ClockTHREE-Junior_v2

Assembly and User Guide

C3Jr_v2

Index

VERSION INFORMATION

KIT VERSION	2
SW VERSION	0_6
USER GUIDE VERSION	1_0

IMPORTANT

1

SAFETY: Please read this MANUAL carefully before assembling the kit. It contains important information, Warning, and Cautions that must be followed to ensure safe operation and to maintain the product in a safe condition.

USE PROPER POWER CORD: Use only the power cord and connector appropriate for the voltage and plug configuration in your country.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES: To avoid explosion, do not operate the equipment in an atmosphere of explosive gas.

DO NOT REMOVE COVERS DURING OPERATION: To avoid personal injury or death, do not remove equipment covers without first removing the power source connected to the poduct. Do not operate the product without the covers properly installed.

Do not attempt to operate if protection may be impaired: If the product appears damaged or operates abnormally, protection may be impaired. Do not attempt to operate the equipment under these conditions. Please contact us.

Links

2

Wyolum	: www.wyolum.com
WiseTime with Arduino	: http://timewitharduino.blogspot.com/
C3Jr Project Repository	: http://code.google.com/p/clockthree/
Arduino	: http://arduino.cc/
Sparkfun	: http://www.sparkfun.com/products/9766
Smoke Testing	: http://en.wikipedia.org/wiki/Smoke_testing#Electronics_and_electrical_engineering

Introduction

3

We are so excited for you to build this kit ! The ClockTHREE_Junior is a simpler, smaller version of our ClockTHREE RGB word clock. This is a very easy to build project, which you can likely complete over a weekend, and requires only basic electronics skills. The completed ClockTHREE_Junior, version 2 - a.k.a C3Jr_v2 - will make a fine addition to your home or office and will surely attract a lot of conversation. The C3Jr_v2 shows time using a set of words. A group of LED's located behind the face plate light up individual words to indicate time, such as “IT'S TEN MINUTES PAST FIVE”.

It features mono-color LEDs instead of RGB full color. The LED matrix is smaller at 16 columns and 8 rows, giving a total of 128 addressable LEDs. Other than that, it is similar to the C3 in terms of build instructions. The SW code is also almost the same as that for C3. On the hardware side, we use a 8 bit row driver, instead of the dual 16 bit drivers used in the C3. It is compatible with the Arduino IDE, and uses an ATMega Micro-controller. The kit is provided with the software already installed on the micro-controller.

This guide covers the procedures for assembling the C3Jr_v2 kit. Please exercise appropriate safety practice while soldering. All parts are through-hole mounted, and there are no surface mounted parts for you to solder or worry about. This is an open-source hardware+software project. For design files, source code, & support, please contact us at << info@wyolum.com >>

Before commencing assembly, please read this manual carefully and acquaint yourself with the build process.

The kit consists of the following :

- ELECTRONICS - Main Board (PCB), with set of components
- MECHANICAL - A set of Baffles, Front Face Plate, Rear Plate and fixing hardware
- Wall Wart – 12V DC output, 1A

Bill of Materials

4

WYOLUM : CLOCKTHREE-JUNIOR (C3Jr_v2) PARTS LIST

Part	Value	Vendor	Vendor P/N	NOTE1	NOTE 2
BT1	BATT_RTC	DigiKey	3003K-ND		
*	3V CR2032 Battery	DigiKey	P189-ND	Coin Battery for BT1 socket	
C3, C6, C7, C9, C10	100n	DigiKey	399-5863-ND		
C8	100u	DigiKey	P833-ND		
C11, C12	22p	DigiKey	BC1034CT-ND	Optional	if using crystal
CD1, CD2, CD3	CDOT1			Optional	if using ChronoDot
D1 ~ D128	LED	DigiKey	C535A-WJN-CU0V0231-ND		
D258	DBG	Generic	Any 3mm/5mm LED/Color	Optional	
D260	PWR	Generic	Any 3mm/5mm LED/Color	Optional	
DIL-U1	STP16DP05	DigiKey	3M5479-ND	Optional	if using rowBoB
J1	V_IN	DigiKey	H2960CT-ND	USB-Mini connector	
J2	V_IN	DigiKey	ED2982-ND	USB-B, Optional, instead of J1 or J3	
J3	V_IN	DigiKey	CP-002B-ND	Barrel socket, Optional, instead of J1 or J2	
K1	PWR_SEL	DigiKey	SAM1031-50-ND		
*	Jumper	DigiKey	XG8T-0231-ND	Shorting Link (Jumper) for PWR_SEL	
K2	LED_ENABLE	DigiKey	SAM1031-50-ND		
*	Jumper	DigiKey	XG8T-0231-ND	Shorting Link (Jumper) for PWR_SEL	
K3	7Seg_Sel	--	--	Solder Bridge for uC pin selection	
P1	7SegDisp	Sparkfun	COM-09766	Optional, 7 segment 4 digit display	
P7	FTDI	DigiKey	SAM1043-50-ND		
P12	V_OUT	DigiKey	SAM1031-50-ND	Optional	5V output
P13	ISP	DigiKey	SAM1095-36-ND	Optional	
P41	STACK-L	DigiKey	SAM1009-50-ND		
P42	STACK-R	DigiKey	SAM1043-50-ND		
Q1 ~ Q17	2N5401	DigiKey	2N5401GOS-ND		
R1 ~ R16	100E	DigiKey	CF18JT100RCT-ND		
R17, R18, R19, R22, R23, R31, R36, R37, R38	10k	DigiKey	CF18JT10K0CT-ND		
R20, R21	4k7	DigiKey	CF18JT4K70CT-ND		
R24, R25, R26	1k	DigiKey	CF18JT1K00CT-ND		
R30	100E	DigiKey	CF18JT100RCT-ND		
R32	LDR	DigiKey	PDV-P9007-ND	Optional	

