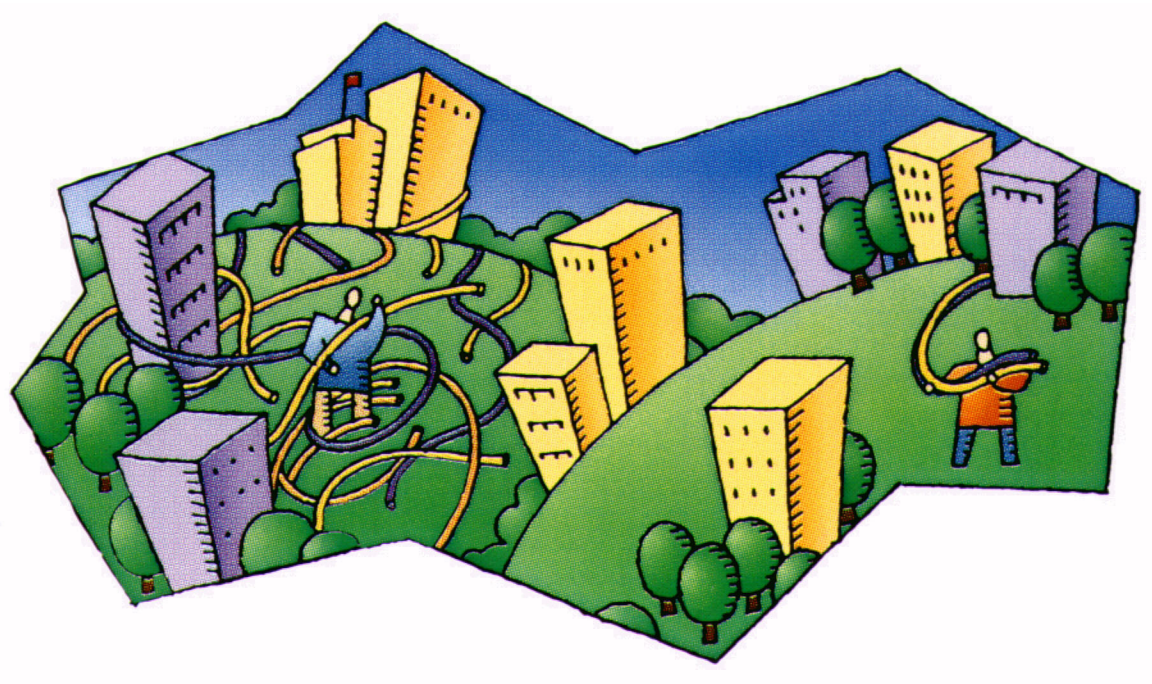

TWC NV User Manual

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Chapter 1. Introduction

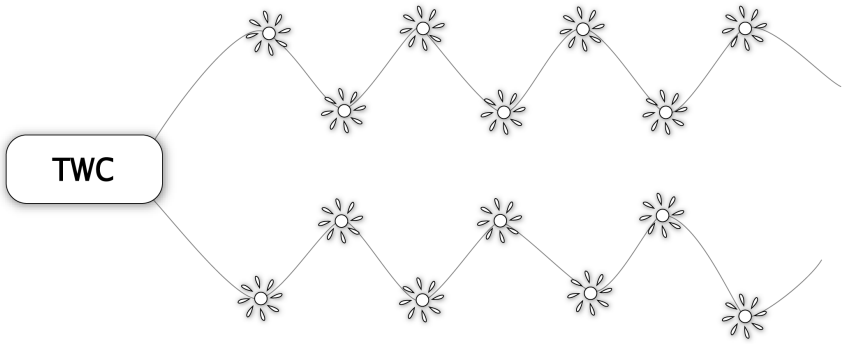
The TWC NV is a microprocessor based irrigation control system. A central controller and up to 200 field decoders comprise a complete system. In addition the controller will accept input from several external sensors in order to adjust its irrigation to the local weather conditions.

Communication between the controller and the field decoders happens over a two-wire path. Depending on the signal from the controller, the field decoders each activate or deactivate a valve. The controller signals to the field decoders based on configurable schedules, eliminating the need for human interaction when the park, garden or other surroundings need watering - once set up, the TWC NV runs on its own.

1.1. The Two-wire Technology

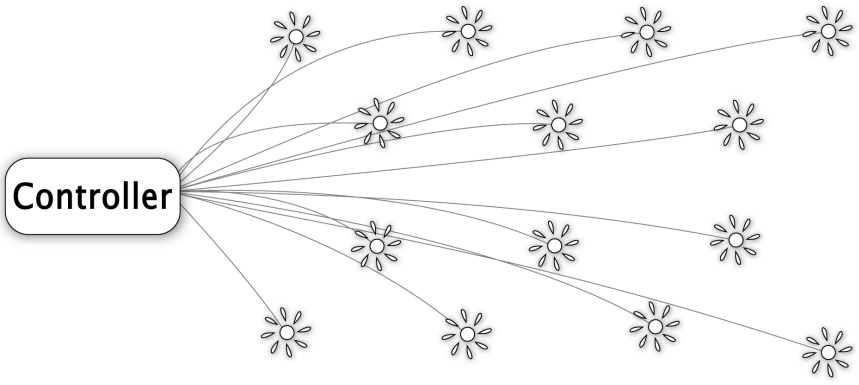
The TWC NV uses two-wire transmission technology to tell the field decoders when to act. This means that instead of laying out a cable to each individual valve, just one single cable is laid out, and the field decoders all connect to the same cable:

Figure 1.1. Two-wire layout:



In contrast, this is how the above system would look using a conventional irrigation system that needs a dedicated cable to each individual valve:

Figure 1.2. Conventional layout:



The two-wire technology has several obvious advantages over a conventional system:

- Ease of installation: You are only handling one roll of wire - not endless number of wire stubs.

- Ease of expansion: When you need to add a decoder in the field, you don't have to dig in a new cable and risk damaging the existing web of cables already in the ground - you simply attach the new decoder to the existing cable.
- Cost reduction: You save money on expensive copper cable - typically as much as 80 percent compared to traditional cabling.

1.2. The Controller

The heart of a two-wire system is the controller. This is a microprocessor controlled device that stores your irrigation programs and sends signals on the two-wire path, telling the individual decoders in the field when to activate their valve(s).

1.3. The Decoders

Decoders in an TWC NV system are mainly concerned with two specific commands: "start" and "stop". Depending on whether they are attached to an irrigation valve, a booster pump relay or a master valve, the decoders will start and stop the device according to the instructions they get over the two-wire path.

A decoder, the solenoid it is attached to and the valve the solenoid pulls open are all together referred to as a "station".

1.4. Features

Here are the main features that the TWC NV utilizes to help you automate your irrigation:

- Controls up to 200 field decoders, attached to valves or relays.
- Measures water flow and raises alarms or halts irrigation on unexpected flow.
- Operates over as much as 40,000 feet of AWG14 cable in a loop layout (10,000 feet per branch in a star layout).
- Allows for 10 independent irrigation programs. In addition there is a fixed test program that activates all installed decoders in turn.
- Each program can run up to 100 steps, each activating up to five or ten decoders, depending on configuration.
- Each decoder can run for up to 999 minutes (In fact, you can boost this even further by increasing the "water budget". Read more in Section 4.2.4, “Setting the water budget” [page 29]).
- Each decoder can cause a booster pump to be activated if needed.
- All programs have six start times per day.
- All programs can run simultaneously.
- You configure each program to run on any selection of days in a 14 or 15 day period.
- You can activate one or more valves manually while one or more programs are running, up to a total of 10 simultaneously running valves.
- A master valve can be selected that will open when any program or decoder is run. You typically assign master valve status to the valve controlling access to municipal water or pumping decoder.

- PC software lets you control the TWC NV remotely via a PC, connecting via a serial cable, a modem, GPRS or TCP/IP.

Chapter 2. System Installation

Before you start the installation procedure, please make sure that everything is included in your package.

Apart from the manual you're holding, the TWC NV box should contain the following:

Figure 2.1. TWC NV Box Contents

- One TWC NV controller.
- Two keys for the controller cabinet.
- Two mounting pads for the back of the controller cabinet.

2.1. Mounting the Controller

Though the TWC NV is designed to resist both rain and direct sunlight, you should place it in a friendlier environment if possible. Installing the TWC NV inside a utility room or a shed is the perfect solution, but if this is not possible, try to place it somewhere dry and out of sight.

Furthermore, make sure that you place the controller in a location that meets these requirements:

- The controller must have access to 120V AC.
- You must be able to connect the two-wire to the controller at the location.

- To minimize electromagnetic interference, make sure that the controller is placed at least 15 feet away from any high-draw motors like air conditioners, refrigerators, pool pumps, etc.

Once you've designated a suitable location for the controller, you're ready to mount it on the wall - or whatever vertical surface you have chosen. Here's what you are going to need in order to mount the controller properly:

- Three screws to mount the controller.

Important

The screw heads must have a diameter of at least 3/8 inches, and the screw bodies must be no wider than 3/16 inches.

- A screw driver that matches the above screws.
- A pen or a marker to mark up where to put the screws.
- If you're mounting the controller on a concrete wall you will need an electric drill and three wall anchors for the screws.

Before you start mounting the controller you should remove the lower front plate inside the controller cabinet by twisting the two plastic screws loose with a coin (the screws won't come off but remain attached to the plate even when twisted loose):

Figure 2.2. Front plate removed

Now you're ready to get to work.

Procedure 2.1. Mounting the controller

1. Place one of the screws in the wall where you want to mount the controller.

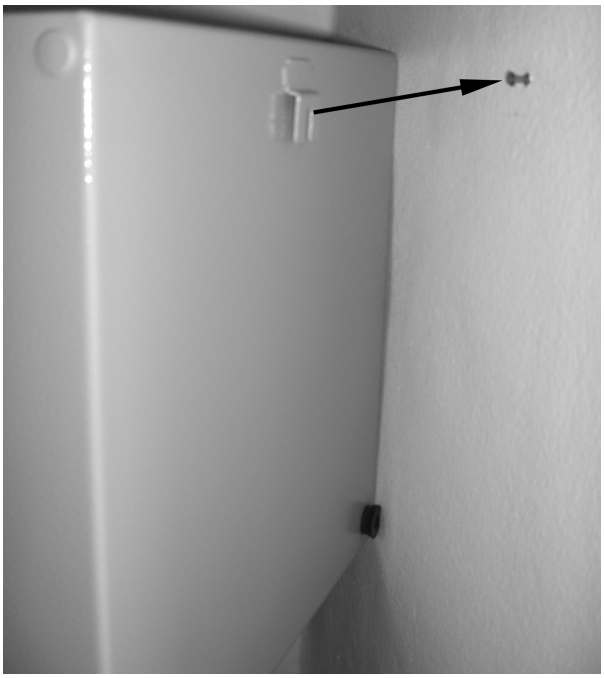
Important

The screw must have a space of eight inches to the left of it in order for the controller to fit on the screw and the cover to be able to open once the controller is on the wall.

You should leave the screw head 1/8 inch out of the wall in order for the controller to fit.

2. Place the controller on the wall by hooking the centered hole on the back of the controller onto the screw in the wall.

Figure 2.3. Centered hole for wall mounting



If the controller doesn't seem to fit firmly on the screw, take it down, tighten the screw a bit more and try again. Repeat until the controller seems stable on the screw.

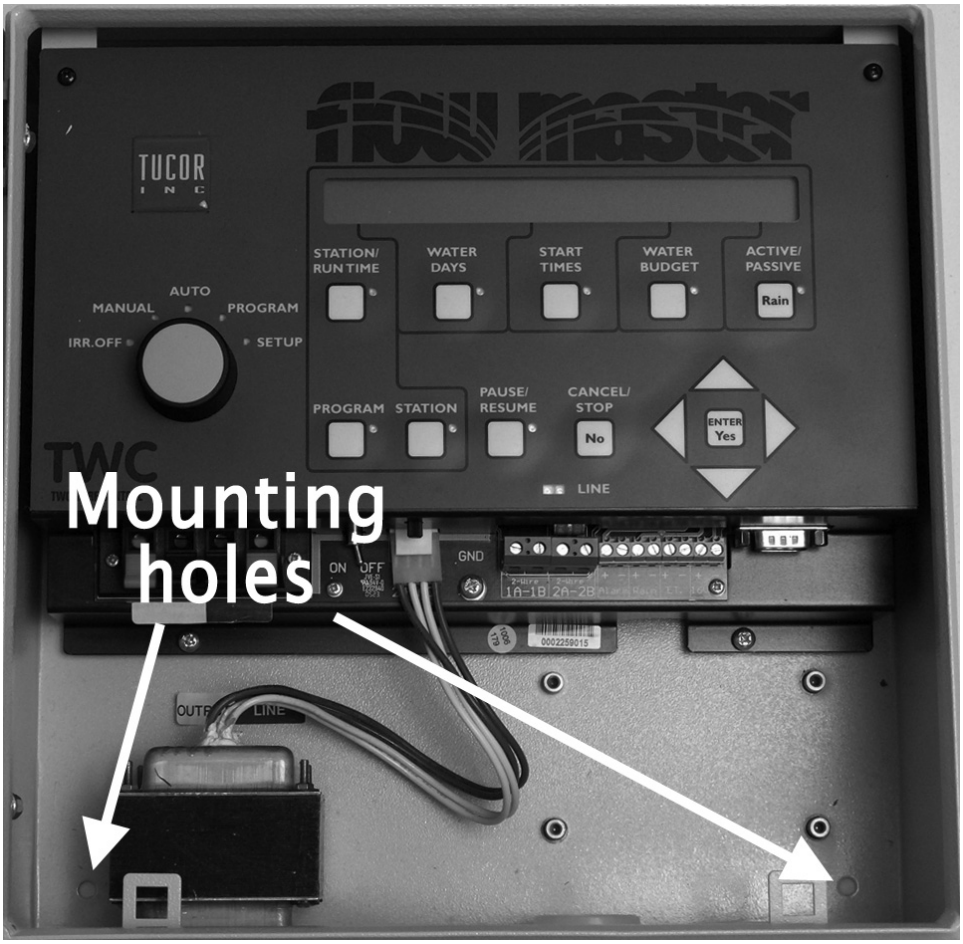
Note

The rubber pads you see on the bottom corners of the controller cabinet above might be delivered separately for you to assemble.

3. Make sure the controller is level.

4. Use a pen to put marks on the wall through the two holes in the back of the controller cabinet.

Figure 2.4. Marking up the mounting holes



5. If you're placing the controller on a concrete wall, take down the controller, drill out the holes for the two new screws, possibly put in the wall anchors, and put back the controller on the wall.

6. Fasten the two last screws in the wall through the holes in the back of the controller cabinet.

   Now the controller should be mounted firmly on the wall.

After mounting the controller, it's time to connect the power and two-wire - follow the instructions in the next section to do this.

2.2. Connecting the Controller

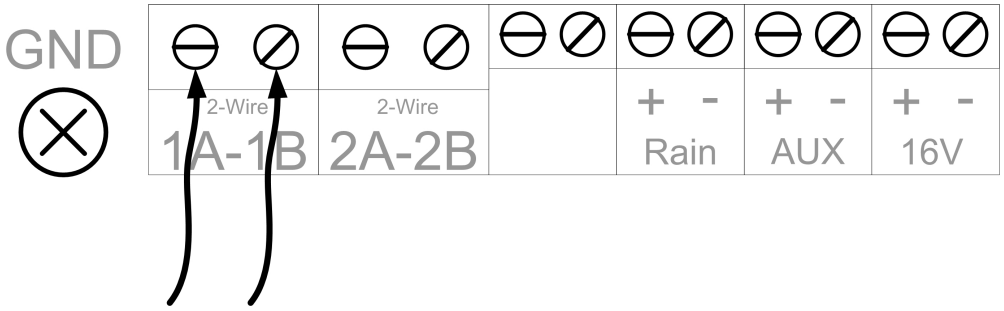
You need to connect two lines to the controller: the power line and the two-wire path.

