SENSORS AND SYSTEMS

Quality monitoring and process control in injection molding

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measure. analyze. innovate.

Contents

Cavity pressure monitoring during the injection molding process reduces quality assurance costs.

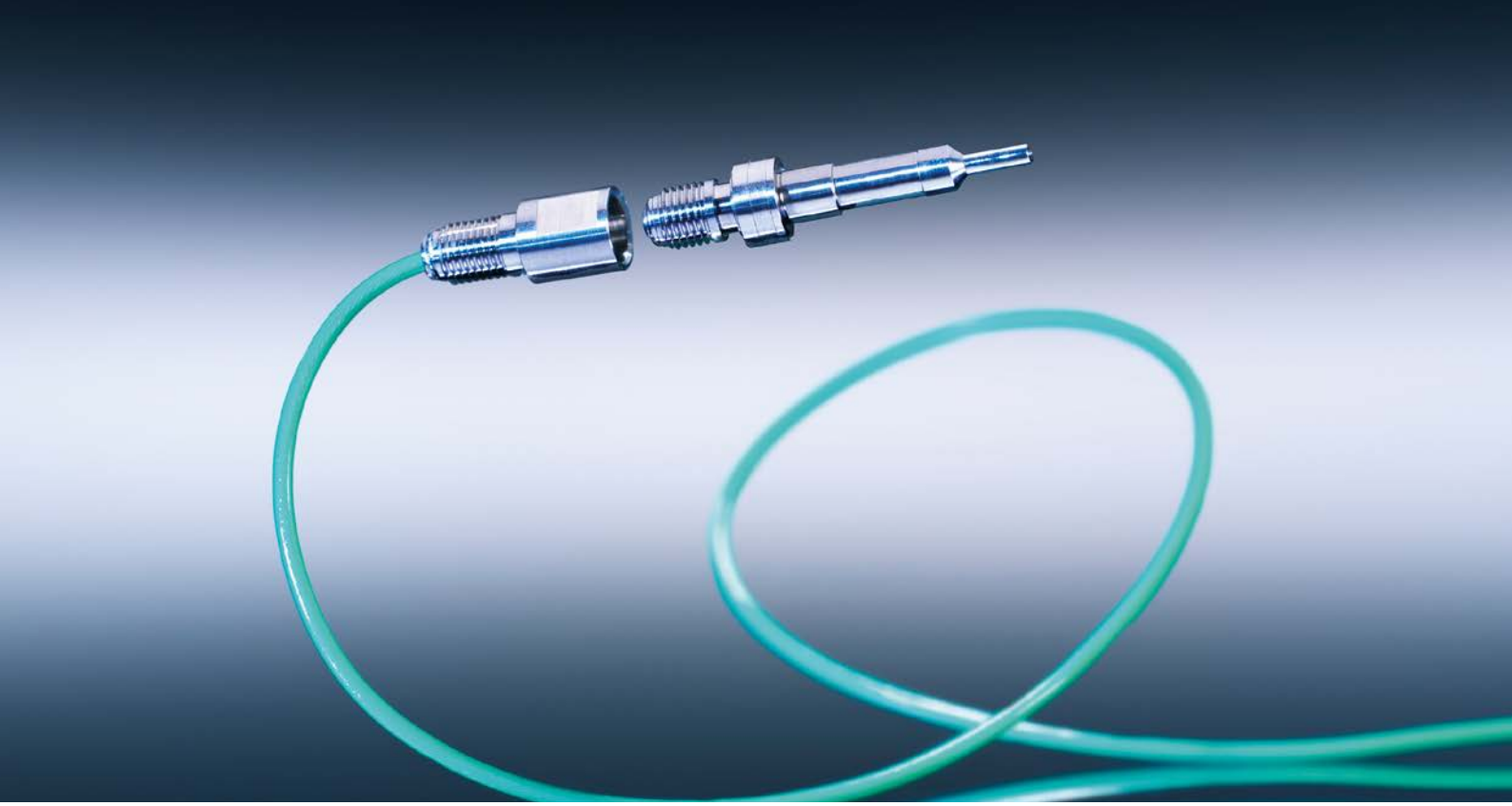
Focusing on process efficiency

100% quality in production – the goal that all injection molders strive to achieve. The surest way to achieve zero-defect production during injection molding of plastics is by integrating quality assurance into the process. Kistler offers the technology, expertise and service you need to achieve this.

Optimized process efficiency thanks to technology from Kistler
To achieve the objective of zero defect production with maximum cost efficiency, Kistler focuses on cavity pressure. It is the most informative process variable, because it describes conditions immediately – while the molded part is actually being created. Sensors and systems based on cavity pressure determine whether or not a part is scrap at the earliest possible moment.

Lower QA costs for processors and OEMs
Process-integrated cavity pressure monitoring during injection molding cuts the costs of quality assurance. This cost-effective solution protects plant operators against the possibility of faulty parts reaching the customer; it also prevents disruptions to downstream assembly operations.

Injection molding with Kistler – now online
View our animation to experience convincing, first-class Kistler solutions – the sure way to achieve 100% quality in your production:
www.kistler.com/injection-molding



For every injection molding process, Kistler supplies the ideal sensor – tailored to the installation conditions, the part geometry and the plastic material.

Sensors for every measuring task

Exact, reproducible pressure measurement values can only be obtained with reliable sensors that measure precisely. Piezoelectric sensors from Kistler are rugged and maintenance-free.

Piezoelectric sensors
Sensors from Kistler offer virtually unlimited service lifetimes; they deliver highly linear measurement results, and they operate independently of temperature. They provide high-precision measurements of minimal pressure variations (range: up to 2,000 bar) and/or temperature changes of up to 300°C.

Cavity pressure can be determined directly, indirectly, contact-free, or together with the contact temperature. Direct-measuring sensors are in contact with the melt in the cavity, and they measure the pressure without transmission pins. They can be installed in a bore, either with or without an adapter. On many sensors, the front can be adapted to the surface of the cavity so that no mark can be seen on the part. Alternatively, the force can be measured behind an ejector pin or measurement pin; it can then be converted into the pressure with the help of the pin diameter. This method is recommended if there is insufficient space for a direct-measuring sensor. For optical components with Class A surfaces or components on which marks are not permitted, the cavity pressure can be measured contact-free with a measuring pin: the compression of the mold steel is the basis for this method. CAD data is used to simplify positioning of the sensors in the mold.

Temperature sensors
After pressure, the temperature in the mold is the most important process parameter. Anomalies in mold temperature control, flow rate fluctuations or blocked cooling channels can be detected even more reliably using sensors in the mold.

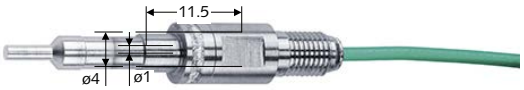
Kistler offers various temperature sensors for this purpose which measure the contact temperature in the cavity and the mold temperature. This approach ensures that the temperature is fully measured in the injection mold. As well as temperature sensors, Kistler's portfolio includes temperature amplifiers that amplify the signal from the temperature sensors to a standardized 0–10 V signal and transmit it to the ComoNeo.

Piezoresistive sensors
To monitor and control injection molding machines, hot runner systems and 3D printers, Kistler offers sensors based on piezoresistive measurement technology. They allow combined monitoring of the pressure and temperature of a plastic melt in one sensor, for virtually unlimited measuring periods.

The pressure-sensitive element is a highly stable piezoresistive cell manufactured with SOI (Silicon On Insulator) technology. Measuring chains 4021B, 4001A and 4004A – comprising the sensor, cable and amplifier – are already calibrated when delivered, and they contain no transfer media such as oil or mercury.

