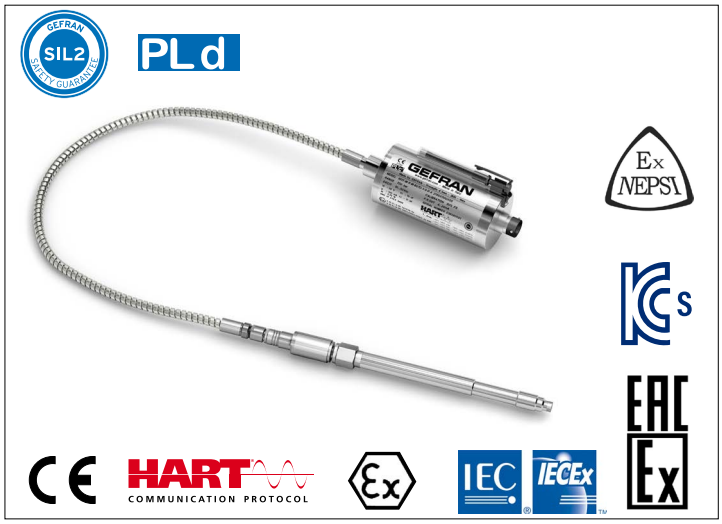
GEFRAN

SMART HART MELT PRESSURE TRANSMITTERS
HI IMPACT



INSTRUCTION MANUAL

cod. *80624F_Edit.* ***02-2025 ENG***

ATTENTION!

This manual is an integral part of the product, and must always be available to operators.

This manual must always accompany the product, including if it is transferred to another user.

Installation and/or maintenance workers MUST read this manual and scrupulously follow all of the instructions in it and in its attachments.

GEFRAN will not be liable for damage to persons and/or property, or to the product itself, if the following terms and conditions are disregarded.

The customer must respect trade secrets.

Therefore, this manual and its attachments may not be tampered with, changed, reproduced, or transferred to third parties without **GEFRAN's** authorization.

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GEFRAN SMART HART SERIES ➔ READY-TO-USE GUIDE

This Ready-to-Use guide can be used by expert instrumentation operators to configure the transmitter using HART Communication or Autozero/Calibration features through magnetic pen or contacts on output connector.
For more full information please refer to the complete manual before operating.
The Ready-to-Use procedure with HART is intended for users already familiar with HART Communicator and loop powered equipment.

READY-TO-USE Using magnetic pen / pin CAL feature

Bring the system to the working temperature with the transmitter installed and connected to the measurement instrument without any pressure applied. For a 6 or 8 pin connector version, Pin A is Sig+/Exc+ and pin B is Sig-/Exc-.
For conduit output configurations, please look at Electrical Connections chapter.
Assure proper loop feeding voltage is applied to transmitter.

The measurement chain connected to the transmitter is calibrated as follows:

1) Reset the offset on the instrument by eliminating the thermal drift with the Autozero function.
With the sensor installed and the extruder at working temperature, wait until the temperature itself is stable, with a possible variation of ± 1°C. Consequently Autozero can be activated.
This allows to compensate all the signal drifts caused by tightening and temperature. Additional Autozero activations could be run once the temperature stability is reached, with ± 1°C of possible variation.

2) Calibrate the instrument activating the CAL function.
The transducer brings its output to the calibration value shown on the transducer data plate (80% of full scale default, if changed with HART command it could be different). With the external Autozero function the calibration procedure is not feasible.

3) If the instrument does not exactly indicate zero, repeat points 1) and 2).

READY-TO-USE Using HART Communicator

Bring the system to the working temperature with the transmitter installed and connected to the measurement instrument without any pressure applied.

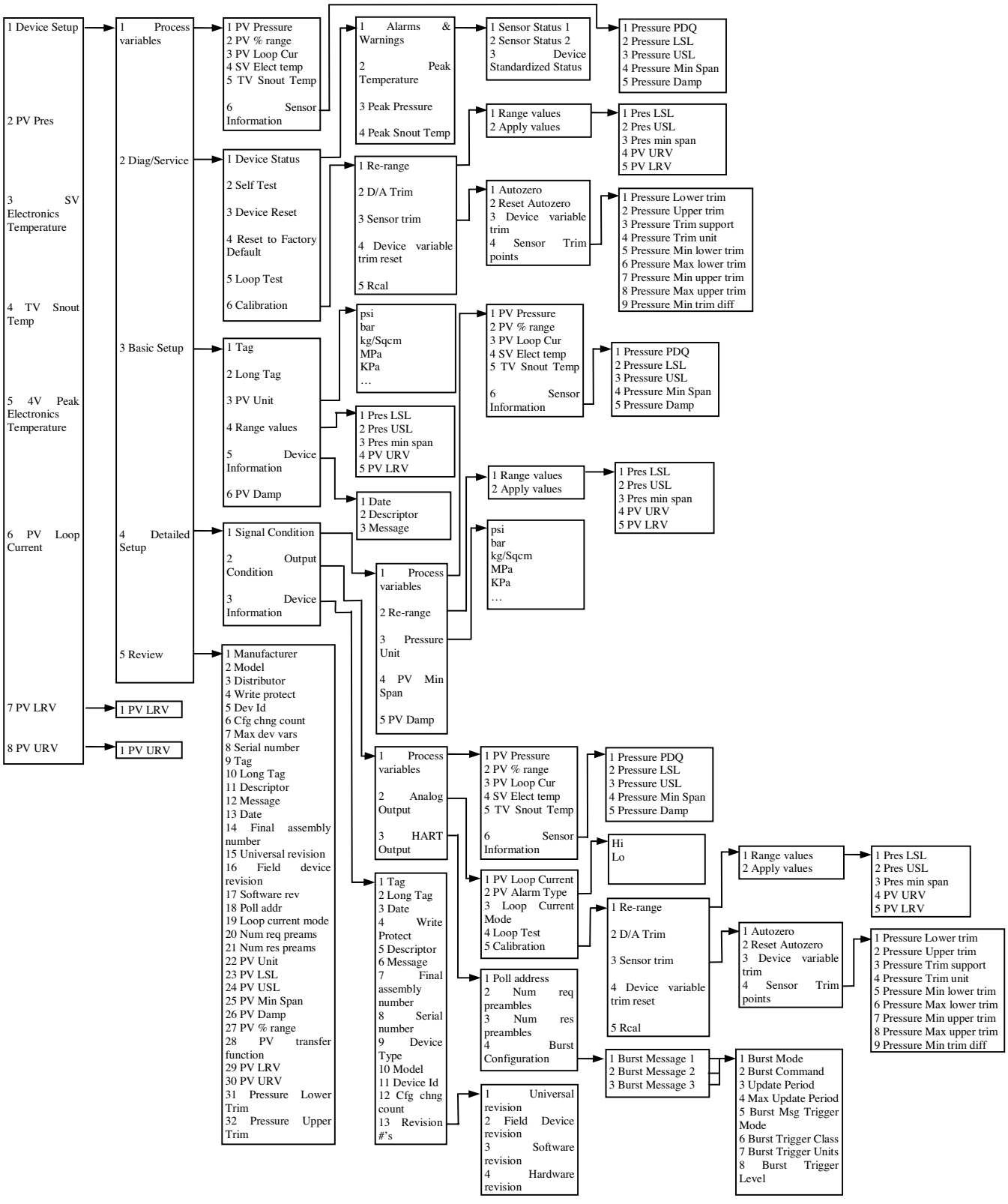
1) Connect Communicator to the loop. In case it's not sure on how to do this, please refer to "Connecting the HART Handheld Communicator" (Figure 8.1).

2) Switch on HART Communicator. For reference please refer to HART Command tree on the following page.

3) From the main menu:
a. Enter Tag (Fast Key 1, 3, 1)
b. Set Pressure Units (Fast Key 1, 3, 3), if needed
c. Set URV (Fast Key 1, 3, 4) if output turndown (rescaling), is needed
d. Perform Autozero (Fast Key 1, 2, 6, 3, 1)

4) Check loop output is zero (4mA).

5) Remove HART Communicator from loop.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1. GENERAL INFORMATION

This manual applies to the following products:
HIE and HIE SIL2 / PL d series as well as HIX and HIX SIL2 / PL d series produced by Gefran spa, via sebina 74 – 25050 Provaglio di Iseo - BS - Italy.

1.1. General information

This manual must be kept near the equipment for easy reading and consultation.
It must be read, understood, and strictly follow in order to avoid and prevent accidents and/or malfunctions.
Gefran will not be liable for any injury to people and/or damage to property deriving from disregard of this manual.

1.2. Copyright

1.3. Correct use

Gefran Melt pressure sensors with amplified current output with HART protocol are designed and built to measure the pressure and temperature variable of melted plastic at different temperatures according to the filling fluid used. The correct temperature range is:

- Up to 350 °C

If the sensors are used as a safety component in compliance with the Machinery Directive, the equipment builder must take all necessary precautions to ensure that any malfunctions of the Melt pressure sensor do not injury to people and/or damage to property. For this reason it's necessary to read carefully the "Safety Manual" (chapter 10).
In case the sensors are used for applications in potentially explosive atmospheres, please read carefully (chapter 12).
Installation and maintenance must only be carried out by suitably skilled and qualified personnel.

2. ACRONYMS

The following acronyms are frequently used:

BFSL	Best Fit Straight Line
DD	Device Descriptor
EEPROM	Electrically Erasable Programmable Read Only Memory
FS	Full Scale Output
HART	Highway Addressable Remote Transducer
LRV	Lower Range Value
PT	Pressure Transmitter
PV	Primary Variable (Pressure)
RTD	Resistance Temperature Detector (A very accurate temperature sensor)
SV	Secondary Variable (Electronics Temperature)
TV	Tertiary Variable (Snout Temperature)
URV	Upper Range Value
Watchdog	An internal timing control for the electronics

3. NAME CODING

HIE	Hart Impact Melt Pressure Transducer
HIX	Hart Impact Melt Pressure Transducer Ex Certified
HIE P	Hart Impact Melt Pressure Transducer PL d Certified
HIX P	Hart Impact Melt Pressure Transducer Ex and PL d Certified
HIE S	Hart Impact Melt Pressure Transducer SIL2 Certified
HIX S	Hart Impact Melt Pressure Transducer Ex and SIL2 Certified

IMPACT "HI" series of Gefran, are pressure transmitters, without transmission fluid, for using in High temperature process environment (up to 350°C). Pressure is transduced by a micro-worked silicon structure (MEMS) and the operating principle is “piezoresistive”.
“IMPACT” is Gefran’s exclusive series of high-temperature pressure sensors that use the piezoresistive principle.
The main characteristic of “IMPACT” sensors is that they do not contain any transmission fluid.
The sensitive element, directly positioned behind the contact membrane, is realised in silicon through microprocessing techniques. The micro structure includes the measurement membrane and piezoresistors.
The minimum deflection required by the sensitive element makes it possible to use very robust mechanics.
The process contact membrane can be up to 15 times thicker than the membrane used in traditional Melt sensors.
Supplied in 2 different confgurations, rigid stem, and rigid + flexible and 4 mechanics, single and modular fixed and single and modular floating, the Melt sensors of GEFRAN are able to meet all installation requirements in the feld.
The coverage relative to the pressures that can be detected by the sensor is almost total; we start from the probe with a minimum range of 0-10 bar to arrive at a version with a scale of 0-1000bar. All models in the catalogue can be supplied in two different accuracy classes*; in particular class M, with accuracy 0.5%FS and class H, with 0.25%FS accuracy.
Ex and Performance Level ‘d’ or SIL2 certified versions are available.

