





<b>0.01 Technical Data (container)</b>	<b>4</b>
Main dimensions and weights (container)	5
Connections	5
Output / fuel consumption	5
<b>0.02 Technical data of engine</b>	<b>6</b>
Thermal energy balance	6
Exhaust gas data	6
Combustion air data	6
Sound pressure level	7
Sound power level	7
<b>0.03 Technical data of generator</b>	<b>8</b>
Reactance and time constants (saturated)	8
<b>0.04 Technical data of heat recovery</b>	<b>9</b>
General data - Hot water circuit	9
General data - Cooling water circuit	9
Exhaust gas heat exchanger	9
<b>connection variant C</b>	<b>10</b>
<b>0.10 Technical parameters</b>	<b>11</b>
<b>1.00 Scope of supply - module</b>	<b>12</b>
<b>1.01 Spark ignited gas engine</b>	<b>13</b>
<b>1.01.01 Engine design</b>	<b>13</b>
<b>1.01.02 Additional equipment for the engine (spares for commissioning)</b>	<b>14</b>
<b>1.01.03 Engine accessories</b>	<b>14</b>
<b>1.01.04 Standard tools (per installation)</b>	<b>15</b>
<b>1.02 Generator-low voltage – 415V</b>	<b>15</b>
<b>1.03 Module accessories</b>	<b>17</b>
<b>1.03.01 Engine jacket water system</b>	<b>19</b>
<b>1.03.02 Automatic lube oil replenishing system</b>	<b>19</b>
<b>1.04 Heat recovery</b>	<b>19</b>
<b>1.05.01 Gas train 80-200mbar</b>	<b>20</b>
<b>1.07 Painting</b>	<b>20</b>
<b>1.11 Engine generator control panel per module- Dia.ne XT4 incl. Single synchronization of the generator breaker</b>	<b>21</b>
Touch Display Screen:	22
Central engine and module control:	26
Malfunction Notice list:	27
<b>1.11.03 Remote information by PROFIBUS-DP</b>	<b>29</b>
<b>1.11.06 Remote Data-Transfer with DIA.NE XT4</b>	<b>30</b>



<b>1.20.03 Starting system</b>	<b>32</b>
<b>1.20.05 Electric jacket water preheating</b>	<b>33</b>
<b>1.20.08 Flexible connections</b>	<b>33</b>
<b>2.00 Electrical Equipment</b>	<b>34</b>
<b>2.02 Grid monitoring device for United Kingdom</b>	<b>34</b>
<b>2.04 Generator circuit breaker panel, IEC/EN</b>	<b>36</b>
<b>2.12 Gas warning device</b>	<b>37</b>
<b>2.13 Smoke warning device</b>	<b>37</b>
<b>3.01 Lube oil system</b>	<b>37</b>
<b>3.03.01 Exhaust gas silencer</b>	<b>38</b>
<b>3.03.04 Pipe work for condensate</b>	<b>38</b>
<b>3.05 Air intake and outlet system</b>	<b>38</b>
<b>3.10.03 Cooling system - dual-circuit radiator</b>	<b>39</b>
<b>3.20 Container – ISA – BS 12 C39</b>	<b>39</b>
<b>4.00 Delivery, installation and commissioning</b>	<b>41</b>
4.01 Carriage	41
4.02 Unloading	41
4.03 Assembly and installation	41
4.04 Storage	41
4.05 Start-up and commissioning	41
<b>5.01 Limits of delivery - Container</b>	<b>41</b>
<b>5.02 Factory tests and inspections</b>	<b>42</b>
5.02.01 Engine tests	42
5.02.02 Generator tests	42
5.02.03 Module tests	42
<b>5.03 Documentation</b>	<b>43</b>



## 0.01 Technical Data (container)

Data at:

			Full load	Part Load	
Fuel gas LHV	kWh/Nm <sup>3</sup>		4,5		
			100%	75%	min.
Energy input	kW	[2]	1.211	938	695
Gas volume	Nm <sup>3</sup> /h	*)	269	209	154
Mechanical output	kW	[1]	515	388	272
Electrical output	kW el.	[4]	499	375	261
Recoverable thermal output					
~ Intercooler 1st stage	kW		49	22	12
~ Lube oil	kW		59	47	39
~ Jacket water	kW		189	170	133
~ Exhaust gas cooled to 180 °C	kW		225	182	142
Total recoverable thermal output	kW	[5]	522	422	326
Total output generated	kW total		1.021	797	586
Heat to be dissipated					
~ Intercooler 2nd stage	kW		39	23	6
~ Lube oil	kW		~	~	~
~ Surface heat	ca. kW	[7]	49	~	~
Spec. fuel consumption of engine electric	kWh/kWel.h	[2]	2,43	2,51	2,66
Spec. fuel consumption of engine	kWh/kWh	[2]	2,35	2,42	2,56
Lube oil consumption	ca. kg/h	[3]	0,16	~	~
Electrical efficiency	%		41,2%	39,9%	37,5%
Thermal efficiency	%		43,1%	45,0%	46,9%
Total efficiency	%	[6]	84,3%	84,9%	84,4%
Hot water circuit:					
Forward temperature	°C		95,0	91,2	87,5
Return temperature	°C		75,0	75,0	75,0
Hot water flow rate	m <sup>3</sup> /h		22,4	22,4	22,4

\*) 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 ±8 % on the thermal output a further reserve of +5 % is recommended for the dimensioning of the cooling requirements.



