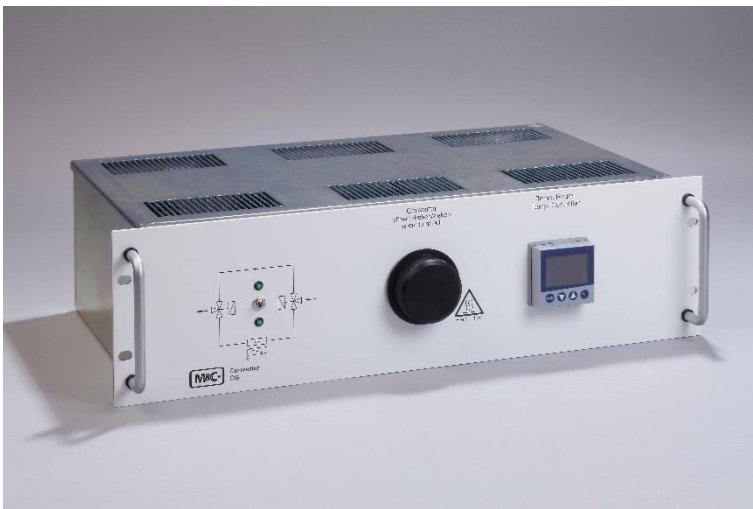


Gas Converter CG[®]

CG-2/-2M, CG-2H-W/-2MH-W

Instruction Manual
Version 1.05.00



**Dear customer,**

Thank you for buying our product. In this instruction manual you will find all necessary information about this M&C product. The information in the instruction manual is fast and easy to find, so you can start using your M&C product right after you have read the manual.

If you have any question regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor. You will find all the addresses in the appendix of this manual.

For additional information about our products and our company, please go to M&C's website www.mc-techgroup.com. There you will find the data sheets and manuals of our products in German and English.

This Operating Manual does not claim completeness and may be subject to technical modifications.

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With the release of this version all older manual versions will no longer be valid. The German instruction manual is the original instruction manual. In case of arbitration only the German wording shall be valid and binding.

CG® is a registered trade mark.

Version: 1.05.00

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1 GENERAL INFORMATION

The product described in this manual has been built and tested in our production facility.

All M&C products are packed to be shipped safely. To ensure the safe operation and to maintain the safe condition, all instructions and regulations stated in this manual need to be followed. This manual includes all information regarding proper transportation, storage, installation, operation and maintenance of this product by qualified personnel.

Please follow all instructions and warnings closely.

Please read this manual carefully before commissioning and operating the device. If you have any questions regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor.

2 DECLARATION OF CONFORMITY



The product described in this operating manual complies with the following EU directives:

EMV-Instruction

The requirements of the EU directive 2014/30/EU "Electromagnetic compatibility" are met.

Low Voltage Directive

The requirement of the EU directive 2014/35/EU "Low Voltage Directive" are met.
The compliance with this EU directive has been examined according to DIN EN 61010.

RoHS Directive

The requirements of the RoHS2 ("Restriction of Hazardous Substances 2") directive 2011/65/EU and its annexes are met.

Declaration of conformity

The EU Declaration of conformity can be downloaded from the **M&C** homepage or directly requested from **M&C**.

3 SAFETY INSTRUCTIONS

Follow these safety directions and instructions regarding installation, commissioning and operation of this device:

Read this manual before commissioning and operating the product. Make sure to follow all safety instructions.

Installation and commissioning of electrical devices must be carried out only by qualified skilled personnel in compliance with the current regulations.

The installation and commissioning of the device must conform to the requirements of VDE 0100 (IEC 364) 'Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V' and must be in compliance with all relevant regulations and standards.

Before connecting the device, make sure to compare the supply voltage with the specified voltage on the product label.

Protection against damage caused by high voltages:

Disconnect the power supply before opening the device for access. Make sure that all external power supplies are disconnected.

Operate the device only in the permitted temperature and pressure ranges. For details please refer to the technical data sheet or manual.

Install the device only in protected areas, sheltered from sun, rain and moisture. The product should not be exposed to the elements.

The converter CG.. is NOT certified to be installed or operated in explosive hazardous areas.

Installation, maintenance, inspections and any repairs of the devices must be carried out only by qualified skilled personnel in compliance with the current regulations.

4 WARRANTY

In case of a device failure, please contact immediately M&C or your M&C authorized distributor.

We have a warranty period of 12 months from the delivery date. The warranty covers only appropriately used products and does not cover the consumable parts. Please find the complete warranty conditions in our terms and conditions.

The warranty includes a free-of-charge repair in our production facility or the free replacement of the device. If you return a device to M&C, please be sure that it is properly packaged and shipped with protective packaging. The repaired or replaced device will be shipped free of delivery charges to the point of use.

5 USED TERMS AND SIGNAL INDICATIONS



Danger

This means that death, severe physical injuries and/or important material damage **will occur** in case the respective safety measures are not fulfilled.



Warning

This means that death, severe physical injuries and/or important material damage **may occur** in case the respective safety measures are not fulfilled.



Caution

This means that minor physical injuries **may occur** in case the respective safety measures are not fulfilled.



Toxic!

Acute toxicity (oral, dermal, inhalation)! Toxic when in contact with skin, swallowed or inhaled.



Corrosive!

These substances destroy living tissue and equipment upon contact. Do not breathe vapors; avoid contact with skin and eyes.

Caution

Without the warning triangle means that a material damage may occur in case the respective safety measures are not met.



Note

These are important information about the product or parts of the operating manual which require user's attention.

Qualified personnel

These are persons with necessary qualification who are familiar with installation, use and maintenance of the product.



Risk of fire hazard!

Highly flammable materials are present. There is an imminent fire hazard.



High voltages!

Protect yourself and others against damage which might be caused by high voltages.



Hot surface!

Contact may cause burn! Do not touch!



Wear protective gloves!
Working with chemicals, sharpe objects or extremly high temperatures re-quires wearing protective gloves.



Wear safety glasses!
Protect your eyes while working with chemicals or sharp objects. Wear safety glasses to avoid getting something in your eyes.



Wear protective clothes!
Working with chemicals, sharp objects or extremely high temperatures re-quires wearing protective clothes.



Use foot protection



Use safety helmet and full protective goggles

6 INTRODUCTION

In combustion processes, such as, for example, in large furnaces in which the nitrogen dioxide content amounts to more than 5 % of the nitrogen oxide emission, continuous measurement of nitrogen oxide **NO_x** consisting of nitrogen monoxide **NO** and nitrogen dioxide **NO₂** is prescribed by law in Germany and many other countries.

7 APPLICATION

The **M&C** gas converters **CG...** convert the **NO₂** content of the sample gas by catalysis into **NO**. To do this, the sample gas is conducted through a special stainless steel cartridge with a catalyst-filling based on carbon-molybdenum. This conversion makes it possible to measure nitrogen oxides indirectly using all commercially available **NO**-selective measurement instruments.

The converter is available in four versions: **CG-2** and **CG-2M** with non-heated gas inlet for 'cold gas' conversion and versions **CG-2H-W** respectively **CG-2MH-W** with heated gas inlet and outlet and a second internal heating circuit for 'hot gas' conversion.

For test purposes, the catalyst can be bypassed via two 3/2-way solenoid valves out of PVDF with version **CG-2M** and one solenoid valve out of stainless steel with version **CG-2MH-W**. The solenoid valves can be controlled internally or externally. The versions **CG-2** and **CG-2H-W** are delivered without bypass valves.

The **M&C** gas converters **CG-2** and **CG-2M...** are designed as compact, user-friendly and easy to service 19" plug-in units for mounting in 19" cabinet systems or with a mounting bracket for wall-mounting.

The **M&C** gas converters **CG-2H-W** and **CG-2MH-W** are executed as a wall mounting unit easy to mount.

The catalyst cartridge is filled and formatted at the works and is ready for use immediately. The ability to select the appropriate catalyst filling and the possibility of adjusting the cartridge temperature optimally to the catalytic reaction by means of an electronic temperature controller provides a wide range of applications for the **M&C** gas converter **CG...**

Version	19"-plug-in	Wall mounting	Bypass	'Hot gas'-Conversion
CG-2	x	Optional		
CG-2M	x	Optional	x	
CG-2H-W		x		x
CG-2MH-W		x	x	x

