*LIGO Laboratory / LIGO Scientific Collaboration*

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TwinCAT Library for PLCInfo

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| **Library** |
| Title | PLCInfo |
| Version | 1 |
| TwinCAT version | V2.11.0 |
| Name space |  |
| Author | Daniel Sigg |
| Description | Information about PLC status/locationIncludes system information |
| Error Code | MasterInfoStruct\_Errors:0x0001 – Link error detected0x0002 – IO reset required0x0004 – Missing frame in redundancy mode0x0008 – Watchdog triggered0x0010 – Ethernet driver not found0x0020 – I/O reset active0x0040 – At least one device not in OP state0x0080 – Distributed clock not in sync0x0100 – Slave count mismatch0x0200 – Frame working counter wrong0x0400 – Illegal AMS address0x0800 – Master not in OP state0x1000 – Frame statistics error |
| Library Dependencies | Error, SaveRestore, TcSystem, TcEtherCAT |

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| **User Interface Type**TYPE IfoIdEnum : (IfoH1, IfoL1, IfoH2, IfoT1, IfoI1)END\_TYPE; |
| Type Name | IfoIdEnum |
| Description | Identification of IFO |
| Definition | ENUM |
| Element | Name: IfoH1Description: H1 |
| Element | Name: IfoL1Description: L1 |
| Element | Name: IfoH2Description: H2 |
| Element | Name: IfoT1Description: T1 |
| Element | Name: IfoI1Description: I1 |

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| **User Interface Type**TYPE LocationIdEnum : (Corner, EndX, EndY, MidX, MidY)END\_TYPE; |
| Type Name | LocationIdEnum |
| Description | Location of PLC |
| Definition | ENUM |
| Element | Name: CornerDescription: Located in Corner station |
| Element | Name: EndXDescription: Located in EX station |
| Element | Name: EndYDescription: Located in EY station |
| Element | Name: MidXDescription: Located in MX station |
| Element | Name: MidYDescription: Located in MY station |

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| **User Interface Type**TYPE PlcTaksInfoStruct :STRUCT Active: BOOL; Name: STRING(16); Priority: DINT; CycleCount: UDINT; CycleTime: LREAL; LastExecTime: LREAL; CycleTimeExceeded: BOOL; CycleTimeError: UDINT;END\_STRUCTEND\_TYPE; |
| Type Name | PlcTaksInfoStruct |
| Description | Structure used in the user interface to describe the information for all available tasks in the PLC. |
| Definition | STRUCT |
| Output Tag | Name: ActiveType: BOOLDescription: True if task is configured and active |
| Output Tag | Name: NameType: STRING(16)Description: Name of task |
| Output Tag | Name: PriorityType: DINTDescription: Priority of task |
| Output Tag | Name: CycleCountType: UDINTDescription: Cycle count of task |
| Output Tag | Name: CycleTimeType: LREALDescription: Predefined cycle time in µs |
| Output Tag | Name: LastExecTime Type: LREALDescription: Cycle time of last executed cycle in µs.  |
| Output Tag | Name: CycleTimeExceededType: BOOLDescription: True if cycle time exceeded allocated time. |
| Output Tag | Name: CycleTimeErrorType: UDINTDescription: Error counter (updated at rate of task running PLCInfo) |

