Application For Certification In Accordance With FCC Part 101

for

Triton Network Systems, Inc.

28 GHz Fast Ethernet
Wireless Consecutive Point Millimeter-Wave Transceiver
Models: TNS-28-ETP-FE-100, TNS-28-ETP-200, TNS-28-ETP-300, TNS-28-ETP-400, TNS-28-ETP-500, TNS-28-ETP-600

FCC ID: OQT-28-ETP-FE

October 1999

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Test Report Certification

Company Name:	Triton Network Systems, Inc. 8529 SouthPark Circle, 4th Floor Orlando, FL 32819
Attention:	Mr. Michael Clark
Model No:	TNS-28-ETP-FE-100 TNS-28-ETP-FE-200 TNS-28-ETP-FE-300 TNS-28-ETP-FE-400 TNS-28-ETP-FE-500 TNS-28-ETP-FE-600
Report Date:	October 8, 1999
ITS Report:	J99019097B
Test Site Location:	INTERTEK TESTING SERVICES NA INC. 70 Codman Hill Road Boxborough, Massachusetts 01719

We attest to the accuracy of this report:

Signature	Signature
Kouma Sinn	Peter Boers
Testing Performed By	Reviewer
Sr. Project Engineer	Sr. EMC Staff Engineer
Title	Title/Date

1. Introduction

On August 23 to 28, 31, September 1 and 27, 1999, we tested the "Triton Network Systems' 28 GHz Fast Ethernet Invisible Fiber™ unit", Models: TNS-28-ETP-FE-100 (27.500–27.700 GHz), TNS-28-ETP-FE-200 (27.700-27.900 GHz), TNS-28-ETP-FE-300 (27.950-28.150 GHz), TNS-28-ETP-FE-400 (28.150-28.350 GHz), TNS-28-ETP-FE-500 (27.500-27.850 GHz) and TNS-28-ETP-FE-600 (28.000-28.350 GHz) to determine if they were in compliance with FCC Part 101 requirements. We found that the unit met the requirements when tested as received.

2. Product Description

A production version of the sample was received on August 23, 1999 in good condition. The 28 GHz Fast Ethernet radio is a data-link radio device. A pair of radios, working together, forms a full duplex 100 Mbps data link, in accordance with the Fast Ethernet specification as specified in IEEE 802.3. Within the radio network model, the radio link acts as a physical layer link, or bit pipe, similar to a bi-directional optical regenerator. The radio replicates data without regard to content. However, radios can provide integral packet switching in a Fast Ethernet application.

The 28 GHz Fast Ethernet radio uses a 100 MHz channel pair (50 MHz transmit, 50 MHz receive) to carry an aggregate data rate of approximately 120 Mbps in each direction across the link. The Fast Ethernet payload accounts for 100 Mbps.

The radios are designed to be installed by operators on building rooftop, towers, or other suitable structures to provide high-bandwidth communication links. Operators can use linked radios to provide broadband fixed wireless technology services to an entire metropolitan service without using fiber optical cable.

2.1. Multiple list/ Family Information

Segmented Band – Fast Ethernet

Part number coding					Frequency Band
TNS	**FF**	**PPA**	**BB**	**XXX**	
TNS	28	SNP	FE	100	27.500 GHz to 27.700 GHz
TNS	28	SNP	FE	200	27.700 GHz to 27.900 GHz
TNS	28	SNP	FE	300	27.950 GHz to 28.150 GHz
TNS	28	SNP	FE	400	28.150 GHz to 28.350 GHz

Programmable Offset - Fast Ethernet

Part number coding					Frequency Band
TNS	**FF**	**PPA**	**BB**	**XXX**	
TNS	28	SNP	FE	500	27.500 GHz to 27.850 GHz
TNS	28	SNP	FE	600	28.000 GHz to 28.350 GHz

2.2. Frequency Availability

The frequencies available for this particular device operating under FCC rules, Part 101.101 as:

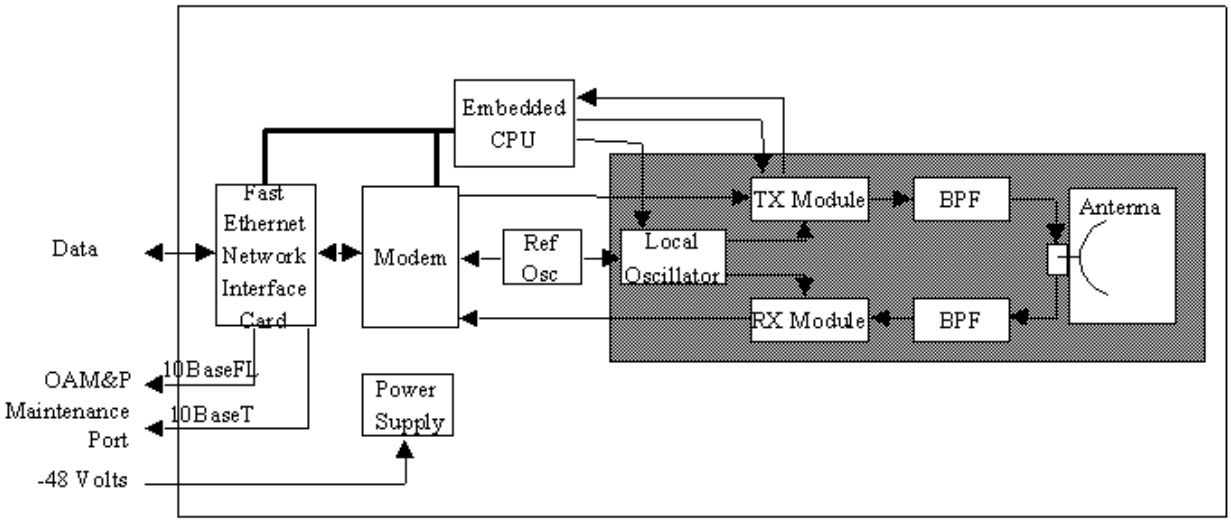
Radio Services	Frequency Band (GHz)	Subpart of Service	Note
Common Carrier (Pt 101)	27.5 – 28.35	LMDS	N/A

