

Gas engine unit(s)

1x TCG 2020 V20

Total electrical output:

Fuel:

2000 kW

Natural gas



Picture may differ from actual engine

Below given technical data are non-binding and only for information. For the correct scope of supply, please refer to the Scope of Supply List.

Table of contents

Table of contents	3
1. Summary.....	4
2. Key Facts.....	4
3. Technical description of the delivery	12
3.1 Unit.....	12
3.1.1 Engine TCG 2020 V20.....	12
3.1.2 Three-phase internal pole synchronous alternator	13
3.1.3 Unit components	15
3.1.4 Genset assembly	16
3.1.5 Zero-pressure gas controlled system and accessories for connection	16
3.1.6 Motor control unit TEM-EVO-system.....	17
3.1.7 Spare parts for commissioning	25
3.1.8 Standard documentation.....	25
3.1.9 Tools	26
3.2. Plant components.....	27
3.2.3 Heat recovery.....	27
3.2.4 Exhaust system.....	30
3.3. Services.....	31
3.3.1 Packing	31
3.3.3 Documentation.....	31
4. Checklist	32

1. Summary

- | | |
|--|--|
| ▪ Fuel: | Natural gas |
| ▪ Specific genset: | 1 x TCG 2020 V20 |
| ▪ Mode of operation: | Parallel and Island mode |
| ▪ NOx emissions: | 500 mg/m ³ NC (@5% O ₂) |
| ▪ | |
| ▪ Alternator frequency / voltage: | 50 Hz / 400 V |
| ▪ Requirements for connection to the grid: | Dynamic |
| ▪ Setting up the system: | Power House |

2. Key Facts

We will fulfil your requirements with our Natural gas unit 1 x TCG 2020 V20:

- | | |
|--------------------------|---|
| ▪ Electrical output: | 2000 kW at a cos ϕ 1 |
| ▪ Thermal output: | 2003 kW, at an exhaust temperature after heat exchanger of 120 °C |
| ▪ NOx emissions: | 500 mg/m ³ NC (@5% O ₂) |
| ▪ Fuel input (+5%): | 4585 kW |
| ▪ Gas consumption (+5%): | 451 m ³ /h |
| ▪ Electrical efficiency: | 43,6 % |
| ▪ Thermal efficiency: | 43,7 % |
- Should an excess of heat be present, a radiator ensures that the engine can still run at peak efficiency and that you can still profit from electricity being generated.
 - Your heating costs will be reduced as you are using the heat that you have generated. (mention any funding that is applicable)
 - Long-term cost advantages through a reduction in total costs due to less lubricant consumption and components optimised for efficiency.
 - Maximised service intervals and proven durability result in class leading maintenance costs and dependable through life operation
 - Our worldwide service network, provides maintenance support with factory trained technicians and local contacts.
 - Innovative concepts such as remote diagnosis, remote parameter configuration and generation of operating values
 - Fast delivery times and low costs for replacement parts through the new logistics centre contribute to reduced downtime

3. Technical description of the delivery

3.1 Unit

3.1.1 Engine TCG 2020 V20

Modern, highly efficient stationary Otto four-stroke engine with a lean-burning V engine: water-cooled with mixture exhaust turbo charging and mixture cooling; anti-clockwise rotation direction in accordance with DIN 6265 (seen from flywheel side).

Engine components:

- One-piece, rigid, ventilated crankcase
- Gear-driven propulsion unit with low level of wear and tear
- Single cylinder heads with four valves and seat rings, optimised turbulence swirl, spark plugs positioned centrally in the combustion chamber, intensive cooling for the spark plug bases which enables optimum combustion characteristics
- Gear-driven camshaft in the V-chamber for both rows of cylinders, controlling two inlet and outlet valves per cylinder, O-rings provide oil seals on the valve shanks
- Wear-free, microprocessor-controlled high-voltage ignition system with low voltage distribution, one ignition coil per cylinder and battery-buffered voltage supply
- Anti-knock system with knocking sensor to monitor every cylinder, enabling knock-free operation with the best possible output at the highest level of efficiency, all whilst keeping within emissions limits
- The volume ratio of gas and air in the multi-gas mixer is measured by means of air extraction via a dry air filter (with optical maintenance indicator) and is supplied with gas from the DVGW proofed safety gas train
- Exhaust turbocharger condenses the gas mixture, final return cooling takes place in a 2 stage mixture cooler (low temperature setting in a separate cooling circuit)
- Fast-reacting throttle to regulate the power
- Electronic regulation and monitoring of the power/speed and of the air/gas mixture at the mixer/actuator via the combustion chamber temperature (1 temperature sensor per cylinder), by the MWM TEM-system.
- Mean combustion temperature of each individual cylinder is measured to regulate the exhaust emissions
- Highly efficient electric starter; flange-mounted to the crankcase.
- Forced lubrication by means of a gear pump, lubricant heat exchanger is integrated into the engine cooling circuit; oil filter present in the main stream;
- Control of charge pressure and regulation to different ambient conditions by an bypass valve (exhaust waste gate) in the exhaust gas.
- Connection to the cooling water pipes and vibration decoupling via rubber compensators with counter flanges
- Exhaust outlet with stainless steel compensator and counter flange for connection to the exhaust pipe
- Knock sensors, sensors to check the position of the gas mixers, sensors to check the following: cooling water temperature, suction air, oil temperature, combustion chamber

temperature, exhaust gas temperature, oil level, oil pressure, crankcase pressure and speed. Actuator for the throttle, gas mixer, control for pre-heating the cooling water. Ignition coil is completely cabled onto two central connection members (1 connection member per row of cylinders), cables can be removed.

