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

**Application Note**

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

For the TEC-1091 this Document is only valid if Hardware v3.00 or newer is used. For older TEC-1091 Hardware please refer to the 5217B

# 1 Introduction

This Application Note documents the use of Meerstetter Engineering TEC-Controllers with Analog Voltage Output Temperature Sensors. To use this feature, you need the temperature input circuit configuration “-VIN1” or “-VIN2”.

It describes what you need to do to correctly connect your sensor and get it working with your TEC-Controller.

The following sensors where 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

To be compatible with the Meerstetter Engineering TEC-Controllers the Voltage Output temperature sensors must fulfill the following requirements:

- Linear Voltage/Temperature output
- Output Voltage Range matches TEC-Controller measurement range (See TEC-Controller Datasheets)

If a sensor has an output voltage range too large for the specific TEC-Controller in use a simple resistive voltage divider can be employed. For an example, see 4.3 Voltage Output Sensor LMx35.

# 3 Configuration

The Parameters of the temperature sensor must be entered so the TEC-Controller can calculate the temperature. You can do this by using the Service Software or the MeCom Communication Protocol.

You only need to enter the Voltage at a given temperature (Reference Voltage and Reference Temp) and the Temperature Slope, the rest is calculated automatically.

## 3.1 TEC Service Software:

Enter the three values in the tab “Advanced” → “Temperature Conversion” in the field “CHx Object Voltage to Temperature Conversion”.

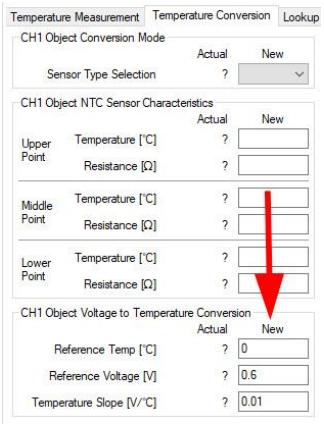



Figure 1: Configuration with TEC Service Software as example with LM61 values

## 3.2 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<br>2.8V @ 0.25mA | 0.1V … 3.2V[2] | -2.039V … 2.039V |
| TEC-1090 | | | | | |
| TEC-1122 | | | | | |
| TEC-1123 | | | | | |
| TEC-1091 | ADS1220 | 5V | 4.0V @ 1mA | 0.1V … 4.9V[2]<br>-0.1V … 5.1V[3] | |
| TEC-1092 | | | | | |
| TEC-1161 | | | | | |
| TEC-1162 | | | | | |
| TEC-1163 | | | | | |
| TEC-1166 | | | | | |
| TEC-1167 | | | | | |

The internal reference is voltage 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.

## 3.3 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 cannot be configured with to VIN2.

**Table 2. -VIN2 Voltage Overview**

| TEC Model | ADC Chip | Current source (IA) | Absolute Input Voltage | Differential input voltage |
|---|---|---|---|---|
| TEC-1091 | ADS1220 | 5V, max. 50mA | 0.1V … 4.9V[2]<br>-0.1V … 5.1V[4] | -2.039V … 2.039V |
| TEC-1161 | | | | |
| TEC-1162 | | | | |
| TEC-1163 | | | | |
| TEC-1166 | | | | |
| TEC-1167 | | | | |

