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Title: GPRS Antenna positioning			

Abstract: This document presents investigations and measurements done to find the GPRS antenna configuration which is the best compromise between MICS and GPRS performances.

	Name	Function	Signature	Date
prepared by	Pierrick Calvet	RF Engineer	[signature]	Sept 27th 2011
prepared by	Laura Delaporte	Engineering intern	[signature]	Sept 27th 2011
reviewed by	Julien Thoron	HM system Engineer	[signature]	Sept, 28th 2011
reviewed by	Michel Fleury	QA RA	[signature] p.o. O. Vitadamnt	Sept 28, 2011
approved by	Fabio Belletti	HM Project Leader	[signature]	Sep 28, 2011

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REVISION HISTORY

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A	1	-	Creation	P. Calvet	2011-03-02
	2	-	Add measurements with various GPRS antennas	L. Delaporte	2011-08-31
	3	-	Minor changes	P. Calvet	2011-09-01
	4	all	adding from review of synthesis results	T. Scordilis	2011-09-15

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1.1 Introduction

1.1.1 Scope and Methodology

This document presents investigations and measurements performed on the GPRS antenna and its position in the SmartView Monitor. The main reason is that the GPRS antenna placement has an influence on the performance of the RF on the MICS band and on the GPRS band.

Having found a new placement of this GPRS antenna to improve MICS band communication from the clinical study, it has been shown that the new GPRS antenna system was not functional for US band of GPRS and its placement has some risk concerning the manufacturability. Therefore a new placement has to found. This new placement will be a compromise between GPRS mode and MICS mode. This process is a inter-team process as it involves both teams from SELCO and SORIN.

Due to this influence on both subsystem, a methodology has to be deployed :

1. find and elaborate different GPRS antenna positions suitable for manufacturing, using RF recommendation from the MICS subsystem. The type of antenna might be changed.
2. mount the different prototype in order to measure using a Base Station simulator the performance of the GPRS on each sub band (EU800 EU1700 US900 US1900)
3. keep the best GPRS antenna position
4. for this position perform the radiation tests of the MICS antenna subsystem
5. perform system measurement in MSL Fluids to confirm

1.1.2 References

The measurements, performed by the HM team, concern MICS and ISM band only. GPRS measurements appears in radio report from external laboratory.
The followings documents are used as references for this study :

Reference	Rev.	Description
SRN02_113001	A	Antenna GPRS performances (Performances des antennes GPRS)
SRN02_112701	A0	Mesure SWR (matching of the GPRS antenna)
REQ1029	F	RF production test specification
R052-RAD-11-104102-1	A Ed. 0	Smartview monitor KA911 Radio test report
ZL70101 DS	june 2008	Data sheet of the ZL chipset
ZL70101 DM	dec 2007	Design Manual of the ZL chipset

1.1.3 Codendi reference items

The following tracker ID are referenced in the HM changes tracker in Codendi:

Artifact ID	Summary
3741	bad GPRS performance
4038	GPRS modem is not correctly working in US band

1.1.4 Expected improvements

The GPRS antenna positioning is intended to improve the performances of the SmartView monitor from a GPRS point of view and shall not degrade MICS band performances. This improvement can be in terms of SWR or radiated gain for the GPRS antenna and in terms of ERP for the MICS band.

1.1.5 Implications analysis

The GPRS antenna is changed. This means the HomeMonitor bill of material has to be updated.

The GPRS antenna position has moved so the mounting instruction for the production personnel has to be updated.

As a MICS antenna gain has changed, the RF production test specification document (REQ1029) has to be updated with the news limits values for the MICS output power calibration.

1.2 Technical analysis

1.2.1 GPRS antenna moving from HM V1 to RF+ Quick

Introduction

In order to connect the SmartView Monitor to mobile network, a GPRS module and its associated antenna are placed in the SmartView Monitor. The GPRS antenna position in the first version of SmartView Monitor (V1) is shown on figure 1.1.

System tests have shown this antenna position disturbs the communication in the MICS band and increases the follow-up duration.

The following chapters present measurements done on various SmartView Monitor for various GPRS antenna positions.
The original position means the `Siretta Echo 1` GPRS antenna in SmartView Monitor V1 position whereas the new position means the antenna placed on auxiliary serial link connector side.

Figure 1.1: The GPRS antenna is originally placed on the On-Demand button HM side.

MICS band measurement

The SmartView Monitor GPRS version 1103001 with shielding cabinet over digital electronic is used for these measurements. Its radiation pattern is measured on channel 5 (403.65MHz) on both polarizations in followings cases :

- GPRS antenna in its original position (SmartView Monitor V1).
- GPRS antenna placed under HM PCB to hide it from MICS antenna without the need to physically remove it.
- GPRS antenna in its new position (auxiliary serial link connector side, opposite side of ISM IFA). See figure 1.2.

These radiation patterns are compared to the one of a PSTN version of the SmartView Monitor without any PSTN cable.

As shown on figures 1.3 and 1.4, the radiated power by the SmartView Monitor with the GPRS antenna placed at its original position is between 3 to 7dB lower than the radiated power in the others cases.

In the new position (auxiliary serial link connector side), the GPRS antenna influence on MICS IFA radiation pattern is reduced on both polarizations. The radiation pattern is similar to the one when the GPRS antenna is moved under the SmartView Monitor PCB or to the one of SmartView Monitor PSTN version.

The radiated power increase has been verified on both polarizations for 3 frequencies on MICS band as shown the figures 1.5(a) to 1.7(b).

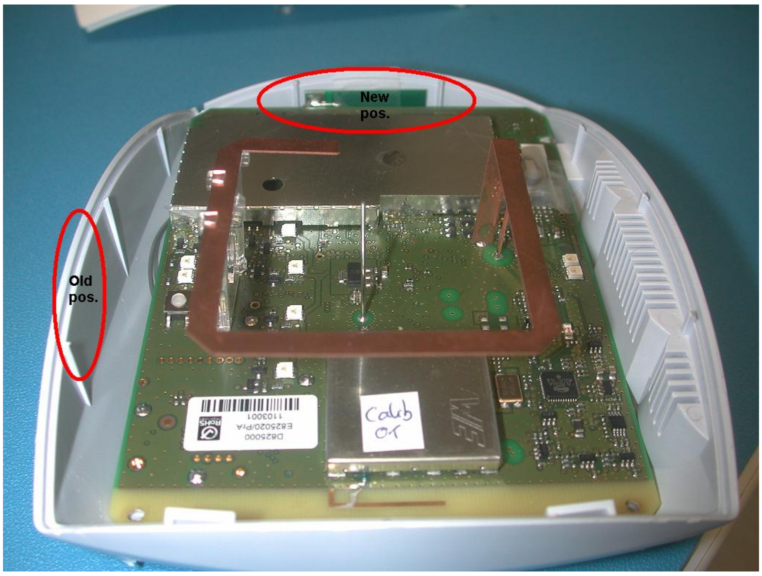


Figure 1.2: The new GPRS antenna position is moved at the opposite side of ISM IFA.

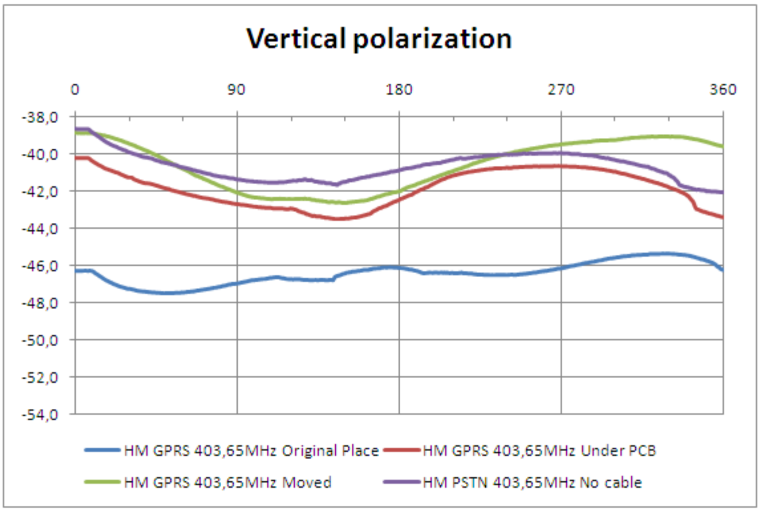


Figure 1.3: In its original position, the GPRS antenna reduces the MICS IFA radiated power in the vertical polarization between 3 to 7dB.This graph represent the radiated power over azimuth angles in vertical polarization. The levels have to be seen as absolute in order to compare them.

