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TECController Library Documentation

Sheila Dwyer

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| **Library** | |
| Title | TECController |
| Version | 1 |
| TwinCAT version | 2.11.2230 |
| Name space |  |
| Author | Sheila Dwyer |
| Description | Controls the temperature of an SHG oven, using Beckhoff modules EL3692 to measure the temperature using a 10kOhm thermistor (epcos PN: B57861S0103F040), EL3102 to sense the temperature and a TEC from Laird technologies, HOT20, 31, F2A, 0909 and EL4132 for TEC outputs.  The TEC is installed in the SHG with the wider side facing upwards, as shown in the picture. This is because the data sheet indicates that the narrower side should be the cool side.  C:\Users\Sheila2\Documents\My Documents\ALS\SHG oven\ALSSHG 001.JPGC:\Users\Sheila2\Documents\My Documents\ALS\SHG oven\ALSSHG 002.JPG  With the unity gain frequency of the servo set to 5Hz, the overshoot is about 20%, so this is a good nominal setting. |
| Error Codes | 0x0001 – Thermistor resistance too high (open)  0x0002 - Thermistor resistance too low (short)  0x0003 - TEC Voltage too high  0x0004 – TEC Current is too high  0x0005 – TEC power dissipated if too high  0x0006 – Integrator limit is exceeded (currently integrator limit is 100V)  0x0007 – Thermistor data invalid  0x0008 – Thermistor measurement error |
| Library Dependencies | SaveRestore, Error, ReadADC, WriteADC |

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| **Hardware Input Type**  TYPE TECControllerInStruct :  STRUCT  ThermStatus: ThermStatusStruct;  ThermValue: REAL;  TECVoltageReadback: INT;  TECCurrentReadback: INT;  END\_STRUCT  END\_TYPE | |
| Type name | TECControllerInStruct |
| Description | Hardware inputs |
| Definition |  |
| Element | Name: ThermStatus  Type:ThermStatusStruct  Description: Structure of status indicators for resistance measurement module EL3692 |
| Element | Name: ThemValue  Type: REAL  Description: resistance of thermistor |
| Element | Name: TECVoltageReadback  Type: INT  Description: readback of voltage across the TEC |

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| **Hardware Input Type**  {copy type definition here} | |
| Type name |  |
| Description |  |
| Definition |  |
| Element | Name:  Type:  Description: |
| Element | Name:  Type:  Description: |
| Element | Name:  Type:  Description: |

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| **Hardware Output Type**  TYPE TECControllerOutStruct :  STRUCT  ThermControl: ThermControlStruct;  TECVoltageSet: INT;  END\_STRUCT  END\_TYPE | |
| Type name | TECControllerOutStruct |
| Description | Hardware outputs |
| Definition | STRUCT |
| Element | Name: ThermControl  Type: ThermControlStruct  Description: Structure of control bits for EL3692 |
| Element | Name: TECVoltageSet  Type:INT  Description: voltage sent to the TEC (in units of volts over the TEC, the gain of the controller board is taken out in the code) |

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| **User Interface Type**  TYPE TECControllerStruct :  STRUCT  Error: ErrorStruct;  ThermistorTemperature: LREAL;  (\*~(OPC : 1 : Make variable visible for OPC-Server) (OPC\_PROP[005] : 3 : OPC\_PROP\_RIGHTS)  (OPC\_PROP[0100] :C: Unit) (OPC\_PROP[0101] :Temperature measured by thermistor: Description)  (OPC\_PROP[0102] :40: HOPR)  (OPC\_PROP[0103] :15: LOPR)\*)  TECVoltageBack: LREAL;  (\*~(OPC : 1 : Make variable visible for OPC-Server)  (OPC\_PROP[005] : 1 : OPC\_PROP\_RIGHTS)  (OPC\_PROP[0100] :V: Unit)  (OPC\_PROP[0101] :Readback of voltage across TEC: Description)\*)  TECCurrentBack: LREAL;  (\*~ (OPC : 1 : Make variable visible for OPC-Server) (OPC\_PROP[005] : 1 : OPC\_PROP\_RIGHTS)  (OPC\_PROP[0100] :Amps: Unit)  (OPC\_PROP[0101] :Readback of current across TEC: Description) \*)  TECVoltsOut: LREAL;  (\*~ (OPC : 1 : Make variable visible for OPC-Server) (OPC\_PROP[005] : 3 : OPC\_PROP\_RIGHTS) (OPC\_PROP[0100] :V: Unit)  (OPC\_PROP[0101] :Voltage across TEC setting: Description)\*)  Fault: BOOL;  (\*~(OPC :1: Make variable visible for OPC-Server)  (OPC\_PROP[005] :1: OPC\_PROP\_RIGHTS)  (OPC\_PROP[0101] :Fault: Description)  (OPC\_PROP[0106] :Fault: ONAM)  (OPC\_PROP[0107] :None: ZNAM)\*)  SetTemp: LREAL:=35;  (\*~ (OPC : 1 : Make variable visible for OPC-Server)  (OPC\_PROP[005] : 3 : OPC\_PROP\_RIGHTS)  (OPC\_PROP[0100] :C: Unit)  (OPC\_PROP[0101] :Set Temperature: Description)\*)  Servo: BOOL;  (\*~(OPC :1: Make variable visible for OPC-Server)  (OPC\_PROP[005] :3: OPC\_PROP\_RIGHTS)  (OPC\_PROP[0101] :PI Servo: Description)  (OPC\_PROP[0106] :On: ONAM)  (OPC\_PROP[0107] :Off: ZNAM)\*)  UnityGain: LREAL:=5;  (\*~ (OPC : 1 : Make variable visible for OPC-Server) (OPC\_PROP[005] : 3 : OPC\_PROP\_RIGHTS)  (OPC\_PROP[0100] :: Unit)  (OPC\_PROP[0101] :Proportional term of PI controller: Description) \*)  ClearInt: BOOL;  (\*~ (OPC : 1 : Make variable visible for OPC-Server)  (OPC\_PROP[005] : 3 : OPC\_PROP\_RIGHTS)  (OPC\_PROP[0106] :Clear: ONAM)  (OPC\_PROP[0107] :Integrator On: ZNAM) \*)  OldControlSig: LREAL;  (\*~ (OPC : 1 : Make variable visible for OPC-Server)  (OPC\_PROP[005] : 3 : OPC\_PROP\_RIGHTS ) (OPC\_PROP[0100] :: Unit)  (OPC\_PROP[0101] :Control Signal from last servo cycle: Description)\*)  END\_STRUCT  END\_TYPE | |
| Type name | TECControllerStruct |
| Description | User interface inputs and outputs for TECController |
| Definition | STRUCT |
| Input tags | Name: Error  Type: ErrorStruct  Description: for use by error handler |
| Input tags | Name: ThermistorTemperature  Type: LREAL  Description: Temperature (in C) measured by thermistor |
| Input tags | Name: TECVoltageBack  Type:LREAL  Description: Voltage readback, in units of volts over TEC |
| Output tags | Name: TECCurrentBack  Type:LREAL  Description:TEC Current readback |
| Output tags | Name: TECVoltsOut  Type:LREAL  Description:Volts sent to TEC, in units of volts over TEC |
| Output tags | Name: Fault  Type:BOOL  Description: Is there an error condition that required output voltage to go to zero? |
| Output tags | Name:SetTemp  Type:LREAL  Description: Temperature setting for servo |
| Output tags | Name:Servo  Type:BOOL  Description: Is the servo on? |
| Output tags | Name:UnityGain  Type: LREAL  Description: unity gain setting for servo |
| Output tags | Name:ClearInt  Type:BOOL  Description: Allows the user to clear the integrator, in case the servo gets into a bad state where the integrator value is too high. |
| Output tags | Name:OldControlSig  Type:LREAL  Description: TECVoltsOut from last cycle in which the servo was on. This is saved so that when the servo is turned on again, it will initialize with the old value. |

