

# ClockTHREE-Junior\_v2

**Assembly and User Guide**

**# C3Jr\_v2**



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## **VERSION INFORMATION**

KIT VERSION	v2
SW VERSION	v0_6
USER GUIDE VERSION	v1_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 product in an atmosphere of explosive gas.

**BEFORE YOU SOLDER** the IC sockets check that every leg has come through the PCB. Trust us, you don't want to notice twenty pins in that a leg got bent.

Be careful with the baffles, they are fragile.

# Links

## 2

- Wyolum : [www.wyolum.com](http://www.wyolum.com)
- Support & Discussion : <http://wyolum.com/forum/index.php>
- 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](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 IS TEN MINUTES PAST FIVE IN THE EVENING".

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](mailto: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 – 5V DC output, 1A

# Bill of Materials

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## BoM, for kit building assembly

ref	value	Vendor	Vendor P/N	NOTE1	NOTE 2
BT1	BATT_RTC	<a href="#">DigiKey</a>	3003K-ND		Battery Socket
*	3V CR2032 Battery	<a href="#">DigiKey</a>	P189-ND		LR2032 Coin Battery
C1,C2,C8	100u	<a href="#">DigiKey</a>	P833-ND		Capacitor Voltage Rating >= 16V
C3,C4,C5,C6,C7,C9,C10	100n	<a href="#">DigiKey</a>	399-5863-ND		Decoupling capacitor
D1 to D128	LED	<a href="#">DigiKey</a>	C535A-WJN-CU0V0231-ND		CREE LED 5mm Cool White Clear 110deg
D258	DBG	<a href="#">DigiKey</a>	1080-1134-ND		Debug LED, 3mm or 5mm LED, any Color
D260	PWR	<a href="#">DigiKey</a>	1080-1134-ND		Power On LED, 3mm or 5mm LED, any Color
J1	V_IN	<a href="#">DigiKey</a>	H2960CT-ND		USB-Mini Socket
K1	PWR	<a href="#">DigiKey</a>	SAM1031-50-ND		Header, Male, 3 pin, for PWR_SEL
*		<a href="#">DigiKey</a>	S9341-ND		Jumper socket for PWR_SEL K1
K2	LED_ENABLE	<a href="#">DigiKey</a>	SAM1031-50-ND		Header, Male, 3 pin, for LED_ENABLE
*		<a href="#">DigiKey</a>	S9341-ND		Jumper socket for LED_ENABLE K2
K4	SCL	<a href="#">DigiKey</a>	SAM1031-50-ND		Header, Male, 2 pin, Link for INT, OPEN for EXT
*		<a href="#">DigiKey</a>	S9341-ND		Jumper socket for SCL, K4
K5	SDA	<a href="#">DigiKey</a>	SAM1031-50-ND		Header, Male, 2 pin, Link for INT, OPEN for EXT
*		<a href="#">DigiKey</a>	S9341-ND		Jumper socket for SDL, K5
P7	FTDI	<a href="#">DigiKey</a>	SAM1031-50-ND		Header, Male, 6 pin, for FTDI
Q1 to Q17	2N5401	<a href="#">DigiKey</a>	2N5401GOS-ND		Transistor, TO-92-3
R1 to R16	100	<a href="#">DigiKey</a>	CF18JT100RCT-ND		Resistor, 1/8W, 5%
R17,R18,R19,R22,R23,R31,R36,R37,R38	10k	<a href="#">DigiKey</a>	CF18JT10K0CT-ND		Resistor, 1/8W, 5%
R20,R21	4k7	<a href="#">DigiKey</a>	CF18JT4K70CT-ND		Resistor, 1/8W, 5%
R24,R25,R26	1k	<a href="#">DigiKey</a>	CF18JT1K00CT-ND		Resistor, 1/8W, 5%
R30	100E	<a href="#">DigiKey</a>	CF18JT100RCT-ND		Resistor, 1/8W, 5%
R32	LDR SOCKET	<a href="#">DigiKey</a>	A32932-ND		Socket header, 2 pin, for LDR
--	LDR	<a href="#">DigiKey</a>	PDV-P9007-ND		LDR, 10k to 100k
R33,R35	680E	<a href="#">DigiKey</a>	CF18JT680RCT-ND		Resistor, 1/8W, 5%
R34	2k	<a href="#">DigiKey</a>	3352T-202LF-ND		Pot, Thumbwheel, Ceramic,
SP1	SPEAKER	<a href="#">DigiKey</a>	102-1169-ND		Audio Buzzer
SW12,SW22,SW32,SW52	INC	<a href="#">DigiKey</a>	450-1644-ND		Push button switch, Long Button
SW42	RST	<a href="#">DigiKey</a>	450-1649-ND		Push button switch, Short Button
U1	STP8DP05	<a href="#">DigiKey</a>	497-6271-5-ND		IC, Row Driver
*	Socket STP8DP05	<a href="#">DigiKey</a>	A100206-ND		Socket for IC U1
U2	7805	--	--		SHORTING LINK between VI and VO
U3	ATMEGA8-P	<a href="#">DigiKey</a>	ATMEGA328-PU-ND		Micro Controller
*	IC ATMEGA8-P	<a href="#">DigiKey</a>	A100210-ND		Socket for IC U3
U4	74HC154	<a href="#">DigiKey</a>	568-1407-5-ND		IC, Column Driver
*	IC 74HC154	<a href="#">DigiKey</a>	3M5479-ND		Socket for IC U4
U6	DS3231N	<a href="#">DigiKey</a>	DS3231S#-ND		IC, RTC
X1	16MHz	<a href="#">DigiKey</a>	X908-ND		Resonator, with capacitors, 3 pin