Warning

The TWC NV runs on 120V AC and must be installed in compliance with local electrical codes. Unauthorized installation will void the warranty of the TWC NV.

You connect the two-wire by running it through a hole in the bottom of the controller cabinet and fastening it to the two-wire terminals (`1A-1B`) using a flat head screw driver:

Figure 2.5. Connecting the two-wire



There's room for connecting two cables directly to the controller - the other line can be connected to the terminals labeled 2A-2B. Both wires will receive the same signals when the controller is up and running.

2.2.1. Grounding the Controller

To secure your TWC NV against lightning, you must ensure that the controller is grounded. There are two ways of assuring this:

1. Make sure that the main power supply is securely grounded.
2. Connect a ground rod to the controller.

Do both for maximum surge protection.

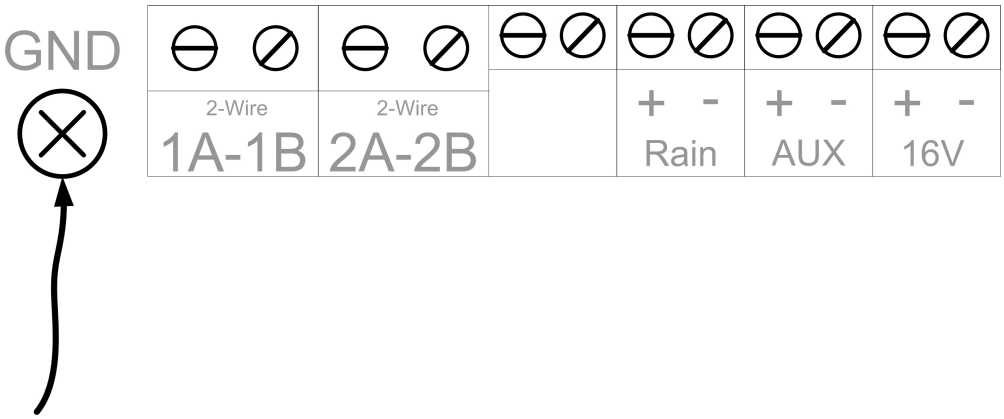
Tip

Though using a ground rod is optional, you should definitely connect a ground rod if:

- Your mains is grounded a long way from where you connect the TWC NV.
- You are using a long two-wire (increased risk of the two-wire picking up surge)

Both must be connected to the screw labeled GND (the green wire from the power cable is already connected to this):

Figure 2.6. Connecting a ground rod



Warning

You will void the warranty by not grounding your TWC NV properly - either by connecting the controller to common and/or by using a ground rod.

2.2.2. Connecting Sensors

The TWC NV accepts incoming alarms from rain sensors and auxiliary alarms (typically used for a pump sensor.) This section tells you how to connect the two.

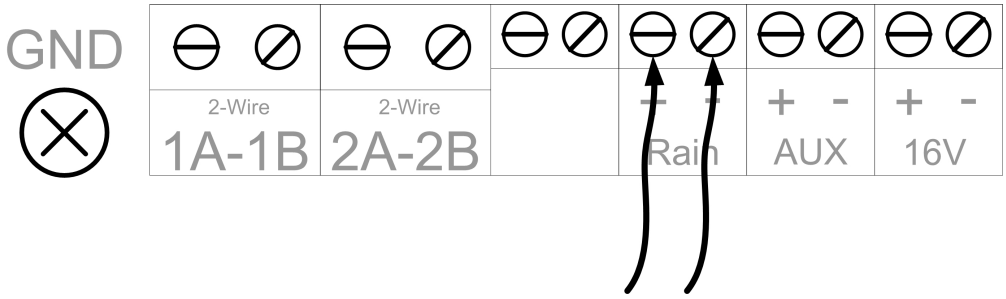
Note

Flow sensors are connected to the two-wire in the field and not directly to the controller.

2.2.2.1. Connecting a Rain Sensor

You can connect a rain sensor to the TWC NV via the grey terminals labeled "Rain":

Figure 2.7. Connecting a rain sensor



Important

Be aware of the polarity when you connect devices to the TWC NV: Connect plus to plus and minus to minus or you won't see the expected behavior from the connected devices.

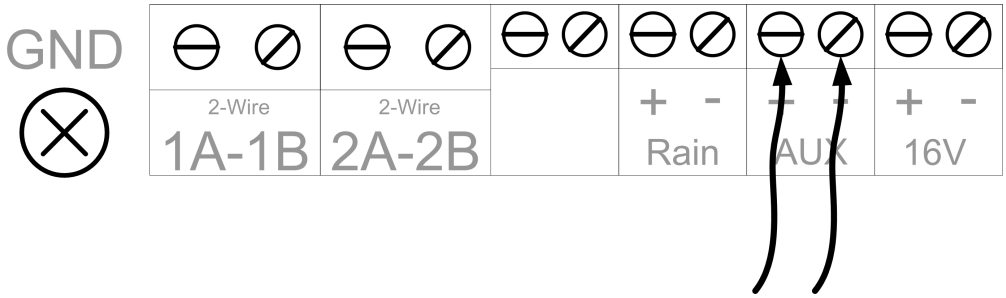
See Appendix A, *Rain and pump alarms* [page 69] for more details on how to configure the controller to work with a rain sensor.

2.2.2.2. Connecting an Alarm or Flow Sensor

The grey terminals labeled "AUX" are intended for a regular auxiliary alarm.

You connect to the TWC NV via the grey terminals labeled "AUX":

Figure 2.8. Connecting an alarm



Important

Be aware of the polarity when you connect devices to the TWC NV: Connect plus to plus and minus to minus or you won't see the expected behavior from the connected devices.

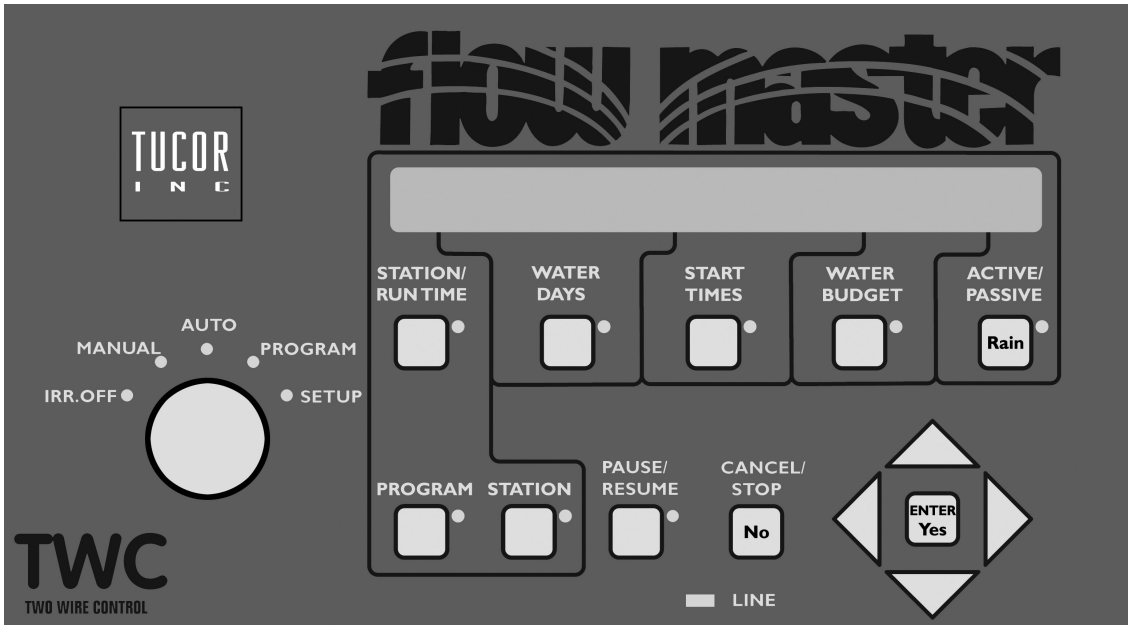
Flow sensors are configured from the PC software that ships with your controller - you can not do this physically at the controller cabinet.

Chapter 3. Operating the Controller

It is essential that you feel comfortable with the interface of the TWC NV before you start configuring decoders, irrigation programs, etc.

This section explains what all the controls are for in the different modes - in Chapter 4, *Programming* [page 19] and Chapter 5, *Running the* TWC NV [page 37] you will learn how to actually use the controls to operate the system.

Figure 3.1. TWC NV front plate



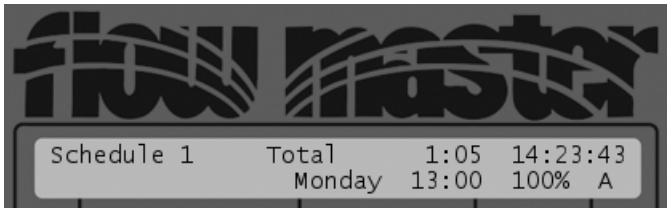
3.1. The Display

The TWC NV has a back lit LCD display with two rows of 40 characters. Since the limit is 40 characters per row, sometimes words are abbreviated, but all messages should still be easy to understand - if in doubt about a message, consult this manual.

The text layout in the display varies from mode to mode (more about modes in Section 3.2.1, “The Five TWC NV Modes” [page 15]), though in several layouts you'll find the current time in the upper right hand corner.

A typical message is the following that is displayed when the TWC NV is idle, waiting for the next program to run:

Figure 3.2. A standard display when idling in Auto mode

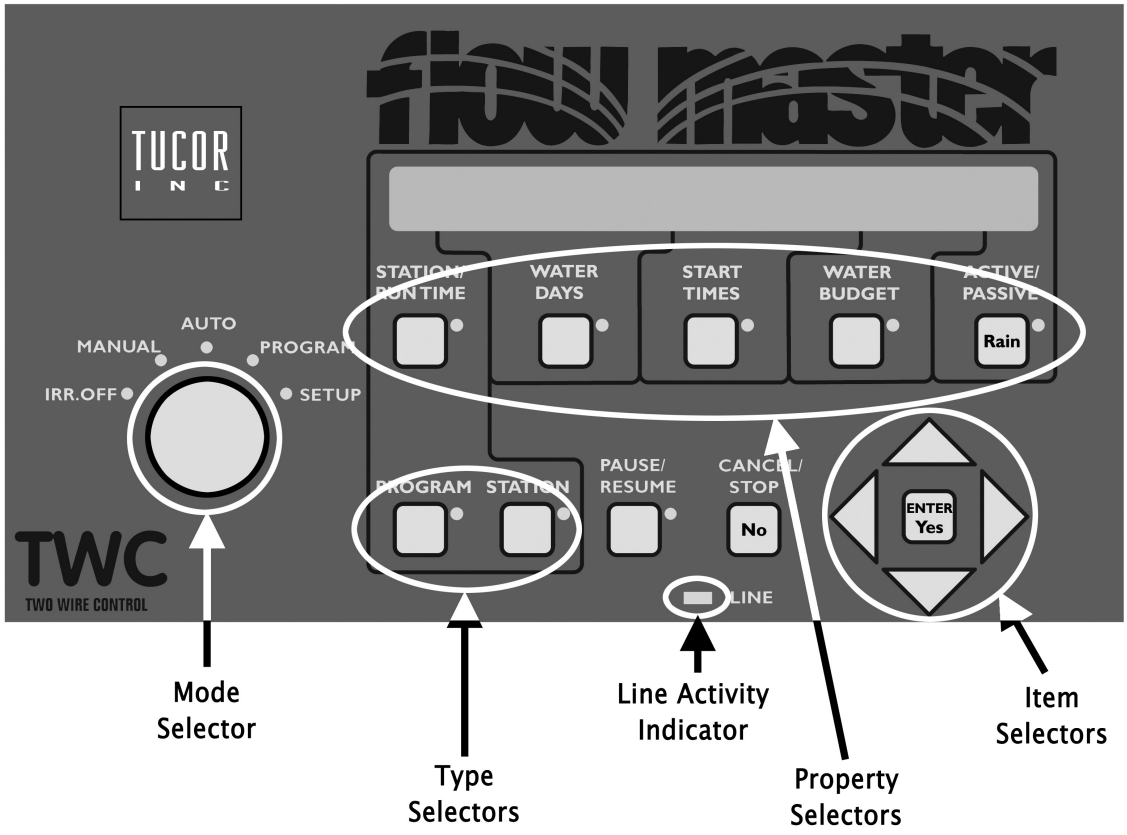


This simply states that the next schedule to run is number one, the total run time will be 1:05 and it will start Monday at 13:00 (1:00 PM,) running with a water budget of 100%. In the top right you see the current time.

You will learn all about schedules in Section 4.2, “Configuring irrigation programs” [page 22].

3.2. Buttons and Controls

Figure 3.3. Controls on the TWC NV front plate



The controls on the TWC NV can be divided into six groups:

- *Property selectors:* When configuring an irrigation program, these buttons let you select which properties of the program you want to edit.
- *Type selectors:* These buttons let you select between programs and stations when in manual mode.

- *Item selectors:* These buttons are used in pretty much every mode. They let you scroll up, down and sideways in the various menus the TWC NV shows you. In the middle is the *ENTER/YES* button that is used for confirmation.
- *CANCEL/STOP/NO Button:* Is used whenever you need to answer reject a suggestion made by the controller, or when you need to exit menus.
- *Mode selector:* This is a selector knob used to switch between the five different modes of the TWC NV.

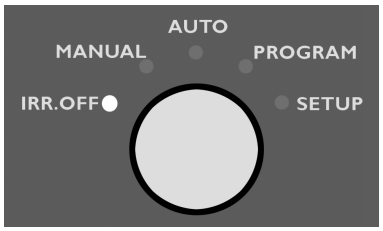
  When you change to a new mode, allow up to one second before the display reflects the change.
- *PAUSE/RESUME Button:* You use this to pause and resume running programs and stations.

Finally there is the *line activity indicator* which is not really a control - two LEDs that flash green and red every half second when the outgoing two-wire is active. The *line activity indicator* offers you an immediate visual indication of the condition of the two-wire path.

3.2.1. The Five TWC NV Modes

Looking at the *mode selector* from left to right, you see five possible modes for the TWC NV:

Figure 3.4. Mode Selector in "Irrigation Off"



3.2.1.1. IRR. OFF

This is short for "Irrigation Off" - practically this means that the connection to the two-wire path is shut down and no programs will be run. The display will still be lit and you'll see this message:

Figure 3.5. Idling in Irr. Off mode:

3.2.1.2. Manual

In manual mode you can start a program or a single decoder manually.

3.2.1.3. Auto

This is the normal operating position and is probably where your system will spend the most of it's time. When in auto mode the TWC NV makes sure that all programs are run according to schedule. Once everything is configured, you switch the system to auto mode and leave it to do its job.

You also have the option of starting additional valves manually while a program is running in auto mode. This can be useful if you notice that an area needs a little extra watering but you don't want to create a new program to take care of it - just turn on the nearest valve for a few minutes.

3.2.1.4. Program

This is the mode you switch to when creating programs - you will learn more about this mode in Chapter 4, *Programming* [page 19].

3.2.1.5. Setup

This mode lets you set the date and time and configure the controller for various sensor inputs.

