
FCC ID: JNB9796254

Prepared for:

TELENEXUS, INC.
P.O. Box 851265
Richardson, Texas 75085

By:

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Submitted to:

Federal Communications Commission
Equipment Approval Services
P.O. Box 358315
Pittsburgh, Pennsylvania 15251-3315

October 1999

**FCC Application for Certification
of an Intentional Radiator**

TELENEXUS, INC.
Identity Flex Transceiver

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Certificate of Compliance

Applicant: Telenexus, Inc.

Applicant's Address: P.O. Box 851265
Richardson, Texas 75085

Model: Identity Flex Transceiver

Serial Number: N/A

Project Number: 00162-10

Test Dates: October 20, 21, 22, 1999

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measurement data and this report. I believe them to be true and accurate. The **Telenexus, Inc., Identity Flex Transceiver** was tested and found to be in compliance with FCC Part 90 for Intentional Radiators.

Jeffrey A. Lenk
President

This report has been reviewed and accepted by **Telenexus, Inc.**. The undersigned is responsible for ensuring that the **Telenexus, Inc., Identity Flex Transceiver** will continue to comply with the FCC rules.

1.0 Equipment Under Test (EUT) Description

The **Telenex, Inc., Identity Flex Transceiver** is a 1 watt Amplitude Shift Keyed transmitter and homodyne receiver operating in the 909.75 to 921.75 MHz band. . In the downlink mode, filtered Manchester coded data shifts the transmitter between two power levels differing by more than 25 dB at a 300 kbps signaling rate. In the uplink mode, the RF Transceiver transmits an unmodulated carrier at approximately 916.25 MHz and the toll tag amplitude modulates the reflected signal with one of two frequencies, 600 kHz or 1200 kHz, to encode the uplink binary data. The RF Transceiver homodyne receiver downconverts the 600 kHz and 1200 kHz modulation tones to baseband and filters and removes amplitude variation from the FSK signal.

The **Telenex, Inc., Identity Flex Transceiver** is intended for operation under the requirements of Part 90 (Subpart I and M). Specific test requirements include the following:

47 CFR 2.1049	Occupied Bandwidth
47 CFR 90.205	Effective Radiated Power (ERP)
47 CFR 90.210 (k)	Out of Band Emissions - Conducted
47 CFR 1.1310	Radiofrequency Radiation Exposure Limits
47 CFR 2.1055(d) & 47 CFR 90.213 (a)	Frequency Stability vs. Temperature
47 CFR 2.1055(a) & 47 CFR 90.213 (a)	Frequency Stability vs. AC Power

This unit does not re-modulate or re-key the signal. Based on the lack of re-keying/re-modulation circuitry, the following tests were not performed:

47 CFR 90.209	Bandwidth Limitations
47 CFR 90.211	Modulation Requirements
47 CFR 90.214	Transient Frequency Behavior

The system tested consisted of the following:

<u>Manufacturer & Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Telenex, Inc.	N/A	JNB9796254	Identity Flex Transceiver

The equipment within this report was tested to verify its compliance with FCC Rule Parts 2, and 90, for Intentional Radiators. A separate verification report pursuant to Part 15, Subpart B has been prepared for the **Telenex, Inc., Identity Flex Transceiver** as a Digital Device.

2.0 Occupied Bandwidth Measurements

Measurements were made on the **Telenex, Inc., Identity Flex Transceiver** to determine the occupied bandwidth in accordance with Part 2.1049.

2.1 Test Procedure

All measurements were performed in a controlled laboratory environment. The occupied bandwidth of the **Telenexus, Inc., Identity Flex Transceiver** was measured using a Hewlett Packard HP 8566 Spectrum. The occupied bandwidth was measured based on the emission width 26 dB below the peak emission level.

2.2 Test Criteria

Section 2.989 requires that the occupied bandwidth for Certification units be measured and reported as part of the device filing.

2.3 Test Results

Data for occupied bandwidth testing is located in Appendix A of this report. The widest bandwidths for each of the modulation types used by the **Telenexus, Inc., Identity Flex Transceiver** are listed below.

Service Type	Reference Frequency	Occupied Bandwidth
AM	916.25 MHz	3.13 MHz

3.0 Effective Radiated Power (ERP) Measurements

Measurements were made on the **Telenexus, Inc., Identity Flex Transceiver** to verify compliance with the maximum effective radiated power (ERP) requirements of §90.205.

