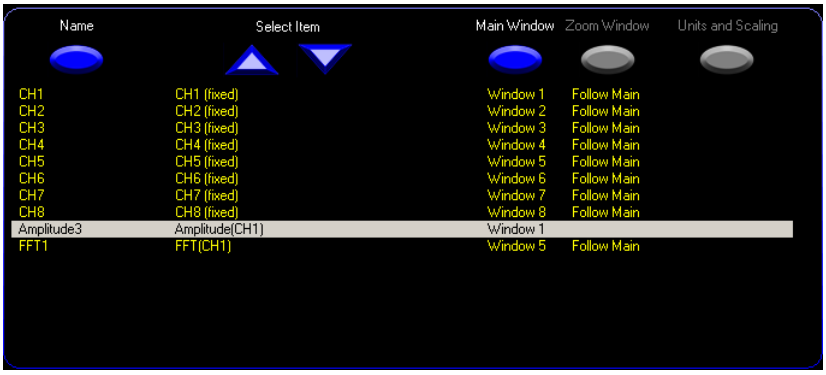


Upon choosing Histogram, the Analysis Preview window displays the selected source and result window.



Histogram Parameters

Parameters for any Measurement can be edited after the original Measurement definition is complete. Select the Measurement to be edited from the list of Definitions using the Cursor 1 control.



The parameters for the highlighted item appear in the bar along the bottom of the screen. Click on any parameter bar button to adjust the associated parameter.

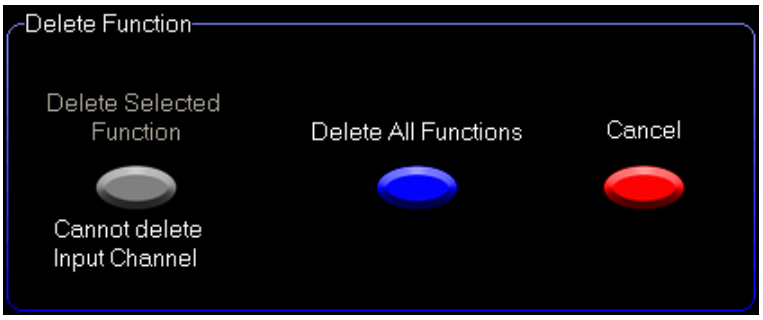
The Parameters for Histograms are:

- ***Use Time Result*** or ***Use Level Result*** - many Measurements result in X and Y values
- ***From Measurement*** - allows changing of Measurement to be Graphed
- ***Ranging*** - Turn Auto Ranging on or off (manually set the upper and lower levels with Range Min and Range Max)
- ***Update Rate*** - update the rate from Every Acquisition to every 300s
- ***Bins*** - define how many bins will be across the X axis of the display from 10 (low resolution) to 500 (high resolution).

Note: *The total number of readings (hits) is available by defining an "Area" Measurement on the Histogram. The percentage of readings in a bin may be calculated by dividing the number of readings in a bin (obtained with a Cursor Measurement) by the total number of readings from the Area Measurement.*

Deleting a Function

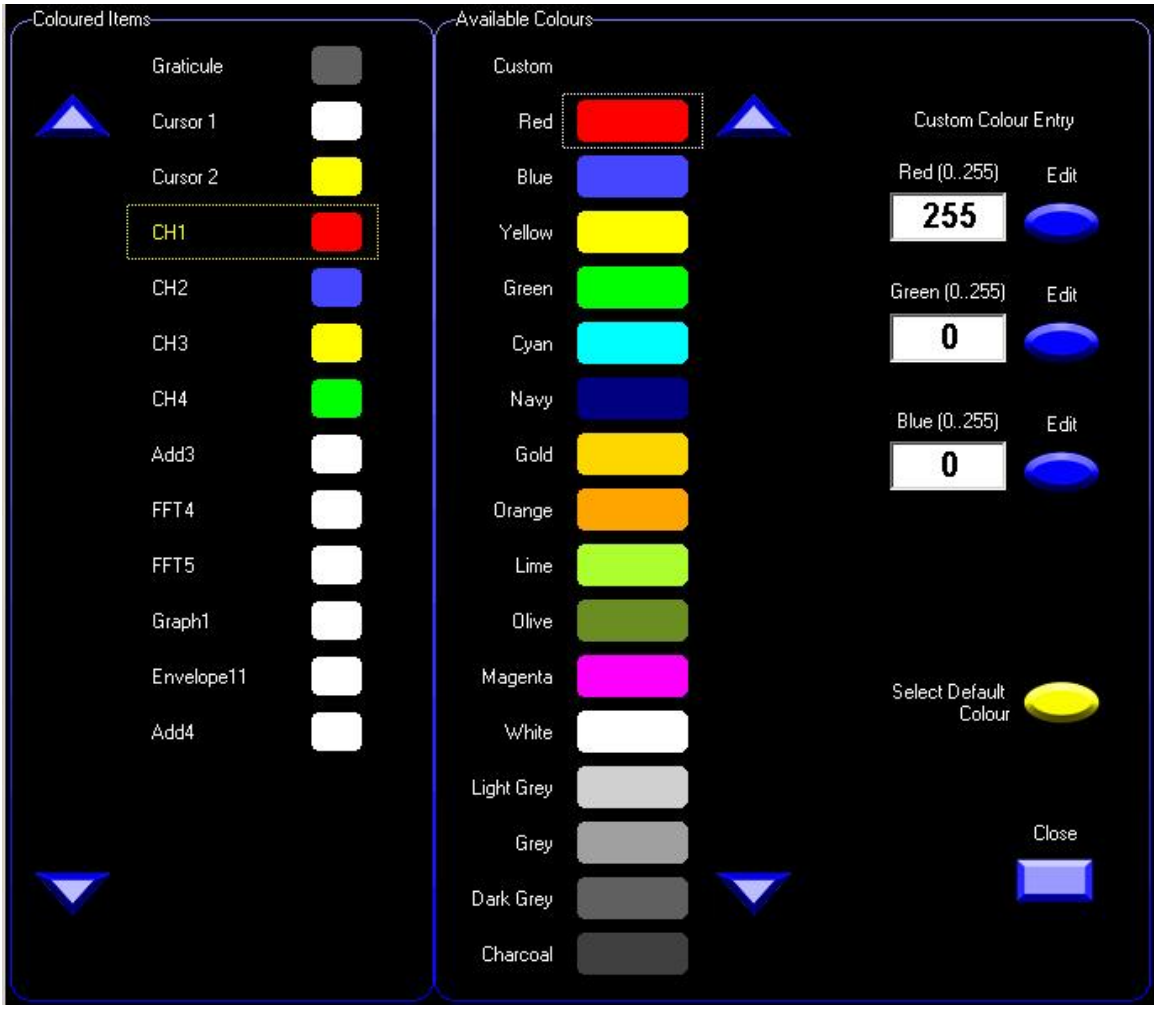
1. Select (highlight) the function in the list on screen, then press the ***Delete Function*** button to display the Delete Function control panel as shown below.



2. The Delete Function control panel offers selections for deleting a function, deleting all functions or canceling the operation.

Changing the Color of a Trace

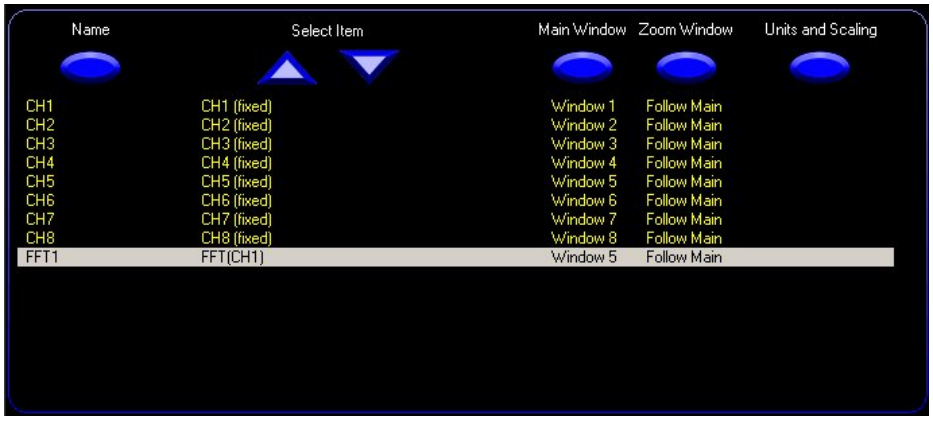
1. Select the function in the list on screen then press the ***Change Color*** button to display the Color control panel.



2. Make the required changes and press the ***Close*** button to exit the control panel.
3. Press the ***Home*** button to exit the ***Analysis*** menu.

Using the Analysis Control Panel

The Analysis Control Panel contains controls for naming, selecting, viewing, and scaling items.

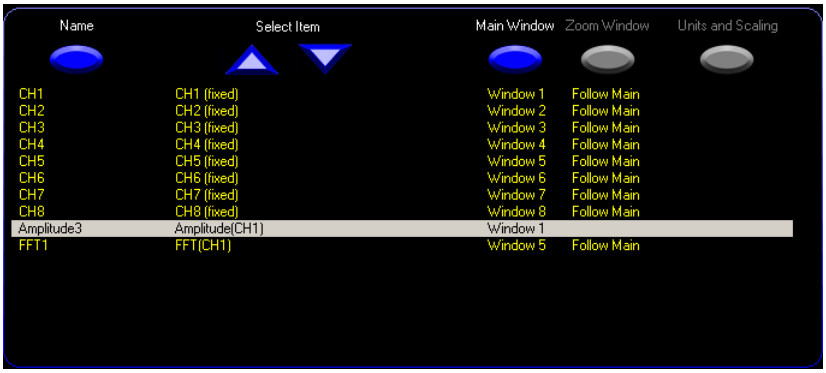


Name

Clicking on the **Name** button opens a typewriter-style entry window, allowing you to type a name for the function.

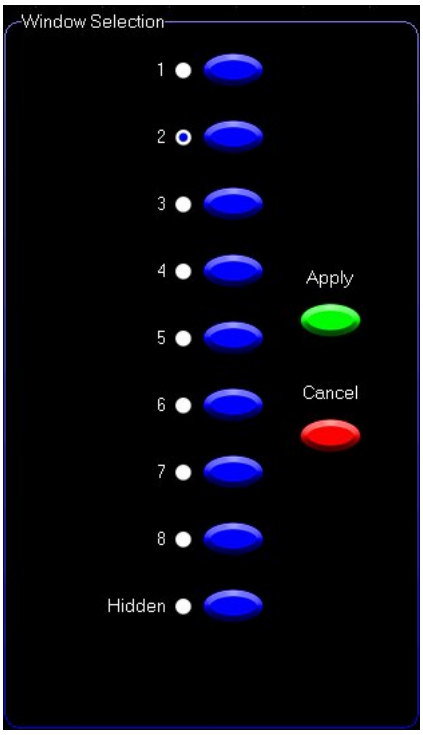
Select Item

The **Select Item** arrows allow you to scroll through the list of items in the Analysis window. Click on the up and down arrows to move the highlighted selection.



Main Window

The result of the analysis definition is put in a default window. Select another window from the list using the appropriate menu button or the **Cursor 2** control.



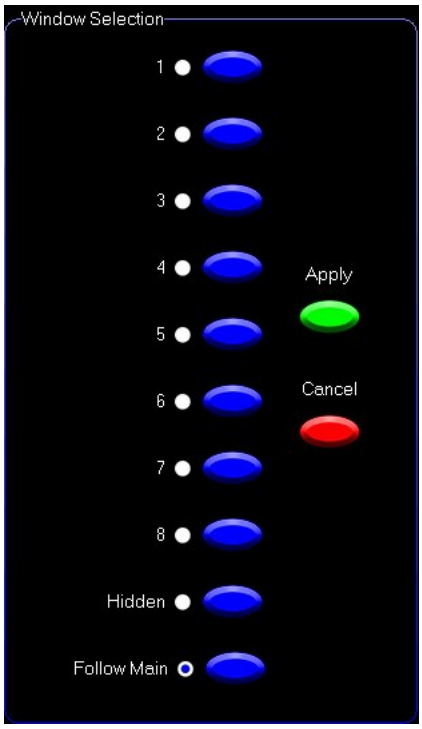
It is important to know what window the analysis is in.

If the display for **Page2** is not set up to show that window, the analysis trace will not be displayed.

Example - the analysis definition is assigned to Window 5, but the Display for Page2 is only set up to view four windows.

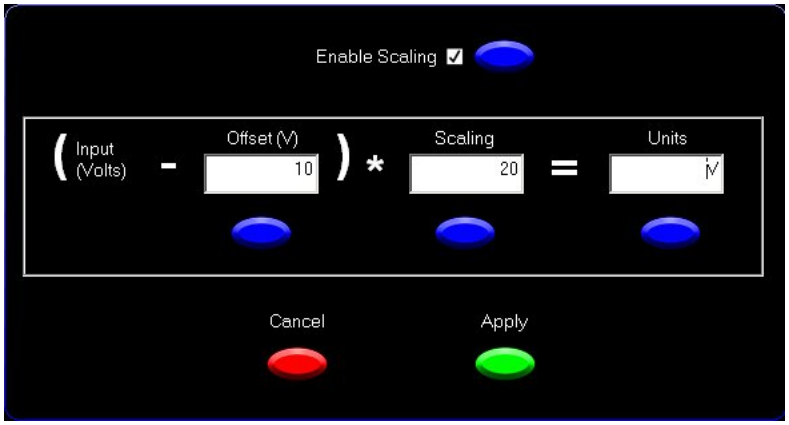
Zoom Window

The **Zoom** for an analysis trace definition can be put in the same window as the Main (Follow Main) or put in any other window. Select a window for the zoomed view.



Units and Scaling

Each Analysis result waveform can be scaled with a multiplication factor and given an offset and units.



Chapter 5: Tutorial

Introduction

This tutorial demonstrates Sigma's key features while avoiding getting lost in details.

Before You Begin

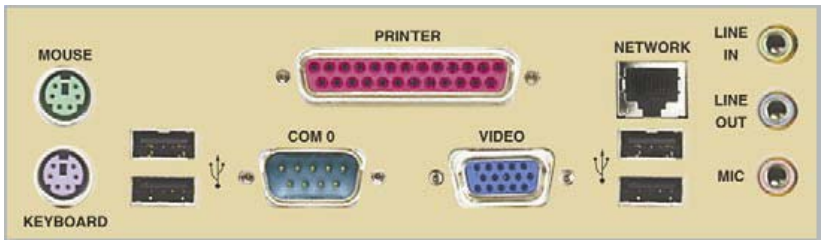
Before you begin the tutorial, you need to do the following:

1. **Connect a minimum of two input signals.**
   Use a transient signal, for example a "thwacker" or microphone, and a repetitive signal. This signal can simply be the square wave from the calibration connector.
2. **Power up the instrument.**
   Wait until the Sigma software has loaded.

Back Panel Connections and PC Features

The Sigma is a fully featured Windows 2000 or Windows XP PC. The back panel houses the PC connections:

- PS/2 connectors for mouse and keyboard
- Serial, parallel and four ultra-fast USB 2.0 interfaces
- 100 MBit Ethernet
- Standard sound in/out



Back Panel PC connections

The expansion slot can be used to add one of the two factory installed options:

- First is the SynchroScope to do rotational measurements.
- Second is the dual video which allows the internal screen to show live scope data while the external secondary monitor shows LabView, Word or Excel simultaneously.

Note: Other PC cards are not supported.

The internal hard disk holds the local software and scope data can be stored on it. You can also install your own software and run it directly on your Sigma. The hard disk is 20 GB or bigger.

The Sigma doesn't contain an internal removable drive, however data can be exchanged over a network. If you require removable media, several USB based devices ranging from floppy disc drives to Zip, CD- or even DVD-recorders are available. Also, the newly available USB RAM-sticks are large, cheap and run without driver installation.

Tutorial

This tutorial assumes you have a thwacker, microphone or other transient source connected to Ch1 and a repetitive signal of about 1 kHz connected to Ch2 (calibration signal or audio cable).

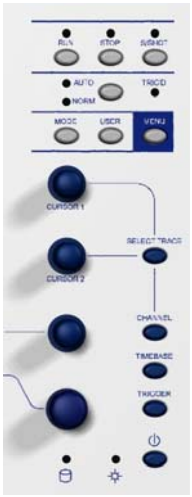
Loading a Default Setup

1. Press the **MENU** button on the front panel.
2. In the upcoming menu at the right side of the display, press ***File***, then ***Recall***.
3. In the popup menu, press ***Recall Default Setup*** and then confirm with ***OK***.
4. You're done loading a default.

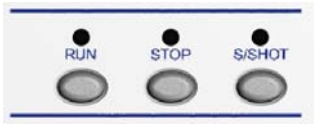
The default setting of Sigma is as follows:

Scope mode
CH1 to 4 sens = 5 V / Div
Sample rate = 200 kS/s or 5 ms/Div
10 k Mem, 8 bit resolution
CH1 to 4 baseline = equally spaced from top to bottom
Zoom 10:1
Yt and Zoom Split display
Trigger CH1 DC rising edge, 5 V level, 20 % Pretrigger
Trigger mode AUTO
Vertical cursors only
Cursors ON and placed at left / right border of the display
Analysis Window layout (Page 2): 1 by 4
Multi channel Cursor1 and Cursor2 readout enabled
y-Axis labels enabled
x-Axis label enabled

Using the Sigma Front Panel



RUN / STOP / S/SHOT Buttons



RUN = Continuous acquisition every time a trigger occurs
(former LIVE)

STOP = Holds last acquisition
(former HOLD LAST)

S/SHOT = Arms Sigma and acquires the next trigger, then stops
(former HOLD NEXT or ARM)

AUTO/NORM Buttons

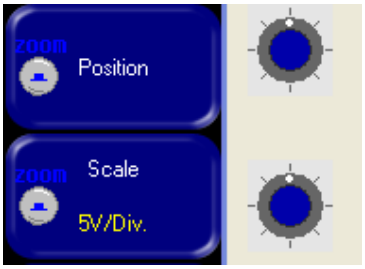
1. Switch between **AUTO** and **NORM** trigger using the front panel buttons.
2. Use a thwacker/microphone signal to acquire data.

AUTO = Automatic acquisition, even if no signal trigger occurs.
System is free-running showing live display.

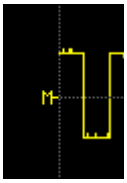
NORM = Acquisition starts when signal trigger occurs.

Channel/Position/Scale Buttons

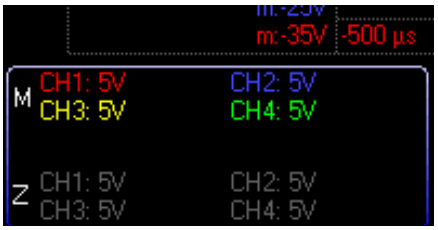
1. Press the front panel **CHANNEL** button. Change the ***Position*** and ***Scale*** of CH1 using the two front panel knobs.



Note: *These knobs change functions depending on the menu currently displayed.*

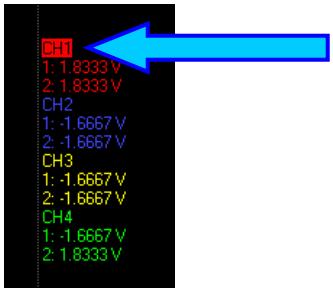


POS marker for each channel on Sigma´s display



SENS indication for each channel on Sigma´s display

2. The "active trace" is indicated by the inverted channel name at the left side of the display. Use the **SELECT TRACE** front panel button to change the active trace to CH2. Change the position and scale of that channel using the front panel knobs.



The inverted CH1 indicates that Channel 1 is currently the ***active trace***

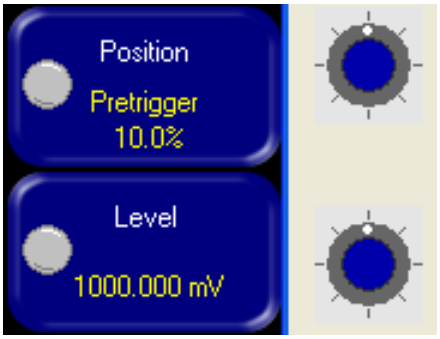
Timebase

1. Press the front panel **TIMEBASE** button.

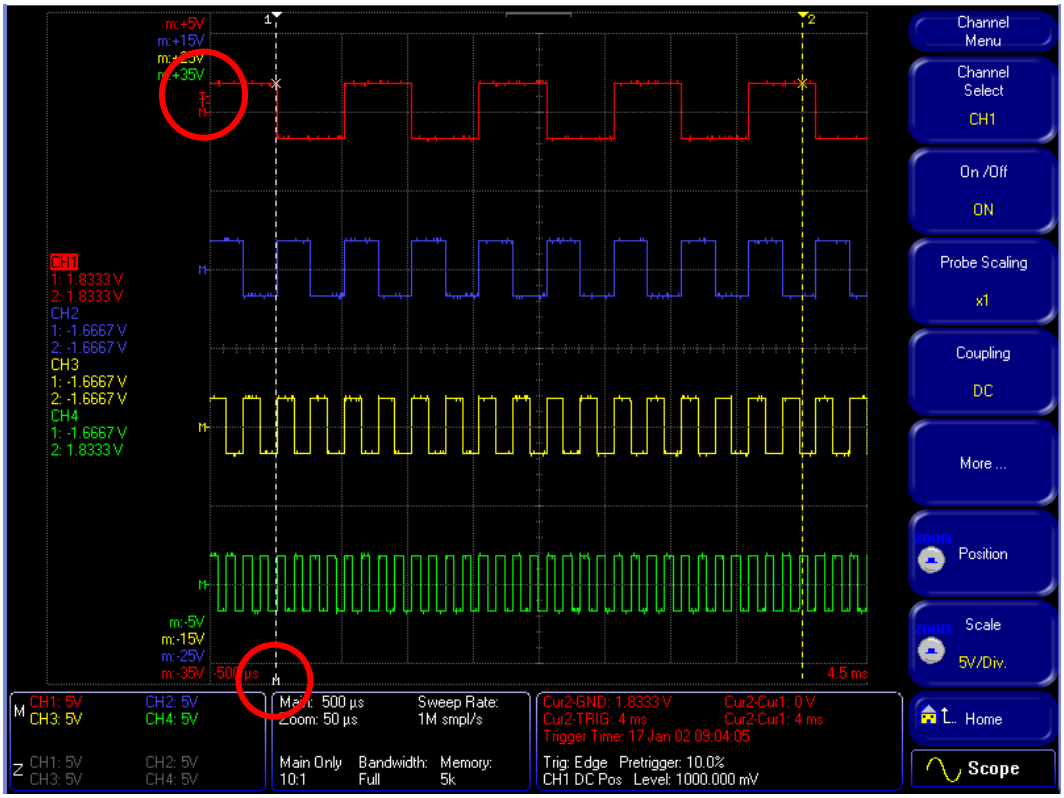
   Change the timebase using the knob (which is now the timebase control).

Timebase and sample rate display

2. Press front panel **TRIGGER** button. Change the trigger ***Position*** and ***Level*** using the knobs (which are now trigger controls).



3. Trigger level and trigger position are displayed on the screen.



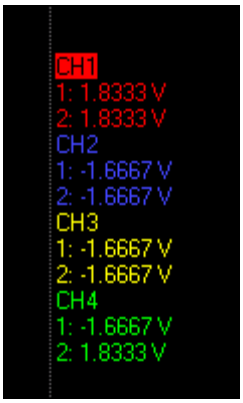
Trigger position and trigger level indication. Sigma 30, 75, 90, and 100 have two T's at the level because those models have hysteresis trigger.

4. Leave the ***Trigger*** menu by pressing the ***Home*** button.

Cursors

1. Move the cursors using the **Cursor** knobs on the front panel.

   Cursor readouts are shown simultaneously for all channels.

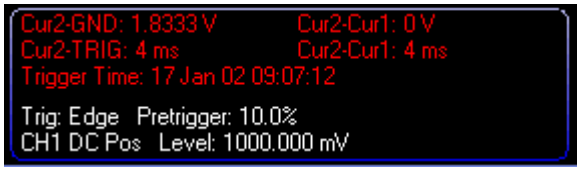


Cursor readouts

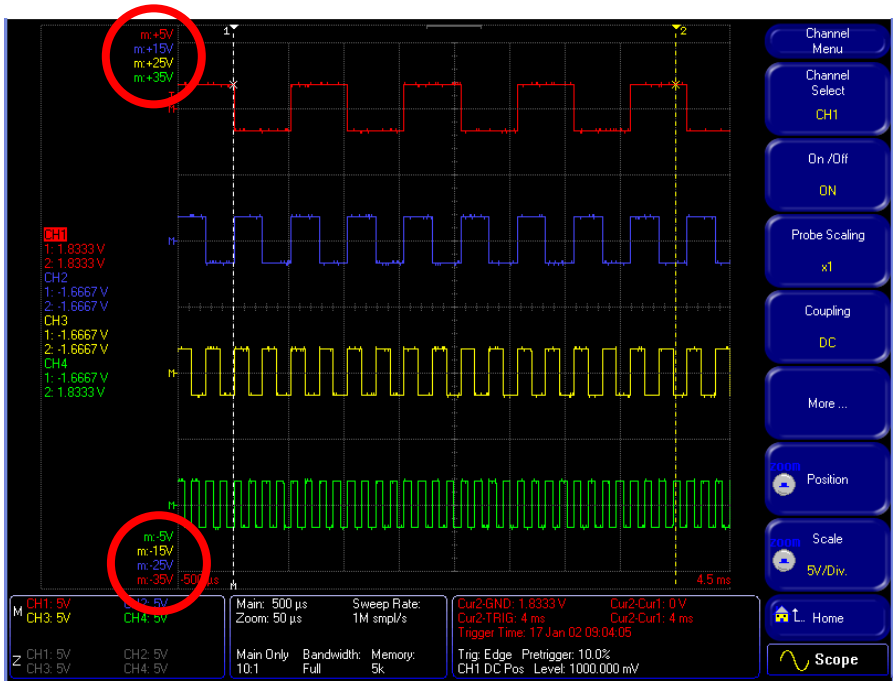
Currently, both Cursor 1 and Cursor 2 readings are enabled. The difference reading 1-2 is disabled. All these readouts can be enabled / disabled independently.

