



Flo Controller

4-zone irrigation control with Modbus, BACnet, LoRaWAN, and Bluetooth LE

POCKET MANUAL

1 Safety Information

WARNING: ELECTRICAL

Disconnect all power before wiring. The 24 VAC input rectifies to approximately 35 V peak internally. Installation should be performed by qualified personnel.

WARNING: LOADS

Valve outputs are for solenoid valve coils only: 0.6 A RMS per AC channel or 1.5 A peak DC pulses. Do not drive motors, pumps, or heaters.

OUTDOOR SEAL

All M12/M8 connectors must be mated or capped and both antenna bulkheads torqued. Cap every unused port.

Document FLO-PM-100 · Revision 1.0 · Firmware v5.x · Model GROWBUD013

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PRINT FORMAT

Finished size: 4.25 x 5.5 in. The 28-page count is suitable for saddle-stitch booklet production.

2 Product Overview

The Flo Controller is a professional 4-zone irrigation controller for greenhouse, indoor, and field operations. It drives 24 VAC or latching DC solenoids and connects through LoRaWAN, Bluetooth LE, and RS-485.



VALVE ZONES

4

AC triac or DC H-bridge

RS-485

3 modes

Modbus slave, master, BACnet

POWER

3 inputs

USB-C PD, 12 VDC, or 24 VAC

SCHEDULES

16

Autonomous on-board slots

2.1 Electrical Specifications

PARAMETER	VALUE
USB-C PD	5-20 V USB Power Delivery, up to 20 W; power only
DC supply	9.0-16.0 VDC, nominal 12 VDC
AC supply	20-26 VAC RMS, nominal 24 VAC
Mode selection	Automatic and hardware-latched at boot
AC valve output	0.6 A RMS per channel; 2.4 A total
DC valve output	1.5 A peak per channel; 9-12 V pulses
Standby	Up to 250 μ A DC or 0.5 VA AC
RTC	Supercap-backed

2.2 Environment & Mechanical

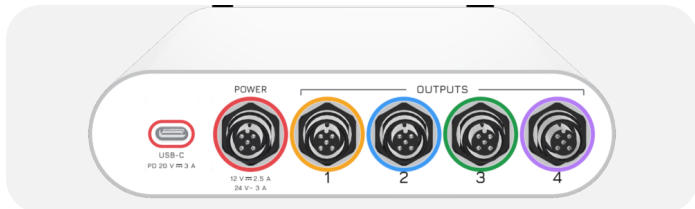
PARAMETER	VALUE
Operating temperature	-20 to +70 °C
Enclosure	Obround extruded aluminum, 165 x 40 x 160 mm
Panel A	USB-C, M12 POWER, four numbered OUTPUTS
Panel B	M12 RS-485, M8 LEAK and SENSE, USER button, two SMA antennas
Connectors	M12 A-coded 5-pin and M8 3-pin; IP68 rated
Compliance basis	CISPR 22/32 Class B; FCC Part 15; RoHS/REACH

SUPPLY MODE

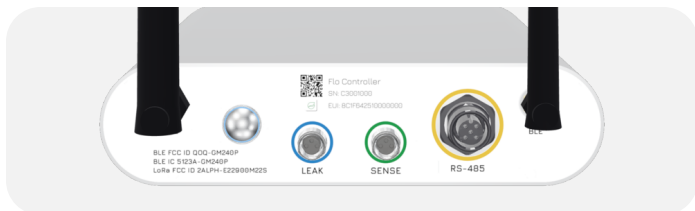
All four valves must use the same AC or DC type because drive mode is global for the current power cycle.

3 Panel Reference

PANEL A · POWER + OUTPUTS



PANEL B · DATA + ACCESSORIES



- Attach the 915 MHz antenna at LoRa.
- Attach the 2.4 GHz antenna at BLE.
- LEAK and SENSE are the two M8 accessory inputs.
- The illuminated USER button handles commissioning and status.

3.1 POWER IN

PIN	SIGNAL	DESCRIPTION
1	+12 VDC	9.0-16.0 VDC supply
2	DC return / GND	DC return and chassis ground
3	24 VAC hot	20-26 VAC RMS
4	24 VAC return	Floating AC return
5	Shield	Shield drain to ground

DO NOT COMBINE SUPPLIES

Connect either DC pins 1/2 or AC pins 3/4 - never both. The controller detects the powered rail at boot and latches the global drive mode.

3.2 Valve Outputs

PIN	SIGNAL	DESCRIPTION
1	Valve Power A	Switched valve drive
2	Harness ID	Valve-type identification
3	Valve Power B	Switched return
4	Aux I/O	Flow, leak, or auxiliary input
5	Shield	Shield drain

Harness ID Coding

RESISTOR	VALVE TYPE
2.2 k Ω	24 VAC solenoid
10 k Ω	Latching DC solenoid
Open	Unknown; harness fault

3.3 RS-485 & Accessories

PIN	SIGNAL
1	A (D+)
2	B (D-)
3	GND
4	Shield
5	Shield drain

The port includes on-board 120 Ω termination and fail-safe bias. It carries no power; externally power third-party sensors.

