SPM2141P

Six digit dcf clock

for big displays, with temperature display

Datasheet

Version: Firmware 1.79-145

StefPro™
Software development for processors

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Data Sheet Version 2.0.0 - Valid from 01.01.2021.

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Safety

Follow the manual

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

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

Intended Use
The IC 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 IC:

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

Wear during the initial commissioning eye protection.
-
The pins of a IC are very pointed and sharp! Therefore, this may cause in sores in case of incorrect handling.
-
Use always passing a ESD bracelet to avoid electric charges! The IC can be damaged if handling without an earthing tape and housing!

Modifications of the example circuit
The successfully built circuit 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

Product overview

Here you will find an overview of the product family of the SPM21xx and SPM22xx IC for 7 segment LED displays.

SPM2 x x x

- 1 Simple alarm function, the whole week is the same alarm time
- 2 Extended alarm function, the alarm time can be set separately on each day
  - 0 One LED per segment in display, low LED current = dark
  - 2 One LED per segment in display, average LED current = slightly dark
  - 3 One LED per segment in display, higher LED current = bright
  - 4 One to several LED's per segment in display, highest possible LED current = very bright
  - 9 One to several LED's per segment in display, higher LED current = very bright
    - 0 Without temperature display in alternation
    - 1 With temperature display in alternation

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 clock synchronizes itself automatically once a day. The hour of the synchronization can be set in the menu.

The time is displayed according to DIN 5008, which means a leading 0 at the hour. 8 a.m. looks like 08:00:00 and 8 p.m. 20:00:00

Due to the 6-digit display, the date is not shown according to DIN 5008. The 24 December 2020 looks on the display like 24.12.20.

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 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 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.

Alarm Function

The simple alarm clock function allows you to set one alarm time so that you are wake up every morning.

In the menu the alarm and the snooze time can be set. With the adjusted snooze time the alarm waits if the alarm is not stopped at a wake-up call, but the snooze function is activated. The maximumalarm time can be adjusted between 2 and 60 minutes.

The alarm can be activated and deactivated also outside the menu.If the wake-up call is active with S1 or S2 the alarm clock can be stopped and with S3 or S4 the snooze function will be activated.

⚠ NOTICE
Dissembled time Because the DCF clock daily synchronized with the current DCF time, it is possible that in worst cases, an incorrect time is read and therefore the wake-up call comes at a wrong time! Therefore, the time synchronization should eventually be placed in a time of day where it is possible to check the correct time before sleeping, if the alarm function is used.

Technical data

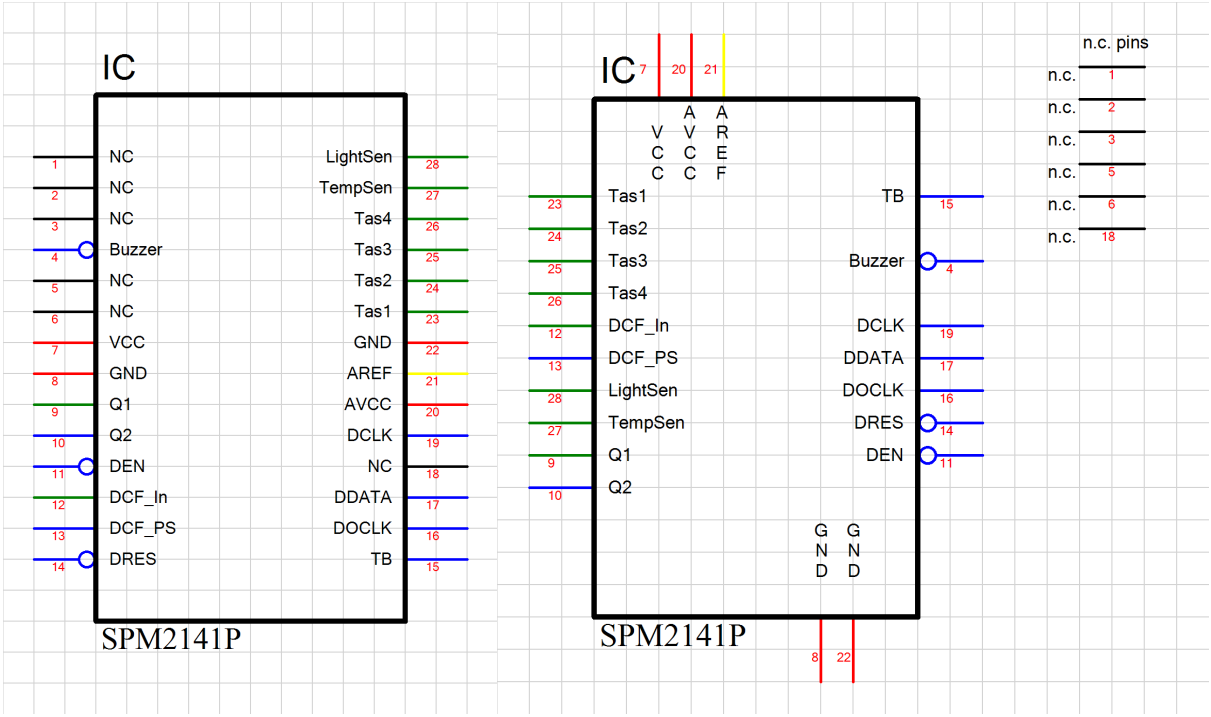
- Voltage (VCC): 3 V - 5 V
- Current: 20 mA (at 5 V)
- Power: approximately 100mW (at 5 volts)

- Number of Pins: 28
- Display Power: directly to the controller is the maximum LED current 40mA
- Clock frequency: 8MHz
- Accuracy of the timer: better uncalibrated [[ACCURACY_OF_TIME_UNCAL_EN]] %; calibrated better [[ACCURACY_OF_TIME_CAL_EN]] %
- 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.

- Other properties, refer to the datasheet for Atmel® ATMega8, ATMega88, ATMega168, ATMEGA168P, ATmega328P

Construction description



Pin assignment

Reset

Reset input to reset the microcontroller is normally not required.In case of higher EMC requirements a 100nF capacitor should be soldered to ground!

VCC

Operating voltage (3 V - 5 V)

AVCC

Analog operating voltage (VCC ± 0.3 V), there should be a coil with about 10µH connected between VCC and AVCC.

AREF

Internal analog reference voltage should be blocked with a 1 nF ceramic capacitor

GND

Ground

Q1, Q2

The connecting of the 8MHz quartz is shown in Figure 1

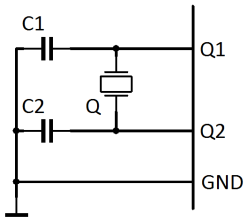


Figure 1: Connection of qaurtz

C1 and C2 are 20pF to 27pF ceramic capacitors (depending on the quartz) Q is an 8MHz quartz

N.C.

Do not connect, connect to no other signal!

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.

DDATA

The serial display data output, this must be connected to the serial data input of the first shift register.

DCLK

Output for the clock of the serial display data output, it must be connected to the clock input of all shift register (You may buffer this signal [1]).

DOCLK

Output for the data transfer of the shift register to the output buffer, it must be connected to the storage clock input of all shift registers (You may buffer this signal [1]).

$\overline{\text{DEN}}$

$\overline{\text{DEN}}$ is an output. This turns on the outputs of the output buffers and off. This is used for brightness control. $\overline{\text{DEN}}$ needs to be connected all the shift registers (You may buffer this signal [1]).