Select Trace Button

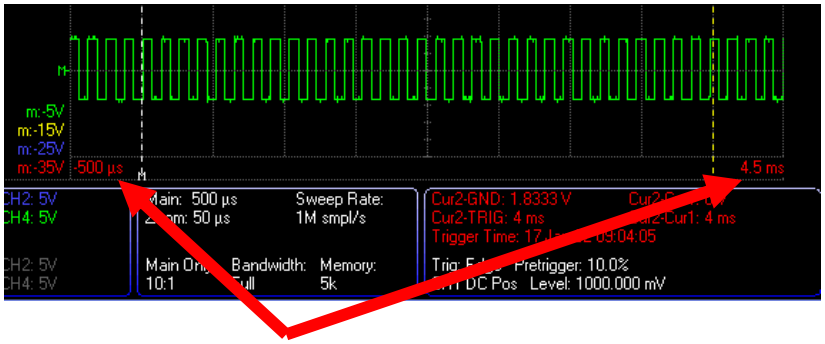
1. Use the front panel **SELECT TRACE** button to change the active trace and the enhanced cursor readout for the active trace at the lower part of the display.



Enhanced cursor readout for the active trace



The y-axis full scale readout appears on the left side of the display area
The x-axis time scaling appears in the lower part of the display area



x-axis time information

Zoom Button

1. Press the front panel **TIMEBASE** button.

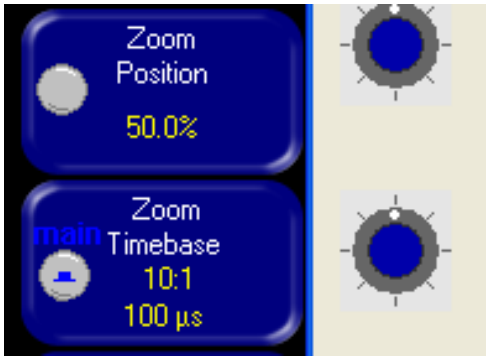
   Note the ZOOM label displayed on the ***Timbase*** button next to the front panel knob.

Timebase button with ZOOM indicator

2. Press the knob to activate the zoom mode.

The display is split into a main and a zoom area. Note that the zoom area has its own x-axis label.

3. Modify the zoom display using the two knobs (which are now ***Zoom Position*** and ***Zoom Timebase.*** First change the ***Zoom Position*** and then adjust the ***Zoom Timebase*** to further investigate an area of interest, for example, the area around the trigger.



4. Press the ***Zoom Timebase*** knob to set the controls back to ***Main***. The ***Main & Zoom*** display remains active.
5. Leave the ***Timebase*** menu by pressing the ***Home*** button.

Up to now you have controlled most of the scope's important features:

- Acquisition Modes
- Channel Sensitivity and Position
- Timebase
- Trigger Level and Pretrigger
- Cursors
- Zoom Position and Timebase

And you did all this just with the front panel…

…no menus, no mouse, no keyboard.

Using the Menus

You can access almost 90% of all of Sigma's features using the following three menus:

- ***Channel*** menu
- ***Timebase*** menu
- ***Trigger*** menu

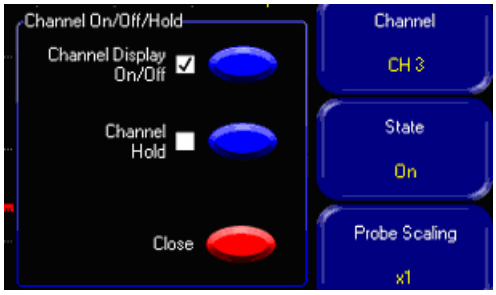
These menus are easily accessed using a front panel button. You can then change the required settings and exit the menu using the ***Home*** button.

Using the Channel Menu

1. Make CH3 the active trace using the front panel **SELECT TRACE** button then press the front panel **CHANNEL** button.

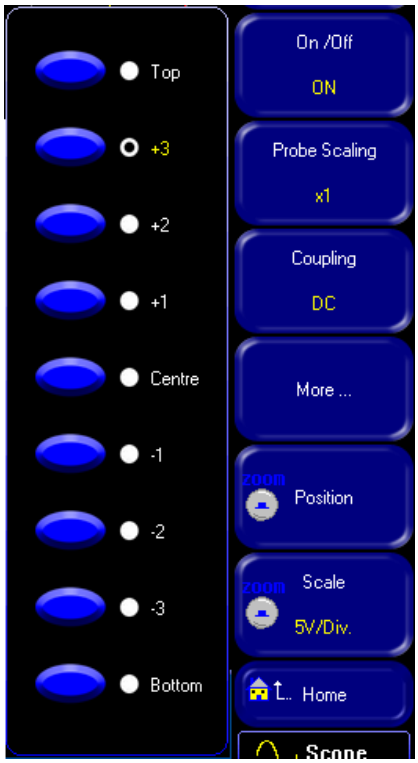
   The ***Channel*** menu appears.

2. Select ***On/Off*** by touching the button on the touch screen display.



3. Switch CH3 to OFF by touching the blue ***Channel Display*** button. Notice that the checkmark is deselected.
4. Make CH1 the active trace using the front panel **SELECT TRACE** button. Press the ***Position*** button.

   Move the position of CH1 up and down to view the effect. Select ***Center***.

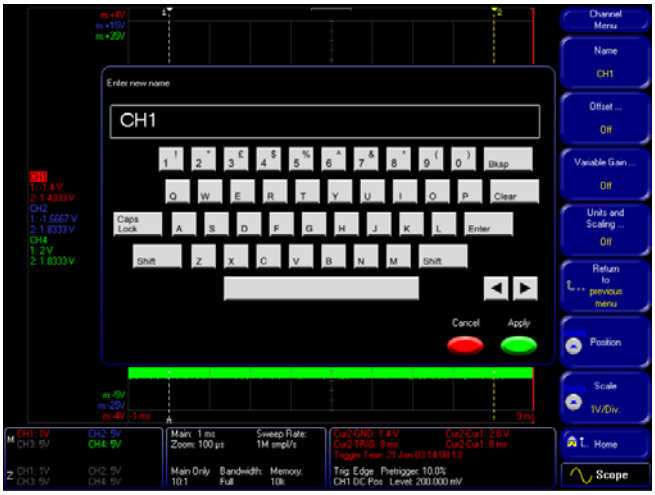


Position controls

5. Press the ***Scale*** button. Change the sensitivity to 1V/Div.

Scale controls

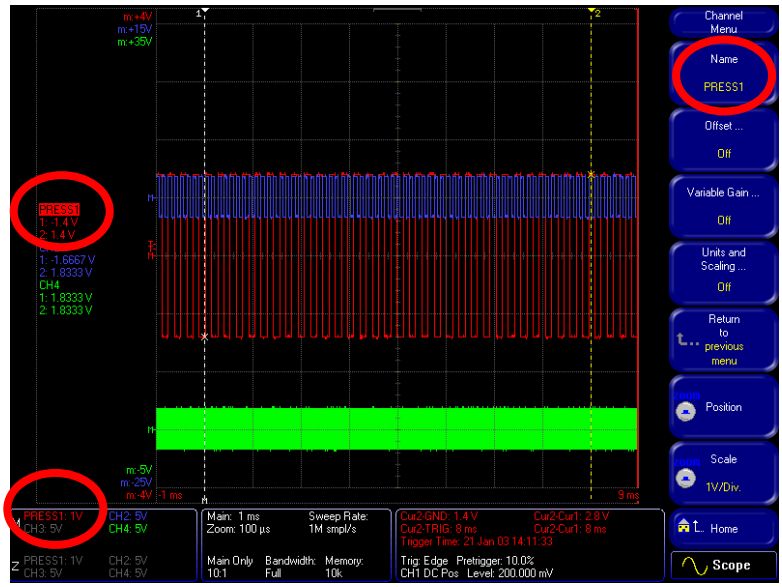
6. Press the ***More*** button then the ***Name*** button. A full size keyboard appears on the screen.



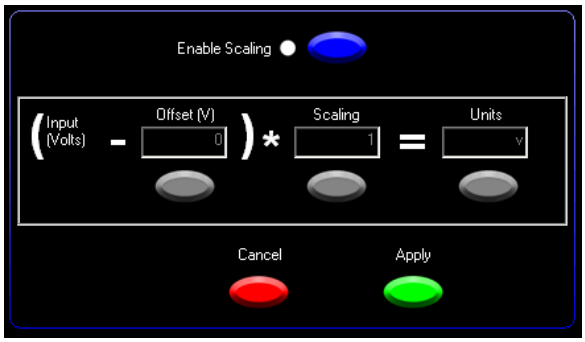
7. Press the ***Clear*** button first, then enter PRESS1 as the name for CH1.

8. Finish the entry by pressing ***Apply***.

   Note the new channel name, PRESS1, appearing in the display several times.



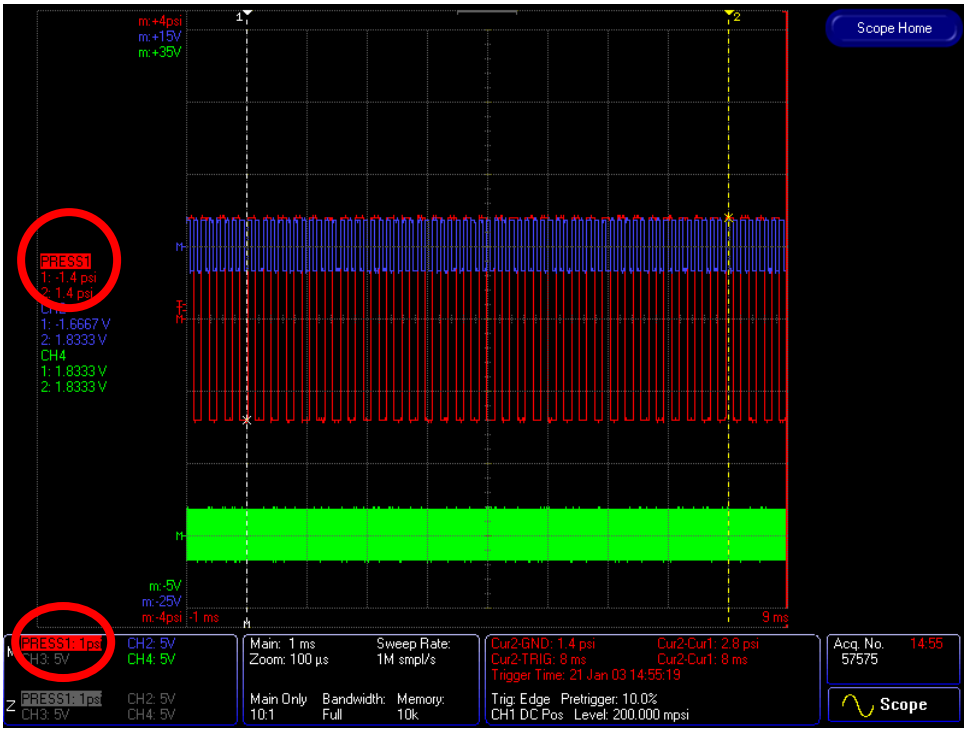
9. Press the ***Units and Scaling*** button. The controls for scaling appear on the screen.



10. Enable scaling using the enable checkbox at the top of the display.

11. Press the ***Units*** button. The alphanumeric keyboard reappears. Clear V and enter PSI. Close the keyboard by pressing the ***Apply*** button. Now PSI appears in the units field.

12. Close the Units and Scaling controls by pressing the ***Apply*** button.
    Note the new channel units PSI appearing in the display several times.



13. Exit the ***Channel*** menu by pressing the ***Home*** button.

Using the Timebase Menu

1. Press the front panel **TIMEBASE** button.
   The ***Timebase*** menu appears.

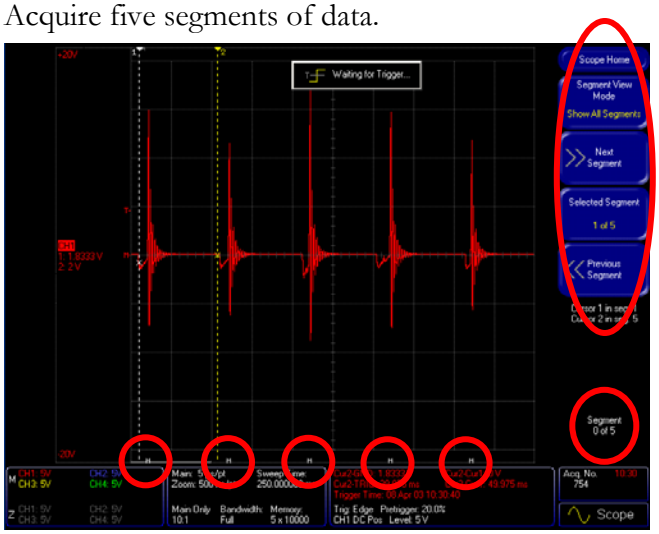
2. Press the ***Main/Zoom*** button. Set the display back to Main.

   Press the ***MultiShot*** button.

3. Select ***MultiShot On***. Change number of segments to five.

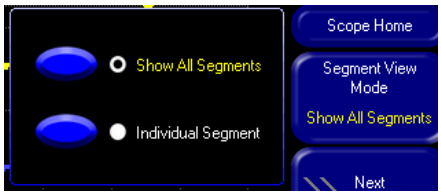
   Press the ***Apply*** button to exit the controls then press the ***Home*** button to exit the ***Timebase*** menu.

4. Acquire five segments of data.

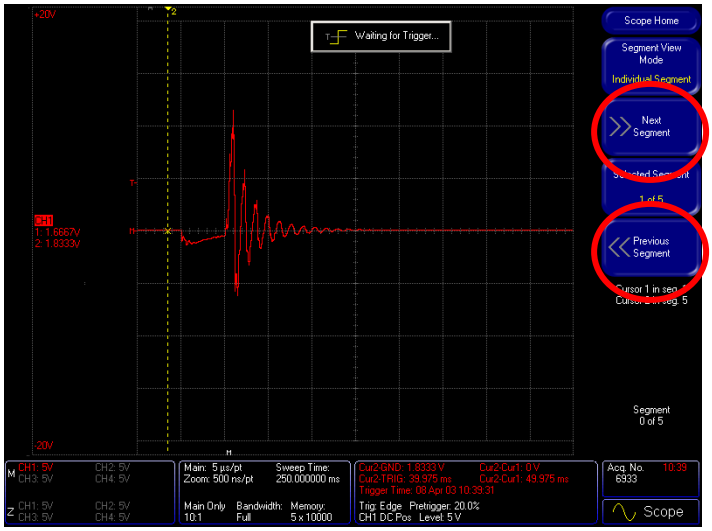


Note the five trigger marks and the additional segment information appear on the screen

5. Note the cross segment cursor readout.
6. Set the display to ***Individual Segment*** in ***Segment Mode View***.



7. Step back and forth through the five segments using the ***Next Segment*** and ***Previous Segment*** buttons.



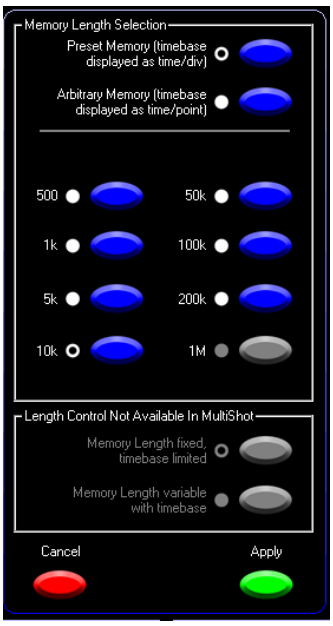
8. Press the front panel **TIMEBASE** button to open the ***Timebase*** menu.

   Switch back to ***Multi Shot Off*** in the ***Multi Shot*** menu. Press the ***Apply*** button to exit the controls.

9. Press ***Memory Length*** button.

   The two possible selections are ***Preset Memory*** and ***Arbitrary Memory*** from the ***Memory*** menu. Arbitrary Memory is often used for rotating machinery, where a length of 360, 720 or 3600 might be desirable. You can switch between them by pressing the upper two buttons in the menu.

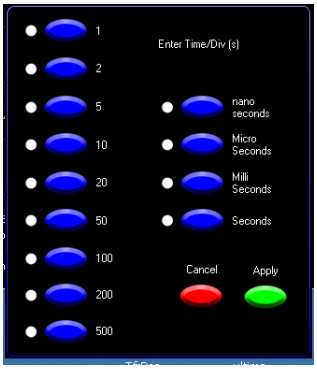
Fixed Memory selected



Arbitrary Memory selected

10. Leave the ***Memory*** menu by pressing the ***Cancel*** button.

11. Press the **Timebase** button.

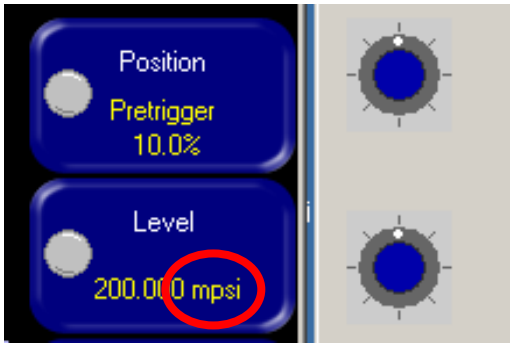


12. Change the Timebase using the controls
13. Exit the ***Timebase*** menu by pressing the ***Home*** button.

Using the Trigger Menu

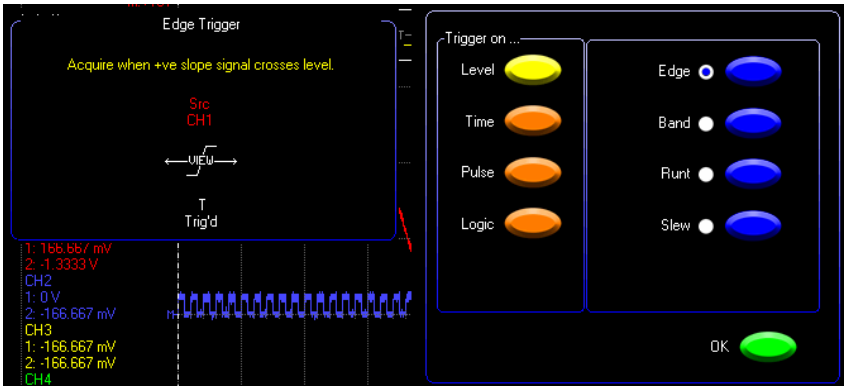
1. Press the front panel **TRIGGER** button.
   The ***Trigger*** menu appears.

2. Note that the trigger level is displayed in psi in the Level field.



Note: *Sigma 30, 75, 90, and 100 have Trigger Hysteresis, much like the ACCURA 100.*

3. Press the ***Triggering Mode*** button.



4. Press the ***Position*** button.

5. Press the ***Level*** button.

6. Exit the ***Trigger*** menu by pressing the ***Home*** button.

Using the Other Menus

The menu structure of Sigma is simple:

- The front panel MODE button is used to switch between different modes of operation.
- The front panel USER button allows you to custom program menu button for ease of access.
- The front panel **MENU** button opens the ***Master*** menu, allowing access to all other settings like display settings, storage and preferences.

These menus are easily accessed using a front panel button. You can then change the required settings and exit the menu using the ***Home*** button.

Using the Master Menu

The front panel **MENU** button opens the ***Master*** menu, where you can access other settings.

1. Press the front panel **MENU** button.

The ***Master*** menu appears.

Acquisition
Options like resolution, glitch detect, averaging

Display
Screen layout, display mode, persistence

Measurement and Cursors
Snapshot measurements, cursor features

Data Transfer
Xfer to ProView, Excel and FlexPro

File
Save, Recall, Export, Print

Utilities
Preferences, Calibration, Options

2. Press the ***File*** button.
   The ***File*** menu appears.

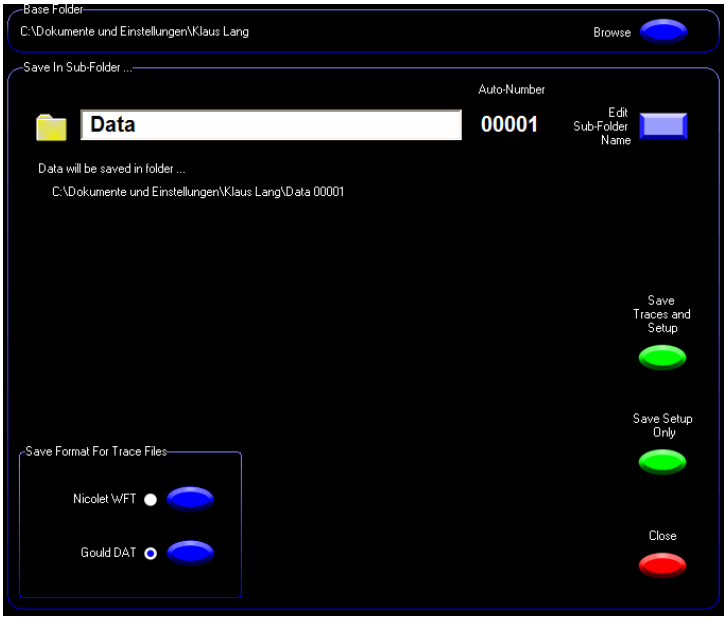
Save
Save traces and / or setups

Export
Export data to other data or graphic formats

Recall
Recall traces, setup or setup defaults

Print Screen
Print hardcopy to windows printer

4. Press the ***Save*** button.
   The control panel that appears allows you to easily browse the directory tree, select a new Base folder or enter a new subfolder name in which to save your data.



5. Exit this panel by touching the ***Close*** button.

6. Exit the ***File*** menu by pressing the ***Home*** button.

Using the User Function Menu

1. Press the front panel **USER** button to open the ***User Function*** menu. This button enables quick and direct access to commonly used functions such as Auto Setup, Save, Print and Export.

Initiates the Auto Setup process. Starting the Auto Setup process automatically makes the appropriate settings on the Sigma to display several cycles of a repetitive AC signal on any active channel.

Performs the saving of waveform data and system setup. To modify the setup of saving waveform data go to Main Menu → File → Save.

Performs the printing of waveform data. To modify the default printer and setup, go to the Windows Printer setup utility.

Performs exporting of waveform data. To modify the setup of exporting data go to Main Menu → File → Export.

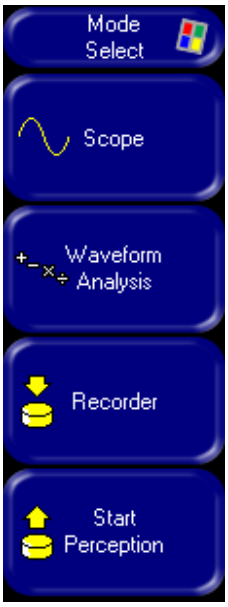
This button is used to open a menu where you can program the other keys.

2. To exit the ***User*** menu, press any menu button on the front panel or the ***Home*** button.

Using the Mode Select Menu

1. Press the front panel **MODE** button.

The ***Mode Select*** menu appears.



These four buttons are used to switch Sigma into one of four operation modes:

Scope – Plain oscilloscope, no math

Waveform Analysis – Math features

Recorder – Direct to disk acquisition (optional)

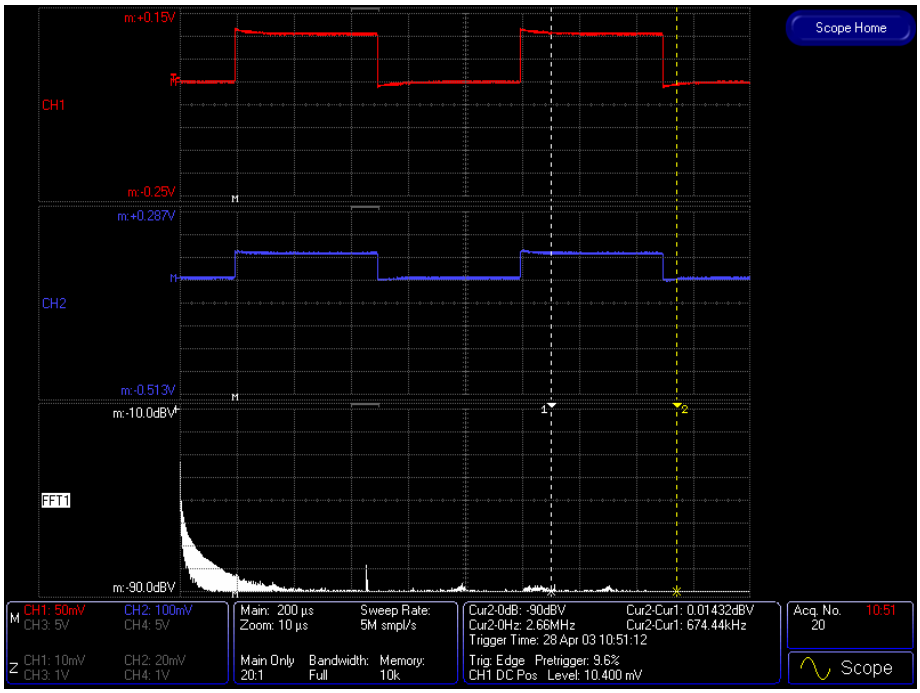
Start Perception – Direct to Disk recall/review recordings

2. Press the ***Waveform Analysis*** button to enter analysis mode.

   The ***Analysis Home*** menu appears.

Analysis Home menu

3. Press the front panel **MENU** button, then press the ***File*** button and then the ***Recall*** button.
4. Press the ***Recall Setup Only*** button to load the preprogrammed setup, "Analysis example 1."
5. Perform another acquisition and watch the displayed result on the screen.



Sigma analysis screen example

6. Press the front panel **MODE** button and then the ***Recorder*** button to enter Recording mode.
7. Exit the ***Mode*** menu by pressing the **Scope** button.

   For details on the operation of the Recorder and Start Perception buttons, refer to the section on Using the Direct to Disk Option found later in this manual.

Using the Mouse and Keyboard

Although not required for operation, a mouse and keyboard can provide enhanced ease of use and functionality.