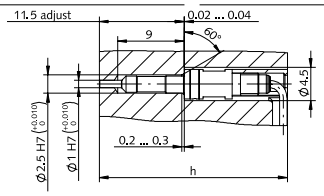
Direct cavity pressure measurement

Front diameter		**1 mm**	
Measurands (p: pressure; T: temperature)		p	p+T
Technical data	**Type**	**6183D… [1]**	**6188A…**

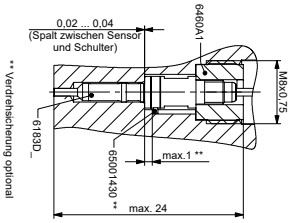


Installation sketch

Installation with spacer sleeve



Installation with mounting nut

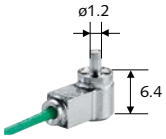
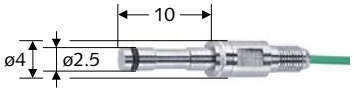
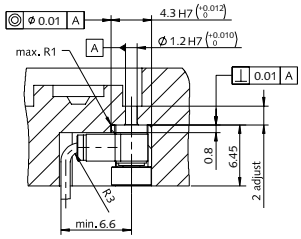
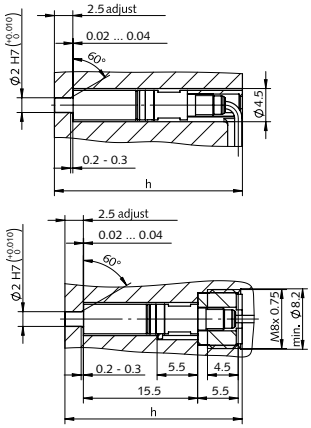
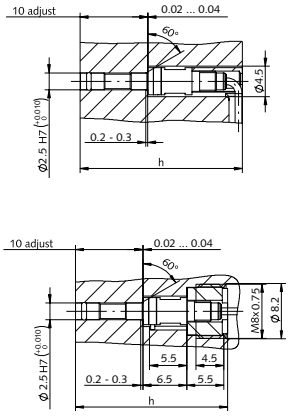


Measuring range			
Temperature (type K thermocouple)	°C	–	0 … 450
Pressure	bar	0 ... 2,000	0 ... 2,000
Sensitivity	pC/bar	≈–2.25 (Unisense)	≈–4.8
Sensor front			
Machinable		•	–
Option: abrasion protection (not machinable)		•	–
Cable technology			
Single wire with/without connector [2]		•	•
Single wire with crimp contact [3]		•	•
Coaxial, with standard [4]/custom cable length[5]		•	–
Conductive spacer sleeve		•	–
Compensating cable with standard [6]/custom cable length [7]		–	•
Exchangeable cable		•	by Kistler
Operating temperature			
Melt temperature	°C	<450	<450
Mold temperature	°C	<200	<200

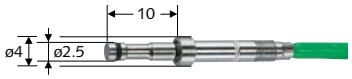
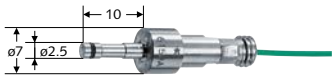
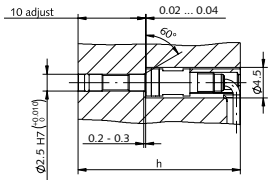
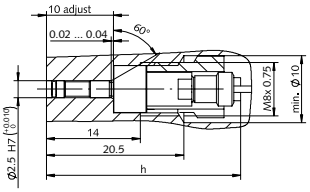
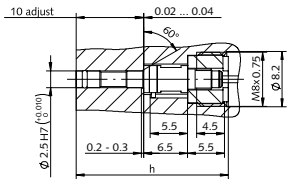
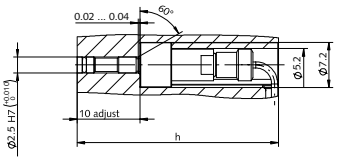
Applications + characteristics		Thermoplastics Smallest front area Waterproof (IP67)	Thermoplastics
Accessories			
Spacer sleeve	Type	6464A1 [8]	6464A3 [8]
Minimum overall height	mm	25.5	36
Mounting nut	Type	6460A1	–
Minimum overall height	mm	24	–
Data sheet: see www.kistler.com		**6183D (003-450)**	**6188A (000-887)**

• Variant available – Variant not available 1) Standard product 2) Cables can be shortened by user, standard length 1.5/5 m

[6] l = 0.4/0.8/1.2/1.6/2 m [7] Custom length (lmin = 0.15 m/lmax = 5 m) [8] Accessory supplied with product

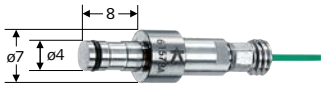
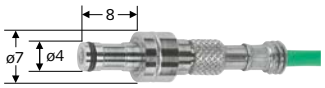
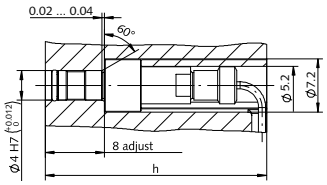
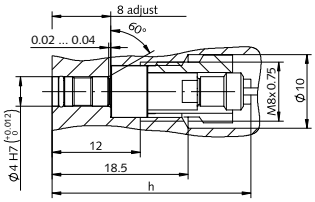
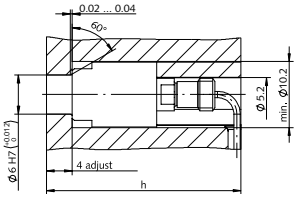
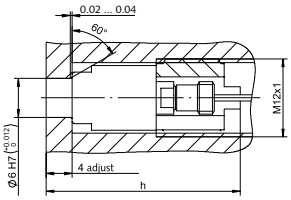
1.2 mm	2 mm	2.5 mm
p	p	p
6184A...	**6185A...**	**6182D... [1]**
		
 Installation with thrust washer Minimum overall height: see table		
–	–	–
0 ... 2,000	0 ... 2,000	0 ... 2,000
≈–1.2	≈–2.2	≈–2.5 (Unisense)
•	•	•
•	•	•
•	•	•
•	•	•
–	•	•
–	•	•
–	–	–
–	•	•
<450	<450	<450
<200	<200	<200
Thermoplastics Low overall height Cable outlet 90°	Thermoplastics Insensitive to installation conditions Waterproof (IP67)	Thermoplastics Small front area Waterproof (IP67)
6470 (thrust washer) [8]	6464A1 [8]	6464A1 [8]
8.5	25.5	24
6465 [8]	6460A1	6460A1
11.6	24	22.5
6184A (000-600)	**6185A (003-263)**	**6182D (003-449)**

[3] Connection to contact element 1712/1714, custom length (lmin = 0.04 m/lmax = 1.5 m) [4] l = 0.2/0.4/0.6/0.8 m [5] Custom length (lmin = 0.1 m/lmax = 5 m)

Front diameter		**2.5 mm**	
Measurands (p: pressure; T: temperature)		p+T	p
Technical data	**Type**	**6189A... [1]**	**6159A... [1]**
			
Installation sketch			
Installation with spacer sleeve			
Installation with mounting nut			
Measuring range			
Temperature (type K thermocouple)	°C	0 … 450	–
Pressure	bar	0 ... 2,000	0 ... 2,000
Sensitivity	pC/bar	≈–6.5	≈–2.5
Sensor front			
Machinable		–	•
Option: abrasion protection (not machinable)		–	•
Cable technology			
Single wire with/without connector [2]		•	•
Single wire with crimp contact [3]		–	•
Coaxial, with standard [4]/custom cable length [5]		–	•
Conductive spacer sleeve		–	•
Compensating cable with standard [6]/custom cable length [7]		•	–
Exchangeable cable		by Kistler	•
Operating temperature			
Melt temperature	°C	<450	<450
Mold temperature	°C	<200	<200
Applications + characteristics		Thermoplastics	Thermoplastics Small front area
Accessories			
Spacer sleeve	Type	6464A3 [8]	6459
Minimum overall height	mm	33	32
Mounting nut	Type	–	6457 [8]
Minimum overall height	mm	–	29
Data sheet: see www.kistler.com		**6189A (000-536)**	**6159A (000-032)**

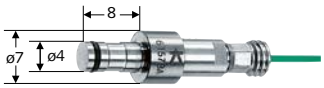
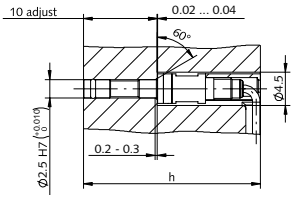
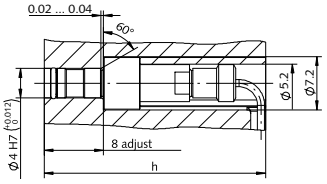
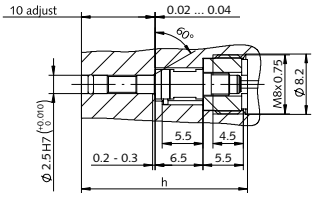
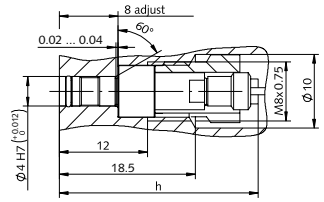
• Variant available – Variant not available 1) Standard product 2) Cables can be shortened by user, standard length 1.5/5 m