$\overline{\text{DRES}}$

$\overline{\text{DRES}}$ resets all the shift registers to a default value. This pin is not necessary, if the selected shift register hasn't this pin it can be used anyway. If $\overline{\text{DRES}}$ is used it must be connected to all shift register (You may buffer this signal [1]).

[1]If too many inputs are connected to this output signal, this signal will be distorted too much and therefore the display may fault. You will need to check the datasheet of the shift register for the input current.

Tas1, Tas2, Tas3, Tas4

Inputs for the keyboard.

Buzzer

On this connector a buzzer can be connected as an acoustic alarm optionial. The plus pole must be connected to VCC pin of the buzzer, the minus pin must connected with â€œSummerâ€.

LightSen

Analogue input for a light sensor.

TempSen

Analogue input for a temperature sensor.

TB

Tap to verify the accuracy of the time base, min. 0,999 99 kHz and max. 1.000 01 kHz, the larger is the different from the 1 kHz the less accurate the IC. Production pin.The quartz can be adapted by firmware, see menu item "Calibrate quartz" or by adapting the quartz capacitors.

Basic circuit

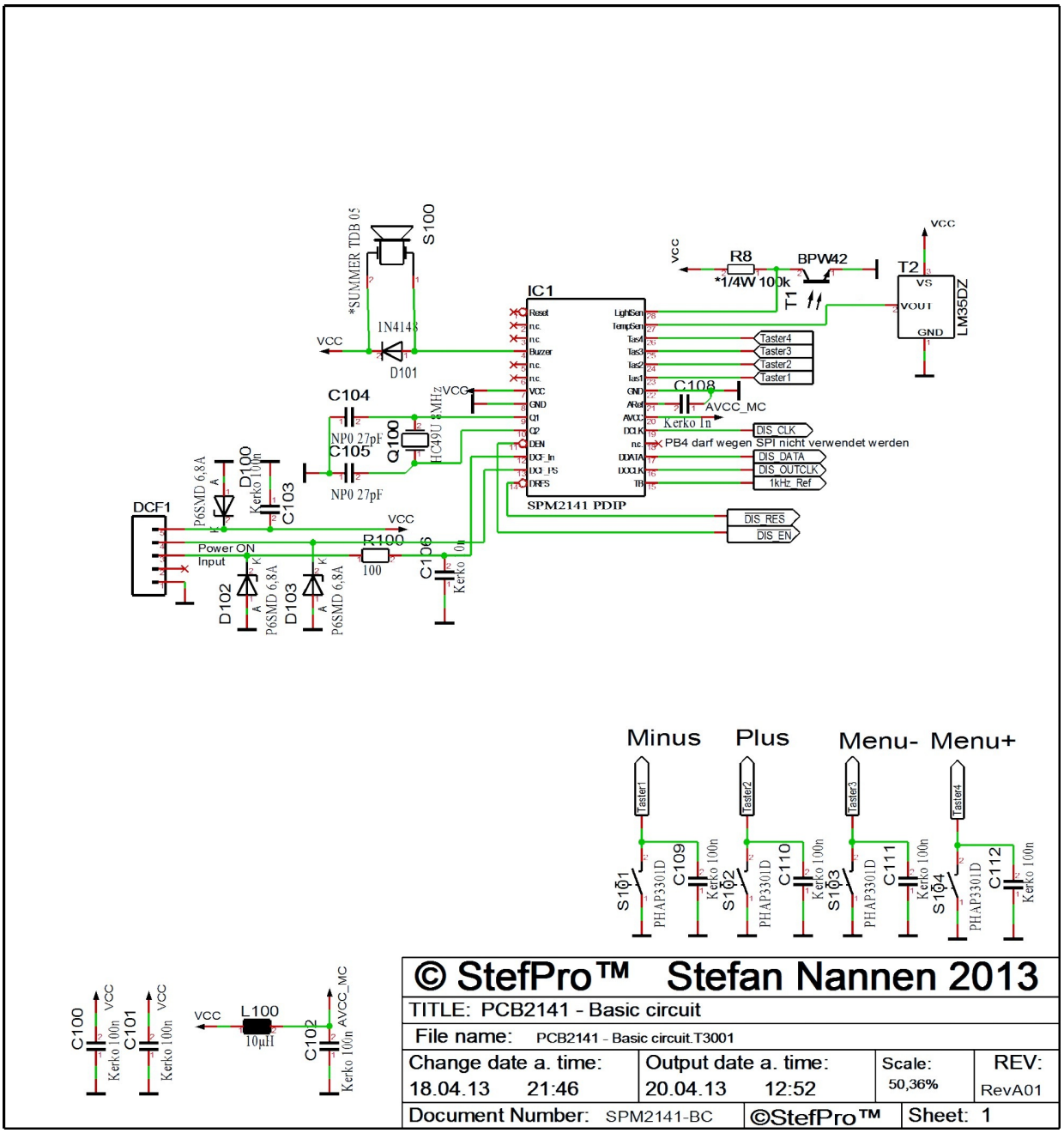


Figure 2: Basic circuit of SPM2141P part 1

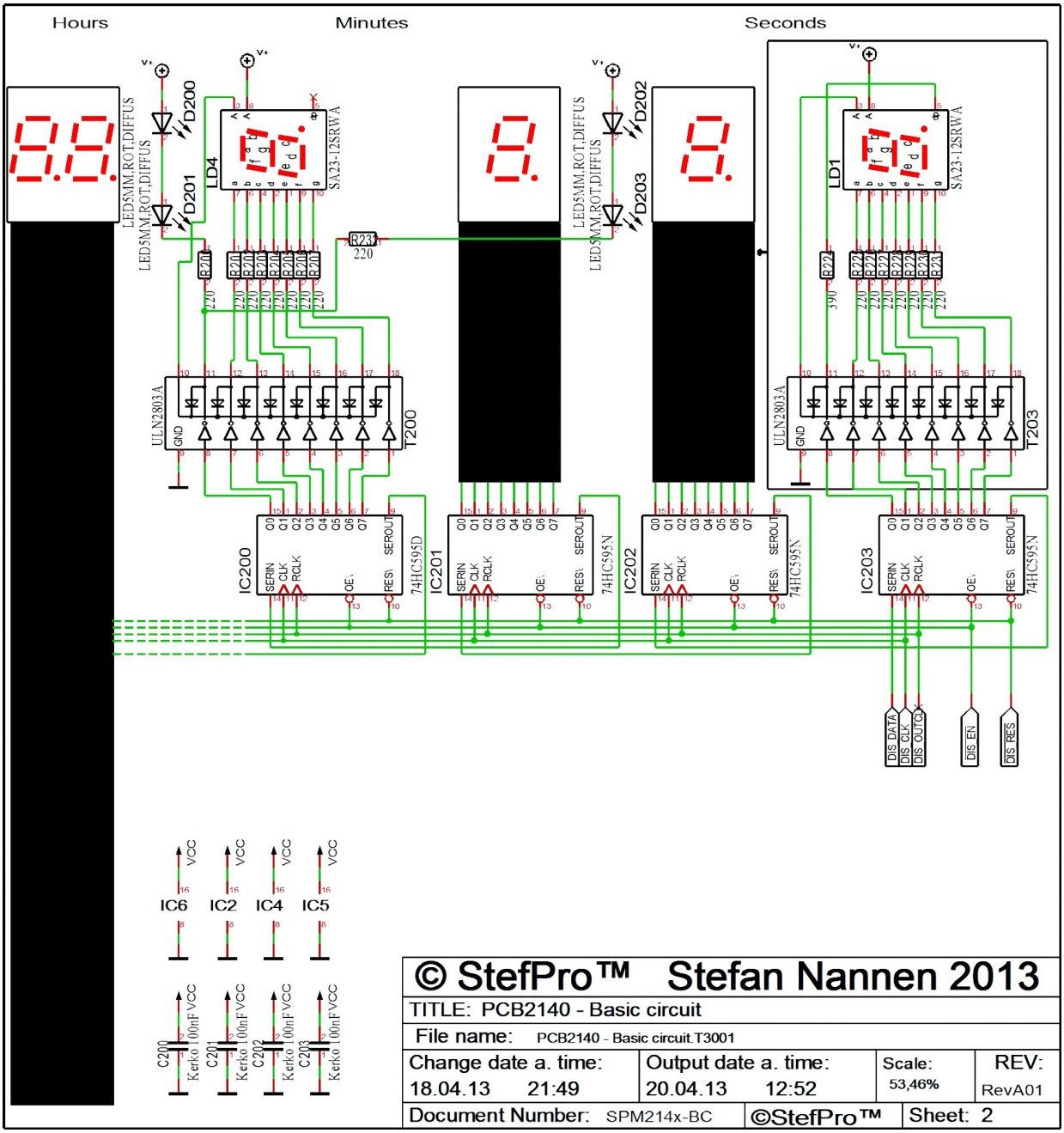


Figure 3: Basic circuit of SPM2141P part 2

NOTICE
Adaptation of the resistors from the circuit part 2 may be necessary.

Properties of the components

Shift register

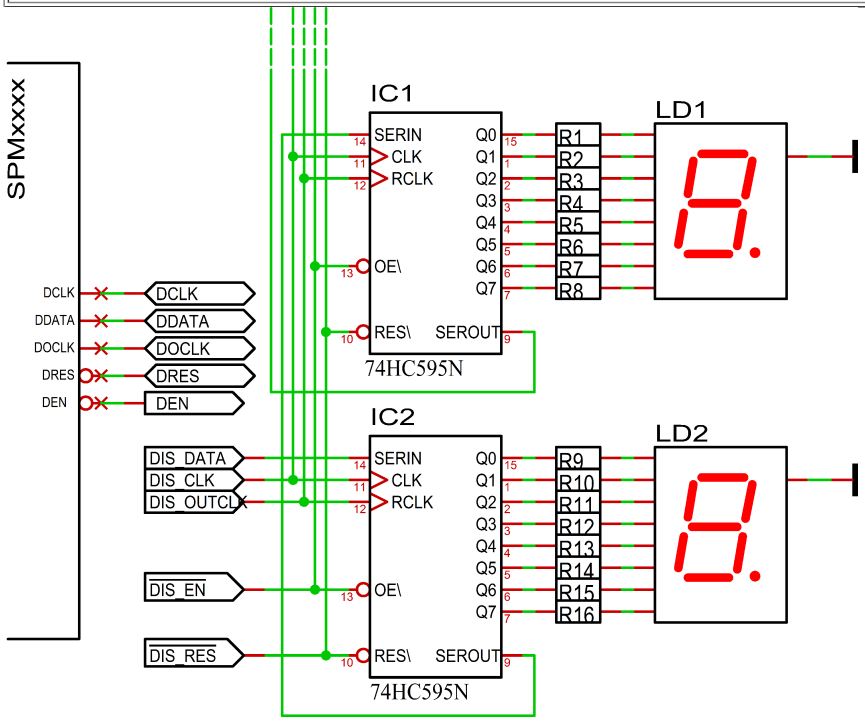
The shift register receives the data to be displayed serially and stores it in the output buffer. IC1 and IC2 are conventional 8-bit shift register of type 74HC595, the operating voltage and the blocking capacitors of IC1 and IC2 were not shown in the draw.The pin SERIN of IC2 have to be connected to pin DDATA of SPM2141P, pin SERIN of IC1 have to connected to SEROUT of IC2, with more displays this continues like this. The shift register which is connected directly to DDATA of SPM2141P is the unit digit of the information.