Your Sigma can be fully controlled with a mouse and an external keyboard. Therefore, you can even create "remote control" by using longer cables. You can also control your Sigma from another PC using simple software solutions like PC Anywhere.

Using a Mouse

With a mouse connected to your Sigma, you can:

Control the channels

- Move baselines
- Change channel sensitivity by hovering over the status display and turning the mouse wheel

Control timebase and trigger

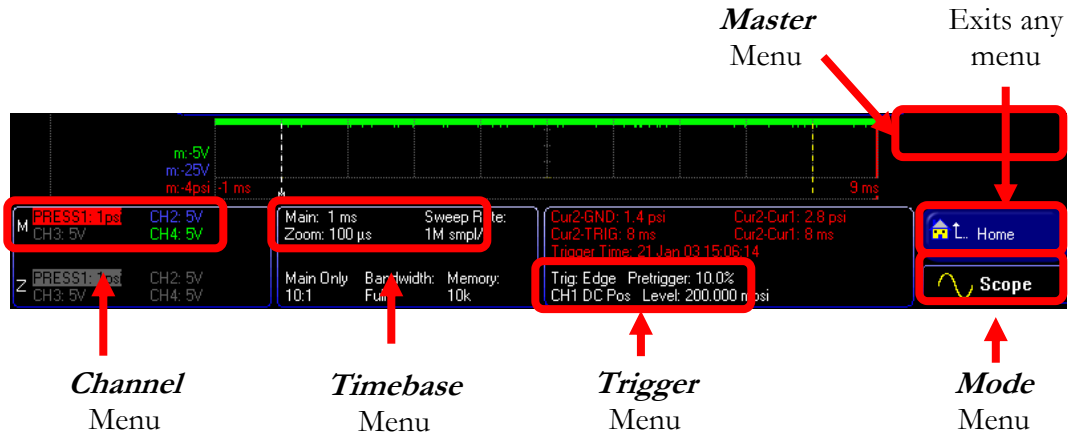
- Move pretrigger
- Move trigger level
- Change timebase by hovering over the status display and turning the mouse wheel
- Change zoom timebase by hovering over the status display and turning the mouse wheel

Enjoy "click and drag" functionality

- Move Cursors
- Move zoomed x-axis area
- Zoom with a rubberband

Operate the menus

You can open all menus by clicking on the appropriate sections in the status display field at the bottom of the screen.



Click the marked sections on the Sigma screen to enter different menus. You can then use the mouse pointer to make selections just as you would by using the touchscreen and your finger.

Clicking on the ***Home*** button exits the current menu.

Using a Keyboard

Using an external keyboard, you can easily enter alpha-numeric characters. For example, you can change a channel name by pressing the front panel **CHANNEL** button and then pressing the ***More*** button and finally the ***Name*** button. When the alpha-numeric input field has opened, select ***Clear*** first, then click in the text entry area. You can then type the entry on the external keyboard. When you are finished, press the Apply button to exit the panel.

If you are using an external keyboard, you can also easily switch to Windows by press in the **Windows** key on the keyboard.

CONGRATULATIONS! YOU HAVE COMPLETED THE TUTORIAL!

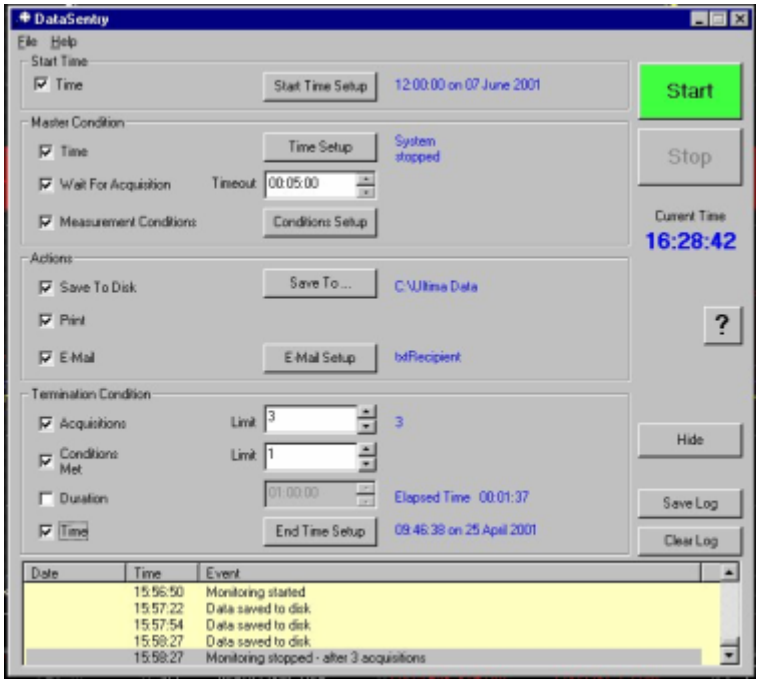
Chapter 6: Using the DataSentry Option

DataSentry is an optional application you can purchase for your system to alert you when important test data occurs or to quickly gather waveform information, allowing unattended operation of your system. A Windows program, DataSentry is closely linked to the main oscilloscope application using the COM interface.

DataSentry can save to disk internally or over the network link, print to a local printer or over the network or e-mail a message coupled with the data and instrument setup. All these functions can be carried out at set times, when triggered during acquisition or when a certain limit condition made on measurement results is reached. The functions can be terminated after a number of completed events or after a time interval. An event list enables a quick overview of the completed functions.

Using the DataSentry Window

The DataSentry window is divided into panels for Start Time, Master Condition, Actions, and Termination Condition. Connection times, start and stop times and any save actions that have been completed are shown at the bottom of the window. The panels are described in the following sections.



Start

Starts system monitoring by DataSentry.

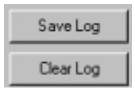
Stop

Stops system monitoring by DataSentry.

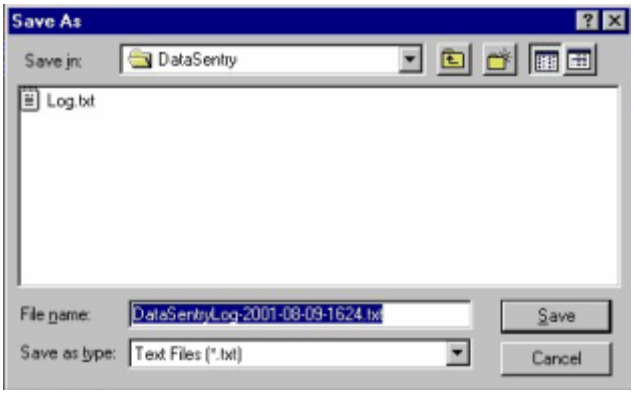
Hide

Switches to the DataSentry Monitor Display, which enables the oscilloscope display to be observed while at the same time having a display of DataSentry activity.

Save Log/Clear Log



Save Log opens a **Save As** dialog. Clear Log clears the event log.

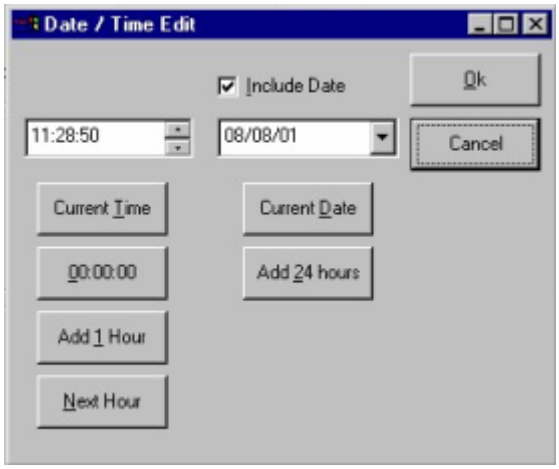


Start Time Panel

The Start Time panel sets, enables and displays the initial start up time.

Selecting the ***Time*** checkbox enables the preset start time and date, which must be done before starting DataSentry.

The ***Start Time Setup*** button opens the Date/Time Edit dialog, where you can select the date and start time.



Select the ***Include Date*** checkbox to add the date to the entry.

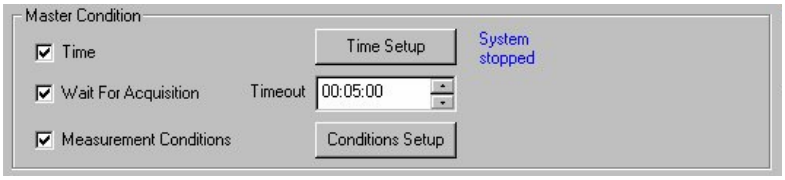
In the upper left time entry box select the hours, minutes or seconds with the left mouse button and enter the required value using the keyboard or use the up /down arrows to set the time.

In the upper right date entry box enter the day, month or year required using the keyboard or click on the arrow to open a calendar.

The buttons below the time and date entry boxes allow you to quickly set the current time or date, set the time to zero, add one hour, change the entry to the next hour, or add 24 hours.

Master Condition Panel

This panel contains controls that allow you to set up the gating ***Time***, ***Wait for Acquisition*** and ***Measurement Conditions***.



Time - enables regular intervals or specified times to start actions.

The ***Time Setup*** button opens the **Time Setup** dialog (see the following section).

The system status is shown to the right of the ***Time Setup*** button.

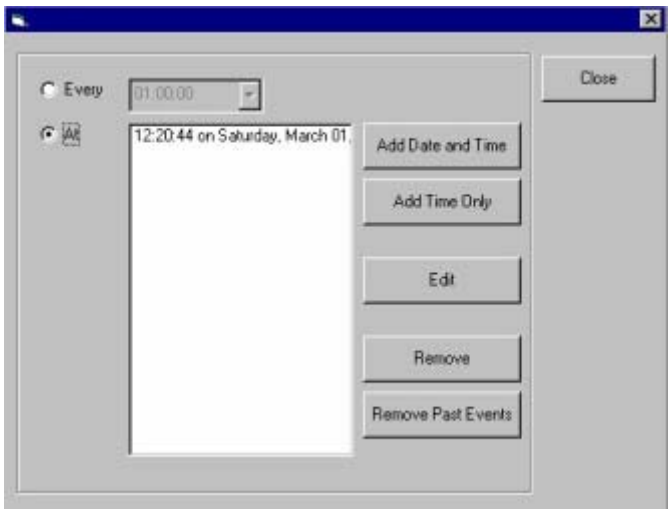
Selecting the ***Wait For Acquisition*** checkbox enables an acquisition to start actions.

Enter the ***Timeout*** in hours, minutes and seconds. If there is no acquisition before the timeout is reached the sequence will move on.

Selecting the ***Measurement Conditions*** checkbox enables the memory condition to start actions.

The ***Measurement Conditions Setup*** button opens the **Measurement Conditions** dialog, allowing you to set up the conditions (see the *Measurement Conditions Dialog* section later in this section).

Time Setup Dialog



Every – runs DataSentry at equal timed intervals.

Set time intervals up to a maximum of 23 hours 59 minutes and 59 second periods using the keyboard for direct entry or using the mouse and clicking the up/down arrows.

At – runs DataSentry at time intervals of unequal length or greater than 24 hour periods. The list of time intervals is displayed in order. The two top buttons select the ***Date and Time Edit*** dialog (see the previous section to learn about this dialog). Clicking on the second button allows you to ***Add Time Only***.

The ***Edit*** button allows you to change an entry in the list. To change an entry, first select the appropriate line with the left mouse button, then click on the ***Edit*** button.

The ***Remove*** button allows you to remove an entry from the list. To remove an entry, use the left mouse button to select the line and then click on the ***Remove*** button. A dialog will appear asking you to confirm the removal. Click Yes or No.

The ***Remove Past Events*** button deletes all times and dates from the list prior to the current date and time.

Measurement Conditions Setup Dialog

The **Measurement Conditions Setup** dialog contains a list of measurement conditions that are being tested. When the list is shown for the first time or following a reset to defaults, it will be empty.

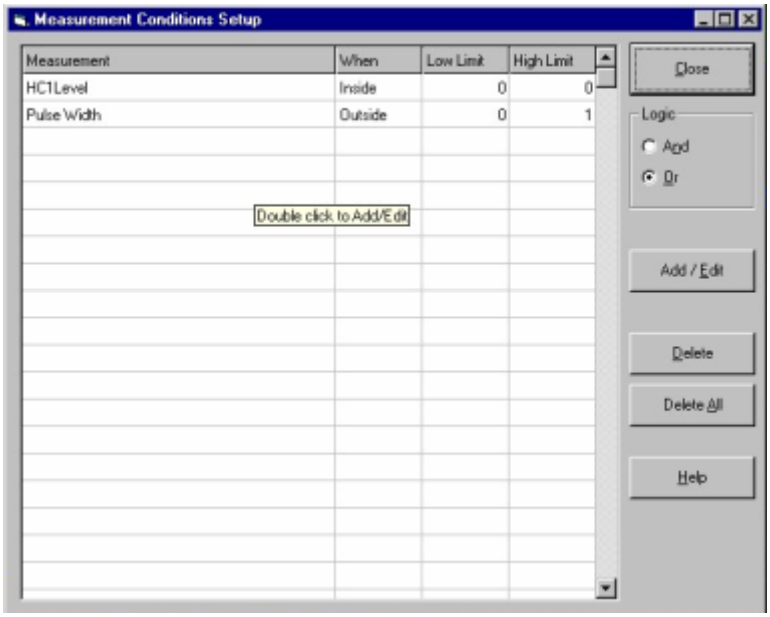
You can add new items to the condition list from a list of measurements. This list is automatically retrieved from the oscilloscope and is presented as a drop down list.

Each item in the condition list consists of the selected measurement, an upper and a lower bound, and ***fail when outside/inside*** selection. Conditions become true when the result of the selected measurement either falls within the bounds in the case of ***inside***, or falls outside the bounds in the case of ***outside***.

Any number of (measurement, bounds, inside / outside) condition items can be added to the condition list.

In addition, there is a single ***And/Or*** selection that governs how the true/false condition result is interpreted. Clearly, if ***And*** is selected, all of the condition items in the list have to be true for the overall result to be true. In the case of ***Or***, only a single condition item needs to be true for the overall condition to cause action.

While managing the list of conditions, youcan insert new entries, edit existing entries, remove existing entries or remove all entries.



Measurements are taken from the main instrument and the selection depends on whether the instrument is operating in Page1 or Page2.

Double click on ***Measurement*** at the top of the column to add a measurement from the Page1 or Page2 list or click to select and use the ***Add/Edit*** button. Click on the arrow to open the list of available measurements for selection.

Double click on ***When*** to set whether the measurement condition should be Inside or Outside limits or click to select and use the ***Add/Edit*** button.

Double click on ***Low Limit*** to add a low limit measurement or click to select and then use ***Add/Edit*** button.

Double click on ***High Limit*** to set the high limit measurement or click to select and then use ***Add/Edit*** button.

You can select ***And*** or ***Or*** logic for all measurements listed. Select the logic operator by clicking on the corresponding bullet. When a column is selected, click on the arrow to open the list available for selection.

To delete an entry, click on the row and then use the ***Delete*** button to remove the full entry.

The ***Delete All*** button deletes all conditions and a dialog appears asking you to confirm.

Actions Panel

The Actions panel contains controls that allow you to set the action you want the system to take when the set conditions are met. You can select from any combination of ***Save to Disk***, ***Print*** and ***E-Mail.***

Save to Disk - the system saves data to disk when set conditions are met.

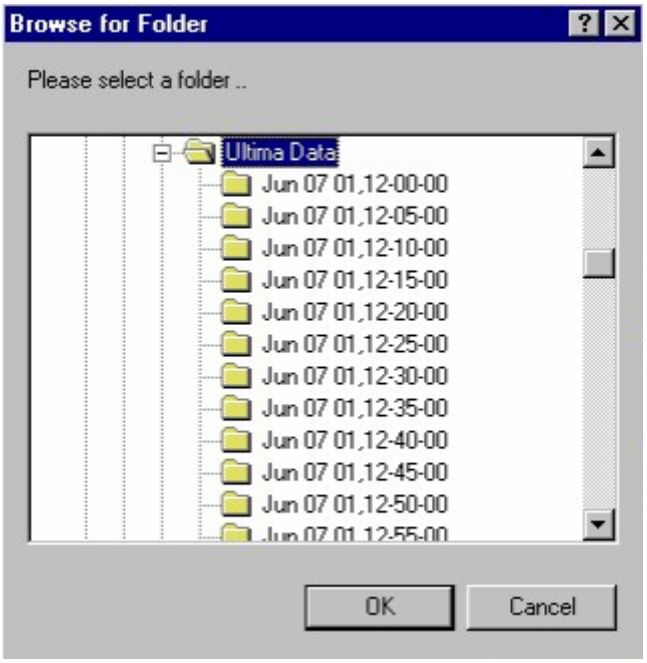
The ***Save To*** button opens the **Browse for Folder** dialog (see the following section) allowing you to browse and select the required folder. The currently selected folder appears to the right of the ***Save To*** button.

Print – the system prints the data when set conditions are met.

E-Mail – the system sends an e-mail alerting you when the set conditions are met.

The ***E-Mail Setup*** button opens the **E-Mail Setup** dialog (see the *E-Mail Setup Dialog* section later in this chapter), allowing you to enter the address of the e-mail recipient. The current recipient is displayed to the right of the ***E-Mail Setup*** button.

Browse for Folder Dialog



Select a folder and the data will be saved with date and time under the selected path. Note the data format is defined by the setting under the **File** menu in the main instrument application. The alternative formats are WFT and DAT. If you need to save data to another PC via the network see instructions for the main instrument to set up networking.

E-Mail Setup Dialog

SMTP server - enter your local server address or machine name for Simple Mail Transfer Protocol (SMTP). (Refer to your local network administrator.)

Destination address - enter the e-mail address of the intended recipient.

Subject – Enter a title for the subject line of the e-mail.

Message – Enter a message or information about the e-mail.

Attach traces and instrument setup – select this option to send the traces and instrument setup as an attachment to the e-mail message.

Termination Condition Panel

The Termination Condition can be set to a number of acquisitions, the measurement conditions being met, reaching the set time duration, or reaching a set end time (or a combination of conditions).

Acquisitions – termination occurs after the set number of acquisitions.

Enter a ***Limit*** for the number of acquisitions required to terminate the running sequence in the box using the keyboard or clicking on the up/down arrows. The current number of acquisitions selected is displayed to the right of the entry box.

Conditions Met – termination occurs after a selected number of Measurement Conditions have been met.

Enter a ***Limit*** for the number of measurement conditions required to terminate the running sequence in the box using the keyboard or clicking on the up/down arrows. The current number of conditions to be met is displayed to the right of the entry box.

Duration – termination occurs after a set amount of time has elapsed.

Enter the time duration required to terminate the running sequence into the box using the keyboard or clicking on the up/down arrows. The entry is in hours:minutes:seconds. A display of the time elapsed since the start of the sequence is displayed next to the entry.

Time – termination occurs at a set end time. Click on the ***End Time Setup*** button to open the ***Date/Time Edit*** dialog to change the date and time. The selected time and date for termination is displayed next to the button.

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Chapter 7: Using the Direct to Disk Option

Direct To Disk is an optional package you can purchase for your system offering continuous storage to hard disk of up to 1 GigaSample of data with 200 kS/s aggregate sample rate turning your Sigma into a real recorder. The Direct To Disk package includes the ability to record directly to disk on the Sigma and Perception Viewer Software to recall your Direct To Disk data for review.

These four buttons are used to switch SIGMA into one of four operation modes:

Scope – standard scope mode

Waveform Analysis – real-time analysis and window definition

Recorder – Direct to Disk recording/acquisition

Start Perception – Direct to Disk recall/review recordings

Note: *The last two items are options.*

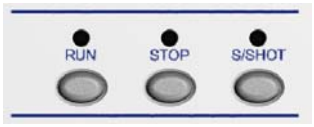
If ***Recorder*** or ***Start Perception*** is selected without the Direct To Disk option installed, a menu appears:

Using the Recorder Option

In Record mode, the display always rolls. A status message on the display in the lower right corner says Display Only and the STOP LED is on.

There are two ways to acquire data: **untriggered** (free run) or **triggered**

Untriggered Acquisition



Pressing RUN starts a recording. The RUN LED is on and all trigger settings are ignored. This recording is terminated either by pressing STOP or after the predefined time in DURATION has elapsed.

During Acquisition, information on how long the recording is running / remaining time is displayed.

Triggered Acquisition

Pressing S/SHOT starts a recording with trigger settings enabled.
Therefore pretrigger is filled, the system waits for trigger, after a trigger is received the posttrigger is filled.

The system can be in several states:

- **Acquiring pretrigger**
- **Waiting for trigger**
  Triggered (just a point in time)
- **Acquiring post trigger**

  The status display shows one of the three conditions (except triggered)
  Timing info how long the recording is running / remaining time is displayed.

  A triggered acquisition stops after filling post trigger information or by pressing STOP before. In Triggered acquisition, the user can force a trigger by pressing AUTO trigger button.

Trigger Settings in the Direct to Disk Mode

The trigger settings in Direct to Disk mode are completely different from scope mode.

Selections for Trigger Mode are:

- Manual/External Trigger
- Single Channel Trigger
- All Channels Or'ed

Trigger mode **Manual**
Manual/Remote only, Trigger using AUTO button or ext Trig in.

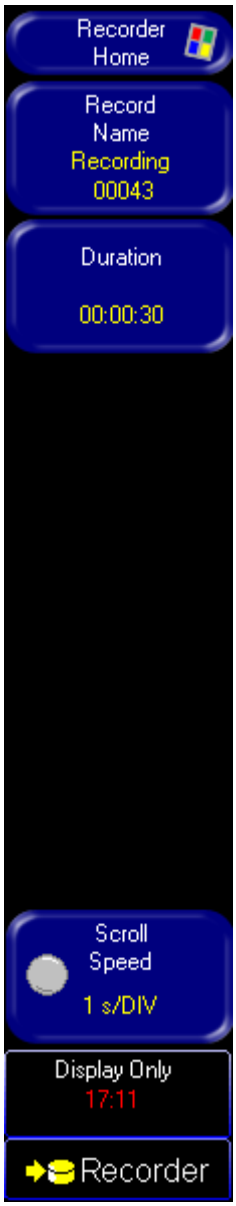
Trigger mode **SINGLE CHANNEL**
Source entry: Selection of trigger channel
Slope entry: Disabled, Rising Signal Crossing, Falling Signal Crossing or Signal Leaves Band

Trigger mode **ALL CHANNELS ORED**
Settings are similar as in the SINGLE Mode however independent for all channels.

Pretrigger entry is possible in all three modes.

There is also a TRIG HOLDOFF that can be turned On or Off. If selected, any trigger is ignored until pretrigger amount of data has been acquired. If disabled, a trigger is recognized even if pretrigger is not yet acquired.

Recorder Home Menu



The ***Record Name*** button displays the Name under which the NEXT recording will be stored. The Default is RECORDING 00000.

If the ***Record Name*** button is pressed, a menu appears allowing the change of the Recording Name and directory.

Note: *Recordings are stored to a different default directory with a different file extension versus the data stored in Scope Mode.*

Each time RUN and STOP are pressed, data is saved and recordings are created with automatically generated names numerically incremented.

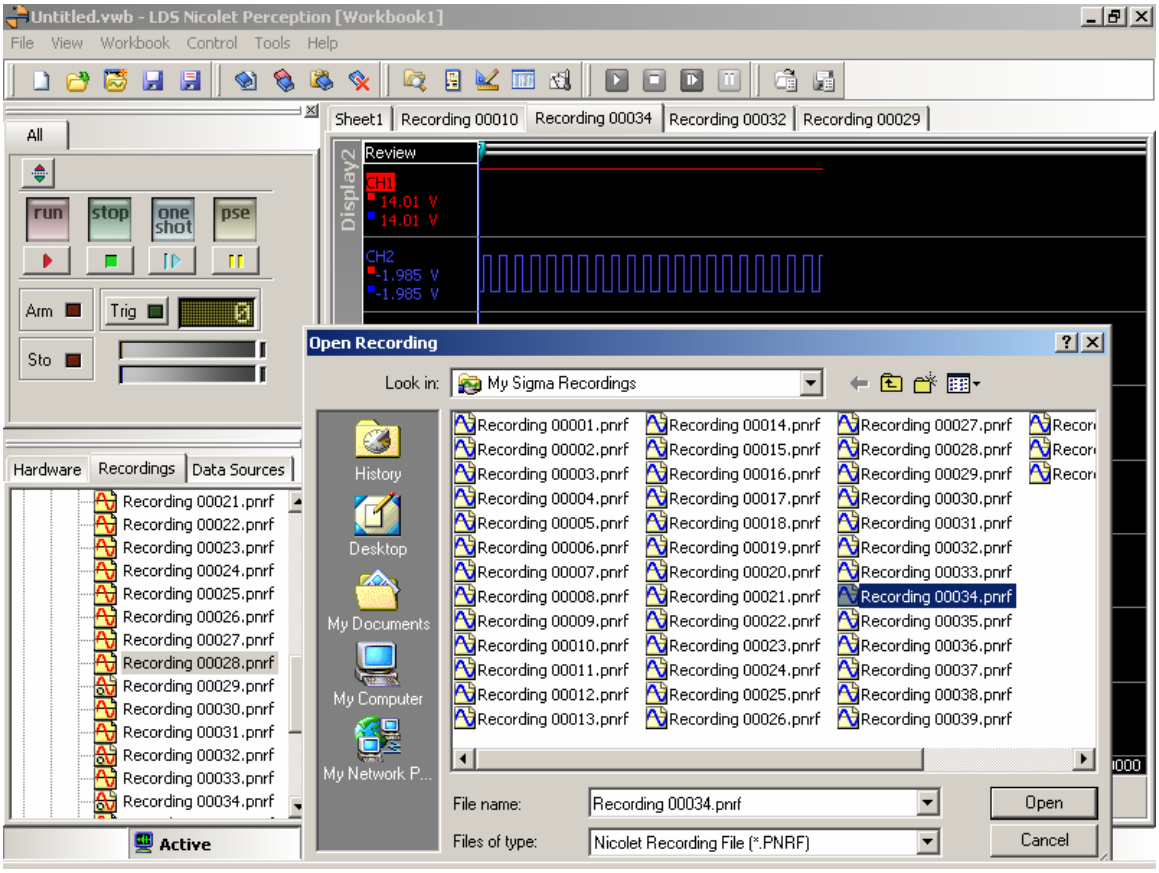
Selecting ***Duration*** displays the record length of the next recording in hh:min:sec. If the DURATION button is pressed, a numerical entry appears to enter the values.

