

Control Board

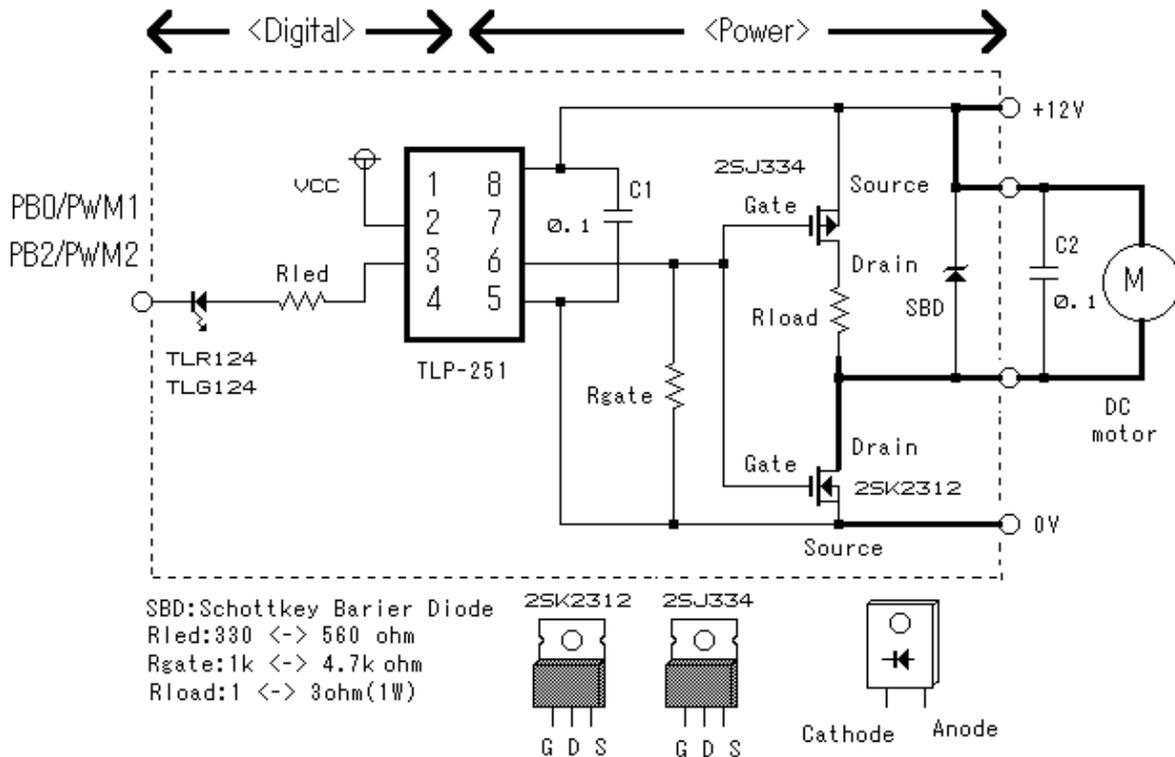
*Abstract

MCR machine is line trace robot.
This machine has two motors and sensors.

You must make motor control circuit and monitor indicators which gets sensor information.

*Motor control circuit

Please watch the following circuit diagram.



H8/3048F has internal PWM(Pulse Width Modulation) circuit module.

<<short explanation of control circuit>>

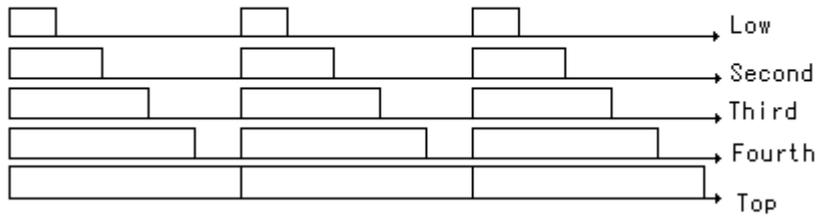
TLP-251 is photo isolator. Isolate digital world and power world.
Rled is indicator to human being.

Power MOS-FETs flow current to DC motor or 0V.
Rload is equivalent to disc brake on automobile.
SBD is free wheel diode to avoid high voltage crash.
C2 will absorb the noise of DC motor.
Rgate is the voltage stabilizer of MOS-FET' s gate.
C1 stabilizes voltage of power.