### Main dimensions and weights (container)

Length	mm	~ 12.200
Width	mm	2500-3000
Height	mm	~ 2.600
Weight empty	kg	~ 20.500
Weight filled	kg	~ 21.600

### Connections

Hot water inlet and outlet	DN/PN	80/10
Exhaust gas outlet	DN/PN	250/10
Fuel gas connection (container)	mm	100/16
Fresh oil connection	G	28x2"
Waste oil connection	G	28x2"
Cable outlet	mm	800x400
Condensate drain	mm	18

### Output / fuel consumption

ISO standard fuel stop power ICFN	kW	515
Mean effe. press. at stand. power and nom. speed	bar	14,16
Fuel gas type		Biogas
Based on methane number   Min. methane number	MZ d)	135   100
Compression ratio	Epsilon	16
Min./Max. fuel gas pressure at inlet to gas train	mbar	80 - 200 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	50
Spec. fuel consumption of engine	kWh/kWh	2,35
Specific lube oil consumption	g/kWh	0,30
Max. Oil temperature	°C	90
Jacket-water temperature max.	°C	95
Filling capacity lube oil (refill)	lit	~ 216

c) Lower gas pressures upon inquiry

d) based on methane number calculation software AVL 3.1



## 0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 312 GS-D225
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		12
Bore	mm	135
Stroke	mm	170
Piston displacement	lit	29,20
Nominal speed	rpm	1.500
Mean piston speed	m/s	8,50
Length	mm	2.400
Width	mm	1.457
Height	mm	2.065
Weight dry	kg	3.200
Weight filled	kg	3.530
Moment of inertia	kgm <sup>2</sup>	7,77
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	kW	1.211
Intercooler	kW	88
Lube oil	kW	59
Jacket water	kW	189
Exhaust gas cooled to 180 °C	kW	225
Exhaust gas cooled to 100 °C	kW	288
Surface heat	kW	27

### Exhaust gas data

Exhaust gas temperature at full load	°C [8]	448
Exhaust gas temperature at bmep= 11,2 [bar]	°C	~ 463
Exhaust gas temperature at bmep= 7,5 [bar]	°C	~ 487
Exhaust gas mass flow rate, wet	kg/h	2.677
Exhaust gas mass flow rate, dry	kg/h	2.489
Exhaust gas volume, wet	Nm <sup>3</sup> /h	2.091
Exhaust gas volume, dry	Nm <sup>3</sup> /h	1.857
Max.admissible exhaust back pressure after engine	mbar	60

### Combustion air data

Combustion air mass flow rate	kg/h	2.469
Combustion air volume	Nm <sup>3</sup> /h	1.911
Max. admissible pressure drop at air-intake filter	mbar	10



### Sound pressure level

Aggregate a)		dB(A) re 20 $\mu$ Pa	
31,5	Hz	dB	80
63	Hz	dB	87
125	Hz	dB	91
250	Hz	dB	91
500	Hz	dB	90
1000	Hz	dB	89
2000	Hz	dB	86
4000	Hz	dB	86
8000	Hz	dB	89
Exhaust gas b)		dB(A) re 20 $\mu$ Pa	
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	115
Measurement surface	m <sup>2</sup>	97
Exhaust gas	dB(A) re 1pW	123
Measurement surface	m <sup>2</sup>	6,28

a) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.

b) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.

The spectra are valid for aggregates up to bmep=18 bar. (for higher bmep add safety margin of 1dB to all values per increase of 1 bar pressure).

Engine tolerance  $\pm$  3 dB



### 0.03 Technical data of generator

Manufacturer		Leroy-Somer e)
Type		LSAC 49.1 L9 e)
Type rating	kVA	785
Driving power	kW	515
Ratings at p.f. = 1,0	kW	499
Ratings at p.f. = 0,8	kW	493
Rated output at p.f. = 0,8	kVA	616
Rated reactive power at p.f. = 0,8	kVar	370
Rated current at p.f. = 0,8	A	857
Frequency	Hz	50
Voltage	V	415
Speed	rpm	1.500
Permissible overspeed	rpm	1.800
Power factor (lagging - leading)		0,8 - 0,95
Efficiency at p.f. = 1,0	%	96,9%
Efficiency at p.f. = 0,8	%	95,7%
Moment of inertia	kgm <sup>2</sup>	11,31
Mass	kg	1.870
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Construction		B3/B14
Protection Class		IP 23
Insulation class		H
Temperature (rise at driving power)		F
Maximum ambient temperature	°C	40

#### Reactance and time constants (saturated)

x <sub>d</sub> direct axis synchronous reactance	p.u.	1,51
x <sub>d</sub> ' direct axis transient reactance	p.u.	0,10
x <sub>d</sub> '' direct axis sub transient reactance	p.u.	0,08
x <sub>2</sub> negative sequence reactance	p.u.	0,08
T <sub>d</sub> '' sub transient reactance time constant	ms	10
T <sub>a</sub> Time constant direct-current	ms	15
T <sub>do</sub> ' open circuit field time constant	s	2,11

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.



## 0.04 Technical data of heat recovery

### General data - Hot water circuit

Total recoverable thermal output	kW	522
Return temperature	°C	75,0
Forward temperature	°C	95,0
Hot water flow rate	m³/h	22,4
Nominal pressure of hot water	PN	10
min. operating pressure	bar	3,5
max. operating pressure	bar	9,0
Pressure drop hot water circuit	bar	0,80
Maximum Variation in return temperature	°C	+0/-5
Max. rate of return temperature fluctuation	°C/min	10

### General data - Cooling water circuit

Heat to be dissipated	kW	39
Return temperature	°C	50
Cooling water flow rate	m³/h	15
Nominal pressure of cooling water	PN	10
min. operating pressure	bar	0,5
max. operating pressure	bar	5,0
Loss of nominal pressure of cooling water	bar	~
Maximum Variation in return temperature	°C	+0/-5
Max. rate of return temperature fluctuation	°C/min	10

