TÜV AMERICA

EMC - TEST REPORT
UNITED STATES STANDARD 47 CFR PART 15, SUBPART B

Test Report File No.	:	**SC504972-06** Date of Issue: 03 October 2005
Model / Serial No.	:	**0001-1103 / G140410373**
Product Type	:	Hand Held Unit - Contactless Smart Card Reader Integrated with PDA
Applicant	:	CUBIC TRANSPORTATION SYSTEMS INCORPORATED
Manufacturer	:	CUBIC TRANSPORTATION SYSTEMS INCORPORATED
License holder	:	CUBIC TRANSPORTATION SYSTEMS INCORPORATED
Address	:	5650 Kearney Mesa Road
	:	San Diego, CA 92111
Test Result	:	■ **Positive** ☐ **Negative**
Test Project Number Reference(s)	:	**SC504972-06**
Total pages - Test Report	:	31

NOTE: All test equipment used during testing is calibrated and traceable to NIST.

TÜV America, Inc. and its professional staff hold government and professional organization certifications and are members of AAMI, ACIL, AEA, ANSI, IEEE, NVLAP, and VCCI

TÜV AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 678 1400 FAX 858 546 0364

DIRECTORY
Test Report

Technical Documentation

Appendices

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TEST REGULATIONS:

The tests were performed according to the following regulations:

☐ - EN 50081-1: 1991

☐ - EN 55011: 1998, Amendment A2: 2002 ☐ - Group 1 ☐ - Group 2
☐ - Class A ☐ - Class B

☐ - EN 55013: 1990

☐ - EN 55014: 1993 ☐ - Household appliances and similar
☐ - Portable tools
☐ - Semiconductor devices

☐ - EN 55022: 1987 ☐ - Class A ☐ - Class B

☐ - EN 55022: 1998, Amendment A2: 2003 ☐ - Class A ☐ - Class B

☐ - VCCI ☐ - Class A ITE ☐ - Class B ITE

☐ - CNS 13438: 1994 ☐ - Class A ☐ - Class B

■ - 47 CFR Part 15, Subpart B

☐ - 107(b)
■ - 107(a)

☐ - 109(b)
■ - 109(a)
☐ - 109(g) ☐ - Class A ☐ - Class B

☐ - AS/NZS 3548: 1995 ☐ - Class A ☐ - Class B

☐ - CISPR 11: 1997 ☐ - Group 1 ☐ - Group 2
☐ - Class A ☐ - Class B

☐ - CISPR 22: 1997 ☐ - Class A ☐ - Class B

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Environmental Conditions In The Laboratory:

	Actual
Temperature	: 22-24 °C
Relative Humidity	: 22-47 %
Atmospheric Pressure	: 99.5 kPa

Power Supply Utilized:

Power supply system	: 115 V / 60 Hz / 1ϕ

Symbol Definitions:

■ - Applicable
☐ - Not Applicable

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Details of Test Procedures:

General Standard Information

The test methods used comply with ANSI C63.4-1993 -"Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted Emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω/50 μH (CISPR 16) characteristics. Tabletop equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with the peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated Emissions from the EUT are measured in the frequency range of 30 MHz to 22 GHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Tabletop equipment is placed on a 1.0 x 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 10 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.

Field Strength Calculation:

The field strength is calculated by adding the Antenna and Cable Factor to the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor

Assume a receiver reading of 27 dBμV is obtained. The Antenna and Cable Factor of 14 is added, giving a field strength of 41 dBμV/m. The 41 dBμV/m value was mathematically converted to its corresponding level in μV/m.

FS = 27 + 14 = 41 dBμV/m

Level in μV/m = Common Antilogarithm [(41 dBμV/m)/20]= 112 μV/m

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Test Conditions: CONDUCTED EMISSIONS (Interference Voltage)

The CONDUCTED EMISSIONS (Interference Voltage) measurements were performed in the following location at the San Diego Testing Facility:

☐ **- Test not applicable**

■ - SR-3, Shielded Room, 12' x 20' x 8', Metal Chamber

Test Equipment Used:

Model No.	Prop. No.	Description	Manufacturer	Serial No.	Date Cal'ed
9252-50-R-24-BNC	457	LISN, 50 μH /250 μH/50 Ω/ 0.25 μF	Solar Electronics Co.	941720	07/05
ESHS 20	428	EMI Test Receiver	Rhode & Schwarz	837055/001	03/05
CAT-20	613	20 dB Attenuator	Mini-Circuits	--	Verified

Remarks: One year calibration cycle for all test equipment and sites.

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Test Conditions: RADIATED EMISSIONS (Electric Field)

The RADIATED EMISSIONS (Electric Field) measurements were performed in the following location at the San Diego Testing Facility:

☐ **- Test not applicable**

■ - Canyon #1 (10- and 30-Meter Open Area Test Site), Carroll Canyon, San Diego
(Date of listing Aug. 29, 2003. Site Verification Valid for 3 years from listing.)

