Sapien™ 2Wire Controller
Bidding Specifications

Model Specifications
The Underhill Sapien™ 2Wire irrigation controller model no. TW3-115 shall be capable of managing up to 63 stations using Underhill single station, field programmable decoders part number TW-TK-DEC-1. The Sapien comes standard with a sealed, external transformer (p/n TW-75VA-115V or TW-75VA-230V) for domestic and international applications.

The Sapien is typically for indoor applications but can be ordered in a high-impact plastic, wall mount enclosure, a stainless steel wall mount enclosure or stainless steel, sloped top-entry pedestal-type enclosure. Mechanical dimensions and weights are listed below.

Construction
The Sapien case shall be plastic-injected from virgin ABS and all other electrical components shall be considered "new". The PCB's shall be ROHS compliant with lead-free solder and components.

Product Features
The Sapien shall have the following set of terminal blocks for the following inputs or outputs:

- A 2-position terminal block for 24VAC inputs (non-polarized)
- A 2-position terminal block for the 2Wire Communication path out to valves in the field (L1/L2 also non-polarized)
- A single ground terminal for a #14 AWG copper ground wire to a separate earth ground rod or plate.
- A 2-position terminal block for a normally-closed Master Valve or pump start
- A 2-position terminal for a flow sensor input (not supported by current software version)
- A 2-position terminal block for rain switch/sensor
- A 2-position terminal block for an Underhill specific hand-held remote. This remote port is not compatible with the any generic hand-held remotes available in the domestic irrigation market.
- A 4-position terminal block to terminate a 4-pin connector for the purpose of programming a decoder with a corresponding station number or address code.

The Sapien shall incorporate a 128 x 64 black and white display that remains constantly illuminated allowing view of all menus and submenus in both low-light and full sunlight conditions.

The Sapien shall come standard with a cable subassembly with clips for the purposes of programming or testing an Underhill single-station decoder p/n TW-TK-DEC-1.

The Sapien shall also come standard with a sealed 1.3 amp externally mounted 120VAC transformer. See the electrical specifications within these specs for maximum allowable input and output current ratings.

The Sapien shall have the following programming capabilities:

- 4 independent programs (A, B, C & D) and a single station Manual mode
- "Stack" programming (operating one program sequentially after another) or "Overlap" mode depending on site requirements, mainline capacity and delivery pressure.
- Programming capability to operate 1 station per program and each program with the same or overlapping start times. (wiring sizing and distance of 2Wire path can support this capability)
- Enter specific watering exclusion hours to meet local water conservation requirements
- Enter up to 8 calendar days as "black-out" or event days when irrigation is suspended
- 12 start times per day for each of the four programs using a 24-hour clock format
- 7-day watering calendar or odd/even days. No exclusion for months ending in 31, representing two consecutive odd days
- Selectable run times in minutes and seconds from 30 seconds to 9 hours in 30-second increments
- An alternative to selecting run time is to select a precipitation to be applied and the controller will automatically calculate the corresponding run time from the station's precipitation rate programmed from within the 'Auto Schedule' menu.
- Dedicated normally closed master valve or pump start can send a 24VAC signal to a pump start relay.
- User defined "pump-prime" allowing system to pressurized prior to the beginning of a programmed start time from 1-15 minutes in 1-minute increments. This function will open the master valve as part of this sequence and power the 2Wire path prior to sending a command to the first decoder in the program
- User defined pump or station delay function from 0-99 seconds in 1-second increments for slowly closing valves to avoid a low-pressure trip of a pump system.
- Most menu functions display line current in milliamps (mA) that represents the number of decoders multiplied by 3 mA. For example, 30 stations with decoders should display a mA value of approximately 90 mA's

- Station run log identifies station faults that may be specific to a broken 2Wire path, a wire integrity connection issue, a solenoid that has reached end of life or an improperly programmed or responding decoder
- Independent program seasonal adjust on a monthly basis from 10-255% in 1%-increments
- Built-in electrical diagnostics to determine 2Wire com path, decoders, wire connections and valve solenoid integrity
- User-defined imperial vs. metric display values
- Current date and time displayed
- Non-volatile memory stores the programming information indefinitely.
- Current date and time stored in replaceable coin-cell battery with an expected life of 3-5 years
- Compatible with most normally-closed rain or rain/freeze switches
- Program D ignores a rain sensor override and is intended for stations under eaves or non-permeable roofs.
- Heavy-duty overlay with dome buttons provides positive tactile navigation of the Sapien's menus and submenus
- Manual single station operation with a user defined runtime

