Specification
DPL-Series
Inclinometer Module

Version 1.9

Specification

DPL-Series Inclinometer

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1.1 History

Ver.	Date	Purpose	Author
0.9	2008-06-06	Creation for NS-15/DPL2-UXG	K.Schink
1.0	2008-08-14	- chapter 7.3: corrections for explanation of filter values 5, 6 and 7 - additional explanation for forbidden commands - drawing competition	K.Schink, M.Zürn
1.1	2008-12-05	Competition/changes DPL-Ux only	M.Zürn
1.2	2009-03-11	Remove forbidden commands	D.Bieschke
1.3	2009-03-17	Forbidden commands implemented (SC): Special characteristic marks included	M. Kalinowski R.Gottfried-G.
1.4	2009-06-22	Additional Information's	M.Zürn
1.5	2009-09-30	Update Parameter	M.Zürn
1.6	2009-10-29	Minor changes	R. Stonies
1.7	2010-06-10	Update programmable parameters	M.Zürn
1.8	2011-08-19	Updated Temperature Drift Offset section	R.Stonies
1.9	2011-12-21	Add options,layout	M.Zürn

2 General Information

The NS-xx/DPL2-xxx is a microcontroller based inclinometer using a biaxial inclination sensor and integrated temperature sensor. It mainly designed for OEM use. All devices are named NSxxDPL2 in succession.

2.1 Functional Description

The digitally controlled inclinometer contains:

- two basic inclination sensor cell based on a conductance measurement principle
- electronic excitation of the cell
- readout of the cell signal
- linearization
- temperature compensation
- interface option A: output 1 via UART/TTL-level interface
- interface option B: output 2 via SPI interface

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2.2 Part Number

These products can be ordered by following part number:

type	range	output	supply	order number
NS-2/DPL2-UXD	- 2°… + 2°	UART (TTL-level)	+5 VDC +/-0.25V	G-NSDPL2-007
NS-2/DPL2-SXD	- 2°… + 2°	SPI	+5 VDC +/-0.25V	G-NSDPL2-021
NS-5/DPL2-UXD	- 5°… + 5°	UART (TTL-level)	+5 VDC +/-0.25V	G-NSDPL2-009
NS-5/DPL2-SXD	- 5°… + 5°	SPI	+5 VDC +/-0.25V	G-NSDPL2-023
NS-10/DPL2-UXG	- 10°… +10°	UART (TTL-level)	+5 VDC +/-0.25V	G-NSDPL2-004
NS-10/DPL2-SXG	- 10°… + 10°	SPI	+5 VDC +/-0.25V	G-NSDPL2-016
NS-15/DPL2-UXG	- 15°… +15°	UART (TTL-level)	+5 VDC +/-0.25V	G-NSDPL2-003
NS-15/DPL2-SXG	- 15°… + 15°	SPI	+5 VDC +/-0.25V	G-NSDPL2-017
NS-30/DPL2-UXN	- 30°… + 30°	UART (TTL-level)	+5 VDC +/-0.25V	G-NSDPL2-011
NS-30/DPL2-SXN	- 30°… + 30°	SPI	+5 VDC +/-0.25V	G-NSDPL2-001

3 Mechanics and Connections

3.1 Mounting

This inclinometer is mounted in parallel to the xy-plane, where the base plate is taken as reference.
To minimize the mechanical offset, please use the `reference edge ´of the board (fig. 3.4).

3.2 Label information

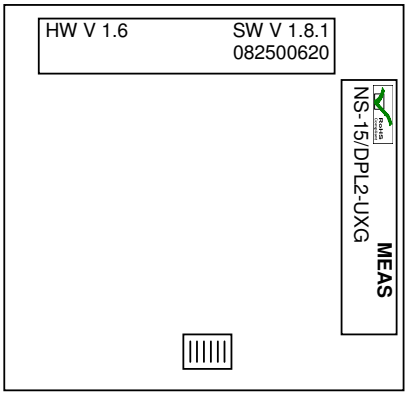

Fig. 3.2: top view, position of cells and labels

Parts will be marked with two labels glued on top of the ceramic sensing elements.
These labels contain the following information:

Model:	NS-xx/DPL2-xxx
MEAS version:	internal HW/SW-Versions
Serial No.:	YYWWNNNNN

YYWWNNNNN consists of nine digits. YY shows the year of production (2008=08), WW the week of the production and NNNNN the number for identifying.