3.2.2. Navigating in the display

When navigating and editing values in the TWC NV display there are a couple of rules of thumb:

- When an item is surrounded by "greater than" and "less than" signs, it is selected, but not open for editing. Like in this example where the Name column of a decoder is selected:

Figure 3.6. Name column selected

If you want to open this setting for editing, push the ENTER button, and the greater than and less than signs are replaced with blinking arrows:

Figure 3.7. Name column open for edit

Note

You can see the full instructions on naming decoders in Section 4.1, “Configuring field decoders” [page 19].

- Pushing the ENTER button on a selected field will open it for editing, and pushing ENTER in an already open field will save the currently selected value and exit the field.
- The *item selectors* serve two purposes:
  - Navigate between the different fields in a display

- When a field is opened for editing, the *item selectors* are used to set the desired value.

Sometimes the up/down pair act the same way as the left/right pair, but in other cases they behave differently. Returning to the example of decoder configuration,

- When you are editing the decoder type, up/down and left/right will work exactly the same, scrolling the list of decoder types.
- When you are editing the decoder address, up/down will increase/decrease the address ID, but left/right will navigate between the five digits of the address, allowing you to use up/down to work on just one digit at a time. This way you don't have to press the button forever when assigning a high address like 30,389.

- Some dialogs can be exited by pushing the CANCEL button, but in others you may have to navigate to an OK or FINISH field and push the ENTER button. OK typically saves the current item and returns to the sub menu that lists the items, whereas FINISH will save the current item and exit the sub menu all together.

Important

These are all rules of thumb - some displays may behave differently. This manual should inform you when this is the case.

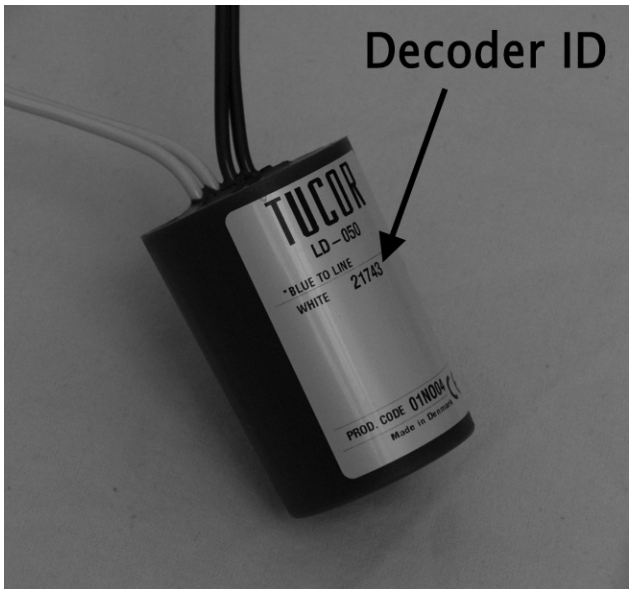
Chapter 4. Programming

Before trying to configure anything, make sure you have read Section 3.2.2, “Navigating in the display” [page 16].

4.1. Configuring field decoders

Before you can build irrigation schedules you should configure your list of field decoders. All decoders get an ID number between 600 and 49,999 from the factory - you can see it printed on the decoder label:

Figure 4.1. Decoder ID number on label

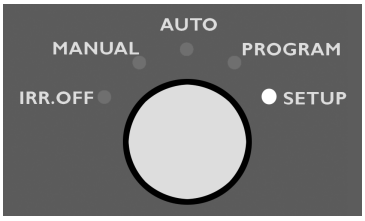


So get a hold of all the decoders you intend to put in the ground and walk through this procedure:

Procedure 4.1. Configuring a field decoder

1. Put the controller in SETUP mode:

   #### Figure 4.2. Mode Selector in "Setup"

   Now the display will look something like this:

Figure 4.3. Controller in SETUP mode

2. Select 1. Installation and push the ENTER button.

   Depending on your switch settings (see Appendix D, *Changing DIP switch settings* [page 77]) the display will look in one of two ways:

Figure 4.4. Installation menu with switch number 10 open

Figure 4.5. Installation menu with switch number 10 closed

3. Now you need to select the Decoders menu item, and depending on your switch settings this will be either number 1. or 2. Select it and push the ENTER button.

   The first time you enter this menu, not decoders exist in the system and you'll see a rather blank display:

Figure 4.6. Entering the Decoder menu for the first time

4. Push the ENTER button to open the first decoder entry for editing:

   From here on we assume that you want to add a decoder with the following data:

Name	DEC001
Type	1
Address	21743
Booster	
Flow	20 GPM

5. Push the ENTER button to activate the Name column for editing and use the *item selectors* to enter a name for your decoder.

   You scroll through numbers and letter with up/down or left/right *item selectors* and when a character is in place, you push the ENTER button to move on to the next character:

Figure 4.7. Naming a decoder

Note

Decoder names can not contain trailing spaces. If you push the ENTER button without selecting a character, the TWC NV will assume that you are done with the naming and exit the editing mode. Leading spaces are OK.

When you are done the display will look like this:

Figure 4.8. Done naming a decoder

6. Use the *item selectors* to move to the Type column, push the ENTER button to open the value for editing, use the *item selectors* to set the right value and push the ENTER button again to exit the column.

   You can read more about decoder types in Appendix B, *Decoder Types* [page 73].

7. Use the *item selectors* to move to the Address column, push the ENTER button to open the value for editing, use the *item selectors* to scroll up to the right address and push the ENTER button again to exit the column.

Note

You read the decoder address on the label directly on the decoder itself.

8. Use the *item selectors* to move to the Boo column, push the ENTER button to open the value for editing, use the *item selectors* to set the booster pump you want this decoder to activate and push the ENTER button again to exit the column.

   You can read more about booster pumps and how to configure the TWC NV to use them in Section 4.3, “Configuring booster pumps” [page 30].

9. Use the *item selectors* to move to the Flow column, push the ENTER button to open the value for editing, use the *item selectors* to set the flow for this decoder in GPM and push the ENTER button again to exit the column.

10. Use the *item selectors* to move to OK and push the ENTER button to save your decoder settings.

11. Now you'll see your new decoder in the overview:

Figure 4.9. Decoder list

Note

Any selection of booster pump is not displayed in the overview.

12. Push the ENTER button if you want to configure another decoder and repeat from step 5.

4.2. Configuring irrigation programs

The TWC NV runs step based programs, meaning that you have maximum flexibility in how you want to use your valves in the field.

You are not limited to just running a number of valves sequentially - with step based irrigation you can run a group of valves simultaneously and even reuse valves across different steps within the same program. Also, you are not restricted to running valves in any specific order - you can run any valve at any time in any and as many steps as you like.

Take a look at the following program for an illustration of the possibilities:

Table 4.1. Sample step based irrigation schedule

Step	Run time (minutes)	Station #1	Station #2	Station #3	Station #4	Station #5
1	10	ST004	ST005	ST012	ST124	ST078
2	22	ST105	ST006			
3	0	*ST060*	*ST070*	*ST080*		
4	17	ST072	ST089	ST190	ST191	
5	12	ST001	ST023			
6	5					
7	20	ST150	ST155	ST156		
8	10	ST070	ST001	ST002		
Total run time:	**96 minutes**					

Things to note in the example above:

- You are not locked into a fixed number of stations per step.
- Stations can be re-used in multiple steps.
- You can freely select stations in any order.
- You can insert a break in your program by inserting a step that runs no stations (see step 6 above.)
- You can temporarily take a step out of irrigation by setting the run time to 0 minutes (see step 3 above.)
- Though the example uses only five stations per step you can enable the controller to run ten stations per step - this is a configuration issue. Please see Appendix D, *Changing DIP switch settings* [page 77] for instructions.

In addition to what you can read out of the example, here are a few other things you should know about programs:

- A program like the above can be run up to 6 times per day.
- The duration of all the steps in a program can be altered relatively by increasing or decreasing the water budget (see Section 4.2.4, “Setting the water budget” [page 29].)
- You can of course emulate simpler controller behavior running just one station in each step.

The following sections explain how to configure the different aspects of a programs. Typically you would configure a complete program in one sitting, but you can always come back and modify any part of the program.

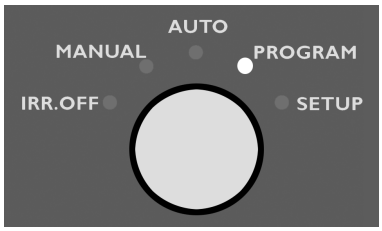
Important

A common mistake when building irrigation programs is forgetting to set their status to `Active`. This means that they won't be included in the automatic irrigation carried out by the controller in `AUTO` mode, so make sure to activate your programs if you actually want them to run at the designated times.

Passive programs can always be run in `MANUAL` mode.

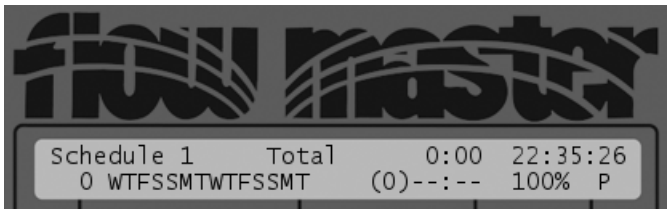
For each of the procedures in the following sections it goes that you must first turn the mode selector to PROGRAM mode:

Figure 4.10. Mode Selector in "Program"



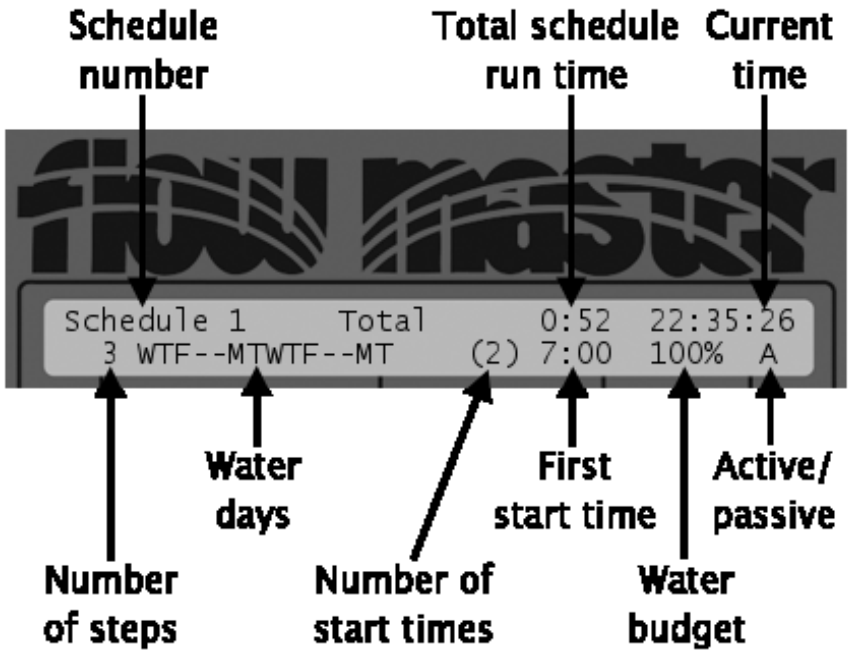
The first time you do this the display will show the empty details for the controller's first program:

Figure 4.11. First time in PROGRAM mode



When you have configured a program, the display will look something like this instead:

Figure 4.12. PROGRAM with fully configured program



Moving clockwise around the display this means that:

- We are looking at Schedule 1

- The schedule will run for a total of 52 minutes before all steps have completed
- The current time is just past 10:30 in the evening
- The schedule is active and will be included when running in AUTO mode
- The schedule runs at a water budget of 100%
- The last of start time is at 7:00 in the morning
- There are a total of two start times each water day
- The schedule does not run on weekends
- The schedule has a total of three steps (you can not tell how many stations are run in each step)

As you move through the following sections you learn how to configure all of these settings.

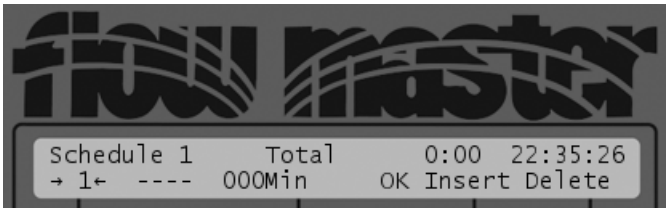
4.2.1. Assigning steps, stations and run times

Procedure 4.2. Configuring the steps of an irrigation program

1. Use the *item selectors* to scroll to the schedule you wish to edit.
2. Push the STATION button to open the schedule for editing of steps, stations and run times.

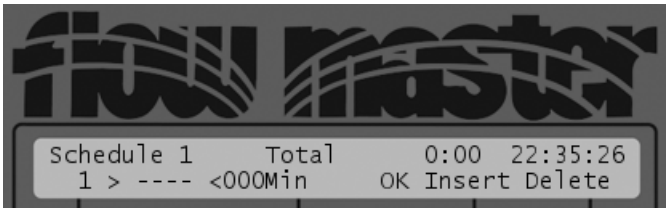
   Now the first column is activated, and you can use the *item selectors* to scroll to the step you wish to edit. If this is the first time you edit the schedule you can only select step one (after that is saved, you can select one and two, after that, one, two, three, and so on)

   Figure 4.13. Selecting step to edit

3. Select the step you wish to edit and push the ENTER button.
4. Now move to the four dashes:

   Figure 4.14. Selecting first station

This position is a placeholder for where you will select the first station to run in this step. Push the ENTER button to activate it for editing:

Figure 4.15. Selecting first station from list

The first station as declared in the decoder list (see Section 4.1, “Configuring field decoders” [page 19] for details) will be selected, and you can use the item selectors to scroll to the station you wish to select.

Important

Note how a new set of four dashes appeared next to the column you are now working on. The controller will keep adding a bar of dashes as a placeholder for the next station you select in this step (see Appendix D, *Changing DIP switch settings* [page 77] for instructions on how to swap between five or 10 maximum stations in each step.)

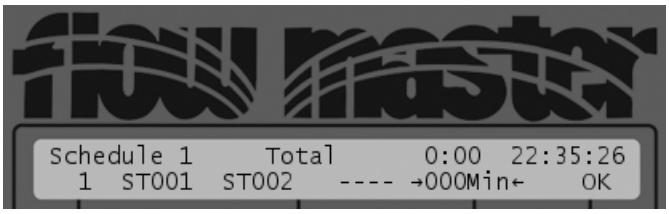
Also note that the Delete field has been pushed out to the right of the display. However, you can still navigate to the right and get a hold of the Delete option when you have selected your stations.

Note

When you have added a station to a step, you can not remove that slot again. That is, if you have a step running four stations and want to pull out a station and have the step run just three stations, you have to delete the step all together and add a new instead.

5. Push the ENTER button to select a station and continue selecting as many stations as needed.
6. Navigate to the 000Min field and push the ENTER button to activate it for editing:

Figure 4.16. Selecting the step run time



7. Use the *item selectors* to set the desired run time for this step and push the ENTER button to save.
8. Navigate to the OK field and push the ENTER button to save the entire step.

Note

If you have added three or more stations to this step you will have to scroll to the right of what you currently see in the display, as the OK field will be hidden to the right.

9. If you are done editing the steps for this schedule, push the STATION button to exit - otherwise select a new step and repeat this procedure from step 3.

4.2.2. Determining the water days

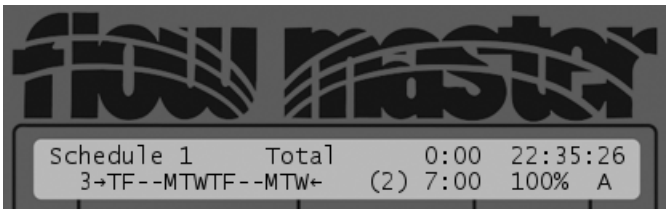
The TWC NV lets you define which days in a 14 or 15 day cycle your schedules should run. You can read about how you change the cycle length from 14 to 15 days in Appendix D, *Changing DIP switch settings* [page 77], but for these instructions we assume you are running a 14 day cycle.

