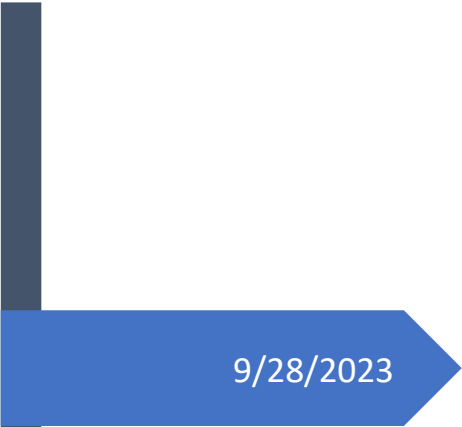


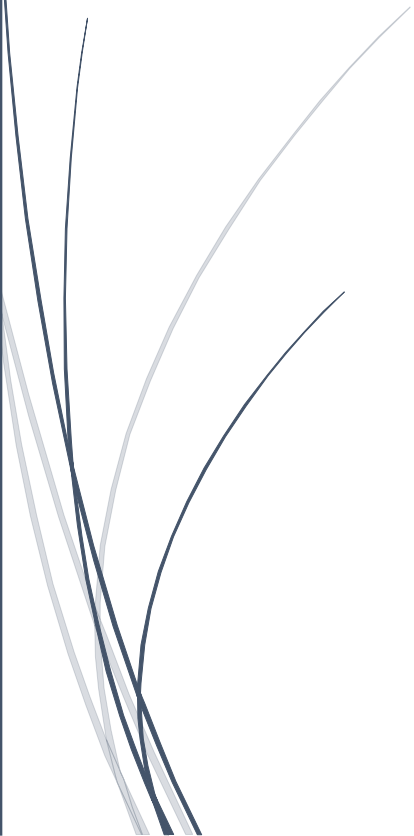
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9/28/2023

iFilter Master Controller

Integrators Guide

DRAFT

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Alex-Tronix

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1 Introduction

1.1 Intended Audience

This document covers some of the technical detail needed to implement a connection from a Third-party system.

2 Theory of Operation

2.1 Protocol Documentation

The provided RS-485 interface supports a subset of the ModBus™ legacy serial protocol. The iFilter Master Controller is a “Slave” device and will only respond to specific requests.

**Upon Reset Alex-Tronix iFilter Master equipped controllers default to an I.D. of 42
Serial settings are fixed at 9600 baud, 8 data bits, No Parity, and 1 Stop Bit. (9600, 8-N-1)**

2.2 What starts a Backwash

Backwash cycle requires:

- Backwash Time must be non-zero
- At least one assigned tank

Either of the following may trigger a cycle:

- Periodic Time
- Pressure Differential (Sensor or PD Dry Contact)

2.2.1 Prerequisites

2.2.2 Automatic (Internal)

2.2.3 Manual

Any of the following may trigger a cycle:

- Pressed “Manual Start” in “Status” function
- Remote “Start” command over serial protocol
- Momentary contact of the EXT START terminals (if supported)

3 Registers (aka Holding Registers)

Registers may be read with (ModBus™ FC=0x03 READ MULTIPLE HOLDING REGISTERS) and/or written to one at a time (FC=0x06 WRITE SINGLE REGISTER).

Please Note: Registers are listed in numerical register order. Please refer to the Table of contents to find a specific register

3.1 User Configuration Registers (0x0F00-0C)

These registers directly reflect and update all the user configurable “functions” that a user may adjust directly on the iFilter Master Controller. Registers are transmitted as a 16-bit binary values (see protocol documentation). Functions that use fractional decimal values are represented in countable increments of *unit* values. For example, Pressure Differential Setting uses 0.2 psi units so 7.4 psi is represented by the decimal value of:

$$7.4 \frac{\text{psi} * 1 \text{ count}}{0.2 \text{ psi}} = 37 \text{ (aka 0x25, 0b00100101) within the protocol}$$

Every user configurable “function” has a minimum and maximum value. Some registers are further limited to a small set of values. Any attempt to write an invalid value will result in the protocol error VALUE_ERROR.

