PIGEON PLEX

Finch

User Manual

Revision Control

Version	Description	Name	Date

Index

Overview

Finch is an IOT (Internet of Things) gateway able to communicate over user configurable connections such as 4G/LTE, Wi-Fi and Bluetooth

The device comes standard with one RS485 port with the ability to communicate over a range of different communication protocols. These protocols include but are not limited to the following:

- Modbus Client
- Modbus Server
- Modbus Passive Listener
- DLMS (Device Language Message Specification)
- The small footprint of the Finch and in meter mounting capabilities makes it ideal for large scale applications as well as monitoring of outlying meters. All user configured parameters are stored in flash memory

General Applications

Some use cases for the Finch include the following:

- **Remote Metering**: The IoT device can be used in utility metering applications to collect data from gas, water, or electricity meters, enabling remote meter reading and billing.
- **Remote Asset Monitoring:** The device can be deployed in remote locations to monitor the condition and performance of critical assets like pipelines, remote machinery, or unmanned stations. This can help with predictive maintenance and reducing downtime.
- **Energy Management:** By connecting the IoT device to energy meters or smart plugs, it can help monitor energy consumption in homes, offices, or factories. The data can be analyzed to identify energy-saving opportunities and optimize energy usage.

These are just a few examples, and the versatility of Finch opens numerous possibilities for various industrial and commercial applications.

Digital Twin Eco-system

Part Numbering

Powering Device

Max 4.2V typical 4.2V 2A peak

IO

The RS485 port is not optically isolated, a dedicated ground connection is recommended for each bus connection.

Technical Overview

Register Table

A common register table is used to provide a flexible modular product that is easily adapted to each use case. The diagram below shows the register table positioned as the central repository for data – all operations read from this table and write the result to the table. The table definition details each register and is divided into user and system areas. These are further divided into volatile, flash values, flash for values that are loaded at boot and will not change – for example, a setpoint where the default value always starts at a known value. Eeram is used for values that change and must be retained during power fail – examples are runtime, pulse count or a setpoint that must remember its last value.

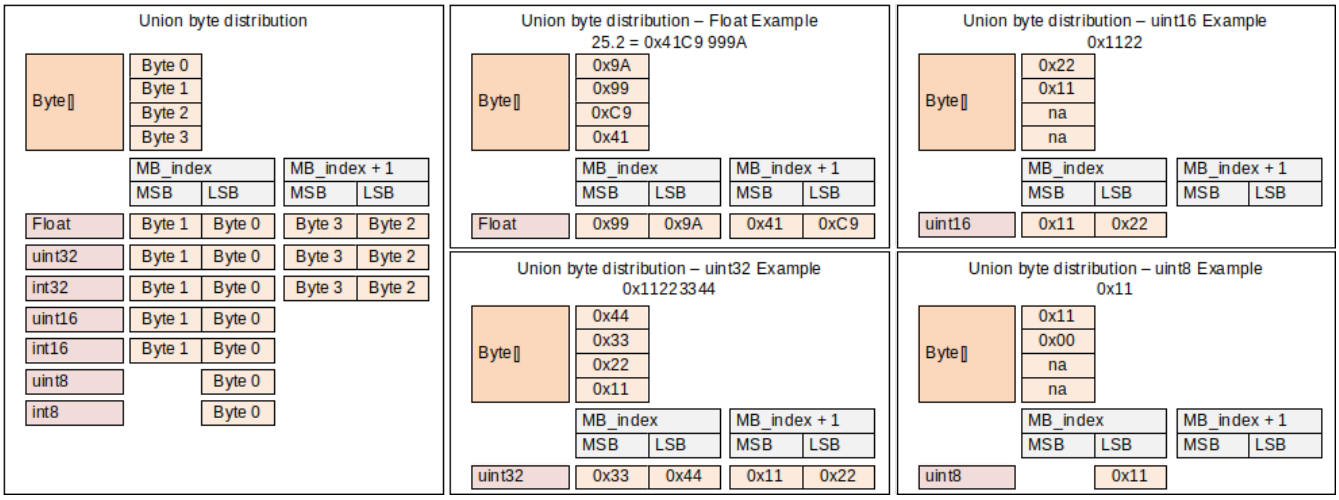
Data Types

The register table is made up of 16-bit registers. The following data types are supported by using 16-bit registers as a base.

Data Type	Data Type Enum	Number of Registers	Note
uint8	1	1	0 to 255
uint16	2	1	0 to 65 535
uint32	3	2	0 to 4 294 967 295
int8	4	1	-127 to +127
int16	5	1	-32 767 to +32 767
int32	6	2	-2 147 483 647 to + 2 147 483 647
float	7	2	-3.4E+38 to +3.4E+38. Little Endian byte swap

Remember to allocate the correct number of registers when creating the Index. If a data type uses 2 registers, then allocate register x for the data type and register x+2 for the next.

The format is Little Endian Byte Swap. As an example, the float value of 25.2 (0x41C9 999A) is written as 0x999A 0x41C9. The words are from lowest Modbus index to Highest Modbus index and the word sequence is MSB LSB.



When writing to registers where the value exceeds the max value of a data type, the results will be as follows.

Example write value 300 to an uint8. The result will be 44. This is explained by looking at the bytes

300 in decimal = 0x12C in hex. If we look at the size of an uint8 it is 1 byte. take the 0x2C and convert to decimal. The result was 44. This means that type casting shows the bytes available in the registers at the correct byte position and does not do range checking.

Register Table - Logical Areas

The register table is divided into user and system logical areas. Each area is further divided by memory type into volatile and nonvolatile with non-volatile divided into flash and EERAM.

Each register is 16 bits and can be assigned a data type to identify how it is represented. Each register therefore has 2 tables, the register table, and the register type table.