Bill of Materials

4

WYOLUM : CLOCKTHREE-JUNIOR (C3Jr_v2) PARTS LIST

Part	Value	Vendor	Vendor P/N	NOTE1	NOTE 2
R33, R35	680E	DigiKey	CF18JT680RCT-ND		
R34	2k	DigiKey	CF18JT2K00CT-ND		
SP1	SPEAKER	DigiKey	102-1169-ND		
SW1	INC	DigiKey	450-1657-ND		
SW2	DEC	DigiKey	450-1657-ND		
SW3	MODE	DigiKey	450-1657-ND		
SW4	RST	DigiKey	450-1657-ND		
SW5	ENTER	DigiKey	450-1657-ND		
SW12	INC	DigiKey	450-1650-ND	Optional, for rear mount, in place of SW1	
SW22	DEC	DigiKey	450-1650-ND	Optional, for rear mount, in place of SW2	
SW32	MODE	DigiKey	450-1650-ND	Optional, for rear mount, in place of SW3	
SW42	RST	DigiKey	450-1650-ND	Optional, for rear mount, in place of SW4	
SW52	ENTER	DigiKey	450-1650-ND	Optional, for rear mount, in place of SW5	
U3	ATMEGA8-P	DigiKey	ATMEGA328-PU-ND		
*	Socket for U3	DigiKey	A100210-ND		
U4	74HC154	DigiKey	568-1407-5-ND		
*	Socket for U4	DigiKey	3M5479-ND		
U5	STP8DP05	DigiKey	497-6271-5-ND		
*	Socket for U5	DigiKey	A32870-ND		
U6	DS3231N	DigiKey	DS3231S#-ND		
X1	16MHz	DigiKey	X908-ND		

OTHER PARTS					
BF1	Baffle	Angus Hines			
BP1	BackPlate	Angus Hines			
P8,P9,P10,P11,P14,P15,P53,P54	screw_4mm			Fixing Screws for Board and Baffle	
P43	Pad01	--		Break Out Pad, no component	
P49 ~ P52, rowBoB1	screw_3mm			Fixing Screws for rtcBoB and rowBoB	
P24 ~ P39	PROTO-6	--		Prototyping area	
FM1	Frame	Ikea		Optional	
FP1	FacePlate	Angus Hines		Angus Hines	
PCB1	PCB			Main Board	

