



2022

Installation Manual

Mobile Browsers

This Manual belongs to:

Cell

R2Dfuel release

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Introduction to R2Dfuel

R2Dmax is a GPS/GSM driven micro-controller designed to manage, display, record and transmit the live activities associated with the non-commercial dispensing and receiving of liquid kerosene-based fuels like diesel and paraffin in both mobile and fixed installations, the web-based interface is tailored to display the data in a user-friendly manner offering an array of essential and convenient reports both live and historic.

Specifications

Power supply	8 to 36Volt DC (default is 12V DC)
Power supply (Battery back-up)	12V DC (1.2 – 48Ah lead acid or gel cell)
Current consumption (24v)	190 mA typical with 3x FLS, peaks of 700mA on solenoid operation
Current consumption (12v Bat)	280 mA typical with 3x FLS, peaks of 900mA on solenoid operation
Inputs	1 x analogue, 4 x digital, 5 x virtual, 3 x UART
Outputs	2 x open collector (solenoid max. 2000mA DC limited to 2 seconds)
Battery Charging output	1 x 13.8V DC 1A regulated output with protection and cut out
Size of Micro controller	160 x 80 x 55 mm (Approx.)
Weight	420g (Approx.)
Operating temperature	-20 to 60 deg. C

Notes: Current consumption drops by 130mA if the device is set to low power mode, useful in Solar and Mobile Bowser applications. The solenoid valve is not held open with full 2000mA power, after opening the valve the output power drops to below 600mA for holding open only. This allows the maximum pump dispensing time to remain uncompromised. Duty cycles and maximum pump run times should always be considered when setting up the max FDT (fuel dispense time) variable.

The product and offering are subject to a **PRODUCT LIABILITY DISCLAIMER – TERMS OF USE, WARRANTY & LIABILITY WAIVER this must be read and acknowledged prior to proceeding with any installations.**

The author of this manual assumes that the installation of the R2Dfuel system and related products will be carried out by competent, suitably trained, and qualified personnel.

If you are unsure of any information in this manual, contact the author of this manual immediately.

If you have not had suitable training in the installation of fuel products, especially in high voltage applications, contact your employer or franchisor for advice and engage the services of experienced and suitable professionals.

The R2Dfuel MOBILE generator Kit and Quick Install Guide

The R2Dfuel mobile bowser kit consists as follows:

1. One steel housing UPS Controller with cable glands
2. One 1000mm BLE Fuel Level sensor with base receiver
3. 5m length of 4mm 2 core cabtyre with Anderson plug attached
4. One Piusi flowmeter with 2m cable and 1" BSP Galvanised nipple
5. One 12volt brass solenoid valve 1" BSP with 2m cable



The functions of the kit are as follows:

- a. R2D UPS controller – A visual representation of fuel readings from the FLS including the total sum and percentage of fuel in the tank. The UPS battery voltage is also displayed. The device houses a Tag receptacle which turns on the backlight to assist with night readings and this is also used to activate the Pump and solenoid for fuel dispensing and recording.
- b. Flowmeter – A turbine meter that is driven by the flow of fuel past an impeller to count litres
- c. Solenoid – An electronic shut-off valve that is switched by the Controller and prevents draining of the tank via the hose nozzle.

Please note in cases where the Kit is supplied with a wireless Bluetooth probe, there are two packages, one for the controller and ancillary equipment and one for the probe, both boxes must have matching BOX numbers, as the probe has already been assigned to the controller.

Quick install Guide

- 1) Assess the installation, take pictures, measurements and capture the IMEI number of the KIT, the bar code provided on the KIT will give you all the KIT information, complete your job card with regards to all the information requirements pertaining to your responsibility.
- 2) Fit the flowmeter and solenoid first and test for leaks, this gives you maximum space to work.
- 3) Install a working SIM into the R2D controller and securely mount the controller housing using a minimum 4 x M6mm bolts screwed into the Rivet nut mounts supplied
- 4) Route and connect the input voltage supply cable to the appropriate coloured Busbars in the controller housing , allow some extra length at the trailer hitch end.
- 5) Route and connect both the solenoid and flowmeter cable to the R2D controller
- 6) Route and connect the pump motor supply wires to the appropriate coloured Busbars in the controller housing.
- 7) Program and Fit the BLE Fuel Level sensor. Check the base receiver is connected to the R2D controller (view separate installation guide, “R2D Fuel Level Sensor Installation Guide”).
- 8) Pump out a measured volume of fuel, so that the calibration process of the flowmeter can be done.

