

*cod. 80177F Edit. 10/2021 - 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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## 1. GENERAL INFORMATION

This manual applies to KE - K7 Performance Level “c” 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 followed 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

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### 1.3 Correct use

Gefran Melt pressure sensors with amplified electrical output 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: 538°C.

If the sensors are used as a safety component in compliance with the Machinery Directive, it's necessary to read carefully the “Safety Manual” (chapter 8, pag.10).

## 2. MECHANICAL DIMENSIONS

For the mechanical dimensions keep as reference the product datasheets or Gefran website [www.gefran.com](http://www.gefran.com)

## 3. INSTALLATION AND POSITIONING ON THE MACHINE

### TECHNICAL DATA

Extrusion processes require very high temperatures. Extrusion pressure can be checked by means of especially designed transducers.

Thanks to their special mechanical construction, in which the measurement element is isolated from the Melt, they resist to such high temperatures. The constructive principle is based on hydraulic of pressure; mechanical strain is transferred by means of a non-compressible transmission liquid.

Strain gauge technology translates the physical quantity (pressure) into an electrical signal.

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 coaxialities greater than 0.2 mm will break the transducer during assembly.

It is essential that hole depth guarantees 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.

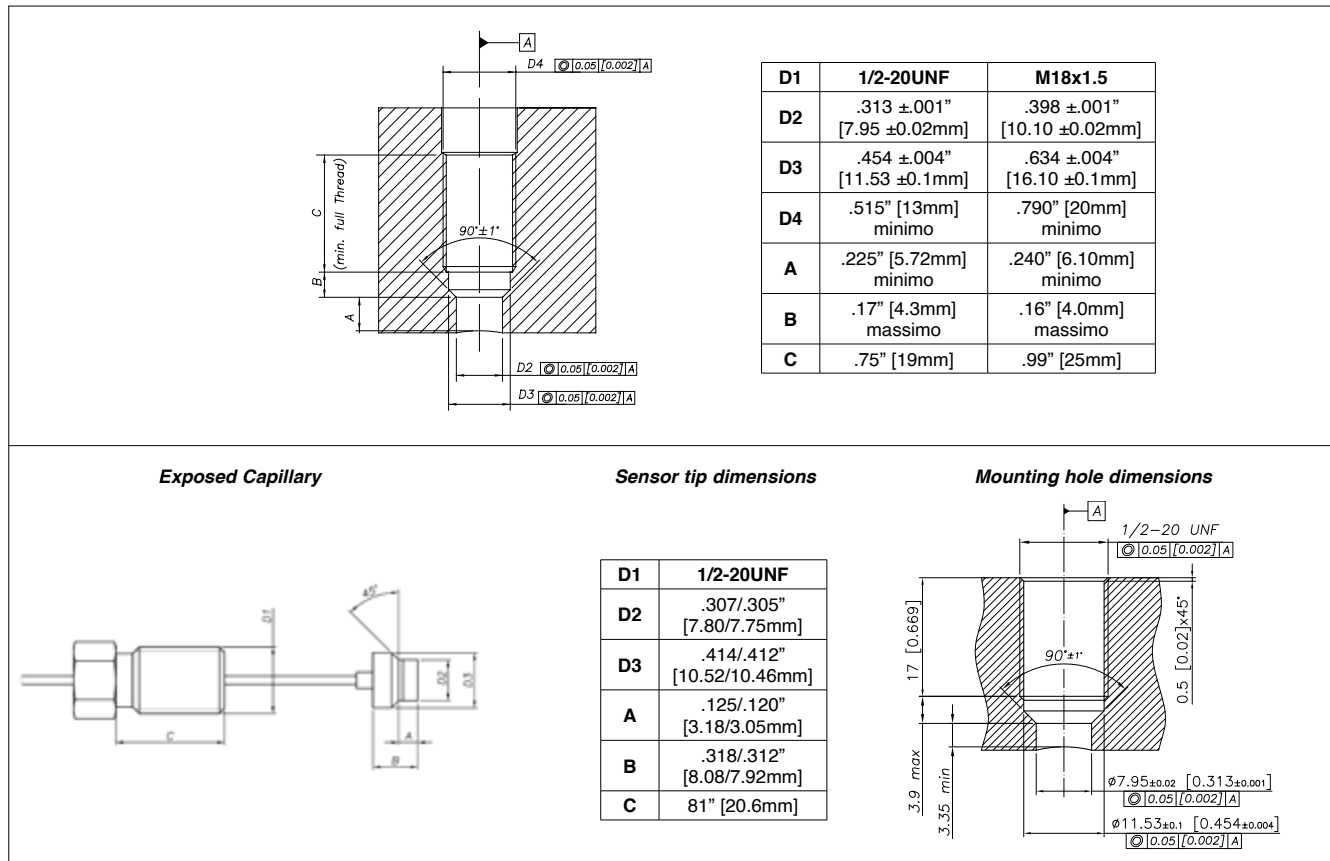
**d)** The transducer should be removed only with the machine empty (without pressure) but still hot.

**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.

### 3a - Installation seat

The installation seat has to be realized:



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:

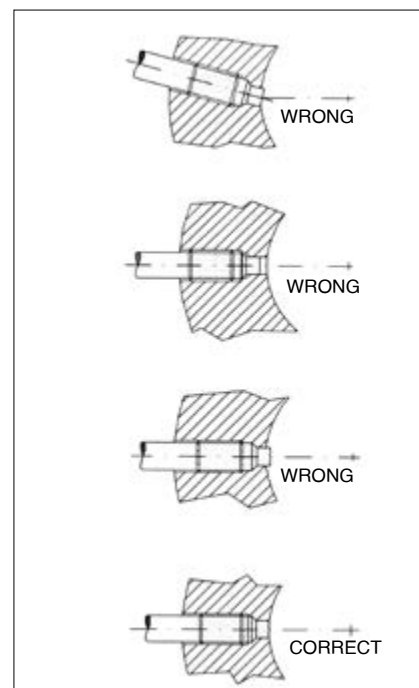
- 1) Coat the end of the rod with the appropriate ink.
- 2) Lubricate the threaded part to prevent friction.
- 3) Insert the dummy plug and screw it fully down.
- 4) Remove the rod and examine it.

With the exception of 45° surfaces, the ink should be intact on the entire surface.