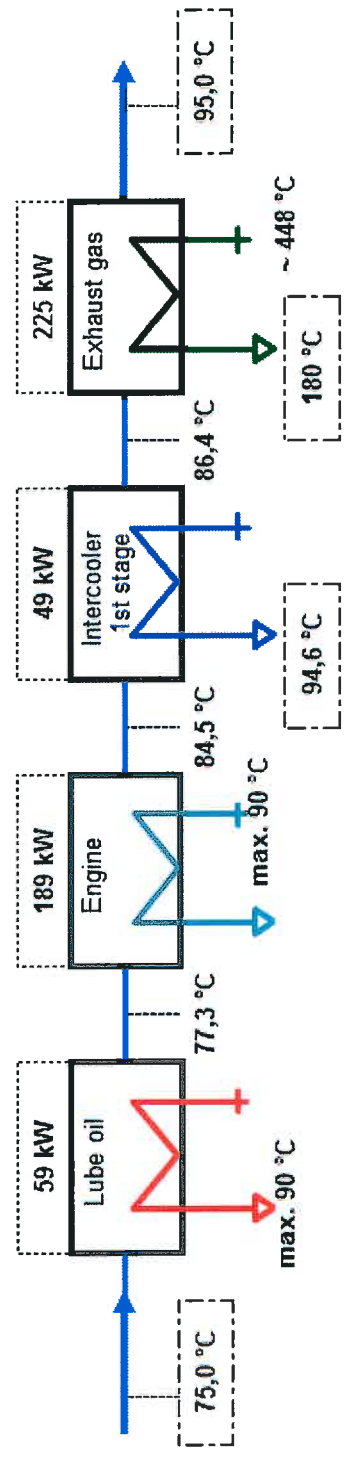
### Exhaust gas heat exchanger

Type	shell-and-tube	
PRIMARY:		
Exhaust gas pressure drop approx	bar	0,02
Exhaust gas connection	DN/PN	250/10
SECONDARY:		
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	80/10

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

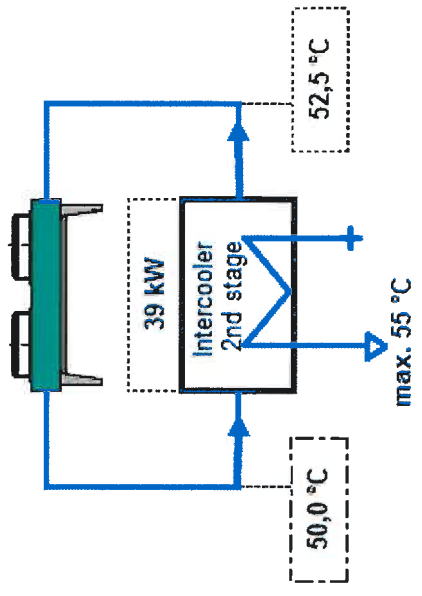
**Hot water circuit**

**Recoverable thermal output = 522 kW**  
(±8 % tolerance +5 % reserve for cooling requirements)  
**Hot water flow rate = 22,4 m³/h**



**Low temperature circuit (calculated with Glykol 37%)**

**Heat to be dissipated = 39 kW**  
(±8 % tolerance +5 % reserve for cooling requirements)  
**Cooling water flow rate = 15,0 m³/h**





## 0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures and the methane number and subject to technical development and modifications.

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; reference value --> 65%CH<sub>4</sub>
- (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:

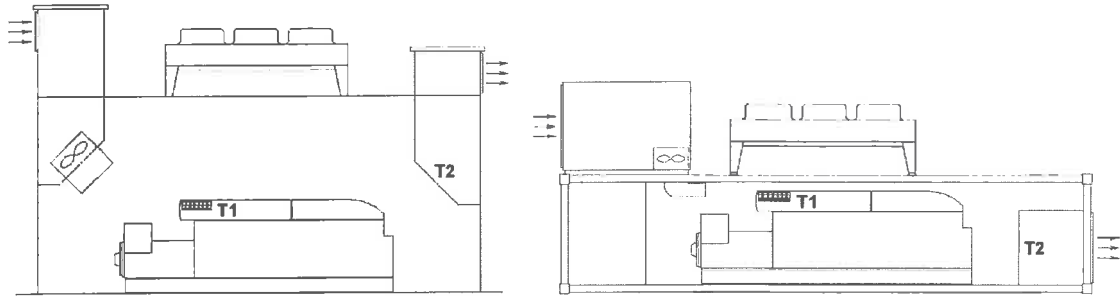
Barometric pressure:	1000 mbar (14.5 psi) or 100 m (328 ft) above sea level
Air temperature:	25°C (77°F) or 298 K
Relative humidity:	30 %
- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)

Pressure:	1013 mbar (14.7 psi)
Temperature:	0°C (32°F) or 273 K

### Output adjustment for turbo charged engines

Standard rating of the engines is for an installation at an altitude ≤ 500 m and an air intake temperature ≤ 30 °C (T1)

Maximum room temperature: 50°C (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 carried out by the engine management system.

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: **TI 1100-0110, TI 1100-0111 and TI 1100-0112.**

If possible, railway trucks must not be used for transport (**TI 1000-0046**).

#### **Parameters for the operation of control unit and the electrical equipment**

Relative humidity 50% by maximum temperature of 40°C.

Altitude up to 2000m above the sea level.

#### **Parameters for using a gas compressor**

The gas quantity indicated under the technical data refers to standard conditions with the given calorific value. The actual volume flow (under operating conditions) has to be considered for dimensioning the gas compressor and each gas feeding component – it will be affected by:

- Actual gas temperature (limiting temperature according to TI 1000-0300)
- Gas humidity (limiting value according to TI 1000-0300)
- Gas Pressure
- Calorific value variations (can be equated with methane (CH<sub>4</sub>) variations in the case of biogas)
- The gas compressor is designed for a max. relative under pressure of 15 mbar(g) (0.22 psi) and a inlet temperature of 40°C (104°F) , if within scope of supply GE Jenbacher

## **1.00 Scope of supply - module**

### **Design:**

The module is built as a compact package. Engine and generator are connected through a coupling and 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 the module to be placed 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, valve guides and spark plug sleeves individually replaceable; exhaust and inlet valves 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 to 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

## **1.01.02 Additional equipment for the engine (spares for commissioning)**

The initial set of equipment with the essential spare parts for operation after commissioning is included in the scope of supply.

