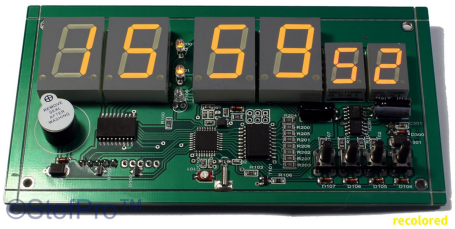
SPO2133.04

Six digit dcf clock

with 4x20mm + 2x14mm yellow 7 segment LED displays and temperature

Datasheet

Version: Firmware 1.72-131



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Data Sheet Version 1.0.4 - Valid from 22.03.2017.

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 IC is designed for driving small to middle 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 can analyze the DCF77 signal, which is received by a receiver and demodulated. Thereceived time and date can output directly to a 7-segment displays.

The DCF77 signal is a low frequency radio signal which transferred the time and date. It will besent in Frankfurt am Main, derived of the local atomic clock and sent with the carrier frequencyof 77.5 kHz. Therefore, these watches are also known as radio clock.

The input for the DCF77 antenna can now automatically detect whether a pullup resistor isrequired and whether the input has to be inverted.

Even a simple alarm function is implemented.

This IC has the new **OnChip FullMultiPlex Display technology**. With this technology also small very weak displays can work and the displays are generally brighter.

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 the **temperature** will be displayed alternately with the time and or date.

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 - 12 volts DC
- Current: 200mA
- Power: approximately 1.8 W (at 9 volts)
- Volume level of the buzzer: approx. 85 to 90 DB

Construction description

Installation of the module (Dimensions)

