MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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Dosimetric Assessment
Test Report
Class II Permissive Change

for the

Kenwood
TK-3200

Tested and Evaluated In Accordance With
FCC OET 65 Supplement C: 01-01

Prepared for

Kenwood Communications Corporation
3975 Johns Creek Court, Suite 300
Suwanee, GA 30024

Engineering Statement: The measurements shown in this report were made in accordance with the procedures specified in Supplement C to OET Bulletin 65 of the Federal Communications Commission (FCC) Guidelines [FCC 2001] for uncontrolled exposure. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment evaluated is capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1999.

SAR Evaluation
Class II Permissive Change

FCC ID: ALH36923130
APPLICANT: Kenwood

Applicant Name and Address: Kenwood Communications Corporation
3975 Johns Creek Court, Suite 300
Suwanee, GA 30024

Test Location: **MET Laboratories, Inc.**
4855 Patrick Henry Dr. Bldg #6
Santa Clara, CA 95054
USA

<table>
<tr><td>EUT:</td><td colspan="3">Kenwood TK-3200</td></tr>
<tr><td>Date of Receipt:</td><td colspan="3">April 3, 2006</td></tr>
<tr><td>Device Category:</td><td colspan="3">Licensed Non-Broadcast Transmitter Held to Face (TNF)</td></tr>
<tr><td>RF exposure environment:</td><td colspan="3">Controlled Exposure/Occupational</td></tr>
<tr><td>RF exposure category:</td><td colspan="3">Portable FM UHF PTT Radio Transceiver</td></tr>
<tr><td>Power supply:</td><td colspan="3">7.4 VDC Li-ion 2000mah KNB-45L</td></tr>
<tr><td>Antenna(s):</td><td colspan="3">170mm Whip
75mm Stubby</td></tr>
<tr><td>Production/prototype:</td><td colspan="3">Production</td></tr>
<tr><td>Modulation:</td><td colspan="3">FM</td></tr>
<tr><td>Duty Cycle:</td><td colspan="3">100%</td></tr>
<tr><td>TX Range:</td><td colspan="3">450-470 MHz</td></tr>
<tr><td>Maximum Tested RF Output Power in CW Mode:</td><td>460 MHz</td><td>Peak Conducted</td><td>32.7dBm</td></tr>
<tr><td>Maximum SAR Measurement @ 50% Duty Cycle:</td><td>Body: 2.40mW/g</td><td colspan="2">Head: 1.72mW/g</td></tr>
</table>


Shawn McMillen

INTRODUCTION

This measurement report demonstrates that the Kenwood TK-3200 FCC ID: ALH36923130 described within this report complies with the Specific Absorption Rate (SAR) RF exposure requirements specified in ANSI/IEEE Std. C95.1-1999 and FCC 47 CFR §2.1093 for the General Population / Uncontrolled Exposure environment. The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 were employed.

A description of the device under test, device operating configuration and test conditions, measurement and site description, methodology and procedures used in the evaluation, equipment used, detailed summary of the test results and the various provisions of the rules are included in this dosimetric assessment test report.

SAR DEFINITION

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (*dU*) absorbed by (dissipated in) an incremental mass (*dm*) contained in a volume element (*dV*) of a given density (*ρ*). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1).

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

Figure 1.1
SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \sigma E^2 / \rho$$

where:

σ - conductivity of the tissue - simulant material (S/m)
ρ - mass density of the tissue - simulant material (kg/m3)
E - Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

DESCRIPTION OF DEVICE UNDER TEST (EUT)

Applicant:	Kenwood		
Description of Test Item:	Portable FM UHF PTT Radio Transceiver		
FCC ID:	ALH36923130		
Model Number:	TK-3200		
Serial Number:	N/A		
Battery Type(s) Tested:	7.4 VDC Li-ion 2000mah KNB-45L		
Antenna Type(s) Tested:	170mm Whip 75mm Stubby		
Tested Body Worn Accessories:	Plastic Belt Clip Head Set		
Maximum Duty Cycle Tested:	100%		
Transmitter Frequency Range (MHz):	450 - 470 MHz		
Tested Frequencies (MHz):	460 MHz		
Maximum Tested RF Power Output CW Mode:	460 MHz	Peak Conducted	32.7dBm
Maximum SAR Measurement @ 50% Duty Cycle:	Body: 2.40mW/g	Head: 1.72mW/g	
Application Type:	Certification		
FCC Classification:	Licensed Non-Broadcast Transmitter Held to Face (TNF)		
Exposure Category:	Controlled Exposure/Occupational		
FCC Rule Part(s):	FCC 47 CFR §2.1093,		
Standards:	IEEE Std. 1528-2003, FCC OET Bulletin 65, Supplement C, Edition 01-01		

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SAR MEASUREMENT SYSTEM

MET Laboratories, Inc SAR measurement facility utilizes the DASY4 Professional Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland for performing SAR compliance tests. The DASY4 measurement system is comprised of the measurement server, robot controller, computer, near-field probe, probe alignment sensor, specific anthropomorphic mannequin (SAM) phantom, and various planar phantoms for brain and/or body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). The Cell controller system contain the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the DASY4 measurement server. The DAE4 utilizes 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.