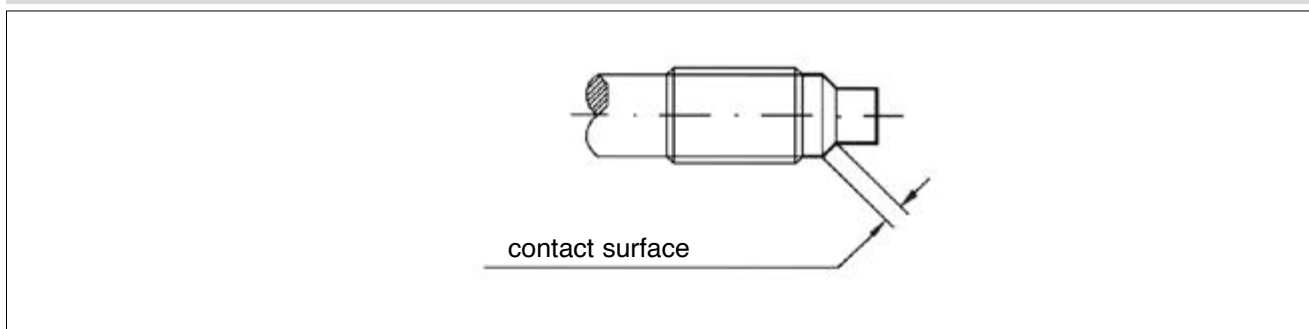
## DRILLING TOOL KIT

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 tip.
- 3) Lubricate 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: 50 Nm, the maximum is 56.5 Nm.

### 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.

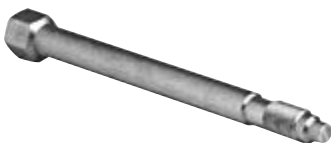


Figure 1



Figure 2

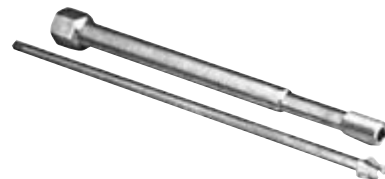


Figure 3

## 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	

#### Connections

The sensors have to be connected as shown in the diagram on the next pages.

To obtain a higher immunity from field noise, connect the cable shield to the female connector case on sensor side.

#### Calibration procedure

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  $\pm 1^{\circ}\text{C}$ . Consequently Autozero can be activated.  
 This delay gives the system time to recognize and compensate all the signal drifts caused by tightening and temperature.  
 Additional Autozero activations could be run once the temperature stability is reached, with  $\pm 1^{\circ}\text{C}$  of possible variation.
- 2) Calibrate the instrument and have it display the calibration value shown on the transducer data plate (80% of full scale). 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.

## 4. NE21 AND NE43 COMPATIBILITY SPECIFICATIONS

The KE and K7 series are fully compatible with the NE21 and NE43 Namur recommendations (refer to tab. 1).

**Table 1 - NAMUR NE21 and NE43: Analog output value**

Failure	KE series (current output)	K7 series (voltage output)
Broken power cable	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Sensor not connected	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Broken power supply	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
DT strain gauge bridge links	Electrical output $> 21 \text{ mA}$	Electrical output $> 11.125 \text{ V}$
Pressure over 200% of the zero-relative span factory @ RT	Electrical output $> 21 \text{ mA}$	Electrical output $> 11.125 \text{ V}$
Overvoltage	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Undervoltage	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Voltage variations	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Error in the program sequence	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Overheating of the electronics	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$
Error on primary or first amplification stage	Electrical output $< 3.6 \text{ mA}$	Electrical output $< 0.25 \text{ V}$

## 5. SENSOR TECHNICAL SPECIFICATIONS

### 5a - KE series Performance Level “c” - Technical data

Accuracy (1)	<b>H</b> $\leq \pm 0.25\%$ FSO (100...1000 bar) <b>M</b> $\leq \pm 0.5\%$ FSO (35...1000 bar)
Resolution	16 bit
Measurement range	0..17 to 0..1000bar 0..250 to 0..15000psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 700bar/10000psi
Measurement principle	Extensimetric
Power supply	13...30Vdc
Maximum current absorption	23mA (40mA with relay optional)
Output signal Full Scale (FSO)	20mA
Zero balance (tolerance $\pm 0.25\%$ FSO)	4mA
Response time (10...90% FSO)	8ms
Output noise (RMS 10-400Hz)	$< 0.025\%$ FSO
Calibration signal	80% FSO
Power supply polarity reverse protection	YES
Compensated temperature range housing	0...+85°C
Operating temperature range housing	-30...+85°C
Storage temperature range housing	-40...+125°C
Thermal drift in compensated range: Zero / Calibration / Sensibility	$< 0.02\%$ FSO/°C
Diaphragm maximum temperature	538°C / 1000°F
Zero drift due to change in process temperature (zero)	$< 3.5$ bar/100°C / $< 28$ psi/100°F
Thermocouple (model KE2)	STD : type “J” (isolated junction)
Protection degree (with 6-pole female connector)	IP65
FSO = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability.	

Sensors are manufactured in compliance with:

- EMC directive
- RoHS directive
- Machinery directive

Electrical installation requirements and Conformity certificate are available on our web site: [www.gefran.com](http://www.gefran.com)



## 5b - K7 series Performance Level "c" - Technical data

Accuracy (1)	<b>H</b> <±0.25% FSO (100...1000 bar) <b>M</b> <±0.5% FSO (35...1000 bar)
Resolution	16 bit
Measurement range	0..17 to 0..1000bar 0..250 to 0..15000psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 700bar/10000psi
Measurement principle	Extensimetric
Power supply	18...30Vdc
Maximum current absorption	15mA (30mA with optional relay)
Output signal Full Scale (FSO)	10,5Vdc
Zero balance (tolerance ± 0.25% FSO)	0,5Vdc
Response time (10...90% FSO)	8ms
Output noise (RMS 10-400Hz)	< 0.025% FSO
Calibration signal	80% FSO
Power supply polarity reverse protection	YES
Compensated temperature range housing	0...+85°C
Operating temperature range housing	-30...+85°C
Storage temperature range housing	-40...+125°C
Thermal drift in compensated range: Zero / Calibration / Sensibility	< 0.02% FSO/°C
Diaphragm maximum temperature	538°C / 1000°F
Zero drift due to change in process temperature (zero)	< 3.5 bar/100°C / < 28 psi/100°F
Thermocouple (model K72)	STD : type "J" (isolated junction)
Protection degree (with 6-pole female connector)	IP65
FSO = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability.	

Sensors are manufactured in compliance with:

- EMC directive
- RoHS directive
- Machinery directive

Electrical installation requirements and Conformity certificate are available on our web site: [www.gefran.com](http://www.gefran.com)

## 6. TRANSPORT, STORAGE AND DISPOSAL

Melt sensors are made with "Filled" technology and contain a pressure transmission fluid.

Low-compression fluid such alloy of sodium and potassium is used.

Fluid volumes depend on the mechanical structure of the sensor, and leaks can occur only if the contact diaphragm is broken.

Any other type of break will not cause emission to the environment.

Never transport store the sensors without the protective cap and without the original packaging.

