

**IEC60870-5-103 Slave 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 Slave 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 L₁
- <49> Earth fault L₂
- <50> Earth fault L₃
- <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 L₁
- <65> Start /pick-up L₂
- <66> Start /pick-up L₃

- <67> Start /pick-up N
- <68> General trip
- <69> Trip L₁
- <70> Trip L₂
- <71> Trip L₃
- <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 L₁
- <87> Trip measuring system L₂
- <88> Trip measuring system L₃
- <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 ₁	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L ₂	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L ₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L _{1-E}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L _{2-E}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L _{3-E}	<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 ₁ - L ₂	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

3. Configuration Details

Configuration of KSGl is done through the configuration utility named “EasyConnect”. The IEC103 slave 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. Poll Delay

Description: Delay between two consecutive polls for the slave to go offline.

Default: 20000

Range: 0-65535 ms

3.2.6. Cyclic Period

Description: Period for sending the cyclic data.

Default: 0

Range: 0-4294967 seconds

3.2.7. Clock Valid Period

Description: Slave Sets the clocks as invalid incase of time synchronization command not being received in this period.

Default: 1440

Range: 0 to 70000 Minutes

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, from which specific IEC103 slave types can be mapped.

IEC103 slave Types	<u>103-T1</u> <u>103-T2</u>	<u>103-T3</u> <u>103-T4</u> <u>103-T9</u>	<u>103-T20</u>
IEC101/ 104 master types	<u>14-M1</u> <u>14-M2</u>	<u>14-M4</u> <u>14-M5</u> <u>14-M6</u> <u>14-M7</u> <u>14-M8</u>	<u>14-C1</u> <u>14-C2</u> <u>14-C3</u>
IEC103 master types	<u>103-T1</u> <u>103-T2</u>	<u>103-T3</u> <u>103-T4</u> <u>103-T9</u>	<u>103-T20</u>
Modbus master types	<u>MB-T1</u> <u>MB-T2</u> <u>MB-T3</u> <u>MB-T4</u>	<u>MB-T5</u> <u>MB-T6</u>	<u>MB-T7</u> <u>MB-T8</u> <u>MB-T9</u> <u>MB-T10</u>
DNP3.0 master types	<u>DN-T1</u> <u>DN-T3</u>	<u>DN-T2</u> <u>DN-T4</u>	<u>DN-T5</u>
SPA master types	<u>SP-T1</u> <u>SP-T2</u>	<u>SP-T3</u> <u>SP-T4</u>	<u>SP-T5</u> <u>SP-T6</u>
Courier master types	<u>CR-T1</u> <u>CR-T2</u>	<u>CR-T3</u>	<u>CR-T4</u> <u>CR-T5</u>

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IEC101/104 Type Details

IEC101/104 types	Type Details
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

Modbus types	Type Details	Supported Formats
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

IEC103 types	Type Details
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

DNP3.0 types	Type Details
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

SPA Type Details				
SPA types	Type Details	Supported Data Types	Supported Data Formats	Update Methods
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

Courier Type Details			
Courier types	Type Details	Supported Data Formats	Update Methods
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