IEC 60870-5-103

IEC 60870-5-103 is a protocol for power system monitoring and controlling. Mostly used for communication between protection devices and devices of a control system in a substation (RTU) over fiber optics.

Info about protocol

Telegram Structure

Telegram format with fixed length

	7	6	5	4	3	2	1	0
0	Start byte							
1	RES	PRM	FCB ACD	FCV DFC	Function code			
2	Link address (1-2 bytes)							
3	Checksum							
4	Stop byte							

Telegram format with variable length

	7	6	5	4	3	2	1	0
0	Start byte							
1	Length							
2	Length							
4	Start byte							
5	RES	PRM	FCB ACD	FCV DFC	Function code			
6	Link address							
7	Type identification							
8	SQ	Number of objects						
9	Cause of transmission							
10	ASDU address							
11	Function type							
12	Information number							
13...	Information elements...							
x	Checksum							
x	Stop byte							

- **RES** - Reserved
- **PRM** - 1 if master, 0 if slave

PRM = 1

- **FCB** - alternating bit for successive services per station

- **FCV** - (if **FCV**=1 **FCB** enabled)

PRM = 0

- **ACD** - access demand (if **ACD**=1 there are class 1 data)
- **DFC** - data flow control (if **DFC**=1 further messages may cause data overflow)

Function Code

PRM=1

Dec	Frame type	Service function	FCV
0	SEND/CONFIRM expected	Reset of remote link	0
1	SEND/CONFIRM expected	Reset of user process	0
2	SEND/CONFIRM expected	Reserved	-
3	SEND/CONFIRM expected	User data	1
4	SEND/REPLY expected	User data	0
5		Reserved	-
6		Reserved	-
7		Reserved	-
8	REQUEST for access demand	Expected response specifies access demand	0
9	REQUEST/RESPOND expected	Request status of link	0
10	REQUEST/RESPOND expected	Request user data class 1	1
11	REQUEST/RESPOND expected	Request user data class 2	1
12		Reserved	-
13		Reserved	-
14		Reserved	-
15		Reserved	-

PRM=0

Dec	Frame type	Service function
0	CONFIRM	ACK: positive acknowledgment
1	CONFIRM	NACK: message not accepted, link busy
2		Reserved
3		Reserved
4		Reserved
5		Reserved
6		Reserved

7		Reserved
8	RESPOND	User data
9	RESPOND	NACK: requested data not available
10		Request user data class 1
11	RESPOND	Request user data class 2
12		Reserved
13		Reserved
14		Reserved
15		Reserved

Type identification

Standard IEC 60870-5-103 data types[1-255]

- [1-31] - standard definition
- [32-255] - for special use

Dec	Description	Direction	Support
1	Time-tagged message	Monitor	Yes
2	Time-tagged message with relative time	Monitor	Yes
3	Measurands I	Monitor	Yes
4	Time-tagged measurands with relative time	Monitor	Yes
5	Identification	Monitor	Yes
6	Clock synchronization	Both	Yes
7	General interrogation	Control	Yes
8	End of general interrogation	Monitor	Yes
9	Measurands II	Monitor	Yes
10	Generic data	Both	No
11	Generic identification	Monitor	No
20	General command	Control	Yes
21	Generic command	Control	No
23	List of recorded disturbances	Monitor	No
24	Order for disturbance data transmission	Control	No
25	Acknowledgment for disturbance data transmission	Control	No
26	Ready for transmission of disturbance data	Monitor	No
27	Ready for transmission of a channel	Monitor	No
28	Ready for transmission of tags	Monitor	No
29	Transmission of tags	Monitor	No
30	Transmission of disturbance values	Monitor	No
31	End of transmission	Monitor	No

Cause of transmission

Standard IEC 60870-5-103 cause of transmission [0-255]

- [0] - not used
- [1-63] - standard definition
- [64-255] - for special use

Dec	Description

1	Spontaneous
2	Cyclic
3	Reset frame count bit (FCB)
4	Reset communication unit (CU)
5	Start/ restart
6	Power ON
7	Test mode
8	Time synchronization
9	General interrogation
10	End of general interrogation
11	Return information caused by a remote command
12	Return information caused by a local command
20	Command "ACK positive"
21	Command "ACK negative"
31	Transmission disturbance data
40	Generic write command with ACK positive
41	Generic write command with ACK negative
42	Generic read command data valid
43	Generic read command data invalid
44	Generic write conformation

Settings

Timeouts (ms)				
		Monitor	Master	Slave
	Reading data	Waiting data in serial port buffer	Waiting data in serial port buffer	Waiting data in serial port buffer
	Pause before send	Not used	Pause before send data	Pause before send data

Address				
		Monitor	Master	Slave
	Link	Not used	Remote device address	Own system address
	ASDU	Not used	Remote device address	Own system address

Commands ack.				
		Monitor	Master	Slave
	Auto ack. system commands	Not used	Not used	Auto acknowledge system commands

	Auto ack. control commands	Not used	Not used	Auto acknowledge commands

System

For all system functions user can set custom address:

```
┌APDU────────────────────
   ASDU:  1
```

General Interrogation

This function will send telegram Type-identification = 7

```
┌General interogation───────────────
   Send                    Scan: 0
```

Clock synchronization

This function will send telegram Type-identification = 103 (C_CS_NA_1)

```
┌Clock synchronization──────────
   Send        □ IV    □ SM    □ SB
   ☑ PC time   2021-11-30 04:41:22  ▼
```

If "PC time" checkbox is checked, then the PC time will be sent. If it's not checked user can set time manually.

Time tag status bits:

- **IV** - invalid time
- **SM** - Summer/Winter
- **SB** - Substitute

General Command

This function allows user to send command to slave device.

```
┌General Command ───────────────
   FUN: 1    INF: 1    Rii: 0
   
   ON                 OFF
```

Tags

This function allows user to created named points. After points created user can send it manually or set reply checkbox to automatic reply.

- To export Tags to csv file:**Tags -> Export -> Save file dialog appear**
- To import Tags from csv file:**Tags -> Import -> Open file dialog appear**

There are two ways of creating tags:

1. Create tag button.
2. Double click a signal with the left mouse button in the statistic tab.

Main parameters:

- **Name** - user-friendly tag name
- **Type** - the type of value.
- **Asdu** - Identifier of the device
- **Fun -** function number
- **Info**- Identifier of values from the device.

Here is an example image of the tag window with the**TimeTaggedMessage(1)** type selected. Each type has different options that can be configured when sending data. For example this type depicted in the picture below can send a value **Off** or **On** and it also is time-tagged. The user in this case can either select a specific time that they have in mind or just mark the PC checkbox and The Vinci software will automatically send the current PC time. As you can see the **Value** box in this example is greyed out that is because this tag is created on a**master** simulation, and this type doesn't support writing to slave.

Setup

To setup an IEC 60870-5-103 simulation it is fairly straightforward.

1. Select IEC 60870-5-103 and the mode.

2. Select Serial Port settings according to your device specification.

3. Select settings in the settings tab according to your device and preference.

4. Press the green **START** button and the simulation should start. If everything was done correctly The Vinci software should establish communication with the IEC 60870-5-103 device which you can monitor in the console tab.