

# SMART Irrigation Controllers

Utilizing Weather-based irrigation  
controllers to conserve water

# Categorization

- Signal-based
- Stand-alone
- Add-on ET
- Historical-Based

# Categorization

- Signal-based - “Signal based controllers receive a signal, such as radio, pager, cellular, or internet to obtain  $ET_0$  values. Some manufacturers calculate daily  $ET_0$  and transfer it to the controllers, while others transmit the weather data to the controller, which then calculates the  $ET_0$ .” (Al-Ajlouni, 2011).
- Stand-alone – “Stand-alone controllers utilize on-site weather stations that collect weather parameters and send it to the controller, which then calculates  $ET_0$  and the irrigation run-time” (Riley, 2005; Moore, 2007).
- Historical-based – “Historical-based irrigation controllers use pre-programmed historical  $ET_0$  of the climatic region to schedule irrigation.” (Al-Ajlouni, 2011)
- Add-on ET – “Add-on ET controllers are devices attached to a conventional time-based controller that is unable to calculate irrigation runtime. Add-on ET devices either bypass or allow time-based controllers to irrigate based on site-specific conditions” (Dukes et al., 2009).

# Selected controllers

#	Controller	Selected	Not selected and why	Average of Irrigation Adequacy *	Average of Irrigation Excess *
1	<a href="#">Alex-Tronix Enercon Plus</a>		High water irrigation excess	100%	1.00%
2	<a href="#">Alex-Tronix Smart Clock</a>		It is not ET controller	100%	0.20%
3	<a href="#">Aqua Conserve Aqua ET-6</a>	Selected		100%	0.20%
5	<a href="#">Calsense ET2000e</a>		Commercial	100%	0.00%
6	<a href="#">Cyber-Rain XCI</a>		High water irrigation excess	100%	11.60%
7	<a href="#">ETwater Smart Controller</a>		High water irrigation excess	100%	1.50%
8	<a href="#">Hunter ET System</a>	Selected		100%	0.50%
9	<a href="#">Hunter Solar Sync</a>		High water irrigation excess	100%	7.55%
10	<a href="#">Hydrosaver ETIC</a>		High water irrigation excess and the irrigation adequacy is not 100 %	98.9%	1.50%
11	<a href="#">Irritrol Smart Dial</a>	Selected		100%	0.00%
12	<a href="#">Rain Bird ET Manager</a>	Selected		100%	0.00%
13	<a href="#">Rain Master RME Eagle</a>		Commercial	100%	0.00%
14	<a href="#">SMG Superior Controls Sterling 8</a>		The irrigation adequacy is not 100 %	92.9%	0.00%
15	<a href="#">Toro Intelli-Sense</a>		The company does not want to participate	100%	0.00%
16	<a href="#">WeathermaticSL1600</a>	Selected		100%	0.40%
17	<a href="#">WeatherTRAK</a>		The company does not want to participate	100%	0.00%

\*(Irrigation Association, 2007).

# The six irrigation controllers:

RainBird ET manager



\$128

\$676

WeatherMatic SL1600



\$ 230

Irritrol smart dial



\$ 285

Hunter Pro C (control)



