TEST REPORT

HEARING AID COMPATIBILITY

T-Coil TEST REPORT

Model No.	:	RM-375
Applicant	:	Nokia Inc.
Address of Applicant	:	12278 Scripps Summit Dr.San Diego CA92131 USA
FCC ID		QMNRM-375
Date of Receipt	:	2008-04-03
Date of Test(s)	:	2008-04-25
Date of Issue	:	2008-05-07

EUT Type	CDMA 2000 1xRTT Mobile Phone
Tx Frequency	CDMA Cellular (824.70 MHz ~ 848.31 MHz) CDMA PCS (1851.25 MHz ~ 1908.75 MHz)
FCC Classification	Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s)	§ 20.19
HAC Standard	ANSI PC63.19 – 2006 V3.12

C63.19-2006 HAC Category : T4 (T CATEGORY)

Tested by	:	**Leo Kim**	**2008-05-07**
Approved by	:	**Jim Kim**	**2008-05-07**

Contents

1. General Information

1.1 Testing Laboratory

SGS Testing Korea Co., Ltd.

Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

Telephone : +82 +31 428 5700

FAX : +82 +31 427 2371

Homepage : www.electrolab.kr.sgs.com

1.2 Details of Applicant

Applicant : Nokia Inc.

Address : 12278 Scripps Summit Dr.San Diego CA92131 USA

Contact Person : Stephen Walmsley

Phone No. : +1 604 456 5544

Fax No. : -

1.3 Version of Report

Version Number	Date	Revision
00	2008-05-07	Initial issue

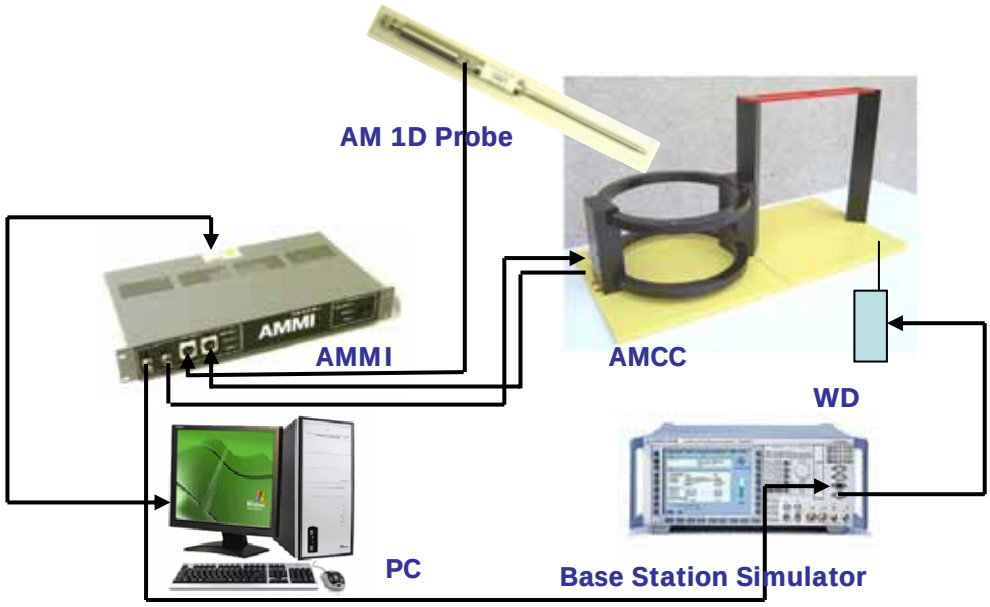
1.4 Description of EUT(s)

EUT Type	: CDMA2000 1xRTT Mobile Phone
Model	: RM-375
FCC ID	: QMNRM-375
Hardware Version	: 4000
Software Version	: DS_1100B_GEN
Mode of Operation	: CDMA Tri Band (AWS band not reported in the HAC report)
Serial Number (MEID)	: 268435456102530144
Max Conducted Power	: CDMA Cellular (24.65 dBm) CDMA PCS (23.85 dBm)
Duty Cycle	: 100%
Tx Frequency Range	: CDMA Cellular : 824.7 ~ 848.31 MHz CDMA PCS : 1851.25 ~ 1908.75 MHz
Antenna	: Fixed Internal

1.5 Test Environment

Ambient temperature	: 22.2 ° C ± 2
Tissue Simulating Liquid	: 22.2 ° C ± 2
Relative Humidity	: < 60 %

1.6 T-Coil Measurement System



<Figure-1> HAC T-Coil Test Measurement Set-up

The WD is mounted on the Test Arch phantom (provided with the HAC RF extension). Its acoustic center is centered and represents the reference for the combination of ABM and RF field evaluation. The ABM fields of the WD (frequency range < 20 kHz) are scanned with a fully RF shielded active 1D probe. The probe axis is oriented in the space diagonal to the three orthogonal axes, and its single sensor can be oriented to the axes by 120° rotation. The probe signal is evaluated by an Audio Magnetic Measurement Instrument (AMMI) which is interfaced to the DASY4 computer via USB. The AMMI also provides test and calibration signals and interfaces to the Helmholtz Audio Magnetic Calibration Coil (AMCC). Predefined or user-definable audio signals for injection into the WD during the test are available at a connector of the AMMI.

The new T-Coil measurement job allows flexible control of scan, rotation, measurement duration, as well as selection of the measurement mode and signal source for all ABM measurements. Filtering as required by the standard is applied to the sampled signal resulting in the signal level, (weighted) noise level and a third-octave resolution spectrum for the frequency slope. This information is represented numerically and graphically during the scans and graphically evaluated in the postprocessor. The superposition of the quantities (signal level, frequency slope, signal to noise ratio) leads to an overall classification according to ANSI-C63.19. Coarse, fine and point scan together with user selectable test signals, minimize the time for the manufacturer to find the “optimal point” with the highest class for the WD.

1.7 System Components

Test Arch (enables easy and well defined positioning of the phone and calibration dipoles as well as simple teaching of the robot)	370 x 370 mm x 375 mm
Device Holder / Positioner (supports accurate positioning of any phone) effect on near-field	<+/- 0.5dB
Audio Magnetic Field Probe AM1D frequency range sensitivity pre-amplifier dimensions	 0.1 - 20 kHz(RF sensitivity <-100 dB, fully RF shielded) <-50 dB A/m @ 1 kHz 40 dB, symmetric tip diameter / length: 6 / 290 mm, sensor according to ANSI-PC63.19
Audio Magnetic Measurement Instrument (AMMI) sampling rate dynamic range test signal generation calibration dimensions	 48 kHz / 24 bit 85 dB user selectable and predefined (via PC) auto-calibration / full system calibration using AMCC with monitor output 482 x 65 x 270 mm
Helmholtz Calibration Coil (AMCC) dimensions	 370 x 370 x 196 mm, according to ANSI-PC63.19

1.8 Signal Verification

According to ANSI C63.19-2006 section 6.3.2.1, the normal speech input level for HAC T-coil tests shall be set to -16 dBm0 for GSM and UMTS (WCDMA), and to -18 dBm0 for other standards. This technical note shows a possibility to evaluate and set the correct level with the HAC T-Coil setup with a Rohde & Schwarz communication tester CMU200.

Establish a call from the CMU200 to a wireless device. The calibration signals are only available while the call is connected.

Get the internal reference level of the CMU200 (in dBm0) Select CMU200 Network. Bitstream." Decoder Cal" to have a 1 kHz signal with a level of 3.14 dBm0 at the speech output. Run the measurement job and read the voltage level at the multimeter display "Coil signal". The "peak" voltage shall not be limited (i.e. no yellow error symbol shown). Read the RMS voltage corresponding to 3.14 dBm0 and note it. Calculate the desired signal levels of -16 dBm0 and -18 dBm0:

3.14 dBm0 = -2.61 dBV

-18 dBm0 - 21.14 dB = -23.75 dBV

Determine the 1 kHz input level to generate the desired signal level of -18 dBm0 Select CMU200 Network. Bitstream. "Codec Cal" to loop the input via the codec to the output. Run the measurement job (AMMI 1kHz signal with gain 10 inserted) and read the voltage level at the multimeter display "Coil signal". Calculate the required gain setting for the above levels:

gain 10 = -32.67 dBV

difference for -18 dBm0 = -23.75 - (- 32.67) = 8.92 dB

gain factor 10^[(8.92) / 20] = 2.792

resulting gain 10 * (2.792) = 27.92

Run the measurement with the gain and verify the level . Adjust if necessary.

The gain settings were adjusted to achieve the same average level for other signal types.

