

RETLIF TESTING LABORATORIES
TEST REPORT R-4155N4
September 24, 2003

FCC COMPLIANCE TEST REPORT
ON

RADIANCE, INC.
INDOOR POSITIONING TRANSCEIVER
FCC ID: Q9V-400-A

APPLICANT Radianse, Inc. 439 South Union Street, Suite 401 Lawrence, MA 01843	MANUFACTURER SAME
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TEST SPECIFICATION: FCC Rules and Regulations Part 15, Subpart C, Para. 15.231 (e)

TEST PROCEDURE: ANSI C63.4:1992

TEST SAMPLE DESCRIPTION

BRANDNAME: LanPak

MODEL: 400A

TYPE: Indoor positioning/asset location system transceiver (Receiver verified)

POWER REQUIREMENTS: DC via 120VAC, 60Hz external power supply

FREQUENCY OF OPERATION: 433.92MHz

TYPE OF TRANSMISSION: Pulsed emission containing manchester encoded data bits

FCC ID: Q9V-400-A

APPLICABLE RULE SECTION: Part 15, Subpart C, Section 15.231 (e)

TESTS PERFORMED

15.231 (e) Spurious Emissions (30MHz to 4.4GHz)

15.231 (e) Field Strength of Fundamental (433.92MHz)

15.231 (c) Occupied Bandwidth, 0.25% of Fundamental Frequency

15.207 (a) Conducted Emissions

Duty Cycle Determination

TEST SAMPLE OPERATION

The EUT is dc powered via an external 120VAC, 60Hz power supply. The device is normally manually operated but can be programmed to operate automatically. The device transmits a 433.92MHz signal used to calibrate associated system receivers. Operation of the EUT complies with the parameters required in Part 15, Subpart C, Section 15.231 (e) for devices which will transmit data and with the general requirements of 15.231 for both automatic and manual operated devices. For testing purposes only the EUT was configured to continuously transmit.

TEST SAMPLE / TEST PROGRAM

- When manually activated the transmitter automatically ceases transmission within five seconds after activation per the requirements of 15.231 a (1).
- In automatic mode the transmitter ceases transmission within 5 seconds after activation per the requirements of 15.231 a (2).
- In automatic mode operation is limited so that the duration of each transmission is less than one second (8.016msec) and the silent period between transmissions is more than 30 times the duration of the transmission and over ten seconds per the requirements of 15.231 (e) .
- The device is not employed for RC purposes involving fire, security and safety of life.
- The fundamental field strength at 433.92MHz did not exceed 4398 μ V/M (Average) at a test distance of 3 meters.
- The peak value of fundamental emissions did not exceed a peak field strength limit corresponding to 20dB above the maximum permitted average limit.
- The field strength of harmonic and spurious emissions did not exceed 439 μ V/M as specified in 15.231 (e) for a fundamental frequency of 433.92MHz.
- The device operates at a single frequency of 433.92MHz The bandwidth of emissions did not exceed 0.25% of the operating frequency as specified in 15.231 (c) and was determined as follows:

Fundamental Frequency	=	433.92MHz
0.25% of Center Frequency	=	1.0848MHz
1.0848 divided by 2	=	0.542MHz
Bandwidth Range	=	Fundamental Frequency + and - 0.542MHz
433.92MHz - 0.542MHz	=	433.378MHz
433.92MHz + 0.542MHz	=	434.462MHz
Bandwidth Range	=	433.378MHz - 434.462MHz

- The device uses an internal loop antenna
- Radiated Emissions from the EUT were measured in all three axis. The attached Radiated Emissions test data is representative of the worst case orientation.

DETERMINATION OF FIELD STRENGTH LIMITS

The field strength limits shown below were calculated as instructed in Section 15.231 (e).

Fundamental Frequency: 433.92MHz

Where F is the frequency in MHz, the formula for calculating the maximum permitted fundamental field strength for the band 260-470MHz, $\mu\text{V/m}$ at 3 meters is as follows:

$$\begin{aligned} 16.6667(F) - 2833.3333 &= \text{Field Strength Limit } (\mu\text{V/m}) \\ 16.6667 \times 433.92 &= 7232 \\ 7232 - 2833.3333 &= 4398 \\ \text{Field Strength Limit} &= 4398 \mu\text{V/m} = 72.8\text{dB}\mu\text{V/M} \end{aligned}$$

The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level which equals $439.8 \mu\text{V/m} = 52.8\text{dB}\mu\text{V/M}$.

