

MEKATORA CONTROL SYSTEMS

MKT-VFP-2200i

Helix series, intake variant

Raw Water Intake Pump

Device tag **P-101**

Variable-frequency centrifugal raw-water intake pump.

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Precision Through Automation

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1 Overview

The **MKT-VFP-2200i** (Helix series, intake variant) is a single-stage centrifugal raw-water intake pump driven by an integrated vector-controlled variable-frequency drive. It is the first stage of a Mekatora water-purification train: it lifts feed water from a surface source — lake, river or reservoir — and delivers it to the coagulation tank for chemical pre-treatment.

The drive provides programmable soft-start ramping and built-in motor diagnostics (current, winding temperature, run-hour counter, fault code). All control and telemetry are exposed over Modbus TCP on the device's own Ethernet port; there are no analog wiring requirements.

2 Process specifications

Parameter	Value
Rated flow	200 m ³ /h at 100 % speed
Discharge pressure (TDH)	5 bar at 100 % speed (~1 bar at idle)
Suction pressure (atmospheric)	0.95 bar at full flow
Speed control	VFD, 0–100 % of rated frequency
VFD ramp time-constant	2 s (first-order, soft-start)
Rated motor current	~ 40 A at rated flow
Motor thermal model	25 °C ambient, +45 °C rise at rated
Thermal lag	60 s first-order
Overtemperature trip	> 95 °C raises FAULT_CODE = 2
Overcurrent trip	> 1.3 x rated (~52 A) raises FAULT_CODE = 1
Run-hours counter	32-bit, register-pair encoded

Discharge pressure follows a quadratic curve with speed:

$$P_{disch} \approx 1.0 + 4.0 \cdot (S/100)^2 \quad [\text{bar}]$$

where S is SPEED_PV in percent. Motor current scales linearly with flow:

$$I_{motor} \approx 4.0 + 0.18 \cdot Q \quad [\text{A}]$$

where Q is the delivered flow in m³/h.

3 Network configuration

Item	Value
IP address	172.28.0.47
Subnet	172.28.0.0/24
TCP port	502 (Modbus TCP)
Unit identifier	echoed in the response; not validated (point-to-point)
Byte order	big-endian (Modbus standard)
Word order (u32)	high word at register N, low word at N+1

The device speaks **Modbus TCP only**. Serial-line concepts (CRC-16, RTU framing, broadcast addressing, Listen-Only Mode) do not apply; do not expect the unit ID byte to gate access — it is informational.

4 Register map

Modbus uses 1-based “register numbers” in narrative, but the on-the-wire PDU address is **register_number** – 1. Both columns are shown below for clarity. All scaled fields are signed 16-bit integers; the engineering value is the wire value divided by the scale.

4.1 Coils (FC 01 read · FC 05 / 0F write)

Reg	Addr	Name	R/W	Description
1	0x000	RUN_CMD	RW	Master start/stop. ON enables the VFD soft-start.
2	0x001	AUTO_LEVEL	RW	Cascade T-601 level onto SPEED_SP. In AUTO the controller owns SPEED_SP.

4.2 Holding registers (FC 03 read · FC 06 / 10 write · FC 16 mask · FC 17 read+write)

Reg	Addr	Name	Scale	Range	Unit	R/W	Description
1	0x000	SPEED_SP	×10	0..1000	0..100 %	RW	VFD speed reference. Writes are clamped to 0..100.

4.3 Input registers (FC 04 read only)

Reg	Addr	Name	Scale	Type	Unit	Description
1	0x000	SPEED_PV	×10	int16	%	Actual VFD output speed.
2	0x001	SUCTION_P	×100	int16	bar	Suction pressure.
3	0x002	DISCHARGE_P	×100	int16	bar	Discharge pressure.
4	0x003	FLOW	×10	int16	m ³ /h	Delivered flow.
5	0x004	MOTOR_I	×10	int16	A	Motor current.
6	0x005	MOTOR_T	×10	int16	°C	Motor winding temperature.
7	0x006	RUN_HOURS_HI	×1	uint16	h	High word of 32-bit run-hours counter.
8	0x007	RUN_HOURS_LO	×1	uint16	h	Low word of 32-bit run-hours counter.
9	0x008	FAULT_CODE	×1	uint16	code	0 = ok, 1 = overcurrent, 2 = overtemp.

To reconstruct the run-hours counter: **run_hours** = (RUN_HOURS_HI << 16) | RUN_HOURS_LO.

