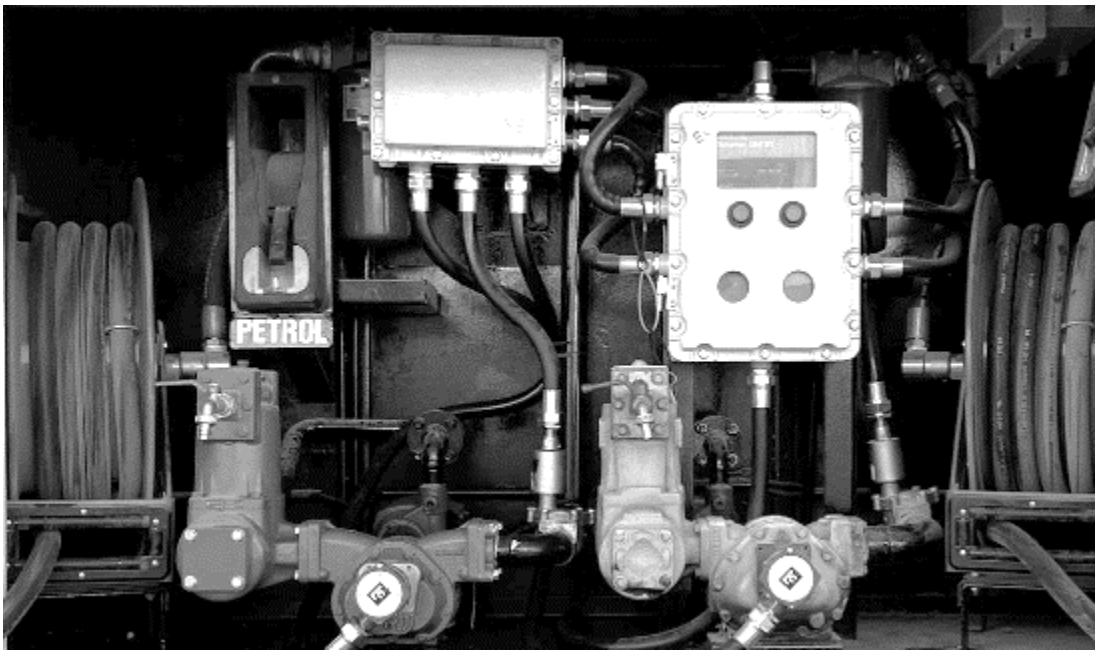
Gatex Fuel Control Systems

Installation Manual

Fuel-EYE Industrial for stationery and mobile tankers



Last update: 07.2023

Legal information:

This document is for trained technical personnel of Gatex channel-partners

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Fuel-EYE, Fuel Control Systems

Greeting from Gatex IOT, the developer and manufacturer of Fuel Control Systems.

This manual provides you with technical details on peripherals, installations & setup, operation, and regulatory information for the FCS systems for your mobile bowsers for both bulk deliveries and fleet fueling applications.

About

Fuel-EYE is a Linux-based embedded computer connected to a 7-inch or 15-inch HMI to provide visible real-time information of Volume, Receiving Asset Code, License Plate Number, Totalizer and Status Messages to the fuel operators and field personnel.

Fuel-EYE connects with your existing flow meters and measurement instruments on industry standard protocols for data acquisition; Fuel-EYE takes control of pumps, valves or OEM controllers to impose its own workflow.

Fuel-EYE workflow contains 4 levels of authentications of operators, vehicles (machines, assets), area codes and projects; and optionally captures the odometer or engine hours of the fuel receivers at the time of fueling for further analytical reports on fuel consumption.

Fuel-EYE is a cloud connected system, with an internal SQL database, which logs the transactions internally and uploads a replica of transactions to the cloud servers for online monitoring and reporting. The internal database of Fuel-EYE ensures uninterruptable fuel supply in rural areas with poor network coverage. The internal database contains asset master tables and authentication information and gets synchronized with the cloud database periodically.

Fuel-EYE is the only bidirectional system on the market which can utilize a single flow meter for both IN and OUT directions at two different flow rates as if there are two flow meters are installed. The bidirectional device is a cost-saving system and suitable for applications where there is a space limitation to install two flow meters such as mobile bowsers.

Fuel-EYE comes in different variants and models to serve your applications of bulk deliveries, fleet fueling, terminal transfers and receive operations and fueling stations controls. Fuel-EYE Industrial, FCS-RP, FCS-CW and FCS-Panel are models available at the time of this write-up.

Please refer to manufacturer's website on https://gatex.us.com for the latest products and updates.

Channel partners and resellers technical communications and feedback, please email us to:
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Product Release Milestone

Unidirectional Systems

1.5.11 Initial launch of the product B2B workflow - June 2018

1.5.17 First commercial release – October 2018

1.5.18 PTS controllers integrated for petrol stations

1.5.19 One-time scan workflow added

1.5.29 Bill printer, price and amount implemented

1.5.30 BLE nozzle reader launched – Jan 2020

1.5.31 B2C workflow launched – April 2021

FCS3.2 (CW Comprehensive version) single mainboard product variants launched July 2021

FCS3.4 Gatex totalizer module launched – Jan 2022

Bidirectional Systems

FCS2.0.10.4 Initial launch of bidirectional system – May 2020

FCS2.0.11 First commercial release of FCS2.0 – November 2020

FCS2.0.17 Multi-KFactor launched

Last update of this document 21.08.2025

HSE considerations

Before you start make sure that you have met with the site health and safety requirements as per international and local standards of the Oil & Gas industry.

Make sure that all necessary safety precautions have been taken.
Provide for proper ventilation, temperature control, fire prevention and evacuation.
Provide easy access to appropriate fire extinguishers for your product.

