

# Mathematical Operations With Lua (FW version 1.7)

Mathematical operations can be applied to Lua signals as in any other protocol. This can be done by configuring WCC Lite according to solution needed. To create an example which would test multiple mathematical operations, Excel configuration and Lua script is required. Device sheet should look similar to this:

name	device_alias	enable	protocol	execution_type	error_limit	ip	id	mode	scan_rate_ms	retry_count	timeout_ms	bind_address	host	port	asdu_size	cot_size	ioa_size	rwt	swt	t1	t2	t3	time_sync	message_size	cache_size
Modbus TCP device	Modbus_TCP	1	Modbus TCP				1	tcp	300	3	10000	0.0.0.0		502											
IEC104 SCADA system	IEC104_SCADA	1	IEC 60870-5-104 slave									0.0.0.0		2404	2	2	3	8	12	15	10	20	1	249	100
LUA device	LUA0	1	Lua runner	signal	0																				
LUA device	LUA1	1	Lua runner	signal	0																				
LUA device	LUA2	1	Lua runner	signal	0																				
LUA device	LUA3	1	Lua runner	signal	0																				
LUA device	LUA4	1	Lua runner	signal	0																				
LUA device	LUA5	1	Lua runner	signal	0																				
LUA device	LUA6	1	Lua runner	signal	0																				
LUA device	LUA7	1	Lua runner	signal	0																				
LUA device	LUA8	1	Lua runner	signal	0																				
LUA device	LUA9	1	Lua runner	signal	0																				
LUA device	LUA10	1	Lua runner	signal	0																				
LUA device	LUA11	1	Lua runner	signal	0																				
LUA device	LUA12	1	Lua runner	signal	0																				

Each Lua device is created to send result values to Modbus TCP signals with different mathematical functions applied. This way the same Lua script can be reused and is more optimal since signal alias for each device can stay the same. There are many other solutions but this one allows to observe results more clearly.

In the field "ip" for Modbus TCP master, enter IP address of Wi-Fi connection for computer in use. In the field "host" for IEC104 slave protocol enter IP address of WCC Lite device.

Signals for these devices should be mapped in example to this:

signal_name	device_alias	signal_alias	source_device_alias	source_signal_alias	execute	enable	multiply	add	bit_select	min_value	max_value	absolute_threshold	threshold_units	suppression_values	suppression_time_ms	gi	log	number_type	job_todo	tag_job_todo	common_address	info_address	data_type
Result_modbus0	Modbus_TCP	result0	LUA0	result		1											1	SIGNED16	3;0;1	3;0;1			
command LUA	LUA0	command	IEC104_SCADA	Command0	1												1						
result LUA	LUA0	result															1						
Command IEC104.0	IEC104_SCADA	Command0	LUA0	command		1		5								1	1				1	1	50
Result_modbus1	Modbus_TCP	result1	LUA1	result		1											1	SIGNED16	3;1;1	3;1;1			
command LUA	LUA1	command	IEC104_SCADA	Command1	1												1						
result LUA	LUA1	result															1						
Command IEC104.1	IEC104_SCADA	Command1	LUA1	command		1		-5								1	1				1	2	50
Result_modbus2	Modbus_TCP	result2	LUA2	result		1											1	SIGNED16	3;2;1	3;2;1			
command LUA	LUA2	command	IEC104_SCADA	Command2	1												1						
result LUA	LUA2	result															1						
Command IEC104.2	IEC104_SCADA	Command2	LUA2	command		1	5									1	1				1	3	50
Result_modbus3	Modbus_TCP	result3	LUA3	result		1											1	SIGNED16	3;3;1	3;3;1			
command LUA	LUA3	command	IEC104_SCADA	Command3	1												1						
result LUA	LUA3	result															1						
Command IEC104.3	IEC104_SCADA	Command3	LUA3	command		1		1								1	1				1	4	50
Result_modbus4	Modbus_TCP	result4	LUA4	result		1											1	SIGNED16	3;4;1	3;4;1			
command LUA	LUA4	command	IEC104_SCADA	Command4	1												1						
result LUA	LUA4	result															1						
Command IEC104.4	IEC104_SCADA	Command4	LUA4	command		1	6	2								1	1				1	5	50
Result_modbus5	Modbus_TCP	result5	LUA5	result		1											1	SIGNED16	3;5;1	3;5;1			
command LUA	LUA5	command	IEC104_SCADA	Command5	1												1						
result LUA	LUA5	result															1						
Command IEC104.5	IEC104_SCADA	Command5	LUA5	command		1		2	3							1	1				1	6	50
Result_modbus6	Modbus_TCP	result6	LUA6	result		1											1	SIGNED16	3;6;1	3;6;1			
command LUA	LUA6	command	IEC104_SCADA	Command6	1												1						
result LUA	LUA6	result															1						
Command IEC104.6	IEC104_SCADA	Command6	LUA6	command		1	5	34	4							1	1				1	7	50
Result_modbus7	Modbus_TCP	result7	LUA7	result		1											1	SIGNED16	3;7;1	3;7;1			
command LUA	LUA7	command	IEC104_SCADA	Command7	1												1						
result LUA	LUA7	result															1						
Command IEC104.7	IEC104_SCADA	Command7	LUA7	command		1			2	20						1	1				1	8	50