Gefran accepts its Melt sensors (defective or damaged by use) for disposal.

## 7. SAFETY

NaK, composed of Sodium and Potassium (22 Na / 78 K), is an eutectic alloy (i.e., a mixture of two or more substances with a lower melting point than that of its single components) with low compressibility and excellent resistance to high temperatures (up to 538°C).

Above all, it is a non-toxic liquid metal that is recognized as GRAS (Generally Regarded As Safe).

This allows K series Melt sensors to work in contact with materials used for foods (wrapping films, beverage containers, etc.) or for pharmaceuticals/cosmetics (drug containers, soaps, etc.).

In addition, it is totally compatible with the European RoHs (Restriction of Hazardous Substances) Directive with regard to electrical and electronic equipment.

If the contact diaphragm breaks due to the application, NaK tends to oxidize or to react with the contact medium (especially in the presence of water or dampness) by an exothermic reaction.

This generates a spark which, due to the scarcity of material contained (from 20 to 40mm<sup>3</sup> on the average), can last few seconds (maximum of 5).

## 8. FUNCTIONAL SAFETY NOTES (FOR PL c CERTIFIED VERSIONS ONLY)

### Application

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

The pressure sensors KE/K7 perform the following safety function:

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 specifications written in the datasheet and in the current operation manual.

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

Parameter	Value	Measuring Unit
Category	2	-
DC <sub>avg</sub>	Low	-
MTTF <sub>D</sub>		
Current output	74	Years
Voltage output	73	Years
Relay output	72	Years
PFH <sub>D</sub>		
Current output	1,54E-06	1/h
Voltage output	1,56E-06	1/h
Relay output	1,60E-06	1/h
PL	c	-

In the evaluation three different failure types have been excluded:

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

## Limitations and maintenance

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 PL. The sensors must be powered by non-distributed networks and in any case with a length of less than 30 m.

The periodical maintenance activities to be done in order to preserve the device in the designated category are:

- Visual inspection of the process front end membrane and of the pitch of the thread, in order to evaluate abnormal abrasion or wearing due to incorrect mounting lasting in time.  
Every 1 year.
- Installation hole inspection: correct profile and dimension and absence of material residuals or occlusions of the pressure channel. Every 2 years.
- At any new installation or re-installation use anti-seize compound paste in order to avoid grip of the thread.

## Effect on the security function of the performance variations

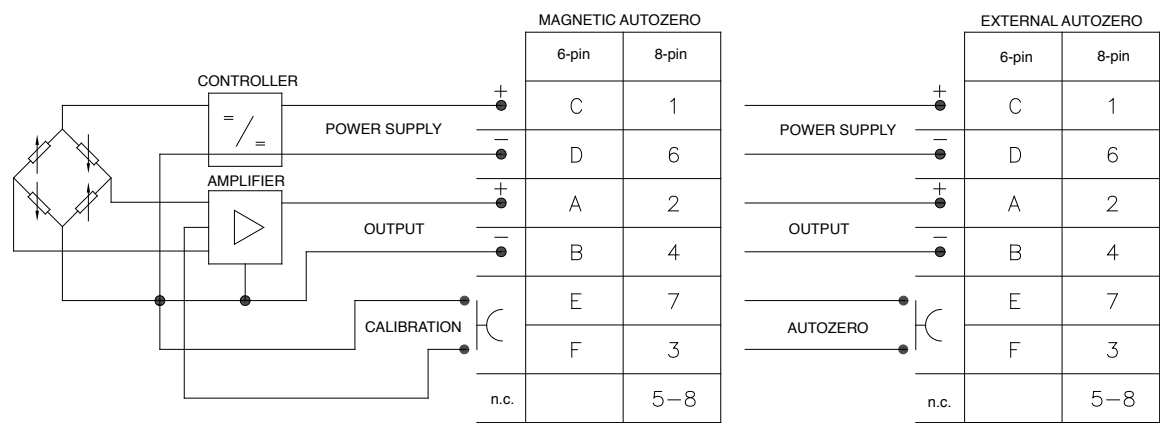
The limit of performance degradation in order to avoid the loss of the security function is  $\pm 5\%$  of the span at room temperature.

## SRP/CS interface and protection devices

The SRP/CS interface is the multi-polar connector type VEAM VP07RA10-6PT2 (code GEFran CON031), type AMPHENOL 62IN-5016-10-7P-4-M (code GEFran CON366) and type BINDER 8 poles M18 DIN/EN 45326 (code GEFran CON029), as illustrated in fig. 4, where are also pointed out the connections in case of voltage amplified output (4 wires: 2 for supply and 2 for signal) or current amplified (2 wires connection).

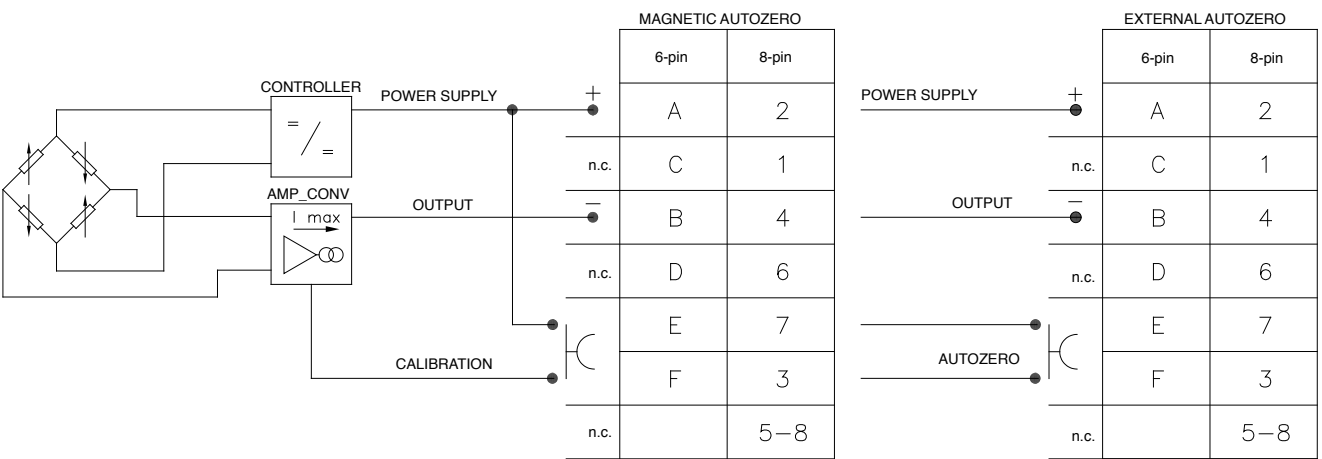
In the case of relay output with retransmitted output in current (2 wires) or voltage (4 wires) the connections are shown in fig. 5.

