RETLIF TESTING LABORATORIES TEST REPORT R-4589N June 30, 2006

FCC COMPLIANCE TEST REPORT ON

MARKEM CORPORATION
800 SERIES
HIGH SPEED, COMPACT RFID TAG DISPENSER & APPLICATOR
WITH
900 - 928MHz FREQUENCY HOPPING SPREAD SPECTRUM
RFID TAG READER
FCC ID: QME811RFID

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 C63.4:2003, FCC Measurement Guideline for Frequency Hopping Spread

Spectrum Devices

TEST SAMPLE DESCRIPTION

BRANDNAME: Markem

MODEL: 800 Series

TYPE: RFID Tag Dispenser with 902 - 928MHz FHSS Tag Reader

POWER REQUIREMENTS: 120VAC, 60Hz

FREQUENCY BAND OF OPERATION: 902 to 928MHz FHSS

FREQUENCIES TESTED: 902.416MHz, 914.716MHz and 926.531MHz

FCC ID: QME811RFID

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(d) Conducted Spurious Emissions (30MHz to 9.5GHz)

15.247(d) 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, 800 Series, High Speed RFID Tag Dispenser and Applicator with 902 -928MHz Frequency Hopping Spread Spectrum RFID Tag Reader. The intended use is in industrial/commercial applications for inventory tracking. The FHSS RFID Module is intended to be professionally installed by trained personnel.

ANTENNA DESCRIPTION

The product will be sold with the following antenna:

PCB Antenna: 0dBi Gain

The antenna will connect to the RFID Module via a reverse SMA connector. The RFID Module and antenna will be professionally installed by trained personnel.

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 at 902.416MHz measured 354.7kHz. The 20dB bandwidth at 914.716MHz measured 354.7kHz and the 20dB bandwidth at 926.531MHz measured 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 maximum 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 902.41MHz, 914.68MHz and 926.53MHz 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)(4) 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 antenna used with this transmitter is a PCB antenna 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 falls within a restricted band is required to be measured. If radiated measurements were required then the following procedure was used. The transmitter was placed directly on the turntable 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 during RF conducted measurements and spurious radiated emissions were not required.

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)(5) 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.