Transmission to the DASY4 measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

MEASUREMENT SUMMARY

FACE-HELD SAR MEASUREMENT RESULTS 450MHz Band ANSI/IEEE C95.1 1999 – SAFETY LIMIT HEAD: 8.0 W/kg (averaged over 1 gram) Spatial Peak – Controlled Exposure/Occupational												
Freq (MHz)	**Chan**	**Cond. Power Before (dBm)**	**Cond. Power After (dBm)**	**Battery Type**	**Antenna Type**	**Sep Dist (cm)**	**Test Pos**	**Accessory**	**SAR over 1g**	**Drift (dB)**	**Adjusted SAR Over 1g**	
											Duty Cycle	
											100%	**50%**
460	Mid	32.9	32.8	Li-ion	Stubby	2.5	Face Held	None	2.92	-0.254	3.44	1.72
460	Mid	32.9	32.8	Li-ion	Whip	2.5	Face Held	None	1.56	-0.235	2.21	1.10

Measured Mixture Type	450 MHz Head		**Date Tested**	April 3, 2006
Dielectric Constant εr	**IEEE Target**	**Measured**	**Relative Humidity**	42%
	43.5	45.5	**Ambient Temperature (C)**	22.7
Conductivity σ (mho/m)	**IEEE Target**	**Measured**	**Fluid Temperature (C)**	21.6
	0.87	0.83	**Fluid Depth**	≥15cm

BODY-WORN SAR MEASUREMENT RESULTS 450MHz Band ANSI/IEEE C95.1 1999 – SAFETY LIMIT BODY: 8.0 W/kg (averaged over 1 gram) Spatial Peak – Controlled Exposure/Occupational												
Freq (MHz)	**Chan**	**Cond. Power Before (dBm)**	**Cond. Power After (dBm)**	**Battery Type**	**Antenna Type**	**Sep Dist (cm)**	**Test Pos**	**Accessory**	**SAR over 1g 100% Duty cycle**	**Drift (dB)**	**Adjusted SAR due to drift Over 1g**	
											Duty Cycle	
											100%	**50%**
460	Mid	32.9	32.7	Li-ion	Stubby	1.1	Body	Head Set/ Belt Clip	4.35	-0.306	4.81	2.40
460	Mid	32.9	32.7	Li-ion	Whip	1.1	Body	Head Set/ Belt Clip	1.98	-0.335	2.81	1.40

Measured Mixture Type	450 MHz Body		**Date Tested**	April 3, 2006
Dielectric Constant εr	**IEEE Target**	**Measured**	**Relative Humidity**	42%
	56.7	57.2	**Ambient Temperature (C)**	22.6
Conductivity σ (mho/m)	**IEEE Target**	**Measured**	**Fluid Temperature (C)**	22.0
	0.94	0.90	**Fluid Depth**	≥15cm

DETAILS OF SAR EVALUATION

The Kenwood TK-3200 FCC ID: ALH36923130 was determined to be compliant for localized Specific Absorption Rate based on the test provisions and conditions described below. Detailed test setup photographs are shown in the Appendix.

1. The configurations which produced the highest SAR values during the original evaluation were repeated using the Li-ion battery.

2. The EUT was tested for body-worn SAR with a belt-clip accessory. The belt-clip provided 1.1cm separation between the back of the EUT and the outer surface of the planar phantom.

3. The EUT was tested for face-held configurations with the front of the EUT facing the planar phantom. The EUT was placed at a separation distance of 2.5cm from the outer surface of the phantom.

4. The device was positioned next to the phantom surface using either the DASY device positioner or low-loss polystyrene.

5. The EUT was tested at a 100% duty cycle in CW mode. The SAR values were scaled to account for any negative drift which occurred over the course of the test. A 50% duty cycle was applied to the final SAR values based on an equal transmit and receive time.

6. A SAR versus time sweep was carried out on the configuration that produced the highest measured SAR. The probe was positioned at the power measurement reference position.

7. The conducted power levels were measured before and after each test using a HP E4418B Power Meter according to the procedures described in FCC 47 CFR 2.1046. The EUT was set to the maximum power level for each SAR evaluation.

8. The SAR evaluations were performed with a fully charged battery.

9. The fluid temperature was measured prior to and after each SAR evaluation to ensure the temperature remained within ±2 deg C of the temperature of the fluid when the dielectric properties were measured.

10. The dielectric parameters of the simulated body fluid were measured prior to the evaluation using an 85070D Dielectric Probe Kit and an 8722D Network Analyzer.

11. During the SAR evaluations if a distribution produced several hotspots over the course of the area scan, each hotspot was evaluated separately.

EVALUATION PROCEDURES

The evaluation was performed in the applicable area of the phantom depending on the type of device being tested.

(i) For devices held to the ear during normal operation, both the left and right ear positions were evaluated using the SAM phantom.
(ii) For body-worn and face-held devices a planar phantom was used.

The SAR was determined by a pre-defined procedure within the DASY4 software. Upon completion of a reference check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 15mm x 15mm.

