# Photovoltaik / PV with generator sets

Simon - 2024-10-10 - [application](#)

As an upfront information, there are two video trainings available for photovoltaik / PV support in a network with generator sets:

easYgen Training: Solar Diesel:

[https://easygen.org/wp-content/uploads/2023/11/easYgen_6.7.mp4](https://easygen.org/wp-content/uploads/2023/11/easYgen_6.7.mp4)

Webinar recording:

[https://wss.woodward.com/manuals/Support/Webinar_Recordings/easYgen-3000XT_v2.15/Webinar_easYgenXT%20Software%20Version%202.15-0.mp4](https://wss.woodward.com/manuals/Support/Webinar_Recordings/easYgen-3000XT_v2.15/Webinar_easYgenXT%20Software%20Version%202.15-0.mp4)

Connecting existing or new Gensets with superimposed PV-DIESEL CONTROLLER via Woodward's easYgen3000XT and/or Woodward's MFR 300

**Introduction**

Conventional Power Generation in rural regions with weak grids or on islands is often based on Power Stations (reciprocating engines) fired by fossil fuels. Beside the required maintenance for these types of Gensets, the dominating cost factor is the fuel itself. The logistics in rural regions/islands also increase the local fuel price. Independent Power Producer aim to get rid of this continuously increasing cost factor and are therefore highly interested in any kind of reduction potential.

As before described applications can often be found in the Sunbelt region, PV power is considered as an appropriate source to offer grid support for lowest cost. But in order to grant stable grid conditions, island grids require some additional considerations as:

- Providing sufficient spinning reserve for load jumps

- Providing sufficient over-current capacity to trigger fuses and secure installation in the event of short circuits

- Operating Genset at its optimal operating point and avoid increasing wear due under-load

- Providing common control functions for more than single Genset as

  - Load dependent Start/Stop

  - Automatic synchronizing to bus-bar

  - Predictive maintenance of Genset

  - Managing automatic load share of Gensets

  - Leveling utilization of Gensets (operating hours)

Woodward with its partners in conventional Power Generation and in systems and solutions in Photovoltaic have developed a System to extend Genset installations with PV-Power in order to reduce fuel consumption and according OPEX-cost. By using PV as "negative load", amortization times for the required PV-Plant extension of 3-4 years are achievable. Given that PV plants are designed for a lifetime of at least 20 years, investors can run such Hybrid systems with highest profitability. The trend of dropping PV-cost and increasing fuel cost is an additional factor and reduces risk for operators and investors.

**easYgen3000XT**

(software version 2.15 and higher)

The 'easYgen' is a Genset Controller which manages the control of the single Genset as well as the control of up to 32 Gensets working on the same bus bar. Thus it accommodates common control functions as

o   Load dependent Start/Stop

o   Automatic synchronizing to bus-bar

o   Predictive maintenance of Genset

o   Managing automatic load share of Gensets

o   Leveling utilization of Gensets (operating hours)

The Gensets are linked via the CAN bus line and operate in a multi master mode. The data on this CAN bus are arranged as below.

