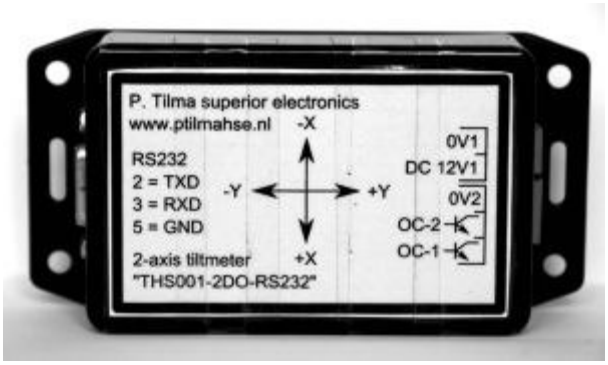
Manual

Two axis inclinometer TILT001-2DO-RS232



Features :

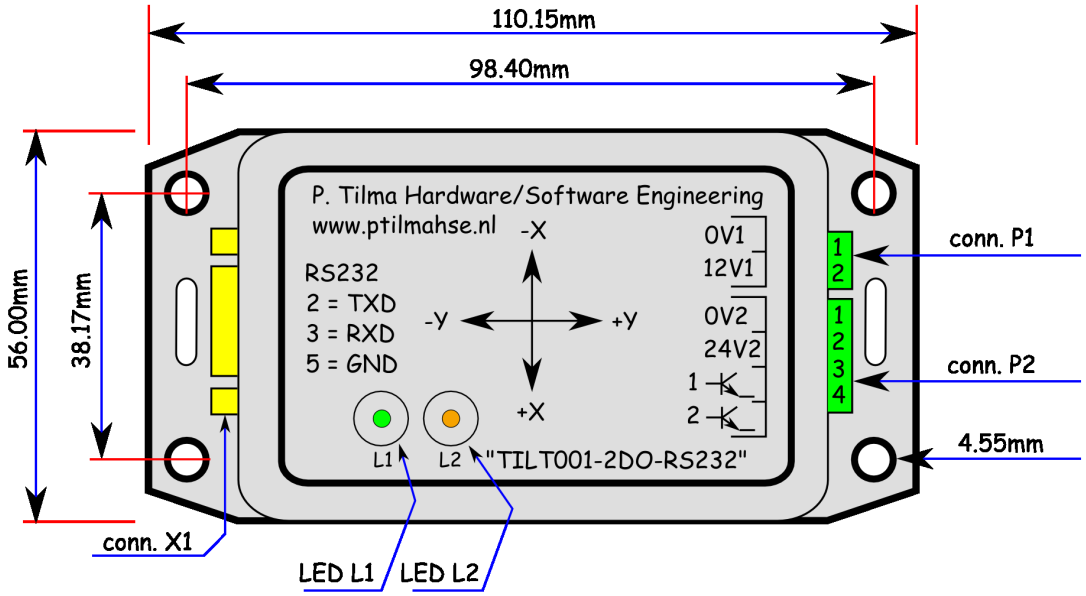
- Two-axis inclination measurement
- Isolated RS232 interface.
- Two isolated outputs.
- Alarm conditions configurable.
- Temperature compensated.
- Desktop software.

Section 1 - **Contents**

Section 2 - **General description :**

The TILT001-2DO-RS232 is a low cost two axis intelligent inclinometer. Sensor and electronics are housed in an enclosure which can be easily mounted. Communication with the device is possible by means of an optoisolated RS232 interface. Commands are implemented to perform calibration, change operational mode or request measurements for inclination and acceleration. Desktop software is included for configuration and testing. The module is equipped with two configurable optoisolated digital outputs.

