

My Pool Project

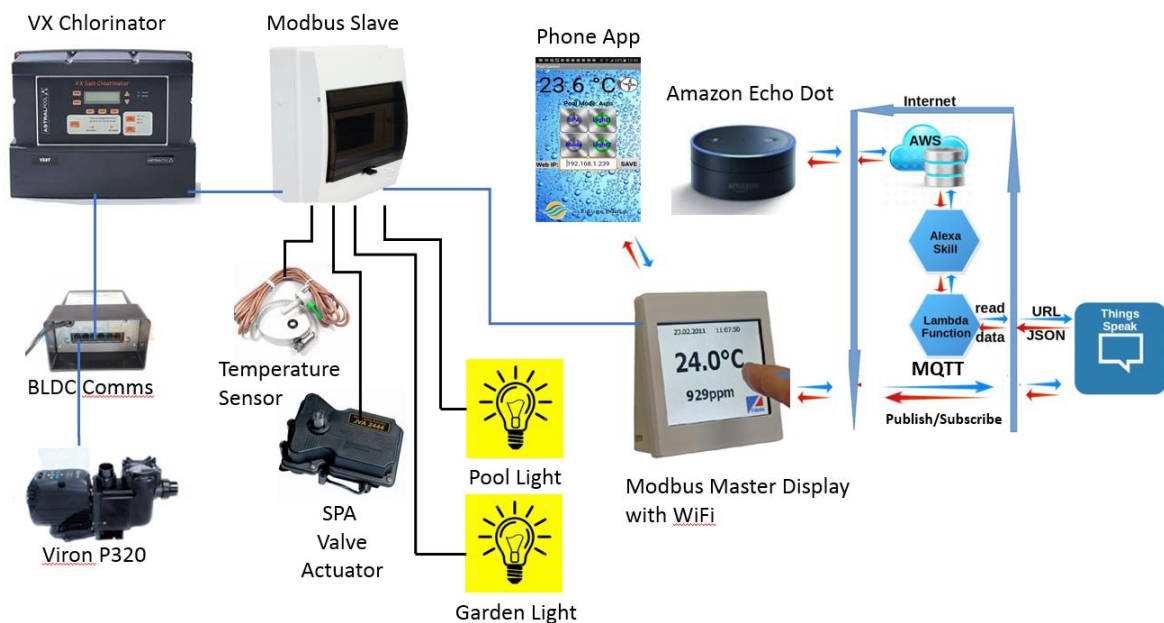
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Project Summary:

This project is to allow remote control of my pool and associated lights with a dedicated display in the house, a phone application and Amazon Alexa. Any and/or all of these input devices may be used to control the pool. The pool temperature and the status of the control devices are monitored as additional information.

The base system installed by the pool company consisted of an AstralPools VX chlorinator and a Viron P320 multispeed pump. To turn on the spa for example you had to go to the pool equipment enclosure and manually change the pool mode from “auto” to “on”, turn the valve to direct water to the spa, and manually set the pump speed to “high”.



The schematic above shows the logical connectivity of the systems, which can be divided into three fundamental categories being, the standard AstralPools functionality, the Modbus Slave local control device and the Modbus Master remote display device.

Standard AstralPools Functionality

The first stage of the project is to enable communication between the VX chlorinator and the Viron multispeed pump. This is achieved by the addition of the Viron BLDC communications module.

Once installed you need to:

1. Enable “Fast Comms” on the Viron pump.
2. Enable “Fast Comms” on the VX chlorinator.
3. Select “3 speed pump enable” on the VX chlorinator.

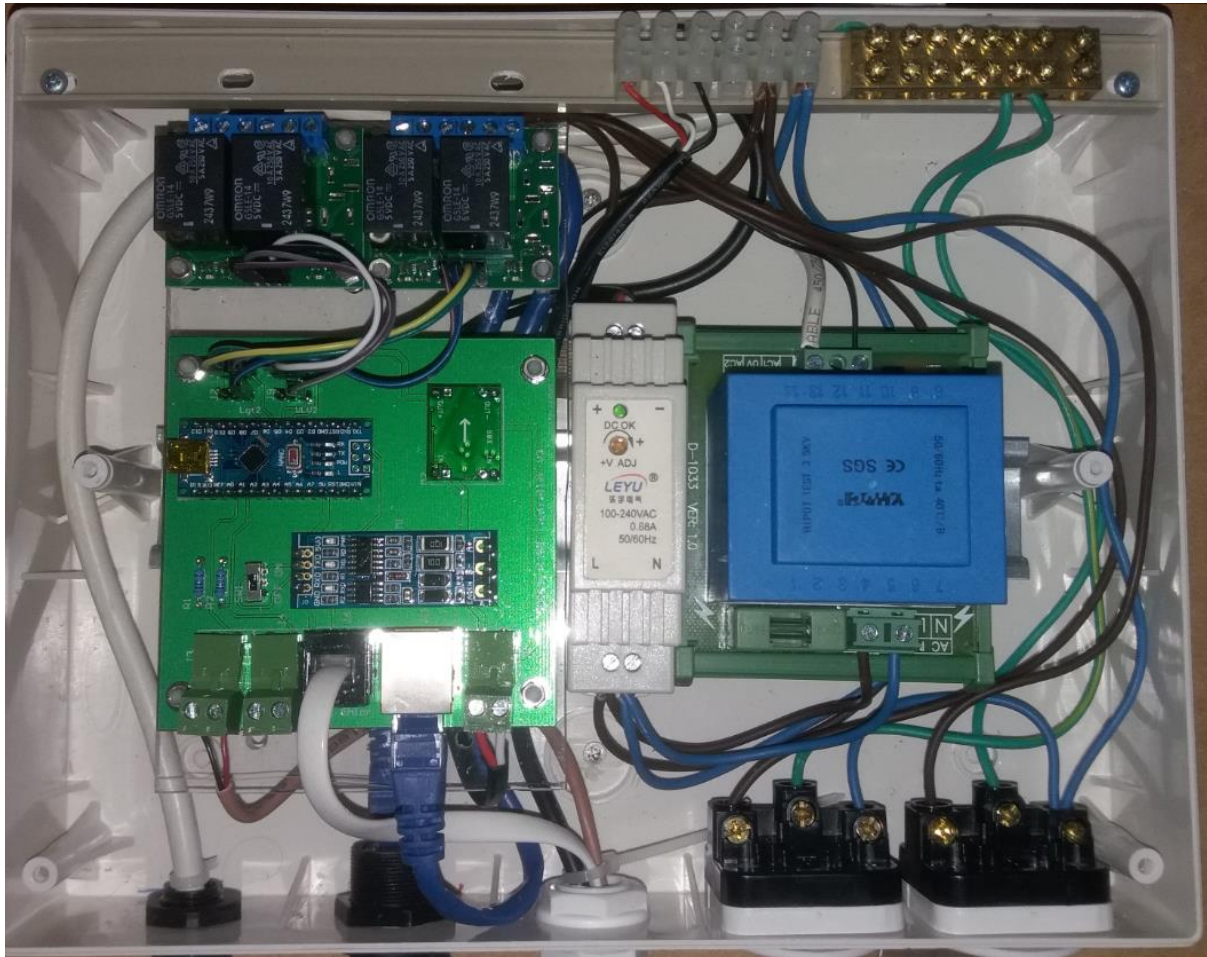
Once this is done additional configuration menus on the VX chlorinator are shown which enable the operator to associate the desired pump speed with the mode of operation. In this case for normal chlorination (pool mode auto), then a low speed 1 is desired, while when spa operation (pool mode on) is requested, then high speed 3 is desired.

