ENGINEERING TEST REPORT

Mobile Payment Terminal
Model No.: K78-205
FCC ID: P3A- K78-205

Applicant:

Keycorp Limited
Level 5, Keycorp Tower
799 Pacific Highway
Chatswood NSW 2067
Sydney Australia

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, PARTS 2, 22 and 24 (Subpart E)

UltraTech's File No.: KYC-012FCC22-24

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: February 11, 2004	
Report Prepared by: Dan Huynh Issued Date: February 11, 2004	Tested by: Hung Trinh, RFI Technician Test Dates: January 28 - February 2 & 11, 2004

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	▪ Exhibit 1: Submittal check lists ▪ Exhibit 2: Introduction ▪ Exhibit 3: Performance Assessment ▪ Exhibit 4: EUT Operation and Configuration during Tests ▪ Exhibit 5: Summary of test Results ▪ Exhibit 6: Measurement Data ▪ Exhibit 7: Measurement Uncertainty ▪ Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Radiated Emission Setup Photos	OK
2	External Photos of EUT	External EUT Photos	OK
3	Internal Photos of EUT	Internal EUT Photos	OK
4	Cover Letters	▪ Letter from Ultratech for Certification Request ▪ Letter from the Applicant to appoint Ultratech to act as an agent ▪ Letters from the Applicant to request for Confidentiality Filing	OK
5	Attestation Statements	--	--
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block Diagrams	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	Parts Lists	OK
10	Operational Description	▪ Software Description of Module ▪ GM48 Transceiver Logic and Audio Parts ▪ GM48 Transceiver Radio Module ▪ GM48 Module	OK
11	RF Exposure Info	SAR Test Report	OK
12	Users Manual	GPRS/GSM K78-205 Advanced Mobile Payment Terminal User Guide	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2, 22 and 24
Title:	Telecommunication – 47 Code of Federal Regulations (CFR), Parts 2, 22 & 24
Purpose of Test:	To gain FCC Certification Authorization for Radio operating in the frequency 824.2 – 848.8 MHz and 1850.2 – 1908.75 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 20-39	2002	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 & EN 55022	2002 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	1999	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Keycorp Limited
Address:	Level 5, Keycorp Tower, 799 Pacific Highway Chatswood, NSW 2067 Australia
Contact Person:	Mr. Ken McAnulty Phone #: +61 2 9414 5200 Fax #: +61 2 9415 1363 Email Address: kmcanulty@keycorp.net

MANUFACTURER	
Name:	Keycorp Limited
Address:	Level 5, Keycorp Tower, 799 Pacific Highway Chatswood, NSW 2067 Australia
Contact Person:	Mr. Ken McAnulty Phone #: +61 2 9414 5200 Fax #: +61 2 9415 1363 Email Address: kmcanulty@keycorp.net

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Keycorp Limited
Product Name:	Mobile Payment Terminal
Model Name or Number:	K78-205
Serial Number:	Preproduction
Type of Equipment:	Non-broadcast Radio Communication Equipment
External Power Supply:	N/A
Transmitting/Receiving Antenna Type:	Integral
Primary User Functions of EUT:	Wireless mobile payment terminal

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	3.6V for GSM module
RF Output Power Rating:	PCS 850: 0.96 W (Peak Conducted Power) PCS 1900: 0.75 W (Peak Conducted Power)
Operating Frequency Range:	824.2 – 848.8 MHz, 1850.2 – 1908.75 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	200kHz
Emission Designation*:	300KGXW
Antenna Connector Type:	Custom made helical stub antenna screw-in with M4 x 0.7 thread
Antenna Description:	Manufacturer: Mobile Mark Type: Custom made helical stub antenna screw-in with M4 x 0.7 thread Model: PSTGO-900/1900M4/7 Frequency Range: 850 – 1900MHz Gain: 0 dBi

* Per 47 CFR § 2.201 and §2.202

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Communication Port	1	RJ11	Non-shielded
2	External Port	1	Mini DB Connector	Shielded
3	Power Jack	1	Plug-in Power Jack	Non-shielded

3.5. ANCILLARY EQUIPMENT

None.

EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	3.6 volts (nominal) external replaceable Li ion rechargeable battery pack

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	None.
Special Hardware Used:	None.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use.

Transmitter Test Signals	
Frequency Band(s):	▪ 824.2 – 848.8 MHz ▪ 1850.2 – 1908.75 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	▪ 824.2 MHz ▪ 836.4 MHz ▪ 848.8 MHz ▪ 1850.2 MHz ▪ 1880.0 MHz ▪ 1909.8 MHz
RF Power Output (measured maximum output power):	PCS 850: 0.96 W (Peak Conducted Power) PCS 1900: 0.75 W (Peak Conducted Power)
Normal Test Modulation:	Pseudo random data modulation.
Modulating Signal Source:	Internal

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: November 4, 2003.

5.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
2.1046 & 24.232	RF Power Output	Yes
2.1047(a)	Audio Frequency Response	See original filing test report
2.1047(b)	Modulation Limiting	See original filing test report
2.1049	Emission Limitation & Emission Mask	See original filing test report
2.1051, 2.1057, 22.917& 24.238	Spurious emissions at antenna terminals	See original filing test report
2.1053, 2.1057, 22.917 & 24.238	Field strength of spurious radiation	Yes
2.1055	Frequency Stability	See original filing test report

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

5.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:1992 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. RF POWER OUTPUT [§§ 2.1046 & 24.232]

6.5.1. Limits

§ 24.232 (b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

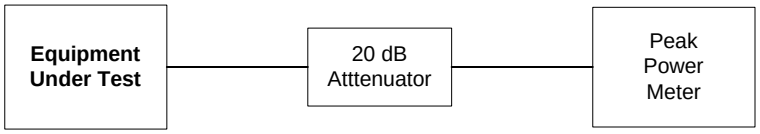
6.5.2. Method of Measurements

Refer to Exhibit 8, Section 8.1 of this report for measurement details

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Peak Power Meter	Hewlett Packard	HP 8900D	3412A00103	9 kHz – 26.5 GHz
Attenuator	Weinschel Corp	46-20-34	BM1347	DC – 18 GHz

6.5.4. Test Arrangement



6.5.5. Test Data

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured Peak Power (dBm)	*Calculated e.i.r.p. Peak Power (dBm)
PCS 850			
Lowest	824.2	29.80	29.80
Middle	836.4	29.81	29.81
Highest	848.8	29.81	29.81
PCS 1900			
Lowest	1850.2	28.73	28.73
Middle	1880.0	28.71	28.71
Highest	1909.8	28.73	28.73

* e.i.r.p. = (peak conducted power in dBm) + (antenna gain in dBi)

Sample calculation at 824.2 MHz: e.i.r.p. = 29.80 dBm + 0 dBi (the maximum gain of the antenna)
= 29.80 dBm

6.6. BAND-EDGE CONDUCTED EMISSIONS [§§ 2.1051, 22.917& 24.238]

6.6.1. Limits

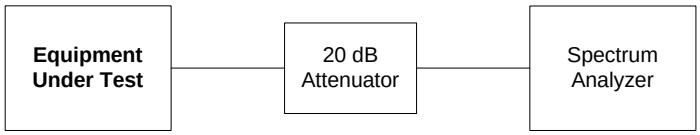
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

6.6.2. Method of Measurements

Using the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 1 % of the span
- VBW $\geq$ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge
- Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- The marker-delta value now displayed must comply with the limit specified
- Now, using the same instrument settings, enable the hopping function of the EUT
- Allow the trace to stabilize
- Follow the same procedure listed above to determine if any spurious emissions cause by the hopping function also comply with the specify limits.
- Submit this plot

