

NSCL-ELECTRONIC

**CAMAC ECLine
MODEL 4516
16 CHANNEL, 3 FOLD
PROGRAMMABLE LOGIC UNIT**

USER'S MANUAL

June 1982

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 LISTS AND ADDITIONAL ADDENDA WITH ANY CHANGES TO MANUAL.

A T T E N T I O N

INTRODUCTION

The CAMAC Model 4516 is a logic unit characterised by high density, programmability and high speed operation. Its particular design makes the unit flexible for a large variety of applications, some of which will be discussed later. The unit is conceived as sixteen identical channels each of them accepting three inputs and providing one output.

Programmability concerns the possibility of selecting the logic function required on the three inputs, out of any combination of AND and OR.

The bloc diagram in the following figure, shows the principle of the circuit.

The output of each channel can be vetoed (or strobed) by a common pulse. The 16 outputs are also grouped in groups of eight to build two eightfold OR which, also can be strobed by the general strobe pulse.

CAMAC ECL_{inE} Model 4516 16-Channel, 3-Fold Programmable Logic Unit

- **High density:** 16 channels in a single-width CAMAC module.
- **High input rate:** > 150 MHz capability.
- **100 Ω or high-impedance complementary ECL inputs:** (user-option) permit reuse of inputs in subsequent logic.
- **Complementary ECL outputs:** differentially drive flat, twisted-pair cable.
- **Programmable "AND/OR" functions:** permit all combinations of 3-fold logic.
- **Common Veto facility:** minimum width 3.5 nsec for low system downtime.
- **Common "OR" output:** useful for fast, unrefined triggers.
- **CAMAC packaging:** higher density, better cooling, ease of remote control.

The LeCroy Model 4516 is a high-speed, multichannel 3-fold coincidence unit designed to provide the flexibility of full CAMAC system control and general-purpose logic functions to meet a wide range of coincidence requirements in modern particle physics experiments. Oriented toward large trigger logic use, the 4516 offers low cost and high density, exceptionally high speed with low complexity, and local or remote programmability of logic functions. It is designed to be directly compatible with its companion module, the LeCroy Model 4416 16-channel discriminator.

Low-Cost/High Density

The 4516 offers significant savings over conventional NIM logic units. Packaged 16 channels to a single-width CAMAC module, it not only costs less per channel, but also occupies substantially less rack space and decreases the cost of associated cabling and power supply hardware.

The high density of the 4516 is made possible by the extensive use of ECL, by the use of cable headers designed to mate with 16-channel twisted pair flat cable, and by the implementation of the CAMAC standard. Lemo connectors for the common Veto and the OR outputs are located on the rear panel to conserve front panel space. Use of the CAMAC standard permits high density by providing increased power with adequate cooling to maintain reliable operation.

High Speed/Low Complexity

With a minimum coincidence width of only 3.5 nsec, the Model 4516 is perfectly compatible with the Model 4416 discriminator and all other LeCroy ECL_{inE} CAMAC modules. This permits high trigger efficiency through low system downtime. Use of ECL logic elements permits coincidence decisions in excess of 150 MHz.

