iOLFOG-D, iOLFOG-S-D
iMGYR-x-D

Single Axis Fiber Optical Gyro or MEMS Gyro
with Digital CAN/RS232 Interface
and optional Analog Interface

- Communication Interface Control Document -

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Document History

RevNo	Changes	Date
2.4	CAN trigger included	04.02.2008
2.5	Description of error/status byte included	17.03.2008
2.7	Temperature model for MGYR-B included	28.05.2008
2.8	PGND clarified on connector	20.06.2008

1 Introduction

The iOLFOG-S-D is a ruggedized fiber optical gyro for harsh environment with high bandwidh, digital output via RS232 and CAN and mounted in a very ruggedized housing. It is recommended for advanced applications in stabilisation, navigation and pointing tasks. The gyro can also be used as a replacement of rate gyros or rate integrating gyros, the output is available in for rate mode and angle mode. As an option the angular rate can be output as an analog signal (0...5 V).

The iMGYR-x-D is a MEMS gyro providing the same interface as the iOLFOG-x-D gyro. In the following mainly the iOLFOG-x-D is described, but it is valid accordingly for the iMGYR-x-D.

The gyro can be delivered in several configurations regarding to bandwidth, range of angular range, resolution, linearity and temperature stability.

The iOLFOG-S-D consists of three parts:

1. Power conditioning with a wide range of supply voltage (7...20 V or customer specific). The internal power supply is not isolated in the standard configuration.
2. Fiber optical gyro (FOG) in open-loop technology with a high resolution analog interface for angular rate and temperature.
3. Micro-processor board with high resolution analog-to-digital converter for gyro signal digitisation, temperature modelling, build-in-test equipment, CAN interface for high speed data output, RS232 interface for system configuration and low rate data output, firmware upload and factory calibration.

The gyro comes in a robust aluminum housing with size 100x100x80 mm. For higher quantitiy enquiries the iOLFOG-S-D can also be delivered in a customer specific enclosure. It is operated from one single power (7...20 V) [option: 10…34 V DC].

As an option the iOLFOG-S-D can be delivered with an additional analog output (0...5 V, 16 bit).

An incremental encoder input (odometer input) is available as an option to measure the speed of a vehicle (e.g. to perform a dead-reckoning).

The technical data can be found in the corresponding data sheets.

2 Pinout

The industrial iOLFOG-S-D has a 15 pin SubD15 connector (male) to connect all interfaces. It can also be delivered in the military version with a connector of Type MIL-C-38999-III (22 pin).

The pinout is as follows:

DSub-15 15 pin (male)

- Pin 1: Analog Signal GYRO-DAC16 (0V bis +5V, 16 Bit)
- Pin 2: Not used (BSL -> Factory only)
- Pin 3: ERR/TRIG-OUT (CMOS)
- Pin 4: GND
- Pin 5: VIN (+7V bis +20V power supply)
- Pin 6: Don't use (Factory only)
- Pin 7: AGND (only if the analog output is equipped [option])
- Pin 8: PGND (Power GND, to be used for power supply)
- Pin 9: Not used (Factory only)
- Pin 10: CAN High
- Pin 11: CAN Low
- Pin 12: RXD (RS232)
- Pin 13: TXD (RS232)
- Pin 14: GND
- Pin 15: TRIG-IN (CMOS)

24WC35PN MIL38999 22 pin (male)

- Pin 1: Analog Signal GYRO-DAC16 (0V bis +5V, 16 Bit)
- Pin 2: ENC Z+ (Inremental-Encoder, RS422)
- Pin 3: Not used (BSL -> Factory only)
- Pin 4: CAN High
- Pin 5: ERR/TRIG-OUT (CMOS)
- Pin 6: CAN Low
- Pin 7: PGND (Power GND, to be used for power supply)
- Pin 8: RXD (RS232)
- Pin 9: VIN (+7 V bis +20 V power supply)
- Pin 10: TXD (RS232)
- Pin 11: Not used (Factory only)

- Pin 12: GND
- Pin 13: AGND (only if the analog output is equipped [option])
- Pin 14: TRIG-IN (CMOS)
- Pin 15: GND
- Pin 16: ENC Z- (Inremental-Encoder, RS422)
- Pin 17: ENC A+ (Inremental-Encoder, RS422)
- Pin 18: ENC A- (Inremental-Encoder, RS422)
- Pin 19: ENC B+ (Inremental-Encoder, RS422)
- Pin 20: ENC B- (Inremental-Encoder, RS422)
- Pin 21: Not used
- Pin 22: Not used

The analog output is available only as an option. If the analog output is available, then the user must take care, that the load of the output is < 100 µAmps to avaiod signal distortion.

