ABD05.xx / ABD06.xx

Notes to Settings

Version of Monitor ABD05M/ ABD06M: V01.50.02

Rev.: 5 / TF / 26.10.2011

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1 General

1.1 Abbreviations and Terminology

ABD	AirBubbleDetector
WD	WatchDog
CRC	Cyclic Redundancy Check
ADC	Analog to Digital Converter
ABD05M	Monitor for sensor series ABD05.xx, expert version
ABD06M	Monitor for sensor series ABD06.xx, expert version
ABDM	Monitor for sensors ABD06.xx, standard version

`Ampl`	Logarithm value of signal amplitude in range of one gain step, 0 ... 255, [0.1 dB]
`AmplMax`	Reference to `Ampl`, 0 ... 255, [0.1 dB]
`Gain`	Step of Gain, 0 … 4, each step with 10 dB
`ADCZero`	Reference value for ADC, measured during zero calibration, 0 … 1023
`ABDOut`	Value for output bubbles, 0 ... 240

1.2 Supported Devices

Sensors	***Version of Firmware***
ABD06.xx	V1.30.03
ABD05.10/ .11/ .20/ .40/ .5x/ .60/ .62	V1.30.03
ABD05.30	V2.00.00

Table 1. Supported Devices

2 Monitor

2.1 Graphic

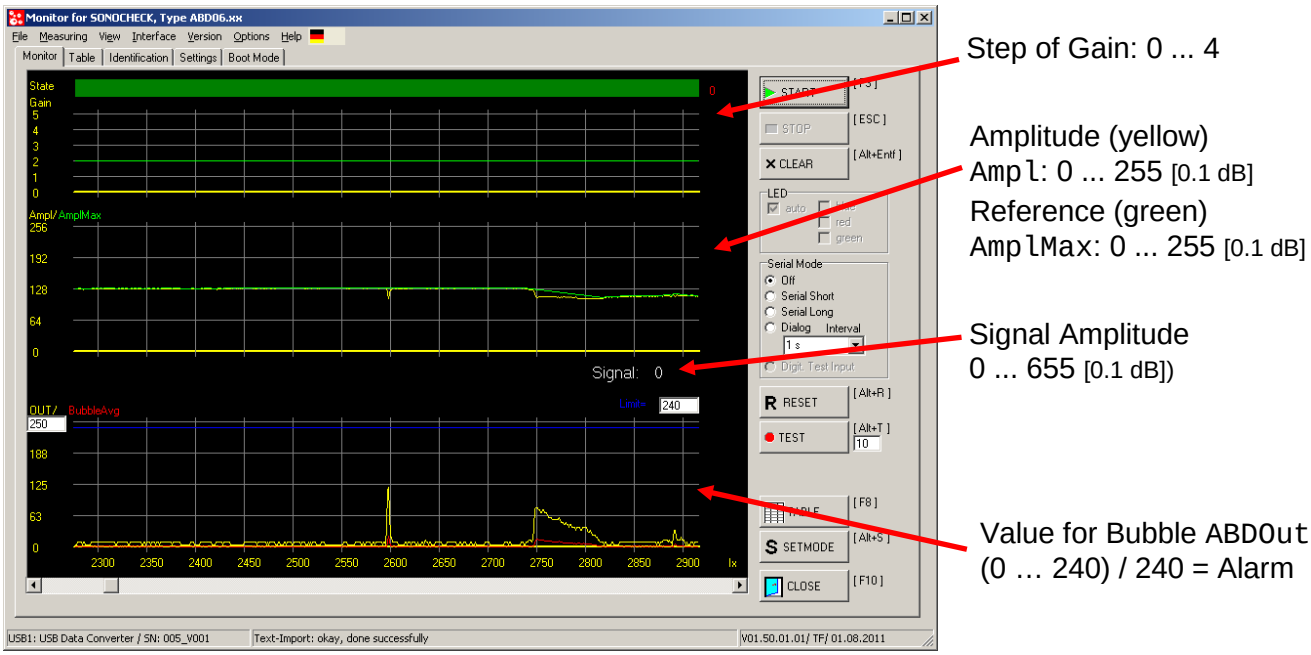


Figure 1. Monitor with measuring data. recorded with serial protocol 'long'

2.2 Note to Signal Amplitude

The sensor adjusts gain for optimal signal acquisition. The higher the amplitude the lower is the required step of gain. Measured amplitude (`Ampl`) is shown in monitor (yellow).

