*LIGO Laboratory / LIGO Scientific Collaboration*

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TwinCAT Library for Low Noise VCO

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| **Library** | |
| Title | LowNoiseVco |
| Version | 3 |
| TwinCAT version | 2.11 |
| Name space | – |
| Author | Daniel Sigg |
| Description | Controls the low noise VCO, [D0900605](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?.submit=Number&docid=D0900605&version=)  The low noise VCO is based on a frequency difference divider. It requires a 71MHz/10dBm reference source and a VCO source at either 125MHz or 79MHz. Both RF levels as well as the RF level at the output of the frequency difference divider are monitored. The only set value is an offset into the VCO 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.  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.  The 3 RF power monitors which have the calibration  The corresponding temperature readout has the calibration  The RF power levels should be alarmed when outside ±1dBm of nominal. |
| Error codes | 0x01 – Power supply voltages out-of-range  0x02 – Reference RF power level out-of-range  0x04 – Divider RF power level out-of-range  0x08 – Output RF power level out-of-range  0x10 – Frequency out-of-range  0x20 – Invalid set frequency |
| Library dependencies: | Error, ReadADC. WriteDAC |

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| **Hardware Input Type**  TYPE LowNoiseVcoInStruct :  STRUCT  ReferenceMon: INT;  DividerMon: INT;  OutputMon: INT;  ReferenceTemp: INT;  DividerTemp: INT;  OutputTemp: INT;  TuneMon: INT;  Frequency: LREAL;  ExcitationSwitch: BOOL;  PowerOk: BOOL;  FrequencyLive: BOOL;  END\_STRUCT  END\_TYPE | |
| Type name | LowNoiseVcoInStruct |
| Description | Structure of the hardware inputs that are wired up for the low noise VCO |
| Definition | STRUCT |
| Element | Name: ReferenceMon  Type: INT  Description: Monitors the RF power at the reference input |
| Element | Name: DividerMon  Type: INT  Description: Monitors the RF power at the divider input |
| Element | Name: OutputMon  Type: INT  Description: Monitors the RF power after the output amplifier |
| Element | Name: ReferenceTemp  Type: INT  Description: Monitors the temperature of the reference RF detector |
| Element | Name: DividerTemp  Type: INT  Description: Monitors the temperature of the divider RF detector |
| Element | Name: OutputTemp  Type: INT  Description: Monitors the temperature of the output RF detector |
| Element | Name: TuneMon  Type: INT  Description: Monitor for the frequency offset |
| Element | Name: Frequency  Type: LREAL  Description: Measured frequency |
| Element | Name: ExcitationSwitch  Type: BOOL  Description: Monitors the excitation input enable |
| Element | Name: PowerOk  Type: BOOL  Description: Voltage monitor readback |
| Element | Name: FrequencyLive  Type: BOOL  Description: Keep alive for frequency measurement |

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| **Hardware Output Type**  TYPE LowNoiseVcoOutStruct :  STRUCT  TuneOfs: INT;  ExcitationEn: BOOL;  END\_STRUCT  END\_TYPE | |
| Type name | LowNoiseVcoOutStruct |
| Description | Structure of the hardware outputs that are wired up for the low noise VCO |
| Definition | STRUCT |
| Element | Name: TuneOfs  Type: INT  Description: Setpoint for the frequency offset |
| Element | Name: ExcitationEn  Type: BOOL  Description: Enables the excitation input |

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| **User Interface Type**  TYPE LowNoiseVcoStruct :  STRUCT  Error: ErrorStruct;  ReferenceMon: LREAL;  ReferenceNom: LREAL;  DividerMon: LREAL;  DividerNom: LREAL;  OutputMon: LREAL;  OuptutNom: LREAL;  ReferenceTemp: LREAL;  DividerTemp: LREAL;  OutputTemp: LREAL;  TuneOfs: LREAL;  TuneMon: LREAL;  ExcitationEn: BOOL;  ExcitationSwitch: BOOL;  PowerOk: BOOL;  Frequency: LREAL;  FrequencyLive: BOOL;  FrequencySet: LREAL;  FrequencyTol: LREAL;  FrequencyServoEn: BOOL;  FrequencyServoFault: BOOL;  END\_STRUCT  END\_TYPE | |
| Type name | LowNoiseVcoStruct |
| Description | Structure of the user interface tags that are used to control the low noise VCO |
| Definition | STRUCT |
| Output Tag | Name: Error  Type: ErrorStruct  Description: For error handler |
| Output Tag | Name: ReferenceMon  Type: LREAL  Description: Monitors the RF power at the reference input in dBm |
| Input Tag | Name: ReferenceNom  Type: LREAL  Description: Nominal value for the RF power at the reference input in dBm |
| Output Tag | Name: DividerMon  Type: LREAL  Description: Monitors the RF power at the divider input in dBm |
| Input Tag | Name: DividerNom  Type: LREAL  Description: Nominal value for the RF power at the divider input in dBm |
| 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: ReferenceTemp  Type: LREAL  Description: Monitors the temperature of the reference RF detector in C |
| Output Tag | Name: DividerTemp  Type: LREAL  Description: Monitors the temperature of the divider RF detector in C |
| 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: 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: FrequencyLive  Type: BOOL  Description: Indicates if the frequency of the VCO is updating |
| Input Tag | Name: FrequencySet  Type: LREAL  Description: Setpoint for the VCO frequency output |
| Input Tag | Name: FrequencyTol  Type: LREAL  Description: Tolerance for the VCO frequency output |
| Input Tag | Name: FrequencyServoEn  Type: BOOL  Description: Enables the frequency PID |
| Output Tag | Name: FrequncyServoFault  Type: BOOL  Description: Indicates a fault in the frequency servo |

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| **Function Block**  FUNCTION\_BLOCK LowNoiseVcoFB  VAR\_INPUT  LowNoiseVcoIn: LowNoiseVcoInStruct;  END\_VAR  VAR\_OUTPUT  LowNoiseVcoOut: LowNoiseVcoOutStruct;  END\_VAR  VAR\_IN\_OUT  LowNoiseVco: LowNoiseVcoStruct;  END\_VAR  VAR  END\_VAR | |
| Name | LowNoiseVcoFB |
| Description | Controls the low noise VCO. One function block for each low noise VCO chassis needs to be instantiated. |
| Input argument | Name: LowNoiseVcoIn  Type: LowNoiseVcoInStruct  Description: Input hardware structure |
| Output argument | Name: LowNoiseVcoOut  Type: LowNoiseVcoOutStruct  Description: Output hardware structure |
| In/out argument | Name: LowNoiseVco  Type: LowNoiseVcoStruct  Description: User Interface structure |

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| **Visual** | |
| Name | LowNoiseVcoVis |
| Description | Displays several MON and temperature readings, power and excitation status, and error alarms |
| Placeholder | Name: LowNoiseVCO  Type: LowNoiseVCOStruct  Description: Low Noise VCO structure |