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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C (15.247) FHSS Specifications for an Intentional Radiator on the Sato Corporation Model: SATO M8485SE Printer with RFID Reader

FCC ID:	MMFM8485SE
GRANTEE:	Sato Corporation 1-207, Onari-Cho, Omiya-ku Saitama-shi Saitama Japan,
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	August 4, 2004
FINAL TEST DATE:	August 2 and August 3, 2004
AUTHORIZED SIGNATORY:	Mark Briggs Vice President of Engineering

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Sato Corporation model SATO M8485SE Printer with RFID Reader pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Sato Corporation model SATO M8485SE Printer with RFID Reader and therefore apply only to the tested sample. The sample was selected and prepared by Keisuke Yamada of Sato Corporation

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units that are subsequently manufactured.

SUMMARY OF RESULTS

Note – remove references in the table below that do not apply to the radio tested

FCC Part 15 Section	RSS 210 Section	Description	Measured Value	Comments	Result
15.247	6.2.2(o)(a)	20dB Bandwidth	263 kHz	The channel spacing shall be greater than the 20dB bandwidth	Complies
15.247	6.2.2(o)(a)	Channel Separation	400 kHz		Complies
15.247	6.2.2(o)(a)	Number of Channels	63	50 hopping frequencies: average time of occupancy <0.4 second within a 20 second period.	Complies
15.247	6.2.2(o)(a)	Channel Dwell Time	0.317 seconds per 20 seconds		Complies
15.247	6.2.2(o)(a)	Channel Utilization	All channels are used equally	Refer to Theory of Operations for detailed description of the hopping algorithm	Complies
15.247 (b) (3)	6.2.2(o)(a)	Output Power	20.85 dBm (0.122 Watts) EIRP = 0.192 W	Maximum permitted is 1Watt, with EIRP limited to 4 Watts for a 50-channel system.	Complies
15.247(c)	6.2.2(o)(e1)	Spurious Emissions – 30MHz – 25GHz	All spurious emissions < -20dBc	All spurious emissions < -20dBc.	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 25GHz	-15.2dB @ 3611.2MHz	Emissions in restricted bands must meet the radiated emissions limits detailed in 15.207. All others must be < -20dBc	Complies
15.207		AC Conducted Emissions	-4.9dB @ 0.197MHz		Complies
	6.6	AC Conducted Emissions	N/A	N/A	Complies
15.247 (b) (5)		RF Exposure Requirements	FCC /IC limits of power density not exceeded provided antenna is located a minimum of 20 cm from persons	Refer to MPE calculation for 20cm derivation. Refer to User's Guide for installation instructions requiring a 20cm separation	Complies
15.203		RF Connector	Antenna is integral to the device	Integral antenna or specialized connector required	Complies

EIRP calculated using antenna gain of 2dBi.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.6

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Sato Corporation model SATO M8485SE Printer with RFID Reader is an RFID label printer which is designed to apply RFID tag labels and, via the built-in RFID reader (transceiver operating in the 902-928 MHz band) verify the tag. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 120/240 V, 50/60 Hz, 7/3.5 Amps.

The sample was received on August 2, 2004 and tested on August 2 and August 3, 2004. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	Proposed FCC ID #
SATO M8485SE Printer with RFID Module	40404118	

OTHER EUT DETAILS

The antenna is a 2dBi antenna that is internally mounted within the printer with no user-accessibility.
The printer uses a WJ-SX2001 module to provide the rfid transceiver.
The EUT can be configured with various interfaces. The printer tested was configured with a serial data interface.

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 27 cm wide by 43 cm deep by 32 cm high.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer/Model/Description	Serial Number	FCC ID Number
Dell PP01L Laptop	TW-0791UH-12800-15T-B122 (Asset #526)	DoC
Dell ADP-70EB AC Adapter	-	-
Sato CL408e Printer	45590309	DoC

No equipment was used as remote support equipment for emissions testing:

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
CL 408e Parallel	Laptop	Multiwire	Shielded	1
EUT AC in	AC Mains	3 wire	Unshielded with ferrite at EUT connector	1.5
M8485SE Serial	Laptop serial	Multiwire	Shielded	4

EUT OPERATION DURING TESTING

The EUT was continuously transmitting a modulated signal on either the low channel (902.8MHz), the middle channel (915.2MHz) or the high channel (927.6MHz) for output power, bandwidth and spurious emissions measurements. For channel occupancy measurements an unmodulated signal was hopped in accordance with the hopping algorithm across all available channels.

