ASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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TwinCAT Library for Demodulators

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Library	
Title	Demodulator
Version	2
TwinCAT version	2.11
Name space	Demodulator
Author	Daniel Sigg
Description	Monitors the 4-channel demodulator, D0902796, the 2-channel demodulator, D1000181, and the 2-channel phase-frequency discriminator, D1002476. Demodulators are used by ISC for length and alignment sensing, whereas phase-frequency demodulators are used for laser locking. Each channels comes with an RF monitor of the LO and the RF inputs. The 2-channel chassis implement an additional power supply monitor, which indicates that the supply voltages are within range. Each channel of the phase-frequency discriminator has a monitor of the sign of the frequency comparison. The RF detector measures the power off a -20 dB directional coupler. It is a logarithmic device and has the following equation: LO: $P = -69\ \mathrm{dBm} + 16.667\ \mathrm{dBm/V} \times U$ RF: $P = -72\ \mathrm{dBm} + 16.667\ \mathrm{dBm/V} \times U$ The 4-channel demodulator chassis used for ASC has the LO split between all channels, whereas the LO for the LSC is per channel.
Error codes	1 – Power supply voltages out-of-range 2 – LO power level out-of-range 3 – RF power level overload 4 – Sign is wrong
Library dependencies	Error

Demodulator Type TYPE DemodulatorTypeEnum : (Quad, Single, SingleFast, PhaseFrequency); END_TYPE	
Type name	DemodulatorTypeEnum
Description	Enumerates the different types of available demodulators
Definition	ENUM
Element	Name: Quad Description: Denotes an ASC quad demodulator chassis used for wavefront sensing
Element	Name: Single Description: Denotes a single channel of an LSC quad demodulator chassis used for length sensing
Element	Name: SingleFast Description: Denotes a single channel of a fast LSC dual demodulator chassis used for length sensing
Element	Name: PhaseFrequency Description: Denotes a single channel of an LSC dual phase-frequency discriminator chassis used for laser locking

Hardware Input Type

```
TYPE DemodulatorInStruct :
STRUCT
        RFMon:          INT;
        LOMon:          INT;
        Sign:           BOOL;
        PowerOk:        BOOL;
END_STRUCT
END_TYPE
```

Type name	DemodulatorInStruct
Description	Structure of the hardware inputs that are wired up for a demodulator channel. The phase-frequency discriminator only uses the sign. The 2-channel chassis share a power ok bit. The power ok bit is reflected in the hardware output structure. The second channel daisy chains its power ok input from the output of the first channel.
Definition	STRUCT
Element	Name: RFMon Type: INT Description: Monitors the RF power at the RF input
Element	Name: LOMon Type: INT Description: Monitors the RF power at the LO input
Element	Name: Sign Type: BOOL Description: Sign of phase-frequency discriminator
Element	Name: PowerOk Type: BOOL Description: Voltage monitor readback

Hardware Input Type TYPE DemodulatorQuadInStruct: STRUCT Seg: ARRAY [1..4] OF DemodulatorInStruct; END_STRUCT END_TYPE	
Type name	DemodulatorQuadInStruct
Description	An array of four DemodulatorInStruct used to describe a four channel demodulator chassis used for wavefront sensing
Definition	STRUCT
Element	Name: Seg Type: ARRAY [1..4] OF DemodulatorInStruct Description: Quad array of demodulator channels

Hardware Output Type TYPE DemodulatorOutStruct : STRUCT PowerOk: BOOL; END_STRUCT END_TYPE	
Type name	DemodulatorOutStruct
Description	Structure of the hardware outputs that are wired up for a demodulator channel. The power ok bit is a simple reflection of the power ok bit at the input. It is used for daisy chaining multiple channels.
Definition	STRUCT
Element	Name: PowerOk Type: BOOL Description: Voltage monitor readback

User Interface Type

```
TYPE DemodulatorLscStruct :
STRUCT
    Error:              ErrorStruct;
    DemodulatorType:    DemodulatorTypeEnum;
    RFMon:              LREAL;
    RFMax:              LREAL;
    LOMon:              LREAL;
    LONom:              LREAL;
    Sign:               BOOL;
    SignNom:            BOOL;
    PowerOk:            BOOL;
END_STRUCT
END_TYPE
```

