# Specification
# DPG-Series
# Inclinometer


Version 1.3

# DPG-Series Inclinometer

## Contents

# DPG-Series Inclinometer

# 1 History

| Ver. | Date | Purpose | Author |
|---|---|---|---|
| 0.7 | 2008-04-28 | Creation | R. Gottfried-G. |
| 0.8 | 2009-04-09 | Addenda | M. Zürn |
| 0.9 | 2010-06-17 | Update parameter | M. Zürn |
| 1.0 | 2011-04-28 | Minor changes | F. Schwieger |
| 1.1 | 2011-08-28 | Temperature offset comments added | R. Stonies |
| 1.2 | 2011-12-21 | Add options, layout | M. Zürn |
| 1.3 | 2015-07-06 | Update Chapter 3 point 7 & add. minor changes<br>Update Fig 4.2, Dimensions & Weight | F. Schwieger |

# 2 General Information

The NS-xx/DPG2-RUx is a µC controlled inclinometer for industrial applications. The NS-xx/DPG2 features a measuring range up to ± 30°.

## 2.1 Features

- two inclination sensor cells based on a conductance measurement principle
- electronic excitation and readout of the cell signal
- digital linearization
- temperature compensation
- outputs RS232 & voltage

## 2.2 Type and order codes

Required type of product can be ordered by use of one of the following part numbers:

| Type | Measurement angle | Output | Supply | Order number |
|---|---|---|---|---|
| **NS-5/DPG2-RUD** | +/- 5° | RS232, voltage | +7… 30 VDC | G-NSDPG2-003 |
| **NS-10/DPG2-RUG** | +/-10° | RS232, voltage | +7… 30 VDC | G-NSDPG2-001 |
| **NS-15/DPG2-RUG** | +/-15° | RS232,voltage | +7… 30 VDC | G-NSDPG2-002 |
| **NS-30/DPG2-RUN** | +/-30° | RS232 ,voltage | +7 ... 30VDC | G-NSDPG2-005 |

# 3 Notice

Please observe all proper safety rules and regulations for electrical devices when installing this inclinometer. In addition, the following recommendations are made.

1. Do not apply power to the inclinometer during installation.
2. Avoid applying any mechanical pressure or stress to the housing.
3. Do not operate an inclinometer beyond the maximum angular sensing range or threshold. Irreparable damage may occur.
4. Do not exceed the maximum fastening torque for the mounting screws, as the base plate may become warped and/or irreparably damaged.
5. Use detergents free of alcohol or acid for cleaning of the housing.
6. Avoid direct solar radiation.
7. Recommended tightening torque of cable gland (3±0.5 Nm) should be checked once in a year after purchase to secure IP class of sensor module.
8. Should the inclinometer fail to operate properly, consult this manual for possible solutions. Do not attempt to open the inclinometer, as damage may occur. For other troubleshooting measures, please contact our service team.

# 4 Mechanics and Connections

## 4.1 Mounting

**For operation this inclinometer has to be mounted horizontally (see Fig. 4.1), reference is the base plate.**

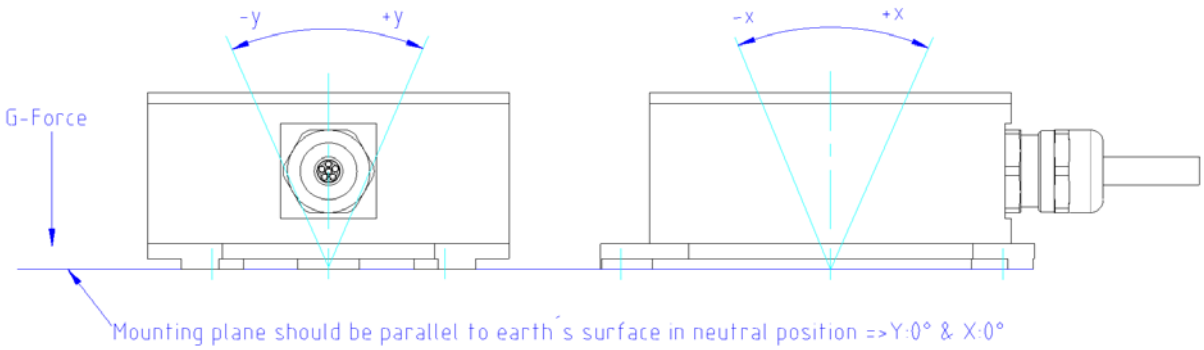



**Fig. 4.1 Mounting position of sensor module & inclination axis**

## 4.2 Mechanical data

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Weight | | | | 270 | | g |
| Dimensions | | W x D x H | | 84 x 70 x 34.2 | | mm |
| Protection class | | | | IP 67 | | |

## 4.3 Dimensions

The mechanical dimensions of the module are shown in Fig.4.2.