(yx = y: LD1, x: LD2) R1 to R16 are series resistor for the LED in the 7-segment displays.

NOTICE

It can be used other shift register, but only 74HC595 have been tested yet.

NOTICE

Big displays
For larger displays which have larger current or higher voltage than the operating voltage of IC1 or IC2, a transistor buffer between the shift register and the series resistors must be used, see array transistor. Observe the maximum possible current which is in datasheet.



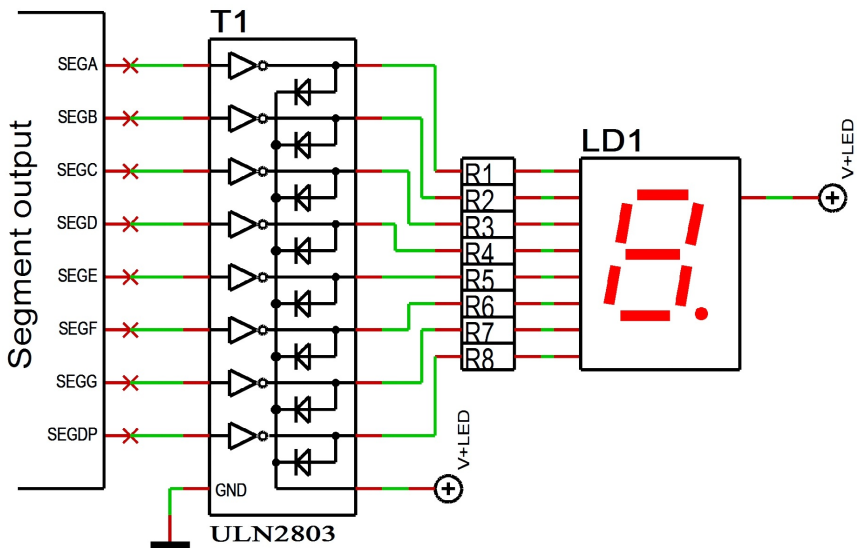
Output	Segment
Q0	Dezimalpunkt (DP) und Doppelpunkt an dem Display Zehnerminuten.
Q1	A
Q2	B
Q3	C
Q4	D
Q5	E
Q6	F
Q7	G

Transistor array

For the sake of convenience, a transistor array is used for drive the cathode, in this case it is the ULN2803. The current and voltage amplifier for the LED's may also be constructed totally discrete and another transistor array may be used.If you using any other transistor arrays, the suitability for current and voltage load needs to be checked.

NOTICE

For smaller displays with just one LED per segment and low current, the transistor array T1 can be omitted if the driving IC can withstand the current. In this case the 7 segment display must be connected to VCC instead of V + LED!



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 - Funktioniert perfekt
- — 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

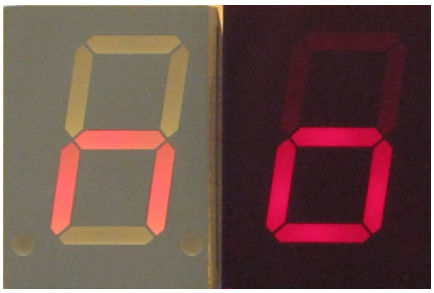


Figure 4: SA08-11SRWA left without and right with contrast pane with back light.

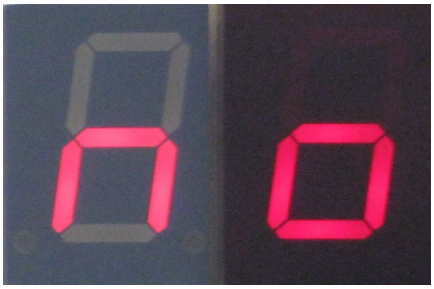


Figure 5: SA08-11SRWA left without and right with contrast pane without back light.

