



Novo™ 2Wire Converter

Troubleshooting Guide

Introduction

The following documentation has been developed to troubleshoot a Novo™ 2Wire Converter. Two generations of Novo 2Wire Converters exist and are principally distinguished by different overlays as shown in Figure 1-1.

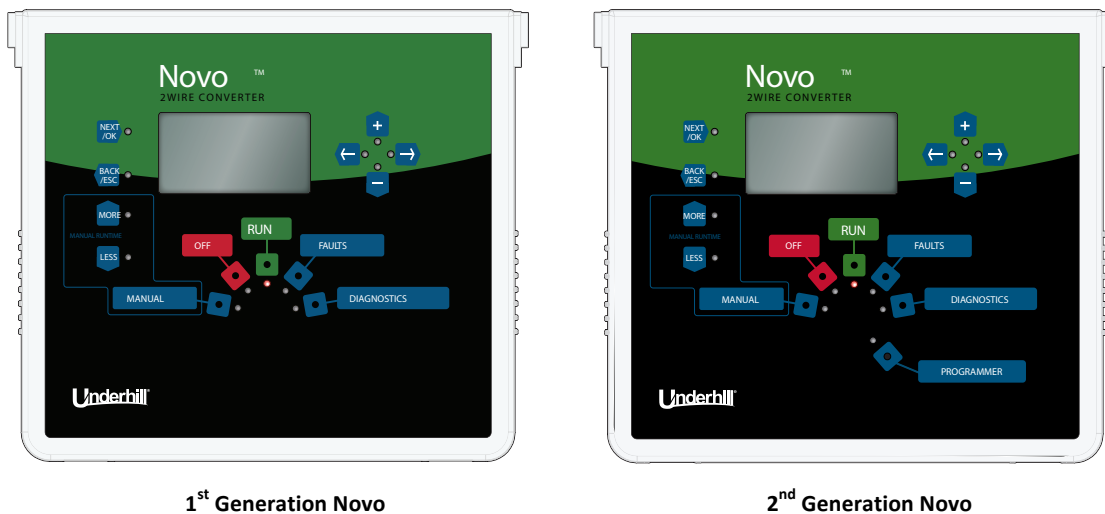


Figure 1-1

The differences between the two generations are:

- 1) The 2nd generation Novo has the ability to “Clear a Fault” in the Faults” menu and
- 2) It can program or test a Decoder (TW-TK-DEC-1) or 8-Station Sender (TW-SEN-8).

Both generations of Novo’s have the same mechanical footprint and all other menus function remain the same.

Common 2Wire Field Faults

Common 2Wire field faults are listed as:

- 1) The Novo display is blank,
- 2) A sequential number of stations will not operate,
- 3) A station will operate from the Novo, but not from the host controller,
- 4) The RUN menu is constantly displaying a “Fault” message,
- 5) How to use the Novo’s “Fault” Menu,
- 6) How to use the Novo’s “Diagnostic” Menu,
- 7) A station will cycle “On”, then “Off”,
- 8) Some of the display characters are illegible,
- 9) Master Valve / Pump Start Behavior.

Possible root causes and methods to troubleshooting each field fault are listed below.

1) **The Novo Display is Blank (no characters)**

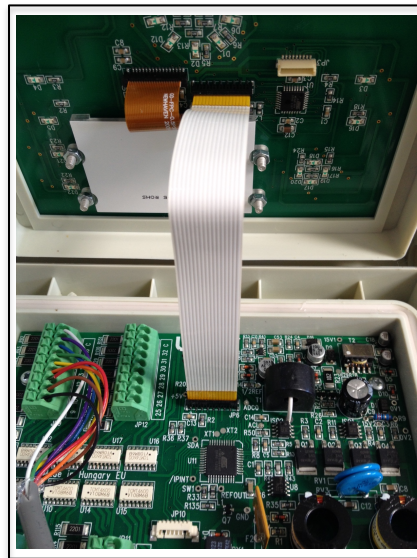
The “host” controller’s display appears to be functioning “ok”, but the Novo display is blank

Possible Root Causes

- 1) The ribbon cable between the output board on the Novo and the Novo’s display has come loose or is disconnected.
- 2) There is no AC power to the Novo’s transformer or the transformer is blown.