Signal	Duration[s]	Peak to RMS [dB]	RMS [dB]	Gain Factor	Gain Setting
1 kHz	1	16.2	- 12.7	4.33	**27.8**
300 Hz – 3000 Hz	2	21.6	- 18.6	8.48	**55.2**

1.9 DUT Positioning and Test Procedure

<Figure-2> illustrate the references and reference plane that shall be used in the WD emissions measurement.

- The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.
- The grid is centered on the audio frequency output transducer of the WD (speaker or T-coil).
- The grid is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the WD handset, which, in normal handset use, rest against the ear.
- The measurement plane is parallel to, and 1.0 cm in front of, the reference plane.

<Figure- 2 > WD reference and plane for T-Coil measurements

- Geometry and Signal check
- Background noise measurement. The background noise is measured at the center of the listening area.
- Coarse resolution axial scan (narrowband signal, 1 sec measurement times, 50 * 50 mm). Only ABM1 is measured in order to find the location of the T-Coil source.
- Fine resolution axial, radial-transverse and radial-longitudinal scans, positioned appropriately based on optimal ABM1 of

coarse resolution axial scan (narrowband signal, 1 sec measurement times, variable grid size with 2 mm spacing). Both ABM1 and ABM2 are measured in order to find the location of the SNR point. ABM1 and ABM2 point measurements in axial, radial-transverse and radial-longitudinal coil orientations, positioned appropriately based on optimal signal quality of fine resolution scans. SNR is calculated for each coil orientation.

- Frequency response point measurement is axial coil orientation, positioned appropriately based on optimal signal quality of fine resolution axial scan.

1.10 Minimum Requirements

1.10.1 Articulation Weighting Factor

The following AWF factors shall be used for the standard transmission protocols

Standard	Technology	AWF(dB)
TIA/EIA/IS-2000	CDMA	0
TIA/EIA-136	TDMA(50 Hz)	0
J-STD-007	GSM(217)	-5
T1/P1P1/3GPP	UMTS(WCDMA)	0
iDEN™	TDMA (22 and 11 Hz)	0

1.10.2 Signal Quality Categories

Category	Telephone parameters WD signal quality ((signal + noise) to noise ratio in dB)	
	AWF = 0	AWF = -5
Category T1	-20 to -10 dB	-15 to -5 dB
Category T2	-10 to 0 dB	-5 to 5 dB
Category T3	0 to 10 dB	5 to 15 dB
Category T4	> 10 dB	> 15 dB
(Note : For cases where it can be shown that the audio-band interference is not dominated by the RF pulse rate of the phone, AWF does not apply)		

1.10.3 The delta between Ambient Noise and ABM2 measurement should be greater than 10 dB

1.10.4 Field Intensity

- Greater or equal to -13 dB A/m (Axial)

- Greater or equal to -18 dB A/m (Radial)

1.11 WD Radio Configuration Selection

- The device was chosen to be tested in the worst-case under RC1/SO3

Cellular Band

Radio Configuration	Service Option	Voice Coder	Channel	Power(dBm)
RC1	SO3	8k Enhanced Low	1013	24.54
		8k Enhanced Low	384	24.50
		8k Enhanced Low	777	23.70
RC3	SO3	8k Enhanced Low	384	24.30
RC43	SO3	8k Enhanced Low	384	24.40

PCS Band

Radio Configuration	Service Option	Voice Coder	Channel	Power(dBm)
RC1	SO3	8k Enhanced Low	25	23.75
		8k Enhanced Low	600	23.76
		8k Enhanced Low	1175	23.77
RC3	SO3	8k Enhanced Low	600	23.70
RC43	SO3	8k Enhanced Low	600	23.71

2. Measurement Equipment

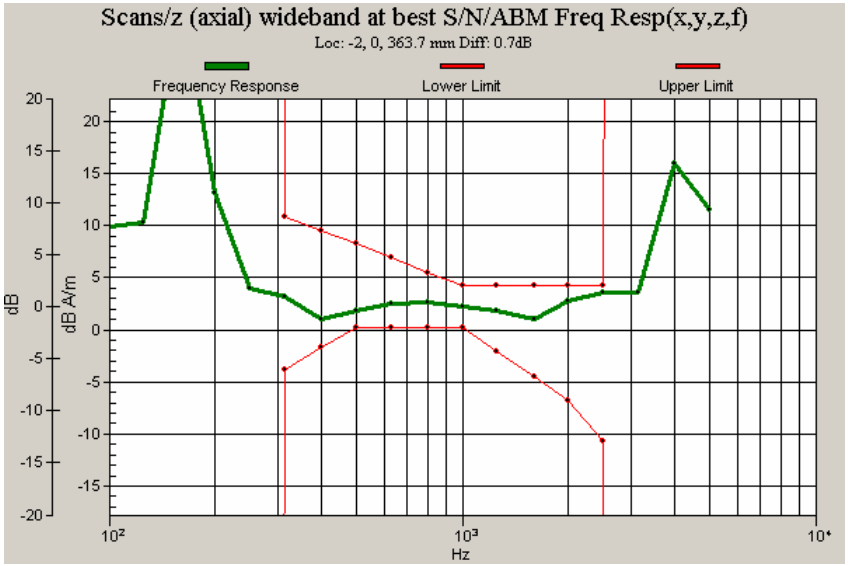
Manufacturer	Device	Type	Serial Number	Due date of Calibration
Stäubli	Robot	RX90BL	F03/5W05A1/A/01	N/A
SPEAG	Probe	AM1DV2	1025	September 19, 2008
SPEAG	Data acquisition Electronics	DAE3	567	August 30, 2008
SPEAG	Software	DASY 4 V4.7	-	N/A
SPEAG	Test Arch	SD HAC P01 BB	-	N/A
R & S	Universal Radio Communication Tester	CMU 200	109495	December 6, 2008
SPEAG	Audio Magnetic Calibration Coil	AMCC	1065	N/A
SPEAG	Audio Measuring Instrument	AMMI	1026	N/A

