

**Please note for initial powering up**

Many of the IN-9 tubes are unable due to its long storage time to display a full scale glow; they need to be „formatted“ once.

Therefore simply keep the NixieTherm powered up for some hours without turning off. Adjust from time to time the rising scale display by turning the shaft on bottom side with a slot screwdriver.

**Final display range adjustment**

As the display remains steady for a while – your ambient temperature must remain also steady of course – you can do the final adjustment of the displayed value with respect to a reference temperature probe with the TR2 trimmer and the supplied shaft.

In the same way the display can be adjusted at any time for accuracy. But please consider that the NixieTherm thermometer should be powered up for at least a half an hour before doing these adjustments due to the self heating of the temperature sensor, which must also be corrected.

Therefore the temperature display is much too low when turning on the NixieTherm after a longer time of no operation (e.g. at night) and will start rising up slowly.

**Vendor**

This kit was carefully engineered and assembled in Germany by



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[www.NixieTherm.eu](http://www.NixieTherm.eu)

Have you any suggestions?  
 Don't hesitate and contact me.

Congratulations for purchasing this stunning thermometer **NixieTherm**.

For successful assembly of the this kit please read the following helpful hints.

- ✓ This kit is designed for someone who has advanced experience with assembling electronics.
- ✓ If you believe that the kit is too complicated for your skill level please do not try to assemble it - this generally ends up with a device that is not repairable and results in you being very frustrated. Please contact the provider and they can offer you other options that will end in a more fulfilling result!
- ✓ Take your time - this kit should take 1-2 hours to complete if uninterrupted. Assembling the kit in a hurry will lead to frustration and the troubleshooting afterwards takes three times as long.
- ✓ Ensure your work area is well lit (daylight preferred) and clean.
- ✓ Electronic tools, such as pliers, small side-cutters or tweezers should be handy. You will also need a T8 (Torx) or SW2 Allen screwdriver for the housing assembly.
- ✓ A soldering iron station with a 1 mm round tip (maximum) and a 0.8 mm (maximum) fine electronic solder (lead-free) is required. For lead-free solder good experience was made with type **Iso-Core EL Sn95,5 Ag3,8 Cu0,7** with 0,5 mm Ø and 3,5% Flux from **Felder Löttechnik** an **400°C** soldering tip temperature.
- ✓ For the intermediary function test you need a multimeter with at least 200 VDC range.
- ✓ A loupe to read the small device markings is often helpful.
- ✓ Assemble the board in the order as stated in the instructions - this has been proven and will minimize mistakes.
- ✓ It is assumed that you understand that semiconductors (diodes, ICs, transistors) or electrolytic capacitors are polarized components. Appropriate markings are silk-screened on the PCB and shown on the board schematic.

Together with this construction guide you get some additional helpful documents:

- ✓ The full colour schematic of the NixieTherm
- ✓ A full part list with the colour coding of the resistors
- ✓ A bilingual operation manual is available for download at [www.NixieTherm.eu](http://www.NixieTherm.eu)  
 Please keep this manual handy.

**Safety precautions:**

During assembly, operation, measurements and maintenance extra precautions must be taken. The generated high voltage of 125V is dangerous. Assemble the circuit at your own risk. The functionality cannot be guaranteed when assembled by the customer. No responsibility can be taken for any personal claims and damages during assembly and commission, especially for damages based on insufficient technical knowledge.

The NixieTherm thermometer may only be operated in a solid and moisture-proof enclosure.

The person who completes the kit and assembles this board into an enclosure for operation is considered by the German directive VDE 0869 as a manufacturer and is required to indicate their name and address including all documents when selling the thermometer. Ready-to-go devices, which are assembled from kits, are counted safety-related as an industrial made product.

