ClockTHREE-Junior_v2

Assembly and User Guide

 # C3Jr_v2

add LICENSE Information on this page :

- ° Creative Commons : http://creativecommons.org/licenses/
- ° Open Source Hardware (OSHW) : http://freedomdefined.org/OSHW
- ° OSHW Logo : http://oshwlogo.com/
- ° Open Hardware Summit : http://www.openhardwaresummit.org/

example :

This work is licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported License. To view a copy of this license, visit http://creativecommons.org/licenses/by-sa/3.0/ or send a letter to Creative Commons, 444 Castro Street, Suite 900, Mountain View, California, 94041, USA.

Index

VERSION INFORMATION

KIT VERSION	v2
SW VERSION	v0_6
USER GUIDE VERSION	v1_0

IMPORTANT

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.

Some components are polarized. They must be inserted the correct way around.

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

- ° Wyolum   : 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/

- ° seeed studio   : http://www.seeedstudio.com/depot/

- ° Sparkfun   : http://www.sparkfun.com/products/9766

- ° Smoke Testing   : http://en.wikipedia.org/wiki/Smoke_testing#Electronics_and_electrical_engineering

Introduction

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 >>

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

Bill of Materials

BoM, for kit building assembly

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

Bill of Materials

NOT USED COMPONENTS

C11,C12	22p	DigiKey	BC1034CT-ND	Optional	if using crystal instead of resonator
CD1,CD2,CD3	CDOT1	DigiKey	3M9515-ND	Optional	if using I2SD, rtcBoB or ChronoDot, Socket, 4 pin
DIL-U1	STP16DP05	DigiKey	3M5479-ND	Optional	if using rowBoB, 24 pin IC socket
J2	V_IN	DigiKey	ED2982-ND	Optional	USB-B, Socket
J3	V_IN	DigiKey	CP-002B-ND	Optional	Barrel socket
K3	7Seg_Sel	--	--	Optional	Solder Bridge for uC pin selection
P1	7SegDisp	Sparkfun	COM-09766	Optional	7 segment 4 digit display
P13	ISP	DigiKey	SAM1095-36-ND	Optional	Header, 3x2 pin
P41	STACK-L	DigiKey	SAM1009-50-ND	Optional	Socket, 4 pin, right angle, for daisy-chaining boards
P42	STACK-R	DigiKey	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	DigiKey	450-1657-ND	Optional	Right Angle switch, for Top access
U2	7805	DigiKey	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

Photo of Kit

KIT CONTENTS

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

° Cable – Mini USB to USB-A. This allows the C3jr_v2 to be powered via a computer USB port or using an external Wall Wart (not supplied) having a USB output.

Tips, before you start Assembly

° 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 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

