SGC (Smart Grid Converter) Component

Short Description: This document describes the AIT's Smart Grid Converter (SGC) HILCompatible component. At the end of this document links for further readings are provided.

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REQUIREMENTS

There are two sets of requirements. First one is related to Typhoon HIL requirements, and the key requirements are listed in Table 1. Any Typhoon HIL device that fulfills the listed requirements supports this component. This component supports the C-HIL simulation of AIT HIL Controller, therefore the second requirement is to connect this device with Typhoon HIL device.

Table 1. List of Typhoon HIL requirements for SGC component

Item	Number/Value	Comment
SPCs	4	2 SPCs are fully used internally, 2 are available through the DC and AC ports
Simulations Step	2µs	2µs or smaller simulation step is required
HIL Analog Outputs	16 or 19	16 Analog Outputs are required. Additional 3 are required for parallel operation mode.
HIL Digital Outputs	16	16 Digital Outputs are required.
HIL Digital Inputs	18	These are PWM control signals and contactor control signals.

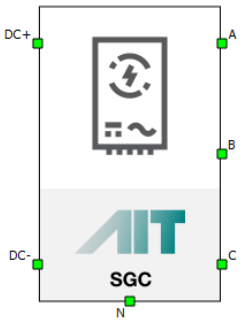
AIT HIL Controller does not work properly on 404 and 402 devices. Only way to use this controller on these devices is to connect HIL device with AIT HIL Controller through Breakout board, where Analog outputs 16 – 32 need to be connected with AGND.

COMPONENT DESCRIPTION

AIT's Smart Grid Converter component is real-time simulation ready component designed to work with AIT HIL Controller. AIT's HIL Controller is a versatile controller platform designed for modern

Smart Grid and emerging Low Inertia Micro Grid applications. AIT HIL Controller, connected to Typhoon HIL simulator where the SGC component is being simulated in real-time represents a Controller Hardware-In-the-Loop (C-HIL) system.

Table 2. SGC component in HILCompatible Library and paired HILCompatible device

Paired HILCompatible Device	Library Component	Component Parameters/Tabs
Manufacturer: Austrian Institute of Technologies HILCompatible: AIT HIL Controller 		Property tabs: ☐ HIL System Parameters ☐ SGC Parameters ☐ Controller Parameters

COMPONENT PARAMETERS

SGC parameters are divided in 3 tabs as listed in Table 2. All tabs and its properties are described in following subsections.

Tab: “HIL System Parameters”

In this block tab, HIL system Parameters are specified. Its layout is shown in Figure 1:

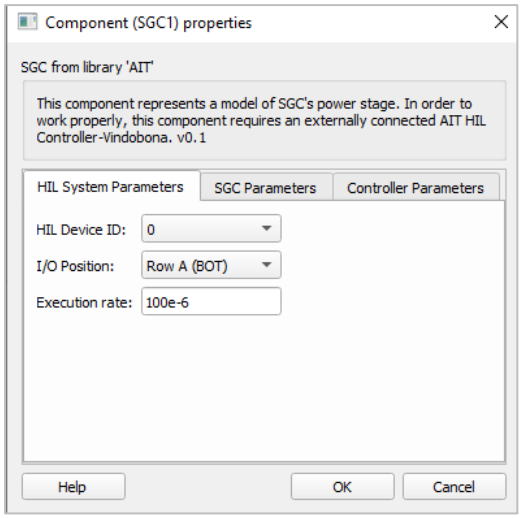


Figure 1. SGC HIL system parameters

Table 3. SGC HIL system parameters

Name	Description
HIL Device ID	This parameter should match the HIL device setting to which the AIT HIL Controller is connected. This is important only in multi-HIL simulations.
I/O Position	This parameter is available only when HIL604 or HIL 606 is used. It defines the chosen row - Row A (BOT) or Row B (TOP) for analog and digital I/Os.
Execution rate	Execution rate of the internal signal processing in seconds.

