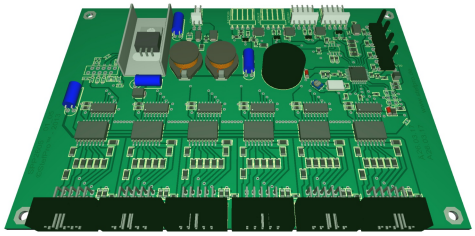
SPO9542.19

Four digit temperature display

Datasheet

Version: Firmware 1.82-148



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Data Sheet Version 1.0.0 - Valid from 01.01.2021.

Table of Contents

Safety

Follow the manual


The module is only safe in operation if all instructions are read in this datasheet.

General understanding of safety
By the module there are no hazard under normal use.

Intended Use
The module is designed for driving big displays.
The power should come from a safe transformer (also protected transformer) or a corresponding low voltage power supply for the circuit.
Never use a higher voltage or direct mains voltage!

Concealed Hazards


DANGER
following hazards may arise in case of wrong construction of the circuit and wrong handling of module:

- 
With the direct connection to mains, it's a dangerous voltage on the module and other components, use a safety transformer!
- 
Reverse polarity and overloading the module may cause in smoke. This smoke possibly contains toxic substances which must not be inhaled! Ventilate the room.
- 

Reverse polarity or overload of the module can cause a hot surface on the IC or other component in the circuit.
  - There is a risk of burning when touching.
  - And flammable materials, for example Paper, can come in fire.
- 
Spalling of parts on reverse polarity or overloading of the module.

Wear during the initial commissioning eye protection.
- 
The pins of the components can be pointed and sharp even after installation! Therefore, this may cause in sores in case of incorrect handling.
- 
If the buzzer emits more than 90 dB, it may cause hearing loss over a long period of time. The circuit board is intended for installation in a housing, thereby lowering the level of the buzzer used.
- 
Use always passing a ESD bracelet to avoid electric charges! The module can be damaged if handling without an earthing tape and housing!

Modifications of the example circuit
The successfully built device may be damaged. Therefore check as appropriate all housing part and lines for damage. This applies in particular to parts of the directly (for example power cord and power supply) or indirectly come into contact with mains voltage.

Application and Function description

Function description

This IC is suitable for big displays and has a SPI interface for Shift registers or LED driver.

This IC also has an adjustable brightness control for the display, thereby the display is easy toread during the day and at night it does not light out the entire room.

With this IC, up to 2 **temperatures** can be displayed alternately.

This IC has a bootloader, which allows you to update the IC firmware.This means that you will always remain at the current state of the Firmware for the IC, without further costs.

Technical data

- Operating voltage: 9 to 15 volts DC
- Current: max 2A
- Power: approximately 24 W
- Volume level of the buzzer: approx. 85 to 90 DB
- Temperature accuracy:
  - Worst inaccuracy: ±2.5 °C
  - Typical: ±1 °C
  - Calibrated: <±1 °C

  The values apply when using the LM35, when calibrated, the value can also be reached for other sensors.

Construction description

Installation of the module (Dimensions)

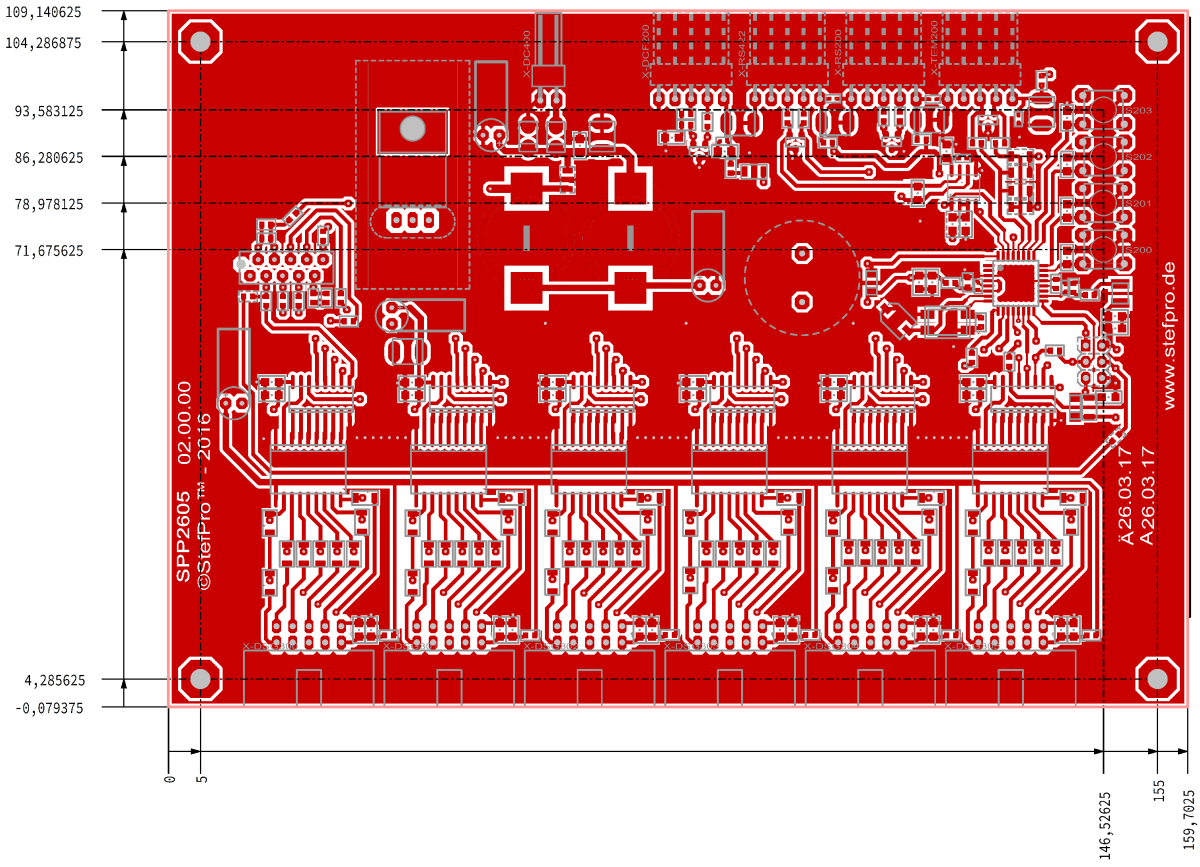


Figure 1:Installation (Dimensions) description for module SPP2605.8

Secure the module securely in a housing with an M3 screw.