The Sapien can incorporate standard, solid-core, direct burial wire depending on the number of stations operating at the same time, remote control valve holding current or 2Wire com path length. Utilize 12, 14 or 18 AWG wire or specify Underhill twisted, 2-conductor wire in a poly jacket as noted in the table below:

No.	Description	Part Number
1	2-conductor 14AWG wire reel, 1,000 ft	TW-2CJ-14-1000
2	2-conductor 18 AWG wire reel, 2,500 ft.	TW-2CJ-18-2500
3	2-conductor Jacketed 14 AWG, wire reel, 2,500 ft. (Black)	TW-2CJB-14-2500
4	2-conductor Jacketed 14 AWG, wire reel, 2,500 ft. (Red)	TW-2CJR-14-2500

Product Operation

The Sapien shall have 9 (qty) menus with some menus having one or more submenus.

The default menu shall be the "RUN" menu shall display the following:

- Date and time, including day of week
- Accumulative system current draw in milliamps (mA)
- A table with projected scheduled start time, day of week and number of stations assigned by program
- The RUN menu will also display current controller activity such as the following

- Electrical fault conditions that may have occurred in the last manual or scheduled
- Pump priming if programmed
- Rain suspension when the Sapien is connected to a rain or rain/freeze switch
- Pause condition while the Sapien waits the inter-station delay period.

The "SET CURRENT DATE/TIME" menu allows a user to select the current year, day and month. Then set a 24-hour clock for hours and minutes.

The "SET WATERING DAYS/TIMES" menu allows a user to select day to water selecting between odd/even days or a 7-day weekly calendar. When "ODD" watering is selected the Sapien will irrigate both consecutive odd days for months ending with an odd number value.

This menu will also allow a user to select 8 unique calendar days that can be pre-selected to suspend any scheduled irrigation. These days will remain from year to year unless deleted or changed. If an irrigation start time has begun on the previous day and the scheduled program window extends beyond midnight, the controller will complete the remaining scheduled irrigation but not any additional start times on the no-water day.

The "SET START TIMES" menu allows a user to assign up to 12 start times per program. This is intended for over-seeding or sod applications where multiple start times are needed until a root mantle can be established. Start times shall be identified in a 24-hour clock format. This menu will also allows selection of a specific non-irrigation times to meet local water restrictions or user-required periods when no scheduled irrigation is allowed. The start and stop time of this timeframe is user selected in a 24-hour clock format.

The "SET RUN TIMES /PRECIPITATION & SEASONAL ADJUST menu provides three separate functions. A station can be assigned a run time from 30 seconds to 9 hours using the left and right as well as the up and down arrow keys. The Sapien displays the station previous, current and next station in ascending numerical order for convenience particularly when selecting run times for stations with similar exposures or other landscape attributes. Stations with runtimes are assigned to a program and the same station can be assigned to more than one program. Start times may have to be staggered when the same station is assigned to different programs so the corresponding station(s) operate.

A user may also choose to set stations corresponding to a precipitation in lieu of a run time by selecting the "More or Less' buttons on the faceplate. The precipitation can be adjusted in 0.04" increments from 0.0 to 9.9". The precipitation rate can also be adjusted in 0.01" increments using the up and down arrow buttons.

The precipitation rate for that station in inches/hour can be set from a menu in the 'Auto Schedule' Menus.

The Sapien shall have the ability to percent adjust on a monthly basis for seasonal changes by program. These adjustments can be made from 0-250% in 1% increments.

The "PUMP OPERATIONS" menu provides 3 (qty) separate functions. The first is to turn the pump start on so that it's associated with a program start time or manual station operation. When operating a station in manual mode with the pump "On", this function must be turned "Off" in this menu upon completion of the manual operation. This function can also be used for a normally closed master valve that will also automatically open with any start time assigned to a program and/or a manual station operation.

The second choice is to select a delay sequence allowing a well pump to prime prior to a scheduled start time. The range is 0-15 minutes (0 being the factory default) in 1-minute increments.