R32

Resistors

Vertical, R1 ~ R16
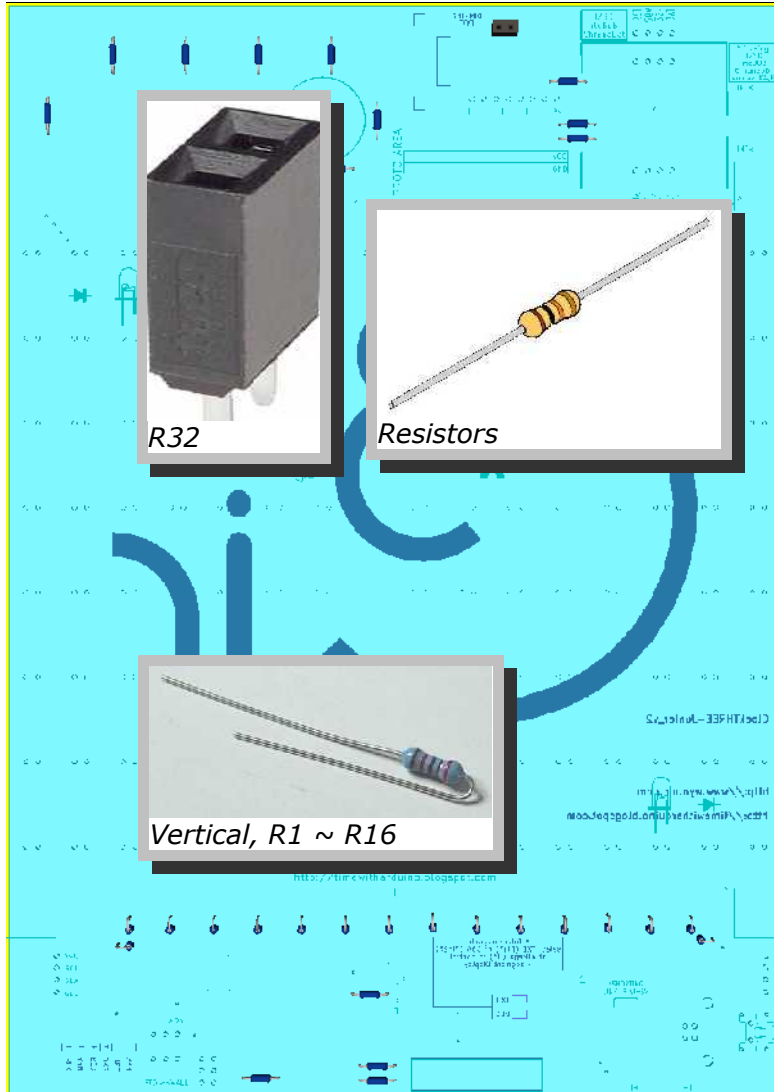
RESISTORS

Start by soldering the resistors. The polarity (orientation) does not matter. Resistors have colored bands to indicate value.

PARTS

R1 to R16 : 100 Ohm [brown-black-brown] – mounted vertically (bend like a hair pin)

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 (RTC IC) is mounted on-board. Not needed if using Chronodot or I2SD.

