

## Pressure gauges for SF<sub>6</sub> gas monitoring

**Dry of filled with dampening fluid**

**Case diameter DS 100 (4")**

**Type 1.M5: wetted parts in copper alloy**

**Type 1.M6: wetted parts in stainless steel AISI 316L**

These instruments are manufactured to monitor the electrical operation on hermetically sealed systems containing Sulphur Hexafluoride gas (SF<sub>6</sub>). The indication and the electrical operations are calibrated to the gas density (isochore) according to the relation pressure-temperature. The 1.M5 model is suitable for indoor installation while the 1.M6 model has been designed for the outdoor installation as well. The oil filled executions are particularly suitable for installation when vibrations are apparent.

### Accuracy of indication (referred to the instruments range):

±1% at +20 °C of ambient temperature; ±2.5% within the temperature range -20...+60°C related to the calibration pressure of the reference isochore.

### Accuracy of intervention:

- see accuracy of indication for set-point equal to pressure of calibration;
- when set-point is different from pressure of calibration, calculate it according to the instrument range.

### Alarm contacts, non adjustable contacts, with antitampering sealing:

- on air with magnetic block (80%Ag-20%Ni);
- inductive with galvanic exit.

**Ambient temperature:** -20...+60 °C.

**Storage temperature:** -40...+60°C

**Calibration pressure (PC):** refer to order specifications.

**Ranges:** also vacuum & compound gauges from 1,6 to 25 bar.

**Electrical connection:** junction box with cable gland M20 x 1,5.

**Nominal diameter:** DN100.

**Gas sealeakage rate** ≤ 1x10<sup>-6</sup> mbar x l/s<sup>-1</sup> (helium test with mass spectrometer).

**Case:** AISI 304.

**Ring:** bayonet lock, AISI 304 with antitampering sealing.

**Window:** glass.

**Movement:** stainless steel with bimetallic temperature compensator.

**Dial:** white aluminium with black markings and coloured sectors as per customer's specification.

**Pointer:** black anodised aluminium.



### 1.M5 -SF6 : copper alloy wetted parts, suitable for indoor ambients

#### 1 -Standard dry version

**Process connection:** OT58.

**Sensing element:** phosphor bronze.

**Protection degree:** IP 54 as per IEC 529, UNI 8896.

#### 3 -Silicon oil filled version

**Process connection:** OT58.

**Sensing element:** phosphor bronze.

**Protection degree:** IP65 as per IEC 529, UNI 8896.

**Window:** safety glass.

### 1.M6 -SF6 : AISI 316L wetted parts, suitable for outdoor ambients

#### 1 -Standard dry version

**Process connection and sensing element:** AISI 316L.

**Protection degree:** IP 54 as per IEC 529, UNI 8896.

#### 3 -Silicon oil filled version

**Process connection and sensing element:** AISI 316L.

**Protection degree:** IP 65 as per IEC 529, UNI 8896.

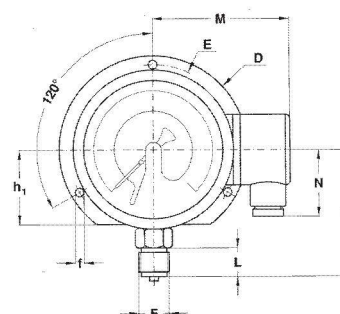
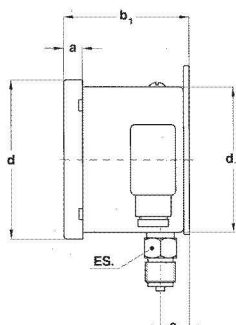
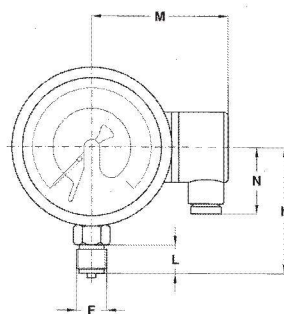
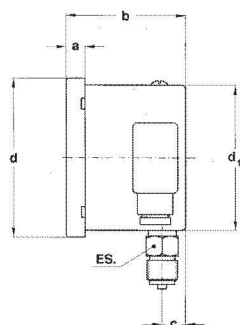
**Window:** safety glass.