$$S = PG \over 4\Pi Dsq$$

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

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

$$Dsq = \frac{241}{12.56 \text{ x } .6} = 31.97$$

$$D = sq. root 31.97 = 5.65cm$$

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Data Sheet 2 of 3

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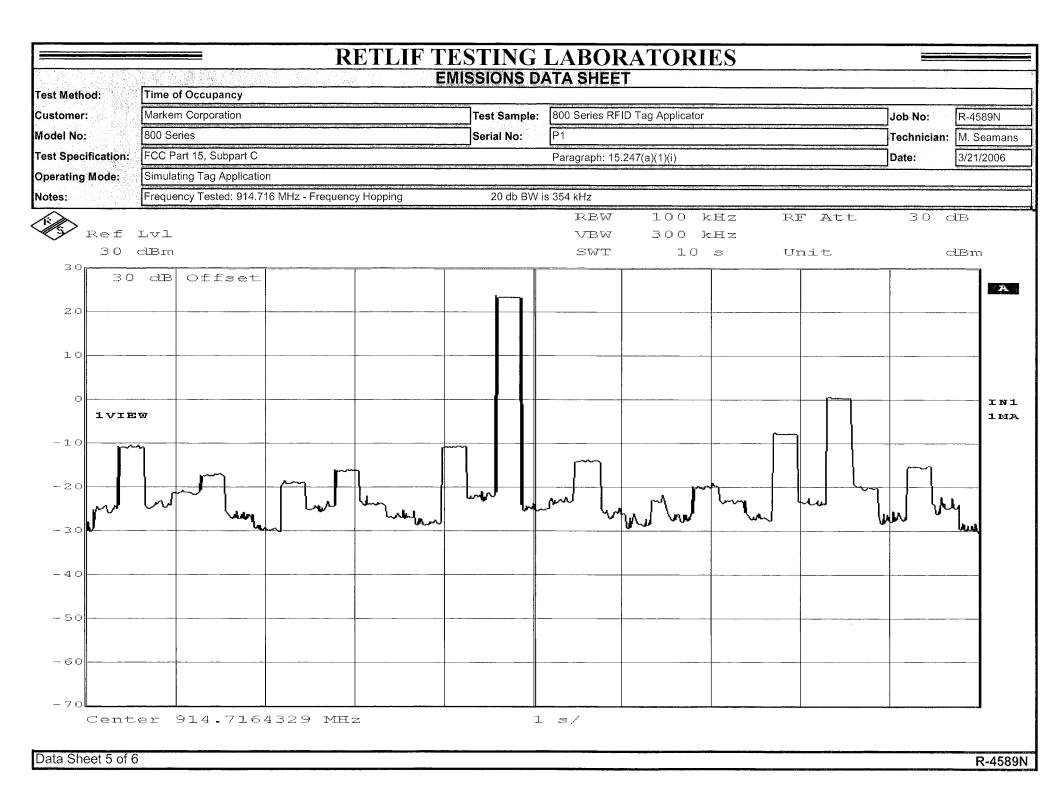
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lo:	800 Series			Serial No:	P1				Technician:	M. Sea
ecification:	FCC Part 15, Subpart	C			Paragraph: 15.	247(a)(1)(i)			Date:	3/21/20
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tomer:	Markem Corporation		No. 10. No. 10	Test Sample:	800 Series RFI	D Tag Applicator			Job No:	R-4589N
el No:	800 Series			Serial No:	P1				Technician:	M. Seam
Specification:	FCC Part 15, Subpart C		A COMPANY OF THE STATE OF THE S		Paragraph: 15.	247(a)(1)(i)			Date:	3/21/200
rating Mode:	Simulating Tag Applicati	on							<u> </u>	
ıs:	Frequency Tested: 926.5	3 MHz - Frequency	Hopping	20 db BW is	354 kHz					27. W. S. A. P. S. L. S. S.
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r:	Markem Corporation		Test Sample: 800	) Series RFID	Tag Applicator		Job No:	R-4589
<b>)</b> :	800 Series		Serial No: P1	ACCOMMON A RESTORATION			Technician:	44. 7. 9.95577720
cification:	FCC Part 15, Subpart C		Pa	ragraph: 15.2	47(c)		Date:	3/20/200
g Mode:	Simulating Tag Application			- w 2 - 3 - 3 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1				SERVICE VERNOR SERVICE
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lethod:	Spurious RF Conducted Emissions 30 MHz to	o 9.5 GHz				<u> - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - </u>	<u> </u>
mer:	Markem Corporation	Test Sample:	800 Series RFII	D Tag Applicator		Job No:	R-45891
No:	800 Series	Serial No:	P1			Technician:	A. LANCE OF MANAGEMENT
pecification:	FCC Part 15, Subpart C		Paragraph: 15.2	247(c)		Date:	3/20/20
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	Frequency Tested: Frequency Hopping 902.41-9	926.53 MHz Spurious	Limit: 3.29 dBm				W. S. C. Philosophy & Co.
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			EMISSIONS D.	ATA SHEET				
est Method:	Spurious RF Conducted Emissions	30 MHz to 9.5 GHz	WAY THE SAME					
ustomer:	Markem Corporation	N. N	Test Sample:	800 Series RFID	Tag Applicator		Job No:	R-4589N
odel No:	800 Series		Serial No:	P1			Technician:	M. Seamans
est Specification:	FCC Part 15, Subpart C			Paragraph: 15.2	47(c)		Date:	3/20/2006
perating Mode:	Simulating Tag Application							
otes:	Frequency Tested: Frequency Hopping	902.41-926.53 MHz	Spurious	_imit: 3.29 dBm			72. W 32. 32. 32. 32. 33. 33. 33. 33. 33. 33.	
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est Method:	Band-e	Band-edge Compliance of RF Conducted Emissions											
ustomer:	AND DESCRIPTION OF THE PARTY OF	n Corporation			Test Sa	mple: 80	0 Series RFID	Tag Applicato	r		Job No:	R-4589N	
odel No:	800 Se				Serial N	o: P					Téchnician:	M. Seama	
est Specificatio		art 15, Subpart C				Pa	aragraph: 15.24	47(c)			Date: 3/20/		
perating Mode:	The second second	ting Tag Application	NOON DAY ON KAROO MONDO SA PARA MARAA	KCHONEDAD ANDANIENJAN VONGANIANIANA WATIRANIA									
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mer:	Markem Corpor	ation			Test Sample:	800 Series RFID	Tag Applicato	or		Job No:	R-4589N
No:	800 Series		# 4 PA J. May Mark 7 A 19 A		Serial No:	P1				Technician:	M. Seam
pecification:	FCC Part 15, St		and the second second second second			Paragraph: 15.2	47(c)			Date:	3/20/200