Bill of Materials

4

A picture of the kit contents

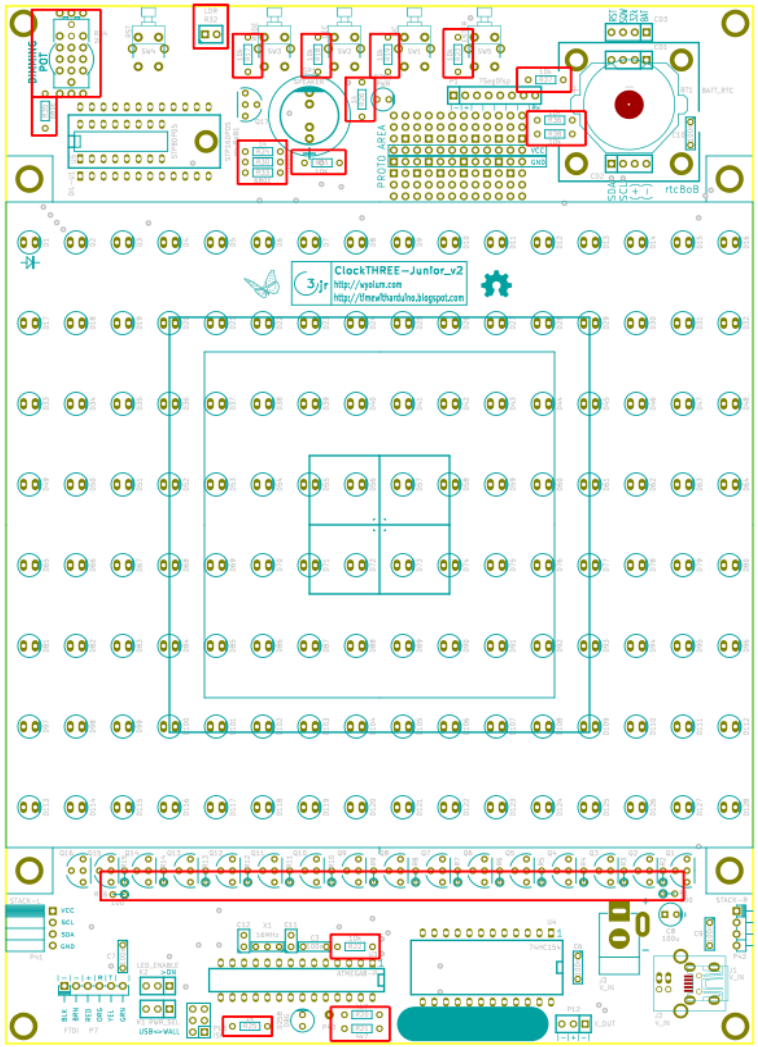
Tips, before you start Assembly

5

- Read through and understand the entire set of instructions before you get started. I know, they always say that, but heed the advice this time. It could save you hours of rework and much consternation. We've captured all of the mistakes and blunders made in creating and building the prototypes and tried to foresee problems you may have.
- Take your time. Enjoy the build process and take a break when you feel fatigued. You will have this clock for years to come (and hand it down to your grandchildren!) so there are no worries if it takes you an extra day or week to build it.
- Leave the paper on the front cover and front frame until final assembly. This protects the parts from scratching and smudging.
- Soldering:
  - We assume that this is NOT your first soldering project. If it is, we'd suggest getting a cheap learn-to-solder kit to get started. If this is your first project in a while, here is a quick refresher on soldering. The main thing is to double and triple check that the part is in the correct place with the correct orientation (if applicable). While de-soldering is possible, it is troublesome and time consuming and risky. Make it a goal that you will not have to de-solder in the course of making this clock.
  - After each step, evaluate the solder joints from the front and back of the board. On the back, the solder should be shiny and make a volcano shape, as opposed to a dome shape. On the front, you should see that the solder came all the way trough the board. If it doesn't look good, try re-heating the joint until the plated-through-hole sucks up the solder.
  - Check that the solder does not cause a short to neighboring parts.
  - If you do make a mistake, don't panic. Use a solder sucker to remove the solder and pull the piece gingerly while applying heat. If you damage a trace in the process of de-soldering, send a picture of the damaged area and we will help you make the most of the situation. It may be possible to "blue wire" around the damage.

Resistors

6



RESISTORS

Start by soldering the resistors. The polarity (orientation) does not matter.

PARTS

R1 to R16 : 100 Ohm [brown-black-brown]

R17, R18, R19, R22, R23, R31, R36, R37, R38 : 10k [brown-black-orange]

R20, R21 : 4k7 [yellow-violet-red]

R24, R25, R26 : 1k [brown-black-red]

R30 : 100 Ohm

R32 : LDR (light dependent resistor, may be supported in future release)

R33, R35 : 680 Ohm [blue-grey-brown]

NOTE

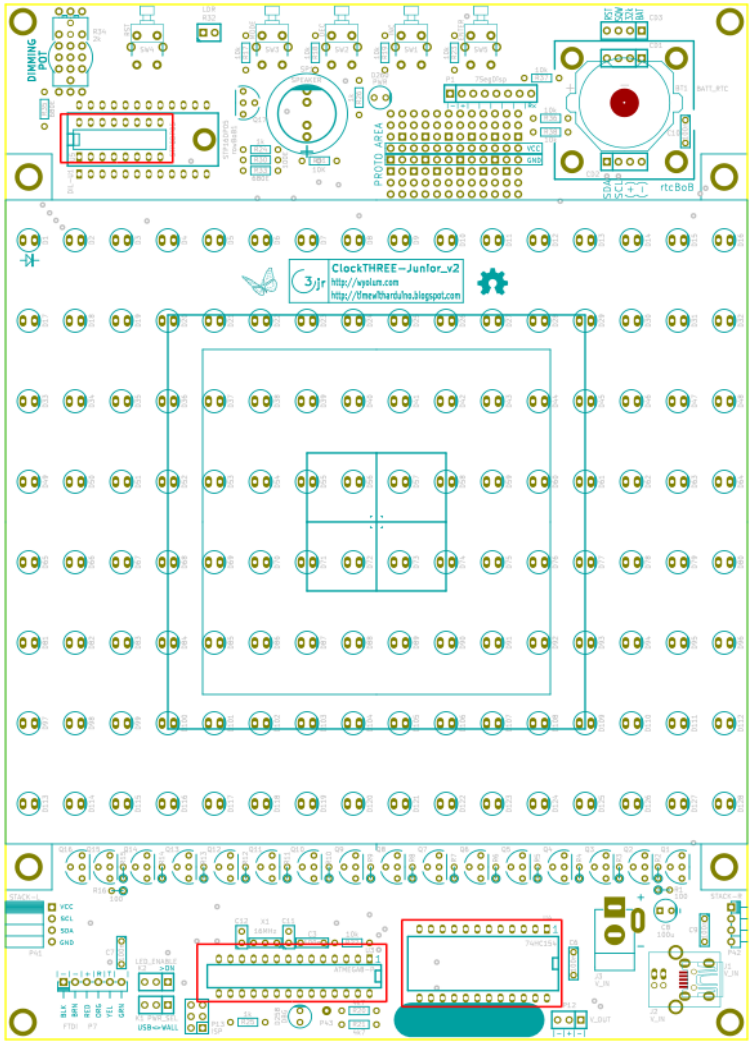
R26 : only if DBG LED is used.