An area scan was determined as follows:

Based on the defined area scan grid, a more detailed grid is created to increase the points by a factor of 10. The interpolation function then evaluates all field values between corresponding measurement points.

A linear search is applied to find all the candidate maxima. Subsequently, all maxima are removed that are >2 dB from the global maximum. The remaining maxima are then used to position the cube scans.

A 1g and 10g spatial peak SAR was determined as follows:

Based on the area scan, a 32mm x 32mm x 34mm (7x7x7 data points) zoom scan was assessed at the position where the greatest V/m was detected. The data at the surface was extrapolated since the distance from the probes sensors to the surface is 3.9cm. A least squares fourth-order polynomial was used to generate points between the probe detector and the inner surface of the phantom.

Interpolated data is used to calculate the average SAR over 1g and 10g cubes by spatially discretizing the entire measured cube. The volume used to determine the averaged SAR is a 1mm grid (42875 interpolated points).

Z-Scan was determined as follows:

The Z-scan measures points along a vertical straight line. The line runs along a line normal to the inner surface of the phantom surface.

DATA EVALUATION PROCEDURES

The DASY4 post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe Parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion Factor	$ConvF_i$
	- Dipole Compression Point	dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC - transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = Compensated signal of channel i (i = x, y, z)
U_i = Input signal of channel i (i = x, y, z)
cf = Crest factor of exciting field (DASY parameter)
dcp_i = Diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E}-\text{fieldprobes}: \quad E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

$$\text{H}-\text{fieldprobes}: \quad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

with V_i = Compensated signal of channel i (i = x, y, z)
$Norm_i$ = Sensor sensitivity of channel i (i = x, y, z)
$\mu V/(V/m)^2$ for E-field probes
$ConvF$ = Sensitivity enhancement in solution
a_{ij} = Sensor sensitivity factors for H-field probes
f = Carrier frequency (GHz)
E_i = Electric field strength of channel i in V/m
H_i = Magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

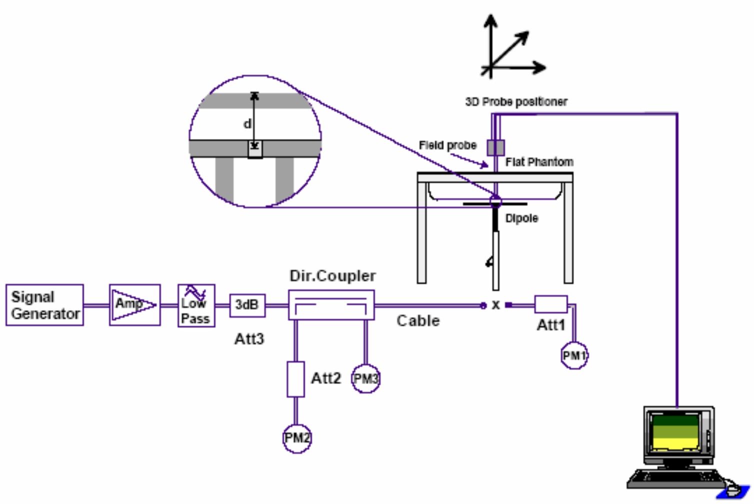
with P_{pwe} = Equivalent power density of a plane wave in mW/cm2
E_{tot} = total electric field strength in V/m
H_{tot} = total magnetic field strength in A/m

SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluation a system check was performed with a 450 MHz dipole using the validation phantom. The dielectric parameters of the simulated brain fluid were measured prior to the system performance check using an 85070C Dielectric Probe Kit and an 8722D Network Analyzer. A forward power of 250mW was applied to the dipole and the system was verified to a tolerance of ±10%.

Test Date	450MHz Equivalent Tissue	SAR 1g (W/kg)		Permittivity Constant εr		Conductivity σ (mho/m)		Ambient Temp. (C)	Fluid Temp. (C)	Fluid Depth (cm)
		Calibrated Target	Measured	IEEE Target	Measured	IEEE Target	Measured			
04/03/06	Head	1.32±5%	1.27	43.5 ±5%	45.7	0.87±10%	0.83	23.0	22.0	≥15

Note: The ambient and fluid temperatures were measured prior to the fluid parameter check and the system performance check. The temperatures listed in the table above were consistent for all measurement periods.



SIMULATED EQUIVALENT TISSUES

Simulated Tissue Mixture		
Ingredient	**450MHz Head**	**450MHz Body**
Water	38.56%	52.00%
Sugar	56.32%	45.65%
Salt	3.95%	1.75%
HEC	0.98%	0.50%
Bactericide	0.19%	0.10%

SAR SAFETY LIMITS

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	**(Occupational / Controlled Exposure Environment)**
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)	4.0	20.0

Notes:

1. Uncontrolled exposure environments are locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.

2. Controlled exposure environments are locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

ROBOT SYSTEM SPECIFICATIONS

1.1. SPECIFICATIONS

Positioner:

Robot:	Staubli Unimation Corp. Robot Model: RX90
Repeatability:	0.02 mm
No. of axis:	6