Table 1 Summary of possible versions

Figures 1 and 2 show the functional scheme of the gas converter type **CG..**

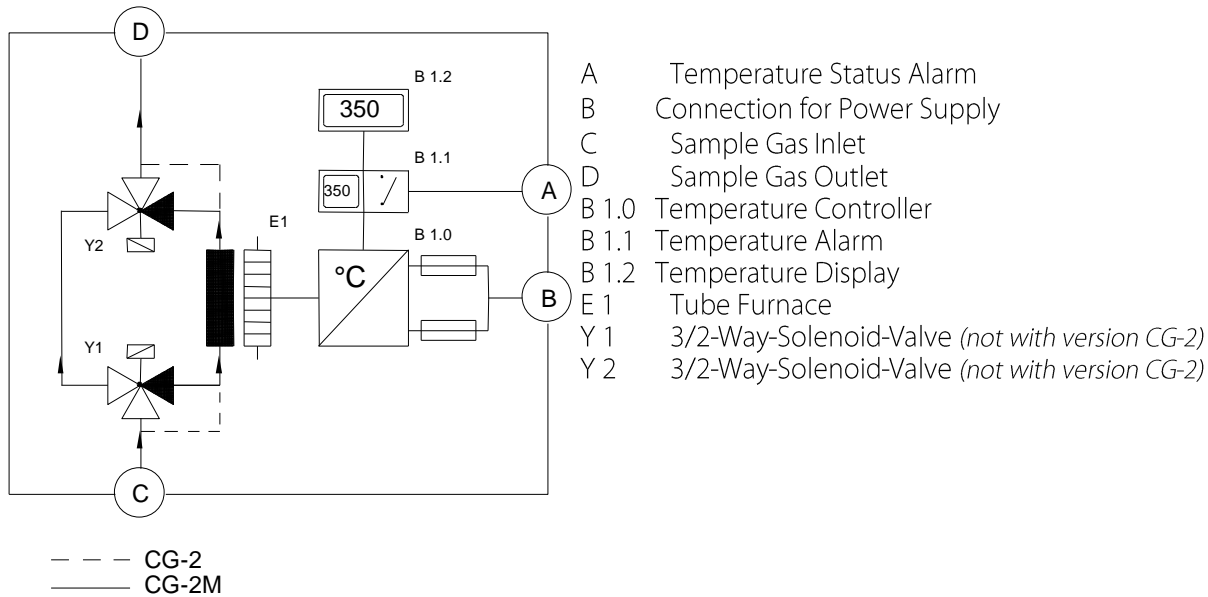


Figure 1 Functional diagram of **CG-2** and **CG-2M**

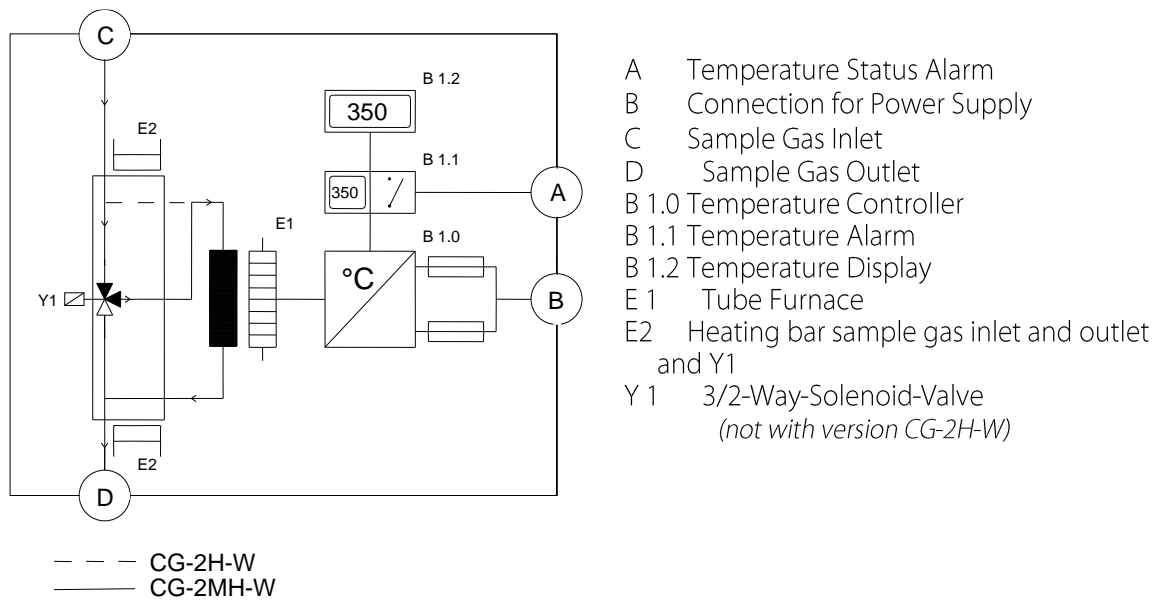
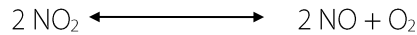


Figure 2 Functional diagram **CG-2H-W** and **CG-2MH-W**

8 OPERATING PRINCIPLE OF THE CONVERSION

The conversion of nitrogen dioxide NO_2 into nitrogen monoxide NO passes according to the following reaction equation:



The reaction equilibrium is shifted at room temperature onto the side of the original material NO_2 . A shift of the equilibrium towards the products and the resultant high product yield can only be achieved as subject to a high-energy input, i.e. increase of temperature.

A nearly 100 % conversion of NO_2 and therefore a complete conversion to NO is achieved with a cartridge filled with a metal catalyst within a temperature range of 620 to 680 °C [1148 to 1256 °F].

The energy input can be reduced explicitly by using a carbon-molybdenum based catalyst. With this type of catalyst, a nearly complete conversion of NO_2 to NO is achieved within a temperature range of 320 to 380 °C [608 to 716 °F].

The catalyst is supplied as a ready-to-use formatted cartridge.



Note

Dust-loaded gases may choke up the catalyst filling. For this reason, an appropriate gas conditioning system is to be mounted upstream of the converters CG... in order to separate out suspended particles!



Note

For converters with unheated sample gas in- and outlet at dew points above 10 °C [50 °F] a sample gas drying/cooling shall be provided!

To minimize the loss of NO_x in the sample gas conditioning, according to DIN EN 14792:2005 (description of the NO_x reference measuring method) the usage of sample gas coolers is not allowed in case the NO_2 fraction is higher than 10 % of the NO_x content (note: because of the high solubility of NO_2).

If the dew point simultaneously is higher than 10 °C [50 °F], a converter with heated in- and outlet has to be used ('hot gas converter').

8.1 SELECTION OF THE APPROPRIATE CATALYST MATERIAL

For the conversion, as noted preliminary, two catalyst materials are available.

As a standard material, a carbon-molybdenum mixture **type C** is used as catalyst. The carbon supporting material guarantees optimal contact between the gas to be converted and the surface of the catalyst combined with a simultaneously low flow resistance.

The catalyst type C, operated within a flow range of 30 ... 60 NI/h, is able to convert NO₂ concentrations up to 200 ppm to NO, achieving conversion ratios of > 95 %. If necessary, the operating temperature of the converter has to be raised within the admissible range.



Note

For catalyst type C no oxygen in the sample gas as well as in the test gas is necessary. A calibration with test gas NO₂ in N₂ is possible.

Alternatively, to type C, a cartridge with metal filling **type SS** is available. It is possible to convert NO₂ concentrations of up to 2000 ppm into NO. A temperature adaption might also be necessary.



Figure 3 Notch to differentiate the two cartridge types



Note

For catalyst type SS, oxygen in the sample gas as well as in the test gas (> 1 vol% O₂) is necessary. A calibration with NO₂ in N₂ is not possible.

8.2 SELECTION OF THE APPROPRIATE CATALYST TEMPERATURE

The converter with carbon-molybdenum cartridge filling is pre-adjusted to 350 °C [662 °F] in the factory. In case of a metallic cartridge filling, the converter temperature is adjusted to 660 °C [1220 °F]. The catalyst temperature can be adjusted continuously using the temperature controller on the front of the converter (see chapter 20.2).



Note

Depending on the gas composition and the flow temperature can be adjusted and optimised within a certain level:

320 to 380°C [608 to 716 °F], type C respectively

620 to 680°C [1148 to 1256 °F]. type SS.

**Note**

High NO₂-concentrations, especially in connection with high flow ratios need higher operating temperatures of the converter, in particular the startup process of the maximum values.

**Note**

High operating temperatures of the converter, especially the startup process of the maximum values leads to an increased abrasion of converter components, in particular sealing- and oven-components!

**Danger**

The maximum allowable operating temperature for catalyst type C is 380 °C [716 °F]. Temperatures above 400 °C [752 °F] lead to a combustion of the converter material. Urgent fire danger !

**Danger**

The maximum allowable operating temperature for catalyst type SS is 680 °C [1256 °F]. Temperatures above 680 °C [1256 °F]. can lead to a destruction of the catalyst resp. converter!

8.3 CROSS SENSITIVITIES AND INFLUENCE OF INTERFERING/CARRIER GAS

From operating experiences in different applications as well as laboratory measurements with different CG-converter- and catalyst types we got a lot of experiences about influencing factors on the NO₂-NO conversion process. The following hints make no claim to be complete but can help choosing the adequate catalyst type as well as give an indication for the integration of the CG-converter into a certain system environment.

In practice, often several influencing factors have any effect at the same time. With their effect on the NO₂- conversion they are possibly interacting and therefore can complicate an explicit interpretation of a certain device performance.

**Note**

Carbon monoxide (CO)

In the conversion process from NO₂ to NO carbon monoxide is generated or destroyed (oxidized). The hereby resulting CO-concentration downstream the converter depends on: catalyst type, NO₂-concentration, O₂-concentration in the sample gas and can be some 10 ppm. Therefore, a CO-measurement should not be installed downstream the converter but with a separate sample gas way to avoid faulty measurements.

**Note**

Oxygen (O₂)

In the conversion process, oxygen is generated proportional to the NO₂ concentration. This fact can lead to a faulty measurement in a downstream oxygen trace measurement (ppm)!

**Note**

Sulfur dioxide (SO₂)

In the operating temperature range of the catalyst type SS of > 600 °C [1112 °F] existing concentrations of sulfur dioxide are partially destroyed (oxidized). This fact can lead to faulty

measurements in a downstream SO₂-measurement. The exact loss of concentration depends proportional on the oxygen concentration of the sample gas and can be up to 25 % from the basic value.

Therefore, a SO₂-measurement should not be installed downstream the converter with catalyst type SS but with a separate sample gas way.



Note

Ammonia (NH₃)

In the operating temperature range of the catalyst type SS of > 600 °C [1112 °F] existing concentrations of ammonia are almost completely transformed into NO if –as required for type SS- enough oxygen is in the sample gas. In the operating temperature range of the catalyst type C around 350 °C [662 °F], Ammonia in concentrations >100 ppm can affect the NO₂-No conversion.