# Bill of Materials

## 4

### NOT USED COMPONENTS

C11,C12	22p	<a href="#">DigiKey</a>	BC1034CT-ND	Optional	if using crystal instead of resonator
CD1,CD2,CD3	CDOT1	<a href="#">DigiKey</a>	3M9515-ND	Optional	if using I2SD, rtcBoB or ChronoDot, Socket, 4 pin
DIL-U1	STP16DP05	<a href="#">DigiKey</a>	3M5479-ND	Optional	if using rowBoB, 24 pin IC socket
J2	V_IN	<a href="#">DigiKey</a>	ED2982-ND	Optional	USB-B, Socket
J3	V_IN	<a href="#">DigiKey</a>	CP-002B-ND	Optional	Barrel socket
K3	7Seg_Sel	--	--	Optional	Solder Bridge for uC pin selection
P1	7SegDisp	<a href="#">Sparkfun</a>	COM-09766	Optional	7 segment 4 digit display
P13	ISP	<a href="#">DigiKey</a>	SAM1095-36-ND	Optional	Header, 3x2 pin
P41	STACK-L	<a href="#">DigiKey</a>	SAM1009-50-ND	Optional	Socket, 4 pin, right angle, for daisy-chaining boards
P42	STACK-R	<a href="#">DigiKey</a>	SAM1043-50-ND	Optional	Header, 4 pin, right angle, for daisy-chaining boards
P43	CONN_1	--	Break Out Pad, no component	Optional	ATMega Port PC2
SW1,SW2,SW3,SW4,SW5	INC	<a href="#">DigiKey</a>	450-1657-ND	Optional	Right Angle switch, for Top access
U2	7805	<a href="#">DigiKey</a>	MC7805CTGOS-ND	Optional	ONLY if V_IN > 5V. ELSE USE SHORTING LINK

### MISC. COMPONENTS

BF1	BAFFLE	Angus Hines
BP1	BackPlate	Angus Hines
FM1	FRAME	Ikea or None
FP1	FacePlate	Angus Hines
P8,P9,P10,P11	CONN_1	Fixing Screw for Board
P14,P15,P53,P54	CONN_1	Fixing Screw for Baffle
P49,P40,P51,P52	CONN_1	Fixing Screw for rtcBoB
rowBoB1	CONN_1	Fixing Screw for rowBoB
P24 to P39	DIL6	Prototyping area
PCB1	PCB	Main Board, seeed

