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Overview of Features

The TW-3 irrigation controller, is the first of several products, closely related.

TW-3: Entry Level Controller:

1 single 2/3 wire path. Decoder type factory configurable:

TW/2W: 1-127 Tonick TW/2W, 'Watermation' decoders

TW/TOR: 1-99 Toro SC3000/Trident, 3 wire decoders

TW/GEM: 1-95 Gemini decoders, which can be mixed with and extended to 127 stations using Tonick TW/2W decoders

Waterproof case

Waterproof external transformer. UL Listed/CE conforming.

Up to 12 starts/program.

History of decoders run, minutes, ins/mm precipitation and any failures

History of stations failed

Precipitation rate definable for each station.

Set station run time by minutes& seconds OR by precipitation.

4 programs. Each will run independently of one another, so up to 4 decoders on at once if run times are concurrent. Best thought of as 4 independent controllers in one box. Run-times, from 1 - 32,767 seconds

Overlapping starts on the same program will stack.

A program entering a 'No Water' window or, at midnight, a 'watering blackout date', will stop. A running program will however continue into a no watering day until finished.

Manual run of decoders in addition to the above programs, so up to 5 decoders on at the same time. However, the Gemini version will suspend any automatic programs whilst operating manually.

Electrical wire path tests. Readout of line current. Rapid testing of decoders one by one.

Seasonal adjust, by month, for each program

Programming station numbers and testing of Tonick TW/2W, 2 wire decoders, using a plug-in test lead with 4 crocodile clips. This feature is not available in the TW/TOR, Toro version.

DTMF decoder built-in, to allow remote control with a hand held transmitter with DTMF keypad. Only needs an off-the-shelf receiver, like a Bearcat Scanner to receive the radio signal. A mobile phone option is also easily and inexpensively implemented.

TW-3: Multi-Path Controller:

Up to 3 other controllers can be cascaded, using RS485 communications, to produce 4 separate decoder wire paths. The other 3 will act as slaves to the master. This option is for the golf market where up to 4 wire paths are needed.

Master will allow up to 255 stations to be spread over the 4 controllers. Maximum decoders per wire path as per the Entry Level.

Other features as per the Entry Level.

SAPIEN: Smart Watering Controller:

Plugging in the UI weather station & setting the Latitude (to the nearest few degrees N or S) will bring the controller into an auto adjust schedule mode. This will override seasonal adjust in the Entry Level controller.

Individual stations may be exempted, such as those under glass.

The Controller is configured as follows:

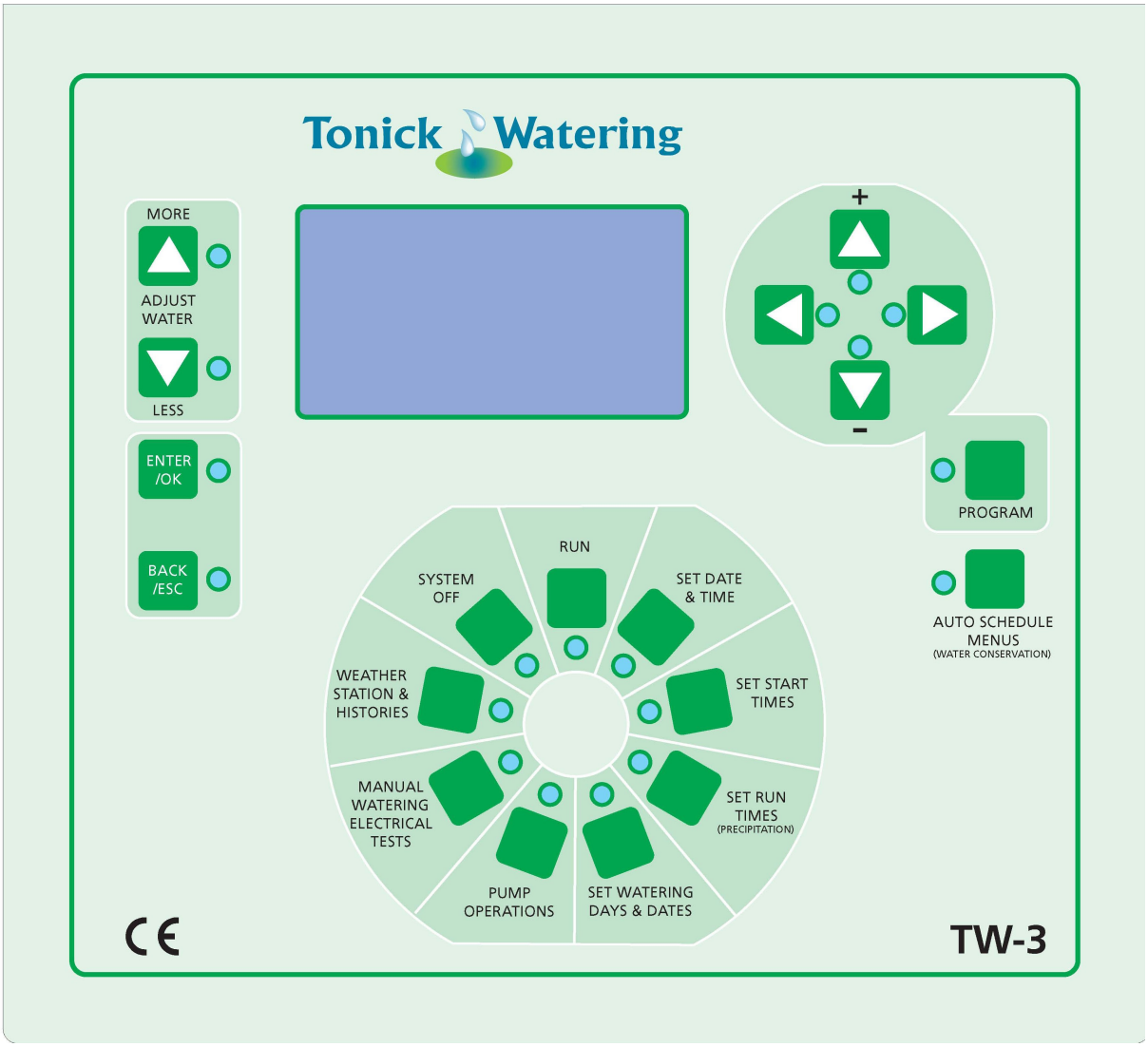
Set the run-time or precipitation for each station to the maximum needed for peak summer daily water loss. Run times needed for each station can be obtained from a free subscription to the UI web calculator.

Enter into the controller the peak summer average daily ET figure. (This can be obtained from a website or tables to be published).

Thereafter, on each watering day, the controller will apply enough water to restore that lost since the last watering. Any usable rainfall will be factored into the equation.

Note: This action is similar to the Hunter Solar Sync and ICC or I-core. No additional data is needed by the controller. However, the Hunter Controllers do not factor in quantitative usable rainfall.

Key Functions



ENTER/OK

- ENTER (lock in the change) a parameter that has been edited
- ENTER a highlighted menu
- COPY the last station's parameter into the current station's parameter
- HOME to the start of a history log

BACK/ESC

- Reject a change made to a parameter
- Return from a sub-menu to the next upper
- Pressing the BACK/ESC without first pressing the ENTER/OK key will reject any changes edited.

LEFT & RIGHT Arrows

- Moves the highlighted to the left or right
- Increments or decrements the station number

UP (+) &DOWN(-) Arrows

- Increases or decreases the highlighted value
- Moves up and down a vertical menu
- In manual single station, turns a station on (+) and off (-)
- In the Run Log and Failed Log, the down arrow drills back to earlier entries, while the up arrow moves back to the more recent.

PROGRAM

- changes the program A-B-C-D-A... etc. to allow editing.

ADJUST WATER (more/less)

Only in SET RUN TIMES, alters the irrigated amount by +/- 1mm (0.04”) for each press.

The run-time is altered to accommodate this. (See Precipitation Rate)

AUTO SCHEDULE MENUS

(Only accessible when in SYSTEM OFF dial position).