Note: The communications between the VX chlorinator and viron pump in Australia is not MODBUS. Although AstralPools in Europe does support the viron pump with MODBUS, the Australian version is a proprietary protocol.

MODBUS Slave Local Control Device

The local control device is installed in the pool equipment enclosure adjacent to the VX chlorinator and viron pool pump. This device is essentially a Arduino Nano microcontroller which supports the inputs (temperature and pool status) and the digital outputs for the valves and lights. The microcontroller is also programmed as a Modbus slave for communication to the Modbus master display controller.

The microcontroller is programmed using the Arduino IDE software on windows.



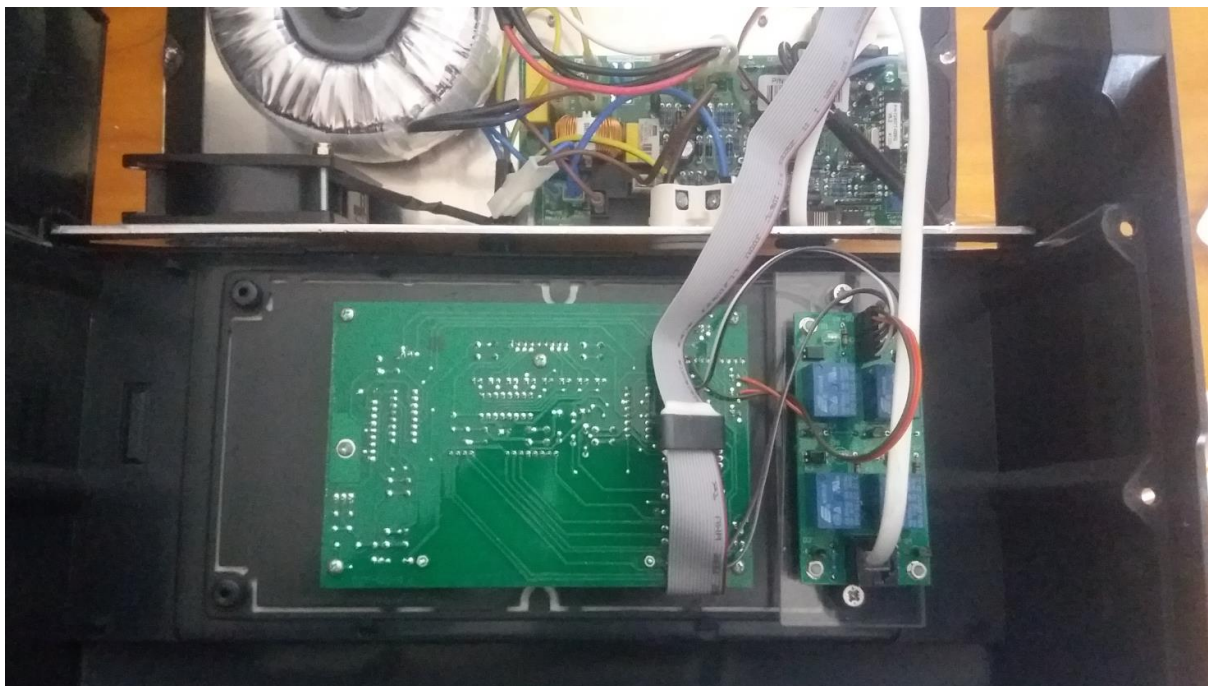
The major components of the Modbus slave local controller include:

1. Arduino Nano microcontroller PCB
2. 24VDC power supply (power for both local controller, interface module and remote display controller)
3. 24VAC power supply for Jandy valve actuator
4. 4 x Relay modules for the valve and lights control
5. A standard 12 pole IP54 electrical enclosure with DIN rail mounting
6. 2 x panel mounted electrical sockets for the light connections.

In addition there is a VX Chlorinator interface module PCB (below) which is installed into the chlorinator itself to provide the local I/O control and connected to the Modbus slave local controller via a standard RJ12 six core cable.



Below shows the interface module installed into the VX chlorinator



MODBUS Master Remote Display Device

The Remote display device is a 3.5 inch Nextion touch screen mounted into a custom 3D printed enclosure to house the touch screen and the Modbus master PCB. Power and communications are provided by a standard RJ45 CAT5e network cable connected to the Modbus slave controller. Modbus communications are via one pair of the CAT5e cable using RS485 communication modules with two pairs being used for the 24VDC power.

The display allows the remote monitoring and control of all the connected pool devices. In addition the display also has two timers associated with the lights to enable automatic on/off control of the lights. The timers in the VX Chlorinator are still used for the automatic control of the pool chlorination.

The Modbus master display uses a ESP8266 NodeMCU microcontroller programmed as a Modbus master device for communication to the Modbus slave. The ESP8266 NodeMCU also supports WiFi connectivity, with the provision of web/client services to support both the mobile phone application, and Amazon Alexa functionality.