\$ 89

Aqua Conserve ET-6



\$ 216

ET Hunter system

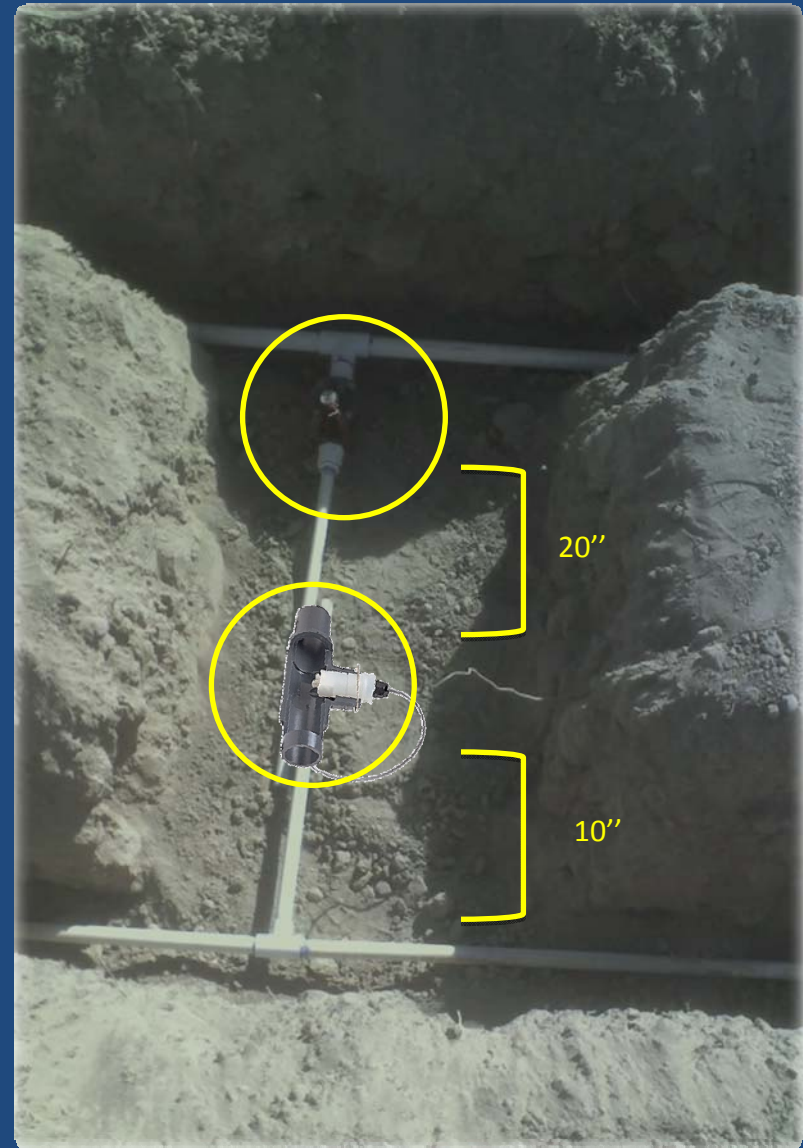


\$ 89

\$ 620

# Installing the irrigation system

(May 2008)



Hunter ICV valve 1"

SeaMetrics IP80 flow sensor 1/2"