Below with and above without back 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.

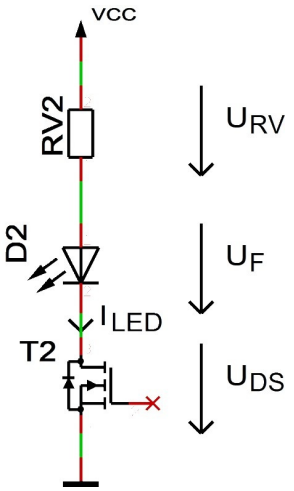
All segments with 4 LEDs were limited with a 220 ohm resistor. All segments with 2 LED (decimal point on SA23 and SA40) were limited with 390 ohm resistor.

Since this circuit is not optimized for minimal component and power requirements, the readability for direct exposure to headlights or sunlight is good even without a contrast panal.

It is recommended to place a contrast panel in front of the display, see figure 5 and 4.

Note: The menu is always displayed with 100% brightness.

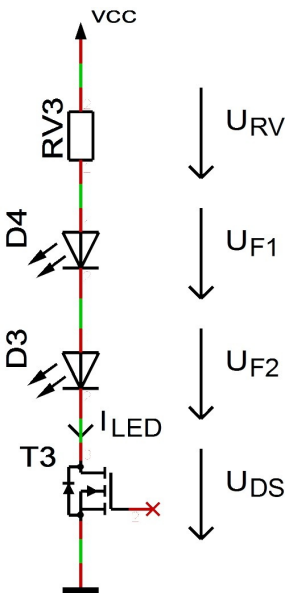
Calculate the series resistor for one LED



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

- UDS ≈ 0
- ILED < 35 mA

Calculate the series resistor for two LED



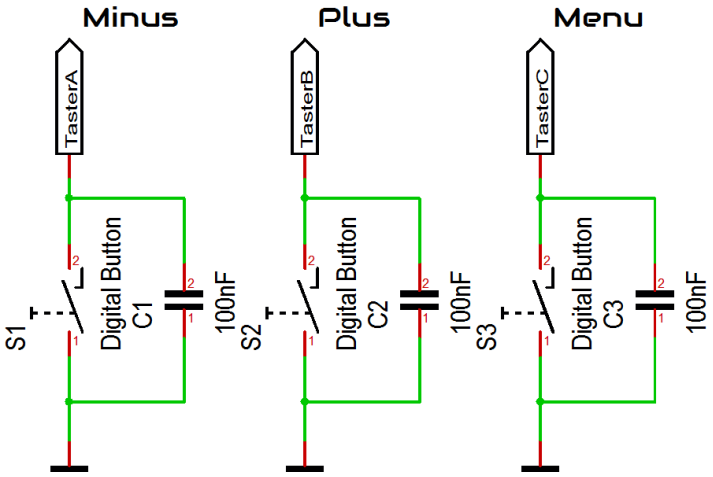
$$RV3 = \frac{VCC - U_{F1} - U_{F2} - U_{DS}}{I_{LED}}$$

- UDS ≈ 0
- ILED < 35 mA

Keyboard

Inputs for the keyboard. The buttons must switch the pin to ground when it is pressed. It is expressly recommended to use digital compatible switches. A capacitor (C1) to suppress bouncing is an advantage.

The remote control of the controller is simply possible by parallel adding or replacing the button with NPN transistors.



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.

Power supply properties

Since the clock is usually to be operated on a 230 volt power supply, a power supply unit is required. This can be a normal transformer power supply or a switching power supply.

Transformer power supply:

- Pro:
    - Cheap
    - Little interference for DCF reception
- Contra:
    - Heavy
    - Depending on the power is it big
    - Poor efficiency
    - Even if the circuit requires little power, some power may be needed
    - Higher electricity costs

Switching Power Supply:

- Pro:
    - Light
    - Small
    - Good efficiency is possible
    - Standby possible with very low power requirements
    - Lower electricity costs than with the transformer power supply
- Contra:
    - Larger interference for DCF reception
    - Usually a little more expensive

Switching power supplies should be preferred, unfortunately they have the disadvantage that many can interfere with the DCF reception and the DCF clock is not synchronized.Switching power supplies with a PE feedthrough (PE is connected to ground) often have better interference behavior, but this cannot be generalized.The switching power supplies offered in our shop have been tested and only minimally interfere with DCF reception.

WARNING
Use only a power supply unit with electrical isolation!

Quartz properties- Accuracy of the time

The quartz, microcontroller, quartz capacitor combination decisively determine the accuracy of the clock. Since only the controller is supplied, prior

coordination is not possible.

The accuracy can be measured on the TB pin, which can be found in the pin assignment. If the clock is inaccurate, first check the soldering points of the quartz, the quartz capacitors and the controller. These solder points must be correctly soldered and dirt such as Flux should be removed.

You can carry out a calibration yourself with the appropriate measuring equipment or you can order it from us with cost. Check the items in our shop.

To carry out the calibration, measure on pin TB with a multimeter, which frequency or period measurement can or with a frequency meter the output frequency. This should be as accurate as possible at 1 kHz or 1ms (for period measurement). A long gate time (duration of the frequency measurement) is advantageous because the interrupts create a little jitter (slight variation in the frequency). The calibration can be done digitally in firmware in somewhat rough steps in the menu "Calibrate quartz" or with a trim capacitor (this is not listed in a kit or parts list) in very fine steps. The best result is achieved by a trimming capacitor. However, since these are rarely produced, they are expensive and the increase of accuracy is minimal. Furthermore, for trimming capacitors you need a good tactile adjustment tool, a "normal" screwdriver usually does not work.

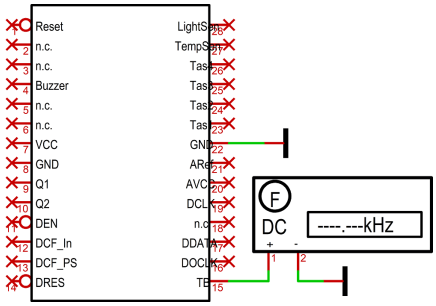


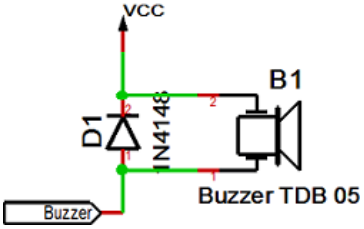
Figure 6: Calibrate quartz

NOTICE
Of course, the measuring device must have a corresponding accuracy.

Add quartz properties, how to calibrate.

Buzzer properties

The buzzer B1 must be self-producing and have a minimum voltage of VCC. Does the buzzer have not VCC, a series resistor have to be installed.The buzzer may further maximum of 40mA directly from the IC SPM2141P. The plus pole of the buzzer have to be applied to VCC and the minus pin of the buzzer have to connected to the IC.D1 is the idle diode when operating with coils.

