TRM-EX

EXPLOSION-PROTECTED FIELD GAS ANALYZER

TRM-EX

Stationary analyzer for toxic, combustible and specialty gases & oxygen — electrochemical, thermocatalytic and infrared sensing · 1Ex db IIC T6 Gb X

WARNING Strictly follow these Instructions for Use. Personnel who install, use or service this product must fully understand and observe the instructions. Use the analyzer only for the purpose specified in this document.

CONTENTS

1 INTRODUCTION

These Instructions for Use (IFU) are intended for studying the construction and operating principle of the TREMON TRM-EX field gas analyzer (hereafter — the analyzer). The document contains the main technical data, use information, maintenance recommendations and other information required for correct operation, repair and storage of the analyzer.

The manufacturer reserves the right to make design changes that improve the technical and consumer qualities of the product; minor discrepancies between this IFU and the delivered analyzer that do not affect quality, performance, reliability or service life are therefore possible.

The analyzer is approved for use and complies with the applicable EU directives; current versions of the declarations, certificates and normative documents are available on request from the manufacturer.

2 SAFETY INFORMATION

Before working with the TRM-EX, make sure these Instructions for Use have been read and understood before installation / operation / servicing of the equipment. Pay particular attention to the warnings and cautions. All warnings are listed below and repeated where relevant at the start of the corresponding chapter(s).

WARNING
Indicates a potentially hazardous situation which, if not avoided, may result in physical injury or equipment damage. It may also warn against unsafe practices.

NOTICE
Additional information on how to use the product.

Personnel admitted to work with the analyzer must have studied this IFU and completed safety-at-work instruction. Access to the internal parts of the analyzer for any work must be carried out only by trained personnel. The analyzer housing must be earthed — internal and external earthing devices are provided.

2.1 STRICTLY FOLLOW THE INSTRUCTIONS FOR USE

Any use of the analyzer requires full understanding and strict observance of these instructions. The analyzer is intended only for the purposes stated in this IFU. To prevent ignition, the analyzer cover must be tightly closed until its power is disconnected. Before removing the cover for maintenance or calibration, make sure the surrounding atmosphere is free of flammable gases or vapours.

Metal parts of the analyzer are made of stainless steel or aluminium alloy with a total mass content of magnesium, titanium and zirconium below 7.5 %. The analyzer offers a high degree of protection against mechanical-impact ignition hazards per IEC 60079-0.

2.2 USE IN EXPLOSIVE ZONES

Equipment or components used in potentially explosive atmospheres must be tested and approved for use under the corresponding conditions. Modification of components, or use of faulty or incomplete parts, is not permitted. Maintenance and calibration operations must be performed only by qualified service personnel.

Explosion protection is ensured by compliance with ATEX 2014/34/EU and IEC 60079-0 and by the following types of protection: flameproof enclosure “db” per IEC 60079-1, and protection from dust ignition by enclosure “tb” per IEC 60079-31.

Ex marking per IEC 60079-0: 1Ex db IIC T6 Gb X · Ex tb IIIC T85°C Db X. The “X” suffix means the following specific conditions of safe use apply:

- flameproof joints are not to be repaired;
- analyzers must be installed vertically, sensor downwards;
- the flame arrestor must be protected from mechanical damage and impact;
- external electrical circuits must be connected using Ex-certified cable glands marked to the analyzer’s protection level, with ingress protection not below IP65 and a valid ATEX/IECEx certificate. Unused openings must be closed with Ex-certified stopping plugs marked accordingly.

> **WARNING**
> Flameproof (Ex db) construction — DO NOT OPEN WHEN ENERGIZED. Isolate the supply and confirm the atmosphere is non-hazardous before opening the cover.

3 PURPOSE & CONSTRUCTION

3.1 GENERAL DATA

The TRM-EX field gas analyzer is intended for measuring and transmitting information on the content of combustible gases and vapours of flammable liquids (including petroleum-product vapours), toxic gases and oxygen in the air of the working zone, process gas media, industrial premises and open spaces of industrial sites, pipelines and air ducts — and for issuing a warning alarm when set thresholds are exceeded.

The analyzer is intended for stationary installation. Area of application — zones per the explosion-protection marking in which explosive gas/vapour–air mixtures may form.

Sensors used in the analyzer:

- **IR** — infrared sensor;
- **CT** — thermocatalytic sensor;
- **EC** — electrochemical sensor;
- **SMC** — semiconductor sensor.

Sampling method — diffusion. Operating mode — continuous. Analysed medium — working-zone air and process gas media.

> **NOTICE**
> Application — explosive zones 1 or 2 (gas) and 21 or 22 (dust) per IEC 60079-10-1 / IEC 60079-10-2 according to the equipment’s explosion-protection marking and IEC 60079-14.

