ENGINEERING TEST REPORT

MOBILE PAYMENT TERMINAL
Model No.: K78-200 & K78-204/LP9100

Applicant:

KEYCORP LIMITED
Level 8, 67 Albert Avenue
Chatswood NSW 2067
AUSTRALIA

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, PARTS 2 and 90 (Subpart I)

Class II Permissive Changes

UltraTech's File No.: KYC5-FCC90

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: January 29, 2002	
Report Prepared by: Dan Huynh Issued Date: January 29, 2002	Tested by: Hung Trinh, RFI Engineer Test Dates: January 14, 2002

- *The results in this Test Report apply only to the sample(s) tested, which was randomly selected.*
- *Under no circumstances may this report 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	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 Emissions at OFTS	OK
2	External Photos of EUT	Refer to Original Submission	--
3	Internal Photos of EUT	Internal EUT Photos of Modified PCB and Antenna Connector	OK
4	Cover Letters	• Letter from Ultratech for Certification Request • Letter from the Applicant to appoint Ultratech to act as an agent	OK
5	Block Diagram	Refer to Original Submission	--
6	Schematics	Refer to Original Submission	--
7	ID Label/Location Info	Refer to Original Submission	--
8	Operational Description	Refer to Original Submission	--
9	Users Manual	Refer to Original Submission	--
10	RF Exposure Info	SAR Test Report	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 90
Title:	Telecommunication - Code of Federal Regulations, 47 CFR, Parts 2 & 90
Purpose of Test:	To gain FCC Certification Authorization for Radio operating in the frequency bands 806-821 MHz (25 kHz Channel Spacing).
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. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2000	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	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Keycorp Limited
Address:	Level 8, 67 Albert Avenue Chatswood NSW 2067 AUSTRALIA
Contact Person:	Mr. Ken McAnulty Phone #: +61 2 9415 2900 Fax #: +61 2 9415 1363 Email Address: kmcanulty@keycorp.net

MANUFACTURER	
Name:	Research In Motion Ltd.
Address:	295 Philip Street Waterloo, Ontario Canada, N2L 3W8
Contact Person:	Mr. Masud Attayi Phone #: 519-888-7465, ext. 2442 Fax #: 519-888-6906 Email Address: mattayi@rim.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:	K78-200 & K78-204/LP9100
Serial Number:	Pre-Production
Type of Equipment:	Licensed Non-Broadcast Radio Communication Equipment
External Power Supply:	None
Transmitting/Receiving Antenna Type:	Integral

K78-200 & K78-204/LP9100 MOBILE PAYMENT TERMINAL - PRODUCT DESCRIPTION

The K78-200 & K78-204/LP9100 are mobile payment terminals for use in both mobile and fixed applications. The terminal is capable of supporting magnetic card and smart card transactions by using wireless data communication via the Motient network.

The terminal features a printer module, a battery module, user interface including a display, an integrated wireless modem module and a dial up modem (model K78-200 does not contain a PSTN modem). The K78 terminal may also be used in a fixed configuration through external communication ports.

The terminal provides the following features:

(a) Credit/debit transactions off-line or on-line through the internally fitted wireless modem module.
(b) Smart card transactions
(c) Print receipts through the integrated printer or an external device.
(d) Storage of transaction logs on a removable storage media

Magnetic Card Reader
The K78 supports a magnetic card reader.

Customer and Merchant Smart Card Slots
The K78 supports two full size smart cards, one for the merchant and one for the customer. Each card is fully enclosed within the K78.

SAM Slots
The K78 supports 1 SAM module.

LCD
The terminal provides a 128(h) x 64(v) LCD monochrome graphics display.

Power Switch
The power switch on the K78 prevents accidental powering on or off.

Printer
The terminal includes a thermal printer.

Communications Module
The terminal includes an internal wireless modem module.

External Cable
The terminal provides an external port connector to support RS 232 ports through external interface cable 763-578059.

The external cable may be used for connection of external devices such as an external modem, printer or PC.