R32, LDR

IC Sockets

IC Socket, U5

IC Socket, U3
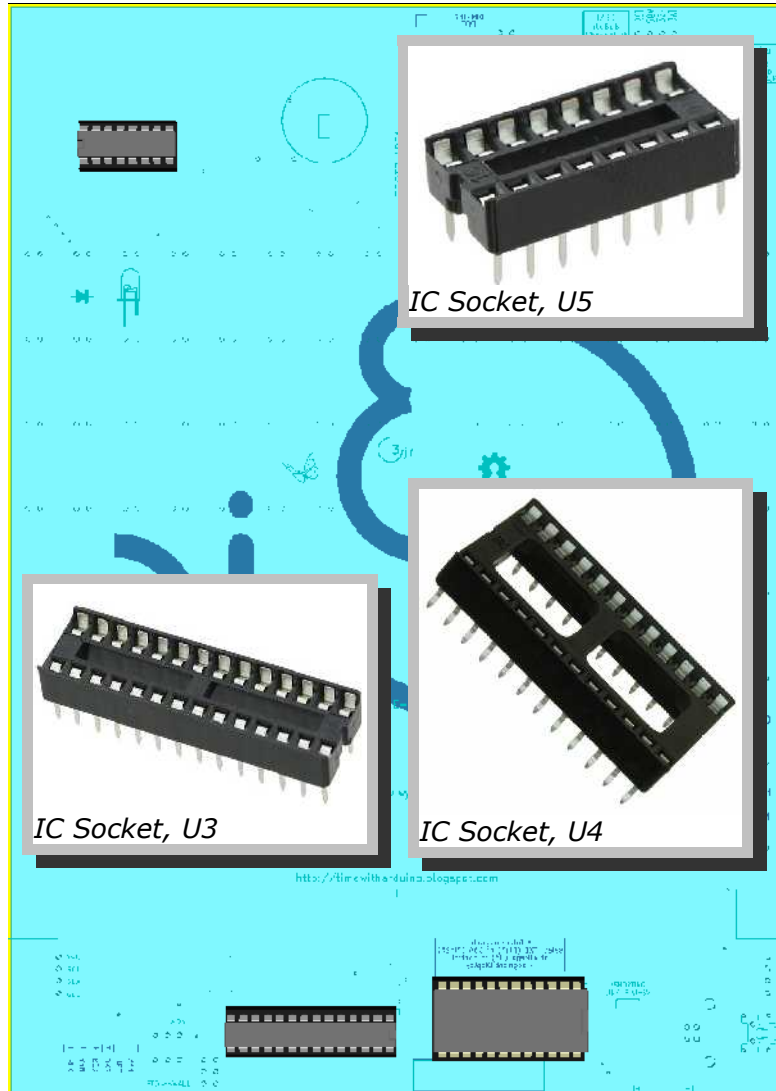
IC Socket, U4

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

C3, C4, C5, C6, C7, C9, C10

C1, C2, C8

CAPACITORS

There are three polarized capacitors (C1, C2, C8), and the others are non-polarized.
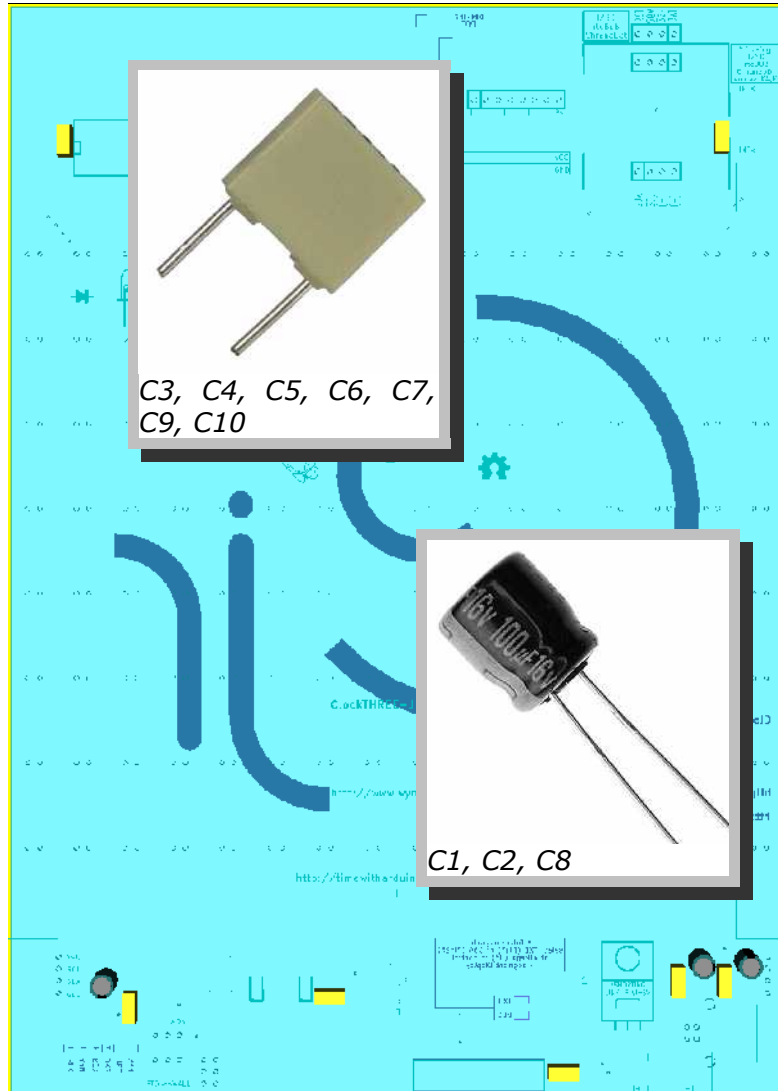
PARTS

C3, C4, C5, C6, C7, C9, C10 : 100nF decoupling/filtering capacitors
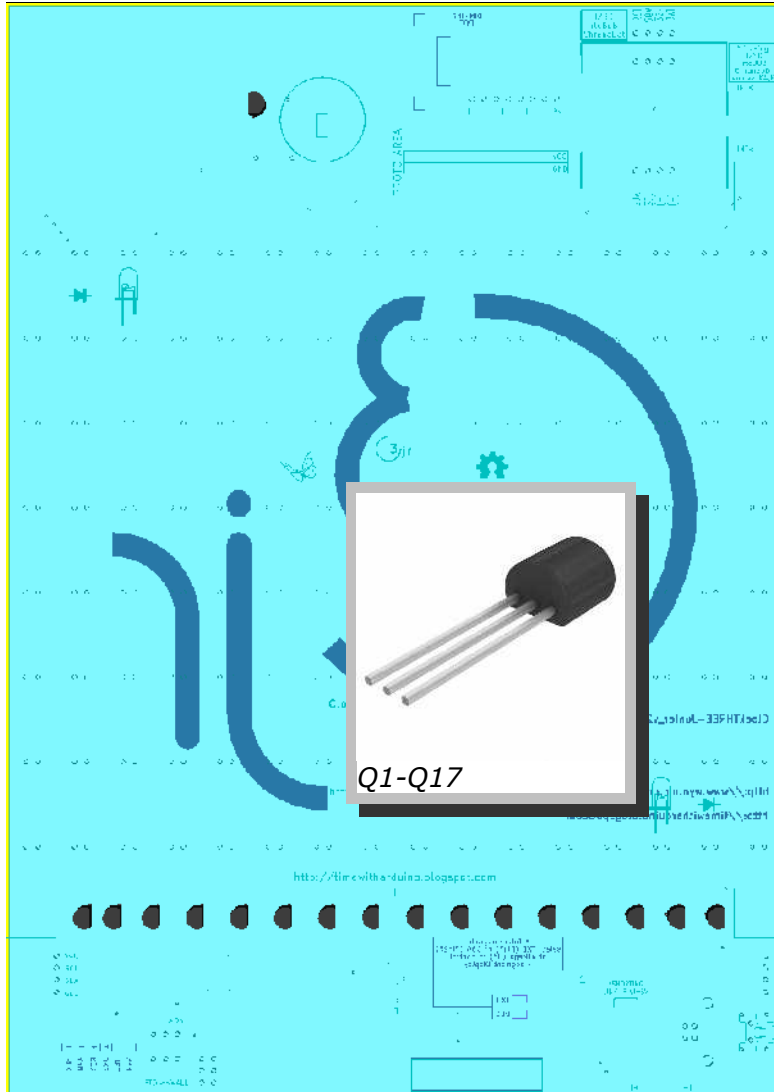
C1, C2, C8 : 100uF Electrolytic capacitor (polarized)