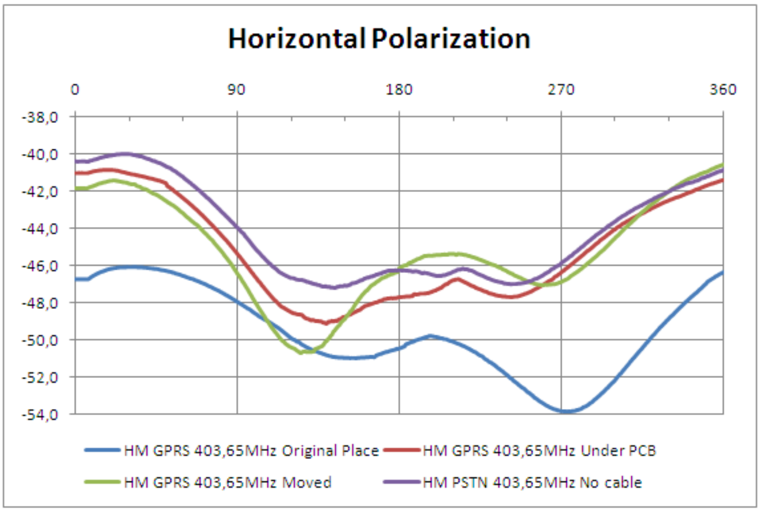
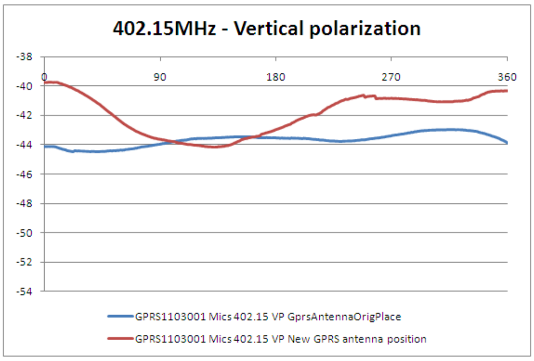
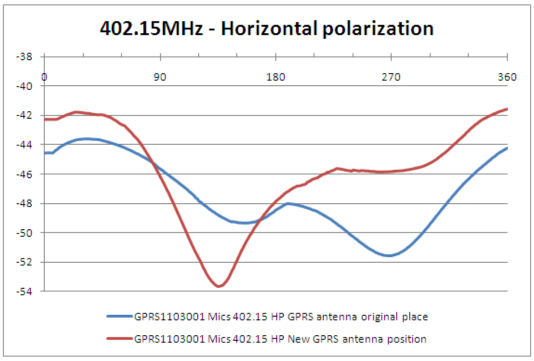


Figure 1.4: The radiated power by MICS antenna in horizontal polarization is reduced by the vicinity of the GPRS antenna in its original position.

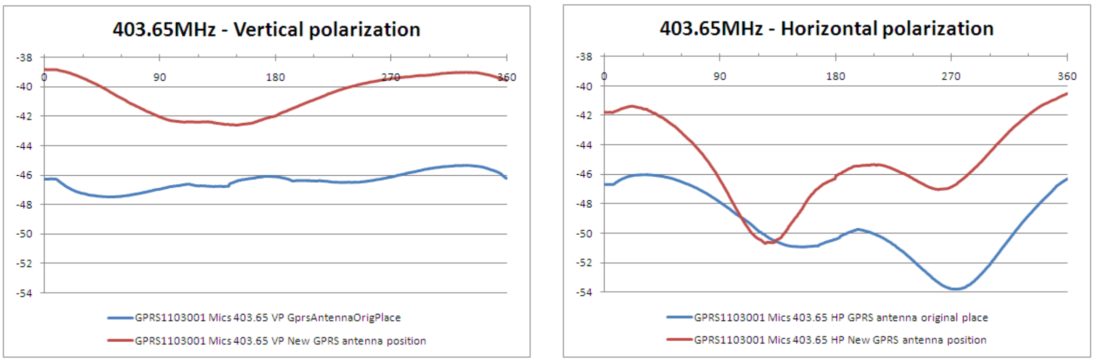


(a) Vertical polarization



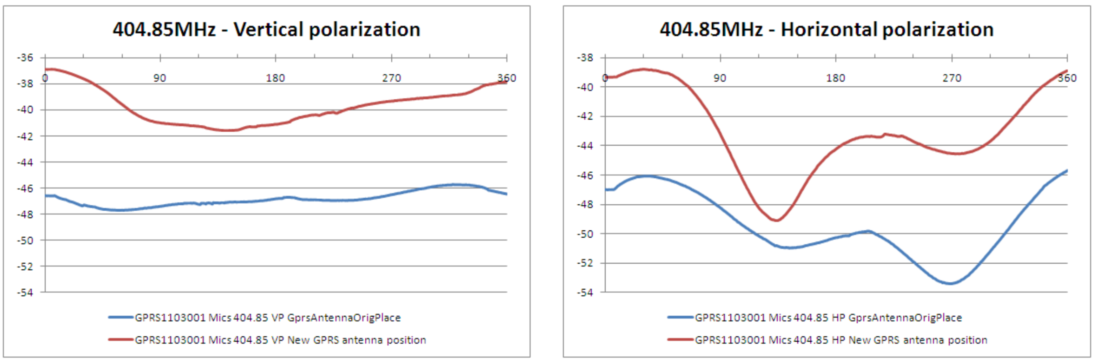
(b) Horizontal polarization

Figure 1.5: MICS band radiation pattern - Channel 0



(a) Vertical polarization (b) Horizontal polarization

Figure 1.6: MICS band radiation pattern - Channel 5



(a) Vertical polarization (b) Horizontal polarization

Figure 1.7: MICS band radiation pattern - Channel 9

On some angles, for example 135^o in horizontal polarization, the radiated power by the MICS IFA in case of the new GPRS antenna position is less than in case of the original position.
This could be due to the USB power supply cable which moved from one test to another one. Indeed, some previous measurements have shown the MICS radiation pattern is sensitive to the cable position. Even though the cable position is fixed along the plastic support (cf. figure 1.8), at the bottom of support, the cable is sufficient free to wind itself around it.

Figure 1.8: The USB cable position is fixed along the support for the radiation pattern measurement.

→ Nevertheless, this angle (back of the product) is not a natural position of SmartView Monitor at patient's house and the new GPRS antenna position increases globally system performance.

ISM band measurements

As shown on figures 1.9, 1.10, 1.11 and 1.12, no significant variation is observable when the radiation patterns of SmartView Monitor PSTN version (without PSTN cable) is compared to those of SmartView Monitor GPRS version with GPRS antenna placed on both positions.

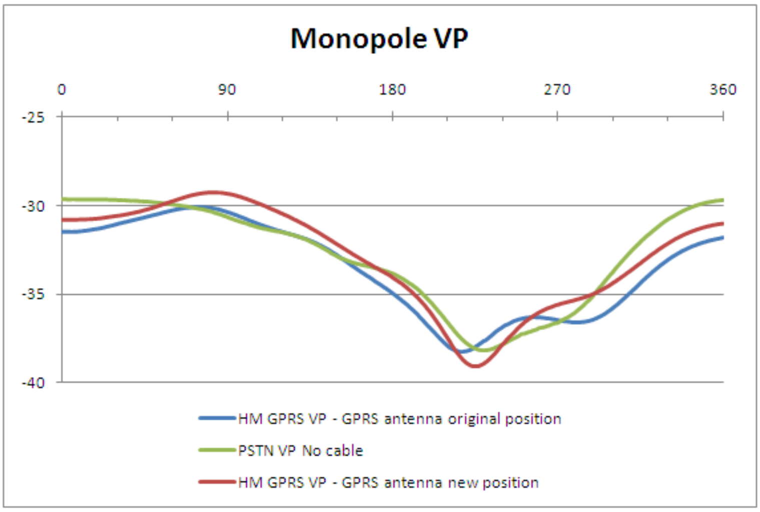


Figure 1.9: Monopole radiation pattern in vertical polarization

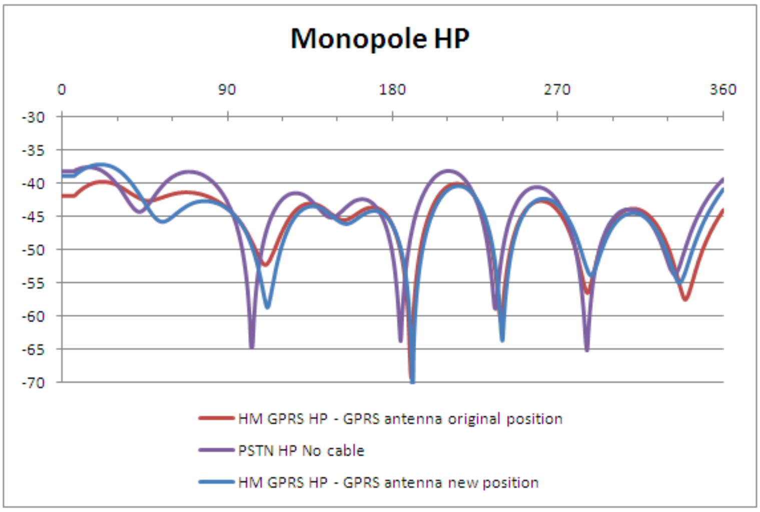


Figure 1.10: Monopole radiation pattern in horizontal polarization

→ The GPRS antenna position does not have any influence on ISM antennas radiation pattern and their radiated powers.