[6] l = 0.4/0.8/1.2/1.6/2 m [7] Custom length (lmin = 0.15 m/lmax = 5 m) [8] Accessory supplied with product

4 mm		6 mm
p	p+T	p
6157C... [1)]	**6190C... [1)]**	**6152B... [1)]**
		
 		 
–	0 … 450	–
0 ... 2,000	0 ... 2,000	0 ... 2,000
–9.4 (Unisense)	≈–9	≈–9.4 (Unisense)
•	–	•
•	–	•
•	•	•
•	–	•
•	–	•
•	–	–
–	•	–
•	•	•
<450	<450	<450
<300	<200	<300
Thermoplastics Elastomers LSR	Thermoplastics Elastomers LSR	Thermoplastics Thermosetting plastics Elastomers LSR
6459	6459	6462
30	37	32
6457 [8)]	6457 [8)]	6453 [8)]
27	30	30
6157C (003-339)	**6190C (000-680)**	**6152B (003-397)**

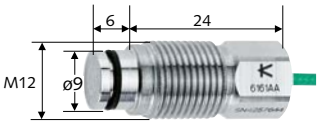
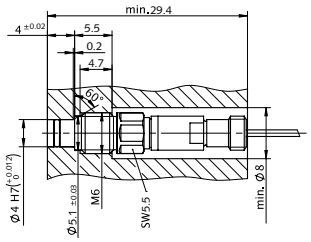
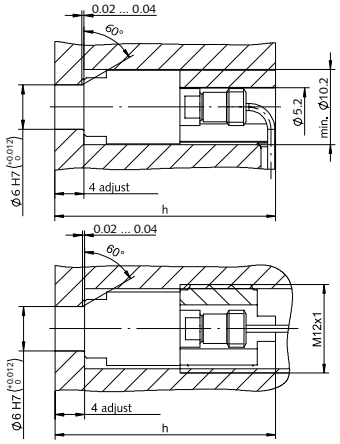
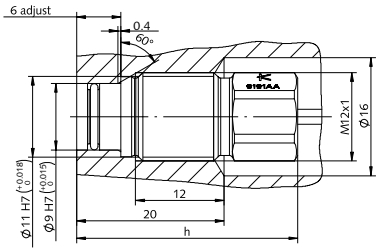
[3)] Connection to contact element 1712/1714, custom length (lmin = 0.04 m/lmax = 1.5 m) [4)] l = 0.2/0.4/0.6/0.8 m [5)] Custom length (lmin = 0.1 m/lmax = 5 m)

Direct cavity pressure measurement – low pressure range

Front diameter		**2.5 mm**	**4 mm**
Measurands (p: pressure; T: temperature)		p	p
Technical data	**Type**	**6178C...**	**6167A...**
			
Installation sketch			
Installation with spacer sleeve			
Installation with mounting nut	(for 6182C and 6178A only)		
Measuring range			
Temperature (type K thermocouple)	°C	–	–
Pressure	bar	0 ... 200	0 ... 200
Sensitivity	pC/bar	≈–12 (Unisense)	≈–16.5
Sensor surface			
Machinable		•	–
Option: abrasion protection (not machinable)		–	–
Cable technology			
Single wire with/without connector [2]		•	•
Single wire with crimp contact [3]		•	–
Coaxial, with standard [4]/custom cable length [5]		–	•
Conductive spacer sleeve		–	•
Compensating cable with standard [6]/custom cable length [7]		–	–
Exchangeable cable		–	•
Operating temperature			
Melt temperature	°C	<450	<450
Mold temperature	°C	<200	<200
Applications + characteristics		Foam injection molding Compression molding Thermoplastics High sensitivity	Low-viscosity materials With diaphragm
Accessories			
Spacer sleeve	Type	6464A1 [8]	6459
Minimum overall height	mm	21	30
Mounting nut	Type	6460A1	6457 [8]
Minimum overall height	mm	22.5	27
Data sheet: see www.kistler.com		**6178C (003-448)**	**6167A (000-033)**

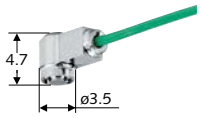
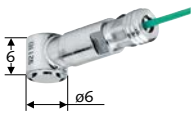
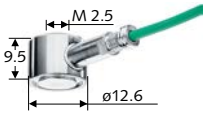
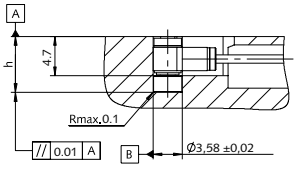
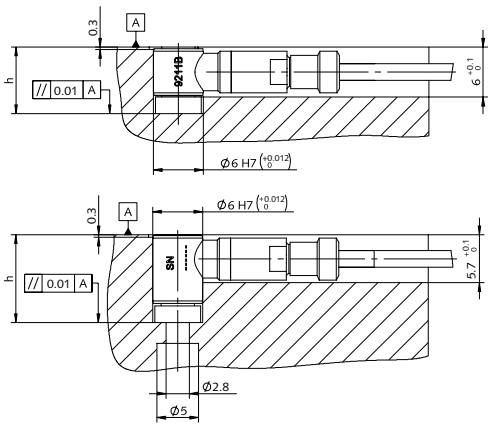
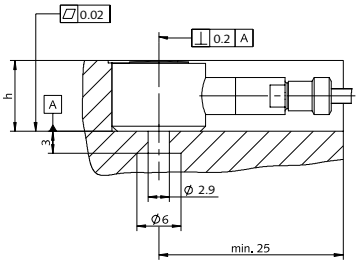
• Variant available – Variant not available

[1] Standard product [2] Cables can be shortened by user, standard length 1.5/5 m
[6] l = 0.4/0.8/1.2/1.6/2 m [7] Custom length (lmin = 0.15 m/lmax = 5 m)

	6 mm		9 mm
p	p	p	p
6165A...	**6162A...**	**6163A...**	**6161A... [1]**
			
			
–	–	–	–
0 ... 200	0 … 200	0 … 1,000	–0.9 … 200
≈–4.0	≈–18.5	≈–3.9	≈–18.4
–	–	–	–
–	–	–	–
•	•	•	–
–	–	–	–
•	•	•	•
•	–	–	–
–	–	–	–
•	•	•	•
<450	<450	<450	<450
<200	<200	<200	<200
Low-viscosity materials SMC/transfer molding Welded front gap	Fiber-reinforced composites SMC/RTM Welded front gap	Fiber-reinforced composites High-pressure RTM Composites Welded front gap	Fiber-reinforced composites SMC/RTM Welded front gap
–	6462	6462	–
30	32	32	30
–	6453 [8]	6453 [8]	–
27	30	30	–
6165A (000-033)	**6162A (000-888)**	**6163A (000-889)**	**6161A (003-053)**

[3] Connection to contact element 1712/1714B, custom length (lmin = 0.1 m/lmax = 1.5 m) [4] l = 0.2/0.4/0.6/0.8 m [5] Custom length (lmin = 0.1 m/lmax = 5 m)
[8] Accessory supplied with product

Indirect cavity pressure measurement

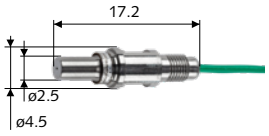
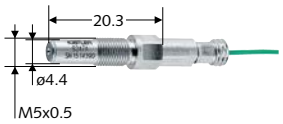
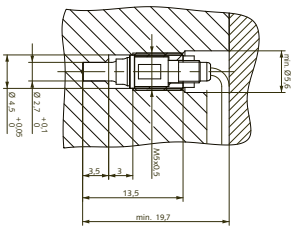
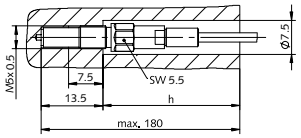
Front diameter		3.5 mm	6 mm		12.6 mm
Technical data	**Type**	**9210A... [1]**	**9211B... [1]**	**9213B...**	**9204B... [1]**
					
