



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Advanced LIGO

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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	<p>ALSStateEnums: none</p> <p>ALSStateMachine:</p> <p> ALSLockStruct:</p> <p> 1 — No communication from X</p> <p> 2 — No communication from Y</p> <p> CommDiffStruct:</p> <p> 1 — X Arm</p> <p> 2 — TR_X limit not set</p> <p> 3 — TR_X</p> <p> 4 — COMM BBPD DC limit not set</p> <p> 5 — COMM BBPD</p> <p> 6 — COMM PFD</p> <p> 7 — COMM beat note RF power</p> <p> 8 — SHG</p> <p> 9 — PLL</p> <p> 10 — Comm</p> <p>ALSEndStateMachine:</p> <p> ALSLockEndStruct:</p> <p> 1 — No communication from corner PLC2</p> <p> 2 — PLL</p> <p> 3 — PDH</p>
Library Dependencies	<p>ALSStateEnums: none</p> <p>ALSStateMachine: SaveRestore, Error, ReadADC, WriteDAC, ALSStateEnums, DCPower, Photodetectors, LowNoiseVco, PLLforVCO, TECController, SHG, FiberDistribution, DelayLogic, IscWhitening, Demodulator</p> <p>ALSEndStateMachine: SaveRestore, Error, ReadADC, WriteDAC, ALSStateEnums, ALSCommunication, RtCommunications, DCPower, Photodetectors, ALSLaser, LowNoiseVco, DelayLogic, IscWhitening, RFAmplifier, Demodulator, CommonMode, ALSLaserLocking, ALSPDHLocking</p>

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

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 .
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

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 .
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

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

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)

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

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

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

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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 differntial 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