Quick check List

- 9) Check basic operations of Tagging input and solenoid operations FLS inputs on controller LCD screen.
- 10) Check the flowmeter input counting.
- 11) Check GSM connectivity and settings by sending SMS command “INFO” provided the Sim card has SMS functions, alternatively send the command from the server platform or USB-C port.
- 12) Take pictures and record details of the completed installation.
- 13) Leave machinery, equipment and site clean, tidy and safe.

Tools and sundries required

Cleaning rags, cleaning solvent, Tape measure, Vernier calliper, Permanent Marker, Notebook & Pen, Hacksaw, Multi meter, Side cutter, screwdriver set, vice grips, Pump pliers, pipe wrench, shifting spanner, drill machine, vacuum cleaner, flexible magnet stick, 5mm drill bit, 20mm hole saw, 35mm hole saw, cutting paste, cable ties, insulation tape, 1-2mm 2 core connecting cable for power input, 12mm Sprag outer sleeving, PTFE plumbing tape, loxeal 58-11 thread sealant, pipe cutter, pop rivet gun, 8mm Socket for drill, 8mm Socket and ratchet, Laptop with micro USB and USB-C type cables and Calibration flask



Safety

Ensuring the safety of yourself and those around you cannot be emphasised enough during any installation. Remember, during an installation there may be fuel leaking out of tanks including fuel residue where you will be working, electrical connections must be done with battery disconnected and engine/exhaust temperatures considered safe below 50 degrees.

Ensure that every safety measure is put in place before starting the installation of any system and especially where high volumes of fuel are involved. Ensure you are familiar with local legislation, company health and safety procedures and any other requirements pertinent to your installation.

1. Cordon off the area where you will be working to prevent 3rd party interference.
2. Ensure all electrical supply breakers and battery connections to the bowser are off, and, if possible, are clearly marked as such so they are not accidentally switched back on again during the installation.
3. Ensure all fuel shut off valves from the tanks are closed, and again clearly marked as such so that they are not accidentally switched back on again during the installation.
4. Ensure you have the necessary fuel recovery equipment to contend with any spills.
5. Ensure that you bring the necessary firefighting equipment with you, and you are aware of the site safety requirements and location of safety equipment on the site.
6. Personal Protective Equipment must always be worn.
7. Do not proceed to install on Equipment that you consider in any likelihood as “unsafe”



**FUEL BOWSER WORK IN
PROGRESS**

DO NOT SWITCH BREAKERS

TIPS –

Make use of an oil drain tray or plastic tub to catch any fuel that leaks out when pipes are removed or cut. You will be working on a client's premises. Respect their safety rules and regulations.

