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

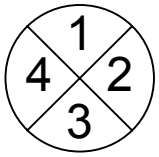
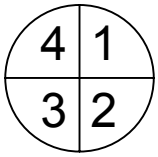
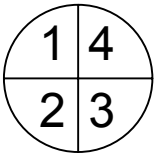
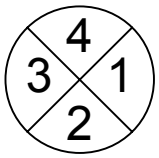
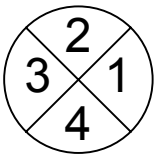
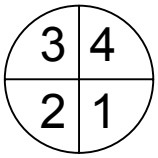
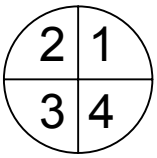
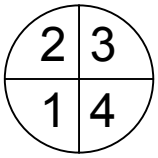
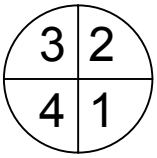
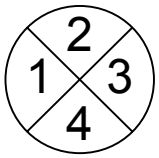
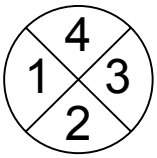
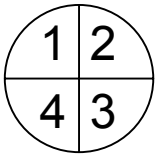
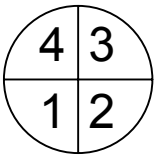
Usage example:

```
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)

	Orientation			
	Cross		Plus	
Rotation	**Normal**	**Flipped**	**Normal**	**Flipped**
Up				
Right				
Down				
Left				

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

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

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

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

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

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

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

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

User Interface Type

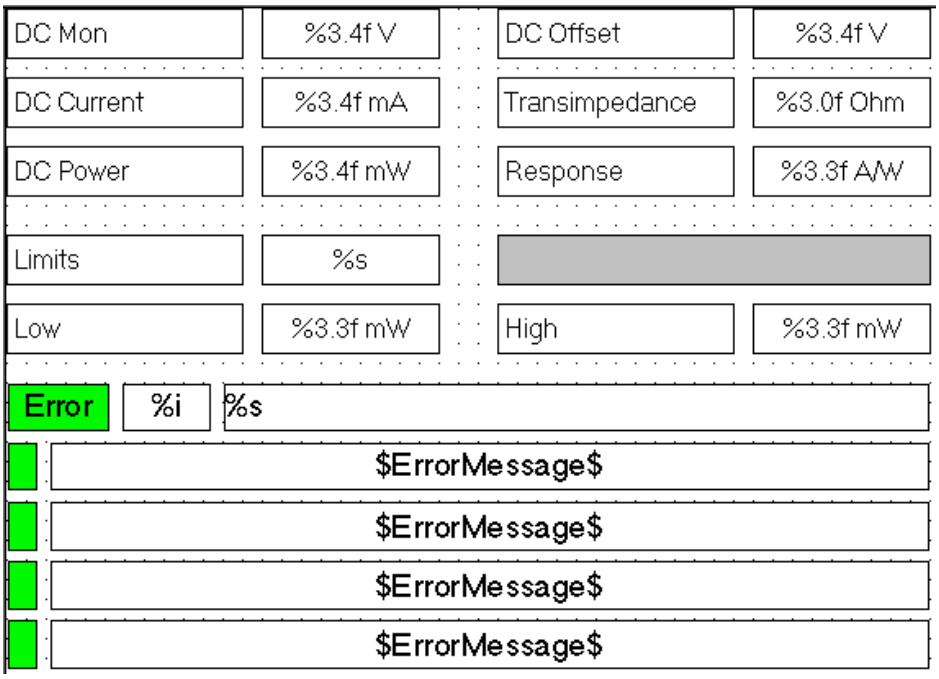
```
TYPE QuadDCPowerStruct :
STRUCT
    Error:          ErrorStruct;
    Seg:            ARRAY [1..4] OF DCPowerStruct;
    Sum:            LREAL;
    Threshold:      LREAL;
    Flip:           BOOL;
    Orientation:    QuadDCPowerOrientationEnum;
    Rotation:       QuadDCPowerRotationEnum;
    Pitch:          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

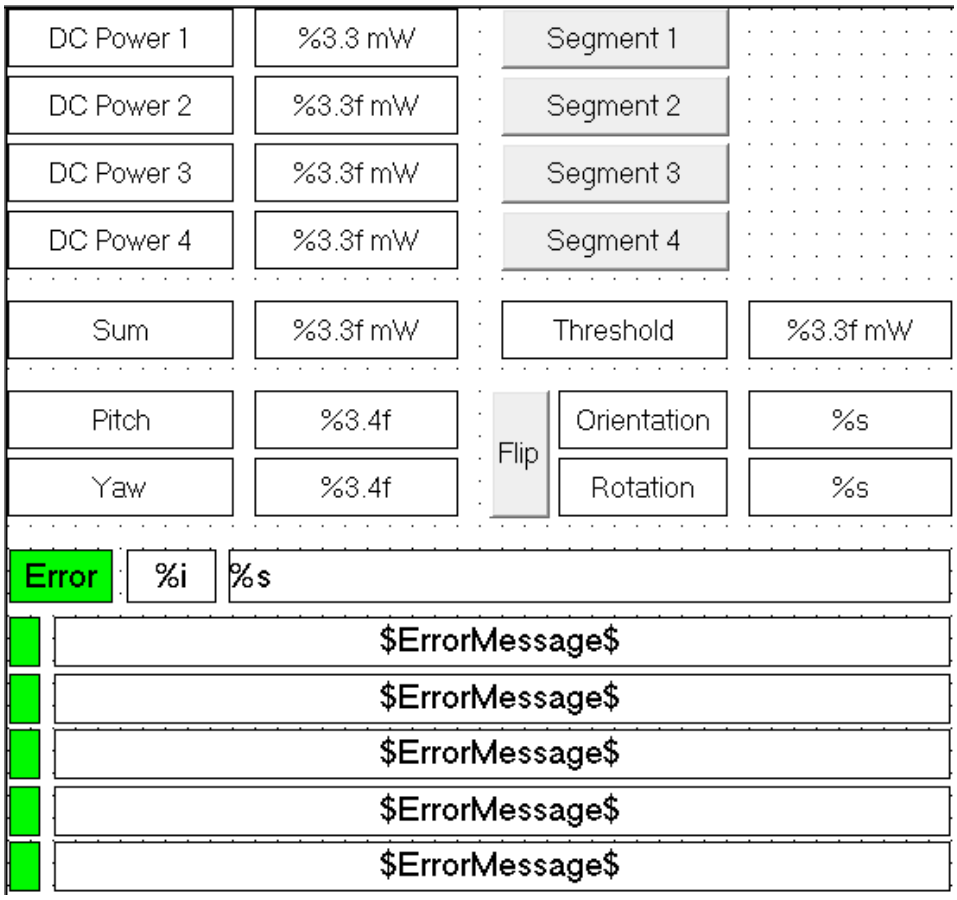
Function Block FUNCTION_BLOCK QuadDCPowerFB VAR_INPUT Request: SaveRestoreEnum; QuadDCPowerIn: QuadDCPowerInStruct; END_VAR VAR_IN_OUT QuadDCPowerInit: QuadDCPowerStruct; QuadDCPower: QuadDCPowerStruct; END_VAR	
Name	DCPowerFB
Description	Controls the DC Power
Input argument	Name: Request Type: SaveRestoreEnum 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

Visual



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

Visual



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