GEFRAN

Manual of Electrical Installation for Pressure Probes KM series

Code 80778
Edition 01-2024 (translation of original version)

CONTENTS

1. GENERAL PRECAUTIONS

The system must be used only in accordance with the required protection level.
The sensor must be protected against accidental knocks and used in accordance with the instrument's ambient characteristics and performance levels.
Sensors must be powered with non distributed networks.
(*) See further limitations for Safety applications at paragraph 4 on page 8.

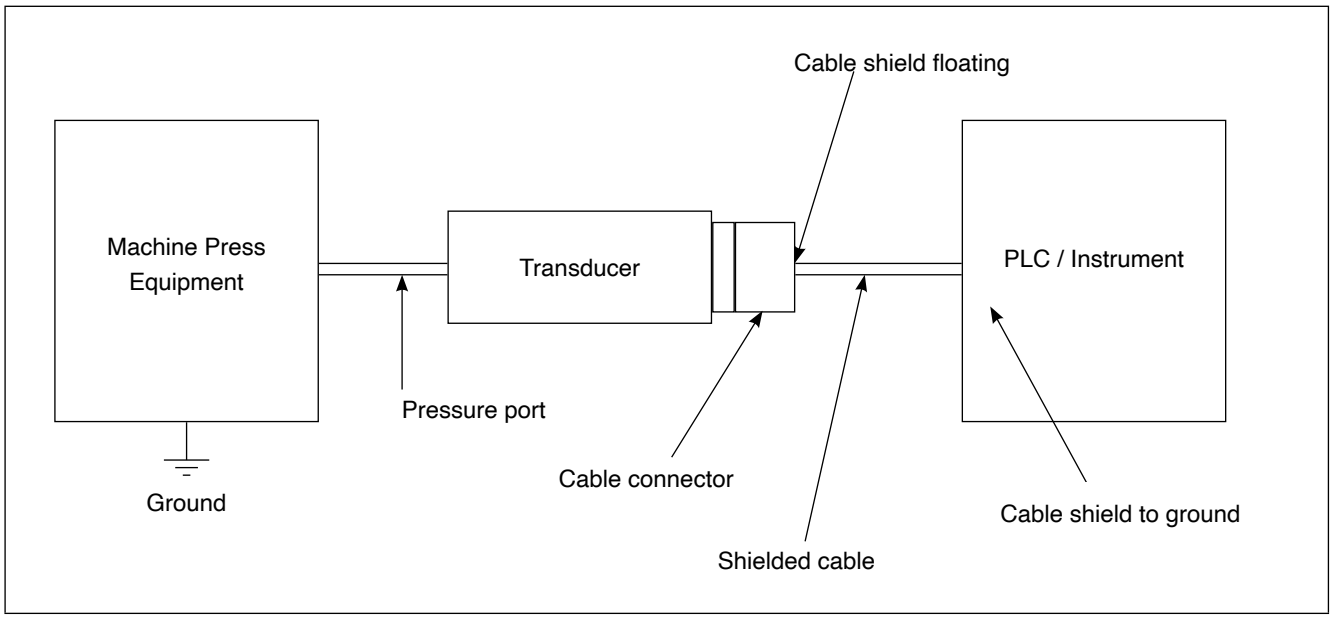
2. TRANSMITTERS WITH AMPLIFIED ANALOG OUTPUT

Transducers: KM series

Outputs: 4…20 mA; 0…10 V; 1…5 V; 0,5…4,5 V ratiometric.

Installation remarks
- The transducer must be grounded (normally through the machine body or equipment it is installed on).
- To prevent interference, separate the power cables from the signal cables.

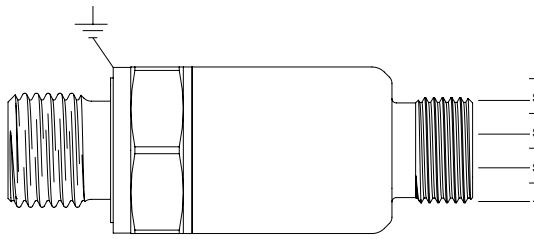
2.1. Standard installation (recommended)



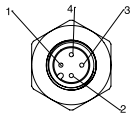
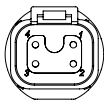
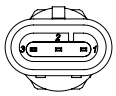
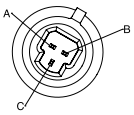
- Shielded cable advised for L > 30 m (*)
- In case of use of a shielded cable, the cable shield must be grounded on PLC side and left floating on machine side (on M12 electrical connector it's possible to connect the shield on machine side by leaving floating the PLC side).