Troubleshooting

- 1) Open the interior of the Novo 2Wire Converter and confirm the white ribbon cable is attached to both connectors of each printed circuit board (PCB), see Figure 2-1. If the Novo is less than 2 years old, it is covered under warranty and can be replaced.

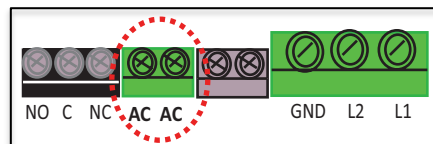


Confirmation of Ribbon Cable Remains Connected on Both Ends
Figure 2-1



Note: If replaced, the existing Decoders or 8-Station Senders do not require re-programming.

- 2) The Novo is shipped with a separate external transformer. Using a multi-meter set to “AC volts” and measure voltage across the 2 (qty) AC terminals shown in Figure 2-2. The meter should display 26-28.1 volts AC. If less than this amount, then replace the transformer. If no voltage is measured, then check where the transformer is plugged into and measure again. You may simply need to reset a GFIC receptacle or subpanel circuit breaker. If +/- 120 volts are measured at the receptacle where the transformer is plugged into, then replace the transformer.



AC Terminals on Novo
Figure 2-2

2) A Sequential Number of Stations Will Not Operate

Example, stations 1-8, or 33-40 will not operate.

Possible Root Causes

- 1) The host controller uses station modules and a corresponding station module is not seated properly or is defective,
- 2) The color-coding from the cable assembly on the Novo connecting to the “host” controller’s station outputs is out of order,
- 3) A “branch” in the 2Wire path to these stations is broken or there is a faulty wire connection.

Troubleshooting

- 1) Visually inspect the “host” controller’s station modules and confirm they’re seated properly. To verify a station module is operating use a known working solenoid and connect directly to one of the station outputs and to the “valve-common” terminal. Operate this station manually from the “host” controller. If it works, then move to #2. If solenoid doesn’t click, hum or buzz, then replace the station module or try another station within the station modules range.
- 2) The color coding on the cable assembly between the Novo (standard mechanical footprint) and the Host controller should be per the table below:

Station No.				Color Coding
Vale Common				White
8	16	14	32	Purple
7	15	23	31	Blue
6	14	22	30	Green
5	13	21	29	Yellow
4	12	20	28	Orange
3	11	19	27	Red
2	10	18	26	Brown
1	9	17	25	Black



Note: All white “Valve Common” wires must be terminated in the controller’s “Valve-common” terminal input.

Verify all of the color-coded wires are connected in the Novo as well.

When used with 8-Station Senders, the wiring color is the per the attached table

Sender #5		Sender #6		Sender #7		Sender #8	
Sta. No.	Sender Wire Color	Sta. No.	Sender Wire Color	Sta. No.	Sender Wire Color	Sta. No.	Sender Wire Color
33	Black	41	Black	49	Black	57	Black
34	Brown	42	Brown	50	Brown	58	Brown
35	Red	43	Red	51	Red	59	Red
36	Orange	44	Orange	52	Orange	60	Orange
37	Yellow	45	Yellow	53	Yellow	61	Yellow
38	Green	46	Green	54	Green	62	Green
39	Blue	47	Blue	55	Blue	63	Blue
40	Grey	48	Grey	56	Grey	X	Grey
Com	White	Com	White	Com	White	Com	White

- 3) Station 07 works and station 17 works, but stations 08-16 will not operate. Verify Steps 1 and 2 first. If it generally appears stations 08-16 are located in one portion of your site, then locate and open valve box for station 07. Is there a 3-way wire connection denoting a separate wire branch for stations 08-16? If so, verify the connection is dry and remake as necessary. You may have to open additional valve boxes to locate the where the wire branch is located.

