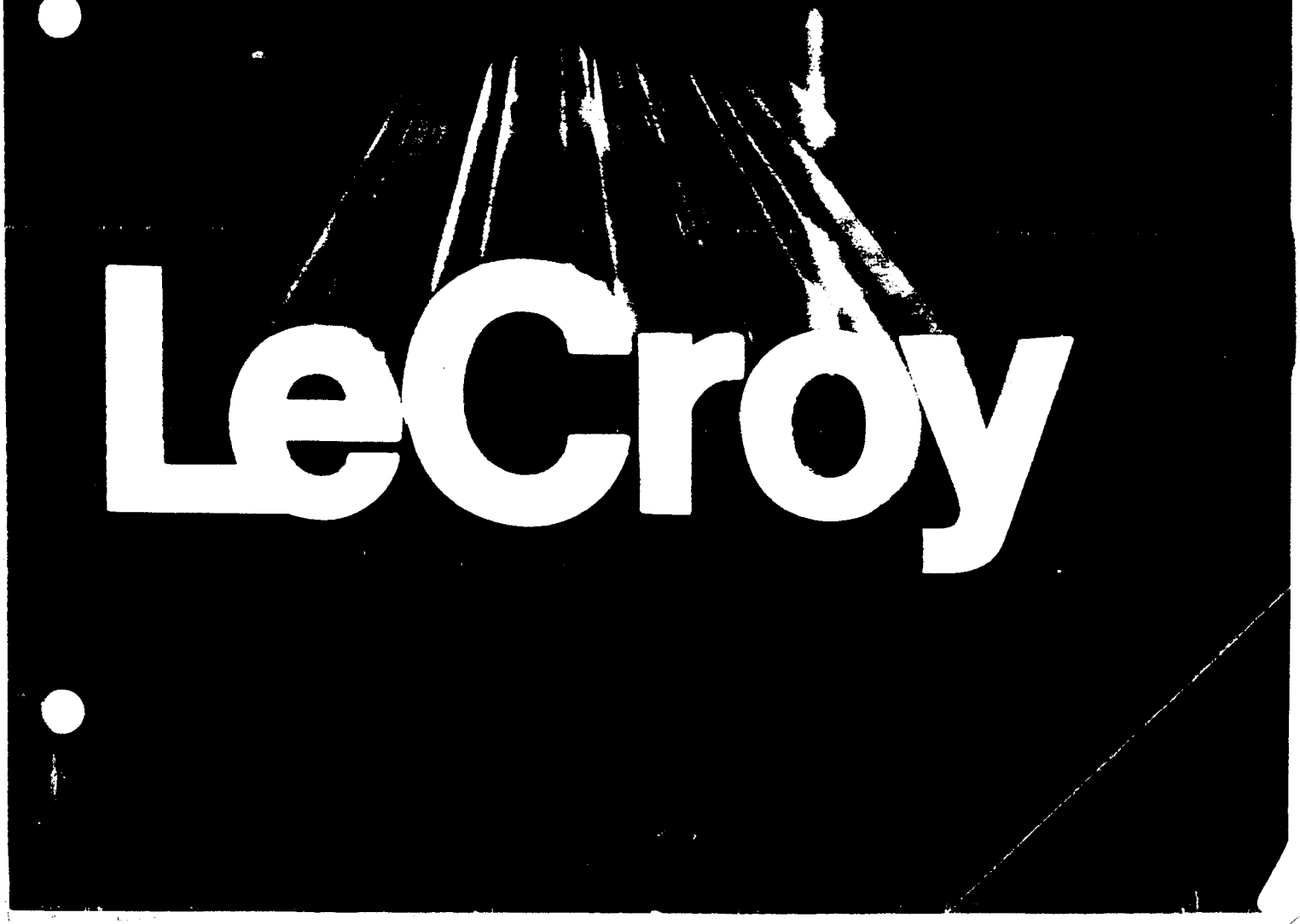
CAMAC ECLine
MODEL 4418
16 CHANNEL, PROGRAMMABLE
LOGIC DELAY/FAN-OUT
USER'S MANUAL



WARRANTY

LeCroy Research Systems warrants its instrument and software products to operate within specifications under normal use and service for the period of one year from date of shipment. Custom monolithics and hybrids sold separately and all spare or replacement parts and repairs are warranted for 90-days. This warranty extends only to the original purchaser and shall not apply to fuses, magnetic recording media, disposable batteries, or any equipment not manufactured by the company. All non-LeCroy products are provided with the original equipment manufacturer's warranty, which is typically 90-days from the date of shipment.

In exercising this warranty, LeCroy will repair or, at its option, replace any product returned to the factory 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. If the failure has been caused by misuse, neglect, accident, or abnormal conditions or operations, repairs will be billed at a nominal cost. In such cases, an estimate will be submitted before work is started.