Note

Nitrous Oxide (N₂O)

There was no influence of this gas detected on the NO₂ conversion with catalyst type C or SS.

9 TECHNICAL DATA

Converter Series CG [®]	CG-2	CG-2M	CG-2H-W	CG-2MH-W
Part No. Converter	50A1600(a)	50A1500(a)	50A1900(a)	50A1920(a)
Part No. Converter cartridge Type C Carbon-Molybdenum	95A9003			
Part No. Converter cartridge Type SS metallic Filling	95A9004			
Gas inlet and –outlet non-heated (cold) or heated (hot)	Non-heated	Non-heated	Heated	Heated
Bypass solenoid valves	-----	2 x	-----	1 x
Gas inlet temperature	Max. +80 °C [176 °F], dew point "dry"		Max. +250 °C [482 °F], dew point <160 °C [320 °F]	
Temperature range, adjustable	Max. 680 °C [1256 °F]			
Gas flow rate	30 to 60 NI/h, max. 90 NI/h			
Operating pressure	Max. 2 bar abs. (pressure deviations only with max. 0.1 bar/min)			
Warm-up time	Approx. 30 min.			
Volume of the converter cartridge	Approx. 35 cm ³			
Operating temp. converter cartridge type C	Min. 320 °C [608 °F] typ. 350 °C [662 °F] max. 380 °C [716 °F]			
Operating temp. converter cartridge type SS	Min. 620 °C [1148 °F] typ. 660 °C [1220 °F] max. 680 °C [1256 °F]			
Max. NO ₂ concentration	200 ppm (type C), 2000 ppm (type SS) at new catalyst			
Conversion rate NO ₂ in NO	Effectiveness > 95 % for a new catalyst			
Service life of the NO ₂ /NO catalyst	Change as a preventive measure every 6 months for type C** Change as a preventive measure every 12 months for type SS**			
Differential pressure	< 20-60 mbar depending on type			
Ambient temperature	+10 to +50 °C [50 to 122 °F]			
Storage temperature	-25 to +65 °C [-13 to 149 °F]			
Relative air humidity	< 80 %			
Connection sample gas inlet and outlet	PVDF-fitting G1/4 i DIN 228/1		Ø 6 mm tube fitting, 1.4571*(316Ti*)	
Power	230 V 48-62 Hz or 115 V 48-62 Hz (a)		230 V 48-62 Hz or 115 V 48-62 Hz (a)	
Power consumption	520 W	620 W	940 W	
Electrical connections	Mains power plug connector incl. 2 fine fuses 5 x 20 mm, 230 V / 3.15 A _T or 115 V / 6.3 A _T , 2 m [≈ 6.6 ft] cable with shockproof plug. Alarm- and control signals 9 pin Sub-D-connector			
Status signals for temperature	1 Contact potential free, max. contact rating 24 V, 1 A			
Material of sample contacting parts	Stainless steel SS316Ti, PTFE, FKM, PVDF		Stainless steel SS316Ti, PTFE, FKM, PVDF, aluminium hard coated	
Degree of protection	IP20, EN 60529			
Housing	19" rack mounting, 3 U, depth 350 mm [≈ 13.8"]		Wall mounting, height 350 mm [≈ 13.8"], depth 3 U	
Weight	Approx. 6 kg [≈ 13.2 lb]			
Electrical equipment standard	EN 61010, EN 60519-1			
Option for CG-2 and CG-2M	Mounting bracket, 3U – 84HP, Part No.: 50A3000			

* Standard Ø 6 mm connection, optional Ø ¼" – please indicate with order.

** The indicated service life of 6 respectively 12 months is the minimum service live of the catalyst material under normal conditions and in not highly corrosive, reducing or oxidizing atmospheres. The operator is responsible for checking and, if necessary, adjusting the life cycles.

Please note: NI/h and NI/min refer to the German standard DIN 1343 and are based on these standard conditions: 0 °C [32 °F], 1013 mbar.

10 DESCRIPTION

Figure 4 shows the conversion unit version **CG-2** and **CG-2M** in the 19"-rack housing.

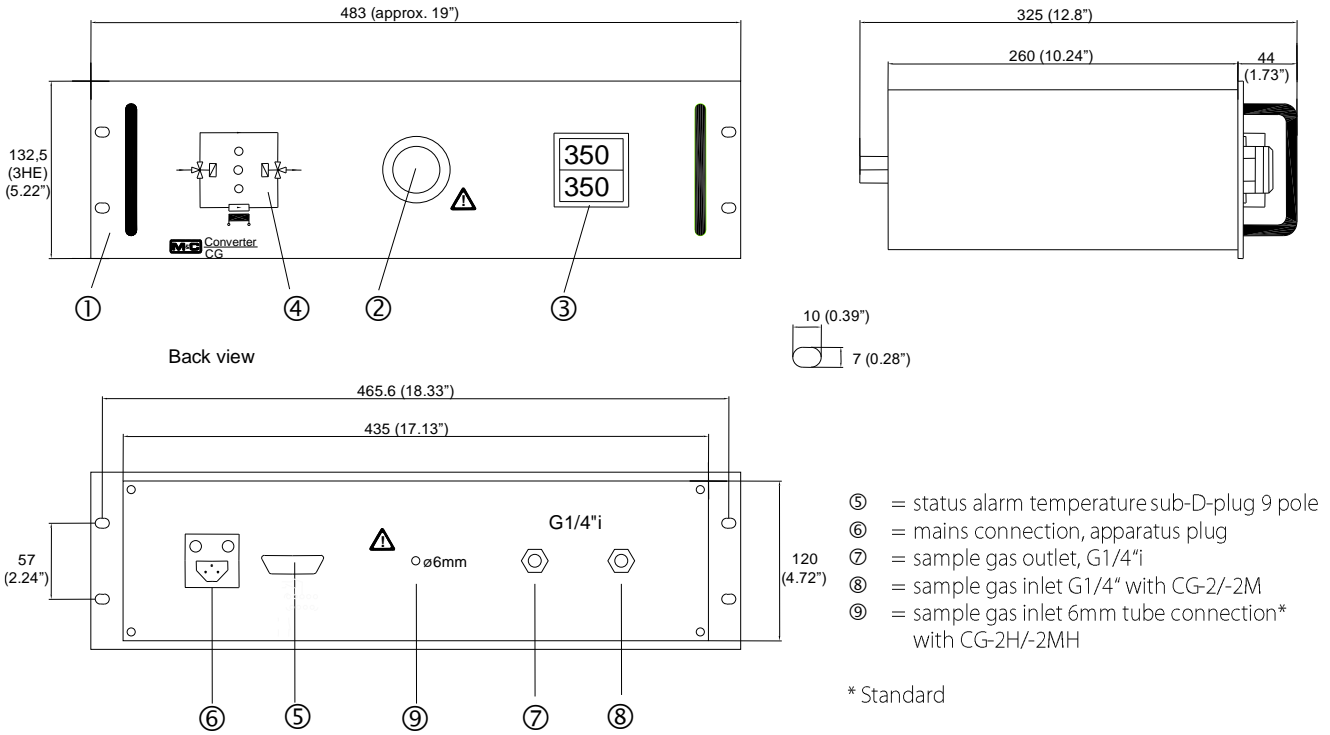


Figure 4 CG-2 and CG-2M

Figure 5 shows the conversion unit versions **CG-2H-W** and **CG-2MH-W** in a wall mounting housing.

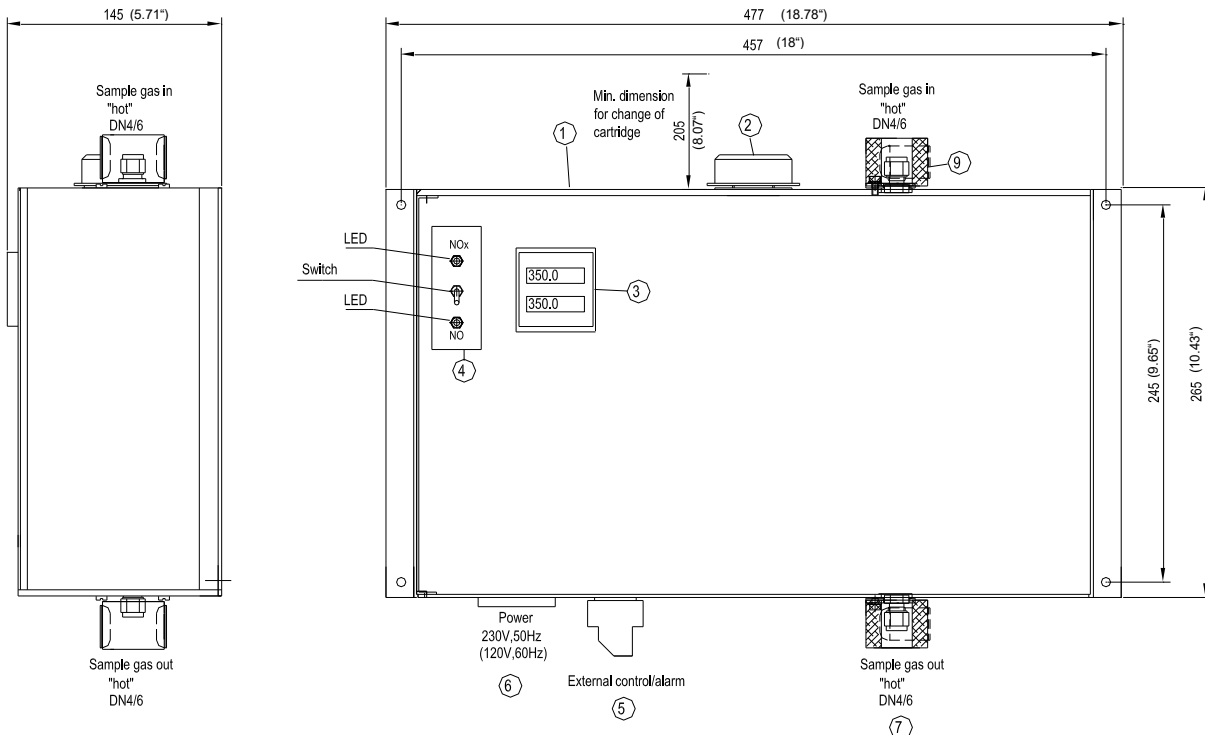


Figure 5 CG-2H-W and CG-2MH-W

The **M&C** gas converters type **CG-2** and **CG-2M** are designed as compact, user-friendly and easy to service 19" plug-in units ① (figure 4) suitable for mounting in 19" cabinet systems. When fitted with the optional mounting bracket with a vertical swivel-holder (**50A3000**), the converters can also be wall-mounted.

