OBID® i-*scan*

APPLICATION-NOTE

ID ISC.ANT800/600

Installation and tuning of a gate antenna with 1 m x 1 m read window

Reading in any desired label orientation

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Note

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General information's regarding this document

- The sign "☞" indicates extensions or changes of this document compared with the former issue.
- The following figure formats are used:
  0...9: for decimal figures
  0x00...0xFF: for hexadecimal figures,
  b0...1 for binary figures.
- The hexadecimal value in brackets "[ ]" marks a control byte (command).

Contents

1. Characteristics and application of the Antenna Gate

The Antenna Gate described here was designed for reading Smart Labels (transponders) attached to product on conveyor belts, tilt tray conveying systems or pallets. The read window has a maximum size of 1m x 1m. Any label orientation is permitted.

This presumes that no significant magnetically conducting materials (e.g. metal) are located in the direct vicinity of the antenna or label. The minimum separation distances can be found in section 1.3.

The gate consists of two base and two complementary antennas. Antenna ID ISC.ANT800/800-B Antenna Type B is the complementary antenna for the base antenna ID ISC.ANT800/600-A Antenna Type A. One base and one complementary antenna together make up a gate.

In order to meet the RF requirements, to enlarge the read window and thus be able to read labels in a horizontal orientation as well, two gates in a special mounting configuration are required.

Detailed information about the products along with installation notes for the individual antennas can be found in the mounting instructions for ID ISC.SAT.C-A, ID ISC.ANTPS-A and ID ISC.ANT800/600 or can be acquired in an antenna training course offered by FEIG ELECTRONIC GmbH.

Mounting Instructions are also contained on the OBID® i-*scan* CD available from FEIG ELECTRONIC GmbH.

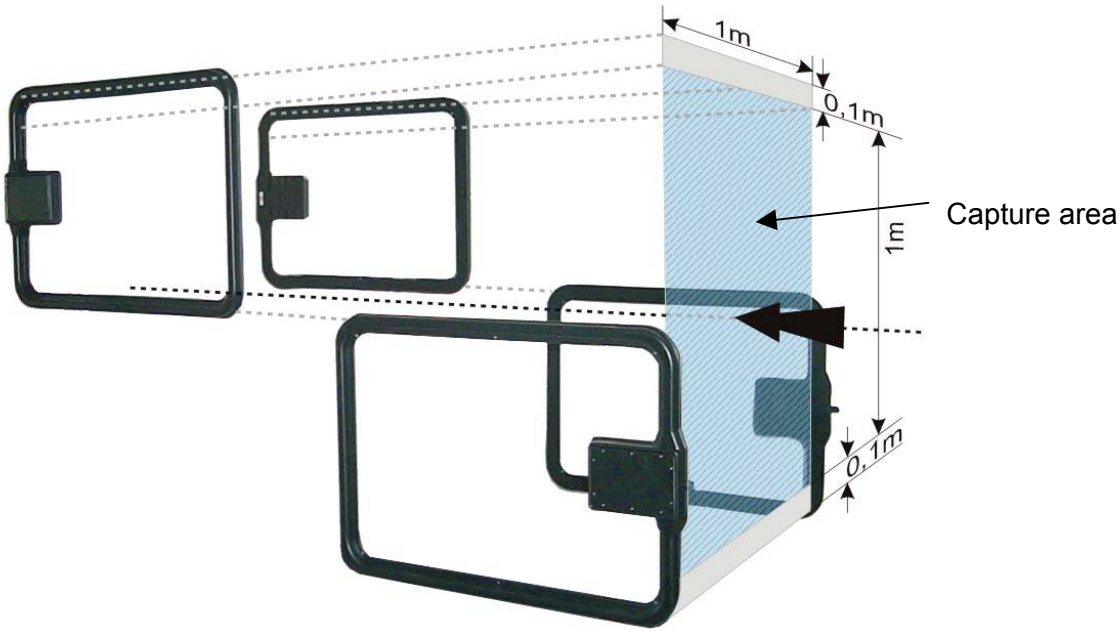
1.1. Project notes

The antenna setup described here enables detection of labels moving through the gate in a horizontal direction. The label orientation is non-critical. The labels are detected at least once when moving along the horizontal line of motion at a particular point or area within the antennas. The area of detection depends on the label orientation.

The capture area of the antennas has a size indicated in the illustration below.
Note: The overall capture area of the antenna is larger than shown in the illustration. This means there are label orientation in which the labels are detected outside the capture area. The labels that are oriented parallel to the antennas can also be detected at greater distances when next to or outside the antennas.

Therefore no product having a label may be stored in the capture area near the gate antenna. They must remain more than 0.8 m (32 inches) from the gate. Otherwise the antennas will need to be shielded to prevent unwanted pickup of extraneous tags around the gate.

Figure 1: Capture area of the antennas



To achieve 3-dimensional capture of the labels in the capture area drawn above, the following conditions must be met:

- The gate width (GD) must be less than 135 cm (53 in.).
- The labels should be at least ISO card size (46 mm x 75 mm [1.8 x 2.95 in]).
- The activation field strength sensitivity of the labels should less than or equal to 85 mA/m.
- The distance from label to label should be greater than 10 cm (3.9 in). .
  The distance from label to label may be reduced if the gate width GD is reduced correspondingly. This applies especially to distances of less than 5 cm (1.9 in).

- No more than 16 labels at a time should be located in the capture area of the antenna. The number of labels may be increased by correspondingly reducing the gate width (GD) and adjusting the maximum speed accordingly.
- The maximum speed of motion of the label should not exceed 0.5 – 1 m/s (this depends on the number of labels, the number of data blocks, the required data protocol and the label type).
- The antenna should have a separation of greater than 50 cm (20 in) from metal parts.
- There should be no devices in the vicinity of the Reader that could cause noise interference. The difference between the noise levels (U_{max} - U_{min}) should be less than 20 mV.
- The Reader ID ISC.LR200-B should be set for an RF power of 4 watts. At an RF power of greater than 4 watts the conditions for approval according to the R&TTE directive are exceeded.
- When using ISO15963 transponders, the Readers should be adjusted as described in section “4.6. Regulatory agencies in EU countries and the USA“.

1.2. Required components

The following are required to construct the gate:

- Qty. 1 ID ISC.LR200-B (Reader)
- Qty. 2 ID ISC.ANTPS-A (180-degree, two-way Power Splitter)
- Qty. 2 ID ISC.ANT800/600-A(800 x 600 mm Loop Antenna Typ A)
- Qty. 2 ID ISC.ANT800/600-B (800 x 600 mm Loop Antenna Typ B)
- Qty. 4 EMC- ferrite toroids, available from: Würth Elektronik GmbH & Co.KG, diameter da=28, B.No.742 701 4.

The cables on the antennas ID ISC.ANT800/600 and on the Power Splitter ID ISC.ANTPS-A are each 3.5 m long. This means the Readers should be installed near the antennas. For longer distances between Reader and base or complementary antenna, the ID ISC.ANT.EC extender can be used to lengthen the antenna cable at 7.20 m. This will however result in a slight loss of performance.

The cable extender also requires:

- 2 x ID ISC.ANT.EC

Components required for commissioning:

- Qty. 1 ID ISC.SATC-A Automatic Tuning Controller
- Service software ISCStart Version 4.02 or higher on a PC running under MS Windows. The ISCStart software is contained on the OBID® i-*scan* CD-ROM available from FEIG ELECTRONIC GmbH.
- Qty. 1 SWR Meter with SMA sockets or adapter to SMA sockets
- Qty. 1 cable RG 58 C/U approx. 20 – 25 cm long with 2 SMA plugs
- Qty. 1 amber blade screwdriver (Tuning tool for tuning capacitors).
- Qty. 1 Oscilloscope
- Qty. 2 test loops

For additional information on these devices, see the individual instructions or section 5. .

1.3. Preparing the installation location / metal-free areas

To ensure flawless operation of the gate, all larger metallic parts must be removed from the vicinity of the antennas.

