Pressure Transmitter SCP07

Safety Manual

Parker

ENGINEERING YOUR SUCCESS.

Safety Manual
Pressure Transmitter SCP07

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Version	Date	Amendment
1.1 EN	03/2020	First revision

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1 Scope

This document includes system information and safety requirements for the pressure transmitter SCP07, which have to be considered and fulfilled within the overall safety application.
It shall be used as input for the

- development of the overall safety application.
- overall installation and commissioning planning.
- overall safety validation planning.
- overall operation, maintenance and repair planning.

2 General information

2.1 Declaration of conformity

EU-Konformitätserklärung

EC-Declaration of Conformity

Dokument-Nr.: 38/17
Document-No.:

Hersteller: Parker SensoControl
Manufacturer

Anschrift:
Adress

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Produktbezeichnung:
Name of product

DRUCKSENSOR ANALOG
PRESSURE SENSOR ANALOG
SCP07-XXX-XX-XX

Das bezeichnete Produkt stimmt mit den Vorschriften folgender europäischer Richtlinien überein:
The indicated product is in correspondence with the following regulations of European Council:

2014/30/EU
Richtlinie zur Angleichung der Rechtsvorschrift der Mitgliedsstaaten über die elektromagnetische Verträglichkeit (EMV-Richtlinie)
Council Directive for the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC directives)

2011/65/EU
Richtlinie zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (RoHS-Richtlinie)
Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS directives)

2006/42/EG
Richtlinie über Maschinen und zur Änderung der Richtlinie 95/16/EG (Maschinenrichtlinie)
Directive on machinery and amending Directive 95/16/EC (Machinery directives)

Folgende harmonisierte Normen kamen zur Anwendung:
The following standards were applied:

Angewandte harmonisierte Normen für EMV-Richtlinie:
Applied harmonized standards for EMC directives:
EN 55011:2009/A1:2010
EN 61000-6-3:2007/A1:2011/AC:2012
EN 61000-6-1:2007
EN 61326-1:2013

Angewandte harmonisierte Normen für RoHS-Richtlinie:
Applied harmonized standards for RoHS directives:
EN 50581:2012

Angewandte harmonisierte Normen für Maschinenrichtlinie:
Applied harmonized standards for Machinery directives:
EN ISO 13849-1:2015
EN ISO 13849-2:2012

Ort, Datum: *Place, date*	Bielefeld, 13.06.2017
Aussteller: *Issuer*	**Dr.-Ing. Andreas Neises** Div. Quality Manager
Rechtsverbindliche Unterschrift: *Signature*	i.V.

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

This declartion certifies the compliance with the indicated directives but implies no warranty of properties. The safety intructions of the accompanying product documentation shall be observed.

2.2 Used symbols and formats

Requirement:
Requirements which shall be adhered to maintain safe system operations.

Recommendation:
Recommendation on how to handle certain aspects of requirements.

Warning:
Warning on faults and errors during the application development.

Note:
A note provides additional and important information of the system behavior.

2.3 Disposal

Dispose the SCP07 according to the valid regulations on waste electrical and electronic equipment.

2.4 Reference

No.	Description
/1/	International standard IEC 61508:2010 Functional safety of electrical, electronic and programmable electronic safety-related systems
/2/	Safety standard EN ISO 13849-1:2015 Safety of machinery - Safety-related parts of control systems
/3/	Siemens standard SN 29500: Failure rates of components
/4/	EMC standard EN 61000-4-5:2005 Electromagnetic Compatibility; Testing and measurement techniques - Surge immunity test
/5/	Safety standard ISO 25119:2010 / EN 16590:2014 Tractors and machinery for agriculture and forestry - Safety-related parts of control systems

2.5 Abbreviations

Abbreviation	Description
AgPL	Agricultural Performance Level: Safety classification according to ISO 25119 / EN 16590
CCF	Common Cause Failure
CRC	Cyclic Redundancy Check
DC	Diagnostic Coverage
DTI	Diagnostic Test Interval
ECU	Electronic Control Unit
EEPROM	Electrically Erasable Programmable ROM
EMC	Electromagnetic Compatibility
FRT	Fault Reaction Time
FTT	Fault Tolerance Time
FS	Full Scale
GND	Ground
HW	Hardware
I/O	Input / Output
MDT	Mean Downtime
MTBF	Mean Time Between Failure
MTTFd	Mean Time To Dangerous Failure
MTTR	Mean Time To Restoration
PFH	Probability of dangerous Failure per Hour
PL	Performance Level: Safety classification according to EN ISO 13849
PST	Process Safety Time
RAM	Random Access Memory

Abbreviation	Description
ROM	Read Only Memory
SFF	Safe Failure Fraction
SIL	Safety Integrity Level: Safety classification according to IEC 61508
SN	Siemens Standard
SRL	Software Requirement Level
SW	Software
TBD	To be determined / to be defined
VCC	Voltage at the common collector
VFB	Voltage Feedback
VSRC	Valid Safety Relevant Configuration

3 Qualification Tests

3.1 Compliance information

Standard		Description	Parameter
	CE	Conformity	See Declaration of Conformity on page 5
KBA (Kraftfahrtbundesamt)	E1	Certification Requirement in accordance to the EC type-approval of the Kraftfahrt-Bundesamt (KBA) - Federal Motor Transport Authority: All vehicle types with a 12 V respectively 24 V - electrical wiring and battery (-) at the body.	According UN ECE Regulation No. 10
See also Functional Safety Classification (see „Functional Safety Classification“ on page 13)			

3.2 Electromagnetic and Electrical Tests

CE Conformity (electrical safety)

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
Manufacturer Company Standard	Supply voltage	Current variant: Operation with U_{max} = 32 V DC and U_{min} = 9 V DC for a duration of 60 minutes each Ratiometric voltage variant: Operation with U_{max} = 5.5 V DC and U_{min} = 4.5 V DC for a duration of 60 minutes each	X	X
Manufacturer Company Standard	Starting profile switch-on hysteresis	Overvoltage and hysteresis: $U_{Test} = U_{max} + 3\%$ t = 5 min Undervoltage and hysteresis: U_{Start} = Unom ΔU = 0.1 V $U_{min} = U_{switch-off}$ t at $U_{switch-on}$ = 5 min	X	X

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
Manufacturer Company Standard	Broken cable supply lines	Interruption of supply lines Current variant: U_{max} = 32 V U_{min} = 9 V Ratiometric voltage variant: U_{max} = 5.5 V U_{min} = 4.5 V t = 60 sec	X	X
Manufacturer Company Standard	Short circuits	Output signals to VCC or GND in each case t = 60 sec	X	X
Manufacturer Company Standard ISO 16750-2; 2012-11	Polarity Protection	Change supply polarity t = 5 min Current variant: No current limitation of supply necessary Ratiometric voltage variant: Current limiting of supply to 2 A	X	X
Manufacturer Company Standard	Current consumption	Supply current consumption without load Current variant: $I_{max} \leq 50$ mA Ratiometric voltage variant: $I_{max} \leq 20$ mA	X	X
Manufacturer Company Standard	Load test	48 hours at minimum temperature: 12 hours without operating, 36 hours with operating U_{min} and I_{min} 48 hours at maximum temperature with operation I_{max} and U_{max}	X	X
Manufacturer Company Standard ISO 16750-2: 2012-11	Insulation Resistance	Unpowered; 500 V_{DC}; 60 sec; 50 % rh; 35 °C between Connector pins and electric conductive housing without galvanic contact Insulation resistance > 10 MΩ	X	X

EMC (CE Conformity)

