USER MANUAL

Features

compact size

low cost

easy to use

high stability and precision

low power consumption

modern architecture with digitally performed temperature control

compatible with 2-TE, 3-TE and 4-TE Peltier element

overheat and overcurrent protection

output voltage: +/- 3...14.5 V / 200 mA

current / voltage / temperature monitor available over LCD and PC

compatible with standard and SMIPDC-F IR detection modules

split grounds and filtering for EMC improvement

firmware upgrade option is available

supply voltage range: 9...16 V; wider range available on demand

PTCC-01-ADV theory of operation

Please note:
In the currently used nomenclature the names or symbols of intelligent controllers and IR detection modules are different in comparison to the names used previously, when the software was released.
In the following text, ***PIPDC*** *(new name) is exchangeable with* ***SMIPDC*** *(old name), as well as* ***PTCC*** *(Programmable Thermoelectric Cooler Controller, new name) is exchangeable with the* ***SmartTEC Advanced*** *(old name).*

When the power supply is applied and IR detection KIT is turned on, **PTCC** probes the type of the connected IR detection module. When **PIPDC** or module containing internal 1-wire memory is found, the settings are downloaded, and, following the user settings, the hardware is set. If the **PTCC** cannot find any of the said above module types, and it is compatible with IR detection module with no memory, the **PTCC** internal settings are applied instead. If **PTCC** is not compatible with “no memory” modules, it indicates an error and finishes the operation.

If no error occurs, the detector is then being cooled down. It usually takes around 30 seconds until the valid detector temperature is reached, the power supply for the IR module is being turned on afterwards, and the module is ready to operate.

The controller instantly probes the in-circuit currents and voltages. If any abnormal behavior is recognized (meaning short or open circuit on the supply, TEC or thermistor lines, or the **PTCC** is unable to reach the set temperature of the detector within 2 minutes) the supply is being turned off and the error is indicated.

User can check the conditions of operation of the module and the controller using the user interface (the simplified keyboard and the LCD) or the PC and the software, which is available on the VIGO website: http://www.vigo.com.pl/pub/File/download/SmartManager-setup.exe

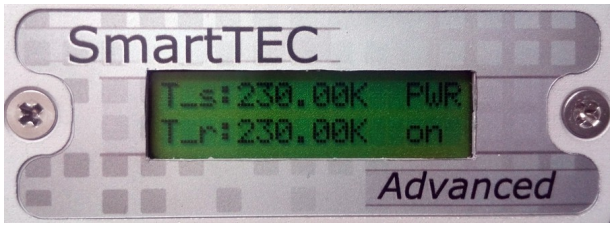
SmartTEC menu structure

Quick view of the most important parameters

T_s - set temperature

T_r - read temperature

PWR - on/off



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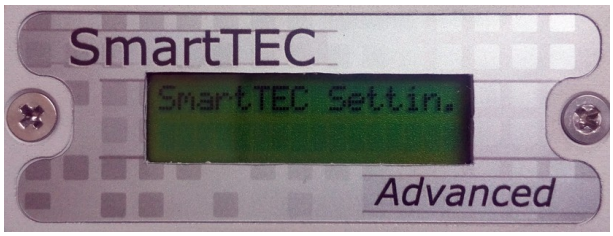
The PTCC parameters that are measured or read from the memory

↓

PTCC parameters available for adjustment



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Parameters measured internally by the PIPDC

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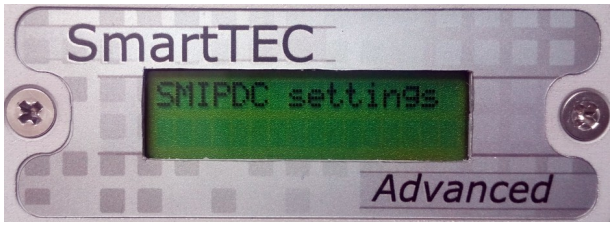
User settings of the PIPDC module



Setting the PTCC parameters

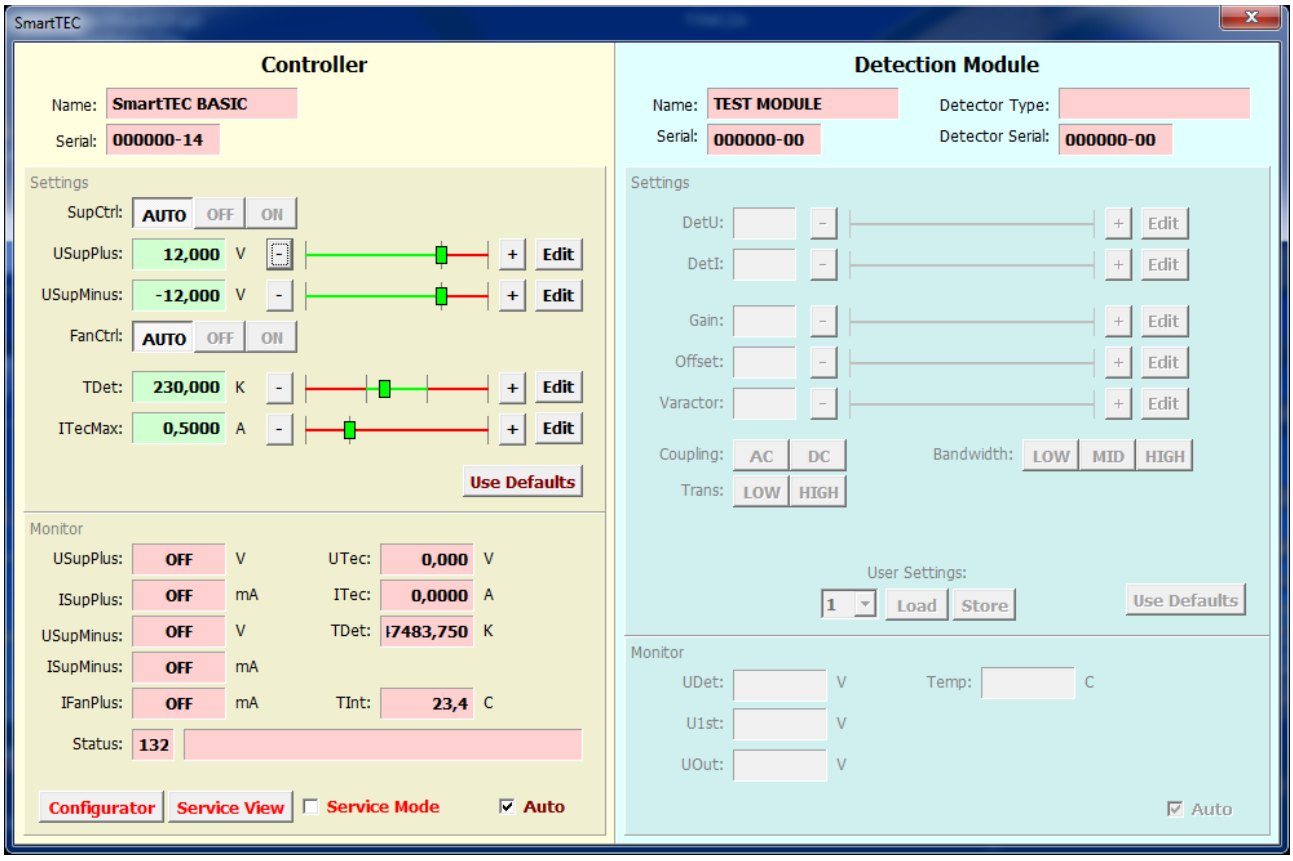
The current chapter contains the information regarding the **PTCC** settings. Please note, that having the connected IR detection module equipped with the memory (1-wire or **PIPDC**), manipulation of the parameters affects the IR module internal memory – the **PTCC** memory is inactive. Each time the IR detection kit is restarted, the newly set parameters are used.