All data are fully temperature compensated. Additionally to the angular rate the accumulated angle (integral of angular rate) can be output via RS232 and CAN. The integrator can be resetted by an RS232 command.

The user can set an additional gyro offset which will be substracted internally after the internal calibration calculation.

The gyro can be delivered with an additional interface to read counts from an external incremental encoder (A/B). This allows to use the iOLFOG-S-D to be used in vehicle control and guidance applications like AGV operation.

3 Interface Description

The iOLFOG-S-D / iMGYR-x provides two serial interfaces, one RS232 for configuration and one CAN interface for data output. Each package contains a package counter so the user can recognize if data packages will be lost during transmission. CAN and RS232 data output can be used also simultanously if required.

The parameters which configure the interfaces are stored in a FLASH memory and will therefore not be changed by hardware reset (except the command ‘rs232 mode’). Before you can use commands changing FLASH parameters you must boot the gyro while sending some “-“ characters during power-up. Then setup the FLASH password (‘marvin’) to protect yourself against configuration changes during e.g. testing the gyro. Afterwards send a “reset” to the gyro to go back to the operational mode.

3.1 RS232 Interface

The RS232 works with 8 databits, 1 stopbit, no parity and no protocol.

The RS232 interface provides the following commands.

`flash password <text>`	Setup password. You must setup the password before using commands which write to the FLASH memory (i.e. 'can mode'). <text> = marvin
`ana skal <Float>`	Scale factor of analog output in deg/s/V. Output is 0..5 V, this means 2.5V corresponds to 0 deg/s (only as option available)
`can id <Hex>`	Identifier for CAN messages (Standard-CAN)
`can speed <50|100|125|250|500|1000>`	CAN-Baudrate in kBd
`can rate <Float>`	Data output frequency in Hz via CAN; it will be rounded to an integer divider of the internal data rate (e.g. if internal data rate is 500 Hz, selectable output rates are 500/250/167/125/100/83...Hz). For automatic output, the 'can trigger id' must be –1 (OFF).
`can mode <Hex>`	CAN data output mode Bits 0-2: 0 = CAN off 1 = Data package format „1“ (float 4 bytes) 2 = Data package format „2“ (int 2 bytes) 3 = Data package format „3“ (long 4 bytes) option only: 4 = Data package format „4“ (float 4 bytes)
`can scf <Float>`	scale factor of data output via 'can mode 2' in deg/s/LSB
`can trigger id <Hex>`	Set trigger id. If a message with this ID is sent to the system, a CAN message with 'can id' according to 'can mode' is sent back to the user. The triggered data output on CAN is switched ON if trigger id >= 0. This feature is deactivated if CAN control id is –1 (OFF). Angular rate output is averaged between two trigger signals.
`dac offset <Float>`	Offset of DAC16 (in V)
`dac skal <Float>`	Scale factor of DAC16
`help`	Show list of commands (you can also type in i.e. 'help rs232' which shows you all commands starting with 'rs232')

