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Stationary Reader

SR3000 (V1) and SR3000 V2

Installation Manual

D02C2.1 SR3000

DEC-2013

This documentation covers two versions of the Stationary Reader SR3000 (V1) and SR3000 V2 manufactured by BioControl, Norway.
Documentation version 2.1 completely replaces previous versions.

Modifications since last documentation versions:
Version 2.1
- *Updated for the new SR3000 V2*
- *Removed chapter* "Figures, drawings, tables"
- *New command 0x3c Get System Status – valid for SR3000 V2 only!*
- *New chapter "Diagnostics with SR3000 Config tool"*
- Minor changes

Version 1.7
- New command 0x2d

Version 1.6
- New Baudrates 1200,2400,4800

Version 1.5
- X23 – 8 - Enable real time auto tuning
- Appendix B: New Program Loader
- Appendix D: The SR3000 Config program
- Minor changes

Version 1.4
- Appendix C: The Application for a slaughterhouse.

Version 1.3
- New command 0x11
- Default settings
- Table 3.2: Description of RS-232 connector G changed Pins 5, 2, 3.

Version 1.2
- New command 0x0f
- New HEX output frame

Version 1.1
- Table 3.4: Description of RS-232 connection Pin 9 changed to Pin 5.
- Table 3.11: Set slave - fixed dipswitch settings

1 Contents

2 System overview

The SR3000 is a Stationary Reader for ISO 11784/11785 transponders with very good reading performance thanks to its dedicated RFID processor and auto-tuning function. The reader is equipped with two processors:

- Atmega which is responsible for communication, and
- DSP/ARM responsible for reading transponders.

SR3000 comes with a range of panel antennas and can read and control two inputs and two outputs. It is therefore ideally equipped for integration by System Integrators and OEM's.

Figure 2.1 shows an overview of an SR 3000 Single Reader configuration system which consists of:

- Stationary Reader (SR3000),
- Antenna (SA SR3000), and
- Power Supply (PS SR3000).

The PC is optional and is not required for a working system.

The SR3000 is installed in an IP 65 enclosure with clear RFID indicator lights. A simple communication protocol sets and reads the I/O's and can also switch on/off the HF-field. The integrated auto-tuning warrants optimum identification in dynamic environments, even when the antenna environment changes due to (unexpected) external circumstances. The DSP-algorithm is fine-tuned for optimum RFID performance with both FDX-B and HDX transponders.

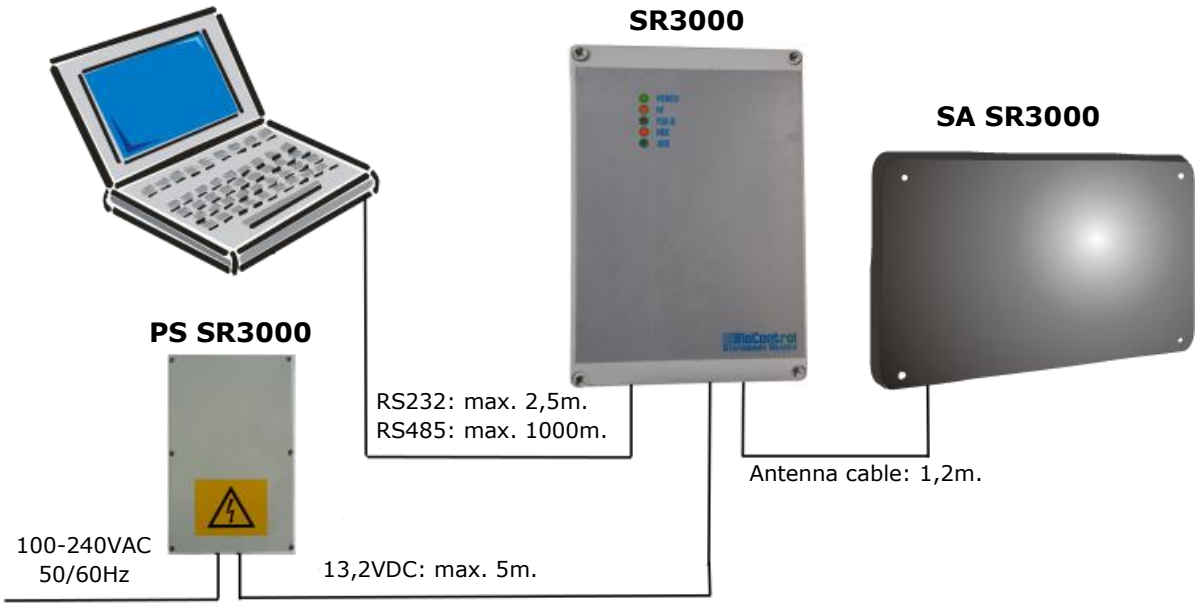

Figure 2.1: SR3000 Single Reader configuration

3 Installation

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This information is only valid for Multiple Reader installations with SR3000 (V1): *Because of minor carrier frequency differences between SR3000 V2 and SR3000 (V1), a Multiple Reader installation must be equipped with ONLY V1's OR V2's (a mix of V2 and V1 must not be installed in the same Multiple Reader installation).*
In case of service and replacement of a V1 by a V2 in a Multiple Reader installation, all V1's in that installation must be replaced. Contact BioControl for the replacement strategy for these installations. See chapter 3.5.2

3.1 Antenna installation guidelines

To get a reliable identification of animals passing the stationary reader antenna, a 'safety area' outside the antenna must be respected. Inside this area metal-reinforced building structures or other metal equipment short-circuiting the antenna electromagnetic field are not allowed.
By following the guidelines set out in this chapter, you will be able to cover most installation requirements to achieve maximum performance of the SR3000.

- The antenna wire used has proven to be water resistant and can be exposed to water.
- Use the pre-drilled holes on the antenna for mounting.
- Do not mount the antenna in direct sunlight.
- Mount the antenna on a nonconductive material (e.g. plywood).
- If mounted on a concrete wall, make sure the wall does not contain any metal reinforcement.
- Metal in proximity of the antenna (e.g. fences, pipes and metal loops) will cause damping or detuning and the reader system will have lower performance.
- Do not cut the antenna wire to make it shorter. This will cause detuning.
- Make sure that the antenna wire is properly fixed so it cannot move. If the antenna wire has physical movement then this can reduce the performance.

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- The antenna is made of litz wire which has many insulated wires. To have good current flow and low resistance, the end of the cable must be soldered very hot so that all individual insulated wires are connected – **DO NOT CUT THE END OF THE ANTENNA CABLE!**

Table 3.1: Antenna parameters range

SR3000 version	Antenna inductance			Q factor
	Minimum	Perfect	Maximum	
V1	25,2uH	25,9uH	26,6uH	80-90
V2	25,4uH	26,3uH	27,2uH	80-90

3.2 Power supply

Power supply is a critical factor in RFID. For best RFID performance use ONLY original BioControl PS SR3000 DC stabilized power supply or car battery.

Table 3.2: Power supply range

SR3000 version	Power supply	Typical
V1	11-14 VDC	13,2 VDC
V2	11-30 VDC	13,2 VDC

Current consumption varies with the type of antenna which is used and power supply voltage. The table below shows the current consumption with a medium size antenna (600x400mm)

Table 3.3: Current consumption with medium size antenna (60x40cm)

SR3000 version	Power supply	Current consumption
V1	13,2 VDC	1,1 A
V2	13,2 VDC	1,4 A

Note:

- Mount SR3000 Power Supply minimum 1 meter away from SR3000 board and antenna.
- Do not share power with other equipment!
- Make sure that a mains (AC power) electrical wiring system is property grounded!

3.3 Electronic enclosure

For EMC-compliance the SR3000 IP 67 enclosure should be installed on the metal mounting bracket that is supplied with the SR3000.

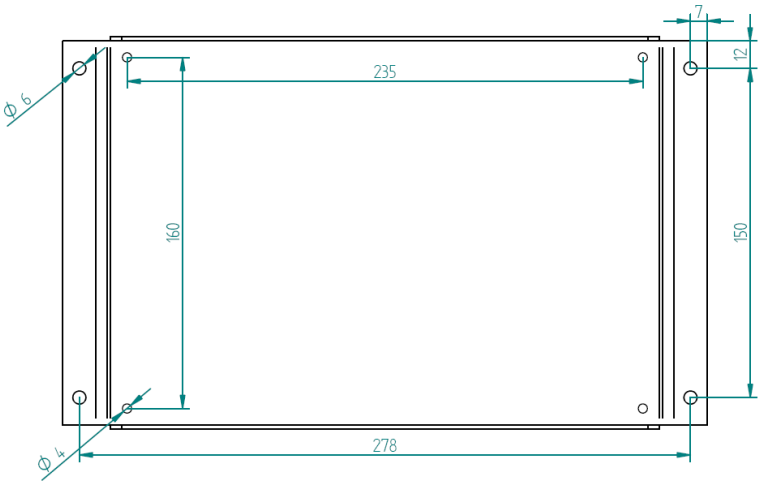


Figure 3.1: Mechanical dimension and drilling pattern of metal mounting bracket

3.4 Connections

3.4.1 Cable inlets

The cables should be pulled through the grommets according to the table below (recommendation).

Note: One cable per grommet only!

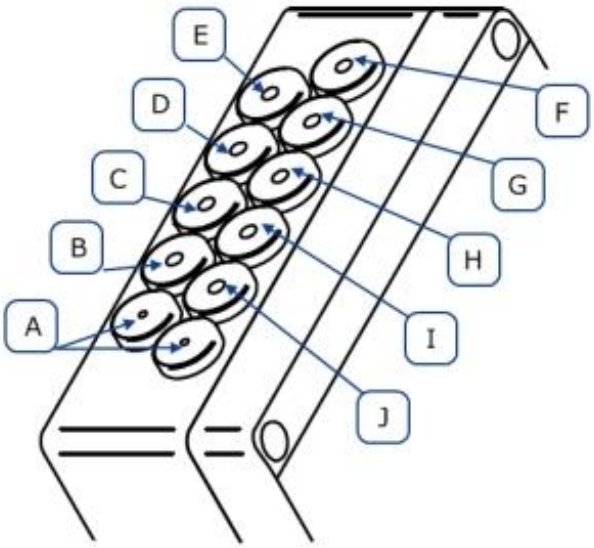


Figure 3.2: Cable inlets overview

Table 3.4: Description of recommended cable inlets

Cable glant	Cable description
A	Antenna cable
B	RS232 cable (Pre-assembled)
C	Input 2
D	Output 1
E	Output 2
F	Power supply
G	Input 1
H	RS-485 cable
I	Synchronization OUT
J	Synchronization IN

3.4.2 Connectors description

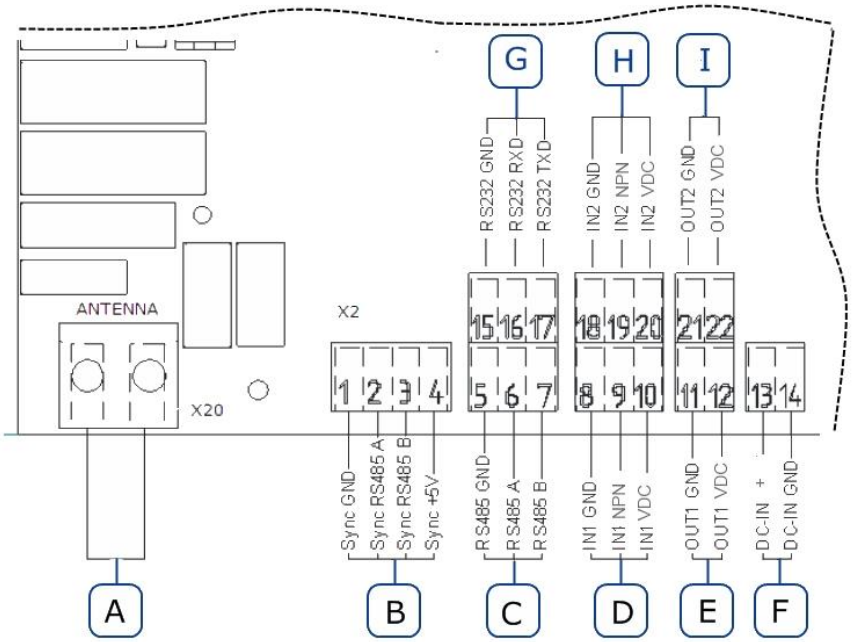


Figure 3.3: Connectors overview

Table 3.5: Description of cable connectors

Connector	Pin	Function	Description
A	ANT	Antenna terminals	Two antenna terminals
B	Pin 1	Reader synchronization	Ground. LIYCY
	Pin 2	Reader synchronization	RS485 - A. LIYCY
	Pin 3	Reader synchronization	RS485 - B. LIYCY
	Pin 4	Reader synchronization	+5VDC. LIYCY
C	Pin 5	RS485 - Communication	Ground
	Pin 6	RS485 - Communication	RS485 – A
	Pin 7	RS485 - Communication	RS485 – B
D	Pin 8	Input 1,	Ground
	Pin 9	Input 1,	NPN input
	Pin 10	Input 1,	VDC*
E	Pin 11	Output 1	Ground
	Pin 12	Output 1	VDC output*
F	Pin 13	Power supply	VDC input*
	Pin 14	Power supply	Ground
G	Pin 15	RS232 - Communication	Ground to 5 PIN DSUB
	Pin 16	RS232- Communication	RX to 3 PIN DSUB
	Pin 17	RS232- Communication	TX to 2 PIN DSUB
H	Pin 18	Input 2	Ground
	Pin 19	Input 2	NPN input
	Pin 20	Input 2	VDC*
I	Pin 21	Output 2	Ground
	Pin 22	Output 2	VDC output*

*** Note** that these values may vary depending on power supply voltage.

3.4.3 Connecting the antenna wire

Pull the antenna wire through the grommets and then through the ferrite (see figure below) to the antenna connector [A]. The ends of the antenna should be screwed tight in the connector. The ferrite should be used for EMC reasons.