Signal amplitude is calculated internally following:

Signal Amplitude [0.1 dB] = (4 - `Gain`) * 100 + `Ampl`

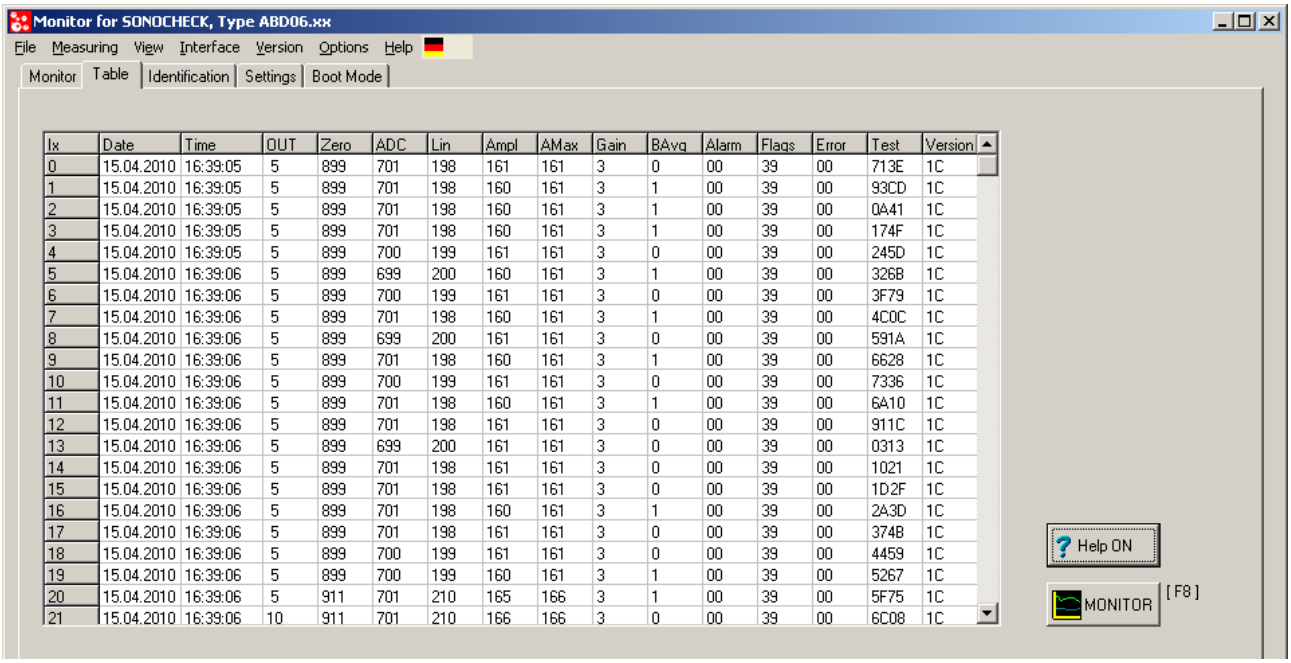
All adjusting values are regarded to signal amplitude.
The calculated signal amplitude is shown in diagram as text (Signal: …)

2.3 Note to Value for Bubble

The output value for bubbles will be calculated internally as the difference between measured signal amplitude `Ampl` and reference value `AmplMax`, multiplied with factor for output (see chapter 4.4).

Output Factor and Limit of Bubbles correspond with each other: e.g. Limit of 4.8 dB (= 48 [0.1 dB]) multiplied with factor of 5 is 240. That is the max. value for bubble output and means bubble alarm.

