*LIGO Laboratory / LIGO Scientific Collaboration*

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TwinCAT Library for AOM Driver

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| **Library** |
| Title | AomDriver |
| Version | 1 |
| TwinCAT version | 2.11 |
| Name space | – |
| Author | Daniel Sigg |
| Description | Controls the AM-modulated AOM driver, [E1900038](https://dcc.ligo.org/LIGO-E1900038).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. 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.The RF power monitor has the calibration$$P=22 dBm-10 dBm/V×(U-4 V)$$The corresponding temperature readout has the calibration$$T=20°C+50°C/V×(U\*1.10-6 V)$$The factor 1.10 is due to the voltage divider at the temperature readout.The RF power levels can be alarmed when outside ±1dBm of nominal. |
| Error codes | Version 1:0x01 – Power supply voltages out-of-range0x02 – Output RF power level out-of-range0x04 – Excitation switchVersion 2:0x01 – Power supply voltages out-of-range0x02 – Output RF power level out-of-range0x04 – Excitation switch |
| Library dependencies: | Error, SaveRestore, ReadADC. WriteDAC |

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| **Hardware Input Type (Version 1)**TYPE AomDriverInStruct :STRUCT OutputMon: INT; OutputTemp: INT; ModulationMon: INT; Spare: INT; ExcitationSwitch: BOOL; PowerOk: BOOL;END\_STRUCTEND\_TYPE |
| Type name | AomDriverInStruct |
| Description | Structure of the hardware inputs that are wired up for the AOM driver |
| Definition | STRUCT |
| Element | Name: OutputMonType: INTDescription: Monitors the RF power after the output amplifier |
| Element | Name: OutputTempType: INTDescription: Monitors the temperature of the output RF detector |
| Element | Name: ModulationMonType: INTDescription: Monitor for the modulation signal |
| Element | Name: SpareType: INTDescription: not used |
| Element | Name: ExcitationSwitchType: BOOLDescription: Monitors the excitation input enable |
| Element | Name: PowerOkType: BOOLDescription: Voltage monitor readback |

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| **Hardware Output Type (Version 1)**TYPE AomDriverOutStruct :STRUCT ModulationBias: INT; ExcitationEn: BOOL; DewhiteSwitchAB: BOOL; DewhiteSwitchA: BOOL;END\_STRUCTEND\_TYPE |
| Type name | AomDriverOutStruct |
| Description | Structure of the hardware outputs that are wired up for the AOM Driver |
| Definition | STRUCT |
| Element | Name: ModulationBiasType: INTDescription: Set point for the modulation bias |
| Element | Name: ExcitationEnType: BOOLDescription: Enables the excitation input |
| Element | Name: DewhiteSwitchABType: BOOLDescription: Enables the dewhitening switches A and B |
| Element | Name: DewhiteSwitchAType: BOOLDescription: Enables the dewhitening switch A |

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| **Hardware Input Type (Version 2)**TYPE AomServoInStruct :STRUCT OutputMon: INT; OutputTemp: INT; ErrorMon: INT; ControlMon: INT; Limiter: BOOL; ExcitationSwitch: BOOL; RfSwitch: BOOL; PowerOk: BOOL;END\_STRUCTEND\_TYPE |
| Type name | AomServoInStruct |
| Description | Structure of the hardware inputs that are wired up for the AOM servo |
| Definition | STRUCT |
| Element | Name: OutputMonType: INTDescription: Monitors the RF power after the output amplifier |
| Element | Name: OutputTempType: INTDescription: Monitors the temperature of the output RF detector |
| Element | Name: ErrorMonType: INTDescription: Monitors the input error point |
| Element | Name: ControlMonType: INTDescription: Monitors the output control point |
| Element | Name: LimiterType: BOOLDescription: Indicates that limits are reached |
| Element | Name: ExcitationSwitchType: BOOLDescription: Monitors the excitation input enable |
| Element | Name: RfSwitchType: BOOLDescription: Monitors the state of the RF on/off switch |
| Element | Name: PowerOkType: BOOLDescription: Voltage monitor readback |

