

TCM5

Thermal Conductivity Monitor

1. Features:

- Thermal conductivity measurement by **wear-free silicon sensor**
- Fast continuous **in-line gas analysis**
- Sensor mechanically **robust, vibrations and impact resistant**
- **IP65** wall mounting cabinet
- **115/230 V AC** power supply (optional **11...36 V DC** or **24 V AC**)
- 5-digit red **14mm LED display** freely scalable
- **Scaling** with freely programmable decimal point and rounding
- Multi-segment **linearisation**, max and min values
- **4 - 20 mA analogue output** freely scaleable
- **2** freely adjustable **limit value relay switches** (optional)
- **RS232** or **20 mA/TTY data interface** (optional)

2. Applications

The Thermal Conductivity Monitor TCM5 is used for the **in-line operational monitoring of gas characteristics** in processes that can be detected by changes in the thermal conductivity of the gas. This is useful in quite a number of applications. A few examples are:

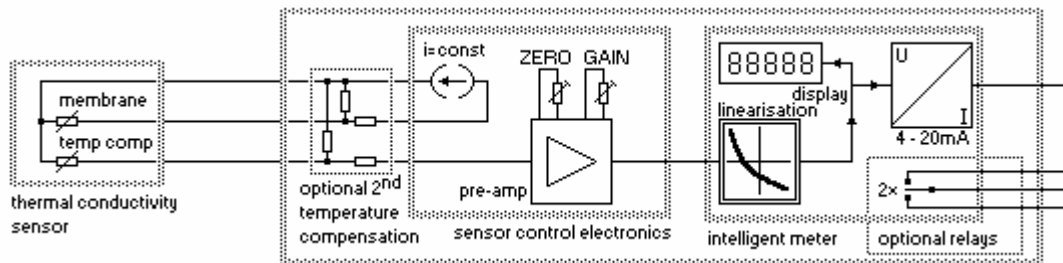
- discrimination of **natural gases** of different origin or composition,
- determination of **CO₂** vs. **methane** contents in **landfill** or **digester gas**,
- estimation of carbon dioxide contents in **exhaust gas**,
- measurement of **helium** or **xenon** contents in mixtures with air

Reference should be made to the appropriate literature to determine the applicability of this gas analysis method. With the Thermal Conductivity Monitor TCM5 many process parameters which are correlated to the thermal conductivity of the gas may be directly displayed using linearisation. In this case the instrument accepts a maximum number of 16 points in the linearisation curve.

3. Principle of Operation

In the sensor thin film nickel resistors on a microminiaturised silicon nitride membrane are heated by

a constant current. The temperature of these resistors is determined by the thermal conductivity of the gas, i.e. its ability to take away the heat from the membrane. The temperature of the nickel resistors in turn is measured via a change of resistance by the sensor control electronics in the Instrument and converted to a non-linear DC signal in the volt range. This voltage is used as the input to an industry standard intelligent meter.



4. Description

The Thermal Conductivity Monitor TCM5 consists of the sensor, the sensor control electronics and the intelligent meter. The latter two are combined within a wall mounting IP65 protective enclosure.

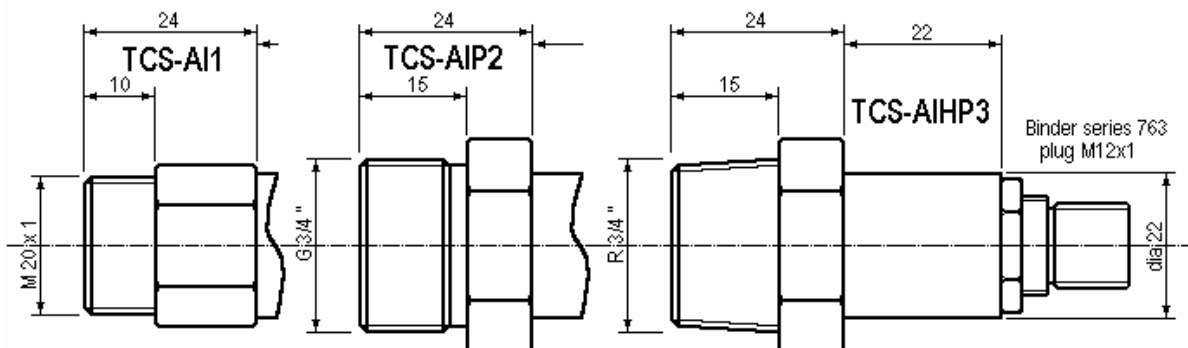
4.1 Sensor

There are optionally four types of sensor available (special purpose assemblies on request):



