

Total solder points: 954

Skill level :

Beginner 1  2  3  4  5  Advanced

HIGH-Q  
**velleman-kit**



## PC FUNCTION GENERATOR

# K8016

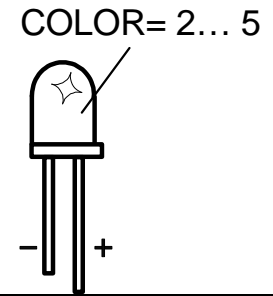
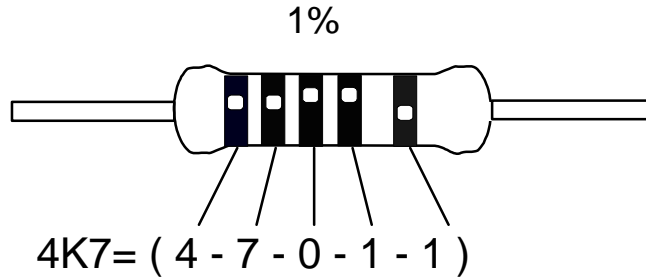
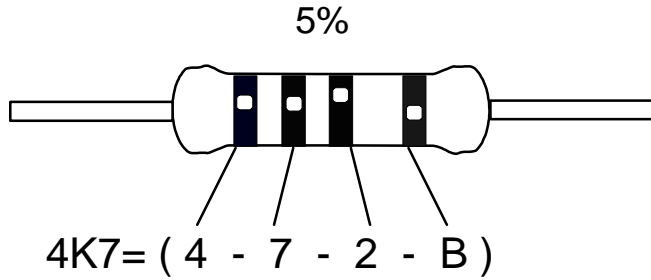
### Features:

- Frequency range from 0.01Hz to 1 MHz.
- Crystal-based stability.
- Optically isolated from the PC.
- Low sine wave distortion.
- TTL level synchronization output.
- Stores up to 32K of waveform points.
- Standard waveforms: Sine, Square, and Triangle.
- Predefined library waveforms included: Noise, Sweep,...
- Includes Windows™ '95/'98/NT/2000 integrated software for the function generator and Velleman PC oscilloscopes.
- You can create your own waveforms with the integrated signal wave editor.
- Can be chained with Velleman PC oscilloscopes to the same PC printer port (LPT1, 2 or 3).

### Specifications:

- Power supply: Standard 12V DC adapter, 800mA (PS1208).
- Direct Digital wave synthesis (DDS), 32K wave table.
- Frequency setting resolution: 0.01%.
- Amplitude range: 100mVpp to 10Vpp @ 600 Ohm output load.
- Amplitude resolution: 0.4% of full scale.
- Offset: from 0 to -5V or +5V max. (resolution: 0.4% of full scale).
- Vertical resolution: 8 bit (0.4% of full scale).
- Maximum sample rate: 32MHz.
- Typical sine wave distortion (THD): < 0.08%.
- Triangle wave linearity: 99% (0 to 100KHz)
- Output impedance: 50 Ohm.
- Dimensions (wxdxh): 235x165x47mm (9.3"x6.5"x1.9").

*Windows™ is a registered trademark of Microsoft® Corporation.*



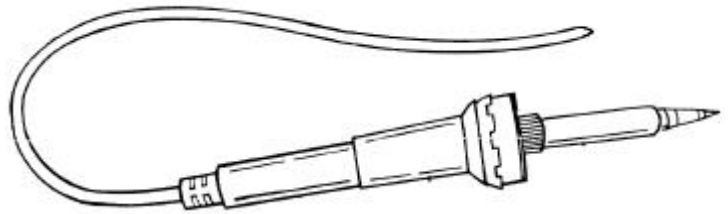
C O D E	I	P	E	SF	S	DK	N	D	GB	F	NL	C O D E
	<i>CODICE COLORE</i>	<i>CODIGO DE CORES</i>	<i>CODIGO DE COLORES</i>	<i>VÄRI KOODI</i>	<i>FÄRG SCHEMA</i>	<i>FARVE KODE</i>	<i>FARGE KODE</i>	<i>FARB KODE</i>	<i>COLOUR CODE</i>	<i>CODIFI- CATION DES COU- LEURS</i>	<i>KLEUR KODE</i>	
0	Nero	Preto	Negro	Musta	Svart	Sort	Sort	Schwarz	Black	Noir	Zwart	0
1	Marrone	Castanho	Marrón	Ruskea	Brun	Brun	Brun	Braun	Brown	Brun	Bruin	1
2	Rosso	Encarnado	Rojo	Punainen	Röd	Rød	Rød	Rot	Red	Rouge	Rood	2
3	Aranciato	Laranja	Naranjado	Oranssi	Orange	Orange	Orange	Orange	Orange	Orange	Oranje	3
4	Giallo	Amarelo	Amarillo	Keltainen	Gul	Gul	Gul	Gelb	Yellow	Jaune	Geel	4
5	Verde	Verde	Verde	Vihreä	Grön	Grøn	Grønn	Grün	Green	Vert	Groen	5
6	Blu	Azul	Azul	Sininen	Blå	Blå	Blå	Blau	Blue	Blue	Blauw	6
7	Viola	Violeta	Morado	Purppura	Lila	Violet	Violet	Violet	Purple	Violet	Paars	7
8	Grigio	Cinzento	Gris	Harmaa	Grå	Grå	Grå	Grau	Grey	Gris	Grijs	8
9	Bianco	Branco	Blanco	Valkoinen	Vit	Hvid	Hvidt	Weiss	White	Blanc	Wit	9
A	Argento	Prateado	Plata	Hopea	Silver	Sølv	Sølv	Silber	Silver	Argent	Zilver	A
B	Oro	Dourado	Oro	Kulta	Guld	Guld	Guldl	Gold	Gold	Or	Goud	B

## 1. Assembly (Skipping this can lead to troubles !)

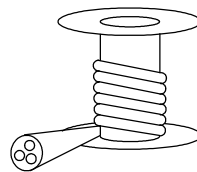
Ok, so we have your attention. These hints will help you to make this project successful.

Read them carefully.

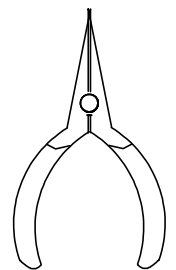
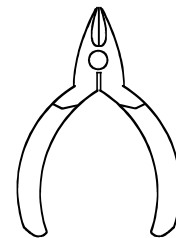
### 1.1 Make sure you have the right tools:





- A good quality soldering iron (25-40W) with a small tip.
- Wipe it often on a wet sponge or cloth, to keep it clean; then apply solder to the tip, to give it a wet look. This is called 'thinning' and will protect the tip, and enables you to make good connections. When solder rolls off the tip, it needs cleaning.