3.3 Mechanical data

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Weight				20	25	g
Dimensions		W x D x H	45 x 45 x 15 (21)			mm

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3.4 Dimensions

The mechanical dimensions of the board are depicted by fig. 3.4.
The board is made of FR4-Epoxy with a thickness of 1.5 +/-0.15 mm.

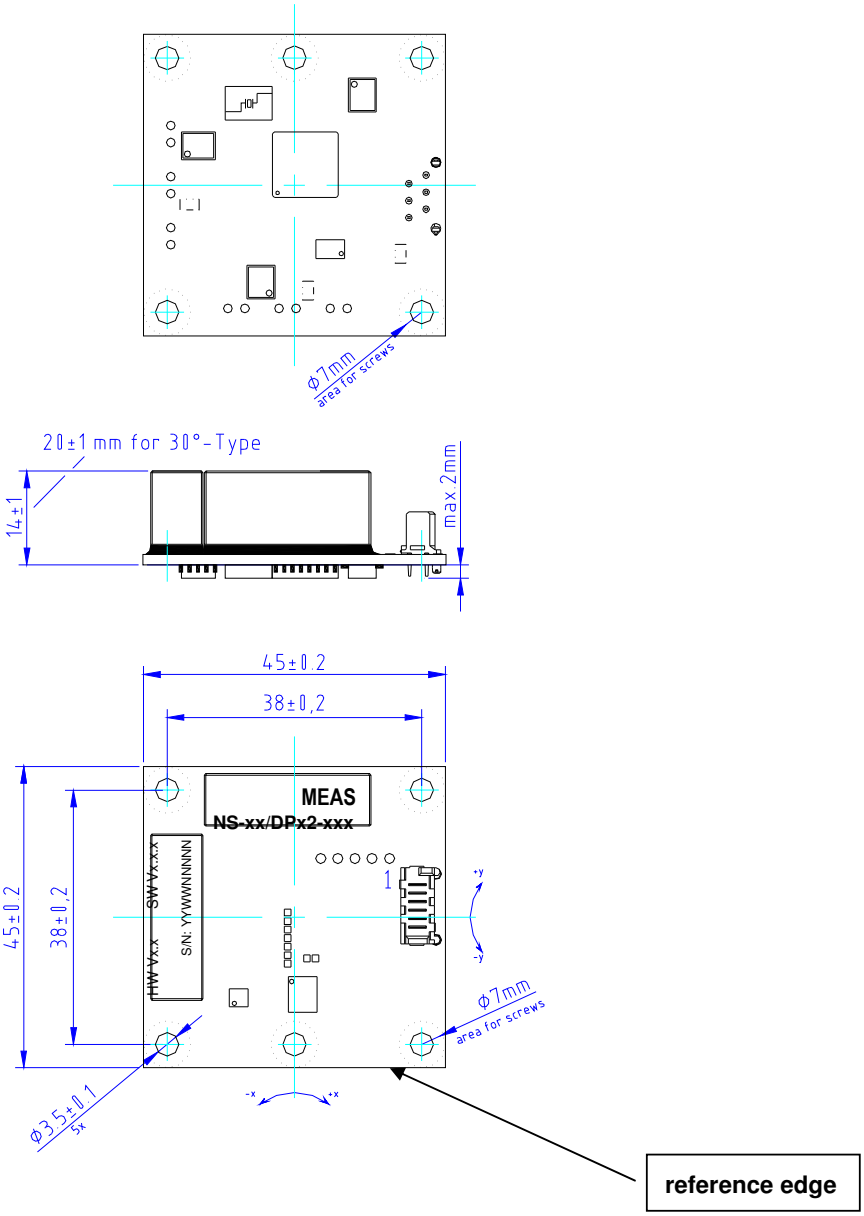

Fig. 3.4 : Top view, cross sectional and bottom view (top-down) of the board including dimensions and placement of the connector

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3.5 Connector

The following connector can be used: Molex, Picoflex PF-50 6-Pin Jack (90325-0006).

