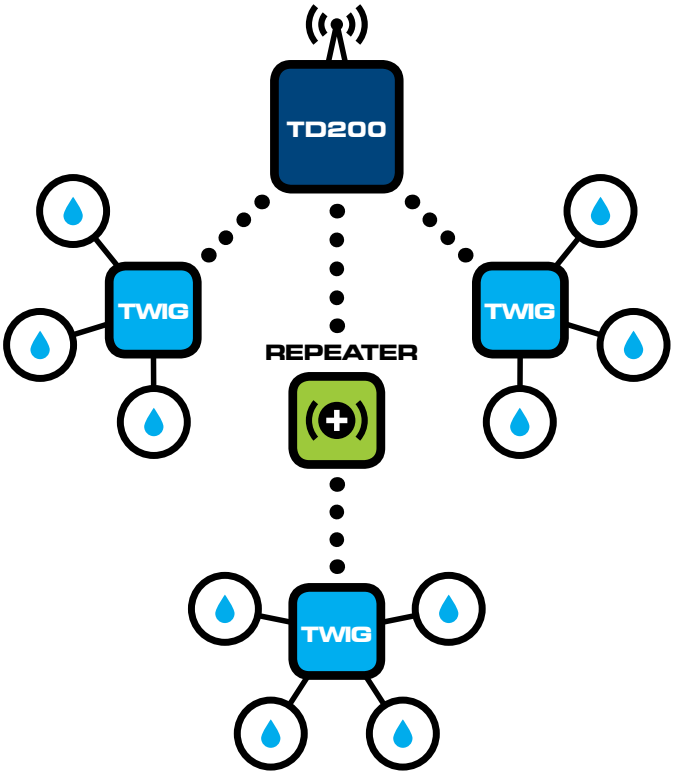
NELSON

Wireless Controls

twig®

RESOURCE MANUAL

Includes Certification Quick Quiz,
Practice Exercises & Appendices



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RESOURCE MANUAL

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Warning:

Nelson Wireless radio frequency (“RF”) products should not be used to control mechanisms or devices remotely, including mechanisms or devices that can cause death, bodily injuries, and/or property damage if improperly or inadvertently triggered. No Nelson Wireless Control product is intended for use in any application where the safety of life or property is at risk.

The customers and users of devices and mechanisms controlled with RF products must understand and must use all appropriate safety procedures in connection with the devices, including without limitation, using appropriate safety procedures to prevent inadvertent triggering by the user of the device. If someone is going to do service or maintenance on the equipment they must follow the safety instructions identified in this manual

All RF products are susceptible to RF interference that can prevent communication. It is solely the responsibility of the users to understand that failure to trigger RF devices both on or off is possible and that the user assumes the risks to life or property.

Do not use any Nelson Wireless Control products over the limits in this manual. Excessive voltage or extended operation at the maximum voltage could cause product failure. Never use any radio antenna other than the antennas provided for use by Nelson Irrigation Corporation.

Do not make any physical or electrical modifications to any Nelson Wireless Control product. This will void the regulatory certifications and may cause product failure.

Electrical Safety Caution:

Some components of this wireless irrigation system may be powered by 120V AC electricity. Electricity and water are in abundance in irrigation and are a safety concern. Care must be taken to avoid having any electrical power in contact with your body or with water. If it does happen then electrical shock or injury can result. Normal and accepted practices of powering down any components before doing any installation or service work on the devices are recommended.

Also some components of this wireless irrigation system may be powered by 12V DC batteries. The possibility of an electrical short exists from these devices. Using the normal and accepted electrical safety practices is necessary.

In summary, if the rules are not followed personal safety is compromised. Attempting to perform work while power is on can cause a shock or a spark that can ignite a fire.

Personal Safety Caution:

Ladders:

Ladder climbing to work above ground level may be required for some maintenance in field projects. Danger exists for falling from a ladder. Use of normal safety practices for ladder loads, angle of lean, rungs and slippage avoidance are recommended.

Antenna safety:

Do not locate an antenna mast near power lines. Look up and live! Make sure that no power lines are where possible contact can be made with the mast. Contact with electric wires can be lethal! See Appendix A for more information.

Use a tool for opening control box latches. The latches on control boxes are held closed tightly in order to seal out water. Use a tool to open control boxes to avoid getting fingers hurt.

Keep controller boxes sealed. Avoid insect intrusion. Never leave any access holes open in control boxes. Never leave the door of the box open.

Only the antennas provided by Nelson Irrigation shall be used in the Nelson wireless control network.

Mobility of Control System Caution:

The wireless control system is capable of relocation from site to site in order to accommodate crop changes. Each site must be evaluated for safety purposes to meet personnel and property safety. Every wireless control irrigation site must have a water relief valve installed that can discharge water to relieve excess pressure for safety purposes.

LIMITED WARRANTY

Nelson Irrigation Corporation warrants the Nelson Wireless TWIG Control Products (the "Products") against defects in materials and workmanship for one year from the date of retail purchase by the original purchaser ("Warranty Period") when used with Nelson Irrigation valves and casings and as described in the Nelson TWIG documents.

This Limited Warranty does not apply to (1) Products that have been used with valves or casings not manufactured by Nelson Irrigation; (2) consumables (such as batteries); (3) software, even if packaged or sold with the Product or embedded in the Product; (4) a Product that has been modified by anyone who is not a representative of Nelson Irrigation; (5) damage caused by use with non-Nelson Irrigation products; (6) damage caused by accident, abuse, misuse, flood, fire, earthquake, or other external causes; (7) damage caused by operating the Product outside the permitted or intended uses described in the Nelson TWIG documents or with improper voltage or power supply; (8) damage caused by failure to follow the Product instructions; or (9) damage caused by service (including, without limitation, installation, removal, or unauthorized repair, upgrades, or expansions) performed by anyone who is not an authorized representative of Nelson Irrigation. Recovery and reinstallation of software programs and user data are not covered under this limited warranty. Nelson Irrigation does not warrant that the operation of the Product will be uninterrupted or error-free.

EXCLUSIVE REMEDY. Under this limited warranty, if a defect in the Product arises and a valid claim is received by Nelson Irrigation within the Warranty Period, Nelson Irrigation will, at its option and to the extent permitted by law, either (1) repair the Product at no charge, using new or refurbished replacement parts, or (2) exchange the Product with a new or refurbished Product.

DISCLAIMER & LIMITATION OF LIABILITY

The limited warranty written above is the only express warranty Nelson Irrigation provides for the Product, and the above remedy is your sole remedy. To the maximum extent permitted by applicable law, NELSON IRRIGATION EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES AND CONDITIONS OF ANY KIND, WHETHER STATUTORY OR IMPLIED, ARISING FROM COURSE OF CONDUCT OR OTHERWISE, REGARDING THE PRODUCT, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT THAT APPLICABLE LAW PROHIBITS THE DISCLAIMER OF IMPLIED WARRANTIES, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT ARE LIMITED IN DURATION TO THE ONE-YEAR PERIOD OF THE EXPRESS WARRANTY ABOVE.

Some States do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

You expressly understand and agree that, to the maximum extent permitted by applicable law, Nelson Irrigation and its subsidiaries and affiliates (collectively, "Nelson Irrigation Parties") shall not be liable to you under any theory of liability – whether contract, tort, strict liability, negligence, breach or failure of any warranty, or otherwise – for any indirect, incidental, special, consequential, or exemplary damages that may be incurred by you in conjunction with the Product or these terms, including a) crop or other consequential damages resulting from any defects or breach of warranty and b) any loss of data, whether or not a Nelson Irrigation Party or its representatives have been advised of or should have been aware of the possibility of any such losses arising. You expressly understand and agree that, to the maximum extent permitted by applicable law, the Nelson Irrigation parties' total liability in connection with the Product or this limited warranty will not exceed the amount you actually paid for the Product.

No agent, employee or representative of Nelson Irrigation Corporation has authority to waive, alter or add to the provisions of this warranty nor to make any representations or warranty not contained herein.

Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

NOTICE REGARDING WIRELESS SERVICE. The Product operates over a wireless network and relies on the availability of wireless services provided by third-parties. Nelson Irrigation does not guarantee the availability of continuous wireless services and does not warrant the Product against wireless service interruptions, hackers, eavesdroppers, or viruses.

INSTRUCTIONS TO OBTAIN WARRANTY SERVICE. To obtain warranty service, contact Nelson Irrigation at 509-525-7660. It is your responsibility to backup any data, software, or other materials you may have stored or preserved on the Product. It is likely that such data, software, or other materials will be lost or reformatted during service, and Nelson Irrigation will not be responsible for any such damage or loss.

SEVERABILITY. If any term is held to be illegal or unenforceable, the legality or enforceability of the remaining terms shall not be affected or impaired. This warranty gives you specific legal rights, and you may also have other rights that vary by state to state.

GOVERNING LAW. This Limited Warranty shall be governed by the laws of the State of Washington regardless whether choice-of-law rules point to the law of another jurisdiction.

ARBITRATION. Any claim or dispute in connection with this Limited Warranty shall be resolved in a cost effective manner through binding, non-appearance-based arbitration located in the State of Washington, using JAMS commercial arbitration rules. The arbitration shall be initiated through an established alternative dispute resolution provider mutually agreed upon by the parties. The alternative dispute resolution provider and the parties must comply with the following rules: a) the arbitration shall be conducted by telephone, online, and/or be solely based on written submissions, the specific manner of which shall be chosen by the party initiating the arbitration; b) the arbitration shall not involve any personal appearance by the parties or witnesses unless otherwise mutually agreed by the parties; and c) any judgment on the award rendered by the arbitrator may be entered in any court of competent jurisdiction.

If the foregoing arbitration clause does not apply for any reason, you agree to submit to the personal jurisdiction of the state courts located within Walla Walla County, Washington and the federal courts in the Eastern District of Washington for the purpose of litigating all such claims or disputes, which courts shall have exclusive jurisdiction of such claims or disputes. Notwithstanding the foregoing, Nelson Irrigation may seek injunctive or other equitable relief to protect its intellectual property rights in any court of competent jurisdiction.

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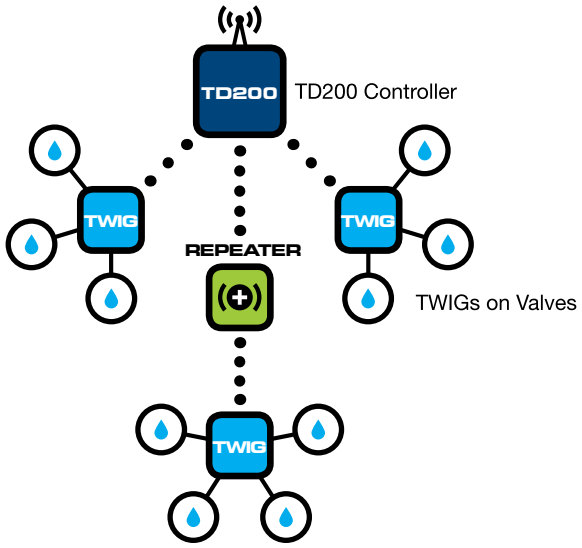
Section 1: Wireless Components

The wireless automation for agricultural valves:

The most reliable method of automation in the field is wireless control because it solves real wire problems on the farm. The Nelson wireless control system is specifically designed for farm use. This shows how a wireless system network may be organized:

Simplicity is achieved in the TWIG for rugged farm use. Also immediate response that is needed for valve control is provided in the TWIG system. It is essentially real-time, two-way every 20 seconds. It gives immediate status of each TWIG valve signal, battery voltage, and a report of a problem of open circuit, short or if the signal is missing. The TWIG network is much more responsive than monitoring type networks that may take as long as 15 minutes to update.



Components and Parts:

Parts that make up a TWIG system:

The TD200 controller holds the programs for the wireless radio commands. It is capable of controlling up to 100 TWIGs on valves.

1.1 The TD200 Controller:

TD200 door open

Part no.	Description
11953-001	TD200 Controller 110VAC power
11953-005	TD200 Controller 12VDC power (order DC solar power kit separately)

TD200 INPUT PORT INFORMATION

Input ports P and X are for programming. Ports C and B are to hook up to other controllers.

This shows the connection port Conn 1 which is the green port. It can input from a flowmeter or a pause event switch.

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1.2 THE TWIG (VALVE) CONTROL MODELS:

Internal antennas

Part no.	Model	Description
11737-001	TWIG-1i	Wireless TWIG, operates one valve
11737-002	TWIG-2i	Wireless TWIG, operates up to two valves
11737-004	TWIG-4i	Wireless TWIG, operates up to four valves

This model is good where there is no external antenna parts exposed to damage. Mounting bracket is to be ordered separately. Consult factory for part number of TWIG for 'T' and elbow style valves.

TWIG models that require remote antennas:

The remote external antenna mounting options below are SPECIAL ORDER only!

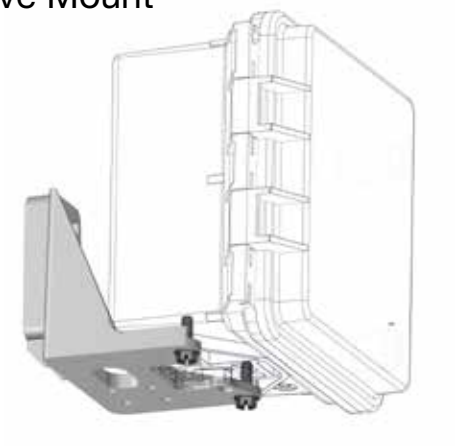
Part no.	Model	Description
12110-001	TWIG-1e	Wireless TWIG, operates one valve
12110-002	TWIG-2e	Wireless TWIG, operates up to two valves
12110-004	TWIG-2e	Wireless TWIG, operates up to four valves

This model is good for applications where the external antenna is to be placed above obstructions to improve communication such as over trees in orchards.

Connection for external antenna is built-in. Mounting bracket, antenna and cables to be ordered separately.

1.3 THE TWIG MOUNTING BRACKET KITS:

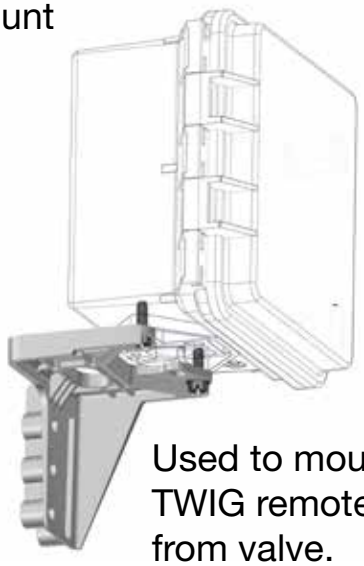
PART NUMBER 11948-001
Valve Mount



Used on 800 Series
& 1000 Series valves.

PART NUMBER 11948-002
Remote Mount

Consult factory for part number of TWIG for 1000 Series 'T' and elbow style valves.



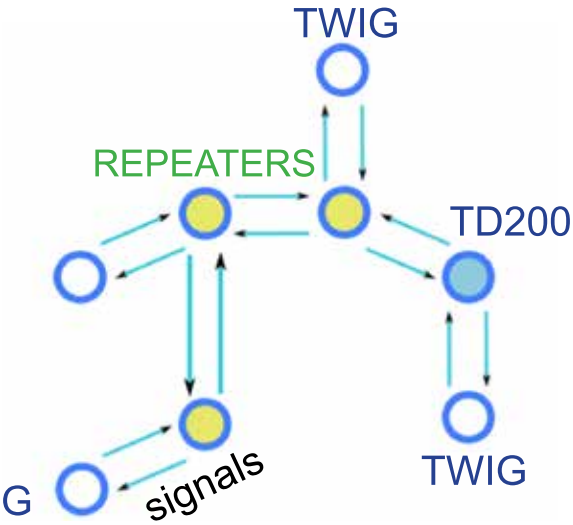
Used to mount TWIG remote from valve.

1.4 THE TWIG REPEATER:

Part no.	Model	Description
12025-001	TWIG-Repeater AC	110VAC power. (order antenna separately)
12025-002	TWIG-Repeater DC	12VDC power (order antenna & solar kit separately)

The TWIG-Repeater Kit includes one #11948-002 (Remote Mount bracket) so it can be mounted onto a pole.

Example of Repeater in a network



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1.5 THE CONTACT TWIG ASSEMBLY (4 LATCH CONTACTS):

Part no.	Model	Description
12246-001	Contact-TWIG D-cell	D-cell battery power. (order antenna separately)
12246-002	Contact-TWIG 12VDC	12VDC power. (order antenna separately)
12246-003	Contact-TWIG 110VAC	110VAC power. (order antenna separately)

Note: Capable of controlling four switches. Mounting hardware not included.

1.6 THE SOLENOID KITS FOR TWIG VALVES:

Part no.	Model	Description
8925-035	E23	Solenoid #7510-052 used on small valves, 12VDC latch.
8925-029	E29	Solenoid #7510-029 used for all size valves, 12VDC latch.

Note: These solenoids are latch type and are to be ordered with the control valve.

1.7 THE SOLAR POWER KITS:

BATTERY AND SOLAR POWER KITS:

The TD200 and TWIG-Repeater are available in either 110VAC or a 12VDC battery/solar power option. The 12VDC solar power option provides for automation to remote areas where no electricity power source is available. These kits are specific to the TD200 or the TWIG-Repeater. They can not be interchanged. The support pole is not provide and is to be sourced locally.

Part no.	**Model**	**Description**
12224-001	Solar Kit, TD200	12VDC 10 Watt, Solar Charge controller kit, TD200
12224-002	Solar Kit, Repeater	12VDC 10 Watt, Solar Charge controller kit, Repeater

Part no.	**Model**	**Description**
12075-001	Solar Kit, TD200 w/battery	12VDC 10 Watt Panel, Solar Charge controller kit, for TD200 and Contact-TWIG, Includes Battery in box.
12075-002	Solar Kit, Repeater w/battery	12VDC 10 Watt Panel, Solar Charge controller kit, for TWIG-Repeater, Includes Battery in box.

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1.8 THE ANTENNA KITS:

Antenna factors for the best advantage and antenna kits:

The antenna is the main communication link. The range between the TD200 and the TWIGs depends upon good antennas. Transmit signal power is only half the solution. Receive power on the same antenna is the other half of the solution for a robust radio network. Only the approved antennas can be used for the TWIG network. See Appendix A for more details. Here are the part numbers.

Part No.	Description
12000-010	Omni (6dBi) with 10’ cable
12000-020	Omni (6dBi) with 20’ of cable
12000-030	Omni (6dBi) with 30’ of cable
12000-040	Omni (6dBi) with 40’ of cable
12000-050	Omni (6dBi) with 50’ of cable
12281	Di-pole 2dBi Articulating, short range

11818	Omni Antenna with u-bolts and mounting bracket
11865-xxx	RP-SMA to N cable (10 or 20’ long)
11996-xxx	N to N cable (20’, or 30’ long)
11997	Lightning Arrestor with mounting bracket
11998	Coax weatherproofing tape

The only difference between these Omni antenna kits is the length of the co-axial antenna cable. The length should be selected carefully because there is some signal loss within the cable. Length should not be any longer than needed but long enough that it easily connects. An appropriate length will have enough that a small amount of extra cable can be coiled to give room for making the connections. The water proof seal tape must be used to keep moisture out of the cable junctions.

SECTION 1

KNOWLEDGE QUICK QUIZ QUESTIONS

1. A TWIG network can operate between 1 and _____ TWIGs in the network.

2. True or False?
   You will have about the same reliability comparing a buried control wire system and a TWIG wireless control system?