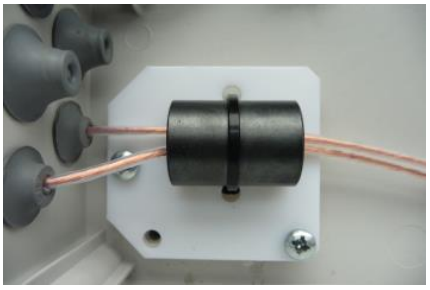


Figure 3.4: Ferrite with bracket

Warning! *Do not touch the antenna connector [A] as they are charged and could give you an electric shock. Always switch off the power before opening the box.*

3.4.4 Connecting the LIYCY reader synchronization cable

When using more than one SR3000, ON/OFF synchronization of the HF-field is essential because two or more antennas are active with a relatively small distance between them. For this reason, each SR3000 unit contains a synchronization terminal. HF-synchronization requires one master which triggers the HF-field of one or more slaves.
The electronics handling the synchronization is a standard RS485 industrial communication bus. It is capable to handle a maximum cable length of 200 meters.

Use the cable LIYCY 2*2*0.25mm (or equivalent). LIYCY is a low-cost standard signal cable and recommended for the reader synchronization. It consists of 2 pairs of independent twisted wires in a shielded cable. It is used for its robustness against electric and magnetic disturbances.

If two or more readers are used then connect wire sync cable between readers one-to-one as described in the table below.

Table 3.6: Wire sync connection

SR3000-1	SR3000-2	SR3000-n	LIYCY wire (recomm.)
Pin 1	Pin 1	Pin 1	Brown* –GND
Pin 2	Pin 2	Pin 2	Yellow*- A
Pin 3	Pin 3	Pin 3	Green*- B
Pin 4	Pin 4	Pin 4	White*- +5VDC

*colors depend on used cable

Note: one pair is for +5V power and ground, and the other pair is for the RS485 -A and -B. The shielding should be connected to GND.

If more readers are used, connect 1 to 1, 2 to 2, etc, as in the table above.

Note: One SR3000 must be set as Master, others connected to sync. bus as Slaves – see chapter 3.5.2

3.4.5 Connecting the RS-232 cable to a PC

Table 3.7: Description of RS-232 connection

SR3000	Description	9 Pin DSUB female
Pin 15	Ground, RS232	Pin 5
Pin 16	RX, RS232	Pin 3
Pin 17	TX, RS232	Pin 2

Note: on the SR3000 RS-232 must be set to ON by the micro switch block X24 pins 5 and 6 - see chapter 3.5.3

3.4.6 Micro switch description – X11, X23, X24

See also chapter 7 Main board to find micro switches on the printed circuit board.

Table 3.8: Description of X11 micro switch

	X11	Default
1	Synchronization Power from Master to Slave cards	ON
2	Synchronization Ground from Master to Slave cards	ON
3	Master / slave selection	OFF
4	Always ON	ON

Table 3.9: Description of X23 micro switch

	X23	Default
1	Node addressing	ON
2	Node addressing	OFF
3	Node addressing	OFF
4	Node addressing	OFF
5	For future use	OFF
6	Set default mode when ON	OFF
7	For future use	OFF
8	Enable real time auto tuning	ON

Table 3.10: Description of X24 micro switch

	X24	Default
1	Enables RS232 – DSP	OFF
2	Enables RS232 – DSP	OFF
3	Enables RS485	OFF
4	Enables RS485	OFF
5	Enables RS232 – Atmega	ON
6	Enables RS232 – Atmega	ON
7	End resistor. Reader synchronization	OFF
8	End resistor RS485 – Communication	OFF

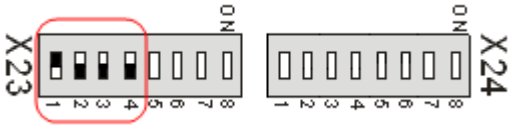
3.5 Set/configuration

3.5.1 Set/configuration of Node Address

The node address on the SR3000 must be set both when used as RS232 (Single Reader Configuration) and RS485 (Single and Multiple Reader Configuration).

The 4 first micro switches on X23 set the node address. In the table below a "1" indicates that the switch is ON, "0" indicates that the switch is OFF. "X" indicates that the position of it is not relevant to setting the node address.

Table 3.11: Set node address

X23 Node address	
1	1000XXXX
2	0100XXXX
3	1100XXXX
4	0010XXXX
5	1010XXXX
6	0110XXXX
7	1110XXXX
8	0001XXXX
9	1001XXXX
10	0101XXXX
11	1101XXXX
12	0011XXXX
13	1011XXXX
14	0111XXXX
15	1111XXXX

Note: configuration of node address is set independent of master / slave configuration.

3.5.2 Set/configuration of master and slave (Multiple Reader configuration)

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Note: *because of minor carrier frequency differences between SR3000 V2 and SR3000 (V1), a Multiple Reader installation must be equipped with ONLY V1's OR V2's (a mix of V2 and V1 must not be installed in the same Multiple Reader installation).*
In case of service and replacement of a V1 by a V2 in a Multiple Reader installation, all V1's in that installation must be replaced. Contact BioControl for the replacement strategy for these installations.

When SR3000's are installed close to each other, the HF-field of all readers must be synchronized. As a rule of thumb for the SR3000, when using Medium or Large antennas, the readers must be synchronized if they are closer than 50 meters from each other. This distance mainly depends on the amount of interference between the readers. The amount of interference depends on field strength generated by the antennas, the amount of metal shielding in the surroundings, and the angle of the antennas in relation to each other.

In a system like this there must always be only one master. It does not matter where the master is. The rest are slaves. There can be many slaves. End resistors must be set for the first and the last SR3000. The end resistors are necessary for error free bus communication. Example to connect max 15 readers is below.

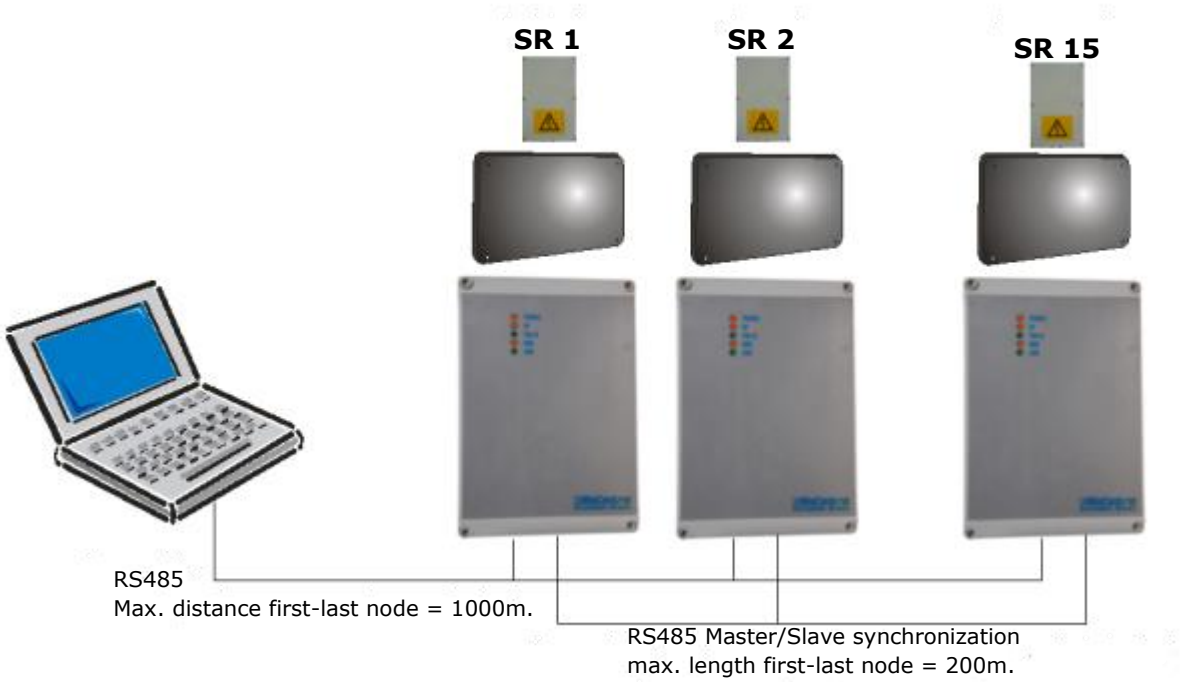


Figure 3.5: Multiple Reader configuration

Note: For each node, below settings must be made:
- Set master or slave (X11).
- Set end resistor or not for synchronization (X24/7).
- Set end resistor or not for RS 485 communication (X24/8).

Table 3.12: Example settings of readers.

Node	Master/Slave	End resistor
SR1	Slave	ON
SR2	Master	OFF
SR3	Slave	OFF
SRn	Slave	ON

Master or slave is set on the micro switch block X11. Follow the tables below for settings. "1" indicates that the switch is ON. "0" indicates that the switch is OFF. "X" indicates that the position is not related to this setting.

Table 3.13: Set master

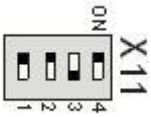
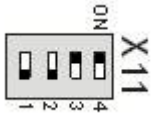
X11. Set master		
1	1	Power from Master
2	1	Ground from Master
3	0	Master
4	1	Always ON

Table 3.14: Set slave

X11. Set slave		
1	0	Power from Master
2	0	Ground from Master
3	1	Slave
4	1	Always ON

End resistor is set on the micro switch block X24. Follow the tables below for settings. "1" indicates that the switch is ON. "0" indicates that the switch is OFF. "X" indicates that the position is not related to this setting.

Table 3.15: Set end resistor

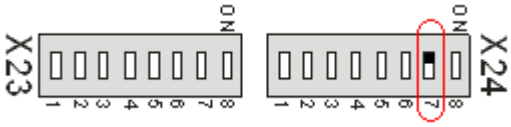
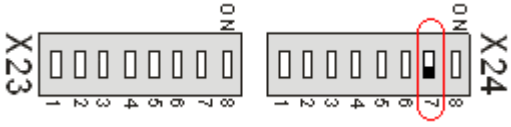
X24. Set end resistor		
1	X	Enables RS232 – DSP
2	X	Enables RS232 – DSP
3	X	Enables RS485
4	X	Enables RS485
5	X	Enables RS232 – Atmega
6	X	Enables RS232 – Atmega
7	1	100 Ohm end resistor. Reader synchronization
8	X	100 Ohm end resistor RS485 – Communication

Table 3.16: Not set end resistor

X24. End resistor NOT set		
1	X	Enables RS232 – DSP
2	X	Enables RS232 – DSP
3	X	Enables RS485
4	X	Enables RS485

5	X	Enables RS232 – Atmega
6	X	Enables RS232 – Atmega
7	0	100 Ohm end resistor. Reader synchronization
8	X	100 Ohm end resistor RS485 – Communication

Note: settings for master/slave and end resistor are done independently of each other.

3.5.3 Set/configuration of RS232 serial /RS485 bus communication

RS-232 and RS-485 are set on the micro switch block X24. Follow the tables below for settings. "1" indicates that the switch is ON. "0" indicates that the switch is OFF. "X" indicates that the position is not related to this setting.