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
DIN EN 61000-6-3 DIN EN 61326-1 DIN EN 61326-2-3	Emission	Conducted emission: 150 kHz to 30 MHz Radiated emission: 30 MHz to 1 GHz	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-1	Electrostatic Discharge (ESD)	Direct discharge: Contact discharge: ±2 kV, ±4 kV Air discharge: ±2 kV, ±4 kV, ±8 kV 10 discharges per test point	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-1	Electrostatic Discharge (ESD)	Indirect discharge: (horizontal coupling-plate) Contact discharge: ±2 kV, ±4 kV 15 discharges per test point	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-1	Electrostatic Discharge (ESD)	Indirect discharge (vertical coupling-plate) Contact discharge: ±2 kV, ±4 kV 15 discharges per test point	X	X
DIN EN 61000-4-3: 2011-04 DIN EN 61326-1 DIN EN 61326-2-3	Immunity	Immunity radio frequency: 80 MHz to 1.0 GHz (10 V/m) 1.4 GHz to 2.0 GHz (3 V/m) 2.0 GHz to 2.7 GHz (1 V/m) 3 m, horizontal and vertical	X	X
DIN EN 61000-4-4: 2013-04 DIN EN 61326-1 DIN EN 61326-2-3	Burst	Test voltage: Supply lines: ±2 kV Data lines: ±1 kV Duration : 5 min Pulse form: 5/50 ns Frequency: 5 kHz Polarity: positive and negative	X	X

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
DIN EN 61000-4-5: 2007-06 DIN EN 61326-1 DIN EN 61326-2-3	Surge	Symmetrical coupling (L-N): Supply lines: ±0.5 kV, ±1 kV Coupling: 2 Ω / 18 µF Unsymmetrical coupling (L-PE, N-PE, LN-PE): Supply lines: ±0.5 kV, ±1 kV, ±2 kV Signal lines: not required, cable length < 30 m Coupling: 12 Ω / 9 µF Number of repeats: 5	X	---
DIN EN 61000-4-8 DIN EN 61326-1 DIN EN 61326-2-3	Immunity	Conducted disturbances 0.15 MHz – 80 MHz, 3 V, 80% AM sine wave 1 kHz	X	X
DIN EN 61000-4-8 DIN EN 61326-1 DIN EN 61326-2-3	Power Frequency Magnetic Fields	50 Hz / 60 Hz 30 A/m 60 seconds for each axis	X	X
DIN EN 61000-4-8 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Power Frequency Magnetic Fields	50 Hz / 60 Hz 30 A/m 60 seconds for each axis	X	X

EMC (Automotive)

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
CISPR 25/ECE R10	Emission	Artifical network (AN): 150 kHz to 108 MHz, 1 m, 120 kHz bandwith class 3 Antenna measurement (RE): 150 kHz to 30 MHz, 1 m, 9 kHz bandwith class 4 30 MHz to 1 GHz, 1 m, 120 kHz bandwith class 3 1 GHz to 2.5 GHz, 1 m, 120 kHz bandwith class 5	X	X
ISO 11452-2: 2004-11	Immunity	Absorber lined chamber: 200 MHz to 2 GHz, 200 V/m, CW, AM(1 kHz/80%), PM (577 us duration, 217 Hz repetition rate)	X	X
ISO 11452-4: 2011-12	Immunity	BCI: 20 MHz to 400 MHz, 200 mA, AM, (1 kHz, 80%)	X	X
ISO 7637-2: 2004-09	Emission	Transient emissions on supply cables (12 V system) severity level III : +75 V, -100 V	X	---
ISO 7637-2: 2004-09	Emission	Transient emissions on supply cables (24 V system) severity level III : +150 V, -450 V	X	---
ISO 7637-2: 2004-09	Road vehicles, electrical disturbance by conduction and coupling (data, signal), test level 4 Test level 4 for 12 V and 24 V systems	Pulse 1 (12 V system): -150 V, 5000 pulses, severity level: IV Pulse 1 (24 V system): -600 V, 5000 pulses, severity level: IV Pulse 2a (12 V system): +50 V, 5000 pulses, severity level: IV Pulse 2a (24 V system): +50 V, 5000 pulses, severity level: IV Pulse 2b (12 V system): +10 V, 10 pulses, severity level: IV Pulse 2b (24 V system): +20 V, 10 pulses, severity level: IV	X	---

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
ISO 7637-2: 2004-09	Road vehicles, electrical disturbance by conduction and coupling (data, signal), test level 4 Test level 4 for 12 V and 24 V systems	Pulse 3a (12 V system): -150 V, 1 hour, severity level: IV Pulse 3a (24 V system): -200 V, 1 hour, severity level: IV Pulse 3b (12 V system): +100 V, 1 hour, severity level: IV Pulse 3b (24 V system): +200 V, 1 hour, severity level: IV Pulse 4 (12 V system): -7 V, 1 pulse, severity level: IV Pulse 4 (24 V system): -16 V, 1 pulse, severity level: IV	X	---
ISO 7637-3: 2007-07	Immunity	Capacitive coupling (CCC) 12 V system test level: IV (-110 V) test time: 10 min 24 V system test level: IV (-150 V) test time: 10 min	X	X
ISO 7637-3: 2007-07	Immunity	Capacitive coupling (CCC) 12 V system test level: IV (+75 V) test time: 10 min 24 V system test level: IV (+150 V) test time: 10 min	X	X
ISO 7637-3: 2007-07	Immunity	Inductive coupling (ICC) 12 V system test level: IV (-110 V) test time: 10 min 24 V system test level: IV (-150 V) test time: 10 min	X	X

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
ISO 7637-3: 2007-07	Immunity	Inductive coupling (ICC) 12 V system test level: IV (+75 V) test time: 10 min 24 V system test level: IV (+150V) test time: 10 min	X	X
CISPR 25	Emission	Conducted emission 150 kHz to 108 MHz	X	X
ISO 10605: 2008-07	Electrostatic Discharge (ESD)	Powered-up test with direct discharge: - contact discharge: ±2 kV, ±4 kV, ±6 kV, ±8 kV - air discharge: ±4 kV, ±8 kV, ±15 kV 3 discharges per test point	X	X
ISO 10605: 2008-07	Electrostatic Discharge (ESD)	Powered-up test with indirect discharge - contact discharge: ±2 kV, ±4 kV, ±6 kV, ±8 kV 50 discharges per test point	X	X
ISO 10605: 2008-07	Electrostatic Discharge (ESD)	Unpowered test with direct discharge - contact discharge to pins and connectors: ±2 kV, ±4 kV 3 discharges per test point	X	X
ISO 10605: 2008-07	Electrostatic Discharge (ESD)	Unpowered test with direct discharge: - air discharge to surface: ±4 kV, ±8 kV, ±15 kV 3 discharges per test point	X	X

EMC (Functional Safety with Normal Condition)

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
DIN EN 61000-4-2: 2009-12 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Electrostatic Discharge (ESD)	Direct discharge: Contact discharge: ±6 kV Air discharge: ±2 kV, ±4 kV, ±8 kV 10 discharges per test point	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Electrostatic Discharge (ESD)	Indirect discharge (horizontal coupling-plate): Contact discharge: ±6 kV 15 discharges per test point	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Electrostatic Discharge (ESD)	Indirect discharge (vertical coupling-plate): Contact discharge: ±6 kV 15 discharges per test point	X	X
DIN EN 61000-4-3: 2011-04 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Immunity	80 MHz to 1.0 GHz (20 V/m) 1.4 GHz to 2.0 GHz (10 V/m) 2.0 GHz bis 2.7 GHz (3 V/m) 3 m, horizontal and vertical	X	X
DIN EN 61000-4-4: 2013-04 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Burst	Supply: ±3 kV (5/50 ns, 5 kHz) Signal: ±2 kV (5/50 ns, 5 kHz)	X	X