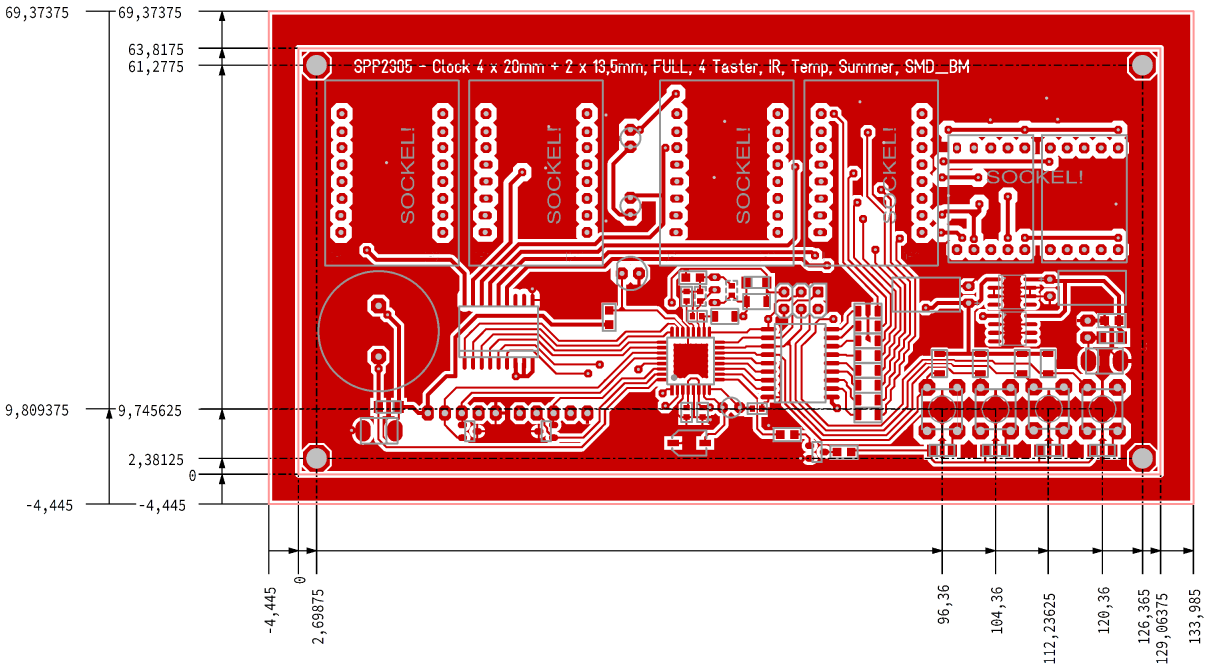


Figure 1:Installation (Dimensions) description for module SPP2305.4

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

Connectors

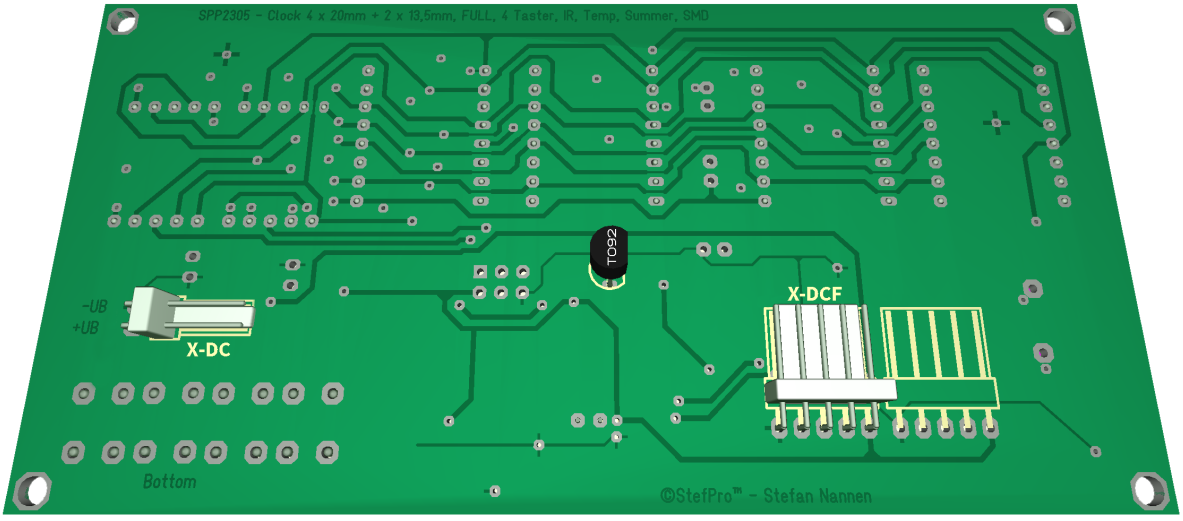


Figure 2:Connector description for module SPP2305.4

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 - 12 volts DC, 200mA

X-DCF : DCF input, DCF PowerSave output: Print connector 5 pin

Pin	Name	Direction	Function	Maximum
1	GND	Power		
2	N.C.		Do not connect	VCC
3	DCF in	Digital input	DCF signal input	VCC
4	DCF ps	Digital Output	DCF PowerSave output	VCC
5	VCC	Power		5 volts DC DC, 30mA

Signal description

V+

Operating voltage

VCC

Operating voltage for external modules

GND

Ground

DCF ps

DCF Modules Enable pin, this pin enables the DCF modules when needed. Whether the pin is LOW or HIGH active can be set in the menu.

DCF in

Input for the DCF77 antenna. Inverting can be adjusted automatically or manually. Pull up resistor can be switched on in the menu.

Properties of the components

DCF module properties

- The module has to be able to work with an operating voltage of 5V (some modules have an operating voltage range of 1.2 to 15 volts, these are also usable)
- The output has to be able to drive a CMOS input with a input impedance of 10kO
- For DCF modules with open collector (open collector) or open drain output the input detected automatically by default whether a pull-up resistor is required. In menu a pull-up resistor can be connected or disconnected permanently.
- Polarity of the output:
  - The output has to be non inverting, the high state has to be 100ms or 200ms
  - The output has to be inverting, the low state has to be 100ms or 200ms
  - The receiving LED should at good reception signal flash every second for 100 ms and 200 ms. Does the receiving LED goes off every second for 100 ms and 200 ms, then the polarity is wrong. Unfortunately, you then connected a wrong module, this can't be analyzed with the microcontroller.
  - Whether the output is non inverting or inverting, is detected automatically by default or can be set in the menu.
  - The receiving LED should at good reception signal flash every second for 100 ms and 200 ms. Does the receiving LED goes off every second for 100 ms and 200 ms, then the polarity is wrong. To correct this, you has to be invert the setting for the inverting DCF input pin in the menu. (Instead of on → off → on or off)
- The DCF module can have a power on / off pin. Then the DCF module is automatically switched off when the DCF signals from the microcontroller are not analyzed. In the menu can be set if the DCF module is with low or high on.