A wire break may exist between valve box 07 and 08, so verify if there is any site disruption, such as a new fence post, new tree or shrub, recent irrigation sprinkler head repair or gopher mound provide an indicator of where to look next. Locate and repair as needed. Running a temporary new wire pair on the ground between stations 07 and 08 may help confirm the wire where the wire break exists.

3) A Station Will Operate From the Novo But Not From the “Host” Controller

You can manually operate a station from the Novo. When attempting to manually operate the same station from the “host” controller, the station won’t operate.

Possible Root Causes

- 1) The color-coded cable between the Novo and the corresponding station is not connected properly,
- 2) The output on the Novo is defective,
- 3) Any station above 32 will not operate.

Troubleshooting

- 1) Verify the color-coded cable is connected to both the Novo and the “host” controller’s corresponding terminal output. The color-coding sequence can be found in the table on the previous page paying close attention to the station number. If the station number is above 32, then also confirm the 8-Station Sender Number is also addressed properly.
- 2) Using a “known” working solenoid, attach it to the “host” controller’s station output that isn’t working. Connect the other solenoid wire to the “valve-common” input. Determine if the station can be operated manually from the “host” controller. If the solenoid hums, clicks or buzzes than the station output is ok.

To determine if the Novo's corresponding station output is defective move one of the color-coded wires from the station above or below this specific station on the "host controller". See if the station will operate manually from the "host controller" thru the Novo. If it does, than that specific station output on the Novo is no longer operating. If the "host" controller has an "open" or us-used station, then move the single color-coded wire to this location on both the host controller and corresponding station on the Novo. Confirm the "host" controller can operate this station manually.



Note: If moving to another 8-station terminal block on the Novo, make sure the valve common wire is also connected to the remaining valve commons for the Novo.

- 3) When more than 32 stations are managed, confirm an 8-station sender has been installed (Underhill part number TW-SEN-8). If the Sender address is less than 5, than no stations 33 and higher will operate. Depending on the generation of Novo is used you may need a portable programmer or can program the Sender in the "Programming" menu.

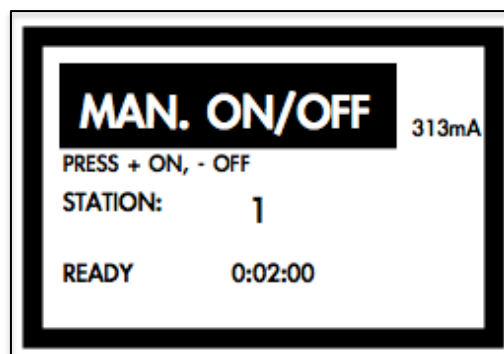


Note: Don't forget to move the "slide-switch" from the "RUN to the PROG" position when programming or testing a decoder or 8-station Sender.

4) The "Run" Menu Constantly Displays a "Fault" Message

The Novo incorporates a feature that will display the total number of decoders operating in milliamps (mA) even in idle mode (no stations operating). For example, let's say you have 18 stations. The Novo displays 18 x 3 (or 3mA load per decoder) for a total of +/- 54 mA. If the value is less, then you may quickly be able to determine how many stations aren't operating by the displayed value in the RUN menu.

The Novo will also display the "holding-current" of the solenoid currently operating plus 3mA load for the decoder. For example, if operating an Irritrol valve with a published holding current of 280 mA, the actual holding current could be 310mA + 3mA for the decoder due to manufacturing variability, length of wire and wire integrity. In this example the Novo displays 313mA as that stations current draw. See Figure 5-1 with an example display screen.



Displayed Holding Current of Station 8
Figure 5-1



Note: Different valve solenoids have varying in-rush and holding currents. The displayed values may often times be higher than published catalog data.

Possible Root Causes

- 1) A solenoid is reaching end-of-life and is drawing too much holding current,
- 2) Too many stations are being operated at one time,
- 3) A decoder has been damaged,
- 4) The 2Wire path to one or more stations is broken or a field splice has been compromised or failed.