Register Section	Note	Address from	Address to
Volatile user	Use for variables display variables such as IO	0	149
Non-Volatile user Flash	Use for variables display variables such as setpoints. These values are read from Flash on restart and NOT written to flash on change. This allows for default values. If the value is to be saved on write, then use EERAM.	150	199
Non-Volatile user EERAM	Use for changing variables such as counters and runtime. These values are not saved in flash so have no initialization. Can be initialized via file and will retain last value between power cycles.	200	249
Volatile system	Predefined use. Refer to User Selected System Values.	250	299
Non-Volatile system Flash	Predefined use. Refer to User Selected System Values. Flash	300	349
Non-Volatile system EERAM	Predefined use. Refer to User Selected System Values. EERAM	350	397
Special Registers	Reboot – Write 0x55AA. Not written to NV	398	
	Factory Reset – Write 0x1928. Not written to NV	399	
Non-Volatile String value registers	Used to store string values	400	420

Note – Control blocks can write to any Non-Volatile register. Any write from a control block to Flash or EERAM space does not initiate a write to either Flash or EERAM – this allows registers in this space to be used as scratch registers. Ensure that registers are not double allocated.

SPIFFS FILING SYSTEM

A filing system to store non-volatile data – SPIFFS is an acronym for Serial Peripheral Interface Flash File System. The filing system contains ASCII text files to save the various user defined options. SPIFFS is not a memory type – it is a file system.

The files are used for configuration, default values, personalities, and control loops. Each file has a defined format and syntax and is described in the relevant sections.

The register table has a user and a system section. The user values hold registers that need to maintain the values between power cycles can be seen as the fallback values. The system section holds the configuration of the display such as baud rates, address etc. Refer to the detailed **Register Table.**

Non-Volatile section of the register table will be written on change according to the following rules.

When a change is detected a 30 second timer is set.

The timer will be reset each time there is a change.

Continual requests shorter than 30 seconds will prevent NVR (Non-Volatile Registers) write until there is more than a 30 second gap between consecutive writes.

After the 30 second timer, the obj_mb_nvr.txt SPIFFS file will be written.

DO NOT continually write to Non-Volatile addresses. Only use this area to hold setpoints or values that are expected to be retained between reboots. If a setpoint is written from a controller where the value is not expected to be retained between power cycles, then use the Volatile address space. 30 second write cycle equates to a minimum flash life of 30 years.

The files are loaded using edgeUP-App or a 3rd party serial port utility – edgeUP-App is recommended for reliable trouble-free filing.

EERAM

Memory that retains data values after power cycle or power fail. EERAM user section holds user non-volatile values where a pre-determined fallback value is not required. EERAM system holds runtime and pulse counts.

EERAM Rules

User values are saved when changed (either comms or console).

System values are saved on change every second. If there is no change, no registers are saved.

FLASH

Memory that retains data values after power cycle or power fail. These registers are read from a text file on SPIFFS. Flash registers are read after power cycle or reboot.

When a write is received in the user or system section of flash, it must be written to SPIFFS if the value is to become nonvolatile. This is done by using the write configuration register.

LED indicator Definitions

The Finch is equipped with 4 application controlled LED indicators:

1. **Power**
   - Solid LED indicator - The device is powered up.
2. **Status**
   - 1 second pulse - The device firmware application is running.
3. **Network**
   - 1 second pulse – The device is connected to a network & has a valid internet connection.
   - 2 second pulse – The device is connected to a network but with no internet connection.
4. **Bus**
   - 1 second pulse – The device has received valid packets (MODBUS or DLMS) from a server device.

Console

A text console for direct basic commands is available on the USB port. The command echo is on meaning the character typed is echoed back. If a command is not completed, the console will time out after 5 seconds. To check if the console is connected, press enter – reply will be error if USB connected and device communicating. The console commands are used to communicate with the Engineers Tool.

By default, the console is locked and requires the "password" command to unlock it. The device comes with a default password, which can be changed; however, if the password is changed, there is no "forgot password" functionality, and the device will be locked out if the new password is forgotten. In the locked state, the console displays basic logs but no configuration changes can be made. Once unlocked, configurations can be set, and additional logs will be shown. For safety, the console automatically locks after 300 seconds, requiring it to be unlocked again for further configuration. Passwords are always case sensitive.

Command	Description
psw:<Password>	**Unlock console - default password is "finch" + last 4 characters of the MAC case sensitive** **Example: If MAC = "xx xx xx xx B3 F5" password is "finchB3F5"**
psw-set:<New password>	**Set new password - Warning if new password is forgotten there is no forgot password functionality**
?	Help – prints out the list of commands
dir	Lists the SPIFFS directory files
log	Set the USB log verbosity
printn	Print file contents with no line number – then the file index as listed by the SPIFFS directory
printl	Print file contents with line number – then the file index as listed by the SPIFFS directory
reboot	Reboot the device
writet	Write a text file - replies ok. Send the file name followed by each text line, all lines are Ack'd (0x06).
info	Product Family model, firmware version, serial number,
format	Format SPIFFS
rit	Register index type. Used to set the data type of the register. rit index type Example, set the type of register index 20 to float: rit 20 7
riv	Register index value. Used to set the data value of a register. riv index value Example, set the value of register index 20 to 12,5: riv 20 12,7
rir	Register index read. Used to read the type and value of a register index. rir index
ris	Register index string. Used to write string values to special registers, ris index, (String value) Example, set the Wi-Fi SSID to "Test Wi-Fi": ris 401,Test Wi-Fi The command is followed by a space, then the special register address, then delimited by a comma ',' and finally the string value to store. String will be stored up to the termination character
pd	This will return a print-out of the directory of the file system.
pf:<file name>↵	This will print the contents of the file with the name
rf:<file name>↵	Remove a file with the name
nf:<file name>|<file contents>↵	Create/Replace a file with the name containing
mb-print-points:Portx	Prints all the read points and associated data to console.
dlms-print-points:Portx	Prints all the read points and associated data to console.
dlms-history	Print dlms history
modbus-write: port, address, register address, register type,value	Used to write to a single Modbus register of a connected device (only works if finch is set up as a client)
modbus-write-multi: port, address, register address, num registers, register type,value	Used to write to multiple registers in order of a connected device (only works if finchis set up as a client)

User Selected System Values

File obj_mb_nvr.txt

User defined system values and registers that must retain their value after power cycle (e.g., Port one board rate) are defined in the obj_mb_nvr.txt file. Registers 300 to 349 are fixed and cannot be used for user defined values. Registers 300 to 349 are saved in SPIFFS. Registers 150 to 199 are for user defined values. The structure of obj_mb_nvr.txt must not be changed. The line sequence must be as per the template.