3. Measurement Result

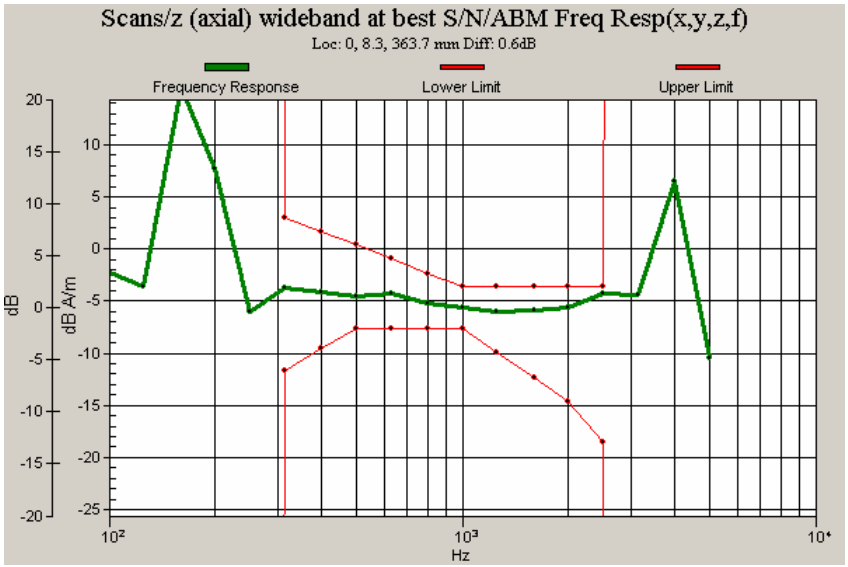
3.1 T-Coil Measurement Result

3.1.1 Frequency Response

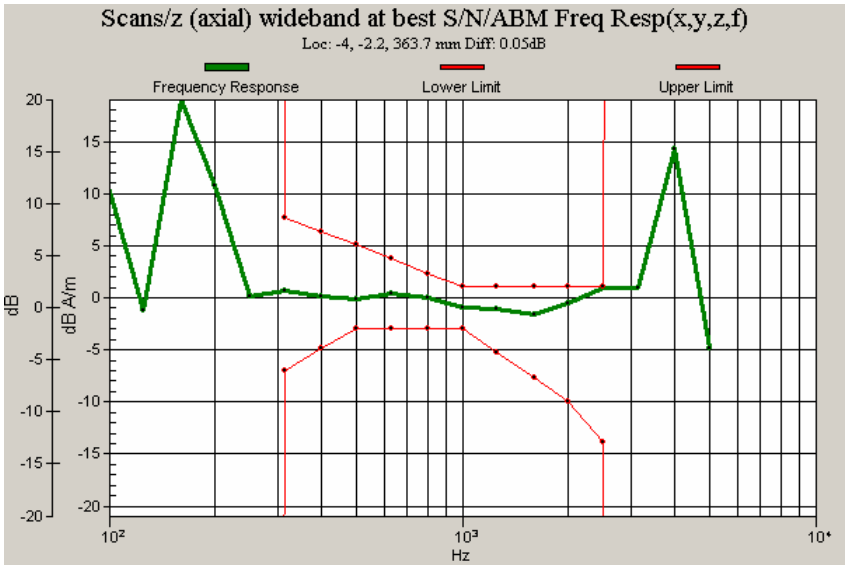
Cellular Low Channel



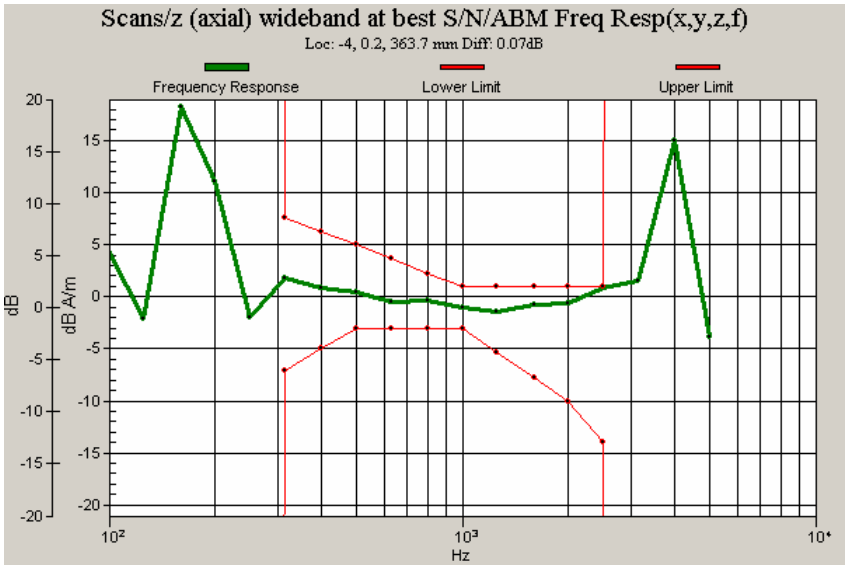
Cellular Middle Channel



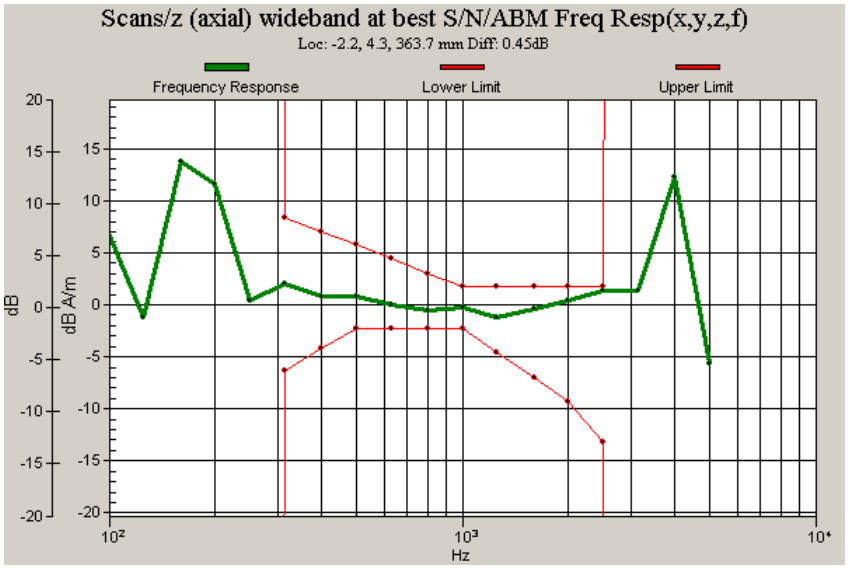
Cellular High Channel



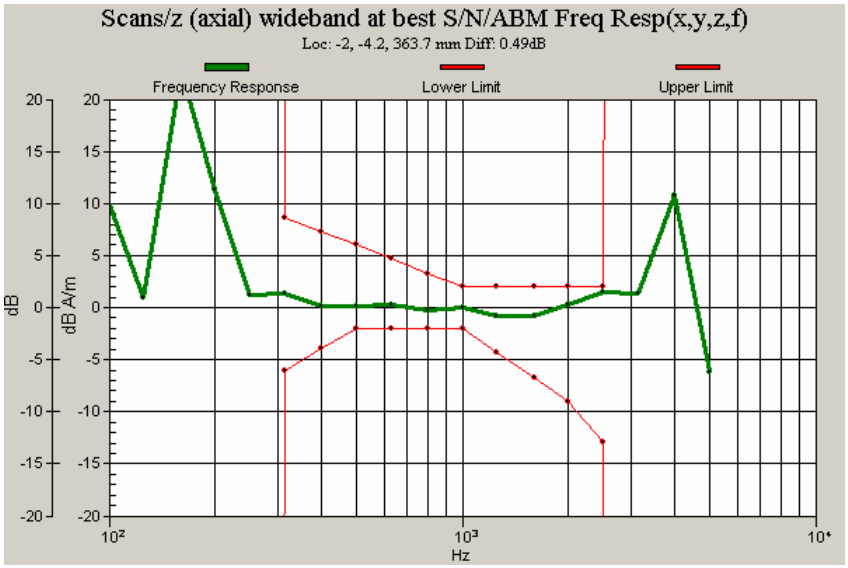
PCS Low Channel



PCS Middle Channel



PCS High Channel



3.1.2 T-Coil Field Intensity & SNR

Probe Position	Frequency Band	Channel	Measured Point Location (x mm, y mm)	Ambient Background Noise (dB A/m)	ABM2 (dB A/m)	ABM2 – Ambient Background Noise (dB)	ABM1 (dB A/m)	SNR (dB)	T-Coil Rating
Axial	Cellular	1013	-2, 0	-59.7	-39.73	19.97	2.77	46	T4
		384	0, 8.3	-59.6	-42.04	17.56	-4.73	42	T4
		777	-4, -2.2	-59.6	-39.78	19.82	0.525	44.1	T4
	PCS	25	-4, 0.2	-59.4	-38.1	21.3	0.195	42.9	T4
		600	-2.2, 4.3	-59.5	-42	17.5	0.471	43.4	T4
		1175	-2, -4.2	-59.6	-38.96	20.64	0.321	43.3	T4
Radial1 (Longitudinal)	Cellular	1013	-8.3, -2.2	-59.8	-47.79	12.01	-5.69	42.7	T4
		384	-10.5, 2	-59.4	-46.08	13.32	-7.09	41.4	T4
		777	-10.5, 2.2	-59.4	-47.05	12.35	-7.41	41.3	T4
	PCS	25	-6.3, -2	-59.8	-44.84	14.96	-5.51	42.4	T4
		600	-8.5, -0.2	-58.9	-46.09	12.81	-4.95	41.9	T4
		1175	-12.3, 2	-59.9	-45.33	14.57	-8.26	41.6	T4
Radial2 (Transversal)	Cellular	1013	0, -12.3	-59.7	-49.09	10.61	-8.2	44.2	T4
		384	-0.2, 10.3	-59.7	-48.63	11.07	-6.62	42.9	T4
		777	-2.2, -2.2	-59.8	-47.46	12.34	-9.75	43.0	T4
	PCS	25	-6.2, -6.2	-59.2	-48.26	10.94	-9.48	42.5	T4
		600	-6.2, 8.3	-59.5	-45.69	13.81	-8.60	42.7	T4
		1175	0, 8.5	-59.8	-48.85	10.95	-6.34	42.6	T4

3.2 Summary of Result

Probe Position	Frequency Band	Channel	ABM1	Frequency Response	T-Rating
Axial	Cellular	1013	Pass	Pass	T4
		384	Pass	Pass	T4
		777	Pass	Pass	T4
	PCS	25	Pass	Pass	T4
		600	Pass	Pass	T4
		1175	Pass	Pass	T4
Radial1 (Longitudinal)	Cellular	1013	Pass		T4
		384	Pass		T4
		777	Pass		T4
	PCS	25	Pass		T4
		600	Pass		T4
		1175	Pass		T4
Radial2 (Transversal)	Cellular	1013	Pass		T4
		384	Pass		T4
		777	Pass		T4
	PCS	25	Pass		T4
		600	Pass		T4
		1175	Pass		T4