Connectors

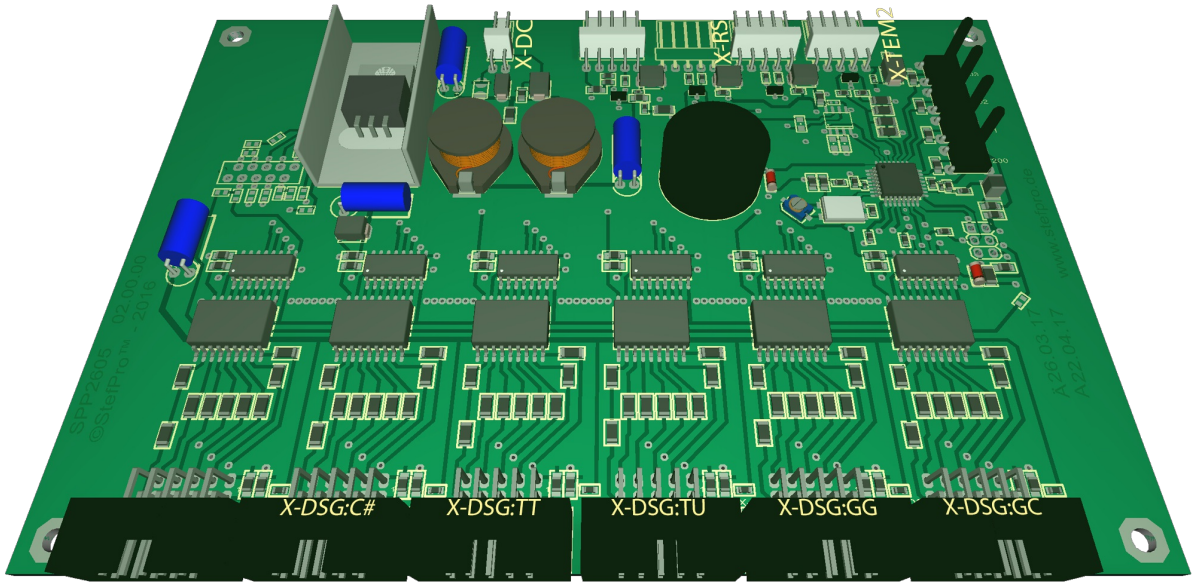


Figure 1:Connector description for module SPP2605.8

Insert the appropriate plugs with little effort.

DANGER

Make sure that you have connected all signals correctly. There is no overload and polarity protection!

X-DC : DC Power input : Print plug 2 pole

Pin	Name	Direction	Function	Maximum
1	GND	Power		
2	V+	Power	Power supply input of the module	9 to 15 volts DC, max 2A

X-RS UART : SERIAL : Print connector 5 pin

Pin	Name	Direction	Function	Maximum
1	GND	Power		
2	N.C.		Do not connect	VCC
3	RXD	Digital input	Receive	VCC
4	TXD	Digital output	Transmit	VCC
5	VCC	Power		When used as the voltage supply input of the module: 3 V - 5 V DC, max 2AOtherwise : VCC DC, 30mA

X-TEM : Temperature input : Print connector 5 pin

Pin	Name	Direction	Function	Maximum
1	GND	Power		
2	TempSen2	Analog input	Temperature sensor input 2	VCC
3	LightSen	Analog input	light sensor input	VCC
4	TempSen	Analog input 1	Temperature sensor input 1	VCC
5	VCC	Power		5 volts DC DC, 30mA

X-DSG : Display segment output : Box header 10 pin

Pin	Name	Direction	Function	Maximum
1	GND	Power		
2	V+	Power	LED Power output	9 to 15 volts DC DC, 8 x 35mA = 280mA
3	SEG_G	Analog output	Segment G output	9 to 15 volts DC
4	SEG_F	Analog output	Segment F output	9 to 15 volts DC
5	SEG_E	Analog output	Segment E output	9 to 15 volts DC

6	SEG_D	Analog output	Segment D output	9 to 15 volts DC
7	SEG_C	Analog output	Segment C output	9 to 15 volts DC
8	SEG_B	Analog output	Segment B output	9 to 15 volts DC
9	SEG_A	Analog output	Segment A output	9 to 15 volts DC
10	SEG_DP	Analog output	Segment DP output	9 to 15 volts DC

The segment outputs A - G have internal 100 ohms, for 250mW and the segment outputs DP have internal 300 ohms, for 500mW.

⚠ WARNING

For segment outputs A - G at 35mA is the minimum segment voltage 8.5V and for segment outputs DP at 35mA is the minimum segment voltage 1.2V so that there is no overloading of the resistors.You can reduce the current with a resistor in series. The minimum segment voltage is thereby also reduced.

Names of connector X-DSG:xy

This are the names:

- X-DSG: C # = channel number 1 or 2
- X-DSG: TT = temperature tens
- X-DSG: TU = temperature units
- X-DSG: GG = degree symbol °
- X-DSG: GC = Celsius C

Signal description

V+

Operating voltage

VCC

Operating voltage for external modules

GND

Ground

LightSen

Analogue input for a light sensor.

TempSen0

Analogue input for a temperature sensor 0.

TempSen1

Analogue input for a temperature sensor 1.

SEG_A, SEG_B, SEG_C, SEG_D, SEG_E, SEG_F, SEG_G, SEG_DP

Cathode connections for the LED segments of the 7 segment displays.