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
DIN EN 61000-4-5: 2007-06 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Surge	Symmetrical coupling (L-N): Supply lines: ±0.5 kV, ±1 kV Coupling: 2 Ω / 18 µF Unsymmetrical coupling (L-PE, N-PE, L-N-PE): Supply lines: ±0.5 kV, ±1 kV, ±2 kV Signal lines: not required for cable length <30 m Coupling: 12 Ω / 9 µF Number of repeats: 5	X	---
DIN EN 61000-4-6: 2014 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Immunity	Conducted disturbance 0.15 MHz – 80 MHz 10 V 80% AM sine wave 1 kHz	X	X
DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3 DIN EN 61000-4-29	Voltage Dips	V_{dip}: 40% T_d: 10 ms T_r: 10 s Number of repeats: 3	X	X
DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3 DIN EN 61000-4-29	Short Interruptions	V_{dip}: 100% T_d: 20 ms T_r: 10 s Number of repeats: 3	X	X

EMC (Functional Safety with Fail-safe Condition)

Standard	Test Description	Test Parameter	Current	Ratiometric voltage
DIN EN 61000-4-2: 2009-12 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Electrostatic Discharge (ESD)	Direct discharge: Contact discharge: ±6 kV Air discharge: ±2 kV, ±4 kV, ±8 kV 10 discharges per test point	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Electrostatic Discharge (ESD)	Indirect discharge: (horizontal coupling-plate) Contact discharge: ±6 kV 15 discharges per test point	X	X
DIN EN 61000-4-2: 2009-12 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Electrostatic Discharge (ESD)	Indirect discharge: (vertical coupling-plate) Contact discharge: ±6 kV 15 discharges per test point	X	X
DIN EN 61000-4-3: 2011-04 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Immunity	80 MHz to 1.0 GHz (20 V/m), 1.4 GHz to 2.0 GHz (10 V/m), 2.0 GHz to 2.7 GHz (3 V/m), 3 m, horizontal and vertical	X	X
DIN EN 61000-4-4: 2013-04 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Burst	Supply: ±3 kV (5/50 ns, 5kHz) Signal: ±2 kV (5/50 ns, 5kHz)	X	X

Standard	Test Description	Test Parameter	Current variant	Ratiometric voltage v.
DIN EN 61000-4-5: 2007-06 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Surge	Symmetrical coupling (L-N) Supply lines: ±0.5 kV, ±1 kV Coupling: 2 Ω / 18 µF Unsymmetrical coupling (L-PE; N-PE, L-N-PE) Supply lines: ±0.5 kV, ±1 kV, ±2 kV Signal lines: not required, cable length <30 m Coupling: 12 Ω / 9 µF Number of repeats: 5	X	---
DIN EN 61000-4-6: 2014 DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3	Immunity	Conducted disturbance 0.15 MHz – 80 MHz, 10 V, 80% AM sine wave 1 kHz	X	X
DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3 DIN EN 61000-4-29	Voltage Dips	V_{dip}: 40% T_d: 10 ms T_r: 10 s Number of repeats: 3	X	X
DIN EN 61326-3-1 DIN EN 61326-1 DIN EN 61326-2-3 DIN EN 61000-4-29	Short Interruptions	V_{dip}: 100% T_d: 20 ms T_r: 10 s Number of repeats: 3	X	X

3.3 Environmental Qualification

Standard	Test Description	Test Parameter
DIN EN 60068-2-6: 2008-10 DIN EN 60068-2-14: 2010-04	Environmental testing - Vibration (sinusoidal) with temperature profile	5 Hz - 2000 Hz, 20 g, 5 hours for each axe, -40 °C --> +125 °C, 2 temperature cycles per axes
DIN EN 60068-2-31: 2008 ISO 16750-3: 2012-12	Environmental testing: Free fall	1 m free fall on concrete ground, 6 axes
DIN EN 60068-2-14: 2009 DIN EN 60068-2-64: 2008 ISO 16750-3: 2012-12	Road vehicles - Environmental conditions and testing for electrical and electronic equipment: Mechanical loads - Random vibration - Text VII	10 Hz - 2000 Hz, broadband random, 32 hours for each axe, -40 °C --> +85 °C, 4 temperature cycles per axes see ISO 16750-3:2012-12 clause 4.1.2.7
DIN EN 60068-2-27: 2009	Environmental testing: Shock	50 g / 11 ms, half-sine wave, 3 positive, 3 negative shocks/axis
DIN EN 60068-2-27: 2009	Environmental testing: Bump	Bump, 30 g / 6 ms, half-sine wave, 1000 shocks per axis
DIN EN 60068-2-2: 2008-05 ISO 16750-4: 2010-04	Environmental testing: Cold storage	24 hours with -40 °C
DIN EN 60068-2-2: 2008-05 ISO 16750-4: 2010-04	Environmental testing: Dry heat (storage)	96 hours with 85 °C
IEC 60068-2-14: 2009 DIN EN 60068-2-14: 2010-04	Environmental testing: Change of temperature Na	-40 °C --> +85 °C, 100 cycles, duration time 1 hour, temp. change 10 seconds
IEC 60068-2-14: 2009 DIN EN 60068-2-14: 2010-04	Environmental testing: Change of temperature Nb	-40 °C --> +85 °C, 10 cycles
IEC 60068-2-14: 2009 DIN EN 60068-2-14: 2010-04	Environmental testing: Life test thermal shock	Weibull test according ISO 16750-1:2003 ΔT_{prac} = 60 Kelvin Frequency of temperature differences = twice a day Number of days in the year = 365 days Lifetime = 10 years
ISO 16750-4: 2010-04	Environmental testing: Ice water shock	10 cycles, T_{max}: 85°C, Duration time: 5 min
IEC 60068-2-30: 2005 DIN EN 60068-2-30: 2005	Environmental testing: Damp heat cyclic	+25 °C to 55 °C with 93 % r.h. 6 cycles (each cycle 24 hours)
DIN EN 60068-2-78: 2014-02	Environmental testing: Damp heat constant	21 days with 40 °C and 93 % r.h.
IEC 60068-2-60: 1996-09 ISO 16750-4: 2010-04	Flowing mixed gas corrosion test	Sulfur dioxide SO2, Hydrogen sulfide H2S, Nitrous oxide NO2, Chlorine Cl2
DIN EN 60529: 2000-09 DIN 40050-9: 1993-05	IP Protection Class	IP 67, IP 69K IP6KX Dust Tight according to ISO 12103-1 Arizona test dust A2 fine
ISO 16750-5: 2010-04	Chemical resistance	Gas/petrol, diesel, cleaner solvent, antifreeze, urea, battery fluid, brake fluid, engine oil, hydraulic oil

4 System Information

The SCP07 is designed for the operation in working machinery and further suitable application areas and qualified espacially for use under harsh conditions.

The pressure transmitter is a passive intelligent sensor. Its basically function is to convert the physical quantity “pressure” to an electrical signal.

Available output types

- Current variant: Current output signal. This variant provides two opposing current outputs 4 ... 20 mA and 20 ... 4 mA.
- Ratiometric voltage variant: Ratiometric voltage output signal. This variant provides two opposing ratiometric voltage outputs 10% * VCC ... 90% * VCC and 90% * VCC ... 10% * VCC.