* For HIX products sold to EAC Customs Union (EAC mark), due to a different method of calculation, the limits of accuracy are the following:
_M = 1%
_H = 0,5%
For all the other details and technical features please keep as reference the product datasheets or Gefran website www.gefran.com.

4. SENSOR TECHNICAL SPECIFICATIONS

Accuracy (1)	**H** <±0.25% FS (100...1000 bar) **M** <±0.5% FS (10...1000 bar)
Resolution	16 bit
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Measurement range	0…10 to 0…1000 bar 0…150 to 0...15000 psi
Rangeability	3:1
Maximum overpressure (without degrading performances)	1.5 x FS (up to 1200 bar/ 17400 psi max)
Measurement principle	Piezoresistive
Power supply	13...30Vdc
Maximum current absorption	23mA (40mA with optional relay)
Output signal Full Scale (FS)	20mA
Zero balance (tollerance ± 0.25% FS)	4mA
Calibration signal	80% FS
Power supply polarity reverse protection	Yes
Compensed temperature range housing	0...+85°C
Operating temperature range housing	-30...+85°C
Storage temperature range housing	-40...+125°C
Diaphragm maximum temperature	23…350 °C / 660 °F
Zero signal variation due to process temperature variation in range (20 to 350°C)	< ± 1.2%FS
Span signal variation due to process temperature variation in range (20 to 350°C)	< ± 1%FS
Standard material in contact with process medium	Diaphragm: 15-5 PH with GTP+ coating Stem: 17-4 PH
Thermocouple (model HIX2)	STD: type “J” (isolated junction)
Protection degree (with 6-pole female connector CON300)	IP66
Electromagnetic compatibility – Emission	EN 61326-1 / EN 61326-2-3 / EN61326-3-1
Electromagnetic compatibility – Immunity	EN 61326-1 / EN 61326-2-3 / EN61326-3-1

FS = Full scale output
(1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).
For HIX sold to EAC Customs Union (EAC mark), due to a different method of calculation, the limits of accuracy are the following:
_M = +-1%
_H = +-0,5%

Sensors are manufactured in compliance with:
- EMC compatibility directive
- RoHS directive
- Machinery directive
- Ex regulations (ref. par.12)

Electrical installation requirements and Conformity certifcate are available on our web site: www.gefran.com

5. MECHANICAL DIMENSIONS

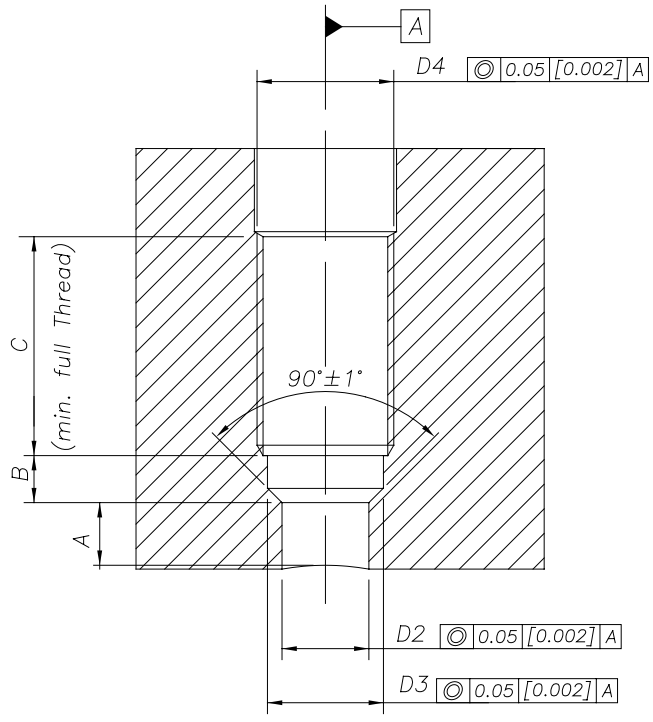
For the mechanical dimensions keep as reference the product datasheets or Gefran website www.gefran.com

6. INSTALLATION AND POSITIONING ON THE MACHINE

Extrusion processes require very high temperatures. Extrusion pressure can be checked by means of especially designed transducers.
The IMPACT series sensors are suitable for pressure measurements with high temperature and are based on the piezoresistive technology.
Following advice for extending the sensors lifetime.
a) Avoid shocks and abrasions to the in contact diaphragm. Protect the transducer with its cover each time you remove it from its seat.
b) The seat must be prepared perfectly and with appropriate tools in order to respect the depth and axiality of the holes and tapping.
Pay particular attention to the coaxiality of the holes to the thread, because diaxialities greater than 0.2 mm will break the transducer during assembly.
It is essential that hole depth guarantee the absence of chambers or air pockets in which extrusion material may be trapped.
To prevent contact with the extrusion screw or with tools used to clean the extrusion chamber, the front diaphragm must not extend from the inner wall of the extruder.
c) Before assembling the transducer in machines already in operation, make sure that the housing is clean. Remove any residual with the suitable cleaning device.
d) The transducer should be removed only with the machine empty (without pressure) but still hot.
e) The transducer should be cleaned with solvents for the material being processed.
Any mechanical action on the contact diaphragm modifies its operation and could break it.

6.1. Installation seat

The installation seat has to be realized:



D1	1/2-20UNF	M18x1.5
D2	.313 ±.001" [7.95 ±0.02mm]	.398 ±.001" [10.10 ±0.02mm]
D3	.454 ±.004" [11.53 ±0.1mm]	.634 ±.004" [16.10 ±0.1mm]
D4	.515" [13mm] minimum	.790" [20mm] minimum
A	.225" [5.72mm] minimum	.240" [6.10mm] minimum
B	.17" [4.3mm] maximum	.16" [4.0mm] maximum
C	.75" [19mm]	.99" [25mm]

Incorrect working or shape of the side can result in properties out of specification, bad behaviour or damage to the sensor.

The side should be clean and without any polymer residual.

Drilling kit

A drilling kit with formed tools for drilling, reaming and tapping is available to facilitate correct preparation of the assembly seat. The assembly seat must be perfect to assure proper transducer function and long lifetime. Drilling kits are available in the following versions: **KF12, KF18**.

Drilling procedure

1) To drill hole (D4) up to a distance from the hole equal to the sum of (A+B+C) (tool 3).
2) Make the pass through hole (D2) by the tool 1.
3) To create the seal seat at a distance from the hole equal to dimension (A) (tool 4).
4) With a roughing tap, create threading 1/2-20UNF-2B (recognizable from the greater number of threads beveled at the mouth) (tool 5).
5) With a finishing tap, go over threading 1/2-20UNF-2B up to a distance from the bottom equal to the sum of (A+B) (tool 6).
6) To ream the hole (D2) with reamer (tool 2).

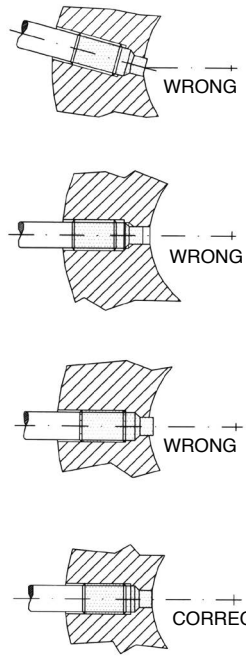
Installation seat check

The dimensions of the assembly seat have to be checked after preparation and before the transducer installation.
Use dummy plug SC 12/18 as follows:
1) Coat the end of the rod with the appropriate ink.
2) Lubricate the threaded part to prevent friction.
3) Insert the dummy plug and screw it fully down.
4) Remove the rod and examine it.
With the exception of 45° surfaces, the ink should be intact on the entire surface.

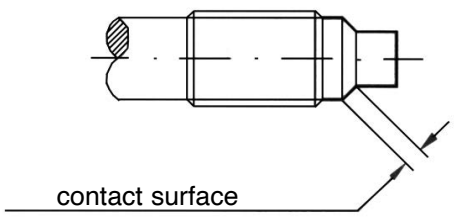
6.2. Drilling tool kit

VERSION CODE		KF12	KF18
THREADING TYPE		1/2-20UNF-2B	M18x1.5
1		Ø 7.6	Ø 9.75
2		Ø 7.95	Ø 10.1
3		Ø 13	Ø 20
4		Ø 11.5 with pilot guide	Ø 16 with pilot guide
5		1/2-20UNF-2B roughing	M18x1.5 roughing
6		1/2-20UNF-2B finishing	M18x1.5 finishing

CORRECT INSTALLATION



CORRECT SEAL



TRANSDUCER INSTALLATION

Installation procedure

1) Make sure the drilling procedure has been realized correctly. If the sensor is installed in a previously used hole, make sure the hole is completely clean and free of any plastic residual.
2) Remove the protective cap from the sensor top.
3) Lubrificate the thread with non-grip grease such as Neverseez (Bostik), or C5A (Felpro), or equivalent.
4) Insert firmly the sensor into the hole, first by hand and then with a wrench, 1/4 turn at a time. Recommended torque: 40 Nm.

NOTE: Please pay particular attention to the sensor installation when it's provided in its fixed mechanis configuration.
In this case, during the clamping phase any misalignment. Has tube avoided, otherwise a possible interference of the sensor mechanical coupling can occur.

Removal (Figure 1)

To remove the transducer from its seat and carry on the working process, dummy plugs with identical mechanical dimensions are available.
The dummy plugs differ by type of threading; max pressure range is 2000 bar for all rods.
The dummy plugs are available in the following versions: **SC12** 1/2-20UNF seat - **SC18** M18x1,5 seat

Brackets (Figure 2)

Models with flexible sheaths require the housing precise fixing. Suitable fastening brackets (SF18) are recommended.
Remember that the fastening point must be vibration-free (vibrations affect the measurement) and that temperatures must not exceed the maximum temperature range for the strain gauge housing (as stated on the sensor technical sheet).

Extruder starting

Bring the system to working temperature with the transducer installed and without any pressure applied.
Wait until all the material is at the same temperature to prevent the transducer damage by semi-solid material.

