RETLIF TESTING LABORATORIES
TEST REPORT R-4396N
April 15, 2005

FCC COMPLIANCE TEST REPORT
ON

MARKEM CORPORATION
THERMAL PRINTER WITH
900 - 928MHz FREQUENCY HOPPING SPREAD SPECTRUM
RFID TAG READER
FCC ID: QMECIMJETRFID

APPLICANT	MANUFACTURER
Markem Corporation 150 Congress Street Keene, NH 03431	SAME

TEST SPECIFICATION: FCC Rules and Regulations Part 15, Subpart C, Para. 15.247

TEST PROCEDURE: ANSI C63.4:2001, FCC Measurement Guideline for Frequency Hopping Spread Spectrum Devices

TEST SAMPLE DESCRIPTION

BRANDNAME: Markem MODEL: CIMJETRFID

TYPE: THERMAL PRINTER WITH RFID Tag Reader

POWER REQUIREMENTS: 120VAC, 60Hz

FREQUENCY BAND OF OPERATION: 902 to 928MHz DSS Frequency Hopping

FREQUENCIES TESTED: 902.416MHz, 914.716MHz and 926.531MHz

FCC ID: QMECIMJETRFID

APPLICABLE RULE SECTION: Part 15, Subpart C, Section 15.247

TESTS PERFORMED

15.247 (a) (1)(i) 20dB Bandwidth

15.247 (a) (1)(i) Number of Hopping Frequencies

15.247 (a) (1) Carrier Frequency Separation

15.247 (a) (1)(i) Time of Occupancy (Dwell Time)

15.247(c) Radiated Spurious Emissions (30MHz to 9.5GHz)

15.247(c) Conducted Spurious Emissions (30MHz to 9.5GHz)

15.247(c) Bandedge Compliance

15.247(b) Peak Output Power

15.207 AC Line Conducted Emissions (150kHz to 30MHz)

TEST SAMPLE DESCRIPTION

The EUT is a Markem Corporation, Model CIMJETRFID, Industrial Thermal Printer with Frequency Hopping Spread Spectrum RFID Tag Reader.. The intended use is in industrial/commercial applications for inventory tracking. The equipment is intended to be professionally installed by trained personnel.

ANTENNA DESCRIPTION

The CIMJETRFID will be sold with the following antenna:

Antenna 1: 1/4 Wave 1.7" whip 0dBi Gain

The antenna will connect to the CIMJET RFID Module via a reverse SMA connector. The RFID Module is internal to the machine and is not accessible to the user/operator.

MEASUREMENT PROCEDURES

15.247 (a) (1) 20dB Bandwidth

With the transmitter operating at maximum data rate the 20dB bandwidth of the 902.416 peak emission was measured using a spectrum analyzer connected to the antenna port. This measurement was repeated at 914.716MHz and at 926.531MHz.

Test Results: The 20dB bandwidth measured was 354.7kHz. The 20dB bandwidth measured at all three frequencies met the maximum allowed 20dB bandwidth of 500kHz. See attached plots.

15.247 (a)(1)(i) Time of Occupancy/Dwell Time

With the transmitter hopping function enabled the time of occupancy (dwell time) was measured using a spectrum analyzer connected to the antenna port. The dwell time at 902.41MHz was measured and determined to be 290msec. The dwell time at 914.716MHz was measured and determined to be 285msec. The dwell time at 926.53MHz was measured and determined to be 300msec. The time of occupancy within a ten second period for each frequency was the same as the dwell time as there was only 1 occurrence observed within the ten second period.

Test Results: The time of occupancy met the maximum allowed time of occupancy of 400msec within a ten second period. See attached plots.

15.247 (a)(1) Channel Carrier Frequency Separation

With the transmitter hopping function enabled the channel carrier frequency separation was measured using a spectrum analyzer connected to the antenna port. The peaks of two adjacent channels were captured and the separation between them was measured.

Test Results: The channel carrier frequency separation was 493kHz which met the minimum requirement of 354kHz which is the 20dB bandwidth of the hopping channel. See attached plot.

15.247 (a)(1) Number of Hopping Frequencies

With the transmitter hopping function enabled the number of hopping frequencies was measured by using a spectrum analyzer connected to the antenna port. With the span set to the frequency band of operation (902 - 928MHz) a plot was taken clearly showing all hopping frequencies.