3 Table



Ix	Date	Time	OUT	Zero	ADC	Lin	Ampl	AMax	Gain	BAvg	Alarm	Flags	Error	Test	Version
0	15.04.2010	16:39:05	5	899	701	198	161	161	3	0	00	39	00	713E	1C
1	15.04.2010	16:39:05	5	899	701	198	160	161	3	1	00	39	00	93CD	1C
2	15.04.2010	16:39:05	5	899	701	198	160	161	3	1	00	39	00	0A41	1C
3	15.04.2010	16:39:05	5	899	701	198	160	161	3	1	00	39	00	174F	1C
4	15.04.2010	16:39:05	5	899	700	199	161	161	3	0	00	39	00	245D	1C
5	15.04.2010	16:39:06	5	899	699	200	160	161	3	1	00	39	00	326B	1C
6	15.04.2010	16:39:06	5	899	700	199	161	161	3	0	00	39	00	3F79	1C
7	15.04.2010	16:39:06	5	899	701	198	160	161	3	1	00	39	00	4C0C	1C
8	15.04.2010	16:39:06	5	899	699	200	161	161	3	0	00	39	00	591A	1C
9	15.04.2010	16:39:06	5	899	701	198	160	161	3	1	00	39	00	6628	1C
10	15.04.2010	16:39:06	5	899	700	199	161	161	3	0	00	39	00	7336	1C
11	15.04.2010	16:39:06	5	899	701	198	160	161	3	1	00	39	00	6A10	1C
12	15.04.2010	16:39:06	5	899	701	198	161	161	3	0	00	39	00	911C	1C
13	15.04.2010	16:39:06	5	899	699	200	161	161	3	0	00	39	00	0313	1C
14	15.04.2010	16:39:06	5	899	701	198	161	161	3	0	00	39	00	1021	1C
15	15.04.2010	16:39:06	5	899	701	198	161	161	3	0	00	39	00	1D2F	1C
16	15.04.2010	16:39:06	5	899	701	198	160	161	3	1	00	39	00	2A3D	1C
17	15.04.2010	16:39:06	5	899	701	198	161	161	3	0	00	39	00	374B	1C
18	15.04.2010	16:39:06	5	899	700	199	161	161	3	0	00	39	00	4459	1C
19	15.04.2010	16:39:06	5	899	700	199	160	161	3	1	00	39	00	5267	1C
20	15.04.2010	16:39:06	5	911	701	210	165	166	3	1	00	39	00	5F75	1C
21	15.04.2010	16:39:06	10	911	701	210	166	166	3	0	00	39	00	6C08	1C

Figure 2. Table with measuring data, recorded with serial protocol 'long'

Column	***Meaning***
OUT	`ABDOut` / Output value of Sensor: 0 … 25 Liquid 25 ... 150 Small Bubbles 240 Large Bubbles/ Air 241 Fault
Zero	`ADCZero` / Zero value of ADC (10-bit/ 0 ... 1023), will be measured before sent pulse, normally ca. 900
ADC	Value of ADC, inverted signal (10-bit/ 0 ... 1023), the smaller value the higher is the signal
Lin	Lin = Zero - ADC, difference according to linear measured signal amplitude
Amp	`Ampl` / Logarithm value of Lin in 0.1 dB-steps (0 ... 255 → 0 ... 25.5 dB)
AMax	`AmplMax` / Reference to amplitude, for measurement of bubbles
Gain	Step of gain in 10 dB steps, the higher the more the signal will be amplified
BAvg	Averaged value of the difference between AMax - Ampl in 0.1 dB, bubble size
Alarm	If a failure is occurred state of error flags, normally 0, [Hex]
Flags	State, LED, alarms ... [Hex]
Error	If a failure is occurred error code [Hex], normally 0
Test	Only relevant in case of errors, internal test values [Hex]
Version	Special code for version of hard- and firmware [Hex]