APPENDIX

A. Test Setup Photo

- Please see the attachment

APPENDIX

B. DASY4 HAC Report

Cellular Low Axial

Date/Time: 2008-04-25 11:25:50

Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_Low_#2.da4

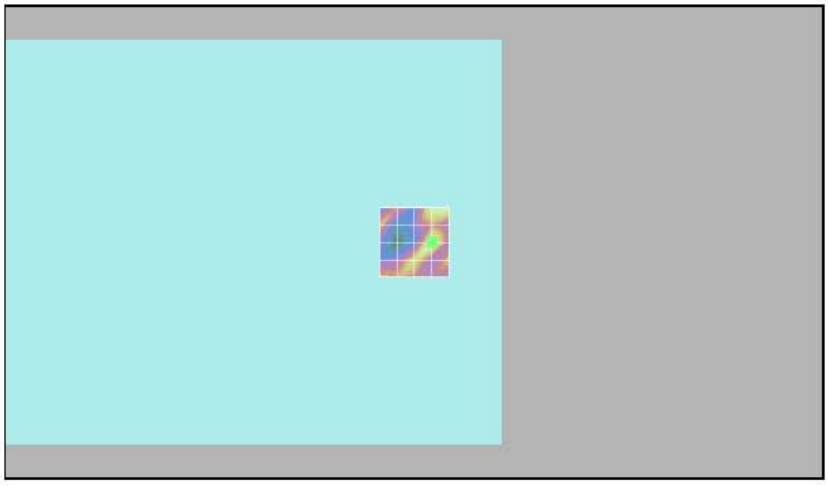
DUT: RM-375; Type: Folder; Serial: 2684354561C2503144

Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 46.0 dB
ABM1 comp = 2.77 dB A/m
BWC Factor = 0.150005 dB
Location: -2, 0, 363.7 mm



Cellular Low Radial1

Date/Time: 2008-04-25 2:17:38

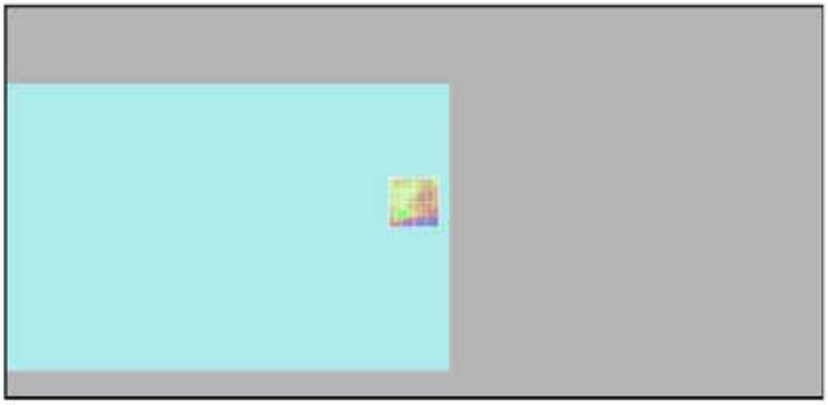
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 43.0 dB
ABM1 comp = -9.75 dB A/m
BWC Factor = 0.150005 dB
Location: -2.2, -2.2, 363.7 mm



Cellular Low Radial2

Date/Time: 2008-04-25 11:31:33

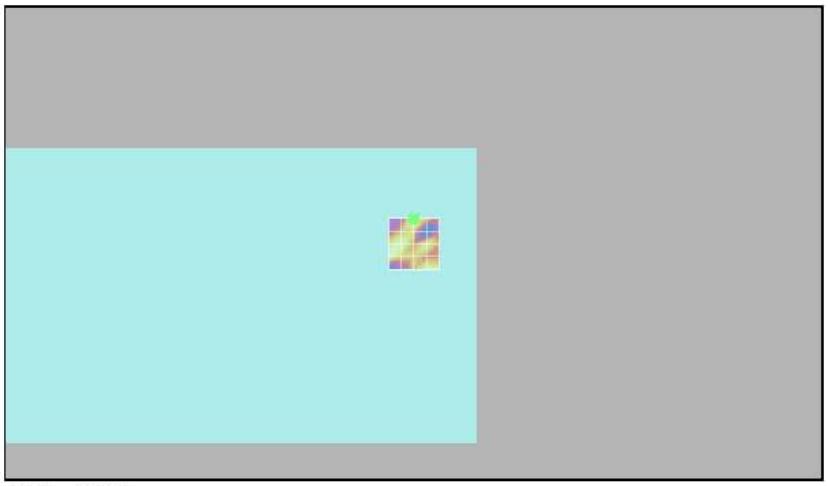
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_Low.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 44.2 dB
ABM1 comp = -8.20 dB A/m
BWC Factor = 0.150005 dB
Location: 0, -12.3, 363.7 mm



0 dB = 162.7

Cellular Middle Axial

Date/Time: 2008-04-25 12:35:08

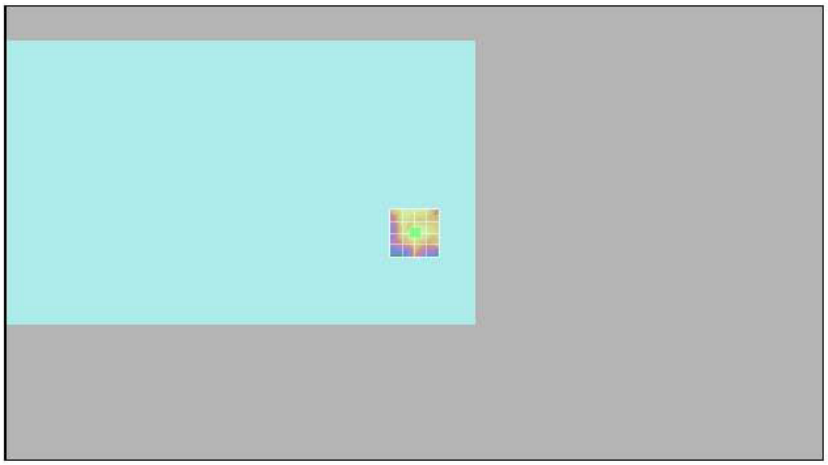
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_Mid.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.7 dB
ABM1 comp = -4.73 dB A/m
BWC Factor = 0.150005 dB
Location: 0, 8.3, 363.7 mm



Cellular Middle Radial1

Date/Time: 2008-04-25 12:38:05

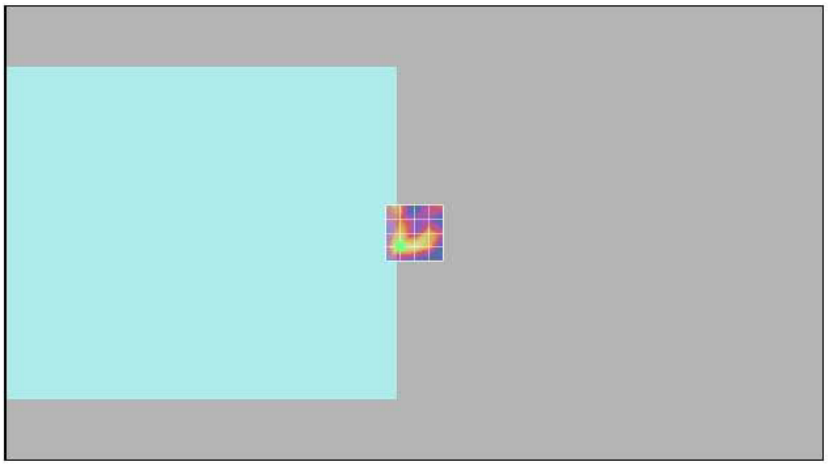
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_Mid.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 41.4 dB
ABM1 comp = -7.09 dB A/m
BWC Factor = 0.150005 dB
Location: -10.5, 2, 363.7 mm



Cellular Middle Radial2

Date/Time: 2008-04-25 12:40:46

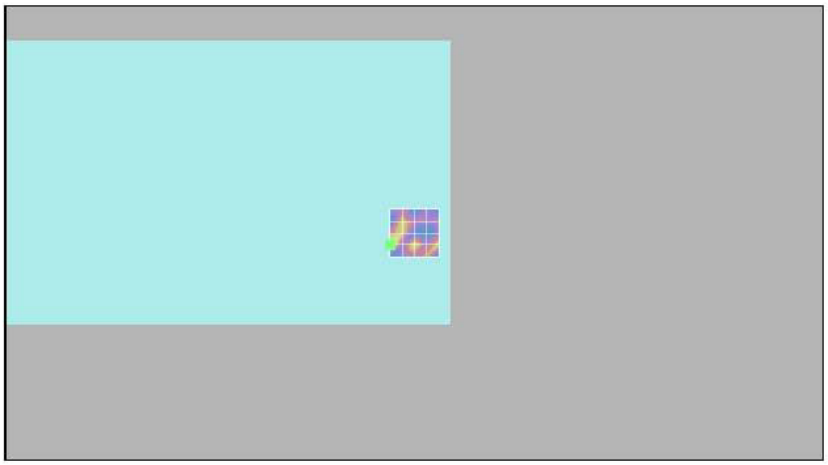
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_Mid.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.9 dB
ABM1 comp = -6.62 dB A/m
BWC Factor = 0.150005 dB
Location: -0.2, 10.3, 363.7 mm