ERP measurements were made at the Professional Testing "Open Field" Site 1, located in Marble Falls, Texas, to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

3.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable which allows 360 degree rotation. A measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 meters.

A Spectrum Analyzer with peak detection was used to find the maximums of the radiated emissions during the variability testing. All final measurements were taken using a Quasi-Peak Adapter with a measurement bandwidth of 120 kHz.

ERP testing of the **Telenexus, Inc., Identity Flex Transceiver** was performed at the maximum power transmitting condition.

3.2 Test Criteria

According to Section 90.205, LMS systems operating pursuant to subpart M in the 902-927.5 MHz band will be authorized a maximum of 30 watts ERP. A patch antenna, which was provided by the customer and typically sold with the EUT, was attached to the EUT and used for the ERP measurements. This process was also used for the spurious emission measurements. ERP testing was performed by measuring the maximum electric field from the **Telenexus, Inc., Identity Flex Transceiver** and translating this level to ERP using the following formula:

$$\text{ERP} = \{(E \cdot r)^2\} / (30)$$

Where:

E = Electric Field in v/m

r = distance from the measurement antenna to the EUT in meters

This formula was obtained from the Industry Canada document, 'Guidelines for Measurement of Radio Frequency Fields at Frequencies from 10 kHz to 300 GHz, Document Reference NIR-E, dated January 1994'.

3.3 Test Results

Measurements were performed utilizing a spectrum analyzer IF/video bandwidth of 3 kHz/10 kHz. For final measurements, the frequency span was set for 3 MHz and was centered on the peak of the output signal.

Data for ERP testing is located in Appendix B of this report **Telenexus, Inc., Identity Flex Transceiver** met the §90.205 ERP requirements.

4.0 Antenna Port Emission Tests

Conducted emissions measurements were made to determine out of band radiated noise produced by the **Telenexus, Inc., Identity Flex Transceiver** in accordance with Section 90.210 (k). Evaluation of the spurious emissions for this device was based primarily on Mask K criteria using representative traffic signals.

Conducted emissions measurements were made at Professional Testing's Round Rock, Texas laboratory. All measurements were made in an environmentally controlled setting.

4.1 Test Procedure

The spurious emissions for the device were measured at the maximum power transmitting condition. These signals were selected for use for this test based on the criteria described in 47 CFR 2.989 (h).

The conducted spurious emissions of the **Telenexus, Inc., Identity Flex Transceiver** was measured by a Hewlett Packard HP 8566 Spectrum Analyzer. The Spectrum Analyzer was used to find the

maximums of the conducted emissions during the testing. All final measurements were made using a peak measurement method. The final measurements provided were determined by using the following formula:

$$\text{Corrected Level} = \text{Recorded Level} + \text{Cable Loss}$$

4.2 Test Criteria

In order to evaluate the EUT versus the out of band emission criteria of §90.210, a representative emission mask suitable for this band (Emission mask K) was selected. Since the transmitter is operated at 909.75 to 921.75 MHz band, transmitter related emissions for the **Telenexus, Inc., Identity Flex Transceiver** shall be reduced by the following amount with respect to the level of the fundamental:

Frequency (MHz)	Attenuation versus <u>the fundamental (dB)</u>
909.75 to 921.75	0
edge (1 MHz) at 909.75 and 921.75	$55 + 10 \log(P)$
$2f_c$ to $10f_c$	$55 + 10 \log(P)$

Based on the data obtained from the conducted emission data from the antenna port, the peak power of this unit is 1 watts, which translates the $43 + 10 \log(P)$ term to a minimum attenuation of 55 dB.

4.3 Test Results

Conducted emission data sheets are contained in Appendix C of this report. The **Telenexus, Inc., Identity Flex Transceiver** met the §90.210(k) emission mask requirements. Documentation of the immediate area surrounding the intended emission is shown as part of the occupied bandwidth plots.

5.0 Radiofrequency Radiation Exposure Evaluation

An evaluation was performed to provide data regarding the **Telenexus, Inc., Identity Flex Transceiver** with respect to the Radiofrequency Radiation Exposure requirements of 47 CFR 1.1310.

5.1 Evaluation Procedure

The primary method of controlling radio frequency radiation exposure from the **Telenexus, Inc., Identity Flex Transceiver** will be the responsibility of the installer of the equipment. The device is to be professionally installed by personnel trained and familiar with installation and configuration of wireless systems. The installer is responsible for antenna selection, site selection and final site configuration. Final compliance with Commission RF exposure regulations for this type of site is the responsibility of the installer and is addressed under separate OET documents.