Note: As a default the RS232 is set to ON

Table 3.17: Turn ON RS-232

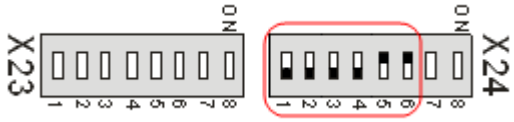
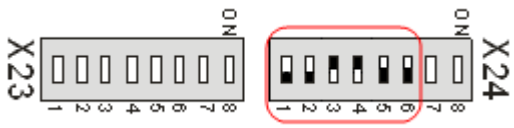
X24. Set RS-232		
1	0	Enables RS232 – DSP
2	0	Enables RS232 – DSP
3	0	Enables RS485
4	0	Enables RS485
5	1	Enables RS232 – Atmega
6	1	Enables RS232 – Atmega
7	X	100 Ohm end resistor. Reader synchronization
8	X	100 Ohm end resistor RS485 – Communication

Table 3.18: Turn ON RS-485

X24. Set RS-485		
1	0	Enables RS232 – DSP
2	0	Enables RS232 – DSP
3	1	Enables RS485
4	1	Enables RS485
5	0	Enables RS232 – Atmega
6	0	Enables RS232 – Atmega
7	X	100 Ohm end resistor. Reader synchronization
8	X	100 Ohm end resistor RS485 – Communication

4 Operation

4.1 Instructions for proper installation and operation

- It is important to plan the layout of the installation such that only one animal at a time is picked up by the stationary reader antenna.
- Each animal that passes the antenna must wear a good-functioning FDX-B or HDX transponders.
- Ear transponders should always be attached on the same side of the animal, either right or left ear. Mount the panel antenna on this side.
- If any new animals are introduced, always check that the transponder is placed on the same side as for the rest of your herd.
- Shield/direct the animal traffic such that the antenna cannot pick-up transponders of other animals unintentionally.
- Ensure that no conductive materials are close to the antenna.
- Do not direct high pressure cleaner directly towards the SR3000 housing.
- Don't change antenna cable length.
- Install Power Supply minimum 1 meter away from Stationary Reader and Antenna!

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- Cables should be placed so that they will not be walked on, chewed by animals or squashed in any way.
- DO NOT CUT THE END OF THE ANTENNA CABLE!

4.2 Antenna – auto tuning

The SR3000 has auto tuning to achieve optimum reading performance. This is a mechanism in the reader that adapts the reader to the antenna. It has two kinds of auto tuning.

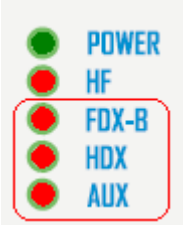
- First auto tuning is during the first 5 seconds after power up. It is indicated by the three lower LED's and the charge HF LED. During tuning the three lower LED's are on and the HF LED is blinking very fast. This tuning is done to adapt the reader to the connected antenna. This is done because of component tolerances, antenna tolerances and the fact that some metal will always be in proximity of the antenna.
- Second auto tuning is done continuously to cope with changing ambient and circuit board temperatures. This ensures optimum performance. However it is possible to turn it OFF by setting X23 -8 to OFF.

Auto-tuning of the SR3000V2 consist of two stages (coarse and fine) for optimum antenna adjustments.

4.2.1 Indication of incorrectly tuned antenna after power on (valid for both V1 and V2):

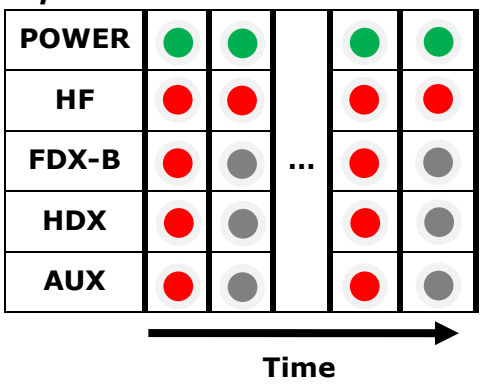
The reader and the antenna can be detuned in two ways described below and the sequence is shown only at start-up of the device for a few seconds after the auto-tuning.

- **Too low antenna inductance**

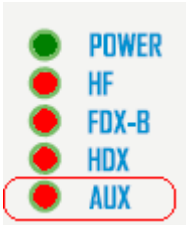


If the antenna inductance is lower than the tuning window can cope with, then the **<u>three</u>** indicated LED's blink 10 times after auto tuning. The reason can be too much steel in the proximity of the antenna, or the antenna or the reader can be broken. It can also be as simple as loose antenna terminals.

Table 4.1: LED's sequence of too low antenna inductance

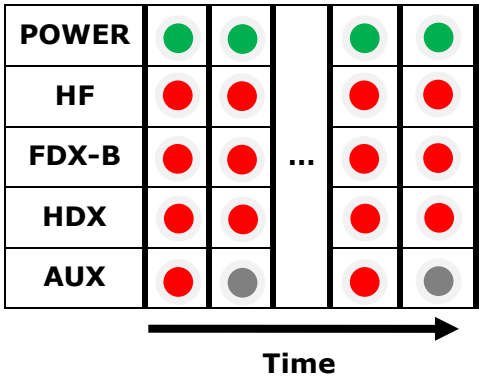


- **Too high antenna inductance**



If the **<u>AUX</u>** LED blinks 10 times after auto tuning then the antenna inductance is higher than the tuning window can cope with. The reason is antenna malfunction.

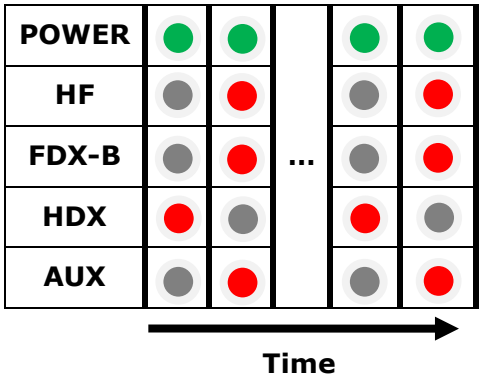
Table 4.2: LED's sequence of too high antenna inductance



4.2.2 Indication of reader malfunction – SR3000 V2 only.

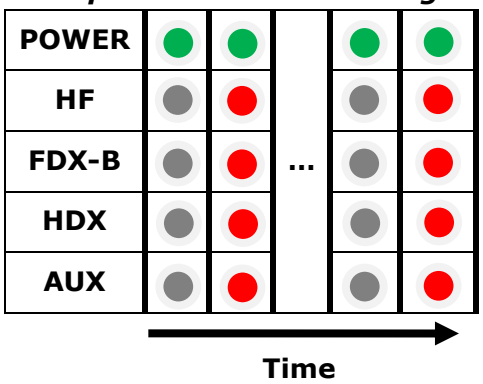
- If no antenna is present or there is an antenna malfunction, the below sequence is shown (only at start-up of the device for a few seconds).

Table 4.3: LED's sequence of no antenna present or antenna malfunction (only after full autotuning)



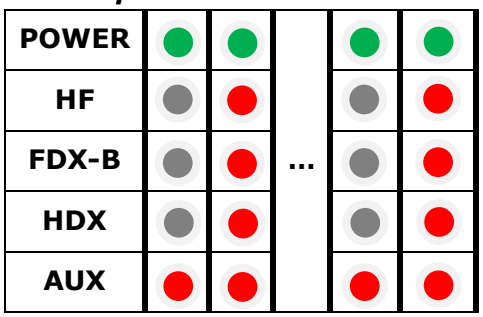
- If the below LED sequence is shows, the coarse tuning of the antenna is running. The reason can be big temperature changes. If this state is permanent (more than 10s) the reason is antenna malfunction. Reading of transponders could be possible with reduced range.

Table 4.4: LED's sequence of coarse tuning of antenna is running



- The below LED sequence shows that the SR3000 V2 failed to start-up, and the device will have wrong clock configuration due to a broken crystal. Disconnect device and call service.

Table 4.5: LED's sequence of SR3000 V2 failed to start-up



4.3 I/O Configuration

The SR3000 V1 and SR3000 V2 are equipped with:

- **RS232 interface** - standardized computer interface to communicate with a PC or other serial device
- **RS485 interface** - addressable interface on a bus
- **Hardware Synchronization** - The second RS485 for Master/Slave synchronization with optical isolation.
- **Two inputs** - equipped with pull-up resistors, can be used e.g. for detecting gate switch or photo cell.

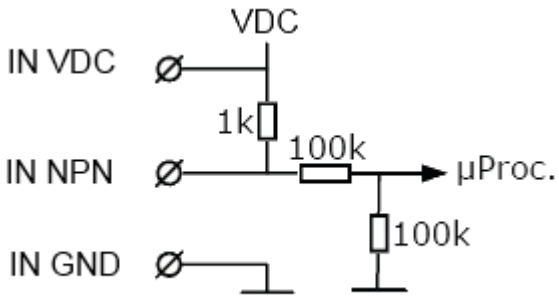


Figure 4.1: Input 1 and 2 of SR3000 V1

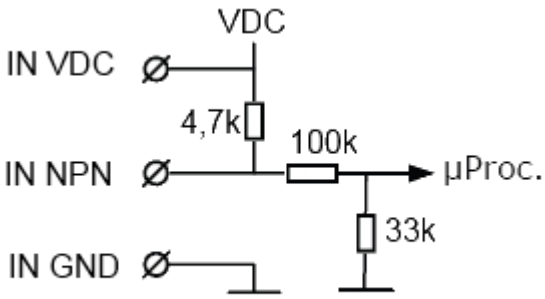


Figure 4.2: Input 1 and 2 of SR3000 V2

- **Two solid state outputs** - can be used e.g. to operate relays or actuators.

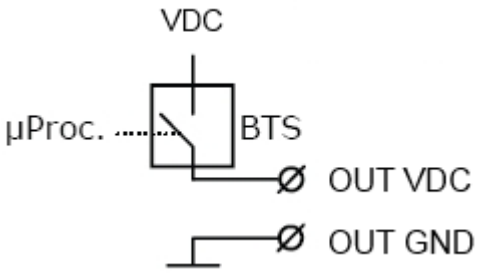


Figure 4.3: Output 1 and 2 (max 1.0A per output)

4.4 The hardware overview

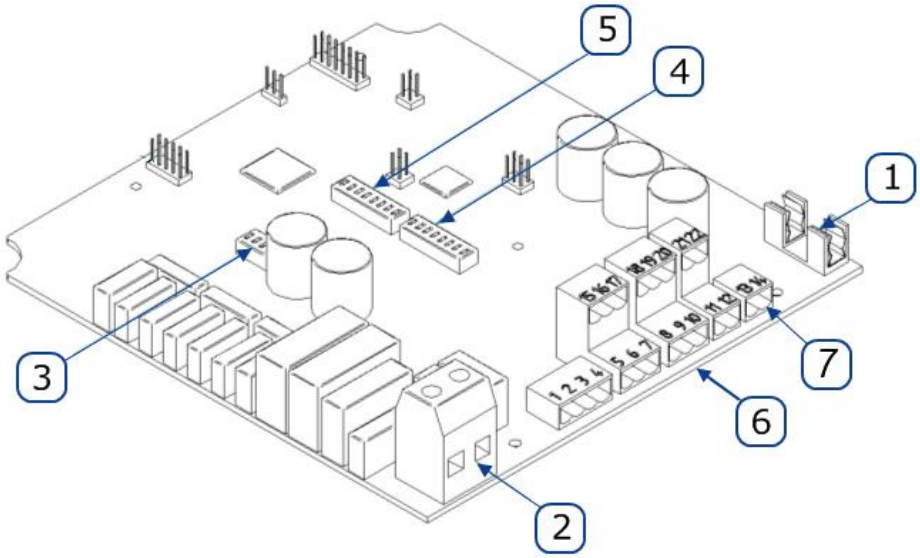


Figure 4.4: PCB overview

Table 4.6: Description of the main board

	Component	Description
1	Fuse	F5A/250V slow
2	ANT	Antenna connector
3	X11	Master or Slave configuration
4	X23	Set/configuration
5	X24	Set/configuration
6	Con	Interface connectors
7	Power	Main power supply connector

4.5 Recommended Operating Conditions

Table 4.7: Characteristics overview

Parameter	min.	typ.	max.	Unit
Dimension		171x164		mm
Power Supply voltage SR3000 V1	11	13,2	14	VDC
Power Supply voltage SR3000 V2	11	13,2	30	VDC
Current consumption with 60x40cm antenna SR3000 V1		1,1		A
Current consumption with 60x40cm antenna SR3000 V2		1,4*		A
Outputs voltage		13,2**		VDC
Outputs current			1	A
Inputs voltage		13,2**		VDC
Operating temperature range	0		45	^{o}C
RS-232 interface			1	pcs
RS-485 interface	`		1	pcs
RS485 Master/Slave synchronization (galvanic isolation)			1	pcs
Inputs (pull-up resistor)			2	pcs
Outputs			2	pcs
Cable length first-last node for synchronization			200	m
Cable length for connecting SR 3000 SI to a PC using RS-232		1,5	3	m
Cable length for connecting SR 3000 SI to a PC using RS-485			1000*	m

* current consumption depends on an antenna parameters such as size and Q factor.
** the voltage depends on main power supply voltage

5 Trouble shooting guidelines

Problem	Solution
Metal pipes are placed where I want the antenna to be.	Cut away metal pipes. Mount the antenna on wood, plastic or other non conductive material.
One reader installation performs worse than another installation.	- Make sure that all animals have only one type of ISO transponder. - Best performance is achieved if all the transponders are on the side of the animal which is closest to the antenna panel. - Check that transponders have stable reading. To do this the transponder must be removed from the animal, tested in front of the antenna and compared with a good transponder. - Sometimes HDX and FDX can have reduced performance. This will happen if the transponder is physically damaged or if the environment is extremely noisy. - Check that there is no metal in proximity of the reader that can have mechanical vibrations (especially for FDX-B). - Check that the power supply is stable and in the required range, otherwise use battery. - Check that the antenna wires are not damaged. - Retighten antenna wires on terminal ANT. - Check that the antenna is tuned. Restart the board while looking at the LED's. Make sure that no steel work is added or removed in the proximity of the antenna after the reader is tuned. - Check that protected earth, PE, is connected from pin 14 to the main fuse board. - If other stationary readers are in the same area then they must be synchronized. - If synchronization is not possible then an absolute minimum distance of 50meters must be respected between unsynchronized equipment. - Check that protected earth, PE, is working. Earth problems can cause worse performance. Contact electrician.
On one reader the Power LED and the Charge LED are always on. It does not read transponders.	The reader is in Slave mode and the connection to the master is not working.

