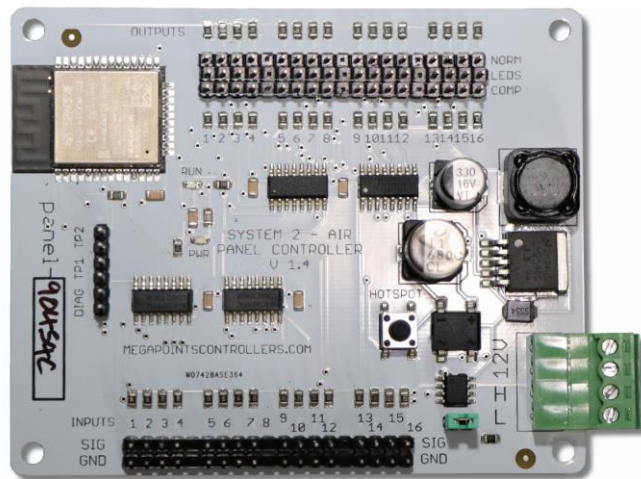# System2
Panel Controller User Reference
by MegaPoints Controllers

Sixteen input and sixteen output mimic panel controller for your model railway.

All the convenience of Wi-Fi configuration with a robust bullet-proof, wired CAN bus two wire network.

User Guide

This guide also applies to the in-32 and out-32 products.

Revision 6   OCT 2023   Status: Published

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Table of contents

Documentation revisions

This document is for the Panel Controller software version 10 or later. The version 10 software was published on 29-SEP-2023. If your Panel Controller software is earlier than version 10, you are encouraged to update to obtain the new features and stability improvements. The software release notes are published in the appendix at the end of this document.

What is System2 Air?

System2 is our new generation of model railway accessory bus products that feature our V-Port protocol (virtual port) and can address up to 60,000 devices. You can scale an installation from a single Servo-8 Controller (8 V-ports) right up to a huge layout as your needs grow. Flexibility is baked in and as we announce new modules that will work right alongside other System2 modules.

The "Air" in System2 refers to how you configure the system. It's done wirelessly using Wi-Fi. This means you can configure a device using your PC, tablet or phone and replaces the need for buttons, flashing lights and extension cables to reach under baseboard locations.

We use Wi-Fi for configuration and a CAN network for data. This offers high speed, low latency and above all else reliability. You can even shut down the Wi-Fi network when your configuration is complete making your system secure and robust. It's not required for operation at all.

Software for all System2 Air modules can be updated over the air if your network allows Internet access. A single button push is all that's needed to download and install the latest version. This means as new ideas and features are introduced everyone gets to benefit from them. You can even see the changes that have been introduced since your last update and choose whether to install or not. You won't get nagging reminders to update. It's flexible and entirely up to you when or if you decide to do it.

System2 has been real world tested on some of the largest exhibition model railway layouts in the UK for over a year before launching, so you can be confident it's fit for your needs and fit for purpose.

Each of our System2 boards has the administrative core baked in. You can connect to any board's admin web page and from there manage your entire network. There's no central point of control (or failure) as they are all peers in their own right.

We use standard web protocols for configuration so that your browser can connect and perform all administrative tasks without requiring any special apps and app permissions. This leaves you in control of your network.

System2 Air, for the smallest to the largest layouts and everything in between.

In order to use System2 you'll need a Wi-Fi router configured for DHCP with optional Internet access. This is the standard router configuration as supplied by your Internet Service Provider.

Designed and manufactured in Cheshire, England.

How to use this document

Treat this guide as a reference. All settings are documented and examples given where appropriate. It is designed to accompany the System2 Air – Panel Controller video that will demonstrate all the functions and use cases.

in-32 and out-32 product variations

The in-32 and out-32 are variations of the Panel Controller. They are essentially the same as a panel controller with either the inputs stripped off or the LED outputs stripped off and the remaining ports doubled to 32.

One in-32 and one out-32 are functionally equivalent to two Panel Controllers.

The configuration of the in-32 and out-32 is the same as the panel controller where it applies.

in-32

The in-32 is a 32 port input device that allows you to connect up to 32 switches, pushbuttons or sensors.

out-32

The out-32 is a 32 port output device suitable for driving up to 32 pairs of LEDs.

System2 Panel Controller

Introduction

The System2 Panel Controller is a 16 input and 16 output device primarily suited to driving mimic panels on System2 networks. It features a Wi-Fi based intuitive configuration from the comfort of your PC, tablet or phone.

- Each input channel is individually configurable for:
    - Switch type
        - Push to make
        - Toggle
        - Block Detector
        - Points Position Sensor
    - Latching time (delay)
    - RGB colour
    - Invert the switch logic

- Each output channel can:
    - Drive single and dual LEDs
    - Reverse its output

This is a 12 Volt device and should be connected to a minimum of 2 Amp regulated power supply.

MegaPoints Controllers use static sensitive components that must be handled with care.

Avoid touching any components or the circuit printed on the bottom of the board.

Avoid placing the board on any metallic surfaces including track.

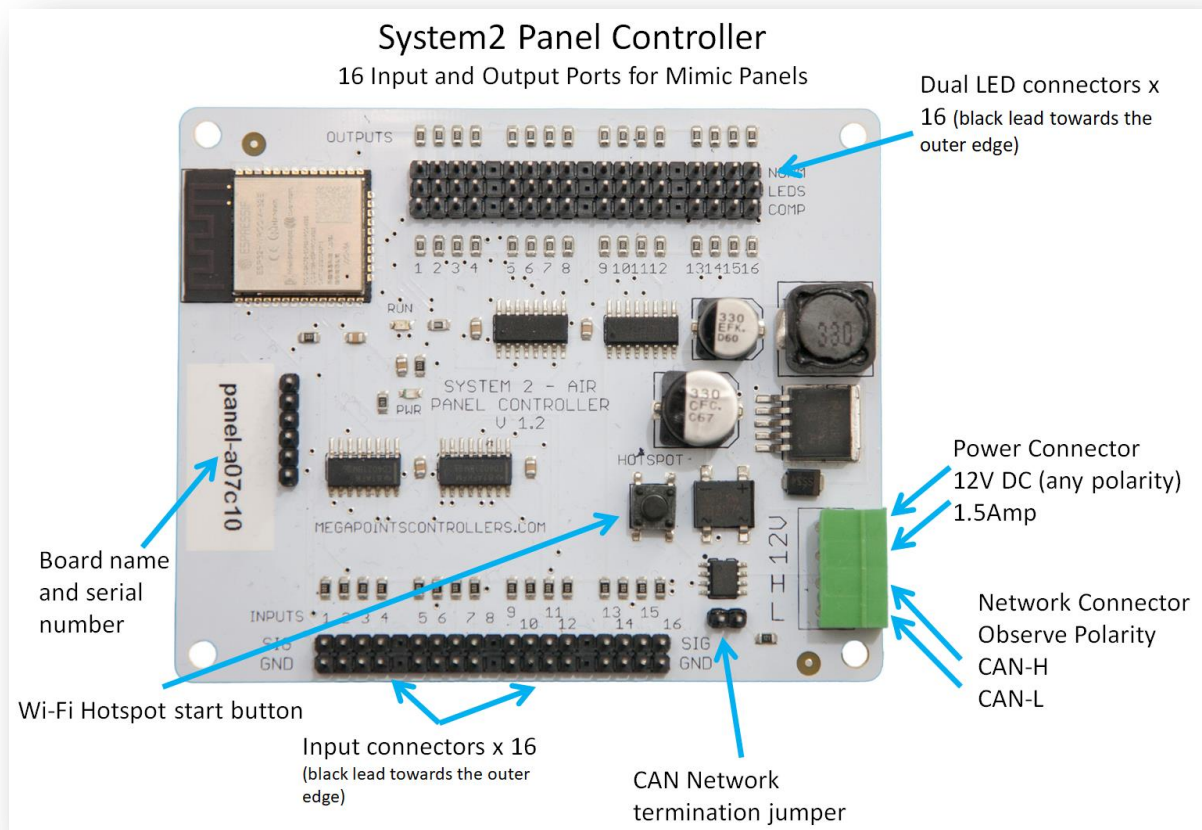DO NOT connect any part of this device directly to your track bus.