VOLTAGE OUTPUT



The cable shield is tied to connector via cable clamp

CURRENT OUTPUT



The cable shield is tied to connector via cable clamp

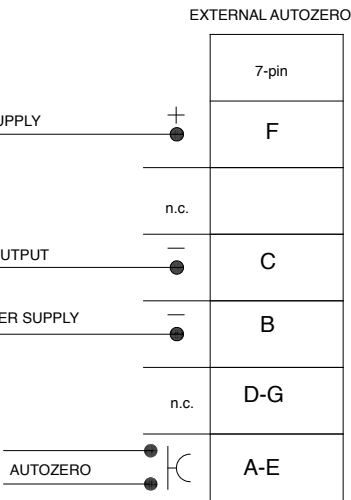
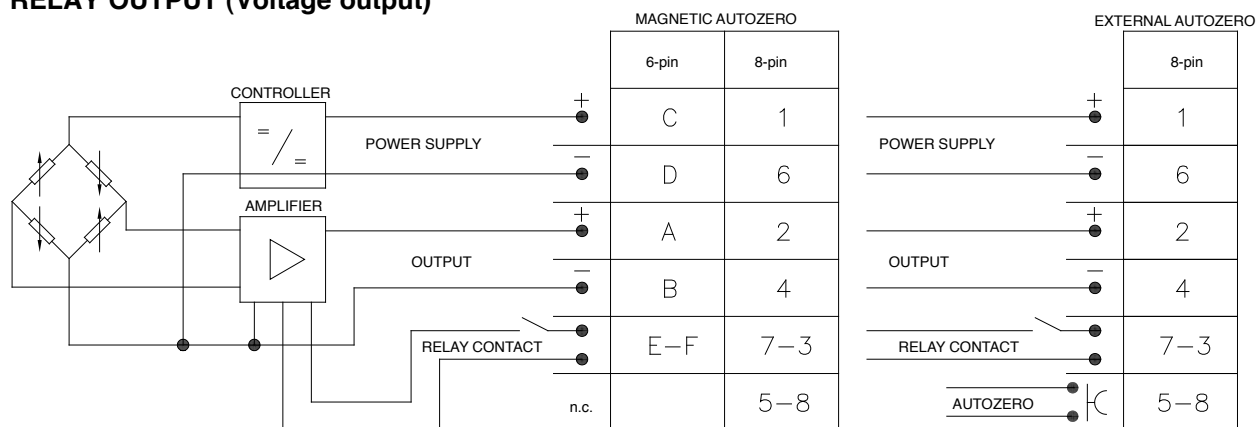


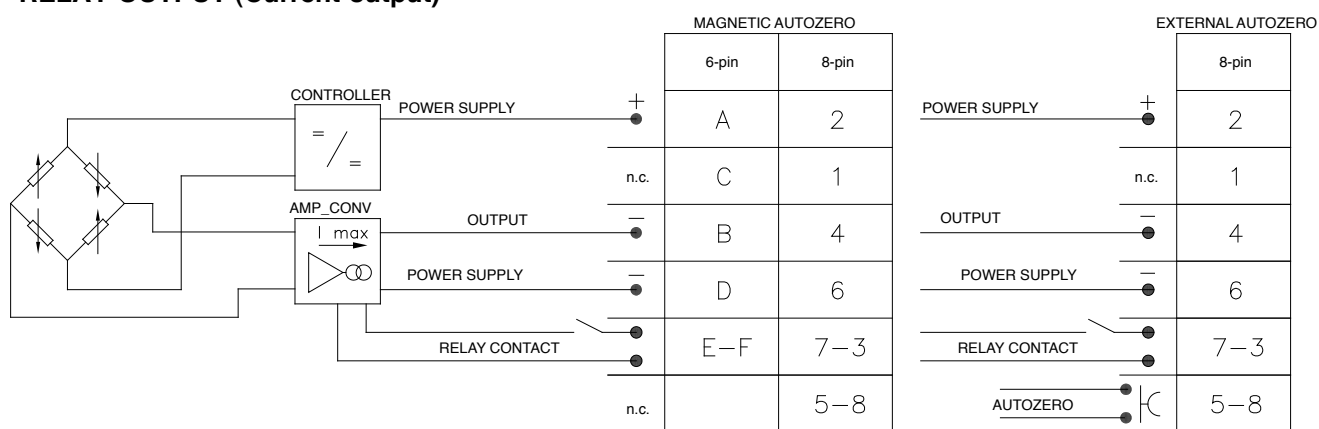
Fig. 4 - SRP/CS interface

## RELAY OUTPUT (Voltage output)



The cable shield is tied to connector via cable clamp

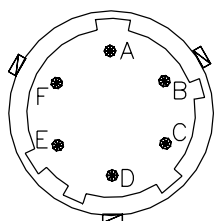
## RELAY OUTPUT (Current output)



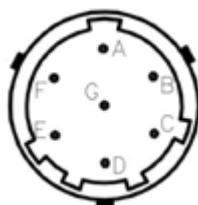
The cable shield is tied to connector via cable clamp

Fig. 5 - SRP/CS interface

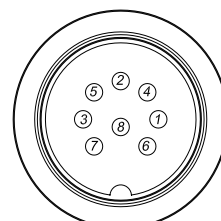
6 pin connector  
VPT07RA10-6PT2  
(PT02A-10-6P)



7 pin connector  
(AMPHENOL)  
62IN-5016-10-7P-4-M



8 pin connector (Binder)  
M16 DIN/EN45326  
(09-0173-00-08)



## Response time

The response time at dangerous event is 8 ms.

The response time at a fail condition is 400 ms.

## Environmental and operational limits

In order to maintain the device in the designated category it must work within the following limits (Tab.2):

Limit	Voltage output	Current output
Overpressure without degradation	2 x FS 1,5 x FS over 700 bar	2 x FS 1,5 x FS over 700 bar
Supply	18..30 Vdc	Load diagram
Process fluid temperature K series	23..538 °C	23..538 °C
Operating electronic temperature	-30..+85 °C	-30..+85 °C
Storage temperature range	-40..+125 °C	-40..+125 °C
Dust protection	IP 6X (EN 60529)	IP 6X (EN 60529)
Water protection	IP X5 (EN 60529)	IP X5 (EN 60529)
Vibrational levels	EN 60068-2-6 (5g, 10..500 Hz)	EN 60068-2-6 (5g, 10..500 Hz)
EMC– Emissions	EN 61326-1 EN 61326-2-3 EN61326-3-1	EN 61326-1 EN 61326-2-3 EN61326-3-1
EMC – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1	EN 61326-1 EN 61326-2-3 EN61326-3-1

Tab.2 - Environmental and operational limits

## Muting of the safety function

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

## Indications and alarms

The transducers of series K can have two different electrical output: analog amplified (0,5..10,5 V o 4..20 mA) and/or a relay output.