Basic circuit

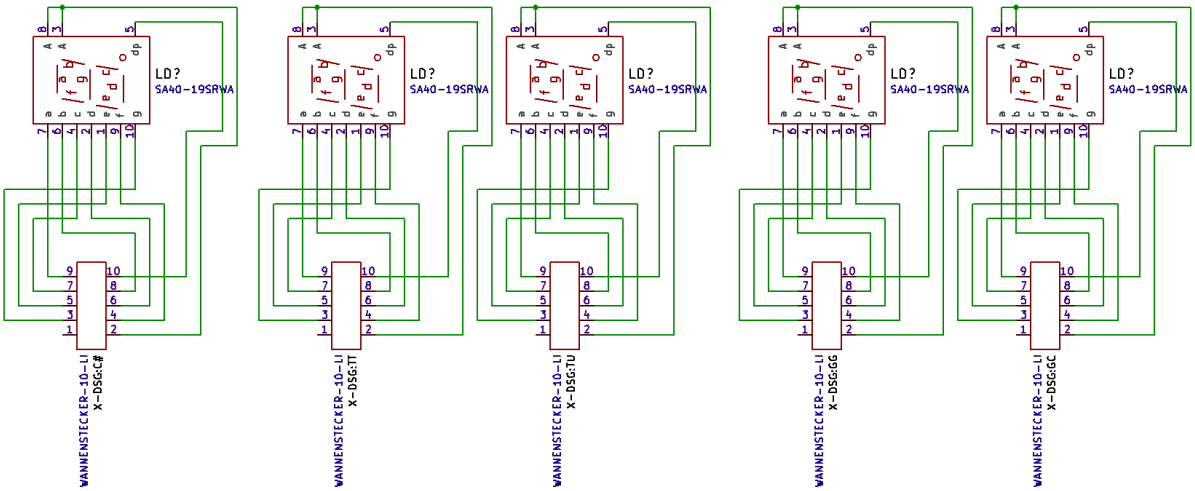
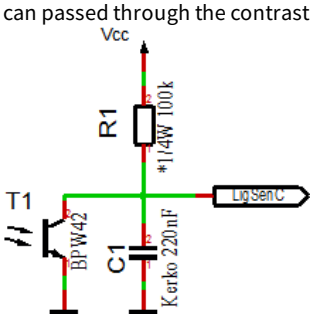


Figure 2: Basic circuit of SPO9542.19
Here is an example of the wiring between the module and SA40 7 segment displays from KingBright.

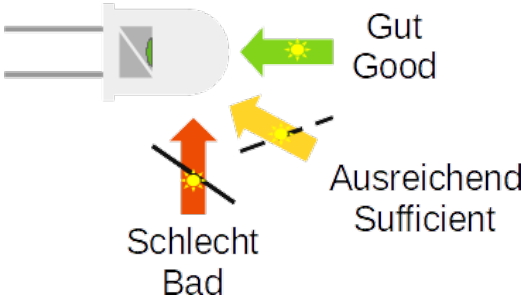
Properties of the components

Properties of light sensor with Phototransistor

The light sensor is used to control the brightness of the display.As light sensors many phototransistors are suitable, in the example circuit a BPW42 is used.If another phototransistor is used, may you need to change the value of the pull-up resistor R1. The menu allows to adjust the calculation factor, offset and the control speed.If the sensor is mounted behind a contrast panel, it must be taken to ensure that the wavelength of the phototransistor can passed through the contrast screen.



In the case of the BPW42 and similar photo transistors in the LED diode housing, the incidence of light must take place as follows in order to achieve the best result:

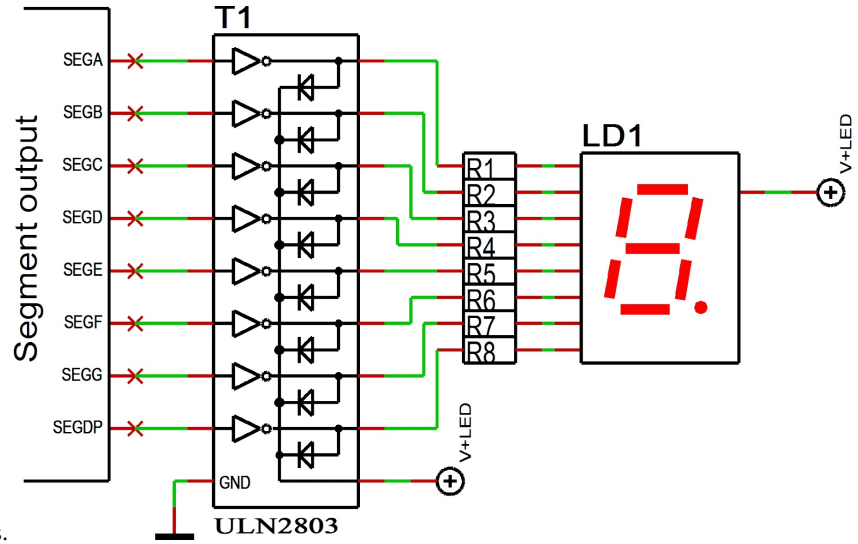


NOTICE

When using a different phototransistor or a different photodiode, it may be necessary to adapt R1 (top picture) and the settings in the menu!

Transistor array

For the sake of convenience, a transistor array is used for drive the cathode, in this case it is the ULN2803.This transistor array is located on the



module as well as the resistors.

7 segment displays

The seven-segment display LD1 and LD2 must have a common anode. Via R1 to R8 the brightness of the LEDs can be set.

