

AquiTron

MSR Range

AT-MSC

Multi-Sensor Controller
For Refrigerant Gas Sensing



**INSTALLATION
& OPERATION
INSTRUCTIONS**



aquilar
leak detection solutions



Please read instructions carefully and keep them in a safe place (preferably close to the module) for future reference. These instructions must be followed carefully to ensure correct operation.

A. GENERAL INFORMATION

The AT-MSC can accept upto 3x AT-MC sensors which can be different gas types if required. Alternatively, one ATEX compliant sensor can be connected to the SC slot (X3)

The controller monitors the measured values and activates the alarm relays if the set alarm thresholds for pre-alarm and main alert are exceeded. In addition, the values are provided for direct connection to the BMS via an RS-485 interface and also as 4–20 mA output.

B. PRODUCT INFORMATION

POWER REQUIREMENTS

100-240 Vac @ 50/60 Hz, Output rating type 5 5VA Output Rating type 7 15VA

REMOTE INTERFACE

3x relays with SPDT contacts, potential-free max. 250 V AC, 5 A
2x transistor outputs, 24 V DC, 0.1 A (plus switching)
Serial RS-485 interface with protocol for AT-DGC or Modbus protocol
2x digital inputs

LOCAL BUS OUTPUT

2x local bus connection for AT-SC sensors and 3x analog input (4–20 mA) for AT-MC sensors; max. 3 sensors in total or 1 ATEX rated sensor.

LC-DISPLAY

LCD Display with input data

ENCLOSURE

RAL 7035 (Light Grey) Polycarbonate IP65UL 94

COMPATIBLE SENSORS

Digital AT-MC Sensors/ATEX Sensors (Gas Specific)

SENSOR MAINTENANCE

Easy maintenance and calibration when replacing sensors

APPROVALS

EMC Directives 2014/30/EU
Low Voltage Directive 2014/35/EU
IEC/EN 61010-1:2010 EN 50271
EN 50290 Type I IEC/EN 61508-1-3
EN 50402 IEC/EN 62990-1:Type SM
EN 50104 EN 14624 EN378

 Unit 30, Lawson Hunt Industrial Park,
Broadbridge Heath, Horsham, West Sussex,
RH12 3JR

 +44 (0) 1403 216100

 info@aquilar.co.uk

 www.aquilar.co.uk

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1 GENERAL

These instructions explain the basics of dimensioning, laying and terminating of the cables as well as the procedure of commissioning of the AT-MSC Multi Sensor Controller. During installation, especially the applicable local technical requirements and regulations concerning wiring, electrical security, environmental conditions and fire protection must be considered.

1.1 SAFETY

The user manual must be carefully read, understood and followed by all persons who install, use, maintain and check the product. The product can only fulfil its intended functions if it is installed, used, maintained, cared for and checked in accordance with the instructions provided by Aquilar Ltd. Updated references to standards always refer to the current edition. Due to on-going product development, Aquilar Ltd reserves the right to change specifications without notice. The information contained herein is based on data considered to be accurate. However, no guarantee or warranty is expressed or implied concerning the accuracy of this data.

1.2 RESPONSIBILITY OF INSTALLER AND OPERATOR

It is the installer and operator's responsibility to ensure that all devices are installed and used in compliance with all international, national and local regulations and requirements. The device must be checked for correct installation and functionality by a qualified person before measurement operation is started.

The AT-MSC devices have been tested for functionality by the manufacturer before delivery. During commissioning, a documented functional test is also required. The installation should only be carried out by trained installation technicians, taking into account the current safety procedures for control installations.

The required equipotential bonding connections (also e.g. secondary potential to ground) or grounding measures are to be carried out according to the respective project requirements. It must be ensured that no ground loops are created in order to avoid undesired interference in the measurement electronics. The requirements of EN 60079-29-2 (gas detectors - selection, installation, use and maintenance of devices for the measurement of combustible gases and oxygen) as well as the requirements of EN IEC 62990-2 (gas detectors selection, installation, use and maintenance of devices for the measurement of toxic gases and vapours) must be observed for installation, operation and maintenance.

1.3 SERVICES

It is recommended that these devices be inspected on a regular basis. Performance deviations can be corrected based on regular maintenance. Recalibration and parts replacement can be performed in the field by a qualified technician using the appropriate tools. Regular maintenance is to be carried out according to the instructions.

1.4 DISPOSAL OF DEVICES



In accordance with Directive 2012/19/EU, the device must not be disposed of as municipal waste. Return the device for disposal to your national sales organisation, which you can contact if you have any questions about disposal.

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2 APPLICABILITY

These instructions explain the basics of dimensioning, laying and terminating of the cables as well as the procedure of commissioning of the AT-MSC Multi Sensor Controller. During installation, especially the applicable local technical requirements and regulations concerning wiring, electrical security, environmental conditions and fire protection must be considered.

2.1 GENERAL NOTES

This User Manual is only valid for

- AT-MSC Multi Sensor Controller

2.2 INTENDED USE

The AT-MSC device must not be used in potentially explosive atmospheres. The device must only be installed in areas within the environmental conditions as specified in the Technical Datasheet. The intended sites are all areas being directly connected to the public low voltage supply, e.g. residential, commercial and industrial environments as well as small enterprises.

