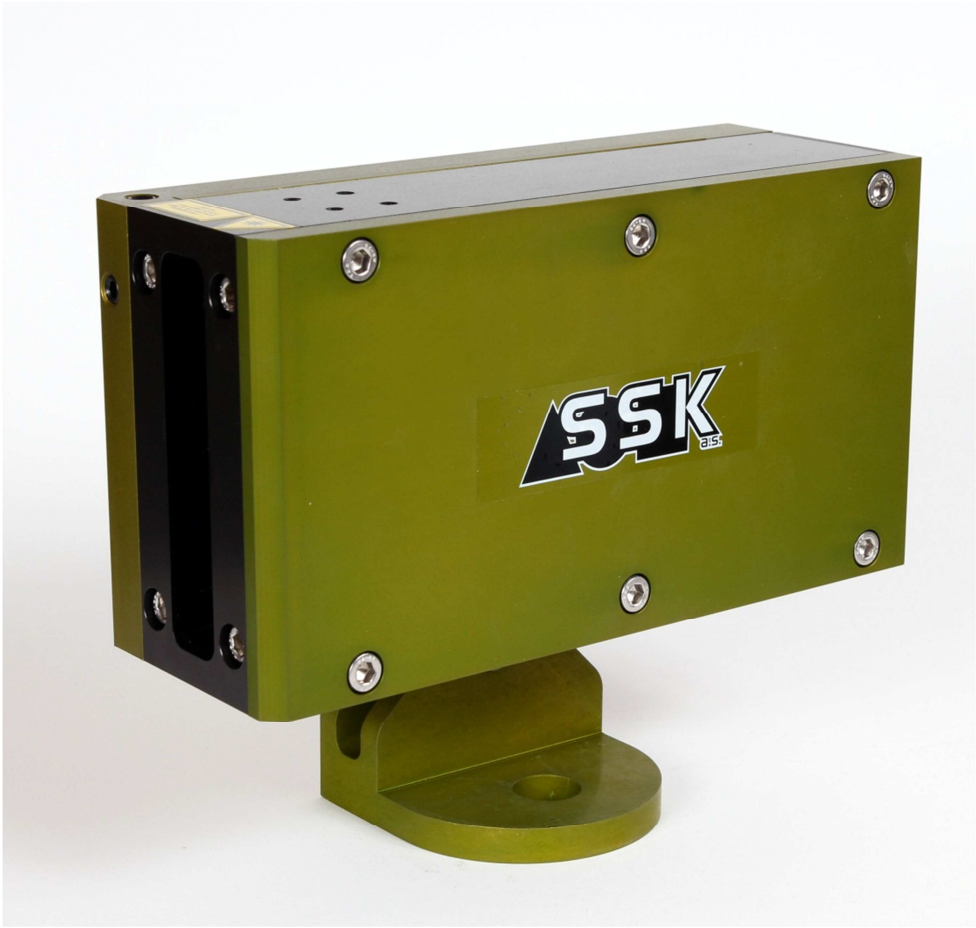
Universal position sensor and hot metal detector

SDIS – 1050



USER MANUAL

Frýdecká 201 • 739 61 Třinec • Czech Republic
tel. : +420 558 993 080 • fax. : +420 558 993 082
www.ssktrinec.cz • e-mail: info@ssktrinec.cz

1. Introduction

SDIS is universal configurable sensor for the detection of hot metal and its position. For its versatility can sensor operate as a hot metal detector (responds to the presence of hot material), or as a loop scanner (determines the position of the material in the field of view).
Main advantages of SDIS are high speed scanning, comfortable and easy setting and displaying parameters using the push buttons and display on the unit or remote (RS232, RS485), wide set of options, two independent sets of detection parameters and switching between them (also remotely).

