*LIGO Laboratory / LIGO Scientific Collaboration*

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TwinCAT Library for   
DC Power

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| **Library** | |
| Title | DCPower |
| Version | 1 |
| TwinCAT version | 2.11 |
| Name space | – |
| Author | Alexa Staley, Sheila Dwyer |
| Description | Monitors the DC Power of photodiodes and quad photodiodes  Supports 3 types of PDs, DCPowerSimple is for use with the generic PD interface (LIGO-D1002932-v4), DCPowerPhotodiodeAmp is for bare PDs (Thorlabs SM1PD1A) controlled through the amplifier D1200543-v6, DCPowerLegacyLSC is the DC readbacks for LSCPDs.  Each photodetector type supports DC offset adjustment.  For DCPowerPhotodiodeAmp the transimpedance is set to 1000 Ohms, and an Enum allows the user to select the gin setting of 0, 10, 20 or 30dB, which the code translates into a ratio DCPower.Gain, used along with the transimpedance to calculate the photocurrent, DCPower.DCCurrent.  The DCCurrent is then divided by DCPower.Responsivity to give the power in Watts, DCPower.Power  Each photodetector also support optional low and high limits, the user chooses which ones to enforce.  Quad detectors compute sum, pitch and yaw depending on how the detector is mounted. (not sure if this is implemented yet) |
| Error codes | DCPower:  0x01 – DC offset too large (greater than 10 or less than -10)  0x02 – ABS(Transimpedance) less than 1  0x03 – Responsivity too small  0x04- Power too low (below limit)  0x05 – Power too high  0x06 – Power limits exceeded (either too low or too high)  DCQuadPower:  0x01 – Error in Segment 1  0x02 – Error in Segment 2  0x04 – Error in Segment 3  0x08 – Error in Segment 4  0x10 – Sum below threshold |
| Library dependencies | Error, ReadADC, SaveRestore |

Usage example:

ALSDoublingPathIRDCPDFB (

Photodiode\_Type := DCPowerPhotodiodeAmp,

DCPowerIn := ALSDoublingPathIRDCPDIn,

DCPowerOut => ALSDoublingPathIRDCPDOut,

DCPower := Ifo.ALS.C.DoublingPathIRDCPD,

Request := Request,

DCPowerInit := ALSDoublingPathIRDCPDInit);

Ifo.C.DoublingPathIRDCPD.Responsivity:=0.65; (\*just a guess\*)

Associated MEDM screens:

\opt\rtcds\userapps\release\isc\common\medm\CUST\_DCPD.adl

**Table of quad photodiode orientation**

**(Front view)**

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|  | **Orientation** | | | |
| **Cross** | | **Plus** | |
| **Rotation** | **Normal** | **Flipped** | **Normal** | **Flipped** |
| **Up** | 1  2  3  4 | 1  4  3  2 | 1  4  3  2 | 4  1  2  3 |
| **Right** | 4  1  2  3 | 2  1  4  3 | 4  3  2  1 | 1  2  3  4 |
| **Down** | 3  4  1  2 | 3  2  1  4 | 3  2  1  4 | 2  3  4  1 |
| **Left** | 2  3  4  1 | 4  3  2  1 | 2  1  4  3 | 3  4  1  2 |

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| **Hardware Input Type**  TYPE DCPowerInStruct :  STRUCT  DCPower: INT;  Status: BOOL;  END\_STRUCT  END\_TYPE | |
| Type name | DCPowerInStruct |
| Description | Structure of the hardware inputs that are wired up for the DC Power |
| Definition | STRUCT |
| Element | Name: DCPower  Type: INT  Description: Monitors the DC power |

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| **Hardware Output Type**  TYPE DCPowerOutStruct :  STRUCT  Gain: BOOL;  END\_STRUCT  END\_TYPE | |
| Type name | DCPowerOutStruct |
| Description | Structure of the hardware output that are wired up for the DC Power |
| Definition | STRUCT |
| Element | Name: Gain  Type: BOOL  Description: Gain setting for diodes |