ting Mode:	Simulating Tag	AND THE PARTY OF T									400
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st Method:	Band-	edge Compl	iance o	f RF Con	ducted	Emissio	ns	<del></del>	- <u>- 2000</u>		** !						<del></del>	
stomer:	Marke	m Corporatio	n			Access Ministry (Co.		Tes	st Sample:	800 Series R	FID Ta	g Applicator					Job No:	R-4589N
del No:	800 S	eries				- 4 - 50 - 50 (OZ. 10 (OZ. 17)	AND STREET	15 (c) 15 (d) 1897 (K)	rial No:	P1			Carrier vo	W			Technician:	75 60° 27, 50 (SAN) CSC 970
st Specification:	FCC F	art 15, Subp	art C	K-1001001000000000000000000000000000000				and the second second		Paragraph: 1	5.247(c	c)			On Spirit Street Street	Burney Company	Date:	3/20/200
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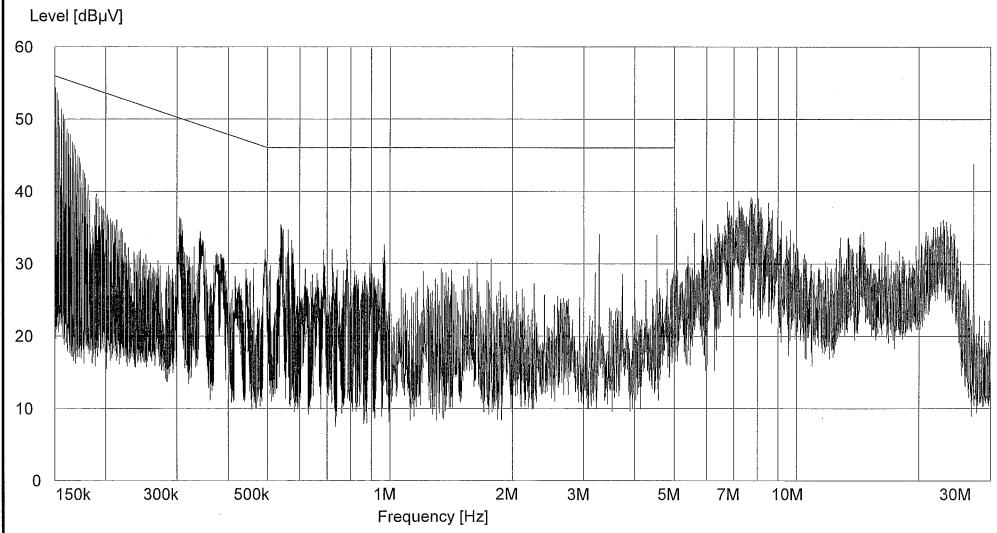
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t Method:	Band-edge Com	pliance of RF Conduct	ed Emissions	micololic D	AIA SIILL					
stomer:	Markem Corporat	tion		Test Sample:	800 Series RF	ID Tag Applicate	r		Job No:	R-4589N
del No:	800 Series			Serial No:	P1		THE THE THE PROPERTY OF THE PR		Technician:	ACCOUNTS AND USE OF FACE
t Specification:	FCC Part 15, Sub	part C			Paragraph: 15	.247(c)			Date:	3/20/2006
erating Mode:	Simulating Tag A	pplication					New York of the Control of the Contr		W. S. C.	-340
es:	Frequency Tested	d: Frequency Hopping 9	02.41-926.53 MHz							
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	Peak Output Power Markem Corporation			Test Sample:	800 Series RFID	Tag Applicator		Job No:	R-4589N
	800 Series			Serial No:	P1	7 Tag Applicator		<del>a ea</del>	100 05 10 100 110 110
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cification:	Name of the second seco				Paragraph: 15.2	247(b)		Date:	3/21/2006
g Mode:	Simulating Tag Appl	902.41 MHz - no Frequei	nov Honning						Salar Salar and Salar Sala
	I requestey rested.	Marker	Marine Committee Com		RBW	500 kH	z RF Att	30 c	
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Method:	Peak Output Power	47,400000000000000000000000000000000000		**************************************					
mer:	Markem Corporation			Test Sample:	800 Series RFID	Tag Applicator		Job No:	R-4589N
l No:	800 Series			Serial No:	P1			Technician:	M. Seama
Specification:	FCC Part 15, Subpart C	,			Paragraph: 15.2	47(b)		Date:	3/21/2006
iting Mode:	Simulating Tag Applicat	ion		F - 40					
	Frequency Tested: 914.	or a second of the second of t	THE RESERVE THE PROPERTY OF THE PROPERTY OF THE PARTY OF						
>		Marker			RBW	500 kHz	RF Att	30 d	Æ
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mer:	Markem Corporation			Test Sample:	800 Series RFI	Tag Applicator	M. SP N. S. W. J. W.	Job No:	R-4589N
No:	800 Series			Serial No:	P1			Technician:	M. Seama
pecification:	FCC Part 15, Subpart C		V. 89 L. 21000000000000000000000000000000000000		Paragraph: 15.2	247(b)		Date:	3/21/2006
ting Mode:	Simulating Tag Applicat	tion							
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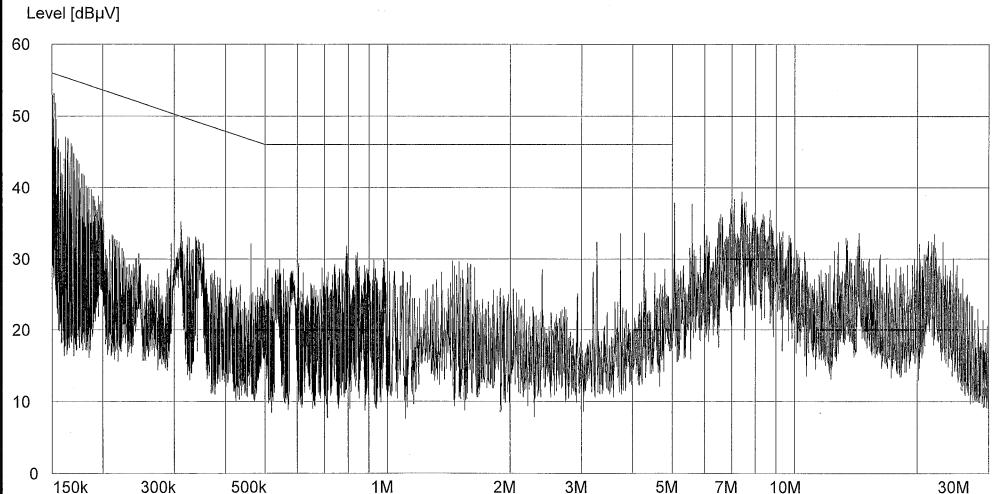
#### RETLIF TESTING LABORATORIES **EMISSIONS DATA SHEET** Test Method: Conducted Emissions 150 kHz to 30 MHz Test Sample: 800 Series RFID Tag Applicator Job No: R-4589N Customer: Markem Corporation Model No: 800 Series Serial No: Technician: M. Seamans FCC Part 15, Subpart C Test Specification: Paragraph: 15.207 (a) Date: March 20, 2006 Simulating Tag Application Operating Mode: Notes: Lead Tested: 120 VAC 60 Hz Hot Peak Readings to Average Limits.



