

Orion Research Inc.

Emissions Testing
Performed
on the
RF Link Data Transfer Transmitter
Model: TX232
FCC Part 15, Subpart C, Section §15.249

Date of Test: January 19 and January 20, 1999

JOB #J99000641A
VFV/Rbt
ORI0641A.VFV
January 26, 1999
DOT: January 19 and January 20, 1999
Contact: Mr. Joe Cheng

Total No. of Pages Contained in this Report: ____

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INTERTEK TESTING SERVICES NA INC.

TO: Orion Research Inc.
Mr. Joe Cheng
FROM: Vathana F. Ven
DATE: January 20, 1999
JOB #: J99000641A

RE: Emissions Testing Performed On The RF Link Data Transfer Transmitter, Model:
TX232

On January 19 and January 20, 1999 we tested the TX232 to determine if it was in compliance with the FCC Part 15, Subpart C, Section §15.249. A production version of the sample was received on January 19, 1999 in good condition. We found that the unit met the requirements when tested as received.

The fundamental output power and harmonic emission limits are outlined in paragraph (a) of this section. The fundamental field strength allowed at a distance of 3 meters was 50,000 $\mu\text{V}/\text{m}$. Harmonic emission at frequencies outside of the forbidden bands of the FCC Part 15, Subpart C §15.205 must be lower than the limit of 500 $\mu\text{V}/\text{m}$.

Spurious Scan (30-1000 MHz) Digital Circuit Portion

Radiated emissions showed the system to be 3.7 dB below the FCC Part 15, Subpart C, Section §15.209 emissions at 191.7 MHz. All other emissions were at least 3.8 dB below the applicable limits

AC mains line-conducted emissions testing was not performed as the unit is battery powered.

INTERTEK TESTING SERVICES NA INC.

TO: Orion Research Inc.
Mr. Joe Cheng
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RE: Emissions Testing Performed On The RF Link Data Transfer Transmitter, Model:
TX232

Fundamental Scan (916.5 MHz) Transmitter Circuit Portion

The maximum level of the fundamental signal at 916.5 MHz was 31, 623 $\mu\text{V/m}$, which is 4 dB below the FCC Part 15, Subpart C, Section §15.249 requirement.

Spurious and Harmonic Scan (916.5-9165 MHz)

Radiated emissions limits showed the system to be 6 dB below the FCC Part 15, Subpart C, Section §15.249 and §15.209 emission requirement at 3666.0 MHz. All other emissions were at least 7 dB below the applicable limits.

Summary

In summary, this report confirms that the TX232 is compliant with the FCC Part 15, Subpart C, Section §15.249 requirements when production units conform with the initial sample.

Please address all questions and comments concerning this report to Andrew J. Bellezza, Staff Engineer/Emissions .

INTERTEK TESTING SERVICES

LABORATORY MEASUREMENTS
Pursuant To
Part 15, Subpart C
For
Intentional Radiators

Manufacturer
(Name and Address):

Orion Research Inc.
500 Cummings Center
Beverly, MA 01915

Attention:

Mr. Joe Cheng

Model Number:

TX232

Serial Number:

Not Labelled

Site:

1C

Certification

We attest to the accuracy of this report:

Signature

Signature

Vathana F. Ven

Testing Performed By

Reviewer

Title

Title/Date

INTERTEK TESTING SERVICES

Introduction

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C, General Requirements.

A. **Test Set-Up:** The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (1992).

1. The test site is plastic and fiber glass with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (1992). Information on the site has been filed with the FCC as required by Rule §2.948. The address of the site is 70 Codman Hill Road, Boxborough, Massachusetts.
2. Power to the site is nominal line voltage of 117 V_{AC} and 230 V_{AC}, 60 Hz.
3. The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the groundplane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the search for maximum signal levels. The height of the antenna is varied from one meter to four meters.
4. Detector function for radiated emissions is in peak or quasi-peak mode. Average readings, were taken at frequencies above 1 GHz.