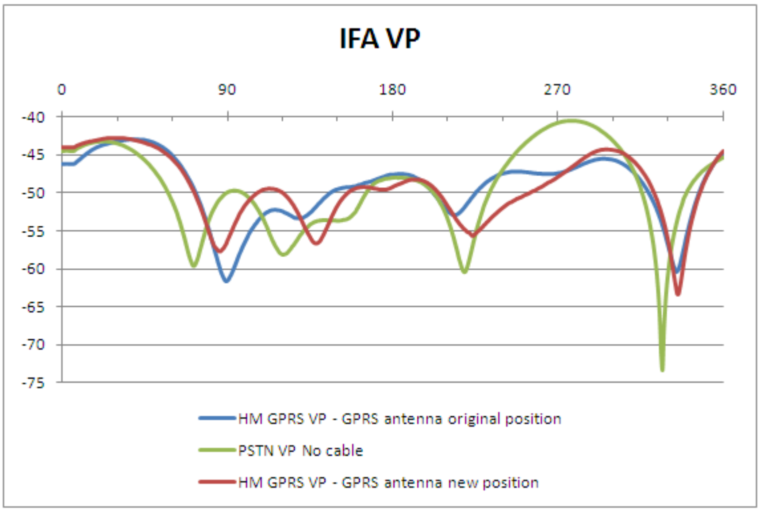


Figure 1.11: IFA radiation pattern on vertical polarization

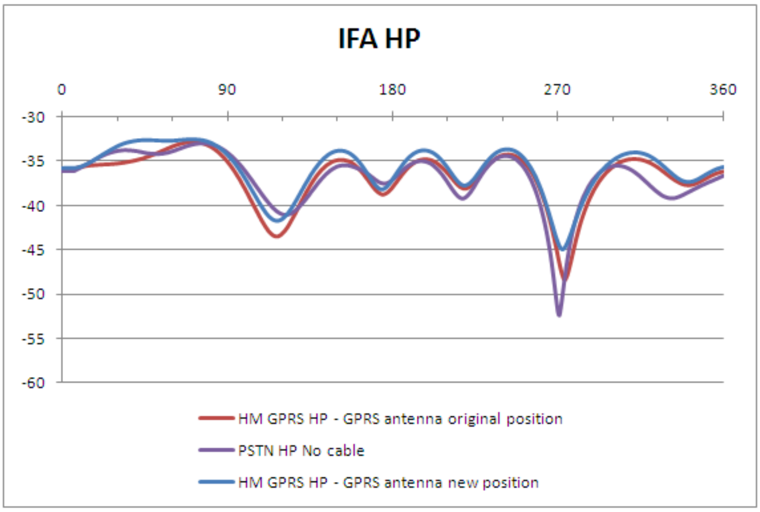


Figure 1.12: IFA radiation pattern on horizontal polarization

Conclusion

The GPRS antenna placed on auxiliary serial link connector side restores the system performances at the SmartView Monitor PSTN version level.

→ The new GPRS antenna position is effective in the SmartView Monitor RF+ Quick version.

1.2.2 GPRS issue during qualification campaign

In June 2011 during qualification tests campaign at LCIE laboratory, the GPRS modem could not attach itself to the radio communication tester (CMU200) on GSM850 and PCS1900 bands. On GSM900 and DCS1800 bands, the modem did not seem to have any difficulties to attach itself on the CMU200.

The following hypothesis was done: As the modem output power is important (EIRP max = +33dBm i.e. 2W), the modem has probably a protection circuit in order to avoid to damage its power amplifier. On GSM850 and PCS1900 bands, the reflection coefficient is too high and the modem put itself in a safe mode.
On GSM900 and DCS1800 bands, the reflexion coefficient should be lower and the modem does not change its working mode.

No GPRS performance measurement was done during these qualification campaign.

→ The artifact ID 4038 (GPRS modem is not correctly working in US band) was submitted in Codendi.

1.2.3 SWR measurement

In order to measure the reflection coefficient of Siretta Echo1 antenna under SWR representation, a coax probe has to be soldered on the antenna pad as shown on figure 1.13. With this setup, the reflection coefficient of the GPRS antenna is measured in a 50Ω reference plan likes the module output.
Furthermore, the antenna impedance is measured in the SmartView Monitor mechanical housing.

Some matching components in the module have to be removed in order to disconnect its RF circuitry from the antenna pad. These components are shown on figure 1.14.

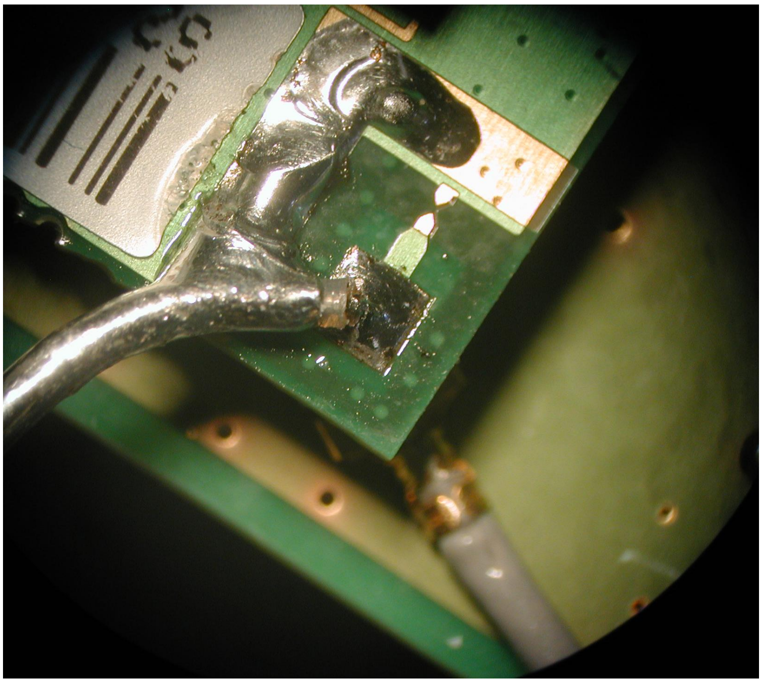


Figure 1.13: A coax probe has to be soldered on GPRS module antenna pad to measure the reflexion coefficient.

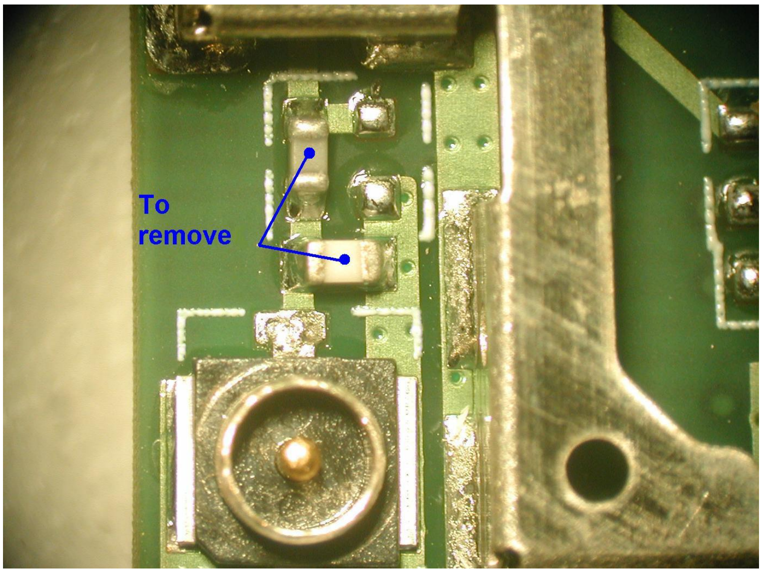


Figure 1.14: Some matching components have to be removed from GPRS module.

The SWR has to be measured with a Vector Network Analyzer (VNA). This one has to be calibrated with the followings parameters :

- Start 800MHz - Stop 2600MHz
- 1601 points
- Calibration 1 port - Extension port with a short at the coax probe end.

The calibration must be made at the end of the measurement cable. Some ferrite beans must be placed near the end of the measurement cable in order to avoid RF current flowing on its shielding and then to avoid measurement disturbances (figure 1.15).