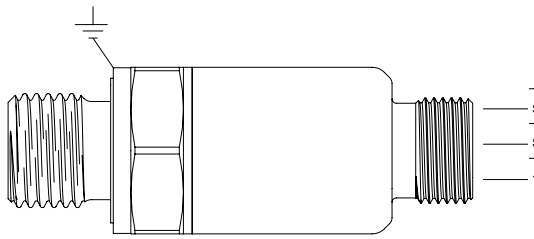
For current output version, using a premoulded 3 wires cable to connect transducer to control system, a slight immunity degradation performance is foreseeable.

2.2. Electrical connections



RATIOMETRIC AND VOLTAGE OUTPUT

	Z - M12 x 1	D - Deutsch DT04-3P	G - Deutsch DT04-4P	S - AMP Superseal 1.5	K - Metripack 150
					
supply +	3	A	2	3	B
supply -	2	B	1	1	A
signal	1	C	4	2	C
⏚	4	/	3	/	/

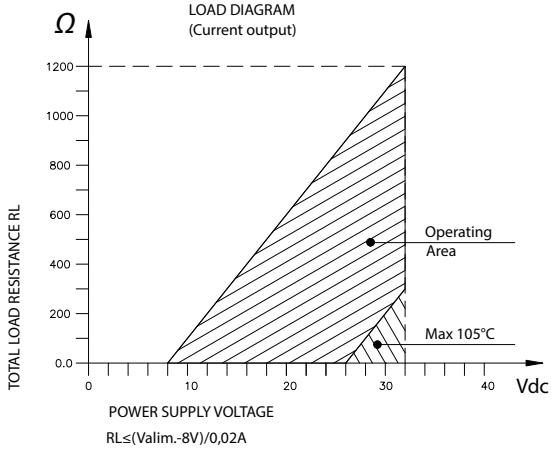


CURRENT OUTPUT

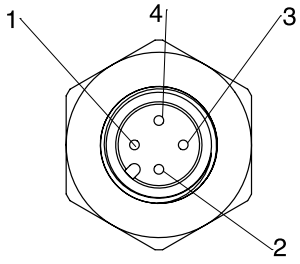
	Z - M12 x 1	D - Deutsch DT04-3P	G - Deutsch DT04-4P	S - AMP Superseal 1.5	K - Metripack 150
supply +	1	A	2	3	B
signal	2	B	1	1	A
⏚	4	n.c.	3	n.c.	n.c.

2.3. Interfaces with SRP/CS and voltage devices

LOAD DIAGRAM

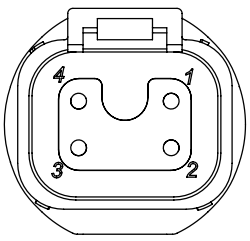


Z - M12 x 1 (4 pin)*

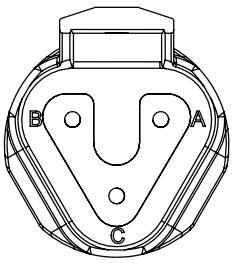


Every connector has a protection rating IP69K/ IP67 with female connector properly installed.
M12 with female homologated connector mounted, tightening torque 0.6Nm + low strenght threadlocker

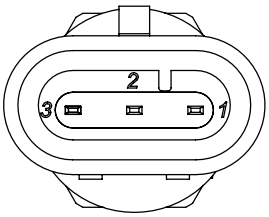
G - Deutsch DT04-4P



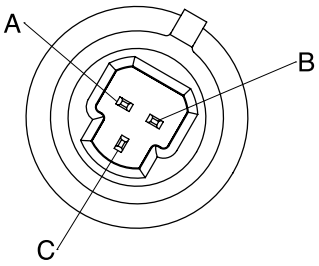
D - Deutsch DT04-3P



S - AMP Superseal 1.5



K - Metripack 150



Every connector has a protection rating IP69K/IP67 with female connector properly installed

Notes:
1. The IP rating specified in this document normally applies with the suitable female connector plugged-in and properly wired.
2. Concerning M12, the pressure transducers with measuring range of 60 bar and below require vented cable and/or mating connector, to allow the compensation of the atmospheric pressure reference.

