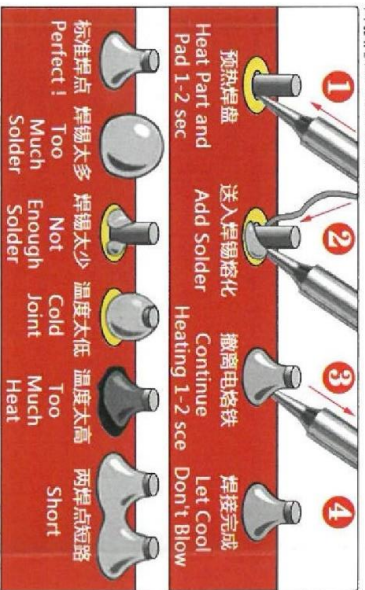


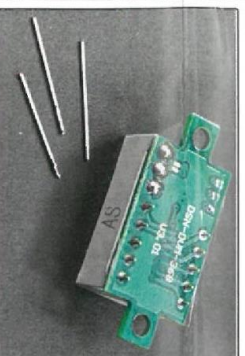
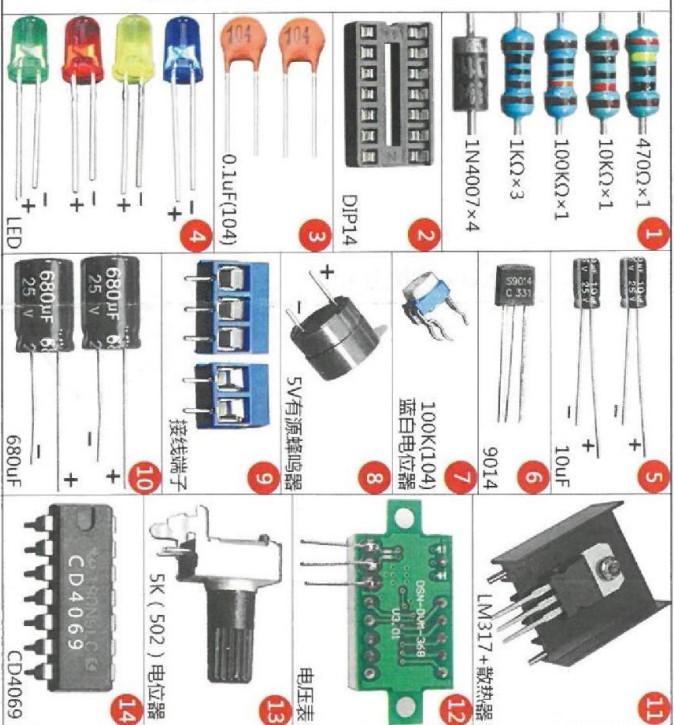
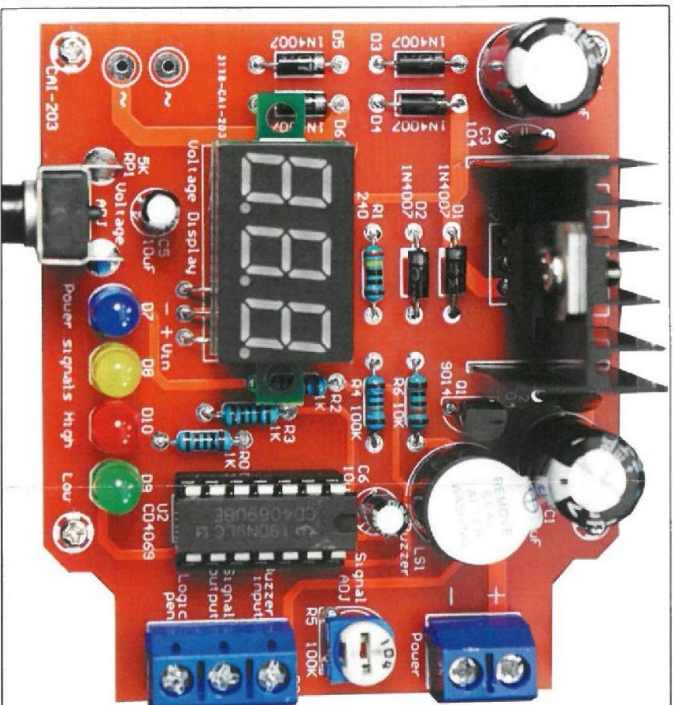
LM317可调稳压电源安装教程 (CAI-203)