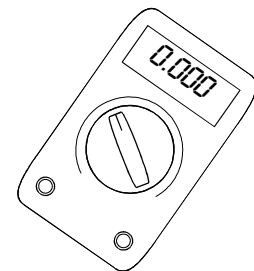
- Thin raisin-core solder. Do not use any flux or grease.
- A diagonal cutter to trim excess wires. To avoid injury when cutting excess leads, hold the lead so they cannot fly towards the eyes.



- Needle nose pliers, for bending leads, or to hold components in place.
- Small blade and phillips screwdrivers. A   basic range is fine.



**For some projects, a basic multi-meter is required, or might be handy**

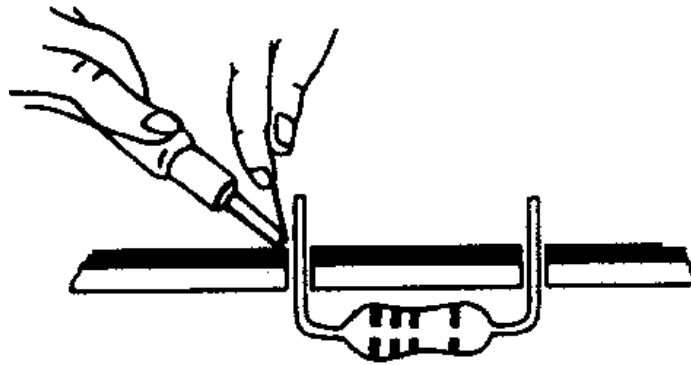


### 1.2 Assembly Hints :

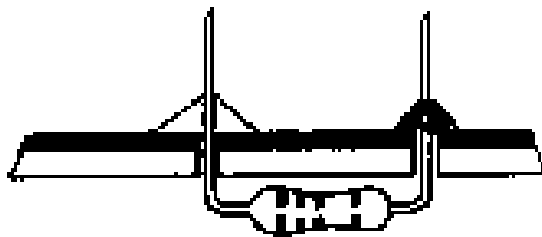
- ⇒ Make sure the skill level matches your experience, to avoid disappointments.
- ⇒ Follow the instructions carefully. Read and understand the entire step before you perform each operation.
- ⇒ Perform the assembly in the correct order as stated in this manual
- ⇒ Position all parts on the PCB (Printed Circuit Board) as shown on the drawings.
- ⇒ Values on the circuit diagram are subject to changes.
- ⇒ Values in this assembly guide are correct\*
- ⇒ Use the check-boxes to mark your progress.
- ⇒ Please read the included information on safety and customer service

\* Typographical inaccuracies excluded. Always look for possible last minute manual updates, indicated as 'NOTE' on a separate leaflet.

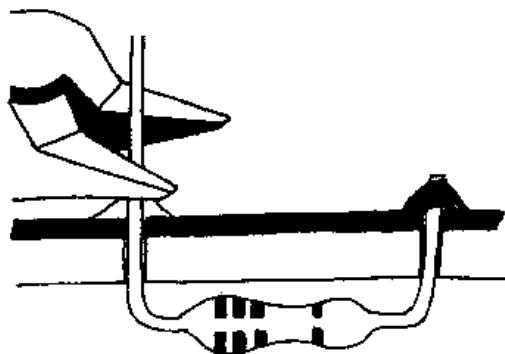
### 1.3 Soldering Hints :



Mount the component against the PCB surface and carefully solder the leads

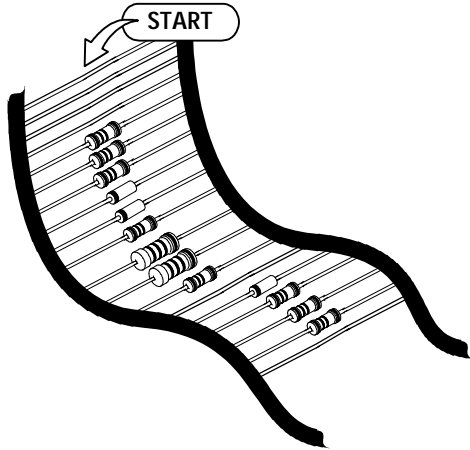


Make sure the solder joints are cone-shaped and shiny



Trim excess leads as close as possible to the solder joint

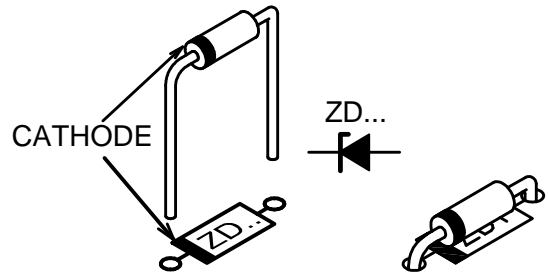
**AXIAL COMPONENTS ARE TAPED IN THE CORRECT MOUNTING SEQUENCE !  
DO NOT CONNECT ANY POWER SOURCE TO THE KIT BEFORE ALL COMPONENTS ARE MOUNTED.**



REMOVE THEM FROM THE TAPE ONE AT A TIME !

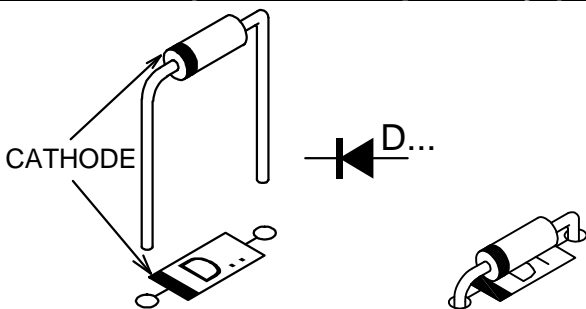
- D16: 1N4148
- D17: 1N4148
- D18: 1N4148
- D19: 1N4148
- D20: 1N4148
- D21: 1N4148
- D22: 1N4148
- D24: 1N4148
- D25: 1N4148
- D35: 1N4007

## 2. ZENERDIODE (Watch the polarity!)



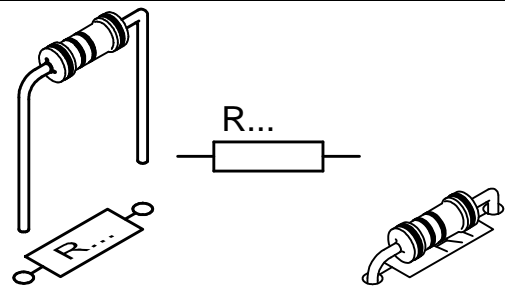
- ZD1: 5V1/0.5W

## 1. DIODES (Watch the polarity!)



- D1: 1N4148
- D2: 1N4148
- D3: 1N4148
- D4: 1N4148
- D5: 1N4148
- D6: 1N4148
- D7: 1N4148
- D8: 1N4148
- D9: 1N4148
- D11: 1N4148
- D12: 1N4148
- D13: 1N4148
- D14: 1N4148
- D15: 1N4148