Installation sketch					
					

h = minimum overall height, see table

Measuring range					
Force [2]	kN	0 ... 0.25	0 ... 2.5	0 ... 2.5	0 ... 10
Overload	kN	0.3	3	3	12
Sensitivity [2]	pC/N	≈–10	≈–4.4	≈–4.4	≈–1.6
Cable technology					
Single wire with/without connector [3]		•	•	•	•
Coaxial		–	•	•	•
Exchangeable cable		–	•	•	•
Operating temperature range	°C	–40 ... 200	–40 ... 200	–40 ... 200	–40 ... 200
Applications + characteristics		All injection molding processes Smallest force sensor Cable output at the side Especially for molds with modular structure	All injection molding processes Especially for multi-cavity molds	All injection molding processes With M2.5 fastening thread, especially for multi-cavity and small molds	All injection molding processes With M2.5 fastening thread
Accessories					
Thrust washer	Type	9406 [4]	9411 [4]	9413 [4]	–
Main installation dimensions					
Dimensions	mm	ø3.5	ø6	ø6	ø12.6
Actual height	mm	4.7	6	8.5	9.5
Minimum overall height	mm	6.7	8	10.5	9.6
Data sheet: see www.kistler.com		**9210A (000-601)**	**9211B (000-555)**	**9213B (000-556)**	**9204B (000-128)**

[1] Standard product
[2] Conversion formula for pressure sensitivity: pressure sensitivity [pC/bar] = nominal force sensitivity [pC/N] × area of ejector pin [mm²] × 0.1
[3] Cables can be shortened by the user, standard length 1.5/5 m
[4] Accessories supplied with product
[5] Elongation is proportional to the cavity pressure

Contact-free cavity pressure measurement

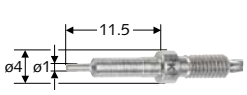
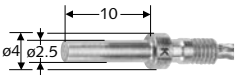
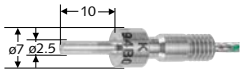
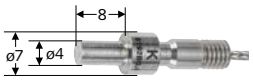
Longitudinal measuring pin – thread		M5	M5
Technical data	**Type**	**9239B...**	**9247A...**
			
Installation sketch			
			

h = minimum overall depth, see table

Measuring range			
Strain [5]	με	±800	±1,400
Overload	με	±1,000	±2,000
Sensitivity	pC/με	≈–14.4	≈–8.6
Cable technology			
Single wire with/without connector		•	•
Coaxial		•	•
Exchangeable cable		•	•
Operating temperature range	°C	0 ... 200	0 ... 200
Applications + characteristics		Optical components Class A surfaces **Smallest possible design if installation space is limited** Silicone Measurement of compression of steel caused by cavity pressure	Optical components Class A surfaces Silicone Measurement of compression of steel caused by cavity pressure
Accessories			
Hollow bolt	Type	9497A1	–
Reamer	Type	–	1300A79
Socket key AF inside	mm	5	5.5
Handheld charge amplifier	Type	5811A	5811A
Main installation dimensions			
Minimum overall depth	mm	19.7	39.6
Distance to cavity wall	mm	2–3	3–5
Data sheet: see www.kistler.com		**9239B (003-613)**	**9247A (000-143)**

Temperature measurement

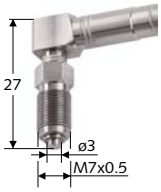
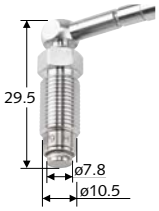
Cavity temperature

Front diameter		1 mm	2.5 mm		4 mm
Technical data	**Type**	**6193B...**	**6195B...**	**6194B...**	**6192B...**
					
Thermocouple type		K (NiCr-Ni)	K (NiCr-Ni)	K (NiCr-Ni)	K (NiCr-Ni)
Measuring accuracy		IEC548 Cl. 1	IEC548 Cl. 1	IEC548 Cl. 1	IEC548 Cl. 1
Operating temperature range					
Mold (sensor and cable)	°C	0 … 600	0 … 600	0 … 600	0 … 600
Mold (connector)	°C	0 … 200	0 … 200	0 … 200	0 … 200
Melt (at the front of the sensor)	°C	0 … 450	0 … 450	0 … 450	0 … 450
Pressure range	bar	0 … 2,000	0 … 2,000	0 … 2,000	0 … 2,000
Cable					
Positive (+)		green	green	green	green
Negative (–)		white	white	white	white

Mold temperature

Description			Mineral-insulated thermocouple	Angle thermocouple	Thermocouple with bayonet cap
Technical data		**Type**	**6196A...**	**6197A...**	**6198A...**
					
Thermocouple type			J (Fe-CuNi)	J (Fe-CuNi)	J (Fe-CuNi)
Measuring accuracy			DIN EN 60584	DIN EN 60584	DIN EN 60584
Operating temperature range		°C	0 … 400	0 … 400	0 … 400
Lead cross-section		mm^2	0.22	0.22	0.22
Cable					
Positive (+)			black	black	black
Negative (–)			white	white	white

Piezoresistive sensors

Front diameter		**3 mm**	**7.8 mm**	**9 mm**
Measured variables (p: pressure; T: temperature)		p+T	p+T	p+T
Technical data	**Type**	**4004A…**	**4021A…**	**4001A…**
				
Measuring range				
Temperature	°C	0 … 350	0 … 350	0 … 250
Pressure	bar	500/1,000/2,500	200/500/1,000/ 2,000/3,000	±2/5/10/20/50
Sensor surface				
Machinable		–	–	–
Option: abrasion protection (not machinable)		–	–	–
Operating temperature				
Sensor front	°C	350	350	275
Amplifier	°C	75	60	75
Applications and features		Hot runner melt pressure measuring, additive manufacturing	Melt pressure measuring for injection molding machines	Resin transfer molding
Accessories				
Cables		1200A229A2 1200A227A2 4785A41…	4790A1 4757A… 1787A…	1200A229A2 1200A227A2

For every mold concept, Kistler offers the right connection technology – precisely tailored to the installation conditions, the number of cavities and the maintenance requirements.

Connection technology for all installation conditions

Increasing numbers of cavities and more complex temperature conditioning concepts: these factors are making the structure of injection molds more complicated. But at the same time, molds should be designed so they are easy to maintain and disassemble. Kistler has responded consistently to these changes with its connection technology for pressure and temperature sensors.

Single-wire and multi-channel cable technologies from Kistler ensure that sensor signals are transmitted accurately and reliably to the process monitoring system. In single-wire technology, the cable consists of just one conductor with a very small cross-section. It can be installed flexibly in drilled channels, and shortened as required.

Kistler's single-wire or coaxial technology makes it possible to connect up to eight different sensors in molds with multiple cavities, or several sensors per cavity. This method of connecting all the sensors to the process monitoring system saves space and avoids confusion. Signals from combined pressure/temperature measurements can also be transmitted using multi-channel cable technology and a thermocouple amplifier.

For complex and modular molds, contact elements connect cables in different mold elements. Contact surfaces in both elements establish the electrical connection. This makes mold installation far simpler than conventional connection technology.

Another option is the use of conductive spacer sleeves. If the installation is not angled, the spacer sleeve can be screwed onto the sensor instead of a cable; this makes it much simpler to drill the installation bore for the sensor. A contact element is installed on the other side to guarantee secure transmission of the charge.

Connection technology: cavity pressure sensors

Single-wire connection cables

Technical data	Type	1666A... [1]	1674AZsp	1900A17...
Sensor connection		M4 [2]	M4 [2]	M3 [3]
Length	m	1.5/5	0.04 ... 1.5 [4]	1.5/5/Zsp [4]
Operating temperature range	°C	0 ... 200	0 ... 200	0 ... 200
Color		green	green	green

Contact elements for single-wire technology

Illustrated: Type 171420

Technical data	Type	1712C0 [1]	1714C0 [1]
Number of channels		1	4
Structural dimensions	mm	M8×5.2 (for each element)	ø12×9.5 (for each element)
Axial offset during installation	mm	max. 0.3	max. 0.1
Operating temperature range	°C	0 ... 200	0 ... 200
Data sheet: see www.kistler.com		**1712C (003-437)**	

Conductive spacer sleeve for single-wire technology

Technical data	Type	1720A1	1720A2	1720A3
Sensor connection		M3 [3]	M3	M4
Contact element		1712C1	1712C1	1712C1
Length	mm	40	80	70
Operating temperature range	°C	0 ... 200	0 ... 200	0 ... 200

Coaxial connection cables

Illustrated: Type 1645C

Technical data	Type	1963A...	1955A...	1645C...	1650A...	1900A19L...
Sensor connection		M4 [2]	M4 [2]	M4 [2]	M3 [3]/M4 [2]	M3 [3]
Plug connection		Fischer	Fischer	Fischer	Mini-Coax	Fischer
Length	m	0.4/sp [5]	0.4/sp [6]	0.2/0.4/0.6/0.8/1.0/1.2/1.5/1.6/2.0/2.5/3.0/sp [6]	0.4/0.8/sp [6]	0.4/1.0/sp [6]
Operating temperature range	°C	0 ... 200	0 ... 260	0 ... 200	0 ... 200	0 ... 200
Covering		Steel-braided	Steel-braided	PFA	PFA	PFA

