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EZI/O™ EZIO-4THIE *

Enhanced Thermocouple Input Module

Part Number: **EZIO-4THIE**

EZIO family offers two modules for interfacing to thermocouples:
- EZIO-4THI (not recommended for new applications)
- EZIO-4THIE

This document describes EZIO-4THIE module.

> *Note: This module requires EZPLC editor version 1.4 or later; firmware revision C.3 or later.*
> **To check the firmware revision of your EZPLC:**
> Using the EZPLC Editor Software access the menu item **EZPLC > INFORMATION**... a window will open displaying the current **EXEC Software** and **BOOT Software** revisions.
> **To upgrade the firmware:**
> Download firmware at www.EZAutomation.net (down loads section).Once downloaded, use EZPLC editor and select **Setup>Upgrade Firmware** menu item.

The module has following features:
- Up to 4 thermocouple inputs with user selectable thermocouple types on each input
- User programmable broken thermocouple detection
- User programmable units for temperature -- Centigrade, Fahrenheit or Kelvin
- Automatic Cold Junction Compensation (CJC) with Internal or External Sensor

Wiring

Pin #1

Pin #	Thermocouple Input Pin Functions	
	Internal CJC Sensor*	**External CJC Sensor** (National LM19)**
1	INPUT1 +	INPUT1 +
2	INPUT1 -	INPUT1 -
3	INPUT2 +	INPUT2 +
4	INPUT2 -	INPUT2 -
5	INPUT3 +	INPUT3 +
6	INPUT3 -	INPUT3 -
7	INPUT4 +	DO NOT USE
8	INPUT4 -	CJC Sensor Vout
9	DO NOT USE	CJC Sensor Vs+
10	DO NOT USE	DO NOT USE
11	DO NOT USE	CJC Sensor Gnd

CJC Sensor LM 19 Pin Out

TO-92

+Vs Vout GND

BOTTOM VIEW
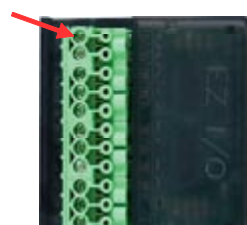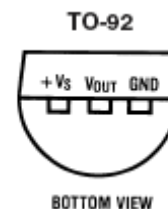
 * CJC : Cold Junction Compensation
 ** Only 3 thermocouple inputs are available when External CJC is used

Which CJC Sensor, internal or external, to use?

The module provides automatic cold junction compensation (CJC). It can use internal (default) or external temperature sensor for this purpose. With both sensor types, the module provides very repeatable temperature readings. You may select internal or external based on below given guidelines:

Use Internal CJC Sensor: If you need repeatable but not very accurate readings (typical +/- 6 deg C). This allows you to use 4 thermocouples with the module. Internal sensor is automatically used if external sensor is not selected for input #4.

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Use External CJC Sensor: If you need repeatable as well as more accurate (max +/- 3 deg C) readings. You will need to use LM19 temperature sensor, and you can use only 3 thermocouples. ***To use External Sensor, select "CJC Sensor (LM19)" for Input #4 type, in the configuration dialog box. (see below).***

Specifications

Number of Channels: **4**
Thermocouples supported: **See table below**
PLC Update Rate: **All inputs every PLC scan**
Base Power Required:
    10mA @ 3.3 VDC supplied by base
Operating Temperature:
    32° to 140°F (0° to 60°C)
Storage Temperature:
    -4° to 158°F (-20° to 70°C)
Relative Humidity: **5 to 95% (non-condensing)**
Environmental Air: **No corrosive gases permitted**
Vibration: **MIL STD 810C 514.2**
Shock: **MIL STD 810C 516.2**
Noise Immunity: **NEMA ICS3-304**

Cold Junction Compensation (CJC):
    Automatic, Internal or External sensor
External CJC Sensor: **LM19**
Conversion Time: **1ms per channel**
Warm-Up Time:
    30 minutes typically ± 1°C repeatability
Linearity Error (End to End):
    ± 1°C max. ± 0.5°C typical
Maximum Inaccuracy:*
    ± 3°C (excluding thermocouple error)
Replacement Terminal Block: **EZIO-TERM11**

* When used with an external CJC sensor; with internal sensor, the inaccuracy may be larger, but readings still repeatable.