This device is not marketed outside the wireless communications community. In order to install this system properly, the maximum output power versus the frequency range should be reported in the User's Manual for the device such that this issue can be addressed when the installation site of this device is designed.

5.2 Evaluation Results

The output power level for the **Telenexus, Inc., Identity Flex Transceiver** is reported in the User's Manual as being 1.0 watts. In addition, the transmitting frequency for this device is reported as 916.25 MHz. Based on this information, the **Telenexus, Inc., Identity Flex Transceiver** meets the necessary requirements regarding RF exposure.

6.0 Frequency Stability vs. Temperature Test

Measurements were made on the **Telenexus, Inc., Identity Flex Transceiver** to verify compliance with the frequency stability requirements of §2.1055(a) and 90.213(a). Under these specifications, the EUT is tested to verify satisfactory frequency stability versus changes of temperature.

6.1 Test Procedure

The EUT was placed in an environmental test chamber and powered such that the frequency control element received normal voltage and the transmitter provided nominal RF output. The chamber was programmed to cool from room temperature to -30 degrees C and then step in 10-degree increments, each step held for 20 minutes, to 50 degrees C. A HP 8591E Spectrum Analyzer was used to measure the transmitting frequency.

6.2 Test Criteria

When combined, Sections 2.1055(a) and 90.213(a) indicate that fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge is not subjected to frequency tolerance restrictions.

6.3 Test Results

Data for this test is located in the Appendix D of this report. **Telenexus, Inc., Identity Flex Transceiver** meets the frequency stability requirements for frequency stability versus temperature variation based on the criteria listed above.

7.0 Frequency Stability vs. AC Voltage Test

Measurements were made on the **Telenexus, Inc., Identity Flex Transceiver** to verify compliance with the frequency stability requirements of §2.1055(d) and 90.213(a). Under these

specifications, the EUT is tested to verify satisfactory frequency stability versus changes of AC Voltage.

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor. AC Power to the input terminals was varied from 100VAC to 140VAC. The normal AC mains power for this system is 115 VAC. The center frequency and center frequency power level was recorded at 5 volt intervals over this range.

7.2 Test Criteria

When combined, Sections 2.1055(a) and 90.213(a) indicate that fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge is not subjected to frequency tolerance restrictions.

7.3 Test Results

Data for this test is located in the Appendix E of this report. **Telenexus, Inc., Identity Flex Transceiver** meets the frequency stability requirements for frequency stability versus temperature variation based on the criteria listed above.

8.0 Form 731 Information

The following information is provided for inclusion in the FCC Form 731 for the **Telenexus, Inc., Identity Flex Transceiver**.

8.1 Emission Designator

As with the emission bandwidth, the emission type emitted by the **Telenexus, Inc., Identity Flex Transceiver** is depended on the service that it operates with. Due to the intended installation of the system, the RF output signals of the **Telenexus, Inc., Identity Flex Transceiver** are complaint with the AM and NBFM protocol requirements. This output emission designators (based on Party 2.201) for these services are:

Service Type	Emission Description	Emission Designator
AM	(1) Modulation Type: Double-Sideband Amplitude Modulation (2) Nature of Modulating Signal: A single channel containing quantized or digital information without the use of a modulating sub-carrier, excluding time-division mutiplex. (3) Data Transmission	A1D

8.2 Output Power

In the ERP tests, the highest power attained from the EUT was 0.97 watt. Since the system automatically controls the maximum output power, this level should be constant for all single carrier operations.

Due to the operating features of the EUT, 1 watt is the maximum composite power available from the device. The data in the this report showed the power from the EUT is below this power level. Therefore, the power rating requested for the grant for the **Telenexus, Inc., Identity Flex Transceiver** is:

1 watts

8.3 Frequency Band of Operation

The transmission frequency of the **Telenexus, Inc., Identity Flex Transceiver** is:

916.75 MHz

9.0 Modifications

No modification was made on the **Telenexus, Inc., Identity Flex Transceiver** during the test.

10.0 List of Test Equipment

A list of the test equipment utilized to perform the conducted and radiated emission measurements is given below. The date of calibration is given for each.