Table 2. Meaning of data in table

4 Settings

4.1 Form for Settings

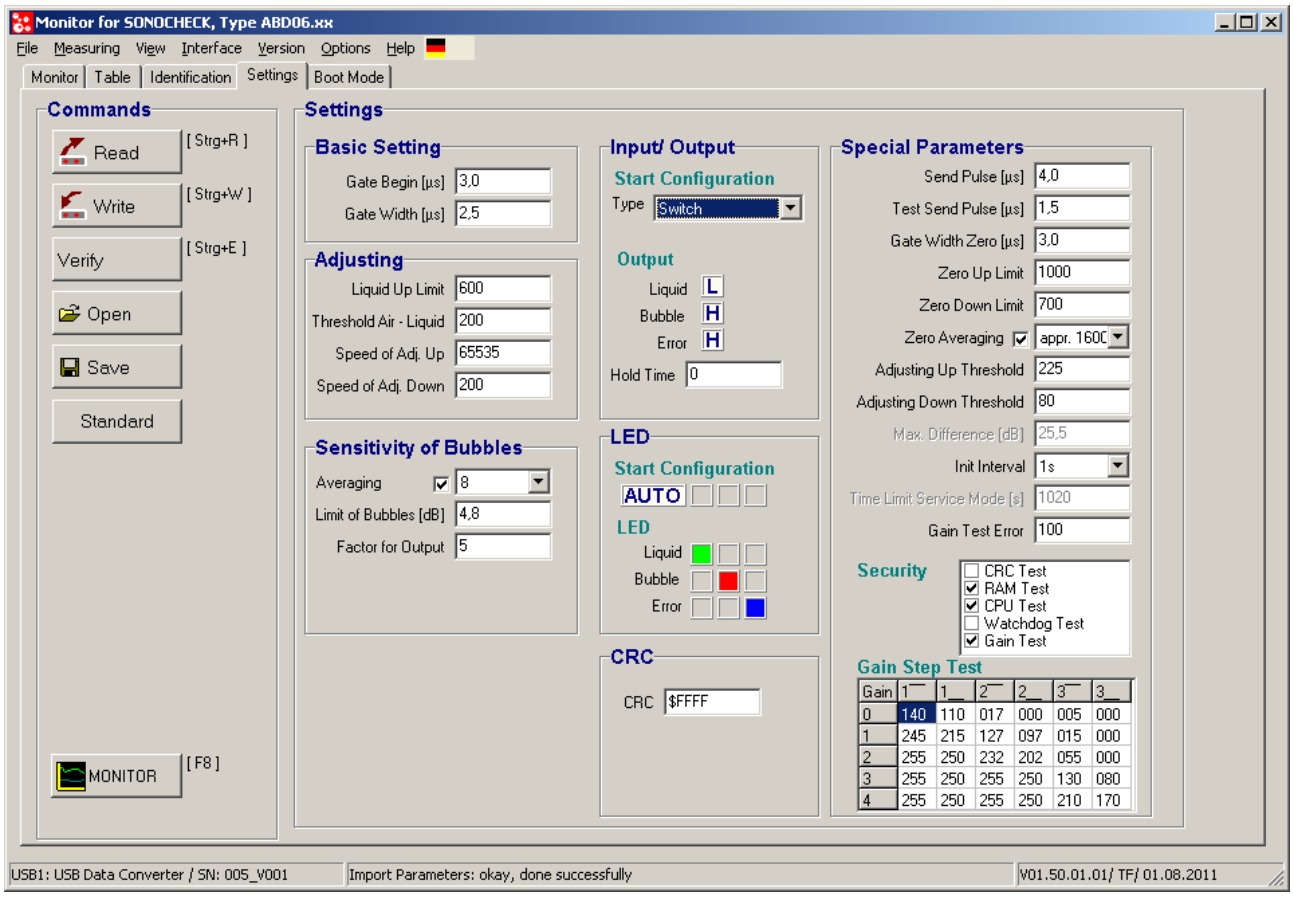


Figure 3. Form for Settings

Note 1
The described functions are not available with all devices and versions.

Note 2
The Assistant for settings type ABD06 was removed in expert version of monitor (ABD05M/ ABD06M). For using assistant apply standard monitor ABDM.

4.2 Basic Settings

4.2.1 Gate Begin / Gate Width

Gate Begin and Gate Width depend on width of channel directly, measured on the smallest position. It will be assumed that ultrasonic signal is received to following time:

Time-of-Flight [µs] = Width of Channel [mm] * 0.7 + 2

Gate should be set, that the received signal is acquired safely. With it all influence signals should be gated out, e.g. dying down of transmitter pulse, acoustical overdrive from sender to receiver over tube or casing.

