



Technical Description

Genset

JGS 312 GS-N.L

with Island Operation
no special Grid Code



Electrical output

633 kW el.

Emission values

NOx < 500 mg/Nm³ (5% O₂)

CO < 650 mg/Nm³ (5% O₂)



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0.01 Technical Data (at genset)

Data at:

| | | | Full load | Part Load | |
|---------------------------------------------------------------|-------------|-----|--------------|-----------|--------|
| | | | | 75% | 50% |
| Fuel gas LHV | BTU/scft | | 917 | | |
| | | | 100% | 75% | 50% |
| Energy input | MBTU/hr | [2] | 5,671 | 4,405 | 3,139 |
| Gas volume | scf/hr | *) | 6,184 | 4,804 | 3,423 |
| Mechanical output | bhp | [1] | 881 | 661 | 441 |
| Electrical output | kW el. | [4] | 633 | 472 | 311 |
| Heat to be dissipated | | [5] | | | |
| ~ Intercooler 1st stage (Engine jacket water cooling circuit) | MBTU/hr | | 288 | 119 | 3 |
| ~ Intercooler 2nd stage (Low Temperature circuit) | MBTU/hr | | 159 | 125 | 78 |
| ~ Lube oil (Engine jacket water cooling circuit) | MBTU/hr | | 287 | 252 | 215 |
| ~ Jacket water | MBTU/hr | | 751 | 682 | 604 |
| ~ Surface heat | ca. MBTU/hr | [7] | 233 | ~ | ~ |
| Spec. fuel consumption of engine electric | BTU/kWel.hr | [2] | 8,954 | 9,327 | 10,107 |
| Spec. fuel consumption of engine | BTU/bhp.hr | [2] | 6,437 | 6,663 | 7,115 |
| Lube oil consumption | ca. gal/hr | [3] | 0.06 | ~ | ~ |
| Electrical efficiency | % | | 38.1% | 36.6% | 33.8% |

*) approximate value for pipework dimensioning

[] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of $\pm 8\%$ on the thermal output a further reserve of $+5\%$ is recommended for the dimensioning of the cooling requirements.



Main dimensions and weights (at genset)

| | | |
|---------------|-----|----------|
| Length | in | ~ 190 |
| Width | in | ~ 70 |
| Height | in | ~ 90 |
| Weight empty | lbs | ~ 17,870 |
| Weight filled | lbs | ~ 18,930 |

Connections

| | | |
|------------------------------------------|--------|---------|
| Jacket water inlet and outlet | in/lbs | 3"/145 |
| Exhaust gas outlet | in/lbs | 10"/145 |
| Fuel Gas (at genset) | in/lbs | 2½"/232 |
| Water drain ISO 228 | G | ½" |
| Condensate drain | in | 0.7 |
| Safety valve - jacket water ISO 228 | in/lbs | 1½"/2.5 |
| Lube oil replenishing (pipe) | in | 1.1 |
| Lube oil drain (pipe) | in | 1.1 |
| Jacket water - filling (flex pipe) | in | 0.5 |
| Intercooler water-Inlet/Outlet 1st stage | in/lbs | 3"/145 |
| Intercooler water-Inlet/Outlet 2nd stage | in/lbs | 2½"/145 |

Output / fuel consumption

| | | |
|-------------------------------------------------------|------------|---------------|
| ISO standard fuel stop power ICFN | bhp | 881 |
| Mean effe. press. at stand. power and nom. speed | psi | 218 |
| Fuel gas type | | Natural gas |
| Based on methane number Min. methane number | MN d) | 94 75 |
| Compression ratio | Epsilon | 12.5 |
| Min./Max. fuel gas pressure at inlet to gas train | psi | 1.16 - 2.9 c) |
| Allowed Fluctuation of fuel gas pressure | % | ± 10 |
| Max. rate of gas pressure fluctuation | psi/sec | 0.145 |
| Maximum Intercooler 2nd stage inlet water temperature | °F | 122 |
| Spec. fuel consumption of engine | BTU/bhp.hr | 6,437 |
| Specific lube oil consumption | g/bhp.hr | 0.22 |
| Max. Oil temperature | °F | 189 |
| Jacket-water temperature max. | °F | 203 |
| Filling capacity lube oil (refill) | gal | ~ 57 |

c) Lower gas pressures upon inquiry

d) based on methane number calculation software AVL 3.1 (calculated without N2 and CO2)



0.02 Technical data of engine

| | | |
|--------------------------------------------|---------------------|--------------|
| Manufacturer | | GE Jenbacher |
| Engine type | | J 312 GS-C85 |
| Working principle | | 4-Stroke |
| Configuration | | V 70° |
| No. of cylinders | | 12 |
| Bore | in | 5.31 |
| Stroke | in | 6.69 |
| Piston displacement | cu.in | 1,782 |
| Nominal speed | rpm | 1,800 |
| Mean piston speed | in/s | 402 |
| Length | in | 94 |
| Width | in | 57 |
| Height | in | 81 |
| Weight dry | lbs | 7,055 |
| Weight filled | lbs | 7,782 |
| Moment of inertia | lbs-ft ² | 184.41 |
| Direction of rotation (from flywheel view) | | left |
| Radio interference level to VDE 0875 | | N |
| Starter motor output | kW | 7 |
| Starter motor voltage | V | 24 |

Thermal energy balance

| | | |
|------------------------------|---------|-------|
| Energy input | MBTU/hr | 5,671 |
| Intercooler | MBTU/hr | 447 |
| Lube oil | MBTU/hr | 287 |
| Jacket water | MBTU/hr | 751 |
| Exhaust gas cooled to 356 °F | MBTU/hr | 1,259 |
| Exhaust gas cooled to 212 °F | MBTU/hr | 1,553 |
| Surface heat | MBTU/hr | 136 |

Exhaust gas data

| | | |
|---------------------------------------------------|--------|---------|
| Exhaust gas temperature at full load | °F [8] | 945 |
| Exhaust gas temperature at bmep= 163.2 [psi] | °F | ~ 966 |
| Exhaust gas temperature at bmep= 108.8 [psi] | °F | ~ 988 |
| Exhaust gas mass flow rate, wet | lbs/hr | 7,875 |
| Exhaust gas mass flow rate, dry | lbs/hr | 7,304 |
| Exhaust gas volume, wet | scfhr | 100,149 |
| Exhaust gas volume, dry | scfhr | 88,778 |
| Max.admissible exhaust back pressure after engine | psi | 0.870 |

Combustion air data

| | | |
|----------------------------------------------------|--------|-------|
| Combustion air mass flow rate | lbs/hr | 7,621 |
| Combustion air volume | SCFM | 1,574 |
| Max. admissible pressure drop at air-intake filter | psi | 0.145 |



Sound pressure level

| | | | |
|----------------|----|----------------------|-----|
| Aggregate a) | | dB(A) re 20 μ Pa | 98 |
| 31,5 | Hz | dB | 83 |
| 63 | Hz | dB | 90 |
| 125 | Hz | dB | 94 |
| 250 | Hz | dB | 94 |
| 500 | Hz | dB | 93 |
| 1000 | Hz | dB | 92 |
| 2000 | Hz | dB | 89 |
| 4000 | Hz | dB | 89 |
| 8000 | Hz | dB | 92 |
| Exhaust gas b) | | dB(A) re 20 μ Pa | 115 |
| 31,5 | Hz | dB | 108 |
| 63 | Hz | dB | 119 |
| 125 | Hz | dB | 113 |
| 250 | Hz | dB | 117 |
| 500 | Hz | dB | 112 |
| 1000 | Hz | dB | 111 |
| 2000 | Hz | dB | 103 |
| 4000 | Hz | dB | 101 |
| 8000 | Hz | dB | 98 |

Sound power level

| | | | |
|---------------------|--|-----------------|-------|
| Aggregate | | dB(A) re 1pW | 118 |
| Measurement surface | | ft ² | 1,044 |
| Exhaust gas | | dB(A) re 1pW | 123 |
| Measurement surface | | ft ² | 67.60 |

a) average sound pressure level on measurement surface in a distance of 3.28ft (converted to free field) according to DIN 45635, precision class 3.

b) average sound pressure level on measurement surface in a distance of 3.28ft according to DIN 45635, precision class 2. The spectra are valid for aggregates up to bmep=217.55661 psi. (for higher bmep add safety margin of 1dB to all values per increase of 15 PSI pressure).