If **PTCC** is compatible with the module having no memory on board, and the connected module doesn't respond to the sent 1-WIRE and **PIPDC** commands, then the internal **STCC** EEPROM memory is used for configuration.

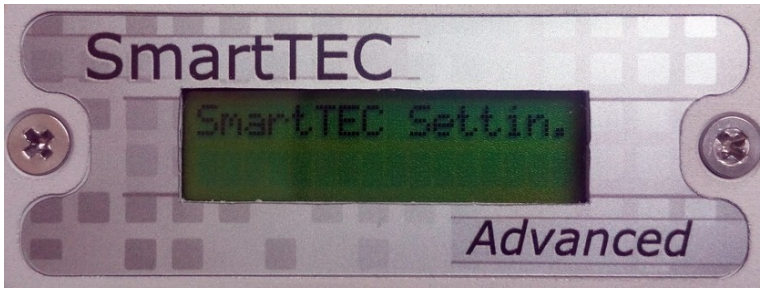
Please be careful – IR detection modules having no internal configuration memory cannot be exchanged! No matter what type of IR module is connected, it is always treated the same way following the configuration stored in internal memory. Valid for one module, may be invalid for another.

Usually, user settings are available for the adjustment within factory limits (narrower than the hardware limits). For example, if the IR module power supply is +/- 9 V, then allowing the user to manipulate the supply voltage with no limits is considered as a potential source of the module damage. The limits are applied in the factory and user is unable to adjust the values in full range.

In the PC software, there is a green part of the slider showing the parameter range available for the user, or the buttons are clickable (unavailable are grayed instead)



To change or check the user setting, the following menu option should be chosen:

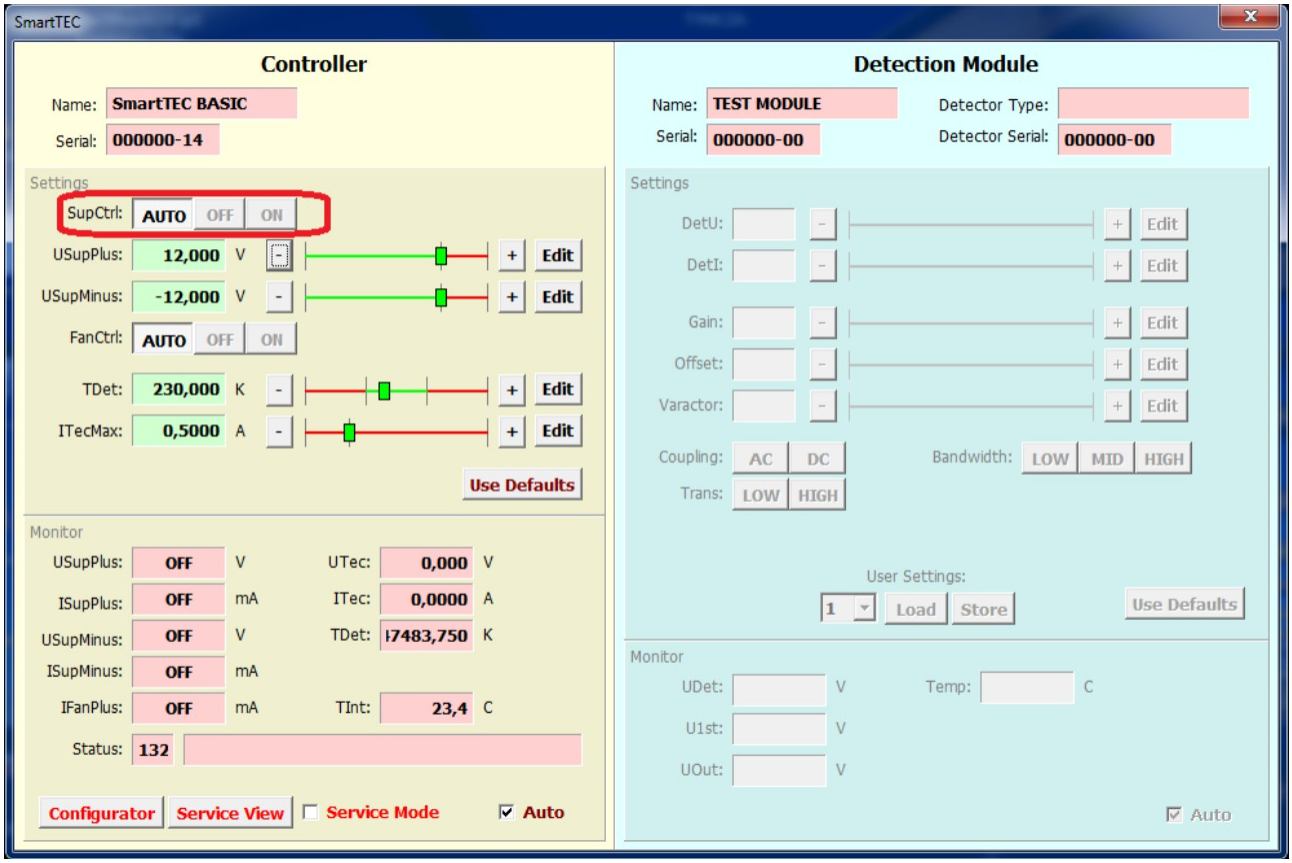


Parameters available for the adjustment

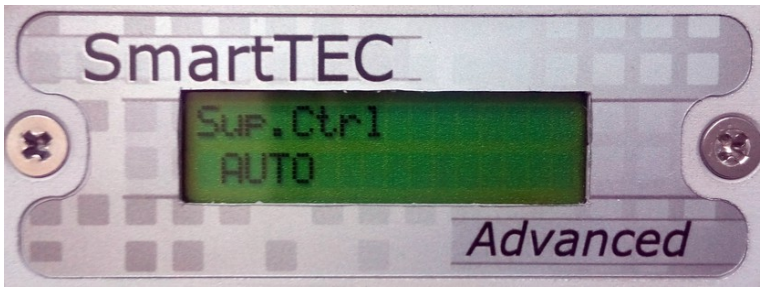
1) Module Power Supply Control

The parameter controls the moment of turning the IR module supply on to prevent powering the detector when not properly cooled down.