*Okay, and now, Ladies and Gentlemen, start your soldering irons!*

1. **Placing the resistors**

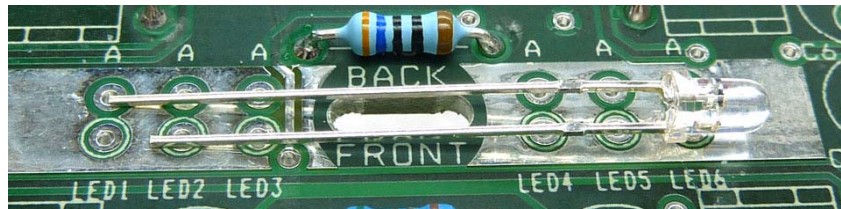
We will start with the low profile electronic parts; so let's start with the resistors and here it is the best to start with those values which are mostly used in the circuit. Pay attention with the values of the 2k49 and 249k resistors. They differs only in one colour ring (brown or orange) – and this is somewhat difficult to compare. Therefore first finish assembling one value before you pick up the next. Also note that the positions R23 and R24 are reserved for further modifications and remain free in this circuit.

2. **Placing the semiconductors**

Start first with assembling the three diodes D1...D3. Take care for correct orientation. The cathode ring is marked on the assembly drawing and also with a circle around the solder pad.

3. **Placing the RGB LEDs**

Flush-mount now the LEDs to the PCB and adjust them to sit straight. Also take care for the orientation. The anode is the long leg and this pin is marked on the PCB with an "A", the cathode is marked similarly to the diodes with a ring. Please solder only one wire first, than adjust and when finished solder the remaining leads. Do this as fast as possible not to damage the LEDs due to the high soldering temperature.



4. **Placing the IC sockets**

Now insert all three 8-pole IC sockets. Pay attention to the correct direction marked with a notch. **Please do not insert any IC at this stage!**

5. **Placing the MosFet transistor IRFD220 (T2)**

**Caution!** This is an electrostatic sensitive device. So you should discharge yourself by touching any metal work before placing the transistor.

Note the correct orientation; the print must not read upside down; also the Drain pin has two legs, which are tied together; this is shown also on the PCB and on the picture on the right side.

**Tip:** To fix the part, solder the drain connection from the top side..



6. **Placing the npn transistor MJE340 (T1)**

Take a pair of flat pliers and hold the transistor around 3 mm from the package. Than bend all the leads straight downward. Now fit the transistor and turn around the PCB.

The transistor will adjust itself for correct alignment. Nevertheless solder only the middle leg, check and modify for correct adjustment. Than solder the remaining two legs.

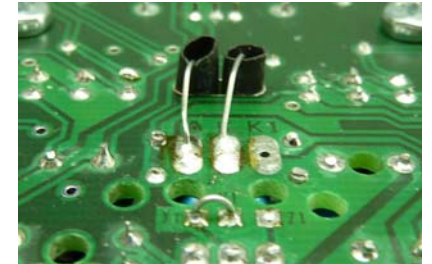


Now fit the electronic board. Pay attention at the two tube's leads. They must be threaded through the milling groove in the middle of the board. Also these leads may not cross match.

Pick up the four Philips screws M3x6 and tighten them softly within the tapped holes of the mounting brackets. Maybe the screws must be bend a little bit if the holes of the bracket will not fit to the holes of the board. Now fasten the four screws with your screwdriver in a crosswise fashion.

Pick up the supplied shrinking tube and cut them in the middle. Thread both halves through the leads of the tube, the milling groove of the PCB and push them as close as possible to the tube's glass body.

Now cut the leads as they must be soldered to the pads „A“ and „K“. Pay attention not to stick the leads too far through the drilling holes of these pads as they may produce a short circuit with the parts located on the assembly side.



Now an additional jumper (you may use a short lead from a cut part's leg) must be set between the solder pads X1 and Y1.

Finally pick up the Plexiglas PCB frame, remove the films and attach them to the enclosure as shown on the right picture.



Now thread the remaining four Philips M3x16 screws through the holes of the four rubber feeds.

Pick up the black bottom cover, remove the protective films and attach them to the case. If all is well, both bent leads from the tube should a little press on the bottom. This will fix the tube in its final scale position and is intentional.

Pay attention to correct orientation of the bottom cover.

The louvres are now located at the front side, so you should see the soldering pads mentioned before when looking through the louvres. Also only the left potentiometer TR2 may be accessible through the drilled hole. Have a look at the right picture for assistance.

Now assemble the four rubber feet to the bottom cover. Please don't over tighten the screws. Attach the shaft to the trimmer and press it to its mechanical end.

