4413 UPDATING PROGRAMMABLE DISCRIMINATOR
4415A NON-UPDATING PROGRAMMABLE DISCRIMINATOR

- CAMAC Packaging
- 16 Inputs Per Module
- ECLine Compatible
- Updating or Non-Updating Versions
- Adjustable Output Widths
- Remote or Local Threshold Adjustment and Monitor

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GENERATION OF LOGIC PULSES FOR COUNTERS OR EXPERIMENT TRIGGERS

The Model 4413 and Model 4415A are part of the LeCroy family of ECLine programmable logic modules which are used in first level trigger electronics for High Energy Physics or Heavy Ion experiments as well as other demanding high speed applications. These units offer many advantages including external control/monitor capability and built-in test functions.

A discriminator generates precise logic pulses in response to input signals exceeding a given threshold. Output pulses are of standard amplitude and of preset duration or proportional to the input rate. The threshold is a specific voltage of interest to the user (which can be set above some critical noise level or correspond to a physical quantity such as energy). In other applications, the threshold level can correspond to a certain level of integrated rates (coincidence events).

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LeCroy's CAMAC discriminators, Model 4413 and Model 4415A, are high performance modules which offer external programmability. These units have 16 inputs, which between them accommodate a wide range of input signal levels. Both units have differential ECL logic outputs (which offer noise immunity) and are compatible with LeCroy's ECLine family of CAMAC modules. These modules include the Model 4448 Coincidence Register, the Model 4508 Programmable Lookup Unit, the Model 4516 Logic Unit, the Model 4532 Majority Logic Unit and many more. Descriptions and specifications of the above units can be found on their own separate data sheets.

Each module offers a variable threshold range. The 4413 covers from -15 mV to -1.0 V. The 4415A covers from -30 mV to -600 mV for negative-going, single-ended pulses, from 30 mV to 600 mV for positive pulses and from 15 mV to 300 mV for differential signals. Threshold level and output pulse width can be adjusted via a front-panel potentiometer or can be externally set. The 4413 allows the threshold level to be programmed and monitored remotely via CAMAC. The 4415A can be set by applying an external voltage level which is proportional to the required threshold. A monitor point is provided on each unit to permit accurate measurement of the threshold with a voltmeter. Both units are very stable and exhibit no multiple pulsing.

Various input signal formats can be utilized with these discriminators. The 4413 accepts negative signals via front-panel Lemo connectors and provides 150 MHz operation with 5 nsec typical double pulse resolution. Inputs to the versatile 4415A are either AC (optional) or DC (factory set) coupled, and either differential or single-ended (user settable options), positive or negative going. Each input has a 2-pin header which provides compatibility with systems which utilize the low cost and convenience of ribbon cable connections.

Both modules have two separate differential ECL outputs per channel. Output widths may be adjusted from 4.5 nsec to 100 nsec in the 4413 in the Updating Mode and from 100 nsec to 1 μsec in the 4415A as supplied from the factory. The long output width of the 4415A makes it very useful in "VETO" applications. If other than factory settings are required in the 4415A, a simple user change of circuit components permits variation of the actual range covered. The minimum output width for the 4415A is approximately 20 nsec with modification for a maximum repetition rate of 30 MHz.

A built-in test feature simulates an input signal for each channel upon receipt of either an F(25) command or a NIM level signal applied to the test input connector. This permits rapid, simultaneous testing of all enabled discriminator channels.

For additional system flexibility, input masking is made possible by simultaneously inhibiting any combination of the 16 inputs via CAMAC command. This feature allows the user to generate or simulate any desired trigger configuration. It also allows complete point-to-point checks of the system electronics without requiring removal of wires or disassembly of the data acquisition system.

Three operation modes are built into the 4413: Updating, Burst Guard and Retiming. The first two modes are classic features of LeCroy discriminators. The Retiming mode has been introduced to give the user the possibility of retiming input pulses randomly arriving in time within a window (eventually defined by the VETO signal) with a common synchronization pulse.

