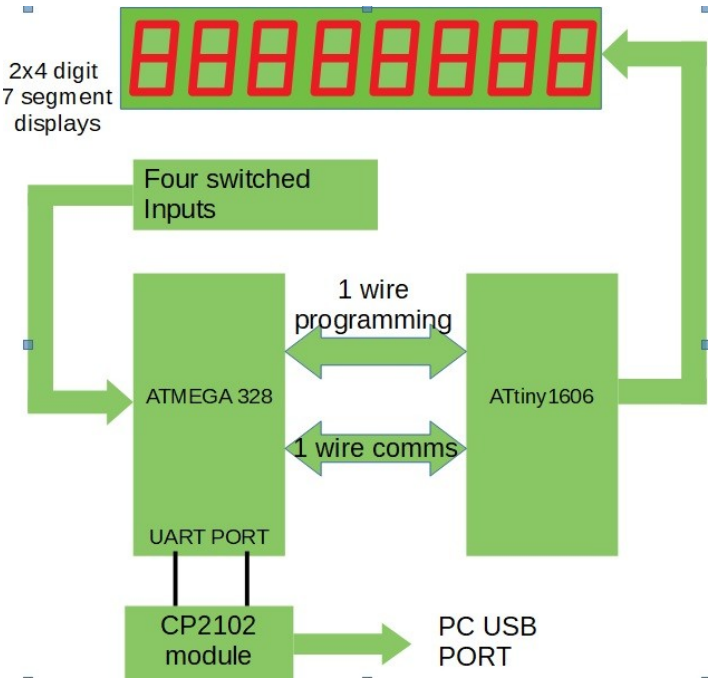
Introducing PCB111000_CP2102

PCB111000_CP2102 is a cut down version of PCB_111000_UNO posted by osbornema on 18 July 2020. It is designed to provide an introduction to C programming for AVR devices and consists of:

A CP2102 module with Rx/Tx and power provided on a 6 pin header
An Atmeg328 for user programs
An ATtiny 1606 that drives an 8 digit seven segment display.



System diagram for PCB111000_CP2102

The Atmega 328 hosts:
- A Hex/text bootloader
- An optional UPDI programmer
- User programs
- Text commentary for several sample programs.
- A default program provided for test purposes.

The ATtiny1606
- Drives the display
- Provides resources for the user projects

One of the switches controls reset and display intensity. The others are or data entry.