After updating registers in the non-volatile flash memory space, a timer is started. The register is only stored 30 seconds after it has been updated

Register	Type	Enum	Notes
300/301	uint32	3	Port 1 Baud Rate. Default: 9600. Valid Baud rate supported: 4800, 9600, 19200, 38400, 57600, 76800, 115200
302	uint8	1	Port 1 Parity, Default: None. Valid Parity supported: 0 (None), 1 (Odd), 2 (Even)
303	uint8	1	Port 1 Stop Bits, Default: 1, Valid Stop bits supported: 1 (1 stop bit), 2 (2 stop bits)
304	uint8	1	Port 1 Data Bits, Default 8, Valid data bits: 5, 6, 7, 8
305	uint8	1	Port 1 Address. Default 1. Options between 1 and 255. Values outside this range will not be accepted. Not used in modbus Client mode.
306	uint8	1	Port 1 Type, Default 0 (Disabled). Supported types: 0: Disabled, 1: Modbus Client, 2: Modbus Server,3: Modbus Listener, 4: DLMS Client
307/308	uint32	3	Port 2 Baud Rate. Default: 9600. Valid Baud rate supported: 4800, 9600, 19200, 38400, 57600, 76800, 115200
309	uint8	1	Port 2 Parity, Default: None. Valid Parity supported: 0 (None), 1 (Odd), 2 (Even)
310	uint8	1	Port 2 Stop Bits, Default: 1, Valid Stop bits supported: 1 (1 stop bit), 2 (2 stop bits)
311	uint8	1	Port 2 Data Bits, Default 8, Valid data bits: 5, 6, 7, 8
312	uint8	1	Port 2 Address. Default 1. Options between 1 and 255. Values outside this range will not be accepted. Not used in modbus Client mode.
313	uint8	1	Port 2 Type, Default 0 (Disabled). Supported types: 0: Disabled, 1: Modbus Client, 2: Modbus Server,3: Modbus Listener, 4: DLMS Client
314			SIM info update interval in minutes
315			Spare
316	uint16	2	Log verbosity. Refer to log verbosity
317	uint16	2	System network mode. Refer to system network mode
327	Uint16	2	
328	Uint16		spare
329	Uint16		spare
330	uint16	2	UO port 1 configuration bits/flags - see UO flag bitmask definitions
331	uint16	2	UO port 2 configuration bits/flags - see UO flag bitmask definitions
332	uint16	2	MQTT (Message Queuing Telemetry Transport) – ping interval
333	uint16	2	MQTT – Device settings update interval
334	uint16	2	MQTT – Device location update interval
339	uint16	2	MQTT – Modbus data update interval
340	uint16	2	MQTT – Modbus settings update interval
341	uint16	2	MQTT – DLMS point update interval
342	uint16	2	MQTT – DLMS object update interval (Not used for now)
343	uint16	2	MQTT – DLMS settings update interval (Not used for now)
344/345	uint32	3	MQTT – log date update interval
346	uint16	2	System enable mask
347	uint16	2	Daily reboot interval

User Selected Text Values

User defined text values and registers that must retain their value after power cycle (e.g., Wi-Fi SSID). Each value is then stored in its own discrete text file:

The register ranges from 400 onwards and are defined in the table below:

Register	Description
401	Wi-Fi SSID – stored in SSID.txt
402	Wi-Fi Password – stored in wifi_pass.txt

403	OTA (Over the Air) server URL address store – stored in OTA_url.txt
404	PPPOS APN store
405	MQTT URL – stored in mqtt_url.txt
406	MQTT Username – stored in mqtt_username.txt
407	MQTT password – stored in mqtt_password.txt
408	MQTT client – stored in mqtt_client.txt
499	RTC manually set time (Only available when device is not connected to internet access)

To write to one of the text registers use the register index string “ris” command.

Example, set the Wi-Fi SSID to “Test Wi-Fi”: ris 401,Test Wi-Fi

The command is followed by a space, then the special register address, then delimited by a comma ‘,” and finally the string value to store. String will be stored up to the termination character

To read a specific value, firstly use the ‘dir’ command to get the file directory and each file’s index. Afterwards use the ‘printn’ or ‘printl’ then the file index as listed by the SPIFFS directory of the associated file to read the file context.

System network mode

System network modes are set by writing to the non-volatile register 317. The register determines the network modes by using the following bitmask in the register, with each bit representing an enable (1) or disable (0) state.

The bitmask for the system network mode is described as the following

Bit 16	**Bit 15**	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Bluetooth server enable

Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
Reserved	Reserved	Reserved	Reserved	Reserved	Ethernet TCP/IP enable	Mobile Data enable	Wi-Fi enable

Wi-Fi

To connect to a Wi-Fi network, attach a Wi-Fi Antenna (2.4GHz) to the designated UFL receptacle labled Wi-Fi, then set the System mode register (311) to enable Wi-Fi (Set bit 1 high). riv 317 1

The device’s Wi-Fi will then try to connect to the SSID stored in the text register 401 with the passkey stored in text register 402.