3. The data communication flow within the network moves two-way very frequently? What is the time between each communication _____?

4. True or False?
   Some wireless networks simply send out commands and hope the signals are received. The TWIG system provides immediate verified response which is very useful because it is a two-way system and there is feedback at the controller that the communication worked.

5. The central communication point for the TWIG network is the TD200. The data signals for both transmit and receive pass through the _____.

6. The TD200 can run as many as 200 valves by using a combination of _____, _____, and _____ TWIG models in the system and in the programs.

7. True or False?
   The 24V AC continuous voltage solenoids can be operated by the TD200 controller.

ANSWERS ON PAGE 68

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Section 2:
TWIG Network

2.1 THE TWIG ADVANTAGES AND FEATURES:

TD200 CONTROLLER FEATURES:

The following discussion refers to the basic wireless network in this figure.

The TD200 uses simple programming steps to create a coordinated irrigation schedule for up to 100 TWIGs. It is the backbone of the wireless network. Programs are loaded into the TD200 controller through the simple press of buttons.

The programming menus in the TD200 are used to set up the irrigation schedule for each valve. The program is based within the controller. The TWIG valve modules do not have the irrigation schedule but simply operate the valves as instructed by the controller. The TD200 also has a USB port so a USB stick can retain programs and log irrigation events.

The TD200 programming easily create groups of one or more TWIG valves. The groups can operate one time or multiple times or even continuously repeating. A schedule can be set to wait for a future time to start a program.

TWIG FEATURES:

There are three models of TWIGs for the various field irrigation applications:

- TWIG-1 is to control a single valve to open and close in a sequence such as frequent irrigation of a solid set sprinkler or drip system.
- TWIG-2 controls two valves to open and close in a sequence. It is useful for dual irrigation systems in the same orchard such as sprinkler over-tree and under-tree or a sprinkler and drip system combination.
- TWIG-4 controls up to four valves to open and close in a sequence. One benefit is the number of TWIGs in the field are reduced.

  In addition to these standard models, external TWIGs can be special ordered for some special applications where an external antenna is needed. They require Omni antennas.

The TWIG is powered by 2 D-cell batteries located inside the weatherproof enclosure. The batteries power the radio and the latching solenoids. The solenoids provide the on/off control of valves.

Table 1

Features	Benefits
Accurate, synchronized control without control wires or AC power	Low cost installation
Weatherproof box	Trouble-free operation, even under sprinkler water.
Simple menu-driven programming	Saves time and reduces errors
Programming changes are made only through the TD200 controller	Unauthorized individuals cannot change irrigation programs at the field valves.
One year TWIG module operation with two D-cell alkaline batteries	Battery is reliable for one irrigation season
Repeater to handle the agricultural terrain.	Blind spots or vegetation obstacles do not limit where the TWIG system can be used.
Synchronized control of up to 200 irrigation valves	Economical system, even for large farms

ADDITIONAL FEATURES

Live feedback from the valves.
Reliable two-way data communication every 20 seconds. There is a big difference between monitoring networks and true valve control. The TWIG technology has very short time latency, which is the lag time from initiating a request to a network and receiving the response. Think about turning on a faucet and waiting for the water to flow (latency) compared to the amount of water that comes out (throughput). The latency of many other networks is like an old pump well in which you have to prime it to get the flow started; on a TWIG network, it's like the fast convenience of pressurized indoor plumbing. Less latency means better, quicker valve response. Status reports are always up to date; sent to the controller showing the actual battery voltage and radio signal strength of each TWIG in the network.

Manual control can be done two ways.
All Nelson valves have the option of manual control with the selector handle on the valve or by using the TD200 'MANUAL CONTROL' to close or open a valve immediately. Also the TWIG is capable of running a short manual solenoid test to check the solenoid function.

OFF/RUN/PAUSE Controller feature.
A OFF/RUN/PAUSE gives full field control.

-The OFF mode, the program is kept from operating (and valves are not allowed to open) until the TWIG modules receive an ON command.

-The RUN feature is used often by irrigation field personnel. Programs can be run without the work of changing anything. No programming the controller. Just turn the dial to RUN.

-The PAUSE feature closes ALL the valves for all running programs. The valves remain closed until the dial is rotated back to RUN and irrigation resumes where the program(s) were when paused.

Reviewing a program.
The TD200 system lets the user quickly review the programs and rapidly advance the time to make sure any errors can be corrected. Simply go to the MANUAL CONTROL and move through the groups.

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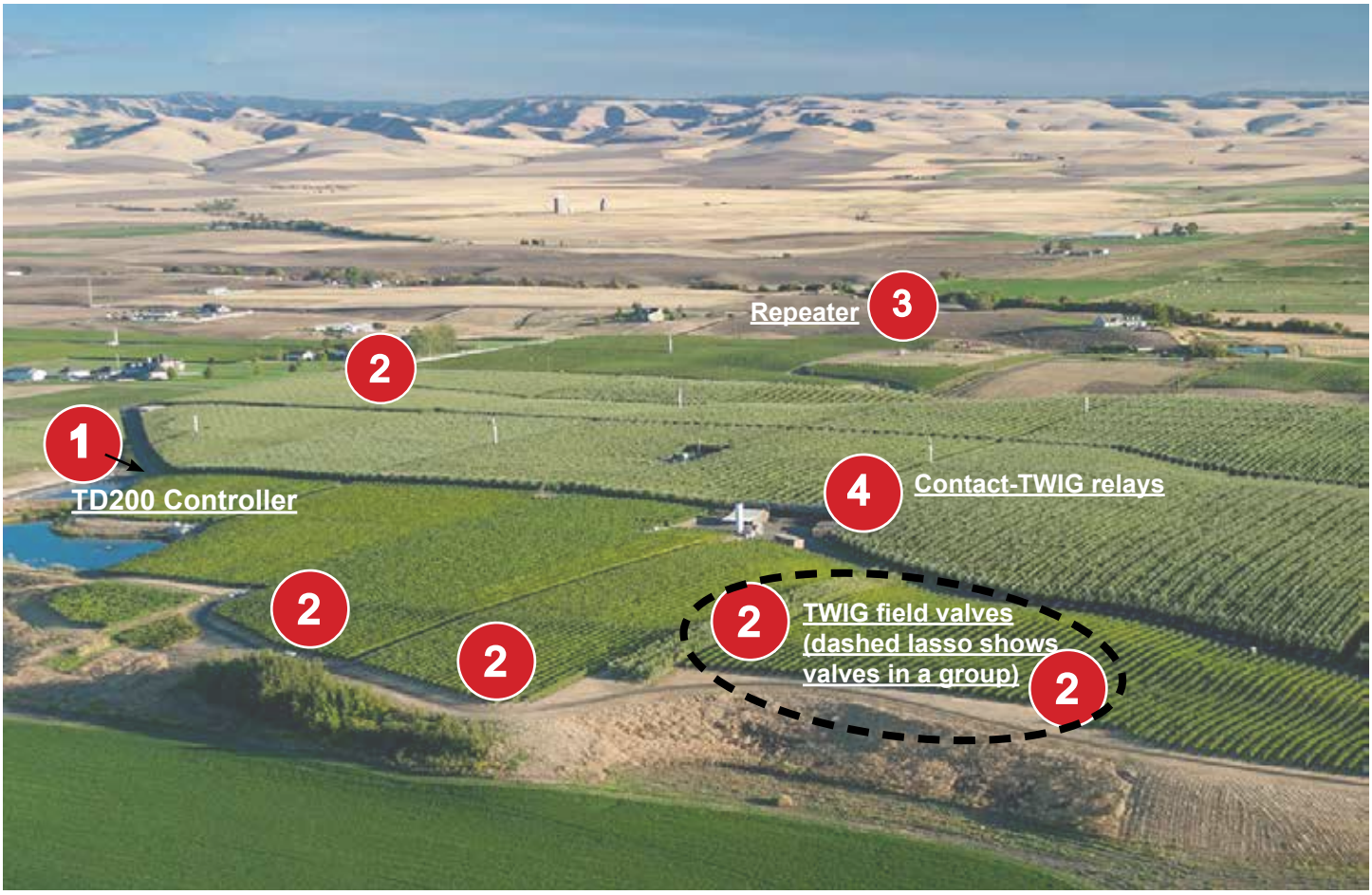
Optional power sources.
Every TD200 controller can be powered by either 110 V AC or alternatively a 12V DC battery having a solar charger. If electricity is available then it is the preferred source of power.

Caution: Do not connect a 12VDC battery if the TD200 is plugged into electricity! Use only one power source at a time! If using the 12VDC battery then it must be the only power supply that is connected. The Demo Kit battery pack is to be used temporarily because the capacity of a set of AA batteries will last about only a day. If electricity is available then it is the best source of power.

2.2 TWIG FIELD APPLICATIONS:

The TD200 is the foundation of the TWIG network:
The Nelson Wireless TWIG Control System basically consists of a TD200 Controller capable of controlling up to 100 TWIGs in a programmed sequence. The TWIGs are located in the field on solenoid operated valves. The TD200 and the TWIGs that it controls are in a local area network. Each TWIG is uniquely addressed with an identity that was assigned at the factory. The TWIGs automatically self register to the designated TD200. A repeater can be installed in the network to facilitate the communications. And a Contact-TWIG can be added to the network to turn devices such as pump switches on and off.

Each of the components refer to this picture which is an aerial view of an irrigation system.



Components of Nelson Wireless Controls

1 TD200 controller is the foundation of the system and manages the TWIGs on each valve. It includes proprietary Nelson high power radio. Capable of controlling up to 100 TWIGs on valves. The TWIG network has two-way communication every 20 seconds and monitors battery and signal strength for each TWIG valve.

2 TWIGs on field valves. There are three TWIG choices available. These control one, two or up to four valves independently. Antenna options are the standard low-profile internal antennas or special order external Omni antennas.

3 Optional REPEATERS can be used to extend the network radio signals. Self organizing radio logic works to extend the signals if needed to reach longer distances.

4 Accessories include Contact-TWIG switches, solar power kits and Omni antennas to work in about any farm application.

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2.3 BEST PRACTICES FOR TWIG WIRELESS SYSTEM DESIGN:

A GOOD SYSTEM IS MANAGEABLE:
Building good wireless TWIG networks does not happen by accident. They are the result of hard work by the irrigation dealers, designers and installers, who identify irrigation requirements and select the best solutions to meet the needs of the farms. Most farms only have a few requirements for their valve control network. The big one is Manageability: No matter how good the network design is, the available people must be able to manage and support the network. A network that is too complex or difficult to maintain cannot function effectively and efficiently.

The steps required to design a good network are as follows:
Step 1. Verify the grower goals and technical requirements. Is pump control and Internet access needed?

Step 2. Determine the functions required to meet the needs identified in Step 1.

Step 3. Perform a TWIG network-readiness and field survey to understand the topography.

Step 4. Layout a solution showing the valve locations on the site plan.

Step 5. Create a project plan and a bill of materials.

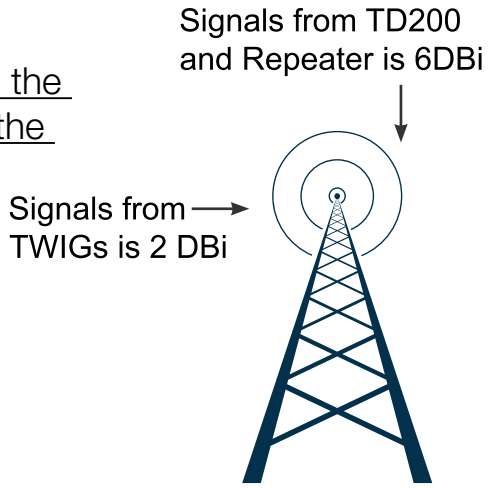
Reliability is essential. Wireless network users generally do not think in terms of the complexity of the underlying network. They think of the network as a way to access the irrigation controls they need, when they need them.

FIELD LAYOUT OF ZONE VALVES:
Knowledge of the farming crop and soil is generally the best way to make the field layout. It is the ideal to divide the field into equal size irrigation blocks (these are also called zones). The best effort is necessary to group the same soil type, crop and watering requirements for each block. All of this design work is done while staying within the available water supply. The blocks typically each have a zone valve to control the water flow for the block. In some cases multiple valves are used in a block for individual laterals. After the field design is finished and zone valves located, then the controller location can be determined.

LOCATING THE CONTROLLER:
The controller is the heart of the control system. If possible locate it near the system pump or at a convenient place. The power supply required for the controller is 110VAC or a 12VDC battery which requires a charging system be used. The 110VAC is always best if it is available. The TD200 controller cabinet is designed for outdoor use and is rain and water resistant however it is a good idea to mount the controller in an area out of direct sunlight. Mounting it on the side of a building or under cover will help it to last longer and reduce temperature and moisture aging. After the controller location is set then the antenna support and cable needed can be determined.

THE ADVANTAGE OF PROPER ANTENNAS:
Strong radio power can give longer range but strong transmit power is only half the solution. Receiver power on this same antenna is the other half of the answer. Receive signal is very much affected by the noise floor present at the site (static). The source of noise in the environment range from digital products of all forms and other radio communications. Antennas are everywhere so look around and try to minimize the noise to the antennas for both the TWIG units and the TD200. Even weather conditions can limit communication because moisture in the air weakens signals.

Remember the signal between antennas on the TD200 and the Repeater are stronger than the signals from the TWIGs.



BEST PRACTICES FOR ANTENNAS:
The antenna is the backbone and focal point of the network. Make sure that the location is carefully selected. The basics are:

1) Locate the antenna only high enough to clear line of sight obstacles. It is a lightning target so do not go up higher than necessary.

2) Minimize the antenna cable length because cable does cause some amount of signal degradation. Route the cable in locations where it won't be damaged.

3) The cable connections are the greatest source of trouble so make them carefully and use the connectors sealant tape provided in the antenna kits.

4) Use the specified surge arrestors that come with the kit. Substitution of cable, connectors or surge arrestors is at the installer's own risk and it can be a major source of service troubles.

5) Use approved grounding methods. It may save your system from big damage!

INSTALLATION SIMPLICITY (TWIG identity):
For convenience, the TWIG address identity is labeled on the outside of the TWIG. Write each address identity onto the field map. That makes it simple for the controller startup when assigning valves to groups.

TIP! Keep a copy of the field map at the controller. It can be a great tool for managing the irrigation system.

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SECTION 2

KNOWLEDGE QUICK QUIZ QUESTIONS

1. Select the best answer. The essential parts for a Nelson wireless control system are:
   a) pump control contact switch
   b) TD200, Antenna, TWIG.
   c) program created to include the repeater

2. True or False?
   The irrigation schedule programs are retained in the memory within the TWIGs that are mounted onto the field valves.

3. Obstacles in the field and line-of-sight blind spots that block communication can be solved using a component called a TWIG-_____.

4. True or False?
   If the TD200 is using 12 VDC power then it must not be plugged into 110 electrical outlet at the same time.

5. Choose the best answer. The Nelson wireless control system was designed to be:
   a) Reliable
   b) Manageable
   c) Simple
   d) all of the above

6. Choose the best answer to fill in the blank. Create a map of the field and keep it at the TD200 because it will save _____ and it is a good management tool showing the TWIG numbers and locations.
   a) energy
   b) wire
   c) time

ANSWERS ON PAGE 68

Section 3: Wireless irrigation practice

3.1 WIRELESS APPLICATION AND FIELD DESIGN:

The great irrigation systems begin with a great plan. For irrigation automation, three systems merge together in the field. It all has to work!

Automation of irrigation requires three systems working together.

(1) the pumping system
(2) the wireless network system.
(3) the irrigation pipe system.

Before beginning a field design plan for the unplanned. Consider ahead of time some solution for unusual events that could happen in any of the three systems.

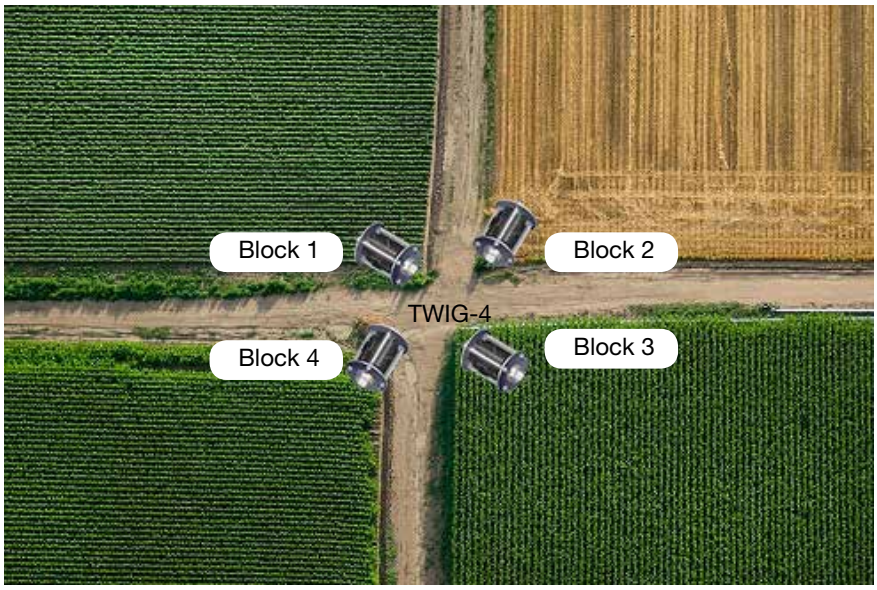
The first rule of automation is to plan for a pressure relief valve.

Provide pressure relief to protect the pipe system from bursting due to excess pressure. Unplanned events do happen and regardless of the cause, the pressure relief will protect the system rather than damaging the pump and pipes (relief is similar to a fuse protecting an electrical system).

3.2 PLAN THE VALVE LOCATIONS CONSIDERING THE TWIG NETWORK:

The first thing to do is make a field map that shows the irrigation system design. Using the map you can determine the best place for the TD200 controller. Next determine the distances from the controller to each TWIG valve. Check the line-of-sight and avoid any obstacles. Typically a TWIG-1 model will be needed at each valve.

Consider the use of multi-valve TWIGs where the valves are close together. The picture here shows where 4 field blocks join together at the corners. One advantage in this situation is that one TWIG-4 can operate all four of the valves separately or altogether at the same time. The multi-valve TWIG can be used if the valves are separated only by a short distance (50 feet or less).



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Locate all the TWIGs within the allowed signal range shown on the range bar graphs in Section 4. Then consider the crop and the elevation of the antenna, make a plan for any repeaters that will be needed. The map will be useful later as a record and to show each TWIG ID number.

3.3 UNDERSTAND WHAT THE SYSTEM NEEDS TO DO:

It is important to keep in mind the person that will make the system work. Success generally comes by using an authorized TWIG designer. The designer that is a TWIG-approved provider is certified and will do the following:

-Recognize the best use and the opportunities that wireless provides.
(understand the ways wireless will improve the owner's irrigation and what it means to them).

-The designer should be comfortable with control systems. It is a new product concept and it takes some new ways of thinking about irrigation.