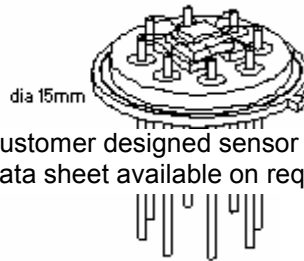
TCS-AI1 (for low pressure applications) stainless steel, with 4-pin plug and 5 m cable, with miniature thermal conductivity sensor element using the chip set of the TCS208 and sintered metal filter for protection, response time for gas exchange approx. 4 sec, max. overpressure at sensor 0.5 bar (7 psi), individually leak tested, dimensions approx. 65 mm x 26 mm dia, total length with cable connected approx. 100 mm, process connecting thread M20x1 male thread. (This thermal conductivity sensor assembly replaces the older products **TCS-A20** and **-A20N**.)

TCS-AIP2 (for medium pressure applications up to 4 bar) stainless steel, with 4-pin plug and 5 m cable, with miniature thermal conductivity sensor element using the chip set of the TCS208 and sintered metal filter for protection, response time for gas exchange approx. 4 sec, max. overpressure at sensor 4 bar (approx. 56psi) for combustible gases, individually leak tested, dimensions approx. 65 mm x 39 mm dia, total length with cable connected approx. 100 mm, process connection parallel thread ISO 228/1 - G 3/4". (This thermal conductivity sensor assembly replaces the previous **TCS-AP6** and **-A26P**.)



TCS-AIHP3 (for high pressure applications up to 160 bar) stainless steel (X5CrNi18 10; 1.4301), with 4-pin plug and 5 m cable, with miniature thermal conductivity sensor element using the chip set

of the TCS208 and sintered metal filter for protection, response time for gas exchange approx. 4 sec, max. overpressure at sensor 160bar (> 2000psi), individually leak tested, dimensions approx. 65 mm x 39 mm dia, total length with cable connected approx. 100 mm, process connecting thread conical male thread ISO 7/1 - R 3/4".



TCS208 (optional, for integration into a customer designed sensor head) unpackaged sensor chip mounted on TO8-base (refer to separate data sheet available on request)

Since the gas exchange at the sensor is effected by diffusion the measured value does not depend on the flow rate of the measured gas. The time for the reaction to a gas change is mainly due to the metal frit (stainless steel filter), which is placed in front of the sensor for mechanical protection and safety. The time constant of the sensor chip itself has been measured to be less than 0.1sec.

4.2 Sensor Control Electronics

This part of the system receives its electrical energy from the +24V DC excitation output of the meter. A first order temperature compensation is achieved within this circuit. The signal temperature dependence remaining is linked to the thermal coefficient of the thermal conductivity in gases itself (compensation by serial or parallel fixed resistors on request - the gases to be measured have to be known). With the analogue adjustment resistors marked 'GAIN' and 'ZERO' the sensor control electronics is adjusted to a particular sensor and process requirement.

4.3 Intelligent Meter

Display: 5-digit, 0.56" High red LED, minus sign displayed for negative values.

Power requirements: A.C.: 85 to 250 V, 50/60 Hz, 15 VA, isolated to 2300 V_{rms} for 1 min
optional D.C.: 11 to 36 V, 11 W; A.C.: 24 V ±10%, 50/60 Hz, 15 VA, isolated to 500 V_{rms} for 1 min

Controls: Five front panel push buttons for modifying alarm values and indicator set-up. External inputs for disabling the front panel and controlling programmable functions.

Display reading range: -19,999 to 99,999 programmable

Reading rate: 1 to 20 readings per second programmable

Response time: better than 1 second for meter to settle for step input plus 3 times the sensor time constant (as described in above 4.1). The response time increases with programmable digital filtering.

