*LIGO Laboratory / LIGO Scientific Collaboration*

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TwinCAT Library for
Delay Line

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of the LIGO Laboratory.

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| **Library** |
| Title | DelayLinePhaseShifter |
| Version | 1 |
| TwinCAT version | 2.11 |
| Name space | – |
| Author | Alexa Staley, Daniel Sigg |
| Description | The delay line shifter delays an input signal by a selectable amount. This amount can be controlled by a step or phase slider. The delay can be between 0ns and 30.762ns for a single delay line.If necessary, multiple delay lines can be chained in series to double, triple or quadruple this delay.  |
| Error Codes | 0x01 – Invalid frequency |
| Library dependencies | Error |

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| **Hardware Output Type**TYPE DelayLogicOutStruct :STRUCT DelayStep: INT;LacthEn: BOOL; END\_STRUCTEND\_TYPE |
| Type name | DelayLogicOutStruct |
| Description | Structure of the hardware output that are wired up for the delay line |
| Definition | STRUCT |
| Element | Name: DelayStepType: INTDescription: The delay line step slider |
| Element | Name: LatchEnType: BOOLDescription: Enables latch |

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| **User Interface Type**TYPE DelayLogicStruct : (\* single delay line \*)TYPE DelayLogicDoubleStruct : (\* double delay line \*)TYPE DelayLogicTripleStruct : (\* triple delay line \*)TYPE DelayLogicQuadStruct : (\* quadruple delay line \*)STRUCTFreqMHz: LREAL;PhaseDeg: LREAL;DelayNs: LREAL;DelayStep: INT;Error: ErrorStruct;END\_STRUCTEND\_TYPE |
| Type name | DelayLogicStruct (single delay line)DelayLogicDoubleStruct (two delay lines)DelayLogicTripleStruct (three delay lines)DelayLogicQuadStruct (four delay lines) |
| Description | Structure of the user interface tags that are used to control the delay line |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: For error handling |
| Input Tag | Name: FreqMHzType: LREALDescription: Input frequency in MHz |
| In/out Tag | Name: PhaseDegType: LREALDescription: Input phase in degrees, between 0 and 360º. |
| In/out Tag | Name: DelayNsType: LREALDescription: Delay of input signal in nanoseconds, between 0 ns and 30.7622 ns (511 steps, single delay line), 61.5244 ns (1022 steps, double delay line), 92.2866 ns (1533 steps, triple delay line) or 123.0488 ns (2044 steps, quadruple delay line). |
| In/out Tag | Name: DelayStepType: INTDescription: Delay steps between 0 and 511 (single delay line), 1022 (double delay line), 1533 (triple delay line) or 2044 (quadruple delay line).One step corresponds to 0.0602ns |

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| **Function Block**FUNCTION\_BLOCK DelayLogicFBVAR\_INPUT Request: SaveRestoreEnum;END\_VARVAR\_OUTPUTDelayLogicOut: DelayLogicOutStruct;END\_VARVAR\_IN\_OUT DelayLogicInit: DelayLogicStruct; DelayLogic: DelayLogicStruct;END\_VAR |
| Name | DelayLogicFB |
| Description | Controls a single delay line  |
| Input argument | Name: RequestType: SaveRestoreEnumDescription: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogicOutType: DelayLogicOutStructDescription: Output hardware structure |
| In/out argument | Name: DelayLogicInitType: DelayLogicStructDescription: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogicType: DelayLogicStructDescription: User Interface structure |

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| **Function Block**FUNCTION\_BLOCK DelayLogicDoubleFBVAR\_INPUT Request: SaveRestoreEnum;END\_VARVAR\_OUTPUTDelayLogic1Out: DelayLogicOutStruct;DelayLogic2Out: DelayLogicOutStruct;END\_VARVAR\_IN\_OUT DelayLogicInit: DelayLogicDoubleStruct; DelayLogic: DelayLogicDoubleStruct;END\_VAR |
| Name | DelayLogicDoubleFB |
| Description | Controls two delay lines |
| Input argument | Name: RequestType: SaveRestoreEnumDescription: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogic1OutType: DelayLogicOutStructDescription: Output hardware structure for 1st delay line |
| Output argument | Name: DelayLogic2OutType: DelayLogicOutStructDescription: Output hardware structure for 2nd delay line |
| In/out argument | Name: DelayLogicInitType: DelayLogicDoubleStructDescription: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogicType: DelayLogicDoubleStructDescription: User Interface structure |

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| **Function Block**FUNCTION\_BLOCK DelayLogicTripleFBVAR\_INPUT Request: SaveRestoreEnum;END\_VARVAR\_OUTPUTDelayLogic1Out: DelayLogicOutStruct;DelayLogic2Out: DelayLogicOutStruct;DelayLogic3Out: DelayLogicOutStruct;END\_VARVAR\_IN\_OUT DelayLogicInit: DelayLogicTripleStruct; DelayLogic: DelayLogicTripleStruct;END\_VAR |
| Name | DelayLogicTripleFB |
| Description | Controls three delay lines |
| Input argument | Name: RequestType: SaveRestoreEnumDescription: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogic1OutType: DelayLogicOutStructDescription: Output hardware structure for 1st delay line |
| Output argument  | Name: DelayLogic2OutType: DelayLogicOutStructDescription: Output hardware structure for 2nd delay line |
| Output argument  | Name: DelayLogic3OutType: DelayLogicOutStructDescription: Output hardware structure for 3rd delay line |
| In/out argument | Name: DelayLogicInitType: DelayLogicTripleStructDescription: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogicType: DelayLogicTripleStructDescription: User Interface structure |

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| **Function Block**FUNCTION\_BLOCK DelayLogicQuadFBVAR\_INPUT Request: SaveRestoreEnum;END\_VARVAR\_OUTPUTDelayLogic1Out: DelayLogicOutStruct;DelayLogic2Out: DelayLogicOutStruct;DelayLogic3Out: DelayLogicOutStruct;END\_VARVAR\_IN\_OUT DelayLogicInit: DelayLogicQuadStruct; DelayLogic: DelayLogicQuadStruct;END\_VAR |
| Name | DelayLogicQuadFB |
| Description | Controls four delay lines |
| Input argument | Name: RequestType: SaveRestoreEnumDescription: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogic1OutType: DelayLogicOutStructDescription: Output hardware structure for 1st delay line |
| Output argument  | Name: DelayLogic2OutType: DelayLogicOutStructDescription: Output hardware structure for 2nd delay line |
| Output argument  | Name: DelayLogic3OutType: DelayLogicOutStructDescription: Output hardware structure for 3rd delay line |
| Output argument  | Name: DelayLogic4OutType: DelayLogicOutStructDescription: Output hardware structure for 4th delay line |
| In/out argument | Name: DelayLogicInitType: DelayLogicQuadStructDescription: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogicType: DelayLogicQuadStructDescription: User Interface structure |

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| **Visual** |
| Name | DelayLogicVis |
| Description | Displays phase, steps, and delay |
| Placeholder | Name: DelayLogicType: DelayLogicStructDescription: Delay Line structure |