Power Supply
The K78 terminal is normally powered from internal batteries. This is a 4.8V NiMH battery pack.

The batteries can be charged or the K78 can be operated using an external power supply (Ault type PW 107) or a 12Vdc car adapter.

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	[x] Portable [x] Mobile [x] Base station (fixed use)
Intended Operating Environment:	[x] Commercial [x] Light Industry & Heavy Industry
Power Supply Requirement:	4.8V NiMH battery pack
RF Output Power Rating:	2 Watts (conducted)
Operating Frequency Range:	806-821 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	25 kHz
Emission Designation:	20K0F1D
Antenna information:	Manufacturer: Ace Technologies Model No.: MAX-1000 Antenna Type: extendable with ¼ length helical over ¼ wavelength whip. Frequency Range: 824 – 894 MHz Gain: 2.0 ± 1 dBi (extended) -1.0 ± 1 dBi (retracted) Radiation Pattern: Omni – directional Connector Type: thread NOTE: This antenna is designed for operating in 824 - 894 MHz band but it is used for operation in 806 – 821 MHz. Therefore, the gain in 806 – 821 MHz is expected to be negative in ERP measurements.

3.4. LIST OF 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:	4.8V NiMH 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 transmitter antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s): ▪ 806-821 MHz band:	Near lowest, near middle & near highest frequencies in each frequency bands that the transmitter covers: ▪ 806 MHz, 813.5 MHz, 821 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 33.0 dBm Maximum ▪ FM Data ▪ 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.

- 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 site 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: August 08, 2001.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
90.205 & 2.1046	RF Power Output	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes (refer to the attached SAR test report)
90.213 & 2.1055	Frequency Stability	Not required for this Class II Permissive Changes
90.242(b)(8) & 2.1047(a)	Audio Frequency Response	Not required for this Class II Permissive Changes
90.210 & 2.1047(b)	Modulation Limiting	Not required for this Class II Permissive Changes
90.209 90.210 & 2.1049	Emission Limitation & Emission Mask	Not required for this Class II Permissive Changes
90.210, 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
90.210, 2.1057 & 2.1053	Emission Limits - Field Strength of Spurious Emissions	Yes

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

The following modifications were made to the original certified equipment:

1) Ground plane modified
2) Antenna connector changed to gold connector
3) Ferrite placed on battery supply rail

There are no other changes made on the existing components and the main PCB.

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 @ FCC 2.1046 & 90.205

6.5.1. Limits @ FCC 90.205

Please refer to FCC 47 CFR, Part 90, Subpart I, Para. 90.205 for specification details.

6.5.2. Method of Measurements

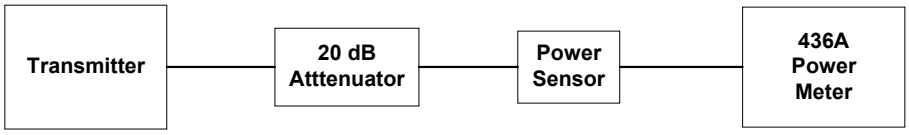
Refer to Exhibit 8, sections 8.1 (Conducted) and 8.3 (Radiated) of this report for measurement details

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz
Attenuator(s)	Bird	…	…	DC – 22 GHz
EMI Receiver/ EMI Receiver	Advantest	R3271	15050203	100 Hz – 26.5 GHz
Attenuator(s)	Weinschel Corp	24-20-34	BJ2357	DC – 8.5 GHz
Dipole Antenna	EMCO	3121C	8907-440	30 MHz – 1 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 MHz – 1 GHz
Synthesized RF Signal Generator	Gigatronic	6061A	5130408	10kHz – 1050 MHz

6.5.4. Test Arrangement

- Power at RF Power Output Terminals



6.5.5. Test Data

6.5.5.1. Conducted RF Output Power Measurements

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured Power (dBm)	Power Rating by the Radio Supplier (Research in Motion) (dBm)
Near Lowest	806.0	33.0	33.0
Near Middle	813.5	32.9	33.0
Near Highest	821.0	32.8	33.0