#### 9 -Nitrogen filled version

**Process connection and sensing element:** AISI 316L.

**Protection degree:** IP 65 as per IEC 529, UNI 8896.

**Window:** safety glass.



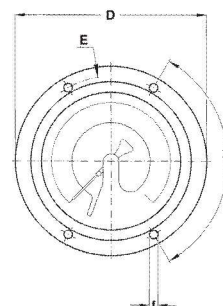
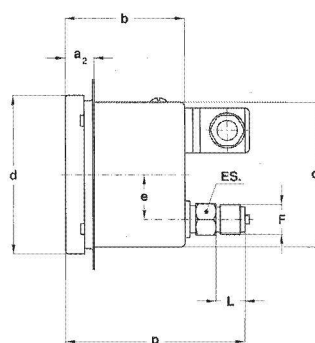
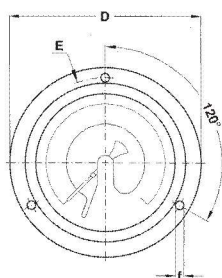
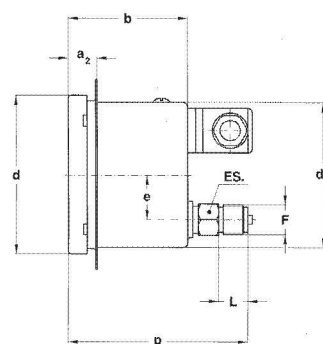
**A** stem mounting;  
lower connection.

**A + C** surface mounting, back flange;  
lower connection.

Type	F	a	b (1)	c	d	d <sub>1</sub>	f	h		D	E	M	N	L	ES	Weight (1)(2)
<b>A</b>	G 1/2 A	0.51" (13)	2.87/3.27" (73/83)	0.63" (16)	4.33" (110)	3.98" (101)		3.50" (89)				3.70" (94)	1.81" (46)	0.79" (20)	0.87" (22)	1.45/1.65 lbs (0,66/0,75 kg)
<b>A+C</b>	<b>43M</b> 1/2-14 NPT	0.51" (13)	3.03/3.43" (77/87)	0.79" (20)	4.33" (110)	3.98" (101)	0.24" (6)	3.50" (89)	2.05" (52)	5.12" (130)	4.65" (118)	3.70" (94)	1.81" (46)	0.79" (20)	0.87" (22)	1.63/1.83 lbs (0,74/0,83 kg)

dimensions inches (mm)

(1) dimensions for single or double contacts; (2) add 0.88 lbs (0,4 kg), when oil filled



**D + E** flush mounting, front flange 3 holes;  
back connection.

**D + Q** flush mounting, front flange 4 holes;  
back connection.

Type	F		b (1)	d	d <sub>1</sub>	e	f	p (1)	D	E	L	ES	Weight (1)(2)
<b>D+E</b>	<b>41M</b> G 1/2 A	0.79" (20)	2.87/3.27" (73/83)	4.33" (110)	3.98" (101)	1.22" (31)	0.24" (6)	4.49/4.88" (114/124)	5.20" (132)	4.65" (118)	0.79" (20)	0.87" (22)	1.41/1.61 lbs (0,64/0,73 kg)
<b>D+Q</b>	<b>43M</b> 1/2-14 NPT	0.79" (20)	2.87/3.27" (73/83)	4.33" (110)	3.98" (101)	1.22" (31)	0.24" (6)	4.49/4.88" (114/124)	5.20" (132)	4.65" (118)	0.79" (20)	0.87" (22)	1.41/1.61 lbs (0,64/0,73 kg)

dimensions inches (mm)

(1) dimensions for single or double contacts; (2) add 0.88 lbs (0,4 kg), when oiled filled



## Magnetic snap action contacts

Set-point hysteresys: 2...5% f.s.v.

Break rating: 30W/50VA (20W/20VA if filled).

Maximum rating: 250 VAC /1A (ohmic load).

Minimum rating: 24 Vcc/20 mA (ohmic rating).

Contact material: Silver-Nickel 80/20%.

Electrical wiring: with junction box as per VDE, see table page 4

LOAD RATINGS as per DIN 16085.