Engine tolerance \pm 3 dB



0.03 Technical data of generator

| | | |
|-------------------------------------------------------------|---------------------|-------------|
| Manufacturer | | STAMFORD e) |
| Type | | CG 634 J e) |
| Type rating | kVA | 867 |
| Driving power | bhp | 881 |
| Ratings at p.f.= 1.0 | kW | 633 |
| Ratings at p.f. = 0.8 | kW | 629 |
| Rated output at p.f. = 0.8 | kVA | 786 |
| Rated reactive power at p.f. = 0.8 | kVAr | 472 |
| Rated current at p.f. = 0.8 | A | 756 |
| Frequency | Hz | 60 |
| Voltage | V | 600 |
| Speed | rpm | 1,800 |
| Permissible overspeed | rpm | 2,250 |
| Power factor (lagging - leading) | | 0,8 - 1,0 |
| Efficiency at p.f.= 1.0 | % | 96.4% |
| Efficiency at p.f. = 0.8 | % | 95.7% |
| Moment of inertia | lbs-ft ² | 531.64 |
| Mass | lbs | 5,071 |
| Radio interference level to EN 55011 Class A (EN 61000-6-4) | | N |
| Ik'' Initial symmetrical short-circuit current | kA | 9.35 |
| Is Peak current | kA | 23.80 |
| Insulation class | | H |
| Temperature rise (at driving power) | | F |
| Maximum ambient temperature | °F | 104 |

Reactance and time constants (saturated)

| | | |
|--------------------------------------------|------|------|
| xd direct axis synchronous reactance | p.u. | 1.53 |
| xd' direct axis transient reactance | p.u. | 0.11 |
| xd'' direct axis sub transient reactance | p.u. | 0.08 |
| x2 negative sequence reactance | p.u. | 0.10 |
| Td'' sub transient reactance time constant | ms | 25 |
| Ta Time constant direct-current | ms | 46 |
| Tdo' open circuit field time constant | s | 3.03 |

e) GE Jenbacher reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

connection variant 1K



0.05 Cooling water circuit

Oil - heat (Engine jacket water cooling circuit)

| | | |
|-------------------------------------------------|---------|-------|
| Nominal output | MBTU/hr | 287 |
| Max. Oil temperature | °F | 189 |
| Loss of nominal pressure of engine jacket water | psi | 2.90 |
| Safety valve - max press. set point | psi | 36.26 |

Engine jacket water - heat (Engine jacket water cooling circuit)

| | | |
|------------------------------------------------------|---------|-------|
| Nominal output | MBTU/hr | 751 |
| Max. engine jacket water temperature (outlet engine) | °F | 194 |
| Engine jacket water flow rate | GPM | 100.1 |
| Safety valve - max press. set point | psi | 36.26 |

Mixture Intercooler (1st stage) (Engine jacket water cooling circuit)

| | | |
|--------------------------------------------------------------|---------|-------|
| Nominal output | MBTU/hr | 288 |
| Max. inlet cooling water temp. (intercooler) | °F | 169.7 |
| Design pressure of cooling water / (max. operating pressure) | lbs | 145 |
| Loss of nominal pressure of engine jacket water | psi | 2.90 |
| Safety valve - max press. set point | psi | 36.26 |

Mixture Intercooler (2nd stage) (Low Temperature circuit)

| | | |
|--------------------------------------------------------------|---------|-------|
| Nominal output | MBTU/hr | 159 |
| Max. inlet cooling water temp. (intercooler) | °F | 122 |
| Aftercooler water flow rate | GPM | 66.0 |
| Design pressure of cooling water / (max. operating pressure) | lbs | 145 |
| Intercooler water pressure drop | psi | 2.90 |
| Safety valve - max press. set point | psi | 36.26 |

The final pressure drop will be given after final order clarification and must be taken from the P&ID order documentation.



0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures as well as the methane number and subject to technical development and modifications. For isolated operation an output reduction may apply according to the block load diagram. Before being able to provide exact output numbers, a detailed site load profile needs to be provided (motor starting curves, etc.).

All pressure indications are to be measured and read with pressure gauges (psi.g.).

- (1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
- (2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of +5 %.
Efficiency performance is based on a new unit (immediately upon commissioning). Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
- (3) Average value between oil change intervals according to maintenance schedule, without oil change amount
- (4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
- (5) Total output with a tolerance of ± 8 %
- (6) According to above parameters (1) through (5)
- (7) Only valid for engine and generator; module and peripheral equipment not considered (at p. f. = 0,8)
- (8) Exhaust temperature with a tolerance of ± 8 %

Radio interference level

The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

Definition of output

- ISO-ICFN continuous rated power:
Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:

| | |
|----------------------|--------------------------------------------------------|
| Barometric pressure: | 14.5 psi (1000 mbar) or 328 ft (100 m) above sea level |
| Air temperature: | 77°F (25°C) or 298 K |
| Relative humidity: | 30 % |
- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)

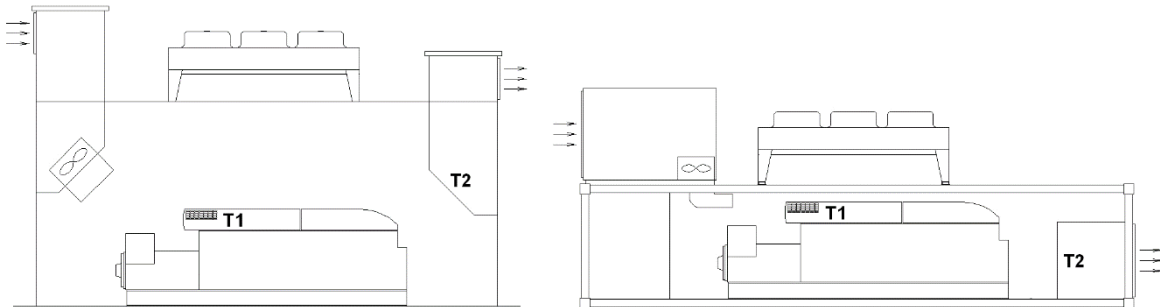
| | |
|--------------|-----------------------------|
| Pressure: | 1 atmosphere (1013.25 mbar) |
| Temperature: | 32°F (0°C) |

Output adjustment for turbo charged engines

Standard rating of the engines is for an installation at an altitude ≤ 1640 ft and combustion air temperature ≤ 86 °F (T1)



Engine room outlet temperature: **122°F (T2)** -> engine stop



If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are done by the engine management.

Exceedance of the voltage and frequency limits for generators according to IEC 60034-1 Zone A will lead to a derate in output.

Parameters for the operation of GE Jenbacher gas engines

The genset fulfills the limits for mechanical vibrations according to ISO 8528-9.

The following "Technical Instruction of GE JENBACHER" forms an integral part of a contract and must be strictly observed: **TA 1000-0004, TA 1100 0110, TA 1100-0111, and TA 1100-0112.**

Transport by rail should be avoided. See **TA 1000-0046** for further details

Failure to adhere to the requirements of the above mentioned TA documents can lead to engine damage and may result in loss of warranty coverage.

Parameters for the operation of control unit and the electrical equipment

Relative humidity 50% by maximum temperature of 104°F.

Altitude up to 2000m above the sea level.

1.00 Scope of supply - Genset

Design:

The genset is built as a compact package.