2.2.1 AT-MSC

The AT-MSC is used for control applications and air quality compliance in commercial buildings and production facilities and is a communication and supply board for the AT-MC series, measuring and warning of toxic and combustible gases, as well as refrigerants and oxygen in stand-alone operation

3 FUNCTIONAL DESCRIPTION

The function of the sensor series AT-MC is not subject of this manual but can be read in the in the relevant datasheets

3.1 AT-MSC/STAND ALONE/ AT-DGC MODE

The AT-MSC has 3 analog inputs for AT-MC sensors with 4–20 mA signal. The connected sensors defined measurement, temperature and voltage range and continuously monitored

In Stand-Alone Mode the unit monitors the measured values, compares them to the 4 alarm thresholds and if exceeded activates the 2 alarm relays as well as a visual and an acknowledgeable, acoustic alarm. A fault occurred activates the fault signal relay and is signalled visually and acoustically

In AT-DGC mode, the AT-DGC continuously monitors the measured values and sensor data via the fieldbus interface. The AT-MSC is then integrated into the system as a slave with its base address. The addressing on the fieldbus level as well as the registration, assignment and parameterisation of the connected sensors on the local bus level is done via the service tool, which is directly connected to the AT-MSC. The cable topology for the RS-485 field bus can be found in the AT-DGC installation instructions

Other options such as LCD display, 3-color status LED, buzzer, digital input for acknowledgment or test function, various communication protocols ensure proper adaptation to the wide range of applications in gas detection technology. For convenient commissioning, the AT-MSC can be pre-configured and parametrised with factory-set defaults

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3.1.1 DISPLAY OPTION

The display shows the current operating status of the gas warning device by means of coloured status LEDs as well as by measured value displays and plain text messages.

Colour of status LED	Interval	Meaning
Green	Continuous	= Operating voltage
	Flashing	= Maintenance message
Yellow	Continuous	= Fault
	Slowly flashing	= Warm-up phase
	Fast flashing	= Special mode
Red	-	= Alarm

3.2 FUNCTION OUTPUT

The display shows the current operating status of the gas warning device by means of coloured status LEDs as well as by measured value displays and plain text messages.

Action (GS = Gas Signal) (AT = Alarm Threshold) (CFM = Collective Fault Message)	Reaction	Alarm LED Display / WAO	Alarm 1 Relay 1	Alarm 2 Relay 2	Alarm 3 Relay 5 Warning Light/Flash	Alarm 4 Relay 4 Horn	Relay 3 ¹ (CFM)
GS < AT 1		GREEN	Inactive	Inactive	OFF	OFF	Inactive
GS ≥ AT 1		RED slowly flashing	Active	Inactive	OFF	OFF	Inactive
GS ≥ AT 2		RED fast flashing	Active	Active	OFF	OFF	Inactive
GS ≥ AT 3		RED fast flashing	Active	Active	ON	OFF	Inactive
GS ≥ AT 4		RED fast flashing	Active	Active	ON	ON	Inactive
GS ≥ AT 4 + horn acknowledged (+ recurrence function)		RED fast flashing	Active	Active	OFF after delay ON	OFF	Inactive
Maintenance due (no alarm or fault)		GREEN flashing	Inactive	Inactive	OFF	OFF	Inactive
Internal error / fault		YELLOW	Inactive	Inactive	OFF	OFF	Active

Note 1: Relay 1 and 2: Operation mode Energized

Status Inactive: Alarm OFF = Relay coil is powered

Status Active: Alarm ON or device tension-free = Relay coil is current-free

Relay 31: Operation mode Energized

Status Inactive: No fault = Relay coil is powered

Status Active: Fault or device tension-free = Relay coil is current-free

Relay 4 und 5: Open-Collector / transistor output, operation mode De-energized

Status OFF: Alarm OFF or device tension-free

Status ON: Alarm ON

Note 2: Alarm thresholds can have the same value, so the relays and/or the horn and flashlight can be triggered together

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3.3 RELAY MODE

Definition of the relay operation mode: The terms energized/de-energized come from the terms energized/ de-energized to trip principle (open-circuit/closed-circuit principle) used for safety circuits. The terms refer to the activation of the relay coil, not to the relay contacts (as they are executed as a changeover contact and available in both principles). The LEDs attached to the modules show the states in analogy (LED off relay current-free)

3.4 RELAY FUNCTION STATIC/FLASH

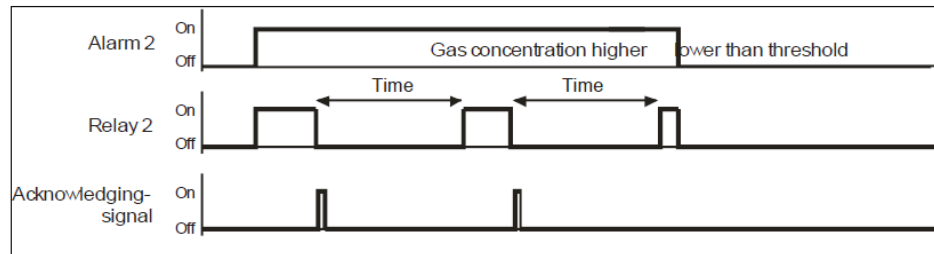
Definition of the relay function: The function flashing represents a connection option for warning devices to improve visibility. If flashing is set, this must not be used as a safe output circuit anymore. A combination of relay mode energized with flashing operation makes no sense and is therefore suppressed.