# Electrical and electronic setup



March to May, 2009

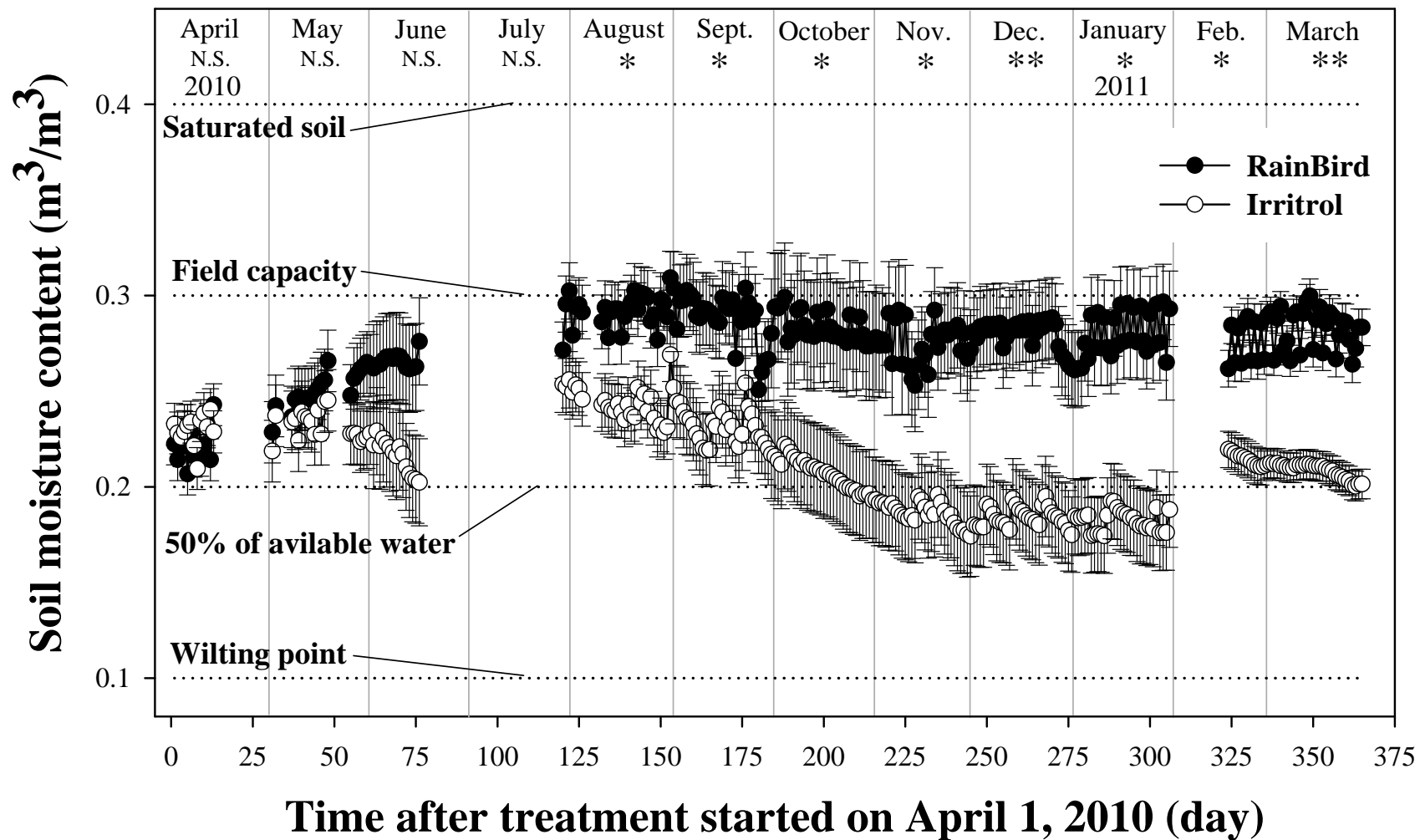
# Results

Treatment	Gallons/ plot	Gallons/ft <sup>2</sup>	Event #	Irrigation frequency	Gallons/ event/ plot	Water saving (%)
Irritrol	157 <sup>a</sup>	1.09	3	16	52	-175 (-53)
Rain Bird	220 <sup>b</sup>	1.53	6	8	37	-112 (-34)
WeatherMatic	322 <sup>c</sup>	2.24	7	7	46	-10 (-3)
Hunter 80% (Control)	332 <sup>c</sup>	2.31	7	7	47	0
Hunter ET	627 <sup>d</sup>	4.35	11	4	57	295 (189)
Aqua Conserve	861 <sup>e</sup>	5.98	40	1	22	529 (259)

Mean separation within column according to Fisher's LSD test ( $P \leq 0.05$ )



# Volumetric soil moisture content



N.S., \*, \*\* Non-significant, or significant at  $P \leq 0.05$ ,  $P \leq 0.001$ .

# Irritrol Smart Dial

In this workshop, the programming features of the Irritrol Smart Dial, a signal-based irrigation-controller, will be highlighted, due to its high performance on a residential level.

(Al-Ajlouni, 2011)

# Setup Procedure

## *Turn Function Dial to “Set-up.”*

(Use the **Upper Line Dial** to move between settings. Use the **Lower Line Dial** to change those settings.)

- SET CLOCK (YEAR) – use the Lower Line Dial to set the correct year.
- SET CLOCK (MONTH) – use the Lower Line Dial to set the correct month.
- SET CLOCK (DAY) – use the Lower Line Dial to set the correct day.
- SET CLOCK (HOUR) – “” to set the correct hour.
- SET CLOCK (MINUTE) – “” to set the correct minute.
- SET TIME ZONE – choose your time zone.

