VIOLA systems

Arctic Modbus Gateway

Arctic Modbus Gateway (2260)

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(according to ISO/IEC Guide 22 and EN 45014)

Manufacturer's Name: Viola Systems Ltd.

Manufacturer's Address:

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declares that this product:

Product Name:

conforms to the following standards:

EMC:

EN 55022 Emission Test (Class A)

1. Radiated Emissions (30-1000MHz)
2. Conducted Emissions (0.15-30MHz)

EN 50082-1 Immunity Test

1. IEC 801-3: Radio Frequency Electromagnetic Field
2. IEC 801-2: Electrostatic Discharge
3. IEC 801-4: Fast Transients, AC Power Ports and Signal cables

Supplementary Information:

"The product complies with the requirements of the Low Voltage Directive 73/23/EEC and EMC directive 89/336/EEC."

Warning!

This is a Class A product. In a domestic environment this product may cause radio Interference which may make it necessary for the user to take adequate measures.

Manufacturer's Contact Information:

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Warranty and Safety Instructions

Read these safety instructions carefully before using the products mentioned in this manual:

Warranty will be void if the product is used in any way in contradiction with the instructions given in this manual or if the product has been tampered with.

The devices mentioned in this manual are to be used only according to the instructions described in this manual. Faultless and safe operation of the devices can be guaranteed only if the transport, storage, operation and handling of the devices is appropriate. This also applies to the maintenance of the products.

To prevent damage both the product and any terminal devices must always be switched OFF before connecting or disconnecting any cables. It should be ascertained that different devices used have the same ground potential. Before connecting any power cables the output voltage of the power supply should be checked.

This product is not fault-tolerant and is not designed, manufactured or intended for use or resale as on-line control equipment or as part of such equipment in any hazardous environment requiring fail- safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of Viola Systems manufactured hardware or software could lead directly to death, personal injury, or severe physical or environmental damage.

Revisions

Date	Document Version	Firmware Version	Description of changes
06/2010	1.0		Lay-out changed

Contents

1 Introduction

This Configuration guide is intended only for configuring Modbus on Viola Arctic device. It therefore presents only Modbus specific functionality. If you need to know more about general Arctic configuration, please refer to Arctic User's Manual. This User's Manual should be shipped with Arctic products or it could be obtained by contacting Viola Systems.

The Modbus Gateway is an adapter application enabling conversions between Serial and Network Modbus protocols. The gateway can operate on two modes; either connecting serial Masters to Slaves behind the network or connecting network Master to Serial slaves.

The gateway offers following core properties:

- Supports Modbus RTU and Modbus ASCII serial protocols.
- Supports ModbusTCP, ModbusRTU over TCP, ModbusRTU over UDP, Modbus ASCII over TCP and Modbus ASCII over UDP network protocols.
- It can generate and filter out gateway exceptions.
- It can route traffic on network based on Modbus addressing enabling intelligent use of network resources.
- Makes automatic connection management.
- Enables multiple server sessions over network.
- Offers unlimited amount of Masters on serial or Network side.
- Offers 30 routes over network to slaves.

2 Parameters

The parameters are divided into two groups:

- Common parameters
- Routes

Common parameters define for e.g. the protocols used in serial and network communications, serial port settings and protocol specific timeouts. Route parameters are only required on Serial Master to Network Slaves mode defining the IP and Modbus addresses of slaves behind the network.

2.1 Common parameters

The common parameters define general settings and settings for Network Master to Serial Slaves mode.

2.1.1 General Settings

Gateway Status

Table 1: Gateway Status

Identifier	Gateway Status
Description	Tthe Modbus gateway functionality enabled for the serial port.
Values	Enabled – Modbus Gateway is enabled Disabled – Modbus Gateway is not enabled
Notes	Each serial port of Arctic has it's own Modbus Gateway definitions.

2.1.2 Gateway Mode

Table 2: Gateway Mode

Identifier	Gateway Mode
Description	The slaves located on network or serial side.
Values	Network Master to Serial Slaves – Slaves are on serial side. Serial Master to Network Slaves – Slaves are on network side.
Notes	If slaves are on network side, the routes are also needed to be defined.

2.1.3 Protocols

Serial Protocol

Table 3: Serial Protocol

Identifier	Serial Protocol
Description	Defines the Modbus protocol used on serial communication.

