*LIGO Laboratory / LIGO Scientific Collaboration*

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TwinCAT Library for   
Delay Line

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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\_STRUCT  END\_TYPE | |
| Type name | DelayLogicOutStruct |
| Description | Structure of the hardware output that are wired up for the delay line |
| Definition | STRUCT |
| Element | Name: DelayStep  Type: INT  Description: The delay line step slider |
| Element | Name: LatchEn  Type: BOOL  Description: 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 \*)  STRUCT  FreqMHz: LREAL;  PhaseDeg: LREAL;  DelayNs: LREAL;  DelayStep: INT;  Error: ErrorStruct;  END\_STRUCT  END\_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: Error  Type: ErrorStruct  Description: For error handling |
| Input Tag | Name: FreqMHz  Type: LREAL  Description: Input frequency in MHz |
| In/out Tag | Name: PhaseDeg  Type: LREAL  Description: Input phase in degrees, between 0 and 360º. |
| In/out Tag | Name: DelayNs  Type: LREAL  Description: 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: DelayStep  Type: INT  Description: 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 DelayLogicFB  VAR\_INPUT  Request: SaveRestoreEnum;  END\_VAR  VAR\_OUTPUT  DelayLogicOut: DelayLogicOutStruct;  END\_VAR  VAR\_IN\_OUT  DelayLogicInit: DelayLogicStruct;  DelayLogic: DelayLogicStruct;  END\_VAR | |
| Name | DelayLogicFB |
| Description | Controls a single delay line |
| Input argument | Name: Request  Type: SaveRestoreEnum  Description: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogicOut  Type: DelayLogicOutStruct  Description: Output hardware structure |
| In/out argument | Name: DelayLogicInit  Type: DelayLogicStruct  Description: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogic  Type: DelayLogicStruct  Description: User Interface structure |

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| **Function Block**  FUNCTION\_BLOCK DelayLogicDoubleFB  VAR\_INPUT  Request: SaveRestoreEnum;  END\_VAR  VAR\_OUTPUT  DelayLogic1Out: DelayLogicOutStruct;  DelayLogic2Out: DelayLogicOutStruct;  END\_VAR  VAR\_IN\_OUT  DelayLogicInit: DelayLogicDoubleStruct;  DelayLogic: DelayLogicDoubleStruct;  END\_VAR | |
| Name | DelayLogicDoubleFB |
| Description | Controls two delay lines |
| Input argument | Name: Request  Type: SaveRestoreEnum  Description: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogic1Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 1st delay line |
| Output argument | Name: DelayLogic2Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 2nd delay line |
| In/out argument | Name: DelayLogicInit  Type: DelayLogicDoubleStruct  Description: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogic  Type: DelayLogicDoubleStruct  Description: User Interface structure |

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| **Function Block**  FUNCTION\_BLOCK DelayLogicTripleFB  VAR\_INPUT  Request: SaveRestoreEnum;  END\_VAR  VAR\_OUTPUT  DelayLogic1Out: DelayLogicOutStruct;  DelayLogic2Out: DelayLogicOutStruct;  DelayLogic3Out: DelayLogicOutStruct;  END\_VAR  VAR\_IN\_OUT  DelayLogicInit: DelayLogicTripleStruct;  DelayLogic: DelayLogicTripleStruct;  END\_VAR | |
| Name | DelayLogicTripleFB |
| Description | Controls three delay lines |
| Input argument | Name: Request  Type: SaveRestoreEnum  Description: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogic1Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 1st delay line |
| Output argument | Name: DelayLogic2Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 2nd delay line |
| Output argument | Name: DelayLogic3Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 3rd delay line |
| In/out argument | Name: DelayLogicInit  Type: DelayLogicTripleStruct  Description: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogic  Type: DelayLogicTripleStruct  Description: User Interface structure |

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| **Function Block**  FUNCTION\_BLOCK DelayLogicQuadFB  VAR\_INPUT  Request: SaveRestoreEnum;  END\_VAR  VAR\_OUTPUT  DelayLogic1Out: DelayLogicOutStruct;  DelayLogic2Out: DelayLogicOutStruct;  DelayLogic3Out: DelayLogicOutStruct;  END\_VAR  VAR\_IN\_OUT  DelayLogicInit: DelayLogicQuadStruct;  DelayLogic: DelayLogicQuadStruct;  END\_VAR | |
| Name | DelayLogicQuadFB |
| Description | Controls four delay lines |
| Input argument | Name: Request  Type: SaveRestoreEnum  Description: Request save/restore/safemode or noop |
| Output argument | Name: DelayLogic1Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 1st delay line |
| Output argument | Name: DelayLogic2Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 2nd delay line |
| Output argument | Name: DelayLogic3Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 3rd delay line |
| Output argument | Name: DelayLogic4Out  Type: DelayLogicOutStruct  Description: Output hardware structure for 4th delay line |
| In/out argument | Name: DelayLogicInit  Type: DelayLogicQuadStruct  Description: Save/restore variable in persistent memory |
| In/out argument | Name: DelayLogic  Type: DelayLogicQuadStruct  Description: User Interface structure |

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| **Visual** | |
| Name | DelayLogicVis |
| Description | Displays phase, steps, and delay |
| Placeholder | Name: DelayLogic  Type: DelayLogicStruct  Description: Delay Line structure |