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

TRANSISTORS

With transistors, orientation matters. The silk screen indicates the correct orientation.

There are extra mounting holes for the transistors so we can use other types of package versions with offset legs if necessary. At present, the three holes in a single row are the ones that are used (TO-92 package). You can ignore the extra offset hole (useful if you have to use transistors with TO1, TO18, TO5, TO72 packages).
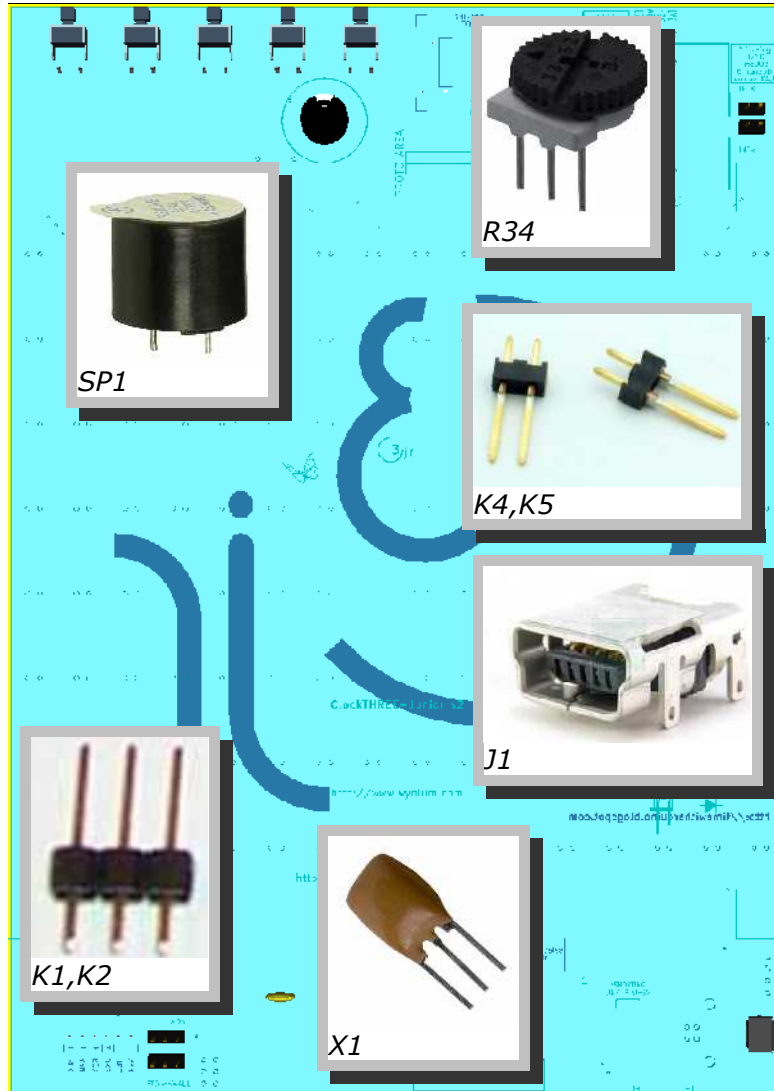
PARTS

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

Q17 : 2N5401 [near Speaker]

Q1-Q17

Other Parts

R34

SP1

K4,K5

J1

K1,K2

X1

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

SW12~SW52

SW42

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.

Jumpers

JUMPERS OR SHORTING LINKS

These act like switches to select options. Shorting Links or Jumpers need to be fixed at four places.

