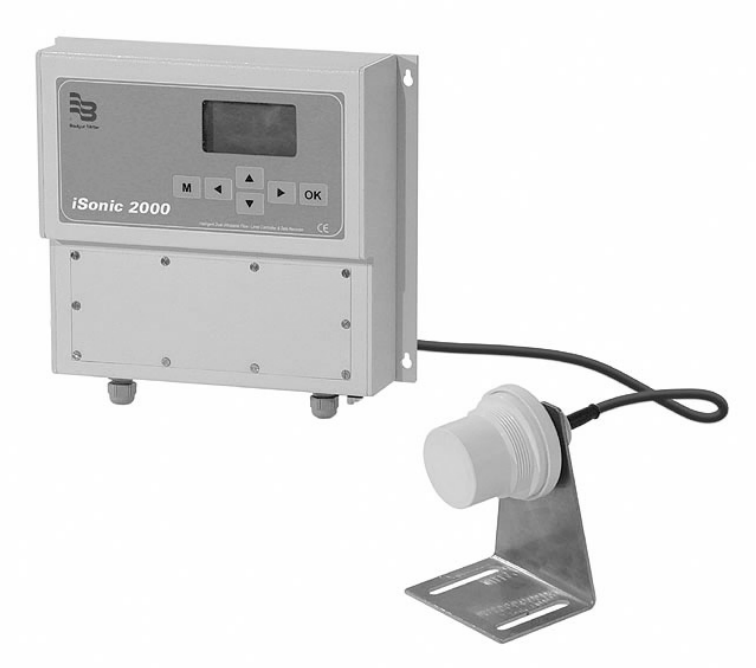
Badger Meter Europa GmbH

iSonic 2000

Intelligent ultrasonic meter and controller



Communications

May 2006

Version iSonic 2000 Communications 05/06-e

1. Introduction

This document solely describes the communication capabilities of the iSonic 2000. For further instructions see the other manuals.

The instrument has two communication ports, where Port 1 is RS232 only and Port 2 can be strapped to be either RS232 or RS485. Port 1 is wired to the external DB9 connector whilst Port 2 is only accessible on the screw terminals.

The unit can interface via:

1. RS232 (Short haul – 20meters)
   This interface is used between instrument and PC / Laptop, usually for configuration and data retrieval. PC / Laptop have RS232 ports standard and the connection is a simple cable. Typically the cable connects to the external DB9 Port 1 connector.

2. RS485 (Medium haul - 1200meters)
   This interface is typically used when:
   a. A single instrument needs to communicate over a longer distance to the plant operating room
   b. Multiple instruments are coupled via a local network to a main controller

   When interfacing to a PC, an RS485-RS232 converter is needed, this should preferably be a converter that switches automatically between listen and talk modes.
   For this interface Port 2 is used and the unit must be strapped internally to the RS485 setting.

3. MODEM (Requires a telephone line)
   The instruments do not intrinsically have a MODEM on board so an external device must be connected. The requirement for the MODEM is that is Hayes compatible (AT-Command Set). The MODEM connects to Port 2 of the instrument via a special cable. Port 2 of the unit must be strapped internally for RS232 communication. Once the instrument is correctly configured, a user/operator can phone the unit to retrieve current status, retrieve data logs and change configuration.

4. GSM MODEM (Requires a GSM network)
   This instrument works very similar to the MODEM, again an external device has to be connected but thanks to the GSM standard any GSM modem will do. The interface is same as the MODEM, an RS232 connection on the screw terminals.
   Once the instrument is correctly configured, a user/operator can phone the unit to retrieve current status, retrieve data logs and change configuration. The configuration programs as supplied by the CSIR cater for these dial-up sessions.
   With this communication method there is additional option, the unit can communicate via SMS (Short Message Service). This means that a user can interrogate the unit from a standard GSM Cell-phone and retrieve the current status. Alternatively the unit can be set to generate a specific set of SMS alarms. These messages are automatically sent to pre-configured recipients when the unit detects an alarm condition.