## **1.01.03 Engine accessories**

**Insulation of exhaust manifold:**

Insulation of exhaust manifold is easily installed and removed

**Sensors at the engine:**

- Jacket water temperature sensor



- Jacket water pressure sensor
- Lube oil temperature sensor
- Lube oil pressure sensor
- Mixture temperature sensor
- Charge pressure sensor
- Minimum and maximum lube oil level switch
- Exhaust gas thermocouple for each cylinder
- Knock sensors
- Gas mixer / gas dosing valve position reporting.

**Actuator at the engine:**

- Actuator - throttle valve
- Bypass-valve for turbocharger
- Control of the gas mixer / gas dosing valve

### **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 – 415V**

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% I<sub>2</sub> continuous, in case of fault I<sub>2</sub> 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
  - Bearings
- Polarisation index
- No Load saturation characteristic (remanent voltage)
- Stator voltage unbalance
- Direction of rotation, phase sequence
- No-Load Vibration Test per IEC 34-14 --- Rigid Mounting at min. medium and max. speed
- Excitation Test
- Setting of AVR System Parameters
- High voltage test of the stator windings (2 x Unom. + 1000 V) and the rotor windings (min. 1500 V)

## **1.03 Module accessories**

### **Base frame**

Welded structural steel to accommodate engine, generator and heat exchangers.



### **Flexible coupling**

With torque limiter to couple engine with generator. The coupling isolates the major subharmonics of engine firing impulses from the generator.

### **Bell housing**

To connect engine with generator housing. With two ventilation and control windows.

### **Anti-vibration mounts**

Arranged between engine/generator assembly and base frame. Isolating pads (SYLOMER) for placement between base frame and foundation, delivered loose.

### **Exhaust gas connection**

Connection of exhaust gas turbocharger; including flexible connection to compensate for expansions and vibrations.

### **Combustion air filter**

Dry type air filter with replaceable filter cartridges, including flexible connection to carburetor and service indicator.

### **Interface panel**

Totally enclosed sheet steel cubicle with front door, wired to terminals, ready to operate. Cable entry at bottom.

Painting: RAL 7035

Protection: IP 54 external, IP 20 internal (protection against direct contact with live parts)

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

Dimensions:

- Height: 1000 mm (39 in)
- Width: 800 mm (32 in),
- Depth: 300 mm (12 in)

Power supply from the starter battery charger.

Power distribution to the engine mounted auxiliaries (power input from the supplier of the auxiliaries power supply):  
3 x 415/240 V, 50 Hz, 16 A

### **Essential components installed in interface panel:**

- Terminal strip
- Decentralised input and output cards, connected by a data bus interface to the central engine control of the module control panel.
- Speed monitoring
- Relays, contacts, fuses, engine contact switch to control valves and auxiliaries
- Measuring transducer for excitation voltage
- Air conditioning system (**option**)



### 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, 415/240 V
- Oil filter
- Necessary pipework

## 1.04 Heat recovery

Engine-mounted intercooler and lube oil heat exchanger, jacket water heat exchanger, exhaust gas heat exchanger mounted to the engine res. to the module base frame, complete with interconnecting pipe work.

The insulation of heat exchangers and pipework is not included in GE Jenbacher scope of supply.

#### Heat exchanger - air/fuel mixture to warm water (intercooler)

The engine-mounted intercooler is of two stage design. The first stage is integrated with the warm water circuit. The second stage requires low temperature water.

#### Heat exchanger - lube oil to warm water

Heat recovery via a mounted heat exchanger which is integrated in the warm water circuit.



### Heat exchanger - engine jacket water to warm water

The plate-type heat exchanger is mounted to the module base frame, complete with interconnecting pipework, for recovery of engine jacket water.

### Heat exchanger - exhaust gas to warm water

Horizontally mounted to module base frame, complete with interconnecting pipework, for recovery of exhaust gas heat.

Consisting of:

- Inlet chamber, with flushing connection for cleaning
- Tube type heat exchanger
- Outlet chamber with condensate drain and flushing connection for cleaning
- Thermocouple for monitoring of exhaust gas outlet temperature

## 1.05.01 Gas train 80-200mbar

Consisting of:

- Shut off valve
- Gas filter, filter fineness <3µm
- Gas admission pressure regulator
- Pressure gauge with push button valve
- Solenoid valves
- Leakage detector
- Gas pressure switch (min.)
- Gas pressure regulator
- Gas flow meter (option)
- p/t compensation (option)

The gas train complies with DIN - DVGW regulations.

## 1.07 Painting

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

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: 2200 mm (including 200 mm (8 in) pedestal \*)
- Width: 800 -1200mm\*)
- Depth: 600 mm \*)

### Protection class:

- external IP42
- Internal IP 20 (protection against 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

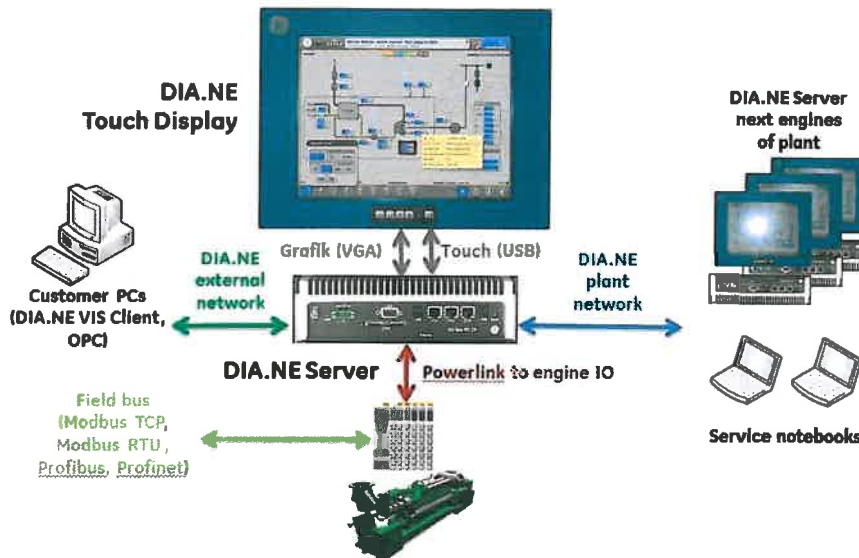
Auxiliaries power supply: (from provider of the auxiliary supply)  
3 x 415/240 V, 50 Hz, xx