December 1982

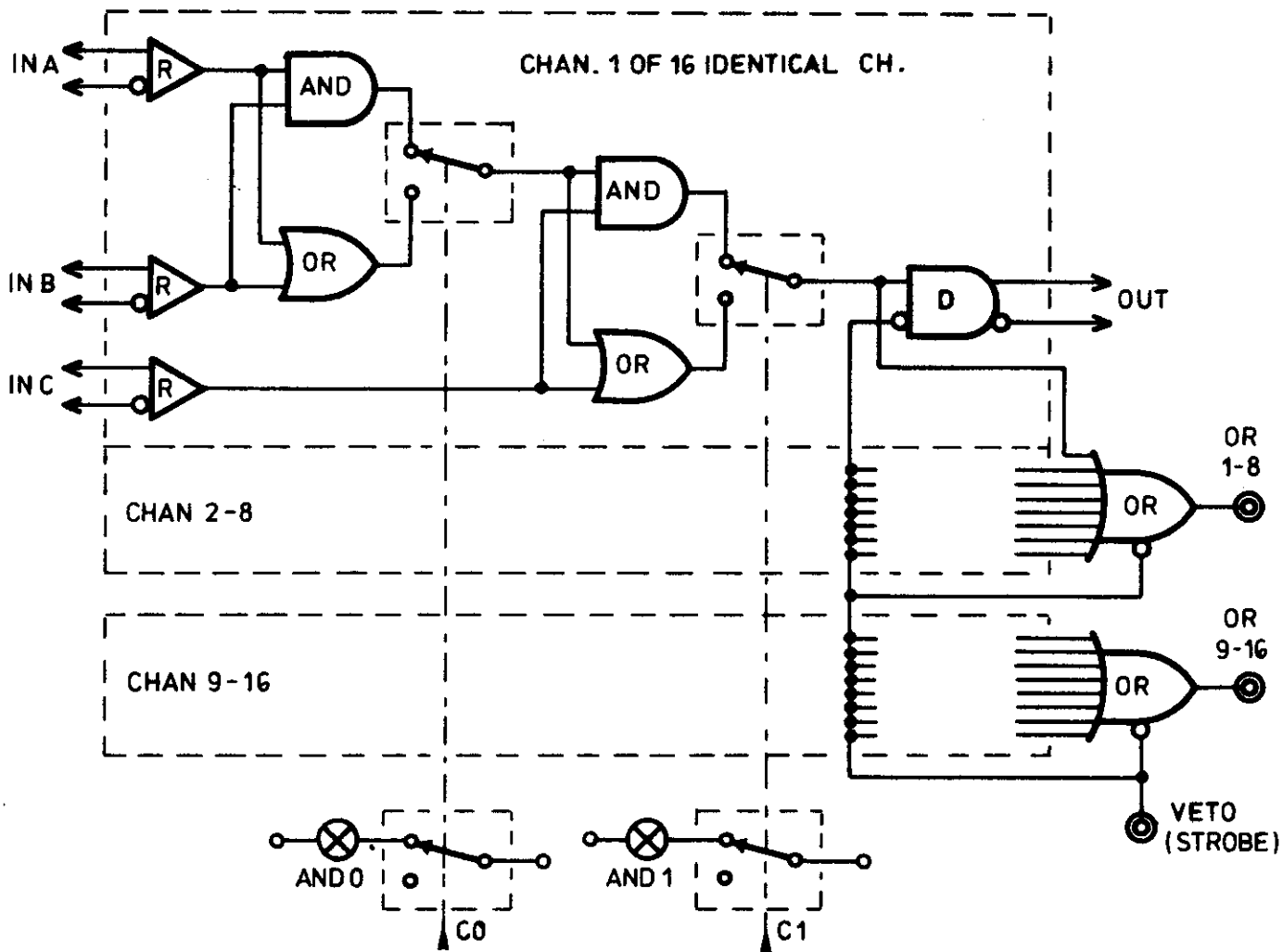
Innovators in Instrumentation

The complementary ECL outputs of each 4516 channel are designed for use with inexpensive, flat twisted-pair cables, allowing fast and accurate system interconnection. The low parts count resulting from the elimination of the usual ECL-to-NIM conversion stage yields low cost and high reliability. Output durations are equal to the coincidence overlap. Convenience of use is also made possible by ECL-level inputs, which can either receive and terminate incoming signals in 100 Ω , or receive and pass on incoming signals off a high impedance for further logic or scaler use.

Local Or Remote Programmability of Logic Functions

Two rear-panel switches determine whether the 4516 is in Local or Remote Mode. In the Local Mode, manual and/or selection of logic gates 0 and 1 is made via these 2 rear-panel switches. In the Remote Mode, this selection is made via CAMAC command if the rear panel control switches are in center position (AND/REMOTE/OR). Front-panel LED's indicate the logical AND status, of C0 and C1 which are common to all channels.

The Model 4516 can be programmed to perform the functions of single 48-fold or triple 16-fold fan-in, and any combination of AND or OR logic. This ability to achieve a variety of logic functions and to redistribute the input signals via high impedance to subsequent units for other logic purposes makes the Model 4516 a convenient and generally useful component of today's demanding trigger systems.



SPECIFICATIONS

CAMAC Model 4516

16-CHANNEL, 3-FOLD PROGRAMMABLE LOGIC UNIT

INPUT CHARACTERISTICS

Number of Channels: 16, all identical.