Seat cleaning & Cleaning tool

As mentioned in the notes, the seat must be cleaned before the transducer installation.
The cleaning tool is a hard metal cutting tool specially designed to remove working materials residuals.

Recommended procedure (Figure 3)

The following procedure must be implemented with the material in a fluid condition.
1) Insert the tool in the seat and screw down the cutting rod (normally a 1/4 turn at a time).
2) Turn the pilot cutter clockwise until there is no resistance to cutting.
3) Repeat the procedure until the seat is completely clean.

For constructive reasons, the maximum torque applicable to the cutter is 15 Nm (1.5 Kgm).
If the hole occlusion requires higher torque for removal, use the drilling kit and follow the recommended procedure.
The cleaning tool is available in the following versions: **CT12** 1/2-20UNF seat - **CT18** M18x1,5 seat.

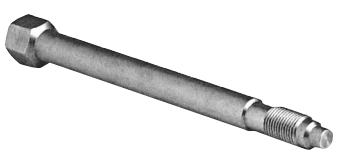


Figure 1

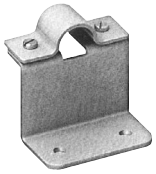


Figure 2

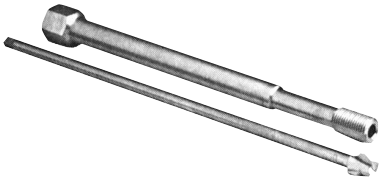


Figure 3

ORDER CODES FOR TOOLS and ACCESSORIES

MOUNTING BRACKET	SF 18

CLEANING TOOL KIT	CT
1/2-20UNF	12
M18x1,5	18

DUMMY PLUG	SC
1/2-20UNF	12
M18x1,5	18

DRILL KIT	KF
1/2-20UNF	12
M18x1,5	18

6.3. Torquing the sensor

Screw the sensor after checking the correct shape of the side.

Hold the flexible part while screwing the jam bushing.

For safety operations at least 6 pitch of the jam bushing must be screwed into the hole.

The torque must be 40 Nm.

6.4. Connecting amplifier (only for modular versions)

The electronics must be connected to the primary part by aligning the 2 red points on each connector.

Take care not to force the connectors together: check the correct aligning of the 2 red points.

Fix the flexible sheath to the machine. Take care not to fix the sheath to parts heated at over than 220°C.

Screw the electrical cable connector to the electronics and switch on the sensor.

Wait 60 seconds before starting to operate the transducer.

To disconnect the electronics from the primary sensor, take care to handle the two connectors next to the red points and not to force the disconnection.

Remark:
In modular versions the decoupling between the electronics and the primary element is not allowed.

6.5. Wiring and calibration

Connections

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 or safety integrity levels.
The sensors must be powered with non-distributed networks and always at lengths of less than 30 mt.
*In case of safety applications see further limitations in paragraph 10.

The sensors have to be connected as shown in the diagram at chapter 7.
To obtain a higher immunity from field noise, connect the cable shield to the female connector case on sensor side.

Calibration procedure using the magnetic pen/Pin CAL

Bring the system to the working temperature with the transmitter installed and connected to the measurement instrument without any pressure applied.
The measurement chain connected to the transmitter is calibrated as follows:

1) To reset the offset on the instrument by eliminating the thermal drift with the autozero function.
With the sensor installed and the extruder at working temperature, wait until the temperature itself is stable, with a possible variation of ± 1°C. Consequently Autozero can be activated.
This allows to compensate all the signal drifts caused by tightening and temperature.
Additional Autozero activations could be run once the temperature stability is reached, with ± 1°C of possible variation.

2) Calibrate the instrument activating the CAL function. The transducer brings its output to the calibration value shown on the transducer data plate (80% of full scale default, if changed with HART command it could be different).
With the external Autozero function the calibration procedure is not feasible.

3) If the instrument does not exactly indicate zero, repeat points 1) and 2).
In this way, the instrument is calibrated to give the exact indication in the chosen engineering unit.

Calibration procedure using HART communication

Bring the system to the working temperature with the transmitter installed and connected to the measurement instrument without any pressure applied.

1) Connect Communicator to the loop. In case it's not sure on how to do this, please refer to "Connecting the HART Handheld Communicator" (Fig. 8.1).
2) Switch on HART Communicator. Please refer to HART Command tree on Ready-to-Use guide.
3) From the Main Menu:
a. Enter Tag (Fast Key 1, 3, 1)
b. Set Pressure Units (Fast Key 1, 3, 3), if needed
c. Set URV (Fast Key 1, 3, 4) if output turndown (rescaling), is needed
d. Perform Autozero (Fast Key 1, 2, 6, 3, 1)
4) Check loop output is zero (4mA).
5) Remove HART Communicator from loop.

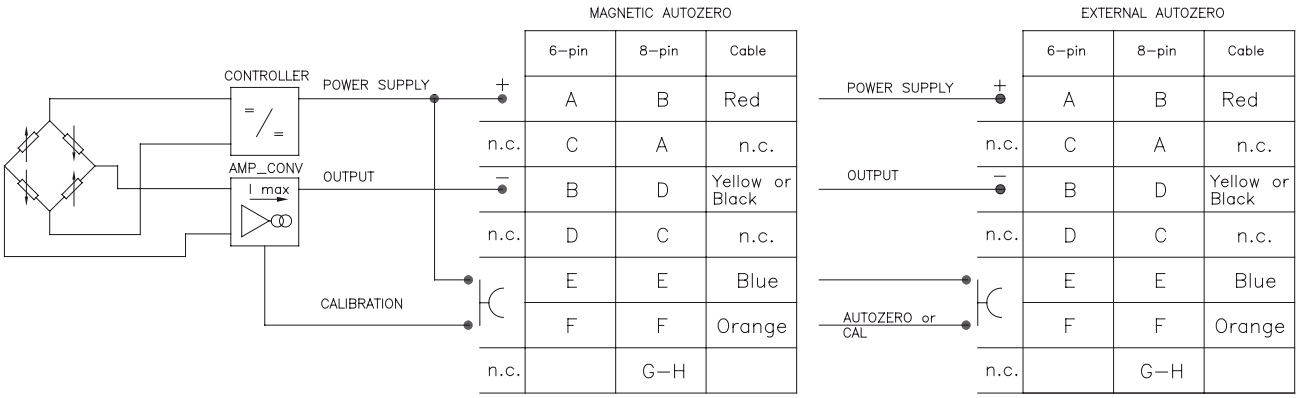
7. ELECTRICAL CONNECTIONS

The interface to controller can be:

- the multi-polar connector type VEAM VP07RA10-6PT2 (code GEFRAN CON301),
- the multi-polar connector type BENDIX PC02E-12-8P 8 poles (code GEFRAN CON356)
- the multi-polar cable outlet with conduit output type ½ 14-NPT as illustrated in fig 7.1.

Where are also pointed out the connections (2 wires connection current amplified). In the case of relay output with retransmitted output in current (2 wires) the connections are shown in fig. 7.2.

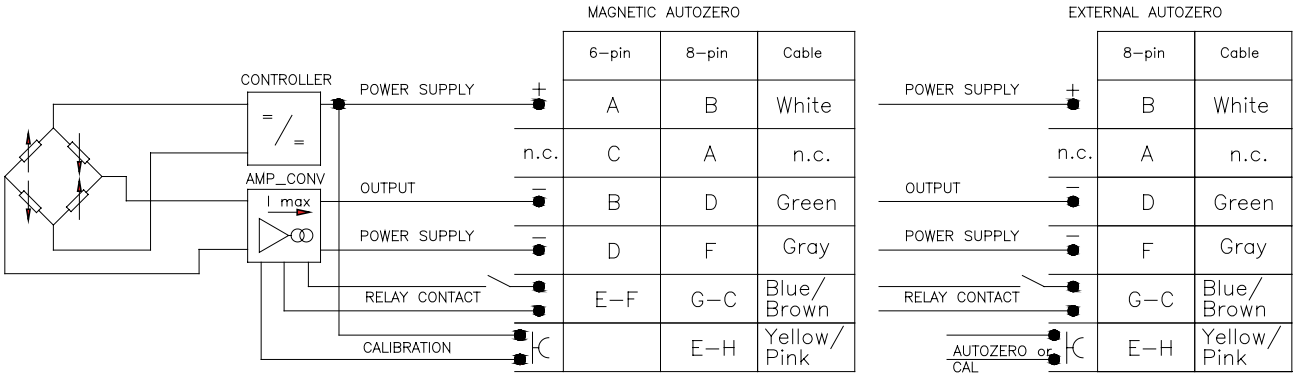
CURRENT OUTPUT (NO RELAY)



The cable shield is tied to both sides, i.e. to the sensor connector and to the controller

Fig 7.1

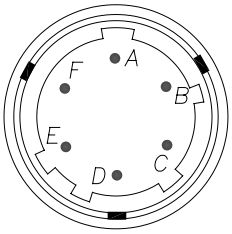
RELAY OUTPUT



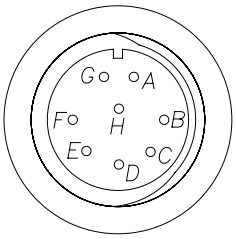
The cable shield is tied to both sides, i.e. to the sensor connector and to the controller

Fig 7.2

6 pin Connector VPT07RA10-6PT2 (PT02A-10-6P)