Register	**Description**
401	Wi-Fi SSID – stored in SSID.txt
402	Wi-Fi Password – stored in wifi_pass.txt

Example

In this example we will set the network mode to Wi-Fi only. Then set the SSID to myWIFI and the passkey to myPasskey:

riv 317 1

ris 401,myWIFI

ris 402,myPasskey

Mobile

To connect to a mobile LTE network, first insert a SIM card into the internal sim tray on the LTE module card and connect an appropriate LTE antenna to the UFL receptacle labelled Mobile. Afterwards set the System mode register (317) to enable Mobile (Set bit 2 high). riv 317 2

The device will then start up the LTE modem and connect to an LTE network on the next boot after the config has been set for mobile.

If the SIM inserted requires a specific APN it can be specified in register 404.

Register	Description
404	PPPOS APN store

Ethernet

To connect the device to an ethernet network for the intention of using ethernet as a data connection, firstly insert the ethernet cable into the RJ45 connector, followed by setting the System mode register (317) to enable Ethernet (Set bit 3 high). riv 317 4

Ethernet will then Connect to a DHCP enabled network. Currently only DHCP enabled networks are supported, additional Ethernet features in development.

System specific modes

System daily reboot

To enable daily reboot on the Finch, set bit 0 of the bitmask in register “System enable mask” (346) to 1.

Afterwards the system will reboot after the daily reboot interval has elapsed. The daily reboot interval is stored in register “Daily reboot interval” (347). The interval is stored in minutes and can be changed to the user’s desire. The default interval is 1440 minutes, or 24 hours.

To enable specific time daily reboot on the Finch, set bit 0 of the bitmask in register “System enable mask” (346) to 2.

Afterwards the system will reboot after the daily reboot interval time starting from 12am as 0 . The daily reboot interval is stored in register “Daily reboot interval” (347). The interval is stored in minutes and can be changed to the user’s desire. The default interval is 1440 minutes, or 12:00 at night.

BLE Server

Creates a BLE server that a device can connect to, with bi-directional comms.

The GAP device name is set to: PP_xx_xx_ xx_ xx_ xx_ xx. XX represents the device’s mac address in Hex.

Example:

To enable the BLE server write to register 317 with the value 256: riv 317 256

To enable both the BLE Server and Wi-Fi write a value of 257 to register 311: riv 317 257

To enable both the BLE Server and Mobile network write a value of 258 to register 317: riv 317 258

MQTT

MQTT is an OASIS standard messaging protocol for the Internet of Things (IoT). It is designed as an extremely lightweight publish/subscribe messaging transport that is ideal for connecting remote devices with a small code footprint and minimal network bandwidth.

To set up the MQTT functionality of the Finch, the device should first be connected to a network source. The Finch can connect to Mobile networks through an LTE data connection or to IP (Internet Protocol) network through Wi-Fi or ethernet.

The birds transmit JSON strings to a user defined MQTT broker client through a data connection, either WIFI, LTE/4G or ethernet. The Finch publishes information to the “data” topic and subscribes to the “commands” topic. The birds are differentiated by their ICCIDs on the MQTT broker, i.e. *ICCID/data* (*A4E57C764FA0/data*) or *ICCID/commands* (*A4E57C764FA0/commands*).

Only after the device’s network interface is configured will the device try and connect to a MQTT broker. The MQTT broker’s config can be set with the following text registers:

Register	**Description**
405	MQTT URL – stored in mqtt_url.txt
406	MQTT Username – stored in mqtt_username.txt
407	MQTT password – stored in mqtt_password.txt
408	MQTT client – stored in mqtt_client.txt

The timeouts (In number of minutes are stored in the registers described below. For example, if we want the device to send a device settings log message every hour, we will set register 333 to 60. The console command to set register 333 to 60 will be: riv 333 60

Register	Type	Enum	Description
333	uint16	2	MQTT – Device settings update interval
334	uint16	2	MQTT – Device location update interval
335	uint16	2	MQTT – Input data update interval
336	uint16	2	MQTT – Input settings update interval
337	uint16	2	MQTT – Output data update interval
338	uint16	2	MQTT – Output settings update interval
339	uint16	2	MQTT – Modbus data update interval

340	uint16	2	MQTT – Modbus settings update interval
341	uint16	2	MQTT – DLMS point update interval
342	uint16	2	MQTT – DLMS object update interval (Not used for now)
343	uint16	2	MQTT – DLMS settings update interval (Not used for now)
344	uint32	3	MQTT – log date update interval

Input and output in the table above refers to the two integrated inputs and two integrated digital outputs of the device.

Log Verbosity

Use the console log command to change the log output level to the console.

Value	Description
0	None
1	Error
2	Warning
3	Info (default prior to reading mb_nvr settings)
4	Debug
5	Verbose

Console Errors

dir / format

Error Value	Description
0	No Error
1	SPIFFS get file list error or format error

Log

Error Value	Description
0	No error
1	Length exceeded
2	Undefined mb type
3	No string null terminator
4	Not a number

printn / printl

Error Value	Description
0	No error
1	File at index given not found
2	
3	
4	NSPIFFS index read error
5	No file at SPIFFS index
6	Unable to read file for print
7	No CR or max line length exceeded

writet

Error Value	Description

0	No error
>0 <0xFC	File append error in line number shown Or SPIFFS file name not found if parsing file
0xFC	File name error
0xFD	File open error
0xFE	Could not mount SPIFFS
0xFF	SPIFFS locked

Modbus

The Finch has two dedicated RS485 Ports that can be configured for various communication protocols. One such protocol that is supported is Modbus. Each port can be independently configured as a modbus Client, Server or Passive Listener.

