Parker MEGGITT

SAFETY MANUAL

vibro-meter®

IPC707
signal conditioner
– IEC 61508 SIL 2 and ISO 13849 PL c Cat 1

SIL Safety

This document contains important information about products that are intended for use in safety-related applications.

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PREFACE

About this manual

This manual provides reference information on using the IPC707 signal conditioner, from Parker Meggitt's vibro-meter® product line, in safety-related applications.

It is applicable to IPC707 measurement chains consisting of a IPC707-compatible sensor, IPC707-compatible cabling and a IPC707 signal conditioner with diagnostics.

About Parker Meggitt and vibro-meter®

Parker Hannifin Corporation – usually referred to as just Parker – is a global leader in motion and control technologies, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. For more than a century the company has been enabling engineering breakthroughs that lead to a better tomorrow.

Parker Meggitt joined the Parker Aerospace Group in September 2022 following the successful acquisition of Meggitt PLC, a world leader in aerospace, defense and energy. This included the Meggitt facility in Fribourg, Switzerland, operating as the legal entity Meggitt SA (formerly Vibro-Meter SA). Accordingly, the vibro-meter® product line is now owned by Parker.

Working closely with its customers, Parker Meggitt delivers technologically differentiated systems and products for the most demanding environments with high certification requirements for applications across its core end markets: aerospace, energy and industrial.

For the energy market (power generation, oil & gas and other industrial markets), vibro-meter® products and solutions include a wide range of vibration, dynamic pressure, proximity, air-gap and other sensors / measurement chains capable of operation in extreme environments, machinery protection and condition monitoring systems, and innovative software.

To learn more about Parker Meggitt (Meggitt SA), our proud tradition of innovation and excellence, and our solutions for energy markets and applications, visit our website at www.meggittsensing.com/energy

Who should use this manual?

This manual is intended for personnel such as designers and operators of machinery protection and/or monitoring systems in safety-related applications that use a IPC707 measurement chain as an input (sensor) to an external monitoring and/or protection system (safety instrumented system) that performs a safety function.

The system designers and operators are assumed to have the necessary technical training in safety, reliability, electronics and/or mechanical engineering (professional certificate/diploma or equivalent) to enable them to design, install, configure, use and maintain such safety instrumented systems.

Structure of the manual

This section gives an overview of the structure of the manual and the information contained within it. Some information has been deliberately repeated in different sections of the document to minimize cross-referencing and to facilitate understanding through reiteration.

The chapters are presented in a logical order. You should read those that are most relevant to your safety-related application and then keep the document at hand for future reference.

The structure of the document is as follows:

Chapter 1	Introduction Explains the purpose and scope of this safety manual. Introduces the IPC707 signal conditioner and IPC707 measurement chains.
Chapter 2	System description Explains the operation of a IPC707 signal conditioner with diagnostics. Specifies the requirements for a valid measurement chain such as sensor, cabling, signal conditioner, measurement chain and power supply considerations.
Chapter 3	How to use the system for safety Explains how a IPC707 measurement chain is used in safety-related applications in terms of the various safety properties.
Chapter 4	Configuration Provides configuration information for IPC707 measurement chains.
Chapter 5	Installation and commissioning Provides installation and commissioning information for IPC707 measurement chains.
Chapter 6	Operation and maintenance Provides operation and maintenance information for IPC707 measurement chains, including proof tests.
Chapter 7	Safety issues Provides safety parameters and highlights safety considerations relevant to the design, installation, configuration, use and maintenance of IPC707 measurement chains in safety-related applications.
Chapter 8	Service and support Provides contact information for technical support. Includes information regarding important SIL safety product information and the procedure to follow in order to opt in and receive such SIL product communications. Includes information regarding product returns and the procedure to follow in order to report problems and return Parker Meggitt (Meggitt SA) energy products for repair.

Related publications and documentation

See 1.5 Related documentation and 1.6 Applicable standards.

Abbreviations

The following table defines some abbreviations useful to this safety manual and related documentation.

Abbreviation	Meaning
AC	alternating current
CAxxx	piezoelectric accelerometers (vibration sensors) used with a IPCxxx signal conditioner (for example, CAxxx and IPC707), from vibro-meter®
CPxxx	dynamic pressure sensors (piezoelectric pressure sensors) used with a IPCxxx signal conditioner (for example, CPxxx and IPC707), from vibro-meter®
CMS	condition monitoring system
DC	diagnostic coverage
DC	direct current
FMEDA	failure modes, effects and diagnostic analysis
HFT	hardware fault tolerance
IEC 61508	IEC standard “Functional safety of electrical/electronic/programmable electronic safety-related systems”
IEC 61511	IEC standard “Functional safety – safety instrumented systems for the process industry sector”
IPC707	signal conditioner (charge amplifier) for use with piezoelectric-based accelerometers or dynamic pressure sensors, from vibro-meter®
IPCxxx	signal conditioner used with CAxxx and CPxxx sensors (for example, CAxxx or CPxxx and IPC707), from vibro-meter®
ISO 13849	ISO standard “Safety of machinery – Safety-related parts of control systems”
MI	mineral insulated
MPS	machinery protection system
MTTR	mean time to repair/restoration
N/A	not applicable, not available
PFD	probability of failure on demand (low demand system)
PFDavg	average probability of failure on demand
PFH	probability of failure per hour (high demand system)
PL	performance level
PNR	part number
SFF	safe failure fraction
SIF	safety instrumented function
SIL	safety integrity level

Abbreviation	Meaning
SIS	safety instrumented system
SRS	safety-related system
vibro-meter®	Parker Meggitt product line
VibroSmart®	VibroSmart® distributed monitoring system (DMS) based machinery monitoring and protection systems, from vibro-meter®
VM600^{Mk2}/VM600	VM600^{Mk2}/VM600 rack-based machinery monitoring and protection systems, from vibro-meter®

SAFETY

Symbols and styles used in this manual

The following symbols are used in this manual where appropriate:

The WARNING safety symbol

THIS INTRODUCES DIRECTIVES, PROCEDURES OR PRECAUTIONARY MEASURES WHICH MUST BE EXECUTED OR FOLLOWED. FAILURE TO OBEY A WARNING MIGHT RESULT IN INJURY TO THE OPERATOR AND/OR THIRD PARTIES, AND/OR RESULT IN DAMAGE TO EQUIPMENT.

The CAUTION safety symbol

This draws the operator's attention to information, directives or procedures which must be executed or followed. Failure to obey a caution can result in damage to equipment.

NOTE: This is an example of the NOTE paragraph style. This draws the operator's attention to complementary information or advice relating to the subject being treated.

Important remarks on safety-related applications

USE OF A IPC707 SIGNAL CONDITIONER IN SAFETY-RELATED APPLICATIONS (FUNCTIONAL-SAFETY CONTEXTS) ASSUMES THAT THE INSTRUCTIONS AND RECOMMENDATIONS IN THIS SAFETY MANUAL ARE IMPLEMENTED AS APPROPRIATE BY THE END USER.

FAILURE TO FOLLOW THE INSTRUCTIONS AND IMPLEMENT THE RECOMMENDATIONS IN THIS SAFETY MANUAL MIGHT RESULT IN INJURY TO THE OPERATOR AND/OR THIRD PARTIES, AND/OR RESULT IN DAMAGE TO EQUIPMENT AND WILL INVALIDATE ANY WARRANTY.

Important remarks on safety

Read this manual carefully and observe the safety instructions before installing and using the equipment described.

By doing this, you will be aware of the potential hazards and be able to work safely, ensuring your own protection and also that of the equipment.

Every effort has been made to include specific safety-related procedures in this manual using the symbols described above. However, operating personnel are expected to follow all generally accepted safety procedures.

All personnel who are liable to operate the equipment described in this manual should be trained in the correct safety procedures.

Parker Meggitt does not accept any liability for injury or material damage caused by failure to obey any safety-related instructions or due to any modification, transformation or repair carried out on the equipment without written permission from Parker Meggitt (Meggitt SA). Any modification, transformation or repair carried out on the equipment without written permission from Parker Meggitt will invalidate any warranty.

Electrical safety and installation

WHEN INSTALLING A IPC707 MEASUREMENT CHAIN, OBSERVE ALL SAFETY (WARNING AND CAUTION) STATEMENTS IN THIS MANUAL AND IN THE *CAXXX PIEZOELECTRIC ACCELEROMETERS INSTALLATION MANUAL* OR THE *CPXXX DYNAMIC PRESSURE SENSORS INSTALLATION MANUAL*, AS APPROPRIATE, AND FOLLOW ALL NATIONAL AND LOCAL ELECTRICAL CODES. SEE 1.5 RELATED DOCUMENTATION FOR A LIST OF INSTALLATION MANUALS.

ONLY TRAINED AND QUALIFIED PERSONNEL (SUCH AS A QUALIFIED/LICENSED ELECTRICIAN) SHOULD BE ALLOWED TO INSTALL OR REPLACE THIS EQUIPMENT. CHECKS TO ENSURE ELECTRICAL SAFETY SHOULD BE CARRIED OUT BY A COMPETENT PERSON.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN DEATH, SERIOUS INJURY, AND/OR EQUIPMENT DAMAGE.

