



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Advanced LIGO

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**TwinCAT Library for the
ALS Laser**

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Library	
Title	ALSLaser
Version	4
TwinCAT version	2.11
Name space	–
Author	Alexa Staley, Daniel Sigg
Description	Monitors the ALS Laser Contains parameters to control the noise eater and the laser crystal temperature
Error codes	0x0001 – Safety interlock engaged 0x0002 – Laser diode 1 guard alarm 0x0004 – Laser diode 2 guard alarm 0x0008 – Laser diode 1 current out-of-range 0x0010 – Laser diode 2 current out-of-range 0x0020 – Laser crystal TEC error signal out-of-range 0x0040 – Doubler crystal TEC error signal out-of-range 0x0080 – Laser diode 1 TEC error signal out-of-range 0x0100 – Laser diode 2 TEC error signal out-of-range 0x0200 – Noise eater readback signal out-of-range 0x0400 – Noise eater relay off
Library dependencies	ReadADC, WriteADC, SaveRestore, Error

Hardware Input Type	
TYPE ALSLaserInStruct :	
STRUCT	
LaserDiode1PowerMonitor: INT;	
LaserDiode2PowerMonitor: INT;	
LaserCrystalTECErrorSignal: INT;	
DoublingCrystalTECErrorSignal: INT;	
LaserDiode1TECErrorSignal: INT;	
LaserDiode2TECErrorSignal: INT;	
NoiseEaterMonitor: INT;	
LaserDiode1TempGuard: BOOL;	
LaserDiode2TempGuard: BOOL;	
InterLock: BOOL;	
END_STRUCT	
END_TYPE	
Type name	ALSLaserInStruct
Description	Structure of the hardware input that are wired up for the ALS laser
Definition	STRUCT
Element	Name: LaserDiode1PowerMonitor Type: INT Description: Laser diode 1 power monitor
Element	Name: LaserDiode2PowerMonitor Type: INT Description: Laser diode 2 power monitor
Element	Name: LaserCrystalTECErrorSignal Type: INT Description: Laser crystal, TEC error signal
Element	Name: DoublingCrystalTECErrorSignal Type: INT Description: Doubling crystal, TEC error signal
Element	Name: LaserDiode1TECErrorSignal Type: INT Description: Laser diode 1, TEC error signal
Element	Name: LaserDiode2TECErrorSignal Type: INT Description: Laser diode 2, TEC error signal
Element	Name: NoiseEaterMonitor Type: INT Description: Noise eater monitor

Element	Name: LaserDiode1TempGuard Type: BOOL Description: Laser diode 1, temp guard
Element	Name: LaserDiode2TempGuard Type: BOOL Description: Laser diode 2, temp guard
Element	Name: InterLock Type: BOOL Description: InterLock

Hardware Output Type TYPE ALSLaserOutStruct : STRUCT CrystalTemperature: INT; DoublerTemperature: INT; NoiseEaterRelayOn: BOOL; NoiseEaterRelayOff: BOOL; END_STRUCT END_TYPE	
Type name	ALSLaserOutStruct
Description	Structure of the hardware output that are wired up for the ALS laser
Definition	STRUCT
Element	Name: CrystalTemperature Type: INT Description: Crystal Temperature
Element	Name: DoublerTemperature Type: INT Description: Doubler Temperature
Element	Name: NoiseEaterRelayOn Type: BOOL Description: Used to turn the noise eater on/off
Element	Name: NoiseEaterRelayOff Type: BOOL Description: Unused

Auxiliary Type TYPE ALSLaserModelEnum : (Mephisto, Prometheus); END_TYPE	
Type name	ALSLaserModelEnum
Description	Enumerated type describing the laser model
Definition	ENUM
Element	Name: Mephisto Description: Mephisto laser
Element	Name: Prometheus Description: Prometheus laser

User Interface Type

TYPE ALSLaserStruct :

STRUCT

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    Error:                ErrorStruct;
    Model:                ALSLaserModelEnum;
    LaserDiode1PowerMonitor:  LREAL;
    LaserDiode2PowerMonitor:  LREAL;
    LaserDiodePowerNominal:    LREAL;
    LaserDiodePowerTolerance:  LREAL;
    LaserCrystalTECErrSignal:  LREAL;
    DoublingCrystalTECErrSignal: LREAL;
    LaserDiode1TECErrSignal:   LREAL;
    LaserDiode2TECErrSignal:   LREAL;
    TECTolerance:           LREAL;
    NoiseEaterMonitor:      LREAL;
    NoiseEaterNominal:      LREAL;
    NoiseEaterTolerance:    LREAL;
    NoiseEaterRelay:        BOOL;
    NoiseEaterRelayNom:     BOOL;
    LaserDiode1TempGuard:   BOOL;
    LaserDiode2TempGuard:   BOOL;
    InterLock:              BOOL;
    CrystalTemperature:     LREAL;
    CrystalCalibration:     LREAL;
    CrystalFrequency:       LREAL;
    PZTTuningCoefficient:   LREAL;
    PZTFrequency:          LREAL;
    DoublerTemperature:     LREAL;

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END_STRUCT

END_TYPE

Type name	ALSLaserStruct
Description	Structure of the user interface tags that are used to control the ALS Laser
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: For error handler
Output Tag	Name: Model Type: ALSLaserModelEnum Description: Laser model
Output Tag	Name: LaserDiode1PowerMonitor Type: LREAL Description: Laser diode 1 power monitor in A

