SAFEBACK | SMART AQUACULTURE | GUANGZHOU, CHINA

TK family · Controller integration and wiring guide

How aerators, feeders, sensors, gateways and control boards are wired into one system

Technical guide (EN) · Rev. 2026-10 · To be read with the datasheet of each TK model

1. What this guide is for

Every TK datasheet answers one question: how do I run this machine on its own. But a customer rarely buys a single unit — the aerator has to run on a schedule, the feeder has to dose every day, the probe has to send dissolved oxygen back, and the phone has to show it remotely. Only when they are wired together does the system work. The way they are wired decides three things: whether the equipment can be started and stopped remotely, whether the data can be read back, and — most important — whether a wrong connection will destroy the equipment.

This guide answers three questions: which connection class a device belongs to, how the cable should run, and which connections must never be made. The first three chapters cover the general rules; chapters 4 and 5 go item by item through the two device types that are most often wired wrongly (solar DC aerators, and pneumatic feeders with a VFD); chapter 6 is a quick-reference table for every model.

There are three kinds of reader: sales staff use it to explain to a customer how their system connects; installers wire to it; and the customer's own electrician uses it for acceptance. That is why the text gives the reasoning behind each rule, not just the rule — understand why, and you can work out the next model yourself.

Any item marked "to be confirmed" must be answered in writing by the factory before the order is placed. For anything involving electrical safety, the judgement of a licensed electrician on site and the local code take precedence; this document is not a substitute for construction drawings.

2. System layers and the four connection classes

The whole system has only three layers, and only one RS485 bus between them: the sensing layer is the probes and the monitoring station, the decision layer is the TK-4G-GW gateway, and the actuation layer is the TK-R12-SC4S-BG control board plus the controllers built into the equipment. Replace any one layer and the other two stay as they are.

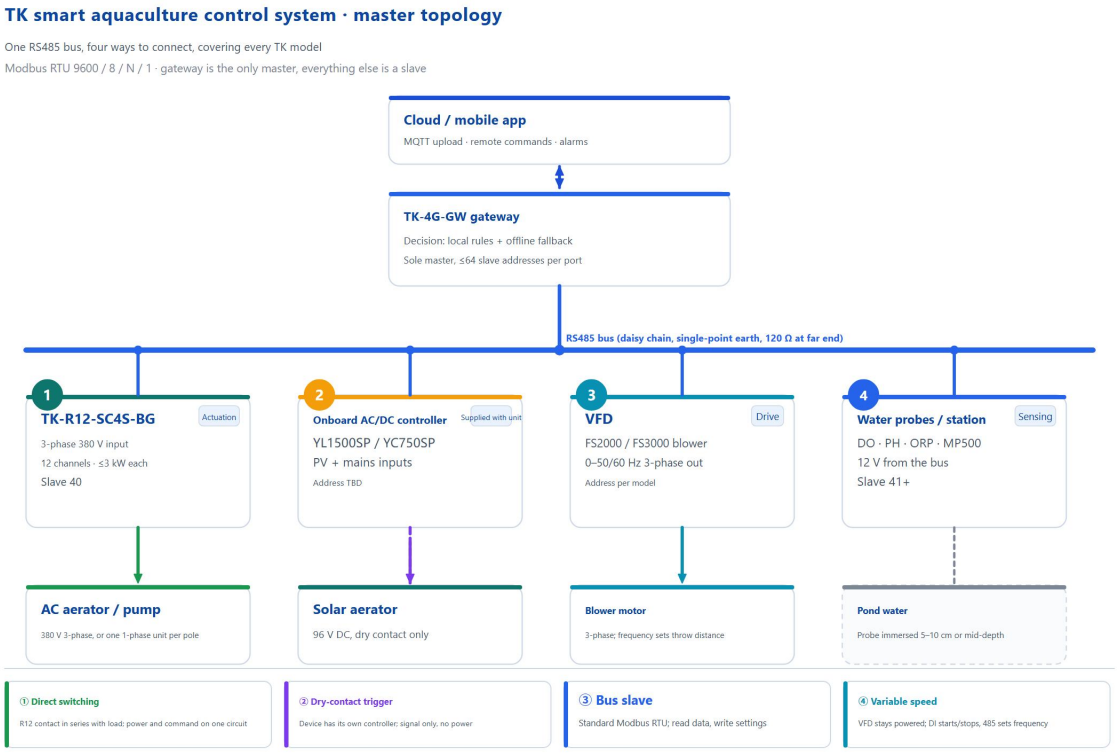


Fig. 1 The gateway is the only master; the control board, onboard controllers, VFDs and probes all hang on the same bus in four different ways

The gateway is the only master and everything else is a slave — including the control board. Remember this first, because it decides who listens to whom: every schedule, threshold and interlock lives either in the gateway or locally in the device. There is never a second master fighting for the bus.