5 Supported function codes

FC	Name	Notes
0x01	Read Coils	
0x02	Read Discrete Inputs	(none defined; returns illegal address)
0x03	Read Holding Registers	
0x04	Read Input Registers	
0x05	Write Single Coil	
0x06	Write Single Register	SPEED_SP clamped to 0..100 on write.
0x0F	Write Multiple Coils	
0x10	Write Multiple Registers	
0x16	Mask Write Register	atomic AND/OR on holding registers
0x17	Read/Write Multiple Registers	write-then-read on holding bank
0x2B/0x0E	Read Device Identification	conformity 0x82 (basic + regular)

Function codes 0x07, 0x08, 0x0B, 0x0C and 0x11 are serial-line diagnostics and return exception **0x01 (illegal function)**. File-record (0x14/0x15) and FIFO (0x18) function codes are similarly unimplemented.

5.1 Exception codes

Code	Meaning	When the device returns it
0x01	Illegal function	FC not in the table above.
0x02	Illegal data address	Register/coil out of range, or <code>start + count > 0x10000</code> .
0x03	Illegal data value	Quantity out of range, or coil value not 0x0000 / 0xFF00.
0x04	Server device failure	Internal binding error (should not occur in normal operation).

6 Device identification (FC 0x2B / MEI 0x0E)

Read with FC 0x2B MEI type 0x0E. Conformity level **0x82** (regular, both stream and individual access supported).

Object ID	Name	Value
0x00	VendorName	Mekatora Control Systems
0x01	ProductCode	MKT-VFP-2200i
0x02	MajorMinorRevision	firmware version (set at build time)
0x03	VendorUrl	https://mekatora.com
0x04	ProductName	Raw Water Intake Pump
0x05	ModelName	Helix series (intake variant)
0x06	UserApplicationName	P-101 (device tag)

7 Operating notes

Open the suction valve fully before starting. The VFD soft-starts the motor over approximately 3 seconds; wait for DISCHARGE_P to stabilise before declaring the pump in service. With AUTO_LEVEL on, the clean-well cascade owns SPEED_SP and normally holds it between 45 and 60 %; a value written there by hand is overwritten on the next scan. Under manual control expect 60–85 % SPEED_SP. Below ~30 % the impeller may not develop enough head for downstream check valves to seat; sustained 100 % accelerates bearing wear and pushes the motor toward thermal limits.

Interlocks and hazards. Running against a closed discharge (“deadhead”) for more than ~30 seconds will overheat the casing and crack the seal; if MOTOR_T exceeds 95 °C the drive trips with FAULT_CODE = 2.

Cycling RUN_CMD faster than once per minute stresses the VFD pre-charge circuit — throttle with SPEED_SP, not with start/stop. Never run the pump dry: the mechanical seal scores within seconds.

8 Appendix A — Example transactions

The MBAP header used by every Modbus TCP frame is:

```
+-----+-----+-----+-----+-----+-----+ ... +
| TID    | PROT   | LEN    | UID| PDU
+-----+-----+-----+-----+-----+-----+ ... +
```

- TID — transaction identifier (echoed by the server).
- PROT — protocol identifier, always 0x0000 for Modbus.
- LEN — number of bytes that follow (UID + PDU).
- UID — unit identifier, echoed but not validated.

8.1 A.1 — Read FLOW (FC 04, register 4 = address 0x0003)

Request:

```
0001 0000 0006 01 04 0003 0001
\__/ \__/ \__/ \ / \ / \__/ \__/
TID  PROT LEN  UID FC start count
```

Reply (decoded as Flow = 1352 / 10 = 135.2 m³/h):

```
0001 0000 0005 01 04 02 0548
      \ / \ / \__/
      FC bc value
```

8.2 A.2 — Set SPEED_SP to 75.0 % (FC 06, register 1 = address 0x0000)

Wire value = 75.0 × 10 = 750 = 0x02EE.

Request:

```
0002 0000 0006 01 06 0000 02EE
      \ / \__/ \__/
      FC reg  value
```

Reply (FC 06 echoes the request verbatim):

```
0002 0000 0006 01 06 0000 02EE
```

8.3 A.3 — Read identification (FC 0x2B / MEI 0x0E, basic stream)

Request:

```
0003 0000 0005 01 2B 0E 01 00
      \ / \ / \ / \ / \ /
      FC MEI cat oid
```

(cat = 0x01 = basic, oid = 0x00 = start at VendorName.)

The reply enumerates objects 0x00 through 0x02; client may continue with oid = 0x03 to retrieve the regular-conformity range (0x03–0x06).

9 Appendix B — Address convention quick reference

You read in vendor doc	What goes on the wire
Coil 1 / register 1	address 0x0000
Coil 100 / register 100	address 0x0063
Register 40001 (legacy “4xxxx” notation)	address 0x0000 of the holding bank, FC 03/06/10

The Modbus PDU carries **register_number** - 1. Tools that ask for “Modbus register address” usually want the **0-based PDU value**; tools that ask for “register number” usually want the **1-based** value.