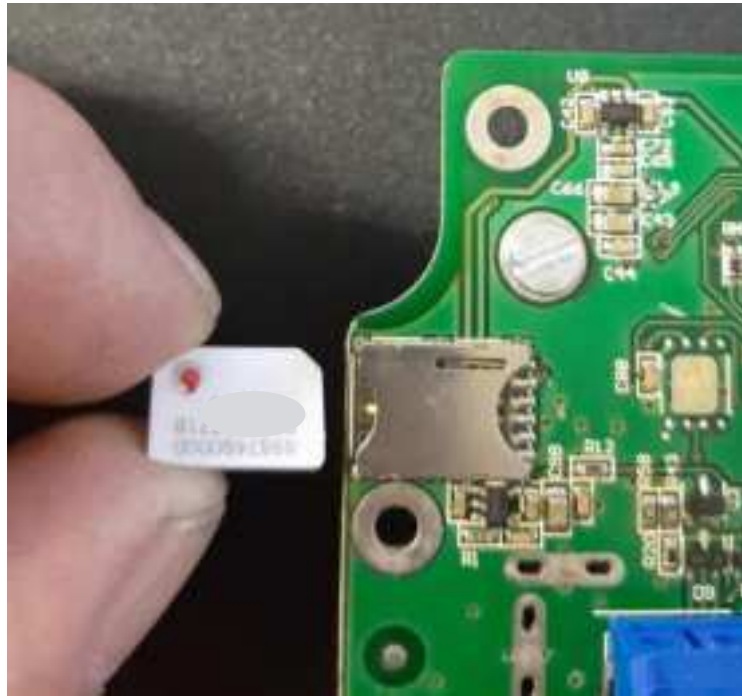
Equipment Placement

- 1) Fit the flowmeter and solenoid upstream (after) of the fuel filter, preferably with the solenoid last in-line and before the dispensing hose attachment point. Ideally with cables facing down and sealed from water ingress.
- 2) The R2Dfuel PSU controller is typically mounted on a strong steel bracket attached to the bowser trailer, so as not to interfere with the existing components and wiring.
- 3) A protected or fused 12-volt power and battery earth can be taken from the primary towing vehicle to supply the R2D controller Busbars via the 50-amp Anderson plug.



Installing the Sim

It is suggested before any wiring is done you first test the SIM card using a phone and then insert the SIM card; the controller will require a working NANO SIM card to communicate with the R2Dfuel server. It is advisable to secure the SIM card with some tape should the controller be installed on a moving vehicle.



Install the SIM card as shown above. The SIM must be active, have a valid data balance and preferably a suitable SMS bundle loaded. The APN may be changed to suit applications or countries outside of South Africa, please contact your Product supplier directly to arrange this. A simple “INFO” message sent to the device will reveal the CSQ (signal strength) as well as the GPRS connectivity status (GPRS=0, no communication from or to the controller, GPRS=2, communication sent from the controller with no handshake reply from the server and GPRS=1 communication established between the device and the server).

Wiring up the Controller

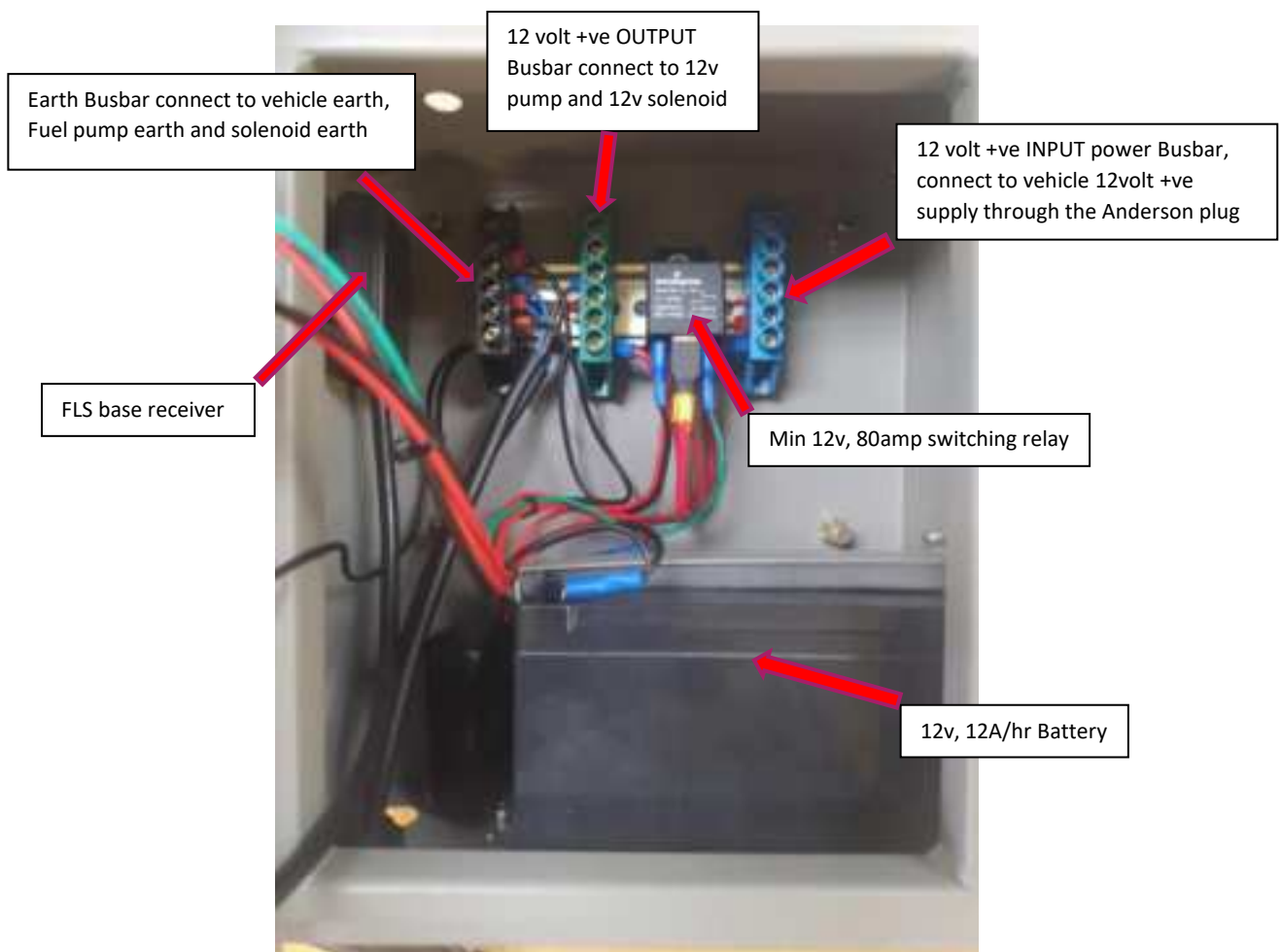
The wiring of the R2Dfuel system must be done as follows. Ensure that all cables used are sufficiently sized to avoid voltage drops over longer lengths.