The user may also select a station delay period for applications involving slow closing valves to avoid a low-pressure trip of a pump system. The range is 0-99 seconds in 1-second increments. Any value selected must be saved as part of this submenu function.

The "MANUAL WATERING & ELECTRICAL TESTS menu provides 4 (qty) separate functions.

- The first function is to test the integrity of the 2Wire path prior to operating any station manually or from a scheduled program start time.
- The second function is manually operates a single station. This will continue for up to 9 hours to allow time for any manual adjustments if sprinklers etc. The runtime can be stopped anytime once started by pressing the down arrow button.
- The third function is to operate all stations within this menu with each station operating for the same user runtime. The range is from 2 seconds to 9 hours in 10-second increments. The factory default is 2 minutes.
- The fourth function is view the "Station Fail Log" which will display the corresponding station number, the time and date the fault occurred, how long the valve ran in minutes and seconds and status.

The "ADVANCED FEATURES" menu provides 7 separate functions listed as follows:

- Station Run Log- Provides a history of the last time each operated providing the station number, date and time, number of minutes of operation and status.

- Station Failed Log – displays on the stations when a fault condition occurs. This is identical to the information presented in the "Manual Watering and Electrical Tests Menu.
- Sensor Bypass – allows you to over-ride a rain or rain/freeze sensor that has been activated allowing for scheduled or manual operation. Program D, ignores rain sensor commands as it's intended for use under eaves or non-pours roofs.
- Last 7 Days of Irrigation – is a table or report for each station that has operated within the last rolling 7 days (from today) displaying the total runtime, how much precipitation has been applied and the number of times the station has operated.
- All other functions listed in the submenu are invalid and not for domestic markets.

Electrical Requirements

The Sapien shall provide "Pure AC" power all the way from the controller, down the 2Wire com path through the decoder to the valve solenoid. This method of power distribution allows the Sapien to utilize existing remote control wire field wires if available for street or parking lot crossings to avoid trenching and pavement repair costs.

The Sapien shall meet the following electrical requirements:

- Transformer Input: 120 VAC, 60Hz (230 VAC 50/60 Hz International applications)
- Transformer Output: 26 VAC, 1.3 amps
- Station Output: 25 VAC, 0.60 amps (600 mA) per station
- Maximum Output: 25 VAC, 1.2 amps (1200 mA) (includes master valve/pump start circuit, (for master valves requiring higher in-rush current, a separate power supply may be necessary)
- Battery Back-up: Lithium coin cell battery (typical 5-years)
- The transformer is waterproof to IP56/NEMA 4X
- The Sapien case, when the cables are correctly clamped through the rubber glands, is waterproof to IP54/NEMA 3X
- UL recognized CE compliant transformer.

Use the supplied transformer with the Sapien as it is sized to provide coordination of protection against short circuits on the decoder 2Wire path.

Optional Enclosures

The Sapien can be specified with any one of the following optional outdoor, weather-resistant enclosures per the table below:

No.	Description	Part Number	Dimensions
1	High-impact plastic wall-mount enclosure	TW-3-PLC	11.5" H x 9.25" W x 5.5" D 29,3cm H x 23,5cm W x 14cm D
2	Stainless- steel wall-mount enclosure	TW-3C-SS-WM	15.25" H x 15.25" W x 4.75" D 38,7cm H x 32,4cm W x 12,1cm D
3	Stainless-steel, sloped top-entry pedestal	TW-3C-SS-PED	39" H x 16.5" W x 17.5" D 99,06cm H x 32,4cm W x 44,45cm D

Installation

The Sapien 2Wire controller shall be secured to a vertical flat surface when wall mounted either indoors, or alternatively outdoors in an approved outdoor weather-resistant enclosure. This orientation is different when installed in a sloped, top-entry pedestal for easier viewing and use.

The sealed transformer shall also be secured to the same vertical surface using the 4 (qty) mounting tabs. Secure with appropriate fasteners applicable to the wall material. Secure the 2 (qty) non-polarized conductors of the supplied transformer to the AC "power" terminals on the Sapien before plugging into a 120 or 230volt power source.

Make any and all other wiring connections for accessories such as a rain switch, pump start or master valve. The master valve wiring shall be specified as a separate two-conductor path from the controller to the master valve location. The master valve should not be part of the 2Wire path so that multiple simultaneous station operation can be maximized.