Checked displays

Manufactor no. Hersteller-Nr.	Manufactor Hersteller	Color Farbe	Brightness Helligkeit

0.39 in - 10 mm			
SA 39-11 SRWA	KINGBRIGHT	Red - Rot	—
SA 39-11 GN	KINGBRIGHT	Green - Grün	—
0.52 in - 13,3 mm			
SA52-11SRWA	KINGBRIGHT	Red - Rot	—
SA52-11LSRWA	KINGBRIGHT	Red - Rot	—
SA52-11EWA	KINGBRIGHT	Red - Rot	—
SA52-11YWA	KINGBRIGHT	Yellow - Gelb	—
SA52-11LYWA	KINGBRIGHT	Yellow - Gelb	—
SA52-11GWA	KINGBRIGHT	Green - Grün	—
SA52-11LGWA	KINGBRIGHT	Green - Grün	—
SA52-11QBWA-D	KINGBRIGHT	Blue - Blau	—
LTS-546AP	Lite-On	Red - Rot	—
TDSR5160	Vishay Semiconductors	Red - Rot	—
TDSG5150	Vishay Semiconductors	Green - Grün	—
0.56 in - 14,2 mm			
SA 56-11 EWA	KINGBRIGHT	Red - Rot	—
SA 56-11 GWA	KINGBRIGHT	Green - Grün	—
0.8 in - 20,32 mm			
SA08-11SRWA	KINGBRIGHT	Red - Rot	—
SA08-11EWA	KINGBRIGHT	Red - Rot	Testis still pending - Test steht noch aus
SA08-11YWA	KINGBRIGHT	Yellow - Gelb	—
SA08-11GWA	KINGBRIGHT	Green - Grün	—
SA08-11PBWA	KINGBRIGHT	Blue - Blau	—
HDSP-8601	Agilent	Green - Grün	—
2.3 in – 56,9 mm			
SA23-12SRWA	KINGBRIGHT	Red - Rot	✓
SA23-12EWA	KINGBRIGHT	Red - Rot	✓
SA23-12YWA	KINGBRIGHT	Yellow - Gelb	✓
SA23-12GWA	KINGBRIGHT	Green - Grün	✓
4.0 in – 100 mm			
SA40-19SRWA	KINGBRIGHT	Red - Rot	✓
SA40-19EWA	KINGBRIGHT	Red - Rot	✓
SA40-19YWA	KINGBRIGHT	Yellow - Gelb	✓
SA40-19GWA	KINGBRIGHT	Green - Grün	✓

- ✓ Works fine. The input voltage of the module may need to be adjusted, we will be happy to advise you. Please note that the ambient brightness can unfortunately reduce the impression of brightness somewhat.
  Funktioniert perfekt. Die Eingangsspannung des Moduls muss ggf. angepasst werden, wir beraten Sie gerne. Bitte beachten Sie, dass die Umgebungshelligkeit den Helligkeitseindruck leider etwas mindern kann.
- — Works but not fine - Funktioniert, aber nicht zu empfehlen
- ✗ Doesn't work - Funktioniert nicht
- ✘ Not tested, would not work directly - Nicht getestet, da nicht direkt möglich.

Effect of an acrylic glass

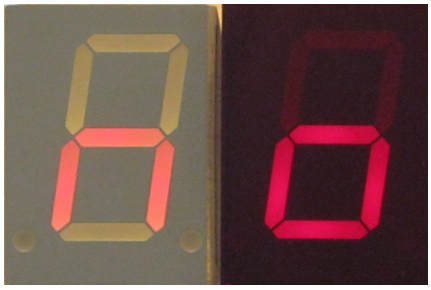


Figure 3: SA08-11SRWA left without and right with contrast pane with front light.

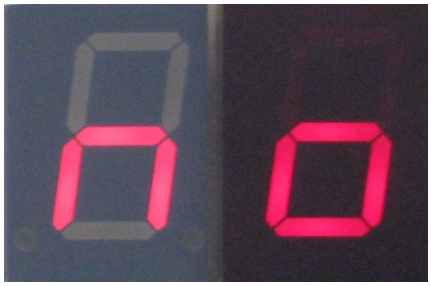


Figure 4: SA08-11SRWA left without and right with contrast pane without front light.

Below with and above without front light.
Because the display control is static, all 7 segment displays can be used. It can only be that, with reduced brightness setting, not all 7 segment displays lead to the desired result.

All segments with 4 LEDs were limited with a 220 ohm resistor. All segments with 2 LED (decimal point on SA23 and SA40) were limited with 390 ohm resistor.

This circuit is not optimised for minimum components and power. The displays are therefore easy to read when illuminated directly by lamps.The brightness of the display is also important for readability. A milky display such as the SA40 is not as easy to read as a display consisting of individual clear LEDs.Even in the shade there is still enough light, namely around 10,000 lux. At maximum current, however, the SA40-SRWA only measured approx. 3,000 lux with a Peaktech 3695.

It is recommended to place a contrast glass in the corresponding display colour in front of the displays, see figure 4 and 3.

Correct colour of the glass.

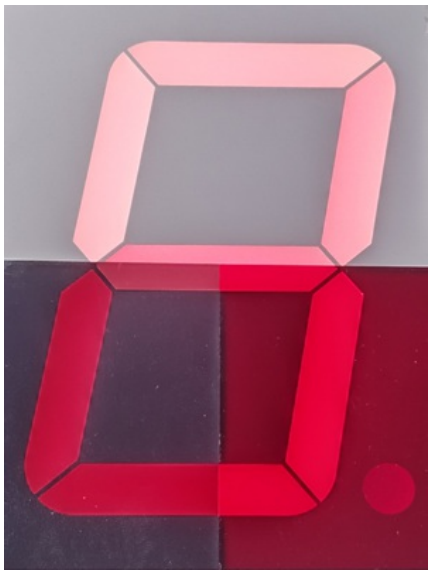


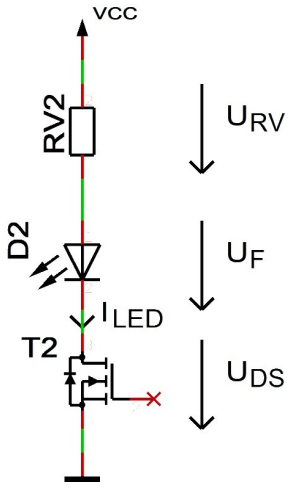
Figure 5: SA40-19SRWA top without, bottom left grey and right with red contrast lens with front light

SPI contrast without front light 2

Figure 6: SA40-19SRWA upper red and lower gray contrast pane with front light.

