



Growbud Controller

4-zone irrigation control with Modbus, BACnet, CANopen, 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 drive solenoid coils and other low-voltage loads (small pumps, fans, heaters) within the channel ratings: 1.35 A RMS per AC channel, about 0.95 A derated at 50 °C, and about 2.2 A across all four on the shared fuse. Beyond those ratings, or for mains-voltage equipment, switch through a relay.

OUTDOOR SEAL

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

Document GBC-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 Growbud Controller is a 4-zone irrigation controller for greenhouse, indoor, and field operations. It drives 24 VAC or latching DC solenoids. Each valve port doubles as a universal sensor input. It connects through LoRaWAN, Bluetooth LE, and a dual-protocol CAN / RS-485 field bus.



VALVE ZONES

4

AC triac or DC H-bridge

RS-485 / CAN

5 modes

Modbus slave/master, BACnet, CAN
slave/master

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	9-30 VDC
AC supply	20-26 VAC RMS, nominal 24 VAC
Mode selection	Automatic and hardware-latched at boot
AC valve output	1.35 A RMS per channel (~0.95 A at 50 °C); ~2.2 A all four
DC valve output	2.99 A peak pulse, one channel at a time; 1.35 A continuous single channel; 9-16 V
Circuit protection	Self-resetting PTCs on each valve channel and on the supply input
Standby	Up to 250 μ A DC or 0.5 VA AC
RTC	Supercap-backed

2.2 Environment & Mechanical

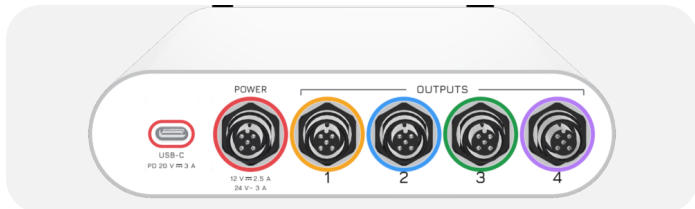
PARAMETER	VALUE
Operating temperature	-20 to +70 °C
Enclosure	Obround extruded aluminum, 165 x 40 x 160 mm
Panel A	USB-C, M12 POWER, four numbered OUTPUTS
Panel B	M12 RS-485 / CAN, two M8 leak-probe ports, USER button, two SMA antennas
Connectors	M12 A-coded 5-pin and M8 3-pin; IP67 mated or capped
Compliance basis	CISPR 22/32 Class B; FCC Part 15; RoHS/REACH

SUPPLY MODE

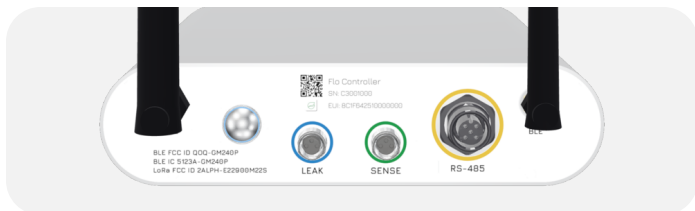
All four valves must use the same AC or DC type because drive mode is global for the current power cycle.

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.
- The two M8 ports are both leak-probe inputs and are identical; either takes either probe.
- The illuminated USER button handles commissioning and status.

3.1 POWER IN

PIN	SIGNAL	DESCRIPTION
1	DC input	9-30 VDC supply
2	DC return / GND	DC return and circuit ground
3	24 VAC hot	24 VAC hot
4	24 VAC return	24 VAC return; not DC ground
5	NC	Not connected

DO NOT COMBINE SUPPLIES

Connect either DC pins 1/2 or AC pins 3/4. Never connect both. The controller detects the powered rail at boot and latches the global drive mode. On this connector the blue conductor (contact 3) is 24 VAC hot, not a 0 V return.

USB-C

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

3.2 Valve Outputs V1-V4 (also sensor inputs)

PIN	SIGNAL	DESCRIPTION
1	Valve conductor A	Switched valve drive terminal A
2	Sensor power	Switched 12 V sensor excitation
3	Valve conductor B	Switched valve drive terminal B
4	Sensor input	Universal: pulse / dry contact / hall flow, 4-20 mA, 0-10 V, or 0-3.3 V
5	GND	Sensor ground; not used for valve wiring

FLOW METER PULSE RATE

Specify flow meters at or below roughly 500 pulses per litre. Pulse inputs are serviced by an I/O-expander interrupt; a higher-K meter (some run to 5880 pulses/L) outruns it and reads low at high flow. A prescaler was designed for this input and deliberately not fitted, so the limit is permanent, not a firmware gap.

ONE PORT, TWO JOBS

Every valve port also carries a 3-wire sensor interface on its spare contacts, so a port can drive a valve and read a sensor at once. The sensor class is chosen in firmware at runtime: there are no board variants and no jumpers to change.

GLOBAL DRIVE MODE

The controller selects one global AC/DC valve mode for all four outputs. Valve type is set in configuration; the controller does not read the valve type off the cable.

FOUR SOLENOIDS AT ONCE

All four AC channels share F2, a 3 A resettable fuse that also feeds the board supply and passes about 2.2 A at 50 °C. Four typical 0.6 A coils held together draw roughly 2.4 A, over that, so stagger the zones or choose lower-current solenoids. F2 resets itself: an overload clears as the board cools. Treat 0.6 A as typical, not guaranteed.

3.3 RS-485 / CAN & Accessories

Field bus + power out (J14) · CANopen / DeviceNet pinout

PIN	SIGNAL
1	NC
2	V+ out (12 V, 0.75 A; switched, fused, current-monitored)
3	GND
4	RS485_A / CAN_H
5	RS485_B / CAN_L

One wired protocol at a time: CAN (FD capable) or Modbus RTU over RS-485, never both. Pick the role to match: Modbus master/slave or BACnet MS/TP on RS-485, master or slave on CAN. Pin 2 powers a bus device from the same cordset at 12 V, 0.75 A, auto-reset fused (0.75 A hold / 1.5 A trip) and current-monitored; that ceiling is fuse coordination with the supply input, so power anything hungrier separately. Fit the 120 Ω termination jumper only at the end of the bus; CAN and RS-485 both terminate at the two ends.

M8 Leak Probe Ports · J16 + J18 (identical)

PIN	SIGNAL	DESCRIPTION
1	Probe excite (L+)	Pulsed probe excitation; brown conductor
3	GND (L-)	Cable reference; blue conductor
4	Probe sense (signal)	Conductivity-sense input; black conductor

An M8 3-pole connector has contacts 1, 3 and 4 (IEC 61076-2-104). There is no contact 2. Connect the two probe electrodes to contacts 1 and 4.

The two leak ports are identical. Both run the same pulsed two-electrode conductivity probe on the same cable, so either port takes either probe.

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. For latching DC, wire red to brown (contact A, positive) and black to blue (contact B, negative); reversing it is harmless but swaps open and close. Polarity is irrelevant in AC mode.
- 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 that already use a Growbud LoRaWAN network. On-board schedules continue if connectivity drops.

B • Wired Automation

The controller operates as a Modbus slave, BACnet node, or CANopen master/slave for actuators and industrial control. It can also aggregate nearby Growbud sensors over Bluetooth. Best for facilities with an existing BMS.

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 Growbud 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

The controller can poll up to 128 third-party Modbus devices. Each device can have up to 16 register entries. It forwards engineering-unit values into Growbud telemetry.

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

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 128 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

The controller 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 on the supercap-backed real-time clock. 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
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, valve type (24 VAC or latching DC), 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