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| **Hardware Output Type (Version 2)**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\_STRUCTEND\_TYPE |
| Type name | AomServoOutStruct |
| Description | Structure of the hardware outputs that are wired up for the AOM servo |
| Definition | STRUCT |
| Element | Name: SetPointType: INTDescription: Set point (offset) for the error signal of the servo  |
| Element | Name: DrivePointType: INTDescription: Drive point (offset) for the control signal of the servo  |
| Element | Name: LowerLimitType: INTDescription: Lower limit of the output drive  |
| Element | Name: UpperLimitType: INTDescription: Upper limit of the output drive |
| Element | Name: GainType: INTDescription: Servo gain |
| Element | Name: PolarityType: BOOLDescription: Polarity of the input signal |
| Element | Name: ExcitationEnType: BOOLDescription: Enables the excitation input |
| Element | Name: BypassType: BOOLDescription: Bypass the servo filters |
| Element | Name: Boost2Type: BOOLDescription: Enable the second boost |
| Element | Name: GenericType: BOOLDescription: Enable the generic filter |
| Element | Name: Boost1Type: BOOLDescription: Enable the first boost filter |
| Element | Name: OptionType: BOOLDescription: Enable the option board |
| Element | Name: OutputSwitchType: BOOLDescription: Switches between servo and ramp inputs  |
| Element | Name: DewhiteSwitchAType: BOOLDescription: Enable the dewhitening switch A |
| Element | Name: DewhiteSwitchBType: BOOLDescription: Enable the dewhitening switch B |

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| **User Interface Type**TYPE AomDriverDewehiteEnum :  AomDriverDewhiteNone, AomDriverDewhiteOne, AomDriverDewhiteTwo);END\_TYPE |
| Type name | AomDriverPowerEnum |
| Description | Enumerated type to describe the dewhitening switch state of the AOM driver |
| Definition | ENUM |
| Enum Tag | Name: AomDriverDewhiteNoneShort: NONEDescription: None of the dewhitening filters is on |
| Enum Tag | Name: AomDriverDewhiteOneShort: ADescription: First dewhitening filter is on |
| Enum Tag | Name: AomDriverDewhiteTwoShort A+BDescription: Both dewhitening filters are on |