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| **User Interface Type**TYPE PlcInfoStruct :STRUCT IfoId: IfoIdEnum; LocationId: LocationIdEnum; Status: ErrorStruct; SvnRevision: DINT; StartTime: TIMESTRUCT; CurrentTime: TIMESTRUCT; Hostname: T\_MaxString; CpuUsage: UDINT: SysLatencyActual: UDINT; SysLatencyMax: UDINT: RuntimeNumber: DINT; ProjectName: STRING(32); NumberOfTasks: DINT; OnlineChangeCount: DINT; RetainLoaded: BOOL; PersistantLoaded: BOOL; Task: ARRAY [1..4] OF PlcTaksInfoStruct;END\_STRUCT;END\_TYPE; |
| Type Name | PlcInfoStruct |
| Description | Structure used in the user interface |
| Definition | STRUCT |
| Output Tag | Name: IfoIdType: IfoIdEnumDescription: Interferometer identification |
| Output Tag | Name: LocationIdType: LocationIdEnumDescription: Building Location |
| Output Tag | Name: StatusType: ErrorStructDescription: Calls error handler |
| Output Tag | Name: SvnRevisionType: DINTDescription: Subversion Revision |
| Output Tag | Name: StartTimeType: TIMESTRUCTDescription: PLC start time |
| Output Tag | Name: CurrentTimeType: TIMESTRUCTDescription: PLC current time |
| Output Tag | Name: ElapsedTimeType: DINTDescription: Elapsed time since last restart in sec |
| Output Tag | Name: HostnameType: T\_MaxStringDescription: PLC host name |
| Output Tag | Name: CpuUsageType: UDINTDescription: CPU usage |
| Output Tag | Name: SysLatencyActualType: UDINTDescription: Actual system latency |
| Output Tag | Name: SysLatencyMaxType: UDINTDescription: Max system latency |
| Output Tag | Name: RuntimeNumberType: DINTDescription: PLC runtime number |
| Output Tag | Name: ProjectNameType: STRING(32)Description: Name of PLC project |
| Output Tag | Name: NumberOfTasksType: DINTDescription: Number of active tasks in current PLC |
| Output Tag | Name: OnlineChangeCountType: DINTDescription: The number of online changes made since the last complete download |
| Output Tag | Name: RetainLoadedType: BOOLDescription: Valid retain data loaded |
| Output Tag | Name: PersistentLoadedType: BOOLDescription: Valid persistent data loaded |
| Output Tag | Name: TaskType: ARRAY [1..4] OF PlcTaksInfoStructDescription: Information on active tasks |

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| **Function Block**FUNCTION\_BLOCK PlcInfoFB:VAR\_INPUT Request: SaveRestoreEnum; Ifo: IfoIdEnum; Loc: LocationIdEnum; Svn: DINT; Status: ErrorStruct;END\_VAR;VAR\_OUTPUT CurrentTime: TIMESTRUCT; CurrentTimeValid: BOOL;END\_VAR;VAR\_IN\_OUT Plc: PlcInfoStruct;END\_VAR:END\_TYPE; |
| Type Name | PlcInfoFb |
| Description | Function block used to monitor the PLC status/location  |
| Definition | Function Block |
| Input Argument | Name: RequestType: SaveRestoreEnumDescription: Request for save/restore/safe mode or noop |
| Input Argument | Name: IfoType: IfoIdEnumDescription: IFO identification |
| Input Argument | Name: LocType: LocationIdEnumDescription: Location ID |
| Input Argument | Name: SvnType: DINTDescription: Subversion status |
| Input Argument | Name: StatusType: ErrorStructDescription: Calls error handler |
| Output Argument | Name: CurrentTimeType: TIMESTRUCTDescription: Current time |
| Output Argument | Name: CurrentTimeValidType: BOOLDescription: Current time valid |
| In/out Argument | Name: PlcType: PlcInfoStructDescription: User interface structure |

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| **User Interface Type**TYPE ECatCommStateEnum : ( ECatCommStateUNDEFINED := 0, ECatCommStateINIT := 1, ECatCommStatePREOP := 2, ECatCommStateBOOT := 3, ECatCommStateSAFEOP := 4, ECatCommStateOP := 8);END\_TYPE |
| Type Name | ECatCommStateEnum |
| Description | EtherCAT state machine  |
| Definition | ENUM |
| Element | Name: ECatCommStateUNDEFINEDDescription: Undefined |
| Element | Name: ECatCommStateINITDescription: INIT |
| Element | Name: ECatCommStatePREOPDescription: PREOP |
| Element | Name: ECatCommStateBOOTDescription: BOOT |
| Element | Name: ECatCommStateSAFEOPDescription: SAFEOP |
| Element | Name: ECatCommStateOPDescription: OP |