The Updating feature is useful whenever two or more pulses arrive at an input within the output pulse width time. In this case, the output is simply extended until the programmed output width elapses after the last such input pulse. This feature prevents erratic behavior in applications where multiple pulses might be expected. The 4413 may also operate in a "time-over-threshold" or Burst Guard mode, if desired.

The 4413 also provides a current sum feature which supplies -2 mA per enabled input to two rear-panel bridged Lemo connector outputs. These outputs may be daisy chained from unit to unit, offering a fast, convenient monitor of discriminator activity or source of gross trigger information.

The 4415A is a non-updating discriminator. This feature provides an output pulse of preset duration for pulses which are separated by more than their double pulse resolution. If a second input pulse occurs during the duration of the output, no additional action is taken by the circuit. This feature is useful in counting and timing applications.

The 4413 MOD200 is a high impedance AC coupled version of the 4413. The purpose is to route the analog input signal to the HVL210 discriminator hybrid and then out to the lower 34 pin connector permitting transfer to an ADC unit, such as the LeCroy model 1885F Fastbus ADC or model 4300B FERA ADC.

The 15 analog inputs are each AC coupled via a 0.1 μF capacitor in series with the input Lemo connectors.

In the standard 4413 the lower ECL output connector produces ECL level output signals, the lower output connector is now an AC coupled fanout of the analog input signal. This is accomplished with 50 Ω coaxial cable permitting proper impedance matching.

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Model 4413
Updating Discriminator

INPUT

Signal Inputs: Sixteen inputs via Lemo front-panel connectors, 50 Ω ±5%. Protected to ±5 A for 0.5 µsec clamping at ±5 V. Reflections < 4% for input pulses of 2 nsec rise time; input offset voltage typically ±3 mV.
Threshold: -15 mV to -1.0 V ±5% or ±2.5 mV, whichever is greater (common to all channels); front-panel screwdriver adjustment in local or through 10-bit DAC in remote mode. Stability better than 0.3%/°C to 60°C operating temperature. Threshold monitor point on front panel has 10:1 ratio of monitor voltage to actual voltage ±5%. Hysteresis, typical 3.5 mV.
Test Input: One Lemo connector on rear panel, 50 Ω ±5%, triggers all enabled channels. Requires NIM level signal (< -600 mV). Minimum width, 3 nsec. Maximum rate, 150 MHz.
Sync-Strobe Input: One Lemo front-panel connector, 50 Ω ±5%. Requires complementary NIM level signals. When using this input, the Sync-Strobe pulse leading edge will determine the output timing while the output width will be determined by the overlap of the un-strobed outputs and the Sync-Strobe pulse. Inputs to be retimed must precede the Sync-Strobe pulse by 10 nsec minimum. Also ensure that the discriminator's output width completely overlaps the Sync-Strobe pulse.
Veto-Input: One Lemo front-panel connector, 50 Ω ±5%. Permits simultaneous fast inhibiting of all channels. Requires NIM level signals. Direct coupled. Must precede input signal by approximately 1 nsec and overlap its leading edge in Update mode or overlap complete input signal in Burst Guard mode. Minimum duration, 3 nsec.

OUTPUT

Discriminator Outputs: Two separate outputs per channel. ECL level (-0.8, -1.7 V) into 100 Ω twisted-pair. Duration, approximately 3.5 nsec to 100 nsec in the Updating mode, continuously variable via screwdriver control, common to all channels. Rise times and fall times < 2 nsec. Width stability better than 0.3%/°C maximum.
Output Operation Modes: Updating or Burst Guard operation selectable by rear-panel switch. Retiming mode active when using the Sync-Strobe input.
Current Sum Outputs: Two bridged, rear-panel Lemo connectors; high impedance current source; generates a current proportional to the input multiplicity at the rate of -2 mA ±10% per hit (-50 mV per hit into two 50 Ω loads); 100 MHz maximum rate. The two connectors can be used for daisy chaining within a group of similar units.