ANTENNA REQUIREMENTS

The antenna port and antenna are contained within the printer.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on August 2 and August 3, 2004at the Elliott Laboratories Open Area Test Site #1 & 2 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 5 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and peak power sensor are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts, the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test distance and the output power limits are given in temrs of Watts, milliwatts or dBm. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp) the following formula is used to determine the field strength limit in terms of microvolts per meter at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \text{ v } 30\ P}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

FCC 15.407 (a)and RSS 210 (o) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Number Of Channels	Output Power
902 – 928	>=50	1 W (30 dBm)
902 – 928	< 50	0.25 W (24 dBm)
2400 – 2483.5	>= 75	1 W (30 dBm)
2400 – 2483.5	>= 75	0.125 W (21 dBm)
5725 – 5850	>=75	1 W (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

RSS 210 (o) AND FCC 15.247 SPURIOUS RADIATED EMISSIONS LIMITS

T limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands detailed in Part 15.205 and for all spurious emissions from the receiver are:

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level.

FCC AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in FCC Part 15.207.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

RSS-210 SECTION 6.6 AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in Industry Canada RSS-210 section 6.6.

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

1 Page

RF Port Emissions, 30 - 10,000 MHz, 02-Aug-04
Engineer: Chris Byleckie

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	20-Nov-04

Conducted Emissions - AC Power Ports; Radiated Emissions; RF Port Emissions, 03-Aug-04
Engineer: Mark Briggs

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer 9KHz-26.5GHz, non programmable	8563E	284	15-Mar-05
Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	01-Jul-05
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	23-Jan-05
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	787	10-Dec-04
Hewlett Packard	EMC Spectrum Analyzer, 9KHz-26.5GHz	8593EM	1141	23-Mar-05
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	12-May-05
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1404	17-Nov-04
EMCO	Biconical Antenna, 30-300 MHz	3110B	1498	15-Jan-05
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	1561	04-May-06
Narda	1.9GHz High Pass Filter		248	12-Apr-05

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T56606 17 Pages

Elliott

EMC Test Data

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	
Contact:	Greg Katterhagen		
Emissions Spec:	FCC15.247; FCC 15 Subpart B	Class:	B
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

SATO Corp.

Model

SATO M8485SE Printer with RFID Reader

Date of Last Test: 8/3/2004

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	
Contact:	Greg Katterhagen		
Emissions Spec:	FCC15.247; FCC 15 Subpart B	Class:	B
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is an RFID label printer which is designed to apply RFID tag labels and, via the built-in RFID reader (transceiver operating in the 902-928 MHz band) verify the tag. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 120/240 V, 50/60 Hz, 7/3.5 Amps.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
SATO	M8485SE	Printer with RFID module	40404118	

Other EUT Details

The antenna is a 2dBi antenna that is internally mounted within the printer with no user-accessibility.
The printer uses a WJ-SX2001 module to provide the rfid transceiver.
The EUT can be configured with various interfaces. The printer tested was configured with a serial data interface.

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 27 cm wide by 43 cm deep by 32 cm high.

Modification History

Mod. #	Test	Date	Modification
1			
2			
3			

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	
Contact:	Greg Katterhagen		
Emissions Spec:	FCC15.247; FCC 15 Subpart B	Class:	B
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L	Laptop	TW-0791UH-12800-15T-B122 (Asset #526)	DoC
Dell	ADP-70EB	AC adapter		
Sato	CL408e	Printer	45590309	DoC

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
CL 408e Parallel	Laptop	Multiwire	Shielded	1
EUT AC in	AC Mains	3 wire	Unshielded with ferrite at EUT connector	1.5
M8485SE Serial	Laptop serial	Multiwire	Shielded	4

Note: For radiated spurious emissions from the transmitter, the serial port of the rf module was connected to the laptop to enable control of the radio. For all other radiated spurious emissions measurements the printer serial port was connected to the laptop.
The EXT port of the printer was not connected. This port is mutually exlcusive to the serial port.

EUT Operation During Testing - Transmitter-Related Emissions

The EUT was continuously transmitting a modulated signal on either the low channel (902.8MHz), the middle channel (915.2MHz) or the high channel (927.6MHz) for output power, bandwidth and spurious emissions measurements. For channel occupancy measurements an unmodulated signal was hopped in accordance with the hopping algorithm across all available channels.

EUT Operation During Testing - Digital Device Emissions

The laptop was displaying a scrolling 'H' pattern and communicating to the connected printers.