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A. Test Set Up (cont'd)

5. Antenna used below 1000 MHz was EMCO, Inc. For measurements between 1000 MHz and 18000 MHz, where required, an Emco Double-Ridge Guide Horn Antenna was used. Alternately, for measurements above 1 GHz, an EMCO M/N 3115 Horn Antenna may have been used.

6. The field strength measuring equipment used included:

Spectrum Analyzer:

Hewlett Packard 8593A

Preamplifiers:

MITEQNSP4000-NF, CDI P-950

LISN:

Solar Electronics

Additional equipment or comments:

Equipment is calibrated at frequent intervals.

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A. Test Set Up (cont'd)

7. The frequency range to be scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency, or 40 GHz, whichever is lower. For line-conducted emissions, the range scanned is 450 kHz to 30 MHz.
8. The EUT is warmed up for 15 minutes prior to the test. AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new battery is used.
9. Conducted measurements were made as described in ANSI C63.4 (1992). An IF bandwidth of 10 kHz is used, and peak or quasi-peak detection is employed.
10. The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application No. 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report. Above 1000 MHz, a bandwidth of 1 MHz is generally used.
11. Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz (where no preamplifier is used), signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

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A. **Test Set Up (cont'd)**

12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

B. This transmitter was found to meet the requirements of Part 15, Subpart C, Section §15.209, General Requirements.

1. The emissions of the transmitter will not exceed the levels defined in §15.209(b).
2. Line-conducted emissions will be below the requirements of Rule §15.207.
3. The device does not operate in any of the restricted bands listed in §15.205(a).

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C. Miscellaneous Information

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|-----|-------------------------------------------------------|---------------------------------|
| 1. | Manufacturer: | Orion Research Inc. |
| 2. | Grantee: | Orion Research Inc. |
| 3. | Model No.: | TX232 |
| 4. | Trade Name: | Orion Research Inc. |
| 5. | Serial No.: | Not Labelled |
| 6. | Date of Test: | January 19 and January 20, 1999 |
| 7. | Frequencies to which device can be tuned: | None |
| 8. | Can customer tune device? | No |
| 9. | Detailed description of operation pursuant to: | 15.249 |
| 10. | Applicable emissions limits: | 15.209, 15.35(b) |
| 11. | Additional Comments: | |

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (1992).

For maximizing emissions, the system was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

Radiated emissions were tested in the range of 30 MHz to 9165 MHz.

INTERTEK TESTING SERVICES

Configuration Information

Equipment Under Test: RF Link Data Transfer Transmitter

Model: TX232

Serial No.: Not Labelled

FCC Identifier: Not Applicable

Support Equipment:

Printer: CBM Corporation

M/N: CBM-910
S/N: 94X0026
FCC ID: Not Applicable

AC Adapter:

CBM
M/N: 91AD-U
S/N: Not Labelled
FCC ID: Not Applicable

Receiver:

Orion
M/N: RX232
S/N: Not Labelled
FCC ID: Not Applicable

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Configuration Photographs

Worst-Case Radiated Emissions

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The following equipment was used to make measurements for emissions testing (the equipment abbreviation corresponds to a measuring device on the following calibration list):