Description of "Subpart of Service"

Abbreviation	Description
LMDS	Local Multipoint Distribution Service (Part 101 Subpart L)

2.3. Block Diagram of the product

TNS-28 Fast Ethernet Radio Block Diagram



3. Summary of Tests and results

Test Performed	Reference	Pass/Fail Criteria
Frequency Availability	101.101	Pass
Frequency Tolerance and Frequency Stability	101.107	Pass
Bandwidth	101.109	Pass
Occupied Bandwidth	2.1049	Pass
Emission Limitations (Mask)	101.111	Pass
Transmitter Power Limitations	101.113	Pass

4. Test plan

4.1. Frequency stability

FCC rules, Part 101, Section 107 requires that the Frequency stability is better than 0.001% over the temperature range from -30 ºC to +50 ºC and an input voltage range of + or -15% of the nominal.

Since the two versions of this product (the SONET OC-3 with either 16QAM or 32QAM mode of modulation and the fast-ethernet version with 8PSK modulation) use the same frequency determining components for the main transmitter, only one version of the product will be tested for frequency stability.

The whole radio will be placed in a temperature controlled chamber, and measurements of the output frequency will be made each 10 degrees between the lower and upper limits, and at nominal temperature the input voltage will be varied plus and minus 15 % from the nominal 48V dc.

4.2. Output power

FCC rules Part 101, Section 113 requires that the output power of the transmitter does not exceed 55dBW or 42 dBW/MHz, with the additional stipulation that no higher power than necessary to carry out the desired communication shall be allowed.
The output power of this transceiver will be measured over the allocated frequency band from 27500 MHz to 28350 MHz in the low end, the middle and the high end of the band for all operating modes of the transceiver.

4.3. Bandwidth

The spectral out of the transceiver will be measured in the low end of the band, approximately in the middle of the band and at the high end of the band, for each of the different modems and/or modulation schemes and at the nominal power rating(s) of the transceiver.
The 99% power bandwidth will be calculated from the spectral display.

4.4. Emission Limitation (Mask)

The spectral out of the transceiver will be measured in the low end of the band, approximately in the middle of the band and at the high end of the band to show that the emissions fall under the mask as defined in FCC rules, part 101.111. The shape of the mask will be calculated based on the rated output power of 1 Watt (30 dBm).

4.5. Spurious emissions

Radiated spurious emissions will be measured at a distance of 3 or 1 meter from the product in the frequency range for 30 MHz to 100 GHz. For the frequency range above 40 GHz, external mixers will be used to down convert the frequency.

4.6. Incidental radiation

Incidental radiation will be measured according to the requirements of FCC Part 15 B and ANSI C63.4:1992.

5. Test results

5.1. Frequency Tolerance and Frequency Stability

The carrier frequency of each transmitter authorized in these services must be maintained within the following percentage of the reference frequency according to FCC rules Part 101.107.

Frequency Range	Frequency Tolerance (Percent)
27500 to 28350 MHz	0.001

Table 1. Measured Frequency Stability versus Input Voltage

Maximum Allowed Frequency Deviation: 283.25 kHz				
Voltage (VDC)	**Reference Frequency (Hz)**	**Measured Frequency (Hz)**	**Deviation (Hz)**	**Pass/Fail**
40.8	28325037112	28325037064	48	Pass
48.0	28325037112	----------	----------	----------
55.2	28325037112	28325037025	87	Pass

Table 2. Frequency Stability versus Temperature

Maximum Allowed Frequency Deviation: 283250 Hz				
Temperature (°C)	**Reference Frequency (Hz)**	**Measured Frequency (Hz)**	**Deviation (Hz)**	**Pass/Fail**
-30	28325037384	28325055900	18516	Pass
-20	28325037384	28325046953	9569	Pass
-10	28325037384	28325043148	5764	Pass
0	28325037384	28325041290	3906	Pass
10	28325037384	28325039400	2016	Pass
20	28325037384	----------	----------	----------
30	28325037384	28325035474	1910	Pass
40	28325037384	28325033400	3984	Pass
50	28325037384	28325032257	5127	Pass

5.2. Output power

FCC rules Part 101, Section 113 requires that the output power of the transmitter does not exceed 55dBW or 42 dBW/MHz, with the additional stipulation that no higher power than necessary to carry out the desired communication shall be allowed.