3.5 HORN FUNCTION (NOT SAFE OUTPUT CIRCUIT BECAUSE RESETTABLE)

The horn function is considered to be active if at least one of the 2 parameters (time or assignment to digital input) is set. The horn function retains its functionality even for alarms in latching mode.

Special function: Recurrence of the horn relay

After an alarm has been triggered, the horn will remain active until it is acknowledged. After acknowledgment of the horn relay (clicking a button or externally via a digital input) a timer starts. When this time has run out and the alarm is still acting, the relay is set again. This process is repeated endlessly as long as the associated alarm remains active.



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4 MOUNTING INSTRUCTIONS



Electronics can be destroyed by electrostatic discharge (ESD). Therefore, the installation work should be done only by persons connected to ground, e. g. by standing on a conductive floor or by taking appropriate grounding meas-

4.1 SITE OF INSTALLATION

When choosing the mounting location, you have to consider the ambient conditions in order to get representative measurement results. Please pay special attention to the following factors:

- External heat sources are not allowed on the installation site.
- Choose mounting location according to the local regulations.
- Consider ventilation conditions! Do not mount next to air passages or suction holes.
- The sample gas must pass the sensor even under adverse flow conditions. A flow test can be performed for instance with smoke tubes.
- Use a wind shield if the flow conditions are > 6 m/s.
- Mount the device at a location with minimum vibration and minimum variation in temperature (no direct sunlight).
- Avoid locations where water, oil etc. may influence proper operation and where mechanical damage might be possible.
- Provide adequate space around the sensor for maintenance and calibration work.
- The installation height depends on the relative gas density of the monitored gas type

4.2 INSTALLATION WORK



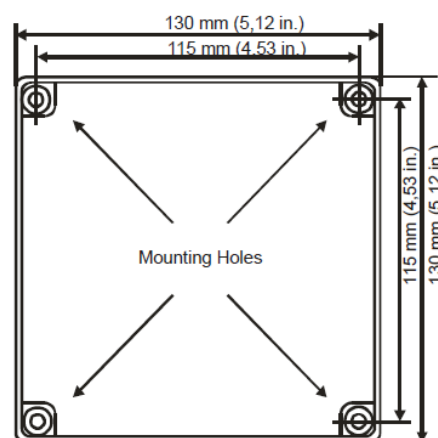
Assembly work must only be carried out under gas-free conditions. The housing must neither be spot-drilled nor drilled through outside the knockouts. The installation of the gas detector always has sensor head downwards, cables are introduced from above.

Depending on the order, the sensors are either already mounted on the housing or enclosed in separate packaging. The housing is delivered in closed condition. Before breaking out the knockouts, the exact position and size of the sensors and cable entries must be determined. The housing type E offers different mounting options depending on the number and types of sensors due to a variety of pre-stampings.

The sensors are usually supplied in separate packaging and should only be mounted on the housing during commissioning to protect them from dirt and damage. For sensors that can be poisoned by silicones, such as all semiconductor and heat tone sensors, it is necessary to use a protective cap and to remove it only after the silicones have dried, and then to energize the unit.

Mounting Procedure:

- Open housing cover
- Determine mounting location for AT-MC and cable entries on the housing.
- Break out the required knockouts on the housing bottom part
- Fix the unit to the wall at the 4 marked fixing points on the back of the housing so that the sensor is always directed vertically to the ground
- The dimensions (housing type C / E = 115 x 115 mm) depend on the type and can be read on the back of the housing
- Fit the cable glands for the required cable
- Check sensor for gas type, measuring range and calibration date.
- Insert sensor and tighten it with M25 hexagon nut
- Close and screw the cover



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5 ELECTRICAL CONNECTION

Electronics can be destroyed by electrostatic discharge (ESD). The installation work should be done only by persons connected to ground, e. g. by standing on a conductive floor or by taking appropriate grounding measures.



Assembly work must only be carried out under gas-free conditions! Consider static electricity instructions

5.1 GENERAL NOTES

- Only a professional should perform the wiring and the connection of the electrical installation according to the wiring diagram in compliance with the relevant regulations and only when de-energized
- The technical requirements and regulations for wiring, electrical security, as well as project specific and environmental and local conditions etc. must be observed when mounting
- All terminals are screw type. The permissible conductor cross section can be read from the relevant technical datasheets
- When selecting and installing the cables you have to comply with the regulations concerning the RS-485 bus installation (see AT-DGC Commissioning Instructions). The installations have to be executed in line topology. Cable lengths and types have to be considered as well
- Avoid any influence of external interferences by using a shielded cable for the 4–20 mA signal, but do not connect the shield
- Avoid any influence of external interferences by using shielded cables for the bus line, but do not connect the shield.
- It is recommended to use the following cable types:

	Europe	USA/Canada
Power supply 230 V	NYM-J 3 x 1.5 mm ²	14 AWG / 300 V
Alarm message 230 V (also possible together with power supply)	NYM-J X x 1.5 mm ²	14 AWG / 300 V
Signal message, bus connection to DGC-06, warning devices 24 V	J-Y(St)Y 2x2 x 0.8 mm ²	min. 300 V
Possible external analog transmitters	J-Y(St)Y 2x2 x 0.8 mm ²	min. 300 V

- Strip the wires as shortly as possible. It is important to ensure that bare wires, e.g. wire shields do not come into contact with the mounted PCB (risk of short-circuit)
- Low voltage wire and mains connected wire must be fixed separately by cable ties or similar, to secure against looseness.
- The alarm signals are available as potential-free change-over contacts
- Use copper conductors only, for the terminal is only for connection to copper wire
- Analog transmitters are connected directly to the spring type terminals of the module. The correct polarity must be observed
- Digital sensors are connected directly to the local bus socket
- When choosing the option "Power Supply ≥ 90 VAC" you must make sure that a switch or a circuit breaker is provided in the building automation especially for the unit. It must be installed easily accessible near the unit. It has to be marked as a disconnecting device for the unit and shall meet the relevant requirements of UL/IEC 60947 and UL/IEC 60947-3.
- The exact position of the terminals for the transmitters and alarm relays is shown in the connection diagrams.