6.5.5.2. ERP Measurements using Substitution Method

EUT's Antenna was extended in full length, EUT Antenna Gain = 2 dBi max.					
Frequency (MHz)	Peak E-Field @ 3m (dBµV/m)	Antenna Polarization (V/H)	Peak Power From Signal GEN. Ps – Cable Loss (dBm)	Substitution Antenna (Dipole) Gain Gd (dBi)	Measured Peak ERP = Ps+Gd-2.15 (dBm)
806.0	132.22	V	32.82	1.96	32.63
806.0	131.66	H	29.36	1.96	29.17
813.5	129.16	V	29.46	1.78	29.09
813.5	132.28	H	29.98	1.78	29.61
821.0	130.03	V	29.73	1.60	29.18
821.0	129.94	H	28.64	1.60	28.09
* The above readings were maximum with EUT oriented in three different orthogonal positions					

EUT's Antenna was retracted, EUT Antenna Gain = 0 dBi max.					
Frequency (MHz)	Peak E-Field @ 3m (dBµV/m)	Antenna Polarization (V/H)	Peak Power From Signal GEN. Ps – Cable Loss (dBm)	Substitution Antenna (Dipole) Gain Gd (dBi)	Measured Peak ERP = Ps+Gd-2.15 (dBm)
806.0	123.97	V	24.57	1.96	24.38
806.0	124.25	H	21.95	1.96	21.76
813.5	122.47	V	22.77	1.78	22.40
813.5	126.41	H	20.47	1.78	20.10
821.0	123.47	V	23.17	1.60	22.62
821.0	123.22	H	21.87	1.60	21.32
* The above readings were maximum with EUT oriented in three different orthogonal positions					

NOTE: This EUT's antenna is designed for operating in 824 - 894 MHz band but it is used for operation in 806 – 821 MHz. Therefore, the antenna gain in 806 – 821 MHz is expected to be negative in ERP measurements.

6.6. RF EXPOSURE REQUIRMENTS @ 1.1310 & 2.1093

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
SAR Tests for Portable Transmitters • Body Tissue • Brain Tissue	 • Complies with SAR limits for General Population/Uncontrolled exposure; refer to SAR test report for detailed. • Not applicable
Caution statements and/or warning labels that is necessary in order to comply with the exposure limits.	Refer to original User Guide for RF Exposure information to users.

6.7. SPURIOUS EMISSIONS AT ANTENNA TERMINAL @ FCC 2.1051 & 90.210

6.7.1. Limits @ 90.210

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Worst Case Emissions Limit	Attenuation Limit (dBc)
FCC 90.210 (g)	FCC 90.210 (g)	43 + 10log (P)

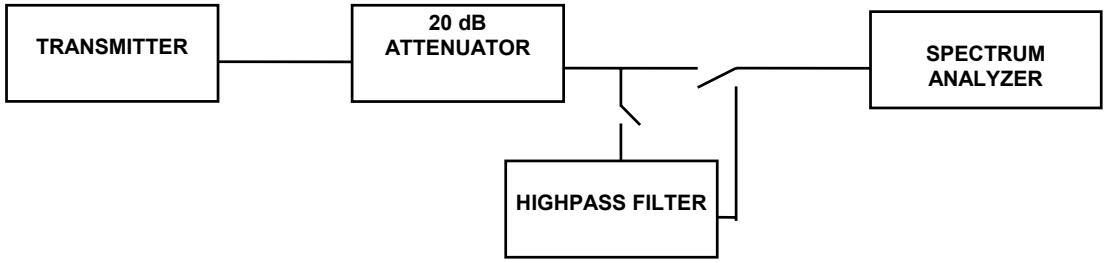
6.7.2. Method of Measurements

Refer to Exhibit 8 § 8.2 of this report for measurement details

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz
Highpass Filter, Microphase	Microphase	CR220HID	IITI11000AC	Cut-off Frequency at 600 MHz, 1.3 GHz or 4 GHz

6.7.4. Test Arrangement



6.7.5. Test Data

The conducted emissions were scanned from 10 MHz to 10 GHz at the following frequencies:

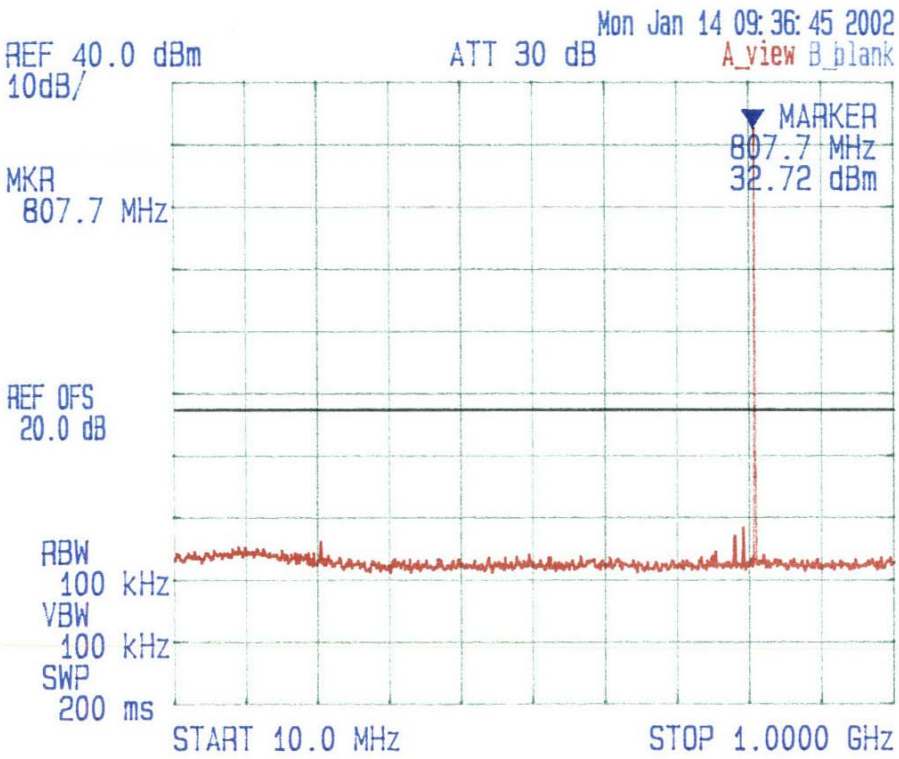
1) 806 MHz, near low end of frequency band;
2) 813.5 MHz, middle of frequency band;
3) 821 MHz, near high end of frequency band

There were no emissions found within 20dB below the limits; refer to the following test data plots for measurement results:

UltraTech Engineering Labs Inc.

KEYCORP LIMITED
MOBILE PAYMENT TERMINAL WITH RIM 802D RADIO
Channel: Low, Frequency: 806 MHz, Power Ouput: 2 W
Transmitter Antenna Power Conducted Emissions

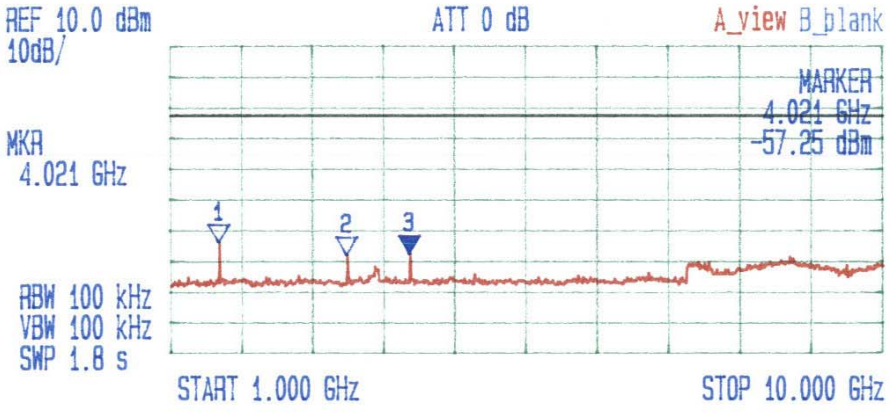
Date: Jan. 14 2002
Tested by: Hung Trinh



UltraTech Engineering Labs Inc.