# Bill of Materials

4

A picture of the kit contents

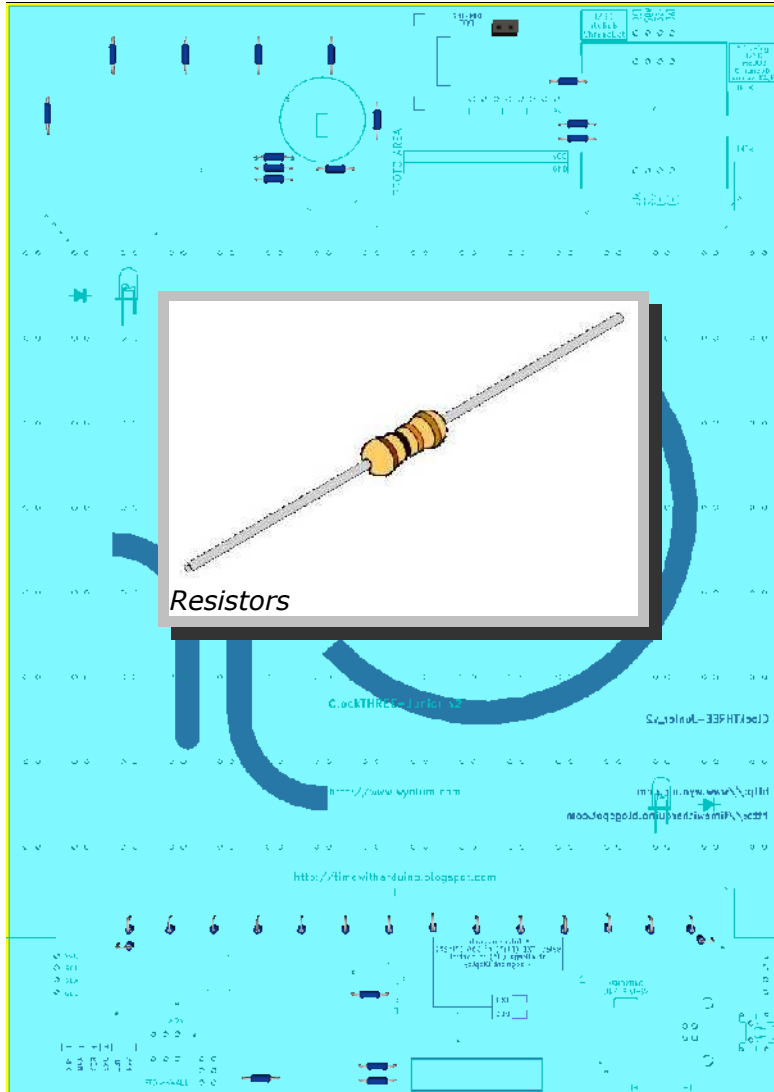
# Tips, before you start Assembly

## 5

- Read through and understand the entire set of instructions before you get started. We 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 through 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 : 2 pin female socket for LDR (light dependent resistor – it's use may be supported in future software release)

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

## NOTE

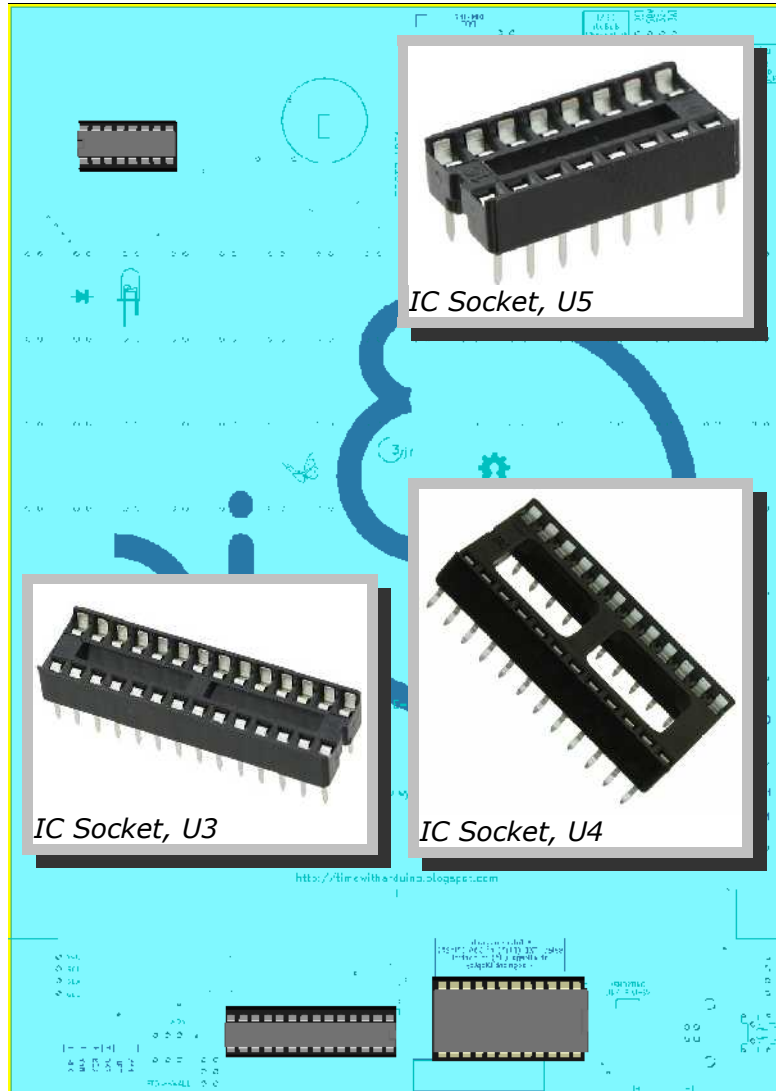
R26 : only if DBG LED is used.

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

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## 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 only when you are ready to test the board. See instructions later in this guide.