Sometimes the reader performs really badly. There is a motor with a variable speed drive nearby.	The variable speed drive must be installed correctly for it not to generate too much RF interference. The following must be checked on the variable speed drive: - Shielded power cables - Shielded control cables - Shielding connected all the way from control panel to speed drive and to motor cables. - Protected earth connected all the way from main fuse board to speed drive and further to motor and control panel. - Main power filters between main supply and variable speed drive.
Low performance on transponders. There is a monitor with CRT tube very close to the reader.	Install monitor according to CE e.g. a flat screen monitor instead. They generate less magnetic field disturbance.
The antenna wires are open. I am afraid that moisture can damage it.	The antennas are designed to cope with moisture and direct hosing.
Several animals can have their transponder in the antenna field at the same time.	This must be solved by having a narrower ally where the animals pass.
One animal has two transponders. One is a FDX neck implant and the other is a HDX ear tag. This seems to cause problems.	FDX and HDX can be read at the same time but this can reduce performance. The only solution is to remove one of the transponders.
Power supply LED is off	Make sure that the board has proper main power supply voltage.
The reader worked well when I installed it, but one year later reading is not as good.	If the SR3000 is installed in an environment where vibrations occur, then all terminals must be tightened once in a while. The antenna terminal is the most critical one. Loose antenna wires will have big impact on detection transponders.
Low performance when SR3000 V1 is working together with SR3000 V2	V1 and V2 cannot work in the same installation!

6 Communication Protocol

The SR3000 comes with an implemented special communication protocol which gives the ability to customize the reader to OEM applications. The reader can communicate with a host device thru either RS232 or RS485 interface.

6.1 System overview

Figure 6.1: The Transponder Logger system

The figure above shows an overview of the example of a Transponder Logger system consisting of:

- Stationary Reader (SR 3000)
- Antenna (SA SR3000)
- Power Supply (PS SR3000)
- Host: any PC with RS232
- BioControl 'Transponder Logger' or 'SR3000 Config' program

The programs can be downloaded from the 'Community' section on the BioControl website http://www.biocontrol.no.

6.2 Default settings of communication

Originally the reader comes with the following default setup used for the communication with a host device, e.g. PC:

Table 6.1: Default communication settings

Parameter	Value
Baud rate	115200 bit/s
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Table 6.2: Default mode setup

Send format:	0x06	hexadecimal
Send mode:	0x04	send transponder when requested only

Note: *In this mode reader is sending transponder only when requested by host!*

However it is possible to change the above settings, and some of them are stored in nonvolatile memory and are restored after power on (please refer to the section below for more details).
It is possible at any time to restore the default settings by hardware. To do this the dip switch X23 pin 6 must be ON when you turn on the SR3000.

6.3 Communication between SR3000 and host

The messages are sent as hexadecimal values coded in ASCII. Each hexadecimal value can be in the range 0x00 to 0xFF, thus two ASCII characters are needed for each sent value. Every frame is starting with two colons '**::**', and ending with semicolon ';'. One frame consists of the following items:

::ddssmmppcc;
Example: **::01f82d01f6;**

Table 6.3: SR3000 communication frame structure

Parameter	Description	Example
Start character	Two colons as the start character	**::**
Destination address	Two ASCII characters defines the destination address	**dd (01)**
Source address	Two ASCII characters defines the source address	**ss (f8)**
Message type	Two ASCII characters.	**mm (02)**
Parameter	Optional	**pp (01)**
Checksum	The binary sum of all characters, starting with the destination address, ending with the last character before the checksum itself	**cc (f6)**
Stop character	One semicolon	**;**

6.3.1 Checksum calculation

The checksum is calculated by adding the ascii value of all characters, starting with the destination address, ending with the character in front of the checksum itself. Start and stop characters are not valid for checksum calculation.

Note: Be aware that uppercase letters and lowercase letters have different ASCII values. Thus the checksum will differ for a message if the case is changed!

Example with lowercase letters:
::01f82d01f6;

:: - start characters
01f82d01 –The checksum is calculated from these characters
f6 – the checksum
; - stop character

ASCII value of '0' is 0x30
ASCII value of '1' is 0x31
ASCII value of 'f' is 0x66
ASCII value of '8' is 0x38
ASCII value of '2' is 0x32
ASCII value of 'd' is 0x64
ASCII value of '0' is 0x30
ASCII value of '1' is 0x31

0x30 + 0x31 + 0x66 + 0x38 + 0x32 + 0x64 + 0x30 + 0x31= 0x01f6

When the sum of all the ASCII values are ready, the least significant byte of the calculation is converted into ASCII and added to the end of the message.

0x01f6=> ~~0x01~~ 0xf6=>f6

Example with uppercase letters:
::01f82D01B6;

ASCII value of '0' is 0x30
ASCII value of '1' is 0x31
ASCII value of 'F' is 0x46
ASCII value of '8' is 0x38
ASCII value of '2' is 0x32
ASCII value of 'D' is 0x44
ASCII value of '0' is 0x30
ASCII value of '1' is 0x31

0x30 + 0x31 + 0x46 + 0x38 + 0x32 + 0x44 + 0x30 + 0x31= 0x01B6
0x01B6=> ~~0x01~~ 0xB6=>B6

6.3.2 Messages sent to the SR3000 reader

The following messages are implemented and give the possibility to change reader settings. Each message must be a part of the frame as described above.

Table 6.4: Messages sent to the reader

Message	Description
0x00	Turn the reader off
0x01	Turn the reader on (default)
0x2d	Stop/Start the field of the antenna
0x02	Set mode 1, send new transponder number once *
0x03	Set mode 2, send transponder number continuously *
0x04	Set mode 3, send transponder when requested only(default) *
0x07	Request transponders
0x05	Send as decimal, according to ISO 24631-6*
0x0f	Send as hexadecimal (only transponder number) *
0x06	Send as hexadecimal (default) *
0x11	Change Baud Rate (115200 - default) *
0x23	Set output time
0x08	Set output
0x09	Request input status
0x0c	Request system parameters
0x3c	Get System Status – valid for SR3000 V2 only!
0x2a	Set dump - antenna field strength limitation
0x2b	Get dump settings
0x25	Get VDC voltage
0x26	Full autotuning

Table 6.5: Messages sent to the reader – mode 4

Message	Description
0x94	Set mode 4, (more details in Appendix C) *
0x90	Set the counter start value and delete buffers
0x91	Set the antenna ON time *
0x92	Set the capture time *
0x93	Get the record
0x30	Set date - time

***These settings are stored in nonvolatile memory of the reader and are restored after power on.**

0x00 Turn the reader off

This message is used to put the reader in a kind of sleep mode where the antenna field (HF) and synchronization signal are not generating. When readers are working in multiple configurations it is possible to turn off the antenna field in all by sending this command to the master only. In this mode the reader is not responding for some messages e.g. 'Request system parameters'.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f8005f;

or
::01f8003F;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
00	Message type, Turn the reader OFF
5f	The checksum
;	The stop character

The SR3000 will answer with message '0x21 ACK'.

0x01 Turn the reader on

This message is used to put the reader in "normal" operation mode so the SR3000 is generating antenna field (HF) and synchronization signal.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80160;
or
::01f80140;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
01	Message type, Turn the reader ON
60	The checksum
;	The stop character

The SR3000 will answer with message '0x21 ACK'.

0x2d Stop/Start the field of the antenna

This message works similar like 'Turn off' so the antenna field (HF) is not generating by the reader which receives this command. But the difference is that the Master is generating the synchronization signal all the time.
Example of the message sent to reader address 0x01 from host address 0xf8 is:
STOP:
::01f82d01f6;

START:
::01f82d00f5;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
2d	Message type, Stop/Start the field of the antenna
01	Parameter: 0x01 – stop or 0x00 – start
f6	The checksum
;	The stop character

The SR3000 will answer with message '0x21 ACK'.

0x02: Set mode 1, send new transponder number once (default)

This mode allows the reader to send a unique tag number only once. The tag number will be sent again only when another transponder is read. The output format depends on the output frame settings.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80261;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
02	Message type, Set mode 1
61	The checksum
;	The stop character

The SR3000 will answer with message '0x21 ACK'.

0x03 Set mode 2, send transponder number continuously

This mode allows the reader to send a tag number continuously to a host while the transponder is in the antenna field. The output format depends on output frame settings.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80362;

::	Start characters
01	Destination address (the reader)
F8	Source address (the host, the address is fixed)
03	Message type, Set mode 2
42	The checksum
;	The stop character

The SR3000 will answer with message '0x21 ACK'.

0x04 Set mode 3, send transponder when requested only

A tag is read and stored in the reader's internal memory without sending it to a host. This mode allows the reader to store up to 50 records so it is possible to read them later by command '0x07 Request transponders' one by one.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80463;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
04	Message type, Set mode 3
63	The checksum
;	The stop character

The SR3000 will answer with message '0x21 ACK'.

0x07 Request transponders

This message is to get transponder from the queue in the reader's internal memory. The last read tag is sent as the first one. Once the tag is sent it is deleted from the memory. The reader can store up to 50 records, when the memory is full, then the first tag added to the queue will be the first one to be removed.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80766;
:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
07 Message type, Request transponders
66 The checksum
; The stop character

The SR3000 will answer with the transponder number message or with ACK message when there are no more records in the queue so the memory is empty.

0x05 Send as decimal (default)

This mode allows the reader to send only a tag number in decimal format according to ISO 24631-6. Please refer to chapter: Transponder outgoing frame structure for more details.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80564;
:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
05 Message type, Send as decimal
64 The checksum
; The stop character
The SR3000 will answer with message '0x21 ACK'.

0x0f Send as hexadecimal (only transponder number)

This mode allows the reader to send only a tag number in hexadecimal format. Please refer to chapter: Transponder outgoing frame structure for more details.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80f95;
:: Start characters
01 Destination address (the reader)
F8 Source address (the host, the address is fixed)
0f Message type, Send as hexadecimal transponder only.
95 The checksum
; The stop character
The SR3000 will answer with message '0x21 ACK'.

0x06 Send as hexadecimal

This mode allows the reader to send a tag number in hexadecimal format but the tag number is a part of the frame. Please refer to chapter: Transponder outgoing frame structure for more details.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80665;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
06 Message type, Send as hexadecimal
65 The checksum
; The stop character

The SR3000 will answer with message '0x21 ACK'.

0x11 Change Baud Rate

This command may be used to change Baud rate of serial communication. Valid baud rates are described in below table.

Table 6.6: Valid Baud Rates

Baud rate	Value
115200	0x00
9600	0x01
14400	0x02
19200	0x03
28800	0x04
38400	0x05
57600	0x06
1200	0x07
2400	0x08
4800	0x09

Example of the message sent to reader address 0x01 from host address 0xf8 which set '115200' – '0x00' baud rate:

::01f81100c1;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
11 Message type, Change Baud Rate
00 Baud Rate value (check table above)
c1 The checksum
; The stop character

The SR3000 will answer with message '0x21 ACK'.

0x08 Set output

This command can be used to drive hardware outputs (output1 and output2). Please refer to chapter: I/O configuration for more details. Valid settings are described in below table.

Table 6.7: Output settings

Output 1	Output 2	Value
OFF	OFF	0x00
ON	OFF	0x01
OFF	ON	0x02
ON	ON	0x03

Example of the message sent to reader address 0x01 from host address 0xf8 which set Output 1 to ON and Output 2 to OFF:

::01f80801c8;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
08 Message type, Set output level
01 Output level see table above
c8 The checksum
; The stop character

The reader will answer with the message '0x0b Input/output status'

0x23 Set output time

This command can be used to set the time of how long the hardware output shall be turned ON. The time can be set from 1 to 255 x10 milliseconds, separately for Output 1 and Output 2.
Example of the message sent to reader address 0x01 from host address 0xf8 that sets 0xc8 time time (200x10ms) on Input 1:

0xc8 = 200 (x10ms) = 2s

::01f82301c860;
:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
23 Message type, Set output time
01 Triggered output, 0x01- output 1 and 0x02 output 2
c8 Output time, (can be in range from 0x00 to 0xff hexadecimal)
60 The checksum
; The stop character

The SR3000 will answer with the message '0x21 ACK'.