PC software:



PTCC display:



AUTO - the power supply for the module is turned on, when the valid detector temperature is reached (default)

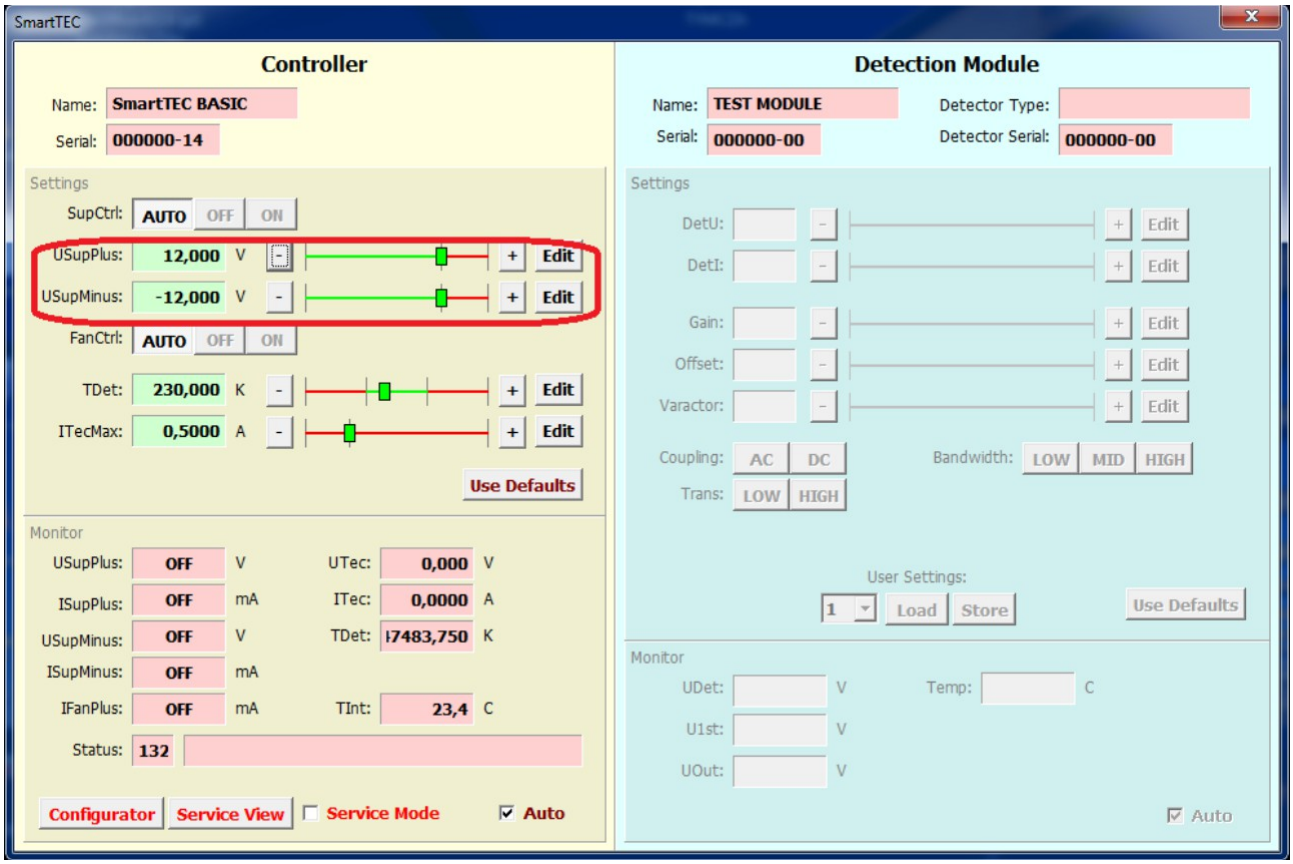
ON - the power supply is always active

OFF - the power supply is always inactive

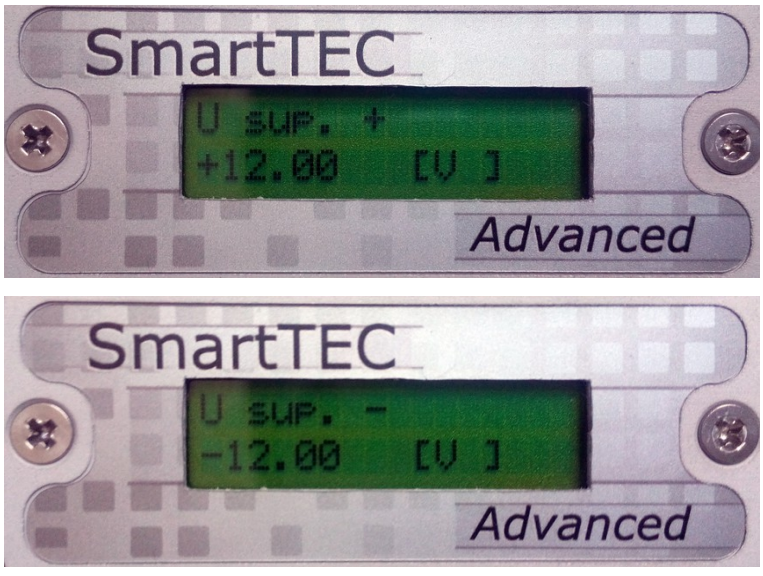
2) Module power supply voltage

The following parameters establish the power supply value for the positive and negative supply line. Hardware limits are +/- 3 … +/- 15 V (set independently), and as mentioned above, may be limited due to IR module safety.

PC software:



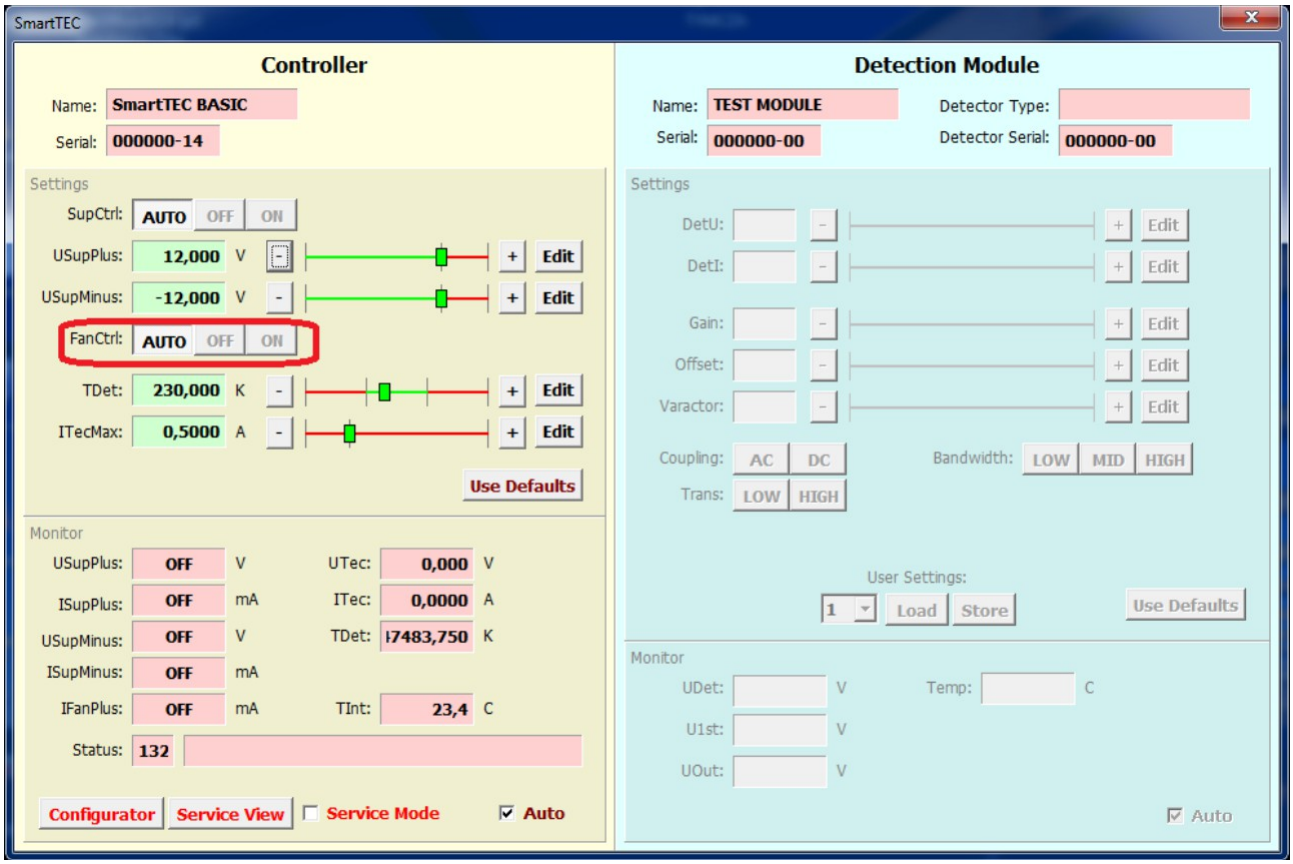
PTCC display:



3) Cooling fan supply control

Manipulating this parameter, user can enable or disable the auxiliary +5 V supply used to power the cooling fan. When **PIPDC** module is connected, the parameter is inactive (because auxiliary voltage, besides supplying the fan, is also used for supplying the microcontroller and therefore needed for normal operation).