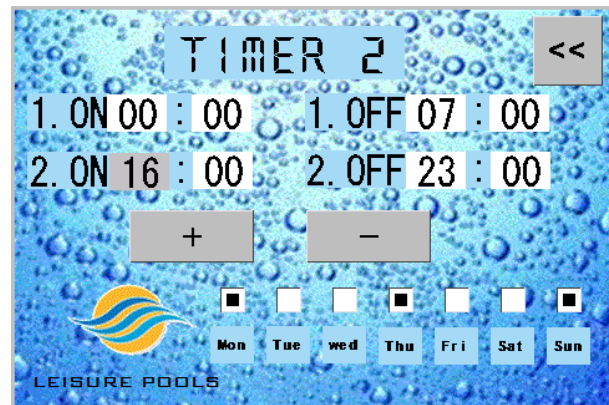
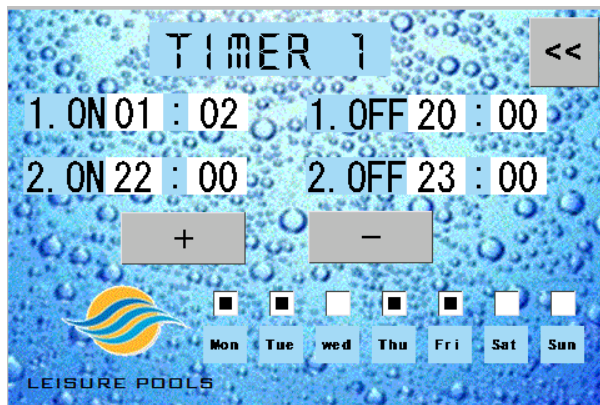
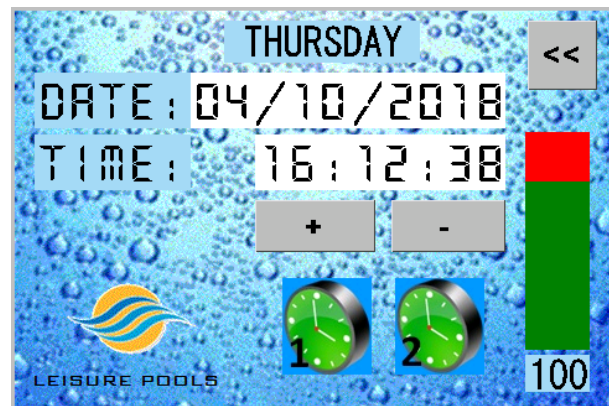
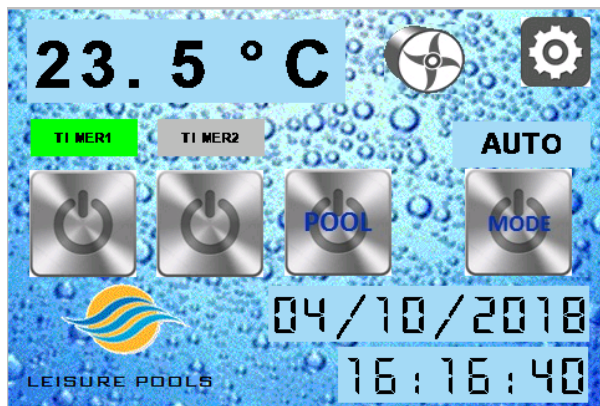
The Modbus master PCB has been sized to match that of the Nextion 3.5" display so that it can be attached together via standoffs and mounted together into the custom 3D printed housing. The housing is a similar size to a standard electrical outlet with identical mounting holes so that standard electrical mounting plates can be used for fixing.

The microcontroller is programmed using the Arduino IDE software on windows.

The major components of the Modbus master display controller include:

1. ESP8266 NodeMCU microcontroller PCB
2. Nextion 3.5" touch display
3. Custom 3D printed wall mount enclosure

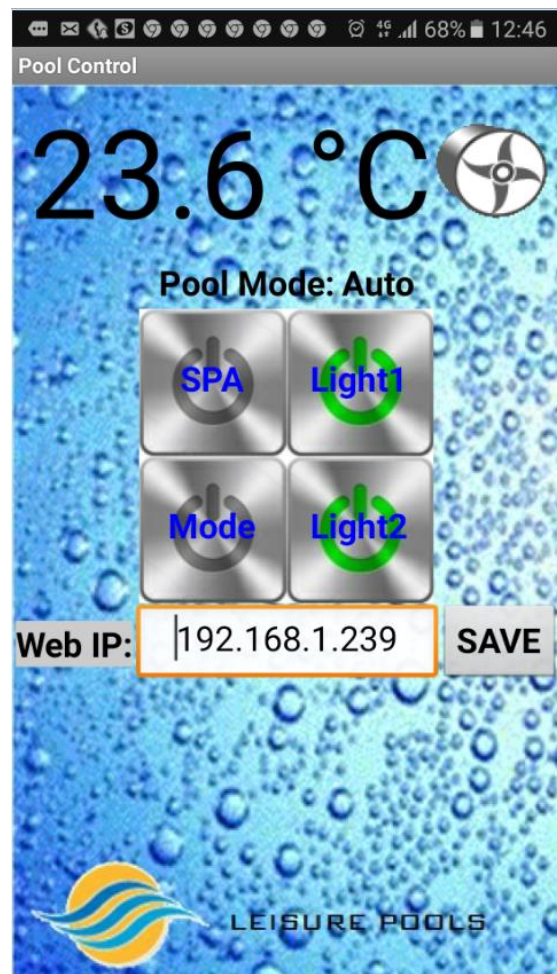
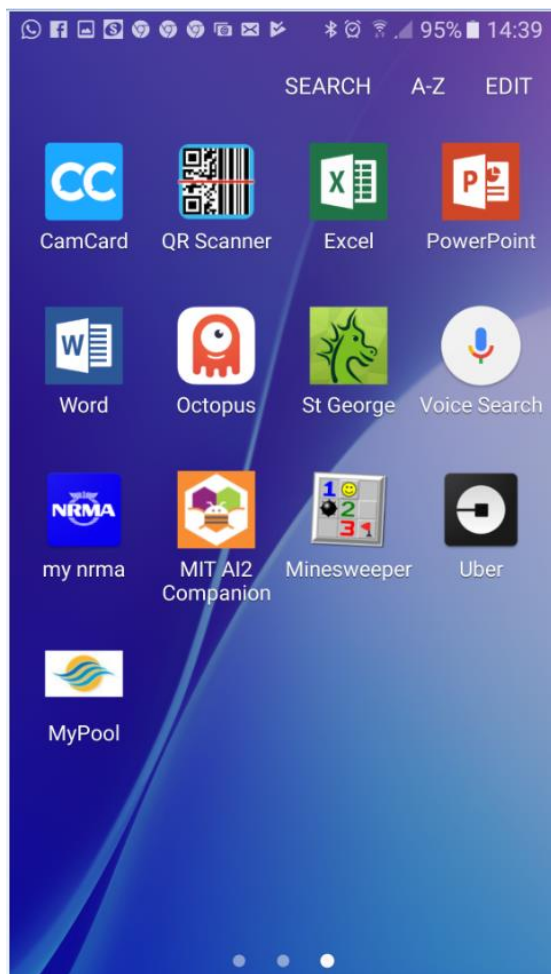




Mobile Phone App

The ESP8266 NodeMCU microcontroller also runs a webserver to support the mobile phone application client. This supports the same monitoring and control functionality as the dedicated display with the exception of the additional automatic timers.

The mobile phone application was made using the MIT App Inventor 2 software, which supports applications for android devices and can be added for download on the google playstore. If the user wants an application for apple phones the same code can be used with the Thunkable software (ie the same owner as MIT App Inventor 2). Thunkable applications can be used on both android and apple phones.



Amazon Alexa Echo

The ESP8266 NodeMCU microcontroller also runs web servers / clients to support the Alexa functionality. This is separated into two parts. The first part is a Belkin switch device emulator which allows Alexa to directly control the spa, pool lights and garden lights. With the Modbus Master controller powered and connected to the home wifi and internet, then upon Alexa device discovery then the three above devices are automatically added to Alexa.

For example:

User asks:

"Alexa, turn the spa on"

Alexa Response:

"ok", *The spa valve will go to the spa position.*

The second part of the Alexa functionality is for the reporting of the pool status information. This status information is sent to the thingspeak IOT service every 1 minute (configurable) via the MQTT publish service. The custom Alexa skill then interacts with the thingspeak IOT to respond to Alexa requests for information. The Pool Mode commands are sent to the Modbus master controller via the MQTT subscribe service.