Figure 1.15: Ferrite beans on cable reduces measurement disturbances

Various GPRS antenna positions have to be tried in order to find an acceptable position which present a low SWR. The goal to reach is a SWR lower than 3:1 on all GPRS bands (GSM850, GSM900, DCS1800 and PCS1900). The frequencies ranges are gathered in table 1.1.

→ These measurements have been done by Eolane Combree. Results are presented in the document SRN02_113001 (Performances des antennes GPRS).

1.2.4 GPRS antenna moving from RF+ Quick position

Following investigations presented in document SRN02_113001, additional tests were done with various GPRS antennas in different positions.

Band name	Frequency range (MHz)	Direction
GSM 850	824.2 - 849.2	Tx
	869.2 - 894.2	Rx
GSM 900	890 - 915	Tx
	935 - 960	Rx
DCS 1800	1710 - 1785	Tx
	1805 - 1880	Rx
PCS 1900	1850.2 - 1910.2	Tx
	1930.2 - 1990.2	Rx

Table 1.1: GPRS bands (GSM850, GSM900, DCS1800 and PCS1900)

Four GPRS antennas were used and placed in various positions in the SmartView Monitor as shown in figures 1.17, 1.18, 1.19 and 1.20. The figure 1.16 resumes the various positions.

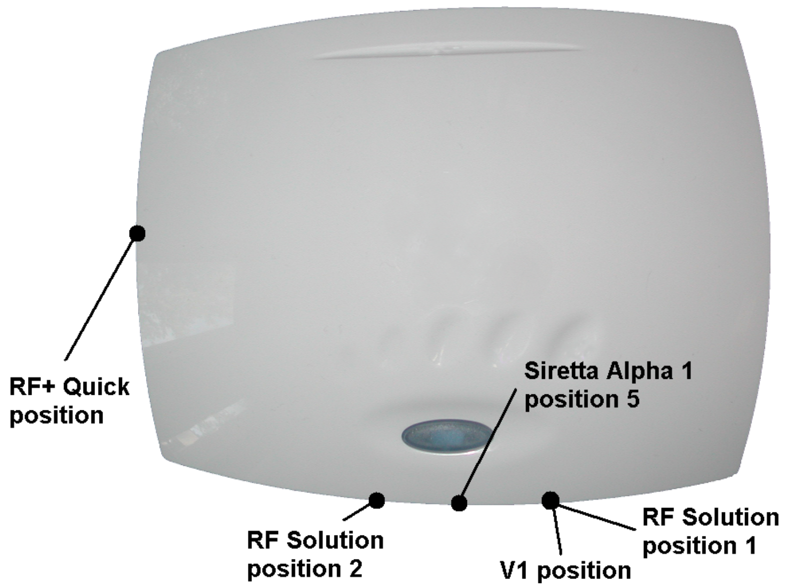


Figure 1.16: The various GPRS antenna configurations

Two tests were performed for each configuration: RF range tests and radiation pattern measurements in anechoic chamber.

RF range tests

A SyndeliRF ICD (CRT-D SN D37YL046)was fixed on a plastic railing placed in a box filled with a muscle simulating liquid so that the IMD was 1 cm under the surface of the

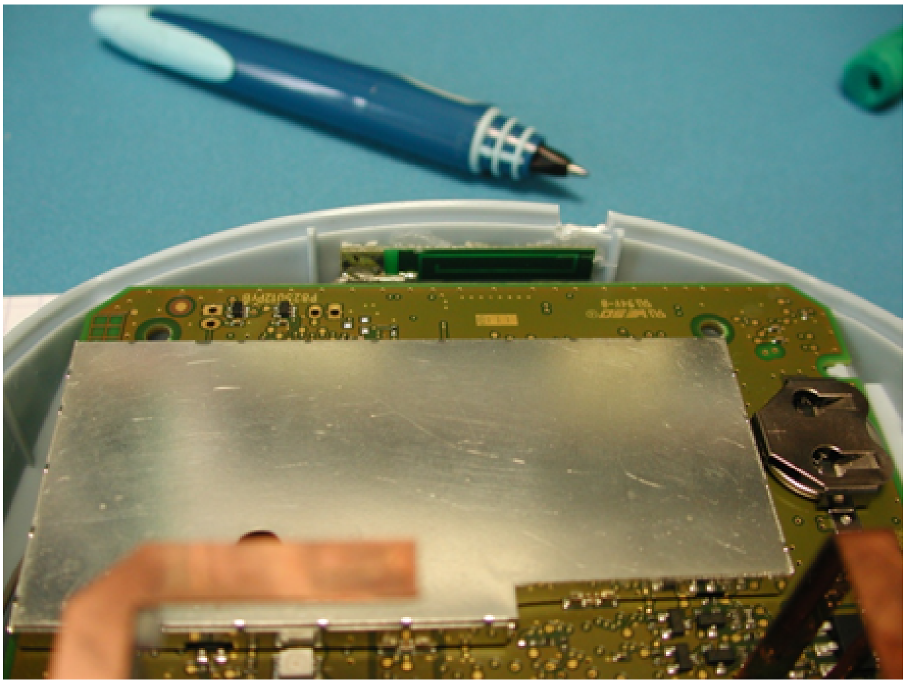


Figure 1.17: Siretta Echo1 in RF+ Quick antenna position

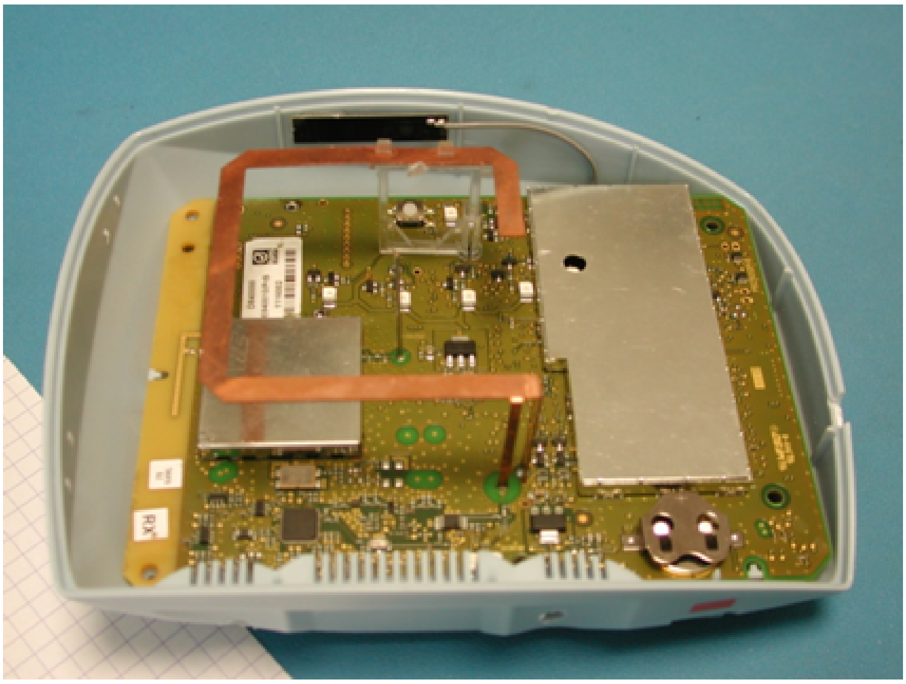


Figure 1.18: RF Solution antenna (Position 1)

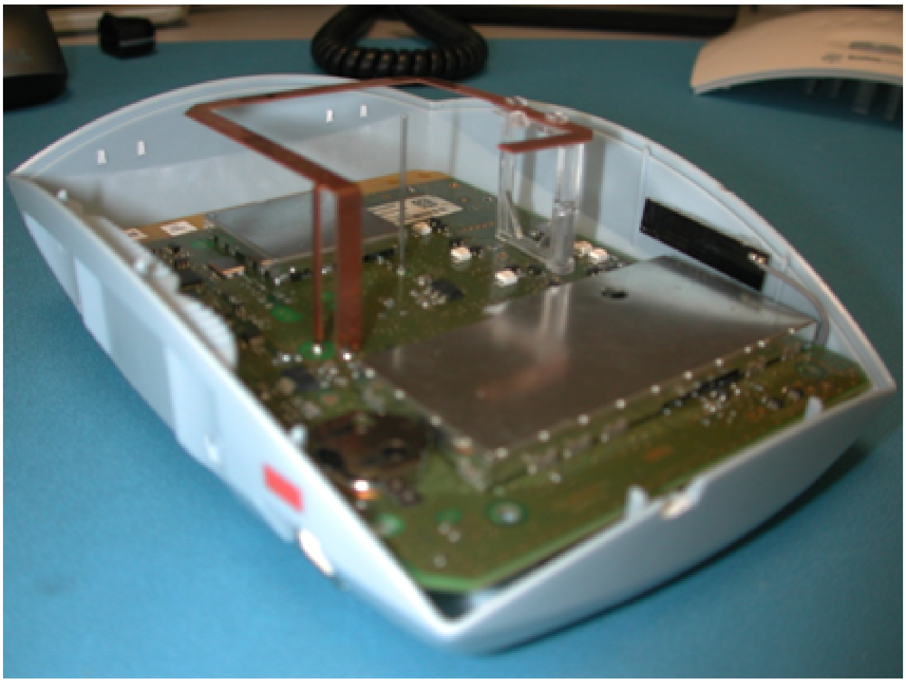


Figure 1.19: RF Solution antenna (Position 2)