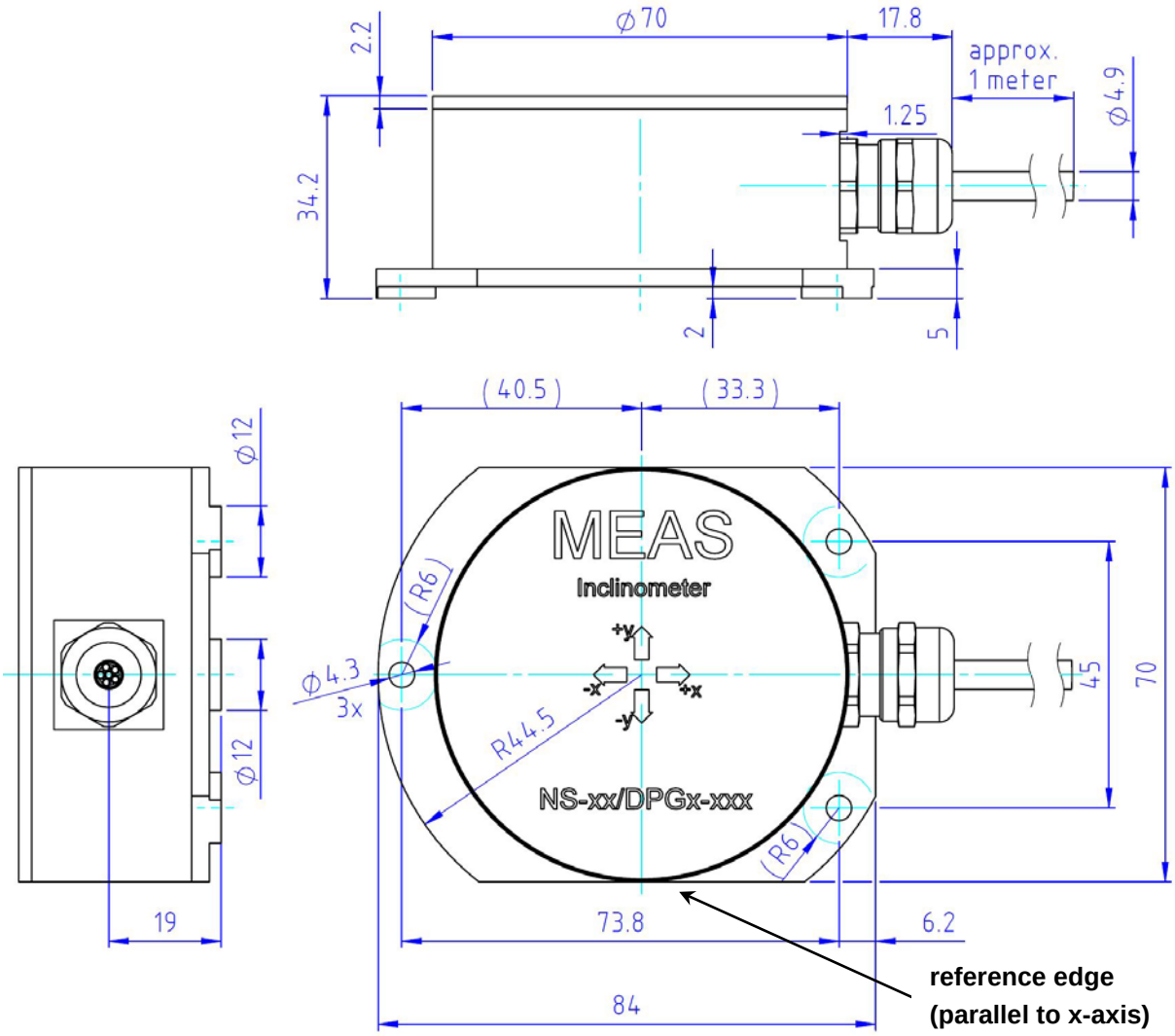
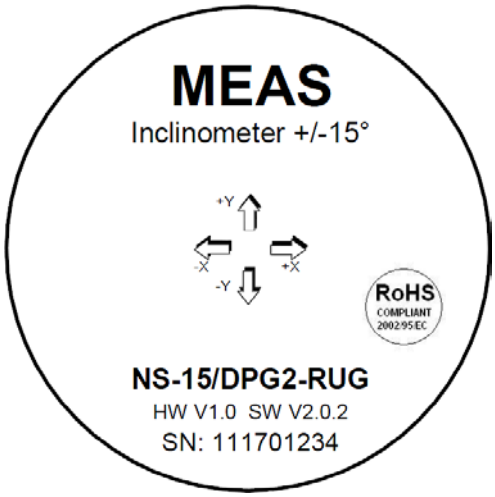