R31: only if R32 [LDR] is used.

R36, R37, R38 : only if DS3231 (SMD) is mounted on-board. Not needed if using Chronodot or I2SD.

IC Sockets

7



IC SOCKETS

The sockets are polarized - so make sure to align them correctly with the legend marking on the board. (If you happen to solder one of these in backwards, don't fret, just be sure to plug the IC as indicated on the board).

PARTS

U3 : 28 pin socket, 0.3" width - for ATMega processor

U4 : 24 pin socket, 0.6" width - for Column Driver 74HC154

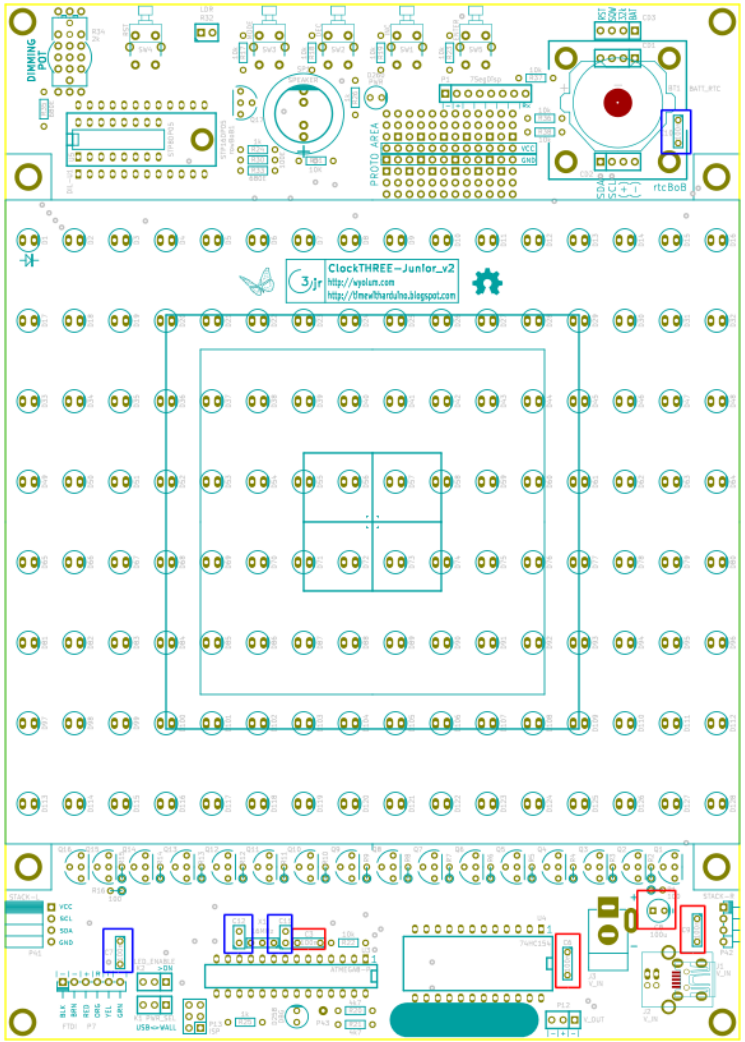
U5 : 16 pin socket, 0.3" width - for row driver STP8DP05

NOTE

Install the IC's in their sockets when you are ready to test the board. See instructions later in this guide.

Capacitors

8



CAPACITORS

There is one polarized capacitor (C8), and all the others are non-polarized.