The M&C gas converters type **CG-2H-W** and **CG-2MH-W** are executed in a compact, user-friendly and easy to service manner for wall mounting ① (figure 5).

All operating elements are mounted on the front panel of the converter for easy access. These are:

- Mounting adapter with handle for the catalyst cartridge ②;
- Temperature controller with digital temperature display/temperature alarm ③;
- Selector switch for bypassing the catalyst cartridge ④ (only versions **CG-2M/-2MH-W**).

The catalyst cartridge is mounted in a heat-insulated tube furnace. The special mounting adapter ② on the front plate respectively on the above housing side of the converter allows the hot catalyst cartridge to be released and removed without tools being needed.

The converter temperature is electronically controlled and can be set continuously at the temperature controller ③ on the converter's front panel respectively above housing side within a range between +50 °C [122 °F] and +680 °C [1256 °F], depending on the catalytic reaction (see chapter 20.3).

An alarm for excessively high and low temperatures is provided as a status contact output at the 9-pin sub-D-plug ⑤ (terminals 5 and 9) on the rear side of the converter.

With the version **CG-2M** and **CG-2MH-W** internally or externally controlled PVDF 3/2-way bypass solenoid valves allow the catalyst to be bypassed, for example for test purposes. The desired sample gas path is selected internally via the switch ④ on the converter's front panel or can be switched externally via the 9-pin sub-D-plug located on the rear of the converter (see chapter 14.2). Two green LED's confirm the sample gas path selected:

internally:

Switch position "up" - upper LED lights up green - sample gas path selected via bypass
 Switch position "down" - lower LED lights up green - sample gas path selected via catalyst

Only for version **CG-2MH-W**:

Switch position "up" - upper LED lights up green - sample gas path selected via catalyst
 Switch position "down" - lower LED lights up green - sample gas path selected via bypass

The supply-connections are located on the rear or on the upper and lower side of the converter housing. These are:

- 9-pin sub-D-plug ⑤ (necessary for operation of the device, see chapter 14.2),
- connection socket for shockproof plug ⑥
- sample gas outlet G 1/4" ⑦,
- sample gas inlet G 1/4" ⑧ with **CG-2/-2M** and
- sample gas inlet, 6mm tube connection (standard) ⑨ with **CG-2H-W/-2MH-W**.

The built-in ventilator in conjunction with the ventilation slots in the converter's side panels respectively cover provide the necessary ventilation.

11 RECEIVING THE CG...

The **CG...** converter is a completely pre-installed unit. The standard catalyst cartridge supplied is already installed.

- Remove the **CG...** converter and any accessories carefully from the transport packaging immediately after arrival and check the contents of the delivery against the delivery note;
- Check the goods for any transport damage and - if necessary - inform your transport insurer immediately of any damage.

12 STORAGE

Cartridges should not be stored for more than 1 year. Storage must be vibration-free and dry.



Note

The converter should be stored in a protected frost-free room!

13 INSTALLATION INSTRUCTIONS

The converter housing of the versions **CG-2** and **CG-2M** is designed as a 19" unit and is also suitable for wall-mounting or mounting plate by using a special mounting bracket. The versions **CG-2H-W** and **CG-2MH-W** are executed as wall mounting housing.



Note

Because of the system of protection IP 20 (EN60529) the converter has to be built into a protective cabinet respectively housing. When mounting outdoors, the converter must be installed in a protective housing, frost-free in winter and adequately ventilated in summer. Direct sunlight is to be avoided.

In order to avoid the re-oxidation of NO to NO₂ in long sample lines, the converter must be mounted in the immediate vicinity of the gas-analyser if possible.

The converter should be installed away from sources of heat and in a position which allows air to circulate freely in order to avoid any heat accumulation.

To avoid a heating-up of other devices in case of a 19"-rack, we recommend a minimum mounting height of 4U.

14 SUPPLY CONNECTIONS

14.1 HOSE/TUBE CONNECTIONS

The gas inlet and outlet hoses/tubes of versions **CG-2/-2M** are connected on the rear of the converter. Here, the standard executions provide G 1/4" threaded joints. The versions **CG-2H-W/-2MH-W** as wall mounting execution with heated sample gas inlet and outlet are equipped with a 6 mm tube connector of stainless steel.

The appropriate tube or hose threaded joint connections are available optionally from M&C.



Note

Do not confuse hose/tube connections for sample gas inlet and outlet; the connections are labelled accordingly!

Check for tightness after connection!

When connecting the sample gas supply hoses or tubes to the corresponding threaded connections, pay attention to the following points:



Note

The tightness of the connections can only be guaranteed if the end section of the connection hose/tube is flat (use a hose-cutter)!

- Loosen the sleeve nut of the clamping-ring threaded joint by turning to the left. Take care that the nut is removed carefully from the body of the threaded joint to avoid losing the clamping ring which is mounted loose in the nut.
- Push the sleeve nut over the connection hose/tube.
- Push the clamping ring respectively the pressure and the cutting ring onto the connection hose/tube with the thicker bulge pointing to nut.
- Push the hose/tube onto the supporting nipple in the threaded joint.
- Tighten the sleeve nut by hand.

The hose/tube is now mounted in such a way that it cannot slip and is resistant to pressure.

Connecting a heated sample line with an inner tube of PTFE to the converters **CG-2H-W/-2MH-W**, a respective support sleeve is absolutely necessary.

14.2 ELECTRICAL CONNECTIONS



The wrong mains voltage can destroy the device. When connecting, take care that the mains voltage corresponds with the information provided on the type identification plate!



Note

For the erection of power installations with rated voltages up to 1000V, the requirements of VDE 0100 and relevant standards and specifications must be observed!

A main switch must be provided externally.

The main circuit is equipped with a fuse corresponding to the nominal current (over current protection); for electrical details see technical data.

The converter is connected to the mains at the rear respectively the lower side of the converter housing via a shockproof plug with 2 meter [\approx 6.6 ft] connecting cable (X1, see circuit diagram in the appendix).

The general status alarm for signalling temperatures outside the permitted range and the facility for connecting the solenoid valves externally are provided at the 9-pin sub-D-plug on the rear or lower side of the converter housing.



Note

Correct functioning of the converter is only guaranteed when the sub-D-plug X2 is mounted!

Figure 6 shows the pin configuration in the sub-D-plug X2.

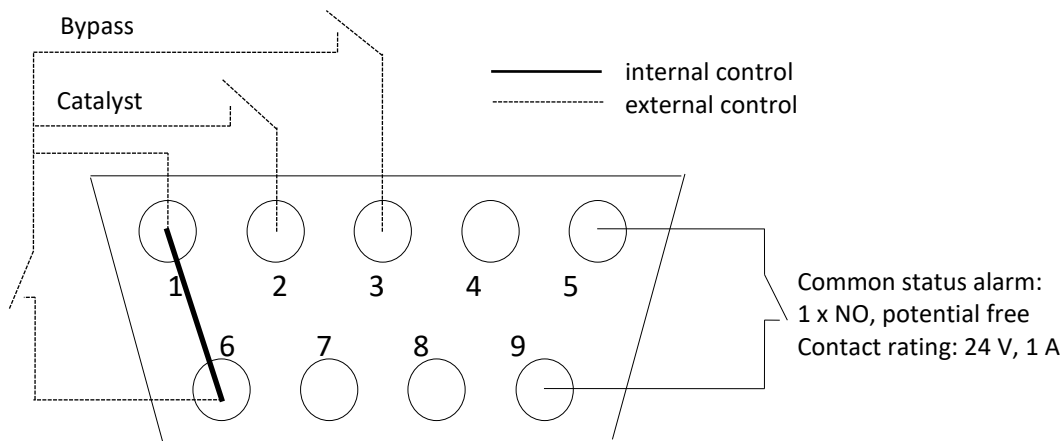


Figure 6 Pin configuration in the sub-D-plug X2

Contacts 5 and 9 are provided in the sub-D-plug to ensure sure signalling of temperatures outside the permitted range (see figure 6). This involves a potential-free make-contact with a switch rating of 24 V, 1A. The alarm is signalled if temperatures exceed the permitted temperature range by $\pm 5^\circ\text{C}$ [$\pm 9^\circ\text{F}$].

The versions **CG-2M** and **CG-2MH-W** have got solenoid valves switching between the sample gas paths. The valves can be controlled either internally or externally by the customer (see figure 6).

**Note**

If the converter is controlled internally, the bridge between contacts 1 and 6 in the D-sub plug is absolutely necessary!