Unit test runs:

The units are subjected to a test run in the manufacturer's facility. The test runs take place on calibrated test stands. The test records are supplied with the documentation.

Corrosion protection:

Standard protection of the engine respectively the genset to guard against corrosion during transport and extended storage at the place of destination; maximum length of protection is 24 months after delivery, assuming the genset is stored in a closed dry environment

3.1.2 Three-phase internal pole synchronous alternator

Manufacturer: Marelli

Type: MJB 560 LB4, 400 V, 50 Hz

Three phase synchronous alternator, brushless, self-inducing, self-regulating, with damper cage for 30% asymmetric load and parallel operation. Soluble neutral point, protection type IP23, with protection against tropical and humid conditions (max. 70% humidity), "N" radio interference suppression grade, for a maximum 1000 m installation height and 40°C ambient temperature.

General assembly

The alternator is composed of the main alternator as an internal pole alternator, an exciter alternator as an outer pole alternator and a voltage regulator with a power output stage, and is supplied via auxiliary winding or via the alternator output terminal, the supply being regulated according to output.

The exciter stator is supplied according to output via the voltage regulator. The three phase alternating current is aligned over the rotating diode disc and is then directed to the cogwheel of the alternator. The voltage of the main alternator is held constant when the load changes by changing the exciting current using the thyristor actuator in the voltage regulator.

Construction type

Construction B20 in accordance with DIN 42950, IM 1101 in accordance with IEC 60034-7. According to this construction type, the generator feet are installed underneath the bearings.

Protection type and ventilation

The protection type IP23 in accordance with IEC 60034-5 is made possible due to the ventilation type IC 01 in accordance with IEC 60034-6 with internal cooling and self-ventilation.

Stator

The stator winding corresponds to insulation class H / Utilization according to data sheet in accordance with VDE 0530/IEC 60034.

Rotor

The stator winding corresponds to insulation class H / Utilization according to data sheet in accordance with VDE 0530/IEC 60034.

The rotor is balanced as standard using a half feather key of the precision class G 2.5 in accordance with VDE 0530/IEC 60034, part 14. The absolute maximum rotational speed is 2250 rpm for 4-pole alternators and 1.25 x nominal speed for 6- and 8-pole alternators.

Winding

The alternator is equipped with a 2/3-step winding in order to suppress the harmonic content in the neutral point in the case of non-linear loads.

The winding is insulated with high quality cast resin that is applied with latest procedure (VPI).

Shaft bearing

The alternator is built as a 2 bearing machine.

Regreasable anti-friction bearings. The drive-end side is designed as fixed bearing and the non-drive-end-side as loose bearing

Regulation system

Digital Voltage Regulator MEC 100 D with integrated diode failure monitoring, mounted in auxiliary terminal box.

Nominal voltage setting $\pm 10\% U_N$.

Standards and regulations

IEC 60034-1, EN 60034-1, BS 4999-5000, VDE 0530, DIN 6280-3, VDE 0530, NF 51-100, OVE M-10, NEMA MG 1.22, ISO 8528-3

Standard components / assembly groups

- Central terminal box with main terminal and neutral startpoint, auxiliary terminal boxes for the voltage regulator and terminal strip for accessories
- Cos-phi and reactive power controller with voltage tracking
- Static converter for alternators and parallel network operation
- Temperature monitors (6 pcs.) PT 100 – sensor in the winding (3x active, 3x replacement)
- Temperature monitors (1 pc each.) PT 100 – sensor per bearing
- Heating when stationary: 230 V $\pm 5\%$, 2 pieces 200 W
- By standard there are no Current transformers for measuring purposes or protection included.
- By standard with anti-magnetic plate without cable flange and without glands.

Electrical data and characteristics

- Voltage precision, static $\pm 0.5 \dots 1\%$
- rotational speed changing + 4 / -6%, cold and warm engine
- Voltage curve Ph Ph tick-over, deviation < 5% (voltage harmonic content)
- THD distortion factor (Total Harmonic Distortion) $\leq 2\%$
- Radio interference suppression grade THF (Telephonic Harmonic Factor) < 2%, in accordance with IEC 60034-1 / VDE 0530
- Sustained short circuit current for a three pin terminal short circuit: > 3 x nominal current for 5s
- Overload capacity 10% for 1 hour within 6 hours, in accordance with IEC 60034-1 / VDE 0530
- In accordance with VDE 0530, the maximum rotational speed is determined by means of a centrifuge test with 1.2 times the nominal speed for 2 minutes

Current transformer TCG 2020 V20 included

3.1.3 Unit components

Base frame

Steel construction is bend resistant and torsionally stiff to support the engine and alternator and has an integrated lubricant tank. The increased oil volume extends the service life of the lubricant. Loose delivered steel spring elements are installed underneath the base frame.

Coupling

Highly elastic, axially pluggable flange coupling that allows for the torsionally elastic connection of the engine and alternator. The disc-shaped rubber portion lessens torsional oscillation to a high degree. The rubber portion can be radially dismounted.

Regulating the oil level

Automatic oil level regulation. Regulation by an immersion probe connected to the oil level monitoring (min/max.) and control of the solenoid valves and clean oil pump that tops up the lubricant.

Pre-lubricating pump

An electrical pump on the unit performs the pre-lubrication; this can be emptied via the same type of pump after the three-way stopcock has been configured.

Air filter

Microfiber dry air filter with optical maintenance indicator.

Placed in front of the genset and delivered loose. The air filter is assembled on-site by the customer as long as no assembly for these components is listed in this offer.

Additional parts for the unit

The following components are supplied “loose” and are not installed onto the unit. Installation for these parts must be performed by the customer, unless MWM has included the installation for said components in this offer.