You can control rotate speed with PWM.

PWM is the one of method which controls DC motor.

PWM (Pulse Width Modulation)



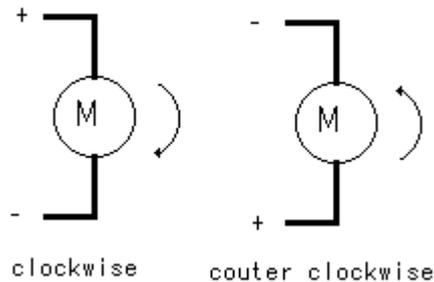
PWM is the digital control method of DC motor.

Supplied voltage is kept and changed term of high voltage.

In this case PWM module changes power of DC motor such as automobile gear.

DC motor characteristics is easy to understand.

DC motor characteristic



DC motor gets direct current flow and rotates.

Change the polarity voltage to reverse direction.

In Japan many amount of DC motors are used.

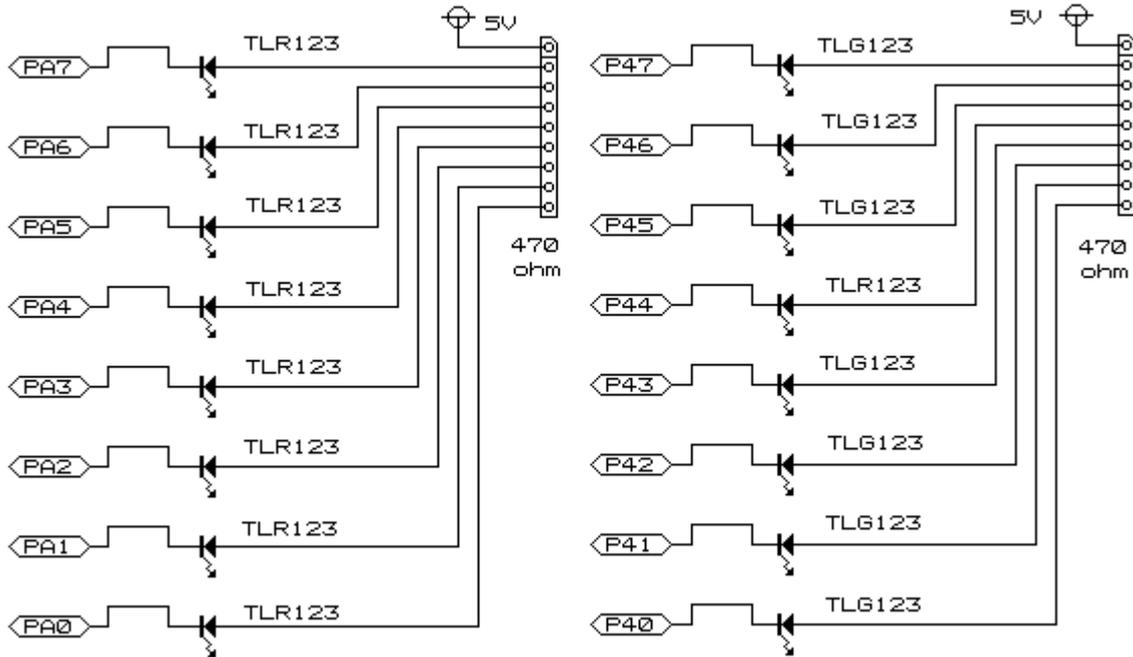
Some famous DC motor manufacturers sale a lot of DC motors everyday.

<< DC motor manufacturers >>

- 1 Mabuchi
- 2 Japan Pulse motor
- 3 Mitsumi
- 4 Tsukasa electric
- 5 Futaba

***Indicator circuit**

Please watch the following circuit diagram.



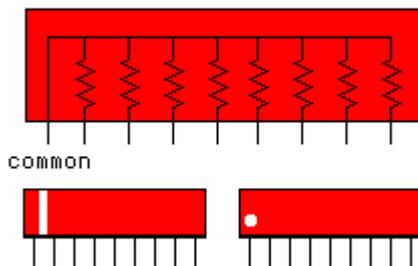
H8/3048F gets the road state and put them to LEDs.

