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Beam Diverter Library documentation

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LIGO Scientific Collaboration

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| **Library** |
| Title | BeamDiverter |
| Version | 1 |
| TwinCAT version | 2.11.0 |
| Name space |  |
| Author | Sheila Dwyer and Jax Sanders |
| Description | Controls a beam diverter D1100642. The beam diverter moves an optic into or out of a beam using a coil and magnets. There are two reed switches that sense the current position of the beam diverter. The coil current is driven by the beckhoff module EL7332. According to T1100252-v2 the beam diverter needs about half of an Amp of current. The EL7332 used in the “direct velocity” mode, with the Motor nominal resistance set to 10 Ohms, produces 1mA per 0.066 units of “velocity” when a 10 Ohm resistor and 330uH inductor are attached. The maximum current seems to be 1 Amp, or -1.2 Amps, reached for velocity settings above ±20,000.The readbacks under info setting for both coil current and voltage do not work, at least not in the direct velocity operating mode. To move the beam diverter this library sets the velocity to ±7250 when the user asks to either open or close the beam diverter, applies this voltage for 5 seconds then uses the reed switches to check that the beam diverter has moved. The time could be shortened if desired. Each beam diverter can be locked (the DC motor disabled).  |
| Error Code | 0x0001 Beam diverter open/close error0x0002 Beam diverter was stopped0x0004 DC motor controller error (Beckhoff module EL7332) |

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| **Hardware Input Type**TYPE BeamDiverterInStruct :STRUCT ClosedPositionSwitch: BOOL; (\* closed position reed switch \*) OpenPositionSwitch: BOOL; (\* open position reed switch \*) DCMReady: BOOL; DCMWarning: BOOL; DCMError: BOOL;END\_STRUCTEND\_TYPE; |
| Type name | BeamDiverterInStruct |
| Description | Structure of the hardware inputs that mapped into the EtherCAT memory space by the EtherCAT-to-Modbus gateway. There are two switches used as sensors for a readback of the diverter position , and readbacks from the DC motor controller.  |
| Definition | STRUCT |
| Element | Name: ClosedPositionSwitchType: BOOLDescription: Indicates that beam diverter is closed |
| Element | Name: OpenPostionSwitchType: BOOLDescription: Indicates that beam diverter is open |
| Element | Name: DCMReadyType: BOOLDescription: Readback from EL7332 indicating that the motor is ready |
| Element | Name: DCMWarningType: BOOLDescription: Readback from EL7332 indicating that the motor is ready |
| Element | Name: DCMErrorType: BOOLDescription: Readback from EL7332 indicating that the motor has an error |

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| **Hardware Output Type**TYPE BeamDiverterOutStruct :STRUCT DCMVelocity: INT:=0.0; DCMEnable: BOOL;END\_STRUCTEND\_TYPE; |
| Type name | BeamDiverterOut |
| Description | Structure of the hardware output that is mapped into the EtherCAT memory space by the EtherCAT-to-Modbus gateway.  |
| Definition | STRUCT |
| Element | Name: DCMVelocityType: INTDescription: Proportional to the current through the coil.  |
| Element | Name: DCMEnableType: BOOLDescription: Enables the DCM |

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| **Enumerated Type**TYPE BDivPositionEnum : (BDivOpen, DivClosed, BDivUnknown);END\_TYPE |
| Type Name | BDivPositionEnum |
| Description | Specifies the beam diverter position |
| Definition | ENUM |
| Element | Name: BDivOpenDescription: Beam diverter is open |
| Element | Name: DivClosedDescription: Beam diverter is closed |
| Element | Name: BDivUnknownDescription: The beam diverter state is unknown |

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| **Enumerated Type**TYPE NonWorkingSwitchEnum : (BDivNone, BDivOpenSwitch, BDivClosedSwitch);END\_TYPE; |
| Type Name | NonWorkingSwitchEnum |
| Description | Specifies if the beam diverter has a broken switch |
| Definition | ENUM |
| Element | Name: BDivNoneDescription: Switches are good |
| Element | Name: BDivOpenSwitchDescription: Open switch is broken |
| Element | Name: BDivClosedSwitchDescription: Closed switch is broken |

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| **Enumerated Type**TYPE BDivActivityEnum : (BDivInactive , BDivOpening, BDivClosing, BDivStopped);END\_TYPE; |
| Type Name | BDivActivityEnum |
| Description | Specifies the current activity of the beam diverter  |
| Definition | ENUM |
| Element | Name: BDivInactiveDescription: No activity by beam diverter |
| Element | Name: BDivOpeningDescription: Opening the beam diverter |
| Element | Name: BDivClosingDescription: Closing the beam diverter |
| Element | Name: BDivStoppedDescription: Beam diverter state change was stopped by user |