Tab: “SGC Parameters”

In this block tab, nominal values are specified. Its layout is shown in Figure 2:

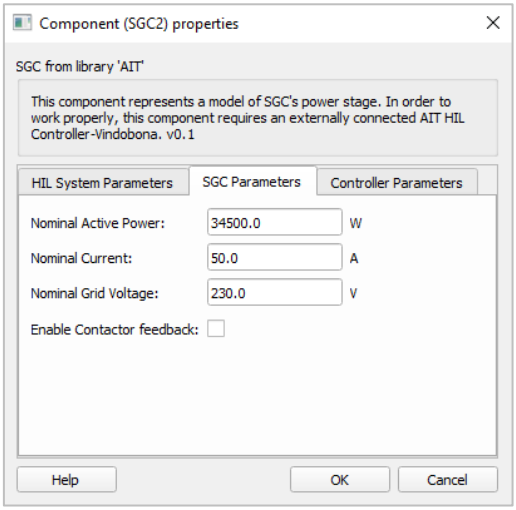


Figure 2. SGC Parameters

Table 4. SGC Parameters

Name	Description
Nominal Active Power	Nominal active power of the power stage in W .
Nominal Current	Nominal current of the power stage in A .
Nominal Grid Voltage	Nominal grid voltage of the power stage in V (phase-neutral).
Enable Contactor feedback	Enable port which allows access to SGC’s contactor feedback.

Tab: “Controller Parameters”

In this block tab, controller parameters are specified. Its layout is shown in Figure 3:

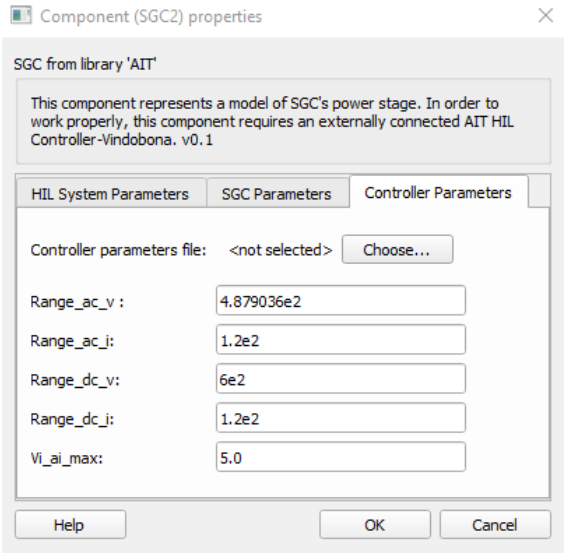


Figure 3. SGC controller Parameters

Table 5. SGC controller parameters

Name	Description
Controller Parameters file	Settings file (txt format) for setting the SGC measurement ranges, if applicable (Range_ac_v, Range_ac_i, Range_dc_v, Range_dc_i).
Range_ac_v	These Parameters are read from the controller. They define the SGC measurement ranges and the SGC peak analog input voltage. They directly influence the analog outputs scaling settings.
Range_ac_i	
Range_dc_v	
Range_dc_i	
Vi_ai_max	

SGC measurement ranges can be set manually or through a settings file exported from AIT HIL Controller. That can be done by clicking on button *Choose…*

PORTS DESCRIPTION

Table 6. Description of SGC component ports

Name	Type	Description
DC+	electrical	Positive connection of the DC bus
DC-	electrical	Negative connection of the DC bus
A	electrical	Phase A (u,r) connection
B	electrical	Phase B (w, s) connection
C	electrical	Phase C (v, t) connection
N	electrical	Neutral connection

If *Enable contactor feedback* is checked on component, signal processing type of port will appear on top of the SGC component.

IO MAPPING

Analog outputs and DIs that are used when simulating the SGC component are defined in Table 7, *Table 8* and *Table 9*.The I/O Position settings in the HIL System Parameters tab in the component's Parameters determines which Row is used.