Each Lua device has command and result signals. Command received from IEC104 protocol is sent to Lua command signal and then this signal sends back a response for IEC104 protocol. If the response does not have negative cot

attributes, value is then sent to Lua result signal which sends value to Modbus TCP result signal. Mathematical operations are applied to IEC104 protocol signals since it is the one sending the commands.

As mentioned before Lua script for each Lua device is going to be unchanged and should look like this:

```
local saved = get(signals.result) --getting result signal which is equated to new variable 'saved'
local command = get(signals.command) --getting command signal which is equated to new variable 'command'

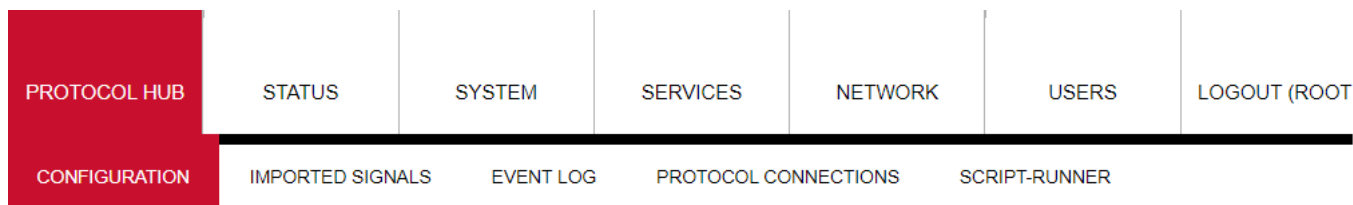
--get() function returns nill if there is no valid value

if not command then --if command is not nill
    if saved then --if signal is not nill
        publish(signals.result, saved.value) --this value is published to result signals and saved value
    end
    return 0
end

local time_diff = time_ms() - tonumber(command.time) --compares command time and real time
local is_command = time_diff < 30000 and time_diff > -30000 --if command time differs from
--real time more than 30s it will not be executed

if string.find(command.attributes, "nt") or string.find(command.attributes,
    "iv") or string.find(command.attributes, "ov") then
    --searching if signal has negative attributes
    if is_command then --if command execution time is not exceeding the limits then
        command.attributes = "cot=7,cotn" --equates negative cot values to response signal attributes
        publish(signals.command, command) -- and publishes value to command signals and value
        if saved then --if there is saved value then
            publish(signals.result, saved.value) --restores saved value to result signals
        end
        return 0
    end
else
    if is_command then
        command.attributes = "cot=7"
        publish(signals.command, command) --in this cycle command value is being returned as well as
        --cot7 and cot10 values in case given signal is command and has no negative attributes
        command.attributes = "cot=10"
        publish(signals.command, command) --publishes response to the command
        save(signals.result, command.value) --command value is being saved to result signal
    end
    publish(signals.result, command.value) --in this row command value is being published to result signals
end
```