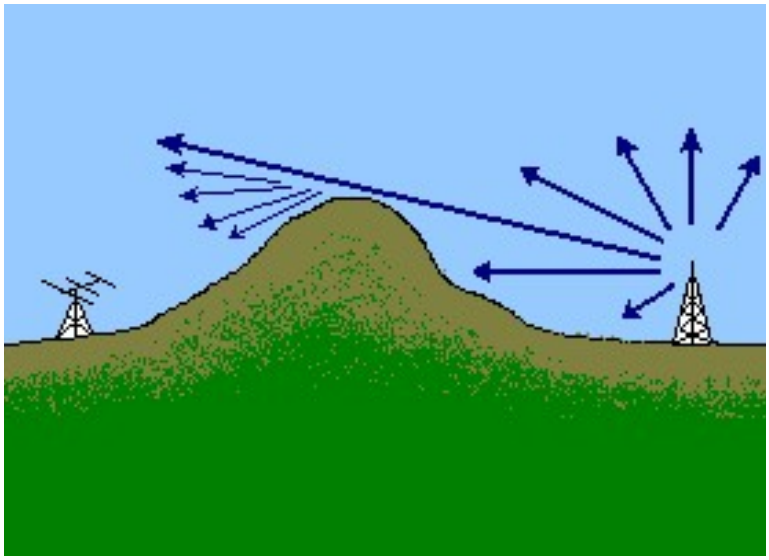
- Ideally the designer will do several systems a year to keep fully engaged in the TWIG wireless products (that is generally true but you have to start somewhere).

- Bundle the wireless products with other Nelson products so compatibility is assured (it is best to combine TWIG wireless equipment with Nelson valves and other Nelson products.)

- Be selective choosing the initial projects. They will be the best projects that have people that have some successes already and a good relationship with the Nelson TWIG dealer. Try to stay away from projects having personnel which have a short fuse because the first experience may be a bumpy road.

3.4 WORKING WITH RADIOS IN IRRIGATED AGRICULTURE:

Radio signals have issues penetrating water and soil. These are in abundance in the field. When radio waves hit an obstacle like the soil some of the power is reflected and some of it is absorbed into the ground. In either case the signal is weakened. Normally there is a lot of water in vegetable crops which will absorb the signal. Keep in mind that for farm crops such as onions the crop growth changes as the season progresses. Initially the bare ground transforms into full onion tops filled with water. Stay close enough to the controller or use a repeater so that it does not become a problem.



Obstructions to wireless signals can be a problem in agriculture.

3.5 THE TWIG LIST OF BEST WIRELESS PRACTICES:

Care in following the rules of good wireless practices will provide for successful radio communication. Operating outside of good practices may cause your communication to malfunction and stop working.

1. Keep within the recommended range. Locate antennas as high as practical.
2. Stay within the recommended environmental limits. Plan for crop growth so it does not block the signal and so that you can have good communication for the life of the crop.
3. Keep in mind that the TWIG should be accessible because they contain batteries that will need to be replaced after some period of time.
4. Watch the battery power. A radio's power determines the strength of the radio's signal and its range. That power rating also affects the radio's battery life. For example, a 1W radio may have a stronger signal and transmit farther than a 1/2 W radio, but it will also draw more power and drains the battery more quickly unless there is a sleep mode. Nelson's TWIG system has both high power and efficient battery management because it sleeps between every 20 second two-way data transfer. Because it's more important to have a reliable system than a powerful one, it's best to have a system such as the TWIG that is designed to balance the best signal and the lowest power battery possible.
5. Other components can be added to the system to increase wireless control coverage. For example, many systems are outfitted with repeaters, which receive and relay signals. This allows you to use a radio to transmit and receive over a larger area.
6. Never operate with any other battery or power source than specified.
7. It is not allowed to co-locate (be next to each other or closer than within 12 inches) with other radios and to transmit simultaneously.
8. Never operate with any other antenna than what is supplied for approved use.
9. TWIG wireless control systems are pre-approved by the FCC and do not require licensing; however, installations near an airport are subject to stricter rules. If near an airport then check with the local FCC for more details.

SECTION 3

KNOWLEDGE QUICK QUIZ QUESTIONS

1. Select the best answer.
   A pressure relief valve can save a lot of problems. Which of the following makes pressure relief essential?
   a) lower pressure pipe is less expensive. It may already be in the field.
   b) unexpected things can happen and the relief valve acts as if it is a fuse to protect the system
   c) it is the first rule of automation
   d) all of the above

2. True or False?
If there is no place for dumping water from a relief valve, then it likely isn't needed. Pressure relief can be left off of the system.

3. Choose the best answer to complete the sentence.
   A repeater can extend the distance that a TWIG system covers so the repeater ...
   a) should always be planned for and included in the list of materials.
   b) is a signal booster.
   c) can be added anytime if needed.
   d) makes it so that a radio operator license is required for the grower.

4. True or False?
Ordinary controllers limit using the same valve to only one program. A useful function built into the TWIG system is that any valve can be in more than one program at a time.

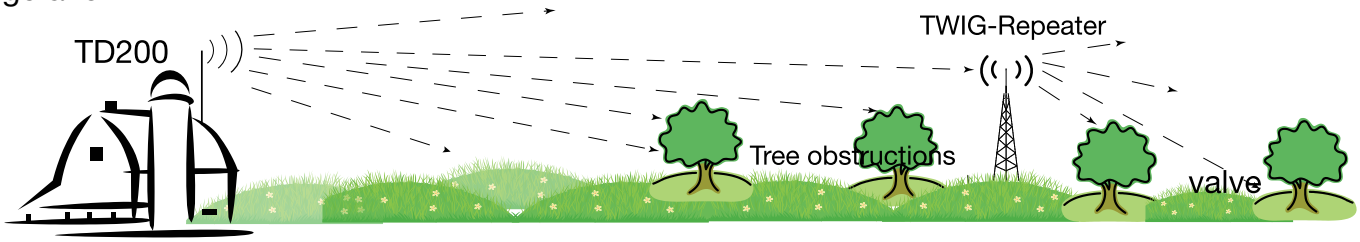
5. Choose the best answer to complete the sentence.
   The TWIGs have ideal power management. A big part of long battery life is the _____ mode that takes over when the radios are not working.
   a) switch
   b) sleep
   c) charge
   d) pump

ANSWERS ON PAGE 68

Section 4: System Planning

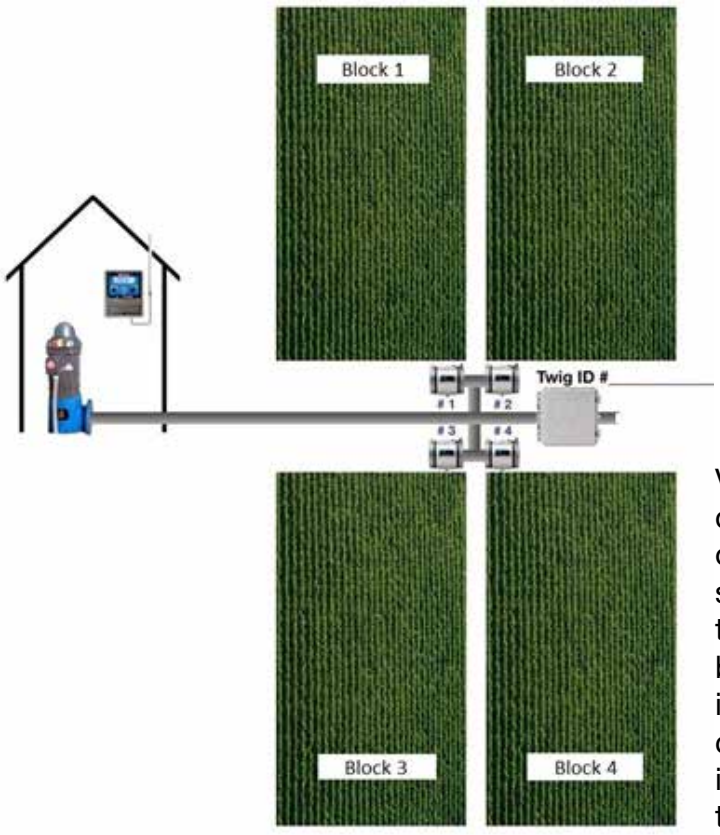
4.1 HOW TO BUILD A WIRELESS VALVE CONTROL SYSTEM:

Understanding the path of the radio signals: All the valve control commands originate at the TD200 controller. The signals between the radios move in both directions for transmit and receive. You must plan for the signals to reach the valves and be sure to avoid obstructions of soil, water and vegetation.



Line-of-sight requirement: The radio signals for the TWIG network are line-of-sight between antennas. This graphic sketch above shows good line-of-sight between the barn and the repeater antenna. On the other hand, a line-of-sight intercepts obstructions by the trees. That would obstruct or diminish radio signals farther out to the valve. In this example a repeater was needed. One other possible solution is to use a pole and elevate the TWIG above the tree as shown in the picture on the right.

TWIG mounted over tree



Valves in a cluster require fewer TWIGs: Irrigation design for wireless means a different approach to the overall field. Designers must carefully plan the water source, where the pumps will be located and where the valves are planned. The valve location for field blocks may benefit by being close together as shown in this example. The advantage is that one TWIG-4 can be used to control the four valves if each valve is not more than 50 away. Each valve has an identity that is unique and can run independently.

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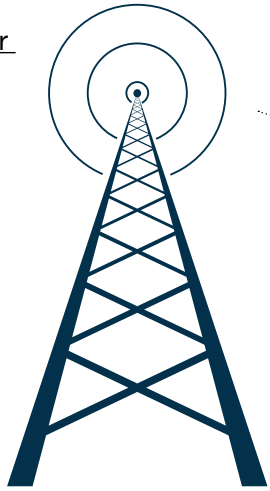
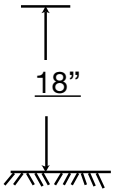
BAR GRAPH GUIDE FOR SPACING TD200 DISTANCE TO TWIGS IN VARIOUS CROPS

TD200 controller antenna 15 ft. height



TWIG in the field located 18 in. height



DIRECT LINE OF SIGHT

LOW GROWING ROW CROP

TRADITIONAL TREE SPACED ORCHARD

HIGH DENSITY TRELLIS ORCHARD TREE & VINE

ADJUSTMENT FACTORS

TWIG HEIGHT	ADJUSTMENT TO BAR GRAPH DISTANCE
On the ground surface	40% *Example: Spacing limit to 40% of graph*
At 18” above ground	100% of graph distance
At 6 ft. above ground	125%
At 15 ft. above ground	150% *Example: Use graph distance x 1.5*

Stay within signal range: A common problem is to space the radios to far apart and not consider obstructions that block the signal. Be sure to check the range. If the distance exceeds the range then use a repeater to make the communication reliable.

Why a strong signal is important: A weak signal will work harder thus taking more battery power. Precise timing and good signal strength helps a lot so stay within range. Batteries are an essential part of the TWIG system and great care has been taken for effective power management. Waking and sleeping each radio when they are not working is a good way to retain the battery charge but knowing when to sleep and wake up again is the key. The radios will not sleep until the message return has been completed. Until a reply from the field TWIG confirms back to the controller, the "retry" stays working. So the sleep time advantage can be used to extend battery life. Strong signals result in longer batter life and in a reliable system.

Communication between the TD200 controller and each TWIG:
The simplest route of the radio signal is direct. Keep in mind that radio can project is all directions at once so very complex signal routes can be developed. It is best to set up the network in the field so that each TWIG talks directly back and forth to the controller. Repeaters can be used if necessary.

THE CONTROLLER ANTENNA IS STRONGER THAN THE TWIG ANTENNA. LOCATE THE TWIGS CAREFULLY!

Determine range between controller and TWIG valves:
It is essential for owners to know the maximum range for the system. The distance presented in the guide are only achievable under optimum installation conditions. The environment is the variable which must be considered in all aspects of the radio system.

Basic range factors:
Radio signals have issues penetrating water and soil. These are in abundance in the field. When radio waves hit an obstacle like the soil some of the power is reflected and some of it is absorbed into the ground. In either case the signal is weakened. To overcome this issue two antennas have been designed within the TWIG box. The TWIG has built in a signal logic to immediately switch to the antenna having the stronger of the two signals. Still it is necessary to adjust the range graphs if the radios are on the ground.

There typically is a lot of water in crops which will absorb the signal. The graph below is used to show the limits of spacing between the units in the field. To build these graphs radios have been compared at several heights. The height of about 18 inches above the ground was selected for the TWIG as a typical height. But predicting variables in the crop and environment are impossible.

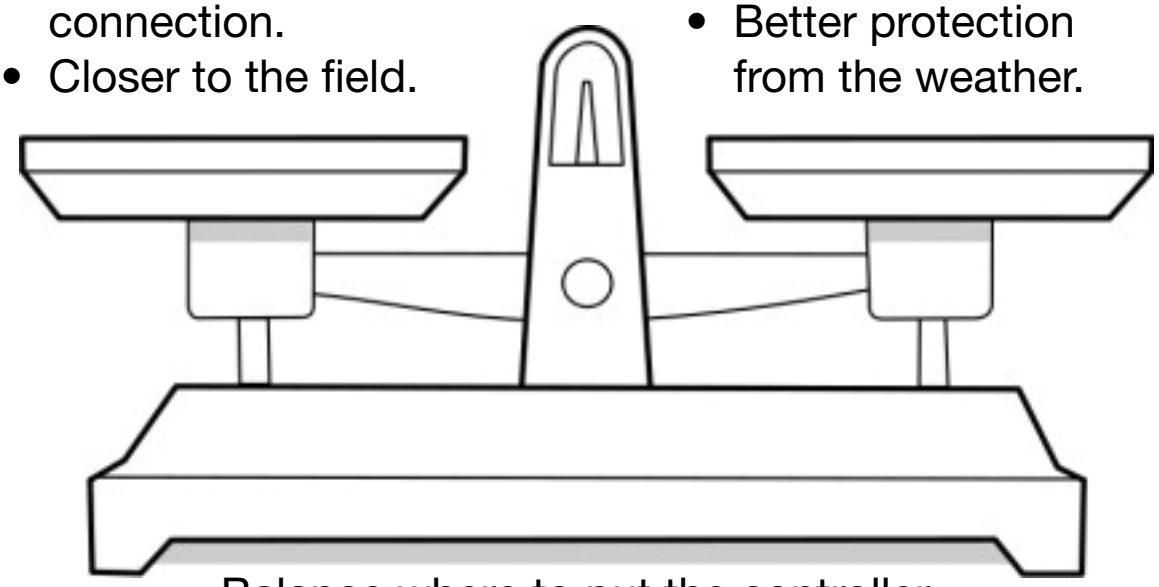
4.2 THE TD200 CONTROLLER LOCATION:

Start the system setup at the TD200 controller. Otherwise you may waste time because the network can not be setup if the TD200 is not turned on. The antenna and controller mounting should both be done at the start. When powered on, the TD200 controller sends out the radio signals and permits the appropriate TWIG units to join with it. The following are the steps to take for installing and setting up a system. If a TWIG-Repeater is going to be used then it needs to be powered on too. Don't turn on the TWIGs until the TD200 controller and any TWIG-Repeater are powered on.

STEP1: Consider the location for both the controller and the antenna. Balance the benefits when choosing where the TD200 is situated.

- <u>TD200 at Pump:</u>
- Operator present during start-up.
- Direct flowmeter connection.
- Closer to the field.

- <u>TD200 at HQ:</u>
- Electrical service.
- Internet may be there for future connection.
- Better protection from the weather.



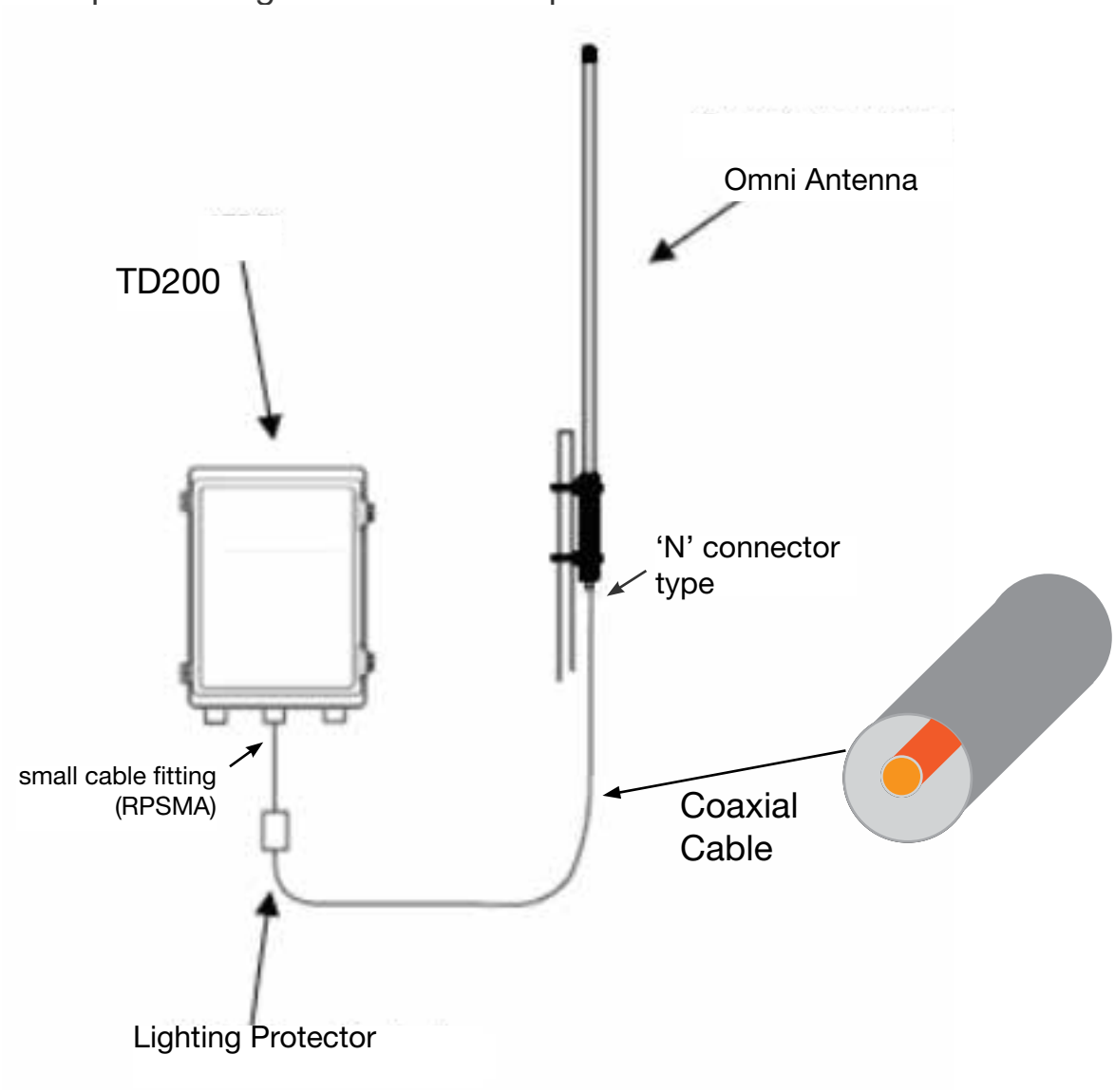
Balance where to put the controller.

ANTENNA MOUNTING

One of the questions we typically get is, “What’s the best way to mount the antenna for the TD200?” The answer is “It’s important to mount the antenna at a high point.”

Whichever length of Coaxial Cable you choose, it is imperative that you handle it correctly. Because the cable consists of a small conducting wire, it really is no stronger than that tiny wire. It’s very easy to get a kink in a cable when you’re pulling it through a hole, for instance, and that could break the small antenna wire. When that happens, the cable is useless.

Example drawings of antenna setup.