6.6.3. Test Arrangement



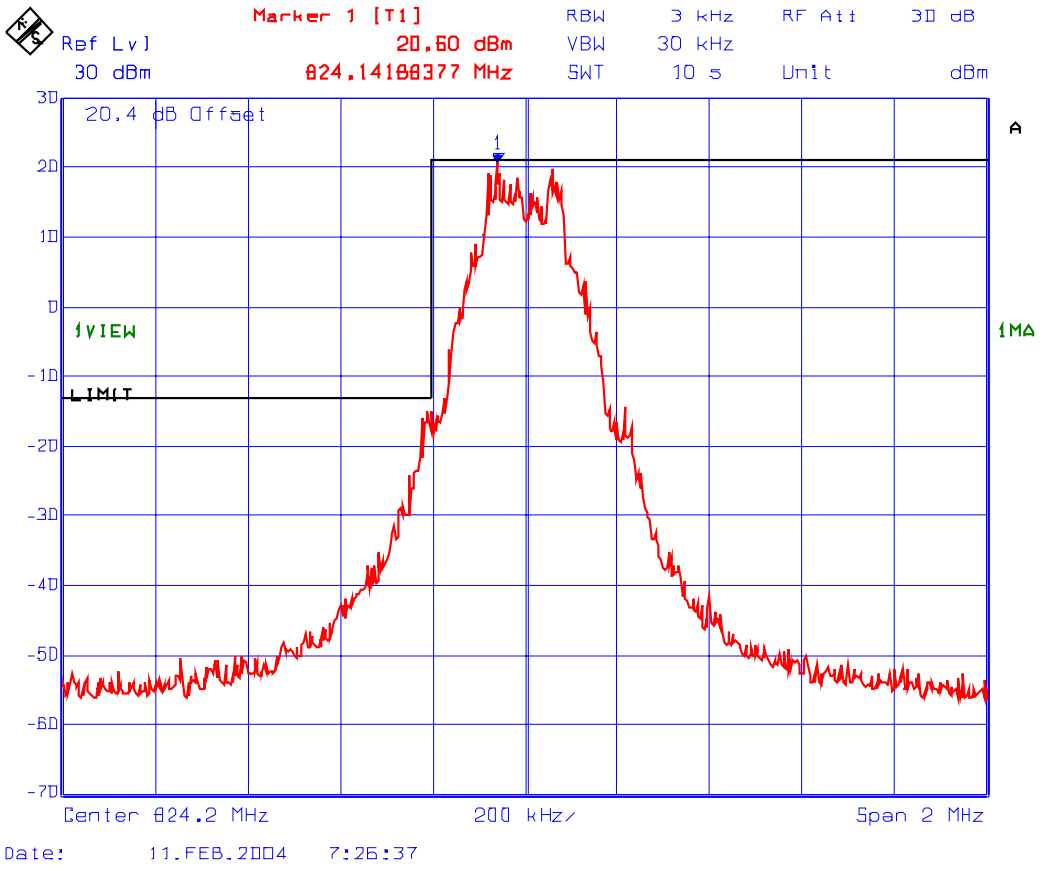
6.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
Attenuator	Weinschel Corp.	46-20-34	--	DC – 18 GHz