LISN11

LOG3

HP3

PRE1

PRE8

HORN2

INTERTEK TESTING SERVICES

EQUIPMENT LIST TABLE 1

Abbr	Equipment	Manufacturer	Model	Serial	Cal Due
ANT1	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	1649, 1650, 1651	16Jun99
ANT4	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	3317, 3245, 3352	16Jun99
ANT5	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	1670, 1671, 1672	16Jun99
CLMP1	ABSORBING CLAMP	FISCHER CUSTOM	F-201	122	13Jun99
CLMP2	ABSORBING CLAMP	FISCHER CUSTOM	F-201	297	16Jan99
DIP1	TUNED DIPOLE SET	COMPLIANCE DESIGN	A100	402	30Jan99
DIP2	TUNED DIPOLE SET	COMPLIANCE DESIGN	A100	506	16Jun99
DIP3	TUNED DIPOLE SET	COMPLIANCE DESIGN	A100	3947	23Jan99
HORN1	HORN ANTENNA	EMCO	3115	4632	03Oct99
HORN2	HORN ANTENNA	EMCO	3115	4675	03Oct99
HORN3	HORN ANTENNA	EMCO	3116	2090	11Feb99
HP1	SPECTRUM ANALYZER	HEWLETT PACKARD	8591	3308A01445	05May99
HP2	SPECTRUM ANALYZER	HEWLETT PACKARD	8591	3346A02319	20Jul99
HP3	SPECTRUM ANALYZER	HEWLETT PACKARD	8593A	3009A00659	30Apr99
LISN1	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	871083	15Jan99
LISN10	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	941712	15June99
LISN11	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	941713	15June99
LISN12	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	941714	15Jun99
LISN13	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	955107	15Jan99
LISN14	LISN	SOLAR ELECTRONICS	6338-5-TS-50-N	871131	27Jan99
LISN15	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	865575	3/31/99
LISN2	LISN	SOLAR ELECTRONICS	6338-5-TS-50-N	871132	27Jan99
LISN3	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	8379114	14Jan99
LISN4	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	837929	15Jan99
LISN5	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	934610	15Jun99
LISN6	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	934611	15Jun99
LISN7	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	934612	15Jun99
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	871047	07Oct99
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	871055	07Oct99

INTERTEK TESTING SERVICES

EQUIPMENT LIST TABLE 2					
Abbr	Equipment	Manufacturer	Model	Serial	Cal Due
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	883147	07Oct99
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	883151	07Oct99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953947	14Jan99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953948	14Jan99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953949	14Jan99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953950	14Jan99
LOG1	BICONOLOG ANTENNA	EMCO	3142	1116	13Jan99
LOG2	BICONOLOG ANTENNA	EMCO	3142	1223	03Oct99
LOG3	BICONOLOG ANTENNA	EMCO	3142	1224	19Dec99
LOG4	BICONOLOG ANTENNA	EMCO	3142	1225	21Dec99
LOOP1	LOOP ANTENNA	EMPIRE DEVICES	LG105	61	17Jan99
LOOP2	LOOP ANTENNA	EMPIRE DEVICES	LP105	905	17Jan99
LOOP3	LOOP ANTENNA	EMCO	6509	9612-1403	24Jun99
PRB1	LINE PROBE	SOLAR ELECTRONICS	8614-1	932725	15Jun99
PRB2	LINE PROBE	SOLAR ELECTRONICS	8614-1	932731	10Aug99
PRE1	PREAMPLIFIER	COMPLIANCE DESIGN	P950	1648	18May99
PRE2	PREAMPLIFIER	COMPLIANCE DESIGN	P950	5107	18May99
PRE3	PREAMPLIFIER	COMPLIANCE DESIGN	P950	1828	18May99
PRE4	PREAMPLIFIER	COMPLIANCE DESIGN	P950	1844	18May99
PRE5	PREAMPLIFIER	COMPLIANCE DESIGN	P950	PROTO1	18May99
PRE6	PREAMPLIFIER	HEWLETT PACKARD	8447D	1937A03354	18May99
PRE7	PREAMPLIFIER	HEWLETT PACKARD	8447D	2944A08718	18May99
PRE8	PREAMPLIFIER	MITEQ	NSP4000-NF	507145	11Oct99
REC1	RECEIVER	HEWLETT PACKARD	8542	3520A00125	OUT
REC1	RF FILTER	HEWLETT PACKARD	85420	3427A00126	OUT
REC2	RECEIVER	HEWLETT PACKARD	85422	3625A00188	04Jan99
REC2	RF FILTER	HEWLETT PACKARD	8542	3427A00177	04Jan99
REC3	RECEIVER	HEWLETT PACKARD	8546A	3325A00160	OUT
REC3	RECEIVER	HEWLETT PACKARD	8546A	3330A00158	OUT
SCOPE1	OSCILLOSCOPE	TEKTRONIX	TDS380	B011379	01Oct99
SIG1	SIGNAL GENERATOR	HEWLETT PACKARD	8648B	3537A01040	10Apr99
TEK1	SPECTRUM ANALYZER	TEKTRONIX	2784	B010153	30Apr99