Figure 2 Metal-free zone, side view

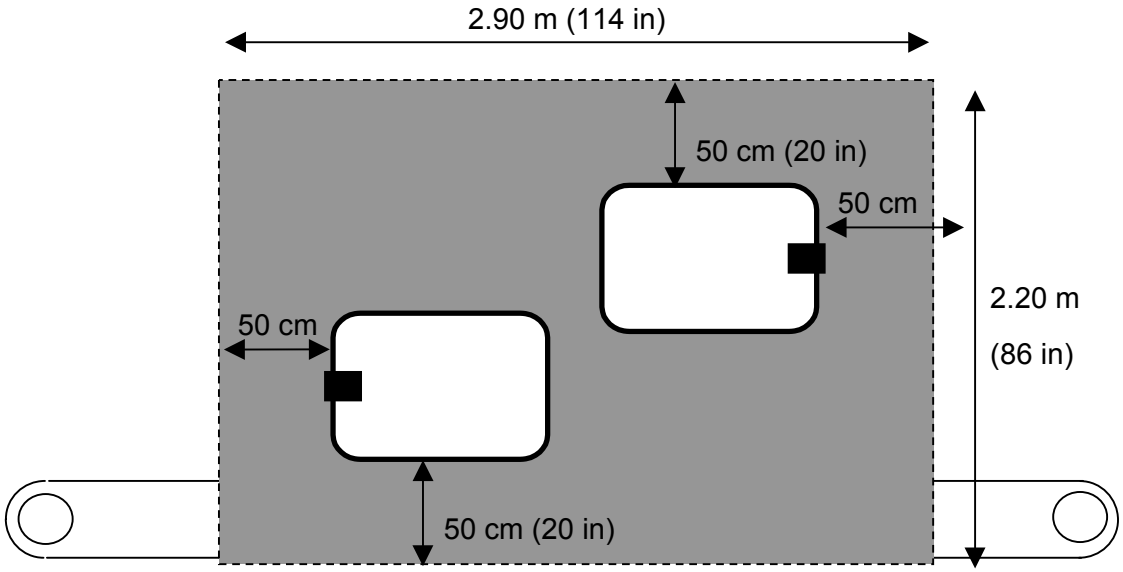
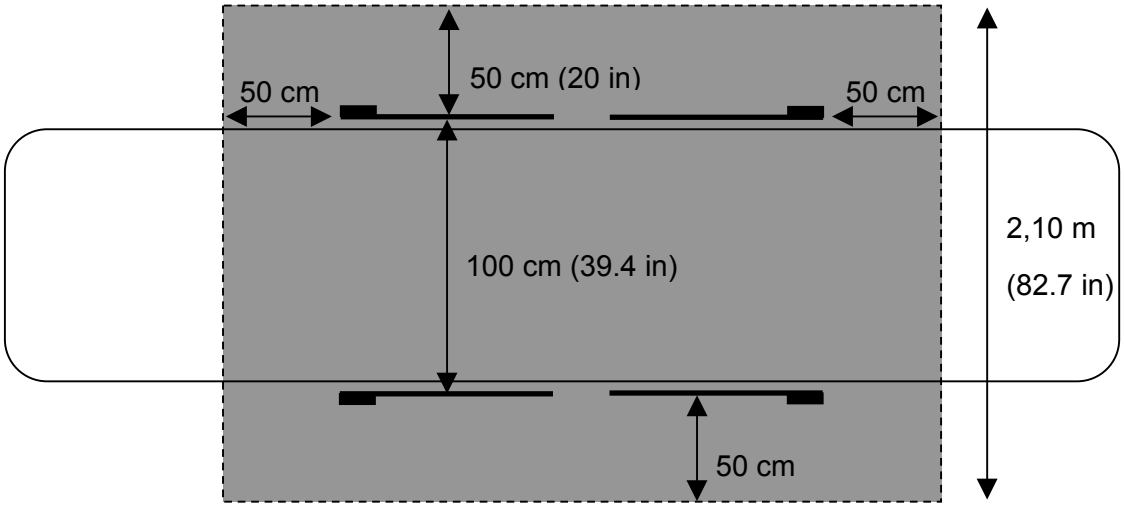


Figure 3 Metal-free zone, view from above



If metal cannot be avoided in the vicinity of the antennas, note the following:

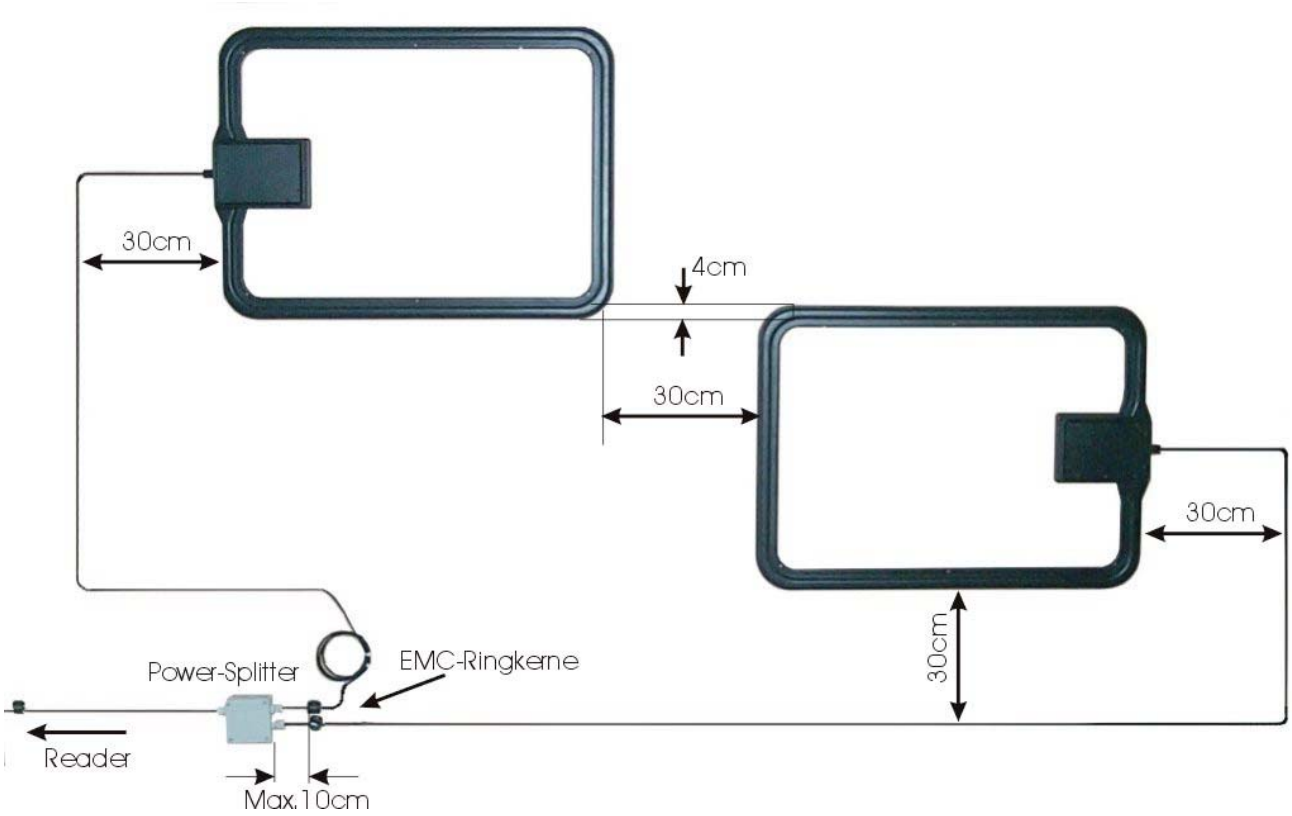
- The minimum separation between metal and the antenna must be 10 cm (3.9 in). At 30 cm (12 in), the read distance will be significantly reduced. At more than 50 cm (20 in) there is virtually no measurable effect.
- The effect of metal parts depends greatly on their size and shape. Thin metal rods affect the magnetic field lines less than objects having large surface area.
- Larger metal surfaces (edge length > 50 mm) parallel to the antennas or the labels result in a short circuit of the magnetic field lines. The result is that the label cannot be read.
- Metal parts beneath the conveyor belt change the path of the magnetic field lines. This results in significant loss of reading range. Horizontally oriented labels cannot then be read.
- The metal parts are not permitted to form closed loops or circuits. Loops must be isolated at some point around their perimeter to prevent formation of a closed loop.
- The metal parts in the immediate vicinity of the antenna must be grounded in star fashion using a good High Frequency connection.
- Since the Reader is contained in a metal housing and the antennas are coupled into the cable connected to the Reader, the Reader should be located at least 50 cm (20 in) from the antennas.
- The Reader housing should not be permitted to make any electrical connection with any metal parts located near the antenna.
- Metal parts underneath the conveyor belt change the path of the magnetic field lines. This results in significant loss of reading range. Horizontally oriented labels cannot then be read.

2. Installation and wiring

2.1. Installation instructions

The antennas and power splitters on both sides of the gate are installed according to the diagram below. The power splitters are connected only after tuning the antennas. Since the Reader is enclosed in a metal housing and the antennas couple into the Reader cables, the Reader should be located at a distance of at least 50 cm (20 in) from the antennas. The second side mirrors side one.

Figure 4 Installation diagram for one gate side including cabling



The two base and complementary antennas are installed on opposite sides, so that a base and complementary antenna always face each other. They should be installed such that all antenna opening/covers face out (away from the gate) or in (towards the middle of the gate). In addition the antenna openings/covers are located to the right and left as shown in the illustration.

Please note the instructions in the mounting instructions for the ID ISC.ANT600/800-A/B.

2.2. Instructions for installing and routing the antenna connection cable

To suppress any possible noise, an EMC toroid core with dia=28 mm should be installed in the antenna cables for the base and complementary antennas and power splitters (vendor: see appendix). Loop the coax cable at least four times tightly through the toroid. The distance between the Reader connection and the toroid should be at least 10 cm (3.9 in).

Figure 5: Installing the toroid on the antenna cable

The cables to the power splitters are first routed in place in the vicinity of the antenna. The power splitter is connected only after tuning the antennas.

The antenna cable should always be routed vertically away from the loop at least 50 cm (20 in). Also maintain a minimum distance of 50 cm (20 in) from the antennas when routing other cables.

If the antenna cable must be routed closer to the antenna, maintain a distance of at least 20 cm. (7.8 in) otherwise you will sacrifice performance.

All antenna cables must be kept at least 30 cm (11.8 in) from parallel routed, current carrying cables.

Excess cable should be wound into a loop having a diameter of ∅ = 10 – 15 cm.

If the existing cable is not long enough, it may be extended using an ID ISC.ANT.EC extender for an additional length of 7.20 m (23.6 ft). Slight loss of sensitivity will result.

To achieve optimum reading distances, the antenna connection cable should **not** be shortened or lengthened.

Please note the instructions in the mounting instructions for the ID ISC.ANT600/800-A/B.