0x09 Request input status

This command can be used to verify the status of hardware inputs (intput1 and intput2). Please refer to chapter: I/O configuration for more details.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80968;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
09	Message type, Request input level
68	The checksum
;	The stop character

The reader will answer with the message '0x0b Input/output status'

0x0c Request system parameters

This command can be used to verify the reader status such as Atmega and DSP/ARM firmware version, antenna voltage and tuning value. It is valid for both SR3000 V1 and SR3000 V2.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f80c92;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
0c	Message type, Request system parameters
92	The checksum
;	The stop character

The reader will answer with the message '0x0d Return system parameters'

0x3c Get System Status – valid for SR3000 V2 only!

This command is similar to 0x0c but with more futures and is valid only for SR3000 V2, the old reader will not respond to this command. By sending this message to the reader it is possible to receive various information about the reader status such as Atmega and DSP/ARM firmware version, antenna voltage, coarse tuning and fine-tuning values, antenna field strength settings, VDC voltage level, power end voltage, and antenna status.
Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f83c95;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
3c	Message type, Get System Status
95	The checksum
;	The stop character

The reader will answer with the message '0x3d Return system status'

0x2a Set dump - antenna field strength limitation

This command can be used to make an antenna field strength limitation through dumping antenna voltage. As a consequence the reading range of transponders will be reduced. This could be useful e.g. in the application where cross reading gives a problem. The below table shows the expected voltage values which may vary depending on the antenna.

Table 6.8: Dump settings – valid for SR3000 V2

Value	SR3000 V2
0x00	430 V
0x01	370 V
0x02	350 V
0x03	300 V

Example of the message sent to reader address 0x01 from host address 0xf8 that sets dump to 0x03:

::01f82a03f5;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
2a Message type, Set dump
03 Dump settings, see table above
f5 The checksum
; The stop character

The SR3000 will answer with message '0x21 ACK'.

0x2b Get dump settings

This command can be used to check the present settings of dump.

::01f82b93;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
2b Message type, Get dump settings
93 The checksum
; The stop character

The SR3000 will answer with message '0x2c Return Dump settings'

0x25 Get VDC voltage

This command can be used to check the status of the reader power supply voltage. This could be useful e.g. when the reader is powered from a battery.

::01f82566;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
2b Message type, Get VDC voltage

93 The checksum
; The stop character

The SR3000 will answer with message '0x26 Return VDC voltage'

0x26 Full autotuning

This command can be used to do a full auto tuning of the reader. Make sure there is no transponder in the antenna field when sending this command to the reader. Example of the message sent to reader address 0x01 from host address 0xf8 is:

::01f82667;
:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
26 Message type, Full autotuning
67 The checksum
; The stop character

The SR3000 will answer with message '0x21 ACK'.

6.3.3 Messages sent from the reader

Each message is a part of the frame as described below. The following messages are available and can be sent from the reader to the host.

Table 6.9: Messages sent from the reader

Message	Description
0x0a	Transponder number in hexadecimal format
0x21	ACK
0x0b	Input/output status
0x0d	Return system parameters
0x3d	Return system status
0x2c	Return Dump settings
0x26	Return VDC voltage

0x0a Transponder number in hexadecimal format

The tag number is a part of the frame which consists of start character, destination and source addresses, message type, transponder number, checksum, and stop character. Please refer to chapter Transponder outgoing frame structure for more details. Example of the transponder message received by the host address 0xf8 sent from the reader address 0x01 is:

::f8010a800090bb9ac8d02ee5;

::	Start characters
f8	Destination address (the host address)
01	Source address (the reader)
0a	Message type, Return Transponder
80	The 8 most significant bits of the transponder, bit 1-8
00	Bit 9-16 of the transponder
90	Bit 17-24 of the transponder
bb	Bit 25-32 of the transponder
9a	Bit 33-40 of the transponder
c8	Bit 41-48 of the transponder
d0	Bit 49-56 of the transponder
2e	Bit 57-64 of the transponder
e5	The checksum
;	The stop character

0x21 ACK - acknowledgment

This message is sent from the reader to the host to acknowledge receipt of a message. The message "ACK" received by the host address 0xf8 sent from the reader address 0x01 is:

::f8012162;

::	Start characters
f8	Destination address (the host)
01	Source address (the reader)
21	Message type, ACK
62	The checksum
;	The stop character

0x0b Input/output status

Through this message the reader sends the hardware inputs and outputs statuses.
The inputs operate from VDC supply. The NPN input pin will be at VDC when not connected and drop to near zero (GND) when triggered by e.g. NPN photocell. See also Connectors description. The input status is coded by MSB of the Input/output status byte.
Input example:

::f8010b21f4;

::	Start characters
f8	Destination address (the host)
01	Source address (the reader)
0b	Message type, Input/output status
21	MSB Input level, LSB Output level
f4	The checksum
;	The stop character

0x**2**1 = **0010** 0001
MSB LSB
MSB=00**10**
Bit 0=0 is Input 1, **bit 1**=1 is Input 2, bit 2=0 and bit 3=0 are not valid
0 -GND
1 -VDC
From the example above:
Input 1 = GND
Input 2 = VDC

Table 6.10: Inputs status

Input 1	Intput 2	MSB Value	Value
GND	GND	0000	0
VDC	GND	0001	1
GND	VDC	0010	2
VDC	VDC	0011	3

The outputs operate from VDC supply. The output status is coded by LSB of the Input/output status byte. Output status from the example above:
0x2**1** = 0010 **0001**
MSB **LSB**
LSB=00**01**
Bit 0=1 is Output 1, **bit 1**=0 is Output 2, bit 2=0 and bit 3=0 are not valid
0- GND=OFF
1- VDC=ON
Output 1 = VDC
Output 2 = GND

Table 6.11: Output status

Output 1	Output 2	LSB Value	Value
GND	GND	0000	0
VDC	GND	0001	1
GND	VDC	0010	2
VDC	VDC	0011	3

0x0d Return system parameters

Through this message the host can receive reader parameters. Example of the message received by the host address 0xf8 sent from the reader address 0x01 is:

::f8010d02000102003301ac1569;
:: Start characters
f8 Destination address (the host)
01 Source address (the reader)
0d Message type, Return system parameters
02 Atmega firmware version
00 Atmega firmware revision
01 Atmega firmware compilation
02 DSP/ARM program version

00 DSP/ARM program revision
33 DSP/ARM compilation - ASCII
01 MSB of antenna voltage,
ac LSB of antenna voltage,
15 Antenna tune value, 0 – 63 decimal (sent as hexadecimal)
69 The checksum
; The stop character

Valid information from above example:
ATMega: ver. 2.0.1
DSP/ARM: ver. 2.0.3
Antenna voltage: 428V
Antenna tuning: 21

0x3d Return system status

Through this message the host can receive reader status. Only SR3000 V2 can send this message. Please refer to the chapter Diagnostics with SR3000 Config tool for more details. Example of the message received by the host address 0xf8 sent from the reader address 0x01 is:

::f8013d0200010200330199131a00052604ff0f9d;

:: Start characters
f8 Destination address (the host)
01 Source address (the reader)
3d Message type, Return system status
02 Atmega firmware version
00 Atmega firmware revision
01 Atmega firmware compilation
02 DSP/ARM program version
00 DSP/ARM program revision
33 DSP/ARM compilation - ASCII
01 MSB of antenna voltage,
99 LSB of antenna voltage,
13 Antenna coarse tuning value, 0 – 31 decimal (sent as hexadecimal)
1a Antenna Fine-Tuning value, 0 – 63 decimal (sent as hexadecimal)
00 Dump settings
05 MSB of VDC voltage
26 LSB of VDC voltage
04 MSB of Internal voltage
ff LSB of Internal voltage
0f Antenna status
9d The checksum
; The stop character

Valid information from above example:
ATMega: ver. 2.0.1
DSP/ARM: ver. 2.0.3
Antenna Voltage: 409V
Antenna Coarse Tuning: 19
Antenna Fine-Tuning: 26
Dump Settings: 0

VDC voltage: 13,18V
Internal Voltage: 12,79V

Antenna Status: 0x0f - CORRECT.
Antenna is in tuning window now.

Antenna Status after the last full tuning:
Antenna was tuned correctly.
Antenna inductance was correct.

Antenna Status description:
0x0f => 0000 1111

x – bit is not valid

Table 6.12: Antenna status

Bit no	Status	Description
0	xxxx xxx1	Antenna was tuned correctly after switching power on
0	xxxx xxx0	Antenna was never tuned correctly after switching power on
1	xxxx xx1x	Antenna is in tuning window now
1	xxxx xx0x	Antenna is out of tuning now or not connected
2 and 3	xxxx 11xx	Antenna inductance is correct
2 and 3	xxxx 01xx	Antenna inductance is too low
2 and 3	xxxx 10xx	Antenna inductance is too high
2 and 3	xxxx 00xx	Antenna has not been connected
0 to 3	xxxx 1111	Antenna status –correct
4-7		reserved

0x2c Return Dump settings

Through this message the reader sends present dump settings. See table Dump settings. Example of dump message received by the host address 0xf8 sent from the reader address 0x01 with dump set to 0x03:

::f8012c03f7;

::	Start characters
f8	Destination address (the host)
01	Source address (the reader)
2c	Message type, Return Dump settings
03	Dump value, 0x03
f7	The checksum
;	The stop character

0x26 Return VDC voltage

Through this message the reader sends the present value of VDC voltage. The received value must be converted from hexadecimal into decimal and divided by 10.

Example of VDC message received by the host address 0xf8 sent from the reader address 0x01 with VDC=13,1V

::f8012683d2;

::	Start characters
f8	Destination address (the host)
01	Source address (the reader)
26	Message type, Return VDC voltage
83	VDC voltage value, 0x83=131 =>131/10= 13,1V
d2	The checksum
;	The stop character

6.4 Transponder outgoing frame structure

The SR3000 has the possibility of sending tag numbers in the following formats:

- Decimal according to ISO 24631-6
- Hexadecimal format, transponder number only
- Hexadecimal format, transponder sent in frame

Transponder sent in decimal format

The SR3000 sends the transponder number in ASCII according to ISO 24631-6 (figure below). The number is sent without destination and source addresses, without message identifier and without checksum.
To set reader in this mode use the message 0x05 'Send as decimal'

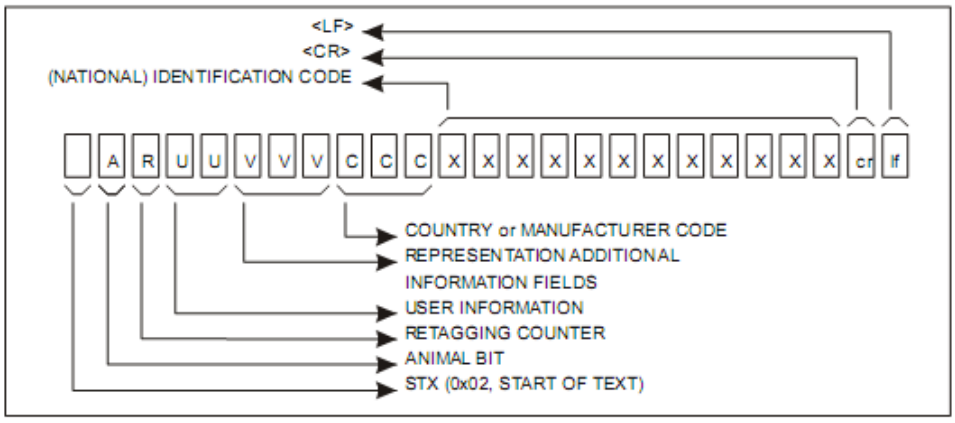


Figure 6.2: ISO 24631-6 frame structure

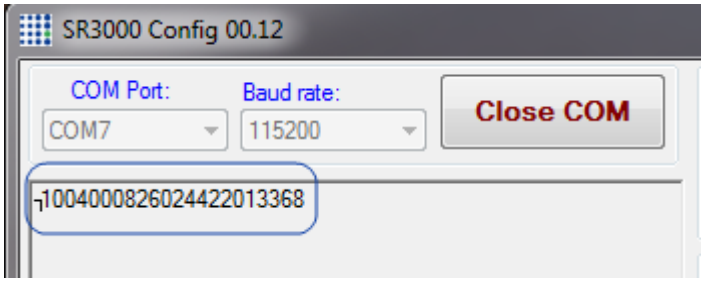


Figure 6.3: Example frames in decimal mode

Transponder sent in hexadecimal format (only transponder number)

When the transponder number is sent in hexadecimal format, the 64 bit specified by ISO 11784 is sent. The number is sent without destination and source addresses, without message identifier and without checksum.
To set reader in this mode use the mode 0x0f 'Send as hexadecimal, only transponder number'

Table 6.5: The 64 bit of transponder specified by ISO 11784

Bit #	Description
1	Flag for animal (1) or non animal (0) application
2-15	Reserved field, usually zero
16	Flag indicating the existence of a data block (1) or not (0)
17-26	ISO 3166 numeric-3 country code
27-64	Individual identification code

In the list above, bit 1 is MSB and bit 64 is LSB

An example of the output in hexadecimal mode (only transponder number):

8000f2C0002E4FF2<CR><LF>

80 The 8 most significant bits of the transponder, bit 1-8
00 Bit 9-16 of the transponder
F2 Bit 17-24 of the transponder
C0 Bit 25-32 of the transponder
00 Bit 33-40 of the transponder
2E Bit 41-48 of the transponder
4F Bit 49-56 of the transponder
F2 Bit 57-64 of the transponder
0D carriage return (0x0d = <CR>)
0A line feed (0x0a = <LF>)

Transponder sent in hexadecimal format

When the transponder number is sent in hexadecimal format, the 64 bit specified by ISO 11784 is sent. The tag number is a part of the frame which consists of start character, destination and source addresses, message type, transponder number, checksum, stop character.

