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TwinCAT Library for ALS State Machine

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| **Library** |
| Title | ALSStateEnums, ALSStateMachine, ALSEndStateMachine |
| Version | 1 |
| TwinCAT version | 2.11 |
| Name space |  |
| Author | Daniel Sigg |
| Description | Monitors the state of the ALS machines; reports the state of end station locking |
| Error Code | ALSStateEnums: noneALSStateMachine:ALSLockStruct:1 — No communication from X2 — No communication from YCommDiffStruct:1 — X Arm2 — TR\_X limit not set3 — TR\_X4 — COMM BBPD DC limit not set5 — COMM BBPD6 — COMM PFD7 — COMM beat note RF power8 — SHG9 — PLL10 — CommALSEndStateMachine: ALSLockEndStruct:1 — No communication from corner PLC22 — PLL3 — PDH |
| Library Dependencies | ALSStateEnums: noneALSStateMachine: SaveRestore, Error, ReadADC, WriteDAC, ALSStateEnums, DCPower, Photodetectors, LowNoiseVco, PLLforVCO, TECController, SHG, FiberDistribution, DelayLogic, IscWhitening, DemodulatorALSEndStateMachine: SaveRestore, Error, ReadADC, WriteDAC, ALSStateEnums, ALSCommunication, RtCommunications, DCPower, Photodetectors, ALSLaser, LowNoiseVco, DelayLogic, IscWhitening, RFAmplifier, Demodulator, CommonMode, ALSLaserLocking, ALSPDHLocking |

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| **Enumerated type (ALSStateEnums)**TYPE ALSCornerStateEnum :(ALSCornerUnlocked, ALSCornerInvalidState);END\_TYPE |
| Type name | ALSCornerStateEnum |
| Description | Enumerates over corner ALS lock states |
| Definition | ENUM |
| Element | Name: ALSCornerUnlockedDescription: Unlocked |
| Element | Name: ALSCornerInvalidStateDescription: Invalid |

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| **Enumerated type (ALSStateEnums)**TYPE ALSEndStateEnum : (ALSEndSMDisabled, ALSEndUnlocked, ALSEndPLLLocked, ALSEndLocked, ALSEndSlowEngaged, ALSEndTransition, ALSEndRedLocked, ALSEndInvalidState);END\_TYPE |
| Type name | ALSEndStateEnum |
| Description | Enumerates over end ALS lock states. For tidal see [T1400733](https://dcc.ligo.org/LIGO-T1400733). |
| Definition | ENUM |
| Element | Name: ALSEndSMDisabledDescription: Disabled |
| Element | Name: ALSEndUnlockedDescription: Unlocked |
| Element | Name: ALSEndPLLLockedDescription: PLL Locked |
| Element | Name: ALSEndLockedDescription: End Locked |
| Element | Name: ALSEndSlowEngagedDescription: Slow Engaged |
| Element | Name: ALSEndTransitionDescription: Transition |
| Element | Name: ALSEndRedLockedDescription: Red Locked |
| Element | Name: ALSEndInvalidStateDescription: Invalid |

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| **Enumerated type (ALSStateEnums)**TYPE TidalCmdEnum : (TidalCmdUnlocked := 0, TidalCmdEndLocked := 1, TidalCmdSlowEngaged := 2, TidalCmdTransition := 3, TidalCmdRedLocked := 4);END\_TYPE |
| Type name | TidalCmdEnum |
| Description | Enumerates over end tidal commands, see [T1400733](https://dcc.ligo.org/LIGO-T1400733). |
| Definition | ENUM |
| Element | Name: TidalCmdUnlockedDescription: Unlocked |
| Element | Name: TidalCmdEndLockedDescription: End Locked |
| Element | Name: TidalCmdSlowEngagedDescription: Slow Engaged |
| Element | Name: TidalCmdTransitionDescription: Transition |
| Element | Name: TidalCmdRedLockedDescription: Red Locked |

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| **User Interface Type (ALSEndStateMachine)**TYPE ALSLockEndStruct :STRUCT Error: ErrorStruct; Enable: BOOL; StateRequest: ALSEndStateEnum; State: ALSEndStateEnum;END\_STRUCT;END\_TYPE; |
| Type Name | ALSLockEndStruct |
| Description | Structure used in the user interface type to monitor the end station locking  |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: Error Handling |
| Input Tag | Name: EnableType: BOOLDescription: Enable button |
| Input Tag | Name: StateRequestType: LREALDescription: Request a state for the ALS end machine |
| Output Tag | Name: StateType: ALSEndStateEnumDescription: End station locking state |

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| **User Interface Type (ALSStateMachine)**TYPE CommDiffStruct:STRUCT Error: ErrorStruct; Ready: BOOL; RFMin: LREAL;END\_STRUCT;END\_TYPE; |
| Type Name | CommDiffStruct |
| Description | Structure used in the user interface to monitor ALS corner PLLs  |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: Error Handling |
| Output Tag | Name: ReadyType: BOOLDescription: Pre-conditions for COMM/DIFF handoff |
| Input Tag | Name: RFMinType: LREALDescription: Beat note threshold (dBm) |