Cellular High Axial

Date/Time: 2008-04-25 2:11:57

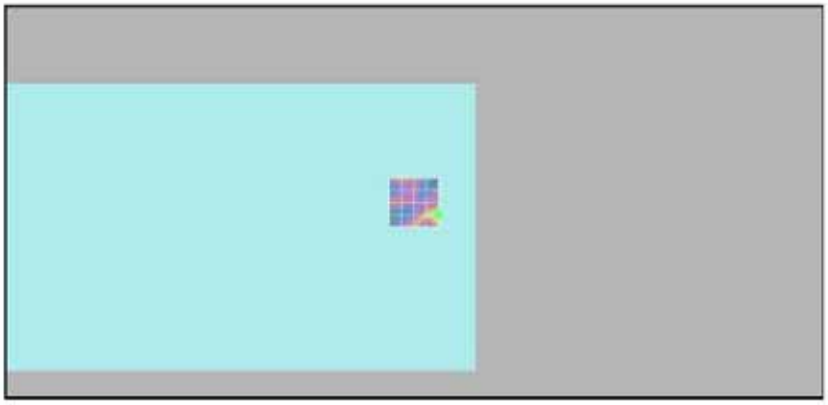
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 44.1 dB
ABM1 comp = 0.525 dB A/m
BWC Factor = 0.150005 dB
Location: -4, -2.2, 363.7 mm



Cellular High Radial1

Date/Time: 2008-04-25 2:14:55

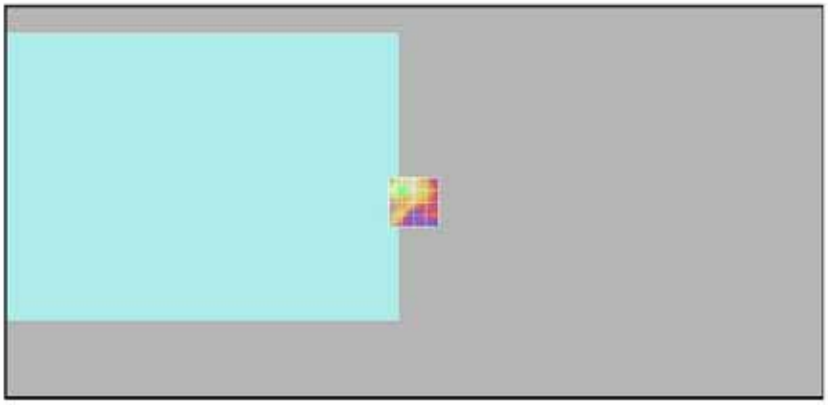
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 41.3 dB
ABM1 comp = -7.41 dB A/m
BWC Factor = 0.150005 dB
Location: -10.5, 2.2, 363.7 mm



Cellular High Radial2

Date/Time: 2008-04-25 2:17:38

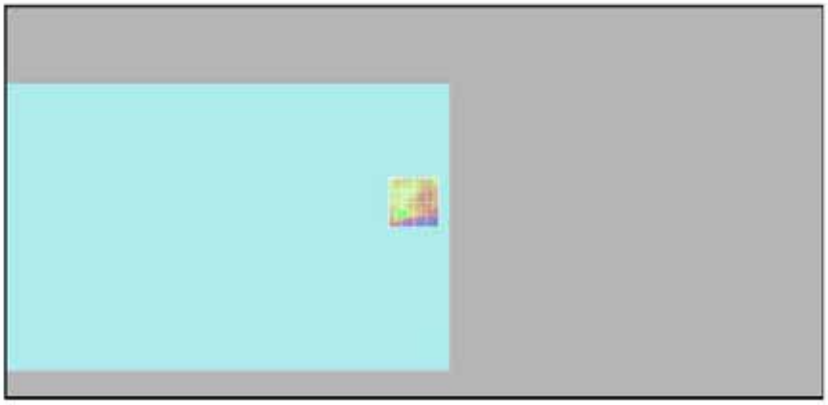
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_Cell_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: CDMA 835MHz; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 43.0 dB
ABM1 comp = -9.75 dB A/m
BWC Factor = 0.150005 dB
Location: -2.2, -2.2, 363.7 mm



PCS Low Axial

Date/Time: 2008-04-25 4:05:02

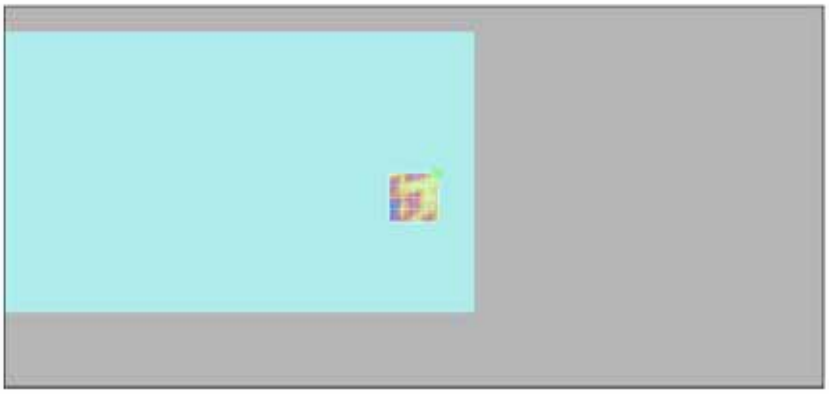
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_Low.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.9 dB
ABM1 comp = 0.195 dB A/m
BWC Factor = 0.150005 dB
Location: -4, 0.2, 363.7 mm



PCS Low Radial1

Date/Time: 2008-04-25 4:07:59

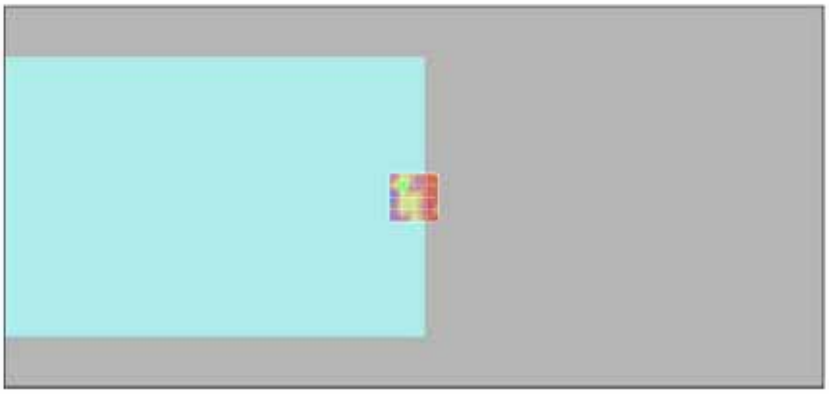
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_Low.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.4 dB
ABM1 comp = -5.51 dB A/m
BWC Factor = 0.150005 dB
Location: -6.3, -2, 363.7 mm



PCS Low Radial2

Date/Time: 2008-04-25 4:10:41

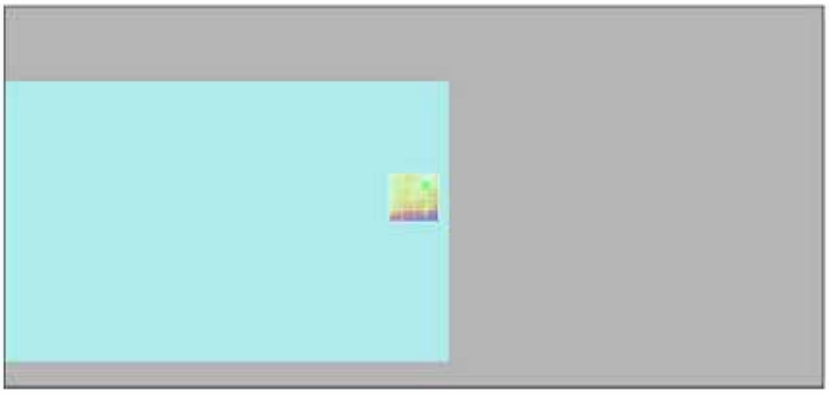
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_Low.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.5 dB
ABM1 comp = -9.48 dB A/m
BWC Factor = 0.150005 dB
Location: -6.2, -6.2, 363.7 mm



