Ag Irrigation Remote Control

Users Manual

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Table of Contents

1. INTRODUCTION

The "***Ag Irrigation Remote Control***" project's goal is to provide RF (Radio Frequency) remote control and monitoring abilities to an Agriculture-Industrial 3-Phase 480VAC Irrigation Pump that is typically used in wheel-line and hand-line irrigation setups within the United States.

- ✔ The project implements
  - Digi Xbee RF radio modules (S3B, 900MHz, 1/4-Watt) which advertises a broadcast range of up to 28-miles (*Practical usage at 2-miles at ground level*)
  - Arduino micro-controller boards, LCD display shields, Zigbee shields, and various discrete devices

- ✔ The project consists of:
  - Hand-Held "***Hand Remote***"
  - Pole mounted "***Pump Controller***"
  - High-Voltage Control "***Installation Kit***" which consists of components to be added to the pumps electrical panel

- ✔ The project is Open Source and its main page Resides at:
  https://github.com/tgit23/AgIrrigationRemoteControl
  - Releases (All Finalized Plans, Files and Documentation) can be downloaded at:
    https://github.com/tgit23/AgIrrigationRemoteControl/releases
  - This document (most recent version) can be seen at:
    https://tgit23.github.io/AgIrrigationRemoteControl/AgIrrigationPumpRemoteControl.pdf
  - Pre-Built Purchasing options are available – See the projects main page link above

A. Signal Strength (2-Miles)

- ✔ Standard Signal distance is recommended for usage of up to 2-miles

  - Elevated or higher gain antennas can be purchased to extend this range

  - Test Scenario
    - Pump-Controller mounted 5-feet from the ground on the power pole next to the pump
    - Hand-Controller checked inside a moving vehicle (~ 3-feet off the ground)

  - Test Environment
    - Houses located on square mile blocks; each mile having approximately 6 to 10 houses per mile
    - Ground level is fairly flat

  - Results
    - < 1-mile - Coverage approximately 99% of spot locations (very few spots inside a house will loose signal)
    - 1-to-2 miles - Coverage approximately 90% of spot locations (a few spots inside a vehicle will loose signal)
    - 2-to-3 miles - Coverage approximately 5% of spot locations (very few spots get a signal)
    - 3-to-4 miles - A few signals were obtained at up to 3-3/4 miles away; but spot

location was very very temperamental.

B. Features

- ✔ A solid rural 2-Mile range
- ✔ No cellular, FCC licensing or other requirements are needed; Just hook it up and use it
- ✔ A single Hand-Remote can control multiple irrigation pumps
- ✔ Multiple Hand-Remotes can control the same irrigation pump
- ✔ Uses the Pump Panels "AUTO" selection; so it doesn't disturb manual operation of Hand-Off & Start sequences
- ✔ Implements a "Stay-Off" after power losses that is required by power companies
- ✔ Easily expandable to offer Pressure and Water-Level monitoring
- ✔ Built upon mass-produced development boards that can be easily purchased and replaced

- ✔ Hand-Remote settable Alarms (buzzer) to notify user of
  - ○ Power changes - For Example; Alarms when pump shuts down due to a power loss
  - ○ Water Pressure boundaries (if equipped) - For Example; Alarms when pressure drops due to a hose that has fallen off or broken pipe
  - ○ Ditch Water-Level boundaries (if equipped) - For Example; Alarms when water in the ditch is too low or too high

2. INSTALLATION INSTRUCTIONS

This section is a guide to installing the PUMP-CONTROLLER using the INSTALLATION KIT. If these products were not purchased they can be built by following the "Building Instructions" booklet.

- ✔ Installation will require the following **SUPPLIES**
  - ○ Pump-Controller
    - ▪ *The white box shown on the right in the picture above*
    - ▪ Including the attached Antenna, Cable and 4-pin plug ending
  - ○ Installation Kit *(Including the following items)*
    - ▪ A 3-Phase Power Supply attached to a DIN rail
      - ▫ 480VAC Input to 24Vdc Output
    - ▪ A Solid State Relay (SSR) attached to a DIN rail
      - ▫ 480VAC (or higher) Load Voltage and 5Vdc Input
    - ▪ 12-feet of RED 600V 16-Gauge or heavier THHN or MTW wire
    - ▪ 4-feet of GREEN 600V 16-Gauge or heavier THHN or MTW wire
    - ▪ A Pump-Panel Exit Cable
      - ▫ A 4-pin plug ending attached to (3) 4ft 600V rated wires
        - ◦ Yellow plug wire → Orange Hookup wire (+Vdc)
        - ◦ Black plug wire → Brown Hookup wire (-Vdc)
        - ◦ White plug wire → Blue Hookup wire (SSR-Control)
        - ◦ Green plug wire → Unused (None)
    - ▪ (2) #8-32 x 1/2" Machine Screws
    - ▪ (1) Wood screw for mounting the PUMP-CONTROLLER to a pole
- ✔ Installation will require the following **TOOLS**
  - ○ Personal protective gear (e.g. insulated/flash protection clothing)
  - ○ Voltmeter - that reads up to or beyond 500VAC
  - ○ Cordless drill
  - ○ Wire strippers and cutters
  - ○ #1 Phillips and #1 Flat head screw drivers
  - ○ Center Punch
  - ○ #29 (9/64") Drill Bit
  - ○ #8-32 Threading tap