3.6 Terminal Connections

3.6.1 Unit with UART interface

	Sensor type NS-xx/DPL2-UXX		
Pin	**Name**	**Description**	**Type**
1	Vcc	Positive power supply	Supply, Input
2	RxD	UART input	Input 1
3	GND	Ground	Supply, Input
4	N.C.	reserved	do not connect
5	N.C.	reserved	do not connect
6	TxD	UART output	Output 1

3.6.2 Unit with SPI interface

	Sensor type NS-xx/DPL2-SXX		
Pin	**Name**	**Description**	**Type**
1	Vcc	Positive power supply	Supply, Input
2	SIMO	SPI data In	Input
3	GND	Ground	Supply, Input
4	CS	Chip Select, low active	Input
5	Clk	Clock, rising edge active	Input
6	SOMI	SPI data Out	Output

4 Absolute Maximum Ratings

CAUTION: Exceeding these values may destroy this part!

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Supply Voltage	Vcc	Measured versus GND	NS-xx/DPL2-xxx	-0.3		+7	V V
Storage temperature	T_{ST}			-55		+85	°C
Operation temperature	T_a			-40		+85	°C
Maximum angle	φ_{max}	Don't exceed the maximum angle during operation (supply voltage applied). Otherwise there is a risk of irreversible drift. Short one-time overshoots (t<30s) do not affect performance.		-10 -10 -30 -30 -60	2 5 10 15 30	+10 +10 +30 +30 +60	°

4.1 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.

5 Operating Conditions

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Ambient Temperature	T_{amb}			-40		+85	°C
Supply Voltage	Vcc	Measured versus GND	NS-xx/DPL2-UXx	4.5		5.5	V
operating range	φ_{op}	Without additional zeroing by the user	NS- 2/DPL2-xxx NS- 5/DPL2-xxx NS-10/DPL2-xxx NS-15/DPL2-xxx NS-30/DPL2-xxx	- 2 - 5 -10 -15 -30		- 2 - 5 -10 -15 -30	°
displayed maximum range	φ_{disp}	Without additional zeroing by the user	NS- 2/DPL2-xxx NS- 5/DPL2-xxx NS-10/DPL2-xxx NS-15/DPL2-xxx NS-30/DPL2-xxx	- 2.2 - 5.5 -11 -16.5 -32		- 2.2 - 5.5 -11 -16.5 -32	°
Supply Current	Icc				7	8	mA

6 Sensor Characteristics

(SC): Special characteristic

6.1 Sensor NS-2/DPL2-UXD, Outputs UART

If not otherwise noted, 25°C ambient temperature, 5V supply voltage applied.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution	Res			0.001		°
Initial offset	$\varphi_{off,I}$	(SC)		+/-0.06		°
Temperature drift offset (1)	$\varphi_{off,T}$	Ta_2 = 0°C…+50°C Ta_3 = -40°C…+85°C		0.03 0.10		° °
Accuracy (absolute incl. $\varphi_{off,T}$)	Acc1 Acc2 Acc3	Ta_1 = +25°C (SC) Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C			0.05 0.08 0.15	° ° °
Cross sensitivity (2)	CCAx, CCAy				1.4	%
Settling time (5° step)	Ts90 Ts99	with default filter settings: to 90% (=final value ±0,5°) to 99% (=final value ±0,05°)		1.6	1 2	s s
Noise RMS				0.001	0.002	°
output rate		typ = default settings, other adjustable	0.5	10	25	1/s

(1) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$

(2) 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.

(3) Cross sensitivity is defined by:
CCAx=Sensx(Inclinationy)/Sensx(Inclinationx)
CCAy=Sensy(Inclinationx)/Sensy(Inclinationy)

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6.2 Sensor NS-5/DPL2-UXD, Outputs UART

If not otherwise noted, 25°C ambient temperature, 5V supply voltage applied.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution	Res			0.001		°
Initial Offset	$\varphi_{off,I}$	(SC)		+/-0.08		°
Temperature drift Offset (3)	$\varphi_{off,T}$	Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C		0.05 0.10		° °
Accuracy (absolute incl. $\varphi_{off,T}$)	Acc1 Acc2 Acc3	Ta_1 = +25°C (SC) Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C			0.05 0.08 0.15	° ° °
Cross sensitivity (4)	CCAx, CCAy				1.4	%
Settling time (5° step)	Ts90 Ts99	with default filter settings: to 90% (=final value ±0,5°) to 99% (=final value ±0,05°)		1.6	1 2	s s
Noise RMS				0.001	0.002	°
output rate		typ = default settings, other adjustable	0.5	10	25	1/s

(4) 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.