Analogue output: 4 - 20 mA, 500Ω max. loop impedance. Digital scaling and offsetting within range; accuracy 0.17% of full range, 3500 point resolution

Alarms (optional): Two relays form C max rating 5 A at 120/240 V AC or 28 V DC (resistive load); 1/8 hp at 120 V AC (inductive load). Relay life expectancy at max rating: 100,000 cycles minimum

Serial communication (optional): RS232 7 or 8 bits, 300 to 19200 baud, alternatively RS485

Connection: High compression cage clamp terminal blocks

This is an industry standard model 'PAX-P' meter manufactured by Red Lion Controls. For further

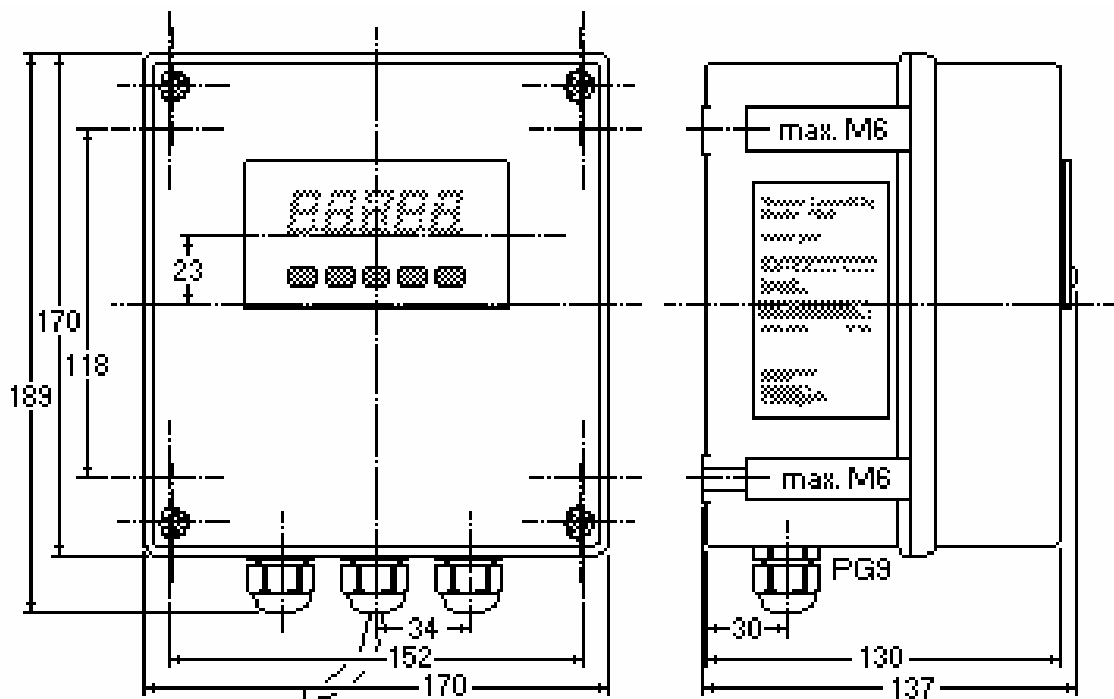
information reference should be made to the meter manufacturer's instruction sheet delivered with the Thermal Conductivity Monitor TCM5 or available separately on request.

4.4 Construction and Dimensions

Weight: 2.3 kg max.

Construction: One-piece front bezel that meets NEMA 4X / IP65 requirements for wash-down and/or dusty environments installed in glass fibre reinforced plastic wall mounting enclosure. Both cover and mounting screws are outside the housing seal. With properly tightened cable glands and round cables IP65 can be achieved for the TCM5.

Dimensions: Height approx. 189 mm (including cable glands); Width 170 mm; Depth 137 mm; wall mounting with 4 screws max M6, rawl plug holes spaced 118 mm vertically and 152 mm horizontally.

