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TwinCAT Library for ISC Whitening Chassis

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Library	
Title	IscWhitening
Version	3
TwinCAT version	2.11
Name space	IscWhitening
Author	Daniel Sigg
Description	<p>Controls an ISC whitening chassis, D1002559, through the 384-channel binary IO chassis, D1100251. The binary IO chassis is controlled through a Modbus interface using four Acromag ES2113 that are connected to an EtherCAT-to-Modbus gateway, HMS AB9000. The setup instructions can be found in T1100607 and C1107420.</p> <p>The ISC whitening chassis contain 8 channels of whitening, D1001530. Each whitening channel employs a gain slider and 3 separately switchable filter stages. The ISC whitening chassis are used to interface the I and Q readouts of an LSC demodulator to the DAQ system, they are used to interface the I and Q readouts of a ASC wavefront sensor, and they are used to interface the 4 segments of a QPD (quad photodiode). Four LSC demodulators can be controlled from a single ISC whitening chassis, or one wavefront sensor, or two QPDs. Up to 6 ISC whitening chassis are controlled from a 384-channel binary IO chassis.</p> <p>This library is organized in two parts:</p> <ul style="list-style-type: none"> - An interface to the binary IO chassis that controls individual IO lines and organizes them by ISC whitening chassis, and - Individual interfaces for the LSC PDs, ASC WFSs and QPDs which interface with the above binary IO chassis data structures.
Error codes	<p>0x0001 – Illegal chassis number</p> <p>0x0002 – Illegal channel index number</p> <p>0x0004 – Invalid data (first channel)</p> <p>0x0008 – Invalid data (second channel)</p> <p>...</p> <p>0x0102 – Invalid data (eighth channel)</p>
Library dependencies	None

Hardware Input Type TYPE IscWhiteningInStruct : STRUCT LiveList: ARRAY[1..8] OF BYTE; PCB: ARRAY[1..4,1..13] OF WORD; InfoDataState: WORD; END_STRUCT END_TYPE	
Type name	IscWhiteningInStruct
Description	Structure of the hardware inputs that mapped into the EtherCAT memory space by the EtherCAT-to-Modbus gateway. For mapping see next page.
Definition	STRUCT
Element	Name: LiveList Type: ARRAY[1..8] OF BYTE Description: Information about the active connections, see HMS AB9000 manual
Element	Name: PCB Type: ARRAY[1..4,1..13] OF WORD Description: Readbacks form the binary IO chassis, see HMS AB9000 and ES2113 manual
Element	Name: InfoDataState Type: WORD Description: State information of the gateway.

Hardware Output Type TYPE IscWhiteningOutStruct : STRUCT PCB: ARRAY[1..4,1..6] OF WORD; END_STRUCT END_TYPE	
Type name	IscWhiteningOutStruct
Description	Structure of the hardware outputs that mapped into the EtherCAT memory space by the EtherCAT-to-Modbus gateway. For mapping see next page.
Definition	STRUCT
Element	Name: PCB Type: ARRAY[1..4,1..6] OF WORD Description: Controls to the binary IO chassis, see HMS AB9000 and ES2113 manual