DETERMINATION OF DUTY CYCLE

The transmitter controls were adjusted to maximize the transmitted duty cycle. The analyzer was set for a frequency span of 0Hz. The sweep time was then adjusted in order to display one full pulse train. The transmitter on time was then summed and compared to the time for one full cycle in order to obtain the duty cycle. As the pulse train was less than 100msec in duration the worst case duty cycle was determined by measuring/calculating the duration of the pulse train and then the “on time” within the pulse train. The on times were determined as follows:

The individual pulse widths within the pulse train were measured and summed in order to obtain the total “on time” within the train.

Fundamental Frequency: 433.92MHz

$$\begin{aligned} \text{Transmitter On Time} &= 4.0865 \text{ milliseconds} \\ \text{Transmitter Cycle Time} &= 8.016 \text{ milliseconds} \\ \text{Transmitter Duty Cycle} &= 50.98 \% \\ \text{On Time divided by Cycle Time} &= \text{Duty Cycle Factor} \\ 4.0865 \text{ divided by } 8.016 &= 0.5096 \\ 0.5096 \text{ converted to dB } (\text{LOG}_{10} .05096)20 &= -5.85\text{dB} \\ \text{Duty Cycle Factor} &= \text{-5.85dB} \end{aligned}$$

As the measured peak field strength of the transmitter was less than the specified average limit without applying the Duty Cycle Correction Factor the duty cycle determination plots have not been included as an exhibit and the duty cycle factor was not applied to the final field strength readings.

TEST SAMPLE / TEST PROGRAM (continued)

SPECTRUM ANALYZER

Due to the nature of the emissions being measured, care was taken to ensure that the resolution bandwidth of the spectrum analyzer was adequate to provide accurate measurements.

GENERAL NOTES

1. All readings were taken utilizing a peak detector function at a test distance of 3 meters.

EQUIPMENT LISTS

Conducted Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4027	LISN	Solar Electronics	10 KHz - 30 MHz	9252-50-R-24BNC	10/02/2002	10/02/2003
4028	Isolation Transformer	Acme	N/A	120x240	01/08/2003	01/08/2004
4050	Transient Limiter	Hewlett Packard	9 KHz - 200 MHz	11970K	01/08/2003	01/08/2004
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	03/18/2003	03/18/2004

Fundamental Field Strength and Spurious Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
3258	Double Ridge Guide	EMCO	1 - 18 GHz	3115	05/14/2003	05/14/2004
4029B	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	07/30/2003	07/30/2004
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	07/25/2003	08/25/2003
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	03/18/2003	03/18/2004

Occupied Bandwidth

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	03/18/2003	03/18/2004

Test Report No. R-4155N4
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RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