There are four ways for a device to join the system, and the criterion is not the model number but what the device looks like:

Class	Criterion	How power is routed	How control is routed
① Direct switching	The device has no controller of its own: power on it runs, power off it stops	The control board contact is in series with the load	One circuit; power and command are not separated
② Dry-contact trigger	Has its own controller, with a "remote start/stop" or "external control" terminal	Powered from its own supply, not through the control board	The control board provides a dry contact only
③ Bus slave	A standard Modbus RTU slave with A/B terminals	Powered by the device itself	Directly on the bus, polled by the gateway
④ Variable speed	Three-phase induction motor that needs speed control	Breaker feeds the VFD, the VFD feeds the motor	DI start/stop plus AI or 485 speed reference

The order is fixed, and if you follow it you cannot go wrong. First ask whether the device can go on RS485 — if it can, it is class ③, and both data and commands travel on the bus. If not, ask whether it

has its own controller — if it does, and has external control terminals, it is class ②. A bare motor with no controller is class ①. And if it is a three-phase motor that needs speed control, it is class ④ and needs its own VFD.

Two common misunderstandings. The first is to treat "can be switched remotely" as "can report data": class ① only switches power — the control board knows whether the channel is closed and how much current is flowing, but not whether the motor is actually turning (phase-loss protection is a separate matter). To read the device's own status and fault codes, the device must be on RS485. The second is to assume a VFD also controls the feed rate. A VFD only changes fan speed; the feed rate is set by the feeder mechanism. They are not the same thing.

3. General wiring rules

The four sections of this chapter apply to every model. If something is wrong here, no amount of checking at the individual device will find it.

3.1 The RS485 bus

- **Topology** Daisy chain, in series from the gateway to each device in turn — never a star from a single point. Star wiring often seems to work over short distances, but it creates reflections at the branch point, which shows up as "fine most of the time, drops out now and then". That is the hardest class of fault to trace.
- **Polarity** A to A, B to B. Reversed polarity means the device simply does not answer, and nothing is damaged; GND must be connected, and the bus is earthed at one point only. The shield is earthed at one end and left open at the other.
- **Termination** If the bus is longer than 50 m, or the baud rate is above 9600, fit 120 Ω between A and B at the far end. Not needed for two devices sitting on a bench.
- **Separation from power cables** Never in the same conduit as 380 V power. Keep ≥100 mm when running parallel, and cross at right angles. Control signal cables (dry contacts) follow the same rule.
- **Number of slaves** The gateway is rated for 64 addresses, but in practice keep a single bus to 16 or fewer, and require one full polling cycle to take less than a third of the reporting interval. When there are many devices, add a second gateway and split the bus rather than piling everything onto one cable.

3.2 Address planning

Factory default: 40 for relay and power devices, 41 for water-quality probes. With several of the same kind, number them 40, 42, 43 … and log them in the wiring schedule — on site, "which number is this

one" comes up far more often than "what is this one".

Address	Use	Note
40	Control board (TK-R12-SC4S-BG)	Factory default; with several boards use 40, 42, 43…
41+	Water-quality probes, monitoring station	DO / PH / ORP / MP500, incrementing by type
42–49	Reserved for onboard controllers, VFDs and other actuation slaves	See chapters 4 and 5; the factory register map governs

An address conflict shows up as "one of the two devices can never be read", and whichever is powered up first is the one that works. When you see that, check the addresses before suspecting the cable.

3.3 Power

- **Gateway** DC 12 V, a dedicated supply of ≥2 A. The current spike at the moment of a 4G transmission is significant, and an under-sized supply causes repeated restarts — this is the leading cause of "the gateway keeps dropping off", more common than a signal problem.
- **Control board** DC 12 V with ≥1 A of headroom continuously. Relay switching draws a burst of current, so do not share a small supply with inductive loads.
- **Probes** Can be powered from the 12 V on the bus terminals, which saves a cable; but once there are several probes, check the total current, and beyond that give them a local supply and let the bus carry signals only.

Every 12 V supply must be taken from a point separate from the motors, pumps and contactor circuits. The classic symptom of a shared supply is that the gateway restarts every time a motor starts.

3.4 Earthing and surge protection

PE must be solidly connected, with a cross-section at least half that of the phase conductor; an unearthed control board can leave the enclosure live. Fitting the equipment in an IP55 or better enclosure takes the system to IP65 overall — leave 50 mm of clearance above and below inside the enclosure and do not mount it hard against the VFD. In thunderstorm-prone areas fit an SPD (four-stage) inside the enclosure and bond everything equipotentially: Vietnam's rainy season brings frequent thunderstorms and humidity above 80% for months, so this is not optional.

4. Connecting a solar DC aerator to the controller

Models covered: TK-YL1500SP (96 V DC / 1.5 kW) and TK-YC750SP (96 V DC / 0.75 kW). What sets these two apart from the AC models is that they already contain their own electrical control, and must not be given a second set of power switching when they join the system.

4.1 What interfaces the machine already has

Each machine ships with an AC/DC controller (about 2.8 kg) which is the heart of the unit: it brings the PV DC and the mains AC together onto a 96 V bus, performs maximum-power-point tracking, and falls back to mains when there is not enough sun. It is not a TK-R12 control board, and the two are not interchangeable. The "to be confirmed" in the last row of the table below is the precondition for this whole chapter, and the question must be answered in writing by the factory before ordering.