M8 Sensor Ports

The ports marked LEAK and SENSE accept Growbud wired flow, leak, and auxiliary accessories.

USB-C

Power only, up to 20 W USB-C PD. Use when 24 VAC valve drive is not required.

4 Installation & Wiring

- 1 Mount with the valve panel facing the irrigation manifold.
- 2 Attach both antennas before applying power.
- 3 Connect each solenoid using a Growbud valve harness. All valve types must match.
- 4 Optional: daisy-chain RS-485 A/B/GND with shielded twisted pair and terminate the far end.
- 5 Apply USB-C PD, 12 VDC, or 24 VAC as required.
- 6 Confirm the USER button illuminates.

MODE MISMATCH

A supply/valve mismatch raises fault 12 and interlocks the affected channels off.

5 Deployment Configurations

A • Wireless LoRaWAN



Best for fields, greenhouses, and sites already using a Growbud LoRaWAN network. On-board schedules continue if connectivity drops.

B • Wired Automation

The Flo operates as a Modbus slave or BACnet node and can aggregate nearby Growbud sensors over Bluetooth. Best for facilities with an existing BMS.

COMING SOON

Amazon Sidewalk support is planned in a future firmware release; no hardware change is expected.

6 Commissioning

- 1 Get the Growbud app or open www.growbud.app and create an account.
- 2 Apply power; confirm the USER button illuminates.
- 3 Press USER once. It blinks while pairing mode is active.
- 4 Choose Add Device and select the Flo Controller.
- 5 Name the controller and assign a room or zone.
- 6 Select the deployment configuration and RS-485 role.
- 7 Name each valve zone and test each output once.

CURRENT FIRMWARE

Protocol configuration tables are held in RAM and re-pushed by the app after a power cycle.

7 Modbus Slave Mode

ITEM	VALUE
Register width	16-bit, big-endian
Addressing	0-based
Function codes	0x03, 0x04, 0x06, 0x10
Slave address	1-247; broadcast unsupported
Layout	Global 0x0000-0x000F; channels at 0x0010 + ch x 0x10; schedule 0x0050-0x005F

Global Input Registers · FC 0x04

REG	NAME	DESCRIPTION
0000	fw_version	Firmware version
0001	mode_configured	0 unknown; 1 AC; 2 DC
0002	mode_detected	0 unknown; 1 AC; 2 DC; 3 both rails
0003	device_fault	Device fault code

7.2 Input Registers

REG	NAME	DESCRIPTION
0004	vboost_mv	VBOOST rail, mV
0005	vbus_mv	VBUS / 24 V rail, mV
0006	board_temp_c_x10	Board temperature, 0.1 °C
0007	schedule_active	1 when a schedule is firing
0008-000F	reserved	Reads 0

Per-Channel Inputs · base 0x0010 + ch x 0x10

OFFSET	NAME	DESCRIPTION
+0	state	Output state
+1	fault	Channel fault
+2	level_pct	0-100%
+3	current_ma	Current, mA
+4...+15	reserved	Reads 0

Bases: ch0 0x0010 · ch1 0x0020 · ch2 0x0030 · ch3 0x0040

7.4 Holding Registers

Global · FC 0x03 / 0x06 / 0x10

REG	NAME	DESCRIPTION
0000	slave_address	1-247; immediate
0001	role	0 MASTER; 1 SLAVE
0002-000F	reserved	Writes rejected

Per-Channel Holding Block

OFFSET	NAME	DESCRIPTION
+0	cmd_onoff	0 off; non-zero on
+1	cmd_level	0-100%
+2	cmd_pulse	Bits 0-14 duration ms; bit 15 polarity
+3...+15	reserved	Writes rejected

INTERLOCK CHAIN

All external commands pass through the same hardware interlocks. A refused command returns exception 0x04.

7.6 Schedule Register Block

Select an entry, stage its fields, then write commit.

OFF	NAME	DESCRIPTION
+0	sel	Entry 0-15
+1	enabled	0 or 1
+2	ch	Channel 0-3
+3	days_mask	Sun bit 0 through Sat bit 6
+4	hour	0-23
+5	minute	0-59
+6	action	0 ON; 1 OFF; 2 PULSE; 3 LEVEL
+7	duration_s	Seconds
+8	level_pct	0-100
+9	polarity	0 OPEN; 1 CLOSE
+10	commit	Write-only commit
+11...+15	reserved	-

7.7 Exceptions

CODE	MEANING
0x01	ILLEGAL_FUNCTION
0x02	ILLEGAL_DATA_ADDRESS
0x03	ILLEGAL_DATA_VALUE
0x04	SLAVE_DEVICE_FAILURE

8 Modbus Master Mode

Flo can poll up to 8 third-party Modbus devices with up to 16 register entries per device and forward engineering-unit values into Growbud telemetry.