- 1 set of maintenance-free steel spring elements, the height of which can be adjusted to enable the unit to be aligned onto the on-site foundation. These bearing elements enable a vibration isolation level of 88-94% to be reached. Mechanical vibration is reduced by means of a rubber moulded frame on the underside of the bearing
- 2 solenoid valves with connecting parts to enable the flow of lubricant.
- 1 set of flexible hoses for the lubricant inflow and outflow connections
- 1 insulating mat for the exhaust compensator
- 1 oil separator for crankcase ventilation with integrated filtration of oil mist, directing it back towards the engine.
- 1 vacuum regulator to be installed onto the oil separator.
- 1 set of parts to install the oil separator.
- 1 can of retouch paint RAL 5010, gentian violet

3.1.3.1 Air pre-heating and filtering

Preheating the combustion air serves to ensure that the combustion air temperature in the intake system of the engine is kept constant. The following components are included in the delivery and are supplied “loose”. Installation of these parts must be performed by the customer, unless MWM has included the installation for said components in this offer.

- Composed of one case in which an air-water heat exchanger and 4 filter cassettes are installed. The support frame of the filter cassettes is equipped with easy-release fastenings enabling them to be detached quickly and without using tools. A maintenance indicator is present on the housing to make monitoring the soiling level of the filter cassettes easy
- 1 piece of piping from the air pre-heating unit to the engine
- 2 strong special hoses to create elasticated connections between the air pre-heating unit / pipe or gas mixer / pipe + hose clamps
- 1 three-way valve DN 32 + counter flange to regulate the amount of cooling water in the air-water heat exchanger
- 2 shut-off valves DN32 + counter flange
- 1 throttle valve DN32 + counter flange
- 1 air bleeder
- 1 water pump + counter flange

3.1.4 Genset assembly

Assembly

The gas engine and alternator are elastically coupled and built onto a shared base frame, enabling a sprung vibration-insulated installation on a suitable on-site foundation.

Paint

Robust paint composed of:

- Undercoating present for otherwise non-coated components that are made from stainless steel, non-ferrous metals, galvanised and chromed parts, dry layer thickness 10^{+5} μm
- Primer for complete unit, dry layer thickness 40^{+30} μm
- Coating in hue RAL 5010, gentian violet for the complete unit, dry layer thickness 90^{+40} μm

Wiring

Clustering of all cables on a clamping rail for easy connection with TEM-system via plug-in connectors

name plate in English and Turkish

3.1.5 Zero-pressure gas controlled system and accessories for connection

Zero-pressure gas controlled system

Supplied loose, installation on-site, unless MWM has included the installation for said components in this offer.

Type of gas 1: Natural gas
Nominal size (outlet side): DN 80

Safety gas controlled system as a compact unit in accordance with the German Technical and Scientific Association for Gas and Water (DVGW)
Operating side in gas flow direction right, composed of:

- 1 ballcock
- 1 gas filter
- 1 pressure gauge
- 1 pressure monitor
- 2 solenoid valves
- 1 zero pressure regulator
- 1 outlet piece
- 2 counter flanges to install the gas controlled system into the gas piping
- 1 seal monitoring unit

The gas controlled system is designed for a **gas flow pressure of 80 mbar** with a permitted oscillation of $\pm 10\%$, oscillation frequency $< 10/ h$.

The equipment present on the gas controlled system may vary slightly depending on the type of gas and operation.

Should an order be placed, an authoritative parts list will be generated.

Accessories for connection

Supplied loose, installation on-site, unless MWM has included the installation for said components in this offer.

- 1 elasticated connecting pipe with protective steel mesh, enabling a flexible connection between the gas pipe and the gas mixer

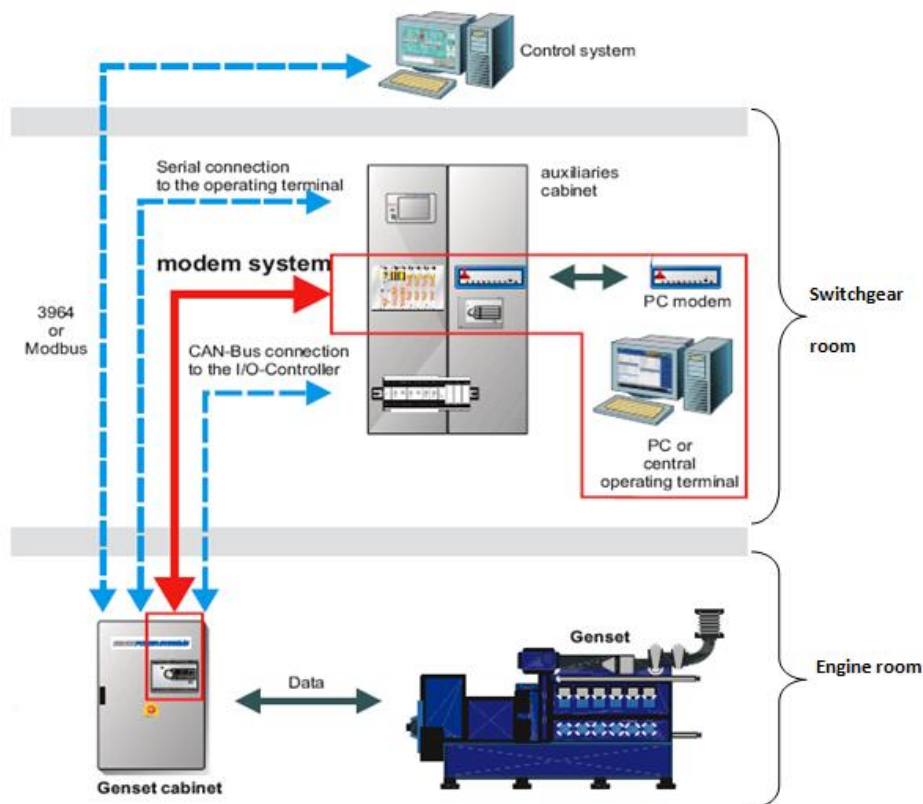
3.1.6 Motor control unit TEM-EVO-system

Supplied loose, installation and wiring on-site, unless MWM has included the installation for said components in this offer.