**Fig. 4.2 Top and lateral views with dimensions of the inclinometer with metric cable screw**

## 4.4 Label information




The label placed on top of the module contains the following information:

| | |
|---|---|
| Type Code : | see table in chapter 2.2 |
| HW/SW Code : | internal Hardware/Software-Versions |
| Serial No.: | YYWWNNNNN |

Serial Number consists of nine digits. YY shows the year of production (2011=11), WW the week of the production and NNNNN the unique number for identification and traceability.

## 4.5 Cable and configuration

The inclinometer is delivered with a cable of approximately 1 m length.

| | |
|---|---|
| Type of cable: | LiYCY 6x0,14mm$^2$ |
| Conductor resistance: | 131 Ohm/km |
| Capacity: | 90pF/m at 1kHz |

**Following configuration/cable color scheme is in use:**

| Cable color | Name | Description | Type |
|---|---|---|---|
| White | Vcc | Positive power supply | Supply, Input |
| Yellow | GND | Ground | Supply, Input |
| Brown | Out X | Voltage output X | Output |
| Green | Out Y | Voltage output Y | Output |
| Grey | RxD | RS 232 input | Input |
| Pink | TxD | RS 232 output | Output |

# 5 Absolute Maximum Ratings

CAUTION: Exceeding these values may damage this part!

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | Vcc | Measured versus GND | -0.3 | | +30 | V<br>V |
| Storage temperature | $T_{ST}$ | | -55 | | +85 | °C |
| Operation temperature | $T_a$ | | -40 | | +85 | °C |
| Maximum angle | $\varphi_{max}$ | Don't exceed the maximum rating while module is connected to power supply!<br>Otherwise an irreversible drift can occur! | -10<br>-30<br>-30<br>-60 | 5<br>10<br>15<br>30 | +10<br>+30<br>+30<br>+60 | °<br><br><br> |

## 5.1 Definition of Absolute Maximum Ratings

Absolute maximum ratings are limiting values of permitted operation and should never be exceeded under the worst possible conditions either initially or consequently. If exceeded by even the smallest amount, instantaneous catastrophic failure can occur. And even if the device continues to operate satisfactorily, its life may be considerably shortened. Operation at an absolute maximum rating is permitted (although not desirable even a short test is believed by some to cause incipient failure) but operation at two or more limits (i.e., output current and ambient temperature) almost always means that some other limit has been exceeded (in this instance, probably package power dissipation). In certain ICs that include an internal thermal shutdown, fault conditions will generate higher than permitted (steady-state) temperatures and activate device thermal shutdown circuitry. These fault conditions can be tolerated for short periods of time, but they will affect life expectancy and should be avoided. Except for a maximum output voltage rating (often done as a leakage current test), production testing of the absolute maximum ratings is not usually performed.