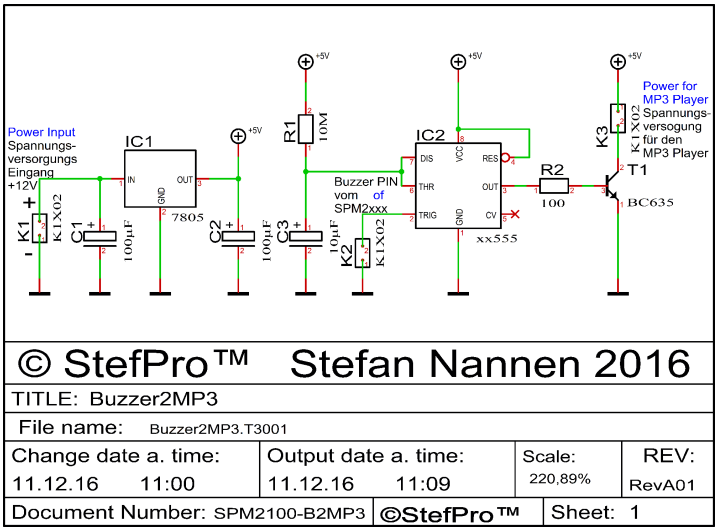


Buzzer to MP3 player

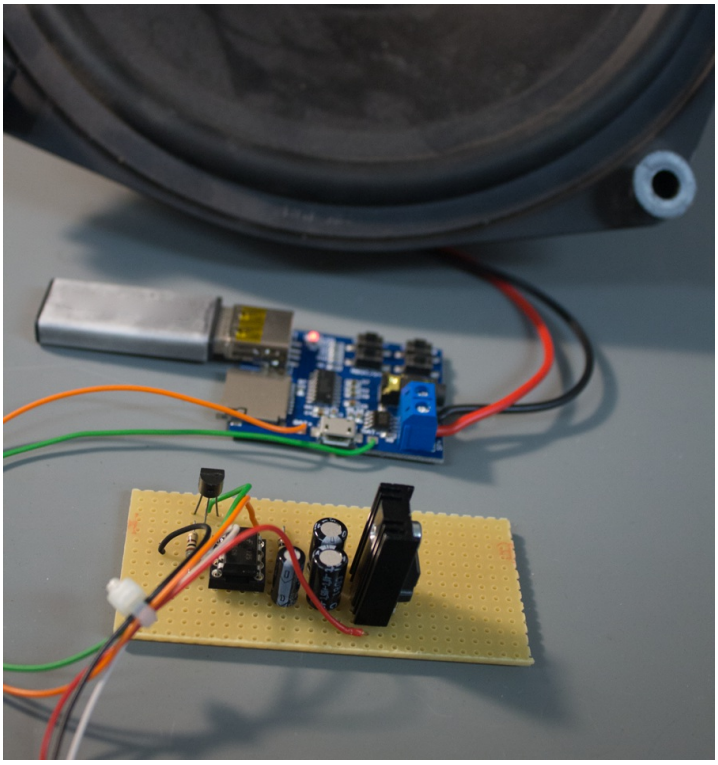
If an MP3 player is to be used instead of a self-exciting buzzer, a small circuit must bridge the signal off time.

This is possible with this very simple circuit, with a NE555, build-up as a retriggerable mono-flop.

Furthermore, there is a small power supply for the MP3 module, because most of the imported modules requires a voltage supply of 5 volts.The current is still acceptable with a connected 4 Ohm loudspeaker for a 7805 with heat sink and a current of 200 to 500 mA, since the alarm shouldnot play for more than 30 min. However, it is also possible to use a PIN compatible DCDC converter by different manufacturers.



Combination R1 and C3 gives a mono time of approx. 2 min.



Colors of thin wires:

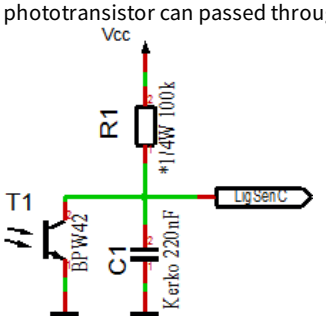
- red: plus supply voltage (<= + 12 Volt)
- black: minus supply voltage
- white: Buzzer signal from the IC SPM2141P
- orange: plus MP3 Player Module (+5 Volt)
- green: minus MP3 Player Module

Colors of the signals:

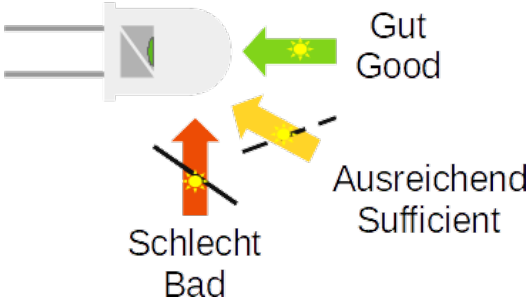
- yellow: Trigger signal
- light blue: MP3 Player Power Supply
- dark blue: Output from the MP3 Player

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

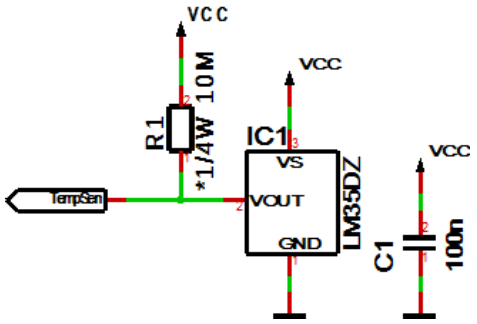
When using a different phototransistor or a different photodiode, it may be necessary to adapt R1 (top picture) and the settings in the menu!

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!

Installation the DCF clock

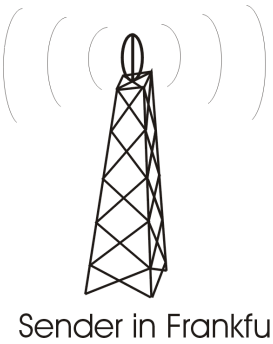


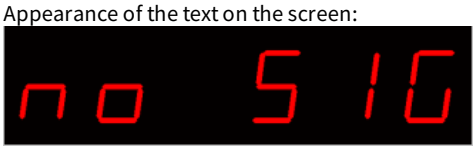
Figure 7: Align the DCF antenna

The external antenna receives the DCF77 signal and should be directed to Frankfurt, as shown in Figure 7.
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 sig**nal„ (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**nal„ 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**nal„ no signal.

„**SEArCH**„ Search the fifty-ninth second.

„**rEAdXX**„ read the dcf time.

Emitted electrical disturbances by the display

In the near field generates the display, by the fast on and off switching of the LEDs, disturbances.These depend on the brightness of the display. For EMC / CE conformity hese disturbances are uninteresting because they are strong only in the near field and occur only under 30 MHz.For sensitive antennas as a DCF77 antenna these disturbances may problematic, because this increase the distance between the antenna and the display.

To illustrate, a few simple relative measurements were performed with an oscilloscope:

Test setup

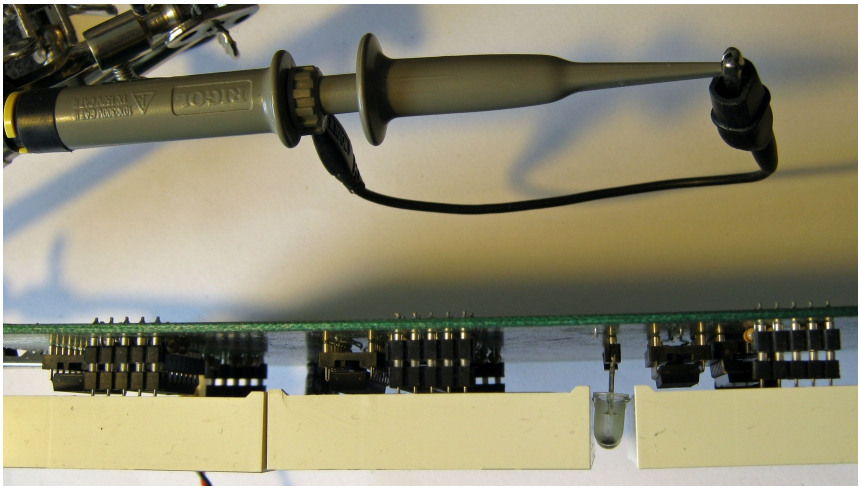


Figure 8: Test setup for the measurement

Measurement results

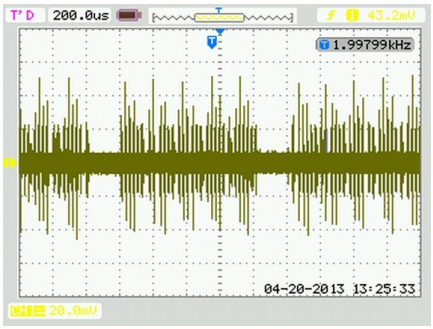


Figure 9: Measurement display is switched off

Figure 9 the display is off, only a decimal point indicates the synchronization status of the DCF time. The "Receive brightness" is on brightness level 0. Only the data packets to determine every second.

