Neptune™ RS-485 Connection Guidelines

Neptune™ pool and spa motors can be connected to a master controller that supports the Modbus protocol over an RS-485 network. For this to work, the master must be properly connected to the Neptune™ motor(s) as well any other devices that may be connected to the RS-485 bus. These three important things must be true for a Neptune™ motor to work on an RS-485 network:

    (1) [All units are properly wired together](#)
    (2) [Communication parameters must be set correctly](#)
    (3) [Each unit on the RS-485 network must have a unique ID assigned to it](#)

These three topics and how they relate to the Neptune™ motor are covered below. Additionally, the main controller must support Neptune™ motors. There is a set of commands that the master must send to the Neptune™ motor to control it and the master must know and support that command set.

All Units Are Properly Wired Together

This is the physical connection part and it's helpful to know a little about the RS-485 network. It requires three wires that run from the master controller to each device on the network. An RS-485 network is commonly referred to as a master-slave configuration where the main controller is the "master" and the rest of the devices on the network (such as a Neptune™ motor) are "slaves" or "nodes". As a rule, there will only be one master but there can be one or more slaves, the maximum number of slaves on a single network varies due to many factors but is typically around 32. It can be more but there are special considerations for larger networks that will not be discussed here. Each slave must be assigned a unique ID so that the master can direct commands to it, more on that later.

Before proceeding, make sure that the electric circuit supplying the Neptune™ motor is switched off and any required lockout / tagout procedures are followed. Allow three minutes after removal of power to ensure that all internal circuits have discharged to a safe level.

After removing the four screws that secure the top cover on the Neptune™ motor the top cover can be lifted to access the RS-485 wiring block (see the *Neptune™ Installation and Operation Manual* for further instructions):


Terminal Block Detail

RS-485 Terminal Block
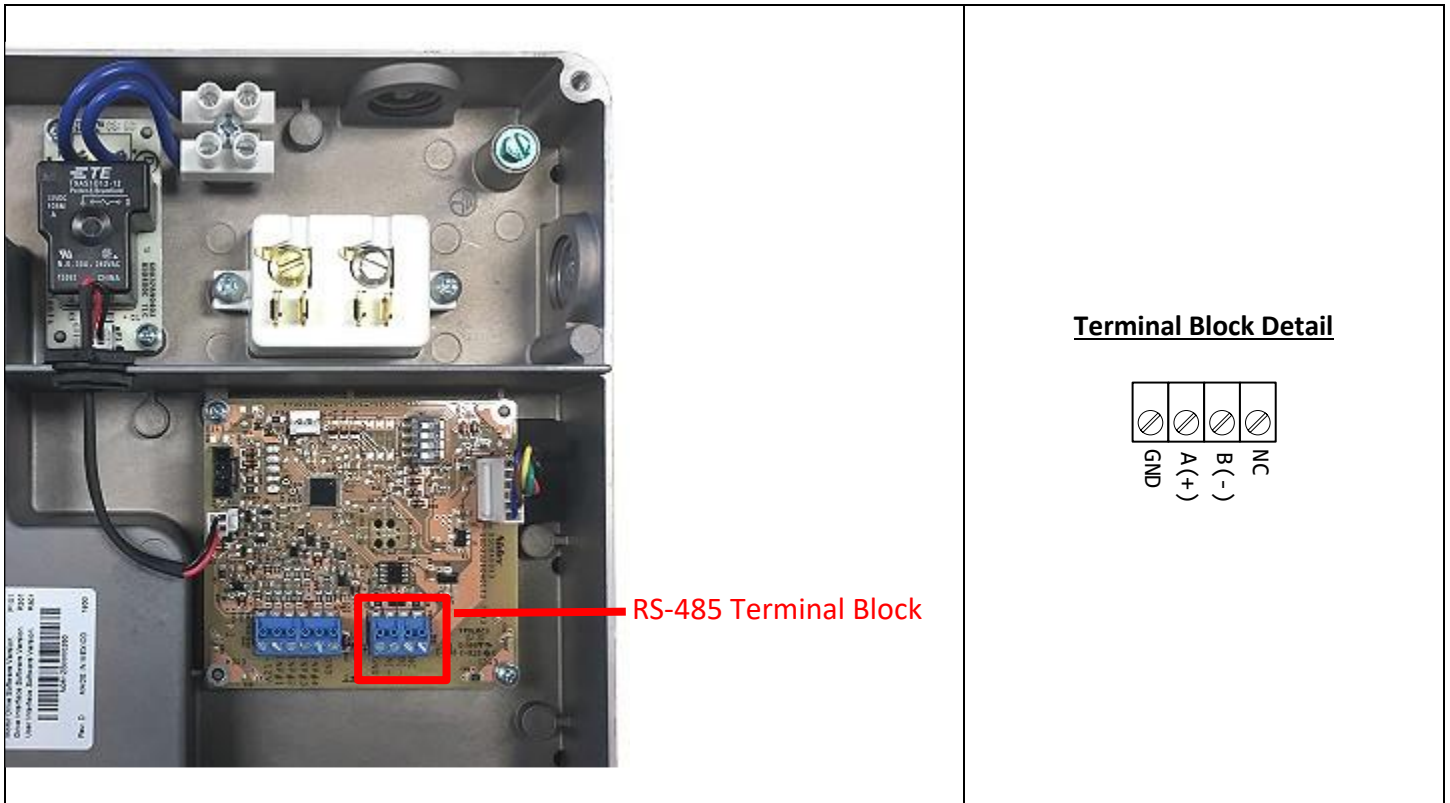
Note that there are three contact points on the wiring terminal: GND, A and B ("NC" is No Connect). Wiring for RS-485 is very simple: connect the 'A' from the master device to the 'A' on the Neptune™ terminal block, the 'B' from the master device to the 'B' on the Neptune™ terminal block and the 'GND' from the master device to the 'GND' on the Neptune™ terminal block. If there is more than one node/slave then they will be wired in a "daisy chain" fashion. Here are a two examples:

Master to single node/slave
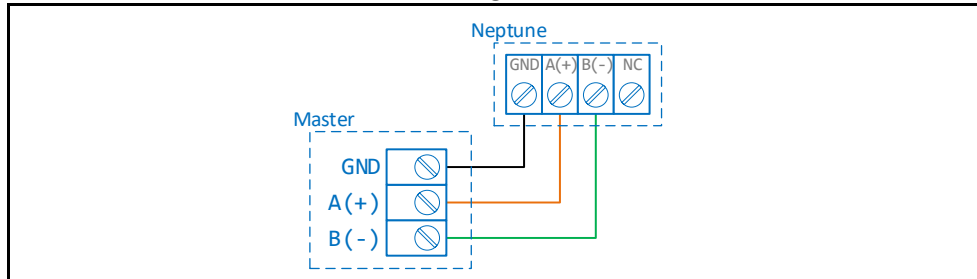
Master to multiple nodes/slaves
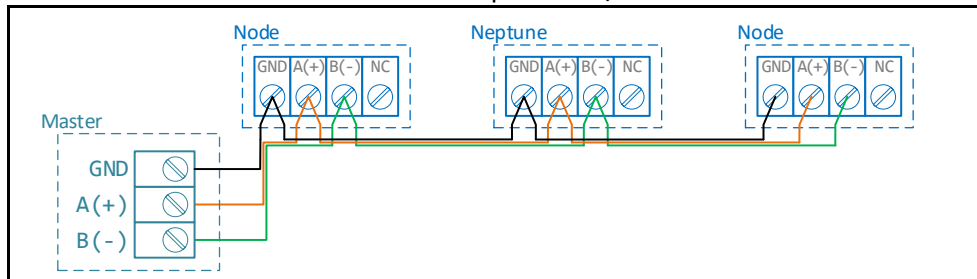
The combination of a master with one or more nodes and the wire that connects them is called the "bus", in this case an RS-485 bus. Proper wiring technique will help the installation work more reliably. This is a list of things that should help:

➢ For the simplest installation, the maximum length of bus wire from the master to the very last slave should be less than 500-600 feet. Greater lengths of wire require a special termination at each end of the bus and with lengths this long being uncommon, termination is not described here. With proper termination an RS-485 bus can be as long as approximately 4000 feet but careful attention must be given to configuring a bus and it's nodes at that length.

➢ Bus wire should always be twisted pair – the most common example is Cat5/Cat6 cabling typically used for Ethernet networks. Cables of this type usually have four pairs of twisted wires (for a total of eight wires) of which only three are needed here. The A/B wires should be connected to one twisted pair and the ground wire should be attached to a wire in a different twisted pair. This will provide the best noise immunity and best signal transmission.