Troubleshooting

- 1) As a solenoid reaches end-of-life, it draws more current. When operating a station with a suspected faulty solenoid observe the mA draw when operating manually from the Novo. If the display shows 600mA or higher then the solenoid is beginning to fail and warrants replacement **or** two stations are being operated at the same time. A good troubleshooting method to use is to operate another valve in close proximity assuming it's the same make and model. If another valve displays a much lower holding current than this is a good visual indicator of a faulty solenoid.
- 2) The combined current draw exceeds the current delivery of the Novo. You may need to add another decoder or move one of the two stations to another decoder with a combined lower current draw.
- 3) Replace the decoder and re-program another decoder with the corresponding station number. Verify the Novo is grounded to a ground rod or ground plate that is separate from any other grounding measures used for the "host controller".
- 4) If one or more stations continues to post a "fault" after all previous 3 possible root causes have been completed then locate the valve box and corresponding decoder. Verify the decoder operates by temporarily disconnecting it from the field and bring it back to the Novo. Temporarily disconnect the existing 2Wire path to the L1 and L2 terminals. Using a "known" working solenoid connect its wires to the decoder and connect the red and black wires of the decoder to the L1/L2 terminal block. Operate this station manually from the Novo. The solenoid should buzz, hum or click. If it doesn't, then replace the decoder and program with the corresponding station number. If the solenoid does buzz, then the "fault" could be a compromised wire splice or broken wire. Running a pair of wires on the ground from the valve that won't operate to a valve that does should quickly provide confirmation that a broken 2Wire path exists. Locate and fix or replace the broken wire as needed.



Note: The following are for someone who is familiar w/ 2Wire systems and have the proper equipment. Opening wire connections that carry "live" voltage may result in direct shorts and/or permanent damage to the Novo that is not covered under warranty.

- 5) For advanced 2Wire users – disconnect the AC transformer for a few moments. Disconnect the 2Wire path located on the L1/L2 terminal and move these 2 wires to the AC terminal position while keeping the transformer wires also intact. Reconnect the transformer to send 28.1 volts continuously down the 2Wire path. Use a digital clamp meter, (with a "lobster claw") so that wire splices remain intact while recording current along the 2Wire path. Some voltage drop is expected due to wire length and wire size. If the voltage drops significantly between two valve boxes, then it's more than likely the wire path is compromised. Locate and repair as needed.

5) How to use the Novo's "Faults" Menu

The Novo's "Fault" menu is used to display any number of "fault" conditions in a numerical sequence.



Note: This menu displays field Faults downstream of the Novo - an important fact to remember.

Press the "Down" (-) button will display the next 7 stations wired into the controller. Press the "Up" (+) button to scroll back up the previously displayed 7 stations.

In the 2nd generation Novo, previously displayed "Faults" can be manually cleared. Any displayed "Fault" can be cleared so to confirm a field repair has been completed successfully.

Possible Root Causes

- 1) A solenoid is drawing too much current and needs replacement,
- 2) A decoder is faulty.
- 3) There is a break in the 2Wire path to one or more stations,
- 4) A wire splice has failed,

Troubleshooting

- 1) Operate the station "manually" from the Novo and view its displayed current draw in mA. If the site incorporates all of the same valve series, compare the value displayed to another corresponding station in close proximity. If the displayed current is significantly higher, then replace the solenoid.
- 2) Locate and bring back the disconnected decoder to the Novo. Using a known working solenoid, connect the 2 (qty) yellow wires to the solenoid and connect the black and red wires to the L1/L2 terminal. If the solenoid buzzes, hums or clicks, then the decoder is "ok". If a "Fault" message appears and the solenoid does not operate, the decoder needs to be replaced. Program and test a new decoder using the same methodology before installing in the field.
- 3) If the decoder operated in Step 2, then a broken wire exists or a wire splice has failed. Check wire connections in valve boxes first. A quick test to isolate where a wire brake might be is to run a pair of wires above ground temporarily then again attempt to operate a station(s) from the Novo or "host controller".
- 4) Wire connections made with duct tape, painter's blue tape, wire nuts only or no wire nuts will fail particularly if the valve box fills with water. Remake all wire connections with 3M DBRY connectors as provided with Underhill decoders. Grease-filled wire nuts will be a future point of failure so its not recommended as a long-term repair.