Testing was performed at a test distance of:

■ - 10 meters

Test Equipment Used:

Model No.	Prop. No.	Description	Manufacturer	Serial No.	Date Cal'ed
LPB 2520/A	738	Antenna, Bilog	Antenna Research	1169	02/05
ESVS 30	6723	EMI Test Receiver	Rhode & Schwarz	830350/006	03/05

Remarks: One year calibration cycle for all test equipment and sites.

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Equipment Under Test (EUT) Test Operation Mode:

The equipment under test was operated under the following conditions during testing:

☐ - Standby

☐ - Test Program (H - Pattern)

☐ - Test Program (Color Bar)

☐ - Test Program (Customer Specified)

☐ - Practice Operation

☐ - Normal Operating Mode

■ - Polling

Configuration of the equipment under test:

☐ - See Constructional Data Form in Appendix B

■ - See Product Information Form(s) in Appendix B

The following peripheral devices and interface cables were connected during the testing:

☐ - _____ Type: _____

☐ - _____ Type: _____

☐ - _____ Type: _____

☐ - _____ Type: _____

☐ - _____ Type: _____

☐ - _____ Type: _____

☐ - Unshielded power cable

☐ - Unshielded cables

☐ - Shielded cables MPS. No.: _____

☐ - Customer specific cables

☐ - _____

☐ - _____

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Test Results:

Conducted Emissions, 10/150 kHz - 30 MHz

■ - PASS ☐ - FAIL ☐ - NOT APPLICABLE

Minimum limit margin 11.3 dB at 20.5 MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (Electric Field), 30 MHz - 1000 MHz

■ - PASS ☐ - FAIL ☐ - NOT APPLICABLE

Minimum limit margin 5.5 dB at 41.6 MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

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GENERAL REMARKS:

NOTE: All photographs are representative of setup for maximum emissions.

SUMMARY:

All tests according to the regulations cited on page 3 were

■ - **Performed**

☐ - Performed with the following **exceptions**

The Equipment Under Test

■ - **Fulfills** the general approval requirements cited on page 3.

☐ - **Does not** fulfill the general approval requirements cited on page 3.

Statement of Measurement Uncertainty

The data and results referenced in this document are true and accurate. The measurement uncertainty is calculated to be ±2 dB for conducted emissions and ±4 dB for radiated emissions.

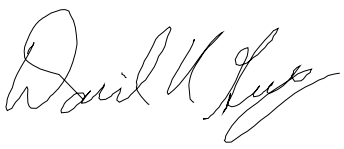
Equipment Received Date: 29 September 2005

Testing Start Date: 29 September 2005

Testing End Date: 29 September 2005

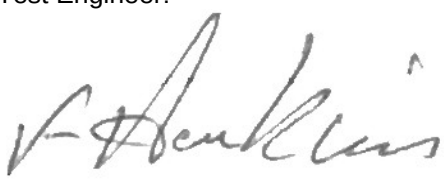
- TÜV AMERICA, INC. -

Reviewing Engineer:



David Gray
(EMC Engineer In Charge)

Test Engineer:



Frank Harkins
(EMC Engineer)

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Technical Documentation

Test Data Sheets

and

Test Setup Drawing(s)

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TUV America
Conducted Emissions

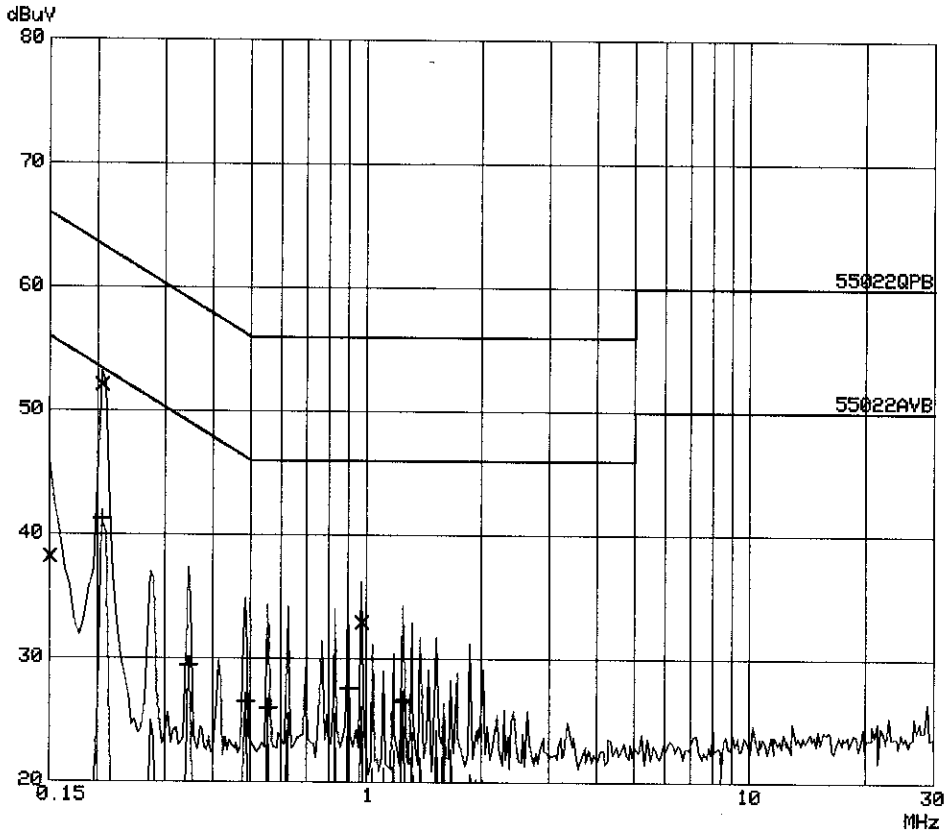
EUT:	HHU microreader
Manuf:	Cubic Trans
Op Cond:	Polling
Operator:	Frank Harkins
Test Spec:	EN55022 Class B
Comment:	115VAC 60Hz line1
	SC55022 B
Date:	29. Sep 05 09:27

