

LCM



EtherCAT[®] Laser Control Module

The LCM EtherCAT slave module provides all ACS Controllers and Control Modules the ability to control a laser source directly and to synchronize its activation and pulsing to motion and to achieve the highest quality laser micro-machining and optimal throughput. It interfaces with a variety of lasers such as DPSS, CO₂, excimer, fiber, Q-switched, picosecond, femtosecond, to name a few.

Programming the LCM is made simple by utilizing the dedicated high level function commands that are a part of the ACSPL+ motion programming language.

Laser Micro-machining Made Simple

- Dynamic laser power control by digital pulse modulation
- Pulse synchronization with XYZ motion path at random points as well as at programmable intervals
- Laser gating (on/off) synchronization with XYZ motion path at specific positions
- Flexible electrical interface: laser enable output safety interlock input, fault input for robust safety implementation, general purpose programmable I/O
- User defined operational zones
- Programmable laser delay compensation
- Ability to combine different laser operation modes to meet unique application requirements
- Ability to output virtual trajectory path (single-axis or multi-axis) as AqB or P/D signals (optional)
- Easy programming with high level operation commands

A Wide Range of Laser Control Modes to Address Many Machining Application

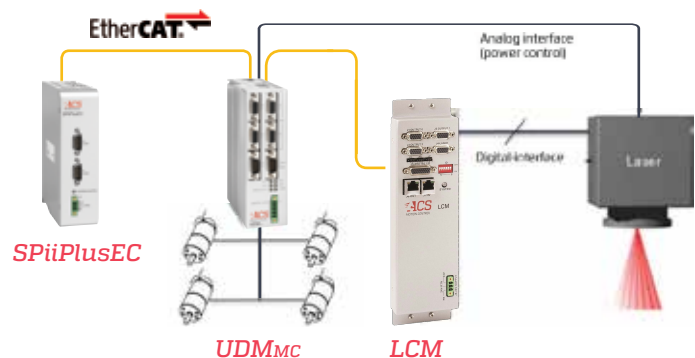
- Digital Modulation Mode (for power control)
 - › Fixed frequency
 - › Fixed pulse width
 - › Fixed duty cycle
- Tickle Mode
 - › Fixed frequency and pulse width
- Fixed Distance Pulse Firing Mode
- Random position, Array Based Pulse Firing Mode
- Array Based Gating Mode
- Axis Range Windowing Mode
- Hybrid modes combining many operation modes

All ACS Motion Controllers Support the Multi-dimensional Motion for Laser Micro-machining

- Rapid point to point positioning on a single or multi-axis using 3rd order interpolation
- Up to 5 axes coordinate motion path with G-Code or ACS native XSEG motion commands with advanced look-ahead and corner rounding algorithms
- Enhancing accuracy by dynamic error mapping compensation
- Supporting Cartesian and non-Cartesian coordinate systems

CE (Pending)

EtherCAT[®] is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany



**In-Position
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ACS
MOTION CONTROL

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Specifications

Control supply

Input voltage: 24Vdc ±10%.
 Max. input power: <3 W.
 Input current: <0.2A.

Laser Electrical Interface

Laser enable output: One, opto-isolated, two terminal.
 Current: Min. 5mA, Max. 20mA. 5Vdc(±10%)/24Vdc(±20%), sink/source
Laser fault input: One, opto-isolated, two terminal.
 Current: Min. 5mA, Max. 20mA. Configured as sink or source by interconnection with laser interface and external power supply 5Vdc (±10%) or 24Vdc (±20%)
Laser control signal output: One, differential, RS422
Laser safety input: One, single-ended, opto-isolated.
 Current: Min. 3mA, Max 15mA. Automatic voltage detection

Time Based (Pulse Modulation) Modes

Fixed frequency and variable duty cycle
Fixed pulse width and variable frequency
Fixed duty cycle and variable frequency
 Pulse Frequency Range: 0.035Hz - 1MHz
 Duty Cycle: 0-100%:
 Duty Cycle Update Rate: (CTIME of controller)
 Pulse width min 6.67ns
 Pulse width max 111ms.