Replacement parts and accessories

Use only approved replacement parts and accessories.

Do not connect with incompatible products or accessories.

Only use replacement parts and accessories intended for use with IPC707 measurement chains that have been approved by Parker Meggitt (Meggitt SA).

Using incompatible replacement parts and accessories could be dangerous and may damage the equipment or result in injury.

For information on replacement parts and accessories:

- Visit the Parker Meggitt website at www.meggittsensing.com/energy
- Contact your local Parker Meggitt representative.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

This safety manual provides the specific information required to use a IPC707 with diagnostics in safety-related applications, in accordance with the IEC 61508 and ISO 13849 safety standards.

Refer to the *CAxxx piezoelectric accelerometers installation manual* or the *CPxxx dynamic pressure sensors installation manual*, as appropriate, for more general information on the IPC707 and the information required to use a IPC707 without diagnostics in standard (non-safety related) applications. See 1.5 Related documentation.

1.2 IPC707 measurement chains

To use a IPC707 in safety-related applications requires a IPC707 measurement chain consisting of the following components:

- IPC707-compatible sensor
- IPC707-compatible cabling
- IPC707 signal conditioner with diagnostics.

The components of a IPC707 measurement chain are shown in Figure 1-1 and listed in Table 1-1.

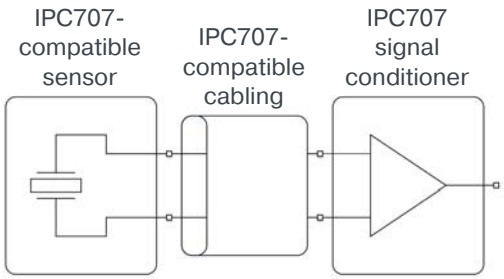


Figure 1-1: IPC707 measurement chain (block diagram)

Component	Description	Comments / Notes
IPC707-compatible sensor	Symmetrical piezoelectric sensor providing a charge-based output signal. Note: Sensors can have a short length of integral low-noise cable.	IPC707-compatible sensors must meet specific electrical requirements
IPC707-compatible cabling	Low-noise cabling connecting the sensor and the signal conditioner	IPC707-compatible cabling must meet specific electrical requirements
IPC707 signal conditioner	IPC707 signal conditioner with diagnostics providing an analogue output signal	Only a IPC707 signal conditioner with diagnostics must be used in safety-related applications
Notes See 2.3 Valid IPC707 measurement chains for further information on the specific electrical and other requirements.		

Table 1-1: Components of a IPC707 measurement chain

1.2.1 IPC707-compatible sensor

IPC707-compatible sensors are symmetrical piezoelectric-based accelerometers or dynamic pressure sensors. These sensors can have a short length of integral low-noise cable, which can be a mineral-insulated (MI) cable, that is considered as part of the sensor.

Typical IPC707-compatible sensors include many CAxxx piezoelectric accelerometers and CPxxx dynamic pressure sensors from Parker Meggitt's vibro-meter® product line. Contact your local Parker Meggitt representative for further information regarding sensor compatibility.

1.2.2 IPC707-compatible cabling

IPC707-compatible cabling is typically low-noise cabling. This cabling can include any combination of sensor integral cable, (extrinsic) cable and/or cable assembly used to connect a IPC707-compatible sensor to a IPC707 signal conditioner with diagnostics.

Typical IPC707-compatible cabling includes low-noise cables and cable assemblies from Parker Meggitt's vibro-meter® product line. Contact your local Parker Meggitt representative for further information regarding cabling compatibility.

1.2.3 IPC707 signal conditioner with diagnostics

The IPC707 signal conditioner converts the charge-based signal from symmetrical piezoelectric sensors into an analogue output signal suitable for input to a machinery monitoring and/or protection system.

It is a versatile and highly-configurable device that supports optional diagnostics using innovative diagnostic technology that continuously runs health checks on the components of the measurement chain (sensor, cabling and signal conditioner) and updates the output signal (diagnostic component) to indicate the integrity of the measurement chain and the source of detected problems.

ONLY A IPC707 SIGNAL CONDITIONER WITH DIAGNOSTICS MUST BE USED IN SAFETY-RELATED APPLICATIONS.

A IPC707 measurement chain can be used as an input (sensor) to an external monitoring and/or protection system (safety instrumented system (SIS)) configured to perform a safety function (safety instrumented function (SIF)), as shown in Figure 1-2.

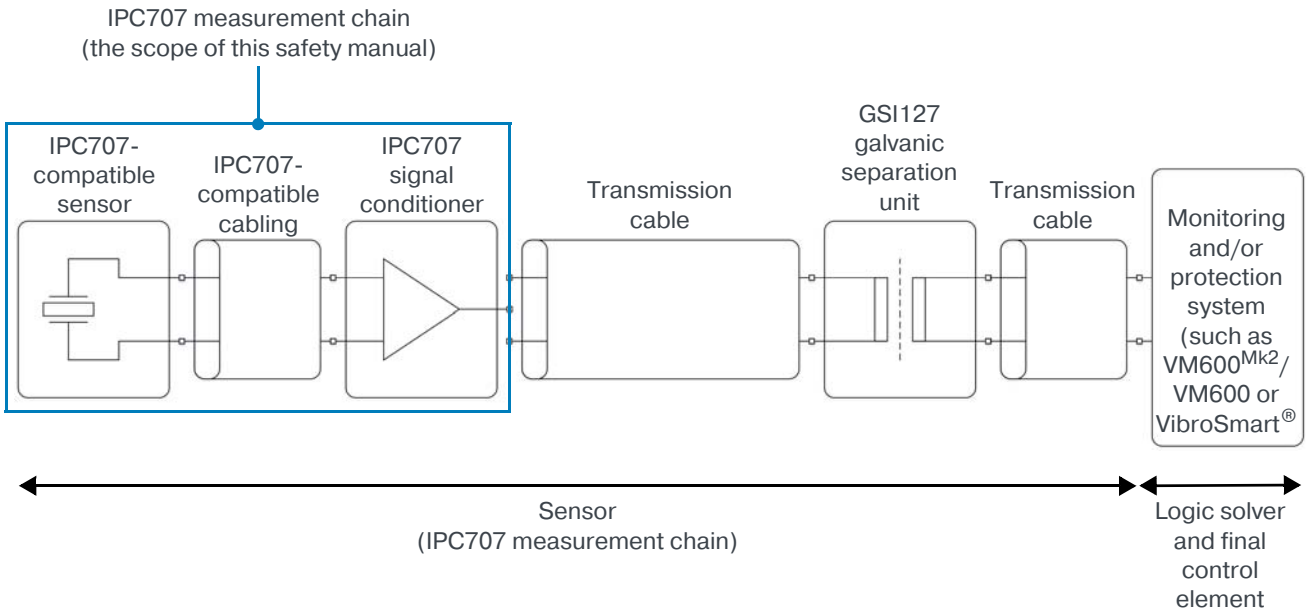


Figure 1-2: IPC707 measurement chain
as an input to a monitoring and/or protection system

In certain industries and applications, the monitoring and/or protection systems used are known by other names. For example, the terms “machinery protection system (MPS)” and “condition monitoring system (CMS)” are commonly used in the oil & gas industry.

1.3 IPC707 signal conditioner

1.3.1 Reference part numbers

One version of the IPC707, developed in accordance with the IEC 61508 and ISO 13849 safety standards, is available.

Table 1-2 lists the reference part number for the IPC707.

Part number (PNR)	Product
244-707-000-012	IPC707

Table 1-2: Reference part number for the IPC707 signal conditioner

1.3.2 Configurations

The IPC707 is a highly-configurable product. When ordering a IPC707, the part number (PNR) and ordering option codes are used to specify the complete configuration of the IPC707. For example, a complete IPC707 ordering number – including part number (PNR) and ordering option codes – with order option codes is:
244-707-000-012-Ax-Bx-Cxxxxx-Dx-Exx-Fxxxxx-Gx.

NOTE: IPC707 signal conditioners are configured in the factory as part of the manufacturing process. During manufacture, the configuration of a IPC707 is fixed and cannot be changed later.

Importantly, when ordering a IPC707, the IPC707 can be configured as either “with diagnostics” or “without diagnostics”. The ordering option code Bx is used to specify the configuration of a IPC707’s optional diagnostics as follows:

- Ordering number 244-707-000-012-Ax-B2-Cxxxxx-Dx-Exx-Fxxxxx-Gx for a IPC707 with diagnostics.
- Ordering number 244-707-000-012-Ax-B1-Cxxxxx-Dx-Exx-Fxxxxx-Gx for a IPC707 without diagnostics.

NOTE: Only a IPC707 signal conditioner with diagnostics (ordering option code B2) is suitable for use in safety-related applications.

NOTE: Refer to the *IPC707 signal conditioner data sheet* for further information on ordering option codes.