Selecting the **Scroll Speed** button displays the scroll speed (independent from sample rate or memory length). The default is 1 sec / Div. Turning the **Timebase** knob changes the scroll speed.

Using Data Review/Start Perception Option

Perception Viewer software is used to open and review data that has been previously recorded on the Sigma. By default, Sigma recordings are stored in a folder called: "My Sigma Recordings."

Refer to the Perception Viewer software manual for details on software operation.



Using the Channel Menu in Direct to Disk Mode

All settings are identical to scope mode.

Timebase Menu in Direct to Disk Mode:

The two Timebase Menu settings available in the Direct to Disk mode are ***Horizontal Scaling*** and ***Sample Rate***.

Horizontal Scaling is active and is used for acquisitions using external clock.

Timebase is used to set the sample rate in Samples / Seconds which is independent of the scroll speed. Depending on the number of channels that are active (displayed) will depend on maximum sample rate available for all active channels. The maximum aggregate sample rate is 200 kS/s.

Master Menu in Direct to Disk Mode

Acquisition Submenu

All Acquisition menu selections are inactive with preset settings. Bandwidth is set to its lowest setting, HighRes mode is ON, Glitch is Detect is off, Average is off, and External timebase is off.

Display Submenu

Most Display menu selections are inactive with preset settings. Display Mode is set to YT, Persistence is off, Display Mode is Roll. The Recorder Windows Layout button allows the user to set the number of panes to be displayed on the screen. This is a Direct to Disk specific selection and differs from the scope display layout. Selections include:

- Overlapped (full screen)
- 2 panes
- 3 panes
- 4 panes
- 6 panes
- 8 panes
- "Auto"

Channel assignment to panes is fixed and predefined:

	4 Channel Unit	8 Channel Unit
2 panes	1-2 / 3-4	1-4 / 5-8
3 panes	1-2 / 3 / 4	1-3 / 4-6 / 7-8
4 panes	1 / 2 / 3 / 4	1-2 / 3-4 / 5-6 / 7-8
6 panes	-	1-2 / 3- 4 / 5 / 6 / 7 / 8
8 panes		All separated
Auto		As many panes as there are active channels

All the other menus (**Cursor**, **Data Transfer**, **File**) function just as they normally do.

Additional Settings in the Direct To Disk Mode

The following functions are disabled in the Direct to Disk mode:

- Multi-Shot
- Sample rate or sens or pos switch during recording
- Triggered slow fast slow acquisition
- Data transfer

While in the Direct to Disk (recording) mode, the highest possible resolution is selected automatically (i.e. 8 Bit on Sigma 75, 10 Bit on Sigma 60, 12 Bit on Sigma 30 and 90, and 14 Bit on Sigma 100) hardware filters are always set to the lowest value (if they are more than 100 kHz) and software based tracking filters (as in 10 Bit mode of Sigma 60) are used.

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Chapter 8: Using the Synchroscope Option

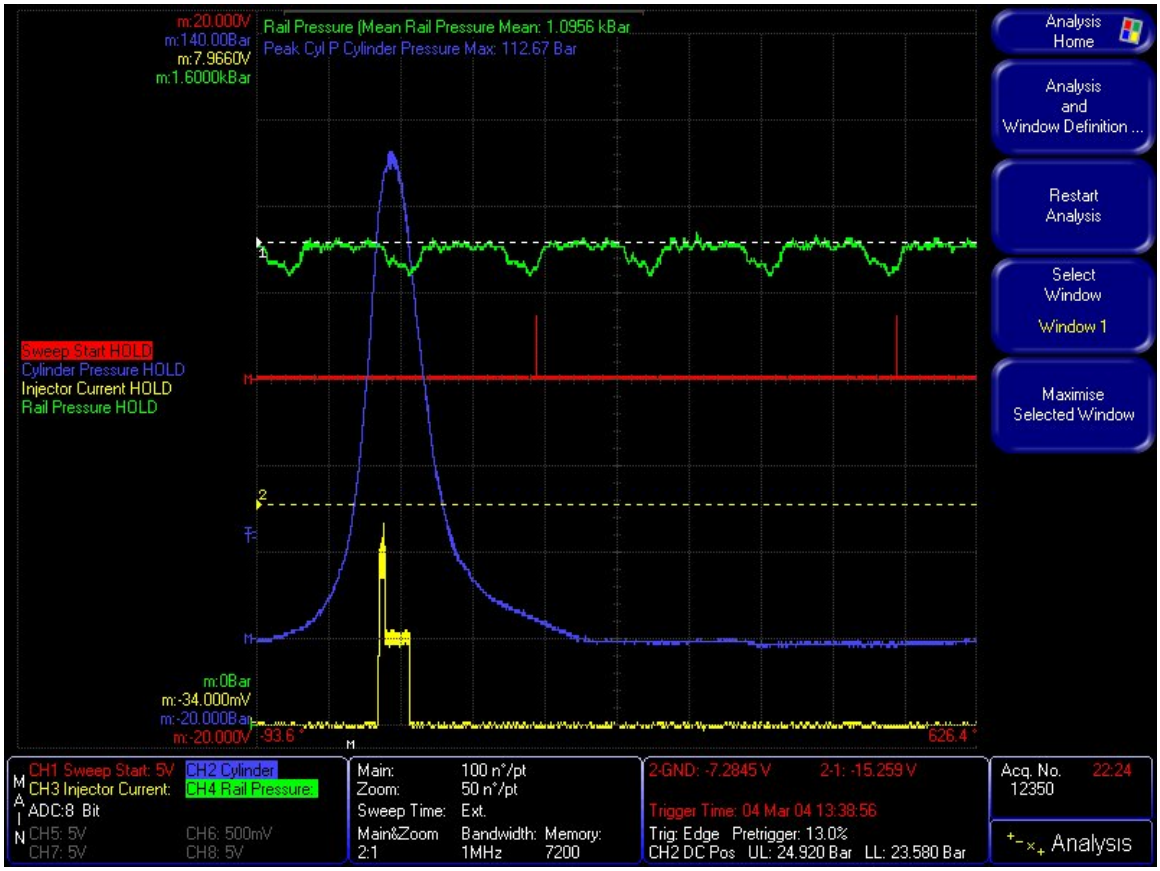
Introduction

The Synchroscope is designed for use in testing rotational systems. The basic concept of Synchroscope is to produce a sampling clock that is synchronized to degrees of rotation. It will track RPM changes, ensuring the sample points remain static in degrees irrespective of angular velocity. Additional features include trigger marker detection and real time RPM waveform display.

There are two fundamental modes of operation, Full Rev and Pulse to Pulse. Full Rev mode is used when the rotational encoder signals are not equally spaced, for example ignition timing markers. The Synchroscope bases its RPM calculation on a full revolution, and produces an output sample clock at 360/ 3600/ 7200 degrees. In Pulse to Pulse mode, there must be equally spaced timing marks, though missing or extra pulse for 0 degree indication are handled. This mode produces more accurate sample clocks and is also used for determining RPM changes during a cycle.

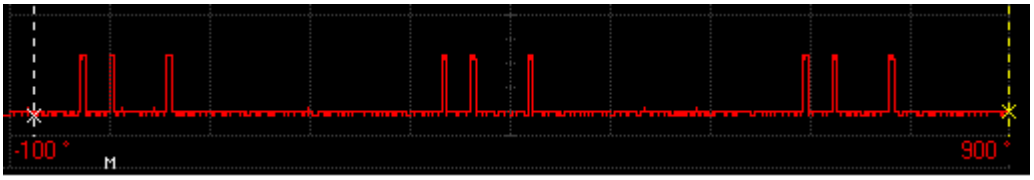
In the automotive field with modern electronic control there is a continued drive for performance, reducing emissions and increasing efficiency

Measurements are typically made of pressure waveforms and the timing of injection in a diesel as shown. While the majority of applications are in the automotive industry, the Synchroscope has other applications with rotational devices such as motors and generators.



Full Rev Mode

Full Rev mode is used when the rotational encoder signals are not equally spaced, for example as in ignition timing markers. In the example show below there are three pulses produced for timing in a revolution: one at 30º before Top Dead Center (TDC), one at TDC and one at 60º past TDC.



In the Full Rev mode, the Synchroscope measures the time between each cycle, and then divides this value into the number of degrees required for each sample (360, 3600, 7200). The time is measured on one cycle for setting the sample positions on the next cycle.

To identify the TDC pulse, and therefore synchronize the display to each revolution, we used the marker trigger mode. In this example, the 'Separation<" setting is used with the rotational limit at 40º. As the shaft rotates, the Synchroscope looks for a pulse less than 40º from the last and triggers the timebase at this point. In the example, the trigger will occur on the TDC pulse as it is 30º from the previous pulse. The Sigma trigger delay or pretrigger setting can now be used to position the trigger point on screen. In the previous figure the pretrigger is set at 10%, indicated by the M.

The advantage of using Full Rev mode is that the event pulses from the encoder or timing marks do not need to be equally spaced to create the timebase. The limitation is that if there is significant velocity change during a rotation the accuracy of the sample points in degrees will be variable. In that event, Pulse-Pulse mode should be used.

Full Rev Marker Options

In the previous example, the Separation< mode was used to detect the marker point. The Full Rev Marker options are:

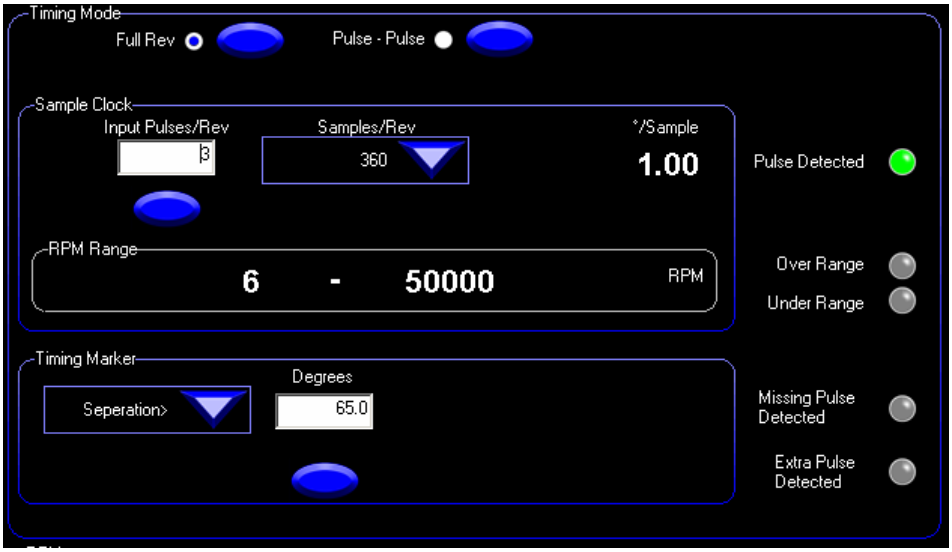
- **Every Event** - In this case a trigger occurs every event output. It is mainly used when there is only 1 timing mark.
- **Not Within** - In this case a trigger is produced if no event occurs after the specified number of degrees.

- **Separation>** - Triggers on the next event input after the timeout period. If an event occurs before the timeout the timer is reset

- **Separation<** - Trigger if an event occurs within a specified period

Full Rev Mode Setup

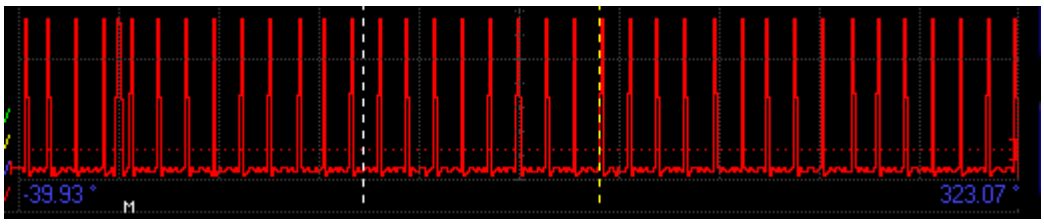
The Synchroscope set up page is in Sigma's **Acquisition** menu.



1. From the **Acquistion** menu on your Sigma, select ***Synchroscope Setup*** to enter the set up page.
2. Select ***Enable Synchroscope*** to switch on the mode.
3. Select ***Full Rev*** to show the setup.
4. Enter the number of pulses per revolution, and select the output sample rate. In the example shown above, 360 is selected and the degrees/sample is indicated.
5. The status LEDs indicate when an event is received and give warnings if out of range.
6. The last selection is for the marker type and separation required.

Pulse to Pulse Mode

In pulse to pulse mode it is assumed that there is a constant spacing between event pulses from the shaft encoder. The Synchroscope measures the time between each pulse and sets the sample rate for the next pulse period. A sample waveform is shown below.

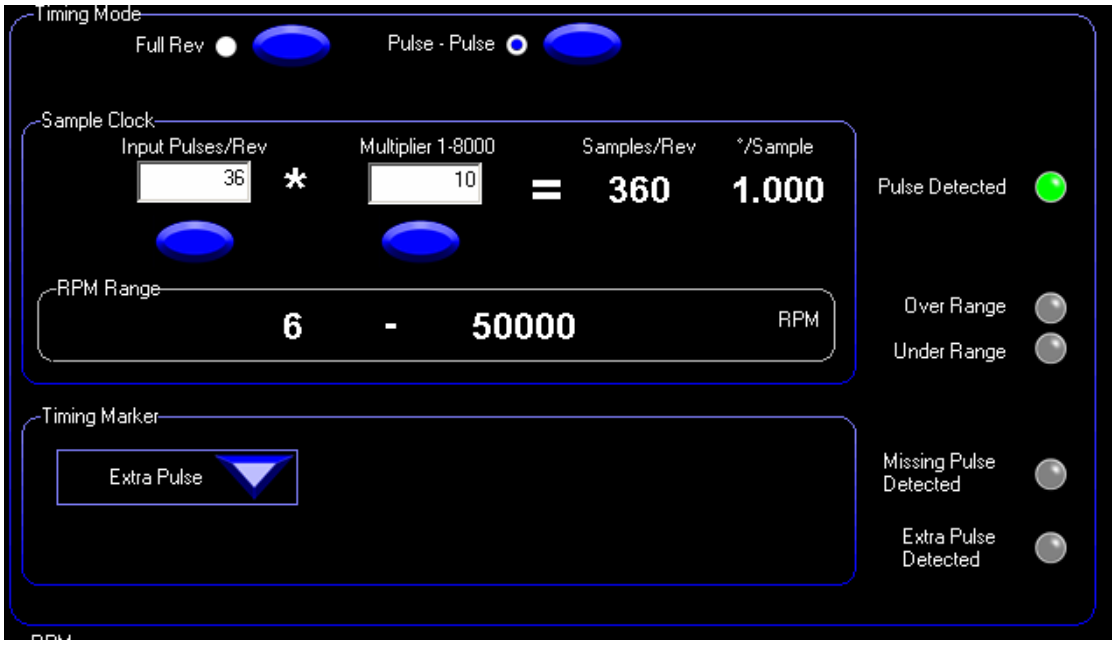


In the example, there are 36 pulses per revolution, each equally spaced from the TDC marker and extra pulse. The samples between pulses, (the multiplier value) can be set from 1 -8000 to provide very fine resolution in degrees. The advantage of this mode is that the Synchroscope can respond to RPM changes between each input event and so the accuracy of the sampling is improved. This mode is also used for real time RPM waveform capture.

The example uses Extra Pulse triggering to detect the TDC marker. There is also a missing pulse mode. There is no need to set the time between pulses as the extra pulse is assumed if it occurs at <75% of the time between the last two pulses. A missing pulse is assumed if the time is > 150% of the previous period.

Pulse to Pulse Mode Setup

The Synchroscope set up page is in Sigma's **Acquisition** menu.



1. From the **Acquistion** menu on your Sigma, select ***Synchroscope Setup*** to enter the set up page.
2. Select ***Enable Synchroscope*** to switch on the mode.
3. Select ***Pulse-Pulse*** to show the setup.
4. Enter the number of encoder pulses per rev.

Note: *Ignore any missing or extra pulses for timing markers. For example, if there are nominally 36 pulses with one missing pulse, enter 36, not 35.*

5. Set the multiplier required for the given degrees of resolution required. The degrees/sample indication shows the resolution set.
6. Select the timing marker mode.

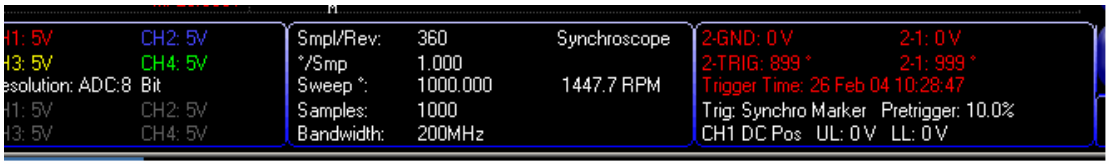
Real Time RPM

This feature displays the RPM as well as the X information and is automatically ranged at the same time an RPM waveform is entered into the Analysis page so a display of RPM is given as a trace. The trace will show changes in RPM and will be updated once per revolution in the Full Rev mode and every period for the Pulse – Pulse mode.

Sigma Synchroscope Controls

In addition to the Synchroscope setup page there are other controls when it is enabled.

The Instrument Status area changes to show data related to rotational timebase instead of time.

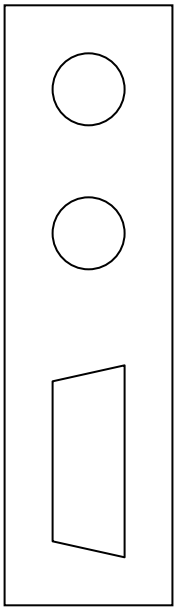


In this example, the timebase readout is changed to show Smpl/Rev, degrees/sample and the sweep length in degrees. Also, there is a readout of the current RPM. The cursor readouts are also now in degrees.

To change the timebase sweep, enter the **Timebase** menu and use the ***Sweep Degree*** control to adjust the displayed degrees. Pressing the menu button allows direct entry. Note that the sweep is based on the number of samples times degrees/sample. If the multiplier and input pulses per rev are such that the degrees/sample is not an integer, then the sweep length may not be an integer. The memory length control is disabled in Synchroscope mode as it is not relevant.

The **Trigger** menu also changes. There is now an additional trigger mode, Synchro Marker. This mode is automatically selected if the marker is set on the Synchroscope dialog, but it can be overridden to select triggering off another channel, or external trigger. In this way the Synchroscope can be used to generate a sample clock, but triggering can be from any other channel. When the Synchroscope is fitted, the normal TTL external trigger is replaced by an analog one. The control for trigger level appears when external trigger is selected.

Synchroscope Rear Panel



Event In (encoder) ± 4V max 25V

External Trigger ± 4V max 25V

I/O connector – see below for pin out

I/O Connector Pin Out

1	SCL _ Probe	9	+12 V 2 A fused
2	GND	10	External timebase out LVDS +
3	Event in TTL	11	External trigger out TTL
4	GND	12	External timebase out TTL
5	External trigger TTL	13	External timebase out LVDS -
6	+5 V 2 A fused	14	External system clock LVDS +
7	SDA_Probe	15	External system clock LVDS -
8	GND		

Tutorial

Determining How to Set the Synchroscope

The first thing you need to do is decide how you want to see the data and what signal source you have to synchronize, trigger and to display with scaling on the X axis in degrees and the Y axis in bar or psi, for example.

a) Synchronization is per revolution and rotation systems vary from one pulse per revolution to large numbers from an encoder. Another often used method for obtaining a signal is to collect a signal from gear wheel teeth and these can vary considerably in number.
b) Another determination is whether the engine is to be tested at a steady speed or if the speed is varying during a revolution. To follow speed changes during a revolution, it is necessary to have more equally spaced pulses. Encoders providing 1 degree pulses allow the sychroscope to adjust for speed changes every degree. Also, it is necessary to decide the resolution of samples per revolution.
c) Finally, it must be determined how to trigger. The standard trigger system can be used via the input channels or the external trigger on the rear of the instrument below the synchroscope input clock. The synchroscope has a trigger features to identify an extra pulse or a missing pulse systems used in the automotive industry to run engine management.

In this tutorial, a simple pulse train with 7 pulses per revolution is used. The speed of rotation is 3000 RPM for an input frequency of 350 Hz from the New Test Generator.

Synchroscope Set Up

1. To set the Synchroscope to lock to the input signal, select the front panel **MENU** button, then select **Acquisition** from the menu on the touch screen, then select **Synchroscope Set Up** to open the display shown below.
2. Enable the Synchroscope by clicking on the **Enable Synchroscope** button in the upper left corner of the display.
3. Select the input type from the two selections in the upper middle of the display. *Analog* is via the BNC on the back panel and allows adjustment of trigger level and introducing the filter. *TTL* is via the D connector, also on the back panel. For this tutorial, connect to the Analog on the back panel (Event In).
4. Since the input is going to be pulses at a regular interval, the Synchroscope can be set to lock Pulse – Pulse (the button in the upper middle of the display).

5. Set Input pulses per Rev to 7 using the keyboard or by selecting the button below the text box to activate the touch screen numeric keypad (left side of the display in the middle).

6. Enter the multiplier to set the samples between each pulse period (here the setting is 360) The total number of samples is calculated along with the sample interval in degrees. (Example shows 0.143 degrees/sample) You can try different numbers giving degree/sample values. The RPM range that the Synchroscope will remain locked to is shown in the RPM Range panel. If sample/rev is set high the RPM range will be limited because it will exceed the sample rate possible via the scope clocking system.

7. Check that the Pulse is detected by making sure the Pulse Detected light is glowing green. Also check that the Over range and Under range lights are not on. If the Pulse Detected light is not on, adjust the trigger as described below. (Lights are on the right side of the display.)

8. If the input does not have a recognition pattern, select None from the Timing Marker Recognition panel and trigger from a channel for the Tutorial. When you close this panel, use the **Trigger Channel Trigger** menu and select *divide by 7* using Channel 1.
When selecting Every Event, there needs to be a single pulse, which will then trigger once per revolution.
If there is a missing pulse in Pulse – Pulse the system will find the missing point and identify the trigger point as the next pulse after the space.
The example display shows that an extra pulse has been detected and the Extra Pulse light is on.

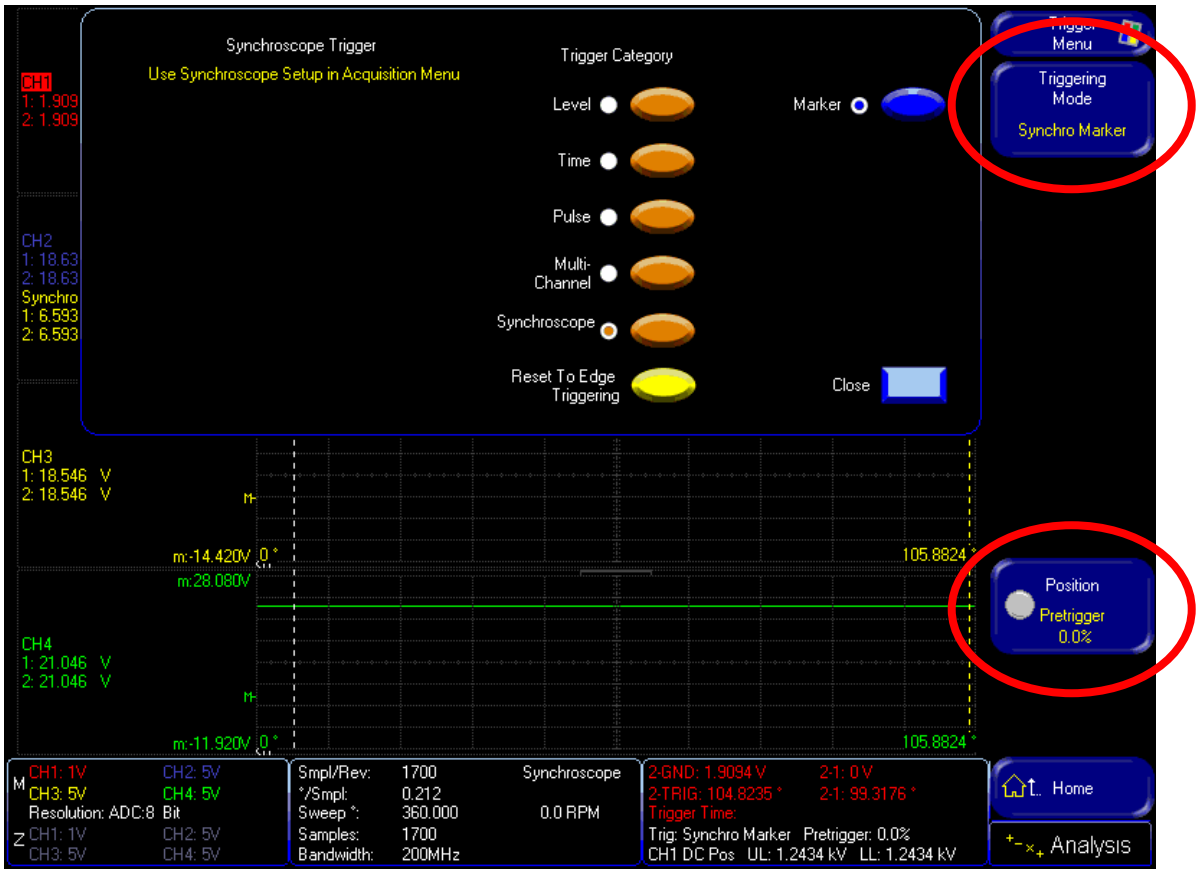
9. The trigger level adjustment is made in the Acquisition Menu mode using the adjacent front panel knob if the synchroscope trigger is used.