3.2 APPEARANCE / OVERALL DIMENSIONS

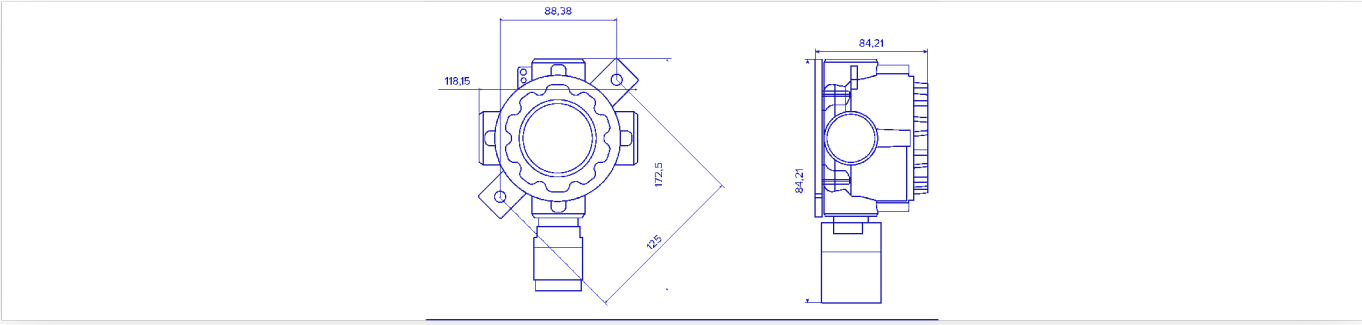

Fig. 1 — Housing appearance & overall dimensions (mm) — TRM-EX with electrochemical sensor

Overall dimensions (H×W×D) of the TRM-EX with electrochemical sensor ≈ 186 × 118.15 × 84.21 mm.

3.3 ANALYZER CONSTRUCTION

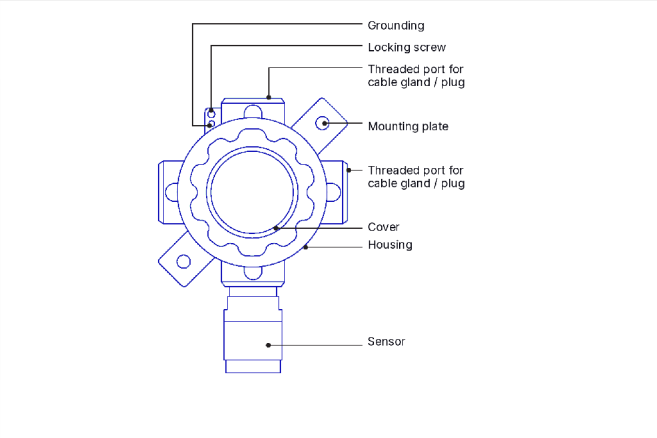

Fig. 2 — Analyzer construction

The housing has two threaded entries for cable glands or plugs (not supplied). Two cable entries on either side of the upper housing are for connecting the power supply, output signal and relay contacts; the lower entry allows direct connection of the sensor socket.

A mounting plate is built into the housing, allowing different mounting configurations. The analyzer has a single connection-thread variant — 1/2″ NPT.

A stainless-steel metal-ceramic element is fitted: max. pore size 107.8 µm, min. density 3.193 g/cm³, min. thickness 5 mm.

3.4 NAMEPLATE

The nameplate carries: model name; technical specification; supply parameters; explosion protection; year of manufacture; serial number; manufacturer contacts. The cover also bears the warning “WARNING — DO NOT OPEN WHEN ENERGIZED”.

Fig. 3 — Nameplate (cover)

3.5 ORDERING INFORMATION

The TRM-EX is produced in several configurations. Ordering designation:

TRM-EX-X1-X2-X3-X4

X1 — chemical formula of the measured component (Appendix B) · **X2** — upper range limit & units (Appendix B) · **X3** — cable-entry thread: 1 (1/2″ NPT) · **X4** — relay block: 0 = none, 1 = fitted

4 TECHNICAL CHARACTERISTICS

4.1 OPERATING CONDITIONS

- Ambient temperature −40 °C to +60 °C;
- Relative humidity 0 to 98 % (non-condensing);
- Atmospheric pressure 84 to 106.7 kPa.

Resistant to sinusoidal vibration 10–150 Hz, amplitude 0.15 mm, acceleration 19.6 m/s² (2g). Immune to RF electromagnetic fields 80–1000 MHz, 0.8–0.96 GHz and 1.4–6.0 GHz up to 3 V/m. Keep mobile phones / radios at least 2 m away to avoid interference.

4.2 ANALYZER CHARACTERISTICS

Metal parts	stainless steel / aluminium alloy
Mg+Ti+Zr content	< 7.5 % by mass
Mass (aluminium housing, with sensor)	1.4 kg
Precious materials	none

4.3 ELECTRICAL CHARACTERISTICS

Electrical supply, DC	24 V (nominal); 12–24 V range
Max. power consumption (excl. heater)	≤ 2.5 W
Output signal type	RS-485 · Modbus RTU (base configuration)
Analog current output	4–20 mA (base configuration)
Relay (optional)	3 × changeover — 1 A 30 V DC / 0.5 A 125 V AC / 0.3 A 80 V DC
Ex marking (IEC 60079-0)	1Ex db IIC T6 Gb X · Ex tb IIIC T85°C Db X
Ingress protection	IP65

4.4 OUTPUT SIGNALS

A unified analog output “4–20 mA current loop” is provided. On analyzers with digital output the signal is transmitted by Modbus RTU over RS-485. On analyzers with relay output (“dry contact”) the fault relay trips on loss of power; threshold relays trip on reaching the threshold (for oxygen — below and above the permitted level) to drive external audible / visual and other devices (valves, ventilation, etc.).