Engine and generator are mounted to the base frame. To provide the best possible isolation from the transmission of vibrations the engine is mounted to the frame by means of anti-vibrational mounts. The remaining vibrations are eliminated by mounting the module on isolating pads (e.g. Sylomer). This, in principle, allows for placing of the genset to be directly on any floor capable of carrying the static load. No special foundation is required. Prevention of sound conducted through solids has to be provided locally.



1.01 Spark ignited gas engine

Four-stroke, air/gas mixture turbocharged, aftercooled, with high performance ignition system and electronically controlled air/gas mixture system.

The engine is equipped with the most advanced

LEANOX® LEAN-BURN COMBUSTION SYSTEM

developed by GE JENBACHER.

1.01.01 Engine design

Engine block

Single-piece crankcase and cylinder block made of special casting, crank case covers for engine inspection, welded steel oil pan.

Crankshaft and main bearings

Drop-forged, precision ground, surface hardened, statically and dynamically balanced; main bearings (upper bearing shell: 3-material bearing / lower bearing shell: sputter bearing) arranged between crank pins, drilled oil passages for forced-feed lubrication of connecting rods.

Vibration damper

Maintenance free viscous damper

Flywheel

With ring gear for starter motor

Pistons

Single-piece, made of light metal alloy, with piston ring carrier and oil passages for cooling; piston rings made of high quality material, main combustion chamber specially designed for lean burn operation.

Connecting rods

Drop-forged, heat-treated, big end diagonally split and toothed. Big end bearings (upper bearing shell: sputter bearing / lower bearing shell: grooved bearing) and connecting rod bushing for piston pin.

Cylinder liner

Chromium alloy gray cast iron, wet, individually replaceable.

Cylinder head

Specially designed and developed for GE JENBACHER-lean burn engines with optimized fuel consumption and emissions; water cooled, made of special casting, individually replaceable; Valve seats and valve guides and spark plug sleeves individually replaceable; exhaust and inlet valve made of high quality material.

Crankcase breather

Connected to combustion air intake system

**Valve train**

Camshaft, with replaceable bushings, driven by crankshaft through intermediate gears, valve lubrication by splash oil through rocker arms.

Combustion air/fuel gas system

Motorized carburetor for automatic adjustment according fuel gas characteristic. Exhaust driven turbocharger, mixture manifold with bellows, water-cooled intercooler, throttle valve and distribution manifolds to cylinders.

Ignition system

Most advanced, fully electronic high performance ignition system, external ignition control.

Lubricating system

Gear-type lube oil pump to supply all moving parts with filtered lube oil, pressure control valve, pressure relief valve and full-flow filter cartridges. Cooling of the lube oil is arranged by a heat exchanger.

Engine cooling system

Jacket water pump complete with distribution pipework and manifolds.

Exhaust system

Turbocharger and exhaust manifold

Exhaust gas temperature measuring

Thermocouple for each cylinder

Electric actuator

For electronic speed and output control

Electronic speed monitoring for speed and output control

By magnetic inductive pick up over ring gear on flywheel

Starter motor

Engine mounted electric starter motor

1.01.04 Standard tools (per installation)

The tools required for carrying out the most important maintenance work are included in the scope of supply and delivered in a toolbox.

1.02 Generator-low voltage

The 2 bearing generator consists of the main generator (built as rotating field machine), the exciter machine (built as rotating armature machine) and the digital excitation system.

The digital regulator is powered by an auxiliary winding at the main stator or a PMG system



Main components:

- Enclosure of welded steel construction
- Stator core consist of thin insulated electrical sheet metal with integrated cooling channels.
- Stator winding with 2/3 Pitch
- Rotor consist of shaft with shrunken laminated poles, Exciter rotor, PMG (depending on Type) and fan.
- Damper cage
- Excitation unit with rotating rectifier diodes and overvoltage protection
- Dynamically balanced as per ISO 1940, Balance quality G2,5
- Drive end bracket with re greaseable antifriction bearing
- Non-drive end bracket with re grease antifriction bearing
- Cooling IC01 - open ventilated, air entry at non-drive end , air outlet at the drive end side
- Main terminal box includes main terminals for power cables
- Regulator terminal box with auxiliary terminals for thermistor connection and regulator.
- Anti-condensation heater
- 3 pieces PTC thermistors for winding temperature monitoring+3 pieces PTC thermistors spare

Option:

Current transformer for protection and measuring in the star point
xx/1A, 10P10 15VA , xx/1A, 1FS5, 15VA

Electrical data and features:

- Standards: IEC 60034, EN 60034, VDE 0530, ISO 8528-3, ISO 8528-9
- Voltage adjustment range: +/- 10 % of rated voltage (continuous)
- Frequency: -6/+4% of rated frequency
- Overload capacity: 10% for one hour within 6 hours, 50% for 30 seconds
- Asymmetric load: max. 8% I₂ continuous, in case of fault I₂ x t=20
- Altitude: < 1000m
- Max permitted generator intake air temperature: 5°C - 40°C
- Max. relative air humidity: 90%
- Voltage curve THD Ph-Ph: <4% at idle operation and <5% at full load operation with linear symmetrical load
- Generator suitable for parallel operating with the grid and other generators
- Sustained short circuit current at 3-pole terminal short circuit: minimum 3 times rated current for 5 seconds.
- Over speed test with 1.2 times of rated speed for 2 minutes according to IEC 60034

Digital Excitation system ABB Unitrol 1010 mounted within the AVR Terminal box with following features:

- Compact and robust Digital Excitation system for Continuous output current up to 10 A (20A Overload current 10s)
- Fast AVR response combined with high excitation voltage improves the transient stability during LVRT events.



- The system has free configurable measurement and analog or digital I/Os. The configuration is done via the local human machine interface or CMT1000
- Power Terminals
 - 3 phase excitation power input from PMG or auxiliary windings
 - Auxiliary power input 24VDC
- Excitation output
- Measurement terminals: 3 phase machine voltage, 1 phase network voltage, 1 phase machine current
- Analog I/Os: 2 outputs / 3 inputs (configurable), +10 V / -10 V
- Digital I/O: 4 inputs only (configurable), 8 inputs / outputs (configurable)
- Serial fieldbus: RS485 for Modbus RTU or VDC (Reactive power load sharing for up to 31 GEJ engines in island operation), CAN-Bus for dual channel communication
- Regulator Control modes: Bump less transfer between all modes
 - Automatic Voltage Regulator (AVR) accuracy 0,1% at 25°C ambient temperature
 - Field Current Regulator (FCR)
 - Power Factor Regulator (PF)
 - Reactive Power Regulator (VAR)
- Limiters: Keeping synchronous machines in a safe and stable operation area
 - Excitation current limiter (UEL min / OEL max)
 - PQ minimum limiter
 - Machine current limiter
 - V / Hz limiter
 - Machine voltage limiter
- Voltage matching during synchronization
- Rotating diode monitoring
- Dual channel / monitoring: Enables the dual channel operation based on self diagnostics and setpoint follow up over CAN communication.. As Option available
- Power System Stabilizer (PSS) is available as option. Compliant with the standard IEEE 421.5-2005 2A / 2B, the PSS improves the stability of the generator over the highest possible operation range.
- Computer representation for power system stability studies: ABB 3BHS354059 E01
- Certifications: CE, cUL certification according UL 508c (compliant with CSA), DNV Class B,
- **Commissioning and maintenance Tool CMT1000** (for trained commissioning/ maintenance personal)
- With this tool the technician can setup all parameters and tune the PID to guarantee stable operation. The CMT1000 software allows an extensive supervision of the system, which helps the user to identify and locate problems during commissioning on site. The CMT1000 is connected to the target over USB or Ethernet port, where Ethernet connection allows remote access over 100 m.
- Main window
 - Indication of access mode and device information.
 - Change of parameter is only possible in CONTROL access mode.
 - LED symbol indicates that all parameter are stored on none volatile memory.
- Setpoint adjust window
 - Overview of all control modes, generator status, active limiters status and alarms.
 - Adjust set point and apply steps for tuning of the PID.
- Oscilloscope
- 4 signals can be selected out of 20 recorded channels. The time resolution is 50ms. Save files to your PC for further investigation.
- Measurement



- All measurements on one screen.