10. Close this menu and the acquisition will be running, but you may need to set the channel trigger.

Channel Triggering (when there is no pattern available in the locking pulse train)

11. From the **Trigger** menu, select ***Synchroscope*** and then select ***Synchro Marker***.

12. Select ***Pulse*** and use the divide by function for Channel 1, setting it to 7.

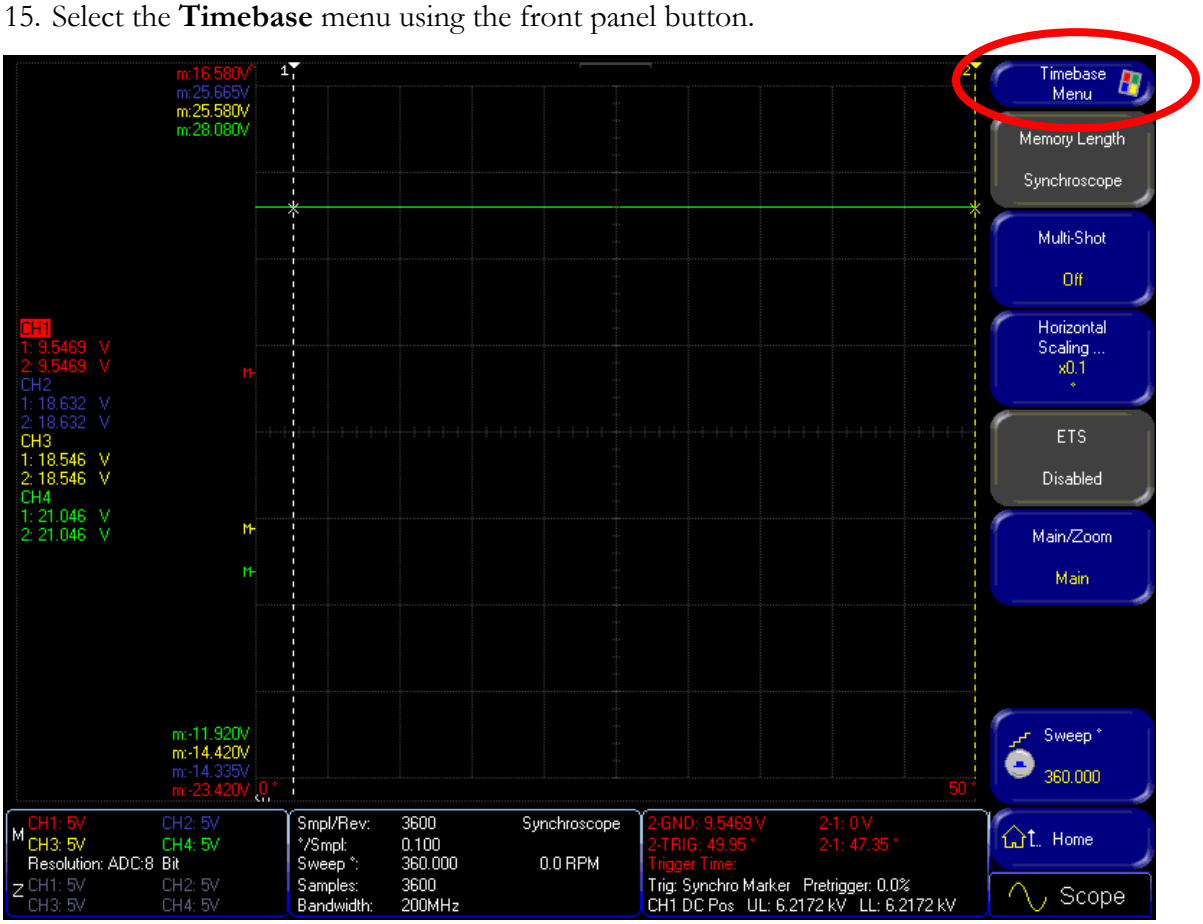


13. Pretrigger and Trigger delay is set by the control shown while in the Trigger Menu (lower right in the display).

Setting the Degree Span

14. Now select the X span which is equivalent to the Timebase in the conventional mode.

15. Select the **Timebase** menu using the front panel button.



16. The sweep will now be in degrees and the **Timebase Control** knob will adjust the degrees span in the main timebase.

17. Pressing the knob will change the adjustment resolution. Set the window to be 360 degrees as shown.

Setting the Degree Span Using the Touch Screen Entry Panel

18. Using the touch screen **Sweep** button will bring up a numeric entry panel as shown, which allows you to enter the degree span. If you want to display several resolutions, this entry method provides a quick, precise entry. Set the degree span to 3600 to display 10 revolutions.

Note that the RPM is displayed live as a read out value, as are the samples per revolution, degrees/sample and the sweep degrees.

It will now be necessary to switch to Waveform Analysis mode.

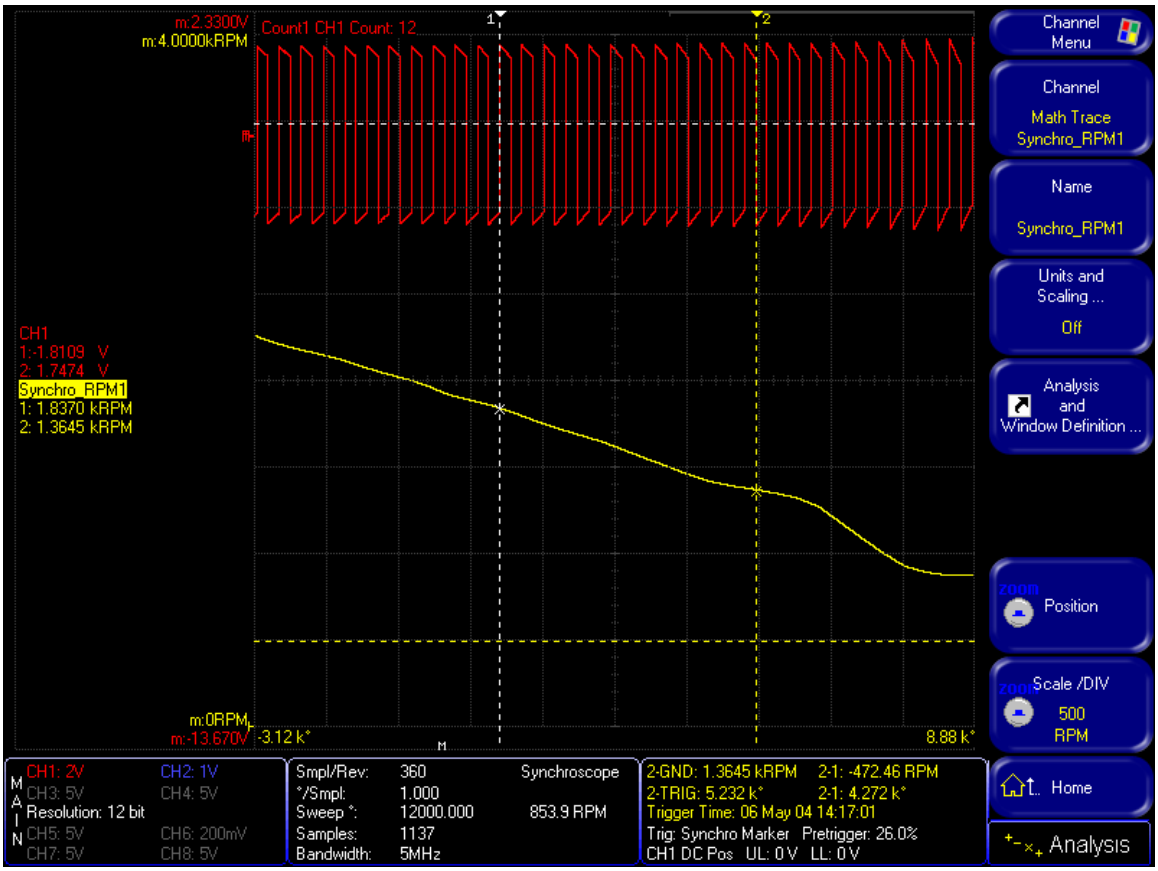
Waveform Analysis Mode

In the Waveform Analysis mode and with the synchroscope function on a trace of RPM is automatically added into the function list.

19. Switch to **Analysis** mode and select ***Master Menu*** and then ***Display*** to set the display to one window.

20. Switch to **Analysis Preview** mode and put Channel 1 and the RPM trace into Window 1.

21. Now go to the Timebase and set the displayed degrees to cover a number of revolutions. The example below has 12,000 degrees with 360 degrees per revolution using a single pulse per revolution. If you used 7 pulses at 360 degrees per pulse = 2520 you will need to set the timebase to 75600 for 30 revolutions.



22. Vary the input and note the revolutions have the same period shown on Channel 1 and the RPM displays the RPM value with the new analysis waveform.

23. To change the RPM scaling, display the **Channel** menu and select ***Math Trace RPM*** then the scale range can be adjusted using the front panel knob. In this example, the display shows the scale is set to 500 RPM/div.

24. Use the cursors to read the RPM values.

Setting the Sychroscope Using Timing Full Rev Mode (optional)

If you decide to use a single pulse per revolution as a convenient input, use the Full Rev mode, which establishes a preset number of samples per revolution. In the example shown it is 7 samples per revolution and 3600 samples but the number of samples can be set to 360 or 7200 from the ***Samples/Rev*** selection.

The triggering changes to:

None – trigger from a channel

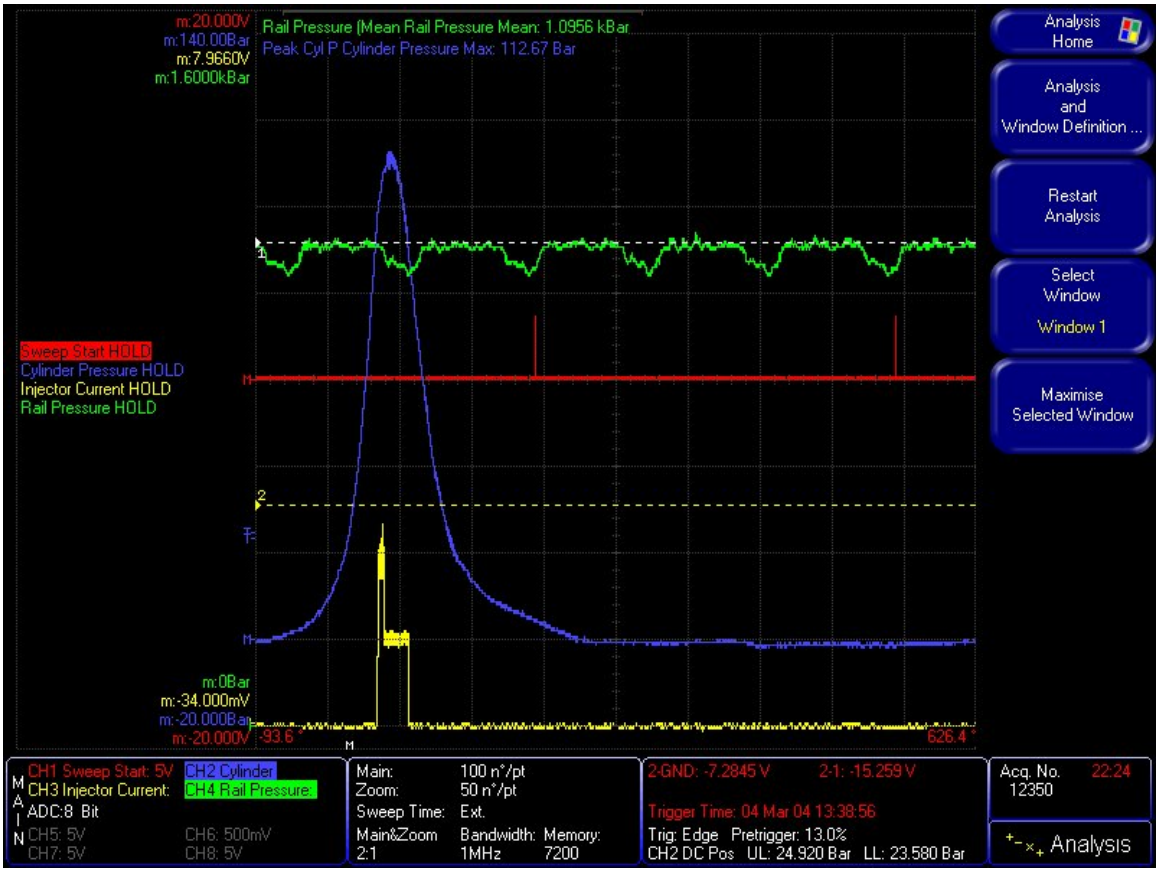
Every Event – suitable for a once per sync pulse

Not Within – allows for a trigger point to be set at a degree spacing from a pulse.

Separation < or > - allows for waveforms that do not have a regular pattern. A space or a pulse can be identified by setting the value of degrees.

Example of a Real Application

Measuring diesel injection:



The timebase range is 2 revolutions, 720 degrees with 93.6 degrees of pre-trigger. The timebase display area has been changed from this as shown in the information above.

The locking pulses are 1 degree and the resolution increased to sample at 100 n°/sample.

Channel 1 (red) shows a once per rev pulse for measuring timing.

Channel 2 (blue) measures the cylinder pressure.

Channel 3 (yellow) is the injector current.

Channel 4 (green) is the rail pressure showing a dip at each cylinder firing.

Note the Channel labels and the Scaling.

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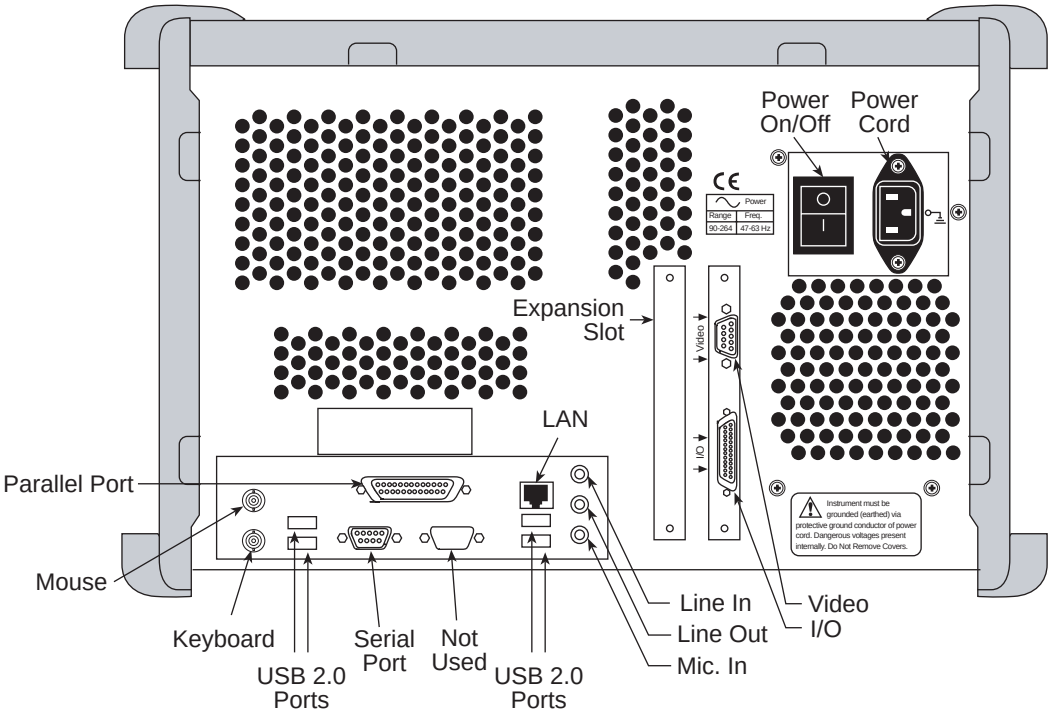
Appendix A: Rear Panel Connector Pinouts

Sigma Rear Panel



I/O Connector

The I/O connector is a standard 15 way D socket. This connector contains both LVDS and LVTTL (+3.3 V) signaling. The LVTTL inputs are compatible with +5 V logic levels, although +3.3 V logic is specified.

Pin No.	Name	Type	Description
1	FAST_EXTERNAL_SYSCLK	Input, LVDS, Hi	This can be used instead of the Master 200 MHz oscillator. Upper and lower frequency limits are governed by the ADC used. For Sigma 60 the limits are 200 MHz down to 50 MHz.
2	GROUND	Ground	Ground
3	SLOW_EXTERNAL_TBCLK	Input, LVTTL, Hi	Slow external timebase clock from 0 up to about 5 MHz
4	FAST_EXTERNAL_TBCLK	Input, LVDS, Hi	Fast external timebase clock. If this pin is used with the FAST_EXTERNAL_SYSCLK selected and both are derived from a common source, the frequency limits are (FAST_EXTERNAL_SYSCLK / 2) down to 0. If this pin is used with the 200 MHz Master oscillator, the frequency limits are 50 MHz down to 0. There will be 5 ns of jitter due to resampling of the fast external timebase clock by the 200 MHz clock.
5	GROUND	Ground	Ground
6	GROUND	Ground	Ground
7	Not Used		
8	TRIGGER_OUT	Output, LVTTL, Lo	This output is always high at 3.3 V (LVTTL) and goes low for a short pulse when a trigger is received.
9	FAST_EXTERNAL_SYSCLK	Input, LVDS, Lo	Complement to the differential signal on pin 1
10	+3.3 V	+3.3 V	+3.3 Volts, 1 Amp. Protected by a resettable fuse
11	GROUND	Ground	Ground
12	FAST_EXTERNAL_TBCLK	Input, LVDS, Lo	Complement to the differential signal on pin 3
13	EXT_TRIG	Input, LVTTL, Hi	External trigger
14	EVENT_IN	Input, LVTTL, Hi	An input bit. Can be used to signal an event has happened.
15	EVENT_OUT	Output, LVTTL, Hi	An output bit. Can be used as limit testing failed output.

Video Output Option

On the rear panel of the instrument is a 15 way high density D-type connector conforming to standard VGA pinout configuration. The output signal is a standard 800 x 600 pixel Super VGA signal with the colors the same as on the oscilloscope's display.

Pin	Signal Description
1	Analog red output
2	Analog green output
3	Analog blue output
4	Not connected
5	Ground
6	Ground
7	Ground
8	Ground
9	Not connected
10	Ground
11	Not Connected
12	SDA (DDC)
13	TTL horizontal sync
14	TTL vertical sync
15	SCL (DDC)

Serial Port

The serial port is a 9 pin Male DB9 plug fitted to the rear of the Sigma.

Pin	Signal	Description
1	DCD	Data Carrier Detect
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

Appendix B: Windows Task Bar, Printers and Networks

Accessing the Windows Task Bar

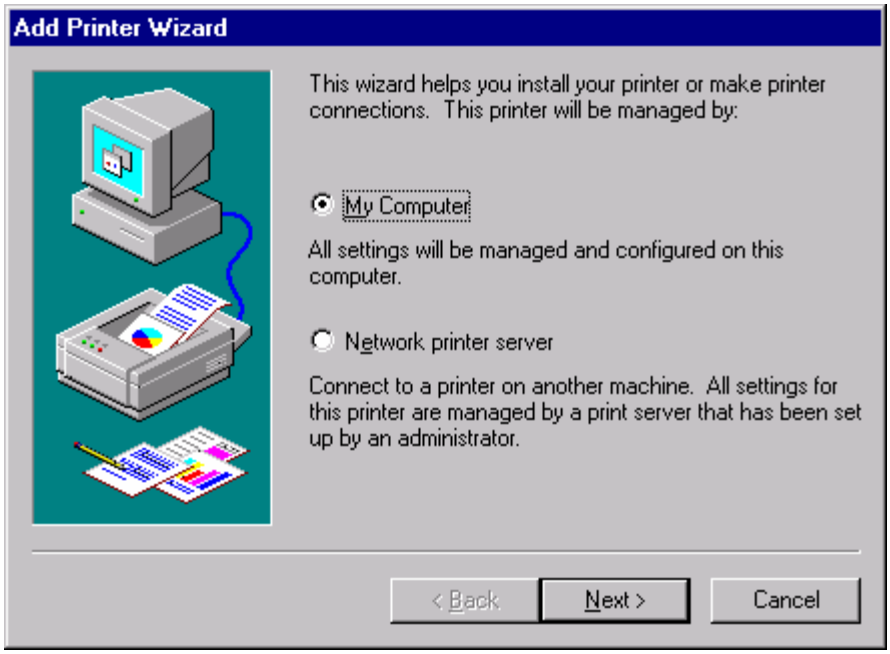
To access the Windows Task Bar, press '**Ctrl'** and '**Esc'** simultaneously on the Sigma keyboard. Some Sigma systems may come equipped with a keyboard that includes a Windows key near the space bar. Pressing this key also provides access to the Windows Task Bar.

Installing New Printers (Drivers)

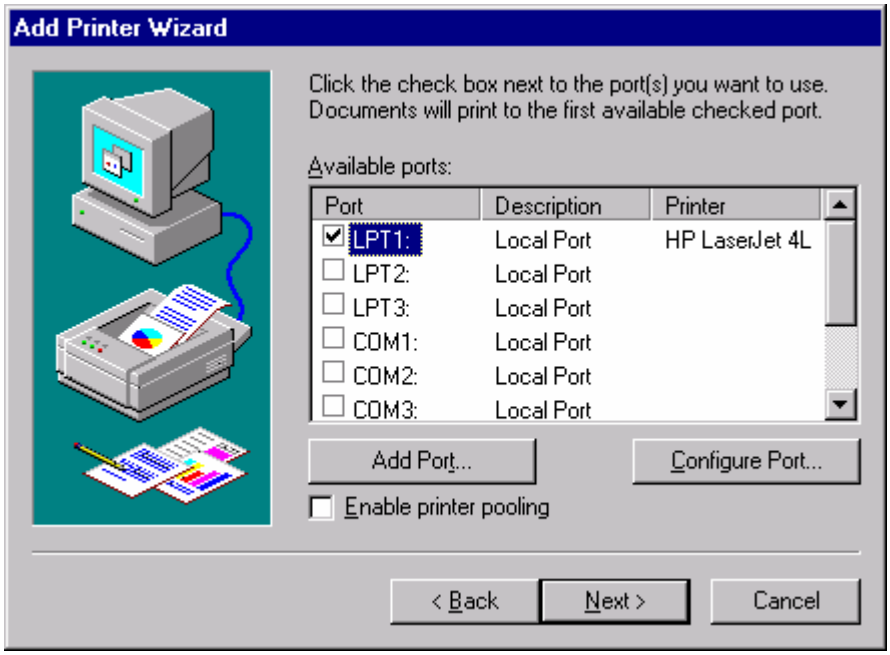
The Sigma is preinstalled with a generic printer driver on LPT1 from the factory. Windows supports most available printers, and any of them can be installed on the Sigma System.

To install a new printer (driver):

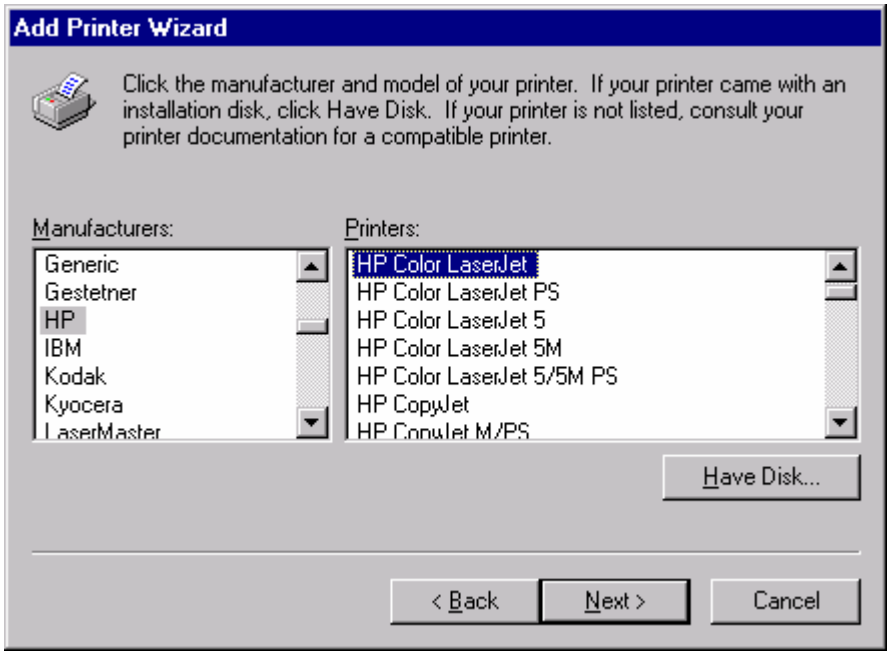
1. From the **Windows Start** menu, select **Settings** and then **Printers**.
2. In the Printers window, double-click the icon, Add New Printer. The following dialog appears.



3. Select 'My computer' or 'Network printer server' and click **Next>**.



4. Select the 'LPT1 port' and click **Next>**. For a network printer, the appropriate network identification for the printer must be entered. A network system administrator may need to provide this information.



5. Select the manufacturer and model from the Windows list of supported printers and then click 'Have Disk' to install the appropriate printer driver for the model selected.

Note: *Most manufacturers ship printer drivers with the printer or provide drivers from their web site. Should you have questions installing a particular printer driver, please consult the printer manufacturer for details.*

6. When asked to print a test page, click **Yes** and click **Finish**.
7. Windows installs the printer drivers and prints a test page.