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5.2 TERMINAL CONNECTIONS



Connecting the 24 V field bus voltage to the field bus terminals BUS_A / BUS_B can destroy the Board completely!

- Open the cover. Insert the cable from above and strip it.
- Remove terminal blocks from Board

- AT-MC Sensor: Connect to analog input AI_01, AI_02, AI_03 (X13). The correct polarity must be observed.

Pin 1 = +24 V

Pin 2 = AI_01 Signal

Pin 3 = AI_02 Signal

Pin 4 = AI_03 Signal

Pin 5 = GND

- Replug terminal carefully on the Board.
- Close cover.

The power requirement of the AT-MC sensor heads depends on the measuring principle used. Therefore, the maximum number of sensor heads depending on the operating voltage must be observed according to the table below

Supply voltage	E11XX-X MXX-X	P34XX-X	SXXX-X	I-S1164-X S4X0-A	XXX-X	P34XX-X	SXXX-X	I-S1164-X S4X0-X	XXX-X	E11XX MXX-X
	Series SC					Series MC				
24 V DC	2	1					3			
24 V AC	2	1					0			
230 V AC 5 VA	2	1					3			
230 V AC 15 VA	2	1					3			

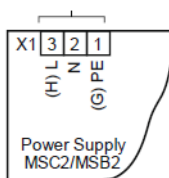
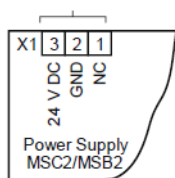


IMPORTANT: Do not connect x2 AT-SC sensor heads of the same gas or same gas group

5.3-5.3.1 CONNECTION DIAGRAMS OPERATING VOLTAGE OF AT-MSC

Type 2
24 V DC $\pm$ 20%
24 V AC $\pm$ 15% 50/60 Hz

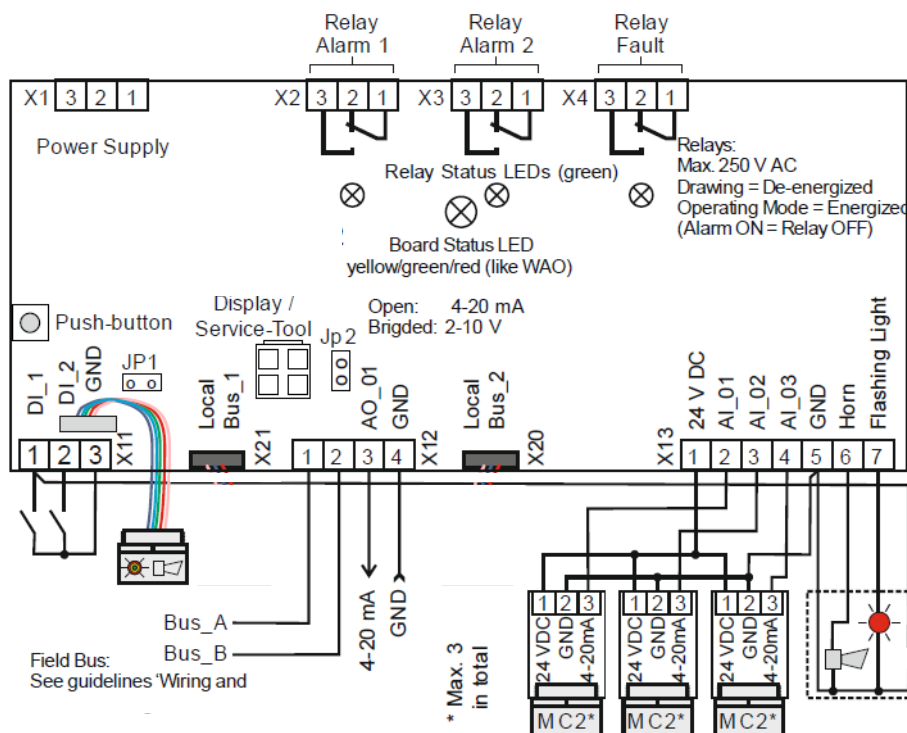
Type 5
5 VA
100-240 V AC 50/60 Hz



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5.3.2 INPUTS AND OUTPUTS OF AT-MSC

Please see below, relay R3 is the fault signalling function which can be deactivated



6 COMMISSIONING

Before delivery all devices without exception run through a complete functional test with an initial calibration of the sensors.

