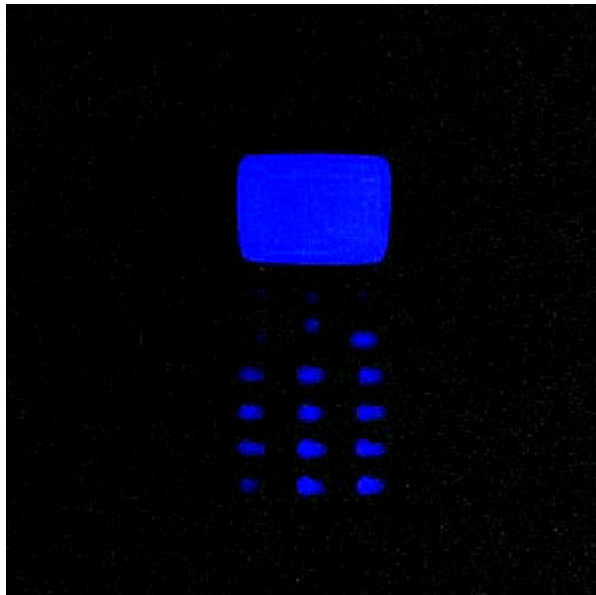




NuukiaWorld project

Changing the display and keyboard illumination color



You can make your phone cool looking just by changing the color of the lights. The green color is so common that others easily notice different colors. The procedure is easy for an experienced electronic hobbyist.

WARNING! Although the author succeeded in the operation described below, no guarantee can be given for the instructions. Opening and soldering components in a mobile phone contains always a risk to damage the equipment seriously. Electrostatic discharge can damage the device without any visible handling mistake.

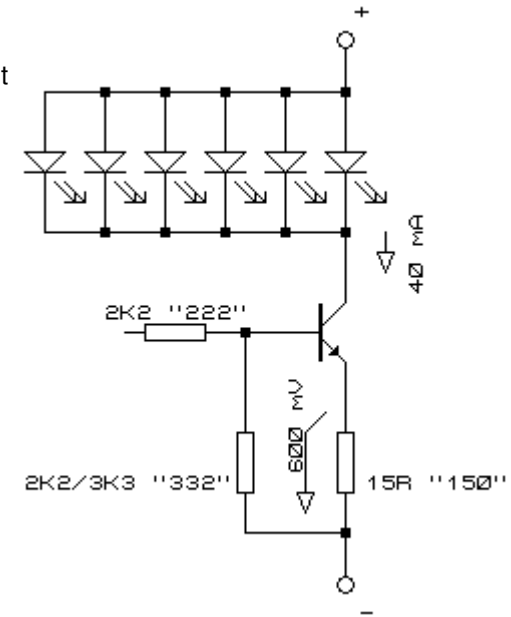
Introduction

The illumination of a Nokia 5110 / Nokia 6110 phone is implemented with 12 SMD (surface-mount) LEDs. The LEDs are connected in to six-LED groups: six LEDs are directly connected in parallel with a simple current-sink. Both groups have their own current-sink. The keyboard LEDs are driven with slightly higher current than the backlight LEDs.

The LEDs must be driven with a constant-current sink because the power is taken directly from the battery supply line V_B . The V_B voltage varies between 3.0 V and 5.1 V! The current flow through one group seem to be approximately 40 mA (6.7 mA / LED).

The display group consist of special LEDs with horizontal light direction (the LEDs light the plastic display backlight diffuser from the sides). These LEDs may be replaced with standard 0805-size LEDs, if they are soldered on their sides. Even size 1206 works, but it requires more careful soldering (there is not too much space for the display element).

The keyboard LEDs are of size between 0603 and 0805. They are soldered normally. Even size 1206 can be used, but it is quite hard to solder because these big LEDs covers the footprints entirely and heating them is impossible.



Step-by-step instructions for Nokia 6110



The both groups of LEDs must contain same type of LEDs because they share a common series resistor. If you try to use different LEDs in a single group, some LEDs may light dimly or not at all. Refer to table 1 for LED parameters.

Table 1. Possible LED types for Nokia 6110 style phones.

Group	Size	V _F	Soldering
Display LEDs	0805 (1206 possible)	preferably less than 2.5 V	on the side
Keyboard LEDs	0603 (0805 possible)	preferably less than 2.5 V	normal mounting

Red color is easiest to obtain and is enough different than the normal green. Also blue and white colors would be interesting but much harder to obtain. One source for 0805 red LEDs is the [RS-catalog](#), article number 429-552 (five LEDs per package).



● Helsingissä RS-luettelon LEDejä voi tilata mm. [Yleiselektronikka Oy:n](#) myymälässä. Toimitettaessa normaalitoimitusten mukana Suomeen ja myymälästä noudettaessa ei toimituskulujakaan tule. Hinta vuonna 1999 oli 28,65 mk pussia kohden (RS-luettelon tuotenumero 429-552, viisi punaista 0805-LEDiä) (sis. ALV). **HUOMAUTUS!** Tilaukset ja tuotteiden haku pitää tehdä Yleiselektronikan Teollisuuskadun myymälästä. Puhelimitse ja postitse LEDejä ei saa.

