OPERATOR'S MANUAL

MODEL 1275

16-CHANNEL
TIME STRETCHER

CE

LeCroy

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CE CONFORMITY

CONDITIONS FOR CE CONFORMITY

Since this product is a subassembly, it is the responsibility of the end user, acting as the system integrator, to ensure that the overall system is CE compliant. This product was demonstrated to meet CE conformity using a CE compliant crate housed in an EMI/RFI shielded enclosure. It is strongly recommended that the system integrator establish these same conditions.

CAUTION

COOLING

For optimal reliability, it is important that the Model 1275 Time Stretcher be well cooled. Be sure fans move sufficient air to maintain exhaust air temperature at less than 50° C.

INSTALLATION

“Hot” insertion (insertion with crate power turned on) of modules is not recommended in the present VME specification. Although, such a hot insertion does not represent a hazard to any of the components of the 1275, it is recommended that you install the 1275 with the power off.

SPECIFICATIONS

The information contained in this manual is subject to change without notice. The reference for product specification is the Technical Data Sheet effective at the time of purchase.

ELECTROSTATIC SENSITIVITY

Both the motherboard and the sixteen daughter cards use bipolar circuitry exclusively, and as such, can be handled without special precautions regarding electrostatic discharge phenomena.

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GENERAL INFORMATION

PURPOSE

This manual is intended to provide instruction regarding the setup and operation of the LeCroy Model 1275 Time Stretcher. In addition, it describes the theory of operation and presents other information regarding its functioning and application.

UNPACKING AND INSPECTION

It is recommended that the shipment be thoroughly inspected immediately upon delivery. All material in the container should be checked against the enclosed Packing List and shortages reported promptly. If the shipment is damaged in any way, please notify the Customer Service Department or the local field service office. If the damage is due to mishandling during shipment, you may be requested to assist in contacting the carrier in filing a damage claim.

WARRANTY

LeCroy warrants its instrument products to operate within specifications under normal use and service for a period of one year from the date of shipment. Component products, replacement parts, and repairs are warranted for 90 days. This warranty extends only to the original purchaser. Software is thoroughly tested, but is supplied "as is" with no warranty of any kind covering detailed performance. Accessory products not manufactured by LeCroy are covered by the original equipment manufacturers' warranty only.

In exercising this warranty, LeCroy will repair or, at its option, replace any product returned to the Customer Service Department or an authorized service facility within the warranty period, provided that the warrantor's examination discloses that the product is defective due to workmanship or materials and has not been caused by misuse, neglect, accident or abnormal conditions or operations.

The purchaser is responsible for the transportation and insurance charges arising from the return of products to the servicing facility. LeCroy will return all in-warranty products with transportation prepaid.

This warranty is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract, or otherwise.

PRODUCT ASSISTANCE

Answers to questions concerning installation, calibration, and use of LeCroy equipment are available from the Customer Service Department, 700 Chestnut Ridge Road, Chestnut Ridge, New York, 10977-6499, (914) 578-6030.

MAINTENANCE AGREEMENTS

LeCroy offers a selection of customer support services. For example, Maintenance Agreements provide extended warranty that allows the customer to budget maintenance costs after the initial warranty has expired. Other services such as installation, training, on-site repair, and addition of engineering improvements are available through specific Supplemental Support Agreements. Please contact the Customer Service Department for more information.

DOCUMENTATION DISCREPANCIES

LeCroy is committed to providing state-of-the-art instrumentation and is continually refining and improving the performance of its products. While physical modifications can be implemented quite rapidly, the corrected documentation frequently requires more time to produce. Consequently, this manual may not agree in every detail with the accompanying product and the schematics in the Service Documentation. There may be small discrepancies in the values of components for the purposes of pulse shape, timing, offset, etc., and, occasionally, minor logic changes. Where any such inconsistencies exist, please be assured that the unit is correct and incorporates the most up-to-date circuitry.

SOFTWARE LICENSING AGREEMENT

Software products are licensed for a single machine. Under this license you may:

- Copy the software for backup or modification purposes in support of your use of the software on a single machine.
- Modify the software and/or merge it into another program for your use on a single machine.
- Transfer the software and the license to another party if the other party accepts the terms of this agreement and you relinquish all copies, whether in printed or machine readable form, including all modified or merged versions.