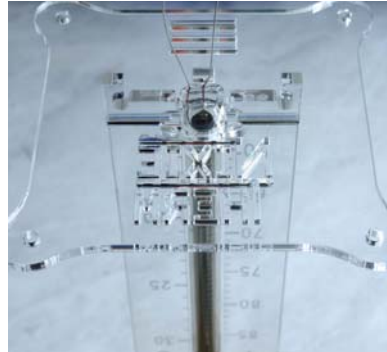


Finally fit the supplied label, unclamp your NixieTherm from the vice and place it down on its feet.

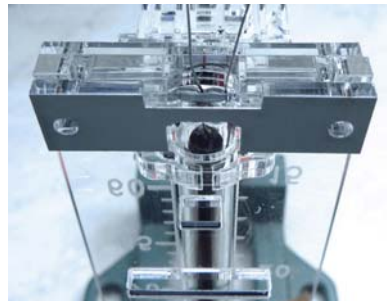
After tightening the four pan head screws with an appropriate screwdriver we have finished or work.

**Congratulations. Now have a lot of fun with your self-assembled NixieTherm thermometer.**

Now fit the top cover to the scale. Remember, we are working „upside down“ so the milling „NixieTherm“ must be readable mirrored. Furthermore these words must be located at the front of the scale – this is the direction from which you are normally looking at the thermometer. Have a close look at the pictures on right, which will help you to find the correct fitting position.



At this stage it is time to check the alignment of the bargraph tube. If the tube is dropped in the right way round you will see the **anode mesh** when looking at the scale from the front (non-mirrored digits). When looking from the back you should see a metallic surface in the tube with the print of type and manufacturing date. If not, simply rotate the tube by 180°.



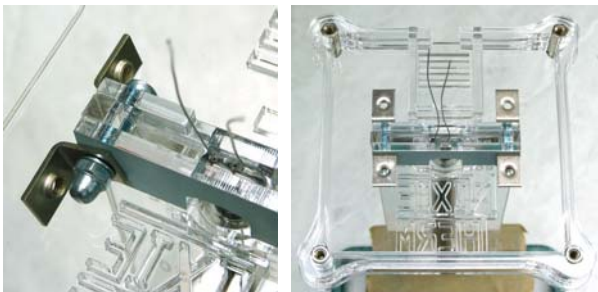
Now take both LED covers and remove the protective films from the mirrored side. Both covers have a deep milling groove for the tube and (on the first few kits only one cover has) a slight wider milling groove for the space of the resistor R5, which is located near the LEDs at the position of the back cover. Therefore (when only one cover with this slight wider groove is supplied) this cover must be mounted from the back of the scale. Both deep milling grooves must facing “downwards” to the tube. Have a close look again at the picture on the right for assistance. The mirrored face of the LED covers must face to the scale on both sides as it will reflect the LED lighting.



For mounting the PCB holder pick up two mounting brackets, two M3x16 screws and two washers and assemble as shown in the left picture. Now slide this combination through the drilling holes of the LED covers and the scale.

At the threaded end now fit again a mounting bracket, a washer and a dome nut and tighten them slightly only by hand.

Now adjust all four brackets for orientation upwards and parallel to the top cover. Now tighten the screws again, but only such that the mounting brackets can slightly adjusted by pushing them.



Now pick the four flat hat M3x8 screws and the M3x12 metal spacers and stick them „from bottom to top“ through the drill holes of the top cover. Only tighten them slightly by hand. Pick up both inner Plexiglas frames and peel off the films. Slide them gently over the four distances. Pay attention to the orientation of the „thermic chamber“ and the cutout for the USB connector. The picture on the right gives you assistance in this assembly stage.

**7. Placing the ceramic capacitors / EMV-inductor**

Start with placing the two 330pF capacitors C12 and C13, than place the six 100nF capacitors. If you're looking for C9: It is located above the power switch left to the EMV-inductor L2; this inductor we will fit next. As it's leads are very short it's recommended to solder one lead from the top side to fix the part when turning round the PCB.

**8. Placing potentiometers / switching converter inductor**

Now fit the potentiometers TR1, TR2 and the inductor L2. Do not push the supplied shaft in one of the potentiometers yet.