Test Results: The number of hopping channels is 50 which meets the specified 25 hopping channel minimum for 20dB bandwidth greater than 250kHz. See attached plot.

15.247(b) Peak Output Power

With the transmitter operating at maximum data rate the peak power of the 902.41MHz peak emission was measured using a spectrum analyzer connected to the antenna port. The span of the spectrum analyzer was approximately 5 times the 20dB bandwidth. This measurement was repeated at 914.68MHz and at 926.53MHz.

Test Results: The peak output power measured at all 3 frequencies was 23.82dBm (241mW). The peak output power measured met the 1watt (30dBm) limit specified in 15.247(b).

De Facto EIRP Limit:

15.247(b)(3) specifies that if transmitting antennas with directional gain of greater than 6dBi are used then the peak output power of the transmitter must be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. The gain antenna used with this transmitter is a 1/4 wave wire whip with 0dBi gain. As the maximum peak power measured was 23.82dBm the de facto EIRP limit is also met.

15.247 (c) Spurious RF Conducted Emissions

With the transmitter operating at maximum data rate the spurious RF conducted emissions were measured using a spectrum analyzer connected to the antenna port. The span of the spectrum analyzer was set wide enough to capture the peak level of the in band emission and all spurious emissions from 30MHz to 9.5GHz.

Test Results: All Spurious RF conducted emissions observed were within the limit specified in 15.247 (b) (20dB down in any 100kHz bandwidth) See attached plots

15.247 (c) Band Edge Compliance of RF Conducted Emissions

With the transmitter operating at maximum data rate the band edge spurious RF conducted emissions were measured using a spectrum analyzer connected to the antenna port. The span of the spectrum analyzer was set 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 falling outside of the authorized band. This procedure was performed for both the upper and lower band edge. The procedure was repeated with the transmitter hopping function enabled.

Test Results: All Spurious RF conducted emissions observed at the band edges were within the limit specified in 15.247 (b) (20dB down in any 100kHz bandwidth) See attached plots

15.247 (c) Spurious Radiated Emissions

The field strength of any emission observed during spurious RF conducted measurements that fell within restricted bands was measured. The transmitter was placed on a 80cm high wooden test stand which was located 3 meters from the test antenna on an FCC listed open area test site. Emissions from the EUT were maximized by rotating the test sample and adjusting the test sample orientation and antenna polarization. The maximized peak field strength of each emission was measured and recorded and compared to the limit specified in 15.35 (b) (peak limit corresponds to 20dB above the maximum permitted average limit). The spectrum analyzer video bandwidth was then set to 10Hz the peak field strength of each emission was measured. The peak reading was adjusted by a duty cycle correction factor (if applicable) and the corrected reading was then compared to the average limit specified in 15.209.

Test Results: No harmonic/spurious frequencies were observed in any restricted bands and the measured spurious radiated emissions complied with the specified requirements.

AC Line Conducted Emissions

The transmitter was placed on a 0.8m high wooden test stand above the floor of the test area)ground plane). The rear of the test sample was aligned flush with the rear of the test stand. The test stand was situated such that the test sample was located 0.4m from all other grounded surfaces. The power cord of the test sample was connected to an artificial mains network (LISN). The spectrum analyzer was connected to the RF port of the LISN and measurements were taken in the frequency range of 150kHz to 30MHz on each the hot and neutral leads.

Test Results: The AC line conducted emissions met the limit specified in 15.207 (a).

RF Exposure

Spread Spectrum Transmitters operating under 15.247 are categorically excluded from routine environmental evaluation for demonstrating RF exposure compliance with respect to MPE or SAR limits however per 15.247(b)(4) must be operated in a manner that ensures the public is not exposed to RF energy levels in access of the commission's guidelines. The device will be professionally installed and the user/installation manual contains the proper cautionary statements and specifies that the device be installed so that a minimum separation distance of 20cm will maintained. Based on the transmitter power and maximum antenna gain (see calculation below) the 20cm separation distance exceeds the calculated distance for acceptable MPE power density levels to meet both the Occupational/Controlled Exposure and the General Population/Uncontrolled Exposure requirements of 1.1309. The calculation below uses the more stringent General Population MPE Limits.