<u>Device</u>	<u>Description</u>	<u>Date Last Calibrated</u>	<u>Calibration Due</u>
HP 8566B	Spectrum Analyzer	10/30/98	10/30/99
HP 85650A	Quasi Peak Adapter	10/30/98	10/30/99
MITEQ AFS4-00101800-40-10P-N	Preamplifier	05/10/99	05/10/00
EMCO 3108	Biconical Antenna	07/10/99	07/10/00
EMCO 3146	Log Periodic Antenna	07/10/99	07/10/00
EMCO 3115	Double Ridged Horn Antenna	05/10/99	05/10/00
HP8591E	Spectrum Analyzer	01/25/99	01/25/00
Omega HH506R	Thermometer	04/99	04/00

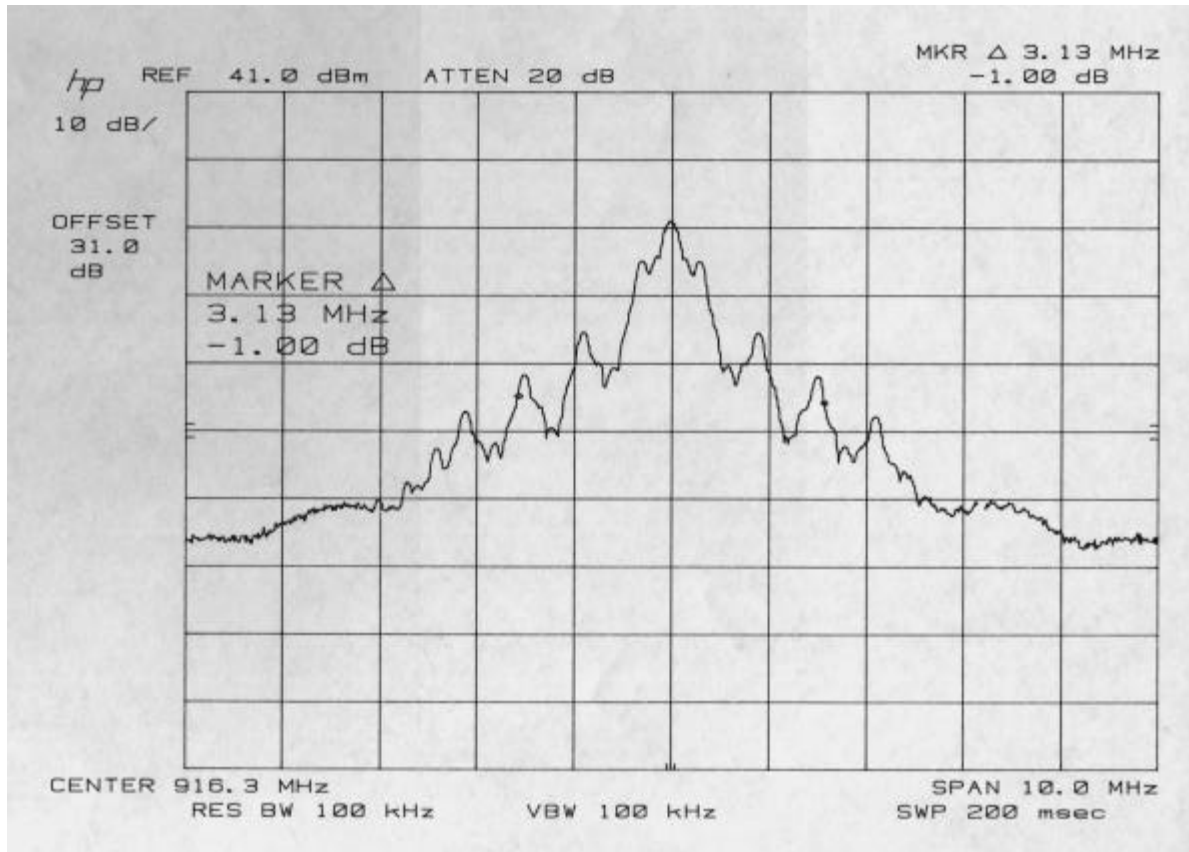
Occupied Bandwidth Data Sheet

Telenexus, Inc.
Identity Flex Transceiver

SERIAL #: N/A

PROJECT #: 00162-10

DATE: September 21, 1999



COMMENT #1: 26 dB Bandwidth = 3.13 MHz

COMMENT #2:

TEST ENGINEER: _____ APPROVED BY: _____
 Larry Zhou Jeffrey A. Lenk

Appendix B

Effective Radiated Power Test Data

Effective Radiated Power Data Sheet

Telenexus, Inc.
Identity Flex Transceiver

SERIAL #: N/A

PROJECT #: 00162-10

DATE: September 15, 1999

EUT Horizontal, Antenna Horizontal

Freq. (MHz)	EUT Direction (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Level ERP (watts)	Limit (watts)	Margin (watts)
916.25	0.00	2.00	95.30	22.70	6.70	124.70	0.885	30.00	-29.11