6.1 GENERAL NOTES

Only trained technicians should perform the following when commissioning:

- Check for correct mounting location
- Check if connection is correct according to connection diagram.
- Check power voltage
- Install and connect the sensor units on the housing if not already installed ex works.
- Address the device if used in AT-DGC mode
- Register AT-MC sensors
- Adjust application parameters
- Calibrate (if not already factory-calibrated, see datasheet of AT-MC sensors)
- For sensors that can be poisoned by silicones, such as all semiconductor and catalytic bead sensors, it is necessary to use a protective cap (C2-Z1) and to remove it only after the silicones have dried and then energize the unit
- Required instruments for commissioning:

Hand Held Service Tool

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6.2 VISUAL INSPECTION

- Right cable type used.
- Correct mounting height depending on the relative gas density of the gas type to be monitored.
- LED status

6.3 SELECTION GAS TYPE WITH UNIT, MEASURING RANGE AND SIGNAL TYPE

- The gas type with unit, the measuring range and the signal type (analog or bus) are pre-set on the Board for factory-fitted sensors.
- If other sensors are connected, the configuration on the Board must be adjusted using the optional display or hand held service tool, otherwise the device will recognise a communication error.
- The configuration contains all the necessary information and is used to compare the configuration data stored in the parameter set of the sensor with the settings.

6.4 REGISTRATION/ASSIGNMENT OF AT-SC/AT-MC SENSORS

SC sensors physically connected to the device are registered on the device. The sensor is automatically recognized via the gas type and measuring range factory-integrated in the SC address.

For AT-MC sensors, the 4–20 mA signal is recognised/monitored. Please refer to the hand held service tool for registration. Up to 3 AT-MC sensors can be connected to the AT-MSC

AT-MC sensors must always be registered from input 1

The number of the 'analogue input' determines the position of the measuring point in the parameterisation (AI1 =MP1, AI2 = MP2, AI3 = MP3).

AT-MSC Sensor Example

Input	Mode	Field Bus Address	Gas Type	Measuring Range	Result
1	MC2	DP01	CO	300 ppm	CO MC2 assigned to input 1 und thus field bus address DP01
2	SC2	DP02	NO ₂	30 ppm	NO ₂ SC2 assigned to input 2 und thus field bus address DP02
3	SC2	DP03	C ₃ H ₈	100 % LEL	C ₃ H ₈ SC2 assigned to input 3 und thus field bus address DP03

Only the parameters with blue background have to be worked on for the addressing in the board and the AT-SC registration.

Mode: AT-MC = MC with 4–20 mA signal, assignment to Input 1

Gas type and meas. range: Selection of gas type and range of the AT-MC connected

With the MC, the assignment of gas type and measuring range should be checked by the installer for conformity looking at the laser engraving. Gas type and measuring range set in the AT-MSC for the measuring points are checked for consistency

6.5 SELECTION GAS TYPE WITH UNIT, MEASURING RANGE AND SIGNAL TYPE

The base parameter set is stored in the unit in a fail-safe manner and documented in the enclosed calibration and test protocol. Necessary changes of parameters for adaptation to the application are to be carried out only by experts with the hand held service tool.

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6.6 STAND ALONE OPERATION

In stand-alone operation, monitoring, evaluation and warning are carried out directly on the unit. For this purpose, the alarm thresholds as well as the assignment of the alarms to the local alarm relays and outputs for a visual and acoustic warning must be parameterised directly on the unit.

Alarm 1 = Relay 1
Alarm 2 = Relay 2
Fault = Relay 3

6.7 ADDRESSING FOR AT-DGC MODE

A base communication address is assigned to the unit with the help of the hand held Service-Tool. With this base address, the data of the sensor head assigned to input 1 are sent to the Gas-Controller AT-DGC via the field bus. Any further SC/MC registered automatically occupies the subsequent address.

6.8 RUNNING IN CHARACTERISTICS

After switching on or after an internal reset of the microcontroller, the device always runs through a start routine with defined status of the outputs. The start always begins with the diagnosis and warmup stages. When they have succeeded and finished, the measurement operation starts. External intervention is not possible during this start routine. The states of analog output, relays, field bus and signal LEDs for all operating stages are shown in the following table.

Start	LED on Display			Analog Output	Relays		Field Bus	Board LED 3-colour
	Power	Alarm	Fault		Alarm	Fault		
Diagnosis (ca. 0.5 sec.)				< 2 mA	OFF	Error ⁴	Communication STOP	
OK								
Warm-up period			2s 2s 2s	< 2 mA	OFF	Error ⁴	Communication STOP	2s 2s 2s
OK								
Measuring mode	⁶	²		4–20 mA ¹	³	OK ⁵	Communication OK	
Maintenance message		²		4–20 mA ¹	³	OK ⁵	Communication OK	3s 1 3s
Special mode	⁶	⁷		2 mA ⁸	⁷	Error ⁴	Communication OK	
Detected fault	⁶	⁷		2 mA	⁷	Error ⁴	Communication OK	
Processor failure				< 1 mA	OFF	Error ⁴	Communication STOP	

- 1 Depends on the measured gas concentration
- 2 Status depends on the gas concentration and the alarm threshold
- 3 Status depends on the gas concentration, the alarm threshold and the operating mode
- 4 Relay de-energized, contact open
- 5 Relay energized; contact closed (OK state)
- 6 Brightness cyclically flashing when message to field bus
- 7 Previous status doesn't change.
- 8 No influence on the analog signal if the Special Mode was triggered by the operator.