4.5 METROLOGICAL CHARACTERISTICS

Analyzers with electrochemical sensors can provide volume-fraction or mass-concentration measurements. Conversion of volume fraction, ppm (or vol.), to mass concentration, mg/m³, uses:

$$C_{mg/m^3} = (M \cdot C_{ppm}) / (R \cdot T/P)$$

where C_{mg/m^3} — mass concentration; C_{ppm} — ppm value; M — molar mass; R = 8.314472; T — temperature, K. For normal conditions (T = 293.15 K, P = 101.325 kPa): $C_{mg/m^3} = C_{ppm} \cdot K$, where K is the conversion coefficient.

Additional error caused by ambient-temperature change per each 10 °C — ±0.2 of the main-error limit. Output-signal settling time depends on ambient temperature and measured component. Permissible interval of operation without output correction — not less than 6 months. The list of measured gases is given in Appendix B; remaining metrological characteristics (measurement error, response time, etc.) are stated in the type-approval description.

4.6 RELIABILITY CHARACTERISTICS

MTBF — infrared sensor	70 000 h
MTBF — thermocatalytic sensor	35 000 h
MTBF — electrochemical sensor	35 000 h
Service life (excl. sensor)	12 years
Analyzer service life (in service)	15 years

Failure criterion — unrecoverable excursion of the main error beyond permitted limits, or loss of function. Thermocatalytic sensors use pellistors that lose sensitivity in the presence of poisons/inhibitors (silicones, sulfides, chlorine, lead, halogenated hydrocarbons); membranes resist poisons to maximise life. Typical sensor life: IR > 5 yr, thermocatalytic 4–5 yr, electrochemical > 2 yr.

5 PREPARATION FOR WORK

After unpacking, check completeness, seals and explosion-protection marking, and confirm the absence of mechanical damage. If the analyzer was transported at sub-zero temperature, keep it switched off in normal conditions for at least 8 h before use.

5.1 CABLE-GLAND MOUNTING (EXAMPLE)

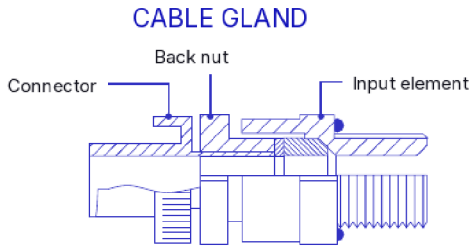

Fig. 4 — Assembled cable gland & cable

5.2 ARMORED-CABLE GLAND MOUNTING (EXAMPLE)

Fix the input element of the cable gland into the corresponding holes in the analyzer housing. Hand-tighten, then torque with a spanner (cable-gland mounting torque 32.5 N·m). When the gland is tightened, the seal must clamp the outer sheath of the cable. On re-mounting a cable gland, all seals must be replaced per the cable-gland documentation.

Prepare the cable by stripping the outer sheath and armour to a length sufficient for mounting; leave the required length of armour. Typical strip lengths — conductors 55 mm, sheath 40 mm, armour 25 mm.

! CAUTION

After mounting, do not dismount the gland except for special inspection. The gland is not serviceable; spare parts are not supplied. Gland parts are not interchangeable with any other design. Using parts from different manufacturers invalidates the certificate.

I NOTICE

Assemble in the sequence A–M per the gland manufacturer's instructions; use a second spanner on the body part where required to avoid stripping the sheath thread. Final torque on the sealing part 32.5 N·m; on the armour-clamp part 15 N·m, then 32.5 N·m as specified.

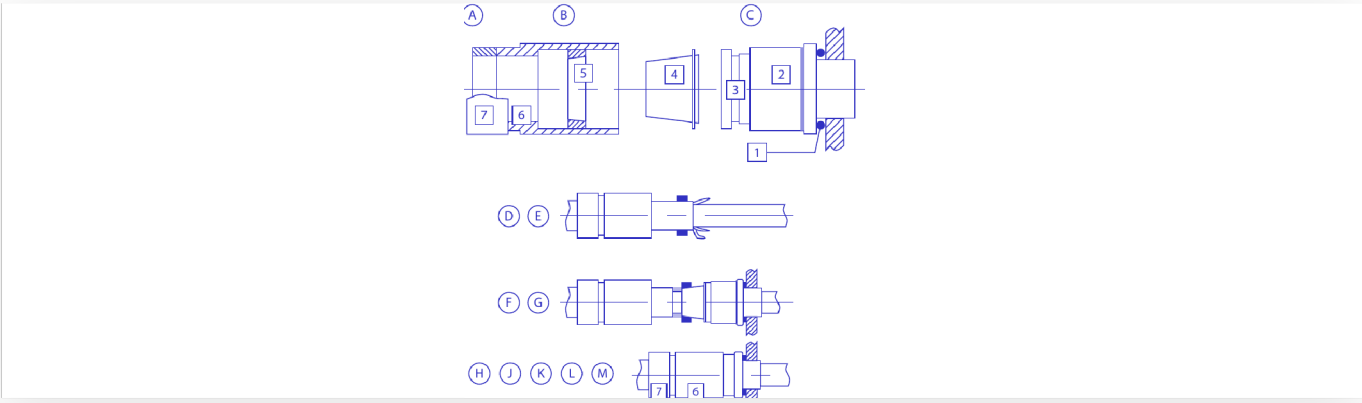

Fig. 5 — Armored cable gland — assembly sequence A–M

6 ANALYZER MOUNTING

Mount the analyzer per applicable standards, taking into account the molar mass of the monitored gas. Analyzers must be earthed; the earth screw is on the outside of the housing and marked with the earth sign. Locate the analyzer near the possible leak point.