In fig. 6 are shown the significant value of the outputs in case of analog signal:

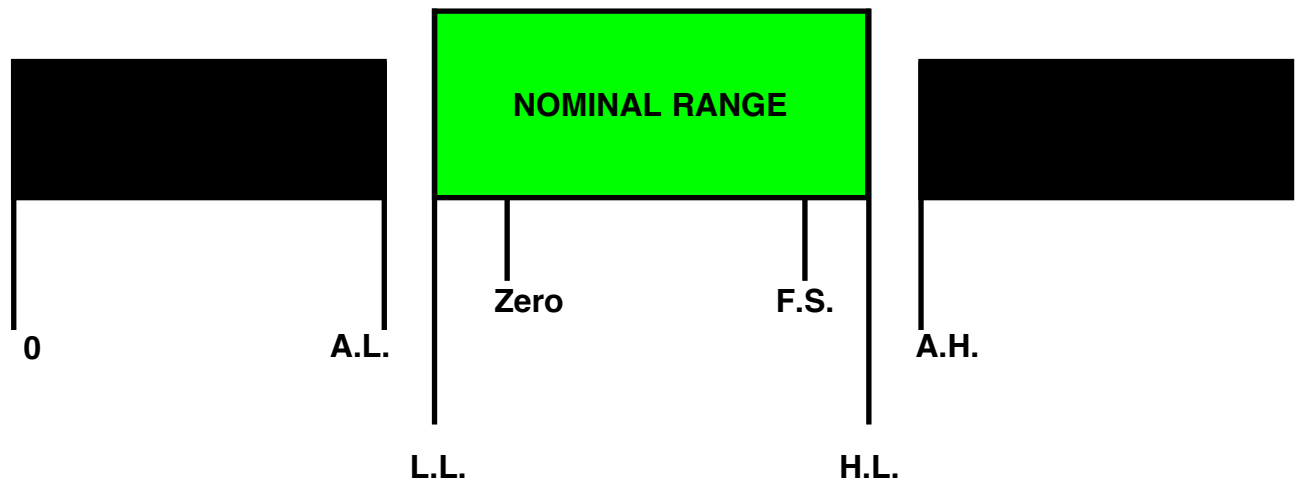


Fig.6 - Outputs levels

TABLE VALUES OUTPUTS:	OUTPUT 4-20 mA	OUTPUT 0,5-10,5 V	GENERIC OUTPUT
L.L. = Low Limit	= 3,68 mA	= 0,300 V	= Zero -2,00% Span
A.L. = Alarm Low	< 3,600 mA	< 0,250 V	< Zero -2,50% Span
H.L. = High Limit	= 20,960 mA	= 11,100 V	= F.S. + 6,00% Span
A.H. = Alarm High	> 21,000 mA	> 11,125 V	> F.S. + 6,25% Span

Tab. 3

In case of relay output, the relay is normally closed except when:

- there is an alarm
- the % of F.S. set as the alarm threshold has been exceeded

In table 4 are pointed out the failures, their effects on the output signal, on the relay output and how to reset them:

Failure	Analog output	Relay output	How to reset
Supply wire broken	<3,6 mA < 0,25 V	OPEN	Remove problem
Sensor unconnected	<3,6 mA < 0,25 V	OPEN	Remove problem
Supply system broken	<3,6 mA < 0,25 V	OPEN	Remove problem
Strain gauge bridge connection detachment	>21 mA > 11,125 V	OPEN	Send sensor to factory for repair
Pin detachment	>21 mA > 11,125 V	OPEN	Send sensor to factory for repair
Pressure over 200% of the span vs factory zero @ RT	>21 mA > 11,125 V	OPEN	Switch off and on
Overvoltage	<3,6 mA < 0,25 V	OPEN	Switch off and on
Undervoltage	<3,6 mA < 0,25 V	OPEN	Switch off and on
Voltage variations	<3,6 mA < 0,25 V	OPEN	Switch off and on
Program sequence error	<3,6 mA < 0,25 V	OPEN	Switch off and on
Overtemperature on electronics	<3,6 mA < 0,25 V	OPEN	Switch off and on
Primary or front end stage error	<3,6 mA < 0,25 V	OPEN	Switch off and on

**Tab. 4 - Failures, effect on electrical outputs and reset**

The analog output levels shown refer to sensors with 4-20 mA output and 0.5-10.5V.

For other electrical output levels, in case of alarm the output level is calculated as follows:

Out Alarm Low(mA,V)< Zero value (mA,V) – 2.50 % span (mA,V)

Out Alarm High (mA,V)> F.S. value (mA,V) + 6.25 % span (mA,V)

In the melt K sensors, no hardware feedback have been implemented.



## 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:





- ✓ Pin CAL
- ✓ Magnetic sensor


The event combinations give the following functions:

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

### 1) AUTOZERO

<i><b>Application mode</b></i>	<i><b>Limits</b></i>		<i><b>Result</b></i>
	<i><b>FSO (bar)</b></i>	<i><b>% adjustment</b></i>	
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.
	> 35, < 100	40	
	> 100, < 200	20	The precision of the zero value will be defined by the accuracy class of the sensor.
	≥ 200	10	
<b>NOTE:</b> 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.			

 Magnetic pointer	 2...5 seconds	 Remove	<ol style="list-style-type: none"> <li>1) Machine pressure = 0 bar and transducer powered.</li> <li>2) Put magnetic pointer on marked spot (2...5 seconds).</li> <li>3) Remove magnetic pointer.</li> <li>4) Ready !</li> </ol>  = marked spot
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 **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)

<b>Application mode</b>	<b>Limits</b>	<b>Result</b>
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 $\pm 20\%FS$ .	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.
<b>NOTE:</b>  The Calibration function is not allowed for "external Autozero" version.		

## 3) TOTAL RESET OF THE CALIBRATION VALUES

<b>Application mode</b>	<b>Limits</b>	<b>Result</b>
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.
<b>NOTE:</b> In the current transducers output value, when applying the magnet can see an imbalance of the output signal up to 7mA.		

## Maintenance and troubleshooting

In order to assure the correct execution of the safety function, it's necessary to make the following maintenance activities:

### 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 aggressive 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.