2. Principle of operation

SDIS is a scanning sensor. Its field of view is scanned by polygonal mirror. When a hot product crosses the scanned field of the sensor, the scanned infrared radiation is reflected onto the photocell of sensor and electronically processed. Depending on the intensity of infrared radiation is possible to determine whether the requested material is in the field of view, and according to the current position of the mirror can be derived material position in the field of view.
The sensor uses highly reliable and proven PbS photocell, designed with regard to the requirements of the steel industry. The spectral response of a PbS, unlike other types of infrared radiation detector covers a wide range of hot metal and steel is from 250 ° C.
SDIS scanning system is designed so that the infrared radiation is reflected to the photocell from each facet of rotating mirror very accurate, even in the case when the entire sensing field is covered with hot material. Radiation received by photocell is modulated by a rotating mirror. It provides:

- increasing the signal/noise ratio, which allows detection at low temperatures independent of the interfering background
- suppression hysteresis and overload of photocell
- increase the life of photocells

Photocell signal processing is performed in modern digital signal processor, enabling fast, accurate and stable evaluation, wide range of possibility to set of evaluation parameters with regard to the environment and thus achieve high reliability sensor independently of steam, scale, material, temperature fluctuations, etc. Parameter setup is simple and intuitive. Thanks to the built-in display and buttons directly on the device the parameters can be easily monitored (or change) directly on the sensor. With built-in communication via RS232 and RS485 sensor can be adjusted and monitored remotely using a PC.
The sensor can operate in two modes:

LS - Loop Sensor - i.e. a sensor for measuring the position of hot material edges in the sensor field of view. In this mode the sensor must be therefore positioned so as to be in his field of view located edge of material. On the edge of the hot material occurs pulse on a photocell. Rotation angle of the mirror motor at the time of detection of the pulse is directly proportional to the position of the edge of the hot material in the sensor field of view.

HMD - hot metal detector - a device only detects the exceeding signal amplitude of photocells over the set threshold. It does not matter if the field of view of the sensor is an edge of the material. It is necessary to limit field of view (depending on site conditions) by the appropriate mechanical shutters or cover. (The basic limitation of the field of view is done by shield inside the sensor - max viewing angle is necessary to specify when ordering).

3. General description

SDIS is a standalone sensor, heavy duty and easy to assembly and commissioning.
Its basic features are:

3.1 Mechanical:

- hermetically sealed, accurately machined housing made of aluminum alloy.
- suport wall with mounting stand, adjustable in both directions, adapted to the cooling unit with water and blowing air windscreen to prevent pollution.
- connection of water and air in the supporting wall - when necessary the sensor can be easily replaced without disconnecting water or air.

3.2 Electrical:

- connection of all electrical signals via one connector
- control using display and buttons
  - alphanumeric LED display to show parameters
  - 4 buttons for easy parameter setting
  - 3 LEDs to display the status:
    - green - flashes when the unit is in operation
    - yellow - indicates the presence of material the field of view
    - red - warning or malfunction of the unit
- built-in diagnostics unit:
  - detection of exceeding the internal temperature over 60 ° C
  - detection of a motor speed failure
  - detection of power failure

4. The mounting and wiring

4.1. Location

The distance between the SDIS and the measured product is not critical and depends on the scanning angle so as to cover the entire measurement field. Measured product may not fill the entire sensor field of view. Just intersects only a portion of 1 cm ² at a distance of 4 m sensor
The optimal distance between the sensor and the various types of materials are as follows:

Material	Distance between product and sensor
Wires with a diameter of 5-12 mm	0,20 – 3 m
Small bars, 10 × 10 to 40 × 40	0,20 – 4 m
Billets and small beams	0,50 – 6 m
Blooms	minimum 2 m
Thin sheets	1,00 – 6 m
Thick plates	1,00 – 8 m
Slabs	minimum 2m

For very hot products it is the best to place the sensor as far as possible to avoid excessive destruction due to direct radiation.
For cold and less-emitting products is the signal-to-noise ratio increased by placing sensors in the shortest possible distance.
The sensing surface should ideally be perpendicular to the measured product.
When selecting the location of the sensor attention to the following must be paid:

- Other source of infrared radiation in addition to the measured material can not intersect the sensor field of view (door furnace, the reflection of the product in the water pool, sun reflection from shiny metal in the area, etc.)
- Field of view of sensor must not be covered with any other product than the product being measured