# 6 Operating Conditions

| Parameter | Symbol | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Operating Temperature | $T_{op}$ | | | -40 | | +85 | °C |
| Supply Voltage | Vcc | Measured versus GND | | 7 | | 30 | V |
| Operating range | $\varphi_{op}$ | | NS-5/DPG2-RUD<br>NS-10/DPG2-RUG<br>NS-15/DPG2-RUG<br>NS-30/DPG2-RUN | -5<br>-10<br>-15<br>-30 | | +5<br>+10<br>+15<br>+30 | °<br>°<br>°<br>° |
| Displayed range | $\varphi_{disp}$ | | NS-5/DPG-RUD<br>NS-10/DPG2-RUG<br>NS-15/DPG2-RUG<br>NS-30/DPG2-RUN | -5.5<br>-11.5<br>-16.5<br>-32 | | +5.5<br>+11.5<br>+16.5<br>+32 | °<br>°<br>°<br>° |
| Supply Current | Icc | | | | 20 | | mA |

# 7 Sensor Characteristics

## 7.1 Sensor NS-5/DPG2-RUD, Output RS232, voltage

If not otherwise noted, 25°C ambient temperature, 12V supply voltage were applied.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Resolution | Res | | | 0.001 | | ° |
| Accuracy (digital output) (absolute incl. $\varphi_{off,T}$ ) | Accd1<br>Accd2<br>Accd3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | 0.04<br>0.06<br>0.10 | °<br>°<br>° |
| Initial Offset | $\varphi_{off,I}$ | | | ±0.15 | | ° |
| Temperature drift Offset (1) | $\varphi_{off,T}$ | Ta = -25°C … +75°C<br>Ta = -40°C … +85°C | | | 0.05<br>0.10 | °<br>° |
| Accuracy (analogue voltage output) | Acca1<br>Acca2<br>Acca3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | 0.05<br>0.08<br>0.15 | ° |
| Cross sensitivity | CCAx,<br>CCAy | See (2) | | | 1.4 | % |
| Settling time (5° step) | $T_{s90}$<br>$T_{s99}$ | with default filter settings:<br>to 90% (=final value ±0.5°)<br>to 99% (=final value ±0.05°) | | 1.6 | 1<br>2 | s<br>s |
| Noise RMS | | | | 0.001 | 0.002 | ° |
| Output rate digital | | Typ= default settings, other adjustable | 0.5 | 10 | 25 | measure-ments/s |
| Output analog | $V_{xout}$,<br>$V_{yout}$ | Nominal -5° to +5° | 0.5 | | 4.5 | V |
| Output analog | $V_{xout}$,<br>$V_{yout}$ | Including overtravel | 0.3 | | 4.7 | V |

(1) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$
Please note: The offset drift given above is not a relative but an absolute number as the drift is not necessarily a linear function of temperature. In other words: The offset drift specified is the maximum to be observed in the given temperature interval.

(2) CrossSens is defined by:
CCAx=Sensx(Inclinationy)/Sensx(Inclinationx)
CCAy=Sensy(Inclinationx)/Sensy(Inclinationy)

## 7.2 Sensor NS-10/DPG2-RUG, Output RS232, voltage

If not otherwise noted, 25°C ambient temperature, 12V supply voltage were applied.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Resolution | Res | | | 0.001 | | ° |
| Accuracy (digital output) (absolute incl. $\varphi_{off,T}$ ) | Accd1<br>Accd2<br>Accd3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | 0.06<br>0.09<br>0.15 | °<br>°<br>° |
| Initial Offset | $\varphi_{off,I}$ | | | ±0.15 | | ° |
| Temperature drift Offset (3) | $\varphi_{off,T}$ | Ta = -25°C … +75°C<br>Ta = -40°C … +85°C | | | 0.05<br>0.10 | °<br>° |
| Accuracy (analogue voltage output) | Acca1<br>Acca2<br>Acca3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | 0.06<br>0.09<br>0.15 | ° |
| Cross sensitivity | CCAx, CCAy | See (4) | | | 1.4 | % |
| Settling time (5° step) | $T_{s90}$<br>$T_{s99}$ | with default filter settings:<br>to 90% (=final value ±0,5°)<br>to 99% (=final value ±0,05°) | | 1.6 | 1<br>2 | s<br>s |
| Noise RMS | | | | 0.001 | 0.002 | ° |
| Output rate digital | | Typ = default settings, other adjustable | 0.5 | 10 | 25 | measure-ments/s |
| Output analog | $V_{xout}$, $V_{yout}$ | Nominal -10° to +10° | 0.5 | | 4.5 | V |
| Output analog | $V_{xout}$, $V_{yout}$ | Including overtravel | 0.3 | | 4.7 | V |

(3) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$
Please note: The offset drift given above is not a relative but an absolute number as the drift is not necessarily a linear function of temperature. In other words: The offset drift specified is the maximum to be observed in the given temperature interval.