a. R2Dmax Controller



Flowmeter connection point

lift the screw terminal connector blocks up to reveal the designation of each screw connector. This is printed on both sides of the PCB for installer convenience. ONLY the flowmeter is connected directly to the controller in Mobile bowser applications



Starting from top right on the board, the pins marked as follows are:

All the information below is informative & only the Flowmeter is connected to the PCB in Mobile Bowser applications that which is highlighted in yellow below

FM- Flowmeter negative (*Polarity insensitive at the flowmeter*)

FM+ Flowmeter positive (*Polarity insensitive at the flowmeter*)

SOL+ Solenoid positive (*NOT USED*)

SOL- Solenoid negative (*NOT USED*)

15-30V Positive 24v DC from transformer power supply in Kit or 24volt vehicle

GND Negative 24v from power supply and common earth

The terminal connectors at the bottom of the board are as follows (right to Left):

12V 12v positive backup battery connection or primary 12V source if 24V is not available

GND 12v negative backup battery connection or primary 12V source if 24V is not available

BLU Blue wire of 4 core cable from Fuel Sensor (1)

BRW Brown wire of 4 core cable from Fuel Sensor (1)

GRN/Y Green/Yellow wire of 4 core cable from Fuel Sensor (1)

BLK Black wire of 4 core cable from Fuel Sensor (1)

BLU Blue wire of 4 core cable from Fuel Sensor (2)

BRW Brown wire of 4 core cable from Fuel Sensor (2)

GRN/Y Green/Yellow wire of 4 core cable from Fuel Sensor (2)

BLK Black wire of 4 core cable from Fuel Sensor (2)

R2Dmax Connection Points (back)