4.2. Mounting

SDIS has an adjustable mounting foot allows horizontal rotation and vertical tilt. Mounting base is fitted with 18 mm hole for mounting on the structure.
The stand is strong enough to ensure a perfect fit sensor. The sensor is equipped with connections for enclosure cooling water and compressed air for cleaning and protection of optics.
They can be used in heavy metallurgical environments (high temperature, humidity, dust).
In some cases, however, it is useful to protect the sensor with the heat resistant screen and in the case of excessive steam with additional ventilation. To increase the detection accuracy and lifetime of the sensor should be mounted on a solid, non shaking pedestal.

4.3. Electrical connection

SDIS sensor is equipped with a 14-pin connector Amphenol PT.
Specification of Lapp Cable Ölflex Servo FD770 CP:

- Multiple core cable: 6 × 2x0, 25 mm ² and 2 x 0.5 mm ² shielded
- Rugged design for industrial applications
- Outer diameter: 10.3 mm
- Minimum bending radius: 50 mm
- Each wire is labeled with a different color

Note: Unused cores must be insulated or connected to free terminals.
Note: When disconnecting the cable, plug the sensor connector with protective cover for protect the contacts from corrosion.

4.4. Connection of air and water

Cooling water and cleaning air is fed to the quick couplers cooling housing that is also the sensor mounting stand. Cooling housing is separately attached to the sensor, so the sensor can be replaced without disconnecting the cooling water and air and setting changes the sensor mounting.

4.4.1. Cooling

The cooling channel housing is positioned, allowing the cooling water sensor.
Conditions for cooling:

- The sensor is recommended to cool at ambient temperatures above 50 ° C. Laboratory tests have shown that a properly cooled sensor can operate at temperatures up to 100 °C.

Specifications of cooling water:

- Industrial pure water, maximum temperature 25 ° C
- Maximum recommended pressure: 4 bars.
- Flow rate: 1 -2 liters / min.

Cooling circuit:

- Material: aluminum cooling groove in the housing.
- Connection: Hose diameter 10 mm (for quick couplers).

4.4.2. Cleaning air

Compressed air is used to remove dust on the windscreen in front of the sensor. The system is designed to give the high pressure area in front of the sensor.
System Specifications cleaner air:

- Air Quality: Air must be dry, free of grease and dust free
- Air pressure: 50 to 120 g / cm ²
- Flow: 4-16 l / min.
- Connection: Hose 10mm (for quick couplers)

5. Technical specification

5.1. Mechanical

- Weight: 4 kg
- Adjustable stand with mounting hole dia. 18 mm
- Dimensions: viz. drawing

5.2. Optical

- Spectral sensitivity: PbS photocell, range 1-3 micron with a maximum response at 2.2 micron
- Temperature range of materials: depends on the material to be scanned:
  - For iron and steel from 250 ° C when set to high sensitivity. If it is expected higher product temperature than 400 ° C, it is not appropriate to set a high sensitivity, because he could detect scale or reflections.
  - For other materials, such as copper, bronze, cast iron, etc. The temperature range depends on the infrared radiation of the product.

- Angles - standard sensor is supplied with a viewing angle of 50 degrees, with a special mask inside the aperture angle can be reduced to 30 respectively. 10 degrees. Side angle or width of the scanned field - 3 degrees max

5.3. Electrical

- Power:
  - Voltage: 24V DC
  - Power consumption: 12 VA

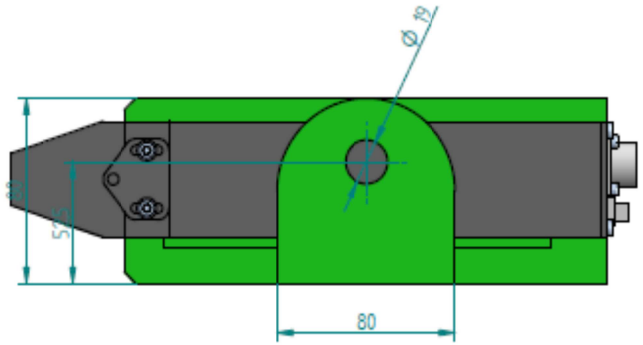
- Signal the presence of the product:
  - Semiconductor: complementary push-pull outputs 0/24VDC 50 mA
    - response time: 1 ms
  - Relay: single-pole switch:
    - switching capacity: 250V, 5A max
    - closing time: 10 ms
    - opening time: 5 ms