➢ Typical wire size is 24 gauge (this is what is found in Cat5/Cat6 cable) and 22 gauge is acceptable, too.

➢ The terminal labeled GND means ground but this <u>does</u> <u>not</u> mean earth ground! GND is used by convention but it should really be called "common", the term ground here can be misleading. This GND wire provides a common reference point for the bus and is important for reliable connections.

➢ The master and all nodes should be connected with all three wires. You may encounter installations with only the A and B wires present but this is a recipe for unreliable communications and allows for circuit damage on the attached devices under certain circumstances.

➢ Keep all RS-485 cabling as far as possible from sources of electrical noise (e.g. other motors, fluorescent light fixtures, etc).

➢ There can only be one master device on the bus, ensure that all other nodes are slaves.

➢ All slaves must have a unique ID (the master does not have an ID)

➢ If you have the A and B wires swapped, the node will not work. If you are unsure about your wiring it is OK to swap the A & B wires to see if that resolves the issue. Do <u>not</u> accidentally swap either A or B with GND, though, as this will almost certainly damage one or more nodes on the network.

If the unit being wired is a pool model, replace the cover and tighten the four screws before restoring power. Then continue setup in the Communications Settings below.

If the unit being wired is a spa model, proceed to the Changing Spa Motor ID section. Follow the steps in setting the DIP switch before replacing the cover and restoring power.
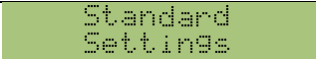
Communication Settings

The Neptune™ motor is configured by default to work on Modbus RTU networks operating at 9600 baud, 8 data bits, 1 stop bit, no parity. These communication parameters can be modified if necessary but that is an advanced topic not covered here.

Unique Node IDs

Each device on the bus must have a unique ID except for the master which does not need an ID. Modbus IDs start at 1 and end at 247 and any unused value can be used. Neptune™ pool and spa motors have a default ID of 240 but this value can be changed using the methods described below. The pool motor has a user interface and the spa motor does not so the procedure is different for each.

Changing Pool Motor ID – Follow the steps in the table below to change the Pool Motor ID

Step	Instructions
1	If not powered up, apply power to the motor
2	If the display shows "REMOTE MODE": A. Press the **Speed 2** and **Speed 3** buttons simultaneously and hold them down for five seconds and you will see this screen: `Quit Remote Mode Are You Sure?!` (the red color indicates flashing text). B. Press **Menu/Enter** to confirm. C. After confirming the change, the pump stops if it is running. The pump will no longer respond to commands from the external control system. If a UI programmed flow is scheduled to run at this time, it will restart the motor at the programmed flow speed.
3	If the motor is presently running, press the **Start/Pause** key to stop it.
4	Press **Menu/Enter** to enter the settings menu. You should see this screen `Standard Settings` next. Press **Menu/Enter** again and you will see `Time of Day 2:30 AM` which is the time setting screen.
5	Press the down button ▼ until you see this screen `Remote Control <Disable>`. Press **Menu/Enter** and "Disable" will flash. Press the down button ▼ and "Disable" will change to "Enable". Press **Menu/Enter** again and the setting will be changed.
6	Press the down button ▼ once and you will see this screen `Node ID <240>` (the number might be different from 240). Press **Menu/Enter** and the number will start to flash. Use the ▼ and ▲ keys to change the ID to a different value. When adjusted to the value you want to use press **Menu/Enter** to accept the new setting.
7	Press **Start/Pause** to exit the settings menu. Immediately after exiting the menu the motor will return to remote mode and you will see the `REMOTE MODE` screen. The motor has returned to Modbus mode using the newly changed ID value.