Identifier	Serial Protocol
Values	Modbus RTU – Serial devices use Modbus RTU protocol
	Modbus ASCII – Serial devices use Modbus ASCII protocol
Notes	Modbus RTU is more efficient and should be used whenever possible.

Network Protocol

Table 4: Network Protocol

Identifier	Network Protocol
Description	Defines the TCP/IP and Modbus protocol used on network communication.
Values	Modbus TCP – Modbus TCP protocol over TCP
	Modbus RTU over TCP – Modbus RTU protocol over TCP
	Modbus RTU over UDP – Modbus RTU protocol over UDP
	Modbus ASCII over TCP – Modbus ASCII protocol over TCP
	Modbus ASCII over UDP – Modbus ASCII protocol over UDP
Notes	If Viola Systems M2M Gateway is used to tunnel network traffic over SSH, use Modbus RTU over UDP when possible for efficient communication. The SSH tunnel already contains TCP properties like reliable message delivery.

2.1.4 Framing

Slave Response Timeout

Table 5: Slave Response Timeout

Identifier	Slave response timeout
Description	Defines the time in microseconds (10E-6 seconds) how long Arctic waits the response from Modbus slave. If the response is not received, Arctic can generate and return Modbus gateway exception.
Values	0 – 90 000 000 microseconds (0 – 90 seconds)
Notes	The reply timeout of Modbus Master must be greater than the Gateway (Arctic) timeout. Otherwise the flow of request-reply communication is violated. Arctic does not accept a new request before the reply from slave is received or the reply timeout is elapsed. The delays in network communication can vary especially in wireless (e.g. GPRS/EDGE/ Mobitex) networks. When the slaves are located on network side, use e.g. PING to estimate the delay packets spend on network.

Inter-Frame Timeout

Table 6: Inter-Frame Timeout

Identifier	Inter-frame timeout
Description	Defines the idle time in microseconds (10E-6 seconds) that marks the end of Modbus frame in serial communication. If the value is zero, the Gateway uses standard 4 character time.
Values	0 … 2 000 000 microseconds (0 – 2 seconds)
Notes	Use as small value as possible to speed up communication and increase the value if problems arise. Some PC programs can insert unexpected delays between serial characters.

2.1.5 Exceptions

Generate Gateway Exceptions

Table 7: Generate Gateway Exceptions

Identifier	Generate Gateway exceptions
Description	Defines does the Gateway generate and return Modbus Gateway exception message to Master if no valid reply is not received from slave.
Values	Enabled – Generation of Gateway exceptions is enabled Disabled - Generation of Gateway exceptions is disabled
Notes	This functionality is useful for debugging. See also parameter "Pass Gateway exceptions".

Pass Gateway Exceptions

Table 8: Pass Gateway Exceptions

Identifier	Pass Gateway exceptions
Description	Defines are the Gateway exception replies from slave side passed to master.
Values	Enabled – Gateway exception replies are passed to Master Enabled – Gateway exception replies are passed to Master
Notes	filtered away Notes

2.1.6 Serial Settings

Serial Port

Table 9: Serial Port

Identifier	Serial Port
Description	Defines the serial port that Gateway uses for Modbus serial communication.

Identifier	Serial Port
Values	Port 1 – Serial port 1 (RS-232 console/application port) Port 2 – Serial port 2 (RS-232/422/485 application port)
Notes	If a single serial port or RS-422/485 is required, use Port 2. If Port 1 is used, the console switch of Arctic must be on Application position. DIP-switches below the DB-9 serial connector specify the RS-232/422/485 settings of Port 2.

Serial Speed

Table 10: Serial Speed

Header 1	Speed
Description	Defines the serial port speed for Modbus communication.
Values	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Notes	Check the speeds supported by connected Modbus equipment. If special serial port speed is required, please contact Viola Systems.

Serial Data Bits

Table 11: Serial Data Bits

Identifier	Serial Data bits
Description	Defines the number of data bits used on Modbus serial communications.
Values	5, 6, 7, 8, Auto (8 for Modbus RTU, 7 for Modbus ASCII)
Notes	Check the data bits supported by connected Modbus equipment. Generally Modbus RTU communication uses 8 data bits and Modbus ASCII communication uses 7 data bits.