Tested modules

Module	GND	VCC	DCF input	PowerSave output	Comment
Conrad DCF Modul	1 (GND)	2 (Betriebs...)	3 (DCF Ausgang)	-	
ELV DCF Modul	3 (Masse)	1 (+ UB)	2 (Signal-Ausgang)	-	
Pollin DCF Modul	GND	VCC	DATA	PON	Caution An additional circuit is required for an operating voltage of more than 3.3V!

Our standard color coding for DCF signals

- GND: black
- VCC: rot
- DCF input: green
- PowerSave output: white (is not supported by each DCF receive module)

WARNING
Please check the pin assignments! It is not in our hands whether the manufacturers of the DCF receive modules change the pin assignments at a later date.

Installation the DCF clock

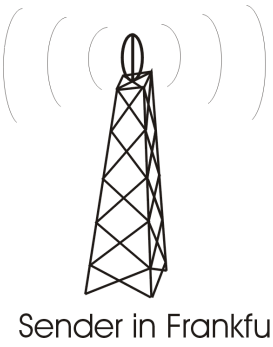
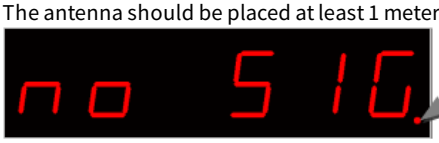


Figure 1: Align the DCF antenna

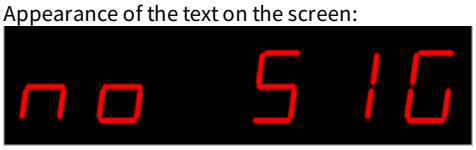
The external antenna receives the DCF77 signal and should be directed to Frankfurt, as shown in Figure 1.
The antenna should be placed at least 1 meter away from a monitor, computer or other disturbing electronic devices .



During installation, the receiving LED can be used as an orientation to the quality of reception. The LED should flash at intervals of one second.If the antenna is properly aligned and the signal is strong enough, the display changes of "no signal" (No impeccable DCF77 signal) in "SEArCH" (search for the 59th second). Was the 59th second found so will the display shows "rEAd60" (read the DCF time) henceforth. It still takes 60 seconds to display the correct time.If the clock is not synchronized to the DCF time, the receiver LED flashes DCF work cycle (power reserve is in operation), if the LED is enabled in the menu.Is the display not changed to "SEArCH", the antenna is probably disturbed by a device or the antenna is too close to the display.Because the DCF antenna is so sensitive that it can disturb by the display in the near field, there is the possibility to reduce the brightness of the display during the synchronization, or to deactivate the display. This problem have all other DCF clocks with multiplexed LEDs displays also.By a darker display the DCF antenna can be mounted significantly closer to the display.

Synchronize with active display

This mode is active when in menu under "receive brightness" the brightness is set > 0.
Appearance of the text on the screen:



"no Sig" no signal.

"SEArCH" Search the fifty-ninth second.

"rEAdxx" read the dcf time.

Synchronize with deactivated display

This mode is active when in menu under "receive brightness" the brightness is set to 0.
When synchronizing with disabled display, only one decimal point for orientation appears.