- For gases lighter than air — locate above the possible leak point.
- For gases heavier than air — locate below the protected zone.

Prefer locations with good air circulation; restricted natural airflow can slow the response. For correct operation, air velocity at the installation point should be 0.2–6.0 m/s. Isolate the analyzer from vibration and direct sunlight and maintain the temperature within the analyzer's ratings. Install where the unit is accessible for servicing.

The independent mounting plate has two mounting holes and two fixing holes to the housing, adjustable along two diagonals.

7 ANALYZER CONNECTION

WARNING

Access to internal parts must be by trained personnel only. Installation and connection must be done with the supply voltage disconnected. The housing must be earthed (internal & external earthing devices provided). Do not expose the analyzer to temperatures outside the rated ranges.

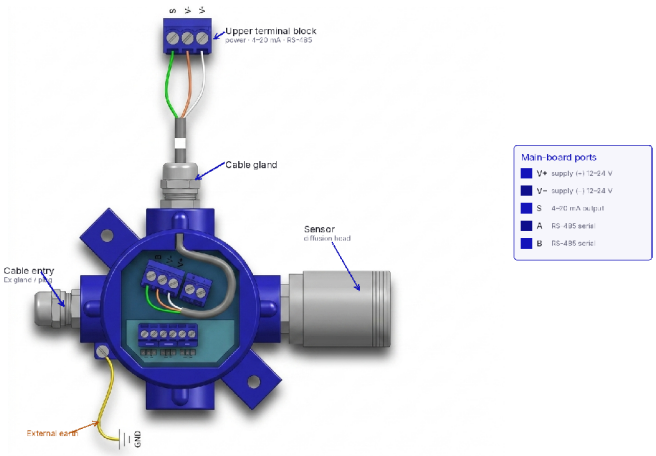

Fig. 6 — Analyzer connection diagram

8 GROUNDING

To limit RF interference and ensure EMC, correct grounding is required. With a shielded cable, the shield protecting the conductors guards against stray capacitive coupling and external magnetic fields.

This shield must be connected to the earth screw at one extreme point only — on the analyzer side. The other end (controller side) must be terminated or connected to a free terminal.

CAUTION

Two-sided shield grounding is not permitted: potential differences can cause currents that produce incorrect readings or false tripping.

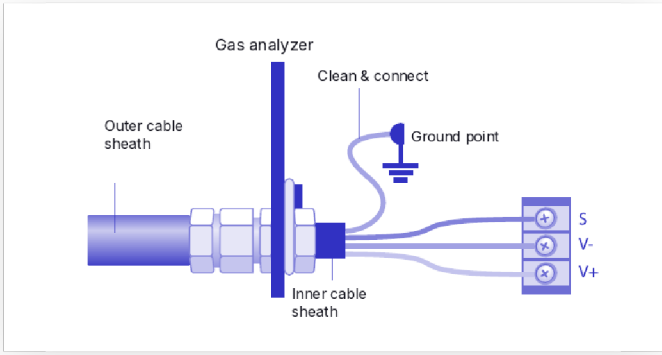

Fig. 7 — Analyzer grounding diagram

9 ANALYZER OPERATION SETUP

The 4–20 mA current output is configured by default as below. During calibration phases the current output is 3 mA to avoid false alarms.

DEFAULT	DESCRIPTION
2.0 mA	Analyzer fault
2.0 mA	Analyzer warm-up
3.0 mA	Calibration mode
4.0–20.0 mA	Normal measuring mode
22.0 mA	Measuring-range exceeded

The analyzer has a built-in RS-485 serial interface, Modbus RTU. The address in the RS-485 Modbus RTU network is set with the hand-held setup terminal; addresses 1–247 may be assigned (0 is not usable). The last analyzer in an RS-485 chain must be fitted with a 120 Ω terminating resistor — already present on the board but not engaged; fit the jumper to engage it.

10 RELAY MODULE OPTION

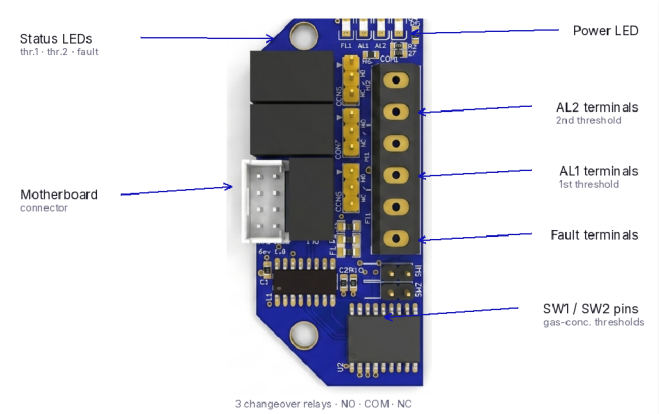

Fig. 8 — Optional relay board

The optional relay board has three relay outputs, each with three contacts (changeover: NO — normally open, NC — normally closed). Contact state is set by a jumper. Alarm thresholds 1 and 2 are set by jumpers on pins SW1 and SW2.

SW1	SW2	THR. 1	THR. 2
Open	Open	10 %	15 %
Open	Closed	10 %	20 %
Closed	Closed	20 %	25 %
Closed	Open	20 %	40 %

Thresholds as % of measuring range. For oxygen (always present in the atmosphere) different values are used — e.g. SW1/SW2 Open/Open → 19 % / 23 %.