Table 7. Used analog outputs channels (if ROW B is used, all channels are shifted by 32)

Signal	Row A (BOT)
Va	AO1
Vb	AO2
Vc	AO3
Van_grid	AO4
Vbn_grid	AO5
Vcn_grid	AO6
VDC1m	AO7
VDC2m	AO8
IDCm	AO9
Ila	AO10
Ilb	AO11
Ilc	AO12
Iln	AO13
Ia_grid	AO14
Ib_grid	AO15
Ic_grid	AO16
In_grid	AO17
Vn	AO26
Vn_grid	AO27

Table 8. Used digital outputs channels ((if ROW B is used, all channels are shifted by 32))

Digital Signal	Row A (BOT)
DO1	DO1
DO2	DO2
DO3	DO3
DO4	DO4
DO5	DO5
DO6	DO6
DO7	DO7
DO8	DO8
DO9	DO9
DO10	DO10
DO11	DO11
DO12	DO12
DO13	DO13
DO14	DO14
DO15	DO15
DO16	DO16

Table 9. Used digital inputs channels (if ROW B is used, all channels are shifted by 32)

Digital Signal	Row A (BOT)
Sa_1	DI 4
Sa_2	DI 18
Sa_3	DI 17
Sa_4	DI 5
Sb_1	DI 7
Sb_2	DI 20
Sb_3	DI 19
Sb_4	DI 8
Sc_1	DI 10
Sc_2	DI 22
Sc_3	DI 21
Sc_4	DI 11
S1	DI 13
S2	DI 24
S3	DI 23
S4	DI 14
contactor switches	DI 1
	DI 2

INTERNAL STRUCTURE

The global internal structure of the SGC component is shown in Figure 4.

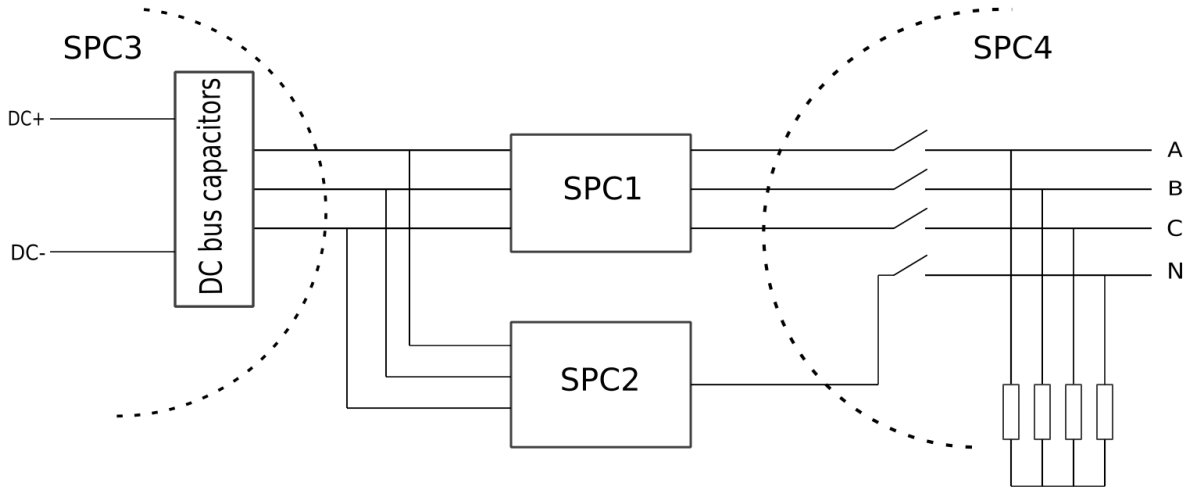


Figure 4. SGC internal structure

In order to simulate the SGC component, 4 Signal Processing Cores (SPCs) are required, two of which (SPC1 and SPC2) can be found in the internal structure of the SGC component. In addition, there are DC bus capacitors on the DC side of the SGC component, which use SPC3. Lastly, contactors and resistors for large resistances are on the AC side, which use SPC4.

LINKS

HILCompatible Step-by-Step Guide – contains step-by-step instructions how to get the HILCompatible up and running with provided model examples and automated test examples.

Hardware User Guide – Typhoon HIL devices user guide

Typhoon HIL web page – Typhoon HIL web page dedicated to AIT HIL Controller.