# Setup Procedure

- **AUTO DAYLIGHT SAVINGS?** – choose whether or not you would like the Smart Dial to automatically adjust its clock for Daylight Savings by selecting “Yes” or “No”.
- **SET ACTIVE STATIONS** – choose how many stations you wish to have active within your irrigation system.
- **SET MASTER VALVE** – choose whether or not you wish to have the Smart Dial control the Master Valve of your irrigation system.
- **STACKING**- “When the Stacking option is enabled, the controller is constrained to run **one automatic watering schedule (A or B) at a time**. Overlapping station cycle starts are prioritized as follows: Schedule “A” stations followed by schedule “B” stations; number sequence from low to high. When the Stacking option is not enabled, one station in schedule A and one station in schedule B can operate concurrently.” (Smart Dial User Guide).

# Setup Procedure

- **SET WATER DISTRICT** – “If the Smart Dial user is a participant in a water agency program, a water district code number will be provided during the ET Everywhere service activation procedure.
  - Turn the Upper Line dial to select **Set Water Dist. # Digit 1**.
  - A cursor indicates the adjustable digit of the five-digit number. Turn the Upper Line dial as necessary to move the cursor.
  - Turn the Lower Line dial to adjust the underlined digit.
  - Repeat these steps to enter the assigned number.
  - Example: Water district code number set to 11234.” (Smart Dial User Guide).
- **SET ET ZONE #** - “If required, an ET Zone number will be provided during the ET Everywhere service activation process.
  - Turn the Upper Line dial to select **Set ET Zone # Digit 1**.
  - A cursor indicates the adjustable digit of a five-digit value. Turn the dial as necessary to move the cursor.
  - Turn the Lower Line dial to adjust the underlined digit.
  - Repeat these steps to enter the number. (Smart Dial User Guide).

# Setup Procedure

- **MAX Backup ET** – “If the Smart Dial fails to receive the ET Everywhere service data, the last broadcast ET data received will be used to calculate the watering cycles. The controller will continue operating in this mode up to four consecutive days, after which the Maximum Backup ET value will be used in the daily watering calculation. A lost communications alert condition will be displayed.  
The Backup ET value entered can range from 0.00 to 9.99 and should represent the highest Weekly ET value expected for the year. This data will be automatically adjusted to coincide with the current seasonal ET reference data.  
**Note:** For location-specific ET information, contact a local Farm Advisory Service for assistance.
  - Turn the Upper Line dial to select **Set Max Backup ET Digit 1**.
  - A cursor indicates the adjustable digit of the three-digit value.
  - Turn the dial as necessary to move the cursor.
  - Turn the Lower Line dial to adjust the underlined digit.
  - Repeat these steps to enter the maximum Backup ET value.” (Smart Dial User Guide).
- **SET ZIP CODE** – Enter the zip code corresponding to the location of the Smart Dial.

# Setup Procedure

## Turn Function Dial to “Schedule”

- **SET SCHEDULE** – The Smart Dial allows you to create multiple schedules (Schedule A,B,C, U...etc.) that can be selected and applied to stations. Use the **Lower Line Dial** to choose which schedule you would like to program.
- **SET IRR START HOUR/MIN** – Choose the start time for your watering window.
- **SET WINDOW HOUR/MIN** – Choose how long you wish the watering window to be open.
- **SET HiET START** – Select the start time when Evapo-transpiration is highest.  
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- **SELECT WATER DAYS** – Manually choose acceptable days to water, or select “Set by WeatherTRAK (Dflt)” to allow the Smart Dial to automatically create a watering schedule.
- **NON-WATER DAY (if Fully Automatic Mode chosen)** – Choose any days you do not wish to have the Smart Dial initiating irrigation cycles.

