



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Advanced LIGO

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TwinCAT Library for VCXO

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Library	
Title	Vcxo
Version	1
TwinCAT version	2.11
Name space	–
Author	Daniel Sigg
Description	<p>Controls the VCXO, D1600500</p> <p>The internal RF power monitors has the calibration</p> $P = 12 \text{ dBm} - 10 \text{ dBm/V} \times (U - 4 \text{ V})$ <p>With U the measured voltage.</p> <p>The external RF power monitors have the calibration</p> $P = -8 \text{ dBm} + R - 10 \text{ dBm/V} \times (U - 4 \text{ V})$ <p>Where R is the coupler ratio in dB (positive between 0 and 120 dB) that is used by the measurement setup.</p> <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 RF power levels should be alarmed when outside ± 1dBm of nominal.</p> <p>The only set value is a tune offset into the VXCO which translates into a frequency offset at the output. A binary output is used to enable the excitation input. Additional monitors are available for the tune voltage, the state of the excitation switch, and a power ok bit.</p> <p>If a frequency counter has been setup through the timing system, the measured frequency can be stabilized by feeding back to the bias offset. This then allows the user to select a fixed output frequency.</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 enabled</p> <p>0x08 – Invalid coupler 1 ratio</p> <p>0x10 – Invalid coupler 2 ratio</p> <p>0x20 – Invalid frequency</p> <p>0x40 – Controls error</p> <p>Controls errors:</p> <p>0x01 – Unity gain frequency too high</p> <p>0x02 – Unity gain frequency too low</p> <p>0x04 – High limit reached</p> <p>0x08 – Low limit reached</p> <p>0x10 – Invalid error signal</p> <p>0x20 – Invalid set frequency</p>
Library dependencies:	Error, SaveRestore, ReadADC. WriteDAC

Hardware Input Type	
TYPE VcxolnStruct :	
STRUCT	
OutputMon: INT;	
Extra1Mon: INT;	
Extra2Mon: INT;	
OutputTemp: INT;	
Extra1Temp: INT;	
Extra2Temp: INT;	
TuneMon: INT;	
Spare: INT;	
ExcitationSwitch: BOOL;	
PowerOk: BOOL;	
END_STRUCT	
END_TYPE	
Type name	VcxolnStruct
Description	Structure of the hardware inputs that are wired up for the VCXO
Definition	STRUCT
Element	Name: OutputMon Type: INT Description: Monitors the RF power at the output amplifier
Element	Name: Extra1Mon Type: INT Description: Monitors the RF power at the first extra monitor
Element	Name: Extra2Mon Type: INT Description: Monitors the RF power after the second extra monitor
Element	Name: OutputTemp Type: INT Description: Monitors the temperature of the output RF detector
Element	Name: Extra1Temp Type: INT Description: Monitors the temperature of the first extra RF detector
Element	Name: Extra2Temp Type: INT Description: Monitors the temperature of the second extra RF detector
Element	Name: TuneMon Type: INT Description: Monitor for the frequency offset

Element	Name: Spare Type: INT Description: Spare tag
Element	Name: ExcitationSwitch Type: BOOL Description: Monitors the excitation input enable
Element	Name: PowerOk Type: BOOL Description: Voltage monitor readback

Hardware Output Type TYPE VcxoOutStruct : STRUCT TuneOfs: INT; ExcitationEn: BOOL; END_STRUCT END_TYPE	
Type name	VcxoOutStruct
Description	Structure of the hardware outputs that are wired up for the VCXO
Definition	STRUCT
Element	Name: TuneOfs Type: INT Description: Setpoint for the frequency offset
Element	Name: ExcitationEn Type: BOOL Description: Enables the excitation input