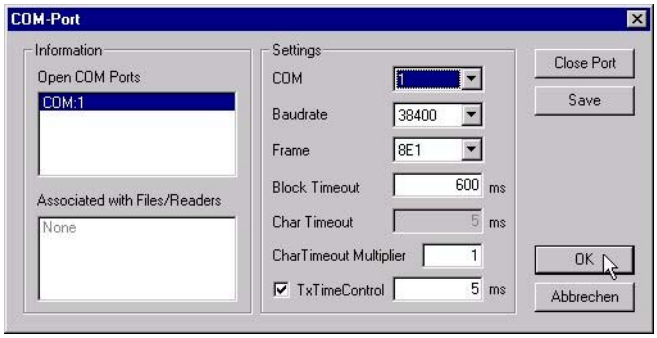
3. Tuning the gate

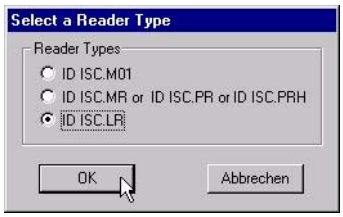
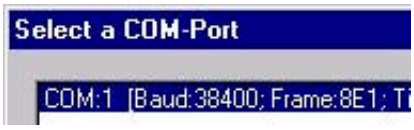
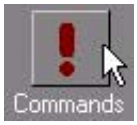
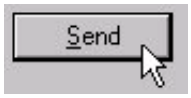
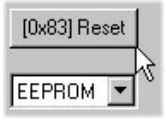
To calibrate the antenna you must first remove the cover over the antenna opening. The recommended tightening torque of the cover screws when recovering the antenna 0.2 Nm – 0.25 Nm.

Next the first base and opposite complementary antenna is directly connected to the Reader.

The tuning procedure begins with the base antenna. Next the first complementary antenna is calibrated. Since the complementary antenna affects the working point of the base antenna, the basis antenna must then be recalibrated.

3.1. Preparations

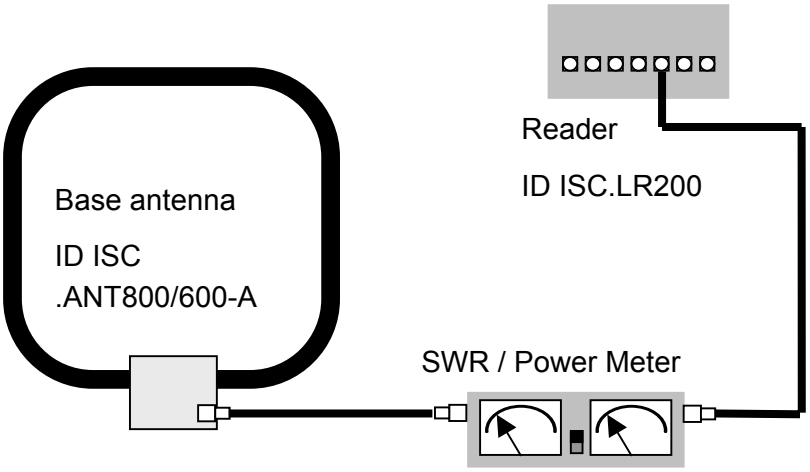
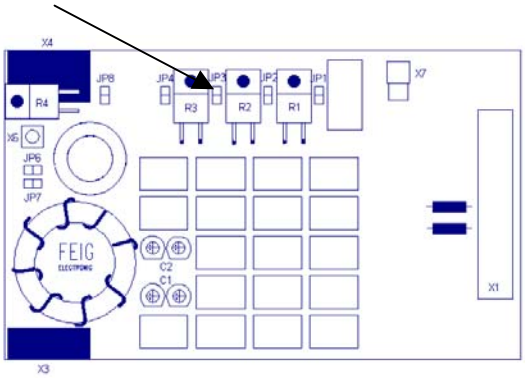
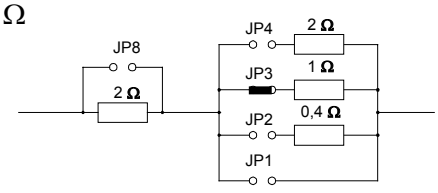
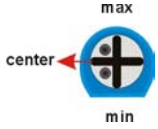
Step	Procedure	Note
1	Connect the ID ISC.LR200 Reader to the PC through the RS232 or RS485 port	See Installation Manual ID ISC.LR200
2	Install the Demo Software ISC-Start	Located on the OBID® i-*scan* CD-ROM
3	Run the ISCStart program	
4	Open the COM port settings	
5	Check the COM port settings and confirm by clicking on **OK.**	
6	Now open the menu **File – New - Reader**	

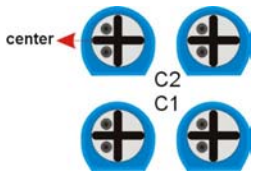
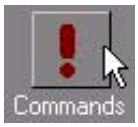
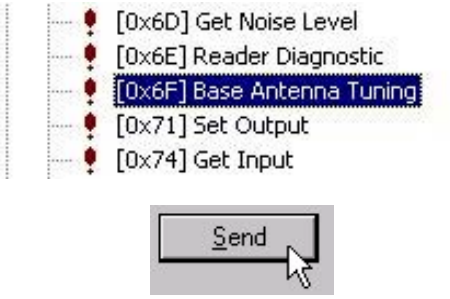
7	Select **ID ISCLR** and click on OK	
8	Select *COM: x [Baud 38400.....]*	
9	Click on **Commands**	
10	Select ***Baudrate Detection[0x52]*** command	
11	Click on **Send**	
12	The program tests all possible baud rates. It stops as soon as the baud rate set on the Reader has been detected (default 38400 / 8E1) and confirms with OK	
13	Click on **Configuration**	
14	Select ***ID ISCLRxxx Configuration***.	
15	Select destination memory ***EEPROM*** instead of ***RAM***.	
16	Click on **Reset [0x83]** to set the Reader to the default configuration.	

17	Click on **Read** to load the Reader configuration into the PC and to load the ISCStart program.	

3.2. Tuning the base antenna

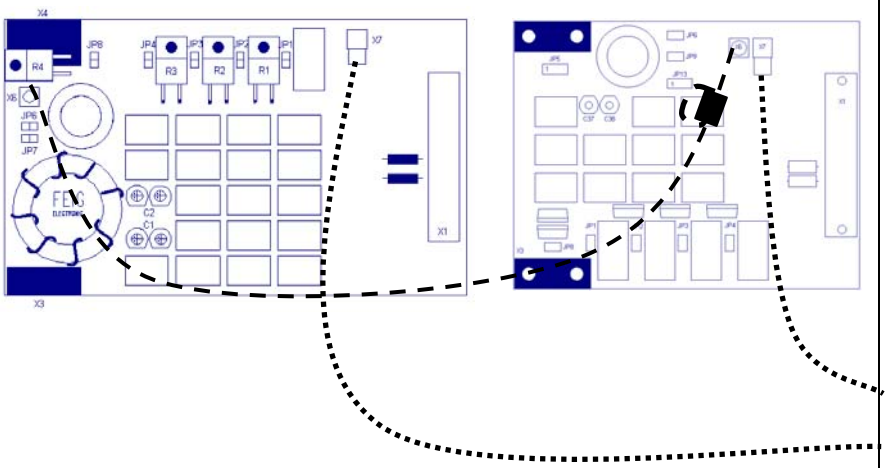
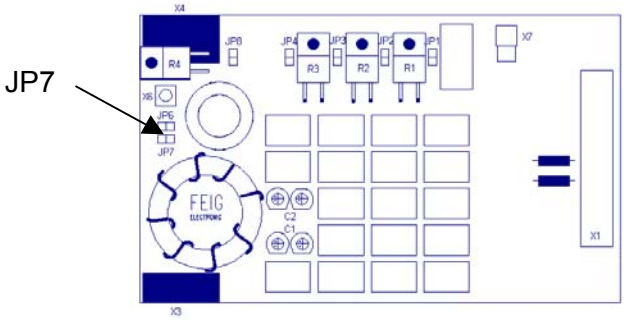
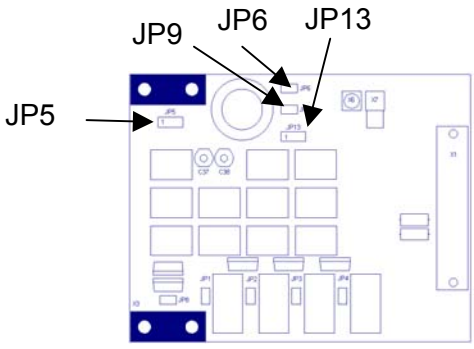
For antennas consisting of more than one gate, first connect the gates directly to the Reader and calibrate them individually. Then the gates can be connected to the power splitters.

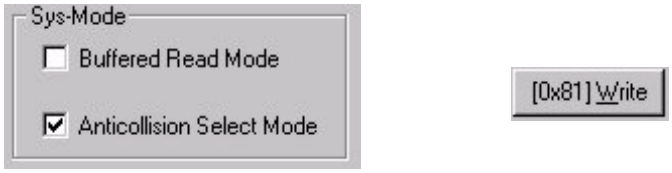
Step	Procedure	Note
1	connect the Reader to the base antenna through the SWR bridge. See also section: 3.7. Measuring the standing wave ratio (VSWR)	
2	Jumpers JP1 – JP4 and JP6 –8 should be checked and set as necessary. Jumpers JP6 + JP7 are left out during normal operation and during tuning.	Jumper JP4 must be in.  JP1, JP2, JP4, JP6, JP7 and JP8 = out Rges = 3 Ω 
3	Set trim capacitors C1 and C2 to their center position.	