Table 6.5: The 64 bit of transponder specified by ISO 11784

Bit #	Description
1	Flag for animal (1) or non animal (0) application
2-15	Reserved field, usually zero
16	Flag indicating the existence of a data block (1) or not (0)
17-26	ISO 3166 numeric-3 country code
27-64	Individual identification code

In the list above, bit 1 is MSB and bit 64 is LSB

An example of the output seen on SR3000 Config in hexadecimal mode:

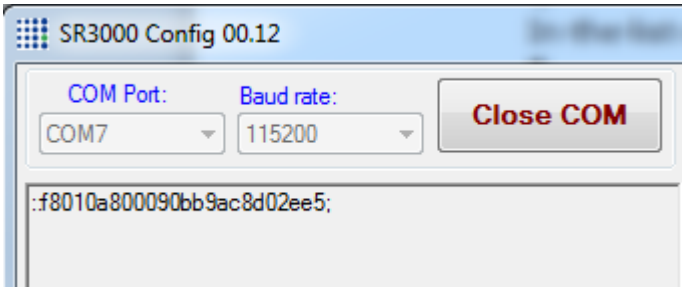


Figure 6.2: Example frame in hexadecimal mode

:f8010a800090bb9ac8d02ee5;

::	Start characters
f8	Destination address (the host address)
01	Source address (the reader)
0a	Message type, Return Transponder
80	The 8 most significant bits of the transponder, bit 1-8
00	Bit 9-16 of the transponder
90	Bit 17-24 of the transponder
bb	Bit 25-32 of the transponder
9a	Bit 33-40 of the transponder
c8	Bit 41-48 of the transponder
d0	Bit 49-56 of the transponder
2e	Bit 57-64 of the transponder
e5	The checksum
;	The stop character

Appendix A:

BioControl Transponder Logger program

The Transponder Logger is a simple PC-program that displays the current transponder number and stores it in a file with date/time stamp. The Transponder Logger program can be downloaded from the 'Community' section on the BioControl website.

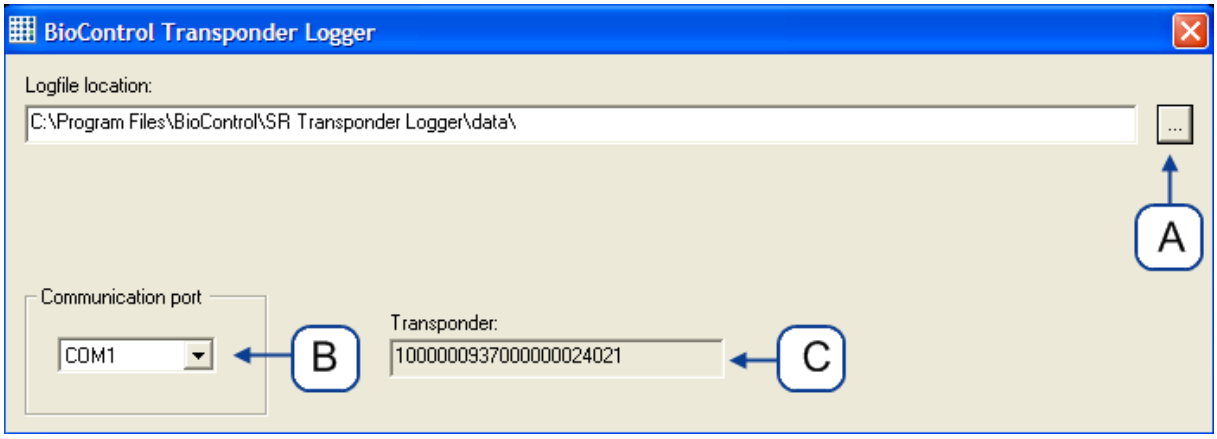


Figure A 1: Transponder Logger program overview

Steps to follow:

1. Turn on the SR3000 and connect it to the PC with the RS232 or RS485 interface
2. Download and run the latest version of Transponder Logger
3. Select Communication port ('B' field) where the SR3000 is connected
4. Select Log file location by pressing the Browse button beneath "A" field, default is "C:\Program Files\BioControl\SR Transponder Logger\data\"
5. The log file name is generated from the date, for today the name will become: BC DD-MM-YYYY.csv (e.g. BC 20-01-2009.csv)
6. The program will create the log-file automatically
7. Field "C" shows current transponder number

The log file is a standard text file with csv-extension, which is automatically opened by Excel. The two fields are separated by semicolons.
When opened in a text file editor like Notepad, the file will look like this:

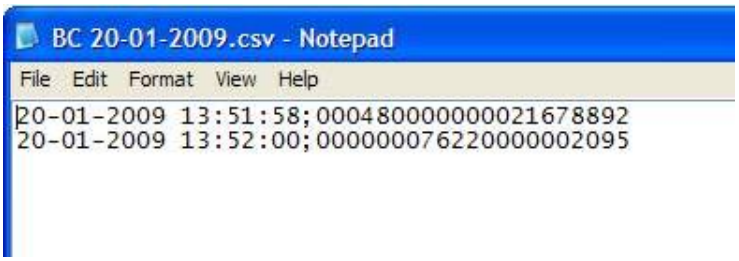


Figure A 2: Log file opened in the Notepad

When opened in Excel (automatically opened by double-clicking the file):

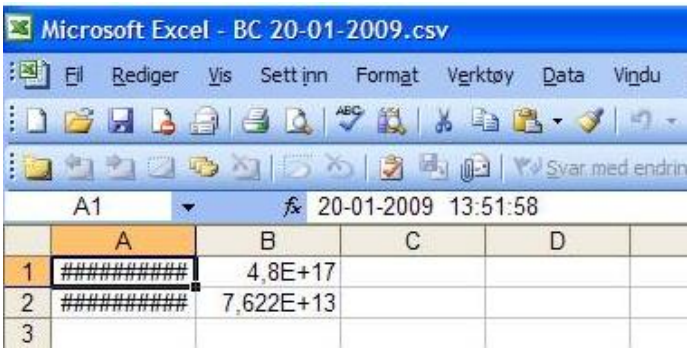


Figure A 3: Log file opened in Excel

Column A must be widened to show the time and date correctly:

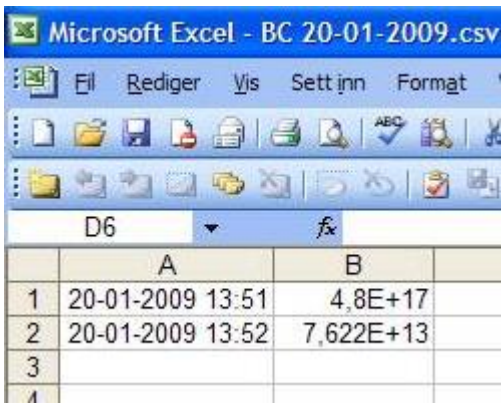


Figure A 4: Widen column A

Then column B must be formatted as a number without decimals to show all the digits of the transponder:

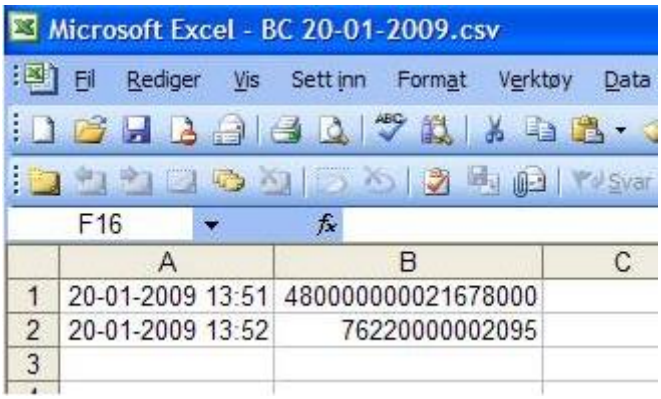


Figure A 5: Format column B

The number is a copy of what the SR sends on RS232 or RS485. Excel does not display/store leading zero's in the transponder number.

Note: SR3000 must be setup into decimal mode for this.

Appendix B:

Loading new firmware into SR3000 (V1 and V2)

The SR3000 contains two microprocessors:

- ATmega processor for the Application Program/Communication
- DSP/ARM for reading transponders

The SR3000 firmware can be reloaded from a PC with RS232 or RS485 interface to embed the latest RFID algorithms into the DSP/ARM, or to load a different Application Program in the Atmega processor.

The 'SR3000 Program Loader' is the tool to do the firmware upgrades and can be found on the 'Community' section on the BioControl website. This is common software for both version of SR3000, both V1 and V2.

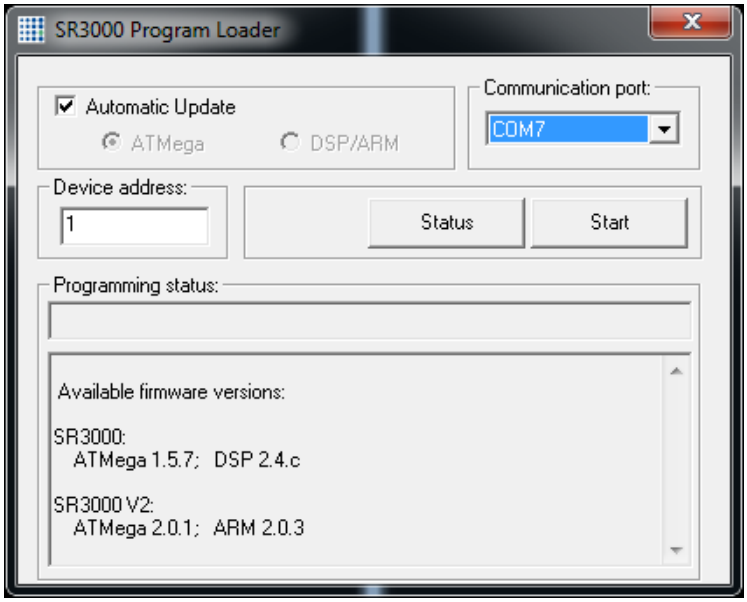


Figure B 1: SR3000 Program Loader

Steps to follow:

1. Download and run the latest version of 'SR3000 Program Loader'.
2. Make sure the SR3000 is powered and connected to a PC with either RS232 or RS485 interface.
3. If Automatic Update is checked then the firmware of both Atmega and DSP/ARM processors will be updated. To update only one processor (Atmega or DSP/ARM), uncheck "Automatic Update" and select the desired one.
4. The Program loader selects relevant firmware to hardware version.
5. Select appropriate Communication port where the SR3000 is connected.
6. Select Device address of the SR3000 which you want to reload. In Single Reader configuration default address is "1".
7. Press the 'Start' button to upgrade firmware.
8. Wait until data transmission is finished and the message Successful appears in the Programming status field (see figure below).
9. Close the Program Loader.

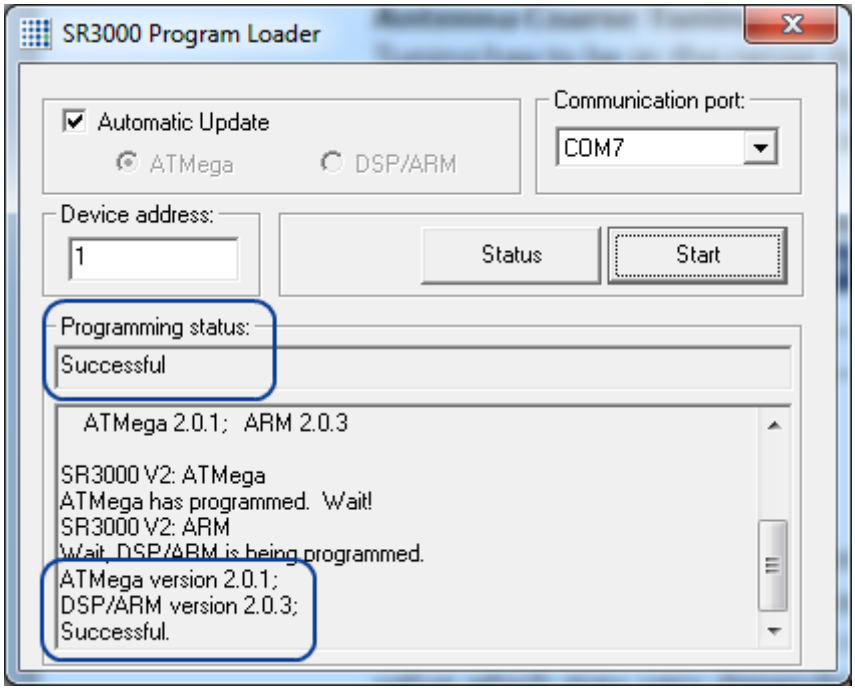


Figure B 2: Firmware loading successful

If the transmission fails, an error message will appear in the Programming status field, check the reason below.

