



*Modbus Master Protocol Details*  
*for*  
*KALKI Protocol Gateway/GatewayLite*

**Product User Guide**

Version – 1.0

**KALKI Communication Technologies Pvt.. Ltd.,**  
#147, 2nd Floor, 5th Main, 7th Sector,  
H.S.R. Layout, Bangalore,  
INDIA – 560034.  
Phone: 91-80-5721263  
<http://www.kalkitech.com>

**CONTENTS**

<b>1. Introduction</b>	<b>3</b>
<b>2. Protocol Interoperability List</b>	<b>3</b>
<b>2.1. Channel / Node Parameters:-</b>	<b>3</b>
<b>2.1.1 <u>Channel Parameters for the Modbus TCP Master:-</u></b>	<b>3</b>
<b>2.1.2 <u>Channel Parameters for the Modbus RTU Master:-</u></b>	<b>4</b>
<b>2.1.3 <u>Node Parameters:-</u></b>	<b>4</b>
<b>2.2. Protocol Specific Functions:-</b>	<b>5</b>
<b>3. Protocol Profile Details</b>	<b>6</b>
<b>3.1. Object Type: -</b>	<b>6</b>
<b>3.2. Function Types: -</b>	<b>6</b>
<b>3.3. Data Formats: -</b>	<b>6</b>
<b>3.4. Start Address:-</b>	<b>7</b>
<b>3.5. Number of Points: -</b>	<b>7</b>
<b>3.6. Scale: -</b>	<b>7</b>
<b>3.7. Mode: -</b>	<b>7</b>
<b>3.8. Event: -</b>	<b>7</b>
<b>3.9. Polling Cycle: -</b>	<b>7</b>
<b>4. Time Synchronization in Modbus Master: -</b>	<b>8</b>
<b>4.1. Time Sync Details: -</b>	<b>8</b>
<b>5. Mapping Details from other protocols: -</b>	<b>9</b>
<b>6. Protocol Type Details: -</b>	<b>10</b>

## 1. Introduction

This document contains the details of configuring Modbus TCP/RTU Master protocol for KALKI GatewayLite using “Easy Connect” Configuration utility.

## 2. Protocol Interoperability List

The types, which are not supported in KALKI GatewayLite, are stroked off.

### 2.1. Channel / Node Parameters:-

#### 2.1.1 Channel Parameters for the Modbus TCP Master:-

Channel Attributes	Default Value	Supported Values	Details
Channel Type	TCP/IP	TCP	NA
IP Address or Host	0.0.0.0	--	Should specify the IP Address of the TCP Slave device.
Port Number	502	Unreserved Ethernet ports	Indicates the TCP/IP Connection Port Number.
Network Delay	2 mSec	0 → 1000 mSec	Indicates the Network Propagation Delay. This network propagation delay will be considered while time synchronization.
Retries	2	1 → 5	Indicates the Maximum number of retries when there is no reply from the slave device.
First Char Wait	0 mSec	0 → 100 mSec	Delay between receiving a character and transmitting next character
Header Timeout	1000 mSec	0 → 100000 mSec	Indicates the maximum waiting time in milliseconds within which the first byte of a response from the Station should be received after the transmission of a request message.

**2.1.2 Channel Parameters for the Modbus RTU Master:-**

Channel Attributes	Default Value	Supported Values	Details
Channel Type	RS232	RS232/RS422/RS485	NA
Communication Mode	Full Duplex	Half Duplex/ Full Duplex	NA
Baud rate	9600 baud	600 → 19200 baud	Indicates the Baud Rate at which communicates.
Data Bits	8 bits	7/8 bits	Indicates the No of Data Bits
Stop Bits	1	1/2	Indicates the Number of Stop Bits
Parity	Even	Even/odd/none	Indicates the Parity Type
Port	Com1	Com1 → Com4	Indicates the Name of the Port
Flow Control	None	None/Hardware/Software	Indicates the Type of flow control.
CTS Delay	30 msec	0 → 100 sec	Indicates the Delay between rising of CTS signal by the modem and starting of a new transmission
Header Time out	1000 msec	0 → 10000 sec	Indicates the maximum waiting time in milliseconds within which the first byte of a response from the Station should be received after the transmission of a request message.
Retries	2	0 → 5	Indicates the Maximum number of retries when there is no reply from the end device.

