



USER GUIDE

SNAPlink

Wireless Serial Adapter for RS-232 and RS-485/RS-422 Devices

©2008-2017 Synapse Wireless, All Rights Reserved. All Synapse products are patent pending. Synapse, the Synapse logo, SNAP, and Portal are all registered trademarks of Synapse Wireless, Inc.

Doc# 116-081614-031-B000

6723 Odyssey Drive // Huntsville, AL 35806 // (877) 982-7888 // Synapse-Wireless.com

Disclaimers

Information contained in this manual is provided in connection with Synapse Wireless products and services and is intended solely to assist its customers. Synapse reserves the right to make changes at any time and without notice. Synapse assumes no liability whatsoever for the contents of this manual or the redistribution as permitted by the foregoing limited license. The terms and conditions governing the sale or use of Synapse products is expressly contained in the terms and conditions for the sale of those respective products.

Synapse retains the right to make changes to any product specification at any time without notice or liability to prior users, contributors, or recipients of redistributed versions of this manual. Errata should be checked on any product referenced.

Synapse and the Synapse logo are registered trademarks of Synapse Wireless. All other trademarks are the property of their owners.

For further information on any Synapse product or service, contact us at:

Synapse Wireless, Inc.
6723 Odyssey Drive
Huntsville, Alabama 35806
256-852-7888
877-982-7888
256-924-7398 (fax)
www.synapse-wireless.com

NOTE: This equipment is meant to be installed in accordance with all applicable local, state, and national electrical codes. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Read these instructions, keep these instructions, and heed all warnings.

Instructions



This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

License governing any code samples presented in this Manual

Redistribution of code and use in source and binary forms, with or without modification, are permitted provided that it retains the copyright notice, operates only on **SNAP**[®] networks, and the paragraphs below in the documentation and/or other materials are provided with the distribution:

Copyright 2008-2016, Synapse Wireless Inc., All rights Reserved.

Neither the name of Synapse nor the names of contributors may be used to endorse or promote products derived from this software without specific prior written permission.

This software is provided "AS IS," without a warranty of any kind. ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS AND WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT, ARE HEREBY EXCLUDED. SYNAPSE AND ITS LICENSORS SHALL NOT BE LIABLE FOR ANY DAMAGES SUFFERED BY LICENSEE AS A RESULT OF USING, MODIFYING OR DISTRIBUTING THIS SOFTWARE OR ITS DERIVATIVES. IN NO EVENT WILL SYNAPSE OR ITS LICENSORS BE LIABLE FOR ANY LOST REVENUE, PROFIT OR DATA, OR FOR DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF THE USE OF OR INABILITY TO USE THIS SOFTWARE, EVEN IF SYNAPSE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Table of Contents

Introduction	1
Download Supporting Materials	1
Document Conventions	1
Getting Started	2
Powering the SNAPlink	2
Understanding Point-to-Point Mode	2
Understanding Multipoint Mode	2
Defaulting to Broadcast State	4
SNAPlink LED Indicators	4
Installing and Using the SNAPlink EasySet Software	6
Installing EasySet	6
Using EasySet	7
Connect a SNAPlink Device	7
Selecting Basic Communications Settings	8
Configuring Your Adapter Using DIP Switches	17
DIP Switch 1	17
DIP Switch 2	19
Troubleshooting	20
Signal Strength Problems	20
Multiple Masters	20
Can't Find a Master	21
Poor Performance	21
Paired But Not Communicating	21
Specifications	22
Pin Outs	25
Regulatory Information and Certifications	27
RF Exposure Statement	27
FCC Certifications and Regulatory Information (USA Only)	27
Declaration of Conformity	28
Industry Canada (IC) Certification	28

Introduction

The SNAPlink family of industrial-class, mesh networking, wireless serial adapters allows you to wirelessly connect RS-232 and RS-485/422 serial devices. SNAPlink adapters provide the highest data-rates, longest distance, and most reliable signal in the industry.

SNAPlink adapters are configured using internal DIP switches or the SNAPlink EasySet software, an intuitive application running on Microsoft® Windows®-based computers that allows you to configure the device quickly and easily. Please refer to the **Specifications on page 22** for exact operating system requirements.



Download Supporting Materials

You can find SNAPlink documentation, including this User Guide and the Quick Start guide packaged with your device, online at:

<http://info.synapse-wireless.com/SNAPlinkintro>

You can also download the EasySet software from that site, allowing you even more configuration and control over your SNAPlink devices.

Document Conventions

Please note the following terminology while reading this document:

- The term **SNAPlink** is used to refer to any of the **SNAPlink** models listed above.
- The RS-232 models are referred to by their model number, **SL232**.
- The RS-485/422 models are referred to by their model number, **SL485**.
- The term **serial port** refers to the data communications port – either the RS-232 port (DE-9F connector) of an SL232 device or the RS-485/422 terminal block of an SL485 device.
- The micro-USB port of the SNAPlink adapter may be referred to as simply the **USB port**.
- The term **RS-232 device** or **RS-485/422 device** refers to the data communications device you are attaching to the SNAPlink adapter.
- The term **UART Parameter** refers to SNAPlink configuration settings that indicate how quickly data is wirelessly transmitted based on serial data that is received from the serial device.

Getting Started

SNAPlink devices provide many configuration options for compatibility with nearly any RS-232, RS-422, or RS-485 device. This section provides instructions to get your devices up and running in using the DIP switches inside the devices, or the EasySet software.

Powering the SNAPlink

You can power your SNAPlink units with 6–30 volts DC connected to the power terminal blocks, or through its USB connection.

You may use the terminal blocks to provide power even when you have the device connected to a computer for configuration (using the EasySet software) or for data transfer, though when connected to a USB port there is no need for additional power. If you have both power options connected and disconnect one, the SNAPlink seamlessly switches to the other power source.

Hand-tighten the terminal block screws. (To between 0.35 and 0.40 Nm (3.1 to 3.5 inch pounds) for best results.)

Understanding Point-to-Point Mode

All models of SNAPlink can operate in either point-to-point mode, also known as unicast, or in multipoint mode, also known as multicast.

In point-to-point mode two SNAPlink units are paired, thereby providing a wireless connection between two external serial devices.

To pair a point-to-point configuration:

1. Make sure both devices are powered.
2. On one SNAPlink device, hold the button for at least 5 seconds, until LED A turns red. Release the button and LED A should be flashing red.
3. Repeat this process on the second SNAPlink device.

You should now find that LED A on both devices changes to solid green.

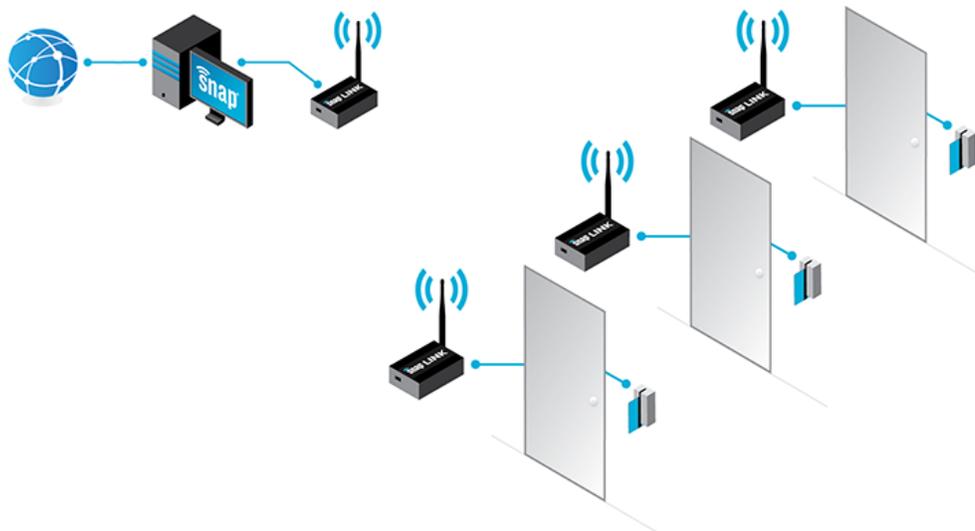
NOTE: If you have an exceptionally noisy RF environment, you may find that one or both of the devices have LED A flashing amber rather than green. If this occurs, you should consider switching your devices to a different SNAP channel, which would use a different radio frequency. You can make this change using the EasySet software or using the DIP switches inside the SNAPlink device.