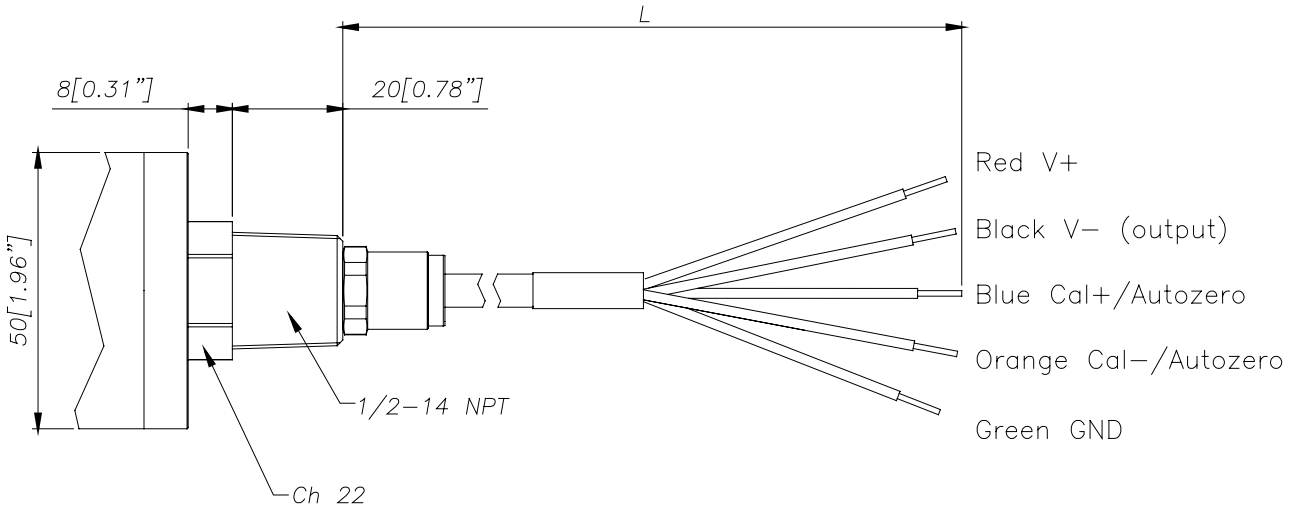


8 pin Connector (PC02E-12-8P) Bendix



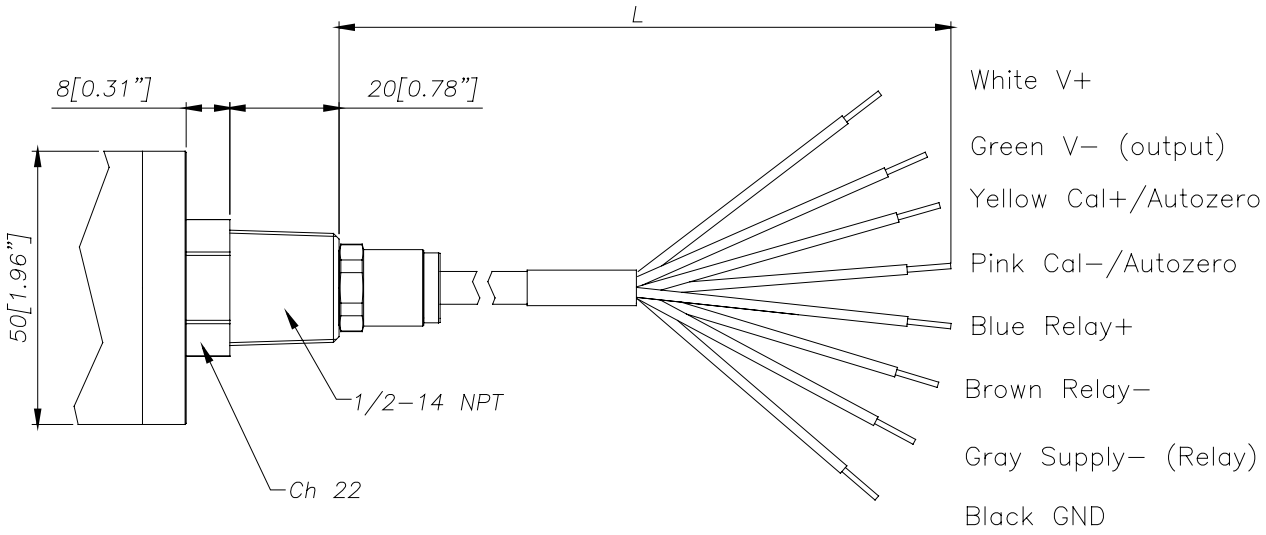
Cable outlet (1/2 14-NPT) L = 1 m

Current output



Cable outlet (1/2 14-NPT) L = 1 m

Relay output - Magnetic Autozero/External Autozero



8. COMMAND MODES

The command modes must be used by the user only to make periodical recalibrations of the system in the process, and are made through:

- Magnetic sensor/Pin CAL
- HART Communication

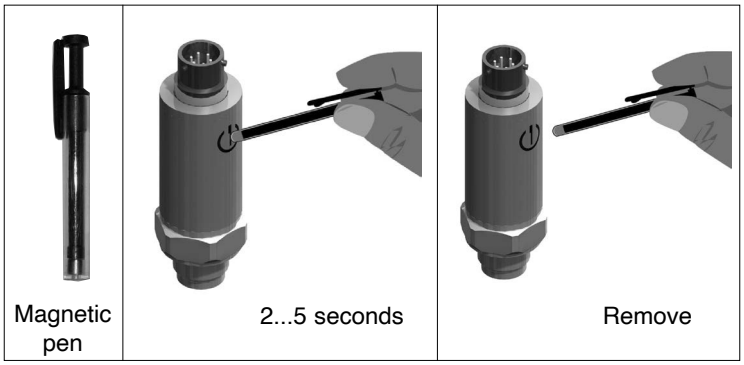
8.1. Using Magnetic pen and Pin CAL

The event combinations give the following functions:

1. Autozero
2. Calibration (CAL)
3. Reset autozero

1) AUTOZERO

Application mode	*Limits*		*Result*
	FS (bar)	*% adjustment*	
The Autozero function is activated by : 1) positioning the magnet near the Autozero label on the shell of the sensor. 2) Short-circuiting the pin E-F (external Autozero version). The magnet has to be maintained on the Autozero position for a time within 2 to 5 seconds.	≤ 35	100	The Autozero effect will be visible after waiting 2 seconds starting from the function removal. The precision of the zero value will be defined by the accuracy class of the sensor.
	> 35, < 100	40	
	> 100, < 200	20	
	≥ 200	10	
NOTE: For all transmitters with current outputs, during the Autozero phase, output can rise up to 7 mA. That's a short variation only visible during the Autozero phase; it won't have any effects on the final signal.			



1) Machine pressure = 0 bar and transducer powered.
2) Put magnetic pen on marked spot (2...5 seconds).
3) Remove magnetic pen.
4) Ready !

 = marked spot

Warning: the periodical zero ricalibration through the Autozero function must be done at stable temperature and no pressure in the extrusion chamber.

2) CALIBRATION (CAL)

Application mode	*Limits*	*Result*
Start CAL: The Calibration function is activated by short-circuiting the pin E – F for a minimum time of 1 second. Stop CAL: Release the E - F short-circuit.	The whole Zero unbalancement in comparison to the zero done by the manufacturer, has to be ± 20%FS.	During the Calibration phase the signal will be unbalanced to the 80% FS. The calibration effect is visible 2 seconds after short-circuiting E - F. The Calibration function doesn't work outside the defined limits..

NOTE:

The Calibration function is not allowed for "external Autozero" version.

3) TOTAL RESET OF THE CALIBRATION VALUES

Application mode	*Limits*	*Result*
The magnet has to be maintained on the Autozero position for a time of 20 to 25 seconds.		The Zero and Span of the transmitter will be recalibrated to the factory settings.

NOTE:

In the current transducers output value, when applying the magnet can see an imbalance of the output signal up to 7mA.

During HART Handheld Communicator connection

In case of hazardous areas please refer to the handheld communicator user manual for instructions for using HART Communicator correctly.

Please consider a minimum of 250 Ohm resistance has to be present in the loop. The loop current is not measured directly by the HART Communicator.

Anywhere along the 4-20 mA wire the HART Communicator can interface with the device.

Please see the picture below (Fig 8.1).

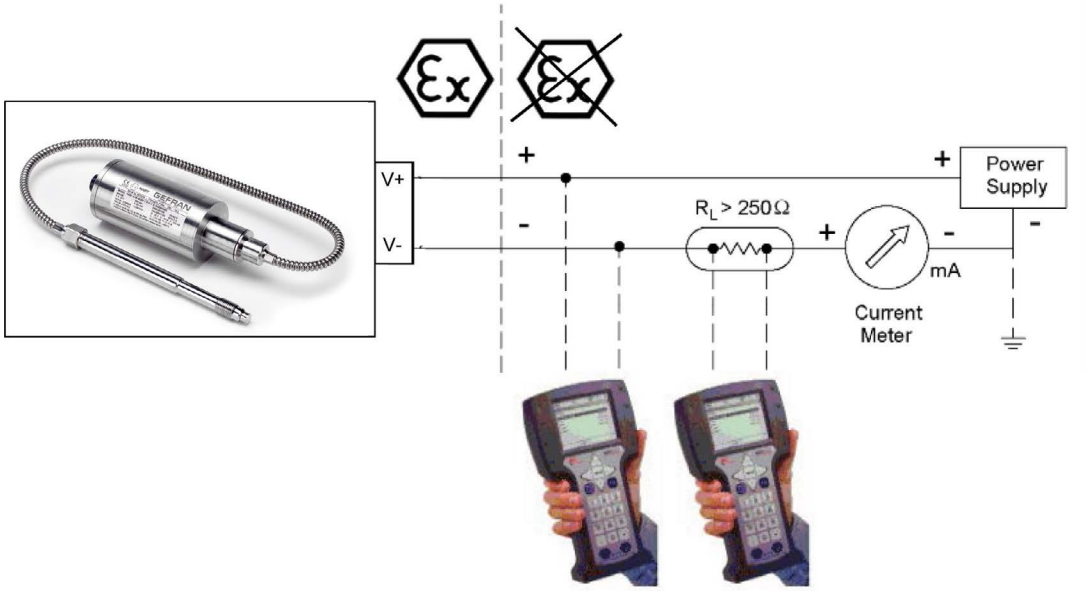


Fig. 8.1 Hart Handheld Communicator Interface

Procedure

1. Connect Power Supply and HART Communicator as in the above drawing.
2. In case of commissioning on the bench with a dead weight tester or with a calibrated pressure generator, please check pressure connection is not leaking.
3. Apply power to the transmitter and switch on the HART Communicator by pressing using the ON/OFF key. The HART Communicator LCD display should show H Pressure Transmitter in the upper left corner. If this is not present, please refer to chapter 9. ”Safety”, Troubleshooting section.
4. Set PV Units (Fast Key 1, 3, 3) to proper pressure unit (e.g. bar, psi, kgf/cm², MPa, etc.).
5. Set Tag (Fast Key 1, 3, 1).
6. In case the transmitter output has to be re-ranged, fix the proper LRV (Fast Key 7,1) and URV (Fast Key 8, 1).

Note: URV can’t be turned down below the PV Minimum span (Fast Key 1, 3, 4).
Attention: after modification of LRV and/or URV value/s, it's needed to verify that the parameterization process has been successfully concluded, through a reference of pressure at LRV and URV values.

7. Fix Lower Trim with device variable trim method (Fast Key 1, 2, 6, 3, 3).
8. Check transmitter output. Zero pressure output should read 4 mA.

Attention:
The following phases are not part of a standard system setup and should be carried out by qualified personnel only. According to this please consider the transmitter is very steady and it’ s been accurately calibrated in our factory using precise pressure sources. Such a task should only be carried out using these type of devices.

9. By means of calibrated pressure generator, apply the same pressure already set in URV during step 6. Output should equal 20mA. In case output isn't 20 mA, please go to step 10.

10. In order to calibrate full scale output, please apply firstly pressure equal to full scale pressure. Then you can proceed to set Upper Trim value with Device Variable Trim method (fast key 1, 2, 6, 3, 3; anyhow please consider Lower Trim value has to be done).
Now output should be the same of the full scale pressure.