Proposal:
Gate Begin = Time-of-Flight * 0.5
Gate Width = Gate Begin

Note:
With very small channels (< 3.4 mm) the signal should be determined more exactly. It is useful to scan the signal with a small Gate Width (1 µs) and with a Gate Begin at high resolution of 0.5 µs. Criteria for good setting is a maximum of dynamic, the difference between full and empty tube. Following Gate Begin and Width should be set afterwards:
Gate Begin = determined maximum – 1 µs
Gate Width = 2 µs

4.3 Adjusting

4.3.1 Liquid Up Limit

The limit is a protection against overdriving due to gross faults. If signal amplitude higher than the given limit, sensor goes into safe state (bubble alarm). This value should not be changed normally.

Proposal:
Liquid Up Limit = 600 [0.1 dB]

4.3.2 Threshold Air - Liquid

Plausible limit to detect an empty tube. If signal amplitude is lower than the defined limit, sensor goes to safe state, means bubble alarm.

This value should be found out by a test. Criterion for good setting is a safe output of state bubble in case of an emptied tube.

Proposal:
Empty tube
Restart sensor
Measure signal amplitude (see chapters top)
Threshold Air - Liquid = Signal amplitude [0.1 dB] + 100
(Typical values: 100 ... max. 300)

Note:
With very small channels (< 3.4 mm) the threshold with emptied tube should be checked more exactly. Put in and pull out the tube some times to find out the maximum of signal amplitude.

4.3.3 Speed of Adjusting Up and Down

Sensor acts to changed acoustical conditions, e.g. decreasing elasticity of tubing material. These parameters define the speed of adjusting to compensate alter conditions.

The Speed Up should be always much higher than Speed Down, because the intention of sensor is the detection of falling signals and to interpret they as bubbles. Sensor must not compensate falling signals caused by bubbles.
Optimal values for these parameters have to find out experimentally. E.g., if the pressure inside the tubing is changed rapidly (the acoustical coupling is changed too), the ratio of speed up and down should be adjusted.

Speed of Adjusting Up/ Down [dB / s] = Value of Parameter * 0.0076

Proposal for elastic tubes, normal application:

Speed of Adjusting Up	= 65535 (max.)	→ 500 dB / s
Speed of Adjusting Down	= 200	→ 1.52 dB / s

Proposal for rapid changes of pressure inside the tube:

Speed of Adjusting Up	= 10000	→ 76 dB / s
Speed of Adjusting Down	= 1000	→7.6 dB / s

4.4 Bubble Sensitivity

4.4.1 Limit of Bubbles / Factor for Output

Bubbles cause a decreasing of signal. The limit of bubbles defines the threshold to give out bubble alarm. The limit corresponds with Factor for Output in calculation of value for bubbles.

We don't recommend changing these parameters. Only in special cases the pair of parameters should be changed.

Parameters	***less sensitive***	***Proposal***	***more sensitive***	***extreme sensitive***
Limit of Bubbles [dB]	6.0	**4.8**	3.0	2.4
Factor for Output	4	**5**	8	10

Table 3. Output Factor and Limit for Bubbles

Note:
The output value for bubbles will be calculated internally as the difference between measured signal amplitude `Ampl` and reference value `AmplMax`, multiplied with factor for output.

Output Factor and Limit of Bubbles correspond with each other: e.g. Limit of 4.8 dB (= 48 [0.1 dB]) multiplied with factor of 5 is 240. That is the max. value for bubble output and means bubble alarm.

Example:
Bubble causes falling signal of ca. 1 dB (=10 [0.1 dB]). Using factor of 5 the Bubble Output is set to 50. If a serial protocol is applied the controlling can registry that small bubble.

4.4.2 Averaging

The decreased signal caused by bubbles can be averaged for a high stability of system. The response time to bubbles can be varied.

Proposal:

Averaging	= 8	normal application, fast but with high stability
	= 1 (OFF)	extreme fast reaction to bubbles (or a disturbance)
	= ca. 125	slow reaction to bubbles, only large bubbles will be detected

4.5 Input / Output

4.5.1 Start Configuration

Configuration of serial interface after restart. That setting is especially important for ABD05, because there is not a separate switching output.

