## *MAX6675, MAX31855, AND ARDUINO NANO CONFIGURATION*

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*Materials are referred to as their name in parenthesis*
1 Arduino nano for a thermocouple and an LCD display (*lcdNano*) **no longer used**
1 Arduino nano to be connected to 4 MAX6675 thermocouple breakout boards (*coupleNano*) code: multiRead6675ForArduino.ino
1 Arduino nano to be connected to 4 MAX31855 thermocouple breakout boards (*newCoupleNano*) code: 8waySecondUnit.ino
2 mini-USB to USB connection
8 K-type thermocouples (*thermocouple*)
4 MAX6675 breakout boards (*MAX*)
4 MAX31855 breakout boards (*MAX31855*)
1 16x2 LCD display (*LCD*) **no longer used**
1 LCD, MAX, lcdNano breakout board (*lcdBreakout*) -- 4 sets of header pins
1 4-way MAX31855 newCoupleNano breakout board (*newCoupleBreakout*) -- 5 sets of header pins (wide boards should be attached to this).
1 4-way MAX coupleNano breakout board (*coupleBreakout*) -- 3 sets of header pins (skinny boards should be attached to this).
Code: https://github.com/ahellerjones/Thermocouple
*finalReader.pde is the only file from the gitHub that must be downloaded and/or run. Unless the Arduino code needs to be reuploaded.*
Processing IDE
Arduino IDE

## *QUICK-START GUIDE*

Super fast reference guide if you know what you're doing and have read the entire manual before:

- Connect one or both of the TC readers. Set twoOrOne on line 29 to the correct value.
- Set the MAX_READ_COUNT and/or MAX_TIME to the desired values.
- Run a quick test, if it doesn't work, switch the usb plugs.

Full Configuration:

1. This portion assumes everything has been downloaded / all materials are present.
2. Refer to **Serial Configuration** portion below to set up the connections with the host computer.
3. The program can be started by pressing the play button at the top left of the Processing IDE, the program is stopped by pressing the stop button next to it.

4. The program will end once either end condition is satisfied, MAX_READ_COUNT **or** MAX_TIME. Set MAX_TIME and/or MAX_READ_COUNT to the desired values on line 24 of the Processing code. MAX_READ_COUNT incremements once every iteration of the code, thereby designating how many data entries the code will capture. MAX_TIME obviously just halts the program after a specific amount of time. MAX_TIME is in units minutes, 10.5 runs for 10 and a half minutes. The program *must reach an end condition* to return a file. ***All data collected will be lost if the program is stopped before the program ends.***

7. On line 28 in *finalReader.pde,* the sample rate can be altered. This value is in units milliseconds and determines how many entries per second. Do not alter the value below 350.

8. The main method will repeatedly print to the console with the X's replaced with temperatures:

TC B: XXX.XX *C
TC C: XXX.XX *C
TC D: XXX.XX *C
TC E: XXX.XX *C
Time Elapsed: 3:14 out of 5:00
Entry number: 12 out of 50

for each each iteration of the main method to the command line. Thus the console will display multiple iterations of the above, the last one printed is the most current. If the program is configured for two units by altering the boolean twoOrOne on line 29, TC F through I will also print their temperature readings. Each of these lines represents the reading on the thermocouples respectively to the letter after TC, in degrees celsius.

9. If the program does not seem to be running at all, switch your designation of the variables FOURWAYPORTNUM and NEWFOURWAYPORTNUM. This is generally the thing that goes wrong most of the time. If that does not work refer to **Serial Configuration** again, remember that the Serial Ports on the Arduino IDE are 0 indexed. If the the USB connections are switched at all the Serial Ports in the Processing Code should be re-evaluated.

10. Finally, the program will halt and print File Completed: fileName and output a file with name as follows: date separated by periods, the word tempData, and number of minutes on the hour for uniqueness appended on the end: 2019.3.13tempData57.csv

## ***ASSEMBLY***

Everything should be pre assembled, if not,

### ***lcdBreakout (NO LONGER USED)***

1. Place the lcdNano into the 2 rows of header pins on lcdBreakout directly across from the 5 vertical header pins. This will be referred to as the 'top' of the board
    a. The mini-USB port on the lcdNano should be facing **RIGHT** with D13 on the lcdNano in the last header pin on the top row of header pins
2. Place a MAX into the row of 5 header pins.
    a. The thermocouple attachment should be facing **LEFT**
3. Insert a thermocouple into the thermocouple attachment.
    a. Insert the **RED** connection into T+, **BLUE** into T-
    b. If the connections are not red or blue, you're going to have to guess and check. The quickest way to guess and check is to set the Processing code to run indefinitely, hold the thermocouple you wish to test tightly between your fingers. If the temperature increases on the Processing readout, the connection is correct, if it goes down then the connection needs to be switched.
4. Insert the LCD into the bottom row of header pins with the LCD facing **DOWN.**
    a. The last pin on the LCD should be in the **LEFTMOST** header pin.