Though you can adjust road sensor and put them to H8/3048, H8 gets incorrect information. Indicators show the sensor information to human being. If H8 gets incorrect information, adjust road sensor and soldering.

Red LEDs is used as road sensor indicators.
Green LEDs is used as duty ratio indicator or other information indicators.

<<short explanation of this circuit>>

TLR123 is Toshiba LED Red 123 (123 is house number).
TLG123 is Toshiba LED Green 123 (123 is house number).
In this course you use resistor array as current limit resistor.
Resistor array has 7 or 8 resistors in one package.



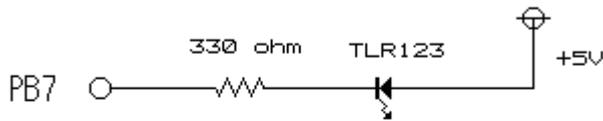
Straip or dot means common
*** In soldering common pin must be connected to 5V ***

Calculate resistor value
Vcc = 5.0V , VF = 2.0V (forward voltage of LED) , IF = 10mA (forward current of LED)
 $R = (5.0V - 2.0V) / 10mA = 300\text{ ohm}$
Reduce current -> 470 ohm

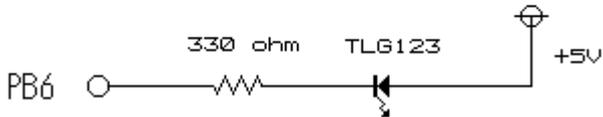
*Dump Status circuit

Please watch the following circuit diagram.

Dump Status



Crossing White Lines(Red LED)



Illegal Read Pattern(Green LED)

Though H8/3048F gets the road state, you can not recognize OK or NG.

Dump status circuit shows OK or NG to human being.

At cross white line H8 turns on red LED.

At getting illegal road state H8 turns on green LED.

Calculate resistor value

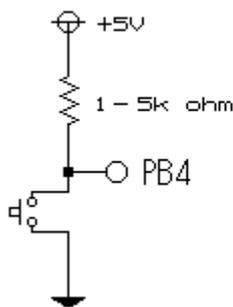
$$V_{cc} = 5.0V, V_F = 2.0V \text{ (forward voltage of LED)}, I_F = 10mA \text{ (forward current of LED)}$$

$$R = (5.0V - 2.0V) / 10mA = 300 \text{ ohm} \Rightarrow \text{Select } 330 \text{ ohm.}$$

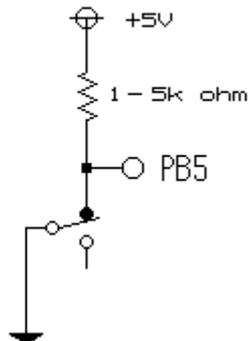
*Switch circuit

Please watch the following circuit diagram.

Start Switch



Mode Switch



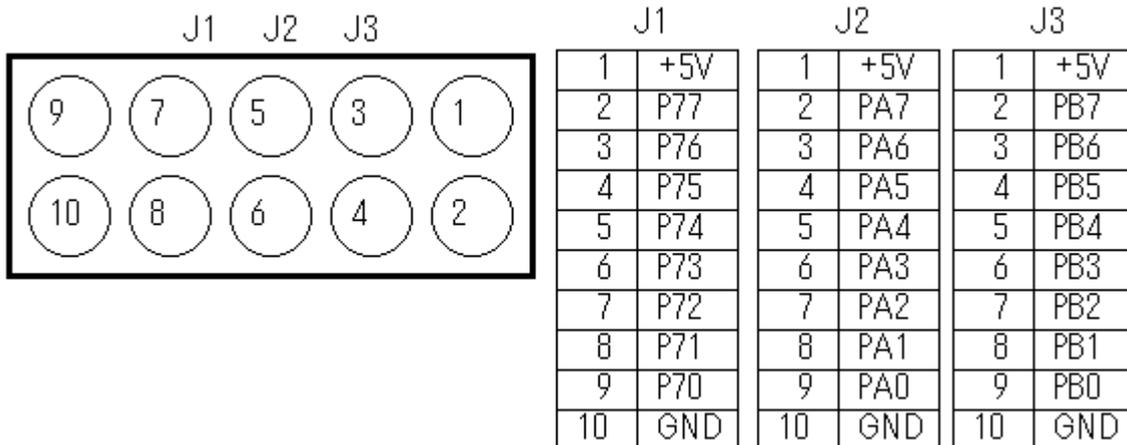
Switch circuit has two switches.
One is start switch, other is mode switch.