1.3.3 Identifying

As shown in Figure 1-3, the product label on the top of a IPC707 signal conditioner shows the complete ordering number – including part number (PNR) and ordering option codes.

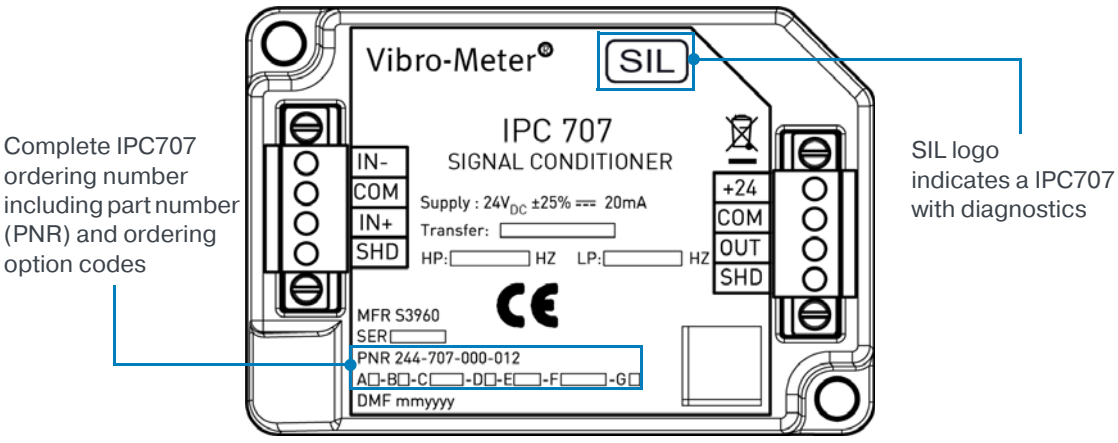


Figure 1-3: Top view of a IPC707
with a typical product label showing the complete ordering number (PNR)

NOTE: A IPC707 signal conditioner with diagnostics, suitable for use in safety-related applications, is identified by the ordering option code B2 and a SIL logo.

1.4 Use in safety-related applications

It is the end-user's responsibility to ensure that only a IPC707 signal conditioner with diagnostics is used in a safety-related application, and that the recommendations in this safety manual are implemented as appropriate by the end user.

FAILURE TO FOLLOW THE INSTRUCTIONS AND IMPLEMENT THE RECOMMENDATIONS IN THIS SAFETY MANUAL MIGHT RESULT IN INJURY TO THE OPERATOR AND/OR THIRD PARTIES, AND/OR RESULT IN DAMAGE TO EQUIPMENT.

Always check the product label to ensure that the part number (PNR) and ordering option codes are correct before installing or replacing a IPC707 (1.3.2 Configurations and see 1.3.3 Identifying).

1.5 Related documentation

This safety manual is limited to the information and actions that are required to ensure compliance with the relevant safety certifications and standards.

Table 1-3 lists other documentation, such as data sheets and manuals, that must be referred to for information outside the scope of this safety manual.

Document name	Document reference
IPC707 signal conditioner data sheet	262-712
CAxxx piezoelectric accelerometers installation manual	MACA/E
CPxxx dynamic pressure sensors installation manual	MACP/E

Table 1-3: Related documentation

NOTE: Ensure that the latest version of related documentation is being used by obtaining the documents from the Parker Meggitt website at www.meggittsensing.com/energy or by contacting your local Parker Meggitt representative.

1.6 Applicable standards

Document name	Document reference
IEC 61326-3-2: 2018 Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-2: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – Industrial applications with specified electromagnetic environment	Ed. 2 (2018)
IEC 61508: 2010 Functional safety of electrical/electronic/programmable electronic safety-related systems	Ed. 2 (2010)
ISO 13849-1: 2023 Safety of machinery – Safety-related parts of control systems – Part 1	Ed. 4 (2023)
ISO 13849-2: 2012 Safety of machinery – Safety-related parts of control systems – Part 2	Ed. 2 (2012)

Table 1-4: Applicable standards

2 SYSTEM DESCRIPTION

2.1 Operation of a IPC707 with diagnostics

As shown in Figure 2-1, the output from a IPC707 is an analogue signal consisting of a dynamic measurement component (AC) and a quasi-static diagnostic component (DC).

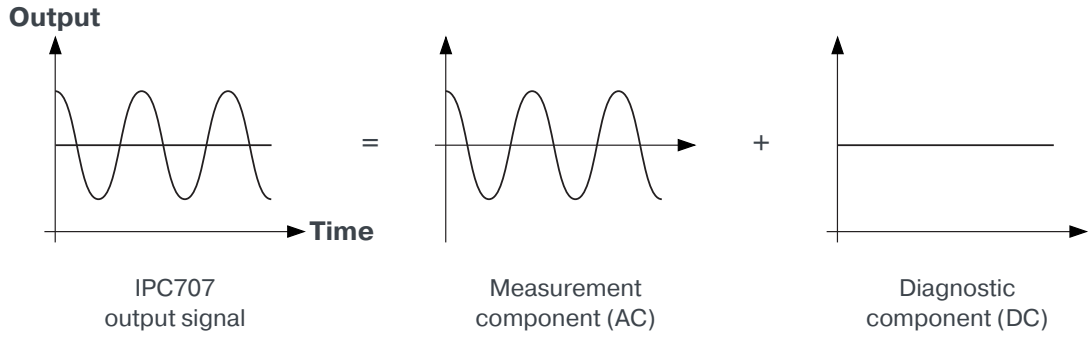


Figure 2-1: Output signal from a IPC707 signal conditioner

For the output signal from a IPC707 with diagnostics:

- The measurement component (AC) corresponds to the measured acceleration or dynamic pressure.
- The diagnostic component (DC) corresponds to the status of the measurement chain.
  That is, for a IPC707 with diagnostics, internal electronic circuitry continuously checks the integrity of the measurement chain (sensor, cabling and signal conditioner) and updates the nominal value of the diagnostic component (DC) of the output signal to indicate the health of the IPC707 measurement chain.

NOTE: Only one diagnostic component (DC) value corresponds to normal operation of a IPC707 measurement chain. All other values indicate a problem with the measurement chain (see Table 2-1).

Table 2-1 lists the permitted values for the diagnostic component (DC) of the output signal from a IPC707 with diagnostics. See also Figure 7-1.

Diagnostic component (DC) value	Measurement chain OK?	Description
13 mA_{DC} ±0.5 mA_{DC} or 8 V_{DC} ±0.5 V_{DC}	Yes	Normal operation. The measurement component (AC) of the output signal from the IPC707 chain can be trusted.
11 mA_{DC} ±0.5 mA_{DC} or 6 V_{DC} ±0.5 V_{DC}	No	Problem with the sensor and/or cabling (λ_{DD})
10 mA_{DC} ±0.5 mA_{DC} or 5 V_{DC} ±0.5 V_{DC}		Problem with the signal conditioner (λ_{DD})
<8 mA_{DC} or <3 V_{DC}		Other problem with the measurement chain or power supply (λ_{DD})
Other current or voltage value		Problem with the signal conditioner not detected by internal diagnostics (λ_{DU})

Notes
The output signal from a IPC707 can be either a current (mA) or a voltage (V) signal, depending on the configured transfer unit (see 1.3.2 Configurations).
Although the output signal from a IPC707 has a maximum tolerance of ±0.5 mA_{DC} or ±0.5 V_{DC} to allow for operation in all circumstances (including strong electromagnetic interference), a typical tolerance of ±0.2 mA_{DC} or ±0.2 V_{DC} is seen during normal operating conditions.
A problem with a IPC707 could hide/mask other problems in the measurement chain such as a problem with the sensor, cabling, signal conditioner and/or power supply.

Table 2-1: Permitted values for the diagnostic component (DC) of the output signal from a IPC707 with diagnostics

For reference, Table 2-2 lists the permitted value for the diagnostic component (DC) of the output signal from a IPC707 without diagnostics.

Diagnostic component (DC) value	Description
12 mA_{DC} ±0.5 mA_{DC} or 7 V_{DC} ±0.5 V_{DC}	Normal operation
Other current or voltage value	Problem with the measurement chain (sensor, cabling and/or signal conditioner)

Table 2-2: Permitted values for the diagnostic component (DC) of the output signal from a IPC707 without diagnostics

Refer to the *CAxxx piezoelectric accelerometers installation manual* or the *CPxxx dynamic pressure sensors installation manual* for more information on a IPC707 without diagnostics.

2.2 IPC707 measurement chains in safety-related applications

When a IPC707 measurement chain is used in a safety-related application, certain conditions/restrictions apply.

AS AN INPUT (SENSOR) TO AN EXTERNAL SAFETY INSTRUMENTED SYSTEM (SIS) PERFORMING A SAFETY INSTRUMENTED FUNCTION (SIF), A IPC707 MEASUREMENT CHAIN MUST CONSIST OF A IPC707-COMPATIBLE SENSOR, IPC707-COMPATIBLE CABLING AND A IPC707 SIGNAL CONDITIONER WITH DIAGNOSTICS.