4.1 Functional Safety Classification

The SCP07 has the following functional safety classification and parameters:

Standard	Description	Parameter of the current variant	Parameter of the ratiometric voltage variant
IEC 61508/1/ (see “Reference” on page 6)	Safety Integrity Level (SIL)	2	2
	Architecture	1oo1 (single channel)	1oo1 (single channel)
	Hardware Failure Tolerance (HFT)	0	0
	Safety-related subsystem	Type B	Type B
	Safe Failure Fraction (SFF)	95.8% *	93.1%*
	Average frequency of dangerous failure per hour (PFH)	$6.1 \bullet 10^{-9}$	$4.9 \bullet 10^{-9}$

Standard	Description	Parameter of the current variant	Parameter of the ratiometric voltage variant
EN ISO 13849-1 /2/ (see “Reference” on page 6)	Performance Level (PL)	d	d
	Category (Cat.)	2	2
	Diagnostic Coverage (DC)	94,7% *	91,0%*
	Common Cause Failures (CCF)	70 points	70 points
	Mean Time To dangerous Failure ($MTTF_d$)	981 years	2090 years
ISO 25119 / EN 16590 /5/ (see “Reference” on page 6)	Agricultural Performance Level (AgPL)	d	d
	Category (Cat.)	2	2
	Diagnostic Coverage (DC_{avg})	94,7% *	91,0%*
	Mean Time To dangerous Failure ($MTTF_d$)	981 years	2090 years
	Software Requirement Level (SRL)	Not relevant	Not relevant

* with an external monitoring according to this safety manual.

4.2 Technical Data

Pressure

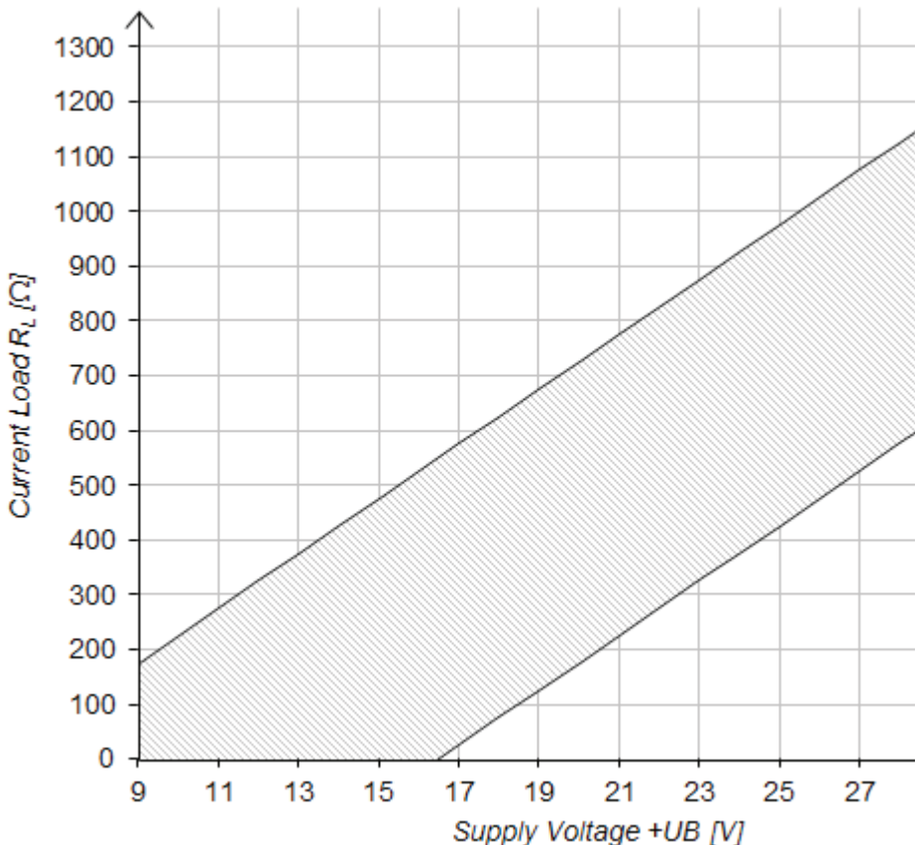
Parameter	Min.	Max.
Nominal pressure range	0...10 bar	0...1200 bar
Overload (depending on pressure range)	50 bar	2400 bar
Installation torque of the pressure connection	15 Nm	35 Nm

Output of current variant

Parameter	Min.	Max.
Current with nominal pressure range	4 mA	20 mA
Current at off-state	0 mA	2 mA
Current accuracy output SIG1 (depending on ambient temperature)	1 %FS	2.5 %FS
Current accuracy plausibility check output SIG1 + output SIG2 (depending on ambient temperature)	2.5 %FS	Depending on application and ECU tolerance: For example 3 %FS
Current load (depending on power supply)	0 Ω	1325 Ω
Electrical protection	Short circuit protected (signal on GND/VCC)	

Note:
- The accuracy is only guaranteed under reference conditions ($T_{medium} = T_{ambient}$).
- The maximum current load depends on the power supply and is calculated by R_{max} = (+UB-5.5 V) / 0.02 A.

Operating area for current outputs of the current variant



Warning:
If the application operates at the maximum load limit, pressures above 100 %FS can not be displayed!

Output of ratiometric voltage variant

Parameter	Min.	Max.
Current with nominal pressure range	10% * VCC	90% * VCC
Current at off-state	0 V	5% * VCC
Current accuracy output SIG1 (depending on ambient temperature)	1 %FS	2.5 %FS
Current accuracy plausibility check output SIG1 + output SIG2 (depending on ambient temperature)	2.5 %FS	Depending on application and ECU tolerance: For example 3 %FS
Load resistance	≥ 10 kΩ	-
Load current	-	1.3 mA
Capacitive load	-	10 nF
Electrical protection	Short circuit protected (signal on GND/VCC)	

Power supply

Parameter	Min.	Max.
Current variant: Voltage supply (power supply pin VCC)	9 V DC	32 V DC
	Supply lines inverse-polarity protected.	
Ratiometric voltage variant: Voltage supply (power supply pin VCC)	4.5 V DC	5.5 V DC
	Supply lines inverse-polarity protected with current limit of up to 2 A.	

General accuracy

Parameter	Min.	Max.
Linearity, pressure hysteresis and repeatability	---	0.5 %FS
Long-run stability	---	0.2 % FS

Timing

Parameter	Min.	Max.
Startup time	---	40 ms
Response time	---	1 ms

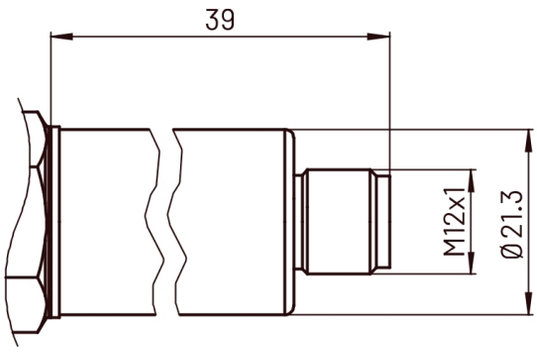
Mechanical data

Component	Description
Housing	Welded stainless steel
Degree of protection	IP67, IP69K
Electrical connection	M12, DT04
Pressure connection	G 1/4
Installation torque	Maximum 35 Nm
Material with medium contact	EN/DIN 1.4548 / FK
Material housing	EN/DIN 1.4301
Material diaphragm	EN/DIN 1.4548
Material connector	PBT-GF30 or 1.4301 (M12 in stainless steel)
Dimensions (W x H x D)	F02 G 1/4 with M12x1 PBT: 54 x 22 x 26 mm (wrench size 22) F02 G 1/4 with M12x1 stainless steel: 62 x 22 x 26 mm (wrench size 22) F02 G 1/4 with DT04x1 PBT: 65 x 22 x 26 mm (wrench size 22)
Weight	F02 G 1/4 with M12x1 PBT: ca. 50 g F02 G 1/4 with M12x1 stainless steel: ca. 70 g
Operating chassis temperature Ratiometric voltage variant	-40 °C ... +85 °C
Operating chassis temperature Current variant	

