

**IEC60870-5-103 Master Protocol Details  
for  
KALKI Protocol Gateway/GatewayLite**

**Product User Guide**

Version – 1.0

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## 1. Introduction

The purpose of this document is to describe the functionalities of IEC103 Master protocol implemented in the Kalki Protocol Gateway / Kalki Substation GatewayLite. This will contain details of interoperability, configuration details & mapping of the data from some of the other master protocols available in Kalki Protocol Gateway.

## 2. Interoperability

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters are marked in the white boxes as follows:

- Function or ASDU is not used
- Function or ASDU is used as standardized (default)

### 2.1. Physical Layer

#### 2.1.1. Electrical Interface

- EIA RS-485
- Number of loads ..... For one protection equipment

NOTE - EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

#### 2.1.2. Optical Interface

- Glass fibre
- Plastic fibre
- F-SMA type connector
- BFOC/2,5 type connector

#### 2.1.3. Transmission speed

- 9 600 bit/s
- 19 200 bit/s

## 2.2. Link Layer

There are no choices for the link layer.

## 2.3. Application Layer

### 2.3.1. Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

### 2.3.2. Common address of ASDU

- One COMMON ADDRESS of ASDU (identical with station address)
- More than one COMMON ADDRESS of ASDU

### 2.3.3. Selection of standard information numbers in monitor direction

#### 2.3.3.1. System functions in monitor direction

- | INF                                     | Semantics                    |
|---|------------------------------|
| <input checked="" type="checkbox"/> <0> | End of general interrogation |
| <input checked="" type="checkbox"/> <0> | Time synchronization         |
| <input checked="" type="checkbox"/> <2> | Reset FCB                    |
| <input checked="" type="checkbox"/> <3> | Reset CU                     |
| <input checked="" type="checkbox"/> <4> | Start/restart                |
| <input checked="" type="checkbox"/> <5> | Power on                     |

#### 2.3.3.2. Status indications in monitor direction

- | INF                                      | Semantics                 |
|--|---------------------------|
| <input checked="" type="checkbox"/> <16> | Auto-recloser active      |
| <input checked="" type="checkbox"/> <17> | Teleprotection active     |
| <input checked="" type="checkbox"/> <18> | Protection active         |
| <input checked="" type="checkbox"/> <19> | LED reset                 |
| <input checked="" type="checkbox"/> <20> | Monitor direction blocked |
| <input checked="" type="checkbox"/> <21> | Test mode                 |
| <input checked="" type="checkbox"/> <22> | Local parameter setting   |
| <input checked="" type="checkbox"/> <23> | Characteristic 1          |
| <input checked="" type="checkbox"/> <24> | Characteristic 2          |

- <25> Characteristic 3
- <26> Characteristic 4
- <27> Auxiliary input 1
- <28> Auxiliary input 2
- <29> Auxiliary input 3
- <30> Auxiliary input 4

#### 2.3.3.3. Supervision indications in monitor direction

**INF Semantics**

- <32> Measurand supervision I
- <33> Measurand supervision V
- <35> Phase sequence supervision
- <36> Trip circuit supervision
- <37> I>> back-up operation
- <38> VT fuse failure
- <39> Teleprotection disturbed
- <46> Group warning
- <47> Group alarm

#### 2.3.3.4. Earth fault indications in monitor direction

**INF Semantics**

- <48> Earth fault L<sub>1</sub>
- <49> Earth fault L<sub>2</sub>
- <50> Earth fault L<sub>3</sub>
- <51> Earth fault forward, i.e. line
- <52> Earth fault reverse, i.e. busbar

#### 2.3.3.5. Fault indications in monitor direction

**INF Semantics**

- <64> Start /pick-up L<sub>1</sub>
- <65> Start /pick-up L<sub>2</sub>
- <66> Start /pick-up L<sub>3</sub>

- <67> Start /pick-up N
- <68> General trip
- <69> Trip L<sub>1</sub>
- <70> Trip L<sub>2</sub>
- <71> Trip L<sub>3</sub>
- <72> Trip I>> (back-up operation)
- <73> Fault location X in ohms
- <74> Fault forward/line
- <75> Fault reverse/busbar
- <76> Teleprotection signal transmitted
- <77> Teleprotection signal received
- <78> Zone 1
- <79> Zone 2
- <80> Zone 3
- <81> Zone 4
- <82> Zone 5
- <83> Zone 6
- <84> General start/pick-up
- <85> Breaker failure
- <86> Trip measuring system L<sub>1</sub>
- <87> Trip measuring system L<sub>2</sub>
- <88> Trip measuring system L<sub>3</sub>
- <89> Trip measuring system E
- <90> Trip I>
- <91> Trip I>>
- <92> Trip IN>
- <93> Trip IN>>