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

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6.3 Sensor NS-10/DPL2-UXG, Outputs UART

If not otherwise noted, 25°C ambient temperature, 5V supply voltage applied.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution	Res			0.001		°
Initial Offset	$\varphi_{off,I}$	(SC)		+/-0.08		°
Temperature drift offset (5)	$\varphi_{off,T}$	Ta_2 = 0°C… +50°C Ta_3 = -25°C… +85°C		0.05 0.10		° °
Accuracy (absolute incl. $\varphi_{off,T}$)	Acc1 Acc2 Acc3	Ta_1 = +25°C (SC) Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C			0.06 0.09 0.15	° ° °
Cross sensitivity (6)	CCAx, CCAy				1.4	%
Settling time (5° step)	Ts90 Ts99	with default filter settings: to 90% (=final value ±0,5°) to 99% (=final value ±0,05°)		1.6	1 2	s s
Noise RMS				0.001	0.002	°
output rate		typ = default settings, other adjustable	0.5	10	25	1/s

(6) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$

(7) 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)

6.4 Sensor NS-15/DPL2-UXG, Outputs UART

If not otherwise noted, 25°C ambient temperature, 5V supply voltage applied.

Parameter	Symbol	Conditions	Min	Typ	Max		Unit
Resolution	Res			0.001			°
Initial Offset	$\varphi_{off,I}$	(SC)		+/-0.08			°
Temperature drift Offset (9)	$\varphi_{off,T}$	Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C		0.05 0.10			° °
					|φ| ≤ 10°	**10° < |φ|**	
Accuracy (absolute incl. $\varphi_{off,T}$)	Acc1 Acc2 Acc3	Ta_1 = +25°C (SC) Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C			0.06 0.09 0.15	0.17 0.20 0.25	° ° °
Cross sensitivity (8)	CCAx, CCAy				1.4		%
Settling time (5° step)	Ts90 Ts99	with default filter settings: to 90% (=final value ±0,5°) to 99% (=final value ±0,05°)		1.6	1 2		s s
Noise RMS				0.001	0.002		°
output rate		typ = default settings, other adjustable	0.5	10	25		1/s

(9) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$

(10) 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.

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

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6.5 Sensor NS-30/DPL2-UXN, Outputs UART

If not otherwise noted, 25°C ambient temperature, 5V supply voltage applied.

Parameter	Symbol	Conditions	Min	Typ	Max		Unit
Resolution	Res			0.001			°
Initial Offset	$\varphi_{off,I}$	(SC)		+/-0.08			°
Temperature drift Offset (9)	$\varphi_{off,T}$	Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C		0.1 0.15			° °
					|φ| ≤ 10°	**10° < |φ|**	
Accuracy (absolute incl. $\varphi_{off,T}$)	Acc1 Acc2 Acc3	Ta_1 = +25°C (SC) Ta_2 = 0°C… +50°C Ta_3 = -40°C… +85°C			0.06 0.09 0.15	0.3 0.5 0.8	° ° °
Cross sensitivity (10)	CCAx, CCAy				1.4		%
Settling time (5° step)	Ts90 Ts99	with default filter settings: to 90% (=final value ±0,5°) to 99% (=final value ±0,05°)		2	1 2		s s
Noise RMS				0.002	0.005		°
output rate		typ = default settings, other adjustable	0.5	10	25		1/s

(12) Temperature drift offset is defined in general by:
$\varphi_{off,T} = \varphi_{off}(T_a) - \varphi_{off}(25°C)$

(13) 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.

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

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6.5.1 Step response/filtering NS-15/DPL2-UXG

Step response NS-15/DPL2-UXG, fast change from angle 5° to angle 0°, at Ta=25°C
Measured at output rate 25Hz*.