WARNING:
When in hazardous locations, turn power OFF before replacing any peripheral or connecting any wire. DO NOT disconnect equipment unless power has been switched OFF or the area is known to be Non-Hazardous.

Gatex Fuel Control Systems are using 12v and 5v DC at low current consumption. All components which are operating in Zone-1 of ATEX DIRECTIVE 1999/92/EC are installed in ATEX Exd IIC T6 explosion proof enclosures; all components which are operating in Zone-0 of ATEX DIRECTIVE 1999/92/EC are designed as intrinsically safe with Exia or Exib certification.

When handling electronic components/boards, always use proper Electrostatic Discharge equipment and follow proper procedures.

IMPORTANT
The above statement does ONLY ensure that the components are explosion proof and suitable to be installed and operated in the hazardous environment. It is necessary to comply with international and local explosion proof wiring and implementation procedures and obtaining ATEX Compliance for your sites or tankers after the project commissioning.

Work must be performed by qualified personnel trained in the proper application, installation, and maintenance of equipment and/or systems in accordance with all applicable codes and ordinances.

Use explosion proof conduits for wiring, fittings, and threaded entries into equipment and follow the ATEX or NEC500.8 code to make connections with five threading levels and applying Ex seal to the junctions.

ATEX Compliant Wiring

Peripherals

Fuel-EYE Industrial

GateX Fuel-EYE Industrial is a Linux based embedded computer with ATEX Exd IIC T6 enclosure made of 14mm cast Aluminum and two tempered glass windows.

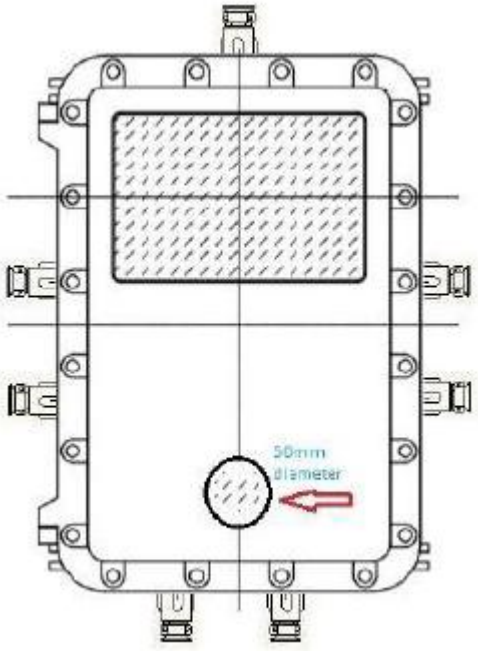
The controller contains below modules:

- 7" LCD display with customized1000 cd/m2 illumination
- Mifare HF RFID reader for operator authentication
- Totalizer module with Modbus on RS485 output
- Command board for power distribution and control relays

The controller is connected wirelessly to a 3G/4G modem for cloud connection and via BLE to Gatex UHF Nozzle Reader.

Mainboard Specifications

CPU: Quad-core 64-bit ARM Cortex A53 - 1.2 GHz
GPU: 400MHz Video Core IV multimedia
Memory: 2GB LPDDR2 – 900Mhz
USB ports: 4 expandable
Video outputs: HDMI
Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
GPIO: 12 Digital – 5 Analog – 3 UART
Pulse count maximum frequency: 1 MHz
Max working temperature: 73° Celsius



Electrical ratings:
Voltage input: regulated12v DC
Voltage output: regulated12V and 5V DC

Current consumption:
Xi3 with MF7: 640mA
Max consumption: 760mA

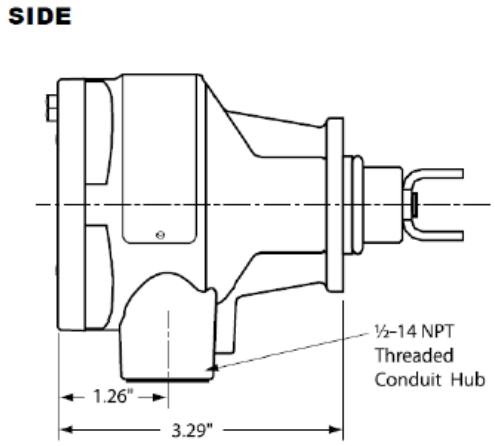
Fuel-EYE Industrial is a family member of Gatex FCS controllers. FCS-RP, FCS-CW and FCS-Panel are other variants which are tailored to meet specific requirements of "Receive", "Transfer" and "Dispensers" respectively.

Pulse Output Device

A POD or pulse generator is a device which converts the flow meter's rotations of gears into electrical pulses, connectable to FCS controller for accumulation and volume calculations.

The POD mounts directly to the front cover of any LC or TCS flow meter in place of the packing gland. The motion of the meter's blocking rotor is magnetically coupled through a stainless steel wall to the electronics compartment of the POD. This eliminates the dynamic seal of the packing gland and isolates the electronics from the process fluid in the meter.

Inside the electronics compartment, an optical shaft encoder converts the rotary motion into a high resolution, two-channel, quadrature square wave. Both outputs are driven by field effect transistors (FETs) and switch from zero volts in the "ON" state to the power supply voltage in the "OFF" state. As supplied from the factory, there is a 2.2K pull-up resistor on each output which can be removed from the circuit in the field to produce a true "open drain" output. As open drain devices, the outputs can sink up to 100 mA in the "ON" state and sustain up to 30 VDC in the "OFF" state.