3. TECHNICAL SPECIFICATIONS

Non Linearity (BFSL)	± 0.15% FS (typ); ± 0.25% FS (max)
Hysteresis	+ 0.1% FS (typ); + 0.15% FS (max)
Repeatability	± 0.025% FS (typ); ± 0.05% FS (max)
Zero offset tolerance	± 0.15% FS (typ); ± 0.25% FS (max)
Span offset tolarance	± 0.15% FS (typ); ± 0.25% FS (max)
Accuracy at room temperature (1)	< ± 0.5% FS
Pressure ranges (2)	From 4 bar to 1000 bar (See table)
Overvoltage	36 Vdc continuous 48 Vdc according to ISO7637-2 Pulse 5
Insulation voltage	500Vdc
Overpressure (without degrading performance)	See table
Pressure containment (burst test)	See table
Pressure Media	Fluids compatible with Stainless Steel AISI 430F and 17-4 PH
Housing	Stainless Steel AISI 304
Long term stability (accuracy)	<0,2%FS per year (within compensated temperature range -20...+85 C° and nominal pressure range)
Operating temperature range (process)	-40...+125°C (-40...+257°F)
Operating temperature range (ambient)	-40...+125°C (-40...+257°F)
Compensated temperature range	-20...+85°C (-4...+185°F)
Storage temperature range	-40...+125°C (-40...+257°F)
Temperature effects over compensated range (zero)	± 0.01% FS/°C typ (± 0.02% FS/°C max.)
Temperature effects over compensated range (span)	± 0.01% FS/°C typ (± 0.02% FS/°C max.)
Response time (10...90%FS)	< 1 msec.
Warm-up time (3)	< 30 sec.
Mounting position effects	Negligible
Humidity	Up to 100%RH non-condensing
Weight	50 gr. nominal
Mechanical shock	100g 6ms according to IEC 60068-2-27 50g 11ms according to ISO 19014-3
Vibrations	20g max at 10...2000 Hz according to IEC 60068-2-6 Random ASD 10...2000Hz according to ISO 19014-3
Ingress protection	IP67/IP69K with female homologated connector mounted
Output short circuit and reverse polarity protection	YES

FS = Full scale

1) Incl. Non-Linearity, Hysteresis, Repeatability, Zero-offset and Span-offset tolerance (acc. to IEC 62828-2)

2)The operating pressure range is intended from 0.5 to 100% FS; sensor is relative, so the 'bar indication is always meant to be barg

3)Time within which the rated performance ia achieved

4) The devices must be supplied with a Class 2 Power Supply (as for NEC) or LPS Power Supply (as for EN 60950). If devices are permanently connected to the machine it's requested an external switch or circuit breaker and external overcurrent protection.

5) See possible restrictions in the paragraphs "Electrical connections" and "Accessories on request".

RANGE (Bar)	**4**	**6**	**10**	**16**	**20**	**25**	**40**	**60**	**100**	**160**	**200**	**250**	**400**	**600**	**1000**
Overpressure (Bar)	8	12	20	32	40	50	80	120	200	320	400	500	800	1200	1200
Burst pressure (Bar)	16	24	40	64	80	100	160	240	400	640	800	1000	1500	1500	1500

Nominal Output signal (short circuit protected)	**4…20 mA (2 wires)**	**1..5 Vdc (3 wires)**	**0…10 Vdc (3 wires)**	**0,5...4,5 ratiometric (3 wires)**
Supply voltage, polarity protected	8-32 Vdc	8-32 Vdc	12-32Vdc	5 ± 0,25 Vdc
Supply – current consumption	-	4 mA		
Output impedance	-	≤ 90 Ω		
Load R (connected to 0 V)	See chart	R ≥ 5 kΩ		

