



**LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY**

*LIGO Laboratory / LIGO Scientific Collaboration*

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**Advanced LIGO**

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**TwinCAT Library for AOM Driver**

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<b>Library</b>	
Title	AomDriver
Version	1
TwinCAT version	2.11
Name space	–
Author	Daniel Sigg
Description	<p>Controls the AM-modulated AOM driver, <a href="#">E1900038</a>.</p> <p>The frequency difference mixer is using the same RF mixer circuit but without a divider and a VCO. It implements none of the extra frequency controls of the VCO neither.</p> <p>The fixed ratio frequency source locks an OCXO to an RF signal using an internal PLL, in order to generate a clean higher order harmonics.</p> <p>The RF power monitor has the calibration</p> $P = 22 \text{ dBm} - 10 \text{ dBm/V} \times (U - 4 \text{ V})$ <p>The corresponding temperature readout has the calibration</p> $T = 20^\circ\text{C} + 50^\circ\text{C/V} \times (U * 1.10 - 6 \text{ V})$ <p>The factor 1.10 is due to the voltage divider at the temperature readout.</p> <p>The RF power levels can be alarmed when outside <math>\pm 1</math>dBm of nominal.</p>
Error codes	<p>Version 1:</p> <ul style="list-style-type: none"> <li>0x01 – Power supply voltages out-of-range</li> <li>0x02 – Output RF power level out-of-range</li> <li>0x04 – Excitation switch</li> </ul> <p>Version 2:</p> <ul style="list-style-type: none"> <li>0x01 – Power supply voltages out-of-range</li> <li>0x02 – Output RF power level out-of-range</li> <li>0x04 – Excitation switch</li> </ul>
Library dependencies:	Error, SaveRestore, ReadADC. WriteDAC

<b>Hardware Input Type (Version 1)</b>	
TYPE AomDriverInStruct :	
STRUCT	
OutputMon:	INT;
OutputTemp:	INT;
ModulationMon:	INT;
Spare:	INT;
ExcitationSwitch:	BOOL;
PowerOk:	BOOL;
END_STRUCT	
END_TYPE	
Type name	AomDriverInStruct
Description	Structure of the hardware inputs that are wired up for the AOM driver
Definition	STRUCT
Element	Name: OutputMon Type: INT Description: Monitors the RF power after the output amplifier
Element	Name: OutputTemp Type: INT Description: Monitors the temperature of the output RF detector
Element	Name: ModulationMon Type: INT Description: Monitor for the modulation signal
Element	Name: Spare Type: INT Description: not used
Element	Name: ExcitationSwitch Type: BOOL Description: Monitors the excitation input enable
Element	Name: PowerOk Type: BOOL Description: Voltage monitor readback

<b>Hardware Output Type (Version 1)</b>	
TYPE AomDriverOutStruct :	
STRUCT	
ModulationBias:	INT;
ExcitationEn:	BOOL;
DewhiteSwitchAB:	BOOL;
DewhiteSwitchA:	BOOL;
END_STRUCT	
END_TYPE	
Type name	AomDriverOutStruct
Description	Structure of the hardware outputs that are wired up for the AOM Driver
Definition	STRUCT
Element	Name: ModulationBias Type: INT Description: Set point for the modulation bias
Element	Name: ExcitationEn Type: BOOL Description: Enables the excitation input
Element	Name: DewhiteSwitchAB Type: BOOL Description: Enables the dewhiting switches A and B
Element	Name: DewhiteSwitchA Type: BOOL Description: Enables the dewhiting switch A

**Hardware Input Type (Version 2)**

TYPE AomServoInStruct :

STRUCT

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    OutputMon:          INT;
    OutputTemp:         INT;
    ErrorMon:           INT;
    ControlMon:         INT;
    Limiter:            BOOL;
    ExcitationSwitch:   BOOL;
    RfSwitch:           BOOL;
    PowerOk:            BOOL;

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END\_STRUCT

END\_TYPE

Type name	AomServoInStruct
Description	Structure of the hardware inputs that are wired up for the AOM servo
Definition	STRUCT
Element	Name: OutputMon Type: INT Description: Monitors the RF power after the output amplifier
Element	Name: OutputTemp Type: INT Description: Monitors the temperature of the output RF detector
Element	Name: ErrorMon Type: INT Description: Monitors the input error point
Element	Name: ControlMon Type: INT Description: Monitors the output control point
Element	Name: Limiter Type: BOOL Description: Indicates that limits are reached
Element	Name: ExcitationSwitch Type: BOOL Description: Monitors the excitation input enable
Element	Name: RfSwitch Type: BOOL Description: Monitors the state of the RF on/off switch
Element	Name: PowerOk Type: BOOL Description: Voltage monitor readback

