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SAR Test Report

Report Number: M130531F

Test Sample: Tait Push to Talk Transceiver

Type: TPDH5A

FCC ID: CASTPDH5A
IC ID: 737A-TPDH5A

Tested For: TAIT Limited

Date of Issue: 12 June 2013

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SAR EVALUATION

TAIT Push to Talk Transceiver, **Type:** TPDH5A **Report Number:** M130531F

1.0 GENERAL INFORMATION

Test Sample:		TAIT Push to Talk Transceiver
Type:		TPDH5A
Serial Number:	**16-Key**	25452380
	4-Key	25452378
FCC ID:		CASTPDH5A
IC ID:		737A-TPDH5A
Hardware Version:		0006
Software Version:		1.04.00.003
Manufacturer:		Tait Limited
Maximum SAR		**3.35 mW/g**
Device Category:		Portable Transmitter
Test Device:		Production Unit / Prototype Sample
RF exposure Category:		Occupational/Aware user
Tested for:		Tait Limited
Address:		558 Wairakei Road Christchurch 8140 New Zealand
Contact:		Bruce Jensen
Phone:		+64-3-357 0805
Fax:		+64-3-359 4632
Email:		bruce.jensen@taitradio.com

Test Standard/s:

FCC CFR 47 §2.1093 Radiofrequency radiation exposure evaluation: portable devices
KDB 447498 D01 General RF Exposure Guidance v05r01
KDB 643646 D01 SAR Test for PTT Radios v01r01
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r01
KDB 865664 D02 RF Exposure Reporting v01r01

IEEE 1528: 2003

Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
RSS-102 Issue 4
IEC 62209-1:2006 and IEC 62209-2:2010
Human exposure to radio frequency fields from hand-held and body-mounted devices-Human models, instrumentation and procedures.
Part 1: Procedure to determine the specific absorption rate (SAR) for hand- held devices used in close proximity to the ear (frequency range 300 MHz to 3 GHz)
Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz

Statement Of Compliance:

The TAIT Push to Talk Transceiver, Type TPDH5A. Complied with FCC and IC Occupational/controlled RF exposure limits of 8.0mW/g per requirements of 47CFR2.1093(d).

Test Dates:

4th June till 11th June 2013

Test Officer:

Peter Jakubiec

Authorised Signature:

Peter Jakubiec

2.0 DESCRIPTION OF DEVICE

2.1 Description of Test Sample

The device tested was a TAIT Push to Talk Transceiver, Type: TPDH5A operating in 450 MHz frequency band. It will be referred to as the device under test (DUT) throughout this report. The DUT has a set of external fixed length antennas and was tested in the Face Frontal and Belt Clip configurations of the phantom. There are two variants of the DUT available, one with 4 keys and one with 16 keys present on the outer case. The differences in construction are limited to the presence or lack thereof of some of the plastic keys, (i.e. the PCB and other internal electronics are identical). SAR testing was conducted on the 16-Key variant. Some SAR testing was done on the 4-key variant to confirm the SAR distribution is the same for both variants.

Operating Mode during Testing	: Continuous Wave 100% duty cycle
Operating Mode production sample	: 50% duty cycle
Modulation:	: FM
Device Power Rating for test sample and identical production unit	: 4 W
Device Dimensions (LxWxH)	: 137 x 60 x 32mm
Antenna types	: Helical and Whip
Applicable Head Configurations	: Face Frontal
Applicable Body Configurations	: Belt Clip Position
Battery Options	: 7.4V 1880mAh Low Capacity Li-ion : 7.4V 2400mAh High Capacity Li-ion

2.2 Test sample Accessories

The radios are not shipped with any particular default battery or accessory. It is up to the customer to choose the combination of batteries and accessories which best fits the intended the use for the radio. See section 7.2 for an explanation of how the default accessories were selected for the purposes of testing to KDB643646.

2.2.1 Battery Types

Both 7.4 V 2400 mAh Li-ion and 7.4V 1880mAh Li-ion Battery Packs are used to power the DUT. SAR measurements were performed with both 7.4 V battery packs.

2.2.2 Antenna Description and Characteristics

The device was supplied with two sizes/types of antennas each to cover the full operating frequency range.

Product Code	IPN	Type	Antenna Length (mm)	Report Reference	Frequency Range
TPA-AN-011	007-00023-02	Whip	155	Wide	400-470 MHz
TPA-AN-013	007-00040-01	Helical	68	Wide	400-470 MHz

2.2.3 Body Worn Accessories

Number of body worn accessories containing small metallic parts is sold with the DUT, which are listed in the table below. All of the listed accessories can be used in any combination of battery mentioned in section 2.2.1 above and any Audio Accessory mentioned in section 2.2.3 below.