User Interface Type	
TYPE VcxoStruct :	
STRUCT	
Error:	ErrorStruct;
OutputMon:	LREAL;
OuptutNom:	LREAL;
OutputTemp:	LREAL;
TuneOfs:	LREAL;
TuneMon:	LREAL;
TuneLimit:	LREAL;
ExcitationSwitch:	BOOL;
ExcitationEn:	BOOL;
PowerOk:	BOOL;
Frequency:	LREAL;
FrequencyFault:	BOOL;
Controls:	VcxoControlsStruct;
END_STRUCT	
END_TYPE	
Type name	VcxoStruct
Description	Structure of the user interface tags that are used to control the VCXO
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: TuneOfs Type: LREAL Description: Setpoint for the frequency offset in V
Output Tag	Name: TuneMon Type: LREAL Description: Monitor for the frequency offset in V
Input Tag	Name: TuneLimit Type: LREAL Description: Limit for the frequency offset 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
Output Tag	Name: Frequency Type: LREAL Description: Frequency of the VCO output
Output Tag	Name: FrequencyFault Type: BOOL Description: Indicates if the frequency of the VCO is no longer updating correctly
Input Tag	Name: Controls Type: VcxoControlsStruct Description: VCO frequency controls parameters

User Interface Type	
TYPE VcxoControlsStruct:	
STRUCT	
Error:	ErrorStruct;
Fault:	BOOL;
SetFrequency:	LREAL;
SetFrequencyOffset:	LREAL;
DiffFrequency:	LREAL;
Enable:	BOOL;
UnityGain:	LREAL;
ClearInt:	BOOL;
END_STRUCT	
END_TYPE	
Type name	VcxoControlsStruct
Description	Structure of the user interface that is used to control the frequency of the low noise VCO
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: For error handler
Output Tag	Name: Fault Type: BOOL Description: Indicated a servo fault
Input Tag	Name: SetFrequency Type: LREAL Description: Set frequency in Hz
Input Tag	Name: SetFrequencyOffset Type: LREAL Description: Set frequency offset in Hz
Output Tag	Name: DiffFrequency Type: LREAL Description: Difference between measured and set frequency in Hz
Input Tag	Name: Enable Type: BOOL Description: Enable the servo
Input Tag	Name: UnityGain Type: LREAL Description: Unity gain frequency in Hz
Input Tag	Name: ClearInt Type: BOOL Description: Clear the history of the integrator

Function Block FUNCTION_BLOCK VcxoFB VAR_INPUT Request: SaveRestoreEnum; VcxoIn: VcxoInStruct; Frequency: LREAL := 0.0; FrequencyError: BOOL := TRUE; ExtUpdateRate: INT := 1; UseSigmaDelta: BOOL := TRUE; END_VAR VAR_INPUT CONSTANT R1: LREAL := 20.0; R2: LREAL := 20.0; END_VAR VAR_OUTPUT VcxoOut: VcxoOutStruct; Extra1Mon: INT; Extra2Mon: INT; END_VAR VAR_IN_OUT VcxoInit: VcxoStruct; Vcxo: VcxoStruct; END_VAR	
Name	VcxoFB
Description	Controls the VCXO. One function block for each VCXO chassis needs to be instantiated.
Input argument	Name: Request Type: SaveRestoreEnum Description: Save restore command
Input argument	Name: R1 Type: LREAL Description: Ratio of coupler 1 in dB, must be between 0 and 120.
Input argument	Name: R2 Type: LREAL Description: Ratio of coupler 2 in dB, must be between 0 and 120.
Input argument	Name: Frequency Type: LREAL Description: Externally measured frequency of VCO Default: 0

Input argument	Name: FrequencyError Type: BOOL Description: Externally measured frequency is invalid Default: TRUE (invalid)
Input argument	Name: ExtUpdateRate Type: INT Description: How much is the update rate of external frequency readback slower than the processing clock. For 10 ms processing clock, a value of 100 corresponds to 1s updates, such as through the timing system. Default: 1 (10ms)
Input argument	Name: VcxoIn Type: VcxoInStruct Description: Input hardware structure
Output argument	Name: VcxoOut Type: VcxoOutStruct Description: Output hardware structure
Output argument	Name: Extra1Mon Type: INT Description: Uncalibrated output of first extra RF monitor corrected for a coupler ratio different from 20dB.
Output argument	Name: Extra2Mon Type: INT Description: Uncalibrated output of first extra RF monitor corrected for a coupler ratio different from 20dB.
In/out argument	Name: VcxoInit Type: VcxoStruct Description: Save/restore variables in persistent memory
In/out argument	Name: Vcxo Type: VcxoStruct Description: User Interface structure