The colour of the disc also makes a difference, see 5 and 6 with 20,000 lux front light.Note: The menu is always displayed with 100% brightness.

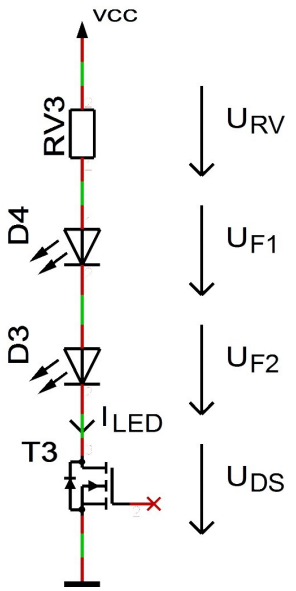
Calculate the series resistor for one LED



$$RV2 = \frac{VCC - U_F - U_{DS}}{I_{LED}}$$

- UDS ≈ 0
- ILED < 35 mA

Calculate the series resistor for two LED



$$RV3 = \frac{VCC - U_{F1} - U_{F2} - U_{DS}}{I_{LED}}$$

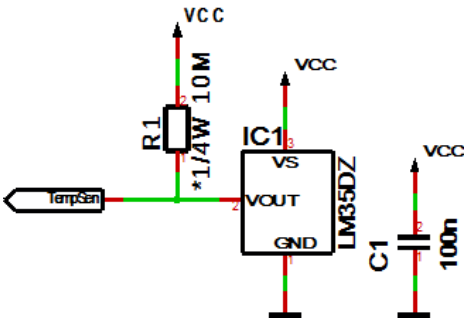
- UDS ≈ 0
- ILED < 35 mA

Temperature sensor

The temperature sensor is used to display the temperature and it must be an analog sensor with 10mV / 1°C. This is to be connected to the temperature sensor input (TempSen).

From version 1.79-144 the temperature sensor can be calibrated and also display negative temperatures.The calibration is done with one decimal place, but the display is always an integer.

When installing the temperature sensor, make sure that it does not receive any foreign heating, installation directly on the circuit board can make a difference of several Â° C (Kelvin) under certain circumstances!



R1 is optional for the detection of whether a sensor is connected or not; this is not necessary with permanent wiring.

Method of calibration with a temperature value

You can carry out a calibration with a temperature value yourself with a suitable temperature measuring device.

1. Use a temperature measuring device that is as accurate as possible to measure the temperature that the connected temperature sensor is

exposed to; ideally, both sensors are thermally coupled.
2. Select Show temperature in the menu and press the + button for longer than a second, the currently measured temperature is displayed.
3. Set the temperature from the precise temperature measuring device and wait briefly until the display jumps back.
4. The correct temperature should now appear on the display. If this is not the case, repeat the process.

Procedure for calibration with an offset value

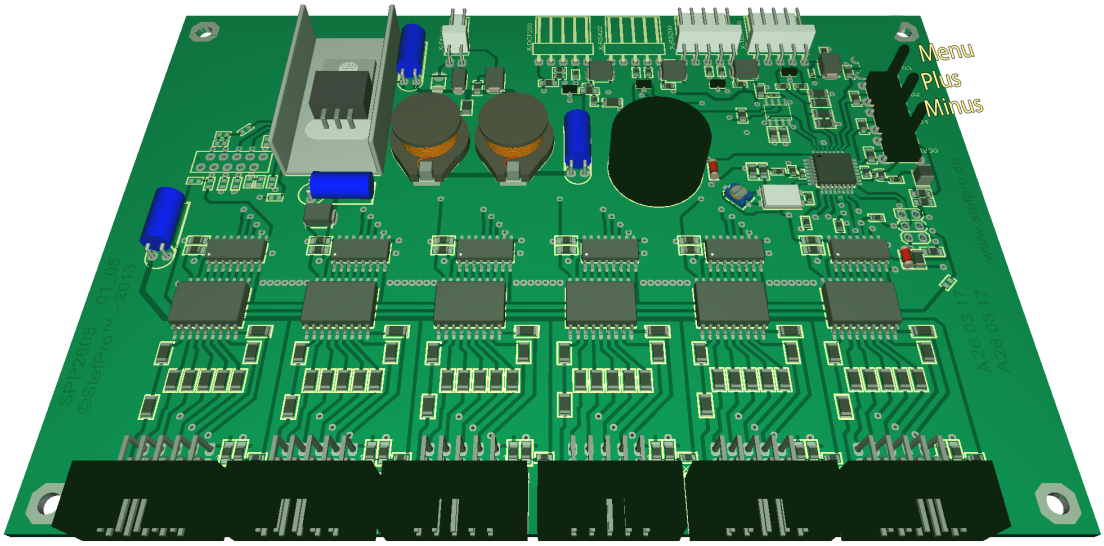
The calibration with offset value is intended if you buy a sensor with a previously measured offset value.

1. Select Display temperature in the menu and press the button for longer than one second, the current offset value is displayed.
2. Set the supplied offset value and wait briefly until the display jumps back.
3. The correct temperature should now appear on the display. If this is not the case, please contact us.

The calibration only refers to the offset, the linearity cannot be changed!

Button description

Overview of buttons



Button functions

Button functions

Menu	Opens the menu, next setting
Plus or +	Function key, usually +, On or jump into and exit a submenu
Minus or -	Function key, in general - or off

To open the menu you have to press the menu or StartStop button for a long time.Use the menu button to navigate forward.