6) How to Use the "Diagnostics Menu"

The Diagnostics menu in the Novo provides a user the ability to isolate a "Fault" issue between a host irrigation controller and the Novo.

When selected this menu offers two sub-routines listed as:

- View Sender Commands
- Edit Decoder Setup

You can view this submenu anytime during valve operation without it impacting other programming commands down the 2Wire path. It was developed as a diagnostic tool to reduce troubleshooting time in the field.

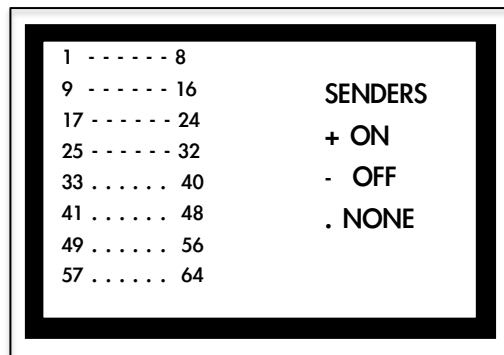
Possible Root Causes

If a "Fault" such as "Station Failed to Turn On" is displayed it could be:

- 1) The color-coded wire connected to the corresponding 9-position terminal block in the Novo has come loose,
- 2) The opposing end of the color-coded cable is not connected properly to the corresponding station output on the "host" controller or,
- 3) The color-coded cable is terminated in the incorrect position on the host controller's terminal output.

Troubleshooting

- 1) Verify the color-coded cable is making contact with the corresponding station on any one of the four, 9-position terminal blocks on the Novo. Use a small, flat-bladed screwdriver to push in the lock/release mechanism. If the cable is clasped onto the wire insulation and not the conductor, the station will not operate
- 2) Verify the opposing end of this cable is properly secured to the "host" controller's corresponding station output. Operate the station "manually" from the "host" controller. Press the "Diagnostics" menu button, then press "NEXT/OK" to view "Sender Commands." When "View Sender Commands" is selected the Novo will display the following screen, see Figure 8-1 below.



Sender Command Screen

Figure 8-1

If a signal is reaching a corresponding station 1-32, the "-" symbol will be displayed as a "+". If the non-operable station is above 32 stations and an 8-Station Sender is being used, make sure its programmed to the corresponding sender address per the table below:

Station Numbers	8-Station Sender Address Code
33-40	5
41-48	6
49-56	7
57-63	8

Otherwise stations 33-63 will always be displayed with a ".".

3) Verify the color-coded cable is connected the same station in the “host” controller as it is in the Novo. See the tables on pages 3 & 4 for the proper order and color-coding.

7) A Station will Cycle “On” and “Off” during Scheduled Irrigation

A station is operated manually from the Novo or from a scheduled start time from the “host” controller. After a few seconds or even a minute the station will stop operating and may stay “Off” for a minute before resuming valve opening. This may occur several times throughout the selected runtime duration.

Possible Root Causes

- 1) A solenoid is drawing too much current or,
- 2) More than one station is operating at a time and current draw demand is too high.

Troubleshooting

- 1) Operate the station that cycles “On and Off” then observe the current draw in mA’s on the Novo display. If the current exceeds about 700mA, then remove and replace the solenoid.
- 2) Operate the station and observe the current draw in mA’s on the Novo display. If the current exceeds 700mA, then disconnect one of the valve solenoid wires and operate again. Repeat the same test procedure for the second solenoid temporarily disconnecting the previously connected station. Either one or more solenoid is drawing too much current or the combined load demand is too high for the Novo. You may need to add another decoder or “bridge” another pair of stations together where the combined current draw isn’t as high.