Procedure 4.3. Setting the water days for an irrigation schedule

1. Use the *item selectors* to scroll to the schedule you wish to edit.

2. Push the WATER DAYS button to activate the water days field:

Figure 4.17. Water days open for editing



The water days are represented with just one letter and always with today as the first one in line. So the above means that today is Thursday, and that the schedule runs on all days except weekends (Saturday and Sunday are "dashed out" in the display.)

3. Now use the left/right item selectors to navigate through the 14 day cycle, and activate days by pushing the ENTER button on them, or omit them from the schedule by pushing the CANCEL button on them.

4. When you are done, push the WATER DAYS button to save and exit the water days.

   Now your schedule will be run on the days you have selected - provided that the controller is in AUTO mode and the schedule is active.

Note

If you use the link feature (read more in Appendix C, *Running linked programs* [page 75]) of the TWC NV things look a little different:

Assuming that this schedule is a slave, it will only be run if both itself and the master schedule is configured to be run on the given day. So, if your slave schedule should run on Fridays but the master schedule should not, then your slave schedule will not run.

4.2.3. Setting the daily start times

The start times determine when in the selected water days your schedule should run. Each schedule run up to six times per day.

Important

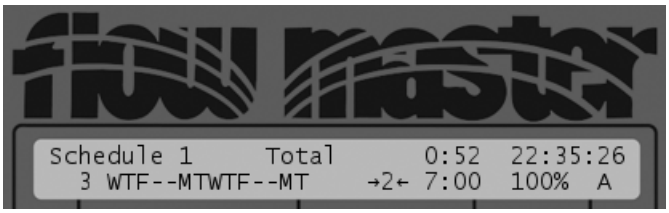
Two programs can not share the same start time. If you have two programs with identical start times, only one of them will be run. Program start times can overlap, as long as the total number of running stations does not exceed 10, but the TWC NV will only start one program each minute.

Thus, if you want to run two programs at the same time you have to run one of the programs just a minute later.

Procedure 4.4. Setting start times

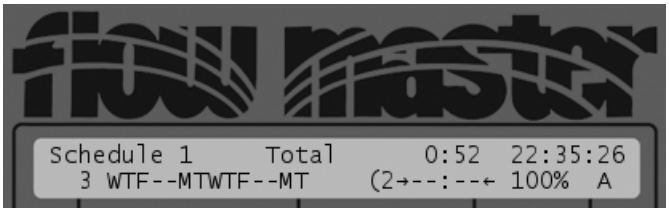
1. Use the *item selectors* to scroll to the schedule you wish to edit.
2. Push the START TIMES button to activate the start times field:

Figure 4.18. Start times open for editing



3. Use the *item selectors* to choose the start time you wish to edit and push the ENTER button to activate the start time for editing:

Figure 4.19. Start times open for editing



Note

The leftmost arrow will be sitting on top of the parenthesis that surround the number of start times - this is simply because of the limited space in the display.

4. Now use the *item selectors* to adjust the clock to the desired start time and push the ENTER button to save.

   Now you'll be sent back to the previous step, and you can keep looping here until you have set all your start times

5. Once you're all done, push the START TIMES button to close the start times field for editing.

Note

When programming your schedules you won't see any warnings if steps or programs overlap each other. However, when you move to AUTO mode, you'll see a warning if an overlap exists:

Figure 4.20. Start time overlap

This message means that you have an overlap in program 1 on the second day in your irrigation period (14/15 day loop) at 04:00.

4.2.4. Setting the water budget

Water budget is a concept that allows you to increase or decrease the amount of water used for irrigation without having to re-configure your schedules.

If you experience a dry period you can increase the amount of water used by all stations in all steps in an entire program, simply by increasing the water budget. And of course the other way around: if you're getting a lot of rain, you can decrease the water usage by lowering the water budget.

You can adjust the water budget to a value between 0 and 250 percent with 100 percent representing a normal water consumption. When the water budget increases, the controller simply adds to the run time for each step in your program, so, if a step normally lasts half an hour on a 100 percent water budget and you increase the water budget to 110 percent, your step will run for 33 minutes.

Warning

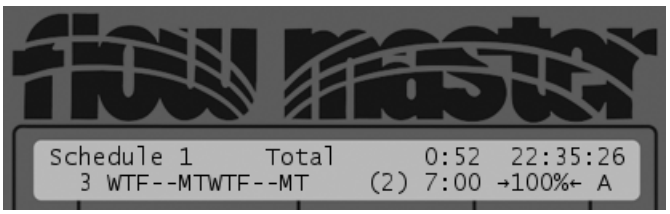
Keep in mind that increasing the water budget might lead to unexpected schedule overlaps as the total run time for a program will increase with the water budget.

Procedure 4.5. Adjusting the water budget

1. Use the *item selectors* to scroll to the schedule you wish to edit.

2. Push the WATER BUDGET button to enable editing of the water budget:

Figure 4.21. Water budget open for editing



3. Now use the *item selectors* to adjust the water budget to the desired value (0-250 percent) and push the WATER BUTTON to save and exit the field.

4.2.5. Toggling a program between Active, Passive and Link

All programs can be either active or passive, indicating whether or not they will be included when the TWC NV is running in AUTO mode (see Section 5.2, “Running in Auto mode” [page 42] for more information on running in AUTO mode.)

You can always run a passive program in MANUAL mode - the acitve/passive setting simply determines whether or not the program will be included in AUTO mode.

There is a third run mode called "link mode" where all programs are run back to back - this is described separately in Appendix C, *Running linked programs* [page 75].

Procedure 4.6. Toggling active/passive/link

1. Use the *item selectors* to scroll to the schedule you wish to edit.

2. Push the ACTIVE/PASSIVE button to toggle the active/passive/link setting.

   The setting will simply be indicated by the first letter of the setting:

Letter	Program is:
A	Active
P	Passive
L	A link master program (see Appendix C, *Running linked programs* [page 75] for details)

Note

Only program number one can be a link master.

Important

Toggling active/passive/link is a bit different from adjusting the other aspects of a program in that your changes take effect immediately - there is no "opening for edit, edit, close" round trip - once you push the ACTIVE/PASSIVE the setting is toggled.

4.3. Configuring booster pumps

Booster pumps are pumps placed along your pipe, helping to keep up the water pressure throughout the system.

The TWC NV lets you define up to nine booster pumps in your system, and when you configure field decoders, you can assign a booster pump to each (see for details Section 4.1, “Configuring field decoders” [page 19].) This means that if you assign booster pump Boost5 to field decoder ST001, the booster will be activated whenever ST001 is run.

This way you don't have to worry about assigning booster pumps to a program - the controller will ensure that the pumps are started when a station is run that needs a booster.

Note

When a station that needs a booster to run is halted, the booster will keep running for another 10 seconds in case another station that need the booster will start running immediately after. If no one needs the booster after the 10 seconds, the pump decoder closes down.

The rationale is to avoid having the pumps start and stop more frequently than needed.

This goes for master valves as well.

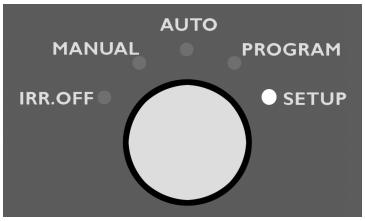
You need special booster pump decoders for this, and before you start, you need to know the switch code and the address for the pump decoder you are using.

If you use a pump decoder supplied by Tucor, the switch code defaults are right, and you just need to read the address of the decoder, if not, consult the documentation for your pump decoder to find the appropriate switch code.

Procedure 4.7. Configuring for booster pumps

1. Put the controller in SETUP mode:

Figure 4.22. Mode Selector in "Setup"



Now the display will look something like this:

Figure 4.23. Controller in SETUP mode

2. Select 1. Installation and push the ENTER button.

   Depending on your switch settings (see Appendix D, *Changing DIP switch settings* [page 77]) the display will look in one of two ways:

Figure 4.24. Installation menu with switch number 10 open

Figure 4.25. Installation menu with switch number 10 closed

3. Select `3. Pump` (or `4. Pump` depending on your switch settings).

   Now you enter the list of pump decoders:

Figure 4.26. Pump decoder list

4. Use the *item selectors* to scroll to the pump you wish to configure and push the ENTER button.

   Now the booster pump is opened and the switch code field is selected:

Figure 4.27. Pump decoder edit

5. Push the ENTER button to open the switch code field for editing, use the *item selectors* to set the right value and push the ENTER button again to save and exit the field.

6. Navigate to the address field and push the ENTER button to open it for editing. Now use the *item selectors* to set the right value and push the ENTER button to save and exit the field.

7. Move to the OK field and push the ENTER button.

   Now you return to step 3 in this procedure and you can run this loop until you have configured all the desired booster pumps.

4.4. Configuring the master valve

The master valve is located where the water flows from the water supply to your pipe system, and the TWC NV can take on the task of opening the master valve only when irrigation is taking place. The master valve will always stay open for an extra 10 seconds after the last station has halted - the note below explains why.

Note

When a station that needs a booster to run is halted, the booster will keep running for another 10 seconds in case another station that need the booster will start running immediately after. If no one needs the booster after the 10 seconds, the pump decoder closes down.

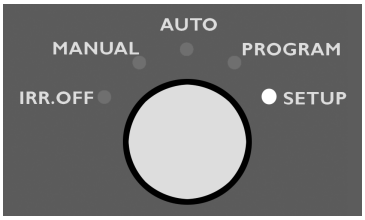
The rationale is to avoid having the pumps start and stop more frequently than needed.

This goes for master valves as well.

Procedure 4.8. Configuring the master valve

1. Put the controller in SETUP mode:

   Figure 4.28. Mode Selector in "Setup"



   Now the display will look something like this:

   Figure 4.29. Controller in SETUP mode

2. Select 1. Installation and push the ENTER button.

   Depending on your switch settings (see Appendix D, *Changing DIP switch settings* [page 77]) the display will look in one of two ways:

Figure 4.30. Installation menu with switch number 10 open

Figure 4.31. Installation menu with switch number 10 closed

3. Select `3. Pump` (or `4. Pump` depending on your switch settings).

   Now you enter the list of pump decoders:

Figure 4.32. Pump decoder list

4. Use the *item selectors* to scroll to number one on the list (`1. Master`) and push the ENTER button.

   Now the master pump is opened and the switch code field is selected:

Figure 4.33. Master valve decoder edit

5. Push the ENTER button to open the switch code field for editing, use the *item selectors* to set the right value and push the ENTER button again to save and exit the field.

6. Navigate to the address field and push the ENTER button to open it for editing. Now use the *item selectors* to set the right value and push the ENTER button to save and exit the field.

7. Move to the OK field and push the ENTER button.

Chapter 5. Running the TWC NV

5.1. Running in Manual mode

In manual mode you can run individual stations or entire programs freely, ignoring the scheduling that handles irrigation when running in AUTO mode (see Section 5.2, “Running in Auto mode” [page 42]).

Important

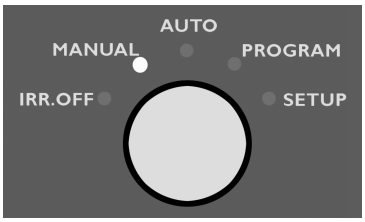
Switching to or from manual mode will halt all irrigation immediately.

Here's how you run individual stations in MANUAL mode:

Procedure 5.1. Running a station in manual mode

1. Turn the *mode selector* to MANUAL:

   Figure 5.1. Mode Selector in "Manual"

   Now the display will look like this:

   Figure 5.2. Select program or station in manual mode

2. Push the STATION button - now the display will tell you how many stations are currently running and allow you to select the one you wish to run manually:

   Figure 5.3. Decoder status in manual mode

3. Use the *item selectors* to scroll to the station you wish to run and push the ENTER button.

   Now you can use the *item selectors* to set the duration in minutes:

Figure 5.4. Decoder status in manual mode with one active decoder

4. Set the duration and push the ENTER button.

   Now the controller will swap to "overview" mode where you can see the number of running stations:

Figure 5.5. Decoder status in manual mode with one active decoder

Tip

You can scroll through the list of running stations with the *item selectors*. This list includes any stations run by manually started programs.

Note

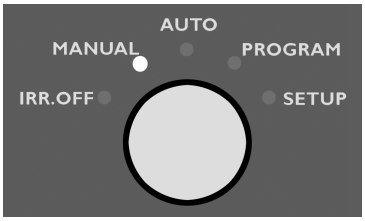
You can run several stations manually - just repeat the above procedure.

MANUAL mode also let's you run complete programs of choice - the procedure is somewhat similar to running stations:

Procedure 5.2. Running a program in manual mode

1. Turn the *mode selector* to MANUAL:

Figure 5.6. Mode Selector in "Manual"

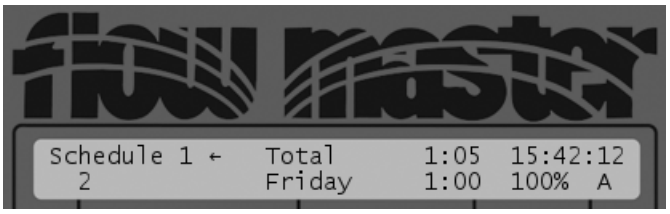


Now the display will look like this:

Figure 5.7. Select program or station in manual mode

2. Push the PROGRAM button and you can use the item selectors to scroll through the list of programs:

Figure 5.8. Select program for manual run



When browsing the list of programs you will see their next scheduled run time along with their basic information. In the example above you see that schedule 1 will run the following Friday at 1:00 at a water budget of 100%. It two steps that adds up to a total run time of an hour and five minutes.

3. Select the program you wish to run and push the ENTER button.

Now you can select which step of the program should be run first:

Figure 5.9. Select first step in a manually run program

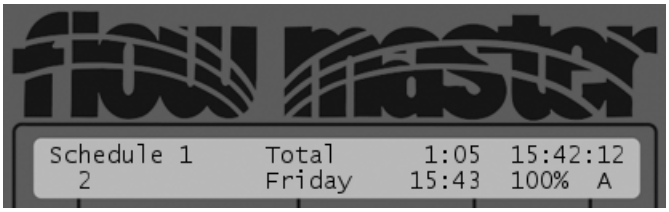
Note

If the program has only one step, this dialog will be skipped and you will move on to the next step automatically.

4. Use the item selectors to select the first step to run and push the ENTER button.

Now the display will show the selected schedule as pending - programs will only be started on the top of each minute, so your program will potentially be pending for a full minute:

Figure 5.10. Manually started program pending



Note

If you start another program manually before the next full minute is reached, the TWC NV will overwrite your previous selection and start the last program you chose.

5. Once the program starts running, the display will change and tell you which station is running and the remaining time for both the station and the program:

Figure 5.11. Manually run program started

Note

You can run several programs manually - just repeat the above procedure.

5.1.1. Pausing/Resuming programs

Procedure 5.3. Pausing manually run programs

1. If you have only started one program, and no additional stations, skip to the next step.

   If you have more than one manually started program, or if you have one program and one or more stations running, use the *item selectors* to locate a station run by the program you wish to pause.

2. Push the PAUSE button. You will be prompted to confirm:

Figure 5.12. Pausing a manually run program

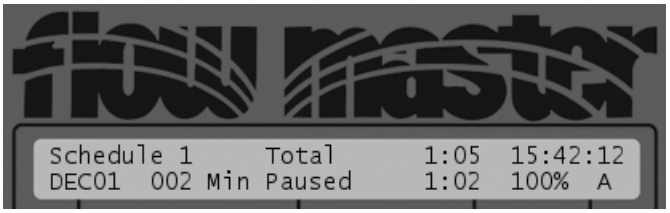
3. Push the ENTER button to pause the currently running program.