Routine Test

Following routine tests will be carried out by the generator manufacturer

- Measuring of the DC-resistance of stator and rotor windings
- Check of the function of the fitted components (e.g. RTDs, space heater etc.)
- Insulation resistance of the following components
 - Stator winding, rotor winding
 - Stator winding RTDs
 - Bearing RTDs
 - Space heater
- No Load saturation characteristic (remanent voltage)
- Stator voltage unbalance
- Direction of rotation, phase sequence
- High voltage test of the stator windings ($2 \times U_{nom.} + 1000 \text{ V}$) and the rotor windings (min. 1500 V)

1.03 Module Accessories

Base frame

Common Base Frame fabricated with welded structural steel. Frame to mount the engine, jacket water heat exchangers, pumps and engine auxiliaries, as well as generator.

Coupling

Engine to Generator coupling is provided. The coupling isolates the major sub-harmonics of engine alternating torque from generator.

Coupling housing

Provided for Coupling

Anti-vibration mounts

2 sets of isolation, one is arranged between engine block assembly and base frame. The second is via insulating pads (SYLOMER) for placement between base frame and foundation, delivered loose.

Exhaust gas connection

A flanged connection is provided that collects the exhaust gas turbocharger output flows, includes flexible pipe connections (compensators) to compensate for heat expansions and vibrations.

Combustion air filter

A Dry type air filter with replaceable filter cartridges is fitted. The assembly includes flexible connections to the fuel mixer/carburetor and service indicator.

Interface panel (M1 cabinet)

Totally enclosed sheet steel cubicle with hinged doors, pre-wired to terminals, ready to operate. All Cable entry will be via bottom mounted cable gland plates.



Painting: RAL 7035

Protection: External NEMA 3 (IP 54), Internal IP 20 (protection against direct contact with live parts)

Cabinet design is according to IEC 439-1 (EN 60 439-1/1990) and DIN VDE 0660 part 500, respectively.
Ambient temperature 41 - 104 °F (5 - 40 °C), Relative humidity 70%

Dimensions:

- Height: 51 in (1300 mm)
- Width: 47 in (1200 mm)
- Depth: 16 in (400 mm)

Control Power Source: The starter batteries and the cabinet mounted battery chargers will provide the power source for this enclosure.

Interface Panel contents and control functions:

- The cabinet houses the unit Battery Charger and primary 24VDC Control Power Distribution (breakers, fuses, and terminals) from the unit Batteries
- Distributed PLC Input and Output cards, located in the cabinet, gather all Engine and Generator Control I/O. These cards transmit data via data bus interface to the central engine control of the module control panel located in the A1 cabinet. Data bus is via CAN and B&R Proprietary Data Highway (Data Cables provided by GE)
- Speed monitoring relays for protection are provided.
- Gas Train I/O Collection, including interface relays and terminals for gas train shutoff valves.
- Transducer for generator functions, such as excitation voltage.
- Door Mounted Emergency Stop Switch with associated Emergency Stop Loop interface relays.
- Miscellaneous control relays, contacts, fuses, etc. for additional control valves, and auxiliaries.
- Interface Terminal Strips

Skid Mounted 3 Phase Devices are Powered by 3 x **480/277 V, 60 Hz, 50 A**

AC Power for engine mounted auxiliaries (heater, pumps, etc.) are routed through a separate J-box mounted on the side M1 cabinet (Box E1). This is done to maintain signal segregation (AC from control)

NOTE: Generator Current Transformer wiring is connected directly to the Generator and does NOT pass through the M1 cabinet.

1.03.01 Engine jacket water system

Engine cooling jacket system

Closed cooling circuit, consisting of:

- Expansion tank
- Filling device (check and pressure reducing valves, pressure gauge)
- Safety valve(s)



- Thermostatic valve
- Required pipework on module
- Vents and drains
- Jacket water pump, including check valve
- Jacket water preheat device

1.03.02 Automatic lube oil replenishing system

Automatic lube oil replenishing system:

Includes float valve in lube oil feed line, including inspection glass. Electric monitoring system will be provided for engine shut-down at lube oil levels "MINIMUM" and "MAXIMUM". Solenoid valve in oil feed line is only activated during engine operation. Manual override of the solenoid valve, for filling procedure during oil changes is included.

Oil drain

By set mounted cock

Aftercooling oil pump:

Mounted on the module base frame; it is used for the aftercooling of the turbocharger; period of operation of the pump is 15 minutes from engine stop.

Consisting of:

- Oil pump 250 W, 480/277 V
- Oil filter
- Necessary pipework

1.05.04 Gas train (customer delivered gas train components)

GEJ to provide during project execution a detailed interface specification (parameters and requirements) for customer provided gas train. Customer to purchase and install components according to this mandatory GEJ specification.

Consisting of:

- Gas pressure regulator or TEC JET gas dosing valve (TEXTMARKE)
- Electrical control of customer provided gas train components

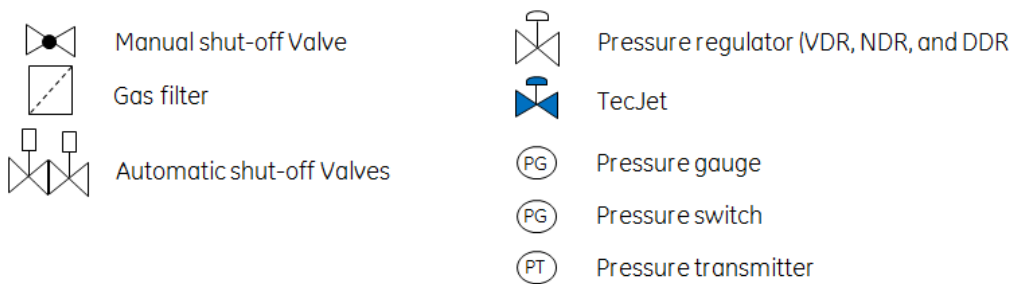
Maximum distance from gas train outlet to gas entry on engine, including flexible connections (not provided from GEJ), needs to be in accordance with TI 1510 – 0064.

Below there is a chart where the interfaces "D" and "T" are illustrated.



The following table shows the basic gas strain design:

| Gas train | Pressure control device | Basic design |
|------------------------------------------------------|-------------------------|--------------|
| Main gas train for engine type 2, 3, 4 & 6 | NDR | |
| | TecJet | |
| Pre chamber gas train (additional for engine type 6) | DDR | |



1.07 Painting

- Quality: Oil resistant prime layer
Synthetic resin varnish finishing coat
- Color:

| | |
|-------------------------|-----------------------|
| Engine: | RAL 6018 (green) |
| Base frame: | RAL 6018 (green) |
| Generator: | RAL 6018 (green) |
| Module interface panel: | RAL 7035 (light grey) |
| Control panel: | RAL 7035 (light grey) |



1.11 Engine generator control panel per module- Dia.ne XT4 incl. Single synchronization of the generator breaker

Dimensions:

- Height: 87 in (including 8 in pedestal *)
- Width: 32 -48 in*
- Depth: 24 in *

Protection class:

- external IP42
- Internal IP 20 (protection again direct contact with live parts)

*) Control panels will be dimensioned on a project specific basis. Actual dimensions will be provided in the preliminary documentation for the project.

