RKD User Manual

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Chapter 1. Introduction

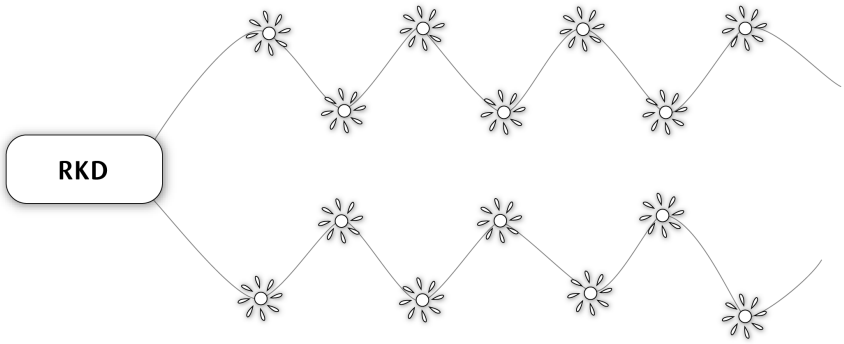
The RKD is a microprocessor based irrigation control system. A central controller and up to 100 field stations comprise a complete system. In addition the controller will accept input from several external sensors in order to adjust its irrigation to the local weather conditions.

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

1.1. The Two-wire Technology

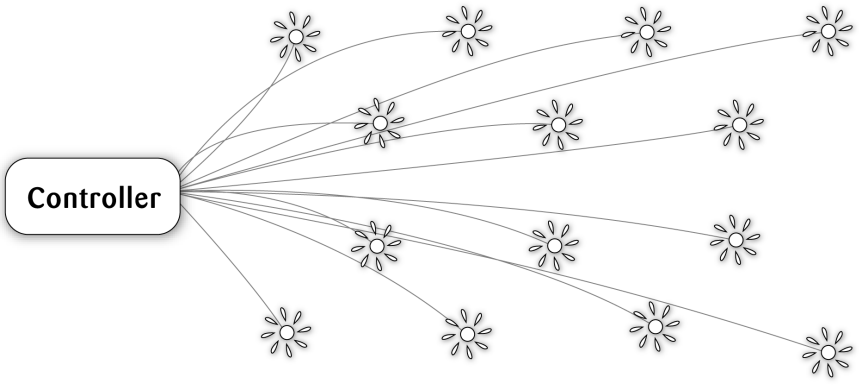
The RKD uses two-wire transmission technology to tell the stations when to act. This means that instead of laying out a cable to each individual valve, just one or two single cables are laid out, and the stations all connect to the same cable(s):

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.

- Ease of expansion: When you need to add a station 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 station 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 stations in the field when to activate their valve.

In the case of RKD, the controller doubles as a station programmer, allowing you to manage the identities of all stations in your system.

1.3. The Stations

Stations in an RKD 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 stations will start and stop the device according to the instructions they get over the two-wire path.

1.4. Irrigation Features

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

- Controls up to 100 field stations, attached to valves or relays.
- Provides ET corrected irrigation for optimal adjusted water consumption.
- Measures water flow and raises alarms or halts irrigation on unexpected flow.
- Operates over as much as 6000 feet of AWG16 cable.
- Allows for 10 independent irrigation programs. In addition there is a fixed test program that activates all 100 stations in turn.
- A program can activate up to 100 stations in named order.
- Each station can run for up to 17:59:50 (In fact, you can boost this even further by increasing the "water budget". Read more in Section 5.3.4, “Adjusting Water Usage (Water Budget or ET)” [34]).
- Each program can activate a one or more booster pumps in addition to the stations.
- All programs have 12 start times per day.
- All programs can run simultaneously.
- You configure each program to run on any selection of days in a 14 day period, or on odd/even dates.
- You can activate one or more valves or programs manually while one or more programs are running, up to a total of 12 simultaneously running valves.
- A master valve can be selected that will open when any program or station is run. You typically assign master valve status to the valve controlling access to municipal water or pumping station.

- Up to 10 moisture sensors that can monitor soil moisture and adjust irrigation accordingly.

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 RKD box should contain the following:

Figure 2.1. RKD Box Contents

- One RKD controller.
- Two keys for the controller cabinet.
- Two mounting pads for the back of the controller cabinet.
- One short current tracker.

2.1. Mounting the Controller

Though the RKD is designed to resist both rain and direct sun light, you should place it in a friendlier environment if possible. Installing the RKD 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 120 VAC.
- 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.

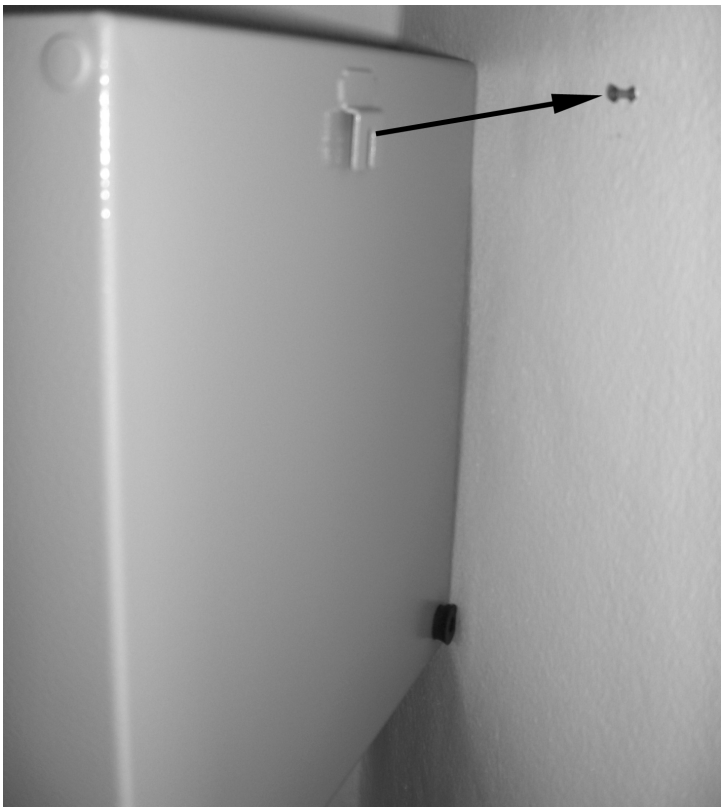
   Important

   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 in 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, 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

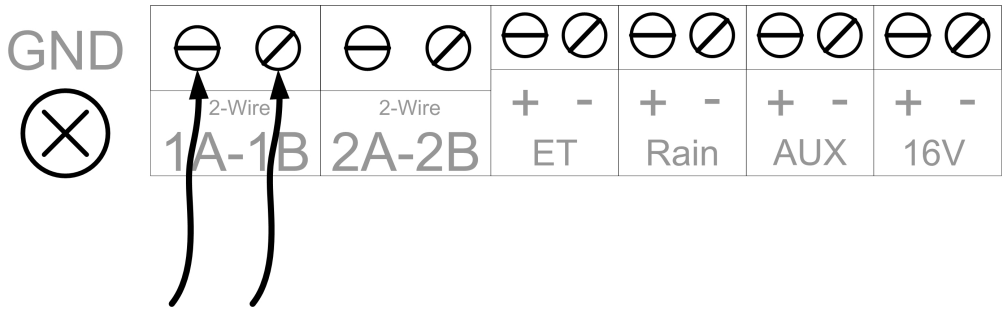
You need to connect two lines to the controller: the power line and the two-wire path.

Warning

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

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

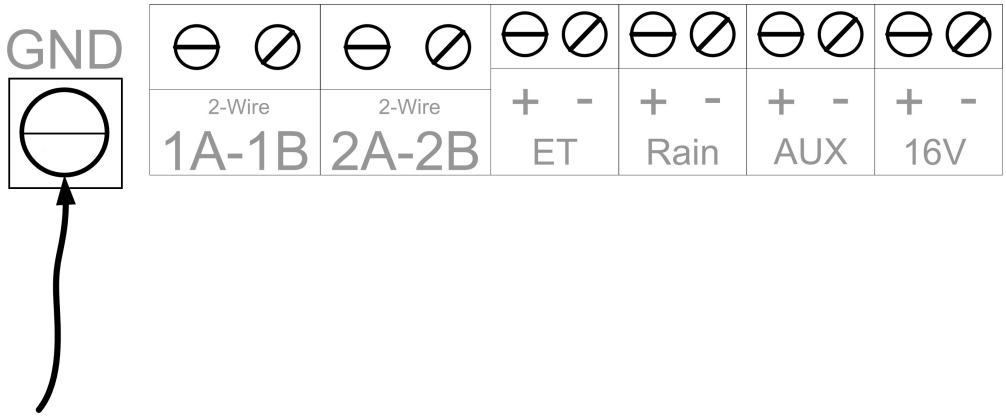


There's room for connecting two cables directly to the controller - the other line can be connected to the terminals labeled 2A-2B. Both wires will receive the same signals when the controller is up and running.

2.2.1. Grounding the Controller

To secure your RKD against lightning, you must ensure that the controller is grounded through a ground rod connected to the ground lug.

Figure 2.6. Connecting a ground rod



Warning

You will void the warranty by not grounding your RKD properly.

2.2.2. Connecting Sensors

The RKD takes input from different sensor types: ET devices, rain sensors, flow sensors and regular auxiliary alarms. This sections shows you how to connect these sensors to the controller.

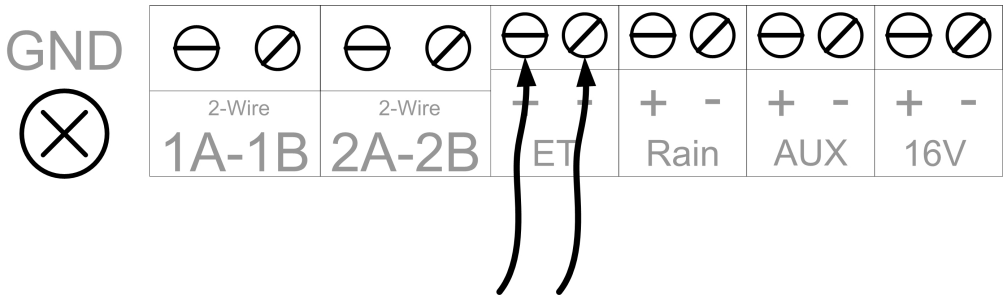
2.2.2.1. Connecting an ET Device

The RKD supports ET in two ways:

1. "ET Enabled" mode in which the controller just lets an external device tell it when to irrigate and when to stay passive. In this mode the controller supports two ET devices: WR-7 and WR100i. To make the controller receive instructions from an ET device, connect the "ET enable A" from the device to the grey terminals labeled "ET."

2. "ET Pulses" mode where you connect a weather station that continuously tells the controller how much water is evaporating. Combined with the input from a rain sensor the controller will then on its own figure out how much to irrigate. Running in this mode you still just connect the weather station to the ET terminals.

Figure 2.7. Connecting an ET device



Important

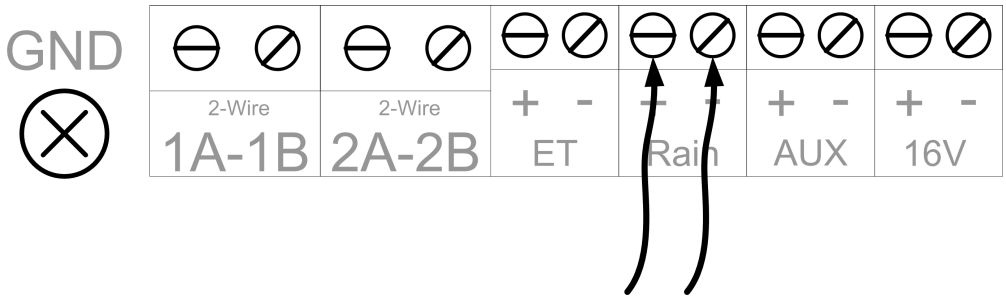
Be aware of the polarity when you connect devices to the RKD: Connect plus to plus and minus to minus or you won't see the expected behavior from the connected devices.

You can read a whole lot more about configuring the controller for ET input in Appendix B, *Adding an ET Device* [101].

2.2.2.2. Connecting a Rain Sensor

You can connect a rain sensor (pulse or switch) to the RKD via the grey terminals labeled "Rain":

Figure 2.8. Connecting a rain sensor



Important

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

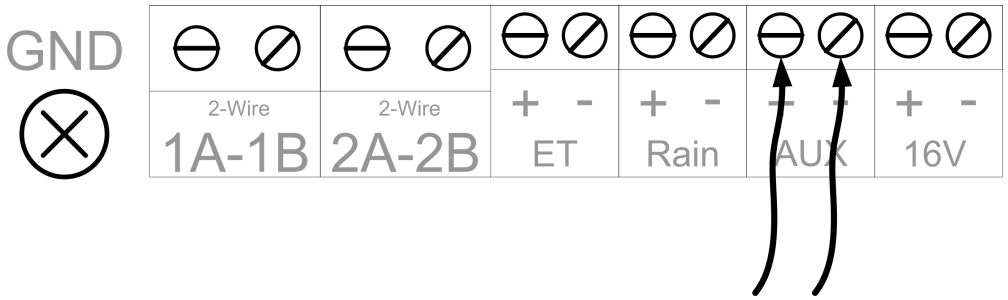
See Appendix A, *Adding a Rain Sensor* [85] for more details on how to configure the controller to work with a rain sensor.

2.2.2.3. Connecting an Alarm or Flow Sensor

The grey terminals labeled "AUX" are intended for either a regular auxiliary alarm or a flow sensor.

You connect either one to the RKD via the grey terminals labeled "AUX":

Figure 2.9. Connecting an alarm or flow sensor



Important

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

Note

See Section 6.3, “Alarms” [47] for details on available alarms.

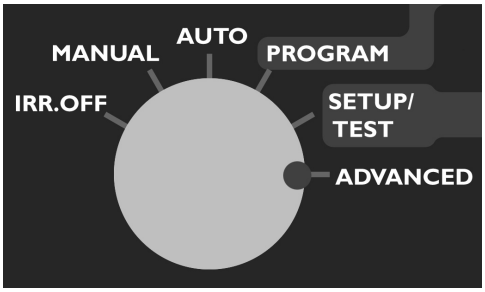
See Appendix C, *Adding a Flow Sensor* [123] for more details on how to configure the controller to work with a flow sensor.

Chapter 3. Entering Moisture Sensor License

Before you can utilize moisture sensors with your controller, you need to enter a license key as described in this procedure:

1. Turn the mode selector to ADVANCED

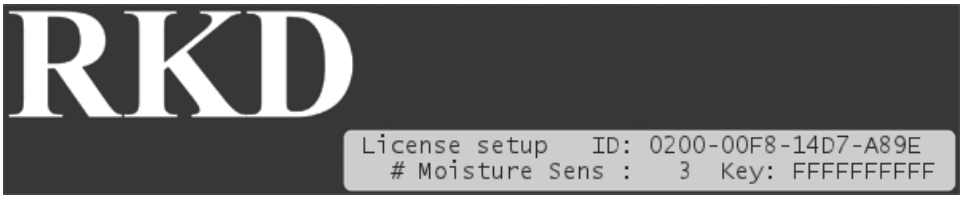
Figure 3.1. Mode selector in ADVANCED



Now the display looks like this:

Figure 3.2. Display message on switch to ADVANCED mode

2. Select `9. License`, and you will see a display like this (your ID will be different):



Note

To obtain a license key for more stations you need to know the ID you see in this display - keep this ready when ordering.

3. Press the ENTER button once and the first license key character starts blinking. Now you can use arrow keys to select the right characters and the right arrow to move on to the next character.

   If your license code is correct, you will see a message like the following:

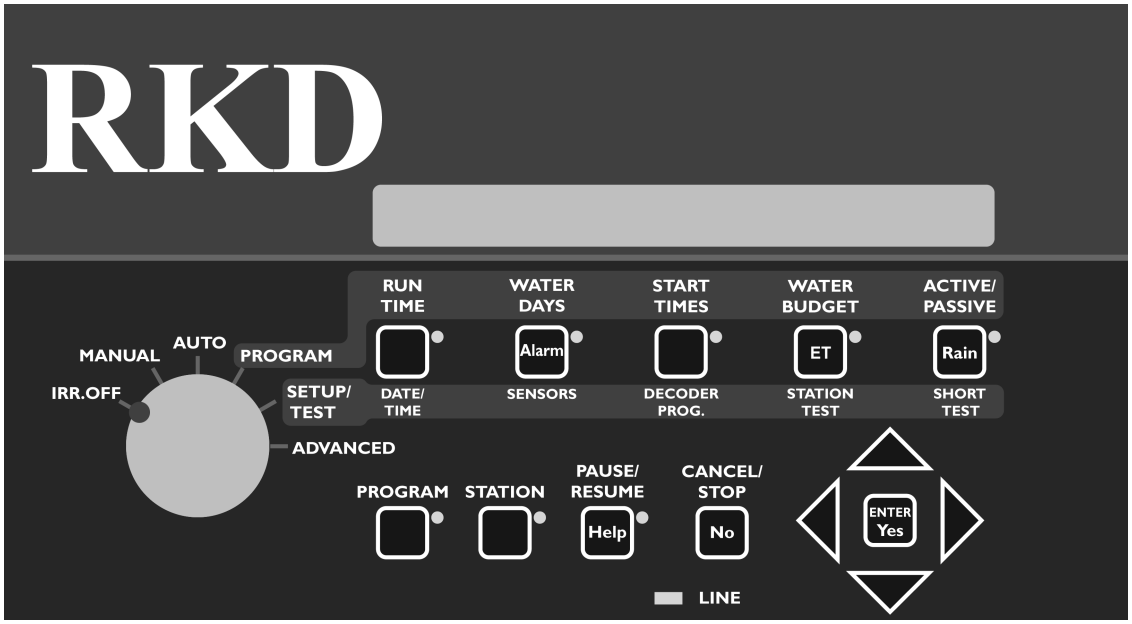
In this case the license is valid for three moisture sensors.

Chapter 4. Operating the Controller

It is essential that you feel comfortable with the interface of the RKD before you start configuring stations, irrigation programs etc.

This section explains what all the controls are for in the different modes - in Chapter 5, *Programming the* RKD [21] and Chapter 6, *Running the* RKD [41] you will learn how to actually use the controls to operate the system.

Figure 4.1. RKD front plate



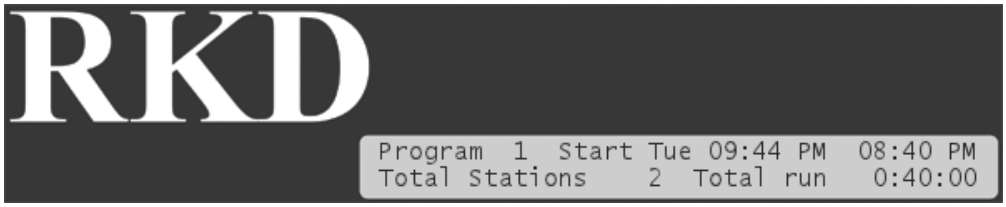
4.1. The Display

The RKD 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 4.2.1, “The Six RKD Modes” [18]), 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 RKD is idle, waiting for the next program to run:

Figure 4.2. A standard display when idling in Auto mode

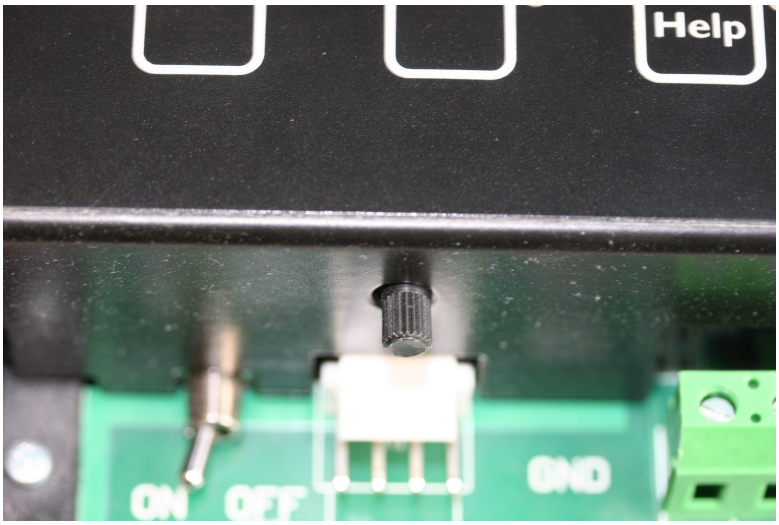


This simply states that the next program to run is program number one, the program's total run time is 40 minutes, and it will run on Tuesday at 09:44 PM, activating two stations in turn. In the top right you see the current time.

You will learn all about programs in Section 5.3, “Configuring Irrigation Programs” [27].

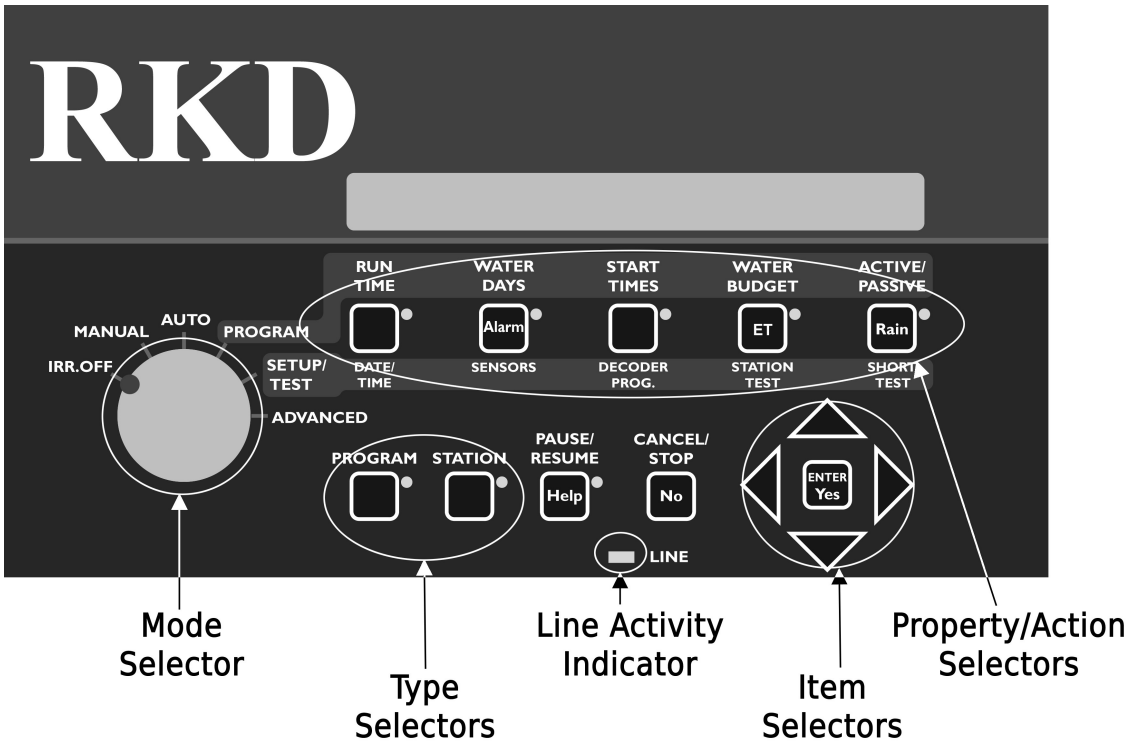
Tip

If the display does not seem clear and easy to read, try turning the contract adjustment knob to the left which will increase light in the display:



4.2. Buttons and Controls

Figure 4.3. Controls on the RKD front plate

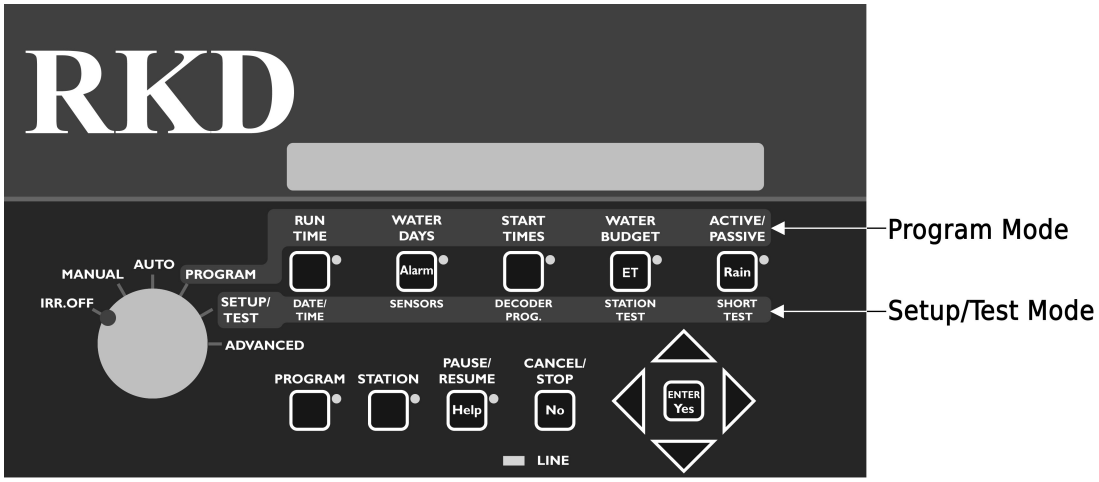


The controls on the RKD can be divided into five groups:

- *Property/action selectors:* When configuring an irrigation program, these buttons let you select which properties of the program you want to edit. In setup/test mode they have different functionality.

  Note that when in Program Mode, the functions corresponds to the text on top of the buttons. In Setup/Test mode the functions corresponds to the text below the buttons.

Figure 4.4. Different roles of property/action selectors:



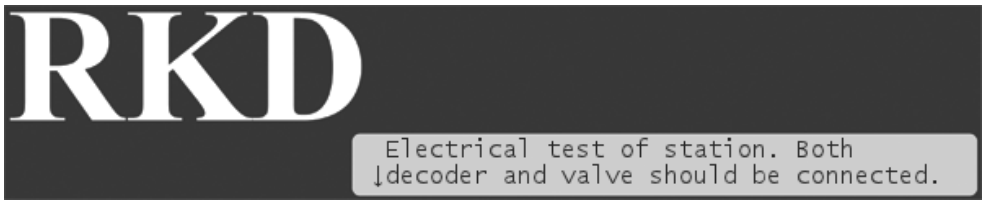
Read more about the different modes in the following section.

- *Type selectors:* These buttons let you select between programs and stations when in auto or 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 RKD 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 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 six different modes of the RKD.

  When you change to a new mode, allow up to one second before the display reflects the change.
- *PAUSE/RESUME/Help Button:* This button serves two purposes: It is used to pause and resume running programs, and it will provide you with short help instructions for most of the options you encounter when programming the RKD.

  For example, if you turn the *Mode selector* to *SETUP/TEST*, push the *STATION TEST* button and then push the *Help* button, you'll see the following message in the display:

Figure 4.5. Help text for station test:



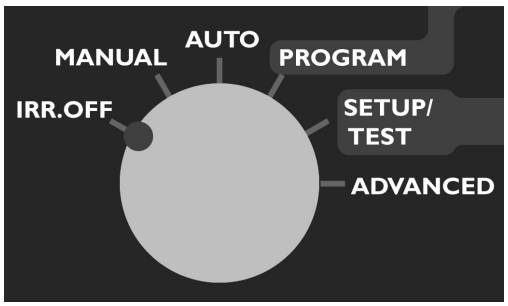
When you see arrows in the help text it's an indication that you can use the *Item selectors* to scroll for more help text.

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.

4.2.1. The Six RKD Modes

Looking at the *mode selector* from left to right, you see six possible modes for the RKD:

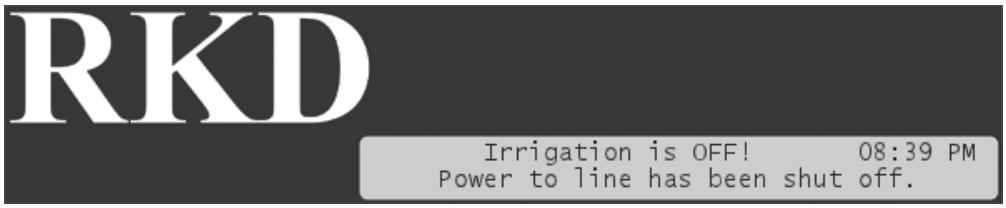
Figure 4.6. The mode selector:



4.2.1.1. 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 4.7. Idling in Irr. Off mode:



4.2.1.2. Manual

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

4.2.1.3. 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 RKD 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 or programs 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.

4.2.1.4. Program

This is the mode you switch to when creating programs - you will learn more about this mode in Section 5.3, “Configuring Irrigation Programs” [27].

4.2.1.5. Setup/Test

This mode lets you set the date and time, configure the controller for various sensor inputs, identify and test your stations, and test for shorts on the two-wire path.

4.2.1.6. Advanced

In advanced mode you can configure a lot of settings that you don't have to change in the daily work with the controller:

- FloStack - plan and control system flow.
- FloGuard - monitor the controller for potential problems.
- Intelliset - manage ET devices, moisture sensors and related operations.
- Define a custom irrigation period
- Assign booster pumps to programs
- Manage the run sequence and mapping of your stations

- Enable/disable whether or not to display the line V/mA.
- Adjust the power the controller uses to pull open your valves.
- Feature manager - enable/disable features only used by a subset of users, like misting and "cycle & soak" irrigation.
- Erase the entire controller's data - in case you're setting up a new system from scratch.

Chapter 5. Programming the RKD

Like conventional controllers, the RKD must be programmed to control your irrigation. The controller itself needs to be configured with basics like date and time, and in addition, the stations need to be configured and tested. Finally, you need to create your irrigation programs, and possibly configure the system for sensor inputs.

All of this happens at the controller, and this chapter walks you through all the tasks.

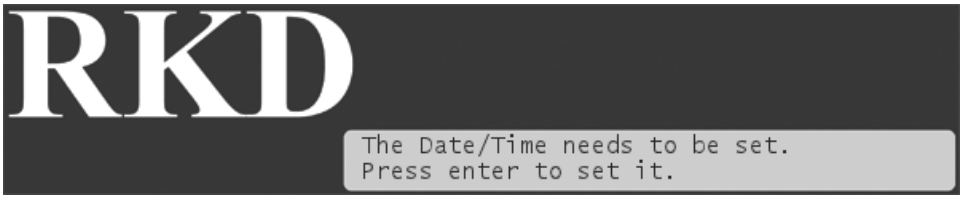
5.1. Basic Controller Configuration

The controller will remember date/time for up to two weeks when not connected to a power outlet. Most likely it will have lost this information when you first receive it, so the very first thing you have to do to get going is to set the date and time:

Procedure 5.1. Setting date and time for the first time

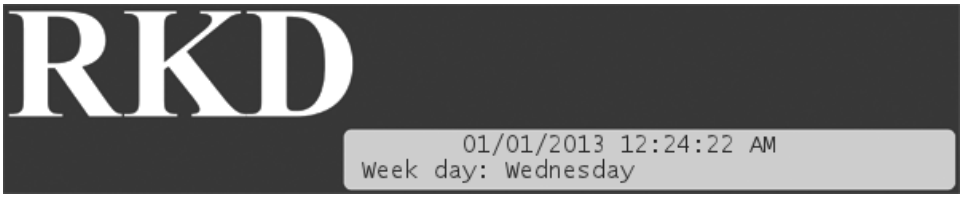
1. Turn on the controller. The display will ask you to set the date and time:

   Figure 5.1. Controller's first message

2. Push the ENTER button and you'll see the a display along these lines:

   Figure 5.2. Setting the initial date/time

3. Now use the *item selectors* to adjust the date/time - up/down changes the values, left/right moves between the fields.

   Note

   You don't have to set the week day - the controller will calculate this based on the date you enter.

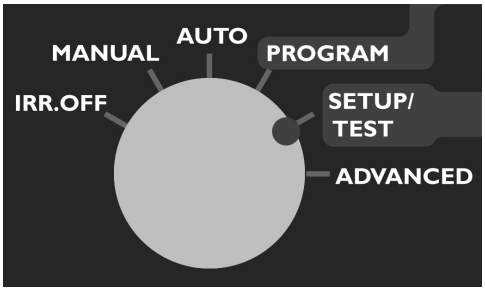
4. When you're happy with the setting, push the ENTER button.

If you need to adjust the date/time later on, follow this procedure:

Procedure 5.2. Setting the date and time

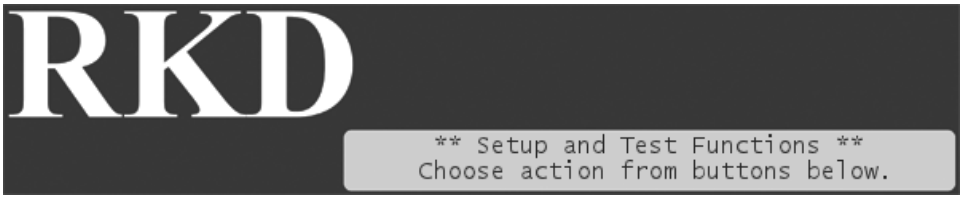
1. Turn the mode selector to SETUP/TEST:

Figure 5.3. Mode selector in SETUP/TEST



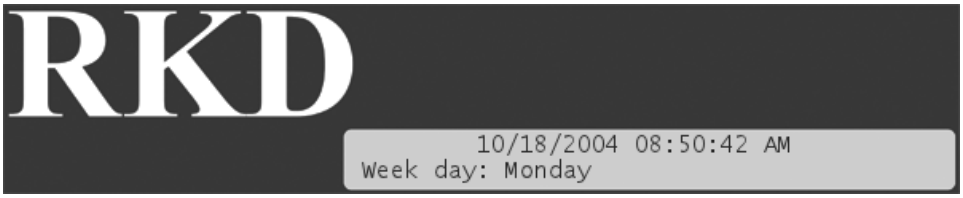
The display will now look like this:

Figure 5.4. Display message on switch to SETUP/TEST mode



2. Push the DATE/TIME selector. The button will start blinking and the display will look something like this:

Figure 5.5. Setting date and time



The blinking cursor indicate what you're about to edit. In this example you're about to edit the month slot which is set to 10 - October.

3. You change the settings with the up and down *item selectors* and move between the day, month and year slots with the left and right *item selectors*.

4. Push the ENTER button to save your setting - now the controller will save the date and return to the default screen for *setup/test* mode.

Note

The week day will be calculated automatically from the date you choose.

Important

Daylight savings are not handled automatically.

5.2. Configuring Stations

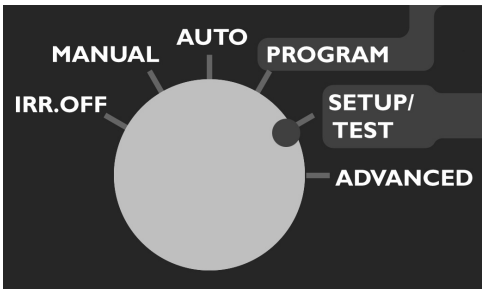
The RKD controller doubles as a station programmer - you can set the identities of your stations, change existing identities and test that a station is working before you place it in the field.

Before you can do any of the above, you need to connect the station to the controller:

Procedure 5.3. Connecting a station to the RKD Controller

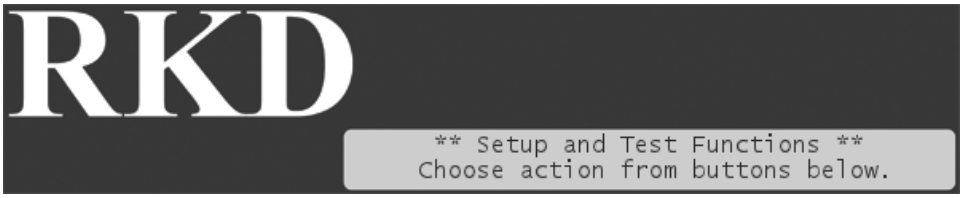
1. Remove the lower front plate of the controller as described in Section 2.1, “Mounting the Controller” [5]
2. Turn the mode selector to SETUP/TEST

   Figure 5.6. Mode selector in SETUP/TEST

   Now the display looks like this:

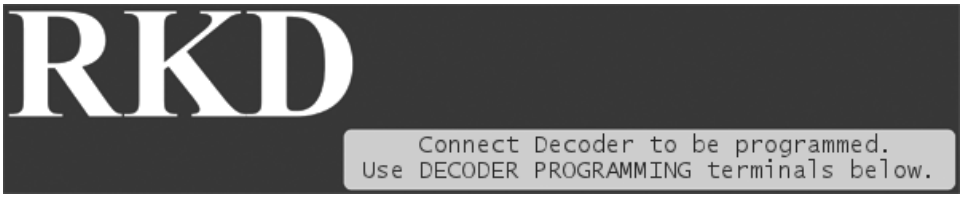
   Figure 5.7. Display message on switch to SETUP/TEST mode

3. Push the DECODER PROG. button.

   Now the RKD disables the two-wire to the field (the LEDs stop blinking), switches to programming mode, and asks you to connect the station you want to manage:

Figure 5.8. Prompting for the station to program



Warning

Switching to *setup/test* mode will stop any irrigation that might be going on - all programs are exited immediately.

4. Connect the station to the programming terminals. The blue wires go in the two right most terminals and the white wires go to the left, just as illustrated on the label beneath the terminals:

Figure 5.9. How to connect a station to the controller

5. Once the station has been properly connected, push the ENTER button, and you are ready to name, rename or test the station.

Note

If the station was not connected properly or has failed, the controller will tell you that it could not detect a station.

After connecting the station to the controller, proceed to assigning an identity to the station:

Procedure 5.4. Assigning an identity to a station

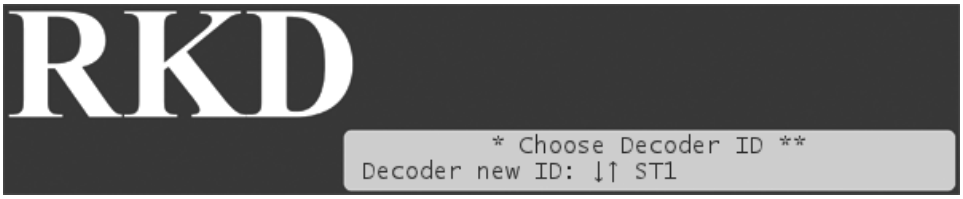
1. Follow Connecting a station to the RKD Controller [23] using the station you wish to name. Now the display will look like this:

Figure 5.10. New station connected

If the station has already been named, "New" will be replaced with the name of the station instead.

2. Use the *item selectors* to put the star next to "1. Change ID" and push the ENTER button.

Figure 5.11. Selecting the station ID:



3. Now you can use the *item selectors* to choose a name for the station. A station can be designated to one of three different name types:

   1. A station name - "ST1", "ST2", "ST3".....”ST99", "ST00". 100 station names are available (number 100 is called ST00 due to restrictions on the length of the name).

   2. A booster pump name - "BO1" or "BO2" are available. Read more about how to use booster pumps in Section 5.3.6, “Adding a Booster Pump” [39].

   3. A master valve name - "MV" is the sole master valve name in the system. Read more about how you use the station to control the master valve in Section 5.3.7, “Adding a Master Valve (Supply Pump)” [40].

   4. A cut-off valve - "COV" is available. The COV will activate if an "Unscheduled flow" alarm is raised. You can read more about flow alarms in Appendix C, *Adding a Flow Sensor* [123].

   Important

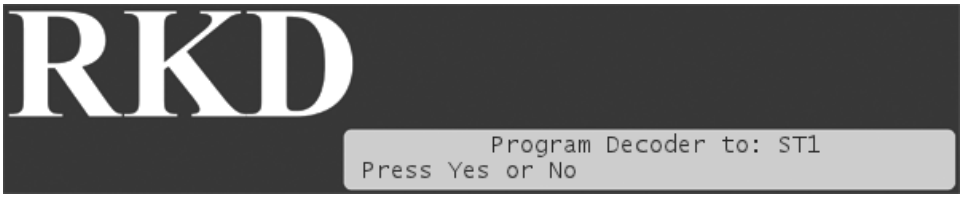
   The COV must be a "normally open" valve.