EUT Horizontal, Antenna Vertical

Freq. (MHz)	EUT Direction (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Level ERP (watts)	Limit (watts)	Margin (watts)
916.25	0.00	1.00	82.00	22.70	6.70	111.40	0.041	30.00	-29.96

EUT Horizontal, Antenna Vertical

Freq. (MHz)	EUT Direction (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Level ERP (watts)	Limit (watts)	Margin (watts)
916.25	0.00	1.60	79.90	22.70	6.70	109.30	0.026	30.00	-29.97

EUT Vertical, Antenna Vertical

Freq. (MHz)	EUT Direction (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Level ERP (watts)	Limit (watts)	Margin (watts)
916.25	0.00	1.50	95.70	22.70	6.70	125.10	0.971	30.00	-29.03

TEST ENGINEER: _____ APPROVED BY: _____
 Larry Zhou Jeffrey A. Lenk

Appendix C

Antenna Conducted Emission Test Data

Antenna Conducted Data Sheet**Telenexus, Inc.
Identity Flex Transceiver**

SERIAL #: N/A

PROJECT #: 00162-10

DATE: October 21, 1999

Freq. (MHz)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)	Resolution Bandwidth
908.75	-31.1	-25.0	-6.1	100 kHz
909	-32	-25.0	-7.0	100 kHz
909.25	-31.1	-25.0	-6.1	100 kHz
909.5	-29.9	-25.0	-4.9	100 kHz
909.750	-29.30	-25.0	-4.3	100 kHz
910.000	-28.70	30.0	-58.7	100 kHz
910.500	-28.30	30.0	-58.3	100 kHz
911.000	-26.60	30.0	-56.6	100 kHz
911.500	-24.30	30.0	-54.3	100 kHz
912.00	-24.10	30.0	-54.1	100 kHz
912.50	-21.50	30.0	-51.5	100 kHz
913.00	-19.60	30.0	-49.6	100 kHz
913.50	-20.20	30.0	-50.2	100 kHz
914.00	-13.60	30.0	-43.6	100 kHz
914.50	-10.70	30.0	-40.7	100 kHz
915.00	-7.40	30.0	-37.4	100 kHz
915.50	1.40	30.0	-28.6	100 kHz
916.00	16.10	30.0	-13.9	100 kHz
916.25	22.1	30.0	-7.9	100 kHz

COMMENT #1: Cable Loss and a 30 dB attenuator factor was adjusted to the corrected level.

COMMENT #2: This table includes the data from 908.75 MHz to 916.25 MHz.

TEST ENGINEER: _____ APPROVED BY: _____
Larry Zhou **Jeffrey A. Lenk**

Antenna Conducted Data Sheet**Telenexus, Inc.
Identity Flex Transceiver**

SERIAL #: N/A

PROJECT #: 00162-10

DATE: October 21, 1999

Freq. (MHz)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)	Resolution Bandwidth
916.250	22.10	30.0	-7.9	100 kHz
916.500	14.50	30.0	-15.5	100 kHz
917.000	0.50	30.0	-29.5	100 kHz
917.500	-9.80	30.0	-39.8	100 kHz
918.000	-10.80	30.0	-40.8	100 kHz
918.50	-12.00	30.0	-42.0	100 kHz
919.00	-19.70	30.0	-49.7	100 kHz
919.50	-20.20	30.0	-50.2	100 kHz
920.00	-21.10	30.0	-51.1	100 kHz
920.50	-25.30	30.0	-55.3	100 kHz
921.00	-24.60	30.0	-54.6	100 kHz
921.50	-27.60	30.0	-57.6	100 kHz
921.75	-28.40	-25.0	-3.4	100 kHz
922.00	-28.50	-25.0	-3.5	100 kHz
922.25	-28.4	-25.0	-3.4	100 kHz
922.50	-28.9	-25.0	-3.9	100 kHz
922.75	-28.4	-25.0	-3.4	100 kHz

COMMENT #1: Cable Loss and a 30 dB attenuator factor was adjusted to the corrected level.

COMMENT #2: This table includes the data from 916.25 MHz to 922.75 MHz.