The electronics compartment also serves as a conduit junction box. The POD has an O-ring sealed, threaded cover. The standard wire entrance is a ½-14 NPT female hub which accepts threaded conduit or a cable gland. A screw-type, removable, terminal block on the circuit board facilitates wiring of the unit. With the wiring entrance sealed and the cover in place, the housing has a weatherproof rating of NEMA 4X.

Specifications

Supply Voltage: 9 to 30 VDC
Current: maximum 50 mA
Operating Temperature: -40 to 80°C
Pulse Resolution: 100 pulses per channel per revolution, unscaled (see the Output
Pulse Transmission Distance: 1,524 meters
Enclosure: Aluminum Alloy ADC12 – IP66 rating
Shock: 50G for 10ms
Vibration: 1G at 10-150Hz
Electromagnetic Compatibility:
EU Directive 2004/108/EC(EMC)
· IEC 61000-4-2
· IEC 61000-4-3
· IEC 61000-4-5
· IEC 61000-4-6
· IEC 61000-4-17
· IEC 61000-4-29
· IEC 61000-6-3
· ISO 7637-2

Certificates:
IECEx DNV 11.0012X, ATEX 12438X, CE 2460
UL listed for Class I, Division 1 & 2, Groups C & D

UHF Nozzle Reader

Gatex UHF RFID reader is designed with a flexible BLE 5.1 protocol, enabling it to support multiple network topologies that can be easily configured through AT commands. With this technology, single or multiple BLE readers can be connected to one station, allowing for the simultaneous reading of RFID data.
This configuration is particularly useful in applications where vehicle identification is required for fleet fueling through a mobile tanker or fuel bowser, as only one reader and one station are needed.
Additionally, for petrol stations with centralized forecourt controllers, a reading station can be set up where multiple readers can communicate with a single communication hub, making the process more efficient and streamlined.
UHF Nozzle Reader BLE Communication Protocol
UHF BLE Nozzle Reader supports BLE 5.1 Wireless Communication.
The UHF BLE Nozzle Reader is designed with software and hardware flexibility in mind, with the preprogrammed firmware of the manufacturer, you could quickly integrate the reader into your applications.

Specifications

Bluetooth protocol: Bluetooth Specification V5.1 BLE
Working frequency: 2.4 GHz ISM band
Interface: Serial
Communication Range: 30m
To send and receive no byte limit between modules
Modulation method: GFSK (Gaussian Frequency Shift Keying)
Transmission power: - DBM, 23-6 DBM, 0 DBM, 6 DBM, can be modified by the AT command
Power supply: + 3.3 VDC 50 mA
Working temperature: - 5 ~ + 65 Centigrade
PA12 Nylon Material

Industrial Keypad

Gatex Industrial keypad is designed for harsh environments.

The keypad provides alphanumeric functionality and a 4-core cable connection to Gatex fuel controllers, passed via an ATEX conduit with a G20 connection.

Specifications

Microcontroller: ATmega32U4
Operating Voltage: 5V
Input Voltage (recommended): 7-9V
Input Voltage (limit): 6-9V
Digital I/O Pins: 20
PWM Channels: 7
Analog Input Channels :12
DC Current per I/O Pin: 20 mA
DC Current per I/O Pin: 20 mA
DC Current for 3.3V Pin: 50 mA
Flash Memory: 32 KB (ATmega32U4) of which 4 KB used by bootloader
SRAM: 2.5 KB (ATmega32U4)
EEPROM: 1 KB (ATmega32U4)
Clock Speed: 16 MHz
Buttons: SS-306 22mm
Keys: engraved
Layout: Standard telephonic key-12 with 4 additional keys.
Enclosure: Exd IIC T6.

Solenoid Valves

In the applications where there is no electrical pump to control, a solenoid valve will be necessary to control the flow and authorize fueling upon authentication of the operators and vehicles.

The bore size of the solenoid valve depends on the flow meter size, pump pressure and fueling application and can be 1-inch, 2-inch or 3-inch.

A 3-inch valve is normally used for bulk deliveries on large fuel transport mobile tankers where a 1-inch valve is normally used in the fuel dispenser installations or on the fuel bowsers with 1-inch flow meter.

The 2-inch valve is the most commonly used solenoid valve for the mobile bowsers which operate for both Fleet Fueling and Bulk Transfers, having a 2-inch PTO pump.