rs232 speed <9600|19200|38400|57600|115200>	RS232-Baudrate in Bd
rs232 rate <Float>	Data output frequency in Hz via RS232; it will be rounded to an integer divider of the internal data rate (e.g. if internal data rate is 500 Hz, selectable output rates are 500/250/167/125/100/83...Hz). Important: The user has to take care that the selected RS232 baud rate is sufficient for selected data rate!
rs232 mode <Hex>	RS232 data output mode (this mode will not be stored permanently in the FLASH! The gyro starts up always with mode = 0 to allow operation after power-on even if a wrong mode (e.g. too high data rate with too low baudrate) has been commanded previously). Bits 0-2: 0 = RS232 data transmission off 1 = Data package format „1“ (float 4 bytes) 2 = Data package format „2“ (text mode) option only: Output of angle (integration) 3 = Data package format „3“ (float 4 bytes) 4 = Data package format „4“ (text mode)
resint	Reset of internal integrator (only for rs232 modes 3+4 and can mode 4)
offadj <value>	additional customer adjustable offset compensation [deg/s] which will be subtracted from all angular rate data after internal compensation and before output or before integration. As default this value should be set equal zero.
lowpass <freq>	lowpass filtering of the output values (only available for angular rate float output format). <freq> is the stop band frequency of the lowpass of first order [Hz].
reset	Software reset
simu gyro <Float>	Simulation of gyro [deg/s]
simu temp <Float>	Simulation of temperature [°C]
simu off	Switch off simulation of rate and temperature
show conf	show config data (resides in FLASH memory)
show morecal	show more cal data (resides in FLASH memory)

Via RS232 three different types of data packages for low speed data transmission are selectable for test purposes:

```
1.    „Float Rate Data Package“
      Byte 1          = Sync-Byte 0x7E
      Bytes 2...5     = Gyro data as float in IEEE-754 format (rad/s)
      Byte 6          = Status/error-byte (error code of gyro, 0=OK)
      Byte 7          = package counter

2.    „Text Mode Rate Data Package“
      Bytes 1...9     = Gyro data as text in format %+9.3lf (deg/s)
      Byte 10         = blank
      Byte 11...16    = Temperature as text in format %+6.2f (°C)
      Byte 17         = blank
      Byte 18...19    = package counter as text in hexadecimal format
      Byte 20...21    = CR/LF

3.    „Float Angle Data Package“
      Byte 1          = Sync-Byte 0x7E
      Bytes 2...5     = Angle data as float in IEEE-754 format (rad)
      Byte 6          = package counter

4.    „Text Mode Angle Data Package“
      Bytes 1...9     = Angle data as text in format %+9.3lf (deg)
      Byte 10         = blank
      Byte 11...12    = package counter as text in hexadecimal format
      Byte 13...14    = CR/LF
```

3.2 CAN Interface

The CAN interface provides the following data structures:

Identifier adjustable via RS232 (Standard-CAN). Four different types of data packages are selectable (via RS232 switchable).

```
1.    „Float Rate Data Package“
      DLC = 8 Byte (length of message)
      Bytes 1...4     = Gyro data as float in IEEE-754 format (rad/s)
      Bytes 5...6     = Temperature (16-Bit-Integer, Lo-Byte first)
      Byte 7          = Status/error-byte (error code of gyro, 0=OK)
      Byte 8          = package counter

2.    „16 Bit Rate Data Package“
      DLC = 6 Byte (length of message)
      Bytes 1...2     = Gyro data as 16-Bit-Integer (Lo-Byte first),
                        scalefactor via RS232 adjustable
      Bytes 3...4     = Temperature (16-Bit-Integer, Lo-Byte first)
      Byte 5          = Status/errorbyte (error code of gyro, 0=OK)
      Byte 6          = package counter

3.    „32 Bit Rate Data Package“
      DLC = 8 Byte (length of message)
      Bytes 1...4     = Gyro data as 32-Bit-Integer (Lo-Byte first),
                        scalefactor fix (depends on internal oversampling)
      Bytes 5...6     = Temperature (16-Bit-Integer, Lo-Byte first)
      Byte 7          = Status/errorbyte (error code of gyro, 0=OK)
      Byte 8          = package counter

4.    „Float Integral Data Package“
      DLC = 8 Byte (length of message)
      Bytes 1...4     = computed angle as float in IEEE-754 format (rad/s)
      Bytes 5...6     = Temperature (16-Bit-Integer, Lo-Byte first)
      Byte 7          = Status/error-byte (error code of gyro, 0=OK)
      Byte 8          = package counter
```

The temperature can be calculated from the 16 Bit-value read via CAN with the following formula:

Temp [℃] = Temp_16Bit * 0.04069 – 50 (if your sys tem is of type iOLFOG)

Temp [℃] = Temp_16Bit * 0.181818 – 48.96 (if your system is of type iMGYR)