11. When transmitter Output Damping is needed, please set PV Damping (fast key 1, 3, 6) to the proper value.

12. Press the left arrow key until the HART Communicator is off-line. Then switch off the power. At this point the pressure transmitter can be installed in the process.

Autozero using HART communication

With the transmitter installed and connected to the measurement instrument without any pressure applied and with the system at the working temperature, once temperature itself is stable, i.e. with a possible variation of ± 1°C, Autozero can be performed. If the zero trim function is selected (fast key 1, 2, 6, 3, 1) the output will be modified to show zero pressure. Such a task is carried out by the transmitter electronics automatically by regulating digital PV to zero while analog output will be 4 mA.

Usually an Autozero is all that is needed once installation is completed as the transmitter span has been calibrated at the factory.

In case the Full Scale Output is not correct when tested with a calibrated pressure source or dead weight tester, the transmitter span can be regulated using the Device Variable Trim method (fast key 1, 2, 6, 3, 3).

Please apply Zero Pressure firstly and follow the prompts on the handheld HART Communicator. Once completed, please apply a known calibrated full scale pressure to the transmitter and follow the prompts on the handheld HART Communicator. Once completed, the digital PV will be corrected to full scale output.

Transmitter functions using HART communication (with fast key sequences)

Autozero (1, 2, 6, 3, 1)
Digital modification to zero: it affects both the digital and analog output. Please consider this operation is different from Lower Sensor Trim as Autozero has to be done ONLY at zero pressure.

Reset Autozero (1, 2, 6, 3, 2)
Reset Autozero correction.

Device Variable Trim (1, 2, 6, 3, 3)
Digital modification to zero and full scale: it affects both the digital and analog output.
Please consider this operation is different from Autozero as Lower Sensor Trim can be made at positive pressures, i.e. above zero.
Note: *Such an operation has to be carried out with a known calibrated pressure source only.*

D/A trim (1, 2, 6, 2)
This function is used to match the digital representation of the analog output with its real analog loop current.
Note: *Such an operation should be carried out with a known calibrated current (mA) meter only*.

Re-range
The 4mA and 20mA points, i.e. LRV and URV respectively, can be regulated in order to improve output resolution. This means a Re-range (also called "Turndown") ratio of 3:1 is possible.
Please consider accuracy data is reliant upon the Full Sensor Range without applying any turndown.

Note: *In case pressure applied to the transmitter is not in the range of the 3:1 turndown ratio, the transmitter will refuse the command.*
Such a condition will be shown by the output not adjusting to 20mA after a few requests.

LRV Rerange (7, 1)

This function is the pressure at which the transmitter will display a 4 mA output as entered directly by the operator. LRV variation affects the transmitter span so the range is restricted by the minimum span value found in fast key (1, 3, 4, 3).

URV Rerange (8, 1)
This is the pressure at which the transmitter will display a 20 mA output as entered directly by the operator. This range is restricted by the minimum span value found in fast key (1, 3, 4, 3).

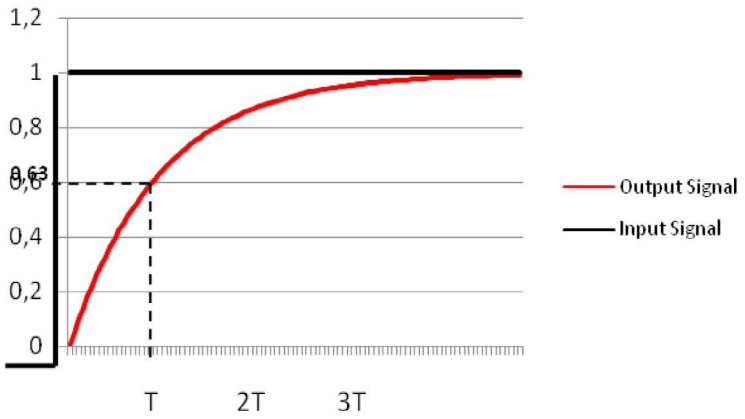
LRV Rerange by applying a known pressure (1, 2, 6, 1, 2)
Such a function is performed by applying a known pressure and starting the procedure in order to set the 4mA point according to the pressure reference value.
Note: *Such an operation should be carried out with a calibrated pressure source only.*

URV Rerange by applying a known pressure (1, 2, 6, 1, 2)
Such a function is performed by applying a known pressure and starting the procedure in order to set the 20mA point according to the pressure reference value.
Note: *Such an operation should be carried out with a calibrated pressure source only*.

Device Variable Trim reset (1, 2, 6, 4)
This function is used to restore the Zero, Lower, and Upper Trim to the factory setting values.

R-Cal (1, 2, 6, 5)
Activating R-Cal, the output will be fixed to the percentage of span fixed by such function.
80% is default value.

Damping (1, 3, 6)
The damping time constant affects the speed with which the output signal reacts to changes in pressure as shown in the figure on the next page.
By default damping is off, but values between 0 and 30 seconds can be fixed using the handheld communicator. Only one decimal digit is allowed.



Status (1, 2, 1, 1)

Reads Device Status.

The status is shown in 3 bytes:

Standardized Device Status:

Bit	Function
0	Reserved
1	Non volatile memory failure
2	Not used
3	Watchdog reset executed
4	Voltage conditions out of range
5	Not used
6	Not used
7	Not used

Sensor Status 1:

Bit	Function
0	Input stage error
1	Sensor overrange
2	Sensor broken
3	Micro controller overheated
4	Error parameter
5	Voltage error
6	Watchdog error
7	Cycle error

Sensor Status 2:

Bit	Function
0	Reserved
1	Sensor under range
2	Low loop voltage
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used

PV Unit (1, 3, 3)
The PV unit sets the unit of measure that the pressure related parameters are transmitted. The transmitter can be configured using several engineering units such as psi, bar, MPa, and kgf/cm² and many others.
After setting a new pressure unit, all entries for pressure are converted to the new unit, using the following rules:

1 psi = 0.068947 bar = 0.0068947 MPa = 0.070309 kgf/cm²

Tag (1, 3, 1)
An inventory “Tag” identification number may be stored in transmitter memory (8 characters maximum). Software tag is a single question mark by default.

Long Tag (1, 3, 2)
An inventory “Long Tag” string (32 byte) may be stored in transmitter memory.

Descriptor (1, 3, 5, 2)
For further transmitter description, e.g. location, function, position, etc., a 16 character text can be input.

Message (1, 3, 5, 3)
A 20 character message can be fixed and displayed on the Hart Communicator.

SV Electronics Temperature (1, 1, 4)
Electronics temperature, i.e. the temperature measured on the electronics housing, is used for reference and factory diagnostics only.

TV Snout Temperature (1, 1, 5)
Temperature measured on Transducer Snout, only for fluid-free models (HI), otherwise it equals to 0.

Poll Address (1, 4, 2, 3, 1)
Multidrop mode allows to have more than one transmitter (up to 15) on a single loop. When this value is different from zero, the transmitter is in Multidrop mode.
For instance a Multidrop mode would be a group of Hart devices wired in parallel on a single fed loop and each device being assigned a unique poll address (1-15).
The Hart communicator would prompt for the single transmitter address to communicate with and would poll that particular device only. All others would remain unvaried.

Burst configuration (1, 4, 2, 3, 4)
If the transmitter is used in Burst Mode, the sensor displays one-way digital communications from the transmitter to the host.
In this case communication speed is faster as the transmitter has not to be polled to send information. Data transmitted in Burst Mode include Pressure Variable, Analog Output value, pressure in percentage of range and Diagnostic Data.
Access to other information can still be obtained through normal Hart command.

Reset to factory default (1, 2, 4)
The transmitter factory settings (including zero and span) can be restored. The list of parameters restored is reported below:

1. Restore LRV and URV to their values at shipment.
2. Restore the Pressure Unit (bar, psi, etc.) to its value at shipment.
3. Set the Analog Output Alarm Level to Low.
4. Remove all Pressure Damping.
5. Clear all Sensor and Analog Output Trim values.
6. Clear Burst Mode.
7. Restore the Address to Zero.
8. Restore the R-Cal option to its value at shipment.

HART Communicator Fast Key Sequences
The Hart Communicator Fast Key sequences are reported in the following table. Please consider Fast Keys as shortcuts to rapidly moving through the menu tree.

HART Communicator Fast Key Sequences

Function	Fast Key Sequence
Read PV Pressure	1, 1, 1
Read % of Full Scale	1, 1, 2
Read Analog Output	1, 1, 3
Read SV Electronics Temperature	1, 1, 4
Read TV Snout Temperature	1, 1, 5
Read Peak Pressure Value	1, 2, 1, 3
Read Peak Temperature Value	1, 2, 1, 2
Read Sensor Diagnostic Status	1, 2, 1, 1
Read PV Minimum Span	1, 3, 4
Perform Sensor Self-Test	1, 2, 2
Perform Sensor Master Reset	1, 2, 3
Perform Loop Test	1, 2, 5
Perform D/A Trim	1, 2, 6, 2
Perform Autozero	1, 2, 6, 3, 1
Reset Autozero	1, 2, 6, 3, 2
Perform Device variable trim	1, 2, 6, 3, 3
Device variable trim reset	1, 2, 6, 4
Set Rcal	1, 2, 6, 5
Set Tag	1, 3, 1
Set Long Tag	1, 3, 2
Set PV Unit	1, 3, 3
Set Lower Range Value (LRV)	1, 3, 4, 5
Set Upper Range Value (URV)	1, 3, 4, 4
Display Lower Set Limit (LSL)	1, 3, 4, 1
Display Upper Set Limit (USL)	1, 3, 4, 2
Set Date	1, 3, 5, 1
Set Descriptor	1, 3, 5, 2
Set Message	1, 3, 5, 3
Set PV Dampening	1, 3, 6
Set PV Analog Output Alarm Type	1, 4, 2, 2, 2
Set Poll Address	1, 4, 2, 3, 1
Set Burst Configuration	1, 4, 2, 3, 4

Alarm and Saturation values burst mode

No special requirements are defined for the burst mode.

Alarm and Saturation values in multidrop mode

If the device is in multidrop mode, the NAMUR levels are no longer achievable. Instead the fail safe condition is indicated by the field device status and by the additional diagnostics.

8.3. Autocompensation effect on impact series

Impact series sensors work on a piezoresistive principle by a silicon chip. All the components need about an accurate thermal compensation either of the zero signal or of the span signal.
This compensation eliminates the sensor drift effects and is realized by the temperature signal digital reading through the silicon chip.
The components thermal inertia can generate signal over/under elongations (<15% FS) during fast thermal gradients. In steady state the signal is correctly compensated.