Table 3. Transmitter output power

Mode Operation	Frequency (MHz)	Measured Power (dBm)	Pass/Fail
8PSK	27525	+30.1	Pass
8PSK	27825	+30.1	Pass
8PSK	28325	+30.0	Pass

5.3. Bandwidth

Bandwidth (101.109)

Emission Designator: Part of the application (License or Certification) require the inclusion of an emissions designator as determined by 47 CFR 2.201 and 2.202

The characteristics of the emissions designator are as follows:

	Value
Necessary Bandwidth – This may be calculated using the formulas of 2.202 or if that is not possible with the occupied bandwidth	850MHz
First Symbol – Type of modulation of the main carrier	G
Second Symbol – Nature of signal(s) modulating the main carrier	1
Third Symbol – Type of information be transmitted	D

Occupied Bandwidth (2.1049)

Occupied Bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the emitted power. This is also known as the 99% bandwidth.

Table 4. Occupied Bandwidth summary

Mode	Channel	Authorized BW (MHz)	Measured Occupied Bandwidth (MHz)	Detail information	Pass/Fail
8PSK	Low	850	44.1	Figure 2	Pass
8PSK	Mid	850	43.7	Figure 3	Pass
8PSK	High	850	43.7	Figure 4	Pass

5.4. Emission Limitation (Mask)

The mean power of emissions must be attenuated below the mean output power of the transmitter in accordance with the following schedule (from FCC 101.111):

Table 5. Emission Limitations Mask Schedule

Percentage Shift From Center Frequency	Attenuation Equation From Part 101.111.2(ii)	Attenuation Below Center Frequency Peak (dBc)	Spectrum Analyzer RBW
0 to 50	None	0	1 MHz
50 to 250	11 + 0.4(P-50) + 10 Log B	28 to 56	1 MHz
Greater than 250	43 + 10 Log(P_o)	43	4 kHz

P = Percent removed from the carrier frequency.
B = Authorized bandwidth in MHz.
P_o = Mean output power in Watts.
Attenuation greater than 56 dB is not required. Equation at 250 % removed from the center frequency yields 108 dB.
For a 1 Watt system: 43 + 10Log (1) Watts) = 43 + 0 = 43 dB.

Note: Emission mask plots shown in Figures on the following pages show compliance of the EUT with the emission mask requirements defined in Part 101.111.2 (ii)

Figure 1. FCC mask for the 28 GHz LMDS band (500MHz.div)