SERVICE PROCEDURE

Products requiring maintenance should be returned to the Customer Service Department or authorized service facility. If under warranty, LeCroy will repair or replace the product at no charge. The purchaser is only responsible for the transportation charges arising from return of the goods to the service facility. For all LeCroy products in need of repair after the warranty period, the customer must provide a Purchase Order Number before any inoperative equipment can be repaired or replaced. The customer will be billed for the parts and labor for the repair as well as for shipping. All products returned for repair should be identified by the model and serial numbers and include a description of the defect or failure, name and phone number of the user. In the case of products returned, a Return Authorization Number is required and may be obtained by contacting the Customer Service Department at (914) 578-6030.

PRODUCT DESCRIPTION

INTRODUCTION

The LeCroy Model 1275 is a 16 channel high precision time stretcher, packaged in the 9U VME format. It was designed for time-of-flight detectors in nuclear and particle physics experiments that require picosecond timing resolution.

The 1275 latches input timing pulses to a free-running clock. The time difference between the arriving pulse and a subsequent clock edge defines a *direct* or *raw* pulse width. This time is stretched internally by a factor of about 20, forming a *stretched* pulse. These two pulses are assembled into an output pulse train. The edges in this pulse train can then be measured by a LeCroy multihit TDC (e.g., the Models 3377, 1877S, and VT960) to a resolution of 500 ps; the direct pulse width is then calculated by dividing the stretched pulse width (via the TDC data) by the stretch factor, to a resolution of about 25 ps. The stretch ratio can be calibrated from the data itself.

GENERAL DESCRIPTION

The 1275 Time Stretcher consists of 16 STT100 time-stretcher daughtercards, which feature a stretch ratio of 20 and a clock frequency of 61.5 MHz. It derives its supply currents from the VME connectors, but does not respond to any address on the VME bus. A power-supply connector area is available for power supplied from external power supplies, if stand-alone operation is desired.

All 1275 inputs are differential ECL (dECL) and are terminated by a balanced impedance matching network. Similarly, all outputs are buffered, producing dECL signals to avoid external disturbances to upset the precision of the time stretching. The 1275 can operate using either an external clock provided via a dECL input, an external clock provided via a NIM-standard coaxial cable (SMA connector), or the 61.5 MHz internal clock.

For each positive-going input edge, occurring at a time t_0, at one of its inputs, the time stretcher generates four transitions (two pulses), at the following times, see Figure 1 (note: the figure is not to scale; it does not illustrate a stretch factor of 20).

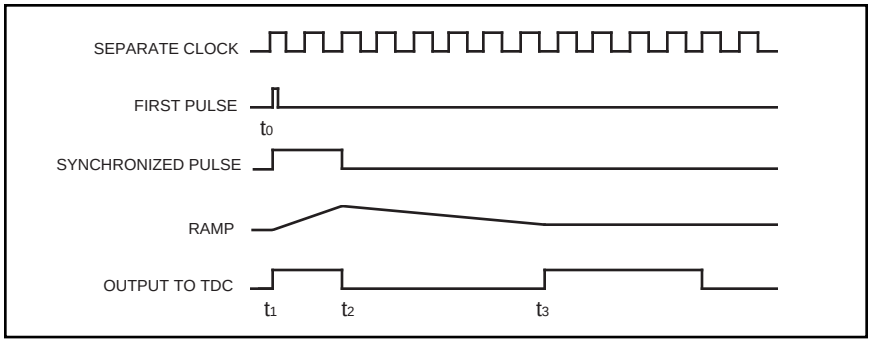

Figure 1: Long time base stretcher.

1. One positive-going edge at a fixed delay after the input's positive edge. Let's call t_1 the time at which this first, positive-going edge occurs.

2. One negative-going edge at the second next positive-going transition of the clock. Let's call t_2 the time at which this second transition occurs.

3. Another positive-going transition after the stretched time has elapsed after the clock tick. Let's call t_3 the time of this third transition.

4. Another negative-going edge at the second edge after the stretched time. This fourth transition is not designed to be used to measure time.

Note: The polarity of these edges are output on the (+) side of the output connector, which is on the right hand side.