Combined pressure/temperature connection cables

Technical data	Type	2219B...	2219BG	2219BG1
Sensor connection		6190CA... with connectors	6190CAG without connector for use with Type 2205	6190CAG1 without connector for use with Type 2205
Length	m	0.8/1.2/2/sp [6]	2	5
Operating temperature range	°C	0 ... 200	0 ... 200	0 ... 200

[1] Standard product [2] 6159.../6157.../6177.../6167.../6152.../6172.../6162.../6163.../9211.../9213.../9204... [3] 6182.../6183.../9239...A... [4] Custom length (lmin = 0.04 m/lmax = 1.5 m) with crimp contact [5] Custom length (lmin = 0.1 m/lmax = 2 m) [6] Custom length (lmin = 0.1 m/lmax = 5 m)

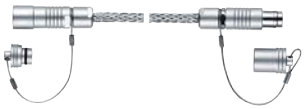
Multi-channel technology: cavity pressure sensors

Multi-channel connectors for single-wire technology

Single-wire sensors for these connectors have extensions G and G1 (example: Type 6157BAG)

Technical data	Type	1722A... [1]	1708B... [1]	1710B... [1]
Number of channels		4 or 8, with mold identification	4, with mold identification up to 125°C	8, with mold identification up to 125°C
Used for these sensor types		All single-wire and coaxial sensors	All single-wire sensors	All single-wire sensors
Connection		Cut-and-grip technology or mini-coax	Cut-and-grip technology	Cut-and-grip technology
Operating temperature range	°C	0 ... 120	0 ... 200	0 ... 200
Data sheet: see www.kistler.com		**1722A (003-264)**	**1708B (003-138)**	**1710B (003-138)**

Extension cable with flexible steel-braided covering



Technical data	Type	1995A... [1]	1997A... [1]
Number of channels		4	8
Length	m	1/2/5/sp [2]	1/2/5/sp [2]
Connector (system)		4-channel	8-channel
Connector in mold		4-channel	8-channel
Operating temperature range	°C	0 ... 200	0 ... 200

Single-channel technology: cavity pressure sensors

Single-channel connector for single-wire technology

Technical data	Type	1839
Used for these sensor types		All single-wire sensors
Connection		Cut-and-grip technology
Operating temperature range	°C	0 ... 200

Extension cables: single-channel technology, pressure

Illustrated: Type 1661A...

Technical data	Type	1667C... [1]	1661A...	1672B...	1662A...
Length	m	2/5/10/sp [3]	2/5/10/sp [3]	2/5/10/sp [3]	1/2/5/sp [3]
Connector (system)		BNC	BNC	TNC	TNC
Connector in mold		1-channel	1-channel	1-channel	1-channel
Operating temperature range	°C	0 ... 125	0 ... 200	0 ... 125	0 ... 200
Covering		Fluoropolymer	Steel	Fluoropolymer	Steel

Cable technology: contact temperature sensors

Multi-channel temperature amplifier for temperature sensors without connector

Technical data	Type	2205B...
Measuring range	°C	0 ... 400
Thermocouple	type	K/J/N
Number of channels		2/4/8
Operating temperature range	°C	0 ... 125

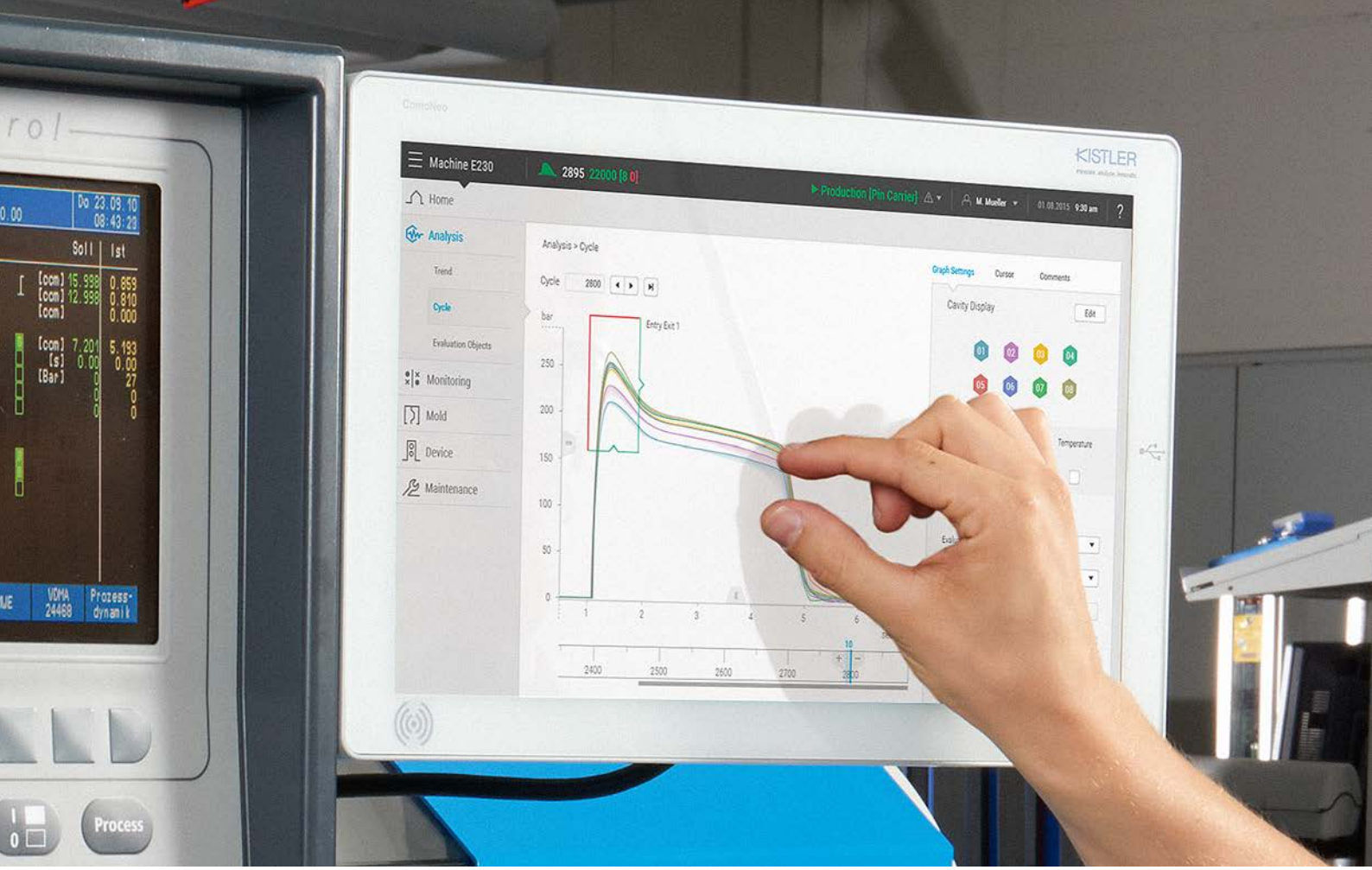
Characteristics	2-, 4- or 8-channel temperature amplifier for installation in molds for thermocouples of types K/J/N.
Application	Connection of up to 8 pressure/temperature sensors (temperature signal) or 8 temperature sensors to ComoNeo Type 5887A... .
Accessories	External housing Type 5700A23, installation support Type 1300A20
Data sheet: see www.kistler.com	**2205B (003-617)**

High-temperature extension cables for temperature sensors with connector

Cables are also used for the thermocouple in combined sensors, Types 6189A… and 6190CA… .

Technical data	Type	2290A...	2295A...
Thermocouple type		K/J	K/J
Length	m	2/5/10/sp [4]	2/5/sp [4]
Connector (system)		Bare ends	1-channel temperature
Connector in mold		1-channel	1-channel
Operating temperature range	°C	0 ... 200	0 ... 200

[1] Standard product
[2] Custom length (lmin = 0.3 m/lmax = 20 m)
[3] Custom length (lmin = 0.2 m/lmax = 5 m)
[4] Custom length (lmin = 0.1 m/lmax = 30 m)



Kistler offers optimally configured system technology for every quality assurance strategy.