INTERTEK TESTING SERVICES

Article 1 - Services, LABORATORY will:

- 1.1 Act for CLIENT in a professional manner, using the degree of care and skill ordinarily exercised by and consistent with the standards of the profession.
- 1.2 Provide only those services that lie within the technical and professional areas of expertise of LABORATORY and which LABORATORY is adequately staffed and equipped to perform.
- 1.3 Perform all technical services in substantial accordance with the generally accepted laboratory testing principles and practices.
- 1.4 Promptly submit formal reports of technical services performed indicating, where applicable, compliance with specification or other contract documents. Such reports shall be complete and factual, citing where appropriate the technical services performed, methods employed, and values obtained.
- 1.5 Employ instrumentation which has been calibrated within a period not exceeding twelve (12) months from the time of use by devices of accuracy traceable to the National Institute of Standards and Technology of the United States Department of Commerce.
- 1.6 Consider all reports to be the confidential property of client, and distribute reports only to those persons, organizations or agencies designated by CLIENT or his authorized representative.
- 1.7 Retain all pertinent records relating to the services performed for a period of three (3) years following submission of the report of the suspension of manufacturing of product subject to follow-up services, whichever is later, during which period the records will be made available to CLIENT upon reasonable request.

Article 2 - Client's Responsibilities, CLIENT or his authorized representative will:

- 2.1 Provide LABORATORY with all plans, schematics, specifications, addenda, change orders, drawings and other information for the proper performance of technical services.
- 2.2 Designate a person to act as CLIENT's representative with respect to LABORATORY's services to be performed under this Agreement; such person or firm to have complete authority to transmit instructions, receive information and data, interpret and define CLIENT's policies and decisions with respect to the project and to order, at CLIENT's expense, such technical services as may be required.
- 2.3 Designate a person who is authorized to receive copies of LABORATORY's test reports.
- 2.4 To undertake the following:
 - (a) Secure and deliver to LABORATORY, without cost to LABORATORY, preliminary representative samples of that equipment proposed to require technical analysis, together with any relevant data.
 - (b) Furnish such labor and equipment needed by LABORATORY to handle samples at the LABORATORY and to facilitate the specified technical analysis.

Article 3 - General Conditions

- 3.1 LABORATORY, by the performance of services covered hereunder, does not in any way assume any of those duties or responsibilities customarily vested in the CLIENT's employees, or any other party, agency or authority.
- 3.2 LABORATORY shall not be responsible for acts or omissions of any other party or parties involved in the design, manufacture or maintenance of the equipment or the failure of any employee, contractor or subcontractor to undertake any aspect of equipment's design, manufacture or maintenance.
- 3.3 LABORATORY is not authorized to revoke, alter, relax, enlarge or release any requirement of the equipment's design, manufacture or maintenance unless specifically authorized by CLIENT or his authorized representative.
- 3.4 This Agreement may be terminated by either party on ten (10) days written notice or by mutual agreement. If this Agreement is terminated by either party, LABORATORY shall be paid in full for all services performed through the termination date, and the CLIENT shall be provided with a complete report of the results of technical analysis conducted prior to termination.
- 3.5 Neither CLIENT nor LABORATORY may delegate, assign, sublet or transfer his duties or interest in this Agreement without the written consent of the other party.
- 3.6 ***The only warranty made by LABORATORY in connection with its service performed hereunder is that it will use that degree of care and skill as set forth in Article 1.1 and 1.3 above. No other warranty, expressed or implied, is made or intended for services provided hereunder.***

- 3.7 Where the LABORATORY indicates that additional testing is advisable to obtain more valid or useful data, and where such testing has not been authorized in writing, CLIENT agrees to view such test reports as inconclusive and preliminary.
- 3.8 The LABORATORY shall supply technical service and prepare a report based solely on the sample submitted to the LABORATORY by the CLIENT. The CLIENT understands that application of the data to other devices is highly speculative and should be applied with extreme caution.