		
4	Click on **Commands** at the ISCStart Program Window	
5	Select the command ***[0x6F] Base Antenna Tunning]*** and click on **Send** to send all the settings.	
6	Now connect the Static Antenna Tuning Controller **ID ISC.SAT.C-A** to the antenna tuner of the base antenna and press the “Start“ key on the controller. The tuning process takes several seconds. When completed, the **green LED** will come on for 4 seconds. .	 **Tuning mode: Is activated by** holding down the Start key greater than two seconds (< 2 sec). **Control mode:** Is activated by briefly pressing the Start key shorter than two seconds (< 2 sec).
7	The controller runs then automatically turns off and can then be unplugged.	**<u>Important:</u>** **Do not unplug the controller before the green LED has gone out!** **Now you may begin tuning the complementary antenna**.

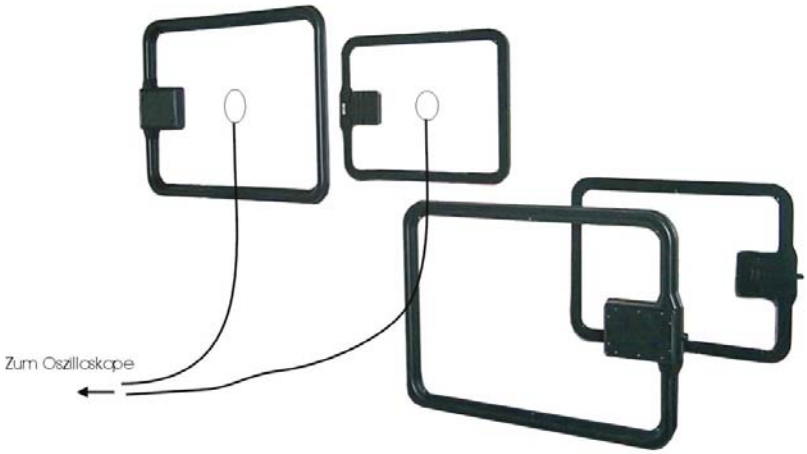
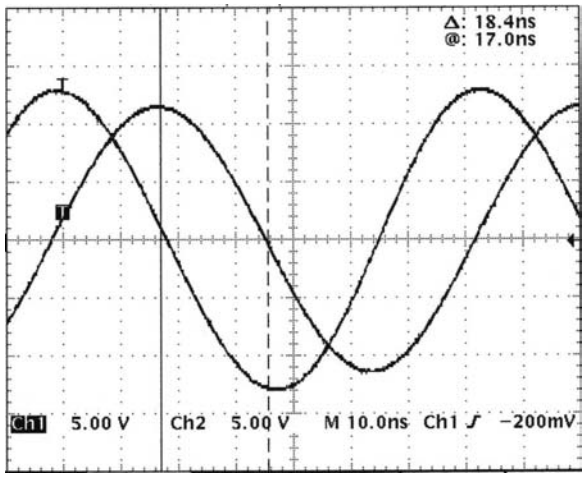
8	If the tuning was not properly concluded, this is indicated by the **red LED.** If an error occurs at the beginning of the tuning procedure, the **LED flashes** for 4 seconds. If an error occurs during or at the end of the tuning procedure, the **LED turns on** solidly for 4 seconds. If the battery is low, the **yellow LED turns on** for 4 seconds.	**If the red LED flashes for 4 seconds,** this indicates there is no RF power at the antenna. Possible causes: • Reader or RF power turned off. • Cable between Reader and antenna defective. • The SMA connectors were not properly attached to the Reader or antennas or are not properly seated on the SMA sockets. • The cable is pinched or shorted in the SMA plug. ♦ The controller was not properly plugged into the board. If the **red LED comes** on solidly for 4 seconds, the tuning was not properly finished. Possible causes: • Cable between Reader and antenna is defective. • The SMA connectors were not properly attached to the Reader or antennas or are not properly seated on the SMA sockets. • The cable is pinched or shorted in the SMA plug. ♦ Modulation is turned on in the Reader. ♦ Antenna Q set too high (resistor settings). ♦ The controller was not properly plugged into the board. ♦ Tuner board is defective. .

3.3. Tuning the complementary antenna

Step	Procedure	Note
1	Connect the base antenna (X6/REF) to the complementary antenna (X6). Use the $\lambda/4$ cable supplied with the Controller. The plug with the ring core must be connected to the complementary antenna. Connect the Reader X1 to the complementary antenna X7.	 The end of the cable with the toroid is connected to the complementary antenna.
2	Jumper J7 on the base antenna should be closed.	
3	The trim capacitors C37 and C38 on the complementary antenna should be turned to the center position.	
4	Set jumpers JP5, JP6, JP9 and JP13 on the complementary antenna as follows. JP5 : Position 1-2 JP6 : Close JP9: Close JP13 : Position 1-2	

5	Click on the **Configuration** button.	
6	Use the ISCStart demo program to read out the complete configuration. Then set the RF power (configuration block CFG3) to 4 watts and turn off the modulation (CFG10). Each change in the configuration must be written to the Reader's EEPROM by clicking on the Write button.	**1. Set for 4 W RF power and save setting** Configuration CFG3 RF-Interface I.  **1. Turn off modulation and save setting** CFG10 General : Buffered Read Mode = OFF. 
7	Now plug the Static Antenna Tuning Controller **ID ISC.SAT.C-A** into the antenna tuner on the complementary antenna and press the "Start" key on the controller.	 **Tuning mode:** is activated by holding down (> 2 seconds) the Start key greater then two seconds. **Control mode:** is activated by briefly pressing (< 2 seconds) the Start key shorter then two seconds.

8	If tuning was successfully completed, this is indicated by the green LED coming on for 4 seconds. Next the controller turns itself off automatically and can then be unplugged.	If the tuning was not successfully completed, check all cable connections and be sure that the controller is making good contact. **Important:** **Do not unplug the controller before the green LED has gone out!**
9	Disconnect the reference cable	
10	Set the jumpers on the base and complementary antennas to the operating position.	**Base antenna:** **JP6** and **JP7** open **Complementary antenna:** **JP5** to Position 1-2
11	Use a 2-channel oscilloscope and two test loops to check the phase angle between the base and complementary antenna.	Both loops must be the same size, be exactly parallel to each other at the same point on the antennas, and be located as close to the center of the antenna surface as possible. The test cables are described in: 5. . Loop on base antenna to Channel A on oscilloscope Loop on complementary antenna to Channel B on oscilloscope. **Oscilloscope settings** Voltage range: 5 Volt/Div. Offset channel A+B: 0 Volt Coupling : DC Sweep time: 10 ns/Div. Trigger source: Channel A Trigger Mode: Normal Trigger point: Leading edge

		 Trim capacitors C37 and C38 can be used to correct the phase of the currents between the two antennas. See also: Section: 3.8. . **Settings:** • The amplitudes should be nearly identical. Tolerance 30% • The phase angle should be 90° +/- 10° (corresponds to a time delay of 18.4 ns) 
12	During fine tuning, be sure that both trim capacitors are adjusted evenly so that when finished, both are in the same position.	

Possible problems if the antenna has not been calibrated

- No RF power on the antenna.
  - RF power not turned on (on the Reader).
  - Cable between Reader and antenna defective.
  - Transformer was switched between the Reader and antenna, and jumper JP1 or JP2 is open.
- RF power incorrectly set (≠ 4W)
- Base antenna not calibrated or defective
- Distance between base and complementary antenna too great or too short.
- Controller not correctly plugged into the board.
- Jumpers on base or complementary antenna not properly set.
- Connection between base and complementary antenna (reference cable) not properly made.
- Modulation on Reader turned on.
  - Buffered Read Mode turned on
  - Transponder read turned on (ISCStart: Test and Measurement)
- Tuner board defective.

3.4. Retuning the base antenna / fine tuning

Step	Procedure:	Note:
1	At this point, always recalibrate the base antenna	Depending on the antenna coupling, the base antenna will be more or less out of tune with the complementary antenna. This means you must recalibrate the antenna.
2	Plug the Static Antenna Tuning Controller **ID ISC.SAT.C-A** into the antenna tuner of the base antenna and press the “Start“ key on the controller. The tuning process will take several seconds; when it is finished, the **green LED** will turn on for 4 seconds.	 **Control mode:** is activated by briefly pressing (< 2 seconds) the Start key greater than two seconds. **Tuning mode:** is activated by holding down (> 2 seconds) the Start key shorter than two seconds.
3	If the operating RF power deviates from the 4 W set during tuning, set the operating RF power correctly.	
4	Disconnect the test loops and the oscillo-scope.	
5	Wait 15 minutes until the operating temperature of the antennas is reached.	

6	Use the trim capacitors C1 and C2 to fine tune the base antenna.	• Use the plastic blade screwdriver to turn both trim capacitors C2. • Find the smallest SWR by observing the SWR meter while adjusting the capacitors. • Use the plastic blade screwdriver to turn both trim capacitors C1. • Find the smallest SWR by observing the SWR meter while adjusting the capacitors.  The capacitors that are associated with each other should be set to approximately the same capacitance. To check the setting, use a standing wave meter (VSWR) between the antenna and the Reader. The SWR after fine tuning should be ≤ **1.3:1**.