PARTS

LED ENABLE : ON or OFF

PWR_SEL : board power via FTDI or Mini-USB socket J1
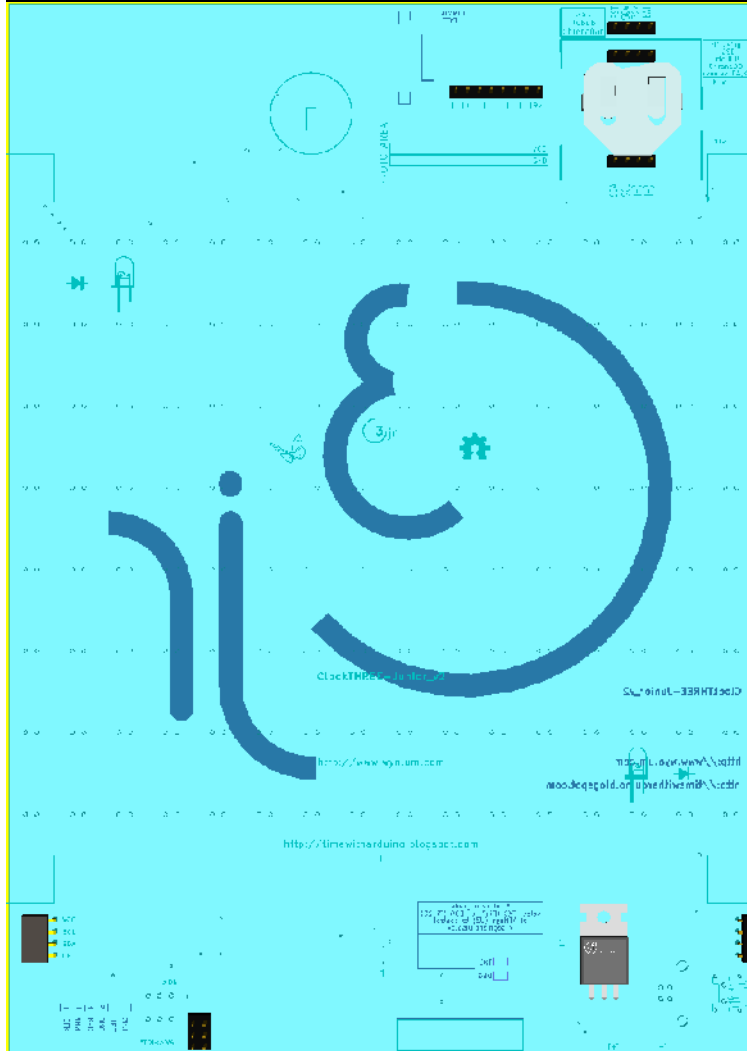
K4 : ON if using Internal RTC (U6) or OFF if using External RTC (eg I2SD)

K5 : ON if using Internal RTC (U6) or OFF if using External RTC (eg I2SD)

Jumper

Optional Parts

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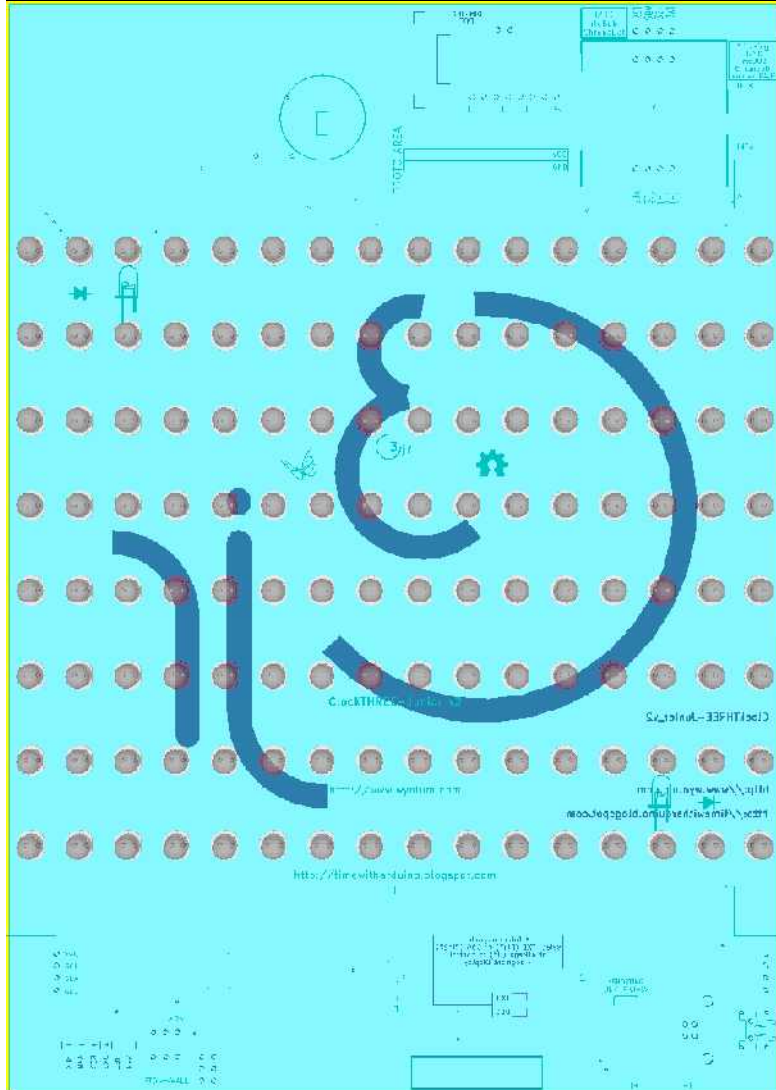
U2 : 7805 – fix shorting link between VI and VO if input is 5V. If input is more than 8V, fix 7805 voltage regulator.