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

Antenna Port Conducted Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 8/2/2004; 8/3/2004
Test Engineer: Chris Byleckie; M Briggs
Test Location: SVOATS #1; SVOATS #2
Config. Used: -
Config Change: -
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on table

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 19 °C
Rel. Humidity: 66 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	20dB Bandwidth	15.247(a)	Pass	263 kHz
2	Output Power	15.247(b)	Pass	20.85 dBm 0.122 W
3	Channel Occupancy / Separation	15.247(a)	Pass	400kHz spacing 317ms/20s
4	Number of Channels	15.247(a)	Pass	63
5	Spurious/ Out-of Band Emissions	15.247(a)	Pass	All emissions > -20dBc

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

Modifications Made During Testing:

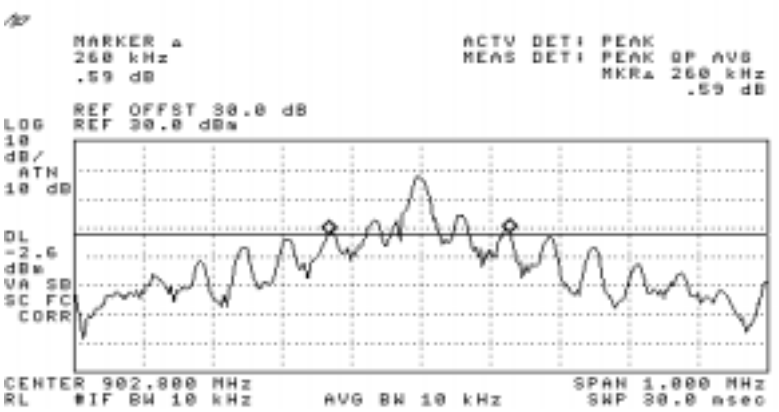
No modifications were made to the EUT during testing

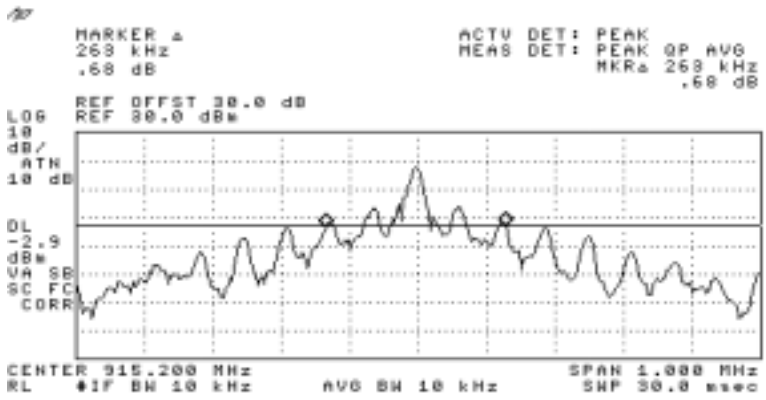
Deviations From The Standard

No deviations were made from the requirements of the standard.

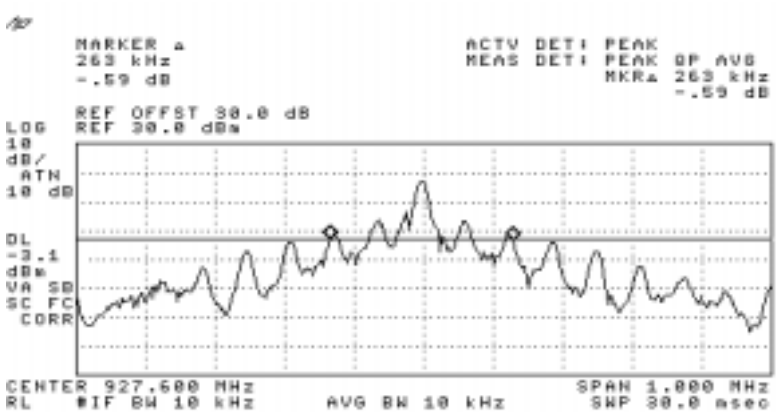
Run #1: Signal Bandwidth

Channel	Frequency (MHz)	Res BW	20dB Signal Bandwidth	99% Bandwidth
Low	902.8	10kHz	260 kHz	398 kHz
Mid	915.2	10kHz	263 kHz	413 kHz
High	927.6	10kHz	263 kHz	418 kHz





Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A



Run #2: Output Power

Measured with a peak power meter

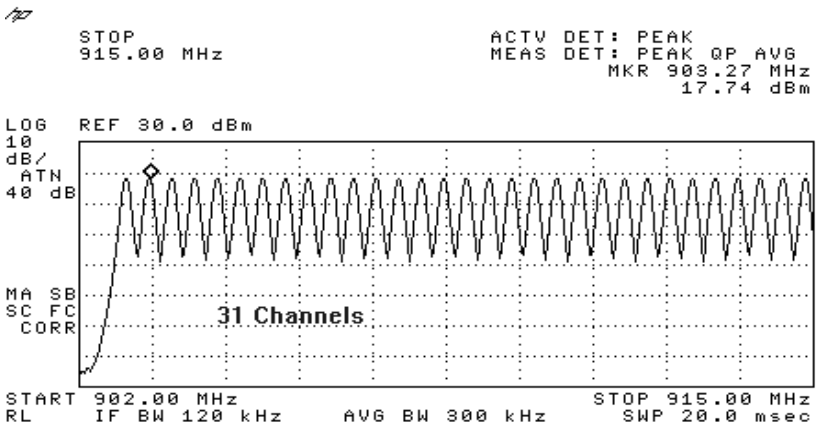
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	902.8	20.75	0.119
Mid	915.2	20.82	0.121
High	927.6	20.85	0.122