# Capacitors

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## CAPACITORS

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

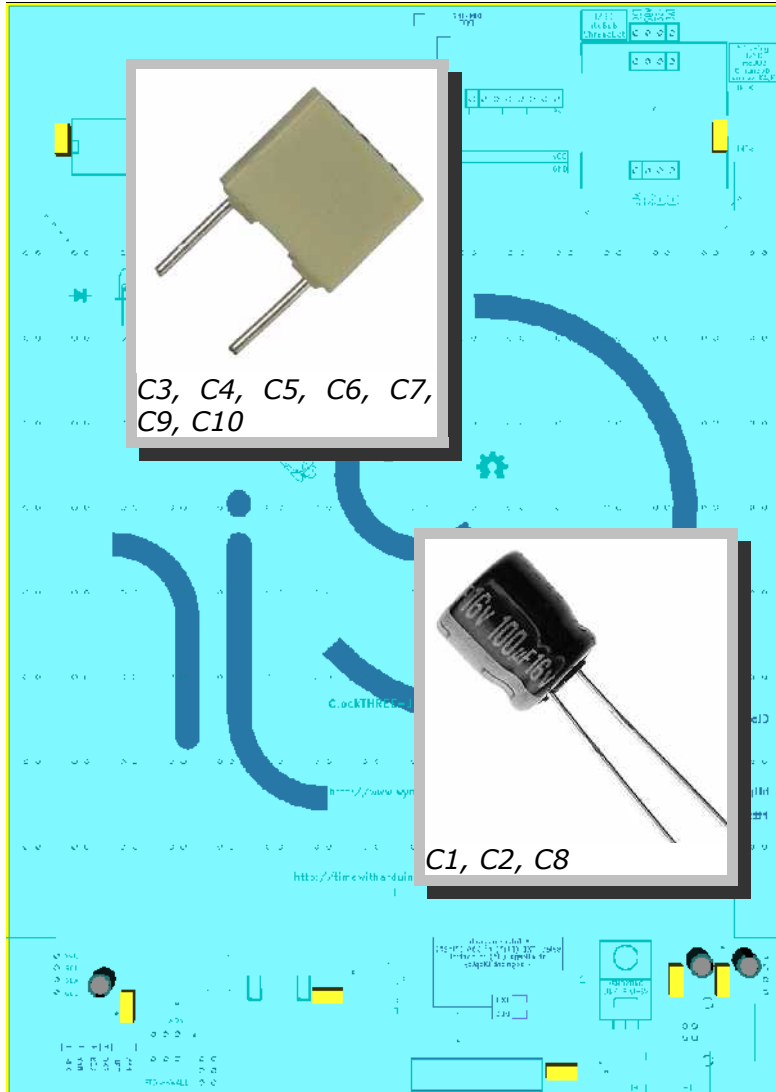
## PARTS

C3, C4, C5, C6, C7, C9, C10 : 100nF decoupling/filtering capacitors

C1, C2, C8 : 100uF Electrolytic capacitor (polarized)

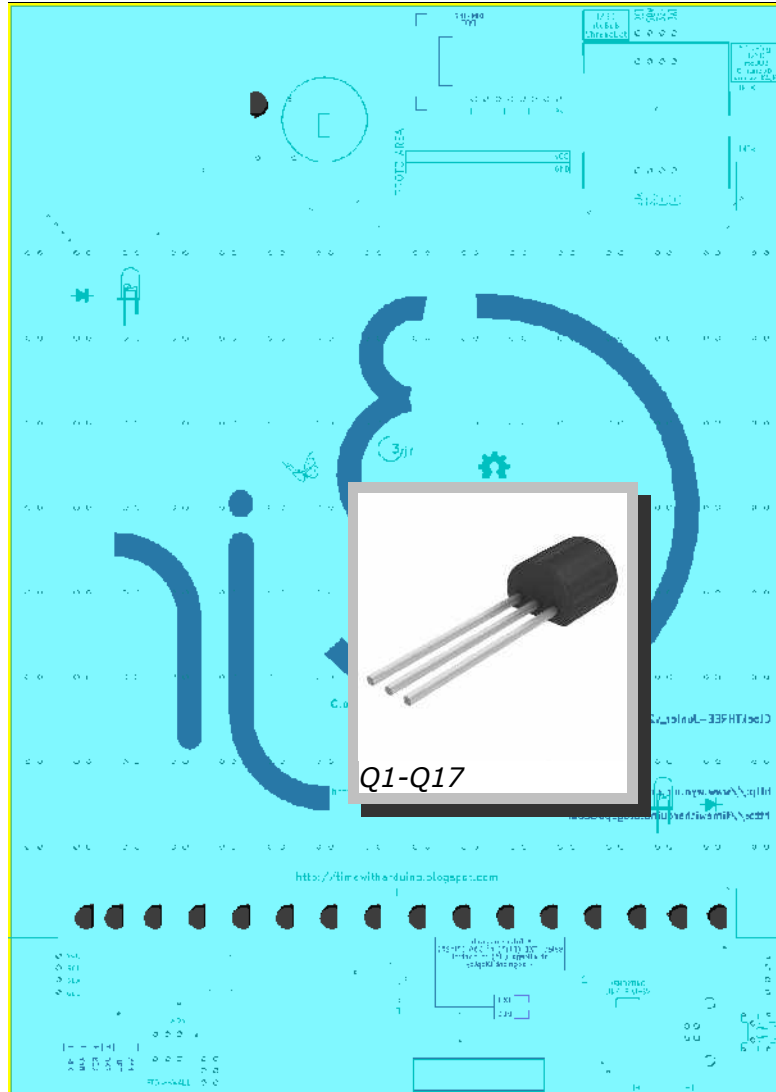
## NOTES

C11, C12 : Only required if X1 is a Crystal. Not required if X1 is a 3 pin resonator.  
By default, the kit is supplied with the 3 pin resonator.