For example:

User asks:

"Alexa, ask my pool, check the status"

Alexa Response:








"The temperature is 25.5 celsius. Mode is auto. Spa is off. Pump is on."



This puts the ESP8266 Wifi into a dedicated access point mode which serves a configuration page on the 192.168.4.1 IP address. The user simply accesses this page using any browser in a computer or mobile phone and enters the configuration data. The system automatically scans for available wifi networks, so the user can simply select their wifi and enter the password information. At this point the user can also enter the thingspeak configuration details and enable the Alexa functionality for use. Note the Alexa functionality should only be enabled if the thingspeak account has been fully setup.






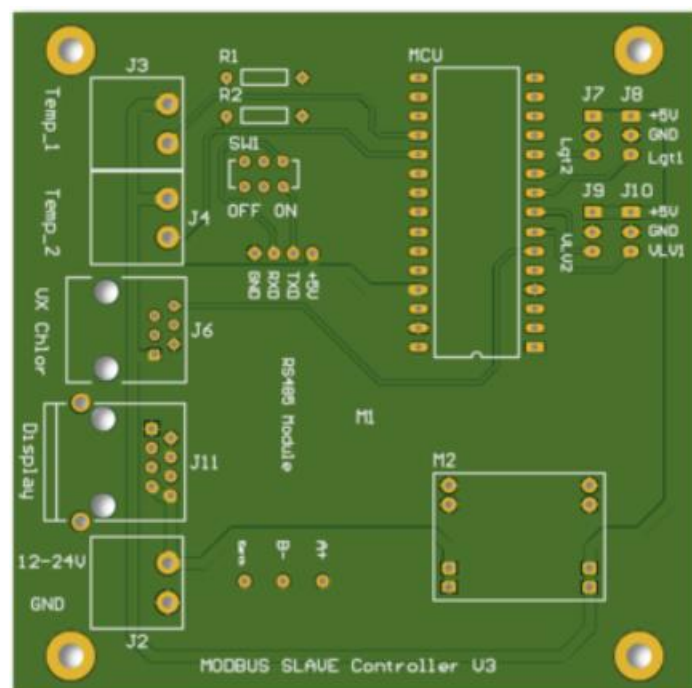
Major Component List:

Item		Description	QTY
1		Modus Slave Controller PCB – Refer to schematic diagram	1
2		VX Chlorinator Interface PCB - Refer to schematic diagram	1
3		24 VDC-15W Power Supply https://www.aliexpress.com/store/product/Din-Rail-series-DR-15-24V-AC-24VDC-single-output-high-quality-led-switching-power-supply/509864_32773686204.html?spm=2114.12010612.0.0.5bda df47haA9um	1
4		24 VAC-20VA Power Supply https://www.aliexpress.com/item/P-230VAC-S-24VAC-20VA-DIN-Rail-Mount-Power-Transformer-Module-D-1033T-R-AC24V/32311212639.html?spm=2114.search0104.3.31.XZ4q3d&ws_ab_test=searchweb0_0,searchweb201602_2_5460015_10152_10065_10151_10130_10068_10344_5560015_10342_10343_10340_10341_5470015_10307_10137_10060_10131_10155_10132_10133_10154_10056_10055_10054_10059_100031_10099_10338_10339_5380015_10103_10102_440_10052_10053_10050_10107_10142_10051_10326_10084_10083_10080_10082_10081_10110_10175_10111_10112_10113_10114_143_10312_10313_10314_5570_015_10078_10079_10073_5550015,searchweb201603_2,ppcSwitch_3&btsid=f29743f2-92d7-4487-a3c2-684a69d7a7ad&algo_expid=69a75a8c-997e-4cf4-b7db-38b3bc45df85-4&algo_pvid=69a75a8c-997e-4cf4-b7db-38b3bc45df85	1
5		5VDC – 2 Channel Relays https://core-electronics.com.au/pololu-basic-2-channel-spdt-relay-carrier-with-5vdc-relays-assembled.html	2
6		12 Pole IP54 Electrical Enclosure https://www.sparkydirect.com.au/p/5568510/nls---12-pole-surface-mount-ip54-rated-distribution-board---30297.html	1
7		Panel Mount Electrical Sockets http://www.clipsal.com/Trade/Products/ProductDetail?CatNo=415MP15	2
8		Aqualink Temperature Sensor https://www.epools.com.au/product/aqualink-air-solar-temp-sensor-kit/	1
9		Jandy 24VAC Valve Actuator https://www.bestpoolsupplies.com.au/product/805/Jandy-Zodiac-Valve-Actuator	1
10		RJ12 Cable – 6P6C, 3 m	1

11		Astralpool Viron BLDC Pump Comms https://www.poolspot.com.au/astralpool-viron-bldc-pump-comms-box-interface-module-no-cables	
12		Modbus Master Controller PCB – Refer to schematic diagram	1
13		Nextion 3.5" Display https://www.itead.cc/nextion-nx4832k035.html	1
14		3D Printed Custom Enclosure – Wall Mount	1
15		CAT5e cable – 20m https://www.ebay.com.au/itm/Blue-20m-40m-50m-Ethernet-Network-Lan-cat-5e-Cat5e-fast-cable-AU-Seller-POE/162943298913?hash=item25f02d6d61%3Am%3AmR9oRQ9wkNsy5O-Y3Bhgk_w&var=462015402662	1
16		DIN Rail Bracket https://www.ebay.com.au/itm/DIN-Rail-Mount-Bracket-Equipment-Rack-G3NE-Electrical-for-SSR-R99-12-Fins/222613815002?epid=7006185240&hash=item33d4d13eda:g:6ZoAAOSwqbxZ8ALX:rk:10:pf:0	1
17		Perspex Sheet 3mm https://www.ebay.com.au/itm/Clear-Acrylic-Perspex-Sheet-2-Pack-A4-Size-297mm-x-210mm-x-3mm/221572093277?hash=item3396b9d55d:rk:5:pf:0	1

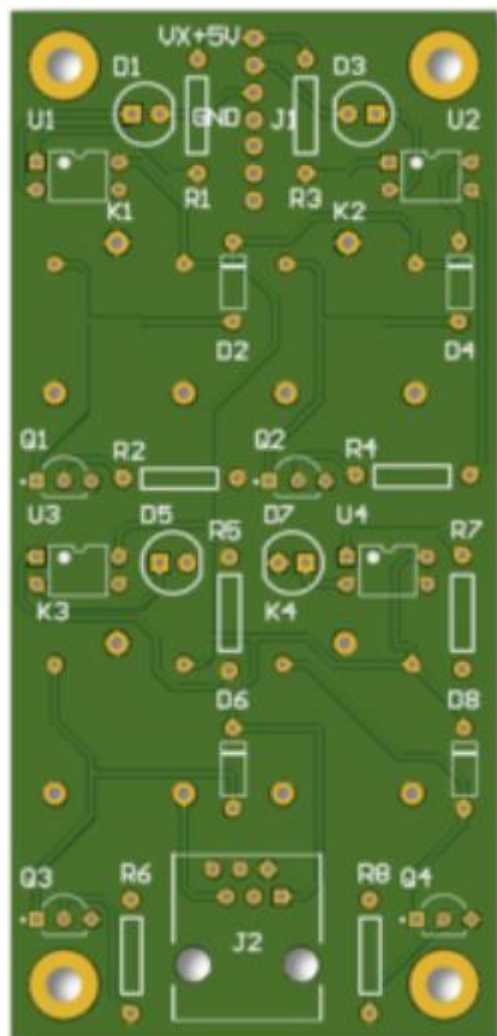
Modbus Slave Controller PCB Components:

Designator		Description	QTY
J2		Phoenix 1757242 MSTBA 2.5/ 2-G-5.08 Base Strip/Header 4 Kilo-Volt Surge 320 Volt Rated III/2 12 Amp Green Plug-In	1
J3		Phoenix 1757242 MSTBA 2.5/ 2-G-5.08 Base Strip/Header 4 Kilo-Volt Surge 320 Volt Rated III/2 12 Amp Green Plug-In	1
J4		Phoenix 1757242 MSTBA 2.5/ 2-G-5.08 Base Strip/Header 4 Kilo-Volt Surge 320 Volt Rated III/2 12 Amp Green Plug-In	1
J6		RJ11 6P6C Telephone Cable Socket	1
J7		2.54mm (0.1") Pitch SIL Vertical PC Tail Pin Header, 6.1mm mating pin height, gold (hi-temp mould), 3 contacts	1
J8		2.54mm (0.1") Pitch SIL Vertical PC Tail Pin Header, 6.1mm mating pin height, gold (hi-temp mould), 3 contacts	1
J9		2.54mm (0.1") Pitch SIL Vertical PC Tail Pin Header, 6.1mm mating pin height, gold (hi-temp mould), 3 contacts	1
J10		2.54mm (0.1") Pitch SIL Vertical PC Tail Pin Header, 6.1mm mating pin height, gold (hi-temp mould), 3 contacts	1
J11		Socket; RJ45; PIN: 8; Cat: 5e; shielded; gold plated; THT; angled 90°	1
M1		RS485 Module with auto flow control https://www.ebay.com.au/itm/TTL-to-RS485-Module-Serial-Port-UART-Hardware-Automatic-Flow-Control-NEW-AU/302554547091?hash=item4671a80393:g:rxwAAOSw8axaJlx0	1
M2		MP1564EN Buck Converter Board https://www.ebay.com.au/itm/Mini-Step-Down-Module-DC-DC-Converter-Input-7V-28V-Output-5V-3A-Replace-LM2596/263005707656?hash=item3d3c5c9d88:g:OPkAAOSw3gJZKOIy	1
MCU		Arduino Nano https://www.ebay.com.au/itm/USB-Nano-V3-0-ATMEGA328P-CH340G-5V-16M-Micro-Controller-Board-Kit-FOR-Arduino/263004104622?hash=item3d3c4427ae:m:mG9wjOtg7xhbnljE7SgX9xw	1
R1, R2		Resistor; Carbon Composition; Res 10K Ohms; Pwr-Rtg 0.25 W; Tol 1%; Axial	2
SW1		JS Series DPDT On-On PC Pin Through Hole Subminiature Slide Switch	1






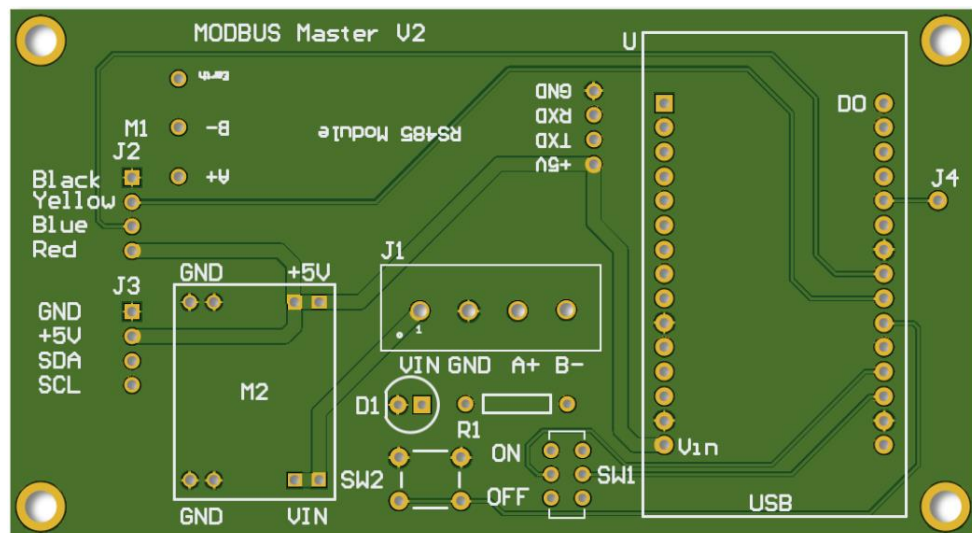
VX Chlorinator Interface Module PCB Components:

Designator		Description	QTY
D1, D3, D5, D7		LED	4
D2, D4, D6, D8		1N4148 Diode	4
J1		Header HDR 7 POS 2.54mm Solder ST Thru-Hole Bag	1
J2		Socket 6P6C Telephone Cable	1
K1, K2, K3, K4		SONGLE SRD-05VDC-SL-C	4
Q1, Q2, Q3, Q4		BC547/PN100 Transistor	4
R1, R3, R5, R7		'Resistor; Metal Film; Res 1 Kilohms; Pwr-Rtg 0.25 W; Tol 5%; Axial; TCR 15 ppm/DegC	4
R2, R4, R6, R8		Resistor; Metal Film; Res 510 ohms; Pwr-Rtg 0.25 W; Tol 5%; Axial; TCR 15 ppm/DegC	4
U1, U2, U3, U4		'LTV-817 Series Single Channel 35 V 5000 Vrms Transistor Output Optocoupler - DIP-4	4