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| **User Interface Type (Version 1)**TYPE AomDriverStruct :STRUCT Error: ErrorStruct; OutputMon: LREAL;  OuptutNom: LREAL; OutputTemp: LREAL; ModulationBias: LREAL; ModulationMon: LREAL; ExcitationSwitch: BOOL; ExcitationEn: BOOL; PowerOk: BOOL; DewhiteSwitch: AomDriverDewhiteEnum;END\_STRUCTEND\_TYPE |
| Type name | AomDriverStruct |
| Description | Structure of the user interface tags that are used to control the AM driver |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: For error handler |
| Output Tag | Name: OutputMonType: LREALDescription: Monitors the RF power after the output amplifier dBm |
| Input Tag | Name: OutputNomType: LREALDescription: Nominal value for the RF power at the output amplifier in dBm |
| Output Tag | Name: OutputTempType: LREALDescription: Monitors the temperature of the output RF detector in C |
| Input Tag | Name: ModulationBiasType: LREALDescription: Set point for the modulation bias in V |
| Output Tag | Name: ModulationMonType: LREALDescription: Monitor for the modulation signal in V |
| Input Tag | Name: ExcitationEnType: BOOLDescription: Enables the excitation input |
| Output Tag | Name: ExcitationSwitchType: BOOLDescription: Monitors the excitation input enable |
| Output Tag | Name: PowerOkType: BOOLDescription: Voltage monitor readback |
| Input Tag | Name: DewhiteSwitchType: AomDriverDewhiteEnumDescription: 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\_STRUCTEND\_TYPE |
| Type name | AomServoStruct |
| Description | Structure of the user interface tags that are used to control the AOM servo |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: For error handler |
| Output Tag | Name: ErrorMonType: LREALDescription: Monitors the input voltage in V |
| Output Tag | Name: ControlMonType: LREALDescription: Monitors the output voltage in V |
| Output Tag | Name: OutputMonType: LREALDescription: Monitors the RF power after the output amplifier dBm |
| Input Tag | Name: OutputNomType: LREALDescription: Nominal value for the RF power at the output amplifier in dBm |
| Output Tag | Name: OutputTempType: LREALDescription: Monitors the temperature of the output RF detector in C |
| Input Tag | Name: SetPointType: LREALDescription: Set point for the input bias in V |
| Input Tag | Name: DrivePointType: LREALDescription: Drive point for the output bias in V |
| Input Tag | Name: LowerLimitType: LREALDescription: Lower limit of the output drive in V |
| Input Tag | Name: UpperLimitType: LREALDescription: Upper limit of the output drive in V |
| Output Tag | Name: LimitReachedType: BOOLDescription: Indicates that the output limits have been reached |
| Output Tag | Name: LimitCountType: DINTDescription: Count of how many times limits have been reached |
| Input Tag | Name: LimitResetType: BOOLDescription: Reset the limit count |
| Output Tag | Name: RfSwitchType: BOOLDescription: Indicates that the RF amplifier is powered up |
| Input Tag | Name: PolarityType: BOOLDescription: Polarity of the input signal |
| Output Tag | Name: ExcitationSwitchType: BOOLDescription: Indicates that the excitation is enabled |
| Input Tag | Name: ExcitationEnType: BOOLDescription: Enables the excitation input |
| Input Tag | Name: GainType: INTDescription: Servo gain in dB (-32 to +31) |
| Input Tag | Name: BypassType: BOOLDescription: Bypass the servo filters |
| Input Tag | Name: Boost1Type: BOOLDescription: Enable the first boost filter |
| Input Tag | Name: Boost2Type: BOOLDescription: Enable the second boost |
| Input Tag | Name: GenericType: BOOLDescription: Enable the generic filter |
| Input Tag | Name: OptionType: BOOLDescription: Enable the option board |
| Input Tag | Name: OutputRampType: BOOLDescription: Switches between servo and ramp inputs  |
| Output Tag | Name: PowerOkType: BOOLDescription: Voltage monitor readback |
| Input Tag | Name: DewhiteSwitchType: AomDriverDewhiteEnumDescription: State of dewhitening filter stages |

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| **Function Block (Version 1)**FUNCTION\_BLOCK AomDriverFBVAR\_INPUT Request: SaveRestoreEnum; AomDriverIn: AomDriverInStruct;END\_VARVAR\_OUTPUT AomDriverOut: AomDriverOutStruct;END\_VARVAR\_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: RequestType: SaveRestoreEnumDescription: Save restore command |
| Input argument | Name: AomDriverInType: AomDriverInStructDescription: Input hardware structure |
| Output argument | Name: AomDriverOutType: AomDriverOutStructDescription: Output hardware structure |
| In/out argument | Name: AomDriverInitType: AomDriverStructDescription: Save/restore variables in persistent memory |
| In/out argument | Name: AomDriverType: AomDriverStructDescription: User Interface structure |

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| **Function Block (Version 2)**FUNCTION\_BLOCK AomServoFBVAR\_INPUT Request: SaveRestoreEnum; AomServoIn: AomServoInStruct;END\_VARVAR\_OUTPUT AomServoOut: AomServoOutStruct;END\_VARVAR\_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: RequestType: SaveRestoreEnumDescription: Save restore command |
| Input argument | Name: AomServoInType: AomServoInStructDescription: Input hardware structure |
| Output argument | Name: AomServoOutType: AomServoOutStructDescription: Output hardware structure |
| In/out argument | Name: AomServoInitType: AomServoStructDescription: Save/restore variables in persistent memory |
| In/out argument | Name: AomServoType: AomServoStructDescription: User Interface structure |