3.5. Tuning the second base antenna and complementary antenna

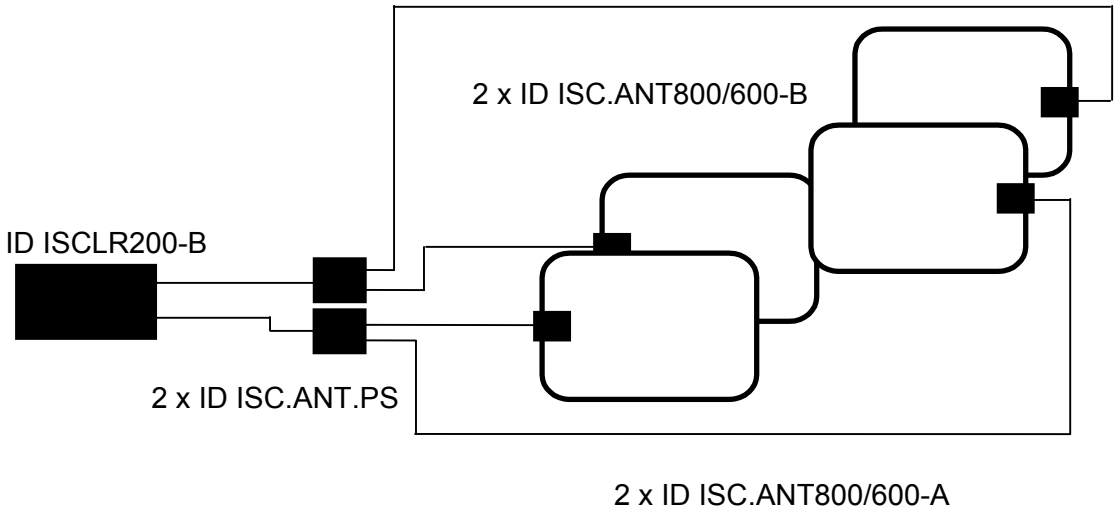
Now you must connect the second base and opposite second complementary antenna directly to the Reader.

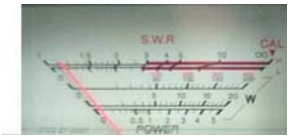
The tuning procedure begins with the base antenna. Next calibrate the second complementary antenna. Since the complementary antenna affects the working point of the base antenna, the second base antenna must then be recalibrated.

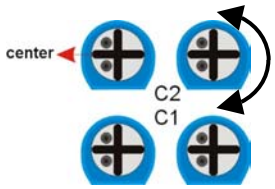
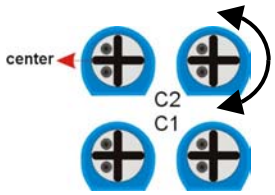
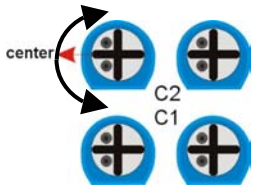
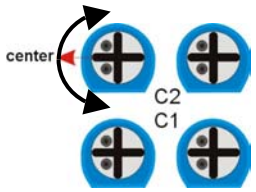
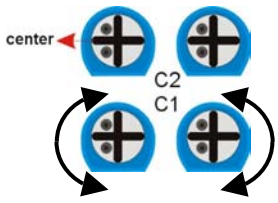
Step	Procedure	Note
1	Calibrate the second base antenna as described in section: 3.2. Steps 1 - 7	Here the second base and the opposite second complementary antenna must be connected directly to the Reader.
2	Calibrate the second complementary antenna as described in section: 3.3. Steps 1-10	
3	Fine calibrate the second base antenna as described in section: 3.4. Steps 1-6	

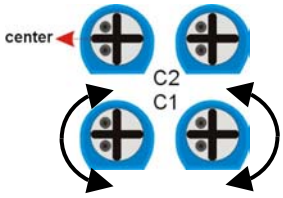
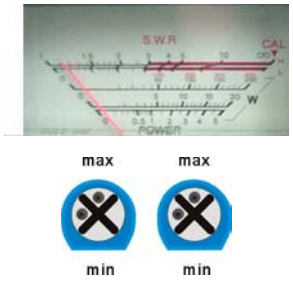
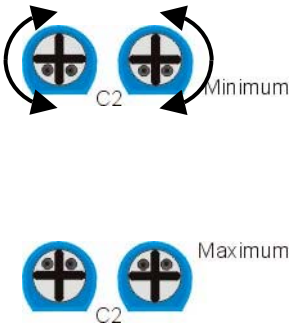
3.6. Installing the Power Splitters

Figure 6 Connection diagram: One Reader and two base and two complementary antennas



Step	Procedure	Note
1	Connect the two base antennas to the first power splitter, terminal X1, X2.	See Figure 6
2	Connect the power splitter terminal X3 through the SWR meter to the Reader ID ISC.LR200-B terminal X2	
3	Connect the two complementary antennas to the second power splitter, terminal X1, X2	See Figure 6
4	Connect the power splitter to the Reader ID ISC.LR200-B terminal X1	
5	Set Jumper JP1 and JP2 to the second power splitter	
6	The SWR should be at ≤ **1.3:1**	

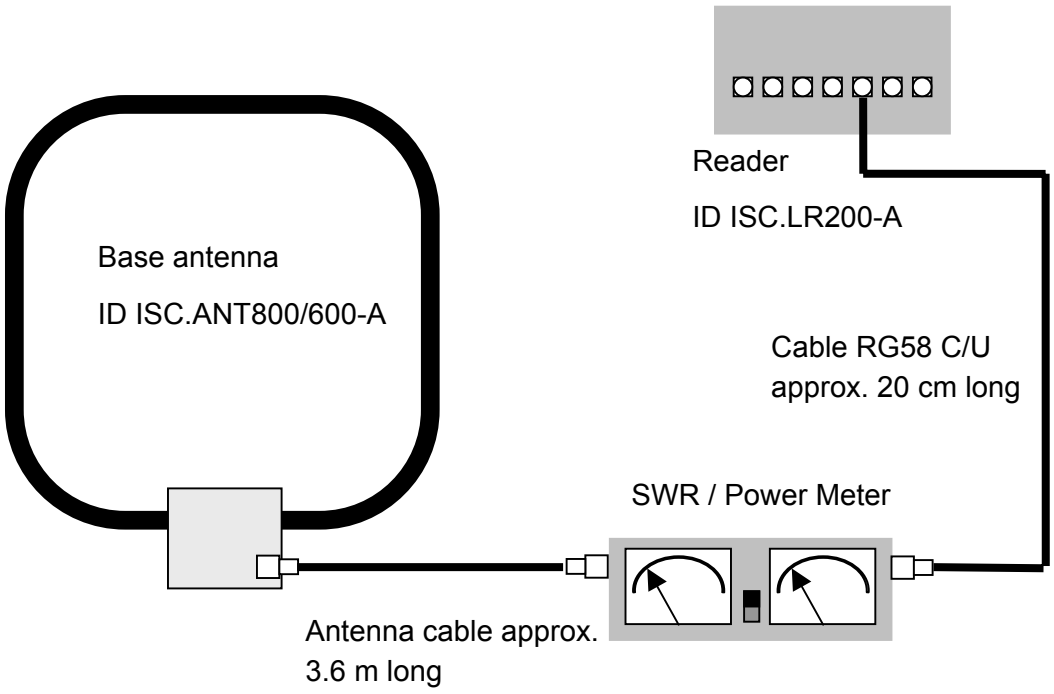
7	Turn the rightmost of the two trim capacitors **C2** on the **first base antenna** slowly counterclockwise. The SWR must drop! Otherwise turn the trim capacitor slowly clockwise. Continue turning until the SWR reading no longer drops or maximally ¼ turn.	
8	Turn the **rightmost** of the two trim capacitors **C2** on the **second base antenna** slowly counterclockwise. The SWR must drop! Otherwise turn the trim capacitor slowly clockwise. Continue turning until the SWR reading no longer drops or maximally ¼ turn.	
9	Now, use the **leftmost** trim capacitors **C2** to fine tune the **first** base antenna. Find the smallest SWR by observing the SWR meter while adjusting the capacitors	
10	Use the **leftmost** trim capacitors **C2** to fine calibrate the **second** base antenna. Find the smallest SWR by observing the SWR meter while adjusting the capacitors	
11	Use the plastic blade screwdriver to turn **both** trim capacitors **C1** of the **first** base antenna Find the smallest SWR by observing the SWR meter while adjusting the capacitors	

12	Use the **both** trim capacitors **C1** to fine calibrate the **second** base antenna Find the smallest SWR by observing the SWR meter while adjusting the capacitors	
13	The SWR after fine tuning should be ≤ **1.3:1**. The capacitors that are associated with each other should be set to approximately the same capacitance.	
14	If the adjustment range of the trim capacitors is not sufficient, set for the best possible SWR value. Now both trim capacitors must be set their minimum or maximum. Then turn the capacitors 180°, from either their minimum or maximum.	
15	Now you must recalibrate the antennas using the ID ISC.SAT.C controller. Then you will have double the adjustment range available.	Repeat steps 1-11

3.7. Measuring the standing wave ratio (VSWR)

Once an antenna has been calibrated or the local conditions have changed, the question arises: How well are the Reader and base antenna adjusted to each other? A useful tool for evaluating the adjustment of the antenna to the impedance of 50 Ω is the VSWR meter. This device measures the ratio between outgoing and reflected energy. A VSWR of up to 1.3:1 is considered a good value. A wattmeter is often integrated into these devices.

Figure 7: Inserting a VSWR meter into the antenna cable



The cable between the Reader and the SWR meter should either be very short (< 20 cm) or 7.20 m (RG 58=Lambda/2) long. If the VSWR is greater than 1.3:1 after tuning, use trim capacitors C1 and C2 to perform a slight adjustment.

Furthermore the VSWR meter can be used at any time to check the tuning of the base antennas. If changes in local conditions result in detuning of the antennas, this can be verified whenever desired.