11 CALIBRATION

11.1 ANALYZER CALIBRATION

Periodic calibration is recommended for correct operation. Calibration comprises two steps — zero and sensitivity (span); each can be performed independently. For correct operation, perform both steps. Before calibration the analyzer must be switched on and stabilised for 4 hours. During calibration the current output is 3 mA to avoid false alarms. Use a cylinder with the appropriate calibration gas mixture per the verification method, a regulator, a calibration adapter and the hand terminal.

11.2 DEPENDENCE ON AMBIENT PRESSURE

The measuring signal depends on the partial pressure of the measured component. Changes in atmospheric or absolute pressure with altitude can change the partial pressure. Real value = measured value × P_i / 1013, where P_i is the current pressure in the measuring cell.

11.3 PREPARATION FOR CALIBRATION

Two-point calibration is performed with zero and reference gases; each gas can be calibrated independently. The analyzer must be on for at least 4 hours to stabilise. During calibration it switches automatically to inhibit mode (default 3 mA). Zero gas: N_2 for infrared analyzers; air (O_2+N_2 with zero content of the measured gas) for others. For sensitivity, use a reference mixture at 25–75 % of the sensor range.

11.4 CALIBRATION PROCEDURE

A hand terminal (supplied separately) is required. The manufacturer recommends calibration every 3 to 6 months depending on operating conditions; a 3-month interval suits most users.

12 MAINTENANCE

WARNING

Access to internal parts must be by trained personnel only. Do not operate an analyzer with mechanical damage to the housing or damaged seals. The housing must be earthed. Repair only by the manufacturer or authorised persons; on-site repair is not provided.

12.1 GENERAL

Maintenance (MT) ensures normal operation over the service life. Perform MT by trained persons familiar with electrical-safety rules for explosive zones and this IFU.

- external inspection — ≥ once / 6 months;
- periodic function check — ≥ once / 12 months;
- sensor replacement — as needed.

12.2 EXTERNAL INSPECTION

Check for mechanical damage and contamination that could affect operation; if needed, clean with a damp clean cloth.

CAUTION

Use of alcohol, acetone or other solvents as cleaning agents is prohibited!

12.3 VERIFICATION

Before commissioning and after repair — initial verification; in service — periodic verification. Interval depends on sensor type. On-site verification is allowed at 20±5 °C, 30–80 % RH, 84–106.7 kPa, cylinders conditioned at 20±5 °C for ≥ 24 h, with mechanical/dust/field influences excluded.

12.4 SENSOR REPLACEMENT

The sensor module is a replaceable part. If readings exceed the permissible error and cannot be corrected by calibration, or the sensor fails, replace it: switch off power; loosen the sensor-housing locking screw with a hex key (not supplied); remove the cover over the sensor; check / clean / replace the metal filter if it blocks sampling; carefully remove the sensor; fit the new sensor into the socket; reassemble in reverse order.

> **CAUTION**
> After sensor replacement, perform calibration per this IFU and verification per the verification method.

12.5 MARKING

Analyzer marking contains: manufacturer name & trademark; analyzer designation; year of manufacture; serial number; Ex marking per IEC 60079-0; ingress protection IP; ambient temperature range; certificate number & certification body; and the warning "WARNING — DO NOT OPEN WHEN ENERGIZED".

13 SCOPE OF DELIVERY

ITEM	QTY
Gas analyzer	1
Data sheet / passport	1
Instructions for Use	1
Verification method	1
Packaging	1

> **NOTICE**
> The verification method is supplied one copy per batch of 10 analyzers, but not fewer than one copy per delivery.

14 STORAGE & TRANSPORT

14.1 STORAGE

The analyzer and its documentation are packed in a cardboard box. Store in the manufacturer's packaging in heated storage at +5 to +40 °C, on shelving. The atmosphere must be free of corrosive impurities. Keep ≥ 0.5 m from heating devices. Designated storage life — 1 year (in manufacturer's packaging), counted from acceptance. After > 12 months storage, perform zero and sensitivity setup at commissioning.

14.2 TRANSPORT

Transport conditions per storage; temperature range −50 to +50 °C. Transport by air, rail, water and road in closed vehicles (and heated pressurised aircraft holds) per the carriage rules for the relevant transport. During transport and loading, packaged analyzers must not be subjected to sharp impacts or precipitation.

15 WARRANTY

Warranty period for the analyzer electronics (excluding sensor) — 36 months from sale. Warranty on the fitted sensor — 12 months. Warranty is void if operating and storage conditions are not observed. The analyzer warranty period is counted from the date of shipment to the customer.

16 DISPOSAL

The analyzer contains no precious materials. After the service life, dispose of the analyzer in an environmentally safe manner in accordance with local waste-collection regulations and environmental legislation.

> **NOTICE**
> Manufacturer: Tremon Solutions B.V., Eindhoven, The Netherlands · sales@tremon.nl · www.tremon.nl

TRM-EX

Appendices

A · Modbus communication protocol · B · Gas list & measuring ranges

A APPENDIX A — MODBUS COMMUNICATION PROTOCOL

The TRM-EX supports Modbus RTU. Default RTU parameters:

Baud rate	9600
Slave address	1
Parity	None
Stop bits	1

Baud rate and slave address are set with the configurator software. The slave ID is set via the display (hand-held terminal on displayless models) or PDM software. For the “RS-485 Connected” parameter, set “YES” when there is a permanent Modbus connection — the analyzer then reports an error on loss of Modbus communication; set “NO” to suppress that error.