Understanding Multipoint Mode

In multipoint mode, one of the SNAPlink devices is designated the master and one or more other devices can be configured as slaves. In this configuration, messages sent by the master will be sent to all slave devices, while

messages sent by the slaves will be received only by the master unit.

For example, imagine a installation where doors are controlled by access card readers. Each reader uses serial communications to report access information back to a hub. A single master unit could be used to receive serial information from each of the individual doors. The master unit could also be used to broadcast information back to all readers, provided you don't mind them all receiving the same message.



To pair a point-to-multipoint configuration:

In a point-to-multipoint configuration, your master device sends communications heard by each of the slave devices, but the slaves can only send data back to the master.

1. Make sure all devices are powered.
2. On the master SNAPLink device, press the button four times within a 3-second period. LED A should switch to flashing amber. Again, push the button four times within a 3-second period. LED A should switch to a slow flash between green and amber, indicating that it is a master unit.
3. For each slave SNAPLink device, press the button four times within a 3-second period. LED A may briefly switch to flashing amber, but should quickly go to a solid green, indicating that it has found its master. (If you have an exceptionally noisy RF environment, you may find that one or more of the slave devices have LED A flashing amber rather than green. If this occurs, you should consider switching your devices to a different SNAP channel, which would use a different radio frequency. You can make this change using the EasySet software or using the DIP switches inside the SNAPLink device.)

NOTE: If you have an exceptionally noisy RF environment, you may find that one or both of the devices have LED A flashing amber rather than green. If this occurs, you should consider switching your devices to a different SNAP channel, which would use a different radio frequency. You can make this change using the EasySet software or using the DIP switches inside the SNAPLink device.

Canceling Pairing State

If you accidentally put a unit into Pairing state, while LED A is rapidly flashing red, hold down the **MODE** button until LED A goes dark, about 5 seconds. The unit is now back in Broadcast state.

Unpairing Units

If you have SNAPlink devices that are paired to each other and you wish to return them to Broadcast state, hold the **MODE** button until LED A turns red, about 5 seconds. Release the **MODE** button. This will cause the device to drop its current partner and go into Pairing state. From there you can cancel the Pairing state to return to Broadcast state, or introduce it to a new SNAPlink device in Pairing state with which it will connect.

Demoting a Multipoint Mode Master

If you have a SNAPlink device set as a multipoint master, hold the **MODE** button about 5 seconds until LED A rapidly flashes amber. This sets the unit back to multipoint pairing state, seeking a multipoint mode master. Any multipoint mode slaves that had been pair with this device before its demotion should be re-paired with the new multipoint mode master.

Exiting Multipoint Mode

For a SNAPlink device in multipoint pairing state or for a multipoint mode slave device, press and hold the **MODE** button until LED A glows steadily, about five seconds, to return the device to Broadcast state. LED A will turn off. The device is now ready to be configured for point-to-point mode or multipoint mode.

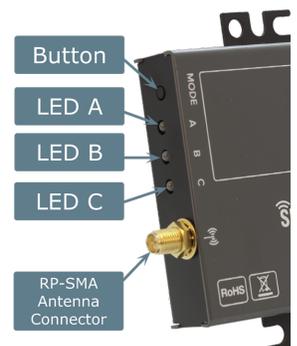
Defaulting to Broadcast State

To return a SNAPlink to Broadcast state and set its network and serial settings based on the internal DIP switches, disconnect power from the device, hold the **MODE button**, and reapply power. After 5 seconds, the LEDs will rapidly flash green-amber-red. Release the **MODE button**.

This should leave LED B green (indicating power), LED A off (indicating Broadcast state), and LED C green if an RS-232 connection is made.

SNAPlink LED Indicators

Each SNAPlink device has three LEDs on it, labeled A, B, and C, on the end with the RP-SMA antenna connection.



LED	LED State	Description
A	OFF	Default State
	Rapidly flashing Red	Unit is seeking a pair
	Solid Green	Unit is paired with a strong signal
	Solid Amber	Unit is paired with a weak signal
	Solid Red	Unit is paired with a weak or no signal
	Any Color and flickering	Wireless communications are occurring
	Flashing Amber	Unit is in multipoint mode and seeking a master
	Slowly alternating between green and amber	Unit is in multipoint master mode.
	Slowly alternating between red and amber	Unit is in multipoint mode and has detected another master on the same channel and network
B	Solid Green	Unit is powered
	Flickering Green	Unit is communicating on the USB port
C	Solid green	An RS-232 device is attached and idle
	Flickering green	An RS-232 device is attached and data is being transferred
	Off (while powered)	An RS-485/422 device is attached and idle

NOTE: It may be difficult to differentiate an amber colored LED from one showing green or red, depending upon your viewing angle. When viewed from above, an amber LED may look red and when viewed from below it might look green. If in doubt, try viewing the LED at different angles.

Installing and Using the SNAPlink EasySet Software

The SNAPlink EasySet software provides a graphical interface for configuring the SNAPlink and accessing settings like bps rate, flow control, and parity bits.

EasySet is currently available for Microsoft Windows 7 and newer operating systems, and can be downloaded from the Synapse Wireless website at:

<http://info.synapse-wireless.com/SNAPlinkintro>

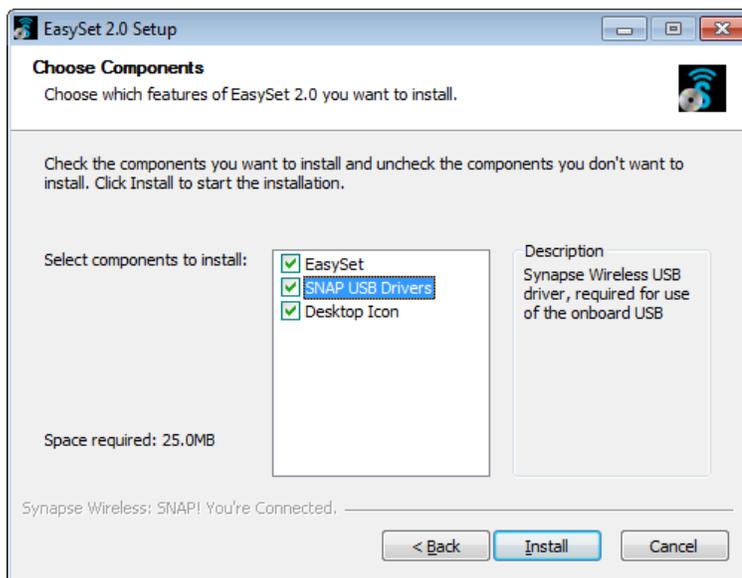
After downloading the software launch the installer to guide you through the installation process.