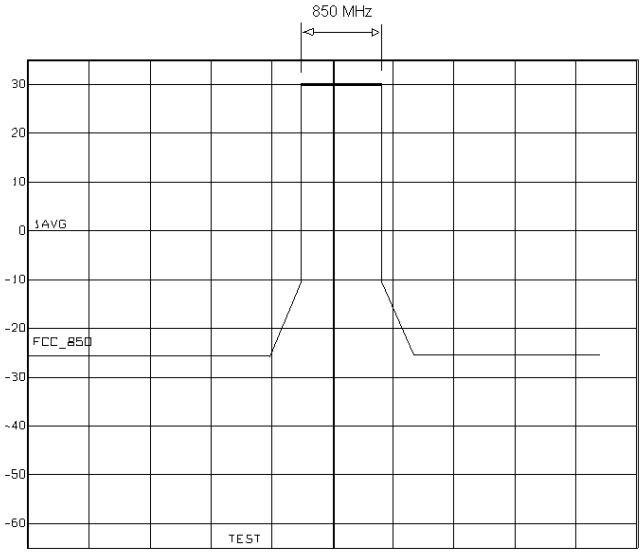


Figure 2. – 8PSK, 1Watt output at the lower band edge

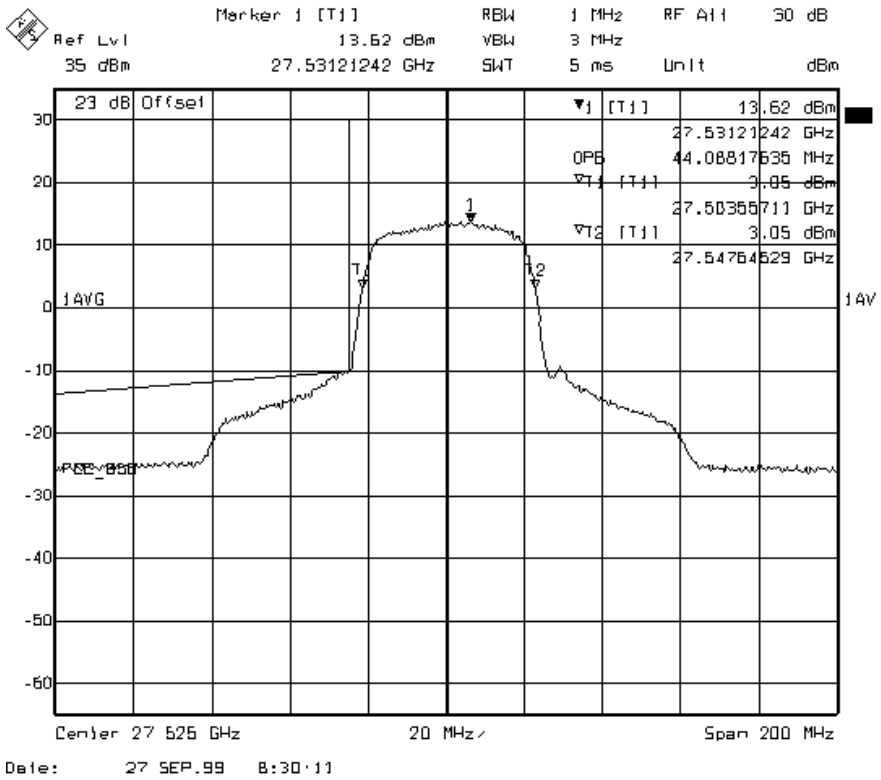


Figure 3. – 8 PSK, 1Watt output at the middle of the band

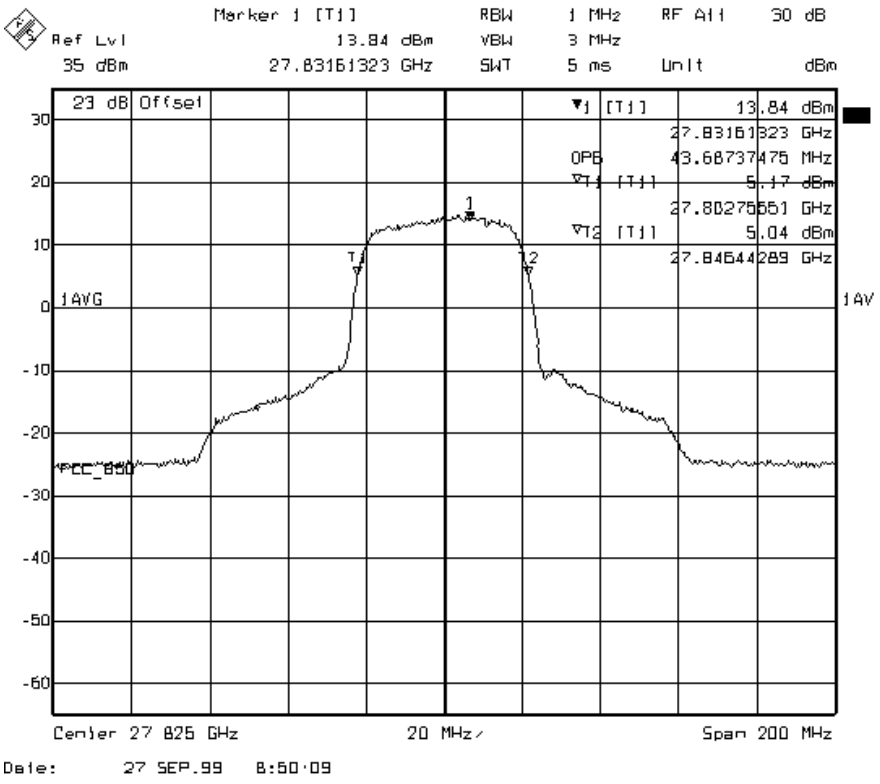
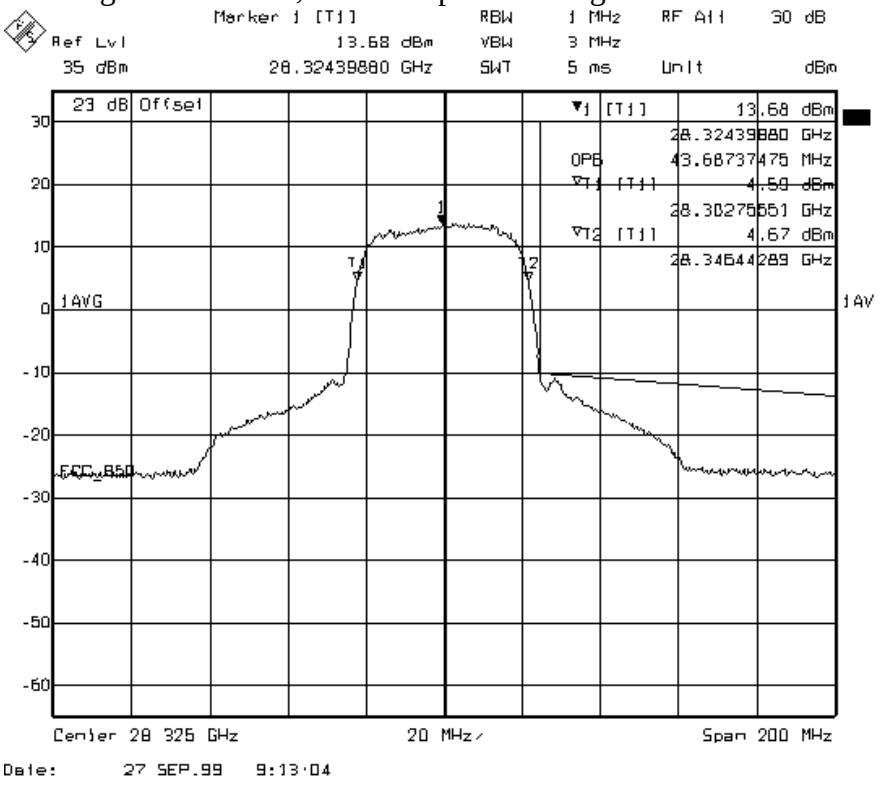