General key functions

- A submenu is always opened with the "Plus" or "+" key and with menu display "... E" it can be exited again with "Plus" or "+".
- For numerical properties, the number is increased with the "Plus" or "+" key and decreased with the "Minus" or "-" key.
- If it is an On / Off property, then "Plus" or "+" sets On and "Minus" or "-" sets Off.
- With lists, the value is changed according to the order with the "Plus" or "+" button, with "Minus" or "-" this happens in the opposite way.
- In special cases, this is described in detail next to the images.

Menu+	Opens the menu, next setting
Menu-	Opens the menu, previus setting
Plus or +	Function key, usually +, On or jump into and exit a submenu
Minus or -	Function key, in general - or off

To open the menu you have to press one the menu buttons.Use the menu+ button to navigate forward and the menu- button to navigate backward.

General key functions

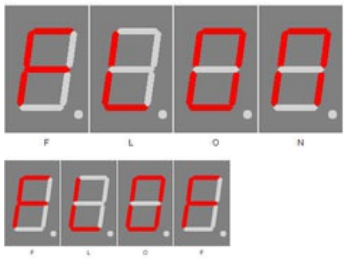
- A submenu is always opened with the "Plus" or "+" key and with menu display "... E" it can be exited again with "Plus" or "+".
- For numerical properties, the number is increased with the "Plus" or "+" key and decreased with the "Minus" or "-" key.
- If it is an On / Off property, then "Plus" or "+" sets On and "Minus" or "-" sets Off.
- With lists, the value is changed according to the order with the "Plus" or "+" button, with "Minus" or "-" this happens in the opposite way.
- In special cases, this is described in detail next to the images.

Menu

Level 1	Level 2
Normal⇓	
Show Temperature channel 0⇓	
Show Temperature channel 1⇓	
Display mode⇓	
Change speed display⇓	
Brightness⇓	Brightness menu ➞Brightness max ➞Brightness min ➞Brightness automatically ➞Brightness speed ➞Brightness factor ➞Brightness offset ➞Exit brightness settings ↻
Info section⇓	
IC number⇓	
Firmware version⇓	

⇓: Next step in main menu. ➞: Next step in sub menu. ↻: The submenu starts again.

Normal

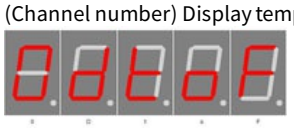


Normal mode, outside of the menu.

The - button Switches the display to 100% (flashlight).

Show Temperature channel 0

(Channel number) Display temperature on

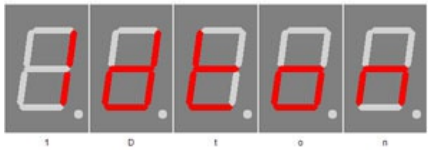


(Channel number) Display temperature off

Enables the temperature display. Plus (+) enables the temperature display and minus (-) disables it.

Long press + activates the calibration via temperature input, long press - activates the calibration via offset value. You can find more information in the chapter "Temperature sensor" - "Method of calibration ...".

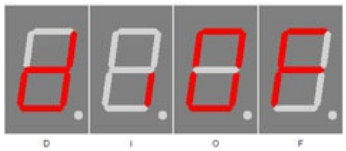
Show Temperature channel 1

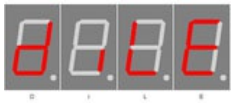


Enables the temperature display. Plus (+) enables the temperature display and minus (-) disables it.

Long press + activates the calibration via temperature input, long press - activates the calibration via offset value. You can find more information in the chapter "Temperature sensor" - "Method of calibration ...".

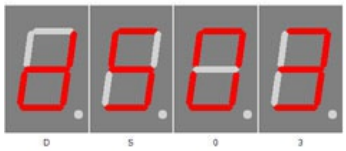
Display mode





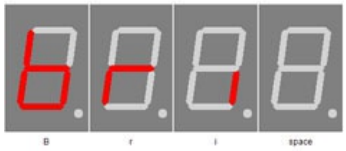
The mode for the channel display can be set with the plus (+) and minus (-) buttons:OF: No channel display
LE: One LED (one segment A = 0 or B = 1 of display 5) is used.
01: The display 5 shows 0 or 1 for the channel.
AI: The display 5 shows A or I for the channel. A = channel 0 and I = channel 1.
oi: The display 5 shows O or I for the channel. o = channel 0 and i = channel 1.

Change speed display



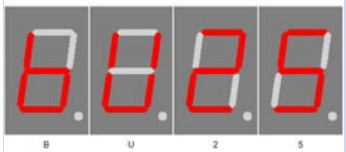
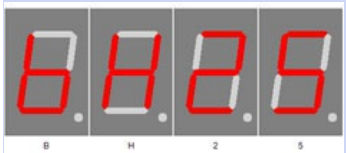
The change speed can be set in seconds with the plus (+) and minus (-) buttons, the range is 1 to 10 seconds.

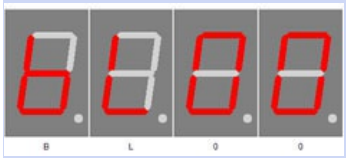
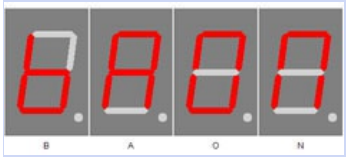
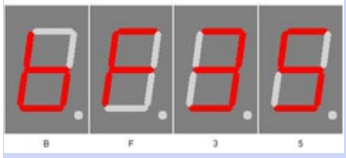
Brightness



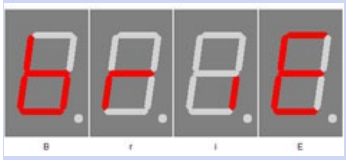
With plus (+) you enter the sub-menu brightness.

Brightness

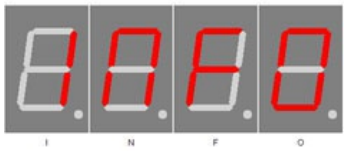
Brightness menu  Brightness	Sets the brightness of the menu.The number can be between 10 and 25, with 10 being the darkest menu and 25 the lightest.
Brightness max  Brightness high	In this menu item, the maximum brightness plus (+) und minus (-) of the display can be adjusted. This is also used when auto brightness is disabled. The number can be between 0 and 25, with 0 being the darkest and 25 the lightest.