   Since programs can only be paused on top of each minute, you might see the controller go into pause pending mode:

Figure 5.13. Pause Pending

4. Once the pause takes effect the display will look like this:

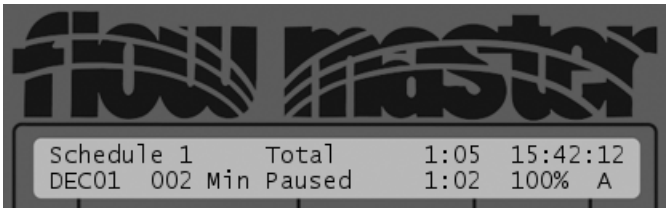
Figure 5.14. Manually run program paused



Procedure 5.4. Resuming manually started programs

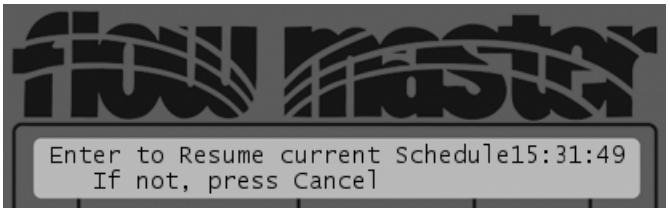
1. A paused program will look like this:

Figure 5.15. Manually run program paused



   To resume the program, push the RESUME button and you'll be prompted to confirm:

Figure 5.16. Resuming a manually run program



Note

If you have more than one manually started program, you must use the *item selectors* to scroll to the one you wish to resume.

2. Push the ENTER button and the program will be resumed - just as when pausing a program there might be a slight delay until you pass the top of the next minute. In the mean time the display will look like this, telling you when the program will be resumed:

Figure 5.17. Manually run program resume pending

3. Once the program is resumed the display looks just as when the program is running normally:

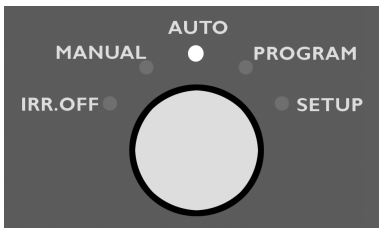
Figure 5.18. Manually run program resumed

5.2. Running in Auto mode

Running the TWC NV in AUTO mode is what it is all about. Once you have configured your irrigation schedules, you should simply move the mode selector to AUTO and the controller will automatically run all of your active programs according to their schedules.

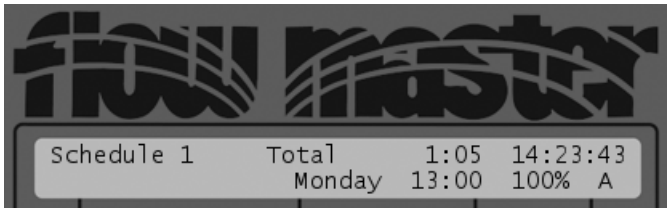
To put your controller in AUTO mode, simply move the mode selector to AUTO:

Figure 5.19. Mode Selector in "Auto"



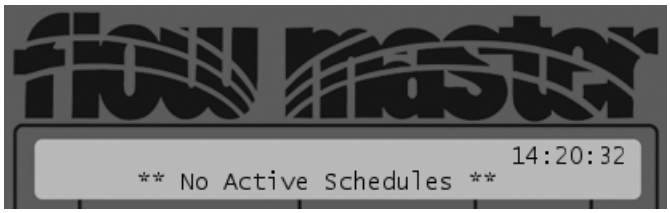
When the controller is idling in AUTO mode it tells you which program will be run next, when it will start and the total duration of the program:

Figure 5.20. Idling in AUTO mode



If you don't have any active programs, the controller will tell you so and shortly after it will jump to PROGRAM mode where you can activate any programs you wish to include in the automatic run:

Figure 5.21. No active schedules



5.2.1. Running extra stations in AUTO mode

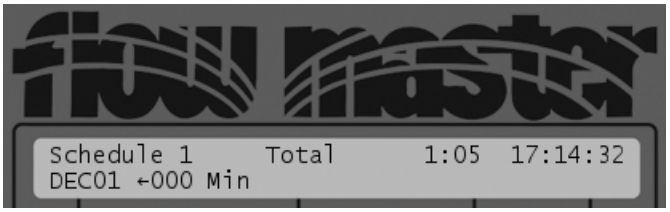
When your controller is running in AUTO mode you might need to add a little extra irrigation to certain areas of your turf, and the TWC NV lets you do this easily by running additional stations manually.

This procedure shows you how it's done:

Procedure 5.5. Running extra stations in AUTO mode

1. In AUTO mode, push the STATION button. Now you will be prompted to select the station you wish to run manually:

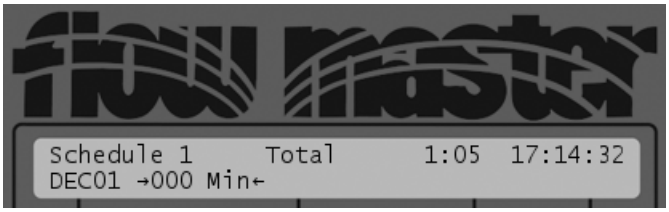
   ### Figure 5.22. Selecting a station to run in manual mode

   Use the *item selectors* to browse to the station you wish to run and push the ENTER button.

2. Now the arrows will surround the duration of the the manual run:

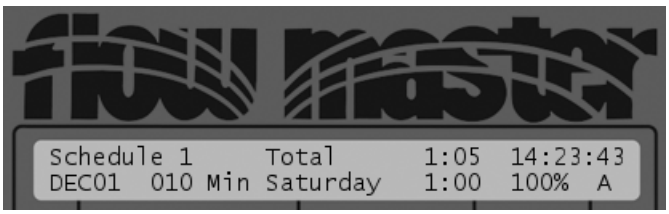
Figure 5.23. Selecting duration of manual run



Use the *item selectors* to select the number of minutes you with to run the station and push the ENTER button.

3. The controller returns to the main AUTO display, but in the bottom left part of the display you see that DEC01 is now running for 10 minutes:

Figure 5.24. Station running manually in auto mode



When the manually started station is done running, it will disappear from the display.

Note

If several stations have been started manually in AUTO mode you can browse through the list with the *item selectors*.

Note

Stations started manually in AUTO mode can not be paused or cancelled.

5.2.1.1. Pausing/Resuming programs

Procedure 5.6. Pausing programs

1. When the program is running push the PAUSE button. You will be prompted to confirm:

Figure 5.25. Pausing a program

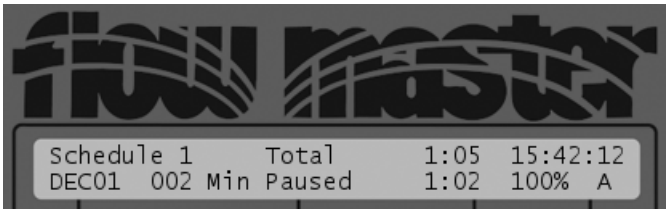
2. Push the ENTER button to pause the program.

   Since programs can only be paused on top of each minute, you might see the controller go into pause pending mode:

Figure 5.26. Pause Pending

3. Once the pause takes effect the display will look like this:

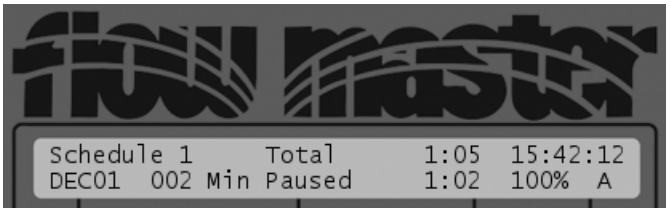
Figure 5.27. Manually run program paused



Procedure 5.7. Resuming paused programs

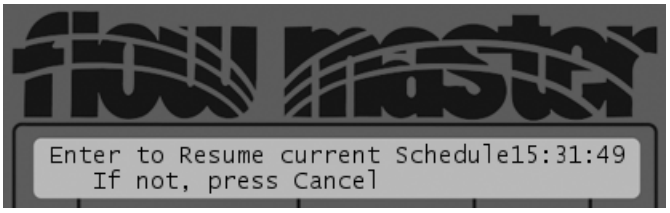
1. A paused program will look like this:

Figure 5.28. Program paused



   To resume the program, push the RESUME button and you'll be prompted to confirm:

Figure 5.29. Resuming a paused program



2. Push the ENTER button and the program will be resumed - just as when pausing a program there might be a slight delay until you pass the top of the next minute. In the mean time the display will look like this, telling you when the program will be resumed:

Figure 5.30. Program resume pending

3. Once the program is resumed the display looks just as when the program is running normally:

Figure 5.31. Program resumed

Chapter 6. Troubleshooting from the Controller

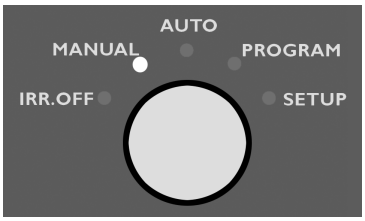
6.1. Running the "Water Test"

The "water test" is a built-in program that will activate all 200 decoders in turn. This way you can walk through the landscape and ensure that all decoders are actually pulling the valves open and water starts flowing.

Procedure 6.1. Running the test program

1. Turn the *mode selector* to MANUAL:

   Figure 6.1. Mode Selector in "Manual"

   Now the display will look like this:

   Figure 6.2. Select program or station in manual mode

2. Push the PROGRAM button, select the Test program (located before program number one) and push the ENTER button.

   Now you'll be prompted for how long each station should be run in the test:

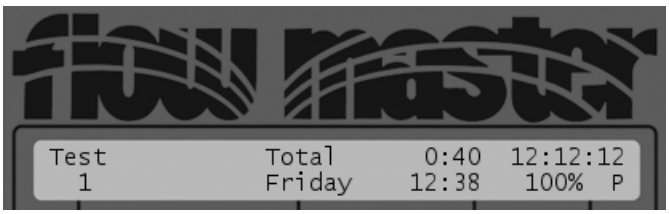
   Figure 6.3. Select station run time in decoder test

3. Use the *item selectors* to set the run time for each station during the test and push the ENTER button.

Now the test program will be scheduled for a run (the TWC NV will only start programs on the top of each minute, so you might have to wait a few seconds for the test to start running in this case we must wait 48 seconds, and the test will run at 12:13:00):

Figure 6.4. Test program scheduled



4. Once the test starts running, the display will look as when running any other program, showing the remaining run time for the full program and for the currently running station:

Figure 6.5. Test running ok

In this example ST001 has just started running and everything looks OK.

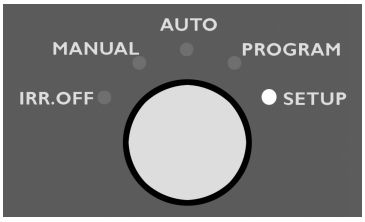
Figure 6.6. Test running, faulty station

An alternative is to run the "Decoder test", which is practically the same thing, except that you move from decoder to decoder manually without the restriction of a fixed run time for each:

Procedure 6.2. Running the decoder test

1. Put the controller in SETUP mode:

Figure 6.7. Mode Selector in "Setup"



Now the display will look something like this:

Figure 6.8. Controller in SETUP mode

2. Select 3. Test, then 1. Test of Line Decoders and push the ENTER button.

   Now the display will look like this:

Figure 6.9. Select station run time in decoder test

3. Push the ENTER button to start the test.

   Now you can inspect the valves in the fields one at a time - you simply skip to the next decoder by pushing the ENTER button.

6.2. Testing Programs

The easiest way to test whether a program is running correctly that is, it activates the correct decoders, master valves and booster pump relays is to try to run the program manually. Check out Running a program in manual mode [page 38] for instructions on how to do this.

Tip

If you don't want to wait the entire program out just to see that everything activates in the right order, you can decrease the water budget to 1 percent (check Section 4.2.4, “Setting the water budget” [page 29] for instructions) before running the program.

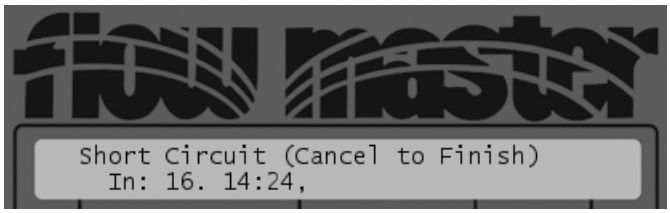
This way you can "follow" the program by walking from decoder to decoder in the terrain as they activate for just one percent of the original run time (at least one minute per decoder).

6.3. Testing the Two-wire Path

When in AUTO or MANUAL mode, the first indication that you might have a short or a fault somewhere on the two-wire path is that the *line activity indicators* (the green and red LEDs on the controller) will flicker, or be not lit at all.

If the TWC NV senses a current leak somewhere, the two-wire path will move to 50Hz mode, meaning that the LEDs will flicker extremely fast . After a while you'll see an indication that a short occurred:

Figure 6.10. Short circuit notice



If the leak is severe (current more than 600-650mA), the LEDs will turn off due to the loss of voltage - this is a built-in security mechanism that prevents the controller from short circuiting However, current will still be running on the two-wire.

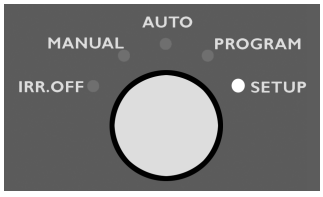
Note

You can make the controller display voltage and current:

Procedure 6.3. Making the controller display voltage/current

1. Put the controller in SETUP mode:

Figure 6.11. Mode Selector in "Setup"



Now the display will look something like this:

Figure 6.12. Controller in SETUP mode

2. Select `3. Test` and push the ENTER button.

3. Select `4. Line survey` and push the ENTER button.

   Since the line survey was not previously activated, you will see this display with voltage and current readings in the upper right hand corner:

Figure 6.13. Controller showing line survey data

Had the line survey been active the controller would have switched back into showing the current time instead.

Note

The display will return to showing the time if you power down the controller.

There are two stages of testing the two-wire for shorts: you can run a built-in short test from the controller, and if something seems wrong, you can inspect the two-wire in the field, using a clampmeter.

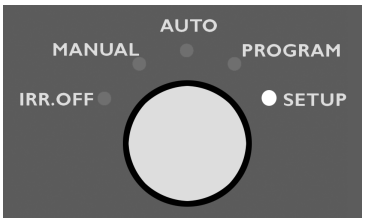
6.3.1. The Built-in Short Test

If you suspect your system to have a short somewhere in the field, you can validate your suspicion by using the built-in short test in the controller. This test won't tell you anything you can't see if you've configured the controller to display voltage and current in the display, but it's the first step in the troubleshooting process:

Procedure 6.4. Running the short test

1. Put the controller in SETUP mode:

Figure 6.14. Mode Selector in "Setup"



Now the display will look something like this:

Figure 6.15. Controller in SETUP mode

2. Select `3. Test` and push the ENTER button.
3. Select `2. Short Finding` and push the ENTER button.
4. Inspect the measurements in the display:
   - If the two-wire is ok, the voltage will be relatively high (34-35V), and the current relatively low. In a test setup this is what it looked like:

     ### Figure 6.16. No short on two-wire path

     The voltage is 35V and the current is 9mA.

     In addition, the *line activity indicator* LEDs will be constantly lit.

   - If there is a short somewhere in the system, the voltage/current relationship is reversed, and you'll see a relatively high current and lower voltage instead:

     ### Figure 6.17. Short on two-wire path

     Now the voltage is 0V and the current is 229mA something is causing the system to "eat up" a lot of current.

     In addition, if the voltage is very low, the *line activity indicator* LEDs will both be out.