Logic Inputs: 3, 100 Ω direct-coupled; high impedance by simple user option. Reflections < 10% for complementary ECL signal of 2 nsec risetime.

Veto: Rear-panel connector. Permits simultaneous gating of all channels. 50 Ω ; requires NIM-level signal (> -600 mV) direct-coupled. Must overlap coincidence of the 3 front panel inputs by a minimum of 5 nsec.

OUTPUT CHARACTERISTICS

Complementary Output: One per channel. ECL level (-0.8 and -1.6 V). Capable of driving 100 Ω twisted-pair cable. Duration equal to input overlap. Risetimes and falltimes 2.5 nsec into 100 Ω termination.

OR Output: Two rear-panel connectors. Negative-going voltage output at NIM level. Width is identical to the coincidence overlap.

CAMAC COMMANDS

X: An X-response is generated when a valid N,A,F command is recognized.

Z: Sets all channels to OR Mode.

F26·A0: Sets all C0's to AND Mode.

F24·A0: Sets all C0's to OR Mode.

F26·A1: Sets all C1's to AND Mode.

F24·A1: Sets all C1's to OR Mode.

F27·A0: Gives a Q-response if C0 switch is in AND Mode.

F27·A1: Gives a Q-response if C1 switch is in AND Mode.

GENERAL

Logic Functions: Fan-in (3 X 16-fold and 1 X 48-fold), and any combination of AND and OR coincidence.

Maximum Rate: 150 MHz input and output.

Coincidence Width: 3.5 nsec up, determined by input pulse duration.

Double-Pulse Resolution: Less than 5 nsec at minimum input width.

Input-Output Delay:

A or B to OUT	11 nsec typical
A or B to OR	12 nsec typical
C to OUT	8 nsec typical
C to OR	9 nsec typical
Veto to OUT	8 nsec typical
Veto to OR	6 nsec typical

Power Requirements: +6 V at 50 mA
-6 V at 1.25 A

Note: As a factory option, it is possible to replace the two 1-8 and 9-16 OR outputs by two 1-16 OR outputs.

SPECIFICATIONS SUBJECT TO CHANGE

CIRCUIT DESCRIPTION

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

The differential ECL input pulses are terminated on $2 \times 56 \Omega$ resistors. This termination is mounted on SIL sockets and it is easily removed if high input impedance is desired.

The input pulses are then accepted by a line receiver 10115, the output of which goes, through a 110Ω resistor, to a 220Ω termination, before entering the next line receiver. The point between the 110Ω and 220Ω resistors is where channels A and B meet together. The voltage drop on the 220Ω resistor will then be proportional to the number of coincident inputs. That is, the voltage drop, when both the A and B channels are receiving a pulse, will be twice as much as if only channel A or channel B were receiving a pulse.

The discrimination at the level of the second line receiver (for instance IC 20 for the first logic channel) will allow then the choice between an AND function and an OR function.

The discrimination level is applied for instance on pin 13 of IC20. The level is generated by an operational amplifier (IC 27) sensible in input to a voltage level correlated to a TTL logic level COR 0. The latter can be generated either by manual operation (rear panel three position switch), or by remote control through the CAMAC functions $F(26)*A(0)$ for AND mode and $F(24)*A(0)$ for OR mode.