**2.1.3 Node Parameters:-**

Node Attributes	Default Value	Supported Values	Details
Node Address	1	1 → 255	Indicates the Address of Remote slave Device. This is the physical station address which has to be set in the remote device.
Time Synchronization	Disabled	Enable / Disable	Modbus master can send time synchronization messages if this is enabled. Check Time Synchronization section for details. This option is custom defined. For more information contact support.
Starting Offset Address	0	Integer value	The time Synchronization command is issued by using the function preset multiple registers. This attribute will be the starting address in this query.
Time synchronization interval	0 Secs	Integer value in Secs	This is the time interval between successive time synchronization command.

## **2.2. Protocol Specific Functions:-**

<b>Function Types</b>	<b>Object Types</b>	<b>Supported Data Formats</b>
Read Coil Status (FC = 1)	SI (Single Indications)	NA
	DI (Double Indications)	NA
Read Discrete Inputs (FC = 2)	SI (Single Indications)	NA
	DI (Double Indications)	NA
Read Holding Register (FC = 3)	AI (Analog Inputs)	Unsigned Single Register, Signed Single Register Unsigned 32 bit (msw-lsw) Unsigned 32 bit (lsw-msw) Signed 32 bit (msw-lsw) Signed 32 bit (lsw-msw) Float Float (lsw-msw) Double
	PC (Pulse Counters)	Unsigned Single Register Signed Single Register Unsigned 32 bit (msw-lsw) Unsigned 32 bit (lsw-msw) Signed 32 bit (msw-lsw) Signed 32 bit (lsw-msw)
Read Input Register (FC = 4)	AI (Analog Inputs)	NA
Force Single Coil (FC = 5)	SC (Single Commands)	NA
Force Single Register (FC = 6)	AO (Analog Outputs)	Unsigned Single Register Signed Single Register Unsigned 32 bit (msw-lsw) Unsigned 32 bit (lsw-msw) Signed 32 bit (msw-lsw) Signed 32 bit (lsw-msw) Float (msw-lsw) Float (lsw-msw) Double
Force Multiple Coil (FC = 15)	DC (Double Commands)	NA
Force Multiple Register (FC = 16)	AO (Analog Outputs)	Unsigned Single Register Signed Single Register Unsigned 32 bit (msw-lsw) Unsigned 32 bit (lsw-msw) Signed 32 bit (msw-lsw) Signed 32 bit (lsw-msw) Float Float (lsw-msw) Double

### 3. Protocol Profile Details

#### 3.1. Object Type: -

Each profile entry is classified according to its type. Various available types and its details are given below. These types can be mapped to respective types from the mapping protocols.

Object Types	Details
SI (Single Indications)	These are the single indications, which can hold a single binary value.
DI (Double Indications)	These objects can have values 0 → 3. '1' is considered as off state and '2' is considered as on state.
AI (Analog Input)	It can hold various analog values depending upon the data format specified.
PC (Pulse Counter)	It can hold various analog values depending upon the data format specified. It gets mapped to corresponding pulse counters present in the Master.
SC (Single Command)	It is a single command using which we can set either 0 or 1 to a corresponding address.
AO (Analog Output)	Using this we can set an analog set point to an address.
DC (Double Command)	It is a double command. '1' indicates off state and '2' indicates the on state.

#### 3.2. Function Types: -

Kalki GatewayLite supports the following function Types.