Setting	*Interface Mode*	*Notes*
Switch	0	**Easy Bubble Detection (yes / no)** Output: Switching output Input: Serial input (e.g. controlling of LED) External Bubble Test via serial interface using command
Serial Standard	1	**Bubble Detection (with output of bubble values), Diagnosis** Output: Serial output, sends long protocol automatically Input: Serial input (e.g. controlling of LED) External Bubble Test via serial interface using command
Serial Diagnosis	2	**Bubble Detection (with output of bubble values)** Output: Serial output, sends short protocol automatically Input: Serial input (e.g. controlling of LED) External Bubble Test via serial interface using command
Serial Dialogue	3	**Service only** Output: serial, dialog mode (for internal analysis) Input: serial (for commands) External Bubble Test not useful
Digital Test Input	4	**Easy Bubble Detection (yes / no)** Output: Switching output Input: digital test input, active L releases bubble simulation (Bubble Test)

Table 4. interface Mode and configuration of in- and output

ATTENTION:
Using Interface Mode 4 serial input becomes inactive, because it get the alternate function as digital input for bubble test. There is no communication more possible. To change this setting, you have to send serial commands immediately after power on (e.g. command to change to Interface Mode 1).

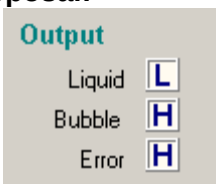
Testequipment for ABD05.xx (USB Data Converter, Type V007) supports Interface Mode 4, due to internal power off/ on for power supply.

Set hook for support power off/on option

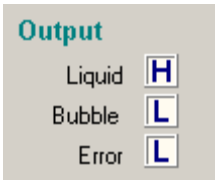
4.5.2 Output

Assignment of logical level to different events:

Proposal:



Standard application



Inverse configuration, failed power supply leads to alarm

4.5.3 Hold Time

After each changing of the switching output, the defined hold time is started newly. The next level change is not possible until the hold time is up.

It is useful to avoid jittering of connected relays.

4.6 LED

Configuration of LEDs useful for sensors with integrated LED only (e.g. ABD05.50).

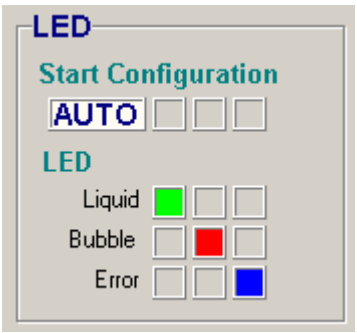
4.6.1 Start Configuration

After restart the defined LED is switched on.
AUTO = The sensor switches the blue one for a short time after restart, then the sensor controls LED automatically according detected events.

4.6.2 LED

Assignment of LED to events.
This setting is useful, if sensor controls LEDs automatically (AUTO).

Proposal:



4.7 CRC

There is an optional protection against inconsistent flash code - especially useful for applications with high requirements to safety. To activate CRC the procedure has to be enabled (see chapter 4.8.12)

Parameters (settings) are included in calculation of CRC. In case of activated CRC, you have to set a proper CRC after each changing of settings.

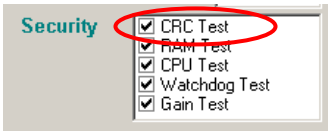


Figure 4. Activating CRC Test

For changing please act in the following sequence:

1. Stop monitoring [ESC]
2. Change to form “Settings” and edit parameters
3. Write parameters into sensor [Ctrl+W]
4. Change to form “Monitor”, select Serial Mode “Seriell lang/ Serial long”
5. Start monitoring [F3]
6. Change to form “Table” [F8]
7. The sensor will output a CRC-Error 87H, see Column “Error “. In the column “Test” the new calculated CRC will be given.
8. Change to form settings and edit CRC. Note: there are hexadecimal characters with a leading “$”
9. Write parameters into sensor [Ctrl+W], the new CRC is included
10. The sensor should start without an error message.
11. If you want, you can verify CRC with the function: Read parameters [Ctrl+R].

CRC is handled as parameter. That means, you can CRC read, write, export or import together with all other settings.

In applications without safety requirements CRC procedure should be disabled.

4.8 Special Parameters

These parameters are more sophisticated and should be changed from customer only by consulting the service staff of SONOTEC.

4.8.1 Send Pulse

Time interval for charge pump of transmitter in µs.

Standard Value:
Send Pulse = 4 µs *(optimum, adjusted to External Bubble Test, see chapter 4.8.2)*

4.8.2 Test Send Pulse

Time interval for charge pump of transmitter in case of an activated External Bubble Test. The received signal will be decreased for ca. –8 dB.