9. MAINTENANCE

Melt pressure sensors must be installed and electrically connected by trained people, following all applicable recommendations, with zero pressure and voltage, and with the machine switched off.
The sensor must be removed with the plastic in melt state and the machine in hot conditions.
Always remove the sensor before cleaning the machine, using steel brushes or similar tools.
Always wear protective gloves and always take adequate ESD precautions to prevent electrostatic discharges that could damage the sensor.
Always use the wrench for the hexagonal nut when installing and removing the sensor.
DO NOT force the electronics housing.
Once the sensor is removed, clean it gently with a soft cloth while the material is still malleable.

9.1. Transport, storage and disposal

The melt pressure sensors Impact series are realized with piezoresistive silicon technology completely “fluid free”.
Even if these are designed with a thick diaphragm, they must be always transported and stocked with the protection cap and with the package.
Gefran allows melt pressure sensors of own production, also defective units or damage by the use, for the disposal.

10. FUNCTIONAL SAFETY NOTES (FOR SIL 2 / PL d CERTIFIED VERSIONS ONLY)

Safety function(s) and related parameters

The safety function of the transducer is the correct transduction of the pressure in the extrusion chamber in order to detect overpressures and the overcoming of a fixed safety pressure threshold. The transduction is correct when it's within the declared uncertainty.

The designated category to which are limited the use of safety related parts is Category 2.

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, β_D factors	0,02	--
λ_{DD} Analog output Relay output	 4,04E-07 4,22E-07	 1/h 1/h
λ_{DU} Analog output Relay output	 6,18E-08 3,20E-08	 1/h 1/h
DCavg Analog output Relay output	 90 90	 % %
SFF Analog output Relay output	 94,21 96,99	 % %
MTTFd Analog output Relay output	 245 251	 years years
PFH Analog output Relay output	 6,18E-08 3,20E-08	 1/h 1/h
Systematic capability	2	--
SIL (EN IEC 62061) SIL (IEC/EN 61508)	2	--
PL (EN ISO 13849)	d	--
Life time	20	years

In the evaluation three different failures have been excluded:

- Wearing/corrosion of the mechanical parts at the process front end [13849-2:2012 prospect A.4]
- Break of the mechanical parts at the process front end [13849-2:2012 prospect A.4]
- Plastic deformation due to excessive loads of the mechanical parts at the process front end [13849-2:2012 prospect A.4]

Effect on the safety function of the performance variations

The limit of performance degradation in order to avoid the loss of the safety function is ± 5% of the span at room temperature.

SRP/CS interface and protection devices

The interface to controller can be:

- the multi-polar connector type VEAM VP07RA10-6PT2 (code GEFRAN CON301),
- the multi-polar connector type BENDIX PC02E-12-8P 8 poles (CON356)
- the multi-polar cable outlet with conduit output type ½ 14-NPT as illustrated in fig.7.1, where are also pointed out the connections (2 wires connection current amplified).

  In the case of relay output with output in current (2 wires) the connections are shown in fig. 7.2.

Response time

The response time of the safety function is:
Analog output = 250 ms
Relay output = 1s

The response time of diagnostic functions is:
Analog output = 500 ms
Relay output = 500 ms

Suspension of the safety function

In H series transducer it's not allowed any suspension or bypass of the safety function.

Indications and alarms

The H series transducers can have two different electrical outputs: analog amplified (4.20 mA) and, in addition as an option, a relay output.

In fig. 10.2 are shown the significant values of the output in case of analog signal:

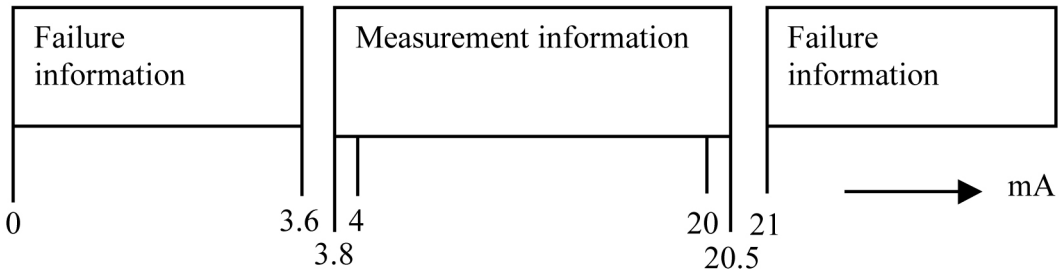


Fig. 10.2 - Output levels

In case of relay output, the relay will be closed only if:

1. There are no failures detected by diagnostics
2. The detected pressure is below the threshold

In all the others situations, the relay is normally open.

In table 10.3 are pointed out the failures, their effects on the output signal, on the relay output and how to reset them: (see Fig. 10.2 for Analog output levels)

Failure	Analog output	Relay output	How to reset
Supply wire broken	LOW	OPEN	Remove failure
Sensor unconnected	LOW	OPEN	Remove failure
Supply system broken	LOW	OPEN	Remove failure
Broken primary element	HIGH	OPEN	Send sensor to factory for repair
Broken chip	HIGH	OPEN	Send sensor to factory for repair
Pin detachment	HIGH	OPEN	Send sensor to factory for repair
Pressure over 150% of the span vs factory zero @ RT	HIGH	OPEN	Switch off and on; if error persists send to factory for repair
Preload loss exceeds -30 % of span vs factory zero @ RT	HIGH	OPEN	Switch off and on; if error persists send to factory for repair
Overvoltage	LOW(*)	OPEN	Switch off and on; if error persists send to factory for repair
Undervoltage	LOW(*)	OPEN	Switch off and on; if error persists send to factory for repair
Primary or front end stage error	HIGH	OPEN	Switch off and on; if error persists send to factory for repair
Program sequence error	LOW(*)	OPEN	Switch off and on; if error persists send to factory for repair
Overtemperature on electronics	LOW(*)	OPEN	Switch off and on; if error persists send to factory for repair
Error in RAM memory	LOW	OPEN	Switch off and on; if error persists send to factory for repair
Error in ROM memory	LOW	OPEN	Switch off and on; if error persists send to factory for repair
Error in CPU	LOW	OPEN	Switch off and on; if error persists send to factory for repair
Analog output error	LOW	OPEN	Switch off and on; if error persists send to factory for repair

Tab. 10.3 - Failures, effect on electrical outputs and reset
(*) In such conditions the Alarm Type can be programmed via HART at HIGH.

The HIE P/S and HIX P/S series are fully compatible with the NE21 and NE43 Namur recommendations
In the H series melt sensors, no hardware feedback have been implemented.

Alarm and Saturation values burst mode
No special requirements are defined for the burst mode.

Alarm and Saturation values in multidrop mode
If the device is in multidrop mode, the NAMUR levels are no longer achievable. Instead the fail safe condition is indicated by the field device status and by the additional diagnostics.

Mainteinance and troubleshooting

To maintain the device in the designated category it must be used only by skilled people and strictly following the present safety instructions and the operating manual regarding the mechanical installation, the electrical connection, the maximum rated and environmental conditions.

Visual inspection of the process front end membrane and of the pitch of the thread

The activity evaluates abnormal abrasion or wearing due to uncorrect mounting or by aggresive process materials. The thread pitch inspection must assure the sensor integrity to avoid fluid outcoming from the extrusion chamber or poor sealing of the sensor mounted in its side.

Periodicity: every 1 year.

Installation hole check

The activity evaluates the hole profile and dimensions in order to avoid failures or sensor bad functioning.

Periodicity: every 2 years.

Sensor calibration check

The activity evaluates the sensor transduction characteristic curve. This is implemented by applying known pressure and checking the output detected values.

Periodicity: every 2 years.

Pressure channel occlusion check

The activity evaluates the presence of eventual occlusions of the pressure channel which will lead to improper functioning. At any new installation or re-installation use anti-seize compound paste in order to avoid grip of the thread.

Periodicity: it is good practice to make the control whenever any variation of the operating conditions occurs, i.e. variation related to the material and/or the temperature, which can cause pressure channel occlusions.

Command modes check

The activity evaluates the proper functioning of the command modes and their effects on the sensor. This is implemented by feeding the sensor out of the line and performing the following operations: RESET AUTOZERO, AUTOZERO, CALIBRATION.

Periodicity: every 2 years.

In the tab. 10.4 the most common failures and troubleshooting are pointed out:

Failure	Possible causes	Troubleshooting
The sensor doesn't signal pressure and no alarm signal is activated	• Pressure channel occlusion • Output stage failure • Over Pressure from 106,5% to 200% of span (HM/HW/HK) • Over Pressure from 106,5% to 150% of span (HI)	1 - Sensor power-off and disassembly 2 - Double check possible pressure channel occlusion and clean it from residuals or material 3 - Do the AUTOZERO function. If the problem persists, send the sensor to factory for repair 4 - Reduce the process pressure under the F.S. value 5 - Switch on the sensor off-line and slightly press with the finger the membrane; if the output signal is stable, send it for factory reparation
The sensor alarm signal is "HIGH"	• Broken primary element • Input stage error • Detected pressure value over threshold (2 x 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 • Overtemperature on electronics • Pin detachement	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 manual
The CAL function doesn't work	• Broken electronics • Zero signal threshold out of range • Broken connector/cut cable	1 - Stop the machine 2 - Make the TOTAL RESET OF THE CALIBRATION VALUES; if the value is outside ± 20 % FS, disassemble the sensor, check and clean the hole, mount again the sensor and re-do the CAL function 3 - If the zero is within ± 20 % FS, check cable and connector 4 - If the problem persists, send the sensor to factory for repair
The AUTOZERO function doesn't work	• Broken electronics • Zero signal outside activation range • Broken connector/cable (only external autozero version) • Wrong magnetic pen positioning	1 - Check the correct magnetic pen positioning on the autozero logo 2 - If the problem persists, stop the machine 3 - Make the TOTAL RESET OF THE CALIBRATION VALUES; if the value is outside ± 40 % FS, disassemble the sensor, check and clean the hole, mount again the sensor and re-do the AUTOZERO function 4 - If the zero is within ± 40 % FS, check cable and connector 5 - If the problem persists, send the sensor to factory for repair
Transmitter not communicating with HART communicator	• Broken electronics • HART communicator wrongly connected	4. Check Power Supply 5. Verify HART communicator connection 6. Verify 250 ohm series resistor
HART communicator missing HW/HM/HK/HI series features	• Broken electronics • HART communicator wrongly connected • HART communicator database (DD) not updated	5. Check Power Supply 6. Verify HART communicator connection 7. Verify 250 ohm series resistor 8. Verify HART communicator database

Tab. 10.4 Most common failures and troubleshooting

Application for use relevant to the designated category

The HIE P/S and HIX P/S series transducer can be used in a pressure sensing chain in order to stop any pressure generating system if a pressure threshold is overcome.
The threshold is only set in factory and can't be changed by the user.

In diagram "A" (Fig. 10.5) is shown a possible application: the sensor detects the pressure and gives in output an analog electrical value proportional to the pressure itself; SRP/CS compares the signal with its internal alarm threshold: if the threshold is exceeded the SRP/CS will stop the pressure generation systems.