Body Worn Accessory	Part Number	Spacing between the phantom and the back of the DUT
Battery Clip	TPA-CA-201	14 mm
Nylon Case with Battery Clip	T03-00038-0018 with TPA-CA-201	14 mm
Nylon Case Belt Loop	T03-00038-0017	7 mm
Nylon Case D-Stud with D-Stud Spring Clip	T03-00038-0016 with T03-00038-0023	31mm
Nylon Case D-Stud with D-Stud Belt Loop	T03-00038-0016 with T03-00038-0022	42mm
Soft Leather Case with Battery Clip	T03-00038-0021 with TPA-CA-201	14mm
Leather Case with Spring Clip	T03-00038-0005	17 mm
Leather Case with D-Stud Spring Clip	T03-00038-0007 with T03-00038-0023	31mm
Leather Case with D-Stud Belt Loop	T03-00038-0007 with T03-00038-0022	42mm
Leather Case Belt Loop	T03-00038-0009	10 mm

2.2.4 Audio Accessories

There are seven audio accessories available for DUT:
According to KDB643646 publication ”For audio accessories with similar construction and operating requirements, test only the audio accessory within the group that is expected to result in the highest SAR, with respect to changes in RF characteristics and exposure conditions for the combination. If it is unclear which audio accessory within a group of similar accessories is expected to result in the highest SAR, good engineering judgment and preliminary testing should be applied to select the accessory that is expected to result in the highest SAR.”
For the Speaker – Microphone group T03-00045-BFAA audio accessory was chosen which represents typical accessory of this type, there is very minor difference in connector/cable assembly between T03-00045-BFAA and other Speaker – Microphones. For Headset-Microphone and for Earphone-Microphone combined audio accessory group, two representative models were chosen based on the connector and cable shape and size - T03-00046-EFAA and T03-00046-DEAA, the other two accessories of this group have very similar construction respectively.

Audio Accessory	Part Number
Speaker- Microphone	T03-00045-CFAA
Speaker- Microphone	T03-00045-DMAA
Speaker- Microphone	T03-00045-BFAA
Headset-Microphone	T03-00046-EFAA
Headset-Microphone	T03-00046-DEAA
Earphone-Microphone	T03-00047-CBAA
Earphone-Microphone	T03-00047-BAAA

2.3 Test Signal, Frequency and Output Power

The DUT is operating in the 450 MHz frequency band. The frequency range is 406.2 MHz to 469.9 MHz. The transmitter was configured into a test mode that ensured a continuous RF transmission for the duration of each SAR scan. The device transmission characteristics were also monitored during testing to confirm the device was transmitting continuously. FCC guidelines (KDB 643646 and a device specific KDB) were followed to determine the required SAR testing configurations. The device has an audio accessory output to which a supplied hands free speaker/microphone was connected during all testing in the body positions. Excluding the audio accessory there were no wires or other connections to the DUT during the SAR measurements.

Table: Test Frequencies

Frequency Range	Traffic Channels	Nominal Power (dBm)
406.2 MHz – 469.9 MHz	1-5	36.02

2.4 Conducted Power Measurements

The conducted power of the DUT was measured in the 406.2 MHz to 469.9 MHz frequency range with a calibrated Power Meter. The results of this measurement are listed in table below.

Table: Frequency and Output Power

Channel	Channel Frequency MHz	Battery Type	Maximum Conducted Output Power dBm
1	406.2	Li-ion	36.26
2	422.125	Li-ion	36.28
3	438.050	Li-ion	36.29
4	453.975	Li-ion	36.28
5	469.9	Li-ion	36.27

2.5 Battery Status

The device battery was fully charged prior to commencement of measurement. Each SAR test was completed within 30 minutes. The battery condition was monitored by measuring the RF power at a defined position inside the phantom before the commencement of each test and again after the completion of the test, additionally by measuring the conducted RF at the antenna port before the commencement of each test and again after the completion of the test.

Table: Battery Details

Battery #1:	Low Capacity Li-ion 7.4V 14Wh 1880mAh	**Battery #2:**	High Capacity Li-ion 7.4V 18Wh 2400mAh
Model No.:	T03-00011-AAAA	**Model No.:**	T03-00011-CAAA
Serial No.:	25368789	**Serial No.:**	25371663

2.6 Details of Test Laboratory

2.6.1 Location

EMC Technologies Pty Ltd
176 Harrick Road
Keilor Park, (Melbourne) Victoria
Australia 3042

Telephone: +61 3 9365 1000
Facsimile: +61 3 9331 7455
email: melb@emctech.com.au
website: www.emctech.com.au

2.6.2 Accreditations

EMC Technologies Pty. Ltd. is accredited by the National Association of Testing Authorities, Australia (NATA). **NATA Accredited Laboratory Number: 5292**
Last assessed in May 2012, next scheduled assessment in December 2013

EMC Technologies Pty Ltd is NATA accredited for the following standards:

AS/NZS 2772.2:	RF and microwave radiation hazard measurement
ACMA:	Radio communications (Electromagnetic Radiation - Human Exposure) Standard 2003
FCC:	Guidelines for Human Exposure to RF Electromagnetic Field OET65C 01/01
EN 50360: 2001	Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)
EN 62209-1:2006	Human Exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models instrumentation and procedures. **Part 1:** Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (300 MHz to 3 GHz)
EN 62209-2:2010	Human Exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models instrumentation and procedures **Part 2:** Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz
IEEE 1528: 2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

Refer to NATA website www.nata.asn.au for the full scope of accreditation.

2.6.3 Environmental Factors

The measurements were performed in a shielded room with no background network signals. The temperature in the laboratory was controlled to within 21 ± 1 °C, the humidity was 40 to 47 %. The liquid parameters were measured prior to the commencement of the tests. Tests were performed to check that reflections within the environment did not influence the SAR measurements. The noise floor of the DASY5 SAR measurement system using the SN1380 probe is less than 5μV in both air and liquid mediums.