Used to alter individual station's parameters.

- Precipitation Rate PR (default 1”/hour)
- Crop coefficient Kc (default 100%)
- Root Depth (default 9”)
- Maximum Usable Rain per Hour (default 1”/hour)
- Wettest Soil Water Level
- Driest Soil Water Level
- See Irrigation Applied over Last 7 Days

(greyed menu entries are reserved for future use)

THE DIAL POSITIONS:

The circular array of keys simulates a mechanical rotary switch. The current switch 'position' is indicated by the corresponding red LED illuminated. Unlike a rotary switch, an alternative position can be selected directly with a push; the buttons do not need to be 'rotated' as with a rotary switch.

The controller will remember the former dial position on power-up.

SYSTEM OFF

Turns the controller to standby.

- All automatic programs are terminated and will not start again if the run position is reselected
- Any manually operated stations are shut off
- The Master Valve (or Pump) is turned off immediately
- The decoder wire path is de-energised immediately
- Radio Remote Control is not guaranteed to operate in this dial position
- Decoder Programmer/Tester available from this menu
- Auto Schedule Menus key active when dial in this position

RUN

Run automatic programs

A display screen, illustrated later, shows:

- The current in milliamperes (mA) taken by the decoder wire path
- The next start, if waiting , for each program A, B , C, D
- The station number running and the time left from its run
- The progress through a program as [stations done]/[total stations]
- Any manually operating stations. Program M
- A FAILURES message if there have been any station failures in a previous automatic or manual program

The failures message may be reset by entering the STATION FAILED LOG history. This is available by pressing the ENTER/OK key from this RUN position, or in the WEATHER STATION & HISTORIES dial position.

SET DATE & TIME

- Edit time in 24 hour format e.g. 1pm is 13:00
- Edit date as dd/mm/yy. However , date is the displayed in American format mm/dd/yyyy. e.g. 20th September 2010 is displayed as 09/20/2010

SET START TIMES

Up to 12 starts per day can be set for each of the 4 programs. Programs start on the ¼ hour, but a manual program can be started at any time. (See MANUAL WATERING). A from-to window can also be set, when automatic (but not manual) watering will cease or be prevented from starting.

- Set Program Starts
- Set 'No Watering' window

SET RUN TIMES or PRECIPITATION

Station run durations can be set to 30 second intervals from zero (station off) to 9 hours 6 minutes 7 seconds. Alternatively, using the More/Less Water keys, the precipitation can be set in 1mm (0.04”) increments, with the runtime adjusted to give this from the station's precipitation rate (PR).

Each of the 4 programs A, B, C, D is assigned a monthly seasonal adjust from 10% to 255%. Watering time and precipitation will be adjusted by this figure. e.g. if this month's adjust is 50%, 10 minutes runtime will be adjusted to 5 minutes, and this time and precipitation logged as 5 minutes in the history file. Default adjust entries are 100% for all months of the year.

- Set Station Run Times
- Set Monthly Seasonal Adjust

SET WATER DAYS & DATES

Allowable days to water can be set to any day of the week (Sunday-Saturday), even days of the month or odd days of the month. If Odd is set, the controller will not water on 31st of the month, nor 29th February in a leap year.

A sub menu allows up to 8 'No Watering' dates to be specified.

- Set Days to Water
- Set 'No Water' Dates

PUMP OPERATIONS

The Master Valve (or pump) can here be turned on or off, irrespective of what else is going on.

Pump (actually water pipe network) priming time can be set from 0-99 minutes. The Master Valve and decoder wire path will be energised for that time prior to the first decoder in the program being operated. Prime Time is not used in Manual operations

Off-On Delay can be set from 0-99 seconds. This is obeyed by all programs to cater for slowly closing valves dropping the water pressure too much and causing a pump low pressure trip. It is also useful when 'following the water around' during testing, allowing the observer time to get to next station before it turns on.

- Master Valve On/off
- Set Pump Priming Time
- Set Off-On Delay

MANUAL WATERING & ELECTRICAL TESTS

From long experience, the most important parameter to monitor is the current taken the the decoder wire path; this is here displayed in mA. UI/Tonick decoders take approximately 3mA each, so providing the Master Valve is turned off (see PUMP OPERATIONS), the current taken with no solenoids active is a good indication of line condition. For example, with 40 decoders on the line, the indicated current with no Master Valve nor solenoids on should be 40 x 3mA=120mA.

- Decoder Power On/Off
- Manual Run One Station
- Manual Run Program (station x through station y for z minutes)
- See log of Stations Failed

WEATHER STATION & HISTORIES

This position is divided into 2 main functions.

1. Set up the Weather station (or alternative 'Click'-type sensor)
   i. 'Click'-type Sensor Bypass or Active
   ii. Set Latitude of Controller
   iii. Set initial Soil Wetness
   iv. Test the Weather Station
   v. Discard any introduced water.
   vi. Set daily peak summer ET loss (mm/day or "/day)
2. Explore Histories
   i. Station Run Log
   ii. Station Failed Log

(greyed menu entries are reserved for future use)

Example Screens & Their Keys

System Off Screen

The **System Off Screen** terminates all automatic and manual programs, turns off the Master Valve and power to the decoders.

In this position pressing the ENTER/OK key will enter the Select Units Menu. The user may then choose either Metric: Degrees Centigrade and mm, or English: Degrees Fahrenheit and Inches

Scrolling down and pressing the ENTER/OK key will enter the decoder programmer tester screen. In this mode, decoders may be programmed with a station (zone) address, prior to installation onto the field wiring

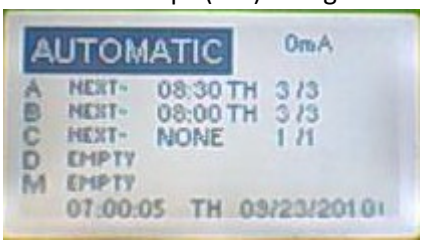
The clock shows the time in 24 hour format, the day of the week, in this example **SU**nday and the date in American format.

Whilst in this and only in this menu position, hence no watering going on, the AUTO SCHEDULE MENUS key is active.

RUN Screens

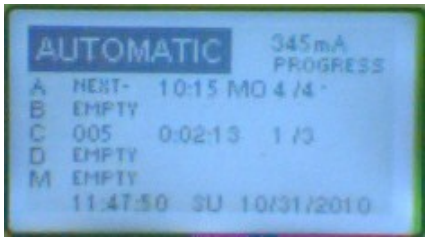
The **Automatic or RUN Screen** shows what is happening or going to happen on each of the four automatic programs A, B, C, D and the Manual Run program M.

To the right of the word AUTOMATIC (or RUN) is the decoder line current in milliamps (mA). Program A is awaiting the next start at 08:30 on Thursday, program B is awaiting a start at 08:00 on Thursday. Program C has no starts set at all, or no watering days enabled. Program D has no run times set for any of its stations. Program M, the Manual run, has nothing in it. Should radio remote control be active, this will then show which station is running.



To the right of the times and days shown is the PROGRESS statistic. In the case of A this figures is 4/4. The first figure is the number of stations run and the second, the total number of stations that have non-zero run times in them. In this example, the four stations all ran during the previous start

In this screen, program C is running station 5, which has 2 minutes 13 seconds left to go. The progress is1/3, showing that one station has run already out of 3,



Whilst No. 5 is running, the decoder line current and Master Valve are collectively taking 345mA. This is the summation of all the standby currents of the decoders, the Master Valve and the solenoid attached to decoder 5.

Other messages instead of "NEXT-"

"PRIME"

An automatic start has begun and the controller is priming the pipes. The Master Valve is on, as is the decoder power, but no stations have started. (See PUMP OPERATIONS)

"------"

The controller has just turned the last station off and is signaling the next to turn on.