You will also need:

- 12 Volt DC regulated power supply.
    - 500 mA per Panel Controller.
- Network cable (twisted pair).

      o Telephone cable

      o Alarm cable

      o Such as CW1109B/Y supplied by CPC/Farnell . See website for cable links. Non twisted pair cable is OK for testing purposes, not for installation.

To use the network features of this board you will require:

- A Wi-Fi Router that is configured for:
    o DHCP (default enabled on most routers)
    o An active internet connection (only required for software updates).
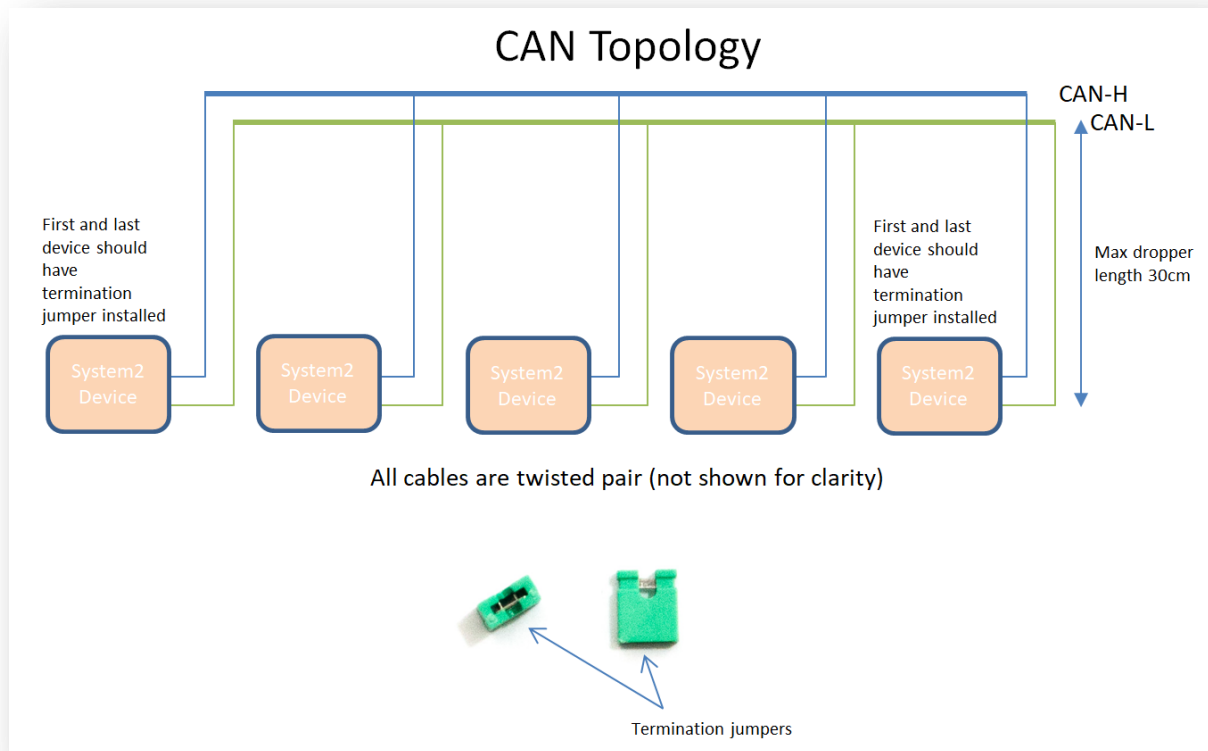- A current browser that supports HTML5.

First use

See the image below for connection details.

System2 Panel Controller
16 Input and Output Ports for Mimic Panels

Dual LED connectors x 16 (black lead towards the outer edge)

Power Connector 12V DC (any polarity) 1.5Amp

Network Connector Observe Polarity CAN-H CAN-L

Board name and serial number

Wi-Fi Hotspot start button

Input connectors x 16 (black lead towards the outer edge)

CAN Network termination jumper

- Connect each board to a 12 Volt regulated power supply, minimum 500 mA per Panel Controller.
- Connect the network cable to the two screw terminals. Observe the 'H' and 'L' terminals. Ensure all the 'H' and 'L' wires connect to each other respectively.
- If your board was part of a starter kit it will be configured as EasyConfig board 1.
- Connect an LED cable pair to output #1 ensuring the black lead is toward the outer edge.
- Connect a button lead to input #1 ensuring the black lead is toward the outer edge.

Network cabling

CAN Topology

First and last device should have termination jumper installed

First and last device should have termination jumper installed

CAN-H
CAN-L

Max dropper length 30cm

System2 Device

System2 Device

System2 Device

System2 Device

System2 Device

All cables are twisted pair (not shown for clarity)

Termination jumpers

You can fit the termination jumpers to the first and last board on your network if not already fitted (see above two diagrams). The jumpers may have been pre-installed to all boards, remove all except the first and last System2 boards on the network.

See the above diagram for network cabling. All cables should be a twisted pair signal cable. Fit any termination jumpers (supplied as part of a starter kit) to the boards at the ends of the network for a maximum of two jumpers per network.

You can use droppers to a main bus much like DCC or connect boards to each other in daisy chain fashion. Ensure the CAN-H and CAN-L connects to the same terminal in all cases.

Getting your first board on your local Wi-Fi network

There's a dedicated YouTube video demonstrating this. Follow this link to view: `https://youtu.be/G3ajZazycP4`. It will probably be easier than going through the following text.

With your updated software the procedure here overrides that in the Starter Kit Quick Start Guide. It has changed slightly making it more intuitive and easier. The very first board on from your System-2 Air should be configured for your Wi-Fi. This will allow you to connect and adjust the board settings such as servo movement type, speed or range adjustment as well as download future software updates and change port addresses. We suggest using the Panel Controller for this example.

Broadly speaking, here's how to connect to your Wi-Fi:

- Apply 12 DC regulated power to the Panel Controller.
- Observe the RUN LED flashing about once per second (may take up to 30 seconds on first time boot..
- Hold the HOTSPOT button for 1 second; observe the RUN LED flash rate increase to double.
- From your phone, tablet or other Wi-Fi device scan for Wi-Fi networks and locate the hotspot network for the panel controller (it will be the device name/serial number on the sticker) such as "panel-xxxxxx" or "serv8-xxxxxx".
- Connect to this network hotspot network. You may receive a warning stating this network does not connect to the Internet. This is OK.
- If your device states "sign-in required", select this option and go to the sign-in page.
- If your device does not offer a sign-in page, navigate your browser to "4.3.2.1/admin".
- Enter the SSID and password for your local network. Note case sensitivity (screenshot below).
- Press the "Scan WiFi" button. After a few seconds the adjacent text box will populate with scanned networks. Select the appropriate network (strongest signals towards the top).
- Enter a password (case sensitive) and press the save button.
- Your devices IP address will now be displayed near the top (red band). Make a note of this.
- Press the reboot button when ready and access the device via your usual network using the IP address obtained previously.
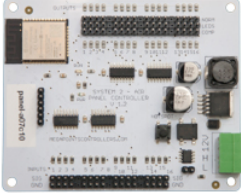
Admin Interface

The admin web page is shown on the page below. It is the place where you will change any settings for the Panel Controller. Each board on the System2 network has its own management web page and is unique to the board type and features.