Figure 4. – 8PSK, 1Watt output at the high end of the band



5.5. Spurious emissions

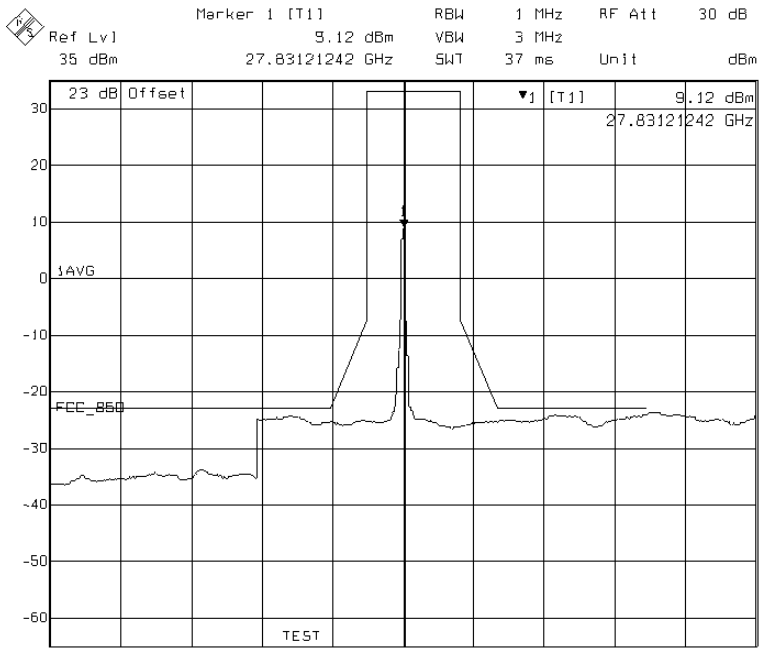
Table 1. Spurious emissions and harmonic scan from 0.030 to 100 GHz

Frequency (GHz)	Reading (dBuv)	Antenna Factor (dB)	Net Reading (dB)	Limit (dB)	Margin (dB)
No spurious emissions were detected within 56 dB from the carrier level.*					

*****Measurement sensitivity was such that any signal within –56 dB from the carrier could be detected. Measurements were made both conducted on the antenna terminal and radiated with a EUT to antenna distance of 1 meter. The unit was transmitting in 8PSK mode.

The total output power measured with a power meter equals to 30.0 dBm.

Figure 5. – Wide band view showing absence of spurious emissions



5.6. Incidental radiation

The Triton Network Systems 28 GHz Fast Ethernet transceiver meets the requirements of FCC Part 15, Class B for incidental radiators. A full report substantiating that is available under ITS report J99019097F

6. Equipment list

The following equipment was used for radiated and conducted emissions testing in accordance with FCC Part 101.

Table 7. Equipment List

Abbr	Equipment	Manufacturer	Model	Serial	Cal Due
Tek1	Spectrum Analyzer	Tektronix	2784	B010153	02/03/00
PRE8	Pre-Amplifier	MITEQ	NSP4000-NF	507145	10/11/99
HORN2	Horn Antenna	EMCO	3115	9602-4675	10/03/99
HORN3	Horn Antenna	EMCO	3116	2090	03/06/00
MIX1	Harmonic Mixer	MILLITECH	MHB-10-R00W0	015	N/A
MIX2	Harmonic Mixer	MILLITECH	MHB-15-R00W0	019	N/A
MIX3	Harmonic Mixer	MILLITECH	MHB-19-R00W0	011	N/A
MIX4	Harmonic Mixer	MILLITECH	MHB-22-R00W0	013	N/A
------	Wattmeter	HP	436A/022	1803A04424	2/12/00
-------	Attenuator	Weinschel	54-20	09632	
-------	Temperature chamber	Watlow	Series 1500		
----------	Spectrum Analyzer	R & S	FSEK	1088.3494.30	05/24/00
----------	Watt Meter	Anritsu	ML2438A	97400002	01/20/00