6.9 SENSOR CALIBRATION

Calibration of the AT-SC and AT-MC during commissioning is only necessary if the calibration date is no longer up to date. (See relevant technical datasheets for calibration and storage times)

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7 OPERATING MODES

During operation, the unit can assume different operating modes. A distinction is made between the warm-up phase, measuring mode and special mode, whereby special mode is divided into 2 different subcategories.

7.1 RESTART (DIAGNOSTIC AND WARM-UP STAGE)

The device is designed in a way that it generally runs through all internal device tests (diagnostics) in the Board and in the connected sensor head(s) after each power-up or processor reset before the measuring operation starts. That means that the processor's internal components and the associated program and working memories as well as the other components of the input and output units are tested. This process takes approximately 0.5 seconds. When all diagnostics have been successful, the warm-up phase of the sensor element starts. The warm-up is necessary for the sensor element in the sensor head to assume a stable state after return of the voltage without triggering a pseudo alarm. If several sensors are connected, the duration of the warm-up phase depends on the sensor head with the longest warm-up phase.

When using a display or a AT-MSR-PT (Handheld Service Tool):

During the warm-up phase, the yellow LED flashes every 2 seconds and "Power ON Time" appears in the display.

Subsequently, the display shows

- the current bus address at the top left,
- the gas type in the top centre and
- the unit at the top right.

"Warm-up Time" appears in the lower section of the display

After the end of the warm-up phase, measurement operation starts and the necessary diagnostic functions continue to run in the background.

7.2 MEASURING MODE

In normal operating mode = measuring mode, there are no faults present, the gas concentration of the sensor is continuously polled, checked for plausibility, output on the analog output (if available) and provided on the field bus. The gas concentration is displayed on the built-in display, if available.

When the alarm evaluation is activated, only with alarm threshold > 0 , the gas signal is checked with each measurement cycle, if it is $\geq$ alarm threshold (alarm evaluation for increasing concentration) respectively $\leq$ alarm threshold (alarm evaluation for falling concentration) and if exceeding respectively falling below, the alarm LED and the optional alarm relay are triggered. If the value falls below/ exceeds the alarm threshold minus / plus the set hysteresis again, the alarm is automatically cancelled. If the latching function is programmed, the alarm remains active until manual acknowledgement.

The device continuously monitors itself, the measurement signal, the analog output, the alarm relay and the communication to the sensor head.

If the measurement signal falls below the zero point, this will be tolerated:

- for combustible gases with catalytic bead sensor element (Pellistor) up to a limit of - 10 % of the measuring range, the analog output signal drops down to 2.4 mA, within this range no error is generated,
- for all other gases up to a limit of - 4.5 % of the measuring range, the analog output signal drops down to 3.3 mA, within this range no error is generated.

Active dead band suppresses the 4–20 mA signal around the zero point

If the measurement signal exceeds the full-scale value, this will be tolerated up to a limit of + 6 % of the measuring range, the analog output signal increases up to ≥ 21.2 mA and there will be still no error generated.

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7.3 SPECIAL MODE

The Special Mode includes all operating conditions outside the measuring operation. In Special Mode operation the query of the gas concentrations is slightly delayed, but there is no alarm evaluation. The fault relay switches to status "Error" only if fault signalling function is active. The flashing yellow LED and the optional display indicate the Special Mode. A fault overlays the LED display by continuous operation of the yellow LED.

The gas warning device takes the Special Mode in the following cases:

- Internal device fault
- Measurement signal exceeds > 6 % of measuring range
- Measurement signal falls below < - 4.5 % of measuring range (< - 10 % for Pellistor sensors)
- Diagnostic and warm-up stage after the return of voltage (Power On Status)
- Service mode activated by the operator (no influence on the analog output signal).

7.3.1 MAINTENANCE AND CALIBRATION MODE



The operator may set the gas detector in the Special Mode only when gas-free state is ensured (no alarm), because the alarm function is not available in this mode.

The operator can activate the Special Mode on the optional display or via the external AT-MSR-PT. This mode includes commissioning, calibration, testing, repair and decommissioning. Pending alarms are held in active Special Mode, but new alarms are not generated. The operator can exit the Special Mode after completion of work; if there are no further entries or operations, the unit will automatically return to the measurement mode after 15 minutes.

7.3.2 FAULTS

The fault signalling function of relay 3 can be deactivated in order to use the relay only as an alarm relay. If the fault signalling function for relay 3 is deactivated on a stand-alone device, it loses SIL conformity.

The following shows all possible errors, possible causes, the related troubleshooting and the resulting device status. When the cause of the error has been eliminated, the Board restarts with the "measuring mode" including diagnostic functions on its own. It isn't necessary to acknowledge the error message*. If an error occurs, it is output in the option with display and in the menu error status in plain text. If there is more than one error, it is output with a cumulative, bit-coded error code. If the error directly affects the measured value, the error is also displayed instead of the measured value.