R-4589N

Data Sheet 1 of 2

#### **RETLIF TESTING LABORATORIES EMISSIONS DATA SHEET** Test Method: Conducted Emissions 150 kHz to 30 MHz Markem Corporation Test Sample: 800 Series RFID Tag Applicator Job No: R-4589N **Customer:** Model No: 800 Series Serial No: Technician: M. Seamans FCC Part 15, Subpart C Paragraph: 15.207 (a) Test Specification: March 20, 2006 Date: Simulating Tag Application Operating Mode: Notes: Lead Tested: 120 VAC 60 Hz Neutral Peak Readings to Average Limits.



R-4589N

Frequency [Hz]

Data Sheet 2 of 2

### **EQUIPMENT LISTS**

## EQUIPMENT LIST

		2	0dB Bandwidth			
EN	Type	Manufacturer	Description Description	Model No.	Cal Date	Due
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006
		Band	Edge Compliance	e		
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006
EN	T		ducted Emissions		C-I D-4	D
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4027	LISN	Solar Electronics	10 KHz - 30 MHz	9252-50-R-24BNC	11/21/2005	11/21/2006
4028	Isolation Transformer	Acme	N/A	120x240	2/1/2006	2/1/2007
5030C 713	10 DB Atten. (50 ohm) EMI Test Receiver	Narda Rohde & Schwarz	DC - 12.4 GHz 20 Hz - 26.5 GHz	757C-10 ESI26	2/7/2006 3/22/2005	2/7/2007 3/22/2006
EN	Toma		Frequency Separa		Cal Data	D
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006
		Number o	of Hopping Freque	encies		
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006
		Pea	ak Output Power			
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006

D 1' . 1	
Radiated	Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	12/3/2004	4/3/2006
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	12/14/2005	12/14/2006
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006
3258	Double Ridge Guide	EMCO	1 - 18GHz	3115	8/1/2005	8/1/2006
		Spurious R	F Conducted Emi	issions		
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006
		Dwell Time	e & Time of Occu	inancy		
EN	Type	Manufacturer	Description	Model No.	Cal Date	Due
EIT	Type	manuractur el	Description	1 <b>110461</b> 110.	Cai Date	Duc
4961B	Attenuator	Narda	DC - 18 GHz	757C-30dB	2/7/2006	2/7/2007
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	3/22/2005	3/22/2006

# TEST SETUP PHOTOGRAPHS CONDUCTED EMISSIONS



# TEST SETUP PHOTOGRAPHS RADIATED EMISSIONS



### TEST SETUP PHOTOGRAPHS

#### GENERAL TEST SETUP FOR BENCH TESTS