A. Electrical Panel Introduction

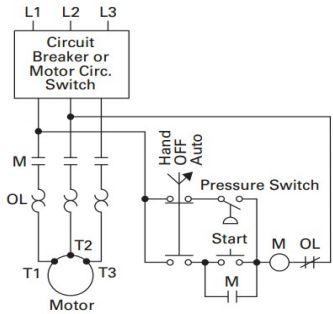
Read through the following section to gain general knowledge on the items within the pumps electrical panel.

Most 3-phase irrigation pumps that do not have variable frequency drives(VFD) or inverters are setup similarly. Below is the details of a pumps electrical panels as an ***example or reference*** to the pumps power circuit. This information was gathered to determine the wiring and power needed to control the pumps power.

Type 3R Industrial Pump Panel—C440 SSOL

Wiring Diagram

Typical Wiring Diagram



✔ Wiring Diagram Description

- **L1, L2, L3** - Are the three HOT wires of the 3-Phase Power (480VAC) going through the main breaker
- **M** - The Starter Contactor (example picture below) contains:
  - Activation Coil - Represented by the **M-Circle** in the wiring diagram just right of the Start Button (this Activates the "Hammer" Switch)
    - The Activation Coil resides "inside" the "Starter Contactor" Assembly; but can be removed by disassembling the unit.
  - Main Contacts - The **M-Contacts** (-||-) that connects the L1,L2,L3 lines → OL (Overloads) → Motor (Sometimes called the "Hammer")
    - The Main Contacts are significant part of the "Starter Contactor" as a whole unit.

  - Hold Contact - Represented by the **M-Contact** (-||-) wired in parallel and just below the Start Button
    - The Hold Contact "LOCKS" the Activation coil ON when the Start-Button is pressed.
    - The Hold (sometimes referred to as an Auxiliary Contact) clamps onto the side of the "Starter Contactor"
    - As shown in picture above as the clamped on the right unit with a Grey square center.
- **Hand, Off, Auto** Switch
  - In the wiring diagram above; the Hand-Off-Auto selector switch is in the "Auto" position where it is then connected to a Pressure Switch
  - The Solid State Relay, that is part of the Installation kit, will be attached where this "Pressure Switch" is shown in the diagram.

- ✔ Description of Operation

  *When **HAND** is selected the "control circuit" (L1 → L2 loop) is still open until the Start Button is pressed. When the Start button is pressed it activates the (M) Activation Coil which in-turn activates the "Hold Contact" (the --| |-- in parallel to the Start Button). This right-side contactor holds the "control circuit" closed until there is a power failure bump or the Hand-Off-Auto Switch breaks open the circuit loading the (M) activation coil.*

  *This Projects SSR-Relay will be connected where the "Pressure Switch" is shown in this wiring diagram and will use the **AUTO** switch selection. This setup will require that the Arduino **NOT re-activate** power after a power failure has occurred until a specified time delay or turned back on. The click in HAND circuit is setup so the power company can re-activate power after a power failure without the over-load of all motors kicking on at the same time.*

- ✔ Checking Amperage Limitations
  - ○ Activation Coil Amperage can be gotten by looking up the "Starter Contactor" specification sheet, for example;
    - ▪ See Page 9 "AC COIL DATA" for NEMA Size #2 Shows 230VA(Volt-amperes which is VA=V*A) so 230VA/480Vac = 0.479Amps @ 480V
    - ▪ The Solid State Relay in the Installation Kit can supply up to 10A; So it is well equipped to handle much larger Starter Contractors.