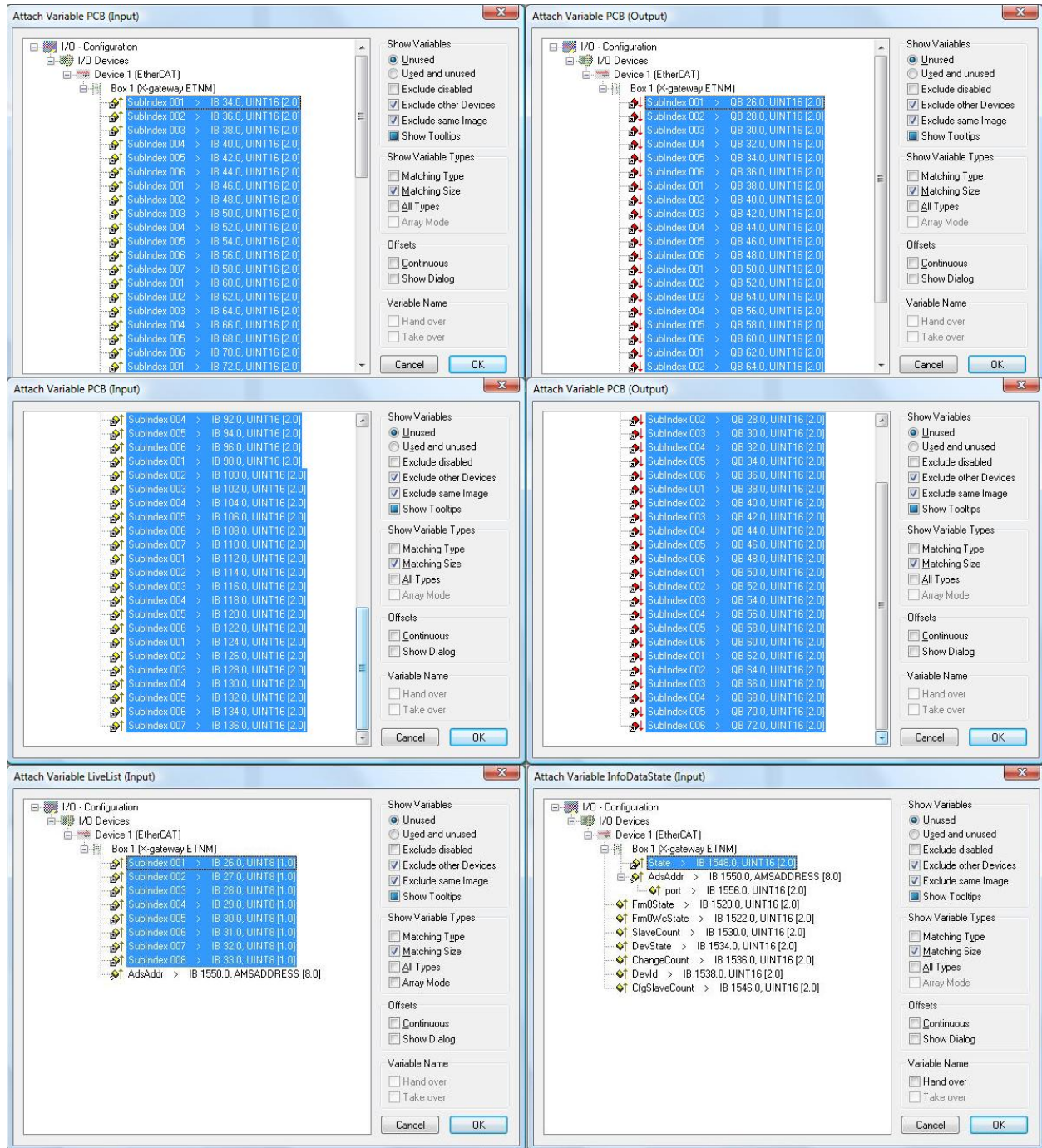


Fig 1. Mapping of IO structures into the EtherCAT memory space.

Internal Interface Type TYPE IscWhiteningStruct : STRUCT Chassis: ARRAY[1..6] OF IscWhiteningRawChassisStruct; END_STRUCT END_TYPE	
Type name	IscWhiteningStruct
Description	Internal interface structure between the binary IO chassis function blocks and the ISC whitening chassis function blocks
Definition	STRUCT
Input/Output Tag	Name: Chassis Type: ARRAY[1..6] OF IscWhiteningRawChassisStruct Description: Contains the binary IO data organized by chassis and channel.

Function Block FUNCTION_BLOCK IscWhiteningInterfaceFB VAR_INPUT In: IscWhiteningInStruct; END_VAR VAR_OUTPUT Out: IscWhiteningOutStruct; END_VAR VAR_IN_OUT Val: IscWhiteningStruct; END_VAR	
Name	IscWhiteningInterfaceFB
Description	Controls a 384-channel binary IO chassis.
Input argument	Name: In Type: IscWhiteningInStruct Description: Input hardware structure
Output argument	Name: Out Type: IscWhiteningOutStruct Description: Output hardware structure
In/out argument	Name: Val Type: IscWhiteningStruct Description: Internal interface structure

User Interface Type TYPE IscWhiteningChannelStruct : STRUCT Error: ErrorStruct; Gain: INT; GainStep: INT; Filter: ARRAY [1..3] OF BOOL; Set: ARRAY [1..3] OF BOOL; Toggle: ARRAY [1..3] OF BOOL; Readback: BYTE; END_STRUCT END_TYPE	
	IscWhiteningChannelStruct
Description	Structure of the user interface tags that are used to control a single channel of the ISC whitening chassis
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: Calls error handler
In/Out Tag	Name: Gain Type: INT Description: Whitening gain in dB from 0 dB to 45 dB in 3 dB steps. This value is tight to GainStep. Any change in one of the two variables will updated the other.
In/Out Tag	Name: GainStep Type: INT Description: Whitening gain in steps from 0 to 15. This value is tight to Gain. Any change in one of the two variables will updated the other.
Output Tag	Name: Filter Type: ARRAY [1..3] OF BOOL Description: True if the whitening filter is on. Each array index represents a filter section.
Input Tag	Name: Set Type: ARRAY [1..3] OF BOOL Description: Set value for the whitening filters. Each array index represents a filter section.
Input Tag	Name: Toggle Type: ARRAY [1..3] OF BOOL Description: Set to True to toggle the state of a whitening filter. Each array index represents a filter section.