*** Exception: Error code 0x8020h (Analogue Output setting CF/AF, See handheld AT-MSR-PT Display): Short circuit or interruption at the analog output.**

- **Disconnect the device from the voltage source and reconnect OR**
- **Activate Special Mode on the display AT-MSR-PT and set the analog output current to 4 mA using the AO test function. Then wait until the error message disappears.**

AT-MSC Multi Sensor Controller

7.3.2 FAULT CODES

	Cause	Remedy	Fault Relay	Analog Output	Field Bus	Display Error Code	Text Mess.	
Sensor Head (SC2 or MC2)			Reaction on Board			DP1-		
Sensor element defective	Internal	Replace SC2/MC2	Error	< 2 mA	Error code is sent	0x8001h	Sensor	
Temperature < -35 °C, > +60 °C						0x8040h	Overtemp.	
Measured value processing						0x8002h	ADC Error	
System voltages <>						0x8004h	Voltage	
RAM / ROM / µC error						0x8008h	CPU Error	
EEPROM error				0x8010h		EE Error		
Measuring value < - 4.5 % (-10 % Pell.) of measuring range	Sensor drift, calibration not correct	Perform calibration		> 21,2 mA			0x8100h	Underrange
Measuring value > 106 % of measuring range	Gas concentration > meas. range	See chapter 8.2					0x8200h	Overrange
Analog input (MC2) > 21,6 mA	MC2 error or incorrect calibration, MC2 not connected	Perform calibration / replace sensor					0x8200h	Overrange
Analog input (MC2) < 3 mA				< 2 mA		0x8100h	Underrange	
Maintenance due	Maintenance date reached	Perform maintenance	No effect		Maintenance message	0x0080h	Maintenance	
MSC2/MSB2							MSC2/MSB2	
Temperature < -35 °C, > +60 °C with display: < -20 °C, > +60 °C	Ambient temp.	Temp.!	Error	< 2 mA	Error code is sent	0x8040h	Overtemp.	
Measured value processing.	Internal	Replace device					0x8002h	ADC Error
							0x8008h	CPU Error
							0x8010h	EE Error
EEPROM error						0x8020h	I/O Error	
No response alarm relay								
Configuration error	Measuring range SC2/MC2 ≠ I/O unit	Adjust meas. range		X mA			0x8010h	EE Error
Deviation of analog output signal < 5 % >	Short-circuit or Interruption at the analog output	Check wiring / load					0x8020h	I/O Error
	Internal	Replace device						
Communication error to sensor head	Sensor head not fitted correctly / wrong gas type	Check it, set correct gas type		< 2 mA			0x9000h / 0xB000h	Communication Error
	Internal	Replace SC2 sensor head						
Hardware Watch Dog triggered	Internal, < system voltage, µC defect.	Replace device		< 1 mA	Comm. STOP	Reset	Reset	
Operating voltage limits exceeded too high / too low	External	Check voltage		< 2 mA		0x8004h	Voltage	
	Internal	Replace device						
Maintenance due (concerns analog input only)	Maintenance date reached	Perform maintenance	No effect			0x0080h	Maintenance	
Manual Special Mode	See chapter 8.3.1	Exit Special Mode	Error			0x0800h		

AT-DGC

Digital Gas Controller

8 MAINTENANCE AND SERVICING



For testing sensors, please use the correct gas and PPM level suitable for the sensor you are servicing. Refer to the correct datasheets for the system and gas you have to determine which PPM level you need.

If bump tested with the incorrect gas you will not guarantee reliable measurement and may require to recalibrate the sensor. If the sensor is damaged, calibration may be required at much shorter intervals or replacement of the sensor. In addition, high heat can lead to the mechanical destruction of the sensor. The warranty will expire by fumigation with incorrect testing methods (i.e. Lighters)

It is mandatory to perform maintenance regularly in order to maintain safety, measuring and warning functions of the gas alarm device. The maintenance includes visual, functional and system inspections and must only be carried out by appropriately qualified personnel.

When carrying out maintenance and repair work according to the user manual, only use original spare parts from the specific manufacturer. Repairs or changes on the warning devices not complying with the maintenance manual or carried out by unauthorized persons can affect proper equipment and safety features and always result in a termination of the manufacturer's warranty and the test certificate. For regular maintenance and calibration by trained technicians we recommend concluding a service contract with our authorized partners.

The maximum calibration interval depends on the gas to be monitored and thus on the type of sensor head as well as on the ambient conditions and must be specified by the operator of the gas detection system.

EN/IEC 62990-2 recommends a calibration interval of 6 months.

It is essential for maintenance and servicing to comply with the requirements of EN/IEC 62990-2 (gas detectors selection, installation, use and maintenance of apparatus for the measurement of toxic gases and vapours) as well as of EN 60079-29-2 (gas detectors - selection, installation, use and maintenance of apparatus for the measurement of combustible gases and oxygen).

8.1 VISUAL INSPECTION

The visual inspection interval may deviate from the manufacturer's recommendation depending on the type of gas and ambient conditions and must always be determined by the person responsible for the gas warning system. The visual inspection should be carried out every 3 months by an instructed person and includes at least the following activities:

- Check the gas detector including the gas inlet for mechanical damage.
- Check the gas detector including the gas inlet on the sensor head for dust, dirt and moisture deposits and clean it with a dry cloth if necessary
- The filter at the gas inlet has to be replaced if extremely dirty.
- Maintenance/calibration interval not exceeded.
- Check the operational and status messages for gas warning devices with display.

Operation indication: Green LED = ON

Alarm indication: Red LED = OFF (no alarm)

Fault indication: Yellow LED = OFF (no fault)

The visual inspection must be documented by a protocol stating at least:

- Identification of the gas detector
- Deficiencies fixed and measures started as well as the date and name of the person responsible for the visual inspection.

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8.2 FUNCTION CONTROL/CALIBRATION AND ADJUSTMENT

 Applying the test gas causes the adjustment of the current signal at the analog output and the triggering of the alarm relay. Connected actuators are put on alert.