- ✔ Links to more information
  - ○ http://www.eaton.com/ecm/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=LatestReleased&noSaveAs=0&Rendition=Primary&dDocName=998056282226
  - ○ http://www.eaton.com/Eaton/ProductsServices/Electrical/ProductsandServices/AutomationandControl/EnclosedControl/NEMA/PumpPanels/index.htm

B. DIN-Rail Mounting

BE SURE THE MAIN BREAKER IS TURNED OFF AND CAREFULLY CHECK THAT THERE IS NO VOLTAGE ON THE OUTPUT OF THE MAIN BREAKER WITH A PROPER METER!!! 480VAC is deadly; and can cause severe flash burn and/or death. (e.g. A meter on the wrong setting can "flash" explode causing "flash" burns on you even at a distance away). I DISCLAIM ANY AND ALL RESPONSIBLITY FOR ANY RISKS, HARMS, INJURIES OR PROPERTY DAMAGE THAT WAS A RESULT OF FOLLOWING ANY INSTRUCTION IN THIS MANUAL.
See https://www.youtube.com/watch?v=6hpE5LYj-CY

1. Check your volt meter
   a) Before leaving to install; check that your volt meter is working by plugging it into a

household outlet (Use the same setting >500 VAC)

b) Make sure the probes are plugged into their correct spots on the meter

c) Do not make any more changes to the volt meter after testing its correct operation.

2. Follow safe practices

a) Never turn ON the main breaker with the panel open

b) Never stand in front of the panel while turning on the main breaker (flash explodes will often blow the front panel clear off) - stand at the side

c) Never work in the same side of the box where the live wires (feed wires) exist – generally at the top of the box

d) Always stand as far away as you can

3. Prepare for Installation

a) Switch the Main Breaker to OFF from the outside of the pumps electrical panel

b) Open the pumps electrical panel

c) Double check your voltmeter setting – Never measure for 480VAC with a lower setting; it will cause many meters to flash explode

d) With leather gloves on, very carefully making sure not to wiggle the probes out of place, measure the following voltages

- From the bottom of the Main Breaker; Measure voltage between each of the 3-connectors (They should all be 0V)
- From the bottom of the Main Breaker; Measure voltage between each of the 3-connectors and the ground metal of the electrical panel (0V)

4. Plan a location inside the Electrical Panel for the Power Supply and SSR mounted on the DIN rail

a) Requires approximately a 6" Wide x 6" Tall x 6 1/2" Deep envelope

b) Find a location as far away from other hot wires as possible (eliminate the risk of a loosened wires falling and touching a low-voltage wire)

a) Preferably a location at the bottom of the box where the exit plug can quickly drop out of the box.

5. Mount the DIN Rail

a) Hold the DIN Rail in the desired location and punch the metal through easily accessible mounting slots in the DIN Rail on both ends

b) Drill two holes in the punch markings (Bit Size #29 – 9/64" - 0.1360")

c) Tap-thread the two holes just drilled (#8-32 threading tap)