NOTE: The EasySet software overrides the dip switches on the SNAPlink device. If you use EasySet, any configurations made with switches must be repeated within the software.

Installing EasySet

Launch the installer and step through the installer process, accepting the software license, to complete the software installation.

You will be offered the opportunity to install SNAP USB drivers, as shown on this screen:



These drivers are needed for EasySet to communicate with the SNAPlink device. If you configure your SNAPlink to use the USB connection as its serial input source, you will also need these drivers installed on the computer sending data. Be sure to disconnect any Synapse USB devices from your computer as the installer runs. (The installer will prompt you with a reminder for this when it is appropriate.)

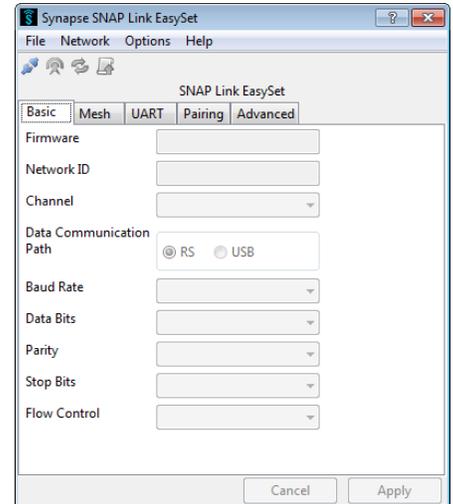
Using EasySet

Launch EasySet by selecting EasySet from the Windows Start menu. EasySet will start up and present this window. You will see four icons in the tool bar across the top of the window. Most of these are inactive (grayed out) until EasySet is connected with a SNAPlink adapter. There are also five tabs in a tab bar below the tool bar.

Toolbar

The four toolbar commands are:

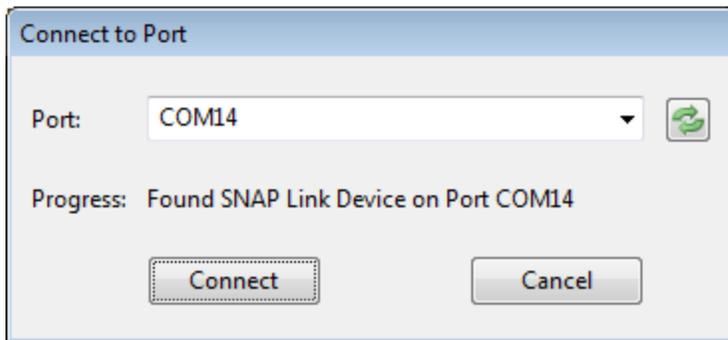
-  **Connect / Disconnect Serial Port** – connects or disconnects from the attached SNAPlink device. Because this icon changes when you connect or disconnect, it also serves as a quick status indicator.
-  **Ping** – causes EasySet to make a quick connectivity test to the attached SNAPlink device.
-  **Refresh Node Information** – causes EasySet to poll the attached SNAPlink device for configuration information.
-  **Upload SNAPpy Image** – prompts EasySet to upload the SNAPlink operating software into the attached SNAPlink device. This is only necessary on release of new SNAPlink software, or if instructed by technical support.



Connect a SNAPlink Device

Connect a SNAPlink device to your computer using the supplied USB cable. The micro-B USB end of the cable fits into the back of the SNAPlink device, and the type-A USB end fits into any standard USB port on your PC. This connection supplies power to the SNAPlink and also allows EasySet to communicate with it.

Press the **Connect Serial Port** button. EasySet will scan all serial ports and will stop when it has found a SNAPlink device.



When EasySet finds a Synapse device, click the **Connect** button. If it failed to find the correct device type, press the **Scan** button (🔄) to the right of the port identifier. This will instruct EasySet to continue the scan.

When successfully connected to a SNAPlink device, EasySet populates the communication fields with the data currently set in the SNAPlink device.

When the SNAPlink device is powered up for the first time, you will see the factory default settings set internally by the DIP switches. Once the configuration is changed by EasySet, the SNAPlink device will retain the new configuration in flash memory.

Tab Bar

There are five tabs across the top of the window — Basic, Mesh, UART, Pairing, and Advanced — which allow you to match the communications settings of your SNAPlink adapter to the serial device you're connecting to.

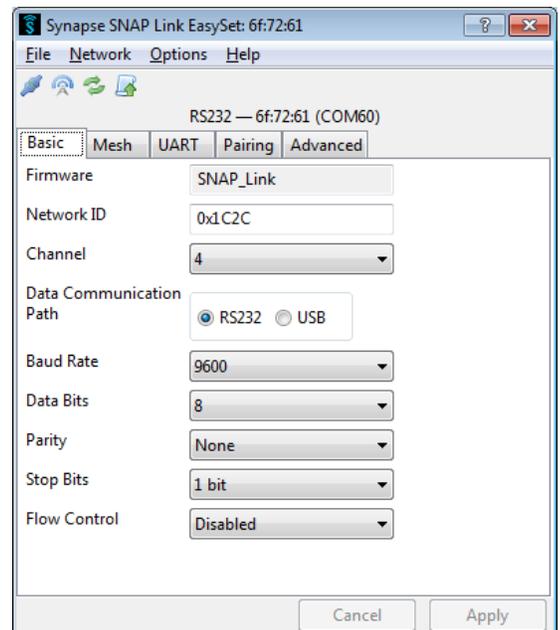
Selecting Basic Communications Settings

Below the icons and immediately above the tab bar is the SNAPlink adapter type: either RS-232 or RS-485/422. To the right of that is the last three bytes of the adapter's MAC (media access control) address. (The MAC address is also in the title bar, and printed on a label on the device.) Finally, the PC-assigned COM port is listed to the right of the MAC address.

Basic Tab

The Basic tab provides information and configuration options for how your SNAPlink device will communicate with other SNAPlink devices and with the connected serial device.

The first three options indicate the loaded device script, and the network ID and channel on which it will communicate.



Firmware	The Firmware field displays the name of the script loaded into your SNAPlink device. This will be SNAP_Link unless Synapse Customer Support has provided an alternate.
Network ID	The Network ID can be thought of as a logical channel. This 16-bit integer may be assigned any hexadecimal value from 0x0001 through 0xFFFFE. Devices in a SNAP network must share both the same channel and same network ID to communicate. This allows multiple SNAP networks to share the same channel if required, although it is preferred to place independent networks on separate physical channels to reduce collisions. SNAPlink defaults to network ID 0x1C2C.
Channel	<p>The Channel number can range from 0 to 14, and corresponds to specific radio frequencies in the 2.4 GHz band. (Channel 15 cannot be used for data transmission due to FCC regulations.) All SNAPlink devices that you wish to include in the same network must be set to identical channel numbers.</p> <p>SNAPlink devices default to channel 4. If you do not have EasySet available, you can modify your channel setting using DIP switches inside the SNAPlink enclosure. See the DIP Switch 1 section for details. Defaulting the device by holding the button while powering up will set it to use the channel specified by the DIP switches.</p>

The remaining fields on the **Basic** tab relate to the connected serial device. Typically these values will depend on the target device. Set the items under the **Basic** tab to match the connected serial device.