Installation instructions of LM317 adjustable voltage-stabilized source

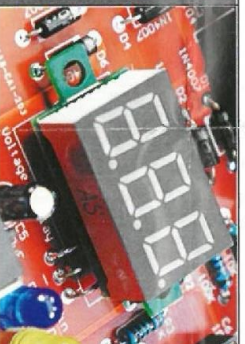
焊接方法 How to Solder



序号	名称	型号	数量	安装位置
1	1/4W电阻器	240Ω (红黄黑黑漆)	1	R1
2	1/4W电阻器	10KΩ (棕黑黑红棕)	1	R6
3	1/4W电阻器	100KΩ (棕黑黑棕漆)	1	R4
4	1/4W电阻器	1KΩ (棕黑黑棕漆)	3	R0, R2, R3
5	1N4007	1N4007	6	D1,D2,D3, D4, D5, D6
6	管座	DIP-16	1	U2
7	瓷片电容	0.1uF (104)	2	C2, C3
8	发光二极管5mm	5mm-B-B	1	D7
9	发光二极管5mm	5mm-G-G	1	D9
10	发光二极管5mm	5mm-R-R	1	D10
11	发光二极管5mm	5mm-Y-Y	1	D8
12	电解电容器	10uF	2	C5, C6
13	三极管	9014	1	Q1
14	蓝白电位器	100K (104)	1	R5
15	有源蜂鸣器	5V-12*9.5mm	1	L51
16	接线端子	KF301 3Pin	1	P1
17	接线端子	KF301 3Pin	1	P2
18	电解电容器	680uF/25V	2	C1, C4
19	集成电路	LM317T	1	U1
20	散热器	25*23*16+2PIN	1	用螺丝固定LM317
21	电位器	RV09 5K (502)	1	RP1
22	集成电路	CD4069	1	U2
23	电压表	DC 0-30V 0.36*3	1	用多余的元件引脚安装
24	变压器	AC 12V-2.5W	1	
25	电源线	2*0.5*1M	1	
26	鳄鱼夹	4cm	2	
27	导线	0.25*2*20CM	2	
28	热缩管	φ3mm*50mm	1	电源线接头
29	电路板	CAI-203 72*62	1	
30	螺母	M2	5	固定外壳
31	螺母	M3	2	固定变压器
32	螺丝	M2*6	2	固定外壳
33	螺丝	M3*6	3	固定变压器与散热器
34	自攻螺丝	PA1.7*5	5	固定电路板
35	外壳	112*69*40MM	1	
36	电位器插	15X17mm 6MM	1	
37	说明书	含电路图 安装步骤	1	



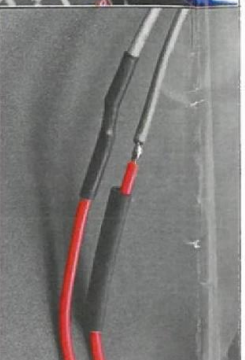
将电压表的引线去掉, 用多余的元件引脚焊接上去, 旁边两个小焊盘不能短路。 Remove the leads from the voltmeter and solder them with extra component pins. The two small pads on the side must not be shorted.



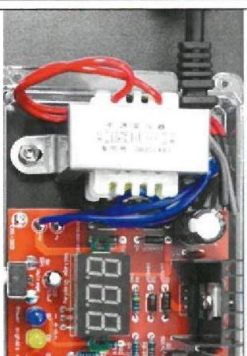
如上图所示, 将电压表焊接在电路板上。 Install the voltmeter on the PCB as shown in the figure above.



用螺丝固定变压器, 将蓝线(不分正负极)焊接在电路板~位置。 Secure the transformer with screws and solder the blue wire (regardless of positive and negative electrodes) to the board ~ position.



变压器的红线(不分正级)接电源线, 套上热缩管, 给热缩管加热收缩。 The red wire of the transformer is connected with the power supply wire and sheathed with the shrinkage tube to heat and tighten the heat shrinkage tube.



