FIO FERTIGATION FAMILY

LWV FIO-C

Flow-paced dosing for up to 16 pumps

The FIO-C is the controller of the FIO family. It reads the flow meters and the water-quality probes, runs the recipe, and drives up to four FIO-P4 pump modules (16 pumps) over one M12 cable. It is set up from the LWV-GCU app over Bluetooth, watched from GCU Cloud, and doses on its own with no network.



Rev A, rendered from the design.

4
FIO-P4 pump modules per controller (16 pumps)

2
pulse flow-meter inputs

1
sensor bus for pH and EC probes, powered at 24 V

24 V DC
supply, ± 10 %

FEATURES

Doses to the water flow

Each pump follows the flow meter at the recipe's mL per litre, so the mix stays right as the flow changes. Very low rates are given as timed micro-doses.

Holds EC and pH

Small corrections from the probes keep EC and pH on target. They are capped (EC within 20 % and pH within 30 % of the recipe) and pause when a probe reads out of band.

Stops when the water stops

No flow for 5 s, a missing pump or a reading outside its band stops the dosing and sounds the alarm. Flow while nothing doses raises an alarm too.

STOP needs no software

The STOP button and the external STOP LOOP cut 24 V to every pump module and open both contacts in hardware. A hardware watchdog does the same if the program hangs.

Phone setup, cloud optional

Pair the LWV-GCU app over Bluetooth with the PIN on the label. GCU Cloud adds remote watching, recipe changes and updates; the controller doses with no network at all.

Every port shows its state

A light and a 6-light bar above each socket move with the real thing, and a two-character code says what is wrong. A healthy box stays calm: nothing flashes unless a person is needed.

SPECIFICATIONS

Power

Supply	24 V DC ± 10 %
Power connector	M12 T-coded (power), male: pin 1 +24 V, pin 3 0 V
Input protection	5 A fuse, surge clamp, electronic fuse with reverse-polarity protection
Voltage window	on above 19.0 V, off below 17.6 V; over-voltage cut-off at 32.6 V
Controller limit	1.2 A with sensor bus, flow meters and option inputs (design budget ≤ 0.8 A)
Pump-module limit	1.94 A ± 5 % on MODULE LINK
Consumption	≈ 0.15 A at 24 V plus connected devices (design estimate; measured value to be confirmed)

Pump modules (MODULE LINK)

Modules	up to 4 FIO-P4 (16 pumps) on one daisy chain
Link power	24 V, cut in hardware by STOP and the watchdog; stays off after an overload until cleared
Bus	RS-485 Modbus RTU master; 19 200 baud at start-up, 115 200 once every module confirms
Termination	120 Ω, switched in software
Jumpers	M12 A-coded, female to male, ≥ 0.5 mm² (20 AWG), up to 4 m (13 ft) each

Inputs

Sensor bus	RS-485 Modbus RTU master, 19 200 baud (9600 option), separate from the pump link
Sensor power	24 V on its own 0.5 A resettable fuse; stays on during a STOP
Flow inputs	2 pulse inputs for 3-wire meters, optocoupled; 24 V, ≈ 30 mA per meter
Flow checks	not connected and short detected
Option inputs	2 × 4–20 mA, loop powered, 100 Ω 0.1 % shunt, 16-bit; fitted at LWV
Option checks	open < 3.6 mA, short > 21 mA

Contact outputs

Contacts	2 solid-state: CONTACTOR (pump power), FLUSH (flush or drain valve)
Rating	24 V AC or DC coil or valve, ≤ 48 V; 1 A-hold resettable fuse and surge clamp each
Checks	each contact checked against its command; both open in hardware on STOP or a hang

Dosing

Modes	flow-paced (default), pulsed micro-dose for very low rates, timed by the clock
Recipes	mL per litre (mL per gallon on US sites), scale %, EC and pH targets and alarm bands
Recipe memory	up to 20 stored, one active
Control loop	every 100 ms
Pump calibration	cup test from the app: 60 s at full speed
Dose accuracy	± 5 % of the recipe per pump over a feed (design target)
EC hold	± 0.1 mS/cm in steady flow (design target)

Safety

STOP	button on the top wall, in series with the external STOP LOOP
STOP response	link power off < 0.1 ms; pump outputs 0 mA within ≈ 15 ms (calculated); contacts open
Watchdog	pump modules and both contacts off within 0.38–0.94 s, in hardware
Restart	power cut: resumes; STOP: waits for PAUSE or the app; crash: off until cleared

Network and setup

Wi-Fi	2.4 GHz to GCU Cloud (optional); antenna inside the box
Bluetooth	Bluetooth LE for the LWV-GCU app; fixed PIN on the label
Updates	from GCU Cloud; refuses any image not built for the FIO-C
Local web page	none
Real-time clock	RV-3032-C7, CR1220 backup cell
Processor	Seeed XIAO ESP32-S3, socketed

Panel

Keys	POWER, CONT, FLUSH, PAUSE, SILENCE, STOP on the top wall
Indicators	port lights with 6-light bars, MODULES 1–5, 4-20 IN 1–2, key lights, 6-light scanner
Code display	2 characters, 14 mm (0.56 in)
Buzzer	2.7 kHz, alarms only; SILENCE acknowledges, hold 3 s to reset