Phys. Port	vPort	Latch Time	Switch Type	Invert Switch	Red	Green	Blue	Colour B/G		Phys. Port	vPort	Invert LED
1	1	500	Push to make (stateless)	☐	0	0	0	■	☐	1	161	☐
2	2	500	Push to make (stateless)	☐	0	0	0	■	☐	2	162	☐
3	3	500	Push to make (stateless)	☐	0	0	0	■	☐	3	163	☐
4	4	500	Push to make (stateless)	☐	0	0	0	■	☐	4	164	☐
5	5	500	Push to make (stateless)	☐	0	0	0	■	☐	5	165	☐
6	6	500	Push to make (stateless)	☐	0	0	0	■	☐	6	166	☐
7	7	500	Push to make (stateless)	☐	0	0	0	■	☐	7	167	☐
8	8	500	Push to make (stateless)	☐	0	0	0	■	☐	8	168	☐
9	9	500	Push to make (stateless)	☐	0	0	0	■	☐	9	169	☐
10	10	500	Push to make (stateless)	☐	0	0	0	■	☐	10	170	☐
11	11	500	Push to make (stateless)	☐	0	0	0	■	☐	11	171	☐
12	12	500	Push to make (stateless)	☐	0	0	0	■	☐	12	172	☐
13	13	500	Push to make (stateless)	☐	0	0	0	■	☐	13	173	☐
14	14	500	Push to make (stateless)	☐	0	0	0	■	☐	14	174	☐
15	15	500	Push to make (stateless)	☐	0	0	0	■	☐	15	175	☐
16	16	500	Push to make (stateless)	☐	0	0	0	■	☐	16	176	☐

EasyConfig Range Selector [Select board Num ▾]

Auto CAN ID ☑ CAN ID [629] (Manual range 1000-1999.) Locate Board ☐

[Share WiFi Credentials] [Revoke WiFi Credentials]

Reset to defaults | **Save Changes** | **Reload Values**
Erase WiFi Credentials | **Update Firmware** | **Reboot**
Reload page | **Documentation** | **Network Monitor**

Panel Controller S/W Rev: 10 | Templates: 10 | IP Address: 192.168.0.55 | Name: panel-451968 | SSID: Megapoints

Protocol [CAN]

Status Log

Firmware up to date. (29-SEP-2023)
Web client connected.

The grey background area relates to the inputs (switches, detectors etc.) and the green background area relates to outputs (LEDs).

From the main admin page you can see the following information:

- Device name and serial number
- Device picture
- User definable text description or location
- Input port configuration including:
    - V-Port
    - Positive latch time (milliseconds)
    - Input type
    - Invert
    - RGB settings for RGB LEDs (requires RGB output board)
- Output port configuration
    - V-Port
    - Invert
- EasyConfig (if selected)
- Locate Board: Will cause the LED on the selected board to flash fast helping you to locate the board if you have many.
- Auto CAN ID. You can override the CAN ID if required.
- Share and revoke Wi-Fi credentials with all boards on the network
- Control buttons (shown in blue text) to:
    - Reset the board
    - Save changes you've made
    - Reload changes (resyncs the web page with board)
    - Erase this boards Wi-Fi credentials (will immediately leave the network)
    - Select the firmware update (requires internet connection)
    - Reboot the board (throws out any unsaved changes if you made a mess)
    - Reload the web page
    - Link to online documentation and support videos
    - A CAN network monitor (for those who prefer watching network packets to trains).
- The next line shows:
    - Product name (Panel Controller)
    - Software version
    - Templates version (should usually match the software version)
    - The local IP address
    - The device network name and serial number
    - The Wi-Fi name you are connected to (SSID)
- The last item is a status log (light yellow background). This provides a real time status such as up to date software, or boards joining the network, whether you saved (or should) save your changes etc.

Board Location

The board location field (top right) should be used to enter meaningful information to help you locate a specific board. We are planning an update for this feature in a future release that will display the first few characters as part of a report when you request all boards to report in (covered later in this document).

We suggest you begin the text with the most meaningful information such as a baseboard number or location for example:

Suggested entry types	B2 Fiddle Yard 12 Station throat A3 Scenic
Avoid	Baseboard B2 Main approach on the left

The location will be added to reports in a future software update. This will be truncated to the first few characters (report formatting) so it's much more useful to state a location such as "B2" or"C12" than the word "Baseboard".

V-Ports

System2 is an event driven system. This means when a button is pressed an event is generated on the network. This event is visible to all connected boards and will be acted on by those boards listening for that event.

At the heart of the system is the "V-Port" or virtual port. The system will allow V-Ports in the range 1 – 60,000 which should be big enough for the largest and most sophisticated layouts.

When you set a V-Port address under the "V-Port" column you are saying that the servo is to listen for events on this V-Port and take commanded action if appropriate.

A corresponding V-Port should be configured on an output channel such as a Panel Controller, PC or DCC interface.

Input Ports

Phys. Port	vPort	Latch Time	Switch Type	Invert Switch	Red	Green	Blue	Colour	B/G
1	1	500	Push to make (stateless)	☐	0	0	0	▬	☐
2	2	500	Push to make (stateless)	☐	0	0	0	▬	☐
3	3	500	Push to make (stateless)	☐	0	0	0	▬	☐
4	4	500	Push to make (stateless)	☐	0	0	0	▬	☐
5	5	500	Push to make (stateless)	☐	0	0	0	▬	☐
6	6	500	Push to make (stateless)	☐	0	0	0	▬	☐
7	7	500	Push to make (stateless)	☐	0	0	0	▬	☐
8	8	500	Push to make (stateless)	☐	0	0	0	▬	☐
9	9	500	Push to make (stateless)	☐	0	0	0	▬	☐
10	10	500	Push to make (stateless)	☐	0	0	0	▬	☐
11	11	500	Push to make (stateless)	☐	0	0	0	▬	☐
12	12	500	Push to make (stateless)	☐	0	0	0	▬	☐
13	13	500	Push to make (stateless)	☐	0	0	0	▬	☐
14	14	500	Push to make (stateless)	☐	0	0	0	▬	☐
15	15	500	Push to make (stateless)	☐	0	0	0	▬	☐
16	16	500	Push to make (stateless)	☐	0	0	0	▬	☐

Refer to the above diagram when reading this section.

Input ports (physical connections to the board such as a switch) are grouped on the leftmost columns. Here is a description of the columns:

Phys Port	Physical Port on the device. Matches the port numbers along the bottom of the device.
V-Port	Virtual port the input is assigned to. If physical port 6 has a pushbutton attached the above configuration will trigger an event on V-Port 6 as defined in the V-Port column. Range is 1 – 60,000.

Latch (ms)	Latch time in milliseconds. We use the latch time to denounce switch contacts or sensors. The latch time locks a switch closed for the latching time. Default values are automatically loaded (see next section for details). Range is 10 – 60,000.
Input Type	This tells the panel controller the input type such as push to make button (default), toggle switch, occupancy sensor, points position sensor. Detailed examples in the next section.
Invert	Reverses the input logic. For push to make type it is ignored, for toggle switches OFF becomes ON and vice versa. For sensors it reverses the input.
RGB	This will configure the input to send RGB values (Red, Green or Blue) to a V-Port with RGB LEDs attached. See the release schedule on the System2 website for release dates. More details on how this operates in the next section. Each RGB value is from 0 – 255.
Colour	This will display for RGB colour for the respective channel.
B/G	Background/foreground colour.

Input Type

You can select the input type by selecting it from the drop down box (above).

The right image (above) shows the default latch times for each of the input types. These may be overridden with values in the range 10 – 60000 ms (hundredth of a second to 60 seconds).

A little creativity with these parameters can yield interesting results. For example if a push to make button is attached to physical port and its input type is set to toggle switch and the latch time set to 30000 you will create an event when the button is pressed (switch something on) and 30 seconds after releasing it will automatically switch off. This effectively creates a timer function to a pushbutton.

You could also use on an occupancy sensor where an event is triggered when a train enters a block and stopped a set interval after it leaves.

Start of day can be used to have the panel controller query all connected System2 boards and request their status. This is useful after an initial power on if your system is large. By default all boards transmit their status when starting, however not all boards boot up at the same time and it's

possible for late arrivals to miss status messages. The start of day button allows toy operator to force an update after all boards are present. During testing, start of day with 50 boards connected takes less than 5 seconds to complete.

RGB Configuration

The RGB section requires an RGB output board (not available at time of writing).

Each Red, Green or Blue column can have the values from 0 – 255. The Colour column will show the colour of the RGB values entered.

Phys. Port	vPort	Latch Time	Switch Type	Invert Switch	Red	Green	Blue	Colour	B/G
1	1	500	Push to make (stateless) ▾	☐	255	0	0	🟥	☐
2	2	250	Push to make (stateful) ▾	☐	0	255	0	🟩	☐
3	3	700	Toggle switch ▾	☐	255	255	0	🟨	☐

Background colours are written underneath foreground colours. This allows you to illuminate a route automatically as read from a points position sensor, say in white and then impose a foreground colour on top from a block occupancy detector.