Configuration for modbus client / server can be done by writing to the following configuration registers in the registry table:

Port 1

Register	Type	Enum	Notes
300/301	uint32	3	Port 1 Baud Rate. Default: 9600. Valid Baud rate supported: 4800, 9600, 19200, 38400, 57600, 76800, 115200
302	uint8	1	Port 1 Parity, Default: None. Valid Parity supported: 0 (None), 1 (Odd), 2 (Even)
303	uint8	1	Port 1 Stop Bits, Default: 1, Valid Stop bits supported: 1 (1 stop bit), 2 (2 stop bits)
304	uint8	1	Port 1 Data Bits, Default 8, Valid data bits: 5, 6, 7, 8
305	uint8	1	Port 1 Address. Default 1. Options between 1 and 255. Values outside this range will not be accepted. Not used in modbus Client mode.
306	uint8	1	Port 1 Type, Default 0 (Disabled). Supported types: 0: Disabled, 1: Modbus Client, 2: Modbus Server,3: Modbus Listener, 4: DLMS Client

Port 2

Register	Type	Enum	Notes
307/308	uint32	3	Port 2 Baud Rate. Default: 9600. Valid Baud rate supported: 4800, 9600, 19200, 38400, 57600, 76800, 115200
309	uint8	1	Port 2 Parity, Default: None. Valid Parity supported: 0 (None), 1 (Odd), 2 (Even)
310	uint8	1	Port 2 Stop Bits, Default: 1, Valid Stop bits supported: 1 (1 stop bit), 2 (2 stop bits)
311	uint8	1	Port 2 Data Bits, Default 8, Valid data bits: 5, 6, 7, 8
312	uint8	1	Port 2 Address. Default 1. Options between 1 and 255. Values outside this range will not be accepted. Not used in modbus Client mode.
313	uint8	1	Port 2 Type, Default 0 (Disabled). Supported types: 0: Disabled, 1: Modbus Client, 2: Modbus Server,3: Modbus Listener, 4: DLMS Client

Modbus Server

The two RS485 ports on the Finch can be configured to independently operate in a modbus server mode. Using the above Registry table settings for Port 1 respectively.

Example

To setup Port 1 as a modbus server with address 25 (0x19), at baud 115200, no parity, 1 stop bit, 8 data bits. Issue the following commands on the console:

riv 300 115200

riv 302 0

riv 303 1

riv 304 8

riv 305 25

riv 306 2

Modbus Client

The two RS485 ports on the Finch can be configured to independently operate in a modbus client mode. Using the above Registry table settings for Port 1 respectively.

Example

To setup Port 1 as a modbus client at baud 9600, no parity, 1 stop bit, 8 data bits issue the following commands on the console:

riv 300 9600

riv 302 0

riv 303 1

riv 304 8

riv 306 1

Multiple baud rates are supported where the baud rate is set according to the control block settings. The default baud rate is set according to the register table.

To set up endpoints for a modbus client to poll or write to registers, control blocks need to be configured. Please refer to the control blocks section of this manual.

Control Block Examples for Modbus Client

Modbus Read Coil

Control Block: 1,[1,1,115200,20,1,0,70,0,0,1,0,0,,,,]

[Port:1, DevAdd:1, Baud:115200, RegAdd:20, RegType:Coil, SwapF:0, DestAdd:70, InputDataType:unused, OutputDataType:unused, ScanRateMs:1s Scale:unused, Shift:unused, LowThresh:unused, HighThresh:unused, DeltaThresh:unused, TimeDelay:unused]

Modbus Read Discrete Inputs

Control Block: 1,[1,1,115200,40,2,0,72,0,0,1,0,0,,,,]

[Port:1, DevAdd:1, Baud:115200, RegAdd:40, RegType:Discrete, SwapF:0, DestAdd:72, InputDataType:unused, OutputDataType:unused, ScanRateMs:1s Scale:unused, Shift:unused, LowThresh:unused, HighThresh:unused, DeltaThresh:unused, TimeDelay:unused]

Modbus Read Holding Register

Control Block: 1,[1,1,115200,200,3,2047,0,3,0,1,1,0,,,,]

[Port:1, DevAdd:1, Baud:115200, RegAdd:200, RegType:Holding, SwapF:2047, DestAdd:0, InputDataType:uint32, OutputDataType: unused, ScanRateMs:1s Scale:1, Shift:0, LowThresh:unused, HighThresh:unused, DeltaThresh:unused, TimeDelay:unused,]

Modbus Read Input Register

Control Block: 1,[1,1,115200,300,4, 2047,35,3,0,1,1,0,,,,]

[Port:1, DevAdd:1, Baud:115200, RegAdd:300, RegType:Input, SwapF:2047, DestAdd:35, InputDataType:uint32, OutputDataType: unused, ScanRateMs:1s Scale:1, Shift:0, LowThresh:unused, HighThresh:unused, DeltaThresh:unused, TimeDelay:unused,]

Modbus Write Coils

Control Block: 2,[1,1,115200,30,1,0,72,0,1]

[Port:1, DevAdd:1, Baud:115200, RegAdd:30, RegType:Coil, SwapF:0, SourceAdd:72, DataType:1(uint8), ScanRateMs:1ms]

Modbus Write Holding Register

Control Block: 2,[1,1,115200,210,3,0,35,0,1]

[Port:1, DevAdd:1, Baud:115200, RegAdd:210, RegType:Holding, SwapF:0, SourceAdd:35, DataType:0(follows source address type), ScanRateMs:1s

The above control block examples Can be combined into one control block file as follows:

obj_cntl.txt

1,[1,1,115200,20,1,0,70,0,0,1,0,0,,,,]

1,[1,1,115200,40,2,0,72,0,0,1,0,0,,,,]

1,[1,1,115200,200,3,2047,0,3,0,1,1,0,,,,]

1,[1,1,115200,300,4, 2047,35,3,0,1,1,0,,,,]

2,[1,1,115200,30,1,0,72,0,1]

2,[1,1,115200,210,3,0,35,0,1]

The above set of control blocks can be sent to the Finch using the MQTT console nf command.

nf:obj_cntl.txt|obj_cntl.txt

1,[1,1,115200,20,1,0,70,0,0,1,0,0,,,,]

1,[1,1,115200,40,2,0,72,0,0,1,0,0,,,,]

1,[1,1,115200,200,3,2047,0,3,0,1,1,0,,,,]

1,[1,1,115200,300,4, 2047,35,3,0,1,3,0,,,,]

2,[1,1,115200,30,1,0,72,0,1]

2,[1,1,115200,210,3,0,35,0,1]

Alternatively, you can use the app to create control blocks and upload them to the Finch.

