MEASUREMENT/TECHNICAL REPORT

Intermec
Technologies Corporation
EMC Test Laboratory
Cedar Rapids, IA

Intermec Technologies Corporation
ABTM3 Radio Module

REPORT NO: 20010809-1

DATE: August 9, 2001

This report concerns: ABTM3 Radio Module, Average Time of Occupancy
Equipment Type: 2400- 2483.5 MHz Frequency Hopping Spread Spectrum Transceiver, FCC 15.247 Industry Canada RSS-210 Issue 4, RSS-102 Issue 1
Measurement procedure used: ANSI C63.4-1992.

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1.0 COMPLIANCE CERTIFICATION

The electromagnetic compatibility test and data evaluations findings of this report have been prepared by the EMC Test Lab, Intermec Technologies Corporation, in accordance with applicable specifications instructions required per-

FCC SECTION	CANADA RSS-210	TEST NAME
15.247 (a)(1)(ii)	6.2.2(o)(a)(a3)	Average Time of Occupancy

The data, data evaluation and equipment configuration represented herein are a true and accurate representation of the measurements of the test sample's electromagnetic compatibility characteristics as of the dates and at the times of the test under the conditions herein specified. The data presented herein is traceable to the National Institute of Standards and Technology.

This report is not an endorsement of the tested product by NVLAP or any agency of the U.S. Government.

NVLAP®

Accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code 100269-0.

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The scope of accreditation at the EMC Test Laboratory is limited to NVLAP codes:

12/CIS22 IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment. **12/CIS22a** IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment, Amendment 1:1995, and Amendment 2:1996. **12/CIS22b** CNS 13438:1997: Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
12/F01 FCC Method - 47 CFR Part 15 - Digital Devices. **12/F01a** Conducted Emissions, Power Lines, 450 kHz to 30 MHz. **12/F01b** Radiated Emissions.
12/T51 AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment.

EMC 017

Interference Technology International

Dave Fry

Date 08/09/01
mm/dd/yy

Dave Fry
Regulatory Engineer II

CERTIFIED NARTE ENGINEER

National Association of Radio and Telecommunications Engineers

1.1 Measurement Uncertainty

Confidence Statement
The measurement uncertainty statements below use a Coverage Factor K = 2.
The Coverage Factor K = 2 equates to an approximate confidence level of 95%.

HP71910A Measurement System
Amplitude Measurements Expanded Measurement Uncertainty of +/- 2.0 dB
Frequency Measurements Expanded Measurement Uncertainty of +/- 1.0 kHz

Lecroy LC584AL
Amplitude Measurements Expanded Measurement Uncertainty, +/- 2.0% full scale
Time Measurements Expanded Measurement Uncertainty, of 10ppm, 5ps pixel resolution

2.0 TRANSMITTER AVERAGE OCCUPANCY

Test Procedure:

1) The permanently attached antenna on the transmitter requires testing as a radiated test. The spectrum analyzer is coupled to the transmitter via a 2.45 GHz monopole antenna. Establish a "master" "slave" connection between two ABTM3 radio modules and transmit several megabytes of data between the radios. To measure the narrow transmission widths accurately connect a digital storage oscilloscope (DSO) with a BW of 500 MHz or greater to the AUX output of the spectrum analyzer IF.

2) Set the spectrum analyzer on a center frequency of 2450 MHz (Ch. 49) of the transmitter. Using 0 Hz span with 300 kHz RBW and 30kHz VBW plot a 30 second sweep while the transmitter is transferring data in the above configuration. This plot shows the number of transmissions on Ch.49 in that 30-second period.

3) While the radio continues to transmit use the DSO to show a similar plot at 5 seconds/division or 50 seconds. Print this plot.

4) Using the oscilloscope trace expansion capability count the number of times the transmitter is on in a 30-second period.

