

14.5 IEC 60870-5-104 Master

IEC 60870-5-104 protocol (in short IEC 104) is a part of IEC Telecontrol Equipment and Systems Standard IEC 60870-5 that provides a communication profile for sending basic telecontrol messages between two systems in electrical engineering and power system automation. Telecontrol means transmitting supervisory data and data acquisition requests for controlling power transmission grids.

IEC 104 provides network access to IEC 60870-5-101 (in short IEC 101) using standard transport profiles. In simple terms, it delivers IEC 101 messages as application data (L7) over TCP, usually port 2404. IEC 104 enables communication between the control station and a substation via a standard TCP/IP network. The communication is based on the client-server model.

 To set up TLS connection for both IEC104 Master and Slave, refer to sections Excel configuration and Certificates. All keys and certificates should be provided in the PEM format.

 If no configuration is set up, IEC104 Master and Slave services are not started.

Configuring IEC 104 Master data points

To use IEC 60870-5-104 Master in WCC Lite, it has to be configured via an Excel configuration. This configuration contains two Excel sheets where parameters have to be filled in `Devices` and `Signals`.

IEC 60870-5-104 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 60870-5-104 master	
asdu_address	integer	Application Service Data Unit address	Yes		0	65535
asdu_size	integer	Common address size in bytes	No	2	1	2
time_sync_interval_sec	integer	The time frame between Time Synchronization requests in seconds	Yes	60		
gi_interval_sec	integer	The time frame between General Interrogation requests in seconds. If 0 requests are disabled	Yes	300		
port	integer	TCP port	Yes		0	65535

ioa_size	integer	Information object address (IOA) size in bytes	No	3	1	3
swt	integer	Send window (k)	Yes			
rwt	integer	Receive window (w)	Yes			
cot_size	integer	Cause of transmission (COT) size in bytes	No	2	1	3
ip	string	Host IP address (ipv4)	Yes			
t1*	integer	Acknowledge timeout t1 (sec)	Yes	15	1	255
t2*	integer	Connection ACKRSN clock t2 (sec)	Yes	10	1	254
t3*	integer	Connection TESTFR clock t3 (sec)	Yes	20	1	172800
originator	integer	Provides a means for a controlling station to explicitly identify itself	No	0	0	255

* - t1, t2 and t3 parameters must meet the inequality: $t2 < t1 < t3$.

IEC 60870-5-104 Master parameters for *Signals*

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 Yes used	Yes			
source_device_alias	string	device_alias of a source device	For commands			
source_signal_aliases	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 log is 0, the signal will not be logged. If the log is more than 0, the 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			
function	integer	Function number	No	0		

info_address	integer	Information object address	Yes			
data_type	integer	ASDU type identifier	Yes		1, 3, 5, 9, 11, 13, 21, 30, 31, 32, 34, 35, 36, 45, 46, 47, 48, 49, 50, 58, 59, 60, 61, 62, 63	
select_ms	integer	Time limit in milliseconds for command execution. Command selection has to be performed before execution if this parameter is specified. Direct command execution can be performed only if this field is left empty or set to zero.	No	0		
periodic_update_ms	integer	Signal value is published periodically according to the value set.	No	-	-	-

Device status signals

IEC 60870-5-104 has an additional signal which can be configured to show communication status. It indicates if the slave device has disconnected from the master (WCC Lite). To configure such signal for IEC 60870-5-104 protocol, `job_todo` and `tag_job_todo` fields with string values are required. For IEC 60870-5-104 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 - device or protocol connection is on and working properly, 2 - device is off or protocol is disconnected, 3 - error or service is down.

Debugging an IEC 60870-5-104 Master application

If the configuration for IEC 60870-5-104 devices is set up, the handler for the protocol will start automatically. If a configuration is missing parameters or contains errors, the protocol will not start. It is done intentionally to decrease unnecessary memory usage.

If IEC 60870-5-104 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 or use WCC Utility to do that.

To launch a debugging session, a user should stop the `iec104-master` process and run the `iec104-master` command with respective flags.

- Step 1: Service must be stopped by entering the following command into the WCC Lite:
`/etc/init.d/iec104-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: **`iec104-master -c /etc/iec104-master/iec104-master.json -d7`**
- Step 3: Once the problem is diagnosed normal operations can be resumed with the following command:
`/etc/init.d/iec104-master start`

IEC 60870-5-104 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
-e [ -redis ] Show redis message
-R [ -readyfile ] Ready notification file
```

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