Interface	Present state	What it means for the system
PV input	100–200 V DC (50–100 V DC on the YC750SP)	The string configuration must fall inside this window, otherwise no output or an alarm
Mains input	AC 220 V, automatic changeover with PV	Serves as the overcast fallback, and is the only AC-side point for remote stop
DC output	96 V DC bus driving a PM synchronous motor	This must never be connected to the control board
Control interface	Remote start/stop dry contact and RS485 port both to be confirmed	Decides whether path S2 or S1 is available

4.2 The three connection paths

For the same machine, the method depends on what terminals its onboard controller provides. In order of preference:

S1 The onboard controller has RS485: put it straight on the bus.

This is the cleanest route. The controller joins the 485 bus as a slave (addresses 42, 43 and up are suggested); the gateway issues start, stop and schedule commands and reads back bus voltage, generated power, operating state and fault codes. No R12 is needed, no interposing relay is needed, and both the wiring effort and the number of failure points are the lowest. The precondition is that the factory publishes the register map — at minimum: start/stop command, operating state, fault code, bus voltage and PV power.

S2 The onboard controller has a remote start/stop dry contact: use one channel of the R12.

Where the controller has a "remote start/stop" or "external control" terminal, the control board never touches the power — it only provides a dry contact. In practice: take one pole of group 1 on the R12

(U1, which gives 220 V against the panel neutral bar) to drive the coil of interposing relay KA1, and wire the normally-open contact of KA1 across COM and DI on the controller. See Fig. 2.

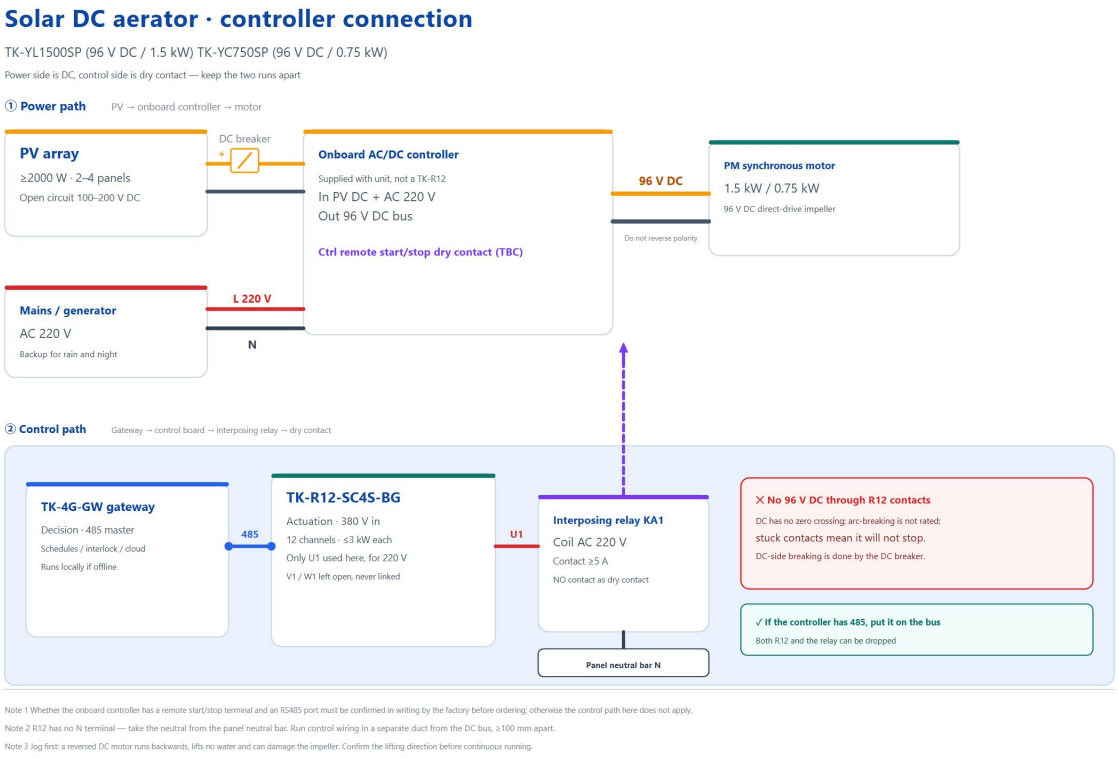


Fig. 2 The 96 V DC side and the 220 V control side are kept completely apart: DC never enters the control board, which only touches the relay coil

Why is a relay needed in between, instead of wiring the R12 contact straight into the controller's dry-contact input? Because the R12 output is a 220 V phase voltage, while the dry-contact terminals are designed for low-level signals. The relay provides isolation: the coil side takes 220 V, the contact side carries a few milliamps. The only selection criteria are coil AC 220 V and contact ≥5 A / 250 V AC; a version with an indicator lamp makes on-site checking easier.

One detail is easily missed: the three poles of the R12 (U1/V1/W1) move together on one lever, and this drawing uses only U1 — V1 and W1 must be left empty, never linked out and never earthed. Cap the two unused terminals.

S3 Wanting the control board to switch the 96 V DC bus directly: not possible.