Volt	Dry versions or filled with azote			Silicon dielectric oil filled versions		
	CC	CA	Inductive load	CC	CA	Inductive load
220	100 mA	120 mA	65 mA	65 mA	90 mA	40 mA
110	200 mA	240 mA	130 mA	130 mA	180 mA	85 mA
48	300 mA	450 mA	200 mA	190 mA	330 mA	130 mA
24	400 mA	600 mA	250 mA	250 mA	450 mA	150 mA

WIRING SCHEME (The numbers shown are the same as those are indicated on the junction box )	THE PRESSURE RAISING MEANS...	CONTACT CODE
...FOR SINGLE CONTACTS		
	<u>Opening PS1</u>	01S
	<u>Closing PS1</u>	02S
... FOR DOUBLE CONTACTS		
	<u>Opening PS1</u> <u>Opening PS2</u> (each contact must not exceed the next one)	06D
	<u>Closing PS1</u> <u>Closing PS2</u> (each contact must not exceed the next one)	09D

## Inductive electric contacts

Set-point hysteresys: 0,3...1% f.s.v.

Electric wiring: with junction box as per VDE , see table page 4.

WIRING SCHEME (The numbers shown are the same as those are indicated on the junction box)	THE PRESSURE RAISING MEANS...	CONTACT CODE
FOR SINGLE CONTACTS...		
	<u>Opening PS1</u>	B1
	<u>Closing PS1</u>	B2
FOR DOUBLE CONTACTS...		
	<u>Opening PS1</u> <u>Opening PS2</u> (each contact must not exceed the next one)	B11
	<u>Closing PS1</u> <u>Closing PS2</u> (each contact must not exceed the next one)	B22

## RANGES

bar	-1...+0,6	-1...+1,5	-1...+3	-1...+5	-1...+9	-1...+15	-1...+24
MPa	-0,1...+0,06	-0,1...+0,15	-0,1...+0,3	-0,1...+0,5	-0,1...+0,9	-0,1...+1,5	-0,1...+2,4

## RECOMMENDATION

The measuring of the temperature necessary to the termic compensation it is detected inside the instrument. This means that these instruments should be installed so that their operating temperature corresponds to the one of the monitored SF<sub>6</sub> gas.

In order to avoid any compensating error due to the different isochores, the PC calibration must be as nearest as possible to the PS contacts setting pressure.

## HOW TO ORDER

## 1° - DESCRIPTION &amp; CODE

## Model

**1.M5** - SF6, for indoor ambients

**1.M6** - SF6, for outdoor ambients

## Version

**1** - Standard, dry

**3** - Filled with silicon dielectric oil version

**9** - Filled with azote oil version

## Mounting type

**A** - lower connection - stem mounting

**D** - back connection - front flange 3 holes

## Technical specification code

To be asked to the Technical & Commercial Service

**Ranges** : from 1,6 to 25 bar, also vacuum and compound

## Process connection

**41M** - 1/2" BSP - G 1/2 A - PF 1/2

**43M** - 1/2" NPT

**Electric schemes** : **01S...B22** - see labels on page 3

## Mounting accessories

**C** - Back flange, for lower connection pressure gauge

**E** - 3 holes front flange, for back connection pressure gauge

**Q** - 4 holes front flange, for back connection pressure gauge

## 2° - CALIBRATION FEATURES

PF - nominal pressure of the circuit filling

PC - calibration pressure, which identifies the reference isochore

PS1 - setting pressure of the contact PS1, on the temperature of SF<sub>6</sub> gas of 20°C

...and if the contacts are two

PS2 - setting pressure of the contact PS2, on the temperature of SF<sub>6</sub> gas of 20°C

## 3° - DIAL LAYOUT

1° : red sector range

2° : orange sector range

3° : green sector range

## USE

Because of its exceptional properties, the Sulphur Hexafluoride is especially used as electrical insulating in:

- high- voltage switchgears;;
- high-tension switching units;

It can replace the dielectric oils (because of their inflammability) on:

- high-voltage cables;
- heavy-duty transformers;
- hollow frequency for high- technology conductors.

## WHY MONITORING THE SF<sub>6</sub> GAS

The essential material properties of SF<sub>6</sub> gas for such applications depend on the density of SF<sub>6</sub> gas. For example the SF<sub>6</sub> gas during the liquid phase, loses many of its insulating properties. This means that the functional safety of the entire system is strongly dependent on the density of the SF<sub>6</sub> gas which is why it must be monitored.