Position Based Mode

Fixed Distance (Constant Spacing) Pulse Firing Mode
 Pulse Frequency Range: 0 - 10MHz
 Max Interval between Pulses: Unlimited
 Pulse Width min: 26.6ns
 Pulse Width max: 1.75ms
 Pulse Width Resolution: 26.6ns
 Optional Additional Time Based Pulses: Up to 2¹⁶ with period range of 53.2ns to 1.75ms and 26.6ns resolution
 Max Position Resolution: equal to encoder resolution

Tickle Mode

Pulse Frequency Range: 1.1kHz – 1 MHz
 Pulse width min: 106ns
 Pulse width max: 27.3ms

Array Based Pulse Firing Mode

Max size of Array (Pulse Positions): 256 points
 Pulse Frequency Range: 0 - 10MHz
 Pulse Width min: 26.6ns
 Pulse Width max: 1.75ms
 Pulse Width Resolution: 26.6ns
 Optional Additional Time Based Pulses: Up to 2¹⁶ with period range of 53.2ns to 1.75ms and 26.6ns resolution
 Max Position Resolution: equal to encoder resolution

Array Based Gating Mode

Max Number of Array Points (On/Off Positions): 256
 Max Gating Frequency: 10MHz
 Max Position Resolution: equal to encoder resolution

Axis Range Windowing Mode

Up to three independent ranges
 Window Min and Max Position Resolution: equal to encoder resolution

Laser Delay Compensation Feature

Within controller cycle with a resolution of 320ns

Digital I/O

Digital Inputs: Eight general purpose inputs. Single ended, opto-isolated, 5Vdc or 24Vdc, sink or source, automatic voltage detection.
 Input current: <15mA each.
Digital Outputs: Eight general purpose outputs. Single ended, opto-isolated, 5Vdc or 24Vdc, sink or source (default). Output current: <50mA each.

Communication:

Two EtherCAT ports, In and Out, RJ45 connector.

Environment:

Operating range: 0 to + 50°C.
 Storage and transportation range: -25 to +60°C.
 Humidity (operating range): 5% to 90% non-condensing.

Dimensions

HxWxD: 264 x 75 x 25 (mm³)
 Weight
 350g

Accessories

LCM-ACC1: Mating connectors kit.

Ordering options

Ordering Options	Field	Example User Selection	Values
Support for AqB and P/D output	1	N	Y - Yes, N - No
Future Option	2	N	Y - Yes, N - No
Future Option	3	N	Y - Yes, N - No
Future Option	4	N	Y - Yes, N - No
Future Option	5	N	Y - Yes, N - No
Future Option	6	N	Y - Yes, N - No

Example: LCM-NNNNNN

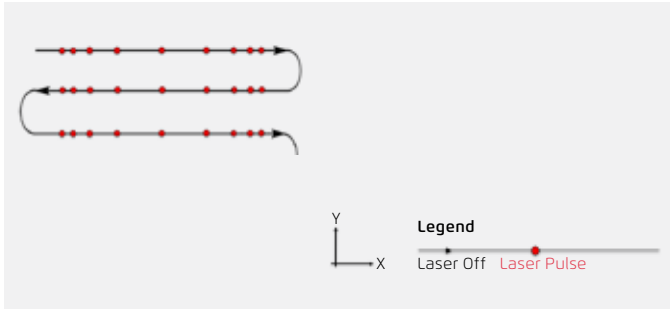
Field		1	2	3	4	5	6
PN	LCM	N	N	N	N	N	N

Capabilities for Laser Processing Applications

It is simple to implement complex micro-machining jobs utilizing the ACSPL+ high level commands dedicated for the LCM operation and related motion.