Section 3 - **Dimensions and connections.**



Connector X1 - DSUB 9 Female	Signal name	Description
Pin 2	TXD	RS232 transmit data
Pin 3	RXD	RS232 receive data
Pin 5	GND	RS232 return

Connector P1	Signal name	Description
Pin 1	0V1	Power supply return
Pin 2	12V1	Power supply 12V

Connector P2	Signal name	Description
Pin 1	0V2	Output supply return
Pin 2	24V2	Output supply
Pin 3	Output 1	High side power switch
Pin 4	Output 2	High side power switch

Section 4 - **Technical specifications :**

Electrical	Operating conditions	Max. ratings
Supply voltage	5..13V	
Supply current	60mA	
Digital outputs (2)	24V	200mA

Mechanical	
Enclosure dimension (length x width x height)	110mm x 56mm x 25mm
Enclosure material	ABS plastic
Enclosure mounting holes	
Connector RS232	DSUB 9 female
Connector power supply	Phoenix MC1,5/2-G-3,81
Connector digital outputs	Phoenix MC1,5/4-G-3,81

Environmental	
Operating temperature	-20°C .. +20°C
Humidity	
Protection	

Measurement	
Number of axes	2
Range per axis inclination / acceleration	70° / 1000mg
Inclination resolution / accuracy	0.1° / 0.2°
Acceleration resolution/ accuracy	1 mg / 5mg
Temperature compensated	Yes

Software	
RS232 communication parameters	9600 baud, 8 databits, 2 stopbits, no parity
Communication protocol	ASCII commands (see table)
Desktop application	Windows/x86

Section 5 - **Communication protocol.**

ASCII commands are implemented to request measurements for inclination and acceleration, perform calibration and change operational mode. The supplied PC application program makes use of these different commands.

Test	Description	Answer
<cr>	Software version	softw,0105<crlf>
toggleOut1<cr>	Toggle digital output 1	
toggleOut2<cr>	Toggle digital output 2	
toggleL1Led<cr>	Toggle led L1	
toggleL2Led<cr>	Toggle led L2	
toggleBoardLed<cr>	Toggle onboard led	

Measurement	Description	Answer
getAccel<cr>	Acceleration values for Xaxis and Y-axis	accelX,300<crlf> accelY,-600<crlf>
repAccelOn<cr>	Acceleration values for Xaxis and Y-axis continously.	
repAccelOff<cr>	Repeat function off for accelleration	
getIncl<cr>	Inclination values for Xaxis and Y-axis	inclX,-15<crlf> inclY, 3<crlf>
repInclOn<cr>	Inclination values for Xaxis and Y-axis continously.	
repInclOff<cr>	Repeat function off for inclination	
getTemp<cr>	Onboard temperature	temp,-155<crlf>
getDutyXaxis<cr>	Duty cycle X axis (* 1000)	dutyXaxis,40000<crlf>
getDutyYaxis<cr>	Duty cycle Y axis (* 1000)	dutyYaxis,60000<crlf>
getRate<cr>	Update rate per second	rate,7<crlf>
setFilter, 50<cr>	Filter property	
getFilter<cr>		filter,50<crlf>

Initialisation	Description	Answer
initAllNv<cr>	Set calibration and alarm variables to default	
initCalNv<cr>	Set calibration variables to default	
initAlarmNv<cr>	Set alarm variables to default	

Calibration	Description	Answer
setCalXH<cr>	Set calibration value for X-axis horizontal	
setCalXMinV<cr>	Set calibration value for X-axis vertical (-1g)	
setCalXPlusV<cr>	Set calibration value for X-axis vertical (+1g)	
getCalXH<cr>	Get calibration value for X-axis horizontal	calXH,50000<crlf>
getCalXMinV<cr>	Get calibration value for X-axis vertical (-1g)	calXMinH,30000<crlf>
getCalXPlusV<cr>	Get calibration value for X-axis vertical (+1g)	calXPlusH,-30000<crlf>
setCalYH<cr>	Set calibration value for Y-axis horizontal	
setCalYMinV<cr>	Set calibration value for Y-axis vertical (-1g)	
setCalYPlusV<cr>	Set calibration value for Y-axis vertical (+1g)	
getCalYH<cr>	Get calibration value for Y-axis horizontal	calYH,50000<crlf>
getCalYMinV<cr>	Get calibration value for Y-axis vertical (-1g)	calYMinH,30000<crlf>
getCalYPlusV<cr>	Get calibration value for Y-axis vertical (+1g)	calYPlusH,30000<crlf>