1.2. DATA ACQUISITION ELECTRONIC (DAE) SYSTEM:

Cell Controller

Processor:	Compaq Evo Clock Speed:2.4 GHz Operating System: Windows XP Professional

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter, and control logic
Software:	DASY4 software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock

Dasy4 Measurement Server

Function:	Real-time data evaluation for field measurements and surface detection
Hardware:	PC/104 166MHz Pentium CPU; 32 MB chipdisk; 64 MB RAM
Connections:	COM1, COM2, DAE, Robot, Ethernet, Service Interface

E-Field Probe

Model:	ET3DV6
Serial No.:	1793
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

EX-Probe

Model:	EX3DV3
Serial No.	3511
Construction:	Triangular core
Frequency:	10 MHz to > 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

1.3. PHANTOM(S):

Validation & Evaluation Phantom

Type:	SAM V4.0C
Shell Material:	Fiberglass
Thickness:	2.0 ± 0.1 mm
Volume:	Approx. 20 liters

PROBE SPECIFICATIONS (ET3DV6)

Construction: Symmetrical design with triangular core
Built-in optical fiber for surface detection system
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g. glycolether)

Calibration: Basic Broadband calibration in air from 10 MHz to 3 GHz

Frequency: 10 MHz to 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)

Directivity: ± 0.2 dB in HSL (rotation around probe axis)
± 0.4 dB in HSL (rotation normal to probe axis)

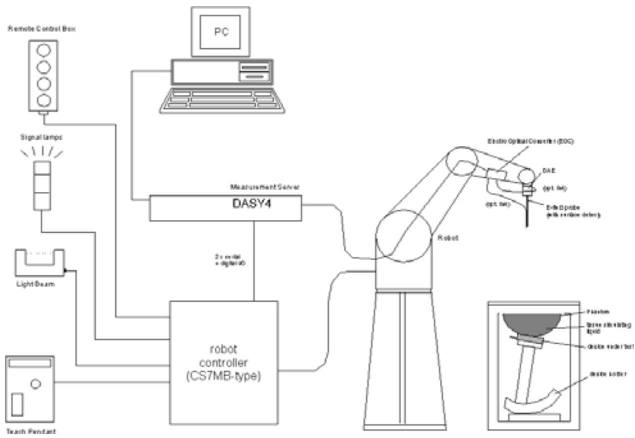
Dynamic Range: 5 µ W/g to > 100 mW/g; Linearity: ± 0.2 dB

Surface Detection: ± 0.2 mm repeatability in air and clear liquid over diffuse reflecting surfaces

Dimensions: Overall length: 330 mm (Tip: 16 mm)
Tip diameter (including protective cover): 6.8 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 2.7 mm

Application: General dosimetric measurements up to 3 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms

SAR Measurement System



Measurement System Diagram

1.4. RX90BL ROBOT

The Stäubli RX90BL Robot is a standard high precision 6-axis robot with an arm extension for accommodating the data acquisition electronics (DAE).

1.5. ROBOT CONTROLLER

The CS7MB Robot Controller system drives the robot motors. The system consists of a power supply, robot controller, and remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.

1.6. LIGHT BEAM SWITCH

The Light Beam Switch (Probe alignment tool) allows automatic ”tooling” of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

1.7. DATA ACQUISITION ELECTRONICS

The Data Acquisition Electronics consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain switching multiplexer, a fast 16-bit A/D converter and a command decoder and control logic unit. Some of the task the DAE performs is signal amplification, signal multiplexing, A/D conversion, and offset measurements. The DAE also contains the mechanical probe-mounting device, which contains two different sensor systems for frontal and sideways probe contacts used for probe collision detection and mechanical surface detection for controlling the distance between the probe and the inner surface of the phantom shell. Transmission from the DAE to the measurement server, via the EOC, is through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

1.8. **ELECTO-OPTICAL CONVERTER (EOC)**

The Electro-Optical Converter performs the conversion between the optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC connects to, and transfers data to, the DASY4 measurement server. The EOC also contains the fiber optical surface detection system for controlling the distance between the probe and the inner surface of the phantom shell.

1.9. **MEASUREMENT SERVER**

The Measurement Server performs time critical tasks such as signal filtering, all real-time data evaluation for field measurements and surface detection, controls robot movements, and handles safety operation. The PC-operating system cannot interfere with these time critical processes. A watchdog supervises all connections, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements.

1.10. **DOSIMETRIC PROBE**

Dosimetric Probe is a symmetrical design with triangular core that incorporates three 3 mm long dipoles arranged so that the overall response is close to isotropic. The probe sensors are covered by an outer protective shell, which is resistant to organic solvents i.e. glycol. The probe is equipped with an optical multi-fiber line, ending at the front of the probe tip, for optical surface detection. This line connects to the EOC box on the robot arm and provides automatic detection of the phantom surface. The optical surface detection works in transparent liquids and on diffuse reflecting surfaces with a repeatability of better than ±0.1mm.

1.11. **SAM PHANTOM**

The SAM (Specific Anthropomorphic Mannequin) twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm) integrated into a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left hand, right hand phone usage as well as body mounted usage at the flat phantom region. The flat section is also used for system validation and the length and width of the flat section are at least 0.75 λO and 0.6 λO respectively at frequencies of 824 MHz and above (λO = wavelength in air).