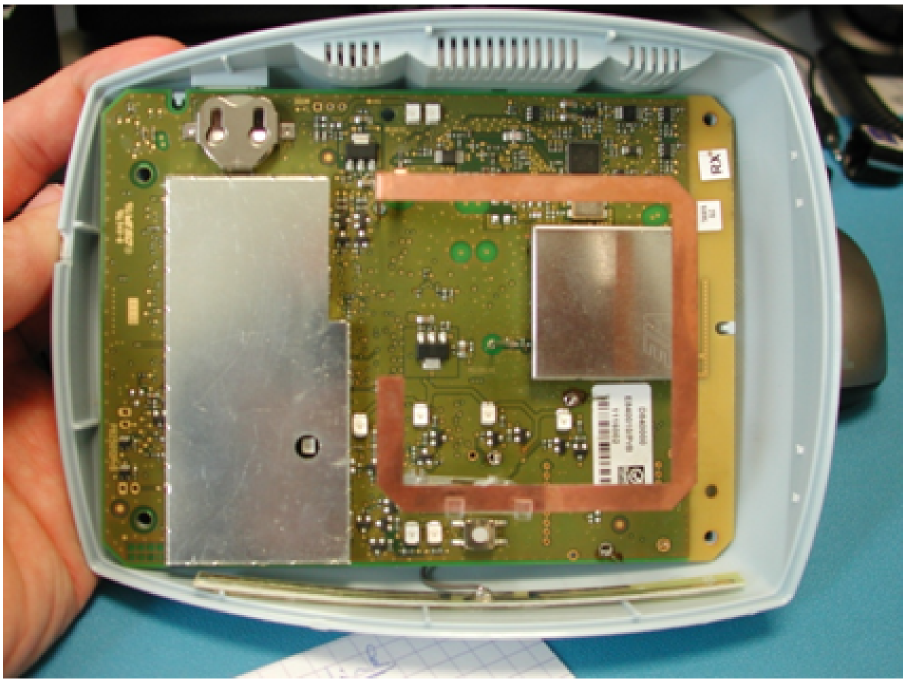


Figure 1.20: Siretta Alpha 1 antenna (Position 5)

liquid (Figure 1.21). The IMD and the SmartView Monitor (KA911 1105003S) were on the same height and set up at various distances by moving the box. A laptop connected to the SmartView Monitor via USB was used to control the SmartView Monitor and to retrieve the data from the IMD after the Follow-Up attempt. For each distance 3 Follow-Up attempts were done. The test environment was kept as identical as possible to avoid external interferences due to movement of objects (Figure 1.22). The results are shown in tables 1.2, 1.3 and 1.4.

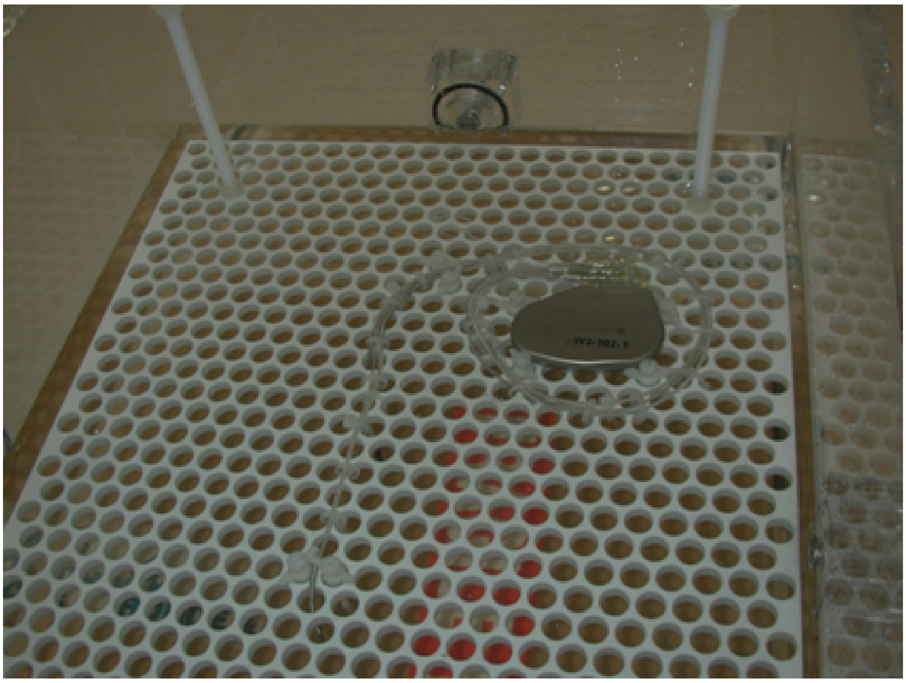


Figure 1.21: IMD on the plastic railing in the muscle simulating liquid

There are three different Follow-Up states:

- OK : Follow-Up has been successful (all ICD's data have been retrieved).
- Not Completed : the SmartView Monitor has connected with the ICD but the Follow-Up last a too long time so the connection was cut before retrieving all ICD's data.
- No Connection: the SmartView Monitor has not succeeded in connecting with the ICD. This behavior is also related to the measurmeent room. Some holes have been evidencied as non funcitonning only in this room : this is due to propagation issue taking into account the ceiling, floor, walls, shelves, etc ...

The Siretta Echo1 antenna in RF+ Quick position and the RF Solution antenna in position 2 have the same performances whereas the Follow-Up success rate for the Siretta Alpha 1

Figure 1.22: Test environment for the RF range tests

Distance	Follow-Up Success	Duration of the Follow-Up (s)
1 m	OK	25 25.2 24.4
1 m 50	OK	34 54.8 56
2 m	OK No connection OK	27.8 - 27.9
2 m 10	OK	111.5 163.3 98.6
2 m 20	No Connection	-
2 m 30	No Connection	-

Table 1.2: Siretta Echo1 in RF+ Quick position test results

Distance	Follow-Up Success	Duration of the Follow-Up (s)
1 m	OK	32.3 33.8 34
1 m 25	No Connection OK No Connection	- 33.9 -
1 m 50	No Connection	-
1 m 75	No Connection No Connection Not Completed	- - -
2 m	Not Completed No Connection No Connection	- - -
2 m 10	No Connection No Connection Not Completed	- - -
2 m 20	No Connection	-

Table 1.3: Siretta Alpha 1 antenna in Position 5 test results

	Position1		Position2	
Distance	Follow-Up Success	Duration of the Follow-Up (s)	Follow-Up Success	Duration of the Follow-Up (s)
1m	OK	24.7 25.2 24.4	OK	24.8 24.5 24.4
1m25	No connection OK No connection	- 25.8 -	OK	24.7 24.9 25.2
1m50	No connection	-	No connection	-
1m75	OK OK No connection	42.8 45.1 -	OK No connection OK	24.9 - 24.6
2m	No connection	-	No connection	-
2m10	Not completed No connection OK	- - 226.4	OK	40.6 36.6 38.9
2m20	No connection	-	No connection	-

Table 1.4: RF Solution antennas test results

antenna in position 5 and the RF Solution antenna in position 1 is much lower with higher durations.

→ Both configurations Siretta Alpha 1 antenna in position 5 and the RF Solution antenna in position 1 are rejected because they deteriorate the efficiency of the data transmission in the MICS band.

→ The RF Solution antenna in position 2 has the same performances (Follow-up duration) as the Siretta Echo1 in RF+ Quick position

Radiation pattern measurement in anechoic chamber

The radiated power by the SmartView Monitor antennas around 360^o is measured on both frequency bands MICS and ISM. For each GPRS antennas configurations shown in figures 1.17 to 1.20, four measurements were made for the both frequency bands:

- Vertical Polarization (VP) and Horizontal Polarization (HP) radiation pattern for the MICS IFA antenna.
- Vertical Polarization radiation pattern for the monopole antenna.
- Horizontal Polarization radiation pattern for the ISM IFA antenna.