2.3 Valid IPC707 measurement chains

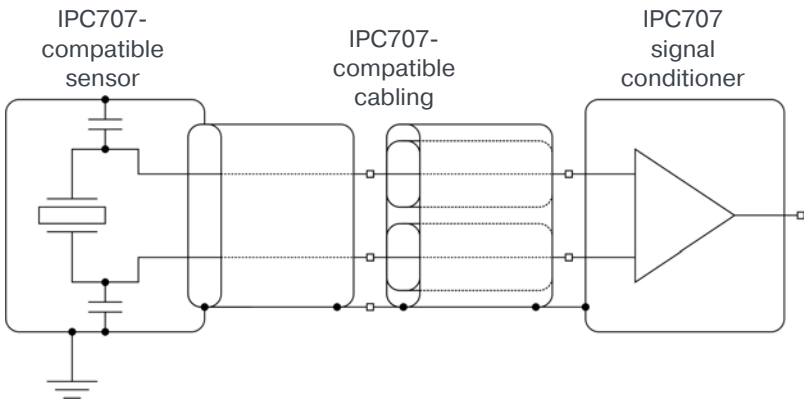
In order to support the correct operation of a IPC707 with diagnostics, each of the following requirements must be met:

- The IPC707-compatible sensor must meet the electrical requirements defined in 2.3.1 IPC707-compatible sensor electrical requirements.
- The IPC707-compatible cabling must meet the electrical requirements defined in 2.3.2 IPC707-compatible cabling electrical requirements.
- A IPC707 with diagnostics must be used and the IPC707 measurement chain must meet the electrical requirements defined in 2.3.3 IPC707 measurement chain electrical requirements.

Figure 2-2 shows a typical IPC707 measurement chain using the terminology required to understand how IPC707-compatible sensors and IPC707-compatible cabling are specified.

Contact your local Parker Meggitt representative for further information regarding valid IPC707 measurement chains.

IPC707 measurement chain (electrical diagram)



Note: IPC707-compatible cabling can include any combination of sensor integral cable, (extrinsic) cable and/or cable assembly

IPC707 measurement chain (equivalent circuits)

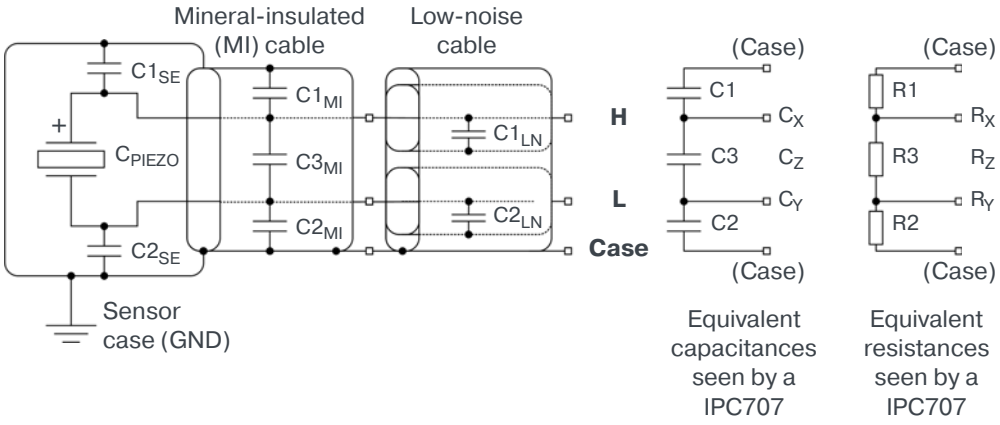


Figure 2-2: IPC707 measurement chain (electrical diagram) and equivalent circuits

As shown in Figure 2-2:

- H (IN+) is the high connection (differential output) from the sensor and cabling.
  A positive change in physical quantity (acceleration or dynamic pressure) generates a positive charge (+) on this output.
- L (IN−) is the low connection (differential output) from the sensor and cabling.
  A positive change in physical quantity (acceleration or dynamic pressure) generates a negative charge (−) on this output.
- Case (COM) is the shield connection from the cabling.

In general, IPC707-compatible sensors and IPC707-compatible cabling are specified in terms of their electrical capacitances and resistances.

As shown in Figure 2-2, in terms of the equivalent electrical capacitances seen by a IPC707 signal conditioner:

- C_{PIEZO} is the capacitance of the piezoelectric sensing element of the sensor.
- $C1_{SE}$ and $C2_{SE}$ are the capacitances between the piezoelectric sensing element of the sensor and the case (housing) of the sensor.

- $C1_{MI}$ and $C2_{MI}$ are the capacitances between the conductors of a mineral-insulated (MI) cable and the shielding of the cable.
  $C3_{MI}$ is the capacitance between the conductors of a mineral-insulated (MI) cable.
- $C1_{LN}$ and $C2_{LN}$ are the capacitances between the conductors of a low-noise cable and the shielding of the cable.
  Note: There is no $C3_{LN}$ as is the conductors of a low-noise cable are individually shielded.
- C1 is the total capacitance seen between H and Case:
  $C1 = C1_{SENSOR} + C1_{CABLING} = C1_{SE} + (C1_{MI} + C1_{LN})$
- C2 is the total capacitance seen between L and Case:
  $C2 = C2_{SENSOR} + C2_{CABLING} = C2_{SE} + (C2_{MI} + C2_{LN})$
- C3 is the total capacitance seen between H and L:
  $C3 = C3_{SENSOR} + C3_{CABLING} = C_{PIEZO} + C3_{MI}$
- C_X is the total capacitance seen between H and Case when L is not connected (floating):
  $C_X = C1 + (C2 \,||\, C3)$
- C_Y is the total capacitance seen between L and Case when H is not connected (floating):
  $C_Y = C2 + (C1 \,||\, C3)$
- C_Z is the total capacitance seen between H and L when Case is not connected (floating):
  $C_Z = C3 + (C1 \,||\, C2)$.

As shown in Figure 2-2, in terms of the equivalent electrical resistances seen by a IPC707 signal conditioner:

- R1 is the total insulation resistance seen between H and Case.
- R2 is the total insulation resistance seen between L and Case.
- R3 is the total insulation resistance seen between H and L.
- R_X is the total insulation resistance seen between H and Case when L is not connected (floating):
  $R_X = R1 \,||\, (R2 + R3)$
- R_Y is the total insulation resistance seen between L and Case when H is not connected (floating):
  $R_Y = R2 \,||\, (R1 + R3)$
- R_Z is the total insulation resistance seen between H and L when Case is not connected (floating):
  $R_Z = R3 \,||\, (R1 + R2)$.

2.3.1 IPC707-compatible sensor electrical requirements

- IPC707-compatible sensors must have a symmetrical output connection, that is, have separate H (+), L (−) and Case (GND) connections.
- IPC707-compatible sensors must have a dynamic range as follows:
  - <50000 pC for frequencies up to 10 kHz
  - <25000 pC for frequencies between 10 to 20 kHz.
- IPC707-compatible sensors must have a piezoelectric sensing element with a capacitance (C_{PIEZO}) >60 pF in order to be able to detect a failure of the sensing element.
- IPC707-compatible sensors must have a capacitance between the conductors of an integral cable ($C3_{MI}$) <60 pF in order to be able to detect a failure of the sensing element.

2.3.2 IPC707-compatible cabling electrical requirements

- IPC707-compatible cabling cannot have capacitance between the conductors, that is, the conductors of the low-noise cabling should be individually shielded to prevent capacitance ($C3_{LN}$) between them.
- To connect IPC707-compatible cabling to a IPC707 signal conditioner, the length of the unshielded conductors (H and L) must be < 5 cm.
- To connect IPC707-compatible cabling to a IPC707 signal conditioner, the cabling shield must be connected to the SHD screw-terminal connector at the input to the IPC707 with a connection resistance ⩽ 0.1 Ω (100 mΩ).

2.3.3 IPC707 measurement chain electrical requirements

- A IPC707 with diagnostics must be used.
- A IPC707 signal conditioner must see a total insulation resistance (sensor and cabling) between H and L (R_Z) > 20 kΩ.
- A IPC707 signal conditioner must see a total capacitance (sensor and cabling) between H and L (C_Z) < 15 nF.
- A IPC707 signal conditioner must see a total serial resistance (cabling) between H and L as follows:
  - < 100 Ω (2 x 50 Ω) for a C_Z value > 10 nF and ⩽ 15 nF.
  - < 200 Ω (2 x 100 Ω) for a C_Z value > 5 nF and ⩽ 10 nF.
  - < 500 Ω (2 x 250 Ω) for a C_Z value ⩽ 5 nF.
- The total insulation resistance to ground (Rx and Ry) shall degrade less than 0.5 decade / min. for a value between 1 GΩ to 10 MΩ.
- A IPC707 signal conditioner must see a total capacitance (sensor and cabling) between L and Case (C2) > 250 pF in order to be able to detect a failure of the sensor and/or cabling.