PCS Middle Axial

Date/Time: 2008-04-25 3:08:55

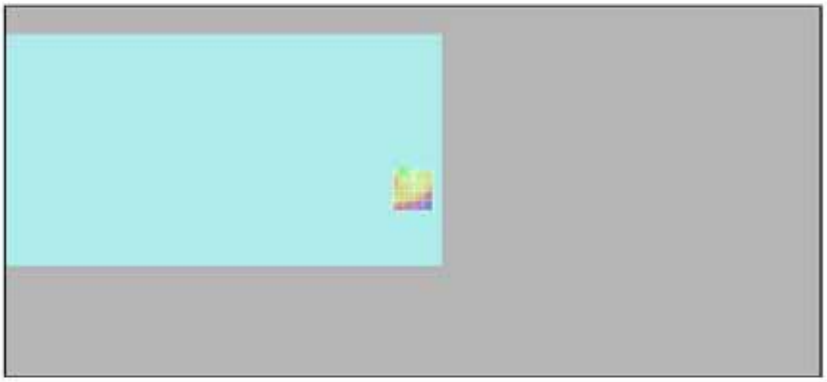
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_Mid.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 43.4 dB
ABM1 comp = 0.471 dB A/m
BWC Factor = 0.150005 dB
Location: -2.2, 4.3, 363.7 mm



PCS Middle Radial1

Date/Time: 2008-04-25 3:11:51

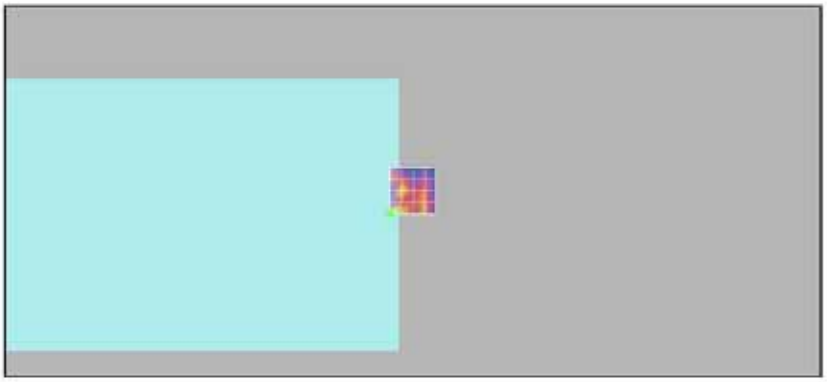
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_Mid.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 41.9 dB
ABM1 comp = -4.95 dB A/m
BWC Factor = 0.150005 dB
Location: -8.5, -0.2, 363.7 mm



PCS Middle Radial2

Date/Time: 2008-04-25 3:14:34

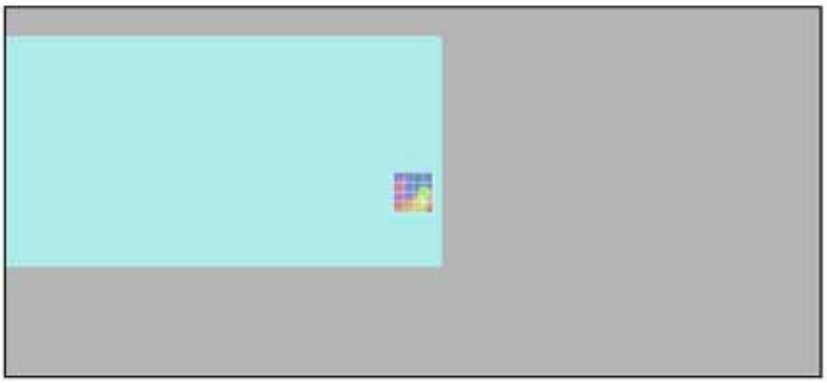
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_Mid.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.7 dB
ABM1 comp = -8.60 dB A/m
BWC Factor = 0.150005 dB
Location: -6.2, 8.3, 363.7 mm



PCS High Axial

Date/Time: 2008-04-25 4:57:40

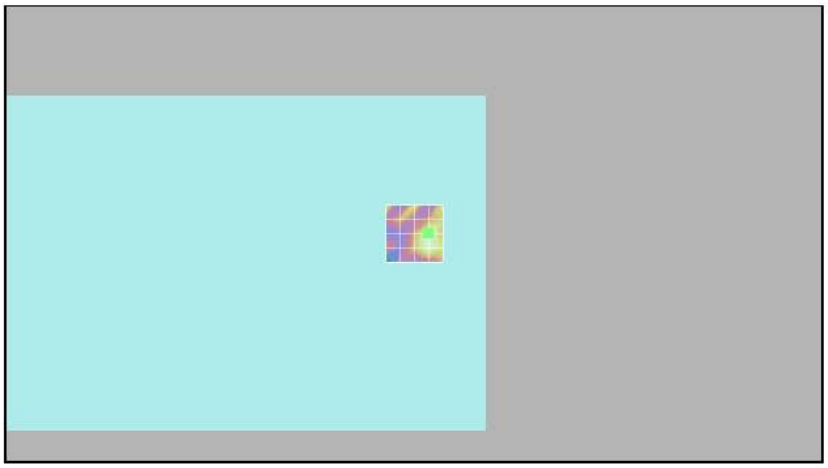
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 43.3 dB
ABM1 comp = 0.321 dB A/m
BWC Factor = 0.150005 dB
Location: -2, -4.2, 363.7 mm



PCS High Radial1

Date/Time: 2008-04-25 5:00:31

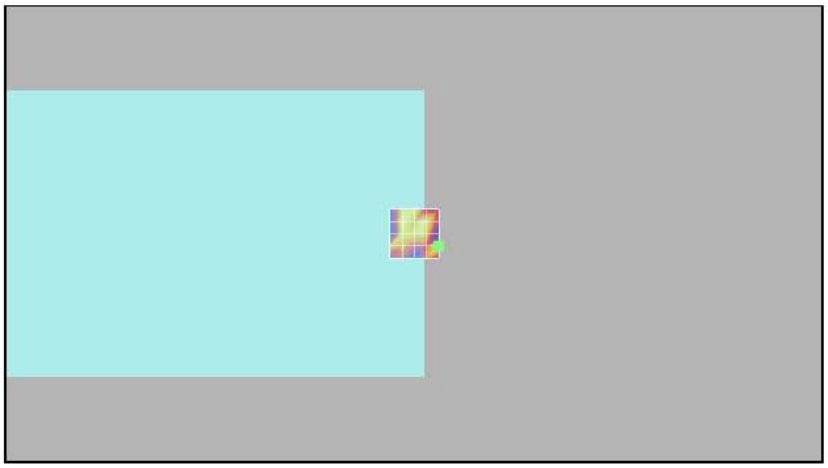
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 41.6 dB
ABM1 comp = -8.26 dB A/m
BWC Factor = 0.150005 dB
Location: -12.3, 2, 363.7 mm



PCS High Radial2

Date/Time: 2008-04-25 5:03:07

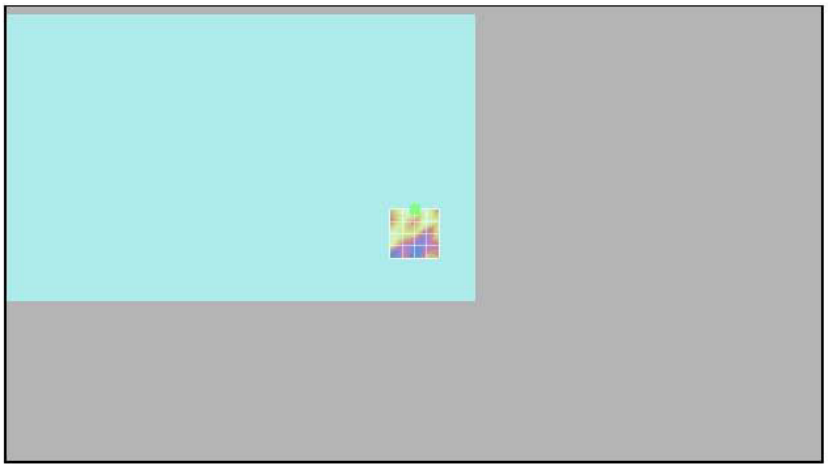
Test Laboratory: SGS Testing Korea
File Name: HAC_TCoil_PCS_High.da4

DUT: RM-375; Type: Folder; Serial: 2684354561C2503144
Program Name: HAC_TCoil_WD_Emission