Modbus register commands

You can also use the console commands modbus-write or modbus-write_multi to manually write to device registers connected to the Finch. These commands will only work if the device is configured as a client and the Baud rate should be set to the correct rate of the receiving device for these commands to work.

Examples:

Command
modbus-write: 1, 1, 200,3,50
Explanation
modbus-write: Port number, Device address to write to, Register address you want to write to, the register type you are writing too see (FinchUserManual.docx) ,the value you want to write into the register.

Comand
modbus-write-multi:2,1,0,5,3,220,221, 222, 223, 2500
Explanation
modbus-write-multi: Port number, Device address, Starting register, Number of registers, Register type (all register needs to be same type see (FinchUserManual.docx) ,Starting register value, Next register value, Next register value, Continue for values up until number of registers.

Modbus Passive Listener

The two RS485 ports on the Finch can be configured to independently operate in a Modbus passive listener mode. Using the above Registry table settings for Port 1 respectively.

Example

To setup Port 1 as a modbus client at baud 115200, no parity, 1 stop bit, 8 data bit. Issue the following commands on the console:

riv 300 115200

riv 302 0

riv 303 1

riv 304 8

riv 306 3

To set up endpoints for a modbus client to poll or write to registers, control blocks need to be configured. Please refer to the control blocks section of this manual.

Control register Examples for Modbus Passive Listener

Modbus Read Holding Register

Control Block: 1,[1,1,115200,200,3,2047,0,3,0,0,1,0,,,,]

[Port:1, DevAdd:1, Baud:115200, RegAdd:200, RegType:Holding, SwapF:2047, DestAdd:0, InputDataType:uint32, OutputDataType: unused, ScanRateMs:0ms (unused), Scale:1, Shift:0, LowThresh:unused, HighThresh:unused, DeltaThresh:unused, TimeDelay:unused,]

DLMS

The Finch has two dedicated RS485 Ports that can be configured for various communication protocols. One such protocol that is supported is DLMS. Each port can be independently configured as a DLMS Client.

Configuration for DLMS client can be done by writing to the following configuration registers in the registry table:

Port 1

Register	Type	Enum	Notes
300/301	uint32	3	Port 1 Baud Rate. Default: 9600. Valid Baud rate supported: 4800, 9600, 19200, 38400, 57600, 76800, 115200
302	uint8	1	Port 1 Parity, Default: None. Valid Parity supported: 0 (None), 1 (Odd), 2 (Even)

303	uint8	1	Port 1 Stop Bits, Default: 1, Valid Stop bits supported: 1 (1 stop bit), 2 (2 stop bits)
304	uint8	1	Port 1 Data Bits, Default 8, Valid data bits: 5, 6, 7, 8
305	uint8	1	Port 1 Address. Default 1. Options between 1 and 255. Values outside this range will not be accepted. Not used in modbus Client mode.
306	uint8	1	Port 1 Type, Default 0 (Disabled). Supported types: 0: Disabled, 1: Modbus Client, 2: Modbus Server,3: Modbus Listener, 4: DLMS Client

Port 2

Register	Type	Enum	Notes
307/308	uint32	3	Port 2 Baud Rate. Default: 9600. Valid Baud rate supported: 4800, 9600, 19200, 38400, 57600, 76800, 115200
309	uint8	1	Port 2 Parity, Default: None. Valid Parity supported: 0 (None), 1 (Odd), 2 (Even)
310	uint8	1	Port 2 Stop Bits, Default: 1, Valid Stop bits supported: 1 (1 stop bit), 2 (2 stop bits)
311	uint8	1	Port 2 Data Bits, Default 8, Valid data bits: 5, 6, 7, 8
312	uint8	1	Port 2 Address. Default 1. Options between 1 and 255. Values outside this range will not be accepted. Not used in modbus Client mode.
313	uint8	1	Port 2 Type, Default 0 (Disabled). Supported types: 0: Disabled, 1: Modbus Client, 2: Modbus Server,3: Modbus Listener, 4: DLMS Client

DLMS-Client

The two RS485 ports on the Finch can be configured to independently operate in a dlms client mode. Using the above Registry table settings for Port 1 & Port 2 respectively.

Example

To setup Port 2 as a dlms client at baud 9600, no parity, 1 stop bit, 8 data bits issue the following commands on the console:

riv 300 9600

riv 302 0

riv 303 1

riv 304 8

riv 306 4

Multiple baud rates are supported where the baud rate is set according to the control block settings. The default baud rate is set according to the register table.

To set up endpoints for a dlms client to poll registers, control blocks need to be configured. Please refer to the control blocks section of this manual.

Control Block Examples for DLMS Client

The two examples below are for a Kamstrup Omnipower single phase meter.

DLMS Device Block (Block 3)

Control Block: 3,[1,9600,0,8,1,32555400,18,16,32,1,1,512,512,1,1,12345,L,0,30]

[Port:1, Baud:9600, Parity:None,Databits:8,Stopbits:1,SerialNum: 32555400,ClientAddr:18,ServelLogicalAddr:16,ServerPhysAddr:32,AddrSizeLogical:1,AddrSizePhys:1,MaxTxPayloadSize:512, MaxTxPayloadSize:512,WinFrameSizeTx:1, WinFrameSizeRx:1,Password:12345,LogicalNameRef:Long,TimeAlignHour:0,TimeAlignMinute:30]

DLMS Endpoint Block (Block4)

Control Block: 4,[32555400,1103823896831,3,2,A14,33,0,9,0.01,0.00,,,,]

[SernialNum: 32555400,RegAddr:1103823896831,ClassID:3,Attr:2,Name: A14,DestAddr:33,InDataType:0,OutDataType:float,Scale:0.01,Shift:0.0,,,,]

DLMS Control block file names

These control blocks named above must be stored in a file on the device.