d) Hold the DIN rail in place and fasten it with (2) #8-32 machine screws

6. Attach (If taken off) the Power Supply and Solid State Relay to the DIN Rail

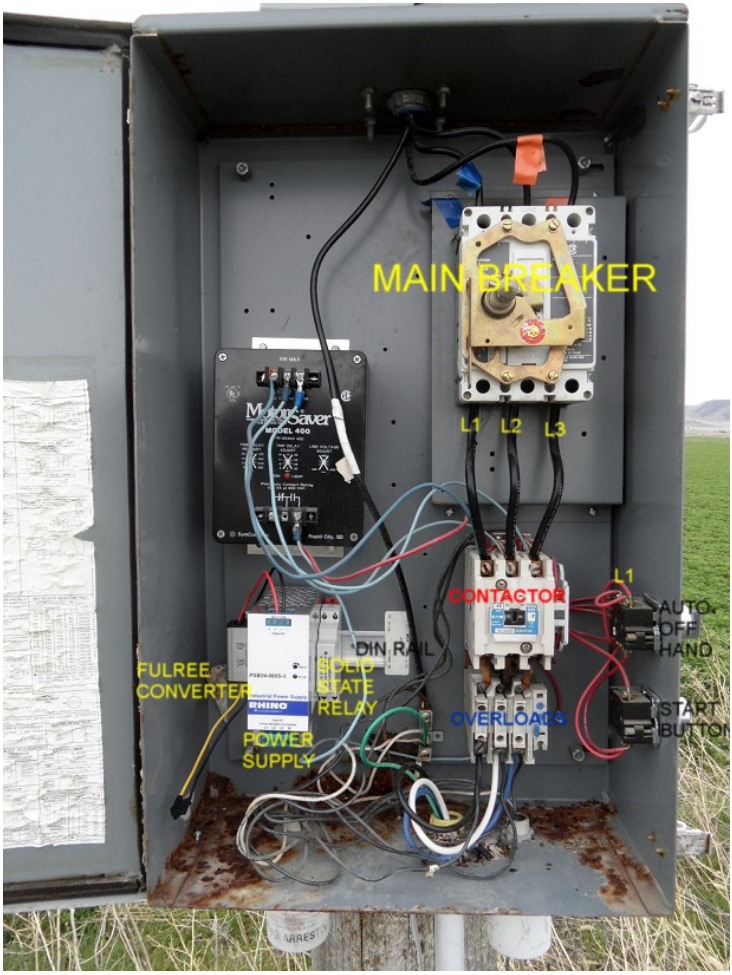
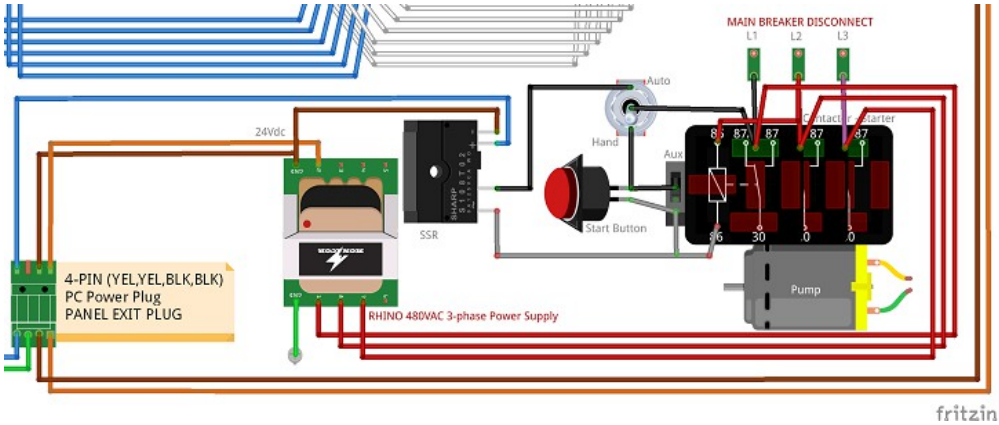


Illustration 1: ***Note****; the Fulree Converter pictured IS NO LONGER USED*

C. Pump Panel wiring

NOTICE: All wiring in this section should be done with 600V rated wire



1. Wire the 480VAC 3-Phase Power Supply attached to the DIN Rail

   a) Using **RED wire**; connect Power Supply Terminals **L1, L2, L3** to the top terminals of the Contactor (i.e. Starter / Hammer) L1, L2, L3 terminals
   - Often this is easiest to do by wiring to a "Motor Saver" unit that is already wired to L1, L2, L3 if your panel has one

   b) Using **GREEN wire**; connect Power Supply Ground (⏚) to a bolt or terminal connected to the panels back-plane

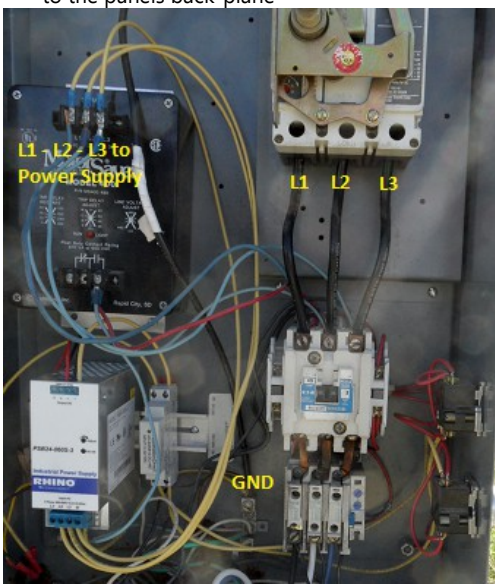
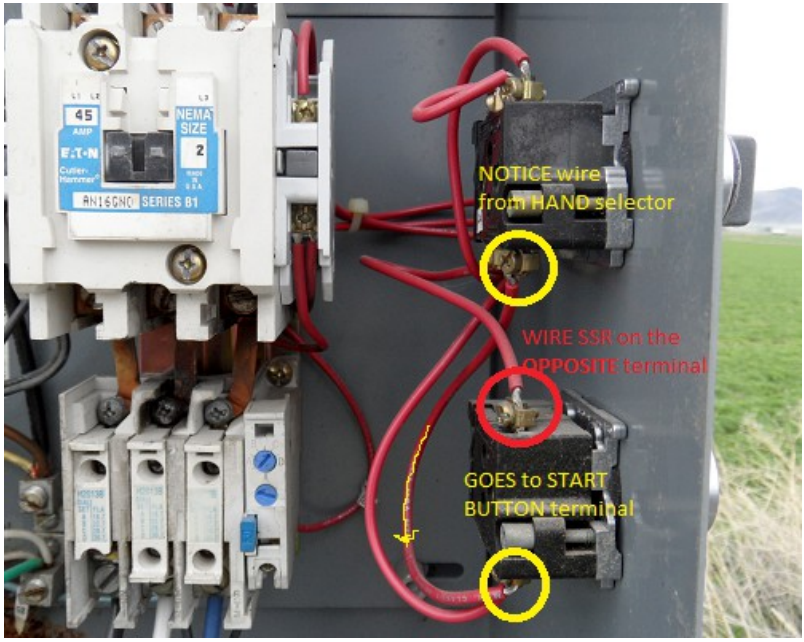
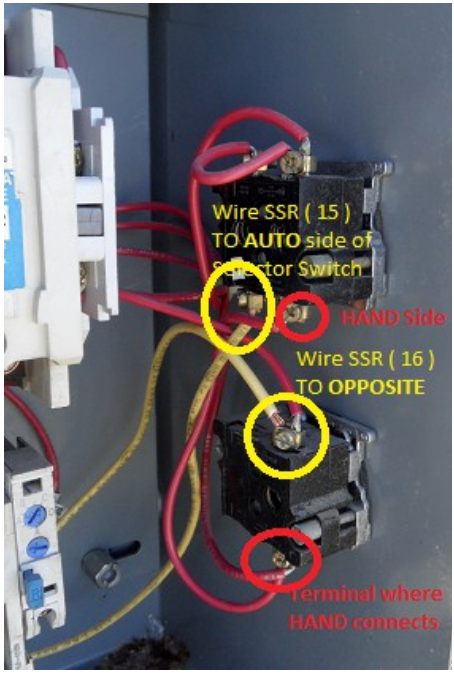