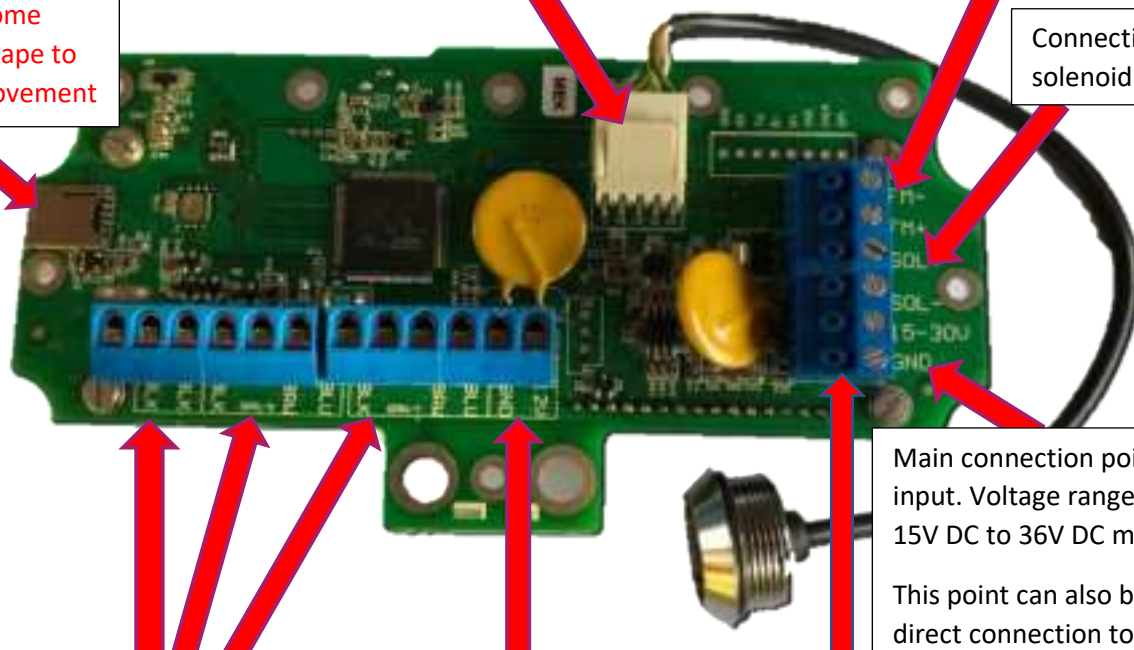
Nano-Sim card slot, chip must face the PC board, with flat edge in line with board edge. **If the controller is mounted to a moving bowser, please secure the Sim with some insulation tape to prevent movement**

Connection point for the TAG receptacle cable plug, standard extension cables up to 10m can be purchased from your product supplier

Connection point for the Flowmeter (FM + & FM -), most digital dispensers can be integrated directly



Connection point for the solenoid (SOL + & SOL -)



Connection points for FLS (Fuel level sensor). Please note connection points are marked by colour. Up to 3 FLS's can be connected and monitored.

The minimum value of any FLS is 1L and maximum is 65500L. With fixed non-moving tanks it is advisable to set the averaging time between 10 and 20 seconds, ideally 20 seconds on 2KL tanks and 10 seconds on 23KL tanks, for moving bowsters between 50 and 80 seconds.

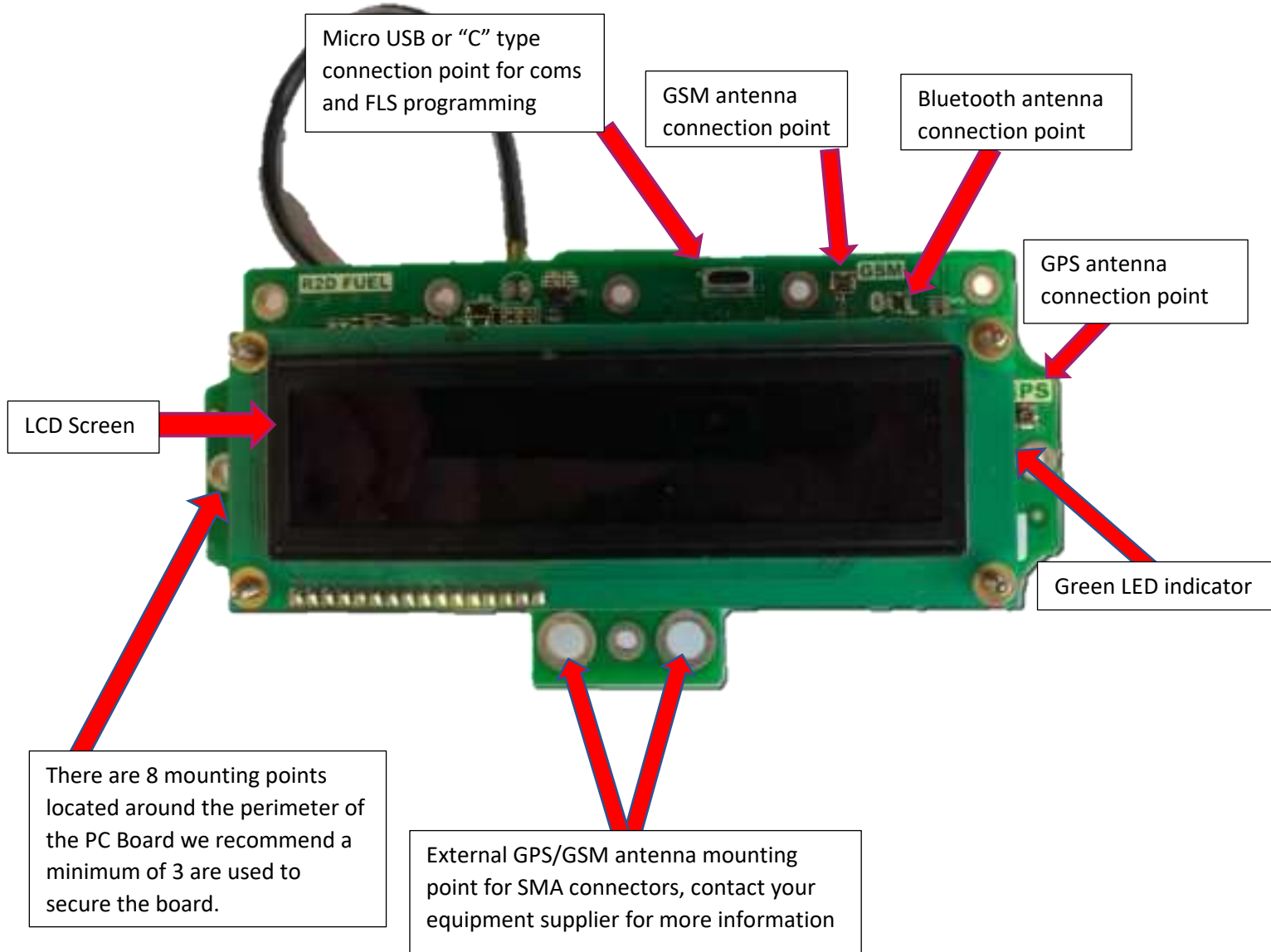
Connection point for a 12 Volt backup battery, this is a regulated output or can be used as the primary input if you only have a 9 -14 Volt supply (e.g., mobile bowser). **It is recommended that a 12V back-up battery is installed.**