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| **User Interface Type**  TYPE DCPowerLimitsEnum : (LimitsNone, LimitsLow, LimitsHigh, LimitsHiLo);  END\_TYPE | |
| Type name | DCPowerLimitsEnum |
| Description | List of optional limit choices |
| Definition | ENUM |
| Enum Tag | Name: LimitsNone  Description: No limit |
| Enum Tag | Name: LimitsLow  Description: Check low limit |
| Enum Tag | Name: LimitsHigh  Description: Check high limit |
| Enum Tag | Name: LimitsHiLo  Description: Check low and high limit |

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| **User Interface Type**  TYPE DCPowerStruct :  STRUCT  Error: ErrorStruct;  PhotodiodeType: LREAL;  Volts: LREAL;  Offset: LREAL;  Transimpedance: LREAL;  GainSetting: DCPowerGainEnum;  Gain: LREAL;  DCCurrent: LREAL;  Responsivity: LREAL;  Power: LREAL;  SplitterR: LREAL;  PowerMon: LREAL;  Limits: DCPowerLimitsEnum;  Range: BOOL;  Low: LREAL;  High: LREAL;  Nominal: LREAL;  Normalized: LREAL;  END\_STRUCT  END\_TYPE | |
| Type name | DCPowerStruct |
| Description | Structure of the user interface tags that are used to control the DC power |
| Definition | STRUCT |
| Output Tag | Name: Error  Type: ErrorStruct  Description: Error handling |
| Output Tag | Name: PhotodiodeType  Type: LREAL  Description: Photodiode type |
| Output Tag | Name: Volts  Type: LREAL  Description: Monitors the photodetector DC power in V |
| In/out Tag | Name: Offset  Type: LREAL  Description: DC offset in V |
| In/out Tag | Name: Transimpedance  Type: LREAL  Description: Photodetector transimpedance in Ohms |
| Output Tag | Name: GainSetting  Type: DCPowerGainEnum  Description: Gain setting in dB |
| Output Tag | Name: Gain  Type: LREAL  Description: Gain as a ratio |
| Output Tag | Name: DCCurrent  Type: LREAL  Description: Photodetector current in mA |
| In/out Tag | Name: Responsivity  Type: LREAL  Description: Photodetector response in A/W |
| Output Tag | Name: Power  Type: LREAL  Description: Monitors the DC power in mW |
| Output Tag | Name: SplitterR  Type: LREAL  Description: Reflectivity of pick off beam splitter in percent |
| Output Tag | Name: PowerMon  Type: LREAL  Description: Power at the pick off beam splitter |
| Output Tag | Name: Limits  Type: DCPowerLimitsEnum  Description: Specifies optional limits |
| Output Tag | Name: Range  Type: BOOL  Description: True if limits exceeded |
| Output Tag | Name: Low  Type: LREAL  Description: Low limit for power in mW |
| Output Tag | Name: High  Type: LREAL  Description: High limit for power in mW |
| Output Tag | Name: Nominal  Type: LREAL  Description: Nominal DC current |
| Output Tag | Name: Normalized  Type: LREAL  Description: Current normalized to nominal |

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| **Function Block**  FUNCTION\_BLOCK DCPowerFB  VAR\_INPUT  Request: SaveRestoreEnum;  PhotodiodeType: DCPowerEnum := DCPowerSimple;  DCPowerIn: DCPowerInStruct;  END\_VAR  VAR\_OUT  DCPowerOut: DCPowerOutStruct;  END\_VAR  VAR\_IN\_OUT  DCPowerInit: DCPowerStruct;  DCPower: DCPowerStruct;  END\_VAR | |
| Name | DCPowerFB |
| Description | Controls the DC Power |
| Input argument | Name: Request  Type: SaveRestoreEnum  Description: Save/restore command |
| Input argument | Name: PhotodiodeTpe  Type: DCPowerEnum := DCPowerSimple  Description: Input of photodiode type |
| Input argument | Name: DCPowerIn  Type: DCPowerInStruct  Description: Input hardware structure |
| Output arugment | Name: DCPowerOut  Type: DCPowerOutStruct  Description: Output hardware structure |
| In/out argument | Name: DCPowerInit  Type: DCPowerStruct  Description: Interface structure for save/restore |
| In/out argument | Name: DCPower  Type: DCPowerStruct  Description: User Interface structure |