#### 2.3.3.6. Auto-reclosure indications in monitor direction

**INF Semantics**

- <128> CB 'on' by AR
- <129> CB 'on' by long-time AR
- <130> AR blocked

### 2.3.3.7. Measurands in monitor direction

**INF    Semantics**

- <144>    Measurand I
- <145>    Measurands I, V
- <146>    Measurands I, V, P, Q
- <147>    Measurands  $I_N$ ,  $V_{EN}$
- <148>    Measurands  $I_{L1,2,3}$ ,  $V_{L1,2,3}$ , P, Q, f

### 2.3.3.8. Generic functions in monitor direction

**INF    Semantics**

- <240>    Read headings of all defined groups
- <241>    Read values or attributes of all entries of one group
- <243>    Read directory of a single entry
- <244>    Read value or attribute of a single entry
- <245>    End of general interrogation of generic data
- <249>    Write entry with confirmation
- <250>    Write entry with execution
- <251>    Write entry aborted

## 2.3.4. Selection of standard information numbers in control direction

### 2.3.4.1. System functions in control direction

**INF    Semantics**

- <0>    Initiation of general interrogation
- <0>    Time synchronization

### 2.3.4.2. General commands in control direction

**INF    Semantics**

- <16>    Auto-recloser on/off
- <17>    Teleprotection on/off
- <18>    Protection on/off
- <19>    LED reset
- <23>    Activate characteristic 1

- <24> Activate characteristic 2
- <25> Activate characteristic 3
- <26> Activate characteristic 4

#### 2.3.4.3. Generic functions in control direction

##### INF Semantics

- <240> Read headings of all defined groups
- <241> Read values or attributes of all entries in one group
- <243> Read directory of a single entry
- <244> Read value or attribute of a single entry
- <245> General interrogation of generic data
- <248> Write entry
- <249> Write entry with confirmation
- <250> Write entry with execution
- <251> Write entry abort

#### 2.3.5. Basic application functions

- Test mode
- Blocking of monitor direction
- Disturbance data
- Generic services
- Private data

2.3.6. Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e., for each measurand there is only one choice.

Measurand	Max. MVAL = rated value times	
	1,2	or 2,4
Current L <sub>1</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L <sub>2</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L <sub>3</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>1-E</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>2-E</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>3-E</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Active power P	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Reactive power Q	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Frequency f	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>1</sub> - L <sub>2</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

### 3. Configuration Details

Configuration of KSGl is done through the configuration utility named “EasyConnect”. The IEC103 master configuration is divided into 3 parts – channel configuration, node configuration & configuration of profile.

#### 3.1. Channel Configurations

Channel configuration involves configuration of the following parameters.

##### 3.1.1. ChannelNumber

*Description:* Indicates the Unique Identification Number For Channel

*Default:* Depends up on the order of creation

*Range:* 1-4,8,16 (Depends upon converter model)

##### 3.1.2. Channel State

*Description:* Indicates Whether the Channel is active or not.

*Default:* 1

*Range:* 0 or 1.

##### 3.1.3. Channel Mode

*Description:* Indicates the type of Link

*Default:* Unbalanced

*Range:* Unbalanced, Balanced.

##### 3.1.4. First Char Wait

*Description:* Indicates the time delay between receiving a character and transmitting the next character

*Default:* 1 millisecond

*Range:* 0-100 milliseconds

### **3.1.5. Channel Type**

*Description:* Indicates the type of Channel

*Default:* RS232

*Range:* RS232/RS485

### **3.1.6. Baud**

*Description:* Indicates the baud Rate

*Default:* 9600

*Range:* 600-19200

### **3.1.7. Data Bits**

*Description:* Indicates the number of Data Bits

*Default:* 8

*Range:* 7,8

### **3.1.8. Stop Bits**

*Description:* Indicates the number of Stop Bits

*Default:* 1

*Range:* 1,2

### **3.1.9. Parity**

*Description:* Indicates the parity Type

*Default:* Even

*Range:* Even, Odd, None

### 3.1.10. Port

*Description:* Indicates the name of the Port

*Default:* Com1.