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

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.

use the guide on the Legend to orient LED's
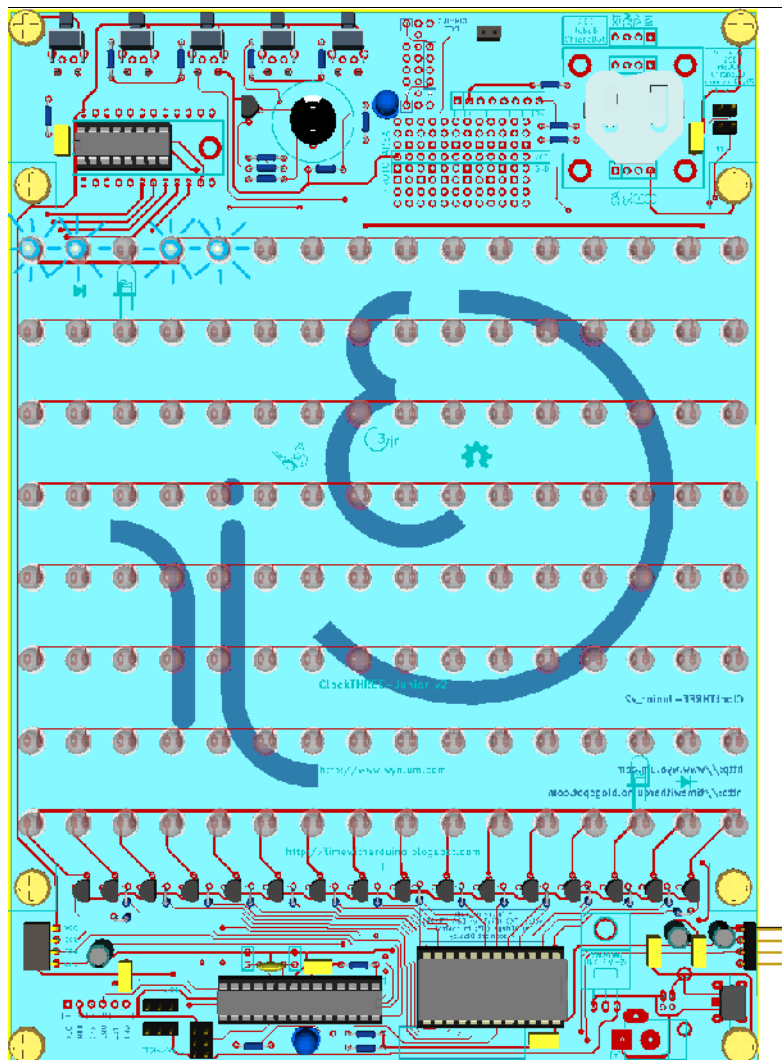
PARTS