PARTS

C3, C6, C9, C10 : 100nF decoupling/filtering capacitors

C8 : 100uF Electrolytic capacitor (polarized)

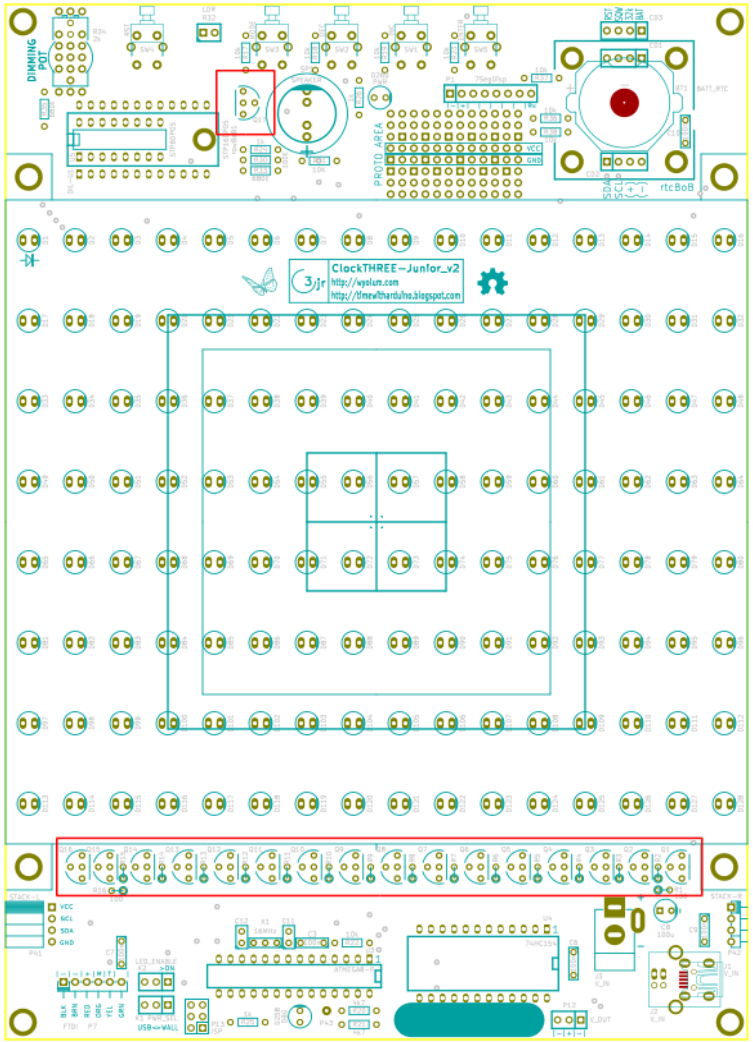
NOTES

C7 : Reset Capacitor, Not required

C11, C12 : Only required if X1 is a Crystal. Not required if X1 is a 3 pin resonator.

Transistors

9



TRANSISTORS

With transistors, orientation matters. The silk screen indicates the correct orientation. We find that using the middle hole is easier than using the offset hole.

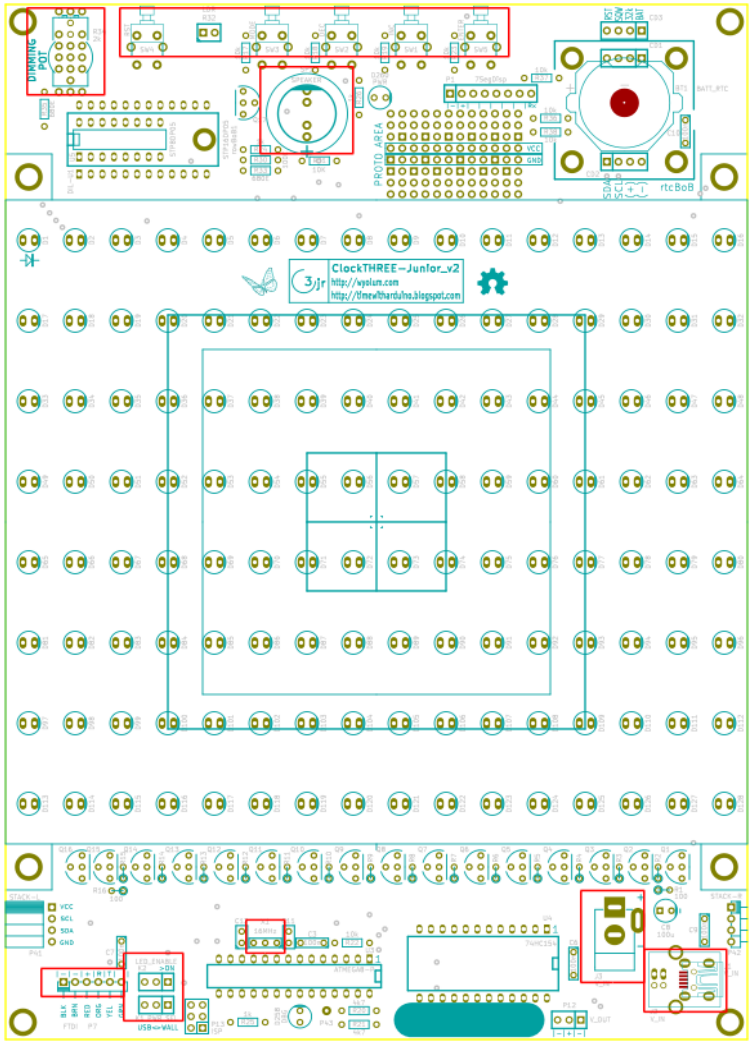
PARTS

Q1-Q16 : 2N5401 [near 100 Ohm resistors]