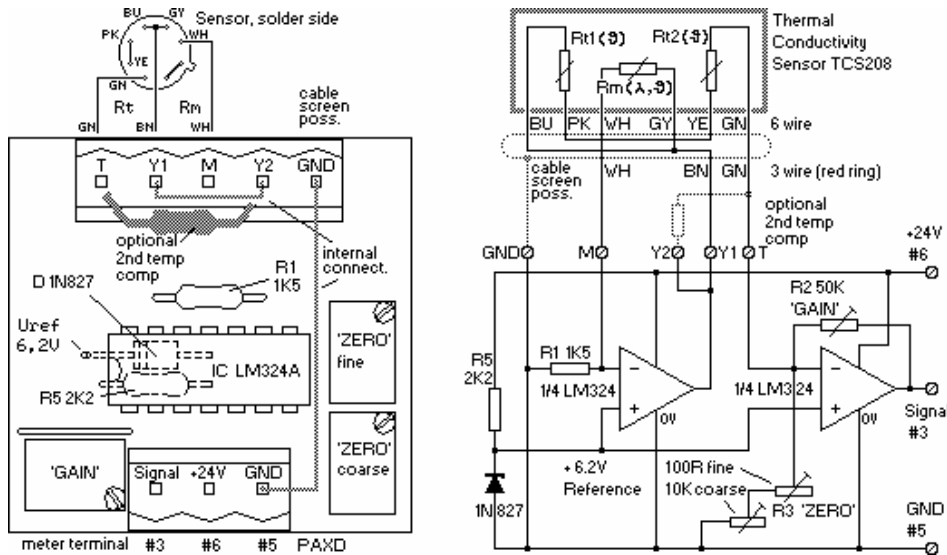


5. Setup and Operation

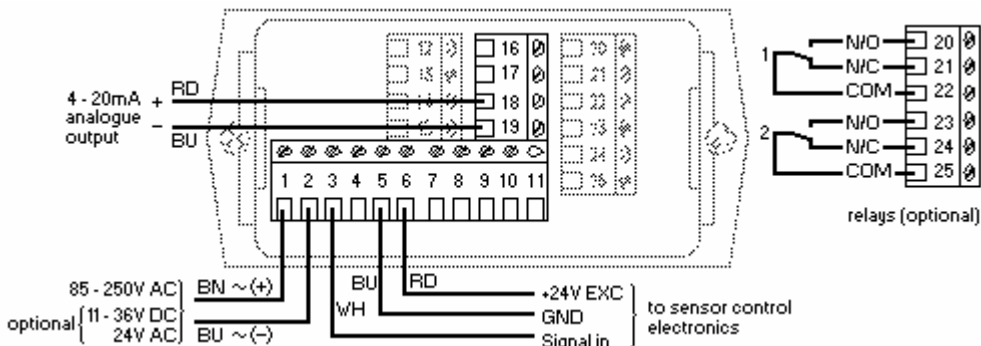
5.1 Connections

When unpacking the equipment the sensor cable is already connected. It may be dis- and re-connected. Within the housing below the meter the sensor control electronics sub assembly (SCESA9) is mounted in a 40 × 40 × 20 mm plastic box with two removable terminal blocks to connect sensor and meter.

Interconnection schematics and circuit diagram:



The screen of interconnection cables must not be grounded. There is a connection within the plug between the sensor housing and the sensor cable screen.



The power supply is fused (0.2A 'T' 5×20mm for 230V AC). Do not use any different type of fuse. Before opening the fuse holder completely disconnect the instrument. Temporary leads fitted are not to be used for permanent installation. In electrically very noisy environments the power supply lines should have an additional suppression capacitor and ferrite suppression core. For additional information refer to the meter manufacturer's instruction sheet delivered with the Thermal Conductivity Monitor TCM5 or available on request.

5.2 Mounting and protection of sensors

Sensor assemblies should be mounted from above or sideways in a suitable fitting (see table below) as closely as possible near the gas flow. Do not use impacting tools (e.g. wrench and hammer) to loosen or fasten the sensor in its fitting because of potential damage to internal hermetic glass seals. The sensor cable must not be damaged by torsion and should not be shortened. The sensor must at all times be protected from excessive moisture. Liquid entering through the metal filter can destroy it. It must not be attempted to measure membrane resistance with an auto-ranging ohmmeter or any instrument exceeding 1mA measuring current or 0.2V measuring voltage at 200Ω even for a very short time because of the 5 millisecond membrane thermal time constant.

Sensor type	Fitting	Seal
TCS-AI1 or TCS-A20N	M20×1	PTFE-tape or similar
TCS-AIP2 or TCS-AP6	G3/4"	metal ring
TCS-AIHP3	R3/4"	conical thread

6. Ordering Information:

Thermal Conductivity Monitor TCM5-..... [options]