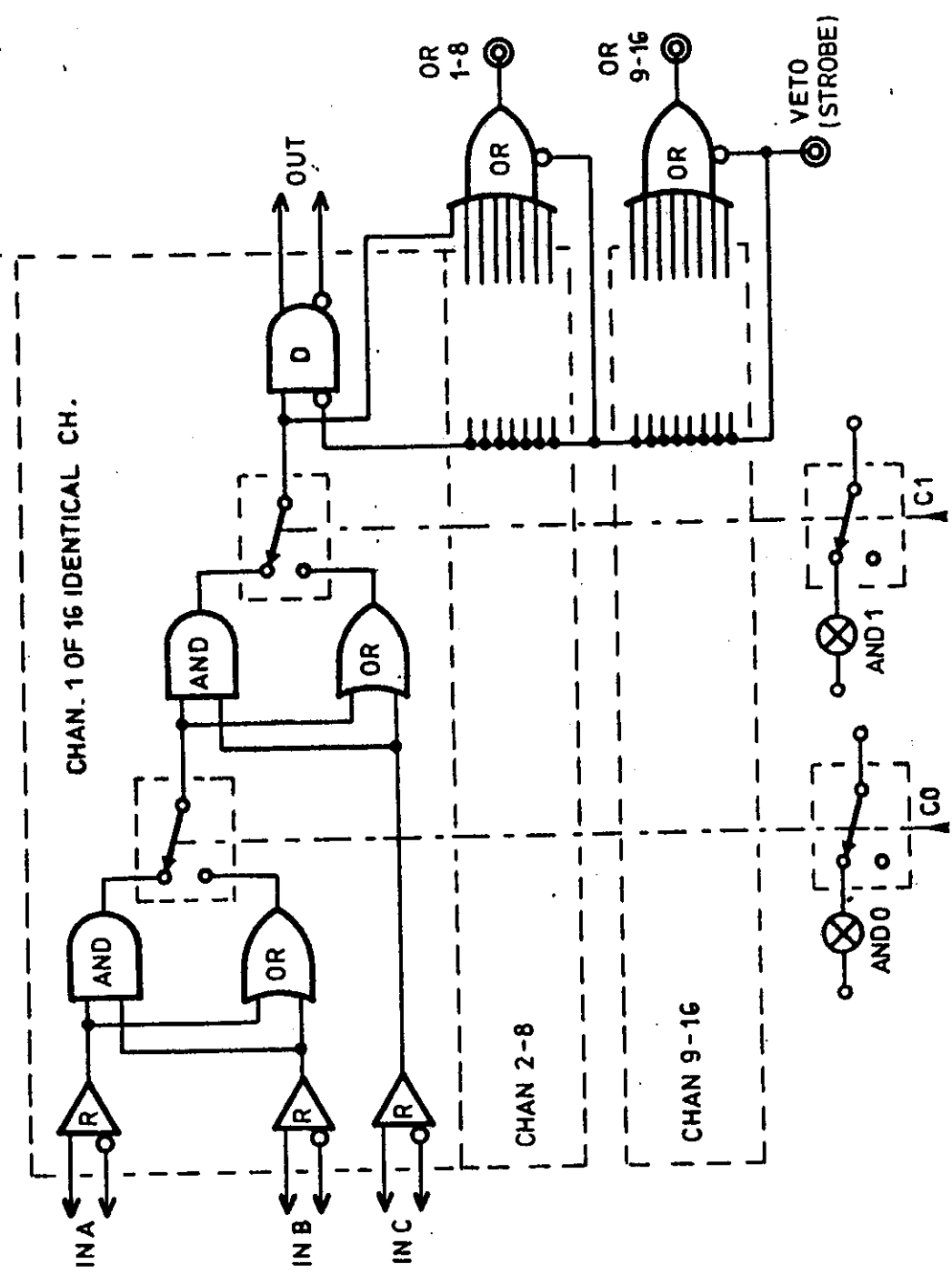
The same arguments apply for the second level of logic between C and (A,B). The discrimination between AND and OR is performed for instance on IC 26. The logic level COR 1 determines which logic function has to be performed.

Also COR 1 can be generated either by manual operation or by CAMAC functions $F(26)*A(1)$ for AND mode and $F(24)*A(1)$ for OR mode.

For each of the two levels of logic, the AND operation is marked out by the firing of a front panel LED, as well as by a $Q=1$ response to a CAMAC $F(24)*A(0)$ ($*A(1)$).

The output of the second level of logic (for instance the output of IC 26) is sent on one side to a line transmitter 10101 generating the final output, on the other side to a diode matrix building up a general OR over eight channels.

An eventual veto input will act either on the two general OR outputs as well as on the single channel outputs. The veto will be effective during the time in which it is overlapped with the outputs. On the contrary, a complementary NIM signal applied to the veto input will act as a strobe.