**9. Placing the electrolytic capacitors**

Fit first both high diameter capacitors C14 and C15. Pay attention not only for correct direction but also not to mismatch them. C14 is the 2μ2 350V capacitor and is located below the blue inductor, C15 is the 470μF 10V capacitor and is located left to IC4. The anode + of all capacitors is marked on the PCB with a corresponding print, the cathode – is marked, as usual, with the ring at it's pad.

Next fit the remaining eleven 100μF capacitors. For optical reasons take care for a clean straight orientation, therefore solder first only one lead each and align the capacitors. When finished, solder the remaining.

**10. Placing small signal transistors / reference diode / temperature sensor**

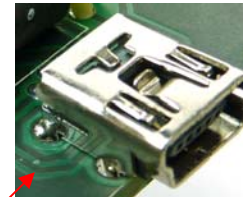
Now fit the remaining 3-leg-electronic parts. Because of a different pin spacing a slightly „anti-mismatch guarantee“ is given but nevertheless have a look at the part's marking (e.g. the LM35 and BC640 have the same pin spacing).

Please pay attention, that the mounting height does not exceed the height of the electrolytic capacitors, so push them slightly lower in the PCB; except...

The temperature sensor IC1 should mounted at the same height as the capacitors for the biggest spacing far away from the board. The flat side of this transistor style sensor points to the rear of the board. Solder carefully as the solder pads have a very narrow spacing; the same care must in...

**11. Placing the USB connector / slide switch**

Fit them into the board and solder one pad for the package mounting from the top side for fixing them. Then turn around the PCB and solder the remaining leads. You may pay attention again to the very narrow spacing of the USB connector's pads. Take care not to short circuit some pads during soldering.



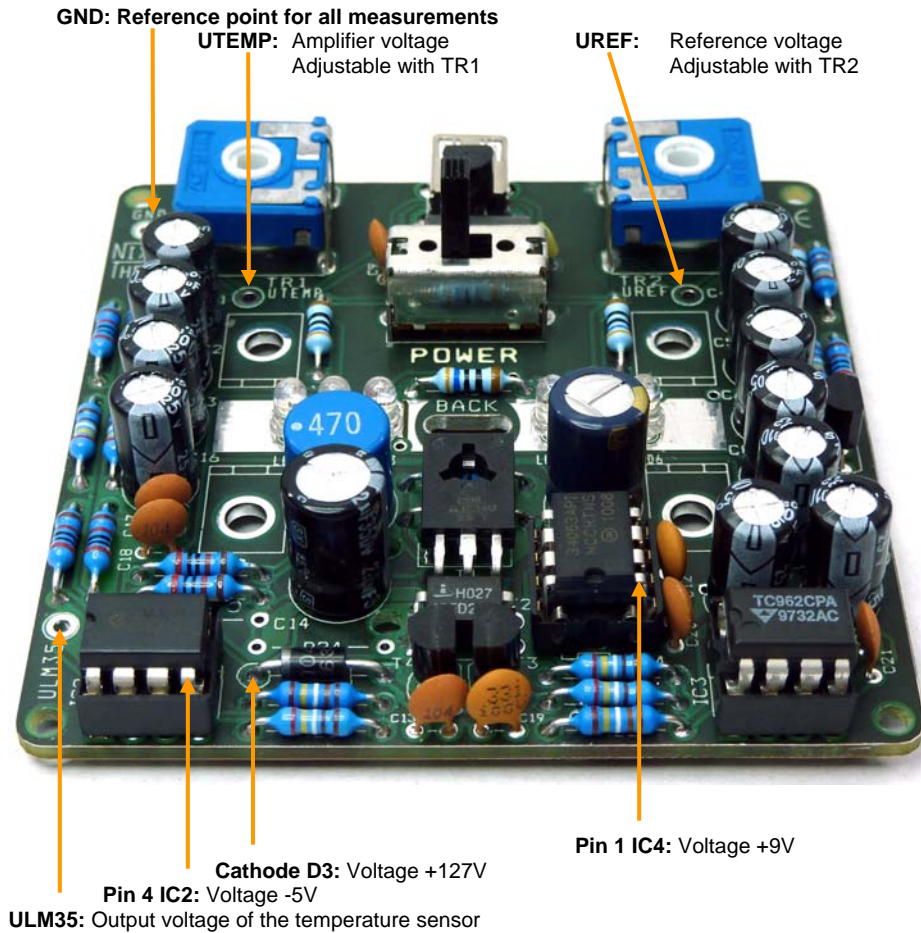
**12. Fitting the ICs**

Finally we should now fit the three remaining integrated circuits into their sockets.