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| **Hardware Input Type**  TYPE QuadDCPowerInStruct :  STRUCT  Seg: ARRAY [1..4] OF DCPowerInStruct;  END\_STRUCT  END\_TYPE | |
| Type name | QuadDCPowerInStruct |
| Description | Structure of the hardware inputs that are wired up for the DC Power |
| Definition | STRUCT |
| Element | Name: Seg  Type: ARRAY  Description: Creates a four array of DCPowerInStruct |

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| **User Interface Type**  TYPE QuadDCPowerOrientationEnum : (Cross, Plus);  END\_TYPE | |
| Type name | QuadDCPowerOrientationEnum |
| Description | Basic quad photodetector orientation |
| Definition | ENUM |
| Enum Tag | Name: Cross  Description: Segment 1 on top, then clockwise |
| Enum Tag | Name: Plus  Description: Segment 1 top/right, then clockwise |

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| **User Interface Type**  TYPE QuadDCPowerRotationEnum : (Up, Right, Down, Left);  END\_TYPE | |
| Type name | QuadDCPowerRotationEnum |
| Description | Photodetector rotation |
| Definition | ENUM |
| Enum Tag | Name: Up  Description: Segment 1 on top or top/right |
| Enum Tag | Name: Right  Description: Segment 1 on the right or bottom/right |
| Enum Tag | Name: Down  Description: Segment 1 on bottom or bottom/left |
| Enum Tag | Name: Left  Description: Segment 1 on the left or top/left |

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| **User Interface Type**  TYPE QuadDCPowerStruct :  STRUCT  Error: ErrorStruct;  Seg: ARRAY [1..4] OF DCPowerStruct;  Sum: LREAL;  Threshold: LREAL;  Flip: BOOL;  Orientation: QuadDCPowerOrientationEnum;  Rotation: QuadDCPowerRotationEnum;  Pitch: LREAL;  Yaw: LREAL;  END\_STRUCT  END\_TYPE | |
| Type name | QuadDCPowerStruct |
| Description | Structure of the user interface tags that are used to control the DC power |
| Definition | STRUCT |
| Output Tag | Name: Error  Type: ErrorStruct  Description: Error handling |
| Output Tag | Name: Seg  Type: ARRAY  Description: Creates a four array for the four monitors of the DC power |
| Output Tag | Name: Sum  Type: LREAL  Description: Sum of the four DC power monitors in mW |
| In/Out Tag | Name: Threshold  Type: LREAL  Description: Threshold for sum in mW |
| In/out Tag | Name: Flip  Type: BOOL  Description: Counterclockwise numbering of segments |
| In/out Tag | Name: Orientation  Type: QuadDCPowerOrientationEnum  Description: Plus or cross configuration |
| In/out Tag | Name: Rotation  Type: QuadDCPowerRotationEnum  Description: Rotation of photodetector in steps of 90 degree |
| Output Tag | Name: Pitch  Type: LREAL  Description: Pitch, calculated by (Top – Bottom) / Sum |
| Output Tag | Name: Yaw  Type: LREAL  Description: Yaw, calculated by (Right – Left) / Sum |

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| **Function Block**  FUNCTION\_BLOCK QuadDCPowerFB  VAR\_INPUT  Request: SaveRestoreEnum;  QuadDCPowerIn: QuadDCPowerInStruct;  END\_VAR  VAR\_IN\_OUT  QuadDCPowerInit: QuadDCPowerStruct;  QuadDCPower: QuadDCPowerStruct;  END\_VAR | |
| Name | DCPowerFB |
| Description | Controls the DC Power |
| Input argument | Name: Request  Type: SaveRestoreEnum  Description: Save/restore command |
| Input argument | Name: QuadDCPowerIn  Type: QuadDCPowerInStruct  Description: Input hardware structure |
| In/out argument | Name: QuadDCPowerInit  Type: QuadDCPowerStruct  Description: Interface structure for save/restore |
| In/out argument | Name: QuadDCPower  Type: QuadDCPowerStruct  Description: User Interface structure |

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| **Visual** | |
| Name | DCPowerVis |
| Description | Displays the DC power |
| Placeholder | Name: DCPower  Type: DCPowerStruct  Description: DC power structure |

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| **Visual** | |
| Name | QuadDCPowerVis |
| Description | Displays the DC power monitors, pitch, yaw, and error |
| Placeholder | Name: DCPower  Type: QuadDCPowerStruct  Description: DC power structure |