GENERAL

Maximum Rate: 150 MHz guaranteed.
Mode Select: Local mode and programmable mode selectable via CAMAC command.
LED Indicators: Two front-panel LEDs indicate that programmable mode and Updating operation have been selected when lit.
Double Pulse Resolution: 5 nsec, typical.
Time Slewing: Less than 500 psec for input amplitudes from 2x to 20x over threshold.
Input-Output Delay: 18 nsec. Delay matching better than ±1 nsec.
Test-Output Delay: 18 nsec.
Sync-Strobe to Output Delay: 9 nsec ±0.5 nsec.
Multiple Pulsing: None; one and only one output pulse is produced for each input pulse regardless of input pulse amplitude and duration.
BG/UPD Switch: A rear-panel switch enables Updating or Burst Guard operation for all channels. A front-panel LED is lit when Updating operation is selected.
Power Requirements: 30 mA at +24 V, 1.3 A at +6 V, 4.1 A at -6 V, 30 mA at -24 V.
Packaging: RF-shielded, CAMAC #1 module.

Model 4415A
Non-Updating Discriminator

INPUT

Signal Inputs: Sixteen inputs via a front-panel 34-pin connector. Single-ended or Differential, DC-coupled (AC-coupled optional). Common mode voltage range ±3 V. Impedance, 110 Ω ±5% differential; 55 Ω ±5% from each pin to ground.
Threshold Monitor: Front-panel, 2-pin connector; high impedance, (5.6 kΩ); has 10:1 ratio of monitor voltage to actual voltage. Range: -0.3 V to -6 V ±10 mV or ±10%, whichever is greater for single-ended pulses and corresponding to threshold of 15 mV to 300 mV for differential inputs. Used as output, indicates the internal threshold control voltage. Used as input, commands the threshold control voltage.
Threshold Range: For single-ended negative pulses: -30 mV to -600 mV; for positive going signal with rise time < 300 µsec, the range is 30 mV to 600 mV; for differential signals, 15 mV to 300 mV. Front-panel screwdriver-adjustable potentiometer or controllable via an external voltage applied to the threshold control connector. The threshold is common to all channels. Hysteresis: 3.6 mV typical.
Test Input: One Lemo front-panel connector, 50 Ω ±5% impedance, triggers all channels simultaneously. Requires NIM level signal (-16 mA into 50 Ω = -0.8 V). Tolerance is ±4 mA according to NIM standard. Minimum width: 10 nsec. Test is enabled only when the REMOTE/LOCAL switch is in REMOTE position.

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A front-panel LED indicates that Test Mode is enabled.
Veto Input: One Lemo front-panel connector, 50 Ω ±2% input impedance, inhibits all outputs during input of VETO. NIM level signals (-16 mA into 50 Ω = -0.8 V). Tolerance is ±4 mA according to NIM Standard; direct coupled.

OUTPUT

Signal Output: Two outputs per channel in two front-panel 34-pin connectors; ECL differential level (-0.8, -1.8 V into 100 Ω twisted pair. Duration: < 100 nsec to > 1 µsec (factory set; user modification for other values. See Table 1). Output duration set by a front-panel screwdriver control, common to all channels. Rise times and fall times typical 2.2 nsec. Width stability: < 0.2% per °C.
Remote/Local Switch: Front-panel switch. In Local position, disables mask register and Test Mode.