*Range:* Com1-16.

### 3.1.11. Flow Control

*Description:* Indicates the type of flow control.

*Default:* None

*Range:* None, Hardware, Software

### 3.1.12. CTS Delay

*Description:* Indicates the delay between rising of CTS signal by the modem and starting of a new transmission

*Default:* 30

*Range:* 0-100milliseconds

### 3.1.13. Post Transmission Delay

*Description:* Indicates the delay between releasing of RTS and end of a transmission.

*Default:* 0 milliseconds

*Range:* 0-100 milliseconds

### 3.1.14. Time Out

*Description:* Indicates the application layer incremental timeout in milliseconds

*Default:* 30000 milliseconds

*Range:* 0-100000 milliseconds

### **3.1.15. Frame Timeout**

*Description:* Indicates the maximum time to allow receiving an entire frame.

*Default:* 15000 milliseconds

*Range:* 0-50000 milliseconds

### **3.1.16. Confirm Timeout**

*Description:* Maximum time to wait for a link layer confirmation.

*Default:* 2000 milliseconds

*Range:* 0-50000 milliseconds

### **3.1.17. Retries**

*Description:* Indicates the maximum number of retries.

*Default:* 3

*Range:* 0-10

### **3.1.18. Link Confirm Mode**

*Description:* Specifies when to ask for link layer confirmations.

*Default:* Always.

*Range:* Never, Always

### **3.1.19. Single Char Acknowledgement**

*Description:* Enable/Disable Single Character Acknowledgement

*Default:* Disable.

*Range:* Enable/Disable.

### 3.1.20. Single Char Response

*Description:* Enable/Disable Single Character Response.

*Default:* Disable.

*Range:* Enable/Disable.

### 3.1.21. Test Frame Period

*Description:* Indicates the time between test frames when a balanced link Mode is selected.

*Default:* 0 seconds

*Range:* 0-1800 seconds

### 3.1.22. Link Address Size

*Description:* Indicates the size of link address. Link address is specified under node configuration depending on this attribute.

*Default:* 1

*Range:* 1,2

## **3.2. Node Configurations**

### 3.2.1. Node Number

*Description:* Indicates the Unique Identification Number For Node

*Default:* Depends up on the order of creation.

*Range:* 1-64,128,256(Depends upon converter model).

### 3.2.2. Node State

*Description:* Indicates whether Node is active or not.

*Default:* 1

*Range:* 0 or 1.

### 3.2.3. Link Address

*Description:* Indicates the link address specified in IEC60870-5-103. The size of the link address comes under channel configuration parameters.

*Default:* 1

*Range:* 0-255 or 0-65535

### 3.2.4. ASDU Address

*Description:* This indicates the value of ASDU address specified in IEC60870-5-103.

*Default:* 1

*Range:* 0-255 or 0-65535 (Depends on the number of Octets).

### 3.2.5. Class1 Poll Delay

*Description:* Indicates the time before class 1 poll when no request pending. '0' indicates the class-1 poll will be given only when ACD bit is set from the slave.

*Default:* 0 ms.

*Range:* 0-60000 ms.

### 3.2.6. Class2 Poll Delay

*Description:* Indicates the time before class 2 poll when no request pending.

*Default:* 500 ms.

*Range:* 0-60000 ms.

### 3.2.7. Clock Synch Interval

*Description:* Denotes interval in which clock is synchronized.

*Default:* 10

*Range:* 1-120 minutes

### 3.2.8. General Interrogation Interval

*Description:* Indicates the Interval in which a General Interrogation command is send. A zero interval means no general interrogation command..

*Default:* 5 minutes.

*Range:* 0-1440 minutes.

### 3.2.9. EOI Action Mask

*Description:* Indicates the Mask specifying operations to perform as a result of receiving EOI/IDENT

- a. Perform Clock Synchronization 0x0001
- b. Perform General Interrogation 0x0002.

*Default:* 3

*Range:* 0,1,2,3.

### 3.2.10. Online Action Mask

*Description:* Indicates the Mask indicating what commands to send when ONLINE received

- a. Perform Clock Synchronization 0x0001
- b. Perform General Interrogation 0x0002

*Default:* 3.