INTERTEK TESTING SERVICES

- 3.9 The LABORATORY agrees to exercise ordinary care in receiving, preserving and shipping (F.O.B. Boxborough, Mass.) any sample to be tested, but assumes no responsibility for damages, either direct or consequential, which arise or are alleged to arise from loss, damage or destruction of the samples due to the act of examination, modification or testing, or technical analysis, or circumstances beyond LABORATORY's control.
- 3.10 The LABORATORY will hold samples for thirty (30) days after tests are completed, or until the CLIENT's outstanding debts to the LABORATORY are satisfied, whichever is later.
- 3.11 The client recognizes that samples of products subject to LABORATORY's review and test procedures may be damaged or destroyed.
- 3.12 The CLIENT recognizes that generally accepted error variances apply and agrees to consider such error variances in its use of test data.
- 3.13 It is agreed between LABORATORY and CLIENT that no distribution of any test, reports or analysis shall be made to any third party without the prior written consent of both parties. The content of all reports, analysis and tests is strictly confidential and shall not be released to any third party without the written consent of the other party.
- 3.14 The CLIENT acknowledges that all employees of LABORATORY operate under employment contracts with the LABORATORY, and CLIENT agrees not to solicit employment of such employees, or solicit information related to other clients from said employees.

Article 4 - Follow-Up Services (for listed products only)

- 4.1 If the product is found to be in compliance with the review and test requirements, it is agreed that CLIENT will abide by the Follow-Up Service Procedure.
- 4.2 It is understood and agreed by the CLIENT that the LABORATORY name or listing mark will not be applied or utilized until authorized representatives of LABORATORY have concluded the procedure set forth in Article 4.1.
- 4.3 All costs associated with the Follow-Up Service Procedure will be the responsibility of CLIENT. CLIENT's failure to pay these charges will result in the revocation of authorization to use the LABORATORY listing mark.

Article 5 - Insurance

- 5.1 LABORATORY shall secure and maintain throughout the full period of this Agreement sufficient insurance to protect it adequately from claims under applicable Workmen's Compensation Acts and from claims for bodily injury,

death or property damage as may arise from the performance of services under this Agreement.

- 5.2 The CLIENT hereby warrants that it has sufficient insurance to protect its employees adequately under applicable Workmen's Compensation Acts and for bodily injury, death or property damage as may arise from the acts of its employees pursuant to the Agreement.
- 5.3 No insurance, of whatever kind or type, which may be carried by LABORATORY is to be considered as in any way limiting any other party's responsibility for damages resulting from their operations or for furnishing work and materials related to the project.

Article 6 - Payment

- 6.1 CLIENT will pay LABORATORY for services and expenses. LABORATORY's invoices will be presented at the completion of its work or monthly and will be paid within thirty (30) days of receipt by CLIENT or his authorized representative.
- 6.2 LABORATORY shall be paid in full as described in Article 6.1 and, in addition, shall be paid in full for any services authorized orally or in writing by an employee or agent of the CLIENT pursuant to Article 2.2.

Article 7 - Extent of Agreement

The Agreement, including these Terms and Conditions and the Schedules attached hereto, represent the entire agreement between CLIENT and LABORATORY and supersedes all prior negotiations, representations or agreements, written or oral. The Agreement may be amended only in accordance with this Agreement or by written instrument signed by CLIENT and LABORATORY.

Article 8 - Collection

- 8.1 CLIENT shall pay LABORATORY interest in the amount of one and one half percent (1.5%) per month on amounts invoiced which are overdue. Invoices which are overdue are defined as those which remain unpaid more than thirty (30) days after presentation.
- 8.2 CLIENT agrees to pay LABORATORY all amounts incurred by LABORATORY in collecting on invoices which are overdue. Such amounts shall include, but shall not be limited to, reasonable attorneys' fees and court costs.