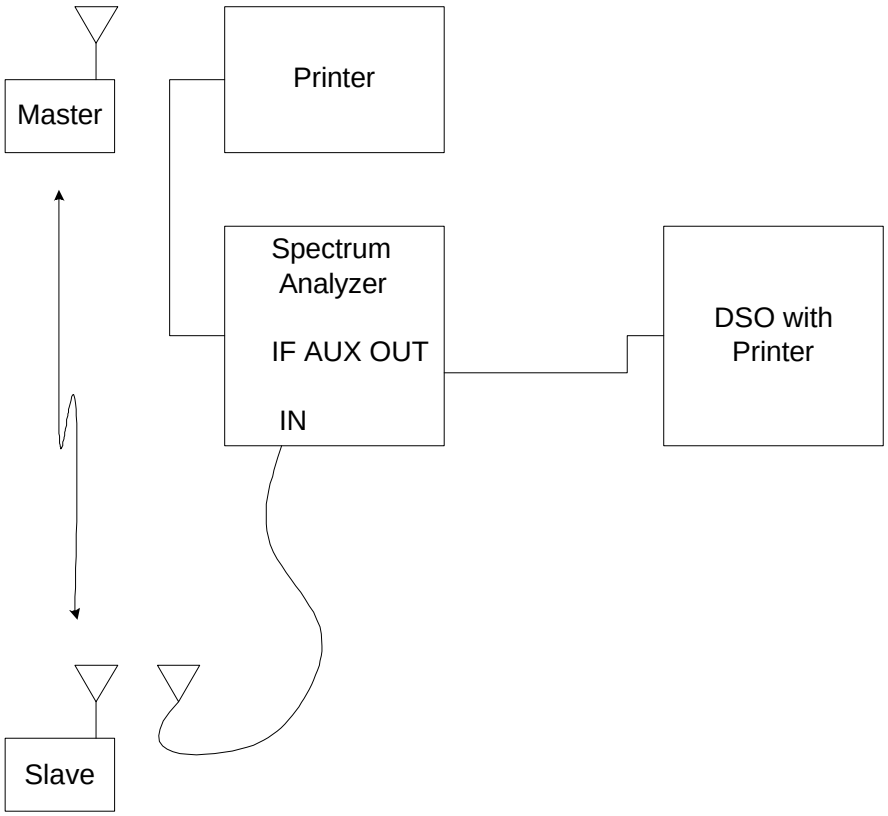
5) Expand the presentation to 0.1mS/division and search for a DM1 transmit event. Using the DSO cursor functions identify the transmit time and plot.

6) Repeat step 5 for a DM3 as well as a DM5 event using a scope setting of 0.5mS/division.

7) Calculate the worst-case average transmitter average occupancy based on the plotted information presented.

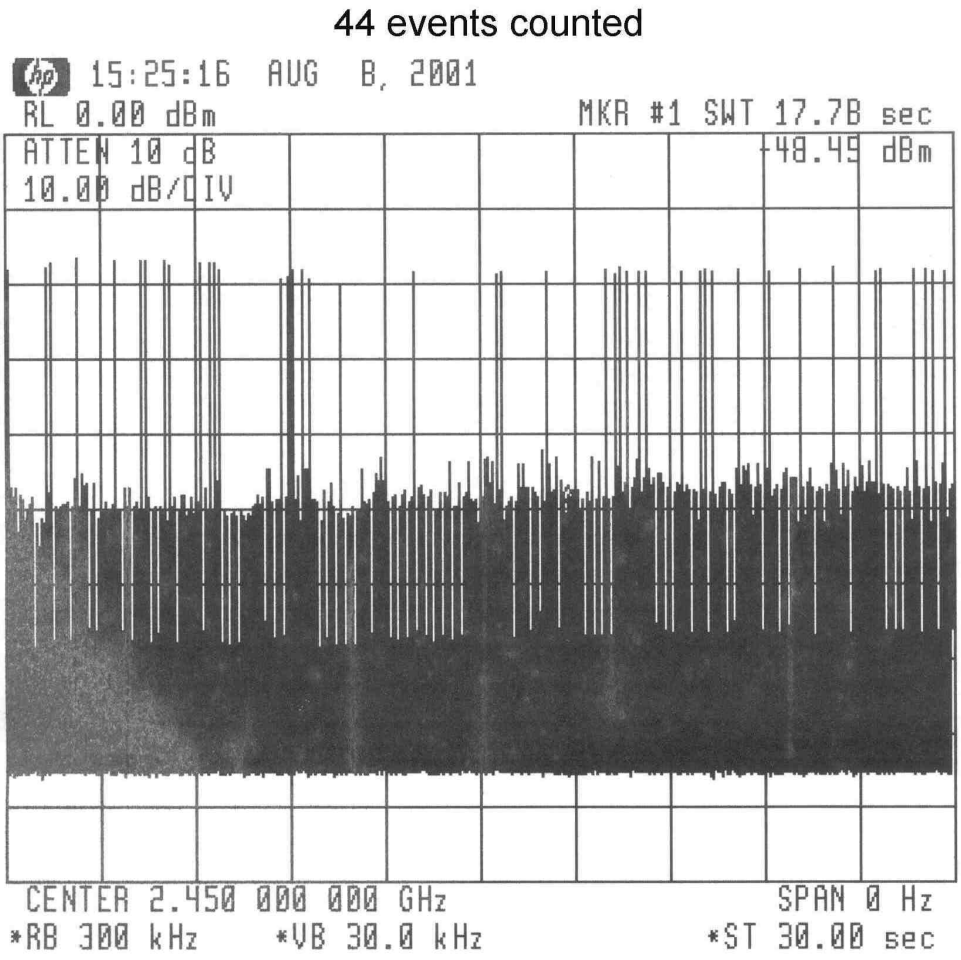
8) Calculate the worst-case transmitter occupancy time using the timing specified for DM1, DM3 and DM5 if those packets could be transmitted and received in the master slave system.