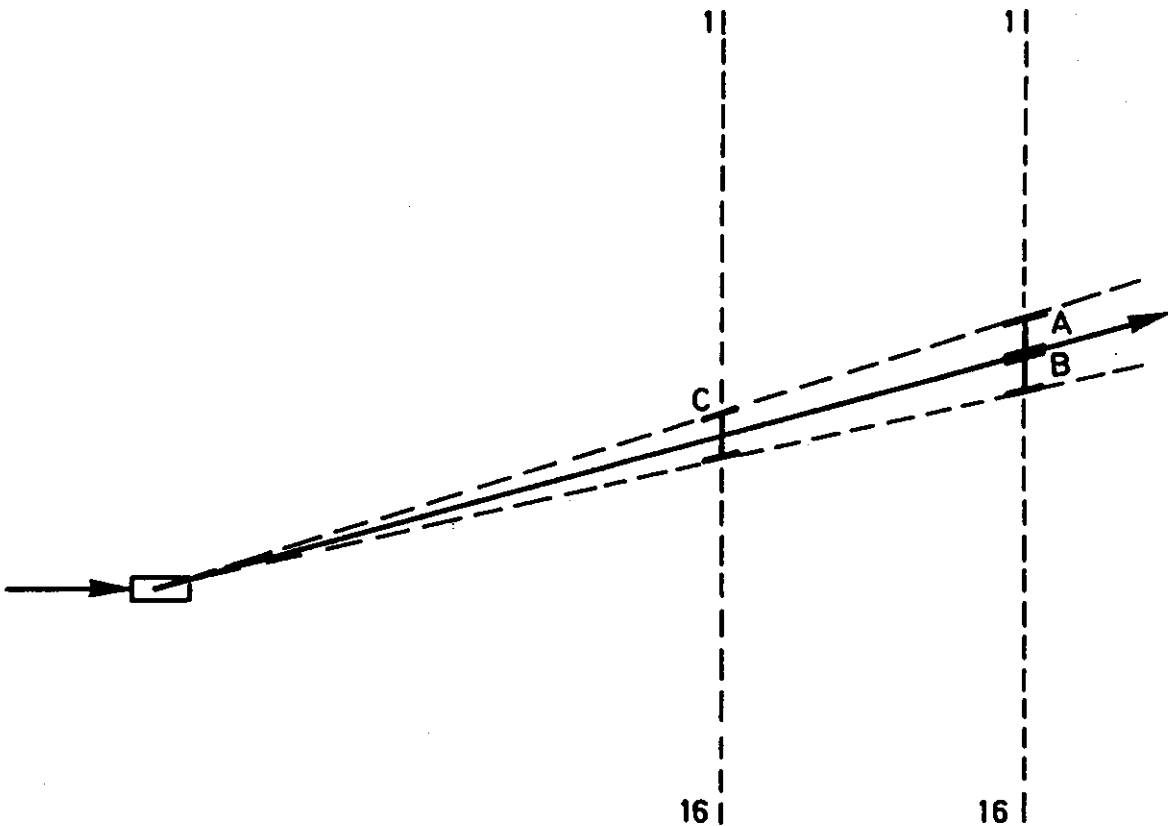


APPLICATIONS

The idea which is at the base of the 4516 is to have a logic element, one channel of 4516, which is intrinsically simple and flexible so that it can be used as a building bloc for any kind of more complicate logic.

So the application of the module is in principle everywhere a logic problem is present. In particular the circuit can also be used to build large OR's up to 24 inputs. Two of this OR's are housed in the same 4516.

Another typical application of the 4516 is for coincidence matrices.



Looking at the figure let's suppose to have two hodoscope planes and that a trigger is required when the two planes are traversed by a particle originated from the target.

Let's also suppose that the shadow of each counter A of the first hodoscope, projected from the target, covers two counters, B and C, of the second hodoscope. A good particle is defined by the logic function $(A \text{ OR } B) \text{ AND } C$, which is exactly what each section of 4516 is able to do. A single 4516 covers completely the needs in the example shown. The two OR outputs could give for instance two separate triggers for the upper and lower solid angle. On customer request, the two OR outputs can also be cabled in order to give both a general OR over all inputs, that is over 48 inputs.