# Transistors

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## 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.

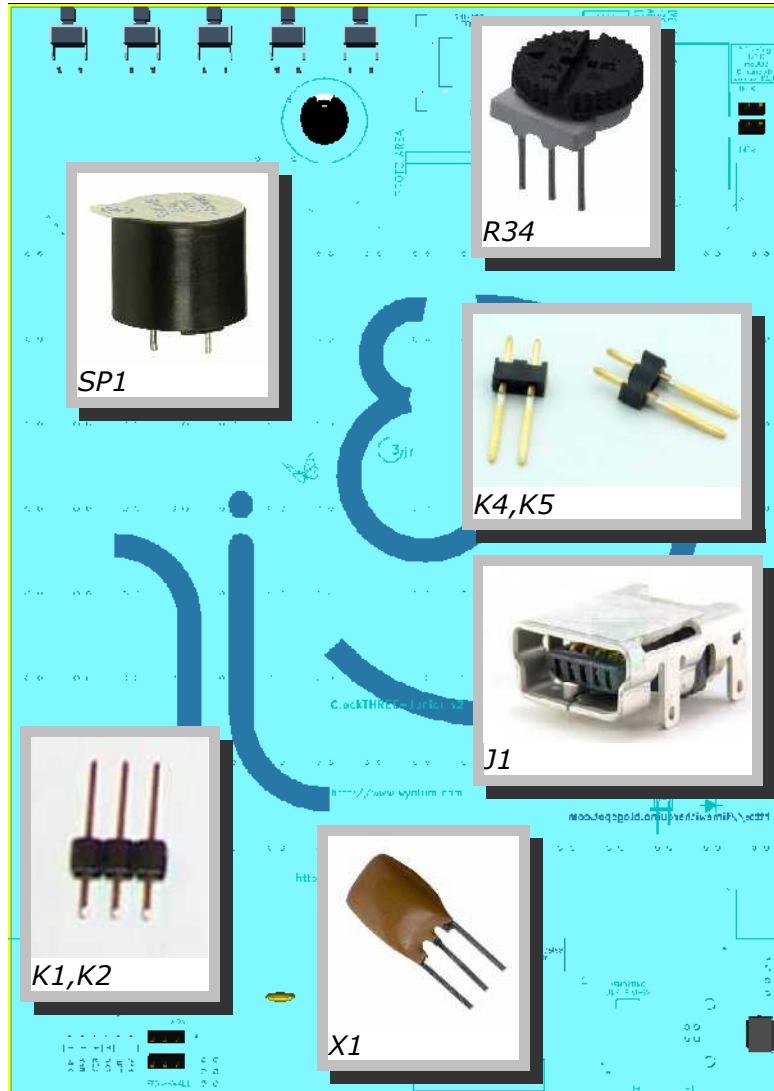
## PARTS

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 parts.

## PARTS

J1 : The Mini-USB type Power Input socket.

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

K4, K5 : 2 pin male header pins for RTC INT or EXT. When using INT RTC, both of these require a shorting link. When using EXT RTC, remove the shorting links.

P7 : 6 pin male header pins for FTDI connector (on Solder side)