The internal reference is voltage 2.048V

[4] 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 / 1122 / 1123

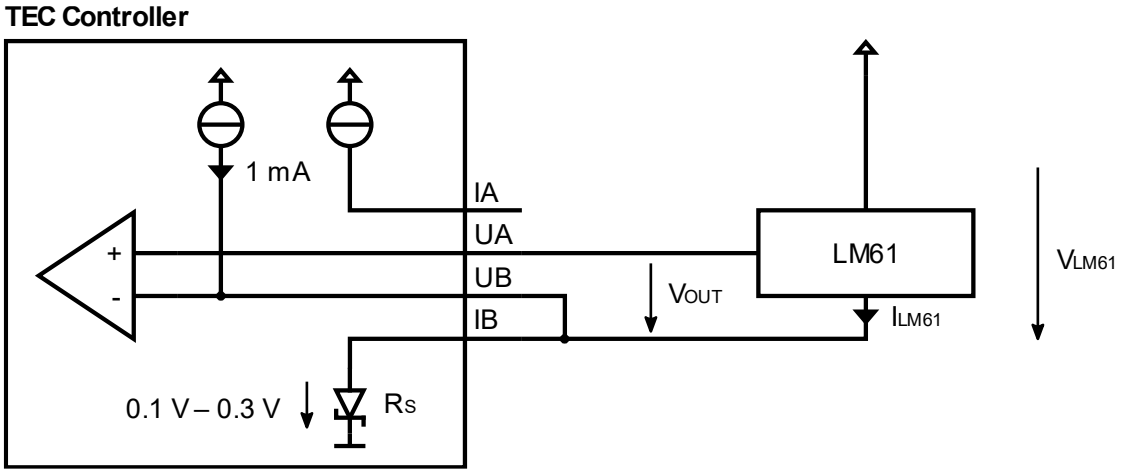



**Table 3. CHx Object Voltage to Temperature Conversion Settings**

| 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 / 1092 / 1161 / 1162 / 1163 / 1166 / 1167