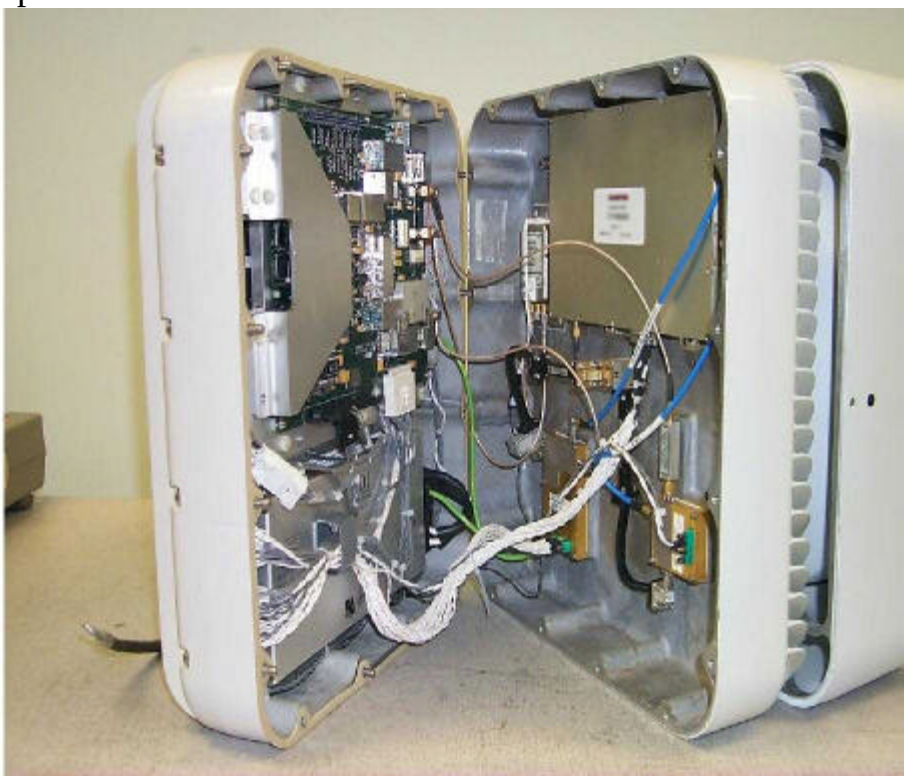
7. Photos of the EUT

Left rear view of the EUT

Right rear view of the EUT

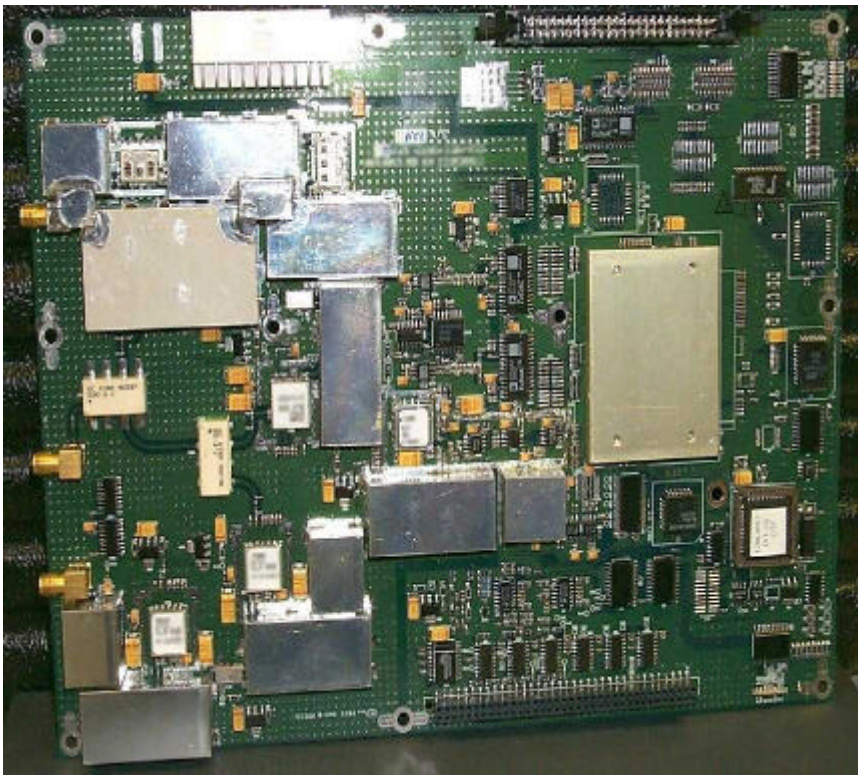
Front view of the EUT