PC software:



PTCC display:

AUTO - auxiliary voltage is enabled (default)

ON - auxiliary voltage is enabled

OFF - auxiliary voltage is inactive

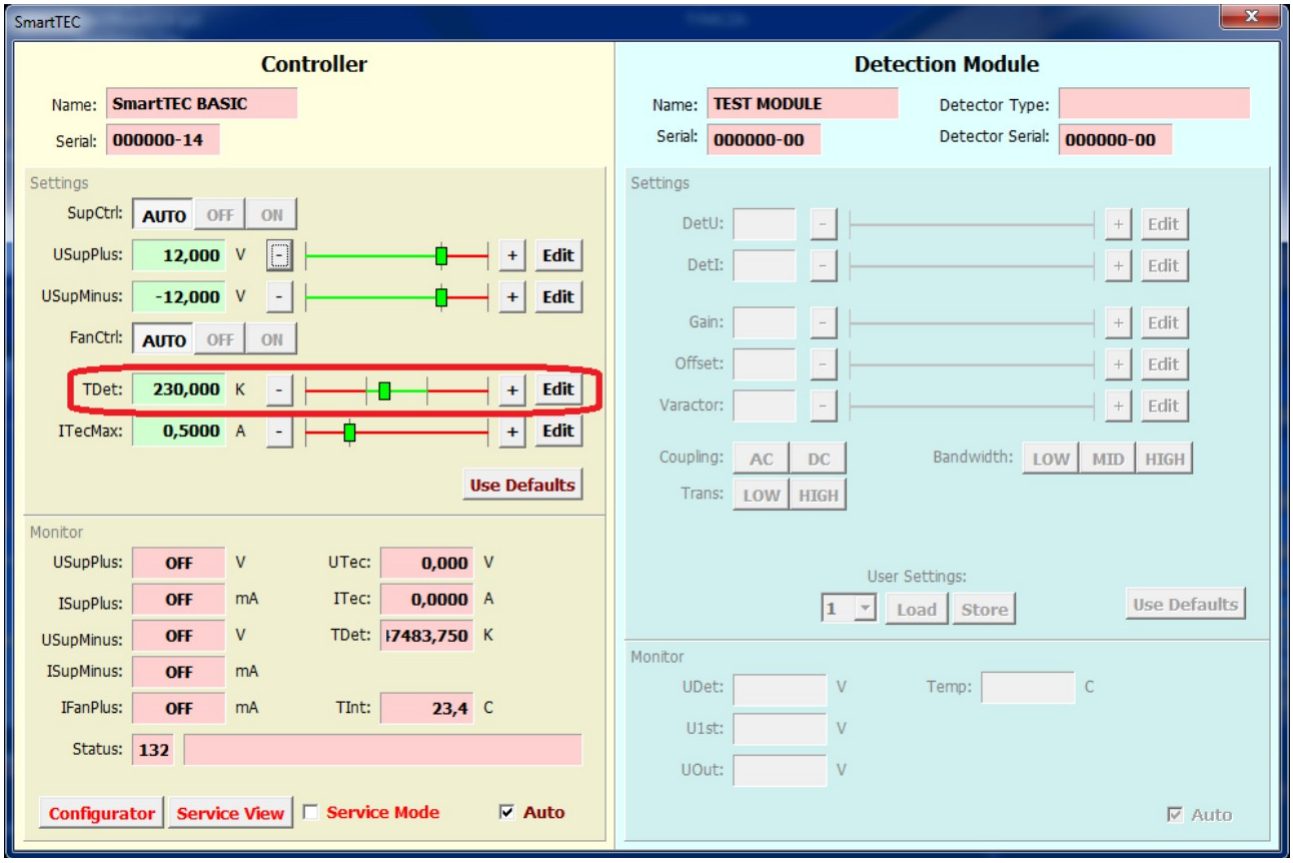
4) Detector temperature

In general, the parameter is responsible for the detector temperature stabilized by the **PTCC** controller.

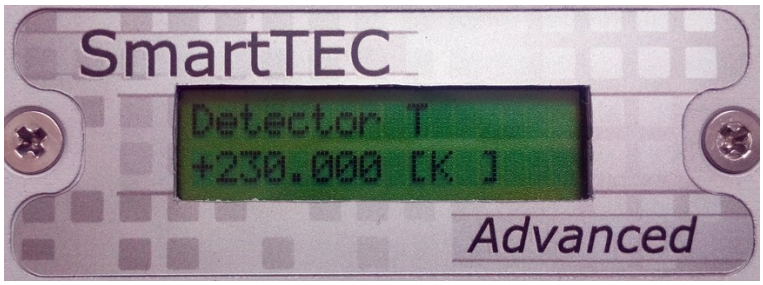
The lower temperature limit is due to the parameters of the Peltier element. It doesn't make sense to set 100 K, if Peltier element may achieve only 200 K. Establishing too low temperature is not risky, however, the **PTCC** would in this case try to cool down the detector for 2 minutes and afterwards will indicate an error and stop working – which may be confusing.

The upper limit is due to the detector safety reasons (for example, in very rare cases, if detector is biased, the bias current may rise above the safety margin in the room temperature and cause the detector overheat, which the limit will prevent). The controller is unable to warm up the detector, therefore there is no risk of heating up, instead of cooling.

PC software:



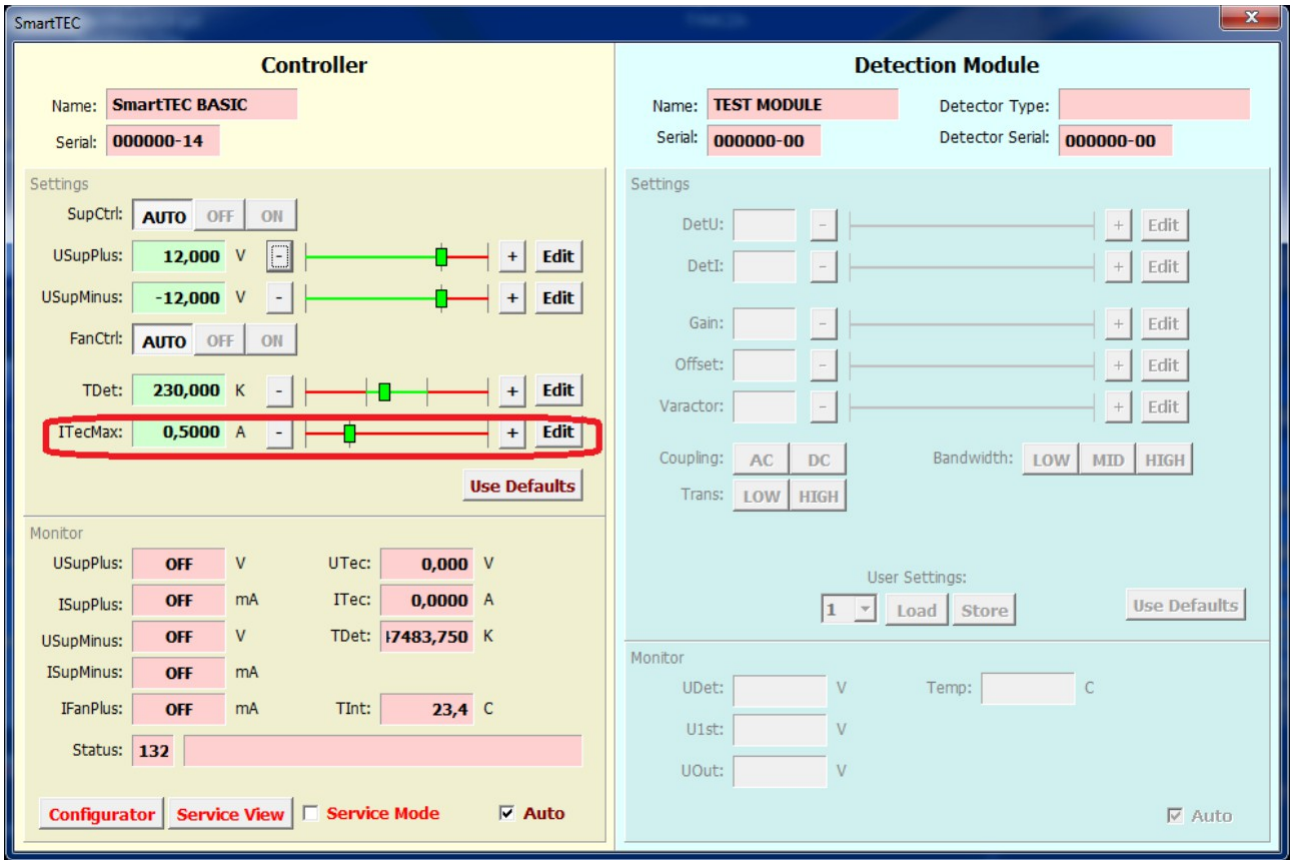
PTCC display:



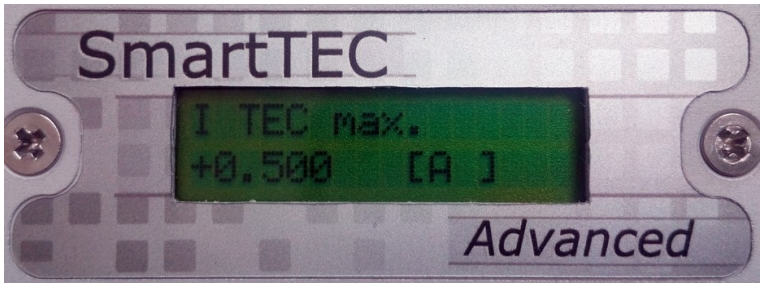
5) Thermo Electric Cooler maximum current

Defining the exact Peltier element parameters is not always needed for the temperature control. However, depending on the Peltier element type, there's always necessary to setup its maximum current. In this particular case, no modification of the parameter is possible, however, sometimes user may decrease the current below maximum avaliable for the TEC.

PC software:



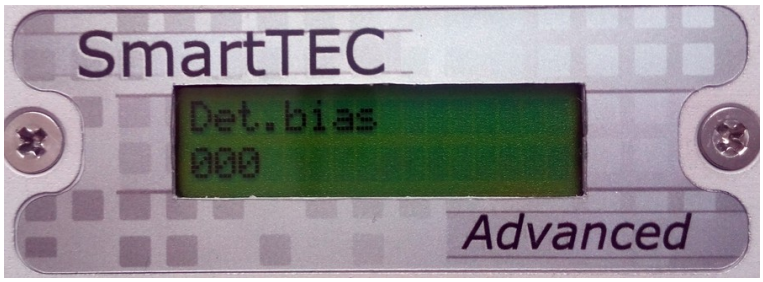
PTCC display:



Setting the PIPDC parameters

The current chapter contains the information regarding the **PIPDC** settings. As for the **PTCC** parameters, some of the parameter ranges may be limited due to the detector and IR detection module safety reasons.

1) **Detector bias voltage**



hardware min.:	0	0 V
hardware max.:	256	1 V

The value set here directly drives internal digital potentiometer. The dependence between the value and the bias voltage is linear. The real bias voltage may be checked in “SMIPDC Monitor” menu.

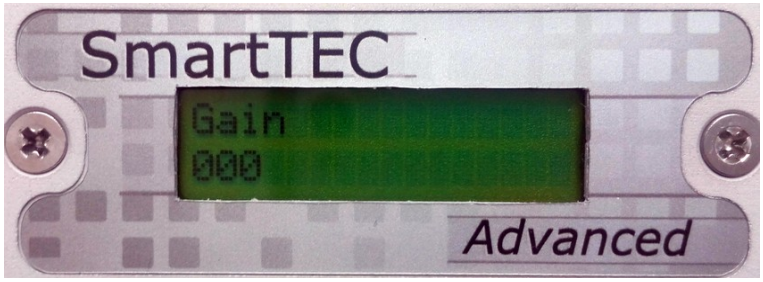
2) **Detector bias current compensation**

hardware min.:	0	0
hardware max.:	256	10 mA

The value set here directly drives internal digital potentiometer. The dependence between the value and the compensation current is linear.

The bias current compensation is used to avoid first preamplifier stage saturation. After changing the bias current compensation, it is necessary to check the voltage behind the first stage (SMIPDC Monitor). It should be as close to zero volts as possible.

3) Preamplifier second stage gain



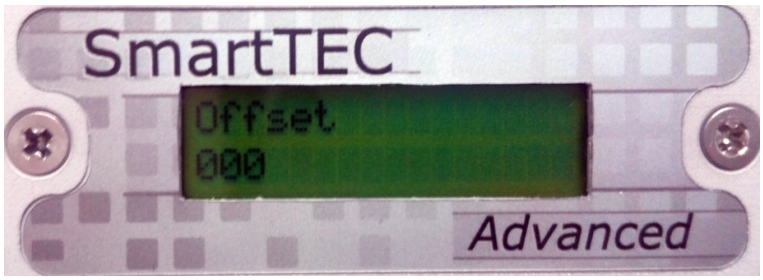
hardware min.:	0	0.5 V/V
hardware max.:	256	(~200 → 50 V/V, larger value doesn't change gain)

The preamplifier consists of two stages:

– first stage is made as a transimpedance amplifier
– second stage is made as a voltage amplifier

The gain setting is responsible for the gain of the second stage. Please note, than the full output voltage range is available, when the gain is set between 5 V/V to 50 V/V. Below 5 V/V, the output voltage range (+/- 1 V over 50 Ohm load) is reduced. The dependence between the potentiometer setting and the gain is linear in decibels.