Data UART	<p>SNAPlink adapters contain two UART (Universal Asynchronous Receiver/Transmitter) connections, one for the USB port and one for the serial communications (RS-232 or RS-485/422) port. This setting indicates which port is connected to your serial device and where the serial data should be transmitted or received. The factory default is to send all serial data through either the RS-232 DE9 or RS-485/422 terminal block and NOT through the USB cable. This leaves the USB port as the means to communicate with EasySet.</p> <p>You can change this arrangement, but it will make your device unreachable via the USB port for further programming by EasySet. If you choose "USB" using this Data UART setting in EasySet and later need to reprogram the device, the easiest method is to reset the device to its default settings. Alternately, if your computer has an RS232 port or if you have an adapter to connect to the RS-232 or RS-485 port on your SNAPlink device, you could use that connection to connect to EasySet.</p>
Bps Rate	<p>Set the SNAPlink bps rate to match that of your serial device. The bps rate for all devices can range from 300 to 115,200. Adapters can send chunks of data in bursts up to 115,200, and safely sustain a maximum of 19,200 bps if one device is sending data, or 9,600 if two devices are constantly sending data to each other.</p> <p>SNAPlink devices default to 9,600 bps. If EasySet isn't available, you can modify your bps rate using DIP switches inside the SNAPlink enclosure. See the DIP Switch 1 section for details. Defaulting the device by holding the button during power-up will set it to the value specified by the DIP switches and clear other routing configuration changes to defaults. Changing the DIP switches and power cycling the device will change the bps rate (and/or SNAP radio channel) without affecting other configuration changes.</p>
Data Bits	<p>Set the number of data bits to 7 or 8. The default is 8.</p>
Parity	<p>Set the parity to none, odd, or even. The default is none.</p>
Stop Bits	<p>Set the stop bits to 1 or 2¹. The default is 1.</p>
Flow Control	<p>This setting should only be enabled for devices needing flow control. RS-485 and RS-422 devices always have flow control enabled. For RS-232 devices, the default is disabled.</p> <p>If you do not have EasySet available, you can modify your flow control setting using a DIP switch inside the SNAPlink enclosure. See the DIP Switch 1 section for details. Defaulting the device by holding the button during power-up will set it to the value specified by the DIP switch.</p>

¹ Early SNAPlink devices required that stop bits always be set to 1. The current version allows either 1 or 2.

Mesh Tab

The **Mesh** tab allows you to tune your network to accommodate unusual environments, such as when you need intermediate nodes to forward your data in case of great distances or interference.

Typically one of the two preconfigured options, "Mesh" or "No Mesh" will be appropriate for your application.

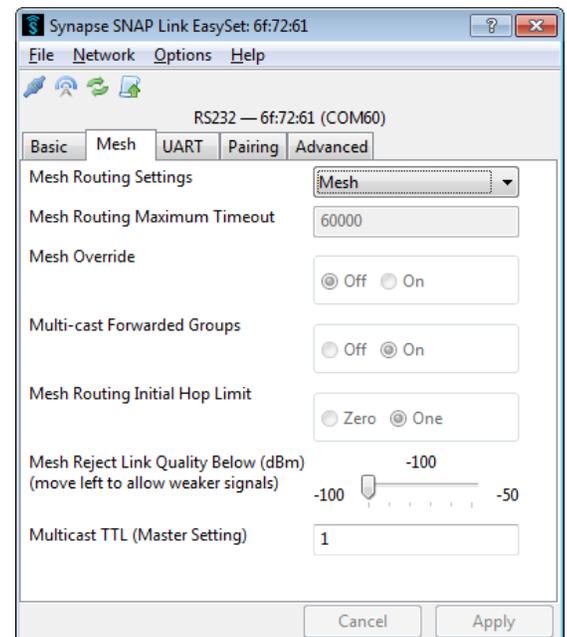
Mesh Routing Settings

SNAP-based nodes in a complex environment will constantly update their communication routes to provide the best path for getting all messages from origin to destination. These routes expire (every minute, by default) and are re-established to be certain that the most efficient path is always in use.

If you configure your SNAPlink device as a mesh device, you are allowing the device to assist other SNAP-based nodes in its environment (with the same channel and network) with their communications. This can make those communications more robust, but does so at the potential expense of interrupting or bottlenecking communications between your SNAPlink devices. If you have fairly low data throughput requirements for your SNAPlinks, you are not likely to have problems with the Mesh configuration enabled. If you have only your network of intercommunicating SNAPlink devices (two paired, or a point-to-multipoint collection), and each node is able to communicate reliably with each of its partners, there is no need to enable the Mesh configuration.

If, however, you have a point-to-multipoint configuration where one or more of the slaves is not able to reliably reach the master, or vice versa, it can help to have an intermediate device (including another slave device in your network) set to enable the mesh configuration to help pass data along.

Configuring your devices with the Mesh settings can also be helpful in an environment where you have multiple paired devices on the same channel and network ID, where one (or more) of the pairs may be at the limits of their ranges. Paired SNAPlink devices will still be willing to assist other SNAPlink devices with their communications, even though they will not act on those communications themselves.



No Mesh

In contrast, the **No Mesh** configuration tells a device to not aid other devices when they are trying to establish routes. With the No Mesh configuration, each node is still perfectly happy to make use of other willing participants in the mesh network, but will not volunteer to forward messages for other nodes.

The advantage of this configuration, even in an isolated environment without outside nodes asking for assistance, is your devices will perform their route discovery tasks once and then not allow those found routes to time out, reducing a small amount of overhead every minute or so. This means if your devices spend a significant amount of time idle and then need to send a burst of data, that burst will not be subjected to increased latency by the need for route discovery.

Mesh Routing Maximum Timeout

The **Mesh Routing Maximum Timeout** setting specifies how long a discovered route can survive before it is discarded and route discovery has to happen again. The Mesh configuration sets this to 60,000 milliseconds, or one minute. (The maximum value is 65,535 milliseconds.) Setting the value to zero instructs that routes should never time out, and will only be discarded if they are found to be unusable. The **No Mesh** configuration sets this to zero.

Mesh Override

The **Mesh Override** setting specifies whether a device is willing to pass along directly addressed messages for other devices. Devices that are directly paired and slave nodes in a point-to-multipoint arrangement send their messages as addressed messages, so these could be affected by this setting. If you have multiple paired point-to-point devices, these devices could also be configured to route and relay messages for each other.

Turning Mesh Override off does not mean that the device is unable to take advantage of the mesh network for its own purposes. It only means that it will not be a polite citizen in its mesh environment, forwarding directly addressed messages for other nodes.

Disabling this setting on an intermediate SNAPlink device in an environment where one or more devices have difficulty communicating reliably with another device can allow that intermediate device to relay the other slaves' messages to the master.

In an environment where every SNAPlink device can directly communicate with every other device this setting is irrelevant.

Multi-cast Forwarded Groups

The **Multi-cast Forwarded Groups** setting performs a similar function as the **Mesh Override** setting, only for multicast messages rather than for directly addressed messages. In the context of SNAPlink devices, the only multicast messages typically sent are from the master to the slave(s) in a point-to-multipoint configuration.

Enabling this setting on an intermediate SNAPlink device in an environment where the master has difficulty communicating with one or more slaves can allow that device to relay the master's messages to the more slaves.

In an environment where every node can directly communicate with every other node, this setting is unnecessary, and enabling it can add overhead to any device on which it is enabled.

Mesh Routing Initial Hop Limit

The **Mesh Routing Initial Hop Limit** specifies *how* close a device expects its target device to be when it starts performing a route discovery.