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	1M	5k	10k	PK+AV	100ms	AUTO	LN OFF	60dB
1M	30M	5k	10k	PK+AV	2ms	AUTO	LN OFF	60dB

Transducer No.	Start	Stop	Name
1	10k	30M	20dBLISN

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 20dB



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TUV America
Conducted Emissions

EUT:	HHU microreader
Manuf:	Cubic Trans
Op Cond:	Polling
Operator:	Frank Harkins
Test Spec:	EN55022 Class B
Comment:	115VAC 60Hz line1
	SC55022 B
Date:	29. Sep 05 09:27

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	38.3	66.0
0.20500	52.1	63.4
0.97000	33.0	56.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.20500	41.3	53.4
0.34500	29.5	49.1
0.48500	26.5	46.3
0.55500	26.0	46.0
0.90000	27.6	46.0
1.24500	26.7	46.0
1.25000	26.5	46.0

* limit exceeded

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TUV America
Conducted Emissions

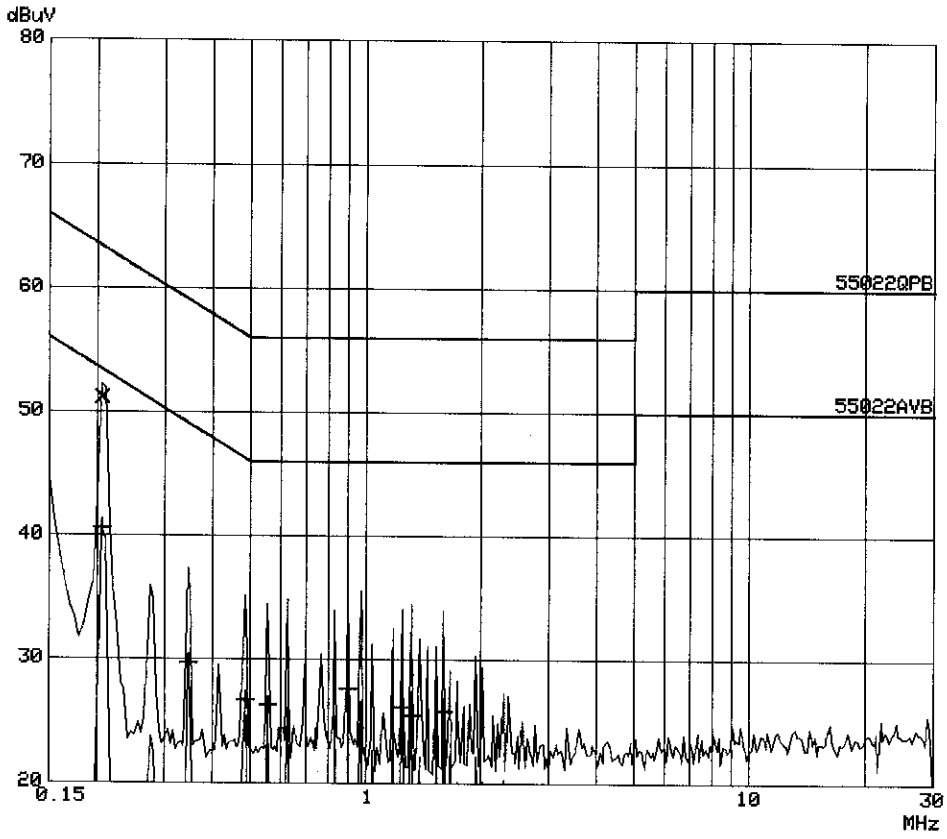
EUT:	HHU microreader
Manuf:	Cubic Trans
Op Cond:	Polling
Operator:	Frank Harkins
Test Spec:	EN55022 Class B
Comment:	115VAC 60Hz line2
	SC55022 B
Date:	29. Sep 05 09:35

