

Eaton Microgrid Controller in the loop with

Typhoon HIL ultra-high fidelity real-time HIL simulation

Eaton

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Typhoon HIL

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Prof. Vannevar Bush

Differential Analyzer
“Analog twin”

The beginning of
Scientific Computing

Power grid simulation
The first big problem



The Microgrid “Digital Twin”

Eaton microgrid controller w/ ultra-high fidelity HIL

Eaton microgrid controller:

Decentralized control architecture

One local controller **per DER**

web based **HMI**

Typhoon HIL real-time simulator:

20ns sampling time

2us and **4us** simulation step

Typhoon **HIL603** real-time simulators

32 Typhoon Processor cores

8 ARM cores

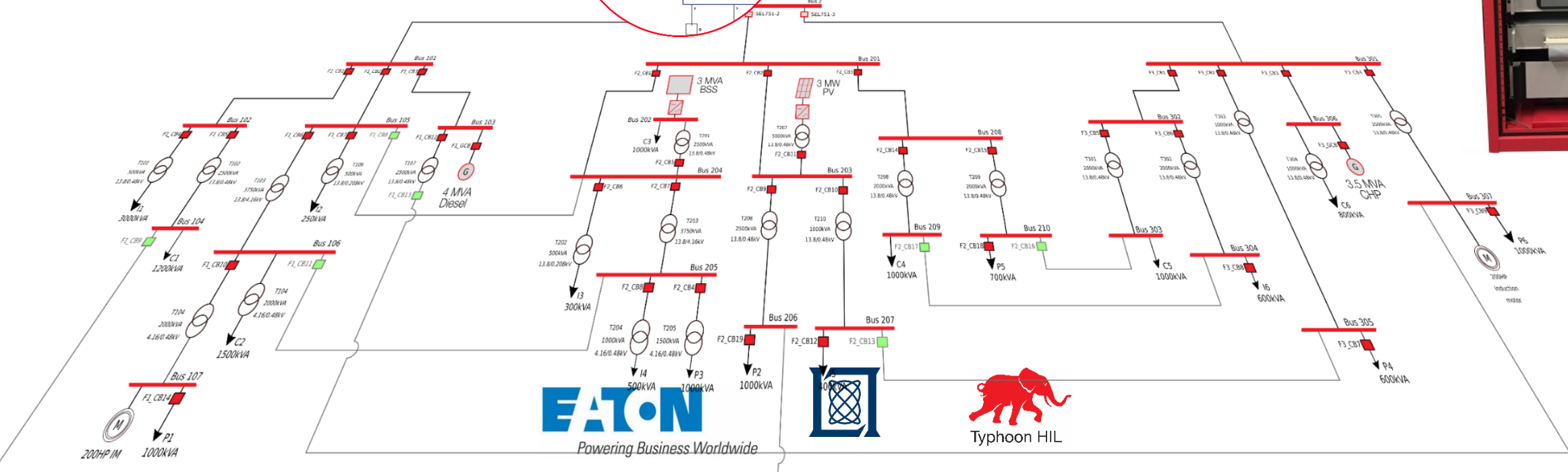
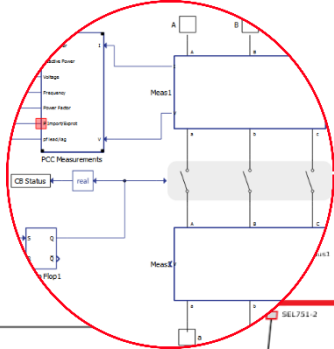
The Eaton logo consists of the word "EATON" in a bold, blue, sans-serif font. The letter "O" is stylized with a white dot in the center.

Powering Business Worldwide

The Eaton logo, featuring the word "EATON" in blue and the tagline "Powering Business Worldwide" below it.