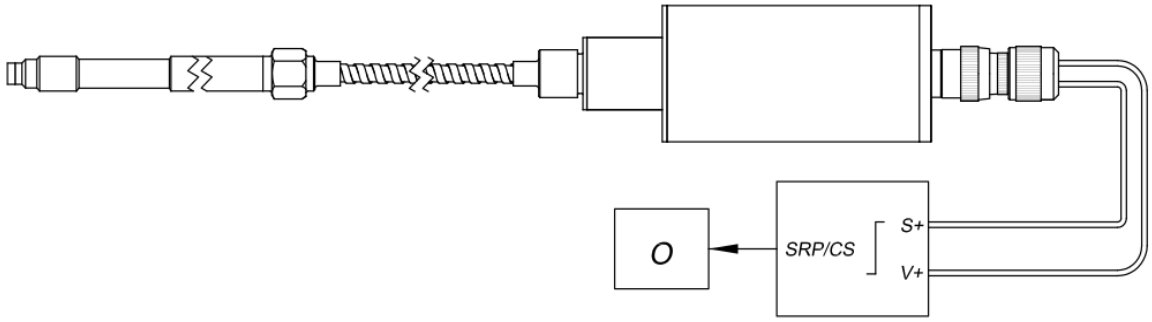


Fig. 10.5 - Application diagram A - Current 2-wires output

In diagram "B" (Fig. 10.6) is shown a second possible configuration with the relay output: the sensor detects the pressure and compares it with a fixed threshold set in the factory and not changeable by the user; if the threshold is exceeded, the relay will change to normally open; the relay output is interfaced with an enable input of the pressure generating system motor drive; when the threshold is exceeded, the open state of the relay stops the pressure generating systems.

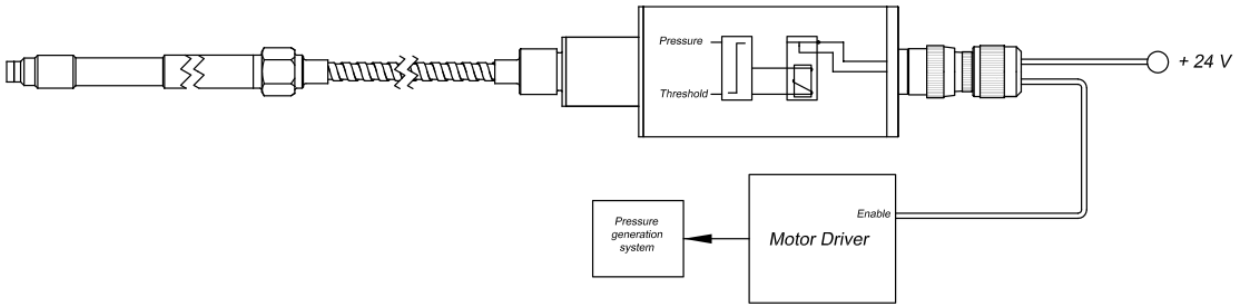


Fig. 10.6 - Application diagram B – Relay Output (Not for "X" versions)

11. RELAY APPLICATION NOTES

Contacts

Relay manufacturers assume you will be using resistive loads when they rate their relays.
The load is a simple resistive element, and it is assumed that the current flow through the contacts will be fairly constant, although some increase may occur due to arcing during "make" or "break." Ideally, a relay with a purely resistive load can be operated at its stated voltage and current ratings and attain its full lifetime.

Precautions for the Contacts

Contacts are the most important elements of relay construction. Contact life is influenced by contact material, voltage and current value applied to the contacts, the type of load, switching frequency, ambient atmosphere, form of contact and the contact bouncing etc.
The material transfer, welding, abnormal usage and the increase in contact resistance bring about the failure of the contacts. Please pay attention to them in application.
In order to better apply the relay, please refer to the following precautions of the contacts.

Inductive loads

Switching inductive loads is difficult, primarily because current tends to continue to flow in inductors, even as contacts are being broken.
The stored energy in inductors induces arcing; arc-suppression schemes are frequently used.
When you are switching inductive loads, you typically will want to derate relay contacts to 40 percent of the resistive load rating.

Capacitive loads

Capacitors resemble short circuits when they are charging, so the in-rush current from a capacitive load can be very high. Series resistors are often used to limit in-rush current; without a limiting resistor, contact welding may occur.

When you are switching capacitive loads, you typically will want to derate relay contacts to 75 percent of the resistive load rating.

Motor loads

When an electric motor starts up, it has very low impedance and requires a large in-rush current to begin building a magnetic field and begin rotating. Once it is running, it generates a back electromagnetic force (emf), which can cause a large inductive spike when the switch is opened. The result is a large in-rush current at “turn-on” and arcing at “turn-off.”

When you are switching a motor load, typical industry practice is to derate to 20 percent of the resistive rating.

Type of load and inrush current

The type of load and its inrush current characteristics, together with the switching frequency, are important factors which cause contact welding.

The table shows the relationship between typical loads and their inrush currents.

Type of load	Inrush current
Resistive load	Steady state current
Solenoid load	10 to 20 times the steady state current
Motor load	5 to 10 times the steady state current
Incandescent lamp load	10 to 15 times the steady state current
Mercury lamp load	Approx. 3 times the steady state current
Sodium vapor lamp load	1 to 3 times the steady state current
Capacitive load	20 to 40 times the steady state current
Transformer load	5 to 15 times the steady state current

Load Inrush Current Wave and Time

Inrush Current And The Reverse Voltage

When the motor, capacitance, solenoid and lamp load make, the inrush current is generated, which is several multiple steady state currents.

When the inductive load such as solenoid, the motor, contactor, the reverse voltage which are from hundreds of to thousands of volts.

Generally in the normal temperature and atmospheric pressure the critical insulation destruction voltage of the air is 200 to 300V.

Therefore if the reverse voltage exceeds this value, the discharge phenomena between contacts will happen.

Both inrush current and the reverse voltage will greatly damage the contacts and obviously shorten the relay life.

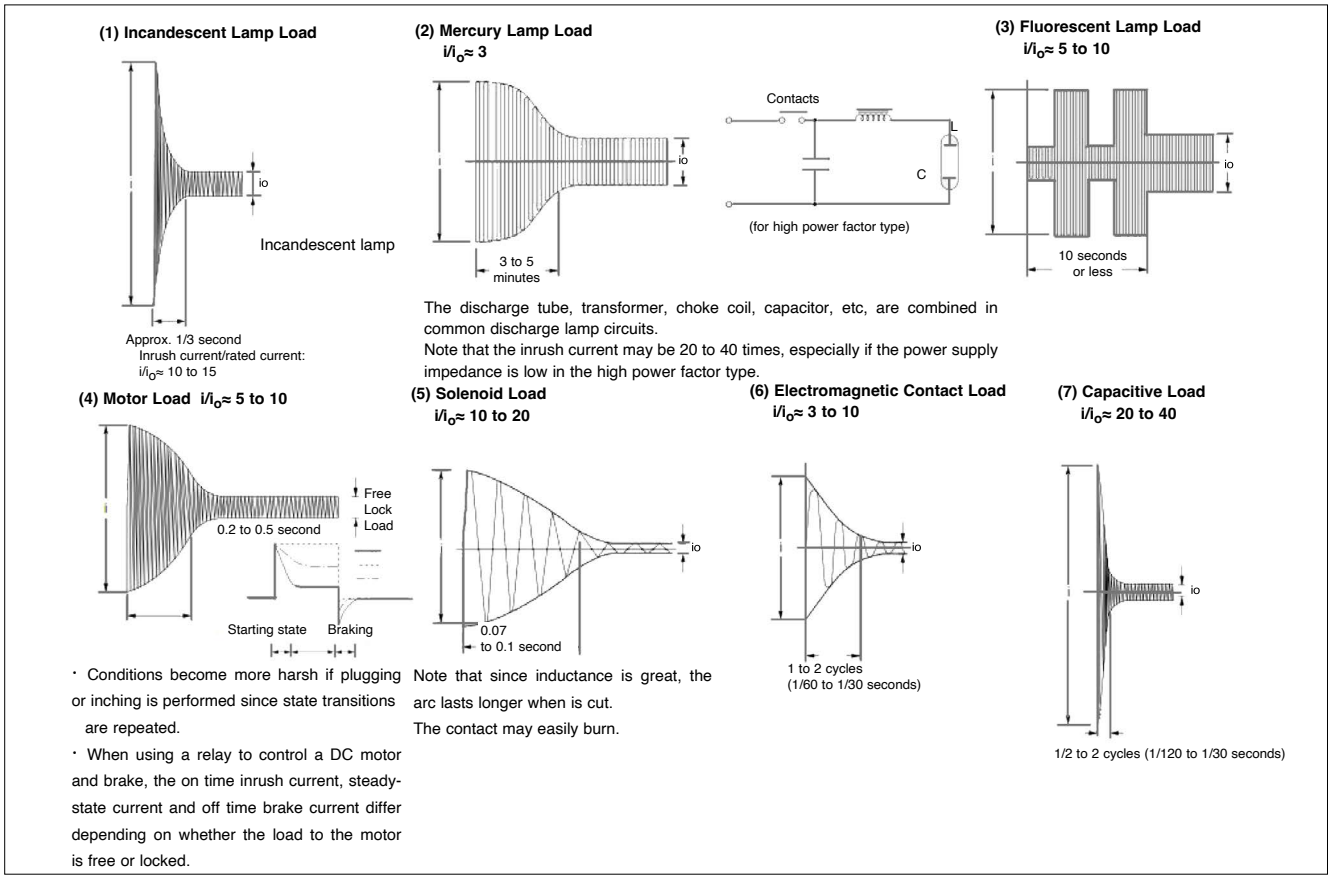
Therefore the proper use of the contact protection circuit may increase the life of the relay.

Material Transfer Of Contacts

Material transfer of contacts occurs when one contact melts or boils and the contact material transfers to the other contact.

This often occurs in circuits where electrical arcs are produced at the moment the contacts “make” such as when the DC current is large for inductive or capacitive loads or when the inrush current is large (several amperes or several tens of amperes).

When material transfer becomes serious, the deformation of the contact surface can be seen by eyes, as shown in figure 11.1.