Before starting check that you have a Torx T6 screwdriver, a soldering iron with a sharp tip, desoldering braid and **thin** solder wire (for SMD soldering). And of course enough soldering skills and good luck.

Preparing steps

1. Open the phone by removing the battery and unscrewing the four screws on the back.

2. After unscrewing hold the phone face down all the time and lift the bottom end of the phone from the face cover. The upper end of the cover is locked with two clips near the IR panel. To remove the cover you have to slightly lift, and push the phone to the IR-port direction. Do not try to remove the cover completely without first checking the way to open the clips - it is hard to explain so check it by yourself.

Note: Hold the face plate cover of the phone face down **all the time**. The earphone will be freed when removing the cover and will be then safely carried by the face cover. Do not touch the display lens inside the cover or the display itself on the phone. The fingerprints are rather hard to clean.

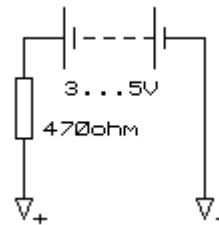


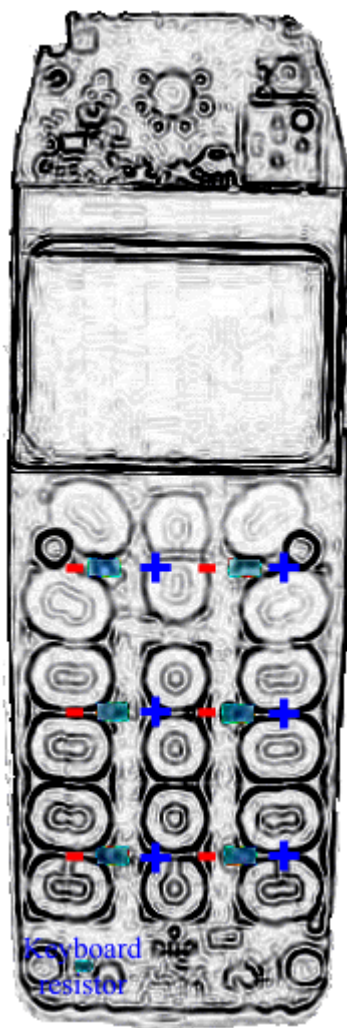
3. Put the cover plate in a safe place face down and continue with the phone. Now you can turn the phone face up. You will see the keyboard six LEDs between the keyboard contacts. Do not touch the components or the copper contacts on the circuit board if not necessary.



4. Open the two screws above the display module and then lift the top circuit board from the phone. There is a conducting wall element between the boards - if it is stuck on the board you are removing, push it firmly down back onto the bottom board. The microphone is mounted on the reverse side in the bottom part of the board, do not try to remove it.

Changing the keyboard LEDs





5. Check the polarity of the keyboard LEDs. It can be done for example with DMM diode range (must measure forward voltages up to 2 volts). The COM probe is at the cathode when there is some measurable voltage drop; wrong direction is shown as infinite in the multimeter. Other possibility for testing is shown in figure on the right. The - probe is at cathode if the LEDs light. Remember to check all six keyboard LEDs. One possible LED arrangement is shown in picture on the left. Please note that it may be possible that all Nokia 5110/6110 series phones are not similar!

6. With the normal ESD precautions, desolder the keyboard LEDs. Avoid touching the keyboard contacts, especially solder on them will cause problems. If you are not going to reuse the LEDs, you can try to heat both ends of the LED simultaneously by carefully pushing the side of the LED with the soldering iron tip side.



7. After removing the LEDs, clean the footprints with desoldering braid. Solder the new LEDs carefully onto the pads. It is better to check the LED polarity twice before soldering.

8. Put the keyboard circuit board back into the phone. Screw back the two screws in the top of the board. Do not overtighten. While pressing the bottom part of the circuit board gently into the phone (normally it is pushed by the face cover) install the battery on the phone. Use a small part of paper under your finger to avoid fingerprints on the keyboard contacts. After installing the battery, you can use a clothespin to press the board. Avoid releasing the pressure while the battery is installed, change your finger to the clothespin "on-the-fly".

9. Press the metallic power button of the phone. Check that the phone powers on normally. All new LEDs should light. If not, immediately turn off the power and remove the battery while pressing the bottom part of the circuit board. Remove the board and check the connections for soldering failures.

10. Measure the voltages over the two 15 ohm series resistors marked with "150" in the bottom part of the board. The voltage over the other (usually the right one) should be the normal 600 mV (that is: 40 mA current through the display LEDs), the voltage over the other is dependent of the LEDs you soldered. If the illumination is switched off while measuring press the power button shortly to turn the lights back on. The constant current sink is not ideal and the voltage may be wrong. In that case, you must adjust the resistance of the series resistor.