External switching is carried out by the customer using potential-free contacts (see figure 6).

**Note**

If the converter is controlled externally, the bridge between contacts 1 and 6 in the D-sub plug must be removed!

With external control, the switch on the front plate of the converter is out of function. The chosen gas way is indicated by the two LED's.

Both main fuses F1 and F2 (230 V, 3.15 A π or 115 V, 6.3 A π) are located in a special adapter above the mains connection socket X1, on the back or the lower side of the converter housing.

15 PREPARATIONS FOR COMMISSIONING

Before initial startup, all plant- and process-specific safety measures must be observed. It is mandatory for the operator to complete the enclosed risk assessment of the product.

The gas exposure risk must be assessed by the operator with regard to the hazards posed by process and calibration gas and the setup at the installation site (e.g. tubing, system cabinet/container/plant). If the risk assessment reveals increased exposure hazards, further measures are required.

A visible label must be attached to the installation site in accordance with the risk assessment provided by the operator.

16 STARTING-UP

Before using the equipment for the first time, check that the safety measures specific to the installation and process are observed!

The following steps are to be taken before the first starting up:

- Connect converter to the mains; compare the mains voltage with the information on the identification plate before starting up.
- If necessary, connect general alarm-contact to the measurement control station.
- Switch sample gas path to 'bypass' if possible.
- Insert catalyst cartridge into the mounting adapter (see chapter 19.1).
- Introduce cartridge into the tube furnace until the limit stop and screw on the closing cap by hand; inserting the cartridge is eased when the outside O-rings are humidified
- Set desired catalyst temperature (pre-adjusted at the works to 350 °C [662 °F] resp. 660 °C [1220°F]) using the temperature controller (see chapter 20.3). The warm-up time is approximately 30 minutes.

**Note**

The maximum working temperature of the converter is 680 °C [1256 °F], using cartridge type C maximum 380 °C [716 °F].

- When the desired temperature is reached, switch sample gas path over to catalyst operation internally or externally.

**Note**

When using a new catalyst cartridge for the first time or after longer periods of storage at room temperature, the response time T_{90} can be substantially longer! A start-up period of approx. 2 hours has to be considered, until the NO_x -values have been stabilized.

**Note**

The carbon-molybdenum mixture type C inside the converter cartridge might be compressed during transport of the gas converter. The compression of the carbon-molybdenum mixture type C has no effect on the physical and chemical properties of the converter cartridge. Before commissioning, the stainless steel demister can easily be pushed down to change the bulk density.

17 CLOSING DOWN

**Note**

The location at which the converter is mounted must remain frost-free even when the device is switched off!

No special measures need to be taken when the converter is taken out of operation for a short period.

In order to avoid unnecessary consumption of the catalyst and to ensure that the catalyst is ready for use at short notice, the catalyst temperature should be reduced below 300 °C [572 °F] in the "stand-by" during brief operational pauses.

When the converter is taken out of operation for more protracted periods, we recommend purging the converter with inert gas or air at ambient temperature, switching off the voltage and interrupting the gas supply.

18 DETERMINING THE CATALYST SERVICE LIFE

The catalyst service life depends essentially on the following factors:

- Converter-temperature
- NO_2 concentration in the sample gas
- O_2 concentration in the sample gas
- Gas flowrate
- Interfering/carrier gases

Figures 7 to 9 show the service life curves of the NO_2/NO catalyst cartridge **type C** at 350 °C [662 °F] depending on the flow rate and the oxygen concentration. During the stated service life, conversion is over 95 %. If the degree of efficiency falls notably below 95 %, the used catalyst cartridge should be replaced (see chapter 19.1).

The curve values are guideline values and are intended to enable the user to be better able to estimate catalyst service life under practical conditions in the relevant installation.

**Note**

Adverse conditions in the installation and long-lasting increased converter temperatures can lead to a substantially shorter catalyst service life!

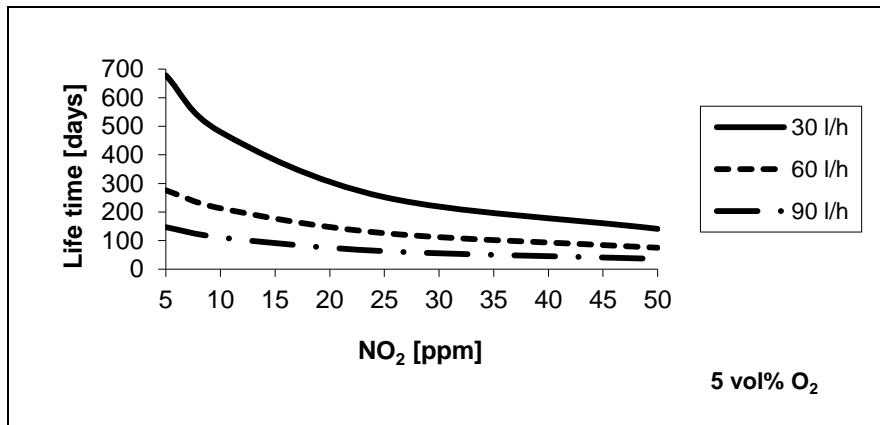


Figure 7 Lifetime depending on NO₂ concentration for various flow rates @ 5 vol% O₂

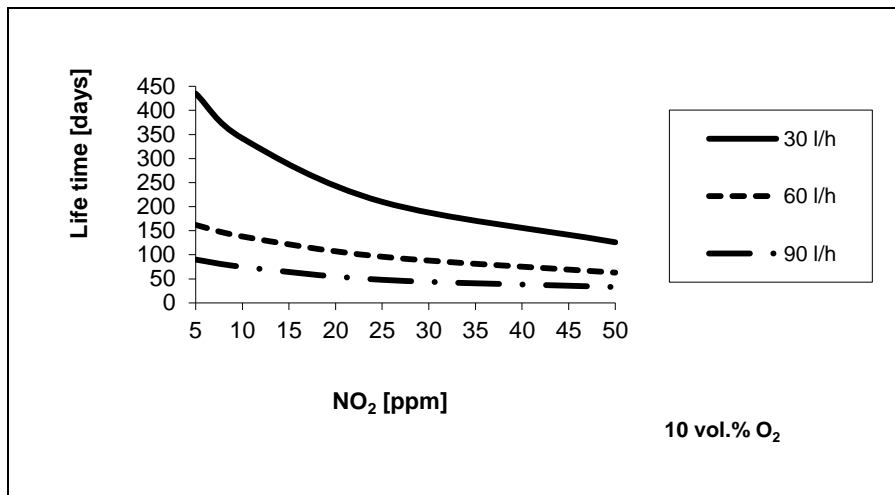


Figure 8 Lifetime depending on NO₂ concentration for various flow rates @ 10 vol% O₂

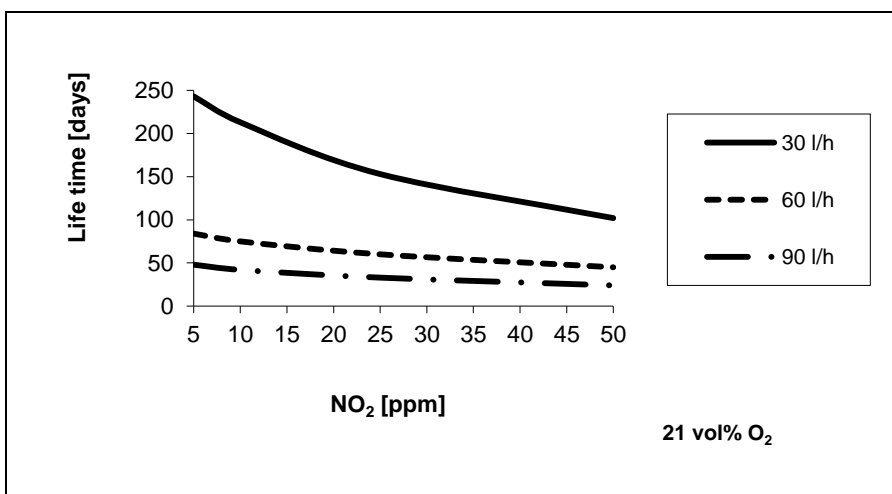


Figure 9 Lifetime depending on the NO₂ concentration for various flow rates @ 21 vol% O₂

18.1 CHECK OF THE EFFICIENCY

To check the efficiency of the converter cartridge a test gas with a NO₂-concentration according to the concentration in the sample gas (e.g. 20 ppm in N₂) is necessary.

Feed test gas upstream the converter and read measured NO-concentration at the analyzer.

$$\text{Efficiency} = \frac{\text{Measured NO-concentration [ppm]}}{\text{NO}_2\text{-concentration in test gas [ppm]}} \times 100 \%$$

For a precise result the measuring range of the analyzer has to be adapted to the concentration of the test gas!

18.2 CONVERSION PPM --> MG/M³

1 ppm --> mg/m ³	DIN 1343	NTP	STP	SATP
	T=0 °C	T=20 °C	T=25 °C	T=25 °C
	p=1013 mbar	p=1013	p=1000	p=1013
Nitrogen monoxide NO	1.34 mg/m ³	1.25	1.21	1.23
Nitrogen dioxide NO ₂	2.05 mg/m ³	1.91	1.86	1.88

Standard conditions

DIN 1343 Standard conditions in Germany

NTP Normal temperature and Pressure mainly in the USA

STP Normal conditions worldwide standardized

SATP new Normal conditions "Standard Ambient Temperature and Pressure"

The table is based on the following calculation. This calculation is based on the ideal gas laws

Molecular weight NO = 30.01

Molecular weight NO₂ = 46.0055

$$\frac{\text{mg}}{\text{m}^3} = \frac{0.1 \times \text{Molecular weight} \times \text{Pressure} \times \text{Concentration in ppm}}{\text{Molecular gas constant } 8.314472 \frac{\text{J}}{\text{kmolK}} \times \text{Reference temperature in Kelvin}}$$

19 MAINTENANCE

Before carrying out maintenance work, make sure that safety measures specific to the installation and process are complied with!