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SECTION 4

KNOWLEDGE QUICK QUIZ QUESTIONS

1. Choose the best answer to fill in the blank.
   If you know how to design a hard wired irrigation control system then your knowledge helps you to plan a good wireless system. The big thing is to plan the system while understanding that _____ is the conductor and the radio signals and the waves radiate in all directions.
   a) wire
   b) air
   c) plants
   d) soil

2. True or False?
A common problem is that the distance between the controller and valves is to far?

3. Finish this sentence from the answers below. Antennas are important and _____.
   a) can be added anytime if the wire gets broken.
   b) should always be planned from the start and included in the system list of materials.
   c) only transmits the TWIG signals.

4. True or False?
The range distance bar graphs are very helpful to make an approximate field layout. These graphs help guide field designs so that the signal will reach the intended TWIG every time _____.

5. True or False?
The location of the TD200 can be randomly selected without much planning. You can always put the TD200 at the office so you can watch flow meters and pressure gages while you start up the pump _____.

ANSWERS ON PAGE 68

Section 5.0: Field Solutions:

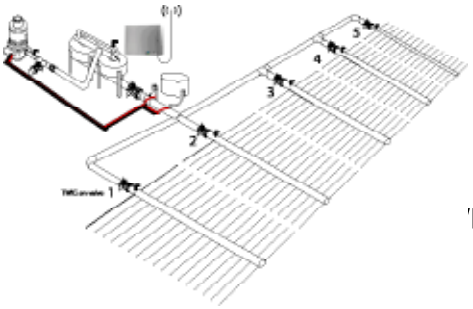
TWIG features really show up in the field to fit the variety of applications. Nelson Irrigation has developed a unique communication method. Radio signals can have so many signal paths that sorting out problems in a field can be very difficult. The TWIG network solution is reliable and simple signals. The signals are easily checked at the controller and at the TIWG valves. That saves a lot of time. The following applications demonstrate the TD200 TWIG network.

5.1 A MAP IS ESSENTIAL FOR A FIELD WIRELESS CONTROL PLAN:

The first thing to do is get a field map. It will help you place the TD200 controller in the best place. Next using the map of the field determine the distances from the controller to each valve. If any valves are separated by more than 50 feet then a single valve TWIG model will be needed at each valve. By considering the crop and the elevation of the antenna, the owner must make the decision of using either the TWIGi (internal) or the TWIGe (external). Always keep within the allowed signal range shown on the bar graphs in Section 3. Write the TWIG number on the field map. In the field it is good to start first by setting up the TD200 controller. This is so that the radio signal strength can be checked along the way while installing the TWIGs. This signal checking capability is a great feature to use during setup.

Always make a field map before doing a control plan. Begin your plan at the TD200 controller. Use a pressure relief valve to protect the pipe system!

5.1.1 Row crop field example: A typical field for row crop is shown below. Most fields will use only one TD200 controller. It is generally located near the pump. This example shows valves for each control block. The controller is close enough to each valve to communicate directly to each one.



'IG

Figure 5.1 Examples of row crop fields for drip irrigation. The TWIG-2 is on a stake and is setup to operates two valves.

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5.1.2 Communication STAR route to field valves:

The STAR is the simplest route of the radio signal. The sketch below show how a star links to the controller. Keep in mind that radio can project is all directions at once so very complex signal routes can be developed. Below is a STAR diagram of the way a field may be set up so that each TWIG-signal talks back and forth directly to the controller.

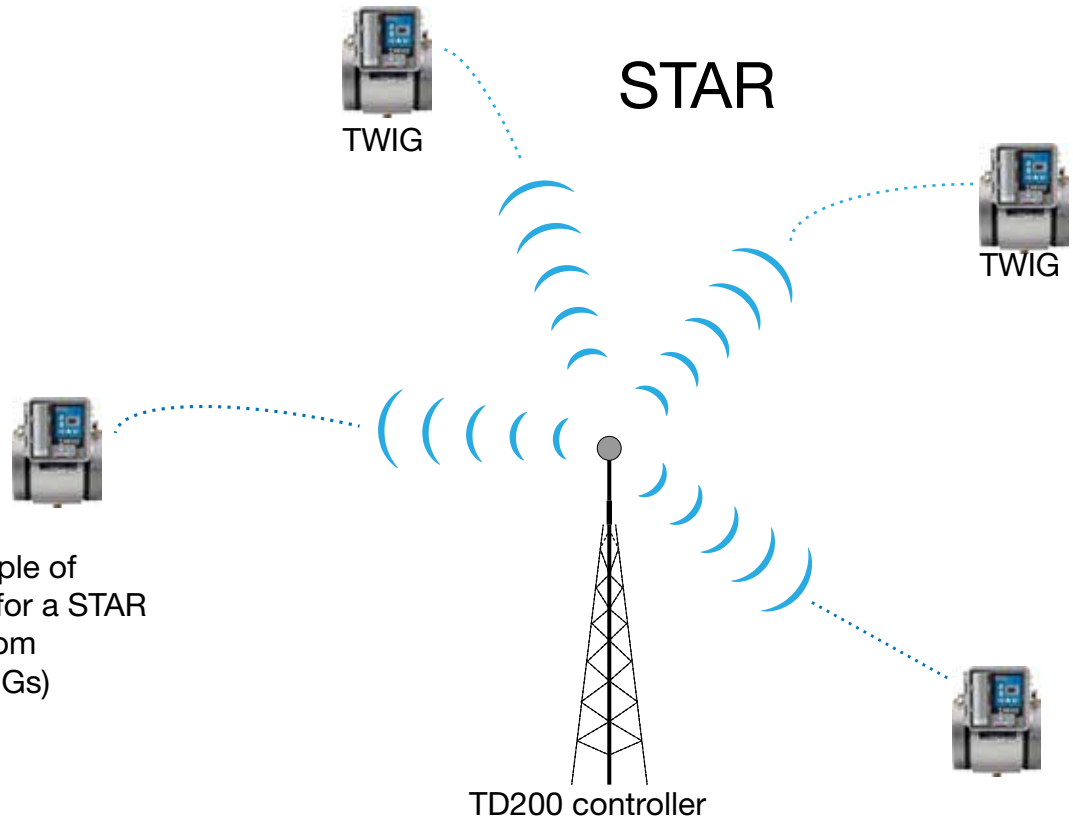

Figure 5.2 Example of communication for a STAR (routing direct from controller to TWIGs)

The STAR routing is the easiest to setup and to troubleshoot. All communication is direct. It is always two-way.

5.1.3 CONTROLLER AT PUMP/FILTERS/HEADWORKS

The TD200 Controller will operate the pumps and master valves (by use of the CONTACT-TWIG). The controller will turn on the relay that connects power to the pump at the time watering starts and then when finished it will shut off the pump. If a BL1000 is used then these contacts are not part of the wireless control but are to be wired right to the BL1000 controller using the two-wire decoders.

5.1.4 Orchard and vineyard example:

The TD200 wireless control system fits well into the orchard and vineyard crops. These crops take a long time to get established and to reach production of the trees or vines. The TD200 durability is designed for long life and the fact that there are no wires will reduce maintenance costs over the long run.

5.1.5 TWIG-Repeaters make a chain together to cover long distances:

This shows a diagram of how to reach long distances using a repeater chain route. Each repeater relays messages along the chain. Any of the TWIG models can be used any place along the chain (if within the range distance). The critical distance to watch out for is that distance between repeaters that chain together. The messages to the further out repeaters goes through each repeater link clear to the end. A missed signal from any repeater will break communication to the rest of the chain. The goal is for each TWIG along the signal route to hear all the messages and respond to any commands specifically intended for it.

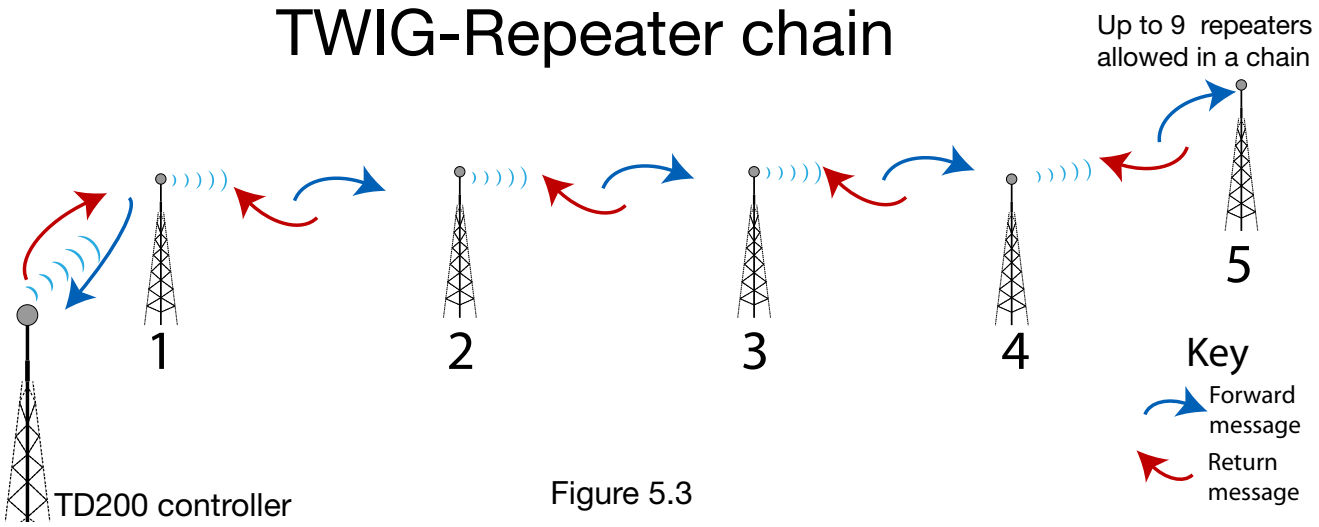

Figure 5.3

Make sure every link of a Repeater chain is good in order to be reliable! A break anywhere orphans the last end of the chain.

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Example of a TWIG Repeater solution: In this example of an orchard/vineyard it was observed that the distance between the TD200 and valves 8, 9, 10, 11 and 12 exceeded the range. The signals were weak. A chain was set up by adding repeater 'R1' which was needed to bridge the distance between the TD200 and valve 8. The other weak valves still had weak signals. So repeater 'R2' was added. As soon as that was done then TWIGs numbered 8 through 12 were linked automatically into the network chain through the repeaters to get a strong signal from the TD200 controller. Repeaters can be located at any convenient place. Here the repeaters were placed outside the orchard to be out of the way. The 'R3' repeater is just an alternative.

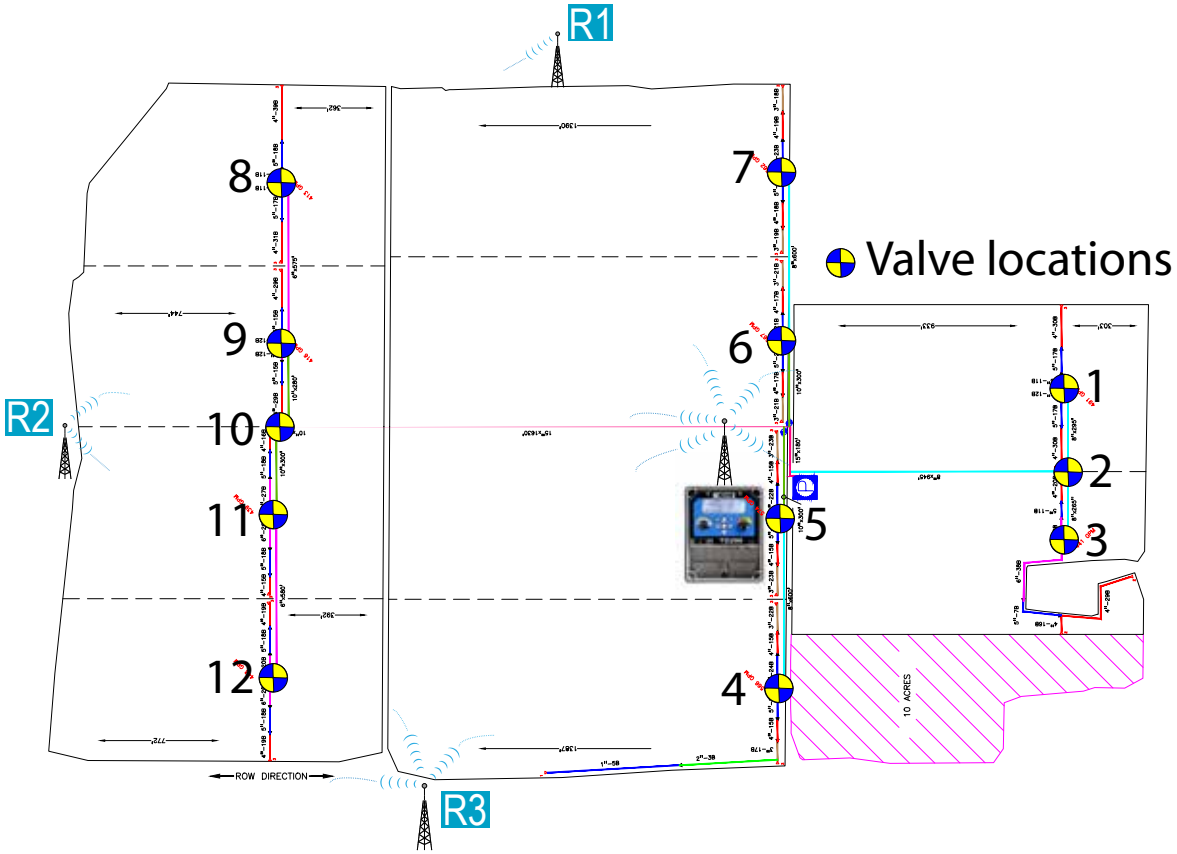

Figure 5.4

5.1.6 A Star/Chain combination works well in agriculture.

Agricultural field variation as above can easily be handled by the TD200 controller because wireless routing is designed to fit all shapes. The Star/Chain combination routing shown above can handle some valves close together and some long distances away. Some TWIGs can be setup to communicate directly to the controller and others can be setup to work through TWIG-Repeaters. Each TWIG must be located within line of sight range to each TWIG-Repeater. The signal transmitted from the TWIGs back to the controller must be checked because it is sent from internal antennas that are not as strong as the repeater antennas.

5.1.7 Feedlot dust suppression gun control:

The TWIG control system here is used to open and close valves for the gun sprinklers distributing water that suppresses dust in cattle feedlots and dairies. This example shows the sprinkler layout that is simple and cost effective. The simple 8 valve wireless setup will work well here.

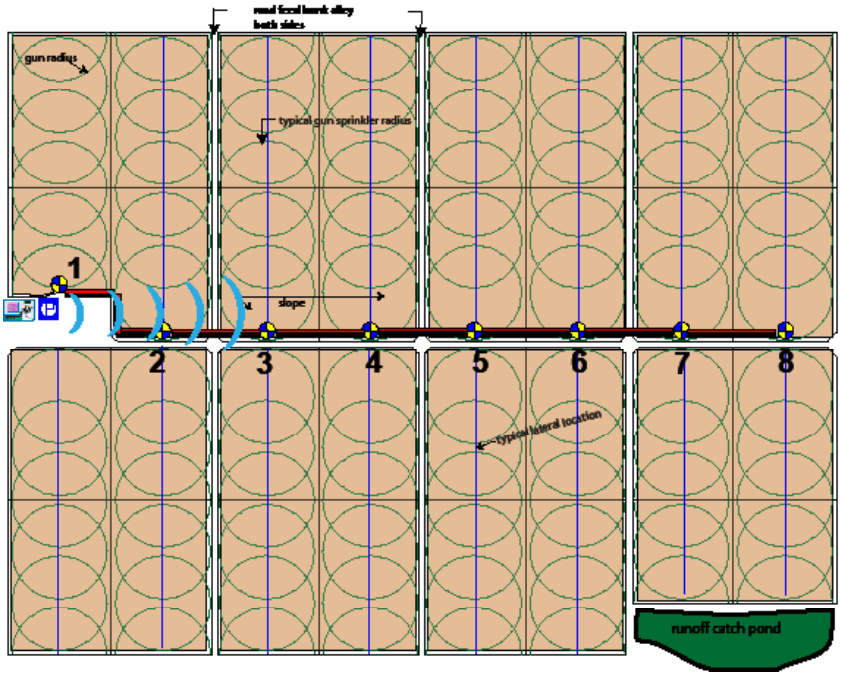

Figure 5.6
TWIG advantages are for changes or retrofit to existing feedlots because it is easy to add any TWIG into a system network.

TD200 advantages:
Operators can quickly change the time of watering for each valve. Very short wetting cycles can be made by easily adjusting the group length of time (%) to increase or decrease watering time. That is important to avoid wet muddy areas.

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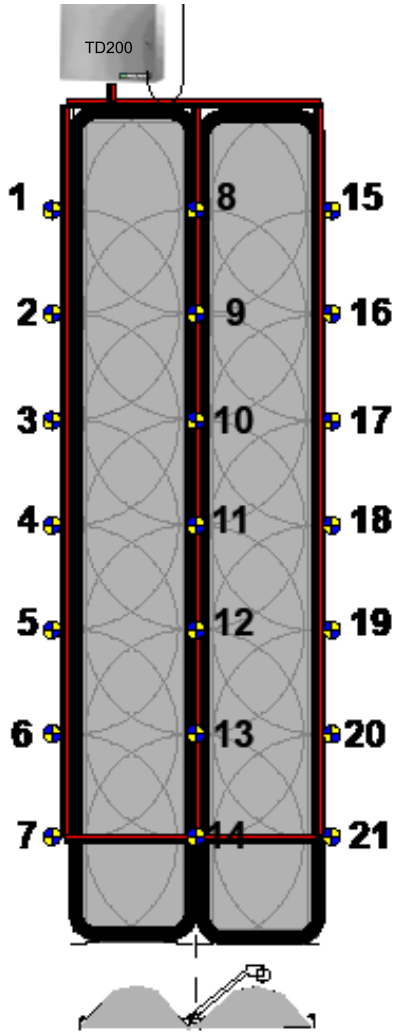
5.1.8 Industrial coal site dust suppression

The TD200 controller TWIG system works well for valves that operate dust control gun sprinklers. Some systems have long communication distance requirements and coal pile obstructions. The TD200 signal is to operate the 800 Series valves at each gun. The layout shown here is for two parallel coal stock piles. The piles are typically made utilizing a stacker loader that operates between the piles. Each valve is a TWIG location. Using the plan layout, it is best to have three chains made by having TWIG-Repeaters located at number 1, 8 and 15. Three simple chains will work well here.



End view of coal piles

The pile length and shapes are ever changing. There is typically a lot of equipment activity at these sites and many obstructions. Sprinklers and valves should not be spaced at the maximum limit. Be conservative in spacing because dust in the air can weaken the signals.

When the pile size has been reduced then the unused gun positions can be easily added or removed from the TWIG radio network and removed from the watering schedule. The antennas at the coal sites are generally elevated high above the maximum height of the coal stack.

These sites use both full circle and part circle sprinklers which have different watering times. The remedy is an easy adjustment to the TD200 controller program. Also full circle sprinkler valves can easily be grouped into sets so that the right amount of watering time is set for full circle guns because these must operate twice as long as the time for the half circle valves. The main consideration is to get adequate water coverage quickly to suppress wind blow of the dust from off the top of the piles. Owners of these systems like to run very short rapid cycles. A good system will be flexible using no more sprinklers than essential but providing good water coverage.