Communication System: PCS 1900; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:
- Probe: AM1DV2 - 1025; ; Calibrated: 2007-09-19
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn567; Calibrated: 2007-09-20
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Cursor:
ABM1/ABM2 = 42.6 dB
ABM1 comp = -6.34 dB A/m
BWC Factor = 0.150005 dB
Location: 0, 8.5, 363.7 mm



APPENDIX

C. Uncertainty Analysis

Uncertainty of Audio Band Magnetic Measurements

Error Description	Uncertainty Value	Prob. Dist.	Div.	(Ci) ABM1	(Ci) ABM2	Std. Unc. ABM1	Std. Unc. ABM2
Probe Sensitivity							
Reference Level	± 3.0 %	N	1	1	1	± 3.0 %	± 3.0 %
AMCC Geometry	± 0.4 %	R	√3	1	1	± 0.2 %	± 0.2 %
AMCC Current	± 0.6 %	R	√3	1	1	± 0.4 %	± 0.4 %
Probe Positioning during Calibr.	± 0.1 %	R	√3	1	1	± 0.1 %	± 0.1 %
Noise Contribution	± 0.7 %	R	√3	0.0143	1	± 0.0 %	± 0.4 %
Frequency Slope	± 5.9 %	R	√3	0.1	1.0	± 0.3 %	± 3.5 %
Probe System							
Repeatability / Drift	± 1.0 %	R	√3	1	1	± 0.6 %	± 0.6 %
Linearity / Dynamic Range	± 0.6 %	R	√3	1	1	± 0.4 %	± 0.4 %
Acoustic Noise	± 1.0 %	R	√3	0.1	1	± 0.1 %	± 0.1 %
Probe Angle	± 2.3 %	R	√3	1	1	± 1.4 %	± 1.4 %
Spectral Processing	± 0.9 %	R	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	± 0.6 %	N	1	1	5	± 0.6 %	± 0.6 %
Field Disturbation	± 0.2 %	R	√3	1	1	± 0.1 %	± 0.1 %
Test Signal							
Ref. Signal Spectral Response	± 0.6 %	R	√3	0	1	± 0.0%	± 0.0 %
Positioning							
Probe Positioning	± 1.9 %	R	√3	1	1	± 1.1 %	± 1.1 %
Phantom Thickness	± 0.9 %	R	√3	1	1	± 0.5 %	± 0.5 %
DUT Positioning	± 1.9 %	R	√3	1	1	± 1.1 %	± 1.1 %
External Contributions							
RF Interference	± 0.0 %	R	√3	1	0.3	± 0.0 %	± 0.0 %
Test Signal Variation	± 2.0 %	R	√3	1	1	± 1.2 %	± 1.2 %
Combined Uncertainty							
Combined Std. Uncertainty (ABM Field)						± 4.1 %	± 6.1 %
Expanded Std. Uncertainty						± 8.1 %	± 12.3 %

APPENDIX

D. Calibration certificate

-AM1DV2 Probe

-DAE

AM1DV2 Probe Calibration Certificate

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Client SGS (Dymstec)

Certificate of test and configuration

Item	**AM1DV2** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AE
Series No	**1025**
Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland

Description of the item
The Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1]. The probe includes a symmetric 40dB low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines the angle of the sensor when mounted on the DAE. The probe supports mechanical detection of the surface. The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components when rotating the probe by 120° around its axis. It is aligned with the perpendicular component of the field, if the probe axis is tilted 35.3° above the measurement plane, using the connector rotation and Sensor angle stated below.
The probe is fully RF shielded when operated with the matching signal cable (shielded) and allows measurement of audio magnetic fields in the close vicinity of RF emitting wireless devices according to [1] without additional shielding.

Handling of the item
The probe is manufactured from stainless steel. In order to maintain the performance and calibration of the probe, it must not be opened. The probe is designed for operation in air and shall not be exposed to humidity or liquids. For proper operation of the surface detection and emergency stop functions in the DASY system, the probe must be operated with the special probe cup provided (larger diameter). Verify that the probe can slide in the probe cup rubber smoothly.

Functional test, configuration data and sensitivity
The probe configuration data were evaluated after a functional test including noise level and RF immunity. Connector rotation, sensor angle and sensitivity are specific for this probe.

DASY configuration data for the probe

Configuration item	Condition	Configuration Data	Dimension
Overall length	mounted on DAE in DASY system	296	mm
Tip diameter	at the cylindrical part	6	mm
Sensor offset	center of sensor, from tip	3	mm
Connector rotation	Evaluated in homogeneous 1 kHz magnetic field generated with AMCC Helmholtz Calibration Coil	**150.2**	°
Sensor angle		**-0.66**	°
Sensitivity	at 1 kHz	**0.0652**	V / (A/m)

Standards
[1] ANSI-C63.19-2007

Test date 19.09.2007 MM / FB

Issue date 20.09.2007

Signature M. Meili

Doc No 884 – SP AM1 001 AF – 1025 – 070919 – G Page 1 (1)

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Audio Magnetic 1D Field Probe AM1DV2
Type No	SP AM1 001 A
Series No	1001 ff.
Manufacturer / Origin	Schmid & Partner Engineering AG Zurich, Switzerland

Description of the item
The Audio Magnetic Field Probe AM1DV2 is a fully RF shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The signal from the pickup coil is amplified in a symmetric 40dB low noise amplifier and fed to a 3 pin connector at the side. Power is supplied via the same and monitored via the LED near the connector. The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components by rotating the probe around its axis.

Handling of the item
The probe is manufactured and designed for operation in air and shall not be exposed to humidity or liquids. In order to keep the performance and alignment, the probe must not be disassembled. The full performance can only be achieved using the SPEAG provided accessories and following the corresponding manual.

Tests

Test	Requirement	Details	Units tested
Sensor angle	Probe configuration data for alignment with field	see corresponding probe certificate	all
Dimensions	according to corresponding probe certificate	verified at delivery / light beam alignment prior to measurement usage	all / in setup by user
Frequency response	within +/- 0.5 dB of ideal differentiator from 100 Hz to 10 kHz	Coil current of AMCC measured with R&S UPL, probe including amplifier and AMMI ADC input	First article
Dynamic range	max. + 21 dB A/m @ 1 kHz Noise level typ. -70 dB A/m @ 1 kHz ABM2 typ. -60 dB A/m	with AMMI	Samples / all
Linearity	within < 0.1 dB from 5 dB below limitation to 16 dB above noise level	tested betwen +15 dB A/m @ 1 kHz, to -70 dB A/m @ 10 kHz	Samples
Sensitivity	typ. -24 dBV / A/m @ 1 kHz at probe output	verified at delivery / calibrated in setup prior to measurement usage	all / in setup by user
RF shielding	immunity to AM modulated RF signal	1 kHz 80 % AM	all

Standards
[1] ANSI PC63.19-2006 Draft 3.12

Conformity
Based on the tests above, we certify that this item is in compliance with the requirements of [1].

Date 22.5.2006

Stamp / Signature

s p e a g

Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Doc No 880 – SP AM1 001 A – A Page 1 (1)

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Client

Certificate of test and configuration

Item	Audio Magnetic 1D Field Probe **AM1DV2**
Type No	SP AM1 001 AE
Series No	**1025**
Manufacturer / Origin	Schmid & Partner Engineering AG Zurich, Switzerland

Description of the item
The Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1]. The probe includes a symmetric 40dB low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines the angle of the sensor when mounted on the DAE. The probe supports mechanical detection of the surface. The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components when rotating the probe by 120° around its axis. It is aligned with the perpendicular component of the field, if the probe axis is tilted 35.3° above the measurement plane, using the connector rotation and Sensor angle stated below.
The probe is fully RF shielded when operated with the matching signal cable (shielded) and allows measurement of audio magnetic fields in the close vicinity of RF emitting wireless devices according to [1] without additional shielding.

Handling of the item
The probe is manufactured from stainless steel. In order to maintain the performance and calibration of the probe, it must not be opened. The probe is designed for operation in air and shall not be exposed to humidity or liquids. For proper operation of the surface detection and emergency stop functions in the DASY4 system, the probe must be operated with the special probe cup provided (larger diameter).

Functional test
The probe configuration data were evaluated after a functional test including amplification, dynamic range and RF immunity.