Over all these connection links, the iSonic can communicate either using the proprietary STALK protocol or alternatively using the MODBUS RTU protocol. In very basic systems it is also possible to activate a TEXT ONLY mode, which reports every second what data is being measured, this can then be used in simple telemetry systems.

2. Ports

Two communication ports are available on the iSonic unit.
The first port is always RS232 and is reserved for communications with a PC/Laptop for configuration and data-log transfer purposes. In its standard configuration, the iSonic presents Port 1 on the external DB9 connector. On this port only the STALK protocol is available and nothing can be set by the user.

The second port is available on the connector block and can be either RS232 or RS485. The unit must be configured internally for RS232 or RS485 operation by means of a jumper setting.
This second port can be used in the following operation modes:

- STALK on RS232
- STALK on RS485
- STALK via MODEM
- STALK via GSM MODEM
- TEXT on RS232
- TEXT via MODEM
- TEXT via GSM MODEM
- MODBUS on RS232
- MODBUS on RS485
- GSM-SMS alarms using a GSM MODEM
- GSM-SMS status reporting using a GSM MODEM

Certain modes are complementary, for instance when a GSM MODEM is connected, it can be used to communicate using STALK but it can also handle SMS requests (status) or generate SMS alarms.

This port can be configured in these modes by setting the proper configuration, either from the LCD menu or using the PC configuration commands.

3. Configuring a GSM modem

A GSM MODEM can be connected to the iSonic instrument using Port2 connections. It is important that the Carrier Detect from the GSM MODEM is connected to the CD connection on the iSonic instrument. To supply the GSM MODEM with power, the 12V generated by the iSonic can be taken from connector block 2. The GSM MODEM parameters can only be configured from the PC configuration program.

Please refer to the PC configuration document for a complete run-down on exact details how to configure this MODEM. Ensure that the following fields are configured correctly:

- Unit Telephone Number
- Initialise

And if SMS is used, then also:

- SMS Service Centre
- Mobile Phone Number #1 (and maybe also #2)
- Station ID

The user can interrogate an iSonic unit that has a GSM MODEM connected. By sending an SMS with a certain message content from a mobile phone, the iSonic will respond to that message. The request message content is defined as follows:

The first four characters must match the unit's password, the fifth character must be a zero. If this message is received by the iSonic, the unit will send the current measurements back to the originator of the SMS.

In other words, if the password for the iSonic unit is set up to be 1234, then simply send an SMS with the content: 12340. This will result in the unit responding with an SMS to your phone, showing the current measurements.

4. STALK mode via (GSM) modem

This mode is used when the operator wants to be able to dial into the unit and interrogate its status. When the unit is properly connected and configured in tandem with the MODEM, the operator can use the supplied PC configuration program to dial the unit and collect data.

5. TEXT mode

This mode can be used in situations where no protocol is necessary or no protocol can be generated. The unit reports its status every second, when a telemetry unit is connected this message will automatically be transmitted to the HOST machine for further processing. This HOST system could run data collection software and create its own data history.

6. MODBUS mode

6.1 Description

Modbus is an open, serial communications protocol based on the master/slave architecture. The iSonic has an implementation of MODBUS which allows operators to change certain parameters and to retrieve the current measurements. For SCADA programmers, suffice to say that an address range is made available on the instrument from MODBUS address 40001 thru to 40350. Details on this address map can be found in Appendix A – “Modbus Address Map”.

On the lowest MODBUS level, the following commands are implemented on the instrument:

01 - Read Coil Status
02 - Read Input Status
03 - Read Holding Registers
06 - Preset Single Holding Register
11 - Fetch Comm Event Counter
16 - Preset Multiple Holding Registers

The register commands (03, 06 and 16) are defined as using MODBUS address 40001 and up. The total range of the instruments implementation allows for addresses 40001 to 40500 inclusive. The entire range is not populated, check on the MODBUS map file which addresses are valid for the instrument.

The standard MODBUS exception responses are generated:
(01, 02, 03) for any illegal message content

(05) an Ack message signifying that the slave is busy processing the request. This is only generated for function 16, and only when the message exceeds a pre-defined length.