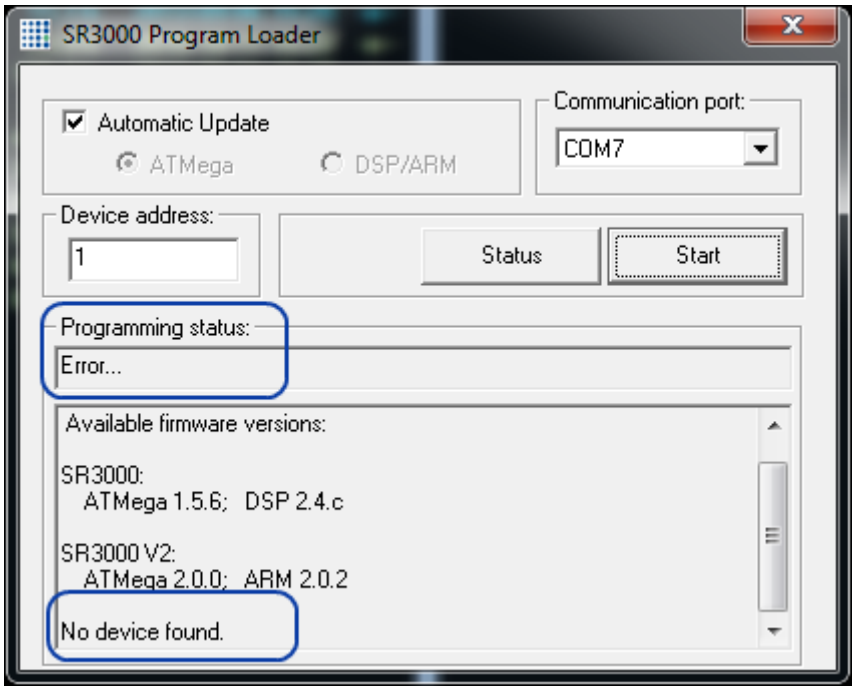


Figure B 3: Error message

Appendix C:

The Application for Slaughterhouse (mode 4)

The SR3000 can work in a slaughterhouse as a single reader that can be installed to an existing sheep or cattle race to allow animals to be read as they pass by the antenna and transmit the data to a host data collection device and store up to 50 records in the internal memory so it is possible to read them later by command '0x93 get records'. Once the tag is read it is added to the buffer and will not be added to the next record as long as the record with this tag exists in the queue.
This mode uses two sensors, one to detect the hook (input1) and the second to detect the carcass (input2). There are four possible cases of the outgoing frames depending on the scenarios described below. The structure of the serial string output consist of: hook counter, tag number, date and time stamp, body and tag status. Example below.

0004,8200CE85AFAA598D,131128095456,No Body,

cccc,XXXXXXXXXXXXXXXX,YYMMDDhhmmss,F,(CR)(LF)

Where:

cccc – hook counter from 0 to 999
XXXXXXXXXXXXXXXX – tag number in xHEX format
YYMMDDhhmmss – date and time
F – inputs status, this field could be:
Empty – if a tag is read and a body is present
No Body – if a tag is read and no body detected
No Tag – If body is sensed and no tag read
No Tag-No Body - no body detected and no tag read
(CR)(LF) – control characters Carriage return and Line Feed

1. The hook sensor detects the hook and starts the read cycle for the time set by "0x91 antenna ON time", the body sensor is triggered when a carcass comes into detection range in time sets by '0x92 capture time', if a tag is read and a body is present the data for the Kill data are sent through the serial port and stored on the reader.
   0015,8200CE85AFAA598D,131128141747,,

2. If tag is read and no body detected (during the "0x92 capture time") the kill data are sent out the serial port showing 'No Body' and stored on the reader.
   0001,8200CE85AFAA598D,131128142022,No Body,

3. If body is sensed and no tag read the kill data are sent out of the serial port showing 'No Tag' and stored on the reader.
   0002,0000000000000000,131128142116,No Tag,

4. If the hook sensor detects the hook and no body is detected and no tag is read then the Kill data are sent out of the serial port showing 'No Tag - No Body' and stored on the reader.

   0004,0000000000000000,131128142147,No Tag-No Body,

The cycle is restarted once the data has been transmitted and the input sensor has been broken with the next hook.
The host software can reset the kill number counter by sending command '0x90 counter start value and delete buffers'
The following messages are implemented for the stationary reader on the slaughterhouse system:

Table C 1: Messages send to the reader valid for mode 4 only

Message	Description
0x94	Set mode 4*
0x90	Set the counter and delete records
0x91	Set the antenna ON time*
0x92	Set the capture time*
0x93	Get the record
0x30	Set date - time

*These settings are stored in nonvolatile memory and are restored after power on of the SR3000.

0x94 Set mode 4 in the SR3000.

This message sets the SR3000 in mode 4 which is dedicated for slaughterhouse application.
An example of command sent to address 0x01 from address 0xf8:

::01f8946c;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
94 Message type, Set mode 4
6c The checksum
; The stop character

The SR3000 will answer with message '0x21 ACK'.

0x90 Set the counter and delete records.

This message is valid for mode 4 only. It gives the possibility to set hook counter from 0 to 999 and deletes all records from the SR3000 memory.
An example of a command that sets counter to 1:
0x0001 = 1
::01f890000129;

:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)

90 Message type: set the counter and delete records
00 The 8 most significant bits of the counter, bit 1-8
01 Bit 9-16 of the counter
29 The checksum
; The stop character

0x03e7 = 999->::01f890**03e7**67; - sets counter to 999.

The SR3000 will answer with ACK message and the transponder's buffer will be cleared.

0x91 Set the antenna ON time (ms).

This message is valid for mode 4 only. It gives the possibility to set the time of how long the reader will generate antenna field after the hook sensor is triggered. The time is set in milliseconds from 1000 to 65500.
An example of command that sets 5 seconds time (5000ms):

0x1388 = 5000ms = 5s

::01f89113883d;
:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
91 Message type: set the antenna ON time
13 The 8 most significant bits of the counter, bit 1-8
88 Bit 9-16 of the counter
3d The checksum
; The stop character

The SR3000 will answer with ACK.

0x92 Set the capture time (ms).

This message is valid for mode 4 only. It gives the possibility to set the time of how long the reader is waiting for the body sensor before sends out the records. The time is set in milliseconds from 1000 to 65500 and cannot be greater than antenna ON time.
An example of command that sets 5 seconds time (5000ms):

0x1388 = 5000ms = 5s

::01f89213883e;
:: Start characters
01 Destination address (the reader)
f8 Source address (the host, the address is fixed)
92 Message type: set the capture time
13 The 8 most significant bits of the counter, bit 1-8
88 Bits 9-16 of the counter
3e The checksum
; The stop character

The SR3000 will answer with message '0x21 ACK'.

0x93 Get the record.

This message is used to receive the oldest record from the SR3000 memory. The first record added to the queue will be the first one to be sent out and it will be removed from the SR3000 memory. The queue capacity is limited to 50 records. Once the memory is full the new records will overwrite the oldest records.

::01f8936b;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
93	Message type: Get the record
6b	The checksum
;	The stop character

The SR3000 will answer with the oldest record from the queue e.g.:
0046,0000000000000000,000101000147,No Tag,

or ACK message when there is no record in the queue

0x30 Set date and time.

The SR3000 has a possibility to keep track of the current date and time as long as the reader is connected to main power. This command gives the possibility to set current date and time in SR3000.

0x0d 0x0b 0x1d 0x0a 0x0a 0x25 = 13 11 29 10 10 37

::01f8300d0b1d0a0a25a6;

::	Start characters
01	Destination address (the reader)
f8	Source address (the host, the address is fixed)
30	Message type: set date and time
0d	YY – year (0x0d = 13)
0b	MM – month (0x0b = 11)
1d	DD – day (0x1d = 29)
0a	hh – hour (0x0a = 10)
0a	mm – minute (0x0a = 10)
25	ss – second (0x25 = 37)
a6	The checksum
;	The stop character

The SR3000 will answer with ACK.

Appendix D:

The SR3000 Config program

The *'SR3000 Config'* is a simple PC-program for easy reader configuration and first diagnostic from a PC. The program gives you the ability to change modes, get inputs state, set outputs, verify the reader status by checking firmware version, antenna voltage and tuning values. All data from the output window can be easily stored in a file by clicking the 'Save log' button.

The *'SR3000 Config'* program can be downloaded from the *'Community'* section on the BioControl website www.biocontrol.no.

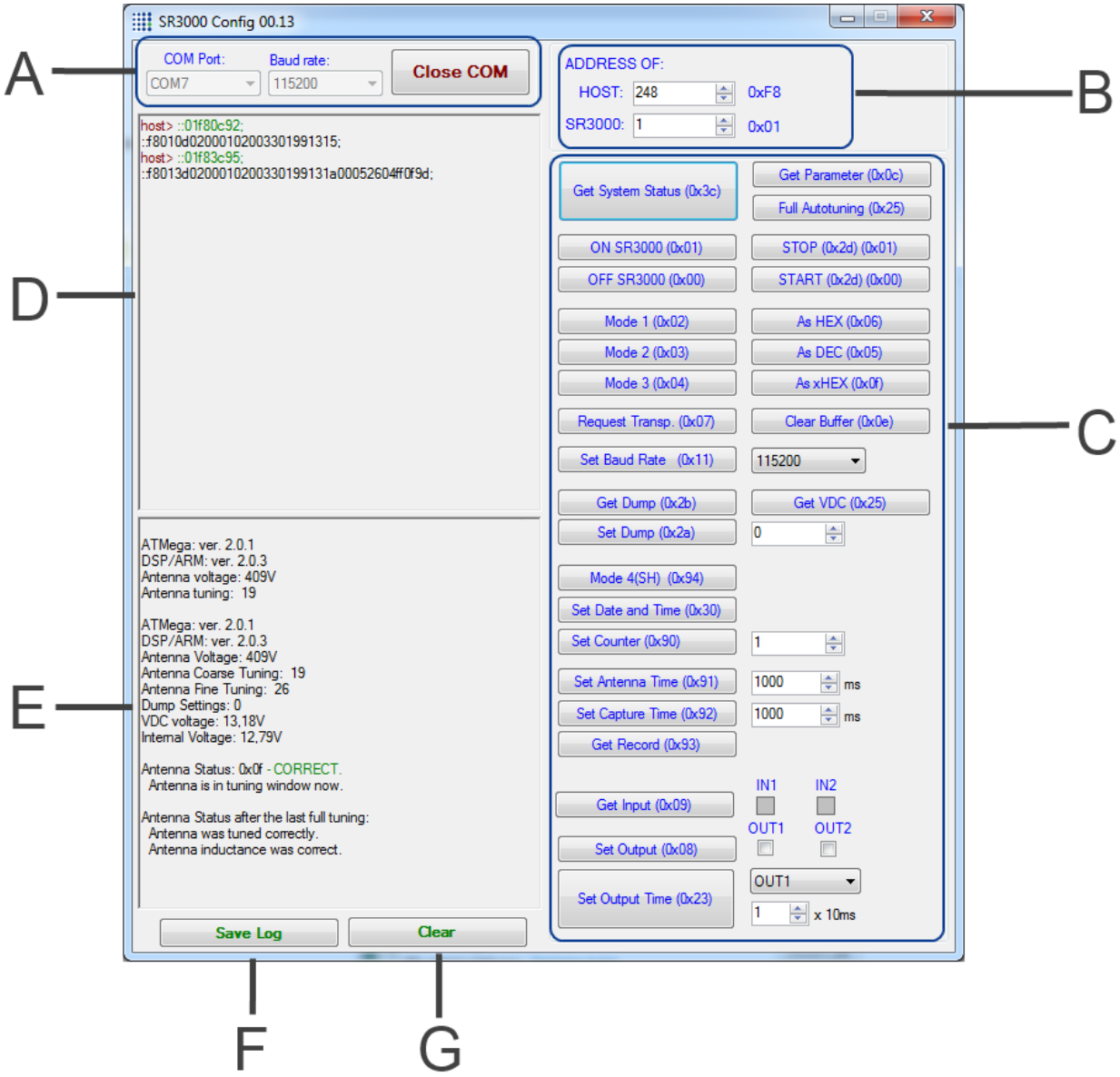


Figure D 1: SR3000 Config program overview

A - serial interface communication settings. Select appropriate Communication port where the SR3000 is connected to a host and Baud rate (default is 115200).

B - device address. It is possible to set both host and reader addresses which will be used globally for all commands. Default value of host is 0xf8 and SR3000 is 0x01.

C - Range of messages that can be sent from host to a reader.

D - terminal window. Messages sent from PC (host) are in green and marked with 'host>', received messages are in black.

E - message translation window. Some messages are decoded to show valid information in an easy way, e.g 'Get parameters'.