EMC compliance according to: Standard / Directive /Regulation	**Title**
2014/30/EU	EMC Directive (Electromagnetic compatibility)
ISO 13766-1:2018	Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 1: General EMC requirements under typical electromagnetic environmental conditions
ISO 13766-2:2018 (*)	Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 2:Additional EMC requirements for functional safety
2015/208/UE	COMMISSION DELEGATED REGULATION (EU) 2015/208 of 8 December 2014 supplementing Regulation (EU) No 167/2013 of the European Parliament and of the Council with regard to vehicle functional safety requirements for the approval of agricultural and forestry vehicles
ECE ONU R10 (Rev 6)	Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility

(*) Only applicable to SIL2/PL d certified models
See further details on Declaration of conformity and User Manual

3.1. EMC Tests performed for mobile hydralic and automotive applications

Test name	Test parameter			ECE R10	EN 14982	2015/ 208/EU Art. 19, An. XV	EN 13766-1	ISO 13766-2
Broadband radiated emission	30-75 MHz, 64-54 dBµV/m 75-400 MHz, 54-65 dBµV/m 400-1000 MHz, 65 dBµV/m			X	X	X	X	NO REQ.
Narrowband radiated emission	30-75 MHz, 54-44 dBµV/m 75-400 MHz, 44-55 dBµV/m 400-1000 MHz, 55 dBµV/m			X	X	X	X	X
Transient emission ISO 7637-2	Slow (12 | 24 V) Fast (12 | 24 V)	-75/+37V -112/+75V	-450/+37V -150/+150V	X	X	NO REQ.	X	NO REQ.
Immunity to RF disturbances ISO 11452-4	100 mA, 20-200 MHz (AM 1 kHz 80 %)			X	X	X	X	NO REQ.
Immunity to RF disturbances ISO 11452-2	30 V/m, 200-800 MHz. AM, H/V Pol. 30 V/m, 0,8-2 GHz, PM, H/V Pol. 100 V/m, 400-800 MHz, AM, H/V Pol. 100 V/m, 800-1000 MHz, PM, H/V Pol. 10 V/m, 2000-2400 MHz, PM, H/V Pol. 5 V/m, 2400-2700 MHz, PM, H/V Pol.			X	X	X	X	X
Immunity to RF disturbance ISO 11452-5	100 V/m, 0,01-400 MHz (AM 1 kHz 80 %) 200 V/m, 0,01-400 MHz (AM 1 kHz 80 %)			NO REQ.	NO REQ.	NO REQ.	NO REQ.	X
Electrostatic discharge	± 4,0 kV contact and air discharge ± 6,0 kV contact and air discharge ± 8,0 kV; 2kΩ/330pF contact discharge ± 8,0 kV; 2kΩ/330pF air discharge ± 15,0 kV; 2kΩ/330pF air discharge			NO REQ.	X	NO REQ.	X	X
Immunity to conducted transient on power supply line ISO 7637-2	1 2a 2b 3a 3b 4 5B	-75 V +37 +10 V -112 V +75 V -6 V +48V	-450 V +37 V 20 V -150 V +150 V -12 V +48V	X	X	NO REQ.	X	X
Immunity to conducted transient on supply lines ISO 16750-2	Starting profile	IV	IV	NO REQ..	NO REQ.	NO REQ.	X	X
Immunity to conducted transient on signal lines ISO 7637-3	3a 3b 1 (DCC) 2a (DCC) 1 (ICC) 2a (ICC)	-80V, 10’ +60V, 10’ -23V, 5’ +23V, 5’ -5V, 5’ +5V, 5’	-110V,10’ +110V,10’ -35V,5’ +35V,5’ -8V,5’ +8V,5’	NO REQ.	NO REQ.	NO REQ.	NO REQ.	X

3.2. EMC Tests performed for industrial applications

Gefran KM products are tested also against industrial standard according to 2014/30/EU Directive (EMC):

- EN 61326-1 “Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1 general requirements”
- EN 61326-2-3 “Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning”