The purchaser is responsible for the transportation charges arising from the return of products to the factory or authorized service 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 Research Systems shall not be liable for any special, incidental, or consequential damages, whether in contract, or otherwise.

POST WARRANTY REPAIRS

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.

RETURN PROCEDURE

To determine your nearest authorized service facility, contact the factory or your local field office. 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, and, in the case of products returned to the factory, a Return Authorization Number (RAN). The RAN may be obtained by contacting the Customer Services Department at 914-425-2000.

Return shipments should be made prepaid. LeCroy will not accept C.O.D. or Collect Return shipments. Air-freight is generally recommended. Wherever possible, the original shipping carton should be used. If a substitute carton is used, it should be rigid and be packed such that the product is surrounded with a minimum of four inches of excelsior or similar shock-absorbing material. In addressing the shipment, it is important that the Return Authorization Number be displayed on the outside of the container to insure its prompt routing to the proper department within LeCroy.

INITIAL INSPECTION

It is recommended that the shipment be thoroughly inspected immediately upon delivery to purchaser. All material in the container should be checked against the enclosed Packing List. LeCroy cannot accept responsibility for shortages in comparison with the Packing List unless notified promptly. If the shipment is damaged in any way, please contact the factory or local field office immediately.

DOCUMENTATION DISCREPANCIES

LeCroy Research Systems is committed to providing state-of-the-art instrumentation. As a result, the Engineering Department at LeCroy is continually refining and improving the performance of 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 unit. 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.

APPLICATIONS ASSISTANCE

Answers to questions concerning the installation, calibration, and use of LeCroy equipment are available from the Customer Services Department, LeCroy Research Systems Corp., 700 South Main Street, Spring Valley, New York, telephone 914-425-2000, or your local field sales office.

A T T E N T I O N

CRATE POWER SHOULD BE TURNED OFF DURING INSERTION AND REMOVAL OF UNIT TO AVOID POSSIBLE DAMAGE CAUSED BY MOMENTARY MISALIGNMENT OF CONTACTS.

SEE POCKET IN BACK OF MANUAL FOR SCHEMATICS, PARTS LIST ADDITIONAL ADDENDA WITH ANY CHANGES TO MANUAL.

A T T E N T I O N

CAMAC ECLine Model 4418
16-Channel Programmable Logic Delay/Fan-Out

- **High density:** 16 independent delay lines in a single-width CAMAC module.
- **Programmable:** full CAMAC control features permit computerized timing adjustment.
- **Low cost:** per-channel cost significantly lower than for conventional non-programmable delay units.
- **Solid-state reliability:** no switches, no relays, no faulty contacts.
- **Deadtimeless:** specially designed passive delay lines operate at frequencies above 100 MHz.
- **Power-off memory:** internal supply maintains delay settings for several hours when CAMAC crate power goes down.
- **Fan-out capability:** triple outputs provide fan-out of 3 per channel.

The new generation of high energy physics experiments, involving extremely high counting rates and/or large detector arrays, requires a "total system" approach to instrumentation. LeCroy's new CAMAC 4000 Series of ultra-fast, high-density programmable instrumentation modules provides the solution to this requirement by allowing the experimenter to achieve full computer control of the data acquisition system within a single instrumentation standard.

For the first time in a single-width CAMAC module, the new LeCroy ECLine Model 4418 Logic Delay/Fan-Out combines the advantages of unprecedented 16-channel density, computer programmability, and deadtimeless solid-state reliability—all at a lower per-channel cost than conventional "delay boxes"!

The 16 independent delay lines, each with a fan-out of three, are individually programmable via CAMAC in steps of one or two nanoseconds (other options available for large quantities). Power supply backup ensures that delay settings are retained even when CAMAC crate power goes down. The use of ECL gates instead of mechanical switches and relays eliminates the reliability problems associated with conventional delay boxes. Because all delay components are passive, deadtimeless operation up to 100 MHz and above is ensured.

CAMAC control of delay lines permits computerization of such routine tasks as coincidence curve-taking, one of the main uses of delay units. The Model 4418 is compatible with all other LeCroy ECLine CAMAC modules.

Innovators in Instrumentation

LeCROY RESEARCH SYSTEMS SA • 101 ROUTE DU NANT D'AVRIL • 1217 MEYRIN 1-GENEVE SUISSE
TELEX: 28230 TELEPHONE: (022) 82 33 55

SPECIFICATIONS
CAMAC Model 4418
16-CHANNEL PROGRAMMABLE LOGIC DELAY/FAN-OUT

INPUT CHARACTERISTICS

Number of Inputs:	16; all identical. 100 Ω direct-coupled; high impedance by simple user option. Reflections < 10% for complementary ECL signals of 2 nsec risetime. Minimum width: 5 nsec.
Input Sensitivity:	±200 mV differential.