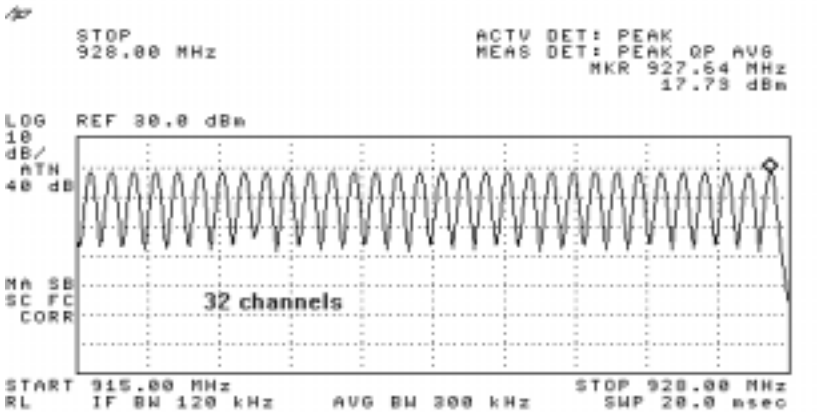
Run #3: Channel Occupancy And Spacing

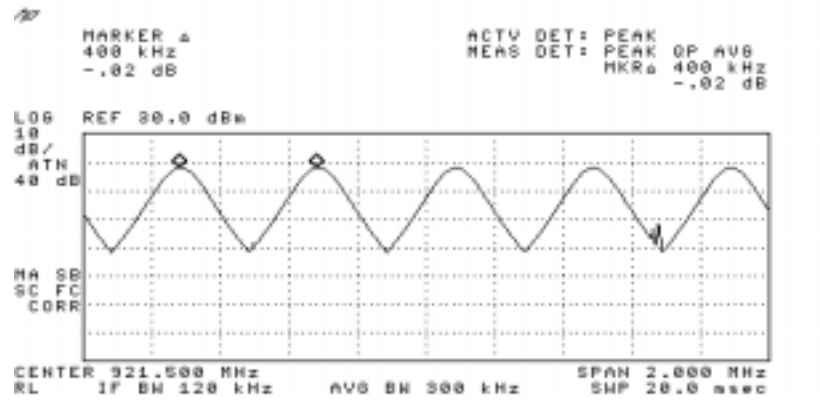
The channel occupancy was measured with the radio transmitting normally (i.e. In hopping mode)
The number of channels was verified with the radio transmitting normally (i.e. In hopping mode)

The number of channels was:	63	
The channel spacing was:	400	kHz
The transmit time on a single channel per transmission:	127.5	ms
The time between successive transmissions on a channel was:	8	s
The channel occupancy per 20s was:	317.5	ms

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

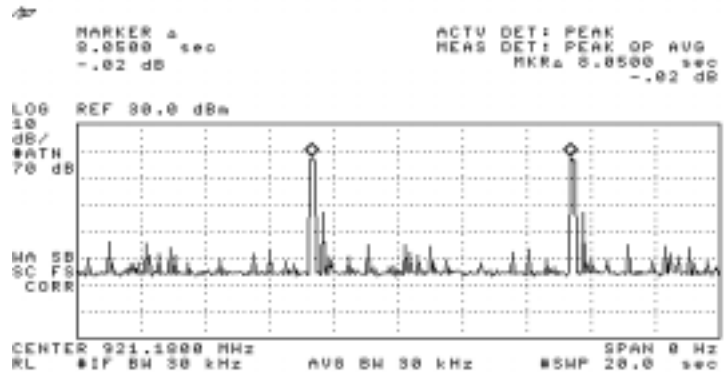




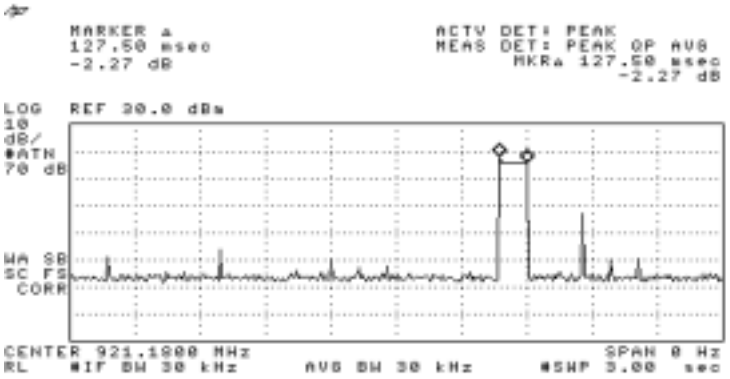


Channel spacing

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A



Time between successive hops on the same channel (8 seconds)