### 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. 410x310x80mm

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

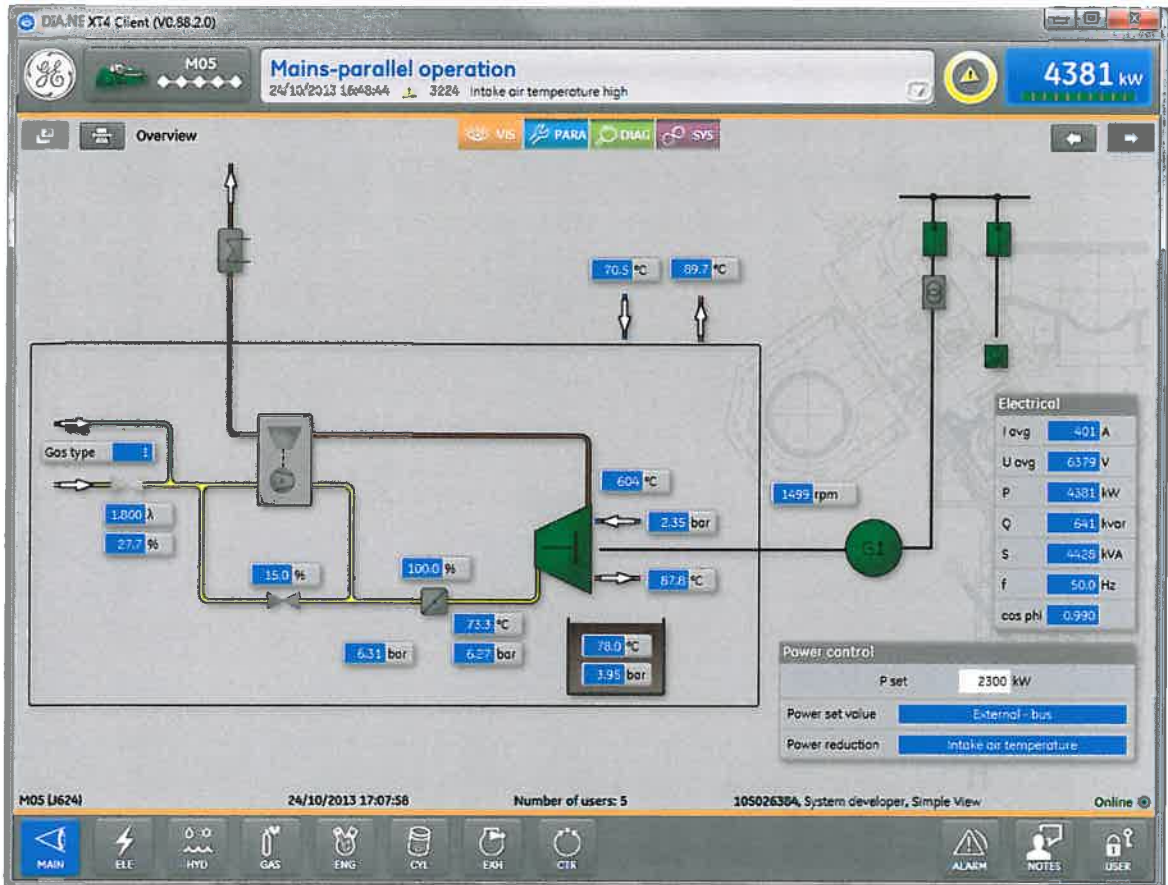
Numeric entries (set point values, parameters...) are entered on the touch numeric pad or via a scroll bar.