(4) CrossSens is defined by:
CCAx=Sensx(Inclinationy)/Sensx(Inclinationx)
CCAy=Sensy(Inclinationx)/Sensy(Inclinationy)

## 7.3 Sensor NS-15/DPG2-RUG, Output RS232, voltage

If not otherwise noted, 25°C ambient temperature, 12V supply voltage were applied.

| Parameter | Symbol | Conditions | Min | Typ | Max | | Unit |
|---|---|---|---|---|---|---|---|
| Resolution | Res | | 0.001 | | | | ° |
| Accuracy (digital output) (absolute incl. $\varphi_{off,T}$ ) | Accd1<br>Accd2<br>Accd3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | \|φ\|≤10°<br>0.06<br>0.09<br>0.15 | \|φ\|>10°<br>0.17<br>0.20<br>0.25 | °<br>°<br>° |
| Initial Offset | $\varphi_{off,I}$ | | | ±0.15 | | | ° |
| Temperature drift Offset (5) | $\varphi_{off,T}$ | Ta = -25°C … +75°C<br>Ta = -40°C … +85°C | | | 0.05<br>0.10 | | °<br>° |
| Accuracy (analogue voltage output) | Acca1<br>Acca2<br>Acca3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | 0.06<br>0.09<br>0.15 | 0.17<br>0.20<br>0.25 | ° |
| Cross sensitivity | CCAx, CCAy | See (6) | | | 1.4 | | % |
| Settling time (5° step) | $T_{s90}$<br>$T_{s99}$ | with default filter settings:<br>to 90% (=final value ±0,5°)<br>to 99% (=final value ±0,05°) | | 1.6 | 1<br>2 | | s<br>s |
| Noise RMS | | | | 0.001 | 0.002 | | ° |
| Output rate digital | | Typ = default settings, other adjustable | 0.5 | 10 | 25 | | measure-ments/s |
| Output analog | $V_{xout}$, $V_{yout}$ | Nominal -15° to +15° | 0.5 | | 4.5 | | V |
| Output analog | $V_{xout}$, $V_{yout}$ | Including overtravel | 0.3 | | 4.7 | | V |

(5) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$
Please note: The offset drift given above is not a relative but an absolute number as the drift is not necessarily a linear function of temperature. In other words: The offset drift specified is the maximum to be observed in the given temperature interval.

(6) CrossSens is defined by:
CCAx=Sensx(Inclinationy)/Sensx(Inclinationx)
CCAy=Sensy(Inclinationx)/Sensy(Inclinationy)

## 7.4 Sensor NS-30/DPG2-RUN, Output RS232, voltage

If not otherwise noted, 25°C ambient temperature, 12V supply voltage were applied.

| Parameter | Symbol | Conditions | Min | Typ | Max | | Unit |
|---|---|---|---|---|---|---|---|
| Resolution | Res | | | 0.001 | | | ° |
| Accuracy (digital output) (absolute incl. $\varphi_{off,T}$ ) | Accd1<br>Accd2<br>Accd3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | \|φ\|≤10°<br><br>0.06<br>0.09<br>0.15 | \|φ\|>10°<br><br>0.3<br>0.5<br>0.8 | °<br>°<br>° |
| Initial Offset | $\varphi_{off,I}$ | | | ±0.15 | | | ° |
| Temperature drift Offset (7) | $\varphi_{off,T}$ | Ta = -25°C … +75°C<br>Ta = -40°C … +85°C | | | 0.05<br>0.10 | | °<br>° |
| Accuracy (analogue voltage output) | Acca1<br>Acca2<br>Acca3 | $Ta_1$ = +25°C<br>$Ta_2$ = 0°C… +50°C<br>$Ta_3$ = -40°C… +85°C | | | 0.06<br>0.09<br>0.15 | 0.3<br>0.5<br>0.8 | ° |
| Cross sensitivity | CCAx, CCAy | See (8) | | | 1.4 | | % |
| Settling time (5° step) | $T_{s90}$<br>$T_{s99}$ | with default filter settings:<br>to 90% (=final value ±0,5°)<br>to 99% (=final value ±0,05°) | | 2 | 1<br>2 | | s<br>s |
| Noise RMS | | | | 0.002 | 0.005 | | ° |
| Output rate digital | | Typ = default settings, other adjustable | 0.5 | 10 | 25 | | measure-ments/s |
| Output analog | $V_{xout}$, $V_{yout}$ | Nominal -30° to +30° | 0.5 | | 4.5 | | V |
| Output analog | $V_{xout}$, $V_{yout}$ | Including overtravel | 0.3 | | 4.7 | | V |

(7) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$
Please note: The offset drift given above is not a relative but an absolute number as the drift is not necessarily a linear function of temperature. In other words: The offset drift specified is the maximum to be observed in the given temperature interval.