Output Tag	Name: Readback Type: BYTE Description: Bit encoded readback value from the whitening chassis
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Function Block FUNCTION_BLOCK IscWhiteningChannelFB VAR_INPUT Chassis: INT; (* 1 to 6 *) Index: INT; (* 1 to 8 *) END_VAR VAR_IN_OUT IscWhitening: IscWhiteningStruct; Channel: IscWhiteningChannelStruct; END_VAR VAR END_VAR	
Name	IscWhiteningChannelFB
Description	Controls a single channel in the whitening chassis (1 byte) Call this function block before IscWhiteningInterfaceFB.
In/Out argument	Name: IscWhitening Type: IscWhiteningStruct Description: Internal interface structure
Input argument	Name: Chassis Type: INT Description: Select the chassis: Values from 1 to 6
Input argument	Name: Index Type: INT Description: Select the channel: Index from 1 to 8
In/out argument	Name: Channel Type: IscWhiteningChannelStruct Description: User Interface structure for a single channel of ISC whitening

User Interface Type TYPE IscWhiteningDemodIQStruct : STRUCT Error: ErrorStruct; I: IscWhiteningChannelStruct; Q: IscWhiteningChannelStruct; END_STRUCT END_TYPE	
Type name	IscWhiteningDemodIQStruct
Description	Structure of the user interface tags that are used to control two channels of the ISC whitening chassis which are used for an LSC demodulator
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: Calls error handler
In/Out Tag	Name: I Type: IscWhiteningChannelStruct Description:
In/Out Tag	Name: Q Type: IscWhiteningChannelStruct Description: Whitening gain in steps from 0 to 15. This value is tight to Gain. Any change in one of the two variables will update the other.

Function Block FUNCTION_BLOCK IscWhiteningDemodIQFB VAR_INPUT Chassis: INT; (* 1 to 6 *) Index: INT; (* 1, 3, 5 or to 7 *) END_VAR VAR_IN_OUT IscWhitening: IscWhiteningStruct; Demod: IscWhiteningDemodIQStruct; END_VAR VAR END_VAR	
Name	IscWhiteningDemodIQFB
Description	Controls two channels in the whitening chassis (2 bytes) Call this function block before IscWhiteningInterfaceFB.
In/Out argument	Name: IscWhitening Type: IscWhiteningStruct Description: Internal interface structure
Input argument	Name: Chassis Type: INT Description: Select the chassis: Values from 1 to 6
Input argument	Name: Index Type: INT Description: Select the channel: Index is 1, 3, 5, or 7 The selected index represents the quad-phase channel, whereas Index+1 represents the in-phase channel.
In/out argument	Name: Demod Type: IscWhiteningDemodIQStruct Description: User Interface structure for two channels of ISC whitening describing the I and Q channels of a LSC demodulator.

User Interface Type TYPE IscWhiteningDemodWfsStruct : STRUCT Error: ErrorStruct; Seg: ARRAY [1..4] OF IscWhiteningDemodIQStruct; END_STRUCT END_TYPE	
Type name	IscWhiteningDemodWfsStruct
Description	Structure of the user interface tags that are used to control eight channels of the ISC whitening chassis which are used for an ASC wavefront sensor demodulator
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: Calls error handler
In/Out Tag	Name: Seg Type: ARRAY [1..4] OF IscWhiteningDemodIQStruct Description: The four segments of a wavefront sensor

Function Block FUNCTION_BLOCK IscWhiteningDemodWfsFB VAR_INPUT Chassis: INT; (* 1 to 6 *) END_VAR VAR_IN_OUT IscWhitening: IscWhiteningStruct; DemodWfs: IscWhiteningDemodWfsStruct; END_VAR VAR END_VAR	
Name	IscWhiteningDemodWfsFB
Description	Controls eight channels in a whitening chassis (8 bytes) Call this function block before IscWhiteningInterfaceFB.
In/Out argument	Name: IscWhitening Type: IscWhiteningStruct Description: Internal interface structure
Input argument	Name: Chassis Type: INT

	Description: Select the chassis: Values from 1 to 6
In/out argument	Name: DemodWfs Type: IscWhiteningDemodWfsStruct Description: User Interface structure for eight channels of ISC whitening describing the I and Q channels of a four segment ASC wavefront sensor demodulator.