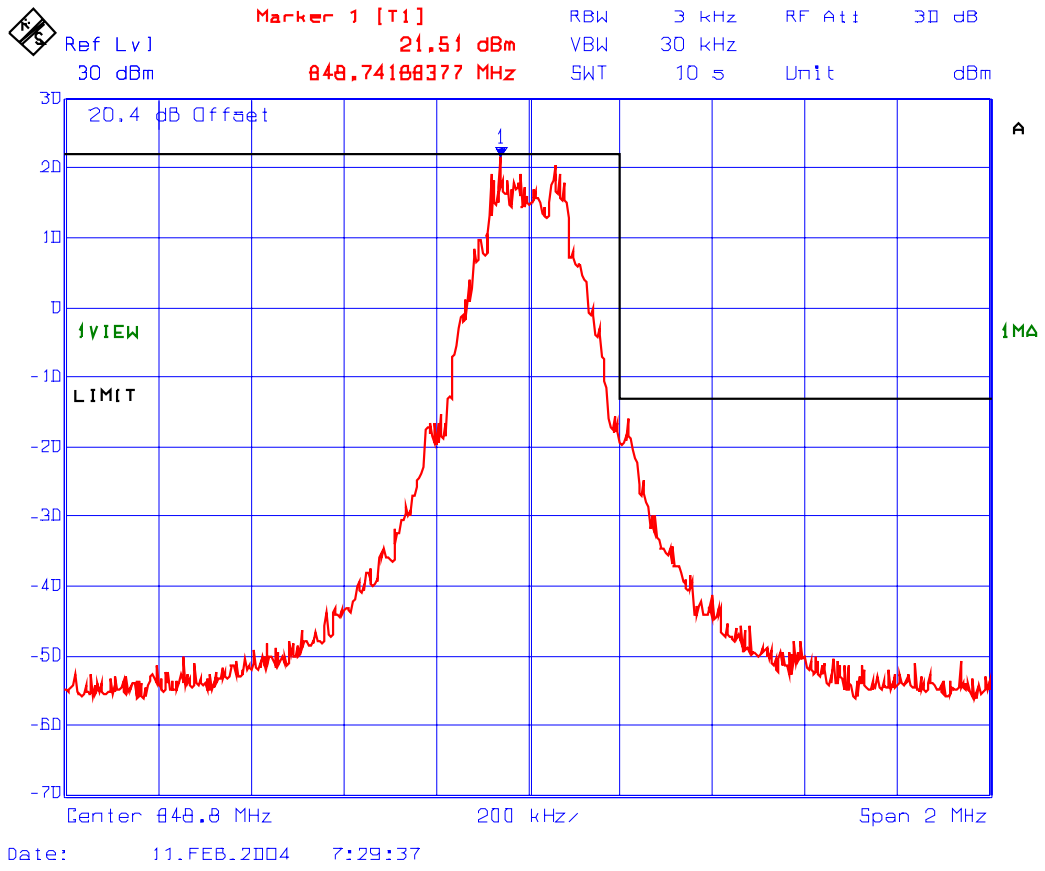
6.6.5. Test Data

Refer to the following test data plots (1 to 4) for measurement results:

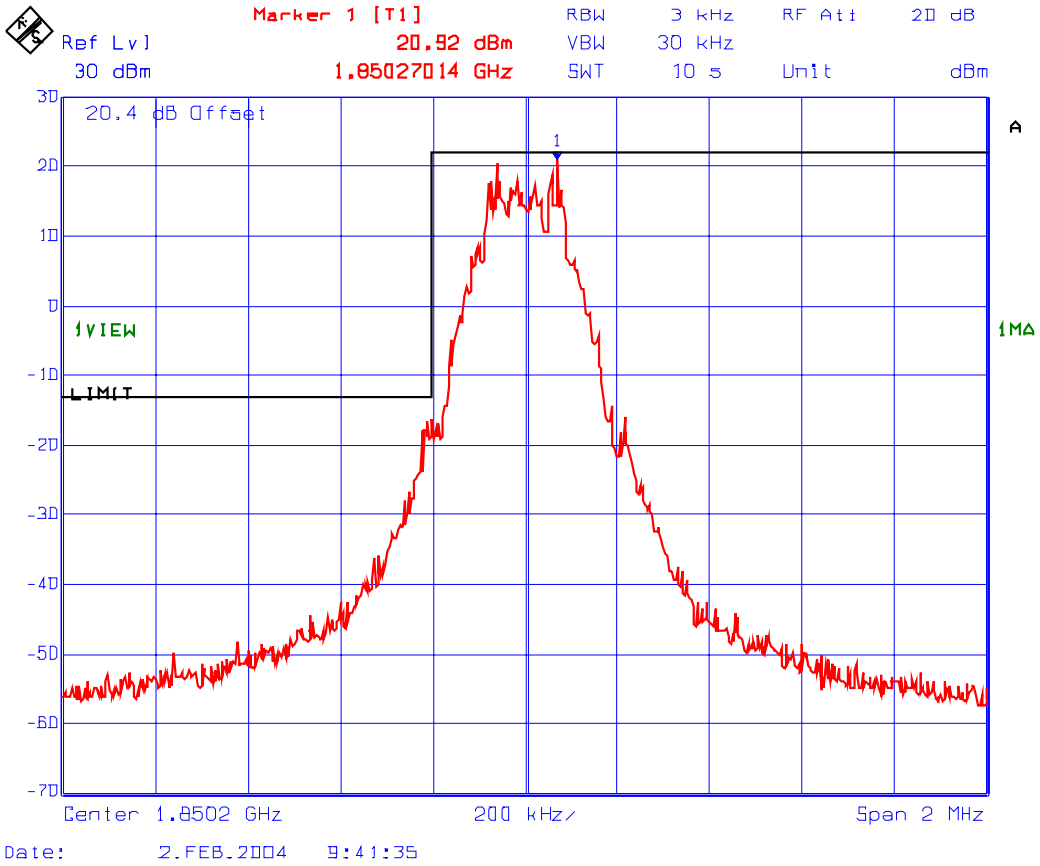
Plot 1:
Band-Edge RF Conducted Emissions (PCS 850)
Low End of Frequency Band