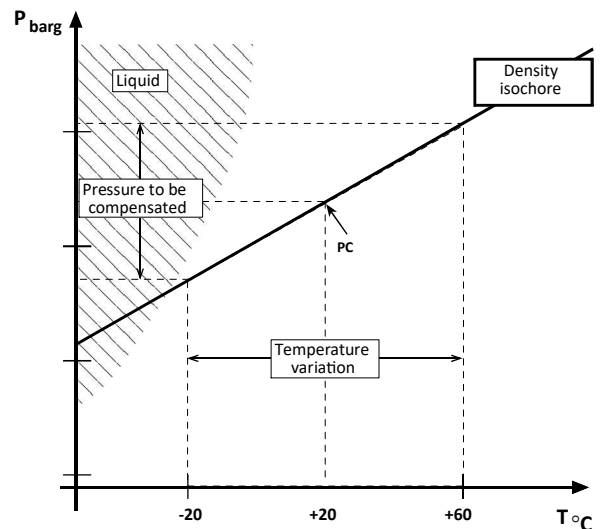
## SF<sub>6</sub> GAS ISOCHORE

In closed gas systems the gas pressure is dependent on the gas temperature. This variation can be represented on a diagram pressure/temperature with lines of equal density called isochores. (Fig.1)

## SF<sub>6</sub> DENSITY MONITORS

In order to work properly, the pressure gauges for SF<sub>6</sub> gas monitoring have to detect the gas temperature as well, and use it to compensate the pressure variations due to the temperature variations. The ordinary pressure gauges with electric contacts are not able to carry out such a compensation so they are not suitable for this

application. These new instruments are especially designed for every single application in order to measure the gas SF<sub>6</sub> density.



## DEFINITION OF ESSENTIAL TERMS

### CALIBRATION TEMPERATURE (reference) - TC

The calibration temperature is the reference temperature required to find the elements required for a correct calibration. The ambient temperature of +20°C is commonly considered as reference temperature.

### AMBIENT TEMPERATURE RANGE -TA

The ambient temperature range is the temperature range within the instruments must compensate the pressure deviations due to SF<sub>6</sub> gas temperature variations.

### FILLING PRESSURE -PF

The filling pressure is the nominal filling pressure of the gas systems closed at the reference temperature (CT) of +20°C. This information is required to dimension correctly the instrument scale range.

## OPERATING CONDITIONS

### TEMPERATURE

The temperature required for compensation is taken inside the instruments. This means that they must be installed so that their ambient temperature corresponds as accurately as possible with that of the SF<sub>6</sub> gas temperature.

### INDICATION AND OPERATION ACCURACY

Every single instrument is adjusted individually at its calibration pressure in order to achieve an accuracy of +1% of the v.f.s. at +20°C.

The compensation adjustment allows to limit the error due to the SF<sub>6</sub> gas temperature variation within +25% of the v.f.s. in the temperature range of -20°...+60°C. (Fig.2).

### CALIBRATION PRESSURE - PC

The calibration pressure defines the reference isochore for temperature compensation. The calibration pressure must be indicated at the calibration temperature (CT) of 20°C.

### CONTACTS SWITCHING POINT (SET) - PS

The switching point defines the adjusted switching pressure of the contact at SF<sub>6</sub> gas temperature +20°C.

### CALIBRATION PRESSURE ISOCHORE - IPC

### PRESSURE SETTING ISOCHORE - IPS

### INDICATION ERROR - PCE

### AVERAGE OPERATING ERROR- PCE and MAXIMUM OPERATING ERROR- PCE MAX

Errors due to the different isochores IPC and IPS at -20°C and +60°C.

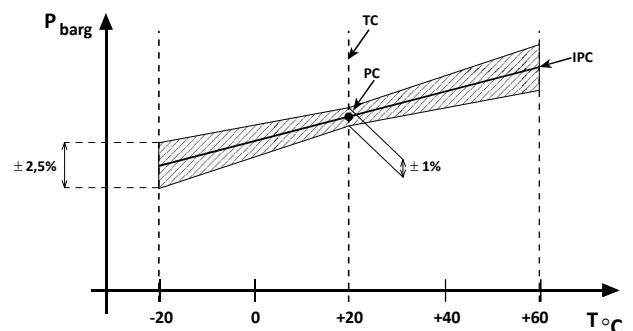


Fig.2

### OPERATING CALIBRATION ISOCHORE

Relevant differences between calibration pressure and operating pressure mean isochores with very different gradients. Since it is possible to calibrate the compensation in one isochore, the calibration pressure must be as close as possible to the operating pressure of the contact switching point. (Fig.3) In this way the isochore related to the operating pressure is included in the compensated maximum errors.