Wireless dust control needs to be flexible because the coal piles change shape frequently.


Figure 5.7

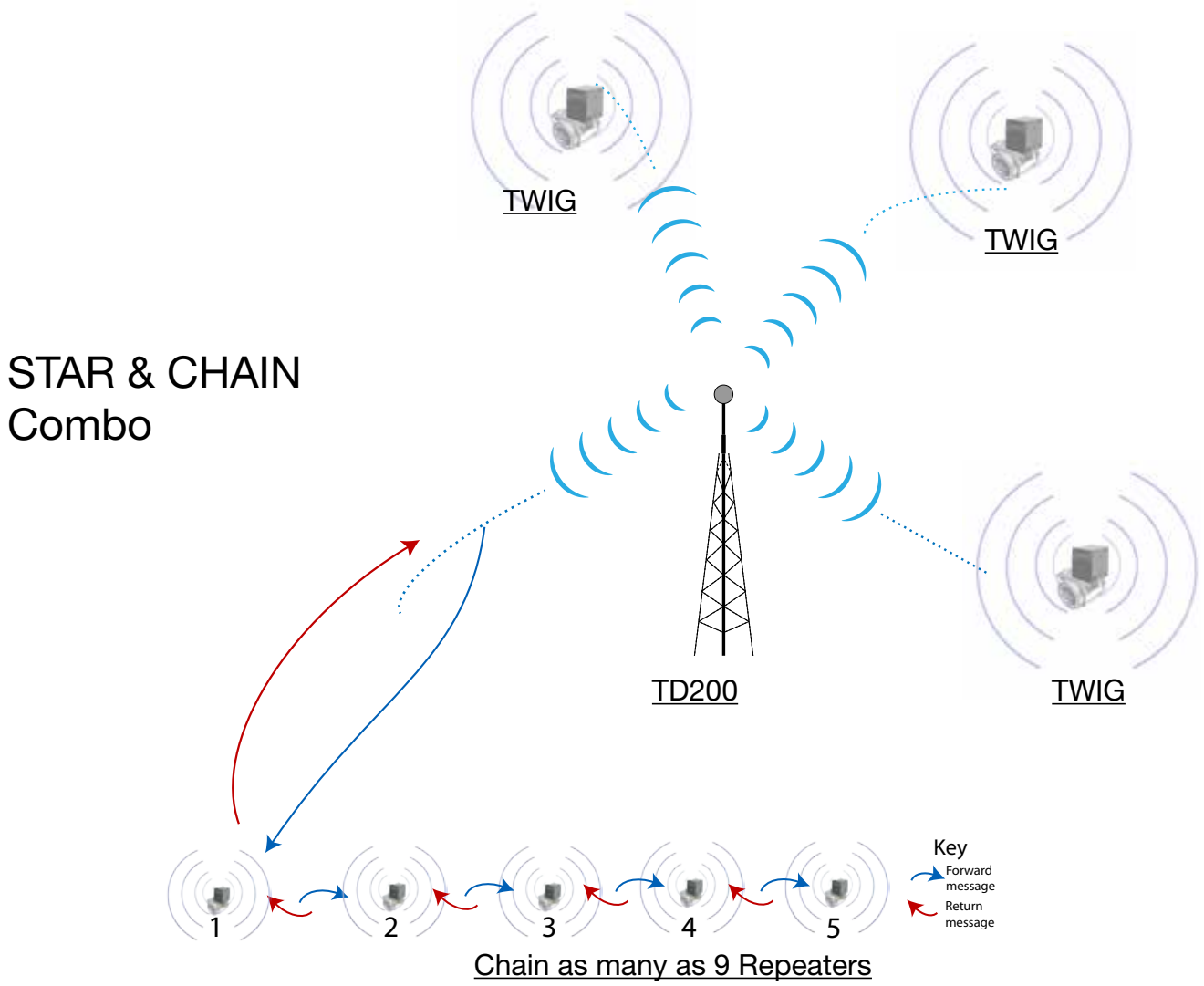


Figure 5.8 Sketch of communication in a Star/Chain combination. The TD200 controller communicates to each TWIG and to the repeaters that are in a chain. Each repeater relays to the next one. This works well to go around problems of signal blockage.

5.1.9 Ways to use the TWIG-4 multi-valve model:

The use of the multi-valve TWIGs is a good way to have only one radio serve many valves. Many drip and filtration valves are located in grouped clusters right next to each other and are remote from the TD200 controller. The TWIG-4 are for several valves that are in clusters. Then one radio can serve as many as four valves. Note that wire is used to connect each valve to the TWIG-4.

The multi-valve TWIG-4 will work well here as long as the distance between the controller and the farthermost valve is less than 50 ft. (the limit of wire length from TWIG to valve). Each valve has a unique id and can work independent of any other valves.

A######(1) ← Last digit of TWIG label.
B######(1 or 2)
D######(1,2,3 or 4)

First letter indicates 'A' for one valve, B for two valves and D for four valves

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Multi-valve clusters

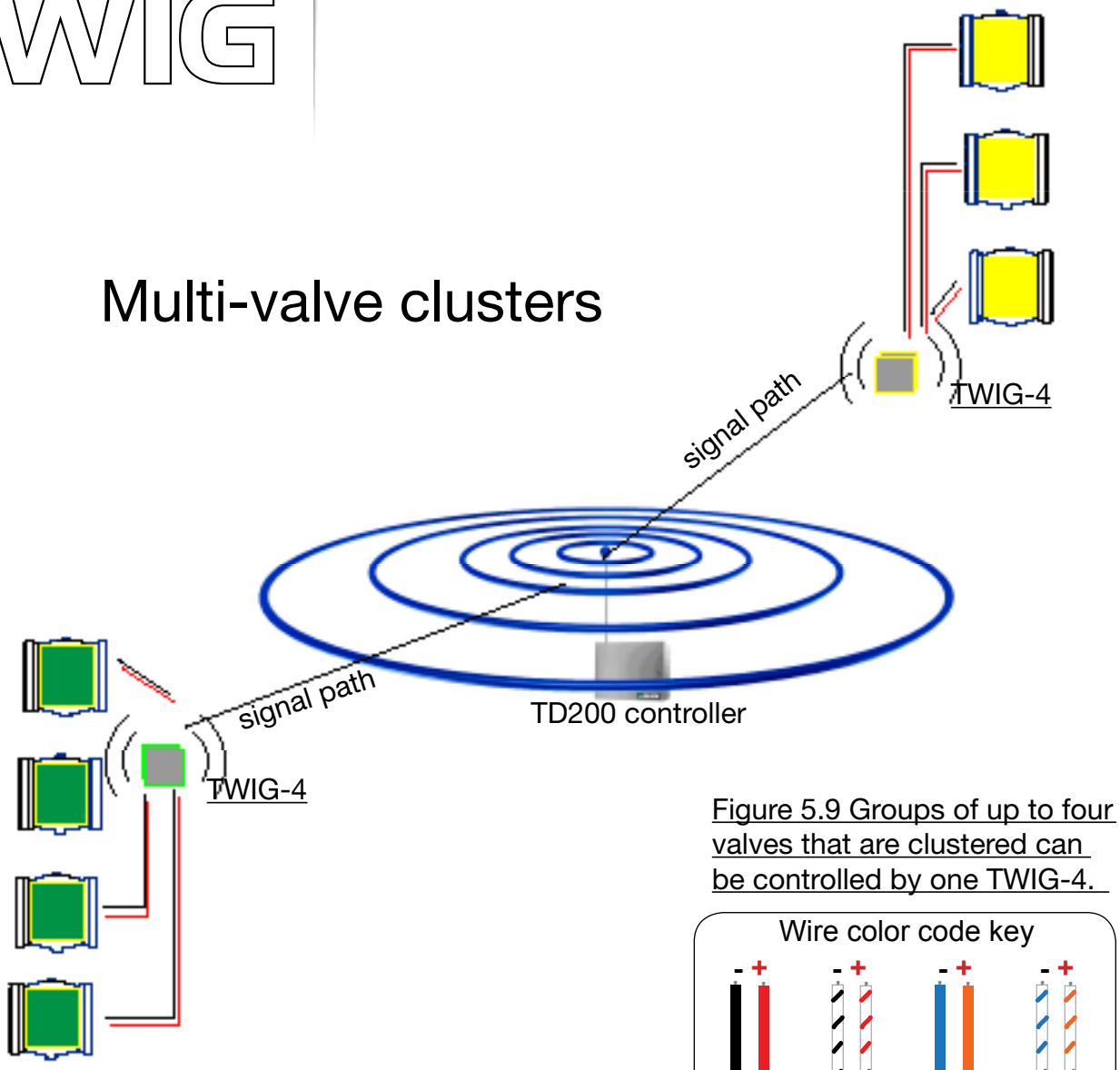

Figure 5.9 Groups of up to four valves that are clustered can be controlled by one TWIG-4.

5.2 Using the wireless Contact-TWIG to signal switches to run pumps:

In the event that it is required to run a pump, the CONTACT-TWIG contains 4 latch switches that can do it. The Contact-TWIG can be set as a master valve. These contacts can work independently to operate a portion of the time or only when the a pump is running. Note that as a safety protection it is a good plan to have a manual switch to disconnect the pump. This gives some protection to avoid accidental operation when not wanted. See Appendix D for details about the Contact-TWIG unit.

TWIG note

The Contact-TWIG and the TWIG-4 provide multi-valve wireless control that can handle as many as four switches or valves. Wire length connecting these must be limited to less than the distance of 50 ft.

SECTION 5

KNOWLEDGE QUICK QUIZ QUESTIONS.

1. A filed map is useful. Select the items that can be put onto a field map.
   a) location of the TD200
   b) valve locations and the radio id for each TWIG
   c) distance to the valves
   d) obstructions that will block signals
   e) all of the above

2. True or False?
Most fields use only one TD200 controller.

3. Fill in the blank with the best answer.
The simple networks are best so the TWIG network signals have a path that is like a _____. network.
   a) Chain
   b) mesh
   c) direct sequence
   d) star

4. True or False?
In order to use a Contact-Twig you have to use a two-wire decoder or a repeater.

5. Fill in the blank with the best answer from the list below.
Orchard trees are obstructions to radio signals so many orchards use _____ to increase the distance that the network can cover.
   a) multi-valve TWIGs
   b) bigger solar panels
   c) repeaters
   d) none of the above

ANSWERS ON PAGE 68

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Section 6: Practice Exercises

6.1 PRACTICE EXERCISES TO IMPROVE UNDERSTANDING:

This section is to focus some exercises on specific types of application examples. Some programs will be created using the TD200 controller and the TWIG LED valve simulator.

Practice Exercise #1 — Using 'ADJUST'.

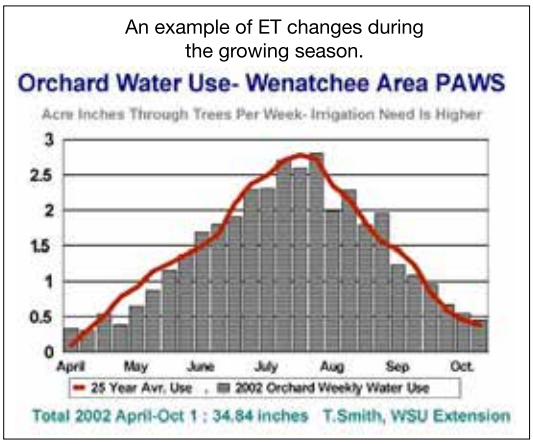
Goal is to make the simple way to change the irrigation time from spring irrigation to summer.

Project details:

You own a system that has 4 valves on it. You want to run each valve separately. You will run it yourself sometimes but other times you want to have a helper start the system. You want to run each valve for 5 hours right now during the spring and then later on during the summer heat you want to run each valve for 10 hours. Irrigation is to cycle twice and then stop.

Make a program. How would you do it? Hint: think about %

An example of ET changes during the growing season.



Solution:

Create a GROUP for each valve then make the run time of each one for 5 hours (one water cycle =20 hours). During the summer use the ADJUST dial position. Change the LENGTH duration to 40 hours and notice that the % changes from 100% to 200%. Each valve will then run the 10 hours of time you want.

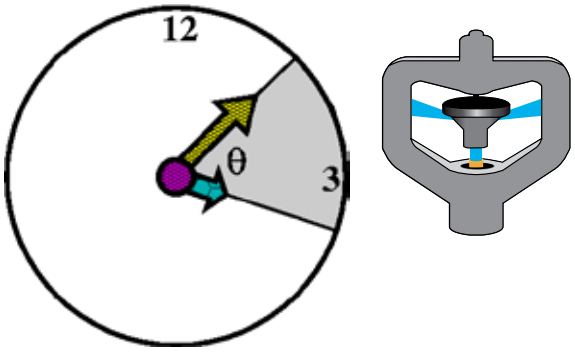
Practice Exercise #2 — Using 'SUSPEND'.

Goal is to temporarily suspend watering and then later restart back at the same place in the irrigation. Your pump also is watering other fields so it cannot be stopped.

Project details:

You need to set the controller so that while there is spraying to be done the water is stopped on one field then resumed later to complete this irrigation cycle. How would you do it? Hint: think outside the PAUSE box.

A timer that is waiting.



Solution:

Use the PROGRAM dial position. Select EDIT Program. Select the program for the field that is to be sprayed. Press the right arrow button to "SUSPEND". Press ENTER. Only this program will stop and any others that are running will stay running. When ready to resume watering this field then someone needs to simply change the program to 'READY'.

Practice Exercise #3 — Create a cooling cycle ‘Program’.

Goal is to setup a program that will to do frequent short irrigation cycles.
Project details: You want to cool fruit by running the system for 10 minutes on and 30 minutes off. Make the programs continuously repeat. How would you do the program and set the equal time for 4 valves?

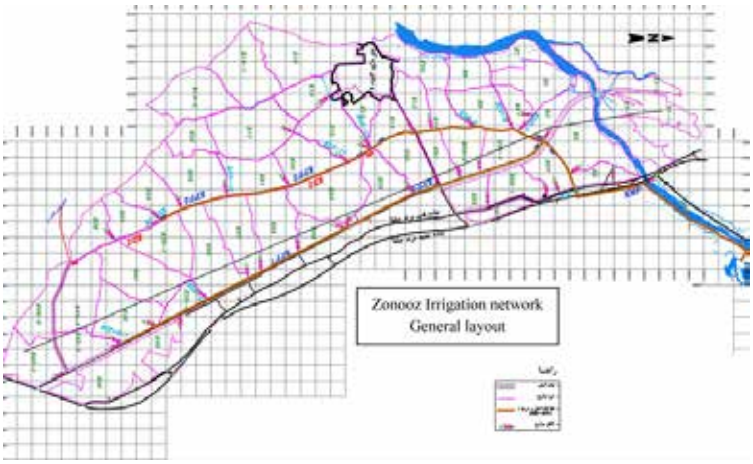
Solution:
Rotate dial to “PROGRAM” and make 4 ‘GROUPs’. Make each group set for 10 minutes then change the program to ‘READY’ after setting the cycles to +++ for continuous. The program will start when the right dial is rotated to ‘RUN’. It will repeat continuously until the dial is rotated from ‘RUN’.

A photo of a Nelson system used for frequent on/off cooling in an orchard of fruit trees.

Practice Exercise #4 — Create programs that each have only one valve in it then setup to run each valve separately.

Goal is to run each valve as a program to give individual control.
Project details: Consider that your fields are scattered so you need to give irrigation instructions to the irrigator by phone. The irrigator is at the TD200 when you tell him what to do. His experience level is to only change time but not do a lot with the controller. You want to run each valve a specific length of time. How would you do it?

Solution:
Previously you would have made a program for each valve. When you want to run a valve you have the irrigator run the program. You explain to simply turn to the ‘ADJUST’ dial position, select the program, press the right arrow to ‘READY’ and press ENTER. Your program will start shortly to run the valve for each program.



A good way to handle valves scattered over a big area.

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Practice using the demo kit

Purpose of the exercise is to experience using the Demo Kit #12338:
This is the hands-on opportunity to experience the user's setup and programming for the Nelson TD200 controller. The TD200 has been designed to be the simple wireless controller for the TWIG system. In order for these to be a good learning experience, a list of things to do has been created. As you do the exercises it will be useful to make notes for future reference.

Hardware to help you get familiar with the TWIG system:
A wireless TWIG-4 LED Valve Simulator has been made so that the programs can be tested by you and the results demonstrated by red LED lights. The LED lights show when a valve would be watering. Also the display menus for each dial position have been printed on the following pages for your reference.

1. Get familiar with the TD200 and the TWIG LED valve simulator box
   1.1 TD200 front panel control
   1.2 Graphic of the wireless TWIGs and LED valve simulator Box
2. Create a network by setting up the multi-valve TWIG-4 to join the TD200 network.
3. Set the correct Date & Time on the TD100
4. Create two programs to use the LED valve Simulator. The two programs should be named DRIP2 and TRIAL1. Make three Groups of valves in Drip2 program and two Groups of valves in Trial1 program.
5. Change the duration of watering to 2 minutes for each group.
6. Experiment with initially leaving one of the valves out of the Trial1 program. Then add it back into the program.
7. Using the USB memory stick Export the programs, Delete the programs from the TD200 and then Import the programs back into the TD200 memory.
8. Adjust one of the programs in some way and then assure that the valves lights do what is wanted.

Demo kit #12338.

7.0: Specifications and Approvals

The Nelson Irrigation Corporation wireless TWIG valve control and TD200 controller is a radio network system. Communication is by radio in the 900 mega-Hertz frequency range. The products used in the system complies with the FCC rules and does not require a radio license. It also has received Industry Canada approval. The compliance with FCC rules has been established for the antennas provided by Nelson and those are the only antennas that are authorized to be used for the wireless TWIG system. Components in the existing product line are listed below.

7.1 TD200 controller

Controller Enclosure:	Poly-plastic
Controller Enclosure Dimensions (no antenna):	10.2” x 11.25” x 5.5”
Controller setup for remote antenna:	SMA connection for antenna 6 dbi omni
Controller Weight (with antenna):	5.5 lbs
Enclosure NEMA Rating	4X
Power Options and (input current wireless):	110VAC (150mA), 12VDC (350 mA)
Electrical Connections:	wire leads and terminal blocks (110 VAC plug if ordered)

7.2 ‘TWIG-1’ module

Enclosure:	Fiberglass reinforced plastic
Enclosure Dimensions:	5.63”x6.88”x4.5”
Weight (with two ‘D’cell batteries):	2.94 lbs
NEMA Rating	4X
Connections:	24 inch wire leads for 1 latch solenoid
Radio Frequency:	908-922 MHz, 8 channels preselected by the TD200
Radio power	slightly less than 1 watt
Address identity:	factory assigned for each unit, first letter is A

7.3 ‘TWIG-2’ or ‘TWIG-4’ multi-valve module

Enclosure:	Fiberglass Reinforced plastic
Enclosure Dimensions:	5.63”x6.88”x4.5”
Weight (with two ‘D’cell batteries):	3.04 lbs
NEMA Rating	4X
Connections:	24 inch wire leads for 2 or 4 latch solenoids
Radio Frequency:	908-922 MHz, 8 channels preselected by the TD200
Radio power	slightly less than 1 watt
Address identity:	factory assigned for each unit, first letter B or D
Antenna options:	Dual internal antennas or SMA connection for an external antenna.