The functional check should only be carried out every 6 months by qualified specialists only and includes at least the following activities:

- Visual inspection
- Check zero-point
- Check sensor sensitivity
- Check alarm relay (only necessary if the alarm relay is used): Apply test gas with a concentration $\geq$ of the set alarm threshold. The alarm relay must change into the alarm status and the actuated device must go into alarm. Perform the test for each alarm relay.
- Check analog output (only necessary if the analog output is used): Apply test gas or, if with display, specify a current signal in the analog output test function menu.
- Check central bus (only necessary if central bus is used): Apply test gas. Read the concentration of the test gas on the Controller and check the corresponding reactions.
- Check the function of LCD and LED for the version with display. Perform a function check

The function control must be documented by a protocol stating at least:

- Identification of the gas detector
- Type and concentration of the zero gas and test gases used
- Display before and after calibration with zero and test gas
- Deficiencies fixed and measures started as well as the date and name of the person responsible for the function control.

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8.3 SYSTEM CHECK/PROOF TEST

Measuring and testing equipment used within of the proof test (multimeters, etc.), must be in a proper state. To meet this requirement, the measuring devices have to be calibrated at regular intervals.

The system check has to be carried out by a qualified person at least every 12 months and includes at least the following activities:

- Visual inspection
- Function control
- Check the relevant parameters for deviations:
 - o Alarm threshold(s)
 - o Assignment and activation of alarm relays
 - o Gas type
 - o Measuring range
- Check 4–20 mA output signal (only necessary if the current signal is used in the application):
 - o Status Fault = 2 mA: The evaluation must be parameterised to "CF/AF". Activate the Special

Mode on the display or AT-MSR-PT. Generate an error by disconnecting the sensor. The analog output provides 2 mA. The connected evaluation unit must recognize and output the error status.

o Lower measuring range value = 4 mA: Activate Special Mode on the display or AT-MSR-PT and then set the analog output current to 4 mA via the AO test function. The connected evaluation unit must correctly recognise and evaluate the lower measuring range value.

o Full-scale value = 20 mA: Activate Special Mode on the display or AT-MSR-PT and then set the analog output current to 20 mA via the AO test function. The connected evaluation unit must correctly recognise and evaluate the full-scale value.

- Check fault signal relay (**Only with fault signalling function**)

Activate the Special Mode on the display or AT-MSR-PT. The fault relay changes into the error status and the connected fault indication unit must report an error. The system check must be documented by a protocol stating at least:

- Identification of the gas detector
- Type and concentration of the zero gas and test gases used
- Display before and after calibration with zero and test gas
- Deficiencies fixed and measures started with the date and name of the person responsible for the system check

8.4 REPAIRS

Please always apply the user manual and maintenance instructions when repairing and replacing parts of the gas warning device. For safety reasons replace parts only by original spare parts from the manufacturer

Appropriate technical qualification is necessary for further repair work, which may only be carried out by the manufacturer or by trained and authorized service partners. After repair before restarting, you have to check the function and the system depending on the type of repair

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8.5 EXCHANGE OF SENSOR HEAD

Instead of performing a field calibration you can simply and comfortably replace the sensor head in the field by a calibrated one. At the end of sensor lifetime, it is the same procedure.

SENSOR HEAD AT-SC

The communication of the local bus is continuously monitored during operation and results in an immediate error message on the Gas-Controller in case of fault or interruption. When replacing the sensor unit, the communication of the local bus is also interrupted when unplugging the AT-SC connector which leads to an immediate triggering of the error message.

- Unplug the sensor head connector from the Board (error message will be activated).
- Loosen the lock nut of the AT-SC or AT-SC with cable extension, open the cable gland.
- Remove used AT-SC
- Take calibrated AT-SC out of packaging, check gas type and measuring range for conformity and valid calibration date.
- Insert the new AT-SC and retighten with lock nut.
- For AT-SC sensor with cable extension, Insert cable via cable gland and close cable gland.
- Insert the AT-SC plug into the socket at the Board. Check plug for proper engagement.

SENSOR HEAD AT-MC

- Disconnect the 3-pin plug on the AT-MC.
- > AO = 0 mA: Current value switches to underrange status (fault message is triggered).
- Loosen the lock nut of the AT-MC.
- Remove used AT-MC.
- Take calibrated AT-MC out of the original packaging, check gas type and measuring range for conformity and check valid calibration date.
- Insert the new AT-MC and retighten with lock nut.
- Connect the 3-pin plug to the AT-MC

The internal diagnostics autonomously check the new sensor head AT-SC for gas type, measuring range and valid calibration status. If they match, the measuring mode starts automatically and the fault message is acknowledged. With the AT-MC, the analog signal is checked autonomously. If the measured value is within the measuring range, the measuring mode starts automatically and the fault message is acknowledged.



Fig 1. and Fig 2. Showing AT-MC and AT-SC sensors with ident numbers and connectors

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9 DECOMMISSIONING

Decommissioning is done by switching off the operating voltage. Programmed data and parameters are not lost. If the gas warning device is put back into operation after being taken out of service for a longer period of time, it must be put back into operation as described in chapter 6.

The warranty is valid for 5 years against all manufacturing defects. Installation instructions must be strictly observed, please refer to Aquilar Terms and Conditions available on this [link](#).

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