2.4 Power supply requirements

Table 2-3 shows the power supply requirements for a IPC707 signal conditioner.

Parameter	Value
Input voltage range	24 V_{DC} ± 25% (18 to 30 V_{DC})
Current consumption (with nominal 24 V_{DC} supply)	20 mA max.
Overvoltage protection	Up to 40 V_{DC} Note: The IPC707 can withstand an overvoltage up to 40 V_{DC} without leading to a dangerous-undetected failure (λ_{DU}).
Power-up time	< 30 s

Table 2-3: IPC707 signal conditioner power supply requirements

The IPC707 signal conditioner should be powered (energised) using a low-voltage power supply such as a sensor power supply output provided by a VM600^{Mk2}/VM600 or VibroSmart® monitoring and/or protection system, a GSI127 galvanic separation unit or other suitable power supply.

In safety-related applications, a IPC707 must be powered using a power supply with a safe limitation of 40 V_{DC}, even in the event of a single fault with the power supply.

3 HOW TO USE THE SYSTEM FOR SAFETY

3.1 Safety function

A IPC707 measurement chain provides an analogue output signal (current or voltage) that is proportional to the electrical charge measured by the sensor (corresponding to the measured acceleration or dynamic pressure) within the safety accuracy, according to the configuration of the IPC707 signal conditioner.

In a safety-related application, the output signal from a IPC707 signal conditioner is an input (sensor) to an external monitoring and/or protection system (safety instrumented system performing a safety function) that takes this input together with other safety-related signals and performs a system-level safety function, such as initiating the shutdown (trip) of a machine.

NOTE: For the external monitoring and/or protection system performing a safety function:
- Any alarms corresponding to a safety function must be configured as latching.
- Any relays corresponding to a safety function must be configured as latching and normally energised (de-energised to trip).
- An analysis must be carried out at the safety-system level to ensure that no alarm can be missed or to identify all possible impacts and acceptability of residual risks in case of a missed alarm.

Table 3-1 lists the safety accuracy and other important safety properties for a IPC707 measurement chain.

3.2 Safety output

A IPC707 measurement chain has one safety-critical output: an analogue signal (current or voltage) consisting of a dynamic measurement component (AC) and a quasi-static diagnostic component (DC), as described in 2.1 Operation of a IPC707 with diagnostics.

In typical safety-related applications:

- The measurement component (AC) is used to indicate whether the machinery being monitored is operating correctly or not.
- The diagnostic component (DC) is used to indicate whether the IPC707 measurement chain is operating correctly or not.

It is important to note that for a IPC707 measurement chain, there is no safe state. Instead, dangerous-detected failures (λ_{DD}) in the measurement chain are indicated by updating the nominal value of the diagnostic component (DC) of the output signal. Accordingly, any required safe state behaviour must be implemented by the external monitoring and/or protection system at the safety-system level.

THE EXTERNAL MONITORING AND/OR PROTECTION SYSTEM MUST BE ABLE TO MEASURE THE SAFETY-CRITICAL OUTPUT WITH AN ACCURACY OF AT LEAST ±0.1 MA OR ±0.1 V.

See also 7.7 Configuring the external monitoring and/or protection system.

3.3 Safety properties

Table 3-1 lists the other important safety properties for a IPC707 measurement chain.

Safety property	Description / Value
SIL level (IEC 61508)	SIL 2
Systematic capability (IEC 61508)	2
PL and Cat levels (ISO 13849)	PL c and Cat 1. See also 3.5 ISO 13849-1 performance level.
Modes of operations	Low Demand mode or Continuous mode
Type of subsystem	Type A
Hardware fault tolerance (HFT)	0
Dangerous-detected failures (λ_{DD})	2261 failure rate (FIT). Note: For dangerous-detected failures (λ_{DD}), the IPC707 output is defined.
Dangerous-undetected failures (λ_{DU})	70 failure rate (FIT). Note: For dangerous-undetected failures (λ_{DU}), the IPC707 output is undefined, that is, other current or voltage values.
Safe-detected failures (λ_{SD}) and safe-undetected failures (λ_{SU})	0 failure rate (FIT). Note: The IPC707 has neither safe-detected (λ_{SD}) nor safe-undetected (λ_{SU}) failures, that is, there is no safe state.
Safe failure fraction (SFF) for Type A subsystem	97% (calculated value). SIL 2 requires ⩾60% is for a Type A device with HFT = 0.
Process safety time (PST)	< 5 ms in Low Demand mode. < 500 ms in Continuous mode. Note: This is the time required for a IPC707 signal conditioner with diagnostics to update the nominal value of the diagnostic component (DC) of the output signal, with the minimum configurable low-pass (LP) filter of 200 Hz.
Allocation of SIL budget	PFDavg < 20% of the SIL 2 budget for a PTI ⩽ 5 years. PFH < 20% of the SIL 2 budget at 7.02×10^{-8} FIT. Note: For a IPC707 measurement chain (that is, IPC707-compatible sensor, IPC707-compatible cabling and IPC707 signal conditioner with diagnostics).
Safety accuracy	Sensitivity: ±10%. High-pass (HP) filter cutoff frequency: −75 to +100% from 1 to 110 Hz. Low-pass (LP) filter cutoff frequency: −40% to +100% from 0.2 to 20 kHz. Noise: ⩽1% of full scale deflection (measurement component (AC)).
Notes Failure rate calculations and analysis were performed with a long-term ambient temperature of 80°C (176°F). For a IPC707 with diagnostics, output values are defined in Table 2-1 and 7.7.1 Defining the alarm levels.	

Table 3-1: Other important safety properties for a IPC707 measurement chain

Additional failure modes, effects and diagnostic analysis (FMEDA) calculations, details and results can be made available on request. Contact your local Parker Meggitt representative for further information.

3.4 Design verification

Table 3-2 lists the important design verifications for a IPC707 measurement chain.

Design verification	Description / Value					
Probability of failure per hour (PFH)	7.02×10^{-8} (calculated value). Note: SIL 2 requires $< 1.00 \times 10^{-6}$.					
Average probability of failure on demand (PFDavg)	Proof test interval (PTI)	1 year	2 years	3 years	5 years	10 years
	PFDavg by proof test years	1.01×10^{-3}	1.24×10^{-3}	1.47×10^{-3}	1.94×10^{-3}	3.09×10^{-3}
	Note: SIL 2 requires $< 1.00 \times 10^{-2}$.					
Notes Only 20 % of the SIL 2 budget is required for a IPC707 measurement chain (that is, IPC707-compatible sensor, IPC707-compatible cabling and IPC707 signal conditioner with diagnostics). Failure rate calculations and analysis were performed for a long-term ambient temperature of 80 °C (176 °F). Typical maintenance intervals for the types of machinery monitored by IPC707 measurement chains are 3 years.						

Table 3-2: Design verification for a IPC707 measurement chain

3.5 ISO 13849-1 performance level

3.5.1 Single IPC707 measurement chain performance level

As an example, Table 3-3 shows the calculated results for a typical single IPC707 measurement chain (HFT = 0) consisting of a CA134-612 sensor, EC119 cable and IPC707 signal conditioner with diagnostics in a category 1 system architecture, according to ISO 13849-1.

Component	MTTFd[1] (in years)	MTTFd category	Average diagnostic coverage (DCavg[2])	Postulated DCavg	Performance level (PL)
CA134-612 sensor	88	High	98%	---	---
EC119 cable	213	High	99%	---	---
IPC707 signal conditioner with diagnostics	226	High	92%	---	---
IPC707 measurement chain	49	High	97%	Medium	c

Notes
1. Mean time to dangerous failure (MTTFd).
2. Average diagnostic coverage (DCavg) from FMEDA calculations, where DCavg = λ_{DDC} / (λ_{DDC} + λ_{DU}), where λ_{DDC} is the dangerous-detected failure rate.

Additional mean time between failures (MTBF) and failure modes, effects and diagnostic analysis (FMEDA) calculations, details and results can be made available on request. Contact your local Parker Meggitt representative for further information.

Table 3-3: Example performance level (PL) for a typical IPC707 measurement chain according to ISO 13849-1

For a single IPC707 measurement chain, the common cause failure (CCF) score is estimated as less than 65 (as per Table F.1 of DIN ISO 13849-1), therefore the highest achievable category is Cat 1.

The average diagnostic coverage (DCavg) is calculated taking into account dangerous-detected failures (λ_{DD}) and dangerous-undetected failures (λ_{DU}), with annunciation failures (λ_{AD} and λ_{AU}) that affect diagnostics omitted.

Accordingly, for a typical single IPC707 measurement chain, the maximum performance level (PL) achievable is PL c Cat 1.

NOTE: In a safety-related application, loss of the safety function is detected by the safety-critical output of the IPC707 signal conditioner being checked by the external monitoring and/or protection system.

3.6 Environmental and application limits

NOTE: Refer to the *IPC707 signal conditioner data sheet* for further information on environmental and applications limits such as temperature, humidity, protection rating, vibration and shock.