This is the single most important red line in this document. The lever relays on the R12 are rated for AC 380 V; an AC arc extinguishes naturally at the current zero crossing, which is why the contacts can be compact. DC has no zero crossing, and at the same voltage the arc is long and hard to extinguish. Breaking 96 V DC will arc, erode the contacts and eventually weld them together — and once welded, the circuit stays closed even with the lever in the off position. The fault therefore does not appear as “does not work” but as “will not stop when it must”, which is a safety incident rather than an

equipment failure.

Breaking the DC side must be done by a DC-rated breaker or DC contactor, selected for the DC voltage and configured to break both poles. In a solar machine the R12 does exactly one job: carry the 220 V control signal to the interposing relay.

One more method that looks as though it would work deserves a separate note: using the R12 to cut the AC 220 V input to the onboard controller.

That is only equivalent to stopping the machine if the controller has “stop when mains is lost” or “PV disabled” logic. If the controller keeps running from PV after mains is lost — which is how most direct-drive units behave — cutting the mains only removes the backup and the machine keeps running, so the command and the effect do not match. With such a device, go back to S1 or S2; do not take the shortcut of cutting the mains.

4.3 Wiring steps for path S2

1. Isolate and prove dead. On the DC side open the DC breaker and wait for the bus capacitors to discharge (≥5 minutes) before touching anything.

2. Fit the R12 into the pond-side control box (IP55 or better) and earth the PE terminal solidly.

3. Take the U1 output of the R12 to terminal A1 of the KA1 coil; take A2 to the neutral bar N in the distribution panel (the R12 has no N terminal, and the neutral must never be connected to U/V/W).

4. Wire the normally-open contact of KA1 across COM and DI on the onboard controller (terminal names as marked on the controller).

5. Give the R12 its 12 V control supply, on a dedicated circuit with ≥1 A headroom.

6. Connect A/B/GND from the gateway to port 1 on the R12 — A to A, B to B, common ground.

7. After power-up, set it in the mobile app: R12 slave address 40, baud rate 9600, matching the gateway.

8. Create the mapping in the gateway: this channel is “pond 1 solar aerator”, and set the schedule.

9. Jog test: send “on” from the phone, listen for KA1 picking up, watch the indicator on the controller, then check that the impeller is lifting water in the correct direction.

10. Record the result in the wiring schedule (device, address, circuit, terminals) and stick it inside the enclosure door.

4.4 Mixing with mains-powered aerators

Where one pond has both a TK-YL1500 (AC) and a TK-YL1500SP (DC), the two machines can share one R12, but they are wired differently: the AC machine goes on group 1 as a direct three-phase supply (class ①), while the DC machine uses U1 of another group as a control signal (class ②). Both groups take part in staggered starting — the AC machine has a large inrush, the DC machine has almost none, so no stagger interval needs to be reserved for it.

In addition, the DC machine should be scheduled in daylight, in the PV output window, and the AC machine at night or as the overcast fallback. Two schedule rules in the gateway express this; no extra hardware is needed.

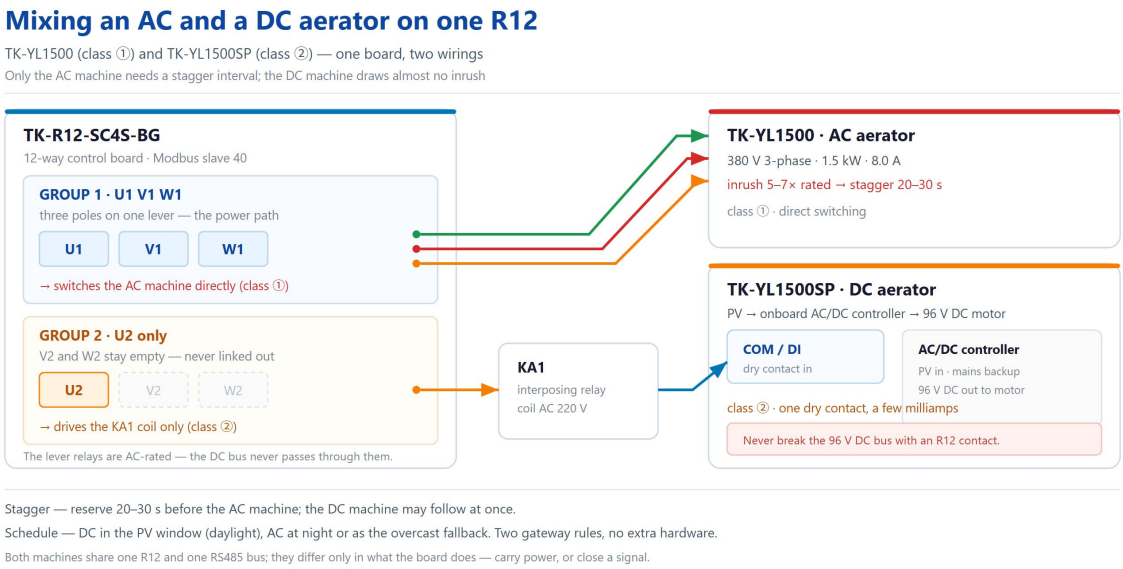


Fig. 3 One pond, one board, two wirings: the AC machine is switched through the power poles, the DC machine through a dry contact and an interposing relay

5. Connecting a pneumatic feeder to the controller and a VFD

Models covered: TK-FS2000 (2.0 kW) and TK-FS3000 (3.0 kW). Both are supplied as standard with a digital panel and local timer, running at fixed speed without a VFD. Adding a VFD is an option; this chapter explains why you would, what must be settled first, and how to wire it.