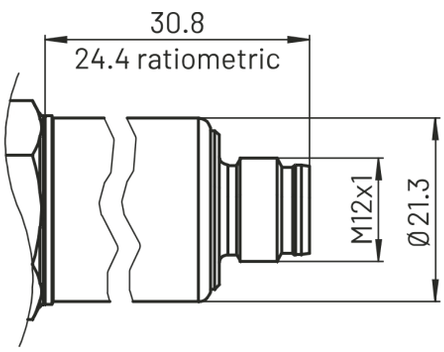
4.3 Technical drawings

Electrical connection

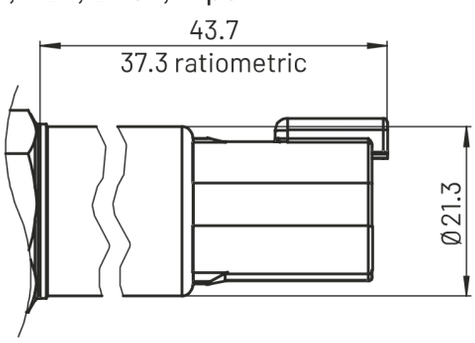
Connector, stainless steel, M12x1, 5-pol



Connector, PBT, M12x1, 5-pol

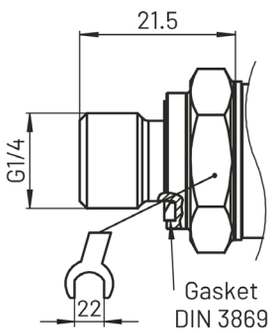


Connector, PBT, DT04, 4-pol

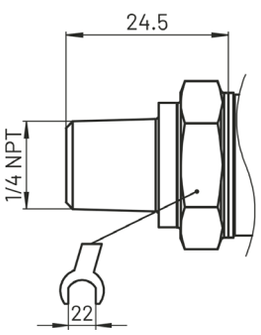


Pressure connection

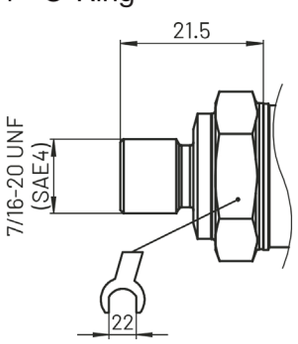
Connector, G 1/4



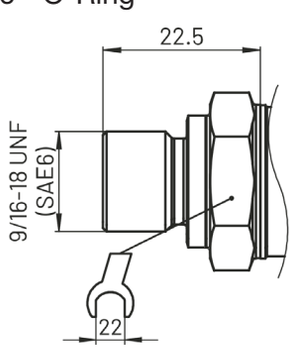
Connector, 1/4 NPT per „Nominal width for US-standard bevelled pipe thread NPT“



Connector, SAE 4 - O-Ring

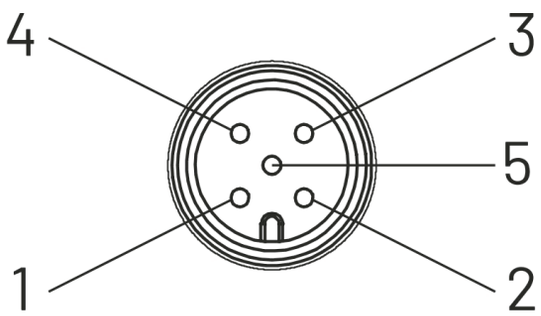


Connector, SAE 6 - O-Ring



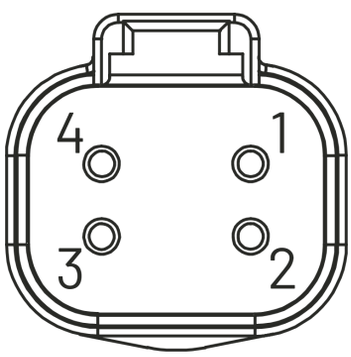
4.4 Pin assignment

Connector, stainless steel, M12x1, 5-pol



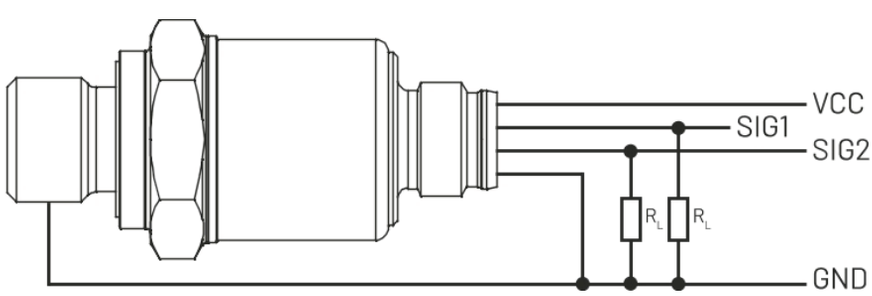
Pin	Name	Description
1	VCC	Power supply
2	SIG2	Inverse pressure signal output
3	GND	Common Ground
4	SIG1	Pressure signal output
5	--	Do not connect

Connector, stainless steel, M12x1, 5-pol



Pin	Name	Description
1	VCC	Power supply
2	GND	Common Ground
3	SIG2	Inverse pressure signal output
4	SIG1	Pressure signal output

4.5 Wiring diagram



4.6 Safety Functions

The pressure transmitter SCP07 executes following safety function:

Safety Function	Safety Integrity	Error Reaction	DTI
Safe conversion of the measured pressure into two proportional redundant-opposing current signals or ratiometric voltage signals (0 ... 100 %FS correspond to 4 ... 20 mA or 0 ... 100 %FS correspond to 10% * VCC ... 90% * VCC) Safety relevance: a) Accuracy of the sum of the single currents b) Maximum conversion delay	IEC 61508 / SIL 2 EN ISO 13849 / PL d ISO 25119 / AgPL d	Safe state (see “Safe State” on page 18)	80 ms

Note:
The outputs of the SCP07 are not safe by themselves but in combination with a redundant signal processing.

4.7 Diagnosis

The SCP07 uses several mechanisms to detect faults in the electronic circuit. Those are realized in a start-up and a cyclic diagnosis.