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

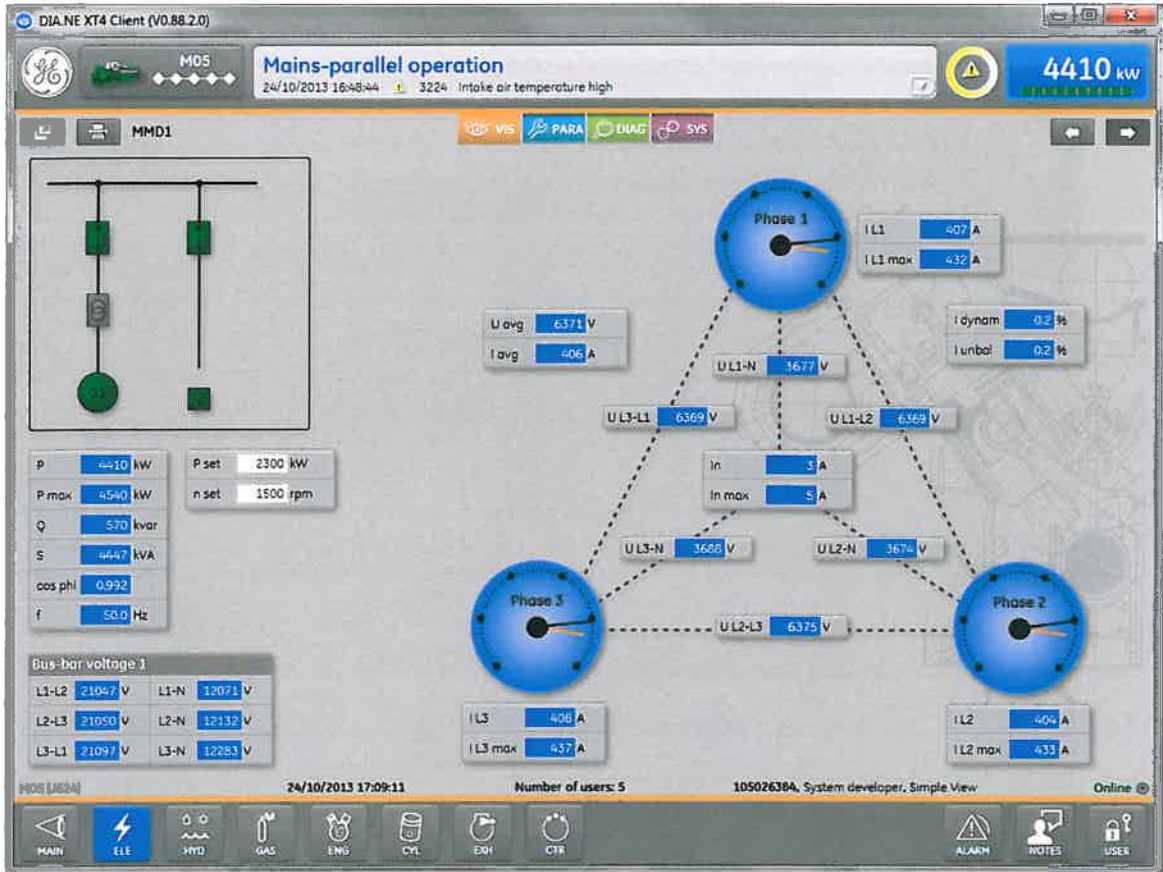
### **Main screens (examples):**



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 **415/240V** or 3x 110V/v3 other measurement voltages available on request

Bus bar voltage 3 x **415/240 V** or 3x 110V/v3 – other measurement voltages available on request

Generator voltage 3 x **415 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: 30m

Maximum distance between module control panel and power panel: 50m

Maximum distance between module control panel and master control panel: 50m

Maximum distance between alternator and generator circuit breaker: 30m

### 1.11.03 Remote information by PROFIBUS-DP

Data transfer from GE JENBACHER-module control to customer's plant management system by PROFIBUS-DP-network according to EN 50170/2.

Data transfer rates: up to 1,5 Mbits/s.

The data transmission by the customer's MASTER must be cyclical.

**Transmitted data:**

Individual failure information, plant operating information, measuring values for generator power, oil pressure, oil temperature, jacket water pressure, jacket water temperature, cylinder and average exhaust gas temperatures.

**GE Jenbacher limit of delivery:**

Bus terminals RS 485 in the module control panel.



## 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 selector 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 selfguidet operation (via GE Jenbacher master control, grid import /export etc.).

**Option - Remote - reset** (see TI-Nr. 1100-0111 chapter 1.7 and 1.9)

### 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.

### 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™ Discovery**

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

## **3. Mobile Internet (OPTION)**

Connection Plant - Customer via secured Internet - connection

See also technical instruction TI 2300-0006

### **Scope of delivery**

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

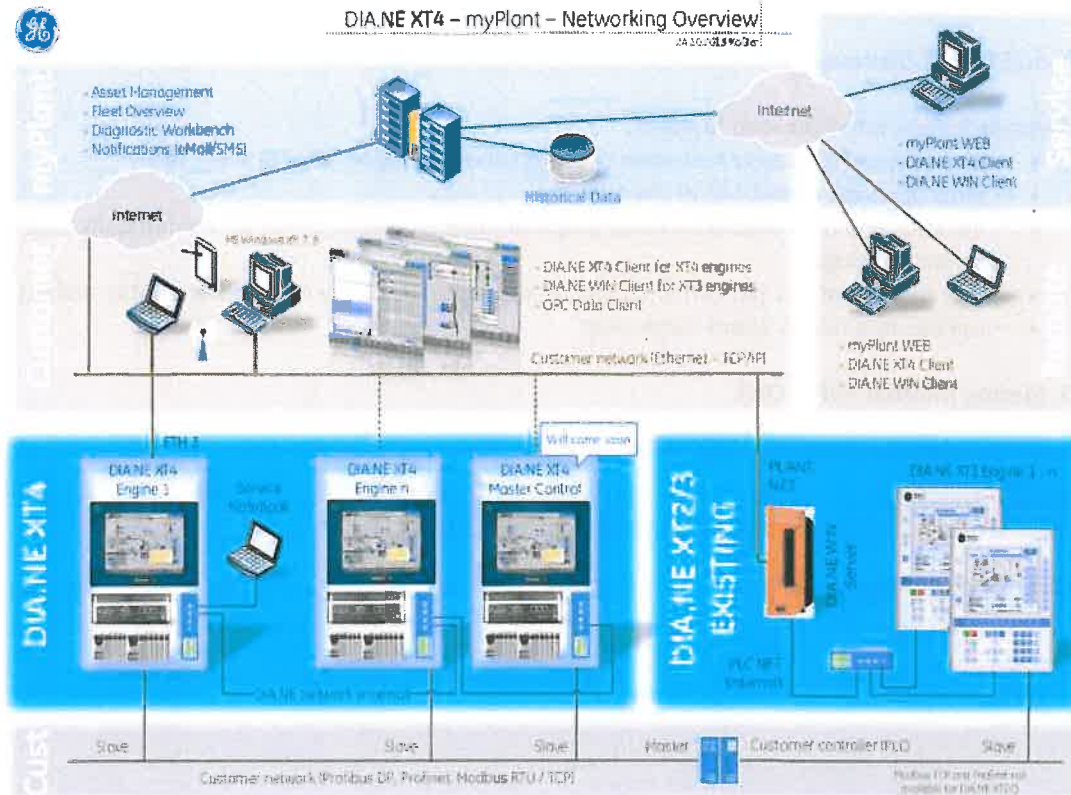
### **Customer requirements**

- SIM card for 3 G



## 4. Network overview

For information only!