KEYCORP LIMITED
MOBILE PAYMENT TERMINAL WITH RIM 802D RADIO
Channel: Low, Frequency: 806 MHz, Power Ouput: 2 W
Transmitter Antenna Power Conducted Emissions

Date:Jan. 24 2002
Tested by: Hung Trinh



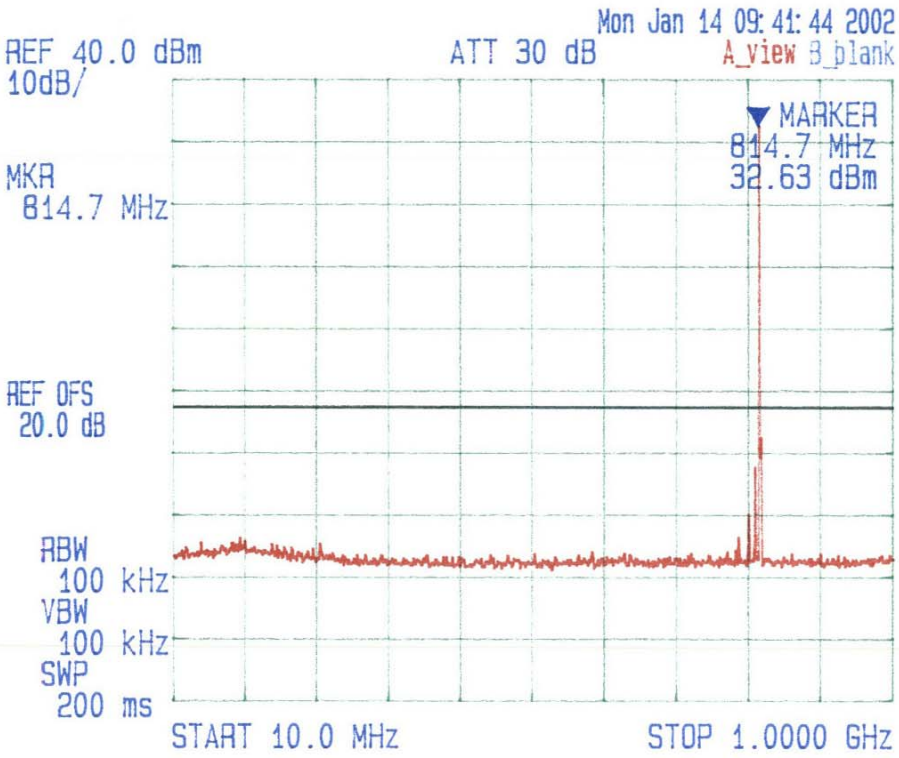
*** Multi Marker List ***

No.1:	1.604 GHz	-53.56 dBm	A
No.2:	3.224 GHz	-57.53 dBm	A
No.3:	4.021 GHz	-57.25 dBm	A
No.4:			
No.5:			
No.6:			
No.7:			
No.8:			
Δ:			

UltraTech Engineering Labs Inc.

KEYCORP LIMITED
MOBILE PAYMENT TERMINAL WITH RIM 802D RADIO
Channel: MID, Frequency: 813.5 MHz, Power Ouput: 2 W
Transmitter Antenna Power Conducted Emissions

Date: Jan. 14 2002
Tested by: Hung Trinh



UltraTech Engineering Labs Inc.