Type of Thermocouple & ranges supported, and error values:

Thermocouple Type	Range			Value reported with Open Thermocouple or incorrect configuration		
	Centigrade	Fahrenheit	Kelvin	Do not report	Low Value	High Value
J	-210°C to +1200°C	-346°F to +2192°F	63°K to 1473°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
K	-200°C to +1372°C	-328°F to +2502°F	73°K to 1645°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
S	-50°C to +1768°C	-58°F to +3214°F	223°K to 2041°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
T	-200°C to +400°C	-328°F to +752°F	73°K to 673°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
E	-200°C to +980°C	-328°F to +1796°F	73°K to 1253°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
R	-50°C to +1768°C	-58°F to +3214°F	223°K to 2041°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
B	250°C to +1820°C	482°F to +3308°F	523°K to 2093°K	Random	0 (0x0000)	65535 (0xFFFF)
N	-200°C to +1300°C	-328°F to +2372°F	73°K to 1573°K	Random	-32768 (0x8000)	+32767 (0x7FFF)
Ambient Temp	*This selection would read modules's ambient temperature*					

Thermocouple Module Setup

To setup the module in EZPLC, follow these steps:

1. In I/O configuration select "4 Enhanced Thermocouple Module (EZIO-4THIE) as shown below, and assign desired starting Input and starting output addresses:

The module takes up 4 input registers (IRs) and 4 output registers (ORs).

Input Registers return thermocouple readings. Output registers are used for configuration of respective thermocouple.
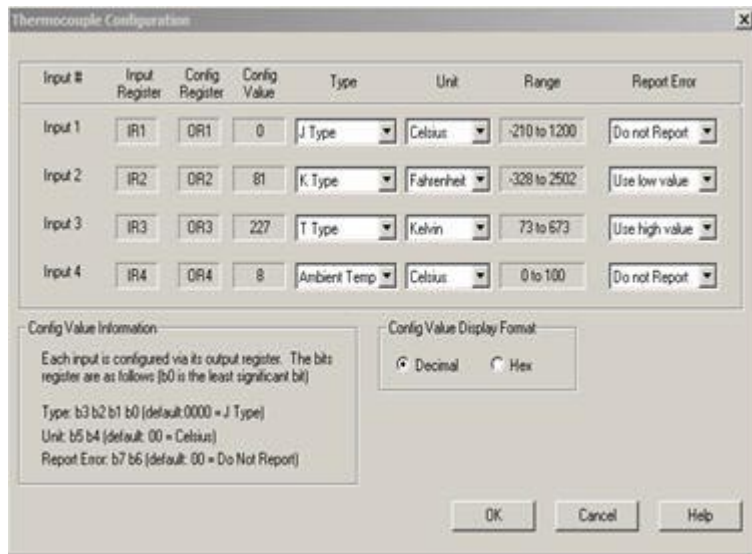
The starting Input Register is used for Input # 1, the next for Input# 2, etc. For example if the starting input address is IR1, then reading from thermocouple at input # 1 would be returned in IR1, from#2 in IR2, from #3 in IR3, and from #4 in IR4.

Similarly Starting OR would configure Thermocouple #1, and next OR would configure Input #2, and so on.
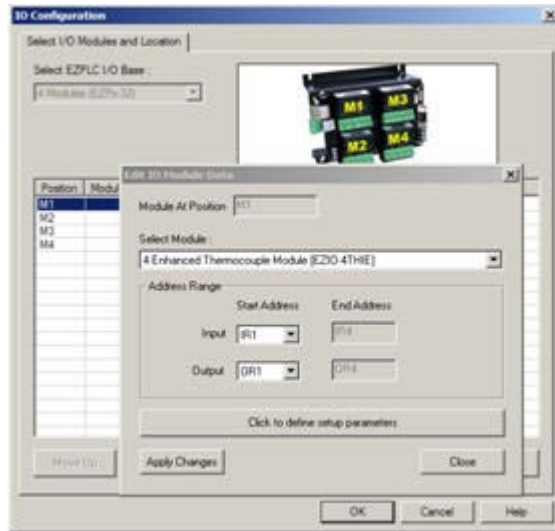
2. Click on "Click to define setup parameters. Following dialog comes up:

For each input, select Type of Thermocouple, Unit of measurement, and Option to report error (such as due to open thermocouple, wrong configuration, etc.). These choices create a config value that is written to corresponding OR registers when the program is written to EZPLC. These values can also be written or modified using ladder logic, but it may be easier to use the dialog box.

