Using Meerstetter TEC Controllers with Voltage Output Temperature Sensors (-VIN1, VIN2)

Application Note

Index

Meerstetter Engineering GmbH
Schulhausgasse 12
CH-3113 Rubigen
Switzerland

Phone: +41 31 529 21 00
Email: contact@meerstetter.ch

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Only valid with TEC Controller firmware v5.10 or newer.

1 Introduction

This application note documents the use of Meerstetter Engineering TEC Controllers with analog voltage output temperature sensors. Only TEC Controllers with the optional temperature input circuit configuration “-VIN1” or “-VIN2” are compatible with this type of temperature sensor.

The document provides information on how to correctly connect the sensor to the controller and how to configure the sensor specific temperature conversion parameters.

The following sensors were tested and are compatible with our TEC Controllers:

- Texas Instruments LMx35
- Texas Instruments LM50
- Texas Instruments LM61

Please note that this list is not exhaustive, there are many other sensors which are compatible with our TEC Controllers.

2 Sensor Requirements

Voltage output temperature sensors must fulfill the following requirements to be compatible with TEC Controllers from Meerstetter Engineering:

- Output voltage varies linearly with temperature.
- Output voltage range matches TEC Controller VIN1 / VIN2 voltage measuring range (See TEC Controller datasheets)

If the maximum output voltage of a sensor exceeds the voltage measuring range of the TEC controller, the output voltage of the sensor can be scaled down with a simple resistive voltage divider. For an example, see 4.3 Voltage Output Sensor LMx35.

3 Configuration

The TEC Controller converts the output voltage of the sensor to the corresponding temperature based on three sensor-specific parameters:

1. Reference temperature (LM61: 0 °C)
2. Reference output voltage @ ref. temperature (LM61: 0.6 V)
3. Output voltage/temperature slope (LM61: 0.01 V/°C)

Please refer to the manufacturer's datasheet for the characteristic parameters of your sensor.

You can configure those parameters either using the Meerstetter TEC Software compatible to the firmware version installed on your TEC Controller or directly using the MeCom Communication Protocol.

For controllers with firmware v5.10, please use the TEC Service Software.

If your controller is running firmware v6.00 or higher, please use the TEC Configuration Software.

We assume that you successfully installed the TEC Service Software or the TEC Configuration Software on your PC. For details about the installation process please refer to the corresponding TEC Controller Setup Guide document.

3.1 TEC Service Software (FW v5.10)

- Navigate to the tab "Advanced" → "Temperature Conversion".
- Enter the three characteristic values in the field "CHx Object Voltage to Temperature Conversion":

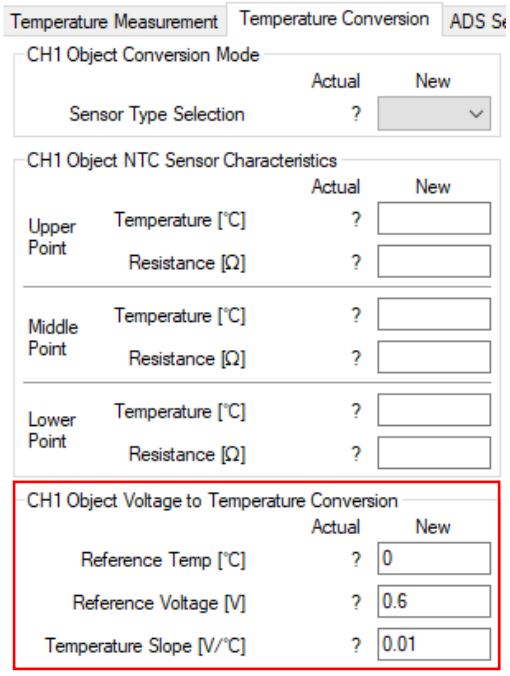

Figure 1: CHx Voltage to Temperature Conversion in TEC Service Software (LM61 values)

- Safe the changed parameters to the TEC Controller by clicking on the "Write Config" button in the bottom right corner of the window.