In the image above you can see physical port 1 is triggering V-Port 1 with a red foreground colour.

Physical port 3 is triggering a yellow colour on vPort 3.

The B/G column is used to set a foreground colour or background colour. For example you could set white to a series of LEDs vPorts indicating a route, and using a colour setting for a block detector set a red colour as foreground to show occupancy on top of a route display.

Output Ports

The Panel Controller can drive a pair of LEDs that will alternate with each colour. When one is on, the other will be off. The intended use it to indicate the direction of a set of points. Single LEDs can also be connected to the output ports and display track occupancy or any other V-Port status.

When used in conjunction with a slow acting System2 motor driver board such as a servo8 the LED pairs can be set to flash when the motor is running. See the respective System2 motor driver board documentation for details.

Connecting Sensors

The following section details how to connect various sensor types to the Panel Controller.

DCC Block Detector

Follow the diagram below to connect our DCC Block Detector to a Panel Controller switch input.

Observe the correct polarity of signal wire that connects the two.

Connect the DCC side of the detector to any single DCC dropper wire so that the sensor is in series.

If the block being sensed is not fully isolated, detection will not occur.
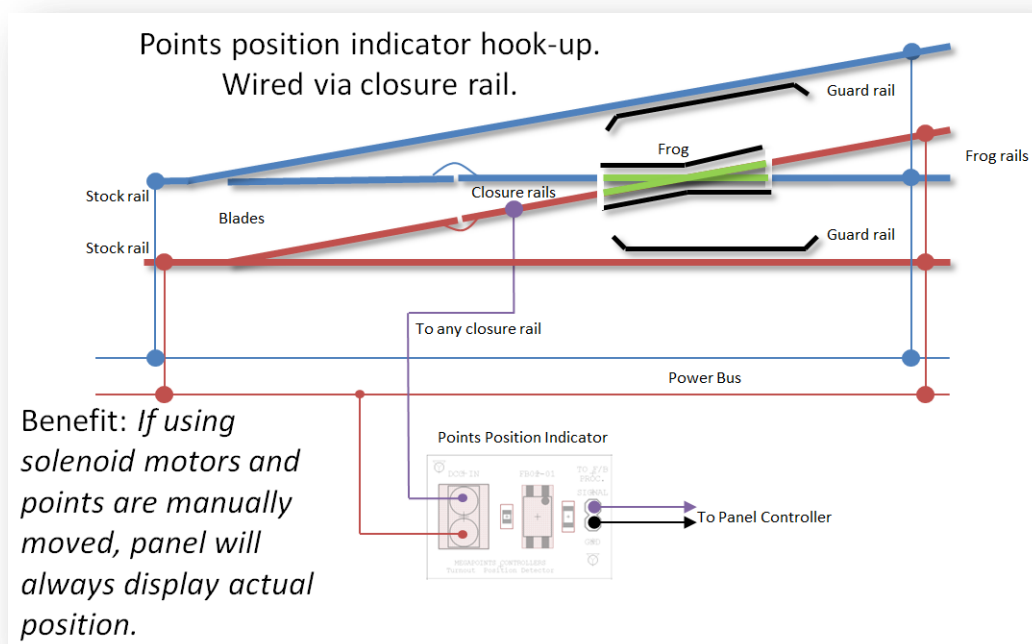

Set the input type on the Panel Controller to Occupancy Sensor.

DCC Points Position Indicator

Follow the diagrams below to sense points position on a DCC layout. You have two options for wiring the sensor, the first connects to the polarity switch and the second connects to the closure rail reading rail voltage. Use whichever method suits your wiring and style.

Points position indicator hook-up.
Wired via frog polarity switch.

Benefit: *Easy and reliable switching via previously installed frog switch.*
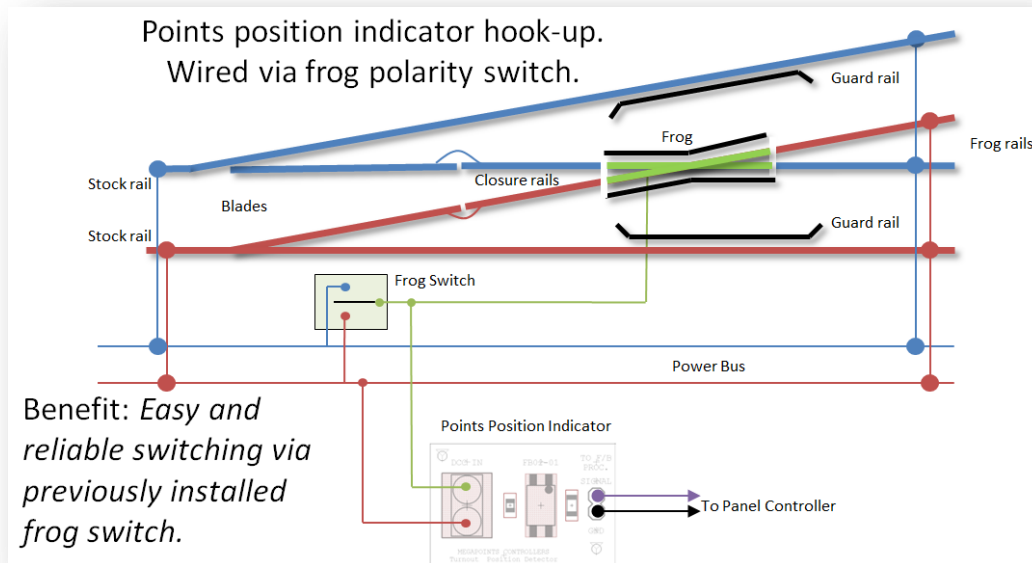
In the above diagram the frog polarity switch output is read by the points position sensor.

Points position indicator hook-up.
Wired via closure rail.

Benefit: *If using solenoid motors and points are manually moved, panel will always display actual position.*

In the above diagram the closure rail is used to sense points direction.

7	7	100	Push to make btn ⌄
8	8	800	Points Pos Sensor ⌄
9	9	100	Push to make btn
10	10	100	Toggle Switch
11	11	100	Occupancy Sensor
12	12	100	Points Pos Sensor
			Push to make btn ⌄

Set the sensor type to points position.

Points Position micro switch

You can also use a micro switch attached to a tie bar to sense points position.
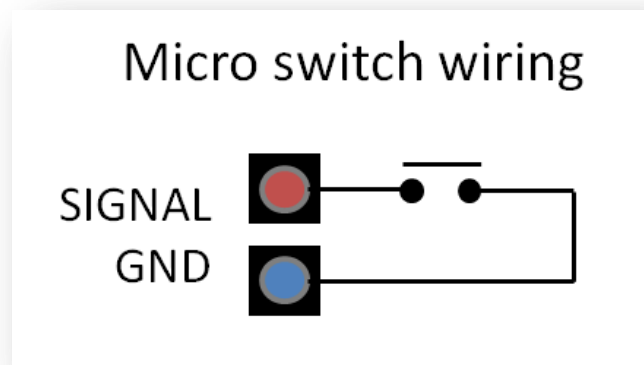
Board level configuration

This section is common to all System2 boards and features examples from the servo8 driver.

EasyConfig setting

The power of System2 allows individual adjustment of every channel including the V-Port ranges. This allows for maximum flexibility when required. To speed installation we've pre mapped the first 10 Panel Controller boards for you into a logical address space on the input V-Port and output V-Ports. This will preselect compatible addresses with other starter kit driver boards and get you up and running quickly.

Refer to the screen shot below for a detailed explanation. Numbers in red circles relate to paragraph number of text.

3   To change the EasyConfig for this board, select the board from the drop down.

1,2   Upon mousing over the drop down box (3) you will observe the greyed out values in the green highlighted areas. This shows the values that are about to be changed.

4   The EasyConfig board number 1 – 10.

5   The first V-Port address of the configuration.

After selecting EasyConfig Board 4 (49) you will observe the following:

1,2　　　　Values have been loaded and background returns to normal white.