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| **User Interface Type**TYPE MasterInfoFastInStruct :STRUCT FrmWcState: ARRAY[0..7] OF WORD;END\_STRUCTEND\_TYPE |
| Type Name | MasterInfoFastInStruct |
| Description | Structure used to interface the PLC at fast rate. |
| Definition | STRUCT |
| Input Tag | Name: FrmWcStateType: ARRAY[0..7] OF WORDDescription: Set of frame working counter states |

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| **User Interface Type**TYPE MasterInfoInStruct :STRUCT SlaveCount: UINT; DeviceStatus: UINT; ChangeCount: UINT; DeviceId: UINT; NetId: T\_AmsNetIdArr; ConfigSlaveCount: UINT;END\_STRUCTEND\_TYPE |
| Type Name | MasterInfoInStruct |
| Description | Structure used to interface the PLC at standard rate. |
| Definition | STRUCT |
| Input Tag | Name: SlaveCountType: UINTDescription: Number of slave terminals connected to the master |
| Input Tag | Name: DeviceStatusType: UINTDescription: Status of the master device (network interface) |
| Input Tag | Name: ChangeCountType: UINTDescription: Number of changes to the device image |
| Input Tag | Name: DeviceIdType: UINTDescription: Device ID |
| Input Tag | Name: NetIdType: T\_AmsNetIdArrDescription: AMS address of master |
| Input Tag | Name: ConfigSlaveCountType: UINTDescription: Number of configured slave terminals |

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| **User Interface Type**TYPE MasterInfoFastStruct :STRUCT State: ARRAY[0..7] OF WORD; Error: ARRAY[0..7] OF BOOL;  Flag: BOOL;END\_STRUCTEND\_TYPE |
| Type Name | MasterInfoFastStruct |
| Description | Structure used to interface the PLC at fast rate. |
| Definition | STRUCT |
| Output Tag | Name: StateType: ARRAY[0..7] OF WORDDescription: Array of working counter states |
| Output Tag | Name: ErrorType: ARRAY[0..7] OF BOOLDescription: Array of working counter errors  |
| Output Tag | Name: FlagType: BOOLDescription: Working counter error flag |

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| **User Interface Type**TYPE MasterInfoStruct :STRUCT Error: ErrorStruct; FrameWorkingCnt: MasterInfoFastStruct; DeviceId: UINT; NetId: T\_AmsNetIdArr; NetIdStr: T\_AmsNetId; AddressError: BOOL; ChangeCount: UINT; DeviceStatus: WORD; DeviceError: BOOL; LinkError: BOOL; ResetRequired: BOOL; MissingFrame: BOOL; Watchdog: BOOL; DriverNotFound: BOOL; ResetActive: BOOL; NotAllInOp: BOOL; DcNotInSync: BOOL; SlaveCountActual: UINT; SlaveCountConfig: UINT; SlaveCountError: BOOL; DeviceState: ECatCommStateEnum; LostFrames: UDINT; FrameRate: LREAL; LostQueuedFrames: UDINT; QueuedFrameRate: LREAL; StatisticsError: BOOL;END\_STRUCTEND\_TYPE |
| Type Name | MasterInfoStruct |
| Description | Structure used in the user interface for a master (network interface) |
| Definition | STRUCT |
| Output Tag | Name: ErrorType: ErrorStructDescription: Error handling |
| Output Tag | Name: FrameWorkingCntType: MasterInfoFastStruct Description: Frame working counters |
| Output Tag | Name: FrameWorkingCounterErrorType: ARRAY[0..7] OF BOOLDescription: Array of working counter errors  |
| Output Tag | Name: FrameWorkingCounterFlagType: BOOLDescription: Working counter error flag |
| Output Tag | Name: DeviceIdType: UINTDescription: Device ID (optional) |
| Output Tag | Name: NetIdType: T\_AmsNetIdArrDescription: AMS network address of master  |
| Output Tag | Name: NetIdStrType: T\_AmsNetIdDescription: AMS network address of master in string form |
| Output Tag | Name: AddressErrorType: BOOLDescription: Address error (all zeroes) |
| Output Tag | Name: ChangeCountType: UINTDescription: Number to changes to the device image |
| Output Tag | Name: DeviceStatusType: WORDDescription: Device status (bit encoded) |
| Output Tag | Name: DeviceErrorType: BOOLDescription: Device error derived from the status |
| Output Tag | Name: LinkErrorType: BOOLDescription: A link error is detected |
| Output Tag | Name: ResetRequiredType: BOOLDescription: A IO reset is required |
| Output Tag | Name: MissingFrameType: BOOLDescription: A missing frame in redundant mode |
| Output Tag | Name: WatchdogType: BOOLDescription: Watchdog has triggered |
| Output Tag | Name: DriverNotFoundType: BOOLDescription: the network driver (miniport) was not found |
| Output Tag | Name: ResetActiveType: BOOLDescription: A reset is active |
| Output Tag | Name: NotAllInOpType: BOOLDescription: Not all terminals are in OP mode |
| Output Tag | Name: DcNotInSyncType: BOOLDescription: The distributed clock is out-of-synchronization |
| Output Tag | Name: SlaveCountActualType: UINTDescription: Number of actual slaves connected to the master |
| Output Tag | Name: SlaveCountConfigType: UINTDescription: Number of configured slaves in the master |
| Output Tag | Name: SlaveCountErrorType: BOOLDescription: A slave count error has been detected |
| Output Tag | Name: DeviceStateType: ECatCommStateEnumDescription: The operational state of the master |
| Output Tag | Name: LostFramesType: UDINTDescription: The number of lost frames |
| Output Tag | Name: FrameRateType: LREALDescription: The frame rate in Hz |
| Output Tag | Name: LostQueuedFramesType: UDINTDescription: The number of lost queued frames |
| Output Tag | Name: QueuedFrameRateType: LREALDescription: The queued frame rate in Hz |
| Output Tag | Name: StatisticsErrorType: BOOLDescription: An error occurred in reading the frame statistics |