"PAUSE"

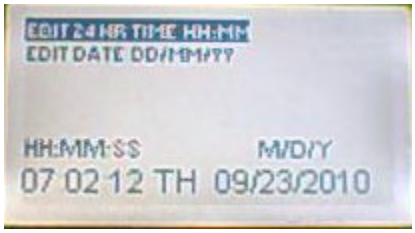
An inter-station (Off-On) delay has been programmed and the controller is waiting for the previous station's valve to shut completely before turning on the next. (See PUMP OPERATIONS)

"RAIN"

The 'Click'-type sensor has been enabled, as opposed to bypassed and is currently asserted (i.e. the switch is open circuit). Watering has been suspended. (See WEATHER STATION & HISTORIES)

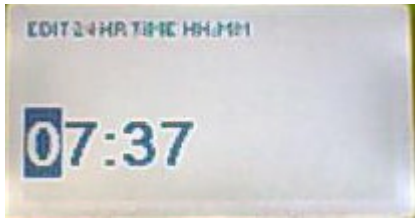
Regime (program) D is independent of the Click-type sensor. Place indoor watering here.

Set Date & Time Screens



This is the menu displayed when pressing the SET DATE & TIME key.

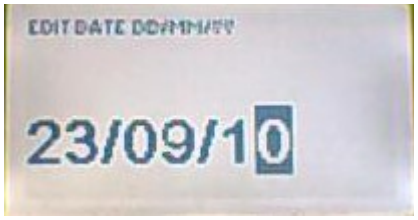
To navigate between the two choices of Edit Time and Edit Date, the Up Arrow (+) and Down Arrow (-) will move the reversing from one choice to another. Pressing ENTER/OK will enter either of the following menus. From those menus, pressing the ENTER/OK to lock in the change, then BACK/ESC key to return to this menu. Pressing the BACK/ESC on its own, will reject the changes made.



This is the menu for **editing the time** in 24 hour format. e.g. 3pm is 15:00. Pressing the LEFT and RIGHT arrow keys will move the reversing from digit to digit. E.g. pressing the RIGHT arrow key, in this example, will move the highlighting from the 0 to the 7.

Pressing the UP arrow key (+) will raise the reversed digit by 1 and the DOWN arrow key (-) will lower it by 1.

Nonsensical times will be prevented, e.g. 37:99

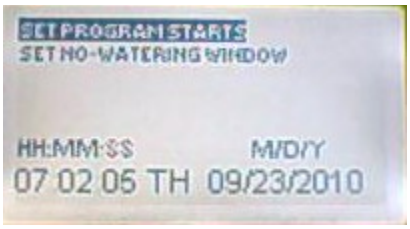


This is the menu for **editing the date**. Note that during editing, the day is the left 2 digits, the month the middle 2 and the last 2 digits of the year are on the right. After editing, the date will be displayed in American format with the month first, followed by the date and the year as a full 4 digits.

The LEFT and RIGHT arrow keys move the highlighting (reversing) from digit to digit, whilst the UP and DOWN arrow keys increase and decrease the highlighted digit by 1. Nonsensical dates are prevented, e.g. 29th February in a non leap year.

Set Start Times Screens

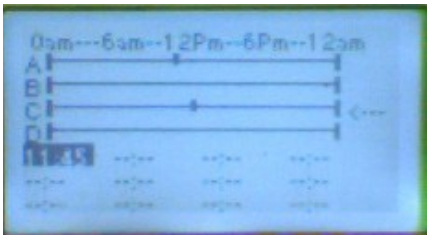
This is the menu displayed when pressing the SET START TIMES key.



To navigate between the two choices of Set Program Starts and Set No Watering Window, the Up Arrow (+) and Down Arrow (-) will move the reversing from one choice to another. Pressing ENTER/OK will enter either of the following menus. From those menus, pressing the Pressing ENTER/OK key to lock in the change, then the BACK/ESC key will return to this menu.

The clock shows the time in 24 hour format, the day of the week, in this example **TH**ursday and the date in American format.

The **Program Starts screen** has 2 parts. The upper part are bar-graphs, whilst the lower has positions for 12 starts.



At the top of the screen is a 12 hour clock, unwound to be in a straight line. On the far left is 0am, then 6am middle 12pm (noon, 12:00), then 6pm (18:00) and finally 12am (midnight, 24:00) on the right.

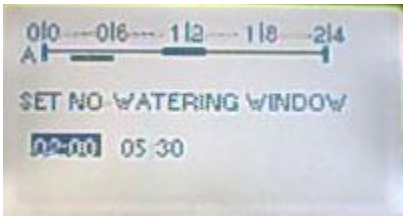
Underneath are 4 bars, one for each program A, B, C and D. The current program for which the starts below belong is shown as a left-pointing arrow <--- to the far right of the bar. **To change programs**, press the PROGRAM key. This will cycle between A-B-C-D-A ...etc.

A thick black line straddling the thin bar is a program. Its approximate total runtime and start time can be determined from the position of the bar relative to the 12 hour clock above. In this example, there is but one start in C at 11:45 (11:45am)

There are positions for 12 starts. Those shown as –:-- are not used. Starts need not be in any particular order. **To activate start**, press & hold down the UP arrow (+) key. The start time will jump from –:-- (off) to 00:00 (midnight), then increment in ¼ hour steps towards 24:00. **To remove a start**, hold down the DOWN arrow (-) key. The start time will decrease in ¼ hour steps to 00:00, then one more press will turn it off showing –:--

As the start time increases or decreases, the program duration bar slides along the thin black line. Starts passing through midnight will show a bar at the right and left ends of the thin black line.

The **No Water Window Screen** allows a period in which no watering may start, or any running automatic programs will terminate. It bis shown as a black bar below the thin one. In this example no watering between 02:00 (2am) and 05:30. As with the starts, these are to the nearest ¼ hour.



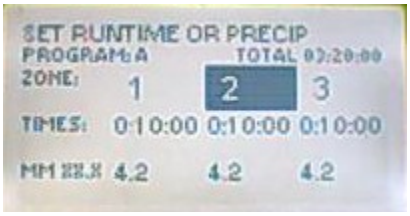
Set Run Times Screens

This is the menu displayed when pressing the SET RUN TIMES key.

To navigate between the two choices of Set Run-times or Precipitation and Set Monthly Seasonal Adjust, the Up Arrow (+) and Down Arrow (-) will move the reversing from one choice to another. Pressing ENTER/OK will enter either of the following menus. From those menus, pressing the Pressing ENTER/OK key to lock in the change, then the BACK/ESC key will return to this menu.

The clock shows the time in 24 hour format, the day of the week, in this example **TH**ursday and the date in American format.

The Set Run-times screen shows the program A, B, C or D.



To change programs, press the PROGRAM key.

The **total program run-time** is shown to the right as TOTAL hh:mm:ss. This includes any off-on delays between stations. (See PUMP OPERATIONS)

The station number to be edited is shown in reverse (highlighted)to the right of the word ZONE:. To increase station numbers use the RIGHT arrow key, to decrease use the LEFT arrow key.

To increase the run-time by 30 seconds press the UP arrow (+) key

To decrease the run-time press the DOWN arrow (-) key

Holding down the key will accelerate the change, so longer run-times will be reached more quickly.

To turn off a station, press the DOWN arrow key (-) until the run-time is zero. This station will not then be included in the current program

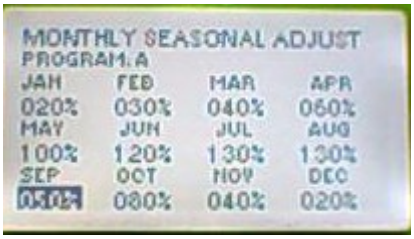
To lock in the changed time press the ENTER/OK key.

To set a precipitation, press the MORE/LESS WATER keys. Each press will increase/decrease the precipitation by 1mm (0.04”). The runtime will be automatically adjusted using the station's precipitation rate. (See AUTO SCHEDULE MENUS)

Unlike the runtime, the precipitation can be decreased below zero to wrap around to the maximum, some 9 hours run-time.

To copy a runtime to the adjacent station, press the ENTER/OK key, then the LEFT or RIGHT arrow key to the next station, then immediately press the ENTER/OK key again. Pressing either the UP or DOWN arrow keys before the ENTER/OK will deactivate this copy.