Transmit time on a single channel

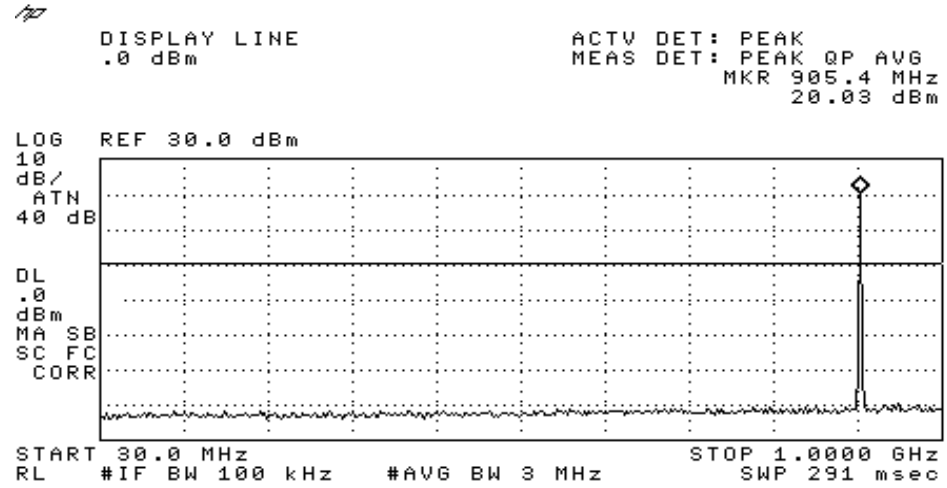
Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

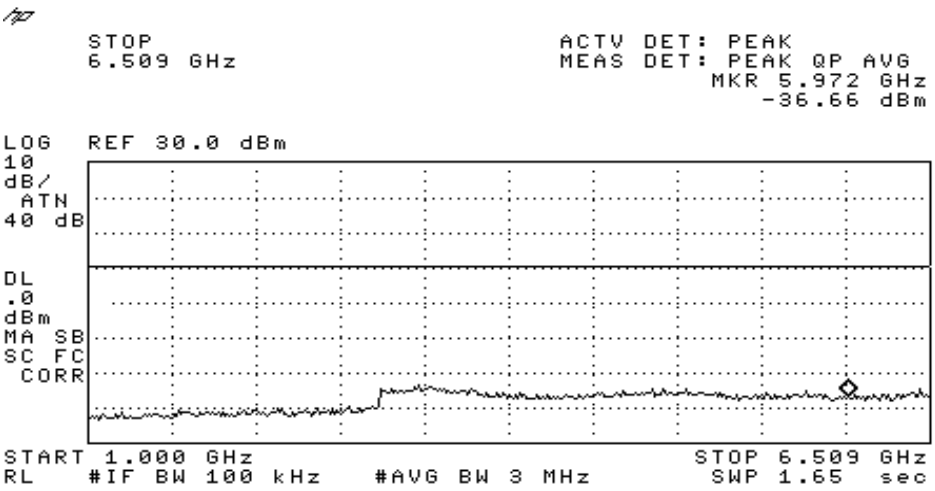
Run #4: Spurious/ Out-of Band Emissions

Out of band spurious measured conducted to 6.5GHz only. Radiated spurious were evaluated to 10GHz.

All spurious emissions were more than 20dB below the fundamental signal level when measured in a 100kHz bandwidth. Refer to the plots below. A plot showing the restricted band that starts at 960 MHz has also been included to demonstarte compliance in that band.