### 1.20.03 Starting system

#### Starter battery:

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	240 x 125 x 125 mm
• Degree of protection	IP20 to IEC 529
• Operating temperature	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 56°C (133 °F) and 60°C (140°F), 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	<b>DN/PN</b>	<b>80/10</b>	Stainless steel
1 Exhaust gas outlet	<b>DN/PN</b>	<b>250/10</b>	Stainless steel
1 Fuel gas inlet	<b>DN/PN</b>		Stainless steel
2 Intercooler in-/outlet	<b>DN/PN</b>	<b>65/10</b>	Stainless steel
2 Lube oil connection	<b>mm</b>	<b>28</b>	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  
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 5 - 40 °C (41 - 104 °F), 70 % Relative humidity

Standard painting: Panel: RAL 7035  
Pedestal: RAL 7020

## 2.02 Grid monitoring device for United Kingdom

Standard United Kingdom for generating plants connected to the low- or high-voltage network.

### Function:

For disconnection of the generators from the grid in case of grid failures.

- Over-/under voltage monitoring
- Over-/under frequency monitoring
- Specially adjustable independent time for voltage and frequency monitoring
- Vector shift monitoring or  $df/dt$  (RoCoF) monitoring for immediate disconnection of the generators from the grid, for example at short interruptions
- Indication of all reference dimensions for normal operation and at the case of disturbance over alphanumeric display 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.

Rated input voltages: 100 V / 110 V / 400 V / 415 V.

Rated input currents: 1 A / 5 A.

Test terminals (manufacturer WAGO, series 282) for the measurement inputs for the implementation of functional tests.

Out of standard scope of supply:

- all necessary instrument transformers,
- additional protection equipment acc. to network operator's specifications and guidelines.

### Settings for the protection equipment acc. to "Engineering Recommendation G59/3":

Parameter	LV Protection (voltage reference from an LV source)		HV Protection (voltage reference from an HV source)		Comments
	Parameter-limit	Max. time delay	Parameter-limit	Max. time delay	



U>> [ANSI 59]	119%	0,5s	113%	0,5s	Power reduction with 1%P /%U above 110%U
U> [ANSI 59]	114%	1,0s	110%	1,0s	Power reduction with 1%P /%U above 110%U
U< [ANSI 27]	87%	2,5s	87%	2,5s	Power reduction with 1%P /%U below 94%U
U<< [ANSI 27]	80%	0,5s	80%	0,5s	Power reduction with 1%P /%U below 94%U
f>> [ANSI 81O]	52Hz	0,5s	52Hz	0,5s	Power reduction with 30%P /Hz above 51Hz
f> [ANSI 81O]	51,5Hz	90s	51,5Hz	90s	Power reduction with 30%P /Hz above 51Hz
f< [ANSI 81U]	47,5Hz	20s	47,5Hz	20s	Power reduction with 10%P /Hz below 49Hz
f<< [ANSI 81U]	47Hz	0,5s	47Hz	0,5s	Power reduction with 10%P /Hz below 49Hz
Vector shift [ANSI 78] or df/dt (RoCoF) [ANSI 81R]	6° or 0,125Hz/s, 5 periods		6° or 0,125Hz/s, 5 periods		for low impedance networks
	10 – 12° or 0,2Hz/s, 5 periods		10 – 12° or 0,2Hz/s, 5 periods		for high impedance networks



## 2.04 Generator circuit breaker panel, IEC/EN

<b>Nominal voltage:</b>	3x415/240V, 50Hz
<b>Nominal current:</b>	1200A
<b>Earthing system:</b>	TN-CS
<b>Protection:</b>	IP54 external, IP20 internal
<b>Ambient temperature:</b>	+5°bis 40°C (50°C with de-rating)
<b>Standard:</b>	IEC/EN61439-2 und IEC/EN60204-1
<b>Color:</b>	RAL 7035
<b>Dimensions:</b>	Height: 2000mm (+base) With: 600mm Depth: 600mm – 800mm (depends on cable connection)



### Function:

The generator circuit breaker (CB) is the electrical connection between the generator and the grid. Closing of the generator circuit breaker is every time initiated by the gas engine control system. The breaker opens in case of engine shut down.

Cable length between generator CB panel and Module control panel: < 50m

### Essential components installed in generator circuit breaker panel:

#### - 1 circuit breaker:

Mount type: Fix construction CB

Motorized 3-phase

Integrated electronic trip unit consisting of:

Adjustable delayed release for overload protection

Adjustable selective short circuit protection

Under voltage trip coil, shunt trip coil, control coil: 24VDC

Status messages and command signals are connected to terminals

Lockable with up to 3 padlocks

CB closing time <70msec

CB opening time <60msec

Short circuit capability 65kA:

Short circuit breaking capacity  $I_{cu}$ ;  $I_{cs}$  (440/690VAC): 65/50kA

Short circuit making capacity  $I_{cm}$  (440/690VAC): 143/105kA

Short time withstand current  $I_{cw}$  (1 sec): 65kA

- 3 current transformers for measuring: 1200A/1A, 1FS5, 30 VA (0,5FS5, 15VA)

- 1 copper busbar system (L1, L2, L3, PE, N + PEN bridge) for cable connection

- Terminals for control cables

- Panel fan, temperature controlled

- Surge arrester type 2 EN 61643-11,  $U_p$  <2,5kV. for auxiliaries

- Generator voltage for synchronizing and measuring, connected to terminals

- Busbar voltage for synchronizing, connected to terminals

- Auxiliaries power supply for gas engine (3 pol. xxx A, only with 3x230/400V,50Hz)





### 3.03.01 Exhaust gas silencer

**Material:**

Steel

**Consisting of:**

- Exhaust gas silencer
- Flanges, seals, fixings

**Insulation:**

The insulation for reducing surface irradiations (heat and sound) of the exhaust gas silencer is not included in our scope of supply and must be provided locally. The insulation (100 mm (4 inch) rock wool covered with 0,75 mm (0,03 inch) galvanized steel sheet) is required to keep the sound pressure level of the container (65 dB(A) in 10 m (32 ft)).

### 3.03.04 Pipe work for condensate

The pipe work for condensate is used to drain off the condensate from the exhaust gas system (exhaust gas silencer, exhaust gas heat exchanger).

