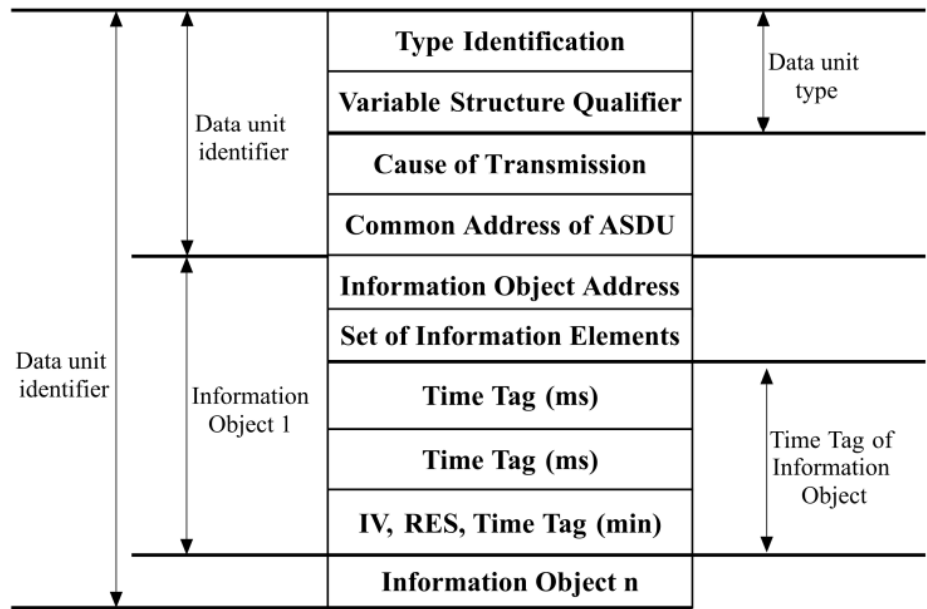


# 14.2 IEC 60870-5-101 Master

The IEC 60870-5-101 protocol is a companion standard for power system monitoring, control associated communications for telecontrol, teleprotection and associated telecommunications for electric power systems. Standard IEC 60870-5-101 was prepared by IEC Technical Committee 57 (Power system control and associated communications).

Standard IEC 60870-5-101 defines an **Application Service Data Unit (ASDU)** Figure below). In ASDU there is an ASDU identifier (with the type of ASDU in it) and information objects.

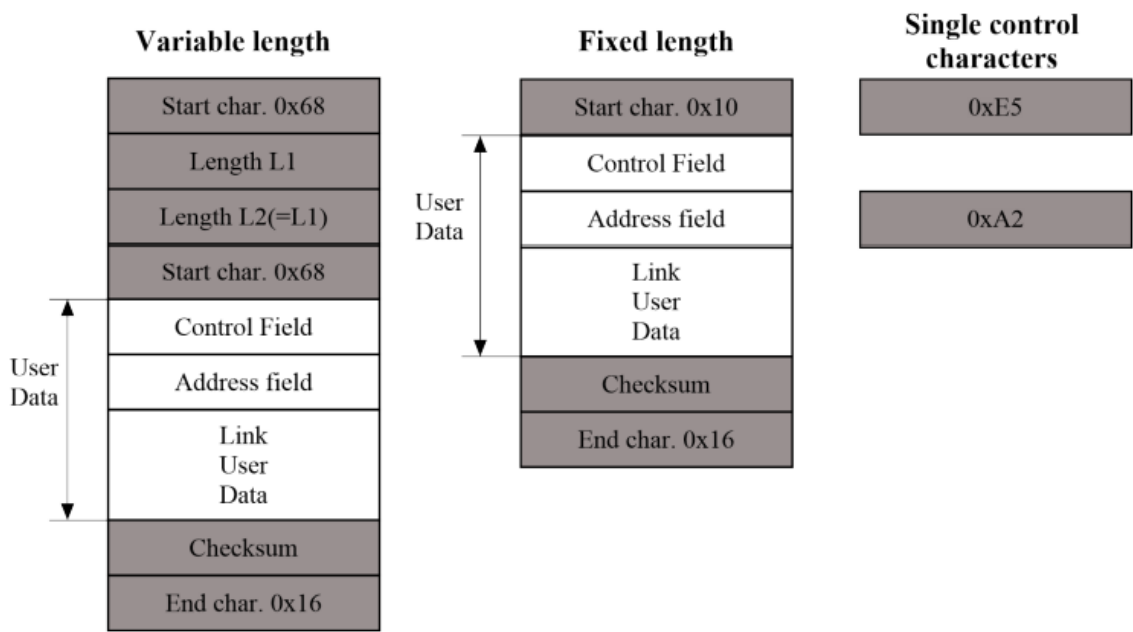


IEC 60870-5-101 ASDU structure

**Common Address of ASDU** Defines the stations' address and can be configured in Devices asdu\_address field for source and *Signals* common\_address field for the destination.

**Information Object Address** Used as destination object address in the control direction and as source object address in the monitor direction can be configured in the Signals info\_address field.

Standard IEC 60870-5-101 transmission frames are separated into 3 different types: **frame with variable length**, **frame with fixed length**, and **single control characters**



IEC 60870-5-101 ASDU structure

**The control field** provides information about the message direction, type of service, and checksum.

**The address field** specifies the link address which points to the message's destination. WCC Lite supports IEC 60870--

5-101 Master protocol over a serial link (according to EIA RS485). Its full functionality list can be found in an [IEC 60870-5-101 PID Interoperability List](#) which can be downloaded separately from this user manual.

## Configuring datapoints (master)

The IEC 60870-5-101 Master in WCC Lite has to be configured in Excel. This configuration contains two Excel sheets where parameters must be filled in Devices and Signals.