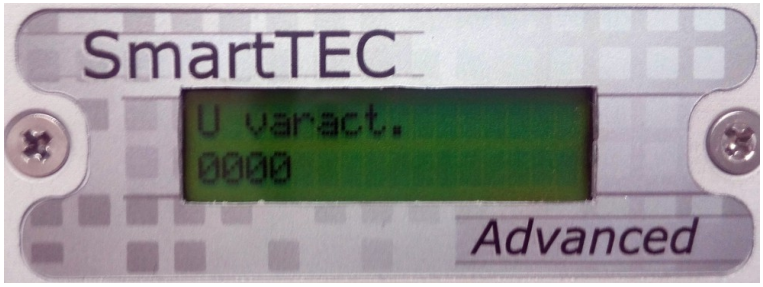
4) Output voltage offset correction



hardware min.:	0	~ +1V
hardware max.:	256	~ -1 V

Output voltage 0V should appear at the output for the potentiometer setting close to the half of the range (128). When it is unable to achieve 0 V, first stage offset is too high, and “Detector bias current compensation” must be adjusted to reduce it. Each time the setting is updated, it is possible to verify the result by checking the output voltage in “SMIPDC monitor” menu.

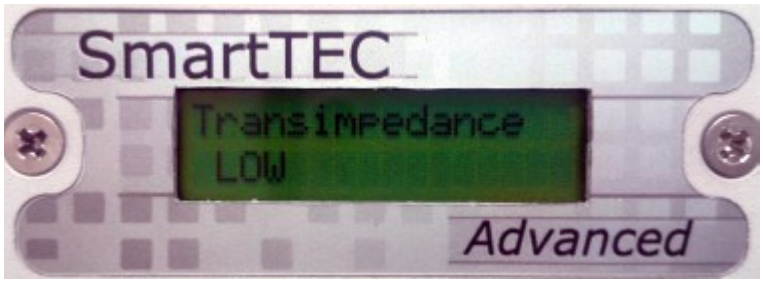
5) Varactor voltage – first stage frequency compensation



hardware min.:	0	- maximum parallel capacitance, lowest top frequency
hardware max.:	4095	- minumum parallel capacitance, highest top frequency

The parameter changes the frequency compensation for the preamplifier first stage. The lower value means the capacitance parallel to the feedback resistor is relatively high, and therefore the circuit might be over-compensated. Higher value of the parameter gives weaker frequency compensation. Lower values leads to oscillation, higher – the circuit is stable, however the ringing behind the signal edges may be visible.

6) Preamplifier first stage transimpedance



LOW	1 kOhm
HIGH	5 kOhm

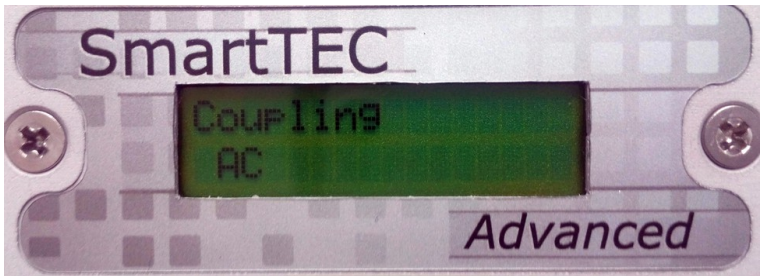
Higher transimpedance results in lower bandwidth (usually around 80 MHz, depending on detector type) and the frequency compensation should be weaker. Preamp is normally more stable and less noisy (5 pA/sqrt(Hz))

Lower transimpedance results in higher bandwidth (usually 220 MHz, depending on the detector parameters), frequency compensation should be stronger to avoid ringing. The input referred noise current density is higher (8 pA/sqrt(Hz)).

Overall IR module transimpedance is calculated as a first stage transimpedance times second stage gain. Therefore for 1kOhm, the transimpedance is 500 Ohm … 50 kOhm, and for 5 kOhm: 2.5 kOhm.... 250 kOhm.

The bandwidth doesn't depend on preamplifier second stage gain.

7) Coupling between first and second stage



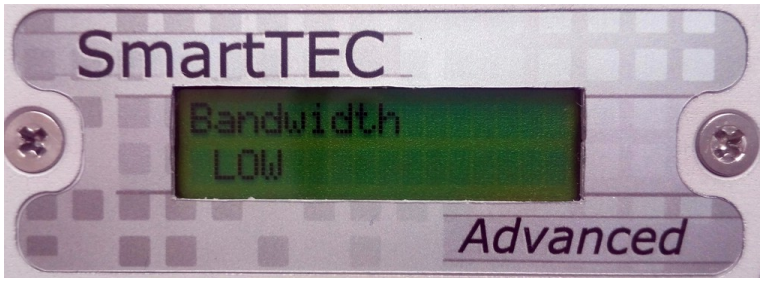
AC

DC

AC coupling results in better output voltage stability, and in general, full gain range is then available and output voltage offset correction is simpler. The lower cut off frequency is around 1 kHz.

DC coupling allows the user to monitor the DC level IR radiation. The IR detection module is less stable in terms of output DC offset, and due to the instability, limited range of gain is convenient for usage.

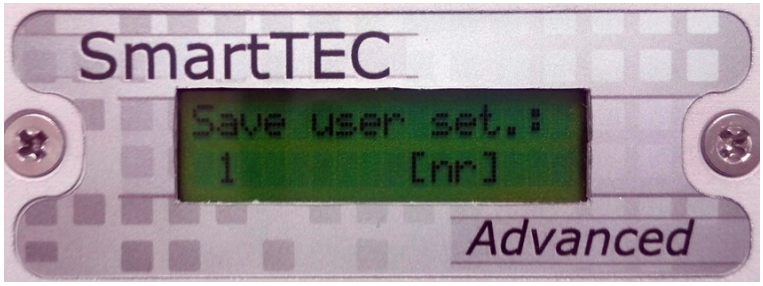
8) Preamplifier bandwidth

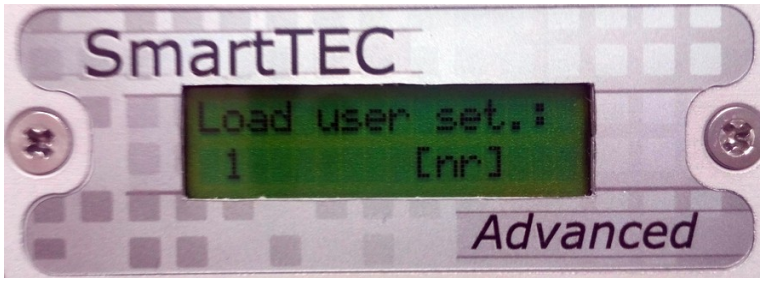


LOW	1.5 MHz
MEDIUM	15 MHz
FULL	depends on detector parameters and first stage transimpedance

It is possible to reduce the bandwidth down to 1.5 MHz or 15 MHz compared to the full bandwidth, this reduces the output noise and simplifies measurement when IR radiation level is weak.

9) Saving and loading user settings





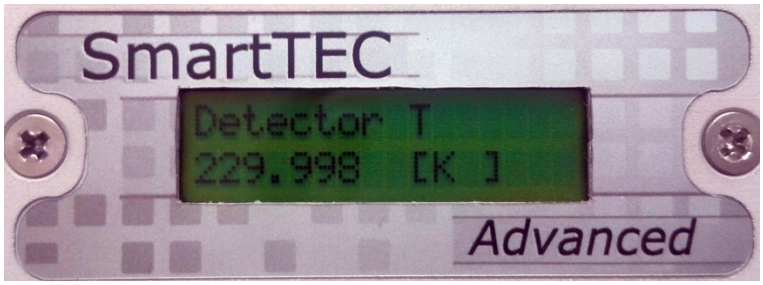
User can store the **PIPDC** settings in one of four memory banks and immediately load when necessary. When “Save user settings” is chosen, current configuration is saved. Choosing “Load user settings” results in replacing current **PIPDC** settings with the settings from the bank. When IR detection kit is restarted, last **PIPDC** configuration is restored.