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

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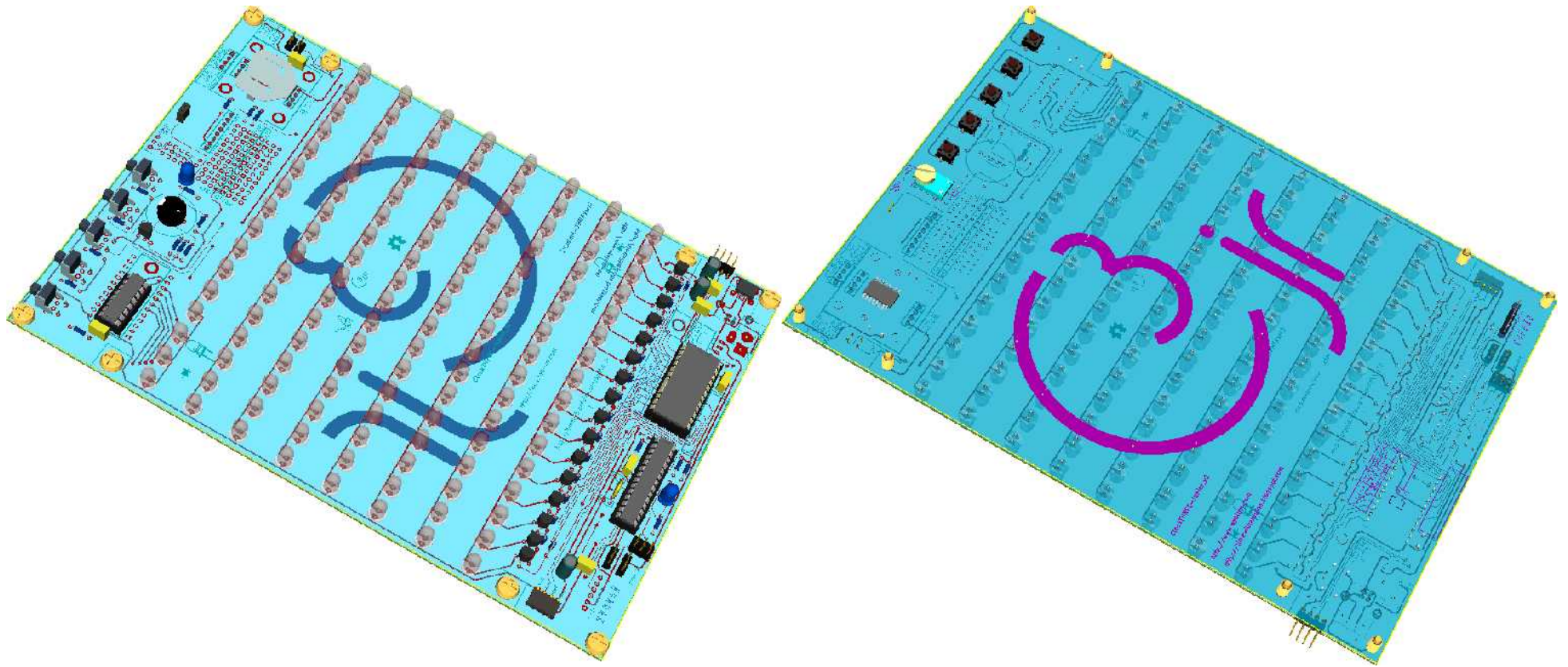
If the LED's don't light up, it's time to shoot a mail to << info@wyolum.com >> before soldering the rest of the LED array.

NOTE :

The PWR LED works only when the C3Jr is powered via connector J1 (Mini-USB socket). It does not work when the board is powered via the FTDI socket.

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

Mechanical Assembly

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

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.

Mechanical Assembly

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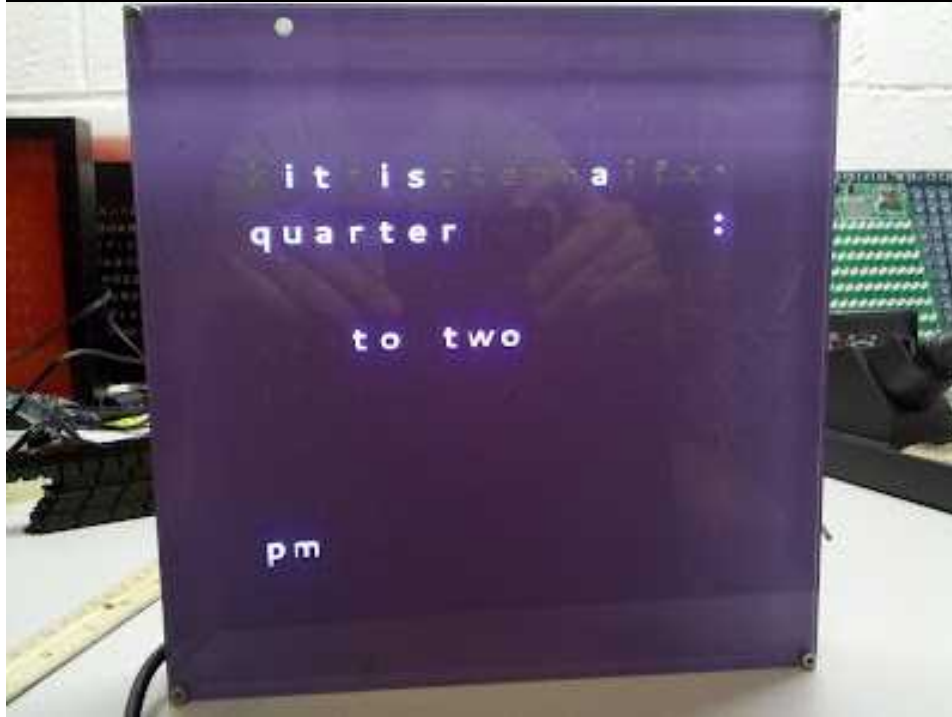
Finally: Your clock is complete. Plug it in using either the wall wart , or the FTDI interface. Either way, ensure that the PWR SEL jumper is in the correct position: on the right two pins for wall wart, on the left two pins for FTDI power.