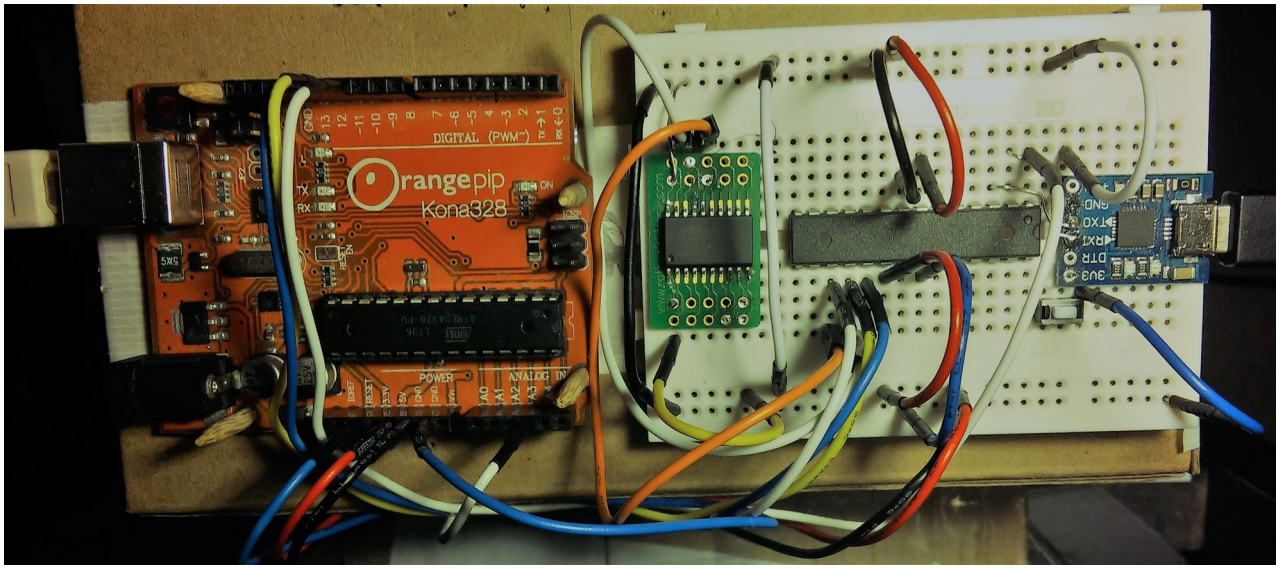
System projects

	Name	Compiler	Platform	Task
1	UNO_programs_328	Arduino	UNO	Uploads bootloader and provides time standard for Atmega 328 calibration.
2	UNO_Calibrates_328	Arduino	Atmega328	Calibrates 328 against the UNO crystal
3	CP2102_UPDI_Programmer	Arduino	Atmega328	Uploads mini-OS to ATtiny1606
4	CP2102_mini-OS	Studio 7	ATtiny1606	Drives display and provides user services
5	cal_one_wire_comms	Arduino	Atmega328	Matches 328/1606 baud rates
6	CP2102_bootloader	Studio 7	Atmega328	Loads user projects
7	FP_arithmetic	Arduino	Atmega328	Test project
8	Recal_328_using_crystal	Arduino	Atmega328	Check calibration post pcb assembly

Note: All projects are closely based on previous versions already posted on AVR freaks.

Checking out the operation of the system projects

Operation can be checked out using the prototype system shown below rather than manufacturing and loading a pcb.



Wiring of the prototype system was as follows
(Note photo has error. It shows connection to ATtiny pin 17 instead of pin 18)

UNO		**Atmega328**		**ATtiny1606**		**CP2102**
UNO programs the Atmega328						
Pin	Port	Pin	Port	Pin	Port	Port
11	PB3 (MOSI)	17	MOSI			
12	PB4 MISO	18	MISO	Note: The CP2102 provides 3.3V logic However it works with 5V logic With no load on the 3V3 DC output the logic is closer to 4V		
13	PB5 SCK	19	SCK			
A3	PC3	1	Reset			
9	PB1	15	Optional LED + 1K detects data download			
Atmega328 programs ATtiny1606						
		17	PB3 (MOSI)	16	Reset	
Atmega328/ATtiny1606 one wire comms						
		18	PB4 MISO	18	PA2	
Atmega 328 comms						
		2	RXD			Tx
		3	TXD			Rx
Atmega 328 control	Pin 28 PC5 to 0V via push button switch (the reset control switch) Plus optional dual LED plus 1K resistors between UNO pins 8 or 9 and 0V					
Optional UNO control	Reset to GND via temporary wire link (Holds UNO in reset)					
UNO +5V: connected to Atmeg328 and ATtiny1606 5V pins Note: the ATtiny 1606 +5V pin can temporarily be disconnected to reset the device						
UNO 0V: connected to the Atmeg328, ATtiny1606 and CP2102 module 0V pins.						
CP2102 3.3/5V: No connection						

Tests carried out on the prototype system

Connect the UNO to a PC.
Open the UNO app *UNO_programs_328* and upload it to the UNO
Open a terminal program and connect (38.4KB)
User prompt s s s s…… should be generated
Connect the *CP2102* to the same PC, open a second terminal program and connect (38.4KB).

Operation	User IO	
	UNO terminal program	CP2102 terminal program
Calibrate Atmega328 (UNO generates Pin Change Interrupt every 8.192mS)	Upload *UNO_Calibrates_328.* Send ‘t’ to make program run	[1]Enter User value for OSCCAL when requested
Upload mini-OS to ATtiny1606	Upload and run *CP2102_UPDI_Programmer*	[2]POR ATtiny1606 Change baud rate to 14.4K Send ‘r’, ‘a’, ‘y’, ‘y’ [3]Upload mini-OS
Calibrate the Atmega328 one wire comms clock	Upload and run cal_one_wire_comms.hex	Change baud rate to 57.6K and press ‘r’ at the user prompt [1]Enter cal correction factor when requested
Upload bootloader to Atmega328	Upload and run *bootloader.hex* Use keypress P rather than p	[4]Get user prompt p/r/t/D
Upload and run Floating_point_numbers: Checks operation of the one-wire link.		Press ‘p’ and send hex file. Keypress ‘r’ to start then ‘f’ and follow instructions. Press reset control switch on breadboard to reinstate p/r/t/D prompt
Upload commentary		Press T at p/r/t/D prompt send test.txt
Read commentary		Press t at p/r/t/D prompt Enter page number then AK