# Setup Procedure

## Turn Function Dial to “Program”

- **SET STA TO PROGRAM** – Each station controlled by the Smart Dial can be programmed with site-specific parameters. Choose which station you wish to program.
- **SET PROGRAM MODE** – Choose “Fully Automated” to take advantage of automatic irrigation scheduling according to weather conditions.
- **SET SCHEDULE** – Select the schedule that you want the station to operate according to.
- **USE WATER WINDOW** – Choose whether you want the station to observe the water window you specified during the “Schedule” programming, (i.e. 23:59 hours).
- **SET SPRINKLER TYPE** – Specify the type of sprinklers installed within the station.
- **PRECIP** – Specify the precipitation rate of the particular sprinkler head.
- **SPKLR EFFICIENCY** – Specify the sprinkler efficiency of the station.
- **SET SOIL TYPE** – Specify the soil type of the station, (i.e. Clay, Sandy, Loam, etc.).
- **SET PLANT TYPE** – Specify the plant type located at the station, (i.e. Turf, Flowers, Trees, etc.)
- **SET ROOT DEPTH** – Specify the root depth of the plants at the station.
- **SET MICROCLIMATE** – Specify the climate local to the station, (i.e. Sunny, Shady, etc.)
- **SET SLOPE FACTOR** – Specify the slope of the plot where the station is located.
- **USABLE RAINFALL** – Specify the amount of usable rainfall received at the location.



# Setup Procedure

The following is a table of station-specific parameters used during research of the the Irritrol Smart Dial irrigation controller.

<b>Input parameter</b>	<b>RainBird ET Manager and ESP controller</b>	<b>Weathermatic SL1600</b>	<b>Irritrol Smart Dial</b>	<b>Control (80% of ET<sub>o</sub>)</b>	<b>Aqua Conserve ET-6</b>	<b>Hunter ET System</b>
ET source	Signal-based	On-site sensor	<b>Signal-based</b>	Manual entered	On-site sensor	On-site sensor
Stand-alone or add on	Add on	Stand-alone	<b>Stand-alone</b>	Stand-alone	Stand-alone	Add on
Program mode	Automatic	Automatic	<b>Automatic</b>	Manual	Automatic	Automatic
Zip code or region	NA	88003	<b>88003</b>	NA	27	NA
Seasonal adjustment	100%	100%	<b>100%</b>	80%	100%	100%
Irrigation cycles/ soak time	NA	Automatic	<b>Automatic</b>	Manual, 3 cycles	Manual	Automatic
Runtime, rep. 1-3	20 min	20 min	<b>Automatic</b>	7, 7, and 10 min	30 min	20 min
Days of irrigation	All days	All days	<b>Set by WeatherTRAK</b>	Wednesday	All days	All days
Start time (HRS)	0400	0500	<b>0100</b>	0300, 1500, and 2300	0000	0200
Plant type	NA	Cool season grass	<b>Cool season grass</b>	Cool season grass	NA	Tall fescue grass
Soil	Clay	Clay	<b>Clay</b>	Clay	NA	Clay
Slope	NA	1-5°	<b>No slope set (zero)</b>	NA	NA	Zero
Sprinklertype	NA	Custom	<b>Stream spray</b>	NA	NA	Custom
Sprinkler efficiency rep. 1 to 3	NA	NA	<b>58%, 74%, and 67%</b>	51%, 73%, and 71%	NA	NA
Precipitation rate rep. 1 to 3 in/hr	NA	0.9, 0.9, and 1.0	<b>0.97, 0.85, and 0.86</b>	NA	NA	0.89, 0.89, and 0.91
Rain shutoff threshold	Enabled	Enabled	<b>Enabled</b>	NA	Enabled	0.02 in
Usable rainfall	0.25 in	Enabled	<b>25%</b>	NA	Enabled	Enabled
Root depth	6 in	NA	<b>6 in</b>	NA	NA	NA
Microclimate	Full Sun	Full Sun	<b>Full Sun</b>	NA	NA	Full Sun