   The master valve ID and the two booster pump IDs are available after ST100 when scrolling up with the *item selectors*

   Use the *item selectors* to scroll to the name you want to assign to the station and push the ENTER button.

   Now you'll be asked to confirm the new name:

Figure 5.12. Confirm station configuration



When you push "Yes" the station is configured and verified, and the controller will remind you that it's a good idea to label the station with the assigned ID:

Figure 5.13. Station configuration done:

4. If you wish to configure another station right away, push the Yes button and use the *item selectors* to scroll down and select the Another option.

   If you're done configuring, push the CANCEL button to exit the station configuration.

Now the station is ready to place in the field and get connected to the two-wire.

5.2.1. Testing a Station

It's a good idea to test whether a station is working before placing it in the field. Follow this procedure to test a station:

Procedure 5.5. Testing a station Before Placing it in the Field

1. Connect the station to the controller and switch to SETUP/TEST mode, as described in Connecting a station to the RKD Controller [23]

2. Scroll to "2. Test" and push the ENTER button.

   If the station is OK, the controller will say "Output for Decoder ST1 OK".

   If the station fails, the controller will say "Output for Decoder ST1 Failed"

There's nothing you can do to repair a defective station - replace it with a new one instead.

5.2.2. Reading Station Configuration

In case you need to determine the identity of a station that has already been programmed, follow this procedure:

Procedure 5.6. Detecting the name of a station that is already configured

1. Connect the station to the controller and switch to SETUP/TEST mode, as described in Connecting a station to the RKD Controller [23]

2. If the station has already been configured, you will see it's name in the display. In the case of "ST25", the display will look like this:

   Figure 5.14. Configured station connected

3. If you wish to reconfigure the station, push the ENTER button and select a new name. Otherwise push the CANCEL button and disconnect the station from the termnials.

5.3. Configuring Irrigation Programs

Once your stations are configured and placed in the field, it's time to start configuring the irrigation programs.

The RKD holds 10 programs that can each activate 100 stations in turn. Each program can run 12 times a day on odd, even or selected days in a two week period. Additionally, each program can activate a booster pump and a master valve throughout the duration of the program.

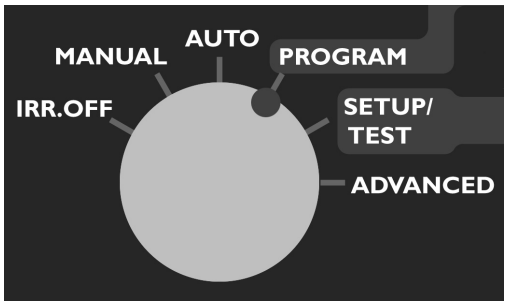
There is also a test program which can not be modified. This program is primarily used to troubleshoot the system and is described in Section 7.2, “Running the "Water Test"” [59].

To start configuring a program, turn the *mode selector* to PROGRAM.

Important

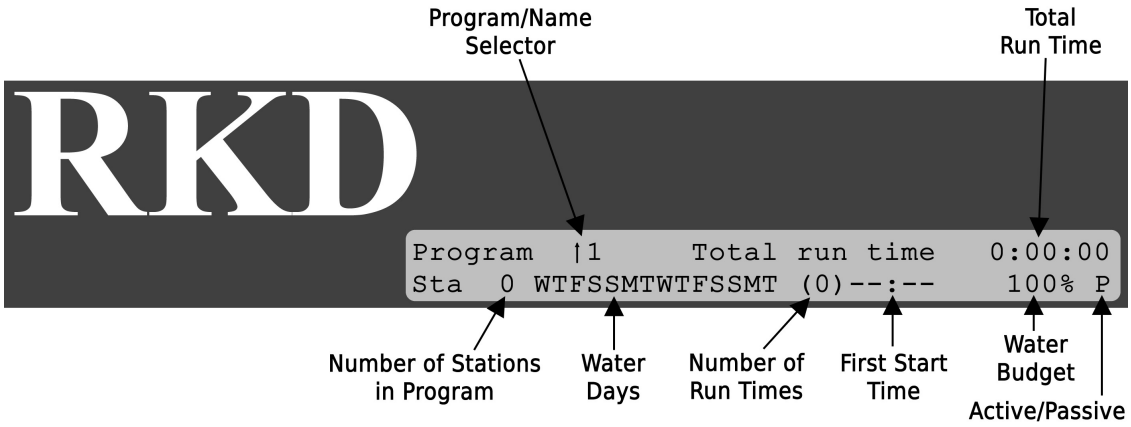
Throughout this section we will assume that the RKD is in program mode.

Figure 5.15. Mode selector in PROGRAM mode



Now the RKD shows you the configuration for "Program 1". The first time you do this, most settings are blank, and the display will look like this:

Figure 5.16. Program mode



The following sections walk you through everything you need to know in order to customize the 10 programs.

5.3.1. Configuring the stations

Each of the 10 programs can activate up to 100 stations in turn. The stations are run in turn according to their IDs, starting from ST01, ST02 etc[1]. To configure a program, simply set the run times of each station to the number of minutes you wish it to run.

Here's an example of an irrigation program:

Station	Run Time
ST01	10min
ST02	5min
ST04	50min
ST16	10min
...	...
...	...

Note

A station can appear in as many programs as you wish, but obviously only one program can run a station at a time.

If two programs wish to run the same station at the same time, the station will simply keep running until the last program no longer needs it running.

Now let's look at how you configure the individual stations in a program.

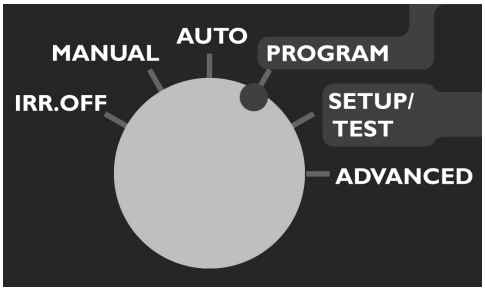
[1] If you want the stations to run in a different order than this, you must assign sequence numbers to each station and the sequence number will determine the order instead.

Read more about sequence numbers in Appendix E, *Changing Station Run Sequence and Mapping* [161].

Procedure 5.7. Configuring a station in a program

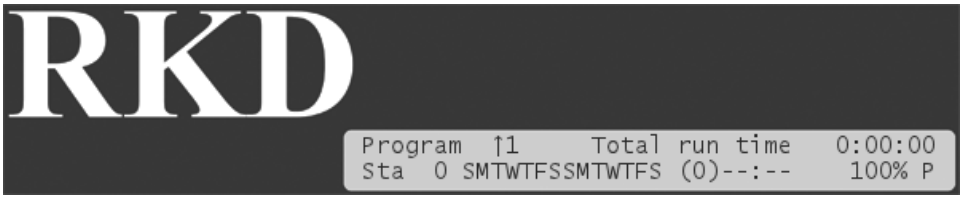
1. Turn the mode selector to PROGRAM

Figure 5.17. Mode selector in PROGRAM



Now the display will look something like this:

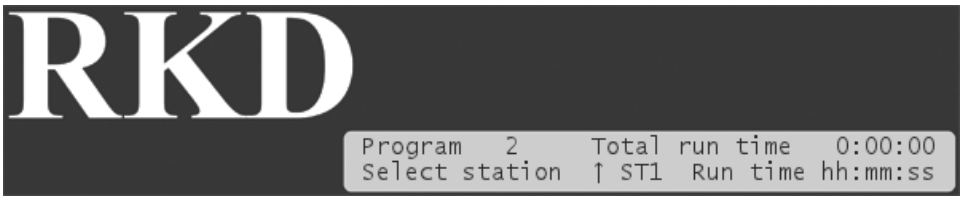
Figure 5.18. Display message on switch to PROGRAM mode



2. Use the *item selectors* to scroll to the program you wish to configure a station for.

3. Now push the RUN TIME button. Say you selected program two - then the RUN TIME button will flash red and the display look like this:

Figure 5.19. Selecting a station



4. Use the *item selectors* to select the station you wish to configure and push the ENTER button.

   Now the cursor jumps to the right of the display, allowing you to select the station run time.

Tip

Instead of browsing through the list of available stations with the *item selectors* you can use the STATION button to browse only stations with a defined run time. This comes in handy when modifying run times of an existing program.

Note

A couple of notes on run times:

- Run times longer than four minutes are run in ten second blocks and will be rounded up to the nearest block.

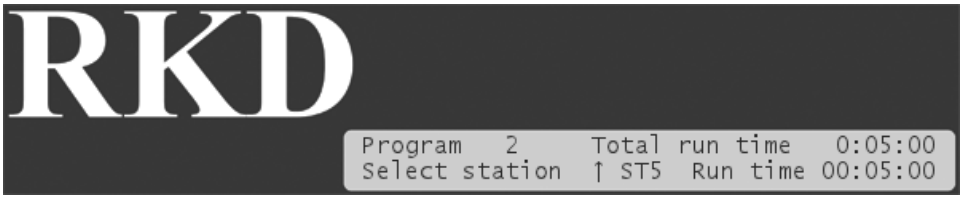
  For instance, run times of 00:04:14 and 00:04:18 will both be rounded to 0:04:20.

- Run time shorter than four minutes are not rounded.
- The maximum run time is 17:59:50.
- You can "delete" a station from a program by simply setting the run time to 0.

5. Use the *item selectors* to select the number of minutes you wish the station to run, and push the ENTER button to save your setting.

   Now the controller returns to the main screen for editing the run time. Say you just set station number five to run five minutes in program two, the display will look like this:

   Figure 5.20. station setting saved:



   Pushing the CANCEL button when adjusting the run time will discard the new run time and keep the original one, even if this is zero.

   Now you can select other stations and repeat steps four and five to determine how they should run in this program.

6. Once you have configured all the stations you need and are back at the default position, push the RUN TIME button to exit the configuration of programs all together.

5.3.2. Setting Water Days

There are three ways to determine which days a program will run.

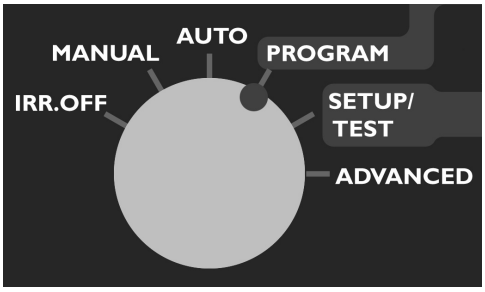
- On all odd dates (1, 3, 5 etc.)
- On all even dates (2, 4, 6 etc.)
- On selected days in a 14 day cycle. You select the days and the RKD will loop through the 14 day schedule.

To make the configuration as intuitive as possible, the 14 day period always starts with the current day.

Procedure 5.8. Setting the water days

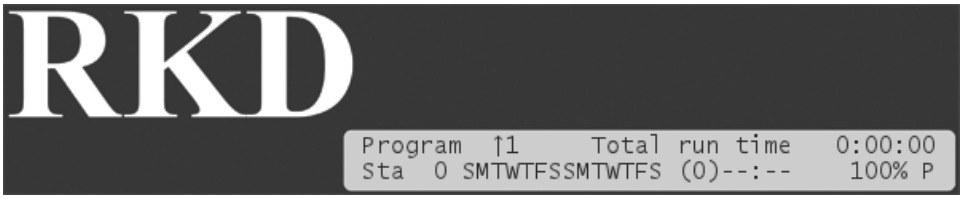
1. Turn the mode selector to PROGRAM

Figure 5.21. Mode selector in PROGRAM

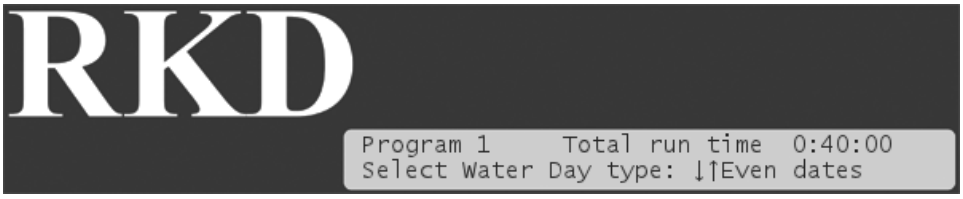


Now the display will look something like this:

Figure 5.22. Display message on switch to PROGRAM mode



2. Use the *item selectors* to navigate to the program you wish to adjust the start times for and push the WATER DAYS button.



3. Use the *item selectors* to choose between "Odd dates", "Even dates" or "14 day period" and push the ENTER button.

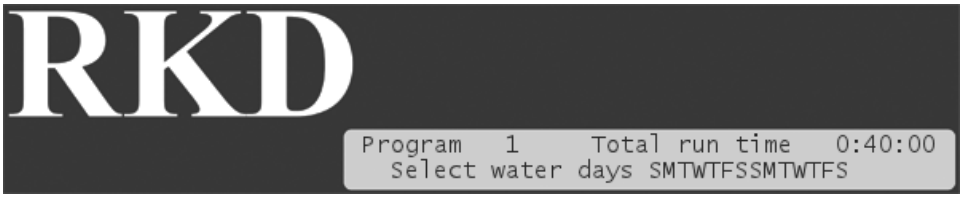
Note

The definition of an "Odd date" does not include the 31st day in a month because this would cause the program to run two days in a row (e.g. May 31 and June 1.) The same goes for February 29 on leap years.

If you select odd or even dates, you are done now, but if you select "14 day period" you need to walk through the next steps as well.

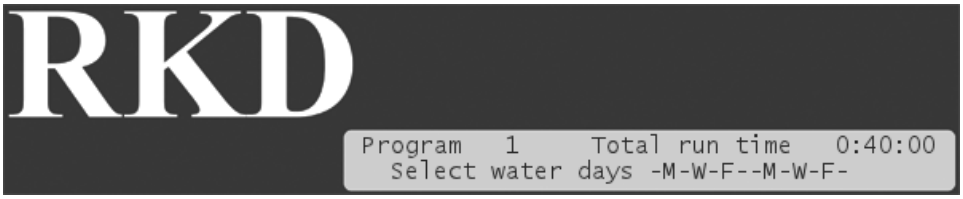
4. Assuming that today is a Sunday, the list of days will start with an "S" and a cursor will be blinking on top of the first "S":

Figure 5.23. Selecting the water days



5. Now you can use the *item selectors* to navigate through the days. The up and down arrows will toggle the selected day to On/Off. Here's how selecting only Mondays, Wednesdays and Fridays would look like:

Figure 5.24. Water days example



6. Once happy with the selection of days, push the WATER DAYS button to save the changes.

5.3.3. Setting Start Times

Each program in the RKD can run up to 12 times per day.

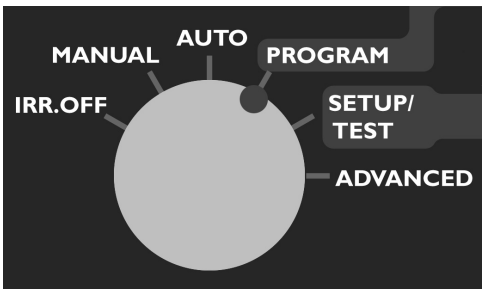
Note

When you set the first start time for a program the controller automatically sets the program as active (see Section 5.3.5, “Activating/deactivating a Program” [37] for details on program status).

Procedure 5.9. Setting start times

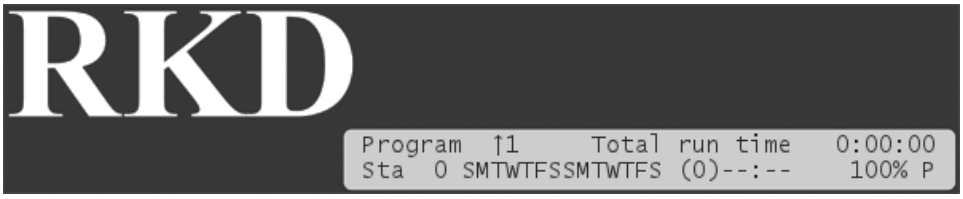
1. Turn the mode selector to PROGRAM

Figure 5.25. Mode selector in PROGRAM



Now the display will look something like this:

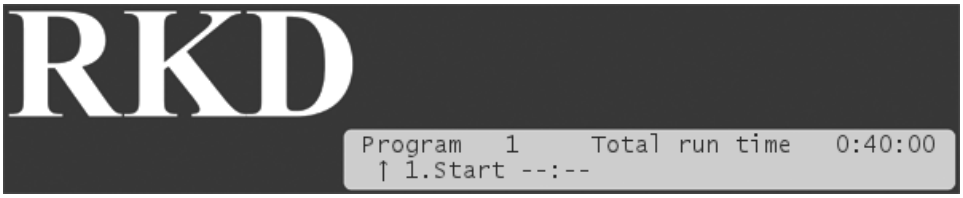
Figure 5.26. Display message on switch to PROGRAM mode



2. Use the *item selectors* to navigate to the program you wish to adjust the start times for and push the START TIMES button.

   Now you'll see the following display:

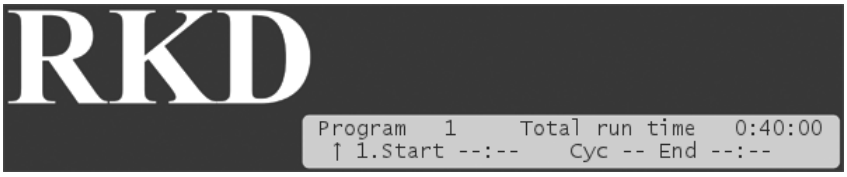
Figure 5.27. Selecting a start time



Note

If you are using the misting feature of RKD you will also see Cyc and End fields:

Figure 5.28. Selecting a start time with misting

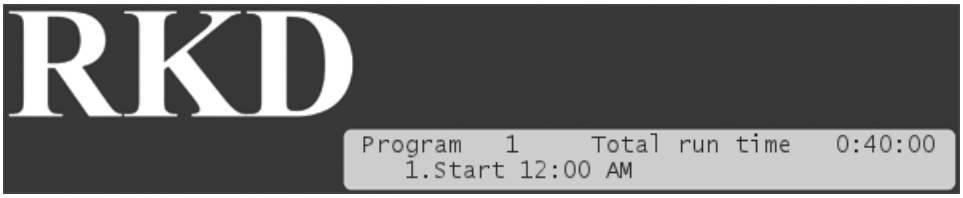


Misting allows you to determine a more complex irrigation scheme where each start time is repeated a number of times within a specified time frame - it is all explained in detail in Appendix H, *Advanced Irrigation: Misting, Cycle & Soak* [169]:

3. Use the *item selectors* to locate the one of the 12 runs you wish to set a start time for, and push the ENTER button.

   Now the cursor will jump to the right, letting you set the start time:

Figure 5.29. Selecting a start time



4. Use the *item selectors* to select the start time and push the ENTER button.

Tip

If you push the up and down arrow at the same time in this field, you will delete the current start time all together.

5. Now the controller will return to the default display for setting start times, and you can repeat steps two and three for all the start times you wish to set.

6. Once you're all done, push the START TIMES button to return to the main programming mode.

Note

Your start times will be sorted by start time - if the second start time you enter is before the first one, they will be swapped around next time you browse the list.

Also, if you select another number for your start than the next chronologically available one, the RKD will save your start with the next chronologically available number anyway. This means that if you have two starts assigned and assign a third one but to the "6" run slot, this will be saved as start 3 and appear as such the next time you want to edit the program.

In short, you can say that your start times are sorted by time and their numbers "compressed" chronologically.

5.3.4. Adjusting Water Usage (Water Budget or ET)

There are two ways of determining how to adjust the amount of water used by an irrigation program:

- Setting the "Water Budget" to a value between 0 and 250 percent. Just as you would expect, this determines how much water is used. However, since the controller simply tells a station to start or stop, the water budget doesn't control the water flow as such, but instead it determines the run time.

  This means that if you have set up a program to run five stations for 10 minutes each, this is what will happen with the water budget set to 100 percent. But if you decrease the water budget to 80 percent, each station will only run eight minutes, and if you set the water budget to 120 percent, each station will run for 12 minutes.

Note

If the water budget is zero, the station will not run at all.

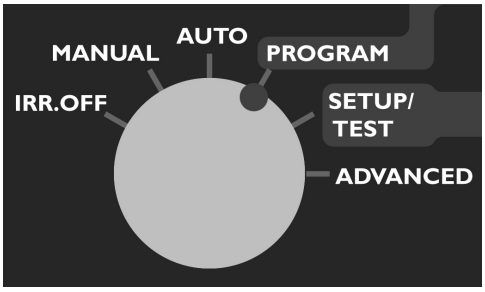
- Letting ET adjustment decide how the irrigation should be carried out. This way you tell the RKD how much water you want the program to provide per day, and then the controller will adjust for any ET and Rain input it receives. See Appendix B, *Adding an ET Device* [101] for details on how to configure the controller for ET.

The following two procedures walk you through configuring a program for each of the two options.

Procedure 5.10. Adjusting the water budget

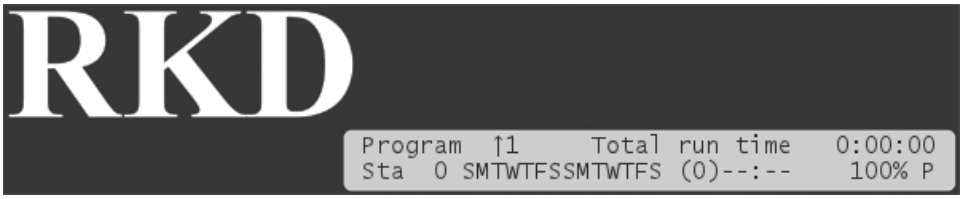
1. Turn the mode selector to PROGRAM

Figure 5.30. Mode selector in PROGRAM



Now the display will look something like this:

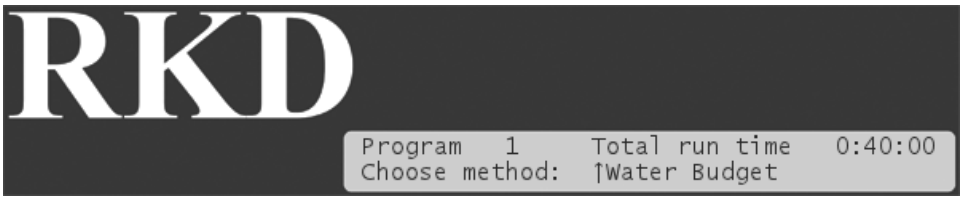
Figure 5.31. Display message on switch to PROGRAM mode



2. Use the *item selectors* to navigate to the program you wish to adjust the water budget for and push the `WATER BUDGET` button.

   Now you'll see the following display:

Figure 5.32. Choosing method for irrigation adjustment

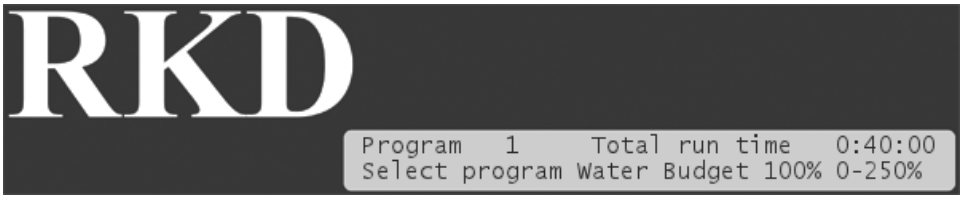


Note

Please see the note below, On switching between Water Budget and ET adjustment [37].

3. Use the *item selectors* to choose "Water Budget" and push the `Water Budget` button. Now you'll see the following screen:

Figure 5.33. Adjusting the water budget



4. Use the *item selectors* to set the appropriate water budget and push the ENTER button to save the setting and exit.

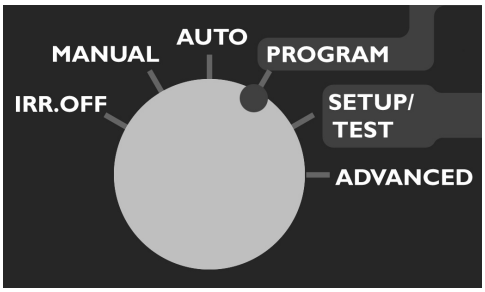
Tip

Adjusting the water budget is an easy way to accommodate shifting weather conditions without having to reconfigure all programs to apply more or less water. Just increase or decrease the water budget as needed, and the proportions will stay intact.

Procedure 5.11. Adjusting the ET

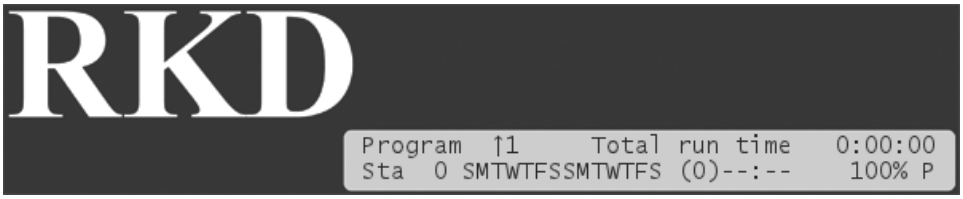
1. Turn the mode selector to PROGRAM

Figure 5.34. Mode selector in PROGRAM



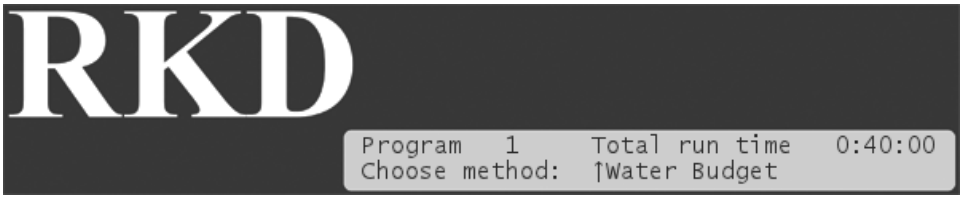
Now the display will look something like this:

Figure 5.35. Display message on switch to PROGRAM mode



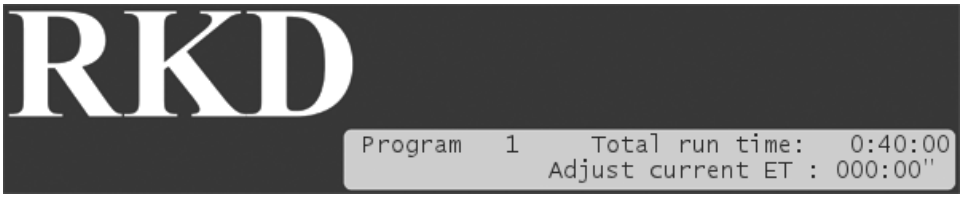
2. Use the *item selectors* to navigate to the program you wish to adjust the water budget for and push the WATER BUDGET button.

Figure 5.36. Choosing method for irrigation adjustment



3. Use the *item selectors* to choose "ET" and push the ENTER button. Now you'll see the following display:

Figure 5.37. Setting program ET



Note

Please see the note below, On switching between Water Budget and ET adjustment [37].

4. If you want the program to run before it has received an ET budget from the controller, you can provide one manually that will then be used as the starting point. After that, any ET figure that is received will be added to what you already entered - thus you can also use this feature to do a one-time adjustment of the ET. Please read Section B.1, “How ET Works with the RKD” [101] to make sure you understand the ET concept.

   Use the *item selectors* to set your desired ET budget for today.

5. Push the ENTER button to save your setting.

6. Programs that use ET adjustment instead of Water Budget adjustment will display the ET value instead of the Water Budget value in PROGRAM mode:

On switching between Water Budget and ET adjustment

If you have previously set a program to be adjusted by either Water Budget or ET, choosing the opposite setting will generate one of two warnings:

Figure 5.38. Shifting from ET to Water Budget

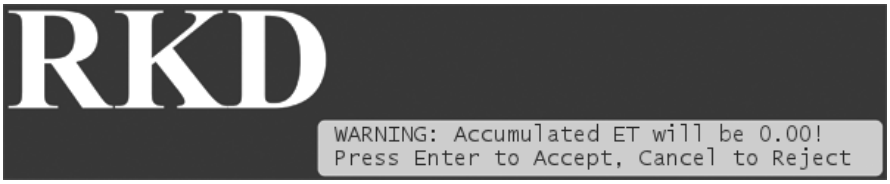
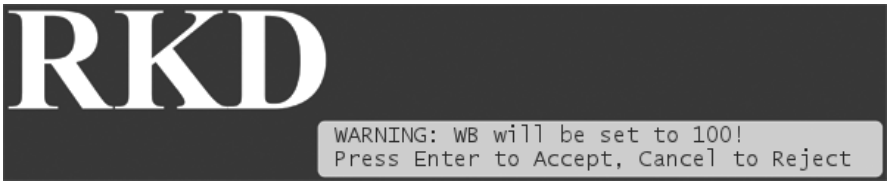


Figure 5.39. Shifting from Water Budget to ET



5.3.5. Activating/deactivating a Program

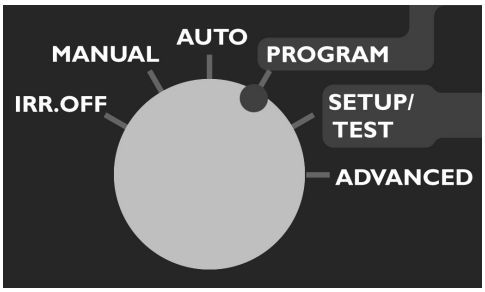
You can toggle the Active/Passive status of each of the 10 programs - only active programs are actually run. By default, newly created programs are set to Active as soon as you assign the first start time to them.

To toggle a program between Active and Passive:

Procedure 5.12. Toggling the Active/Passive setting

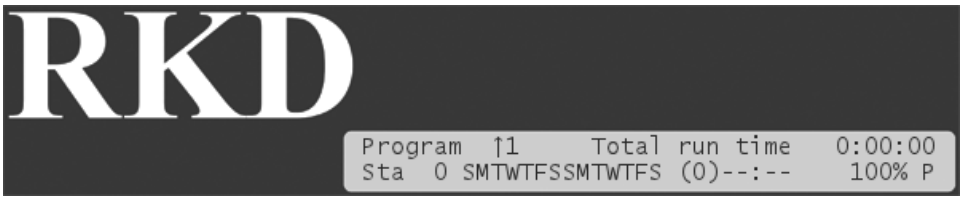
1. Turn the mode selector to PROGRAM

Figure 5.40. Mode selector in PROGRAM



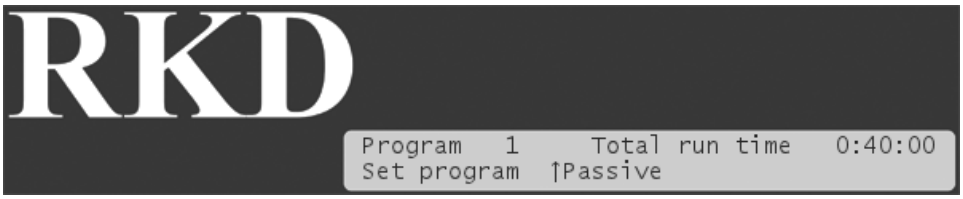
Now the display will look something like this:

Figure 5.41. Display message on switch to PROGRAM mode



2. Use the *item selectors* to select the program you wish to toggle active or passive and push the ACTIVE/PASSIVE button:

Figure 5.42. Toggle the Active/Passive setting



3. Use the *item selectors* to toggle between Active and Passive mode and push the ACTIVE/PASSIVE to save your selection and exit to the main display for Program mode.

Note

Making a program passive does not erase the program. In fact, a passive program can still be run manually. More about this in Section 6.2, “Running RKD in Manual Mode” [46] and Section 6.1.3, “Running Extra Programs in Auto Mode” [45].

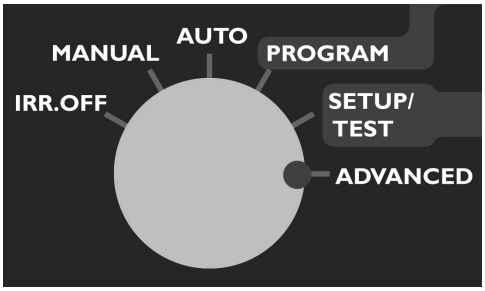
5.3.6. Adding a Booster Pump

The RKD lets you configure two stations to activate booster pumps, and each irrigation program can have one of these booster pumps associated. Here's how you assign a booster pump to a program:

Procedure 5.13. Assigning a booster pump

1. Turn the mode selector to ADVANCED

Figure 5.43. Mode selector in ADVANCED

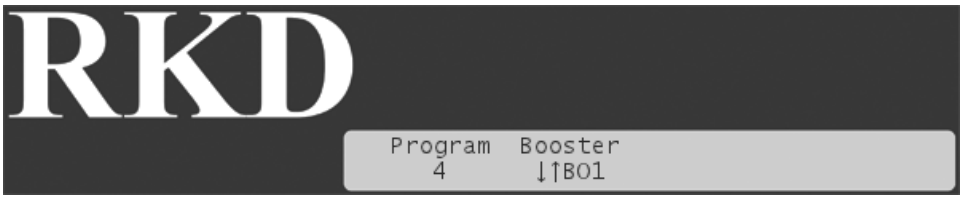


Now the display looks like this:

Figure 5.44. Display message on switch to ADVANCED mode

2. Select `6. Booster to Program Assignment` and push the ENTER button.
3. Use the *item selectors* to select one of the 10 programs and push the ENTER button.
4. Now use the *item selectors* to select between "Non", "BO1" or "BO2":

Figure 5.45. Selecting a booster pump



5. Once done, push the ENTER button to save the setting.
6. Now you can repeat steps three and four for to assign booster pumps to more programs, or push the CANCEL button to return to the main display for Advanced mode.

5.3.7. Adding a Master Valve (Supply Pump)

You might want to have the RKD control the opening of your supply pump when irrigation is active, and shut it down when irrigation is over.

To achieve this, simply configure one of your stations to act as the master valve station that controls the supply pump. Check Section 5.2, “Configuring Stations” [23] for instructions.

If the dedicated master valve station is connected to your two-wire, this will open whenever the system is irrigating, and close when the system is idle - you don't need to configure anything further to make this work.

Note

A station can not run a pump on its own - you must attach a relay connected to an external power source and the station will then activate the relay.

5.3.8. Testing a Program

After setting up your programs, you might want to test them without having to wait around for all of them to actually run.

Since this is the same approach as you would take in a troubleshooting scenario, please refer to Section 7.3, “Testing Programs” [60] in the troubleshooting chapter for instructions.

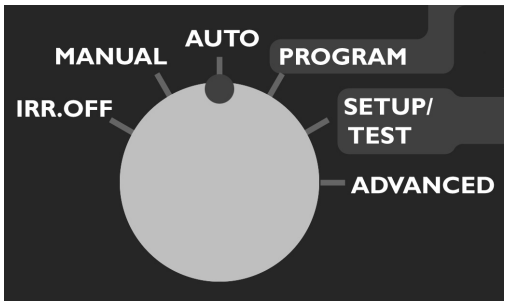
Chapter 6. Running the RKD

Day to day usage of the RKD is pretty simple - the whole point of having a system like this is to automate the irrigation, so little or no intervention will be needed once your system is up and running.

6.1. Running RKD in Auto Mode

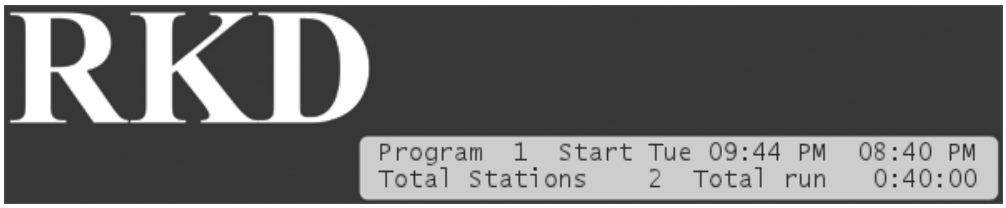
Once your system is configured, turn the *mode selector* to AUTO mode:

Figure 6.1. AUTO Mode



Now the display will tell you which program will run next:

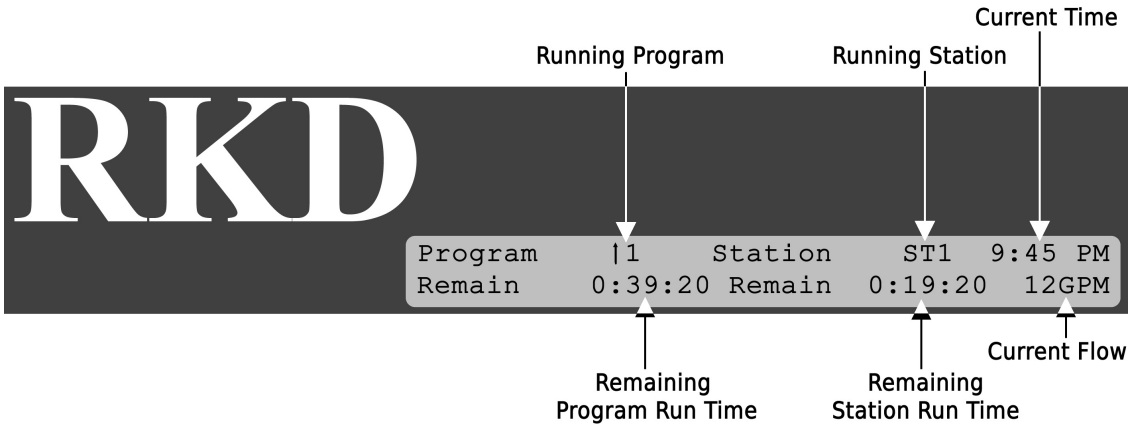
Figure 6.2. Waiting for a program to run



In this case the next program that will run is number one. It has two stations and will run on Tuesday at 09:44 PM for 40 minutes.

You don't have to do anything more - just leave the controller in AUTO mode and the program will be run automatically. Once the program starts, the display will tell you what station is running, and the remaining run time for both the running station and the entire program:

Figure 6.3. Running program



Once this program has finished, the next one in line will appear in the display.

Up to 10 programs can run in parallel.

Tip

You can always get an overview of running programs and stations by using the *item selectors*: Use the left/right arrows to select between programs and stations and the up/down arrows to browse through the items (programs or stations).

6.1.1. Pausing a Running Program

From time to time it may be necessary to pause the irrigation. Here's how you put a running program on hold:

Procedure 6.1. Pausing a program

1. Use the *item selectors* to locate the program you wish to pause, and push the PAUSE/RESUME button.

   The response from the controller will vary depending on the status of the program and the number of programs running:

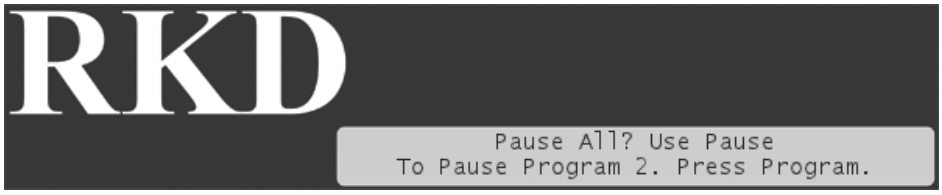
   - If the program you select is the only one running you'll see this display:

     ### Figure 6.4. Confirm pausing a program

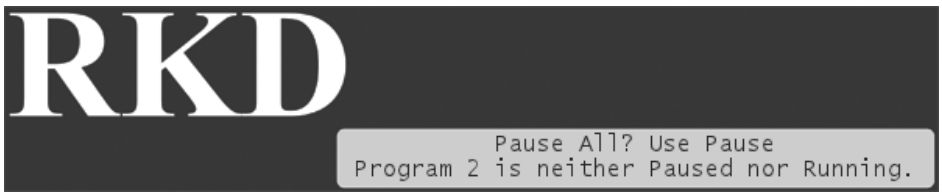
   - If the program you select is one of several running programs you'll see this display:

Figure 6.5. Confirm pausing one of more programs



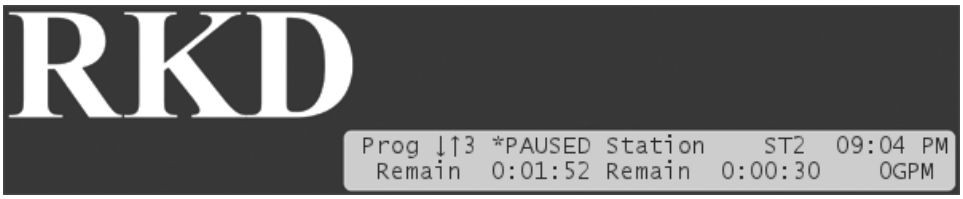
- If the program you select is not running but other programs are, you'll see this display:

Figure 6.6. Confirm pausing a program



2. Push the button that suits your intentions (PAUSE/RESUME or PROGRAM) and the controller will pause the program(s) and return to the list of programs:

Figure 6.7. Paused program



Once you're ready to resume the program, follow this procedure:

Procedure 6.2. Resuming a paused program

1. Use the *item selectors* to locate the program you wish to resume, and push the PAUSE/RESUME button.

   Depending on whether one or more programs are paused you'll see different displays, according to what you did when you paused the program(s).