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| **Function Block**FUNCTION\_BLOCK MasterInfoFastFBVAR\_INPUT Request: SaveRestoreEnum; MasterIn: MasterInfoFastInStruct;END\_VARVAR\_IN\_OUT Master: MasterInfoFastStruct;END\_VAR |
| Type Name | MasterInfoFastFB |
| Description | Function block used to process the fast master information  |
| Definition | Function Block |
| Input Argument | Name: RequestType: SaveRestoreEnumDescription: Request for save/restore/safe mode or noop |
| Input Argument | Name: MasterInType: MasterInfoFastInStructDescription: master info input structure |
| In/out Argument | Name: MasterType: MasterInfoFastStructDescription: User interface structure |

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| **Function Block**FUNCTION\_BLOCK MasterInfoFBVAR\_INPUT Request: SaveRestoreEnum; MasterIn: MasterInfoInStruct;END\_VARVAR\_IN\_OUT Master: MasterInfoStruct;END\_VAR  |
| Type Name | MasterInfoFB |
| Description | Function block used to process the master information  |
| Definition | Function Block |
| Input Argument | Name: RequestType: SaveRestoreEnumDescription: Request for save/restore/safe mode or noop |
| Input Argument | Name: MasterInType: MasterInfoInStructDescription: master info input structure |
| In/out Argument | Name: MasterType: MasterInfoStructDescription: User interface structure |

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| **Program Example:**(\* Global variables \*)VAR\_GLOBAL Device0: MasterInfoStruct; Device0In AT %IB\*: MasterInfoInStruct; Device0FB: MasterInfoFB; Device0FastIn AT %IB\*: MasterInfoFastInStruct; Device0FastFB: MasterInfoFastFB; SaveRestore: SaveRestoreFB; GotoSafe: BOOL; Request: SaveRestoreEnum;END\_VAR(\* Call from fast task with 1 ms update rate \*)PROGRAM DeviceFast Device0FastFB ( Request := Request, MasterIn := Device0FastIn, Master := Device0. FrameWorkingCnt);END\_PROGRAM(\* Call from standard task with 10 ms update rate \*)PROGRAM Device SaveRestore( SaveInterval := T#1m, GotoSafe := GotoSafe, Request => Request ); Device0FB ( Request := Request, MasterIn := Device0In, Master := Device0);END\_PROGRAM |