Alarm configuration	Description	Answer
setInclLowX,-15<cr>	set inclination alarm low value X axis	
setInclHighX,5<cr>	set inclination alarm high value X axis	
getInclLowX<cr>	get inclination alarm low value X axis	inclLowX,-15<crlf>
getInclHighX<cr>	get inclination alarm high value X axis	inclHighX,5<crlf>
setInclLowY,4<cr>	set inclination alarm low value Y axis	
setInclHighY,20<cr>	set inclination alarm high value Y axis	
getInclLowY<cr>	get inclination alarm low value Y axis	inclLowY,4<crlf>
getInclHighY<cr>	get inclination alarm high value Y axis	inclHighY,20<crlf>
setAccelChangeX,250<cr>	set max. acceleration change value X axis	
getAccelChangeX<cr>	get max. acceleration change value X axis	accelChangeX,250<crlf>
setAccelChangeY,40<cr>	set max. acceleration change value Y axis	
getAccelChangeY<cr>	get max. acceleration change value Y axis	accelChangeY,40<crlf>

Alarm configuration (cont.)	Description	Answer
setAlarmAss,FFFFFFFF<cr>	assignment of alarms tooutputs (hexadecimal format, see table below)	
getAlarmAss<cr>		alarmAss,FFFFFFFF<crlf>
setHyst,50<cr>	hysteresis inclination alarm (1/10th of degree)	
getHyst<cr>		hyst,50<crlf>
setOutputConf, FFFFFFFF<cr>	behaviour outputs (hexadecimal format, see tabel below)	
getOutputConf<cr>		outputConf, FFFFFFFF<crlf>

Bit assignment command "setAlarmAss".

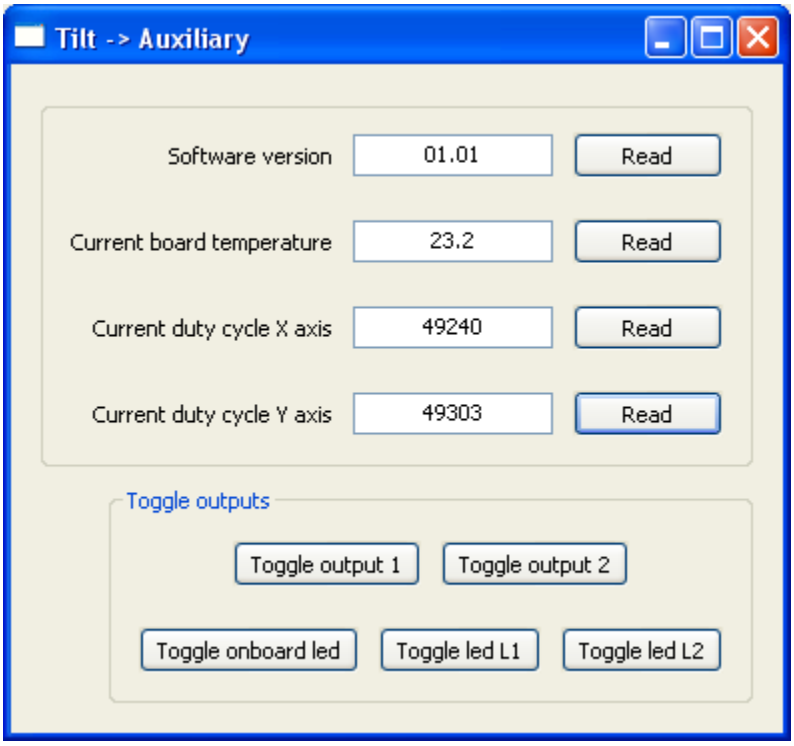
	Output 1	Output 2	L1 (led)	L2 (led)	RS232
Vibration X axis	bit 31	bit 30	bit 29	bit 28	bit 27
Vibration Y axis	bit 23	bit 22	bit 21	bit 20	bit 19
Inclination X-axis	bit 15	bit 14	bit 13	bit 12	bit 11
Inclination Y-axis	bit 7	bit 6	bit 5	bit 4	bit 3