3.2 TEC Configuration Software (FW v6.00 or higher)

- From the main window navigate to the “HR Input x” window, either by clicking on the orange “HR Input x” field or via the tab “View → TEC → Measurement Inputs → High Resolution Input x”.
- Make sure that the “Conversion Type” is set to “Voltage”.
- Enter the three characteristic values of your sensor in the “Voltage to Temperature Conversion Box”:

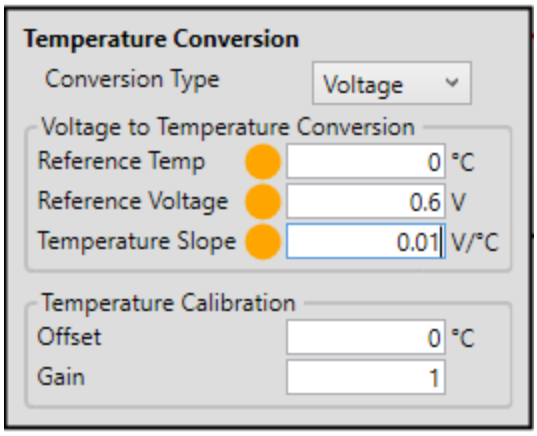

Figure 2: VINx Temperature Conversion settings in TEC Configuration Software (LM61 values)

- Save the changed parameters to the TEC Controller by clicking on the “Unsaved parameters” field in the bottom right corner of any window of the software or by clicking on “Device → Write Config” in the menu bar of the main window.

3.3 General Hardware Information VIN1

Our temperature sensor input circuits are designed for 2-wire or 4-wire sensing of resistive temperature sensors, but with the “Object Sensor Type” -VIN1, it is also possible to use linear voltage sensors.

Older TEC Controllers do not have an internal 5V supply, therefore we must distinguish between older and newer types.

The following table gives you an overview over the voltage ranges:

Table 1. -VIN1 Voltage Overview

TEC Model	ADC Chip	ADC Supply (AVDD)[1]	Current source max U out (IA)	Absolute Input Voltage	Differential input voltage
TEC-1089	ADS1247	3.3V	2.3V @ 1mA 2.8V @ 0.25mA	0.1V … 3.2V[2]	-2.039V … 2.039V
TEC-1090					
TEC-1122					
TEC-1123					
TEC-1091 (< HW v3.00)					
TEC-1091 (≥ HW v3.00)	ADS1220	5V	4.0V @ 1mA	0.1V … 4.9V[2] -0.1V … 5.1V[3]	
TEC-1092					
TEC-1161					
TEC-1162					
TEC-1163					
TEC-1166					
TEC-1167					

The internal reference voltage is 2.048V

In order to not fall below the lower Absolute Input Voltage a Schottky diode is used to replace Rs. This is not necessary for the newer TEC Controllers, but for simplification, it is also assembled this way.

[1] The 3.3V or 5V supply may be inaccurate by about 0.2V.
[2] The input range reaches from GND+0.1V to AVDD-0.1V.
[3] If the preamp (PGA Bypass) is disabled, the input range reaches from GND-0.1V to AVDD+0.1V.

3.4 General Hardware Information VIN2

Our temperature sensor input circuits are designed for 2-wire or 4-wire sensing of resistive temperature sensors, but with the “Object Sensor Type” -VIN2, it is also possible to use linear voltage sensors.

In case of VIN1, the ADC chip itself feeds the IA (with very little current), for the external sensor. In case of VIN2, IA is directly bridged to the 5V supply rail. IB is directly bridged to GND.

Older TEC Controllers do not support the VIN2 input circuit configuration.

Table 2. -VIN2 Voltage Overview

TEC Model	ADC Chip	Current source (IA)	Absolute Input Voltage	Differential input voltage
TEC-1091 (≥ HW v3.00)	ADS1220	5V, max. 50mA	0.1V … 4.9V[4] -0.1V … 5.1V[5]	-2.039V … 2.039V
TEC-1161				
TEC-1162				
TEC-1163				
TEC-1166				
TEC-1167				

The internal reference voltage is 2.048V

[4] The input range reaches from GND+0.1V to AVDD-0.1V.
[5] If the preamp (PGA Bypass) is disabled, the input range reaches from GND-0.1V to AVDD+0.1V.