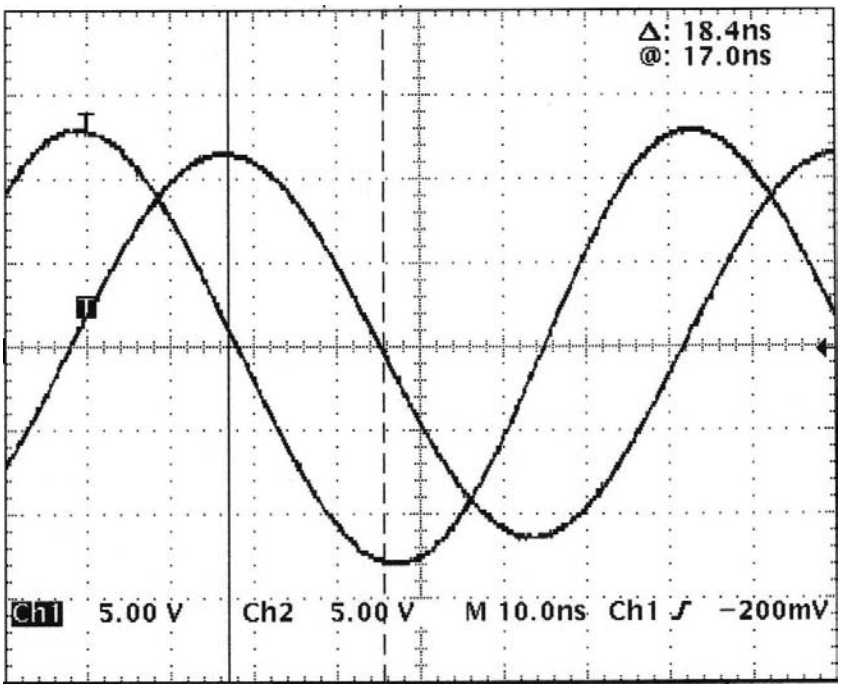
In addition to the losses indicated by the SWR due to mismatching between the cable and the antenna, it happens that the Reader drives different output currents depending on the antenna impedance, resulting in power variance. This means that at 50 Ω a current of approx. 0.3 A flows. No current flows when an output is open, and when there is a short circuit the current is limited to approx. 1.0 A. Matching the antenna also has a slight effect on the noise levels.

3.8. Measuring the phase angle and checking the currents in the antenna

To check or fine adjust the phase angle between the base and complementary antenna, use an oscilloscope and 2 small test loops made of wire to measure the phase angle. AT 13.56 MHz and a phase shift of 90° between the base and complementary antenna, the time delay will be 18.4 ns. Figure 8 shows a printout of this measurement.

Use trim capacitors C37 and C38 to correct the phase of the currents between the two antennas. After tuning the two associated trim capacitors C37 and C38 should be set to approximately the same capacitance.

Figure 8: Phase difference between base and complementary antenna Figure 9: Same C values



C37 C38

If the adjustment range of the trim capacitors is not sufficient, set for the best possible phase value. Now both trim capacitors must be set their minimum or maximum. Then turn the capacitors 180°, from either their minimum or maximum. Now you must recalibrate the antennas using the ID ISC.SAT.C controller. Then you will have double the adjustment range available.

Furthermore the antenna current in both antennas making up a gate should be the same. This can be checked by measuring the amplitude and corrected by changing the serial resistors R (JP8, JP1-4).

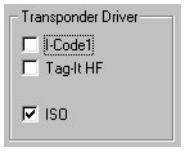
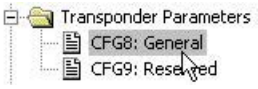
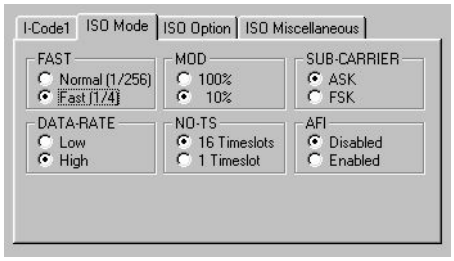
If both currents are the same, the RF power of the Reader will be distributed evenly between both antennas. This means that in a gate consisting of two antennas and at a RF power of 8 W, both antennas will operate at 4 W.

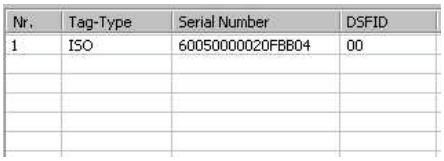
Important: Both test loops must be the same size, have the same cable length, be attached at the same antenna position, and be exactly parallel to each other. In addition, they should be attached as close to the centre of the antenna surface as possible.

4. Startup and testing of the gate

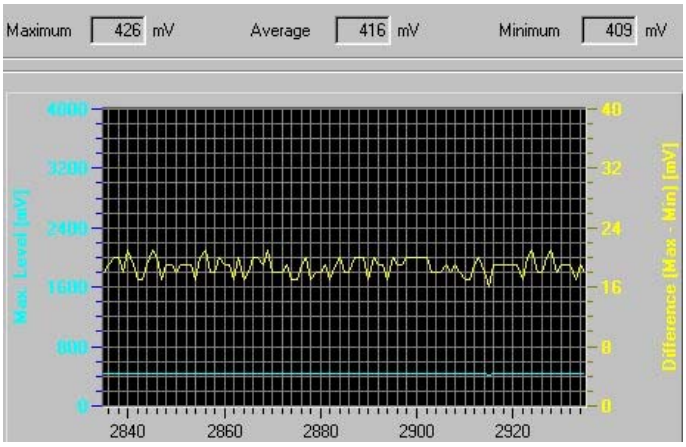
After installing and tuning the antennas, the correct function of the gate can be checked using the Reader, the ISCStart service software (V4.00 or higher), a PC running under MS Windows, and a Smart Label. The ISCStart software can be found on the OBID® i-*scan* CD-ROM supplied by FEIG ELECTRONIC GmbH.

4.1. Reading out the serial number

Step	Action	Remarks
1	Attach a tag to one of the antennas	Adhesive tape may be used
2	Click on Configuration	
3	Set the label type in the configuration block CFG3.	1 **Set tag type** Configuration CFG3 RF-Interface I.  2 **Save setting** 
4	Set transponder parameters: Configuration CFG8 General	
5	Configure all transponder types to be used for the desired mode.	
6	Select Menu: “Test and Measurements”	
7	Select “ISO Inventory“ function	

8	Clock on “Start“ button	
9	The serial number and tag type are displayed in the window	

4.2. Checking the noise level

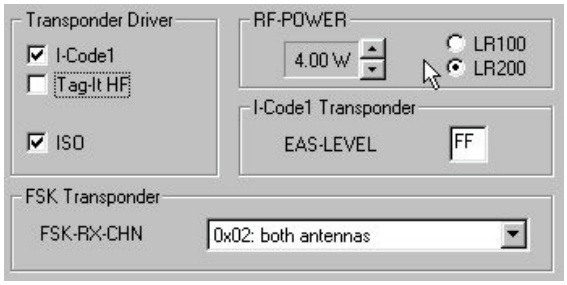
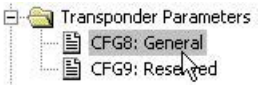
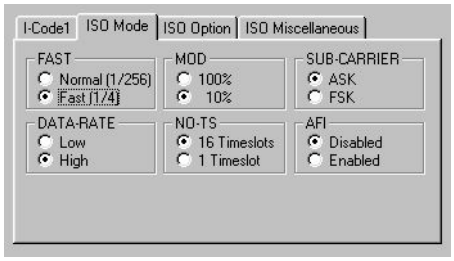
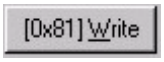
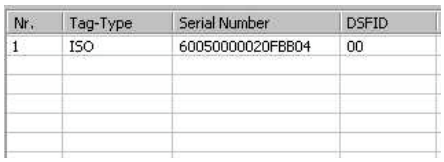
Step	Action	Remarks
1	Select: “Test and Measurements“ menu	
2	Select “Noise Levels“ function	
3	Click on “Start“	
4	Nominal values: Average : 500 – 750 mV Maximum – Minimum < 20 mV	

<u>If the nominal values are not maintained, check the following points:</u>

- Are all cables firmly attached and making good contact ?
- Were the toroid cores installed in the antenna cable ?
- Were the cables routed properly ?
- Are other RFID devices installed in the area ?
- Are there large metal parts located in the vicinity of the antenna? (< 1.0 m)
- Are there noise-generating devices nearby (larger machines or RF devices) ?

To determine which devices may be causing the disturbance, unplug them or power them down one at a time.