Setting this value to zero indicates that the node expects its target node to be within direct radio range, which means any other nodes in the vicinity who might overhear the route request will not attempt to assist with the initial route discovery request, even if they do not have **Mesh Override** enabled.

Setting this to 1 instructs the SNAPlink device to send its route discovery requests in such a way that other nearby nodes that do not have **Mesh Override** enabled will repeat the device's call for a mesh route, increasing the radio chatter during the route discovery process.

In an environment where every node can directly communicate with every other node, zero is an appropriate setting. However, in environments where direct communications may not always be possible, setting this to zero will significantly increase the latency as the network will have to allow the first (unassisted) route request to time out before sending a second route request with a broader appeal for assistance.

Mesh Reject Link Quality Below

When establishing a mesh route, it is possible that a node may have inconsistent link quality with another node, sometimes being able to reach it and other times encountering interference from the environment. It is possible, then, for a node to establish a route where the link quality is at the fringes of what might be considered reliable.

In an environment like this, you can tell a node that it should require a certain standard of link quality (measured in negative dBm) when performing route discovery.

The closer to the -100 dBm end of the scale, the more willing a node is to accept weak signals for its routes. The closer you set a SNAPlink device to the -50 dBm end of scale a node is set to use, the stronger the radio signal it requires for its route discovery process.

In an environment where every node can directly communicate reliably with every other node, changing this from its default of -100 dBm serves no purpose.

WARNING: Adjusting these settings too far to the left or right can result in no communications getting through.

Multicast TTL (Master Setting)

The **Multicast TTL** setting is only meaningful in the context of master nodes in a point-to-multipoint configuration. It specifies how many "hops" a message should be willing to take as it tries to find any willing listener. Each hop represents an intermediate SNAPlink device that has heard the message from the master than then forwards it on to others within range of it before acting on it.

For example, consider an environment where there are four SNAPlink devices in a long line: Master, Client1, Client2 and Client3. Assume the Master device's transmissions cannot get all the way to the farthest device, Client3; but it appears Client1 could get it to Client2 and Client2 could get it to Client3 since each client is about a third of the distance away from its neighbors. In this example, setting the Master TTL to 3 in the Master adapter, and setting

Client 1 and Client 2 to **On** for the Multi-cast Forwarded Groups should help make sure all transmissions are received by Client3. (Note that return messages from Client3 to the Master will also require that Client1 and Client2 have Mesh Override disabled.)

In a point-to-multipoint environment where the master device can directly communicate reliably with all of the slaves, the default value of 0 is appropriate. Setting the value higher will cause devices that do not have the **Multi-Cast Forwarded Groups** feature disabled to unnecessarily forward the data packet, increasing radio chatter. In point-to-point environments, this setting does not affect communications.

In a directly paired environment, this setting has no effect.

UART Tab

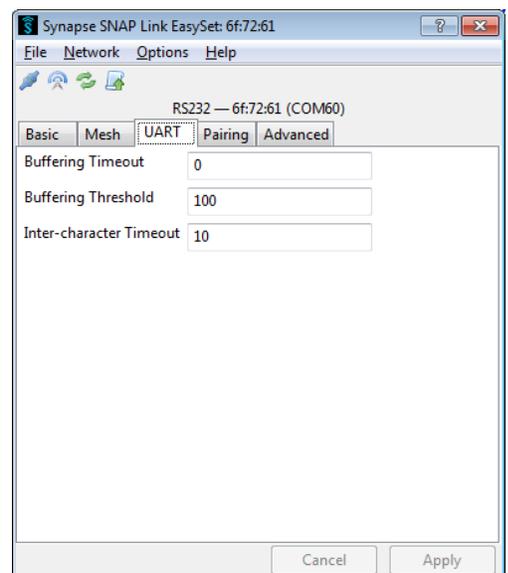
The UART tab contains three parameters for fine tuning data transmission. These can be set according to the needs of the serial device. You may have to adjust them depending upon transmission speed and the size of data packets.

Buffering Timeout

This setting controls the overall serial data timeout. The value is in milliseconds with the default being 0, indicating no timeout enforcement.

The **Buffering Timeout** controls the elapsed time between an initial character being received and a packet of serial data being queued for processing. When the timeout passes, regardless of the number of characters buffered (other than zero) or the rate at which they are received, the buffered data will be sent. The larger this value, the more buffering that will take place. While this allows for more data to be sent per packet, which might be more efficient depending upon your application, it also increases latency.

Note that other events, controlled by **Buffering Threshold** and **Inter-character Timeout**, can also trigger the buffer of data to be sent.



Buffering Threshold

This setting indicates the level where the SNAPlink device will decide that it has enough data to send a packet. If data comes in faster than the threshold checks it is possible the packet size may be larger than the size specified.

The default is 100 bytes, and the maximum is 123 bytes. Values over 100 are not recommended as they could result in buffer overrun.

Buffering Threshold causes buffered data to be sent whenever the threshold is reached. However, triggering the **Buffering Timeout** or **Inter-character Timeout** settings could cause data to be sent before the threshold is reached.

Each packet of data includes a header, which comprises 12 bytes for multipoint packets and 15 bytes for point-to-point packets. So, the actual number of data bytes sent will be either 12 or 15 bytes fewer.

If you set **Buffering Threshold** to a large number, then larger, more efficient packets will be sent, but with greater latency. At higher bps rates setting this value too high can result in dropped characters, as the SNAPlink device may receive more characters than it can fit in a packet before it has an opportunity to realize that the packet is full.

Inter-character Timeout

This setting allows you to tune the inter-character serial data timeout. This value is in milliseconds and defaults to 10.

Inter-character Timeout is the maximum elapsed time that should pass before sending the enqueued packet after receiving a character. It restarts with every received character. This parameter can trigger transmission of buffered data before **Buffering Threshold** is reached. Conversely, if the timeouts are high or disabled altogether, then data will be transmitted when the **Buffering Threshold** is reached.

Setting a large **Inter-character Timeout** can give better reliability but with greater latency.

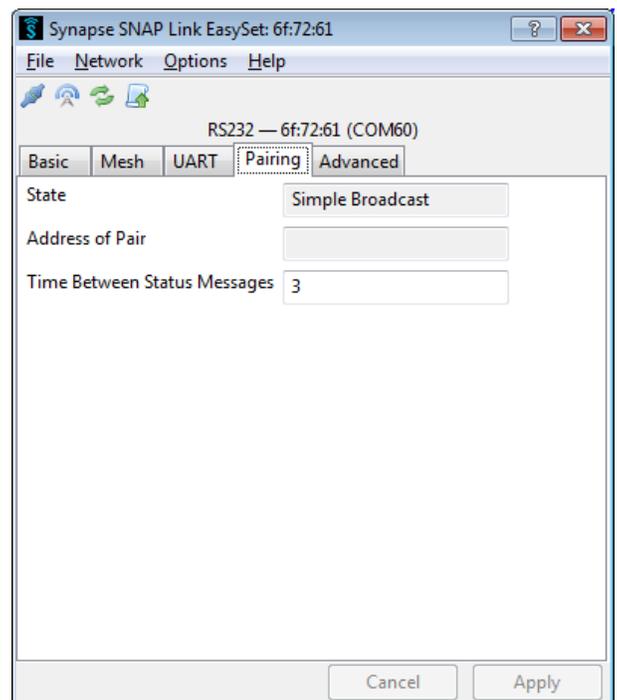
Pairing Tab

The Pairing tab indicates whether the SNAPlink device is paired with another device, which is denoted by displaying the other device's SNAP address.