SmartTEC monitor

This menu option is used for checking of **PTCC** and IR module working conditions.

1) **Measured detector temperature**

PC software: **TDet**



2) **Voltage over Peltier element.**

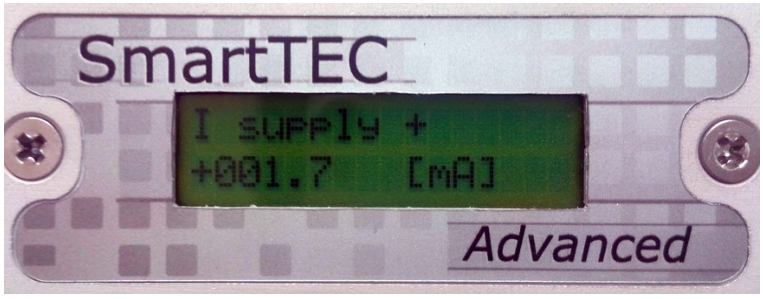
PC software: **UTec**

3) **Current flowing through the Peltier element.**

PC software: **ITec**

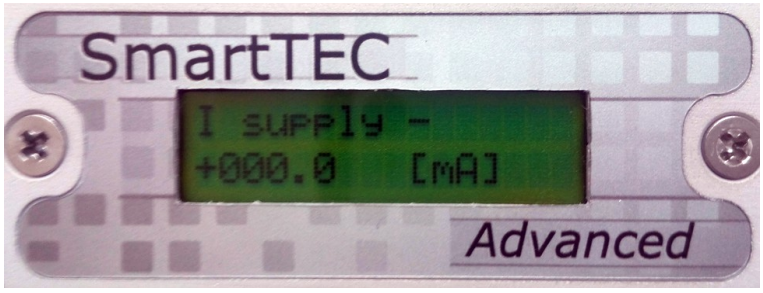
4) **Current consumption from the supply positive line.**

PC software: **ISupPlus**



5) **Current consumption from the supply negative line.**

PC software: **ISupMinus**



6) **Current consumption from the auxiliary supply line (cooling fan)**

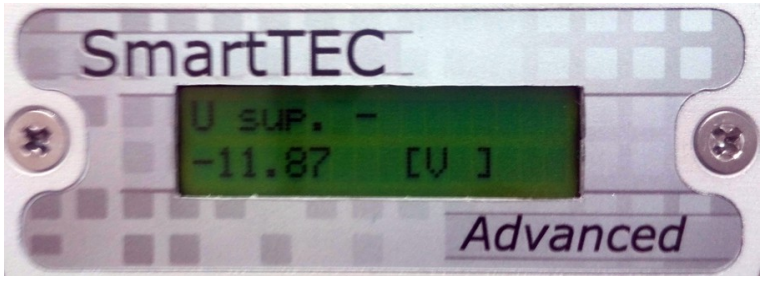
PC software: **IfanPlus**

7) **Supply voltage – positive line.**

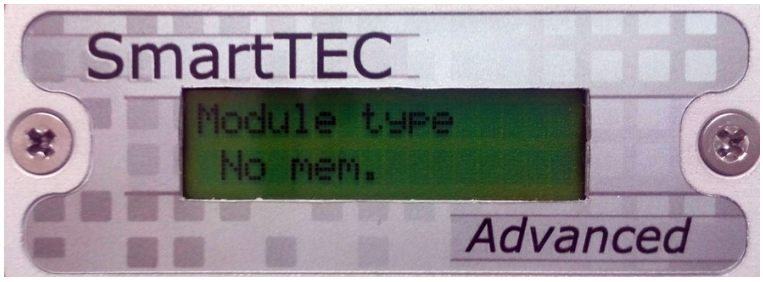
PC software: **USupPlus**

8) Supply voltage – negative line.

PC software: **USupMinus**



9) IR detection module type



N.C. - module not connected

No mem. - module with no configuration memory

1-wire - module with internal configuration memory

SMIPDC - programmable intelligent IR module

10) SmartTEC status

000 **- temperature control loop locked**

001 **- cooling**

002 **- no cooling – TEC controller inactive**

128 **- detector overheat**

129 **- over-current (TEC / supply)**

130 **- TEC lines opened**

131 **- TEC lines shorted**

132 **- thermistor lines opened**

133 **- thermistor lines shorted**

134 **- SmartTEC overheated (circuit)**

135 **- no module connected**

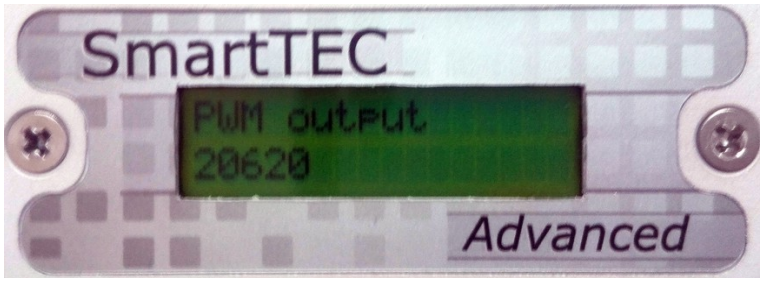
136 **- data pin shorted to the ground**

137 **- PIPDC data error**

138 **- 1-wire data error**

139 **- PTCC configuration memory error (or not programmed)**

11) PWM output

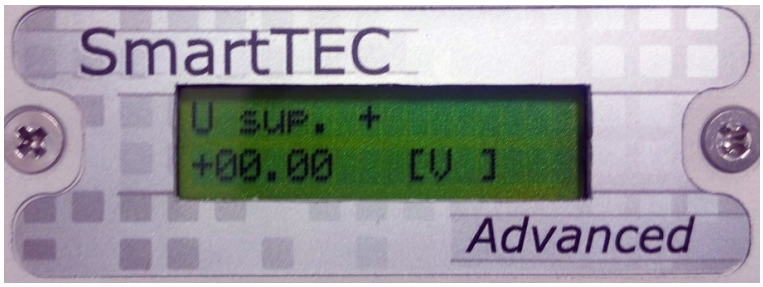


Peltier element is driven by PWM based output stage. Minimum PWM value is 0 (meaning the TEC is not cooling) maximum is 65535 – Peltier is driven with maximum power.

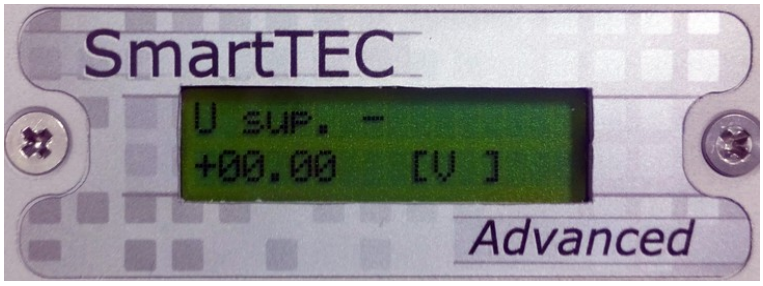
PIPDC monitor

Some of the options included in this sub-menu are redundant to the options in **PTCC** monitor. Those repeated measurements help in finding weak connection (for example: supply voltages measured by **PIPDC** and **PTCC** may be compared to find weak connection). The tolerable and measurable input voltage ranges are matched individually for each monitor input to achieve proper dynamic range.