- Read Coil Status ( FC = 1 )
- Read Discrete Inputs ( FC = 2 )
- Read Holding Register ( FC = 3 )
- Read Input Register ( FC = 4 )
- Write Single Coil ( FC = 5 )
- Write Single Register ( FC = 6 )
- Write Multiple Coils ( FC = 15 )
- Write Multiple Registers ( FC = 16 )

#### 3.3. Data Formats: -

There are various types of data formats

- Unsigned Single Register
- Signed Single Register
- Unsigned 32 bit (msw-lsw)
- Unsigned 32 bit (lsw-msw)
- Signed 32 bit (msw-lsw)
- Signed 32 bit (lsw-msw)
- Float
- Float (lsw-msw)
- Double

### **3.4. Start Address:-**

It is the starting address of data type of the Modbus TCP/RTU Slave.

### **3.5. Number of Points: -**

This implies the total number of points shall read from the Slave device.

### **3.6. Scale: -**

This is the factor by which the Modbus data gets multiplied before sending to the External master (Can be SCADA master). This is especially necessary when Modbus slave does not support floating-point data type and user is interested in acquiring the decimal numbers from the slave. The Modbus TCP /TU Master protocol will multiply the acquired value by scale value and send the same to other devices. The default value of this is 1.

### **3.7. Mode: -**

Modbus standard does not specify anything about the various analog data types. So the data transfer depends upon how slave and master devices interpret the messages. "Mode" is used to interpret the messages differently. If mode is not selected (not ticked) the master will consider all the Master registers are having 16 bit register size. So in order to get a float data from Master, master will request for 2 registers. To get a double data master will request for 4 registers etc. If mode is selected master will assume that the Master register has as much size as data type. So in order to get a float, master will request for a register and Master will reply with 4 bytes of data. To get a double master will still request for a register and Master will reply with 8 bytes of data.

### **3.8. Event: -**

This option indicates whether the configured parameter should be reported when there is change in the value or on the request from the other master protocol. If this option is enabled then the particular parameter is reported to other mapped master protocol when there is change in the value. (Necessarily mapping protocol also must support this option). For example in case of Modbus TCP/RTU master is being mapped to IEC101/104 Slave, the Class mask must be selected as Class 1 for the event based parameters. If this option is disabled (unchecked), then this particular parameter/profile can be mapped as Class 2 data for which mapped parameter are reported on cyclic period.

### **3.9. Polling Cycle: -**

The particular profile is polled at every configured polling cycle milliseconds. *Please note that Modbus polls sequentially.*

## 4. Time Synchronization in Modbus Master: -

There are no specific function codes available in modbus protocol for time synchronization. So the specific functionality is achieved using the existing function code. The addresses used for this is taken on assumption that the specific address (under the same function code) is not used for any other purpose.

The master has to write the date and time in the specific registers and should send it to the slave stations. The slave will interpret it as time synchronization command and will get synchronized.

The time Synchronization has to be enabled from Easy Connect configuration tool to have time synchronization for modbus.

### 4.1. Time Sync Details: -

The **function code 16 (Write Multiple Registers)** is used to do the time synchronization. Analog and Unsigned Single Registers are used to send the time information from Master to Slave. The master has to write the date & time information in continuous registers starting from offset address configured in the node parameter (the base of modbus address is 4XXXX). The higher register addresses are chosen to hold the time information. The date & time information has given below.

The time synchronization command will be repeated in time interval, which can be configured in node parameter of Modbus Master.

**Function Code: 16**

**Description: Write Multiple Registers**

**Format: Unsigned Single Registers**

**Base: 40000**

Offset	Value
X	Year (YYYY)
X+1	Day (DD)
X+2	Month (MM)
X+3	Hour (HH)
X+4	Minutes (MM)
X+5	Seconds (SS)
X+6	Milliseconds (XXX)

Note: The address X is configured in the [node parameter](#)

## 5. Mapping Details from other protocols: -

This section gives detailed idea of the data types in other slave protocols, which can be mapped, to specific Modbus master types.