State

This is the paired state. The value can be:

- **Simple Broadcast** – Unit is in a reset state and is waiting to be configured.
- **Searching for Master** – Unit is in multipoint mode and is searching for a master unit to pair with..
- **Master** – Unit is in multipoint mode and is the master. It is now willing to accept slave units.
- **Slave** – Unit is in multipoint mode, is a slave, and has paired with a master.
- **Ready to Pair** – Unit is in point-to-point mode and is looking for another unit to pair with.
- **Paired** – Unit is in point-to-point mode and has been paired with another.



Address of Pair

When paired, this will be the last three bytes of the MAC address of the unit paired with this device. If a slave, this will be the address of the master. If a master, this field will be blank.

Time Between Status Messages

SNAPlink devices will routinely ping paired partners to confirm that the connection remains valid. This ping information is used for things like setting the color of the RF LED to indicate signal strength between nodes.

This field specifies the number of seconds between pings. The default value is 3 seconds.

Advanced Tab

The **Advanced** tab contains a single checkbox labelled **Button Lockout**. When checked, the **MODE** button on the front of the SNAPlink adapter will be disabled.

This means the pairing state or point-to-multipoint state of the device cannot be modified using the button.

However, the **MODE** button can still be used to perform a reset, putting the SNAPlink device back into broadcast state. (After such a reset, the button will be enabled for pairing and configuration again.)

Configuring Your Adapter Using DIP Switches

If you do not have access to a computer running EasySet, you can configure some communication parameters using the DIP switches located inside the unit.

Changing DIP switch settings will override the default parameters, or parameters previously configured using the EasySet software. However, EasySet can also override the DIP switch settings from DIP switch 1. SNAPlink adapters have built-in intelligence to determine if EasySet or the DIP switches were last used to change the configuration. The general rule is: the last method used to change the settings is the one that takes precedence.

All SNAPlink models have a set of 8 internal switches that set Flow Control, Bps Rate, and SNAP Channel.

The SL485 has a second set of 6 switches that configure the device for either 2-wire or 4-wire operation, and to specify whether the RS-485 or RS-422 standard should be used.

To access the DIP switches, remove the screw adjacent to the serial connection (DE-9 connector or terminal block) and lift the top of the enclosure off to expose the switches.

When you reassemble your device, the enclosure screw should be tightened to a torque of 0.5 to 0.9 Nm (4.4 to 8 inch pounds) for best results.

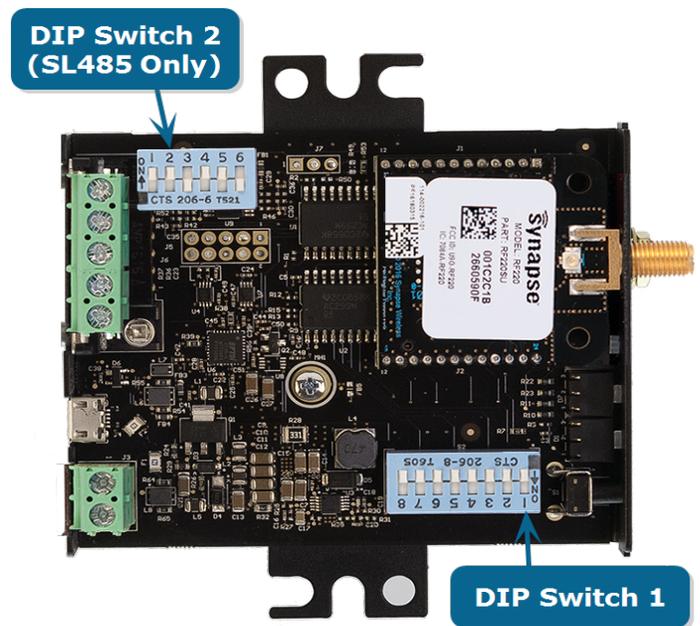
DIP Switch 1

DIP switch 1 is applicable to all SNAPlink devices. It has 8 individual switches, controlling the serial bps rate, flow control, and SNAP radio channel.

Switch 1 controls flow control on SL232 devices. Move this switch "up" to the position labeled "ON" to enable flow control. (Flow control is always enabled for SL485 devices.)

Switches 2, 3, and 4 collectively control the serial bps rate. There are eight speeds you can set with these switches.

Bps Rate	Switch 2	Switch 3	Switch 4
300	On	Off	On
1,200	Off	On	On
2,400	On	On	On
9,600	Off	Off	Off



Bps Rate	Switch 2	Switch 3	Switch 4
19,200	On	Off	Off
38,400	Off	On	Off
57,600	On	On	Off
115,200	Off	Off	On

Switches 5, 6, 7, and 8 collectively control the SNAP radio channel, as follows.

SNAP Channel	Switch 5	Switch 6	Switch 7	Switch 8
0	Off	Off	Off	Off
1	On	Off	Off	Off
2	Off	On	Off	Off
3	On	On	Off	Off
4	Off	Off	On	Off
5	On	Off	On	Off
6	Off	On	On	Off
7	On	On	On	Off
8	Off	Off	Off	On
9	On	Off	Off	On
10	Off	On	Off	On
11	On	On	Off	On
12	Off	Off	On	On
13	On	Off	On	On
14	Off	On	On	On
15	On	On	On	On

Because flow control, the bps rate, and the SNAP radio channel can all be controlled by either the DIP switches or the EasySet software, SNAPlink devices work on a "most recent instructions" basis, using the settings made in EasySet until the DIP switches are modified (or the device is reset by holding the button for five seconds while applying power), and then using the DIP switch settings until they are modified using EasySet. Therefore checking the state of a device's DIP switches is not guaranteed to indicate the channel and bps rate used by the device.

NOTE: Channel 15 is not available for transmitting data for SL485-003, SL485-004, SL232-003, and SL232-004 devices, however it can receive data. It is conceivable that in an environment of mixed first- and second-generation SNAPlinks, where first-generation devices are permitted to use channel 15, second-generation devices could be configured as multicast slaves that could hear and act on instructions from the master without being able to send data back.

DIP Switch 2

DIP switch 2 consists of a bank of six individual switches and is present only in SL485 devices. It is used to configure the device for two-wire or four-wire operation, and to switch between RS-485 and RS-422.

Each of the switches serves its own purpose, such as providing termination resistance on a given connection. While there are 64 potential configurations for this bank of switches, there are four configurations that might be deemed as "safe" for whatever end device you are connecting.

Configuration	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
RS-485 Two-wire Half Duplex	On	On	Off	On	On	Off
RS-485 Four-wire Half Duplex	Off	Off	On	On	On	Off
RS-485 Four-wire Full Duplex	Off	Off	On	On	Off	On
RS-422 Four-wire Full Duplex	Off	Off	Off	On	Off	On

Note that two-wire is always half duplex and four-wire can be switched between half or full duplex. RS-422 is always four-wire, full duplex.

Some device manufacturers might refer to two-wire and four-wire as three-wire or five-wire, respectively. These configurations are identical, but are including the ground wire in their specification.

Unlike the settings you can make with DIP switch 1, you cannot modify these settings using the EasySet software. The only way to configure your SNAPlink for RS-485 vs. RS-422, or to adjust the number of connections or the duplex, is through the DIP switches in bank 2.

Switches 3 and 4 enable 120-ohm terminating resistors, which may be needed depending on your connected equipment. If your equipment requires them, having them off can cause damage to your equipment. Even if your equipment does not require them, having them on will continue to work as desired on nearly all devices. If your device does not require terminating resistors and you are having issues with your communications, you can experiment with turning these terminating resistors off. However the configurations shown above should safely work for all devices.