GENERAL

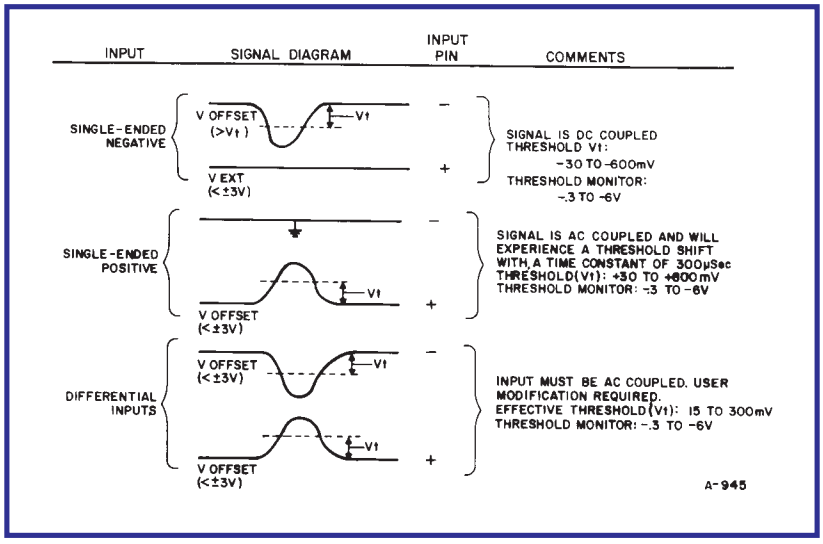
Maximum Repetition Rate: 9 MHz when output width set to 100 nsec. For other settings see Table 1.
Double Pulse Resolution: Typical 110% of output width (between leading edges) or width of pulse plus 12 nsec, whichever is greater.
Time Slewing: < 2 nsec for input amplitudes from 2 to 20 times threshold.

Input Output Delay: Typically 22 nsec.
Test Output Delay: Typically 40 nsec.
Veto Output Delay: Typically 10 nsec.
Multiple Pulsing: None; one and only one output pulse is produced regardless of input pulse amplitude and duration.
Power Requirements: 1.3 A at +6 V, 4.25 at -6 V, 20 mA at -24 V, 33.8 W total.
Packaging: RF-shielded CAMAC #1 module.

User Installed Value for the Timing Capacitor C0 to C15	Output Pulse Width	Maximum Repetition Rate
0 *	~20 nsec to 150 nsec	~30 MHz to 6 MHz
56 pF **	100 nsec to 1 µsec	9 MHz to .9 MHz
680 pF	1 µsec to 10 µsec	900 kHz to 90 kHz
6.8 nF	10 µsec to 100 µsec	90 kHz to 9 kHz
68 nF	100 µsec to 1 msec	9 kHz to .9 kHz

* adjust trim cap parallel to C0 through C15 for proper output pulse width
** factory set

Table 1: Model 4415A User Selectable Output Options



Model 4415A Input Options

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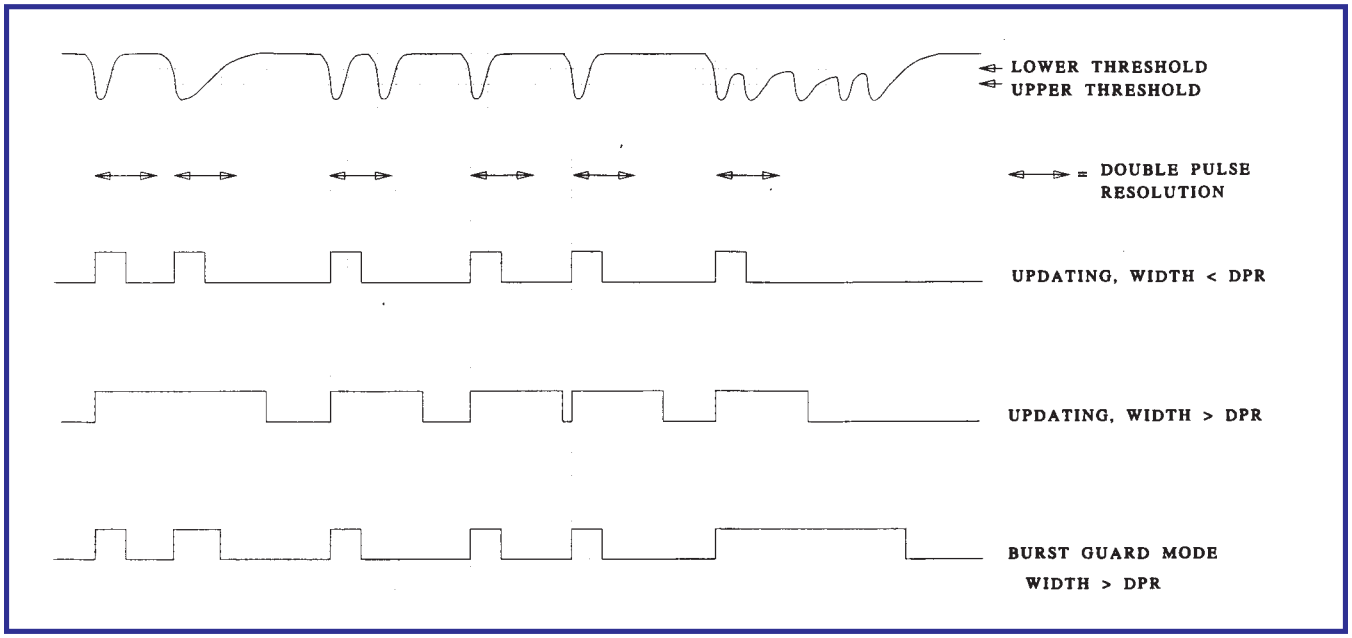