7.4 ‘TWIG REPEATER’ module

Enclosure:	Fiberglass reinforced plastic
Enclosure Dimensions:	5.63”x6.88”x4.5”
Weight (with no batteries provided):	2.50 lbs
NEMA Rating	4X
Connections:	Antenna connection is provided
Radio Frequency:	908-922 MHz, 8 channels preselected by the TD200
Radio power	slightly less than 1 watt
Address identity:	Factory assigned ID. Starts with the letter ‘E’.

7.5 'TWIG RELAY' MODULE

Enclosure:	Fiberglass reinforced plastic
Enclosure Dimensions:	10.2" x 11.25"x 5.5"
Weight (with no batteries provided):	5.5 lbs
Relays	Four 12 VDC latch contacts, 1 amp current capacity
NEMA Rating	4X
Power Options for input:	110VAC (???mA), 12VDC (??? mA)
Connections:	SMA Antenna connector
Radio Frequency:	908-922 MHz, 8 channels preselected by the TD200
Radio power	slightly less than 1 watt
Address identity:	Factory assigned.

7.6 ANTENNA AND ACCESSORIES

Antenna (standard for TD200 and REPEATER	6 dbi mono-pole Omni antenna
Mounting kit for standard 6 dbi	U-bolt bracket, fits 1"-1 1/2" diameter pole
Antenna for short range relays:	2dbi di-pole articulating antenna
Antenna connection:	SMA small connector
Antenna cable	Co-axial cable with end fittings

7.7 APPROVALS, COMPLIANCE

Approvals and compliance are based upon testing that was done with antennas that are supplied with the product The products within the TD200 system are substantially all manufactured in USA. These are the approvals to date and other approvals are pending.

7.7a FCC Rules

Contains FCC ID: ZH6-VRCOMM-HP / Contains transmitter module IC: 9686A-VRCOMMHP. All devices on the system complies with Part 15 Rules. Operation is subject to the following two conditions: (1)this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Normal operation as described by this guide does not require a FCC license by the owner.

7.8 APPROVED 'D' CELL BATTERIES FOR TWIG UNITS

Alkaline 1.5 volt 'D' cell batteries are acceptable for use. Several factors affect the service life, including the temperature and storage, depth of discharge cycles, and power voltage demand. The industry definition of the service life of a battery is the period until it drops to 60% of its rated capacity. The battery voltage is displayed as bars on the TWIG. Just remember that it is well worth using the highest quality batteries that are available and plan on replacing them at the beginning of the season.

7.9 TD200 NETWORK/PROGRAM SPECIAL FEATURES

Network setup uses a self-discovery technology. The TD200 network is made when a TWIG is placed in the setup (RESET) mode. The radios will search for available networks and display on the TWIG the TD200 numbers that are found. When the number that is wanted is ENTERED the 'join' process takes place within about 20 seconds. The TD200 can support 100 TWIG field modules and up to 9 repeaters.

If multi-valve modules are used then it is recommended that no more than 200 valves be controlled by one TD200 controller. It is possible to have as many as 400 valves controlled but not recommended more than 200 valves be used due to the complexity that may occur.

7.9a Programs

The TD200 controller has a large capacity able to easily hold 50 unique programs of moderate size. It is very flexible because there are few limits so that any TWIG/valve can be used in any program and the programs can run concurrently or individually.

Each program can have multiple valves. The time of each one can be individually set to operate in sequence.

7.9b Manual controller operation

The ‘Manual Control’ feature of the TD200 is useful to make a quick check of the system and to run some valves of a period of time in order to adjust soil moisture level. For running any specific valves to water for any reason.

7.9c Repeaters have advanced technology.

These will reinforce the network when needed otherwise they are not in the way for direct TD200 to TWIG communication.

7.9d This wireless technology has built in redundancy of signal transmission.

Due to the nature of wireless systems, transmission and reception of data can never be fully guaranteed. Although loss of signal is rare every communication in this network is double checked. The use of a pressure relief valve to protect the irrigation system pipes is essential.

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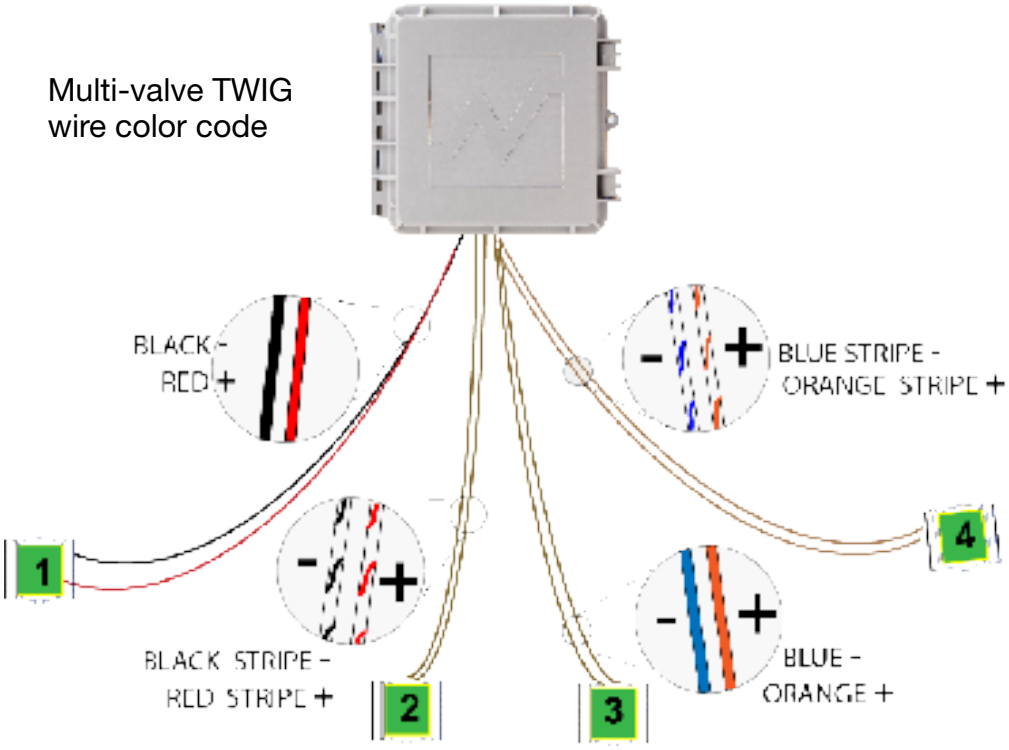

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Appendix A: Antenna Kits

Antenna factors for the best advantage and antenna kits:

The antenna is the main communication link. The range between the TD200 and the TWIGs depends upon good antennas. An antenna's power gain is a key value that describes the antenna's efficiency. As a transmitting antenna, the value describes how well the antenna converts input power into radio waves. As a receiving antenna, the value describes how well the antenna converts radio waves arriving from a specified direction into electrical power. Antenna gain is usually expressed in decibels, and these units are referred to as "decibels-isotropic" (dBi). For a given frequency, the antenna's effective area is proportional to the power gain. Due to reciprocity, the gain of any antenna when receiving is equal to its gain when transmitting.

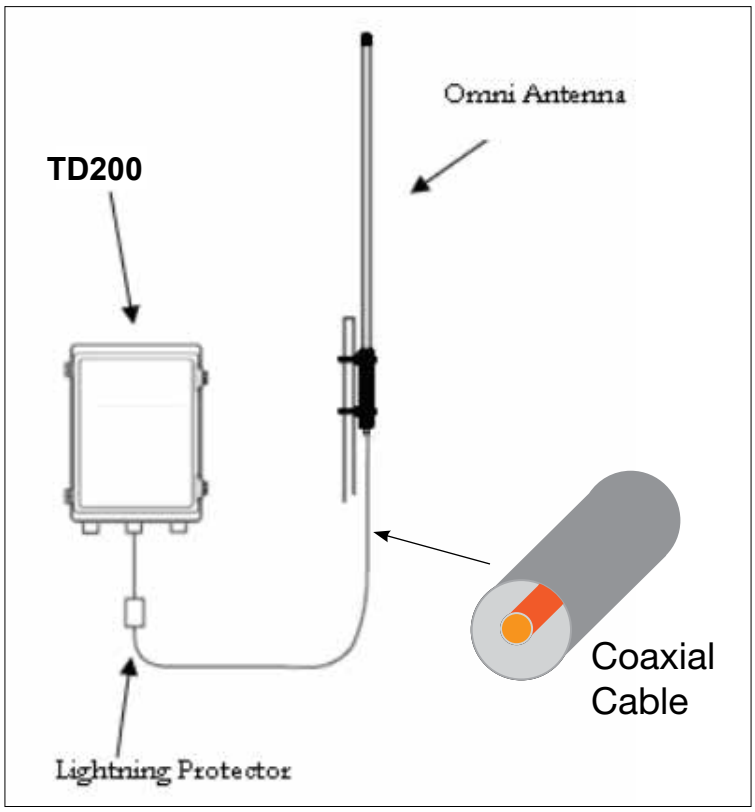
The Nelson Di-pole antenna is rated 2 dBi. The Omni antennas are rated 6 dBi (2.5x more). The longest range is achieved using the Omni antenna. Note: Only the approved antennas can be used for the TWIG network. Here are the kit part numbers:

12000-010	Omni with 10' cable
12000-020	Omni with 20' of cable
12000-030	Omni with 30' of cable
12000-040	Omni with 40' of cable
12000-050	Omni with 50' of cable
12281	Di-pole articulating (no cable)

Each Omni kit includes the following parts:

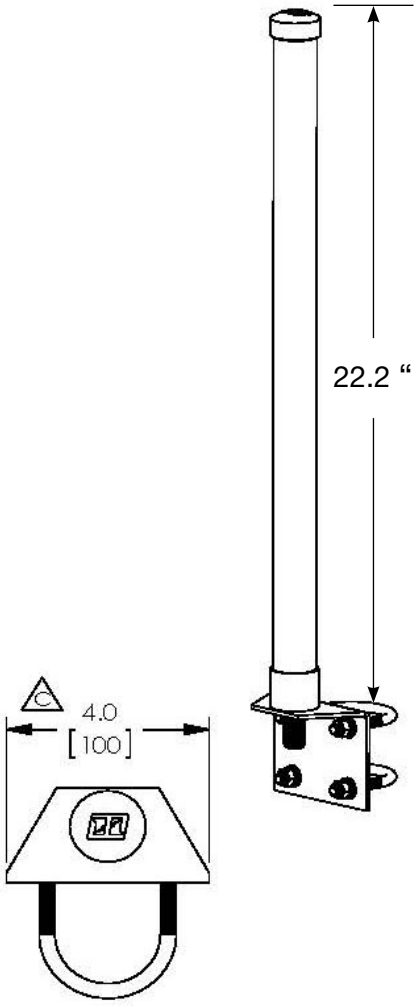
11818	Omni Antenna with u-bolts, +mount
11996-xxx	N to N cable (10, 20, or 30' long)
11865-xxx	RP-SMA to N cable (10' or 20')
11998	Coax weatherproofing tape
11997	Lightning Arrestor with mount

The only difference between these Omni antenna kits is the length of the co-axial antenna cable. The length should be selected carefully because there is some signal degrading within the cable. Length should not be any longer that needed but long enough that it easily connects. An appropriate length will have enough that a small amount of extra cable can be looped to give room for making the connections. The water proof seal tape must be used to keep moisture from entering the cable junctions.

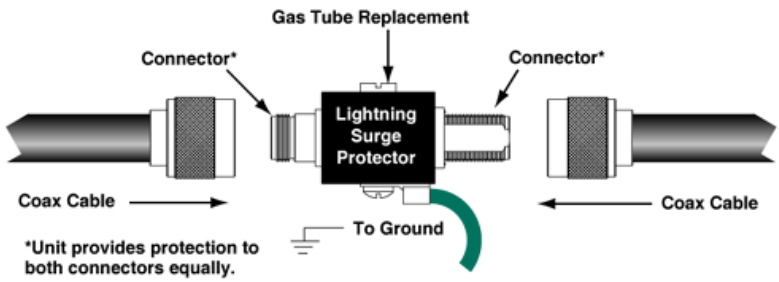


Sharp bends in the co-axial cable should be avoided.

The U-bolts in the mounting kit can be used to mount the antennas onto a round mast up to 2” O.D. (pipe size 1” to 1 1/2” diameter).



The lightning surge protector is to be located in the co-axial cable between the antenna and the device.



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Antenna Assembly

TWIG ANTENNA KITS INCLUDE:

11818	Omni Antenna with u-bolts and mounting bracket
11865-xxx	RP-SMA to N cable (10 or 20’ long)
11996-xxx	N to N cable (20’ or 30’ long)
11997	Lightning Arrestor with mounting bracket
11998	Coax weatherproofing tape

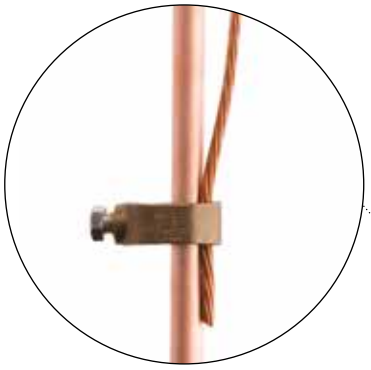
Please follow diagram below to assemble.

Combinations of cable are necessary for 30’, 40’, 50’ configurations

10 ft. Kit	20 ft. Kit	30 ft. Kit	40 ft. Kit	50 ft. Kit
11865-010	11865-020	20’ 10’ 11996-020 + 11865-010	30’ 10’ 11996-030 + 11865-010	30’ 20’ 11996-030 + 11865-020

NOTE: Copper grounding cable connects to lightning arrestor

Cable connection to wireless device
NOTE: Wrap all cable connections with coax tape.



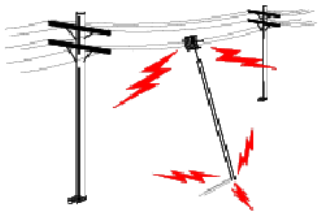
Customer supplied grounding rod and 10ga max copper wire

OUTDOOR INSTALLATION WARNING

IMPORTANT SAFETY PRECAUTIONS:

LIVES MAY BE AT RISK! Carefully observe these instructions and any special instructions that are included with the equipment you are installing.

IMPORTANT: Look over the site before beginning any installation, and anticipate possible hazards, especially these:



CONTACTING POWER LINES CAN BE LETHAL. Make sure no power lines are anywhere where possible contact can be made. Antennas, masts, towers, guy wires or cables may lean or fall and contact these lines. People may be injured or killed if they are touching or holding any part of equipment when it contacts electric lines. Make sure there is NO possibility that equipment or personnel can come in contact directly or indirectly with power lines.

Assume all overhead lines are power lines.

The horizontal distance from a tower, mast or antenna to the nearest power line should be at least twice the total length of the mast/antenna combination. This will ensure that the mast will not contact power if it falls either during installation or later.

TO AVOID FALLING, USE SAFE PROCEDURES WHEN WORKING AT HEIGHTS ABOVE GROUND.

- Select equipment locations that will allow safe, simple equipment installation.
- Don't work alone. A friend or co-worker can save your life if an accident happens.
- Use approved non-conducting ladders and other safety equipment. Make sure all equipment is in good repair.
- If a tower or mast begins falling, don't attempt to catch it. Stand back and let it fall.
- If anything such as a wire or mast does come in contact with a power line, **DON'T TOUCH IT OR ATTEMPT TO MOVE IT**. Instead, save your life by calling the power company.
- Don't attempt to erect antennas or towers on windy days.

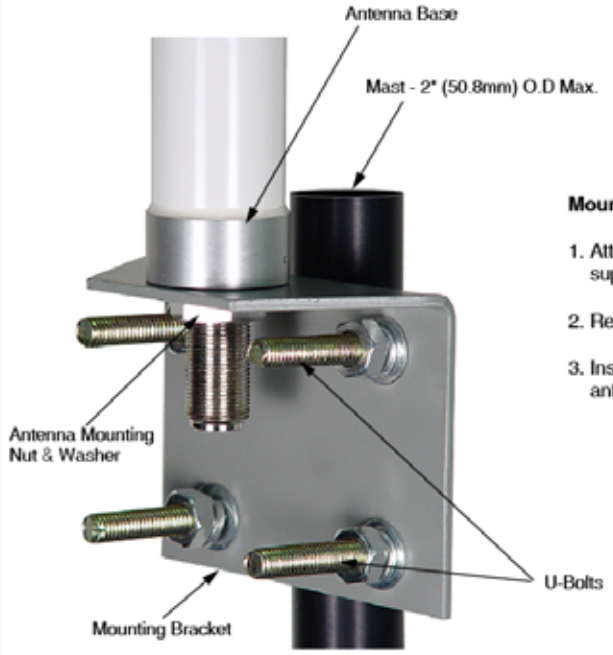
MAKE SURE ALL TOWERS AND MASTS ARE SECURELY GROUNDED, AND ELECTRICAL CABLES CONNECTED TO ANTENNAS HAVE LIGHTNING ARRESTORS. This will help prevent fire damage or human injury in case of lightning, static build-up, or short circuit within equipment connected to the antenna.

- The base of the antenna mast or tower must be connected directly to the building protective ground or to one or more approved grounding rods, using 1 O AWG ground wire and corrosion-resistant connectors.
- Refer to the National Electrical Code for grounding details.
- Lightning arrestors for antenna feed coaxial cables are available from L-com, Inc.

IF A PERSON COMES IN CONTACT WITH ELECTRICAL POWER, AND CANNOT MOVE:

- **DON'T TOUCH THAT PERSON, OR YOU MAY BE ELECTROCUTED.**
- Use a non-conductive dry board, stick or rope to push or drag them so they no longer are in contact with electrical power.
- Once they are no longer contacting electrical power, administer CPR if you are certified, and make sure that emergency medical aid has been requested.

Installation Instructions
Models: HGV-903U and HGV-906U



Mounting Instructions

1. Attach mounting bracket to mast as shown using (2) U-bolts and supplied hardware.
2. Remove antenna mounting bolt and washer from antenna base.
3. Insert antenna into mounting bracket and secure with washer and antenna mounting nut. Do not over tighten.

Appendix B: Field Survey Tools

A field visit to the site gives the designer a chance to see first hand the surrounding area and find out where are the potential problems to solve.

Tools: The field can be evaluated using several tools. A topography map is always useful. It is best to have the contour lines 10 feet or less between contours if such a map is available. A satellite aerial view of the field is also very useful for showing geographic landmarks, canals, rivers and drains. Some mapping and aerial programs provide the advantage of also showing elevations and scale distances.

Wireless Demo Kit: This kit can be used to check radio signals while doing a field site survey.

The #12338 kit is for demonstrating the TWIG system components and it can be used to become familiar with how the TWIG system works. The equipment is relatively portable so it is also good for use in the field. The field signal can be tested and verified in the actual field environment. The TWIG-4 that is included can simulate four control valves.

List of equipment in the kit: This demo kit is a basic setup. Included is a TD200, one TWIG-4, an LED valve simulator and an Omni antenna. The antenna is for use if you want to test the signals in the field. Limited to one per dealer.

Parts in the #12338 kit include:

#11953-001	TD200 Controller, AC
#11737-004	TWIG-4i assembly
#12336	TWIG LED valve simulator
#12000-030	Antenna kit, Omni, 30 ft. cable
#12400	TD200 Demo battery pkg, 12VDC (8 AA)

How to use the kit: This kit can be used to run actual systems because the components are field ready units. The best way to learn the system is to make an example of an irrigation project and create programs. The LED valve simulator can be connected to the TWIG-4 that is included in the kit so that the programs can be actually run and the valve operation visualized.