   - If the voltage is just slightly lower than normal (31-35V) you should consult Table 7.1, “Scenarios with power readings between 31V and 35V” [page 57].)

5. You exit the short finding mode by pushing the CANCEL button.

If you find that there's a short in your system, you should try to locate it, using a clampmeter . Check out Section 7.4, “When there is a Short Circuit in the Field” [page 62] instructions on doing this.

Chapter 7. Troubleshooting in the Field

You discover problems with the installation in the field in a number of ways. The following four sections walk you through how to deal with the most frequent scenarios.

7.1. Checking Power and Current Readings

In a healthy system you should see power and current readings for the two-wire path along these lines:

	Idling	**Heavy Usage (many decoders running)**
Power	33-35V	31-34V
Current	0-3mA (no decoders attached)	400-450mA

Tip

See Section 6.3, “Testing the Two-wire Path” [page 50] for instructions on how to do power and current readings in the display of the TWC NV.

To get a more precise idea of how your current reading should be, you should add the standby usage and the usage for any running units, using these rules of thumb:

Standby Usage

When idling, all connected decoders (this includes master valves and booster pumps) will consume around 0.5mA each. This is not an exact number and will vary by 20-30 percent in each direction - it's normal to see idle consumption in the 0.4- 0.65mA range.

So, for example, 20 connected decoders will consume around 8-13mA and 100 units will consume some 40-65mA. Add to this the standby usage of any other devices connected to the two-wire.

Important

These numbers are for regular small decoders with just one valve connection - decoders with four or six valve connections consume around 1mA. If using decoders with several valve connections, remember to adjust for this in the following examples.

Active Decoders

When active, any decoder, controlling a valve, master valve or booster pump, will consume around 15-25mA.

This means that when running just one decoder, a master valve and a booster pump on a system with 100 connected units, you may use around 115-140mA.

Here are a couple of practical scenarios and how to deal with them:

If the power reading is below 25V

The field installation is consuming so much power that the TWC NV has lowered the power on the two-wire, and you should go locate the problem in the field (Section 7.4, “When there is a Short Circuit in the Field” [page 62].)

Note

The current reading can be "normal" in this situation (400-450mA or lower) - this is one of the TWC NV's safety features.

If the power reading is between 25V and 31V

This is abnormal. The TWC NV will keep running normally, but there's a probability you have a short somewhere you should go locate the problem in the field (Section 7.4, “When there is a Short Circuit in the Field” [page 62].)

If the power reading is between 31V and 35V when no stations are running

In this range you must inspect the current to estimate the health of your system.

Table 7.1, “Scenarios with power readings between 31V and 35V” [page 57] tries to give you an idea of whether or not your system is behaving as expected. You calculate the expected current as `0.5mA x <number of decoders>`. Though no decoder consumes exactly 0.5mA, the figures even out the more decoders you have connected to your system.

Important

Troubleshooting is not an exact science and this is not matrix for exactly determining the health of your system. This table can help point you in the right direction though.

Important

These numbers are for regular small decoders with just one valve connection - decoders with four or six valve connections consume around 1mA. If using decoders with several valve connections, remember to adjust for this in the following examples.

Table 7.1. Scenarios with power readings between 31V and 35V

Current	Current could be in these ranges depending on the number of connected stations:					State
	20	**40**	**60**	**80**	**100**	
Low current (Less than -15%)	< 9mA	< 17mA	< 25mA	< 34mA	< 42mA	It is possible that one or more decoders are not connected correctly. Try running the test program (See).
Normal current (-15% - +20%)	9-12mA	17-24mA	25-36mA	34-48mA	42-60mA	Everything is fine the system is looking healthy.
High current (+20% - +50%)	12-15mA	24-30mA	36-45mA	48-60mA	60-75mA	You might have a problem somewhere on the two-wire causing an excess consumption. This is no more than the TWC NV can handle, but you could be looking at problems that dramatically increase under more moist conditions see Section 7.1.1, “Problems on the Two-wire” [page 57].
Excessive current (More than +50%)	> 15mA	> 30mA	> 45mA	> 60mA	> 75mA	This is a risky situation that can interfere with the functionality of the TWC NV, and you should locate the problem in the field right away. It will typically be a bad connection or a cable left open-ended in the field. Troubleshooting is identical to when locating short circuits in the field (Section 7.4, “When there is a Short Circuit in the Field” [page 62]), but the current will not be as excessive as when a short occurs.

7.1.1. Problems on the Two-wire

It only takes seemingly innocent cracks in the cable insulation or connections to cause big problems: If you remove the insulation on just 1/3 of an inch on a AWG14 cable (both wires) and immerse the cable in water the current can increase by 30mA. If you immerse into salt water the current increases by as much as 170mA.

Obviously this means that just a handful of minor cracks in the insulation can add up to a substantial increase in the current reading, and the problem in detecting these kinds of problems is that they seem to come and go, depending on how moist the soil is.

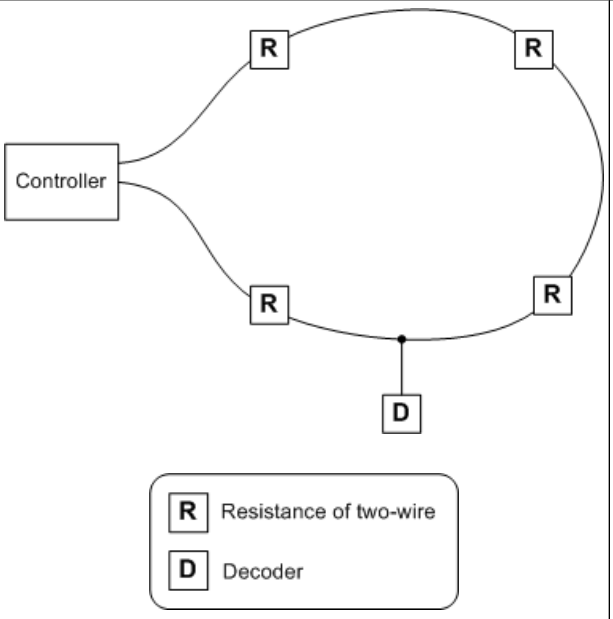
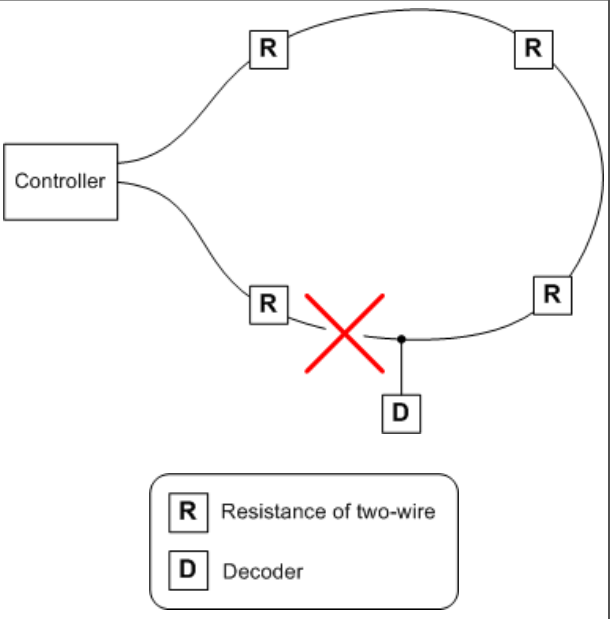
7.2. Dealing with Unstable Decoders

If a decoder seems to fail randomly, typical reasons include:

- The faulty decoder is not connected and placed in the field.
- There are leaks in the insulation on your two-wire - when the soil is dry everything works just fine, but when it gets more moist, decoders seem to fall out randomly. See the previous section (Section 7.1, “Checking Power and Current Readings” [page 55]) for more details.
- In case you have a loop installation, problems may occur if the loop is broken, as the resistance between a decoder and the TWC NV can increase, pushing up the power consumption:

Note

We do not recommend using loop installations since troubleshooting these can be a complex process.

Normal Loop	Loop Broken
	
The resistance between the decoder and the TWC NV is 0.75*R	The resistance between the decoder and the TWC NV is 3*R

To find out whether your loop is broken, follow this procedure:

1. Open the loop in one end if the loop goes all the way back to the TWC NV, just detach one of the two-wires on the controller.
2. Perform an "electrical test" as described in ???. This will activate each in turn if you see decoders failing, chances are that they are on a stretch of the two-wire that has been orphaned by a break of the loop in the field.
3. If everything is still OK, close the loop and open it in the other (detach the opposite two-wire of the one you just tried) end and re-run the test.

If the same decoders keep failing, you should look at the instructions in the following section, Section 7.3, “Dealing with Failing Decoders” [page 59].

7.3. Dealing with Failing Decoders

More often than not, what seems to be a faulty decoder is really a problem on the two-wire between the decoder and the TWC NV, since this is the most vulnerable part of your system.

The approach to troubleshooting failing decoders vary a bit depending on whether you just have one, or several failures the following two sections talk about each scenario.

7.3.1. A Single Decoder Fails

If the failing decoder has just been installed, did you remember to enter the right address for it? See Section 4.1, “Configuring field decoders” [page 19] for instructions.

If the failing decoder has been known to work, perform the electrical test (???) on the decoder in question and follow these guidelines:

If there's little or no reaction from the decoder	1. Put the TWC NV in "Short Mode" (see Section 6.3.1, “The Built-in Short Test” [page 51]), go to the decoder in the field and perform these tests: • Check wires and connections between the two-wire, the decoder and the solenoid (See Figure 7.1, “Checking Connections” [page 60].) • Short circuit the two-wire at the decoder and use a clampmeter to check if power is still OK - if this is the case, the problem is in the decoder or solenoid, and not on the two-wire between the decoder and the TWC NV (See Figure 7.2, “Testing the path to a decoder” [page 60].) • Detach the solenoid and measure the resistance of the solenoid itself. Compare this to another solenoid of the same type (the resistance is typically 20-60 ohms.) If the resistance is significantly higher, try replacing it.  **Note** Some solenoids come with a diode on one of the wires. This is to indicate that the solenoid is polarized and the connection of the wires to the solenoid is significant. Thus you can try to swap the two wires around and see if it makes a difference.

	Others will have red and black wires, indicating the polarity black is minus, red is plus.
If the decoder fails with to high power reading	• Check the two-wire between the solenoid and the decoder for cracks in the insulation or bad connections. • Detach the solenoid from the decoder and measure the resistance of the solenoid itself. If the resistance less than expected, it might be damaged by lightning or it might have a leak. Try replacing the solenoid.

Figure 7.1. Checking Connections

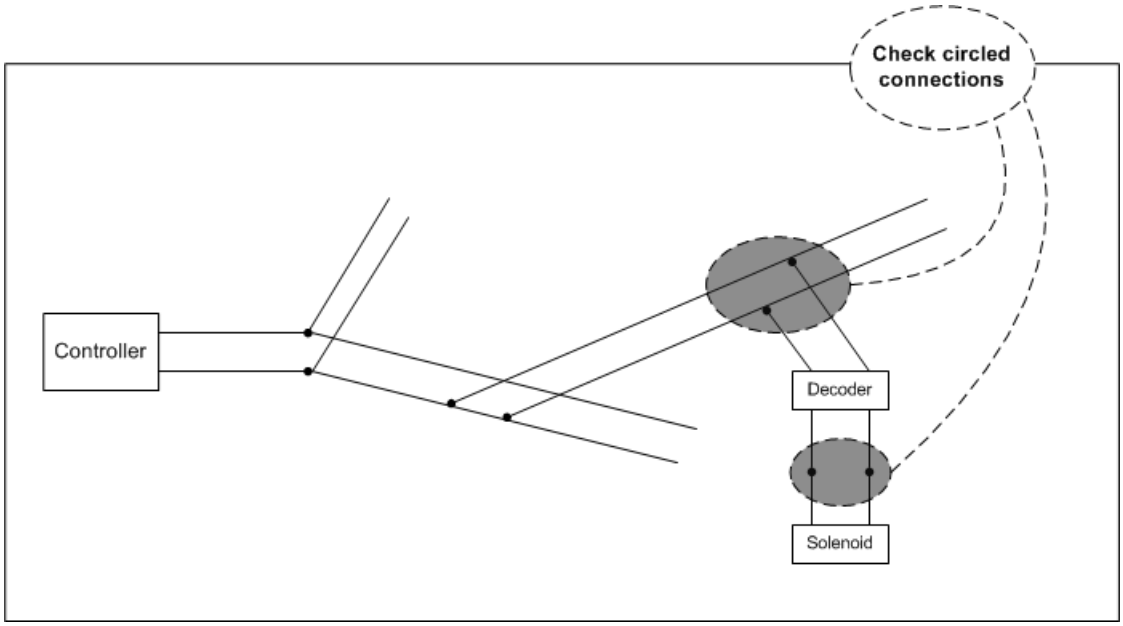
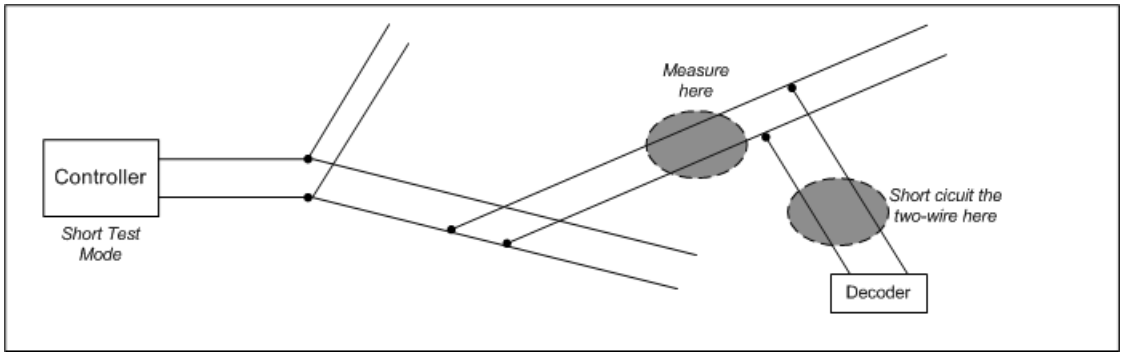


Figure 7.2. Testing the path to a decoder



7.3.2. Several Decoders Fail

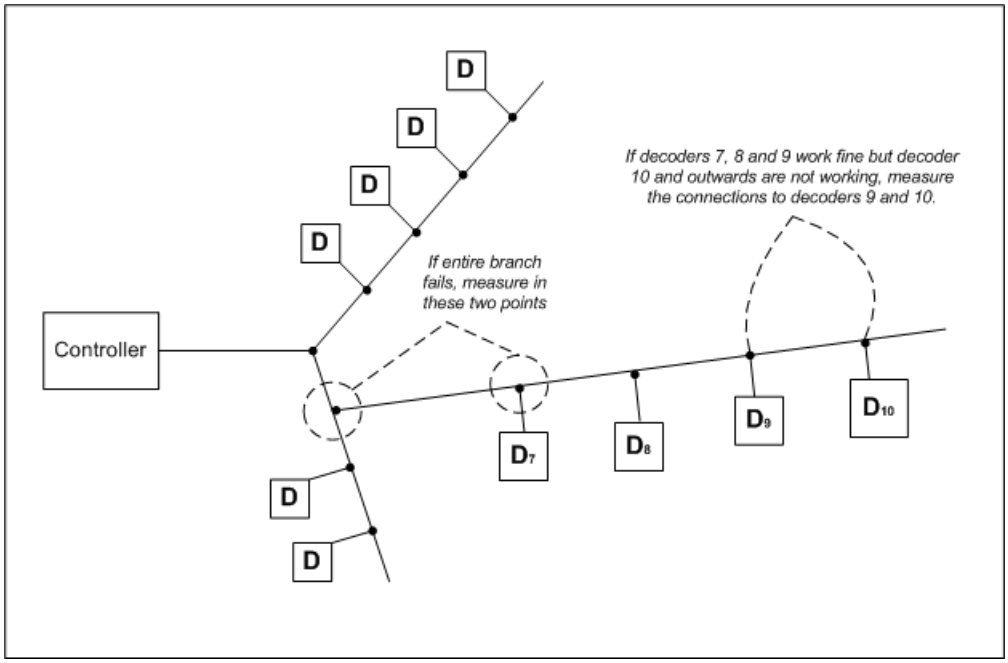
Here is a checklist if multiple decoders fail:

- If two decoders have identical addresses (this can happen if you have decoders from different factory batches, since each batch gets addresses assigned from a fixed number range,) you can get a rather confusing behavior in the system. Imagine the following scenario:
  - We consider two decoders, **M** and **N**.
  - You have configured decoder **M** to have the ID "ST20".
  - Decoder **N** should have been called "ST21", but by mistake you configured this to be "ST20" as well.