TABLE A1 — REGISTER MAP (HOLDING REGISTERS, EXTRACT)

DEC	HEX	REGISTER	DESCRIPTION
0	0x00	REG TYPE	Device model (see 0x33)
1	0x01	REG VALUE	Gas concentration value
2	0x02	REG STATUS	Fault status code (see 0x19)
3	0x03	REG MAX VALUE	Maximum measuring range (see 0x23)
4	0x04	REG UNIT	Measuring unit (see 0x22)
5	0x05	DEVICE STATUS	Device state — operating mode (Table A2) + sensor fault (Table A3)
6	0x06	GAS CONCT VALUE	Gas concentration = reg(0x06) / reg(0x29)
7	0x07	GAS CONCT %	Gas concentration in percent
8	0x08	L TWA	15-minute time-weighted average
9	0x09	S TWA	1-minute time-weighted average
11	0x0B	SENSOR TEMP	Temperature sensor value
12	0x0C	IN VOL	Input voltage = reading / 10
13	0x0D	CURRENT OUTPUT	Output current (mA) = reading / 100
25	0x19	FAULT STATUS	Fault code (Table A3)
32	0x20	SENSOR TYPE	IR 0x4576 · EC 0x8844 · catalytic 0x6522 · semiconductor 0x1906 · PID 0x3754
34	0x22	MEASR UNIT	PPM 2 · VOL 3 · LEL 4 · PPB 5
35	0x23	GAS CONCT RANGE	Maximum range = reading / scaling(0x29)
41	0x29	SCALING FACTOR	Scaling factor
49	0x31	DISPLAY LANGUAGE	English 0 · (other) · none 3
50	0x32	BAUD RATE	Communication speed
60–63	0x3C–0x3F	SERIAL NUMBER	Serial number characters

TABLE A2 — ANALYZER OPERATING MODES

HEX	DEC	DESIGNATION
0x00	0	QUIESCENT
0x01	1	ALARM
0x02	2	WARM_UP
0x03	3	FAULT
0x04	4	INHIBIT
0x05	5	FUNCTIONAL_TEST
0x06	6	CALIBRATION
0x07	7	SETUP

TABLE A3 — ANALYZER FAULT TYPES (EXTRACT)

HEX	CODE	DESCRIPTION
0x00	NO FAULT	No error
0x0D	PROGRAM ERR	Firmware load error
0x10	SENSOR ERROR	Sensor in fault state
0x11	NOT CONNECTED	Sensor not connected
0x12	SIGNAL OUT RANGE	Sensor signal out of range
0x13	TEMPERATURE ERR	Temperature out of range
0x14	SENSOR_TYPE ERR	Sensor type mismatch vs config
0x18	SENSOR SWITCHED OFF	Pellistor power off (over-range)
0x1C	NEGATIVE DRIFT	Signal below minimum
0x1E	OVERRANGE ERR	Sensor over-range
0x20	ADC ERR	ADC circuit fault
0x30	CURRENT OUTPUT ERR	No analog output
0x32	LINE OUTPUT OPEN	Current loop open
0x33	LINE OUPUT SHORT	Current loop shorted
0x40	SUPPLY VOL ERR	Input power failure
0x41	LOW SUPPLY	Input below minimum
0x42	HIGH SUPPLY	Input above maximum
0x50	PRG RAM ERROR	RAM error detected
0x60	PRG FLASH ERR	Flash error detected
0x70	SENSOR EEPROM ERR	Sensor parameter corruption
0x72	ONE WIRE ERR	Main↔sensor board comms error
0xA2	RS485 COMMM ERR	RS-485 comms error
0xB0	RELAY CARD ERR	Relay module failure
0xC0	CPU ERR	CPU error
0xE0	AMBIENT ERROR	Ambient temperature out of range
0xE1	HIGH TEMP ERR	Temperature above max
0xE2	LOW TEMP ERR	Temperature below min
0x90	BATTERY ERROR	Battery in fault state

Register map and fault list are an extract for integration reference; the full map is available from TREMON on request.

B APPENDIX B — GAS LIST & MEASURING RANGES

Field analyzers are named by measuring principle: **TRM-EX-E** (electrochemical), **TRM-EX-CT** (thermocatalytic), **TRM-EX-IR** (infrared cell) and **TRM-EX-SMC** (semiconductor). Each analyzer is factory-configured to the ordered component and range. The list below is carried from the catalogue; contact TREMON for components not shown.