Upload Excel configuration to WCC Lite:



## Protocol configuration

### IMPORT PROTOCOL CONFIGURATION

Here you can import Excel configuration file. Up to 1000 signals are allowed. All previous signals will be replaced.

Configuration file:



Choose File No file chosen

Import configuration



PLC (IEC-61499) Boot file:

Choose File No file chosen

Import FBOOT file

IEC61850 Server model file:

Choose File No file chosen

Import server model file

After uploading configuration no errors should appear and all signal should be represented on the web. To upload Lua script go to *Script-Runner*, select *upload script* and then *start* (for each Lua device):

PROTOCOL HUB

STATUS

SYSTEM

SERVICES

NETWORK

USERS

LOGOUT (ROOT)

CONFIGURATION

IMPORTED SIGNALS

EVENT LOG

PROTOCOL CONNECTIONS

SCRIPT-RUNNER

## Script-Runner

LUA SCRIPT INSTANCE CONTROL

Script Configuration	Script process	Status	Script File	
control1	-	Stopped	No Script provided	<div>1</div> <div>Upload Script</div> <div>Waiting for script</div>

SAVED VALUE CLEARING

Clear all saved values

PROTOCOL HUB

STATUS

SYSTEM

SERVICES

NETWORK

USERS

LOGOUT (ROOT)

CONFIGURATION

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PROTOCOL CONNECTIONS

SCRIPT-RUNNER

## Script-Runner

LUA SCRIPT INSTANCE CONTROL

Script Configuration	Script process	Status	Script File	
LUA	-	Stopped	LUA.lua	<div>2</div> <div>Upload Script</div> <div>Start</div>

SAVED VALUE CLEARING

Clear all saved values

Open Vinci as IEC104 master, enter IP address of WCC Lite and start communication. Then open another Vinci window and connect Modbus TCP master – select Modbus TCP slave in Vinci and enter the same IP address as set in Excel configuration for Modbus device. With both communications running check **Protocol connections** on WCC Lite web interface, it should show *Connected*. From IEC104 Vinci window go to System tab. Select command determined in the Excel configuration (50), IOA (different for each signal) and value. After executing command, each signal (IEC104 command, Lua command, Lua result and Modbus result) will have the same value, which now will be with math applied. For example, command with IOA=1 and value 1 is being executed. In Excel configuration for this signal **add** column has a value of 5, which means that this value is going to be added to the value sent and the result will be 6.

There can be multiple mathematical operations for one signal. For example add, multiply, bit select etc. If that is the case, math will be applied in typical order (eg. first bit select, then multiply, then add). More detailed explanation about mathematical operations in Excel configuration can be found here: **Optional parameters for signals**

A user can also apply mathematical condition for the signal value. For example minimum or maximum value, threshold, suppression time for specific value etc. Minimum and maximum values can be applied to set the range of the signal, if the value is smaller or larger signal state will show invalid or overflow. Thresholds can be used in many ways. It can be a specific value or a percentage. If the signal value passes set threshold it will be represented on imported signals window. Threshold works by comparing old value with new value and then applying the condition of either representing the value or suppressing it, depending on the value change. Suppression value and suppression time is best used together, because suppression time determines how long the specific value should be suppressed. There could be multiple values set for suppression. In Excel configuration those values should be separated by comma.

Mathematical operations combined with Lua script is useful for many cases. They can be used for filtering data, converting units, applying specific mathematical logic or other solutions.

Configuration --> Download

Lua script --> Download

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