(8) CrossSens is defined by:
CCAx=Sensx(Inclinationy)/Sensx(Inclinationx)
CCAy=Sensy(Inclinationx)/Sensy(Inclinationy)

# 8 Interface

## 8.1 Digital Output RS232

For digital communication, the standardized RS 232-Interface (V24) is used in duplex mode. After startup the sensor transmits the angle values in degrees (°) continuously.

### 8.1.1 Electrical Levels

**RS232:**

| PARAMETER | TEST CONDITIONS | MAX | TYP (†) | MIN | UNIT |
|---|---|---|---|---|---|
| $V_{OH}$ High-level output voltage | $D_{OUT}$ at $R_L$ = 3 kΩ to GND, $D_{IN}$ = GND | | 9 | 5 | V |
| $V_{OL}$ Low-level output voltage | $D_{OUT}$ at $R_L$ = 3 kΩ to GND, $D_{IN}$ = VCC | −5 | −9 | | V |
| $I_{IH}$ High-level input current | $V_I$ = VCC | 200 | 15 | | µA |
| $I_{IL}$ Low-level input current | $V_I$ at 0 V | | −15 | −200 | µA |
| $I_{OS}$ (‡) Short-circuit output current | Vcc = 5.5 V, $V_O$ = 0 V | 60 | ±10 | −60 | mA |
| $Ω_O$ Output resistance | Vcc, V+, and V− = 0 V, $V_O$ = ±2 V | 300 | | | Ω |

(†) TA = 25°C.
(‡) Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and no more than one output

### 8.1.2 Interface parameter for all NS–xx/DPG2–RUx (except NS–30/DPG2-RUN)

Baud rate: 9600 Baud
Format: ASCII, 8 data bits, 1 stop bit, no parity
String length: 22 byte
Layout: < D0 ... D21>
D0 ... D10 = “X=±xx.xxx“, <CR>, <LF>
with D2 = sign (+ or -)
with D5 = point
D11 ... D21 = “Y=±xx.xxx“, <CR>, <LF>
with D13 = sign (+ or -)
with D16 = point

Example:

```
…
X=+00.430
Y=-00.084
…
```

### 8.1.3 Interface parameter for NS–30/DPG2–RUN

Baud rate: 9600 Baud
Format: ASCII, 8 data bits, 1 stop bit, no parity
String length: 20 byte
Layout: < D0 ... D19>
D0 ... D9 = “X=±xx.xx“, <CR>, <LF>
with D2 = sign (+ or -)
with D5 = point
D10 ... D19 = “Y=±xx.xx“, <CR>, <LF>
with D12 = sign (+ or -)
with D15 = point

Example:

```
…
X=+00.43
Y=-00.08
…
```

## 8.2 Programming commands

### 8.2.1 Command Reference user level

Default after power on or software reset.

| Commands in user level | Input | Output | Comment |
|---|---|---|---|
| Stop continuous output of inclination values | "**s**" | "s" | Stops the continuous output of angle results or raw values, required for input of commands, terminated by "S" or Reset or Power On, mode temporary |
| Start continuous output of values | "**S**" | "X=+01.234", CR, LF, "Y=-00.007", CR, LF, "X=……" | Starts the continuous output of angle results or raw values, mode temporary |
| Version and serial number | "**V**" | "DPL2 V1.8.0", CR, LF, "SN:123456789", CR, LF, | Output of SW-Version and serial number, use in stopped mode only |
| Read one value | "**R**" | "X=+01.234", CR, LF, "Y=-00.007", CR, LF, | Output of 1 complete string, 1 x-value and 1 y-value, only in stopped mode |
| Activate setup level | "**f**"<br>"**i**"<br>"**m**"<br>"**a**" | "f"<br>"i"<br>"m"<br>"a" | Activate the setup level, chapter 8.2.2. Setup level can be deactivated by sending "K" or resetting with "q". The controller automatically exits this level after about 10 minutes of user inactivity with a reset. |
| | any other | no reaction | No reaction for commands from setup level |

### 8.2.2 Command Reference SETUP level

Setup level will be used for permanent settings, stored.