3.0 DESCRIPTION OF SAR MEASUREMENT SYSTEM

3.1 Probe Positioning System

The measurements were performed with the state of the art automated near-field scanning system **DASY5 Version 52** from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision 6-axis robot (working range greater that 1.1m), which positions the SAR measurement probes with a positional repeatability of better than ±0.02 mm. The DASY5 fully complies with the OET65 C (01-01), IEEE 1528 and EN50361SAR measurement requirements.

3.2 E-Field Probe Type and Performance

The SAR measurements were conducted with the dosimetric probe ET3DV6 Serial: 1380 (manufactured by SPEAG) designed in the classical triangular configuration and optimised for dosimetric evaluation. The probe has been calibrated and found to be accurate to better than ±0.25 dB. The probe is suitable for measurements close to material discontinuity at the surface of the phantom. The sensors of the probe are directly loaded with Schottky diodes and connected via highly resistive lines (length = 300 mm) to the data acquisition unit.

3.3 Data Acquisition Electronics

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. The input impedance of the DAE3 box is 200 MΩ; the inputs are symmetrical and floating. Common mode rejection is above 80dB.Transmission to the PC-card is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The mechanical probe-mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

3.4 Calibration and System Check Procedures and Data

Prior to the SAR assessment, the system validation kit was used to verify that the DASY5 was operating within its specifications. The system check was performed at 450 MHz with the SPEAG D450V3 calibrated dipole.

The validation dipoles are highly symmetric and matched at the centre frequency for the specified liquid and distance to the phantom. The accurate distance between the liquid surface and the dipole centre is achieved with a distance holder that snaps onto the dipole.

System validation is performed by feeding a known power level into a reference dipole, set at a know distance from the phantom. The measured SAR is compared to the theoretically derived level.

3.4.1 Deviation from reference validation values

The reference SAR values are derived using a reference dipole and flat phantom suitable for a centre frequency of 450 MHz. These reference SAR values are obtained from the IEEE Std 1528-2003 and are normalized to 1W.

The calibration reference SAR value is the SAR system verification result obtained in a specific dielectric liquid using the validation dipole after system component calibration. The measured one-gram SAR should be within 10% of the expected target reference values shown in table below.

Date	Frequency (MHz)	Measured SAR 1g (input power = 450mW)	Measured SAR 1g (Normalized to 1W)	Calibration Reference SAR Value 1g (mW/g)	Deviation From Target 1g (%)	Date Calibration Reference Established
4th June 13	450	2.26	5.02	4.58	9.66	11th Dec 12
6th June 13	450	2.12	4.71	4.42	6.59	11th Dec 12
7th June 13	450	2.14	4.76	4.42	7.59	11th Dec 12
11th June 13	450	2.10	4.67	4.42	5.58	11th Dec 12

3.4.2 Liquid Depth 15cm

During the SAR measurement process the liquid level was maintained to a level of 15cm with a tolerance of ±0.5cm. The following photo shows the depth of the liquid maintained during the testing.

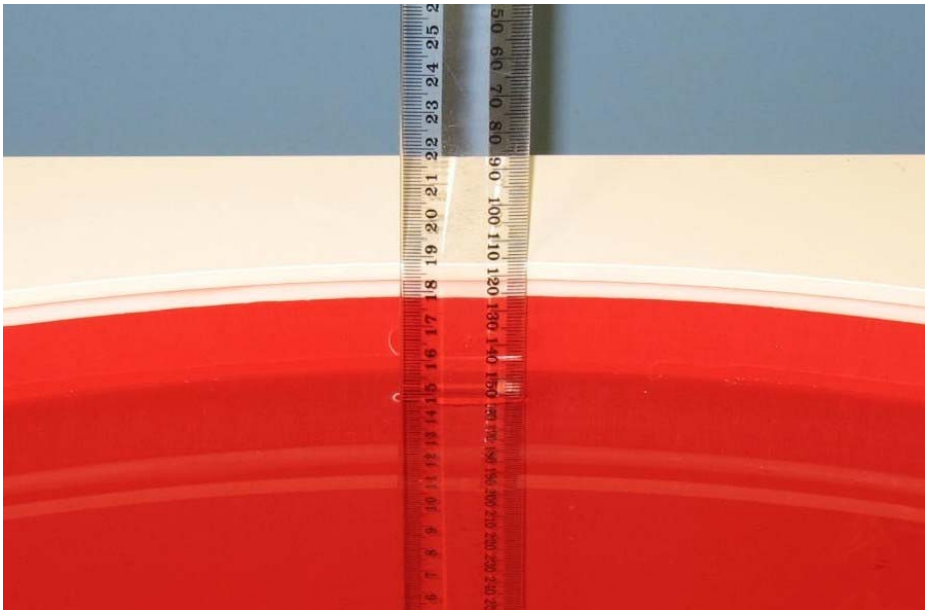

Photo of liquid Depth in Flat Phantom

3.5 Phantom Properties (Size, Shape, Shell Thickness)

For SAR testing in the Face Frontal and Belt Clip positions (also for the System Check) an SPEAG Flat Phantom ELI 4.0 was used. The phantom thickness is 2.0mm +/-0.2 mm and the phantom was filled with the required tissue simulating liquid. Table below provides a summary of the measured phantom properties

Photo 1: Flat_Phantom ELI 4.0 2mm

3.6 Tissue Material Properties

The dielectric parameters of the simulating liquid were measured prior to SAR assessment using the HP85070A dielectric probe kit and HP8753B Network Analyser. The actual dielectric parameters are shown in the following table.