The SmartView Monitor was placed in the anechoic chamber on a remote controlled rotating table. It faces the measuring antenna which correspond to a 0-degrees position (Figure 1.23). The power cable was fixed in order to mitigate its influence on the measurements.

The DUT was connected to the laptop via the serial adapter to launch the configuration scripts. These specifics scripts configure the SmartView Monitor in order to generate a continuous carrier wave on a specific frequency: 403.65MHz (channel 5) for the MICS antenna and 2.45GHz for the monopole and the IFA antennas. The serial adapter was removed for all the measurements.

The results are shown in figures 1.25, 1.24, 1.26 and 1.27.

The GPRS antenna and its position do not affect the radiated power by the ISM antennas as can be seen in figures 1.26 and 1.27.

→ The GPRS antenna only affects the MICS antenna radiation.

However, they have a significant influence in the MICS band: the radiation patterns are slightly identical in function of GPRS antenna configuration. But the radiated power of the Siretta Alpha1 antenna and the RF Solution antenna in position 1 are lower than those of the Siretta Echo1 in RF+ Quick position and the RF Solution antenna in position 2.

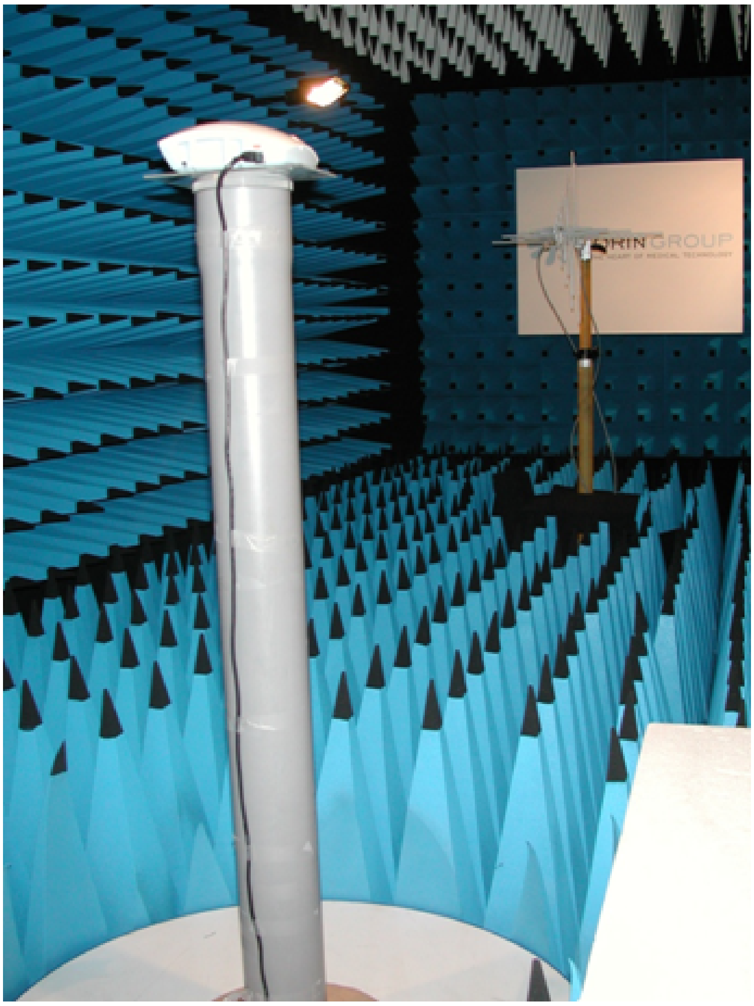


Figure 1.23: The power cable is fixed in order to mitigate its influence on the measurements.