The MWM **T**otal **E**lectronic **M**anagement (TEM)-system can control and monitor all the functions of a gas engine and the engine auxiliary drive in one unit. The monitoring functions protect the engine from breaching permitted limits and guarantees high running times. The TEM-EVO system regulates and optimises the gas combustion in the cylinders. Integrated regulatory functions enable optimised and reproducible engine values in all modes of operation. It is possible to adapt the TEM-EVO system to best match certain applications using a wide range of options.

Only a protection device, a synchronisation device, alternator/ network protection and an effective power measurement device are to be located in the auxiliary unit switch cabinet in addition to the TEM-EVO system.

Structure



The TEM-EVO system is composed of 3 components:

Genset switch cabinet (“AGS”)

Completely wired to the genset; contains the genset controls and the safety chain, which has been tested by the TÜV (German Association for Technical Inspection). A maximum of 8m resp.15 m of wiring may be positioned between the cabinet and the connection to the engine.

I/O controller

To be built into the auxiliary unit switch cabinet (“HAS”, maximum of 250 m distance from the unit switch cabinet, to be connected with three-way shielded bus lines.)

Operating computer

Max. 100 m distance from the genset switch cabinet; to be connected with three-way shielded wiring.

The system is flexible, and can be easily adapted to the local conditions. Both the tendency to develop faults and the wiring time on the system are minimised.

The unit switch cabinet is to be installed in close proximity to the unit. Together with the engine wiring (tested in the factory), the ready-connected, fully tested wiring that links the unit switch cabinet to the unit (connected to the unit using plug-in connectors) guarantees a high level of operational safety and a problem-free activation.

The signals valid for the power unit are exchanged with the TEM-EVO system in the auxiliary unit switch cabinet. The data is then transferred to the unit control system via a CAN bus connection.

The operating computer can be installed either on the unit or in the control centre, wherever it is desired.

Basic functions

- Start and stop programmes run automatically for the gas unit
- Exhaust emissions can be reliably set to a low value
- Integrated digital regulation of speed and output
- TÜV (German Association for Technical Inspection) tested safety chain
- Actuators and sensors are connected to the *I/O controller* in the auxiliary unit cabinet. The data transfer takes place via CAN bus or direct to the TEM-EVO unit cabinet.
- Monitors all the sensors on the unit
- Monitors the engine cooling water
- Controls and monitors the lubricant circuit, including pre- and post lubrication as well as oil changing
- Test mode to test the actuators, sensors and auxiliary units that are connected to the system
- Electronic curve plotter to generate measured values for testing and diagnosis purposes over 40 h/6 min time periods as well in sync with the operating cycle
- Electronic operational log to record warning, fault and operation messages with the date and time at which they occurred, enabling system operation to be monitored in detail.
- Electronic counting of operating hours with a breakdown in 5 load ranges
- An operating computer can be connected
- [MK] Engine cooling water regulation: the cooling water circuit regulation ensures that the cooling water remains at the optimum temperature by activating a three-way valve. If a partial load is present, then the cooling water inlet temperature is increased
- [GK] Mixture cooling circuit: the mixture cooling water inlet temperature is regulated by activating a regulatory valve in the mixture cooling water circuit; monitors the receiver temperature
- [IOC] I/O controller: the auxiliary units, pumps valves, etc. are controlled by the I/O controller and the associated measured values are recorded. The I/O controller is supplied loose and is to be installed into the auxiliary unit switch cabinet
- [16M] 16 parameterisable messages: digital inputs with extensive parametry options to enable systems-specific faults, warnings or messages to be sent directly to the TEM-EVO system. This makes monitoring a unit much simpler and is made much more transparent due to the protocol function in the operating log. The parameterisable messages are stored as potential-free contacts on the *I/O controller* in the auxiliary unit switch cabinet.
- [SER] Serial coupling for data exchange: data exchange such as nominal values, measured values, messages, warnings and fault notifications take place via the serial coupling and the overriding control system by means of protocol 3964R with RK512 via TTY or CS 20mA. The wiring between the TEM-EVO and the overriding control system must not exceed 100 m.
- [AKRK] Anti-knock regulation: highly dynamic anti-knock regulation, individual for every cylinder, this ensures safe operation of the engine even if a low methane number is present. Highest possible output with the highest levels of efficiency, whilst keeping within permitted emissions values
- [GL] Monitoring of the alternator bearing temperatures: display (interface, history, serial coupling) and monitoring of both the alternator bearing temperatures. Should the parameterisable limit value be exceeded, then a fault or warning message will be displayed
- [NATL2] Continuous monitoring of the exhaust temperature behind exhaust turbochargers A and B: display (interface, history, serial coupling) and continuous monitoring of exhaust

temperature behind the exhaust turbocharger. Should the parameterisable limit value be exceeded, then a fault message will be displayed