Standard Value:
Test Send Pulse = 1.5 µs *(adjusted to normal send pulse, see 4.8.1)*

4.8.3 Gate Width Zero

Time gate for zero calibration. In this window the ADC signal is acquired without any ultrasonic signal.

Standard Value:
Gate Width Zero = 3 µs *(optimum for a minimum of needed time)*

4.8.4 Zero Up Limit/ Zero Down Limit

During zero calibration of ADC the value `ADCZero` is acquired as reference (see chapter 3, Column ‘Zero’). This value is checked for plausibility and should be in range of Up and Down Limit. If zero point exceeds these limits, the safe state will be output (bubble alarm).

Standard Value:
Zero Up Limit = 1000
Zero Down Limit = 700

4.8.5 Zero Averaging

During zero calibration of ADC the value `ADCZero` is acquired as reference (see chapter 3, Column ‘Zero’). For more stability the zero point is averaged over long time.

Standard Value
Zero Averaging = ca. 1000 / Floating Averaging

4.8.6 Adjusting Up Threshold/ Adjusting Up Threshold

The range of ADC has a limited dynamic range of ca. 25 dB. This corresponds with measured amplitude `Ampl` and calculated reference `AmplMax` in range of = 0 ... 255 [0.1 dB].

If limits are crossed the amplifier is switched to the next gain step of ±10 dB. Such a way the algorithm supplies operation of ADC in optimal range.

Standard Value:
Adjusting Up Limit = 225
Adjusting Down Limit = 80

4.8.7 Max. Difference

ABD05.30 only

Steps of gain are designed to 10 ± 1 dB. Shortly after switching the gain of amplifier in these steps, small deviations from ideal value of gain could be occurred. If bubble sensitivity is very high, then it is possible that these deviations can cause a failed alarm of bubbles. It lasts a defined time to compensate these deviations by reference `AmplMax` . To minimize this time the algorithm can adjust reference value rapidly in the max. range of this parameter.

Standard Value:
Max. Difference = 1.0 dB

4.8.8 Init Interval

After power on internal procedures are started to check functionality. During this interval the blue LED is switched on as a sign for this phase. For a clearly behave for customer, the init interval can be belonged.

Init Interval is very important for Interface Mode 4 (Dig. Test Input), see chapter 4.5.2. Inside this time interval the superior controlling unit has access via serial interface. After finishing of the time interval the serial interface is disconnected. Maybe it is useful to extend this interval.

Standard Value:
Init Interval = 1s

4.8.9 Time Limit Service Mode

ABD05.30 only

Type ABD05.30 is restricted in functionality strongly. Interface Mode 3 is defined as Service Mode. If the time limit is up the Service Mode is switched off automatically.

Standard Value:
Time Limit Service Mode = 1000 s

4.8.10 Gain Test Error

Internal gain test, as a part of the self-test routines, acts of course to all occurred influences, e.g. electromagnetic singular hits. For a high stability of system the test should get the possibility for repeating. This parameter defines the max. count of repetitions.

Standard Values:
Gain Test Error = 100

4.8.11 Gain Test

Gain Test is part of internal self-test routines. Receiver is tested with 3 different test electrical signals. The results are evaluated with defined limits containing in the table. Limits are set experimentally. They should not be changed.

Standard Value:

Gain Step Test

Gain	1‾	1_	2‾	2_	3‾	3_
0	140	110	017	000	005	000
1	245	215	127	097	015	000
2	255	250	232	202	055	000
3	255	250	255	250	130	080
4	255	250	255	250	210	170

Upper and lower limits [0.1 dB] for test signals 1/ 2/ 3 and step of gain 0 .. 4

4.8.12 Security

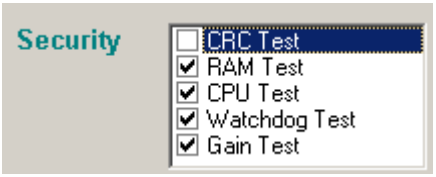
Note: Function available for software version 1.30 or higher.

Using this setting, self-test routines can be enabled or disabled.