<b>Hardware Output Type (Version 2)</b>	
TYPE AomServoOutStruct :	
STRUCT	
SetPoint:	INT;
DrivePoint:	INT;
LowerLimit:	INT;
UpperLimit:	INT;
Gain:	INT;
Polarity:	BOOL;
ExcitationEn:	BOOL;
Bypass:	BOOL;
Boost2:	BOOL;
Generic:	BOOL;
Boost1:	BOOL;
Option:	BOOL;
OutputSwitch:	BOOL;
DewhiteSwitchA:	BOOL;
DewhiteSwitchB:	BOOL;
END_STRUCT	
END_TYPE	
Type name	AomServoOutStruct
Description	Structure of the hardware outputs that are wired up for the AOM servo
Definition	STRUCT
Element	Name: SetPoint Type: INT Description: Set point (offset) for the error signal of the servo
Element	Name: DrivePoint Type: INT Description: Drive point (offset) for the control signal of the servo
Element	Name: LowerLimit Type: INT Description: Lower limit of the output drive
Element	Name: UpperLimit Type: INT Description: Upper limit of the output drive
Element	Name: Gain Type: INT Description: Servo gain
Element	Name: Polarity Type: BOOL Description: Polarity of the input signal

Element	Name: ExcitationEn Type: BOOL Description: Enables the excitation input
Element	Name: Bypass Type: BOOL Description: Bypass the servo filters
Element	Name: Boost2 Type: BOOL Description: Enable the second boost
Element	Name: Generic Type: BOOL Description: Enable the generic filter
Element	Name: Boost1 Type: BOOL Description: Enable the first boost filter
Element	Name: Option Type: BOOL Description: Enable the option board
Element	Name: OutputSwitch Type: BOOL Description: Switches between servo and ramp inputs
Element	Name: DewhiteSwitchA Type: BOOL Description: Enable the dewhitening switch A
Element	Name: DewhiteSwitchB Type: BOOL Description: Enable the dewhitening switch B

<b>User Interface Type</b>	
TYPE AomDriverDewehiteEnum : AomDriverDewehiteNone, AomDriverDewehiteOne, AomDriverDewehiteTwo); END_TYPE	
Type name	AomDriverPowerEnum
Description	Enumerated type to describe the dewhitening switch state of the AOM driver
Definition	ENUM
Enum Tag	Name: AomDriverDewehiteNone Short: NONE Description: None of the dewhitening filters is on
Enum Tag	Name: AomDriverDewehiteOne Short: A Description: First dewhitening filter is on
Enum Tag	Name: AomDriverDewehiteTwo Short A+B Description: Both dewhitening filters are on



<b>User Interface Type (Version 1)</b>	
TYPE AomDriverStruct :	
STRUCT	
Error:	ErrorStruct;
OutputMon:	LREAL;
OuptutNom:	LREAL;
OutputTemp:	LREAL;
ModulationBias:	LREAL;
ModulationMon:	LREAL;
ExcitationSwitch:	BOOL;
ExcitationEn:	BOOL;
PowerOk:	BOOL;
DewhiteSwitch:	AomDriverDewhiteEnum;
END_STRUCT	
END_TYPE	
Type name	AomDriverStruct
Description	Structure of the user interface tags that are used to control the AM driver
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: For error handler
Output Tag	Name: OutputMon Type: LREAL Description: Monitors the RF power after the output amplifier dBm
Input Tag	Name: OutputNom Type: LREAL Description: Nominal value for the RF power at the output amplifier in dBm
Output Tag	Name: OutputTemp Type: LREAL Description: Monitors the temperature of the output RF detector in C
Input Tag	Name: ModulationBias Type: LREAL Description: Set point for the modulation bias in V
Output Tag	Name: ModulationMon Type: LREAL Description: Monitor for the modulation signal in V
Input Tag	Name: ExcitationEn Type: BOOL Description: Enables the excitation input

Output Tag	Name: ExcitationSwitch Type: BOOL Description: Monitors the excitation input enable
Output Tag	Name: PowerOk Type: BOOL Description: Voltage monitor readback
Input Tag	Name: DewhiteSwitch Type: AomDriverDewhiteEnum Description: State of dewhitening filter stages

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User Interface Type (Version 2)	
TYPE AomServoStruct :	
STRUCT	
Error:	ErrorStruct;
ErrorMon:	INT;
ControlMon:	INT;
OutputMon:	LREAL;
OuptutNom:	LREAL;
OutputTemp:	LREAL;
SetPoint:	LREAL;
DrivePoint:	LREAL;
LowerLimit:	LREAL;
UpperLimit:	LREAL;
LimitReached:	BOOL;
LimitCount:	DINT;
LimitReset:	BOOL;
RfSwitch:	BOOL;
Polarity:	BOOL;
ExcitationSwitch:	BOOL;
ExcitationEn:	BOOL;
Gain:	INT;
Bypass:	BOOL;
Boost1:	BOOL;
Boost2:	BOOL;
Generic:	BOOL;
Option:	BOOL;
OutputRamp:	BOOL;
PowerOk:	BOOL;
DewhiteSwitch:	AomDriverDewhiteEnum;
END_STRUCT	
END_TYPE	
Type name	AomServoStruct
Description	Structure of the user interface tags that are used to control the AOM servo
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: For error handler
Output Tag	Name: ErrorMon Type: LREAL Description: Monitors the input voltage in V