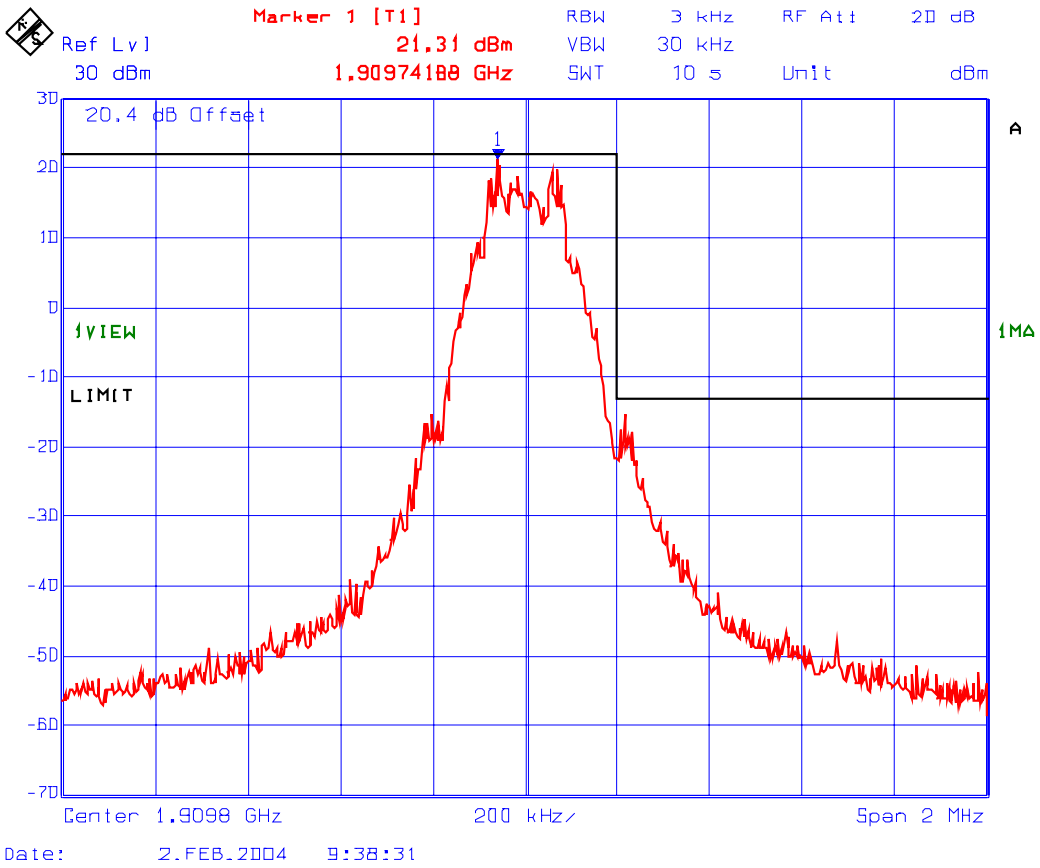
Plot 2:
Band-Edge RF Conducted Emissions (PCS 850)
High End of Frequency Band