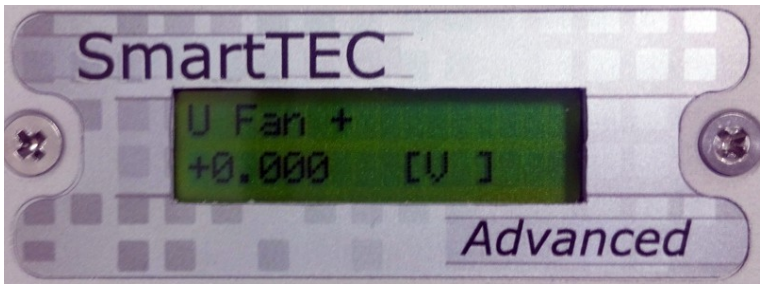
1) **Supply voltage – positive line**



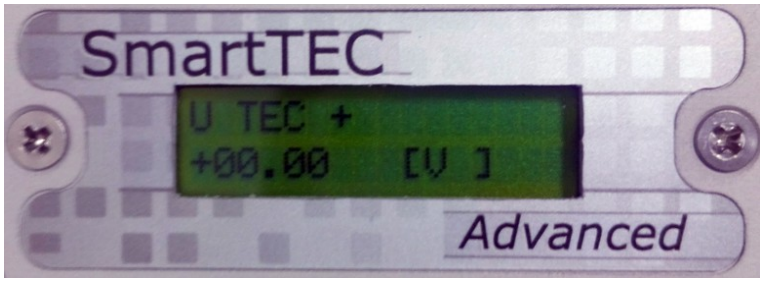
2) **Supply voltage – negative line**



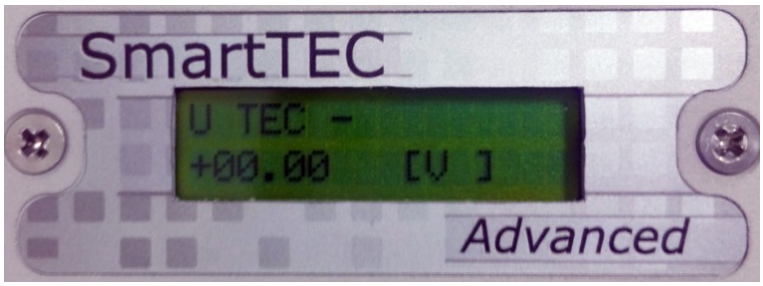
3) **Auxiliary voltage (FAN & microcontroller)**



4) **Voltage at TEC line +**

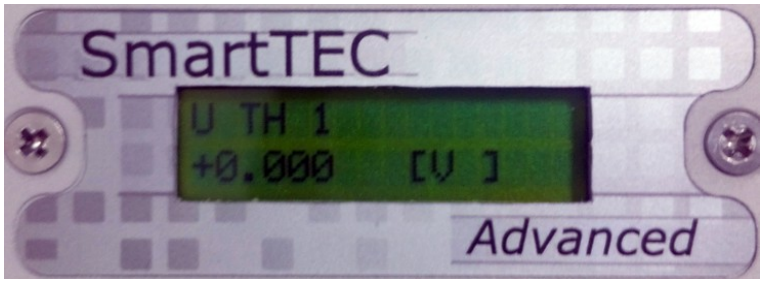


5) **Voltage at TEC line -**



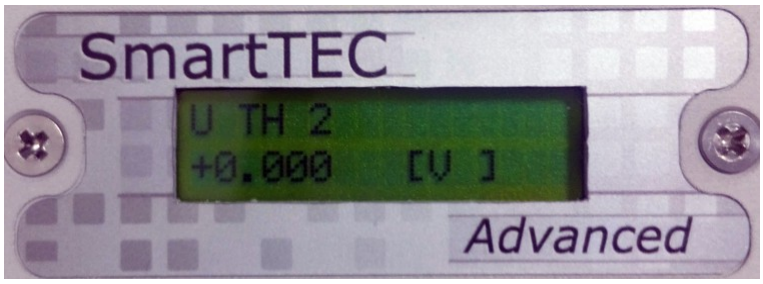
The TEC is powered with negative voltage. This means, the voltage at positive line is close to 0 V (0 ... - 0.5 V), and voltage at negative line is higher in terms of absolute value, and in normal operation potential is lower than GND (-1 …. -9 V)

6) **Voltage on thermistor line 1**



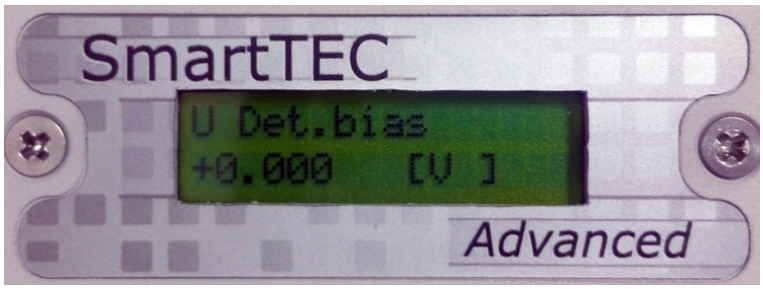
During the normal operation, the voltage here depends on the temperature and should be between 0.5 V and 2 V.

7) **Voltage on thermistor line 2**



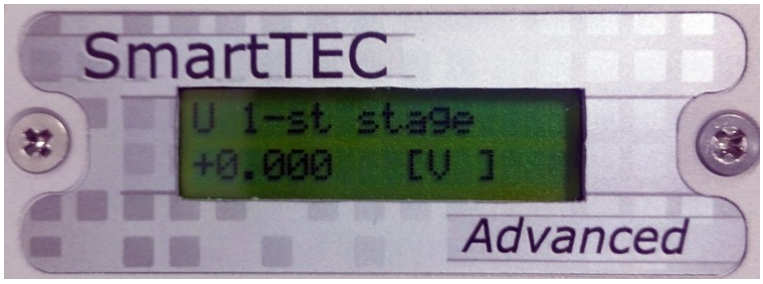
This line is normally at ground potential. However, if the connection to the **PTCC** is weak, the line is pulled up by the thermistor and line 1, and the value is higher.

8) Detector bias voltage



This is the real measured voltage over the detector. This measurement is particularly useful for checking the results of coarse adjustment the detector bias voltage with the digital potentiometer.

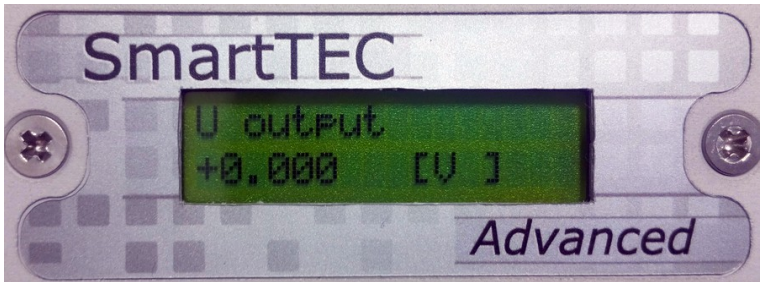
9) Voltage behind the preamplifier first stage



This measurement allows the user to check what is the DC IR radiation level, even when AC coupling to the second stage is chosen. This may be potentially useful in heterodyne detection.

By measuring the voltage at output of the 1st preamp stage, user can check, whether is the risk of preamp saturation and what is the source of output DC offset.

10) Voltage at the module output



The output voltage measurement is useful especially, if it is not possible to validate the setup connection with the oscilloscope. It is also easy to perform an offset cancellation with no additional equipment.