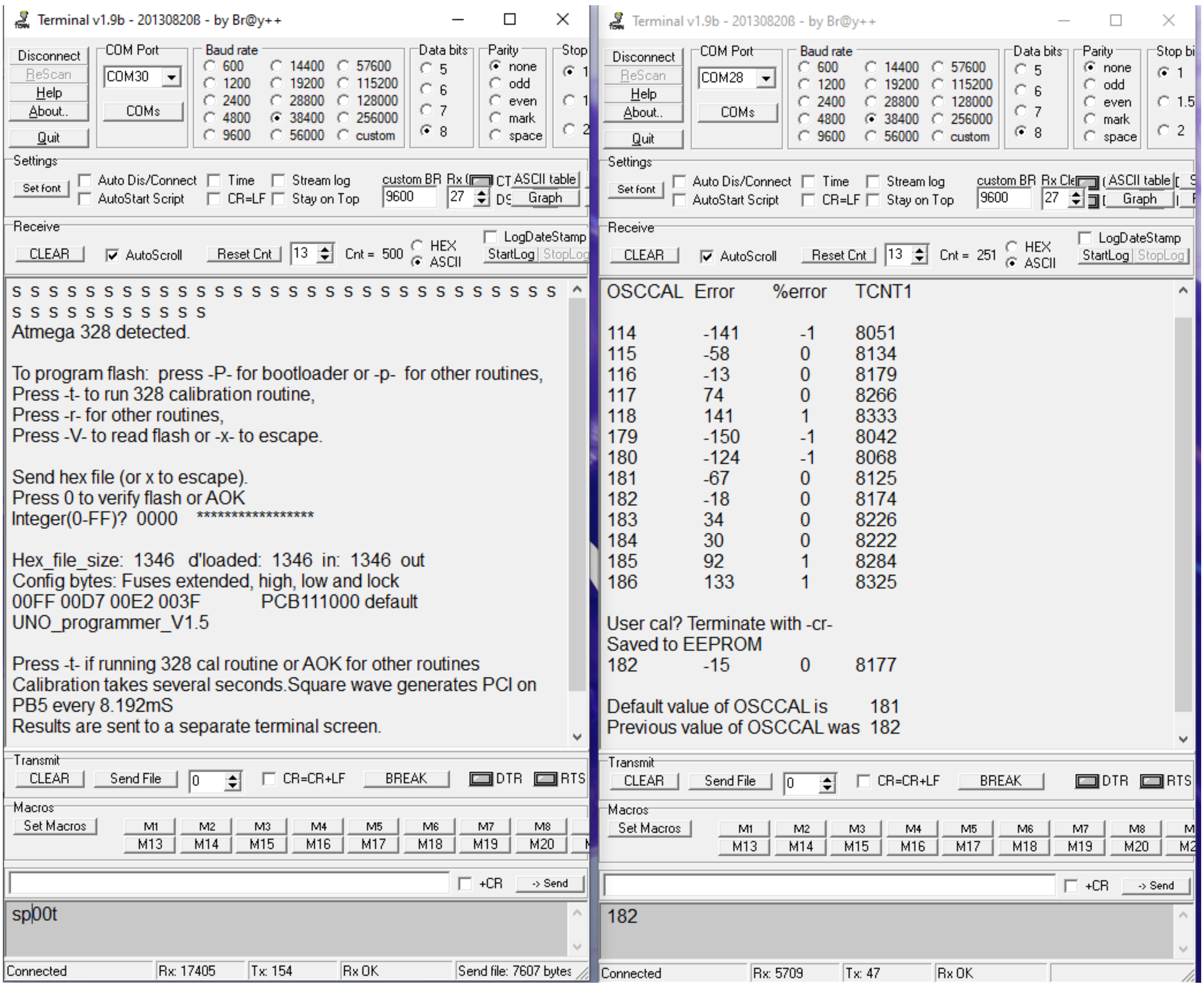
The UNO is used to upload programs to the Atmega328 as follows

Reset the UNO. At the user prompt send ‘s’ then ‘p’ to upload the program and ‘r’ to make it run unless otherwise stated.

All programs running on the Atmega 328 communicate with the PC via the CP2102.
The ATtiny1606 can only be programmed using *CP2102_UPDI_Programmer* running on the Atmega328.
Every test can be rerun by resetting the UNO and pressing r or t as required.

1 Back space not supported
2 Power on Reset
3 Trial application requires the display and only works if the one_wire_comms calibration is adequate.
4 For previously unused devices it may be necessary to pulse the reset control switch or even repeat the bootloader upload.

Terminal sessions generated while calibrating the Atmega328 are shown below.