Illustration 2: All wires being yellow (Use colors in instruction)

2. Wire the Solid State Relay attached to the DIN Rail
   a) Using RED wire; connect Solid State Relay (15) → **AUTO** Terminal of the HAND-OFF-AUTO switch (*Typically the only unused terminal*)
   b) Using RED wire; connect Solid State Relay (16) → **OPPOSITE side** of the start button as the wire from the HAND-OFF-AUTO to the Start Button





3. Wire in the Pump-Panel **Exit Plug**
   a) With the **Plug end** of the EXIT PLUG outside the box; insert the wires through a bottom hole in the Pumps Electrical Panel
   b) Connect the
      - **Orange wire → 24Vdc(+)** of the Power Supply
      - **Brown wire → 24Vdc(-)** of the Power Supply
      - **Blue wire → (A1)+** of the Solid State Relay
   c) Verify that a BROWN wire already exists from **24Vdc(-)** of the Power Supply → **(A2)-** of the Solid State Relay

4. Close the Electrical Panel – Panel Control installation is now complete
   a) Wait until after installing the Pump-Controller before turning the breaker back on.

D. Pump-Controller

1. Plug the PUMP-CONTROLLER into the EXIT PLUG installed in the steps above.
2. Attach the PUMP-CONTROLLER box to the power pole using a wood screw at the desired height up the pole.

E. Testing

1. Turn the Electrical Panel Breaker ON.

2. Switch the Hand-Off-Auto switch to AUTO.

3. Using the HAND-REMOTE Device
   a) Find the Menu-Item "Power" for the Pump-Controller Device just installed
   b) Press (→) to 'SET->' and then UP/DOWN to set to ON

c) Press the square 'Enter' button – The pump should start running
d) While still on the "Power" Menu-Item; Press (→) till 'SET->' and then UP/DOWN to set to OFF
e) Press the square 'Enter' button – The pump should shut off

3. OPERATING INSTRUCTIONS

3.1 Introduction

The HAND-REMOTE display has a **Top Row** and a **Bottom Row**

✔ **Top Row** (i.e. The Status Row – not changed directly)

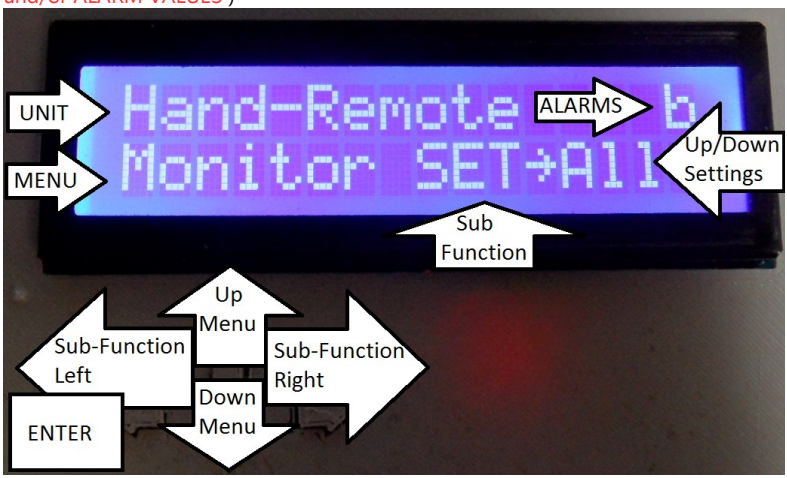
- On the Left - The Device (Unit) that is currently under control or being monitored
- On the Right - The Alarms currently active (Alarm 'ID'entifying letters)