Now our assembly of the electronic parts is finished and we will start to do a first function test.

But beforehand, check your work again for assembly mismatch, correct orientation of the electrolytic capacitors, diodes, transistors and also for solder bridges.

The picture on the following side will give you a little help in that.



The picture shows all assembled parts and the test points we will use

**The function test:**

Connect now the board to your USB power source (an USB loader power supply is recommended) and turn on the thermometer with the Power switch.

**Caution! High voltage is present on the board – don't touch the converter's relevant parts.**

Now the LEDs should light up with their never ending colour play. Now put your black probe of the multimeter on the GND testpoint, and with the red probe check the voltages below:

**Pin 4 of IC2:** negative supply voltage ca.  $-5V \pm 0,6V$

**Pin 1 of IC4:** positive double supply voltage ca.  $9V \pm 1,2V$

**Cathode D3:** Anode voltage for the bargraph tube ca.  $127V \pm 5V$

Testpoint **ULM35:** ca. 0.3V – depending on ambient temperature

Testpoint **UTEMP:** Output voltage of the measuring amplifier, adjustable with TR1 in the range of ca. 3.8...7V (depending on ambient temperature)

Testpoint **UREF:** Reference voltage, adjustable with TR2 in the range of ca. 2.8...5V.

**Don't continue your work until the voltages are within their given range. This may damage the circuit. Check for the fault; mostly a solder bridge or a reverse-mounted part.**

**Adjusting of the measuring amplifier:**

For an exact temperature display a trimming of the amplifier is necessary.

Therefore plug slightly (!) the shaft on TR1.

Now check again the voltage on testpoint **ULM35**. It is in the range of 0.3V and represents the actual ambient temperature ( $10mV/^{\circ}C$ ). Please write down the voltage reading. The amplifier must now be adjusted for 18-fold amplification. Therefore simply multiply the voltage reading by 18 and adjust for that value on testpoint **UTEMP** with the potentiometer TR1. When finished carefully remove the shaft.

Example: ULM35 = 0.3V so adjust for 5.4V with TR1 at testpoint UTEMP.

**Adjusting of the reference voltage:**

This is just a coarse adjustment only to give a suitable display on the tube. The final adjustment is done with the complete assembled thermometer (see last page).

Therefore plug again slightly the shaft on TR2 and adjust for a voltage reading of 3.7V at testpoint **UREF**. When finished remove the shaft and keep it for final use.

Now testing and adjustment of the electronics is finished and we will start to assemble the enclosure. So first disconnect the board from the power supply.

**Assembling of the enclosure**

It is necessary to note that we will mount the enclosure not only „from the top to the bottom“, but also upside down. Therefore it is necessary to secure the thermometer's scale e.g. with a small vice. But before you clamp the scale please cover the jaws with any kind of protective material so as not to scratch the scale's Plexiglas.

Start with peeling off the protective film from the scale. Now apply carefully both tube clamps into the scale's notches. The clamp itself has also a small notch on its back side so fit them in that way that this notch is located on the „rear“ of the scale. When mounted push the tube through.