3.1.1 Pressure Differential Setting (0x0F00)

The trigger point for the “P.D. GAUGE” sensor. This value is only effective when “SENSOR/GAUGE TYPE” (Sect. 3.1.9) is set to “SENSOR”.

Pressure Differential Setting (0x0F00)	decimal	hexadecimal	Units (0.2 psi)
Minimum	5	0x05	1.0 psi
Maximum	150	0x96	30.0 psi
Default	35	0x23	7.0 psi
Example	37	0x25	7.4 psi

3.1.2 Pre-Dwell Time (0x0F01)

The delay time, in seconds, between activating the pressure sustaining master value and the starting backwash tank. Used on systems with smaller pumps to ensure valves open and close.

Please Note: Registers are stored in different binary representation and will rendered differently on the iFilter Master Controller. For example: 255 seconds of pre-dwell may show as

Pre-Dwell Time (0x0F01)	decimal	hexadecimal	M:SS (seconds)
Minimum	0	0x00	0:00 (0 seconds)
Maximum	255	0xFF	4:15 (255 seconds)
Default	0	0x00	0:00 (0 seconds)
Example	60	0x3C	1:00 (60 seconds)

3.1.3 Dwell Time (0x0F02)

The delay time, in seconds, between backwash tanks.

Similar to Pre-Dwell Time, may allow pressure to build to allow adequate cleaning on the next tank, used to ensure valves finish closing. A setting of zero disables the dwell feature and each tank backwashes, one right after another

Dwell Time (0x0F02)	decimal	hexadecimal	M:SS (seconds)
Minimum	0	0x00	Dwell not used
Maximum	99	0x63	1:39 (99 seconds)
Default	0	0x00	Dwell not used
Example	60	0x3C	1:00 (60 seconds)

3.1.4 Periodic Time (0x0F03-5)

This is a composite function across 3 register: Days (0x0F03), Hours (0x0F04), Minutes (0x0F05)

- While powered, triggers backwash at least this often.
- Countdown time is only counted when iFilter Master Controller is powered.
- Countdown resets after every backwash.

All Zeros disables Timer, (Backwash only on Pressure trigger and manual start)

Periodic Time (0x0F03-5)	D, H, M	Hexadecimal D, H, M	DD:HH:MM
Minimum	0, 0, 0	0, 0, 0	Disabled
Maximum	30, 23, 59	0x1e, 0x17, 0x3B	30:23:59
Default	0, 0, 0	0, 0, 0	Disabled
Example	7,4,0	0x07, 0x04, 0	4:00:00 every 7 days powered

3.1.5 Pressure Differential Delay (0x0F06)

The grace period in seconds directly after a backwash cycle. The pressure triggers are ignored until the time is up. After the 3rd consecutive trigger of the backwash the ALARM condition will trigger.

PD Delay (0x0F06)	decimal	hexadecimal	M:SS (seconds)
Minimum	0	0x00	Dwell not used
Maximum	255	0xFF	(255 seconds)
Default	0	0x00	Dwell not used
Example	60	0x3C	1:00 (60 seconds)

3.1.6 Tank Assign (0x0F07-8)

This is a bit mapped Register. Each binary bit in each of the two 16-bit registers Enable (1) or Disable (0) a single backwash tank. The bit mapping is organized Tank #1 thru #16 is enabled by LSb thru MSb on 0x0F07 and tanks #17 thru #32 are on 0x0F08. Both registers are still implemented on iFilter Master Controllers that don't support it. Assign all non-existing task as Disabled (0).

Register	Bit<7>	Bit<6>	Bit<5>	Bit<4>	Bit<3>	Bit<2>	Bit<1>	Bit<0>
0x0F07	Station 8	Station 7	Station 6	Station 5	Station 4	Station 3	Station 2	Station 1
0x0F08	Station 24	Station 23	Station 22	Station 21	Station 20	Station 19	Station 18	Station 17
Register	Bit<15>	Bit<14>	Bit<13>	Bit<12>	Bit<11>	Bit<10>	Bit<9>	Bit<8>
0x0F07	Station 16	Station 15	Station 14	Station 13	Station 12	Station 11	Station 10	Station 9
0x0F08	Station 32	Station 31	Station 30	Station 29	Station 28	Station 27	Station 26	Station 25

3.1.7 Backwash Tank Sequence (0x0F09)

Backwash Tank Sequence (0x0F09)	Value	Hexadecimal	
default	1	0x01	Sequential
	2	0x02	Progressive

3.1.7.1 Sequential (Value 1)

Start each backwash with Lowest Numbered Tank Assigned Every Time.