| CAN-Bus-Address | Detail | Data Type | Unit |
|---|---|---|---|
| Easygen[x].GenRealLoadInW | Generator Real Load in W | DINT | W |
| Easygen[x].GenReactLoadInVar | Generator Reactive Load in var | DINT | var |
| Easygen[x].GenRealLoadInProm | Generator Real Load per mill | DINT | Per mill |
| Easygen[x].GenReactLoadInProm | Generator Reactive Load per mill | DINT | Per mill |
| Easygen[x].GenRatRealPower | Generator Rated Real Power in kW | DINT | kW |
| Easygen[x].GenRatReactPower | Generator Rated Reactive Power in kvar | DINT | kvar |
| Easygen[x].OperMode | Operation Mode | INT (0…3) | |
| Easygen[x].EngineState | Engine State | INT (0…11) | |
| Easygen[x].RealLoadContrState | Real Load Control State | INT (0…11) | |
| Easygen[x].ReactLoadContrState | Reactive Load Control State | INT (0…11) | |
| Easygen[x].GenVoltFreqOk | Generator Voltage and Frequency ok | BOOL | |
| Easygen[x].BbVoltFreqOk | Busbar Voltage and Frequency ok | BOOL | |
| Easygen[x].MainsVoltFreqOk | Mains Voltage and Frequency ok | BOOL | |
| Easygen[x].FourthSysVoltFreqOk | System Voltage and Frequency ok | BOOL | |
| Easygen[x].BusbarxDead | Busbar 1 is dead | BOOL | |
| Easygen[x].Busbar2Dead | Busbar 2 is dead | BOOL | |
| Easygen[x].LoadSharOn | Load Sharing switched on | BOOL | |
| Easygen[x].ReactLoadSharOn | Reactive Load Sharing switched on | BOOL | |
| Easygen[x].GcbClosed | GCB is closed | BOOL | |
| Easygen[x].McbClosed | MCB is closed | BOOL | |
| Easygen[x].GenGroupCbClosed | Gen Group Breaker is closed | BOOL | |
| Easygen[x].DeadBusDeterm | Dead Bus Determination | BOOL | |
| Easygen[x].MainsSetTimeAct | Mains Settling Time is active | BOOL | |
| Easygen[x].ShutdownAlarmAct | Shutdown Alarm is active | BOOL | |
| Easygen[x].RunHours | Running Hours | BOOL | |
| Easygen[x].AlarmClassA | Alarm Class A occured | BOOL | |
| Easygen[x].AlarmClassB | Alarm Class B occured | BOOL | |
| Easygen[x].AlarmClassC | Alarm Class C occured | BOOL | |
| Easygen[x].AlarmClassD | Alarm Class D occured | BOOL | |
| Easygen[x].AlarmClassE | Alarm Class E occured | BOOL | |

| | | |
|---|---|---|
| Easygen[x].AlarmClassF | Alarm Class F occured | BOOL |
| Easygen[x].AlarmClassWarn | Alarm Class Warning occured | BOOL |

## MULTI FUNCTION RELAY MFR 300

Alternative to the MFR300, could an Modbus protocol provide these measurements.

The 'MFR 300' can be integrated in the system to measure Voltage/Frequency in order to sense the load flow in a meshed grid with its characteristic values for active/reactive power and according power factor for each phase. The 'MFR 300' is used in the PV-Diesel application to either measure the values for PV power generation or to detect values for the load. The 'MFR 300' is connected to the superimposed 'DER PV-DIESEL CONTROLLER' via the CAN bus line according to description below.

| CAN-Bus-Address | Detail | Data Type | Unit |
|---|---|---|---|
| MFR300Pdo3[x].Frequency | Frequency in Hz | REAL | Hz |
| MFR300Pdo3[x].TotalActPower | Total active power in W | REAL | W |
| MFR300Pdo3[x].TotalReactPower | Total Reactive Power in var | REAL | var |
| MFR300Pdo3[x].GenRatRealPower | Generator Rated Real Power in kW | REAL | kW |
| MFR300Pdo3[x].GenRatReactPower | Generator Rated Reactive Power in kvar | REAL | kvar |
| MFR300Pdo3[x].PowerFactorL1 | Power Factor L1 | REAL | |
| MFR300Pdo3[x].VoltageL1L2 | Voltage L1-L2 in V | REAL | V |
| MFR300Pdo3[x].PowerFactorL2 | Power Factor L2 | REAL | |
| MFR300Pdo3[x].VoltageL2L3 | Voltage L2-L3 in V | REAL | V |
| MFR300Pdo3[x].PowerFactorL3 | Power Factor L3 | REAL | |
| MFR300Pdo3[x].VoltageL3L1 | Voltage L3-L1 in V | REAL | V |
| MFR300Pdo3[x].CurrentL1 | Current L1 in A | REAL | A |
| MFR300Pdo3[x].CurrentL2 | Current L2 in A | REAL | A |
| MFR300Pdo3[x].CurrentL3 | Current L3 in A | REAL | A |

| Visualization | Detail | Data Type | Range |
|---|---|---|---|
| CobidArrayMfr[x].CobidNoPdo3 | Cobid number of PDO3 | INT | 1380-1429 |
| CobidArrayMfr[x].Mode | Reading Mode of MFR300 | INT | 1380-1429 |

Explanation: x= 1…32