Table: Measured Brain Simulating Liquid Dielectric Values

Frequency Band	∈r (target)	σ (target)	ρ kg/m^3
450 MHz	43.5 ±5% (41.3 – 45.7)	0.87 ±5% (0.82 – 0.91)	1000

NOTE: The liquid parameters were within the required tolerances of ±5%.

Table: Measured Body Simulating Liquid Dielectric Values

Frequency Band	∈r (target)	σ (target)	ρ kg/m^3
450 MHz	56.7 ±5% (53.9 – 59.5)	0.94 ±5% (0.89 – 0.99)	1000

NOTE: The liquid parameters were within the required tolerances of ±5%.

3.6.1 Liquid Temperature and Humidity

The humidity and dielectric/ambient temperatures are recorded during the assessment of the tissue material dielectric parameters. The difference between the ambient temperature of the liquid during the dielectric measurement and the temperature during tests was less than |2|°C.

Table: Temperature and Humidity recorded for each day

Date	Ambient Temperature (°C)	Liquid Temperature (°C)	Humidity (%)
4th June 2013	20.8	20.5	47
6th June 2013	20.7	20.4	46
7th June 2013	20.4	20.1	42
11th June 2013	20.9	20.7	40

Simulated Tissue Composition Used for SAR Test

The tissue simulating liquids are created prior to the SAR evaluation and often require slight modification each day to obtain the correct dielectric parameters.

Table: Tissue Type: Brain @ 450MHz

Volume of Liquid: 30 Litres

Table

Approximate Composition	% By Weight
Distilled Water	38.56
Salt	3.95
Sugar	56.32
HEC	0.98
Bactericide	0.19

Table: Tissue Type: Body @ 450MHz

Volume of Liquid: 30 Litres

Table

Approximate Composition	% By Weight
Distilled Water	51.16
Salt	1.49
Sugar	46.78
HEC	0.52
Bactericide	0.05

*Refer “OET Bulletin 65 97/01 P38”

3.8 Device Holder for DASY5

The DASY5 device holder supplied by SPEAG is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The rotation centres for both scales is the ear opening. Thus the device needs no repositioning when changing the angles.

The DASY5 device holder is made of low-loss material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, to reduce the influence on the clamp on the test results.

Refer to Appendix A2-A3 for photographs of device positioning

5.0 SAR MEASUREMENT PROCEDURE USING DASY5

The SAR evaluation was performed with the SPEAG DASY5 system. A summary of the procedure follows:

a) A measurement of the conducted power value at the antenna port is used as a reference value for assessing the power drop of the DUT. Also a measurement of the SAR value at a fixed location is used. The power is measured at the start of the test and then again at the end of the test.

b) The SAR distribution at the exposed side of the head *or* the flat section of the flat phantom is measured at a distance of 3.9 mm from the inner surface of the shell. The area covers the entire dimension of the head and the horizontal grid spacing is 15 mm x 15 mm. The actual Area Scan has dimensions of 130 mm x 330 mm surrounding the test device hot spot location. Based on this data, the area of the maximum absorption is determined by Spline interpolation. A pre-scan is performed for each phantom configuration to ensure that entire hot spot is identified.

c) Around this point, a volume of 32 mm x 32 mm x 30 mm is assessed by measuring 8 x 8 x 5 points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:

   (i) The data at the surface are extrapolated, since the centre of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 4 mm. The extrapolation is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axes. This polynomial is then used to evaluate the points between the surface and the probe tip.

   (ii) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the “Not a knot”- condition (in x, y and z-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.

   (iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

   (iv) The SAR value at the same location as in Step (a) is again measured

6.0 MEASUREMENT UNCERTAINTY

The uncertainty analysis is based on the template listed in the IEEE Std 1528-2003 for both Handset SAR tests and Validation uncertainty. The measurement uncertainty of a specific device is evaluated independently and the total uncertainty for both evaluations (95% confidence level) must be less than 30%.