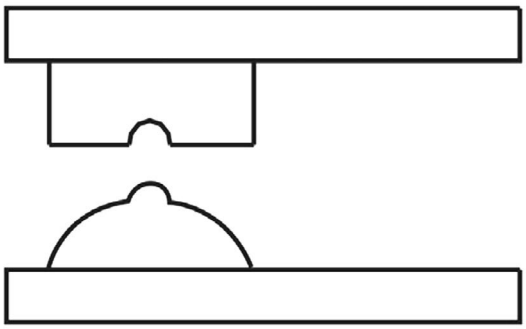


Figure 11.1

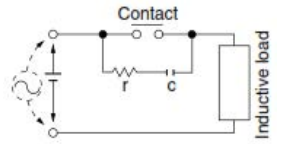
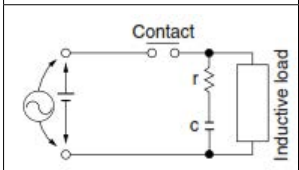
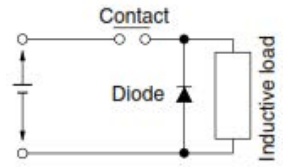
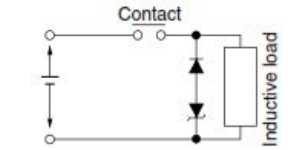
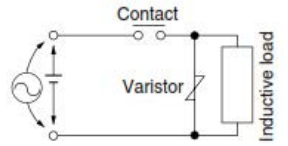
Generally, a concave formation appears on the cathode and a convex formation appears on the anode.

Contact protection circuit

Use of contact protective devices or protection circuits can suppress the counter emf to a low level.
However, note that incorrect use will result in an adverse effect.
Typical contact protection circuits are given in the table below.

Contact protection circuit: Inductive load

Circuit	Voltage		Features/Others	Devices Selection
	CA	CD		

CR circuit		C*	G	If the load is a timer, leakage current flows through the CR circuit causing faulty operation. * If used with AC voltage, be sure the impedance of the load is sufficiently smaller than that of the CR circuit	As a guide in selecting "c" and "r", **c : 0.5 µF to 1µF for 1A contact current** **r : 0.5 Ω to 1 Ω per 1V contact voltage** Values vary depending on the properties of the load and variations in relay characteristics. Capacitor "c" acts to suppress the discharge the moment the contacts open. Resistor "r" acts to limit the current when the power is turned on the next time. Use a capacitor "c" with a breakdown voltage of 200 to 300V. Use AC type capacitors (non polarized) for AC circuits.
		G	C	If the load is a relay or solenoid, the release time lengthens. Effective if the power supply voltage is 24 or 48V.	
Diode circuit		NG	G	The diode connected in parallel causes the energy stored in the coil to flow to the coil in the form of current and dissipates it as joule heat at the resistance component of the inductive load. This circuit further delays the release time compared to the CR circuit. (2 to 5 times the release time listed in the catalog)	Use a diode with a reverse breakdown voltage at least 10 times the circuit voltage and a forward current at least as large as the load current. In electronic circuits where the circuit voltages are not so high, a diode can be used with a reverse breakdown voltage of about 2 to 3 times the power supply voltage.
Diode and zener circuit		NG	G	Effective when the release time in the diode circuit is too long.	Use a zener diode with a zener voltage about the same as the power supply voltage.
Varistor circuit		G	G	Using the stable voltage characteristics of the varistor, this circuit prevents excessively high voltages from being applied across the contacts. This circuit also slightly delays the release time.	-
(G: Good, NG: No Good, C: Care)					

Mounting the protective device

In the actual circuit, it is necessary to locate the protective device (diode, resistor, capacitor, varistor, etc.) in the immediate vicinity of the load or contact.

If located too far away, the effectiveness of the protective device may diminish. As a guide, the distance should be within 50cm.

Switching Capacitive Loads

Using relays to switch capacitive loads requires special care. When a switch closes, a transient current flows to charge the capacitance. This inrush current may be substantially higher than the steady-state current through the system.

Relay's contact welding may occur because of this high inrush current, even though the voltage and steady-state currents are within the switch specifications.

Any capacitance in the system can contribute to inrush currents, whether it is in a reactive device or from a shielded cable.

Inrush currents can be controlled with series impedance, such as a resistor (**about 30 Ω to 50 Ω**), between the switch and the capacitance, as shown in figure 11.2.

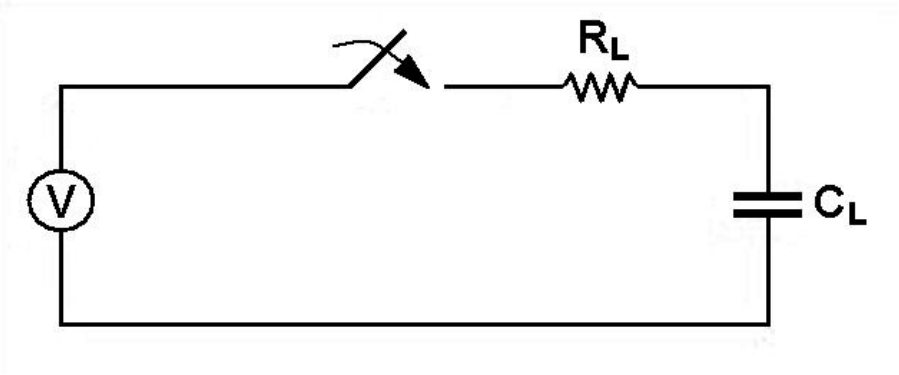


Figure 11.2

Precautions for using the long lead wire

If long wires (> 10 m) are to be used in a relay contact circuit, inrush current may become a problem due to the stray capacitance existing between wires.

Please connect in series the resistance (**10 Ω to 50 Ω**) in the contact circuit, as shown in figure 11.3.

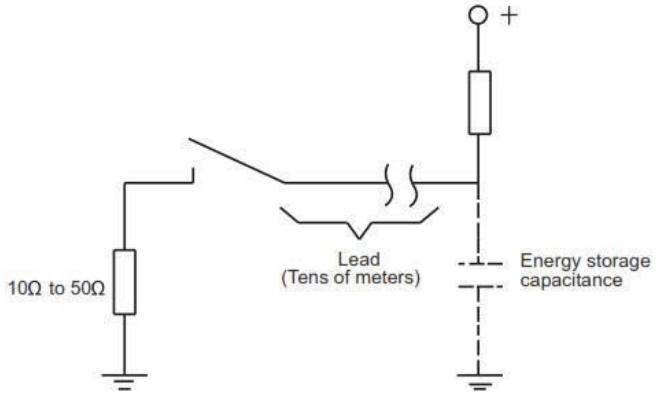


Figure 11.3

Riferimenti:

National Instruments*: http://www.ni.com/white-paper/4197/en/*

Panasonic Corporation*: General application Guidelines ASCTB250E 201402-T*

Hongfa Relay*: Explanation of terminology and guidelines of relay*

Fujitsu Components*: Engineering Reference Relays*

Agilent Technologies Inc *: Application Note 1399*

The HIX transmitters are designed and produced in compliance with:

- ATEX Directive 2014/34/EU According to EN IEC 60079-0:2018, EN 60079-11:2012, EN 60079-26:2015 (see EU Conformity declaration for updated conformity)
- IECEx scheme according to IEC 60079-0:2017, IEC 60079-11:2011
- EAC TR CU 012/2011 regulation
- KCs regulation according to 21-KA4BO-0670 (HIX)
- Nepsi Ex regulation according to GB 3836.1-2010,GB 3836.4-2010,GB3836.20-2010
- PESO CCoE regulation

12. SAFETY NOTES FOR APPLICATIONS IN POTENTIALLY EXPLOSIVE ATMOSPHERES: HIX VERSION

Type of Protection:
• ATEX: group II, category 1G, 1D
GAS type of protection: Ex ia IIC T6, T5, T4 Ga (Ambient Temp.: -20°C...+60°C / +75°C / +85°C)
DUST type of protection: Ex ia IIIC T_{200}85°C, T_{200}100°C, T_{200}110°C
Da IP65 (Ambient Temp.: -20°C...+60°C / +75°C / +85°C)

• IECEx / KCs / Nepsi Ex / PESO: group II, category 1G
GAS type of protection: Ex ia IIC T6, T5, T4 Ga (Ambient Temp.: -20°C...+60°C / +75°C / +85°C)

• EAC Ex: group/category 0
GAS type of protection: Ex ia IIC T6, T5, T4 Ga (Ambient Temp.: -20°C...+60°C / +75°C / +85°C)
DUST type of protection: Ex ia IIIC T_{200}85°C, T_{200}100°C, T_{200}110°C
Da IP65 (Ambient Temp.: -20°C...+60°C / +75°C / +85°C)

Take care that the instruments in the loop are connected in accordance with intrinsically safe installation guidelines before inserting an HART communicator in the loop in an hazardous area.

Operate only with an intrinsically safe, EMC compliant power supply with the following specifications when employing the pressure 4-20 mA output:

- Supply Voltage max. U_o = 30 V
- DC Current Output max. I_o = 100 mA
- Power max. P_o = 0.750 W

The specified values of L_o and C_o for the power supply need to be greater than $C_i + C_{cable}$ and $L_i + L_{cable}$.

- Internal Inductance L_i = 17 uH
- Internal Capacitance C_i = 10 nF

For the models with external Autozero/CAL, the function must be activated only by short circuit on the cable conductors or on cable clamp. No other active electronics circuit is allowed.

Please avoid any dust accumulation on the transmitter.

Installation and maintenance must be held in accordance with International installation and maintenance guidelines for explosive gas atmospheres, such as:

- IEC/EN 60079-14
- IEC/EN 60079-17
- Other national guidelines/standard

一、产品使用注意事项

1、产品的使用环境温度范围为：

温度组别	使用环境温度 Ta
T4	-20°C ~+85°C
T5	-20°C ~+75°C
T6	-20°C ~+60°C

2、 变送器应与已通过防爆认证的关联设备配套共同组成本安防爆系统方可使用于爆炸性气体环境。其系统接线必须同时遵守本产品和所配关联设备的使用说明书要求，接线端子不得接错。本安参数及最大内部等效参数见下表：

最高输入电压 Ui (V)	最大输入电流 Ii (mA)	最大输入功率 Pi (W)	最大内部等效参数	
			Ci(nF)	Li (μH)
30	100	0.75	10	17

Ci和Li的参数包括：连接电缆的电容和电感（最大长度15m）。

3、 产品与关联设备的连接电缆应为带绝缘护套的屏蔽电缆，其屏蔽层应接地。

4、 用户不得自行随意更换该产品的电气零部件，应会同产品制造商共同解决运行中出现的故障，以免影响防爆性能和损坏现象的发生。

5、 产品的安装、使用和维护应同时遵守产品说明书、GB3836.13-2013“爆炸性环境第13部分：设备的修理、检修、修复和改造”、GB/T3836.15-2017“爆炸性环境 第15部分：电气装置的设计、选型和安装”、GB/T3836.16-2017“爆炸性环境 第16部分：电气装置的检查和维护”、GB/T3836.18-2017“爆炸性环境 第18部分：本质安全电气系统”、GB15577-2018“粉尘防爆安全规程”及GB50257-2014“电气设备安装工程爆炸和火灾危 险环境电气装置施工及验收规范”的有关规定。

GEFRAN

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