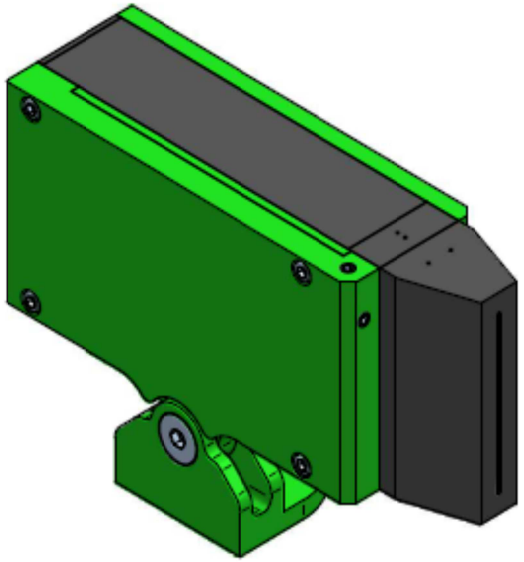
- "Alarm": push-pull output 0/24VDC 50 mA
  - 0V DC power failure, internal temperature or motor speed fault detection
  - 24 V DC if no error is detected

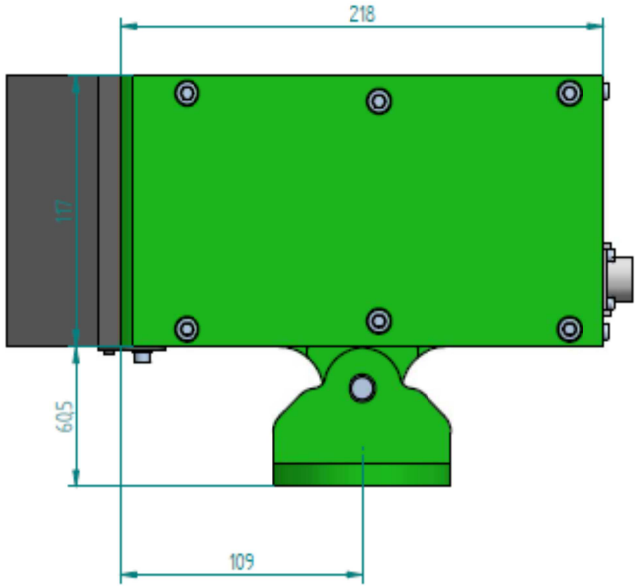
- Analog signals 4-20 mA, response time 1ms
  - position of the material
  - signal intensity

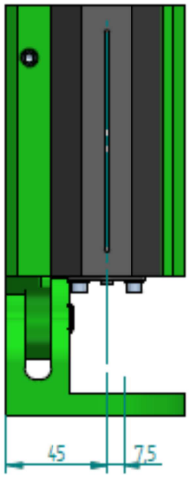
5.4. Environment

- Operating temperature: -10 ° C to +60 ° C.
- At an ambient temperature above 40 ° C it is recommended to cool sensor with industrial water at a temperature up to 25 ° C, pressure of 1-2 bar, flow rate of 1-2 l / min









Projekt: Kamera SSK	Kreslil: Zbyšek Bednarz	Hmotnost: 4,285 kg	Materiál:
Společnost: Contitherm	Schválil:	Pozice:	Výkres sestavy:
Revize:	Název: Sestava kamery	Číslo výkresu: 4009-S-001-11	
Datum: 6.9.2012			

6. Control

Indication LEDs

green - it is blinking at one-second interval when the devise is turned on and the program is running
yellow - indicates the presence of hot material
red - lights in case of malfunction (and during startup):
- motor failure (motor is not running at correct speed – also during startup)
- temperature inside the sensor exceeds 60 ° C