4 Wiring Voltage Output Sensors VIN1

4.1 Voltage Output Sensor LM61

4.1.1 With TEC-1089 / 1090 / 1091 (< HW v3.00) / 1122 / 1123

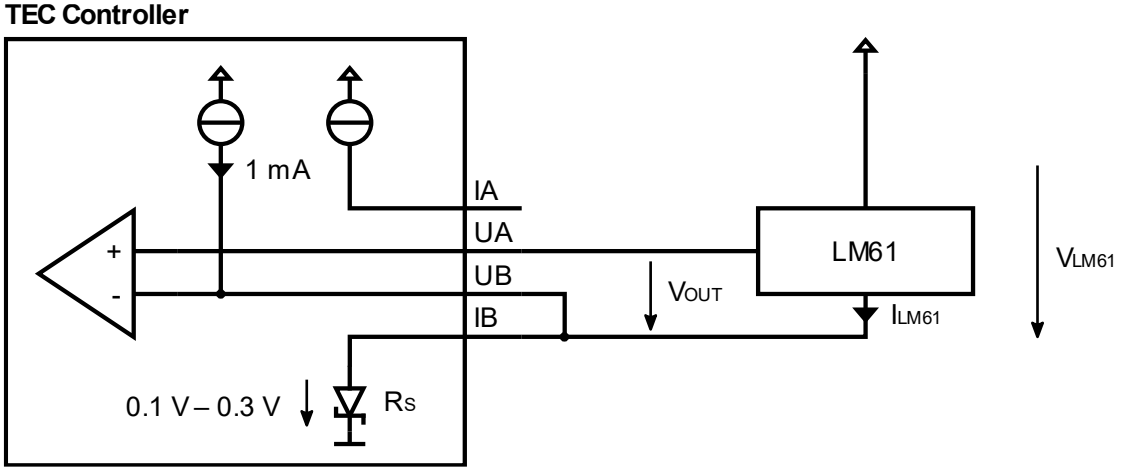

Table 3. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	0
Reference Voltage	V	0.6
Temperature Slope	V/°C	0.01

Using this configuration, the full range from -30°C to 100°C can be used.

4.1.2 With TEC-1091 (≥ HW v3.00) / 1092 / 1161 / 1162 / 1163 / 1166 / 1167

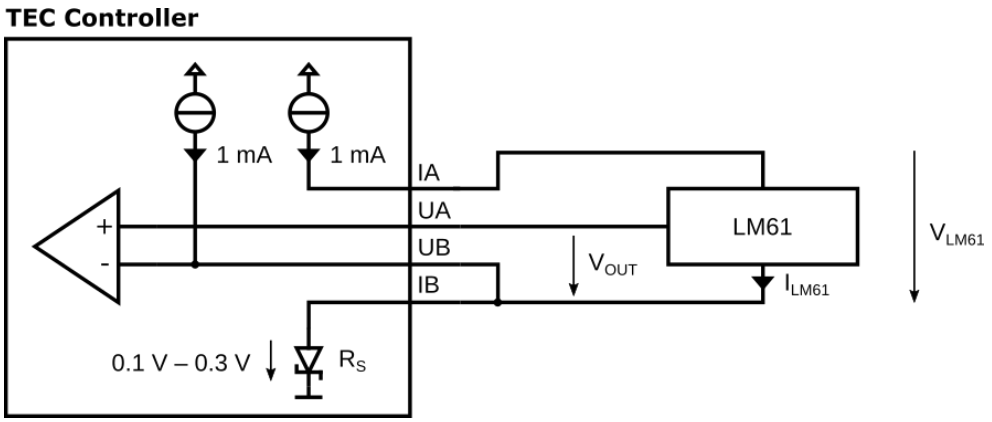

Table 4. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	0
Reference Voltage	V	0.6
Temperature Slope	V/°C	0.01

Using this configuration, the full range from -30°C to 100°C can be used.

4.2 Voltage Output Sensor LM50

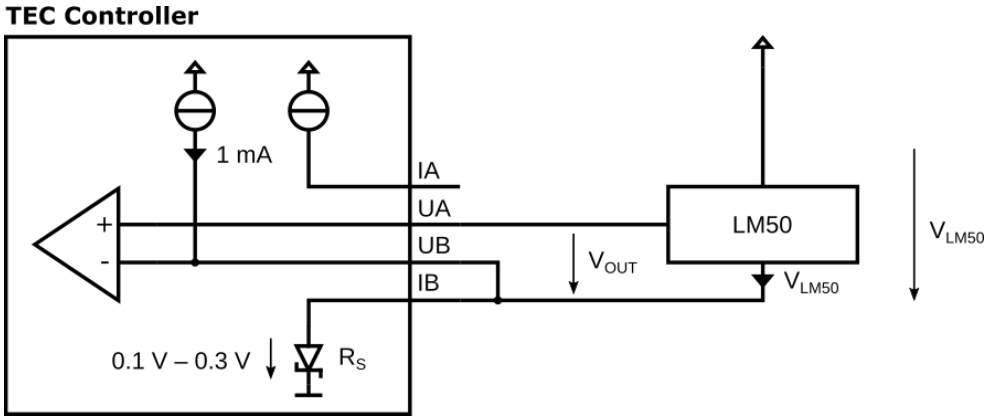

Table 5. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	0
Reference Voltage	V	0.5
Temperature Slope	V/°C	0.01

Using this configuration, the full range from -40°C to 125°C can be used.