2. Push the button you need according to the instructions in the display.

3. When the program(s) resume(s), the display will look as if the program(s) had just kept running.

Note

The last ten seconds of a program might be re-run, so each pause/resume will potentially add ten seconds to the total run time for that program.

6.1.2. Running Extra Stations in Auto Mode

When the RKD is running in auto mode you have the option of manually starting additional stations simultaneously. This can come in handy if a certain part of the terrain needs a little extra watering but you don't want to reconfigure a program for just one time's sake.

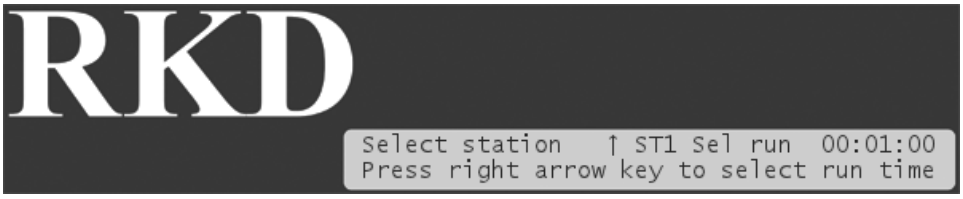
Note

The RKD supports up to 12 simultaneously running stations. This means that if for instance two programs are running, you can start nine more stations manually.

Procedure 6.3. Running a station manually

1. Push the STATION button and the following display appears:

   #### Figure 6.8. Selecting station

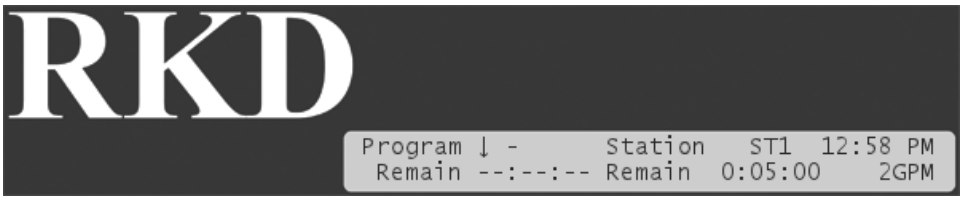
   

2. Use the *item selectors* to select the station you wish to activate. If you're happy with the suggested run time, push the ENTER button.

   Otherwise push the right arrow of the *item selectors* to move the cursor to the right to adjust the run time and then push the ENTER button.

   Now the station will start running immediately:

   #### Figure 6.9. Manually activated station:

   You can use the *item selectors* to browse through the list of running stations and programs from this display.

If you want to run more stations manually, just go through this procedure again for each station you want to activate.

To stop a manually started station before the end of its run time, use the *item selectors* to locate it and push the STOP button.

Tip

You can always get an overview of running programs and stations by using the *item selectors*: Use the left/right arrows to select between programs and stations and the up/down arrows to browse through the items (programs or stations).

6.1.3. Running Extra Programs in Auto Mode

When the RKD is running in auto mode you have the option of manually starting additional programs in parallel.

Note

If you select programs that try to start the same station in overlapping periods, the station will start when the first program asks for it and stop when the last program doesn't need it any more.

So, if program 1 wants to run station 12 from 08:00 to 08:10 and program 2 wants to run that same station from 08:05 to 08:15, the station will be run from 08:00 to 08:15.

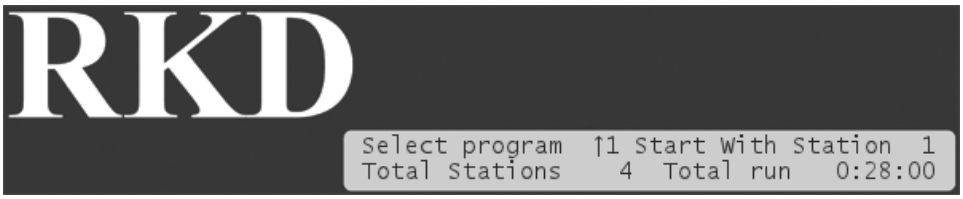
Running a program manually has the advantage that you can select which station should be run first, allowing you to skip a part of the program.

Procedure 6.4. Running a program manually

1. Push the PROGRAM button.

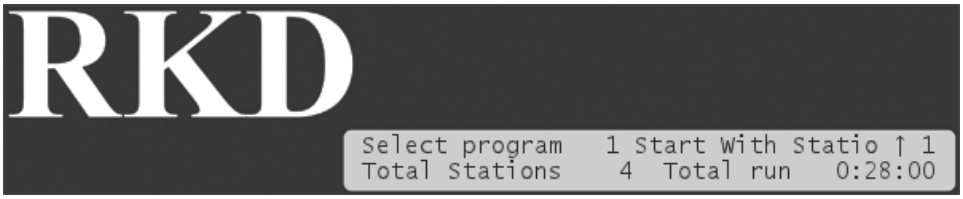
   Now there will be an arrow next to the program number, indicating that you should select the program you wish to run:

   Figure 6.10. Selecting program

2. Use the *item selectors* to pick the desired program and push the right arrow in the *item selectors* to move on to select which station should be the first to run:

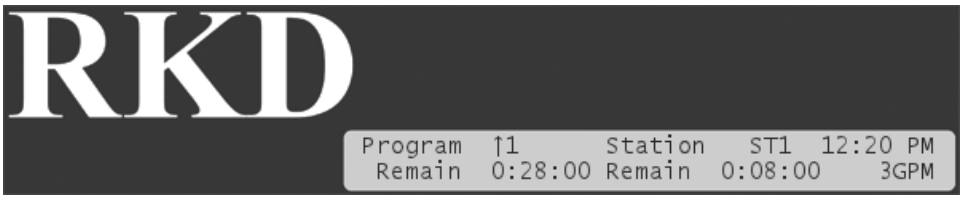
   Figure 6.11. Prompting for first station

3. Use the *item selectors* to select the station you wish to start with, and push the ENTER button.

Now the controller will run the selected program, keeping you informed of the status of the program:

Figure 6.12. Manual program execution:



You can browse through the status of running programs with the *item selectors*.

If you want to run more programs manually, just go through this procedure again for each program you want to activate.

To stop a manually started program before the end of its run time, use the *item selectors* to locate it and push the STOP button.

Tip

You can always get an overview of running programs and stations by using the *item selectors*: Use the left/right arrows to select between programs and stations and the up/down arrows to browse through the items (programs or stations).

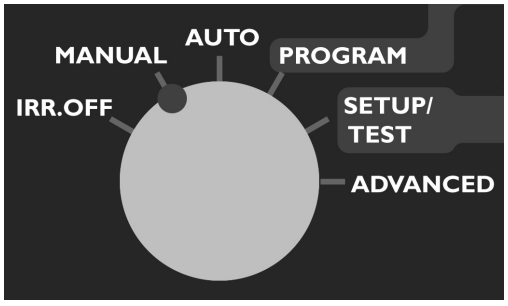
6.2. Running RKD in Manual Mode

The RKD allows you to run all programs and stations manually only - not obeying the schedules for the 10 programs. To enable this feature, turn the *mode selector* to MANUAL mode:

Important

Please check the setting of the "Revert to auto" feature before working in manual mode (See Section 9.4, “Feature Manager” [84].)

Figure 6.13. MANUAL mode



Now the controller is ready to run programs or stations manually, and you're prompted to select one of the two:

Figure 6.14. Prompting for station or program

From here on, the procedure for running stations is identical to Running a station manually [44] and running programs is explained in Running a program manually [45].

Tip

You can manually run programs and stations simultaneously.

6.3. Alarms

When running in AUTO or MANUAL mode, the RKD will react on a number of conditions by raising one or more alarms.

Note

Though some alarms, like a rain alarm, can halt the execution of irrigation schedules, you can always start both stations and programs manually, even when there is an active alarm. Two exceptions: if a short alarm is active, you can not start anything, and if a station is failing you can not start this manually.

6.3.1. Becoming aware of alarms on-site

If the RKD has received an alarm, and is in AUTO or MANUAL mode (see Chapter 6, *Running the* RKD [41] for a description of the two modes), the bottom row of the display will toggle between normal text and the alarm that has arrived.

For example, if you had a rain alarm at 01:10 PM, your display will toggle between normal mode and alarm notification:

Figure 6.15. Normal display

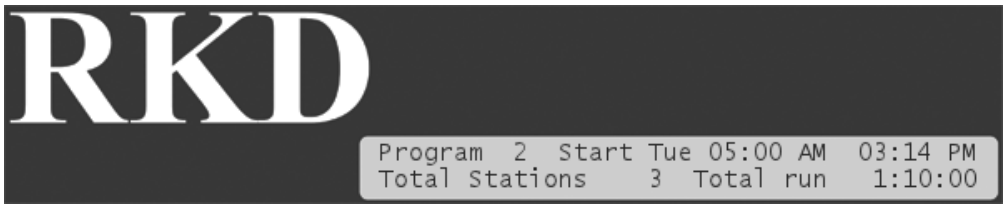


Figure 6.16. Toggled display with alarm info

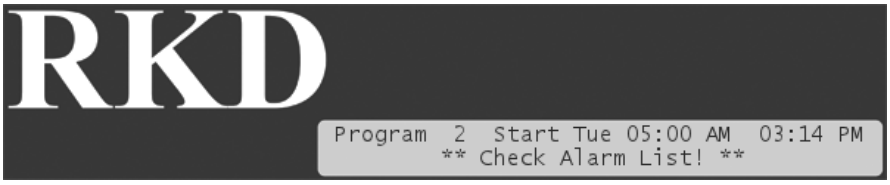
The display will toggle between the two modes in short intervals.

If you had multiple alarms the controller will toggle to a different alarm each time it toggles to notification.

Note

If you had more than three alarms the fourth message in the bottom row of the display will say that you should visit the alarm list for details - the display will look something like this:

Figure 6.17. Display with notification to visit the alarm list



6.3.2. Receiving alarm notifications on email

If your communication subscription with your supplier allows it, the RKD will support sending out alarm notifications to one or more email addresses.

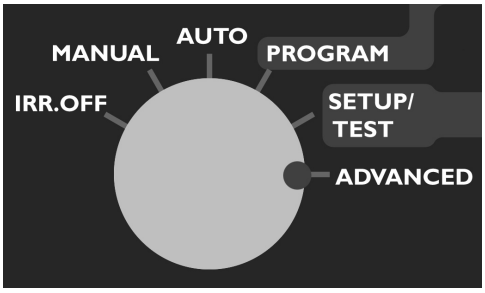
Note

This requires the WIN-100 or LAN-200 module.

To configure your controller to email alarms, follow this procedure:

1. Turn the mode selector to ADVANCED

Figure 6.18. Mode selector in ADVANCED



Now the display looks like this:

Figure 6.19. Display message on switch to ADVANCED mode

2. Scroll down to `Alarm Notification` and press the ENTER button. Now you see the following display:

3. Select `Email addresses` and press the ENTER button. If no email addresses are entered, you can select `Add new`:

Now you can enter an email address using the up/down arrow keys to select the characters. Once you are done, press the ENTER button.

4. Next you configure which alarms should be emailed. Select `Alarm Notification settings` and press the ENTER button. Now you see the following display:

Here you can scroll between the different alarms emitted by the controller.

5. Select the alarm you wish to configure and press the ENTER button. Now you see the following display:

You can select each email address you have entered, and determine if you want an email when this type of alarm is raised and/or when it is recalled.

6. Select the email you wish to configure for the current alarm and press the ENTER button.

   Use the arrow keys to set On and Off to either Yes or No - see the explanation table below:

Table 6.1. Meaning of On/Off/Yes/No

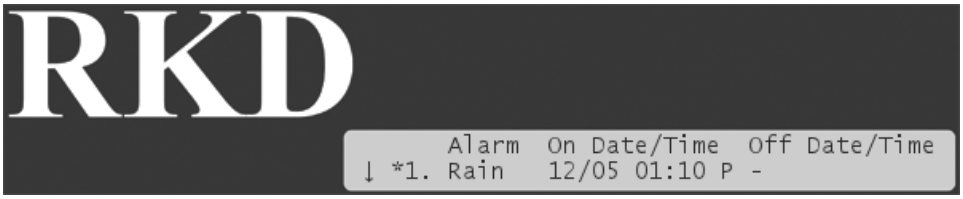
Setting	Selection	Meaning
On	Yes	Send email when the alarm is raised
	No	No email when the alarm is raised
Off	Yes	Send email when the alarm is recalled
	No	No email when the alarm is recalled

6.3.3. Viewing the alarm list

To view the list of alarms in the RKD, follow this procedure:

1. Make sure the controller is running in AUTO or MANUAL mode.
2. Push the ALARMS button. Now you'll see a scrollable list of the different types of alarms known to the RKD:

Figure 6.20. Alarm list



Note

If you have an older version of the RKD that has no ALARMS button, you need to push the WATER DAYS button instead.

In this case there is no Off time for the alarm, meaning that the alarm is still on. Had the alarm ceased you would see the end time too.

Use the *item selectors* to scroll through the list. The list contains information on the latest observed alarms of the 12 known alarm types:

Note

The alarm list will not survive a power failure - if the controller loses power, the list is wiped clean.

Table 6.2. Alarms in the RKD

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
`1. Rain`	Rain alarm.	Will automatically disappear when it stops raining.
`2. Alarm`	Whatever alarm you have attached to the alarm termnial. If you're using the AUX terminal for a flow sensor, you won't ever see this alarm (See Section 2.2.2.3, “Connecting an Alarm or Flow Sensor” [11])	The alarm stays on as long as the attached alarm is active, but you can clear it by viewing the alarm list.
`3. ET`	Evapotranspiration alarm. This will only ever be raised if you're running in "ET-enabled" mode. See Section B.1, “How ET Works with the RKD” [101] for in-depth details about ET.	Will automatically disappear when the "ET enable" device is no longer controlling your irrigation.
`4. Short`	Short alarm.	The alarm stays on as long as there is a short in your system. You can clear the notification by viewing the alarm list.
`5. High F`	High flow alarm	The alarm stays on as long as the flow is too high. You can clear the notification by viewing the alarm list.
`6. MPF`	Main pump failure	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
`7. USch F`	Unscheduled flow alarm. This means that water is flowing in your pipes when you're not irrigating. Such an alarm indicates that you have a leak.	Stays on as long as the flow is too high. The cut-off valve (COV) will be activated, so the alarm will clear itself, but you can clear the notification by viewing the alarm list.
`8. St. Err`	Station error alarm. This means that one or more stations in the field have failed, and will only be raised if you are using a flow sensor.  **Note** This alarm only concerns flow related problems - not any electrical errors that may occur in a station. If you suspect that a stations has an electrical error, please see Section 7.1.1, “Running the "Electrical Test"” [57].	Stays on until all stations are labeled OK (see Section C.4, “Inspecting and Toggling Station Status” [136]). You can clear the notification by viewing the alarm list.

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
9. Max St.	Maximum number of stations reached. This means that a program tried to start a station when the maximum number of stations was already running. This alarm can only be triggered if you have changed the power adjustment to something higher than the default value.	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
10. Repeat.	The number of repeats has been reduced in a misting program. This typically happens if ET expands the run time for repeats and the program can't fit all the repeats into the configured time frame. You can read more about this in Appendix H, *Advanced Irrigation: Misting, Cycle & Soak* [169].	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
11. NW Prg.	A program has not been run because it was set to start in the non-water time window. You can read more about the non-water window in Appendix G, *Defining a Custom Irrigation Period* [167].	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
12. NW Stp.	A program was halted because it was running when entering the non-water time window. You can read more about the non-water window in Appendix G, *Defining a Custom Irrigation Period* [167].	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
13. Mst NR.	There is no response from your moisture sensors.	Stays on until the sensors are all responding.
14. Mst Lv.	One or more of your moisture sensors is reporting a moisture level below the alarm threshold.	Stays on until the moisture level is above the threshold.
15. Rem ET	Your controller is not receiving ET data from the remote ET server.	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.

3. To exit the alarm list push the ALARMS button again, or simply wait about 20 seconds, and the controller will return to the normal display.

   When you have viewed the list of alarms you will no longer be notified in the display about past alarms. Of course you can always revisit the list.

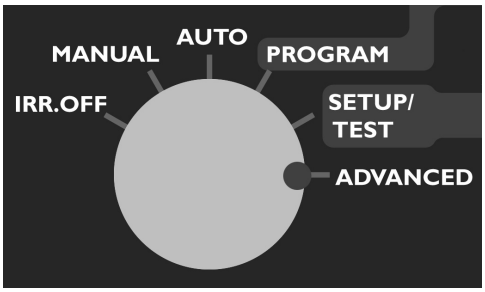
6.4. Monitor Data

If your communication subscription allows, you can enable the controller to send monitor data to your Web interface.

To enable relaying monitor data to your Web interface, follow this procedure:

1. Turn the mode selector to ADVANCED

Figure 6.21. Mode selector in ADVANCED



Now the display looks like this:

Figure 6.22. Display message on switch to ADVANCED mode

2. Use the arrow keys to select `Monitor Data` and press the ENTER button. Now you see the following display:

3. Select `Enable/Disable mon events`.

   Now you get a list of all the events that can trigger monitor data. For each of these you can select them using the ENTER button and enable/disable them:

   - Programs
   - Stations
   - Daily Water Usage
   - Hourly Water Usage
   - System Mode Change
   - Alarms & Rain Shutdown
   - Installation Data Change

- Program Data Change
- Moisture
- Clock Changed
- Water Window
- Daily ET and Rain
- Daily Assigned Program ET
- Hourly Rain
- 2WR Monitoring

4. Finally you can configure how often the controller should poll the two-wire for problems.

   From the main `Monitor Data` menu select `2WR surv log interval` and you will see the following display:

5. Select your desired interval and press the `ENTER` button.

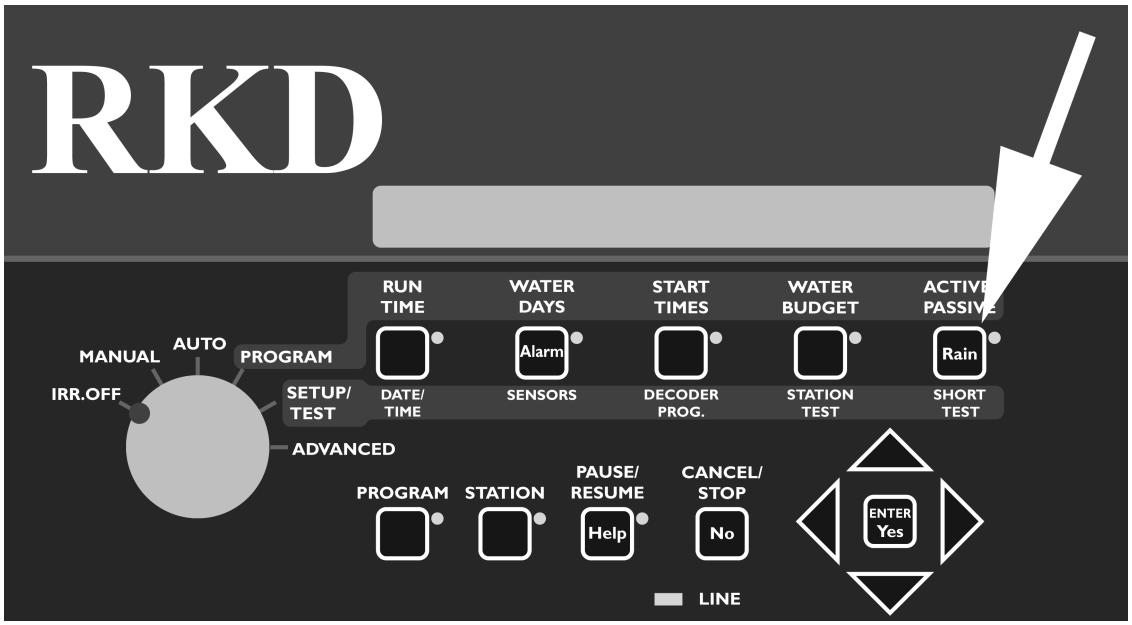
6.5. Rain Shutdown

Despite all the features controlling irrigation in your RKD you still have a manual handle to pull if you want to halt irrigation immediately - typically if heavy rain sets in.

To halt all irrigation immediately, simply push the `RAIN` button on the front plate:

Note

The rain shutdown can be enabled for 999 hours.



You will be prompted to enter the number of hours you wish to halt irrigation. Use the *item selectors* to enter the number of hours and press the ENTER button to start the shutdown.

To end the shutdown, push the CANCEL button.

Chapter 7. Troubleshooting from the Controller

7.1. Testing Stations

This section describes the various ways you can troubleshoot your controller and stations.

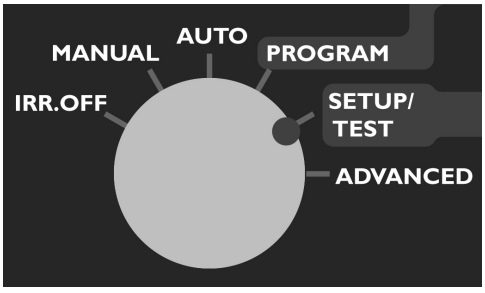
7.1.1. Running the "Electrical Test"

The RKD has a built-in test that will activate each station in turn for just one second in order to check if they are responding correctly. The stations must be connected to the solenoids that activate valves in the landscape, and the test can tell whether the stations and solenoids are working correctly in conjunction.

Procedure 7.1. Running the station test

1. Turn the *mode selector* to SETUP/TEST mode:

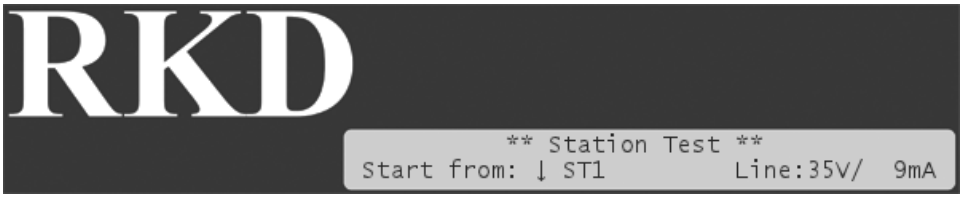
   Figure 7.1. Mode selector in SETUP/TEST

2. Push the STATION TEST button.

   Now you'll be prompted to select the station you wish to start from:

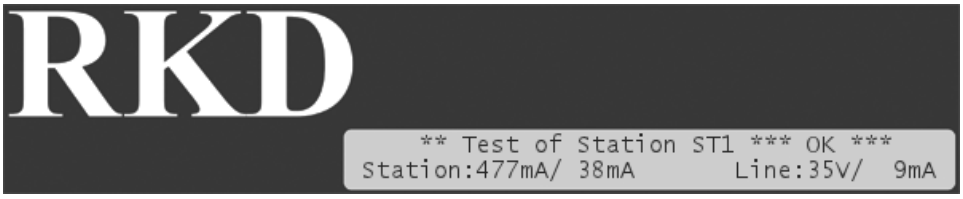
   Figure 7.2. Select first station for test

3. Use the *item selectors* to select a station and push the ENTER button to start the test.

   If the station is ok, the display will look something like this:

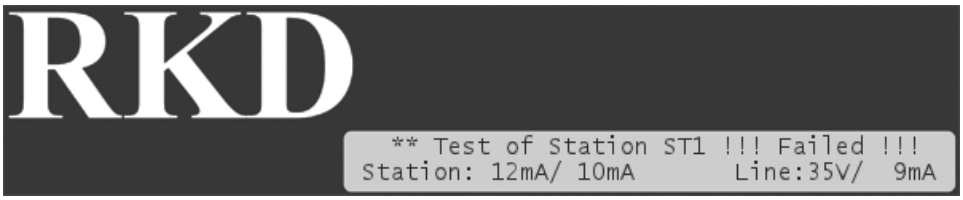
Figure 7.3. station test OK



In this case the station pulled a current of 477mA during the "inrush" period, which is when the station is activating the solenoid, and a current of 38mA once the solenoid was open. Numbers in this range are normal; it takes a larger charge in the "inrush" period to pull the solenoid open, and then a smaller current to keep it open afterwards.

If the station fails, the display will look something like this:

Figure 7.4. station test Failed



Note how the current during "inrush" and afterwards are practically the same - the station or the solenoid isn't responding.

Regardless of whether the station fails or turns out ok, you move on to testing the next station in line by pushing the ENTER button.

7.1.2. Testing Individual Stations

There are two ways to test if a single station is working correctly:

1. If you have physical access to the station, you can detach it from the two-wire, take it to the controller and perform a station test as described in Section 5.2.1, “Testing a Station” [26].

   If this test fails, the station must be replaced.

2. If you don't have access to the station - maybe it's buried in the landscape - you can run the test program (see Section 7.1.1, “Running the "Electrical Test"” [57]). Start the test at the station you wish to test, and then exit it afterwards by turning the *mode selector* to another mode or pushing the CANCEL button.

Important

If a station fails when running the test, you could be looking at a faulty solenoid. If you want to be 100 percent sure that the error lies in the station, you must bring the station to the controller and perform the test described in Section 5.2.1, “Testing a Station” [26].

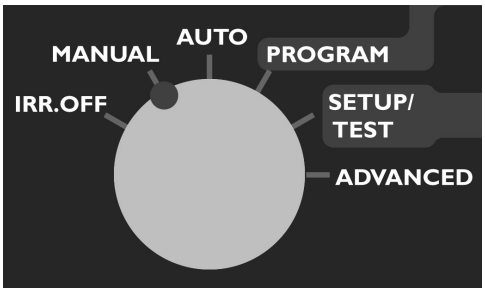
7.2. Running the "Water Test"

The "water test" is a built-in program that will activate all 100 station identities in the system in turn. This way you can walk through the landscape and ensure that all stations are actually pulling the valves open.

Procedure 7.2. Running the test program

1. Turn the *mode selector* to MANUAL mode:

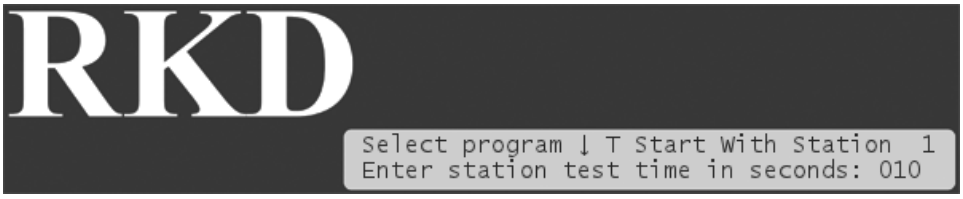
   Figure 7.5. Mode selector in MANUAL mode

2. Push the PROGRAM button, locate the "Test" program (called "T") and push the ENTER

3. Now you can set the time each valve should be pulled open, and which station you wish to start from. The interval must be between 10 and 990 seconds.

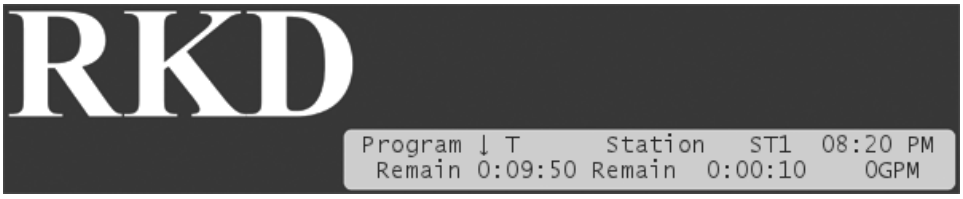
   Figure 7.6. Set the interval time for the "water test"

   Once you've set the interval time, push the ENTER button to start the test program.

4. Once the test program starts running, you'll see each station activated in turn, starting at the station you chose in the last step:

   Figure 7.7. Water test running

Note

All 100 station identities will activate in turn - this means that if you don't have assigned stations at all identities, you will experience "empty" intervals where no stations react to the instructions on the two-wire path.

Note

The test will include Master Valves but not Booster Pumps.

Tip

You can pause the test program just as any regular program. This is described in Section 6.1.1, “Pausing a Running Program” [42].

Tip

You should enable Line Survey to be able to see the current pulled by each station.

7.3. Testing Programs

The easiest way to test whether a program is running correctly - that is, it activates the correct stations, master valves and booster pump relays - is to try to run the program manually. Check out Section 6.2, “Running RKD in Manual Mode” [46] 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 5.3.4, “Adjusting Water Usage (Water Budget or ET)” [34] for instructions) before running the program.

This way you can "follow" the program by walking from station to station in the terrain as they activate for just one percent of the original run time.

7.4. 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 RKD senses a 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 in the lower part of the display that a short occurred:

Figure 7.8. Short notice

If the leak is severe (current more than 600-650mA), the LEDs will turn off due to the loss of power. However, current will still be running on the two-wire.

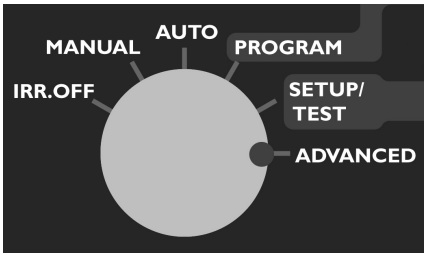
Note

You can make the controller display voltage and current:

Procedure 7.3. Making the controller display voltage/current

1. Turn the *mode selector* to ADVANCED mode:

   ### Figure 7.9. Mode selector in ADVANCED

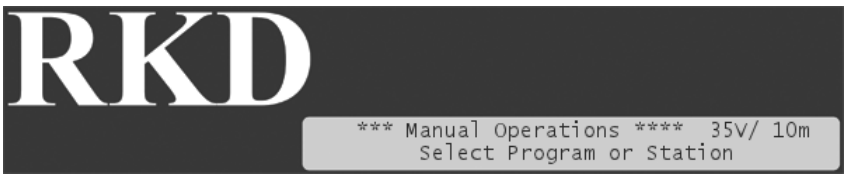
   

2. Select `8. Enable/Disable line V/mA display` and push the ENTER button.

3. Use the *item selectors* to select `Enable` and push the ENTER again.

   When you return to either AUTO or MANUAL mode, you'll see the line status in the upper right hand corner:

   ### Figure 7.10. Line status in manual mode

   Unfortunately there isn't enough room in the display to list the current with the full "mA" suffix - only an "m" could fit in.

   ## 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 either a clampmeter or the current tracker that ships with your RKD.

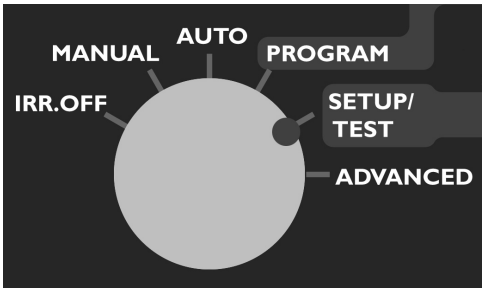
7.4.1. The Built-in Short Test

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 7.4. Running the short test

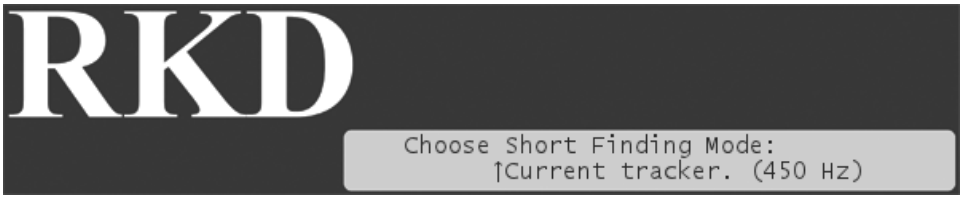
1. Turn the *mode selector* to SETUP/TEST.

   Figure 7.11. Mode selector in SETUP/TEST

2. Push the SHORT TEST button. Now you'll be asked which test mode to run:

   Figure 7.12. Select test frequency

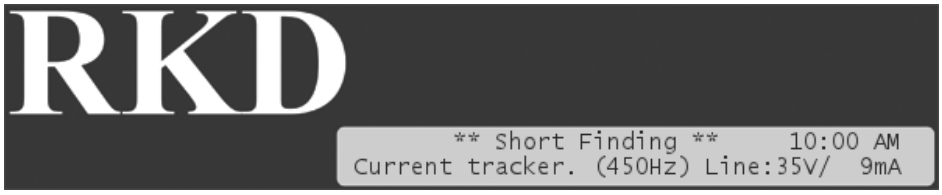
   

   If you just want to view the voltage and current without following up with a field test, it doesn't matter which you choose. But if you want to follow up with the current tracker or a clampmeter in the field, select the setting for the tool you are going to use.

3. 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 7.13. No short on two-wire path

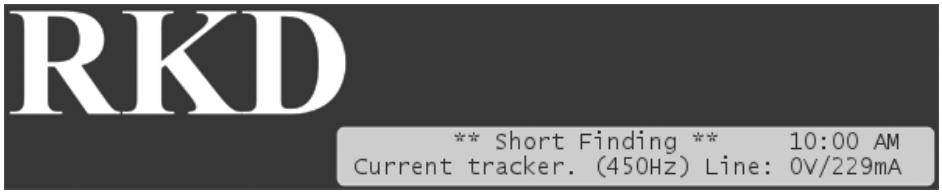


The voltage is 35V and the current is 9mA.

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 7.14. Short on two-wire



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 8.1, “Scenarios with power readings between 31V and 35V” [69].)

If you find that there's a short in your system, you should try to locate it, using a clampmeter or the current tracker that ships with your RKD. Check out Section 8.4, “When there is a Short Circuit in the Field” [75] instructions on doing this.

7.5. Increasing Station Power

In case the stations are not giving out enough power for the valves or pumps to pull open, it is possible to increase the power.

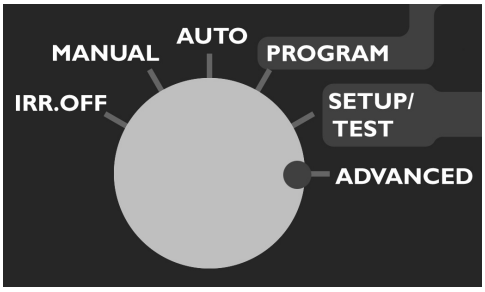
Important

Increasing the power means that there's no guarantee the RKD will operate as efficiently as when running in with factory settings.

Procedure 7.5. Adjusting station power

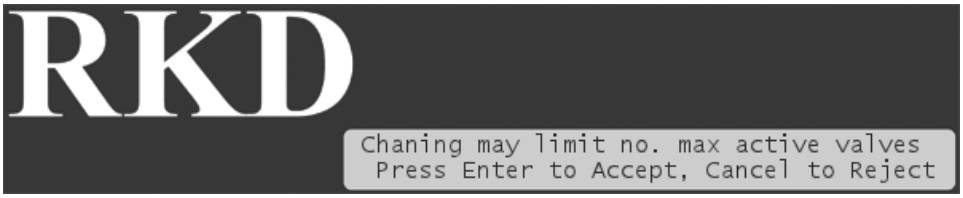
1. Turn the *mode selector* to ADVANCED mode:

Figure 7.15. Mode selector in ADVANCED mode



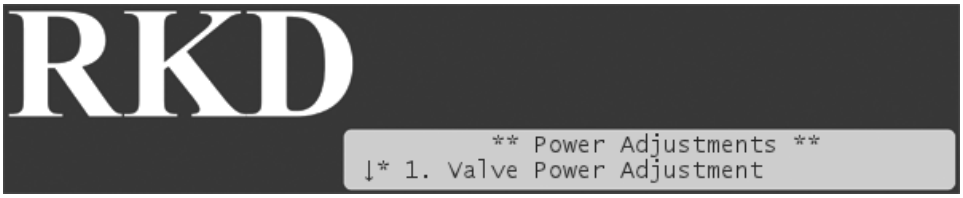
2. Scroll down to `9. Power Adjustment` and push the ENTER button. Now you'll be warned about the consequences of increasing station power:

Figure 7.16. Increasing Station Power Warning



Push the ENTER button to proceed - now you'll see the following screen:

Figure 7.17. Selecting Valve Type for Power Adjustment

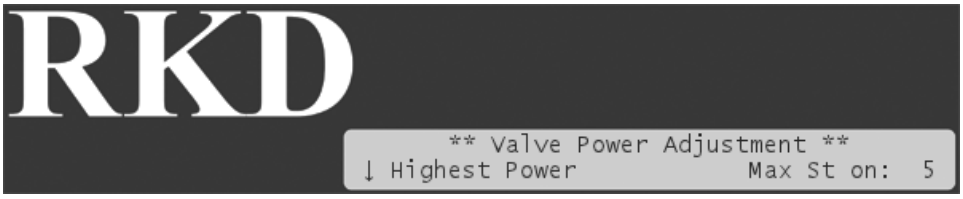


3. Scroll to the station type you wish to adjust the power for (normal valve, master valve or booster pump), push the ENTER button and select between these four settings:

   - Highest power
   - Higher power
   - High power
   - Normal power

   When changing the power setting you can see how may stations can be run at the same time. For example, when changing the power setting for regular valves to "Highest Power" you can run a maximum of five simultaneous valves:

Figure 7.18. Setting Valve Power to Maximum



Chapter 8. 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.

8.1. 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 stations running)**
Power	33-35V	31-34V
Current	0-3mA (no stations attached)	600-650mA

Tip

See Section 7.4, “Testing the Two-wire Path” [60] for instructions on how to do power and current readings in the display of the RKD.

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 stations (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 stations 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.

Active Stations
: When active, any station, controlling a valve, master valve or booster pump, will consume around 25mA.

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

Note

These numbers are valid for an running with normal power settings - if you change the power settings as described in Section 7.5, “Increasing Station Power” [63], the numbers will change - the higher power settings, the higher current readings.

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 RKD has lowered the power on the two-wire, and you should go locate the problem in the field (Section 8.4, “When there is a Short Circuit in the Field” [75].)

Note

The current reading can be "normal" in this situation (600-650mA or lower) - this is one of the RKD's safety features.

If the power reading is between 25V and 31V

This is abnormal. The RKD will keep running normally, but there's a probability you have a short somewhere - you should go locate the problem in the field (Section 8.4, “When there is a Short Circuit in the Field” [75].)

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 8.1, “Scenarios with power readings between 31V and 35V” [69] 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 stations>`. Though no station consumes exactly 0.5mA, the figures even out the more stations 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.

Table 8.1. 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 stations are not connected correctly. Try running the test program (See Section 7.1.1, “Running the "Electrical Test"” [57]).
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 RKD can handle, but you could be looking at problems that dramatically increase under more moist conditions - see Section 8.1.1, “Problems on the Two-wire” [69].
Excessive current (More than +50%)	> 15mA	> 30mA	> 45mA	> 60mA	> 75mA	This is a risky situation that can interfere with the functionality of the RKD, 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 8.4, “When there is a Short Circuit in the Field” [75]), but the current will not be as excessive as when a short occurs.

8.1.1. 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.