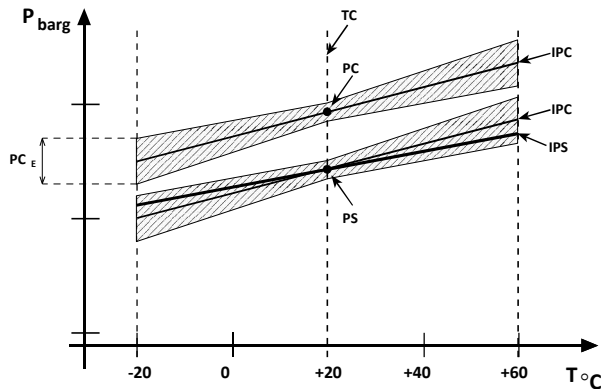


Fig.3

For example if we select a much lower operating pressure than the calibration pressure, we will have to add to the compensation error to the error due to the different gradient of the operating isochore (Fig.4). In this way in case of extreme temperatures (i.s.-20 °C) the indication and the operation would be inaccurate.

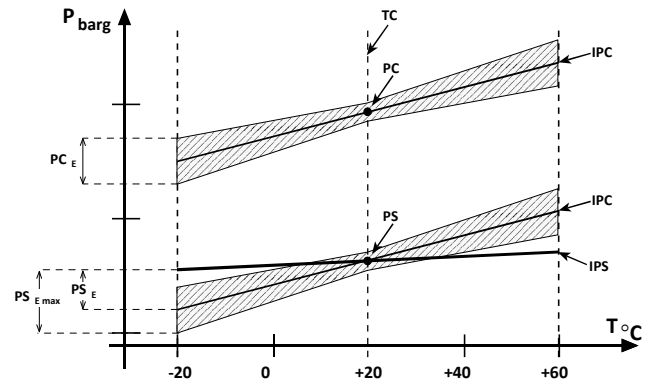


Fig.4

### QUALITY ASSURANCE

All instruments of DRUCK & TEMPERATUR Leitenberger GmbH are designed and produced according to ISO 9001. The SF<sub>6</sub> gas density monitors produced by Leitenberger are individually tested in order to assure perfect working and reliability during measurement time and operation conditions. In order to assure the perfect tightness of the system on which the instrument is mounted, every instrument is checked with a helium mass spectrometer to a max escape rate of 1.10 mbar.l/s<sup>-1</sup>

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### OTHER FEATURES

#### SAFETY

In order to assure safety during operation even in the most heavy conditions (vibrations, impacts..), all electric contacts have magnetic block.

In order to avoid any tampering of the electrical operating adjustment, all contacts are sealed.

#### CALIBRATION

Calibrating these instruments means consider many other aspects such as:

- Bourdon tube thermal drift,
- The compensating bimetal features :

In the hermetically sealed instruments consider also:

- The interaction of the filling liquid depending on its expansion coefficient.
- The interaction of the filling inert gas.

### AVAILABLE MODELS

Beside the main models described below, Leitenberger will be pleased to develop special models on any customer's request.

#### Model 1.M5 for indoor mounting (indoor)

- Wetted parts: copper alloy - Protection degree IP 54 (IEC 529)
- Window: glass

#### Model 1.M6 for outdoor mounting (outdoor)

- Wetted parts st.st. ISI 316L
  - Protection degree P 67 (IEC 529)
  - Window: laminated safety glass- Dielectrical siliconic oil filling- Inert gas filling N<sub>2</sub>)
  - Hermetically sealed box (escape rate 1.10-5mbar)
- This version is hermetically sealed so it is absolutely not sensible to atmospheric pressure deviations.

#### TECHNICAL SPECIFICATIONS

In order to make the customer's choice much easier we created a document containing all the technical aspects, see next page. It will be of great help for choosing your SF<sub>6</sub> Gas Density Monitor.



**DRUCK & TEMPERATUR**  
**Leitenberger GmbH**  
**- GERMANY -**

**TECHNICAL DATA FORM**  
**SF 6**  
**GAS DENSITY MONITORS**

Customer:.....	Equipment:.....
Application:.....	Required q.ty:.....
Note:.....	