3.7 Safety certificate

The IPC707 signal conditioner and measurement chains/systems described in this safety manual are safety certified.

NOTE: The safety certificate can be obtained from the Parker Meggitt website at www.meggittsensing.com/energy or by contacting your local Parker Meggitt representative.

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4 CONFIGURATION

4.1 Configuration

During manufacture, a IPC707 is configured in accordance with the part number (PNR) and ordering option codes defined by the customer at the time of ordering (see 1.3.2 Configurations).

NOTE: Refer to the *IPC707 signal conditioner data sheet* for further information on ordering option codes.

After manufacture, the configuration of a IPC707 cannot be changed.

4.2 Transfer function

For a IPC707 with diagnostics:

- The ratio between the low-pass filter cutoff frequency (f_{LP}) and the high-pass filter cutoff frequency (f_{HP}) must be greater than 5 (that is, $f_{LP} / f_{HP} > 5$) in order to reduce the effect of filter attenuation on the transfer sensitivity.
- The reference frequency (f_{REF}) for sensitivity measurement and for filter attenuation initial value (0 dB) is defined at the middle of bandwidth as follows:
  $f_{REF} = \text{sqrt} (f_{HP} \times f_{LP})$
  where
  f_{HP} = High-pass filter cutoff frequency
  f_{LP} = Low-pass filter cutoff frequency.

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5 INSTALLATION AND COMMISSIONING

5.1 Installation

For general information on the installation of a IPC707 measurement chain, refer to the *CAxxx piezoelectric accelerometers installation manual* or the *CPxxx dynamic pressure sensors installation manual*, as appropriate.

THE IPC707 SIGNAL CONDITIONER USES SIMILAR REMOVABLE SCREW-TERMINAL CONNECTORS FOR ITS INPUT (SENSOR SIDE) AND OUTPUT (MONITOR SIDE) CONNECTIONS, SO ALWAYS CHECK THE WIRING TO ENSURE THAT THE CORRECT SCREW-TERMINAL CONNECTOR IS PLUGGED INTO THE CORRECT SOCKET ON THE IPC707.

5.2 Commissioning

For the commissioning of safety-related applications, it is important to ensure that the correct components are used and that they are connected together correctly:

- A IPC707 signal conditioner with diagnostics must be used (see 1.3 IPC707 signal conditioner).
- A IPC707 signal conditioner with diagnostics must be used and the sensor and cabling must be IPC707 compatible (see 2.2 IPC707 measurement chains in safety-related applications and 2.3 Valid IPC707 measurement chains).
- The external power supply used to power the IPC707 must meet the requirements specified in 2.4 Power supply requirements.
- Correct wiring should be verified.

See also 7.8 Commissioning.

NOTE: It is important to note that a IPC707 measurement chain is used as an input (sensor) to an external safety instrumented system that performs a safety function, so it is the external safety instrumented system that provides the “intelligence” in the system.

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6 OPERATION AND MAINTENANCE

6.1 Proof test

A proof test is required to detect dangerous faults which are undetected by the integrated diagnostics of a IPC707 signal conditioner with diagnostics. The following proof test provides a proof test coverage (PTC) of 75%.

Equipment required

- Small screwdriver
- Charge generator such as the TSU109 or equivalent
- Multimeter or ohmmeter such as a digital multimeter (DMM).

Procedure

1- For the measurement channel of the machinery monitoring and/or protection system using the IPC707 measurement chain, bypass the safety function and take appropriate action to ensure that a shutdown ("trip") of the machinery is not accidentally initiated by the proof test.

2- Disconnect the cable from the input to the IPC707 signal conditioner and check that the diagnostic component (DC) of the output signal from the IPC707 indicates that there is a problem with the measurement chain.

For a IPC707 signal conditioner with diagnostics, a diagnostic component (DC) value of 13 mA_{DC} or 8 V_{DC} indicates normal operation, while other values indicate a problem (see 2.1 Operation of a IPC707 with diagnostics, Table 2-1 and Figure 7-1).

3- Connect a charge generator to the input to the IPC707 signal conditioner and check that the measurement component (AC) of the output signal from the IPC707 corresponds to the known injected charge signal.

For a IPC707 signal conditioner, the measurement component (AC) amplitude and phase values depend on the transfer function configured for the IPC707 (see 1.3.2 Configurations).

4- Connect a multimeter configured to measure ohms (Ω) across the H (+) and L (−) wires of the cabling from the sensor (that is, across the cable disconnected from the input to the IPC707 signal conditioner in step 2 above) and check that the measured resistance value is greater than the minimum insulation resistance value for the sensor.

For CAxxx piezoelectric accelerometers and CPxxx dynamic pressure sensors, the internal insulation resistance value (Ω) is specified in the corresponding data sheet.

5- Reconnect the cable to the input to the IPC707 signal conditioner (that is, reassemble the measurement chain).

6- For the measurement channel of the machinery monitoring and/or protection system using the IPC707 measurement chain, remove the bypass on the safety function and restore the system to normal operation.

6.1.1 Alternative proof test

An alternative proof test could be devised whereby a known physical quantity (acceleration or dynamic pressure) is generated in the system and the measurement component (AC) of the output signal from the IPC707 is checked to ensure that it corresponds to the known physical quantity.

6.2 Maintenance and end-of-life product disposal

For general maintenance and end-of-life product disposal information, refer to the *CAxxx piezoelectric accelerometers installation manual* or the *CPxxx dynamic pressure sensors installation manual*, as appropriate.

See also 7.10 Maintenance.

7 SAFETY ISSUES

7.1 Safety function

In practice, the output signal from a IPC707 signal conditioner is an input (sensor) to an external monitoring and/or protection system (external safety instrumented system performing a safety function) that takes this input together with other safety-related signals.

7.2 Safety outputs

See Table 2-1.

7.3 Safety time

See Process safety time (PST) in Table 3-1.

7.4 Power supply

See 2.4 Power supply requirements.

7.5 Installation

Depending on the type of piezoelectric-based sensor (vibration or dynamic pressure) used by a IPC707 measurement chain, installation must be performed following the guidelines in the *CAxxx piezoelectric accelerometers installation manual* or the *CPxxx dynamic pressure sensors installation manual*, as appropriate.

Environmental restrictions depend on the components of a IPC707 measurement chain: IPC707-compatible sensor, IPC707-compatible cabling and a IPC707 signal conditioner.

NOTE: Refer to the relevant data sheet for further information on environmental restrictions.

7.6 Configuring a IPC707 measurement chain

The IPC707 signal conditioner is a highly-configurable product with ordering option codes that are used to specify the required configuration of a IPC707 at the time of ordering (see 1.3.2 Configurations).

7.7 Configuring the external monitoring and/or protection system

For the external monitoring and/or protection system used with a IPC707 measurement chain, such as a VM600^{Mk2}/VM600 or VibroSmart® protection system, it is important that the alarm levels (alert and/or danger) configured for the vibration or pressure measurements are appropriate for the machinery/system under protection.

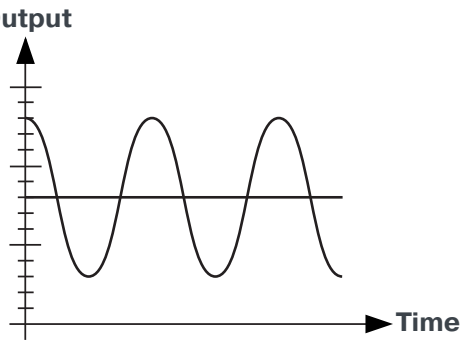
NOTE: Refer to the monitoring and/or protection system documentation for further information.

A IPC707 with diagnostics continuously:

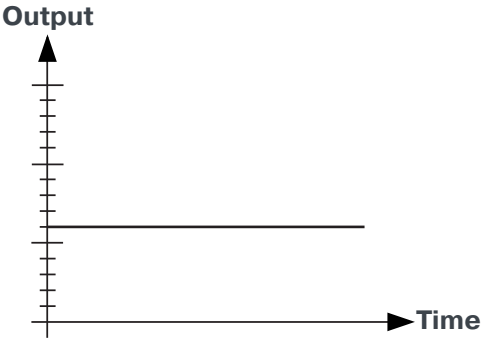
- runs health checks on the components of the IPC707 measurement chain (sensor, cabling and signal conditioner).
- updates the diagnostic component (DC) of its output signal to communicate the integrity of the IPC707 measurement chain and indicate the source of detected problems.
- updates the measurement component (AC) of its output signal corresponding to the measured acceleration or dynamic pressure.

In safety-related applications, the external monitoring and/or protection system used with a IPC707 measurement chain must monitor the diagnostic component (DC) of the IPC707's output signal for the values described in Figure 7-1 and Table 2-1.