Set Run Times Screens (cont)



The Monthly Seasonal Adjust screen shows the percentage by which the run-times and precipitations will be adjusted. 100% in that month will result in the programmed run-time being used, 50%, half that time, etc.

There is a seasonal adjust screen for each program.

To change programs, press the PROGRAM key.

Any run-time and precipitation logged will reflect the adjustment made.

To increase the percentage press and hold the UP arrow (+) key. One press for one percent. A key accelerator will apply so that large changes can be made quickly.

To decrease the percentage press and hold the DOWN arrow (+) key. One press for one percent. A key accelerator will apply so that large changes can be made quickly.

The percentage may be altered to between 10% and 250%

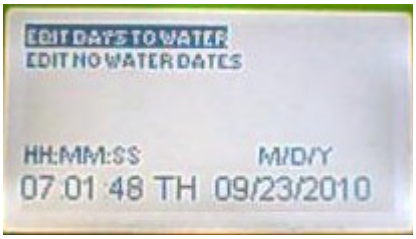
To move from one month to another, press the LEFT or RIGHT arrow keys.

When entering this menu, the current month will be highlighted to allow rapid editing of this month.

Press ENTER/OK before leaving the menu to lock in any changes.

Set Watering Days & Dates

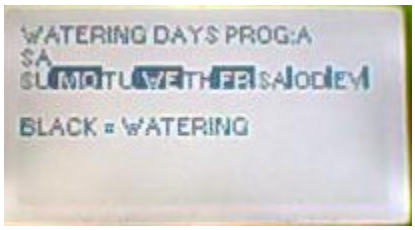
This is the menu displayed when pressing the SET WATERING DAYS & DATES key.



To navigate between the two choices of Set Days to Water and Edit N Water Dates, the Up Arrow (+) and Down Arrow (-) will move the reversing from one choice to another. Pressing ENTER/OK will enter either of the following menus. From those menus, pressing the ENTER/OK key to lock in the change, then the BACK/ESC key will return to this menu.

The clock shows the time in 24 hour format, the day of the week, in this example **TH**ursday and the date in American format.

The Set Days to Water screen shows the program to which it applies to bthe right of PROG:



To change programs, press the PROGRAM key.

Below the title screen is the day to be enabled/disabled, shown in abbreviation:**SU**nday, **MO**nday,**TU**esday, **WE**dnesday, **TH**ursday, **FR**iday, **SA**turday, **OD**d days, **EV**en days.

To select the day to be altered, press the LEFT or RIGHT arrow keys.

To enable the day for watering, press the UP arrow (+) key

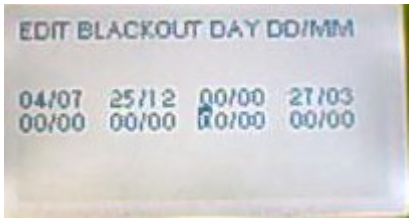
To disable the day for watering, press the DOWN (-) arrow key.

If ODD is selected, it will override any days to water and EVEN

If EVEN is elected, it will override any days to water.

ODD days will not water on 31st of the month, nor 29th February if a leap year.

Up to eight dates may be selected to inhibit watering. Unlike the clock's date menu, nonsensical dates may be entered, which will invalidate the entry. The format is dd/mm. The digit to be edited is highlighted, increased with the UP arrow (+) key and decreased with the DOWN arrow (-) key.



The LEFT arrow key moves one digit to the left and RIGHT, one digit to the right. If at the end of it's travel, it will jump to the adjacent date.

Press the ENTER/OK key to lock in the change, then the BACK/ESC key to leave.

Pump Operations

This is the menu displayed when pressing the PUMP OPERATIONS key.

To navigate between the three choices of Master Valve ON/OFF, and Edit Priming Time and Edit Off-On Delay, the Up Arrow (+) and Down Arrow (-) will move the reversing from one choice to another. Pressing ENTER/OK will enter either of the following menus. From those menus, pressing the ENTER/OK key to lock in the change, then the BACK/ESC key will return to this menu.

To turn on or off the Master Valve select the Master Valve ON/OFF menu, then use the LEFT arrow key to turn it on or the RIGHT arrow key to turn it off.

In the event of a shorted master valve, the fail flag will be highlighted and the Master valve turned off. A failed Master Valve entry will be made in the Log Book.

The Master Valve turns on automatically before a program run (see Prime Time below) and stays on for about one minute after an automatic program finishes, unless manual watering is in progress, in which case it will stay on until the Master Valve On/Off is operated, as above, or the circular key SYSTEM OFF is pressed.

Priming Time: So that pipework can fill with water before stations are operated, a variable delay of 0-99 minutes may be selected. If a non-zero time is selected, the Master Valve and decoder power will be turned on for the number of minutes selected before the first decoder in the automatic program is commanded to turn on. The manual program does not invoke this delay however.

LEFT and RIGHT arrows select the digit to be edited, UP and DOWN arrows increment the selected digit. ENTER/OK will lock in the changes, then BACK/ESC will return to the upper menu.

Inter Station Delay. To avoid a pump low pressure trip caused by slowly closing valves an Off-On delay of 0-99 seconds can be specified. This will be respected by all programs, including manual, even if running concurrently.

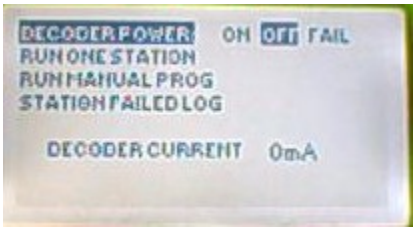
Program total run-time will be adjusted to include this inter-station delay.

LEFT and RIGHT arrows select the digit to be edited, UP and DOWN arrows increment the selected digit. ENTER/OK will lock in the changes, then BACK/ESC will return to the upper menu.

Manual Watering & Electrical Tests

From long experience, the most important parameter to monitor is the current taken the the decoder wire path; this is here displayed in mA. UI/Tonick decoders take approximately 3mA each, so providing the Master Valve is turned off (see PUMP OPERATIONS), the current taken with no solenoids active is a good indication of line condition. For example, with 40 decoders on the line, the indicated current with no Master Valve nor solenoids on should be 40 x 3mA=120mA.

This is the menu displayed when pressing the MANUALWATERING/ELECTRICAL TESTS key.



To navigate between the four choices of Decoder Power ON/OFF, Run One Station, Run Manual Program and view Station Failed Log, the Up Arrow (+) and Down Arrow (-) will move the reversing from one choice to another. Pressing ENTER/OK will enter one of the following menus. From those menus, pressing the BACK/ESC key will return to this menu.

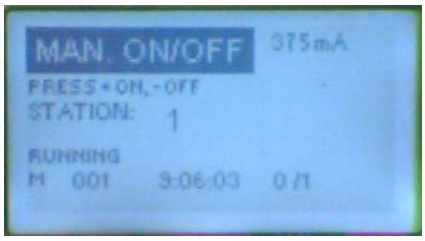
Alternatively, when a manual program or station is running, the RUN key may be pressed to observe the whole picture, which may include automatic programs running in parallel with the manual. This parallel feature is not available in the Gemini version of the controller, TW/GEM. In this case, automatic watering will be suspended during manual watering. It will instead be re-enabled when selecting the RUN dial position.

To stop any automatic watering programs currently running, press the SYSTEM OFF key. This will turn off all decoders, the decoder power and the Master valve.

To turn the decoder power on and off. With the highlighting in the position shown above, the RIGHT arrow key will turn it off and the LEFT arrow key will turn it on. This will not alter the Master Valve. The decoder power current will be displayed to aid diagnosis of any problems.

To change the Master Valve state, press the PUMP OPERATIONS key, then go back to this menu by pressing the MANUAL WATERING.. key

This is the screen to **Run One Station.**



To advance to the station required press the RIGHT or LEFT arrow keys. If the station is currently off, the navigation to the required station may be done more quickly by holding down the arrow key to let the key accelerator speed things up.

To turn the station on press the UP arrow (+) key. The maximum run time of 9 hours 6 minutes 7 seconds is programmed.