Model 4413 Output Modes. Comparison of Updating and Burst Guard Modes with various fast input signals. DPR is the Double Pulse Resolution Interval set to minimum in this example.

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CAMAC COMMANDS

Model 4413

CAMAC COMMANDS

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

Q: A Q response is generated only if the requested function can be executed.

Z: Clears mask register at S2 time, sets module into local mode.

CAMAC FUNCTION CODES

F(0)•A(0): Reads mask register. Q response in remote mode only.

F(1)•A(0): Reads threshold setting when in local or remote mode.

F(16)•A(0): Writes mask register pattern (W1-W16). Executable and Q response generated in remote mode only.

F(17)•A(0): Writes threshold setting register; 11 bits, 10 bits of data (W1-W10) providing 1 mV resolution are used to program common threshold and 1-bit (W11) to set the manual threshold value (front-panel screwdriver control) to the threshold register. In this case, the data presented on W1-10 are ignored. Q response generated in remote mode only.

F(25)•A(0): Test function. Only channels not masked off by F(16) are triggered by internally generated 3 nsec wide pulse. Q response generated in remote mode only.

F(24)•A(0): Set local mode.

F(26)•A(0): Set remote mode.

Note: At power on the unit is set in local mode and mask register is cleared.

Model 4415A

CAMAC COMMANDS

X: An X response is generated for valid N, A, F.

Q: A Q response is generated only if the requested function can be executed.

Z: Disables mask register and clears Test Mode.

I: Disables all outputs if REMOTE/LOCAL switch is in REMOTE position. Inhibit can be disabled by internal modification.

CAMAC FUNCTION CODES

F(16)•A(0): Writes mask register pattern (W1-W16).
A Q response is always generated.

F(17)•A(0): If W1 = 1; enables Test Mode. If W1 = 0; disables Test Mode. Q response is generated.

F(25)•A(0): Test function, triggers all channels. A Q response is given in test mode only when the REMOTE/LOCAL switch is in remote mode.

F(27)•A(0): REMOTE/LOCAL switch test. A Q = 1 response is generated in REMOTE position only.

CAMAC DISCRIMINATOR SELECTION CHART

MODEL	4413	4415A
INPUTS		
No. of Inputs	16	16
Threshold	-15 mV to -1.0 V	-30 mV to -600 mV for negative going single-ended signals, +30 mV to +600 mV for positive going, 15 mV to 300 mV for differential signals.
OUTPUTS		
No. of Outputs/ Channel	2 ECL levels (MOD200 offers 1 ECL and 1 analog output.)	2 ECL levels
Width	4.5 nsec to 100 nsec	100 nsec to 1 µsec (20 nsec to 1 msec with modifications)
Maximum Rate	> 150 MHz	9 MHz (30 MHz with modification)
Double Pulse Resolution	5 nsec typical	Typical 110% of output width or width of pulse +12 nsec whichever is greater.
Updating	Selectable	N/A
POWER		
-24 V	30 mA	20 mA
-12 V	—	—
-6 V	4.1 A	4.25 A
+6 V	1.3 A	1.3 A
+12 V	—	—
+24 V	40 mA	—

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