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| **User Interface Type**TYPE BeamDiverterStruct :STRUCT Error: ErrorStruct; Open: BOOL; Close: BOOL; Stop: BOOL; OpenSwitch: BOOL; ClosedSwitch: BOOL; Position: BDivPositionEnum; Busy: BOOL; Activity: BDivActivityEnum; Locked: BOOL; Message: STRING; FailedAttempts: INT; ResetFailedAttempts: BOOL; NonWorkingSwitch: NonWorkingSwitchEnum; AlternativeBeam: BOOL; CoilPolarity: BOOL;END\_STRUCTEND\_TYPE; |
| Type name | BeamDiverterStruct |
| Description | User interface variables for controlling a beam diverter |
| Definition | STRUCT |
| Output tags | Name: ErrorType: ErrorStructDescription: Errors |
| Input tags | Name: OpenType: BOOLDescription: Request to move to open position |
| Input tags | Name: CloseType: BOOLDescription: Request to move beam diverter to close position |
| Output tags | Name: OpenSwitchType: BOOLDescription: Beam diverter is in the open position |
| Output tags | Name: ClosedSwitchType: BOOLDescription: Beam diverter is in the closed position |
| Output tags | Name: PositionType: BDivPositionEnumDescription: Position of the beam diverter |
| Output tags | Name: BusyType: BOOLDescription: Beam diverter is busy (moving) |
| Output tags | Name: ActivityType: BDivActivityEnumDescription: position of the beam diverter |
| Output tags | Name: LockedType: BOOLDescription: Disable DC motor controller |
| Output tags | Name: MessageType: StringDescription: A message displays weather the beam diverter is ready to be moved, or waiting for a move to finish.  |
| Output tags | Name: FailedAttemptsType: INTDescription: Count of times the beam diverter has tried to move unsucsefully |
| Input tags | Name: ResetFailedAttemptsType: BOOLDescription: Set count back to zero |
| Output tags | Name: NonWorkingSwitchType: NonWorkingSwitchEnumDescription: Describes the broken switch , if any |
| Output tags | Name: AlternativeBeamType: BOOLDescription: The beam diverter uses the alternative configuration to pass the beam through, ie., open is closed. |
| Output tags | Name: CoilPolarityType: BOOLDescription: Coil actuator has opposite polarity |

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| **Function Block**FUNCTION\_BLOCK BeamDiverterFBVAR\_INPUT Request: SaveRestoreEnum; BeamDiverterIn: BeamDiverterInStruct; NonWorkingSwitch: NonWorkingSwitchEnum := BDivNone; AlternativeBeam: BOOL := FALSE; CoilPolarity: BOOL := FALSE; END\_VARVAR\_OUTPUT BeamDiverterOut: BeamDiverterOutStruct;END\_VARVAR\_IN\_OUT BeamDiverter: BeamDiverterStruct; BeamDiverterInit: BeamDiverterStruct;END\_VARVAR ErrorB: BOOL; ErrorCode: DWORD; ErrorMsg: STRING; ErrorHandler: ErrorHandlerFB; TimerIndex: INT :=0;END\_VAR |
| Name | BeamDiverterFB |
| Description | Controls a single beam diverter.  |
| Input argument | Name: RequestType: SaveRestoreEnumDescription: Save/restore request |
| Input argument | Name:BeamDiverterInType:BeamDiverterInStructDescription: Hardware inputs (sensor readouts) |
| Input argument | Name: NonWorkingSwitchType: NonWorkingSwitchEnumDescription: Describes the broken switch , if any |
| Input argument | Name: AlternativeBeamType: BOOLDescription: The beam diverter uses the alternative configuration to pass the beam through, ie., open is closed. |
| Input argument | Name: CoilPolarityType: BOOLDescription: Coil actuator has opposite polarity |
| Output argument | Name: BeamDiverterOutType:BeamDiverterOutStructDescription: Hardware outout (coil voltage) |
| In/out argument | Name:BeamDiverterType: BeamDiverterStructDescription:User interface inputs and outputs |
| In/out argument | Name:BeamDiverterInitType: BeamDiverterStructDescription:User interface initialization |

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| **Visual** |
| Name | BeamDiverterVis |
| Description | Displays current position, as well as the readout of both sensors, error messages, a message indicating if the diverter is ready to move or waiting for a move to complete, and the number of times the beam diverter has failed to move when requested. Also has inputs to request that the beam diverter opens, closes, or flips position, and to reset the count of failed attempts to move.  |
| Placeholder | Name:$BeamDiverter$Type:BeamDiverterStructDescription: |