3　　　　EasyConfig board selection you just made.

All changes you have made are instantly live and useable, however not saved. This is great for testing and trying things out before committing. If you make a mess of things or want to revert you can select the "Reboot" option. This will revert to the last saved settings.

You may observe two horizontal grey lines separating the Port Configuration above the text and below the EasyConfig. With the exception of the Locate Board tick box everything in this section relates to individual port configuration.

Locate Board
The Locate Board check box will cause two actions when selected.

First, it will cause the flashing LED indicator on that board to flash rapidly. This helps locate and identify the board if you have multiple boards in one location.

Second, it will request that all CAN connected boards report in with their stats, assigned IP address, CAN ID, Board Type and software version.

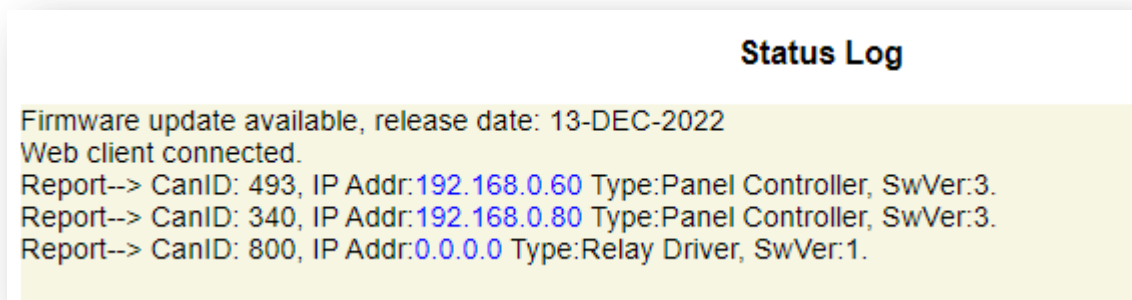

The blue IP address in the Status Log area is clickable and will take you to the management screen for that board.

Any boards not connected to the Wi-Fi will show an IP address of "0.0.0.0".

The above example shows three boards on the network in addition to the Servo-8 board we are issuing the commands from. In summary we have:

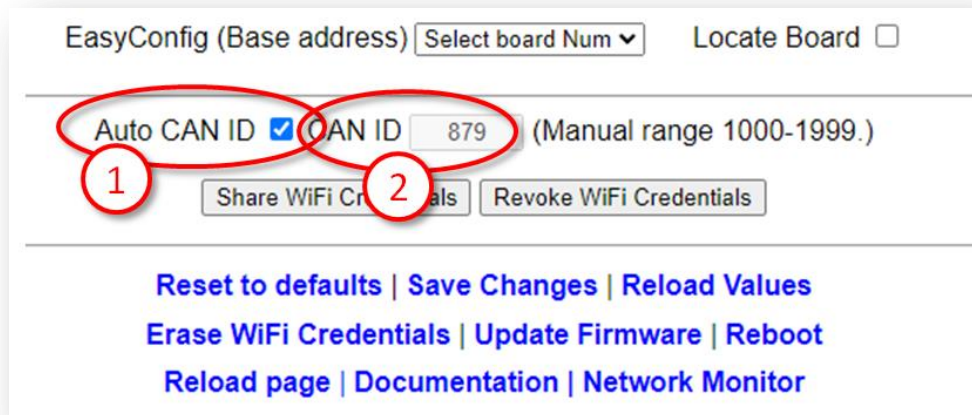The servo-8 board we are connected to via the web browser.

2 x Panel Controller, ID's 493 and 340 with their respective IP addresses showing they are connected to Wi-Fi.

1 x Relay Driver, ID 800 with an unassigned IP address (all zeroes) indicating this is not connected to your Wi-Fi.

Clicking the Locate Board checkbox again will remove the tick and stop the boards rapid flashing. This is reset upon reboot.

CAN ID management
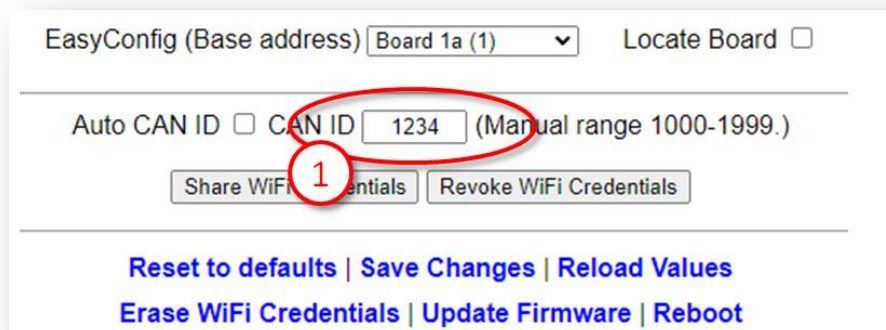
The next area down on the main configuration page concerns network parameters. Refer to the screenshot below and explanation text for details.

| 1 | Auto CAN ID – Normally left selected (default). This will allow the board to automatically assign its CAN address and if a duplicate is detected may automatically reassign to a vacant address. |
| 2 | The current boards CAN ID. Showed greyed out if auto enabled (default). |
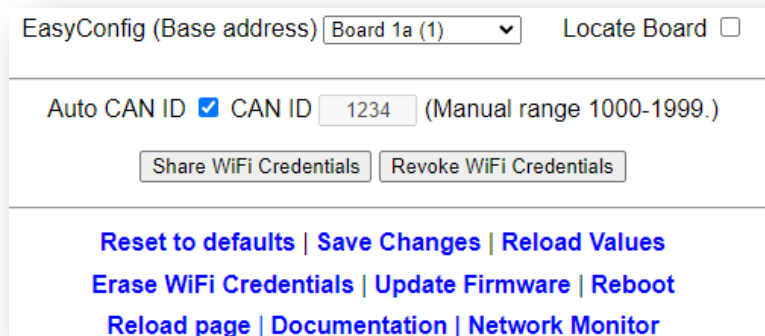
Automatic range: The automatic range for the CAN ID is 1 – 9999. If a duplicate is detected and Auto CAN ID is enabled either this or the other board with a duplicate ID will seek out a vacant CAN ID and update its configuration. When Auto CAN ID is selected do not expect CAN IDs to be persistent as they can change without notice. System2 is designed with this in mind and the board CAN ID is not relevant to operation.

The CAN specification requires all boards to have a unique CAN ID as part of the collision detection mechanism. Forcing duplicates is a bad idea and will lead to data errors.

Manual CAN ID selection: We must ask why? There's no possible benefit we can think of, so it's included for edge use cases. Not recommended to change this. Manual range is 1000 – 1999.

When reselecting Auto CAN ID, the current setting will remain until a collision is detected; whereupon the software will automatically reassign the ID (see below).
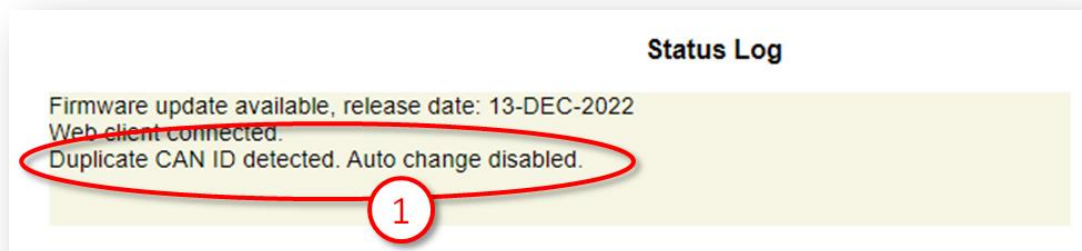
If a duplicate ID is detected and the address manually configured you will observe a message in the Status Log (example below) warning of the duplicate address and that auto change is disabled You need to manually reconfigure this.