DLMS control block files must follow the naming convention: dlms_cntl<device_number - 1>.txt. For each connected device, create a file with the corresponding number. For example, with 5 devices:

- dlms_cntl0.txt for device 1
- dlms_cntl1.txt for device 2
- dlms_cntl2.txt for device 3
- dlms_cntl3.txt for device 4
- dlms_cntl4.txt for device 5

This ensures Finch can connect to multiple DLMS devices. If the files are named incorrectly, they will overwrite each other, and only the last device's control block will function.

DLMS-Historic Data request

Control Blocks

A standard set of control blocks is available to perform control logic and additional communications functions: The control block definitions are in obj_cntl.txt file. The maximum number of lines in the file is 250 – this includes the file name in line 1. This means the maximum number of control blocks allowed is 249 dependent on available memory. Each line is a maximum of 100 characters long including the function block name. This excludes the CR or CRLF line terminator. The lines contain a JSON string that details the control block. Refer to the index of control blocks for details of each block.

The control block file is read on boot (if the file exists) and each line is read and checked. If the line syntax is ok, the control block is created. The entire file is read first to determine the size of memory required for the control block index. If there is enough memory, each line is read and the control block memory allocated and populated with the values in the JSON string. This is done line by line until the end of the file or there is no more memory to allocate at which point an error will be displayed on the console. If a register table is indexed, the register type is set according to the data type definition for the control block.

The syntax of a control block line is:

index,[param1,param2,param....,param last]

Control Block data types are important – in the tables for each control block there are 2 data type columns – Data Type and Register Type.

Data Type defines what the number range and type is allowed in the JSON string defining the control block. Register Type defines the register type that will be assigned on initialization of the control block. If 2 control blocks use the same register where 2 different types are assigned, the last block in line sequence of obj_cntl.txt will take precedence.

If registers of different types are to be linked then use a DataType block to convert.

Some registers are optional – these are defined by allowing a -1 to indicate the register is not used. The -1 must be included in the JSON string because the string is interpreted by index – this means all JSON strings must follow exactly the format of the block.

To protect the configuration from erroneous writes, the outputs are limited to write only in the register table address in the user or system volatile space. The user space includes volatile, EERAM and FLASH.

Control blocks set up the register type on creation of the block. To prevent system registers from having data types changed, no control blocks except the System Transfer can read from the system space. The System Transfer block does not set the register data types.

Note – The concepts of register table, data types, setting up text files and downloading using eZi-App are required to use control blocks. Refer to the eZi-COM-IO user manual for more information.

Index	Control Block Name	Scan	Description
0	No Block		
Communication Modbus Client			
1	Read Register	N/A	Modbus Client Read single / multiple registers.
2	Write Register	N/A	Modbus Client Write single / multiple registers.
Communication DLMS Client			
3	Device Config	N/A	DLMS Client general device configuration
4	Read Endpoint		DLMS endpoint read config

Communication - Modbus Client/Listener Block

Read Register - Index 1

Read 1 or more registers with data format from the server address at the baud rate. Convert to little endian and save at the address in the register table.

Name	Param Index	Param Data Type	Required	Description
Port	0	uint8_t	Yes	RS485 Physical Port number (1 or 2) that the device is attached.
Device Address	1	uint8_t	Yes	Server Device Address. 1-255
Device Baud Rate	2	int32_t	No	Server Device Baud rate. 4800, 9600, 19200, 38400, 57600, 76800, 115200 If using in passive listener mode. This baud rate setting is ignored, and listener will operate at baud specified by register table value
Device Register Address	3	uint16_t	Yes	Register (Start) Address to read from.
Device Register Type	4	uint8_t	Yes	Register Type. See Device **Register Type**
Swap Flags	5	uint16_t	No	Swap Flag Bit Mask: Default 2047. See Swap Flags
Destination Address	6	uint16_t	Yes	Address in Register table in which to store the data.
Input Data Type	7	uint8_t	Yes	Device Point type - Width and how the data is to be interpreted. See Data Types
Output Data Type	8	uint8_t	No	Destination address Data type - Width and how the data is to be interpreted. 0 means out data type follows Input Data Type. See Data Types
ScanRate_S	9	uint32_t	Yes	Interval in seconds between which the server register address is polled. No Effect on Passive Listener
Scale	10	float	No	Value by which to scale the raw data
Shift	11	float	No	Value by which to shift the raw data
Alarm Low Threshold	12	float	No	Minimum value for alarm. Must go below this for alarm to trigger. Must have changed by this amount for a period of Alarm Time Delay (seconds). Leave empty if not used.
Alarm High Threshold	13	float	No	Maximum value for alarm. Must go above this for alarm to trigger. Must have changed by this amount for a period of Alarm Time Delay (seconds). Leave empty if not used.
Alarm Delta Threshold	14	float	No	Change of Value (COV) alarm. Must have changed by this amount for a period of Alarm Time Delay (seconds). Leave empty if not used.
Alarm Time Delay	15	uint16_t	No	Value must be outside the alarm condition for this many seconds before alarm is triggered. Leave empty if not used.

Write Register – Index 2 (Not applicable to Passive Listener)

Write 1 or more registers with data format to the server address at the baud rate. Get write value at the address in the register table.