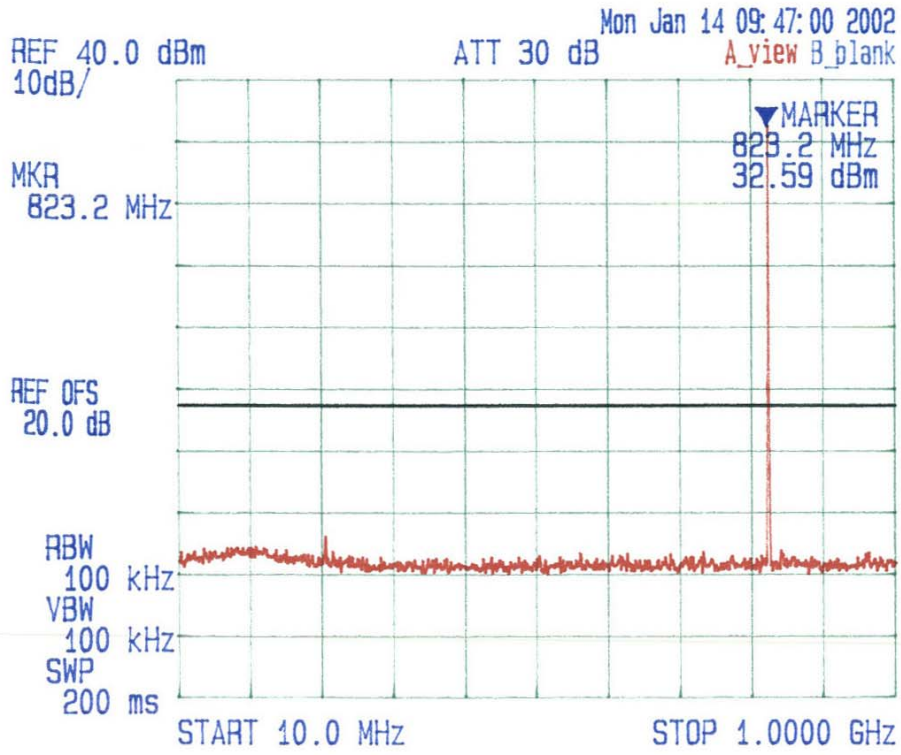
KEYCORP LIMITED
MOBILE PAYMENT TERMINAL WITH RIM 802D RADIO
Channel: MID, Frequency: 813.5 MHz, Power Ouput: .8 W
Transmitter Antenna Power Conducted Emissions

Date: Jan. 14 2002
Tested by: Hung Trinh

UltraTech Engineering Labs Inc.

KEYCORP LIMITED
MOBILE PAYMENT TERMINAL WITH RIM 802D RADIO
Channel: HIGH, Frequency: 831 MHz, Power Ouput: .2 W
Transmitter Antenna Power Conducted Emissions

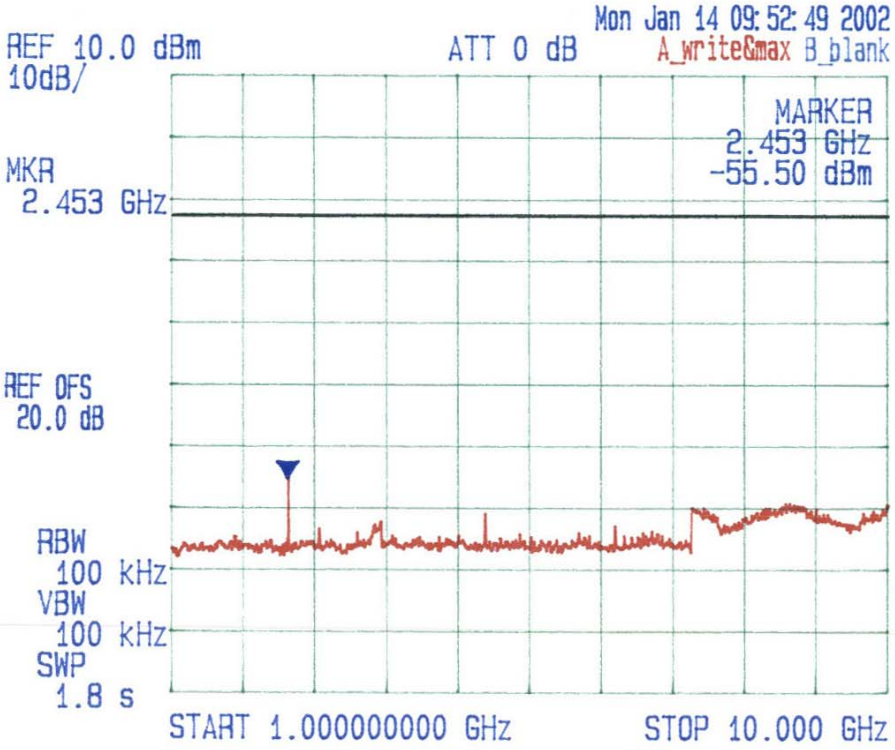
Date: Jan. 14 2002
Tested by: Hung Trinh



