GCU FAMILY

LWV CS-1

Measures the air your plants grow in

The LWV CS-1 is a canopy sensor for GCU-controlled grow pods, one per pod. It hangs by its single M12 cable just above the plants and measures CO_2, air temperature and humidity, leaf temperature and leaf VPD, whether the lights are on, air quality and pressure. A small fan draws room air past the humidity sensor, and the GCU reads every value over RS-485 Modbus.



Rev A, rendered from the design.

6 sensors
CO_2, air temperature and humidity, leaf, light, air quality, pressure

1 M12 cable
carries power, data and the sensor's weight

RS-485
Modbus RTU
every bus setting made in software

±(30 ppm + 3 %)
CO_2 sensor accuracy (SCD30), 400 to 10 000 ppm

FEATURES

Accurate CO_2 at the canopy

A dual-channel infrared CO_2 sensor (Sensirion SCD30) keeps a reference channel and is corrected for air pressure by the on-board barometer. Automatic self-calibration is off for enriched rooms; a one-point correction is written over the bus and kept in the sensor.

Fan-drawn air readings

A small fan pulls room air past the shaded humidity sensor at about 1.8 m/s (model estimate), so temperature, humidity and VPD describe the room, not a case warmed by the lights. The fan's speed is monitored, and the fan is changed from below without opening the sealed box.

Leaf temperature and leaf VPD

An infrared thermometer with a 35° view looks straight down at the leaves. It reports only when the view behaves like leaves, checked against the air temperature and the wet-bulb temperature.

Confirms the lights

A light sensor under the lid learns the room's own lights-on level and reports on or off, the level in percent of it (dimming shows), and any light seen during the dark period. It does not measure PPFD.

Hangs by its cable

The M12 socket sits on top over the centre of weight, so the sensor hangs level from the cable that powers it (model: under 1° of tilt). Hang it 20 to 40 cm (8 to 16 in) above the canopy and raise it as the crop grows.

Built for wash-down

The electronics sit in a box sealed with FKM (Viton) O-rings, designed for IP65 (not yet tested), with no silicone anywhere. Wash mode turns the fan and sensors off; afterwards the sensor finds water on itself and dries out with its fan.

SPECIFICATIONS

Measurements (sensor datasheet values)

CO_2	Sensirion SCD30, dual-channel NDIR, pressure-compensated
CO_2 accuracy	±(30 ppm + 3 % of reading), 400 to 10 000 ppm
CO_2 range	0 to 40 000 ppm; response t63 20 s
Air temperature	Sensirion SHT45 with polyimide membrane: ±0.1 °C typical, −40 to 125 °C
Relative humidity	Sensirion SHT45: ±1.0 %RH typical, 0 to 100 %RH
Leaf temperature	Melexis MLX90614ESF-BCC, infrared, 35° field of view, looking down
Leaf accuracy	±0.5 °C for leaf 0 to 60 °C, sensor 0 to 50 °C
Leaf spot	13 to 25 cm (5 to 10 in) wide at 20 to 40 cm (8 to 16 in)
Lights	ams AS7341, looking up through the lid: on or off, level in % of lights-on, light in the dark period; not PPFD
Air quality	Sensirion SGP41: VOC and NOx index, 1 to 500 (VOC 100 and NOx 1 = the room's normal)
Air-quality spread	unit to unit VOC < ±15, NOx < ±50 index points; full specification after 1.5 h (VOC), 6 h (NOx)
Pressure	Infineon DPS368: ±1 hPa absolute, 300 to 1200 hPa
Calculated	dew point, air VPD, leaf VPD

Air sampling

Fan	Noctua NF-A4×10 5V PWM, 40 mm (1.6 in), held at 4500 rpm and monitored
Air at the humidity sensor	≈ 1.8 m/s (model estimate; 1.0 m/s required)
CO_2 response	t63 ≈ 55 to 60 s (model estimate)

RS-485 and Modbus

Interface	RS-485 half duplex, Modbus RTU
Factory setting	address 10, 19 200 baud, 8N1, terminator off
Set in software	address 1 to 247, 9600 to 115 200 baud, parity, stop bits, reply delay, 120 Ω terminator; no switches
Safe changes	new settings run on trial and go back if nothing answers; re-address by serial number
GCU compatibility	first registers match the SenseCAP S-CO2-03
Updates	over the RS-485 cable; the image is checked before the switch and falls back if it does not confirm itself

Power

Supply	24 V DC from the GCU bus, through the M12
Consumption	≈ 32 mA (0.78 W) average, ≈ 120 mA peak at 24 V (design budget; measured value to be confirmed)
Input protection	1.5 A resettable fuse, reverse-polarity protection, 36 V surge clamp; surge protection on RS-485 A and B