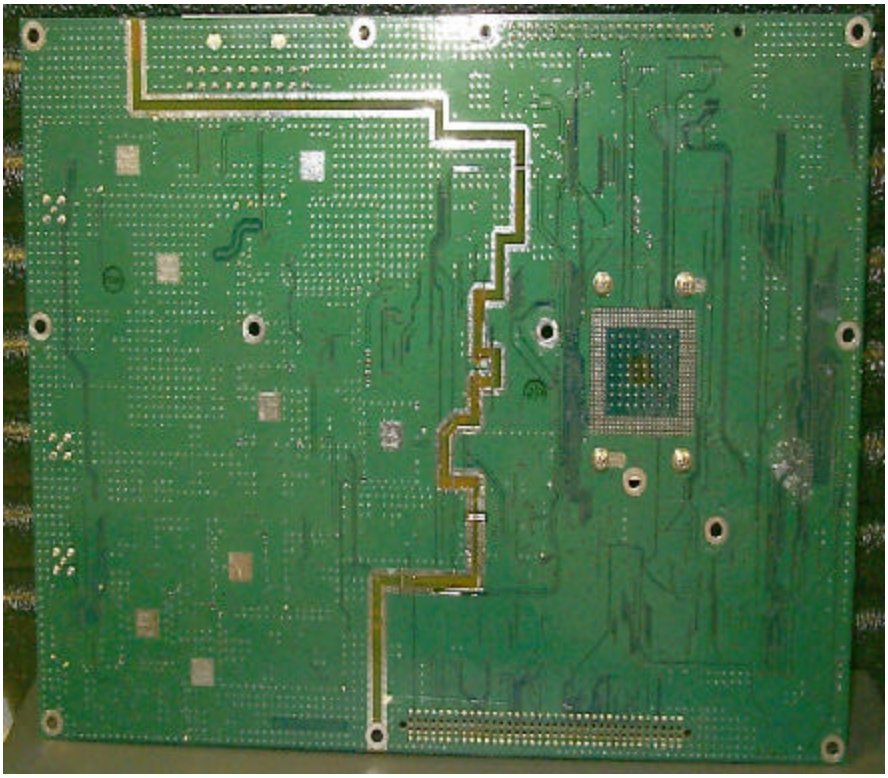
Rear cover open



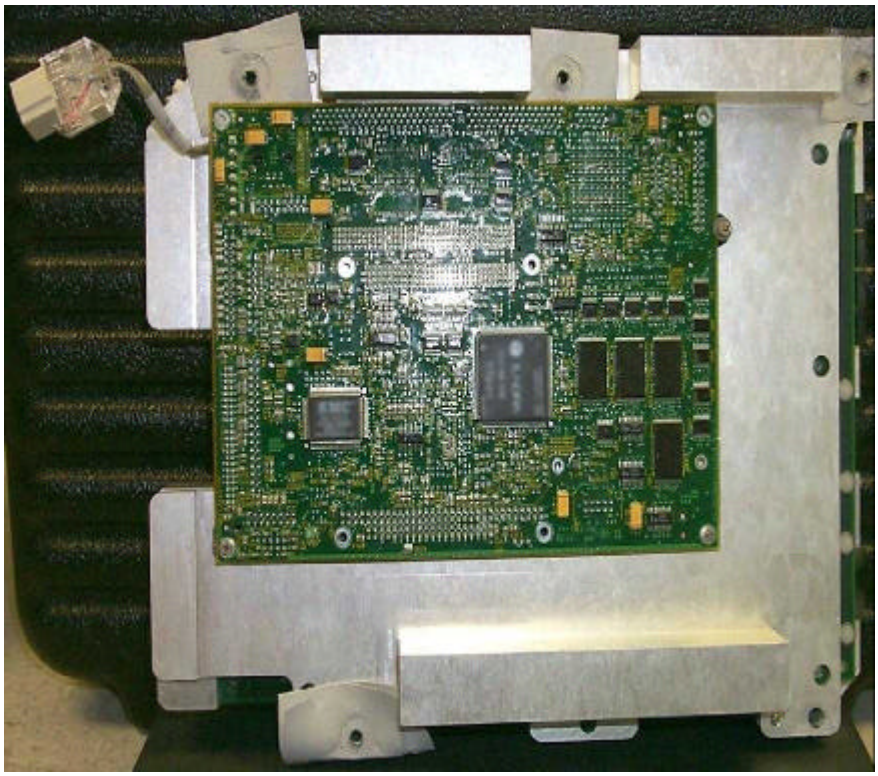
Internal photograph of transmitter, receiver, synthesizer, and filter/attenuator section