Control supply voltage from starter and control panel batteries: 24V DC

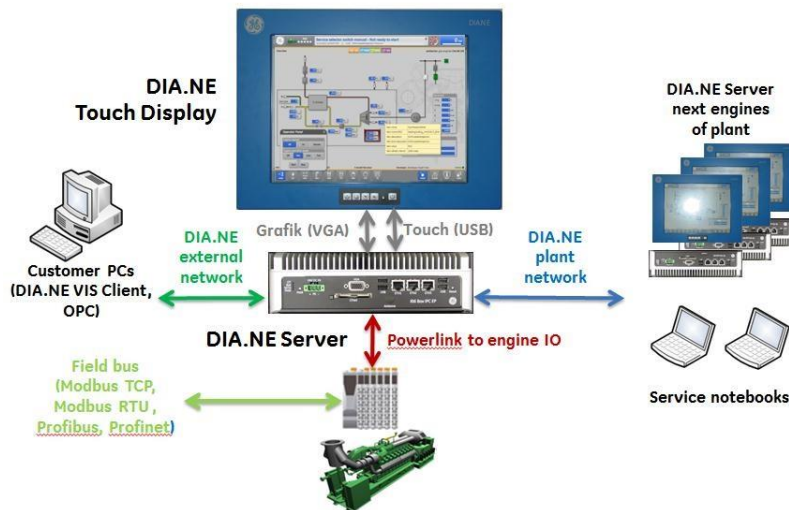
Auxiliaries power supply: (from provider of the auxiliary supply)
3 x 480/277 V, 60 Hz

Consisting of:

Motor - Management - System DIA.NE

Setup:

- a) Touch display visualization
- b) Central engine and unit control





Touch Display Screen:

15" Industrial color graphic display with resistive touch.

Interfaces:

- 24V voltage supply
- VGA display connection
- USB interface for resistive touch

Protection class of DIA.NE XT panel front: IP 65

Dimensions: W x H x D = approx. 16x12x3in

The screen shows a clear and functional summary of the measurement values and simultaneously shows a graphical summary.

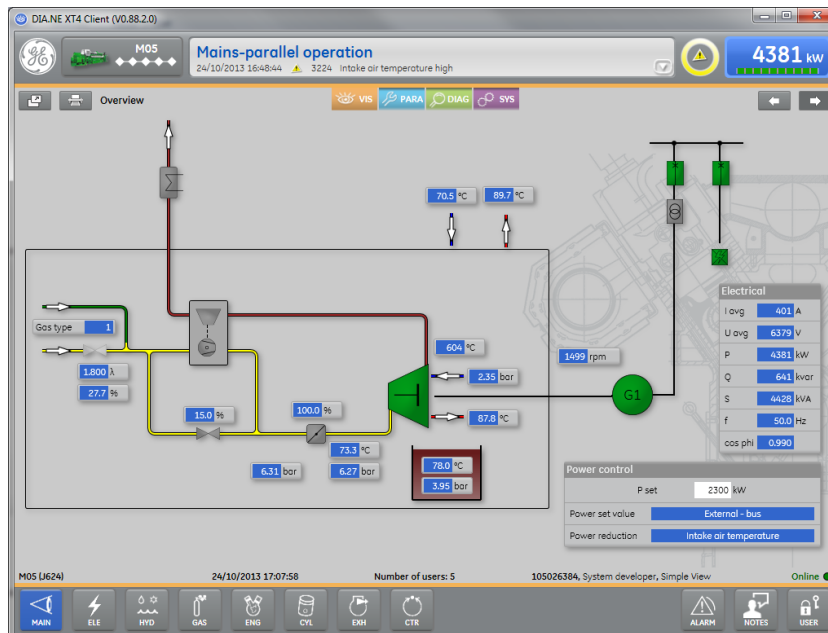
Operation is via the screen buttons on the touch screen

Numeric entries (set point values, parameters...) are entered on the touch numeric pad or via a scroll bar.

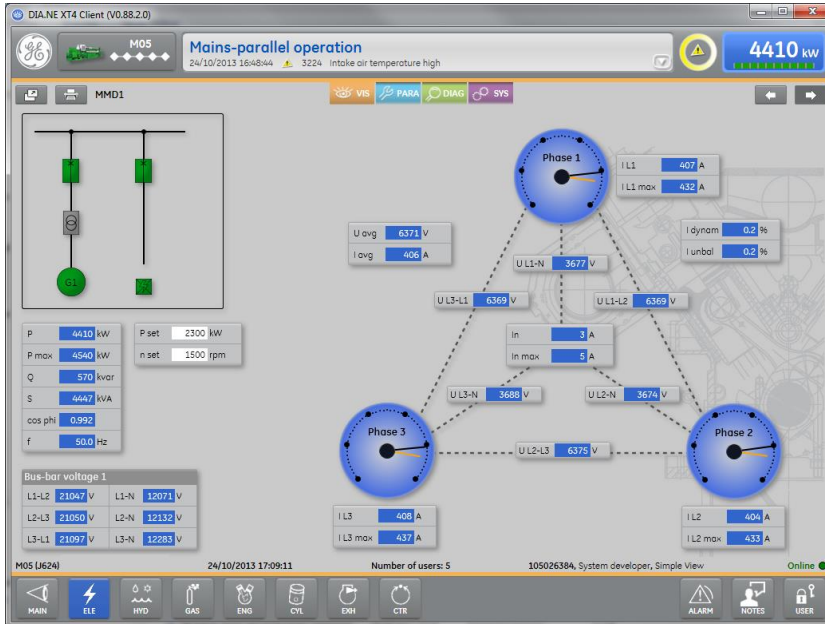
Determination of the operation mode and the method of synchronization via a permanently displayed button panel on the touch screen.

Main screens (examples):

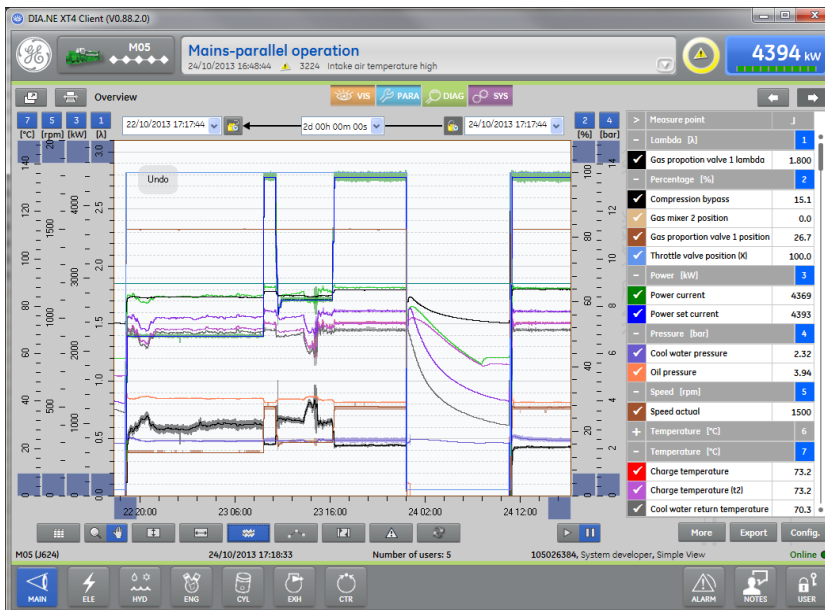
Main: Display of the overview, auxiliaries status, engine start and operating data.



ELE: Display of the generator connection with electrical measurement values and synchronization status



OPTION: Generator winding and bearing temperature
Trending
Trend with 100ms resolution



Measurement values:

- 510 data points are stored
- Measurement interval = 100ms
- Raw data availability with 100ms resolution: 24 hours + max. 5.000.000 changes in value at shut down (60 mins per shut down)



- Compression level 1: min, max, and average values with 1000ms resolution: 3 days
- Compression level 2: min, max, and average values with 30s resolution: 32 days
- Compression level 3: min, max, and average values with 10min resolution: 10 years

Messages:

10.000.000 message events

Actions (operator control actions):

1.000.000 Actions

System messages:

100.000 system messages

Central engine and module control:

An industrial PC- based modular industrial control system for module and engine sequencing control (start preparation, start, stop, aftercooling and control of auxiliaries) as well as all control functions.