Serial Stop Bits

Table 12: Serial Stop Bits

Identifier	Serial Stop bits
Description	Defines the number of stop bits used on Modbus serial communications.
Values	1,2
Notes	

Serial Parity

Table 13: Serial Parity

Identifier	Serial Parity
Description	Defines the parity method used on Modbus serial communication

Identifier	Serial Parity
Values	None – no parity method used Even – even parity bit generated and inspected Odd – odd parity bits generated and inspected
Notes	

Serial Flow Control

Table 14: Serial Flow Control

Identifier	Serial Flow control
Description	Defines is the hardware (RTS/CTS) flow control used on Modbus serial communication
Values	Enabled – RTS/CTS flow control used Disabled – RTS/CTS flow control not used
Notes	Use of hardware flow control is suggested

2.1.7   Network Settings

Server TCP/UPD Port

Table 15: Server TCP/UPD Port

Identifier	Server TCP/UDP port
Description	Defines the TCP or UDP port that Masters can form connections to. Default Modbus TCP/IP communication port is 502.
Values	1 - 32500
Notes	If multiple Modbus Gateways are running on same device (for both serial ports) the TCP/UDP communication ports must not be same. Use e.g. ports 502 and 504. The network and Arctic firewalls must enable TCP or UDP communication for that port.

Maximum Number of Clients

Table 16: Maximum Number of Clients

Identifier	Maximum number of clients
Description	Defines how many network masters can be connected to Gateway simultaneously.
Values	0-20
Notes	Generally use value at least 2 when using TCP communication. Otherwise if the Gateway does not recognize partially closed connection, forming of new connections is not accepted by Gateway before "Connection idle timeout" is elapsed.

Connection Idle Timeout

Table 17: Connection Idle Timeout

Identifier	Connection idle timeout
Description	If the connected Master hasn't sent valid Modbus packets during that timeout the connection is closed by Arctic and therefore the resources are available for new connections. This parameter is especially useful when the network connection is not reliable causing 'hanging' or partially closed connections.
Values	0 – 32500 seconds
Notes	Set this value about two times the polling interval of master.

Enable Keepalive

Table 18: Enable Keepalive

Identifier	Enable keepalive
Description	Defines is the connection testing enabled for TCP network communication.
Values	Enabled – Testing the TCP connection with Master is enabled Disabled – Testing the TCP connection with Master is disabled
Notes	The testing is done by sending TCP keepalive packets on certain intervals.

2.2   Routes

When the Arctic Modbus Gateway is configured to Serial Master to Network Slaves mode the routes are needed to be defined for each connected Modbus slave. Gateway can route traffic based on Modbus addressing therefore enabling more efficient communication where each slave receives only data addressed to it.

Route in Use

Table 19: Route in Use

Identifier	Route in use
Description	Defines is this route entry used to decide to which IP address Modbus request is sent.
Values	Yes – Route information is used No – Route information is not used
Notes	If no route is found for Modbus request is it dropped and Gateway exception is generated if enabled.

Host

Table 20: Host

Identifier	Host
Description	Defines the IP address or Host name where packets are routed by that entry.
Values	IP address or Host name
Notes	If Host names are used the DNS server IP address is required to be defined on Arctic Network settings. The Network Protocol setting on "Common parameters" defines the network- and Modbus protocol used on network communication.

TCP or UDP Destination Port

Table 21: TCP or UDP Destination Port

Identifier	TCP or UDP destination port
Description	Defines the UDP or TCP destination port where this route entry sends Modbus requests.
Values	0 – 32500 (Modbus default is 502)
Notes	The port must be same as used on the network slave device or Gateway behind network.

Filter Slave Address

Table 22: Filter Slave Address

Identifier	Filter slave address
Description	Defines is the routing based on Modbus addresses used for that entry. If not enabled every Modbus request is routed to this entry. If enabled only Modbus requests having destination address matching the Address list of entry are routed.
Values	Yes – Route entry checks for Modbus destination address No – Route entry enables any Modbus destination address
Notes	It's generally good to use Modbus address filtering avoiding unnecessary network traffic.

Address to Filter

Table 23: Address to Filter

Identifier	Address to filter
Description	Comma separated list of the Modbus addresses of slaves behind on this route entry (max. 20 pcs.).
Values	Maximum 20 pcs. of comma (,) separated Modbus destination addresses.

Identifier	Address to filter
Notes	The "Filter Slave address" parameter of Route entry needs to be enabled these addresses to take effect.