OUTPUT CHARACTERISTICS

Complementary Outputs:	Three per channel. ECL levels (−0.8 and −1.7 V). Capable of driving 100 Ω twisted pair cable. Duration equal to input pulse duration ±1 nsec (4418/16) or ±1.2 nsec (4418/32). Risetimes and falltimes, 2.5 nsec into 100 Ω termination.

CAMAC COMMANDS

X, Q:	An X and Q-response are generated when a valid N, A, F command is recognized.
F16•(A0 to A15):	Load delay time setting on write lines W1 to W4. One subaddress for each channel.

GENERAL

Double-Pulse Resolution:	<10 nsec.
Maximum Rate:	>100 MHz.
Input-Output Delay:	(15±1) nsec +(0-15) nsec in steps of 1 nsec, option 4418/16. +(0-30) nsec in steps of 2 nsec, option 4418/32.
Precision on total delay increment:	± 1 nsec, option 4418/16. ± 2 nsec, option 4418/32.
Precision of Step Increment:	Total delay/15 ± 300 psec, option 4418/16. Total delay/15 ± 500 psec, option 4418/32.
Power Requirements:	+ 6 V at 50 mA. − 6 V at 2.5 A.
Power Off Memory:	2 hours min. (typical 10 hours).
Crosstalk:	If adjacent channels get synchronous pulses, then the measured channel can be affected by ± 1 nsec; typical.

LONG RANGE OPTION

Double-Pulse Resolution:	<30 nsec.
Maximum Rate:	>35 MHz.
Input-Output Delay:	(15±1) nsec +(0-120) nsec, option 4418/128.
Precision on total delay increment:	± 8 nsec.
Precision of step increment:	Total delay/15 ± 2.5 nsec.
Minimum Input Width:	>25 nsec.
Output Width:	Equal to input width ±4 nsec.

SPECIFICATIONS SUBJECT TO CHANGE

72 561

CAMAC MODEL 4418

16-CHANNEL PROGRAMMABLE LOGIC DELAY/FAN-OUT

1) INTRODUCTION

The CAMAC Model 4418 is basically a delay for digital signal characterized by programmability, high density, high speed operation and high fan-out.

The unit is conceived as sixteen identical channels, each of them accepting one input and providing three outputs.

Programmability concerns the possibility of selecting the required delay value per channel. Even if the basic module features a time span of 30 nsec and 16 delay steps of 2 nsec, other time spans can be provided on customer request, i.e.:

15 nsec in steps of 1 nsec;
120 nsec in steps of 8 nsec.

The last time span was not included in the original data sheet, it has been introduced indeed only later.

2) CIRCUIT DESCRIPTION

Looking at the detailed circuit diagram, the following should be noted.

The differential ECL input pulses are terminated on 2 x 56 resistors. These terminations are mounted on SIL sockets and they can be easily removed then if high input impedance is desired.

The input pulses are then received by a line receiver 10115 the output of which, after an interconnection by twisted pair cables, goes in parallel to two AND gates 10104. Only one of these two gates at the time is enabled so that the incoming pulse is either sent to the beginning of the following delay line (pin 2) or to its middle point (pin 10).

The choice of the delay is made setting four bits, out of which three are used to set one of 8-line multiplexer (10164) and the last one (MSB) to choose the origin of the delay line.

The four bits for delay are set via CAMAC and stored in a MOS memory (74C173). Due to the low power consumption of this memory, the memory contents can be kept for few hours also in case of power failure. In that case indeed and for the time specified, the power is provided by the set of capacitors in parallel to the -M voltage.

3) TIMING CONSIDERATIONS

Beside the programmable time span, a channel presents a constant input to output delay which has to be always added. This constant delay is slightly dependent from the particular channel and from the particular output chosen and it is $Tc = (15 \pm 1)$ nsec.

Even if the output timing is guaranteed to be a monotonic function of the programmed step, though the user should be aware of the possible non-linearity.

The following table summarizes the main timing characteristics:

MODEL	FULL RANGE FR (nsec)	STEP (nsec)	STEP PRECISION	OUT WIDTH DISPERSION (±) (nsec)	MAX.FREQUENCY (MHz)
4418	15±1	1	FR/15±300psec	1	100
4418/100	30±2	2	FR/15±500psec	1.2	100
4418/200	37.5±2.5	2.5	FR/15±600psec	1.2	100
4418/300	120±8	8	FR/15±2.5nsec	4	35

The following remarks apply:

- the quoted non-linearity has two components, the first one reflects a systematic uncertainty due to the precision in manufacturing, the second one expresses the random uncertainty on each step.
- the output width dispersion reflects on the contrary the degradation of rise and fall time of pulses travelling into the delay lines. The width variation will be then more apparent for longer delay.
- another effect which can influence the fixed delay, is the crosstalk mainly provocated by adjacent channels. This effect is in principle independent from the particular delay range, because it is due to the geometrical properties of the printed board. This effect has been measured to be typically of the order of ±1 nsec.