Table: Uncertainty Budget for DASY5 Version 52– DUT SAR

Error Description	Uncert. Value	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	1g u_i	10g u_i	v_i
Measurement System								
Probe Calibration	6.7	N	1.00	1	1	6.70	6.70	∞
Axial Isotropy	4.7	R	1.73	0.7	0.7	1.90	1.90	∞
Hemispherical Isotropy	9.6	R	1.73	0.7	0.7	3.88	3.88	∞
Boundary Effects	1	R	1.73	1	1	0.58	0.58	∞
Linearity	4.7	R	1.73	1	1	2.71	2.71	∞
System Detection Limits	1	R	1.73	1	1	0.58	0.58	∞
Readout Electronics	0.3	N	1.00	1	1	0.30	0.30	∞
Response Time	0.8	R	1.73	1	1	0.46	0.46	∞
Integration Time	2.6	R	1.73	1	1	1.50	1.50	∞
RF Ambient Noise	3	R	1.73	1	1	1.73	1.73	∞
RF Ambient Reflections	3	R	1.73	1	1	1.73	1.73	∞
Probe Positioner	0.4	R	1.73	1	1	0.23	0.23	∞
Probe Positioning	2.9	R	1.73	1	1	1.67	1.67	∞
Max. SAR Eval.	1	R	1.73	1	1	0.58	0.58	∞
Post Processing	2	R	1.73	1	1	1.15	1.15	∞
Test Sample Related								
Power Scaling	0	R	1.73	1	1	0.00	0.00	∞
Test Sample Positioning	2.9	N	1.00	1	1	2.90	2.90	145
Device Holder Uncertainty	3.6	N	1.00	1	1	3.60	3.60	5
Output Power Variation – SAR Drift Measurement	4.50	R	1.73	1	1	2.60	2.60	∞
Phantom and Setup								
Phantom Uncertainty	7.5	R	1.73	1	1	4.33	4.33	∞
Liquid Conductivity – Deviation from target values	5	R	1.73	0.64	0.43	1.85	1.24	∞
Liquid Permittivity – Deviation from target values	5	R	1.73	0.6	0.49	1.73	1.41	∞
Liquid Conductivity – Measurement uncertainty	2.5	N	1.00	0.64	0.71	1.60	1.78	∞
Liquid Permittivity – Measurement uncertainty	2.5	N	1.00	0.6	0.26	1.50	0.65	∞
Temp.unc. - Conductivity	1.7	R	1.73	0.78	0.71	0.77	0.70	∞
Temp. unc. - Permittivity	0.3	R	1.73	0.23	0.26	0.04	0.05	∞
Combined standard Uncertainty (u_c)						12.0	11.8	
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k= 2			23.9	23.6	

Estimated total measurement uncertainty for the DASY5 measurement system was ±12.0%. The extended uncertainty (K = 2) was assessed to be ±23.9% based on 95% confidence level. The uncertainty is not added to the measurement result.

Table: Uncertainty Budget for DASY5 Version 52- Validation

Error Description	Uncert. Value	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	1g u_i	10g u_i	v_i
Measurement System								
Probe Calibration	6.7	N	1.00	1	1	6.70	6.70	∞
Axial Isotropy	4.7	R	1.73	1	1	2.71	2.71	∞
Hemispherical Isotropy	9.6	R	1.73	0	0	0.00	0.00	∞
Boundary Effects	1	R	1.73	1	1	0.58	0.58	∞
Linearity	4.7	R	1.73	1	1	2.71	2.71	∞
System Detection Limits	1	R	1.73	1	1	0.58	0.58	∞
Readout Electronics	0.3	N	1.00	1	1	0.30	0.30	∞
Response Time	0	R	1.73	1	1	0.00	0.00	∞
Integration Time	0	R	1.73	1	1	0.00	0.00	∞
RF Ambient Noise	1	R	1.73	1	1	0.58	0.58	∞
RF Ambient Reflections	1	R	1.73	1	1	0.58	0.58	∞
Probe Positioner	0.8	R	1.73	1	1	0.46	0.46	∞
Probe Positioning	6.7	R	1.73	1	1	3.87	3.87	∞
Max. SAR Eval.	2	R	1.73	1	1	1.15	1.15	∞
Post Processing	2	R	1.73	1	1	1.15	1.15	∞
Dipole Related								
Deviation of exp. dipole	5.5	R	1.73	1	1	3.18	3.18	∞
Dipole Axis to Liquid Dist.	2	R	1.73	1	1	1.15	1.15	∞
Input power & SAR drift	3.40	R	1.73	1	1	1.96	1.96	∞
Phantom and Setup								
Phantom Uncertainty	4	R	1.73	1	1	2.31	2.31	∞
Liquid Conductivity – Deviation from target values	5	R	1.73	0.64	0.43	1.85	1.24	∞
Liquid Permittivity – Deviation from target values	5	R	1.73	0.6	0.49	1.73	1.41	∞
Liquid Conductivity – Measurement uncertainty	2.5	N	1.00	0.78	0.71	1.95	1.78	∞
Liquid Permittivity – Measurement uncertainty	2.5	N	1.00	0.26	0.26	0.65	0.65	∞
Temp.unc. - Conductivity	1.7	R	1.73	0.78	0.71	0.77	0.70	∞
Temp. unc. - Permittivity	0.3	R	1.73	0.23	0.26	0.04	0.05	∞
Combined standard Uncertainty (u_c)						10.5	10.3	
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k= 2			21.0	20.7	

Estimated total measurement uncertainty for the DASY5 measurement system was ±10.5%. The extended uncertainty (K = 2) was assessed to be ±21.0% based on 95% confidence level. The uncertainty is not added to the Validation measurement result.