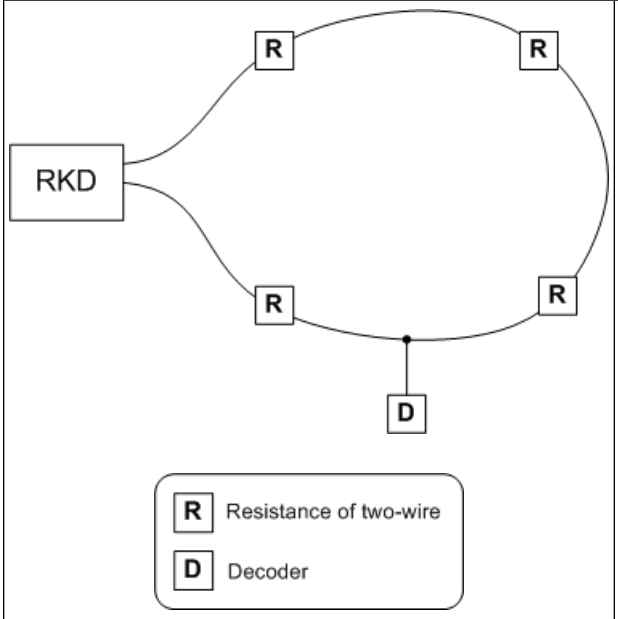
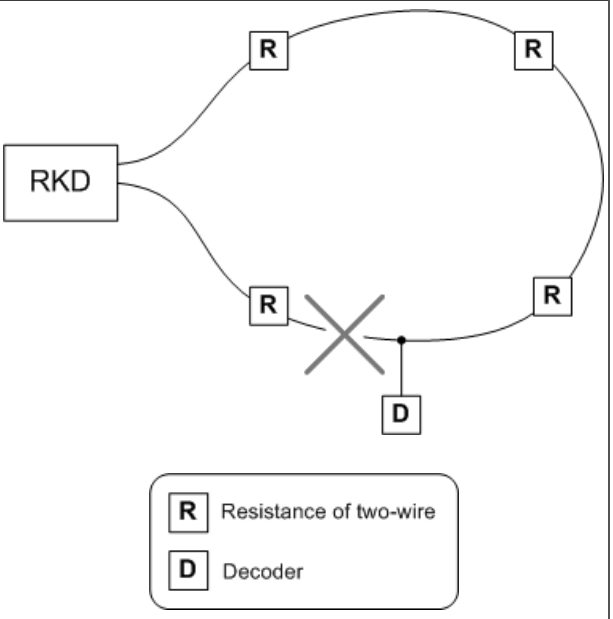
8.2. Dealing with Unstable Stations

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

- The faulty station is not connected and placed in the field according to the instructions in ???.
- You have increased the power used to activate stations (see Section 7.5, “Increasing Station Power” [63].) This means that you need to lower the number of simultaneously running station, or all stations might not work as intended, giving a seemingly random problem depending on which schedule you are running.
- 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, stations seem to fall out randomly. See the previous section (Section 8.1, “Checking Power and Current Readings” [67]) for more details.
- In case you have a loop installation, problems may occur if the loop is broken, as the resistance between a station and the RKD 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 station and the RKD is 0.75*R	The resistance between the station and the RKD 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 RKD, just detach one of the two-wires on the controller.
2. Perform an "electrical test" as described in Section 7.1.1, “Running the "Electrical Test"” [57]. This will activate each in turn - if you see stations 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 stations keep failing, you should look at the instructions in the following section, Section 8.3, “Dealing with Failing Stations” [71].

8.3. Dealing with Failing Stations

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

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

8.3.1. A Single Station Fails

If the failing station has just been installed, did you remember to assign an ID to it? See Section 5.2, “Configuring Stations” [23] for instructions.

If the failing station has been known to work, perform the electrical test (Section 7.1.1, “Running the "Electrical Test"” [57]) on the station in question and follow these guidelines:

If there's little or no reaction from the station	1. Put the RKD in "Short Mode" (see Section 7.4.1, “The Built-in Short Test” [62]), go to the station in the field and perform these tests: • Check wires and connections between the two-wire, the station and the solenoid (See Figure 8.1, “Checking Connections” [73].) • Short circuit the two-wire at the station and use either the Current Tracker or a clampmeter to check if power is still OK - if this is the case, the problem is in the station or solenoid, and not on the two-wire between the station and the RKD (See Figure 8.2, “Testing the path to a station” [73].) • 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. • Take the station to the controller and perform a direct test before replacing it (see Section 5.2.1, “Testing a Station” [26] for instructions.)
If the station fails with to high power reading	• Check the two-wire between the solenoid and the station for cracks in the insulation or bad connections. • Detach the solenoid from the station 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. • Take the station to the controller and perform a direct test before replacing it (see Section 5.2.1, “Testing a Station” [26] for instructions.)

Figure 8.1. Checking Connections

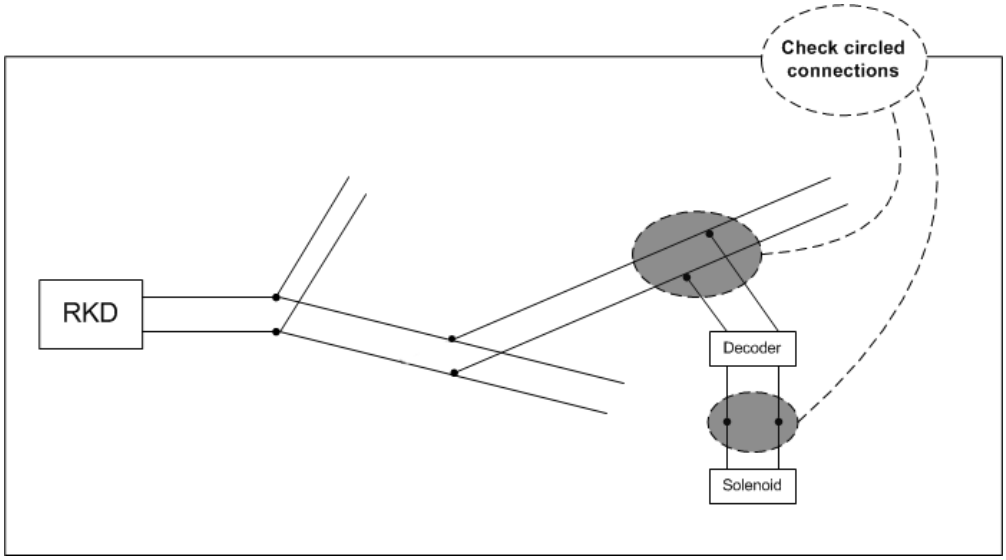
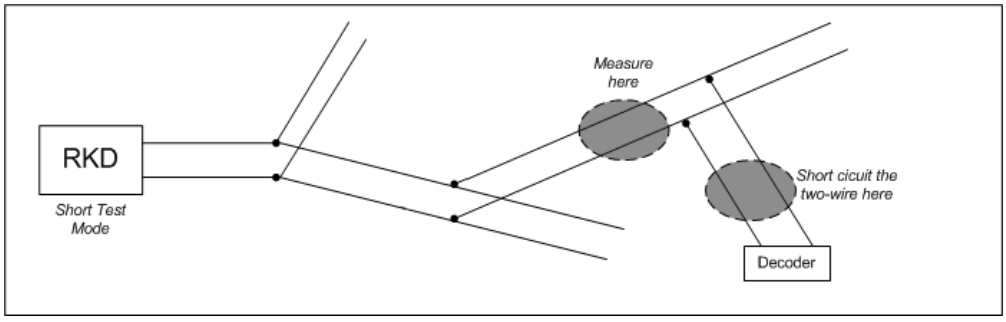


Figure 8.2. Testing the path to a station



8.3.2. Several Stations Fail

Here is a checklist if multiple stations fail:

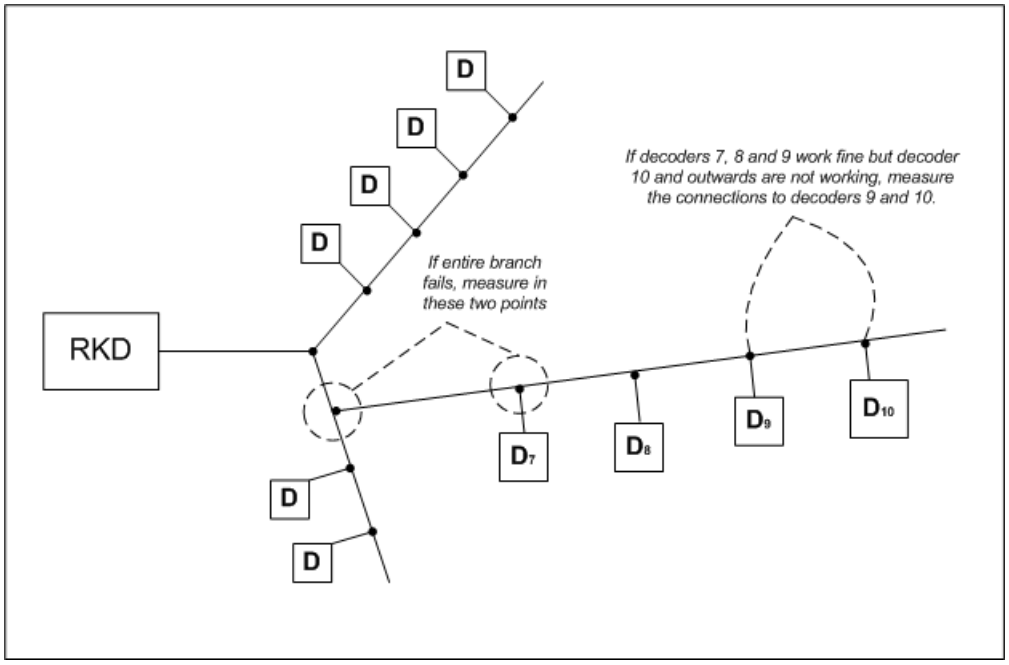
- If two stations are configured with identical IDs (see Section 5.2, “Configuring Stations” [23],) you can get a rather confusing behavior in the system. Imagine the following scenario:
  - We consider two stations, **M** and **N**.
  - You have configured station **M** to have the ID "ST20".
  - Station **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 stations 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

When you:	The following happens:	Because:
		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 stations react to "ST21" since they both think they are "ST20."

- If you're dealing with a new installation, and the failing stations 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 8.3.1, “A Single Station Fails” [71] for more details.)
- If the failing stations are located on the same dead end branch of your two-wire, chances are that the connection to the branch is faulty. If all stations from a point on a branch and outwards fail (stations 9 and 10 in the illustration below), measure the connection to each station until you reach the point of failure.

Figure 8.3. 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.

8.4. 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 RKD to put up the following warning:

Figure 8.4. Short 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 4.3, “Controls on the RKD front plate” [17] if you don't remember what the *line activity indicator* is.)

But you can't always be sure that the RKD 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 stations, solenoids or other electronics attached to the two-wire.

Either way, you will need a Current Tracker (purchased separately), or a regular clampmeter (current leakage meter). Both are good troubleshooting tools but have different strengths and weaknesses:

	Strengths	**Weaknesses**
Current Tracker	• Can measure around the entire two-wire path or individual wires in the cable • Very sensitive when measuring individual wires	• Requires an additional voltmeter (a cheap piece of hardware, though) • No direct association between readings on the controller and the readings from the Current Tracker • Little sensitivity when measuring around the entire two-wire path - typically 50-100mA • Reading depends on the angle between the Current Tracker and the two-wire • Other powered up cables can affect the reading

	Strengths	Weaknesses
		• Optimized for 450Hz troubleshooting mode
Clampmeter (current leakage meter)	• Can only measure around individual wires in the two-wire path. • Very accurate • Good association between readings on the controller and the clampmeter • Very sensitive - will detect changes in the range of 1mA • Doesn't depend on being held in the right angle • Not sensitive to other power cables in the surroundings	• Can not measure around the entire two-wire path • Relatively expensive • Optimized for 50-60Hz normal mode

8.4.1. Using a Current Tracker

The current tracker is used to inspect the two-wire in the landscape in order to locate shorts. You need physical access to the two-wire, or at least parts of it, since the current tracker measures directly on the cable.

Figure 8.5. Current tracker

To use the current tracker you need a voltmeter. The voltmeter must be able to measure up to 200 mV DC - usually an inexpensive model from your local electric supply store is sufficient.

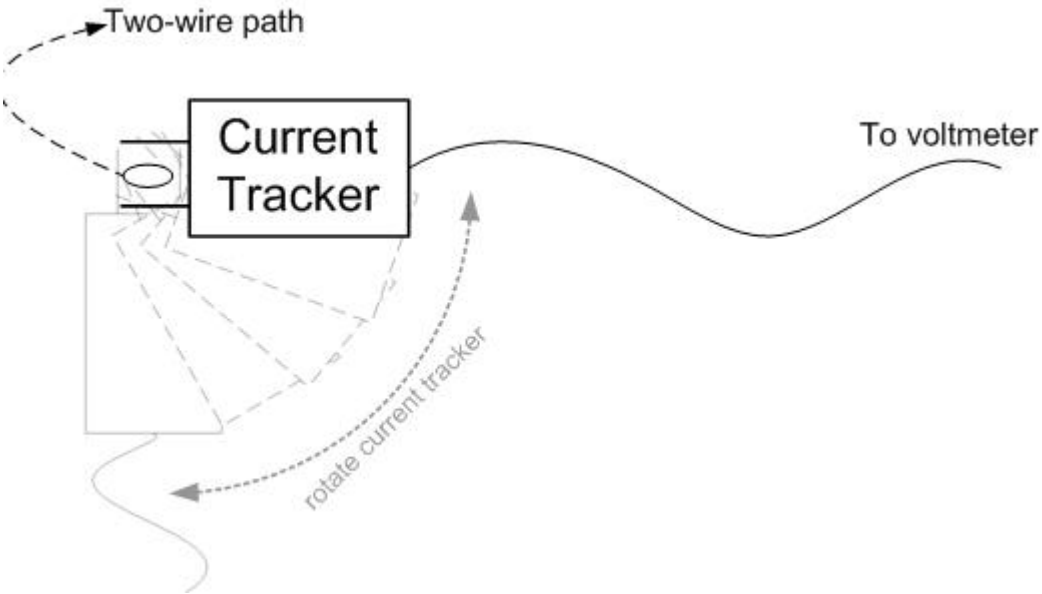
Procedure 8.1. Locating a short on the two-wire

1. Follow the first two steps of Running the short test [62] and select "Current tracker. (450Hz)".
2. Connect the current tracker to your voltmeter. Red line to red termnial, black line to black termnial.
3. Expect to be measuring somewhere in the range 10-200 mV DC and set the voltmeter accordingly - the closest higher setting. Typical settings are 100 or 200 mV.
4. Now start measuring the two-wire from the controller and out. You measure the two-wire by placing the cable between the two blades on the current tracker and checking the voltmeter. If the voltmeter shows nothing, you've passed the point of the short.

Important

If the voltmeter shows nothing, make sure to try placing the blades of the current tracker in different angles around the cable - the current tracker is direction aware and you need to try at least a span of 90 degrees around the cable in order to be sure that there's no signal available:

Figure 8.6. Rotating the current tracker around the two-wire



Ideally, you should rotate the current tracker around the individual wires inside the two-wire - do this if enough plastic is stripped off the two-wire.

Now you can work your way through the entire two-wire installation to locate the point where you can no longer pick up the signal. Hereby you should be able to locate precisely where the short is at.

8.4.2. Using a Clampmeter

Instead of the current tracker that ships with the RKD you can use a clampmeter to locate a short. You need physical access to the two-wire, or at least parts of it, since the clampmeter measures directly on the individual wires in the cable.

Procedure 8.2. Using a clampmeter for short finding

1. Follow the first two steps of Running the short test [62] 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.

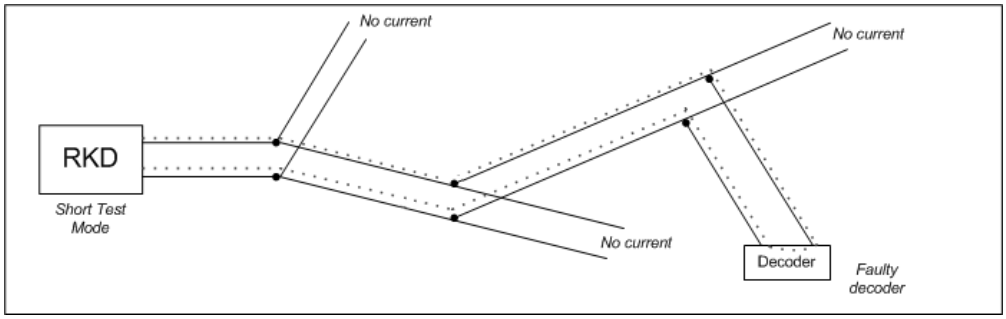
8.4.3. Locating the Short

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

- Current Tracker, clampmeter or both.
- 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 8.7. Faulty station



Note

If your installation loops back to the RKD 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 [79], Phase II: Locating a Faulty Branch in the Field [80], and Phase III: Performing a "Binary Search" on a Faulty Branch [81].

Procedure 8.3. Phase I: Checking for Problems at the Controller

1. Select which which type of probe (Current Tracker or clampmeter) you wish to use for troubleshooting. See Section 7.4.1, “The Built-in Short Test” [62] for instructions.

2. 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 (and the entire two-wire if you're using the Current Tracker.) 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 [80].)

   - If one of the cables connected to the RKD loops back to the controller, you must open the loop before measuring.

   - If more than one non-looped cable is connected to the RKD, you can already now determine which cable holds the short - it will be the one with the highest current reading.

     Note

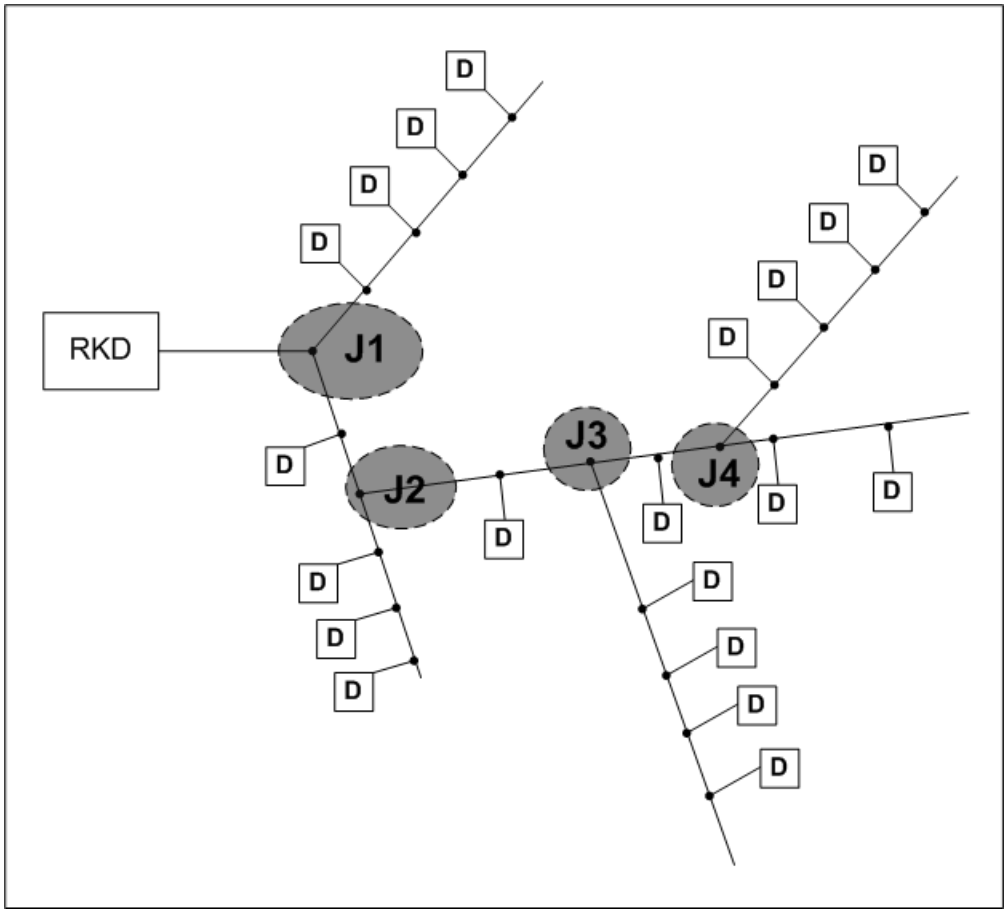
     When measuring with the Current Tracker, readings on the entire two-wire are way lower than when measuring on just one of the wires. Thus remember not to compare the two different types of measurings.

   - 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 RKD.

3. 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 8.4. 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 RKD - perform a binary search on this part of the cable (See Phase III: Performing a "Binary Search" on a Faulty Branch [81] 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 [79]) 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 station attached to the junction itself, make sure you measure on that as well, as the station 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,

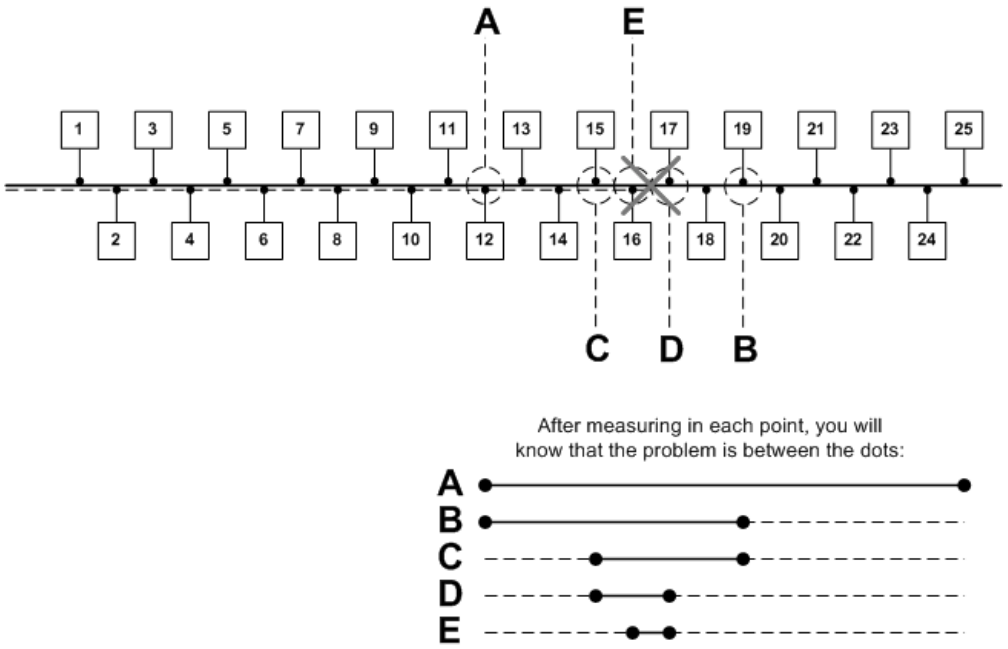
and further out as well. Detach the junction and start by finding the problem on the stretch from the controller - then attach the junction again and work on each branch.

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 [81].

Procedure 8.5. 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 station 1but no current is running at station 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 station 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 station 12 and 19.

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

4. You find no current in point D - the problem is narrowed down to between station 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 station 16 and 17.

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

Chapter 9. Advanced Features

9.1. Intelliset

With the Intelliset feature set you can allow external evapotranspiration (ET) devices to control your irrigation.

Intelliset comes in a couple of flavors:

- Simple ET which allows a WR7 Receiver to tell the RKD if it should irrigate today or not.
- Complex ET control based on historical ET data: you enter the historical ET correction figures for the entire year and use these to adjust your irrigation throughout the year. You can also use the historical data as a fall-back mechanism for a connected weather station.
- Complex ET control which allows the RKD to adjust the irrigation level based on ET data from a weather station - exact amount of rain and environmental conditions.
- Complex ET control based on remote ET data received from a central ET server.

All methods ensure more efficient water consumption than you would see from using a "flat" irrigation scheme throughout the year.

In addition the RKD provides two extra sources of information about irrigation needs:

- Moisture sensors that will tell you exactly how moist your soil is, giving you the best evidence of how much irrigation is needed.
- "Extended rain shutdown" - a feature that will halt all irrigation after a rain alarm has occurred, regardless of what your ET tells you about irrigation needs.

You can read about Intelliset in Appendix B, *Adding an ET Device* [101].

9.2. FloGuard

FloGuard is the RKD safety system that constantly monitors the controller for potential problems and raises alarms when needed.

FloGuard will detect things like pipe leaks, faulty stations, malfunctioning pumps and many other things that could otherwise go unnoticed and damage your system.

You will also get notifications of "normal" alarms like rain alarms, ET input, short curcuits and any alarms stemming from your own auxiliary input devices.

Note

FloGuard requires a flow meter to be connected.

9.3. FloStack

The FloStack feature set helps you plan and control the flow in your system.

By entering an expected flow for each station and a maximum system flow capacity you can ensure that the RKD will not try to start more valves than the system can feed.

An extremely handy feature is the "Learn Flow" feature that automatically detects the flow of each station by running all stations in turn and comparing with measurements from a flow sensor.

You can read about FloStack in Appendix C, *Adding a Flow Sensor* [123] and Appendix F, *Using Simple Flow Management* [165].

9.4. Feature Manager

The Feature Manager lets you enable a few extra features that not all users will need, most notably the Mist Manager.

With the Mist Manager you can add an extra perspective on running irrigation schedules. Instead of a program just running one station at a time for a fixed duration, you can break each run into multiple cycles.

Instead of telling the RKD to run a number of stations for three minutes each, you can tell it to run each station in 18 second time slices 10 times with breaks in between. This adds up to the same water consumption, but allows the irrigation to soak in between the cycles.

Irrigation cycles that are measured in seconds are typically referred to as "misting", whereas cycles that are measured in minutes are referred to as "Cycle & Soak".

You can read all about the Feature Manager in Appendix H, *Advanced Irrigation: Misting, Cycle & Soak* [169].

Another feature is "Revert to auto", which will pull your controller back into auto mode, when it has been sitting in other modes for 10 minutes. This ensures that irrigation will always be resumed, even if someone leaves the controller hanging in a random menu item.

Note

The controller will not revert to auto if in "Irrigation off" or "Extended rain shutdown". Also, when performing a short finding, the time limit is not 10 minutes but three hours.

This feature is disabled by default

Appendix A. Adding a Rain Sensor

The RKD can accept input from an external rain sensor or a tipping rain bucket, and react in three ways:

- Simply stop irrigating if it rains at all (works with sensors and tipping rain bucket.)
- Stop irrigating if the rain level exceeds a certain threshold (works with sensors and tipping rain bucket.)
- Adjust irrigation based on the amount of rain (only works with a ripping rain bucket.)

Note

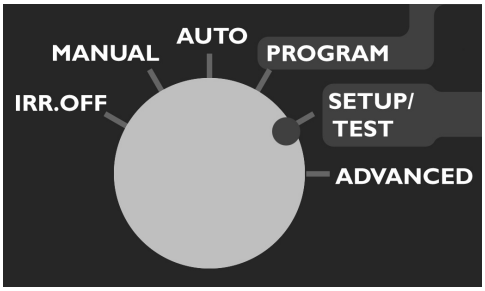
In a master/slave setup you do not need a rain sensor connected to all slaves - the master can simply send out alarms to all slaves instead.

The following procedure walks you through configuring the controller for rain sensor input - it is identical to parts of the procedure for ET (read more in Configuring ET Input [115]):

Procedure A.1. Configuring for a Rain Sensor

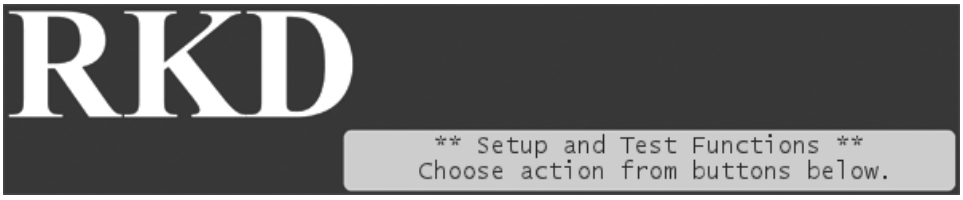
1. Before moving on, make sure you have connected the rain sensor as described in Section 2.2.2.2, “Connecting a Rain Sensor” [10].
2. Turn the mode selector to SETUP/TEST

Figure A.1. Mode selector in SETUP/TEST



Now the display looks like this:

Figure A.2. Display message on switch to SETUP/TEST mode



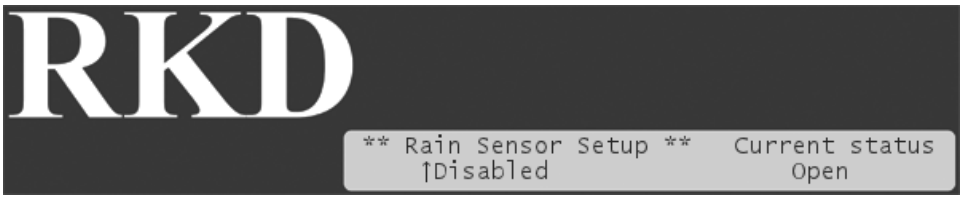
3. Push the SENSORS button. Now you'll see the following display:

Figure A.3. Sensor setup menu

4. Use the *item selectors* to select `2. Rain` and push the ENTER button.

   Now the display looks like this:

Figure A.4. Selecting the rain sensor input



5. Now you can choose between three settings:

   Rain gauge (Pulses)
   : If your rain sensor provides dynamic data in the sense that it sends a pulse for each unit of rain it detects, select `Pulses`.

   Rain contact (N/O or N/C)
   : If your rain sensor simply tells the controller whether to irrigate or not (if it's raining or not), you need to tell the controller if the input is normally open or closed. Whenever the device is in the opposite mode, the controller will hold its irrigation.

   Disabled
   : Don't use the Rain input.

   Use the *item selectors* to locate the setting you want and if you chose anything but `Rain gauge (Pulses)`, push the ENTER button to save your selection and the SENSORS button to exit sensor configuration.

   If you do chose `Rain gauge (Pulses)`, you need to tell the controller how many inches of rain each pulse corresponds, so please continue to the next step.

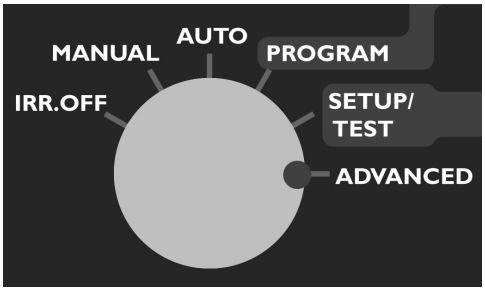
   

   Important

   If you want to receive remote rain data from an ET server, you must disable your local rain sensors.

6. Turn the mode selector to ADVANCED

Figure A.5. Mode selector in ADVANCED



Now the display looks like this:

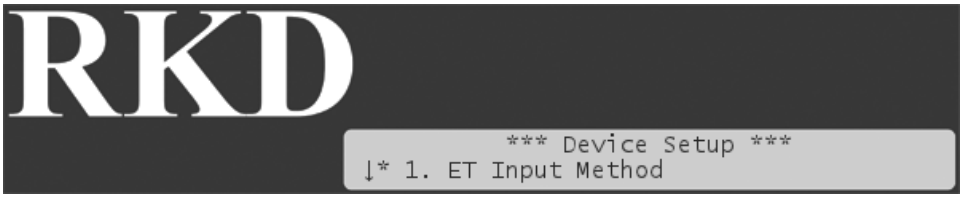
Figure A.6. Display message on switch to ADVANCED mode

7. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

Figure A.7. ET/Rain Setup Menu

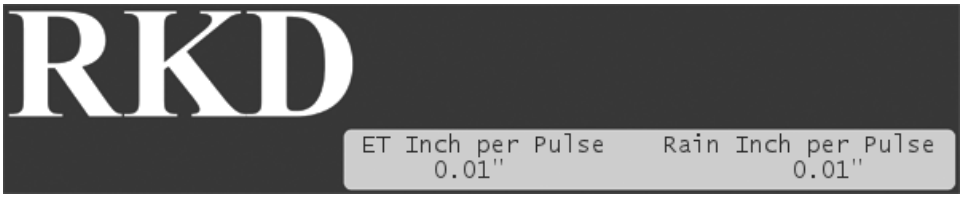
8. Select `6. Device Setup`. Now the display will look like this:

Figure A.8. Intelliset™ Device Setup Menu



9. Select `2. ET/Rain Setup` and then `2. ET and Rain Inch/Pulse settings`. Now you'll see something like this:

Figure A.9. ET and Rain inch per pulse settings



10. Use the *item selectors* to set your values and push the ENTER button to save your settings.

A.1. Setting Hourly Maximum Rain and Rain Alarm Level

The RKD allows for two precautions when you experience rain:

- You can set a threshold value for how much it should rain before the rain alarm will be activated. Here is how this calculation is done:
  - Based on historical ET data for the area, the controller knows how much water is evaporating per day during the current season.
  - The RKD assumes that 75% of the daily ET is evaporating between 8AM and 8PM, and the remaining 25% between 8PM and 8AM.
  - When the amount of rain exceeds the rain alarm level you define, the rain alarm is activated.
  - Now, based on the historical ET data the controller will calculate how much rain will evaporate, and mapping this number against the known amount of fallen rain, the controller will intelligently know when it is safe to turn off the rain alarm (i.e. when enough rain has evaporated that we are below your defined alarm level.)
  - The soil holding value is also a parameter: since you can never benefit from more rain than the soil is capable of holding, the rain alarm will not stay on forever after a few days of intensive rain.

  ## Note

  If you have not provided any historical ET, a default of 0.20" per day is used.

  See Section B.3, “Using Historical ET Data” [113] for instructions on how to provide historical ET to the RKD.

  See Section A.1.1, “How Amount Based Rain Alarms Work” [90] for more details on how the amount based rain alarm works.

- If it rains intensively for more than an hour you may get so much water that the soil can not benefit from all of it - the excess water will simply run off the surface. So if you run programs in ET corrected mode, the controller won't subtract all of the rain from tomorrow's ET figure - it will "cut off" the amount of rain to subtract at the hourly maximum.

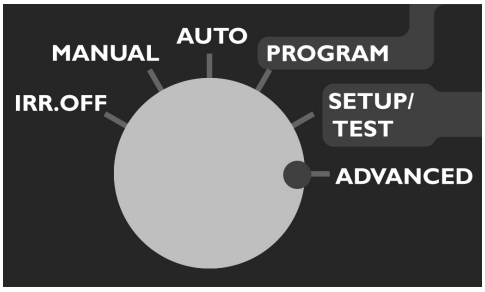
  Example: If the hourly maximum is 0.02" and it rains 0.03" per hour for three hours, only 0.06" and not 0.09" will be subtracted from tomorrow's ET budget.

You can read a lot more about ET in Section B.1, “How ET Works with the RKD” [101].

Procedure A.2. Setting the Hourly Max. Rain and Rain Alarm Level

1. Turn the mode selector to ADVANCED

Figure A.10. Mode selector in ADVANCED



Now the display looks like this:

Figure A.11. Display message on switch to ADVANCED mode

2. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

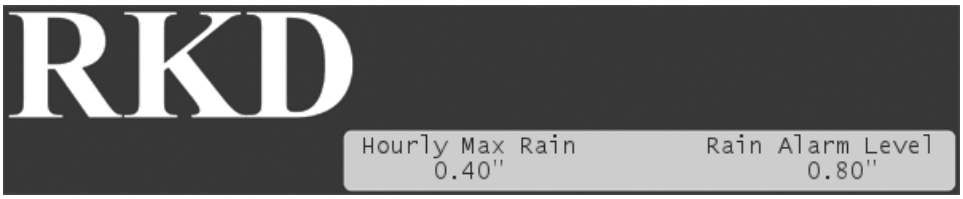
Figure A.12. ET/Rain Setup Menu

3. Select `1. ET`. Now the display will look like this:

Figure A.13. Intelliset™ Menu

4. Select `3. Max Hourly Rain and Rain Alarm Limit` from the menu and push the ENTER button. Now you'll see the following screen:

Figure A.14. Max. Rain Settings



Note

Setting a value to zero is the same as disabling the feature.

Note

If you see "NA" values in this screen you have not configured a rain sensor to provide input using pulses. Please refer back to Configuring for a Rain Sensor [85] for instructions.

5. Use the *item selectors* to set the desired values and push the ENTER button to save your settings.

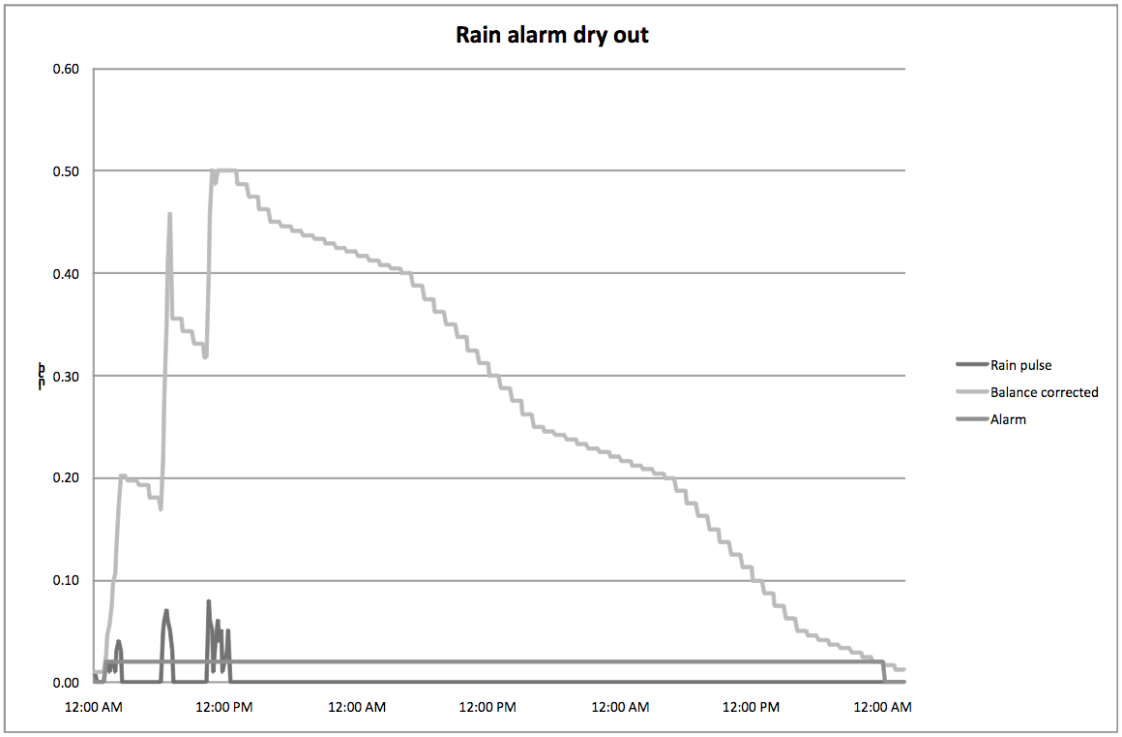
A.1.1. How Amount Based Rain Alarms Work

The following examples show how the amount based rain alarm works. In all the examples the usable rain is 0.86”.

Example A.1.