Connection Idle Timeout

Table 24: Connection Idle Timeout

Identifier	Connection idle timeout
Description	If there hasn't been communication on this route during given amount of seconds the Gateway automatically closes the TCP connection to slave and therefore frees Slave's communication resources. This is especially useful when multiple Masters access same Slave.
Values	0 – 32500 seconds
Notes	Set this parameter about two times the polling interval of Master.

Enable TCP Keepalive

Table 25: Enable TCP Keepalive

Identifier	Enable TCP keepalive
Description	Defines is the connection testing enabled for TCP network communication.
Values	Enabled – Testing the TCP connection with Slave is enabled Enabled – Testing the TCP connection with Slave is enabled
Notes	The testing is done by sending TCP keepalive packets on certain intervals.

2.3   Saving Parameters

When the settings are complete, press the **Apply** button and permanently store the parameters by clicking on **Commit** button. Now reboot the Arctic by pressing **Reboot** button. The Arctic is now ready to deliver data from Network Masters to Serial Slaves.

3 Configuring Network Master to Serial Slaves Mode

When the PLC/RTU slaves supporting serial based Modbus communication are required to be controlled over TCP/IP networks the Gateway on slave side needs to be configured to Network Master-Serial Slaves mode.

Figure 1. *Arctic Modbus Gateway connecting serial slaves to network*
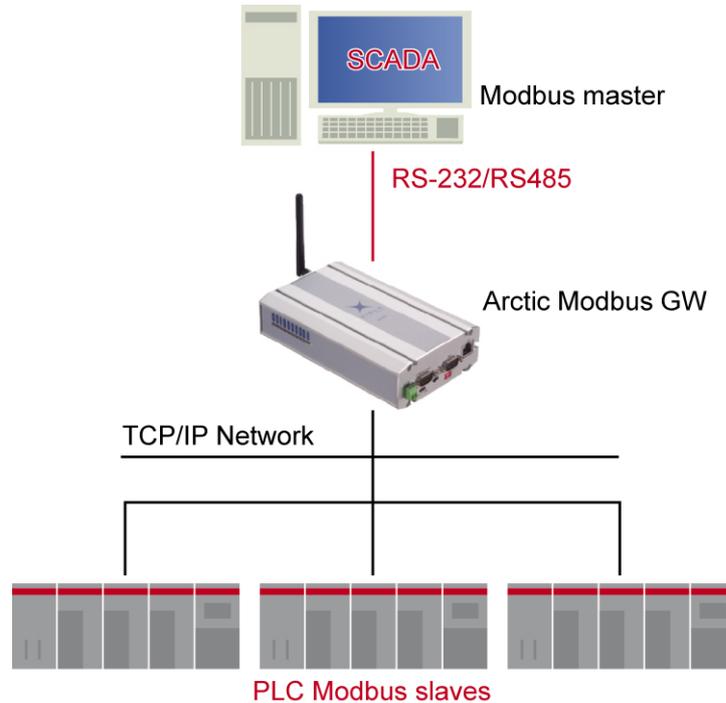
On that mode, the Arctic Modbus Gateway acts like network server where Masters (clients) can connect (the default port being 502) and transmit Modbus requests. The Gateway makes conversions between network and serial protocols. If the slave does not reply during defined timeout or if the reply is corrupted, the Gateway sends "gateway exception message" back to Master if the exception generation is enabled. Otherwise, the reply is returned. Multiple masters can connect simultaneously to Gateway, which handles the multiplexing between masters.

> **Note!**
>
> Each Arctic Modbus Gateway must have a fixed IP address in order the Master to know where to connect. Many client-use optimized networks (like public GPRS, xDSL) does not offer fixed IP addresses but allocate them dynamically. This situation can be solved by using Viola Systems M2M Gateway.

3.1 Settings – Common parameters

Only the common parameters are configured. The routes are unused on Network Master to Serial Slaves mode. The configuration menu is located on Applications -> Modbus GW menu of Arctic WEB configuration.