The following then holds:

$t_1 = t_0 + \Delta$ where Δ is a very small propagation delay

$T < t_2 - t_1 < 2T$ where T is the clock period.

$t_3 - t_2 = \mathcal{S} . (t_2 - t_1)$ where $\mathcal{S}$ is the stretch ratio and is a constant close to 20.

SPECIFICATIONS

Please refer to the Model 1275 technical data sheet in the front of this manual for a complete summary of all relevant specifications.

FRONT PANEL

The 1275's front panel provides connectors for system integration and LEDs to indicate the module status. Cables necessary for proper installation can be purchased from LeCroy. See Installation Section for more information regarding cabling.

Displays

Sixteen colored LEDs reside on the front panel of the 1275 to indicate the status of operations.

First row (internal power, clock selection):

-9V: This yellow LED indicates the status of the internally-regulated -9 V.

+9V: This red LED indicates the status of the internally-regulated +9 V.

A: This green LED indicates the status of "A". When A is ON, an external reference clock is selected.

B: This red LED indicates the status of "B". When B is ON, the chosen external reference clock is the clock fed via the SMA connector.

Second row (V_{EE} = -5.2 V):

1: This yellow LED displays the status of V_{EE} for the first row of daughter cards (numbered CHANNEL 1,2,3,4).

2: This red LED displays the status of V_{EE} for the second row of daughter cards (numbered CHANNEL 5,6,7,8).

3: This green LED displays the status of V_{EE} for the third row of daughter cards (numbered CHANNEL 9,10,11,12).

4: This red LED displays the status of V_{EE} for the fourth row of daughter cards (numbered CHANNEL 13,14,15,16).

Third row (miscellaneous supply status):

-12: This yellow LED indicates the status of the -12 V power supply.

+12: This red LED indicates the status of the +12 V power supply.

-5: This green LED indicated the status of the -5.2 V power supply on the ECL logic of the board.

+5: This red LED indicated the status of the +5 V power supply.

Fourth row (V_{TT} = -2.0 V):

1: This yellow LED displays the status of V_{TT} for the first row of daughter cards (numbered CHANNEL 1,2,3,4).

2: This red LED displays the status of V_{TT} for the second row of daughter cards (numbered CHANNEL 5,6,7,8).

3: This green LED displays the status of V_{TT} for the third row of daughter cards (numbered CHANNEL 9,10,11,12).

4: This red LED displays the status of V_{TT} for the fourth row of daughter cards (numbered CHANNEL 13,14,15,16).

Inputs

All front-panel inputs to the 1275 are differential ECL compatible with the ECLine standard. In the quiescent state, the “+” input is at least 200 mV more negative than the “-” input. Each pair of differential inputs is terminated with an effective 112 ohms.

All inputs corresponding to the times to be stretched are received via the 34-pin connector. A 3M connector type 3414-6034 will mate with the TDC header and provide strain relief. Pin 33 and pin 34 are ground.

Clock Inputs

EXT CLK : A dECL input used to receive the external reference clock.

EXT / CLK : An SMA connector used to receive the clock as a NIM signal on a special coaxial cable.

Front Panel Jumper Options

Above the CLK input, are four pin pairs used for clock selection.

A = 0 : A jumper in this position selects the INTERNAL 61.5 MHz clock.
A = 1 : A jumper in this position selects the EXTERNAL clock input.
B = 0 : A jumper in this position selects the dECL External Clock input.
B = 1 : A jumper in this position selects the NIM External Clock input.

With no jumpers attached, the 1275 will default to Internal Clock operation.

Outputs

The output signals containing the stretched times are driven out on a 34-pin connector. A 3M connector type 3414-6034 will mate with the TDC header and provide strain relief. Pin 33 is connected to circuit ground, and pin 34 is connected to chassis ground. The circuit ground and the chassis ground are connected to each other on the printed circuit board through 100 ohms. The inputs are numbered from bottom to top in ascending order.

The right hand side of the output connector is the (+) output of the dECL pair. The output pulse train is described in the General Description section of this chapter.

INSTALLATION

GENERAL

The LeCroy Model 1275 Time Stretcher is intended for use within a 9U VME crate with the VIPA “hard metric P0” back plane, with the following voltage sources properly connected to the back plane: +5.0 V, -5.2 V, -2.0 V, +12.0 V, and -12.0 V.