5.1 Why a VFD at all

The weak point of a pneumatic feeder is the duct. The longer the duct, the more bends, and the heavier the feed, the higher the resistance — while a fixed-speed fan delivers one air volume, chosen for the worst case (longest distance, heaviest feed). At short range it therefore blows too hard: the feed scatters on the water surface, the breakage rate rises and the landing pattern is inaccurate.

A VFD fixes three things. First, it matches air volume to distance and to feed density — floating feed is light, sinking feed is heavy, and one machine can run two different frequencies for the two. Second, it gives a soft start: the fan has a lot of inertia, and direct-on-line starting drags down the voltage at the far end of the pond (the same reason the R12 staggers starts). Third, it allows a lower frequency for short throws — less power, less noise and less broken feed.

But be clear about what a VFD does not fix: it does not change the feed rate. The discharge rate is set by the feeder mechanism; on both the FS2000 and the FS3000 a 25 kg bag takes about 8 minutes, which is 180–190 kg/hour, whatever the fan. More output means a larger feeder — a different job.

5.2 The motor precondition that must be settled first

Unless this is resolved, a VFD bought for the job cannot be fitted.

On the 220 V single-phase versions of the FS2000 and FS3000, the standard fan motor is usually a single-phase capacitor-run or capacitor-start motor. Such a motor cannot be connected to a general-purpose VFD: the VFD output is a variable-frequency three-phase supply with phases 120° apart, whereas a single-phase capacitor motor creates its rotating field by phase shifting through a capacitor. The principles differ. Connecting a single-phase capacitor motor to a VFD gives, at best, poor torque and overheating; at worst, a burnt winding.

Option	Approach	Suits	Cost
A	Choose the 380 V three-phase model and fit a three-phase VFD directly	Site already has three-phase power; the FS3000 is available in 380 V	Lowest; simplest wiring
B	Convert the 220 V model to a three-phase fan motor and fit a single-phase-in / three-phase-out VFD	Single-phase supply only, but speed control is required	Motor change; must be confirmed on the order
C	No VFD: fixed speed plus several machine positions	Fixed feeding distance, single feed type	No extra cost, but air volume cannot be adjusted

The conclusion is that the VFD decision has to be taken at the selection stage, together with the site's power supply — it cannot be added once the machine is on site. This is also why the 380 V three-phase version of the FS3000 is worth recommending first: it is not a “higher specification”, it is the only configuration in which a VFD can be done cleanly.

5.3 Selecting the VFD

Model	Fan power	Recommended VFD rating	Recommended input	Output
TK-FS2000	2.0 kW	2.2 kW (heavy duty)	Single-phase 220 V or three-phase 380 V	Three-phase 0–50/60 Hz
TK-FS3000	3.0 kW	4.0 kW (heavy duty)	Three-phase 380 V (preferred)	Three-phase 0–50/60 Hz

A fan is a variable-torque load, so in theory a light-duty rating would do; but the impeller has high inertia and a long start, so in practice select heavy-duty or go one frame size up, otherwise it will trip on overcurrent at start. A carrier frequency of 4–6 kHz is recommended: too low and the motor is noisy, too high and motor temperature rise and leakage current increase, which is worse on long cable runs.