Bit assignment command "setOutputConf"

	Polarity	Freeze	Pattern
Output 1	bit 15	bit 14	bit 13
Output 2	bit 11	bit 10	bit 9
L1 (led)	bit 7	bit 6	bit 5
L2 (led)	bit 3	bit 2	bit 1

Section 6 - **Temperature compensation.**

The output of the tilt sensing element inside the TILT001-2DO-RS232 is not entirely independant of temperature. Especially in the case of large temperature differences this effect might influence accuracy. Thats why hardware and software have been implemented to compensate for this effect.

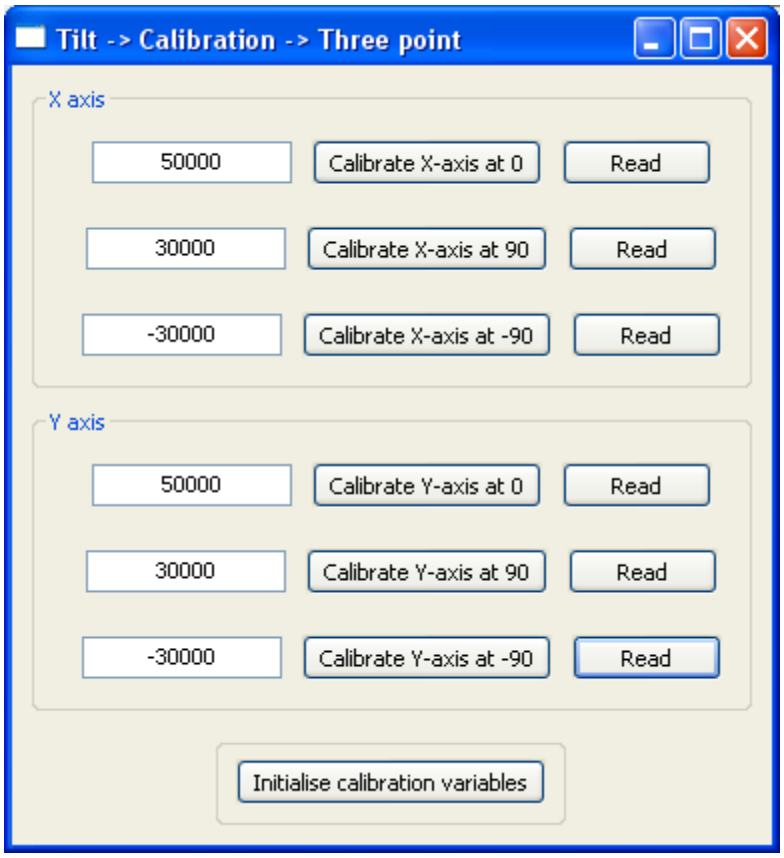


Read current board temperature

Section 7 - **Calibration.**
In menu "Tilt-> Calibration->Three point" you can calibrate the TILT001-2DO-RS232. The procedure is as follows :

Locate the sensor in such a way that the X-axis is parallel to the earth's surface. Press button "Calibrate X-axis at 0".
Locate the sensor in such a way that the X-axis is perpendicular to the earth's surface. Press button "Calibrate X-axis at 90".
Rotate the sensor 180 so that the X-axis is again perpendicular to the earth's surface. Then press button "Calibrate X-axis at -90".