DASY4 configuration data for the probe

Configuration item	Condition	Configuration Data	Dimension
Overall length	mounted on DAE in DASY4 system	**296**	mm
Tip diameter	at the cylindrical part	6	mm
Sensor offset	center of sensor, from tip	3	mm
Connector rotation	Evaluated in homogeneous 1 kHz magnetic field generated with AMCC Helmholtz Calibration Coil	**149.7**	°
Sensor angle		**0.01**	°

Standards
[1] ANSI-C63.19-2006

Date 13.07.2006

Signature

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Audio Magnetic 1D Field Probe AM1DV2
Type No	**SP AM1 001 A**
Series No	1001 ff.
Manufacturer / Origin	Schmid & Partner Engineering AG Zurich, Switzerland

Description of the item
The Audio Magnetic Field Probe AM1DV2 is a fully RF shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The signal from the pickup coil is amplified in a symmetric 40dB low noise amplifier and fed to a 3 pin connector at the side. Power is supplied via the same and monitored via the LED near the connector. The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components by rotating the probe around its axis.

Handling of the item
The probe is manufactured and designed for operation in air and shall not be exposed to humidity or liquids. In order to keep the performance and alignment, the probe must not be disassembled. The full performance can only be achieved using the SPEAG provided accessories and following the corresponding manual.

Tests

Test	Requirement	Details	Units tested
Sensor angle	Probe configuration data for alignment with field	see corresponding probe certificate	all
Dimensions	according to corresponding probe certificate	verified at delivery / light beam alignment prior to measurement usage	all / in setup by user
Frequency response	within +/- 0.5 dB of ideal differentiator from 100 Hz to 10 kHz	Coil current of AMCC measured with R&S UPL, probe including amplifier and AMMI ADC input	First article
Dynamic range	max. + 21 dB A/m @ 1 kHz Noise level typ. -70 dB A/m @ 1 kHz ABM2 typ. -60 dB A/m	with AMMI	Samples / all
Linearity	within < 0.1 dB from 5 dB below limitation to 16 dB above noise level	tested betwen +15 dB A/m @ 1 kHz, to -70 dB A/m @ 10 kHz	Samples
Sensitivity	typ. -24 dBV / A/m @ 1 kHz at probe output	verified at delivery / calibrated in setup prior to measurement usage	all / in setup by user
RF shielding	immunity to AM modulated RF signal	1 kHz 80 % AM	all

Standards
[1] ANSI PC63.19-2006 Draft 3.12

Conformity
Based on the tests above, we certify that this item is in compliance with the requirements of [1].

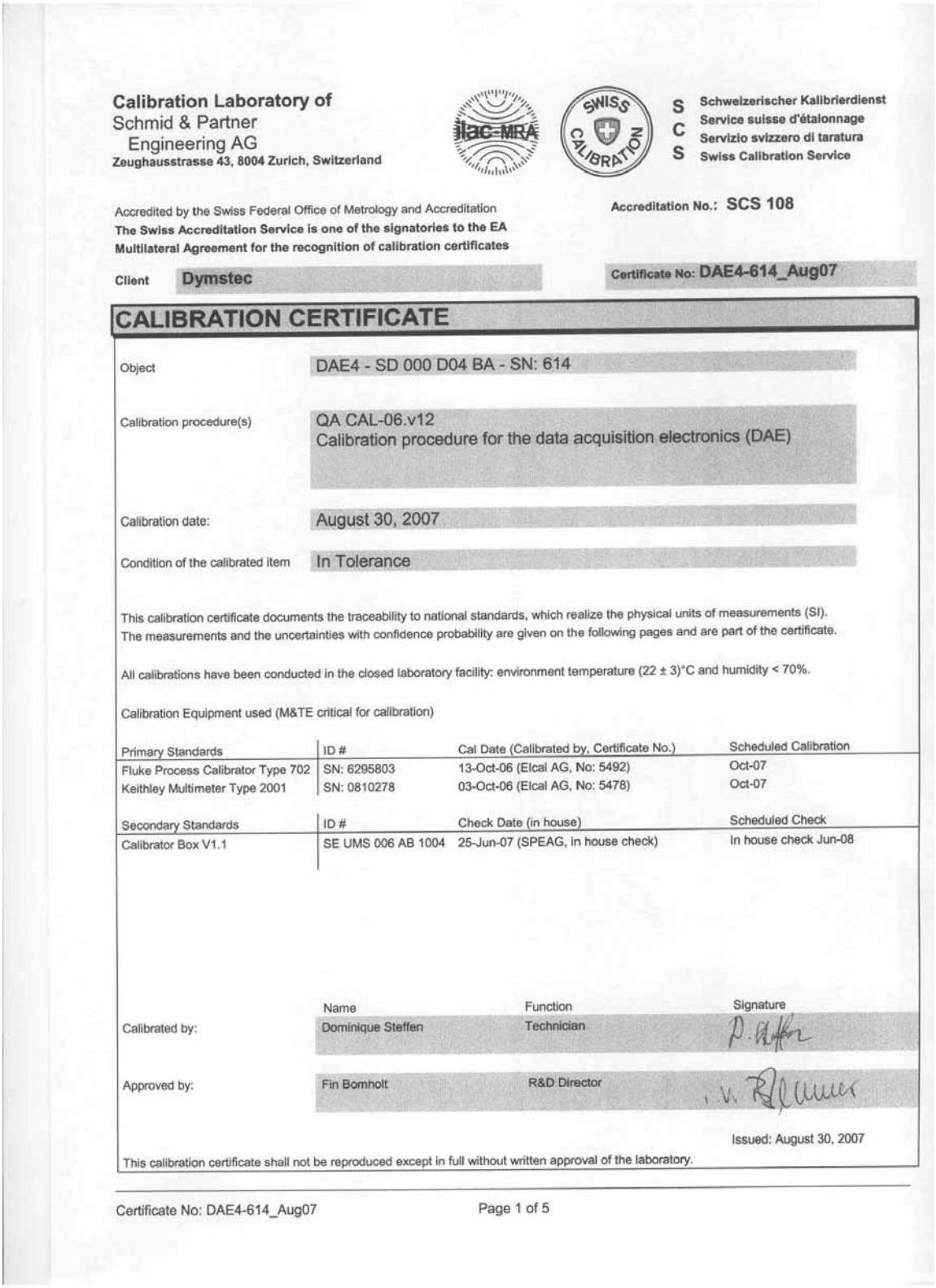
Date 22.5.2006

Stamp / Signature

s p e a g

Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

DAE Calibration Certificate



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Dymstec

Certificate No: DAE4-614_Aug07

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BA - SN: 614
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 30, 2007
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	13-Oct-06 (Elcal AG, No: 5492)	Oct-07
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-06 (Elcal AG, No: 5478)	Oct-07
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1004	25-Jun-07 (SPEAG, in house check)	In house check Jun-08

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: August 30, 2007

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: DAE4-614_Aug07 Page 1 of 5

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters contain technical information as a result from the performance test and require no uncertainty.
- *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
- *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
- *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
- *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
- *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
- *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
- *Input resistance:* DAE input resistance at the connector, during internal auto-zeroing and during measurement.
- *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
- *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.926 ± 0.1% (k=2)	404.433 ± 0.1% (k=2)	405.056 ± 0.1% (k=2)
Low Range	3.95357 ± 0.7% (k=2)	3.93461 ± 0.7% (k=2)	4.00299 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	231 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	200000	200000	0.00
Channel X	+ Input	20000	20008.58	0.04
Channel X	- Input	20000	-19999.47	0.00
Channel Y	+ Input	200000	200000.6	0.00
Channel Y	+ Input	20000	20007.85	0.04
Channel Y	- Input	20000	-20001.41	0.01
Channel Z	+ Input	200000	199999.9	0.00
Channel Z	+ Input	20000	20006.37	0.03
Channel Z	- Input	20000	-20004.86	0.02

Low Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	2000	2000	0.00
Channel X	+ Input	200	199.76	-0.12
Channel X	- Input	200	-199.68	-0.16
Channel Y	+ Input	2000	2000	0.00
Channel Y	+ Input	200	199.84	-0.08
Channel Y	- Input	200	-200.52	0.26
Channel Z	+ Input	2000	2000	0.00
Channel Z	+ Input	200	199.27	-0.37
Channel Z	- Input	200	-201.19	0.59

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	1.30	0.67
	- 200	-0.13	-0.60
Channel Y	200	8.11	7.55
	- 200	-9.10	-9.60
Channel Z	200	-10.71	-10.45
	- 200	9.01	8.76

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	2.57	-0.89
Channel Y	200	0.47	-	4.63
Channel Z	200	-0.15	0.69	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16227	16192
Channel Y	16375	15850
Channel Z	16067	15373

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.31	-0.54	1.27	0.41
Channel Y	-2.27	-3.06	-1.38	0.34
Channel Z	-0.93	-2.53	0.20	0.41

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	196.9
Channel Y	0.2000	200.7
Channel Z	0.2000	202.1

8. Low Battery Alarm Voltage (verified during pre test)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9