Start switch is tack switch and gets trigger from human being.
Mode switch is toggle switch and selects risky or safety mode.

Start switch is connected to PB4.
Mode switch is connected to PB5.

***Connectors**

H8/3048F board has three connectors.

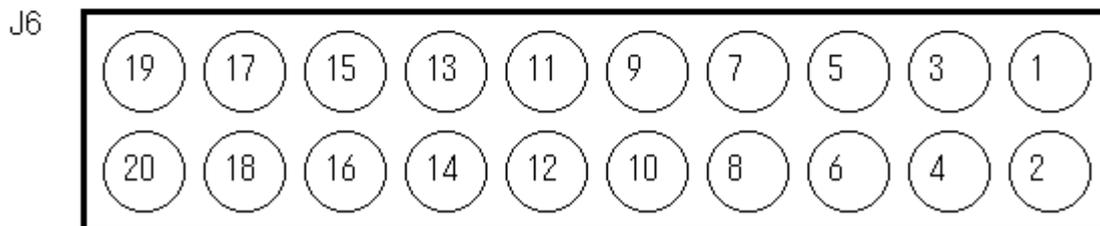


Connector J1 is connected to PORT 7(only inputs).
 Connector J2 is connected to PORT A(bidirection port).
 Connector J3 is connected to PORT B(bidirection port).

Connector J1 is connected to sensor board.
 Connector J2 is connected to indicator red LEDs.
 Connector J3 is connected to motor control circuits, switches and LEDs.

Connector J6 must be soldering 20 pin header connector.

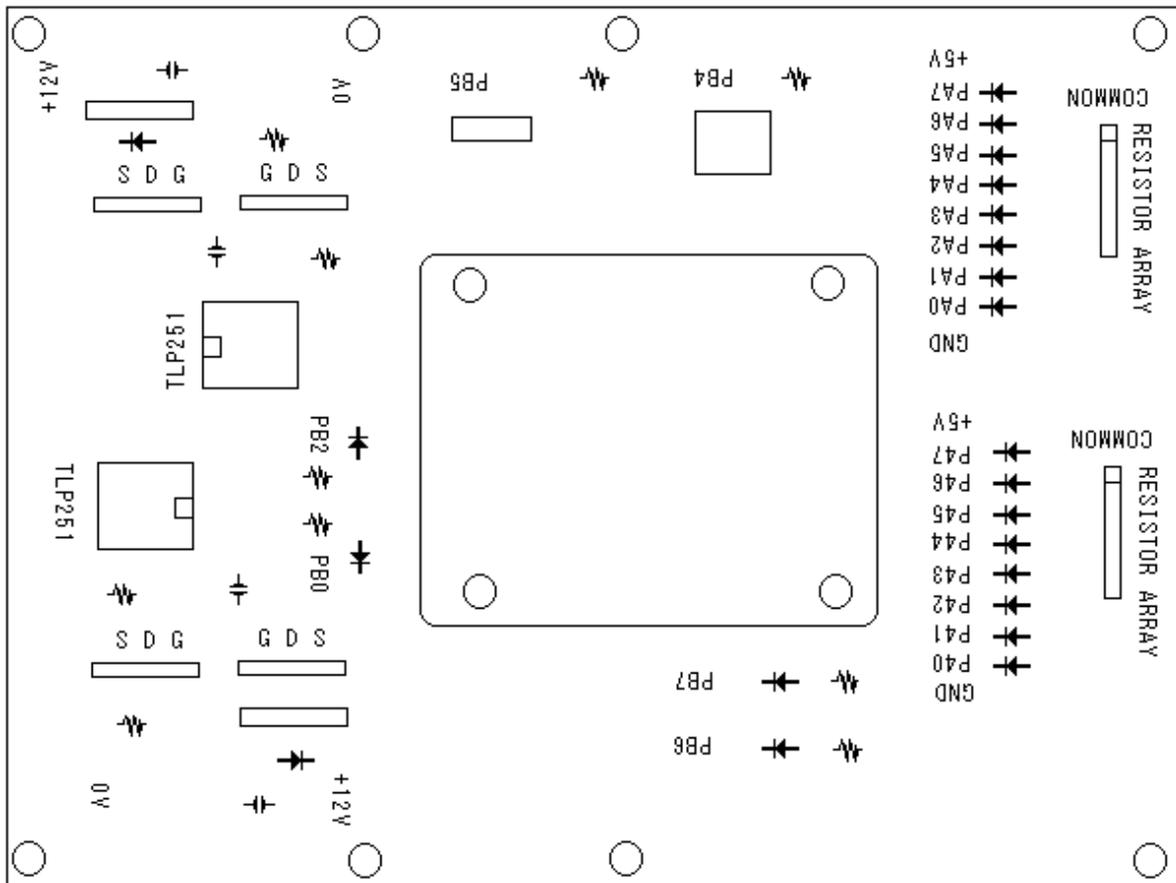
J6	1	+5V	11	P45
	2	P36	12	P44
	3	P35	13	P43
	4	P34	14	P42
	5	P33	15	P41
	6	P32	16	P40
	7	P31	17	P94
	8	P30	18	P92
	9	P47	19	P90
	10	P46	20	GND