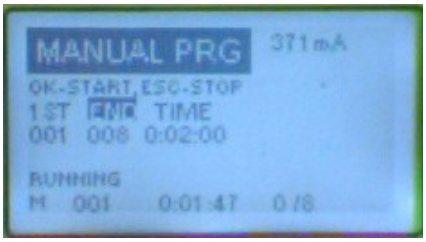
To turn the station off press the DOWN arrow (-) key.

To make the next station turn on and the current one turn off, press the LEFT or RIGHT arrow keys. This will turn off the current station and turn on the next. Some 5-7 seconds will elapse before the next turns on.

Manual Watering & Electrical Tests (cont)

In the example screen above, program M, the manual program, is running station 1 with 9 hours, 6minutes and 3 seconds to go. The decoder power plus Master Valve plus station 1's solenoid collectively take 375mA

This is the screen to **Run a Manual Program**



The starting station is selected by moving the highlighting to '1ST', then using the LEFT and RIGHT arrow keys, then the UP and DOWN arrow keys to select the starting station number. Try and avoid making the starting number greater than the finishing. The software will reverse the order to keep starting less than or equal to finishing.

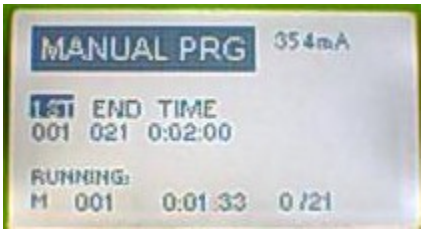
The finishing station is selected by moving the highlighting to 'END', then using the LEFT and RIGHT arrow keys, then the UP and DOWN arrow keys to select the ending station number.

The run-time, common to all stations is adjusted by using the RIGHT arrow key to move the highlighting to 'TIME', then the UP arrow (+) and DOWN arrow (-) to increment and decrement in 10 second intervals. If the shortest on-time is required, set 0:00:00. Decoders will then be operated for about 1-2 seconds with about 3 seconds pause between each.

To start the manual program, press the ENTER/OK key.

To stop the manual program, press the BACK/ESC key

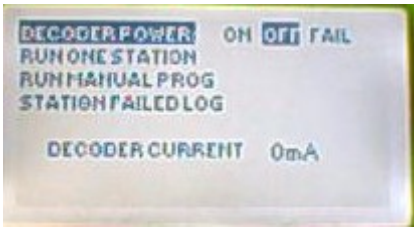
The **decoder power and Master Valve will be left on**, until explicitly turned off. (see SYSTEM OFF)



When the manual program is running, the screen will show RUNNING:, the station number, time to go and the progress.

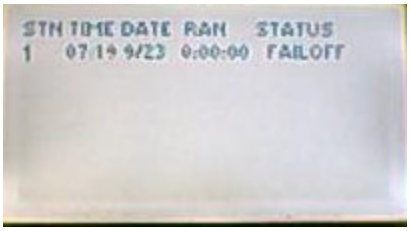
In this example, program M (Manual) is running station 1, with 1 minute 33 seconds left to run. The progress through the manual program is 0 out of 21 stations. i.e. this is the first station to run. After this has finished and when no 2 is running, the progress will show 1/21

At the end of the run, the BACK/ESC key may be pressed to return to the upper menu, when the Station Failed Log my be selected.



Manual Watering & Electrical Tests (cont)

Pressing the ENTER/OK key will go to the log screen below



In the (unfortunate) event of many stations failed, the menu may be scrolled up and down using the UP and DOWN arrow keys.

All failed stations in the past are held in the log including those that have failed in past runs. The observer must check to ensure the date and time of the failure entry matches that of the latest run.

Time is shown as hh:mm and date as mm/dd

RAN: refers to the run-time before the failure was logged, normally zero.

Failures include:

FAIL ON. The station did not respond to an 'on' command

FAIL OFF. The station did not respond to a conventional 'off' command. The software will take all possible measures to turn it off, however, using the emergency off command. The 'ran' time may be logged as zero, even though it could have run for its full programmed time.

FAIL FLOW (*not implemented at present*)

Discover Decoders (TW3/Gemini)

The TW3/GEM will operate both Bailoy/Toro Gemini, 2 wire decoders and Tonick TW/2W orolder TW/WM decoders.

If a decoder is changed from one type to another, use this menu option to get the controller to forget the previous decoder type and learn the new.

Gemini decoders operate in the address range of 1-95. The TW/GEM allows the user to mix these decoders with Tonick TW/2W or TW/WM. These latter operate in the range 1-127. Thus an existing system with up to 95 Gemini decoders may be extended to 127 stations using Tonick decoders.

A mix of up to 4 decoders can be operated at the same time in any combination of Gemini or Tonick. That is, programs A, B, C, D, can be concurrent with any combination of Gemini or Tonick decoders.

The TW3/GEM controller identifies then memorises which decoder is at a particular address during normal watering operations and transparently operates it using the appropriate protocol.

The user must avoid mixing a Tonick and Gemini at the same decoder address, to avoid unpredictable switching results.

Original Watermation MK1 will operate one at a time, but not in combination with any other.

Weather Station & Histories

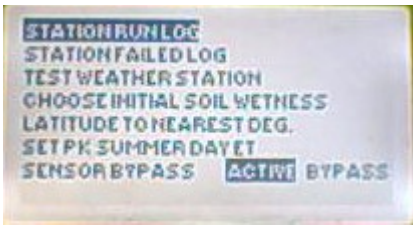
This position is divided into 2 main functions.

Set up the Weather station (or alternative 'Click'-type sensor)
- 'Click'-type Sensor Bypass or Active
- Set Latitude of Controller
- Set initial Soil Wetness
- Test the Weather Station
- Discard any introduced water.
- Set daily peak summer ET loss (mm or "/day)

Explore Histories
- Station Run Log
- Station Failed Log

This is the menu displayed when pressing the WEATHER STATION & HISTORIES key

To select amongst the menu items use the UP arrow and DOWN arrow keys. Enter the selected menu by pressing the ENTER/OK key. Return to this upper menu by pressing the BACK/ESC key.



To make the 'Click'-type sensor active or bypassed,

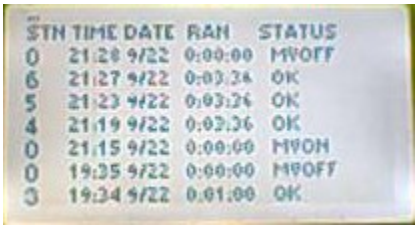
select that menu using the UP or DOWN arrow keys, then use the LEFT arrow key to make it active or the RIGHT arrow key to bypass it.

Program D is independent of the 'Click'-type sensor.

When watering plants or trees that are out of any rain, place the watering program in D. A, B and C will be halted when the click-type sensor inhibits watering, but D will carry on. If there is a fountain or lighting, place this in D if it needs to stay on during the parameter monitored by the click-type sensor

The Station Run Log screen is shown here.

The log database is large, some 1800 entries. When full, oldest entries are overwritten. Navigate up and down 7 entries at a time using the UP and DOWN arrow keys. The ENTER/OK key will home back to the most recent 7 entries.



Time is shown as hh:mm, date as mm/dd, Ran (run-time) as h:mm:ss. Date and time are when it finished,

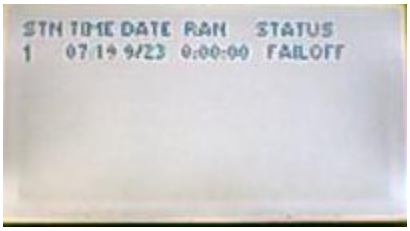
Status:

OK: It ran correctly for the time indicated FAIL ON: The station did not turn on. FAIL OFF: The station did not turn off conventionally. The software took all possible measures to turn it off, however, using the emergency off command.

The Master Valve is here shown as station zero, with the stati MVON, MVOFF and MVFAIL.

Weather Station & Histories (cont)

This is the Station Failed Log screen



In the (unfortunate) event of many stations failed, the menu may be scrolled up and down using the UP and DOWN arrow keys.