Installing a Windows Network

Note: ***READ THIS FIRST***

Your DSO Windows Workstation is setup as:

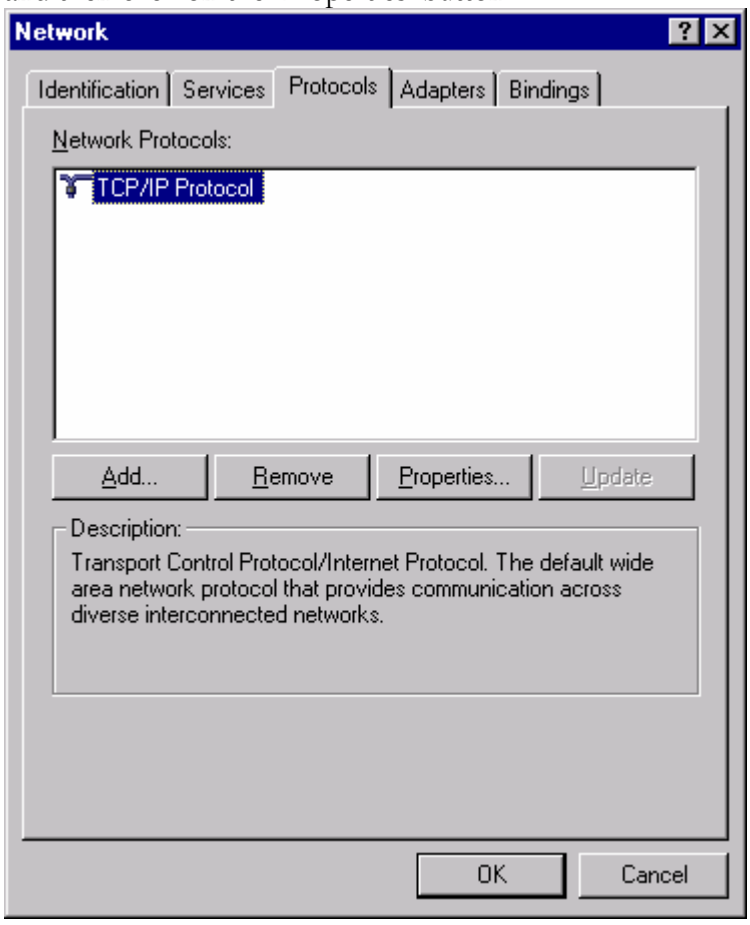
User Name: administrator
Password: sigma

If you plan to change the User Name, the new User Name MUST HAVE FULL "administrator rights" on the DSO Windows system, not necessarily the network to which it may be connected, otherwise the DSO will not function properly.

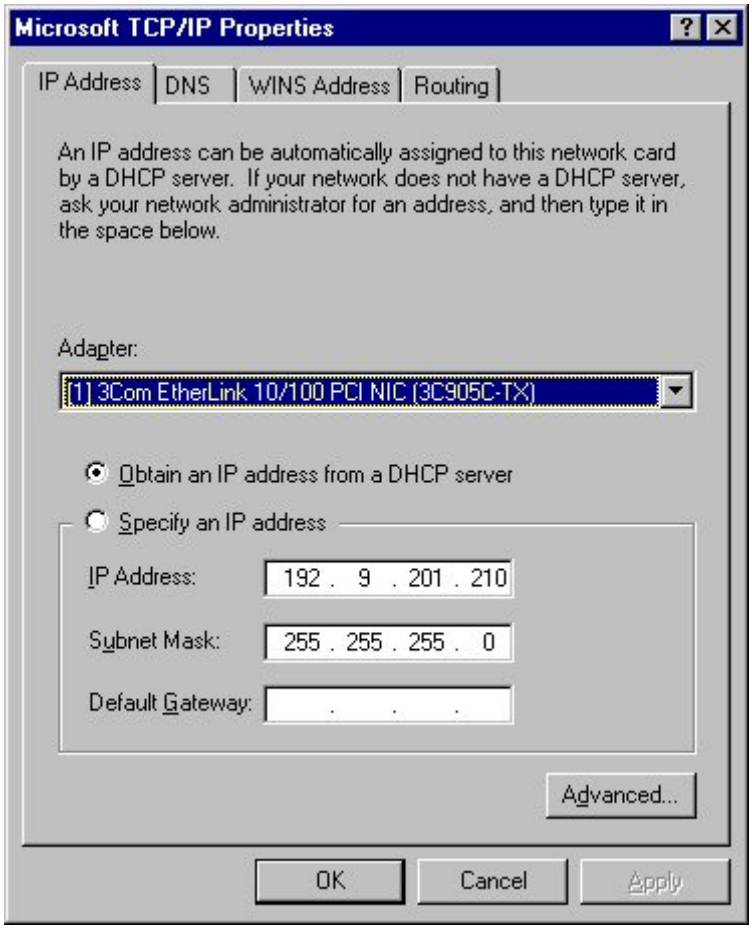
The following steps are only necessary if a connecting to a company network. This procedure assumes a level of understanding windows network configurations and Sigma operation.

Note: *The IP address settings* ***MUST*** *be reset to 'Specify an IP address' with the proper 'IP Address' and 'Subnet Mask' settings as outlined in the diagram in step 3, if the Sigma system is to be restarted* ***WITHOUT*** *a physical connection to the network. Otherwise, the Sigma will be searching for the network connection forever, and appear to hang up the system.*

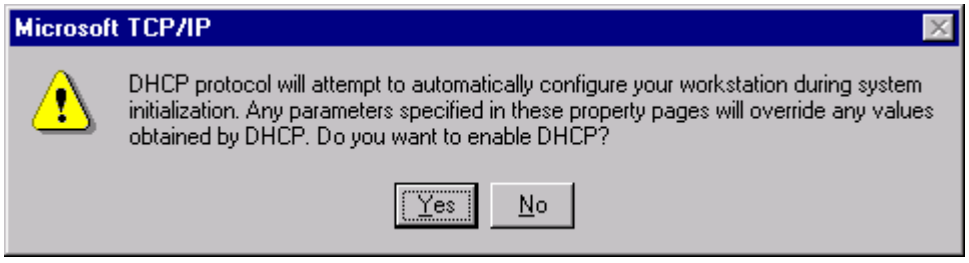
1. Log onto the Sigma as the Administrator to obtain full access rights.
2. Click on the 'Network' icon from the Windows control panel. Click on the 'Protocols' tab and then click on the 'Properties' button.



3. Click on the 'IP Address' tab and select the option called 'Obtain an IP address from a DHCP server'. This enables the Sigma to obtain the IP address automatically from a DHCP server.



4. Selecting the option, 'Obtain an IP address from a DHCP server', causes Windows to display the following window, asking if you want to enable DHCP. Click 'Yes'.



5. Click ***Apply*** and then ***OK*** and restart the Sigma.

Note: *The IP address settings* ***MUST*** *be reset to 'Specify an IP address' with the proper 'IP Address' and 'Subnet Mask' settings as outlined in the diagram in step 3 above, if the Sigma system is restarted* ***WITHOUT*** *a physical connection to the network.*

Appendix C: Export File Format

ASCII TXT Format

To best facilitate a wide range of destination applications, ASCII data can be exported with a choice of the following delineations:

- New Line – a line feed follows each item
- Comma – all items are separated by commas
- Tab – all items are separated by tabs

ASCII export of data contains a header, which will vary depending on the type of data that is being exported.

- Waveform data - amplitude values, time
- Histogram - quantity of hits in bin, range of measurement bins
- Graph – measurement value, measurement progression (sequential)
- FFT – dBV values, frequency point

The following examples use New Line delineations.

The column on right (*Description*) is not included in the actual data export.

Example 1 – Waveform Data (amplitude values in time) for one channel

	Description
LDS-Nicolet Sigma	*instrument identification*
20:56:36 Thursday November 30 2000	*time (H:M:S), date of export*
Trace Type	
YT	*amplitude values in time*
Time of First sample wrt trigger (s)	
0.025	*start of trace to trigger in seconds (25 ms)*
Time per sample (s)	
0.0002	*time between samples (200 μs)*
Units	
V	*units (Volts) – scaled as appropriate*
Number of Samples	
501	*number of samples in the data record*
DATA START	
7.755	*Data in the units indicated with respect*
7.205	*to ground (7.755 Volts)*
0.331	
7.755	
etc.	

Example 2 – Histogram

	Description
LDS-Nicolet Sigma	*instrument identification*
20:56:36 Thursday November 30 2000	*time (H:M:S), date of export*
Trace Type	
Histogram	*histogram data*
Time of Last Hit	
20:54:07 Thursday, November 30, 2000	*time to nearest second, date*
Sample Every Trigger	*'Sample Every Trigger' or 'Time Between'*
0.000000	*value if 'Time Between'*
Units	*measurement unit*
V	*Volts in this example*
Range Minimum	
0.000000	*minimum of range set to 0*
Range Maximum	
0.400000	*maximum of range set to 400 mV*
Number of Bins	
100	*each bin size (400 mV/100 = 4 mV)*
DATA START	
0	*bin #1 - hits = 0 (range 0 to 4 mV)*
0	*bin #2 - hits = 0 (range 4 to 8 mV)*
0	*bin #3 - hits = 0 (range 8 to 12 mV)*
2	*bin #4 - hits = 2 (range 12 to 16 mV)*
8	*bin #5 - hits = 8 (range 16 to 20 mV)*
71	*bin #6 - hits = 71 (range 20 to 24 mV)*
109	*bin #7 - hits = 109 (range 24 to 28 mV)*
131	*bin #8 - hits = 131 (range 28 to 32 mV)*
etc.	

Example 3 - Graph Data

	Description
LDS-Nicolet Sigma	*instrument identification*
20:56:36 Thursday November 30 2000	*time H:M:S, Date Exported*
Trace Type	
GRAPH	*Graph data*
Time of Last Value	
20:54:07 Thursday, November 30, 2000	*Timing of last data point to the second*
Sample Every Trigger	*Sample every trigger or time between*
0.000000	*No valid time for trigger only time*
Units	
V	*Measurement units*
Number of Readings	
202	*202 readings in the graph*
DATA START	
0.1076	*Data in measured units (107.6 mV)*
0.1109	*(110.9 mV)*
0.1109	
etc.	

Example 4 - FFT Data

	Description
LDS-Nicolet Sigma	*Instrument type number*
21:07:31 Monday December 04 2000	*Time H:M:S, Date Exported*
Trace Type	*FFT*
FFTlin	*Linear or logarithmic frequency scaling*
Start Frequency	
0	*FFT frequency at first data point (0)*
Frequency Step	*Frequency step between each data point*
195.313	*(195.313 Hz)*
Units	
dBV	*Units are scaled from the channel range*
Number of Readings	
256	*Data length up to 32 k (256 example)*
DATA START	
-27.59	*dbV is with respect to 1 Volt at the input*
-43.36	*-27.59 dBV = 41.735 mV*
-50.66	
-27.04	
-44.52	
-81.46	

LDS-Nicolet WFT Format

The Sigma standard format is a LDS-Nicolet WFT format. This format is a compact 16-bit binary file format containing an ASCII header to retain scale factors, channel titles, time/date, etc. It is used by Sigma and is supported by a variety of software. Each channel is stored in a separate file of 2-byte integers. It is the most compact format. The WFT format is documented in detail below to facilitate direct data extraction.

Waveform File Specifications

File Header

The WFT file header size is determined by the value entered in the field "Header_Size." The individual file header fields are fixed in length and are ASCII alphanumeric strings, each terminated by a null (00) byte.

The simplest file, containing a single timebase, has a header of 1538 bytes. A file containing multiple waveform segments or multiple timebases expands the header length as needed.

All fields are left justified ASCII character strings, followed by a null byte, followed by spaces if needed to fill the allotted space. If a particular field is not used, its first byte is a null byte.

Since the header contains only ASCII characters and ends with a CONTROL-Z character, the header text can be conveniently viewed on a PC screen by using the MS-DOS "TYPE" command, for example "TYPE WAVE0001.WFT <Return>."

Data Type

"Integer" means an ASCII whole number, for example "2" or "262144." Note that the values are not limited to a 16-bit range: the "Time" field, in milliseconds since midnight, may contain a number as large as 89,400,000.

"Character" means ASCII text, for example "V" or "Test #12."

"Float" means an ASCII number in scientific notation, for example "5.0000000E-6."

Actual Data

The actual data (raw data) follows immediately after the file header. The data is in binary format. Please note that the data type (number of bytes per point, and byte sex) are described in the file header.

In all applications to date, data is in a 16-bit integer range from -32768 to +32767, with the low byte appearing first.

Raw data is converted into time and voltage values by the calculations shown below.

Time = ((point# * HORIZONTAL_NORM) + HORIZONTAL_ZERO) * USER_HORIZONTAL_NORM + USER_HORIZONTAL_ZERO

point# = Represents the n-th point in a sweep.

HORIZONTAL_NORM = Time per point, in seconds.

HORIZONTAL_ZERO = Trigger to 1st point, in seconds.

USER_HORIZONTAL_NORM = User defined multiplier, unitless (normally 1)

USER_HORIZONTAL_ZERO = User defined time offset, in seconds (normally 0)

Volts = ((data - VERTICAL_ZERO) * VERTICAL_NORM) * USER_VERTICAL_NORM + USER_VERTICAL_ZERO

data = Raw digitizer data (-32,768 through 32,767)

VERTICAL_ZERO = Absolute zero reference from the ADC

VERTICAL_NORM = Voltage per level

USER_VERTICAL_NORM =User defined multiplier (normally 1)

USER_VERTICAL_ZERO = User defined offset in volts (normally 0)

Offset	Max. Size (Bytes)	Field Description	ASCII Data Type	Field Description
0	2	Nic_id0	Integer	CPU type ID (byte sex) 1 = VAX, 2 = 68000, 3 = Intel: normally 3
2	2	Niv_id1	Integer	LDS-Nicolet division indicator: always 2
4	2	Nic_id2	Integer	LDS-Nicolet file format: 1 = Time domain, 2 = Frequency domain
6	2	User_id	Integer	User ID
8	12	Header_size	Integer	Length of file header in bytes
20	12	File_size	Integer	Length of file in bytes
32	12	File format version	Integer	Version of file format
44	81	Waveform title	Character	Waveform title
125	3	Date_year	Integer	Date of trigger of segment #1 - year
128	3	Date_month	Integer	Date of trigger of segment #1 - month
131	3	Date_day	Integer	Date of trigger of segment #1 - day
134	12	Time	Integer	Time of trigger of segment #1 - msec since midnight
146	12	Data_count	Integer	Total number of data points
158	12	Vertical_zero	Integer	Data value at which the voltage value is 0.00 volts - VZERO
170	24	Vertical_norm	Float	Voltage magnitude between levels - VNORM
194	24	User_vertical_zero	Float	User voltage offset
218	24	User_vertical_norm	Float	User units per volt
242	11	User_vertical_label	Character	User vertical label: default = "V"

Offset	Max. Size (Bytes)	Field Description	ASCII Data Type	Field Description
253	24	User_horizontal_zero	Float	User time offset
277	24	User_horizontal_norm	Float	User seconds per unit
301	11	User_horizontal_label	Character	User horizontal label: default = "s"
312	129	User_Notes	Character	Note field, additional information
441	196	Audit	Character	Audit array of all calculations
637	21	LDS-Nicolet_Digitizer_Type	Character	LDS-Nicolet digitizer description
658	3	Bytes_per_data_point	Integer	Amount of bytes to store 1 data point: normally 2
661	3	Resolution	Integer	Number of active bits in a data point
664	81	Forward_link	Character	Pathname/file following in time the current file (Note 1)
745	81	Backward_link	Character	Pathname/file preceding in time the current file (Note 1)
826	3	Process flag	Integer	Process Flag - # of memory altering math functions performed
829	3	Data compression	Integer	Type of data compression used on raw data: 0 = none
832	12	Number of segments	Integer	Number of segments
844	12	Length of each segment	Integer	Length of each segment
856	12	Number of timebases	Integer	Number of timebases per segment
868	156	Reserved N/A	N/A	Reserved for LDS-Nicolet internal use only
1024	12	Length of zone 1	Integer	Length in points of zone 1
1036	24	Horiz. norm. zone 1	Float	Time between data points (tpp) - HNORM
1060	24	Horiz. zero zone 1	Float	Time of 1st point in zone 1 with respect to trigger
1084	12	Length of zone 2	Integer	Length in points of zone 2 (Note 1)
1096	24	Horiz. norm. zone 2	Float	Time between data points (tpp) - HNORM (Note 1)
1120	24	Horiz. zero zone 2	Float	Time of 1st point in zone 2 with respect to the trigger (Note 1)
1144	12	Length of zone 3	Float	Time between data points (tpp) - HNORM (Note 1)
1156	24	Horiz. norm zone 3	Float	Time between data points (ttp) - HNORM (Note 1)
1180	24	Horiz. zero zone 3	Float	Time of 1st point in zone 3 with respect to the trigger (Note 1)
1204	332	Reserved N/A	N/A	Reserved for LDS-Nicolet internal use only
1536 (Note 2)	24	Segment #2 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1560 (Note 2)	24	Segment #3 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1584 (Note 2)	24	Segment #4 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1608 (Note 2)	24	Segment #5 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1

Offset	Max. Size (Bytes)	Field Description	ASCII Data Type	Field Description
1632 (Note 2)	24	Segment #6 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1656 (Note 2)	24	Segment #7 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1680 (Note 2)	24	Segment #8 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1704 (Note 2)	24	Segment #9 HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
1536 + (24 * (n-2))	24	Segment #n HDELTA	Float	Time value of 1st point relative to time of 1st point of seg. #1
Header_Size - 2	1	End of HDELTA's	Null	
Header_size - 1	1	End of readable file	Control Z	End of readable data - Raw data follows
Header_size	Data_Count	Start of raw data	Raw	Binary data: normally 16-bit words in two's compliment arranged in low byte/high byte order
File_size - 1	Data_Count * Bytes_per_data_point	End of raw data		

Note 1: Not currently used with the Sigma.
Note 2: These fields are presently only in multi-waveform files.

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Appendix D: Performance Checking

The purpose of this section is to verify the major performance specifications of the Sigma. Should any of these parameters fail to be within specification, it is then recommended that the instrument be serviced or re-calibrated as necessary. Return the instrument to your local distributor for service.

A working knowledge of the Sigma is required in order to successfully complete this procedure. Previous chapters in this User's Guide contains the complete functional instructions.

Reset to Default Settings

This procedure sets the instrument back to the predefined/default system setup.

1. Press the **MENU** button on the front panel.
2. In the upcoming menu at the right side of the display, press ***File***, then ***Recall***.
3. In the popup menu, press ***Recall Default Setup*** and then confirm with ***OK***.
4. You're done loading a default system set.

Sigma Bandwidth Verification

Equipment Required

1. Leveled Signal Generator: Fluke 5820 or equivalent

Procedure

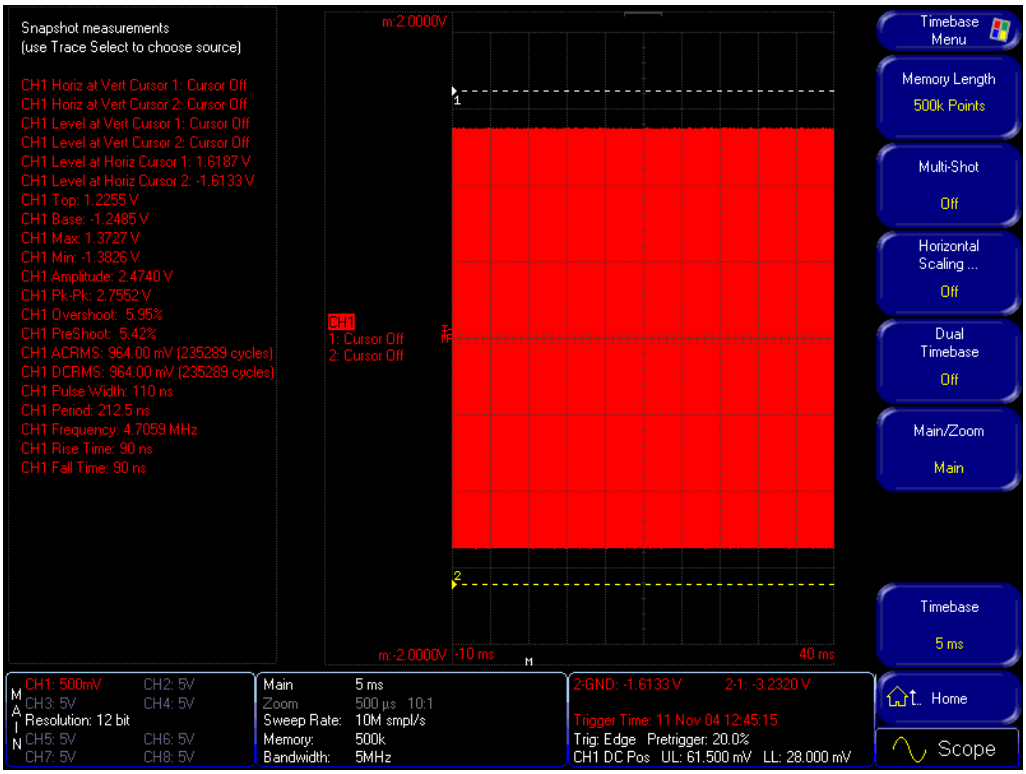
1. Allow the Sigma to run for 30 minutes before starting any verification procedure.
2. Connect the signal generator to a channel input, 50 ohm terminated.
3. Select 500 mV per division on the input channel and set the timebase to 5 ms per division.
4. Turn on the SnapShot Measurements by going to the *Main Menu* and selecting "Measurement and Cursors" and then select "SnapShot Measurement Setup".
5. Set the amplitude of the signal generator to give approximately 6 divisions at 1.01 MHz. Place the horizontal cursors at the top and bottom of the signal to measure the signal amplitude.
6. Set the timebase to it's fastest setting and then increase the frequency of the signal generator until the peak to peak amplitude reduces to 70.7 percent of the signal amplitude measured above.

7. The measured frequency should be equal to or greater than 5 MHz while in the 12-bit mode on a Sigma 30 and 90, 25 MHz while in the 12-bit mode on a Sigma 100 or in the 8-bit mode on a Sigma 90 or 200 MHz while in the 8-bit mode on a Sigma 60.
8. Repeat for the remaining channel inputs.

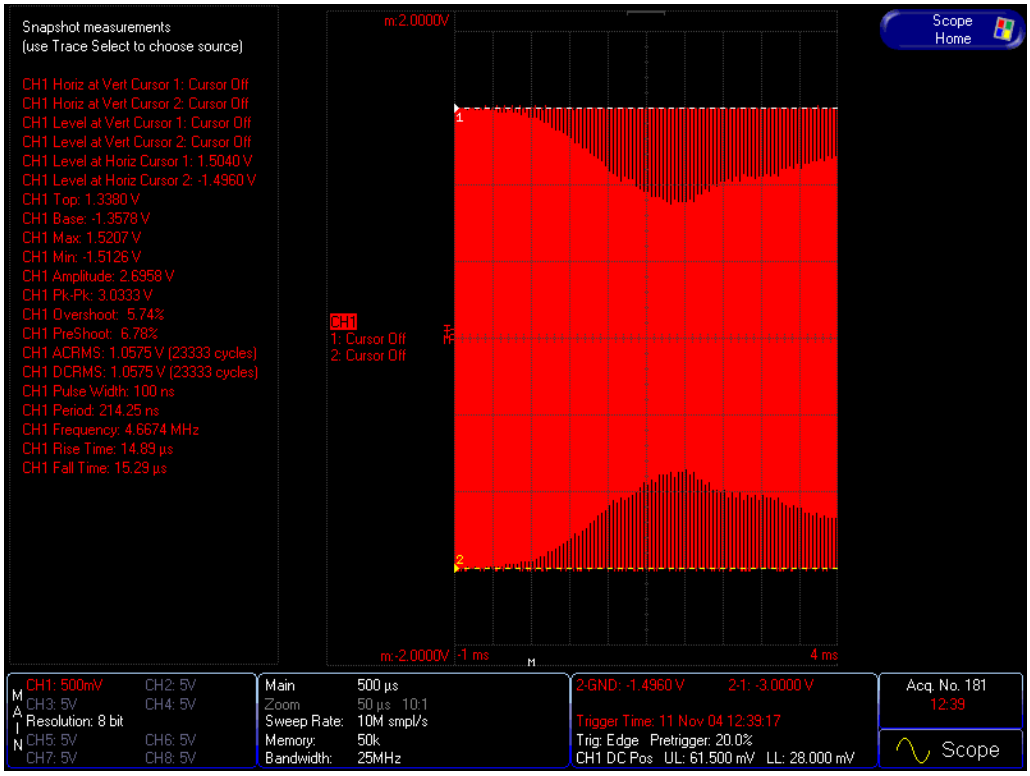
Sigma Models, Resolutions & Bandwidths

Model #	Resolution	Bandwidth
Sigma 30	12-bit	5 MHz
Sigma 60	8-bit	200 MHz
Sigma 75	8-bit	25 MHz
Sigma 90	12-bit	5 MHz
	8-bit	25 MHz
Sigma 100	12-bit	25 MHz