SP1 : Speaker / Buzzer

SW12, SW22, SW32, SW52 : push button switches (on solder side). Long Button

SW42 : push button switch (on solder side). Short Button



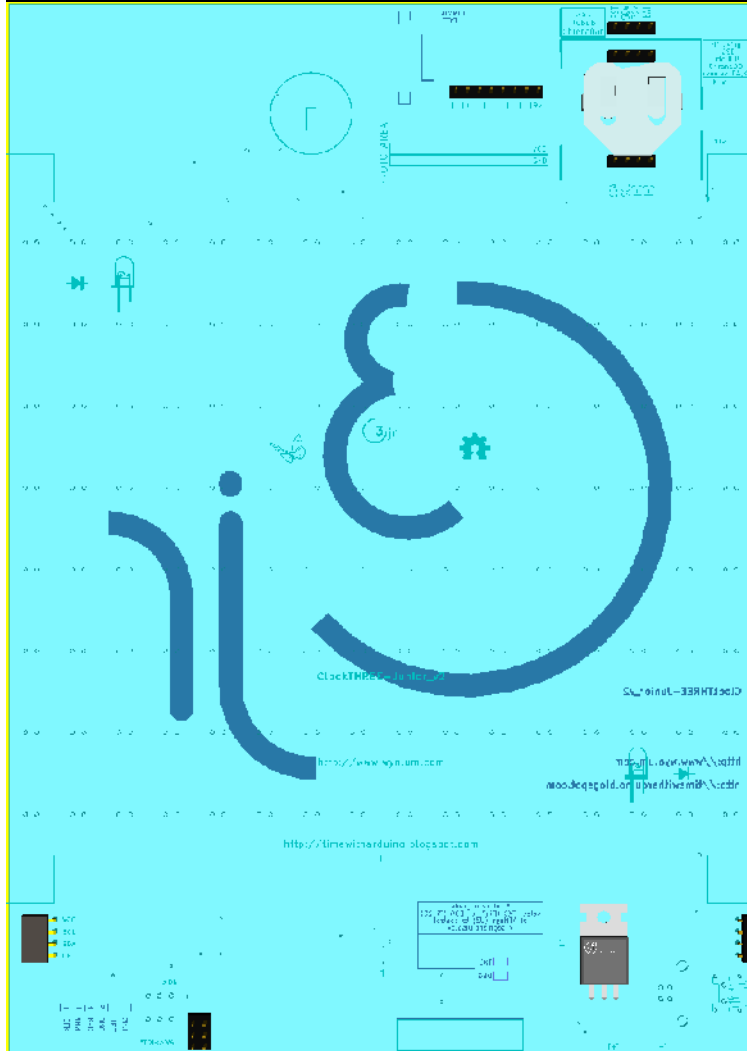
X1 : 16MHz resonator (3 pins, not polarized)

R34 : 2k Thumb wheel Dimming Potentiometer - Pot (on Solder Side). It allows manual control of LED array brightness.



# 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 SMD chip is mounted on solder side of the board. It may be pre-installed in some cases. If you plan to use either I2SD or the ChronoDot, U6 may be disabled by removing jumpers on K4 and K5.

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

**CD1, CD2 CD3 : 4 pin female header sockets.** Use if you plan to install either I2SD or ChronoDot. BT1 has to be removed.

**D258 + R25 : Debug 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). This feature is not yet supported in software.

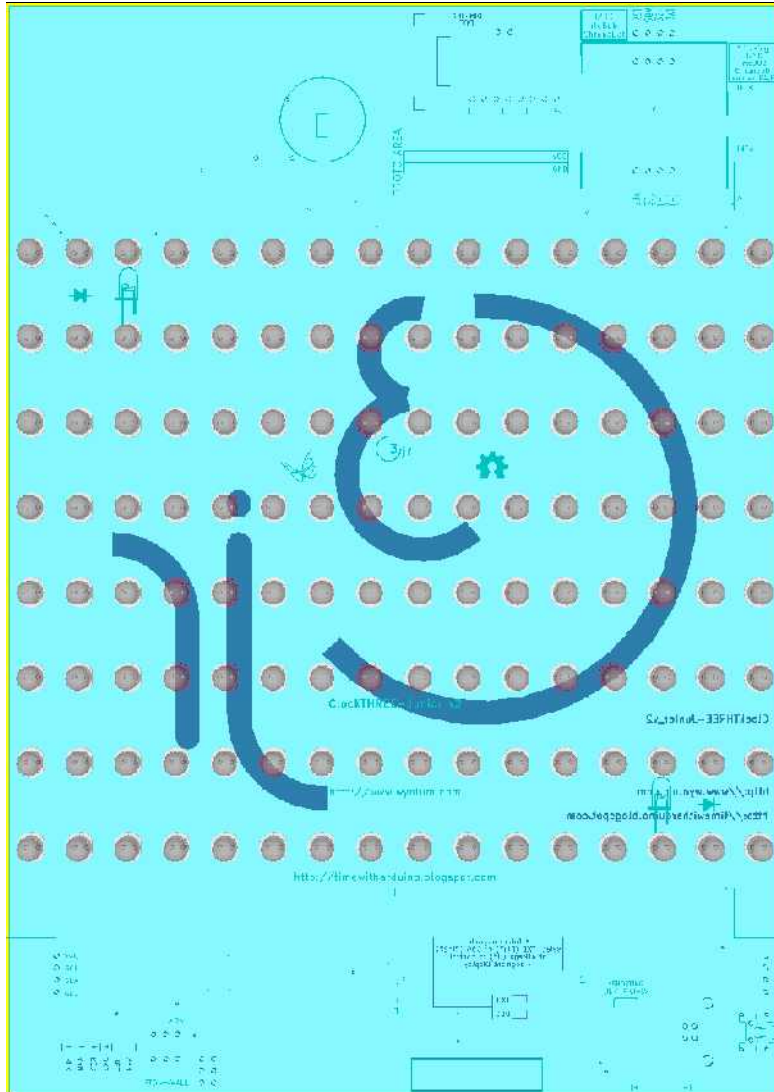
**U2 : 7805** – fix shorting link between VI and VO if input is 5V. If input is more than 8V, fix 7805 voltage regulator.

