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LIGO- E1300430-v3

advanced LIGO

10/15/2013

Communication Library Documentation

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LIGO Scientific Collaboration

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Library	
Title	ALSCommunication
Version	3
TwinCAT version	
Name space	
Author	Sheila Dwyer
Description	Library that passes information needed to automate the ALS system between different PLCs in the beckhoff system, and from and to the real time system.
Error Code	0x001 Timing system error 0x002 communication lost 16#002 — Corner Timing System 16#004 — EX Timing System 16#008 — EY Timing System
Library Dependencies	DCPower, DelayLogic, Demodulator, Error, FiberDistribution, IscWhitening, Photodetectors, ReadADC, SaveRestore, WriteADC

Function blocks provided that pass signals needed for ALS communication between PLCs. PLC2 in the corner receives information from the timing system on corner PLC1, and from each end station, and sends information to each end station. PLC1 also sends information from the timing system to the end stations. This library will also implement communication from the real time system to the beckhoff eventually.

There are not hardware in and out data structures in this library, instead there is a structure for each link which will be used as the output structure on the sending side and the input structure on the receiving side. The user interface structure is used for error messages only.

Each send function block generates a keep alive bit, which toggles between 1 and 0 every 100ms. Each receive function block uses a TOF (Off delay timer), which is a standard function block defined in the IEC 1131-3 standard. There is an explanation on pg 234 of the red Programming Industrial Control Systems Using IEC 1131-1 book by R W Lewis, but the timing diagrams for the on delay timer and off delay timer are mixed up. The general function of this part is to check set a flag (KeepAliveTimeout.Q) if KeepAlive has not toggled in the time KeepAliveTimeout (10 seconds), which causes the error 'Communication Lost'. When this happened the values of the variables to be received are set to some values that should be clearly invalid.

Example usage:

CASE IfoId OF

IfoH1:

```
SendtoEndYFB(Request:=Request, VarStruct=>SendtoEndY,
VCOFreq:=Ifo.SYS.Timing.Y.FO_A.Port[9].Slave.CFC.Frequency[1],
```

```

BeatFreq:=Ifo.SYS.Timing.Y.FO_A.Port[9].Slave.CFC.Frequency[2],
TimingError:=Ifo.SYS.Timing.Y.FO_A.Port[9].Slave.Error,
ALSCommunication:=Ifo.SYS.Communication.C.toEndY);

```

```
IfoL1 ;
```

```
END_CASE;
```

The timing structures are not sent to any other PLC to avoid library dependencies that causing naming conflicts with some of the libraries used by the timing system. This means that each port and each input connector needs to be specified in the PLC, which adds flexibility.

Example usage of send function block:

```

ReceiveFromCornerPLC1FB(Request:=Request,
ALSCommunication:=Ifo.SYS.Communication.C.fromPLC1,
VarStruct:=ReceiveFromCornerPLC1);

```

The user interface type is only for error handling.

User Interface Type	
TYPE ALSCommunicationStruct :	
STRUCT	
Error:	ErrorStruct;
END_STRUCT;	
END_TYPE;	
Type Name	ALSCommunicationStruct
Description	Structure used in the user interface type monitor the communication between ALS machines
Definition	STRUCT
Output Tag	Name: Error Type: ErrorStruct Description: Calls the error handler

User Interface Type	
TYPE ALSCornerStateEnum : (ALSCornerSafe, ALSCornerInvalidState)	
END_TYPE;	
Type Name	ALSCornerStateEnum
Description	Monitors the state of the corner station
Definition	ENUM

Element	Name: ALSCornerSafe Description: Safe state
Element	Name: ALSCornerInvalidState Description: Invalid state

User Interface Type	
TYPE ALSEndStateEnum : (ALSEndSafe, ALSEndInvalidState, ALSEndPLLDisengaged, ALSEndPLLAcquire, ALSENDPLLLocked, ALSEndReflAcquiring, ALSEndReflLockedSlowOff, ALSEndReflLockedSlowOn) END_TYPE;	
Type Name	ALSEndStateEnum
Description	Monitors the state of the end station
Definition	ENUM
Element	Name: ALSEndSafe Description: Safe state
Element	Name: ALSEndInvalidState Description: Invalid state
Element	Name: ALSENDPLLDisengaged Description: ALS END PLL is disengaged
Element	Name: ALSENDPLLAcquire Description: ALS END PLL is acquiring lock
Element	Name: ALSENDPLLLocked Description: ALS END PLL is locked
Element	Name: ALSENDREflAcquiring Description: ALS END Refl is acquiring lock
Element	Name: ALSENDReflLockedSlowOff Description: ALS END Refl is locked with slow off
Element	Name: ALSENDReflLockedSlowOn Description: ALS END PLL is locked with slow on