***coupleBreakout***

1. Refer to the illustration below. Insert the coupleNano into the two sets of header pins on the coupleBreakout. This is the 'top' of the coupleBreakout. The mini-USB connection on the coupleNano should be facing **RIGHT.**
    a. Make sure D13 on the coupleNano is connected to the **RIGHTMOST** pin. V_in will be hanging off and not connected, this is ok.

2. Insert 3 MAX's into the bottom header pins, starting on the **LEFTMOST** header pin and with the couple connection facing **DOWN**.
    a. There will be a 1 pin gap in between each MAX.

3. Insert the last MAX with its GND connection to the **RIGHTMOST** pin in the same configuration as the others. There should be a 2 pin gap in between this MAX and the 3rd.

4. Connect thermocouples to to MAX boards. The thermocouples have labels on them saying BLU -> +. This means that blue connection on a specified thermocouple goes to the + terminal on the MAX board. The MAX boards have printed on them which terminal is + and -.

***newCoupleBreakout***

1. Insert 3 of the MAX31855's into the long row of the newCoupleBreakout. They should sit flush and with 2 header pins between each. Insert one more into the lone header pins.
2. Insert the Nano as configured in the diagram below. If you don't know which Nano is which as they've been separated from their breakout boards, you'll have to reupload the code specified in the materials.

***SERIAL CONFIGUATION_____***

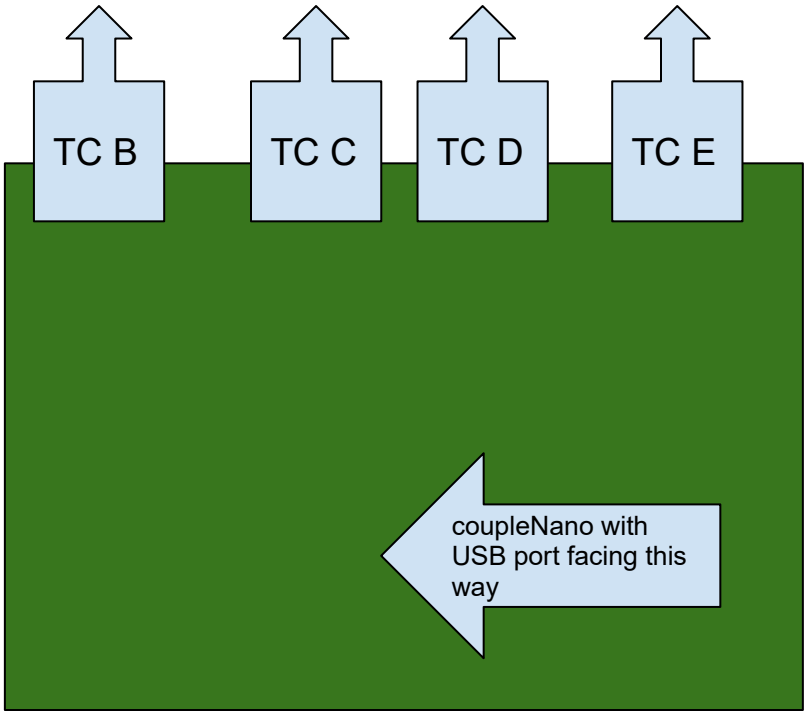
1. Connect the *coupleNano* to a USB port on the main computer. The red power light will turn on on the MAX and the coupleNano. You must use the coupleNano initially, and not the newCoupleNano.
2. Open the Arduino IDE. Go to Tools at the top, and put your cursor over Port. There will be a list of Serial ports, there will be one listed with a (*) Remember what number this is in the list, 0 indexed. This number is the **FOURWAYPORTNUM.** Write it down.
3. With the *coupleNano* still connected, close the Tools tab, connect the *newCoupleNano* to a USB port, check the port listings as stated above. There will be a new port listed, the number in the list will be the **SECONDFOURWAYPORTNUM.** Write it down.
4. Open the Processing code from the gitHub listed as *finalReader.pde*
5. Scroll down to line 27 in *finalReader.pde* and change the variables **FOURWAYPORTNUM** and **NEWFOURWAYPORTNUM** their respective numbers as found above.
6. Line 29 has a boolean called twoOrOne. This allows the program to run with one or both of the units. ***coupleBreakout must always be used.*** The program will not work with only newCoupleBreakout.
7. Run a test by pressing play on the Processing IDE. It should halt for a second and then read values. There will always be text that says "Could not parse -1 for --display" Don't worry about it. If a null pointer exception is thrown, run the code again. It should only take 1-2 tries.
8. If the program does not seem to be running at all, switch your designation of the variables **FOURWAYPORTNUM** and **NEWFOURWAYPORTNUM**. This is generally the thing that goes wrong most of the time. If that does not work ensure that you have the correct numbers, I mess it up all the time so don't be surprised if you get it wrong the first time. If that does not work, download the secondary file from the gitHub and run the procedure again.