(06) When the instrument is busy processing a previous request.

6.2 Functions

Function 01 - Read coil status
With this command the current relay status can be viewed.
The relays are mapped from address 0 through to address 5.

Function 02 - Read input status
With this command the current discrete inputs status can be viewed.
The discrete inputs are mapped from address 0 through to address 4.

Function 03 - Read holding registers
Allows for reading of configuration and status registers. For details on the addressing, refer to the map file for this instrument.

Function 06 – Preset single holding register
Allows for writing of configuration and status registers. For details on the addressing, refer to the address map file for this instrument.

Function 11 (0B Hex) – Fetch comm event counter
As per MODBUS definition, the returned event counter is incremented for each successful message completion. The status can be either FFFF (Device busy) or 0000 (Device free). This status will mostly be 0000, except when lengthy function 16 message's are used.

Function 16 (11 Hex) – Preset multiple registers
Allows for writing of multiple configuration and status registers. For details on the addressing, refer to the address map file for this instrument.
The response to this message can in certain cases be an ACK exception message (05), in this case use the function 11 request to poll the device until the status becomes 0000 again. Alternatively use a time delay for the next message, the maximum busy time for this device is in the order of 2.5 seconds.

6.3 Parameter conventions

Certain registers are byte values only, in this case the upper byte is ignored when received (Function 06 & 16) and made zero when transmitted (Function 03).

Floating point and long integer values are by their nature 4 byte values (32 bits). Since MODBUS only allows for 16 bit values, these 4 byte values are split over two addresses. The MODBUS specification is not clear on implementation of values that span multiple addresses. The below example shows a fictitious example on how the variables are arranged in the MODBUS map. Shown are in sequential order; a LONG, a BYTE, a WORD and a FLOAT.

MODBUS address	
40001	Long Integer (Byte 1 & Byte 0)
40002	Long Integer (Byte 3 & Byte 2)
40003	Byte value (Upper byte is 0)
40004	Word Value (Byte 1 & Byte 0)
40005	Floating Point (Byte 1 & Byte 0)
40006	Floating Point (Byte 3 & Byte 2)

This arrangement has been tested against multiple SCADA systems and found to be working satisfactory.

6.4 Map File

The map file (Appendix A) applies to functions 3, 6 and 16, and shows the following columns:

Modbus Address	Bytes	Description	R/W	Var Type	Detail

Where:
- **Modbus address** is the decimal address of a register according to the MODBUS conventions. The range of addresses starts at 40001 and continues until
- **Bytes** is the number of bytes a register value spans, this can be 1 for a byte, 2 for a word or 4 for a long/float value. In the latter case the value actually spans two addresses.
- **Description** shows what the address content is
- **R/W** shows whether this address is a read-only (R) or read and write (R/W)
- **Var Type** shows the variable type which can be a byte, ascii, word, or float/long.
- **Detail** explains the contents of the register