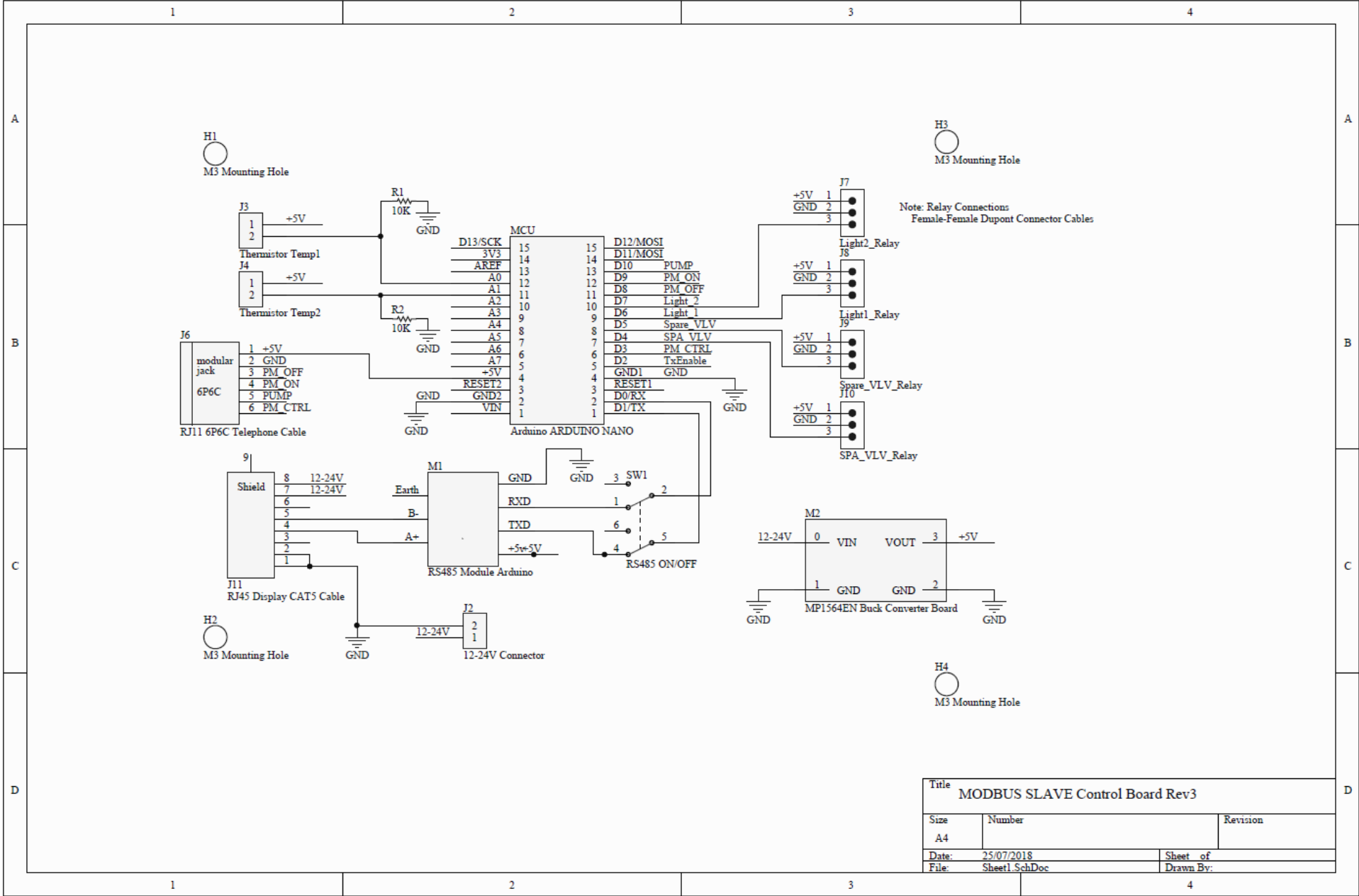


Modbus Master Controller PCB Components:

Designator		Description	QTY
D1		Blue LED, Through Hole package	1
J1		Header Shrouded 4 Position 5.08 mm Pitch Euro Style Terminal Block	1
J2		4 pin right angle header	1
J3		4 pin right angle header	1
J4		AMPMODU 1 Position 2.54 mm Single Row Through Hole Straight Header	1
M1		RS485 Module with auto flow control https://www.ebay.com.au/itm/TTL-to-RS485-Module-Serial-Port-UART-Hardware-Automatic-Flow-Control-NEW-AU/302554547091?hash=item4671a80393:g:rxwAAOSw8axaJlx0	1
M2		MP1564EN Buck Converter Board https://www.ebay.com.au/itm/Mini-Step-Down-Module-DC-DC-Converter-Input-7V-28V-Output-5V-3A-Replace-LM2596/263005707656?hash=item3d3c5c9d88:g:OPkAAOSw3gJZKOIy	1
R1		Resistor; Metal Film; Res 330 ohms; Pwr-Rtg 0.25 W; Tol 1%; Axial; TCR 15 ppm/DegC	1
SW1		JS Series DPDT On-On PC Pin Through Hole Subminiature Slide Switch	1
SW2		Switch Tactile OFF (ON) SPST Round Button PC Pins 0.05A 24VDC 100000Cycles 2.55N Thru-Hole Loose	1
U		NodeMCU V2 Featuring ESP-12E https://www.ebay.com.au/itm/NodeMcu-Lua-WIFI-Internet-Things-development-board-based-ESP8266-CP2102-Arduino/262660551222?hash=item3d27c9f236:g:DpkAAOSwmLIX9gr9	1