Q17 : 2N5401 [near Speaker]

Other Parts

10



OTHER PARTS

Finish off by adding in all the other remaining pasts.

PARTS

J1 (or J2 or J3) : The Mini-USB type Power Input socket. Or use the alternative USB-B (J2) or Barrel Socket (J3).

K1, K2 : 3 pin male header pins for Power Select (Wall Wart or USB) and LED ARRAY (Enable or Disable). Both of these also require a shorting link.

P7 : 6 pin, right angle, male header pins for FTDI connector

SP1 : Speaker / Buzzer

SW1, SW2, SW3, SW4, SW5 : right angle push button switches (top access)

OR

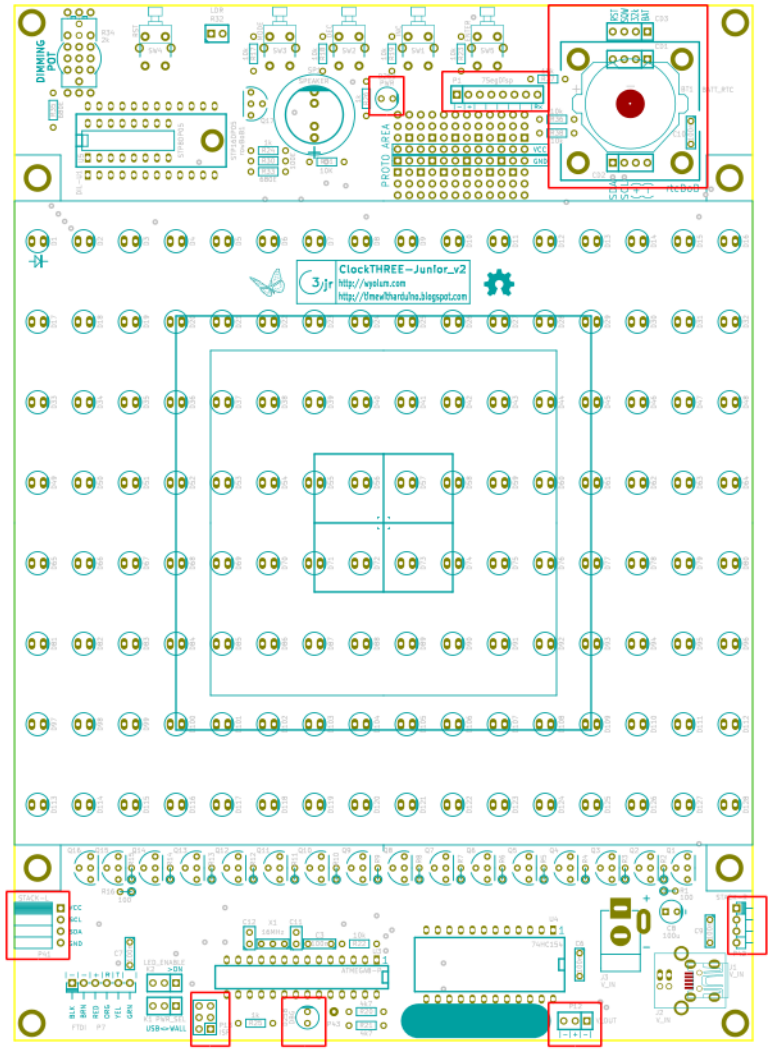
SW12, SW22, SW32, SW42, SW52 : straight push button switches (rear access)

X1 : 16MHz resonator (3 pins, not polarized)

R34 : 5k Thumb wheel Dimming Potentiometer (Pot). The Dimming potentiometer allows manual control of the brightness of the LED array. There are a lot of solder pads for this component, to allow various different types of potentiometers to be used. Whichever pot you use, try to make the control accessible from the top of the board.

Optional Parts

11



OPTIONAL & UN-USED PARTS

The board includes several parts that are either optional, planned for future use, or just included in case they're needed.

PARTS

U6 : DS3231 RTC IC. This is an SMD chip that is mounted on the solder side of the board. It may be pre-installed in some cases. If you are planning to use either the I2SD or the ChronoDot, U6 is not required.