6.5 Appendix A - MODBUS address map

Modbus Address	Bytes	Description	R/W	Var Type	Detail
40001	10	Firmware Version & Serial	R	ASCII	Packed ASCII (2 characters per word)
40002					first three characters = Firmware
40003					last 7 characters = serial number
40004					
40005					
40006	1	Level Unit	R	Byte	mm,m,inch,ft
40007	1	Volume Unit	R	Byte	m3, l, ac-ft,gal(USA), bbl, gal(UK)
40008	1	Flow Unit	R	Byte	m3/s, m3/d, l/s, cfs, mgd(USA), gpm(USA), mgd(UK),gpm(UK)
40009	1	Temperature Unit	R	Byte	0 = C, 1 = F
40010	1	Channel 1 type	R	Byte	Level, Flow, Volume, Dual
40011	1	Channel 1 Function	R	Byte	Add, Subtract ..
40012	1	Channel 2 type	R	Byte	Level, Flow, Volume, Dual
40013	1	Channel 2 Function	R	Byte	Add, Subtract ..
40014	1	Analogue Input 1 Type	R	Byte	4-20mA or 0-5V
40015	1	Analogue Input 2 Type	R	Byte	4-20mA or 0-5V
40016	4	DAC 1, Configuration Value 1	R/W	Float	4mA Percentage
40017			R/W		
40018	4	DAC 1, Configuration Value 2	R/W	Float	20mA Percentage
40019			R/W		
40020	4	DAC 1, Configuration Value 3	R/W	Float	Error Current
40021			R/W		
40022	4	DAC 1, Configuration Value 4	R/W	Float	P Value
40023			R/W		
40024	4	DAC 1, Configuration Value 5	R/W	Float	I Value
40025			R/W		
40026	4	DAC 1, Configuration Value 6	R/W	Float	D Value
40027			R/W		
40028	4	DAC 1, Configuration Value 7	R/W	Float	Deadband
40029			R/W		
40030	4	DAC 2, Configuration Value 1	R/W	Float	4mA Percentage
40031			R/W		
40032	4	DAC 2, Configuration Value 2	R/W	Float	20mA Percentage
40033			R/W		
40034	4	DAC 2, Configuration Value 3	R/W	Float	Error Current
40035			R/W		
40036	4	DAC 2, Configuration Value 4	R/W	Float	P Value
40037			R/W		
40038	4	DAC 2, Configuration Value 5	R/W	Float	I Value
40039			R/W		
40040	4	DAC 2, Configuration Value 6	R/W	Float	D Value
40041			R/W		
40042	4	DAC 2, Configuration Value 7	R/W	Float	Deadband
40043			R/W		
40044	4	Relay #1 ON Setpoint	R/W	Float	Percentage of the process value
40045			R/W		
40046	4	Relay #1 OFF Setpoint	R/W	Float	Percentage of the process value
40047			R/W		
40048	4	Relay #1 Daily Timer Start	R/W	Float	
40049			R/W		
40050	4	Relay #1 Daily Timer Stop	R/W	Float	
40051			R/W		

40052	4	Relay #1 Periodic ON	R/W	Float
40053			R/W	
40054	4	Relay #1 Periodic OFF	R/W	Float
40055			R/W	
40056	4	Relay #2 ON Setpoint	R/W	Float
40057			R/W	
40058	4	Relay #2 OFF Setpoint	R/W	Float
40059			R/W	
40060	4	Relay #2 Daily Timer Start	R/W	Float
40061			R/W	
40062	4	Relay #2 Daily Timer Stop	R/W	Float
40063			R/W	
40064	4	Relay #2 Periodic ON	R/W	Float
40065			R/W	
40066	4	Relay #2 Periodic OFF	R/W	Float
40067			R/W	
40068	4	Relay #3 ON Setpoint	R/W	Float
40069			R/W	
40070	4	Relay #3 OFF Setpoint	R/W	Float
40071			R/W	
40072	4	Relay #3 Daily Timer Start	R/W	Float
40073			R/W	
40074	4	Relay #3 Daily Timer Stop	R/W	Float
40075			R/W	
40076	4	Relay #3 Periodic ON	R/W	Float
40077			R/W	
40078	4	Relay #3 Periodic OFF	R/W	Float
40079			R/W	
40080	4	Relay #4 ON Setpoint	R/W	Float
40081			R/W	
40082	4	Relay #4 OFF Setpoint	R/W	Float
40083			R/W	
40084	4	Relay #4 Daily Timer Start	R/W	Float
40085			R/W	
40086	4	Relay #4 Daily Timer Stop	R/W	Float
40087			R/W	
40088	4	Relay #4 Periodic ON	R/W	Float
40089			R/W	
40090	4	Relay #4 Periodic OFF	R/W	Float
40091			R/W	
40092	4	Transducer 1, Alarm Above	R/W	Float
40093			R/W	
40094	4	Transducer 1, Alarm Below	R/W	Float
40095			R/W	
40096	4	Transducer 1, Hysteresis	R/W	Float
40097			R/W	
40098	4	Transducer 2, Alarm Above	R/W	Float
40099			R/W	
40100	4	Transducer 2, Alarm Below	R/W	Float
40101			R/W	
40102	4	Transducer 2, Hysteresis	R/W	Float
40103			R/W	
40104	4	Analogue 1, Alarm Above	R/W	Float
40105			R/W	
40106	4	Analogue 1, Alarm Below	R/W	Float