Temp [℃] = Temp_16Bit * 0.1525 – 101.16 (if your s ystem is of type iMGYR-B)

Attention when using float-output:

Although the used float data output format is conform to IEEE-754, there may be differences between the VRU's byte order compared to other software. Therfore it may be necessary to adjust the byte order when communicating with other software.

```
Example:
1.23F = 3F 9D 70 A4 (4 Byte hex, IEEE-754)
whereat 3F 9D = seeeeeee emmmmmmm (sign, 8 exponent, 7 HI-mantisse)
    and 70 A4 = mmmmmmmm mmmmmmmm (16 LO-mantisse)

However the byte order in the output is 9D 3F A4 70, because the compiler
used in iOLFOG-S-D software development swaps HI- and LO-Byte in each
word.
```

3.3 Analog Interface (option)

The iOLFOG-S-D can be delivered with an additional analog output as an option. This output provides data with 500 Hz and 16 bit resolution. The output range is 0...5 V. No internal filter is used to limit the bandwidth of the data, so an anti-aliasing filter at the user's side is recommended. An angular rate of 0 °/s corresponds to 2.5 V output voltage.

4 Quick Start

The delivery state of the RS232 is 57600 Baud.

To initialize data transmission on RS232, you must only send the 'rs232 mode' command to the gyro. Make sure, the rs232 rate has a proper value. Type in 'show conf' to see the rs232 data rate.

Use a cross-over cable to operate the RS232.

Remember that a 120 Ohm termination resistor is required to operate the CAN bus.

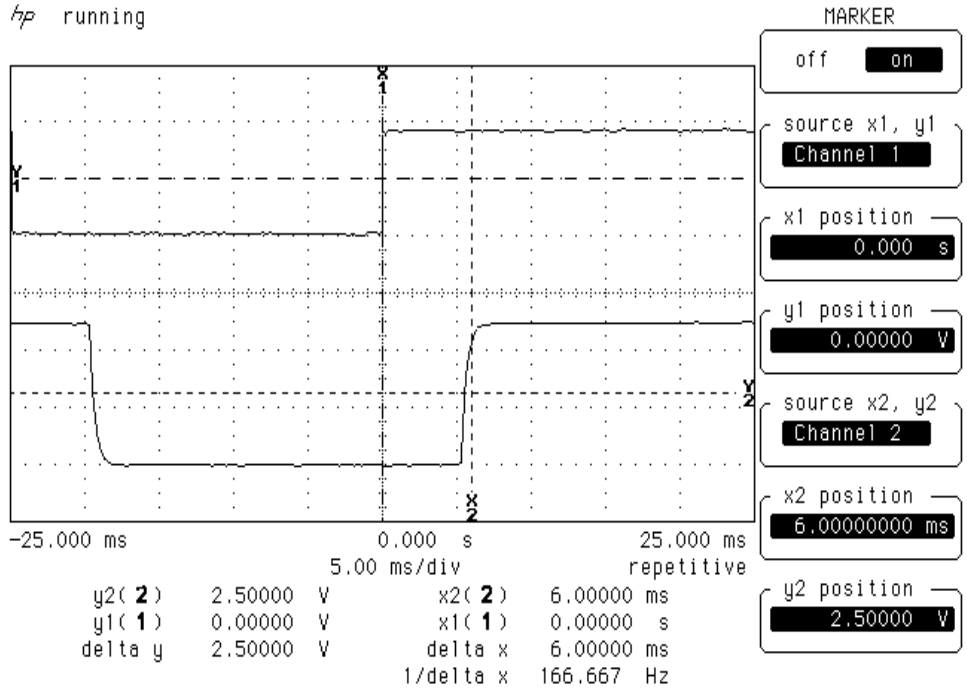
5 Additional Hints

Do not open the gyro! To mount the gyro, please use M4 size screws (without mounting plate) or M6 screws (with mounting plate).