Table A.1. Parameters

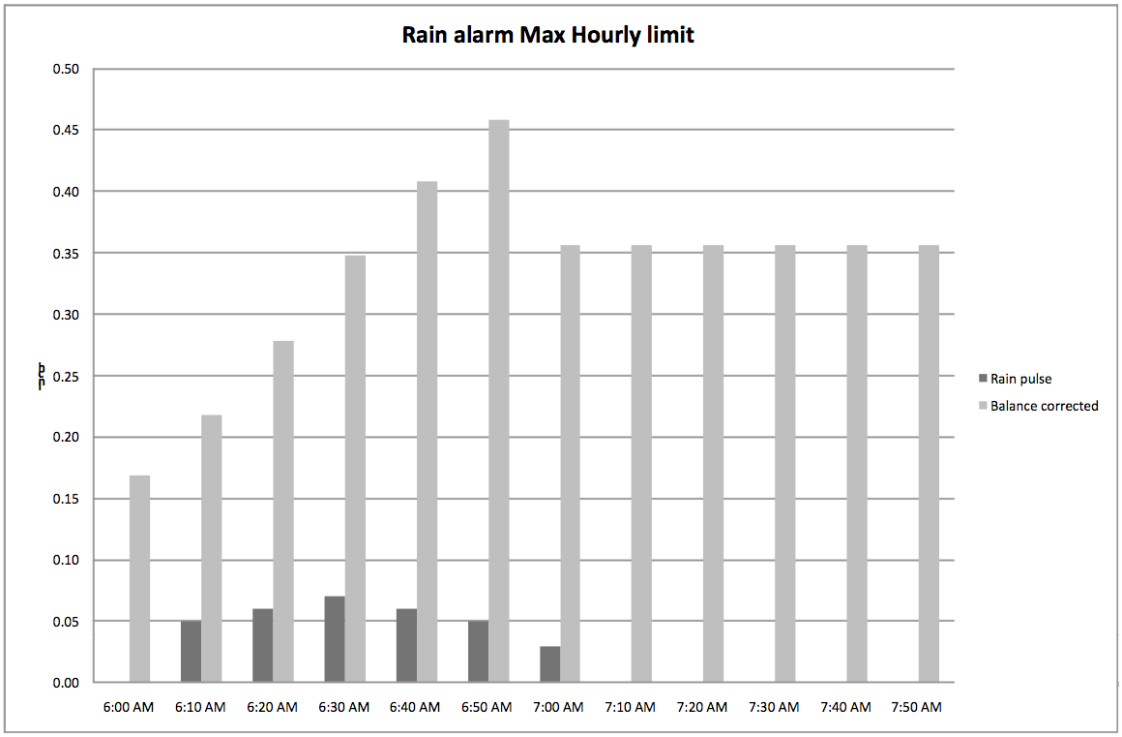
Daily ET	Max. hourly rain	Soil holding	Rain alarm limit
0.20" (standard)	0.20"	0.50"	0.02"



The graphs show the rain built up the balance whenever it rains. Every hour the balance is reduced by a fraction of the Daily ET (¼ during the night and ¾ during the day). When the balance reach the Rain alarm limit the rain alarm will go on/off.

The second rain burst shows a situation where the max hour rain limits makes limitations. More details below.

The third rain burst shows that we hit the soil holding and by that limit the balance.

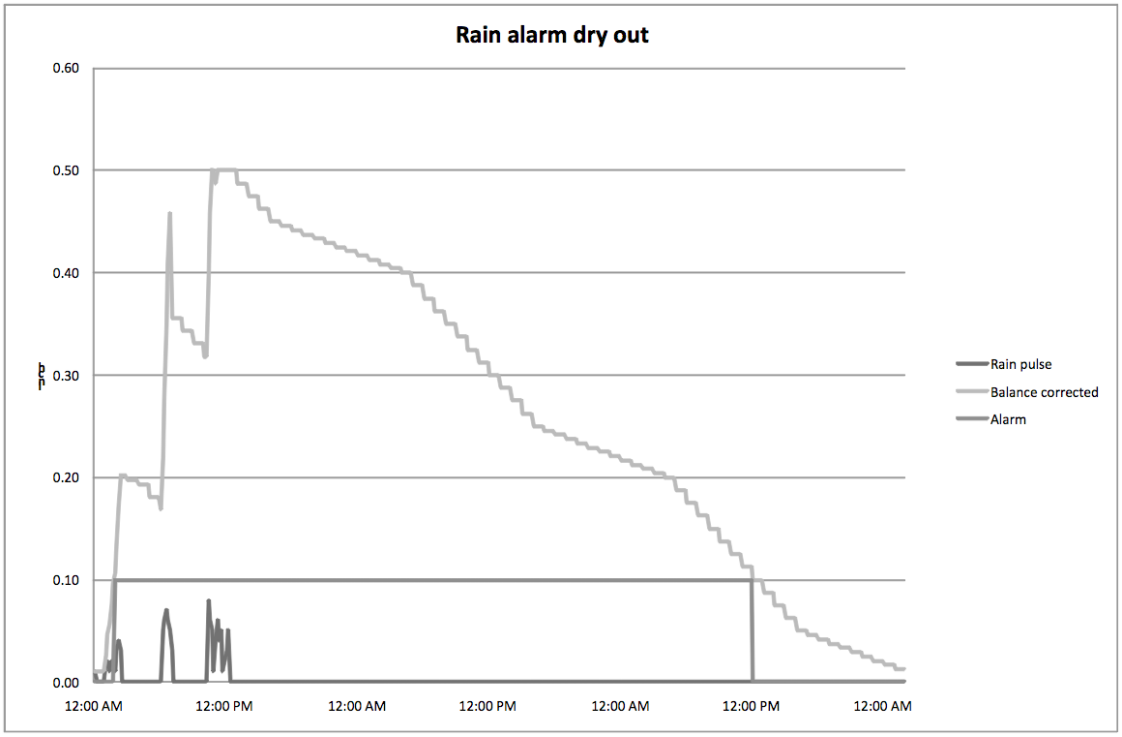


This graph shows how the balance grows minutes by minutes. At each whole hour the balance is corrected for max hourly rain and for the hourly dry out. In this case the hour between 10 AM and 11 AM has too much rain compared to max hourly rain and the balance is reduced.

Example A.2.

Table A.2. Parameters

Daily ET	Max. hourly rain	Soil holding	Rain alarm limit
0.20" (standard)	0.20"	0.50"	0.10"

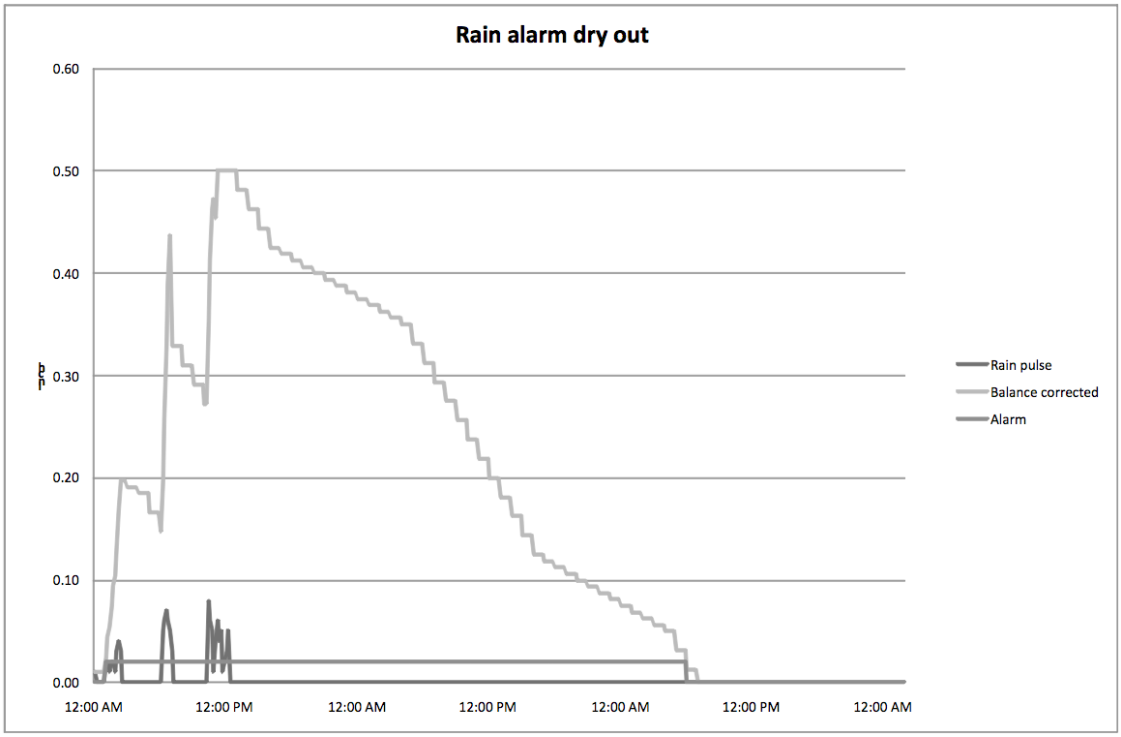


In this graph we see the same as in example 1 except that the rain alarm goes on later and off earlier.

Example A.3.

Table A.3. Parameters

Daily ET	Max. hourly rain	Soil holding	Rain alarm limit
0.30" (standard)	0.20"	0.50"	0.02"



This shows a more dry condition with higher ET than standard. The alarm period is then shorter.

A.2. Configuring the Extended Rain Shutdown Feature

Given enough rain, at some point the RKD will halt irrigation (based on the values you have set in Section A.1, “Setting Hourly Maximum Rain and Rain Alarm Level” [88]). However, there is a way to further refine this feature by defining:

- How many hours the rain alarm must be active before an extended rain shutdown will actually occur.
- If the extended rain shutdown should be longer than the duration of the rain alarm.
- For how long the extended rain shutdown can last.

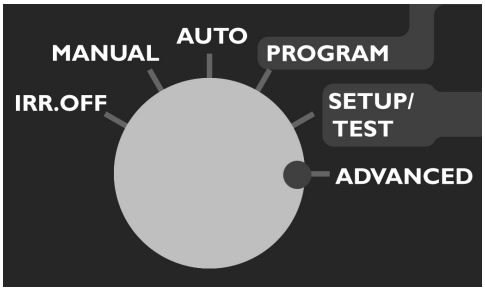
Note

The Extended Rain Alarm behaves exactly as if you pressed the RAIN button manually (see Section 6.5, “Rain Shutdown” [54].)

First you must enable the extended rain shutdown feature set:

1. Turn the mode selector to ADVANCED

Figure A.15. Mode selector in ADVANCED



Now the display looks like this:

Figure A.16. Display message on switch to ADVANCED mode

2. Select `8. Feature Manager`. Now you will see the following:

Figure A.17. Display message on switch to Feature Manager

3. Select `2. Ena/Dis Extended Rain Alarm`. Now you will see the following:

Figure A.18. Display message on switch to Enable Extended Rain Alarm

4. Select `Enable` and push the `ENTER` button to save.

Now you are ready to actually configure the extended rain shutdown parameters:

1. Use the *item selectors* to select `3. Intelliset` and push the `ENTER` button. Now you'll see the following screen:

Figure A.19. ET/Rain Setup Menu

2. Select `3. Extended Rain Alarm`. Now you see the following screen:

Figure A.20. ET/Rain Setup Menu

Important

You will only see this menu item if you enabled the feature as described in the previous procedure.

The three values you must set here are:

Table A.4. Settings for Extended Rain Alarm

Setting	Description
Minimum Rain Duration	For how long must the rain alarm have been active before an extended rain shutdown takes place.
Adjustment	You can use this value to prolong the duration of the rain shutdown. If the rain alarm has been active for an hour and you set the adjustment to 3.0, the shutdown will last three hours.
Max. Shutdown	How many hours can the rain shutdown be kept up. Value is between 0 and 999 hours.

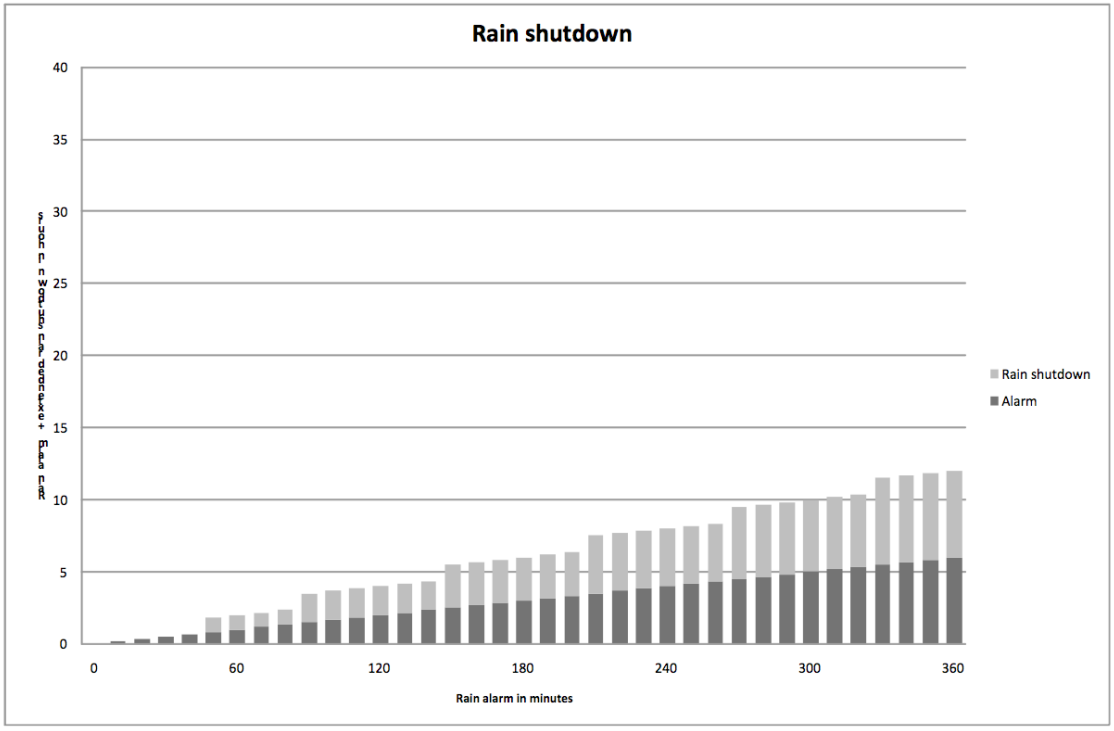
A.2.1. Examples using Different Parameters

The following examples show how the extended rain shutdown feature works on different parameters. It is important to notice that using the amount based rain alarm feature in the RKD (See Section A.1.1, “How Amount Based Rain Alarms Work” [90],) utilize the normal ET to simulate a dry out, which means the rain alarm will stay on as long time as the applied rain will last in respect to ET. Normally it will not be necessary to extend the rain alarm in these cases. If a rain contact is used without any dry out mechanism the extended rain shutdown is an excellent feature to avoid irrigation for a period after rainfall.

Example A.4.

Table A.5. Parameters

Rain min. duration	Adjust factor	Max shutdown
45 minutes	1 (1:1)	999 hours

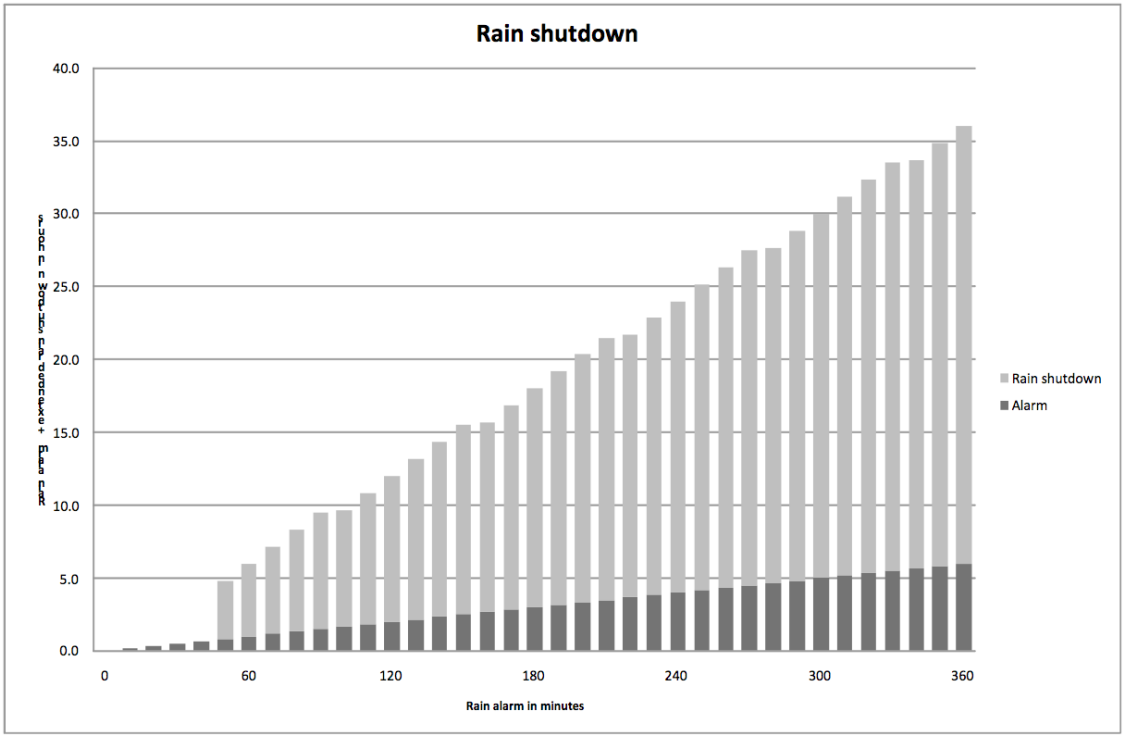


The graph shows how the extended rain shutdown extends the rain alarm. The rain it selves is of course 1 hoyr for 60 minutes, but the extended rain shutdown on top of that varies depending on the parameters. In this case the factor is one so 60 minutes rain alarm gives an extension with one hour rain shutdown. Note that the first 45 minutes don’t have extensions due to the Rain Min Duration.

Example A.5.

Table A.6. Parameters

Rain min. duration	Adjust factor	Max shutdown
45 minutes	5	999 hours

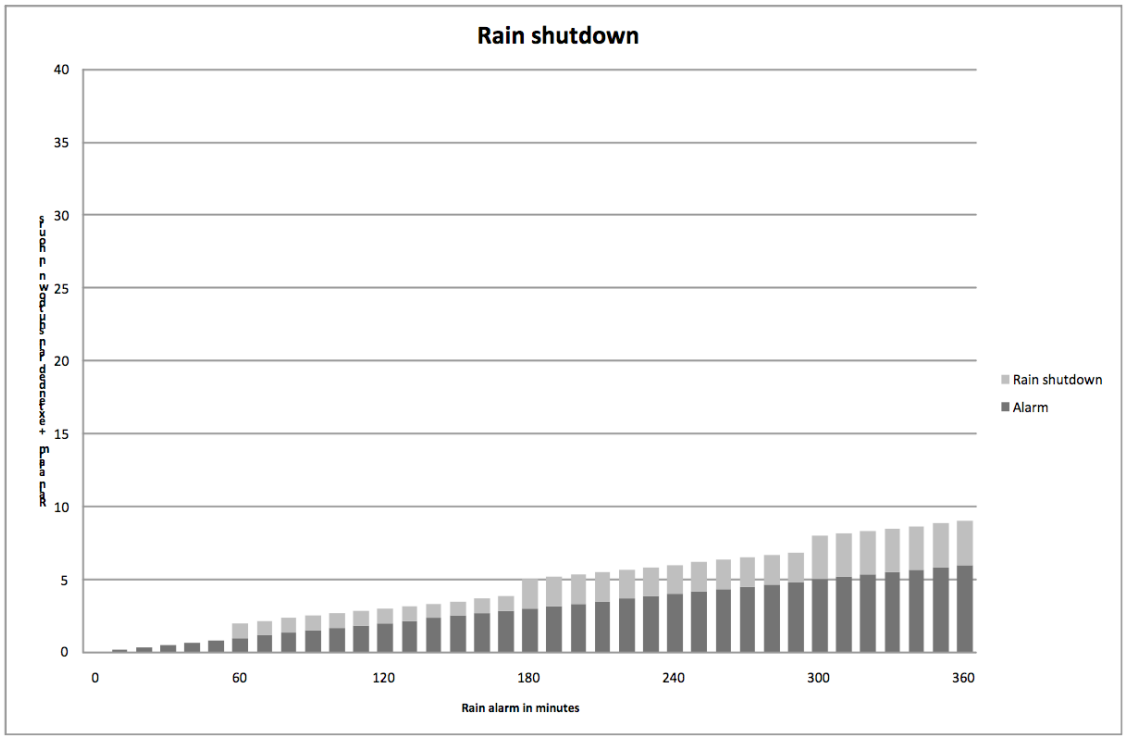


In this example the adjust factor extend each rain alarm hour with 5 hours rain shut down. So 6 hours rain alarm with prevent irrigation for 6+30=36 hours.

Example A.6.

Table A.7. Parameters

Rain min. duration	Adjust factor	Max shutdown
45 minutes	0.5	999 hours

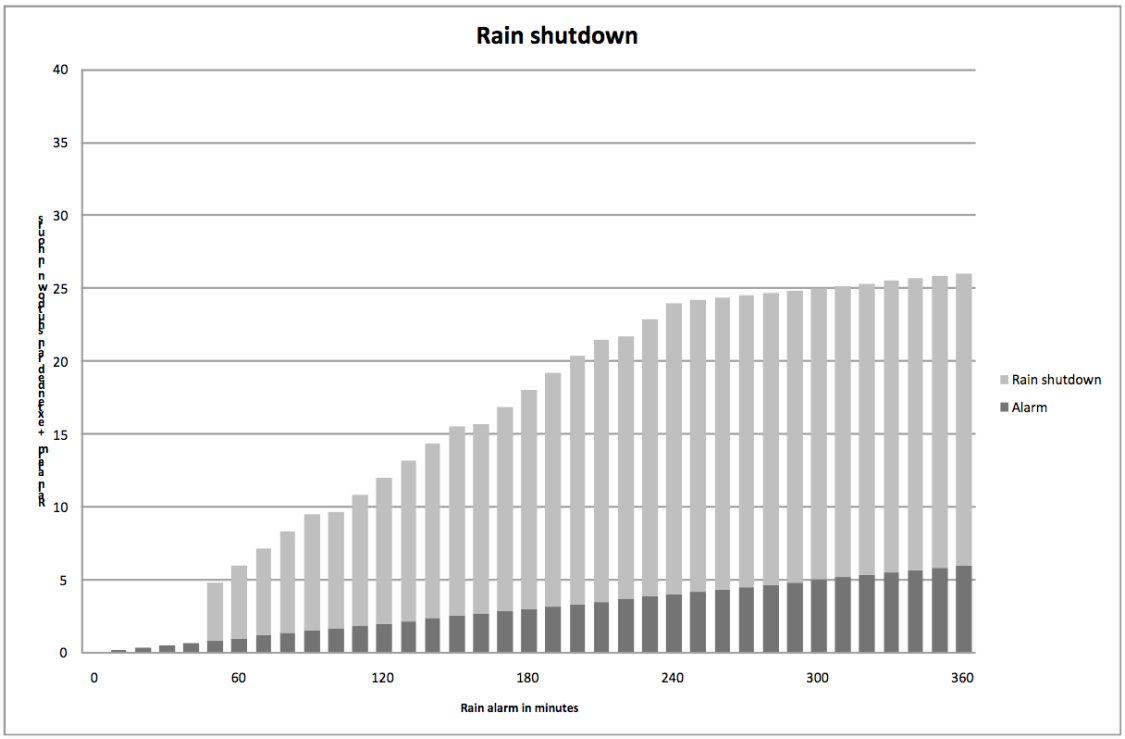


In this example the factor is 0.5 and thus the rain shutdown extension is only half of the rain alarm.

Example A.7.

Table A.8. Parameters

Rain min. duration	Adjust factor	Max shutdown
45 minutes	5	20 hours



This example has the same factor as example 2, but the max shutdown limits the rain shutdown extension in the case of long rain alarm periods.

Appendix B. Adding an ET Device

Evapotranspiration (ET) devices can help the RKD adjust irrigation based on weather conditions. You can either let an ET device provide daily input on how the irrigation should be adjusted, or you can enter historic ET data on how the weather usually behaves throughout the year and the controller will adjust its irrigation accordingly.

Note

Historical ET data acts as "fall back" data for the controller if the communication with a connected weather station should fail. Thus, you should enter historical ET data even if you are using a weather stations.

B.1. How ET Works with the RKD

The RKD will receive ET data from an external weather station or from a historical ET report describing the evaporation throughout the year. Combining this data with the input from a rain sensor or a tipping rain bucket, and the expected level of irrigation the controller can calculate exactly how much water to use for irrigation.

Here's a rough breakdown of how ET works with the RKD - the items are in no particular order but should all be considered when planning for ET adjusted irrigation:

- The controller needs a number of inputs in order to calculate the ET correction:
  - Amount of water that has evaporated and transpired (The ET figure)
  - Amount of rain fall (The rain figure)
  - How much water the soil can retain (Soil holding)
  - How much water is used for irrigation under normal circumstances
- The ET and rain figures are provided by a weather station and a rain sensor - the rest is entered by you at the controller (if you use historical ET data, this is entered at the controller as well).
- Every day at midnight the controller adds up the ET and rain input it has received and calculates how to adjust tomorrow's "ET Budget" - the amount of water that the irrigation should provide.

Note

If you use a custom irrigation period, this happens at the start of your irrigation period, which might not be midnight. Please refer to Appendix G, *Defining a Custom Irrigation Period* [167] for details.

Let's look at two examples - one where ET has exceeded the rain fall, and one that works the other way around:

Example B.1. ET calculation with rain shortage

In this example the rain fall has not been able to make up for the ET.

- 0.30" of water was lost due to ET in the last 24 hours.
- 0.20" of rain has fallen in the last 24 hours.
- Your soil holding is set to 0.50".

Now we're short of 0.10" of water since this is the difference between ET and fallen rain. Thus the ET Budget for tomorrow will be adjusted with 0.4".

Since we don't have any excess water, the soil holding value is irrelevant.

Example B.2. ET calculation with excess rain

In this example the relationship is reversed and we have more rain than ET - soil holding is the same.

- 0.30" of water was lost due to ET in the last 24 hours.
- 0.90" of rain has fallen in the last 24 hours.
- Your soil holding is set to 0.50".

You would think that the ET budget for tomorrow should simply be adjusted with -0.6" because the excess rain lets us irrigate 0.6" less. However, since the soil is only capable of holding 0.5" we can not benefit from all of the rain, but only 0.5" of the 0.6". Conclusion: tomorrow's ET budget will be adjusted with -0.5", meaning that we will not need to irrigate at all. Unless, of course, the ET budget is still positive after adjusting with -0.5.

In other words: we can never benefit more from fallen rain than the soil is capable of holding back. So this example will end up with a -0.5" adjustment no matter how much more rain we have had.

- If you don't connect a weather station but let your programs run from historical ET data the controller simply reads the historical data each midnight, subtracts the rain figure and adds the result to the ET budget.

Note

If you use a custom irrigation period, this happens at the start of your irrigation period, which might not be midnight. Please refer to Appendix G, *Defining a Custom Irrigation Period* [167] for details.

Note

You can still use a tipping rain bucket to measure fallen rain and have this affect the ET correction. Soil holding is still a limiting factor on how much we can benefit from rain fall.

- When the RKD looks at the ET budget and has to figure out how long it has to irrigate, it looks at the "ET Base" setting (see Step 4 [117] for instructions on how to set this value).

  A bit of background is needed to understand how this works:

When the controller is irrigating normally, it is considered to be irrigating at a water budget of 100% (see Section 5.3.4, “Adjusting Water Usage (Water Budget or ET)” [34] for details about water budgets). In order for the ET figure to make sense to the controller, you need to tell it what the ET figure would be when running at a 100% water budget. So, if the "ET Base" setting[1] is 0.20", and today's ET budget says 0.10", the controller will run at a water budget of 50 percent, meaning that programs will only run 50 percent of their configured run time.

The tricky part is to make your irrigation programs fit into this model. If the "ET Base" setting is 0.20", you have to make sure that all your programs are configured to apply exactly 0.20" every day. So you have to look at the application rate in each zone and adjust run time and number of start times accordingly.

Let's look at an example:

Example B.3. Calculating ET run time

The following formula is used to calculate the run time (values explained in the table below):

$(60 \times ET_0 \times K_c) / (P_r \times I_e)$

Table B.1. Formula parts for calculating run time

	Description	Example value
60	A constant value	60
ET_0	Evapotranspiration base	0.20
K_c	Crop coefficient	0.50
P_r	Precipitation rate from manufacturer's data	0.45
I_e	Irrigation coefficient	0.80

Based on the example values above, the run time would be:

(60 x 0.20 x 0.50) / (0.45 x 0.80) = 16.7 minutes.

- It is possible to set a minimum ET value that determines whether irrigation will take place at all (see Step 4 [117]). There can be several reasons to set a minimum ET value:
  - If you only provide an insignificant amount of water, the effect is useless.
  - If you have rotating valves, maybe they won't make a complete rotation before their short run time is over, and you'll get uneven irrigation.

  But isn't a bit of water better than no water at all? Yes, but take a look at this example to see why setting a minimum ET can be a good idea:

[1] We recommend using the highest monthly ET for your area as the base.

Example B.4. How minimum ET value works

In this example we assume the following circumstances for the program in question:

- Today's ET budget has been adjusted to 0.4".
- The program has four start times.
- The minimum ET value has been set to 0.2" because irrigating less than this gives you an uneven irrigation and has little effect on the turf.

Each of the four start times can irrigate one fourth of the total ET budget, meaning 0.1". Here's how each of the four start times will take place:

Table B.2. ET minimum value in effect

Start time #	Action	Explanation
1	No irrigation	The budget is 0.4" and there are four starts left, meaning that each must provide 0.4/4 = 0.1" which is below the 0.2" minimum.
2	No irrigation	The budget is 0.4" and there are three starts left, meaning that each must provide 0.4/3 = 0.13" which is below the 0.2" minimum.
3	Irrigation	The budget is 0.4" and there are two starts left, meaning that each must provide 0.4/2 = 0.2" which equals the 0.2" minimum. Now the 0.2" that the program provided is subtracted from the budget, so the budget is now 0.2".
4	Irrigation	The budget is 0.2" and there is one start left that must provide 0.2/1 = 0.2" which equals the 0.2" minimum.

Now the ET minimum value has ensured that we got two useful irrigations instead of four uneven irrigations.

B.1.1. Examples

The following examples show a week with ET, Rain, ET balance and irrigation with various combinations of ET parameters.

Example B.5. All parameters in use

Table B.3. Parameters

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.20"	0.35"	0.40"	0.10"

The program is set to run one time every day; i.e. it will if ET balance is greater than Min ET. The example starts with 0.20” ET, no rain and an empty ET balance.

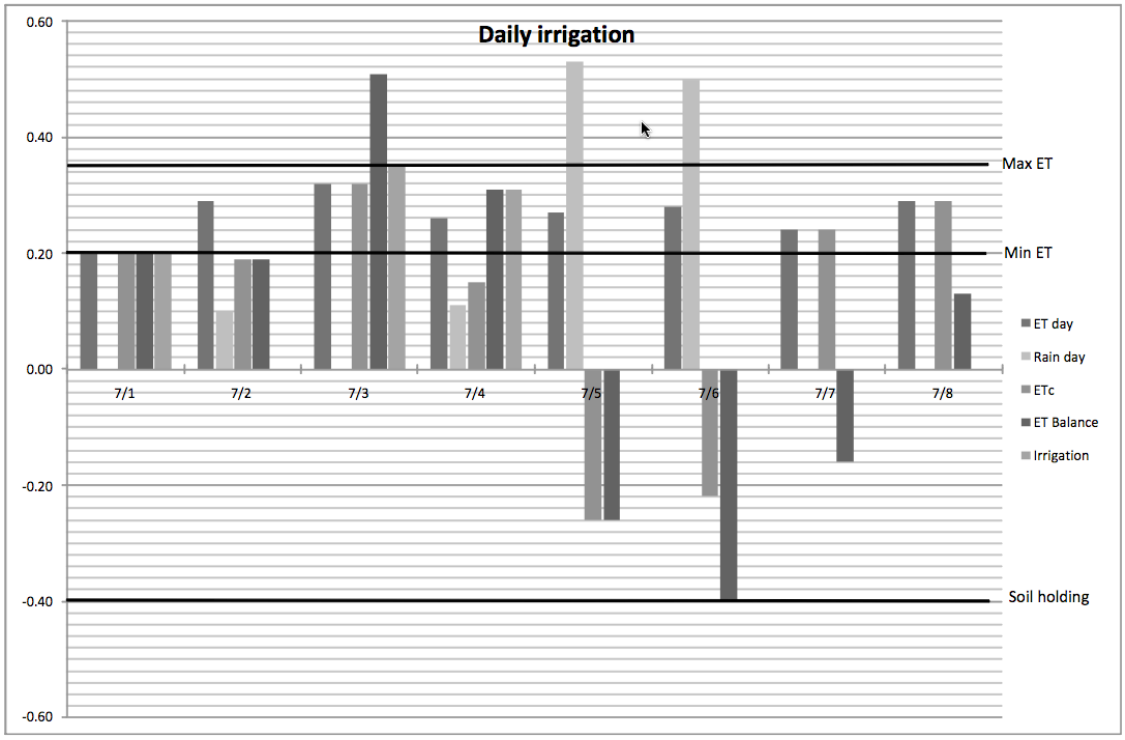


Table B.4. Numbers

	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
Past			0.20	0.00	0.20	0.20	This is what we have when day 1 starts
1	0.20	0.20	0.29	0.10	0.19	0.19	Irrigate ETc from last day
2	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as ET balance < Min. ET (0.20)
3	0.51	0.35	0.26	0.11	0.15	0.31	Irrigate for the last two days, but only Max ET (0.35)
4	0.31	0.31	0.27	0.53	-0.26	-0.26	Irrigation during night. Rain comes during the day.
5	-0.26	0.00	0.28	0.50	-0.22	-0.40	No irrigation as ET balance < 0
6	-0.40	0.00	0.24	0.00	0.24	-0.16	No irrigation as ET balance < 0

7	-0.16	0.00	0.29	0.00	0.29	0.13	

Table B.5. Explanation

Date	Explanation
7/1	The ET balance is set to ETc = ET – Rain. As the ET balance >= Min ET the program will run and use the entire ET balance.
7/2	The ETc = 0.19, which is added to the ET balance. As the ET balance is less than Min ET the program will not run.
7/3	The ET balance will now be the sum of ETc for 7/2 and 7/3; i.e. 0.51”. As this is above the Max ET the program will only apply 0.35” and the remaining 0.16” will be left in the ET balance.
7/4	Just a normal day. ET – Rain from the past day is added to the ET balance and it irrigates.
7/5	A lot of rain. ETc becomes negative and so do the ET balance. No irrigation.
7/6	Another day with a lot of rain. The ET balance would have been -0.48” if it wasn’t limited by the soil holding of 0.40”
7/7+8	Positive ETc and the ET balance increases, but still no irrigation.

Example B.6. No Min ET

Table B.6. Parameters

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.00"	0.35"	0.40"	0.10"

The program is set to run one time every day; i.e. it will if the ET balance is greater than Min ET. The example starts with 0.20” ET, no rain and an empty ET balance.

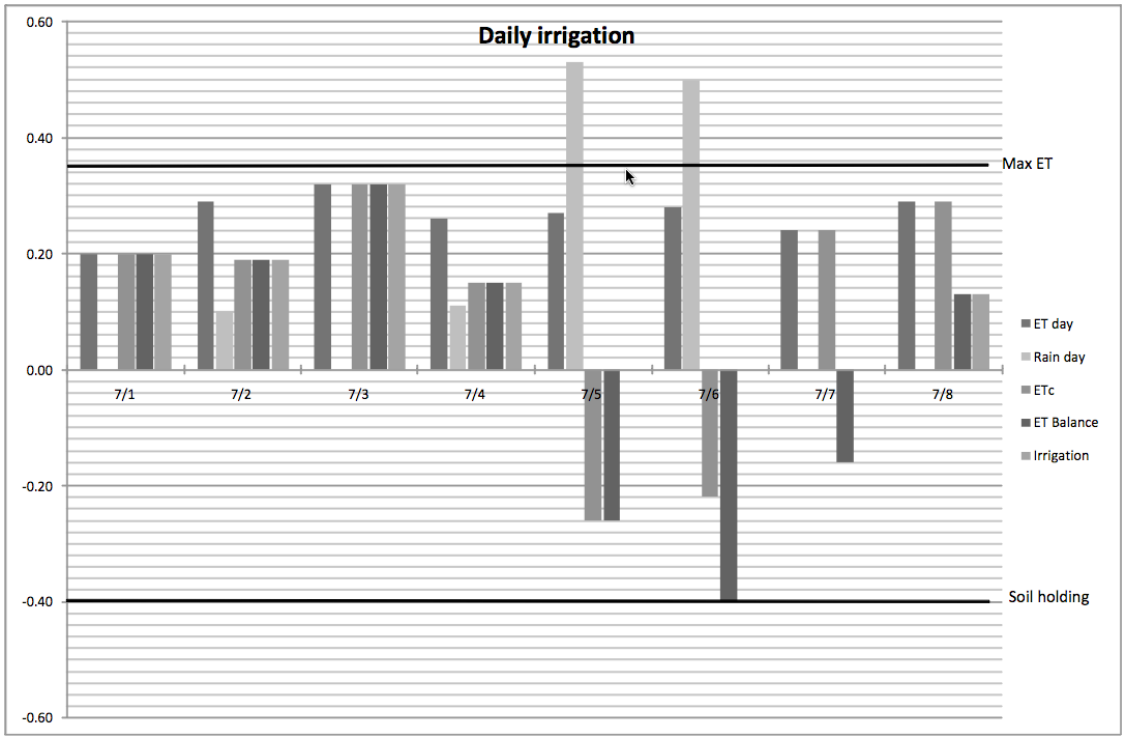


Table B.7. Numbers

	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
Past			0.20	0.00	0.20	0.20	
1	0.20	0.20	0.29	0.10	0.19	0.19	
2	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as no min. ET.
3	0.32	0.32	0.26	0.11	0.15	0.15	
4	0.15	0.15	0.27	0.53	-0.26	-0.26	
5	-0.26	0.00	0.28	0.50	-0.22	-0.40	No irrigation as ET balance < 0. Limited by soil holding.
6	-0.40	0.00	0.24	0.00	0.24	-0.16	No irrigation as ET balance < 0
7	-0.16	0.00	0.29	0.00	0.29	0.13	No irrigation as ET balance < 0

Table B.8. Explanation

Date	Explanation
7/1-4	The ET balance is set to ETc = ET – Rain. As the ET balance is >= Min ET the program will run and use the entire ET balance.
7/5	A lot of rain. ETc becomes negative and so does the ET balance. No irrigation.
7/6	Another day with a lot of rain. The ET balance would have been -0.48” if it wasn’t limited by the soil holding of 0.40”
7/7	Positive ETc and the ET balance increases, but still no irrigation.
7/8	Now we begin to irrigate again.

Example B.7. No Max ET

Table B.9. Parameters

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.20"	0.00" (Infinite)	0.40"	0.10"

The program is set to run one time every day; i.e. it will if the ET balance is greater than Min ET. The example starts with 0.20” ET, no rain and an empty ET balance.