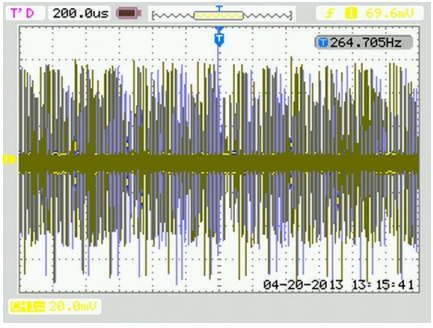


Figure 10: Measurement with brightness level 15

Figure 10 shows the display brightness set to 15 and there will be something displayed. It can be seen slight disturbances in the near field.

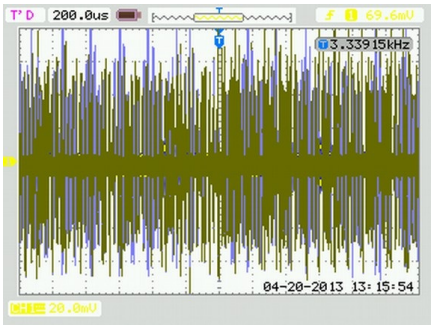


Figure 11: Measurement with brightness level 25

Figure 11 shows on the display brightness set to full brightness level 25 and it will be something displayed. There can be seen big disturbances in the near field.
The measurements were performed with a oscilloscope with 200 MHz bandwidth, a probe 10/1 (in order to obtain the full range) and PeakDetect. It was used the circuit SPP2400.

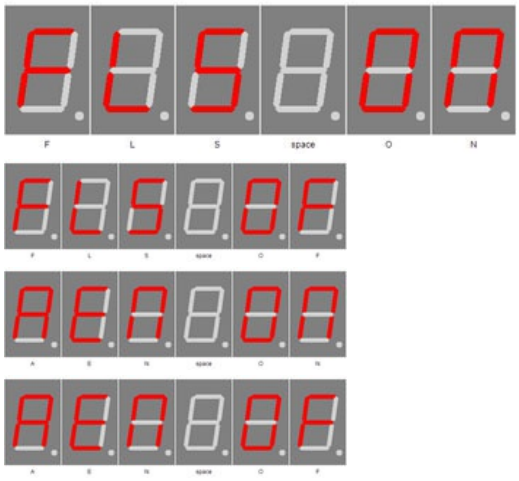
Button description

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 ➞Activate standby ➞StandBy start hour ➞StandBy end hour ➞StandBy Brightness ➞Exit brightness settings ↻
DCF⇓	DCF active ➞Receiving brightness ➞Hour of synchronization ➞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 ➞Day of week ➞Set time ➞Calibrate quartz ➞Exit clock settings ↻
Info section⇓	
IC number⇓	
Firmware version⇓	

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

Normal

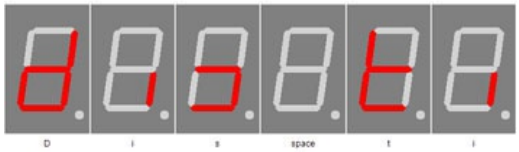


Normal mode, outside of the menu.

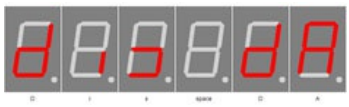
Here the + button has the function of the alarm temporary switch on or off.

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

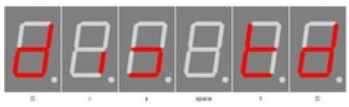
Display mode of clock



Time



Date

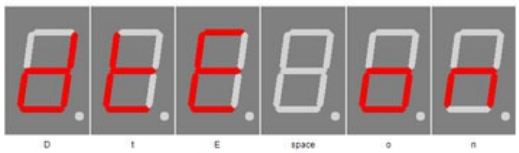


Time & Date

Sets the mode how to display time and date.

- OF: Does not display the time / date. When the temperature display is active, the temperature is displayed continuously. If no temperature display is possible or active, dashes (-) are shown in the display.
- ti: Shows only the time.
- dA: Shows only date.
- td: Shows time and date alternately.

Show Temperature



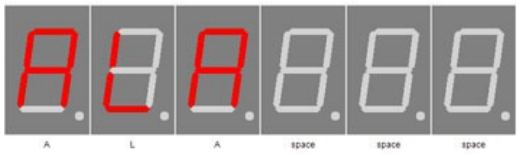
Display temperature on

Display temperature off

Enables the temperature display.

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 ...".

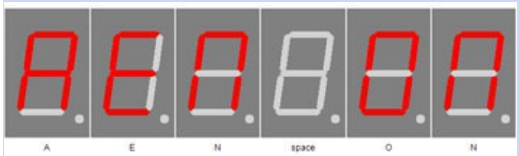
Alarm



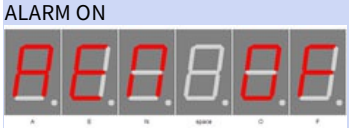
ALARM

With + you enter the sub-menu Alarm.

Alarm enable



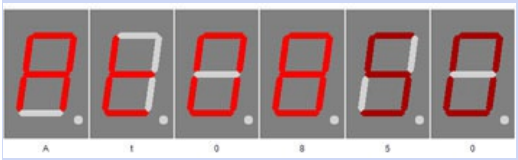
ALARM ON



ALARM OFF

Enables the alarm.

Alarm time hour



Alarm hour

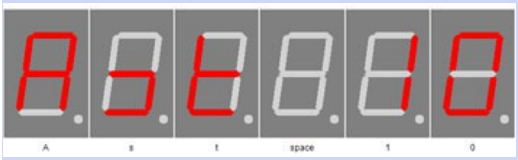
Sets the hour for alarm.The number can be 0-23

Alarm time minute

Alarm minute

Sets the minutes for alarm.The number can be 0-59

Alarm snooze time



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

Alarm after time

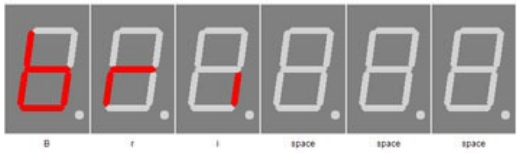
Sets the maximum time in minutes for the alarm.The number can be 2-60.

Alarm exit

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

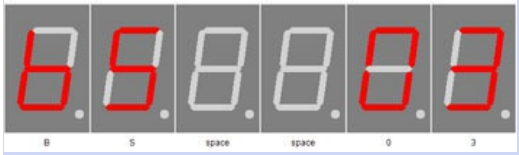
Brightness automatically

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 0-20. The maximum value may differ depending on the firmware.

Brightness factor

Brightness factor

This sets the calculation factor for auto brightness.