Interfaces:

- Ethernet (twisted pair) for remote monitoring access
- Ethernet (twisted pair) for connection between engines
- Ethernet (twisted pair) for the Powerlink connection to the control input and output modules.
- USB interface for software updates

Connection to the local building management system according to the GE Jenbacher option list (OPTION)

- MODBUS-RTU Slave
- MODBUS-TCP Slave,
- PROFIBUS-DP Slave (160 words),
- PROFIBUS-DP Slave (190 words),
- ProfiNet
- OPC

Control functions:

- Speed control in idle and in island mode
- Power output control in grid parallel operation, or according to an internal or external set point value on a case by case basis
- LEANOX control system which controls boost pressure according to the power at the generator terminals, and controls the mixture temperature according to the engine driven air-gas mixer
- Knocking control: in the event of knocking detection, ignition timing adjustment, power reduction and mixture temperature reduction (if this feature is installed)
- Load sharing between engines in island mode operation (option)
- Linear power reduction in the event of excessive mixture temperature and misfiring



- Linear power reduction according to CH4 signal (if available)
- Linear power reduction according to gas pressure (option)
- Linear power reduction according to air intake temperature (option)

Multi-transducer to record the following alternator electrical values:

- Phase current (with slave pointer)
- Neutral conductor current
- Voltages Ph/Ph and Ph/N
- Active power (with slave pointer)
- Reactive power
- Apparent power
- Power factor
- Frequency
- Active and reactive energy counter

Additional 0 (4) - 20 mA interface for active power as well as a pulse signal for active energy

The following alternator monitoring functions are integrated in the multi-measuring device:

- Overload/short-circuit [51], [50]
- Over voltage [59]
- Under voltage [27]
- Asymmetric voltage [64], [59N]
- Unbalance current [46]
- Excitation failure [40]
- Over frequency [81>]
- Under frequency [81<]

Lockable operation modes selectable via touch screen:

- "OFF" operation is not possible, running units will shut down immediately;
- "MANUAL" manual operation (start, stop) possible, unit is not available for fully automatic operation.
- "AUTOMATIC" fully automatic operation according to external demand signal:

Demand modes selectable via touch screen:

- external demand off („OFF“)
- external demand on („REMOTE“)
- override external demand („ON“)

Malfunction Notice list:

Shut down functions e.g.:

- Low lube oil pressure
- Low lube oil level



- High lube oil level
- High lube oil temperature
- Low jacket water pressure
- High jacket water pressure
- High jacket water temperature
- Overspeed
- Emergency stop/safety loop
- Gas train failure
- Start failure
- Stop failure
- Engine start blocked
- Engine operation blocked
- Misfiring
- High mixture temperature
- Measuring signal failure
- Overload/output signal failure
- Generator overload/short circuit
- Generator over/undervoltage
- Generator over/underfrequency
- Generator asymmetric voltage
- Generator unbalanced load
- Generator reverse power
- High generator winding temperature
- Synchronizing failure
- Knocking failure

Warning functions e.g.:

- Cooling water temperature min.
- Cooling water pressure min.
- Generator winding temperature max.

Remote signals:

(volt free contacts)

1NO = 1 normally open

1NC = 1 normally closed

1COC = 1 change over contact

- | | |
|-------------------------------------------------|-----|
| • Ready for automatic start (to Master control) | 1NO |
| • Operation (engine running) | 1NO |
| • Demand auxiliaries | 1NO |
| • Collective signal "shut down" | 1NC |
| • Collective signal "warning" | 1NC |



External (by others) provided command/status signals:

- Engine demand (from Master control) 1S
- Auxiliaries demanded and released 1S

Single synchronizing Automatic

For automatic synchronizing of the module with the generator circuit breaker to the grid by PLC- technology, integrated within the module control panel.

Consisting of:

- Hardware extension of the programmable control for fully automatic synchronization selection and synchronization of the module and for monitoring of the generator circuit breaker closed signal.
- Lockable synchronization selection via touch screen with the following selection modes:
 - "MANUAL" Manual initiation of synchronization via touch screen button followed by fully automatic synchronization of the module
 - "AUTOMATIC" Automatic module synchronization, after synchronizing release from the module control
 - "OFF" Selection and synchronization disabled
Control of the generator circuit breaker according to the synchronization mode selected via touch screen.
 - "Generator circuit breaker CLOSED/ Select" Touch-button on DIA.NE XT
 - "Generator circuit breaker OPEN" Touch-button on DIA.NE XT

Status signals:

Generator circuit breaker closed
Generator circuit breaker open

Remote signals:

(volt free contacts)

Generator circuit breaker closed 1 NO

The following reference and status signals must be provided by the switchgear supplier:

- Generator circuit breaker CLOSED 1 NO
- Generator circuit breaker OPEN 1 NO
- Generator circuit breaker READY TO CLOSE 1 NO
- Mains circuit breaker CLOSED 1 NO
- Mains circuit breaker OPEN 1 NO

Mains voltage 3 x **480/277V** or 3x 110V/v3 other measurement voltages available on request
Bus bar voltage 3 x **480/277 V** or 3x 110V/v3 – other measurement voltages available on request
Generator voltage 3 x ***600 V*** or 3x 110V/v3 – other measurement voltages available on request

Voltage transformer in the star point with minimum 50VA and Class 0,5



The following volt free interface-signals will be provided by GE Jenbacher to be incorporated in switchgear:

- CLOSING/OPENING command for generator circuit breaker
(permanent contact) 1 NO + 1 NC
- Signal for circuit breaker undervoltage trip 1 NO

| | |
|---------------------------------------------------------------------------|-------|
| Maximum distance between module control panel and engine/interface panel: | 99ft |
| Maximum distance between module control panel and power panel: | 164ft |
| Maximum distance between module control panel and master control panel: | 164ft |
| Maximum distance between alternator and generator circuit breaker: | 99ft |

1.11.05 OPC Interface to DIA.NE XT4 visualization via ETHERNET

OPC data interface of GE Jenbacher DIA.NE XT4 visualization system for on-site central control system via ETHERNET 100/1000BaseT TCP/IP protocol.

Software interface:

Supported OPC specifications: OPC DA 1.0, 2.0 and 3.0
Access rights: read
(Optional write function available for certain data points)
Data point update refreshment rate: 100 ms

OPC is based on the Microsoft Distributed Component Object Model (DCOM). All DCOM limitations therefore also apply to this interface.

Data transmitted:

The data offered are e.g. measurement values for generator power, oil pressure, oil temperature, cooling water pressure, cooling water temperature, cylinder and collective exhaust gas temperatures, various counter readings, all failure messages and warnings, and various operational messages on the installation condition.

Max. Cable length:

100m (DIA.NE WIN Server - local Computer)
>100m: fiber optic cable recommended (Ethernet to fiber optic cable converter supplied locally)

GE Jenbacher limit of supply:

Interface 100/1000Base-T with RJ45 bus
at DIA.NE XT4 Server
in the module control cabinet.



1.11.06 Remote Data-Transfer with DIA.NE XT4

General

DIA.NE XT4 offers remote connection with Ethernet.

Applications:

1.) DIA.NE XT4 HMI

DIA.NE XT4 HMI is the human-machine-interface of DIA.NE XT4 engine control and visualization system for GE Jenbacher gas engines.

The system offers extensive facilities for commissioning, monitoring, servicing and analysis of the site.

By installation of the DIA.NE XT4 HMI client program it can be used to establish connection to site, if connected to a network and access rights are provided.

The system runs on Microsoft Windows Operating systems (Windows XP, Windows 7, Windows 8)

Function

Functions of the visualization system at the engine control panel can be used remotely. These are among others control and monitoring, trend indications, alarm management, parameter management, and access to long term data recording. By providing access to multiple systems, also with multiple clients in parallel, additional useful functions are available like multi-user system, remote control, print and export functions and data backup. DIA.NE XT4 is available in several languages.