40107			R/W		
40108	4	Analogue 1, Hysteresis	R/W	Float	
40109			R/W		
40110	4	Analogue 2, Alarm Above	R/W	Float	
40111			R/W		
40112	4	Analogue 2, Alarm Below	R/W	Float	
40113			R/W		
40114	4	Analogue 2, Hysteresis	R/W	Float	
40115			R/W		
40150	4	Measured Channel 1	R	Float	always in mm
40151					
40152	4	Temperature Channel 1	R	Float	always in degrees celcius
40153					
40154	4	Measured Channel 2	R	Float	always in mm
40155					
40156	4	Temperature Channel 2	R	Float	?
40157					
40158	4	Analogue Channel 1	R	Float	
40159					
40160	4	Analogue Channel 2	R	Float	
40161					
40162	1	Discrete Input 1	R	Byte	
40163	1	Discrete Input 2	R	Byte	
40164	1	Discrete Input 3	R	Byte	
40165	1	Discrete Input 4	R	Byte	
40166	1	Relays	R	Byte	Bit 0 = Relay 1,…, Bit 4 = Relay 5 (Also available using function 1)
40167	2	DAC 1, Output Value	R	Word	uA
40168	2	DAC 2, Output Value	R	Word	
40169	4	Totaliser 1	R	Long	
40170			R		
40171	4	Totaliser 2	R	Long	
40172			R		
40173	1	Unit State	R	Byte	
40174	1	Transducer 1 Error Status	R	Byte	IN_RANGE, HI_RANGE_ALARM, LO_RANGE_ALARM
40175	1	Transducer 2 Error Status	R	Byte	IN_RANGE, HI_RANGE_ALARM, LO_RANGE_ALARM
40176	1	Transducer 1 Status	R	Byte	No_Alarm, Hi_Alarm, Lo_Alarm
40177	1	Transducer 2 Status	R	Byte	
40178	1	Analogue Input 1 Status	R	Byte	
40179	1	Analogue Input 2 Status	R	Byte	
40180	1	Discrete Input 1 Status	R	Byte	
40181	1	Discrete Input 2 Status	R	Byte	
40182	1	Discrete Input 3 Status	R	Byte	
40183	1	Discrete Input 4 Status	R	Byte	
40230	4	Custom Table 1, Head 1	R/W	Float	Custom Table 1
40231					
40232	4	Custom Table 1, Point 1	R/W	Float	Custom Table 1
40233					
40234	4	Custom Table 1, Head 2	R/W	Float	Custom Table 1
40235					
40236	4	Custom Table 1, Point 2	R/W	Float	Custom Table 1
40237					
40238	4	Custom Table 1, Head 3	R/W	Float	Custom Table 1