Option	Letter	Code	Description	Remark	EUR
			TCM5	basic unit, all options '0'	936,-
Voltage	V	0	180 - 250 VAC	standard	0,-
		1	85 - 150 VAC	different fuse, test setup	3,-
		2	11 - 36 VDC	or 24 VAC, different instrument	20,-
Sensor	S	0	none	to be ordered separately	0,-
		1	TCS-AI1	max 500 mbar	189,-
		2	TCS-AIP2	max 4 bar	276,-
		3	TCS-AIHP3	max 160 bar	630,-
		9	custom	customised sensor assembly	T.B.D.
Membrane current	M	0	4 mA	for gases with Th.C. \geq CO ₂	0,-
		9	custom	customised for application	112,-
Relays	R	0	none		0,-
		9	2 relays	setpoints custom calibrated	159,-
Data interface	D	0	none		0,-
		1	RS232 std	7 bits, parity odd, 9600 baud	153,-
		9	custom	RS232 or RS485, customised	211,-
pre-Calibration	C	0	setup only		0,-
		1	He 0 - 100%		146,-
		2	Th.C. 28/31	Thermal conductivity in mW/m·K between 28.0 and 31.0 (suitable for natural gas applications)	146,-
		7	mix	customised within the range CO ₂ to He with reference unit and mixing chamber	210,-
		8	on-site	calibrated with customer supplied reference gases	T.B.D. \geq (640,-)
		9	external	at third party laboratory	T.B.D. \geq (1640,-)
Temperature compensation	T	0	1st order only	suitable for e.g. helium in air	0,-
		1	methane	suitable for natural gas analysis	5,-
		9	custom		T.B.D.

All figures shown are indications of net list prices in EUR valid at time of writing. Packing, freight and tax will be added as applicable. This information is in itself not a commercial offer. Please indicate your application and enquire to the address shown on the last page for a full quote.

(Sensor elements and a rail mounting version of 'SCESA' pre-amp assemblies are available separately - full data on request!)

Price indication: *Amplifier* *without calibration* *EUR 98,-*
 TCS208F *sensor element* *EUR 86,-)*

NOTES:**Safety warnings**

This Instrument is under no circumstances to be used on explosive gas mixtures or in any area where such mixtures may occur. For any measurement with toxic or flammable gases the sensor must be tested for gas tightness by the user.

Connection and placing into operation of this Instrument must only be made by personnel properly trained and licensed to work on gas lines and electrical mains powered equipment. When connecting to the gas lines observe the pertinent regulations and guidelines of the individual national institutions and the regulations of the gas supply companies. Before opening the Instrument be sure to disconnect it completely from electrical mains.

Documentation and industrial property rights

This product information leaflet has been carefully checked and is believed to be reliable, however, no responsibility can be assumed for inaccuracies that may not have been caught. All information in this leaflet is subject to change without prior notice.

The supplier of this instrument cannot assume responsibility for the use of any license under his own industrial property rights or those of any third party. Some of the applications of this instrument are protected by third party industrial property rights (e.g. U.S. Patents 4,902,138; 5,333,591; and other U.S. and international patents). The handing over of this leaflet or the delivery of the instrument shall not be construed as to be an act of granting a license.

Limited warranty

The supplier warrants the products he manufactures against defects in materials and workmanship for a period limited to six months from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The supplier's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at the supplier's option. The supplier disclaims all liability for any affirmation, promise or representation with respect to the product.

The customer agrees to hold the supplier harmless from, defend, and indemnify the supplier against damages, claims, and expenses arising out of subsequent sales of this product and based upon personal injuries, deaths, property damage, lost profits, and other matters which the customer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by consumer product safety or warranty legislation in the customer's country.

No warranties expressed or implied are created with respect to the supplier's products except those expressly contained herein. The customer acknowledges the disclaimers and limitations contained and relies on no other warranties or affirmations.

Update history:

- 090298: revised fuse rating, 'preliminary' marks omitted
- 120398: complete 4 resistor temp comp in chapter 3 picture, revised text for TCS-A26P, revised text and picture for TCS-AHP2, pre-amp change from SCESA6 to SCESA9, new 'interconnection schematic and circuit diagram' in chapter 5.1 including 6 wire and 3 wire connections as well as sensor element footprint, improved definition of temp comp options
- 070698: additional low voltage AC/DC power supply option, rev. price for DC version, separate availability of SCESA indicated, revised figs in chapter 5.2 (for DC version), power requirements in chapter 4.2
- 010199: shortened text in chapter 5 (fig smaller as well), data i/f option D8 omitted, Euro-prices, price indications for SCESA and TCS208F
- 050600: replacement of sensor types indicated, mobile phone, U.K. and e-mail addresses added, conversion .wri to .doc
- 070901: U.K. address deleted, new Ilmenau manufactured sensors, change in cable shield, revised figs.
- 110104: DEM-prices deleted, new sensor assembly range with revised pictures, new phone number and e-mail address.
- 100404: sensor pressure ratings corrected, change from PAX-D to PAX-P meter

Subject to change without notice

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