Equipment Setup:

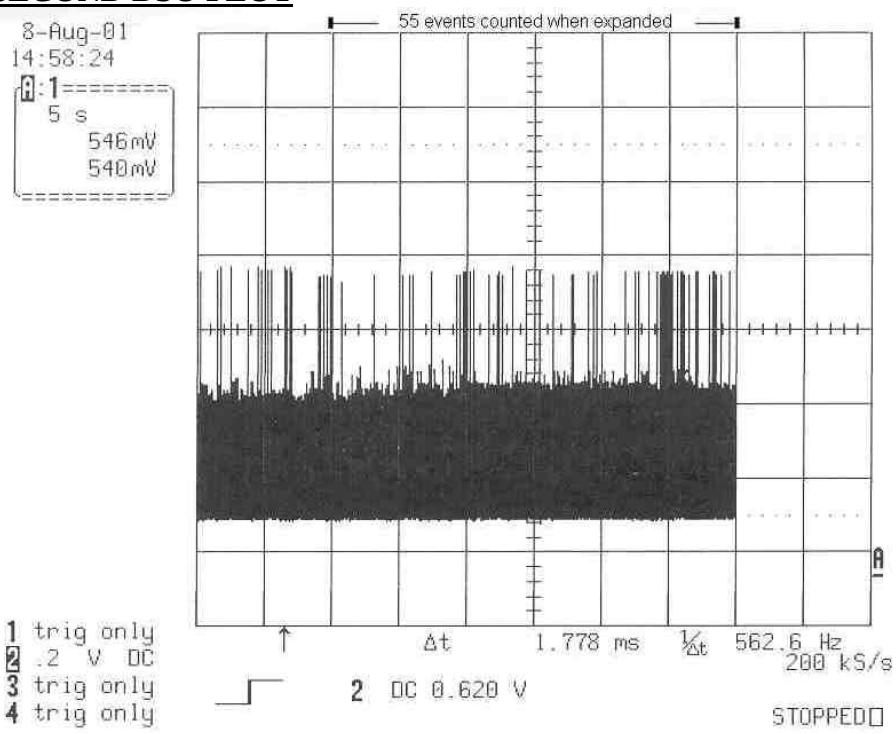


Test Results:

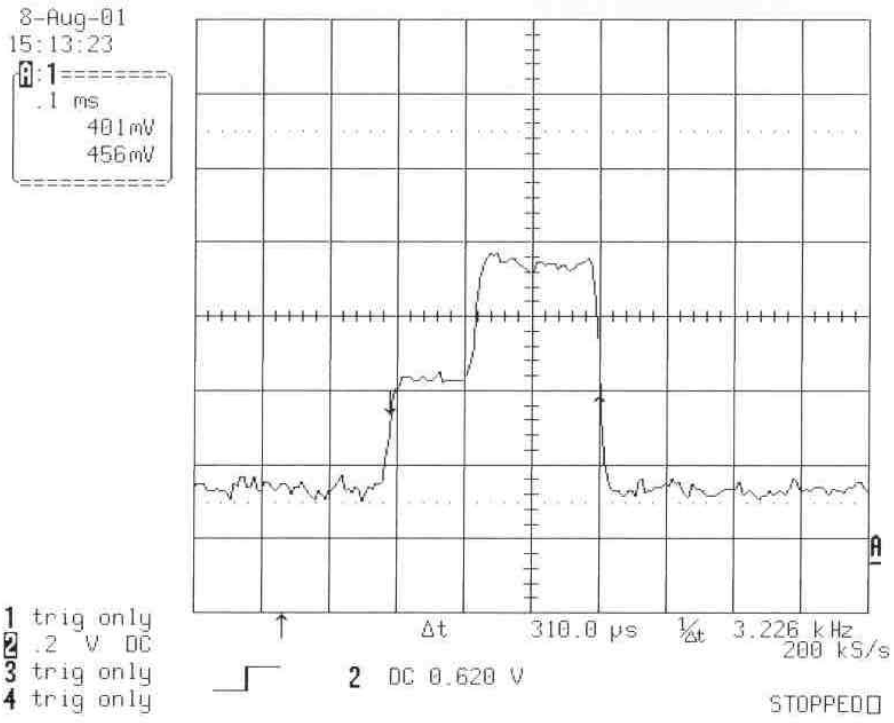
ABTM3 30 SECOND SPECTRUM ANALYZER PLOT



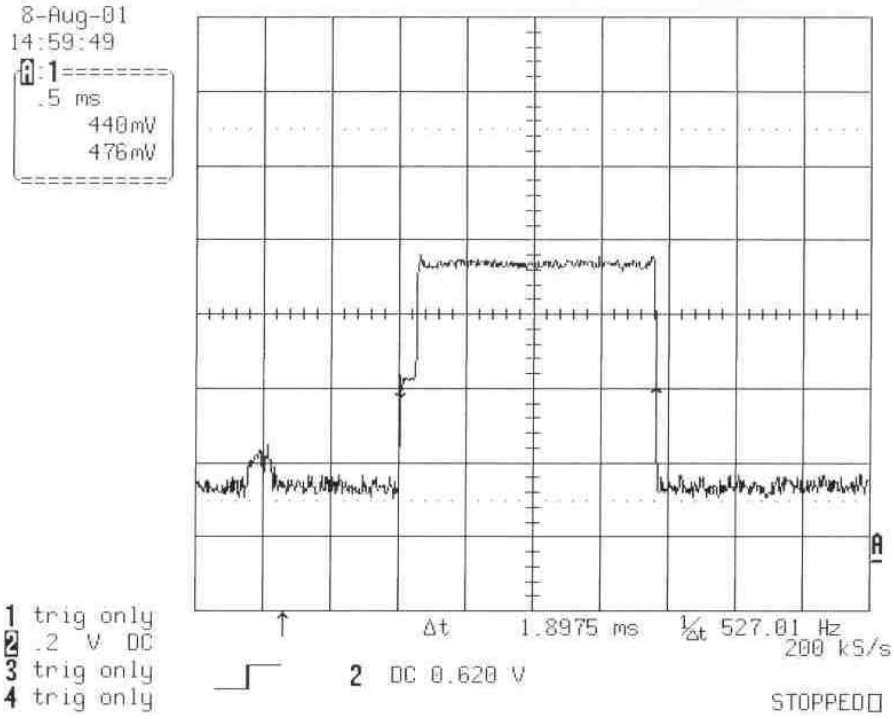
ABTM3 50 SECOND DSO PLOT



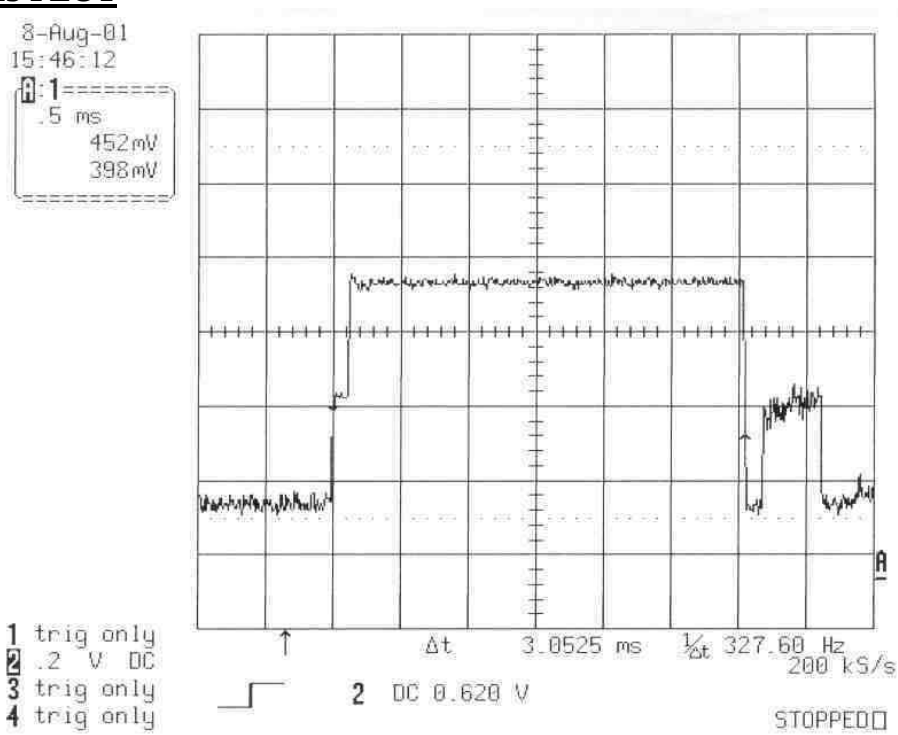
ABTM3 DM1 PLOT



ABTM3 DM3 PLOT



ABTM3 DM5 PLOT



Calculations based on plotted measurements:

Plots show the number of events on a channel to vary. The plots show herein show 44 and 55 events counted. The transmitter may use 3 different packet sizes. Plots show the DM1 to occupy 0.310mS, DM3 to occupy 1.898mS and DM5 to occupy 3.0525mS on a channel. Based on the worst case DM5 plot the average occupancy of any frequency in any 30-second period is calculated below.

55 events of DM5 transmissions of 3.0525mS = 0.1679S channel occupancy in 30 seconds. Well below the 0.4-second occupancy in 30 seconds specified in the regulations.

The transmission of DM1, 3 or 5 is random dependant on the amount of data to transfer, the plots presented are considered typical for operation of the ABTM3 radio. The channel hopping sequences specified in the Bluetooth protocol define each channel is utilized equally in a random pattern. The combination of random DM1, 3 or 5 transmissions and defined hopping sequence utilize each channel equally on average.

Worst-Case Calculations

Average Occupancy calculations based on Bluetooth specification for FHSS operation.