<b>MODEL</b>	<input type="checkbox"/> <b>1.M5</b> Brass internals - Indoor mounting	<input type="checkbox"/> <b>1.M6</b> - St.St. AISI 316L internals - Outdoor mounting	<input type="checkbox"/> .....
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<b>CASE FILLING</b>	<input type="checkbox"/> <b>1 -</b> Weather proof IP54 <input type="checkbox"/> .....	<input type="checkbox"/> <b>3 -</b> Oil filled - Ermetically sealed IP 67 <input type="checkbox"/> <b>9 -</b> Nitrogen gas filled - Ermetically sealed IP 67 <input type="checkbox"/> .....	<input type="checkbox"/> ..... <input type="checkbox"/> .....
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<b>MOUNTING</b>	 <input type="checkbox"/> <b>A</b> Stem mounting Bottom connection	 <input type="checkbox"/> <b>C</b> Wall mounting Bottom connection Back flange	 <input type="checkbox"/> <b>E</b> Panel mounting Back connection Front flange	 <input type="checkbox"/> <b>N</b> Stem mounting Nine O'clock connection	 <input type="checkbox"/> <b>T</b> Stem mounting Three O'clock connection
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<b>CABLE CONNECTION</b>	<input type="checkbox"/> <b>CRH - (std)</b> Right Hand <input type="checkbox"/> ..... <input type="checkbox"/> .....	<input type="checkbox"/> <b>CRH - (std)</b> Right Hand (std) <input type="checkbox"/> ..... <input type="checkbox"/> .....	<input type="checkbox"/> <b>CBK -</b> Back Mounting <input type="checkbox"/> ..... <input type="checkbox"/> .....	<input type="checkbox"/> <b>CBK -</b> Back Mounting <input type="checkbox"/> ..... <input type="checkbox"/> .....	<input type="checkbox"/> <b>CBK -</b> Back Mounting <input type="checkbox"/> ..... <input type="checkbox"/> .....
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<b>PROCESS CONN.</b>	<input type="checkbox"/> <b>21M</b> 1/4" BSP Male G 1/4 A PF 1/4	<input type="checkbox"/> <b>31M</b> 3/8" BSP Male G 3/8 A PF 3/8	<input type="checkbox"/> <b>41M</b> 1/2" BSP Male G 1/2 A PF 1/2	<input type="checkbox"/> ..... .....
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<b>PROCESS CONDITIONS</b>	DESCRIPTION	CODE	PROCESS CONDITION	NOTE
	FILLING PRESSURE	PF	..... <input type="checkbox"/> bar <input type="checkbox"/> MPa <input type="checkbox"/> .....	
	CALIBRATION PRESSURE	PC	..... <input type="checkbox"/> bar <input type="checkbox"/> MPa <input type="checkbox"/> .....	
	TEMPERATURE RANGE	TA	<input type="checkbox"/> -20...+60 °C <input type="checkbox"/> .....	
	CALIBRATION TEMPERATURE	TC	<input type="checkbox"/> + 20 °C <input type="checkbox"/> .....	

<b>SWITCHING PRESSURE</b>	SET POINTS	ACTION	PRESSURE DIRECTION	CONTACT TYPE
	PS1=Set point nr. 1=.....	<input type="checkbox"/> Close <input type="checkbox"/> Open	<input type="checkbox"/> Rising <input type="checkbox"/> Falling	<input type="checkbox"/> Inductive <input type="checkbox"/> Non Inductive
	PS2=Set point nr. 2=.....	<input type="checkbox"/> Close <input type="checkbox"/> Open	<input type="checkbox"/> Rising <input type="checkbox"/> Falling	<input type="checkbox"/> Inductive <input type="checkbox"/> Non Inductive
	PS3=Set point nr. 3=.....	<input type="checkbox"/> Close <input type="checkbox"/> Open	<input type="checkbox"/> Rising <input type="checkbox"/> Falling	<input type="checkbox"/> Inductive <input type="checkbox"/> Non Inductive

<b>DIAL INFORMATION</b>	COLORED SECTORS	FROM	TO	NOTE
	<input type="checkbox"/> RED <input type="checkbox"/> .....			
	<input type="checkbox"/> ORANGE <input type="checkbox"/> .....			
	<input type="checkbox"/> GREEN <input type="checkbox"/> .....			
	<input type="checkbox"/> ..... <input type="checkbox"/> .....			

submit filled form to: DT-Export@Leitenberger.de