$$S = \frac{PG}{4\Pi Dsq}$$

D = Minimum Separation Distance in cm

S = Max allowed Power Density in mW/cmsq

Per 1.1309 For Frequency of 900MHz = F/1500 = .6mW/cmsq

Power = Max Power Input to Antenna = 23.82dBm = 241mW

Gain = Max Power Gain of Antenna = 0dBi = 1 numeric

$$.6\text{mW/cmsq} = \frac{241 \times 1}{4\ (3.14) \times Dsq} = \frac{241}{12.56 \times Dsq}$$

$$Dsq = \frac{241}{12.56 \times .6} = 31.85$$

D = sq. root 31.98 = 5.65cm

EQUIPMENT LISTS

20 dB Bandwidth

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Band Edge Compliance

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Conducted Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4027	LISN	Solar Electronics	10 KHz - 30 MHz	9252-50-R-24BNC	10/28/2004	10/28/2005
4028	Isolation Transformer	Acme	N/A	120x240	1/31/2005	1/31/2006
5030C	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/7/2005	2/7/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Carrier Frequency Separation

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Number of Hopping Frequencies

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Peak Ouput Power

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Radiated Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	12/3/2004	12/3/2005
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	12/13/2004	12/13/2005
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005
3258	Double Ridge Guide	EMCO	1 - 18GHz	3115	8/1/2004	8/1/2005

Spurious RF Conducted Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

Dwell Time & Time of Occupancy

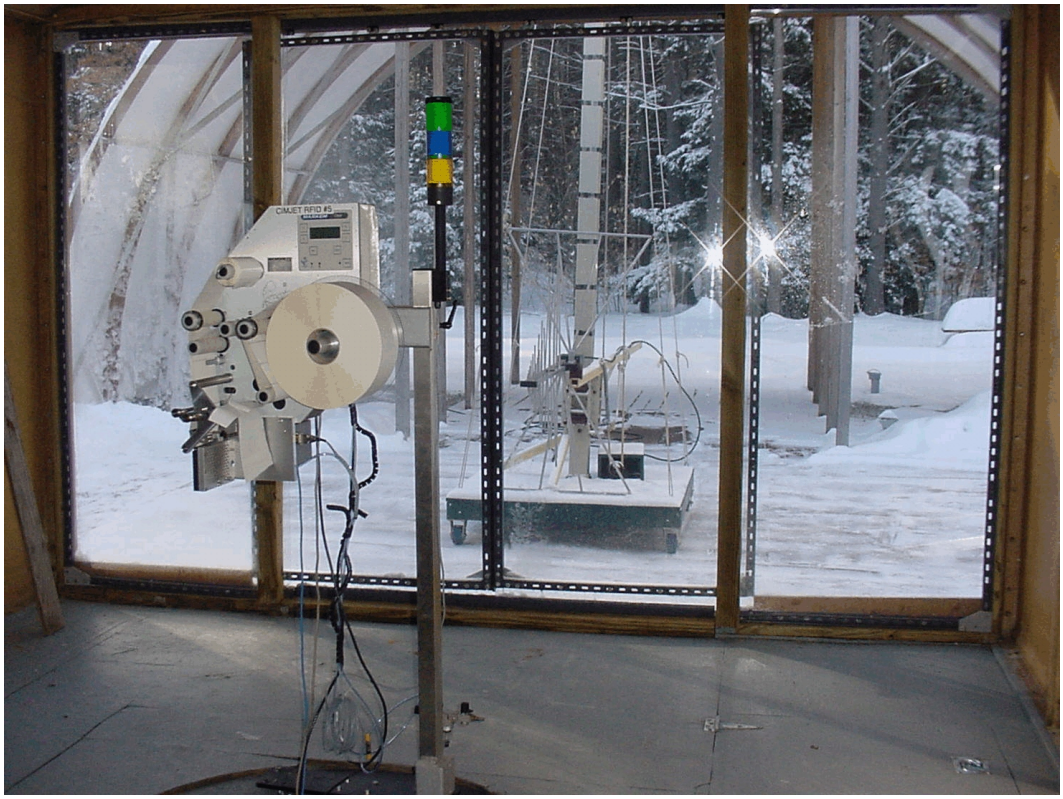
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
5030D	10 DB Atten. (50 ohm)	Narda	DC - 12.4 GHz	757C-10	2/8/2005	2/8/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	10/6/2004	10/6/2005

TEST SETUP PHOTOGRAPHS

CONDUCTED EMISSIONS

TEST SETUP PHOTOGRAPHS

RADIATED EMISSIONS



TEST SETUP PHOTOGRAPHS

GENERAL TEST SETUP FOR BENCH TESTS