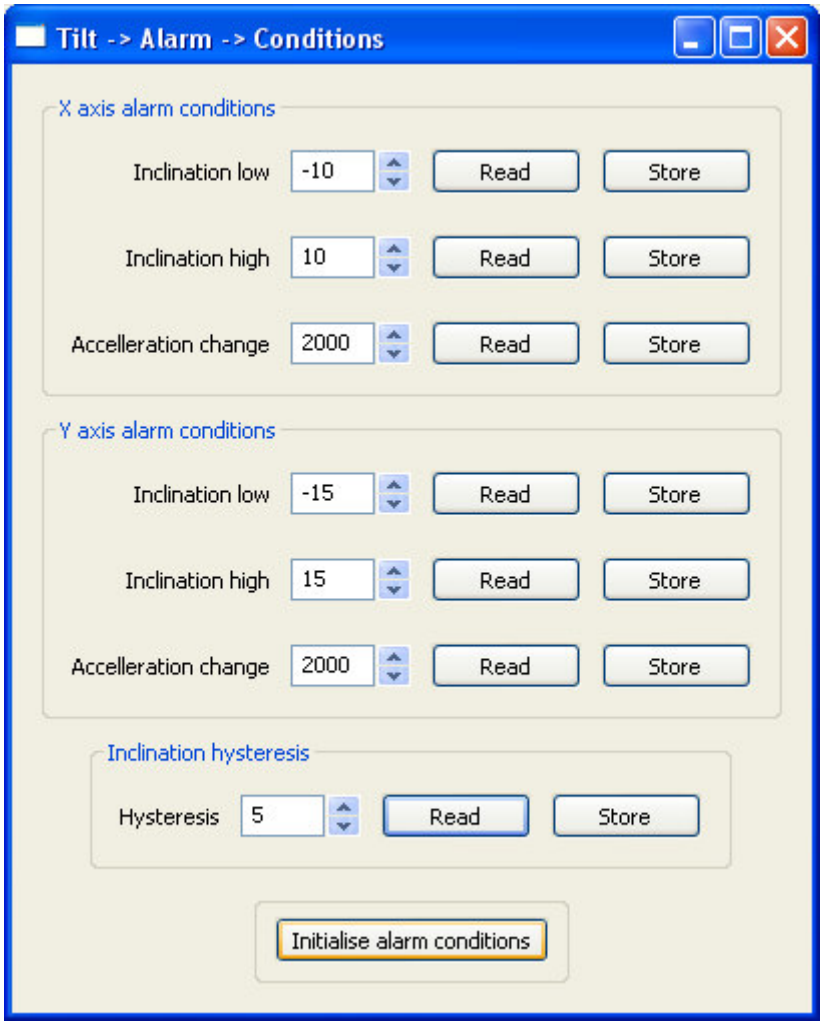
The calibration procedure for the y-axis goes in exactly the same way.



Calibration

Section 8 - **Alarm conditions.**

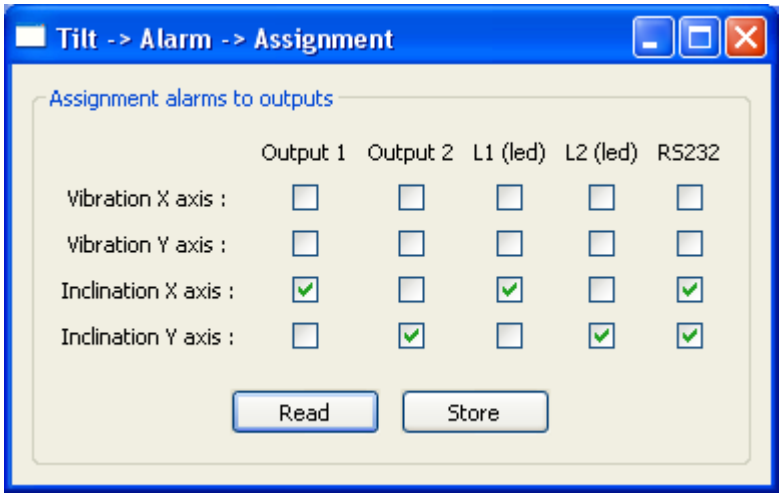
In menu "Tilt->Alarm->Conditions" inclination limits for the X-axis and Y-axis can be set. If the current X-axis or Y-axis inclination exceeds these limitvalues an inclination alarm will be generated.
In the same menu acceleration limits for the X-axis and Y-axis can be set. If the change in X-axis acceleration or Y-axis acceleration exceeds these limitvalues an acceleration alarm will be generated.
To prevent continuously switching at a critical point an hysteresis procedure has been implemented. The hysteresis value can be changed.



