INSTRUCTIONS FOR DIY GA LED CLOCK KIT

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Learning Kit by UltraTek © 2020 Torrance, CA USA
PROJECT SPS
STEM Projects for Students
www.s-p-s.org
Designed in California with foreign and domestic components
Designed for learning electronics, soldering, troubleshooting and basic mechanical skills

WARNING FOR CALIFORNIA USERS:

THIS PRODUCT CAN EXPOSE YOU TO CHEMICALS WHICH IS KNOWN TO STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER DISEASES FOR MORE INFORMATION, PLEASE GO TO WWW.P65WARNINGS.CA.GOV SPECIFICATIONS:

- Dimensions: 14 3/4 x 8 1/4 x 1 inch ABS plastic molded box
- Color: Black or White housing
- LED size: 4 inch x 2.8 inch digit
- 96 LED (SMD 0805/1206), Blue, Red, White or Green to solder
- Blinking colon: between HR and MIN every second
- Only 6 IC chips (SMD) 1 8 pin, 4 14 pins and 1 16 pin SOIC
- PCB 14.168 x 4.25 inch double layer
- 2 ppm accurate TCXO (Temperature Control Crystal Oscillator) 32768 oscillator (+/- 1 minute a year)
- Adjustable HR and MIN push button
- Adjustable brightness MT3608 LED voltage boost converter (screwdriver adjust)
- Dark grey 2074 acrylic Plexiglas 1/8 thick
- Flipper USB connector/adapter cable (optional)
- Logo printing as optional
- Power consumption 100mA @5V typical 50mA using USB phone charger (not included)
- Backup optional 16340 Li-Ion rechargeable battery (optional)
-12HR format, 24HR optional jumper select
- For indoor use not waterproof
- Instruction sheet included

FEATURES

- 4 inch tall, great looking with very bright LED display time visible up to 200 ft
- Solid state no mechanical moving part
- Very affordable
- Learning assemble, soldering, trouble shooting modern electronics skills
- Very easy to assemble, lowest components count, no adjustment of the timing circuitry
- Clock is very accurate less than 1 minute per year
- Clock is running from a TCXO, not from noisy AC 60 Hz
- Big areas for printing messages, images or logos
- Inside of box has room for install other useful electronics devices
- Making old phone charging USB power adapters and USB cables useful again

APPLICATIONS

- Best gift for advertising promotions (CIS) with inscriptions (or logos)
- Learn SMD soldering and troubleshooting
- No need to check phone for time
- For all need to know what time is... Home or business
- Multiple times displayed for multiple countries

- Stopwatch mode for accurate measurements
- WiFi repeaters range extender (optional)
- Live Alert (need internet access) Bluetooth related IOT receivers (optional)
- WiFi camera (optional)
- Night light

PART LIST

- 1 PCB (Printed Circuit Board)
- 96 leds on a cut tape
- 6 IC chips (will be labeled or marked 1 to 6)
- 2 push buttons
- 1 power module with micro USB input, mounting double sticky foam tape
- 1 back up battery with resistor (optional)
- 1 USB phone power adapter (5V) and type A to micro USB charge cable (Not included)

And housing
- 1 Box
- 1 piece Plexiglass
- 4 supporting screws
- Adhesive Velcro (optional)

 TOOLS AND EQUIPMENT REQUIRED

- Tweezers for handling small SMD (Surface Mount Device) parts such as LEDs and ICs.
- Soldering iron 60W or less with small tips, best with adjustable temperature
- Solder wire 0.031 inch diameters or thinner
- Magnifying glass or microscope
- Solder wick for cleaning short solder bridges
- Small electric fan (to suck/blow away solder smoke)
- Multi-meter, Resistance Ohm, Voltage, Current measurement
- Drill press or hand-held drill
- Anti-static wrist strap
- Face mask
- Safety goggles for eyes protecting
- Gloves

Troubleshooting tools (optional)

- Hot air gun to remove soldered components
- Oscilloscope (helpful)
- Frequency counter (optional)
- Power supply with adjustable output and current limiting monitor

ASSEMBLY INSTRUCTIONS

WARNINGS:

SOLDERING IRON IS VERY HOT, PLEASE BE CAREFUL NOT TO TOUCH WITH SKIN

SMOKE GENERATED FROM SOLDERING IS TOXIC, PLEASE AVOID INHALE IT

IF USING LEADED SOLDER, AVOID TOUCH IT, WEAR GLOVES TO PROTECT CONTACT TO LEADED SOLDER

AC 110V/220V CAN BE VERY DANGEROUS, PLEASE BE CAREFUL OF YOUR USB POWER ADAPTERS, TO AVOID ELECTRIC SHOCK NEVER OPEN THE AC POWER ADAPTERS. ALWAYS USING CERTIFED PRODUCTS

1. Solder 96 surface mount LEDs, PCB pads are designed for using common either 1206 (0.12 x 0.06 inch) or 0805 (0.080 x 0.050 inch) LEDs

The PC board layout can accommodate 9, 8, 5 or 4 LEDs on each segment. For learning electronics we offer 4 LEDs each segment. More LEDs can be added later for more brightness or more reliable purposes.