40239					
40240	4	Custom Table 1, Point 3	R/W	Float	Custom Table 1
40241					
40242	4	Custom Table 1, Head 4	R/W	Float	Custom Table 1
40243					
40244	4	Custom Table 1, Point 4	R/W	Float	Custom Table 1
40245					
40246	4	Custom Table 1, Head 5	R/W	Float	Custom Table 1
40247					
40248	4	Custom Table 1, Point 5	R/W	Float	Custom Table 1
40249					
40250	4	Custom Table 1, Head 6	R/W	Float	Custom Table 1
40251					
40252	4	Custom Table 1, Point 6	R/W	Float	Custom Table 1
40253					
40254	4	Custom Table 1, Head 7	R/W	Float	Custom Table 1
40255					
40256	4	Custom Table 1, Point 7	R/W	Float	Custom Table 1
40257					
40258	4	Custom Table 1, Head 8	R/W	Float	Custom Table 1
40259					
40260	4	Custom Table 1, Point 8	R/W	Float	Custom Table 1
40261					
40262	4	Custom Table 1, Head 9	R/W	Float	Custom Table 1
40263					
40264	4	Custom Table 1, Point 9	R/W	Float	Custom Table 1
40265					
40266	4	Custom Table 1, Head 10	R/W	Float	Custom Table 1
40267					
40268	4	Custom Table 1, Point 10	R/W	Float	Custom Table 1
40269					
40270	4	Custom Table 1, Head 11	R/W	Float	Custom Table 1
40271					
40272	4	Custom Table 1, Point 11	R/W	Float	Custom Table 1
40273					
40274	4	Custom Table 1, Head 12	R/W	Float	Custom Table 1
40275					
40276	4	Custom Table 1, Point 12	R/W	Float	Custom Table 1
40277					
40278	4	Custom Table 1, Head 13	R/W	Float	Custom Table 1
40279					
40280	4	Custom Table 1, Point 13	R/W	Float	Custom Table 1
40281					
40282	4	Custom Table 1, Head 14	R/W	Float	Custom Table 1
40283					
40284	4	Custom Table 1, Point 14	R/W	Float	Custom Table 1
40285					
40286	4	Custom Table 1, Head 15	R/W	Float	Custom Table 1
40287					
40288	4	Custom Table 1, Point 15	R/W	Float	Custom Table 1
40289					
40290	4	Custom Table 2, Head 1	R/W	Float	Custom Table 2
40291					
40292	4	Custom Table 2, Point 1	R/W	Float	Custom Table 2
40293					

40294	4	Custom Table 2, Head 2	R/W	Float	Custom Table 2
40295					
40296	4	Custom Table 2, Point 2	R/W	Float	Custom Table 2
40297					
40298	4	Custom Table 2, Head 3	R/W	Float	Custom Table 2
40299					
40300	4	Custom Table 2, Point 3	R/W	Float	Custom Table 2
40301					
40302	4	Custom Table 2, Head 4	R/W	Float	Custom Table 2
40303					
40304	4	Custom Table 2, Point 4	R/W	Float	Custom Table 2
40305					
40306	4	Custom Table 2, Head 5	R/W	Float	Custom Table 2
40307					
40308	4	Custom Table 2, Point 5	R/W	Float	Custom Table 2
40309					
40310	4	Custom Table 2, Head 6	R/W	Float	Custom Table 2
40311					
40312	4	Custom Table 2, Point 6	R/W	Float	Custom Table 2
40313					
40314	4	Custom Table 2, Head 7	R/W	Float	Custom Table 2
40315					
40316	4	Custom Table 2, Point 7	R/W	Float	Custom Table 2
40317					
40318	4	Custom Table 2, Head 8	R/W	Float	Custom Table 2
40319					
40320	4	Custom Table 2, Point 8	R/W	Float	Custom Table 2
40321					
40322	4	Custom Table 2, Head 9	R/W	Float	Custom Table 2
40323					
40324	4	Custom Table 2, Point 9	R/W	Float	Custom Table 2
40325					
40326	4	Custom Table 2, Head 10	R/W	Float	Custom Table 2
40327					
40328	4	Custom Table 2, Point 10	R/W	Float	Custom Table 2
40329					
40330	4	Custom Table 2, Head 11	R/W	Float	Custom Table 2
40331					
40332	4	Custom Table 2, Point 11	R/W	Float	Custom Table 2
40333					
40334	4	Custom Table 2, Head 12	R/W	Float	Custom Table 2
40335					
40336	4	Custom Table 2, Point 12	R/W	Float	Custom Table 2
40337					
40338	4	Custom Table 2, Head 13	R/W	Float	Custom Table 2
40339					
40340	4	Custom Table 2, Point 13	R/W	Float	Custom Table 2
40341					
40342	4	Custom Table 2, Head 14	R/W	Float	Custom Table 2
40343					
40344	4	Custom Table 2, Point 14	R/W	Float	Custom Table 2
40345					
40346	4	Custom Table 2, Head 15	R/W	Float	Custom Table 2
40347					
40348	4	Custom Table 2, Point 15	R/W	Float	Custom Table 2

40349

Hotline

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