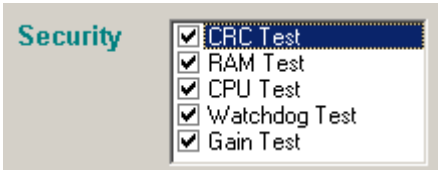
PAY ATTENTEION:
For ABD 06.xx WD Test must not be enabled, because there is not a WD implemented!

PAY ATTENTEION:
If CRC is set, than it has to be calculated newly after each changing of parameters, see chapter 4.7.

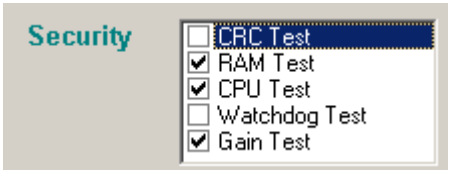
Standard Value:



Standard application ABD05.xx



Security relevant application ABD05.xx



Standard application ABD06.xx

5 Identification

5.1 Form for Identification

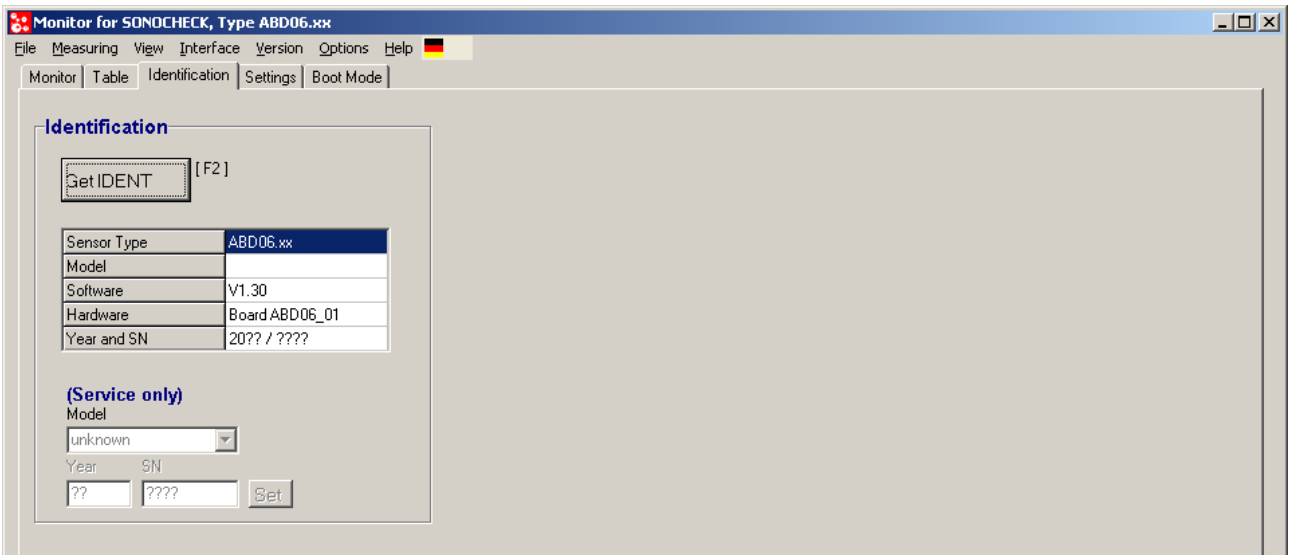


Figure 5. Form for Identification of Sensor, Sensor Type, Version …

5.2 Get Ident

This function is available in Interface Mode 3 only (Dialog).

Depending on type of sensor information about Type/ Subtype/ Hardware/ Software can be read. Such a way sensor can be identified and it can be made sure, that monitor is set correct for type and version.

ABD05.30 only
There are additional information about Model/ Year of Manufacturing and Serial Number

This function will be advanced in the next generations of sensors.
Setting of identification data is allowed for manufacturer only.

File: OM_SONOCHECK_Notes to Settings_FW1.30_Rev.5.0_2011-10-26.doc

SONOTEC

SONOTEC Ultraschallsensorik Halle GmbH
Nauendorfer Straße 2, 06112 Halle (Saale)
www.sonotec.de

e-mail: SONOTEC@sonotec.de
Tel. +49 (0)345/1 33 17- 0
Fax +49 (0)345/1 33 17-99