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	1M	5k	10k	PK+AV	100ms	AUTO	LN OFF	60dB
1M	30M	5k	10k	PK+AV	2ms	AUTO	LN OFF	60dB

Transducer No.	Start	Stop	Name
1	10k	30M	20dBLISN

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 20dB



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TUV America
Conducted Emissions

EUT:	HHU microreader
Manuf:	Cubic Trans
Op Cond:	Polling
Operator:	Frank Harkins
Test Spec:	EN55022 Class B
Comment:	115VAC 60Hz line2
	SC55022 B
Date:	29. Sep 05 09:35

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.20500	51.2	63.4

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.20500	40.6	53.4
0.34500	29.8	49.1
0.48500	26.7	46.3
0.55500	26.3	46.0
0.90000	27.7	46.0
1.24500	26.2	46.0
1.31500	25.6	46.0
1.59500	25.9	46.0

* limit exceeded

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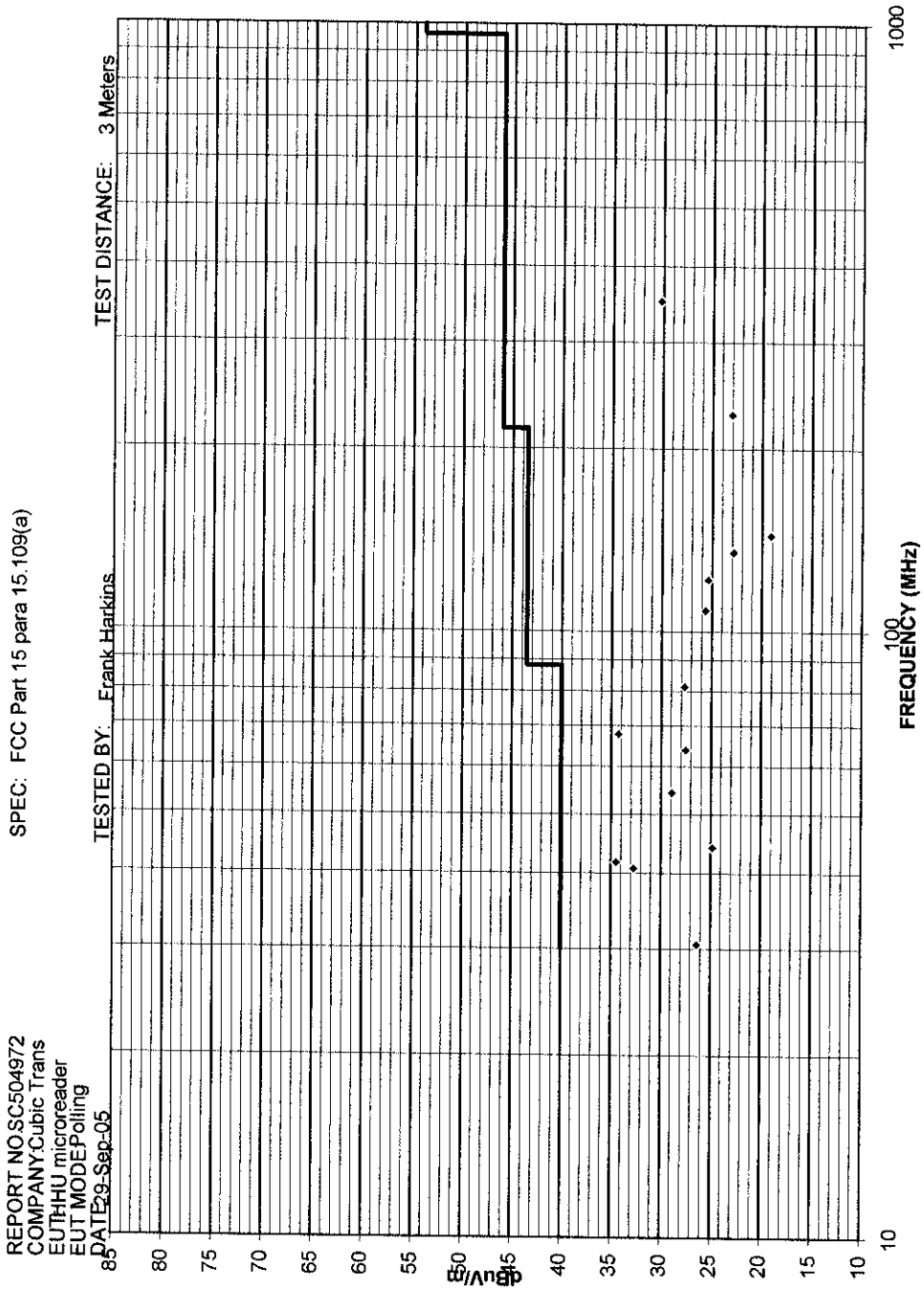