Setting alarmconditions

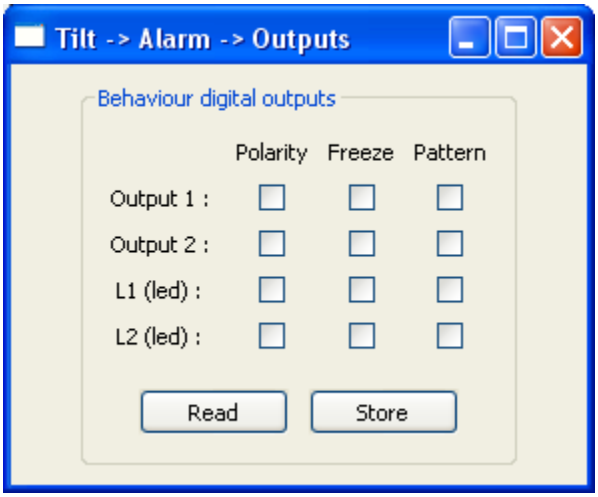
Section 9 - **Alarm assignment.**

Four possible alarmevents can be directed to 5 physical outputs. In menu "Tilt->Alarm->Assignment" you can specify how this redirection takes place. Not all possible combinations are allowed.

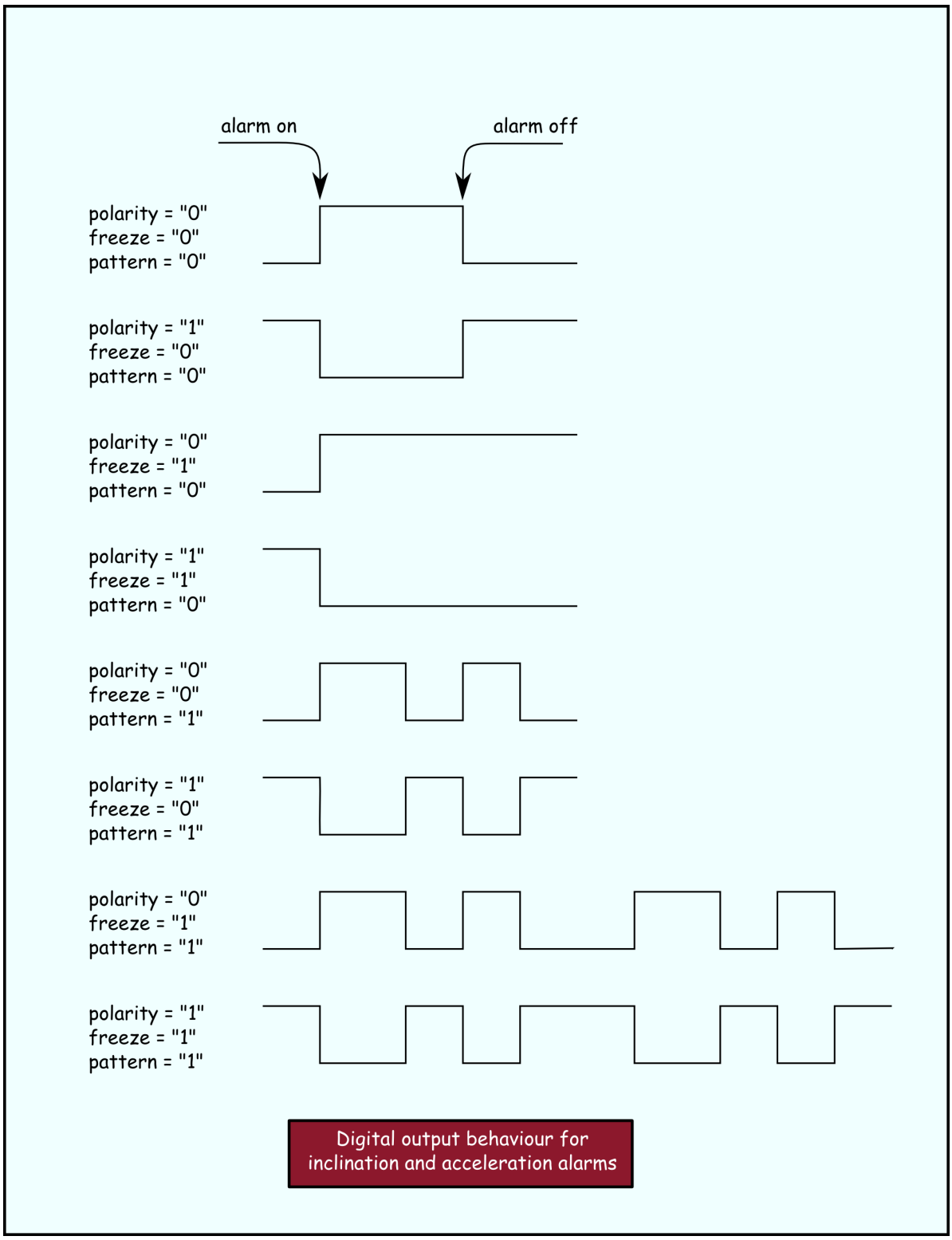


Assignment alarmevents to physical outputs

Section 10 - **Output configuration.**
Three properties determine the behaviour of each output.
Polarity : voltage level of the output will be inverted.
Freeze : if an alarmevent takes place the output will switch, and will stay in that state even if there is no alarm anymore.