5.4 Wiring

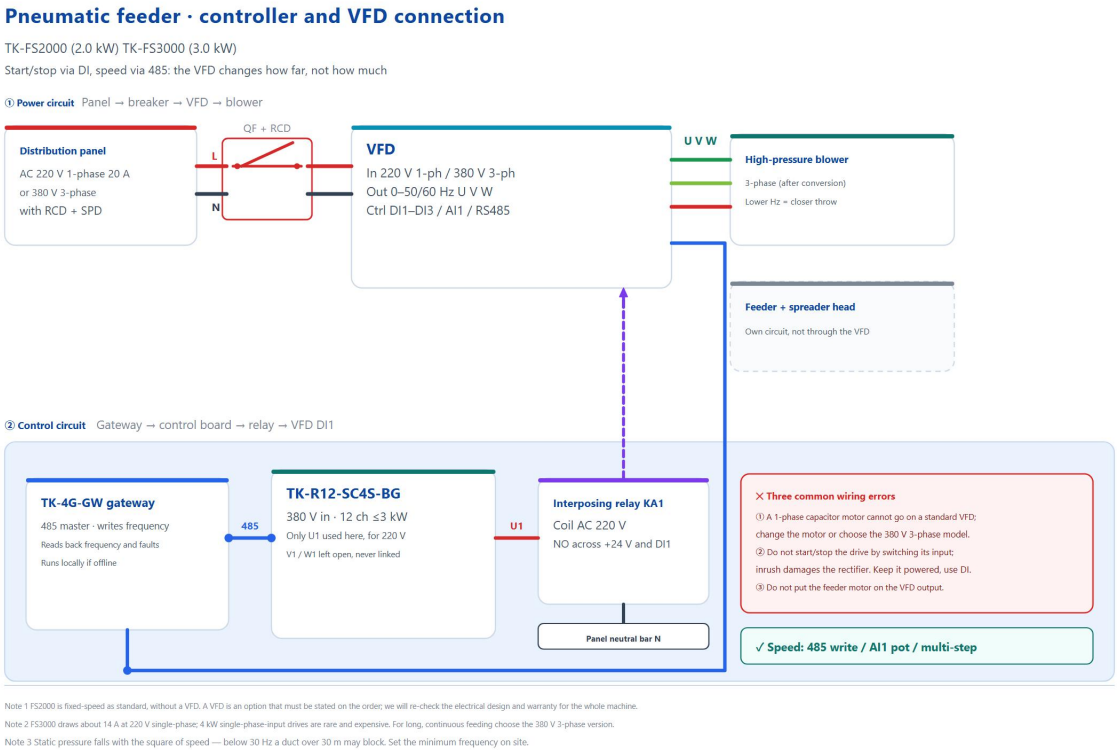


Fig. 4 The VFD stays powered; start/stop goes through DI1 only, speed through 485 or AI1; the feeder motor has its own

circuit and does not pass through the VFD

Power circuit: distribution panel (with RCD and SPD) → QF breaker → VFD R/S/T → U/V/W → fan motor. The VFD input needs its own breaker, which also serves as the isolation point for maintenance.

Control circuit: take one pole of U1 on the R12 (220 V against the panel neutral bar) to drive the coil of interposing relay KA1, and wire the normally-open contact of KA1 across the VFD's +24 V and DI1 terminals — note that this uses the 24 V that the VFD itself provides, not an external supply, so the 24 V does not have to be brought out of the enclosure, which is safer. The VFD ships set to panel start/stop, so the command source must be changed to "terminal control", otherwise DI1 does nothing.

There is a reminder here that matches chapter 4: do not start and stop the VFD by switching its input. Every power-up charges the DC bus capacitors, the inrush is large and it stresses the rectifier — and frequent power cycling is not a design condition for the drive anyway. The correct approach is to leave the VFD powered and start and stop through DI. In this circuit the R12 is the signal source, not a power switch.

5.5 The three ways to set the speed

Method	Wiring	Suits	Limitation
485 frequency write	VFD A/B on the bus; the gateway writes the frequency register	Remote staging, automatic air-volume changes by time of day	Requires Modbus RTU support in the VFD
AI1 potentiometer	10 V / AI1 / GND to a potentiometer or a 0–10 V signal	One-off manual adjustment at installation	Cannot be changed remotely
Multi-step DI2/DI3	Two DIs combined to give 2–4 fixed frequencies	Only a "far / near" choice is needed	Fixed steps, not continuously adjustable

The three are complementary: use 485 as the main speed reference, keep AI1 for fine adjustment during commissioning, and use multi-step speed as the fallback if the 485 link fails. Do not implement AI1 alone — remote adjustment of air volume would then be impossible.

5.6 Parameter checklist

Parameter numbers differ completely between VFD brands, so the table lists only which items must be set and the recommended values; map them to the numbers in the manual of the drive you choose.

Parameter	Recommended	Why
Command source	Terminal control (not panel)	Without this, DI1 does nothing even when wired
Frequency source	485 or AI1	Whichever was chosen in 5.5

Parameter	Recommended	Why
Maximum frequency	50 Hz (nameplate value for a 60 Hz motor)	Above rated speed the motor will overload
Minimum frequency	From 30 Hz, set on site	Below this the static pressure is too low and long ducts block
Acceleration time	8–15 s	The fan has high inertia; too short trips on overcurrent
Deceleration time	15–25 s	Too short raises the bus voltage and may trip on overvoltage
Carrier frequency	4–6 kHz	A compromise between noise, temperature rise and leakage current
Address / baud rate	No conflict with other slaves; 9600	Must match the gateway
Fault relay output	Local lamp or sounder if required	The R12 has no digital input, so faults must be read over 485

The last row deserves a note of its own: the TK-R12-SC4S-BG has no digital input, so a VFD fault signal cannot be wired back to the control board. To see “VFD fault” on the phone, the VFD must be on RS485 and the gateway must read its status word. This is easy to overlook at the selection stage.

5.7 Does the feed rate change once a VFD is fitted

No. This must be made clear to the customer, or there will certainly be an argument at acceptance. The fan frequency only changes the conveying air speed — the feed travels faster or slower through the duct. How many kilograms per hour is set by the speed and opening of the feeder mechanism, and has nothing to do with the fan. Both the FS2000 and the FS3000 discharge a 25 kg bag in about 8 minutes, 180–190 kg/hour, with or without a VFD. To change output, adjust the feeder; to change the landing point and distance, adjust the frequency.