POSSIBILITY OF CASCADING MODULES

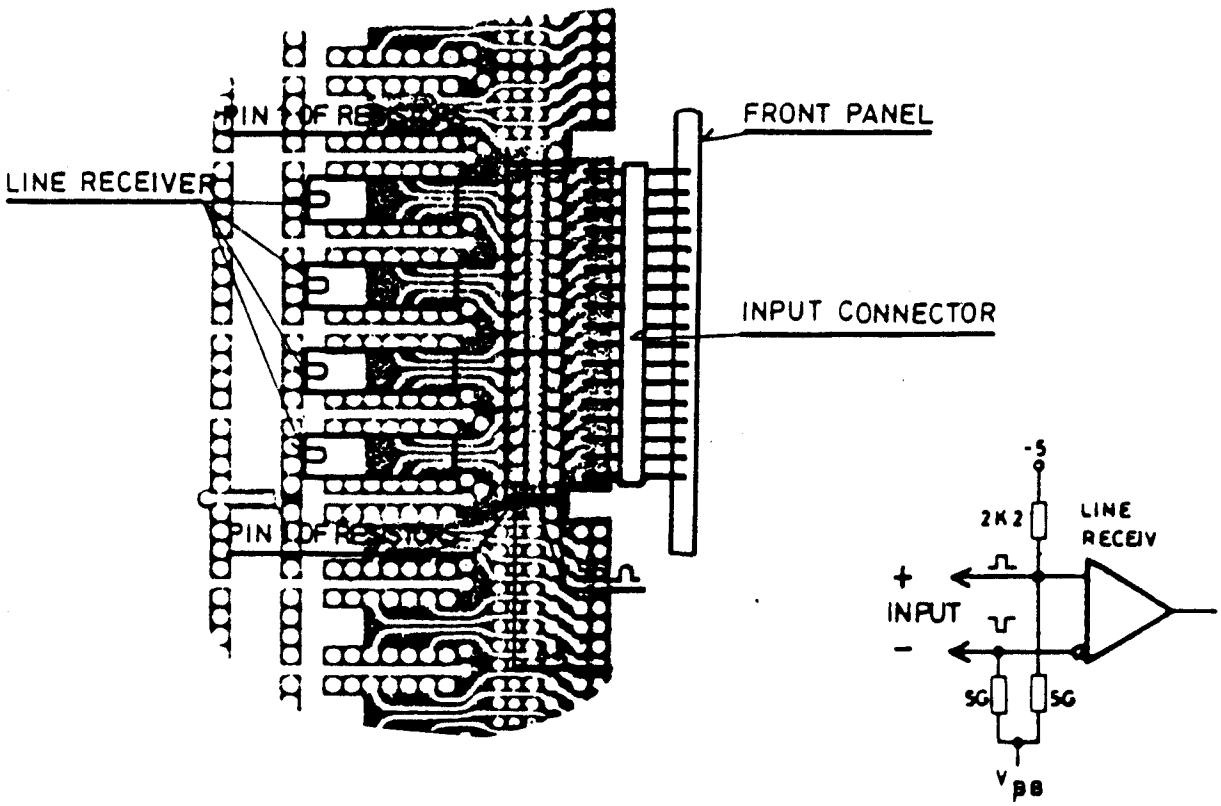
All differential ECL inputs, in ECLine modules, are terminated inside the module by two 56 ohms resistors to VBB, realizing a differential matching impedance of 112 ohms.

The input terminations are included in socket mounted, single in line resistor arrays, which can be removed if more than one unit have to be cascaded on the same driving cable. In this case, only the last unit in the daisy chain must be terminated for proper operation. (For more details see also the ECLine Application Note).

Figures below show the standard input stage of an ECLine module and the lay-out on the board.

WARNING : The resistor arrays are not symmetrical and they must be mounted in the proper way.

LOCATION OF INPUT TERMINATOR



ECL CABLES

Interconnections between different ECLine modules, for transmission of different ECL pulse pairs, can be made either by multiwire cables or by single twisted pair cables for one to one connections.

Such interconnecting cables can be purchased by LeCROY and in particular, as multiwire cables, two types are available, one for short connections using just flat cable, the second one for long interconnections using twisted and flat ribbon cable.

The denomination of such cables is as follows :

- STC-DC/34-LL Multiwire cable for short interconnections
- LTC-DC/34-LL Multiwire cable for long interconnections
- STP-DC/02-LL Single twisted pair cable.

Where LL is the cable length in feet which should be specified by the customer.