Plot 3:
Band-Edge RF Conducted Emissions (PCS 1900)
Low End of Frequency Band



Plot 4:
Band-Edge RF Conducted Emissions (PCS 1900)
High End of Frequency Band



6.7. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053, 22.917 & 24.238]

6.7.1. Limits

§24.238 (a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10lo(P) dB.

6.7.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, Section 8.2 of this report and its value in dBc is calculated as follows:

(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = x dBm (conducted) + 0 dBi – 2.15 dB
(3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
RF Amplifier	Com-Power	PA-102		1 MHz to 1 GHz, 30 dB gain nomimal
Microwave Amplifier	Hewlett Packard	HP 83017A	3116A00661	1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 GHz – 1 GHz
Dipole Antenna	EMCO	3121C	8907-440	30 GHz – 1 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

6.7.4. Test Data

6.7.4.1. PCS 850

Carrier Frequency (MHz): 824.2
Power (dBm): 29.80
Limit (dBc): 42.80
Test Frequency Range (MHz): 30-9000

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	ERP measured by Substitution Method (dBc)	Limit (dBc)	Margin (dB)
1648.4	74.68	Peak	V	-29.27	59.07	42.80	-16.27
1648.4	75.09	Peak	H	-28.46	58.26	42.80	-15.46
2472.6	74.92	Peak	V	-26.90	56.70	42.80	-13.90
2472.6	77.54	Peak	H	-25.49	55.29	42.80	-12.49
All other harmonics and spurious emissions are more than 20 dB below the limit.							

Carrier Frequency (MHz): 836.4
Power (dBm): 29.81
Limit (dBc): 42.81
Test Frequency Range (MHz): 30-9000

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	ERP measured by Substitution Method (dBc)	Limit (dBc)	Margin (dB)
1672.8	74.38	Peak	V	-27.78	57.59	42.81	-14.78
1672.8	75.04	Peak	H	-28.35	58.16	42.81	-15.35
2509.2	77.10	Peak	V	-25.15	54.96	42.81	-12.15
2509.2	77.95	Peak	H	-24.56	54.37	42.81	-11.56
All other harmonics and spurious emissions are more than 20 dB below the limit.							

Carrier Frequency (MHz): 848.8
Power (dBm): 29.81
Limit (dBc): 42.81
Test Frequency Range (MHz): 30-9000

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	ERP measured by Substitution Method (dBc)	Limit (dBc)	Margin (dB)
1697.6	74.87	Peak	V	-27.24	57.05	42.81	-14.24
1697.6	77.50	Peak	H	-26.08	55.89	42.81	-13.08
2546.4	74.70	Peak	V	-26.57	56.38	42.81	-13.57
2546.4	80.07	Peak	H	-22.27	52.08	42.81	-9.27
All other harmonics and spurious emissions are more than 20 dB below the limit.							

6.7.4.2. PCS 1900

Carrier Frequency (MHz): 1850.2
Power (dBm): 28.73
Limit (dBc): 41.73
Test Frequency Range (MHz): 30-20000

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	ERP measured by Substitution Method (dBc)	Limit (dBc)	Margin (dB)
3700.4	74.40	Peak	V	-23.50	52.23	41.73	-10.50
3700.4	71.03	Peak	H	-27.68	56.41	41.73	-14.68
5550.6	76.01	Peak	V	-25.31	54.04	41.73	-12.31
5550.6	77.56	Peak	H	-23.29	52.02	41.73	-10.29
9251.0	69.56	Peak	V	-32.30	61.03	41.73	-19.30
9251.0	73.15	Peak	H	-27.96	56.69	41.73	-14.96
All other harmonics and spurious emissions are more than 20 dB below the limit.							