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| **Type**  TYPE ThermStatusStruct :  STRUCT  UnderRange: BOOL;  OverRange: BOOL;  ExtenRange: BOOL;  DataInvalid: BOOL;  RangeInvalid: BOOL;  AutoRangeDis: BOOL;  Error: BOOL;  SteadyState: BOOL; (\*if last 4 values no more than x/1024 of end value apart, this is true\*)  END\_STRUCT  END\_TYPE | |
| Type Name | ThermStatusStruct |
| Description | Status inputs from EL3692 |
| Definition |  |
| Element: | Name: UnderRange  Type:BOOL  Description: the resistance is under the range |
| Element: | Name: OverRange  Type:BOOL  Description: the resistance is over the range |
| Element: | Name: ExtenRange  Type:BOOL  Description: the EL3692 is using its extended range |
| Element: | Name: DataInvalid  Type:BOOL  Description: |
| Element: | Name: RangeInvalid  Type: BOOL  Description: the range specificed is invalid |
| Element: | Name: AutoRangeDis  Type:BOOL  Description: disable autorange |
| Element: | Name: Error  Type:BOOL  Description: |
| Element: | Name: SteadyState  Type: BOOL  Description: The last four measurements are all within x.1% of the end value |

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| **Type**  TYPE ThermControlStruct :  STRUCT  DisableAutoRange: BOOL;  Mode: BYTE;  Range: SINT;  END\_STRUCT  END\_TYPE | |
| Type Name | ThermControlStruct |
| Description | Structure that controls EL3692 |
| Definition |  |
| Element: | Name: DisableAutoRange  Type:BOOL  Description: disables autorange |
| Element: | Name: Mode  Type:BYTE (maos to 4BIT)  Description: indicates mode, 2 resistor measurement or 1, single shot or continuous measurements |
| Element: | Name: Range  Type:SINT  Description: Allows user to set the range |

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| **Function Block**  FUNCTION\_BLOCK TECControllerFB  VAR\_INPUT  Request: SaveRestoreEnum;  TECControllerIn: TECControllerINStruct;  END\_VAR  VAR\_OUTPUT  TECControllerOut: TECControllerOutStruct;  END\_VAR  VAR\_IN\_OUT  TECControllerInit: TECControllerStruct;  TECController: TECControllerStruct;  END\_VAR  VAR  ErrorHandler: ErrorHandlerFB;  ConvertRtoT: RtoTempFB;  ErrorCheck: ErrorCheckFB;  PIServo: PIServoFB;  END\_VAR | |
| Name | TECControllerFB |
| Description | Main temperature controller function block |
| Input argument | Name: Request  Type:SaveRestoreEnum  Description: Request for save/restore/safemode or noop. |
| Input argument | Name: TECControllerIn  Type: TECControllerInStruct  Description: Hardware inputs |
| Output argument | Name: TECControllerOut  Type: TECControllerOutStruct  Description: Hardware outputs for TECController |
| In/Out argument | Name: TECController  Type: TECControllerStruct  Description: User interface |
| In/Out argument | Name: TECControllerInit  Type: TECControllerStruct  Description: User interface variables to initialize to if power is lost |

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| **Visual**  {copy screen snapshot here} | |
| Name |  |
| Description |  |
| Placeholder | Name:  Type:  Description: |
| Placeholder | Name:  Type:  Description: |
| Placeholder | Name:  Type:  Description: |