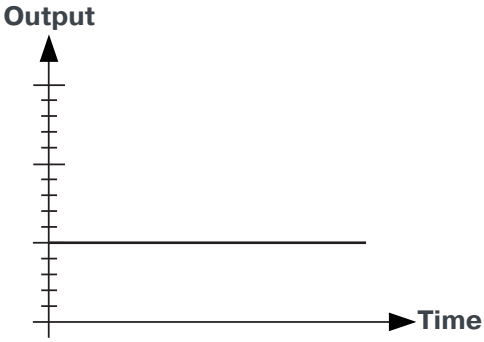
(For reference, Table 2-2 lists the values for the diagnostic component (DC) of the output signal from a IPC707 without diagnostics.)



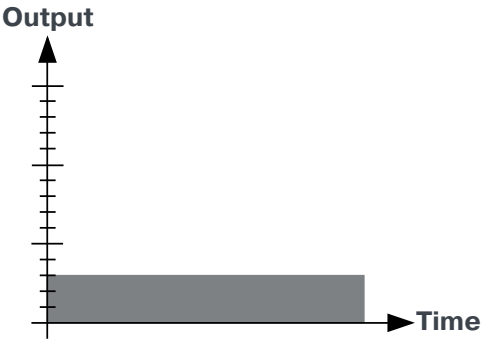
(a) Diagnostic component (DC) value = 13 mA_{DC} or 8 V_{DC}.
Measurement chain OK and measurement component (AC) value can be trusted.



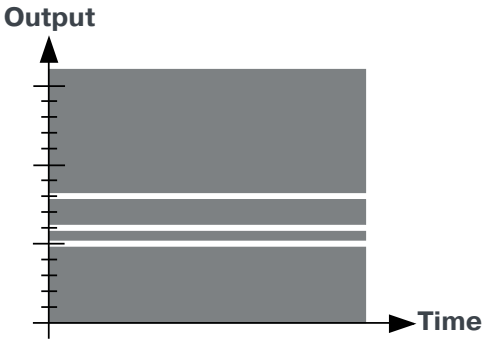
(b) DC value = 11 mA_{DC} or 6 V_{DC}.
Measurement chain not OK!



(c) DC value = 10 mA_{DC} or 5 V_{DC}.
Measurement chain not OK!



(d) DC value = < 8 mA_{DC} or < 3 V_{DC}.
Measurement chain not OK!



(e) DC value = Other current or voltage.
Measurement chain not OK!

Figure 7-1: Output signal from a IPC707 with diagnostics

7.7.1 Defining the alarm levels

As shown in Figure 7-1 (a), during normal operation, a IPC707 signal conditioner with diagnostics will update its output signal as follows:

- Diagnostic component (DC) to 13 mA_{DC} ±0.5 mA_{DC} or 8 V_{DC} ±0.5 V_{DC}.
- Measurement component (AC) to a value <±5 mA_{DC} or <±5 V_{DC} corresponding to the measured physical quantity (acceleration or dynamic pressure), depending on the transfer function configured for the IPC707 (see 1.3.2 Configurations).

As shown in Figure 7-1 (b), (c) and (d), after the detection of a failure (λ_{DD}), a IPC707 signal conditioner with diagnostics will update its output signal as follows:

- Diagnostic component (DC) to one of the following values:
  - 11 mA_{DC} ±0.5 mA_{DC} or 6 V_{DC} ±0.5 V_{DC}
  - 10 mA_{DC} ±0.5 mA_{DC} or 5 V_{DC} ±0.5 V_{DC}
  - <8 mA_{DC} or <3 V_{DC}.

As shown in Figure 7-1 (e), for an undetected failure (λ_{DU}), a IPC707 signal conditioner with diagnostics will update its output signal as follows:

- Diagnostic component (DC) to one of the following values:
  - Other current value or other voltage value.

See also 2.1 Operation of a IPC707 with diagnostics, including Table 2-1 and 3.2 Safety output.

Accordingly, in safety-related applications, an external monitoring and/or protection system using a IPC707 measurement chain must be capable of detecting and reporting the status of the measurement chain as communicated by the diagnostic component (DC) of the IPC707's output signal, that is, corresponding sensor/measurement chain OK check/levels must be suitable (see Figure 7-1 and Table 2-1).

It is also important that the measurement channel / machinery monitoring system using a IPC707 measurement chain is configured to detect and report any problems with the measurement chain as quickly as possible, that is, corresponding delay times must be configured as zero (0).

For the diagnostic component (DC) of the output signal from a IPC707, the configuration of the safety function in the external monitoring and/or protection system must be made in consultation with the safety system engineer (or a similar authority).

For the measurement component (AC) of the output signal from a IPC707, the configuration of the alarm levels in the external monitoring and/or protection system must be made in consultation with the site manager. It is the end user's responsibility to ensure that the alarm levels are appropriate for the machinery/system under protection.

NOTE: Refer to the monitoring and/or protection system documentation for further information.

7.8 Commissioning

A IPC707 measurement chain must be commissioned as an integral part of the overall safety-related system commissioning.

INSTALLATION AND COMMISSIONING SHOULD ONLY BE PERFORMED BY COMPETENT AND AUTHORISED PERSONNEL FOLLOWING THE PLANT SPECIFIC GUIDELINES IN FORCE AT THE INSTALLATION.

7.8.1 Guidelines for commissioning

NOTE: Refer to the monitoring and/or protection system documentation for further information.

7.9 Product lifetime

In safety-related applications, a IPC707 signal conditioner has a product lifetime of 10 years after entry into service.

7.10 Maintenance

Depending on the type of piezoelectric-based sensor (vibration or dynamic pressure) used by a IPC707 measurement chain, maintenance should be performed following the guidelines in the latest version of the *CAxxx piezoelectric accelerometers installation manual* or the *CPxxx dynamic pressure sensors installation manual*, as appropriate.

See 8.1 Contacting us for the contact details relevant to repairing defective hardware.

If a IPC707 measurement chain is under maintenance or repair, then the attached system and equipment may no longer be protected. Therefore, such procedures should only be undertaken by authorised personnel respecting the overall plant operation procedures.

7.11 Mean time to repair

The mean time to repair/restoration (MTTR) for a IPC707 measurement chain is considered to be 8 hours.

7.12 Assumptions

When a IPC707 measurement chain is used in a safety-related application, certain characteristics of connected equipment such as a VM600^{Mk2}/VM600 or VibroSmart® monitoring and/or protection system, or a GSI127 galvanic separation unit, and associated transmission cabling are assumed as follows:

#1

The power supply to a IPC707 is able to provide a minimum supply current of 20 mA_{DC}.

#2

The power supply to a IPC707 is able to ensure a supply voltage of 18 to 30 V_{DC} at the input to the IPC707 (+24V screw-terminal connector) at the maximum current consumption of 20 mA_{DC}.

#3

For a IPC707 configured with a current output, the maximum input impedance for connected equipment is 600 Ω.

NOTE: This is in order to have a IPC707 output signal loss of 1% max.

#4

For a IPC707 configured with a current output, the maximum load capacitance (C_L) is calculated as follows:

$C_L = 1 / (2 \times \pi \times 2 \times f_{LP} \times R)$

where

f_{LP} is the low-pass filter cutoff frequency required by the application,

R is the input impedance of the connected equipment.

NOTE: This is in order to have a IPC707 output signal loss of 10% max. at f_{LP}.

Example

For a IPC707 configured with a current output and a low-pass filter cutoff frequency of 10 kHz connected to a GSI127 galvanic separation unit with an input impedance of 30 Ω:

$C_L = 1 / (2 \times \pi \times 2 \times f_{LP} \times R)$

$C_L = 1 / (2 \times \pi \times 2 \times 10000 \times 30\ \Omega)$

C_L = 265 nF max.

#5

For a IPC707 configured with a voltage output, the minimum input impedance for connected equipment is 50 kΩ.

NOTE: This is in order to have a IPC707 output signal loss of 1% max.

#6

For a IPC707 configured with a voltage output, the maximum load capacitance (C_L) is calculated as follows:

$C_L = 1 / (2 \times \pi \times 2 \times f_{LP} \times 500\ \Omega)$

where

f_{LP} is the low-pass filter cutoff frequency required by the application,

500 Ω is the maximum output impedance of a IPC707 configured with a voltage output.

NOTE: This is in order to have a IPC707 output signal loss of 10% max. at f_{LP}.

Example

For a IPC707 configured with a voltage output and a low-pass filter cutoff frequency of 10 kHz:

$C_L = 1 / (2 \times \pi \times 2 \times f_{LP} \times 500\ \Omega)$

$C_L = 1 / (2 \times \pi \times 2 \times 10000 \times 500\ \Omega)$

$C_L = 15.9$ nF max.

#7

The external monitoring and/or protection system connected to the output of a IPC707 is capable of reading the diagnostic component (DC) of the IPC707's output signal with an accuracy of at least ±0.1 mA or ±0.1 V.

NOTE: This is in order to be able to identify the status of a IPC707 measurement chain, that is, to distinguish between normal operation and a dangerous-detected failure.