Array Based Pulse Firing Mode

Pulsating the Laser at Pre-Defined Positions Along the Path



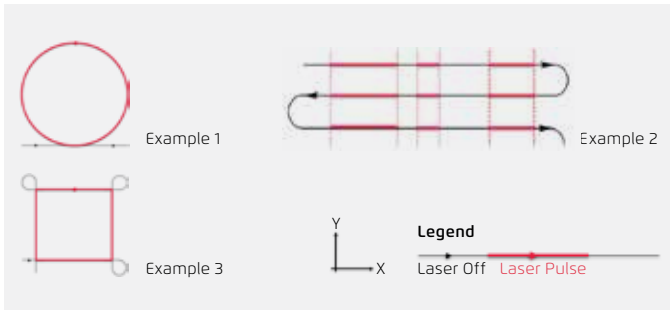
Sample Program

```
LCRandomDist(Index,XY,Width,0,10,Points)
```

- * Index – LCM index
- * XY – the pulses will be fired along 2D XY path
- * Width – pulse width
- * Points – array of the pulse locations, starting from the first pulse at Points[0] to the last pulse at Points[10]

Array Based Pulse Gating

Turning the Laser On/Off at Pre-Defined Positions Along the Path



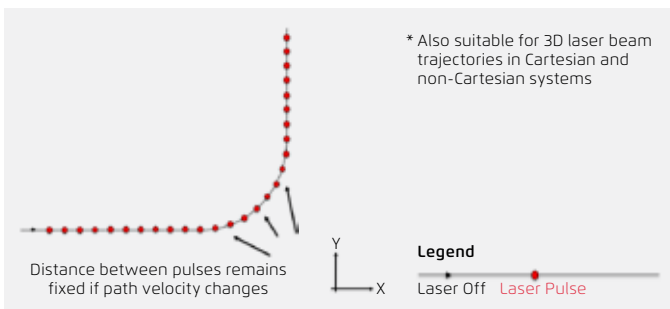
Sample Program

```
LCRandomDist(Index,XY,Width,0,10,Points,States)
```

- * Index – LCM index
- * XY – the pulses will be fired along 2D XY path
- * Width – pulse width
- * Points – array of the pulse state change locations, starting from the Points[0] to Points[10]
- * States – array of signal state ('1' ON or '0' OFF), starting from the States[0] to States[10]

Fixed Distance Pulse Firing Mode

Triggering Laser Pulses at Precise Positions with Fixed Distance Interval



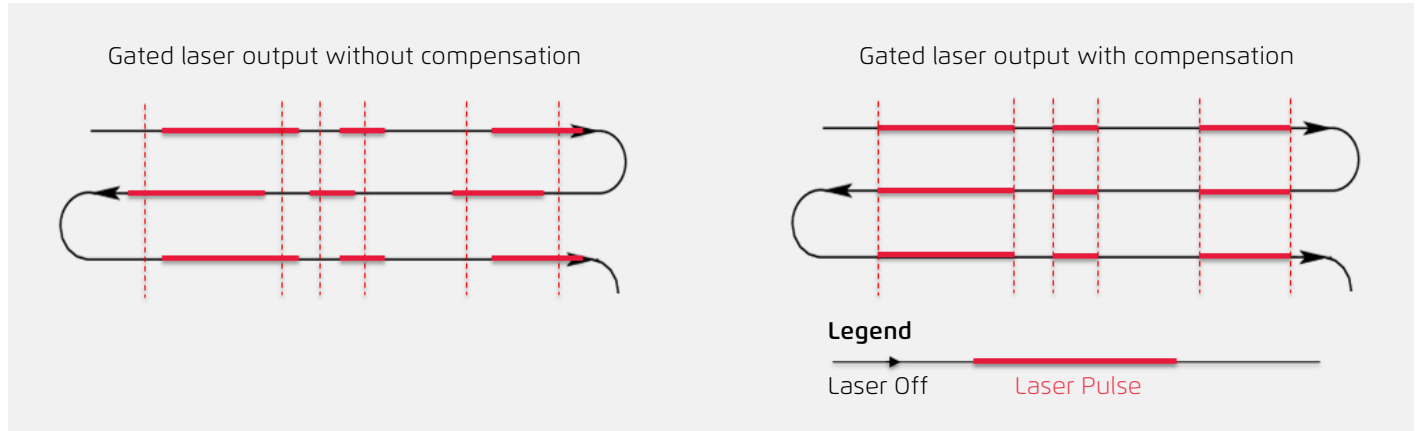
Sample Program

```
LCFixedDist(Index,XY,Width,Start,Interval,Stop)
```