Main connection point for power input. Voltage range between 15V DC to 36V DC max.

This point can also be used for a direct connection to a suitable 18-24V solar panel (min 80Watt)

PLEASE NOTE: The plastic terminal connectors slide off the pin seats for easy removal and fitment, do not connect wires when the supply voltages are present and rather use flexible, braided copper cable to prevent damage to the PCB

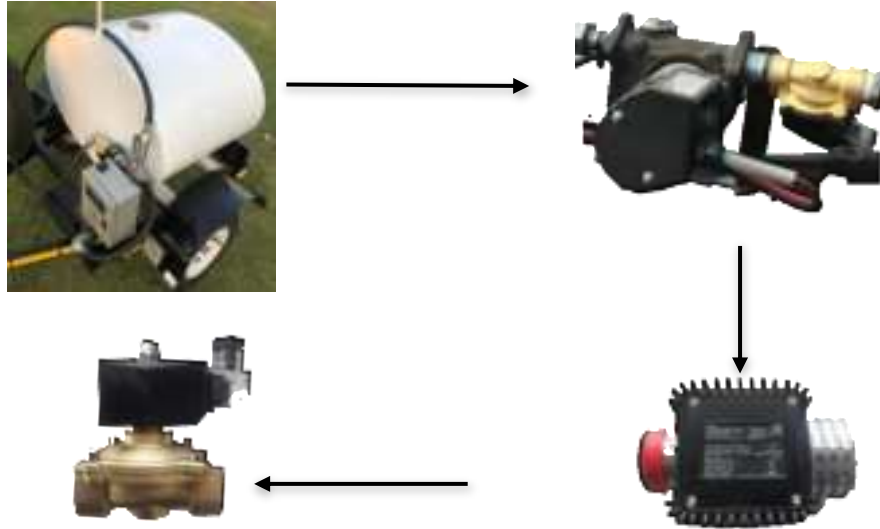
R2Dmax Connection Points (front)



WARNING BE GENTLE WITH THE CIRCUIT BOARD, FORCING THE BOARD INTO AN ENCLOSURE CAN CAUSE THE BOARD TO BEND AND FLEX WHICH IN-TURN CAN CAUSE COMPONENTS TO CRACK AND SOLDERED JOINTS TO BREAK

Installing the Flowmeter and Fuel Solenoid

When installing the Flowmeter and Solenoid, the best order of the parts is as shown below. By installing the solenoid last in line, it will ensure that the Flowmeter always remains full of fuel preventing small losses in accuracy and prevents easy access to tampering.