Note: The TD200 controller and TWIG do not come connected in a network. The wireless radio connection must first be made in order for the equipment to work together. If you need instructions see the User Guide.

CAUTION: Do not connect the demo battery pack if the TD200 is plugged into electricity! Use only one power source for the TD200 at a time. If using the battery pack then it must be the only power supply that is connected. Typically the battery pack is connected only while in the field because the capacity of a set of batteries will last about one day only. If electricity is available then it is the best source of power.

Optional parts useful for wireless demonstrations or field surveys:

#12025-002 TWIG-Repeater
Antenna mast tripod,

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2/5/2015

Nelson Wireless TWIG System
Project Planning Form

Obtain a Site/System Map						
Number of Valves:						
Number of TWIGs:	TWIG-1:		TWIG-2:		TWIG-4:	
Number of Controllers (TD200):_____110V AC, _____12V DC						
Identify Site Constraints						
Elevation:						
Vegetation/Crop type and height:						
Buildings:						
Antenna interference:						
Indentify Controller Locations						
Power (AC or Solar):						
Antenna mounting:						
Length of cable between controller and antenna (<50'):						
Antenna support structure:						
Evaluate TWIG Locations						
Elevation above ground level:						
Mounting (On Valve/Remote):						
Solenoid mounting (On Valve/TWIG): Valve Series: 800 Series Metal, 1000 Series Plastic						
Damage Risk (tractors, livestock, etc.):						
Identify Repeater Locations (if necessary)						
Power (AC or Solar):						
Antenna mounting:						
Length of cable between Repeater box and antenna (<50'):						
Antenna support structure:						
Hydraulic Protection Installed						
Pressure Relief (Required): Y/N		Air Relief: Y/N		VFD: Y/N		
Other Control Accessories needed?						
Contact-TWIG:	110V AC, 12V DC, 'D' Cell batteries					
Master valve control:	Solenoid Power: 24V AC or 12V DC Latch					
Flow meter:						
Pause Event Sensor or Switch:						
Connect to Other Controller:						

Test Radio Signal: It is very useful to test the radio signal in the actual field environment. This can be done using parts from the Dealer Demo kit to make a portable test unit. The parts required are the TD200, antenna kit, a tripod mast and a TWIG or a repeater.


TD200 _____signal check_____ TWIG 

Contact Nelson Irrigation for a source of the aluminum mast support tripods. One antenna mast will be used for the TD200. If the TWIG is to be set high like over tree in an orchard then a second tripod may be necessary and another antenna will be needed. The TWIG-e that can connect to an external antenna will be needed.

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HOW TO ADD TWIG WIRELESS TO EXISTING VALVES

The 1st Rule when considering wireless automation is to include a reliable pressure relief valve! This will protect the system hydraulic pressure from excessive pressure which could damage pipes. It is essential to have this safety valve for a reliable automated system. The valve can be thought of as a fuse if it were compared to an electrical system.

WIRELESS AUTOMATION FOR AN EXISTING SYSTEM OF NELSON VALVES

1) Make sure that each existing valve is working by using the manual selector to open and close the valve.

2) Verify that each valve has a filter in the control tube line of the valve upstream water source line. A filter is essential for reliable operation so it must be used.

3) Select a good location for the TD200 controller. Make sure that there is room for a tall antenna. Use 110 VAC power source if possible. Many growers want the controller near the pump so they can watch as the system starts and fills the pipes.

4) Power up the TD200 because it is the base of the TWIG network.

5) The field site form can be used that is in the User Guide. Do a site survey of the distances between the valves and the location of the controller. The radio signal can be checked using the TD200 and TWIGs (after the TWIG is joined to the TD200). Plan for a repeater and select an appropriate location. The preferred location will have 110 AC power but if a battery must be used then plan for a solar kit.

6) Properly select the TWIG mounting bracket so that the TWIG can be connected in the upright position.

7) If a solenoid is already on the valve make sure that it is the approved 12VDC latching type.

8) Place the TWIGs in the field at the valve locations and make a field map showing the address of each TWIG.

9) Connect the wires between the TWIG and solenoid. Polarity must be respected and only the Nelson approved connectors used.

10) Verify the solenoid operation by actuating the coil using the TWIG menu -SOL-.

11) Return to the TD200 and make sure that all TWIGs have joined the network and every signal is above a number 20. Using the field map that has the TWIG addresses create the program(s) and the Groups to automatically run the system.

STEPS FOR CONVERTING A RISER/ELBOW TYPE VALVE SYSTEM FOR AUTOMATION

Typically manual riser valve systems require every move be done by hand so switching to automation is a big change. The change must be complete in all aspects of system hardware, irrigation schedules and operating mind set. Note that the 1st rule of automation is to use a pressure relief valve to keep pressure limited so damage to pipes can be avoided!

1) The first step is to remove the existing valves from the risers and adapt each riser to the Nelson 800 Series or 1000 Series. These Nelson valves can be operated using a solenoid to open and close the valves. Make sure that the valve has the required filter which will keep the solenoid clean.

2) Consideration should be given for using the elbow version of the 1000 Series because it provides hydraulic control and the elbow is built within the valve.

3) Often the existing system has been moved by hand. Make sure to selected connection for the automatic valve is easy to attach in the event that the system will continue to be moved.

4) Select a good location for the TD200 controller. Make sure that there is room for a tall antenna. Use 110 VAC power source if possible. Many growers want the controller near the pump so they can watch as the system starts and fills the pipes.

5) Power up the TD200 because it is the base of the TWIG network.

6) The field site form can be used that is in the User Guide. Do a site survey of the distances between the valves and the location of the controller. The radio signal can be checked using the TD200 and TWIGs (after the TWIG is joined to the TD200). Plan for a repeater and select an appropriate location. The preferred location will have 110 AC power but if a battery must be used then plan for a solar kit.

7) Properly select the TWIG mounting bracket so that the TWIG can be connected in the upright position.

8) If a solenoid is already on the valve make sure that it is the approved 12VDC latching type.

9) Place the TWIGs in the field at the valve locations and make a field map showing the address of each TWIG.

10) Connect the wires between the TWIG and solenoid. Polarity must be respected and only the Nelson approved connectors used.

11) Verify the solenoid operation by actuating the coil using the TWIG menu -SOL-.

12) Return to the TD200 and make sure that all TWIGs have joined the network and every signal is above a number 20. Using the field map that has the TWIG addresses create the program(s) and the Groups to automatically run the system.

Appendix C: Installation information

Wireless installation requires attention to the TD200 placement, antennas and distance to the devices that are to be controlled. Most of the time the placement of antennas at a high elevation is good for signal communication. The TWIG installation generally goes along at the same time as installing the system valves. Typically each of the zone valves are equipped with TWIGs. Valve placement is set by the pipe layout. That means that the TWIGs need to have special attention to make certain that the TD200 antenna is line of sight. The relief valves are a planned part of the wireless network.

TD200: Start by mounting the TD200 controller at the selected location. The enclosure is weather resistant however it is preferred to have it protected from direct weather and sun exposure. Here are some examples of TD200 mounting. Pole mount is often necessary when the solar power is used.

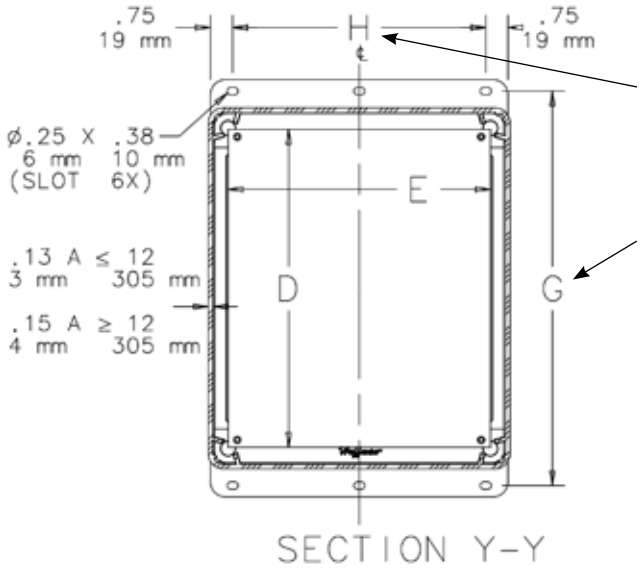
Wood pole mount

TD200 elevated up from pump house

Steel pole mount

Shelter mount

Shelter mount



TD200 and Contact-TWIG box dimensions:
Mounting hole spacing
H=6.56”,

G=11.38”

Antenna: The antenna for the TD200 controller is mounted onto a high location that is available. Many installations use an existing power pole. When power wires are near by the antenna cable should be place as far away as possible. Refer to Appendix A for details about the antenna kits.

Tools and materials suggested for antenna installation

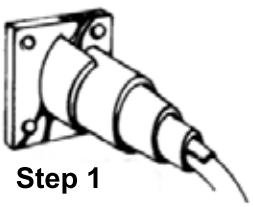
Be sure to have the following tools available before starting the installation. Since the coax cable must be routed from the antenna to the TD200 which may be inside the building the proper drill sizes are necessary.

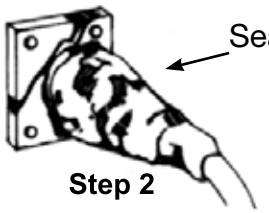
Pole, antenna support
Open end Wrenches
Screwdriver, Phillips Head
Wire Stripper
Copper ground wire
Lag screws, 5/16” x 3 1/2” (if wood pole)
Hand Drill, 1/2” drive
Screwdriver, Flat blade
Wire Cutter
Zip ties
Grounding rod
Electrical Tape

Seal the connector: Water and corrosion are the enemies of radio signals. The solution is to seal all the antenna connections using the #11998 coax-seal tape included in each antenna kit.

Step 1 Wrap the coax-seal tape around the entire connector fitting and cable making sure all joints are covered.

Step 2 With fingers form a smooth surface seal. Press the tape around the fitting making sure all the air is out and the joints are covered and sealed.





Steps to seal the connectors

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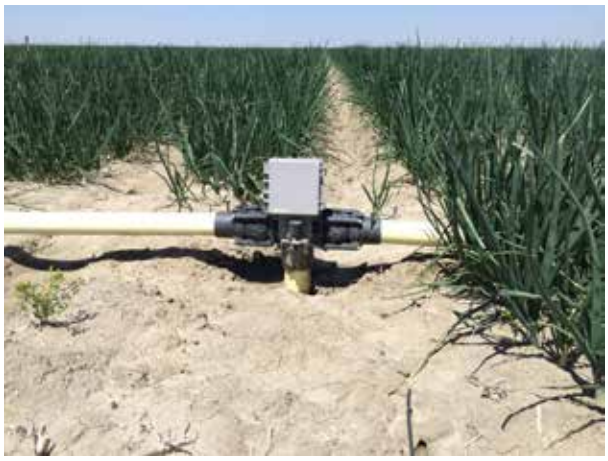
Antenna mounting: The mounting bracket included in the antenna kit is supplied with u-bolts. The u-bolts can be used to mount the antennas onto round pipe size 1” diameter up to 1 1/2” diameter. Here are some examples of antenna mounting.

Antenna on steel pole along side of a shop building.

Antenna mounted on a wood power pole. Antenna cable is as far away from power wires as possible.

TWIG: The TWIG installation requires special attention. A clear line of sight between the TWIG to the controller antenna is required. Here are some examples of how the TWIGs are mounted on valves. These are TWIGs mounted on the 1000 series tee valve.



Here are examples of mounting the TWIGs on a stake or a pole. This method provides for going over the top the crop obstructions to get good line-of-sight. The wires from the solenoids must be extended to connect the TWIG wires.

TWIG-2i on a stake in mint crop

TWIG-2i on a stake in a vineyard. Pivot point to rotate the mast down for access to the TWIG.

TWIG-1i in trellis orchard

TWIG-1i in trellis orchard

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Here are examples of mounting the TWIGs on a valve for a gun riser. The guns are stationary or can be portable. Every position must have good line-of-sight.

Pole mounted repeater

Repeater: The TWIG-Repeater is a valuable part of the wireless network. In many fields it is required to extend the range of the radio signals and also to go around obstacles. If electricity is available to power the repeater it is the preferred model to use. For other fields the power must come from solar charged batteries. The repeater is usually mounted on a pole as shown here.

Repeater that is portable.

Maintenance:

Batteries: It is likely that several of the network devices require batteries for power. Your should plan to replace the ‘D’ cell batteries each year before the irrigation season. The TWIGs each have two ‘D’ cell batteries for the need to be replaced. Recycle the batteries at your local recycler.

Solar Panel: The efficiency of the solar panel will be maintained by keeping the panel surface free of dirt and dull water stains. The field environment can coat the clear panel layer resulting in lower solar power output. An annual cleaning is recommended.

Solenoid: The solenoid should be drained before freezing temperature happens. Freeze damage is one of the main causes of solenoid failure. Other solenoid problems can be found in the wire connections. Check the operation of the solenoid coil before the irrigation season. The solenoid operation test can be done using the TWIG ‘SOL’ function.

Antenna Cable: The antennas can last a long time but do require some annual inspection. When looking for faults, it’s important to know that most faults are connector related. This includes loose connectors, corroded connectors, and poorly installed connectors. Most remaining faults are cable related. The problems may include water in the cable, loose weather wrap, pinched cables, poorly installed ground kits, bullet holes, and even nails in the cable! A small portion of the faults are antenna related. Check the antenna cable to make sure it isn’t damage.

twig

Rev. 17 - 2/15

NELSON WIRELESS CONTROLS
SYSTEM INFO & SETUP

Press ↵ to wake the display. Press → to advance to next menu.

MENU	DESCRIPTION / ACTION
S III SIGNAL STRENGTH	Good signal = S IIIII Poor signal = S I
-SOL- SOLENOID TEST	Press ↵ to begin test.
SOL Ic	Solenoid #1 closed. Press + to open.*
SOL Io	Solenoid #1 open. Press − to close.*
	Press ↵ to end test.**

*When multiple solenoids are controlled by one TWIG, press → and use + or − to test each solenoid.
**After a solenoid test, the valve will return to its original state after several seconds.

b III BATTERY STRENGTH	Max charge = b IIIII Low battery = b I
- Id- TWIG ID	Press ↵ to view the TWIG ID.
A0009	Press ↵ to go back.
-nEt- TD200 NETWORK	Press ↵ to view/configure current network.
00007	Press ↵ to go back. Press → to reset.
rESEt	Press ↵ to search available networks.
00000	Press ↵ to join your network, or
nonE	No networks found.
Join	Join network countdown - display will return to signal menu S III when finished.
ch 2 RADIO CHANNEL	Active channel.

End of Season Maintenance: The TWIG should be unassigned from the TD200 and the batteries removed. Valves should be drained to avoid freeze damage.

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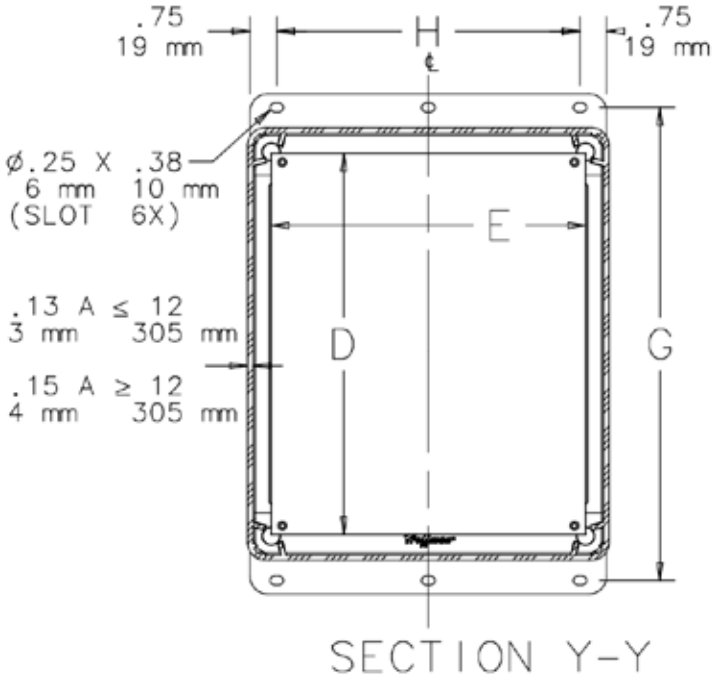
Appendix D: Contact TWIG

Purpose: To provide wireless remote control switches in the TWIG network.

The Contact-TWIG can be utilized for wireless remote control to activate up to four switches. The switches signal control relays to operate master valves, lighting, start and stop the pump and alarms.

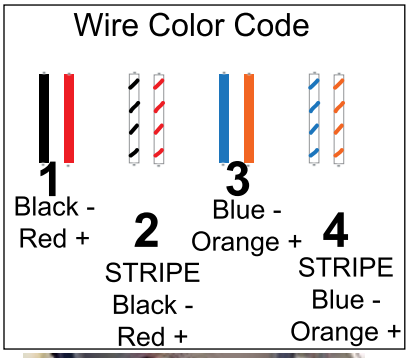
General Description: The Contact-TWIG is capable of switching four dry contact switches. The TD200 controller will activate each of the four contacts and keep the relay(s) latched ON so long as the controller commands the associated switches to be on. When the switches are commanded to go off the contacts will disconnect wires causing the relays to open. When configured as a “Master valve” in a program, the connection will be made if any valves within the program are on.

Enclosure details:

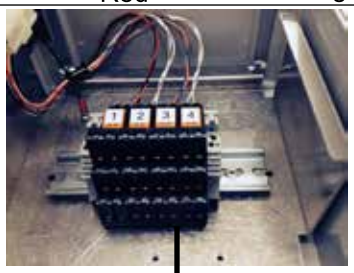


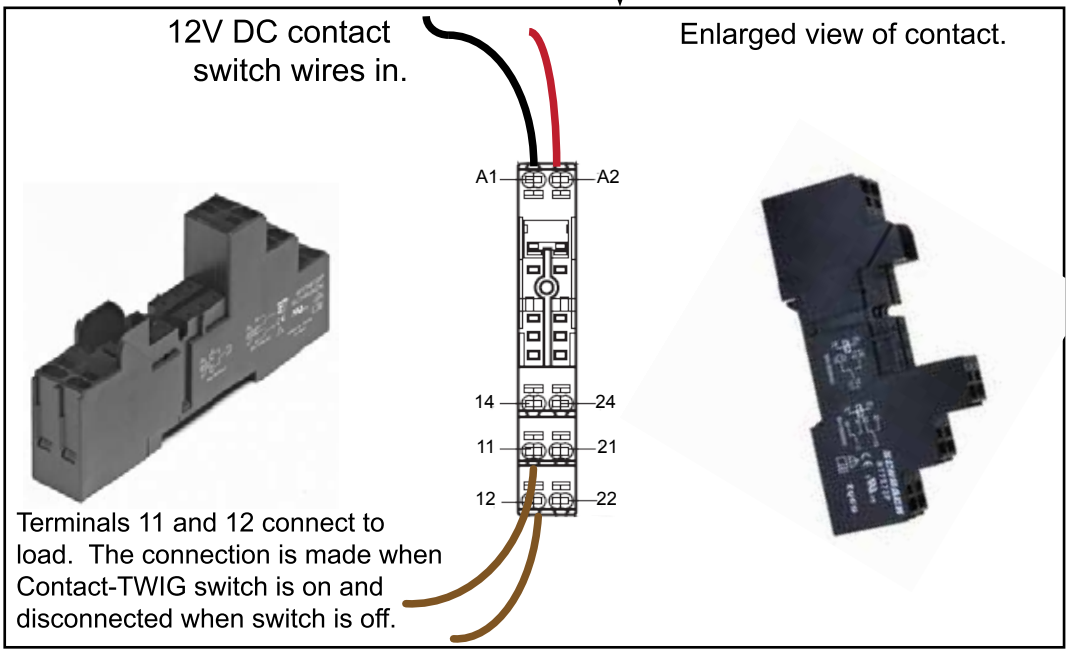
TD200 and Contact-TWIG box dimensions:
Mounting hole spacing
H=6.56”
G=11.38”

Contact-TWIG wiring: The four switches in the box are pre-wired from the factory. These switches latch on and off using a momentary 12V DC pulse. The information below is to show the wires into the four switches are color coded because polarity is important to open and close the switches.