Specifications

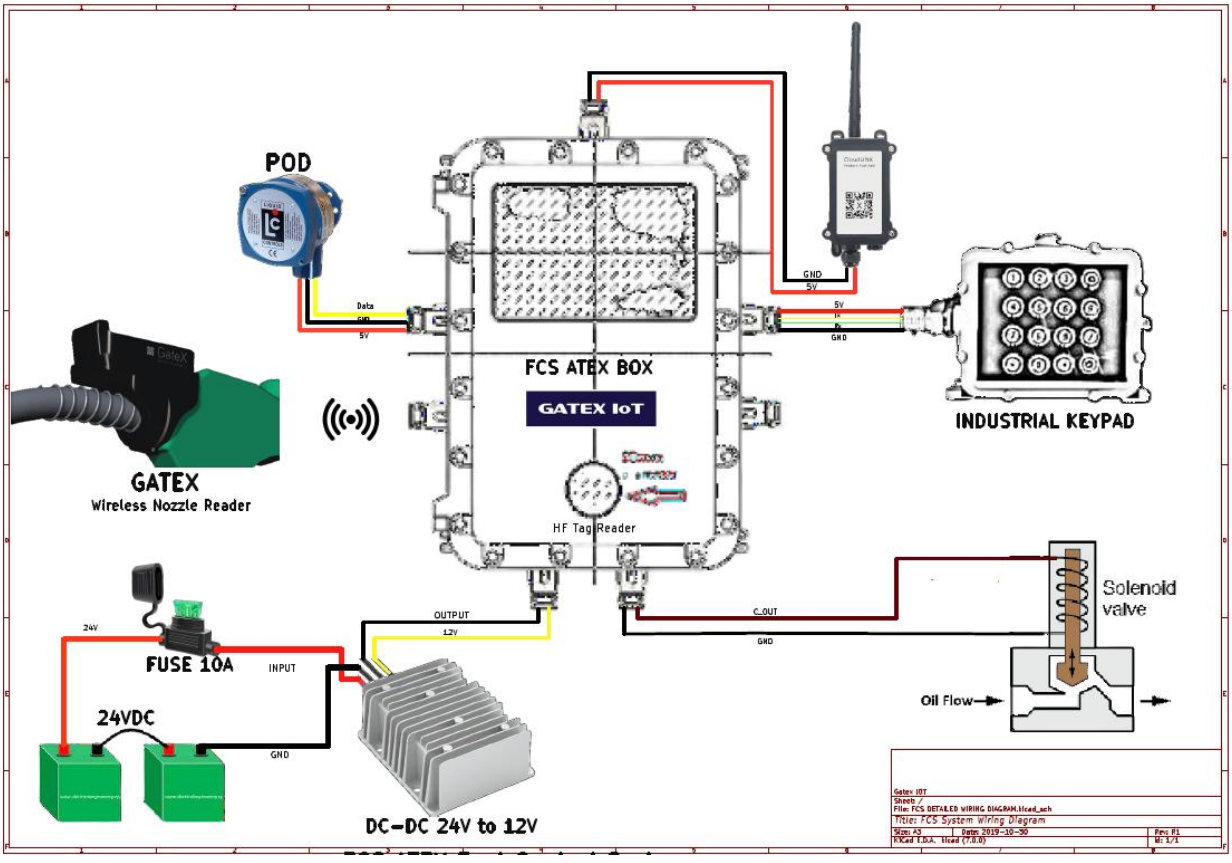
Input Voltage: 12V DC
Body Material: Brass for 1" & 2" – SS316 for 3"
Seal Material: NBR
Orifice 1 Size: depending on application
Flow Coefficient 1: 38.6 Cv
Power Consumption: 10 to 22W
Coil Type: 1/2" NPT Conduit, 18" Leads, Class F or H, NEMA 7, 9 or 4X and DIN Form A, Class H
Maximum Pressure Differential: 230 (AC) or 200 to 230 (DC) psi
Number of Ports: 2
Actuation Type: Pilot
Media: Diesel, Kerosene
Connection: BSP for 1" & 2" – Flange for 3"