Figure 2. *Example of common parameters for Network Master to Serial Slaves mode*
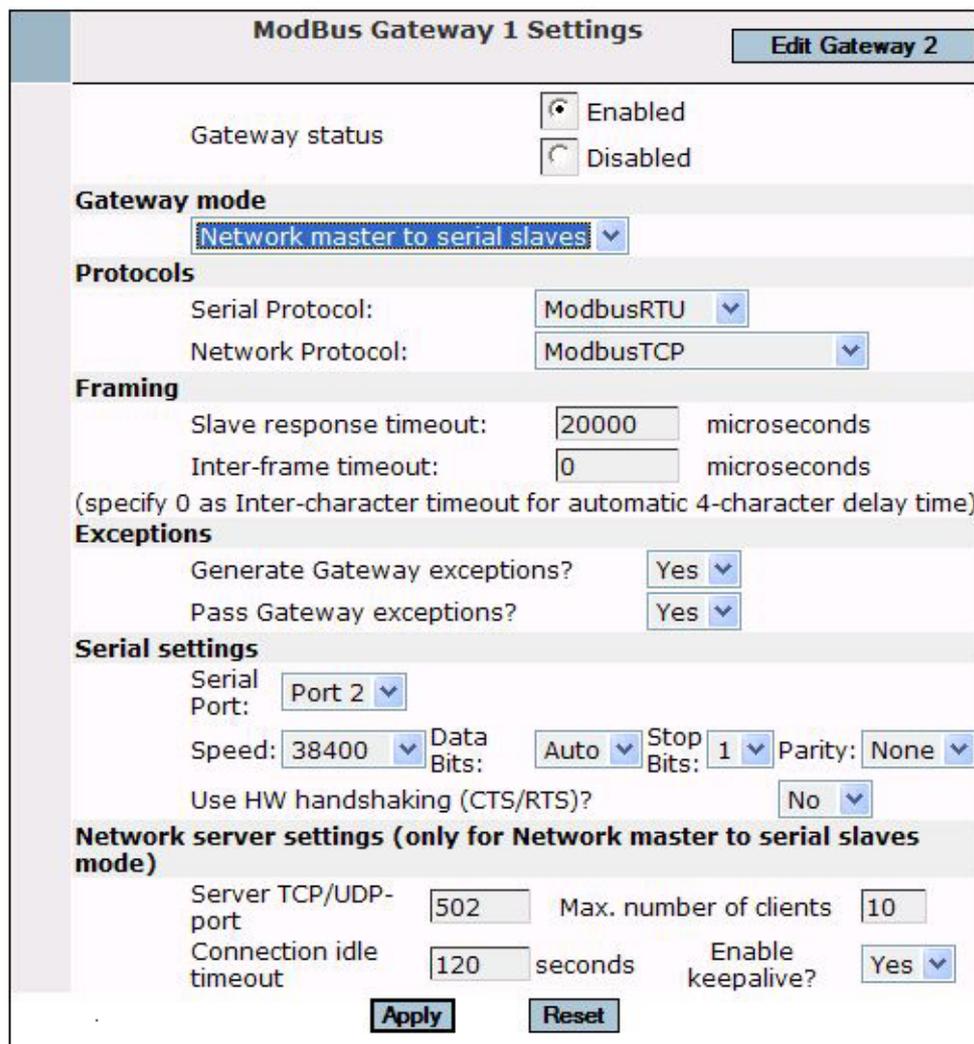
Table 26: Setting guideline for Network Master to Serial Slaves mode
Parameter Value Note

Parameter	Value	Note
Gateway Status	Enabled	
Gateway Mode	Network Master to Serial Slaves	
Serial Protocol	Depends on connected Modbus slave	Prefer Modbus RTU when possible
Network Protocol	Depends on Master side	If Viola Systems M2M tunneling is used, prefer UDP based Modbus network messaging.
Slave response timeout	Depends on connected Modbus slave	Increase this value if problem is on serial communication.
Inter-frame timeout	Modbus RTU protocol has standard timeout of 4 character time. Use value 0 for default.	Increase this value if the problem is on serial communication.

| Parameter	Value	Note
Generate Gateway exceptions	Enable or Disable	Enabling Gateway Exceptions can help system debugging and testing.
Pass Gateway exceptions	Enable or Disable	
Serial Port	Select Port 1 or Port 2	If single serial port or RS-422/485 functionality is required, use Port 2.
Serial Speed	Depends on connected Modbus slave.	
Serial Data Bits	Depends of connected Modbus slave. Use of "Auto" selects 8 data bits for Modbus RTU and 7 data bits for Modbus ASCII.	
Serial Stop Bits	Depends on connected Modbus slave.	
Serial Parity	Depends on connected Modbus slave. Select None, Even or Odd.	
Serial HW Handshaking	Enable if require by slave.	
Server TCP/ UDP Port	Default port for Modbus network communication is 502.	If multiple Modbus Gateway applications are running on same Arctic, the ports must be different for each Gateway application. Use e.g. ports 502 and 504.
Max. Number of clients	Normally use minimum value 2. If multiple Masters are allowed to connect, then increase the value.	If the network is wireless or unreliable, increase this value if there is a problem during the connection.
Connection idle timeout	Set about two times the polling interval of Master. If the polling interval is very long (over hour) use e.g. polling interval+200 seconds	
Enable keepalive	Enabled if the polling interval or idle timeout is very long.	