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REPORT No: SC504972 SPEC: FCC Part 15 para 15.109(a)

CUSTOMER: Cubic Trans TEST DIST: 10 Meters

E U T: HHU microreader TEST SITE: 1

EUT MODE: Polling BICONICAL: 738

DATE: 29-Sep-05 TESTED BY: Frank Harkins LOG PERIODIC: 738

NOTES: Quasi-Peak with 120 KHz measurement bandwidth. RCVR: 6723

Fundamental 13.56MHz

Temperature: 24 Relative Humidity: 47%

EUT MARGIN -5.5 dB at 41.6 MHz

ver 1.8b

FREQUENCY (MHz)	VERTICAL measured (dBuv)	HORIZONTAL measured (dBuV)	CORRECTION FACTOR (dB/m)	MAXIMUM CORRECTED (dBuV/m)	SPECIFIED LIMIT (dBuV/m)	EUT MARGIN (dB)	EUT ROTATION (degrees)	ANTENNA HEIGHT (meters)
30.50	6.1	5.6	20.3	**26.4**	40	-13.6	0	1
40.68	13.6	7.1	19.1	**32.7**	40	-7.3	90	1
41.60	15.6	15.6	18.9	**34.5**	40	-5.5	0	1
44.10	6.6	5.8	18.2	**24.8**	40	-15.2	0	1
54.24	13	7.4	15.9	**28.9**	40	-11.1	90	1
63.90	16.1	16	11.5	**27.6**	40	-12.5	0	1
67.80	24.2	15	10.1	**34.3**	40	-5.7	90	1
81.36	18.2	15.2	9.5	**27.7**	40	-12.3	90	1
108.48	12.2	9.2	13.4	**25.6**	43.5	-17.9	90	1
122.04	10.6	10.9	14.5	**25.4**	43.5	-18.1	90	1
135.60	8	9.8	13.1	**22.9**	43.5	-20.6	90	1
144.40	6.9	7.2	11.9	**19.1**	43.5	-24.4	0	1
228.00	7.3	7.3	15.7	**23.0**	46	-23.0	0	1
350.23	10.9	8.9	19.3	**30.2**	46	-15.8	180	1

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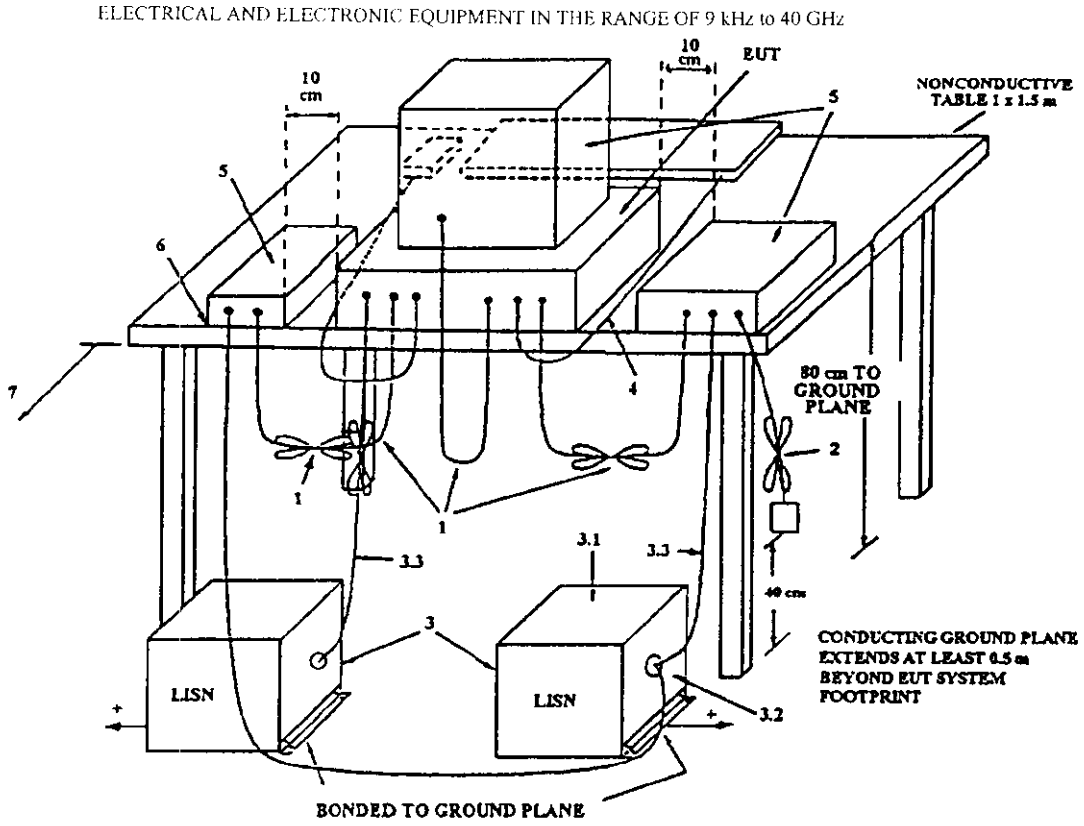
Conducted Emissions Test Setup, 0.15 to 30 MHz



LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.
2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.
3. EUT connected to one LISN. Unused LISN connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, ground plane.
   - 3.1 All other equipment powered from second LISN.
   - 3.2 Multiple outlet strip can be used for multiple power cords of non-EUT equipment.
   - 3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the controller.
5. Non-EUT components being tested.
6. Rear of EUT, including peripherals, shall be all aligned and flush with rear of tabletop.
7. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the floor ground plane.

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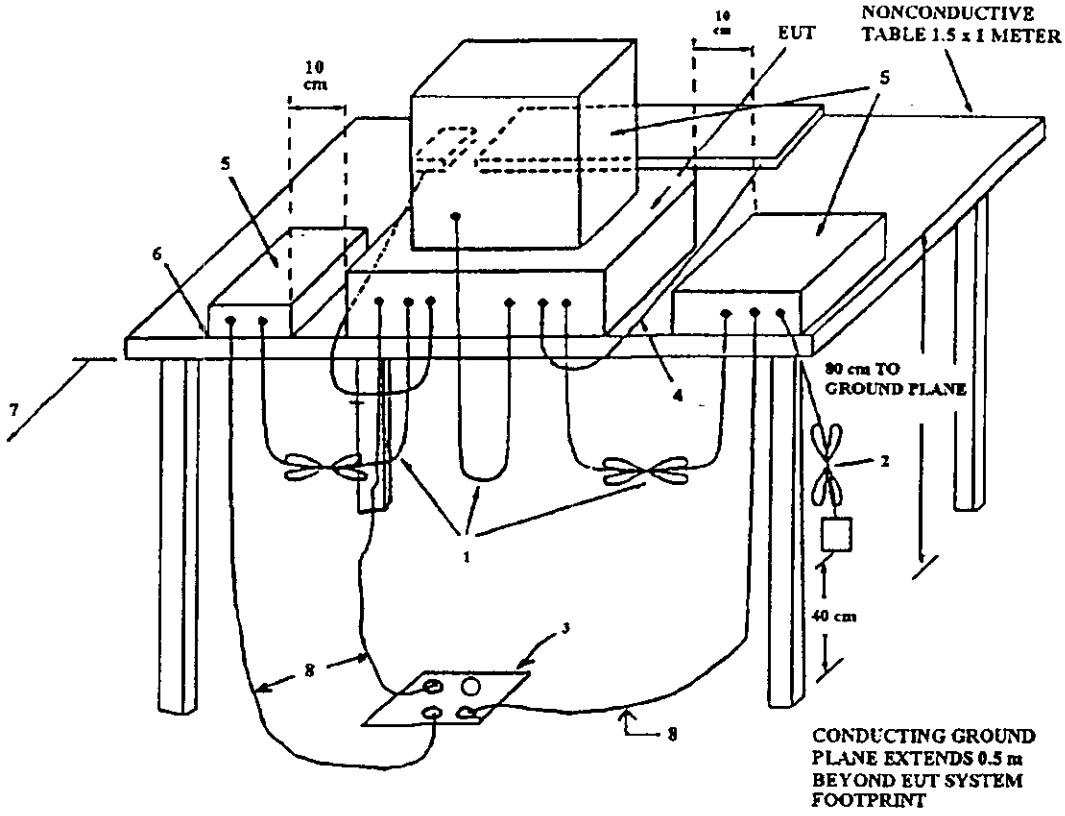
Radiated Emissions Test Setup, 30 to 1000 MHz



LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.
2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.
3. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptacle flush with the ground plane.
4. Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the controller.
5. Non-EUT components of EUT system being tested.
6. The rear of all components of the system under test shall be located flush with the rear of the table.
7. No vertical conducting wall used.
8. Power cords drape to the floor and are routed over to receptacle.

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Appendix A

Test Setups
(Photographs)

NOTE: All photographs are representative of setup for maximum emissions.