All failed stations in the past are held in the log including those that have failed in past runs. The observer must check to ensure the date and time of the failure entry matches that of the latest run.

Time is shown as hh:mm and date as mm/dd

Ran: refers to the run-time before the failure was logged, normally zero.

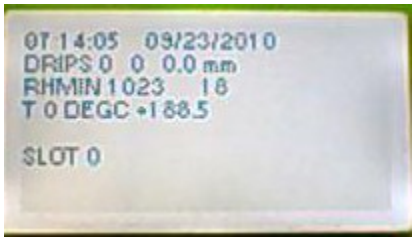
Failures include:

FAIL ON. The station did not respond to an 'on' command

FAIL OFF. The station did not respond to a conventional 'off' command. The software will take all possible measures to turn it off, however, using the emergency off command.

FAIL FLOW (*not implemented at present*)

The Weather station when fitted may be tested in this screen. (*In this example it is not fitted and the software is not enabled, so more on this later!*)

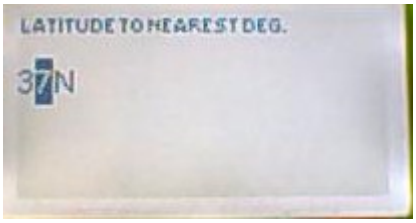


Weather Station & Histories (cont)

Part of the testing of the weather station is to introduce a measured quantity of water into the rain collector to see if the drops are correctly sensed. This is not rainfall, so to prevent the Water Balance being erroneously updated for each station, an opportunity is given to clear out the 'rain'

As part of the water balance calculations, an initial estimate of soil moisture must be made. This screen allows this to be done

To correctly compute the ET, the controller must know its Latitude approximately. Up to about 40 N or S, to the nearest couple of degrees is enough. The latitude can be found from Google Earth, Google Maps or other Internet sources.



Auto Schedule Menus

(Only accessible when in SYSTEM OFF dial position).

The station number may be selected using the LEFT and RIGHT arrow keys.

An edited value may be copied from one station to another by pressing the ENTER/OK key, then using the LEFT and RIGHT arrow keys to select the destination station, then immediately pressing the ENTER/OK key again. If either the UP or DOWN arrow keys are used before the ENTER/OK key, the copy will be disabled.

Precipitation Rate:

This links station run time to ins/mm water applied. See STATION RUN TIMES.

Crop Coefficient (Kc %)

Not used in TW-3. Used in the SAPIEN version

Root Depth

Not used in TW-3. Used in the SAPIEN version

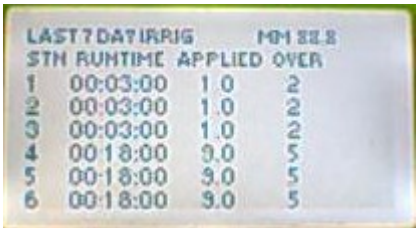
Maximum Usable Rain per Hour

Not used in TW-3. Used in the SAPIEN version

Auto Schedule Menus (Cont)

The irrigation applied over the last 7 days may be examined using this screen.

The starting station for this table will be that selected when this menu is entered. e.g. to start with station 20, select 20 from the AUTO SCHEDULE menu screen using the LEFT/RIGHT arrow keys, the scroll to the LAST 7 DAY IRRIG menu and press the ENTER/OK key.



The total run-time (with the seasonal Adjust factored in) is under RUNTIME in hh:mm:ss

The precipitation applied in mm or inches is displayed under APPLIED.

The number of runs in the last 7 days is displayed under OVER

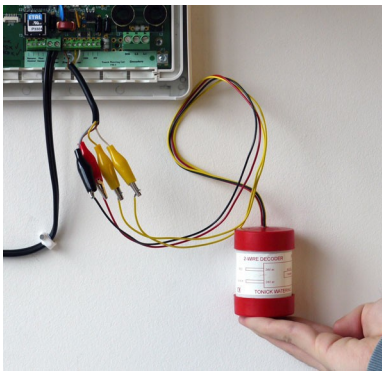
Further stations may be examined using the UP and DOWN arrow keys to scroll 6 at a time. The ENTER/OK key will home back to the starting station.

Programmer Tester for Decoders

This can be reached from the SYSYEM OFF menu screen. This feature is not available in the TW3/TOR, Toro version, and only works with Tonick TW/2W or TW/WM, 2 wire decoders.

Procedure:

1. Open the case by pressing the two tabs at the bottom face of the case and hinge the lid upwards. (Best done with a thumb on each tab and the rest of the fingers on the side of the case.)
2. Plug in the programmer/tester lead
3. Slide the switch near the bottom left of the PCB from 'SEN' to 'PROG'
4. Hang the short cable out through the waterproof cable gland
5. Close the lid.
6. Connect the decoder to be tested or programmed to the crocodile clips, colour to colour
7. Access the decoder programmer/tester screen from the SYSTEM OFF menu.
8. Select TEST or PROGRAM as appropriate
9. IF program, select the station number to be put into the decoder using the LEFT and RIGHT arrow keys



10. To initiate the test or program, press the NEXT/OK key
11. When the procedure is complete, open the case and disconnect the programming cable
12. Slide the switch near the bottom left of the PCB from 'PROG' to 'SEN'
13. Snap shut the lid.
14. To resume automatic watering, press the RUN key.
15. (No watering can be done when the programmer/tester is in operation.)
16. When operating the programmer/tester, select between TEST DECODER and PROGRAM DECODER using the UP (+) and DOWN (-) keys

17. Press the NEXT/OK key to initiate the operation.
18. When testing a faulty decoder, the station numbers will cycle all the way through to the maximum decoder address until the FAIL flag is highlighted. Only then can a new operation be initiated.
19. A programmed decoder will be automatically tested to respond to that address before the pass/fail is indicated.

Remote Control.

General Description

The TW-3 may be remotely operated by injecting a sequence of audio tones into the terminals marked "Remote Control". The signal is isolated from controller ground by an audio signal transformer.

These tones are the same as produced by a touch-tone phone or mobile (cellphone) when dialling and are called DTMF (Dual Tone Multi-Frequency).

The DTMF sequences may be generated in several ways:

- A licensed portable mobile radio transceiver equipped with a keyboard and DTMF dialling capability.
- The Underhill DTMF microphone, plugged into a portable mobile radio transceiver that does not have its own DTMF capability. This may be a low cost, licence-free USA Family Radio System (FRS) transceiver, such as the Motorola Talkabout, or EU licence-free mobile 446MHz.
- A mobile phone (cellphone), with the stored number of the receiving cellphone.
-

In all cases, there must be a receiver next to the controller with the audio taken out through the accessory socket and connected to the controller's remote control terminals. This receiver is advantageously kept on charge to always be ready.

The following types of receiver can be chosen as appropriate to the sending device.

- A standard scanner receiver, pre-programmed to only pick up the frequency of interest.
- The other half of a low cost licence-free transceiver pair, permanently in its charging cradle.
- A mobile phone (cellphone) programmed to auto answer a particular number or numbers. A socket in it for the headset and a separate socket for the charger.

Contact Tonick for the availability of suitable audio cables.

It should be noted, that except for the DTMF microphone, the raw tone strings must be composed using the DTMF keys. These are described in the following section.

The Underhill DTMF Microphone automates these key sequences, when plugged into a transceiver with no DTMF buttons. A simple 5 button cluster and an 8 character alphanumeric LCD makes remote control a simple process.

Key Sequences:

The following functions may be performed under remote control. These correspond to those available under 'Manual Watering' from the TW-3 key board (see Manual Watering and Electrical Tests)

- **Manual water one station.** Turns the station on for just over 9 hours to allow manual operations on the valve/sprinkler assembly at the operator's leisure. The Master valve is turned on immediately
- **Turn the station off.** Note, this leaves both the 2 wire decoder path energised and the Master Valve on.
- **Run a manual program**. Enter starting station, finishing station and number of minutes for each. A zero time in minutes will run each station for about 1 second, with a 3-5 second pause between each. This is useful as a zone test.
- **Abort**. This turns off any station running manually or kills a manual program. If an automatic program is running, this will continue as normal (or resume, in the case of the TW/GEM). If there are no automatic programs running, the 2 wire path will be de-energised and the Master Valve will be turned off. This will also happen after any automatic programs have finished, as long as the Abort has been previously issued. In the case of the Gemini version TW3/GEM, automatic watering will resume after reception of this command.