Preparing for installation

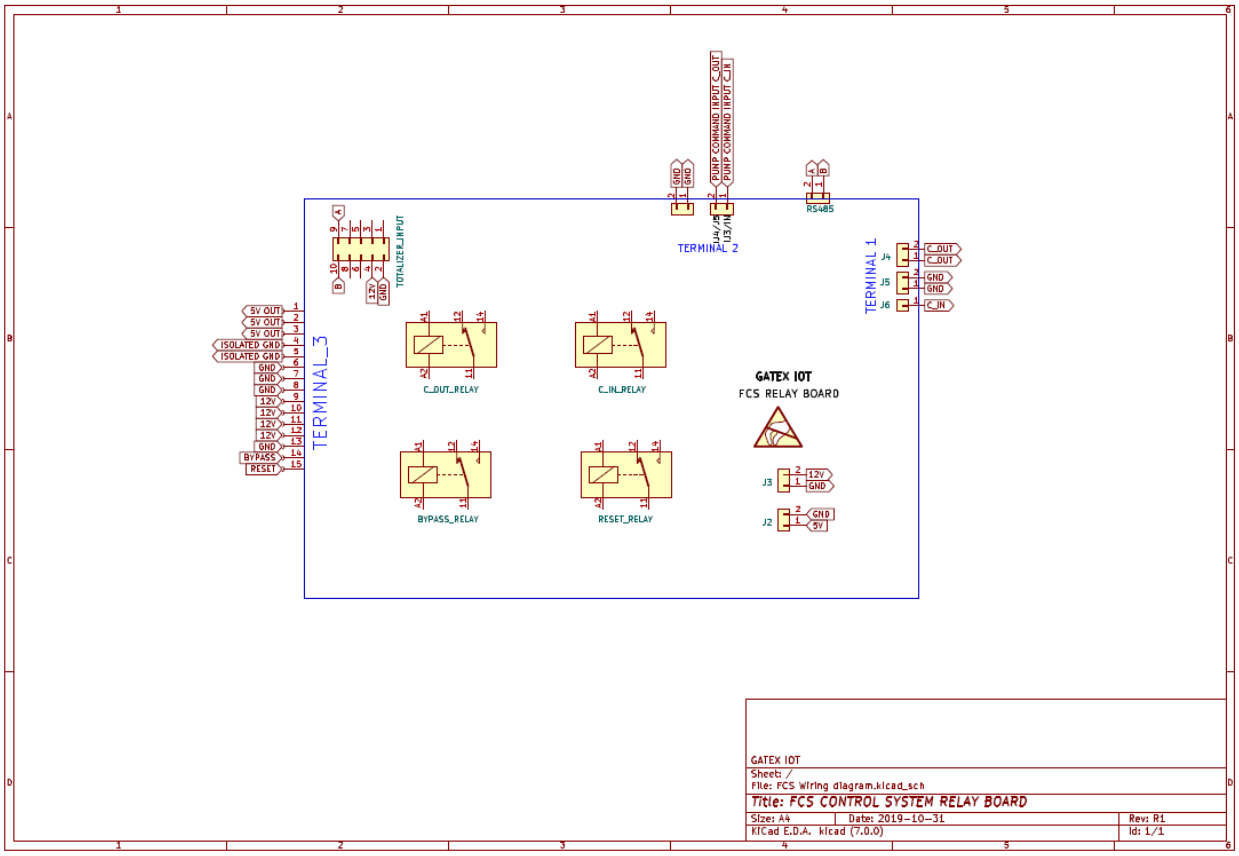
Check List

GateX Fuel-EYE Industrial Peripherals List for Mobile Bowsers			
1	FCS Controller ATEX 300 x 400 x 190	1	14mm cast Aluminum with 2 tempered glass windows
2	Bxd round box	1	
3	Pulse Output Device	1	
4	ATEX Conduits set	1	1 x 5000, 2 x 2000, 1 x 1500, 2 x 500
5	Exe Transmitter box	1	For the antennas and 3G/4G transmitters
6	Master tag	1	HF Key Fob - Yellow
7	Operator tag	1	HF Key Fob - Blue
8	Gatex Industrial Keypad	1	Alphanumeric
9	Solenoid Valve	1	
Level Transmitters Peripherals List			**L-HM-2000-C-T** or **L-HS-3000-C-T**
1	Level Sensor	1	RS232, Capacitive Level sensor 2000mm or 3000mm
2	ATEX BXD Hub	1	
3	ATEX Conduits set	1	1 x 5000
Vehicle Authentication Module Wireless UHF Nozzle Reader			**UHF-B-WL-R**
1	Nozzle Reader & battery pack	1	
2	Wireless Transceiver	1	
3	Nozzle Stand	1	
4	Accessories (cables, glands, reducers & external power adapters)	1	10m 5-core cable (no.9 auto-wire) 24-12v DC 30Amp voltage regulator 10 Amp fuse holder and fast fuse (flat)

Schematic Diagram



FCS Relay Board



Description

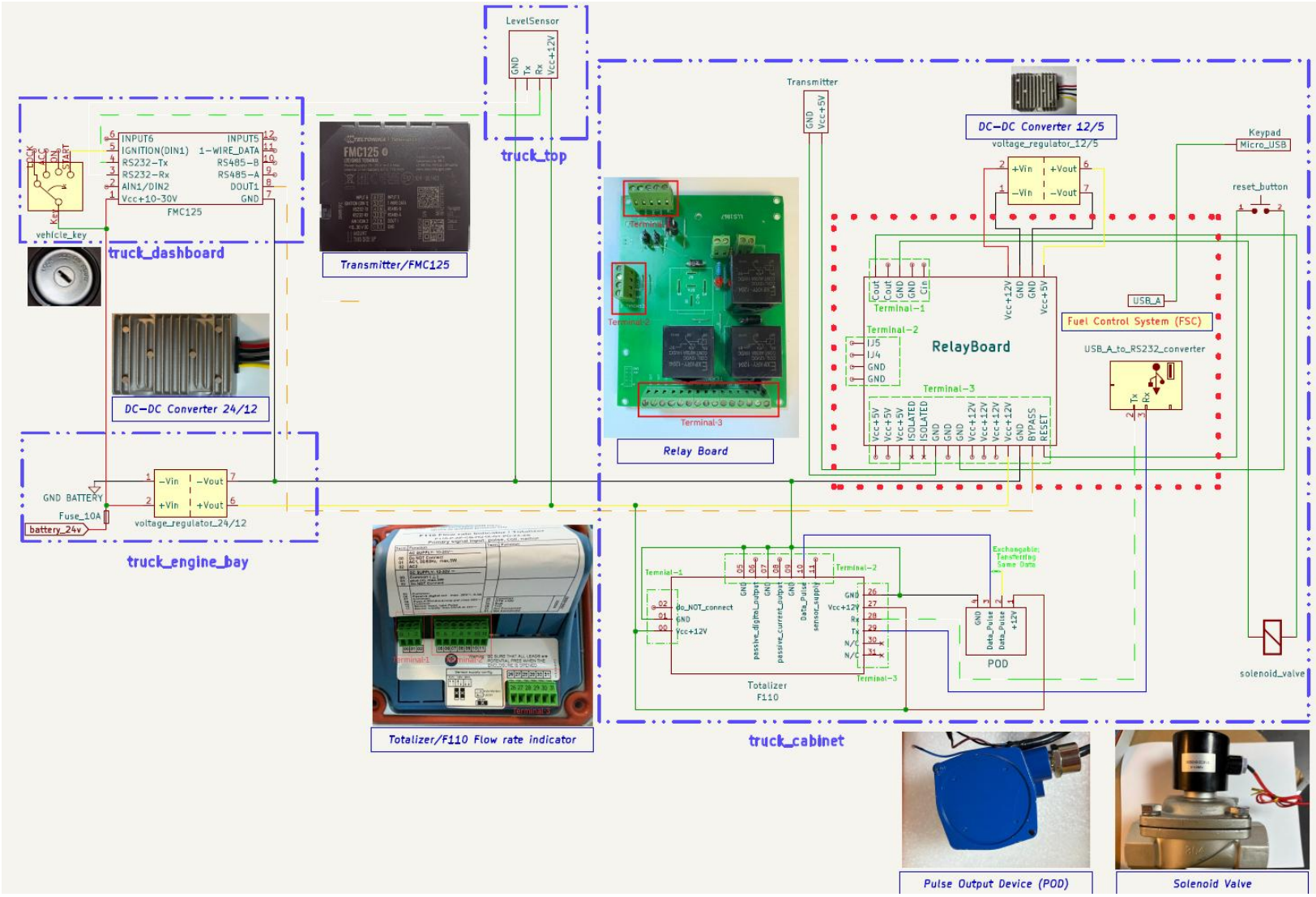
Terminal -1
2x Identical command outputs for OUT flow valve/pump control
1x Command output IN flow valve/pump control (only for bidirectional systems)