Peeling protective film



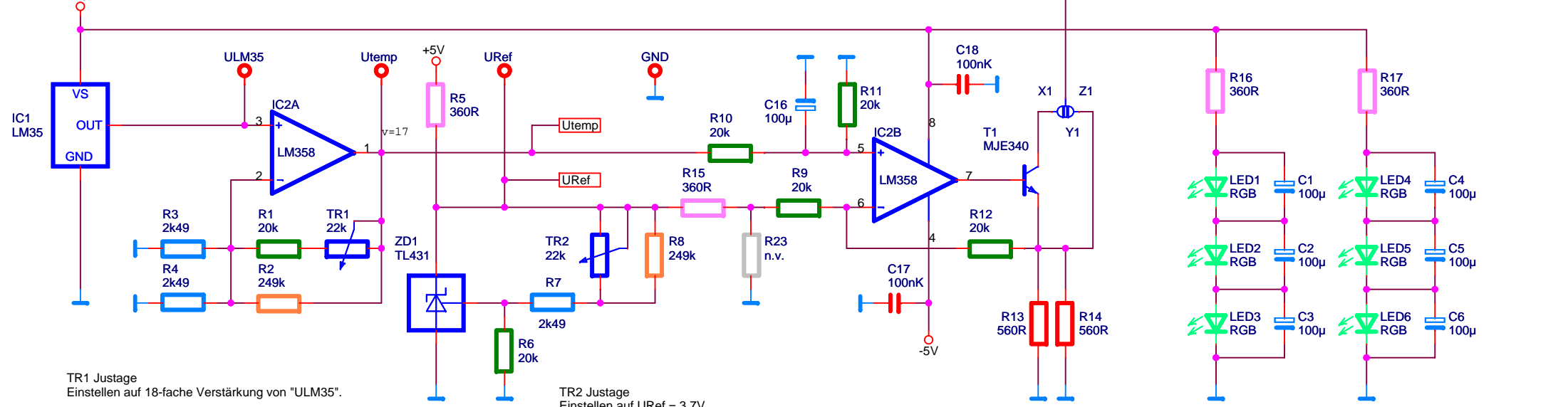
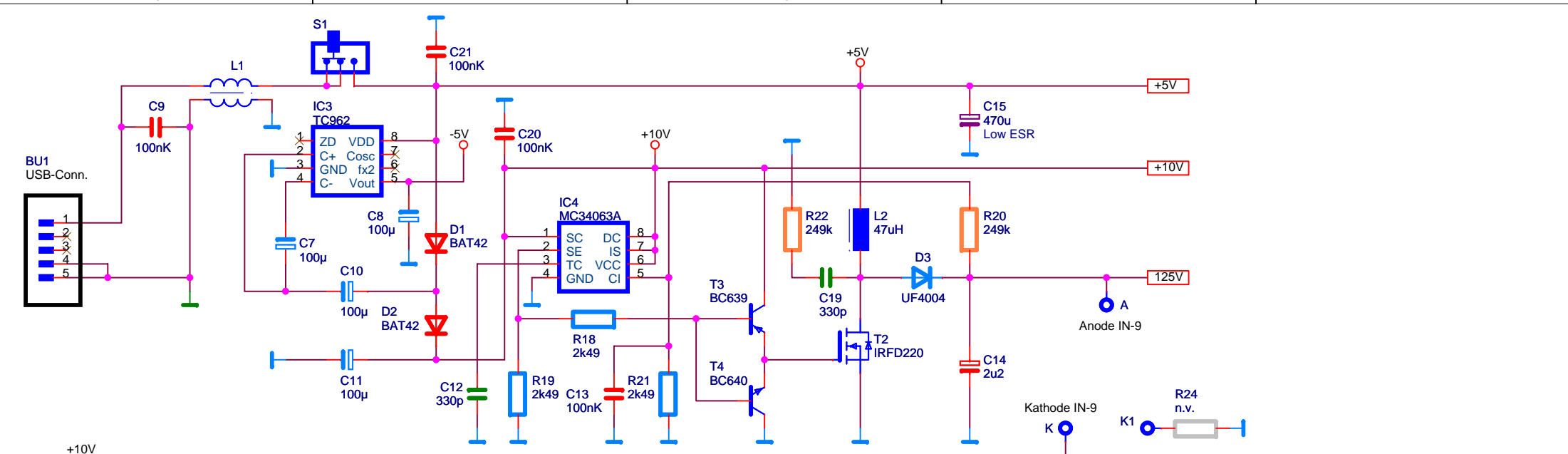
clamp on front



clamp on back

Now fit this „scale-tube-combination“ to your vice in such a way, that the „Mr.Nixie logo“ is readable upside down and located near to the jaws.