Output Tag	Name: ControlMon Type: LREAL Description: Monitors the output voltage in V
Output Tag	Name: OutputMon Type: LREAL Description: Monitors the RF power after the output amplifier dBm
Input Tag	Name: OutputNom Type: LREAL Description: Nominal value for the RF power at the output amplifier in dBm
Output Tag	Name: OutputTemp Type: LREAL Description: Monitors the temperature of the output RF detector in C
Input Tag	Name: SetPoint Type: LREAL Description: Set point for the input bias in V
Input Tag	Name: DrivePoint Type: LREAL Description: Drive point for the output bias in V
Input Tag	Name: LowerLimit Type: LREAL Description: Lower limit of the output drive in V
Input Tag	Name: UpperLimit Type: LREAL Description: Upper limit of the output drive in V
Output Tag	Name: LimitReached Type: BOOL Description: Indicates that the output limits have been reached
Output Tag	Name: LimitCount Type: DINT Description: Count of how many times limits have been reached
Input Tag	Name: LimitReset Type: BOOL Description: Reset the limit count
Output Tag	Name: RfSwitch Type: BOOL Description: Indicates that the RF amplifier is powered up
Input Tag	Name: Polarity Type: BOOL Description: Polarity of the input signal

Output Tag	Name: ExcitationSwitch Type: BOOL Description: Indicates that the excitation is enabled
Input Tag	Name: ExcitationEn Type: BOOL Description: Enables the excitation input
Input Tag	Name: Gain Type: INT Description: Servo gain in dB (-32 to +31)
Input Tag	Name: Bypass Type: BOOL Description: Bypass the servo filters
Input Tag	Name: Boost1 Type: BOOL Description: Enable the first boost filter
Input Tag	Name: Boost2 Type: BOOL Description: Enable the second boost
Input Tag	Name: Generic Type: BOOL Description: Enable the generic filter
Input Tag	Name: Option Type: BOOL Description: Enable the option board
Input Tag	Name: OutputRamp Type: BOOL Description: Switches between servo and ramp inputs
Output Tag	Name: PowerOk Type: BOOL Description: Voltage monitor readback
Input Tag	Name: DewwhiteSwitch Type: AomDriverDewwhiteEnum Description: State of dewhiting filter stages

<b>Function Block (Version 1)</b> FUNCTION_BLOCK AomDriverFB VAR_INPUT Request:                 SaveRestoreEnum; AomDriverIn:            AomDriverInStruct; END_VAR VAR_OUTPUT AomDriverOut:          AomDriverOutStruct; END_VAR VAR_IN_OUT AomDriverInit:         AomDriverStruct; AomDriver:              AomDriverStruct; END_VAR	
Name	AomDriverFB
Description	Controls the AOM driver. One function block for each AOM driver chassis needs to be instantiated.
Input argument	Name: Request Type: SaveRestoreEnum Description: Save restore command
Input argument	Name: AomDriverIn Type: AomDriverInStruct Description: Input hardware structure
Output argument	Name: AomDriverOut Type: AomDriverOutStruct Description: Output hardware structure
In/out argument	Name: AomDriverInit Type: AomDriverStruct Description: Save/restore variables in persistent memory
In/out argument	Name: AomDriver Type: AomDriverStruct Description: User Interface structure

<b>Function Block (Version 2)</b> FUNCTION_BLOCK AomServoFB VAR_INPUT Request:                 SaveRestoreEnum; AomServoIn:            AomServoInStruct; END_VAR VAR_OUTPUT AomServoOut:           AomServoOutStruct; END_VAR VAR_IN_OUT AomServoInit:          AomServoStruct; AomServo:               AomServoStruct; END_VAR	
Name	AomServoFB
Description	Controls the AOM servo. One function block for each AOM servo chassis needs to be instantiated.
Input argument	Name: Request Type: SaveRestoreEnum Description: Save restore command
Input argument	Name: AomServoIn Type: AomServoInStruct Description: Input hardware structure
Output argument	Name: AomServoOut Type: AomServoOutStruct Description: Output hardware structure
In/out argument	Name: AomServoInit Type: AomServoStruct Description: Save/restore variables in persistent memory
In/out argument	Name: AomServo Type: AomServoStruct Description: User Interface structure