Display - main menu

Use buttons **[←]** and **[→]** to display measured values and the current setting (not for setting):

Int= 75% current infrared signal intensity
Pos= 50% current position of the material (in operation mode LS - Loop Scanner)
A1=I16.0 Analog1 output – current value in mA (selected I = intensity)
A2=P12.0 Analog2 output – current value in mA (selected P = position)
Set=Rel1 selected set of gain and threshold (Rel/Man, set 1/2)
Gain 25% selected gain
Thre 25% selected threshold
Mode LS selected operation mode of the sensor (LS or HMD)
Laser= 0 press button **[↲]** to light up the targeting laser for 2 minutes (**Laser= 1**)

Failure message can be flashing on the display (while the red LED is on and alarm output signal drops to 0) in case of malfunction:

Alarm!!! Mot= Err motor failure
Alarm!!! Tem=60°C inside temperature exceeds 60°C

Or warning can be displayed during remote test:

Warning! ExtTest! during remote TEST
(devise act as it is detecting material:
- analog outputs have 12 mA
- yellow LED is lighting, output signal material detect is on and relay is closed)

You can confirm message by button **[↲]** and continue to main menu. You can show message again by pressing button **[↑]**. After automatic logout from the menu the message appears automatically again.

Pressing button [↲] on any main menu item (except Laser = 0), you can login and change the settings – but this is PIN protected.

Re-pressing of [↲] you are prompted to enter the PIN.

The buttons have their numerical meanings: [↑] = 1 [←] = 2 [→] = 3 [↲] = 4, then confirm PIN by [↲].
There are two levels of user privileges to change the settings:

Basic - for change the most important parameters- PIN: **3412**
Advanced - for adaptation of the sensor on actual measuring site - PIN: **2314**
- includes all items of the main menu

Display - basic menu (PIN: 3412)

Use buttons **[←]** and **[→]** for move in menu items, press enter button **[↲]** to get access to submenu. Use escape **[↑]** button to get up in menu tree**.** Device remembers browsing history, you can use buttons **[↲]** or **[↑]** to fast move (e.g. if you change the switching threshold, you can check the device behaves in main menu and you can get simply back by pressing button [↲]) few times. Specific value can be changed by pressing [↲] (name will be flashing). Now use [←] and [→] to change value and confirm it by [↲] (name stops flashing), or go back without saving by pressing [↑].

Sensor	->	**ValSet1**	->	**Thre 25%**	value set 1, threshold is 25%
		ValSet2	->	**Thre 50%**	value set 2, threshold is 50%
		Set=Rel		Rel – value set is chosen by external relay Man1 - measure according ValSet1 Man2 - measure according ValSet2	
Window	->	**Beg 5%**		beginning of measuring window (analog output = 4mA, position 0%)	
		End 95%		ending of measuring window (analog output = 20mA, position 100%)	
SysInfo	->	**SDIS1050**		model number	
		SN:12001		serial number	
		Tem=35°C		temperature inside unit (reports alarm after exceeding 60°C)	
Logout	->	**Logout ?**		confirm to logout (automatically after 10 min)	

Display - advanced menu (PIN: 2314)

Use buttons **[←]** and **[→]** for move in menu items, press button **[↲]** to get access to submenu. Use escape **[↑]** button to get up in menu tree**.** Device remember browsing history, you can use buttons **[↲]** or **[↑]** to fast move (e.g. if you change the switching threshold. We check the device behaves in main menu and you can get simply back by pressing button [↲]). Specific value can be changed by pressing [↲] (name will be flashing). Now use [←] and [→] to change value and confirm [↲] it (name stops flashing), or to go back without saving button [↑].