Table B1 — TRM-EX-E · electrochemical sensor · toxic & specialty gases (1 of 2)

№	CODE	MEASURED COMPONENT	RANGE	UNITS
1	NH_3	Ammonia (NH_3)	0–50	ppm
2	NH_3	Ammonia (NH_3)	0–100	ppm
3	NH_3	Ammonia (NH_3)	0–250	ppm
4	NH_3	Ammonia (NH_3)	0–1000	ppm
5	H_2	Hydrogen (H_2)	0–500	ppm
6	H_2	Hydrogen (H_2)	0–1000	ppm
7	H_2	Hydrogen (H_2)	0–2000	ppm
8	O_2	Oxygen (O_2)	0–25	%vol
9	NO_2	Nitrogen dioxide (NO_2)	0–30	ppm
10	SO_2	Sulfur dioxide (SO_2)	0–10	ppm
11	SiH_4	Monosilane (SiH_4)	0–1	ppm
12	O_3	Ozone (O_3)	0–1	ppm
13	O_3	Ozone (O_3)	0–5	ppm
14	NO	Nitric oxide (NO)	0–50	ppm
15	NO	Nitric oxide (NO)	0–250	ppm
16	CO	Carbon monoxide (CO)	0–300	ppm
17	CO	Carbon monoxide (CO)	0–500	ppm
18	CO	Carbon monoxide (CO)	0–1000	ppm
19	H_2S	Hydrogen sulfide (H_2S)	0–20	ppm
20	H_2S	Hydrogen sulfide (H_2S)	0–50	ppm
21	H_2S	Hydrogen sulfide (H_2S)	0–100	ppm
22	H_2S	Hydrogen sulfide (H_2S)	0–120	ppm
23	H_2S	Hydrogen sulfide (H_2S)	0–250	ppm
24	H_2S	Hydrogen sulfide (H_2S)	0–500	ppm
25	HCN	Hydrogen cyanide (HCN)	0–30	ppm
26	CH_2O	Formaldehyde (CH_2O)	0–10	ppm

Table B1 — TRM-EX-E · electrochemical sensor · toxic & specialty gases (2 of 2)

№	CODE	MEASURED COMPONENT	RANGE	UNITS
27	PH_3	Phosphine (PH_3)	0–10	ppm
28	F_2	Fluorine (F_2)	0–5	ppm
29	HF	Hydrogen fluoride (HF)	0–10	ppm
30	Cl_2	Chlorine (Cl_2)	0–10	ppm
31	HCl	Hydrogen chloride (HCl)	0–25	ppm
32	C_2H_4O	Ethylene oxide (C_2H_4O)	0–20	ppm
33	C_2H_4O	Ethylene oxide (C_2H_4O)	0–100	ppm
34	AsH_3	Arsine (AsH_3)	0–1	ppm
35	BF_3	Boron trifluoride (BF_3)	0–10	ppm
36	BCl_3	Boron trichloride (BCl_3)	0–25	ppm
37	SiH_2Cl_2	Dichlorosilane (SiH_2Cl_2)	0–25	ppm
38	Si_2H_6	Disilane (Si_2H_6)	0–15	ppm
39	GeH_4	Germane (GeH_4)	0–5	ppm
40	$SiCl_4$	Silicon tetrachloride ($SiCl_4$)	0–25	ppm
41	SiF_4	Silicon tetrafluoride (SiF_4)	0–10	ppm
42	SF_4	Sulfur tetrafluoride (SF_4)	0–10	ppm
43	$HSiCl_3$	Trichlorosilane ($HSiCl_3$)	0–15	ppm
44	WF_6	Tungsten hexafluoride (WF_6)	0–10	ppm
45	B_2H_6	Diborane (B_2H_6)	0–1	ppm
46	HNO_3	Nitric acid (HNO_3)	0–30	ppm
47	PF_5	Phosphorus pentafluoride (PF_5)	0–10	ppm
48	H_2Se	Hydrogen selenide (H_2Se)	0–5	ppm

Table B2 — TRM-EX-IR · infrared sensor · CO_2 & hydrocarbons

№	CODE	MEASURED COMPONENT	RANGE	UNITS
1	CO_2	Carbon dioxide (CO_2)	0–5	%vol
2	CO_2	Carbon dioxide (CO_2)	0–5000	ppm
3	C_4H_6	1,3-butadiene (C_4H_6)	0–100	%LEL
4	C_4H_{10}	Butane (n-butane) (C_4H_{10})	0–100	%LEL
5	C_6H_{14}	Hexane (n-hexane) (C_6H_{14})	0–100	%LEL
6	CH_4	Methane (CH_4)	0–100	%LEL
7	C_5H_{12}	Pentane (C_5H_{12})	0–100	%LEL
8	C_3H_8	Propane (C_3H_8)	0–100	%LEL
9	CxHy (CH_4)	ΣCxHy hydrocarbons (by methane)	0–100	%LEL
10	CxHy (C_3H_8)	ΣCxHy hydrocarbons (by propane)	0–100	%LEL
11	CxHy (C_6H_{14})	ΣCxHy hydrocarbons (by hexane)	0–100	%LEL

Table B3 — TRM-EX-CT · thermocatalytic sensor (all ranges 0-100 %LEL)