Dangerous voltage. Remove mains plug before opening the converter's housing!

The **CG...** converter does not need special maintenance periods.

When replacing the catalyst cartridge, it is advisable to change the O-ring-seals provided.

The temperature controller is implemented in the front panel of the converter and can easily be dismantled by pulling out the controller housing.



Remove mains plug before dismantling the temperature controller!

19.1 REPLACING THE CATALYST CARTRIDGE

The catalyst cartridge can be replaced without the aid of tools. The converter does not need to be switched off to replace the cartridge. The following steps should be followed:

- Switch the converter's sample gas path either internally or externally to bypass.



Hot catalyst cartridge.

Touching the cartridge can lead to very severe burns. Wear protective gloves and safeguard cartridge against unauthorised access!



- Turn the closing cap/adaptor with handle ② (see figures 4 and 5) counter clockwise.
- Pull the catalyst cartridge at the closing cap with a rotary motion out of the adaptor.

The re-inserting has to be done in the opposite way.



In order to obtain the required gas-tightness, take care that the cartridge is always inserted into the adaptor right up to the stop.

Moisten the outer O-rings helps placing the cartridge into the oven.

Do not use grease for O-rings because it could affect the efficiency of the catalyst!



After mounting a new catalyst cartridge, a start-up time of approx. 2 hours is necessary to get stable CO and NO_x values.

19.2 REPLACING THE O-RING SEALS

We also recommend replacing the adapter's seals every time that the cartridge is replaced (supplied with each cartridge).



Warning

Hot catalyst cartridges.

Touching the cartridge can lead to very severe burns. Wear protective gloves and safeguard cartridge against unauthorised access!

Figure 10 shows schematically the location of the two inside and outside O-ring seals.

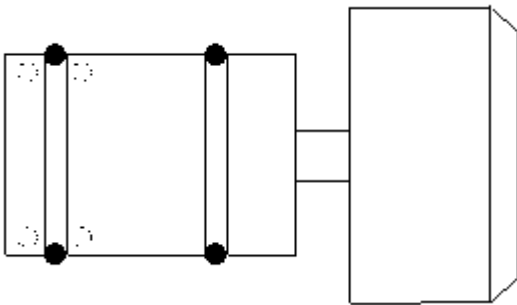


Figure 10 Adapter for catalyst cartridge with handle

The inside seals can be removed using a pointed tool (e.g. a needle).

When replacing the outside seals, they have to be pushed over the adapter into the appropriate seal groove.

The inside seals are to be mounted as follows:

- Lay the seal in the adapter aperture.
- Push the O-ring into the appropriate seal groove using a blunt instrument.



Note

Take care when re-mounting the O-ring seals:

Do not damage the O-rings and take care that they are correctly positioned!

19.3 CHECKING FOR GAS-TIGHTNESS

- Connect device to mains supply.
- Set temperature controller to ambient temperature.

**Note**

The converter must be cooled down to room temperature in order to check for gas-tightness!

- Switch sample gas path to catalyst operation (lower green LED lights up).
- Seal sample gas outlet tightly.
- Connect sample gas outlet with U-tube manometer or similar for 0.6 bar and upstream shut-off valve.
- Release air using the stopcock until the manometer displays a pressure of approximately 0.5 bar.

**Note**

Do not exceed the maximum operating pressure of 2 bar absolute!

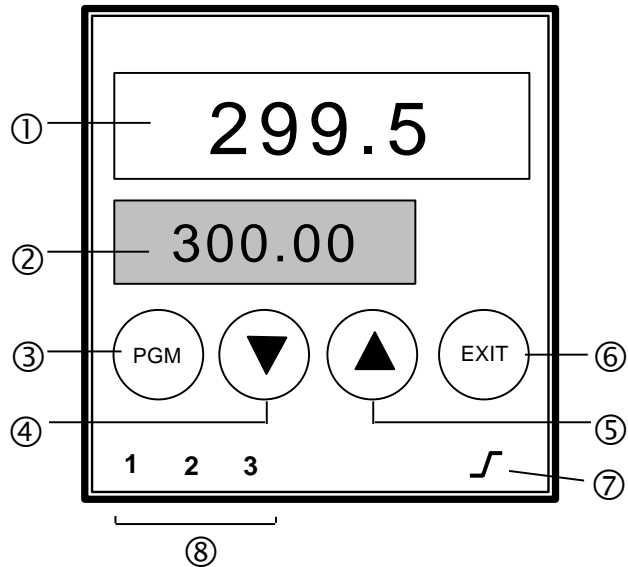
- Close shut-off valve.

A pressure drop of 0.01 bar in 5 minutes is acceptable.

20 USE OF THE TEMPERATURE CONTROLLER

20.1 DISPLAY AND FUNCTION KEYS

- ① Process value display, red
- ② Set-point display, green
- ③ PGM key
- to select the parameters
- ④ Decrement key
- to alter values
- ⑤ Increment key
- to alter values
- ⑥ EXIT key
- to quit the levels
- ⑦ LED for ramp/programme function, green
- ⑧ LED for status indication, yellow
- outputs 1 to 3

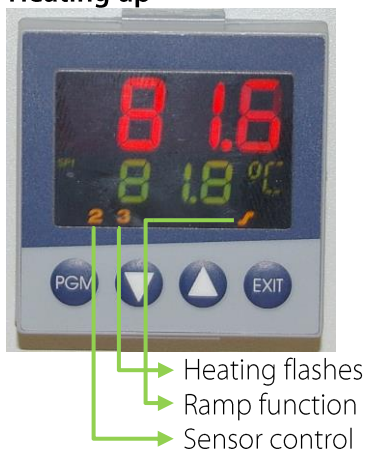


20.2 OPERATING STATE OF THE TEMPERATURE CONTROLLER

The operating state is displayed via the LED's 1 to 3 like:

Operating state	1	2	3
Heating up	off	on	blinking
Normal	heating on	on	on
	heating off	on	off
Alarm/Error	X	off	X

Heating up



Setting value reached





In the event of an alarm, over- or under-temperature alarm, the controller automatically switches to the state of the self-retaining heating switch-off.

20.3 CHANGING THE PARAMETERS OF THE TEMPERATURE REGULATOR




The programming of the regulator is made on different levels.

All important adjustments of the converter are listed in the user level and can be modified after removing the key locking.



In order to remove the locking, please proceed as follows:

- Standard indication (setting value below, actual value above (see photo)) must to be seen.
- Press both together, key PGM and  for 5 seconds,
Indication = **Code 3** (all levels are locked)
- Press PGM
- Change the value from **3** to **2** by using the key 
- The display flashes after approx. 2 seconds and the alteration is taken over.
- The user level is now cleared.
- Press **EXIT**.

In order to go forward to the user level now, press key PGM, Indication = **User**

- Press the key PGM once again, indication = **SP** (setting value, adjustment at works **350** or **680** depending on converter cartridge)
- Press key , indication = **ALSE** (temperature range for sensor and heating control, adjustment at works ± 10)
- Press , indication = **Lo-t** (relative temperature to temperature setting value for low temperature alarm, adjustment at works **-10**)
- Press , indication = **rASL** (ramp gradient, temperature increase in °C/min, adjustment at works **30**)

In order to change one of these parameters, you must press the PGM key again after **SP, ALSE,**

Lo-t or **rASL** are to be read on the display. The respective value is flashing now on the display and can be modified by using the keys  or .

The automatic taking over of the setting value is made after approx. 2 seconds; this is indicated by a short flash of the modified value.

If you press the keys   for a longer time, the speed of changing is increased. The value can only be changed within the admissible range of value.

The abortion of the input is made with **EXIT** before a new value hasn't been taken over. After an abortion, the standard indication is shown.

In order to switch on again the key locking, change the code to 3 again as described above.




Note

If you reduce the setting value by more than 10°C [18 °F], the sensor control will be released and the heating circle switched off. For the reset, wait until the value remains under the new setting value, switch off the mains voltage and switch it on again.

20.4 RESET OF THE CONTROLLER

A reset out of the temperature lock happens with connected mains:

- operating simultaneously the keys **EXIT** and 

A reset only happens in case the actual temperature deviates by $< \pm 10\text{ }^{\circ}\text{C}$ [$\pm 18\text{ }^{\circ}\text{F}$] from the set temperature.

Another method for a reset that functions without problem is to cut the mains voltage for a short moment (remove the mains plug).



Note

Watch carefully the control characteristic after reset. This simplifies the diagnosis of errors when a failure happens again!