The PC board has two sides of components, the LED side and the IC chip side. The LED side with more big mounting holes as down and fewer holes as top

All vertical mounted LEDs are anode (+) on top, cathode (-) on bottom

All horizontal mounted LEDs are anode (+) on left, cathode (-) on right

The supplied SMD has a top and bottom side, the "lens" is on the top side which is smaller than the bottom. There is a tiny little green mark on the lens marked as (-) or cathode of the LED

For 12 Hour clocks, first digit (on the left most) solder two right segments (4 LED each segment marked as segment b and c)

For 24 Hour clocks, solder all segments except the f segment of the first digit.

Referring to the white letter (silkscreen) marking

Digit 1: (12HR model)

Solder 11, 13, 16, 18, 20, 22, 25 and 27 (total 8 LEDs)

Digit 2:

Solder LED 2, 4, 7, 9, 11, 13, 16, 18, 20, 22, 25, 27, 29, 31, 34, 36, 38, 40, 43, 45, 47, 49, 52, 54, 56, 58, 61 and 63 (total 28 LEDs)

Digit 3:

Solder LED 2, 4, 7, 9, 11, 13, 16, 18, 20, 22, 25, 27, 29, 31, 34, 36, 38, 40, 43, 45, 47, 49, 52, 54, 56, 58, 61 and 63 (total 28 LEDs)

Digit 4:

Solder LED 2, 4, 7, 9, 11, 13, 16, 18, 20, 22, 25, 27, 29, 31, 34, 36, 38, 40, 43, 45, 47, 49, 52, 54, 56, 58, 61 and 63 (total 28 LEDs)

Don't forget to add: (colon, 4 LEDs dot 1, 2, 3, 4) to separate the hour and minute.

Soldering 2 terminal SMD LED components tip: plate/apply/melt solder on all the right pads (if you are a right hand) of all horizontal LED pads first. The 2 terminal type of SMD has 2 solder pads, so place some solder on one pad first, pick the SMD part with tweezers, re-melt the solder on the pads, hold on to it, then let the solder cool to securely hold/attached to the location, then solder the other pad with the SMD's other terminal. Do not place solder on both pads, only one first as if both pads got solder makes the PC board pads uneven to place the SMD device.

Search on Youtube videos how to solder SMD components.

2. After all LED soldered, test LED and make sure all LEDs light up with power supply. Pre-adjust power supply to: (not too high may burn the LED not properly soldered)

- RED to 7V or less
- GREEN to 8V or less
- Blue and White to 10V or less

3. Solder all 6 IC (Integrated Circuit) chips. Please note all IC chips has pin 1 on the lower left corners.

- U8 (unmarked) 8 pin SOIC X 1 Micro Controller Unit (MCU)
  (Please note the pin 1 is soldering to the middle of the 14 pin PCB pads)
- U1, U4, U5, U6 (unmarked) 14 pin SOIC X 4 (7 segment LED driver
- U7 16 pin BIG chip x 1 (DS3231SN timing clock)
- U2, U3, U9, U10 are not used

For U1, U4, U5, U6 solder all 14 pins

For U8 solder all 8 pins

All unmarked IC chips has a small concave round indentation to mark the location of pin #1, you may have to shine some light to see the little round mark/shadow with some altered viewing angle

For U7 solder only pin 1, 2 and 13

Please see assembly drawing diagram

No need to solder all the un-used IC pins to save time

Please check the schematics diagram

3.1 Visually exam all IC chips are all placed in the right place and no missing or cold solder joints. Suggest using a magnifying glass to check.

4. Apply power (2V to 5V) to boost (DC-DC) converter power module and connect the output of the module to a multi-meter, put dial to 20V DC

- Pre-adjust the variable screw to the proper voltage
- RED to 7.6V
- GREEN to 9V
- Blue and White to 10.6V

5. Install the power module to the PCB

Please see assembly drawing diagram

6. Install two push buttons to setup time

Please see assembly drawing diagram

7. Connect USB power (5V) to the power module

If the 12HR model will display 10:00, the : will blink every second

If the 24HR model will display 00:00, the : will blink every second

8. Package, a plastic box, 4 screws and the front Plexiglas with template diagram
- drill all the holes print the template (cut it out)
- 4 standoff hole for the 4 screws, 2 setup holes, 1 power cord hole and a mounting hole
- Screw 4 screws to the box to hold against the front plexiglas
- attach the assembled PC board to the plexiglas
- Press the plexiglas with the attached/assembled working PC board

9. Setup time, hold the push button and will increment the Hour and Minute. Suggest using a pencil/pen to push into the drilled holes

10. Congratulations it works! Adjust the LED voltage make the display brighter or dimmer.

TROUBLESHOOTING GUIDE

1. Visually exam all the components are placed at the right places.

2. Visually exam all the solder joins, make sure no solder bridges (shorted circuit) or bad/cold solder joints with bad connections.

3. Measure voltages by using a multi-meter from the power module make sure has the right voltages

4. Check the schematic diagram

5. Common problems

    a. LED missing segments

    Please check the polarity of the LED and soldering joints

    b. Clock is showing 10 00 but not blinking the :

    Please check the soldering job

    c. Nothing happens, no LED on at all

    Please check power system, maybe LED voltages are too low

    d. LED too bright

    Please adjust the power module and lower the voltage. Turn counter clock to lower it