6. Quick reference for the other models

The table covers every model in the TK family today. The connection class refers to the four types in chapter 2; the slave addresses are suggestions and the factory register map governs. A blank entry means the device does not go on the bus.

Model	Supply	Class	Interface and address	Key point
TK-YL1500	AC 220/380 V	① Direct switching	R12 contact, no address	One unit per group in three-phase; one per pole single-phase, neutral taken separately
TK-YL1500SP	96 V DC	② or ③	Dry contact / RS485, 42 suggested	DC must never enter the R12; see chapter 4

Model	Supply	Class	Interface and address	Key point
TK-YC750SP	96 V DC	② or ③	Dry contact / RS485, 43 suggested	As above; shares the same controller platform
TK-FS2000	AC 220 V single-phase	④ (option)	VFD DI / AI / 485	Fixed speed as standard; resolve the motor precondition first, see 5.2
TK-FS3000	AC 220 V or 380 V	④ (option)	As above	The 380 V three-phase version is the natural fit for a VFD
TK-150D	AC 220 V	① Direct switching	One R12 pole, no address	About 200 W, one pole is enough; local panel timer may be used instead
TK-DO100 / PH100 / ORP100	12 V	③ Bus slave	RS485, from 41	Can be powered from the bus 12 V; check total current with several probes
TK-MP500	12 V	③ Bus slave	RS485, from 41	Five parameters in one; immersion depth per manual
TK-WQS station	AC 220 V + 12 V	③ Bus slave	RS485, from 41	Self-contained cabinet; earth separately
TK-4G-GW	DC 12 V ≥2 A	Master	RS485 ×2 (same bus in parallel)	The only master; dedicated supply, not shared with inductive loads
TK-R12-SC4S-BG	AC 380 V three-phase in	Actuation	RS485 ×3, 40	No N terminal; ≤3 kW per channel
TK-FA20-300	AC-DC module	Supply	—	Provides 12/24 V for gateway, control board and probes

6.1 AC aerators (TK-YL1500)

A three-phase unit occupies one group of the R12, with U/V/W moving together. In single-phase installations each pole carries one 220 V device, up to 12 per board; the neutral does not enter the control board — the N of each unit is paralleled and returned to the panel neutral bar. The three poles of a group share one lever, so all three units in a group start and stop together; when grouping, choose units of the same power and duty, which also keeps the phase-current comparison and imbalance criterion meaningful.

Starting strategy: by default, switch groups in at 3–6 second intervals. End-of-line voltage in rural Vietnam is low and transformer capacity is small, so four motors closing at once can pull down a whole branch. Staggered starting here is not a refinement, it is the difference between stable operation and constant tripping.

6.2 Two-bag feeder (TK-150D)

About 200 W, far below the 3 kW per-channel limit, so it can go on any pole of the R12 — one pole is enough. But it has its own control panel and timer, and in most installations the control board is not needed at all; connect it only when remote control from the phone is wanted, using class ①, in series with the 220 V circuit. Note that its rated maximum throw is 17 m with an effective landing zone of about 10–12 m, so where the machine is placed matters more to the result than the electrical control.

6.3 Water-quality probes and monitoring stations

All are class ③ on the bus. A probe can take its 12 V from the bus terminals, saving a power cable; but once four or five probes hang on one bus, check the total 12 V current, and beyond that give them a local supply and let the bus carry signals only. Probe cable and power cable must run separately, ≥100 mm apart — the first cause of drifting dissolved-oxygen readings is not a failed probe but interference.

6.4 How the system components themselves are wired

The gateway, control board, module power supply and touchscreen are not controlled devices — they are the system. The wiring points were covered in chapter 3; two are worth repeating: the gateway needs its own 12 V supply of ≥2 A, and the control board needs 1 A of headroom on its 12 V, not shared with contactor coils. These two account for nine out of ten cases of “mysterious restarts” on site.

7. Commissioning and acceptance

7.1 Six checks before power-up

- ☐ Check every terminal against the drawing, with particular attention to whether a neutral has been landed on U/V/W.
- ☐ Is PE solidly earthed, and is the enclosure equipotentially bonded?
- ☐ Is the 485 polarity consistent, is GND common, is the shield earthed at one end only?
- ☐ Is the 12 V supply on its own circuit, with enough headroom?
- ☐ Are the slave addresses set, and is there any conflict?
- ☐ Do the VFD input breaker rating and the motor nameplate data match the VFD settings?

7.2 Step-by-step commissioning

Work in the order communications first, then actuation, then interlocks, and confirm each step on its own before moving to the next. Powering everything up and testing it all at once makes it impossible to tell which layer a problem is in.

1. Power only the gateway and the probes; confirm the gateway is online and sees every probe.

2. Check each slave address one by one and record it in the wiring schedule.

3. Connect the R12 with its 12 V control supply only, and confirm from the app that it communicates and that all 12 channels read.

4. Test the R12 with no load: switch each group on and off by hand, listen to the relays and watch the indicators.

5. Connect one aerator, jog it to confirm the direction of rotation, then run it continuously for 10 minutes and check that the three phase currents are balanced.