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Photograph of Test Setup:
Conducted Emissions

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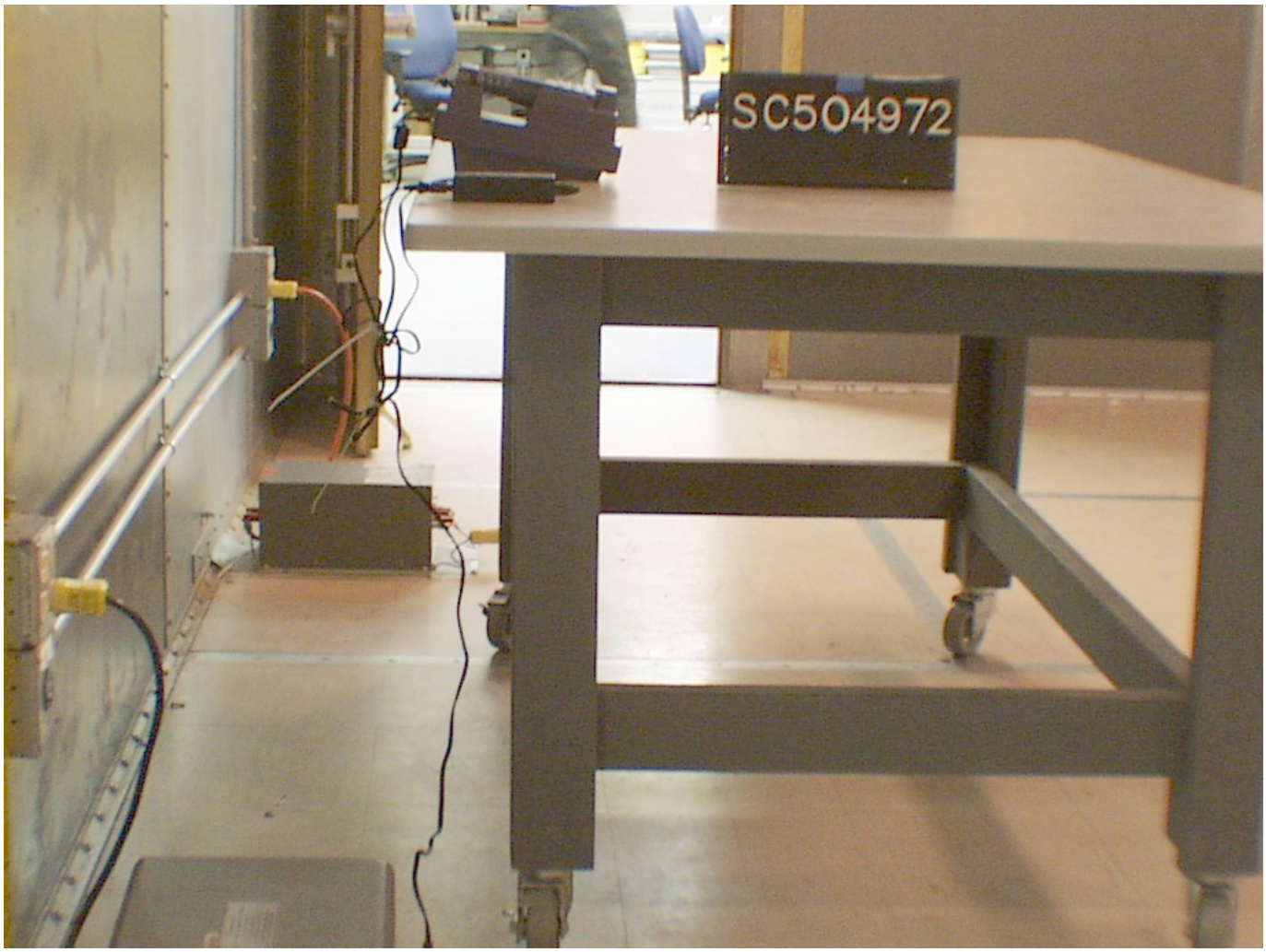
Photograph of Test Setup:
Conducted Emissions



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Photograph of Test Setup:
Radiated Emissions

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Photograph of Test Setup:
Radiated Emissions

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Appendix B

Product Information Form(s)

TÜV AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 678 1400 FAX 858 546 0364

General Equipment Description -- *NOTE: This information will be input into your test report as shown below.*

EUT Description: Contactless Smart Card Reader Integrated with PDA

EUT Name: Hand Held Unit

Model No.: 0001-1103 Serial No.: G140410373

Product Options: Operation on rechargeable battery or on charger cradle.

Configurations to be tested: Polling for cards while docked.

Power Requirements

Regulations require testing to be performed at typical power ratings in the countries of intended use. (i.e., European power is typically 230 VAC 50 Hz or 400 VAC 50 Hz, single and three phase, respectively)

Voltage: 115 VAC (If battery powered, make sure battery life is sufficient to complete testing.)

# of Phases: 1

Current (Amps/phase(max)): 0.9 Current (Amps/phase(nominal)): 0.1

Other: --

Other Special Requirements

This device previously FCC certified, FCC ID: LVCMTR01, under Transition Rules of 15.37(j) (FCC 02-157, ET Docket 98-80), expired July 10, 2005. A new DC power supply with additional filtering replaces the old one to reduce conducted emissions in the 150-450 kHz range. No other changes have been made - the RF circuit design is identical to the previously certified one.