UltraTech Engineering Labs Inc.

KEYCORP LIMITED
MOBILE PAYMENT TERMINAL WITH RIM 802D RADIO
Channel: HIGH, Frequency: 831 MHz, Power Ouput: 2 W
Transmitter Antenna Power Conducted Emissions

Date: Jan. 14 2002
Tested by: Hung Trinh



6.8. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 90.210

6.8.1. Limits @ FCC 90.210

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC RULES	ATTENUATION LIMIT (dBc)
FCC 90.210 (g)	43 + 10 log (P)

6.8.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, § 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 = xxx 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)

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
RF Amplifier	Com-Power	PA-102		1 MHz to 1 GHz, 30 dB gain nomimal
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz, 30 dB nominal
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

6.8.4. Test Data

Tests were performed at 806, 813.5 and 821 MHz and the emissions were scanned from 10 MHz to 10 GHz. No emissions were found within 20 dB below the limits.

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 Directivity	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.

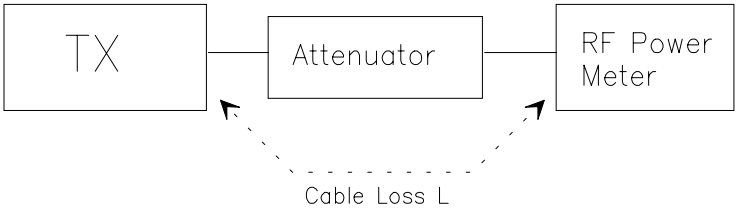
Step 2: Calculation of Average EIRP. See Figure 1

- 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. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum, VBW $\geq$ RBW and SWEEP TIME = AUTO. The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.1057 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.1051 - Spurious Emissions at Antenna Terminal:- The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

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

8.3.1. 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

8.3.2. 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

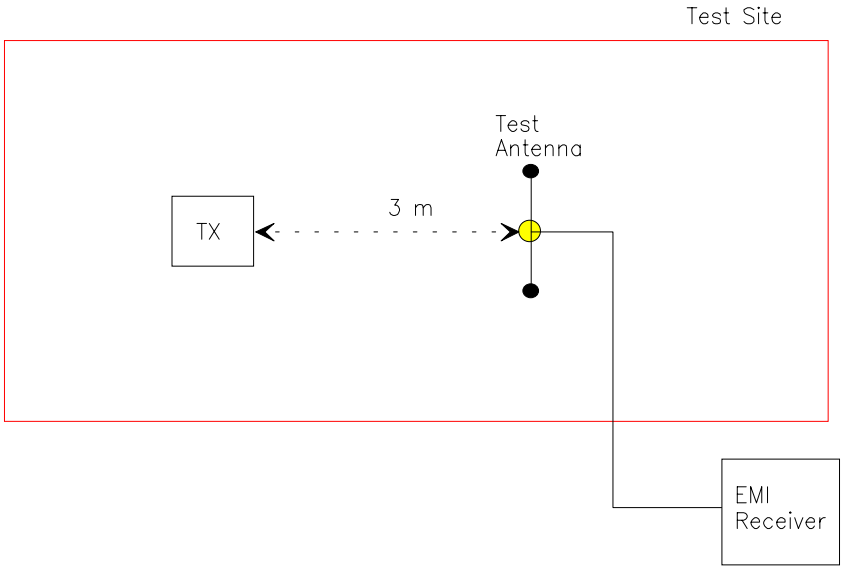


Figure 3