

## 1. GENERAL SPECIFICATION

The second generation Nelson Twig® Wireless Automation System turns valves on and off using a 900 MHz radio network. It shall have the following components:

- a. Master Controller (“Twig-MC”)
- b. Radio Network Hub (“Twig-V Hub”)
- c. Field RTU/Node Radio (“Twig-V” or “Twig-V Plus”)
- d. Repeater (“Twig-V Repeater”, optional)

The system shall be designed with the following specifications:

### a. The radio network

- i. shall provide two-way radio communication from 902-928 MHz (up to 50 channels) and be capable of initiating commands in three seconds,
- ii. shall use radios with power rating of 250 mW, and all antennas shall follow the specification shown in *section 3* of this document

### b. The master controller

- i. shall be powered by 100-240 VAC or 12 VDC battery,
- ii. shall connect to the radio network hub via RS-422 cable,
- iii. shall be operated via mobile device using an app for iOS or Android devices,
- iv. the app shall connect to the controller locally via Bluetooth® or remotely via user-supplied internet connection,
- v. shall have inputs for two 4-20 mA pressure transducers and one pulse-type flow meter,
- vi. shall have two DC latching contacts rated to 16 amps up to 250 VAC.

### c. The radio network hub

- i. shall be powered by the master controller via RS-422 cable,
- ii. shall be capable of communicating with up to 100 Field RTU/Nodes (“Twig-V” devices) and eight repeaters,
- iii. shall use an external 6 dbi omni antenna with no more than 50 feet (15 m) of coaxial cable and an RPSMA bulkhead connector.

### d. The field RTU/node radio (“Twig-V”)

- i. shall have a fully sealed enclosure with vent,
- ii. shall be powered by two D-cell batteries,
- iii. shall be able to control up to two 12 VDC latching solenoids or relays,
- iv. shall use an internal antenna or optional external antenna with RPSMA bulkhead connector.

### e. The field RTU/node radio (“Twig-V Plus”)

- i. shall be powered by rechargeable 3.2V battery with integrated solar panel,
- ii. shall have an integrated, 3-way actuator that connects to a hydraulic control valve,
- iii. shall communicate with a mobile device via Bluetooth® and app for iOS and Android devices,
- iv. the app shall be used to setup and initialize the device,
- v. shall use an internal antenna.

### f. The repeater

- i. shall be optional, and used to extend the range of the radio network,
- ii. shall be powered by 110 VAC or 12 VDC battery,
- iii. shall use an external 6 dbi omni antenna with no more than 50 feet (15 m) of coaxial cable and an RPSMA bulkhead connector.

## 2. MATERIALS, WEIGHTS, DIMENSIONS, ETC.

	Twig-MC	Twig-V Hub	Twig-V (RTU)	Twig-V Plus	Twig-V Repeater
Address Identity	NA	0-XXXXX	1-XXXXX (single) 2-XXXXX (dual) 5-XXXXX (SE single) 6-XXXXX (SE dual)	1-XXXXX 5-XXXXX (SE model)	8-XXXXX
Enclosure					
Material	Polyester	Glass-filled plastic	Glass-filled plastic	Plastic	Fiberglass reinforced polyester
Dimensions (W x H x D)	9.7 x 11.1 x 5.4 in 25 x 28 x 14 cm	4.2 x 7.5 x 3.3 in 11 x 19 x 8 cm	4.2 x 7.5 x 3.3 in 11 x 19 x 8 cm	2.7 x 5.2 x 2.9 in 6.9 x 13 x 7.4 cm	3.9 x 9 x 4.1 in 10 x 23 x 11 cm
Weight (lbs)	5.67	1.53	1.85	0.73	2.4
NEMA Rating	4X	NA	NA	NA	4X
Bluetooth® Interface	4.1	4.1	4.1	4.1	4.1
Radio Frequency	NA	902-928 MHz	902-928 MHz	902-928 MHz	902-928 MHz
Radio Channels	NA	2-50	1-50	2-50	1-50
Radio Power	NA	250 mW	250 mW	250 mW	250 mW
Antenna	NA	External, Omni	Internal or External	Internal	External, Omni
Connections	Ethernet, 2 x RS-422 (to Hub)	RS-422 (to MC), RPSMA (antenna)	24", 20 AWG Wire Leads RPSMA (ext. antenna)	24", 20 AWG Wire Leads (SE model only)	RPSMA (antenna)
Power	110VAC (4W) or 12VDC (3.5W)	NA	3.2V (two D-Cell Batteries)	LiFePO4 Rechargeable, 14505 Cell, 3.2 V, 600 mAh	120VAC or 12VDC

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## 3. ANTENNAS

The field RTU/Node ("Twig-V") is available with an internal or optional external antenna. External antennas are also used with the radio network hub and repeater.

Exact specifications for the internal antenna and approved external omni antenna are shown in the tables below. No other antennas shall be used with the Twig Wireless System without approval from Nelson Irrigation.

Internal Antenna	
Frequency	902-928 MHz
Output Power	24 dBm
Modulation	LoRa
Connector	NA
Antenna Type	Dipole
Nominal Bandwidth	500 KHz
Spreading Factor	8

External Antenna	
Frequency	902-928 MHz
Gain	6 dBi
Antenna Type	Omni
Polarization	Vertical
Horizontal Beam Width	360 degrees
Vertical Beam Width	15 degrees
Connector	N-Male
Impedance	50 Ohms

## 4. AGENCY STATEMENTS

### Federal Communication Commission Interference Statement:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC 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.

### Industry Canada Interference Statement:

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le périphérique hôte final, dans lequel ce module RF est intégré "doit être étiqueté avec une étiquette auxiliaire indiquant le CI du module RF, tel que" Contient le module émetteur IC: 9686A-TWIGVUNO".

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) L'appareil ne doit pas produire de brouillage.
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## 5. CAUTION

TWIG Wireless 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 TWIG Wireless 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 TWIG Wireless 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.

All TWIG Wireless Products are susceptible to RF interference and interruption that can prevent communication. It is solely the responsibility of the user to understand that failure to connect or trigger TWIG Wireless Products both on or off is possible. The user assumes all risks to life or property caused by RF interference or interruption.

Do not use any TWIG Wireless 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 or as specified in this manual.

Do not make any physical or electrical modifications to any TWIG Wireless Product. This will void the regulatory certifications and may cause product failure. Any physical and electrical modifications void the warranty.

### **Electrical Safety Caution:**

Some components of the TWIG Wireless Product may be powered by 120V or 240V 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 must be followed.

Also some components of the TWIG Wireless Products may be powered by DC voltage batteries and solar panels. 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 spark that can ignite a fire, cause injury, or death.

### **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.

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 TWIG Wireless Product network.

### **Caution if system is moved to a new site:**

The wireless control system is comprised of selected TWIG Wireless Products which can be relocated from site to site in order to accommodate crop changes. Each site must be evaluated for safety purposes to meet personnel and property safety. Each irrigation site must have a water relief valve installed that can discharge water to relieve excess pressure for safety purposes.

## 6. 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 or mobile app, 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, lightning, 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. There is no guarantee of app compatibility with past or future upgrades made to service by third-parties.

**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. The prevailing party in any claim or dispute in connection with this Limited Warranty shall be entitled to recover its reasonable attorneys' fees and costs whether before or at arbitration, trial, and upon any appeals.

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