3.1.7.2 Progressive (Value 2)

Start each backwash on the next Numbered Tank finishing the cycle on remaining assigned tanks.

example: {1-8}, {2-8,1}, {3-8,1,2}, {4-8,1-3}, {5-8,1-4}, {6-8,1-5}, {7,8,1-6}, {8,1-7}, {1-8}, ...

3.1.8 Solenoid Type (0x0FOA)

iFilter Master Controllers support 3 output modes, AC, DC Non-Latching, DC Latching. iFilter Master Controller output voltages of 24 VAC or 12 VDC are only manually selectable in field via a two-position switch on the read of the control panel.

Solenoid Type	CAUTION: Incorrect power to a Solenoid/Relay may result in damage or fire. This setting is normally only used as part of the installation process or after a unit reset.		
	2	0x02	Latching

3.1.8.1 Non-Latching (value 1)

Every Active Output is Powered continuously while Active.

3.1.8.2 Latching (value 2)

Outputs are powered momentarily to drive an Output-Device (Latching Solenoid/Relay). Power is applied to Activate and to Deactivate Output-Device.

3.1.9 Sensor Type (0x0FOB)

Sensor Type (0x0FOB)	Value	Hexadecimal	
default	1	0x01	SENSOR
	2	0x02	P.D. GAUGE

3.1.9.1 Alex-Tronix Pressure Sensor or "SENSOR" (value 1)

Configures the iFilter Master Controller to use an Alex-Tronix Pressure Sensor. This pressure sensor is a prerequisite to remote pressure digital measurement and Pressure Differential Setting (0x0F00).

3.1.9.2 Differential Pressure Switch Gauge or "P.D. GAUGE" (value 2)

Configures the iFilter Master Controller to use a normally open (N.O), dry contact, pressure switch input. The physical setting of the pressure switch dictates operation and cannot be measured or set remotely.

3.1.10 Backwash Time (0x0FOC)

The cleaning time, in seconds, spent on each filter tank.

Dwell Time (0x0F02)	decimal	hexadecimal	M:SS (seconds)
Minimum	0	0	controller disabled
Maximum	5999	0x176F	99:59 (5999 seconds)
Default	0	0	controller disabled
Example	60	0x3C	1:00 (60 seconds)

3.2 Command/Control Registers (0x1F02-06)

This block of “holding registers” trigger the enumerated command when a Write operation. It is recommended to write a value of (0x0001) to when triggering a command

3.2.1 Reset Cycle Count to Zero (0x1F02)

3.2.2 Clear Alarm (0x1F03)

This is equivalent to clearing the alarm condition on the iFilter Master Controller. If the condition that triggered the alarm is still present the Alarm condition will trigger again.

3.2.3 Start Cycle (0x1F04)

Start a Backwash cycle if and only if currently “Filtering”. The command is different from the Start/Advance button and will only Start a backwash and will not advance, restart, or end a backwash cycle. This prevents an Out of Sequence network communication from triggering an unexpected outcome.

3.2.4 Advance Cycle (0x1F05)

Advance a Backwash cycle to the next Tank or complete the cycle if and only if currently “Backwashing”. The command is different from the Start/Advance button and will only Advance or End and will not start backwash cycle.

3.2.5 End Cycle (0x1F06)

Ends current backwash cycle immediately. Will not prevent a restart if the conditions that triggered the backwash are still present.

3.3 Status Registers (0x5F00-05)

This block of “holding registers” only report that status of the iFilter Master Controller and are read-only.