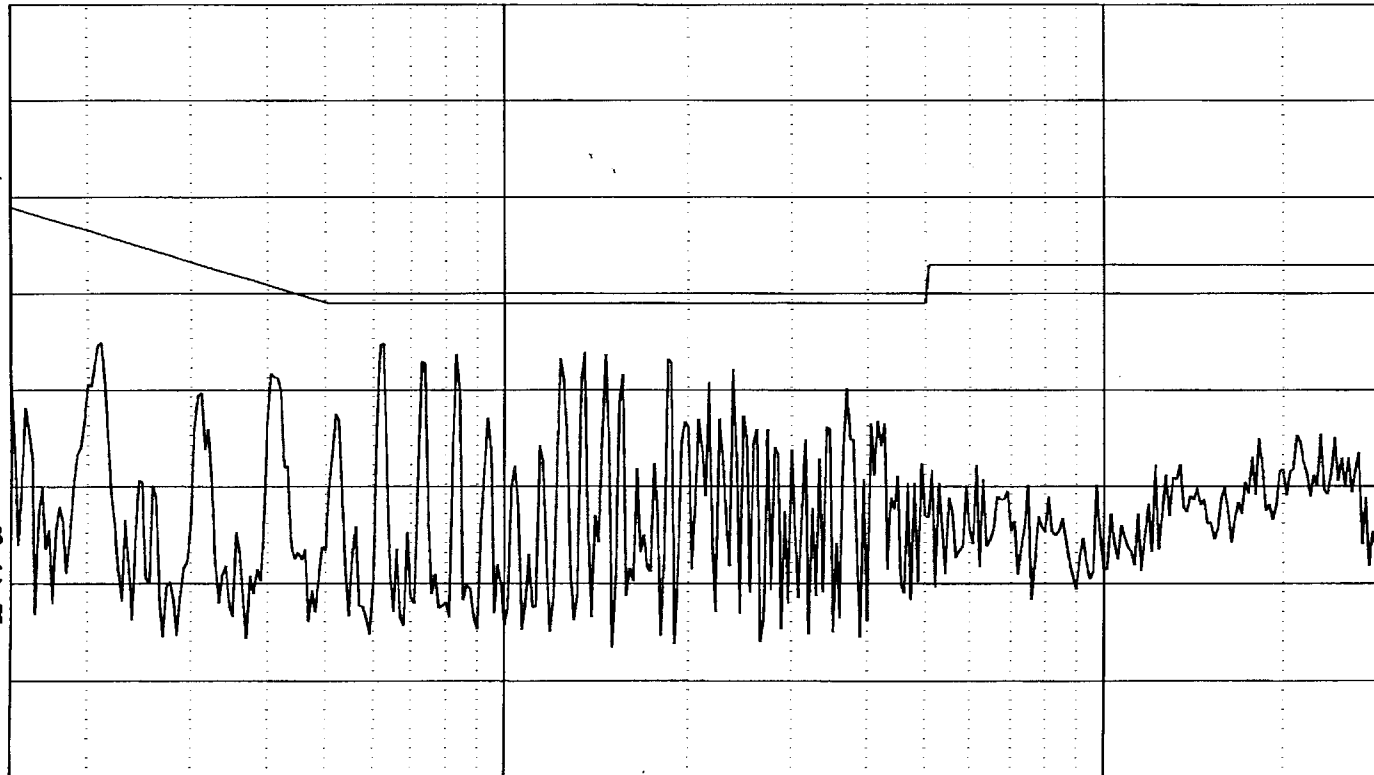
Test Method:	Conducted Emissions 150 kHz to 30 MHz		
Customer:	Radianse, Inc.	Test Sample:	Transceiver
Model No:	M400A	Serial No:	n/a
Test Specification:	FCC Part 15 Subpart C	Paragraph:	15.207(a)
Operating Mode:	Transmitting Data Bursts		
Notes:	Lead Tested: Main Power 120 VAC 60 Hz Hot Peak Readings to Average Limits		
Job No:	R-4155N4		Technician:
		T. Firkowski	Date:
		08/20/2003	

