This document contains easy formatted text that you can copy/paste for writing offers or specifying Woodward power management products for your project.

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| Product(s) described: | easYgen-3400/3500 Genset Controllers |

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## General

The power generation system shall be controlled by a microprocessor based power management system consisting of Woodward easYgen-3400/3500 series controller on each generator source. The generator controllers operate shall operate in a peer to peer system with up to 32 synchronous or asynchronous generators. This system shall provide automatic sequencing of multiple units, multiple segments, synchronization, generator, generator group and utility breaker control, soft loading and unloading for bumpless transfers, real KW load control, reactive KVAR control, metering, communications and diagnostic features. The generator controllers shall be a commercially available control and not PLC based, and shall be configured for operation without the need for customized, proprietary programming or software. The system shall be able to be configured in either a simple island or utility paralleled arrangement. The generator controller shall have the capability to operate with advanced circuit breaker control (Woodward LS-5 or equivalent) for complex systems. Specific requirements are as follows:

## Automatic Unit Sequencing

- Automatically starts and stops generator sets upon utility failure or utility restoration.
- Automatically starts and stops generator sets based on plant load to maintain the power interchange at the utility intertie within predetermined limits.
- Automatic generator set loading and unloading for bumpless transfer
- Automatic load dependent start/stop for improved generator system efficiency with configurable generator priority sequencing based on generator size, service hours, fuel efficiency or fixed sequence.
- Complex applications with multiple generator sets and utility/bus segment interties are controlled via the CAN bus based upon the logic internal to the generator and circuit breaker controllers with optional control inputs from an external PLC.

## Synchronizing

- Independent phase match or slip frequency synchronization with voltage matching for control of multiple circuit breakers on generators, bus segments and utility mains.
- Adjustable phase and voltage window.
- Dead bus closing logic internal to the controller to ensure multiple units close safely within the synchronization parameters.
- Dead field paralleling (run up synchronization).
- Breaker or contactor control for generators.

## Real KW Load Control

- True RMS voltage and current measurement for reduced susceptibility to harmonics.
- Speed bias signal to prime mover speed control freely configurable in the range of +/- 20 ma, +/- 10 volts, or 0-10 VDC, 500 Hz PWM, and discrete raise/lower to control prime movers of different types (diesel engine, gaseous or bio-fueled engine, gas turbine, micro-turbine, etc.).
- Configurable load and unload ramp rates for generators, bus segments, or the entire system at the utility ties.
- Proportional load sharing (isochronous or droop) of up to 32 generators, regardless of KW rating.
- Base load control.
- Process control.
- Import/export control at the utility mains breakers.
- Externally adjustable load or process references using analog inputs, Modbus RTU, or CAN open.
- Digital load sharing integral to the controller without external load sharing control modules.

## Reactive KVAR Control

- Voltage bias signal to AVR freely configurable in the range of +/- 20 ma, +/- 10 volts, or 0-10 VDC, 500 Hz PWM, and discrete raise/lower.
- Configurable load and unload ramp rates for generators, bus segments, or the entire system at the utility ties.
- PF sharing on isolated buses using percentage base reactive load sharing
- VAR/PF control using percentage based load sharing during process, base load or import/export control.
- Externally adjustable VAR or PF references using analog inputs, Modbus RTU, or CANopen.

## Engine-Control/Protection

- Configurable start and stop logic for diesel and gas engines with fully programmable settings.
- CAN SAE J1939 network communication/control to engine ECU.
- Engine over speed and under speed (ANSI 12 & 14).
- Cylinder temperature monitoring for in-line and V engines.
- Engine speed/frequency mismatch detection.
- Cool down timer. Customizable protection based upon J1939 or analog inputs.

## Generator Protection

- Directional power (ANSI 32), reverse power (ANSI 32R), and reduced power (ANSI 32F)
- Unbalanced load (ANSI 46)
- Phase rotation (ANSI 47)
- Phase over current instantaneous (ANSI 50) and time (ANSI 51).
- Phase over current voltage restraint (ANSI 51V)
- Loss of excitation (40Q).
- Ground fault measured (50G)
- Power Factor (ANSI 55).
- Over/under voltage (ANSI 27/59)
- Over/under frequency (ANSI 81 O/U)

## Mains Protection (Generator Decoupling)

- Over/under voltage (ANSI 27/59)
- Phase shift/rotation field (ANSI 78)
- Over/under frequency (ANSI 81O/U)
- Rate of frequency (ROCOF) with the circuit breaker controller on the Mains
- QV monitoring to avoid import of inductive reactive power with the circuit breaker controller on the Mains

## Breaker Protection/Monitoring With Circuit Breaker Controller

- Over/under voltage (ANSI 27/59)
- Phase shift/rotation field (ANSI 27/59)
- Over/under frequency (ANSI 81 O/U)
- Synchronization time out monitoring
- Breaker open/close monitoring

## Measurement

- True RMS Voltage—L-N, L-L, per phase and average; 1-phase or 3-phase generator and mains, 1-phase load bus.
- True RMS current—Line current per phase and average; 1-phase or 3-phase generator, 1-phase mains
- Frequency
- Power—kVA, kVAR and KW per phase and total; PF per phase and average; total generator kWhr and kVARhr

## Communications

- Three CAN communication networks shall be utilized:
    - System control and load share network
    - CANopen visualization and control.
    - Local input/output expansion, remote panel and engine J1939 ECU.
- Serial Modbus RTU (slave) communication for SCADA annunciation and external control.
- Configuration via PC/laptop with Woodward Toolkit service tool and through an integral display, if equipped,
- Multi-level password protection

## Diagnostic Features

- The system shall be designed to allow operation with one or more system node failures. The generator controller and the circuit breaker controller shall be able to provide a missing member alarm, which will allow the system, if programmed accordingly, to go from isochronous to droop load sharing for continued operation.
- Configuration check in load dependent start/stop.
- Phase rotation mismatch
- Network communications error alarm
- Breaker/contactor synchronization time out and reclose alarms
- Speed/frequency mismatch.
- Analog input out of range alarms
- Sequence of events recorder—300 events FIFO with real time clock.
- Graphical overview of generators, generator bus bar and mains with trending on door mounted generator controller and the remote panel.

## Mounting Styles

- The door mounted generator controller shall have sealed soft keys and a large, easy-to-read backlit 5.7” color LCD, with a graphical display and text that can configured in 14 languages.
- The back panel mounted generator controller shall be encased in a rugged aluminum chassis for use in harsh environments or confined spaces. The back panel mounted circuit breaker controller shall be encased in a rugged aluminum chassis designed to be back panel mounted.
- The door mounted remote panel shall be capable of being be used with either the back panel mounted or the door mounted generator controller. Each remote panel shall be able to communicate with one generator controller.