Name	Param Index	Param Data Type	Required	Description
Port	0	uint8_t	Yes	RS485 Physical Port number (1 or 2) that the device is attached.
Device Address	1	uint8_t	Yes	Server Device Address. 1-255
Device Baud Rate	2	int32_t	No	Server Device Baud rate. 4800, 9600, 19200, 38400, 57600, 76800, 115200
Device Register Address	3	uint16_t	Yes	Register (Start) Address to write to.
Device Register Type	4	uint8_t	Yes	Register Type
Swap Flags	5	uint16_t	No	Swap Flag Bit Mask: Default 2047
Source Address	6	uint16_t	Yes	Address in Register table in which to retrieve the data.
Output Data Type	7	uint8_t	No	Server Destination register address Data type - Width and how the data is to be interpreted.
ScanRate_S	8	uint32_t	Yes	Interval in seconds between which the server register address is written to.

Parameter Details

Device Register Type

Modbus devices make their data available in the form of different register types.

Register Type	Value	Description
Coil	1	Usually a digital output. (Read/Write)
Discrete Input	2	Usually a digital input. (Read only)
Holding Register	3	Usually, an internal value or analogue output (Read/Write at discretion of implementation on the device)
Input Register	4	Usually an analogue input (Read only)

Swap Flags

Different Modbus devices may encode data differently due to architectural differences (endianness), or implementation differences. Byte & word swap flags allow us to configure the driver to swap different parts of the raw binary data we receive from the device to account for these differences.

Valid Range: 0 to 2047

Default: 2047

Create the Swap Flag value by adding the desired swap values from below:

Swap Flag	Value
INT16 BYTE	1
INT32 BYTE	2
INT32 WORD	4
INT64 BYTE	8
INT64 WORD	16
INT64 DOUBLE WORD	32
FLOAT / REAL BYTE	64
FLOAT / REAL WORD	128
DOUBLE BYTE	256
DOUBLE WORD	516
DOUBLE DOUBLE WORD	1024

Data Types

Modbus registers can represent their data in many formats. When data is received, our Modbus

driver can interpret the raw binary information in one of the following ways:

Data Type (Input & Output)	Value
Unsigned 8-bit integer (0 - 65,535)	1
Unsigned 16-bit integer (0 - 65,535)	2
Unsigned 32-bit integer (0 to 4,294,967,295)	3
Unsigned 64-bit integer (0 to 4,294,967,295)	4
Signed 8-bit integer (-32,767 - +32,767)	5
Signed 16-bit integer (-32,767 - +32,767)	6
Signed 32-bit integer (−2,147,483,647 to +2,147,483,647)	7
Signed 64-bit integer (−9,223,372,036,854,775,807 to +9,223,372,036,854,775,807)	8
Single Precision Floating Point Number (IEEE 754 - 32-bit)	9
Double Precision Floating Point Number (IEEE 754 - 64-bit)	10

Communication - DLMS Client Block

Device Configuration – Index 3

This control block index will allow for the setup of a single DLMS server device.

Note: If this block is not defined, *control block index 4 (DLMS endpoints)* block will be invalid, as they require a parent device to link back to.

Name	Param Index	Param Data Type	Required	Description
Port	0	uint8_t	Yes	RS485 Physical Port number (1 or 2) that the device is attached.
Device Baud Rate	1	int32_t	No	Device Baud rate. 4800, 9600, 19200, 38400, 57600, 76800, 115200
Parity	2	uint8_t	No	Device Parity
Data Bits	3	uint8_t	No	Device Data Bits
Stop Bits	4	uint16_t	No	Device Stop Bits
Serial Number	5	uint32_t	Yes	DLMS Device Serial number
Client Address	6	int32_t	Yes	
Server Address Logical	7	int32_t	Yes	
Server Address Physical	8	int32_t	Yes	
Server Address Logical Size	9	int8_t	Yes	
Server Address Physical Size	10	int8_t	Yes	
Max Info Field Size Tx	11	int16_t	No	Default: 512
Max Info Field Size Rx	12	int16_t	No	Default: 512
Max Window Size Tx	13	int32_t	No	Default: 1
Max Window Size Rx	14	int32_t	No	Default: 1
Password	15	string	No	Default: No Authentication
Logical Name Referencing	16	char	Yes	Addressing mechanism (L = Long, S = short)
Date Time Alignment (Hour)	17	uint8_t	No	Default: 0
Date Time Alignment (Minute)	18	uint8_t	No	Default: 0

Read Endpoint Configuration – Index 4

This control block defines a single DLMS device endpoint.

Note: This block is only valid and used if a parent device block is correctly defined (control block 3).

Name	Param Index	Param Data Type	Required	Description
Serial Number	0	uint32_t	Yes	DLMS Device Serial number – To link back to
Register Address / Logical Name	1	uint64_t	Yes	Note 48-bit value (MAX = 0xFFFFFFFFFFFF = 281,474,976,710,655)
Context / ClassID	2	uint8_t	no	
Attribute	3	uint8_t	no	
CustomTag	4	String	no	Default logical name as string.
Destination Address	5	uint16_t	yes	Address in Register table in which to store the data.
Input Data Type	6	uint8_t	no	Device Point type - Width and how the data is to be interpreted. Default: it will be handles by internal DLMS driver. Leave blank for now
Output Data Type	7	uint8_t	yes	Destination address Data type - Width and how the data is to be interpreted. See **Data Types**
Scale	8	float	No	Default:1. Value by which to scale the raw data.
Shift	9	float	No	Default:1. Value by which to shift the raw data
Alarm Low Threshold	10	float	No	Minimum value for alarm. Must go below this for alarm to trigger. Must have changed by this amount for a period of Alarm Time Delay (seconds). Leave empty if not used.
Alarm High Threshold	11	float	no	Maximum value for alarm. Must go above this for alarm to trigger. Must have changed by this amount for a period of Alarm Time Delay (seconds). Leave empty if not used.
Alarm Delta Threshold	12	float	No	Change of Value (COV) alarm. Must have changed by this amount for a period of Alarm Time Delay (seconds). Leave empty if not used.
Alarm Time Delay	13	uint16_t	no	Value must be outside the alarm condition for this many seconds before alarm is triggered. Leave empty if not used.