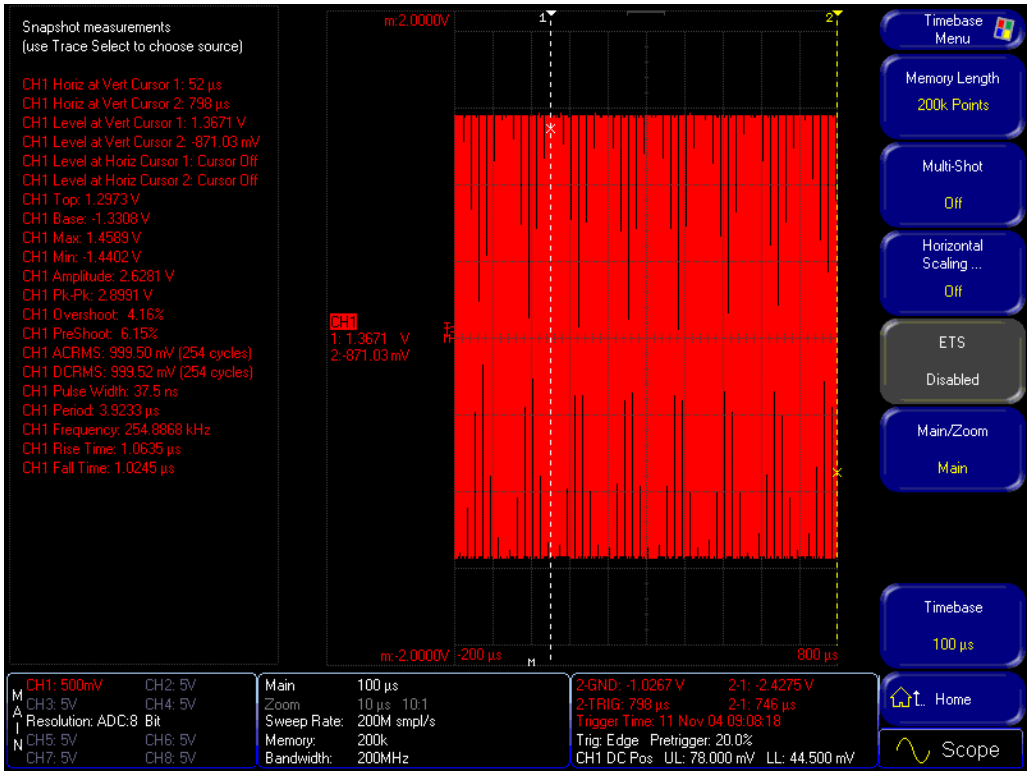
Sigma 30/90/100 12-bit Bandwidth Setup



Sigma 75/90 8-bit Bandwidth Setup



Sigma 60 8-bit Bandwidth Setup



Sigma Gain Verification

Equipment Required

1. Leveled Signal Generator: Fluke 5820 or equivalent

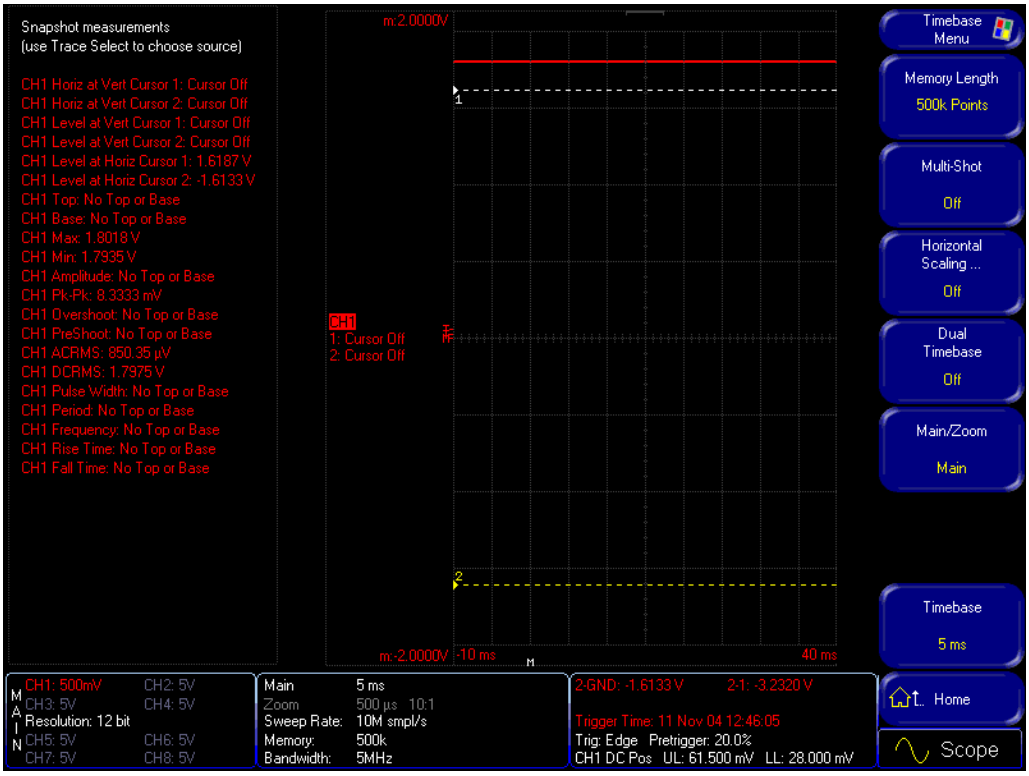
Procedure

1. Allow the Sigma to run for 30 minutes before starting any verification procedure.
2. Connect the signal generator to a channel input.
3. Set the timebase to the fastest setting
4. Turn on the SnapShot Measurements by going to the *Main Menu* and selecting "Measurement and Cursors" and then select "SnapShot Measurement Setup".
5. Use one of the two following charts, depending on the Sigma Model under verification, start from the top of the chart and work your way down.
6. Set the input range on the Sigma with the input range listed in the chart.
7. Inject the corresponding + voltage and measure the value.
8. Compare the injected value with the measured value to determine the error and verify the error is within the corresponding error limit.
9. Inject the corresponding - voltage and measure the value.
10. Compare the injected value with the measured value to determine the error and verify the error is within the corresponding error limit.
11. Repeat steps 6 through 10 for each input range.

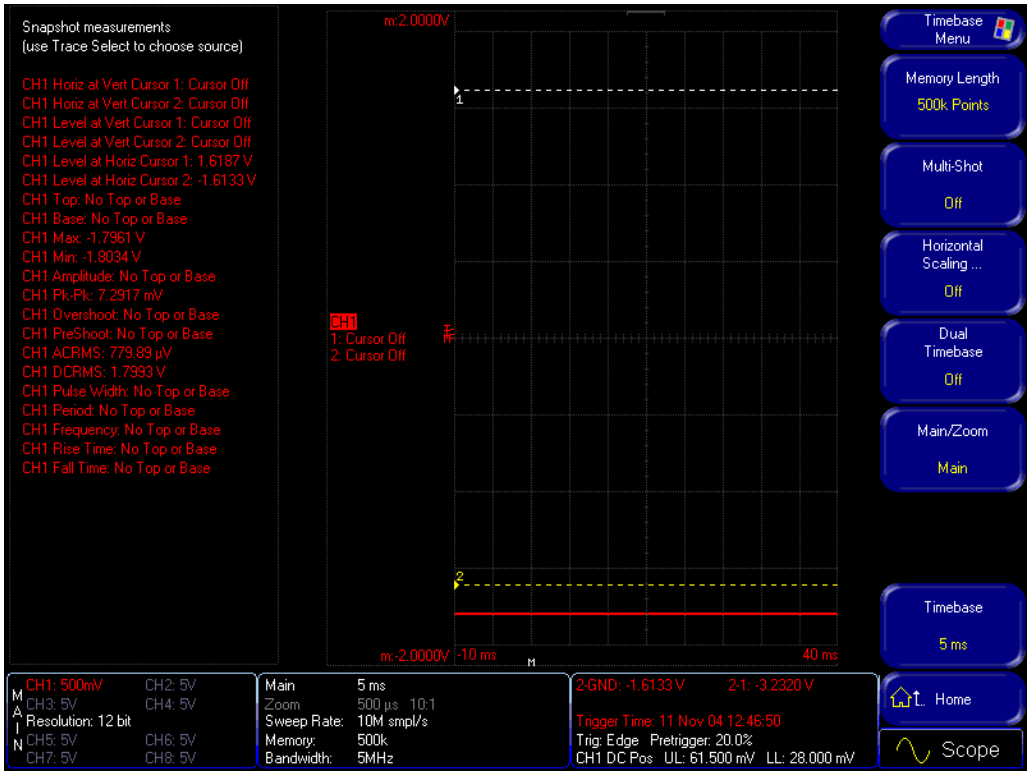
Sigma 30, 75, 90, & 100 Chart

Input Range	Injected Input +/-	Error Limit
160	144 (+/-72)	±0.480 V
80	72 (+/-36)	±0.240 V
40	36 (+/-18)	±0.120 V
16	14.4 (+/-7.2)	±0.048 V
8	7.2 (+/-3.6)	±0.024 V
4	3.6 (+/-1.8)	±0.012 V
1.6	1.44 (+/-0.72)	±4.8 mV
0.8	0.72 (+/-0.36)	±2.4 mV
0.4	0.36 (+/-0.18)	±1.2 mV
0.16	0.144 (+/- 0.072)	±480 µV
0.08	0.072 (+/-0.036)	±240 µV
0.04	0.036 (+/-0.018)	±120 µV

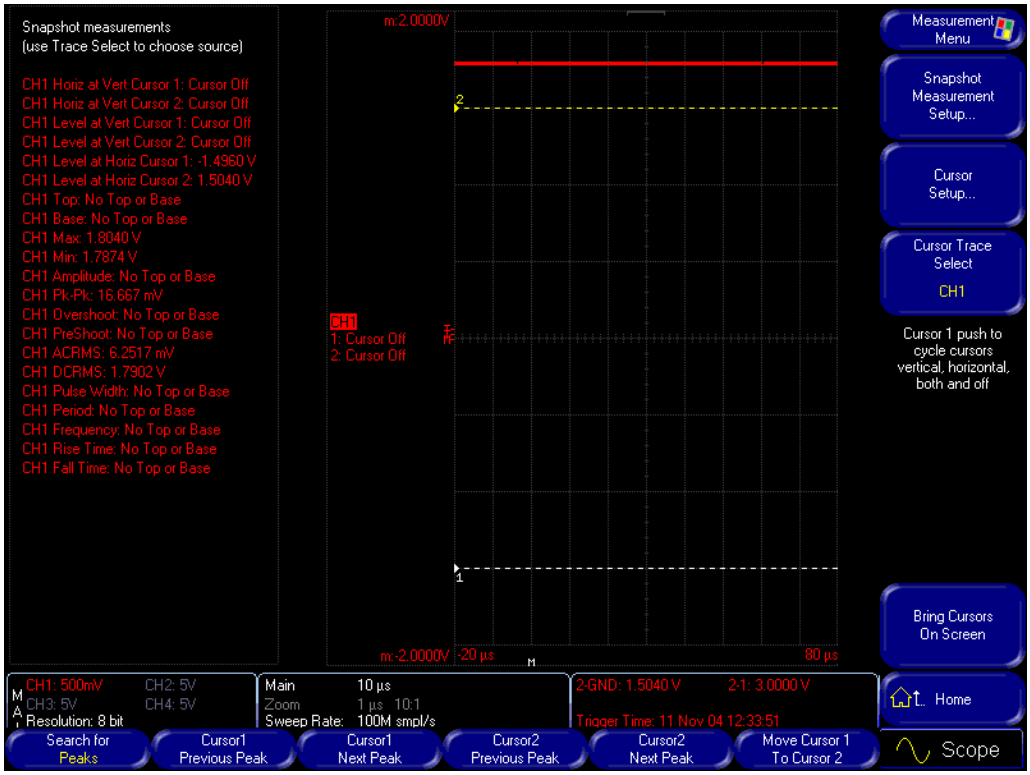
Sigma 30/90 12-bit +Inject Setup



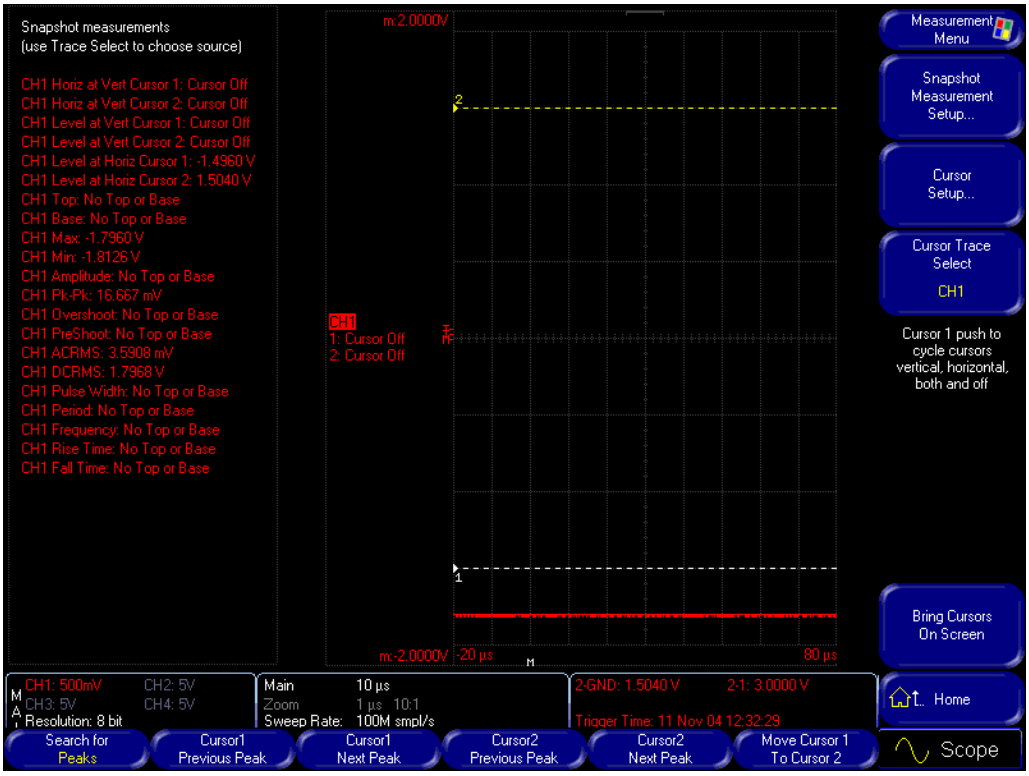
Sigma 30/90 12-bit -Inject Setup



Sigma 75/90 8-bit +Inject Setup



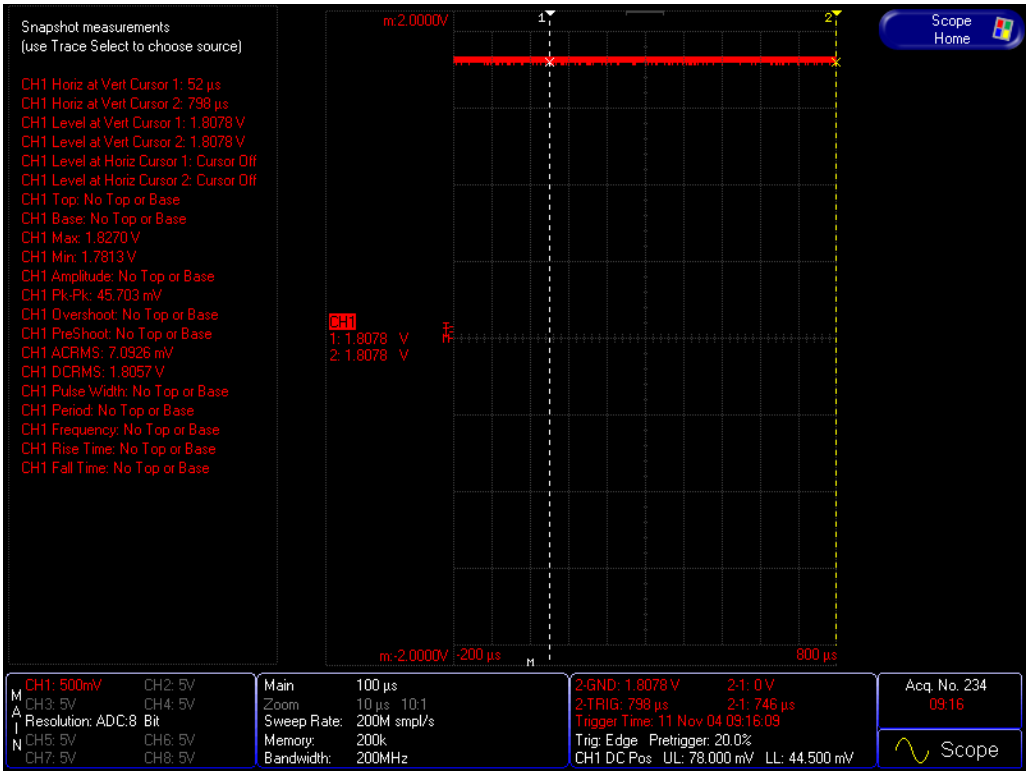
Sigma 75/90 8-bit -Inject Setup



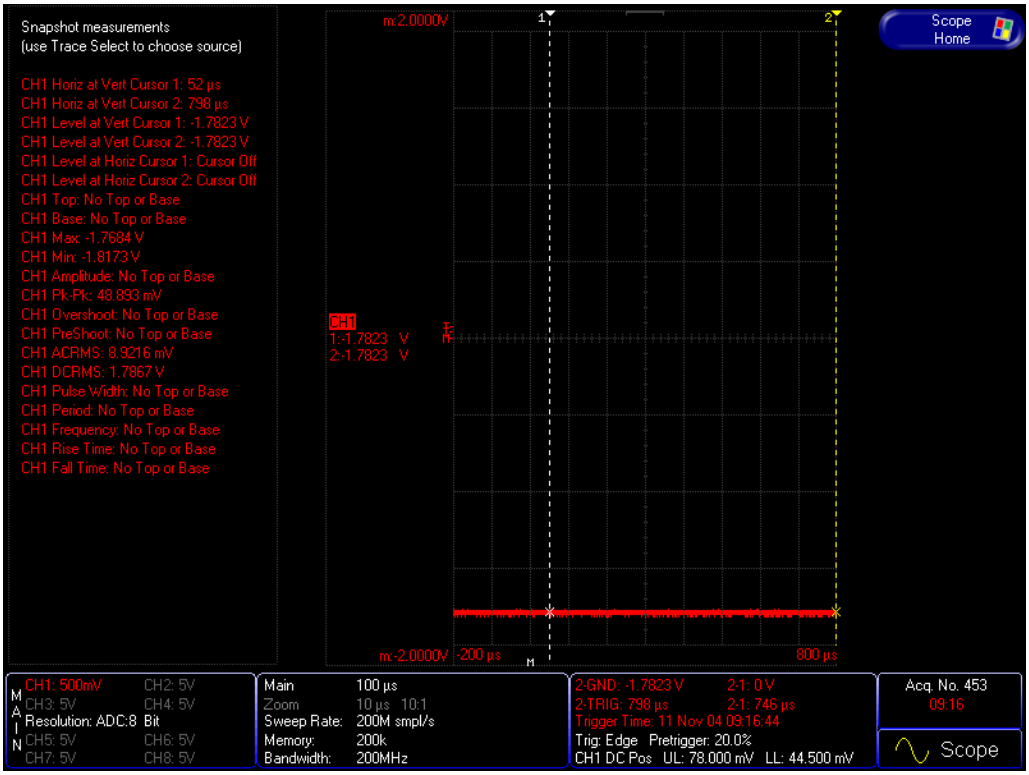
Sigma 60 Chart

Input Range	Injected Input +/-	Error Limit
40	36 (+/-18)	±0.70 V
16	14.4 (+/-7.2)	±0.290 V
8	7.2 (+/-3.6)	±0.140 V
4	3.6 (+/-1.8)	±0.07 V
1.6	1.44 (+/-0.72)	±0.029 V
0.8	0.72 (+/-0.36)	±0.014 V
0.4	0.36 (+/-0.18)	±7.0 mV
0.16	0.144 (+/- 0.072)	±2.9 mV
0.08	0.072 (+/-0.036)	±1.4 mV
0.04	0.036 (+/-0.018)	±700 µV
0.016	0.0141 (+/-0.0072)	±290 µV

Sigma 60 8-bit +Inject Setup



Sigma 60 8-bit -Inject Setup



Sigma RMS Noise Verification

Equipment Required

1. none

Concept

The RMS Noise of each channel is founds by measuring the standard deviation of data captured with no input signal. The coupling for the channel is set to GROUND and no filter is enabled.

Procedure

1. Allow the Sigma to run for 30 minutes before starting any verification procedure.
2. Set the input coupling for all channels to Ground.
3. Set the timebase to the fastest setting
4. Turn on the SnapShot Measurements by going to the *Main Menu* and selecting "Measurement and Cursors" and then select "SnapShot Measurement Setup" and choose AC RMS for the channels under test.

Sigma 30, 75, 90, & 100 Noise Chart

Input Range	Noise Specification	Error Limit
160	.05% FS	0.080 V
80	.05% FS	0.040 V
40	.05% FS	0.020 V
16	.05% FS	8.000 mV
8	.05% FS	4.000 mV
4	.05% FS	2.000 mV
1.6	.05% FS	.800 mV
0.8	.05% FS	.400 mV
0.4	.05% FS	.200 mV
0.16	.07% FS	112 µV
0.08	.15% FS	120 µV
0.04	.25% FS	100 µV

Sigma Common Mode Rejection (for differential models only)

Equipment Required

1. Leveled Signal Generator: Fluke 5820 or equivalent

Concept

The Common Mode Rejection is found by inputting a sine wave of the specified voltage and frequency into the positive (odd channels) and negative (even channels) DC coupled inputs of the channel under test. The CMR is measured using the internal AC RMS measurement procedure. The measured amplitude of the waveform should be less than the CMR limit specified for each range and frequency. The maximum Common Mode Voltage input to the system will be equal to the range under test.

The specification for each Sigma with differential inputs is relative to the input frequency. The specifications are:

Frequency	Results (typical)
10.1 kHz	55dB
80.1 kHz	50dB
350.1 kHz	40dB

To verify this, you must take the measured AC RMS resultant value and divide by the input voltage. From this value, you take the log and multiple by 20. Or:

$$dB = 20 \log (V_{RMSmeasured}/V_{RMSin})$$

Note: *On Sigma software version 2.10.03 and below, the user MUST make certain that both the plus & minus sensitivity settings for both channels are the same BEFORE switching into differential mode. Changing sensitivity settings while in the differential mode will only change the positive input sensitivity setting.*

Procedure

1. Allow the Sigma to run for 30 minutes before starting any verification procedure.
2. Connect the signal generator to a channel input.
3. Set the timebase to the fastest 12-bit setting & a minimum of 10k points acquisition/memory length.
4. Turn on the SnapShot Measurements by going to the *Main Menu* and selecting "Measurement and Cursors" and then select "SnapShot Measurement Setup".
5. Verify that the channel(s) under test are set for the same voltage range and then enable Differential Mode. Channel pairs are: 1-2, 3-4, 5-6, 7-8
6. Input a sine wave of 10.1kHz and the voltage (RMS value) as included in the table below. Verify that the measured AC RMS voltage is less than or equal to the value in the table.
7. Repeat the test for all the ranges indicated and all other differential pairs. Make certain that the differential mode is disabled between tests and both input ranges are changed before proceeding.

Sigma 30, 75, 90, & 100 Chart

Input Range (full scale)	Injected Input +/- (RMS)	Measured Output	AC RMS Error Limit –55dB	AC RMS Error Limit –50dB	AC RMS Error Limit –40dB
16	5.10 V_{RMS}		9.10 mV_{RMS}	16.1 mV_{RMS}	51.0 mV_{RMS}
8	2.55 V_{RMS}		4.53 mV_{RMS}	8.10 mV_{RMS}	25.5 mV_{RMS}
4	1.275 V_{RMS}		2.27 mV_{RMS}	4.03 mV_{RMS}	12.8 mV_{RMS}
1.6	510 mV_{RMS}		910 μV_{RMS}	1.61 mV_{RMS}	5.10 mV_{RMS}
0.8	255.0 mV_{RMS}		453 μV_{RMS}	810 μV_{RMS}	2.55 mV_{RMS}
0.4	127.5 mV_{RMS}		227 μV_{RMS}	403 μV_{RMS}	1.28 mV_{RMS}
0.16	51.0 mV_{RMS}		91.0 μV_{RMS}	161 μV_{RMS}	510 μV_{RMS}

Appendix E: Impulse Attenuators

Model 2000 HV (PL 259 Input Connector)

Model 2000L HV (LEMO 4S. 250 Input Connector)

The Impulse Attenuator for the Sigma is a 50:1 attenuator. It's a voltage divider that converts a maximum 2000 volts DC or AC to the input range of the Sigma. This attenuator has a wide bandwidth and low noise to complement the specifications of the Sigma. Complete specifications are listed at the end of this section.

Note: *The Impulse Attenuator is adjusted at the factory and normally does not require adjustment. As with any equipment, annual calibration is recommended, especially after the first year of operation. If the attenuator is subject to any over-voltage beyond the specified limits, it is recommended that calibration be verified.*

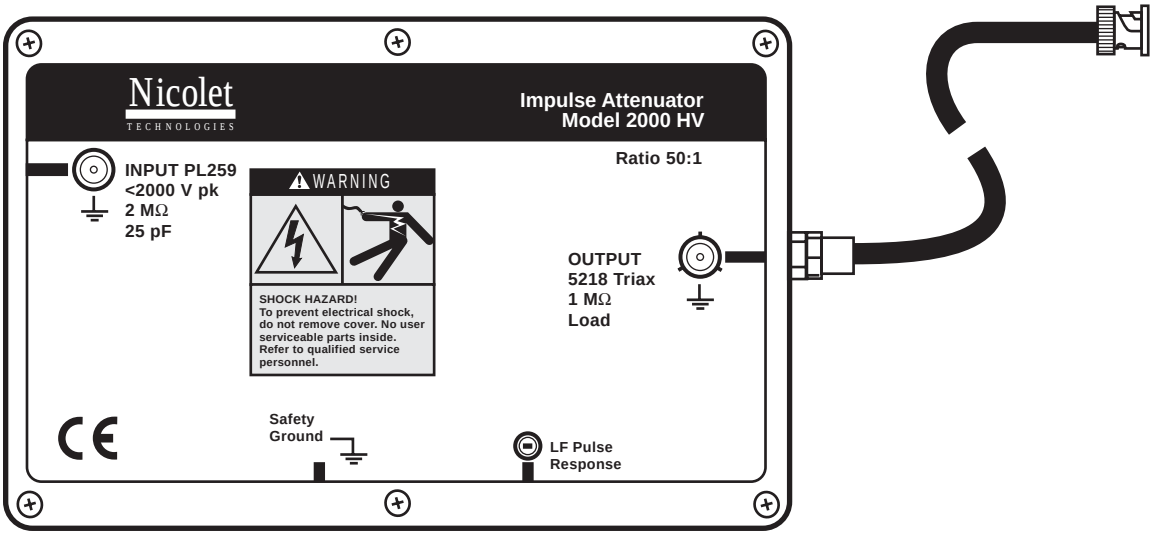
There are two types of Impulse Attenuators:

Impulse Attenuator Model 2000 HV, Part Number 845-071000
Contains one UHF-style SO-239 input connector which accepts a PL-259 male plug.