- [BSX], [BSXK] Preliminary equipment for an eService system [BSX] with wiring set [BSXK]: preliminary equipment to set up remote control for the TEM-EVO (BSX): every TEM-EVO system must have either a mechanical changeover switch or an intelligent selection unit (IEA) connected to the eService modem system
- [SPC] Connection for service PC: robust service plug socket on the TEM-EVO unit switch cabinet. Connecting the service PC interrupts the connection to the operating computer through a control unit (or to the modem, if one is present). The TEM-EVO system can be operated via the service PC
- [AWG20] Activation of the exhaust wastegate, measurement of the position of the actuator and control of the drive motor

Extended functions

- [HK] Heat recovery with the heating circuit: safety chain extended to monitor the heating circuit and regulate the engine cooling water inlet temperature as well as the heating circuit lead temperature by activating the three-way valve in the heating circuit. Measurement of the lead and return temperatures, the temperature of the heating water before the cooling water heat exchanger, monitoring of the exhaust temperature after the exhaust heat exchanger. The heating circuit regulation ensures that the heating water lead temperature remains constant even when the engine is under only partial load, and ensures that the engine's demands regarding the cooling water temperature are catered for.
- [NMOT/NKAT] Monitoring of the exhaust temperatures behind the engine and after the catalytic converter
- [NK/BY] Dump cooling circuit and exhaust bypass control
- [TKS] Radiator controlled for mixture cooling and engine cooling circuit or dump cooling circuit with one cooler per circuit, can be parametrised to use ventilation in stages (maximum 17 stages) or as a frequency regulated ventilator
- [MRTU] Modbus RTU: Serial communication with the Modbus RTU protocol to exchange data over RS485 with an overriding control or a distributed control system. The Modbus master can query status updates, messages, warnings and fault notifications from the TEM-EVO (Slave) and can send nominal values and orders to the TEM-EVO (MTRU is installed in place of the SER option that was included in the basic system).
- [AVW] The TEM-EVO takes over the regulation of the intake air pre-heating by activating the control valve. Should pre-heating be requested, the intake air temperature is set to the parameterisable nominal value. The regulator acts upon the control valve of the heat exchanger unit
- [2MW] Parameterisable counter values: analogue inputs that can be parameterised in various ways to show system-specific measured values and to monitor limit values. For each measured value, two limit values can be parameterised. Should these be exceeded or undercut, either a fault notification, a warning or a message will be displayed. This makes monitoring a unit much simpler and is made much more unambiguous due to both the protocol function in the operating log and the history function
- [BRT] Operating computer: to enable simple operation of the unit with TEM-EVO using a touch monitor with 15" TFT colour display and USB ports for printers, key dongles or USB sticks
- [eSERV IP-1] For systems that are to be operated via the Internet. The IP modem includes a user administration system, access protection via a password with an encrypted connection.

The eServ IP can be integrated into existing site TCP/IP networks (site routers) or operated via separate internet access (Internet-modem). The eServ IP uses fixed, public addresses (dynamic DNS-names or fixed IP-addresses) to enable external availability. Routers and Internet-modems are configured accordingly, with port forwarding, to facilitate eServ IP's operation and availability.

MWM cannot provide support for network problems at customer site.

The connection encryption that supports the IP modem is subject to the issue of an export permit.

Operation

An intelligent operating computer ensures easy interaction with the TEM-EVO system, through which all functions can be accessed. The operating computer is equipped with a 15" TFT touch monitor. The touch function of the operating computer enables easy and intuitive operation of the unit.

With the navigation bar, the user can quickly and directly change between interfaces to operate the unit. Each operating computer interface informs the operator of the current status of the connected unit. All the regulatory, service, control and monitoring functions can be operated conveniently without the need for lengthy training.

The operating unit can be positioned on the system, as specified by the user, either directly on the unit or up to 100 m away from the unit in a control centre. If desired, configurations with operating computers for every unit and/or a central operating computer are possible.

Communication with the user can take place in one of the many languages that are provided in the TEM-EVO. The language can be changed at any time at the press of a button. For maintenance purposes, a different language to the one normally used by system personnel can be temporarily assigned. All the important information and operational options relevant for normal operation are clearly summarised in the "Operation" interface (see fig. 1; following illustration contains options).



Fig. 1. All the most important information and operational function at a glance

Operation Log

The electronic operation log (fig.2) of the TEM-EVO system makes operating the gas unit and its peripheral equipment clear due to its logging functions. All operating messages, switching operations that are relevant to operation and every parameter change are logged with an exact time stamp (date/time).

In total, the TEM-EVO system can monitor and distinguish over 600 different events. This enables a fast and detailed analysis of the operating method of the unit including the auxiliary functions that are controlled by the TEM-EVO.