**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). They allow 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 (D1 to D128).



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 soldering iron and gets the job done in short order.

## PARTS

D1 to D128 : 5mm White LED's

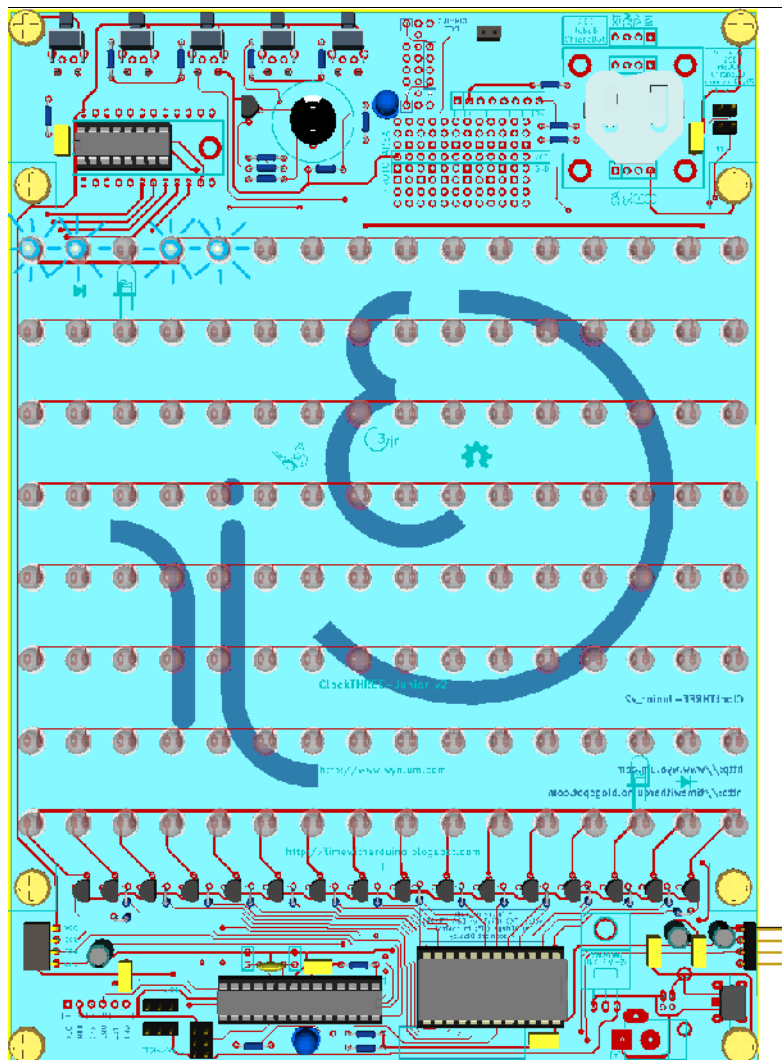
## NOTE

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.

After the Smoke Test, 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.