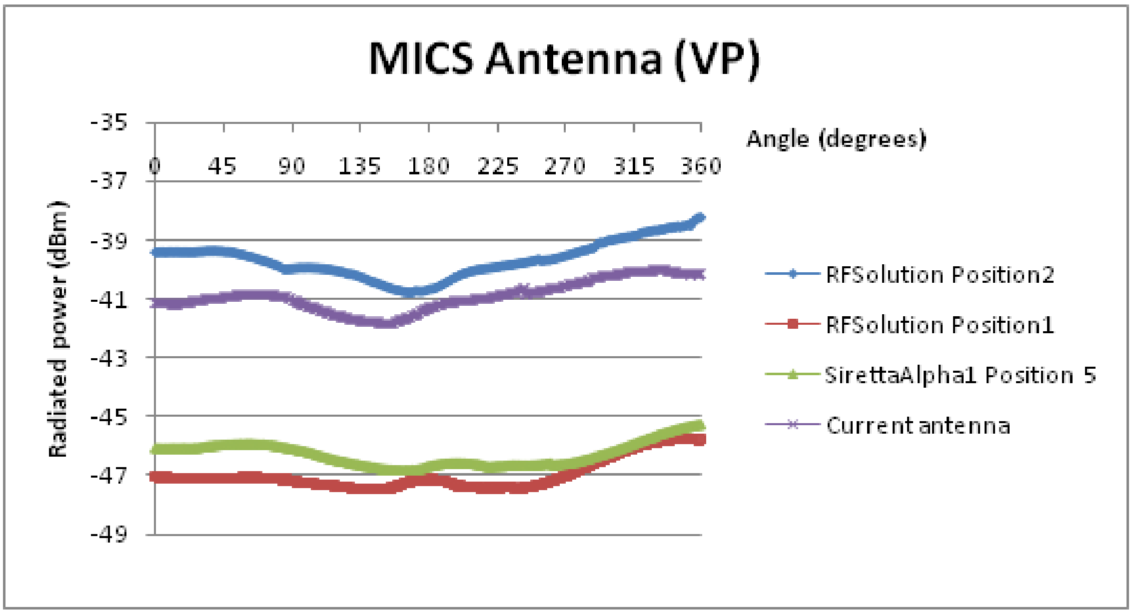


Figure 1.24: Radiated power by the MICS antenna in VP

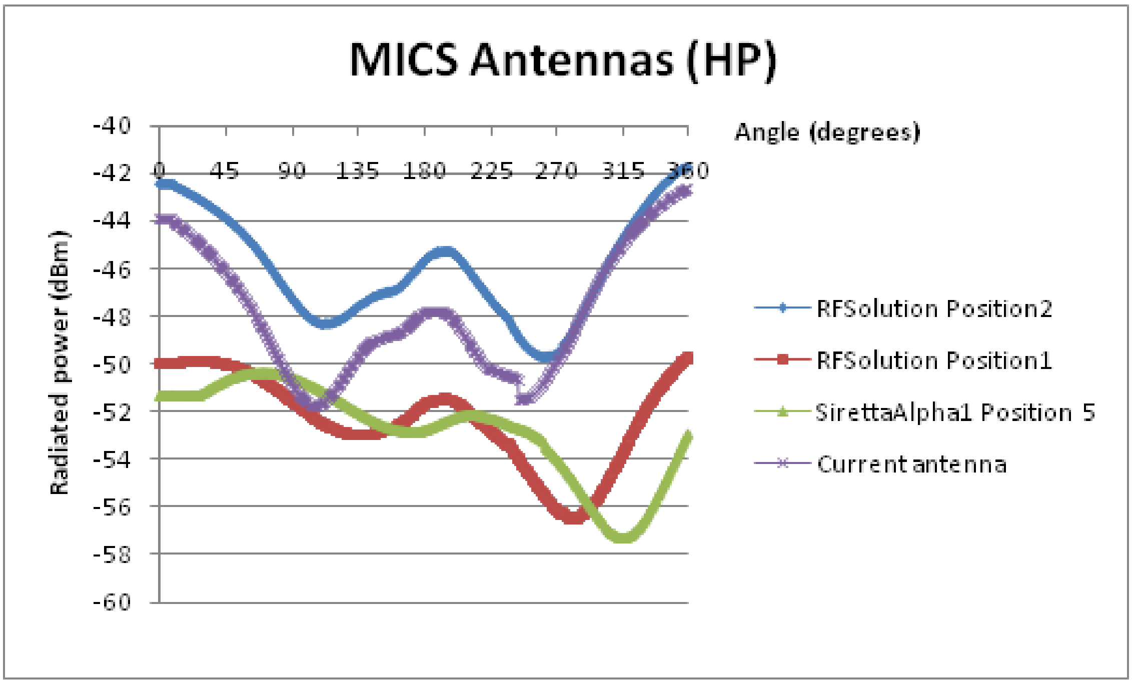


Figure 1.25: Radiated power by the MICS antenna in HP

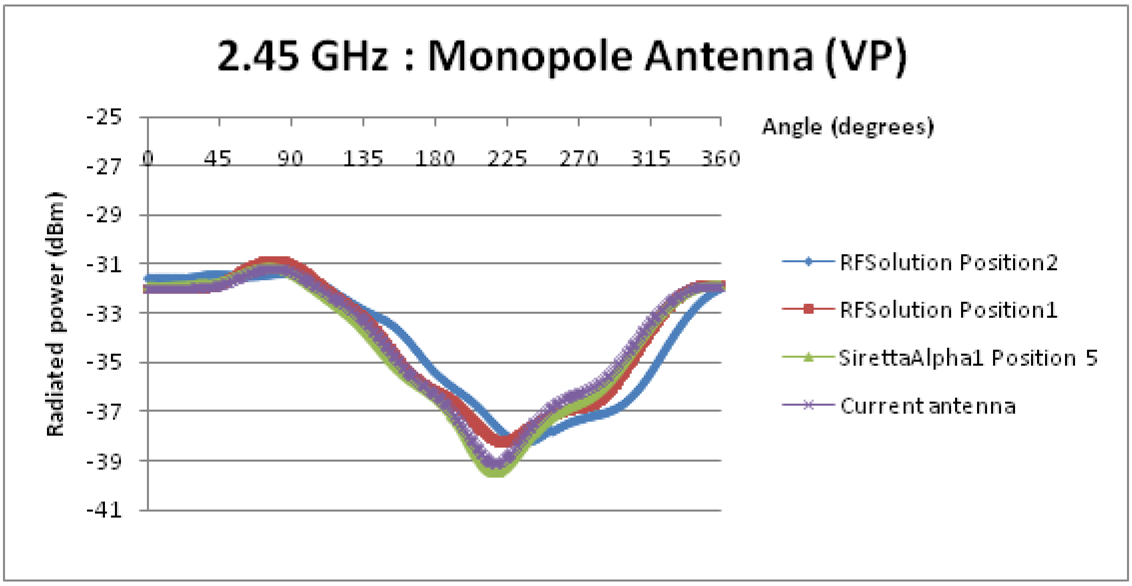


Figure 1.26: Radiated power by the monopole antenna (ISM) in VP

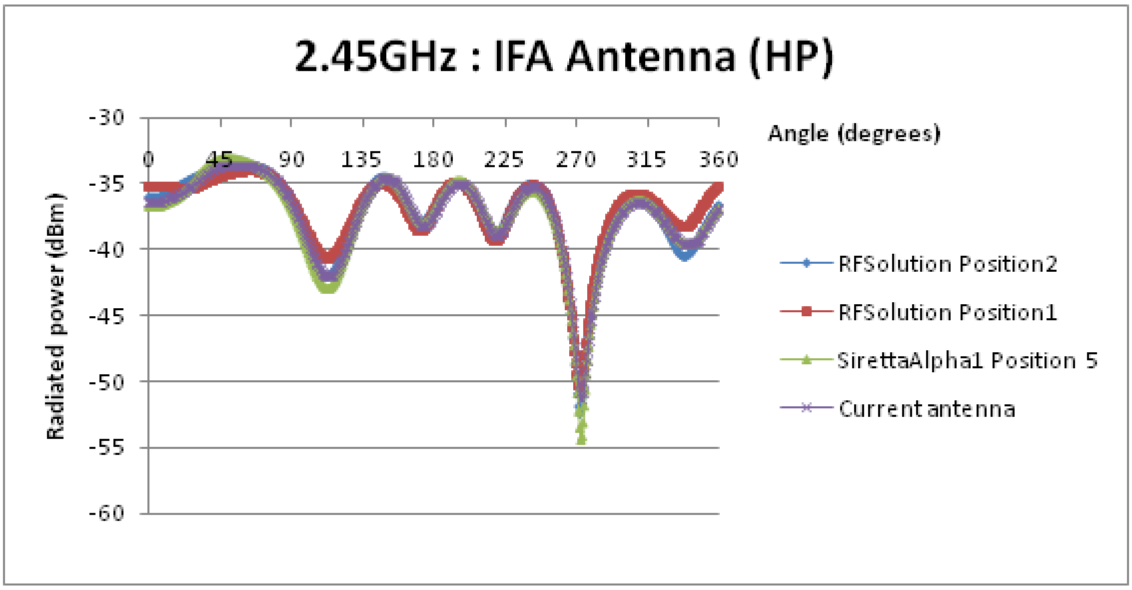


Figure 1.27: Radiated power by the ISM IFA antenna in HP

→ The Siretta Echo1 in RF+ Quick position and the RF Solution antenna in position 2 have similar radiation pattern.

→ The measurements made in anechoic chamber corroborate the results obtained during the RF range tests.

Figures 1.24 and 1.25 also show the radiated power in the MICS band has increased with the RF Solution in position 2 from the radiated power with the Siretta Echo1 in RF+ Quick position.

Radiated power increase varies between -0.1 to 3.8dB in horizontal polarization and between 0.6 to 1.9dB in vertical polarization. In both polarization, the maximum radiated power is at 360^o. There is a difference between 0^o and 360^o because during the measurement, the USB power cable wind itself around the plastic support. As the cable takes part of the MICS antenna radiation, the radiated power is slightly different.

So for this angle, the radiated power increase in horizontal polarization is about 1dB and 2dB for vertical polarization.

→ The conducted output power has to be decreased by 2dB to comply the EU and US regulations.

The both GPRS antenna configurations RF Solution in position 2 and Siretta Alpha 1 in position 5 were implanted on the two SmartView Monitors `KA911 HB1104057S` (1116006) and `HB1104050S`(1116012) to realize some measurements at Emitech Le Mans laboratory and confirm the MICS and GPRS performances improvement. These measurements are described in report `R052-RAD-11-104102-1/A Ed. 0`.

In case of the RF solution in position 2 (HB1104057S), the radiation patterns on three MICS channels shows an EIRP max value of -12.6dBm (330^o in horizontal polarization). As the regulation limit of -16dBm is related to a dipole antenna (ERP), 2.15dB (the theoretical dipole antenna gain is 2.15dBi) has to be subtracted from all values. ERP values are gathered in table 1.5.
The maximum ERP value mentioned in table 1.5 is -14.8dBm i.e. 1.2dB above the regulation limits of -16dBm.

The conducted output power has to be decreased by at least 1.2dB. In order to add a 1dB margin, the conducted output power has to be decreased by 2dB. In order to proceed the Datasheet and Design manual of the ZARLINK chipset has been used as reference.
In production, the HM HB1104057S was measured at a value closed to the upper test bench limit (-18.6dBm for a limit of -18.5dBm). The next test bench limit will be decreased by 2dB. So, every HM which will be calibrated by the test bench will have a radiated power

	HP			VP		
Angle (^{o})	C0	C5	C9	C0	C5	C9
0	-15,7	-15,8	-15,1	-19,7	-17,5	-17,7
30	-18,2	-18,1	-17,7	-20,9	-18,5	-18,7
60	-24,6	-23,9	-24,2	-22,4	-19,8	-20,2
90	-29,4	-25,9	-27,1	-22,2	-20,1	-20,8
120	-22,8	-21,7	-21,2	-20,9	-19,3	-20,0
150	-20,1	-20,7	-19,6	-20,4	-19,1	-19,6
180	-19,4	-20,2	-19,2	-20,3	-19,3	-19,7
210	-21,9	-22,2	-21,5	-20,4	-19,5	-19,9
240	-26,9	-25,7	-26,0	-19,9	-19,1	-19,4
270	-24,8	-24,8	-23,9	-19,3	-18,4	-18,5
300	-18,2	-18,7	-17,5	-19,1	-17,9	-18,0
330	-15,5	-15,7	-14,8	-19,3	-17,7	-17,5

Table 1.5: ERP values in dBm of a modified RF+ Quick SmartView Monitor with RF Solution GPRS antenna in position 2 in Horizontal and vertical polarization versus angles, and for different MICS channel

level 2dB lower than the actual value. The maximum radiated power will be -16.8dBm i.e. below the regulation limits.

The test bench limits for the output power trimming in production has to be reduced by 2dB.the RF production test specification (REQ1029) has to be reduced by 2dB.

→ The RF production test specification (REQ1029) has to be updated in order to reduce the MICS output power from the test bench.

Influence of MICS output power reduction

In order to comply with the regulations, the MICS output power has to be reduced by 2dB. As the MICS antenna is soldered on the HM board and to avoid any damage, the output power reduction is estimated from previous measurements done on others HM board. These measurements are mentioned in table 1.6.
The original value of the `CAL_rf_txrfpwrdefaultset_chan`X field in the `initial.xml` file is `79dec`. In order to reduce the radiated output power by 2dB, the calibration value has to be decreased to `75dec`.
A radiated measurement has been done to measure the effective power decrease when the register value is changed from `79dec` to `79dec` . The radiated power is decreased by 2.4dB as expected.

