



**LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY**

*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO-E1900164-v1

**Advanced LIGO**

6/5/2019

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**TwinCAT Library for AOM Driver**

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LIGO Scientific Collaboration

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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\text{dBm}</math> of nominal.</p> |
| Error codes           | <p>0x01 – Power supply voltages out-of-range</p> <p>0x02 – Output RF power level out-of-range</p> <p>0x04 – Excitation switch</p>  |
| Library dependencies: | Error, SaveRestore, ReadADC. WriteDAC  |

| <b>Hardware Input Type</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<br>Type: INT<br>Description: Monitors the RF power after the output amplifier    |
| Element                    | Name: OutputTemp<br>Type: INT<br>Description: Monitors the temperature of the output RF detector |
| Element                    | Name: ModulationMon<br>Type: INT<br>Description: Monitor for the modulation signal               |
| Element                    | Name: Spare<br>Type: INT<br>Description: not used  |
| Element                    | Name: ExcitationSwitch<br>Type: BOOL<br>Description: Monitors the excitation input enable        |
| Element                    | Name: PowerOk<br>Type: BOOL<br>Description: Voltage monitor readback                             |

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

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

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

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

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| <b>Function Block</b><br>FUNCTION_BLOCK AomDriverFB<br>VAR_INPUT<br>Request:                 SaveRestoreEnum;<br>AomDriverIn:            AomDriverInStruct;<br>END_VAR<br>VAR_OUTPUT<br>AomDriverOut: AomDriverOutStruct;<br>END_VAR<br>VAR_IN_OUT<br>AomDriverInit: AomDriverStruct;<br>AomDriver:                AomDriverStruct;<br>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<br>Type: SaveRestoreEnum<br>Description: Save restore command                              |
| Input argument   | Name: AomDriverIn<br>Type: AomDriverInStruct<br>Description: Input hardware structure                    |
| Output argument  | Name: AomDriverOut<br>Type: AomDriverOutStruct<br>Description: Output hardware structure                 |
| In/out argument  | Name: AomDriverInit<br>Type: AomDriverStruct<br>Description: Save/restore variables in persistent memory |
| In/out argument  | Name: AomDriver<br>Type: AomDriverStruct<br>Description: User Interface structure                        |