Option - Remote demand/blocking

If the service selectors switch at the module control panel is in pos. "Automatic" and the demand-selector switch in pos. "Remote", it is possible to enable (demanded) or disable (demand off) the module with a control button at the DIA.NE XT4 HMI

Note:

With this option it makes no sense to have an additional clients demand (via hardware or data bus) or a self-guided operation (via GE Jenbacher master control, grid import /export etc.).

Option - Remote - reset (see TA-No. 1100-0111 chapter 1.7 an d1.9)

Scope of supply

- Software package DIA.NE XT4 HMI Client Setup (Download)
- Number of DIA.NE XT4 HMI - Client user license (Simultaneous right to access of one user to the engine control)

| Nr. of license | Access |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | 1 Users can be logged in at the same time with a PC (Workplace, control room or at home). |
| 2 - "n" (Optional) | 2- "n" Users can be logged in at the same time with a PC (Workplace, control room or at home). If 2- "n" users are locally connected at Computers from office or control room, then it is not possible to log in from home. |



Caution! This option includes the DIA.NE XT4 HMI client application and its license only – NO secured, encrypted connection will be provided by GE Jenbacher! A secured, encrypted connection – which is mandatory – has to be provided by the customer (via LAN connection or customer-side VPN), or can be realized by using option myPlant™.

Customer requirements

- Broad band network connection via Ethernet(100/1000BASE-TX) at RJ45 Connector (ETH3) at DIA.NE XT4 server inside module control panel
- Standard PC with keyboard, mouse or touch and monitor (min. resolution 1024*768)
- Operating system Windows XP, Windows 7, Windows 8
- DirectX 9.0 c compatible or newer 3D display adapter with 64 MB or higher memory

2.) myPlant™ End Customer version "myPlant™ Discovery" (OPTION, after warranty period)

myPlant™ is the GE Jenbacher remote monitoring solution

Web application with following features:

- Visualization of the current state of the engine (available, in operation, fault)
- View of various readings of the Gen-set
- Visualization of counts as a trend graph (if plant available online, or by manually entering of the counter readings)
- Trend graph of the performance value (low resolution; only if system available online)
- Access to a future spare parts shop
- Remote access to the visualization system DIA.NE XT4 installed beside the engine control system (only during warranty period and as part of a service contract (MSA, CSA))

myPlant™ is free of charge within the warranty period and is also included as part of any service contract (MSA, CSA).

Scope of supply

- Access to myPlant™ Discovery version for up to 4 users
- Connection between plant server and myPlant™ system

Customer requirements

- Permanent Internet line (wired or mobile, (see option 3))
- See technical instruction TA 2300-0008
- Outbound data connectivity (from plant server to Internet) ONLY – INBOUND connections must NOT be allowed!

CAUTION!

It is in the responsibility of the customer to prevent direct access from the Internet to the plant server using technical equipment like firewalls.

GE Jenbacher does not provide such security devices and services as part of this option!



Automatic alarm notification system for myPlant™ - enabled DIA.NE XT systems (all versions).

Function

- Automatic transfer of engine messages to the customer via email or SMS in case of engine trip, engine start/stop or connectivity loss.

Scope of supply

- Feature of myPlant™ web portal

Customer requirements

- Engine must be connected to the myPlant™ system via Internet connection

myPlant™ notification is free of charge within the warranty period and is also included as part of any service contract (MSA, CSA).

4.) Mobile Internet (OPTION)

Connection Plant - Customer via secured Internet - connection

See also technical instruction **TA 2300 - 0006**

Scope of delivery

- Mobile Internet router with antenna to connect to the DIA.NE Server XT4

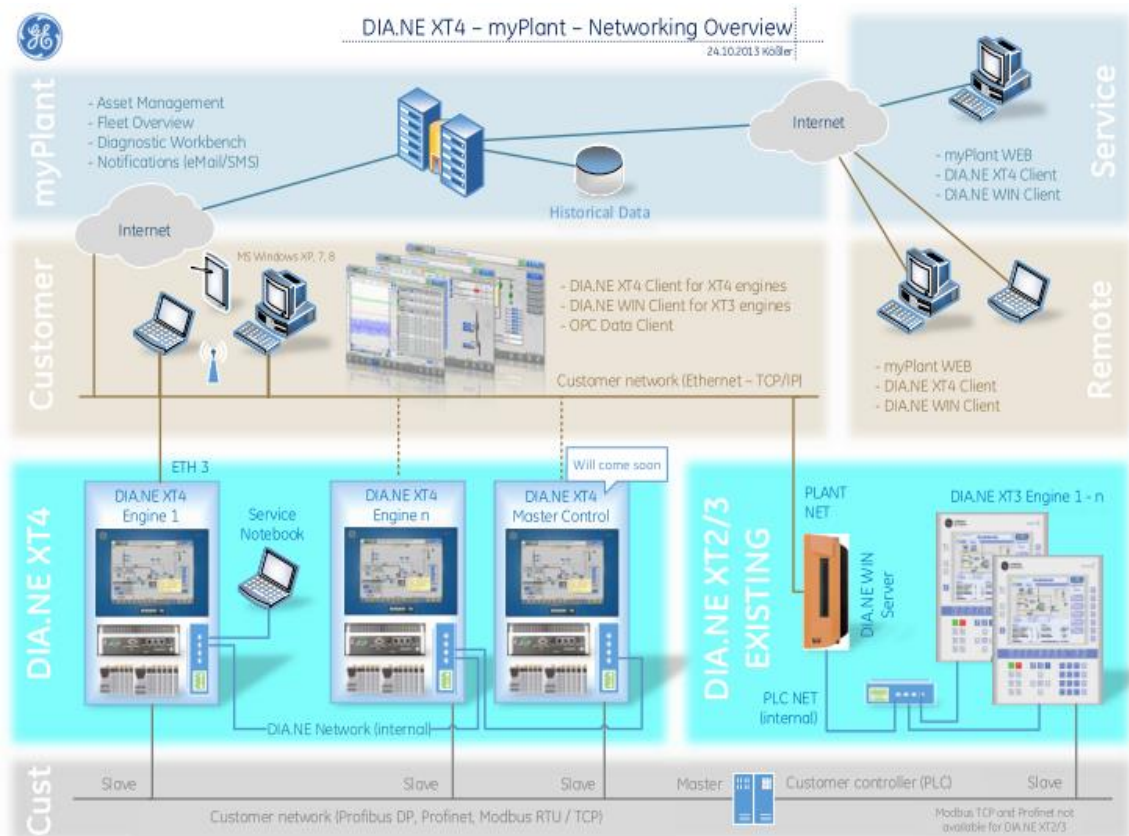
Customer requirements

- SIM card for 3 G



5.) Network overview

For information only!



1.20.03 Starting system

Starter battery (is not included in GE Jenbacher scope):

2 piece 12 V Pb battery, 200 Ah (according to DIN 72311), complete with cover plate, terminals and acid tester.

Battery voltage monitoring:

Monitoring by an under voltage relay.

Battery charging equipment:

Capable for charging the starter battery with I/U characteristic and for the supply of all connected D.C. consumers.

Charging device is mounted inside of the module interface panel or module control panel.



• **General data:**

- Power supply **3 x 320 - 550 V, 47 - 63 Hz**
- max. power consumption **1060 W**
- Nominal D.C. voltage **24 V(+/-1%)**
- Voltage setting range **24V to 28,8V (adjustable)**
- Nominal current (max.) **40 A**
- Dimensions **ca. 10 x 5 x 5 inch (240 x 125 x 125 mm)**
- Degree of protection **IP20 to IEC 529**
- Operating temperature **32 °F – 140 °F (0 °C - 60 °C)**
- Protection class **1**
- Humidity class **3K3, no condensation.**
- Natural air convection
- Standards **EN60950,EN50178
UL/cUL (UL508/CSA 22.2)**

Signalling:

- Green Led: Output voltage > 20,5V
- Yellow Led: Overload, Output Voltage < 20,5V
- Red Led: shutdown

Control accumulator:

- Pb battery 24 VDC/18 Ah

1.20.05 Electric jacket water preheating

Installed in the jacket water cooling circuit, consisting of:

- Heating elements
- Water circulating pump

The jacket water temperature of a stopped engine is maintained between 133 °F (56°C) and 140°F (60°C), to allow for immediate loading after engine start.