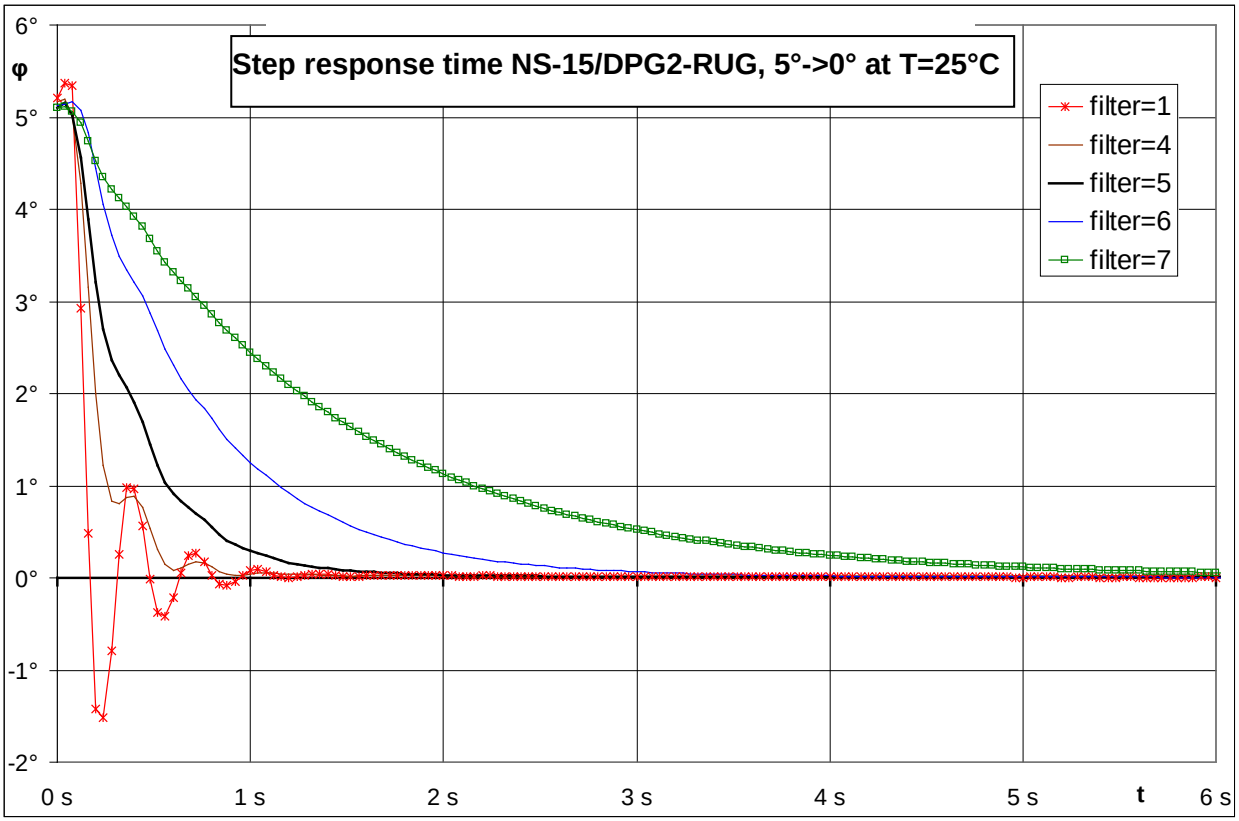
| Commands in setup level | Input | Output | Comment |
|---|---|---|---|
| | | | This level will be terminated (reset) automatically after about 10 minutes of user inactivity. |
| Stop continuous output of inclination values | "**c**" | "c" | Stops the continuous output of angle results or raw values, required for input of commands, terminated by "C", mode permanent,<br>query with " R", see chapter 8.2.1. |
| Start continuous output of values | "**C**" | | Start the continuous output of angle results or raw values,<br>mode permanent, valid after reset. |
| Set zero | "**N**" | "N" | Define 0° position. Offset is stored and used even after reset. |
| Setback zero | "**n**" | "n" | Resets the offset displacement |
| Set lowpass filter | "**M**",<br>**f** | "M",<br>f | Input filter settings with count f = "0"…"7", other characters were answered with "E", see item 1) below. |
| Set output rate | "**O**",<br>**o** | "O",<br>o | Set output rate with count o = "1"..."6", other characters were answered with "E", see item 2) below. |
| Show internal settings | "*****" | "O123 M123", CR, LF<br>"OffX=+00.000<br>OffY=+00.000", CR, LF<br>"Erase Cycl SegF:<br>+00255", CR, LF | "O123": internal setting of output rate in 10ms, "M123": internal filter setting; both values 255 => default settings<br>"Off..": stored Offset values<br>"Erase Cycl Seg…": active Segment and number of erasure procedures for this segment |
| Show currently temperature [°C] | "**T**" | "T= 00.00", CR,LF | Readout the currently temperature in °C. Usable at > software version 2.0.2.<br>Without sign, positive temperature.<br>With sign `- `, negative temperature. |
| Software reset | "**q**" | "q" | Reset the sensor |
| Erase both Info segments,<br>(switch to default settings) | "**E**" | "Seg A deleted" , CR, LF<br>"Seg B deleted" , CR, LF | Erases the info segments of flash storage banks, InfoA and InfoB. This set all changed user values to default settings |
| Forbidden command | "**#**" | "#" | Reserved for factory communication |