✔ **Bottom Row** (i.e. The Control Row – changes are made directly on this row)

- On the Left - The current Menu-Item (*Up-Down Arrows Change Item*)

- In the Middle - The current Action/Function to be applied (Right-Left Arrows Change)
  - If it is (=) - Function; **Read** Value for the current Menu-Item (the "Main Menu")
  - If it is (SET→) - Function; **Set** a New Value for the current Menu-Item
  - If it is (<!) - Function; **Low Alarm** value; "too-low" number value that will trigger alarm
  - If it is (=!) - Function; **Low Alarm** option; "is-equal-to" option that will trigger alarm
  - If it is (>!) - Function; **High Alarm** value; "too-high" number that will trigger alarm
  - If it is (╪!) - Function; **High Alarm** option; "not-equal-to" option that will trigger alarm

- On the Right - The function Value (of or for) the Device (Up-Down Arrows Change the SET and/or ALARM VALUES)



3.1.1 Display Table

✔ Maneuvering the display items can be represented as a table like the one shown below

- The "Location" Column is NOT part of the Display Menu; It shows where the item is **wired** to the Pump-Controller Hardware (if applicable)
- Disabled items are Skipped when maneuvering through the display table

		SUB-FUNCTIONS (←LEFT || RIGHT →)				Location
	Device	MENU ITEMS (=) Up/Down Items ENTER to refresh	SET (→) Up/Down Changes ENTER to Apply	LOW ALARM (=!) (<!) Up/Down Changes ENTER Toggles On-Off	HI ALARM (≠!) (>!) Up/Down Changes ENTER Toggles On-Off	Wire to PIN (NOT for Display)
Menu-Items (UP || DOWN) → ↑	Hand-Remote	Battery(B)	DISABLED	(<!) When less than	(>!) When greater than	A1
	Ditch Pump	Power(P)	(SET→) On (SET→) Off	(=!) Equals "On" (=!) Equals "Off"	(≠!) Not Equal "On" (≠!) Not Equal "Off"	D7
	Ditch Pump	Water (L)	DISABLED	(<!) When less than	(>!) When greater than	V64(Trig=D4,Echo=D5)
	Ditch Pump	Pressure(R)	DISABLED	(<!) When less than	(>!) When greater than	A3
	Canal Pump	Power(P)	(SET→) On (SET→) Off	(=!) Equals "On" (=!) Equals "Off"	(≠!) Not Equal "On" (≠!) Not Equal "Off"	D7
	Canal Pump	Pressure(R)	DISABLED	(<!) When less than	(>!) When greater than	A3
	Canal Pump	Pressure(S)	DISABLED	(<!) When less than	(>!) When greater than	A4

** Note: V64 is Virtual Pin #64; Virtual Pins are memory spaces inside the Pump-Controller and therefore the Pump-Controller firmware actually identifies the connecting pins. This is used when Pump-Controller processing is done before a legitimate value can be determined.*

3.1.2 Alarms

✔ Alarms check read/monitored values against desired values (Low / High boundaries) and notifies the user (buzzing) if boundaries are violated

- Some menu items will have alarms while others will not – this is configured in the firmware and should be on a use-case scenario
- Anytime a button is pressed an active alarm (buzzing) will quite until "idle-monitoring" is started again (No button press for 30-seconds)
- To permanently shut off the active alarm (buzzing) the alarm itself must be turned 'OFF'

✔ Alarms can be either turned ON or OFF

- ON alarms are identified by the single character in the Top-Right of the Display
- Alarms are switched from ON → OFF or OFF → ON by
  - Press UP/DOWN until the Menu Item you'd like to turn an Alarm On/Off for - is selected
  - Press RIGHT button to select which alarm to turn On/Off; Either the Low Alarm (!=, !<) or the High Alarm (! ǂ, !>)
  - Press ENTER button to Toggle the Alarm On/Off (An On-Alarm goes Off; An Off-Alarms goes On)