User Interface Type	
TYPE CornerPLC1toCornerPLC2Struct :	
STRUCT	
KeepAlive:	BOOL;
DiffVCOFrequency:	LREAL;
CommVCOFrequency:	LREAL;
PSLVCOFrequency:	LREAL;
FiberAOMFrequency:	LREAL;
ExVCOFrequency:	LREAL;
ExBeatFrequency:	LREAL;

ExTimingError: DWORD; EyVCOFrequency: LREAL; EyBeatFrequency: LREAL; EyTimingError: DWORD; END_STRUCT; END_TYPE;	
Type Name	CornerPLC1toCornerPLC2Struct
Description	Structure used in the user interface type monitoring the communication between the corner PLC1 and PLC2
Definition	STRUCT
Output Tag	Name: KeepAlive Type: BOOL Description:
Output Tag	Name: DiffVCOFrequency Type: LREAL Description: Diff. VCO frequency
Output Tag	Name: CommVCOFrequency Type: LREAL Description: Comm. VCO frequency
Output Tag	Name: PSLVCOFrequency Type: LREAL Description: PSL VCO frequency
Output Tag	Name: FiberAOMFrequency Type: LREAL Description: Fiber AOM frequency
Output Tag	Name: TimingError Type: LREAL Description: Monitors the timing error
Output Tag	Name: ExCOFrequency Type: LREAL Description: EX VCO frequency
Output Tag	Name: ExBeatFrequency Type: LREAL Description: EX beatn note frequency
Output Tag	Name: ExTimingError Type: DWORD Description: EX timing error monitor
Output Tag	Name: EyCOFrequency Type: LREAL Description: EY VCO frequency
Output Tag	Name: EyBeatFrequency

	Type: LREAL Description: EY beat note frequency
Output Tag	Name: EyTimingError Type: DWORD Description: EY timing error monitor

User Interface Type	
TYPE CornerPLC1toEndStruct :	
STRUCT	
	KeepAlive: BOOL;
	VCOFrequency: LREAL;
	BeatFrequency: LREAL;
	TimingError: DWORD;
END_STRUCT;	
END_TYPE;	
Type Name	CornerPLC1toeEnStruct
Description	Structure used in the user interface type monitoring the communication between the corner PLC1 and end station
Definition	STRUCT
Output Tag	Name: KeepAlive Type: BOOL Description:
Output Tag	Name: VCOFrequency Type: LREAL Description: VCO frequency
Output Tag	Name: BeatFrequency Type: LREAL Description: Beat note frequency
Output Tag	Name: TimingError Type: LREAL Description: Monitors the timing error

User Interface Type	
TYPE CornerPLC2toEndStruct :	
STRUCT	
	KeepAlive: BOOL;
	RefCavTransError: DWORD;
	RefCavTransNorm: LREAL;
	FiberLaunchError: DWORD;
	FiberLaunchNorm: LREAL;
	FiberDistErr: BOOL;

GreenArmTransNorm: LREAL; GreenArmTransPDError: DWWORD; StateRequest: ALSEndStateEnum; END_STRUCT; END_TYPE;	
Type Name	CornerPLC2toEndStruct
Description	Structure used in the user interface type monitoring the communication between the corner PLC2 and end station
Definition	STRUCT
Output Tag	Name: KeepAlive Type: BOOL Description:
Output Tag	Name: RefCavTransError Type: DWORD Description: Reference cavity transmission error
Output Tag	Name: RefCavTransNorm Type: LREAL Description: Normal power level of the reference cavity transmission
Output Tag	Name: FiberLaunchTransError Type: DWORD Description: Fiber launch transmission error
Output Tag	Name: FiberLaunchTransNorm Type: LREAL Description: Normal power level of the fiber launch transmission
Output Tag	Name: FiberDistError Type: BOOL Description: Fiber distribution error
Output Tag	Name: GreenArmTransNorm Type: LREAL Description: Normal power level of the green arm transmission
Output Tag	Name: GreenArmTransPDError Type: DWORD Description: PD error monitoring the green arm transmission
Output Tag	Name: StateRequest Type: ALSEndStateEnum Description: Request the ALS end station state