Emission requirements
Product is compliant to class A according to EN 55011

Immunity requirements

Port	**Test name**	**Basic standard**	**Test parameter**
Enclosure	Electrostatic discharge (ESD)	EN 61000-4-2	4/8 kV contact/air
	EM field	EN 61000-4-3	10 V/m (from 80 MHz to 1 GHz) 3V/m (from 1,4 GHz to 2 GHz) 1 V/m (from 2,0 GHz to **6** GHz)
	Magnetic field	EN 61000-4-8	30 A/m
Power supply VDC	Burst	EN 61000-4-4	2 kV (5/50 ns, 5 kHz)
	Surge	EN 61000-4-5	1 kV/ 2kV
	Conducted RF	EN 61000-4-6	3 V/m (from 150 kHz to 80 MHz)
I/O signa l/ control (including functional earth lines)	Burst	EN 61000-4-4	1 kV (5/50 ns, 5 kHz)
	Surge	EN 61000-4-5	1 kV
	Conducted RF	EN 61000-4-6	3 V (from 150 kHz to 80 MHz)

4. SAFETY MANUAL (for SIL2 / PL d transducers only)

4.1. Application

The pressure sensor KM performs the following safety function:
Measurement and transduction of the read pressure value, with generation of a current or voltage signal within the stated measurement uncertainty (see Sec. 4.2), for comparison with a fixed safety threshold-high threshold (comparison performed by downstream external system/controller).

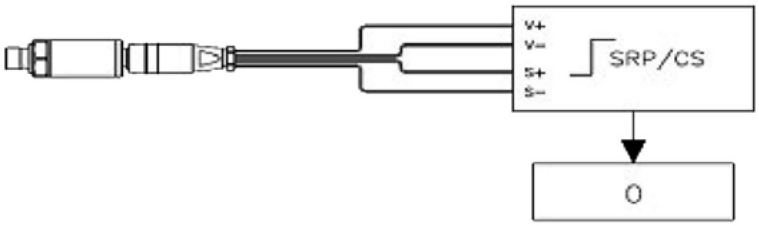
The SIL/PL parameters of the transducer are shown in the table below:

Parameter	Value	Measuring Unit
Architecture	1oo1(D)	--
HFT	0	--
Category	2	--
β factor	0,05	--
β_D factor	0,02	--
λ_{DD}		
Current output	4,94E-07	1/h
Voltage output	4,67E-07	1/h
Ratio-metric voltage output	4,67E-07	1/h
λ_{DU}		
Current output	3,86E-08	1/h
Voltage output	3,79E-08	1/h
Ratio-metric voltage output	3,79E-08	1/h
DC_{avg}		
Current output	92,76%	%
Voltage output	92,50%	%
Ratio-metric voltage output	92,50%	%
SFF		
Current output	95,01%	%
Voltage output	94,93%	%
Ratio-metric voltage output	94,93%	%
$MTTF_D$		
Current output	214,29	years
Voltage output	225,92	years
Ratio-metric voltage output	225,92	years
PFH		
Current output	3,86E-08	1/h
Voltage output	3,79E-08	1/h
Ratio-metric voltage output	3,79E-08	1/h
Systematic Capability	2	--
SIL	2	--
PL	d	--

Three failure exclusions were considered in the evaluation:
- Wear/Corrosion of process mechanical components [13849-2:2012 prospectus A.4]
- Breakage of process mechanical components [13849-2:2012 prospectus A.4]
- Overstress deformation of process mechanical components [13849-2:2012 prospectus A.4

The diagram “A” (Fig. 1) shows a possible application: the sensor detects the pressure and transduces it in an analog electrical signal proportional to the value of the measured value; the SRP / CS compares the signal with the one set as the alarm threshold: in case of exceeding the threshold it shall disable the elements of pressure generation.

VOLTAGE OUTPUT AND RATIOMETRIC



CURRENT 2-WIRE OUTPUT

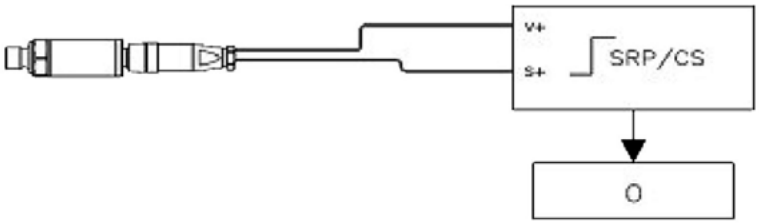


Fig. 1. application diagram A

4.2. Effects on the safety function of performance deviations

The acceptability limit of metrological performance deviations in order not to induce loss of the safety function is ± 5% of the read value at room temperature

4.3. Restrictions of use

The device must only be used in accordance with these operating instructions for mechanical installation, electrical connection, environmental conditions and use in order
to maintain the declared SIL/PL. The sensors must be powered by non-distributed networks and in any case with a length of less than 30 m.