7.0 EQUIPMENT LIST AND CALIBRATION DETAILS

Table: SPEAG DASY5 Version 52

Equipment Type	Manufacturer	Model Number	Serial Number	Calibration Due	Used For this Test?
Robot - Six Axes	Staubli	RX90BL	N/A	Not applicable	✓
Robot Remote Control	SPEAG	CS7MB	RX90B	Not applicable	✓
SAM Phantom	SPEAG	N/A	1260	Not applicable	
SAM Phantom	SPEAG	N/A	1060	Not applicable	
Flat Phantom	AndreT	10.1	P 10.1	Not Applicable	
Flat Phantom	AndreT	9.1	P 9.1	Not Applicable	
Flat Phantom	SPEAG	ELI 4.0	1101	Not Applicable	✓
Data Acquisition Electronics	SPEAG	DAE3 V1	359	21-June-2013	
Data Acquisition Electronics	SPEAG	DAE3 V1	442	04-Dec-2013	✓
Probe E-Field - Dummy	SPEAG	DP1	N/A	Not applicable	
Probe E-Field	SPEAG	ET3DV6	1380	10-Dec-2013	✓
Probe E-Field	SPEAG	ET3DV6	1377	20-June-2013	
Probe E-Field	SPEAG	ES3DV6	3029	Not Used	
Probe E-Field	SPEAG	EX3DV4	3563	21-June-2013	
Probe E-Field	SPEAG	EX3DV4	3657	7-Dec-2013	
Antenna Dipole 300 MHz	SPEAG	D300V3	1012	11-Dec-2014	
Antenna Dipole 450 MHz	SPEAG	D450V3	1074	11-Dec-2014	✓
Antenna Dipole 750 MHz	SPEAG	D750V2	1051	9-Jan-2014	
Antenna Dipole 900 MHz	SPEAG	D900V2	047	22-June-2014	
Antenna Dipole 1640 MHz	SPEAG	D1640V2	314	20-June-2014	
Antenna Dipole 1800 MHz	SPEAG	D1800V2	242	20-June-2014	
Antenna Dipole 1950 MHz	SPEAG	D1950V3	1113	6-Dec -2014	
Antenna Dipole 2450 MHz	SPEAG	D2450V2	724	04-Dec-2014	
Antenna Dipole 2600 MHz	SPEAG	D2600V2	1044	10-Jan-2014	
Antenna Dipole 3500 MHz	SPEAG	D3500V2	1002	13-July-2013	
Antenna Dipole 5600 MHz	SPEAG	D5GHzV2	1008	14-Dec-2013	
RF Amplifier	EIN	603L	N/A	*In test	✓
RF Amplifier	Mini-Circuits	ZHL-42	N/A	*In test	
RF Amplifier	Mini-Circuits	ZVE-8G	N/A	*In test	
Synthesized signal generator	Hewlett Packard	ESG-D3000A	GB37420238	*In test	✓
RF Power Meter	Hewlett Packard	437B	3125012786	30-Aug-2013	✓
RF Power Sensor 0.01 - 18 GHz	Hewlett Packard	8481H	1545A01634	03-Sept-2013	✓
RF Power Meter	Rohde & Schwarz	NRP	101415	17-Sept-2013	
RF Power Sensor	Rohde & Schwarz	NRP - Z81	100174	17-Sept-2013	
RF Power Meter Dual	Hewlett Packard	435A	1733A05847	*In test	✓
RF Power Sensor	Hewlett Packard	8482A	2349A10114	*In test	✓
Network Analyser	Hewlett Packard	8714B	GB3510035	27-Sept-2013	
Network Analyser	Hewlett Packard	8753ES	JP39240130	5-Nov-2013	✓
Dual Directional Coupler	Hewlett Packard	778D	1144 04700	*In test	✓
Dual Directional Coupler	NARDA	3022	75453	*In test	

* Calibrated during the test for the relevant parameters.

8.0 SAR TEST METHOD

8.1 Description of the Test Positions (Face Frontal and Belt Clip)

SAR measurements were performed in the “Face Frontal” and “Belt Clip” positions. Both the “Face Frontal” and “Belt Clip” positions were measured in the flat section of the SPEAG ELI 4.0 phantom.
See Appendix A for photos of test positions.

8.1.1 “Face Frontal Position”

The SAR evaluation was performed in the flat section of the SPEAG phantom. The device was placed 25mm from the phantom, this position is equivalent to the device placed in front of the nose. The supporting hand was not used.

8.1.2 “Belt Clip” Position

The device was tested in the (2.00 mm) flat section of the SPEAG phantom for the “Belt Clip” position. Various belt clip accessories were assessed (see section 2.2.3 for a list of the body worn accessories). The Transceiver was placed at the flat section of the phantom and suspended until the Belt Clip/Belt Loop touched the phantom. The belt clips/loops contained metal parts and the device was connected with the hands free earpiece/microphone.

8.2 List of All Test Cases (Antenna In/Out, Test Frequencies, User Modes)

There are two radio options, two antenna options, seven audio accessory options, two battery options and ten combinations of body worn accessories, for a total of 560 possible body configurations and 8 possible head configurations. The test configurations chosen were according to KDB 643646 and a device specific KDB. There is no default battery or audio accessory defined by the manufacturer for the DUT. The chosen defaults in accordance with KDB 643646 are as follows:

- Default battery for the head positions was the high capacity battery, as it may be capable of delivering more current to the amplifier.
- Default battery for the body positions was the low capacity battery, as it provides the least amount of spacing between the transmitting antenna and the phantom.
- Default audio accessory for the body positions was the speaker microphone (“BFAA”), because the coiled cable was expected to re-radiate energy over a smaller area.
- There is no default body worn accessory supplied with the radio, and all combinations of body worn accessories were assessed.