When you:	**The following happens:**	**Because:**
Try to activate "ST20"	**M** and/or **N** might fail to open.	Since both decoders think they're "ST20", they'll both try to open. If you're lucky, there's enough current on the two-wire to pull open both, but depending on the current and the resistance in the solenoids, one or both can fail to open.
Try to activate "ST21"	Both **M** and **N** fail to open.	None of the decoders react to "ST21" since they both think they are "ST20."

- If you're dealing with a new installation, and the failing decoders seem to be spread randomly in the field, you could be looking at solenoids with built-in diodes - on this type of solenoid it is significant which one of the wires in the cables are connected to what (see Section 7.3.1, “A Single Decoder Fails” [page 59] for more details.)
- If the failing decoders are located on the same dead end branch of your two-wire, chances are that the connection to the branch is faulty. If all decoders from a point on a branch and outwards fail (decoders 9 and 10 in the illustration below), measure the connection to each decoder until you reach the point of failure.

Figure 7.3. Checking a branch



If all connections seem ok, the two-wire itself might be damaged - things to look for along the two-wire:

- Any signs of digging in the ground? Wild animals and staff under equal suspicion here.
- Has any other kind of machinery been at work and unknowingly penetrated the two-wire?
- Check all transitions where the cable runs from underground to over ground, from soil to pipes etc.

Important

If you replace a stretch of the two-wire, make sure to remove the old part completely, as the old piece of cable might interfere with the current in the new cable.

7.4. When there is a Short Circuit in the Field

A "clean" short circuit in the field direct connection between the two wires in the two-wire path with zero Ohms resistance - will cause the TWC NV to put up the following warning:

Figure 7.4. Short circuit notice

Note

In addition to this warning, you'll see that the *line activity indicator* is constantly lit instead of blinking as it normally does. If the short is very severe the *line activity indicator* may stop working all together (Check out Figure 3.3, “Controls on the TWC NV front plate” [page 14] if you don't remember what the *line activity indicator* is.)

But you can't always be sure that the TWC NV will be able to detect a short circuit in the field if the short is in the far end of the cabling, the controller may just experience it as heavy usage. However, the current reading will always reveal a short as the current will be significantly higher than normal (Could exceed the expected value with 100mA or more.)

Typically a short circuit in the field is either a problem with the two-wire itself (cracks in the insulation, bad connections etc.) or consequences of lightning striking the system, damaging decoders, solenoids or other electronics attached to the two-wire.

7.4.1. Using a Clampmeter

In order to use a clampmeter, you need physical access to the individual wires in your two-wire cable - just measuring on the entire two-wire will not work.

Procedure 7.1. Using a clampmeter for short finding

1. Follow the first two steps of Running the short test [page 51] and select "Clampmeter (50/60Hz)."
2. Set the clampmeter to "50 Hz mode" or equivalent. Setting it to "Wide Range" or similar modes might not work out.
3. Now start measuring the two-wire from the controller and out. You measure the two-wire by placing the clampmeter around one of the wires in the two-wire path. When the measurement on the clampmeter is substantially lower than what you see in the controller display, you've passed the point of the short.

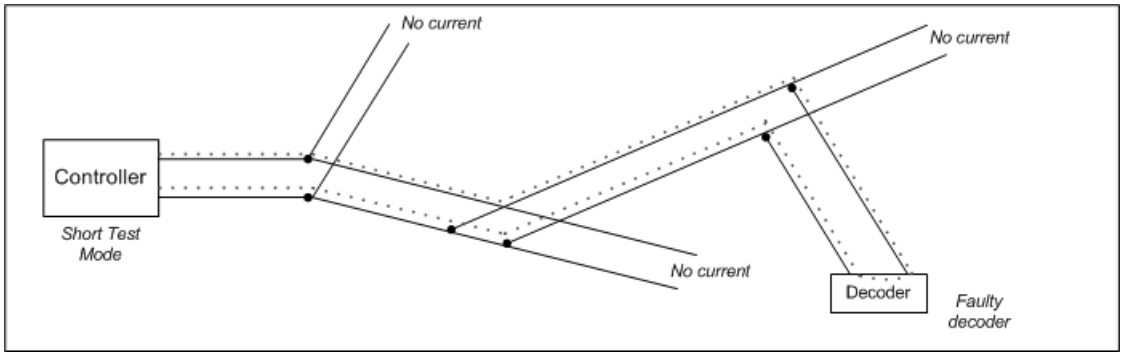
7.4.2. Locating the Short

Before trying to locate the short in your system, make sure you have the following:

- A clampmeter.
- An "as-built" drawing (or equivalent knowledge) of the cable layout for the two-wire path. Notably you need to know of all branches and loops.

The overall rule of thumb when looking for a short is that the current will move from the controller directly to the short and back. This means that you can **"follow the current"** and eventually be led to the short:

Figure 7.5. Faulty decoder



Note

If your installation loops back to the TWC NV you must open the loop, or you won't know which way the current is running around the loop and troubleshooting will be almost impossible.

Note

We do not recommend using loop installations since troubleshooting these can be a complex process.

Troubleshooting falls into three phases and the following three procedures explain how you should go about locating the problem. Walking through each procedure in turn should ensure efficient troubleshooting: Phase I: Checking for Problems at the Controller [page 64], Phase II: Locating a Faulty Branch in the Field [page 65], and Phase III: Performing a "Binary Search" on a Faulty Branch [page 66].

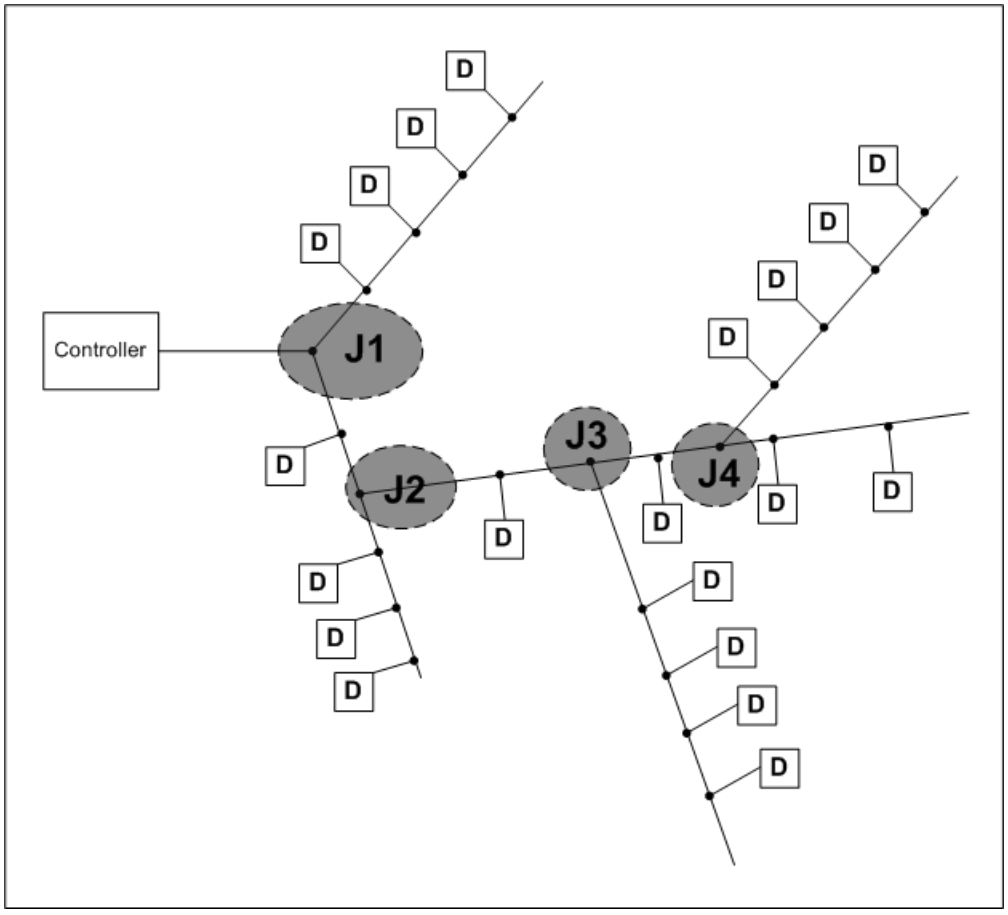
Procedure 7.2. Phase I: Checking for Problems at the Controller

1. Measure the current at the point where the two-wire path is connected to the controller. Measure on both wires in the two-wire path. Note down your readings as you'll use these for comparison if you need to locate a faulty branch in the field (Phase II: Locating a Faulty Branch in the Field [page 65].)

   - If one of the cables connected to the TWC NV loops back to the controller, you must open the loop before measuring.
   - If more than one non-looped cable is connected to the TWC NV, you can already now determine which cable holds the short - it will be the one with the highest current reading.
   - If more than one non-looped cable seem to hold a short, detach all of them and connect and fix one cable at a time.
   - If there is a significant difference between the reading on the two wires in a two-wire, the one wire might have a leak to earth or to the chassis of the TWC NV.

2. If all readings in the previous step seem OK, or maybe even a bit lower than expected, you could be looking at at error in the controller itself. To find out if this is the case, detach all two-wire paths connected to the controller and check the power and current reading: If it is around 32-35V and 0-3mA the controller is OK - otherwise it is defect.

Procedure 7.3. Phase II: Locating a Faulty Branch in the Field



1. Measure in Junction 1 (J1.)

   - If you get no readings from either branch, the problem is on the part of the two-wire leading back to the TWC NV - perform a binary search on this part of the cable (See Phase III: Performing a "Binary Search" on a Faulty Branch [page 66] for instructions.)

   - If your readings on one of the branches are the same as when measuring at the controller (This is the first thing you do when troubleshooting the two-wire see instructions in Phase I: Checking for Problems at the Controller [page 64]) you move on further out one branch at a time, measuring in every fork you meet (J2, J3, J4 etc.) until you locate the faulty branch.

     ### Important

     If you reach a branch that is looped back to the two-wire elsewhere, make sure to open the loop before measuring, or you won't detect the faulty branch.

   - If you have a decoder attached to the junction itself, make sure you measure on that as well, as the decoder and not the two-wire could be the problem.

   - If you get readings on both branches after the junction but they are significantly lower than at the controller, you have problems on the two-wire on both the stretch from the controller to the junction,

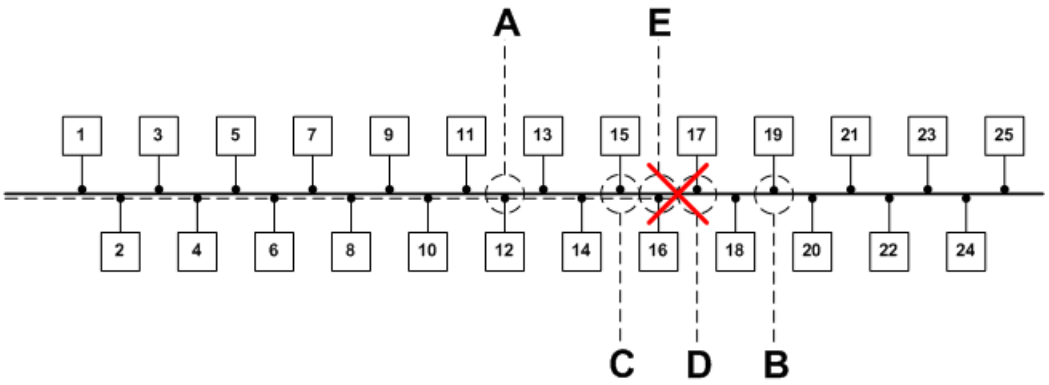
and further out as well. Detach the junction and start by finding the problem on the stretch from the controller - then attach the junction again and work on each branch.

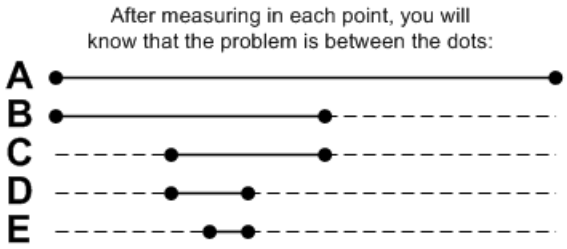
2. When you locate the faulty branch, move on and perform a binary search on the branch as explained in Phase III: Performing a "Binary Search" on a Faulty Branch [page 66].

Procedure 7.4. Phase III: Performing a "Binary Search" on a Faulty Branch

A binary search can help you locate a problem on the two-wire in a structured manner. The concept of a binary search is this: Find a point on the cable where you know for sure current is running. Find another point where there is little or no current. Now measure in the middle between these two points. If you measure current in the middle, you know for sure that there is no problem between the middle and the point where you know current is running - the problem must be in the other half, and you can now repeat this approach at the other half.

Looking at the graphic below we imagine that current is running at decoder 1, but no current is running at decoder 25. To start the binary search we measure in the middle, at point A:





1. You measure in point A and find that the current is running. Now you know that the problem is somewhere between decoder 12 and 25.

2. You measure in point B and find no current. This means that you're in the "dead" half of the cable the problem is somewhere between decoder 12 and 19.

3. You measure in point C and find that the current is running. The problem must be between decoder 15 and 19.

4. You find no current in point D the problem is narrowed down to between decoder 15 and 17 just one more reading will tell you for sure where the problem is.

5. Since you find the current in E to be OK, the problem must be between decoder 16 and 17.

6. If you don't want to replace the entire cable between decoders 16 and 17 (it might be a longer stretch,) you can perform a new binary search on the cable itself, using a clampmeter.

Appendix A. Rain and pump alarms

As shown in the installation instructions (Section 2.2, “Connecting the Controller” [page 8],) the TWC NV allows for a rain sensor and an auxiliary sensor, often used for a pump alarm.

Note

Flow alarms and flow sensors can only be handled from the PC software accompanying the controller and is not discussed here.

The information in this section is for rain and AUX/pump alarms only

When the TWC NV receives an alarm, it will show in the display:

Figure A.1. Rain alarm active

This means that a rain alarm was received at 16:15 on the 12th day of the month.

A rain alarm will cause all irrigation to stop immediately, and a pump alarm will also stop all stations at once.

Important

The TWC NV is still running any active programs inside - it's just not signalling to the stations in the field to actually carry out the irrigation. This means that once the alarm goes away the controller won't just resume the halted program - instead, normal operations are resumed, as if no alarm had ever been active.

Should the alarm go away in the in the middle of a program, irrigation will start at the next step. So, if the alarm goes away seven minutes into a ten minutes step, it will be another three minutes before you will see the valves open in the field.