✔ To Set an alarm **value**
- Press UP/DOWN until the Menu Item you'd like to set an alarm boundary for is selected
- Press the RIGHT button as many times as it takes to see one of the following indicators in the Middle of the Bottom Row
  - (=!) - Sound an alarm if the value becomes EQUAL to the one indicated
  - (ǂ!) - Sound an alarm if the value does NOT-EQUAL equal the one indicated
  - (<!) - Sound an alarm if the value becomes LESS-THAN the one indicated
  - (>!) - Sound an alarm if the value becomes GREATER-THAN the one indicated
- Use the UP/DOWN buttons to select the comparison value or option
  - For Numerical values; Holding the UP/DOWN button for more than 5 counts will increase or decrease the value by 10
- Press ENTER button to apply the selected comparison value (Note; Applying a value will also Toggle the On/Off status of the Alarm)

✔ Notes
- When the Hand-Remote looses signal the alarms are shut-off automatically until signal is restored
- The Battery alarm will disable at any reading under 550. This prevents the battery from alarming while being powered by USB.

4. OPTIONAL ACCESSORIES

Optional Accessories can be added to the Ag-irrigation Remote Control system to enhance monitoring and control abilities.

4.1 Hand-Remote

4.1.1 9V Rechargeable Batteries ($18.90)

It is highly recommended to purchase high output 300mAH or more rechargeable 9V Batteries; as the Hand-Remote will eat threw batteries pretty quickly.

At time of writing EBL 4x 600mAHh 9V Li-ion Rechargeable Batteries with Charger could be purchased for $18.90
http://www.ebay.com/itm/300974624904

NOTE: Even if a USB power is plugged in – If the power switch is turned ON it will still draw power from the battery. If you plug in USB for power be sure the power switch on the Hand-Remote unit is turned OFF.

4.2 Pump-Controller

4.2.1 Pressure

- ✔ Features
  - Offers a way to remotely monitor the water pressure
  - Default programming on pin A3

A. Materials ($9.59)

5V 0-1.2 MPa Pressure Transducer Sensor Oil Fuel Diesel Gas Water Air Sensor
Banggood.com ($9.59/EA)

required

B. Installation

1. Remove the current Pressure Gauge from its location

2. Screw in the Pressure Transducer (*Typically does fit the same hole size and threads as the pressure gauge*)

3. Wire up the Transducer as follows
   a) Transducer RED wire (+5V) → Cat5e ORANGE
   b) Transducer BLACK wire (GND) → Cat5e BROWN
   c) Transducer YELLOW wire (SIGNAL) → Cat5e BLUE

4. Wire the other end of the Cat5e Wire into the Pump-Controller
   a) Cat5e ORANGE → 5VDC
   b) Cat5e BROWN → GND
   c) Cat5e BLUE → A3

C. Firmware Adjustments

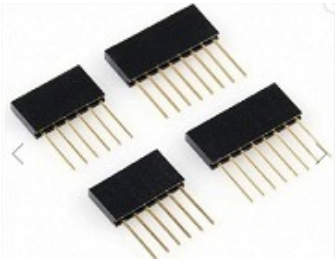
See #5.1.Adding Expansions|outline
To activate the Pressure Sensor on the Hand-Remote Unit

4.2.2 Water Level

- ✔ Features
  - Offers a way to remotely monitor water-level in a ditch
  - Default programming on pins D4 (TRIG) and D5 (ECHO) – *On Pump-Controllers Firmware*

A. Materials ($10.77/ea)

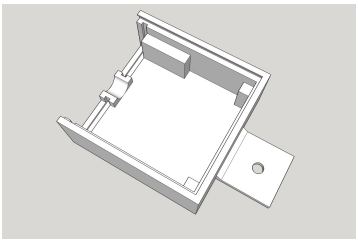
(1) DC 5V Waterproof Ultrasonic Module
Distance Measuring Transducer Sensor
banggood.com ($ 10.77/EA)



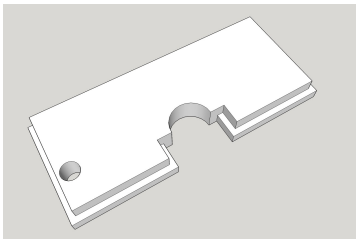
(1) 4-PIN Female Dupont Header
to connect to Circuit Board Pins
(See Dupont Headers in BOM)

B. 3D-Prints ($1.30)

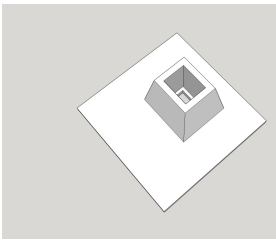
- ✔ Print the Following Models on a 3D-Printer
  - Files Located at
    https://github.com/tgit23/AgIrrigationRemoteControl/tree/master/Accessories/Sonic%20Water%20Level%20Meter/3D-Prints-STL
  - Total Filament = 43.7 cm^3 @ $0.03/$cm^3$ ~ $1.30