High quality, high temperature Polytetrafluoroethylene thread Tape (PTFE), generally referred to as “plumbing tape”, can be used on all fittings other than compression type fittings, this will generally ensure that there are no fuel leaks after installation. However, new technology liquid or paste type thread sealants are kinder to sensitive components downstream. Sometimes a combination of both thread tape and paste is required for stubborn leaks, it is not uncommon to trace fault in fuel components to clogging from a piece of Teflon tape that washed off the ends of the threads and gets clogged in the flowmeter turbine.

Calibration of the flowmeter is an essential post-installation procedure, this can be done remotely or on site from values obtained, either from dispensing into a measured volume container or using the comparison values obtained from the existing in-situ meter. Check the current PPL (Pulse Per Litre) count by sending “INFO” via SMS, this is the value of electronic pulses counted to display a result of One Litre on the LCD screen and R2Dfuel server. Only whole numbers (integers) are acceptable (i.e., 88.5 is unacceptable), by increasing this value you will **decrease** the value of litres shown on the display and R2Dfuel platform and by decreasing it you will **increase** the litres displayed on the LCD screen and R2Dfuel platform. Once the big adjustment is made, fine calibration is done by using the PPLF (Pulse Per Litre Factor) setting, the final litres counted are multiplied by this value settable between 0.800000 and 1.200000 for increased accuracy.

Tip – Determine the current PPL by sending the “info” message, then pump out a measured volume of fuel, for example 100L, the controller display may show a live dispensing of 106L, now do some math $(106/100)=1.06$ now multiply the default or current PPL in this case 88 by 1.06 $(88 \times 1.06) = 93.28$, result 93 is closer than 94 so program the controller PPL for 93 and do further dispensing, the PPLF values can now be used to fine tune the overall values displayed with precision, all these adjustments can be done while monitoring the controller LCD screen where the new result will be instantly displayed.

PPL formula $(\text{R2Dmax displayed volume} / \text{Actual volume dispensed}) \times \text{Current PPL} = \text{NEW PPL}$ *whole numbers only*

PPLF formula $(\text{Actual volume dispensed} / \text{R2Dmax displayed volume}) \times \text{Current PPLF} = \text{NEW PPLF}$

Powering up the unit for the first time

The controller will power up and display a value of fuel remaining in the tanks provided the fuel level sensors has been connected.



On start-up, the green LED situated on the right-hand side of the PC Board will indicate the following:

Solid light with a brief “off” every second = NO GSM or NO SIM card present

Slow flash = busy registering on a GSM network

Brief 0.1 second flash every second = good GSM connection established

With power connected, the Tag receptacle LED on the door of the controller will be lit up RED.

The light on the tag receptacle has a secondary function to display certain conditions, namely.

A slow RED flash – indicates no GPS lock (solid indicates good GPS lock)

Communicating with the Controller

Communication with the controller can be achieved in 3 different ways.

a. SMS

Sending an SMS to the unit will allow the installer to receive basic information that will determine the functionality of the unit.

b. Direct USB connection

Using a USB to micro-USB cable, the installer can communicate via a laptop using the Serial communication software provided by the product supplier.

c. Server

Once logged into the R2Dfuel website, all commands can be sent to the unit directly via internet connection.

SMS Communication

Once the initial installation is complete, the installer can confirm that the controller is working by sending an (info) SMS to it. The message reply contains all the immediate and important data which is essential in evaluating the installation BEFORE the installer leaves site.

A General health and information query “INFO” can be done on the controller via SMS, USB or server. The unit will reply with the following: Each display line is explained below.