Output Tag	Name: LaserDiode2PowerMonitor Type: LREAL Description: Laser diode 2 power monitor in A
Input Tag	Name: LaserDiodePowerNominal Type: LREAL Description: Laser diode power nominal in A
Input Tag	Name: LaserDiodePowerTolerance Type: LREAL Description: Laser diode power tolerance in A
Output Tag	Name: LaserCrystalTECErrorSignal Type: LREAL Description: Laser crystal, TEC error signal in C
Output Tag	Name: DoublingCrystalTECErrorSignal Type: LREAL Description: Doubling crystal, TEC error signal in C
Output Tag	Name: LaserDiode1TECErrorSignal Type: LREAL Description: Laser diode 1, TEC error signal in C
Output Tag	Name: LaserDiode2TECErrorSignal Type: LREAL Description: Laser diode 2, TEC error signal in C
Input Tag	Name: TECTolerance Type: LREAL Description: TEC error signal tolerance in C
Output Tag	Name: NoiseEaterMonitor Type: LREAL Description: Noise eater monitor in V
Input Tag	Name: NoiseEaterNominal Type: LREAL Description: Noise eater nominal value in V
Input Tag	Name: NoiseEaterTolerance Type: LREAL Description: Noise eater tolerance in V
Input Tag	Name: NoiseEaterRelay Type: BOOL Description: Noise eater switch
Input Tag	Name: NoiseEaterRelayNom Type: BOOL Description: Nominal state of the noise eater switch

Output Tag	Name: LaserDiode1TempGuard Type: BOOL Description: Laser diode 1, temp guard, high is alarm
Output Tag	Name: LaserDiode2TempGuard Type: BOOL Description: Laser diode 2, temp guard, high is alarm
Output Tag	Name: InterLock Type: BOOL Description: InterLock, high represent an interlock
In/out Tag	Name: CrystalTemperature Type: LREAL Description: Crystal Temperature in C or V
Output Tag	Name: CrystalCalibration Type: LREAL Description: Crystal temperature coefficient at 1064nm in MHz/C; nominal -3000 MHz/C
In/out Tag	Name: CrystalFrequency Type: LREAL Description: Laser frequency as set by crystal temperature in MHz; updating the CrystalFrequency will update the CrystalTemperature and vis versa
Output Tag	Name: PZTTuningCoefficient Type: LREAL Description: PZT tuning coefficient at 1064nm in MHz/V; nominal 1.5 MHz/V
Output Tag	Name: PZTFrequency Type: LREAL Description: Laser frequency as set by the PZT actuator in MHz
Input Tag	Name: DoublerTemperature Type: LREAL Description: Doubler Temperature

Function Block FUNCTION_BLOCK ALSLaserFB VAR_INPUT CONSTANT LaserModel: ALSLaserModelEnum := Prometheus; END_VAR VAR_INPUT Request: SaveRestoreEnum; ALSLaserIn: ALSLaserInStruct; PZTVoltage: LREAL := 0.0; END_VAR VAR_OUTPUT ALSLaserOut: ALSLaserOutStruct; END_VAR VAR_IN_OUT ALSLaserInit: ALSLaserStruct; ALSLaser: ALSLaserStruct; END_VAR	
Name	ALSLaserFB
Description	Monitors the ALS laser and computes the slow controls feedback
Input argument	Name: LaserModel Type: ALSLaserModelEnum Description: Determines the laser model
Input argument	Name: Request Type: SaveRestoreEnum Description: Request for save/restore/safemode or noop
Input argument	Name: ALSLaserIn Type: ALSLaserInStruct Description: Input hardware structure
Input argument	Name: PZTVoltage Type: LREAL Description: PZT controls voltage in V (error signal for slow controls feedback) Default: 0
Output argument	Name: ALSLaserOut Type: ALSLaserOutStruct Description: Output hardware structure
In/out argument	Name: ALSLaser Type: ALSLaserStruct Description: User Interface structure
In/out argument	Name: ALSLaserInit Type: ALSLaserStruct Description: Save/restore variable in persistent memory

Visual			
Laser Diode 1 Power Monitor	%3.3f A	Laser Diode Power Nominal	%3.3f A
Laser Diode 2 Power Monitor	%3.3f A	Laser Diode Power Tolerance	%3.3f A
Laser Crystal TEC Error Signal	%3.5f C	TEC Tolerance (10s average)	%3.5f C
Doubling Crystal TEC Error Signal	%3.5f C		
Laser Diode 1 TEC Error Signal	%3.5f C		
Laser Diode 2 TEC Error Signal	%3.5f C	Noise Eater Nominal	%3.3f V
Noise Eater Monitor	%3.3f V	Noise Eater Tolerance	%3.3f V
PZT Frequency	%3.5f MHz	PZT Tuning Coefficient	%3.3f MHz/V
Crystal Temperature	%3.5f V	Doubler Temperature	%3.5f V
Crystal Frequency	%5.2f MHz	Temperature Coefficient	%5.2f MHz/V
Crystal Low Frequency	%5.2f MHz	Crystal High Frequency	%5.2f MHz
Slow Frequency Servo	ON	Reset	Enabled
			Running
UGF	%3.4f Hz	Knee for proportional feedback	%3.4f Hz
Laser Diode 1 Temp Guard	Laser Diode 2 Temp Guard	Interlock	
Error	%i	%s	

Name	ALSLaserVis
Description	Displays power monitors, TEC error signals, noise eater status, crystal temperatures, slow temperature controls parameters, and alarms for temperature guards, interlock and error.
Placeholder	Name: ALSLaser Type: ALSLaserStruct Description: ALS laser structure