Reference markings on the phantom top allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. A white cover is provided to cover the phantom during off-periods preventing water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible. The phantom is filled with a tissue simulating liquid to a depth of at least 15 cm at each ear reference point. The bottom plate of the wooden table contains three pair of bolts for locking the device holder.

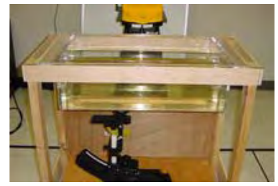
1.12. **PLANAR PHANTOM**

The planar phantom is constructed of Plexiglas material with a 2.0 mm shell thickness for face-held and body-worn SAR evaluations of handheld radio transceivers. The outer dimensions of the planar phantom are 50cm x 50cm x 23cm. The planar phantom is mounted on the wooden table of the DASY4 system.

1.13. **VALIDATION PLANAR PHANTOM**

The validation planar phantom is constructed of Plexiglas material with a 6.0 mm shell thickness for system validations at 450MHz and below. The validation planar phantom is mounted on the wooden table of the DASY4 system.

1.14. SPLIT PLANAR PHANTOM



The Split Planar Phantom is constructed of Plexiglas material with a 2.0 mm shell thickness for face-held and body-worn SAR evaluations of handheld radio transceivers. The outer dimensions of each cell are 70cm x 20cm x 23cm and each side is separated by a 2.0mm Plexiglas wall. The Split Planar Phantom is mounted on the wooden table of the DASY4 system.

1.15. DEVICE HOLDER

The device holder is designed to cope with the different measurement positions in the three sections of the SAM phantom given in the standard. It has two scales, one for device rotation (with respect to the body axis) and one for device inclination (with respect to the line between the ear openings). The rotation center for both scales is the ear opening, thus the device needs no repositioning when changing the angles. The plane between the ear openings and the mouth tip has a rotation angle of 65°.

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

The dielectric properties of the liquid conform to all the tabulated values [2-5]. Liquids are prepared according to Annex A and dielectric properties are measured according to Annex B.

1.16. SYSTEM VALIDATION KITS

Power Capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Construction: Symmetrical dipole with l/4 balun Enables measurement of feed point impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 300, 450, 835, 1900, 2450 MHz

Return loss: >20 dB at specified validation position

Dimensions:
300 MHz Dipole: Length: 396mm; Overall Height:430 mm; Diameter: 6 mm
450 MHz Dipole: Length: 270 mm; Overall Height: 347 mm; Diameter: 6 mm
835 MHz Dipole: Length: 161 mm; Overall Height: 270 mm; Diameter: 3.6 mm
1900 MHz Dipole: Length: 68 mm; Overall Height: 219 mm; Diameter: 3.6 mm
2450 MHz Dipole: Length: 51.5 mm; Overall Height: 300 mm; Diameter: 3.6 mm

TEST EQUIPMENT LIST

Test Equipment	Serial Number	Calibration Date
DASY4 System Robot ETVDV6 EX3DV3 DAE3 300MHz Dipole 450MHz Dipole 835MHz Dipole 1900MHz Dipole 2450MHz Dipole SAM Phantom V4.0C EUT Planar Phantom Validation Phantom	 FO3/SX19A1/A/01 1793 3511 584 003 004 493 001 002 N/A N/A N/A	 N/A Sept 2005 Jan 2006 Sept 2005 Dec 2004 Dec 2004 Sept 2005 June 2004 June 2004 N/A N/A N/A
85070D Dielectric Probe Kt	N/A	N/A
83650B Signal Generator	3844A00910	June 2005
HP E4418B Power Meter	GB40205140	June 2005
HP 8482A Power Sensor	2607A11286	June 2005
HP 8722D Vector Network Analyzer	3S36140188	March 2006
Anritsu Power Meter	6K00001832	June 2005
Anritsu Power Sensor	030864	Jan 2006
Mini-Circuits Power Amplifier	D111903#8	N/A

MEASUREMENT UNCERTANTIES

UNCERTAINTY ASSESSMENT FOR EUT

Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty ±% (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.6	Rectangular	√3	(1-cp)1/2	± 1.9	∞
Spherical isotropy of the probe	± 9.7	Rectangular	√3	(cp)1/2	± 3.9	∞
Boundary effects	± 8.5	Rectangular	√3	1	± 4.8	∞
Probe linearity	± 4.5	Rectangular	√3	1	± 2.7	∞
Detection limit	± 0.9	Rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.9	Rectangular	√3	1	± 0.5	∞
Integration time	± 1.2	Rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 0.54	Rectangular	√3	1	± 0.43	∞
Mech. constraints of robot	± 0.5	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 2.7	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 4.0	Rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 2.2	Normal	1	1	± 2.23	11
Device holder uncertainty	± 5.0	Normal	1	1	± 5.0	7
Power drift	± 5.0	Rectangular	√3		± 2.9	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	√3	0.6	± 3.5./1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 12.14/11.76	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty (k=2)					± 24.29/23.51	

Table: Worst-case uncertainty for DASY4 assessed according to IEEE P1528.
The budget is valid for the frequency range 300MHz to 6GHz and represents a worst-case analysis.