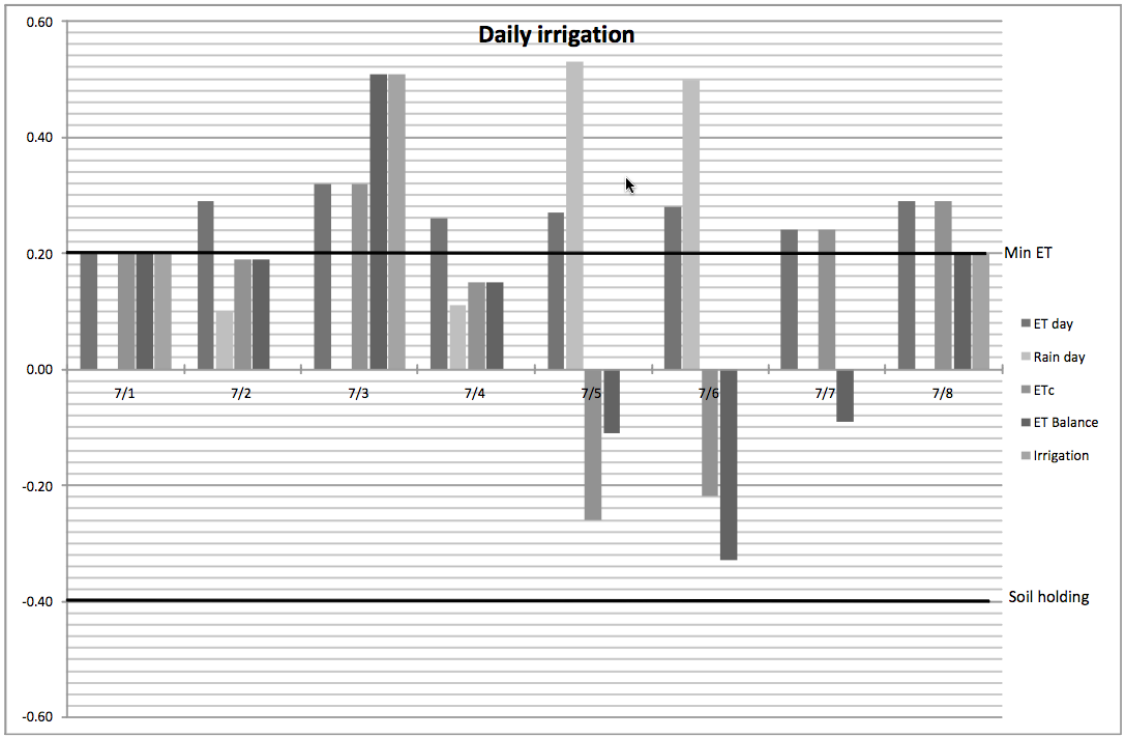


Table B.10. Numbers

	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
1			0.20	0.00	0.20	0.20	
2	0.20	0.20	0.29	0.10	0.19	0.19	
3	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as ET balance < min. ET (0.20)
4	0.51	0.51	0.26	0.11	0.15	0.15	Irrigate for the last two days and no max. ET.
5	0.15	0.00	0.27	0.53	-0.26	-0.11	No irrigation as ET balance < min. ET (0.20)
6	-0.11	0.00	0.28	0.50	-0.22	-0.33	No irrigation as ET balance < 0
7	-0.33	0.00	0.24	0.00	0.24	-0.09	No irrigation as ET balance < 0
8	-0.09	0.00	0.29	0.00	0.29	0.20	No irrigation as ET balance < 0

Table B.11. Explanation

Date	Explanation
7/1	The ET balance is set to ETc = ET – Rain. As the ET balance is >= Min ET the program will run and use the entire ET balance.
7/2	The ETc = 0.19, which is added to the ET balance. As the ET balance is less than Min ET the program will not run.
7/3	A lot of irrigation because there is no limit in Max ET.
7/4	As 7/2
7/5	A lot of rain. ETc becomes negative and so does the ET balance. No irrigation.
7/6	Another day with a lot of rain.
7/7	Positive ETc and the ET balance increase, but still no irrigation.
7/8	Now we begin to irrigate again.

Example B.8. No soil holding

Table B.12. Parameters

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.20"	0.35"	0.00" (Infinite)	0.10"

The program is set to run one time every day; i.e. it will if the ET balance is greater than the Min ET. The example starts with 0.20” ET, no rain and an empty ET balance.

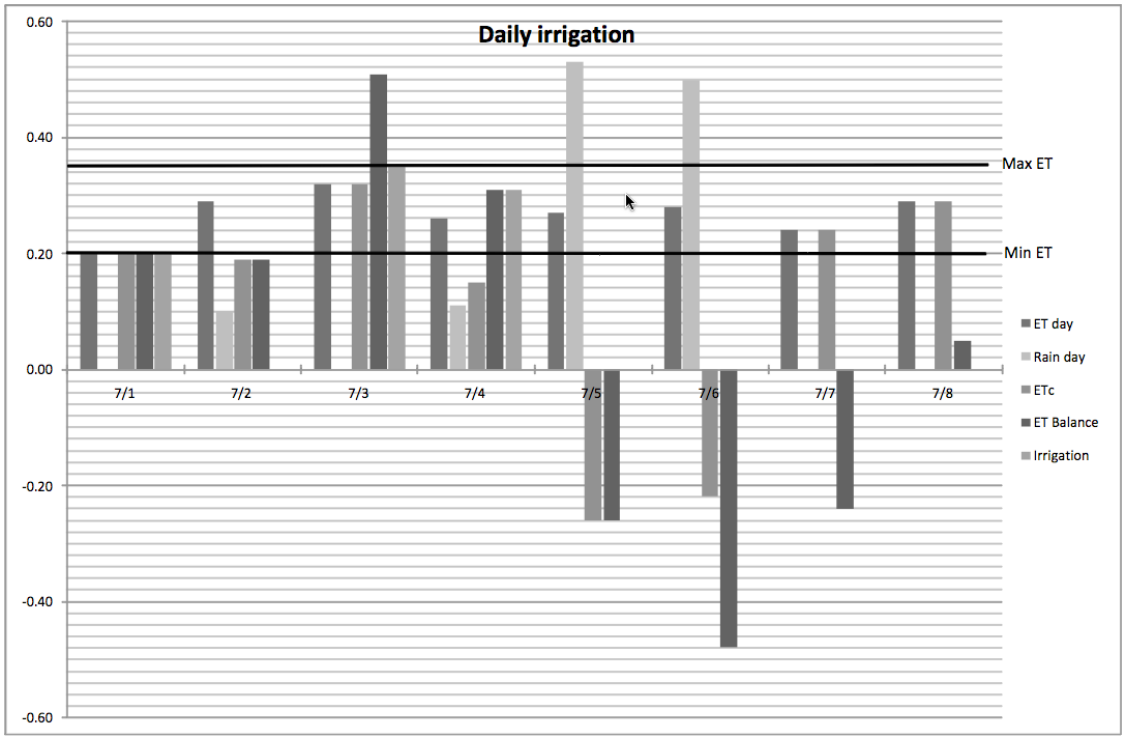


Table B.13. Numbers

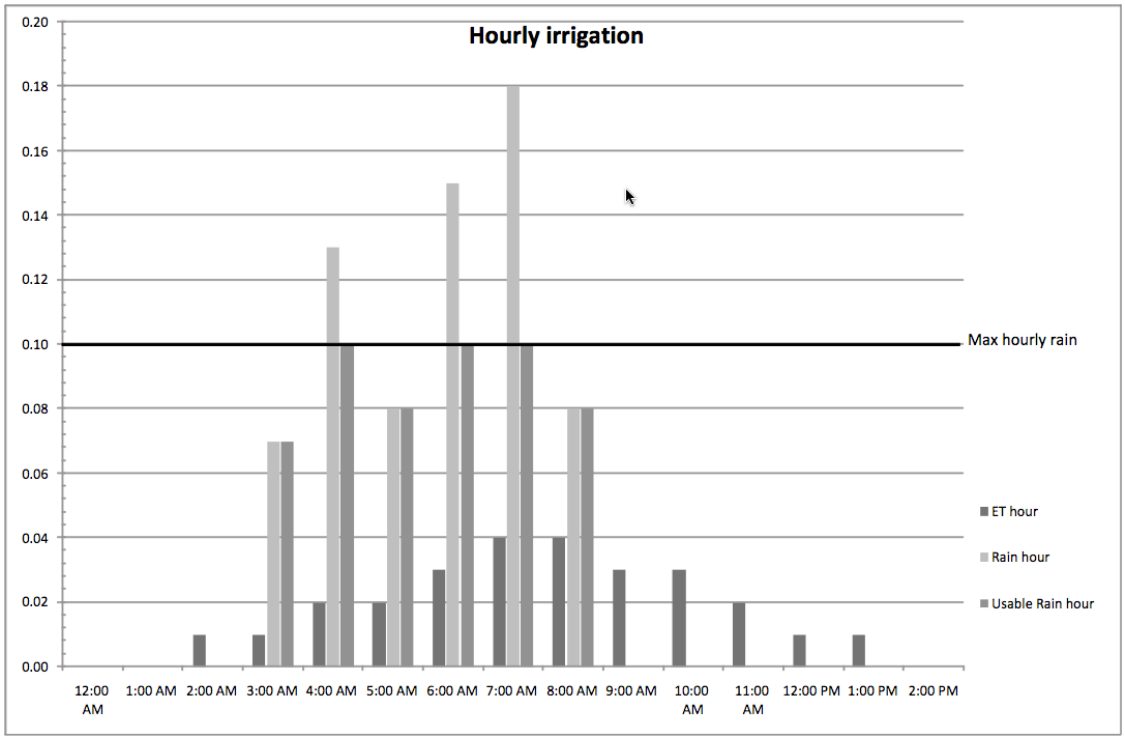
	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
1			0.20	0.00	0.20	0.20	
2	0.20	0.20	0.29	0.10	0.19	0.19	
3	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as ET balance < min. ET (0.20)
4	0.51	0.35	0.26	0.11	0.15	0.31	Irrigate for the last two days, but only max. ET.
5	0.31	0.31	0.27	0.53	-0.26	-0.26	
6	-0.26	0.00	0.28	0.50	-0.22	-0.48	No irrigation as ET balance < 0. Not limited by soil holding.
7	-0.48	0.00	0.24	0.00	0.24	-0.24	No irrigation as ET balance < 0
8	-0.24	0.00	0.29	0.00	0.29	0.05	No irrigation as ET balance < 0

Table B.14. Explanation

Date	Explanation
7/1	The ET balance is set to ETc = ET – Rain. As the ET balance is >= Min ET the program will run and use the entire ET balance.
7/2	The ETc = 0.19, which is added to the ET balance. As the ET balance is less than the Min ET the program will not run.
7/3	The ET balance will now be the sum of ETc for 7/2 and 7/3; i.e. 0.51”. As this is above the Max ET the program will only apply 0.35” and the remaining 0.16” will be left in the ET balance.
7/4	Just a normal day. ET – Rain from the past day is added to the ET balance and it irrigates.
7/5	A lot of rain. ETc becomes negative and so does the ET balance. No irrigation.
7/6	Another day with a lot of rain. No limit in the ET balance as there is no soil holding
7/7+8	Positive ETc and the ET balance increases, but still no irrigation.

Example B.9. Max. hourly rain

The program is set to run one time every day; i.e. it will if ET balance is greater than Min ET. The example starts with 0.20” ET, no rain and an empty ET balance.



The example shows the effect of max hourly rain. If it rains more than Max hourly rain within an hour only the Max hourly rain is used.

B.2. Options for Getting ET Data

Your controller will accept ET data from a number of sources, and the mechanisms using the ET data to calculate irrigation aspects are identical, regardless of input method.

The RKD accepts ET data from the following sources:

Table B.15. Sources of ET Data

Name in controller menu	Description
`Local Weather Station`	Input is pulses from a weather station and tipping bucket (see Section B.4, “Using a Connected Device (Weather Station)” [115].)
`Historic ET`	Manually entered historical ET data (see Section B.3, “Using Historical ET Data” [113].)
`Remote ET & Rain`	ET and rain data is received from the RealNet server.
`Remote ET`	ET data is received from the RealNet server. No rain data received.
`Local WS with Alarm send`	Same as Local Weather Station, but rain alarm activation/de-activation will be passed on to the RealNet server.

You choose your source of ET as described in Section B.4, “Using a Connected Device (Weather Station)” [115] (swap in your preferred source for the local weather station.)

B.3. Using Historical ET Data

If you don't have a local weather station you can use historical ET data to correct your irrigation instead.

Before you start this procedure you need to know how much water evaporates every month of the year - on a daily basis. Meaning that for each month you'll get to enter a figure that will be used each day that month.

Note

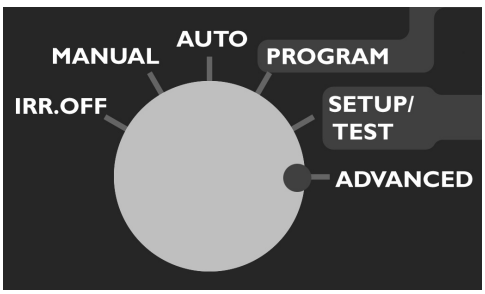
The controller is a bit smarter than just sticking to the same amount of water every day throughout a month.

What really happens is that the figures are interpolated in a linear fashion, so that the ET figure is gradually changed from the middle of a month to the middle of the following month.

Procedure B.1. Configuring for Historical ET Data

1. Turn the mode selector to ADVANCED

Figure B.1. Mode selector in ADVANCED



Now the display looks like this:

Figure B.2. Display message on switch to ADVANCED mode

2. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

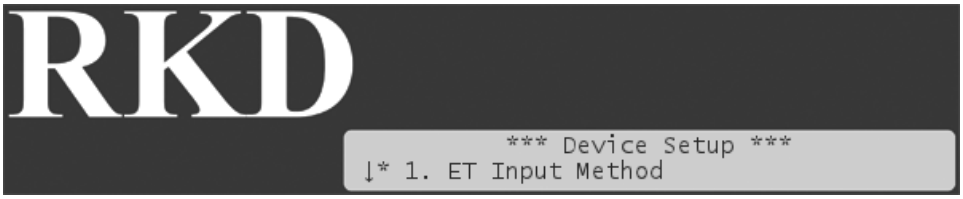
Figure B.3. ET/Rain Setup Menu

3. Select `1. ET`. Now the display will look like this:

Figure B.4. Intelliset™ Menu

4. Select `6. Device Setup`. Now the display will look like this:

Figure B.5. Intelliset™ Device Setup Menu



5. Select `1. ET Input Method`. Now the display will look like this:

Figure B.6. Intelliset™ Device Input Method

6. Select `Historic` and push the `ENTER` button.
7. Push the `CANCEL` button once to go back to the main Intelliset™ menu.
8. Select `5. Historic Data Settings` in the menu and push the `ENTER` button. Now you'll see the following screen:

Figure B.7. Entering Historic ET Data

9. Use the *item selectors* to browse the months and set the daily ET adjustment for each.
10. Push the `CANCEL` button to return to the main Intelliset™ menu.

B.4. Using a Connected Device (Weather Station)

Connecting an ET device on-site gives you the most accurate adjustments as the ET device will monitor the exact weather condition right where irrigation will take place.

Important

If for some reason your weather stations fails and does not provide any input for the RKD the controller will fall back on historical ET data and use these instead. The same goes in case of a power failure - the controller will use the historical data for the part of today that lies before the power failure, and then use real-time ET data from when it is powered up again.

Bottom line: you should always enter a set of historical ET data even when running with a connected weather station.

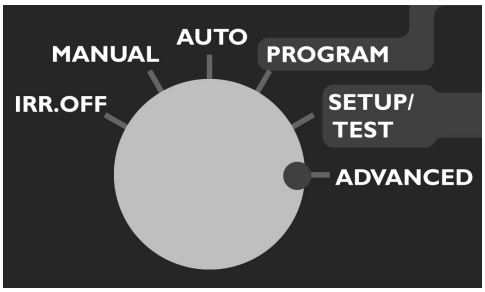
Configuring for ET is a rather lengthy procedure with a lot of steps. Make sure you read Section B.1, “How ET Works with the RKD” [101] before starting this procedure.

Procedure B.2. Configuring ET Input

1. Before moving on, make sure you have connected the ET device as described in Section 2.2.2.1, “Connecting an ET Device” [9].

2. Turn the mode selector to ADVANCED

Figure B.8. Mode selector in ADVANCED



Now the display looks like this:

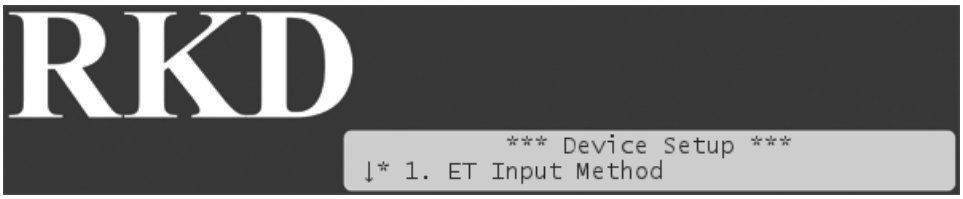
Figure B.9. Display message on switch to ADVANCED mode

3. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

Figure B.10. ET/Rain Setup Menu

4. Select `6. Device Setup`. Now the display will look like this:

Figure B.11. Intelliset™ Device Setup Menu

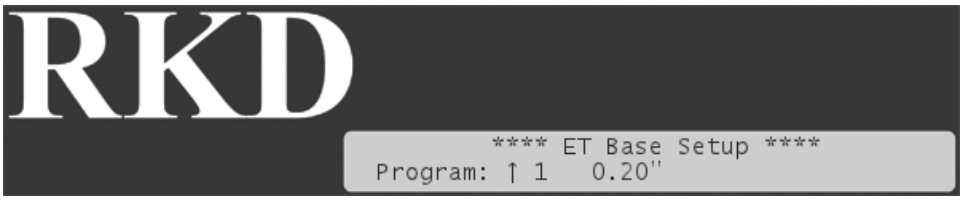


5. Select `1. ET Input Method`. Now the display will look like this:

Figure B.12. Intelliset™ Device Input Method

6. Use the *item selectors* to select `Local Weather Station` and push the ENTER button.
7. Select `3. ET Base Setup` from the menu and push the ENTER button. Now you'll see the following screen:

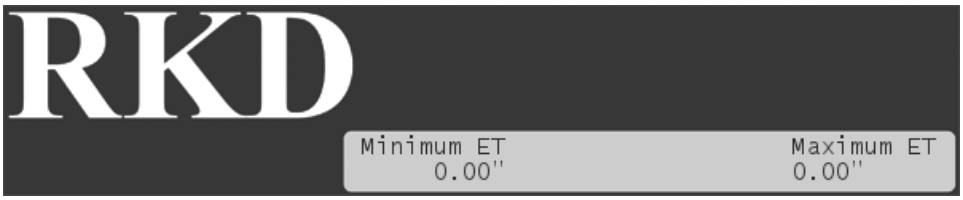
Figure B.13. ET Base Setup



8. For each program, use the *item selectors* to determine how many inches of water the program will provide when running at a 100% water budget. The controller needs this in order to re-calculate run times based on ET corrections.

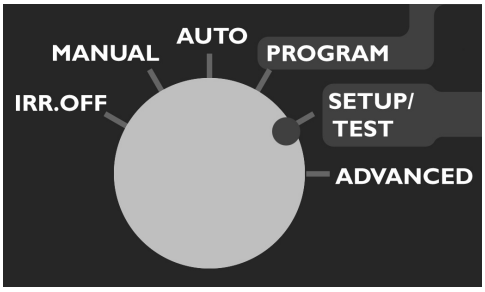
   Push the ENTER button to save the value.
9. Push the CANCEL button once to return to the main Intelliset™ menu.
10. Use the *item selectors* to select `2. ET Limits (Min and Max)` and push the ENTER button. Now you'll see the following screen:

Figure B.14. Minimum and maximum ET



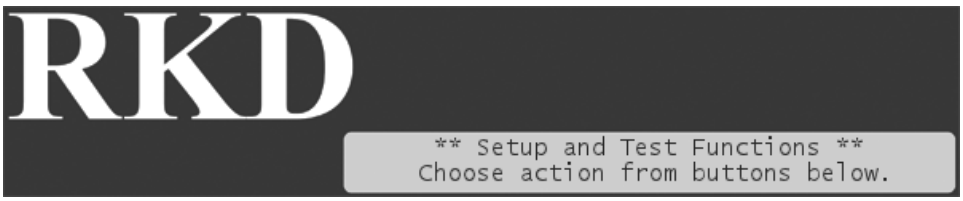
11. Now use the *item selectors* to determine the two values and push ENTER to save your settings:
    - `Minimum ET`: The ET figure must exceed this value in order for the controller to irrigate at all.
    - `Maximum ET`: If the ET balance for a program exceeds this value, the program will only irrigate to that limit, and the remaining water will be added to the ET figure for the following day.
12. Turn the mode selector to `SETUP/TEST`

Figure B.15. Mode selector in SETUP/TEST



Now the display looks like this:

Figure B.16. Display message on switch to SETUP/TEST mode



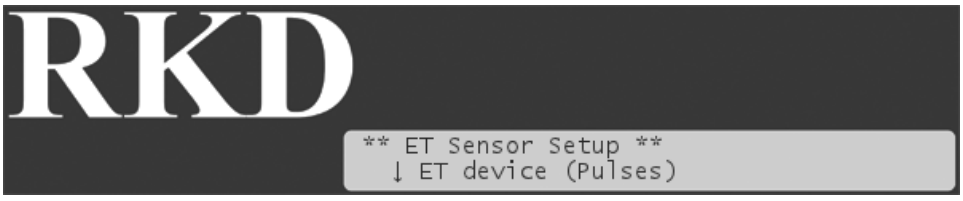
13. Push the SENSORS button. Now you'll see the following display:

Figure B.17. Sensor setup menu

14. Use the *item selectors* to select 1. ET and push the ENTER button.

    Now the display looks like this:

Figure B.18. Selecting the ET sensor input



15. Now you can choose between four settings:

    ET device (Pulses)
    : Select this if you use a connected ET device that provides dynamic ET data for the controller (Tipping rain bucket.)

ET enabled (N/O or N/C)
: If your ET device simply tells the controller whether to irrigate or not, you need to tell the controller if the input is normally open (N/O) or normally closed (N/C). Whenever the device is then in the opposite mode, the controller will hold its irrigation. This is typically a WR7 Receiver.

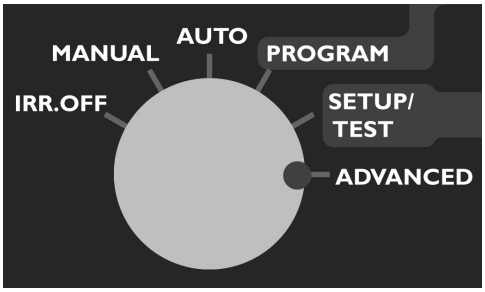
Disabled
: Don't use the ET input.

Use the *item selectors* to locate the setting you want and if you chose anything but `ET device (Pulses)`, push the ENTER button to save your selection and the SENSORS button to exit sensor configuration.

If you chose `ET device (Pulses)`, you need to tell the controller how many inches to the current ET figure per pulse it receives - please proceed to the next step (default setting is 0.01".)

16. Turn the mode selector to ADVANCED

Figure B.19. Mode selector in ADVANCED



Now the display looks like this:

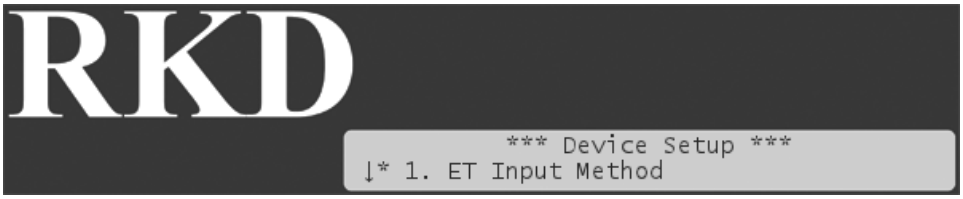
Figure B.20. Display message on switch to ADVANCED mode

17. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

Figure B.21. ET/Rain Setup Menu

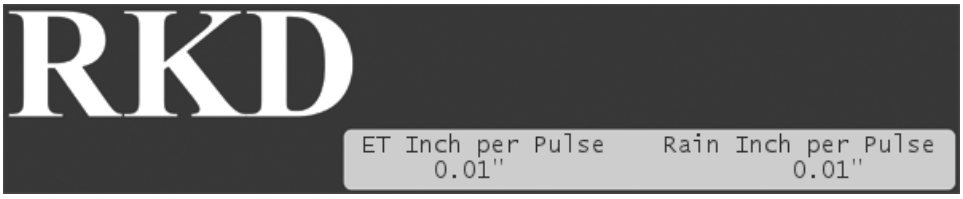
18. Select `6. Device Setup`. Now the display will look like this:

Figure B.22. Intelliset™ Device Setup Menu



19. Select `2. ET and Rain Inch/Pulse Settings`. Now you'll see something like this:

Figure B.23. ET and Rain inch per pulse settings



20. Use the *item selectors* to set your values and push the ENTER button to save your settings.

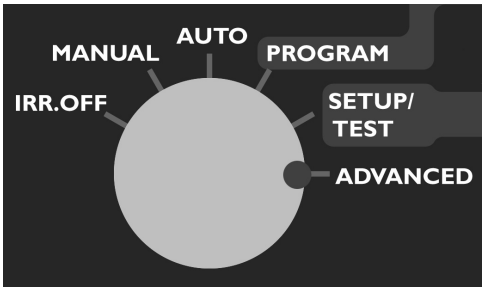
B.5. Checking the Current Aggregated ET and Rain

Every now and then you might want to check out how much rain has fallen or how much water has evaporated - the RKD has a screen that shows you the accumulated values in real time:

Procedure B.3. Reading current aggregated ET and Rain figures

1. Turn the mode selector to ADVANCED

Figure B.24. Mode selector in ADVANCED



Now the display looks like this:

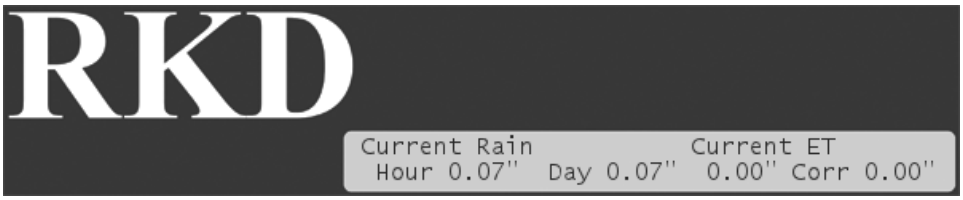
Figure B.25. Display message on switch to ADVANCED mode

2. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

Figure B.26. ET/Rain Setup Menu

3. Select `1. Current Accumulated ET and Rain` from the menu and push the ENTER button. Now you'll see the following screen:

Figure B.27. Accumulated ET and Rain figures



These figures will be reset at midnight when they'll be used to calculate tomorrow's ET budget. Please see Section B.1, “How ET Works with the RKD” [101] for an in-depth explanation of how these figures are used.

Note

If you use a custom irrigation period, this happens at the start of your irrigation period, which might not be midnight. Please refer to Appendix G, *Defining a Custom Irrigation Period* [167] for details.

Tip

If you are running in AUTO mode and want to check the current accumulated values, you can simply push the WATER BUDGET button and you'll skip right to the above display. You exit back by pushing the WATER BUDGET button again.

This way you don't have to exit AUTO mode to check the values.

Appendix C. Adding a Flow Sensor

The RKD can measure the flow of water in your system and react on any unusual situation by quarantining faulty stations, stacking programs that exceed the expected flow or even cutting off the water supply completely if it seems that you have a leak.

This works by letting a flow sensor measure the flow on the main pipe that feeds your system, and connecting the flow sensor to the RKD.

There are four types of flow alarms - three of which can go off when irrigating and one that is only relevant when no stations are running:

Table C.1. Alarm Types

Alarm Name	Description	What happens?
High Flow	Occurs when your system is using more gallons per minute than your defined threshold.	All running programs are halted.
Flow Deviation	Occurs when your flow is above or below a certain percentage from the expected flow.	All running stations are halted and blacklisted.
Unscheduled Flow	Occurs when there is a flow even when there shouldn't be (when no stations are running). This indicates a leak somewhere on the pipe.	cut-off valve (COV) is activated for 17:59:50.
Master Pump Failure (MPF)	Occurs when your flow is below a certain threshold.	The master pump or all running programs are stopped, depending on your configuration (see Section C.2.4, “Setting Alarm Actions” [132])

Before you can take advantage of the features associated with flow sensor input you have to connect a flow sensor (described in Section 2.2.2.3, “Connecting an Alarm or Flow Sensor” [11]) and configure a few things in the controller. The following sections walk you through the process.

C.1. Enabling Flow Sensor Input (pulses)

By default flow sensor input is enabled in the RKD. To enable flow sensor input to accept pulses, follow this procedure:

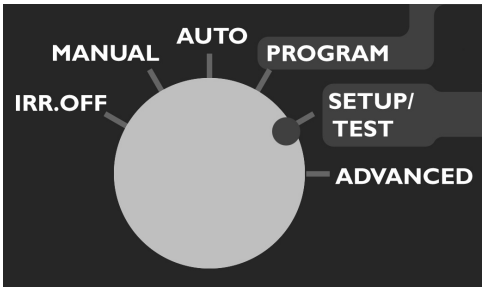
Note

You can enable flow sensor input even if you haven't attached a physical sensor yet - you just won't get any reading from it.

Procedure C.1. Enabling flow sensor pulse input in the RKD

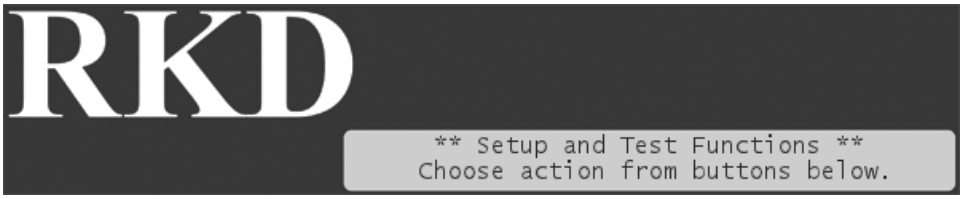
1. Turn the mode selector to SETUP/TEST

Figure C.1. Mode selector in SETUP/TEST



Now the display looks like this:

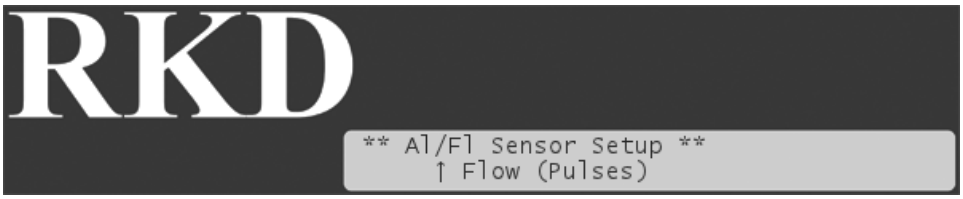
Figure C.2. Display message on switch to SETUP/TEST mode



2. Push the SENSORS button. Now you'll see the following display:

Figure C.3. Sensor setup menu

3. Use the *item selectors* to select item number `3. Alarm/Flow` and you'll see the default setting for sensor setup, `Flow (Pulses)`:



4. Push the ENTER button to save your selection.

Now the RKD is ready to accept input from your flow sensor, but before you can use it to anything meaningful you need to configure threshold values and actions - read more in the next section.

C.2. Configuring for Flow Sensor Input

In the previous section you enabled the RKD to accept flow sensor input - now you need to configure what to do with it and this section walks you through the relevant procedures.

C.2.1. Selecting Sensor Type

By telling the RKD which type of sensor you are using, the controller can calibrate the input it receives from the input terminals. The RKD knows the calibration profiles for five different sensor types - if you're not using one of these you'll have to skip to the next procedure to perform a manual calibration for your sensor.

Using a known sensor type to enable a built-in profile:

Procedure C.2. Using a built-in calibration profile

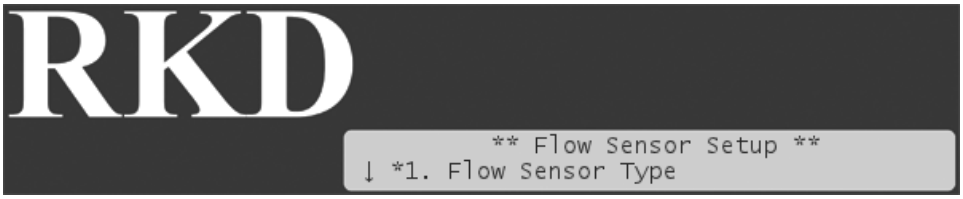
1. Turn the *mode selector* to `ADVANCED`, use the *item selectors* to scroll to item number `3. FloGuard`, and push the `ENTER` button.

   Now you'll see this display:

2. Select `4. Flow Sensor Setup`, and push the `ENTER` button.

   Now you'll see this display:

3. Choose `1. Flow Sensor Type` by pushing the `ENTER` button.

   Now you'll see this display:

4. Use the *item selectors* to select one of the five built-in profiles:

   - FS-100
   - FS-150

- FS-200
- FS-300
- FS-400

5. Push the ENTER button to save your selection.

If your sensor doesn't fit any of the built-in profiles you have to enter your own manually:

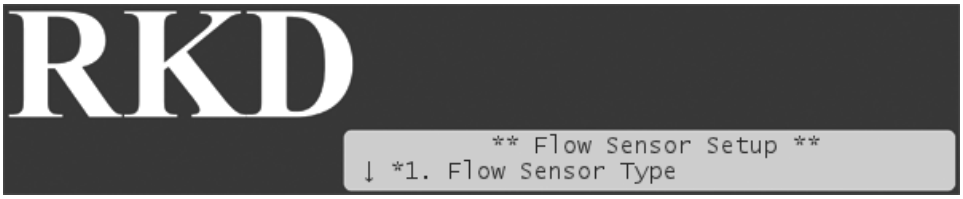
Procedure C.3. Using a custom calibration profile

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

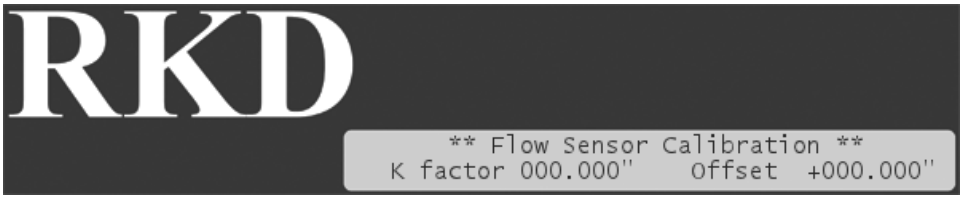
   Now you'll see this display:

2. Select `4. Flow Sensor Setup`, and push the ENTER button.

   Now you'll see this display:



3. Use the *item selectors* to locate the `Custom` option and select it by pressing the ENTER button. Now you'll see the calibration screen:



Note

A bit of background on how calibration affects the calculated flow:

The RKD needs to know the "K" and "Offset" values of your sensor, as the actual flow will be calculated from this formula:

```
ActualFlow = K * (Pulses + Offset)
```

About the two values you need to enter:

- The "Offset" value is to correct the input from your sensor.
- The "K" value can be looked up in the data sheet for your sensor.

4. Use the *item selectors* to enter your values and push the ENTER button to save your settings.

C.2.2. Setting the Flow Sensor Adjustment

If you want to calibrate your flow sensor, you can use the sensor adjustment to multiply the values from your sensor with anything between 0.00 and 9.99.

This comes in handy if you have a standard sensor that behaves slightly different than the built-in profile calculates.

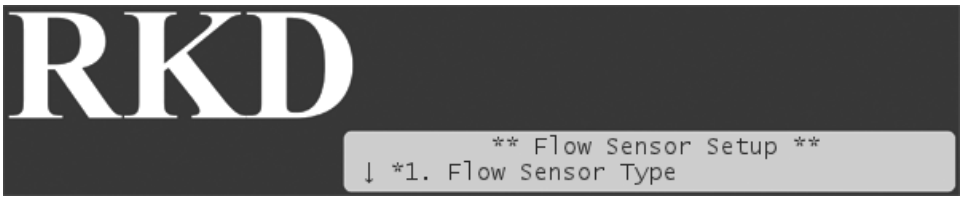
Procedure C.4. Adjusting the flow sensor input

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

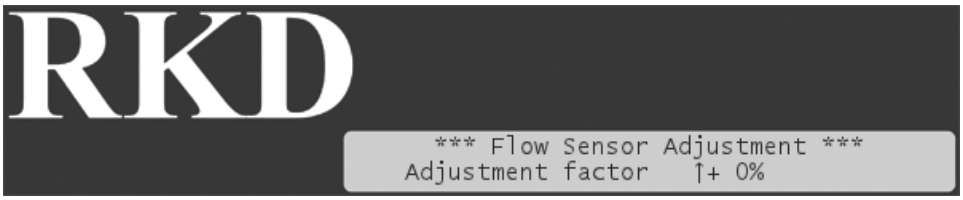
   Now you'll see this display:

2. Select `4. Flow Sensor Setup`, and push the ENTER button.

   Now you'll see this display:



3. Choose `2. Flow Sensor Adjustment`. Now you'll see the screen for adjusting the flow sensor input:



4. Use the *item selectors* to set your adjustment factor.
5. Push the ENTER button to save your selection.

C.2.3. Setting Alarm Thresholds

For each of the alarms described in Table C.1, “Alarm Types” [123] you must set a threshold value, and you also need to tell the controller for how long the alarm must be on before the controller should take action.

Note

Setting a threshold to zero will disable the alarm.

This section describes how to enter these settings.

Procedure C.5. Setting the alarm reaction delay

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

   Now you'll see this display:

2. Choose `2. Alarm Thresholds` and push the ENTER button.

   Now you'll see the following display:

3. Use the *item selectors* to select `1. Alarm Reaction Delay`. Now you'll see the following display:

4. Use the *item selectors* to set the reaction time in minutes. The controller won't raise any sensor alarms until they have been on for this period.

   ### Note

   A Master Pump Failure (MPF) will ignore this setting - MPF alarms have a fixed delay of 30 seconds.

5. Push the ENTER button to save your selection.

Procedure C.6. Setting the high flow threshold

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number 3. FloGuard, and push the ENTER button.

   Now you'll see this display:

2. Choose 2. Alarm Thresholds and push the ENTER button.

   Now you'll see the following display:

3. Use the *item selectors* to select 2. High Flow. Now you'll see the following display:

4. Use the *item selectors* to set the maximum flow in gallons per minute. If this flow is exceeded the controller will raise a high flow alarm.

   If this alarm is activated all running programs will be halted, but the next program will be started normally when it is scheduled. Of course, if the next program also generates a high flow alarm it is halted too.

5. Push the ENTER button to save your selection.

Procedure C.7. Setting the Flow Deviation

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number 3. FloGuard, and push the ENTER button.

   Now you'll see this display:

2. Choose `2. Alarm Thresholds` and push the ENTER button.

   Now you'll see the following display:

3. Use the *item selectors* to select `3. Flow Deviation`. Now you'll see the following display:

4. Use the *item selectors* to set the deviation percentage from expected flow. The controller will raise an alarm if the flow exceeds or falls short of the expected flow with this many percent.

   If this alarm is activated all running stations will be halted and blacklisted (marked as failed). Any programs that include failed stations will simply skip those stations and run the next one in the program. To clear a station you need to mark it OK on the controller (see Managing station status [136] for instructions.)

   You can read more about the expected flow in Section C.2.5, “Setting Expected Station Flow” [133].

5. Push the ENTER button to save your selection.

Procedure C.8. Setting the unscheduled flow threshold

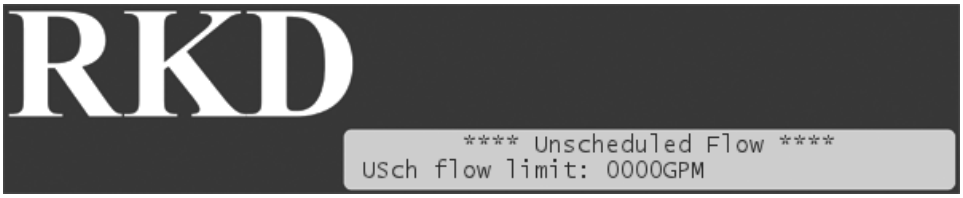
1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

   Now you'll see this display:

2. Choose `2. Alarm Thresholds` and push the ENTER button.

Now you'll see the following display:

3. Use the *item selectors* to select `4. Unscheduled Flow`. Now you'll see the following display:



4. Use the *item selectors* to set the unscheduled flow limit in gallons per minute. This is an alarm that will be raised only when no stations are running. You may have a minor natural leak of water in your pipes but here you can set the maximum flow allowed when no stations are running.