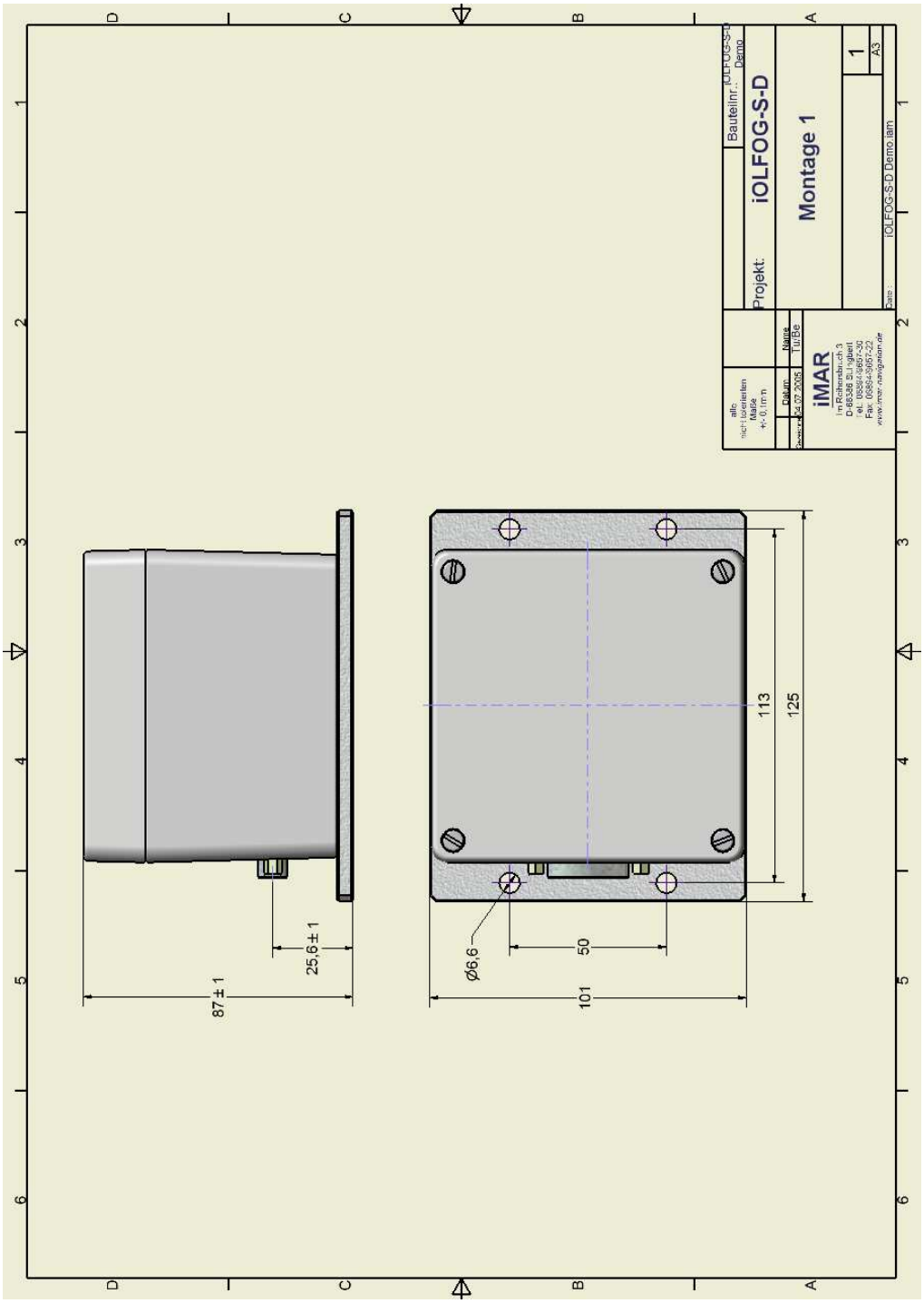
Hint: It is recommended, to connect Analog_GND and PWR_GND on separate lines.

