GTFPGA UNIT: MULTI-FUNCTION AUXILIARY SIMULATION HARDWARE

⫼⫼RTDS Technologies

The GTFPGA Unit is an optional auxiliary hardware component that enhances the capabilities of the RTDS® Simulator for certain applications. The rack-mountable enclosure houses a powerful FPGA board capable of high-speed calculations in parallel with the power system simulation running on the central RTDS Simulator processing hardware.

- Several firmwares available to define functionality
- Connects to central simulation hardware via fibre optic cable
- Sixteen fibre or copper ports on the front of the unit for connection to external IEDs
- Compatible with NovaCor and PB5-based RTDS Simulator systems
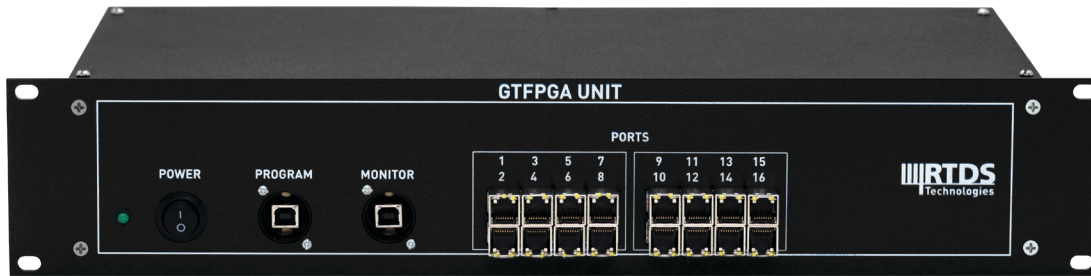
THE GTFPGA UNIT HAS 16 SWAPPABLE FIBRE PORTS FOR FIBRE- OR COPPER-BASED CONNECTIONS

MODULAR MULTILEVEL CONVERTER (MMC) SIMULATION FOR HVDC AND FACTS

The GTFPGA Unit can be used to run detailed models of MMC-based HVDC and FACTS and their associated low-level controls. The available FPGA-based MMC models are substep components, which allows for small timesteps, flexibility of configuration, and low loop delay between the real-time simulation and external controls. The GTFPGA Unit significantly increases the level of detail that can be achieved in modelling MMC valves.

Generic Model (GM)
Represent up to 2 valve legs per GTFPGA Unit
- Model 1024 submodules per valve in half-, full-, or mixed-bridge configurations
- All possible IGBT firing states are considered
- Supports individual submodule capacitances, customized topologies, internal valve to ground faults, and a damping submodule

Unified Model (U5)
Represent up to 6 valve legs per GTFPGA Unit
- Model 512 submodules per valve in half- or full-bridge configurations
- Considers blocked, pos. inserted, neg. inserted, and bypassed states
- Supports internal valve to ground faults and a damping submodule

Control Model
Represent controls for up to 3 valve legs per GTFPGA Unit
- Receives valve current and submodule capacitor voltage from valve models
- Provides firing pulses to valve models via Aurora protocol

FIBRE CABLES CONNECT SIMULATED VALVES TO SIMULATED CONTROLLERS ON VARIOUS GTFPGA UNITS

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IEC 61850-9-2/61869-9 SAMPLED VALUES (SV) STREAMING

The GTFPGA Unit significantly increases the number of SV data streams that can be input and output from the RTDS Simulator and can be used in cases when the GTNETx2 card does not provide the desired stream quantity or sample rate.

Each of the 16 swappable fiber or copper ports on the GTFPGA Unit can simultaneously publish and subscribe a single SV stream. In total, each GTFPGA Unit can publish and subscribe up to 16 independently-configurable SV streams.

When used in the main timestep environment:
- Publishes and subscribes to up to 16 streams at a variety of sampling rates
- Supports a maximum of 24 channels per stream for rates of 80 samples/cycle, 4.8 kHz, 96 samples/cycles
- Supports a maximum of 9 channels per stream for rates of 256 samples/cycle and 14.4 kHz

When used in the substep environment:
- Publish-only capabilities at very high sampling rates
- Supports a maximum of 24 channels for up to 2 streams at 96 kHz
- Supports a maximum of 48 channels for a single stream at 250 kHz

GTFPGA Unit-based SV streams can be configured from within the RTDS Simulator's software
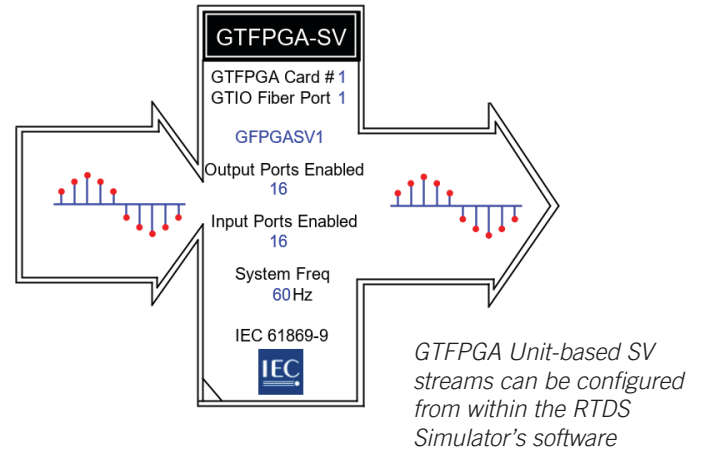
GENERIC POWER ELECTRONICS SOLVER (GPES) FOR CUSTOM-TOPOLOGY CONVERTERS

The GTFPGA Unit provides a highly flexible platform for modelling custom converter topologies with a reduced simulation timestep. GPES provides higher resolution and lower fictitious losses while also supporting more nodes and switches for more complex circuits.
- Timesteps in the 250 ns range
- Each GTFPGA Unit supports circuits with up to 128 nodes and 256 branches
- Receive firing pulses directly from external controls via Aurora protocol
- Interface GPES circuit to models running on central RTDS Simulator hardware

TRAVELLING WAVE RELAY TESTING (TWRT)

The GTFPGA Unit's TWRT firmware allows for the simulation of transmission circuits, including frequency dependent phase domain lines, at the high resolution required to accurately test relays that work on travelling wave protection principles. The GTFPGA Unit is an economical option for users who wish to simulate small-to medium-sized circuits including frequency dependent lines at a low timestep.

- Separate component library including lines, cables, series compensation, faults, breakers, passive branches, and a controlled voltage source
- Timesteps in the 1-3 μs range
- Has been successfully used for testing the TW87 and TW32 elements of the SEL-T400L relay

FREQUENCY DEPENDENT TRANSMISSION LINE AND CABLE MODELLING

In addition to the TWRT firmware for travelling wave relay testing, the GTFPGA Unit can also be used for the dedicated simulation of frequency dependent phase domain transmission line and cables. In this case the surrounding network, which is simulated on the central RTDS Simulator processing hardware, is interfaced to the GTFPGA Unit's line/cable model via a Bergeron interface transmission line.
- Models up to 12 coupled conductors (flexible configuration, i.e. 1 line with 12 coupled conductors or 4 lines with 3 coupled conductors each)
- Timesteps in the 1-3 μs range

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