JUMPER SETTINGS

Install front panel jumpers to configure the 1275 for Internal or External (dECL or NIM) operation, as described in the Product Description chapter.

CABLES

The use of twisted-pair cables generally results in lower cabling costs and typically higher density and is usually adequate for digital signals. Thus, the 1275 was designed to accept 34 conductor ribbon cable. If using twisted-pairs, care should be taken to install high quality, shielded cables to minimize the effects of noise and crosstalk. Many of these cables can be purchased from LeCroy. In particular, there are two types of 34 conductor multiwire cables available; one for short connections using flat cable, and the second for long connections using twisted and flat ribbon cable.

The polarity of the connector is uncommon, so care should be taken to avoid inserting the cable connector upside down.

The model numbers of such cables are as follows:

STC-DC/34/L - flat multiwire cable for short interconnections.

LTC-DC/34-L or DC2 /34-L - twisted-pair multiwire cable for long interconnection.

STP-DC/02-L - single twisted-pair cable, 3 ft maximum length

NOTE: The L is the length in feet that must be specified by the user.

All inputs are differential ECL and terminated by 112 ohms. The terminations are SIP components and may be easily replaced to accommodate other characteristic impedances.

GENERAL

The 1275 has no VME functionality, and does not respond to VME addressing. The module is always enabled to deliver outputs, and only needs a clock source selected to work properly when powered.

CLOCK SELECTION

Front panel jumpers locations are used to select internal vs. external clock (NIM or dECL), as described in the Product Description chapter.

CALIBRATION OF STRETCH FACTORS

The STT100 daughter cards are designed to stretch the direct pulse by a nominal factor of 20. For precision timing, this value should be calibrated. One feature of the Time Stretcher architecture is that the calibration can be accomplished by an analysis of the 1275 output signals by a multihit TDC, such as the LeCroy 3377 (CAMAC), 1877S (FASTBUS), or VT960 (VIPA/VME). These signals must be random with respect to the clock of the 1275. When the 1275 operates using its internal clock, output signals will meet this requirement.

The distribution of the stretched times as a function of direct times can be used to precisely determine the stretch ratio. A least-squares fit can typically be used to extract the Time Stretcher calibration constants. Figure 2 shows a sample scatter plot, with stretched times along the X axis and direct times along the Y axis.

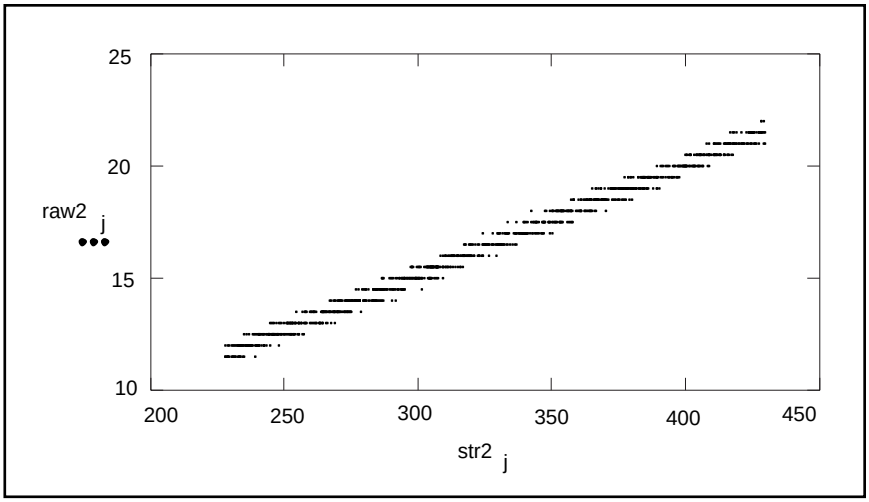

Figure 2: A plot of the raw (or direct) time versus the stretched time.

For the integration in a high time-precision measurement, the 1275 must be cabled to avoid excessive jitters. Also note that to exploit the vernier technique used inside the 1275, an external reference clock must have an excellent stability (such as the stability provided by Quartz resonators). The reference edges during the measurement of a relatively long time may be difficult to determine.