BT1 : CR2036 Battery socket and coin Battery. Used only if U6 is installed on-board.

CD1, CD2 CD3 : 4 pin female header sockets, used if you plan to install either the I2SD or the ChronoDot.

D258 + R25 : DBG LED and Resistor – this one is optional, based on personal preference. Some like it installed, some don't.

D260 + R26 : PWR LED and Resistor - this one is also optional, based on personal preference. Some like it installed, some don't.

P1 : 8 way male header to allow fixing the 7 segment, 4 digit LED display from Sparkfun (see Links).

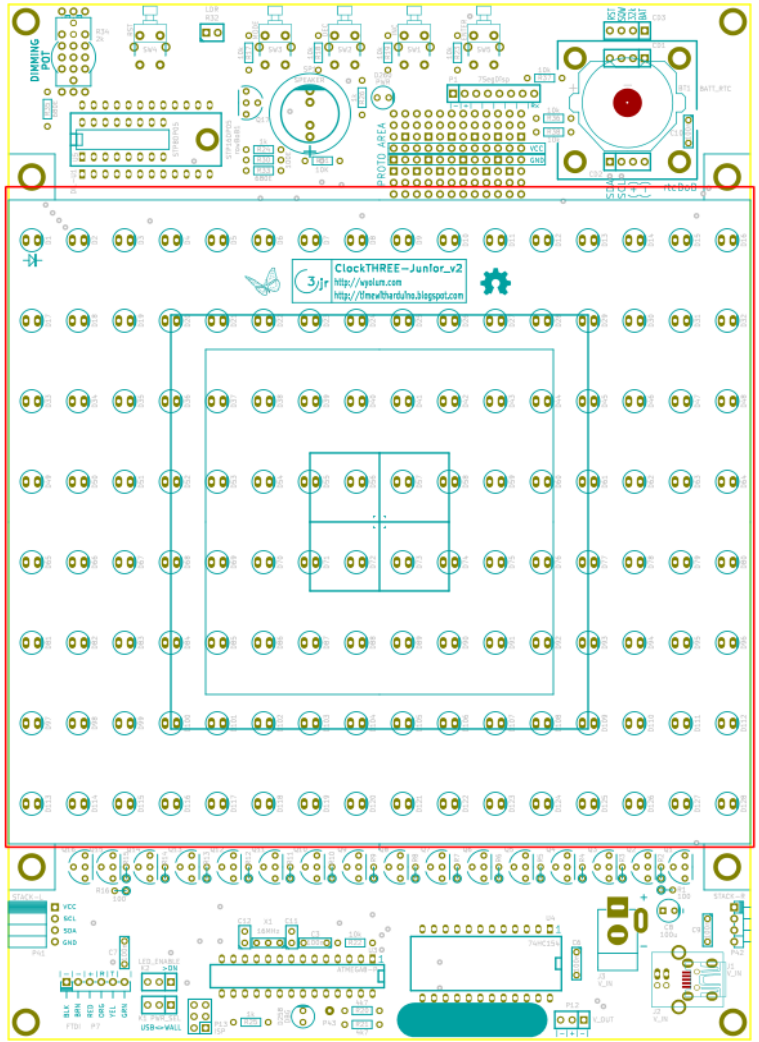
P12 : VOUT – this is an optional 3 way header providing the 5V board supply.

P13 : ISP – For programming the processor.

P41, P42 : C3SB Connectors – Marked as STACK-L and STACK-R, we call this the C3SB (ClockTHREE serial Bus). Allows us to cascade several C3Jr boards).

LED Array

12



LED ARRAY

Install the rest of the LED's for the array. The short lead (Cathode) of the LED always goes toward the label.

This can go very smoothly and quickly. We've found the fastest way to install the field of LEDs is in two steps : even numbered rows and odd numbered rows. This allows ample space for the soldering iron and gets the job done in short order.