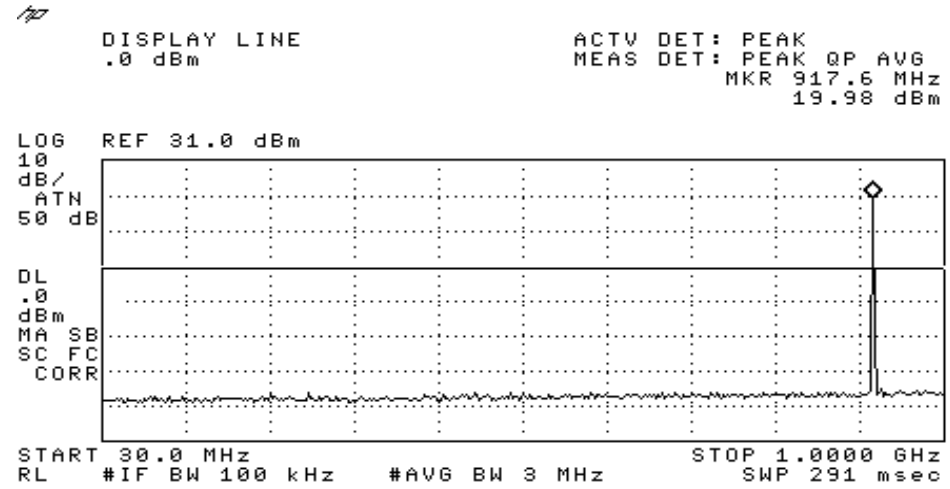
Low Channel 902.8 MHz

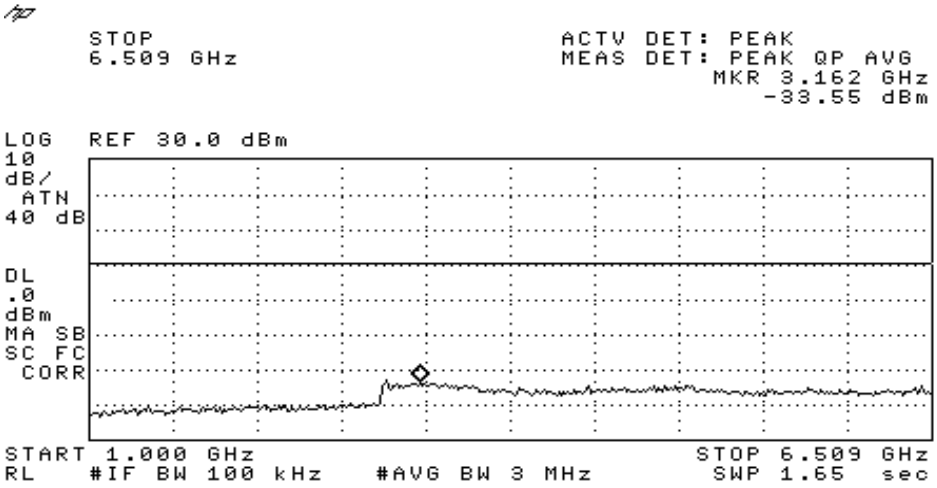




Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

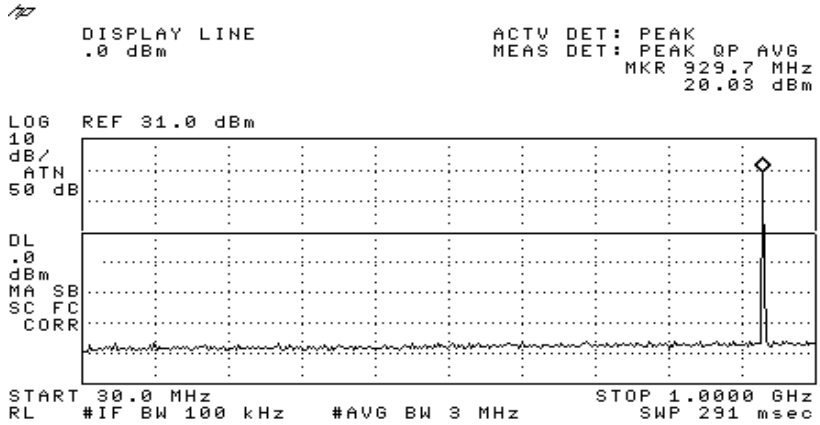
Middel Channel 915.2 MHz

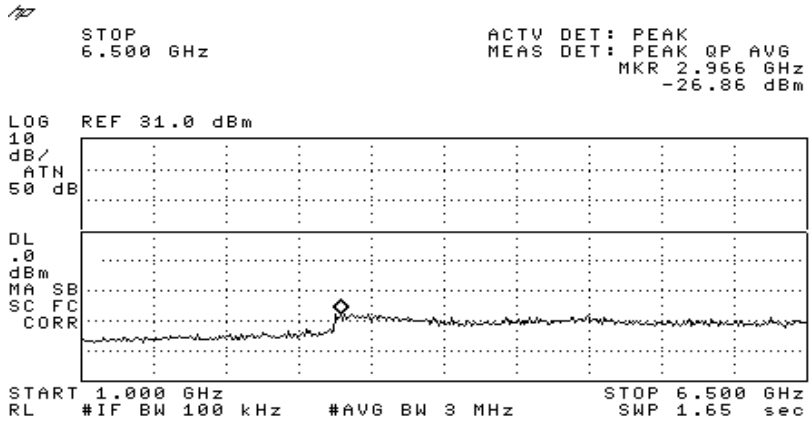


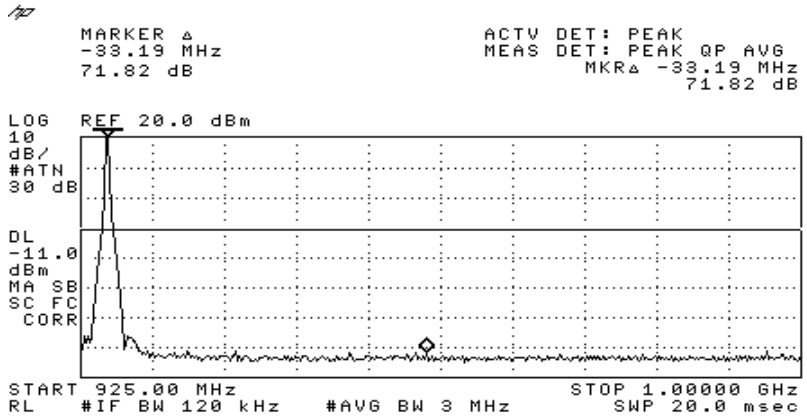


Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

High Channel 927.6 MHz







Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

Radiated Emissions - Transmitter (15.247)

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 8/3/2004
Test Engineer: Mark Briggs
Test Location: SVOATS #1
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Unless stated otherwise the EUT was operating such that it was constantly operating on either the low, center or high channels.

Ambient Conditions:

Temperature: 19 °C
Rel. Humidity: 66 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 30 - 10000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-15.2dB @ 3611.2MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Elliott

EMC Test Data

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 10000 MHz

The fundamental field strength is lower than would be expected given the output power (~22dBm eirp) as the antenna is located inside the enclosure of the printer. The transmitter is designed to interrogate the tag being printed.

Run #1a: Radiated Spurious Emissions, 900 - 10000 MHz. Low Channel @ 902.8 MHz

	H	V
Fundamental emission level @ 3m in 100kHz RBW:		105.2
Limit for emissions outside of restricted bands:	85.2 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3611.181	38.9	V	54.0	-15.2	AVG	126	1.0	Noise Floor
2708.433	34.7	V	54.0	-19.4	AVG	-10	1.0	Noise Floor
3611.181	49.7	V	74.0	-24.3	PK	126	1.0	Noise Floor
2708.433	45.6	V	74.0	-28.4	PK	-10	1.0	Noise Floor
1805.585	33.4	V	85.2	-51.8	Pk	22	1.0	RBW=100kHz
1805.601	32.0	H	85.2	-53.2	Pk	108	1.0	RBW=100kHz