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. 5 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	<ul style="list-style-type: none"> <li>• Pressure channel occlusion</li> <li>• Output stage failure</li> <li>• Over Pressure from 106% to 200% of F.S.</li> </ul>	<ol style="list-style-type: none"> <li>1 - Sensor power-off and disassembly</li> <li>2 - Double check possible pressure channel occlusion and clean it from residuals or material</li> <li>3 - Do the AUTOZERO function. If the problem persists, send the sensor to factory for repair</li> <li>4 - Reduce the process pressure under the F.S. value</li> </ol>
The sensor alarm signal is "HIGH"	<ul style="list-style-type: none"> <li>• Broken extensometer</li> <li>• Error primary element</li> <li>• Pin detachment</li> <li>• Pressure value above threshold (2 x FS)</li> </ul>	<ol style="list-style-type: none"> <li>1 - Sensor power-off and disassembly</li> <li>2 - If the problem persists, send the sensor to factory for repair</li> <li>3 - If the sensor works fine, mount the sensor in the seat following instruction manual</li> </ol>
The sensor alarm signal is "LOW"	<ul style="list-style-type: none"> <li>• Cut cable / broken connector</li> <li>• Device not connected</li> <li>• Broken supply</li> <li>• Overvoltage</li> <li>• Undervoltage</li> <li>• Floating power supply</li> <li>• Program sequence error</li> <li>• Overtemperature on electronics</li> </ul>	<ol style="list-style-type: none"> <li>1 - Sensor power-off and disassembly</li> <li>2 - Check the correct connection of power supply</li> <li>3 - Check the electrical continuity between the female plug and the power supply</li> <li>4 - Check if the power supply level is within specifications</li> <li>5 - Check voltage supply stability</li> <li>6 - If the sensor works fine, mount the sensor in the seat following instruction manual</li> <li>7 - If the problem persists, send the sensor to factory for repair</li> </ol>
The CAL function doesn't work	<ul style="list-style-type: none"> <li>• Broken electronics</li> <li>• Zero signal threshold out of range</li> <li>• Broken connector/cut cable</li> </ul>	<ol style="list-style-type: none"> <li>1 - Stop the machine and make sure the pressure is zero</li> <li>2 - Check the cable and connector and replace if necessary</li> <li>3 - Do the following in sequence: <ul style="list-style-type: none"> <li>• RESET PARAMETER</li> <li>• AUTOZERO</li> <li>• CALIBRATION</li> </ul> </li> <li>4 - If the problem persists, send the sensor to factory for repair</li> </ol>
The AUTOZERO function doesn't work	<ul style="list-style-type: none"> <li>• Broken electronics</li> <li>• Zero signal outside activation range</li> <li>• Broken connector/cable (only external autozero version)</li> <li>• Wrong magnetic pen positioning</li> </ul>	<ol style="list-style-type: none"> <li>1 - Stop the machine and make sure the pressure is zero</li> <li>2 - Make sure you are doing the operation with pen and autozero mark correctly aligned.</li> <li>3 - Run RESET PARAMETERS; if the difference in absolute value between the read and theoretical zero signal is greater than 40% FS, remove the sensor, check and clean its seat, reinsert the sensor and rerun AUTOZERO.</li> <li>4 - If the difference in absolute value between the read and theoretical zero signal is less than 40% FS, check the cable and connector and replace if necessary</li> <li>5 - If the problem persists, send the sensor to factory for repair</li> </ol>

Tab. 5 - Troubleshooting

## Application for use relevant to the designated category

The K 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. 7) 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.