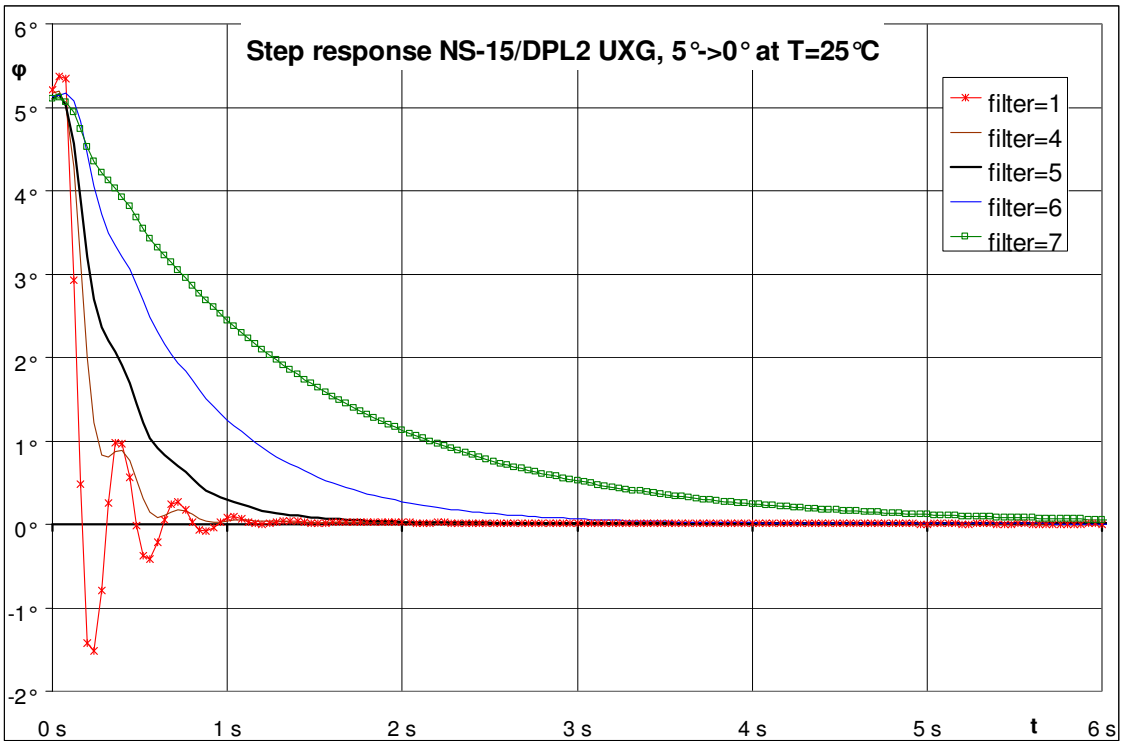

Fig. 6.5.1: step response of NS-15/DPL2 UXG, 5° -> 0° @ Ta=25°C

*For filter settings see command “M” f in chapter 7.1.4 “Command reference setup level”

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7 Interface

The NS-xx/DPL2 is available with UART, RS232 and SPI interface.

7.1 UART / RS232

A standardized UART/RS232 interface is used in duplex mode.
UART output uses inverted CMOS/TTL levels.
After startup the sensor transmits the angle values in degrees (°) continuously.

7.1.1 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

7.1.2 Interface parameter for NS–xx/DPL2–Uxx and NS–xx/DPL2–Rxx

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 -), D5 = decimal point
D11 ... D21 = “Y=±xx.xxx“, <CR>, <LF> with D13= sign (+ or -), D16 = decimal point

Example:

```
…
X=+00.430
Y=-00.084
…
```

7.1.3 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**” “**i**” “**m**” “**a**”	“f” “i” “m” “a”	Activate the setup level, chapter 7.1.4. 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

7.1.4 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, query with “R”, see chapter 7.1.3.
Start continuous output of values	“**C**”		Starts the continuous output of angle results or raw values, 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 low pass filter	“**M**”, **f**	“M”, f	Input filter settings with count f = “0”...”7”, other characters were answered with “E”, see item 1) below.
Set output rate	“**O**”, **o**	“O”, o	Set Output rate with count o = “1”...”6”, other characters were answered with “E”, see item 2) below.

Commands in *setup* level	**Input**	**Output**	**Comment**
Show internal settings	"*"	"O123 M123", CR, LF "OffX=+00.000 OffY=+00.000", CR, LF "Erase Cycl SegF: +00255", CR, LF	"O123": internal setting of output rate in 10ms, "M123": internal filter setting; both values 255 => default settings "Off..": stored Offset values "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. Without sign, positive temperature. With sign `- `, negative temperature.
Software reset	"**q**"	"q"	Reset the sensor
Erase both Info segments, (switch to default settings)	"**E**"	"Seg A deleted" , CR, LF "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 6.5.1: "Step response NS-15/DPL2-UXG"

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

7.2 SPI

Interface parameter for NS–xx/DPL2–Sxx, supply voltage 5.0V:
Baud rate: max. 125 kBaud

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	5V		4.5	V
V_{OL} Low-level output voltage	D_{OUT} at R_L = 3 kΩ to GND, D_{IN} = VCC	0.8		0	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	–20 0	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

7.2.1 Command Reference USER LEVEL

At this level the system starts. It is allowed to read tilt and temperature values.