4.4. Maintenance and periodic inspections

Periodic maintenance to carry-out in order to guarantee the justified exclusion of failures are:

- Visual inspection of the status of the electrical and mechanical connections.
  The maintenance is designed to evaluate possible problems due to situations of incorrect mounting endured over time or particular aggressiveness of the material processed.

Frequency: every two years

Check obstruction of the channel under pressure

- The maintenance has the purpose to verify that there is no occlusion of the pressure channel, which would lead to malfunctioning.
  The inspection is visual, after removing the probe from the process seat.

Frequency: every year.

Testing the sensor calibration

- The test is intended to check the correctness of the transduction curve of the sensor. It’s done by applying known pressure points to the transducer and checking the output values of the probe.

Frequency: every four years.

4.5. Indication of response time

The response time to the pressure transduction is equal to 1 ms
The response time to failure is 500ms*

*except test on error in primary stage, on output stage and on logic (RAM, ROM, CPU), so the value is equal to 5s

4.6. Suspension of the safety function

No suspension or bypass of the safety function is possible in the KM series transducer.

4.7. Indications and alarms

The KM Series pressure sensors in the case of some specific anomalies provide output saturation (positive HIGH or negative LOW).

Table 1 indicates the detected failures and their raw effect on output (HIGH, LOW)
Table 2 indicates, for each type of output, the specific alarm values and accepted limits

Table 1. Detected failures and effect on output

Failure	Output
Power supply cable broken	LOW
Sensor not connected	LOW
Power supply broken	LOW
Broken bridge	HIGH
Pressure over range (> 1,4x FS)	HIGH
Error on primary or first amplification stage	HIGH
Overvoltage	LOW
Undervoltage	LOW
Error in the program sequence	LOW
Overheating of the electronics	LOW
Error RAM	LOW
Error ROM	LOW
Error CPU / Logic	LOW
Analog output error	LOW

Table 2. Accepted limits and alarm values

Output type code	Output range	Alarm LOW (<=)	Low limit value	Zero	FS	High limit value	Alarm HIGH (>=)
P	1…5Vdc	0,70	0,80	1,0	5,0	5,40	5,60
X	0,5…4,5Vdc (RAZIO)	0,20	0,30	0,5	4,5	4,60	4,65
E	4…20mA	3,70	3,80	4,0	20,0	21,60	22,40

4.8. Failures and troubleshooting

In case of failures or malfunctions, on Table 3 you can find the most common failures and the means of appropriate search:

Table 3. Troubleshooting

Failure	Possible cause	Troubleshooting
The sensor doesn't react to pressure	Pressure channel occlusion • Output stage failure	1 - Sensor power-off and disassembly 2 - Double check possible pressure channel occlusion and clean it from residuals or material
The sensor alarm signal is "HIGH"	• Broken primary element • Input stage error • Detected pressure value over threshold (1,4 FS)	1 - Sensor power-off and disassembly 2 - If the problem persists, send the sensor to factory for repair
The sensor alarm signal is "LOW"	• Cut cable / broken connector • Device not connected • Broken supply • Overvoltage • Undervoltage • Floating power supply • Program sequence error • Logi/Process section error • Overtemperature on electronics • Output stage error	1 - Sensor power-off and disassembly 2 - Check the correct connection of power supply 3 - Check the electrical continuity between the female plug and the power supply 4 - Check if the power supply level is within specifications 5 - Check voltage supply stability 6 - Check possible housing overtemperatures Remove the reasons, wait till cooling down and switch on the sensor 7 - If the problem persists, send the sensor to factory for repair 8 - If the sensor works fine, mount the sensor in the seat following instruction manua

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