The number can be 1-99

Brightness offset

Brightness offset

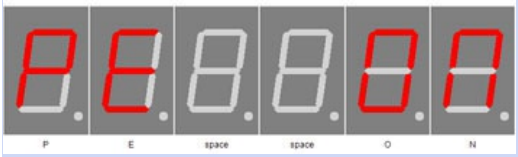
Brightness offset -99

Brightness offset +99

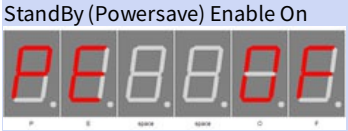
This sets the calculation offset for auto brightness.

The number can be -99 - 99

Activate standby



StandBy (Powersave) Enable On



StandBy (Powersave) Enable Off

Activates standby mode, in which the display is switched off.The clock and alarm function are still available, the time, date or temperature are simply not displayed.

Through the flashlight function can this interrupted.

StandBy start hour

StandBy (Powersave) Start Hour

The standby operation starts from this hour. Only full hour can be set.

The range is from 0 (midnight) to 23 (11pm).

StandBy end hour

StandBy (Powersave) Finish Hour - Endstunde

From this hour on, standby operation ends. Only full hour can be set.

The range is from 0 (midnight) to 23 (11pm).

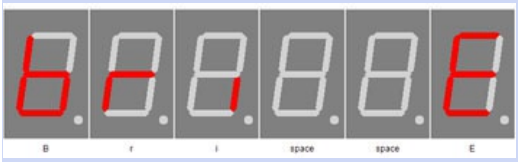
StandBy Brightness

StandBy (Powersave) Brightness level 1

This brightness is set in standby in the operation mode, 0 means off.

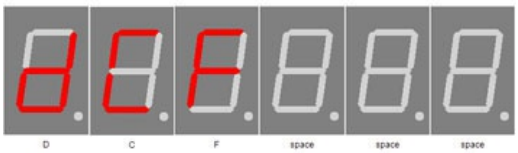
The range is 0 to 90, but 90 corresponds to 9 of the other brightness settings in this menu.

Exit brightness settings



With + you exit the sub-menu brightness.

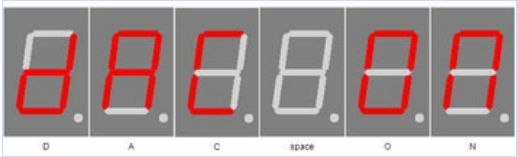
DCF



DCF

With + you enter the sub-menu DCF.

DCF active

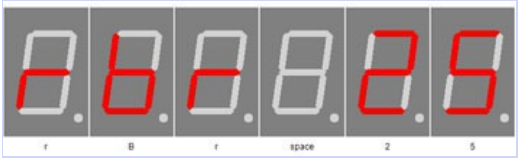


DCF active on

DCF active off

Sets whether or not DCF reception is active. If the DCF reception is deactivated, the clock only works with the built-in quartz clock.Note that in this case the time base must be set as well as possible.

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.

Hour of synchronization

DCF synchronize hour

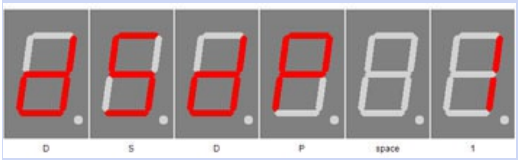
DCF synchronize hour disabled

Sets the hour in which the DCF clock will synchronize. In this hour, the DCF signal will be analyzed until a synchronization has occurred or the hour changes.

The number can be 0-23.

If the display shows "--" instead of a number, the synchronization hour has been deactivated and the dcf receiver is constantly trying to synchronize. In this case, the receipt display can also be displayed permanently.

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: During the synchronization phase, the receive signal is always on the receive LED regardless of the DCF77 synchronization flag.

Only while the clock is trying to receive the DCF signal, see "Hour of synchronization".

DCF input pull up

DCF input pull up auto

DCF input pull up on

DCF input pull up off

DCF77 input pull up

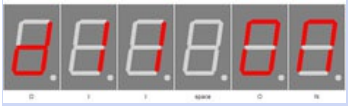
- AU: Pull Up is automatically (default).
  AU is activated by pressing the + button.
- ON: Enables the pull-up resistor
- OFF: Disables the pull-up resistor
  ON and OFF is activated and toggled by the - button.

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

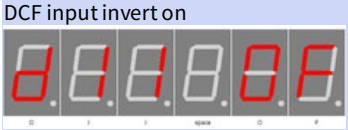
No guarantee for correctness of the information and changes of the manufacturer.

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.*

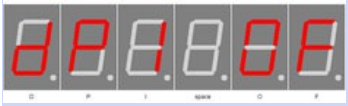
- Conrad DCF module = for PIN3 ON, PIN4 OFF
- ELV DCF module = ON
- Pollin DCF module (3.3 V) = OFF

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

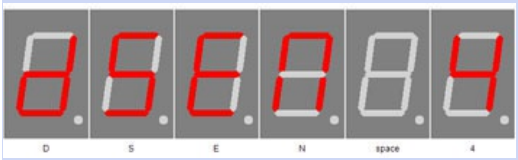
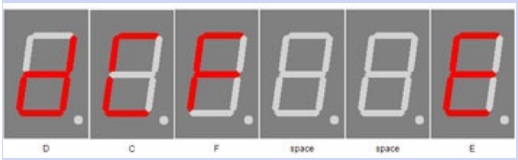
Inverts DCF77 power On / Off output

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

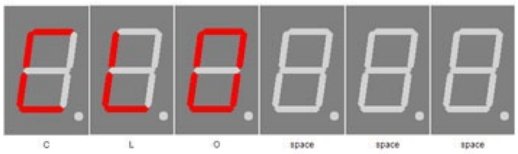
- Conrad DCF module = No power on / off input pin available
- ELV DCF module = No power on / off input pin available
- Pollin DCF module (3.3 V) = ON

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

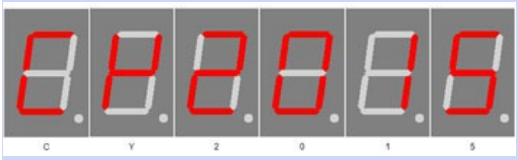
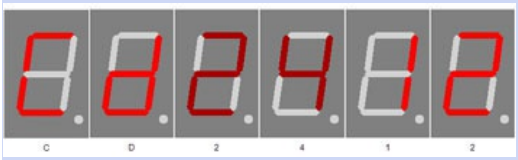
Read the instructions of the receiver module for the power on / off pin of the DCF module to set this setting correctly. Many modules do not have this pin, then this setting can be ignored.

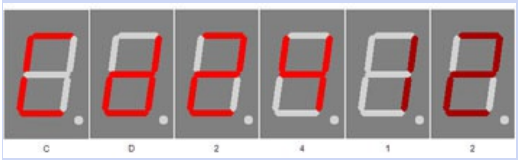
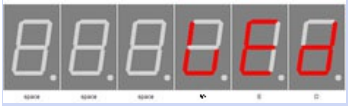
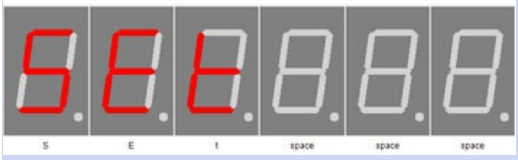
DCF sensitivity  DCF sensitivity	Sets the DCF Sensitivity. 1 has a very low tolerance and 6 has the highest tolerance for reception. The Sensitivity should be set as small as possible to avoid incorrect receiving.The number can be 1-6
DCF exit  DCF Exit	With + you exit the sub-menu DCF

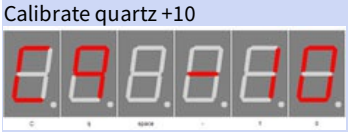
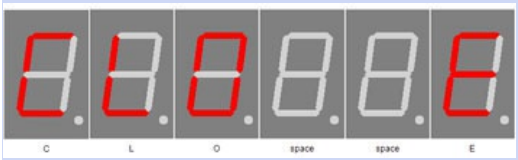
Clock Settings


clock

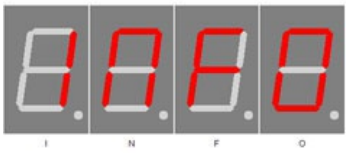
With + you enter the sub-menu clock.