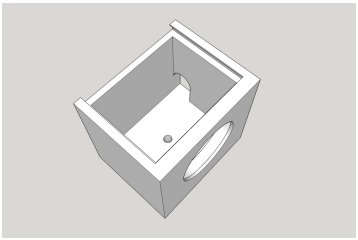
SonicCircuitBoardCase.stl (14.3 cm^3)



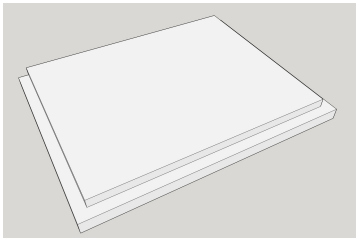
SonicCableCover.stl (2.5 cm^3)



SonicCircuitBoardCover.stl (6.7



SonicHeadCase.stl (17.6 cm^3)



SonicHeadCover.stl (2.6 cm^3)

C. Firmware Adjustments

See 4.1.Adding Expansions
To activate the Ultrasonic Distance Water Level Meter on the Hand-Remote Unit

4.2.3 Auxiliary Contact ($43.75)

- ✔ Auxiliary contact, side mounted, 1 N.O. Contact (NOTE: This must match/fit the pump panels Contactor Unit)
  - https://www.automationdirect.com/adc/Shopping/Catalog/Motor_Controls/Eaton_Cutler-Hammer_Contactors_-z-_Starters_-z-_Overloads/Auxiliary_Contacts/C320KGS1 - $43.75/ea

- ✔ Notes
  - Auxiliary Contactor must be purchased according to the contactor they will FIT on.
    - The above suggested purchase will ONLY work with the NEMA-2 Model # AN16GNO Series B1 Contactor
  - The Auxiliary Contactor typically already used by the Start-lock CANNOT be used for this purpose as it has 480V wires already attached to it.
  - Often a used aux contactor can be found much cheaper on ebay

- ✔ Benefits
  - Offers a way to monitor the actual (i.e. directly) the pump power status

5. TROUBLESHOOTING

- ✔ Support
  - You can email me at tgit28@gmail.com with any questions, comments and or requests. I'm glad to help in any way I can.

- ✔ Hand-Remote Problems

  - The **Display** is or started to show **garbage**
    - Typically this is a symptom of a low battery (Replace the 9V Battery and see if that fixes the problem)

  - The **Menu-Items all show 'ERR'** (Meaning it cannot communicate with the Pump-Controller)

    - 1) Unplug the Pump-Controller Box at the Pump-Panel EXIT PLUG

    - 2) Measure voltage across the two center pins; It should read approximately 24Vdc. If it doesn't --
      - Double check that the main breaker is ON
      - If the pins still do not read voltage; double check the installation steps (Make sure to turn OFF the main breaker before opening the panel)

    - 3) If 24Vdc is measured at the Exit Plug ---
      - Remove the PUMP-CONTROLLER cover

- Measure voltage from the screw terminals labeled 5Vdc and GND; It should read approximately 5Vdc. If it doesn't --
  - Check that the DC power plug is plugged into the Arduino (See BOM to determine which board is the Arduino)
  - Check that board lights are lit and one should be blinking

- 4) If all the above is Okay
  - There may be a more serious problem like a solder joint has come UN-done or system configuration was lost.
  - You can try and re-configure the Xbee and Upload Firmware again; but the unit is deemed broken and should be returned for a replacement

✔ Pump-Controller Problems

○ The **Pump doesn't turn ON** although the Hand-Remote displays that Power is ON

- 1) Be sure the Hand-Off-Auto Selector switch is set to Auto

- 2) Double check the installation steps (Make sure to turn OFF the main breaker before opening the panel)

  - Note: If the Solid State Relay was wired on the wrong side of the Start Button; this will cause a short when the Power was Set → ON on the Hand-Remote and the Solid State Relay may be fried and will need to be replaced.

6. FCC Compliance

✔ An FCC compliance label showing the following should be attached to each device that contains the Xbee Module

Contains FCC ID: OUR-XBEEPRO
The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: *(i.)* this device may not cause harmful interference and *(ii.)* this device must accept any interference received, including interference that may cause undesired operation.

✔ The User Manual should contain the following

CAUTION! To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

✔ See https://www.digi.com/resources/documentation/Digidocs/90000991/reference/r_certs_xb_usa.htm for more information