8) Display Characters are Illegible or difficult to Understand

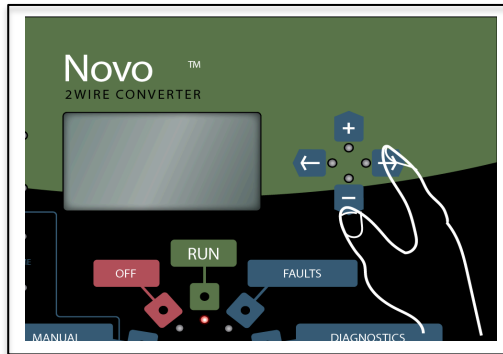
The characters in more than one of the menus or submenus look more like a foreign language than English.

Possible Root Cause

- 1) The Novo was not grounded to a ground rod or ground plate and an electrical surge or strike has impacted the Novo’s memory chip
- 2) A lightning strike has occurred and the Novo’s memory chip has been interrupted.

Troubleshooting

- 1) The remedy for this observed field condition is to reset the EEPROM using the following steps.
 - a. Unplug the Novo from its 120-volt power source and wait 15 seconds.
 - b. As you reconnect the Novo to it’s power source, hold down the “Right” arrow and “Down” (-) buttons simultaneously.



Press the “-” and Right Arrow Buttons Simultaneously
Figure 9-1

- c. The display will show you the following message:



Resetting the EEPROM
Figure 9-1

- d. Disconnect the Novo from its power source one more time, wait another 15 seconds, then reconnect. The EEPROM has now been reset.

- 2) Apply the same steps outlined above.

9) Master Valve / Pump Start Behavior

Many residential and commercial irrigation controllers offer a combined pump start/master valve output. Unless otherwise noted, these combined functions are only compatible with normally closed master valves.

Possible Root Causes

- 1) When operated manually, the Novo does not send a signal to the “host” controller to actuate a master valve or pump start,
- 2) The wire path between the “host” controller and the master valve or pump is broken.

Troubleshooting

The expected behavior of this feature is as follows:

- 1) When any station is operated from a manual command or scheduled irrigation start time, the “host” controller automatically sends a 24-volt signal to the “master valve/pump start” output. The output can be used to open a master valve and/or send

a signal to start a pump. This output generally remains on for the duration of the manual operation and/or the program currently operating. In many cases, a pump station will generally be designed w/ “bypass” piping so some stations can be operated without the need to boost delivery water pressure.

- 2) In this example there is a separate pair of field wires (without a decoder) from the host controller to the master valve or pump start.
- 3) While a master valve can be placed operated from the Novo, it can be difficult to troubleshoot if there is no annotation for maintenance personnel.

When troubleshooting a Novo with a host controller that incorporates a master valve/pump start, stations may appear not to “operate” because there is no command to open the master valve or start the pump from the Novo. In this instance the master valve would have to be bled manually to pressurize the mainline pipe. While the irrigation system will not operate efficiently, the purpose is more than likely to observe station actuation only.



Note: It's important to remember to manually close the master valve once troubleshooting is completed otherwise it's function is negated because control product cannot “reset” this function electrically.

- 4) Using a known working solenoid, connect one wire to station 01 and the other wire to the valve common on the “host controller”. Then operate station 01 manually from the “host” controller. If the pump station or master valve does not function, then no irrigation will be observed operating. Use a wire tracker to trace the wire pair that is separate from the 2Wire system (if installed in this manner). Repair or replace as needed.
- 5) A master valve can be placed on the 2Wire path and is commonly the last or highest station. The color-coded wire from the Novo or corresponding 8-station sender is terminated in the “master valve/ pump start” output so that each time a station is operated the master valve is electrically actuated.



Note: A piece of tape w/ the annotation “MV or PS” on the corresponding station wire is a good method of indicating to someone that this corresponding station has been designated to as a pump start or master valve. This will save quite a few hours of field troubleshooting and countless frustration by making someone aware of this wiring function.