3.2   Saving Parameters

When the settings are complete, press the **Apply** button and permanently store the parameters by clicking on **Commit** button. Now reboot the Arctic by pressing **Reboot** button. The Arctic is now ready to deliver data from Network Masters to Serial Slaves.

4 Configuring Serial Master to Network Slaves Mode

When Modbus Master supporting serial based Modbus, communication needs to control slaves over TCP/IP network. The Gateway on Master side needs to be configured to Serial Master – Network Slaves mode.

Figure 3. *Arctic Modbus Gateway connecting serial Master to network*
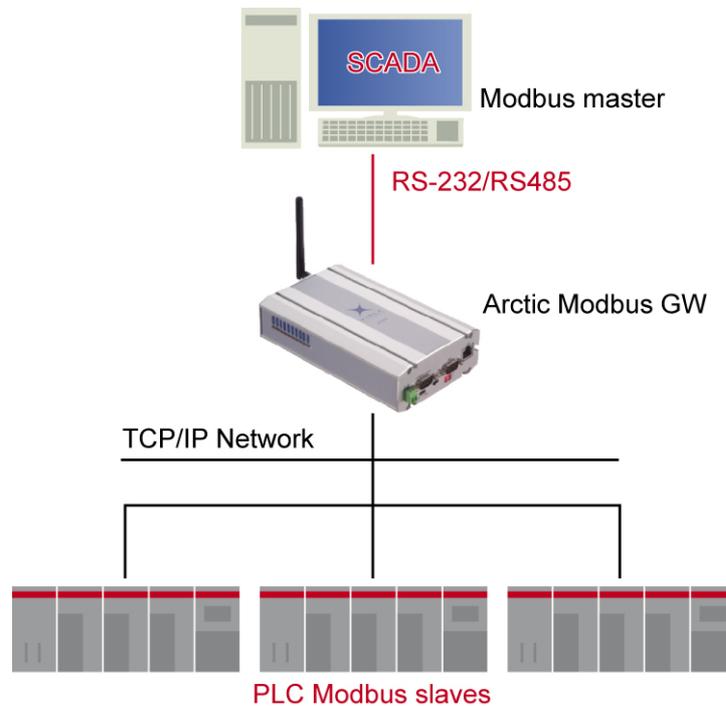
On that mode, Arctic Modbus Gateway routes serial Modbus packets to network and performs conversions between serial and network protocols. The routing based on Modbus addressing allows intelligent use of network resources, which is especially useful for pay-per-use networks like GPRS.

The settings consist of two parts:
- Common settings
- Settings for each route

4.1 Settings – Common Parameters

The configuration menu is located on Applications -> Modbus GW menu of Arctic WEB configuration.

Figure 4. *Example of common parameters for Serial Master to Network Slaves mode*

Table 27: Setting guideline for Network Master to Serial Slaves mode

Parameter	Value	Note
Gateway Status	Enabled	
Gateway Mode	Serial Master to Network Slaves	
Serial Protocol	Depends of connected Modbus Master	Prefer Modbus RTU when possible
Network Protocol	Depends of Slave devices	If Viola Systems M2M tunneling is used, prefer UDP based Modbus network messaging.
Slave response timeout	Depends of connected Modbus slave and delays of TCP/IP network.	Increase this value if problems on slave communication.
Inter-frame timeout	Modbus RTU protocol has standard timeout of 4 character time. Use value 0 for default	Increase this value if problems on serial communication