**Consisting of:**

- Tank for condensate made of plastic  
The tank is constructed with two connections DN 15:  
1 connection for the condensate inlet and a second one which is built as an overflow
- Pipe works for condensate DN 15 made of stainless steel  
1 piece/condensate drain of the exhaust gas system. The connections are made of stainless steel (material: AISI 316)
- Thread connections, holding device for pipe work and equipment for the installation

If needed the pipe work has to be insulated and an additional trace heating has to be provided **on site** to prevent freezing of the condensate.

### 3.05 Air intake and outlet system

**Function:**

- Supply of the required combustion air for the gas engines
- Supply and exhaust of the required cooling air to purge the radiated heat, especially the heat of the engine and the generator

**The air intake system (louver) consists of:**

- Weather protection
  - With sloped plating and birdscreen.
  - Material: zinc-coated steel
- Air intake filter according to EN 779 class G4
- Louver damper
  - Consisting of:
    - U-profile frame and opposing hollow fins installed in plastic bushings



- Motor operated with position switch
- Material: zinc-coated steel
- Noise attenuating system
  - Consisting of:
  - Sheet steel cladding
- Attenuator (type: absorption or combination of resonance + absorption depending on sound level requirement)
- Air intake fan, including E-motor, 415/240 V, 50 Hz, frequency controlled

**The air outlet system consists of:**

- Weather protection
  - Material: zinc-coated steel
- Birdscreen, to protect against rain and/or inclement weather
  - Louver damper
  - Motor operated
- Noise attenuating system

The air intake jalousie flap opens automatically upon engine start.

The air outlet jalousie flap only opens if the room temperature reaches the setpoint at which the air intake fan must start.

### 3.10.03 Cooling system - dual-circuit radiator

The heat produced by the engine (jacket water, lube oil, intercooler) is dumped through a radiator, installed outside.

**Consisting of:**

- Radiator
- Pump
- Electrical control
- Expansion tank

The radiator is designed for an ambient temperature of 35°C (95°F). Special versions for higher ambient temperatures are available upon request.

### 3.20 Container – ISA – BS 12 C39

40' ISO STEEL CONTAINER, Module Installation

**Dimensions:**

- Length: 12192 mm (40 ft)
- Width: 2438 mm (8 ft)
- Height: 2591 mm (8 ft, 6 in)

**Sound pressure level**

65 dB (A) at 32 ft (10 m) (surface sound pressure level according to DIN 45635)

See comments under MC 3.03.01

**Ambient temperature:**

The container is designed for an ambient temperature from -20°C (-4°F) to 32°C (90°F). Other temperatures are available upon request.

**Base frame:**

Self-supporting, i.e. the base frame is designed to withstand static loads from the installation of parts such as the engine, control panels, exhaust gas silencer and radiator.

**Construction:**

Trapezoidal corrugated steel sheeting welded between the base frame and the top frame. The sound absorbent surfaces are comprised of rock wool covered with perforated plating. The container is of a weatherproof design and the roof is suitable for construction work.

A double door to bring in the engine is situated at the front of the container beside the air outlet. There is a door into the control room at the front wall on the side of air inlet. A door into the engine room is situated at the long side of the container.

The doors (engine room resp. control room) are designed with the same cylinder locks. The doors are designed as emergency doors which could be opened in direction of the escape route. They are identified as such and can be opened from inside without other assistance (panic lock).

Dimension of door:                   appr. 1000 mm x 2000 mm (W x H)

**Engine room:**

The floor is designed as an oil pan.

Connections from/to the engine room consist of:

- Top:                                   Cooling water in/outlet; welded flange  
  Exhaust gas outlet; shutted tightly
- Roof:  
  Suspensions for cable trough, gas train, gas pipes, ....
- Wall:  
  Gas inlet; welded flange

**Control room:**

The control room is ventilated by a closeable air intake opening. The air is aspirated by the fans of the engine room. For the cables a recess at the floor of the control room is planned. The control room is equipped with a plastic covering.

**Engine and container installation are essentially performed as follows:**

- Installation and setup of the module
- Installation of the control equipment in a separate control equipment room
- Installation of the gas train
- Installation of the lube oil equipment
- Installation of the air intake and outlet ventilation system
- Installation of the exhaust silencer on the roof
- Installation of the radiator on the roof
- Installation of lighting in the container
- Installation of the auxiliary electrical installations
- Completion of exhaust, fuel, oil and water piping, according to the scope of supply, including all necessary fittings, flexible connections and reinforcements.



- Footboard above the tubes
- Rain drain
- Total signposting

**Fire protection classification:**

The container is not classified for fire protection.

**Coating:**

- Installation:
  - Oil resistant base
  - Synthetic resin as coating varnish
- Colour Container:  
RAL6018 (green)
- Colour roof installation:  
RAL7035 (grey)

## **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.

## **5.01 Limits of delivery - Container**

**Electrical**

- Module:  
At terminals of generator circuit breaker

**Warm water**

At inlet and outlet flanges on container

**Exhaust gas**



At exhaust gas outlet flange on top of the container; special stack provided locally

**Combustion air**

The air filters are set mounted, no external ductwork is necessary

**Fuel gas**

At inlet flange of the container

**Lube oil**

At lube oil connections on container

**Condensate**

At condensate drain on container.

**Insulation**

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

**First filling**

The first filling of module, (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 module 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 test bench of the generator supplier.

### 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 (NOx)

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.

In the case of a container unit the above mentioned test procedure for the module is performed in Jenbach. GE Jenbacher reserves the right to perform the functional test of the container in a GE facility elsewhere.

## 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)

Available Languages

1) DEU, GBR

2) DEU, GBR, FRA, ITA, ESP

3) DEU, GBR, FRA, ITA, ESP, NLD, HUN, RUS, POL, TUR, CZE

4) DEU, GBR, FRA, ITA, ESP, NLD, HUN, RUS, POL, TUR, CZE, SLOWEN, SLOWAK, SERB,  
SCHWED, ROM, PRT, NORWEG, LITAU, LETT, BULGAR, CHINA, DNK, ESTN, FIN, GRC, KROAT