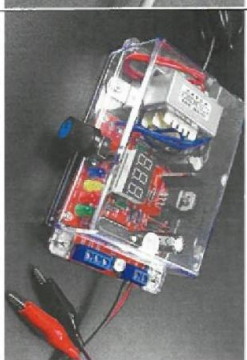
将变压器的线理顺。 Straighten out the wires of the transformer.



将红黑导线剥出5mm左右的铜线, 并上锡。 Peel the red and black lead out of the copper wire approx. 5mm and add solder.



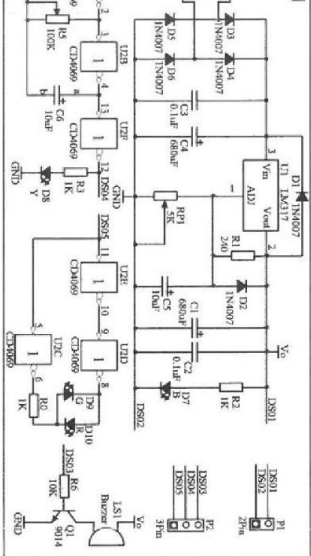
将鳄鱼夹夹在螺丝刀上, 将导线焊接上。 Clip the crocodile clip onto the screwdriver and weld the lead.



将外壳装配上, 接上鳄鱼夹导线, 安装完成。 Fit housing and attach crocodile clip lead. Installation completed.



电路原理图



一、电路工作原理

电路由稳压电路、信号发生电路、逻辑笔电路、蜂鸣器电路组成。电路中使用的变压器为 2.5W，功率比较小，输出电流 $\approx 200\text{mA}$ 。所以该电源只适用于教学实训使用，只能给一些小电路供电。不能给手机充电，如果接入大功率，会出现电压降低或电压波动现象。
LM317 的电压调节范围是 1.25-37V，本电路设置的调节范围是 1.25-12V，因为电路上有 CD4069，其最高工作电压不能超过 15V。所以不能随意增加输入电压。

1、稳压电路：变压器将市电降压为 12V 交流电，通过 D3、D4、D5、D6 组成的桥式整流电路变成直流电。C4 是输入滤波电容，抑前输入电压纹波。C1 是输出滤波电容，用于缓冲感性负载，保证电路稳定工作。由于电容 C1 的存在，容易在电容放电而损坏 LM317，若外接保护二极管 D1，电容 C1 放电时，便可以通过 D1 放电，从而保护 LM317。C5 为调节端滤波电容，具有稳定输出的作用。D2 是为了防止 C5 放电时损坏 LM317 的保护二极管。D7 蓝色 LED 为电压输出工作指示。R2 是 D7 的限流电阻。R1 和 RP1 组成可调输出的电阻网络，改变 RP1 的阻值即可调整输出电压值，电阻 R1 的阻值为 120-240 Ω ，输出电压计算公式： $U_o = (1 + R_{P1}/R_1) \times 1.25$ 。
2、信号发生器电路：U2A、U2B、R5、C6 组成非门振荡电路，假设 U2B 输出为高电平，此时保证 U2B 输出脉冲为高电平，随着 C6 电容的充电，C6 充电为 a+、b- 的电压，电容的 b 端负电压使得 U2A 输入电压下降，当电压降到非门关断电压时，U2A 输出高电平，则 U2A 输出低电平，由于 U2A 输出高电平，则对电容 C6 进行反向充电，U2A 输出低电平，先是原来的 a+、b- 与 a-、b+ 电荷的中和，然后电容 C6 为 b+、a- 的电压充电，当 b 端电压上升到使 U2A 开门电平时，U2A 输出高电平，如此循环，产生方波。方波信号通过 U2F 反向后输出，同时通过 D8 黄色 LED 指示方波状态。通过调节 R5 的阻值可以调节方波的时间，从而调节振荡频率。
3、逻辑笔电路：DS05 为逻辑电平输入端。当输入端为高电平时，U2E 输出为高电平，U2D 输出为低电平，因 U2C 输出为高电平，所以 D9 亮（绿色 LED），表示低电平。当输入端为低电平时，U2E 输出为低电平，U2D 输出为高电平，因 U2C 输出为低电平，所以 D10 亮（红色 LED），表示高电平。如果输入端悬空，容易受外界干扰而处于不确定状态。
4、蜂鸣器电路：由三极管 Q1 和蜂鸣器组成，经三极管基极（DS03）加入高电平，蜂鸣器发声，例如用导线将 DS03 与电源正连接，如果导线是通的，则三极管导通，蜂鸣器发声，如果导线是断的，则三极管截止，蜂鸣器不发声，通过这个原理可以用来测试导线通断。同理，如果将 DS03 端加入低频方波信号，则三极管断续导通，蜂鸣器则发出断续的滴-滴-滴声。