09: 54: 48 AUG 20, 2003

REF 77.0 dB μ V #AT 0 dB

PEAK
LOG
10
dB/
OFFST
10.0
dB

WA SB
SC FC
CORR



START 150 kHz
#RES BW 10 kHz

VBW 10 kHz

STOP 30.00 MHz
SWP 1.21 sec

TXH

RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

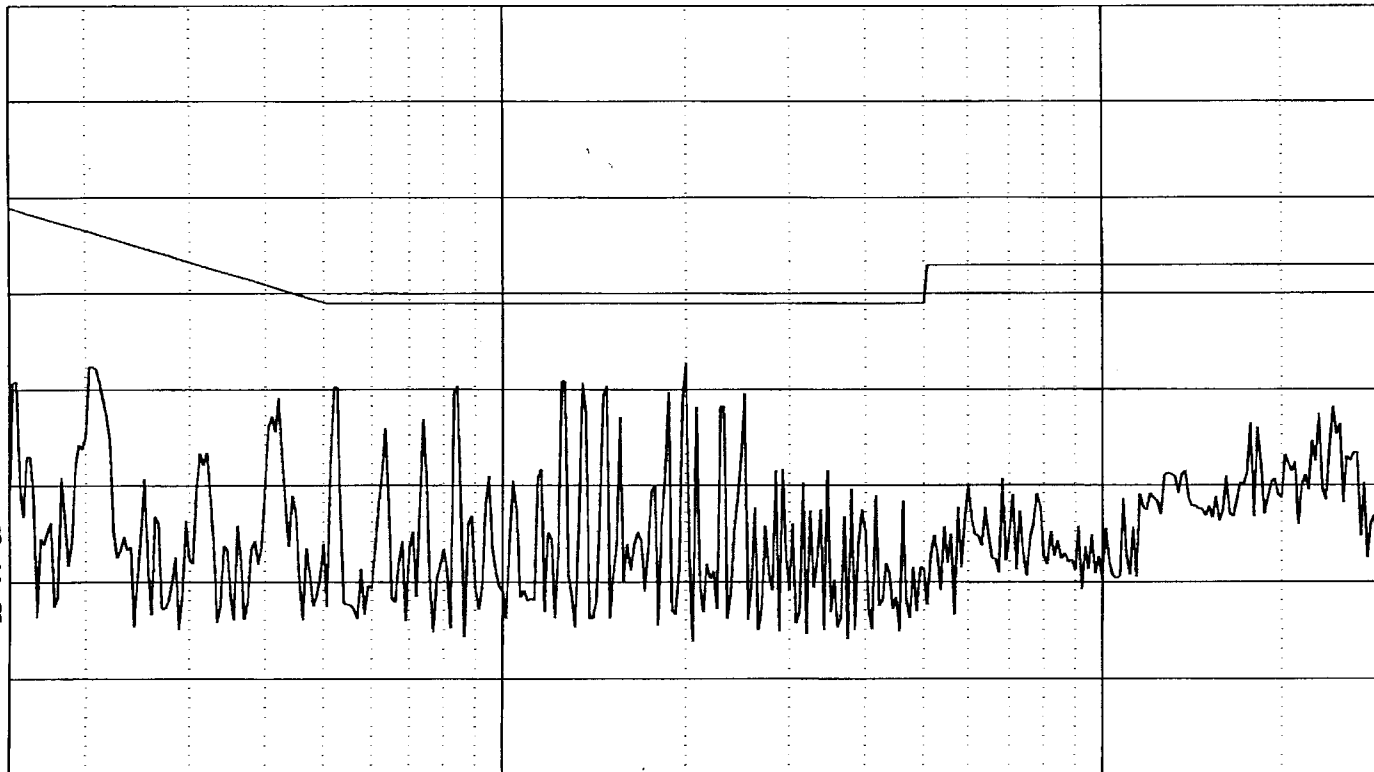
Test Method:	Conducted Emissions 150 kHz to 30 MHz		
Customer:	Radianse, Inc.	Test Sample:	Transceiver
Model No:	M400A	Serial No:	n/a
Test Specification:	FCC Part 15 Subpart C	Paragraph:	15.207(a)
Operating Mode:	Transmitting Data Bursts		
Notes:	Lead Tested: Main Power 120 VAC 60 Hz Neutral Peak Readings to Average Limits		
Job No:	R-4155N4		Technician:
		T. Firkowski	Date:
		08/20/2003	

09:54:07 AUG 20, 2003

REF 77.0 dB μ V #AT 0 dB

PEAK
LOG
10
dB/
OFFST
10.0
dB

WA SB
SC FC
CORR



START 150 KHz
#RES BW 10 KHz

VBW 10 KHz

STOP 30.00 MHz
SWP 1.21 sec

11.2

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

Test Method:

Fundamental Field Strength & Spurious Emissions 30 MHz - 4.4 GHz

Customer:

Radianse, Inc.

Job No:

R-4155N4

Test Sample:

Transceiver

Model No:

M400A

Serial No:

n/a

Test Specification:

FCC Part 15

Paragraph: 15.231 (e)

Operating Mode:

Transmitting Data Bursts

Technician:

T. Firkowski

Date:

08/19/2003

Notes:

[illegible]

EUT emissions observed throughout the given frequency spectrum were recorded and evaluated. Emission levels closest to the limit are listed on this data sheet.

RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

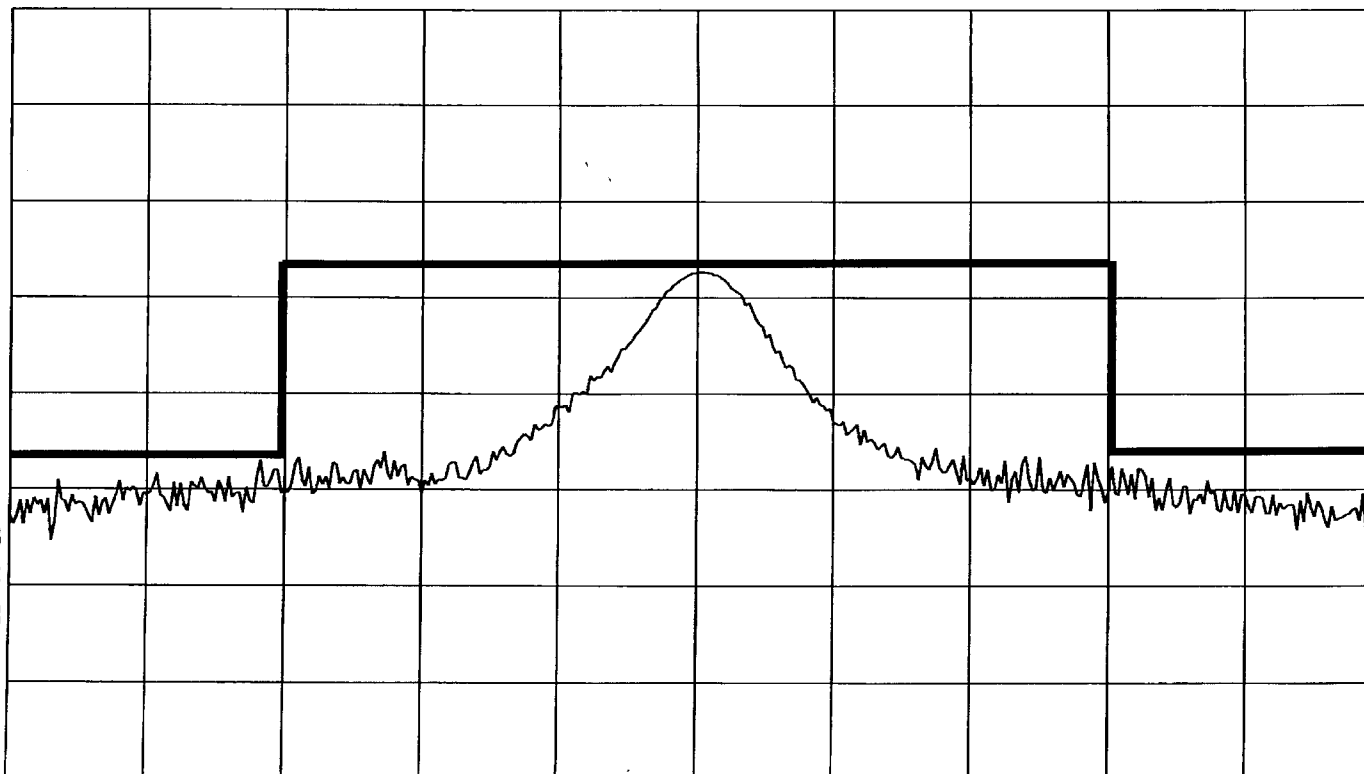
Test Method:	Occupied Bandwidth		
Customer:	Radianse, Inc.	Test Sample:	Transceiver
Model No:	M400A	Serial No:	n/a
Test Specification:	FCC Part 15	Paragraph:	15.231
Operating Mode:	Transmitting Data Bursts		
Notes:			

08:55:23 AUG 21, 2003

REF 87.0 dB μ V #AT 0 dB

PEAK
LOG
10
dB/

VA SB
SC FC
CORR



CENTER 433.920 MHz
#RES BW 100 kHz

VBW 300 kHz

SPAN 1.808 MHz
SWP 20.0 msec