With Auto CAN ID enabled the message is slightly different (see below):
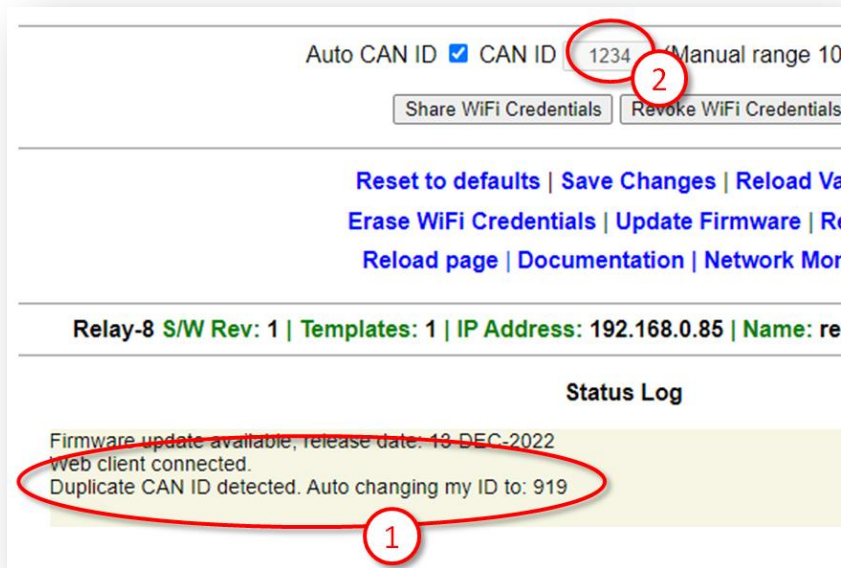
The CAN ID was automatically changed to an unused ID. When the board is rebooted or the web page refreshed the CAN ID field will update to the new value.

Wi-Fi credential sharing

You may recall the procedure to connect the first board to your Wi-Fi network using your phone or tablet to connect to the boards local hotspot? You'll be pleased to know that you don't ever have to go through this again. In this section we'll cover how to share the Wi-Fi configuration with all boards on your CAN bus.

Connect to a System2 board using your browser. Obviously you'll only be able to connect to a board that is connected to your local Wi-Fi.

See the diagram below.

Click the "Share WiFi Credentials" button (1).

You will observe all boards on the CAN bus reporting in (Status Log) (2) with an IP address. These boards will now be accessible via a web browser from the same Wi-Fi network.
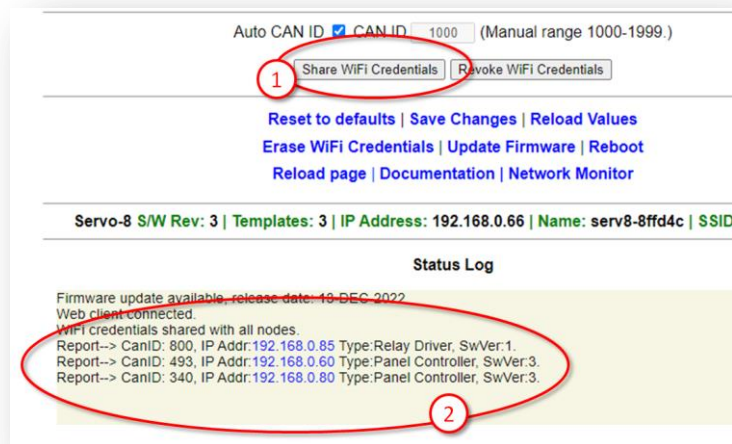
To revoke Wi-Fi access for all connected boards click the "Revoke WiFi Credentials" (1) button (see below):
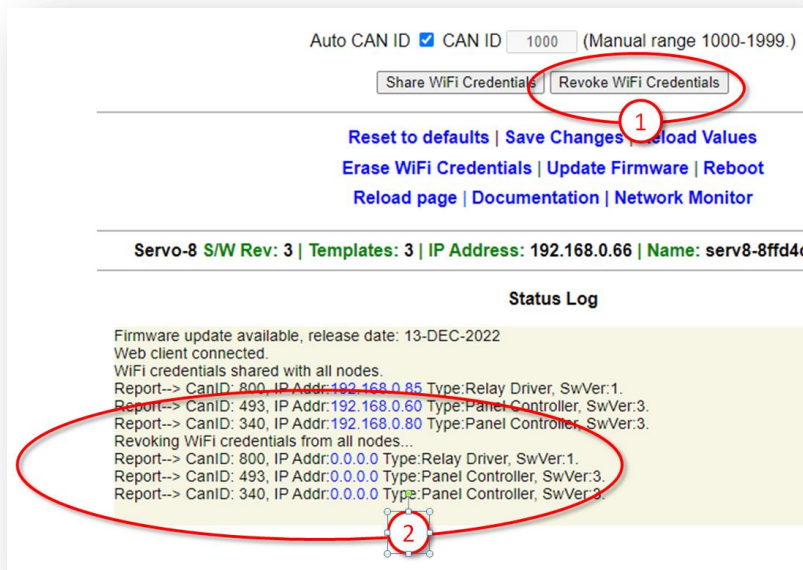
You will observe in the Status Log revocation messages. Each board will restart and show an IP address of "0.0.0.0" showing that it is not connected to any Wi-Fi network.

The board you are issuing the commands from is not affected by this and will remain connected to Wi-Fi until specifically revoked. This is covered later in this guide.

Actions

The action area (1 below) contains blue text that behaves just like buttons. This section covers each in turn.
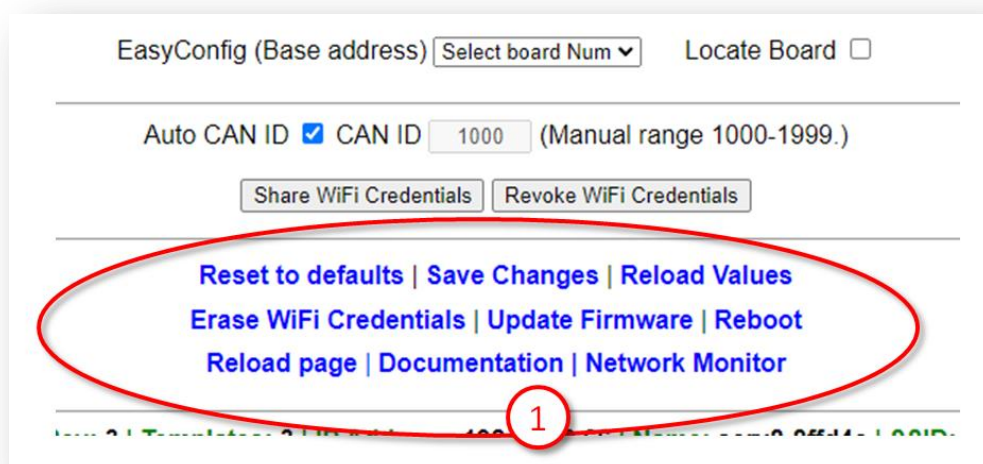
Reset to defaults

This will reset most of the board values to defaults. Observe the message in the Status Log (2). You have reset to defaults and the default values are live, however will revert back to previous settings upon a reboot unless specifically saved. Particularly useful for testing and reverting.
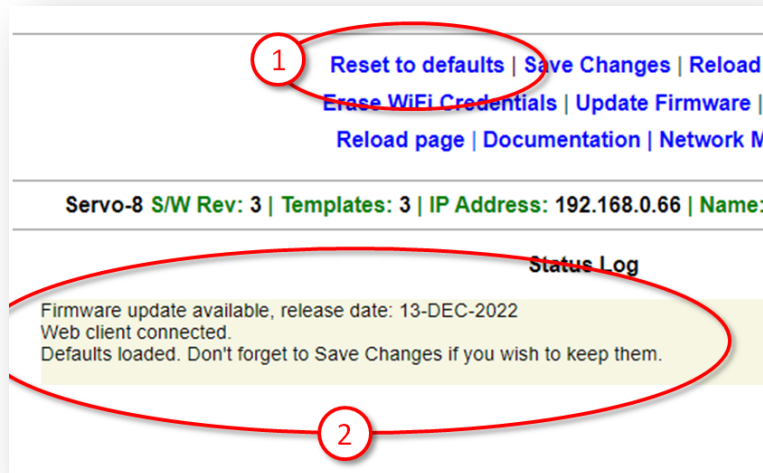
Resetting to defaults changes the following:

- EasyConfig 1a is selected.
- V-Ports including trigger and feedback set for 1a (above).
- Type reset to "Points".
- Reversed checkbox cleared.