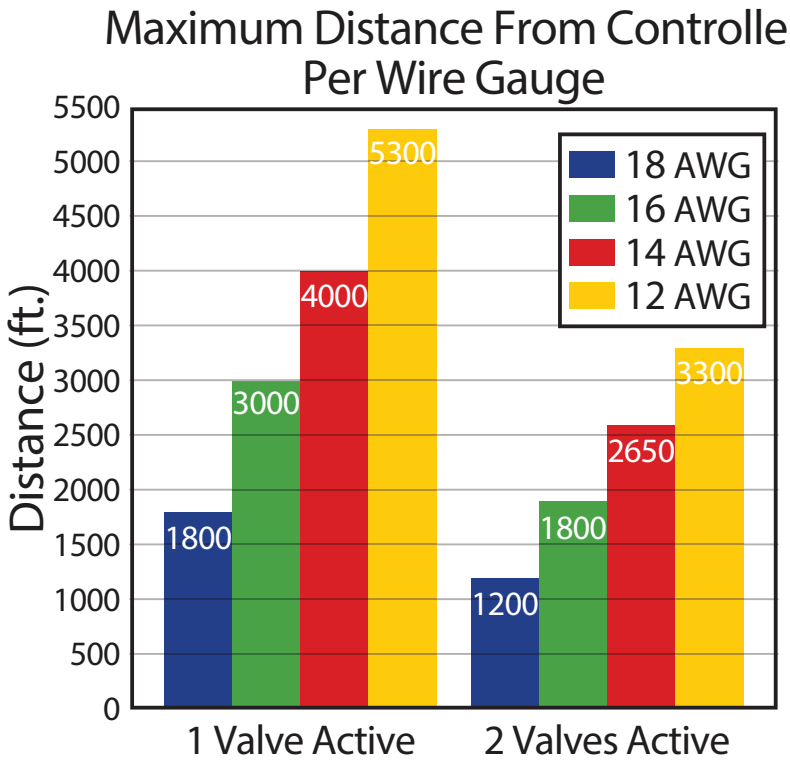
Each single-station decoder can be programmed via the 4-pin cable subassembly enclosed within each Sapien controller. A small slide switch within the Sapien above and to the left of the "Remote Control" terminal needs to be set to the "PROG" mode prior to selecting and programming decoder address codes. Once a decoder is programmed, it will automatically be tested to acknowledge receipt of the programming command prior to installation in the field. Mark with a waterproof marker the corresponding station number of the address programmed into the decoder prior to installing in the field.

It is recommended to maintain separate colors for the 2Wire com path out to the decoders in the field. Single-leg wire runs or single leg wire runs with branches are the recommended methods. While a loop-type wire run can be used, it can be difficult to troubleshoot particularly if this unique design function is unknown to the maintainer of the system.

The wire size shall vary depending on the following site and irrigation schedule requirements:

- The distance from the valve furthest away back to the Sapien
- The holding current of remote control valve series in use,
- The number of valve solenoids to be operated at one time.

The wiring chart below identifies maximum allowable wire distances for the Sapien 2Wire system.



The 2Wire com path shall be continuous between valve boxes whenever possible. 2Wire Com path splices if necessary shall be located in a 6" round valve box for locating in the future.

All wire connections downstream of the Sapien controller shall be made with 3M DBRY waterproof connectors and no other approved equal.

Grounding

The Sapien only requires grounding at the controller per the two following industry standards;

The Irrigation Association's 2011 TL Irrigation Seminar: Proper Grounding Techniques or

The American Society of Irrigation Consultants Guideline 100-2002 (January 2, 2002) for Earth Grounding Electronic Equipment in Irrigation Systems
http://www.asic.org/design_guides.htm

(No additional grounding at specified intervals along the 2Wire path or at the terminus of each 2Wire com path branch is required).

Connect a #14AWG solid copper conductor from the Sapien's earth ground to a ground rod or ground plate depending on existing site conditions and customer requirements. The ground rod or plate shall be located a minimum of 10' away from any other grounding system, like the building ground.

For indoor applications a ground wire should be fastened to a cold-water pipe or follow local electrical codes for grounding. Do not attach a ground wire to an existing ground rod that may already be in place for an electrical subpanel or some other appliance.

The Sapien 2Wire Controller shall be manufactured and sold by Underhill International Corporation, Lake Forest, CA.