Mode LS -> operation mode	LS	- Loop Scanner mode - for measurement of hot material position		
	HMD	- Hot Metal Detector - only for hot material presence detection (without position)		
Sensor -> detection setting	**ValSet1** (value set 1)	->	**Gain 25%**	gain
			Thre 25%	switching threshold
			HysT 10%	hysteresis of switching threshold
	ValSet2 (value set 2)	->	**Gain 75%**	gain
			Thre 50%	switching threshold
			HysT 10%	hysteresis of switching threshold
	Set=Rel		Rel – setting set by relay status Man1 - measure according ValSet1 Man2 - measure according ValSet2	
Window ->	**Beg 5%**	beginning of measuring window (analog output = 4mA, position 0%)		
	End 95%	ending of measuring window (analog output = 20mA, position 100%)		
	HysB 5%	hysteresis at the start of measuring window		
	HysE 5%	hysteresis at the end of measuring window		
Distance -> alternat. window setting	**Mat 2.00**	distance between device to material (meters)		
	Beg 0.90	distance between laser to begin. of meas. window (meters)		
	End 0.90	distance between laser to end. of meas. window (meters)		
Outputs -> setting of analog output	**AnOut1 I**	output signal Analog 1 (I=intensity, P=position)		
	AnOut2 P	output signal Analog 2 (I= intensity, P=position)		
	NoMatOut	->	**A1 4.0**	Analog1 value without material
			A2 last	Analog2 value without material
Filters ->	**SiUp 0**	detection signal filter – switching on after set amount pulses (in miliseconds)		
	SiDo 0	detection signal filter – switching off after set amount pulses (in miliseconds)		
	Pos 6	filter of analog position signal-moving average for x ms (best choice is multiples of 6 – average for 1 mirror rotation)		
Tests ->	**Laser= 0**	laser pointer (0 off, 1 on)		
	Lamp= R0	testing by IRLED (R0/R1 according relay, M0 off, M1 on)		
	Signal -	detection test (- from photocell signal, 0 off, 1 on)		
	An1 -.-	test Analog1 (-.- from photocell, on set value in mA)		
	An2 -.-	test Analog2 (-.- from photocell, on set value in mA)		
	Note:	All tests are canceled after exit from Tests menu		

Comm	->	**RS232**	->	**Term ?** (**=Noname, VT100, SoftCon**) type of connection-PC or type of terminal
communication settings				**Sp=19200** speed
				Par=None parity
				Stop= 1 stop-bit
		RS485	->	**Addr= 0** address
				Prot=Asc protocol Ascii, RTU
				Sp=19200 speed
				Par=None parity
				Stop= 1 stop-bit

SysInfo	->	**SDIS1050**	model number
		SN:12001	serial number
		Fw=6.103	version firmware
		UT 25.55	uptime from last power on
		Tem=35°C	temperature inside unit (reports alarm after exceeding 60°C)
Fact.Res	->	**Reset ?**	reset all settings to the original values after confirmation (you will be automatically logged off)
Logout	->	**Logout ?**	logoff after confirmation (automatically after 10 min)

Explanation of sensor function and menu items

Mode (LS/HMD)- sensor mode
Primary function of sensor is **LS** – loop scanner – sensor for position measurement of the edge of hot material. In this mode, sensor must be situated so, that the edge of hot material is in his field of view. If signal from PbS photocell exceeds threshold, then the edge of this signal is used for detection of material position (usually trailing edge). Angle of rotating mirror in the moment of detection is proportional to material position in the sensor's field of view.
Additionally sensor can be set to **HMD** mode – hot metal detector – sensor only detects if signal from PbS photocell exceeds threshold (menu item **Thre**). Edge of material does not need to be in the field of view. Although basic mask inside the sensor is enough usually to limit sensor's field of view, in some cases it needs to be limited by additional mechanical shields (it depends on place of installation). Please send us max. viewing angle you need in quotation.

Sensor – detection parameters configuration
There is possibility to configure two parameter value sets (gain, threshold, hysteresis) and switch between them (also remotely). This is suitable for production lines with different product profiles. E.g. for thin wire it needs to be higher gain then for thick bars
In each set (**ValSet1**,**ValSet2**) there is possibility to adjust gain (**Gain**), threshold (**Thre**) and hysteresis (**HysT**). Sensor sets output detection signal to on if amplitude of photocell signal exceeds threshold (**Thre**), and sets it off if amplitude is below **Thre-HysT**.
Which value set is actually used can be selected in menu item **Set** - manually (item **Set** is set to **Man1** or **Man2**) or it can be selected remotely by switching relay (item **Set** is set to **Rel**).