Contact terminals inside the box come pre-wired from the factory. This color chart is simply for reference if a repair is required and to show that the wire polarity is essential.





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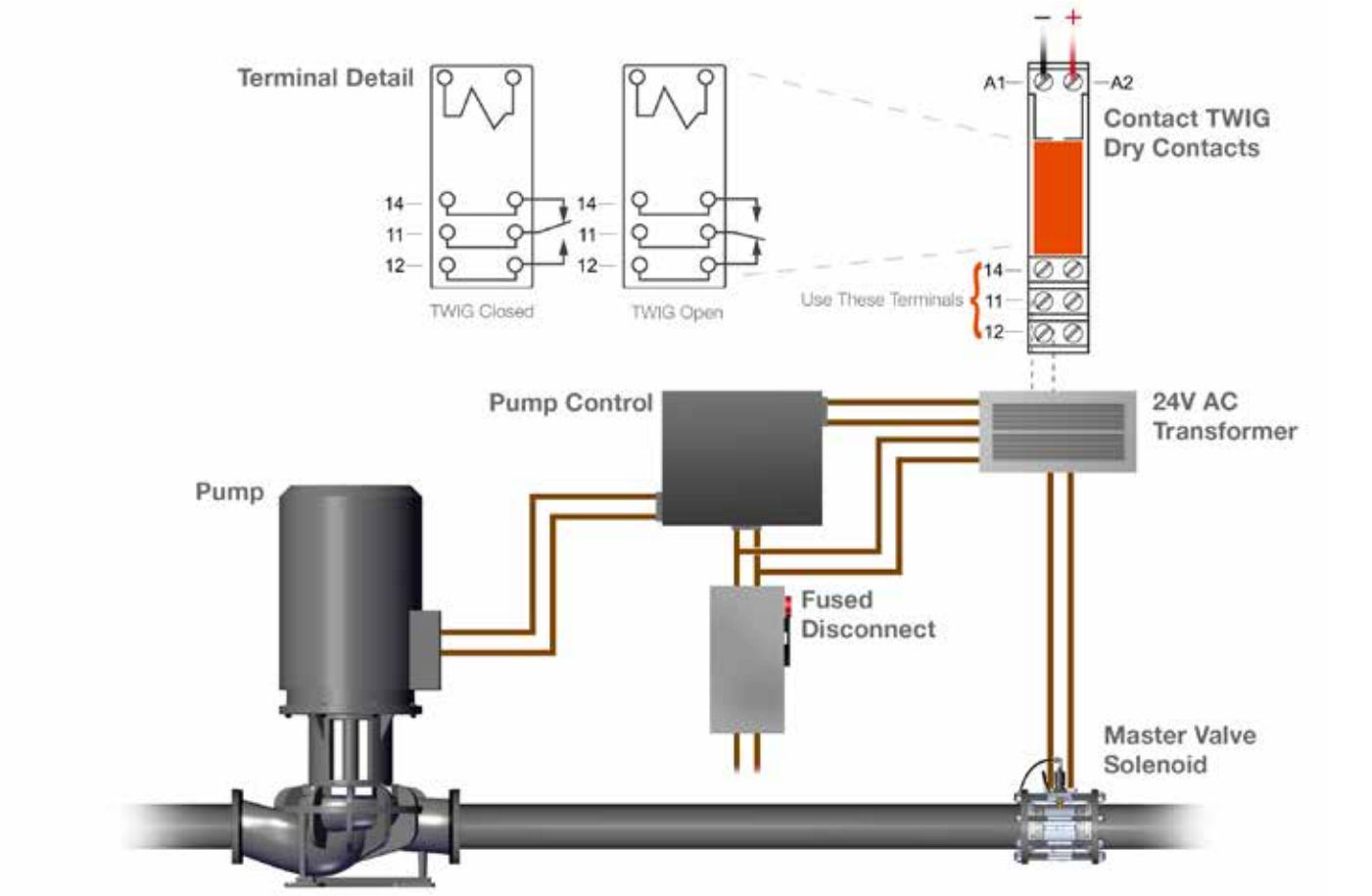
To activate a Master Valve: A master valve is an electric valve installed at the main water supply for the irrigation system. If you damage the irrigation main line, a master valve will shut off the water to the mainline pipe so it can be repaired. An electric master valve is typically a larger size of the same type of valve as you would use for your zone valves, but the master valve typically has a 24V AC solenoid on it that requires continuous power to remain open. However it could have a solenoid of different voltage as long as it matches the power supplied to it. The valve is installed upstream from the zone valves on the main line. It can be controlled by any one of the Contact-TWIG four relays. It is designated as a master valve in the TD200 controller. The power to switch the solenoid is generally a 24V AC source. The master valve will remain open while any valve in the program is on.

To activate a pump: The internal contact switches are latch type that allows a lower voltage signal from the Contact-TWIG to close a circuit of higher voltage. The internal contacts can switch on and off but there is not enough power to run the pump. However, they do put out enough power to connect wires to a pump start relay (generally 24V AC) which in turn closes a relay that completes the higher voltage circuit for current flow needed by the pump motor. The sketch below shows an arrangement of how a master valve and a pump may be wired.



This is a sketch of a typical electric pump layout. In this example one switch is used for the pump and one is used for the master valve. An experienced certified electrician is to make the wiring in conformance with local electrical code).

The Contact-TWIG switches can be assigned in the TD200 controller program to control a Master Valve. They can also be included as part of a 'Group'. The four switches work independently. Unused contacts are not assigned and the extra terminals left empty. The Nelson Contact-TWIG assembly part #12246-xxx includes the items shown in the previous sketch as 5 and 6. The antenna (number 8) and the antenna cable is to be ordered separately.

WARNING: Do not connect the Contact-TWIG directly to the pump. The Contact-TWIG will be damaged. Connect the Contact-TWIG to the pump start relay ONLY.

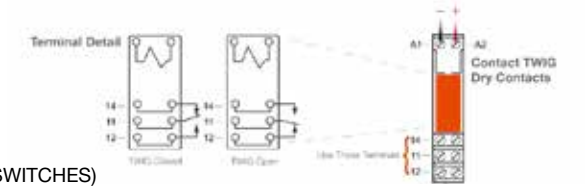
To reduce risk of electrical shock, pump must be properly grounded in accordance with the National Electric Code (NEC) and all applicable state and local codes and ordinances.

To reduce risk of electrical shock, always disconnect the pump from the power source before handling or servicing. Lock out power and tag.

CAUTION: The pump control must be setup to stop the pump at any time that the master valve is closed. Pump controls are to be provided by others. All wiring of pumps should be performed by a qualified electrician.

12506 Rev 0

CONTACT twig



LATCH-TYPE CONTACTS (FOUR 1 AMP SWITCHES)
Press ↵ to wake the display. Press → to advance to next menu.
Oprima ↵ para prender la pantalla. Oprima → para avanzar al próximo menú.

MENU / MENÚ	DESCRIPTION & ACTION / DESCRIPCIÓN Y ACCIÓN
S III **SIGNAL STRENGTH** *FUERZA DE SEÑAL*	Good signal = S IIIII Poor signal = S I *Buena señal* = S IIIII *Mala señal* = S I
-SOL- **SOLENOID TEST** *PRUEBA DE SOLENOIDE*	Press ↵ to begin test. *Oprima ↵ para empezar la prueba.* SOL Ic Solenoid 1 closed. Press + to open.* *Solenoide Nº1 cerrado. Oprima + para abrir.** SOL Io Solenoid 1 open. Press − to close.* *Solenoide Nº1 abierto. Oprima − para cerrar.** Press ↵ to end test.** *Oprima ↵ para terminar la prueba.***
*To test TWIG Contact, press → and use + or − to test each Contact. *Cuando se controla más de un solo solenoide por un TWIG, oprima → y use + o − para probar cada solenoide.* **After test, the Contact will return to its original state after several seconds. ***Después de la prueba, la válvula volverá al estado original después de algunos segundos.*	
b III **BATTERY STRENGTH** *CARGA DE LA BATERÍA*	Max charge = b IIIII Low battery = b I *Carga máx.* = b IIIII *Nivel baja* = b I
- Id- **TWIG ID**	Press ↵ to view the TWIG ID. *Oprima ↵ para ver la TWIG Identificación.* A0009 Press ↵ to go back. *Oprima ↵ para volver al menú.*
-nEt- **TD200 NETWORK** *RED DEL TD200*	Press ↵ to view/configure current network. *Oprima ↵ para ver/cambiar la red activa.* 00007 Press ↵ to go back. Press → to reset. *Oprima ↵ para volver. Oprima → para cambiar.* rESEt Press ↵ to search available networks. 00000 Press ↵ to join your network, or nonE No networks found. *Oprima ↵ para buscar las redes disponibles.* 00000 *Oprima ↵ para conectar a su red, o* nonE *La red no se encuentra.* Join Join network countdown - display will return to signal menu S III when finished. *Cuenta atrás al conectar la red - la pantalla volverá al menú de la señal* S III *al terminar.*
ch 2 **RADIO CHANNEL** *CANAL DE LA RADIO*	Active channel. *El canal activo.*

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Appendix E: Solar/Battery kits

The TD200 and TWIG-Repeater have battery/solar power options. The solar power option brings automation to remote areas where no electricity power source is available. It is a real benefit to mobile systems that move after each crop is completed.

Either 110V AC or a 12V DC power can be selected for the TD200 and the TWIG-Repeater. If electric service is available and reliable then it is the preference because no solar equipment or battery is necessary.

These kits are specific to the TD200 or the TWIG-Repeater. They can not be interchanged. The support pole is not provide and is to be sourced locally.

Solar Kits

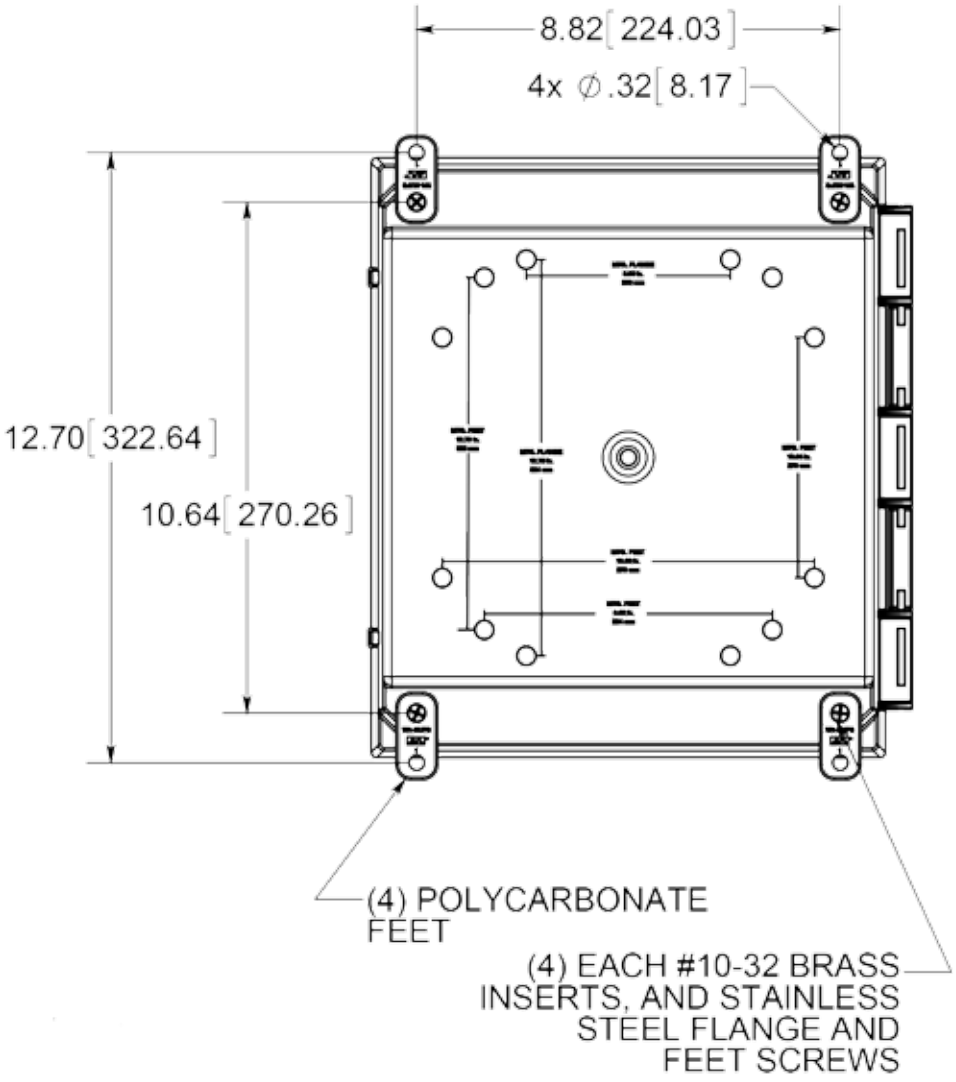
Part number	Description
12224-001*	Solar Kit, TD200
12224-002	Solar Kit, TWIG Repeater
12075-001*	Solar Kit with Battery, TD200
12075-002	Solar Kit with Battery, TWIG Repeater

* This solar kit is for both the TD200 and the Contact-TWIG.

Kit materials list

Part No.	Description
12088	10W Solar Panel
12087	Solar Panel Mounting Bracket
12138	Hose Clamps (2 ea.)
12098	Cable Kit (TD200)
12098-001	Cable Kit (Repeater)
12089	Enclosure with Battery and charger

Solar kit enclosure dimensions and mounting (view from back)



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Appendix F: Troubleshooting

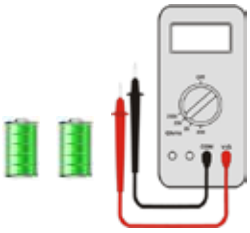
SYSTEM PROBLEMS

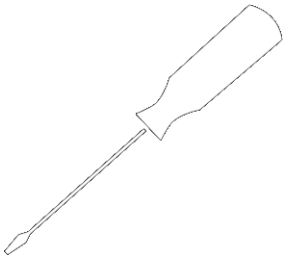
Effective troubleshooting means you follow logical steps and always check out a problem in this order:

1. TD200 Controller (clock).
2. TWIG units.
3. Solenoids.

Don't go out to the field TWIGs until you have learned all you can from the TD200 controller. It is more often the field connections or the solenoid than the controller but too much time can be wasted if it is the controller. Check the displayed information about each field TWIG battery voltage and solenoid. This can usually be done at the controller location unless the controller is down.

A good tool to have is a volt/amp meter and a screw driver.
Carry several fresh 'D' cell batteries.





TD200 TROUBLESHOOTING

In the event the valves are not responding to commands from the controller.

1. Confirm that the cables are plugged in correctly for power and for the antenna is securely connected.
2. Verify that the TD200 programming was saved and the right dial rotated to the 'RUN' position.
3. Make sure that the TD200 is setup to TD200 control.
4. Check to make sure the TD200 is communicating with all the TWIGS and that there are no ? marks or low batteries on the TWIGS. Also check on the TD200 for open circuit messages for any of the valves.
5. Reset the controller network using the following steps:
    a. Put the left dial in the 'SETUP' position.
    b. Move down to the 'Setup Twigs' line and press 'ENTER'.
    c. Move down to the 'Reset Network' line and press 'ENTER'. Then Exit. This reset method is a good way to clean up any TWIGs that have accidentally joined to the TD200.

    OR

6. Reset the controller using these power cycle steps:
    a. Power down the TD200 by unplugging it from electricity.
    b. Power the TD200 back up.
    c. Watch that all the TWIGs are communicating with the TD200 and there are no errors.
    d. Verify the proper TWIG numbers are assigned and the + shows in the selection column for all valves that are to be in a group.
    e. Make sure the proper TWIG address number is assigned to the proper valve.

TWIG TROUBLESHOOTING STEPS FOR COMMUNICATION ERRORS:

1. Is there just one communication error or is there a group of them?
2. If there is more than one, are they all in the same area?
3. If this is the case check the TWIG signals in that area.
4. Go to the TWIGs that are having trouble and Reset any missing TWIG using the TWIG menu and then rejoin it to the proper TD200 address number.
5. Return to the controller and verify that the signal shows the same as the TWIG. If the problem is a weak signal then a TWIG-Repeater can improve the signal strength.

TO CHECK SOLENOID CONNECTIONS;

Go to the TWIG location. Use the solenoid activation feature to operate the solenoid. If the solenoid clicks then the problem may be with the signal. If there is no solenoid click when tested then do the following:

- Physically inspect the connections.
- Make sure the wires within the waterproof connectors are twisted tightly together, making solid contact with one another
- If not made with waterproof connectors replace the connections.

TO CHECK THE SOLENOID COIL:

Disconnect the coil lead wires from the field TWIG. The Nelson TWIG system valves are equipped with low power latching solenoids. These solenoid coils are latch (or pulse) type solenoids that switch by voltage polarity. The correct polarity is essential because the change from open to close is made by reversing the pulse polarity.

TO TEST A LATCH TYPE SOLENOID COIL:

A normal ohmmeter test of resistance will not give the correct test results. In order to test the latch coils use a multimeter with a diode-check setting. In red-to-black check direction the meter should read ~0.6V. In black-to-red direction you should read open (infinite) contact.

Once the trouble has been isolated you need to find out what changed recently that may have caused the problem.

a. Is there the possibility of lightning damage?
b. Any recent work done on the site that could have damaged the solenoid lead wires?

TEST THE VALVE OPERATION:

Use the 3-way manual selector to open and close the valve.

Appendix G: Quiz Answers

Section 1: Answers to Knowledge Quick Quiz Questions
1. 100
2. False. Most reliable is wireless.
3. 20 seconds
4. True
5. Antenna
6. TWIG-1, TWIG-2, TWIG-4
7. False

Section 2: Answers to Knowledge Quick Quiz Questions
1. 'b'
2. False. The programs are in the TD200
3. Repeater
4. True. Use only one power source at a time.
5. 'd'
6. 'c'

Section 3: Answers to Knowledge Quick Quiz Questions
1. 'd'
2. False
3. 'c'
4. True
5. 'b'

Section 4: Answers to Knowledge Quick Quiz Questions
1. 'b'
2. True
3. 'b' should always be planned from the start and included in the system list of materials
4. False, obstacles are not considered in the distance graphs
5. False, The location of the TD200 requires careful consideration.

Section 5: Answers to Knowledge Quick Quiz Questions
1. 'e'
2. True
3. 'd, Star'
4. False
5. 'c Repeaters'

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