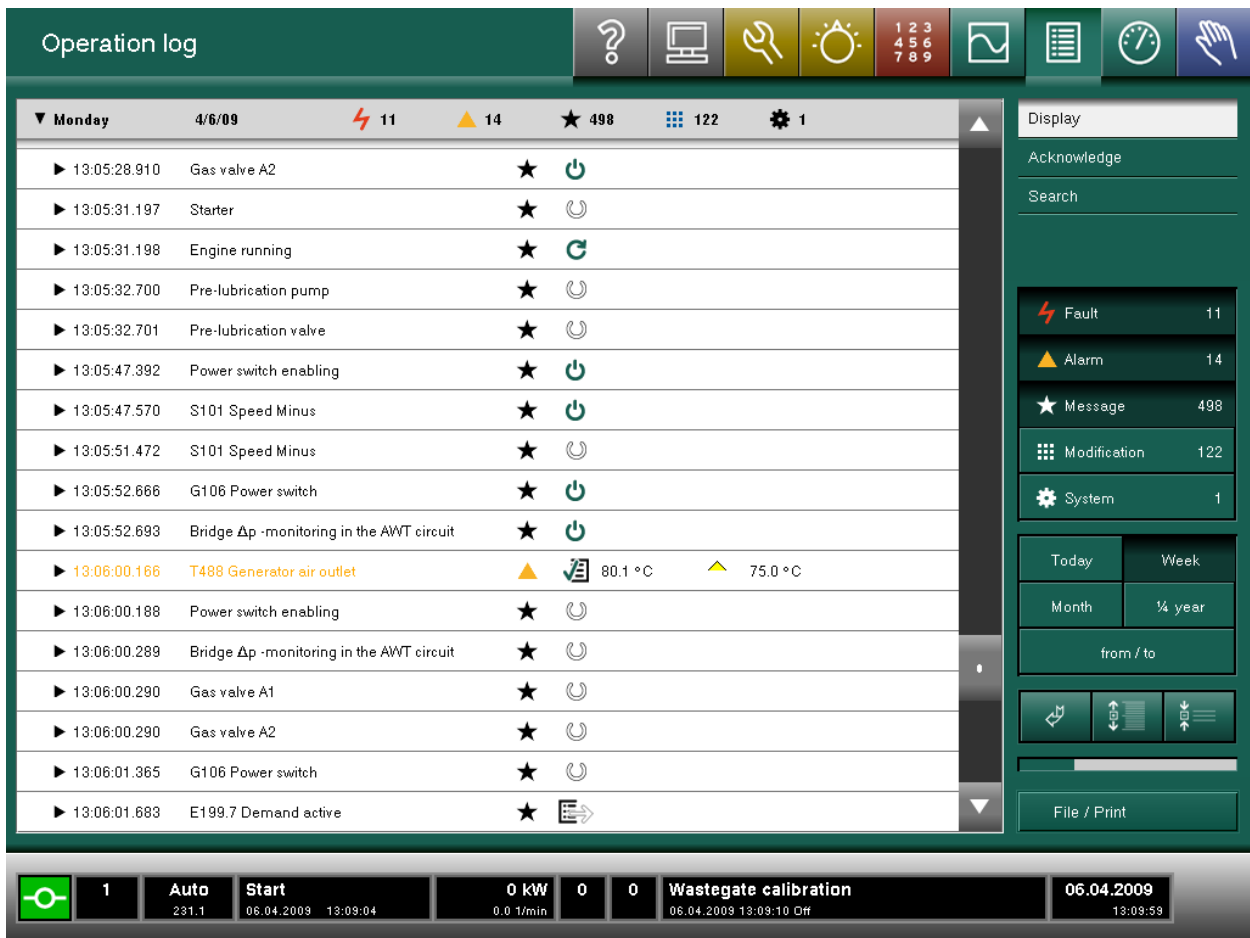
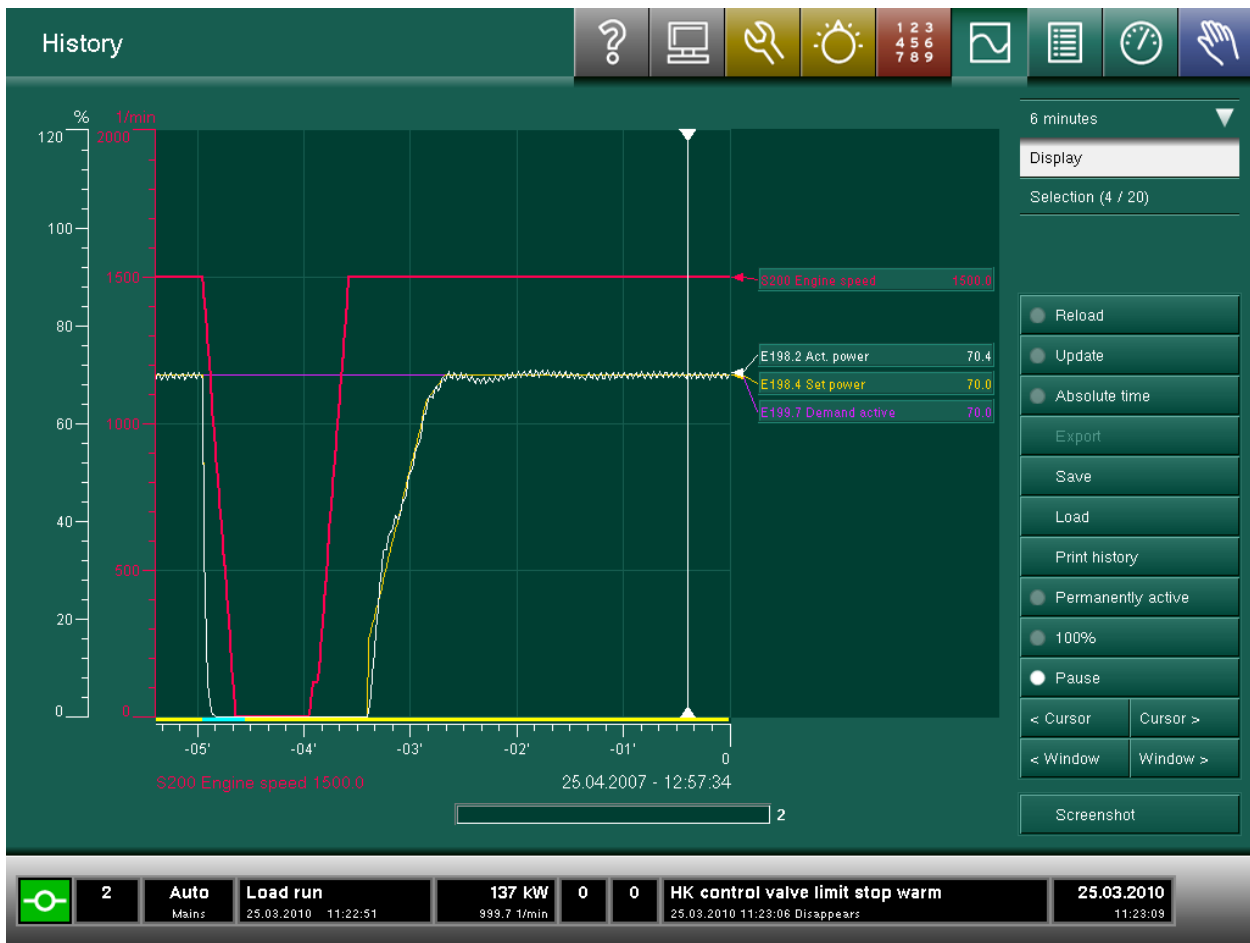