TEST ENGINEER: _____ APPROVED BY: _____
Larry Zhou **Jeffrey A. Lenk**

Antenna Conducted Data Sheet

Telenexus, Inc.
Identity Flex Transceiver

SERIAL #: N/A

PROJECT #: 00162-10

DATE: October 21, 1999

Freq. (MHz)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)	Resolution Bandwidth
908.75	-64	-25.0	-39.0	300 Hz
909	-64.2	-25.0	-39.2	300 Hz
909.25	-63.3	-25.0	-38.3	300 Hz
909.5	-63.9	-25.0	-38.9	300 Hz
909.750	-62.10	-25.0	-37.1	300 Hz
910.000	-63.60	30.0	-93.6	300 Hz
910.250	-63.60	30.0	-93.6	300 Hz
910.500	-65.90	30.0	-95.9	300 Hz
910.750	-65.80	30.0	-95.8	300 Hz
920.75	-65.70	30.0	-95.7	300 Hz
921.00	-66.40	30.0	-96.4	300 Hz
921.25	-62.30	30.0	-92.3	300 Hz
921.50	-66.00	30.0	-96.0	300 Hz
921.75	-65.30	-25.0	-40.3	300 Hz
922.00	-63.20	-25.0	-38.2	300 Hz
922.25	-67.20	-25.0	-42.2	300 Hz
922.50	-64.70	-25.0	-39.7	300 Hz
922.75	-63.70	-25.0	-38.7	300 Hz

COMMENT #1: Cable Loss and a 30 dB attenuator factor was adjusted to the corrected level.

COMMENT #2: This table includes the data from 908.75 MHz to 916.25 MHz.

TEST ENGINEER: _____ APPROVED BY: _____

Larry Zhou

Jeffrey A. Lenk

Antenna Conducted Data Sheet

Telenexus, Inc.
Identity Flex Transceiver

SERIAL #: N/A

PROJECT #: 00162-10

DATE: October 21, 1999

Freq. (MHz)	Recorded Level (dBm)	Cable Loss (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
916.250	-8.40	30.5	22.1	30.0	Ref
1832.500	-62.10	30.5	-31.6	-25.0	-6.6
2748.750	-66.60	30.5	-36.1	-25.0	-11.1
3665.000	-76.20	30.5	-45.7	-25.0	-20.7
4581.250	-80.90	30.5	-50.4	-25.0	-25.4
5497.500	-92.20	30.5	-61.7	-25.0	-36.7
6413.750	-86.60	30.5	-56.1	-25.0	-31.1
7330.000	-88.70	30.5	-58.2	-25.0	-33.2
8246.250	-88.80	30.8	-58.0	-25.0	-33.0
9162.500	-90.20	31.0	-59.2	-25.0	-34.2

COMMENT #1: Cable Loss adjusted to compensate for 30 dB attenuator installed in signal path prior to taking reading.

TEST ENGINEER: _____ APPROVED BY: _____
 Larry Zhou Jeffrey A. Lenk

Appendix D

Frequency Stability vs. Temperature Test Data

Frequency Stability vs. Temperature Data Sheet**Telenexus, Inc.
Identity Flex Transceiver**

SERIAL #: N/A

PROJECT #: 00162-10

DATE: September 22, 1999

Temperature (C)	Frequency (Hz)	Frequency Stability (ppm)
-30	916237120	27.54
-20	916241250	18.71
-10	916254600	9.83
0	916265100	32.28
10	916270520	43.87
20	916269570	41.84
30	916261126	23.79
40	916244010	12.81
50	916241294	18.61

COMMENT #1: Central frequency will stay in band from -30 to 50 Degree C.

TEST ENGINEER: _____ APPROVED BY: _____
Larry Zhou **Jeffrey A. Lenk**

Appendix E

Frequency Stability vs. AC Voltage Test Data

Frequency Stability vs. Temperature Data Sheet

Telenexus, Inc.
Identity Flex Transceiver

SERIAL #: N/A

PROJECT #: 00162-10

DATE: September 22, 1999

AC Power (Volt)	Frequency (Hz)	Frequency Stability (ppm)
100	916244485	11.79
110	916244375	12.03
115	916244460	11.84
120	916244690	11.35
125	916244330	12.12
130	916244205	12.39
135	916244085	12.65
140	916244125	12.56

COMMENT #1: Central frequency will stay in band with AC Power changing from 100 to 140
 Volt.

TEST ENGINEER: _____ **APPROVED BY:** _____
Larry Zhou **Jeffrey A. Lenk**