   If this alarm is activated the cut-off valve (COV) will be activated, and remain on for 999 minutes. It can be turned off just like any other station (see Section 6.1.2, “Running Extra Stations in Auto Mode” [44] for instructions on stopping a station).

   ## Important

   In order for this alarm to take effect when raised, you must assign one of your stations to control a cut-off valve (COV). See Assigning an identity to a station [25] for instructions.

   ## Warning

   If you turn the mode selector away from AUTO or MANUAL mode the cut-off valve (COV) will be reset and the water will no longer be cut off from your system.

5. Push the ENTER button to save your selection.

Procedure C.9. Setting the master pump failure threshold

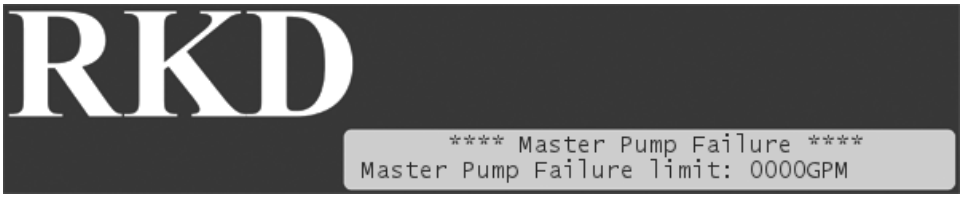
1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

   Now you'll see this display:

2. Choose `2. Alarm Thresholds` and push the ENTER button.

Now you'll see the following display:

3. Use the *item selectors* to select `5. Master Pump Failure`. Now you'll see the following display:



4. Use the *item selectors* to set the minimum flow that must be in your pipe if the master pump is working correctly.

   You can decide whether this alarm should result in all programs to be halted, or all pumps and master valves should be turned off (see Section C.2.4, “Setting Alarm Actions” [132]). The action you choose will be in effect until the next station gets activated (manually or by a program.)

5. Push the ENTER button to save your selection.

C.2.4. Setting Alarm Actions

The only flow alarm for which you can decide the action is the master pump failure alarm - you get to decide whether this should cause all programs to be halted or all pumps and master valves to be shut down.

Procedure C.10. Configuring alarm action for MPF

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

   Now you'll see this display:

2. Choose `3. Action Configuration`. Now you'll see the following display:

3. Use the *item selectors* to choose between:

   - `Pumps/MVs:` All pumps and master valves will be shut down when an alarm goes off. The programs will still be finished even if the pumps are turned off in order not to interrupt the irrigation schedule since an MPF alarm will be cleared next time a program has to start.
   - `Programs:` All running programs will be shut down when an alarm goes off.

4. Push the ENTER button to save your selection.

C.2.5. Setting Expected Station Flow

In order to be able to calculate when the current flow is deviating from the expected flow, the RKD needs to know how much flow you expect each station to pull.

To teach the controller about the expected flow you can either enter a value for each station or run the automated "learn flow" feature that will assess the flow for each station in turn.

Note

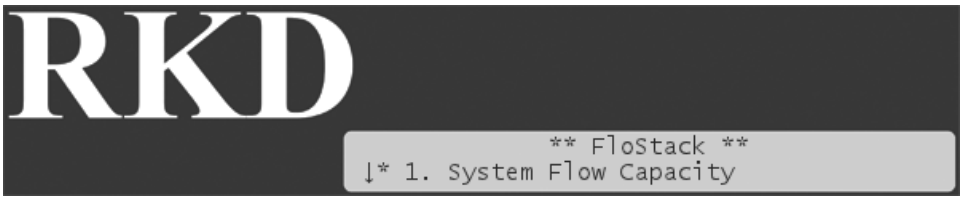
Please be advised that the system will not be able to handle a flow higher than 9999 gallons per minute.

Procedure C.11. Entering expected flow for a station

1. Turn the *mode selector* to ADVANCED and select `2. FloStack`.

   Now you'll see the following display:

   #### Figure C.4. FloStack Menu

2. Scroll down and select `2. Expected Flow` by pushing the ENTER button. Now you'll see a scrollable list of stations and their expected flow in gallons per minute:

   #### Figure C.5. Expected station flow menu

3. Use the *item selectors* to locate the station you wish to configure and push the ENTER button.

4. Now you can set the expected flow using the *item selectors* and save your setting by pushing ENTER again.

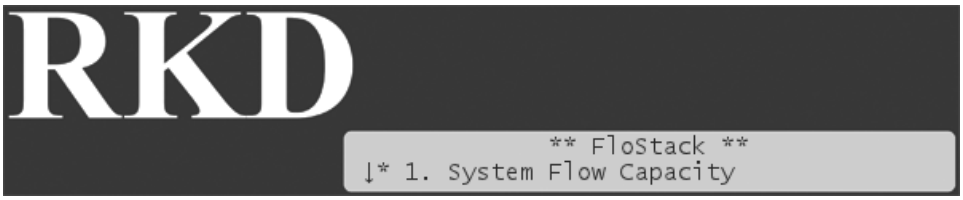
If the above procedure seems to tedious there's an easier way - you can let the RKD asses the expected flow for each station. If you choose this approach the controller will run all stations in turn for a fixed duration, measure the flow for each of them and save the flow as the expected one.

Procedure C.12. Running the "learn flow" feature

1. Turn the *mode selector* to ADVANCED and select `2. FloStack`.

   Now you'll see the following display:

   #### Figure C.6. FloStack Menu

2. Scroll down and select `3. Learn Flow` by pushing the ENTER button. Now you'll see the following display:

   #### Figure C.7. Learn flow dialog

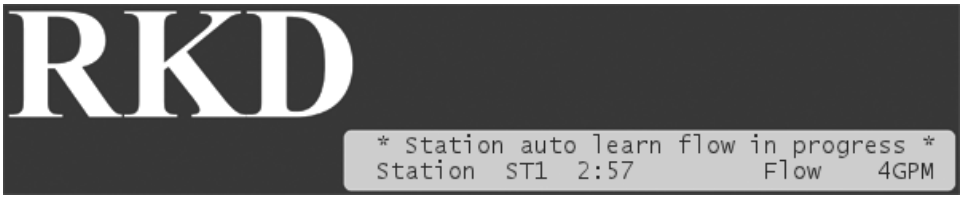
   

3. Use the *item selectors* (both up, down, right and left) to choose a station to start from and set the run time for each station. All stations will be run for the same period of time.

   The RKD measures the flow continuously while the station is running the "Learn Flow" feature but only the last measurement is used. The last measurement is likely to be the most accurate one as the flow will have stabilized after running for a few minutes.

4. Push ENTER to start the test. Now you'll see the starting the test at the station you selected (ST1) and running it for the selected duration (3 minutes):

   #### Figure C.8. Running "Learn Flow"

5. When a station is done running its measured flow will be stored as the expected flow for that station.

   Pushing CANCEL at any time will abort the "learn flow" feature but the stations measured so far are still saved. This means that you don't have to measure all stations in one sitting - simply re-run the "learn flow" feature with a new "Start from" setting to finish what you may have cancelled earlier.

C.3. Viewing the Current Flow

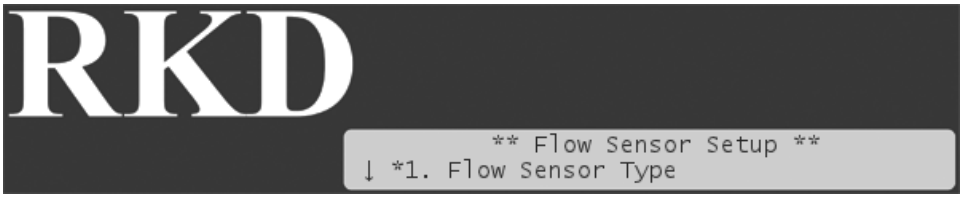
Given that you have configured your flow sensor correctly, the RKD lets you see the real time flow directly in the controller display:

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number 3. FloGuard, and push the ENTER button.

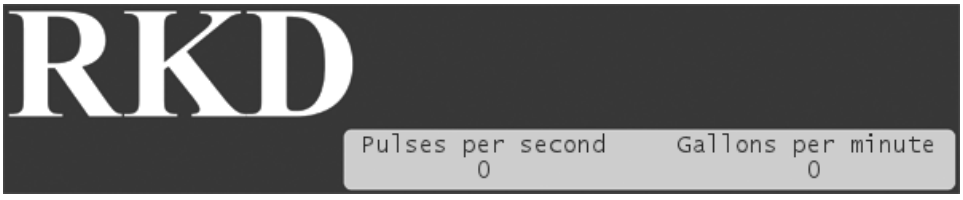
   Now you'll see this display:

2. Select 4. Flow Sensor Setup, and push the ENTER button.

   Now you'll see this display:



3. Select 3. Current Flow Pulses and GPM and you'll see the current system flow in both pulses per second and gallons per minute:



Note

The RKD can measure correctly up to a flow of 250 pulses per second. If your flow exceeds this you should use a sensor that has a higher "water amount per pulse" ratio.

However, a higher frequency is to prefer over a lower one, as it provides the most accurate measuring, so in an ideal world your frequency closes in on 250 pulses per second without ever exceeding it.

See Section C.2.1, “Selecting Sensor Type” [125] for instructions on how to configure your flow sensor.

C.4. Inspecting and Toggling Station Status

Stations can be blacklisted if the controller suspects that they are faulty and cause deviations in the expected flow (see for Setting the Flow Deviation [129] details). However, the controller might blacklist an innocent station since all stations that are running when the deviation takes place are blacklisted. So, to enable these stations again you need to toggle their status from `Failed` to `OK`.

Tip

Since blacklisted stations are simply skipped when running programs that require them, marking a stations as failed is an excellent way of taking a single station out of use without having to redo the program all together.

This can be useful if you just need to check or replace the station in the field.

This procedure explains how you toggle station status:

Procedure C.13. Managing station status

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `3. FloGuard`, and push the ENTER button.

   Now you'll see this display:

2. Select `1. Station Status` by pushing the ENTER button. Now you'll see a scrollable list of stations and their status - Failed or OK:

   ### Figure C.9. Station status list menu

3. If you wish to toggle the status of a station, locate it with the *item selectors* and push the ENTER button.

Tip

Instead of browsing through the entire list of stations you can use the STATION button to browse only failed stations.

Using the *item selectors* again, you can toggle the station between `OK` and `Failed` states.

4. Push the `CANCEL` button to exit the menu.

Appendix D. Moisture Sensors

With moisture sensors your controller can learn the exact moisture levels in the soil and adjust irrigation based on this knowledge.

D.1. The Role of Moisture Sensors

Adding moisture sensors to your RKD takes the guesswork out of irrigation and adds a new level of intelligence to the picture - you now enjoy "Total Cycle Management":

1. Calculate your irrigation
2. Communicate - get feedback from the system
3. Validate - use moisture sensors to get feedback from the soil

Let's examine the three components of Total Cycle Management in turn.

D.1.1. Calculate

When planning irrigation you look at the best evapotranspirational (ET) data you have available. In descending order of accuracy you may have access to one or more of the following:

- Data from a local weather station.

- Real-time ET data from an off-site weather station.
- Daily weather reports from an off-site weather station.
- Historical weather data for your area.

In addition you know about the soil type, vegetation and other factors that should affect your irrigation planning, but even the best planning is still, in essence, guesswork, as you don't know for sure how the soil is responding.

D.1.2. Communicate

With an intelligent irrigation controller like the RKD you get a lot of help in correcting your calculations along the way. A variety of alarms (see Section 6.3, “Alarms” [47]) can be raised and many will lead to your irrigation schedules being adjusted to the new conditions.

For example, if it rains heavily, the RKD won't blindly keep irrigating as you may have told it to.

The RKD logs everything elaborately and even lets you view real-time data in the web based interface. With this knowledge you can re-adjust your calculation, but still, an important piece is missing from the puzzle.

D.1.3. Validate

To validate your calculations and the feedback the system has given you there is no way around measuring the exact levels of moisture in the ground.

By adding moisture sensors to the RKD you are now full circle. Irrigation can now be adjusted automatically based on the data flowing from your moisture sensors, and long term you can adjust your schedules according to what you learn from the full circle irrigation scheme, gradually refining your irrigation schedules to perfection.

When setting up moisture sensors with the RKD, you tell the controller which soil type you are measuring, and then the RKD will pull in data every 10 minutes, and you are allowed to configure precisely how the controller should react to this data - this happens as fine grained as on a per-program basis:

- Set limits for how dry the soil should be before irrigating and how moist it must be before irrigation is prevented.
- Determine whether or not the collected data should affect current irrigation directly, or if the data should just be collected for schedule refinement later on.

The moisture sensors also work in conjunction with the regular ET mechanism and affects the amount of water assigned to irrigation moving forward. The range of ET adjustment can be from zero to two times the daily ET, meaning that a very dry soil can result in ET being doubled and a very moist soil can bring the ET for the following day to zero.

You determine per program how much the controller can adjust the ET by setting a value between 0 and 100%, a 100% being double from normal ET (This is described in Section D.2.2, “How irrigation is adjusted by moisture sensors” [145].)

The following section describes how to attach, setup and configure for moisture sensors with your RKD.

D.2. Connecting, Configuring and Using Moisture Sensors

This section describes how you actually get the moisture sensors ready for use and how they can improve your irrigation.

The RKD works with the following moisture sensors:

- SMS-100 (single sensor)
- SMP-12 (probe with 6 sensors)
- SMP-20 (probe with 5 sensors)
- SMP-40 (probe with 10 sensors)
- SMP-60 (probe with 15 sensors)

D.2.1. Connecting and configuring a moisture sensor

Before you can enjoy the benefits of moisture sensor input you must connect it to the two-wire, obtain a license from your distributor and perform some basic configuration.

Follow this procedure to get your moisture sensor up and running:

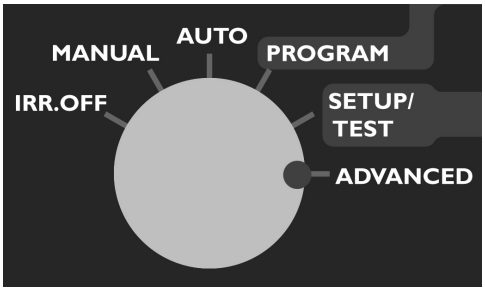
Note

You must have entered a license key for the controller before you are able to configure moisture sensors (See Chapter 3, *Entering Moisture Sensor License* [13].)

Procedure D.1. Assigning an ID to a soil moisture sensor

1. Connect the soil moisture sensor to the RS232 port on the controller via an SMI-100 interface.
2. Turn the mode selector to ADVANCED

Figure D.1. Mode selector in ADVANCED



Now the display looks like this:

Figure D.2. Display message on switch to ADVANCED mode

3. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

Figure D.3. ET/Rain Setup Menu

4. Select `2. Moisture` and push the ENTER button. Now the display looks like this:

Figure D.4. Moisture Menu

5. Select `4. Moisture Sensor Id Assign` and push the ENTER button. Now the display looks like this:

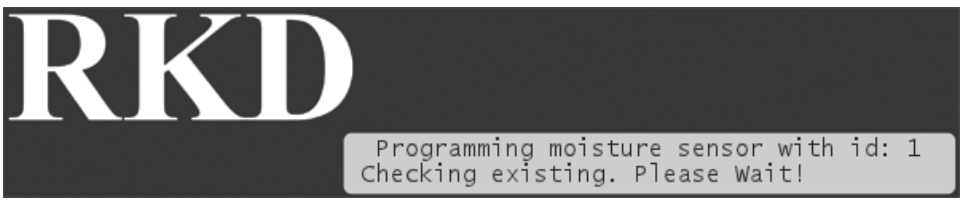
Figure D.5. Moisture Program Settings

The number of sensors available in the list depends on your license.

6. Use the *item selectors* to choose the ID you wish to assign to the newly connected moisture sensor and push the ENTER button.

Now the controller will first check that there are no existing moisture sensors with the ID you chose:

Figure D.6. Checking for existing moisture sensor IDs



If no clashes in ID numbers are found, the controller moves on to detect the new sensor:

Figure D.7. Checking for new moisture sensor

If all goes well you will see the following message in the display:

Figure D.8. Checking for new moisture sensor

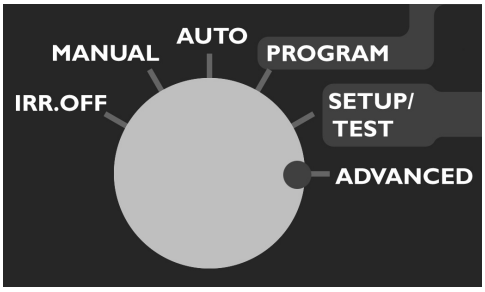
Once your moisture sensor has an ID you need to tell the controller what type of sensor it is and in which type of soil it is placed.

Follow this procedure to make the sensor known to the RKD:

Procedure D.2. Configuring a soil moisture sensor

1. Turn the mode selector to ADVANCED

Figure D.9. Mode selector in ADVANCED



Now the display looks like this:

Figure D.10. Display message on switch to ADVANCED mode

2. Use the *item selectors* to select `3. Intelliset` and push the `ENTER` button. Now you'll see the following screen:

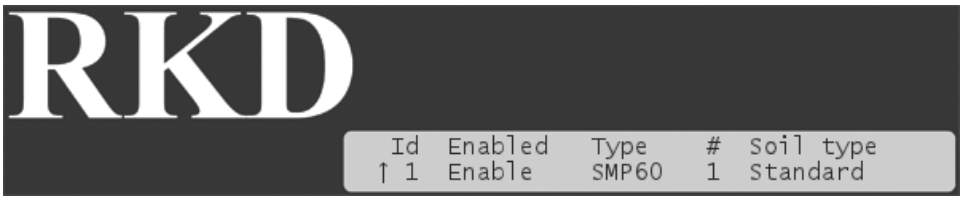
Figure D.11. ET/Rain Setup Menu

3. Select `2. Moisture` and push the `ENTER` button. Now the display looks like this:

Figure D.12. Moisture Menu

4. Select `2. Moisture Sensor Setup` and push the `ENTER` button. Now the display looks like this:

Figure D.13. Moisture Sensor Setup



5. Use the *item selectors* to select the ID of the sensor you wish to configure (You assigned the ID in the previous procedure: Assigning an ID to a soil moisture sensor [141]) and then adjust each column:

Table D.1. Description of columns in Moisture sensor setup

Column	Description
`Enable`	Whether the moisture sensor should be enabled or not.
`Type`	The type of sensor associated with the ID. Supported sensors are: • SMS-100 • SMP-12 • SMP-20 • SMP-40 • SMP-60
`#`	In case your moisture sensor is a probe, this column determines which of the sensors in the probe should control the irrigation.
`Soil type`	The type of soil in which the sensor is placed. Options are: • Clay • Sand • Loam • Standard

6. Push the ENTER button to save your configuration.

7. Repeat steps five and six for all sensors you wish to configure.

Now the moisture sensors are ready to use, and the next sections go into detail on how you assign them to control your irrigation schedules.

D.2.2. How irrigation is adjusted by moisture sensors

Each program can accept input from a moisture sensor and its input can be used for the following:

- Allow irrigation if the moisture level is low enough
- Raise an alarm if the moisture level is too low
- Prevent irrigation if the moisture level is too high
- Optionally adjust the ET balance

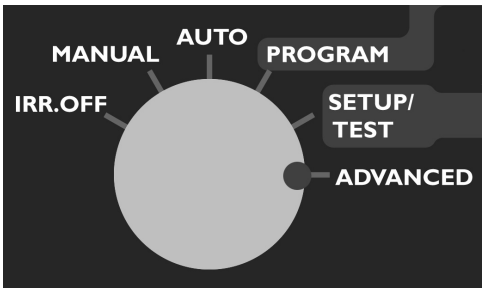
Note

Each moisture sensor can control multiple programs and its input can be interpreted differently by different programs.

Here is how you configure your programs to use a moisture sensor:

1. Turn the mode selector to ADVANCED

Figure D.14. Mode selector in ADVANCED



Now the display looks like this:

Figure D.15. Display message on switch to ADVANCED mode

2. Use the *item selectors* to select `3. Intelliset` and push the ENTER button. Now you'll see the following screen:

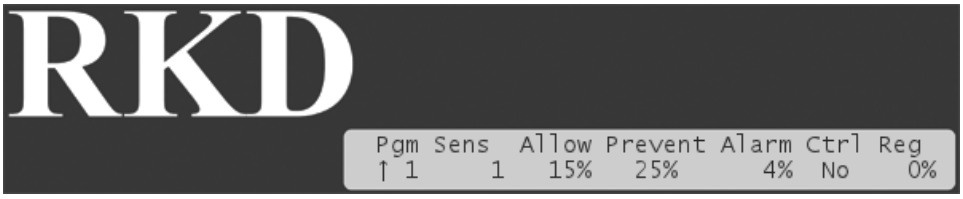
Figure D.16. ET/Rain Setup Menu

3. Select `2. Moisture` and push the ENTER button. Now the display looks like this:

Figure D.17. Moisture Menu

4. Select the first option: `1. Moisture program settings` and push the ENTER button. Now the display looks like this:

Figure D.18. Moisture Program Settings



5. Now, using the *item selectors*, set the values for all seven columns:

Table D.2. Description of columns in Moisture Program Settings

Column	Description
Pgm	The program to assign a moisture sensor to.
Sens	Which sensor to assign.
Allow	The lower threshold for when irrigation will be allowed - e.g. 5% means that irrigation will be allowed as long as the moisture readings are below 5%.
Prevent	The higher threshold for when irrigation will be prevented - e.g. 30% means that irrigation will be prevented if the moisture readings are 30% or higher.
Alarm	The lower threshold for when an alarm will be raised.
Ctrl	Set to Yes or No depending on whether you want the moisture sensors to control your Irrigation. If irrigation is prevented due to high moisture readings, ET for the following day will be increased.
Reg	A percentage with which the ET will be adjusted. 0% means no adjustment and 100% means that the ET will be as much as doubled for the following day.

6. Push the ENTER button to save your configuration.

7. Repeat steps four and five for each program you wish to assign a moisture sensor to.

Once you have completed all the procedures in this section, your system should be up and running, utilizing moisture sensor readings and adjusting irrigation accordingly.

D.2.2.1. How moisture sensor input affects ET

The RKD can handle single sensor and probe moisture sensors via the external RS232 port and an additional external RS232/RS485 (SMI-100) converter. The controller can handle up to 10 moisture sensors on a multi drop line.

The moisture sensor is able to allow or prevent irrigation and/or adjust ET on specific programs dependent on the actual moisture and the setup. All the setup can be done at the controller and on the WEB. It is also possible to view the actual moisture level both on the controller and on the WEB.

The moisture sensors may be set up to simply allow or prevent irrigation. The irrigation is still controlled by water days, WB or ET, start times, etc. The sensor just acts as a switch for one or more programs.

More powerfully, the moisture sensor is also able to adjust the daily ET, which is added to the ET balance corrected for rain for each program. The principle is that high moisture shall reduce the ET applied to the

ET balance and low moisture shall increase the ET applied to the ET balance. With full regulation the adjusted ET shall vary between 0 and double the amount of daily ET. The regulation is individual per program.

Table D.3. Abbreviations

Term	Description
Factor %	A user definable regulation factor between 0 and 100%. Set to 0 means no regulation. Set to 100% means full regulation.
100% regulation when wet	No ET is added to the balance.
100% regulation when dry	2x the ET is added to the balance.
Wet	At or near field capacity.
Dry	At or near permanent wilt point.
Optimal	The target balance between soil and climate ET.
VSM	The actual volumetric soil moisture.
ETm	Moisture adjusted ET and corrected for rain and added to ET balance.
ET	ET for the prior 24 hour period.
Rain	Rain for the prior 24 hour period.

Table D.4. VSM ranges for the different soil types

Soil type	VSM(dry)	VSM(wet)	VSM(Optimal)
Standard	0	49	25.5
Sand	2	22	12
Loam	6	36	21
Clay	15	50	32.5

The following examples show 7 days with various daily ET and rain in combination with start off of dry, wet or optimal soil condition with 0%, 50% or 100% regulation. The examples have the following common conditions:

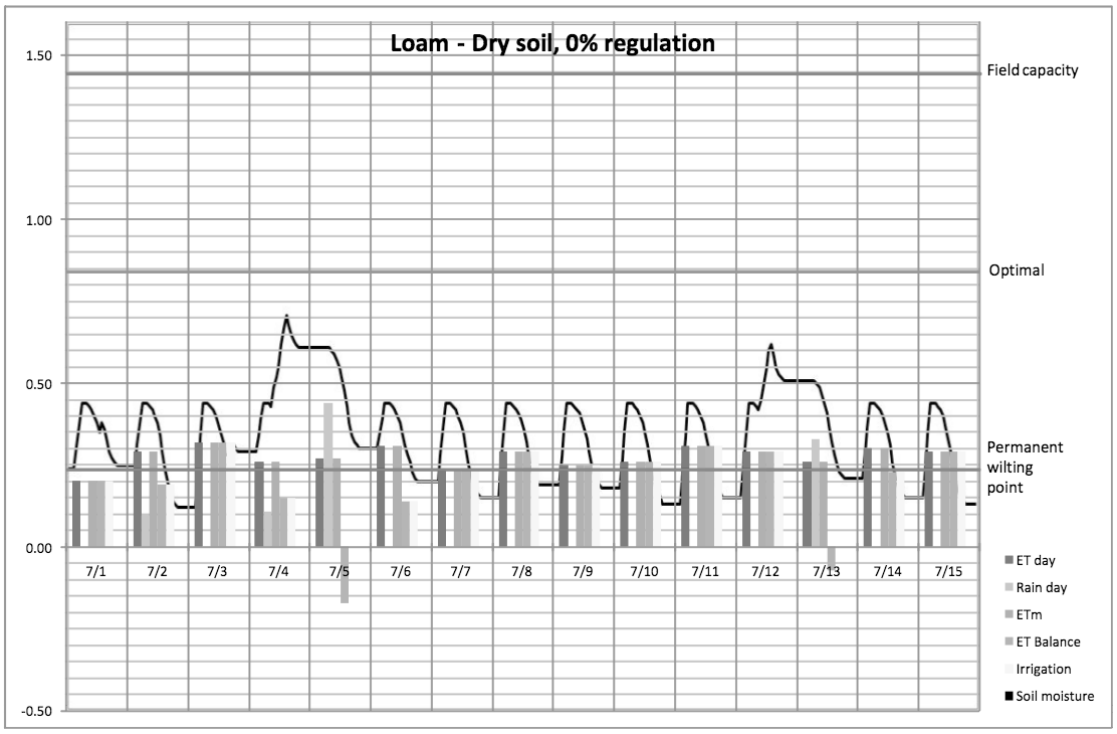
- Soil type loam. Root zone 4”. This means the VSM for dry, optimal and wet corresponds to 0.24”, 0.84” and 1.44” of water.
- The first irrigation period begins with ET=0.20, Rain=0.00”, ET balance = 0.00”.
- The irrigation program runs every day if ET balance is above 0.00” (no minimum/maximum ET defined.)
- Allow and prevent irrigation based on the moisture is not used.
- The water applied by irrigation and rain reach the root zone the same day.

Table D.5.

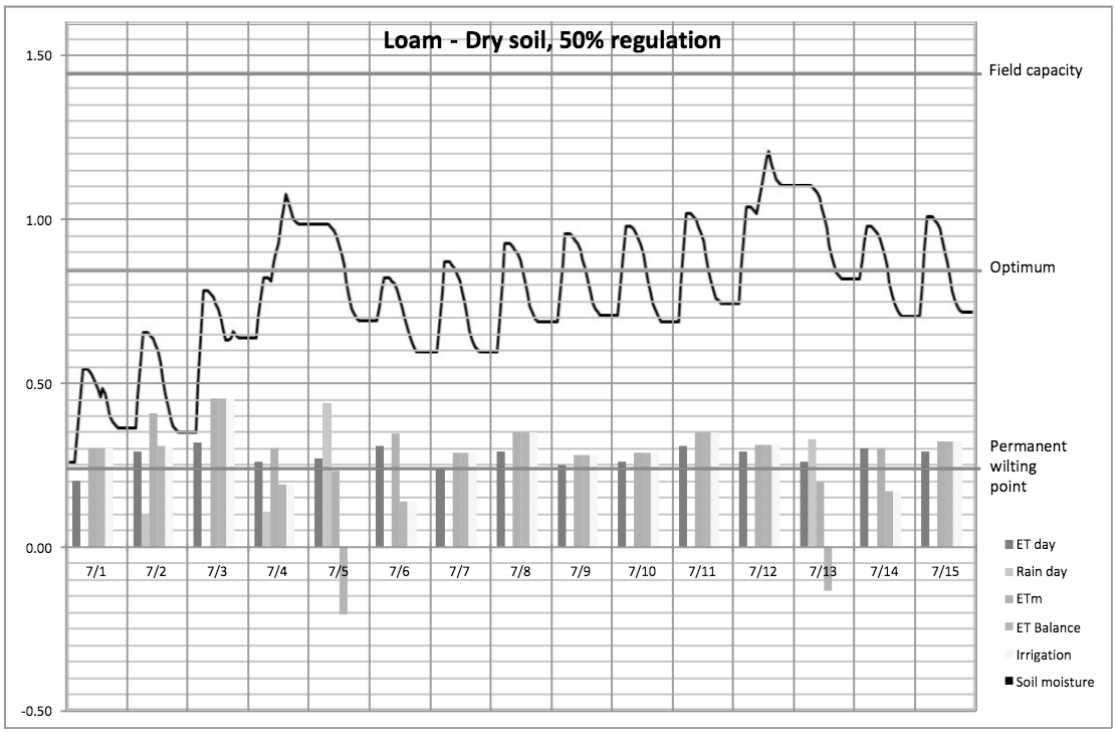
Factor %	VSM %	ET	ETm
0	6 (dry)	0.20	0.20
0	21 (optimal)	0.20	0.20
0	36 (wet)	0.20	0.20
50	6 (dry)	0.20	0.30
50	21 (optimal)	0.20	0.20
50	36 (wet)	0.20	0.10
100	6 (dry)	0.20	0.40
100	21 (optimal)	0.20	0.20
100	36 (wet)	0.20	0.00

Example D.1. Dry start condition (stress point)

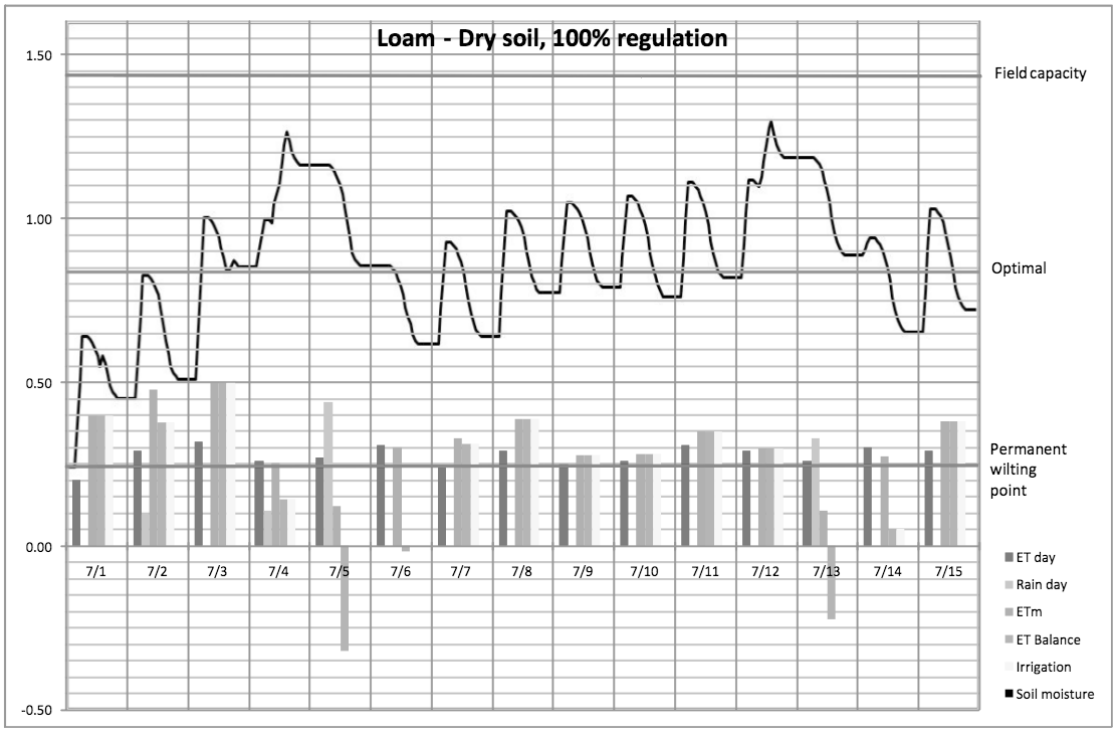
Soil moisture starts at 0.24”



We start with 0.20” ET and no rain the first day. The soil is dry, but we have no regulation. Thus the ETm = ET. Every day the ET balance = ETm (ET) – Rain. There is no irrigation on 7/5 as the ET balance is negative. The result is that we start out with a dry soil and we will keep a dry soil. The moisture content in the soil varies over the day as the irrigation falls in the night (increase soil moisture) and during the day the ET dries out the soil. The example shows that most of the days the soil moisture is below the permanent wilting point at the end of the day.



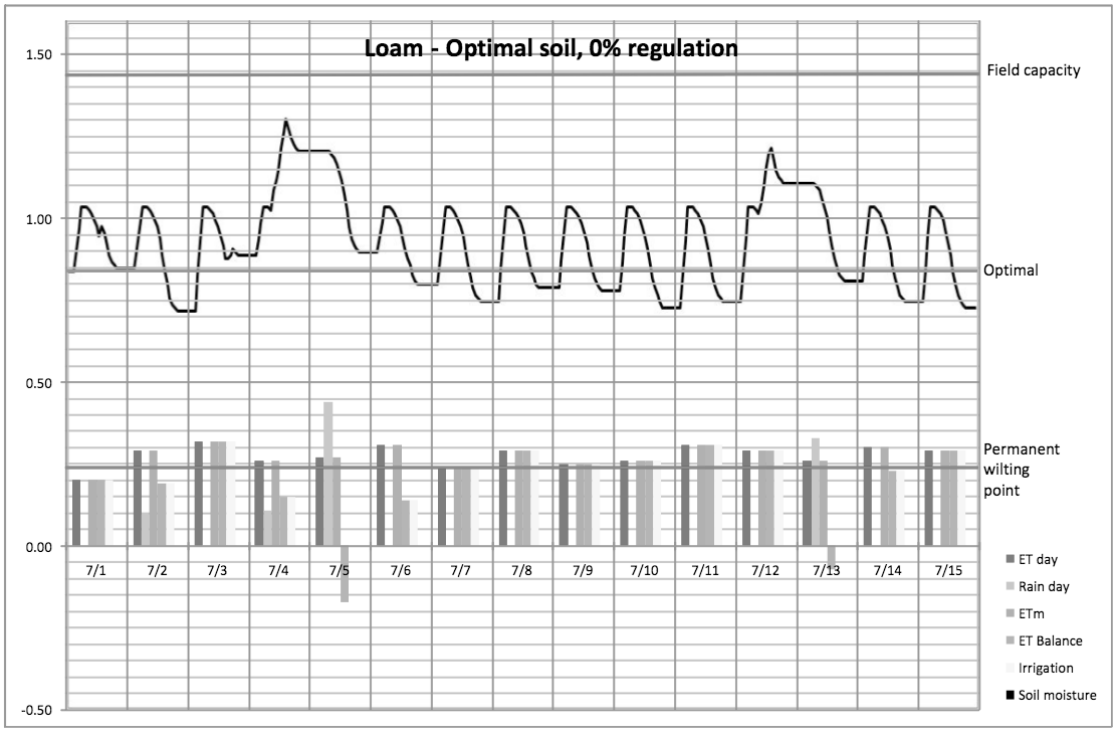
We start with 0.20” ET and no rain the first day. The soil is dry, and we have 50% regulation. Thus the ETm will be regulated up by 50% from the collected ET in the beginning and as the soil moisture reaches the nominal level the ETm is regulated less. The trend shows the soil moisture is growing until it reaches the optimum level.



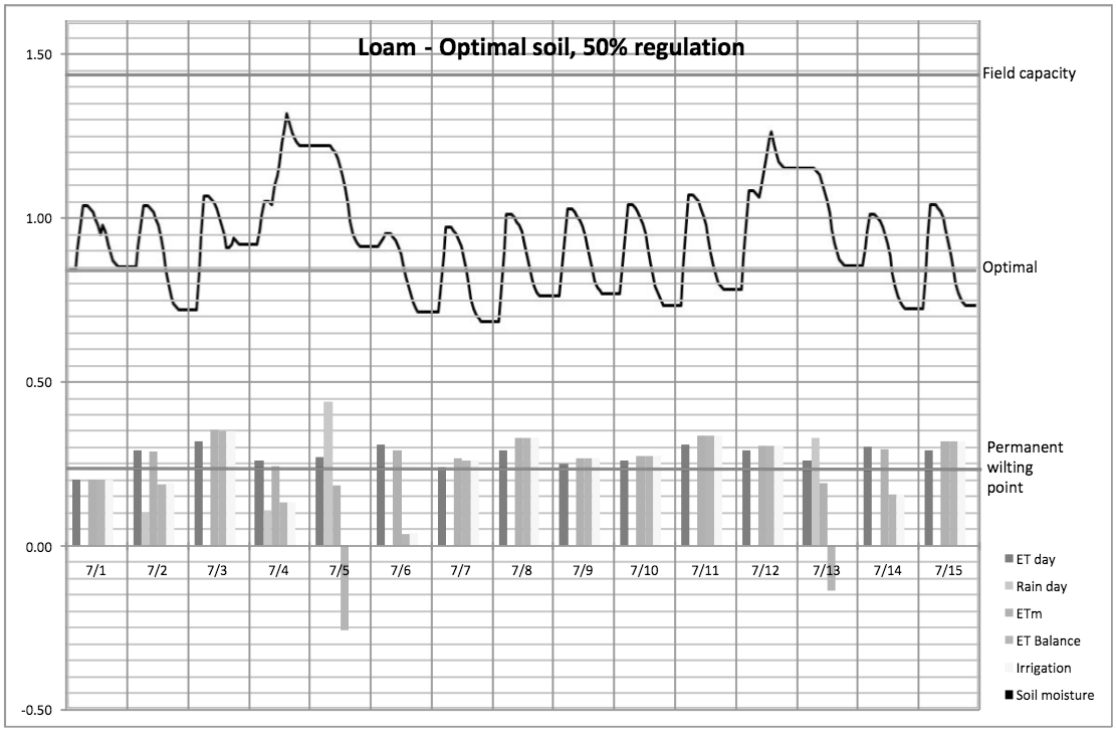
This shows the same tendency as the 50% regulation, just that the regulation of the soil moisture is far more aggressive.