Fig. 2. Logging functions of the operation log

History function

The history function records up to 84 measured values. Up to 18 measured value curves can be depicted together in one diagram. The user can individually compile the measured value curves. The TEM-EVO system records the history in three speed levels:

- Working cycle history: the current value is recorded in every working cycle (1 working cycle corresponds to 2 rotations of the crankshaft)
- 6 min. history: current values recorded every second
- 40 hr history: mean values recorded every 6 minutes



The curves can be retracted using the cursor, and the relevant measured value is displayed as a numerical value with an exact time stamp. Should a fault occur, recording stops after 40 seconds to make diagnosing the fault easier. The “Real time scope” function enables continuous observation of measured values and regulatory functions. Optionally, these can be saved to be analysed further and re-read later.

Diagnosis/service functions

In addition to the history and operating log functions, the TEM-EVO system contains other diagnosis and service functions that play a large part in ensuring a higher level of availability of the gas engine module. Putting the machine into service is also made considerably easier and faster by these functions. This plays a large part in ensuring the total cost-effectiveness of the gas engine module.

There are interfaces for servicing and diagnosing:

- Auxiliary unit test mode
- Digital speed counter
- Electronic ignition system
- Parameterisation
- Oil change
- Electronic operating hours counter
- Language and printer selection
- System setup (software versions, serial number, colour settings, screensaver, etc.)

- As options, there are sometimes other diagnosis and service interfaces (e.g anti-knock regulation, dual gas operation, etc.)

Remote diagnosis

The service, diagnosis and all other interfaces can be accessed via the normal telephone network using a modem to transfer data. With this function, remote diagnosis and remote maintenance can be carried out with exceptionally short reaction times by MWM customer service or by the customer's own stand-by staff. See the description of the modem system for more information on this.

Modem system (eServ IP)

The connection encryption that supports the IP modem is subject to the issue of an export permit.

Delivery specifications and technical data

1 TEM-EVO switch cabinet:

Type of protection: IP 54
Operating temperatures: 5 – 45°C

1 x I/O-Controller:

Measurements: 99 x 114 (W x H) mm
Length (dependent on the number of optional parts): 120 – 700 mm
Type of protection: IP 20
Operating temperature: 5 – 50°C

1 x operating computer with colour display:

Measurements: 310 x 483 x 115 (H x W x D) mm
Type of protection on the front: IP 65
Operating temperature: 5 – 50°C

1 set unit wiring:

The unit wiring set is tested and is ready-installed onto the unit switch cabinet and is composed of 6 pre-assembled wiring harnesses with robust plug connections that are easy to tell apart from one another. It is to be used to connect the unit and the TEM-EVO switch cabinet together, Length: 15 metres.

3.1.7 Spare parts for commissioning

Spare parts for commissioning, comprised of:

- 1 set of spare parts for putting the system into service

3.1.8 Standard documentation

The documentation in English and Turkish will be supplied in duplicate for each plant (1) in paper form. The documentation at least complies with the valid legal requirements, such as the EC Machinery Directive, for example.

The following items are included as standard:

- Maintenance information
- Safety regulations
- Operating manual for the gas unit
- Operating manual for the TEM-system

- Installation directives
- Electrical terminal diagrams
- P&I diagram
- Unit drawing
- All relevant test bench logs and test certificates

Further documents that are of importance to the operator will be supplied depending on what is supplied by MWM.

3.1.9 Tools

Large tool kit

Comprised of:

- Tool kit 1
 - Tool box
 - Double open-end spanner
 - Double end ring spanner
 - Sensor gauge set
 - Socket spanner
 - Sliding bar
 - Extension
 - Cardan joint
 - Screwdriver
- Tool kit 2
 - Tool box
 - Single open-end spanner
 - Double open-end spanner
 - Socket spanner
 - Extension
 - Measuring device
 - Tommy bar
 - Ratchet
 - Offset screwdriver
 - Pin spanner
 - Pliers
 - Brushes
 - Sensor gauge
 - Extracting device
 - Drift
 - Ring spanner
 - Torque wrench
 - Spanner
- Tool kit 3
 - Socket spanner
 - Combination spanner
 - Spanner
 - Pliers

Control valve

Housing from EN-GJL-250, 3-way shape, spindle from 1.4021
Connection flanges 65 / 16 DN / PN

Actuator

Electric linear actuator, 5 kN, type of protection IP 65, mechanical stroke indicator, manual emergency override.

Motor voltage / frequency 230 / 50 V / Hz

Differential pressure monitor with flow protection (GK)

Differential pressure measuring and switching device with robust measuring device and damping reactor, measuring elements made from surface-treated steel 1.4310, with microswitch.