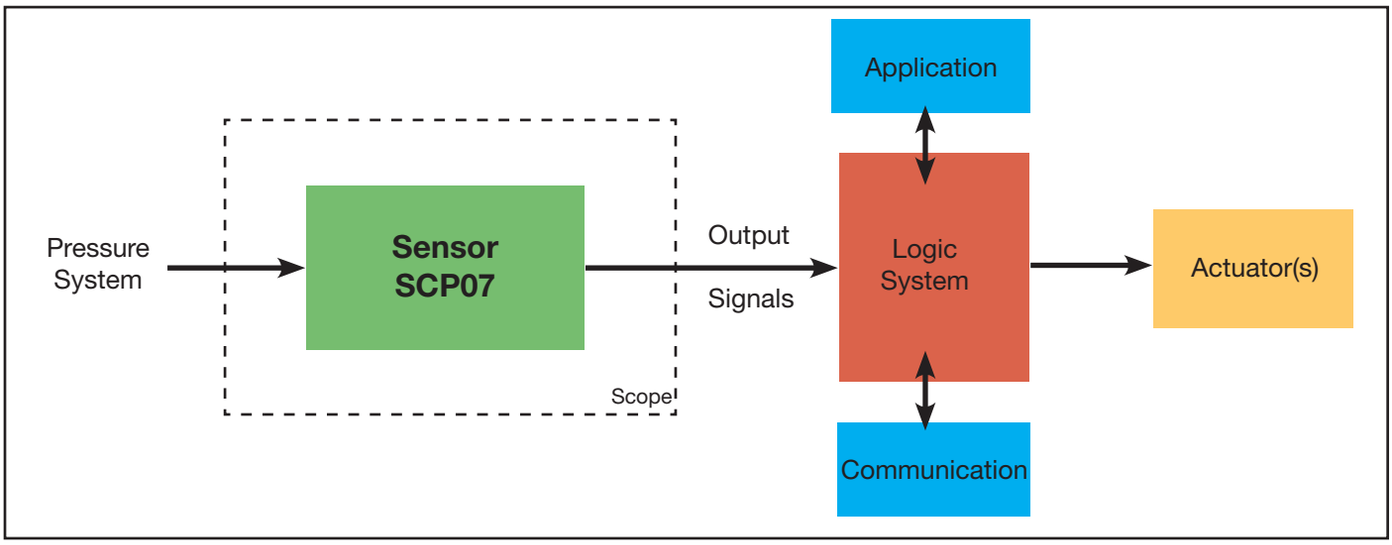
Start-Up Diagnosis
The start-up diagnosis is made once after powering the SCP07 and includes internal tests concerning e.g. the oscillator, the watchdog or any memory. If the start-up diagnosis detects a fault, the safe state (see “Safe State” on page 18) is entered. The SCP07 remains in the safe state.

Cycle Diagnosis
The cycle diagnosis is made every 30...40 ms and includes:
- testing of the temperature element
- testing of the pressure sensor concerning drift, open circuit and short circuit
- testing of the sensor signal range

If the cyclic diagnosis detects a fault, the safe state (see “Safe State” on page 18) is entered as long as the fault is pending.

5 Safety Requirements

The following diagram shows the pressure transmitter SCP07 in a typical application:



Note:
Safety requirements within this manual are characterized by an identifier like SR_F02_<index>. This can be used to trace requirements that shall be followed through the development process of the application.

5.1 Known Issues

Note:
There are no known issues for the SCP07.

5.2 Instructions and Constraints

Safety Standards

REQUIREMENT: ID: SR_F02_001
The current national and international safety regulations, laws, and standards for the whole safety lifecycle have to be observed.

Qualification of staff

REQUIREMENT: ID: SR_F02_002
The pressure transmitter SCP07 must be installed and operated by trained, qualified personnel only. The knowledge and the technical implementation of the safety information provided by this manual are imperative for a safe installation and operation.

Method statement

REQUIREMENT: ID: SR_F02_003

Before setting the SCP07 into operation for an application it is necessary to read and follow the instructions of this safety manual. The limits of the technical data (see “Technical Data” on page 14) must be complied within the application.

Proof test interval

REQUIREMENT: ID: SR_F02_004

A proof test interval of the pressure transmitter SCP07 must be initiated and controlled every 7 1/2 years. As the SCP07 can not be recalibrated, it has to be replaced, if the deviations exceed the maximum tolerances.

Troubleshooting Procedures

REQUIREMENT: ID: SR_F02_005

A faulty transmitter must be replaced immediately. There is no maintenance or repair procedure provided for the SCP07.

CE Conformity

For CE conformity the following restrictions have to be observed: ID: SR_F02_014

- The length of the cables, which are connected to the pressure transmitter, must not exceed 30 meters.

5.3 Fail Safe

The fail safe of the pressure transmitter SCP07:

Type of F02	Signal	State faile safe	Connector M12	Connector DT04
Current variant	Signal output SIG1	Iout < 2 mA	Pin 4	Pin 4
	Signal output SIG2	Iout < 2 mA	Pin 2	Pin 3
Ratiometric voltage variant	Signal output SIG1	Uout < 5% * VCC	Pin 4	Pin 4
	Signal output SIG2	Uout < 5% * VCC	Pin 2	Pin 3

The file safe is entered when the SCP07 recognizes a fault condition.
Both outputs go to the state fail safe at the same time.

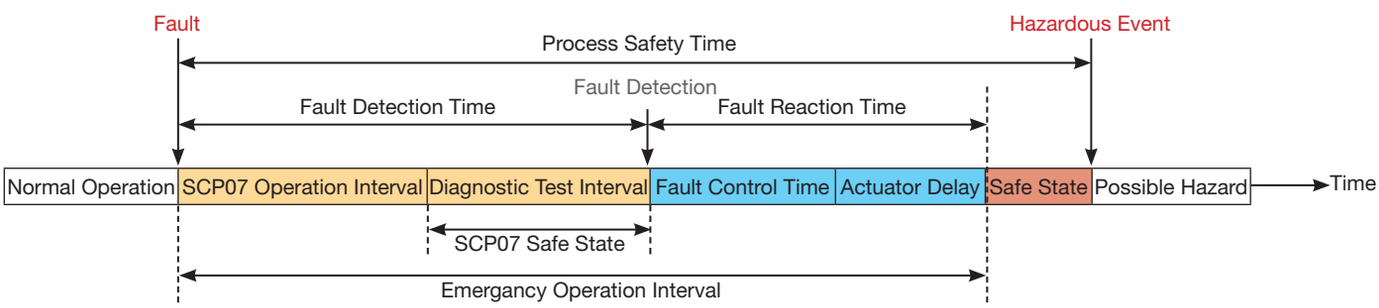
Error reaction

Note:
Specification:
The maximum time between a fault occurrence and the file safe of the SCP07 is 80 ms.

REQUIREMENT: ID: SR_F02_006
The fault detection cycle of the superordinate logic system must be long enough to detect an error reliably.

Example:

The following time diagramm shows the SCP07 in a typical ‚sensor-logic-actuator' application e.g. with an electronic control unit.



Reset condition

Note:
Specification:
If a fault condition isn't pending continously, the SCP07 will leave the fail safe earliest after 60 ms.

REQUIREMENT: ID: SR_F02_007
The diagnostic test interval of the superordinate logic system must be short enough to detect the file safe reliably.