## 3. 1/2W Metalfilm RESISTORS 1%

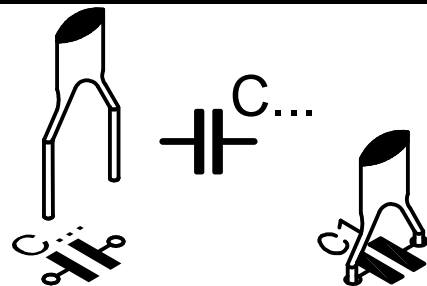


- R1: 10K (1 - 0 - 0 - 2 - 1)
- R2: 1K (1 - 0 - 0 - 1 - 1)
- R3: 1K (1 - 0 - 0 - 1 - 1)
- R4: 1K (1 - 0 - 0 - 1 - 1)
- R5: 1K (1 - 0 - 0 - 1 - 1)
- R6: 100 (1 - 0 - 0 - 0 - 1)
- R7: 100 (1 - 0 - 0 - 0 - 1)
- R8: 100 (1 - 0 - 0 - 0 - 1)
- R9: 100 (1 - 0 - 0 - 0 - 1)
- R10: 100 (1 - 0 - 0 - 0 - 1)
- R11: 100 (1 - 0 - 0 - 0 - 1)
- R12: 100 (1 - 0 - 0 - 0 - 1)

- R13: 200 (2 - 0 - 0 - 0 - 1)
- R14: 200 (2 - 0 - 0 - 0 - 1)
- R15: 1K (1 - 0 - 0 - 1 - 1)
- R16: 470 (4 - 7 - 0 - 0 - 1)
- R17: 9K1 (9 - 1 - 0 - 1 - 1)
- R18: 270K (2 - 7 - 0 - 3 - 1)
- R19: 560K (5 - 6 - 0 - 3 - 1)
- R20: 82K (8 - 2 - 0 - 2 - 1)
- R21: 270K (2 - 7 - 0 - 3 - 1)
- R22: 51K (5 - 1 - 0 - 2 - 1)
- R23: 150K (1 - 5 - 0 - 3 - 1)
- R24: 10K (1 - 0 - 0 - 2 - 1)
- R25: 68K (6 - 8 - 0 - 2 - 1)
- R26: 12K (1 - 2 - 0 - 2 - 1)
- R27: 39K (3 - 9 - 0 - 2 - 1)
- R28: 1K (1 - 0 - 0 - 1 - 1)
- R29: 10K (1 - 0 - 0 - 2 - 1)
- R30: 10K (1 - 0 - 0 - 2 - 1)
- R31: 10K (1 - 0 - 0 - 2 - 1)
- R32: 4K7 (4 - 7 - 0 - 1 - 1)
- R33: 47 (4 - 7 - 0 - B - 1)
- R34: 2K2 (2 - 2 - 0 - 1 - 1)
- R35: 1K (1 - 0 - 0 - 1 - 1)
- R36: 1K (1 - 0 - 0 - 1 - 1)
- R37: 10K (1 - 0 - 0 - 2 - 1)
- R38: 1M (1 - 0 - 0 - 4 - 1)
- R39: 10K (1 - 0 - 0 - 2 - 1)
- R40: 200 (2 - 0 - 0 - 0 - 1)
- R41: 200 (2 - 0 - 0 - 0 - 1)
- R42: 200 (2 - 0 - 0 - 0 - 1)
- R43: 200 (2 - 0 - 0 - 0 - 1)
- R44: 100 (1 - 0 - 0 - 0 - 1)
- R45: 47 (4 - 7 - 0 - B - 1)
- R46: 1K (1 - 0 - 0 - 1 - 1)
- R47: 1K (1 - 0 - 0 - 1 - 1)
- R48: 1K (1 - 0 - 0 - 1 - 1)
- R49: 470 (4 - 7 - 0 - 0 - 1)
- R50: 4K7 (4 - 7 - 0 - 1 - 1)
- R51: 10K (1 - 0 - 0 - 2 - 1)

- R52: 10K (1 - 0 - 0 - 2 - 1)
- R53: 10K (1 - 0 - 0 - 2 - 1)
- R54: 20K (2 - 0 - 0 - 2 - 1)
- R55: 2K (2 - 0 - 0 - 1 - 1)
- R56: 470 (4 - 7 - 0 - 0 - 1)
- R57: 1K (1 - 0 - 0 - 1 - 1)
- R58: 10K (1 - 0 - 0 - 2 - 1)
- R59: 560K (5 - 6 - 0 - 3 - 1)
- R60: 330 (3 - 3 - 0 - 0 - 1)
- R61: 47K (4 - 7 - 0 - 2 - 1)
- R62: 1K (1 - 0 - 0 - 1 - 1)
- R63: 330 (3 - 3 - 0 - 0 - 1)
- R64: 560K (5 - 6 - 0 - 3 - 1)
- R69: 100 (1 - 0 - 0 - 0 - 1)
- R74: 100 (1 - 0 - 0 - 0 - 1)
- R75: 100 (1 - 0 - 0 - 0 - 1)
- R76: 100 (1 - 0 - 0 - 0 - 1)
- R79: 4K7 (4 - 7 - 0 - 1 - 1)
- R84: 2K (2 - 0 - 0 - 1 - 1)
- R85: 2K (2 - 0 - 0 - 1 - 1)
- R86: 2K (2 - 0 - 0 - 1 - 1)

#### 4. CERAMIC CAPACITORS

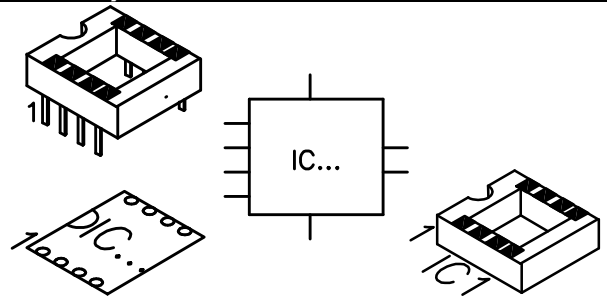


- C1: 100nF (104 -  $\mu$ 1)
- C2: 100nF (104 -  $\mu$ 1)
- C3: 100nF (104 -  $\mu$ 1)
- C5: 100pF (101)
- C6: 33pF (33)
- C8: 1nF (102)
- C9: 100nF (104 -  $\mu$ 1)
- C10: 10nF (103)