Switches 1 and 2 are RX and TX combiners to switch between four-wire and two-wire functionality. There is no valid configuration for any device that has these two switches in different positions from each other.

Switches 5 and 6 enable half duplex and full duplex, respectively. There is no valid configuration for any device that has these two switches in the same position as each other.

Troubleshooting

In the realm of wireless communications, many factors can affect reliable data communications. This section lists a number of known factors and possible remedies.

If your question is not adequately answered here, visit the SNAPlink support forum on the Synapse Wireless website where you can post a question and interact with other SNAPlink users. The SNAPlink Support forum can be accessed at:

<https://forums.synapse-wireless.com/>

You can also contact Synapse Customer Support at <http://support.snapcloud.net/>

Signal Strength Problems

SNAPlink adapters should communicate well when placed in near proximity of one another (as indicated by a mostly green LED A). They might not communicate well when moved farther apart (as indicated by LED A turning amber, indicating weak signal strength, or red, indicating loss of signal). You can make several adjustments to remedy this situation:

- Try orienting the external antenna into different positions. Since antennas work best when they are in the same spacial plane, essentially parallel to one another without being directly above or below each other, try to position the antennas of all your SNAPlink devices in the same orientation.
- There could be other interference problems in your vicinity such as large metal objects, dense foliage, or other objects that prevent signal transmission or cause attenuation (signal loss). Microwave ovens can cause interference problems. Try moving the units physically to another usable location to change interference paths to see if signal strength improves.
- Try changing the channel of each device. There are 15 separate channels (0 to 14 — channel 15 is not available for transmissions) spread within the 2.4GHz frequency. Various other 2.4GHz devices, such as cordless phones and WiFi routers, may be interfering with one channel, but not another one. The Portal software mentioned above includes a Channel Analyzer tool that can help you determine which channel has the least RF interference.

Multiple Masters

In a multipoint network, if SNAPlink devices are unable to pair with a master, check for the presence of multiple masters.

There can be only one master in a multipoint network. If you wish to operate multiple masters within the same vicinity, then be sure to set each master to a different channel and/or network ID using either EasySet or the DIP switches. To reduce near-band interference, set the network channels as far apart as possible.

When operating normally, a SNAPlink master will slowly blink LED A, alternating between green and amber. If it detects the presence of another master on the same channel, it will then alternate the colors between red and amber.

Can't Find a Master

If a SNAPlink device is unable to pair with a master, there may be several possible problems:

- Ensure there are not multiple masters on the network by observing LED A on your master device as described above.
- Ensure all units on the multipoint network are using the same channel number and network ID.
- Ensure the unit is within broadcast range of the master. If in doubt, try to pair the units within the same room. Once paired, move the slave unit farther away while observing LED A. It should start off green, but if the unit is moved to the fringe of its broadcast range, the LED will turn amber, indicating weak signal strength. If the LED turns red, then it has lost its connection with the master.
- Try adjusting the antennas as described above.

Poor Performance

If you believe your SNAPlink adapter are not performing adequately, this could be caused by a number of factors, such as:

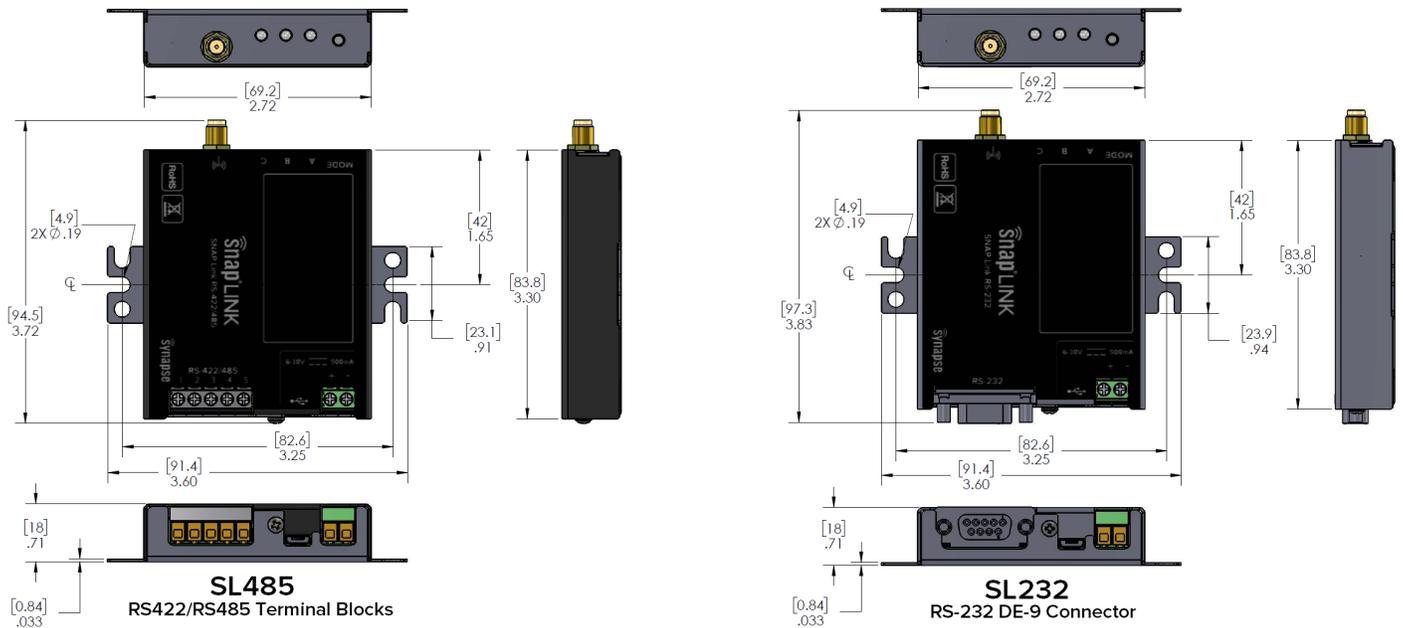
- Poor signal strength – try adjusting the antennas as described above.
- Incorrect data communications parameters – confirm your serial communication settings in EasySet with those of your serial device.
- Premature sending of packets, holding on to packets for too long, or just dropped packets – try optimizing the UART parameters for your particular application.
- For SL485 devices with a two-wire or four-wire connection, try adding a ground line to the fifth connection in the terminal block. Some serial devices may be able to communicate sometimes without a common ground, but will have sporadic failures.

Paired But Not Communicating

If a unit appears to be paired but still doesn't work, check the communications parameters using EasySet.

- If you don't see an occasional flicker of LED C, indicating serial traffic, then you might have an incorrect setting in bps rate, stop bits, parity, or flow control. This would prevent your end device from passing serial data to the SNAPlink device, which then would be unable to transmit it to the paired SNAPlink device.
- If you have more than two SNAPlink units, confirm that each unit is paired to the desired unit as expected. Each unit's MAC address is printed on its label. When a unit is paired with another unit, EasySet will show the last three bytes of that unit's MAC address.