4.3 Voltage Output Sensor LMx35

4.3.1 With TEC-1089 / 1090 / 1091 (< HW v3.00) / 1122 / 1123

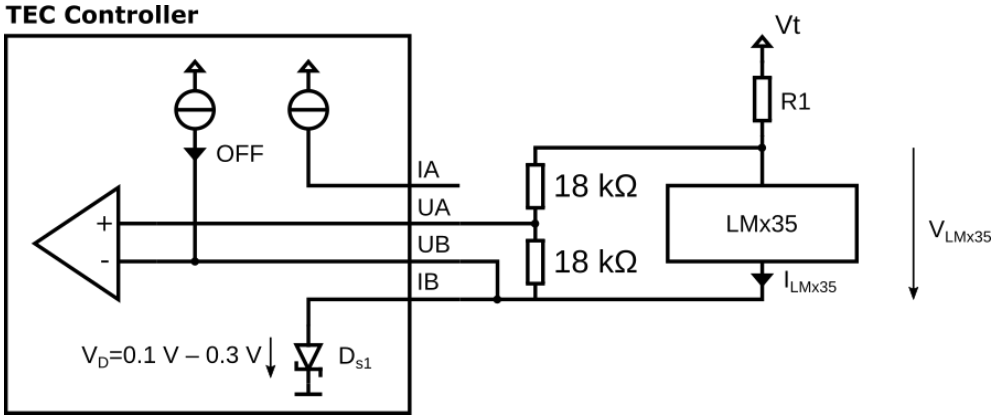

Table 6. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	25
Reference Voltage[6]	V	1.49 (2.98 / 2)
Temperature Slope[6]	V/°C	0.005 (0.01 / 2)

Using this configuration, the full range from -40°C to 125°C can be used.

[6] Divided by 2, because of the two 18k resistors.

4.3.2 With TEC-1091 (≥ HW v3.00) / 1092 / 1161 / 1162 / 1163 / 1166 / 1167

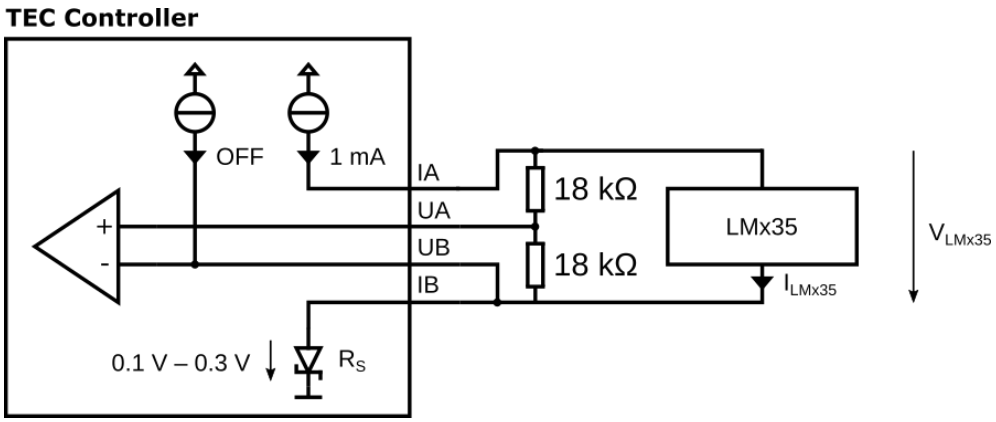

Table 7. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	25
Reference Voltage[7]	V	1.49 (2.98 / 2)
Temperature Slope[7]	V/°C	0.005 (0.01 / 2)

Using this configuration, the full range from -40°C to 125°C can be used.

[7] Divided by 2, because of the two 18k resistors.

5 Wiring Voltage Output Sensors VIN2

5.1 Voltage Output Sensor LM61

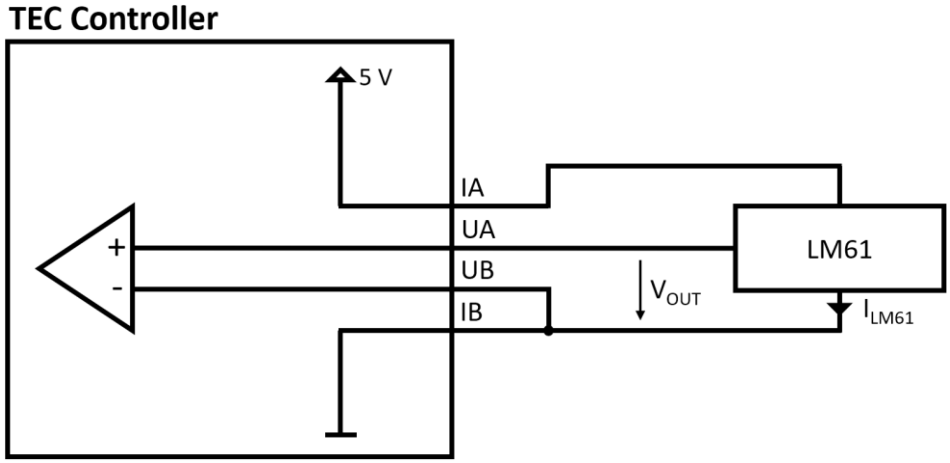

Table 8. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	0
Reference Voltage	V	0.6
Temperature Slope	V/°C	0.01

Using this configuration, the full range from -30°C to 100°C can be used.