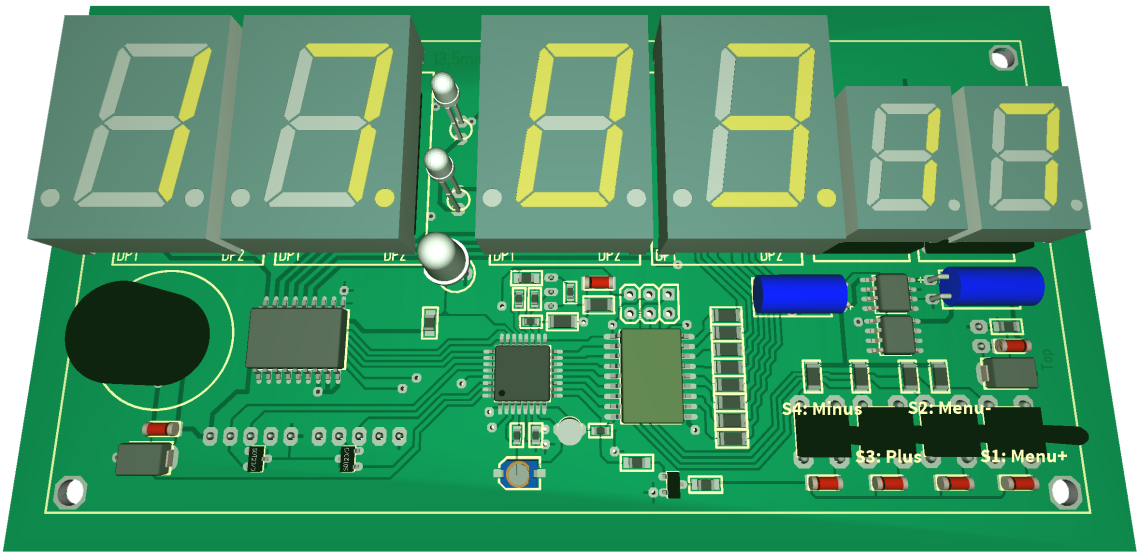

"no Sig" no signal.

"SEArCH" Search the fifty-ninth second.

"rEAdxx" read the dcf time.

Button description

Overview of buttons

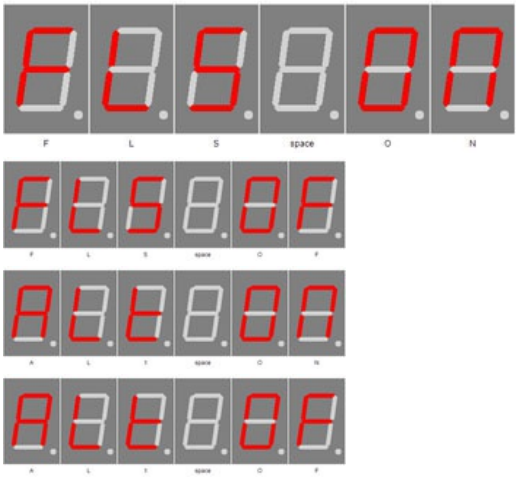


Menu

Level 1	Level 2
Normal⇓	
Display mode of clock⇓	
Show Temperature⇓	
Alarm⇓	Alarm enable ➞Alarm time hour ➞Alarm time minute ➞Alarm snooze time ➞Alarm sound wait time ➞Alarm maximum time ➞Alarm exit↻
Brightness⇓	Brightness menu ➞Brightness max ➞Brightness min ➞Brightness automatically ➞Brightness speed ➞Brightness factor ➞Brightness offset ➞Exit brightness settings ↻
DCF⇓	Receiving brightness ➞Receiving brightness ➞Receive state display ➞DCF input pull up ➞DCF input invert ➞Power save pin invert ➞DCF sensitivity ➞DCF exit↻
Clock Settings⇓	Set hour ➞Set minute ➞Set year ➞Set month ➞Set day ➞ ➞Set time ➞Exit clock settings ↻
Info section⇓	
IC number⇓	
Firmware version⇓	

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

Normal

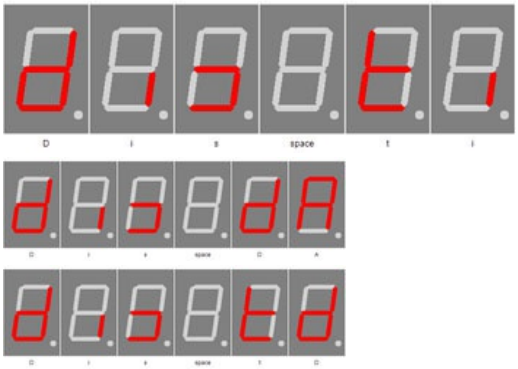


Normal mode, outside of the menu.

Here the + button has the function of the alarm temporary switch on or off.