Terminal-2
Out-flow pump control command from mainboard
IN-flow pump control command from mainboard
2 x GND connections to mainboard

Terminal-3
Reset: input to connect to the remote restart module
Bypass: input for optional remote bypass mechanism
Common GND input
Supply 12v input
3x 12v outputs
3x common GND outputs
2x Isolated GND output
3x Isolated 5v outputs

Totalizer Input
10-pin flat cable to totalizer module

Wiring Diagram



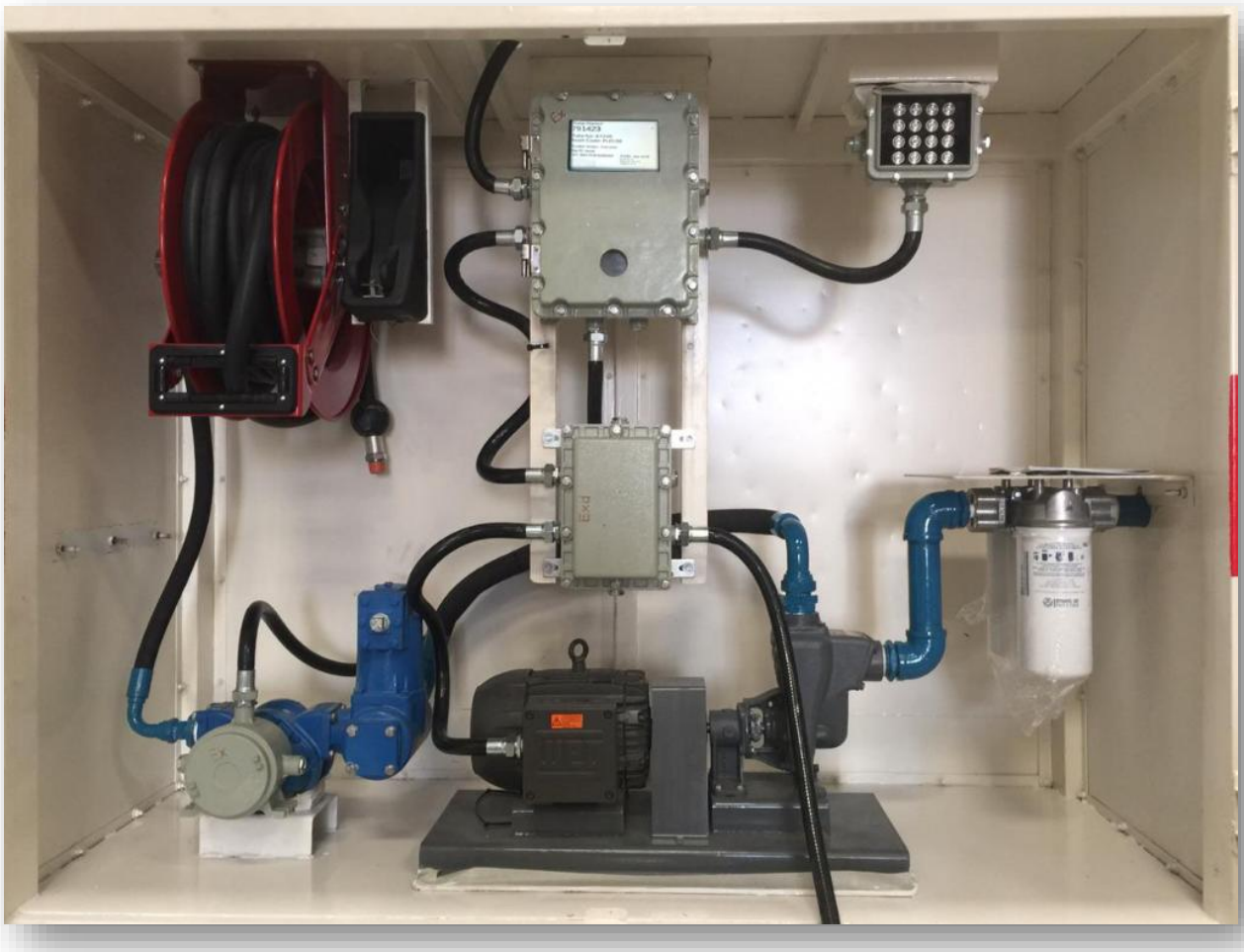
Implementation Steps

1- Run the 5-core auto-cable with the 5m ATEX conduit under the vehicle from battery isolator to the fueling cabinet.
2- Fix the POD on the front chamber of the flow meter (refer to page 13)
3- Fix the Fuel-EYE Industrial controller on the fueling cabinet using two supporting bars.
4- Fix the keypad on any side of the controller on a stand hanging from ceiling of the cabinet.
5- Fix the nozzle stand next to the hose reel.
6- Fix the solenoid valve right after the flow meter's output.
7- Connect the wires as shown in the wiring diagram on page 9 of this installation manual.
8- Power up the system and configure the settings as per your application. (refer to page 15)
9- Calibrate the flow meter and set the new KFactor on the FCS.
10- Apply ATEX Seals on the glands and tighten to conduits, bolts and hand over the system to production team.

Note: read through the subsequent pages of this manual for a detailed wiring instruction.