Manual turn on one station:

* A nnn *

Where:

- * is start of message
- A is the on off/command
- nnn are 3 digits of station number from 001 to 127. These must always be 3 digits
- * is turn **ON**

For those DTMF keypads that do not have the letter A, the tone sequence can be composed by using the number 6 instead of A.

Thus,

*6 nnn * will work the same as * A nnn *

Manual turn off one station:

* A nnn # or * 6 nnn #

Where:

- * is start of message
- A is the on off/command; can be substituted for the number 6
- nnn are 3 digits of station number from 001 to 127. These must always be 3 digits
- # is turn **OFF**

Manual Start Program:

* B nnn * or * 7 nnn *	Set minutes to nnn 000-545
* C nnn * or * 8 nnn *	Set starting station to nnn 001-127
* D nnn * or * 9 nnn *	Set finishing station to nnn 001-127
* A 000 * or * 6 nnn *	Start the program. nnn must = 000

Manual Stop the Program:

* A 000 # or * 6 000 #

Where:

- 000 refers to the program rather than a station 001-127
- # is stop

This command leaves the 2 wire path and the Master Valve energised

Abort:

# # #

Where 3 or more #'s will abort whatever manual is under way, single station or program. If automatic programs are running concurrently, these will continue as normal, (or resume, in the case of the TW/GEM). If there are no automatic programs running, the 2 wire path will be de-energised and the Master Valve will be turned off. This will also happen after any automatic programs have finished, as long as the Abort has been previously issued.

It is a good idea to start any new operations with three or more #'s to clean out any previous half-entered commands.

Watering Algorithm Explained.

Explanatory Notes:

A Regime, is the internal technical name for a watering program.

The STATS ram array keeps a running total of how many stations are active (ARMED#) in the regime and how many are left to do (TODO#) when the regime is running. When TODO# goes to zero, the watering program has finished. If ARMED# is zero, there are no watering times set in a regime, it's blank.

There are 12 possible starts on any day, internally numbered 0 - 11. If a start has started a regime, its number is held in START# in the STATS array. This way, the software knows who is in control of a watering program at any time.

Each start time, internally keeps its finish time computed, so there is a kind of window between start & end. This window only begins on a 1/4 hour and is defined as a number of 1/4 hours, always 1 longer that the actual run time of all the stations combined.

The Start Watering Algorithm:
For each AUTO regime (program) A, B, C, D:

STARTER task runs through the day's list of starts to see if time NOW falls within a start/end window, but outside the 'No Water' window and not on one of the 8blackout dates.

If within a start/end window and if not already running, the regime is activated and its start number is placed in START# in the STATS array. Once this is done, this process will not be repeated by this start (to account for priming time delays before the first decoder is run). Only after TODO# goes to zero, will the next start be able to take control.

Partly overlapping starts will thus stack unless the 2nd starts & finishes at exactly the same times, then it will probably not run.

Regime (program) D is independent of the click-type sensor. If one is fitted and active, place any indoor watering in regime D. When the click-type sensor signals 'stop watering', A, B and C will stop, but D will carry on.

The detailed algorithm is probably best explained by a decision table:
The starter routine enters this table with its own start number to hand.

STATE	ARMED#	TODO#	START#	ACTION
Blank	0	0	Don't care	Nothing - empty regime
Running	>0	>0	My start no.	Nothing, I've already started it
Running	>0	>0	Different	Nothing, another start is running
Ended	>0	0	My start no.	Nothing, I've just run it
Ended	>0	0	Different	Start a new start. START
Running	>0	>0	Not in any start window	A stopped regime has overrun. ABORT

This last entry needs some discussion.
TRYWATERING? will stop a regime if it runs into the 'No Water' window, or after midnight, a blackout date. (However it will continue the running regime into a no water day if it is due to finish after midnight).

If, after this stop period is finished, starts are allowed again, a decision must be made to continue the regime or abort it.

The criteria chosen are:
If in the same start window, continue.
If not in any start window, abort the regime.
If in a different start window, wait for the existing regime to finish.

Clearly, if say start #3 begins near the end of the (watering) day but runs into a blackout day, and start #1 is the earliest on any watering day, then on the next watering day, start #1 will wait for the original start #3 to finish.

If a start begins near the end of a watering day and the next day is not one of the 8 blackout dates, it will continue the running regime into a no water day. This is to cater for commercial (parks) or golf courses, that water overnight.

Multiple Concurrent Regimes:

All 4 regimes, A, B, C, D will run concurrently and each has its own 12 starts (and waterdays). Any station number can be included in each without restriction (unlike the ICC). Thus, if for example, regime A has stations 1 -10 set for 5 minutes and regime B has the same 10 stations set to 5 minutes. Then if start #1 on regime A is 10:00 and start #1 on regime B is 10:15 on the same waterday, the following will happen.

Time:	A	B
10:00	1	
10:05	2	
10:10	3	
10:15	4	1
10:20	5	2
10:25	6	3
10:30	7	4

etc.
so you can see, all 10 decoders get run twice, for 5 minutes each run.

If perversely, the user sets up, regime A decoders 1-3 at 10 minutes and regime B decoders 1-3 at 20 minutes, then sets the same start time at 10:00, the following will happen.

Time:	A	B
10:00	1	1
10:10	2	1
10:20	3	2
10:30		2
10:40		3
10:50		3
11:00	all off	

That means decoder 1 will only run for 20 minutes, not 10 + 20 minutes. Its a bit like a concurrent set of life prison sentences, not a serial set of life sentences. If the user staggered the start times, this would not happen.

Failed Stations:

Previously failed stations will be re-run on each new start. This is a departure from the existing controllers Tonick has designed, when failed stations would not be included in successive watering instances until someone told the controller they were 'fixed'. The advantage of re-running is that a transient failure will not affect watering over the medium term. The disadvantage is it will fill up the history log with the same old problems again and again. In the light of experience, this is the lesser of two evils.

The TW-3 will skip over stations that fail and move onto the next immediately. This has a knock-on effect on concurrent stations running together with flow control in mind. Consider the following scenario.

Time:	A	B
10:00	1	30 (1 is small flow, 30 is big)
10:15	2	31 (2 is a big flow, 31 is small)
10:30	3	32 (3 is small flow, 32 is big)

However , 31 fails, so the running order now becomes

Time:	A	B
10:00	1	30 (1 is small flow, 30 is big)
10:15	2	32 (both 2 & 32 are big, pump drops out on low pressure trip!)
10:30	3	33

HOWEVER...most stations don't fail most of the time. AND very few people use flow control with concurrent stations that alternate between small/large/small/large on *successive* stations. The far more usual scenario is running a group of small flow with large. For example.

1, 2, 3, 4 all large flow
30, 31, 32, 33 all small flow.

In this case the customer could set up

Time:	A	B
10:00	1	30
10:15	2	31
10:30	3	32
10:45	4	33

etc.

Then, in this example, 31 fails, he would get;

Time:	A	B

10:00 1 30
10:15 2 32
10:30 3 33
10:45 4 34
etc.
All are paired A high flow, B low flow, so no low pressure trip!

Mixing Gemini and Tonick Decoders:

Gemini decoders operate in the address range of 1-95. The TW/GEM allows the user to mix these decoders with Tonick TW/2W or TW/WM. These latter operate in the range 1-127. Thus an existing system with up to 95 Gemini decoders may be extended to 127 stations using Tonick decoders.

A mix of up to 4 decoders can be operated at the same time in any combination of Gemini or Tonick. That is, programs A, B, C, D, can be concurrent with any combination of Gemini or Tonick decoders.