Instruction	Byte	SIMO (to the sensor)	SOMI (from the sensor)	explanation
Read serial number	1 2 3 4 5	03H 00H 00H 00H… 00H … 00H 00H	FFH FFH 03H first character, second character … 7th character, FFH	Send serial number i “ASCII” format
Read inclination	1 2 3 4 5 6 7 8	06H 00H 00H 00H 00H 00H 00H 00H	FFH FFH 06H MSB X-axis LSB X-axis MSB Y-axis LSB X-axis FFH	Value in m° as signed integer, MSB first, with 8000H = negative overflow 7FFFH = positive overflow C568H = -15000 => -15° 0000H = 0 => 0° 3A99H = +15001 => +15.001°
Read Temperature	1 2 3 4 5 6	10H 00H 00H 00H 00H 00H	FFH, FFH, 10H, MSB Temperature, LSB Temperature, FFH	Output of actual temperature in tenth of degrees. Example for valid value: 0135H = 309 => 30.9°C
Setup Level	1 2 3 4 5 6	66H 69H 6DH 61H 00H 00H	FFH FFH 66H 69H 6DH 61H	Activate setup level

7.2.2 Command Reference SETUP LEVEL

This level will be terminated automatically after about 10 minutes of user inactivity with a reset.

Instruction	Byte	SIMO (to the sensor)	SOMI (from the sensor)	explanation
Set offset	1 2 3 4 5	01H 00H 00H 00H 00H	FFH FFH 01H (00H) FFH	Define 0° position. Offset is stored and used even after reset.
Reset offset	1 2 3 4 5	02H 00H 00H 00H 00H	FFH FFH 02H (00H) FFH	Set the offset angle to factory value.
RESET	1	AAH 00H 00H	FFH FFH AAH … FFH	Reset the system and return to command level.
Read Filter parameter	1 2 3 4 5	20H 00H 00H 00H 00H	FFH, FFH, 20H, Filter Parameter, FFH	Read parameter 01H…07H. Factory setting: 05H.
Set Filter parameter	1 2 3 4 5	21H xxH Delay > 150 ms 00H 00H 00H	FFH, FFH, 21H, Filter Parameter, FFH	Set parameter 01HH…07H. Factory setting: 05H.

8 Test Requirements

8.1 100% Series Test

100% of delivered parts are measured at 31 inclinations each (x-axis and y-axis) in order to determine corresponding values for Acc1, CCAx and CCAy at a distinct temperature in the range of 18°C to 30°C.

8.2 Statistical Test

Four (two) parts of each fabrication lot between 51 and 160 (1 and 50) are tested at five temperatures:
-25°C, 0°C, 25°C, 50°C, 85°C

Measured, respectively calculated and checked are:
$T\varphi_{off}$, Acc2, Acc3

9 Qualification Testing

9.1 Standards

The sensor NS-xx/DPL(N)2-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

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 EMC

Due to the use of these modules for OEM application no CE declaration is done.

Especially line coupled disturbances like surge, burst, r.f. etc. cannot be removed by the module due to the small board area and low price feature. There is no protection circuit against reverse polarity or over voltage implemented.

The module will be designed using capacitors for blocking and ground plane areas in order to prevent wireless coupled disturbances as good as possible.

11 Additional Information

The information in this sheet has been carefully reviewed and is believed to be accurate; however, no responsibility is assumed for inaccuracies. Furthermore, this information does not convey to the purchaser of such devices any license under the patent rights to the manufacturer. Measurement Specialties, Inc. reserves the right to make changes without further notice to any product herein. Measurement Specialties, Inc. makes no warranty, representation or guarantee regarding the suitability of its product for any particular purpose, nor does Measurement Specialties, Inc. assume any liability arising out of the application or use of any product or circuit and specifically disclaims any and all liability, including without limitation consequential or incidental damages. Typical parameters can and do vary in different applications. All operating parameters must be validated for each customer application by customer's technical experts. Measurement Specialties, Inc. does not convey any license under its patent rights nor the rights of others.

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