Process monitoring systems for every application

Process monitoring systems from Kistler for analysis, optimization, monitoring, documentation, and control of injection molding are suitable for every application. Automatic detection and separation of faulty parts mean lower quality costs.

The ComoNeo monitoring system from Kistler offers a host of pioneering innovations that will make everyday injection molding operations far easier.

In addition to process monitoring, various control and regulation modules for injection molding are included in ComoNeo, or can be added.

Examples of additional system upgrade options: LOG (audit trail), ComoNeoMULTIFLOW 2.0 (for automatic hot runner balancing) and connectivity to the central data analysis software AkvisIO IME.

ComoScout is a process monitoring system for injection molding machines. Unlike ComoNeo, it is not connected to cavity pressure sensors. Instead it makes use of signals coming from the injection molding machine and any other voltage output sensors. ComoScout offers an ideal way to start out with process monitoring – and is equally suitable as a solution for retrofitting injection molding machines with a data interface.

ComoNeo and ComoScout are compact systems, designed to meet industry's needs; they are based on a process-oriented operating philosophy and they fit flexibly into diverse production environments. The advantage: multiple devices can be networked so that all data can be collected centrally. What's more, all integrated devices can be reached and configured from every PC – so there is no need to install additional software.

ComoNeo process monitoring system

Hardware

Technical data	Type	5887A1	5887A2	5887A3	5887A4
Inputs Cavity pressure (connector)		8 (2 × 4-channel)	8 (1 × 8-channel)	16 (2 × 8-channel)	32 (4 × 8-channel)
Automatic choice of measuring range		yes	yes	yes	yes
Voltage inputs i.e. cavity wall temperature (connector)		8 (1 × 8-channel)	8 (1 × 8-channel)	16 (2 × 8-channel)	16 (2 × 8-channel)
Inputs Machine signals		4	4	4	4
Measuring range Machine signals	V	0 ... ±10	0 ... ±10	0 ... ±10	0 ... ±10
Digital inputs		12	12	12	12
Digital outputs		24	24	24	24
Monitoring boxes		128	128	128	128
Measuring time	min	≤40	≤40	≤40	≤40
Dimensions	L×H×W	198 × 77 × 148	198 × 77 × 148	198 × 77 × 148	198 × 77 × 148
Sampling rate per channel	kHz	16	16	16	16
Operating temperature range	°C	0 ... 50	0 ... 50	0 ... 50	0 ... 50
Degree of protection		IP53	IP53	IP53	IP53

Characteristics	ComoNeo Type 5887A... is a compact system for data acquisition as well as visualization, monitoring and control of injection molding processes. To visualize the user interface, we recommend the capacitive multi-touch display, Type 5637A1 (display area: 15.6") that was specifically designed for ComoNeo.
Application	Process analysis, optimization, monitoring and control of the injection molding process. ComoNeo has an internal curve profile history that can store at least 50,000 cycles in the device – these can also be exported via a USB interface.
Accessories	AkvisIO IME Data Analysis Software 2878A……
Data sheet: see www.kistler.com	**5887A (003-231)**

ComoScout process monitoring system

Hardware

Technical data	Type	5889A1
Inputs Cavity pressure (connector)		0
Automatic choice of measuring range		yes
Inputs: frontside sensors		16
Inputs: backside sensors		4
Measuring range, frontside/backside sensors	V	0 ... ±10
Digital inputs		12
Digital outputs		24
Monitoring boxes		128
Measuring time	min	≤40
Dimensions	L×H×W	198 × 77 × 148
Sampling rate per channel	kHz	16
Operating temperature range	°C	0 … 50
Degree of protection		IP53

Characteristics	ComoScout is a compact and lightweight solution for data acquisition and process visualization, monitoring and control, with the focus on signals originating from injection molding machines or sensors (other than cavity pressure sensors). To visualize the user interface, Kistler recommends the capacitive multi-touch display, Type 5637A1 (display area: 15.6") that was specifically designed for ComoNeo and ComoScout.
Application	Process analysis, optimization, monitoring and control of the injection molding process. ComoNeo has an internal curve profile history that can store at least 50,000 cycles in the device – these can also be exported via a USB interface.
Accessories	AkvisIO IME Data Analysis Software 2878A..
Data sheet: see www.kistler.com	**5889A (003-614)**

Capacitive multi-touch display

Technical data	Type	5637A1
Display size		15.6"
Display format		16:9

Characteristics	Multi-touch display specially designed to operate ComoNeo and ComoScout. The ComoNeo user interface is optimized for the display format in compliance with the latest usability standards and guidelines. The display is also fitted with a USB connection for easy export and import of ComoNeo cycles, data and configurations.
Application	Can be connected directly to ComoNeo using the Type 1200A217A … connection cables included in the accessories.
Data sheet: see www.kistler.com	**5887A (003-231)/ 5889A (003-614)**

ComoNeo/ComoScout process monitoring system
Cables

Cable for display, Type 5637A1

Technical data	Type	1200A217A...
Length	m	2.5/5
Use		To connect display, Type 5637A1

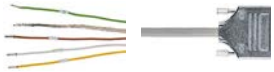
Cables for digital signals

Technical data	Type	1500B42A... [1]	1500B43A... [1]
Connection		Bare ends	Bare ends
Length	m	0 [2]/7/sp [3]	0 [2]/7/sp [3]
Use		Connection to handling system or scrap gate (digital inputs/ outputs, Type 5887A...), 15-pole	Connection to machine signals (digital inputs/outputs, Type 5887A...), 9-pole

Proximity switches

Technical data	Type	2231A1
Use		Trigger (start signal)

Cable for analog signals



Technical data	Type	1500B47A...
Connection		Bare ends
Length	m	0 [2]/7/sp [3]
Use		To connect analog machine signals, 15-pole

Cables for thermocouple amplifier, Type 2205

Illustrated: Type 1457A1A...

Technical data	Type	1491A1A...	1491A2A...
Connection		Connector	Connector
Length	m	2/5/sp [3]	2/5
Use		To connect Type 2205 to 5887A..., 1×4 channels	To connect Type 2205 to 5887A..., 2×4 channels (Y-cable)

Supply for ComoNeo

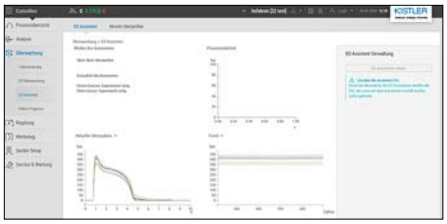
Technical data	Type	5781B5
Type		Plug-in power supply
Voltage (input)		100 ... 240 VAC
Voltage (output)	VDC	24
Connection		Mains plug (country-specific)
Use		Supply from mains, 100 ... 240 V

[1] Standard product [2] Connector only [3] For available lengths, see ComoNeo data sheet 003-231

Add-on products for ComoNeo/ComoScout

Assistance and connection systems

ComoNeoGUARD



Key characteristics	ComoNeoGUARD is a ComoNeo tool that generates and positions the monitoring boxes for good/bad evaluation itself – guiding users quickly and seamlessly to the scrap limits.
Application	The Assistant for user-prompted generation of the EO limits guides the operator through the procedure for defining the scrap limits.
Data sheet: see www.kistler.com	Assistance system included in standard scope of delivery. **5887A (003-231)**

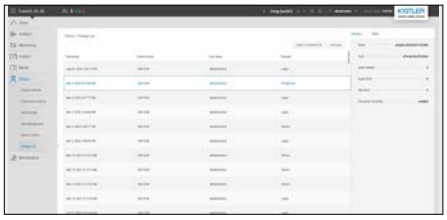
ComoNeoRECOVER

Key characteristics	The purpose of this restart module in ComoNeo is to reproduce the quality of an established injection molding process identically on a new machine.
Application	With ComoNeoRECOVER, pre-established processes can be transferred from one machine to another with no problems at all.
Data sheet: see www.kistler.com	Assistance system included in standard scope of delivery. **5887A (003-231)**

LDAP

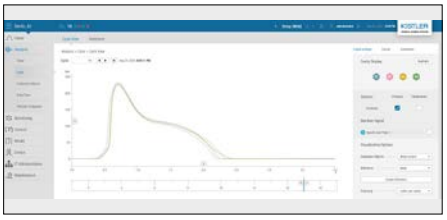
Key characteristics	This software module is integrated in both ComoNeo and ComoScout so the process monitoring system can use the company's existing user management. Existing profiles as well as related rights and restrictions can be imported to ensure efficient, secure and comfortable operation of all injection molding machines.
Application	Direct access to devices with existing user management and use of validated password rules.
Data sheet: see www.kistler.com	**5887A (003-231)** **5889A (003-614)**