1. The name assigned to the controller
2. The unit IMEI number 862549040859442
3. The unit firmware version (9.22)
4. Input voltage 24.1 and battery voltage 13.3
5. CSQ or Cellular Signal Quality (27) out of 31
6. Satellites in view (12+10+10) from the different constellations
7. Satellites currently in use (16) (0 means no GPS lock)
8. 3-dimensional satellite lock (3) perfectly healthy GPS lock
9. Fuel Dispense Time in seconds, 600s (10 minutes) is the default
10. Auto-off time with no dispense activity in seconds default is 60s
11. Pulse count per litre (91) the (1) indicates Flowmeter is present
12. Pulse count per litre correction factor (1.000000)
13. FDL litres threshold drained to trigger SMS (10 x2)
14. FDH litres threshold added to trigger SMS (25 x2)
15. FDI is the interval checks for fuel theft or adds every minute (6)
16. PO= Max amt. of fuel that can be dispensed at once (default 1000)
17. LCK - solenoid locked (0 = RUN, 1 = LOCKED)
18. GPRS=1/2/0 (1=good, 2= no server coms, 0= no communication)

Important other than the **INFO** message, if you need to communicate with the controller via SMS you will have to be assigned as a management number.

Important - Additional Product Considerations and precautions

The general flow of a fuel dispensing system

From the bulk supply tank through a simple in-line strainer to trap large debris, then the fuel pump, next a fuel filter with water trap, then your flowmeter (preferably only one to avoid conflicting readings) then the electric solenoid and lastly the manual valve on the end of the hose which we call the dispensing nozzle. Note: many mechanical flowmeters can be adapted to produce electronic signals for R2Dfuel monitoring.

NB! Fuel filters should be in-line AFTER the main fuel pump, a filter before the pump will reduce the pressure in the suction line and a dirty filter significantly more so. Lower pressure with high temperatures makes it easier to reach the vapor pressure of the fuel and create a vapor lock condition that can also cause the pump to overheat and fail. In layman's terms often referred to as cavitation. So simply this means do not suck from a filter, rather push fuel through the filter.

Flowmeters

It is very important not to exceed the capabilities of the flowmeter and in certain applications a larger and more appropriate flowmeter may be required. The Piusi K24 ATEX/IECEX Pulser supplied in the kit is typically rated at best accuracy performance with flows between 7 and 120 litres per minute, with the maximum operating pressure being 20 BAR (300 PSI) and overall accuracy plus/minus 0.6% (when calibrated and coupled with R2Dmax). The aluminium housing inlet and outlet thread are 1" BSP (male to female) with Bi-Directional flow capability. The only fluids permissible are DIESEL, KEROSENE, PETROL, PETROL ALCOHOL MIXED MAX 20%, AVGAS 100/100LL (PUMP ONLY), JET A/A1 (PUMP ONLY). This turbine flowmeter is also well suited to gravity fed dispensing applications typically found in agriculture. With any flowmeter a calibration after fitment will be required to produce accurate results, generally one can pump a volume of fuel into a measured vessel (*Recommended 200L with minimum acceptable quick reference 20L*) and adjust the pulse per litre count to reflect the correct reported value on the R2Dmax controller, alternatively the comparison can be done using an existing in-situ meter if its accuracy can be relied upon. Adjustments are best made using the R2Dfuel web platform, the USB and or SMS communication options can also be used. Always ensure the cable gland and outer covers are securely sealed to prevent moisture or fuel residues entering the electronic components contained within the flowmeter outer casting. Ideally ensure the cable gland is facing downwards.

Solenoid valves

Make sure the solenoid valve is connected in the correct flow direction and that the valve type and seals are suitable for the liquid product or media passing through it. Do not exceed the operating voltage or open time limits specified by the manufacturer. Many fuel pumps have a limited duty cycle, in some cases as little as 20 - 30 minutes continuous running in one hour, the R2Dfuel controller can help manage this maximum pump time and prevent misuse.

Do not exceed the pressure rating of the valve, high-pressure systems require pilot operated valves, while low pressure systems like gravity fed dispensing types are best fitted with direct acting solenoid valves. Be sure the solenoid valve is always downstream of any high-pressure bypass valves.

Where possible install the valve with the armature tube vertical, this reduces the risk of piston jamming caused by sediment, a particle filter must be fitted upstream of the solenoid valve to prevent sediment contamination of the valve's components.

In any non-commercial fuel dispensing system, the last valve in the circuit should be a manually operated valve being either spring or liquid force return shut actuated downstream of any electronic operated valve. Under no circumstances should any of the springs contained in the solenoid valve be stretched or altered in any way, this may severely affect the opening and closing ability of the device