4.3. Setting the operating parameters

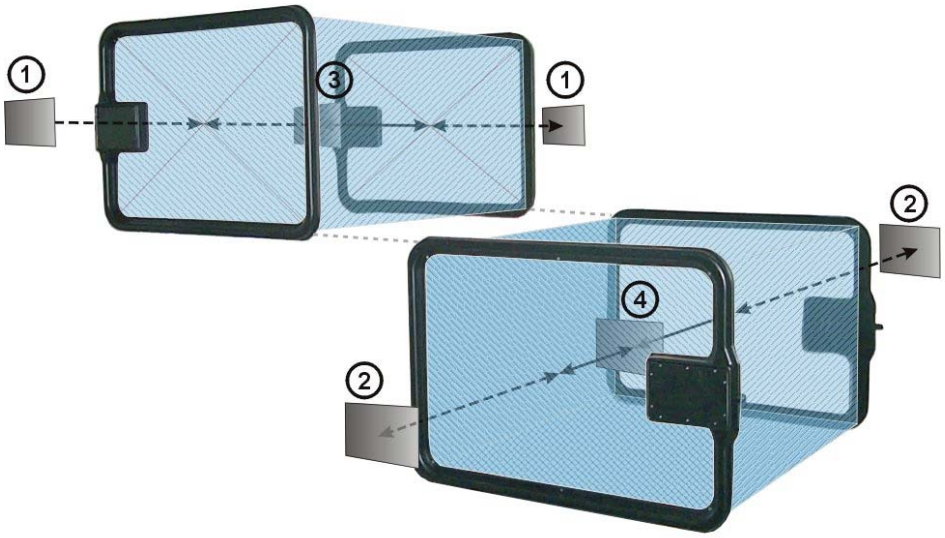
Step	Action	Remarks
1	Select Configuration menu	
2	Configuration CFG3 RF-Interface: Select 4 W RF power Activate necessary transponder drivers. Deactivate unused transponder drivers. Set FSK-transponder, FSK-RX-CHN to “0x02 both antennas“	
3	Set transponder parameters: Configuration CFG8 General	
4	Configure all used transponder types to desired mode	
5	Set new parameters in Reader	
6	Select “Test and Measurements” menu	
7	Select command: “ISO Inventory“	
8	Start command: “ISO Inventory“	
9	*If the tag is placed in the antenna field, the serial number and tag type will be displayed.*	

4.4.Testing the performance

For this performance test we will be assuming the conditions described in the section: “1.1. Project notes“. The indicated ranges and read areas will change correspondingly when different labels are used.

Begin the test by checking the read range **outside** the gate (see Figure 10 points ① and ②), assuming the configuration and local conditions permit. To begin, start the command ISO Inventory in the ISCStart program (see points 6-9, section 4.3. Setting the operating parameters). Assuming a parallel label orientation with respect to the antenna facing out, a read range at the center of the antenna should be 60-65 cm. This test should be repeated for all four antennas. The read range may vary here by a few centimeters (approx. ±2.5 cm).

Figure 10 Testing ranges / gate performance. Label parallel to antenna



Now slowly move the label vertically and parallel to the antenna **in** the gate along the line ③ and ④ from one side to the other. The label should always be read.

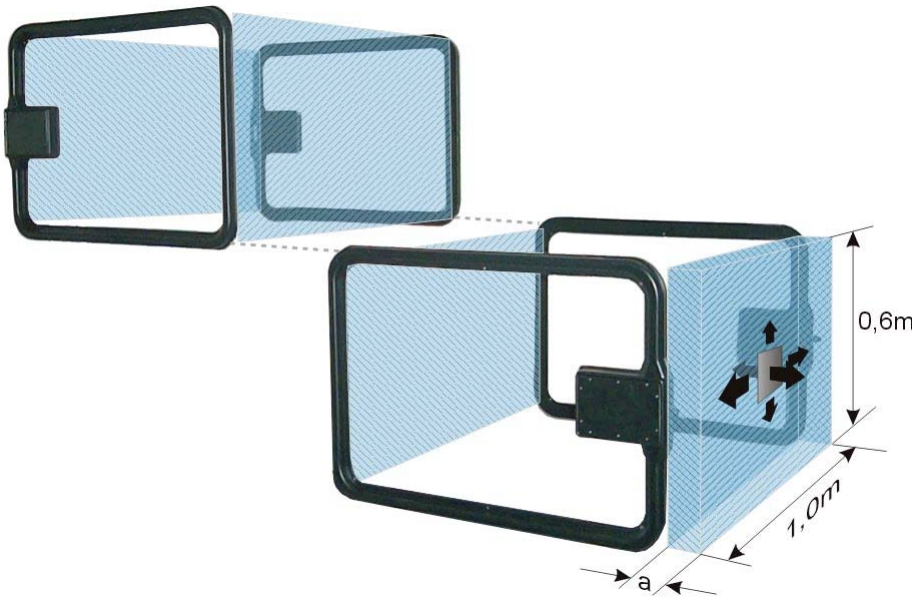
The test for read ranges with label oriented at right angle to the antenna begins with the front side of the lower antenna pair (see Figure 11). Slowly move the label to the right, left, up and down. The label should always be read. Next move the label from outside to inside in the centre of the gate. This will indicate capture area A.

Repeat this test on the back side of the upper antenna.

The sum of the two capture areas must cover the entire capture area (gate width GD x upper edge of upper antenna and lower edge of lower antenna). The transition from the upper to lower antennas is the critical area.

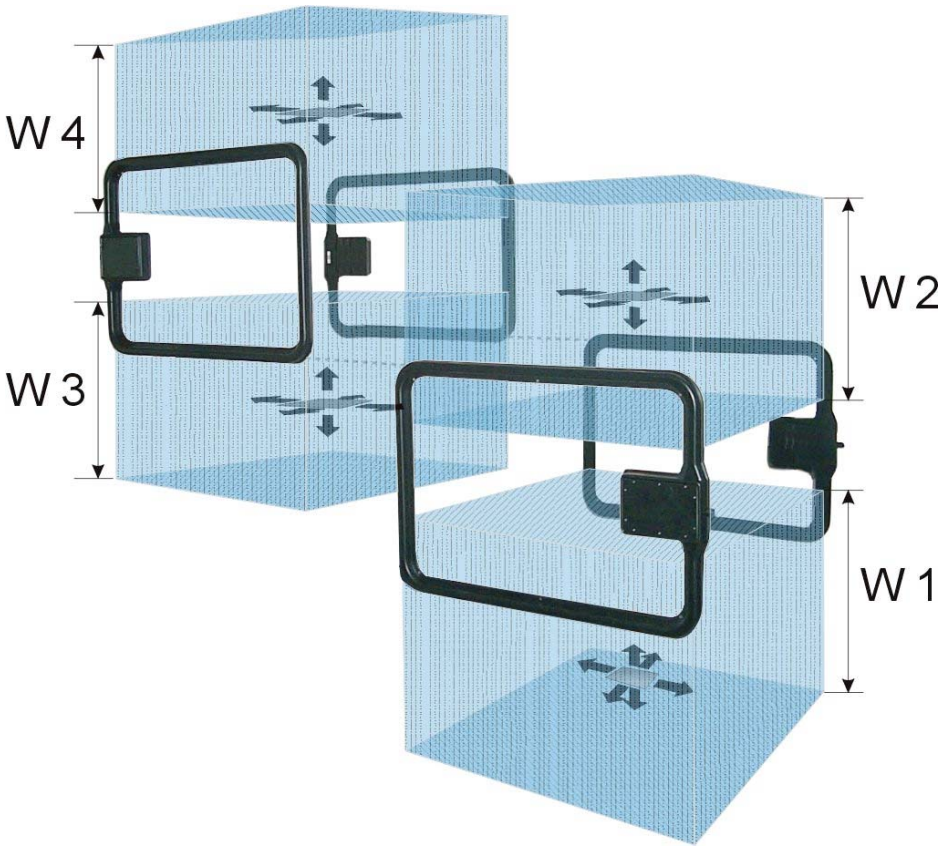
All labels in this orientation are then read twice while being moved horizontally through the antenna. A capture area is located at the beginning and end of an antenna pair. Both capture areas – for each antenna pair – should be approximately equal in size.

Figure 11 Testing ranges / gate performance. Label diagonal to antenna



The read range with horizontal label orientation is checked as shown in Figure 12. Begin the test again with the lower pair of antennas. Slowly move the label above the antennas to the right, left, front and back. The label should always be read. Next position the label in the centre between both antennas at the height of the centre of the antennas. Now move the label from the centre of the antenna up until the capture area stops. This indicates the measured value W2. Moving from the centre of the antenna downward gives you W1.

Figure 12 Testing ranges / gate performance. Label horizontal



Next repeat the tests on the upper antenna pair. This will give you the values for W3 and W4.

The sum of the four measured values must cover the entire area of the upper edge of the upper antenna to the lower edge of the lower antennas. It is critical that the hole between W1 (W3) and W2 (W4) is closed.

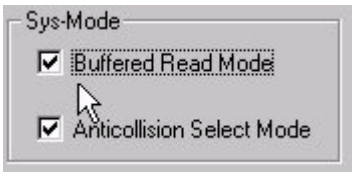
Otherwise slide the upper antennas down (max. 15 cm) until the read hole is closed.

The following problems may arise:

- Antenna incorrectly installed (orientation, distance between antennas, check cable placement)
- Metal in the vicinity that detunes or disturbs the antennas
- The base antennas is improperly tuned (SWR ≥ 1.3)
- The complementary antenna is improperly tuned (Phase <> 90°± 5°, amplitude base antenna <> complementary antenna)
- Noise is too high (Vmax – Vmin ≥ 20 mV)
- EMC toroid cores in the Reader or on the antenna cable are not properly installed.
- Label no sensitive enough, detuned or defective
- Reader improperly configured (RF power, transponder type, modulation, transponder parameters, etc.)
- Defective cable or connector making a poor contact.
- Reader, Transformer, Power Splitter or Antenna defective

4.5.Switching the Reader to Buffered Read Mode

“Buffered Read Mode“ is the normal operating mode for the Reader. This means the Reader reads the tag data at maximum possible speed and stores the data in a ring buffer in the Reader.

Step	Action	Remarks
1	Select **Configuration** menu	
2	Set Reader to **Buffered Read Mode**. (Also set Anticollision Select Mode)	
3	Verify that the EEPROM is selected as the destination memory Save settings in the Reader with the **Write-Button**	 

4.6. Regulatory agencies in EU countries and the USA

The design and RF power of the antennas is affected mainly by the country-specific RF regulations. The entire EU geographic area is covered under uniform limits specified in the R&TTE guideline and EN 300 330. In North America this is regulated by FCC Part 15.