POSSIBILITY OF CASCADING MODULES

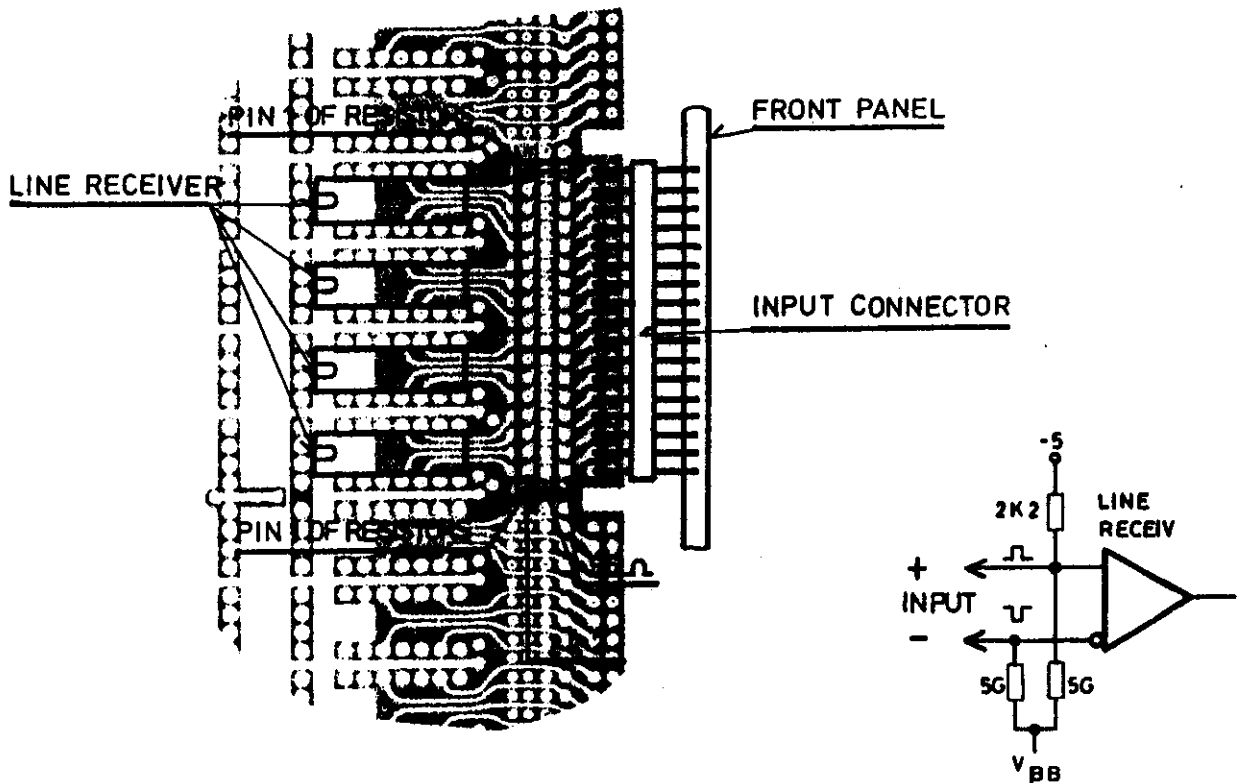
All differential ECL inputs, in ECLine modules, are terminated inside the module by two 56 ohms resistors to VBB, realizing a differential matching impedance of 112 ohms.