F - Save log. Gives the possibility to store all communication from terminal window

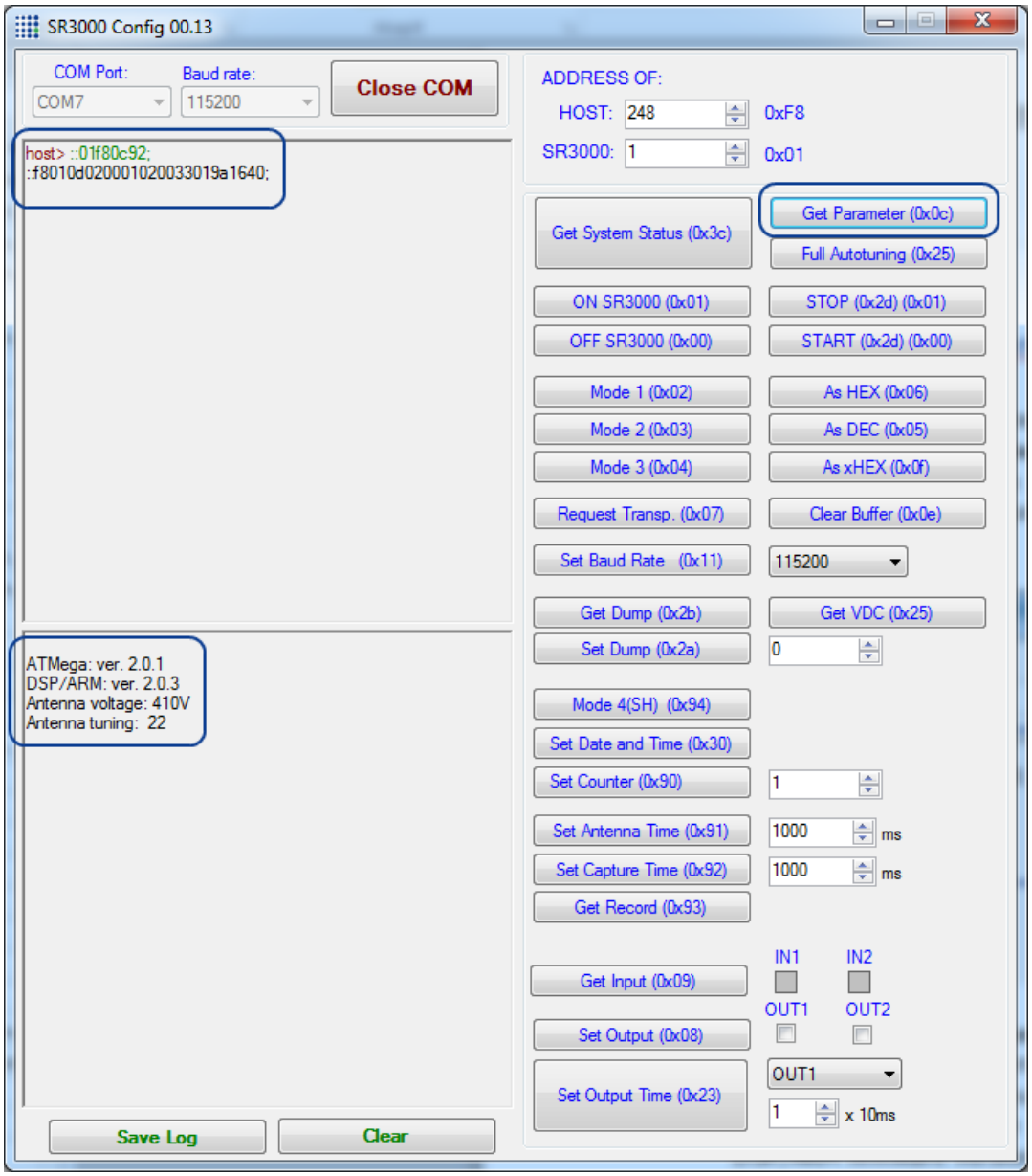
G - Clear. Gives the possibility to clear both terminal and message translation windows.

Diagnostics with SR3000 Config tool.

With SR3000 config software it is possible to do remote reader diagnostics in two ways, by sending one of the below messages from a host. Please refer to Messages sent to the SR3000 reader and Messages sent from the reader.

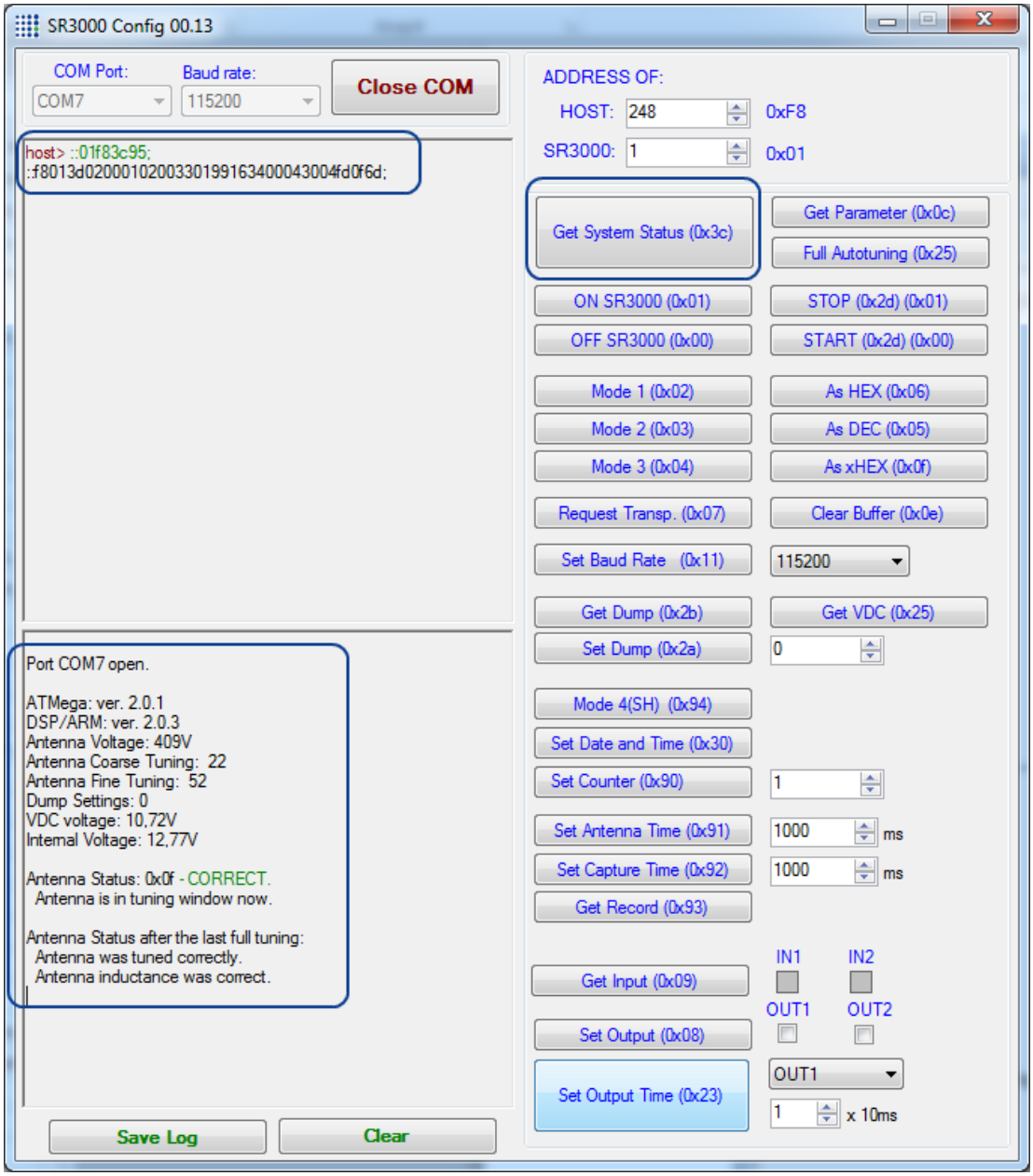
- '0x0c Get parameter' message – valid for SR3000 V1 and SR3000 V2
- '0x3c Get System Status' – valid for SR3000 V2 only

'0x0c Get parameter' message. The reader will answer with:
ATMega firmware version
DSP/ARM firmware version
Antenna Voltage
Antenna Tuning



'0x3c Get System Status'. This diagnostic feature is valid for SR3000 V2 only! This message is an extension of the previous command and gives much more powerful information about the reader and antenna status.

ATMega firmware version
DSP/ARM firmware version
Antenna Voltage
Antenna Coarse Tuning
Antenna Fine-Tuning
Dump Settings
VDC Voltage
Input Voltage
Present Antenna Status
Antenna Status after full tuning



Atmega and DSP/ARM firmware - check the latest SR3000 firmware at the 'Community' section on the BioControl website www.biocontrol.no.

Antenna Voltage can give valid information about the status of the SR3000. To achieve a maximum reading distance the antenna voltage has to be in the range described in the table below.

Table D 1: Antenna voltage range with reference antenna 60x40cm*

SR3000 version	Antenna voltage	Typical
V1		-
V2	400-440 V	430V

*is valid when damping is not used.

For SR3000 V1 different antennas can have different voltages, but SR3000V2 is designed in a way to keep the antenna voltage in the above range so all values outside this limit will indicate reader malfunction. If the voltage is above this maximum voltage limit then the reader board is out of order. The reason of too low voltage could be: loos antenna terminals, a main power supply problem, an antenna malfunction, or too much metal in proximity to the antenna.

Antenna Coarse Tuning has to be in the range described in the table below. This value ensures the correct alignment of the antenna. When the tuning is on the edge (either hi or low), the antenna can operate with problems. As a rule of thumb, the closer the value is to the middle the better. When the tuning value is close to '0', the antenna inductance could be too high. When the tuning value is close to '63'-V1 or '30'-V2, the antenna inductance could be too low.

Table D 2: Coarse tuning range

SR3000 version	Coarse tuning range
V1	0-63
V2	1-30

Table D 3 Antenna inductance

SR3000 version	Antenna inductance			Q factor
	Minimum	Perfect	Maximum	
V1	25,2uH	25,9uH	26,6uH	80-90
V2	25,4uH	26,3uH	27,2uH	80-90

Antenna Fine-Tuning has to be in the range described in the table below. SR3000 generate heat during operation, and electronic components parameters typically vary with temperature. To cover these changes fine-tuning has been introduced in the SR3000 V2.

Table D 4: Fine-tuning range

SR3000 version	Fine-Tuning range
V1	Not valid
V2	0-63

Dump settings show if the antenna field strength limitation (dumping antenna voltage) is in use or not. The consequence of using dumping is that the reading range of transponders could be reduced. The below table shows the expected voltage value, which may vary depending on antenna parameters.

Table D 5: Dump settings – valid for SR3000 V2

Value	SR3000 V2
0x00	430 V
0x01	370 V
0x02	350 V
0x03	300 V

VDC voltage has to be in the range described in the table below, and shows the main power supply voltage. For the reader powered by standard power supply delivered by BioControl the value should be around 13,2V. The table below shows the voltage range for both versions either SR3000 V1 and SR3000V2.

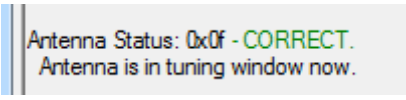
Table D 6: Power supply range

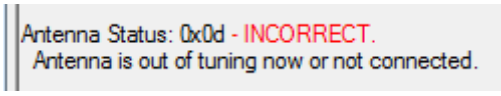
SR3000 version	Power supply	Typical
V1	11-14 VDC	13,2 VDC
V2	11-30 VDC	13,2 VDC

Internal voltage shows the voltage after the internal switching power supply. It shall be in the range described in the table below.

SR3000 version	Internal voltage range
V2	8,4-12,8 VDC

Present Antenna Status gives information about the current antenna status. This value is monitored in real time when the reader is ON.





Antenna Status after full tuning - the reader can indicate the status of the antenna such as:

- Antenna inductance is correct
- Antenna inductance is too low
- Antenna inductance is too high
- Antenna has not been connected

These values are checked after full autotuning which is only done after the device has been restarted or by sending command '0x25 Full autotuning'.

Antenna Status: 0x0f - CORRECT.
Antenna is in tuning window now.

Antenna Status after the last full tuning:
Antenna was tuned correctly.
Antenna inductance was correct.

Antenna Status: 0x00 - INCORRECT.
Antenna is out of tuning now or not connected.

Antenna Status after the last full tuning:
Antenna was not tuned correctly.
Antenna has not been connected.

Antenna Status: 0x04 - INCORRECT.
Antenna is out of tuning now or not connected.

Antenna Status after the last full tuning:
Antenna was not tuned correctly.
Antenna inductance was too low.

Antenna Status: 0x0d - INCORRECT.
Antenna is out of tuning now or not connected.

Antenna Status after the last full tuning:
Antenna was tuned correctly.
Antenna inductance was correct.

Antenna Status: 0x08 - INCORRECT.
Antenna is out of tuning now or not connected.

Antenna Status after the last full tuning:
Antenna was not tuned correctly.
Antenna inductance was too high.