Changing Spa Motor ID

The spa motor has no user interface to provide an easy way to change the Node ID. Instead, there is a set of DIP switches that can be used to select a Node ID. The DIP selection block sits opposite of the RS-485 terminal block as shown below:
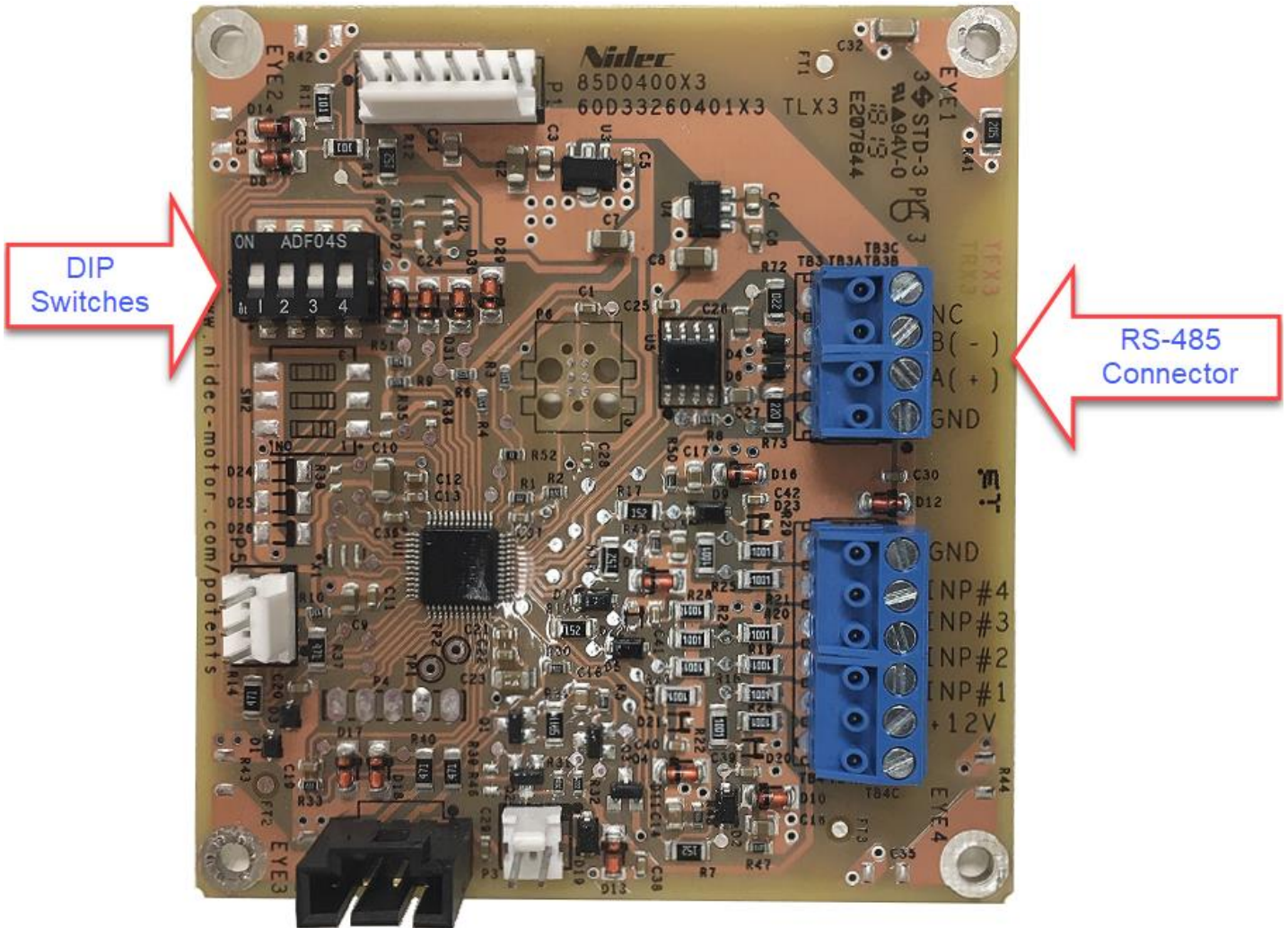
Changing the DIP switch settings will, in turn, change the Node ID used by the motor. See the table below to determine which switch settings correspond to what Node ID:

Switch 1	Switch 2	Switch 3	Node ID
OFF	OFF	OFF	240 *
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	7

* – 240 is the factory default setting but this can be changed
through a combination of Modbus commands not
described here

Use the information in this table with the instructions that follow to change the Spa Motor ID.

Step	Instructions
1	Remove power from the motor and wait 3 minutes for motor to fully power down
2	Loosen the four screw that hold the top on and remove the top to expose the interface board.
3	Set the DIP switches according to the table above to select the Node ID you want to use. Note that switch 4 should always be left OFF.
4	Put the top back on and re-secure the four screws.
5	Apply power to the motor, you should be able to use the newly set Node ID to address the motor

Note that the ID cannot be changed with the motor powered up, the procedure above must be followed.

> **Remember to set your IDs such that they are different than any other ID on the network – Two nodes cannot share the same ID. If there are multiple units sharing the same ID the network will likely act unpredictably and may not work at all.**