- C12: 100nF (104 -  $\mu$ 1)
- C17: 100nF (104 -  $\mu$ 1)
- C20: 100nF (104 -  $\mu$ 1)
- C23: 100nF (104 -  $\mu$ 1)
- C25: 100nF (104 -  $\mu$ 1)
- C26: 100nF (104 -  $\mu$ 1)
- C27: 100nF (104 -  $\mu$ 1)
- C28: 100nF (104 -  $\mu$ 1)
- C29: 100nF (104 -  $\mu$ 1)
- C30: 100nF (104 -  $\mu$ 1)
- C31: 100nF (104 -  $\mu$ 1)
- C32: 10pF (10)
- C34: 100nF (104 -  $\mu$ 1)
- C35: 100nF (104 -  $\mu$ 1)
- C36: 100nF (104 -  $\mu$ 1)
- C37: 100nF (104 -  $\mu$ 1)
- C38: 100nF (104 -  $\mu$ 1)
- C39: 100nF (104 -  $\mu$ 1)
- C40: 82pF (82)
- C41: 100nF (104 -  $\mu$ 1)
- C42: 100nF (104 -  $\mu$ 1)
- C43: 100nF (104 -  $\mu$ 1)
- C44: 100nF (104 -  $\mu$ 1)
- C45: 470nF (474)
- C46: 100nF (104 -  $\mu$ 1)
- C49: 100nF (104 -  $\mu$ 1)
- C50: 100nF (104 -  $\mu$ 1)
- C51: 100nF (104 -  $\mu$ 1)
- C53: 100nF (104 -  $\mu$ 1)
- C54: 100nF (104 -  $\mu$ 1)
- C55: 100nF (104 -  $\mu$ 1)
- C56: 100nF (104 -  $\mu$ 1)
- C57: 100nF (104 -  $\mu$ 1)
- C58: 100nF (104 -  $\mu$ 1)
- C59: 100nF (104 -  $\mu$ 1)
- C64: 100nF (104 -  $\mu$ 1)
- C75: 100nF (104 -  $\mu$ 1)
- C76: 100nF (104 -  $\mu$ 1)
- C79: 100nF (104 -  $\mu$ 1)

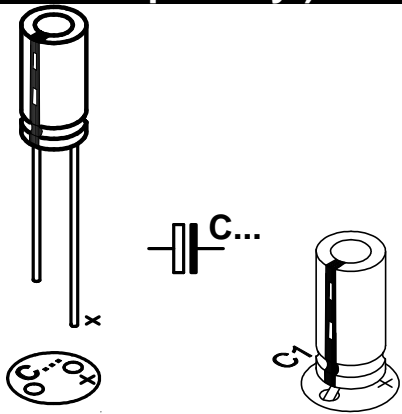
## 5. IC SOCKET

(Watch the position of the notch!)



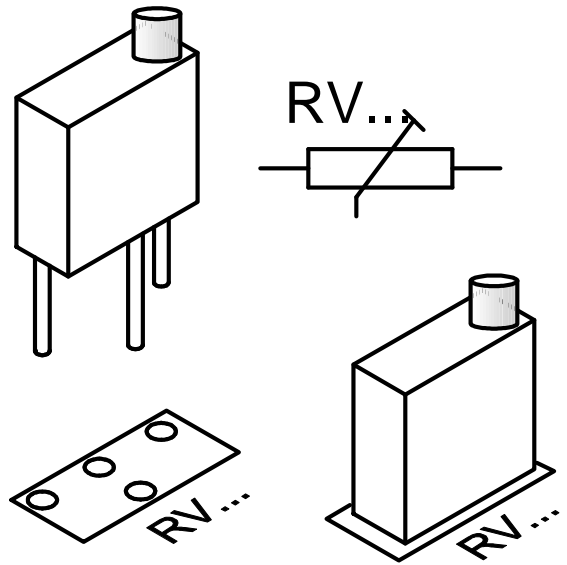
- IC2: 16P
- IC3: 16P
- IC4: 16P
- IC5: 16P
- IC6: 16P
- IC7: 16P
- IC8: 16P
- IC9: 14P
- IC10: 28P
- IC11: 16P
- IC13: 8P
- IC14: 16P
- IC15: 14P
- IC18: 16P
- IC19: 16P
- IC20: 8P
- IC21: 16P
- IC22: 24P
- IC24: 8P
- IC33: 8P
- IC35: 8P
- IC36: 8P
- IC37: 8P
- IC48: 16P
- IC49: 16P
- IC50: 16P

## 6. ELECTROLYTIC CAPACITORS (Watch the polarity!)



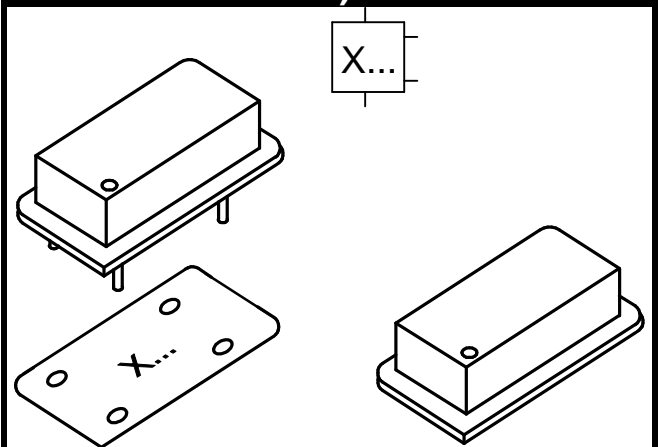
- C4: 4 $\mu$ 7
- C7: 1 $\mu$ F
- C11: 4 $\mu$ 7
- C13: 100 $\mu$ F
- C14: 100 $\mu$ F
- C15: 100 $\mu$ F
- C16: 100 $\mu$ F
- C18: 4 $\mu$ 7
- C19: 100 $\mu$ F
- C21: 4 $\mu$ 7
- C22: 100 $\mu$ F
- C24: 100 $\mu$ F
- C33: 10 $\mu$ F
- C47: 4 $\mu$ 7
- C48: 100 $\mu$ F
- C71: 100 $\mu$ F
- C77: 1 $\mu$ F
- C101: 4 $\mu$ 7
- C102: 4 $\mu$ 7
- C103: 4 $\mu$ 7
- C104: 4 $\mu$ 7

## 7. MULTITURN TRIMMER



- RV1: 2K (K002TW)

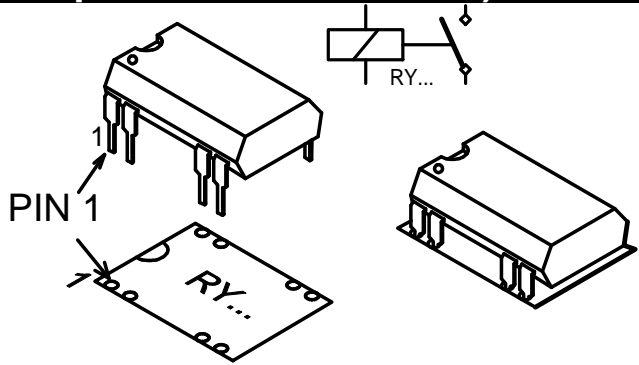
## 8. OSCILLATOR (Watch the position of the notch!)