1) **Set low pass filter exponential, with count f** =
"0": Out value = current value
"1": Out value = (current value + old out value) /2
"2": Out value = (current value + 3 * old out value) /4
"3": Out value = (current value + 7 * old out value) /8
"4": Out value = (current value + 15 * old out value) /16
**"5": Out value = (current value + 31 * old out value) /32, default**
"6": Out value = (current value + 63 * old out value) /64
"7": Out value = (current value + 127 * old out value) /128
"8"..9: reserved, undefined.
Above calculation was made every 10ms.
For example of time response see chapter 7.2.3: "Step response NS-15/DPG2-RUG"

2) **Set output rate (strings per second, 1 string contains x and y-value) with count o =**
"1": 40ms (==25Hz)
"2": 100ms (==10Hz), default
"3": 250ms (==4Hz),
"4": 500ms (==2Hz)
"5": 1000ms (==1Hz) "6": 2000ms (==0,5Hz)
"0", "7", "8", "9": not defined

### 8.2.3 Step response/filtering NS-15/DPG2-RUG

Step response NS-15/DPG-RUG, fast change from angle 5° to angle 0°, at Ta=25°C
Measured at output rate 25Hz.




For filter settings see command "M" f in chapter 8.2.2

# 9 Qualification Testing

## 9.1 Standards

The sensor NS-xx/DPG2-xxx complies with:

- IEC/EN 60068-2-2 — **High Temperature Storage**
  Ta= 85°C, medium : air, 1000h
- IEC/EN 60068-2-78 — **High Humidity**
  Ta= 85°C , RH= 85%, 1000h
- IEC/EN 60068-2-27 — **Mechanical shock test**
  A=30g, t=11ms, halfsine, 50 cycles per axis
- IEC/EN 60068-2-6 — **Vibration loading**
  10 to 150 Hz, 2.5mm amplitude, 5g const. acceleration,
  1 octave/minute, 20 cycles per axis
- IEC/EN 60068-2-14 — **Thermo shock**
  $T_{High}$=85°C ,$T_{Low}$=-40°C,medium:air-air,$T_{dwell}$: 15min,
  $T_{change}$: 30sec,100 cycles
- IEC/EN 61000-6-2 — **Interference resistance industry**
- IEC/EN 61000-6-4 — **Emitted interference industry**

## 9.2 Periodical Testing

The periodical testing is done every 3 years in terms of a product audit.

## 9.3 Material Testing

All materials used in the process will be released by checking the corresponding supplier certificates when available. A regular material analysis from an independent laboratory will not be scheduled.

# 10 Additional Information

## 10.1 Ordering Information

| NORTH AMERICA | EUROPE | ASIA |
|---|---|---|
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