

MEKATORA CONTROL SYSTEMS

MKT-MMF-150r

Strata series

Multi-media Filter

Device tag **F-401**

Tri-media gravity filter with backwash sequencer.

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Precision Through Automation

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1 Overview

The **MKT-MMF-150r** (Strata series) is a 150 m³/h pressure filter with a tri-media bed: anthracite on top for coarse trapping, silica sand for fine filtration, and garnet at the bottom as a high-density support layer. The unit includes an air-scour-assisted backwash sequencer and differential-pressure-based clog detection.

The filter sits between the sedimentation basin and the disinfection skid. Forward flow is gravity-fed at 3 bar inlet pressure; outlet pressure drops as the bed accumulates solids and the differential pressure (DP) rises. When DP or run-time exceeds policy, an operator or supervisory controller initiates a backwash cycle.

2 Process specifications

Parameter	Value
Design flow	150 m ³ /h
Bed media (top to bottom)	Anthracite / silica sand / garnet
Inlet pressure (nominal)	3.0 bar
Clean-bed differential pressure	0.3 bar
Break-through onset DP	0.8 bar, turbidity starts passing above
Critical clog DP	2.0 bar, full break-through
DP accumulation	0.012 bar / (h x (Q/100) ²)
Turbidity reduction	outlet ~ 0.10 x inlet, floor 0.05 NTU
Designed run-length between BWs	~31 h at design flow, 48 h backstop
Backwash cycle nominal duration	8–15 min
BW valve dead-zone	0–5 % (treated as closed even with CMD ON)
BW DP decay rate	0.005 bar/s while wash active
Run-hours and hours-since-BW	32-bit counters, register-pair encoded

The DP curve during forward flow is

$$DP(t) = 0.3 + 0.012 \cdot t_{\text{since BW}} \cdot (Q/100)^2 \quad [\text{bar}]$$

with $t_{\text{since BW}}$ in hours and Q in m³/h. Backwash decreases DP linearly toward 0.3 bar.

3 Network configuration

Item	Value
IP address	172.28.0.234
Subnet	172.28.0.0/24
TCP port	502 (Modbus TCP)
Unit identifier	echoed in the response; not validated
Byte order	big-endian (Modbus standard)
Word order (u32)	high word at register N, low word at N+1

4 Register map

Modbus uses 1-based “register numbers” in narrative; the on-the-wire PDU address is **register_number** - 1. Both columns are shown. All scaled fields are signed 16-bit integers; engineering value = wire / scale.

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

Reg	Addr	Name	R/W	Description
1	0x000	BACKWASH_CMD	RW	Initiate backwash cycle. Forward flow stops while ON.
2	0x001	AUTO_BACKWASH	RW	Initiate on dP 0.8 bar or 48 h elapsed. Not on turbidity.

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	BACKWASH_VLVx10		0..1000	0..100 %	RW	Backwash inlet valve position. Active above 5 %.

4.3 Input registers (FC 04 read only)

Reg	Addr	Name	Scale	Type	Unit	Description
1	0x000	P_IN	x100	int16	bar	Inlet pressure.
2	0x001	P_OUT	x100	int16	bar	Outlet pressure (after the bed).
3	0x002	DP	x100	int16	bar	Differential pressure across the bed.
4	0x003	FLOW	x10	int16	m ³ /h	Forward flow rate (zero during BW).
5	0x004	RUN_HOURS_HI	x1	uint16	h	High word of total run-hours counter.
6	0x005	RUN_HOURS_LO	x1	uint16	h	Low word of total run-hours counter.
7	0x006	HOURS_SINCE_BW_HI		uint16	h	High word of hours-since-backwash.
8	0x007	HOURS_SINCE_BW_LO		uint16	h	Low word of hours-since-backwash.
9	0x008	TURB_OUT	x10	int16	NTU	Outlet turbidity.

To reconstruct the 32-bit counters: **run_hours** = (RUN_HOURS_HI << 16) | RUN_HOURS_LO (and likewise for HOURS_SINCE_BW).

5 Supported function codes

FC	Name	Notes
0x01	Read Coils	
0x02	Read Discrete Inputs	(none defined; returns illegal address)

FC	Name	Notes
0x03	Read Holding Registers	
0x04	Read Input Registers	
0x05	Write Single Coil	
0x06	Write Single Register	
0x0F	Write Multiple Coils	
0x10	Write Multiple Registers	
0x16	Mask Write Register	
0x17	Read/Write Multiple Registers	
0x2B/0x0E	Read Device Identification	conformity 0x82

Serial-line / file-record / FIFO function codes return exception **0x01 (illegal function)**.