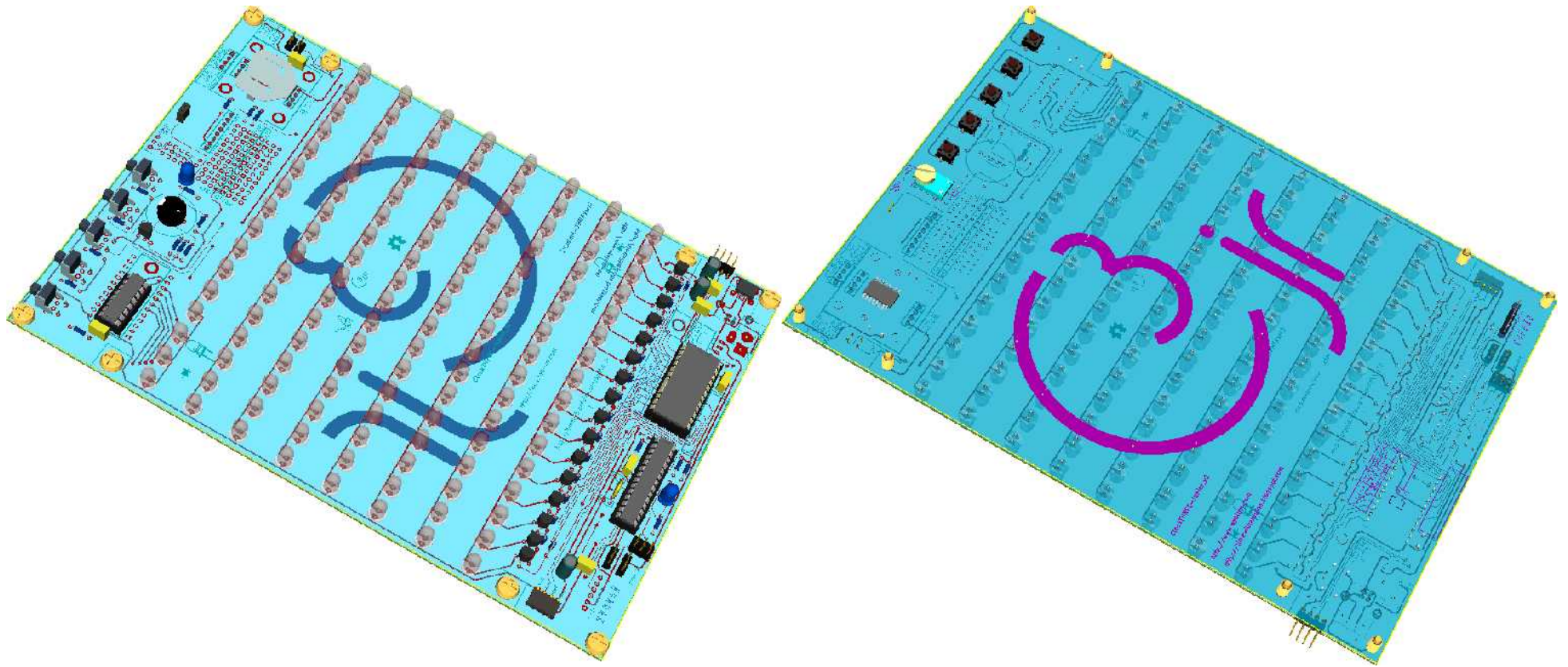
## TAKE A DEEP BREATH

Switch on the Power. In a couple of seconds, LED's D1, D2, D4 and D5 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](mailto:info@wyolum.com) >> before soldering the rest of the LED array.

# The Assembled Board

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Here's how the board will look after all parts are populated.

# Mechanical Assembly

# 15



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. Insert four short screws into the four corners of the backplate. Secure each with 20mm standoff.



## Mechanical Assembly

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Step 3. 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.



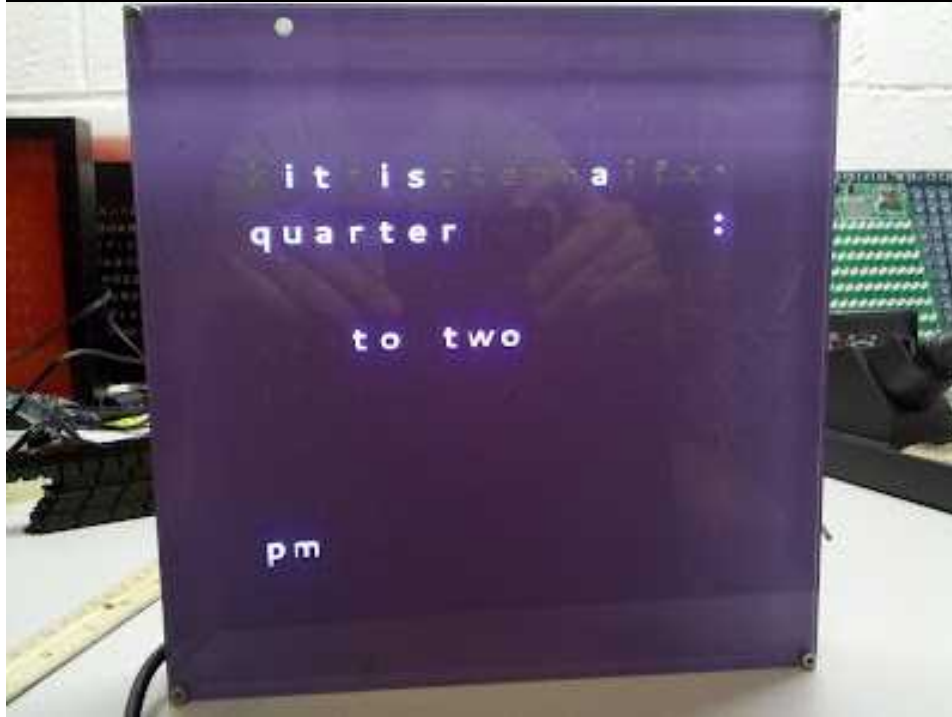
Step 4. Interlock the baffle grid into place with the angled edge against the PCB. This provides a little extra space for the components. We found it simplest to start with the top and bottom horizontal pieces and slide all the vertical pieces into place. Then, place a flat surface, such as a book, on top of the baffles and flip the whole assembly over and lift off the backplate and PCB leaving the baffle grid. Now the remaining horizontal pieces can be 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 us know.

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

Step 5. Place a 7"x6" sheet of velum on top of the baffles. and install the faceplate, securing it with the remaining four hex screws.

# the ClockTHREE\_Junior ver 2

# 16



**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.



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.

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

# Personal Notes

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