3.3.1 Status Code (0x5F00)

Status Code (0x5F00)	Value	Hexadecimal	
	1	0x01	Filtering
	2	0x02	Filtering with PD Delay
	3	0x03	Pre-Dwell
	4	0x04	Backwash
	5	0x05	Dwell

3.3.2 Backwash Tank (0x5F01)

The number of the tank currently in backwash, otherwise 0, if not backwashing

3.3.3 Cycle Count (0x5F02)

A Simple Counter, matches counter accessible from iFilter Master Controller Interface

3.3.4 Differential Pressure (0x5F03)

Reported in 0.1 psi units.

Prerequisites:

- Alex-Tronix Pressure Sensor Installed
- “SENSOR/GAUGE TYPE” is set to “SENSOR”.

3.3.5 Alarm (0x5F04)

Absence of Alarm does not guaranty an absence of problems. Alarm condition only indicates an unresolved issue with a high differential pressure condition. Three failed attempts to backwash clear a high differential pressure condition will set the Alarm. Alarm will not clear automatically and may reset from the status function physically at the iFilter Master Controller or via remote command Clear Alarm (0x1F03)

Alarm (0x5F04)	Value	Hexadecimal	
	1	0x01	No Alarm
	2	0x02	Alarm

3.3.6 Output Fuse (0x5F05)

This Register Indicates a separate but related condition to the light that activates when the output fuse is open. The light is clear and immediate indication of an open fuse. The iFilter Master Controller checks the fuse only after an output was energized.

To avoid a false sense of success the open/blown condition is only cleared when the output that triggered the problem is energized again without issue. Unassigning the offending Tank may allow the iFilter Master Controller to function after replacing the output fuse, but the open/blown condition will remain.

Clearing an open/blown condition:

- All short circuits across any output terminals must be fixed.
- Any unassigned tanks must be assigned again.
- Finally start a backwash cycle run again to clear the condition.

Output Fuse (0x5F05)	Value	Hexadecimal	
	1	0x01	No Alarm
	2	0x02	Alarm

3.4 iFilter Master Controller Identification (0xA100-3F)

These are blocks of 16-bit registers with up to 32 bytes of NUL terminated utf-8 text encoding. The characters are packed in Network byte order (Big-Endian). The intent of this function use is to attempt a Multiple Register Read (FC=0x03) to the verify Identity of responding address as an Alex-Tronix iFilter Master Controller. Each block may be read completely, in-part, or all together as with a single Multiple Register Read. Some Blocks may return an optional 2nd Line. The optional 2nd Line will be prefixed with a Line Feed (0x10) to separate it from the first

3.4.1 Vendor Name¹ (0xA100-F)

Alex-Tronix iFilter Master Controllers will Report:

3.4.2 Model¹ (0xA110-F)

Example Models:

- FM-4
- FM-8
- FM-12
- FM-16
- FM-32

3.4.3 Firmware¹² (0xA120-F)

Firmware (may be of the form):

- v1.001 [LF]
rev: a1a1a1
- v1.123abc
- v0.2z

3.4.4 Serial Number¹ (0xA130-F)

Serial-Number may not be supported and may return a placeholder or may return an internal component identifier and not the Alex-Tronix iFilter Master Controller's Serial Number

3.5 iFilter Master Controller Extras(0xA1F0)

3.5.1 Backwash Tanks (0xA1F0)

The maximum number of Tanks supported by the iFilter Master Controller.

3.5.1Backwash Tanks (0xA1F0)	Value	Hexadecimal
FM-4	4	0x04
FM-8	8	0x08
FM-12	12	0x0C
FM-16	16	0x10
FM-32	32	0x20

¹ May return with Optional 2nd Line

² Formatting of result may be significantly different.

4 Electrical Connections

The subset of the Modbus™ protocol is provided over an RS-485 interface.

Please review the installation documentation for each specific model. Included is an abridged version

4.1 Alex-Tronix FM-4, FM-8

4.1.1 Wiring

The RS-485 conductor pair should be connected to the respective A+ and B- terminals on the back of the FM control panel. 12 volts DC (11 to 17 range depending on installation) up to 250 ma max is available for operating a communications accessory such as a modbus serial to LAN, WAN, or data isolator module. Please consult Alex-Tronix about your specific requirements.