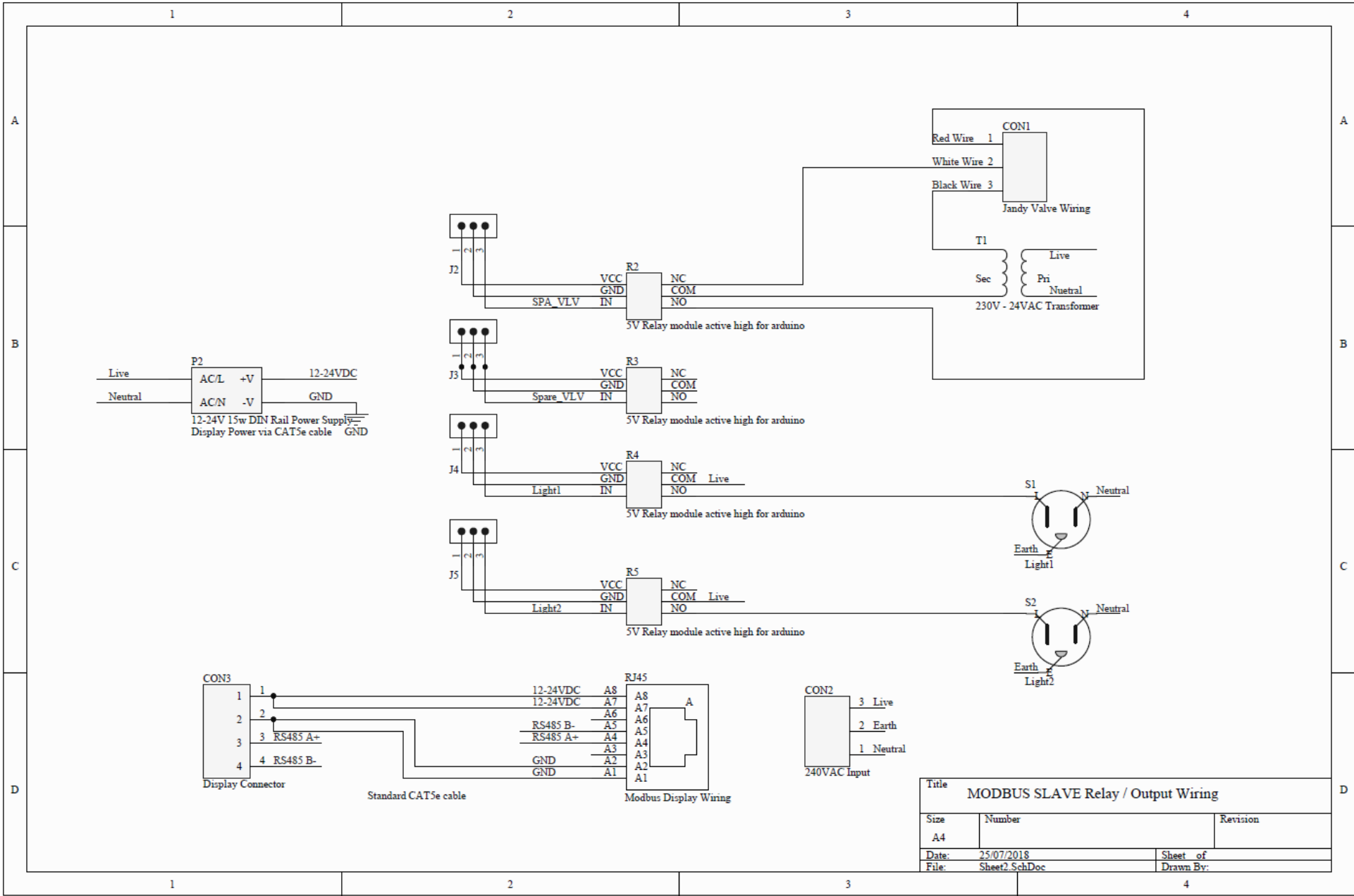


Modbus Slave Schematic

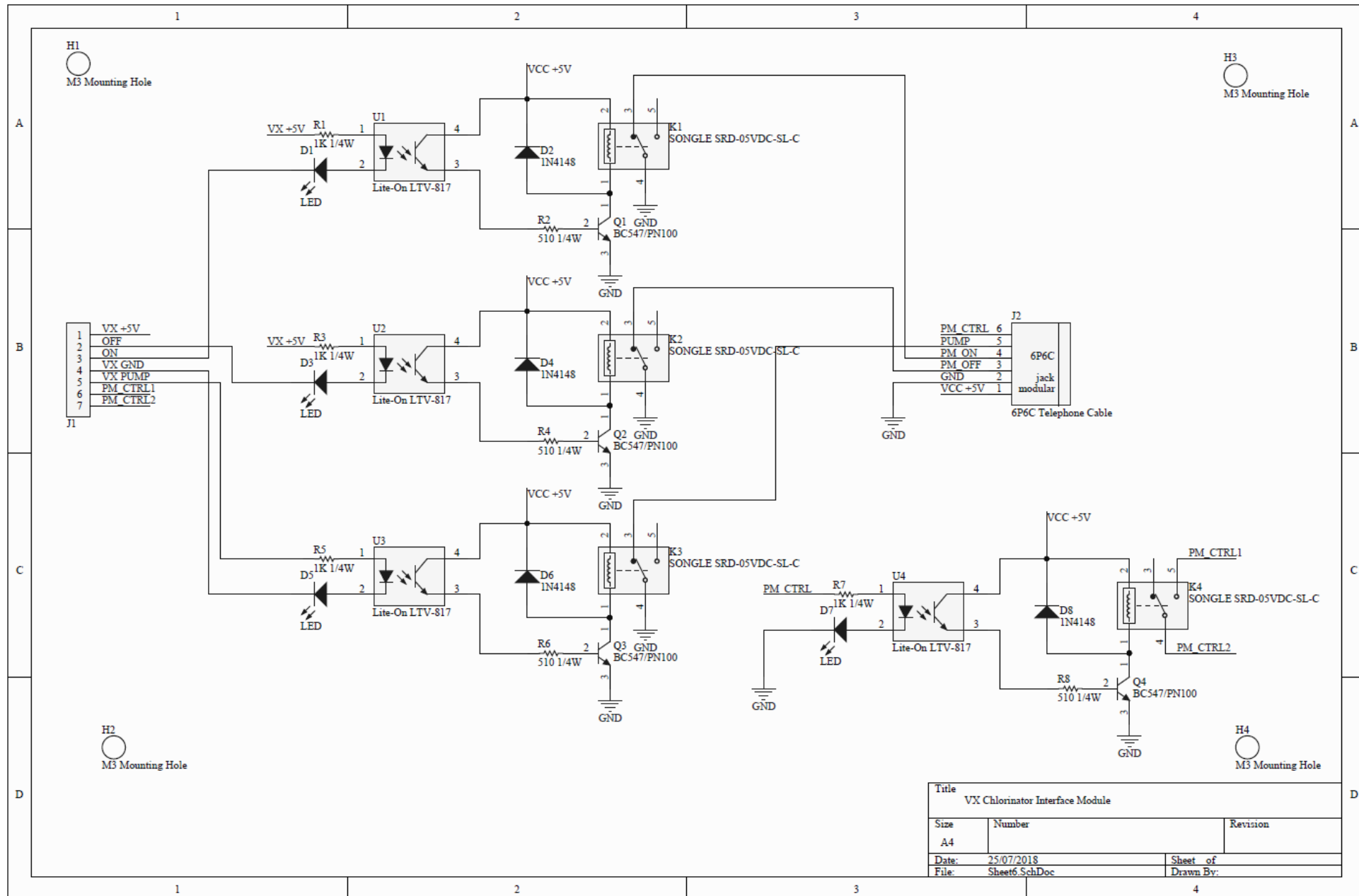


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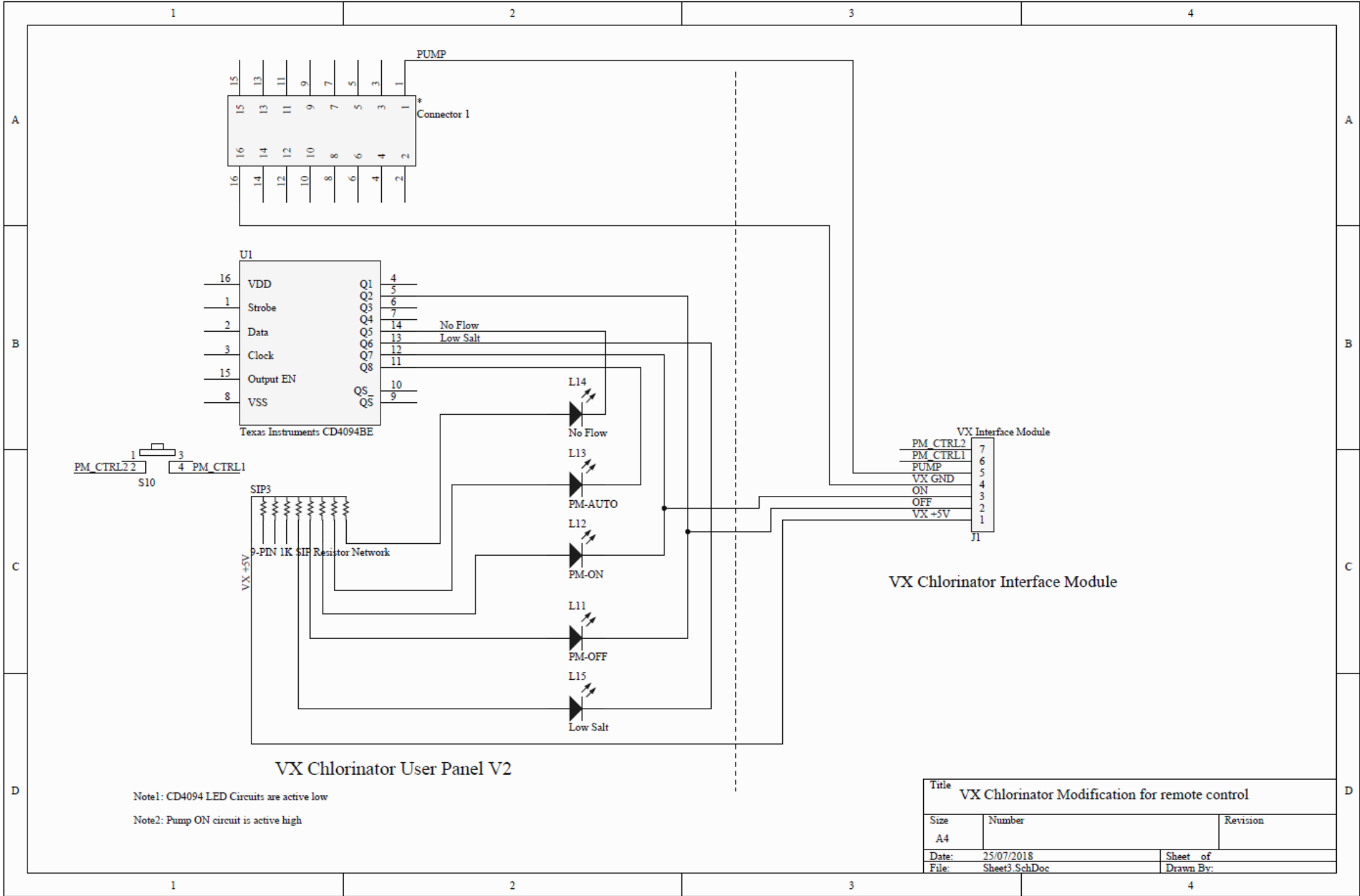
Modbus Slave Relay / Output Wiring



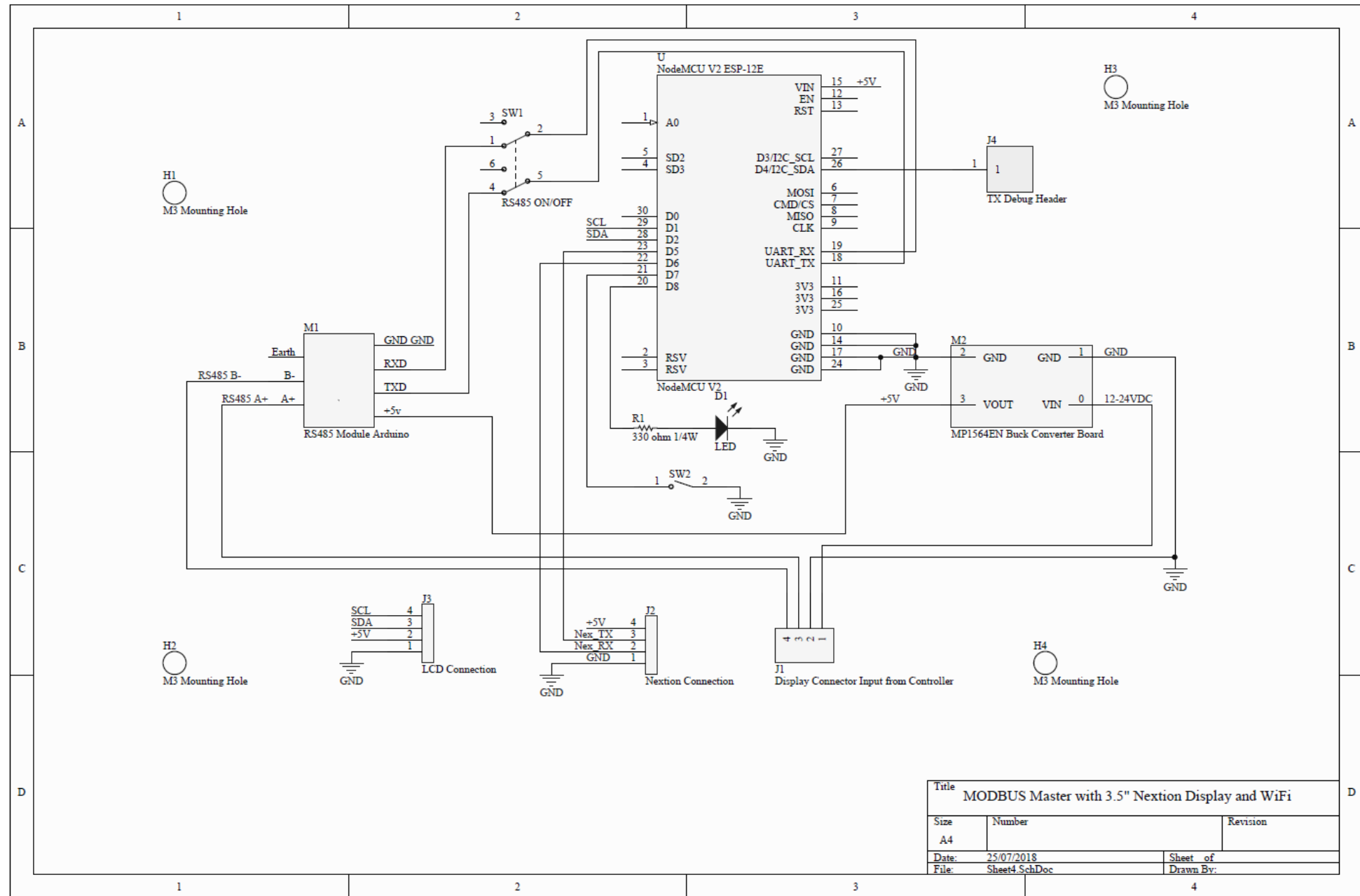
VX Chlorinator Interface Module



VX Chlorinator Interface Connection Wiring



Modbus Master with 3.5" Nextion Display and WiFi



1 2 3 4

A

B

C

D

J1 1 2

Keystone 4527

T1 7 14 13 9 8

24AC4 24AC3 24AC2 24AC1

R1 5K6 1/2W R2 5K6 1/2W

D2 1N4007-T D4 1N4007-T

D1 LED D3 LED

J2 1 2 3 4 5 6

Red
Black
White
NO
COM
NC

Jandy Valve Connection
Relay Connection Valve 1

J3 1 2 3 4 5 6

Red
Black
White
NO
COM
NC

Jandy Valve Connection
Relay Connection Valve 2

Title		
2x24VAC Jandy Valve Power Supply		
Size	Number	Revision
A4		
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File:	Sheet5.SchDoc	Drawn By:

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