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

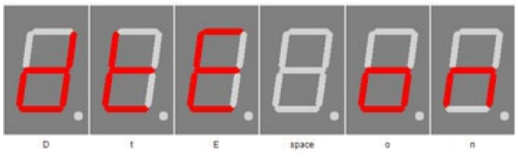
Display mode of clock



Sets the mode how to display time and date.

- ti: Shows only the time.
- dA: Shows only date.
- td: Shows time and date alternately.

Show Temperature



Enables the temperature display.

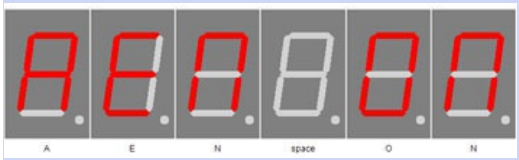
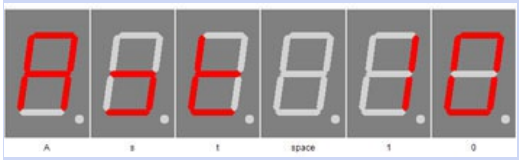
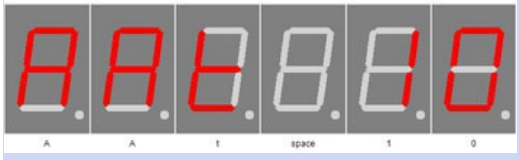
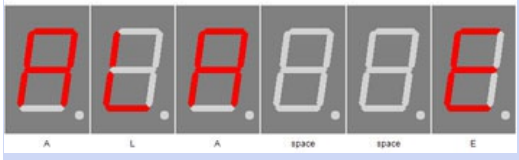
Display temperature on

Display temperature off

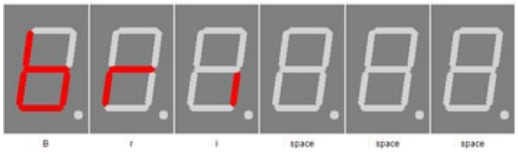
Alarm

With + you enter the sub-menu Alarm.

ALARM

Alarm enable  ALARM ON  ALARM OFF	Enables the alarm.
Alarm time hour 	Sets the hour for alarm.The number can be 0-23
Alarm time minute 	Sets the minutes for alarm.The number can be 0-59
Alarm snooze time 	Sets the minutes for the snooze function.The number can be 1-30 **NOTICE** If "alarm maximum time" is shorter than alarm snooze time, the snooze function is disabled!
Alarm sound wait time  Alarm sound delay	Sets the maximum time in minutes for the alarm.The number can be 0 - 10. **NOTICE** If "Alarm sound delay" greater selected as maximum alarm time, then the display is only set to 100% brightness! No buzzer alarm!
Alarm maximum time 	Sets the maximum time in minutes for the alarm.The number can be 2-60.
Alarm exit 	With + you exit the sub-menu alarm.

Brightness



Brightness

With + you enter the sub-menu brightness.

Brightness menu

Brightness

Sets the brightness of the menu.The number can be 10-25

Brightness max

Brightness high

In this menu item, the maximum brightness of the display can be adjusted.

This is also used when auto brightness is disabled.

The number can be 0-25

Brightness min

Brightness low

In this menu item, the minimum display brightness can be adjusted.

The number can be 0-25

Brightness automatically

Brightness automatically on


Brightness automatically off

This allows to turn on and off auto brightness.

Brightness speed

Brightness speed

This sets the speed of auto brightness.

The number can be 0-10

Brightness factor

Brightness factor

This sets the calculation factor for auto brightness.

The number can be 1-99

Brightness offset

Brightness offset

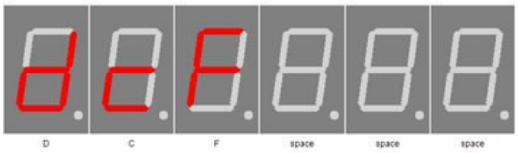
This sets the calculation offset for auto brightness.

The number can be -99 - 99

Exit brightness settings

With + you exit the sub-menu brightness.