<b>Modbus Master types</b>	<a href="#">MB-T1</a> <a href="#">MB-T2</a>	<a href="#">MB-T3</a> <a href="#">MB-T4</a>	<a href="#">MB-T5</a> <a href="#">MB-T6</a>	<a href="#">MB-T7</a> <a href="#">MB-T8</a>	<a href="#">MB-T9</a> <a href="#">MB-T10</a>	<a href="#">MB-T11</a> <a href="#">MB-T12</a>
IEC101/ 104 slave types	<a href="#">14-M1</a> <a href="#">14-M2</a>	<a href="#">14-M1</a> <a href="#">14-M2</a>	<a href="#">14-M3</a> <a href="#">14-M4</a> <a href="#">14-M5</a> <a href="#">14-M6</a> <a href="#">14-M7</a> <a href="#">14-M8</a>	<a href="#">14-C1</a> <a href="#">14-C2</a> <a href="#">14-C3</a>	<a href="#">14-C1</a> <a href="#">14-C2</a> <a href="#">14-C3</a>	<a href="#">14-C4</a> <a href="#">14-C5</a> <a href="#">14-C6</a> <a href="#">14-C7</a>
IEC103 slave types	<a href="#">103-T1</a> <a href="#">103-T2</a>	<a href="#">103-T1</a> <a href="#">103-T2</a>	<a href="#">103-T3</a> <a href="#">103-T4</a> <a href="#">103-T9</a>	<a href="#">103-T20</a>	<a href="#">103-T20</a>	NA
Modbus slave types	<a href="#">MB-T1</a> <a href="#">MB-T2</a>	<a href="#">MB-T3</a> <a href="#">MB-T4</a>	<a href="#">MB-T5</a> <a href="#">MB-T6</a>	<a href="#">MB-T7</a> <a href="#">MB-T8</a>	<a href="#">MB-T9</a> <a href="#">MB-T10</a>	<a href="#">MB-T11</a> <a href="#">MB-T12</a>
DNP3.0 slave types	<a href="#">DN-T1</a> <a href="#">DN-T3</a>	<a href="#">DN-T1</a> <a href="#">DN-T3</a>	<a href="#">DN-T2</a> <a href="#">DN-T4</a>	<a href="#">DN-T5</a>	<a href="#">DN-T5</a>	<a href="#">DN-T6</a>
SPA slave types	<a href="#">SP-T1</a> <a href="#">SP-T3</a>	<a href="#">SP-T1</a> <a href="#">SP-T2</a>	<a href="#">SP-T3</a> <a href="#">SP-T4</a>	<a href="#">SP-T5</a> <a href="#">SP-T6</a>	<a href="#">SP-T5</a> <a href="#">SP-T6</a>	<a href="#">SP-T7</a>
Courier slave types	<a href="#">CR-T1</a> <a href="#">CR-T2</a>	<a href="#">CR-T1</a> <a href="#">CR-T2</a>	<a href="#">CR-T3</a>	<a href="#">CR-T4</a> <a href="#">CR-T5</a>	<a href="#">CR-T4</a> <a href="#">CR-T5</a>	<a href="#">CR-T6</a>

## 6. Protocol Type Details: -

<b>IEC101/104 Type Details</b>	
<b>IEC101/104 types</b>	<b>Type Details</b>
14_M1	Single Indication
14_M2	Double Indication
14_M3	Step position information
14_M4	Measured value, normalized value
14_M5	Measured value, Scaled value
14_M6	Measured value, short floating point value
14_M7	Integrated totals
14_M8	Bitstring of 32 bit
14_C1	Single command
14_C2	Double command
14_C3	Regulating step command
14_C4	Set point command, normalised value
14_C5	Set point command, Scaled value
14_C6	Set point command, short floating point value
14_C7	Set point command, Bitstring of 32 bit