User Interface Type TYPE CornerPLC2Struct : STRUCT KeepAlive: BOOL;

RedArmTransNorm: LREAL; RedArmTransError: DWORD; ALSEndState: ALSEndStateEnum; END_STRUCT; END_TYPE;	
Type Name	CornerPLC1toCornerPLC2Strcut
Description	Structure used in the user interface type monitoring the corner PLC2
Definition	STRUCT
Output Tag	Name: KeepAlive Type: BOOL Description:
Output Tag	Name: RedArmTransNorm Type: LREAL Description: Normal power level of the red arm transmission
Output Tag	Name: RedArmTransError Type: DWORD Description: Error monitoring the red arm transmission
Output Tag	Name: ALSEndState Type: ALSEndStateEnum Description: Request the ALS end station state

Function Block TYPE ReceiveCornerPLC1toCornerPLC2FB: VAR_INPUT Request: SaveRestoreEnum; END_VAR; VAR_IN_OUT ALSCommunication: ALSCommunicationStruct; VarStruct; CornerPLC1toCornerPLC2Struct; END_VAR; END_TYPE;	
Type Name	RecieveCornerPLC1toCornerPLC2FB
Description	Function block used to communicate between corner PLC1 and PLC2
Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct

	Description: User interface structure
In/out Argument	Name: VarStruct Type: CornerPLC1toCornerPLC2Struct Description: User interface structure

Function Block	
TYPE ReceiveCornerPLC1toEndFB:	
VAR_INPUT	
Request:	SaveRestoreEnum;
END_VAR;	
VAR_IN_OUT	
ALSCommunication:	ALSCommunicationStruct;
VarStruct;	CornerPLC1toEndStruct;
END_VAR:	
END_TYPE;	
Type Name	RecieveCornerPLC1toEndFB
Description	Function block used to communicate between corner PLC1 and end station
Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct Description: User interface structure
In/out Argument	Name: VarStruct Type: CornerPLC1toEndStruct Description: User interface structure

Function Block	
TYPE ReceiveCornerPLC2toEndFB:	
VAR_INPUT	
Request:	SaveRestoreEnum;
END_VAR;	
VAR_IN_OUT	
ALSCommunication:	ALSCommunicationStruct;
VarStruct;	CornerPLC2oEndStruct;
END_VAR:	
END_TYPE;	
Type Name	RecieveCornerPLC2toEndFB
Description	Function block used to communicate between corner PLC2 and end station

Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct Description: User interface structure
In/out Argument	Name: VarStruct Type: CornerPLC2toEndStruct Description: User interface structure

<p>Function Block TYPE ReceiveEndtoCornerPLC2FB: VAR_INPUT Request: SaveRestoreEnum; END_VAR; VAR_IN_OUT ALSCommunication: ALSCommunicationStruct; VarStruct; EndtoCornerPLC2Struct; END_VAR; END_TYPE;</p>	
Type Name	RecieveCornerPLC1toEndFB
Description	Function block used to communicate between corner PLC2 and end station
Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct Description: User interface structure
In/out Argument	Name: VarStruct Type: EndtoCornerPLC2Struct Description: User interface structure

<p>Function Block TYPE SendCornerPLC1toCornerPLC2FB: VAR_INPUT Request: SaveRestoreEnum; DiffVCOFreq: LREAL; CommVCOFreq: LREAL;</p>	
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<pre> PSLVCOFreq: LREAL; FiberAOMFreq: LREAL; ExVCOFreq: LREAL; ExBeatFreq: LREAL; ExTimingError: DWORD; EyVCOFreq: LREAL; EyBeatFreq: LREAL; EyTimingError: DWORD; END_VAR; VAR_IN_OUT ALSCommunication: ALSCommunicationStruct; END_VAR; VAR_OUTPUT VarStruct; CornerPLC1toEndStruct; END_VAR; END_TYPE; </pre>	
Type Name	SendCornerPLC1toCornerPLC2FB
Description	Function block used to communicate between corner PLC1 and PLC2
Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct Description: User interface structure
Output Argument	Name: VarStruct Type: CornerPLC1toEndStruct Description: User interface structure
Input Argument	Name: DiffVCOFreq Type: LREAL Description: Diff. VCO frequency
Input Argument	Name: CommVCOFreq Type: LREAL Description: Comm. VCO frequency
Input Argument	Name: PSLVCOFreq Type: LREAL Description: PSL VCO frequency
Input Argument	Name: FiberAOMFreq Type: LREAL Description: Fiber AOM frequency