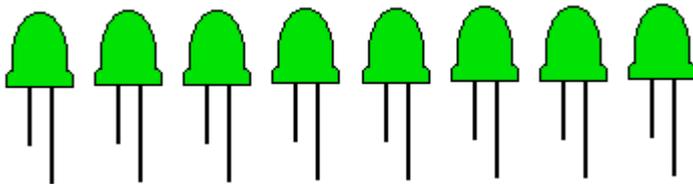
Connector J6 is connected to indicator green LEDs.

*Parts

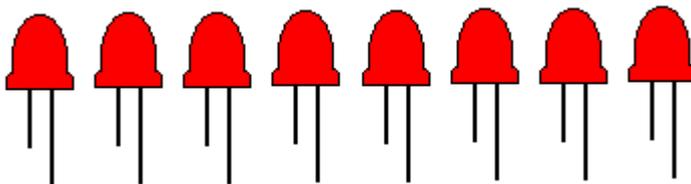
1 PWB(Print Working Board)



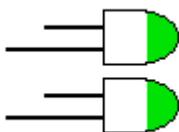
2 Indicator LEDs (green)



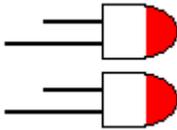
3 Indicator LEDs (red)



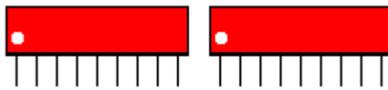
4 Small indicator LEDs (green)



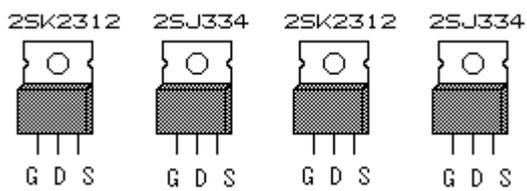
5 Small indicator LEDs (red)



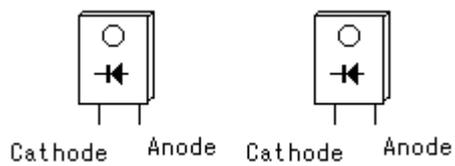
6 array resistor (470 ohm)



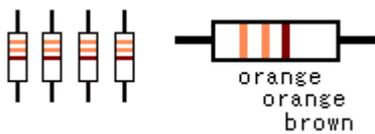
7 MOS FET



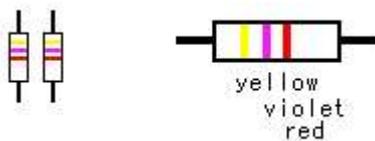
8 SBD



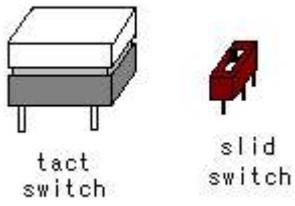
9 resistor (330 ohm)