Enclosure

Size	244 × 155.4 × 42.5 mm (9.61 × 6.12 × 1.67 in)
Case	black ASA tub and bezel, heat-set M3 inserts
Window	3 mm smoked grey polycarbonate, 35 % light transmission
Seal and vent	silicone cord seal, ePTFE vent
Ingress protection	IP65 (design target)
Operating temperature	To be confirmed

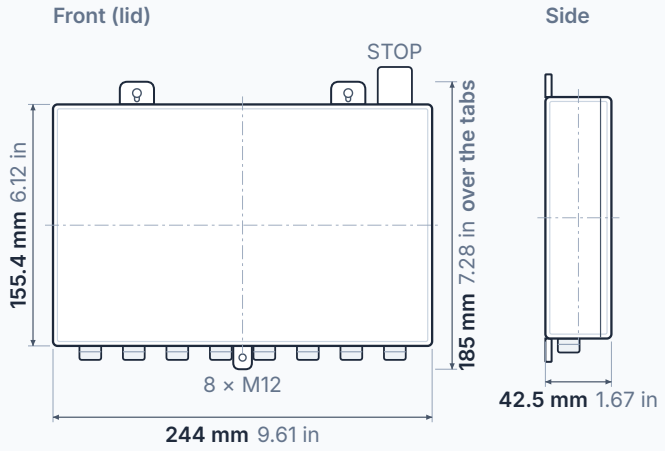
CONNECTORS

PORT	TYPE	USE
24 V IN	M12 T-coded, male, panel receptacle	24 V DC: 1 +24 V, 3 0 V; unplug to isolate for service
STOP LOOP	M12 A-coded, 4-pin, female	external normally closed loop: 1 out, 2 return; bridge plug supplied
CONTACTOR	M12 A-coded, 4-pin, female	24 V coil of the pump-power contactor, pins 1 and 4
FLUSH	M12 A-coded, 4-pin, female	24 V flush or drain valve, pins 1 and 4
FLOW A	M12 A-coded, 4-pin, female	feed-line flow meter: 1 +24 V, 3 0 V, 4 pulse
FLOW B	M12 A-coded, 4-pin, female	second line or flush line; pins as FLOW A
SENSOR BUS	M12 A-coded, 4-pin, male	FIO-WQ and Modbus probes: 1 +24 V, 2 A, 3 0 V, 4 B
MODULE LINK	M12 A-coded, 4-pin, male	up to 4 FIO-P4: 1 +24 V (cut by STOP), 2 A, 3 0 V, 4 B
4-20 IN 1, 2	M16 × 1.5 positions, left wall; plugged	factory option: 4–20 mA sensor (pressure, level or inline EC)

STATUS LIGHTS

LIGHT	MEANING
Scanner	green sweep: all good; amber: something missing; red: alarm; all red, flashing: STOP; blue: setup or update; frozen: program hung
Port lights	dark: unused; dim green: connected; green: active; amber: unplugged or degraded; red: fault
Port bars	move with each port: contact on, flow pulses, link messages; stop halfway at a silent device
MODULES 1–5	dim green: answering; amber: warning; red: not answering or alarm; blue: being added or updated
Code display	dark when all is well; letter = where (H stop, E power, L modules, P pumps, F flow, b sensors, C network, U unit)
Top row	CONT, FLUSH green Auto, amber Hand, red Off; PAUSE, NETWORK, 24 V amber on a problem; ALARM red

DIMENSIONS



Weight	To be confirmed
Mounting	Wall: two keyhole tabs on top, 136 mm (5.35 in) apart, for #8 or M4 pan-head screws; one screw in the bottom tab. Boxes 20 mm (0.79 in) apart, 12 mm (0.47 in) at least. All connections are outside the box.

WORKS WITH

- LWV FIO-P4 pump module: up to 4 per controller (16 pumps)
- LWV FIO-WQ water-quality module, on the SENSOR BUS
- RS-485 Modbus EC and pH probes, on the SENSOR BUS
- Dosing pumps with a 4–20 mA speed input, through the FIO-P4 (Etatron eOne MF supported)
- 3-wire 24 V pulse flow meters
- GCU Cloud and the LWV-GCU app

ORDERING

PART	DESCRIPTION
FIO-C	Fertigation controller, Rev A, in its wall-mount box, with a STOP LOOP bridge plug. Ordering code to be confirmed.
FIO-C option	One or two loop-powered 4–20 mA inputs, fitted at LWV on the left wall.
Link jumper	M12 A-coded extension, female to male, 0.5 mm² (20 AWG); 0.3 m (12 in) for boxes 20 mm (0.79 in) apart.

1. Every figure is a design value until bench tests confirm it. Firmware and GCU Cloud support are in development.
2. A STOP sets every pump output to 0 mA, even with a 4 mA rest current: a pump that alarms on a lost signal then shows a cable alarm, as intended.
3. The FIO-C does not open or close irrigation valves: it follows water that something else turns on.
4. Mount the controller at the left end of a row: a fitted option socket needs about 40 mm (1.6 in) free on its left.
5. IP65 is a design target, to be confirmed by a water-jet test (IEC 60529) with every port plugged or capped. Cap unused ports.