Pay extra attention that the tube doesn't drop out during mounting and do not tighten the jaws too tightly.



TR1 Justage  
Einstellen auf 18-fache Verstärkung von "ULM35".  
TR1 Settings:  
Set for 18 x amplification of "ULM35".

TR2 Justage  
Einstellen auf URef = 3.7V.  
Im fertig aufgebautem Thermometer nach längerer Betriebszeit auf korrekte Temperaturanzeige im Vergleich mit einem Referenzthermometer mittels der von außen zugänglichen Trimmerachse erneut abgleichen.

TR2 Settings  
Adjust for URef = 3.7V.  
When assembled and powered on for a longer time re-adjust again with the supplied shaft for exact display with respect to a reference thermometer.






Brücke X1-Y1 setzen für normalen Betrieb.  
Brücke Y1-Z1 bei gezogenem IC2 setzen für "burn in"

Set jumper X1-Y1 for normal operation.  
Set jumper Y1-Z1 and pull out IC2 for "burn in"

Title		
<b>IN-9 Indoor Thermometer "NixieTherm"</b>		
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## Stückliste / Part List IN-9 Thermometer NixieTherm

Nr.	Inhalt Content	Beschreibung Description	Code	Stück Pieces
1	Widerstände Resistors	360R 	R5, R15, R16, R17	4
		560R 	R13, R14	2
		2K49 	R3, R4, R7, R18, R19, R21	6
		20K 	R1, R6, R9, R10, R11, R12	6
		249K 	R2, R8, R20, R22	4
		Nicht bestückt / not fitted	R23, R24	-
2	Halbleiter Semicond.	BAT42 Small Signal Schottky Diode	D1, D2	2
		UF4004 Ultra Fast Switching Diode	D3	1
		BC639 NPN Switching Transistor	T3	1
		BC640 PNP Switching Transistor	T4	1
		LM35DZ Centigrade Temp.-Sensor	IC1	1
		TL431 (FAN431) Voltage Reference	ZD1	1
		MJE340 NPN HV Transistor	T1	1
		IRFD220 N-Ch. MosFet 200V	T2	1
		IC-Sockel 8 pol.		3
		MC34063A Buck / Boost Converter	IC4	1
		LM358 Dual Low Voltage OPA	IC2	1
		TC962 SC-Voltage Doubler	IC3	1
3	Kondensatoren Capacitors	LEDs RGB slow autochange 3mm	LED1...6	6
		330pF „331“ RM 2,5	C12, C19	2
		100nF „104“ RM 2,5	C9, C13, C17, C18, C20, C21	6
		2µ2 350V	C14	1
		470µF 10V LOWESR	C15	1
		100µF 16V / 25V	C1, C2, C3, C4, C5, C6, C7, C8, C10, C11, C16	11
4	Divers	Schiebeschalter / Slide switch	S1	1
		EMV-Drossel / Inductor	L1	1
		47µH Drossel / Inductor	L2	1
		Schrumpfschlauch / Shrink Tube		1
		Mini USB Buchse / Connector	BU1	1
		Achse / Shaft	Für / for TR2	1
		22k Trimmer / Potentiometer	TR1, TR2	2
		90° Winkel / Mounting Brackets		4
		M3 x 16 Schraube / Screw		6
		M3 Hutmutter / Dome nut		2
5	Mechanik	M3 Fächerschelbe / Washer		4
		M3 x 6 Schraube / Screw		4
		M3 x 8 Flachkopfschraube / Flat Hat Screw		4
		M3 x 12 Distanz / Spacer		4
		GummifüÙe / Bumpers		4
5	Leiterplatte / PCB			1
6	IN-9 Nixie Röhre / Tube			1
7	Thermometer-Skala / Scale			1
8	Oberteil / Top Cover			1
9	Zwischenrahmen / Middle Frame transparent			2
10	Abstandsrahmen schwarz / Distance Frame black			1
11	Bodenteil schwarz / Botton Cover black			1
12	Röhren-Halteklammern / Tubes Clamb			2+1
13	Baumwoll-Handschuhe / Cotton Gloves			1P
14	USB Anschlusskabel / USB connection cable			1
15	Aufkleber / Label			1