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 start + count > 0x10000 .
0x03	Illegal data value	Quantity out of range, or coil value not 0x0000 / 0xFF00.
0x04	Server device failure	Internal binding error.

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

Conformity level **0x82** (regular).

Object ID	Name	Value
0x00	VendorName	Mekatora Control Systems
0x01	ProductCode	MKT-MMF-150r
0x02	MajorMinorRevision	firmware version (set at build time)
0x03	VendorUrl	https://mekatora.com
0x04	ProductName	Multi-media Filter
0x05	ModelName	Strata series
0x06	UserApplicationName	F-401 (device tag)

7 Operating notes

With **AUTO_BACKWASH** on, the sequencer initiates at **DP > 0.8 bar** or 48 h elapsed and owns both **BACKWASH_CMD** and **BACKWASH_VLV**. 0.8 bar is the point where the bed begins passing turbidity downstream, so the wash happens exactly when the filter stops doing its job, well ahead of the 1.5 bar operator warning. At design flow that works out to roughly every 31 h, which leaves the 48 h timer as a backstop for a bed that is barely being used. It deliberately does not trigger on outlet turbidity: turbidity here also carries through from upstream coagulation rather than bed loading, so a wash cannot clear that part of it.

Under manual control, trigger a backwash when **DP > 0.8 bar** or **HOURS_SINCE_BW > 48 h**, whichever comes first. The cycle: assert **BACKWASH_CMD**, drive **BACKWASH_VLV** to 70–100 %, hold for 8–15 min, then drop both back to zero. While the cycle is active, forward **FLOW** is zero — the downstream disinfection skid and clean tank lose inflow. Sequence upstream pumping accordingly.

Confirm **DP** returns to **<= 0.4 bar** before declaring the filter back in service. If a fresh filter still shows **> 0.6 bar** at design flow, suspect media compaction or air-binding; a longer-duration wash with extra air scour usually clears it.

Below 40 % BACKWASH_VLV during a wash, the bed expansion is insufficient (target is 25–35 %) and the cycle fails to clean — DP returns within hours. The actuator is electrically limited to 100 %.

Interlocks and hazards. Operating with DP > 2.0 bar compresses the bed, opens preferential flow channels, and lets unfiltered water break through. The downstream UV unit cannot compensate for high turbidity. Forgetting to clear BACKWASH_CMD after a cycle wastes treated water continuously while keeping forward flow at zero.

Reading TURB_OUT. A clean bed cannot polish below 0.05 NTU, which is the floor the model applies. With the automatic sequencer running, normal operation settles around 0.26 NTU and stays there indefinitely, because the bed is washed at the 0.8 bar break-through onset rather than being allowed to climb past it. The alarm fires above 0.5 NTU, so a reading in that band means either the bed has been left unwashed or coagulation upstream has degraded. Check DP first: if it is near the clean-bed 0.3 bar the filter is fine and the problem is upstream, and a backwash will not fix it.

8 Appendix A — Example transactions

8.1 A.1 — Read DP, FLOW and TURB_OUT in one call (FC 04)

Read 4 registers starting at address 0x0002:

```
0001 0000 0006 01 04 0002 0007
```

The reply spans DP, FLOW, RUN_HOURS_HI, RUN_HOURS_LO, HOURS_SINCE_BW_HI, HOURS_SINCE_BW_LO, TURB_OUT.

8.2 A.2 — Start a backwash sequence

Two writes; both atomic. First raise the inlet valve to 80 %:

```
0002 0000 0006 01 06 0000 0320
      \ / \_ / \_ /
      FC reg value (=80.0 %)
```

Then assert the master enable:

```
0003 0000 0006 01 05 0000 FF00
      \ / \_ / \_ /
      FC coil ON (0xFF00 = ON, 0x0000 = OFF)
```

To end the cycle reverse the order: clear BACKWASH_CMD, then drop BACKWASH_VLV to 0 %.

8.3 A.3 — Reconstruct 32-bit run-hours counter

Read four registers from address 0x0004:

```
0004 0000 0006 01 04 0004 0004
```

Reply payload:

```
... 04 08 0001 7BE5 0000 04D2
      \ / \_ / \_ / \_ / \_ /
      bc HI   LO   HI   LO
      run_hours      hours_since_BW
      =0x00017BE5    =0x000004D2
      =96741 h       =1234 h
```

9 Appendix B — Address convention quick reference

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