Carrier Frequency (MHz): 1880.0
Power (dBm): 28.71
Limit (dBc): 41.71
Test Frequency Range (MHz): 30-20000

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	ERP measured by Substitution Method (dBc)	Limit (dBc)	Margin (dB)
3760.0	71.01	Peak	V	-30.19	58.90	41.71	-17.19
3760.0	71.61	Peak	H	-29.24	57.95	41.71	-16.24
5640.0	75.49	Peak	V	-27.36	56.07	41.71	-14.36
5640.0	74.99	Peak	H	-27.45	56.16	41.71	-14.45
9400.0	73.33	Peak	H	-27.54	56.25	41.71	-14.54
All other harmonics and spurious emissions are more than 20 dB below the limit.							

Carrier Frequency (MHz): 1909.8
Power (dBm): 28.73
Limit (dBc): 41.73
Test Frequency Range (MHz): 30-20000

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	ERP measured by Substitution Method (dBc)	Limit (dBc)	Margin (dB)
3819.6	75.22	Peak	V	-24.82	53.55	41.73	-11.82
3819.6	71.87	Peak	H	-29.11	57.84	41.73	-16.11
5729.4	70.71	Peak	V	-32.20	60.93	41.73	-19.20
5729.4	69.61	Peak	H	-32.12	60.85	41.73	-19.12
9549.0	71.77	Peak	H	-29.53	58.26	41.73	-16.53
All other harmonics and spurious emissions are more than 20 dB below the limit.							

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

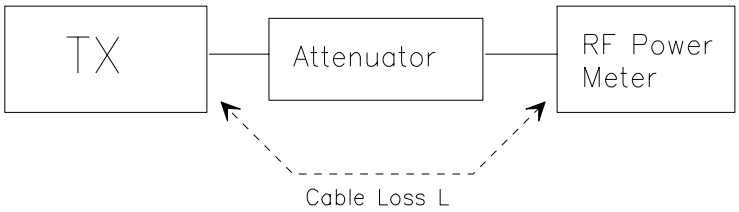
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where:	P:	Actual RF Power fed into the substitution antenna port after corrected.
	P1:	Power output from the signal generator
	P2:	Power measured at attenuator A input
	P3:	Power reading on the Average Power Meter
	EIRP:	EIRP after correction
	ERP:	ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.:

Figure 2

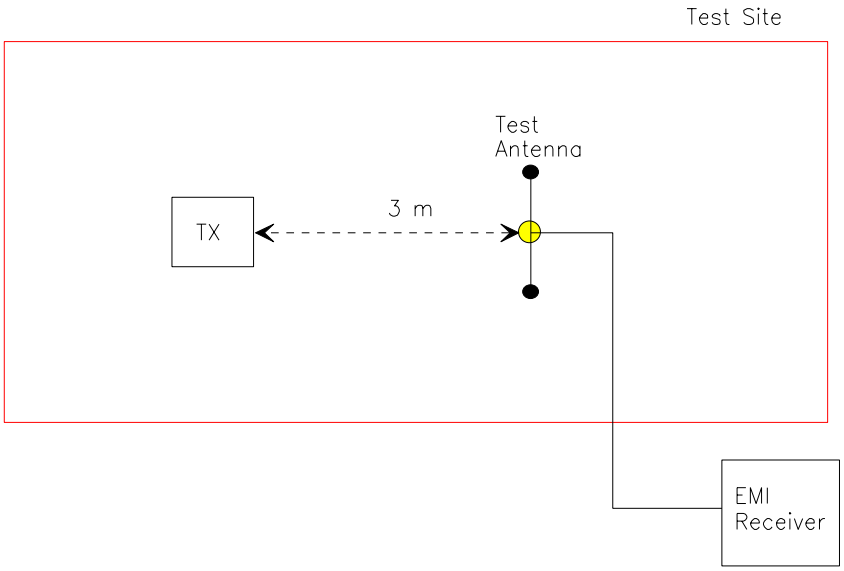


Figure 3