*Range:* 0,1,2,3

### 3.2.11. Blocking Disable Mask

*Description:* Indicates the Mask indicating what commands to send when blocking disabled is received.

- a) Perform Clock Synchronization 0x0001
- b) Perform General Interrogation 0x0002

*Default:* 2

Range: 0,1,2,3

### 2.3.12. VDEW Extension

Description: Enable/Disable VDEW Extension for commands.

Default: Enable.

Range: Enable / Disable.

## **3.3. Profile Attributes**

### 3.3.1. ASDU Types

You can configure the different ASDU types of IEC103 here. The following are major ASDU types available for configuration.

#### **3.3.1.1. Time tagged message**

This corresponds to ASDU TYPE 1 of IEC60870-5-103 ( defined under section **7.3.1.1** ).

#### **3.3.1.2. Time tagged message with relative time**

This corresponds to ASDU TYPE 2 of IEC60870-5-103 ( defined under section **7.3.1.2** ).

#### **3.3.1.3. Measurands - 1**

This corresponds to ASDU TYPE 3 of IEC60870-5-103 ( defined under section **7.3.1.3** ).

#### **3.3.1.4. Time tagged measurands with relative time**

This corresponds to ASDU TYPE 4 of IEC60870-5-103 ( defined under section **7.3.1.4** ).

#### **3.3.1.5. Measurand – 2**

This corresponds to ASDU TYPE 9 of IEC60870-5-103 ( defined under section **7.3.1.8** ).

#### **3.3.1.6. Write General commands**

This corresponds to ASDU TYPE 20 of IEC60870-5-103 ( defined under section **7.3.2.4** ).

### 3.3.2. Function type

It comes as a part Information object identifier. This denotes the function type specified under section **7.2.5.1** of IEC60870-5-103. KSGl supports standard function types and private implementations.

### 3.3.3. Start of Information number

It comes as a part Information object identifier. This denotes the information number specified under section **7.2.5.2** of IEC60870-5-103. KSGl supports standard information numbers and private implementations.

**3.3.4. Number of points**

It denotes the total number of information points starting from the specified information number (3.3.3). The other points will have consecutive information numbers.

**4. Mapping Details to other protocols: -**

This section gives detailed idea of the data types in other slave protocols, to which specific IEC103 master types can be mapped.

<b>IEC103 mast er Types</b>	<a href="#"><u>103-T1</u></a> <a href="#"><u>103-T2</u></a>	<a href="#"><u>103-T3</u></a> <a href="#"><u>103-T4</u></a> <a href="#"><u>103-T9</u></a>	<a href="#"><u>103-T20</u></a>
IEC101/ 104 slave types	<a href="#"><u>14-M1</u></a> <a href="#"><u>14-M2</u></a>	<a href="#"><u>14-M4</u></a> <a href="#"><u>14-M5</u></a> <a href="#"><u>14-M6</u></a> <a href="#"><u>14-M7</u></a> <a href="#"><u>14-M8</u></a>	<a href="#"><u>14-C1</u></a> <a href="#"><u>14-C2</u></a> <a href="#"><u>14-C3</u></a>
IEC103 slave types	<a href="#"><u>103-T1</u></a> <a href="#"><u>103-T2</u></a>	<a href="#"><u>103-T3</u></a> <a href="#"><u>103-T4</u></a> <a href="#"><u>103-T9</u></a>	<a href="#"><u>103-T20</u></a>
Modbus slave types	<a href="#"><u>MB-T1</u></a> <a href="#"><u>MB-T2</u></a> <a href="#"><u>MB-T3</u></a> <a href="#"><u>MB-T4</u></a>	<a href="#"><u>MB-T5</u></a> <a href="#"><u>MB-T6</u></a>	<a href="#"><u>MB-T7</u></a> <a href="#"><u>MB-T8</u></a> <a href="#"><u>MB-T9</u></a> <a href="#"><u>MB-T10</u></a>
DNP3.0 slave types	<a href="#"><u>DN-T1</u></a> <a href="#"><u>DN-T3</u></a>	<a href="#"><u>DN-T2</u></a> <a href="#"><u>DN-T4</u></a>	<a href="#"><u>DN-T5</u></a>

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**IEC101/104 Type Details**

<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

<b>Modbus Type Details</b>		
<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 )

<b>IEC103 Type Details</b>	
<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

<b>DNP3.0 Type Details</b>	
<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