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

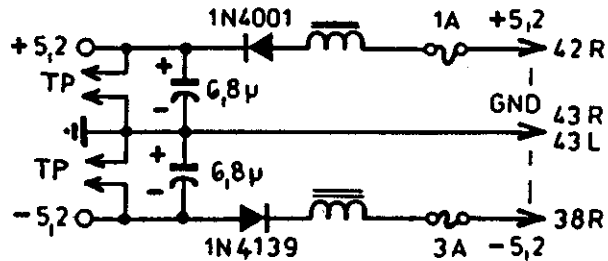
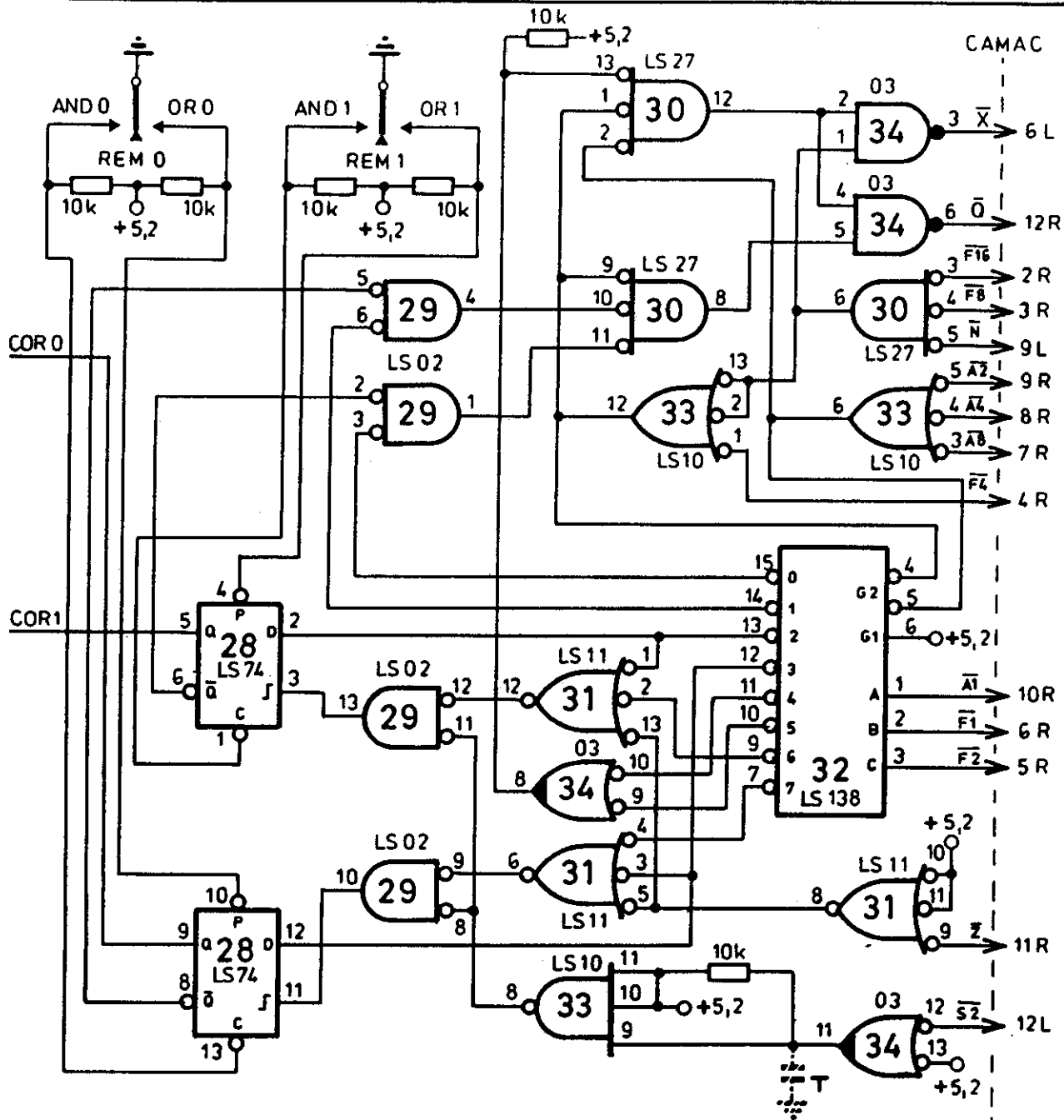
Interconnections between different ECLine modules, for transmission of different ECL pulse pairs, can be made either by multiwire cables or by single twisted pair cables for one to one connections.

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.



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LeCroy RESEARCH SYSTEMS		
DRAWN H.A.Motto	MODEL 4516 16 CHAN. LOGIC UNIT	
CHECKED B.MAURON		
DATE 16 AUG 79		
DRAWING NUMBER: 4516-S1	SHEET 2 OF 3	ECO NO 1008 DATE 7-9-84

Le Croy	I.C.	Designation	GND		-5,2	+5,2
204 042 003	10115	1,2,3,4,5,6,7,8,9,10,11,12, 17,18,19,20.	10	1	8	
204 042 016	10101	13,14,15,16.	16	1	8	
204 042 011	10116	21,22,23,24,25,26	16	1	8	
208 011 007	LM 358	27			4	8
200 031 049	74 LS 74	28	7			14
200 031 051	74 LS 02	29	7			14
200 031 057	74 LS 27	30	7			14
200 031 077	74 LS 11	31	7			14
200 041 062	74 LS 138	32	8			16
200 031 047	74 LS 10	33	7			14
200 031 033	7403	34	7			14

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LeCroy RESEARCH SYSTEMS	
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	ECO N° 1008 DATE 7.9.84