Input Argument	Name: TimingError Type: LREAL Description: Monitors the timing error
Input Argument	Name: ExCOFreq Type: LREAL Description: EX VCO frequency
Input Argument	Name: ExBeatFreq Type: LREAL Description: EX beatn note frequency
Input Argument	Name: ExTimingError Type: DWORD Description: EX timing error monitor
Input Argument	Name: EyCOFreq Type: LREAL Description: EY VCO frequency
Input Argument	Name: EyBeatFreq Type: LREAL Description: EY beat note frequency
Input Argument	Name: EyTimingError Type: DWORD Description: EY timing error monitor

<p>Function Block</p> <p>TYPE SendCornerPLC1toEndFB:</p> <p>VAR_INPUT</p> <p> Request: SaveRestoreEnum;</p> <p> VCOFreq: LREAL;</p> <p> BeatFreq: LREAL;</p> <p> TimingError: DWORD;</p> <p>END_VAR;</p> <p>VAR_IN_OUT</p> <p> ALSCommunication: ALSCommunicationStruct;</p> <p>END_VAR;</p> <p>VAR_OUTPUT</p> <p> VarStruct; CornerPLC1toEndStruct;</p> <p>END_VAR;</p> <p>END_TYPE;</p>	
Type Name	SendCornerPLC1toEndFB
Description	Function block used to communicate between corner PLC1 and end station
Definition	Function Block
Input Argument	Name: Request

	Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct Description: User interface structure
Output Argument	Name: VarStruct Type: CornerPLC1toEndStruct Description: User interface structure
Input Argument	Name: VCOFreq Type: LREAL Description: VCO frequency
Input Argument	Name: BeatFreq Type: LREAL Description: Beat note frequency
Input Argument	Name: TimingError Type: LREAL Description: Monitors the timing error

<p>Function Block TYPE SendCornerPLC2toEndFB: VAR_INPUT Request: SaveRestoreEnum; GreenArmTransPD: DCPowerStruct; FiberDist: FiberDistributionStruct; ALSEndStateRequest: ALSEndStateEnum; END_VAR; VAR_IN_OUT ALSCommunication: ALSCommunicationStruct; END_VAR; VAR_OUTPUT VarStruct; CornerPLC2toEndStruct; END_VAR; END_TYPE;</p>	
Type Name	SendCornerPLC2toEndFB
Description	Function block used to communicate between corner PLC2 and end station
Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct

	Description: User interface structure
Output Argument	Name: VarStruct Type: CornerPLC2toEndStruct Description: User interface structure
Input Argument	Name: GreenArmTransPD Type: DCPowerStruct Description: User interface structure
Input Argument	Name: FiberDist Type: FiberDistributionStruct Description: User interface structure
Input Argument	Name: ALEndStateRequest Type: ALSEndStateEnum Description: Request the state

Function Block	
TYPE SendCornerPLC2FB:	
VAR_INPUT	
Request:	SaveRestoreEnum;
RedArmTransPD:	DCPowerStruct;
ALSEndStateRequest:	ALSEndStateEnum;
END_VAR;	
VAR_IN_OUT	
ALSCommunication:	ALSCommunicationStruct;
END_VAR;	
VAR_OUTPUT	
VarStruct;	EndtoCornerPLC2Struct;
END_VAR;	
END_TYPE;	
Type Name	SendCornerPLC2FB
Description	Function block used to send information to corner PLC2
Definition	Function Block
Input Argument	Name: Request Type: SaveRestoreEnum Description: Request save/restore/safemood or noop
In/out Argument	Name: ALSCommunication Type: ALSCommunicationStruct Description: User interface structure
Output Argument	Name: VarStruct Type: EndtoCornerPLC2Struct Description: User interface structure
Input Argument	Name: RedArmTransPD

	Type: DCPowerStruct Description: User interface structure
Input Argument	Name: ALEndStateRequest Type: ALSEndStateEnum Description: Request the state