- X1: 32MHz. (XO32)

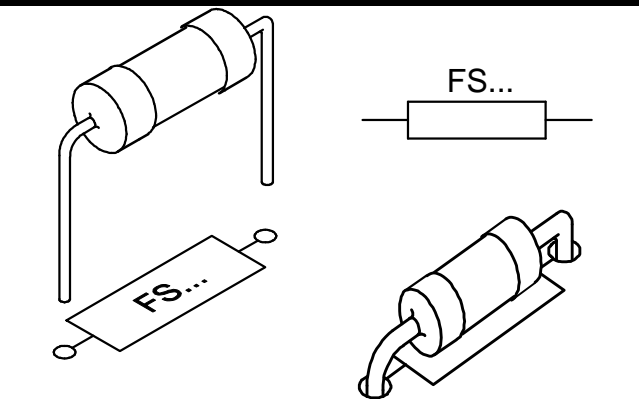


## 9. REED RELAY (Watch the position of the notch!)



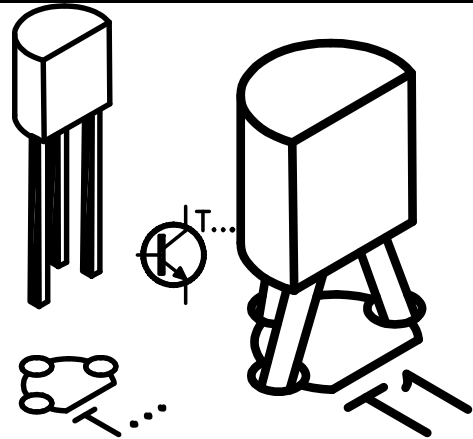
RY1: VR05R051A

## 10. PICO FUSE

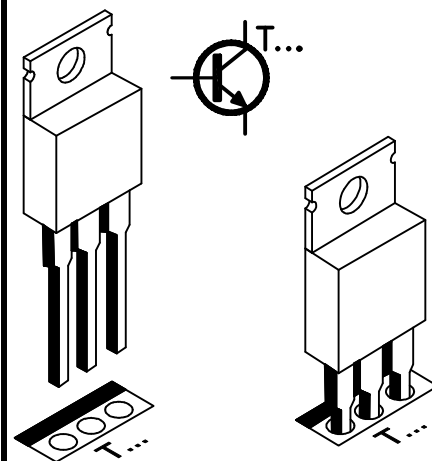


FS1: 1A Fast (PFU1)

## 11. TRANSISTORS

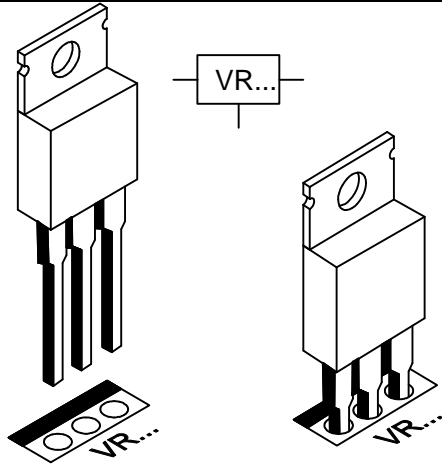


- T1: BC337
- T2: BC327
- T3: BC337
- T4: BC327
- T5: BC337
- T6: BC337
- T7: BC337
- T8: BC327
- T9: BC337
- T10: BC337
- T11: BC337
- T13: BC337
- T14: BC337
- T15: BC327

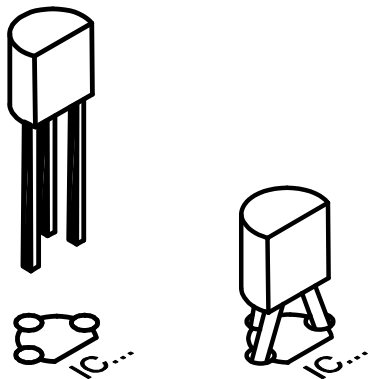


T16: TIP42 (TIP32)

## 12. VOLTAGE REGULATORS

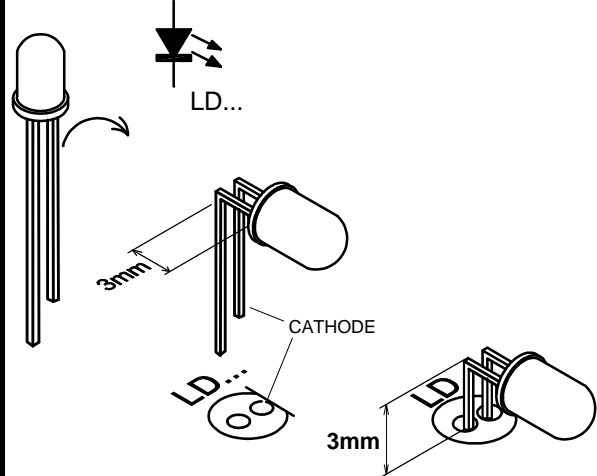


- IC1: 7912 (UA7912)
- IC12: 7812 (UA7812)
- IC17: 7805 (UA7805)



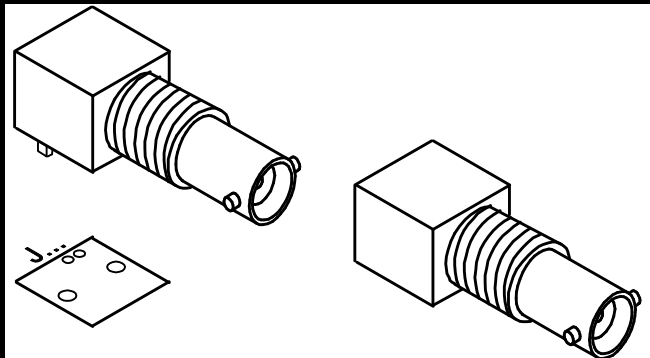
- IC16: 79L05 (UA79L05)