Bluetooth is a master-slave protocol with time slots of 625 uS. So after one radio transmits a packet, (DM1, DM3 or DM5), he then must go into receive for at least one slot. For the DM1 packets, radio #1 can send for 366 uS, then there is 259 uS of "dead" time (366 + 259 = the 625 slot time) then radio #2 transmits for a minimum of 366 uS then the 259 uS of dead time. Then radio #1 can transmit again (on a different channel). The total transaction time is 2 slots or 1.25 mS. So the number of hops on any one channel is (30 / 1.25 mS) / 79 = 303.8. Then 303.8 x 366 uS = 0.1112 second occupancy out of 30 seconds.

For the DM3 similarly radio #1 transmits 1616uS, 259 uS dead time, radio #2 transmits 366us, 259 dead time.

(30 / 2.5 mS) / 79 X 1.616mS = 0.2455 seconds out of 30

and DM5

(30 / 3.75 mS) 79 X 2.866mS = 0.2902 second out of 30

Based on the above calculations, any combination of DM1, 3 or 5 transmissions would not exceed the 0.4-second average occupancy in a 30-second period.

Preformed by: Dave Fry Date: Aug 8, 2001

See 3.0 Measurement Equipment List for the test equipment used for testing.

3.0 Measurement Equipment List

Disc	SN	Cal Date
HP 71910A Modular Measurement System		
HP70001A Mainframe	3544A07456	14 Sept 2000
HP70004A Display	3545A04060	14 Sept 2000
HP70310A Precision Frequency Ref.	3127A02527	14 Sept 2000
HP70900B Local Oscillator	3450A02592	14 Sept 2000
HP70902A IF Section 10Hz-300 kHz	3503A04906	14 Sept 2000
HP70903A IF Section 100k-3MHz	3533A03060	14 Sept 2000
HP70911A IF Section 10-100MHz	3340A00124	14 Sept 2000
HP70910A RF Section 100Hz-26.5 GHz	3503A00271	14 Sept 2000
Lecroy LC584AL 1 GHz DSO w/printer	10795	16 Mar 1999
HP694 Printer w/Centronic to GPIB	SG74A1N0KH	on request