PARTS

D1 to D128 : 5mm White LED's

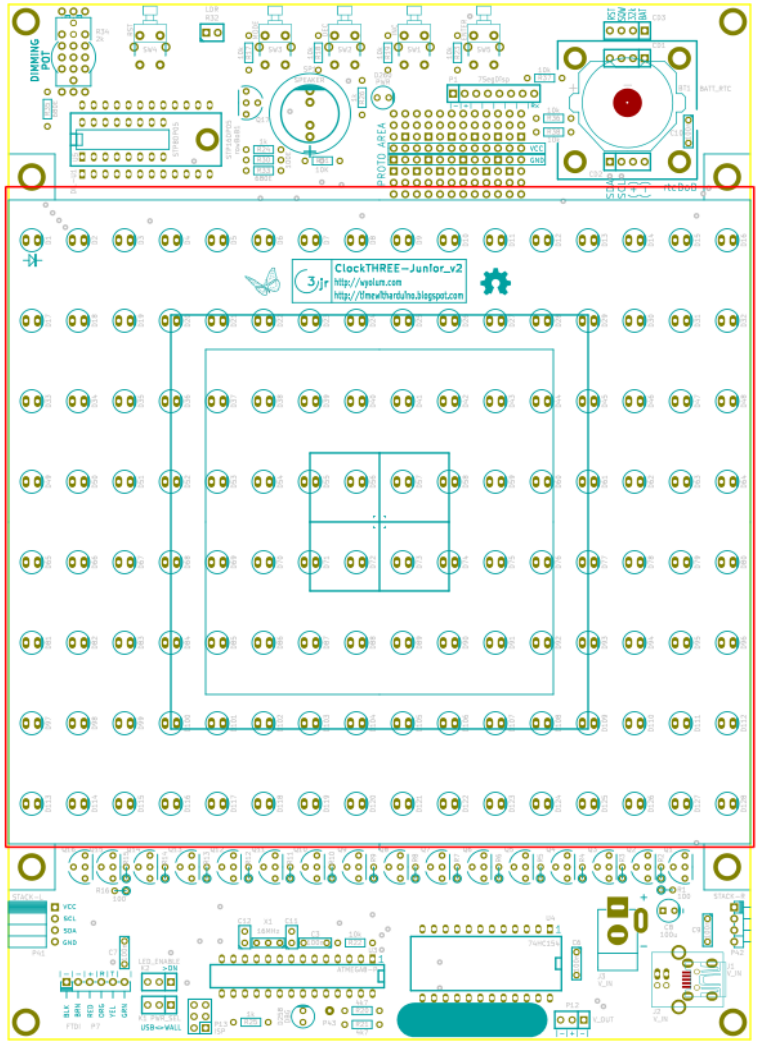
NOTE

It may be advisable to mount the first few LED's (D1 to D6) and test the C3Jr_v2 before filling up the array. See instructions later in this guide << SMOKE TEST>> for details.

Then, finish the rest of the LED array.

Smoke Test

13



Smoke Test

Before installing all of the LED's, it is advisable to confirm if the board is functioning correctly.

If already not done, install all the IC's (U3, U4, U5). Make sure you plug them in the correct orientation.

Ensure LED_ENABLE [K2] has a jumper connected to the ON location.

Ensure PWR_SEL [K1] has a jumper connected to the WALL location.

Plug in the Wall Wart to utility power, and connect its plug to the C3Jr_v2.

TAKE A DEEP BREATH

Switch on the Power. In a couple of seconds, LED's D2, D3, D5 and D6 should light up (_IT_IS). If they do, smile, and give yourself a pat on the back. It's time to go ahead and solder the rest of the LED's.

If the LED's don't light up, it's time to shoot a mail to << info@wyolum.com >> before soldering the rest of the LED array.

The Assembled Board

14

Put 3D views here (front and back)

Mechanical Assembly

15

Put assembly views here

Step 1. Start by inserting the four long screws into the four holes near the center of the backplate. Secure each with a small nut as shown.

Step 2. Slide the completed PCB on to the extended screws with the buttons near the the two keyholes in the top of the backplate. Then place the four small baffle locator's on the screw and secure with four small nuts.

Put assembly views here

Step 3. Interlock the baffle grid into place with the angled edge against the PCB. The provides a little extra space for the components. I found it simplest to start with the top and bottom vertical pieces and slide all the vertical pieces into place. Then, place a flat surface, such as a book, on top of the baffles and flip the whole assembly over and lift of the backplate and PCB leaving the baffle grid. Now the horizontal pieces can by set into place. Finally set the pcb and backplate on upside down on the baffle grid and flip the entire assembly back over. If you find an easier way, please let me know.

Double check that the baffles are not caught up on the locator's in the four corners.

Put assembly views here

Step 4. Insert four hex screws into the four corners of the backplate. Secure with 20mm standoff. Place a 7"x6" sheet of velum on top of the baffles. and install the faceplate, securing it with the remaining four hex screws.

Put assembly views here

Finally: Your clock is complete. Plug it in using either the wall wart , or the FTDI interface. Either way, ensure that the PWR SEL jumper is in the correct position: on the right two pins for wall wart, on the left two pins for FTDI power.

Modes & Functions

17

C3Jr_v2 : Modes and Functions – Buttons and Menus

BUTTONS

- RST Reset
- Mode Menu Modes
- INC Increment, Up, Next
- DEC Decrement, Down, Previous
- ENTER Enter, Select, Accept

MODES

- MT Mode Time
- MC Mode Color
- MA Mode Alarm
- MM Mode Mode
- MN Mode Normal

Describe each mode's function.

Programming

17

- Where to get the code from
- Arduino IDE
- Variables , special Clock Functions etc
- How to Program via FTDI

Personal Notes

18