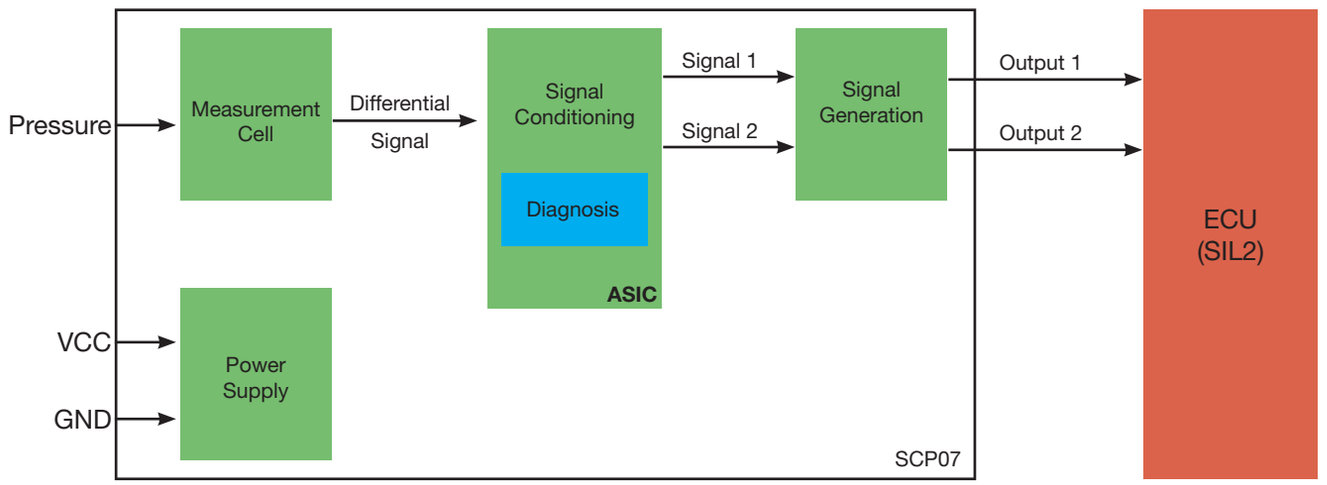
Restrictions

WARNING:
The fail safe may not be entered during an over- or under-voltage condition or during startup. Possibly occuring spikes on the outputs have to be ignored.

REQUIREMENT: ID: SR_F02_022
The superordinate logic system has to consider non-functional operating modes, which do not lead to a fail safe.

5.4 System

System Overview:



REQUIREMENT: ID: SR_F02_008

Exceeding the maximum supply voltage of the SCP07 may cause an unsafe operation. Therefore the superordinate logic system has to monitor the sensor power supply.

REQUIREMENT: ID: SR_F02_018

Take measures to avoid an overvoltage condition at the SCP07.

REQUIREMENT: ID: SR_F02_009

Running the SCP07 outside its temperature limits may cause an unsafe operation. Therefore the superordinate logic system has to monitor the ambient temperature.

REQUIREMENT: ID: SR_F02_019

There have to be taken measures to avoid an over- or under-temperature condition at the SCP07.

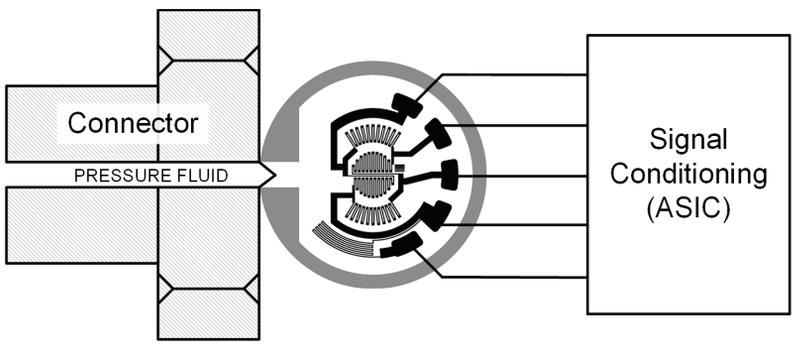
REQUIREMENT: ID: SR_F02_021

The chassis, in which the SCP07 is mounted, has to be connected to the power supply ground, to fulfill the EMC requirements.

5.5 Pressure

The pressure is measured by a welded thin-film capsule, which converts the physical pressure into an electrical signal by a resistor full-bridge. An additional temperature meander makes it possible to compensate the signal.

Functional Diagram:



REQUIREMENT: ID: SR_F02_010

Because the radius of the pressure channel of the SCP07 is very small, measures must be taken for the pressure system to prevent its clogging.

REQUIREMENT: ID: SR_F02_011

Running the SCP07 outside its temperature limits may cause an unsafe operation. Therefore, the superordinate logic system has to monitor the pressure medium temperature.

REQUIREMENT: ID: SR_F02_024

The thread shall be made of stainless steel and shall be free of lubricant.

RECOMMENDATION:

Avoid to exceed the specified pressure ranges of the used SCP07. For a smooth operation the pressure system should be able to provide a stable non-fluctuating pressure. The accuracy of the pressure measurement is only guaranteed under reference conditions, that means if the medium temperature and the ambient temperature is nearly the same. Therefore measures should be taken to effect this.

WARNING:

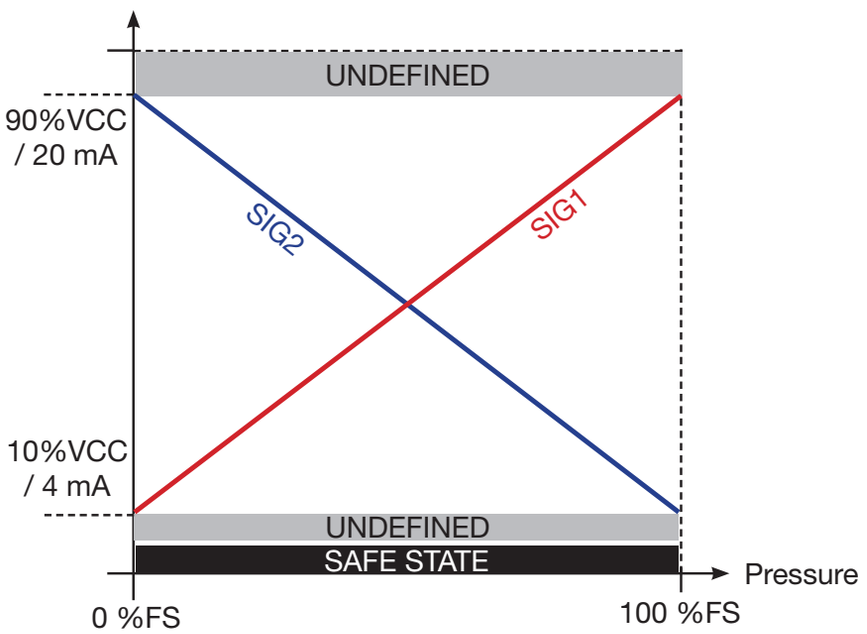
A drift of the measurement cell due to an overpressure as well as an aging-related drift can only be detected at the pressure limits (0 %FS, 100 %FS) of the SCP07.

5.6 Outputs

The outputs of the SCP07 are designed as redundant opposing signals. The opposing signals can be used to establish a redundant signal processing for safety-related applications.

Output signal	Range of current variant	Range of ratiometric voltage variant
SIG1	4 ... 20 mA	10% * VCC ... 90% * VCC
SIG2	20 ... 4 mA.	90% * VCC ... 10% * VCC

Signal Diagram:



REQUIREMENT: ID: SR_F02_012

The superordinate logic system has to provide safety-related input pairs, which fulfill the reservations of the SCP07 outputs (see “Technical Data” on page 14).
(Espacially the requirements for the minimum and maximum loading of the current outputs have to be observed.)

REQUIREMENT: ID: SR_F02_020

The superordinate logic system has to process both output signals simultaneously and to compare them in a meaningful way.

RECOMMENDATION:

For signal processing the two output values should be accumulated by the application and be compared to predefined limits (e.g. 24 mA ±3 %FS).