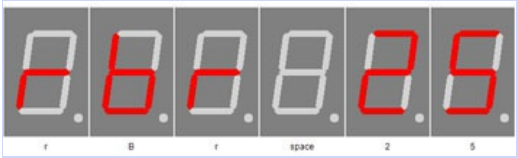
DCF



DCF

With + you enter the sub-menu DCF.

Receiving brightness



Receiving brightness

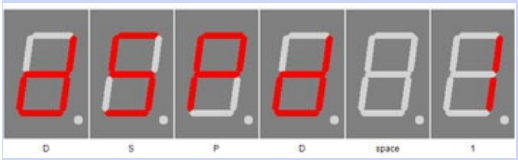
Sets the brightness during the DCF receiving. If 0, the display is turned off and the status of the synchronization is shown by decimal points.The number can be 0-25.

Receiving brightness

DCF synchronize hour

Sets the hour in which the DCF clock will synchronize.The number can be 0-23.

Receive state display

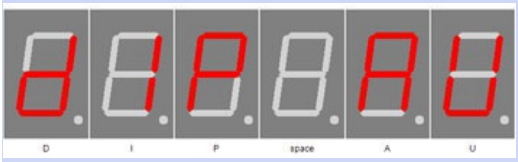


DCF status decimal point display

Sets the mode for the receive LED, which shows the received signal.The number can be 0-2.

- 0: Only until the clock has been synchronized.
- 1: Shows the received signal when the clock is not synchronized with the DCF77 signal.
- 2: Shows the received signal permanently on the receiver LED.

DCF input pull up



DCF input pull up auto

DCF input pull up on

DCF input pull up off

DCF77 input pin with pullup

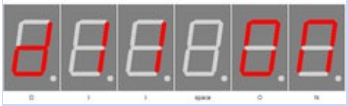
- AU: Pull Up is automatically (default).
  AU is activated by pressing the + button.
- ON: Enables the pull-up resistor
- OFF: Disables the pull-up resistor
  ON and OFF is activated and toggled by the - button.

- Conrad DCF module = ON
- ELV DCF module = ON
- Pollin DCF module (3.3 V) = OFF

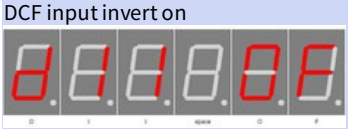
No guarantee for correctness of the information and changes of the manufacturer.

DCF input invert

DCF input invert auto



DCF input invert on



DCF input invert off

DCF77 inverting the input pin

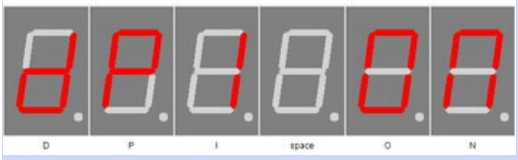
- AU: input is automatically inverted or not (default).
  AU is activated by pressing the + button.
- ON: Input inverts
- OFF: no input inverted*ON and OFF is activated and toggled by the - button.*

- Conrad DCF module = for PIN3 ON, PIN4 OFF
- ELV DCF module = ON
- Pollin DCF module (3.3 V) = OFF

No guarantee for correctness of the information and changes of the manufacturer.

If the receive LED is off every second, the setting must be inverted.

Power save pin invert



DCF powersave invert on

DCF powersave invert off

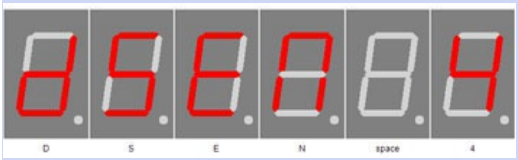
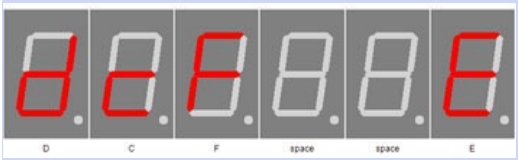
Inverts DCF77 power On / Off output

- ON: Power ON / OFF output is inverted (module ON at GND)
- OFF: power on / off output is not inverted. (module ON at VCC)

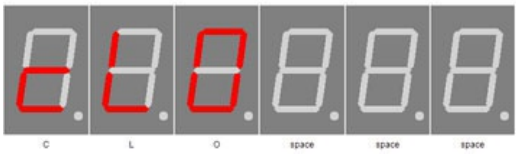
- Conrad DCF module = No power on / off input pin available
- ELV DCF module = No power on / off input pin available
- Pollin DCF module (3.3 V) = ON

No guarantee for correctness of the information and changes of the manufacturer.