11. Switch off the power and remove the battery while pressing the bottom part of the circuit board. Remove the keyboard circuit board and solder a new 0603 resistor on the top of the 15-ohm series resistor. The required value depends on the voltage you measured, so no exact value can be given. The target is to adjust the current through the resistor to 40 mA. The current through the two resistors connected in parallel

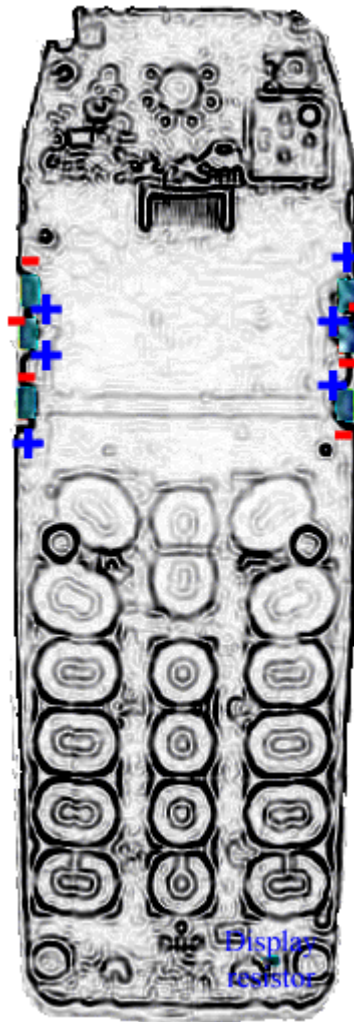


is calculated with equation (1). For example, if you measure 440 mV (a possible value with the RS-components 429-552 LEDs) voltage drop in step 10, you can try to solder a 20-ohm resistor on the top of the original 15-ohm resistor (that is 8.6 ohms together). Repeat the steps 8...10. If the voltage is now about 340 mV, you will get 40 mA from (1) and the current is correct. Normally you have to repeat the steps 8...11 a few times to obtain the correct value for the new resistor. However, the current is not critical; $\pm 10\%$ accuracy for the 40 mA "sounds good".

$$I_{(mA)} = \frac{U_{(mV)}}{R_{1(\Omega)}} + \frac{U_{(mV)}}{R_{2(\Omega)}} \quad (1)$$

Changing the display LEDs

12. Remove the display module from the keyboard circuit board by carefully pushing the four clips outwards behind the board. Avoid touching the display surface because it is rather hard to clean.



13. As in the step 5 measure the polarity of the display LEDs. Note the location of the LEDs carefully because the new LEDs must be soldered exactly in the same places on the footprints. There is no extra space under the display module for slanting LEDs.

14. Repeat the steps 6 and 7 for the display LEDs. Note that you must solder normal SMD LEDs on their sides to get them light parallel to the circuit board. The direction is naturally to the middle of the board.

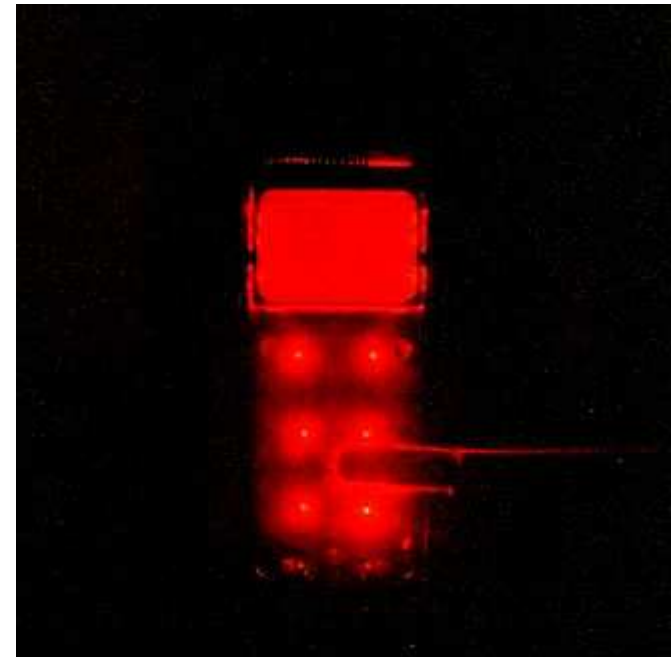
15. Paste small pieces of paper-based tape on the top of the LEDs. This is to ensure that the metallic display module will not touch the LED contacts. Push the circuit board carefully back onto the display module (it is easier to push the board into the module than in the opposite way). Try to make all four clips to snap simultaneously to avoid misalignment in the zebra pad. If the module will not snap into its place, there may be some of the new LEDs soldered in wrong position. They may be under the edge of the display metal or under the plastic diffuser element. There are only small pits in the diffuser for the LEDs.

16. Now iterate the steps 8...11 until the current is adjusted to the original value. If you are using same type of LEDs as in the keyboard, you can use the same resistor value without any iteration. Check especially that the display shows the texts correctly. If not, try to reinstall the display module and check that there is no new LEDs pushing the module to any direction. This may require resoldering some LEDs.


Assembling the phone

17. Remove the battery if you have not removed it after the current measurements. Hold the phone cover face down and push the top of the phone into the clips of the cover. After ensuring correct installation of the top part of the cover, push the bottom end of the phone onto the cover and screw the four screws back that were removed in step 1. Remember to hold the phone and cover plate face down until the screws are tightened. Do not

overtighten.



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