21 TROUBLE SHOOTING

The following table is intended to show the possible sources of errors and their rectification

Problem/Display	Possible Cause	Check/Rectification
LED's do not light up Valves do not switch over Temperature controller out of order	No mains power Sub-D-plug not inserted in socket X2 F1/2 fuses defective	Mains 'ON' OK. Check that mains cable fits properly (X1); OK. Check whether sub-D-plug is present and is properly plugged in; OK. Check whether bridge in sub-D-plug exists (s. Fig. 6); OK. Check fuses and replace if necessary;
Converter does not heat up LED K1 off	Heater defective Temperature controller defective Solid-state relay defective Sensor short circuit	Measure voltage at terminals X4/2 and 3; OK. Replace heater; Not OK. Measure voltage at terminal X4/6 and 7; Voltage < 8 V DC? Check controller according to operating instructions; Voltage > 8 V DC? Replace solid-state relay; Change sensor;
Valves do not switch LED's do not light up	No mains supply (see above) Sub-D-plug not inserted into socket X2 (see above) <u>Internal circuit:</u> No solder link 1-6 in sub-D-plug <u>External circuit:</u> Error in external controller	see above see above Check sub-D-plug and if necessary solder link; Check external controller;
Valves do not switch LED's light up	Valve defective	Check that valves function
No sample gas flow	Valves defective (see above) Gas sample lines blocked or leaking	See above Check gas sample lines; Check for gas-tightness
No conversion	Cartridge used up Cartridge does not heat up (see above) No sample gas flow (see above)	Change cartridge (see chapter 19.1) See above See above

22 PROPER DISPOSAL OF THE DEVICE

At the end of the service life of our products, it is important to take care of the appropriate disposal of obsolete electrical and non-electrical devices. To help protect our environment, follow the rules and regulations of your country regarding recycling and waste management.

23 SPARE PART LIST

Wear, tear and replacement part requirements depend on specific operating conditions. The recommended quantities are based on experience and are not binding.

Converter CG...

(C) Consumable parts, (R) Recommended spare parts and (S) Spare parts			Recommended quantity CG being in operation [years] (a.r. = as required)		
			C/R/S	1	2
95A9003	Catalyst cartridge CG-2-C	C	a.r.	a.r.	a.r.
95A9004	Catalyst cartridge CG-2-SS	C	a.r.	a.r.	a.r.
95A9070	O-ring set for CG-2	S	-	-	1
95A9040	Control board compl. CG – 230 V	S	-	-	1
95A9040a	Control board compl. CG – 115 V	S	-	-	1
95A9057	Heater CG2, 230 V 50/60 Hz	S	-	-	1
95A9057a	Heater CG2, 115 V 50/60 Hz	S	-	-	1
01B8401	Temperature controller CG, type 70304	S	-	-	1
90K6045	Fan 80 x 80, 24 V	C	-	1	2
05V1060	Male connector G1/4"-DN4/6 PVDF	R	2	4	4
05V6600	Ferrule 4/6 PV	R	5	10	15
05V6605	Union nut M10-4/6 PV	R	4	8	10

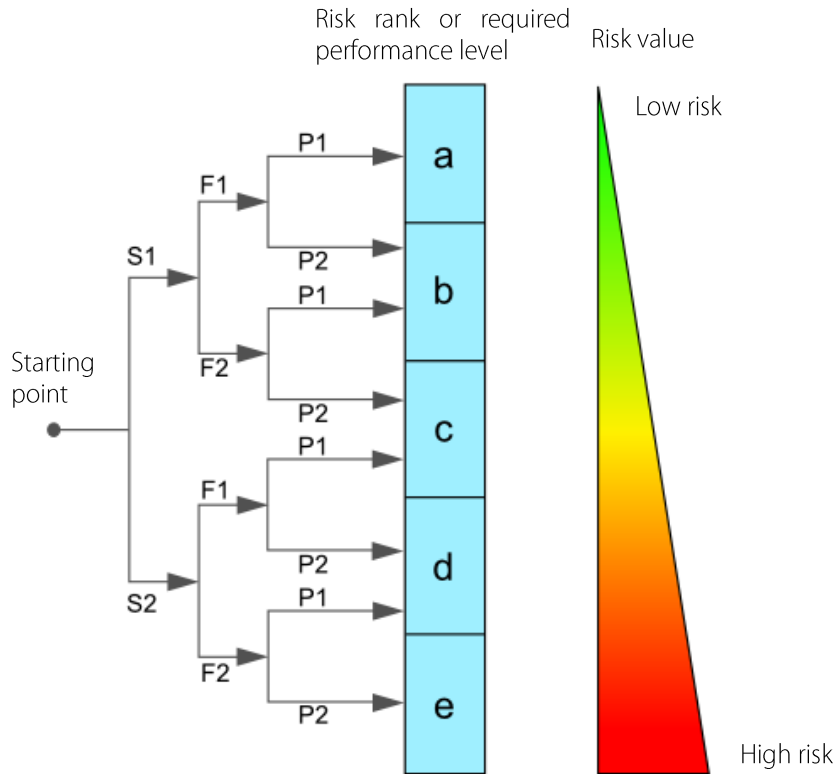
24 RISK ASSESSMENT

The risk assessment provided in this chapter is intended for all work activities on the product. The hazards can occur in the work steps of assembly, commissioning, maintenance, disassembly and in the event of a product fault. During normal operation, the product is protected by a system cabinet or appropriate covers.

Only qualified personnel is permitted to perform the work. The following minimum knowledge is required for the work:

- Employee instruction provided in process engineering
- Employee instruction provided in electrical engineering
- Detailed knowledge of the instruction manual and the applicable safety regulations

The product complies with the current regulations according to state-of-the-art science and technology. Nevertheless, not all sources of danger can be eliminated while observing technical protective measures. Therefore, the following risk assessment and the description of exposure hazards refer to the work steps mentioned above.



Severity of injury:

S1 = 1 = minor (reversible injury)
 S2 = 2 = serious (irreversible injury, death)

Frequency and duration:

F1 = 1 = infrequent or short exposure to hazard
 F2 = 2 = frequent (more than once per hour/shift)

Possibility of preventing or limiting the damage

P1 = 1 = possible
 P2 = 2 = hardly possible

Figure 11 Overview risk assessment



Aggressive condensate possible

Risk rank group A

Chemical burns due to aggressive media possible!
 This applies to all liquids in vessels and in the product.
 In general, for electrical and mechanical work on the product, wear personal protective equipment (PPE) in accordance with the risk assessment.



Caution hot surfaces

Risk rank group A

The temperature inside the product can be higher than $> 180\text{ }^{\circ}\text{C}$.

The hot parts are shielded by mechanical devices. Before opening the products, they must be disconnected from the power supply and a cooling time of more than > 180 minutes must be observed. In general, for electrical and mechanical work on the product, wear personal protective equipment (PPE) in accordance with the risk assessment.



Caution electric shock

Risk rank group C

When installing high-power systems with nominal voltages of up to 1000 V, the requirements of VDE 0100 and their relevant standards and regulations must be observed!

This also applies to any connected alarm and control circuits. Before opening the products, they must always be disconnected from the power supply.



Gas hazard

Risk rank group A-B-C

The hazard potential mainly depends on the gas to be extracted.

If toxic gases, oxygen displacing or explosive gases are conveyed with the product, an additional risk assessment by the operator is mandatory.

In principle, the gas paths must be purged with inert gas or air before opening the gas-carrying parts.

The escape of potentially harmful gas from the open process connections must be prevented.

The relevant safety regulations must be observed for the media to be conveyed. If necessary, flush the gas-carrying parts with a suitable inert gas. In the event of a gas leakage, the product may only be opened with suitable PPE or with a monitoring system. Furthermore, the work safety regulations of the operator must be observed.



Caution crushing hazard

Risk rank group A

The work must be performed by trained personnel only.

This applies to products weighing less than $< 40\text{ kg}$ [$\approx 88.2\text{ lbs}$]:

The product can be transported by 1 to 2 person(s). The instructions for appropriate personal protective equipment (PPE) must be observed.

The weight specifications are contained in the technical data of this product.

Furthermore, the work safety regulations of the operator must be observed.

25 APPENDIX

- Wiring plan **CG-2M**,
Drawing No. : **2224-5.04.0**
- Wiring plan **CG-2MH-W**,
Drawing No. : **2224-5.04.4**
- Wiring plan **CG-2H-W**,
Drawing No. : **2224-5.04.5**



For further product documentation, please see our internet catalogue:
www.mc-techgroup.com