二、安装说明

- 1、先安装好的元器件，再安装差的元器件，电阻器没有正负极，电解电容的长脚是正极。1N4007 的圆圈位置对应电路板黑色标记位置，蜂鸣器的长脚是正极，发光二极管的长脚是正极，CD4069 集成电路先安装座子，其缺口位置对应电路板缺角标记位置。
- 2、IM317 的先用 3mm 的螺丝将 IM317 固定在散热器上，再焊接 LM317。
- 3、安装电压表时，将 3 根导线去掉，焊接上 3 根元件引脚，对应电压表的位置。+ Vin 焊接在电路板上。
- 4、变压器的接线无正负之分，但需要注意的红线（初级）接强电，蓝线（次级）接电路板的-位置。并用 3mm 的螺丝将变压器固定在壳上，用自攻螺丝将电路板固定好。
- 5、变压器接电源线的线头需要加保护，防止短路和触电，用热缩管将焊接好的电源线套上，然后用电烙铁烫一下将线头包裹住。
- 6、用 2mm 的螺丝将外壳的 4 周围固定好。
- 7、安装蜂鸣器：先将皮套按颜色套入导线，再将导线焊接在夹子上。

三、故障排查

出现故障首先要检查元件是否安装错误，焊接是否良好，特别是焊接新手，焊点很容易出现不良，主要表现在焊点不光滑，毛刺多，引脚过长导致引脚旁边的焊盘短路，焊点杂物多，这些都是导致故障的主要原因。
电压调节不了或调范围很小：1、检查电压表背面靠近 3 个引脚旁边有两个小焊盘，不能短路。2、检查电阻 R1 有没有安装错误。
3、用万用表测量 RP1 的电阻是否可变。
没有信号输出或逻辑笔不工作：检查 CD4069 方向有没有接反。检查 CD4069 的 7 脚和 14 脚之间有没有 3V 以上的电压。如果自测电压超过了 15V，有可能是 CD4069 损坏。
蜂鸣器不响：检查 9014 有没有安装错误，检查蜂鸣器的正负有没有接反。
将电压表的引线去掉，用多余的元件引脚焊接上去，旁边两个小焊盘不能短路。

I. Principle of circuit operation

The circuit is composed of voltage regulator circuit, signal generator circuit, logic pen circuit and buzzer circuit. The transformer used in the circuit is 2.5W, the power is small, and the output current is about 200mA. Therefore, the power supply is only suitable for teaching and training, and can only supply power to some small circuits. You can't charge your phone. If a large load is connected, voltage drop or voltage fluctuation will occur.

The voltage regulation range of the LM317 is 1.25-37V, and the regulation range set by this circuit is 1.25-12V because there is a CD4069 on the circuit and the maximum operating voltage cannot exceed 15V. Therefore, the input voltage cannot be arbitrarily increased.

1. Voltage regulator circuit: The transformer reduces the mains power to 12V AC power, and converts it into DC power through the bridge rectifier circuit composed of D3, D4, D5 and D6. C4 is the input filter capacitor that suppresses input voltage ripple. C1 is that output filter capacitor used to cushion the impact load and ensure stable operation of the circuit. Because of the existence of the capacitor C1, the LM317 is easily damaged by capacitive discharge. When the capacitor C1 is discharged by the external protection diode D1, the LM317 can be protected by discharging the capacitor C1 through D1. C5 is that filter capacitor at the regulating end and has the function of stabilize the output. D2 is a protection diode for preventing damage to the LM317 during discharge of the C5. The D7 blue LED is the voltage output operation indication, and R2 is the current limiting resistor for D7. R1 and RP1 form a resistive network with adjustable output. The output voltage can be adjusted by changing the resistance of RP1. The resistance of R1 is 120-240 Ω . The output voltage is calculated as $U_o = (1 + R_{P1}/R_1) \times 1.25$.