## 13. LED MOUNTING (Watch the polarity!)

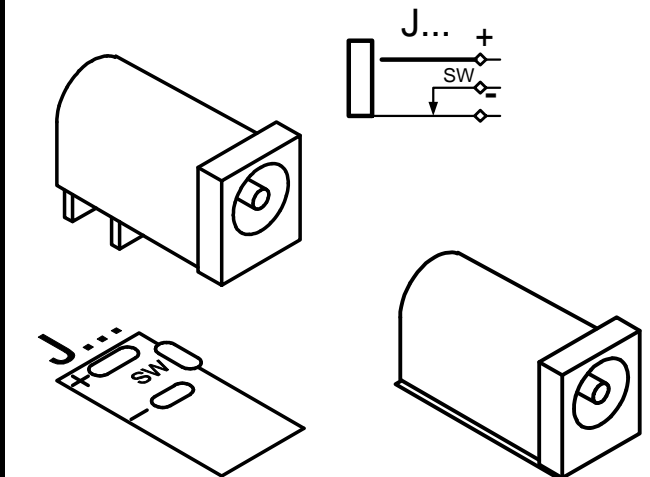


- LD1: LED 3mm. RED
- LD2: LED 3mm. RED

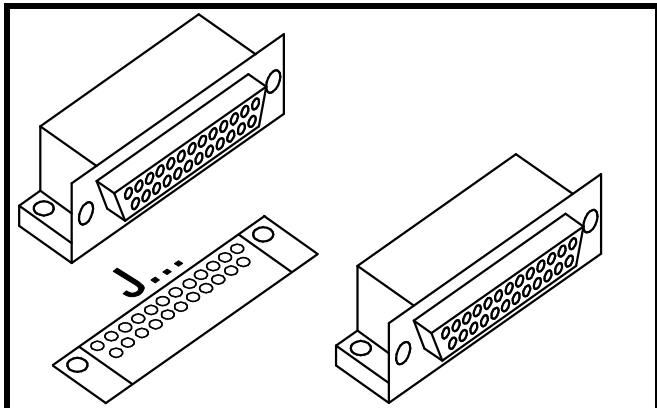
## 14. CONNECTORS



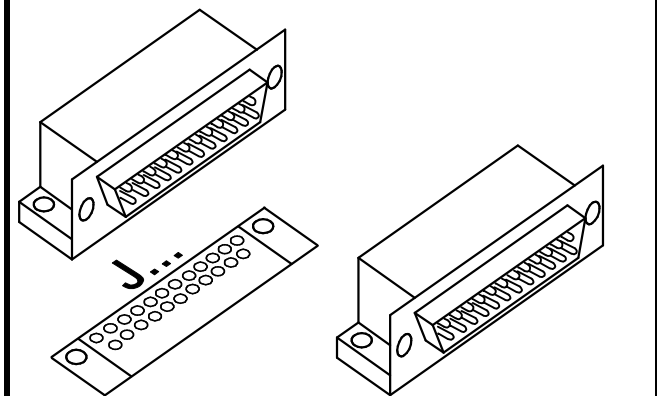
- J6: BNC CONNECTOR PCB
- J8: BNC CONNECTOR PCB



- J14: POWER (DJ-005)

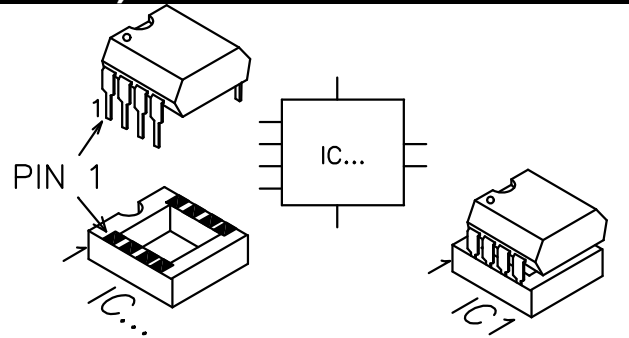


J5: 25P SUB-D, FEMALE !  
(Connection: TO PC-SCOPE)



J7: 25P SUB-D, MALE !  
(Connection: FROM PRINTER PORT)

### 15. IC (Watch the position of the notch!)



- IC2: 74HC595
- IC3: 74HC595
- IC4: 74HC4518
- IC5: 74HC595
- IC6: TDA8702
- IC7: 74F161
- IC8: 74HC162
- IC9: 74HC14
- IC10: CY7C199
- IC11: 74HC4518
- IC13: AD811
- IC14: 74HC4051
- IC15: 74HC132
- IC18: 74HC4051
- IC19: 74HC595
- IC20: 6N136
- IC21: 74HC595
- IC22: VK8016 (GAL22V10)
- IC24: TL081 (TL081CP)
- IC33: AD811
- IC35: 6N136
- IC36: 6N136
- IC37: 6N136
- IC48: 74F161
- IC49: 74F161
- IC50: 74F161

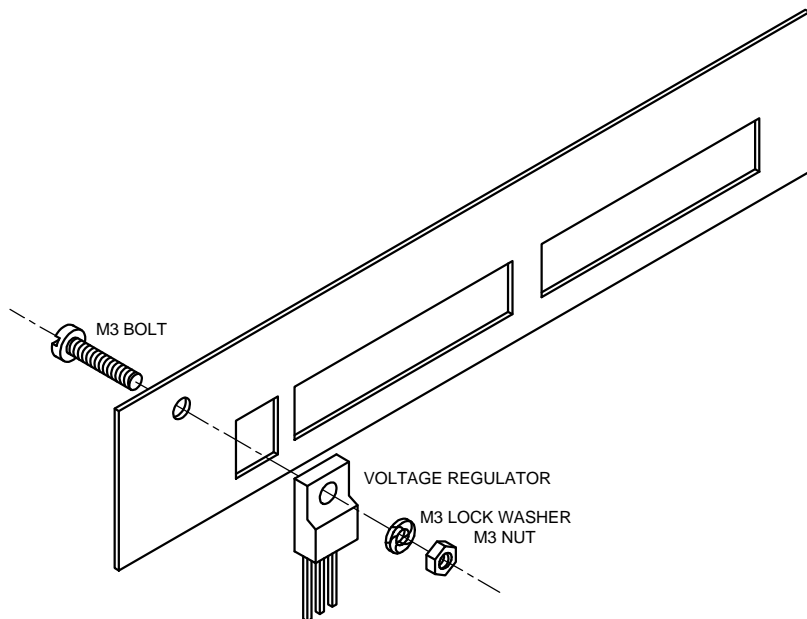
## 16. VOLTAGE REGULATOR & ASSEMBLING

### ❑ IC23: 7805 (UA7805P)

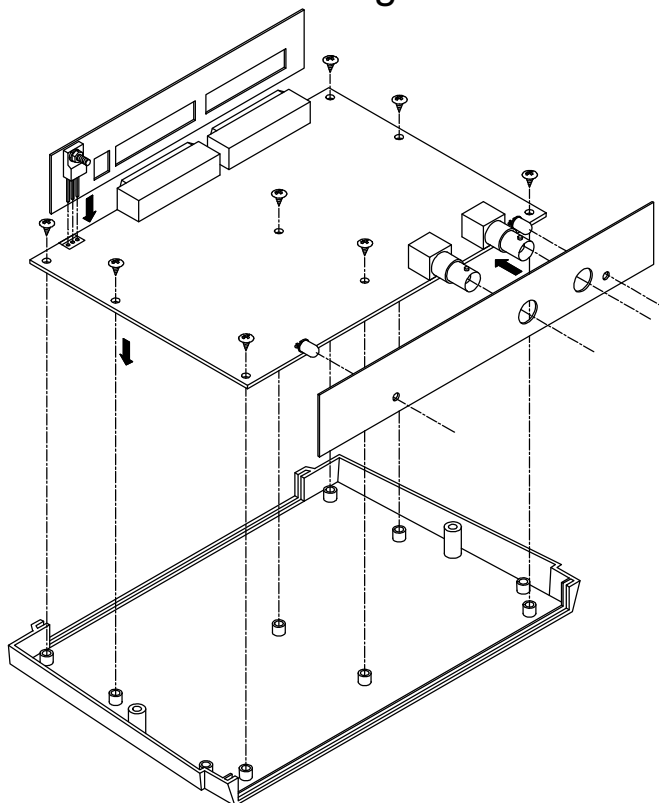
*This regulator must be a plastic type !*

**Attention :** The voltage regulator is a fully isolated (plastic) type because it has to be isolated galvanically from the rear panel. Mount the voltage regulator on the rear panel and fasten it with the supplied M3 bolt, washer and nut as shown on the drawing.