Window – measuring window configuration
For position measurement there is possibility to adjust measuring window - e.g. narrow max. field of view range or adjust start and end limits for analog output signals 4 - 20 mA (menu items **Beg** and **End**), and adjust hysteresis to eliminate signal bouncing at the edges of measuring window (menu items **HysB** and **HysE**).

Distance – measuring window configuration by specifying distances
There is possibility to adjust measuring window alternative way, by specifing the distance between sensor and measured material and distances between start of measured window and laser pointer and between laser pointer and the end of window. Note: This configuration is not always accurate, because intensity of infrared signal depends on conditions in the place of installation.

Outputs – analog outputs configuration
There are two independent analog outputs 4-20 mA in the sensor. It is possible to configure each output to represent or position or intensity of infrared signal. There is also possibility to specify value of output in mA, when there is no material detected (menu item **NoMatOut**).

Filters – configuration of filters and averaging
There is possibility to adjust filters of output signals to improve accuracy or to avoid false detection. By adjusting **SiUp** and **SiDo** values you can specify how many times signal must be detected befor output detection signal is set on (or off respectively) . Value is in miliseconds. By adjusting **Pos** value you can specify moving average of analog output position signal per miliseconds.

Tests – tests of sensor's function
There is possibility to test various sensor's functions, e.g. to check if it is installed correctly. You can manually set detection signal to on, set analog outputs to specified value in mA, or to check detection of infrared signal by switching on infrared LED diode inside the sensor. (Note: Sensor's IR-LED is situated near the beginning of sensors field of view, so its function can be checked correctly only in provided software, where you can view pulse). All tests are ended when you quit menu **Tests**.
There is also possibility to check sensor's function remotely via test relay. Detection signal is set to on, and analog outputs are set to 12mA.

Comm – communication configuration
There is possibility to set various parameters of RS232 and RS485 serial communication here.

SysInfo – information about sensor
Here you can see model number, serial number, firmware version, uptime from start and actual temperature inside the sensor.

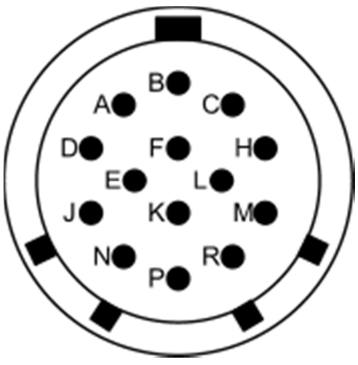
Fact.Res – reset of all set values to factory defaults.

Logout – quit setup mode**.**

7. Connector

Amphenol connector – cable wiring

pin	**color of wire**	**function**
Power:		
F	**red**	24VDC/0,5A , protected by fuse T 0,8A
K	**blue**	GND
Analog outputs:		
A	**yellow**	Analog1 signal 4-20mA (intensity or position–depends on setting)
B	**green**	Analog2 signal 4-20mA (intensity or position–depends on setting)
Digital outputs (push-pull):		
C	**gray**	presence of material (detect = 24VDC/max. 50mA)
H	**ping**	neg. presence of material (detect = 0VDC/max. 50mA)
M	**black**	neg. alarm (all OK = 24VDC/max. 50mA, alarm = 0VDC)
Relay outputs:		
E	**brown (thick w.)**	presence of material - NO (250V/5A)
L	**white (thick w.)**	presence of material - COM (250V/5A)
Relay inputs:		
D	**brown**	external test (TEST - connect GND)
J	**white**	remote change of value sets (connect to GND = switch to Set2).
Communication:		
P	**purple**	isolated GND for RS485
R	**red/blue**	DATA+ RS485
N	**grey/ping**	DATA- RS485



Amphenol PT 06 W 12-14 S