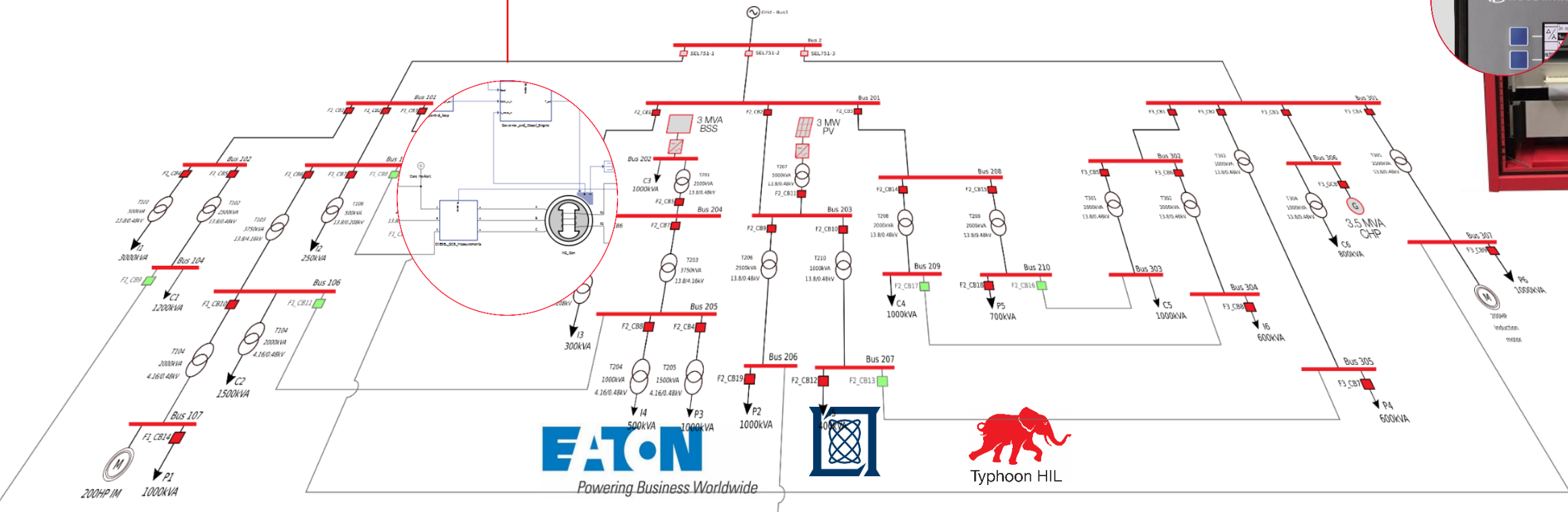
Banshee Microgrid Digital Twin

SEL relay in the loop

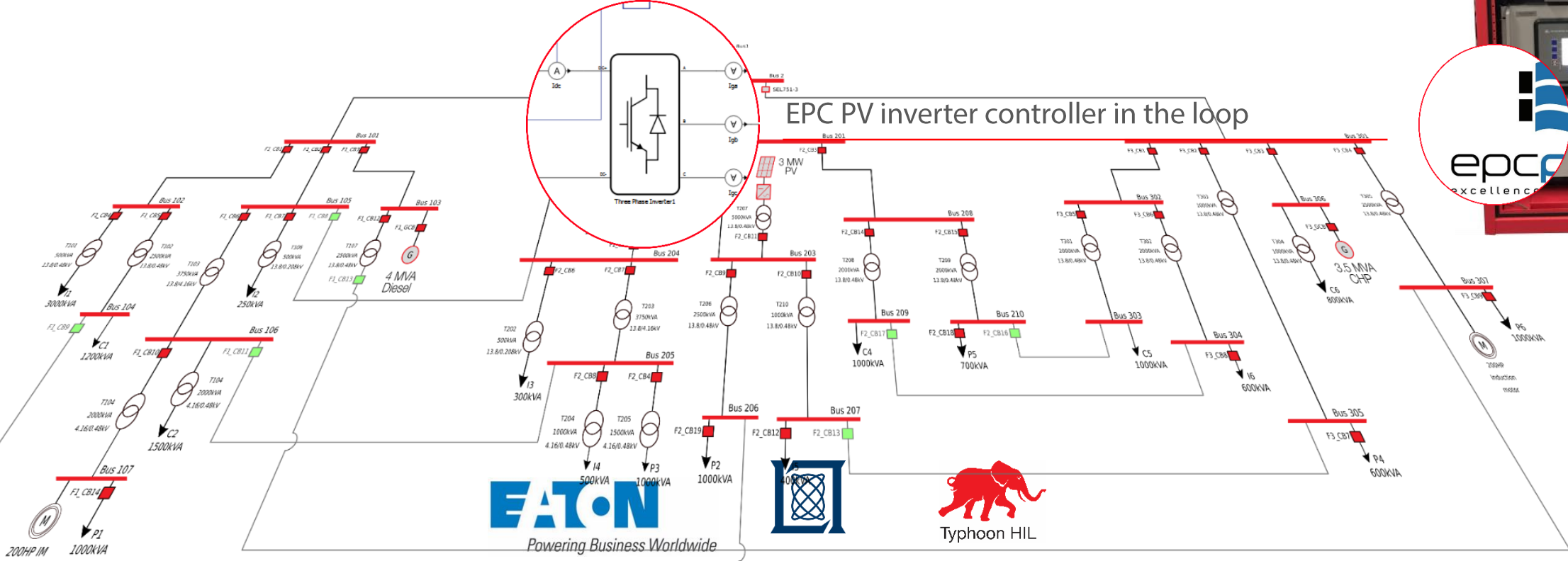


Banshee Microgrid Digital Twin

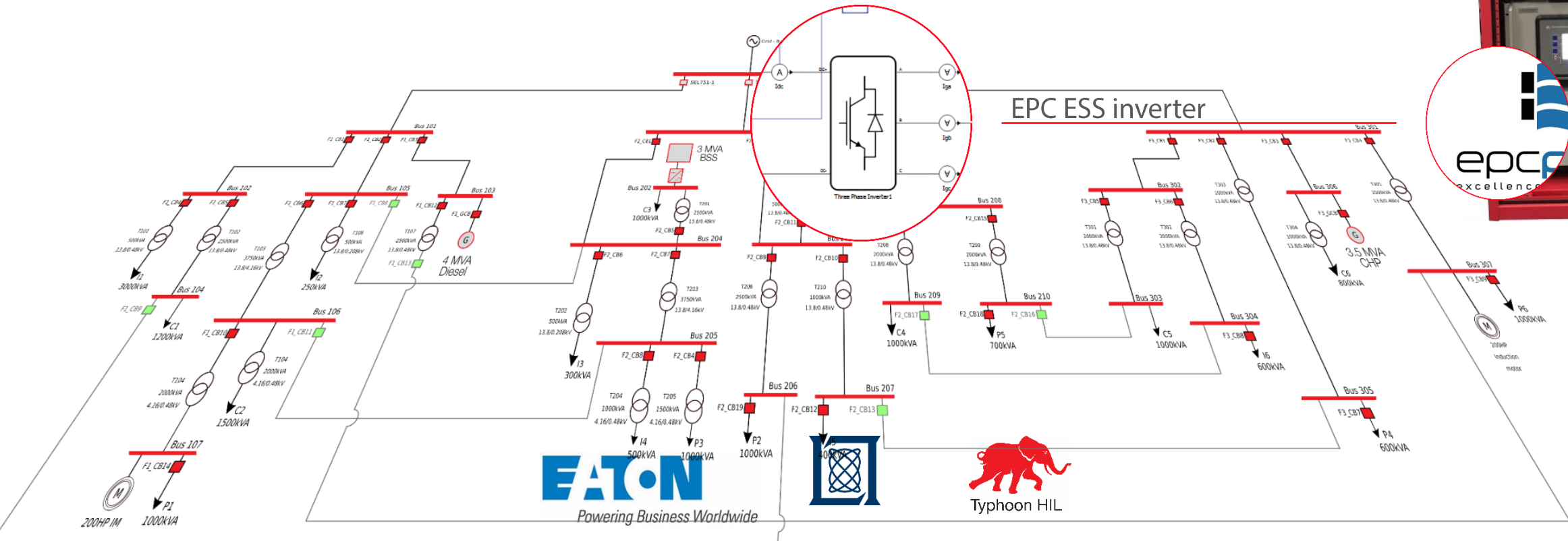
Woodward genset controller in the loop



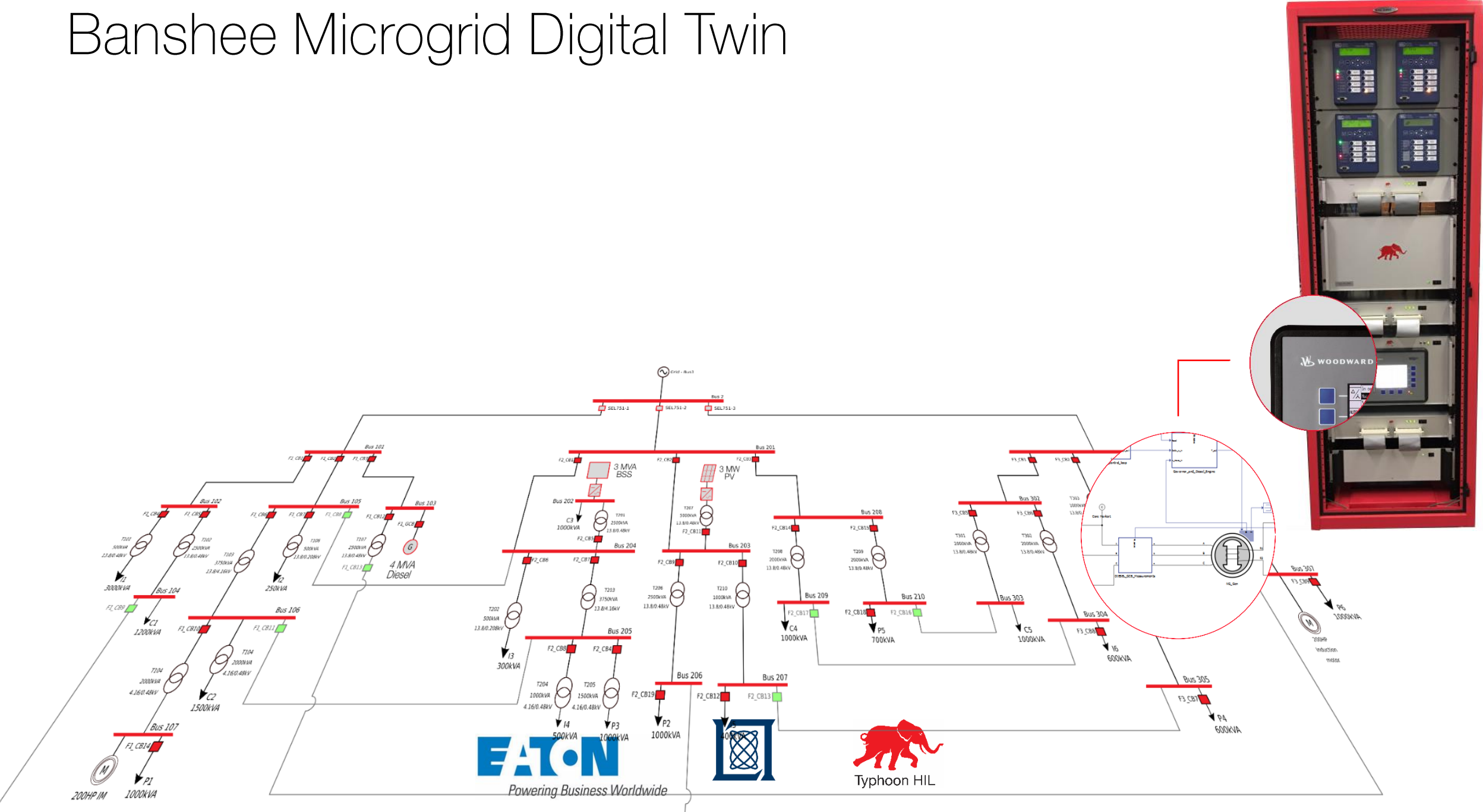
Banshee Microgrid Digital Twin



Banshee Microgrid Digital Twin



Banshee Microgrid Digital Twin



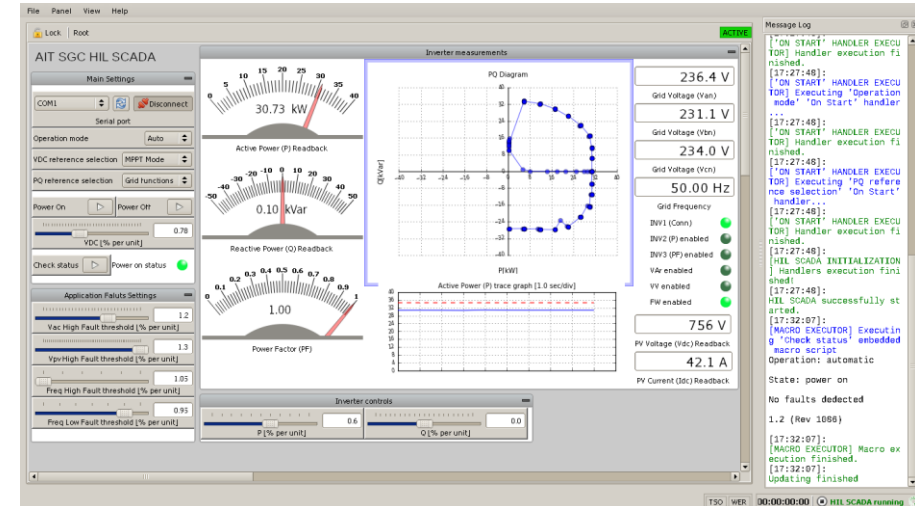
DER example: AIT Smart Grid Converter (SGC) Controller with SunSpec Inverter Protocol



AIT SGC HIL controller front view

• Features

- Full four quadrant (bidirectional operation)
- Active and reactive power control
- Advanced functions: Watt-PF/cos ϕ (P), Volt-var/Q(U), VoltWatt/P(U), Frequency-Watt/P(f)
- Voltage ride through (LVRT&HVRT)



Power Factor control example

Supported SunSpec Models	
001	SunSpec Common Model
103	SunSpec Inverter (Three Phase) Model
120	SunSpec Nameplate Model
121	Inverter Controls Basic Settings
122	Inverter Controls Extended Measurements and Status
123	Immediate Inverter Controls
126	Inverter Controls Static Volt-VAR Arrays
134	Inverter Controls Frequency-Watt Controls

05.03.2017



Banshee Microgrid Digital Twin

Microgrid controller



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