Brightness min  Brightness low	In this menu item, the minimum display brightness can be adjusted with plus (+) und minus (-). The number can be between 0 and 25, with 0 being the darkest and 25 the lightest.
Brightness automatically  Brightness automatically on  Brightness automatically off	This allows to turn on with plus (+) and off with minus (-) the auto brightness.
Brightness speed  Brightness speed	Use plus (+) and minus (-) to set the speed of auto brightness. The number can be between 0 and 20 and delays the brightness calculation by approx. 100 ms.With the setting 20, the brightness is therefore recalculated every 2 seconds.The maximum value may differ depending on the firmware.
Brightness factor  Brightness factor	Use plus (+) and minus (-) to set the calculation factor for auto brightness. The number can be 1-99. There is no unit for this, as it cannot be defined due to component tolerances.
Brightness offset  Brightness offset  Brightness offset -99  Brightness offset +99	Use plus (+) and minus (-) to set the calculation offset for auto brightness. The number can between -99 and 99. There is no unit for this, as it cannot be defined due to component tolerances.

Exit brightness settings	With plus (+) you exit the sub-menu brightness.

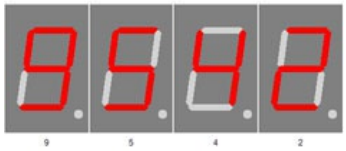


Info section



This indicates the start the information area

IC number



Chip number

IC / device type

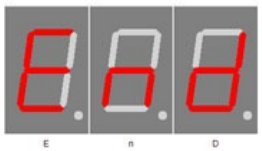
Firmware version

Firmware version

Firmware version

Example, it might be something else at this point.

Menu end



End

End of the menu, hide automatically after 2 seconds.

Attachment

Bootloader handling

Start the IC/module/device in bootloader mode

1. Switch off the IC/module/device.
2. Connect the UART adapter (USB → 3.3 volts or 5 volts UART or RS232 → 3.3 volts or 5 volts UART).
   The signales for the bootloader can be find on connector X-RS UART."RXD" → UART adapter TXD and "TXD" → UART adapter RXD.
3. Press the button S1, power up the IC/module/device with voltage and do not release this button until you hear a short BEEP. The display is off.
4. Now you can connect to the firmware upload tool.

WARNING

Wrong UART level
If an incorrect voltage level (for example directly RS232, ± 12 Volt) is used, the UART adapter or the IC/module/device can be damaged or destroyed. In the worst case, overheating and fire may occur!

NOTICE

Defect firmware
Defect firmware can be detected as follows: Every second a short BEEP.

Use the Firmware Upload Tool to upload an update

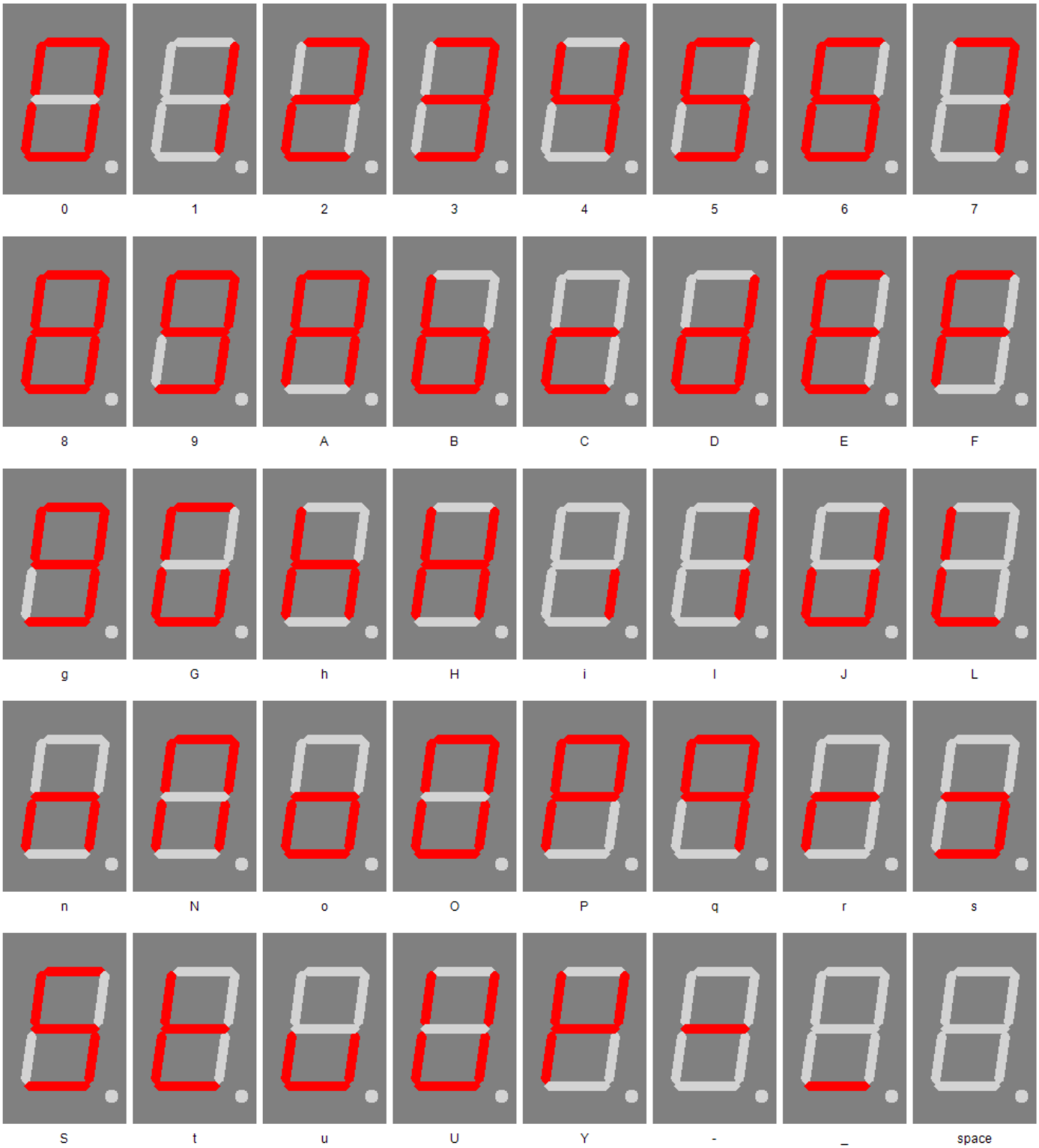
1. Download the latest upload tool from www.stefpro.biz: SP Firmware UP
2. Start the tool
3. Select the COM port.
4. Press the "Load" button and select a firmware which you have previously downloaded from SP Firmware UP
5. Now press the "Connect" button, the data from the IC / Module / device will be read and the compatibility of the new firmware with the IC / module / device will be checked
6. If an upload is possible, you can now press the "Upload Firmware" button. The upload starts and should not be interrupted.