UNCERTAINTY ASSESSMENT FOR SYSTEM VALIDATION

Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty ±% (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	√3	(1-cp)1/2	± 2.7	∞
Spherical isotropy of the probe	± 9.6	Rectangular	√3	(cp)1/2	± 3.8	∞
Boundary effects	± 1.0	Rectangular	√3	1	± 0.0	∞
Probe linearity	± 4.7	Rectangular	√3	1	± 3.2	∞
Detection limit	± 1.0	Rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	√3	1	± 0.5	∞
Integration time	± 1.3	Rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 3.0	Rectangular	√3	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 1.4	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 4.0	Rectangular	√3	1	± 2.3	∞
Dipole						
Dipole Axis to liquid distance	± 2.0	Normal	1	1	± 1.2	11
Input Power	± 5.0	Normal	1	1	± 2.7	7
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 9.8	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty (k=2)					± 19.7	

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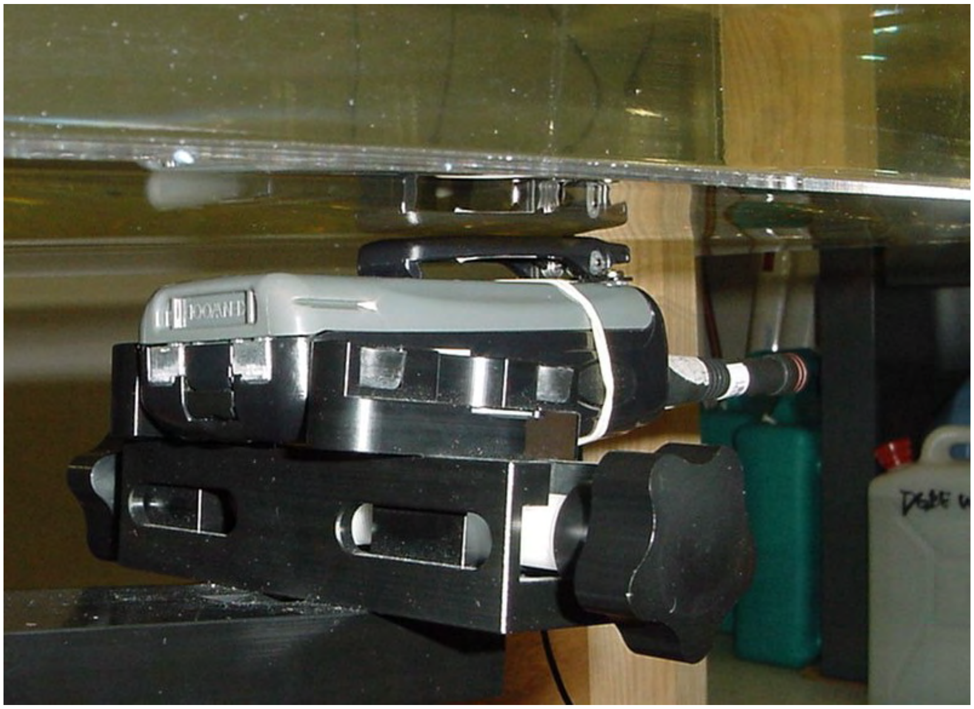
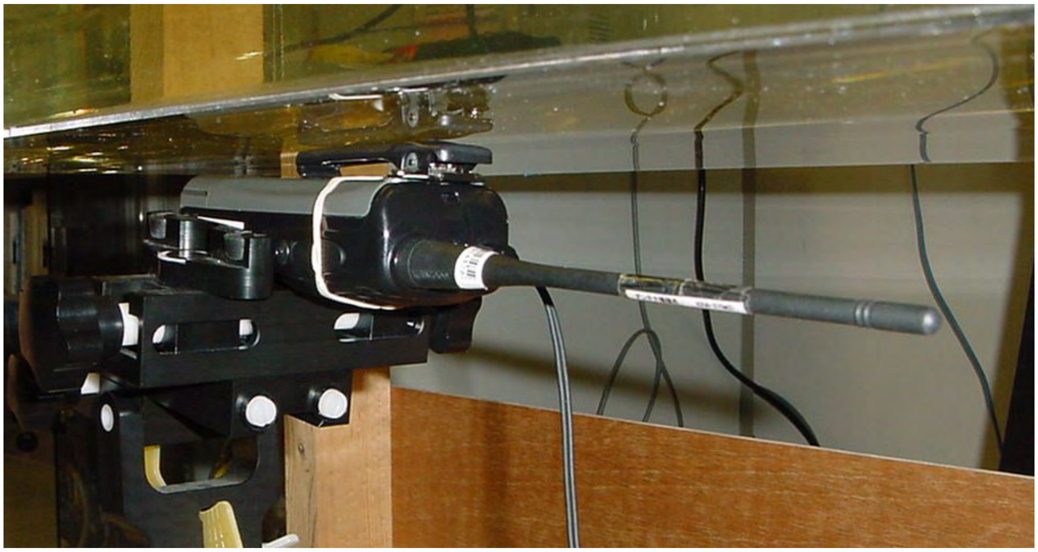
Test Setup Photos