Pattern : an on/off sequence will be send to the output (e.g. buzzer).



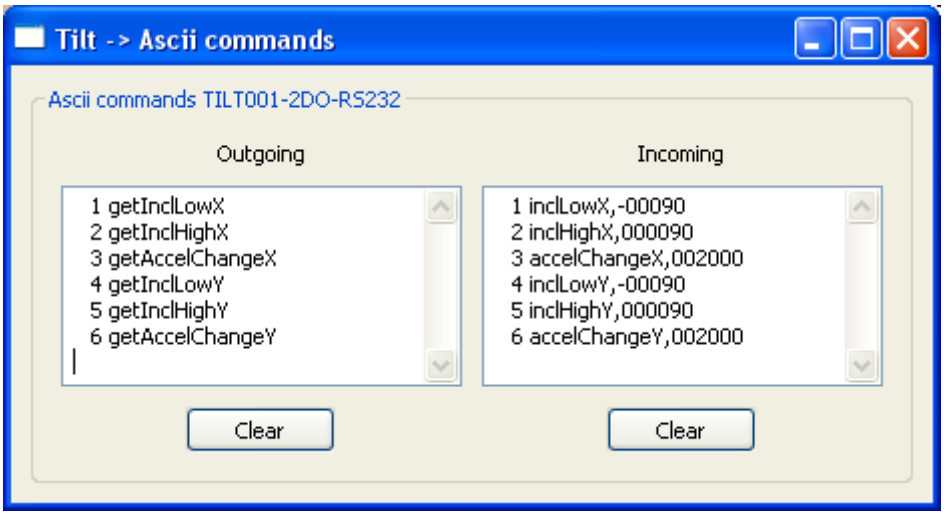
Properties physical outputs



Digital output behaviour for inclination and acceleration alarms

Section 11 - **More PC application screenshots.**

Inclination display in big format.



Underlying ASCII commands

Section 12 - **Package contents.**

Items	Description
1	box with electronics and sensor
2	serial cable (1 to 1, subd 9, male, female)
3	2 pole plug (phoenix MC1,5/2-ST-3,81)
4	4 pole plug (phoenix MC1,5/4-ST-3,81)

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