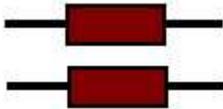
10 resistor (4.7 kilo ohm)



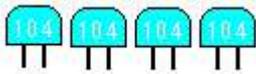
11 switches



12 high power resistor (3 ohm)



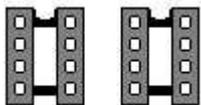
13 capacitors



14 10 pin cables

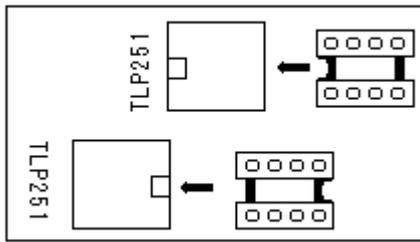


15 8 pin IC socket

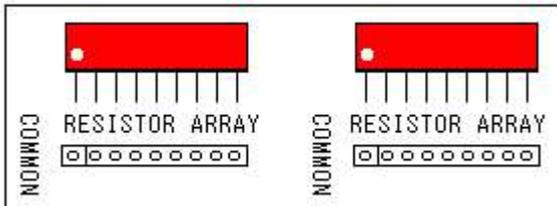


*Assembly

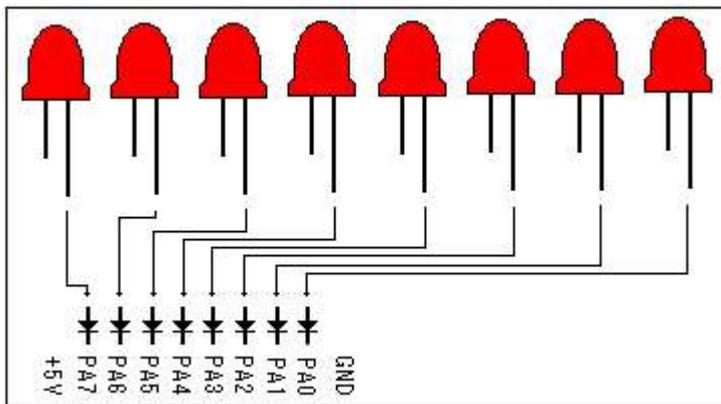
1 Soldering 8 pin IC socket on PWB(Print Working Board). Notice: IC socket has direction.



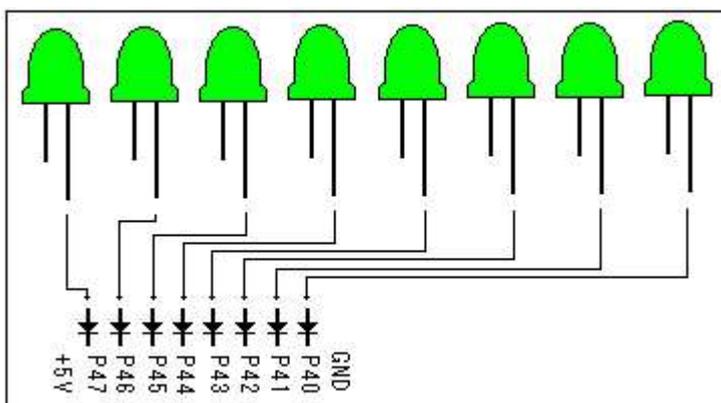
2 Soldering resistor array. Notice: Never fail to set common pin.



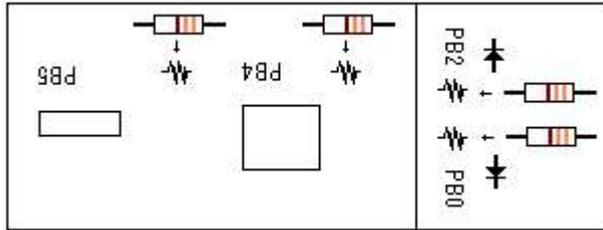
3 Soldering red LEDs. Notice: Check the polarity of LED before soldering.