That is all required to setup the module.

The programmable parameters, namely type, unit, and report error, as well as the computed config value, are described below:

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Type

Select the type of the thermocouple using this field. The possible choices are: J Type, K Type, S Type, T Type, E Type, R Type, B Type, N Type, Ambient Type. The display-only range field depends on the type of the thermocouple selected (along with the unit).

For Input#4 ONLY: If using external sensor for CJC, select "CJC Sensor (LM19)" for Input#4.

Unit

Select the unit for measurement for each thermocouple. The possible choices are: Celsius, Fahrenheit and Kelvin. The display-only range field depends on the unit selected (along with the type of the thermocouple).

Report Error

The Report Error function on the thermocouple module provides diagnostic capabilities to detect open or burnt thermocouple, or incorrect configuration (which can happen if the ladder logic writes an incorrect value to the config register). The following table describes the choices and the resulting actions. You can use these values in ladder logic to detect possible problems with the thermocouples or configurations.

Choice	Value Returned	
	All types EXCEPT B Type	**B Type**
Do Not Report	Interminate	Interminate
Use low value	-32768	0
Use high value	32767	65535

Config Value

The computed ConfigValue (determined by above choices) is the value written to the config (output) register. Each thermocouple input is configured via its config register. The Config Value Display Format option allows you to display (in this dialog box) the config value in either decimal or hex. The actual config value depends on the selections made for the type, unit and report error as shown in the following table:

Bits in Config Registers	Determined by	Default value
Bit 3 – Bit 0	Thermocouple type	0000 (J -type)
Bit 5- Bit 4	Unit Selection	00 (Celsius)
Bit 7 – Bit 6	Report-Error Selection	00 (Do not report)

The values of bits for various selections can be seen from the configuration dialog box.

Thermocouple Module Operation

The Thermocouple provides 4 inputs for thermocouples. Each input can independently configured for by writing to corresponding configuration register. The configuration can be done using the dialog box as described above. Alternately the configuration can be done by writing appropriate values in the Output Registers of the module.

Tag Data Types

In EZPLC the ladder logic accesses memory using tags. Therefore create tags for each of the Input (IR) and output registers (OR) associated with the module. Each tag has a data type to interpret the data values appropriately. Please follow below given guidelines for the tag data types for the module:

● Tags associated with the Output Registers (OR) must be declared UNSIGNED_INT_16
● Tags associated with the Input Registers (IR) must be of SIGNED_INT_16 for all thermocouple types EXCEPT type B in which case it should be UNSIGNED_INT_16.

Interpreting Temperature Values

The thermocouple module provides temperature values with one digit after the decimal point. However these values are presented as whole integer numbers, not as floating point or real numbers. The decimal point is implied.

Thus if a reading from the module is 1234, it should be interpreted as 123.4, or alternately if the temperature is 234.5 degrees (C or F or K), the input register would return a value of 2345.

Open Thermocouple detection

Thermocouple module can detect open or burnt thermocouples. On detecting an open/burnt thermocouple, the module provides a lowest or highest possible value in corresponding Input Register. The choice of low or high value is user programmable. See configuration dialog box, and specification to see the values returned for each thermocouple type.

External CJC Sensor Diagnostics

The thermocouple module provides automatic cold junction compensation. User has an option to use internal (default) or external temperature sensor for this purpose. If external sensor is not selected in Module setup (see setup section), the internal option is automatically used.

The wiring of the 3-terminal external sensor is shown in wiring section above. The reading in input-register corresponding to input #4 can be used to detect incorrect wiring of the sensor. If the reading is above 100 or below 0, the sensor may not be wired correctly.

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