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	All other spurious emissions were more than 20dB below the limit.

Run #1b: Radiated Spurious Emissions, 900 - 10000 MHz. Center Channel @ 915.2 MHz

	H	V
Fundamental emission level @ 3m in 100kHz RBW:		105.0
Limit for emissions outside of restricted bands:	85.0 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2745.173	35.2	H	54.0	-18.8	AVG	360	1.0	Noise Floor
2745.566	35.2	V	54.0	-18.8	AVG	361	1.0	Noise Floor
2745.566	46.9	V	74.0	-27.1	PK	361	1.0	Noise Floor
2745.173	46.1	H	74.0	-27.9	PK	360	1.0	Noise Floor
1830.397	34.8	V	85.0	-50.2	Pk	72	1.2	RBW=100kHz
1830.412	33.3	H	85.0	-51.7	Pk	152	1.2	RBW=100kHz

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	All other spurious emissions were more than 20dB below the limit.

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	N/A

Run #1c: Radiated Spurious Emissions, 900 - 10000 MHz. High Channel @ 927.6 MHz

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	100.1	100.7
Limit for emissions outside of restricted bands:	80.7 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2782.538	34.0	V	54.0	-20.0	AVG	68	1.0	Noise Floor
2782.538	45.2	V	74.0	-28.8	PK	68	1.0	Noise Floor
1855.184	36.1	H	80.7	-44.7	Pk	302	1.8	RBW=100kHz
1855.170	32.5	V	80.7	-48.2	Pk	157	1.0	RBW=100kHz

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	All other spurious emissions were more than 20dB below the limit.

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	B

Conducted Emissions - Power Ports

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 8/3/2004
Test Engineer: Mark Briggs
Test Location: SVOATS #2
Config. Used: #1
Config Change: -
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 59 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 230V/50Hz	FCC 15.207 FCC 15.107	Pass	-4.9dB @ 0.197MHz

Modifications Made During Testing:

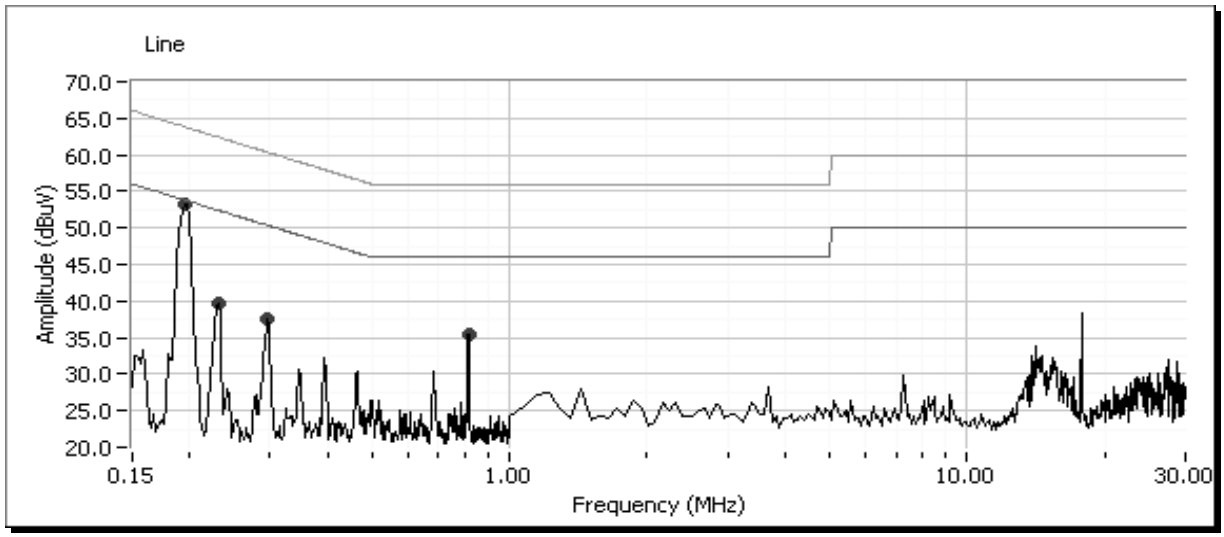
No modifications were made to the EUT during testing

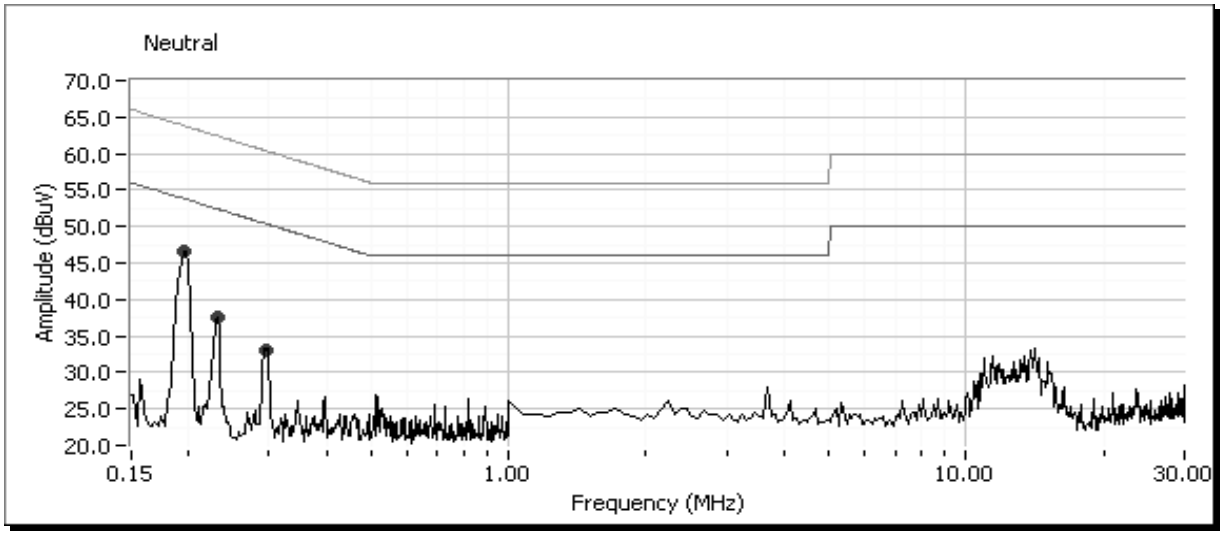
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





EMC Test Data

Client:	SATO Corp.	Job Number:	J56586
Model:	SATO M8485SE Printer with RFID Reader	T-Log Number:	T56606
		Account Manager:	-
Contact:	Greg Katterhagen		
Spec:	FCC15.247; FCC 15 Subpart B	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz

Frequency	Level	AC	FCC 15.207 / 15.107		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.197	48.8	Line	53.7	-4.9	Average	
0.197	46.9	Neutral	53.7	-6.8	Average	
0.197	52.8	Line	63.7	-10.9	QP	
0.197	50.9	Neutral	63.7	-12.8	QP	
0.296	35.4	Line	50.4	-15.0	Average	
0.296	33.9	Neutral	50.4	-16.5	Average	
0.231	35.1	Line	52.4	-17.3	Average	
0.231	40.1	Line	62.4	-22.3	QP	
0.296	36.0	Line	60.4	-24.4	QP	
0.296	34.6	Neutral	60.4	-25.8	QP	