Maps are pushed from the app as a versioned, full-table atomic replacement. A new table must carry a greater version.

8.1 Master Device Config

FIELD	RANGE / VALUE	NOTE
address	1-247	Slave address
baud	9600-115200	Per poll session
parity	none / even / odd	Current firmware uses 8N1
stop_bits	1 / 2	Current firmware uses 8N1

Capacity

- Up to 8 devices on the RS-485 bus.
- Up to 16 configured registers per device.
- Externally power every third-party sensor.
- RS-485 role is exclusive: master, slave, or BACnet MS/TP.

8.2 Master Register Entries

FIELD	VALUE
reg_addr	uint16 target address
func	0x03 or 0x04
word_count	1 or 2
dtype	U16, I16, U32, I32, FLOAT
word_order	ABCD, CDAB, BADC, DCBA
scale, offset	engineering = raw x scale + offset
poll_interval_ms	per-register period

Behavior

- 3 retries with linear 20 ms backoff on timeout or CRC error.
- Modbus exception responses are terminal.
- t3.5 inter-frame silence is enforced.
- Applied configuration version is reported in telemetry.

9 BACnet Integration

Flo exposes valve channels as native BACnet objects on RS-485 using MS/TP or through a Growbud gateway using BACnet/IP.

EXCLUSIVE PORT

BACnet MS/TP occupies the RS-485 port and cannot run simultaneously with Modbus modes.

MS/TP Data Link

PARAMETER	RANGE	DEFAULT
MAC address	0-127	1
Baud	9600 / 19200 / 38400 / 76800	38400
Max master	1-127	127
Max info frames	configurable	1

9.2 BACnet Object Model

OBJECT	INSTANCE	ACCESS / FUNCTION
Device	default 300001	Who-Is / I-Am
Binary Output	BO:0-BO:3	Commandable on/off; priority array
Analog Output	AO:0-AO:3	Commandable 0-100%

Supported services include Who-Is / I-Am, ReadProperty for Present_Value, and WriteProperty with priority arrays.

- Max APDU: 1476
- Segmentation: not supported
- ReadPropertyMultiple: planned
- COV subscriptions: planned

9.3 BACnet Commissioning

FIELD	VALUE / RANGE
enabled	on / off
transport	BACnet/IP or MS/TP
device_instance	0-4194302; default 300001
device_name	up to 32 characters
udp_port	default 47808 (0xBAC0)
bbmd	disabled by default
mstp settings	MAC, baud, max master
points	up to 32 AI / AO / AV / BO mappings

Validation rejects writable flags on non-commandable AI/AV objects and duplicate object type/instance pairs.

10 LoRaWAN Configuration

PARAMETER	VALUE
MAC version	LoRaWAN 1.0.3
Activation	OTAA: DevEUI, JoinEUI/AppEUI, AppKey
Region	US915 sub-band 2; EU868 configurable
Device class	Class C default or Class B
Uplink interval	60 s default; 15 s minimum
Uplinks	confirmed or unconfirmed

DevEUI is printed on the label and shown in the app. Downlinks dispatch valve, schedule, and configuration commands.

11 On-Board Scheduling

Sixteen schedule slots run against the supercap-backed real-time clock, so irrigation can continue through network outages.

Each Entry Defines

- Target channel
- Weekday mask
- Start hour and minute
- Action: ON, OFF, PULSE, or LEVEL
- Duration and level percentage
- Pulse polarity

Manage schedules from the app, Modbus schedule block, or LoRaWAN downlink. Register 0x0007 reports when any schedule is firing.

PERSISTENCE

Committed schedules persist on the device.

12 Troubleshooting

SYMPTOM	ACTION
Fault 12: mode mismatch	Match the supply and valve type; power-cycle to re-latch
Fault 11: leak detected	Inspect the zone; clear the condition; re-enable channel
mode_detected = 3	Disconnect one supply pair at POWER IN
Harness fault	Check the valve harness pin 2 ID resistor
Modbus exception 0x04	Read device_fault and channel fault registers

12.1 Network Troubleshooting

SYMPTOM	ACTION
No Modbus response	Verify role, address, A/B polarity, and termination
MS/TP token loss	Align baud and max_master across the bus
No LoRaWAN join	Confirm sub-band and OTAA keys
Config lost after power cycle	Keep the app connected so current firmware can re-push RAM-resident protocol tables

BEFORE SERVICE

Record the fault code, supply type, connected valve harness type, firmware version, and recent configuration changes.

13 Compliance & Support

- **EMC:** CISPR 22/32 Class B; FCC Part 15.
- **Materials:** RoHS and REACH compliant.
- **Radio:** 902-928 MHz US ISM and 2.4 GHz BLE.
- **Warranty:** 1-year limited warranty.
- **Returns:** 90-day return policy.

GROWBUD SUPPORT

support@growbud.io
growbud.io/guides

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Site Notes