Position the PCB together with the front and rear panel in the bottom half of the enclosure. Now the voltage regulator can be soldered at the component side of the PCB, not at the solder side. Do not fasten the PCB yet.



### ❑ Assemble the enclosure as following.



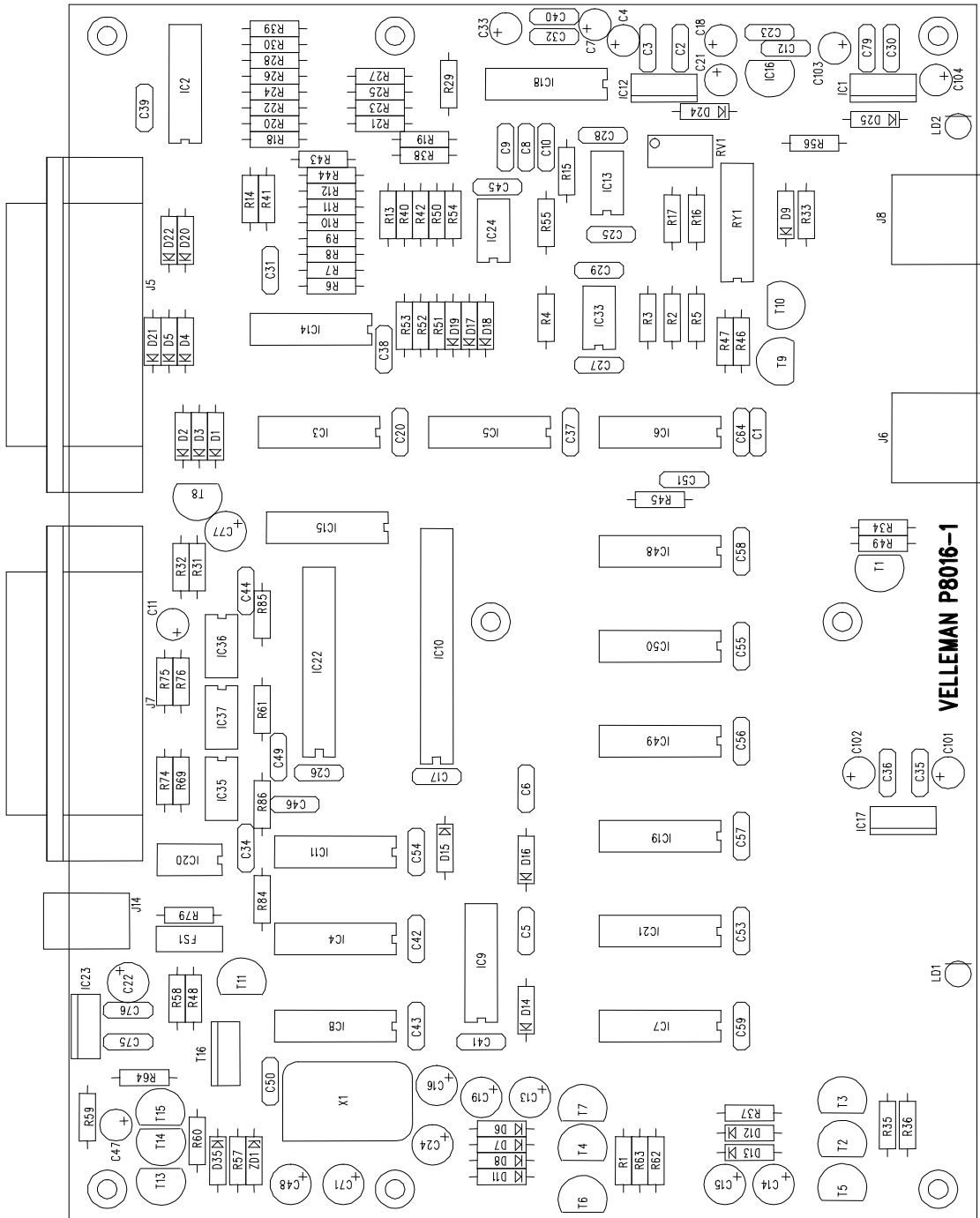
## 17. CALIBRATION

To allow calibration, the unit must be connected to the computer and the supplied software must be installed. Please consult the 'Getting Started' manual for details on the connection and installation procedure.