LOG



Key characteristics	With the LOG feature, ComoNeo and ComoScout provide advanced security and traceability for production: all user activities executed on the process monitoring system are stored electronically, including a time index.
Application	This feature – also known as the audit trail – provides enhanced transparency for all applications but is especially important for medical device manufacturing.
Data sheet: see www.kistler.com	**5887A (003-231)** **5889A (003-614)**

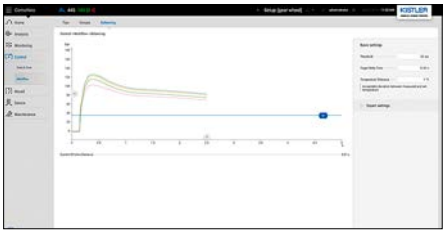
CONNECT



Key characteristics	OPC UA and ComoNeoCONNECT: making process and quality data available to higher-level software solutions.
Application	The OPC UA interface and CONNECT make process and quality data available to a higher-level software solution. All devices include a basic dataset that can be upgraded via CONNECT license.
Data sheet: see www.kistler.com	**5887A (003-231)** **5889A (003-614)**

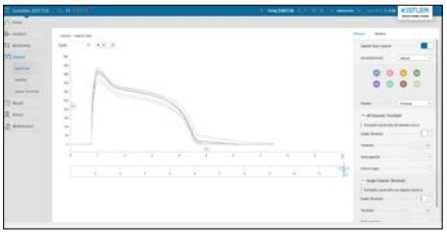
Monitoring and control systems

ComoNeoMULTIFLOW 2.0 hot runner balancing, Type 2809A3



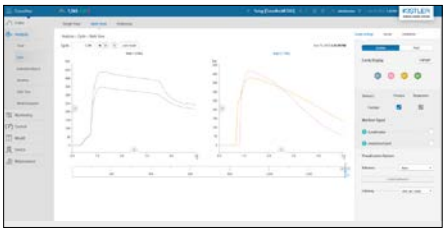
Key characteristics	Software for automatic optimization of hot runner temperatures. Its purpose: to fill all cavities of a multi-cavity mold synchronously and evenly. Closed control loop based on analysis of cavity pressure curves and automatic determination of setpoint temperatures, and transfer of this data to the hot runner control device or the injection molding machine. Support for multiple hot runner controllers. See data sheet for details.
Application	Automatic balancing of the hot runners of multi-cavity injection molds monitored by ComoNeo Type 5887A... during production startup and series production.
Accessories	Ethernet serial converter, Type 2808A2 (hardware)
Data sheet: see www.kistler.com	**5887A (003-231)**

ComoNeoSWITCH



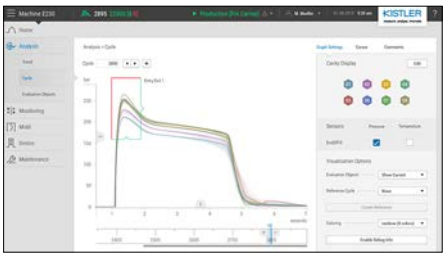
Key characteristics	ComoNeoSWITCH actively provides machine feedback. This allows ideal timing for the switchover from speed control to pressure control in response to cavity pressure.
Application	The automatic switchover control can be used in two different ways. With the first option, setup is manual; with the second, it is fully automatic.
Data sheet: see www.kistler.com	**5887A (003-231)**

ComoNeoMERGE



Key characteristics	ComoNeoMERGE is especially helpful with the production of multi-component parts. All the cavity pressure data measured in the manufacturing process is merged to provide a clear visual overview of the complex multi-component injection molding process.
Application	In multi-component injection molding processes, multiple mold types are used with different sensor positions.
Data sheet: see www.kistler.com	**5887A (003-231)**

ComoNeoCOMPOSITE



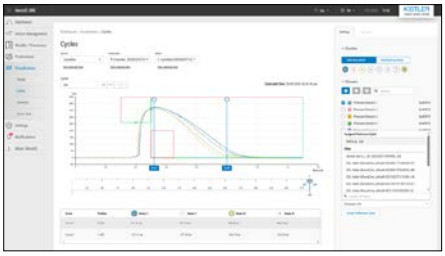
Key characteristics	ComoNeoCOMPOSITE ensures that users can easily recognize the characteristic phases of the process such as evacuation, filling and curing in the pressure curve – so process parameters are optimized and production becomes more cost-efficient.
Application	Capture and recording of the pressure signal with ComoNeoCOMPOSITE allows traceability of the individual process steps. This makes the pressure curve indispensable as a quality assurance tool.
Data sheet: see www.kistler.com	**5887A (003-231)**

Prediction systems

ComoNeoPREDICT

Key characteristics	Kistler's online quality prediction in ComoNeo is based on models that make it possible to calculate part characteristics. The statistical DoE test planning process (Design of Experiments) helps determine relationships between pressure / temperature profiles and defined quality features. The result: reliable statements can be made in advance about each manufactured component.
Application	When manufacturing injection-molded parts, tolerance limits can be taken directly from the part specifications. Online quality prediction offers particular benefits for manufacturers of sensitive, high-precision parts in the medical technology sector and producers of other critical high-grade components. Online quality prediction ultimately opens up the possibility of 100% in-process predictions for all relevant quality characteristics.
For more information:	For more information, please contact your Kistler partner directly.

AkvisIO IME Type 2878A...



Key characteristics	AkvisIO IME is a database and visualization solution for accessing and evaluating process data recorded with ComoNeo and ComoScout. The server application synchronizes the high-resolution sensor data recorded during production via the Thrift interface using an Ethernet connection and saves it in an SQL database explicitly designed for time series data. The standard version enables the trend and cycle display of process data, automatically generates complete production reports including the relevant key figures for process capability analysis and ensures comprehensive security when dealing with tool configurations, access rights and error messages. Extensions for AI-based anomaly detection or integration of injection molding machines as an additional data source are provided by supplementary software modules.
Application	Process analysis, production analysis and efficiency evaluation of all production orders monitored with ComoNeo Type 5887A... and ComoScout Type 5889A... Insight into ongoing production, storage, display and analysis of process and quality information generated by ComoNeo and ComoScout. Analysis based on cycles or trends of meaningful process values. In addition, there are statistical options for evaluating the reject rate and the process capability of the entire production, such as machine utilization or efficiency.
Accessories	2829D01 Connectivity License per ComoNeo/ComoScout required to synchronize data with AkvisIO
Data sheet: see www.kistler.com	**2878A (003-652)**

[1] One license is required for each ComoNeo Type 5887A.

Kistler's range includes the right accessories for installing the sensor, verification and testing.

Handling made simple – our range of accessories

Kistler offers an extensive range of helpful accessories as well as calibration and testing equipment. For inquiries about our range of accessories, please contact our local distribution partners.

Accessories such as the mounting wrench for mounting nuts or the extraction tool for sensors make it easier to handle and install sensors. The simple way to check your installation: our Sensor Tester for cavity pressure sensors. It can test the sensor's sensitivity and the insulation for the entire measuring chain.

Tools

Extraction tools for sensors

Technical data	Type	1315A	1358A	1362A
Outside diameter	mm	ø5.8	ø3.8	ø5.8
Length	mm	150	150	150
Thread	Type	M5	M3 × 0.35	M5
Sensors	Type	6152BA..., 6152BC..., 6157CA..., 6159A..., 6167A..., 6177B..., 6190C..., 6192B..., 6194B..., 9223A... .	6178C..., 6182D..., 6183D..., 6185A..., 6189A..., 6193B..., 6195B... .	6152BB/BD..., 6157CB/CD..., 6190A...

Mounting wrench for mounting nut

Technical data	Type	1383	1356	1363
Outside diameter	mm	ø10	ø5	ø4.4
Length	mm	300	150	60
Sensors	Type	6152B..., 6157C..., 6159A..., 6167A..., 6172B..., 6177B..., 6190C..., 6192B..., 6194B...	6178C..., 6182D..., 6183D..., 6185A..., 6193B..., 6195B...	6184A...