The 4-key and 16-key variants of the radio are expected to produce the same SAR due to only minor variances in construction. Selected worst case configurations of the 16-Key variant were repeated with the 4-Key variant to confirm this.

Only one antenna can be used at a time. Only one audio accessory can be used at a time. Only one battery option can be used at a time. Some body worn accessories are only designed to be used in conjunction with other body worn accessories, and some can be used on their own. The various combinations of body worn accessories available are labelled A – J below. Any combination of body worn accessories can be used with any antenna, any audio accessory and any battery.

Table: Body Accessory Combinations

	Not Combined	Battery Clip	D-Stud Spring Clip	D-Stud Belt Loop
Battery		A		
Nylon Case		B		
Nylon Case Belt Loop	C			
Nylon Case			D	
Nylon Case				E
Soft Leather Case		F		
Leather Case with Spring Clip	G			
Leather Case			H	
Leather Case				I
Leather Case Belt Loop	J			

Applicable Duty Cycle for PTT Radios

KDB 447498 D01 v05 states that the RF exposure of a PTT device should be evaluated with a 50% duty cycle, if the actual duty cycle is <50%. The DUT operates in a half duplex mode, and is only transmitting while a mechanical PTT button is pressed. This is true for all modes of operation, including PABX/PSTN modes. The PTT button must be released periodically to facilitate two way communication, and during real world use the actual duty cycle would be much lower than 50%. The results in section 8.0 have been scaled to a 50% duty cycle, in accordance with KDB 447498.

8.3 FCC RF Exposure Limits for Occupational/ Controlled Exposure

Spatial Peak SAR Limits For:	
Partial-Body:	8.0 mW/g (averaged over any 1g cube of tissue)
Hands, Wrists, Feet and Ankles:	20.0 mW/g (averaged over 10g cube of tissue)

8.4 FCC RF Exposure Limits for Un-controlled/Non–occupational

Spatial Peak SAR Limits For:	
Partial-Body:	1.6 mW/g (averaged over any 1g cube of tissue)
Hands, Wrists, Feet and Ankles:	3.0 mW/g (averaged over 10g cube of tissue)

9.0 SAR MEASUREMENT RESULTS

The SAR values averaged over 1g tissue mass were determined for the sample device for the Face Frontal and Belt Clip configurations of the phantom.

9.1 SAR Measurement Results Head

Table: SAR MEASUREMENT RESULTS – Face Frontal positions Antenna Whip

Test Position	Plot No.	Test Ch.	Test Mode	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured 1g SAR Results 50% Duty Cycle (mW/g)	Measured Drift (dB)	∈r (target 43.5 ±5% (41.3–45.7)	σ (target 0.87 ±5% (0.82–0.91)	Measured RF Power (dBm)
Head Face Frontal 16 Key 04-06-13	1	CW	3	438.1	3.94	1.97	-0.06	42.53	0.8761	36.22
System Check 04-06-13	2	CW 450 MHz	1	450	2.26	-	-	42.3	0.8867	-

Table: SAR MEASUREMENT RESULTS – Face Frontal positions Antenna Helical

Test Position	Plot No.	Test Ch.	Test Mode	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured 1g SAR Results 50% Duty Cycle (mW/g)	Measured Drift (dB)	∈r (target 43.5 ±5% (41.3–45.7)	σ (target 0.87 ±5% (0.82–0.91)	Measured RF Power (dBm)
Head Face Frontal 16 Key 04-06-13	3	CW	3	438.1	3.94	1.97	-0.01	42.53	0.8761	36.20
Head Face Frontal 16 Key Low Capacity Battery 04-06-13	4	CW	3	438.1	4.06	2.03	-0.09	42.53	0.8761	36.21
Head Face Frontal 4 Key Low Capacity Battery 04-06-13*	5	CW	3	438.1	4.09	2.045	-0.11	42.53	0.8761	36.23

Note: The uncertainty of the system (±23.9 %) has not been added to the results.
**Low capacity battery option used*
The FCC SAR limit for occupational exposure is 8.0mW/g measured in a 1g cube of tissue.