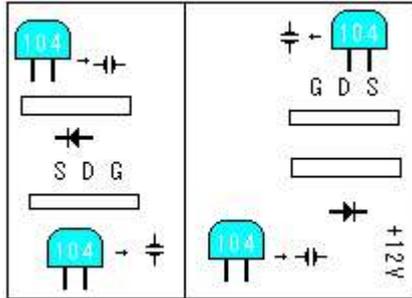
4 Soldering green LEDs. Notice: Check the polarity of LED before soldering.



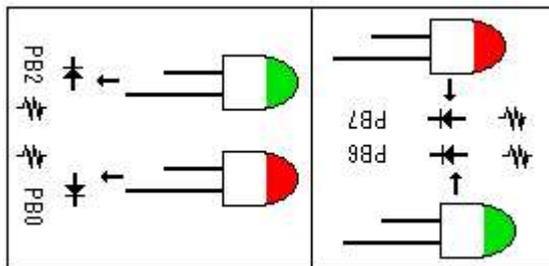
5 Soldering discrete resistors.



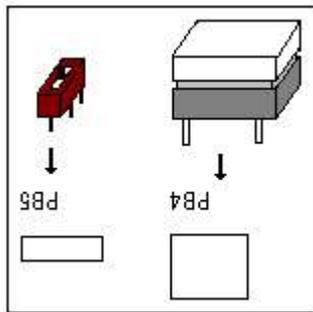
6 Soldering capacitors.



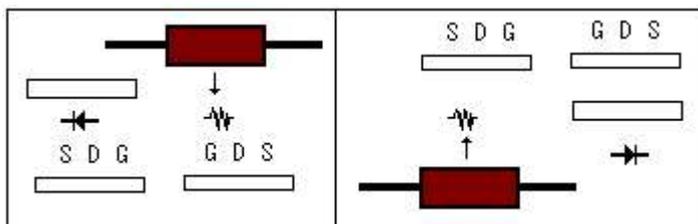
7 Soldering discrete LEDs. Notice: Check the polarity of LED before soldering.



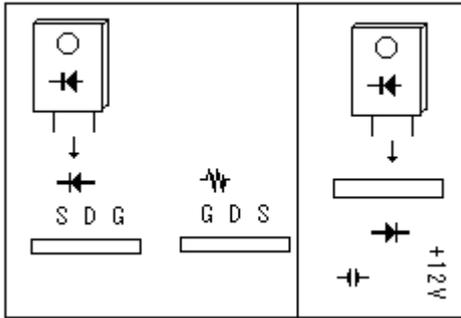
8 Soldering switches.



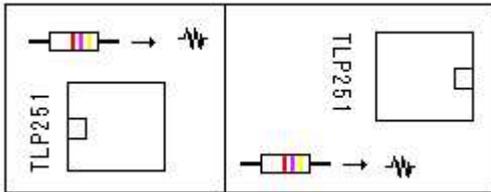
9 Soldering power resistors.



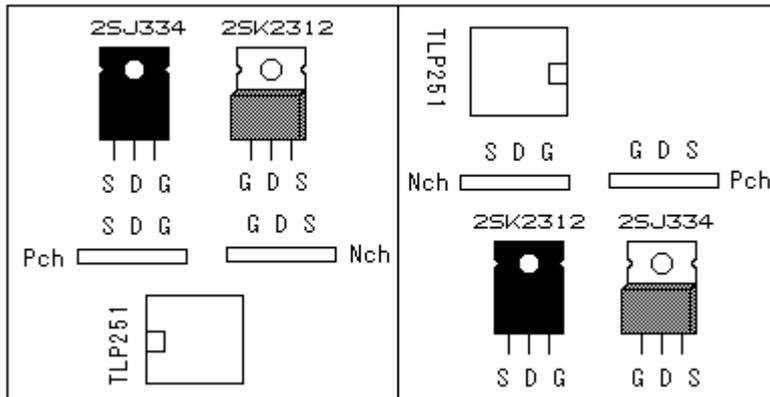
11 Soldering SBDs. Notice: **Check the polarity.**



13 Soldering discrete resistors.



14 Soldering MOS FETs. Notice: **Check the location.**



15 Soldering cables.