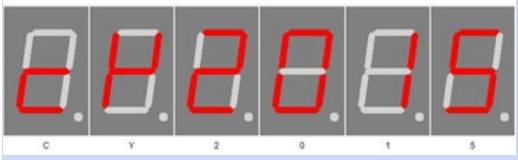
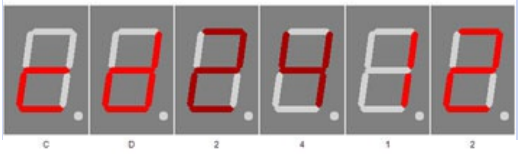
Read the instructions of the receiver module for the power on / off pin of the DCF module to set this setting correctly. Many modules do not have this pin, then this setting can be ignored.

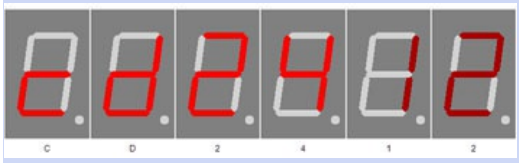
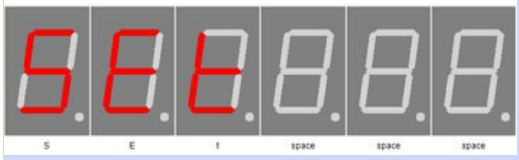
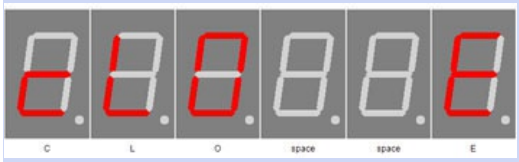
DCF sensitivity  DCF sensitivity	Sets the DCF Sensitivity. 1 has a very low tolerance and 6 has the highest tolerance for reception. The Sensitivity should be set as small as possible to avoid incorrect receiving.The number can be 1-6
DCF exit  DCF Exit	With + you exit the sub-menu DCF

Clock Settings

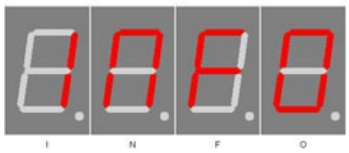


With + you enter the sub-menu clock.

Set hour 	Set the hour. The number can be 0-23.
Set minute 	Set the minute. The number can be 0-59.
Set year 	Sets the year. The number can be 2000-2099.
Set month 	Sets the month. The number can be 1-12.

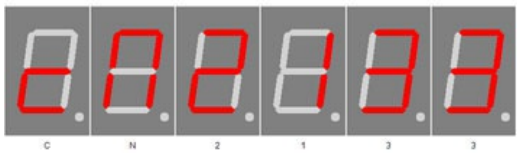
Set day  	Set the day, limit by month. The number can be 1- 28, 29, 30, 31.
	MISSING: MENU_CODE_L2_DATECLOCK_GET_WDATE
Set time  	Sets the time, while looking for DCF time, otherwise the time will be provided directly.
Exit clock settings  	With + you exit the sub-menu clock. Until here the clock, without DCF synchronization, will be taken and used until the next scheduled synchronization.

Info section



This indicates the start the information area

IC number



Chip number

IC / device type

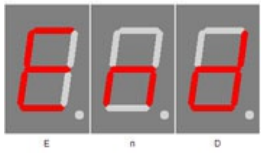
Firmware version

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).
   "DCF in" → UART adapter TXD and "DCF ps" → 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.]]