Measuring range	0 to 0.6	bar
Maximum static operating pressure	10	bar
Maximum permitted medium temperature	70	°C
Type of protection	54	IP
∅ Pressure connector (compression fitting)	12	mm
Differential pressure value (set)	80	mbar

Temperature sensor

Temperature sensor (PT 100 with transmitter) with separate screw-in protective cover made from stainless steel 1.4571 (Specially made for MWM), cap on connector head with clip fastening (can be opened without the use of tools), insertion pipe made from stainless steel 1.4571

3.2.3.2 Engine cooling water system (MK)

The heat that is generated as a result of the gas engine's operation during the cylinder and lubrication cooling is channelled away over the engine cooling water circuit.

Components supplied for the engine water cooling system:

Safety valve (MK)

Membrane safety valve with valve seat that precedes the membrane and is separated from it. Housing made from pressed/red brass, the membrane and seal are made from high temperature and age-resistant rubbery-elastic plastic.

Mounting position Main axle vertical, inlet connectors at the bottom

Maximum response pressure 3.0 bar

Ventilation valve (MK)

Floating ventilator in pressed brass design with red brass effect, the cut-off device and the associated cut-off valve are ready sealed in.

Maximum temperature 120 °C

Maximum pressure 10 bar

Low water safety device (MK)

Water level limiter with glass floats; a glandless device that magnetically transfers the floating action onto a microswitch

Type of protection 65 IP

Maximum operating overpressure 10 bar

Maximum operating temperature 120 °C

Mounting position Main axle vertical

Differential pressure monitor with flow protection (MK)

Differential pressure measuring and switching device with robust measuring device and damping reactor, measuring elements made from surface-treated steel 1.4310, with microswitch.

Measuring range	0 to 0.6	bar
Maximum static operating pressure	10	bar
Type of protection	54	IP
∅ Pressure connector (compression fitting)	12	mm
Differential pressure value (set)	80	mbar

Electrical preheating of the cooling water

Electrical preheating to ensure that the engine can be heated up and kept warm when it is idle. Designed as a container with welded on ends, equipped with heating elements, should be built into the engine cooling water circuit in accordance with the P&I diagram.

Heating output	9	kW
Voltage	400	V

3.2.3.3 Heating circuit system (HK)

Three-way valve DN 100/ PN16, 230 V included

To recover the heat generated by the engine (engine cooling water heat), it is transferred into the heating circuit system.

Components supplied for the heating circuit system:

Temperature sensor

1 x Temperature sensor (PT 100 with transmitter) with separate screw-in protective cover made from stainless steel 1.4571 (Specially made for MWM), cap on connector head with clip fastening (can be opened without the use of tools), insertion pipe made from stainless steel 1.4571

Differential pressure monitor with flow protection (HK)

Tested differential pressure measuring and switching device with robust measuring device and damping reactor, measuring elements made from surface-treated steel 1.4310, with neutral adjustment and microswitch.

Measuring range	0 to 1	bar
Maximum static operating pressure	10	bar
Maximum permitted medium temperature	85	°C
Type of protection	54	IP
∅ Pressure connector (compression fitting)	12	mm

3.2.3.4 Dump cooling system (NK)

The dump cooling circuit channels the excess or unused heat from the unit into the surrounding environment. The heat is extracted from the cooling circuit and is then channelled directly into the dump cooling circuit. A radiator transfers this heat to the surrounding environment.

Components supplied for the dump cooling system:

Ventilation valve (NK)

Floating ventilator in pressed-brass design with red brass effect, the cut-off device and the associated cut-off valve are ready sealed in.

Maximum temperature	120	°C
Maximum pressure	10	bar

Low water safety device (NK)

Water level limiter with glass floats; a glandless device that magnetically transfers the floating action onto a microswitch.

Type of protection	65	IP
Maximum operating overpressure	10	bar
Maximum operating temperature	120	°C
Mounting position	Main axle vertical	

3 way valve (NK)

Three-way control valve with actuator, valve can be used as a distribution and mixing valve.

Control valve

Housing from EN-GJL-250, 3-way shape, spindle from 1.4021
Connection flanges 100 / 16 DN / PN

Actuator

Electric linear actuator, 5 kN, type of protection IP 65, mechanical stroke indicator, manual emergency override.

Motor voltage / frequency	230 / 50	V / Hz
---------------------------	----------	--------

Temperature sensor

Temperature sensor (PT 100 with transmitter) with separate screw-in protective cover made from stainless steel 1.4571 (Specially made for MWM), cap on connector head with clip fastening (can be opened without the use of tools), insertion pipe made from stainless steel 1.4571

3.2.4 Exhaust system

Exhaust counter pressure monitor

Pressure sensor to monitor the maximum permitted exhaust counter pressure after the engine. To be installed into the exhaust line after the engine (turbocharger) and before the oxidation catalytic converter or exhaust silencer.

Membrane pressure monitor, silicon-free with microswitch, membrane: NBR; housing: glass-fibre reinforced plastic, bottom piece of the housing: AISi – die casting.

Supplied with a protective pipe that is approx. 400 mm long.

Switching range	0.5 to 500	mbar
Type of protection	54	IP

Thermocouple NiCr-Ni after catalyst included

Thermocouple NiCr-Ni exhaust gas included

3.3. Services

3.3.1 Packing

Standard unit packing with film

Packing, suitable for transporting by truck. Loose parts in transport cases.

3.3.3 Documentation

Set of further standard documentation

Standard documentation on CD

The content of the standard documentation (paper) will be recorded as pdf-files on CD. A table of contents will link to the files.

The directory- and file names are corresponding to the structure of the paper documentation.