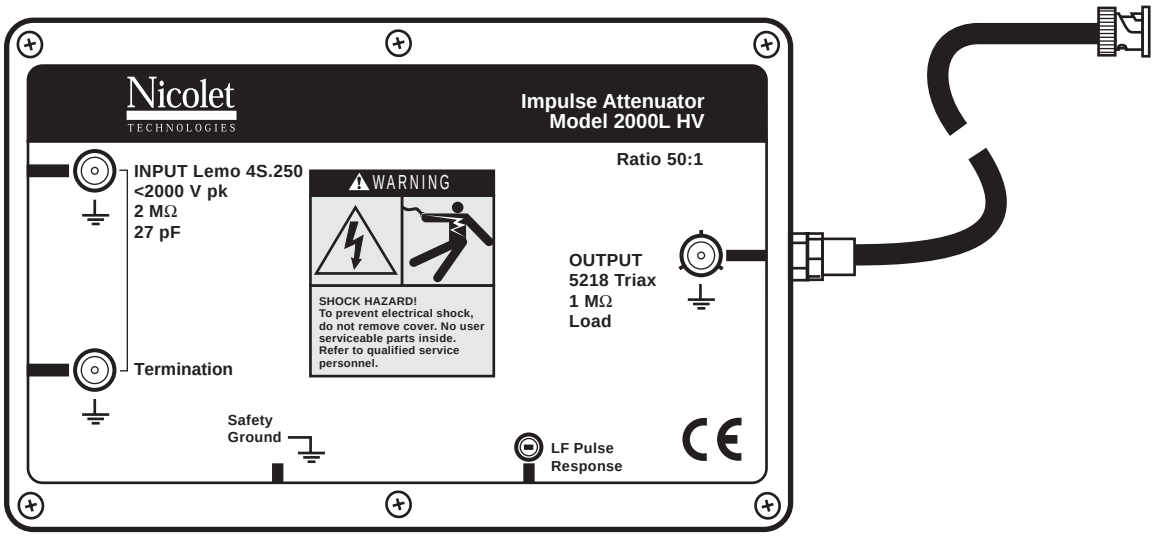
Impulse Attenuator Model 2000L HV, Part Number 845-075600
Contains two LEMO ERA.4S.250 input connectors which accept 4S.250 series male plugs, one of which is a parallel feed through connector for a terminator.

When using the Impulse Attenuator with a Sigma 100HV, it is recommended that the probe scaling factor be set on the channel to which the attenuator is connected. By setting a ×50 probe factor, the Sigma display and measurements will be correctly scaled to the Impulse Attenuator input.

Sigma Impulse Attenuator Model 2000 HV



Sigma Impulse Attenuator Model 2000L HV



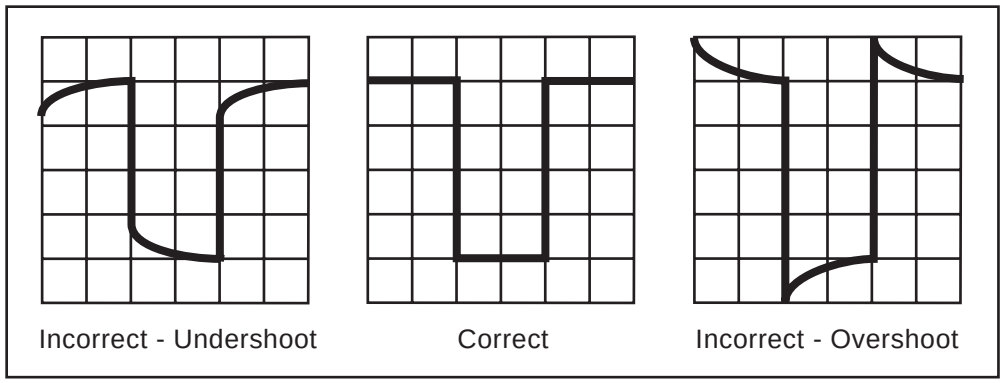
Pulse Response Calibration

The pulse response calibration is performed to better than 0.1% accuracy and requires an exceptionally flat 1 kHz square wave. Such a square wave is available on the Sigma via the front panel "cal pins." Using the **Utilities/Calibration/Probe Calibration Voltage** menu(s), set the calibration pin output voltage to 6 volts peak to peak. Set the probe scaling on the channel to ×50. The channel is now correctly scaled for the Impulse Attenuator.

Connect the Impulse Attenuator to the Sigma cal pins using a clip lead terminated in the connector.

Set the Sigma channel to 1 V/div, 50 μs/div, falling edge trigger with 10% pre-trigger. Use "14 bit repetitive mode" to enhance the resolution of the measurement. The figure below includes two representations of poor pulse responses (mismatch) of about ±20% error. The ±0.25% response of the Impulse Attenuator will not be visible in an unmagnified view.

Incorrect and Correct Waveform Responses



Using the mouse, for simplicity, click and drag a selection box around the entire bottom of the waveform. This method will quickly zoom in on the bottom of the waveform.

Note: *It is essential to always look at the "return to zero" part of the edge to get the degree of accuracy required.*

The zoom scaling should be manually re-set if needed to give 20 mV/div; the horizontal zoom scaling should remain at 50 µs/div. Adjust the "LF Pulse Response" control on the Impulse Attenuator using a small straight bladed screwdriver until the bottom of the pulse waveform is flat to within ±6 mV. This deviation represents a ±0.1% pulse flatness. Note that the "Z" on the zoomed trace display, which is the zoomed ground marker, will generally not line up with the bottom of the trace when using the scope cal pins.

DC Calibration

DC re-calibration should not be needed unless the attenuator has been subjected to excessive over-voltage events. Since the cover has to be removed to perform this adjustment, DC calibration is not a user feature.

Impulse Attenuator Specifications

Parameter	Specification
Attenuator Ratio	50:1
DC Accuracy	±0.25%
Bandwidth (-3 dB)	>30 MHz
Input Impedance Rin Cin	 2 MΩ ±0.25% 25 pF (Model 2000 HV) 27 pF (Model 2000L HV)
Vin (Max Operating)	2000 V continuous
Vin Max	4000 V pk up to 1 kHz for 1 minute
Input Connector	PL259 (Model 2000 HV) LEMO 4S.250 (Model 2000L HV) Termination is done via the termination input
Output Connectors	Triaxial BNC adapter output cable for connection to Sigma, approx. 20" (50 cm)
Temperature Range Storage Normal Operating Extended	 0 °C to 60 °C 15 °C to 35 °C 5 °C to 50 °C
Humidity Range Storage Operating	 95% Relative 95% Relative 30 °C to 50 °C

Appendix F: Service Information

LDS-Nicolet offers comprehensive factory servicing for all LDS-Nicolet oscilloscope products. Extended warranties for calibration, repair or both are available. Installation, on-site or factory training are also available. Contact the factory or your local sales person for more information. For local contact information, visit www.lds-group.com

If service is ever needed on your Sigma, contact the factory with the model and serial numbers, a description of the problem, and your contact information. You will be issued a Return Material Authorization (RMA) number. Attach this number to the unit and/or the accompanying paperwork.

During the warranty period, the customer pays for shipping to LDS-Nicolet. LDS-Nicolet will pay for the return of the equipment in the same fashion as it was received. Outside the warranty period, a quote will be given. A purchase order must be received before work can be performed.

It is recommended that the unit always be shipped in the original shipping container. For frequent shipping, LDS-Nicolet offers a hard shipping container specifically designed for the transport of Sigma and its accessories.

Sigma Replacement Parts

Part Number	Part Description
986A0163	SIGMA 100HV-8CH
986A0162	SIGMA 100HV-4CH
986A0161	SIGMA 100-8CH
986A0160	SIGMA 100-4CH
986A0150	NR SIGMA 90-8CH
986A0149	SIGMA 90-4CH
986A0147	SIGMA 60-4CH
986A0146	SIGMA 30
845-077400	SIGMA DUAL MONITOR OPTION
845-074900	PCI TO PC CARD ADAPT PCMCIA
445-039600	SIGMA FP UNIVERSAL ASSY
445-035300	SIGMA CAL PIN ASSY
426-032300	SOFT/SIGMA 100 OP V2.03.03
426-030600	SOFT/SIGMA UTILITIES V1.0
426-030500	PNR SOFT/SIGMA FP TEST
426-029801	SOFT/CD MSTR SIGMA MANUAL V2.0
426-029702	SOFT/CD MSTR SIGMA OP V2.10.02
426-029601	SOFT/CD SIGMA MANUAL V2.0
426-019602	SOFT/CD-R LDS STANDARD CD
415-062900	SIGMA PAC 100 TESTED
415-060400	SIGMA PAC 12 TESTED
415-060300	SIGMA AUX PSU
415-059600	SIGMA FRONT PANEL TESTED
415-057100	SIGMA PAC8 TESTED
415-057000	SIGMA PACMAN TESTED
397-911803	TEST SOFT/SIGMA NTWORK BOOT DSK
397-911701	TEST SOFT/SIGMA GHOST BOOT DISK
310-060500	SIGMA CAL PIN
267-580300	MFD/PACMAN DIRECT TO DISK MOD
267-574400	NR MFD/SIGMA FP TEST PROCEDURE
267-572201	MFD/SIGMA TEST PROCEDURE
222-935000	SIGMA VIDEO CARD
222-934000	NR HEATSINK W FAN
222-933500	HDD/ 20G ST320014A SEAGATE
222-933400	PCMCIA CARD ADAPTER
222-933100	OBL POWER SUPP 300W ATX12V ZALMAN
222-933000	MEMORY 256MB 266MHZ DDR
222-932900	CELERON 2.4GHZ W/ HEAT SINK, FAN
222-932800	MTHRBD INTEL D865GLC
222-928400	INVERTER NEC-17 DISPLAY
168-952101	DRWG/SIGMA PAC100 ASSY
168-949201	DRWG/SIGMA PAC100 FAB ASSY
168-947200	DRWG/SIGMA PAC12 ASSY
168-945700	DRWG/SIGMA PAC8 ASSY

Part Number	Part Description
168-945600	DRWG/SIGMA PACMAN ASSY
168-944103	DRWG/SIGMA PWRSPLY RETERMINATION
168-943300	DRWG/SIGMA MTHRBD ASSY
168-943202	DRWG/SIGMA PAC8 ASSY/MOD
168-942801	DRWG/SIGMA FP ASSY
168-942700	DRWG/SIGMA AUX PS ASSY
168-942601	DRWG/SIGMA CAL PIN ASSY
168-941201	DRWG/SIGMA FINAL ASSY
168-941102	DRWG/SIGMA FRAME ASSY
167-908100	TEST SPEC/SIGMA 30/90
167-907700	TEST SPEC/SIGMA 60
163-902400	DISPLAY/SIGMA 10.4 RESISTIV TOUCH
143-909200	CASE/SIGMA SOFT SIDE
114-903000	FLTR/SIGMA 80MM FAN GUARD
113-904800	PWRSLPY/SIGMA 300W ZALMAN ATX12V
113-904700	PWRSPLY/SIGMA 300W RETERMINATED
085-988003	CBL/SIGMA CONTROLLER TO MB
085-987902	P CBL/SIGMA TOUCH PNL EXTENS
085-987600	CBL/SIGMA FP TO PACMAN
085-987500	CBL/SIGMA PROBE INTERFACE
085-986602	CBL/SIGMA FP TO MOTHERBD
085-985101	CBL/SIGMA VIDEO
085-970400	CBL/SIGMA PCI TO INV
085-970100	CBL/30 COND 17.5 SS 1.0MM FPC"
085-968600	CBL/TFT INVERTER EXTENDER 4IN
072-902000	FAN/12V 32CFM80MM FBA08A12M1A
049-904500	HANDLE/SIGMA
045-903300	KNOB/SIGMA LG BLUE
045-903200	KNOB/SIGMA SM BLUE
045-902800	KNOB/SIGMA SM FP (LTP-384)
042-926000	COVER/SIGMA CHASSIS LID
042-923200	COVER/DUST 9 PIN D-SUB
035-906200	BUTT/SIGMA FP
034-908100	GUIDE/SIGMA CARD
024-919000	CON/6WAY RIGHT ANGLE HDR
024-915900	CON/2F RC CP C 26-22GA S
022-748800	P DIO/SCT 1N5820 20V 3A
017-922800	LABEL/WIDE SILVER BRDY LAT-20-773

Appendix G: Sigma Specifications

All Sigma Models

Trigger

AUTO MODE:	Timebase free runs
SOURCE:	CH1, CH2, CH3, CH4 External Trigger 5 V TTL
SLOPE:	+ or – with hysteresis up to 8 divs
COUPLING:	AC or DC set by the channel
POST-TRIGGER DELAY:	0 to 399 s to a resolution of 10 ns
PRE-TRIGGER:	0 to 100% with 0.2% resolution
TRIGGER RANGE:	100% of input voltage range (Adjustable 8 or 12-bit digital trigger)
TRIGGER OUTPUT:	TTL level signal via rear connector

Trigger Tools

PULSE WIDTH:	> or < 2 x max. sample clock period to 399 s
FREQUENCY/PERIOD:	0.0025 Hz to 50 MHz max limited by the bandwidth
SKEW:	Preset time between trigger events
COMBINATION:	Edge trigger on all channels with high, low or don't care level selection
BAND:	Enter or leave a band
GATING:	A Delayed by Time Gates B to 399 s B Gates A Delayed by N to 9999 counts
DELAY BY N:	Trigger after N events, 2 to 9999 counts
DIVIDE BY N:	Trigger every N events, 2 to 9999 counts
SLEW RATE[1]:	> or < time to pass through A and B levels
RUNT:	Trigger on low level pulse

[1] This trigger mode is available on channel 1 only

Display

LIQUID CRYSTAL:	10.4" SVGA with color fully adjustable Full annotation of current settings
MODES:	Refresh, Roll,TruTrace®, Persistence (Decay or accumulate), X-Y, Measurement Snapshot, Single shot, Multishot,Hold all or Channel holds
CONTROL:	Front panel and menu via touch panel, mouse and keyboard
AUTO-SETUP:	Sets vertical, horizontal and trigger for repetitive signals >40 Hz

Probe Compensation

1 V ± 5% pk-to-pk at 1 kHz

PC Interfacing

STANDARDS: VGA, Com 1, Centronic, Ethernet and 4 x USB2, PS2 for mouse and keyboard, Sound out and microphone input

Data Storage

Recorded traces, Setups
Stored data is stamped with time and user defined labels

INTERNAL HARD DISK: ≥ 20 Gbyte.

DATA FORMAT: WFT,DAT,TIFF, PDF,WMF,ASCII Text, DIAdem,Window Enhanced Metafile (emf), jpg, bmp

Engineering Scaling

Individual channel and horizontal axis (timebase) scaling

FORMULA: ± Scale Factor x V/Div ± Zero Offset

ENGINEERING UNITS: Four character user scaling entry

Measurements

Measurements are made simultaneously and run live
The Y-T Snapshot measurement list can be assigned to any trace

SNAPSHOT: Level at Vertical cursor 1 or 2, Time at Vertical cursor 1 or 2, Level at Horizontal cursor 1 or 2, Top, Base, Amplitude, Peak to Peak, Max., Min., Risetime, Falltime, Overshoot, Preshoot, Pulsewidth, Frequency, Period, DCRMS, ACRMS Standard deviation TRACE ANALYSIS +, -, *, ÷, Invert Filter, and FFT (FFTs can be averaged 2 to 100 times), Averaging 2 to 5000

Enhanced Analysis Option

MEASUREMENTS:	Level at Vertical cursor 1 or 2, Time at Vertical cursor 1 or 2, Level at Horizontal cursor 1 or 2, Top, Base, Max level, Time at Max level, Mean, Area, Amplitude, Peak to Peak, Pulse width, Period, Frequency, Duty Cycle, Rise Time, Fall Time, Rising Crossing, Falling Crossing, Overshoot, Preshoot, Top Knee, Base Knee, ACRMS (Standard Deviation), DCRMS, Count, Level at Trigger, Time at Trigger, FFT Harmonic
TRACE MATH:	Constant, Log, Antilog, Sine, Cosine, Sum, Delta, Product, Ratio, Square, Square Root, Average
TRACE ANALYSIS:	Integrate, Time shift, Differentiate waveforms. Graph or Histogram of selected measurements

Synchroscope Option

Internal card enables tracking and triggering simultaneously to rotating machinery

Direct To Disk Option

Streaming of channel data with reduced speed to hard disk. Available on all models.

STREAMING SPEED:	200 kS/s aggregate
NUMBER OF CHANNELS:	1 to 8
STORAGE LENGTH:	1 GSample aggregate maximum
STORAGE FORMAT:	LDS-Nicolet Proprietary
TRIGGER:	All channels level or window, ORed
PRETRIGGER:	0 to 100%

Physical Characteristics

DIMENSIONS:	14.9 (w) x 10 (h) x 11.9 (d) in 37.8 (w) x 25.4 (h) x 30.2 (d) cm
WEIGHT:	18 lb, 8.2 kg (4 channel) 19 lb, 8.6 kg (8 channel)

Sigma 100

The Sigma 100 is a four or eight channel, high resolution, high accuracy scope. It offers 100 MS/s sample rate with 12-bit resolution and a 14-bit higher resolution mode.

Vertical

BANDWIDTH: (–3 dB)	
12-bit mode	DC Coupled: DC to 25 MHz AC Coupled: 4 Hz to 25 MHz
14-bit mode	DC coupled: DC to 435 kHz AC Coupled: 4 Hz to 435 kHz
BANDWIDTH LIMITS:	
12-bit mode	5 MHz, 500 kHz
SENSITIVITY RANGE:	5 mV/div to 20 V/div in a 1-2-5 sequence
RESOLUTION:	
12-bit mode	12-bit (1 in 4096) 0.025% of Graticule Full Scale Deflection
HighRes mode	14-bit (1 in 16384) 0.006% of Graticule Full Scale Deflection.
ZOOM:	2 to 50 in a 1-2-5 sequence
INPUT COUPLING:	AC-DC-GROUND
INPUTS:	4 or 8 channels: 1 MΩ, 28 pF 400 V pk Single ended, switchable to differential using channel pairs
Diff mode CMRR	- 60 dB
Diff mode CMV	Equal to measurement range
POSITION RANGE:	± 4 divisions
ACCURACY:	
12-bit mode	± 0.25% ± 3 LSB
HighRes mode	± 0.25% ± 6 LSB

Horizontal

TIMEBASE RANGE:	
12-bit mode	500 ns/div to 100 secs/div (External clock to 10 MHz)
HighRes mode	50 µs/div to 100 secs/div (External clock to 1 MHz)
MAX. SAMPLE RATE:	
12-bit mode	100 MS/s
HighRes mode	1 MS/s
GLITCH DETECT:	10 ns
RECORD LENGTH:	1 MS per channel
SEGMENTATION:	2 to 5000 memory segments. (100 word minimum segment size)
ZOOM:	x2 to x20,000
TIMEBASE ACCURACY:	± 25 ppm

Sigma 100HV

Specifically designed to meet IEEE1122 and IEC61083 standards for high voltage impulse applications. Operates the same as a Sigma 100-4 and incorporates an enhanced magnetically shielded RF enclosure.

Sigma 90

The Sigma 90 is a four or eight channel, high resolution, high accuracy scope. It offers 10 MS/s sample rate with 12-bit resolution, switchable to 100 MS/s sample rate with 8-bit resolution in channel groups of four.

Vertical

BANDWIDTH: (–3 dB)	
12-bit mode	DC Coupled: DC to 5 MHz AC Coupled: 4 Hz to 5 MHz
8-bit mode	DC coupled: DC to 25 MHz AC Coupled: 4 Hz to 25 MHz
BANDWIDTH LIMITS:	
12-bit mode	500 kHz
8-bit mode	5 MHz, 500 kHz
SENSITIVITY RANGE:	5 mV/div to 20 V/div in a 1-2-5 sequence
RESOLUTION:	
12-bit mode	12-bit (1 in 4096) 0.025% of Graticule Full Scale Deflection
8-bit mode	8-bit (1 in 256) 0.42% of Graticule Full Scale Deflection.
ZOOM:	2 to 50 in a 1-2-5 sequence
INPUT COUPLING:	AC-DC-GROUND
INPUTS:	4 or 8 channels: 1 MΩ, 28 pF 400 V pk Single ended, switchable to differential using channel pairs
Diff mode CMRR	- 60 dB
Diff mode CMV	Equal to measurement range
POSITION RANGE:	± 4 divisions
ACCURACY:	
12-bit mode	± 0.25% ± 3 LSB
8-bit mode	± 0.25% ± 1 LSB

Horizontal

TIMEBASE RANGE:	
12-bit mode	5 μs/div to 100 secs/div (External clock to 10 MHz)
8-bit mode	500 ns/div to 100 secs/div (External clock to 100 MHz)
MAX. SAMPLE RATE:	
12-bit mode	10 MS/s
8-bit mode	100 MS/s
GLITCH DETECT:	10 ns
RECORD LENGTH:	1 MS per channel
Cascading	2 MS or 4 MS per channel when using less channels
SEGMENTATION:	2 to 5000 memory segments. (100 word minimum segment size)
ZOOM:	x2 to x20,000
TIMEBASE ACCURACY:	± 25 ppm

Sigma 75

The Sigma 75 is an eight channel, high resolution, high accuracy scope. It offers 100 MS/s sample rate with 8-bit resolution.

Vertical

BANDWIDTH: (–3 dB)	DC coupled: DC to 25 MHz AC Coupled: 4 Hz to 25 MHz
BANDWIDTH LIMITS:	5 MHz, 500 kHz
SENSITIVITY RANGE:	5 mV/div to 20 V/div in a 1-2-5 sequence
RESOLUTION:	8-bit (1 in 256) 0.42% of Graticule Full Scale Deflection.
ZOOM:	2 to 50 in a 1-2-5 sequence
INPUT COUPLING:	AC-DC-GROUND
INPUTS:	8 channels: 1 MΩ, 28 pF 400 V pk Single ended, switchable to differential using channel pairs
Diff mode CMRR	- 60 dB
Diff mode CMV	Equal to measurement range
POSITION RANGE:	± 4 divisions
ACCURACY:	± 0.25% ± 1 LSB

Horizontal

TIMEBASE RANGE:	500 ns/div to 100 secs/div (External clock to 100 MHz)
MAX. SAMPLE RATE:	100 MS/s
GLITCH DETECT:	10 ns
RECORD LENGTH:	1 MS per channel
Cascading	2 MS or 4 MS per channel when using less channels
SEGMENTATION:	2 to 5000 memory segments. (100 word minimum segment size)
ZOOM:	x2 to x20,000
TIMEBASE ACCURACY:	± 25 ppm

Sigma 60

The Sigma 60 is a four channel scope. It offers 8-bit resolution and a 10-bit high-resolution mode.

Vertical

BANDWIDTH: (–3 dB)	
DC Coupled	DC to 200 MHz
AC Coupled	4 Hz to 200 MHz
HighRes mode	800 kHz
FILTERS:	20 MHz, 1 MHz
SENSITIVITY RANGE:	2 mV/div to 5 V/div in a 1-2-5 sequence
RESOLUTION:	8-bit (1 in 256)
	0.42% of Graticule Full Scale Deflection
HighRes mode:	10-bit (1 in 1024)
	0.1% of Graticule Full Scale Deflection
ZOOM:	2 to 50 in a 1-2-5 sequence
INPUT COUPLING:	AC-DC-GROUND
INPUTS:	4 channels: 1 MΩ, 9pF 400 V pk
INPUT OFFSET RANGE:	2 mV/div - 50 mV/div: 0.5 V
	100 mV - 0.5 V/div: 5 V
	1 V - 5 V/div: 50 V
POSITION RANGE:	± 12 divisions
ACCURACY:	
8-bit mode	± 1% ± 2 LSB all ranges except 2 mV and 5 mV
	± 1.5% ± 3 LSB - 2 mV and 5 mV ranges
10-bit mode	± 0.5% ± 6 LSB all ranges except 2 mV and 5 mV
	± 1.0% ± 8 LSB - 2 mV and 5 mV ranges

Horizontal

TIMEBASE RANGE:	50 ns/div to 100 secs/div (External clock to 200 MHz)
HighRes mode	20 μs/div to 100 secs/div (External clock to 500 kHz)
MAX. SAMPLE RATE:	200 MS/s on four channels transient HighRes mode: 2.5 MS/s
GLITCH DETECT:	5 ns (no Glitch detect in HighRes mode)
RECORD LENGTH:	200 k standard, 1 M option
Cascading:	400 k / 2 M or 800 k / 4 M per channel when using less channels
HighRes mode	Memory per channel is half of the memory in the 1 M option
SEGMENTATION:	2 to 5000 memory segments. (100 word minimum segment size)
ZOOM:	x2 to x4000 (x2 to x20,000 with 1 MS)
TIMEBASE ACCURACY:	± 25 ppm

Sigma 30

The Sigma 30 is a four channel 12-bit high resolution, high accuracy scope.

Vertical

BANDWIDTH:	(–3 dB)
DC Coupled	DC to 5 MHz
AC Coupled	4 Hz to 5 MHz
BANDWIDTH LIMITS:	500 kHz
SENSITIVITY RANGE:	5 mV/div to 20 V/div in a 1-2-5 sequence
RESOLUTION:	12-bit (1 in 4096) 0.025% of Graticule Full Scale Deflection
ZOOM:	2 to 50 in a 1-2-5 sequence
INPUT COUPLING:	AC-DC-GROUND
INPUTS:	4 channels: 1 MΩ, 28 pF 400 V pk Single ended, switchable to differential using channel pairs
Diff mode CMRR	-60 dB
Diff mode CMV	Equal to measurement range
POSITION RANGE:	± 4 divisions
ACCURACY:	± 0.25% ± 3 LSB

Horizontal

TIMEBASE RANGE:	5 µs/div to 100 secs/div (External clock to 10 MHz)
MAX. SAMPLE RATE:	10 MS/s
GLITCH DETECT:	100 ns
RECORD LENGTH:	200 k standard, 1 M option
Cascading:	400 k / 2 M or 800 k / 4 M per channel when using less channels
SEGMENTATION:	2 to 5000 memory segments (100 word minimum segment size)
ZOOM:	x2 to x4000 (x2 to x20,000 with 1 MS)
TIMEBASE ACCURACY:	± 25 ppm

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