Below picture illustrates a typical installation of peripherals on mobile bowsers:

Below picture illustrates a typical installation of peripherals on stationary cabinets:



How to fix the POD on the flow meter


Remove Packing Gland Mounting Screws

Follow these procedures to remove the existing hardware:

1. Relieve the pressure from the process piping to the meter.
2. Drain the meter by opening the meter's drain plugs.

NOTE 1: Meters with only two packing gland mounting screws are limited to four orientations.

NOTE 2: When using a cable gland to seal the wire entrance, any of the eight orientations can be used. However, when using conduit, the hub should face down so moisture that may accumulate in the conduit will drain away from the POD electronics.


Packing Gland Removed

3. Remove the mechanical counter, adjuster, and adjuster drive shaft from the front of the meter.

Follow these steps to install the POD onto the flow meter:

1. Verify that the proper POD Model was obtained by comparing the driver tang on the POD to the driver tang on the packing gland that was removed as explained above.

   There are two types of packing gland/POD driver tangs: blade type and fork type.
   Blade type packing glands must be replaced with blade type PODs.
   Fork type packing glands must be replaced with fork type PODs.

2. Determine the desired orientation of the conduit hub. The hub can be positioned in one of eight possible orientations as shown in the figure to the right.

3. Position the O-Ring over the bottom of the POD as shown to the right.

4. Align the fork style or blade style driver with the drive mechanism in the meter and guide the POD into the opening in the meter cover. When properly aligned, the POD will go in until its mounting flange abuts the meter cover.

5. Rotate the POD to the desired orientation and thread in the mounting bolts.

POD Wiring

When wiring the POD, the wires must enter through the POD's conduit hub. For explosion proof rated systems, the wiring must be in explosion-proof rated rigid conduit, or for high vibration installations explosion proof rated braided flexible conduit.

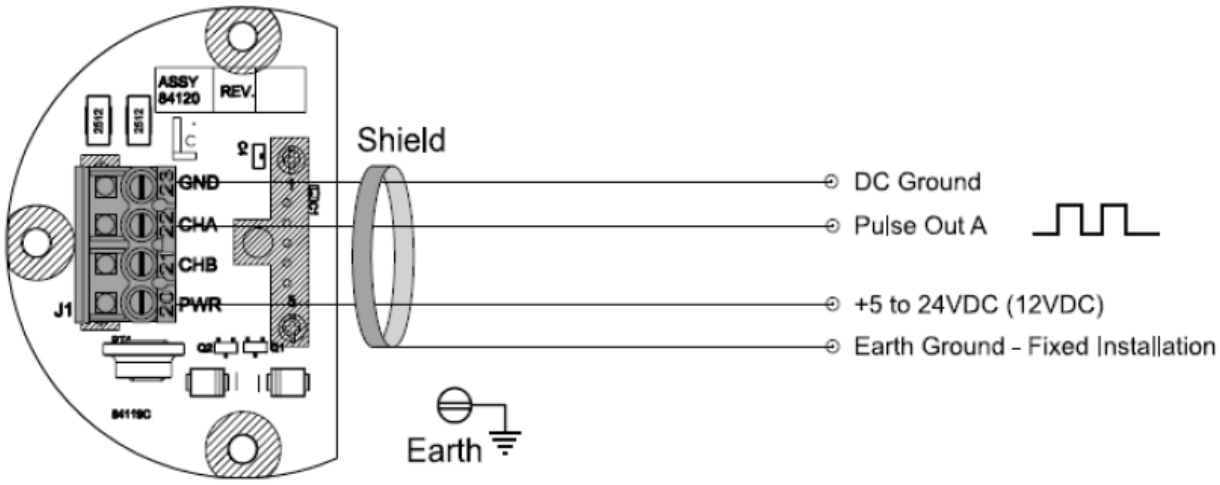
The conduit must be engaged five (5) full threads into the female hub on the POD to meet explosion proof requirements.

When installing in a Division 2 location, use either rigid conduit, flexible conduit, or no conduit. When no conduit is used, the instrument cable must be brought into the POD conduit hub using a cable gland to seal the wiring to maintain the Enclosure NEMA 4X rating.

Regardless of the type of connection used, thread sealant should be applied to prevent moisture from getting into the POD electrical housing.

Use a 4-core shielded cable for pulse connection and run the wire inside an ATEX conduit. A reducer will be required to covert the G20 head of the conduit to ¼" NPT hub input of POD.

Connect three wires between POD terminals as illustrated below. Either of the two channels of pulse outputs can be used to transmit the pulses to FCS.