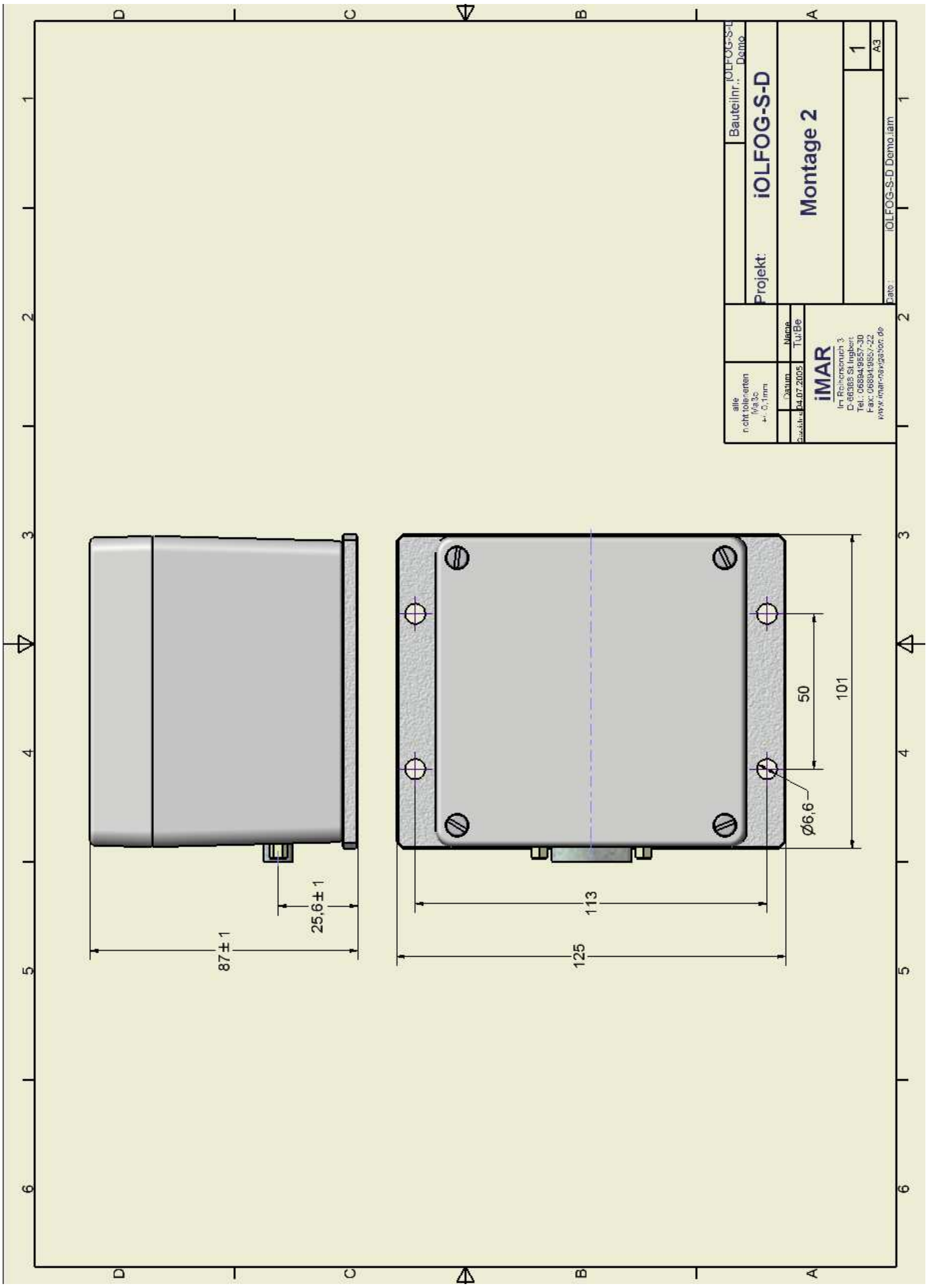
Appendix A Step Response Diagram

The following plot shows the step response of the gyro. The 5 ms delay is caused by the internal sampling at 12.8 kHz and data output at 200 Hz. The time delay is constant with +/- 10 µs (on the analog output channel). The user has to apply his own reconstruction filter (lowpass of half output frequency) if required.



Appendix B Drawings




Projekt:
iOLFOG-S-D
Bauteilnr.: iOLFOG-S-D Demo
Montage 2
1
A3
iOLFOG-S-D Demo.iam
iMAR
04.07.2005
Tu/Be
101
50
Ø6,6
113
125
25,6 ± 1
87 ± 1