User Interface Type	
TYPE IscWhiteningQpdStruct :	
STRUCT	
Error:	ErrorStruct
Seg:	ARRAY [1..4] OF IscWhiteningChannelStruct;
END_STRUCT	
END_TYPE	
Type name	IscWhiteningQpdStruct
Description	Structure of the user interface tags that are used to control eight channels of the ISC whitening chassis which are used for an ASC wavefront sensor demodulator
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: Calls error handler
In/Out Tag	Name: Seg Type: ARRAY [1..4] OF IscWhiteningChannelStruct Description: The four segments of a QPD sensor

Function Block FUNCTION_BLOCK IscWhiteningQpdFB VAR_INPUT Chassis: INT; (* 1 to 6 *) Index: INT; (* 1 or 5 *) END_VAR VAR_IN_OUT IscWhitening: IscWhiteningStruct; Qpd: IscWhiteningQpdStruct; END_VAR VAR END_VAR	
Name	IscWhiteningQpdFB
Description	Controls four channels in a whitening chassis (4 byte) Call this function block before IscWhiteningInterfaceFB.
In/Out argument	Name: IscWhitening Type: IscWhiteningStruct Description: Internal interface structure
Input argument	Name: Chassis Type: INT Description: Select the chassis: Values from 1 to 6
Input argument	Name: Index Type: INT Description: Select the channel: Index from 1 or 5 The selected index represents the first channel of a QPD, whereas Index+1, Index+2 and Index+3 represent the second, third and forth channel, respectively.
In/out argument	Name: Qpd Type: IscWhiteningQpdStruct Description: User Interface structure for four channels of ISC whitening describing the channels of a four segment ASC quad photodiode.

Program Example:

PROGRAM Whitening

VAR

```

    IscWhiteningIn      AT %IB0:      IscWhiteningInStruct;
    IscWhiteningOut     AT %QB0:      IscWhiteningOutStruct;
    IscWhitening:       IscWhiteningStruct;
    IscWhiteningChassis: IscWhiteningInterfaceFB;

    LenSensor:          ARRAY [1..4] OF IscWhiteningDemodIQStruct;
    Power:               IscWhiteningChannelStruct;
    Wfs:                 ARRAY [1..2] OF IscWhiteningDemodWfsStruct;
    Qpd:                 ARRAY [1..2] OF IscWhiteningQpdStruct;

    DemodLen:           ARRAY [1..4] OF IscWhiteningDemodIQFB;
    MonitorPower:        IscWhiteningChannelFB;
    DemodWfs:           ARRAY [1..2] OF IscWhiteningDemodWfsFB;
    MonitorQpd:         ARRAY [1..2] OF IscWhiteningQpdFB;

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```

    I:                  INT;

```

END_VAR

(* Process individual sensors *)

FOR I := 1 TO 4 DO

```

    DemodLen[I] (IscWhitening := IscWhitening, Chassis := 1, Index := I, Demod := LenSensor[I]);

```

END_FOR;

```

MonitorPower (IscWhitening := IscWhitening, Chassis := 1, Index := 5, Channel := Power);

```

FOR I := 1 TO 2 DO

```

    DemodWfs[I] (IscWhitening := IscWhitening, Chassis := I+1, DemodWfs := Wfs[I]);

```

END_FOR;

FOR I := 1 TO 2 DO

```

    MonitorQpd[I] (IscWhitening := IscWhitening, Chassis := 4, Index := I+4, Qpd := Qpd[I]);

```

END_FOR;

(* Process whitening chassis after individual sensors *)

```

IscWhiteningChassis (In := IscWhiteningIn, Out => IscWhiteningOut, Val := IscWhitening);

```

Visual	
Name	IscWhiteningVis
Description	Displays the tags of an 384-channel binary IO chassis organized in six ISC whitening chassis which in turn show a list of 8 channels each. Each channel has 8 bits (1 byte) and shows the readback value. It lets you choose a new set value or apply a toggle value. The channel background turns red if the value is invalid.
Placeholder	Name: whitening Type: IscWhiteningStruct Description: Internal interface structure

Visual	
Name	IscWhiteningChannelVis
Description	Displays the tags of single channel of whitening
Placeholder	Name: channel Type: IscWhiteningChannelStruct Description: ISC whitening channel structure

Visual	
Name	IscWhiteningDemodIQVis
Description	Displays the tags of two channels of whitening
Placeholder	Name: demod

	Type: IscWhiteningDemodIQStruct Description: ISC whitening IQ demodulator structure
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Visual

Name	IscWhiteningDemodWfsVis
Description	Displays the tags of eight channels of whitening
Placeholder	Name: wfs Type: IscWhiteningDemodWfsStruct Description: ISC whitening WFS demodulator structure

Visual

Name	IscWhiteningQpdVis
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Description	Displays the tags of four channels of whitening
Placeholder	Name: qpd Type: IscWhiteningQpdStruct Description: ISC whitening quad photodiode structure