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

Set day  change day	Set the day, limit by month. The number can be 1- 28, 29, 30, 31.
Day of week Monday - Montag Tuesday - Dienstag  Wednesday - Mittwoch Thursday - Donnerstag Friday - Freitag Saturday - Samstag 	Displays the day of the week from the set date.
Set time  Set settings	Sets the time, while looking for DCF time, otherwise the time will be provided directly.

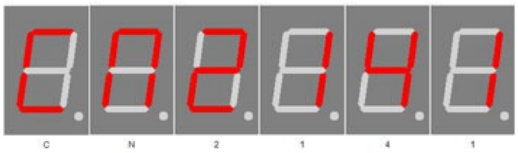
Calibrate quartz Calibrate quartz +10  Calibrate quartz -10	With this setting the quartz can be calibrated, a positive value increases the period time and a negative value reduces it.The period should also be set as precisely as possible to 1ms or 1kHz (for frequency measurement). The measurement must be carried out on pin TB.Further information can be found in the chapter Quartz properties - Accuracy of the time".
Exit clock settings  Clock end	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

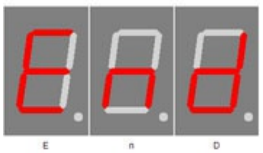
Firmware version

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).
   "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

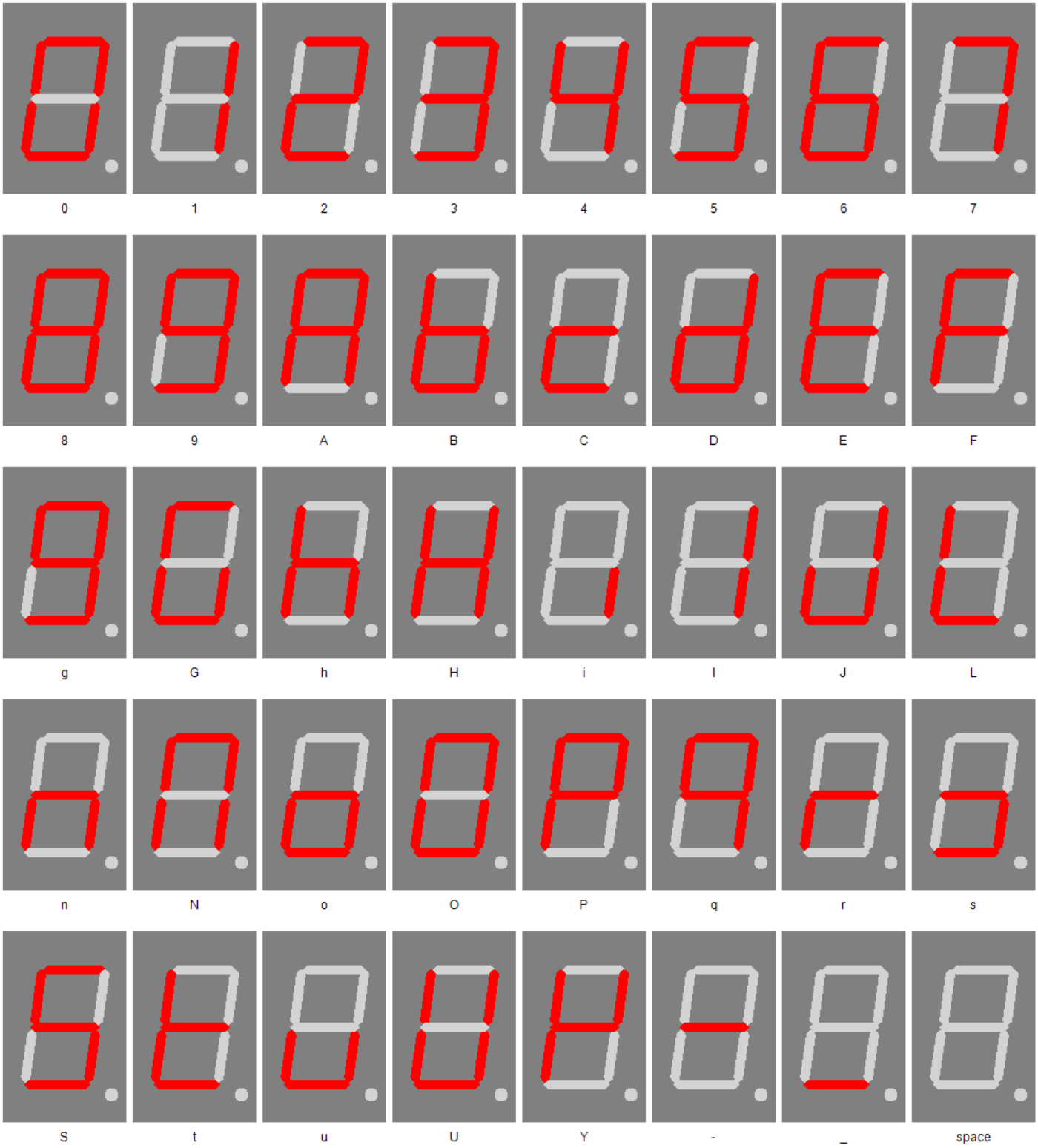
1. Download the latest upload tool from www.stefpro.biz: SP Firmware UP
2. Start the tool
3. Select the COM port.
4. Press the "Load" button and select a firmware which you have previously downloaded from SP Firmware UP
5. Now press the "Connect" button, the data from the IC / Module / device will be 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

Product overview

05.07.2017 - 1.0.5 - ADD
Add Product overview

Quartz properties- Accuracy of the time

12.06.2020 - 2.0.0 - ADD

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

Power supply properties

21.12.2019 - 1.0.5 - ADD
Add SNT description

Buzzer to MP3 player

09.12.2016 - 1.0.2 - ADD
Add buzzer to mp3 player change description

Temperature sensor

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

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

- "Programmed IC": IC which was developed by StefPro and can only used with a minimum basic circuit.
- "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 delivers only the "programmed IC", a basic circuit and possibly an example circuit, but these are not tested for CE and EMC. The "Manufacturer of the whole device" requires the valid VDE, CE and EMC is comply with regulations.
- There is no liability for damages incurred directly by or in the application of the "programmed IC", as well as for damage caused by chemical or electrochemical effects of water or generally from abnormal environmental conditions.
- "Programmed IC's" 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 developed with a "programmed IC" by StefPro modules and devices must be the responsibility of the "Manufacturer of the whole device" sufficiently tested to detect any defects.

Warranty

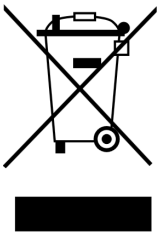
- StefPro warranty only for the programmed IC and their firmware. The warranty is exclusively limited for the replacement of the IC within the warranty period for obvious defects in the hardware, and programming error.
- Warranty does not extend the warranty period or starts a new period again.
- Additional 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 from StefPro is protected by copyright.. Unauthorized reproduction or distribution of programmed IC's 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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