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| **User Interface Type (ALSStateMachine)**TYPE ALSLockStruct :STRUCT Error: ErrorStruct; RequestX: ALSEndStateEnum; RequestY: ALSEndStateEnum; StateX: ALSEndStateEnum; StateY: ALSEndStateEnum; Overall: ALSCornerStateEnum; Comm: CommDiffStruct; Diff: CommDiffStruct;END\_STRUCT;END\_TYPE; |
| Type Name | ALSLockStruct |
| Description | Structure used in the user interface type to monitor the corner station locking  |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: Error Handling |
| Input Tag | Name: RequestXType: ALSEndStateEnumDescription: Request a state for the ALS EX machine |
| Input Tag | Name: RequestYType: ALSEndStateEnumDescription: Request a state for the ALS EY machine |
| Output Tag | Name: StateXType: ALSEndStateEnumDescription: EX station locking state |
| Output Tag | Name: StateYType: ALSEndStateEnumDescription: EY station locking state |
| Output Tag | Name: OverallType: ALSCornerStateEnumDescription: Corner station locking state |
| In/Out Tag | Name: CommType: CommDiffStructDescription: Monitors the common mode ALS |
| In/Out Tag | Name: DiffType: CommDiffStructDescription: Monitors the differential mode ALS |

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| **Function Block (ALSEndStateMachine)**FUNCTION\_BLOCK ALSCornerStateMachineFBVAR\_IN\_OUT PLLLocking: ALSLaserLockingStruct; PDHLocking; ALSPDHLockingStruct; ALSEndLock: ALSLockEndStruct; ALSEndLockInit: ALSLockEndStruct;END\_VARVAR\_INPUT CommunicationError: ErrorStruct; Request: SaveRestoreEnum;END\_VAR |
| Type Name | ALSStateMachineEndFB |
| Description | Function block used to control the end station ALS state machine  |
| Definition | Function Block |
| In/out Argument | Name: PLLLockingType: ALSLaserLockingStructDescription: User interface structure to monitor PLL locking |
| In/out Argument | Name: PDHLockingType: ALSPDHLockingStructDescription: User interface structure to monitor PDH locking |
| In/out Argument | Name: ALSEndLockType: ALSLockEndStructDescription: User interface structure |
| In/out Argument | Name: ALSEndLockInitType: ALSLockEndStructDescription: User interface structure for save/restore |
| Input Argument | Name: CommunicationErrorType: ErrorStructDescription: Indicates a communication error with the front-end |
| Input Argument | Name: RequestType: SaveRestoreEnumDescription: Save/restore request |

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| **Function Block (ALSStateMachine)**FUNCTION\_BLOCK ALSCornerStateMachineFBVAR\_IN\_OUT Lock: ALSLockStruct; LockInit: ALSLockStruct;END\_VARVAR\_INPUT Request: SaveRestoreEnum; CommunicationX: ErrorStruct; CommunicationY: ErrorStruct; Tr\_X: DCPowerStruct; Tr\_Y: DCPowerStruct; Comm\_A: LsSimpleStruct; Diff\_A: LsSimpleStruct; SHGStat: SHGStatStruct; Comm\_PLL: PLLforVCOStruct; Diff\_PLL: PLLforVCOStruct; EndXReportedState: ALSEndStateEnum; EndYReportedState: ALSEndStateEnum;END\_VAR |
| Type Name | ALSStateMachineEndFB |
| Description | Function block used to control the corner station ALS state machine  |
| Definition | Function Block |
| In/out Argument | Name: LockType: ALSLockStructDescription: User interface structure |
| In/out Argument | Name: LockInitType: ALSLockStructDescription: User interface structure for save/restore |
| Input Argument | Name: RequestType: SaveRestoreEnumDescription: Save/restore request |
| Input Argument | Name: CommunicationXType: ErrorStructDescription: Communication errors from end X |
| Input Argument | Name: CommunicationYType: ErrorStructDescription: Communication errors from end X |
| Input Argument | Name: Tr\_XType: DCPowerStructDescription: Transmitted green power X arm |
| Input Argument | Name: Tr\_YType: DCPowerStructDescription: Transmitted green power Y arm |
| Input Argument | Name: Comm\_AType: LsSimpleStructDescription: ALS common mode DC PD |
| Input Argument | Name: Diff\_AType: LsSimpleStructDescription: ALS differential mode DC PD |
| Input Argument | Name: SHGStatType: SHGStatStructDescription: Information about the SHG |
| Input Argument | Name: Comm\_PLLType: PLLforVCOStructDescription: Information about the common mode PLL |
| Input Argument | Name: Diff\_PLLType: PLLforVCOStructDescription: Information about the differrntial mode PLL |
| Input Argument | Name: EndXReportedStateType: ALSEndStateEnumDescription: Reported ALS state from End X |
| Input Argument | Name: EndYReportedStateType: ALSEndStateEnumDescription: Reported ALS state from End Y |