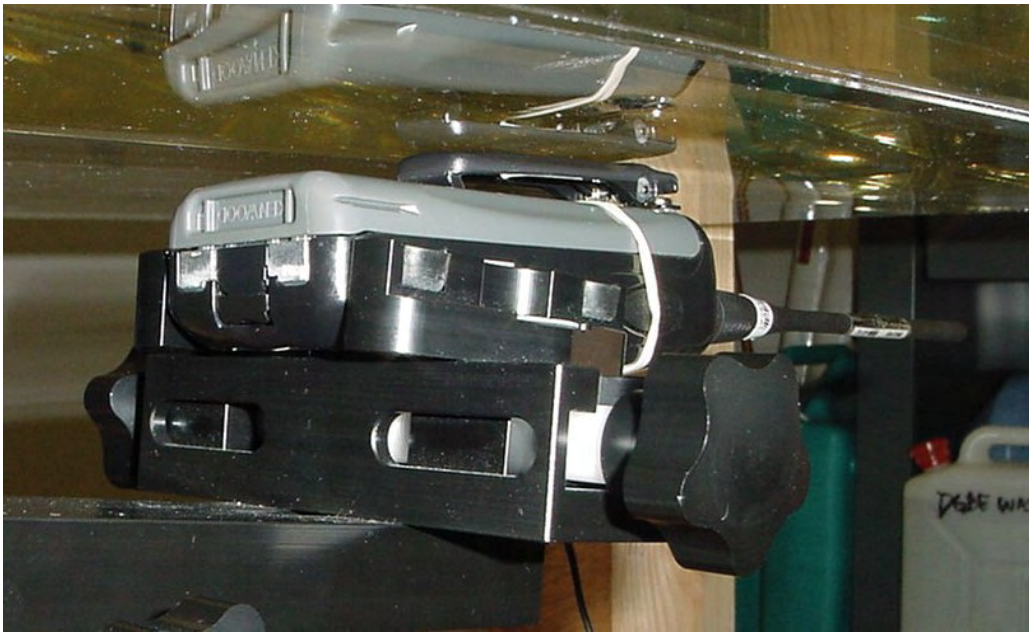


Photograph 1. Body Worn Position with Stubby Antenna

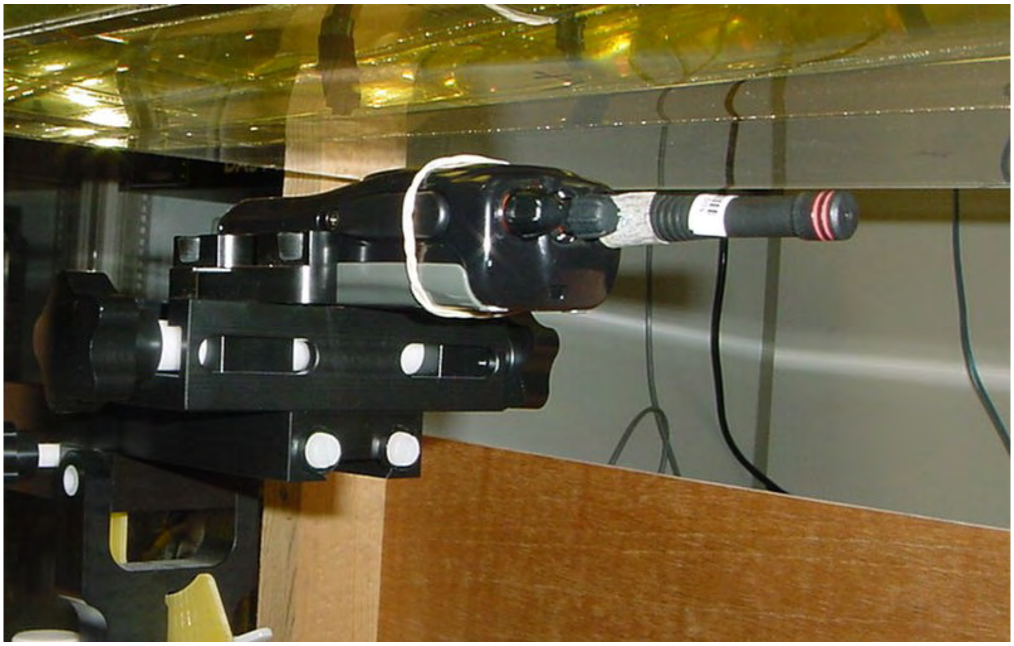
Photograph 2. Body Worn Position with Stubby Antenna