New RF range tests were done to evaluate impact of reducing the SmartView Monitor

Register value	Board 1116001	Board 1116004
79	-15.2dBm	-16.7dBm
⋮	⋮	⋮
76	-17.0dBm	-18.2dBm
75	-17.7dBm	-19.1dBm
74	-18.5dBm	-19.8dBm

Table 1.6: Conducted output power measured against register value on various HM boards

output power on Follow-Up duration time. The table 1.7 summarizes times for each register value for some various distances.

Distance (cm)	*Register* = 79 dec	*Register* = 75 dec
100	25s, 24.7, 25s, 25.2s	28s, 25.3s, 26.9s, 27.6s, 27.4s, 26.6s
120	27.6s, 26.5s, 25.4s	31.6s, 32.9s, 34.5s
140	26.7s, 28s, 27.1s, 25.9s, 25.5s, 25.3s	34.5s, 32.5s, 37.6s, 73.9s, 62.9s, 99.1s
160	25.9s, 25.7s, 29.8s, 30.1s, 28.6s	31.8s, 31.1s, 42s, 47.3s, 38s
170	33.3s, 31.6s, 60.4s, 49.9s, 45.3s, 43.2s	39.4s, 67s, 72.7s, 188.9s, 85s, 53.1s
180	-	-
200	-	-

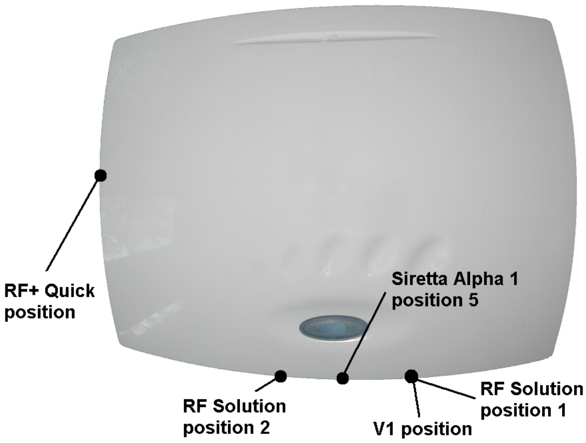
Table 1.7: Reducing the MICS output power by 2dB increase lightly the Follow-Up duration

The Follow-up duration is lightly increased by the MICS output power reduction. It means the new GPRS antenna position influence the MICS communication (increase of noise floor, MICS PA mismatch, ...).

→ The duration increase is acceptable with MISC power reduction of 2dB to comply with regulations.

1.3 Technical Summary

From SELCO measurements the antenna referenced as EAD-AD20 is not suitable at all with SWR of roughly up to 23:1 as mentioned in the next table. Therefore this one has been removed from the scope of measurements. Then taking into account the other positions such as mentioned in the following figure



SWR results	Siretta pos5	RF pos1	RF pos2	EAD AD20
GSM EU800	11-12	5-11	7-2	25-19
GSM US900	8-10	1-9	4-11	18-15
GSM EU1700	6-12	1-4	5-1	4-5
GSM US1900	5-3	2-14	4-16	4-5

There is a direct relation between the SWR and the Tx radiated power of the GPRS modem. The lower the figures are, the better they are[1].

dB losses from MAX power	Siretta pos5	RF pos1	RF pos2	EAD AD20
GSM EU800	-7 -8	-4 -7	-2 -6	-10 -11
GSM US900	-6 -7	0 -7	-4 -8	-8 -9
GSM EU1700	-5 -8	0 -4	0 -5	-4 -5
GSM US1900	-3 -5	-2 -8	-4 -9	-4 -5

As shown in the document **NO influence on the ISM** subsystem has been found

Using the first three position and antennas the MICS performance has been checked

ERP MICS	Siretta pos5	RF pos1	RF pos2	EAD AD20
Δ Quick position in VP dB	-6	-6	+2	-
Δ Quick position in HP dB	-6	-6	+2	-

Due to the complexity of the fluids measurements, one setup has been evidenced : the `RF position2` Then using Fluid measurements gives us the following results

in MSL fluids	Siretta pos5	RF pos1	RF pos2	EAD AD20
FUP duration @ 2m	100s	220s	38s	-

From these results it appears that the `RF position 2` is the better compromise between MICS and GPRS functionality.

[1] as an indication the SWR obtained on the MICS antenna and ISM antennas are below 1.5 on their full bandwidth

1.4 Technical conclusion

None of the GPRS antenna has an impact in the ISM band, but the RF Solution antenna in position 2 gives the most promising results by showing similar performances as the Siretta Echo1 antenna in RF+ Quick position in the MICS band.

In order to comply the radio regulations, the MICS output power has to be reduced by 2dB. The test bench specification REQ1029 has to be updated.

1.5 Conclusion

→ The new GPRS antenna position named `RF Position 2` allows to the Home Monitor to improve performances from a GPRS point of view and as a secondary effect, the performances in the MICS band.

→ The qualification tests done in external laboratory show the GPRS regulations are still respected.

→ No risk for the patient has been evidenced due to this BOM update.

1.6 Instruments

The anti static bench is equipped with the following instruments for all the measurements:

type	brand	SN	calibrated on	calibrated until
spectrum	RS FSL3	dev 100938	2011.01.03	1 year
spectrum	RS FSL6	dev 80974	2010.09.10	1 year
RF gen	HM 8135	05818003	2011.01.01	1 year
oscilloscope	HP 54542C	E2M E024125	2010.12.16	1 year
tightening tool	Agilent $8710 - 1765$	MY39203003	2011.08.02	1 year
vna	Agilent $E5071B$	MY42402954	2011.08.02	1 year

type	serial number	version	comment
laptop	VOSTRO 1720	winXP Pro 2002 serv 3	76413-oem-0011903-00102
LaboXML		4.01.03	running on mentioned laptop

All cables are calibrated for RF purposes, and losses including tightening are taken into account in all correction factors or calibration factors. All tightening are performed using a tightening tool at $0.9N.m$.

Cables are cleaned using hydro-alcoholic fluids to remove any kind of fat substance.

All other small equipments are connected to ground through the anti static carpet on the bench.

1.7 Acronyms

ADC chipset function, analog digital converter

ATE automatic test equipment used to test the integrated chipset

BOM bill of material for a given printed board circuit

BS base station of a radio system

CAS Channel assessment. This process is intended to be used for allocating or reserving the correct channel for the RF transmission

CW carrier wave, used in radio frequency transmission

CPW coplanar waveguide for a transmission line

CPWG coplanar grounded waveguide for a transmission line

DAC chipset function, digital analog converter

dBc unit desciption, decibel relative to the carrier maximum power

dBm unit description, decibel relative to milliwatt

EMC electromagnetic compliance

EIRP Effective isotropic radiated power

ERP Effective radiated power

FM frequency modulation used in radio frequency transmission

FHSS frequency hopping spread spectrum used in radio frequency transmission

FUP follow-up, describe the application phase where the HM is retrieving all the information from the ICD

GHz unit description, gigahertz

Hz unit description, hertz

HV high voltage, expressed the side of PCB, flex that is being used for ICD as high voltage substrate

ICD Implantable Cardiac Defibrillator

IMD Implantable Medical Device

IF radio frequency term as intermediate frequency, used to describe the frequency used in up or down conversion system

IFA inverted F antenna : an antenna that looks like and inverted F letter

ISM industrial, scientific and medical frequency band as described in the $ERC70-3$

kHz unit description, kilo hertz

LBT listen before talk. Process that oblige a device to listen the RF channel before using it, in order to ensure that this channel is not occupied

LIC Least Interferer Channel. A type of LBT process

LPF Low Pass Filter. Electronic function where high frequencies are attenuated whereas low frequencies stay unchanged.

LV low voltage, expressed the side of PCB, flex that is being used for ICD as low voltage substrate

mA unit description, milliampere

MHz unit description, mega hertz

MICS medical implantable communication service

MWS microwave studio for CST, name of a company that provides a electromagnetic modeling software. see *www.cst.com*

OOB out of band, describe the spurious that do not belong to the wanted emission spectrum, and outside the authorized band in usage

PIFA plate inverted F antenna describe an antenna that looks like a plate that has a F letter shape seen from the side

PSU power supply unit

RBW resolution bandwidth

RF radio frequency

RM applicative term : remote monitoring

RSSI receiving signal strength indicator used in radio frequency system

Rx receiver

SPDT single path dual through, describe the type of switch only a single is connected at a given time.

SPI serial peripheral interface used to connect different chip with a reduced number of signals

SWR Standing Wave Ratio. A measurement to express the matching efficiency of an impedance

Tx transmitter

UFL U.FL miniature microwave connector

VBW video bandwidth

XO crystal oscillator

Ω Ohms

END OF DOCUMENT

MISC - MISC1052A