Since the alarm is still ongoing - it is still raining - there is no time in the `Return` field (Think of `Return` as the controller "returning to normal state.") Had the alarm passed, the display would look like this:

Figure A.2. Rain alarm over

If the alarm is over (it stopped raining,) the message will disappear when you push any button on the controller. But as long as the alarm is still active (it's still raining,) it will reappear every time you turn the mode selector to a new mode, reminding you that you still have an alarm.

Note

Should your rain and pump alarms both be active, the second alarm will display when you "push away" the first one, and only after acknowledging that one as well can you carry on programming the controller.

Follow this procedure to set up your controller for alarms:

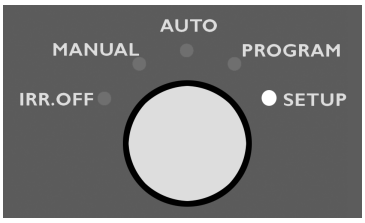
Procedure A.1. Configuring the controller for rain and pump sensors

1. Make sure that your switch settings (see switches seven and eight in Appendix D, *Changing DIP switch settings* [page 77]) match those of your sensors.

2. Make sure that your sensors are connected to the controller as described in Section 2.2.2, “Connecting Sensors” [page 10].

3. Put the controller in SETUP mode:

   Figure A.3. Mode Selector in "Setup"

   Now the display will look something like this:

   Figure A.4. Controller in SETUP mode

4. Select 1. Installation and push the ENTER button.

   Depending on your switch settings (see Appendix D, *Changing DIP switch settings* [page 77]) the display will look in one of two ways:

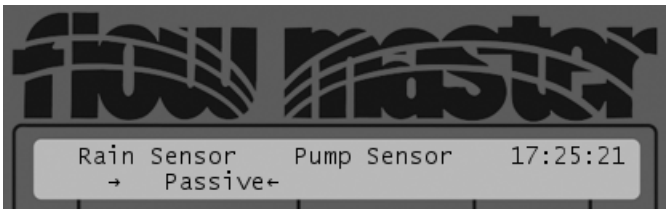
Figure A.5. Installation menu with switch number 10 open

Figure A.6. Installation menu with switch number 10 closed

5. Select `4. Sensors` (or `5. Sensors`, depending on your switch settings.)

   Now the display will look like this:

Figure A.7. Toggling rain sensor state



6. Now use the *item selectors* to select the state (active/passive) of the rain sensor and push ENTER to save.

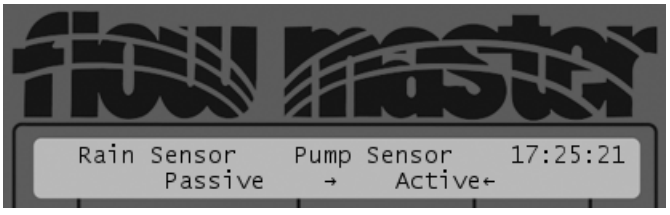
   

   ## Important

   If sensor is put in "Passive" state, the controller will not react on incoming alarms of that type.

   This will take you on to editing the pump sensor state:

Figure A.8. Toggling pump sensor state



7. Use the *item selectors* to set the state of the pump sensor and push the ENTER button to save and return to the menu.

   Now your controller is ready to accept alarms and halt irrigation upon active alarms.

Appendix B. Decoder Types

The factory default for your TWC NV is to allow you to choose between just two built-in decoder types: RB1 for one decoder and RB2 for two decoders,[1]. These decoders have a fixed switch code of 59F350, and allow for one or two attached valves, respectively.

If your needs are more advanced you can define up to five different decoder types manually and use these when configuring decoders as described in Section 4.1, “Configuring field decoders” [page 19].

Note

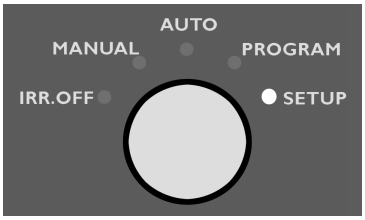
Before moving on, make sure you are familiar with how to navigate and edit data in the display - see Section 3.2.2, “Navigating in the display” [page 16] for instructions.

Procedure B.1. Defining custom decoder types

1. First you must set switch number 10 to "Closed" as described in Appendix D, *Changing DIP switch settings* [page 77].

2. Now turn the mode selector to SETUP mode:

Figure B.1. Mode Selector in "Setup"



If your DIP switch settings were correct, you should see a menu item called 1. Valve Types:

Figure B.2. Installation menu with Valve Types item

3. Select 1. Valve Types and push the ENTER button.

[1]The RB name has no real meaning but remains for historical reasons.

Figure B.3. Custom decoder type list

4. Select one of the five decoder types and push the ENTER button.

   Now the decoder entry will be opened and the switch code field is selected:

Figure B.4. Custom decoder switch code selected

5. Push the ENTER button to activate the switch code field for editing, set the switch code with the *item selectors* and push ENTER to save.

6. Move to the No. of valves column, activate it by pushing the ENTER button, set the number of valves this decoder must be able to open (1-10) and push ENTER to save. This is the number that the controller will use to keep track of how many valves are open in the system.

7. Move to the OK field and push ENTER to save the decoder and return to the Installation menu.

8. Repeat from step four from all the decoder types you wish to configure.

9. Now your custom decoder types will be selectable when entering decoders as described in Section 4.1, “Configuring field decoders” [page 19].

Appendix C. Running linked programs

If you want to run all your programs back to back instead of running them at independent water days and start times, you can use the "link" feature of the TWC NV.

Here's how it works:

- Program number one is declared the link master schedule (see procedure below) and you set the water days and start times as you normally would for any other program (see Section 4.2, “Configuring irrigation programs” [page 22] for instructions)
- All other programs will now have their start times ignored, and you can not edit the start times at all. The remaining programs will simply run back to back, following the start times of program number one.

Important

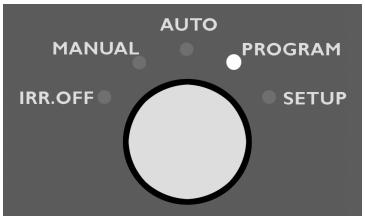
Slave programs will not be run if they are not set to run on the day the master runs. And if they are set to run on days that the master is not, they won't be run either.

Setting up the TWC NV to run in link mode is very simple:

Procedure C.1. Configuring for back to back irrigation

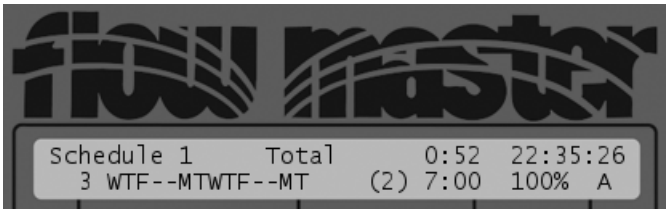
1. Move the mode selector to PROGRAM:

Figure C.1. Mode Selector in "Program"



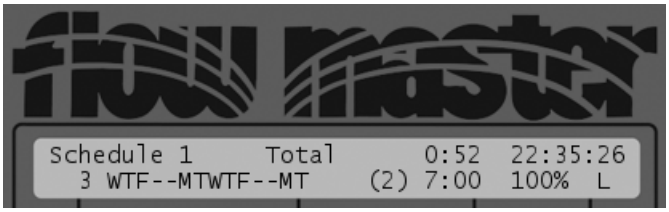
Now you'll see the settings for program number one:

Figure C.2. Program mode



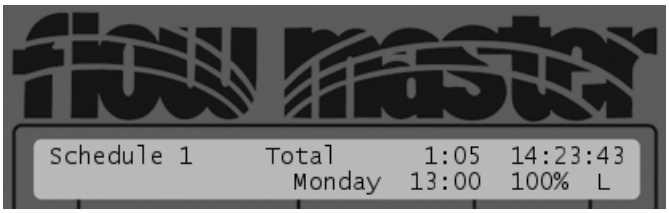
2. Push the ACTIVE/PASSIVE button until you see an "L" in the display:

Figure C.3. Program set to linked mode



3. Move the *mode selector* to AUTO - you'll see the "L" in the lower right hand corner of the display, indicating that the controller will run in linked mode:

Figure C.4. Idling in AUTO mode, waiting or link master



Appendix D. Changing DIP switch settings

The controller lets you emulate a number of DIP switch settings directly in the display (in older versions of the controller you had to open the cabinet a physically flip the switches.)

A DIP switch can be either open or closed, and the TWC NV behavior changes according to these settings. Each DIP switch concerns a specific setting area - the table below explains which DIP switches can be toggled, the setting area they concern, and what the different settings mean:

Note

Changing the settings for DIP switches 1-5 has no effect on the controller.

Table D.1. DIP Switch Settings

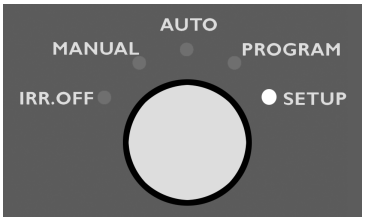
Switch Number	Setting area	Open	Closed	Comment
6	Serial port communicate with	Modem	Direct connection	Deprecated - not used.
7	Pump sensor type	Normally closed	Normally open	Check your sensor documentation for what to choose here.
8	Rain sensor type	Normally closed	Normally open	Check your sensor documentation for what to choose here.
9	Maximum number of decoders per step	5	10	This determines how many station slots will be available in each step when configuring irrigation schedules. See Section 4.2.1, “Assigning steps, stations and run times” [page 25] for details.
10	Decoder types	RB 1 & 2[a]	5 custom	If Open, you can choose between just the two built-in types. If Closed, you can define five decoder types yourself which you can then choose from when configuring decoders. See Appendix B, *Decoder Types* [page 73] for details on how to define your own decoder types. See Section 4.1, “Configuring field decoders” [page 19] for details on how to configure the decoders in your system.
11	Water day period	15 days	14 days	
12	Input alphabet	Full	Limited to 1234567890SGLDB	The RFA 100 field unit only supports the limited character set, so if you plan to use an RFA 100 you should set this switch to Closed to avoid having station names you can not enter on the RFA 100.

[a]The RB name has no real meaning but remains for historical reasons.

Procedure D.1. Changing DIP switch settings

1. Put the controller in SETUP mode:

Figure D.1. Mode Selector in "Setup"



Now the display will look something like this:

Figure D.2. Controller in SETUP mode

2. Scroll to 6. Switch Settings (if you have already changed switch no. 10 to "Closed" it will read 7. Switch Settings instead) and push the ENTER button.

   Now the display will look something like this:

Figure D.3. Changing DIP switch settings

   The top row of numbers (2109 8765 4321) represents the 12 switches - 2 is short for 12, 1 for 11 and 0 for 10.

3. Use the item selectors to toggle between "O" for Open and "C" for Closed.

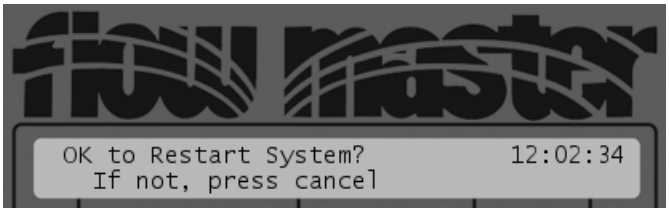
   When you are done with a switch, push the ENTER button and the TWC NV will take you to the next in line.

Note

After saving the setting for switch number 5. you will exit the menu, as switches 1-4 can not be edited.

4. If you made any changes to the switch settings you will be prompted to allow a reboot of the controller:

Figure D.4. Prompting for restart



5. Push the ENTER button to restart the controller or push the CANCEL button to cancel.

   If you accept the restart, the controller will restart in about 30 seconds.

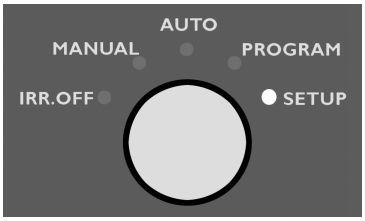
Appendix E. Clearing failed valves

If the controller has detected a problem with a decoder or valve, it will show up on the failed decoders list.

You can view the list by moving the *mode selector* to SETUP mode

1. Move the *mode selector* to SETUP mode:

Figure E.1. Mode Selector in "Setup"

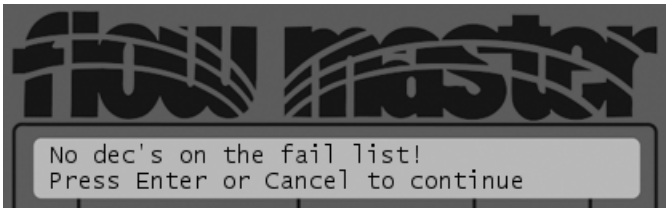


2. Select 1. Installation and then 2. Decoders Failed. Now you'll see the list of failed decoders:

Figure E.2. Failed decoder list

In case there are no decoders on the list, you'll see a message like this:

Figure E.3. Failed decoder list empty



3. To clear a decoder from the list and let it be used again, select it from the list, push the ENTER button. Now you'll be prompted for a confirmation:

Figure E.4. Clearing a failed decoder

4. Push the ENTER button to remove the decoder from the failed list.

Appendix F. Switch Codes

The format of switch codes is as follows:

```
<Group><Control><Inrush voltage><Inrush time><Holding voltage><Holding time>.
```

The meaning of the different parts is:

Group
: Determines the type of device that should react to a broadcast stop commands. Possible values are:

  - 3: Non-irrigation device
  - 4: Pump
  - 5: Valve

Control
: Determines the range of the holding voltage. Possible values are:

  - 9: Low range
  - B: High range

  This is normally set to 9.

Inrush voltage
: Determines the voltage during inrush, when devices are started. Possible values are in a range from 2-9, A-F and 0-1 as listed in the table below. 2 is the lowest and 1 is the highest value.

  This is normally set to F.

Inrush time
: Determines the duration of the inrush pulse, measured in chunks of 10 miliseconds, so 3 equals 30ms, 4 is 40ms etc. Possible values range from 3-9 and A-F, where A-F corresponds to 10-15, so A is 100ms, B is 110ms and the maximum is F, which means 150ms.

  This is normally set to 3. If your valves won't get pulled open, try increasing the value.

Holding voltage
: Determines the holding voltage. This is the current that must be applied after the inrush. Possible values are in a range from 2-9, A-F and 0-1 as listed in the table below. 2 is the lowest and 1 is the highest value.

  This is normally set to 5. If your valves keep shutting off, try increasing this.

Note

Increasing the holding voltage "takes voltage from the rest of the system" and you may end up reducing the capacity of simultaneously running valves.

Holding time
: This is always set to 0.

The table below shows the minimum holding voltage on the decoder output at a two-wire line voltage input of 25V (normally 35V). The output will increase when the two-wire voltage increase. If voltage exceeds 27V the output voltage will be adjusted to avoid unnecessary power usage.

	Holding Voltage	
Voltage select (5th digit)	**Low range (2nd digit set to 9)**	**High range (2nd digit set to B)**
2	0,6	10,1
3	1,6	10,7
4	1,7	11,3
5	2,3	11,8
6	2,9	12,4
7	3,5	13,0
8	4,0	13,6
9	4,6	14,1
A	5,2	14,7
B	5,8	15,3
C	6,3	15,9
D	6,9	16,4
E	7,5	17,0
F	8,1	17,6
0	9,0	18,2
1	9,5	18,8

Glossary

Decoder	The microchip controlled unit handling communication between the controller and all units in the field.
Valve	The valve physically sprinkling out water from the pipe system.
Solenoid	The solenoid is the electrical device that pulls open and closes the valves.
Station	A decoder, solenoid and valve are often referred to as a station. However, the terms station and decoder are used somewhat interchangeably.
Cable	Two wires surrounded by insulation.
Two-wire	Synonym for a cable.
Wire	An individual copper wire.