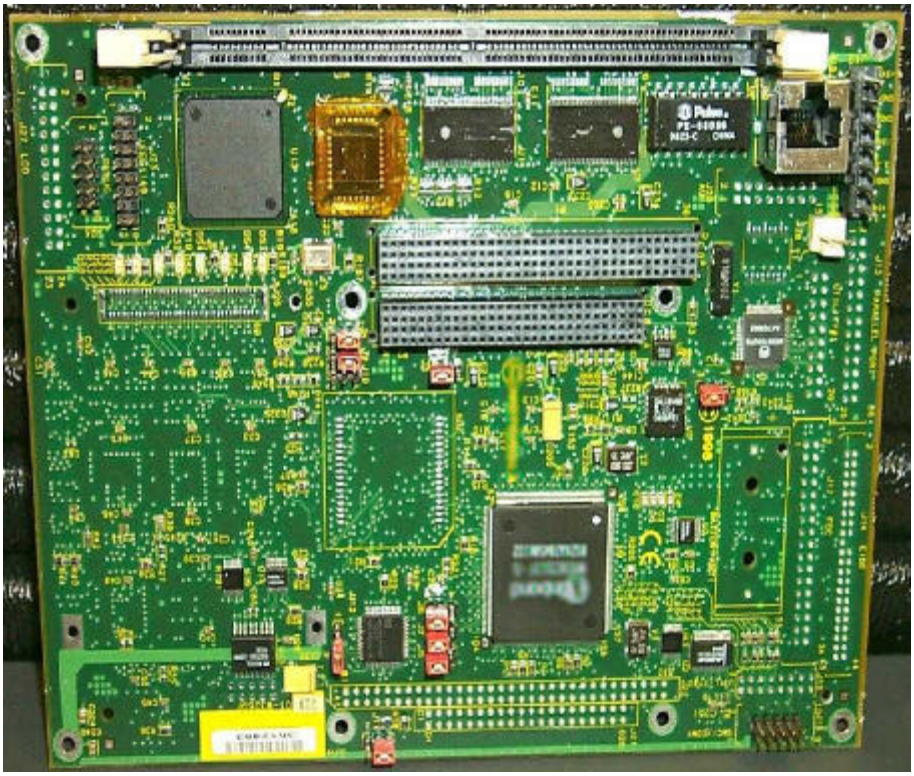
Modem board, top and bottom view



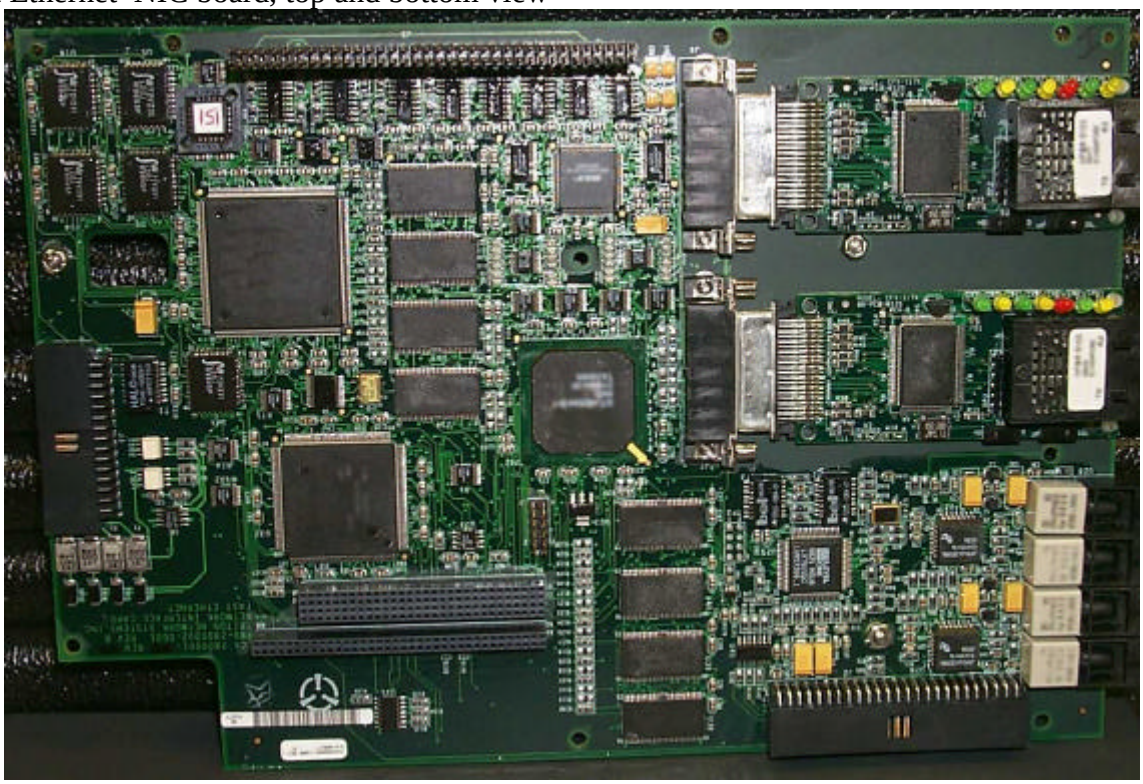


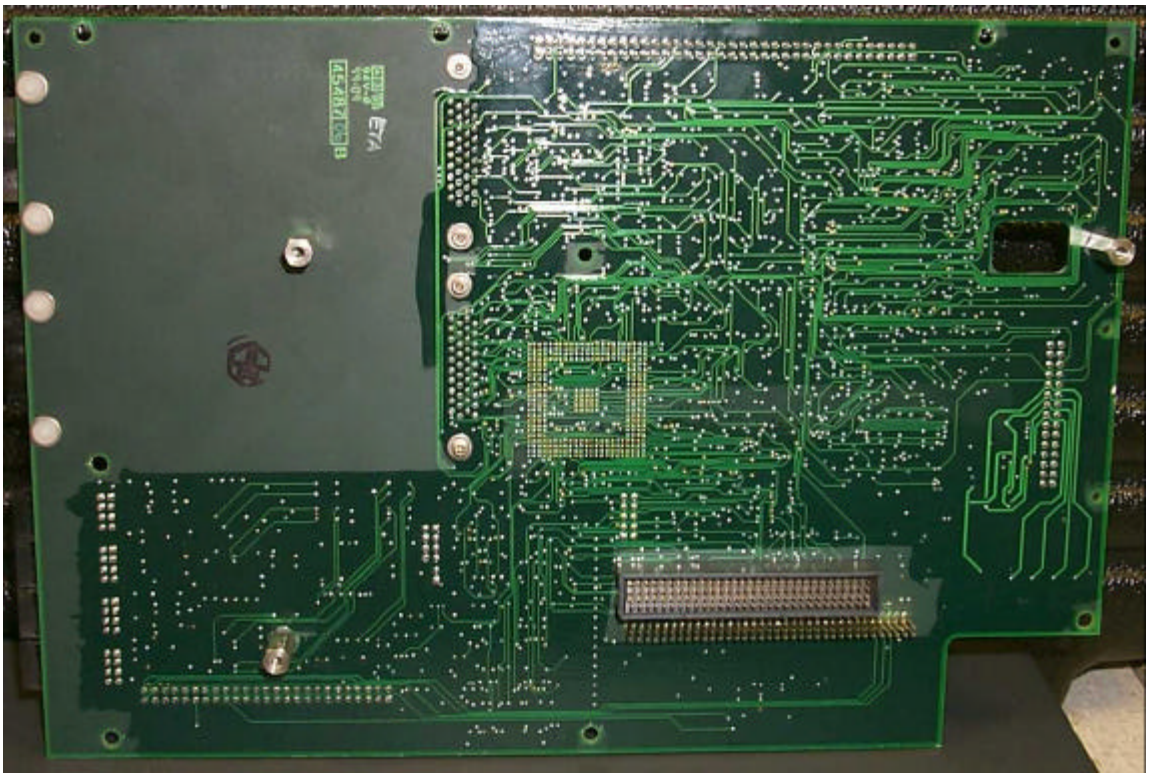
Bottom view of CPU board with heat sink attached, top view of CPU board





Fast Ethernet NIC board, top and bottom view





Power supply, top and bottom view

8. Additional Materials

8.1. Bill of Materials

Triton Part Number	Description
3100001-1003/1002/1001	Reference Oscillator
3328500-1019	Transmitter Module
3228550-1019	Receiver Module
2528000-0002 2528001-0001	Oscillator, Local, Dual Output
2328000-1000	Antenna Assembly
2600000-0001/0002	IF Filter
3428001-0001	Waveguide Isolator
2628001-0001/2/3/4/5/6	Waveguide Filter
3000000-1002	Power Supply
2400001-2000	CPU Assembly
2800001-1000	Network Interface CCA - FE
2700000-0001	Modem