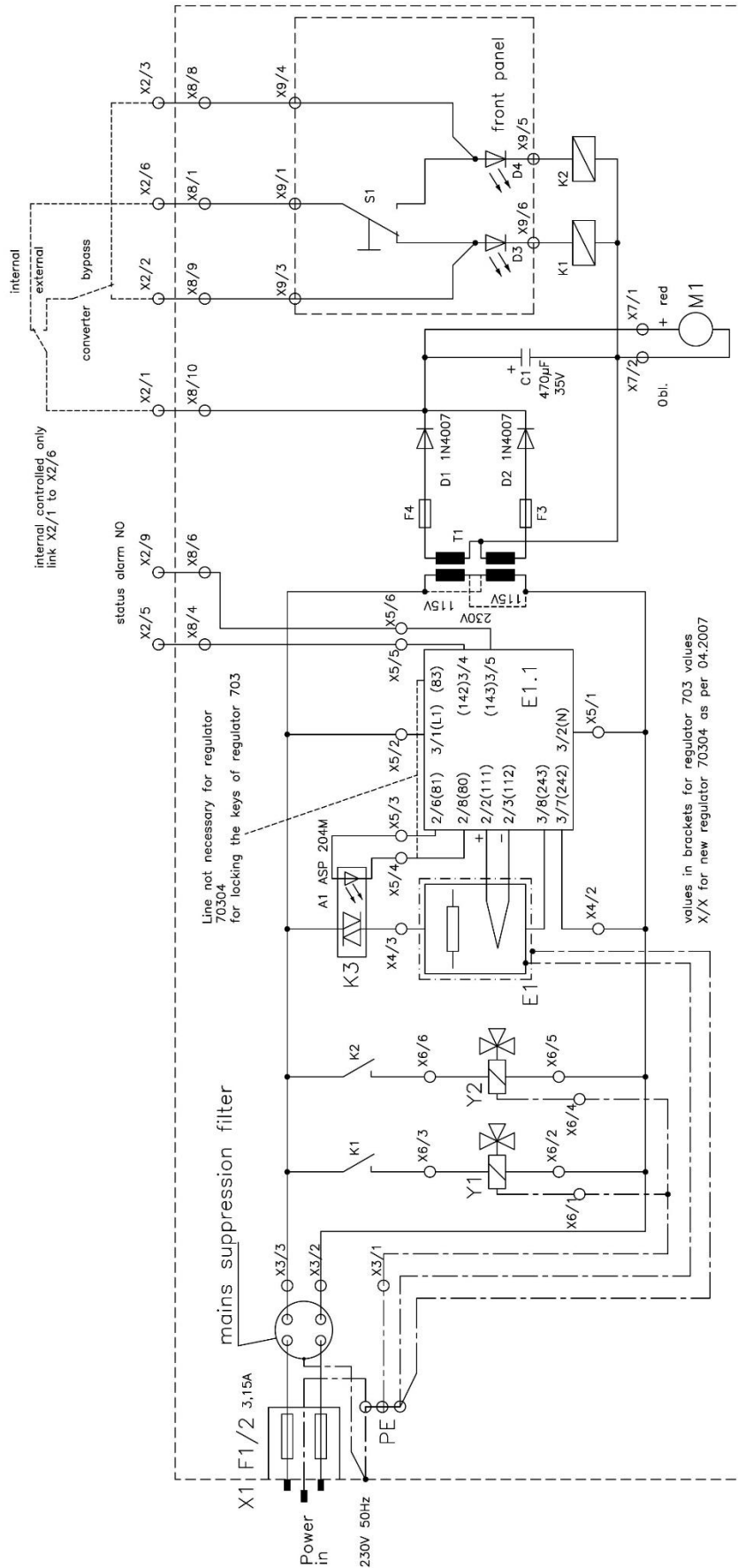


Figure 12 Wiring plan CG-2M, Drawing No.: 2224-5.04.0

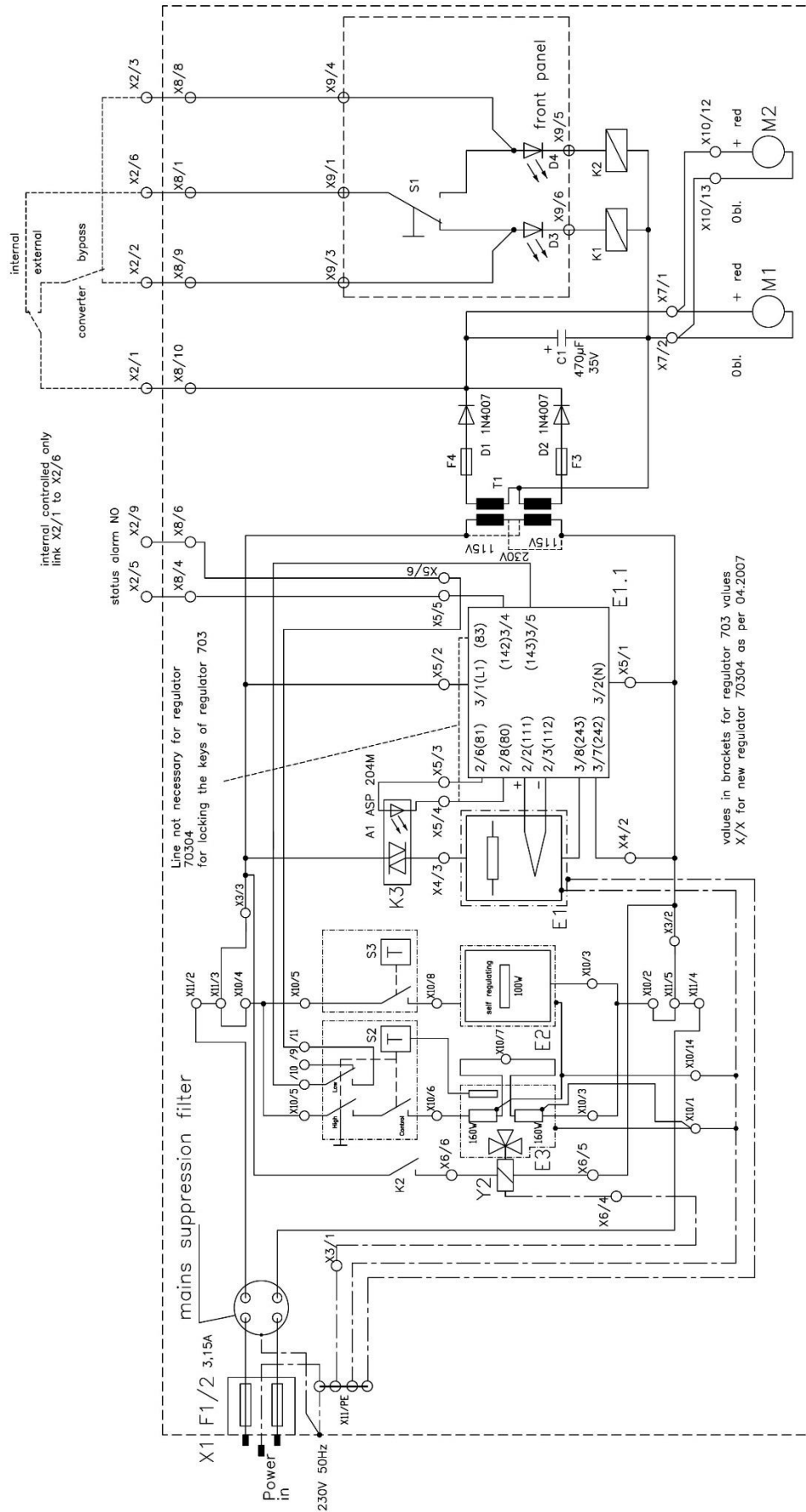


Figure 13 Wiring plan CG-2MH-W, Drawing No.: 2224-5.04.4

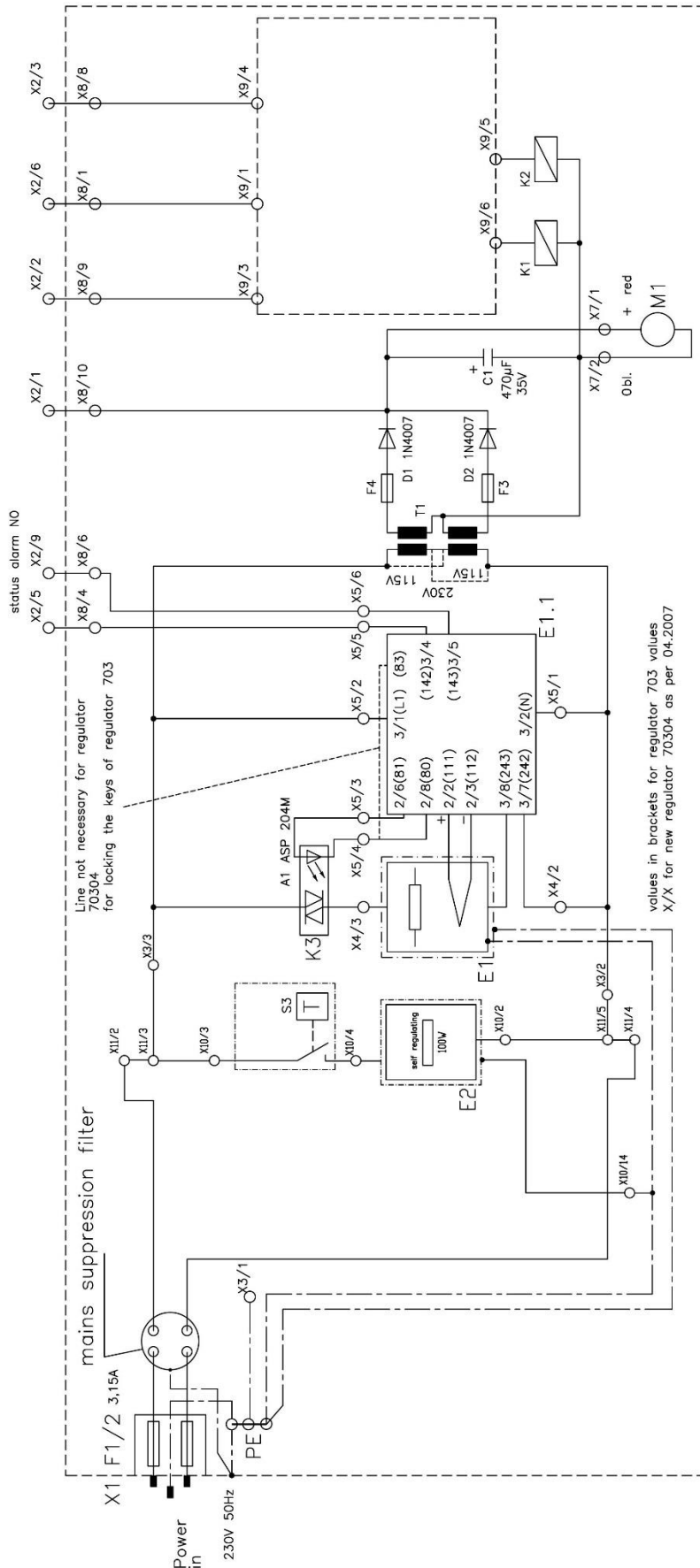


Figure 14 Wiring plan CG-2H-W, Drawing No.: 2224-5.04.5