NOTICE

Firmware upload interruption
If the firmware upload is interrupted or uploaded an inappropriate firmware, so there is a broken firmware, the IC can be operated only in bootloader mode.

7 segment characters

The symbolism of each character:



Change log

Safety

20.03.2017 - 1.0.3 - ADD
Add ESD note

Temperature sensor

22.03.2021 - 2.0.1 - ADD
Add add temperatur sensor and calibration description

Liability, warranty and copyright notice

Definitions

- "Module": A PCB which is delivered without housing and is intended for installation.
- "Manufacturer of the whole device": The manufacturer of the whole device, the natural or legal person is mounted a device which can be made to function without special knowledge. E.G. Simple connection to the network via a euro, safety plug or by connecting to a power supply.

Liability

- Although the information contained in this document has been checked very carefully for accuracy and completeness, for errors and omissions can not be held liable. StefPro reserves the right to any time change any portion of the described hardware and software features.
- StefPro provides only specific "module" which is intended for installation. The "Manufacturer of the whole device" obliges to compliance to the relevant valided VDE, CE and EMC regulations. StefPro has verifies compliance with the requirements for this module random.Because the installation is not performed by StefPro, must additional inspection after installation of the modules by the "Manufacturer of the whole device".
- There is no liability for damages incurred directly by or in the application of the "module", as well as for damage caused by chemical or electrochemical effects of water or generally from abnormal environmental conditions.
- "Modules" by StefPro may not be used in critical equipment. At disregard exclusively the responsibility of "Manufacturer of the whole device."

  Theseinclude:

  - medical devices for implanting or life obtained.
  - Critical equipment for space, aerospace and traffic.
  - Other important life components or systems, where an error is fatal.
- All devices developed with a "Modules" by StefPro must be the responsibility of the "Manufacturer of the whole device" sufficiently tested to detect any defects.

Safety Notes

- Since the built module is operated with an electrical voltage, the valid VDE regulations are complied with.
- Components and modules do not belong in the hands of children!
- The module complies with the requirements of protection class III.
- The "module" may NOT directly to line voltage (or voltage > maximum operating voltage) in any case! It can be fatal!
  - Whenever it is that safe operation is no longer possible, the module / device must be taken out of service and secured against inadvertent operation. This assumption is justified,
  - when the module / device has visible damage,
  - when the module / device has loose parts
  - when the module / device no longer works
  - after prolonged storage under unfavorable conditions (eg outdoors or in moist environments)

Watch for correct voltage and connection of the â€œmoduleâ€ Voltage and / or connection mistakes are beyond our control. Thus we can not assume any liability for damages arising out of it.

Intended operation

- The used electrical parts and components are designed for a temperature between 0 °C ... +45 °C, so the device may only be operated and stored in this temperature range. It is therefore intended for use within a building, which corresponds to the specified environmental conditions. During transport, the temperature may be between -10 °C ... + 50 °C.
- If condensation has formed during transport or storage, the modules must be acclimatized for approx. 2 hours before commissioning.
- It must not be operated in an increased dust, high humidity, explosion risk or aggressive chemical exposure.
- Ensure proper operation and connection. Operating and/or connection errors are outside our area. Unfortunately, we can not accept any liability for damages resulting of this.
- The improper operation of this module may result in damage of this module, personal injury or property damage.
- The safety instructions must be observed!
- The manufacturer is not responsible for all personal injury and property damage caused by improper operation.

Warranty

- StefPro warranty only for the Modules and their firmware. The warranty is exclusively limited for the replacement of the IC within the warranty period for obvious defects in the hardware, and programming error.
- Warranty does not extend the warranty period or starts a new period again.

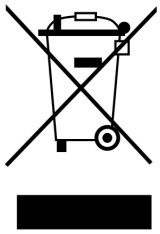
- Additional or deviating claims are excluded, especially claims for damages arising out of the product for damage. This will not affect claims based on inalienable rules under the product liability law.

Copyrightnotice

The circuitry and firmware to the module from StefPro is protected by copyright. Unauthorized reproduction or distribution of Modules with this program or any portion of it. This is pursued bothcriminal and civil law, and may result in severe penalties and compensation for damages.

Disposal information

Do not dispose devices in household garbage!
This modules or devices comply with the EU directive on electronic and electrical equipment (WEEE regulation)and therefore may not be disposed of with household waste. Dispose of the device over your local collection center for electronic equipment!



WEEE-Reg.-Nr.:

DE 58929072 (StefPro UG (haftungsbeschränkt) & Co. KG)

DE 78089358 (StefPro Einzellunternehmen bis zum 01.01.2015)

Impress

StefPro™ UG (haftungsbeschränkt) & Co. KG
- Softwareentwicklung für Prozessoren

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