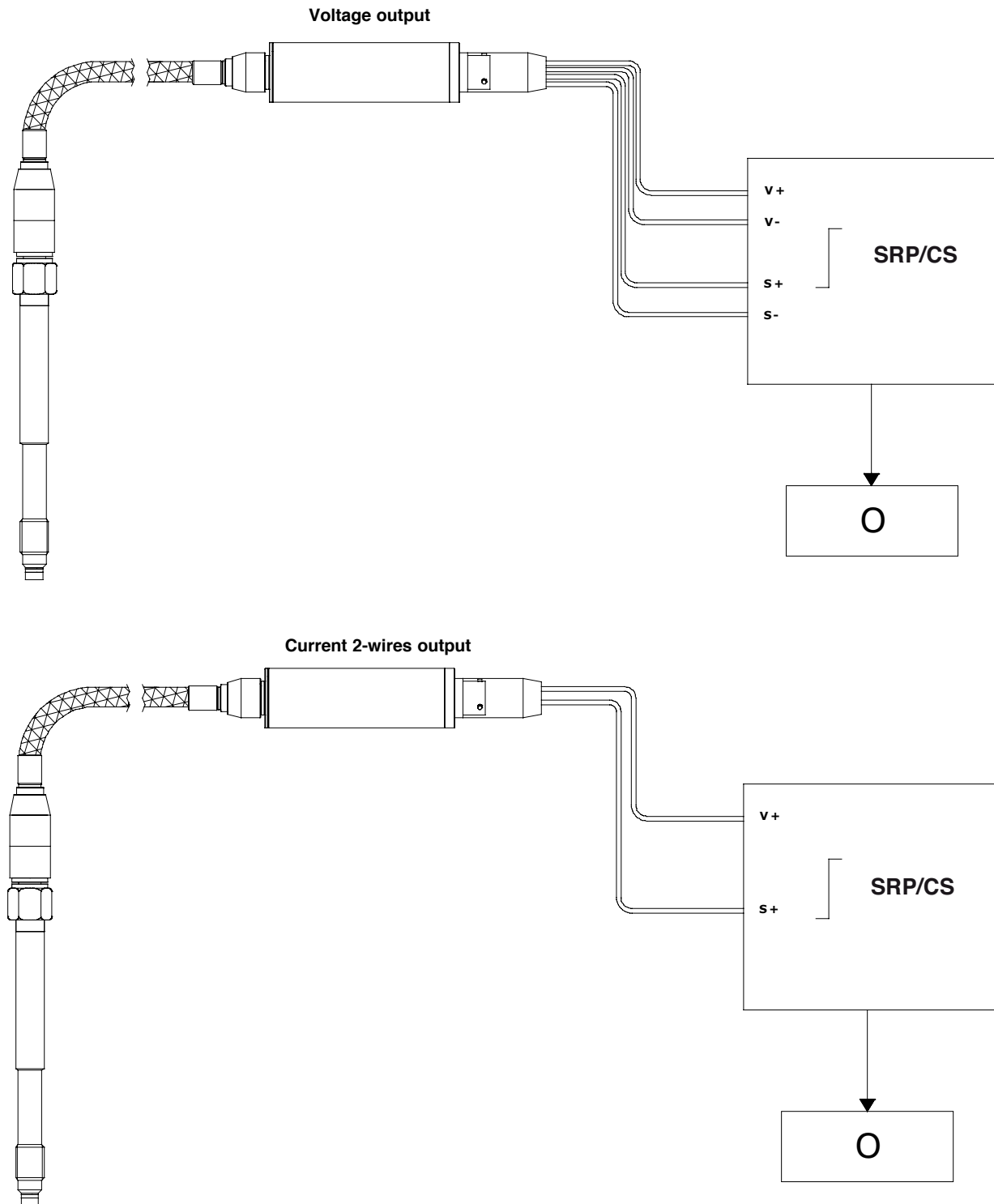
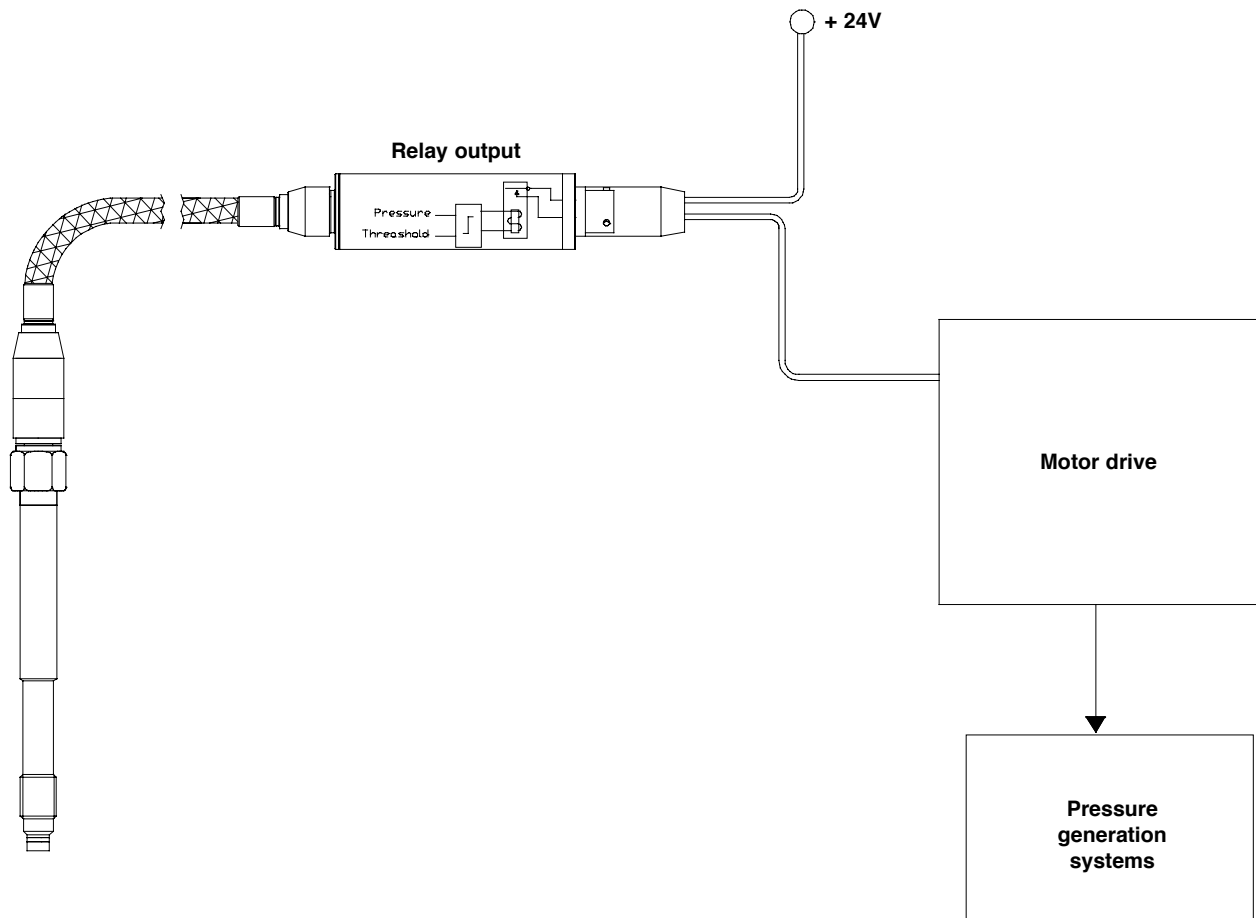


Fig. 7 - Application diagram A

In diagram “B” (Fig. 8) 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. 8 - Application diagram B**

## Category and performance level

The device installed, used, operated and kept following the prescription of the present safety manual and in the operating manual are compliant with:

**EN ISO 13849-1: 2015 Category 2 PL c**

## 9. 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.

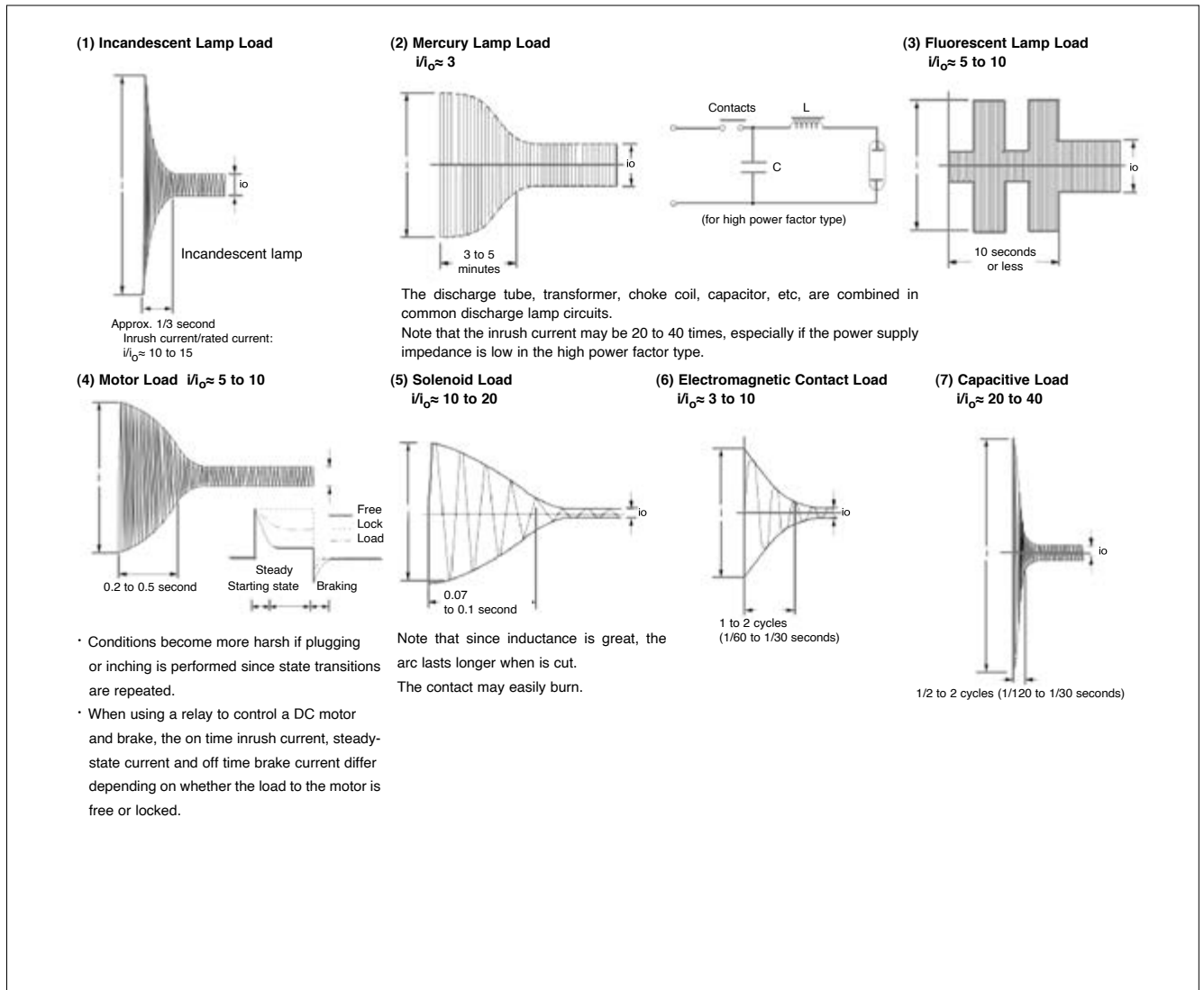
### Type of load and inrush current

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.**

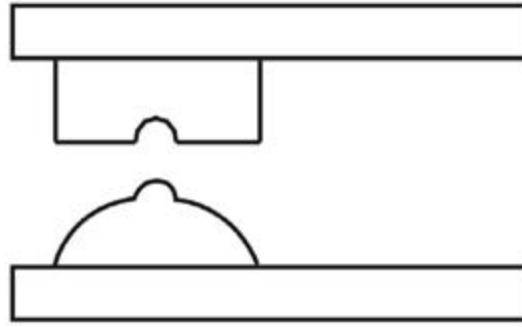
Therefore the proper use of the contact protection circuit may increase the life of the relay.

### 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 9.



**Figure 9**

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		
<b>CR circuit</b>		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", <b>c : 0.5 <math>\mu</math>F to 1 <math>\mu</math>F for 1A contact current</b> <b>r : 0.5 <math>\Omega</math> to 1 <math>\Omega</math> per 1V contact voltage</b> 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.	
<b>Diode circuit</b>		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.
<b>Diode and zener circuit</b>		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.
<b>Varistor circuit</b>		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  $30\ \Omega$  to  $50\ \Omega$ ), between the switch and the capacitance, as shown in figure 10.

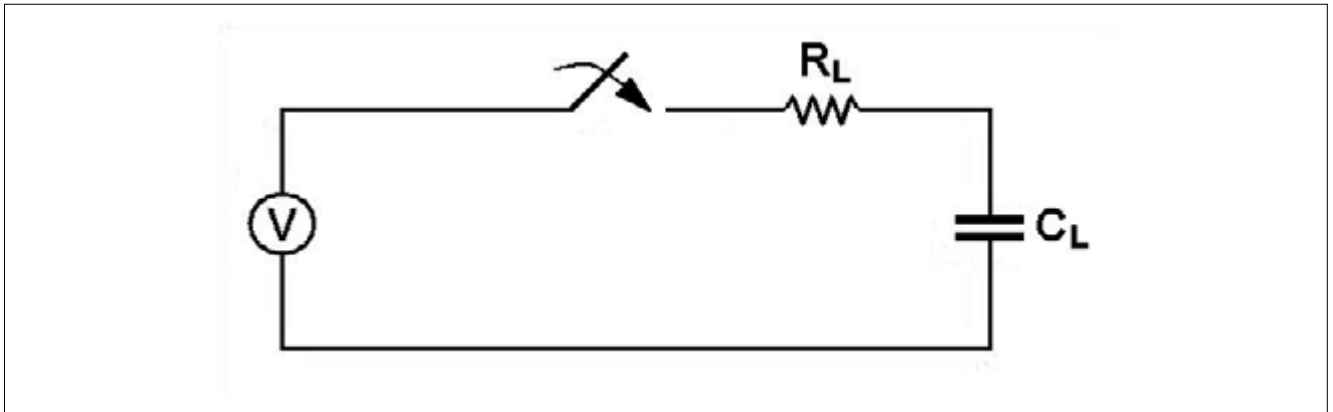


Figure 10

### Precautions for using the long lead wire

If long wires ( $> 10\text{ m}$ ) 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 ( $10\ \Omega$  to  $50\ \Omega$ ) in the contact circuit, as shown in figure 11.

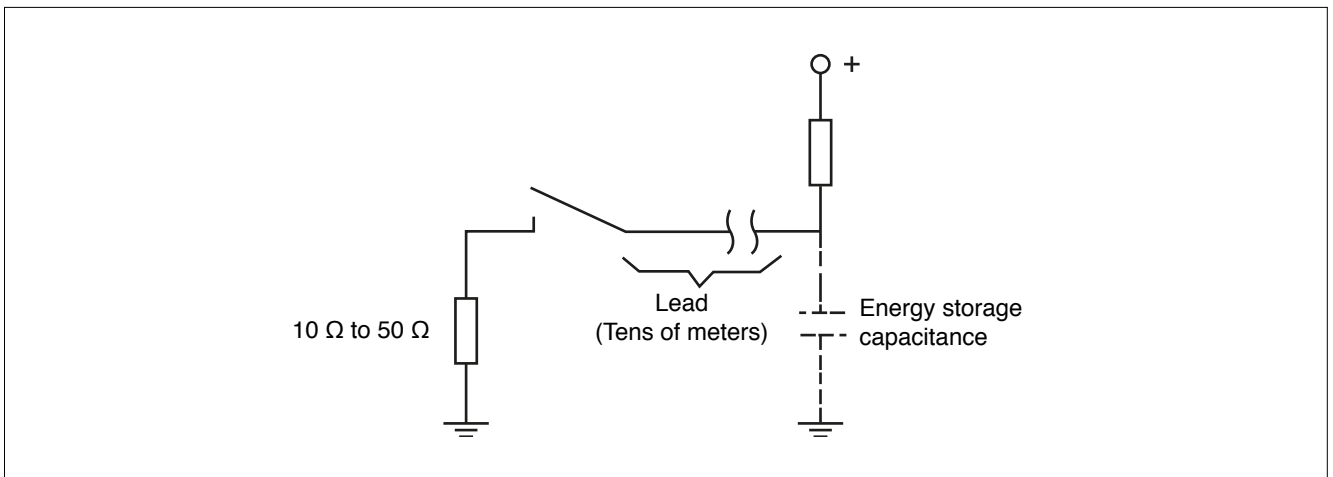


Figure 11

### 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