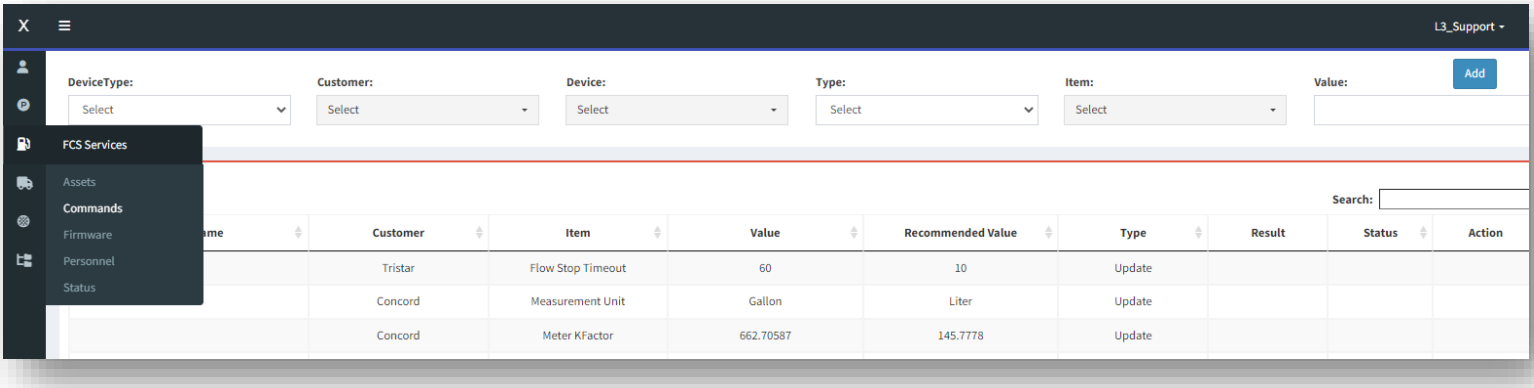


Commissioning Steps

FCS Settings

Upon completion of wiring and powering the FCS up, a series of settings should be decided and applied to the parameters of the controller. The settings define the system's workflow and the connected components to meet your application requirements. Setting is database table of FCS and is permanently saved even if the power is disconnected.

To set the parameters, you will need access to Gatex Technical Platform, designed for channel-partners and Gatex REST API for developers. To obtain your login credentials to the above platforms, please write to L3.support@gatex.us.com



Calibration Process

Post installation calibration is compulsory for flow meters and it is recommended to hire a 3rd party calibration company with expertise and a reference meter to calibration your newly installed flow meter.

Flow meters which are equipped with Gatex FCS, need to be recalibrated on a season change or in case of any incident or impact on the flow meters. Gatex FCS uses fully digital path for signal transferring and electronically calculated and saved data, hence minimizes the need for recalibration of the instruments.

Below are the steps of the calibration process:

- Decide the flow rate of operations and set your pumps/valves on the same flow rate for the calibration process.
- Connect your master meter in series with the site or tanker flow meter
- Circulate the fuel for 500 Liters and note down the reading of both meters
- Repeat the circulation 3 times to collect three samples.
- Apply the master meter's correction factors as per master meter documentation
- Calculate the average and set the KFactor for the new FCS system on Technical Platform
- Remember to restart the system after each change in the Setting (such as KFactor)
- Test run to check the calibration results
- Ask the calibration company to issue a certificate.

FCS Parameters

ID	Parameter	Recommended Value
1	NozzleAddr	1
2	PingInterval	300
3	Sitecode	0
4	Pump	1
5	Price	0
6	Volume	1
9	NozzleAdjustTimeout	30
10	NozzleScanningTimeout	30
11	nozzleDispenserTimeout	2
12	NozzleSkipSelectionTimeout	5
13	Pin	1997
14	FlowrateTimeout	10
15	VolumeDivisor	100
16	Control	0
17	IP	10.42.0.1
18	PTS	0
20	Seneca	1
21	KFactor	145.7778
22	UTCOffset	240
23	TotalizerUSB	USB2.0-Serial
24	TotalizerReadInterval	0
25	Message01	Sitecodes:
26	Message02	Enter Site Number
27	Message03	Enter Project Number
29	UHFReader	1
30	Pulser	0
31	OneTimeScan	1
32	HighGain	0
34	MaxLevel	1000
35	Unit	Liter
36	FuelType	Diesel
37	Company	100549483400003 Atlanta, USA Fuel Man LLC Tax Invoice
38	Tax	0.047619047
39	Currency	AED
40	TimeZone	Asia/Dubai
41	KFactor_IN	0
42	KFactor_OUT	0
43	Sitecode_IN	0

FCS Parameters

44	Sitecode_OUT	0
45	Message01_IN	Purchase Orders:
46	Message02_IN	Enter PO Code:
47	Message03_IN	Enter PO Number:
48	Message01_OUT	Delivery Areas:
49	Message02_OUT	Enter Area Number:
50	Message03_OUT	Enter Project Number:
51	Addr	BLE Nozzle Reader ID
52	Price_IN	0
53	Price_OUT	0
54	Mode	OUT
55	PrinterBaud	9600
56	ValidateAccumulator	1

Important Parameters

Below parameters are to be adjusted according to the site or application requirement at the time of commissioning:

- **Sitecode**: if your application requires to capture the project numbers at the time of fueling a vehicle, enable this parameter. Enabling this parameter will add two more data capturing steps to the fueling workflow: Area Code and Project Number.
  Please refer to Gatex Fuel-EYE Workflow document for more information on site codes.

- **FlowrateTimeout**: Flowrate Timeout is the time interval that FCS waits after zero flow detected to end the transaction. The recommended value is 10 seconds.

- **KFactor**: post installation calibration is compulsory to put the meters in operations. KFactor is calculated and set as per the flow meter circulation test.

- **UHFReader**: Enable if there is a Nozzle Reader installed.

- **Addr**: Set the BLE ID of the nozzle reader if a Nozzle Reader is installed.

- **Mode**: Set the mode to 0 for FCS2.0 bidirectional systems and OUT for FCS2.0 unidirectional applications. The Mode setting will affect the IN/OUT button's functionality.

Contact Gatex IOT

For product related inquiries, please write to: corporate.sales@gatex.us.com

Channel partners and resellers technician communications and feedback, please write to: L3.support@gatex.us.com

You may request the related documents listed below:

Gatex Casper API 1.5.x documentation
Gatex Casper API 2.0.x documentation
Gatex Fuel-EYE Workflow document
Gatex FCS dataflow diagrams
Gatex Technical Dashboard for channel partners
Gatex web portal for fuel operators
Gatex FCS Reports Document
Gatex products datasheets
UHF Asset Tags Installation Manual
Gatex Technical Q&A Maintenance Notes