### IEC 60870-5-101 master parameters for *Devices* tab

Parameter	Type	Description	Required	Default value (when not specified)	Range	
					Min	Max
name	string	User-friendly name for a device	Yes			
description	string	Description of a device	No			
device_alias	string	Alphanumeric string to identify a device	Yes			
enable	boolean	Enabling/disabling of a device	No	1	0	1
protocol	string	Protocol to be used	Yes		IEC 60870-5-101 master	
device	string	Communication port	Yes		PORT1	PORT2
baudrate	integer	Communication speed (bauds/s)	No	9600	600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	
databits	integer	Data bit count for communication	No	8	6	9
stopbits	integer	Stop bit count for communication	No	1	1	2
parity	string	Communication parity option	No	none	none, even, odd	
flowcontrol	string	Number of requests, before the link is considered lost (device status signals are changed) and reconnect attempt will be issued	No	none	none	
link_address	integer	Destination address when in transmit and source address when broadcasting	Yes		0	65535

link_size	integer	Link address size in bytes	No	1	1	2
asdu_address	integer	Application Service Data Unit address	Yes		0	65535
asdu_size	integer	Common address size in bytes	No	1	1	2
ioa_size	integer	Information object address (IOA) size in bytes	No	2	1	3
cot_size	integer	Cause of transmission (COT) size in bytes	No	1	1	2
time_sync_interval_sec	integer	Defines how often (in seconds) a slave will request time synchronization. <b>If greater than 0</b> - slave will request synchronizations and will reset the timer if the master did it earlier. <b>If 0</b> - slave won't request timesyncs, but will allow them. <b>If 1</b> - time syncs are not supported - requests will be dropped.	No	60		
gi_interval_sec	integer	The time frame between General Interrogation requests in seconds if 0 requests are disabled	No	300		
scan_rate_ms	integer	Polling interval in milliseconds. The time frame between two telegrams from the master	Yes	100		
timeout_ms	integer	Response timeout in milliseconds	Yes	1000		
retry_count	integer	Number of retries of failed requests before announcing that the device is in Error state	Yes	1		

## IEC 60870-5-101 master parameters for Signals tab

Parameter	Type	Description	Required	Default value (when not specified)	Range	
					Min	Max
signal_name	string	User-friendly signal name	Yes			
device_alias	string	Alphanumeric string to identify a device	Yes			
signal_alias	string	Unique alphanumeric name of the signal to be used	Yes			

source_device_alias	string	device_alias of a source device	For commands			
source_signal_alias	string	signal_alias of a source signal	For commands			
enable	boolean	Enabling/disabling of an individual signal	No	1	0	1
log	integer	Allow signal to be logged. If the <b>log is 0</b> signal will not be logged. If the <b>log is more than 0</b> signal will be logged	No	0		
gi	boolean	Including/excluding (1 or 0) signals from General Interrogation	No	0	0	1
common_address	integer	Address of a destination device	Yes	1		
info_address	integer	Information object address	Yes			
data_type	integer	ASDU type identifier	Yes			1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 30, 31, 32, 34, 35, 36, 45, 46, 47, 48, 49, 50
periodic_update_ms	integer	Signal value is published periodically according to the value set.	No			

## Device status signals

IEC 60870-5-101 has an additional signal which can be configured to show communication status. It is used to indicate if the slave device has disconnected from the master (WCC Lite). To configure such signal for IEC 60870-5-101 protocol, **job\_todo** and **tag\_job\_todo** fields with string values are required. For IEC 60870-5-101 master required parameters for the status signal will be: **signal\_name**, **device\_alias**, **signal\_alias**, **common\_address**, **info\_address**, **data\_type**, **job\_todo** and **tag\_job\_todo**. **job\_todo** value must be *device\_status* and for **tag\_job\_todo** there are 4 variations: *communication\_status*, *device\_running*, *device\_error*, *unknown\_error*. Each signal has 4 possible values and is based on the same logic. If the signal returns the value of 0, it means an unknown error has appeared, 1 – the device or protocol connection is on and working properly, 2 – the device is off or the protocol is disconnected, and 3 – the error or service is down.

# Debugging an IEC 60870-5-101 Master application

If the configuration for IEC 60870-5-101 devices is set up, a handler for the protocol will start automatically. If the configuration is missing parameters or contains errors, the protocol will not start. It is done intentionally to decrease unnecessary memory usage.

If IEC 60870-5-101 does not work properly (e.g. no communication between devices, data is corrupted, etc.), a user can launch a debug session from the command line interface and find out why the link is not functioning properly. To launch a debugging session, a user should stop the *iec101-master* process and run the *iec101-master* command with respective flags as shown in the table below.

Procedure for IEC 60870-5-101 master service debugging:

- **Step 1:** Service must be stopped by entering the following command into the WCC Lite:  
**/etc/init.d/iec101-master stop**
- **Step 2:** After the service is stopped it must be started with the preferred configuration file (JSON files found in /etc/ folder) and a debug level 7:**iec101-master -c /etc/iec101-master/iec101master.json -d7**  
Additional output forming options are described here: [Command line arguments](#).
- **Step 3:** Once the problem is diagnosed normal operations can be resumed with the following command: **/etc/init.d/iec101-master start**

## IEC 60870-5-101 command line debugging options

```
-h [ -help ] Display help information
-V [ -version ] Show version
-d<debug level> Set debugging level
-c [ -config ] Config path
-r [ -raw ] Show raw telegram data
```

```
-f [ -frame ] Show frame data
-R [ -readyfile ] Ready notification file
```

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🔄Revision #5

★Created 26 January 2024 13:13:10 by Gabriele

✎Updated 27 August 2024 13:37:11 by Augustas