Specifications



General

Radio Frequency	2.4 GHz (2.4000 – 2.4835 GHz)
Spreading Spectrum Type	Direct Sequence (DSSS)
Frequency Control	Offset-Quadrature Phase Shift Keying (O-QPSK)
Network Topology	Point-to-Point Paired; Point-to-Multipoint; Transparent Mesh Networking
Channel Capacity	15 isolated channels; 65534 logical networks per channel
Serial Data Interface	Two: Selectable between RS-232/485/422 or USB
Supported Serial Bps Rates ²	110*, 300, 1,200, 2,400, 4,800*, 9,600, 14,400*, 19,200, 38,400, 57,600, 115,200
Max Sustainable Throughput	19,200 bps

Power Requirements

Supply Voltage	4 – 5.25 VDC; Standard micro-B USB Universal Connector 6 – 30 VDC; Terminal block connections
Max. Power Consumption	RS-232: 0.6W RS-485: 0.825W

Physical Properties

Enclosure Type	Powder-coated steel with integrated mounting flanges
Enclosure Size, SL232 (without antenna)	0.71H x 3.60W x 3.83L in. (1.8 x 9.1 x 9.7 cm)
Enclosure Size, SL485 (without antenna)	0.71H x 3.60W x 3.72L in. (1.8 x 9.1 x 9.5 cm)
Weight	6.3 oz (179 g) with antenna
Operating Temperature	-40° to +70°C
Maximum Operating Temperature	70°C
Operating Humidity	10 to 90% non-condensing
Wireless Link Failure	Integrated Wireless Link Failure LED indicator

RF (Wireless) Properties

Protocol	IEEE 802.15.4, SNAP
Indoor Range (with included antenna)	Up to 1000 feet indoors Line of Sight (LoS)
Outdoor Range (with included antenna)	Up to 3 miles Line of Sight (LoS)
RF Transmit Power	100 mW (20 dBm)
Receiver Sensitivity	-103 dBm at 1% packet error rate
Features	Real-time RSSI signal strength indicator; AT Command; Terminal Emulation; Modem emulation

Antenna

Type Included	External Reverse Polarity SMA connector, omni directional
Gain	3.2 dBi
Length	5.875 in (14.9 cm)
Impedance	50 Ohms unbalanced

Certifications

Complies with FCC Class B, IC, CE, and UL standards.

RoHS (lead-free) compliant.

RS-232

Connector	DE-9F DCE
Data bits	7 or 8
Parity	None, Even, or Odd
Stop bit	1 or 2

RS-485/422

Connector	Terminal block; 2 or 4 wire: TX+, TX-, RX+, RX-, GND (selectable)
Data bits	7 or 8
Parity	None, Even, or Odd
Stop bit	1 or 2

Software

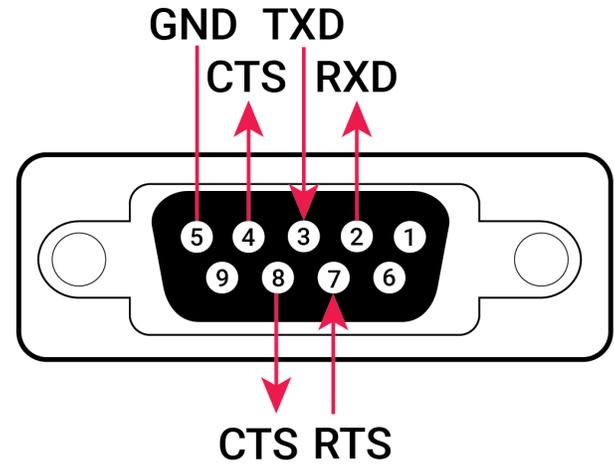
OS Support	Windows 10 or newer for configuration
Configuration	EasySet configuration software downloadable from Synapse

Pin Outs

RS-232 (DE-9F) Pin Outs

The SL232 adapter provides a DE-9 female connector with the following pin out:

Pin	Name	Direction
1	-	-
2	RXD	Out
3	TXD	In
4	CTS	Out
5	GND	N/A
6	-	-
7	RTS	In
8	CTS	Out
9	-	-



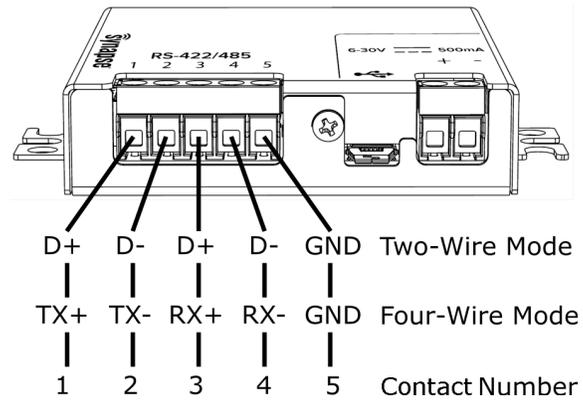
The SL232 adapter uses a standard DE-9 female connector configured as a DCE (Data Communications Equipment) device. A DCE device can be connected to a DTE (Data Terminal Equipment) device using a straight through serial cable. A computer is typically defined as a DTE device, and communications peripherals, such as the SL232, are defined as DCE devices. To connect a DCE device with another DCE device, or a DTE device to another DTE device, a null modem adapter, or crossover cable, is required. The null modem adapter swaps certain pins, typically pins 2 and 3, and 7 and 8, to convert a DCE into a DTE and vice-versa.

RS-485/422 Pin Outs

A terminal block is provided to which the transmit (TX), receive (RX), and ground (GND) wires can be attached. The factory default is set to 2-wire, but can be changed using the DIP switches located on the circuit board inside the adapter case. See the chapter **Configuring Your Adapter Using DIP Switches on page 17** for details in setting the DIP switches.

To wire a connection in two-wire mode, pick a pair of data pins — either 1 and 2, or 3 and 4, based on the following diagram. For a four-wire connection, connect as shown for that configuration. If your application requires a ground wire, sometimes referred to as three-wire or five-wire, then also include terminal block 5 as the ground.

Pin	2 Wire Mode Description	4 Wire Mode Description
1	D+	TX+
2	D-	TX-
3	D+	RX+
4	D-	RX-
5	GND	GND



Tighten the terminal block screws to between 0.35 and 0.40 Nm (3.1 to 3.5 inch pounds) for best results.

Regulatory Information and Certifications

RF Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Certifications and Regulatory Information (USA Only)

FCC Part 15 Class B

These devices comply with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) These devices may not cause harmful interference, and (2) These devices must accept any interference received, including interference that may cause harmful operation.

Radio Frequency Interference (RFI) (FCC 15.105)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Labeling Requirements (FCC 15.19)

This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

If the FCC ID for the module inside this product enclosure is not visible when installed inside another device, then the outside of the device into which this product is installed must also display a label referring to the enclosed module FCC ID.

Modifications (FCC 15.21)

Changes or modifications to this equipment not expressly approved by Synapse Wireless, Inc. may void the user's authority to operate this equipment.

Declaration of Conformity

(In accordance with FCC 96-208 and 95-19)

Manufacturer's Name: Synapse Wireless, Inc.

Headquarters: 6723 Odyssey Drive

Huntsville, AL 35806

Synapse Wireless, Inc. declares that the product:

Product Name: SNAPlink

Model Number: SL232 and SL485

to which this declaration relates, meet the requirements specified by the Federal Communications Commission as detailed in the following specifications:

- Part 15, Subpart B, for Class B equipment
- FCC 96-208 as it applies to Class B personal computers and peripherals

The products listed above have been tested at an External Test Laboratory certified per FCC rules and has been found to meet the FCC, Part 15, Emission Limits. Documentation is on file and available from Synapse Wireless, Inc.

Industry Canada (IC) Certification

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

 **synapse**[®]