REQUIREMENT: ID: SR_F02_013

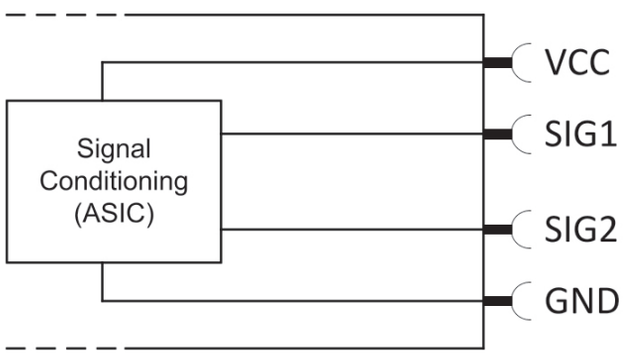
The measured pressure is always represented by output pin SIG1. Output pin SIG2 must only be used for the safety function, as it is not calibrated and temperature compensated.

REQUIREMENT: ID: SR_F02_017

The superordinate logic system has to check, if there is a short circuit between the SCP07 outputs. Depending on the application, this must be done cyclically or at start-up.

Outputs of ratiometric voltage variant

With the ratiometric voltage variant the supply and output pins of the signal conditioning are directly connected to the connector.



REQUIREMENT: ID: SR_F02_015

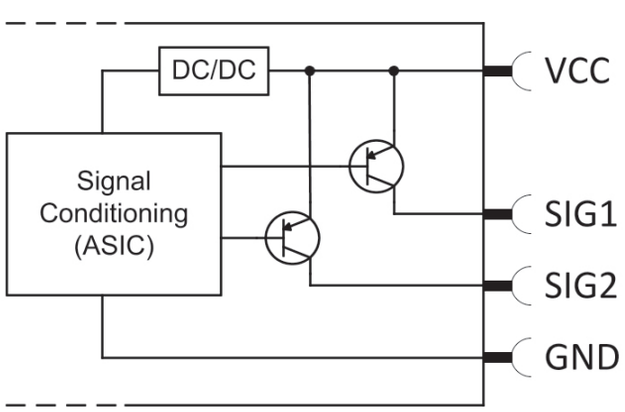
A ratiometric voltage value of < 7.5% * VCC or > 92.5% * VCC may be the result of a damaged SCP07. Therefore, the superordinate logic system must be able to check the current range and react on an invalid value.

REQUIREMENT: ID: SR_F02_025

In case of an electronic ground loss (GND), the two output signals have no defined level. The superordinate logic system must perform a plausibility check of the two output signals (see SR_F02_020 and SR_F02_017).

Outputs of current variant

The signal condititoning is supplied via a DC/DC converter and its outputs are used to generate the current signals.



REQUIREMENT: ID: SR_F02_016

A current value < 3.5 mA or > 20.5 mA may be the result of a damaged SCP07. Therefore the superordinate logic system must be able to check the current range and react on an invalid value.

RECOMMENDATION:

To check, if there is a short circuit between the SCP07 current outputs, one of them could be additional loaded, e.g. with a programmable pull-down resistor. The other one should not change its value.

RECOMMENDATION:

If the inputs of superordinate logic system do not provide suitable load resistors as required in the technical data (see “Technical Data” on page 14), an additional series resistance can be connected to the wiring.

5.7 Decommissioning and Disposal

Note:

For the SCP07 there is nothing to be considered regarding decommissioning. The disposal of the SCP07 has to be done according to national laws.

5.8 Security

Note:

For the SCP07 there is nothing to be considered regarding security.

6 Examples

Adapt your application

The manufacturer controllers have a current input load of 130 Ω or 150 Ω. Some (as the ESX-3XM) do have additional series diodes for reverse protection, which increase the needed minimum supply voltage by theirs forward voltage (VF).

According to the „Technical Data“ the minimum supply voltage for a predefined load resistance can be calculated by:

+UB = R ❿ 0.02 A + 5.5 V + V with +UB > 9 V and V optional

+UB = R ❿ 0.02 A + 16.5 V with +UB < 32 V

Setup diagnosis

The safety related ECUs are delivered with a hardware diagnosis library, which provides startup and cyclic test procedures to detect failures and defects. For the SCP07 following diagnosis functions can be used.

ECU	Diagnosis Function	Parameter	Value
ESX	diag_init_dual_analogin	bInput	DUALAIN1 .. DUALAIN4
		bType	CURRENT_IN
		TBD	TBD (CrissCross = TRUE)
ESX-3Xx	xs_diag_in_init[1]	ou16_Channel	X_IN_01 .. X_IN_12
		opt_Config	T_x_diag_in_config[2]
	xs_diag_in_get_status	ou16_Channel	X_IN_01 .. X_IN_12
		opt_Status	T_x_diag_in_status

[1] First you have to call xs_in_init() with type X_IN_TYPE_CURRENT for both inputs.
[2] Set the structure components to the following values:

7 Transport and Storage

Transport
Check the pressure transmitter for any damage that may have been caused during transportation. Do not use damaged devices.
Storage
Store the pressure transmitter in its original packaging.
The packaging provides protection during storage and transport. For this reason:
• Remove the packaging only immediately before mounting.
• Keep the packaging for use after disassembling or sending the device to repair.

8 Maintenance

Repairs and calibration must only be carried out by the manufacturer.
Due to the long-run stability of the pressure cell, Parker recommends a regular re-calibration depending on the operating conditions of the pressure transducer.

9 Mounting

Preconditions:
- Provide an ESD suitable environment.
- Provide a dry and clean environment.
- The thread and all sealing faces of the pressure transmitter must be undamaged and clean.
- Apply the force to screw the pressure sensor only through the spanner flats provided for this purpose.
- Select a cable diameter that matches the cable connector of the mating plug.
- Protect the cable end from humidity. Otherwise humidity can intrude into the instrument.

See Mechanical Dimensions for needed space.

Required tools
Torque wrench: Width across flats 22

How to mount

WARNING:
Danger of serious injury/or damage to the equipment, when used beyond the specified operative range. Using a wrong type of pressure transmitter can cause serious injury and/or damage to the equipment.
Ensure to select the right type of pressure transmitter according to:
- pressure range
- measurement range
- specific measurement conditions

WARNING:
Danger of serious injury from sudden escaping pressurized media.
Before opening any connections:

- Disconnect energy source.
- Prevent reconnection.
- Depressurize the system, including pressure accumulators, lower upheld load or provide compression-resistant support for upheld load, remove residual energy.
- Test the system for absence of pressure.
- Prevent danger due to adjacent systems components.

1. Screw the SCP07 into your system by hand. Do not damage the thread, otherwise a sealing connection cannot be established.
2. Tighten the SCP07 with the torque wrench and a maximal screwing-torque of 45 Nm.
3. Connect the connector with opposite plug. Make sure the sealing of the connector is present. Make sure to latch the connector into the opposite plug.
4. Attach the used cables for the SCP07 with a cable relief. No force must act on the connectors and cable. Do not bend the cable with a radius smaller than 18 mm.

10 Dismounting

Preconditions:

- Provide an ESD suitable environment.
- The connected pressure transmitter must be cleaned.
- Apply the force to screw off the pressure transmitter only through the spanner flats provided for this purpose.

Required tools

Torque wrench: Width across flats 22

How to dismount

WARNING:
Danger of serious injury from sudden escaping pressurized media.
Before opening any connections:

- Disconnect energy source
- Prevent reconnection
- Depressurize the system, including pressure accumulators, lower upheld load or provide compression-resistant support for upheld load, remove residual energy.
- Test the system for absence of pressure.
- Prevent danger due to adjacent systems components.

1. Make sure the system is depressurized.
2. Remove cable relief from the cables. Do not damage the cables.
3. Disconnect the MOLEX connector from mating plug
4. Screw off the SCP07 from your system with the wrench. Do not damage the threads.

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SM/4156/UK 03/2020

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