- * Index – LCM index
- * XY – the pulses will be fired along 2D XY path
- * Width – pulse width
- * Start - first pulse location
- * Interval – interval between pulses
- * Stop – last pulse location

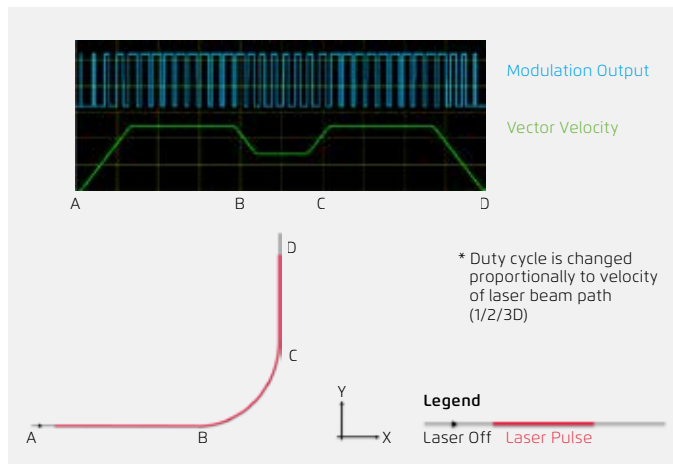
Laser Delay Compensation Feature

Compensating for Laser Time Shift (Delay, Advance) Relative to the Motion



Pulse Modulation Mode

PWM Modulation as a Function of Velocity



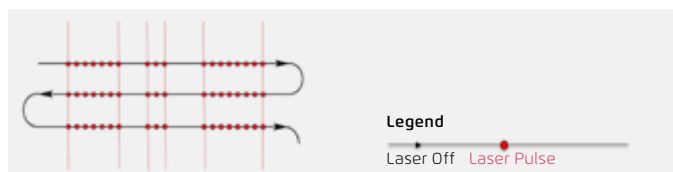
Sample Program

LCModulation(Index,Mode,Freq,Width,DC,XY)

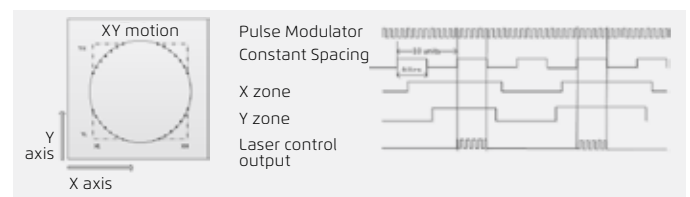
- * Index – LCM index
- * Mode – laser signal modulation with fixed frequency
- * Freq – modulation frequency
- * Width – pulse width (has no effect in this mode)
- * DC - initial duty cycle. The duty cycle will be automatically updated according with motion vector velocity
- * XY – vector velocity is calculated according with (X,Y) axes motion

Examples for Combined Mode

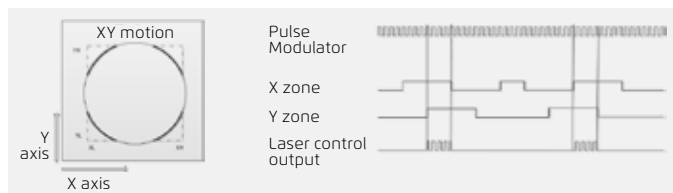
Firing at Fixed Interval Pulse within specific zones defined by Array Based Gating



Fixed Distance Pulse Firing, Digital Modulation & Axis Range Windowing



Axis Range Windowing & Digital Modulation



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