The following are not changed:

- Board location description (upper left of page).
- CAN ID
- IP Address
- Wi-Fi configuration
- Speed

Save Changes

As suggested by the description, this will save all uncommitted changes to non-volatile memory and be retained after reboots.

After saving you'll see the confirmation message (2) in the Status Log below.
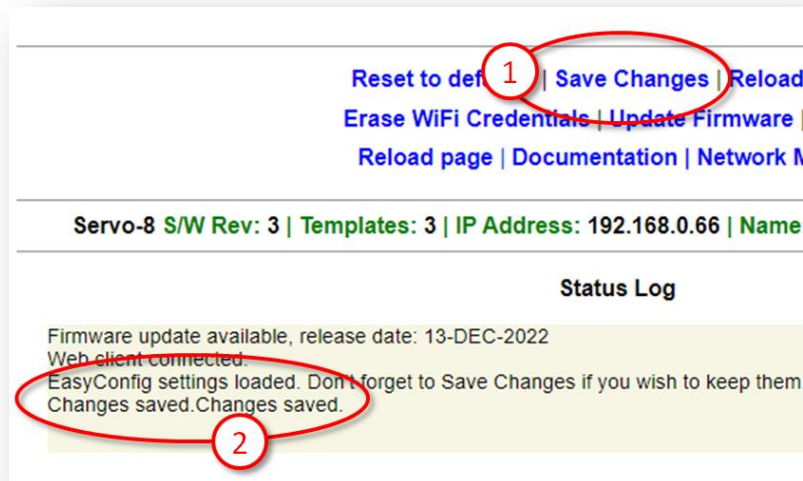
Reload Values

The Reload Values button will reset the parameters to the saved version. This will undo any changes that have not been saved. The browser page will refresh as part of the process.

Erase WiFi Credentials

Erasing the WiFi Credentials will remove the Wi-Fi details and reboot the board you are connected to. This action applies to the board you are connected to only. Other networked boards are unaffected.

If you wish to remove all boards from Wi-Fi see the Wi-Fi Credential Sharing section.

Update Firmware

This section is generic to all System2 boards and uses the Servo8 controller in the examples.

If your board is connected to your Local Wi-Fi and that Wi-Fi has access to the Internet then you can update firmware. If a new firmware is available a message will be presented in the Status Log area:

Click on the Update Firmware to begin the dialogue. You will be taken to a new page.

Any changes that are available since your last update will automatically be listed in the Software Update section along with the dates they were released.

You can see the release dates and what's in each release. If you select to update you'll get all the changes right up to the latest version. The update is not mandatory. Installation is up to you.

In this example were going to select the firmware update. It should complete within 10 minutes. During the update you'll see progress on the web page and the on board LED will flash erratically showing data transfer.

Below is an example log displayed during the software update process:

```
Update initiated.
Beginning firmware update. Two downloads will be processed.
  Onboard LED will flash erratically indicating data transfer.
  The update will take between 4-8 minutes to complete.
  An active internet connection is required for success.
  Please wait, do not reboot! Update in progress...
  Download (1/2). Connecting to update server.
    Received 926816 bytes from the update server.
    Written only: 0/926816. Please Retry.
    Received 926816 bytes from the update server.
     Wrote: 926816 bytes successfully.
      File (1/2) has been updated.
    File (1/2) download complete.
  Download (2/2). Connecting to update server.
    Received 1507328 bytes from the update server.
     Wrote: 1507328 bytes successfully.
      File (2/2) has been updated.
    Rebooting. Please return to the main web page.
```

When complete the board will automatically reboot and re-join the network.

All your configuration data remains unchanged and is preserved across updates.

The update will fail safe. This means that if you interrupt the connection or power off during an update you can return to the update screen and begin the process again though it's not recommended to interrupt the update process.

Select the "Click Here" on the bottom line to return to the main configuration page and not perform any update.

Reboot

Clicking the reboot text will cause the board to immediately restart. You will observe a message in the Status Log that the page will reload automatically after a few seconds along with a "Please wait …" in blue.
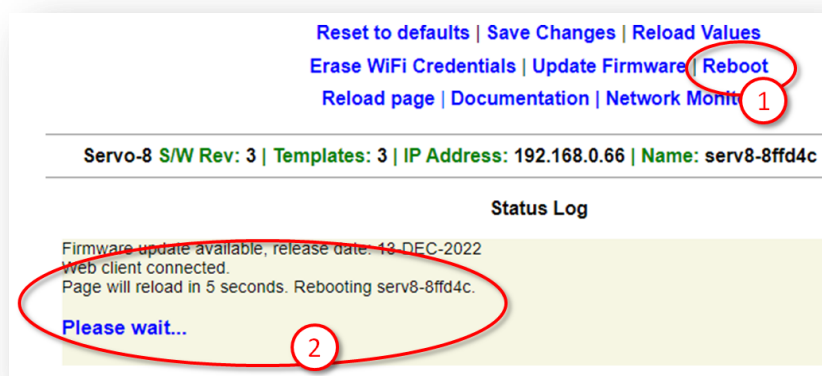
Reload Page

This option reloads the web page and resets the Status Log area. Useful for clearing garbage from the log and confirming you are connected to the board.

Documentation

Clicking the Documentation link will open a new window in your browser and take you to the product page for the board you clicked from. On the product page you'll find links to the relevant documentation and video guides for this product along with recommended accessories.

This option requires an Internet connection.

Network Monitor

WARNING! This section may send you to sleep and is not required reading.

The Network Monitor option takes you to a CAN bus network monitor.

The Network Monitor should be considered experimental, though we relied on it heavily during development.

The Network Monitor will provide a real time display of the traffic on your CAN bus.

The V-Port the packet is intended for is decoded n the right column (1).

The headers (2) contain the following details:

Header	Description
Seq	Packet sequence as observed by the board the Network Monitor is running on.
Min	Number of minutes since starting. Rolls over at 99.
SS	Seconds within the previous minute.
mSS	Millisecond within the previous second.
uSS	Microsecond within the previous millisecond.
CanId	The CAN ID that created the packet.

D 0-7	Data field of the packed (D0 – D7).
V-Port	Decoded V-Port the message is intended for.

The Network Monitor will only display packets created by remote boards. It will not display packets that are locally transmitted.

The local board that is running the packet monitor remains fully operational while the packet monitor is running. It will respond to events in its usual manner.

The data fields (D0-7) will be covered in separate documentation and are data type dependent.

In the above screen shot you can see network packets that were triggered by a button being pushed twice, once to turn on and again to turn off.

Under the V-Port column observe the following events that occurred at minute 17:

Header	Description
1	An event addressed to V-Port 1 is initiated from CAN ID 493.
161	An event is addressed to V-Port 161 from CAN ID 1000 (packet duplicated).
321	An event is addressed to V-Port 321 from CAN ID 1000.
161	An event is addressed to V-Port 161 from CAN ID 1000 (packet duplicated).

CAN ID 493 is a Panel Controller and looking at its configuration we observe V-Port 1 is a push button attached to physical port 1:

So we know what created the packet, a button on physical port 1.

The next packet was created by Can ID 1000. Looking at the Status Log (below) we can see (1) this is a Servo-8 board:
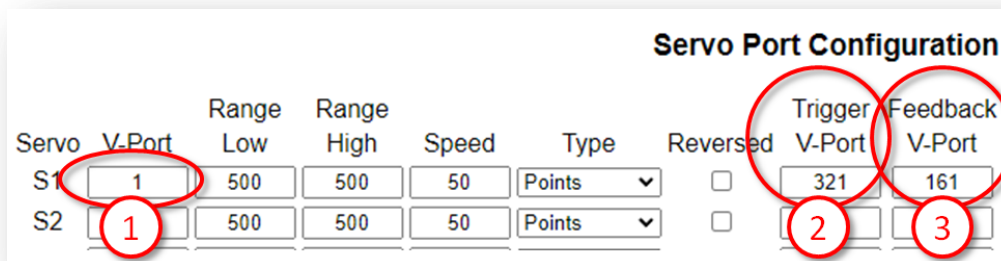
We are also presented with the IP address of the board (2), so clicking on the blue IP address takes us to the Servo-8 management portal.