9.2 SAR Measurement Results Body

Table: SAR MEASUREMENT RESULTS – Body Worn positions Antenna Whip

Test Position	Plot No.	Test Ch.	Test Mode	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured 1g SAR Results 50% Duty Cycle (mW/g)	Measured Drift (dB)	∈r (target 56.7 ±5% (53.9–59.5)	σ (target 0.94 ±5% (0.89–0.99)	Measured RF Power (dBm)
Body Battery Clip 16 Key 06-06-13	6	CW	3	438.1	5.92	2.96	-0.16	56.48	0.9487	36.23
Body Nylon Case Battery Clip 16 Key 06-06-13	7	CW	3	438.1	6.2	3.1	-0.18	56.48	0.9487	36.22
Body Nylon Case Belt Loop 16 Key 07-06-13	8	CW	3	438.1	5.54	2.77	-0.14	57.16	0.9478	36.24
Body Nylon Case D-Stud Spring Clip 16 Key 07-06-13	9	CW	3	438.1	4.03	2.015	-0.15	57.16	0.9478	36.17
Body Nylon Case D-Stud Belt Loop 16 Key 07-06-13	10	CW	3	438.1	1.81	0.905	-0.15	57.16	0.9478	36.15
Body Soft Leather Case Battery Clip 16 Key 07-06-13	11	CW	3	438.1	6.25	3.125	-0.15	57.16	0.9478	36.20
Body Leather Case Spring Clip 16 Key 07-06-13	12	CW	3	438.1	4.69	2.345	-0.21	57.16	0.9478	36.24
Body Leather Case D-Stud Spring Clip 16 Key 07-06-13	13	CW	3	438.1	3.51	1.755	-0.13	57.16	0.9478	36.20
Body Leather Case D-Stud Belt Loop 16 Key 07-06-13	14	CW	3	438.1	1.62	0.81	-0.11	57.16	0.9478	36.21
Body Leather Case Belt Loop 16 Key 07-06-13	15	CW	3	438.1	4.52	2.26	-0.11	57.16	0.9478	36.22
Body Soft Leather Case Battery Clip Extended Battery 16 Key 11-06-13**	16	CW	3	438.1	5.08	2.54	-0.12	55.93	0.936	36.23
Body Soft Leather Case Battery Clip 16 Key EFAA Audio Accessory 11-06-13	17	CW	3	438.1	6.19	3.095	-0.15	55.93	0.936	36.19
Body Soft Leather Case Battery Clip 16 Key DEAA Audio Accessory 11-06-13	18	CW	3	438.1	6.52	**3.26**	-0.13	55.93	0.936	36.23
Body Soft Leather Case Battery Clip 4 Key DEAA Audio Accessory 11-06-13	19	CW	3	438.1	6.11	3.055	-0.16	55.93	0.936	36.22
System Check 06-06-13	20	CW 450 MHz	1	450	2.12	-	-	56.33	0.9601	-
System Check 07-06-13	21	CW 450 MHz	1	450	2.14	-	-	56.92	0.9591	-

Table: SAR MEASUREMENT RESULTS – Body Worn positions Antenna Helical

Test Position	Plot No.	Test Ch.	Test Mode	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured 1g SAR Results 50% Duty Cycle (mW/g)	Measured Drift (dB)	∈r (target 56.7 ±5% (53.9–59.5)	σ (target 0.94 ±5% (0.89–0.99)	Measured RF Power (dBm)
Body Battery Clip 16 Key 07-06-13	22	CW	3	438.1	5.24	2.62	-0.1	57.16	0.9478	36.24
Body Nylon Case Battery Clip 16 Key 07-06-13	23	CW	3	438.1	5.47	2.735	-0.11	57.16	0.9478	36.23
Body Nylon Case Belt Loop 16 Key 07-06-13	24	CW	3	438.1	5.38	2.69	-0.1	57.16	0.9478	36.19
Body Nylon Case D-Stud Spring Clip 16 Key 07-06-13	25	CW	3	438.1	3.86	1.93	-0.14	57.16	0.9478	36.20
Body Nylon Case D-Stud Belt Loop 16 Key 07-06-13	26	CW	3	438.1	1.85	0.925	-0.1	57.16	0.9478	36.24
Body Soft Leather Case Battery Clip 16 Key 07-06-13	27	CW	3	438.1	5.46	2.73	-0.11	57.16	0.9478	36.21
Body Leather Case Spring Clip 16 Key 11-06-13	28	CW	3	438.1	4.14	2.07	-0.15	55.93	0.936	36.23
Body Leather Case D-Stud Spring Clip 16 Key 11-06-13	29	CW	3	438.1	3.41	1.705	-0.1	55.93	0.936	36.15
Body Leather Case D-Stud Belt Loop 16 Key 11-06-13	30	CW	3	438.1	1.59	0.795	-0.12	55.93	0.936	36.18
Body Leather Case Belt Loop 16 Key 11-06-13	31	CW	3	438.1	3.97	1.985	-0.11	55.93	0.936	36.19
System Check 11-06-13	32	CW 450 MHz	1	450	2.1	-	-	55.77	0.9476	-

Note: The uncertainty of the system (±23.9 %) has not been added to the results.
***High capacity battery option used*
The FCC SAR limit for occupational exposure is 8.0mW/g measured in a 1g cube of tissue.

10.0 COMPLIANCE STATEMENT

The TAIT Push to Talk Transceiver model TPDH5A was tested on behalf of TAIT Limited. It complied with the FCC SAR requirements. It also complied with IC RSS-102 requirements.

The highest measured SAR was 6.52 mW/g for a 1g cube. After extrapolating to a 50% duty cycle the highest measured SAR was 3.26 mW/g for a 1g cube. This value was measured in the “body worn” position with the Soft Leather Case with Battery Clip accessory (T03-00038-0021 with TPA-CA-201), and the Whip antenna, 16 Key Variant with DEAA (T03-00046-DEAA) Audio Accessory.

The conducted power of the highest measured SAR was 36.23dBm or 4.198W. The manufacturer’s maximum tune-up power is stated to be 4.32 W. The maximum tune-up tolerance is 4.32 / 4.198 = 1.029 times higher than the conducted power measured during the test.

Applying the tune-up tolerance procedures of KDB 447498 D01, the reported SAR value is 3.26 x 1.029 = **3.35 mW/g** which is below the limit of 8.0mW/g. The reported SAR level complied with the limit even taking into account the measurement uncertainty of 23.9 %.