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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: none  ALSStateMachine:  ALSLockStruct:  1 — No communication from X  2 — No communication from Y  CommDiffStruct:  1 — X Arm  2 — TR\_X limit not set  3 — TR\_X  4 — COMM BBPD DC limit not set  5 — COMM BBPD  6 — COMM PFD  7 — COMM beat note RF power  8 — SHG  9 — PLL  10 — Comm  ALSEndStateMachine:  ALSLockEndStruct:  1 — No communication from corner PLC2  2 — PLL  3 — PDH |
| Library Dependencies | ALSStateEnums: none  ALSStateMachine: SaveRestore, Error, ReadADC, WriteDAC, ALSStateEnums, DCPower, Photodetectors, LowNoiseVco, PLLforVCO, TECController, SHG, FiberDistribution, DelayLogic, IscWhitening, Demodulator  ALSEndStateMachine: 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: ALSCornerUnlocked  Description: Unlocked |
| Element | Name: ALSCornerInvalidState  Description: 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: ALSEndSMDisabled  Description: Disabled |
| Element | Name: ALSEndUnlocked  Description: Unlocked |
| Element | Name: ALSEndPLLLocked  Description: PLL Locked |
| Element | Name: ALSEndLocked  Description: End Locked |
| Element | Name: ALSEndSlowEngaged  Description: Slow Engaged |
| Element | Name: ALSEndTransition  Description: Transition |
| Element | Name: ALSEndRedLocked  Description: Red Locked |
| Element | Name: ALSEndInvalidState  Description: 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: TidalCmdUnlocked  Description: Unlocked |
| Element | Name: TidalCmdEndLocked  Description: End Locked |
| Element | Name: TidalCmdSlowEngaged  Description: Slow Engaged |
| Element | Name: TidalCmdTransition  Description: Transition |
| Element | Name: TidalCmdRedLocked  Description: 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: Error  Type: ErrorStruct  Description: Error Handling |
| Input Tag | Name: Enable  Type: BOOL  Description: Enable button |
| Input Tag | Name: StateRequest  Type: LREAL  Description: Request a state for the ALS end machine |
| Output Tag | Name: State  Type: ALSEndStateEnum  Description: 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: Error  Type: ErrorStruct  Description: Error Handling |
| Output Tag | Name: Ready  Type: BOOL  Description: Pre-conditions for COMM/DIFF handoff |
| Input Tag | Name: RFMin  Type: LREAL  Description: 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: Error  Type: ErrorStruct  Description: Error Handling |
| Input Tag | Name: RequestX  Type: ALSEndStateEnum  Description: Request a state for the ALS EX machine |
| Input Tag | Name: RequestY  Type: ALSEndStateEnum  Description: Request a state for the ALS EY machine |
| Output Tag | Name: StateX  Type: ALSEndStateEnum  Description: EX station locking state |
| Output Tag | Name: StateY  Type: ALSEndStateEnum  Description: EY station locking state |
| Output Tag | Name: Overall  Type: ALSCornerStateEnum  Description: Corner station locking state |
| In/Out Tag | Name: Comm  Type: CommDiffStruct  Description: Monitors the common mode ALS |
| In/Out Tag | Name: Diff  Type: CommDiffStruct  Description: Monitors the differential mode ALS |

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| **Function Block (ALSEndStateMachine)**  FUNCTION\_BLOCK ALSCornerStateMachineFB  VAR\_IN\_OUT  PLLLocking: ALSLaserLockingStruct;  PDHLocking; ALSPDHLockingStruct;  ALSEndLock: ALSLockEndStruct;  ALSEndLockInit: ALSLockEndStruct;  END\_VAR  VAR\_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: PLLLocking  Type: ALSLaserLockingStruct  Description: User interface structure to monitor PLL locking |
| In/out Argument | Name: PDHLocking  Type: ALSPDHLockingStruct  Description: User interface structure to monitor PDH locking |
| In/out Argument | Name: ALSEndLock  Type: ALSLockEndStruct  Description: User interface structure |
| In/out Argument | Name: ALSEndLockInit  Type: ALSLockEndStruct  Description: User interface structure for save/restore |
| Input Argument | Name: CommunicationError  Type: ErrorStruct  Description: Indicates a communication error with the front-end |
| Input Argument | Name: Request  Type: SaveRestoreEnum  Description: Save/restore request |

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| **Function Block (ALSStateMachine)**  FUNCTION\_BLOCK ALSCornerStateMachineFB  VAR\_IN\_OUT  Lock: ALSLockStruct;  LockInit: ALSLockStruct;  END\_VAR  VAR\_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: Lock  Type: ALSLockStruct  Description: User interface structure |
| In/out Argument | Name: LockInit  Type: ALSLockStruct  Description: User interface structure for save/restore |
| Input Argument | Name: Request  Type: SaveRestoreEnum  Description: Save/restore request |
| Input Argument | Name: CommunicationX  Type: ErrorStruct  Description: Communication errors from end X |
| Input Argument | Name: CommunicationY  Type: ErrorStruct  Description: Communication errors from end X |
| Input Argument | Name: Tr\_X  Type: DCPowerStruct  Description: Transmitted green power X arm |
| Input Argument | Name: Tr\_Y  Type: DCPowerStruct  Description: Transmitted green power Y arm |
| Input Argument | Name: Comm\_A  Type: LsSimpleStruct  Description: ALS common mode DC PD |
| Input Argument | Name: Diff\_A  Type: LsSimpleStruct  Description: ALS differential mode DC PD |
| Input Argument | Name: SHGStat  Type: SHGStatStruct  Description: Information about the SHG |
| Input Argument | Name: Comm\_PLL  Type: PLLforVCOStruct  Description: Information about the common mode PLL |
| Input Argument | Name: Diff\_PLL  Type: PLLforVCOStruct  Description: Information about the differrntial mode PLL |
| Input Argument | Name: EndXReportedState  Type: ALSEndStateEnum  Description: Reported ALS state from End X |
| Input Argument | Name: EndYReportedState  Type: ALSEndStateEnum  Description: Reported ALS state from End Y |