1.20.08 Flexible connections

Following flexible connections per module are included in the GE Jenbacher -scope of supply:

| No.Connection | Unit | Dimension | Material |
|--------------------------|---------------|----------------|-----------------|
| 2 Warm water in-/outlet | in/lbs | 3"/145 | Stainless steel |
| 1 Exhaust gas outlet | in/lbs | 10"/145 | Stainless steel |
| 1 Fuel gas inlet | in/lbs | 3"/145 | Stainless steel |
| 2 Intercooler in-/outlet | in/lbs | 3"/145 | Stainless steel |
| 2 Lube oil connection | Hose | | |



Sealings and flanges for all flexible connections are included.

2.00 Electrical equipment

Totally enclosed floor mounted sheet steel cubicle with front door wired to terminals. Ready to operate, with cable entry at bottom. Naturally ventilated.

Protection: IP 42 external, NEMA 12
IP 20 internal (protection against direct contact with live parts)

Design according to EN 61439-2 / IEC 61439-2 and ISO 8528-4.
Ambient temperature 41 - 104 °F (5 - 40 °C), 70 % Relative humidity

Standard painting: Panel: RAL 7035
Pedestal: RAL 7020

2.02 Grid monitoring device

Standard without static Grid - 60Hz alternator

Function:

For immediate disconnection of the generator from the grid in case of grid failures.

Consisting of:

- High/low voltage monitoring
- High/low frequency monitoring
- Specially adjustable independent time for voltage and frequency monitoring
- Vector jump monitoring or df/dt monitoring for immediate disconnection of the generator from the grid for example at short interruptions
- Indication of all reference dimensions for normal operation and at the case of disturbance over LCD and LED
- Adjusting authority through password protection against adjusting of strangers

Scope of supply:

Digital grid protection relay with storage of defect data, indication of reference dimensions as well as monitoring by itself.

Grid protection values:

| Parameter | Parameter limit | Max time delay[s] | Comments |
|-----------|-----------------|-------------------|----------------|
| 59-61Hz | | | Do work normal |



| | | | |
|-----------------------------------------------------|------------------------------------|-----|-----------------------------------------------|
| f<[ANSI 81U] | 59Hz | 0,5 | Load reduction with 10%/HZ below 59Hz! |
| f<<[ANSI 81U] | 58.5Hz | 0,1 | |
| f>[ANSI 81O] | 61,5Hz | 0,1 | Load reduction with 30%/HZ above 61Hz! |
| U<[ANSI 27] | 90% | 1 | Load reduction with 1%P /%U below 95% |
| U<<[ANSI 27] | 80% | 0,2 | Load reduction with 1%P /%U below 95% |
| U>[ANSI 59] | 110% | 30 | Load reduction with 1%P /%U above 105% |
| U>>[ANSI 59] | 115% | 0,2 | Load reduction with 1% P/%U above 105% |
| Df/dt [ANSI 81R] or Vector shift [ANSI 78] | 2Hz/s, 5 Periods Or 8° -3pol | | Cos phi range: 0,8ind (overexcited) - 1 |

2.03.02 Power control

According to external signal

Function:

The external potential free (0/4 - 20 mA = 50 - 100 % of nominal power) signal is a set value for the power control.

At plants with multiple modules, this signal can be used in a series loop on every Engine Management System. This provides an equal load sharing between all modules.

4.00 Delivery, installation and commissioning

4.01 Carriage



According to contract.

4.02 Unloading

Unloading, moving of equipment to point of installation, mounting and adjustment of delivered equipment on intended foundations is not included in GE Jenbacher scope of supply.

4.03 Assembly and installation

Assembly and installation of all GE Jenbacher -components is not included in GE Jenbacher scope of supply.

4.04 Storage

The customer is responsible for secure and appropriate storage of all delivered equipment.

4.05 Start-up and commissioning

Start-up and commissioning with the GE Jenbacher start-up and commissioning checklist is not included. Plants with island operation require internet connection.

4.06 Trial run

After start-up and commissioning, the plant will be tested in an 8-hour trial run. The operating personnel will be introduced simultaneously to basic operating procedures. Is not included in GE Jenbacher scope of supply.

4.07 Emission measurement (exhaust gas analyser)

Emission measurement by GE Jenbacher personnel, to verify that the guaranteed toxic agent emissions have been achieved (costs for measurement by an independent agency will be an extra charge).

5.01 Limits of delivery - Genset

Electrical:

- Genset:
 - At terminals of genset interface panel
 - At terminals of generator terminal box
(screwed glands to be provided locally)
- Genset control panel:
 - At terminal strips
- Auxiliaries:
 - At terminals of equipment which is supplied separately

Cooling water

At inlet and outlet flanges on genset

Exhaust gas

At outlet flange of the genset

Combustion air

The air filters are set mounted



Fuel gas

At inlet and outlet flange of gas train
At inlet flange of gas pipework on genset

Lube oil

At lube oil connections on genset

Draining connections and pressure relief

At genset

Insulation

Insulation of heat exchangers and pipework is not included in our scope of supply and must be provided locally.

First filling

The first filling of genset, (lube oil, engine jacket water, anti freeze-, anti corrosive agent, battery acid) is not included in our scope of supply.

The composition and quality of the used consumables are to be strictly monitored in accordance with the "Technical Instructions" of GE JENBACHER.

Suitable bellows and flexible connections **must be provided locally** for all connections.
Cables from the genset must be flexible.

5.02 Factory tests and inspections

The individual module components shall undergo the following tests and inspections:

5.02.01 Engine tests

Carried out as combined Engine- and Module test according to DIN ISO 3046 at GE Jenbacher test bench. The following tests are made at 100%, 75% and 50% load, and the results are reported in a test certificate:

- Engine output
- Fuel consumption
- Jacket water temperatures
- Lube oil pressure
- Lube oil temperatures
- Boost pressure
- Exhaust gas temperatures, for each cylinder

5.02.02 Generator tests

Carried out on the premises of the generator supplier.

(If Katogenerator is in use -->Is subject to the following standards commercial tests in accordance with IEEE-115, NEMA MG 1.)



5.02.03 Module tests

The engine will be tested with natural gas (methane number 94). The performance data achieved at the test bench may therefore vary from the data as defined in the technical specification due to differences in fuel gas quality.

Carried out as combined Engine- and Module test commonly with module control panel at GE Jenbacher test bench, according to ISO 8528, DIN 6280. The following tests are made and the results are reported in a test certificate:

Visual inspection of scope of supply per specifications.

- Functional tests per technical specification of control system.
 - Starting in manual and automatic mode of operation
 - Power control in manual and automatic mode of operation
 - Function of all safety systems on module
- Measurements at 100%, 75% and 50% load:
 - Frequency
 - Voltage
 - Current
 - Generator output
 - Power factor
 - Fuel consumption
 - Lube oil pressure
 - Jacket water temperature
 - Boost pressure
 - Mixture temperature
 - Exhaust emission (NO_x)

The module test will be carried out with the original generator, except it is not possible because of the delivery date. Then a test generator will be used for the module test.

To prove characteristics of the above components, which are not tested on the test bench by GE JENBACHER, the manufacturers' certificate will be provided.

5.03 Documentation

Preliminary documentation 60 days after receipt of a technically and commercially clarified order:

- Module drawing 1)
- Technical diagram 1)
- Drawing of control panel 3)
- List of electrical interfaces 2)
- Technical specification of control system 2)
- Technical drawing auxiliaries (if included in GE Jenbacher-limit of delivery) 1)

At delivery:

- Wiring diagrams 3)
- Cable list 3)



At start-up and commissioning (or on clients request):

- Operating and maintenance manual 4)
- Spare parts manual 4)
- Operation report log 4)