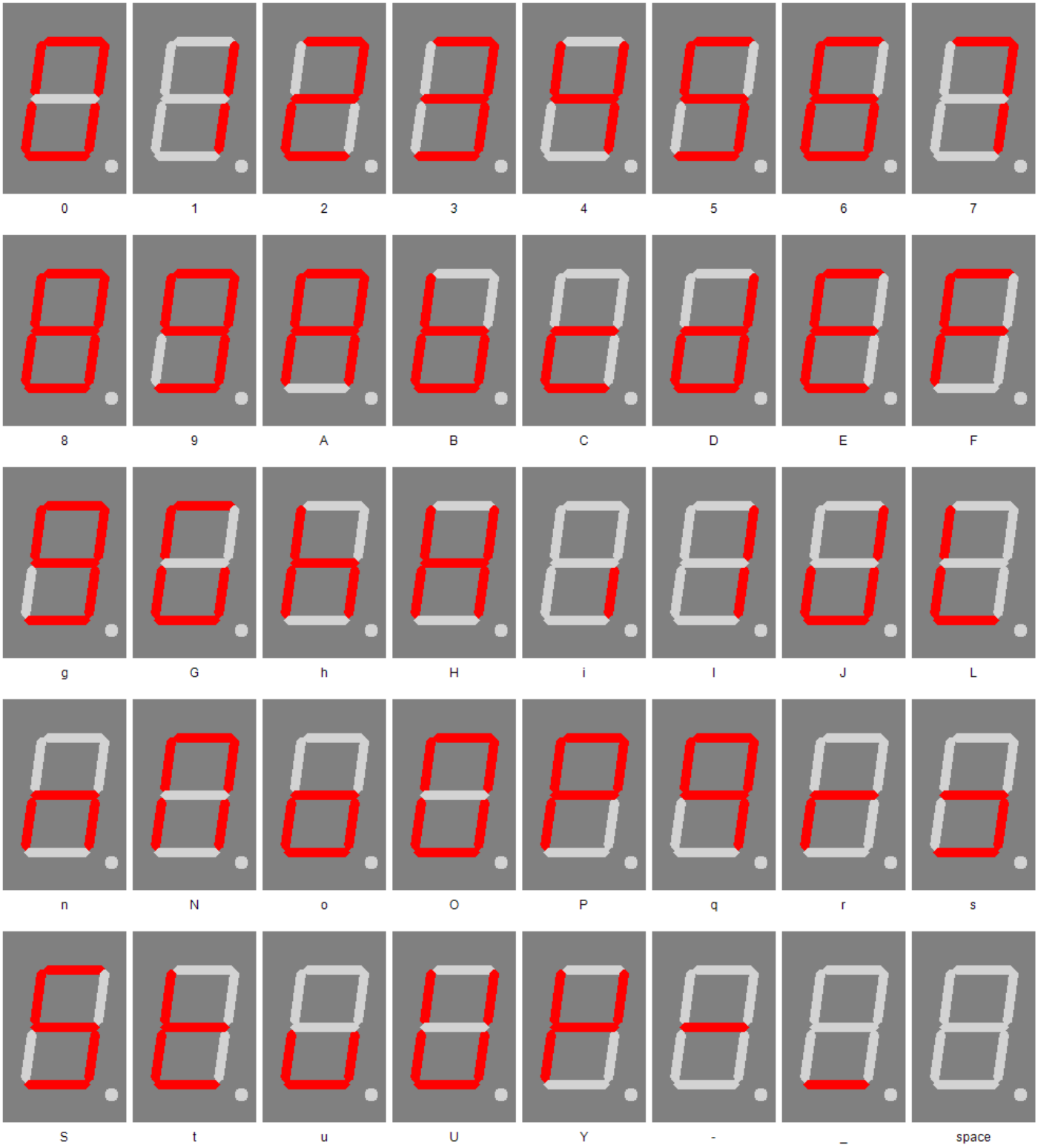
Use the Firmware Upload Tool to upload an update

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

DCF module properties

21.11.2016 - 1.0.1 - ADD
Add list of tested modules
20.03.2017 - 1.0.3 - ADD
Update list of tested modules, add standard pin assingment

Set day

23.04.2017 - 1.0.4 - ERROR
Bugfix wrong title, this sets the day not the month.

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. 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

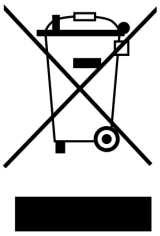
- StefPro warranty only for the Modules and their firmware. The warranty is exclusively limited for the replacement of the IC within the warranty period for obvious defects in the hardware, and programming error.

- 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

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.:

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Impress

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- Softwareentwicklung für Prozessoren

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