Parameter	Value	Note
Generate Gateway exceptions	Enable or Disable	Enabling Gateway Exceptions can help system debugging and testing
Pass Gateway exceptions	Enable or Disable	
Serial Port	Select Port 1 or Port 2	If single serial port or RS-422/485 functionality is required use Port 2
Serial Speed	Depends of connected Modbus Master	
Serial Data Bits	Depends of connected Modbus Master. Use of "Auto" selects 8 data bits for Modbus RTU and 7 data bits for Modbus ASCII.	
Serial Stop Bits	Depends of connected Modbus Master	
Serial Parity	Depends of connected Modbus Master. Select None, Even or Odd	
Serial HW Handshaking	Enable if require by Master	
Server TCP/ UDP Port	Default port for Modbus network communication is 502	Value is not used on Serial Master to Network Slaves mode.
Max. Number of clients	Normally use minimum value 2. If multiple Masters are allowed to connect increase the value.	Value is not used on Serial Master to Network Slaves mode.
Connection idle timeout	Set about two times the polling interval of Master. If the polling interval is very long (over hour) use e.g. polling interval+200 seconds	Value is not used on Serial Master to Network Slaves mode. Each route entry has it's own idle timeout.
Enable keepalive	Enable if the polling interval or idle timeout is very long.	Value is not used on Serial Master to Network Slaves mode. Each route entry has it's own keepalive setting.

4.1.1 Saving Common Parameters

Before proceeding to Route configuration, save the Common parameters by pressing the **Apply** button.

4.2 Settings – Routes

The route entries define how Modbus packets are routed on network from Serial Master to Network Slaves. Up to 30 routes can be specified each having up to 20 slaves. If the routing is based on Modbus addressing is not required or there are more than 20 slaves behind the route, the address filtering for that entry can be disabled.

Figure 5. *Route summary*

The route entry can be edited by pressing Edit button. The routes can also be disabled or enabled by pressing following buttons:

 Disables the Route entry

 Enables the Route Entry

The active routes do not have strikethrough line.

Pressing the Edit button opens following configuration screen:

Figure 6. *Route edit*

Table 28: Setting guidelines for Routes

Parameter	Value	Note
Route in use	Enable or Disable	Each IP address and TCP/UDP port of slaves needs to be defined on separate route entries.
Host	The IP address or Host name of slave or Gateway behind the route.	If Host names are used the DNS server IP address is required to be defined on Arctic Network settings. The Network Protocol setting on "Common parameters" defines the network- and Modbus protocol used on network communication.

Parameter	Value	Note
TCP or UDP destination port	The TCP or UDP port that slave or Gateway on slave side is listening.	Default Modbus port is 502.
Filter slave addresses	Defines is the routing based on Modbus addresses used for that entry. If not enabled, every Modbus request is routed to this entry. If enabled only Modbus requests having destination address matching the Address list of entry are routed.	It's generally good to use routing based on Modbus addressing in order to avoid unnecessary network traffic.
Address to filter	Comma separated list (max 20 pcs.) of Modbus slave addresses behind this route entry.	The "Filter Slave address" parameter of Route entry needs to be enabled these addresses to take effect.
Connection idle timeout (TCP)	Set about two times the polling interval of Master. If the polling interval is very long (over hour) use e.g. polling interval+200 seconds.	
Enable TCP keepalive	Enable if the polling interval or idle timeout is very long.	

4.2.1 Saving Routes

When the parameters are configured, press the Route Ready button and proceed to next route.

4.3 Making Settings Permanent

When all Routes and Common settings are configured permanently store the parameters by **Commit** button and reboot the Arctic Modbus Gateway. The Arctic is now ready to deliver data from serial Masters to network Slaves.

Limited Warranty

Coverage

Viola Systems warrants this hardware product to be free from defects in materials and workmanship for the warranty period. This non-transferable, limited warranty is only to you, the first end-user purchaser. The warranty begins on the date of purchase and lasts for the period specified below:

: one (1) year

Excluded Products and Problems

This warranty does not apply to: (a) Viola Systems software products; (b) expendable components such as cables and connectors; or (c) third party products, hardware or software, supplied with the warranted product. Viola Systems makes no warranty of any kind on such products which, if included, are provided "AS IS." Excluded is damage caused by accident, misuse, abuse, unusually heavy use, or external environmental causes.

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Technical Support

Contacting Technical Support

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Fax: +358 20 1226 220

E-mail: support@violasystems.com

Internet: http://www.violasystems.com

Recording Arctic Information

Before contacting our Technical Support staff, please record (if possible) the following information about your Arctic product:

Product name:

_____

Serial no:

_____

Note the status of your Arctic in the space below before contacting technical support. Include information about error messages, diagnostic test results, and problems with specific applications.

_____

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