Repair set for single-wire cable

Technical data	Type	1207
Number of repair sets		5

Test equipment

Handheld charge amplifier

Technical data	Type	5811A
For sensors		Cavity pressure sensors
Use		Measuring the pre-tension of the measuring pin during installation Insulation measurement of sensors, cables, and complete measuring chains Measuring pressure curves with battery operation when no power supply is available
Data sheet: see www.kistler.com		**5811A (003-646)**

Sensor tester for cavity pressure sensors

Technical data	Type	5495C...
For sensor types		Cavity pressure and temperature sensors
Description		Battery-operated handheld tester with wireless test pin and connection cables to test sensor sensitivity and insulation resistance of cables, and to test the charge amplifiers
Use		Function checks on installed sensors, cables and charge amplifiers
Data sheet: see www.kistler.com		**5495 (003-453)**

Adapters for multi-channel technology cavity pressure sensors

Adapter boxes: single-channel technology to multi-channel technology

Illustrated: Type 5415A1

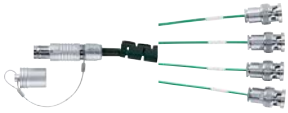
Technical data	Type	5415A1	5415A2
Number of channels		4	8
Connector (system)		4-channel	8-channel
Connector in mold		4 × 1-channel BNC	8 × 1-channel BNC
Operating temperature range	°C	0 ... 200	0 ... 200

Adapter boxes for multi-channel technology

Illustrated: Type 5415A3

Technical data	Type	5415A3	5415A4
Number of channels		8	8
Connector (system)		8-channel	2 × 4-channel
Connector in mold		2 × 4-channel	8-channel
Operating temperature range	°C	0 ... 200	0 ... 200

Adapter cables: multi-channel technology to single-channel technology



Technical data	Type	1991A...	1999A1A0.5	1999A2A0.5
Number of channels		1	4	8
Length	m	2/5/sp [1]	0.5	0.5
Connector (system)		4-channel	4 × BNC	8 × BNC
Connector in mold		1-channel	4-channel	8-channel
Operating temperature range	°C	0 ... 200	0 ... 200	0 ... 200

[1] Custom length (lmin = 0.3 m/lmax = 20 m)

From professional advice on installation to speedy deliveries of spare parts: Kistler's comprehensive range of services and training is at your disposal across the globe.

Kistler service: customized solutions from A to Z

Kistler offers sales and service wherever plastics processors manufacture high-grade injection molded parts.

In addition to sensors and systems, Kistler offers a host of services – from professional advice on installation to speedy worldwide deliveries of spare parts. For an overview of the services we offer, visit **www.kistler.com**. For detailed information on our training courses, please contact our local distribution partners.

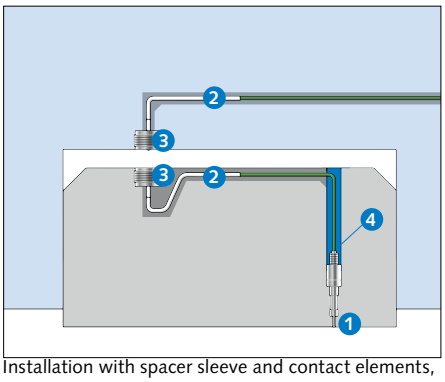
No matter what your assembly problem looks like – we have the right solution for you. Eight typical examples taken from practice are shown on the next page.

Kistler service at a glance:

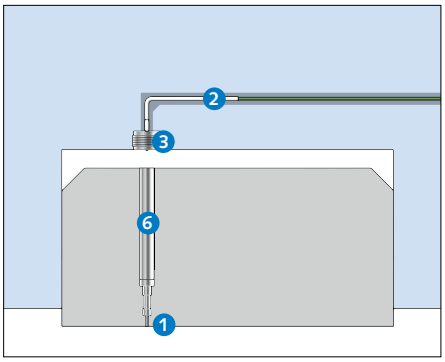
- Consulting
- Support with system commissioning
- Process optimization
- Periodic calibration of sensors used at customers' sites
- Education and training events
- Development services

Installation examples

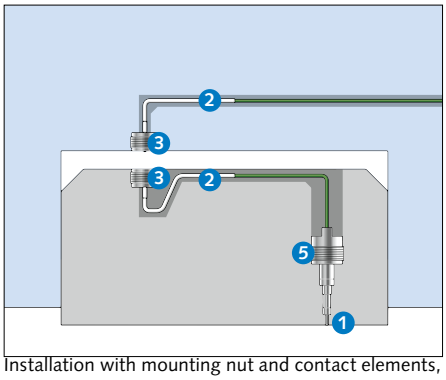
Direct cavity pressure measurement



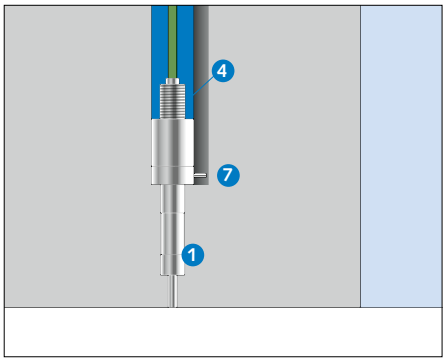
Installation with spacer sleeve and contact elements, cable with protective tube



Installation with conductive spacer sleeve and contact element, cable with protective tube

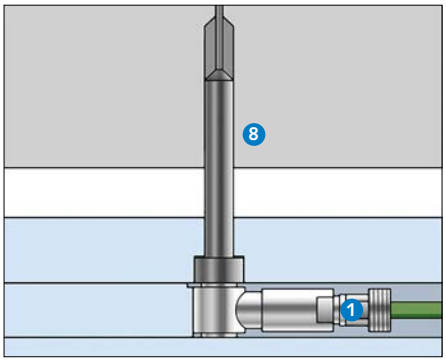


Installation with mounting nut and contact elements, cable with protective tube

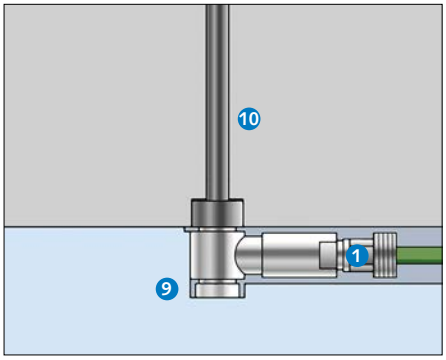


Sensor with machinable front and keyway pin, installation with spacer sleeve

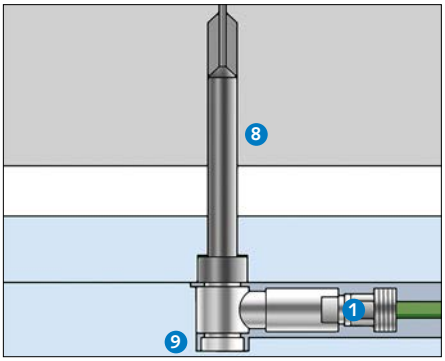
Indirect cavity pressure measurement



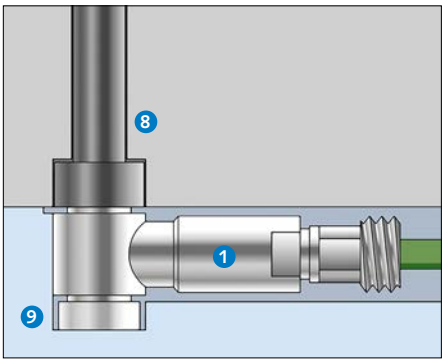
Mounted behind ejector pin in supporting plate



Mounted behind measurement pin in blind hole with thrust washer

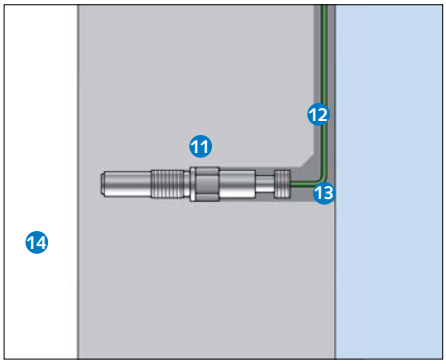


Mounted behind ejector pin in blind hole with thrust washer



Sensor installed with play, mounted behind ejector pin in blind hole with thrust washer

Contact-free cavity pressure measurement



Key

1. Sensor
2. Protective tube
3. Contact element
4. Spacer sleeve
5. Mounting nut
6. Conductive spacer sleeve
7. Keyway pin
8. Ejector pin
9. Thrust washer
10. Measurement pin
11. Contact-free cavity pressure sensor
12. Cable (single-wire or coaxial cable)
13. Mounting hole
14. Cavity

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