Example D.2. Optimal start condition

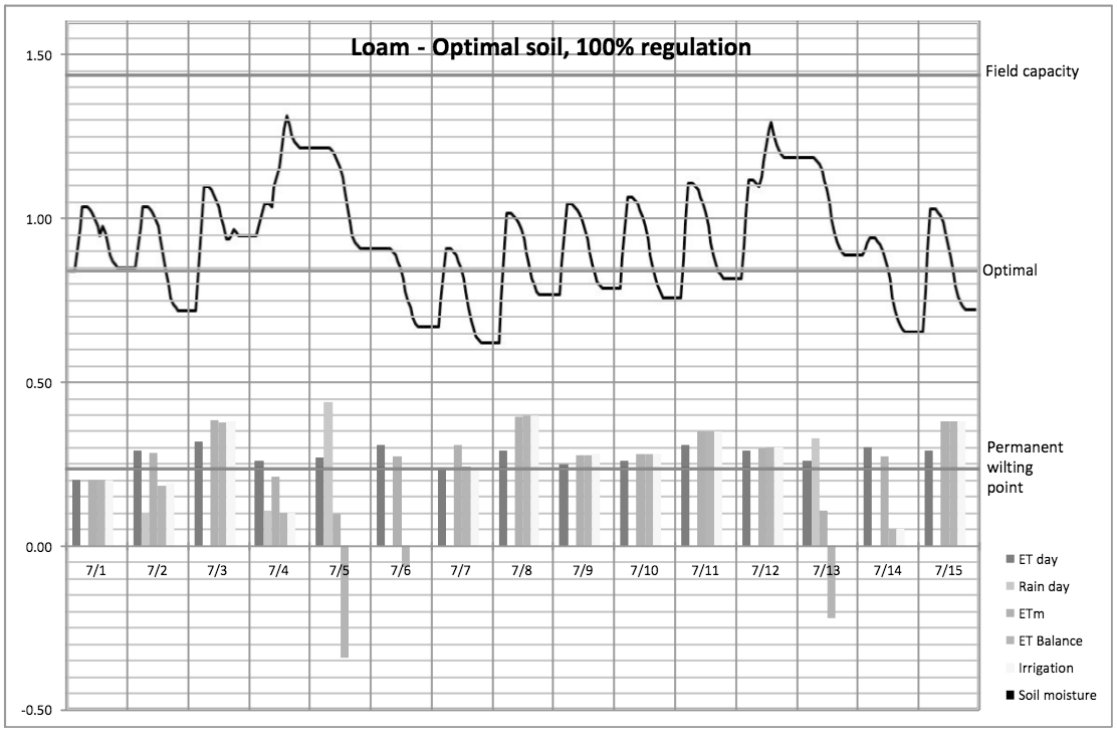
Soil moisture starts at 0.84”



In this case the soil moisture was in balance when we started and it is kept in balance.



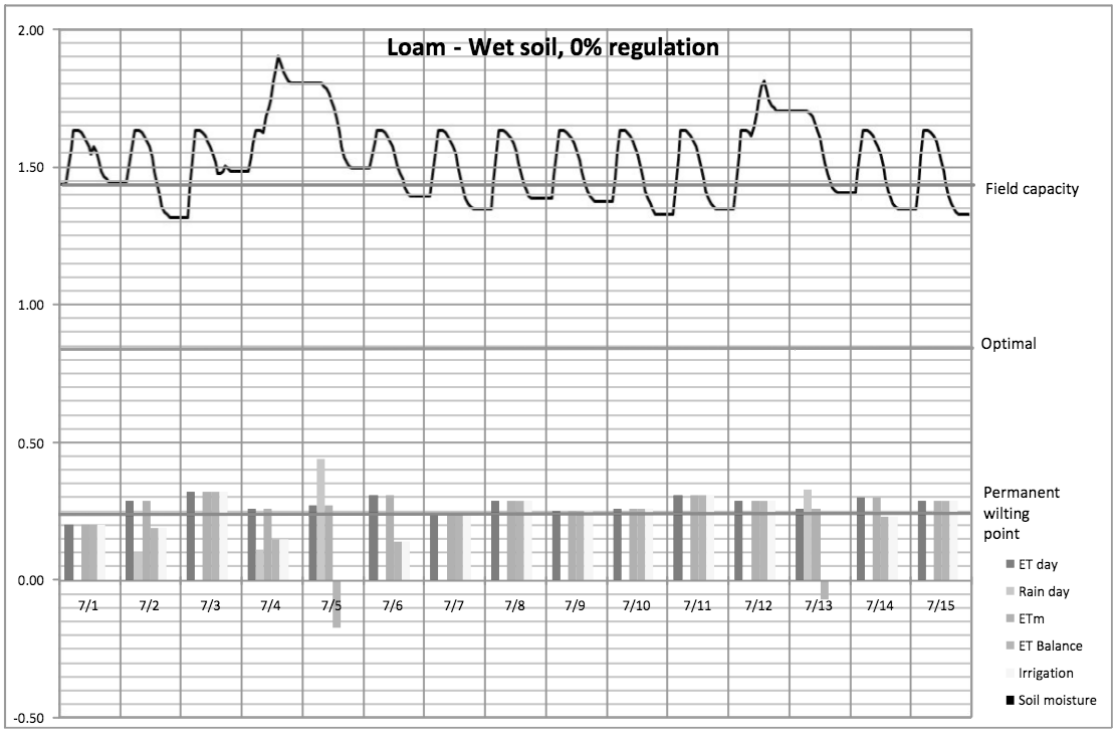
The regulation has very little influence as the soil moisture is in balance and we just deviate slightly from the nominal value.



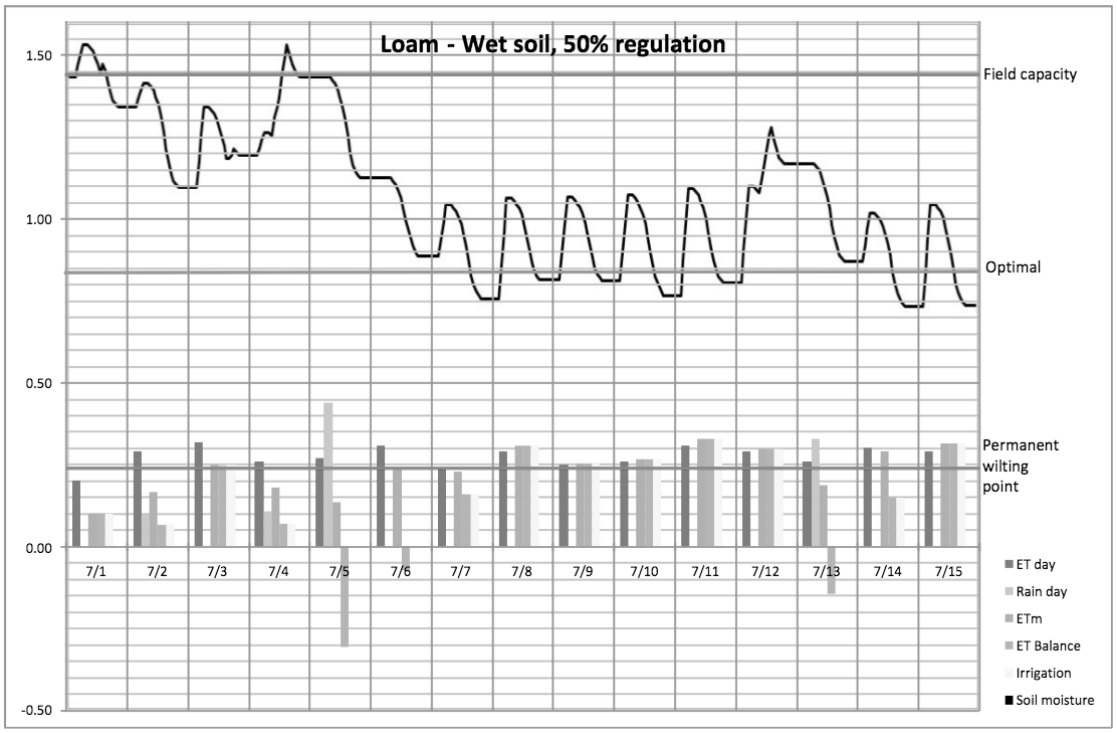
Same as with 50%

Example D.3. Wet start condition (field capacity)

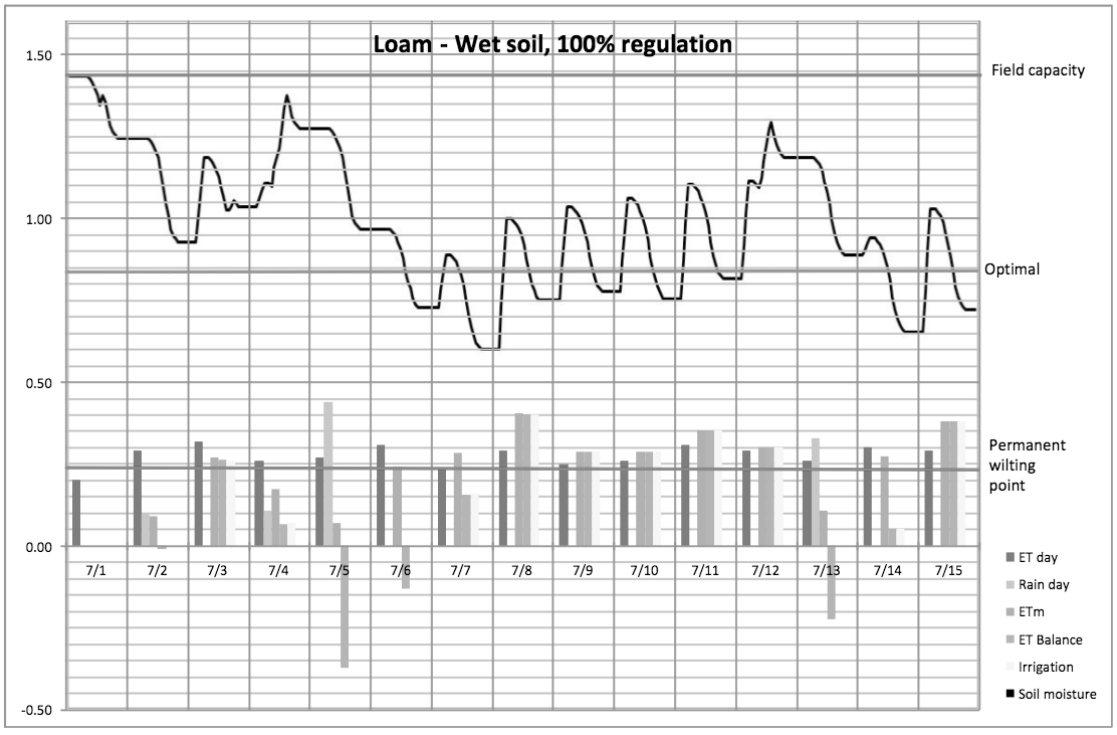
Soil moisture starts at 1.44”



We start with 0.20” ET and no rain the first day. The soil is wet, but we have no regulation. Thus the ETm = ET. Every day the ET balance = ETm (ET) – Rain. There is no irrigation on 7/5 and 7/13 as the ET balance is negative. The result is that we start out with a wet soil and we will keep a wet soil. We even keep the moisture above the field capacity, which means most of the irrigation is waisted.



The soil will dry towards the nominal value over time. It will still irrigate, but with less ETm than the collected ET. Using prevent irrigation above a certain level would avoid irrigation when it is very wet.

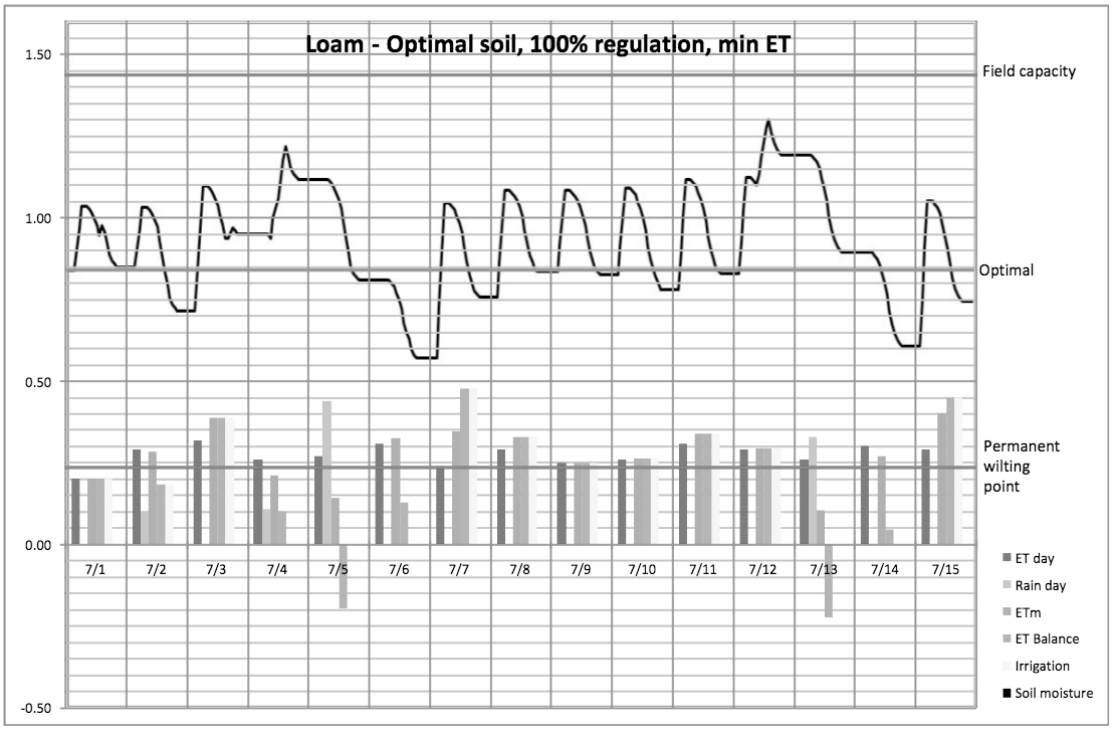


The same picture as the 50% regulation just that the progression towards the nominal value is much faster.

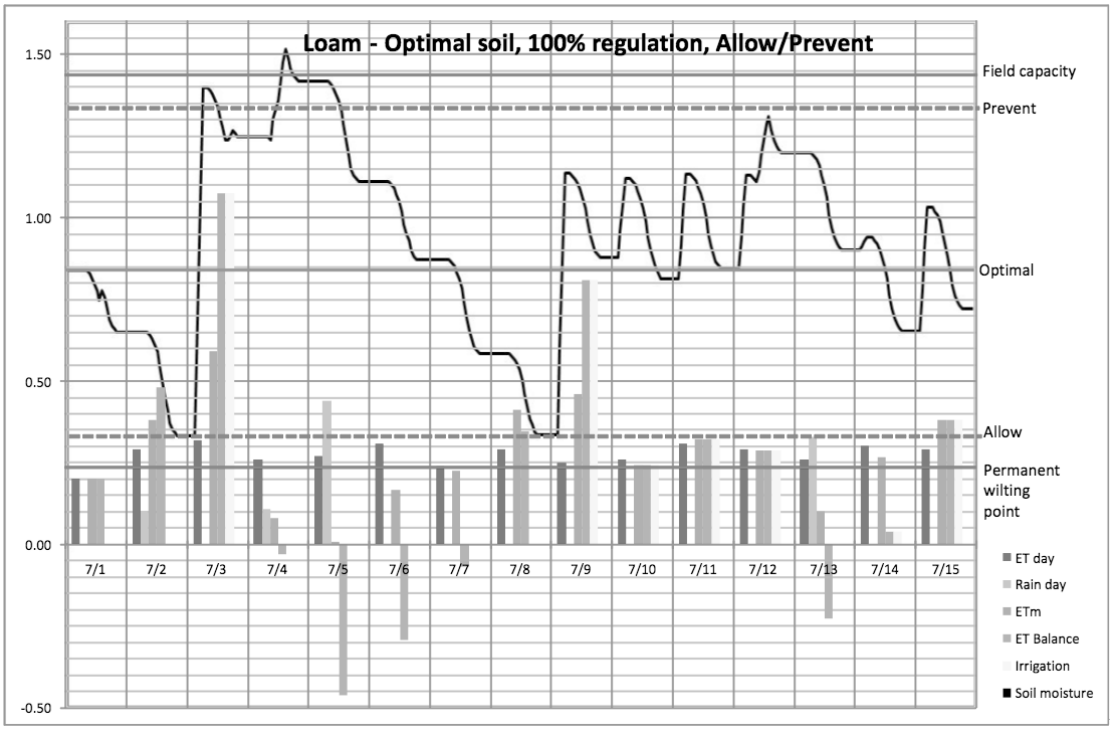
The same results can be drawn for the other soil types.The only difference is the VSM range.

Min and max for ET come into play when the system starts to use the ET balance; i.e. after the moisture correction, which is on what we add to the ET balance. Max hourly rain is during the day when we collect rain. Soil holding is the maximum that the ET balance can go negative.

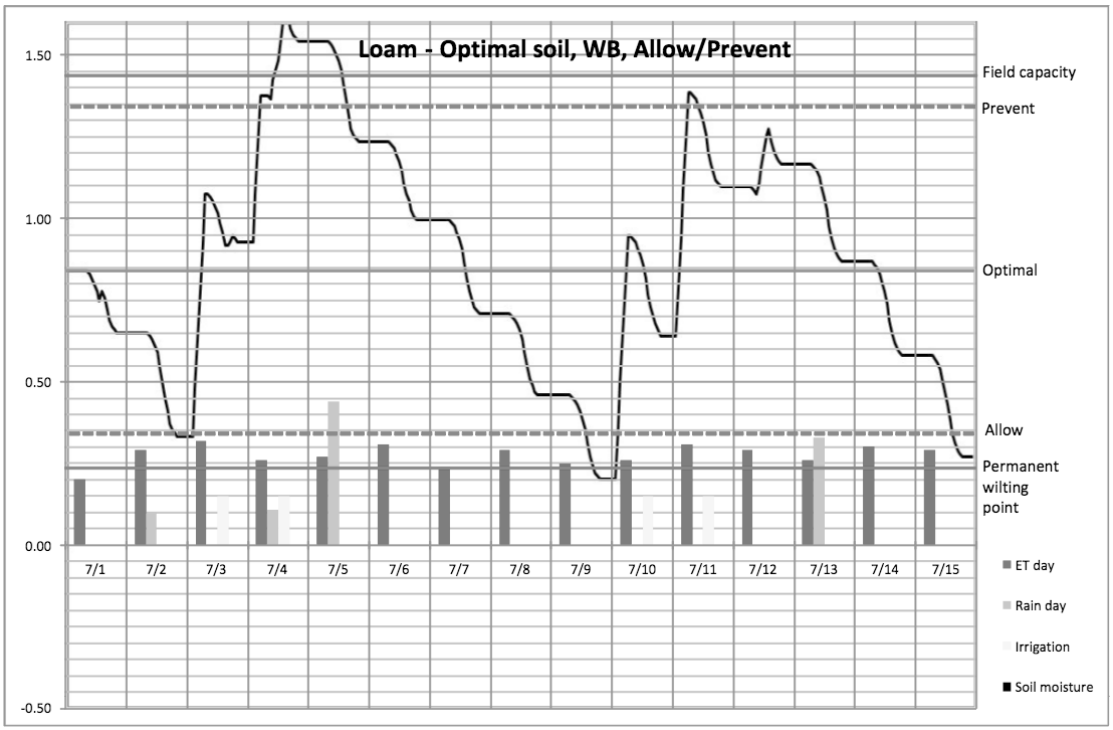
Soil moisture starts at 0.24”.



Compared to the similar example in the beginning the minimum ET of 0.15” avoids the small amount of irrigation on 7/4 and 7/14.



In the example the Allow irrigation is set to 0.34” and Prevent irrigation is set to 1.34”.Thus the irrigation is prevented until the soil moisture drops below 0.34”. At that point the ET balance is large and the first coming days irrigation will increase the soil moisture to above prevent level.The next five days the soil moisture will drop due to ET until it again allows irrigation. In the next period it will not increase above the prevent and start settle at the optimum.



This example has the same allow and prevent settings as the previous, but instead of ET controlled irrigation as water budget program is used.The water budget program is set with start times at 1 AM, 2 AM, 3 AM, 4 AM, 5 AM and 6 AM. Each start apply 0.15” water and it is assumed this is in the soil the following hour. The result is again that the soil moisture drops until it is below 0.34” and then on 7/3 the controller irrigates 6 times 0.15”.The next day it irrgates 3 times 0.15” until it reach the 1.34”.The following days the soil dries out and it all repeates from 7/10

Appendix E. Changing Station Run Sequence and Mapping

Normally stations in a program will be run in the order indicated by their station ID numbers (see Section 5.3, “Configuring Irrigation Programs” [27] for details), but you can circumvent this by assigning sequence numbers to stations instead.

The typical scenario if when you want to add a station to an existing installation - instead of this station always being run as the last one due to its high ID number, you can "merge" it into the middle of the pack by using sequence numbers.

Example E.1. Putting a new station in the middle of the run chain

Consider a scenario where you have 40 stations with ID numbers from 1 to 40 placed in the terrain. You want to add number 41 but you would like it to be run after station 20 instead of in the end of a program cycle. To achieve this you would alter the sequence number for ST41 to 21:

Normal run sequence	**Run sequence after changing the sequence number for ST41 to 21**
ST1	ST1
ST2	ST2
ST3	ST3
...	...
ST20	ST20
ST21	ST41
ST22	ST21
...	...
ST39	ST38
ST40	ST39
ST41	ST40

If station run sequences are changed, this will show when you are assigning stations to a program - if you changed the sequence like in the example above, scrolling through the station list you would see ST41 appear right after ST20 in the list.

Note

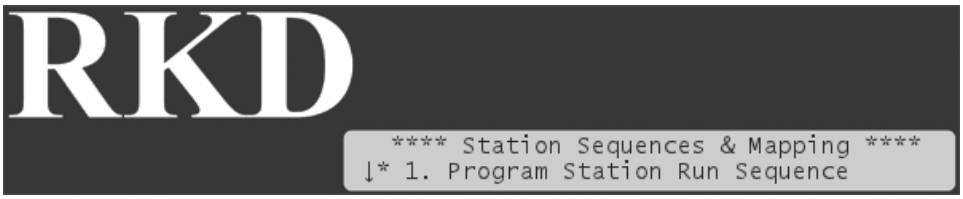
In all other places (station test, expected flow lists, etc.) stations are listed according to station ID and not to run sequence.

The following two procedures show you how to alter and reset station run sequences.

Procedure E.1. Changing the station run sequence

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `6. Station Run Sequence & Mapping`, and push the ENTER button.

Now you will see this display:



2. Select `1. Program Station Run Sequence`. Now you will see the following display:

3. Select `1. Edit` and push the ENTER button.

   Now you will see this display:

4. Use the *item selectors* to select the station you wish to re-arrange and change its sequence number.

5. Push the ENTER button to save your sequences.

Procedure E.2. Resetting station run sequences

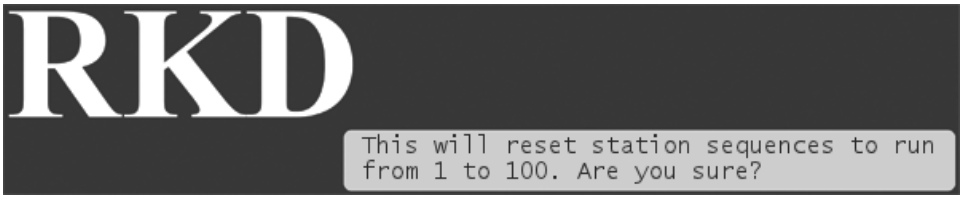
1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `6. Station Run Sequence & Mapping`, and push the ENTER button.

   Now you will see this display:

2. Select `1. Program Station Run Sequence`. Now you will see the following display:

3. Select `2. Reset to factory default` and push the ENTER button.

   Now you will see this display:



4. Push the ENTER button to acknowledge that you're resetting the sequence numbers, or CANCEL to exit.

E.1. Changing Station Output Mapping

In addition to changing the station run sequence, you may alter the mapping between station names and physical stations, meaning that station 1 can be re-mapped to not activate the valve connected to terminal 1, but an arbitrary valve.

This is how it is done:

Procedure E.3. Changing Station Output Mapping

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `6. Station Run Sequence & Mapping`, and push the ENTER button.

   Now you will see this display:

2. Select `2. Station Output Mapping` and press the ENTER button. Now the display will look like this:

3. Select `1. Edit` and press the ENTER button. Now you will see the following display:

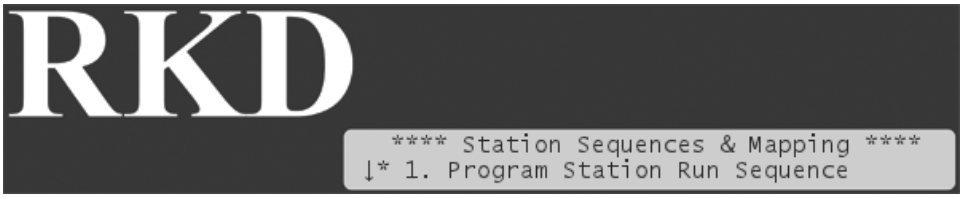
4. Use the *item selectors* to map station names to physical output terminals and press the ENTER button to save your mapping.

In case you want to reset to the factory defaults of stations names mapped directly to corresponding terminal IDs, follow this procedure:

Procedure E.4. Resetting Station Output Mapping

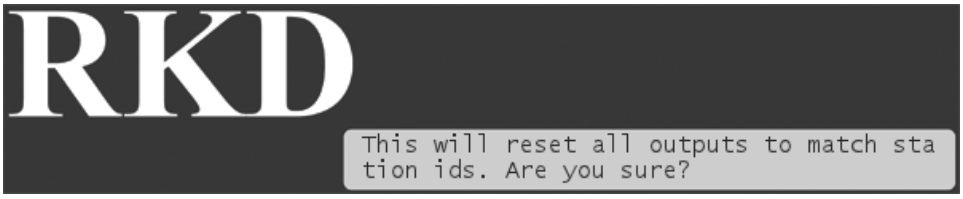
1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `6. Station Run Sequence & Mapping`, and push the ENTER button.

   Now you will see this display:



2. Select `2. Station Output Mapping` and press the ENTER button. Now the display will look like this:

3. Select `2. Reset to factory default`. Now you will see the following display:



4. Push the ENTER button to acknowledge that you are resetting all mappings, or CANCEL to exit.

Appendix F. Using Simple Flow Management

The RKD allows for simple flow management by comparing the current flow to system capacity and preventing too many stations from running at once.

F.1. Configuring for Flow Management

Setting up your system for flow management only involves two things:

1. Defining the expected flow for your stations as described in Section C.2.5, “Setting Expected Station Flow” [133].

2. Set the maximum system capacity as described in Section F.3, “Setting the System Flow Capacity” [165].

F.2. How the Flow Management Works

Whenever a station is about to start, the RKD will try to determine whether the system has sufficient capacity to start the station by doing a little calculation. A station can be started if:

```
(Required Capacity + Capacity in Use) <= Total Capacity
```

In plain words: the capacity required by the station plus the capacity already used must not exceed the total system capacity.

The required capacity and the capacity in use is determined from the station flow, whether entered or learned (see Section C.2.5, “Setting Expected Station Flow” [133] for details).

If a station can not be started it will be queued in "pending" state. On the controller this will appear as "Waiting", just as paused stations. However, pending stations have a higher priority than others next time the RKD frees some capacity. (This is known as the *stacking mechanism*.)

There are a couple of things to keep in mind when using flow management:

- When running in AUTO mode, manually started stations will overrule the flow management and ignore the higher priority of pending stations. Manually started programs will obey the flow management though.
- The entire concept of flow management is ignored when running in MANUAL mode.
- When pausing a program the RKD will release the capacity to flow management and thus the program might go into "pending" state when resumed if the capacity is used up by other stations.

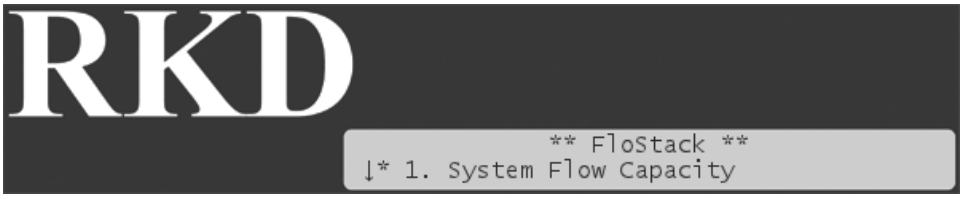
F.3. Setting the System Flow Capacity

If you tell the RKD about the flow capacity of your pipes, the controller can automatically queue up stations that would exhaust the capacity by starting. Here's how you enter the flow capacity at the controller:

1. Turn the *mode selector* to `ADVANCED` and select `2. FloStack`.

   Now you'll see the following display:

Figure F.1. FloStack Menu



2. Select `1. System Flow Capacity` and you'll see this display:

3. Use the *item selectors* to set the system flow capacity and push the ENTER button to save your setting.

Important

Leaving the System Flow Capacity at zero GPM means that the setting won't be used to correct which stations are started.

Appendix G. Defining a Custom Irrigation Period

You can change the standard irrigation window in the RKD that runs from 12:00 AM to 12:00 AM. This has two effects:

1. The entire water cycle will start when your irrigation period starts. If this is different from 12:00 AM, please be aware that:

   - Programs will start running on the first start time after your irrigation period starts. This can potentially lead to a bit of confusion where programs leap into days you wouldn't think they should be running, or start running before they normally would.

   ### Important

   The irrigation period normally starts at midnight, but if you move the start into the PM window, your period starts earlier. Moving the start into the AM window will start the period later.

   #### Example G.1. Skewed days with custom irrigation periods

   Consider a program with four start times: 02:00 AM, 05:00 AM, 06:00 PM and 11:00 PM that runs on odd days.

   If your irrigation period starts at 08:00 PM and runs to 08:00 PM, here's how the program could run:

Date	Start time	Action
September 2.	11:00 PM	Runs despite the even date - your irrigation period has started earlier than midnight.
September 3.	02:00 AM	Runs as expected.
September 3.	05:00 AM	Runs as expected.
September 3.	06:00 PM	Runs as expected.
September 3.	11:00 PM	Will not run despite the odd date - your irrigation window has closed.
...	...	...

   - All ET calculations are based on the irrigation period, be it the standard one or your custom period.

2. You can define a "non-water" window by not letting the period span 24 hours. If you define the start to 06:00 PM and the end to 08:00 AM no programs or stations will be started between 08:00 AM and 06:00 PM.

   ### Note

   You can still run both stations and programs manually in the non-water window.

Programs that try to start in the non-water window will generate an alarm. And if a program is running when the non-water window starts the program is halted and an alarm is raised. You can read more about alarms in Section 6.3, “Alarms” [47].

Here is how you actually define the irrigation period at the controller:

Procedure G.1. Configuring the Irrigation Period

1. Turn the *mode selector* to ADVANCED, use the *item selectors* to scroll to item number `4. Irrigation Period`, and push the ENTER button.

   Now you'll see this display:

2. Use the *item selectors* to set the start and end time and push the ENTER button to save your settings.

Appendix H. Advanced Irrigation: Misting, Cycle & Soak

The RKD lets you go beyond regular irrigation and build misting and "Cycle & Soak" programs.

Important

The basics are the same as when building a regular irrigation program, so make sure to read Section 5.3, “Configuring Irrigation Programs” [27] and pay particular attention to Section 5.3.3, “Setting Start Times” [32] before carrying on here.

H.1. How is This Different from Regular Programs?

Misting and "Cycle & Soak" programs are configured the same way as regular programs (see Section 5.3, “Configuring Irrigation Programs” [27] for a walk-through), except for one point: The program start times have a more elaborate configuration.

In addition to start time, you configure an end time and a cycle count for how often you want the program repeated within this time frame. The controller will then "even out" the repeats within your time frame, leaving identical breaks between them.

So, if the total run time for your program is ten minutes and you configure the program to run three times between 10:00 AM and 11:00 AM, your program will run at 10:00, 10:25 and 10:50, leaving 15 minute breaks at 10:10 and 10:35.

The terms "Misting" and "Cycle & Soak" refer to two variants of this concept:

- **Misting:** typically describes a program that runs its stations for a very short time - run times are in seconds.
- **Cycle & Soak:** typically describes a program that uses longer run times - measured in minutes.

Both will run a number of cycles per start, whereas a normal program will only run once per start.

H.1.1. When the RKD Alters Your Program

There are a number of scenarios where the RKD will reduce the number of repeats in a program start:

Program was paused
: If a program has been paused the RKD will not aggregate the cycles that should have been run in the pause - these cycles are just ignored and the program continues at the point it would be at had it not been paused.

Maximum system capacity met
: If a program tries to run a cycle when the maximum system capacity is reached, this cycle is just dropped.

ET adjustments
: If ET adjustments have dictated that you can irrigate less then normally today, reducing the number of cycles can be the outcome.

If the number of cycles is reduced, a *Repeat* alarm is raised. (See Section 6.3, “Alarms” [47] for details.)

H.2. How to Configure for Misting or Cycle & Soak

A misting program will typically run a number of stations for just a few seconds at a time, and then add longer breaks between the program start times.

Here's an example of a simple misting program:

Station	Run time
ST1	0:00:05
ST2	0:00:08
ST3	0:00:15
ST4	0:00:06
ST5	0:00:08
...	...

Note

Since the RKD will start stations every ten seconds you might experience short breaks between starts in a misting program. For example you'll see short breaks of between five and two seconds in the program above.

For run time over four minutes, the end time is aligned to ten second slots too, so for example a run time of 0:05:13 will run for 0:05:20.

And here's a program that start at various frequencies in different time intervals:

Table H.1. Full misting program example

Start #	Details	Irrigation will start @
1	Start time: 08:00 AM End time: 09:00 AM Count: 3 Repeat duration: 10 minutes	• 08:00:00 AM • 08:25:00 AM • 08:50:00 AM
2	Start time: 09:00 AM End time: 10:00 AM Count: 4 Repeat duration: 10 minutes	• 09:00:00 AM • 09:16:40 AM • 09:33:20 AM • 09:50:00 AM
3	Start time: 10:00 AM End time: 11:00 AM Count: 5 Repeat duration: 10 minutes	• 10:00:00 AM • 10:12:30 AM • 10:25:00 AM • 10:37:30 AM • 10:50:00 AM

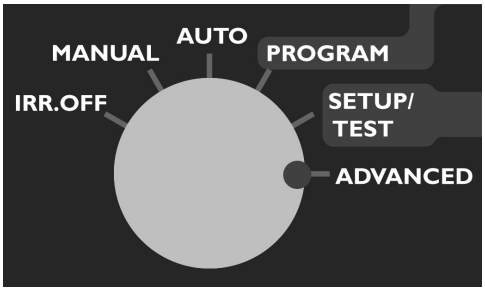
Finally, let's see how you go about creating a misting program on the controller - let's say you want to configure the first start time in the example program above - here's how you would do it:

The first thing you need to do in order to use the misting features is to enable them:

Procedure H.1. Enabling Misting

1. Turn the mode selector to ADVANCED

Figure H.1. Mode selector in ADVANCED



Now the display looks like this:

Figure H.2. Display message on switch to ADVANCED mode

2. Use the *item selectors* to scroll to item number `8. Feature Manager`, and push the ENTER button.

   Now you'll see this display:

3. Select `1. Ena/Dis Cycle and End Time`.

   Now you'll see this display:

4. Use the *item selectors* to select `Enable` and push the ENTER button to save your setting.

And then you're ready to configure the program:

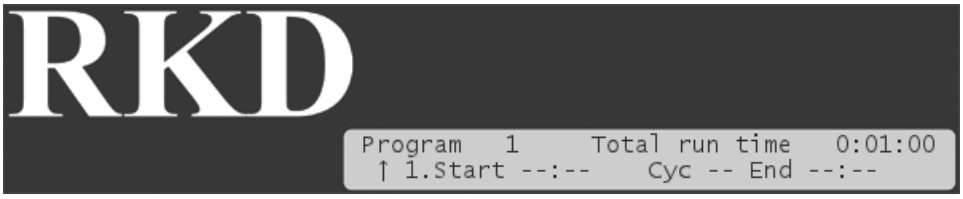
Procedure H.2. Setting the Start Times With Count and End Time

1. Create your program as explained in Section 5.3, “Configuring Irrigation Programs” [27], but when you get to Section 5.3.3, “Setting Start Times” [32], swap that part out for the instructions in this procedure instead.

2. Use the *item selectors* to navigate to the program you wish to adjust the start times for and push the START TIMES button.

   Now you'll see the following display:

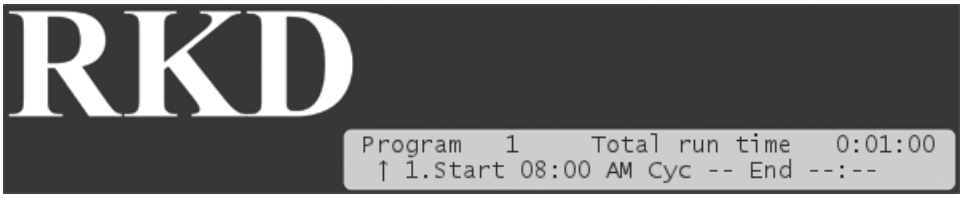
Figure H.3. Ready to select start time



3. Use the *item selectors* to locate the one of the four runs you wish to set a start time for, and push the ENTER button.

   Now the cursor will jump to the right, letting you set the start time:

Figure H.4. Selecting a start time



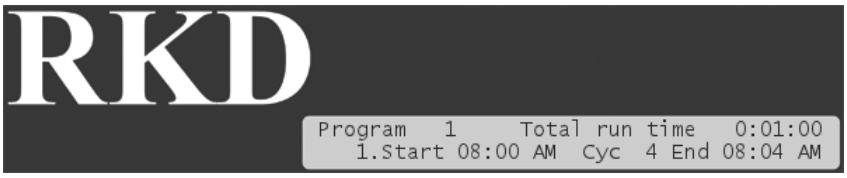
4. Use the *item selectors* to set the start time to 08:00 AM and push the right arrow to jump to the cycle field (Cyc).

5. Use the *item selectors* to set the count to four and push the right arrow to jump to the end time field (End).

Note

As soon as you enter the End field, the controller will set the default end time to `(total run time * count) + start time = 08:04`. You must extend the end time in order get the breaks in between the four cycles:

Figure H.5. Default end time



If you cut the end time shorter, one of two things will happen, depending on which type of program you are dealing with:

- **If you are handling a water budget based program**: The Cyc field will automatically decrease in order to fit in the cycles possible before the end time - you'll see it when you have saved the start time.

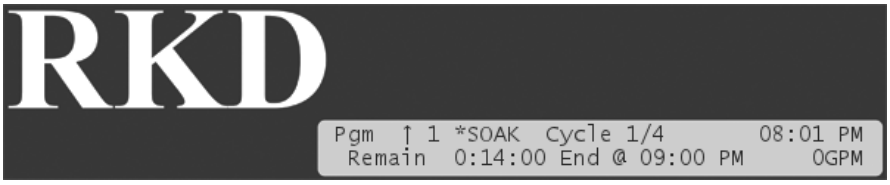
- **If you are handling an ET controlled program**: No adjustments are made to the number of cycles. The fact that ET may decrease the run time of your cycles, you may still be able to fit in your number of cycles even though you lower the end time.

6. Set the end time to 09:00 and push the ENTER button to save your settings - now the cycles will be evenly spread out in the hour between 08:00 and 09:00.

Note

When running this program, the controller still considers the program to be running, even though it is waiting between two cycles - here's what the display will look like right after the first cycle in the first run:

Figure H.6. Soaking break



H.3. Things to Keep in Mind

When using misting or cycle & soak programs, there are a number of things to consider that don't apply to regular programs:

- If you're using ET: Each cycle still obeys the water budget dictated by ET. This means that each cycle might have to run for so long that the time frame for the start time doesn't have enough room to fit in all the cycles. In this case the number of cycles is cut down adequately. The "cut out" irrigation is added to tomorrow's ET figure.
- If you're using a maximum system capacity (see Appendix F, *Using Simple Flow Management* [165] for details) a cycle might be unable to run if the maximum capacity is reached. If the program is ET controlled, the "cut out" irrigation is added to tomorrow's ET figure.
- If you pause a misting program the cycles that should have taken place during the pause are dropped in order to fit the total number of cycles in the program run time window. If the program is ET controlled, the irrigation that is lost on this account is added to tomorrow's ET figure.
- You should ensure that flow limits or reaction delay is set to consider the "on/off" nature of misting programs in order to avoid false alarms. Ideally you should use a separate pipe system without flow sensors for misting programs. Please see Section C.2.3, “Setting Alarm Thresholds” [128] for details on alarm configuration.
- The RKD can handle up to five station starts within ten seconds, so you should avoid starting more than five stations at once, or you will start seeing alarms.

Glossary

Cable	Two wires surrounded by insulation.
Two-wire	Synonym for a cable.
Wire	An individual copper wire.