The TW3/GEM controller identifies which decoder is at a particular address and transparently operates it using the appropriate protocol.

The user must avoid mixing a Tonick and Gemini at the same decoder address, to avoid unpredictable switching results.

The protocol used by the Gemini decoder means that all decoders in a group switch on at the same time. As it would not be reliable to decide which, if any, had not switched, the TW3/GEM briefly operates the group one at a time to determine operability and to flag pass/fail, just before reactivating them as a group for the the programmed run time. The user may thus notice a short pulse of water during this testing phase if the valves are quick acting.

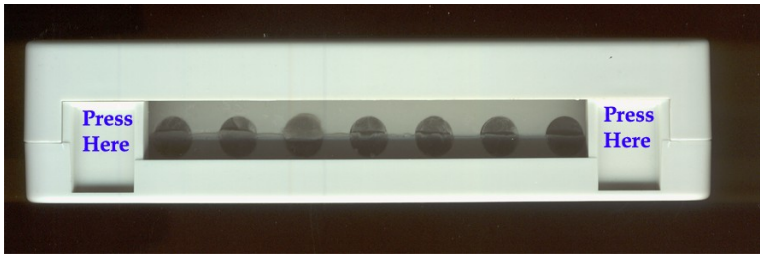
Should a decoder be used for operating lights or a fountain, the output of the decoder must feed a time delay relay to skip over the brief off periods when decoder combinations are changing. A 30 second timed-off would be a conservative figure to use.

The built-in decoder programmer/tester only tests or programs TW/2W or TW/WM decoders. Attempting to use Gemini decoders will not harm the controller's tester, but will flag as a fail.

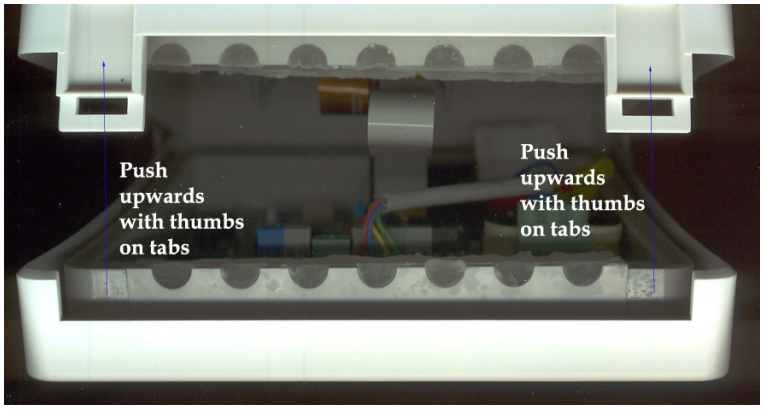
Installation Instructions:

Opening the Case:

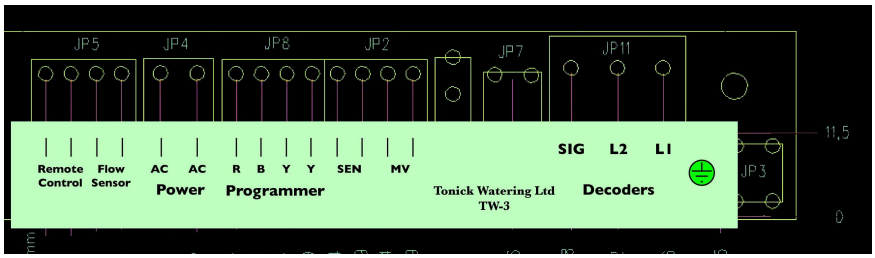
Press in the two tabs on the bottom of each side of the case using thumbs.



With the tabs pressed, swing up the top case.



Connections:



2 Wire (Watermation) decoders/Gemini decoders:

Decoder red wires to L1, decoder black wires to L2. No connection to 'SIG'.

3 Wire (Toro SC3000/Trident) decoders:

Decoder red wires to L1, decoder black wires to L2, decoder green wires to SIG.

Lightning Protection Earth:

Use 4mm^2 or greater green/yellow insulated wire and a ring or fork crimp onto JP3, just to the right of L1, marked with the earth symbol. The screw is an M3 x 6mm.

The earthing wire is to to be terminated on an earth stake or plate, separate from the building earth.

Master Valve or Pump Start:

The MV pair supplies 25VAC, maximum current 0.5A (500mA).

On no account must an external source of power be connected to the MV pair; if volt-free contacts are required an external relay MUST be fitted.

Programmer:

When the decoder programmer/tester is not in use, the slide switch near the bottom left of the PCB must be in the 'SEN' position. Failure to do this will disable the 'click'-type sensor, but will not harm the controller

When using the plug in programmer/tester cable, connect the appropriate colour crocodile clip onto the same colour wire of the Tonick TW/2W or TW/WM decoder to program/test.

The programmer/tester is not available in the TW3/TOR, Toro version.

'Click'-type Sensor (SEN):

Connect a normally closed, rain, wind, freeze sensor to the SEN pair. When watering is permitted, the sensor contacts must be closed, opened to inhibit watering on programs A, B, C. Program D is not affected by the SEN; used for watering under glass or indoors.

Energisation is provided by an internal 24VAC source. On no account must an external source of power be connected to the SEN pair.

Controller Power AC/AC:

Use the supplied transformer. This is sized to provide coordination of protection against shorts circuits on the decoder 2/3 wire path,

Use of other transformers will void the warranty and may damage the controller or decoders under certain circumstances.

Connect the output of the transformer into the AC/AC inputs. Polarity is unimportant.

The transformer is waterproof to IP54/NEMA 4X

Flow Sensor:

This is reserved for future use. Will connect to a volt-free contact-type flow sensor

Remote Control:

Audio input from the headphone output of a radio receiver. 600 Ohm input impedance transformer isolated from controller.

For further details see the Radio Remote Control Installation Manual.

Specifications:

Operating Specifications

• Station Run Time: 30 seconds to just over 9 hours (in 30 second increments) on programs A, B, C, D. PRECIPITATION can be set in 1mm (0.04”) increments

• Start Times: 12 per day, per program (A, B, C, D), for up to 48 daily starts.

• Watering Schedule: 7-day calendar, or true odd or even day programming, made possible by the 365-day clock/calendar.

Electrical Specifications

- External Transformer Input: 120 VAC, 60Hz (230 VAC, 50/60 Hz International Use)
- External Transformer Output: 26 VAC, 1.3 amp
- Station Output: 25 VAC, 0.60 amps per station
- Maximum Output: 25VAC, 1.2 amps (includes Master Valve Circuit)
- Battery Backup: Lithium coin cell battery used only for time keeping during power outages, the nonvolatile memory in the personality module maintains program information and history/fail logs.
- DTMF Remote Control Input: 10-30mW into 600 Ohms. Tone duration >60mS, Inter-tone gap >45mS

Dimensions

Plastic Cabinet,

- Waterproof IP54, NEMA 4, (when lid is closed and cables correctly trapped in the gel cable clamps).
- Height: 6.3" (16 cm)
- Width: 7.33" (18.6 cm)
- Depth: 1.78" (4.5 cm)

External Transformer.

- Waterproof to IP54/ NEMA 4X
- Height: 3.6" (9 cm)
- Width: 2.2" (5,5 cm)
- Depth: 2.75" (7 cm)

Default Settings

- Program A set to one start at 10am (10:00). Stations 1-21 run for 10 minutes. Watering days Monday, Wednesday, Friday.
- All other stations are set to zero run time, no other starts in B, C, D.
- This controller has a non-volatile memory that retains all entered program data even during power outages, without need for a battery.

FCC Notice

This controller generates radio frequency energy and may cause interference to radio and television reception. It has been type tested

and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of

FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Move the controller away from the receiver.
- Plug the controller into a different outlet so that controller and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

“How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the U.S. Government Printing Office, Washington, D.C., Stock No. 004-000-00345-4 (price – $2.00 postpaid).

Certificate of Conformity to European Directives

We certify that the TW-3 controller and External Transformer conform to the

European EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC.

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