Buttons and Interfaces

The C3Jr_v2 comes with a preprogrammed processor, so the clock is ready to use once plugged in. Looking around the clock, you will notice most obviously, the front "faceplate". This refers to the lettered display in your selected font. Take care not to scratch the acrylic surface. On the back, you will notice some engraved text, the ClockTHREE-Junior logo and two keyhole hangers.

Also located on the back are a set of Buttons. Angle brackets are used to denote the buttons. So for instance <mode> refers to the "mode" button. Starting from the right : <reset>, <mode>, <dec>, <inc>, <enter>, and a thumb-wheel "DIM POT" used for dimming the LED matrix. Located at the bottom is the serial interface marked "FTDI". The Mini-USB power input socket J1 allows the clock to be connected to a computer USB port or a wall wart having a USB-A socket.

BUTTONS

It has five buttons for control, and uses large character display to indicate functions and modes.

<RST>	Reset	Does what it says. The reset button is used primarily to re-program the clock. It can also be used to restore function if the clock should become unresponsive, sort of like a <CTRL> + <ALT> + <DEL>
<MODE>	Menu Modes	Brings up the Menu, allowing selection of clock modes. The mode button is usually the initial button you will press to interact with the clock. C3Jr is based on several "modes". The function of each button changes depending on the current mode.
<INC>	Increment, Up, Next	When pressed directly, displays Seconds, else does INC, Up or Next. Used to navigate back and forth through the current menu
<DEC>	Decrement, Down, Previous	When pressed directly, displays Temperature, else does DEC, Down or Previous. Used to navigate back and forth through the current menu
<ENTER>	Enter, Select, Accept	Accepts the selected entry. The <enter> button is used to lock in your selection.

Making it Work

MODE NORMAL (MN)

This is the natural mode. The time is displayed in words on the face plate. There are two sub-modes of Normal-Mode, start the Seconds-Mode by hitting <inc> and seconds will be displayed in large characters. Exit Seconds-Mode by hitting any button. Temperature-Mode is entered when <dec> is hit in Normal-Mode. Once in Temperature-Mode, the temperature unit can be changed using <dec> or <inc>. Hit either <mode> or <enter> to resume Normal-Mode.

MODE TIME (MT)

The first time ClockTHREE is turned on, the time may be incorrect. To set the time, hit <mode>. This puts the clock into "Mode-Mode", the mode that allows you to change modes. Use the decrement button <dec> and increment <inc> to select the Time-Change-Mode, which is indicated with a large "MT" on the display. Large characters are displayed using a 6x7 grid of faceplate letters as pixels.

The 2-digit year is displayed in large characters and is indicated with a "Y" in the lower left hand corner of the display. Use <inc> and <dec> to select the year, then hit <mode> again. Similarly, select the month, day, hour, and minute. Press <enter>, to set the new time, press <mode> to make any further changes. You may hit <enter> at any time, to lock in the changes and return to Normal-Mode.

MODE ALARM (MA)

C3Jr has 30 calendar alarms, that must be set with a computer, and one daily alarm which can be set locally. The daily alarm, when set, will go off every day at the same time.

The daily alarm, can be set without a computer. From Normal-Mode, hit <mode>. Now C3Jr is in Mode-Mode. Use <dec> and <inc> to select Alarm-Mode indicated by MA. Except for displaying the alarm time in words, the alarm is set like setting the time using <dec>, <inc>. After the minutes are set (in five minute steps), the alarm can be turned on or off, indicated by the icons in the lower right hand corner of the display. Finally hit <enter> to return to Normal-Mode. If the alarm is set, the alarm icon will remain on.

MODE COLOR (MC)

Since C3Jr shares the same code as ClockTHREE, you will find the mode COLOR (MC) is available among the Modes. However, since C3Jr comprises of monochrome LED's, the Mode Color is redundant.

Programming

° Where to get the code from

° Arduino IDE

° Variables , special Clock Functions etc

° How to Program via FTDI

Personal Notes