The Servo-8 port configuration is reported as:
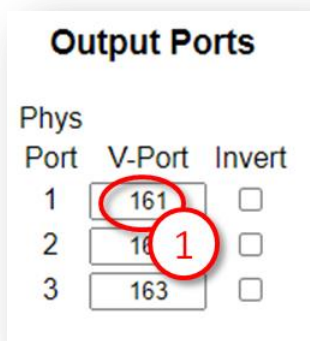
The V-Port (1) is 1 meaning channel S1 (servo 1) is listening for this address (V-Port).

Remember this board has a CAN ID of 1000, and it generated a packet to V-Port 161. This is the configured Feedback V-Port at the marker (3).

If we look at the packet under column D3 you'll observe a "3" in the data byte. Where is this going?

The Output Ports section of the Panel Controller (1 left) matches the Feedback V-Port of the Servo-8. It is this port that is listening for the event.

The data value of "3" indicates to flash. This will cause the panel Controller to flash the LEDs on physical port 1 and is used to indicate a motor in motion.

When the centre of motion for the servo has been reached another event is triggered to V-Port 321. Look at the Servo Port Configuration above. See the Trigger V-Port is configured for 321. The trigger fires when the servo is at its centre position. Particularly useful for firing a frog when the point blades are dead centre.

Looking at the relay driver port configuration (below) we observe:

Relay R1 is configured for events on V-Port 321 and will trigger when the Servo-8 is halfway.

This can be freely changed to respond to the same ports as the push button or any other device. It can also provide feedback data of its own, however setting the Feedback V-Port to "0" disables feedback from the relay.

Finally on the Network Monitor we observe the last packet at minute 17. It's addressed to V-Port 161 and this time contains a 0 in the D3 column. This tells the Panel Controller to stop flashing as the servo has reached its final position.

Skipping ahead to the last packet on the report you can see its to V-Port 161 and contains a 1 under the D3 column. This is the polar opposite of the previous paragraph and indicates the servo has reached the opposite end of motion and sets the Panel Controller indicator appropriately.

At the bottom of the network monitor page are some packet statistics. The leftmost column indicates the peak and current number of packets per second. The right most column shows the sae data over a one minute interval.

Status area

The status area shows information at the board level and is display only.

Board Type (1)

This tells you what the board is. In this case a servo-8.

SW Rev (2)

The current software version loaded.

Templates (3)

Displays the current version of loaded templates. Normally this will match the software version above.

IP Address (4)

The current IP address of the board as allocated from your Wi-Fi.

Board Name and serial (5)

The board serial number. Each is unique and is a combination of the board type and last 3 hexadecimal digits of the MAC address.

SSID(6)

The network name of the configured Wi-Fi network.

In conclusion

We hope you'll agree, System2 Air is a powerful, flexible model railway control system. Future updating is baked in through a trivial firmware update process and new boards are under development to expand the capabilities of the range.

If you've made it this far through the user reference then you'll understand just how much this board is capable of.

Happy railroading!

Appendix A: Software release notes

Version 10 – Release Date: 29-SEP-2023

NOTICE:

> Before updating, save a screenshot of your button type configuration. This update introduces new button types so they will likely change during the update and you may need to reset them. This applies to the button type dropdown box only. vPorts are unaffected.
>
> You should apply the 02-OCT-2023 patch to Servo Drivers before applying this update.

Patch Notes:

- If you are updating from a previous version the default pushbutton type has changed to stateless. If you want to use the previous behaviour (stateful) you must go into the switch type and reconfigure it as 'stateful'.
- To use stateless (the default option from this point on), update your driver boards to 01-OCT-2023 version or later.
- Updated driver boards will support both types of push to make button transparently and also work well with older revision Panel Controllers.
- Common code across Panel Controller, IN-32 and OUT-32 boards. The board personality (type) is set using compile time options.
- Pushbuttons (push to make) are mow stateless.
    - Instead of sending a '0' or '1' they send a '2' indicating the button has been pressed. The Panel Controllers and OUT-32 boards no longer store the state.
- Servo driver must be updated to SEPT-2023 or later to recognise the stateless mode when using push buttons.
- Toggle switches and sensors remain unaffected.
- JMRI mode via MQTT only recognises 'THWOWN' or 'CLOSED' for turnouts. Therefore use toggle switches when using JMRI mode. Sensors remain unaffected.
- Start of day messages only send sensors and toggle switch states. Stateless mode do not send status, else they would toggle any attached motors.
- Updated CAN library. Now detecting bus resets and buss off messages. Takes appropriate action to recover the CAN controller when necessary.
- Added start of day option to the type column. Assigning a button to start of day will force a synchronization event across all boards. This builds a board list over 1 second, then queries each for its status.
- This has the effect of synchronizing all boards across the network even if they missed the initial boot up messages. Particularly useful for the larger installations where all boards can be synchronized once everything has had time to start up.
- Set proper product image at configuration page header.

CAN Network Monitor

- Deduplicated packets.
- Deduplicated the status log web display area.

- Removed vPort decode from non vPort traffic types (management data).

Making life easier

During the initial connection to your Wi-Fi you will have gone through the process of teaching your first System2 board how to access your Wi-Fi. On the initial connection you would have probably used the devices IP Address to connect. IP Addresses are numeric and not very meaningful.

## Use the devices name to connect

Each device has a name printed on the top of the PCB. Look at the example image below.
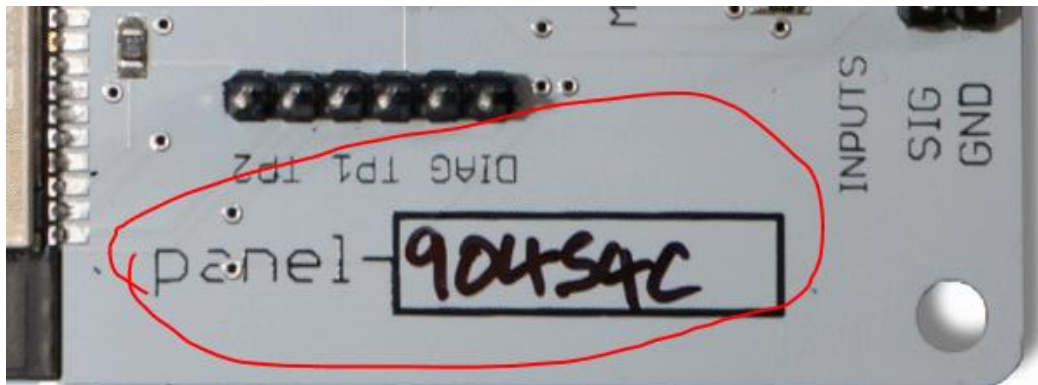
The device name is "panel-90454c". Use this name to connect to your device. In your browser address bar (not search bar or google search) enter "`http://panel-90454c.local`" and your network should locate the device for you. You won't need to enter the IP address again. In the above example substitute your devices name and serial number.

Use the share Wi-Fi credentials for all other boards

Once you have one board connected to your network, use the share Wi-Fi credentials button to bring all connected boards into your Wi-Fi.
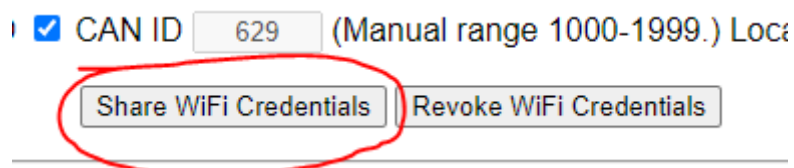
Use the Revoke Wi-Fi button to remove boards from your Wi-Fi. We use these options all the time. Therefore you only need one central admin board connected to your network until it suits you.

Bookmark your devices

Instead of manually maintaining a list of your boards network names, create a bookmark folder within your browser. You can add all the device names to the bookmark folder instead of having to manually enter.

Contacting us

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If you have any product improvement suggestions we'd be very pleased to hear from you.

NOTE: We operate on a policy of continuous improvement. Colours, specifications and even the placement of components may vary from time to time.