2. Signal generator circuit: U2A, U2B, R5 and C6 form a non-gate oscillation circuit. Assuming the U2B output is high, since the voltage across capacitor C6 cannot be abrupt, then the U2A input is also high. The U2A output is low as well as the U2B input. The output at U2B is high. At this point, the output pulse of U2B is guaranteed to be high. With the charging of the C6 capacitor, the C6 is charged to the voltage of a+, b-, and the negative voltage at the terminal b of the capacitor decreases the input voltage of the U2A. When the voltage drops to the non-gate-off voltage, the U2A outputs a high level and the U2B outputs a low level. Since the U2A outputs a high level, the capacitor C6 is reverse charged. As the voltage at terminal b rise to the open level of U2A, U2A outputs a low level and U2B output a high level, so that a square wave is generated. The square wave signal is output backwards through U2F, while the square wave status is indicated through the D8 yellow LED. By adjusting the resistance value of R5, the charge and discharge time can be adjusted, thereby adjusting the oscillation frequency.

3. Logic pen circuit: DS05 is the logic level input. When the input is low, the U2E output is high, the U2D output is low, and since the U2C output is high, D9 is bright (green LED), indicating low. When the input is high, the U2E output is low, the U2D output is high, and since the U2C output is low, D10 is bright (red LED), indicating high. If the input is floating, it is vulnerable to external interference and is in an uncertain state.

4. Buzzer circuit: It is composed of transistor Q1 and buzzer. When high level is added to the transistor base (DS03), the buzzer produces sound. For example, the DS03 is connected to the power supply by a wire. If the wire is on, the transistor turns on and the buzzer sounds. If the wire is broken, the transistor turns off and the buzzer does not sound. This principle can be used to test the wire on and off. Similarly, if a low frequency square wave signal is added to the DS03 terminal, the transistor is intermittently turned on, and the buzzer emits intermittent drop-drop-drop sound.

II. Installation instructions

1. Install the low component first, then install the high component, the resistor has no positive and negative electrode, the long pin of the electrolytic capacitor is the positive electrode, the black circle position of 1N4007 corresponds to the black mark position of the PCB, the long pin of the buzzer is the positive electrode, the long pin of the light emitting diode is the positive electrode, the integrated circuit CD4069 first installs the seat, the notch position corresponds to the PCB with notch mark position.
2. The LM317 is first fixed to the radiator with a screw of 3mm, and then welded to the LM317.
3. When installing the voltmeter, remove the 3 wires, solder the 3 component pins, and solder the corresponding voltmeter position. + Vin to the PCB.
4. There is no difference between positive and negative electrodes in the connection of transformer, but it should be noted that the red wire (primary) is connected with strong current, and the blue wire (secondary) is connected with - position of PCB. The transformer is fixed on the housing with 3mm screws, and the PCB is fixed with tapping screws.
5. Protect the ends of the power supply wires connected to the transformer from short circuit and electric shock. Sleeve the welded power supply wires with heat shrinkable tubes, and then wrap the ends with electric soldering iron.
6. Secure the housing for 4 weeks with 2 mm screws.
7. Install crocodile clip: first insert the leather sleeve into the lead wire according to the color, and then solder the lead wire to the clip.

III. Troubleshooting

In case of failure, first check whether the components are erroneously installed and whether the welding is good. Especially for novice solders, solder joints are prone to defects, mainly in the solder joints are not smooth, burrs, lead too long lead to short circuit to the pad next to the heel, solder joint stolen goods, these are the main reasons for the failure.

The voltage cannot be regulated or the regulation range is small: 1. Check that there are two small pads on the back of the voltmeter close to the 3 pins and that there is no short circuit. 2. Check resistor R1 for installation errors. 3. Use a multimeter to measure whether the resistance of RP1 is variable.

No signal output or logic pen inoperative: Check if direction of CD4069 is reversed. Check the CD4069 for voltages greater than 3V between 7 and 14 pins. If the circuit voltage exceeds 15V, the CD4069 may be damaged.
Buzzer not ringing: Check 9014 for erroneous installation and check that the buzzer is reversed.