Type name	DemodulatorLscStruct
Description	Structure of the user interface tags that are used to control a single channel of a demodulator or a phase-frequency discriminator
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: For error handler
Output Tag	Name: DemodulatorType Type: DemodulatorTypeEnum Description: Demotes the type of demodulator or phase-frequency discriminator channel
Output Tag	Name: RFMon Type: LREAL Description: Monitors the RF power at the RF input in dBm
Input Tag	Name: RFMax Type: LREAL Description: Maximum value for the RF power at the RF input in dBm
Output Tag	Name: LOMon Type: LREAL Description: Monitors the RF power at the LO input in dBm
Input Tag	Name: LONom Type: LREAL Description: Nominal value for the RF power at the LO input in dBm Set to -100 to disable test.
Output Tag	Name: Sign Type: BOOL Description: Monitors the sign of a phase-frequency discriminator

Input Tag	Name: SignNom Type: LREAL Description: Nominal value for the sign of a phase-frequency discriminator
Output Tag	Name: PowerOk Type: BOOL Description: Voltage monitor readback

User Interface Type

```
TYPE DemodulatorAscStruct :
STRUCT
    Error:          ErrorStruct;
    RFMon:          ARRAY [1..4] OF LREAL;
    RFMax:          LREAL;
    LOMonChannel:   ARRAY [1..4] OF LREAL;
    LOMon:          LREAL;
    LONom:          LREAL;
END_STRUCT
END_TYPE
```

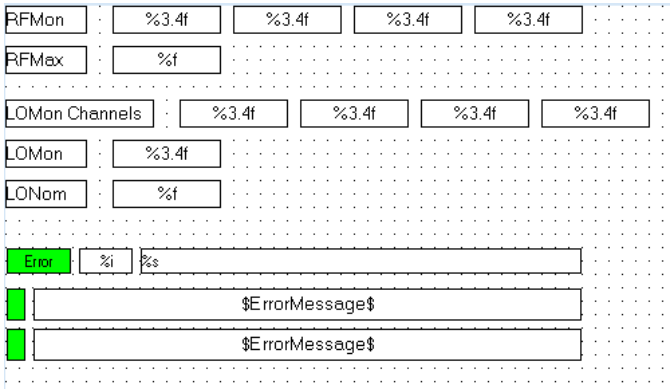
Type name	DemodulatorAscStruct
Description	Structure of the user interface tags that are used to control a four channel demodulator chassis used for wavefront sensing
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: For error handler
Output Tag	Name: RFMon Type: ARRAY [1..4] OF LREAL Description: Monitors the RF power at each RF input in dBm
Input Tag	Name: RFMax Type: LREAL Description: Maximum value for the RF power at the RF inputs in dBm
Output Tag	Name: LOMonChannel Type: LREAL Description: RF power at each of the LO inputs in dBm
Output Tag	Name: LOMon Type: LREAL Description: RF power at the LO input in dBm (sum of all channels)
Input Tag	Name: LONom Type: LREAL Description: Nominal value for the RF power at the LO input in dBm Set to -100 to disable test.

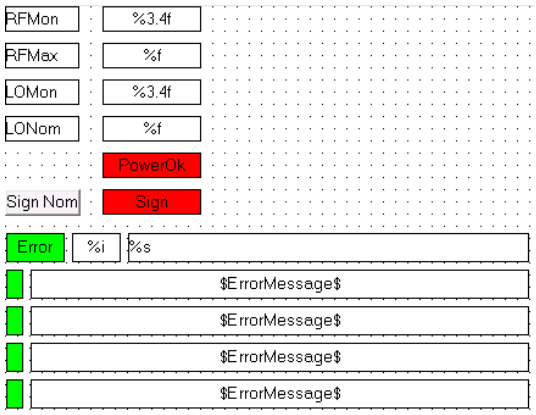
Function Block

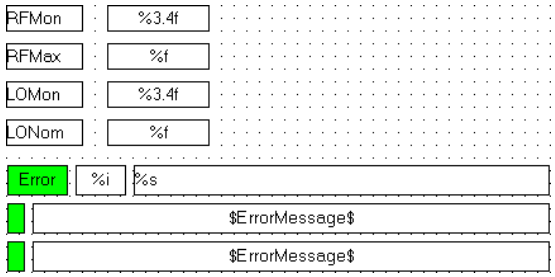
```
FUNCTION_BLOCK DemodulatorLscFB
VAR_INPUT
        Request:            SaveRestoreEnum;
        DemodulatorType:    DemodulatorTypeEnum;
        DemodulatorIn:      DemodulatorInStruct;
END_VAR
VAR_OUTPUT
        DemodulatorOut:     DemodulatorOutStruct;
END_VAR
VAR_IN_OUT
        DemodulatorLscInit: DemodulatorLscStruct;
        DemodulatorLsc:     DemodulatorLscStruct;
END_VAR
VAR
END_VAR
```