**Modbus Type Details**

<b>Modbus types</b>	<b>Type Details</b>	<b>Supported Formats</b>
MB-T1	Single Indication, Read Coil status	NA
MB-T2	Single Indication, Read Discrete inputs	NA
MB-T3	Double Indication, Read Coil status	NA
MB-T4	Double Indication, Read Discrete inputs	NA
MB-T5	Analog I/P, Read Input Registers	NA
MB-T6	Analog I/P, Read Holding Registers	Signed Single Register Unsigned Single Register Signed 32 bit Register ( lsw – msw ) Signed 32 bit Register ( msw – lsw ) Unsigned 32 bit Register ( lsw – msw ) Unsigned 32 bit Register ( msw – lsw ) Float ( lsw – msw ) Float ( msw – lsw ) Double
MB-T7	Single Command, Force single coil	NA
MB-T8	Single Command, Force multiple coils	NA
MB-T9	Double Command, Force single coil	NA
MB-T10	Double Command, Force multiple coils	NA
MB-T11	Analog O/P, Force single register	Signed Single Register Unsigned Single Register
MB-T12	Analog O/P, Force multiple registers	Signed Single Register Unsigned Single Register Signed 32 bit Register ( lsw – msw ) Signed 32 bit Register ( msw – lsw ) Unsigned 32 bit Register ( lsw – msw ) Unsigned 32 bit Register ( msw – lsw ) Float ( lsw – msw ) Float ( msw – lsw )



**IEC103 Type Details**

<b>IEC103 types</b>	<b>Type Details</b>
103-T1	Time Tagged Message (103 TYPE = 1)
103-T2	Time Tagged Message With Relative Time(103 TYPE = 2)
103-T3	Measurands I (103 TYPE = 3)
103-T4	Time Tagged Measurands with Relative Time. (103 TYPE = 4)
103-T5	Identification (103 TYPE = 5)
103-T9	Measurands II (103 TYPE = 9)
103-T20	Write general commands (103 TYPE = 20)
103-T21	Directory



**DNP3.0 Type Details**

<b>DNP3.0 types</b>	<b>Type Details</b>
DN-T1	Binary Input
DN-T2	Analog Input
DN-T3	Binary Output Status
DN-T4	Analog Output Status
DN-T5	Binary Output Command
DN-T6	Analog Output Command

<b>SPA Type Details</b>				
<b>SPA types</b>	<b>Type Details</b>	<b>Supported Data Types</b>	<b>Supported Data Formats</b>	<b>Update Methods</b>
SP-T1	Single Indications	I, O, S, V, M, C	Bits, Hex, Real, Long Int	Polling , Events , polling & events
SP-T2	Double Indications	I, O, S, V, M, C	Bits, Hex, Real, Long Int	Polling , Events , polling & events
SP-T3	Analog Inputs	I, O, S, V, M, C	Bits, Hex, Real, Long Int	Polling
SP-T4	Pulse Counters	I, O, S, V, M, C	Bits, Hex, Real, Long Int	Polling
SP-T5	Object Commands	I, O, S, V, M, C	Bits, Hex, Real, Long Int	NA
SP-T6	Double Commands	I, O, S, V, M, C	Bits, Hex, Real, Long Int	NA
SP-T7	Analog Outputs	I, O, S, V, M, C	Bits, Hex, Real, Long Int	NA

<b>Courier Type Details</b>			
<b>Courier types</b>	<b>Type Details</b>	<b>Supported Data Formats</b>	<b>Update Methods</b>
CR-T1	Single Indications	NA	Polling , Events , polling & events
CR-T2	Double Indications	NA	Polling , Events , polling & events
CR-T3	Analog Inputs	UnsignedInteger (1Byte) – 24H UnsignedInteger (2Bytes) – 25H UnsignedInteger (4Bytes) – 26H SignedInteger (1Byte) – 28H SignedInteger (2Bytes) – 29H SignedInteger (4Bytes) – 2AH CourierNumber (4Bytes) – 2CH Extended Courier (6Bytes) --30 H IEEE floating Format (4Bytes)--34 H	Polling
CR-T4	Single Commands	Indexed String Courier Number	NA
CR-T5	Double Commands	Indexed String Courier Number Two bits setting command	NA
CR-T6	Analog Outputs	UnsignedInteger (1Byte) – 24H UnsignedInteger (2Bytes) – 25H UnsignedInteger (4Bytes) – 26H SignedInteger (1Byte) – 28H SignedInteger (2Bytes) – 29H SignedInteger (4Bytes) – 2AH CourierNumber (4Bytes) – 2CH Extended Courier (6Bytes) --30 H IEEE floating Format (4Bytes)--34 H	NA