5.2 Voltage Output Sensor LM50

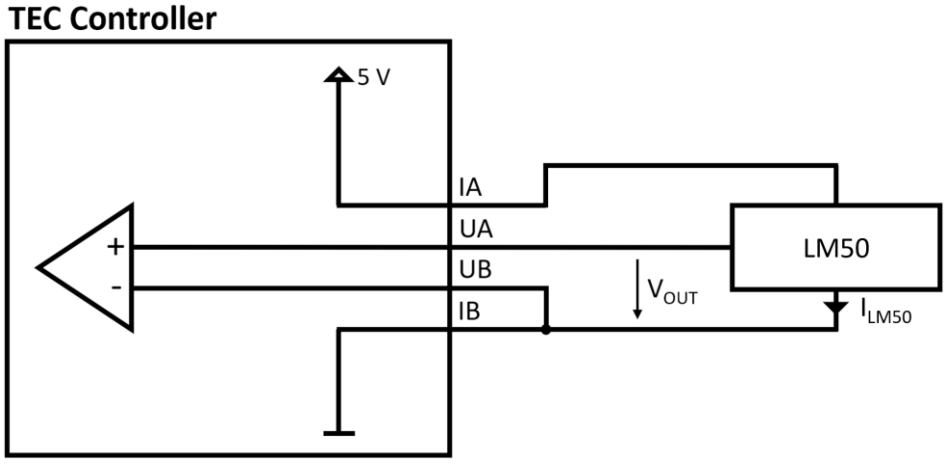

Table 9. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	0
Reference Voltage	V	0.5
Temperature Slope	V/°C	0.01

Using this configuration, the full range from -25°C to 100°C can be used.

5.3 Voltage Output Sensor LMx35

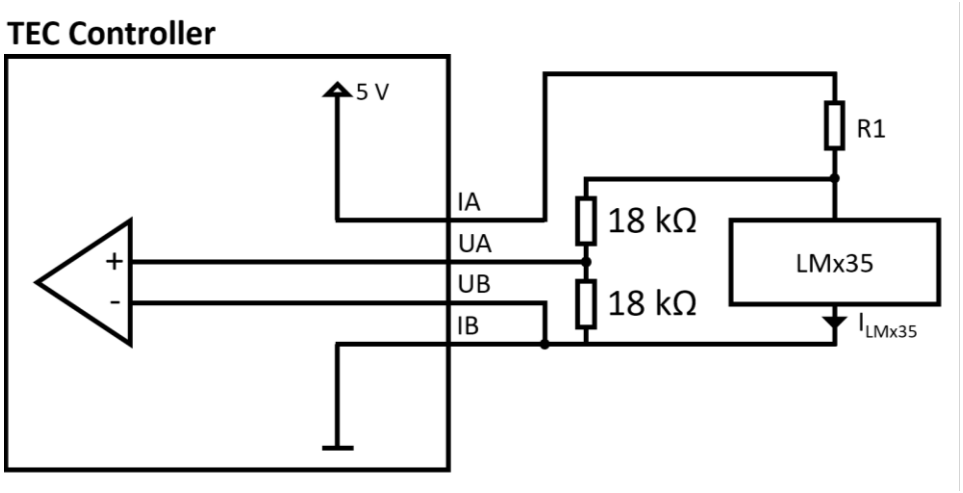

Table 10. HR Input x / CHx Voltage to Temperature Conversion Settings

Name	Unit	Value
Reference Temperature	°C	25
Reference Voltage[8]	V	1.49 (2.98 / 2)
Temperature Slope[8]	V/°C	0.005 (0.01 / 2)

Using this configuration, the full range from -40°C to 125°C can be used.

[8] Divided by 2, because of the two 18k resistors.

A Change History

Date of change	Ver-sion	Changed / Approved	Change / Reason
27 Feb 2023	D	ML	• Add: VIN2
02 Dec 2024	E	MLO / XF	• Add: FW v6.00, CoSo VINx Settings • Add: VIN2 Sensor Connection Example