## *UPDATES*

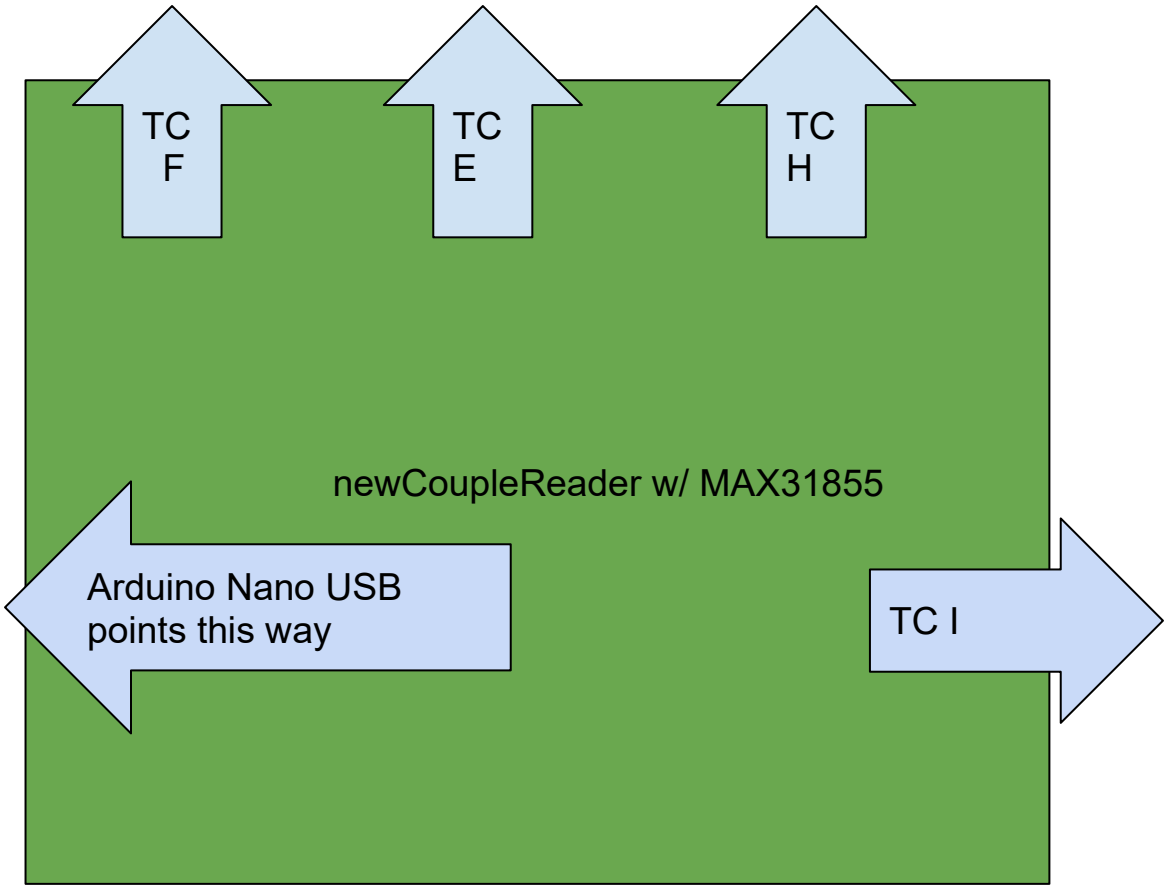
03/13/2019 -- Added second unit, newCoupleBreakout. Updated Quickstart Guide & Serial Configuration for new board. Cleaned up and updated Processing code for new board. Added Diagrams.

05/15/2019 -- Discontinued LCDBreakout given it's redundant nature. Updated Quickstart Guide & Serial Configuration. Added Quick Reference guide. Updated Processing code: Added option to use one or two break out boards with the addition of boolean twoOrOne, see line 29 of finalReader.pde. Added labels to 4 thermocouples to denote their correct orientation in the MAX boards.

## *DIAGRAM*




Email Andy at hellerar@vt.edu with issues. I'm no longer a part of this project, but will answer legitimate questions sent via email.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newCoupleReader w/ MAX31855
Arduino Nano USB
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