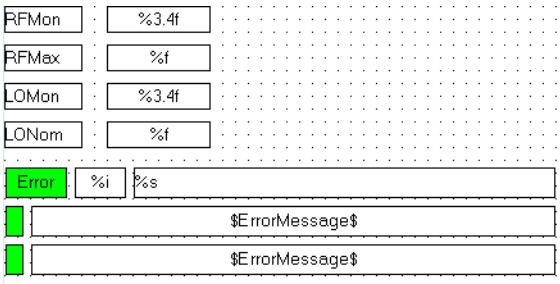
Name	DemodulatorLscFB
Description	Controls a single channel of a demodulator or phase-frequency discriminator chassis. One function block for each demodulator channel needs to be instantiated.
Input argument	Name: Request Type: SaveRestoreEnum Description: Request for save/restore/safemode or noop
Input argument	Name: DemodulatorType Type: DemodulatorTypeEnum Description: Defines the used demodulator chassis
Input argument	Name: DemodulatorIn Type: DemodulatorInStruct Description: Input hardware structure
Output argument	Name: DemodulatorOut Type: DemodulatorOutStruct Description: Output hardware structure
In/out argument	Name: DemodulatorLscInit Type: DemodulatorLscStruct Description: Save/restore variable in persistent memory
In/out argument	Name: DemodulatorLsc Type: DemodulatorLscStruct Description: User Interface structure

Function Block FUNCTION_BLOCK DemodulatorAscFB VAR_INPUT Request: SaveRestoreEnum DemodulatorQuadIt: DemodulatorQuadInStruct; END_VAR VAR_IN_OUT DemodulatorAscInit: DemodulatorAscStruct; DemodulatorAsc: DemodulatorAscStruct; END_VAR VAR END_VAR	
Name	DemodulatorAscFB
Description	Controls a quad channel demodulator chassis. One function block for each ASC demodulator chassis needs to be instantiated.
Input argument	Name: DemodulatorQuadIt Type: DemodulatorQuadInStruct Description: Input hardware structure
In/out argument	Name: DemodulatorAscInit Type: DemodulatorAscStruct Description: Save/restore variable in persistent memory
In/out argument	Name: DemodulatorAsc Type: DemodulatorAscStruct Description: User Interface structure

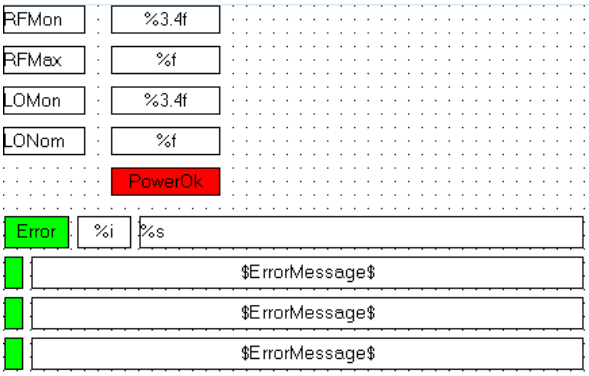
Visual	
	
Name	DemodulatorAscVis
Description	Displays RF Max and Mon, LO Mon and Nom, power status, sign status, and error status
Placeholder	Name: DemodulatorAsc Type: DemodulatorAscStruct Description: Asc Demodulator structure

Visual	
	
Name	DemodulatorLscPhaseFrequencyVis
Description	Displays RF Max and Mon, LO Mon and Nom, power status, sign status, and error status
Placeholder	Name: DemodulatorLsc Type: DemodulatorLscStruct Description: Phase frequency Lsc Demodulator structure

Visual	
	
Name	DemodulatorLscQuadVis
Description	Displays RF Max and Mon, LO Mon and Nom, and error status
Placeholder	Name: DemodulatorLsc Type: DemodulatorLscStruct Description: Quad Lsc Demodulator structure

Visual	
	
Name	DemodulatorLscSingleVis
Description	Displays RF Max and Mon, LO Mon and Nom, and error status
Placeholder	Name: DemodulatorLsc Type: DemodulatorLscStruct Description: Single Lsc Demodulator structure

Visual



Name	DemodulatorLscSingleFastVis
Description	Displays RF Max and Mon, LO Mon and Nom, power status, and error status
Placeholder	Name: DemodulatorLsc Type: DemodulatorLscStruct Description: Single Fast Lsc Demodulator structure