6. Connect the dry contact of the solar aerator and jog it to confirm start/stop and direction.

7. Connect the VFD: start and stop from the panel first to confirm motor direction, then switch to terminal control, and finally test speed control over 485.

8. Set the minimum frequency on site: lower it from 50 Hz until feed transport starts to become unreliable, then add 5 Hz.

9. Set the interlock rules (for example, start the aerator when dissolved oxygen falls below the setpoint) and verify them by deliberately changing the threshold.

10. Power-cycle the system and confirm that every device returns to its previous state and that the gateway reconnects automatically.

7.3 Acceptance checklist

Confirm and sign off item by item at handover: the phone shows the status of every device; remote start/stop works for every class of device; local rules still run after the network is lost; phase-loss protection operates correctly (this can be verified by pulling one phase); a VFD fault is visible on the phone; the wiring schedule matches the installation and is fixed inside the enclosure door.

8. Troubleshooting

Symptom	Most likely cause	What to do
Gateway restarts repeatedly	12 V supply current too low; the 4G transmit burst pulls the voltage down	Use a dedicated supply of ≥2 A on its own circuit
No slaves can be read	A/B reversed, no common ground, address conflict	Check polarity, common ground, addresses
One slave intermittent	Star wiring, no termination, cable sharing a conduit with power	Re-wire as a daisy chain, fit 120 Ω, separate the cables
R12 does not operate	Less than 1 A headroom on the 12 V control supply	Dedicated supply, not shared with inductive loads
One channel has no output	Phase-loss protection has operated on that group	Check the three phase currents of that group to find the lost phase

Symptom	Most likely cause	What to do
Solar machine will not start or stop	Controller lacks the function, dry contact wired wrongly, polarity reversed	Check the terminal names on the label and test continuity with a meter
DC side trips	DC breaker under-rated, or string voltage outside the window	Re-check against 96 V and the maximum current
VFD will not start	Command source not set to terminals, no signal on DI1	Change the parameter; measure continuity between +24 V and DI1
VFD overcurrent	Acceleration time too short, high fan inertia	Increase acceleration to 15 s; go up one frame size if necessary
Duct blocks at low frequency	Minimum frequency too low, too many bends	Raise the minimum frequency, reduce the number of bends
Feed rate is wrong	Fan frequency is being adjusted as if it set the feed rate	Adjust the feeder; frequency is unrelated
DO reading drifts	No common ground, cable too long, sharing a conduit with power	Common ground, add shielding, separate the runs

9. Construction safety and red lines

The five items below are not recommendations — they are things that must never be done:

- **Red line 1** No DC load such as 96 V or 48 V may be connected to the contact circuits of the TK-R12. DC has no zero crossing, the breaking capacity is not rated, and once the contacts weld the mechanical lever cannot open the circuit either. This is a safety incident.
- **Red line 2** Never start or stop a VFD by switching its input. The VFD stays powered; start/stop goes through DI.
- **Red line 3** Never land a neutral on the U/V/W terminals of the R12. Take the neutral of a single-phase device from the panel neutral bar.
- **Red line 4** No live working. After isolating, prove dead; on the DC side also wait for the bus capacitors to discharge.
- **Red line 5** PE must never be left floating. An unearthed control board can leave the enclosure live.

Working practice: electricians must be licensed; isolate the upstream supply and fit a lock-off tag before working inside the enclosure; stop outdoor wiring in thunderstorms; sleeve or overhead-run every cable that crosses a pond bund — never bury it directly in the mud.

Appendix A Associated documents and drawings

Document	Purpose	Note
Fig. 1 TK system master topology	The overall relationship between the four connection classes	Figure 1 of this guide, delivered with it
Fig. 2 Solar aerator connection	Wiring of the TK-YL1500SP / YC750SP	Figure 2 of this guide
Fig. 3 One pond, AC and DC mixed	AC unit on power poles, DC unit on a dry contact	Figure 3 of this guide
Fig. 4 Feeder and VFD connection	Wiring of the TK-FS2000 / FS3000	Figure 4 of this guide
Smart fish pond wiring diagram (CN/EN)	Detailed wiring of an AC pond-wide system	Existing file, in the product set
Datasheets for each model	Single-machine data and installation requirements	See the product manual contents page

Appendix B How to use this document

This document is delivered together with the datasheets for each model and is not priced separately. Figures 1 to 4 are principle diagrams, showing the connections and the direction of signals; they do not replace construction drawings. Actual installation requires electrical drawings issued for the site conditions and confirmed by a licensed electrician.

Every “to be confirmed” item will be updated in a revision of this document once the factory has answered in writing, and recorded in the table below. Where the equipment or the supply conditions on site differ from what is described here, the site measurements and the local electrical code govern; for anything involving safety, this document is not the sole basis for a decision.

Rev.	Date	Change
Rev. 1.0	2026-10-23	First issue. Four connection classes established; the two special cases — solar DC aerators, and pneumatic feeders with a VFD — wired in detail; quick reference for every model; red lines for construction.

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Specifications are subject to change without notice as the product is improved; confirm current data before tendering or volume orders.