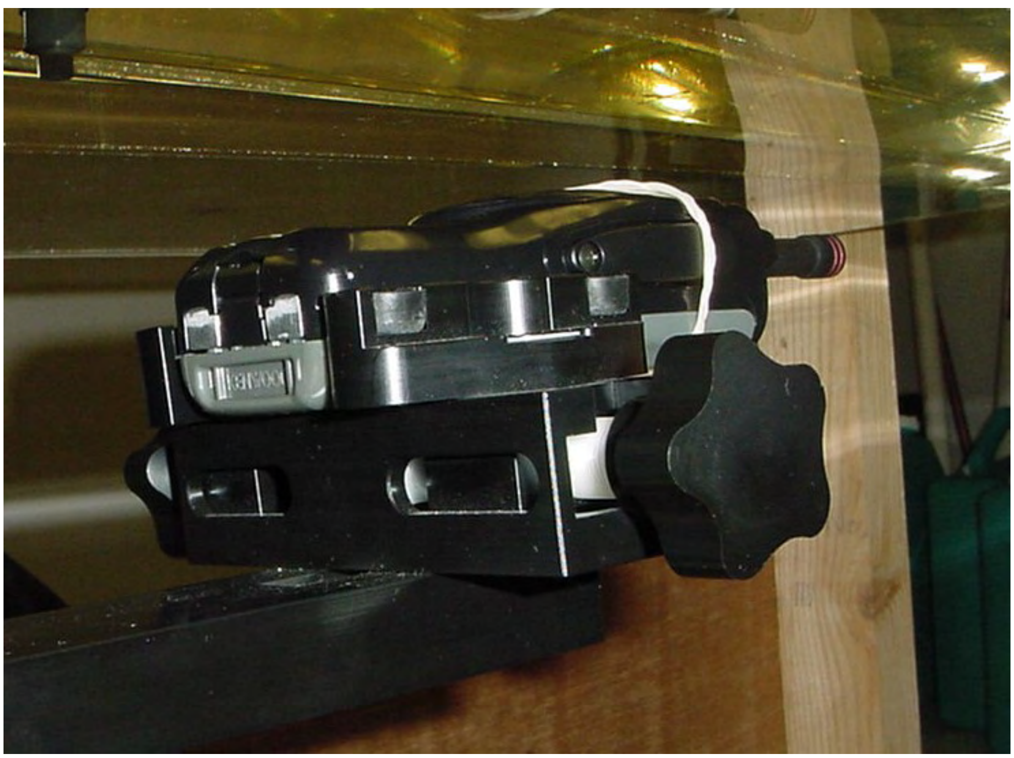
Photograph 3. Body Worn Position with Whip Antenna



Photograph 4. Body Worn Position with Whip Antenna

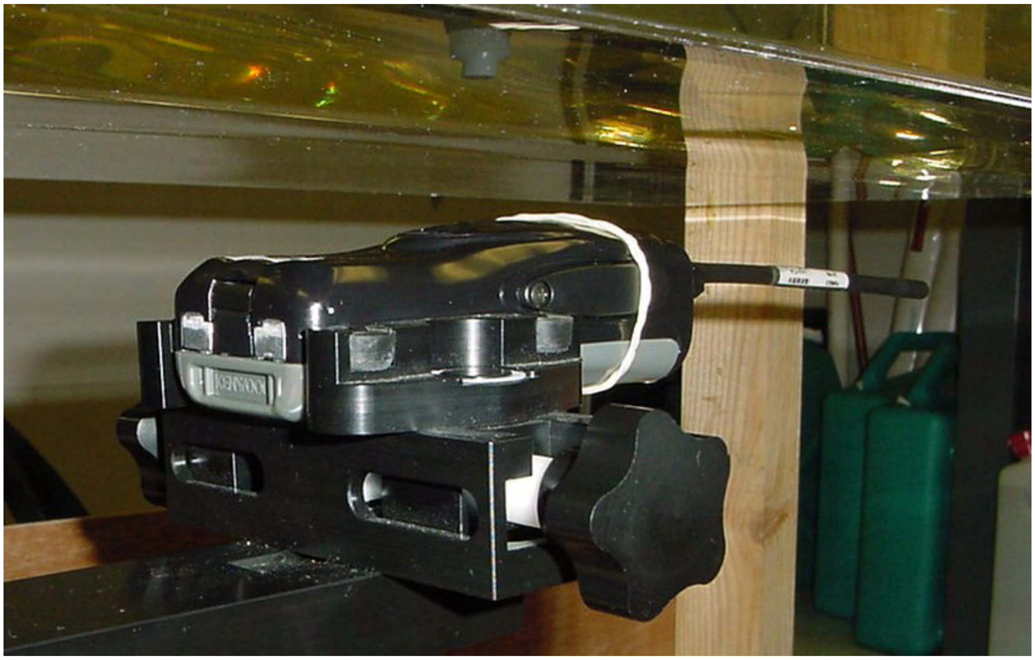


Photograph 5. Face Held at 2.5cm Separation with Stubby Antenna



Photograph 6. Face Held at 2.5cm Separation with Stubby Antenna

Photograph 7. Face Held at 2.5cm Separation with Whip Antenna



Photograph 8. Face Held at 2.5cm Separation with Whip Antenna

External Photos

Photograph 9. Exploded View of TK-3200 and KNB-45L Battery

Photograph 10. TK-3200 with Stubby and Whip Antennas

Photograph 11. TK-3200 Label

Photograph 12. TK-3200 Whip and Stubby Antennas

Photograph 13. TK-3200 Speaker Microphone