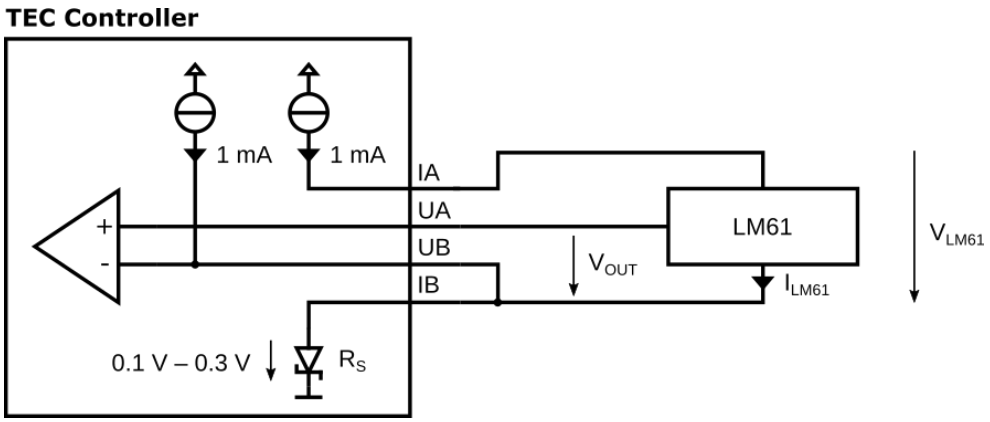



**Table 4. CHx Object Voltage to Temperature Conversion Settings**

| 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

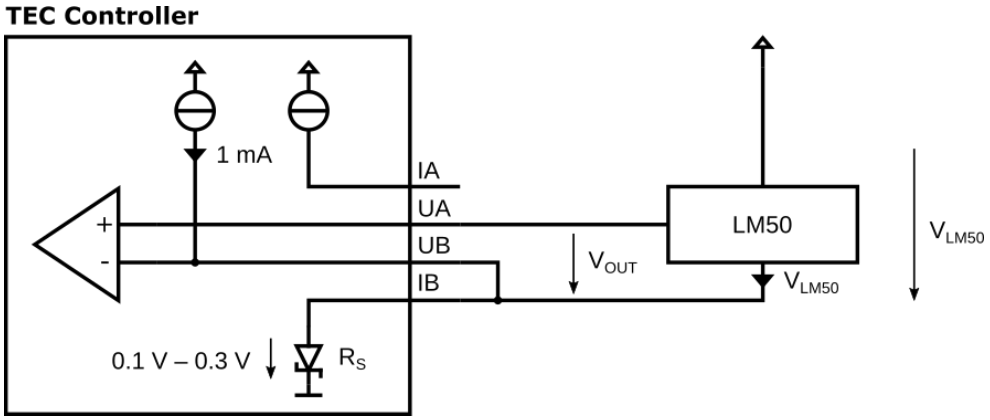



**Table 5. CHx Object Voltage to Temperature Conversion Settings**

| 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 / 1122 / 1123

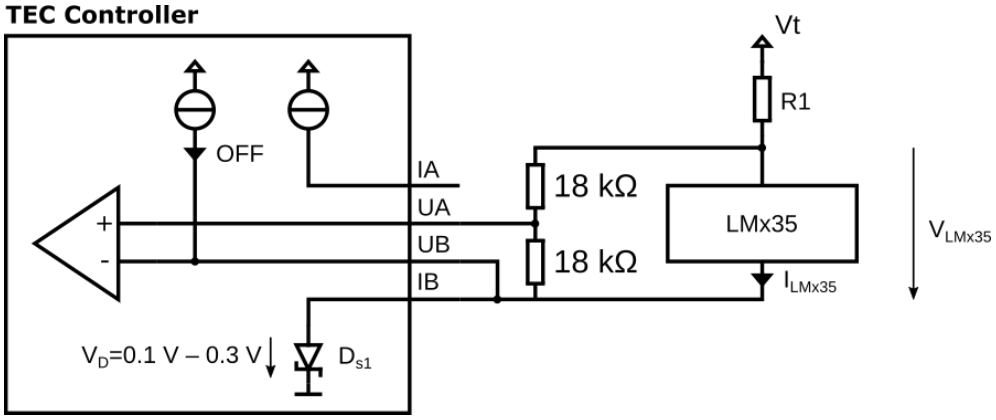



**Table 6. CHx Object Voltage to Temperature Conversion Settings**

| Name | Unit | Value |
|---|---|---|
| Reference Temperature | °C | 25 |
| Reference Voltage | V | 2.98 / $2^5$ |
| Temperature Slope | V/°C | 0.01 / $2^5$ |

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

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

### 4.3.2 With TEC-1091 / 1092 / 1161 / 1162 / 1163 / 1166 / 1167

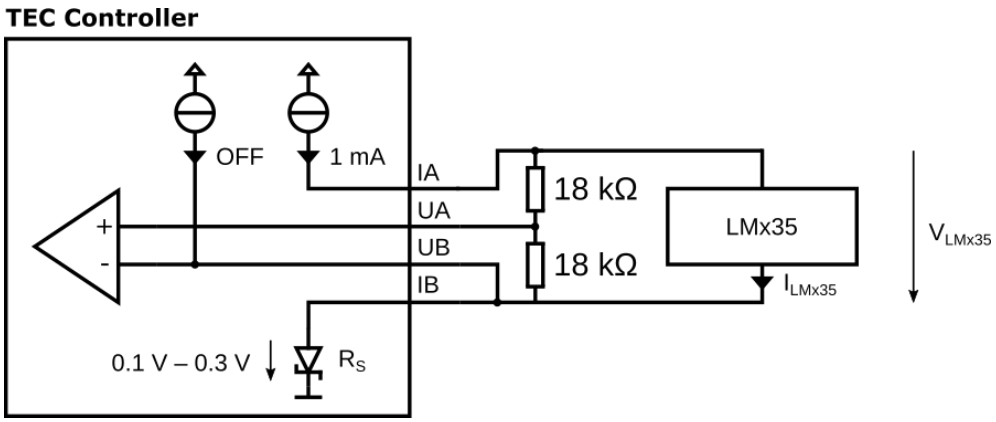


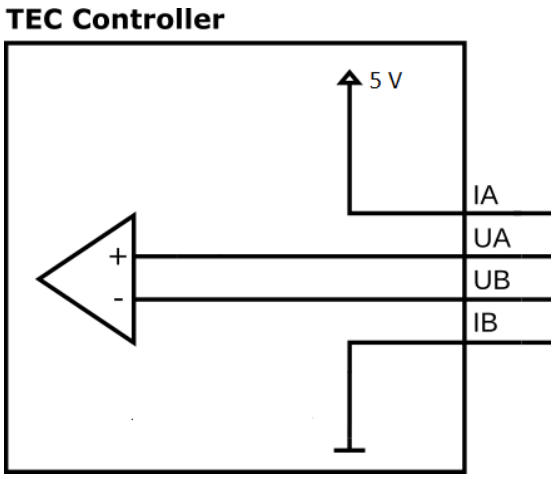

**Table 7. CHx Object Voltage to Temperature Conversion Settings**

| Name | Unit | Value |
|---|---|---|
| Reference Temperature | °C | 25 |
| Reference Voltage | V | 2.98 / $2^6$ |
| Temperature Slope | V/°C | 0.01 / $2^6$ |

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.

# 5 Wiring Voltage Output Sensors VIN2



# A Change history

| Date of change | Ver-sion | Changed / Approved | Change / Reason |
|---|---|---|---|
| 27 Feb 2023 | D | ML | • Add: VIN2 |