Wash and dry

Ingress protection	electronics IP65 (design target, not yet tested); the air path opens downward and drains
Wash mode	on command: fan and sensors off, readings "no data"; ends 60 min after the last request
Wet detection	99 %RH or more for 10 min starts a heater test; a wet sensor flags itself, not 100 %
Dry-out	fan at full speed and heater pulses, then a sensor check and "ready"; valid again after ≈ 5 to 15 min (estimate)
Cleaners	ASA, FKM and 316 stainless, chosen for bleach-based cleaners; printed-ASA soak test still to run
Operating temperature	To be confirmed (the CO_2 sensor is specified for 0 to 50 °C, 32 to 122 °F)

Construction

Size	139.5 × 82.3 × 47.3 mm (5.49 × 3.24 × 1.86 in); 61.3 mm (2.41 in) to the top of the M12
Mass	≈ 214 g (7.5 oz), CAD estimate; not yet weighed
Case	white ASA, four printed parts: tray, lid, fan pod, drip cover
Seals	FKM (Viton) O-rings at the lid, sensor window and M12 nut; ePTFE vent on the CO_2 chamber; no silicone
Fasteners	seven M3 316 stainless screws in brass heat-set inserts
Board	108 × 48 mm (4.25 × 1.89 in), 2 layers, ENIG (lead-free), factory-assembled; top side conformal-coated (acrylic) at LWV
Processor	Seeed XIAO RP2350, socketed; firmware 0.5.0
Status light	one RGB light under the unit, seen through the case floor; no opening

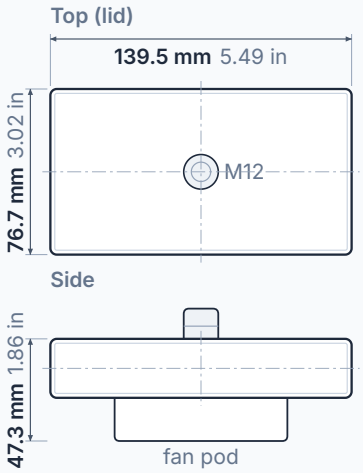
CONNECTORS

PORT	TYPE	USE
M12 BUS	M12 A-coded, 4-pin, female (socket), on the lid	24 V DC and RS-485 from the GCU bus: 1 +24 V, 2 A, 3 GND, 4 B; also carries the sensor's weight

STATUS LIGHTS

LIGHT	MEANING
Green flick every 5 s	running, no fault
Blue flick	the GCU has just read this sensor; no flicks: no communication
Amber blinks, counted	fault: 1 CO_2, 2 temperature/humidity, 3 air quality, 4 leaf, 5 light, 6 pressure, 7 fan, 8 bus settings on trial, 9 went back
Roll-call at power-up	one slot per sensor: green answered, amber missing
Blue, 1 s every 4 s	wash mode: safe to wash
Two short blue flashes	wet: waiting to dry
Cyan	drying; cyan then green: checking the sensors
Steady green, 30 s	dry, checked and ready
Dark	normal with the grow lights off; in the dark period it lights only at power-up, to identify itself or in a wash

DIMENSIONS



82.3 mm (3.24 in) across the two screw ears; the M12 mating face is 61.3 mm (2.41 in) above the bottom.

Weight	To be confirmed
Mounting	Hangs by its M12 cable over the middle of a bench, 20 to 40 cm (8 to 16 in) above the canopy, tied to a ceiling hook or bar or to a light fixture that is raised and lowered. No bracket.

WORKS WITH

- LWV GCU: CO_2, air temperature and humidity on current GCU firmware; every reading with CS-1 support (in development)
- GCU Cloud, through the GCU
- LWV IR blaster (RS-485), on the same M12 bus
- 4-pin A-coded M12 cables
- Any Modbus RTU master, 9600 to 115 200 baud

ORDERING

PART	DESCRIPTION
CS-1	Canopy sensor, Rev A, assembled: board, white printed case, fan, O-rings and drip cover. Ordering code to be confirmed.
M12 cable	Moulded 4-pin A-coded M12 cable: part to be confirmed.

1. Air speed, CO_2 response, tilt and protection figures are design estimates and may change.
2. Sensor figures are the makers' datasheet specifications for each sensor alone, not a measured accuracy of the CS-1.
3. On GCU firmware without CS-1 support it reads as CO_2 (up to 5000 ppm), air temperature and humidity. The other readings, wash mode and updates from the GCU need GCU firmware and GCU Cloud support in development.
4. The M12 cable carries the sensor's weight: use a moulded M12 cable and check its pull rating.
5. Keep silicone sprays and sealants away: silicone vapour permanently damages the air-quality sensor. After cleaning with bleach, rinse the M12 nut and the cable's coupling nut with water.