№	CODE	MEASURED COMPONENT	RANGE
1	NH_3	Ammonia (NH_3)	0-100 %LEL
2	C_2H_2	Acetylene (C_2H_2)	0-100 %LEL
3	C_3H_6O	Acetone (C_3H_6O)	0-100 %LEL
4	C_6H_6	Benzene (C_6H_6)	0-100 %LEL
5	C_4H_6	1,3-butadiene (C_4H_6)	0-100 %LEL
6	C_4H_{10}	Butane (n-butane) (C_4H_{10})	0-100 %LEL
7	C_4H_9OH	Butanol (n-butanol) (C_4H_9OH)	0-100 %LEL
8	$i\text{-}C_4H_8$	Isobutylene (i-C_4H_8)	0-100 %LEL
9	H_2	Hydrogen (H_2)	0-100 %LEL
10	C_6H_{14}	Hexane (n-hexane) (C_6H_{14})	0-100 %LEL
11	C_7H_{16}	Heptane (n-heptane) (C_7H_{16})	0-100 %LEL
12	$o\text{-}C_8H_{10}$	o-xylene (o-C_8H_{10})	0-100 %LEL
13	$m\text{-}C_8H_{10}$	m-xylene (m-C_8H_{10})	0-100 %LEL
14	$p\text{-}C_8H_{10}$	p-xylene (p-C_8H_{10})	0-100 %LEL
15	C_4H_8	Butylene (C_4H_8)	0-100 %LEL
16	C_3H_8O	Isopropyl alcohol (C_3H_8O)	0-100 %LEL
17	C_2H_6O	Dimethyl ether (C_2H_6O)	0-100 %LEL
18	CH_4	Methane (CH_4)	0-100 %LEL
19	CH_3OH	Methanol (CH_3OH)	0-100 %LEL
20	C_8H_{18}	Octane (n-octane) (C_8H_{18})	0-100 %LEL
21	C_5H_{12}	Pentane (C_5H_{12})	0-100 %LEL
22	C_3H_8	Propane (C_3H_8)	0-100 %LEL
23	C_3H_6	Propylene (C_3H_6)	0-100 %LEL
24	C_8H_8	Styrene (C_8H_8)	0-100 %LEL
25	$CxHy\ (CH_4)$	ΣCxHy hydrocarbons (by methane)	0-100 %LEL
26	$CxHy\ (C_3H_8)$	ΣCxHy hydrocarbons (by propane)	0-100 %LEL
27	$CxHy\ (C_6H_{14})$	ΣCxHy hydrocarbons (by hexane)	0-100 %LEL
28	$C_6H_5CH_3$	Toluene (methylbenzene) ($C_6H_5CH_3$)	0-100 %LEL
29	C_6H_{12}	Cyclohexane (C_6H_{12})	0-100 %LEL
30	C_5H_{10}	Cyclopentane (C_5H_{10})	0-100 %LEL
31	C_2H_6	Ethane (C_2H_6)	0-100 %LEL
32	C_2H_5OH	Ethanol (ethyl alcohol) (C_2H_5OH)	0-100 %LEL
33	$C_4H_8O_2$	Ethyl acetate ($C_4H_8O_2$)	0-100 %LEL
34	C_2H_4	Ethylene (C_2H_4)	0-100 %LEL
35	C_2H_4O	Acetaldehyde (CH_3CHO)	0-100 %LEL
36	$C_6H_{12}O_2$	Butyl acetate ($C_6H_{12}O_2$)	0-100 %LEL
37	C_9H_{20}	Nonane (C_9H_{20})	0-100 %LEL
38	C_4H_8O	2-butanone (C_4H_8O)	0-100 %LEL

Table B4 — TRM-EX-SMC · semiconductor sensor · refrigerants

№	CODE	MEASURED COMPONENT	RANGE	UNITS
1	**R-125**	Pentafluoroethane (C_2HF_5)	0-2000	ppm
2	**R-134a**	1,1,1,2-tetrafluoroethane ($C_2H_2F_4$)	0-2000	ppm
3	**R-134a**	1,1,1,2-tetrafluoroethane ($C_2H_2F_4$)	0-5000	ppm
4	**R-143a**	1,1,1-trifluoroethane ($C_2H_3F_3$)	0-2000	ppm
5	**R-22**	Chlorodifluoromethane ($CHClF_2$)	0-2000	ppm
6	**R-32**	Difluoromethane (CH_2F_2)	0-2000	ppm
7	**R-32**	Difluoromethane (CH_2F_2)	0-10000	ppm
8	**R-404a**	Refrigerant R404a (C_2HF_5+$C_2H_3F_3$+$C_2H_2F_4$)	0-2000	ppm
9	**R-404a**	Refrigerant R404a (C_2HF_5+$C_2H_3F_3$+$C_2H_2F_4$)	0-5000	ppm
10	**R-407a**	Refrigerant R407a (CH_2F_2+C_2HF_5+$C_2H_2F_4$)	0-2000	ppm
11	**R-407c**	Refrigerant R407c (CH_2F_2+C_2HF_5+$C_2H_2F_4$)	0-5000	ppm
12	**R-407f**	Refrigerant R407f (CH_2F_2+C_2HF_5+$C_2H_2F_4$)	0-2000	ppm
13	**R-410a**	Refrigerant R410a (CH_2F_2+C_2HF_5)	0-2000	ppm
14	**R-427a**	Refrigerant R427a (CH_2F_2+C_2HF_5+$C_2H_3F_3$+$C_2H_2F_4$)	0-1000	ppm
15	**R-507**	Refrigerant R507 (C_2HF_5+$C_2H_3F_3$)	0-2000	ppm
16	**SF_6**	Sulfur hexafluoride (SF_6)	0-2000	ppm

* Code = chemical formula (or refrigerant designation) used in the analyzer ordering code. Ranges are carried 1:1 from the catalogue; ppm values are volumetric (v/v) at 20 °C and 101.3 kPa. Refrigerant blends are measured as the total mixture.

TRM-EX

CONTACT

Tremon Solutions

Havensingel 100, 5611 VT Eindhoven, The Netherlands
sales@tremon.nl · www.tremon.nl
KVK 95114289 · BTW-ID NL005130552B15

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