Typical Installation and/or Operating Environment

(ie. Hospital, Small Business, Industrial/Factory, etc.)
Mass transit bus and rail stations, on-board busses and passenger rail cars.

EUT Power Cable

☐ Permanent OR ☒ Removable Length (in meters): 11
☐ Shielded OR ☒ Unshielded
☐ Not Applicable

Note: Custom power cable, supplied with product, includes AC mains filter, DC power supply, and ferrite.

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EUT Interface Ports and Cables

Type	Analog	Digital	During Test: Active	During Test: Passive	Qty	Shielding: Yes	Shielding: No	Shielding: Type	Termination	Connector Type	Port Termination	Length tested (in meters)	Removable	Permanent
EXAMPLE:														
RS232	☐	☒	☒	☐	*2*	☒	☐	*Foil over braid*	*Coaxial*	*Metallized 9-pin D-Sub*	*Characteristic Impedance*	*6*	☒	☐
RS232C	☐	☒	☐	☒	1	☒	☐	Braid	--	Metallized 9 pin d-sub	Characteristic impedance	6	☒	☐

EUT Software.

Revision Level: MPU 12.7 511.3 N 12.7 DSP 12.13 511.3 N 12.13

Description: --

Equipment Under Test (EUT) Operating Modes to be Tested -- list the operating modes to be used during test. It is recommended the equipment be tested while operating in a typical operation mode. FCC testing of personal computers and/or peripherals requires that a simple program generate a complete line of upper case H's. Provide a general description of all software, firmware, and PLD algorithms used in the equipment. List all code modules as described above, with the revision level used during testing. Consult with your TÜV Product Service Representative if additional assistance is required.

1. Polling for cards while docked in cradle.

Equipment Under Test (EUT) System Components -- List and describe all components which are part of the EUT. For FCC & Taiwan testing a minimum configuration is required. (ie. Mouse, Printer, Monitor, External Disk Drive, Motherboard, etc)

Description	Model #	Serial #	FCC ID #
Micro Tri-Reader CFCard	0001-1101	G140410373	LVCMTR02
Casio Cassiopeia PDA	IT70M30E	062208344AAAC3	--
Casio Charger Base	IT760I0E	120B00687AAA1	--
DC Power Supply, UMEC	UP0251Q-12P51	TD068385	--

Support Equipment -- List and describe all support equipment which is not part of the EUT. (i.e. peripherals, simulators, etc) This information is required for FCC & Taiwan testing.

Description	*Model #*	*Serial #*	*FCC ID #*

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Oscillator Frequencies

Frequency	*Derived Frequency*	*Component # / Location*	*Description of Use*
27.12 MHz	13.56 MHz	Y1 on Micro Tri-Reader Active Antenna PCB	RF Carrier Frequency
14.7456 MHz	--	Y1 on Micro Tri-Reader Digital Board	DSP Clock Frequency

Power Supply

Manufacturer	*Model #*	*Serial #*	*Type*
UMEC	UP0251Q-12P51	TD068385	☐ Switched-mode: (Frequency) -- ☐ Linear ☐ Other: --

Power Line Filters

Manufacturer	*Model #*	*Location in EUT*
Cubic Transportation Systems	3400-52001	Wall wart at AC outlet end of power cable
Voltrex	SPC5306	At load end of DC power cable, entering charger

Critical EMI Components (Capacitors, ferrites, etc.)

Description	*Manufacturer*	*Part # or Value*	*Qty*	*Component # / Location*
XY Capacitor Module	RIFA	PZB300MC	1	AC line filter module
Compensated Coil	Siemens	B82721-A2362-N1	2	AC line filter module
Ferrite	Voltrex	SPC5306	1	DC power cord

EMC Critical Detail -- Describe other EMC Design details used to reduce high frequency noise.

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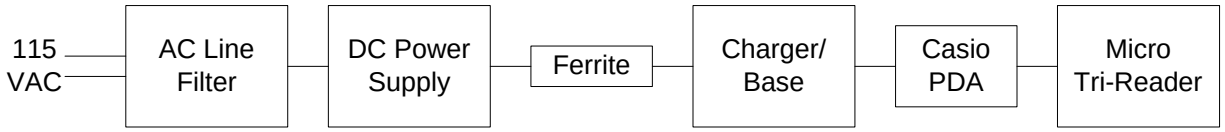
System Configuration Block Diagram -- Provide a line drawing identifying the EUT, simulators, support equipment, I/O cables, power cables, and any other pertinent components to be used during testing. Use a dashed line to separate the equipment in the testing field versus equipment outside testing field.



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Appendix C

Change History

Not Applicable

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Appendix D

Supplemental Information

Not Applicable

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