Terminal settings are: 8 data bits, 1 stop bit, no parity and no handshaking

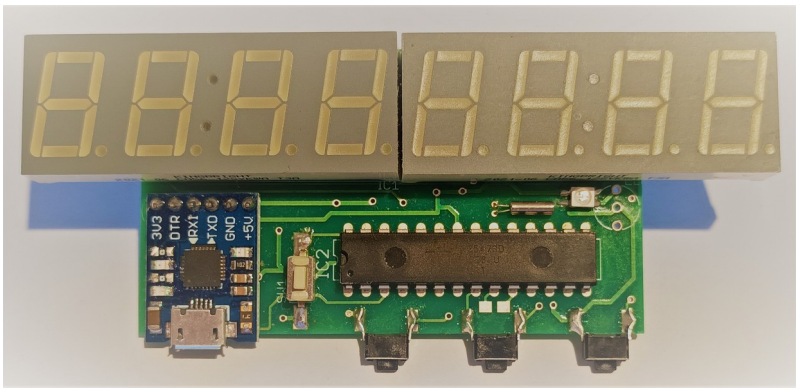
Recommended PCB assembly steps

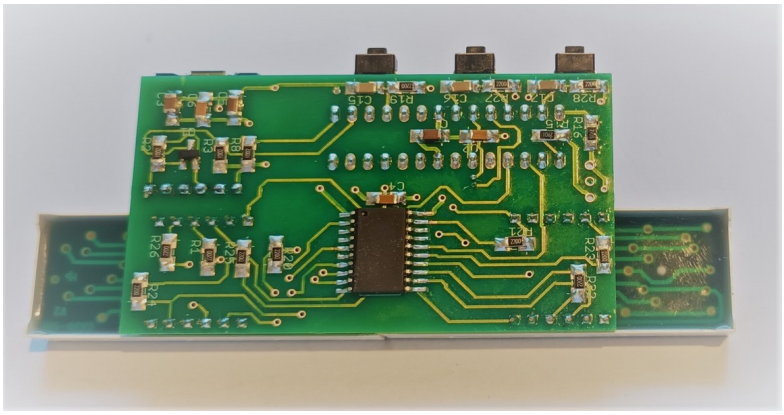
Use a UNO to calibrate the Atmega328 and load it with the bootloader. This requires the test jig shown above but without the CP2102 module. Check that the p/r/t/D prompt is generated.

Solder on all SM resistors, caps and the ATtiny 1606 (see photographs below) to the pcb underside. Check the CP2102 module by connecting it to a PC and then add it to the pcb as follows

Solder a 6 pin vertical header to the upper surface
Slide off the plastic spacer
Trim the vertical pins to a length of several mm
Attach the CP2102 module via the header pins
Place a piece of folder paper between the module and pcb
Solder on the module and remove the paper.
Discard the right angled header

Add remaining components. Note however: addition of the displays and user switches can be delayed until the mini-OS has successfully been uploaded to the ATtiny.
Continuously examine pcb for solder splashes, dry joints and other damage.





Photos of PCB111000_CP2102

Note that tracks are provided for either surface mount or leaded Red/Green LED and watch crystal

The vertical switch is the reset control switch.

The horizontal switches are user switches sw1, sw2 and sw3 counting from the middle of the pcb.

RX/Tx leds on the CP2102 module can be disabled if they are found to be too bright by removing their series resistors as in the photograph.

Setting up a new PCB111000_CP2102 (programs)

Having completed assembly minus the display and user switches

Connect the pcb to a PC with the vertical switch pressed.
Start a terminal session with the baud rate set to 57.6K.
Check for the presence of the p/r/t/D user prompt

Press ‘p’, upload *CP2102_UPDI_Programmer* and use it to upload the mini-OS to the ATtiny1606 (baud rate of 14.4kB required).

Pulse the vertical switch to restore the p/r/t/D user prompt (reset 57.6K baud rate)
Press ‘p’ and upload cal_one_wire_comms.hex
Press ‘r’, ‘r’ to run the program and select a calibration correction factor.

At this point the remaining components should be added to the pcb.

Reconnect the pcb to the PC and reconnect the terminal program to restore the “r r...” user prompt.
Press ‘R’ to test the one wire link and the display.
Press and hold the vertical switch

Release it while the LED is on to reset the program
Release it after the LED has gone off to change the display intensity and reset the program.

Note: both red and green elements should be active.

Upload “FP_arithmetic.ino.standard” to check the operation of PCB11100_CP2102.

Pulse the reset control switch to get the p/r/t/D prompt and load
Recal_328_using_crystal.ino.standard
Check calibration factor agrees with that already obtained plus or minus 1
Power cycle with reset control switch pressed to get the p/r/t/D prompt and press D to get the default application.
Power cycle and the default application should run with a low intensity display.

Setting up a new PCB111000_CP2102 (commentary)

With the exception of the user switches all components and system firmware have now been tested and the pcb is ready for use.