In EU countries the maximum permissible field strength at 13.56 MHz at a distance of 10 m is: 42dBμA/m. In the USA this is 38dBμA/m.

When commissioning the system, be sure that the permissible values as prescribed by the national regulatory agency are not exceeded.

Since FCC Part 15 prescribes a separation of 50 dB between the carrier and sidebands, the Reader may be operated in the USA only using 1 of 256 bit coding (modulation).

When using Reader ID ISC.LR200-B and under optimum ambient conditions, the antennas can be operated in the configuration as described here in EU countries using a maximum of 4 W, or 1.5 W in the USA (see Appendix A, test report from EMC Testhaus Dr. Schreiber). If the limit values are higher or lower, the RF power must be adjusted accordingly or the magnetic radiation needs to be reduced by shielding the antennas.

When commissioning the antennas, the system integrator should be sure that the installation instructions are followed, the necessary Reader settings have been made and that the limit values prescribed by the national regulatory agency are not exceeded.

Furthermore the Reader must be configured as follows:

Parameter	Europe	USA
General		
RF-Power – CFG 3	4 W	1.5 W
ISO15693 Label		
Downlink RF Modulation – CFG 8 / ISO-MODE / MOD	10 %	10%
Downlink RF Data coding – CFG 8 / ISO-MODE / FAST	Fast (1/4) or Normal (1/256)	Normal (1/256)
Timeslots - CFG 8 / ISO-MODE / NO-TS	16 Timeslots	16 Timeslots
Inventory Command Option – CFG 8 / ISO-CMD-OPTION / BREAK	Complete Timeslot length at “NO TAG“	Complete Timeslot length at “NO TAG“
I-Code 1		
Downlink RF Data coding – CFG 8 / ICODE-MODE / FAST	Fast Mode (1/1) or Normal Mode (1/256)	- Normal Mode (1/256)

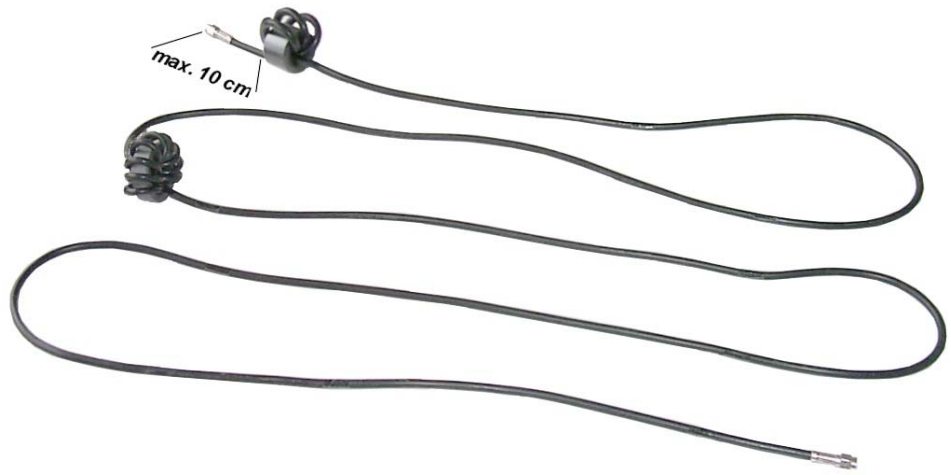
4.7. Installing the toroid cores for use in the USA

To meet EMC requirements in the USA according to FCC Part 15, two toroid cores must be installed in the cables for ID ISC.ANT800/800 types A and B (see drawing below).

The EMC toroid core (∅ 28 mm x 20 mm, dia 1.1 in x 0.787 in) supplied with the Reader must be installed at the beginning of the cable. Loop the antenna cable at least four times tightly through the toroid core. The distance between the Reader connection and the toroid core should be no more than 10 cm (3.9 in). This toroid core is included with the antennas.

In addition, the ∅ 41 mm x 15 mm EMC toroid core must be installed exactly in the center of the antenna cable. Loop the coaxial cable at least ten times tightly through the toroid core.

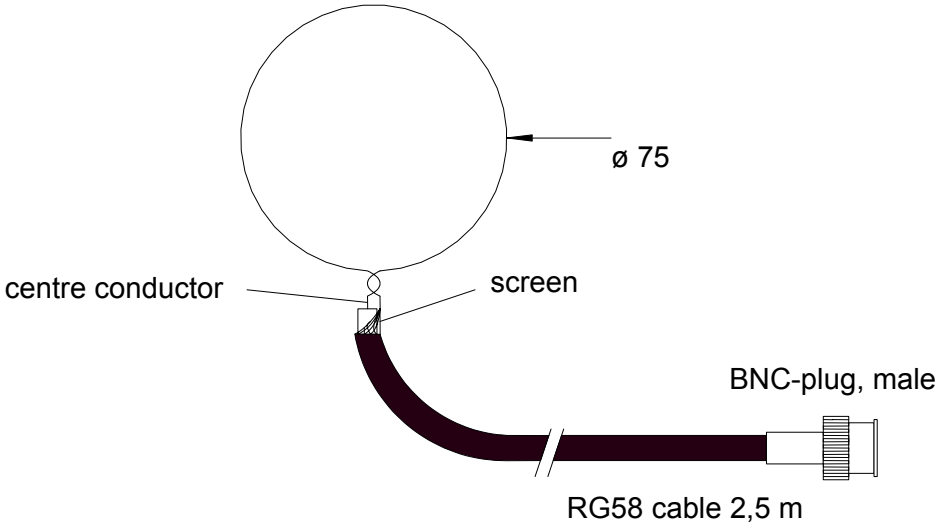
Figure 13: Installing the two toroid cores on the antenna cable



5. Appendix: Helpful tools for constructing and testing the antennas

The following equipment is recommended for tuning, troubleshooting and commissioning the antennas:

- Laptop or personal computer (PC) running under Microsoft Windows 95, 98, ME, 2000, XP.
- Service software ISCStart (V4.02 or higher). This software can be found on the OBID® i-*scan* CD-ROM supplied by FEIG ELECTRONIC GmbH..
- SWR and Power Meter including SMA connectors (female) or appropriate adapters.
- Qty. 1 cable RG 58 C/U approx. 20 – 25 cm (7.8 – 9.8 in) long with two male SMA plugs (generally self-assembled).
- Suitable screwdriver for antenna tuning, with plastic blade, 2.4x0.5mm.
- 2-channel oscilloscope, sweep rate at least 10ns/Div or analog bandwidth of 100 MHz.
- Qty. 2 test loops 1.5 m long (consisting of 50 Ohm, RG58 cable with BNC plug and wire loop (diameter approx. 75 mm [30 in]) at the other end (generally self-assembled).



The following tools are optional but helpful:

- HF Impedance Analyzer (for 13.56 MHz)

5.1. Recommended equipment and possible sources:

1. VSWR – Meter

Alan CTE International VSWR & Power – Meter KW 220

Vendors:

- CB Funkshop Rößner, 91637 Wörnitz, Tel.09868/932945, http://www.cb-funkshop.de
- Garant – Funk, 53879 Euskirchen, Tel. 02251/55757

Alan CTE International VSWR and Wattmeter K155

Vendor:

- Conrad Electronic

2. Antenna analyzer

MFJ HF/UHF SWR Analyzer

- Model MFJ-259B, 1.8 – 170 MHz

Vendors:

- Austin Amateur Radio Supply, USA 1-800 423 2604
- VHT – Impex, Ecke, Germany, Tel.: 05224/9709-0

CIA – HF Complex Impedance Analyzer 5012 – 5000

Vendors:

- AEA, Vista, California 92083, USA
- Garant – Funk, 53879 Euskirchen, Tel. 02251/55757

3. Adapter : UHF-> BNC, BNC-SMA, SMA-SMA, Abschlußwiderstand 50 Ω

Vendors:

- Bürklin OHG, http://www.buerklin.com
- Conrad.com AG, http://www.conrad.de
- Farnell Electronic Components GmbH, 82041 Oberhaching, http://www.farnell.com

4. Amber / Tuning screwdrivers with plastic blade

Blade size: 2,4x0,5mm

Vendors:

- Bürklin Bestellnummer 06 L 8364

5. Oscilloscope

Tektronix TDS 210 or a model from the TDS2xx or TDS3xx. series
Agilent 54622D or a model from the 546xx series
Voltcraft 100 MHz- Oscilloskope 6100
Hameg HM 407 or HM 1507-3

Vendors:

- Tektronix Inc, http://www.tektronix.de oder http://www.tektronix.com
- Agilent Technoligies, http://www.agilent.com
- Conrad Electronic GmbH, 92240 Hirschau, http://www.conrad.de
- ELV Elektronik AG 26787 Leer, http://www.elv.de oder http://www.elv.com
- DataTec GmbH, 72770 Reutlingen, http://www.datatec.com

6. EMC ferrite toroid cores

Diameter da=28, di=16, l=20, B.Nr.742 701 4
Diameter da=40,6 di=27,4 l=15, B.Nr.742 701 5

Vendor
Würth Elektronik GmbH & Co.KG
Riedenstraße 16
74635 Kupferzell
Tel.: 07944 / 91 93 0
www.wuerth.de oder www.wuerth.com

6. Appendix B Test report from EMC Testhaus Dr. Schreiber GmbH

Following is the test report from EMC Testhaus Dr. Schreiber GmbH for this application

H-Field Emission at 13.56 MHz (Carrier)

H-Field Emission at 27.12 MHz (1 Harmonic)