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8 SERVICE AND SUPPORT

8.1 Contacting us

Parker Meggitt's worldwide customer support network offers a range of support, including 8.3 Technical support and 8.4 Sales and repairs support. For customer support, contact your local Parker Meggitt representative. Alternatively, contact our Parker Meggitt (Meggitt SA) office:

Customer Support department
Parker Meggitt (Meggitt SA)
Route de Moncor 4
Case postale
1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: energysupport@ch.meggitt.com
Website: www.meggittsensing.com/energy

8.2 SIL safety product information

For SIL products used in safety-related applications, Parker Meggitt (Meggitt SA) strongly recommends that you opt in and receive SIL product communications as this could include important future information concerning the safety of a product such as safety bulletins and/or product update/replacement information.

If you do not opt in to receive SIL product communications, you might not receive important future information concerning the safety of a product.

For products used in safety-related applications, it is important that:

- Parker Meggitt's technical support team is able to provide you and/or the end-user with product-related safety information such as service bulletins and/or product recalls.

  NOTE: Accordingly, the Energy SIL safety product communications procedure described on page 8-3 should be used in order to opt in and receive such SIL product communications.

- You and/or the end-user provide Parker Meggitt's technical support team with product-related applications information such as operating issues and/or failures.

  NOTE: Accordingly, the Energy product return procedure described on page 8-5 should be used in order to report problems and return Parker Meggitt energy products for repair.

8.3 Technical support

Parker Meggitt's technical support team provide both pre-sales and post-sales technical support, including:

- General advice
- Technical advice
- Troubleshooting
- Site visits.

NOTE: For further information, contact your local Parker Meggitt representative (see 8.1 Contacting us).

8.4 Sales and repairs support

Parker Meggitt's sales team provide both pre-sales and post-sales support, including advice on:

- New products
- Spare parts
- Repairs.

NOTE: If a product has to be returned for repairs, then this should be done in accordance with the Energy product return procedure described on page 8-5.

8.5 Customer feedback

As part of our continuing commitment to improving customer service, we welcome your comments. To provide feedback, complete the Energy customer feedback form on page 8-10 and return it to our Parker Meggitt (Meggitt SA) office (see 8.1 Contacting us).

SIL SAFETY PRODUCT INFORMATION

For SIL products used in safety-related applications, Parker Meggitt (Meggitt SA) strongly recommends that you opt in and receive SIL product communications as this could include important future information concerning the safety of a product such as safety bulletins and/or product update/replacement information.

If you do not opt in to receive SIL product communications, you might not receive important future information concerning the safety of a product.

Energy SIL safety product communications procedure

In order for important future information concerning the use of a Parker Meggitt (Meggit SA) energy SIL safety product to be communicated to users, it is important that we have contact and product information for the users of SIL products.

Accordingly, in order to opt in and receive SIL safety product communications, please use the online SIL safety product communications procedure on the Parker Meggitt website at:
www.meggittsensing.com/energy/service-and-support/silproductcommunications

As described on the website, the SIL safety product communications procedure is as follows:

1- Complete and submit online the Energy SIL safety product communications form that is available on the website (note: * indicates a required field).

For each type of energy SIL safety product, a separate energy SIL safety product communications form must be completed and submitted online.

2- An acknowledgement email will be sent by return to confirm that the form was received and that your contact and product information has been added to the energy SIL safety product database managed by our Customer Support department.

Accordingly, any important future information concerning the use of an energy SIL safety product will be communicated to you, should this become necessary.

NOTE: The Energy SIL safety product communications form reproduced below is included to support the gathering of information required for completion and submission online.

Energy SIL safety product communications form

Customer contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

SIL safety product information

Product type:*

Part number (PNR):*

Serial number (SER):

Note: Enter “Unknown” if the serial number (SER) is not known.

Meggitt SA purchase order number:

Date of purchase (dd.mm.yyyy):

Site where installed:

End-user:

SIL safety product communications

Do you want to opt in and receive important communications information concerning your SIL safety product?:*

☐ Yes

☐ No

Note: For SIL safety products used in safety-related applications, Meggitt SA strongly recommends that you opt in to receive SIL product communications as this could include important future information concerning the safety of a product such as safety bulletins and/or product update/replacement information.

REPAIRS AND RETURNS

Energy product return procedure

If a Parker Meggitt (Meggitt SA) energy product needs to be returned to us, please use the online product return procedure on the Parker Meggitt Energy website at www.meggittsensing.com/energy/service-and-support/repair

As described on the website, all requests for product repair/return should be sent to Parker Meggitt (Meggitt SA), as follows:

1- Please complete and submit online the Energy product return form that is available on the website.

When the form has been processed by Meggitt, a return merchandise authorization (RMA) document and an end-user certificate (EUC) will be emailed by return, which typically takes a few days.

2- It is optional to issue a PO to Parker Meggitt (Meggitt SA) for every product (may include multiple items / serial numbers).

3- Return the product, together with the signed RMA and EUC, to the address indicated on the RMA.

NOTE: Do NOT send goods back to Parker Meggitt (Meggitt SA) without an RMA form! All goods returned must be accompanied by a fully completed and signed RMA form.

Notes:

- An asterisk (*) in the form below indicates a required field. JavaScript must be enabled (in your web browser) for the form to be displayed and completed correctly.
- For every product to be returned:
  - A separate form must be submitted online. Although multiple items of the same product (one part number, different serial numbers) can be covered by a single form.
  - An associated single-use EUC must be included, unless an annual EUC is in place for your company. Although multiple items of the same product can be covered by a single RMA and EUC.
- When a product is returned, all information is sent to our repair center in our Parker Meggitt (Meggitt SA) office. For any queries about product returns, please send an email to energysupport@ch.meggitt.com.
- The RMA document contains a unique reference number that should be used in all communications regarding a product return.

NOTE: The Energy product return form reproduced below is included to support the gathering of information required for completion and submission online.

Energy product return form

Contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

Product information

Product type:*

Part number (PNR):*

Serial number (SER):

Note: Enter “Unknown” if the serial number (SER) is not known.

Ex product:

☐ Yes

☐ No

SIL product:*

☐ Yes

☐ No

Meggitt SA purchase order number:

Date of purchase (dd.mm.yyyy):

Product under warranty:

☐ Yes

☐ No

☐ Don’t know

Site where installed:

End-user:

Return information

Reason for return:*

☐ Repair

☐ Calibration / recertification

☐ Out-of-box problem

☐ Return

If the reason for return is “Repair”, please answer the following questions:*

Type of problem:

☐ Continuous

☐ Intermittent

☐ Temperature dependent

How long was the operating time before the problem?

Description of problem:

Note: Please provide a detailed description in order to help with problem diagnosis.

If the reason for return is “Out-of-box problem”, please answer the following questions:*

Type of out-of-box problem:

☐ Product damaged

☐ Incorrect product configuration

☐ Incorrect product delivered

☐ Problem with documentation / labelling

☐ Product dead-on-arrival

Additional information:

Note: Please provide as much information as possible in order to help with problem diagnosis.

Ex product information – additional information required for Ex products only

Is the product installed in a hazardous area (potentially explosive atmosphere)?:

☐ Yes

☐ No

If the product is installed in a hazardous area, please answer the following questions:

How long was the operating time before the problem?:

Additional information:

SIL product information – additional information required for SIL products only*

Note: For SIL products used in functional-safety contexts/systems, this SIL product information section must be completed.

When was it installed and first operated (dd.mm.yyyy)?:

When was a proof test last executed (dd.mm.yyyy)?:

Is the product installed in a safety-related system?:*

☐ Yes

☐ No

If the product is installed in a safety-related system, please answer the following questions:*

Did the system fail** in a safe mode?:* (That is, the safety relay operated but the trip was spurious.)

☐ Yes

☐ No

☐ Not applicable

Did the system fail** in a dangerous state?:* (That is, the failure did not result in the safe state.)

☐ Yes

☐ No

☐ Not applicable

How long was the operating time before the failure (in hours)?:*

Additional information:

** A faulty indicator LED is considered as a cosmetic failure.

FEEDBACK

Energy customer feedback form

Manual information

Title of manual:

IPC707 signal conditioner safety manual

Reference:	MAIPC707-FS/E	Version:	Edition 3
Date of issue:	December 2024		

Customer contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

Feedback – general

Please answer the following questions:

Is the document well organised?	☐ Yes	☐ No
Is the information technically accurate?	☐ Yes	☐ No
Is more technical detail required?	☐ Yes	☐ No
Are the instructions clear and complete?	☐ Yes	☐ No
Are the descriptions easy to understand?	☐ Yes	☐ No
Are the examples and diagrams/photos helpful?	☐ Yes	☐ No
Are there enough examples and diagrams/photos?	☐ Yes	☐ No
Is the style/wording easy to read?	☐ Yes	☐ No
Is any information not included?	☐ Yes	☐ No

Note: Please include any additional information in the “Feedback – additional” section below.

Feedback – additional

Additional information:

Note: Please provide as much feedback as possible in order to help us improve our product documentation.
Continue on a separate sheet if necessary …

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