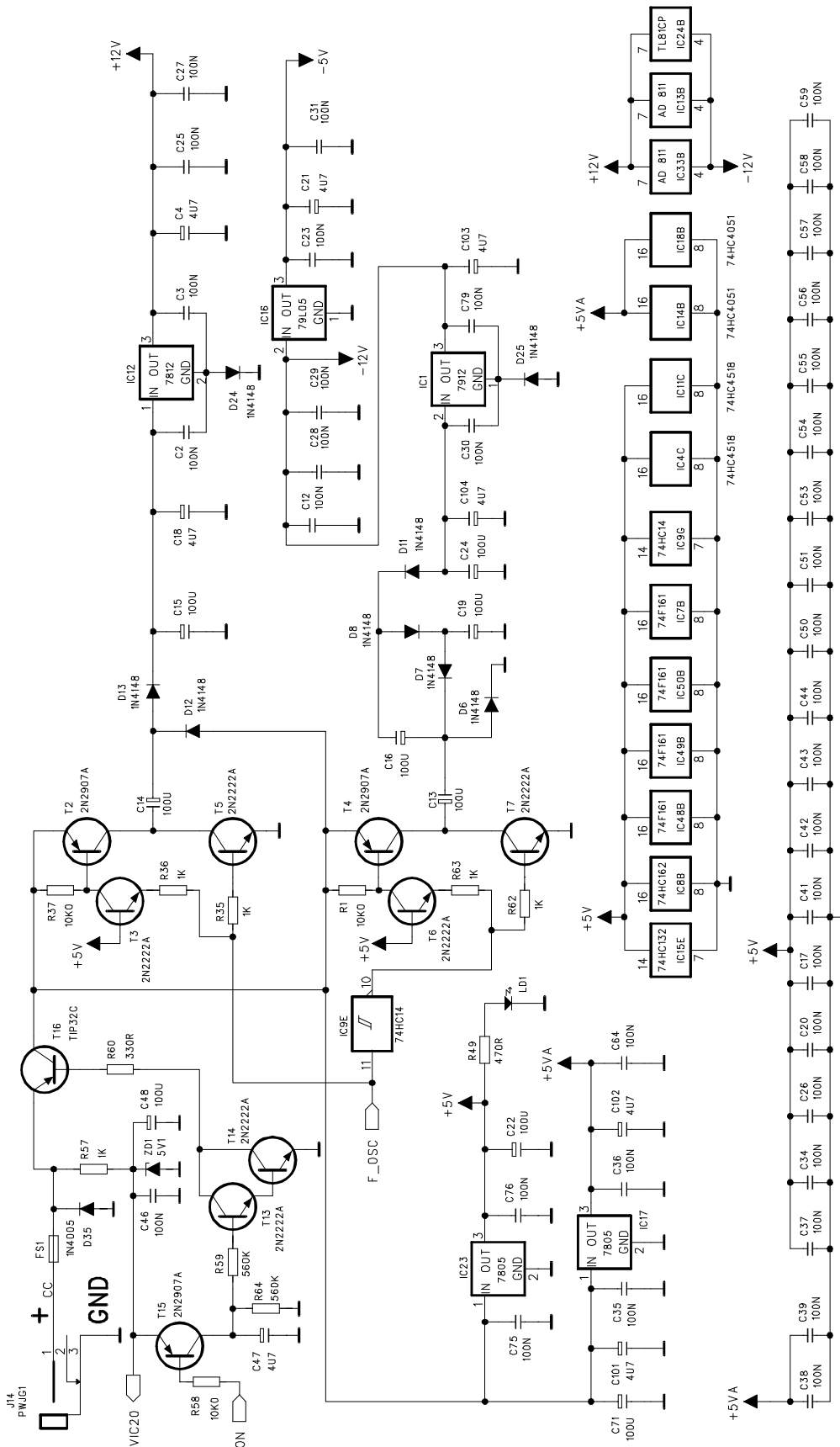
- Select the function generator module [Function generator].
- Select the correct parallel port [Options > Hardware setup].
- Check if the 'POWER ON' (LD1) LED lights. If it does not light, check the complete assembly and check the parallel port settings in the options-hardware setup of the software.
- Make sure the frequency is set to 1000Hz (1KHz). Adjust if necessary (1).
- Make sure the offset is set to 0V. Adjust if necessary (6).
- Make sure the amplitude is set to 5Vpp. Adjust if necessary (7).
- Select sinewave output (4). Readout (9) should now show a sine wave and the 'READY' LED (LD2) should light.
- Connect a digital multimeter to the 'signal out' connector of the generator. Set it to DC volts. Adjust the multi-turn trimmer RV1 until the multimeter displays zero volts. If necessary, adjust the range of the meter to obtain a higher resolution. Now you can check the waveform, using an oscilloscope or one of our PC- or handheld scopes
- If for some the measured values are totally off, please inspect the complete assembly, paying special attention to the solder joints, component positioning and values.
- If everything went well, you can fasten the PCB with the supplied screws, and close the enclosure lid.

*Your function generator is now ready for use !*

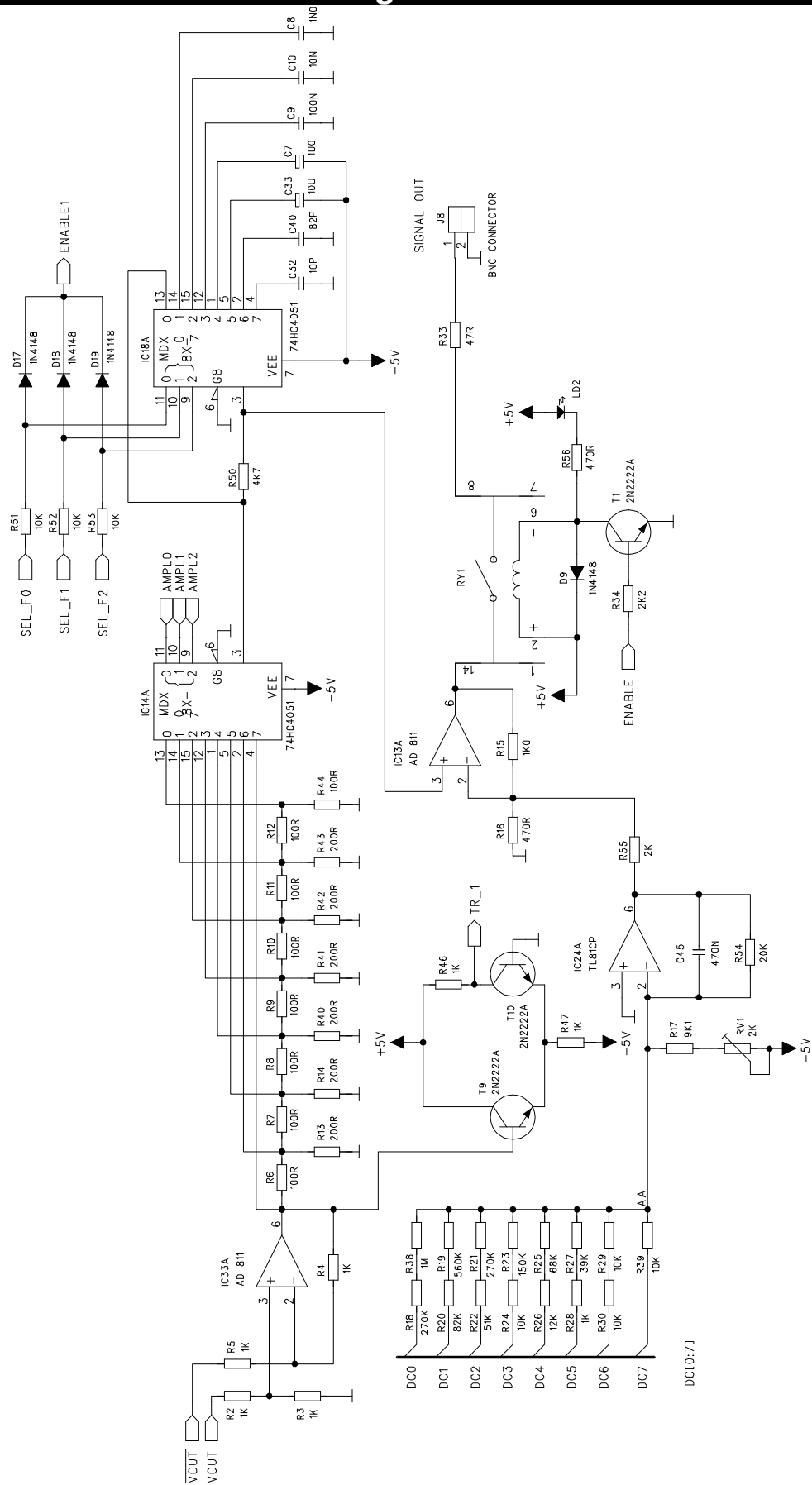
# 18. PCB (Component side).



# 19. SCHEMATIC DIAGRAM: Power supply section.



## 20. SCHEMATIC DIAGRAM: Analogue section.





# 21. SCHEMATIC DIAGRAM: Digital section.

