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1516 CENTRE CIRCLE
DOWNERS GROVE, ILLINOIS 60515-1082

ELITE PROJECT: 28604 DATES TESTED: March 13 through 16, 2000

TEST PERSONNEL: Daniel E. Crowder

TEST SPECIFICATION: Federal Communication Commission (FCC) Part 24

ENGINEERING TEST REPORT NO. 22536

MEASUREMENT OF RF INTERFERENCE FROM

A MODEL SYN8486A

SINGLE CARRIER DUAL BAND RF LINEAR COMPENSATOR

FOR: TRL Technologies
Hofmann Estates, IL

PURCHASE ORDER NO: 98-718

Report By:
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Witnessed By:
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TRL Technologies

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Engineer of Illinois - 44894

ENGINEERING TEST REPORT NO. 22536

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

DESCRIPTION OF TEST ITEM: Single Carrier Dual Band RF Linear Compensator

MODEL NO: SYN8486A **SERIAL NO:** None Assigned

MANUFACTURER: TRL Technologies

APPLICABLE SPECIFICATIONS: FCC Part 24

QUANTITY OF ITEMS TESTED: One (1)

TEST PERFORMED BY: ELITE ELECTRONIC ENGINEERING INCORPORATED
Radio Interference Consultants
Downers Grove, Illinois 60515

DATE RECEIVED: March 13, 2000

DATES TESTED: March 13 through 16, 2000

PERSONNEL (OPERATORS, OBSERVERS, AND CO-ORDINATORS):
CUSTOMER: Hiep Lam of TRL Technologies was present.
ELITE ELECTRONIC: Daniel E. Crowder

ELITE JOB NO.: 28604

ABSTRACT: The model SYN8486A Single Carrier Dual Band RP Linear Compensator complies with the technical requirements in FCC Part 24. See test results and data pages for more details.

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(INCLUDING DATA SHEETS): 141

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1.0 INTRODUCTION:

1.1 DESCRIPTION OF TEST ITEM: During the period of March 13 through 16, 2000, a series of radio interference measurements were performed on a model SYN8486A Single Carrier Dual Band RF Linear Compensator, (hereinafter referred to as the test item) . No serial number was assigned to the test item. The tests were performed for TRL Technologies of Hoffman Estates, IL.

The test item is a single carrier RF linear compensator that operates in the PCS bands, 1930 through 1990 and 1850 through 1910. The test item has a rated gain of 15dB.

The test item is designed to operate in the following frequency ranges:

Block	Downlink Frequency (MHz)	Uplink Frequency (MHz)
A	1930-1945	1850-1865
D	1945-1950	1865-1870
B	1950-1965	1870-1885
E	1965-1970	1885-1890
F	1970-1975	1890-1895
G	1975-1990	1895-1910

1.2 PURPOSE: The test series was performed to determine if the test item meets the technical requirements of the FCC Part 24 for broadband PCS.

1.3 DEVIATIONS, ADDITIONS AND EXCLUSIONS: There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4 APPLICABLE DOCUMENTS: The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 24, dated 1 October 1998
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 1998
- ANSI C63.4-1992, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

1.5 SUBCONTRACTOR IDENTIFICATION: This series of tests was performed by Elite Electronic Engineering incorporated, of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.6 LABORATORY CONDITIONS: The temperature at the time of the test was 20"C and the relative humidity was 28%.

2.0 TEST ITEM SETUP AND OPERATION:

2.1 POWER INPUT: The test item obtained 12VDC from a Tektronix PS280 DC Power Supply through two, 1/2 meter long, unshielded leads.

2.2 GROUNDING: Since the test item was powered with 12VDC from a DC power supply, it was ungrounded during the tests.

2.3 PERIPHERAL EQUIPMENT: The following peripheral equipment was submitted with the test item:

ITEM	DESCRIPTION
HP Signal Generator	M/N E4432B, S/N VS38440973
Ophir Amplifier	M/N GRF5064, S/N 1006
HP Power Meter	M/N 437B, SIN 3110A05097, Next Cal 05/27/00

The output of the signal generator was routed through the amplifier. The output of the amplifier was connected to the test item through a 1 meter long coaxial cable. The power meter was connected to the test item through a 1 meter long coaxial cable.

2.4 MODULATION: The test signal was modulated with three different representative types of modulations: (1) Analog - AMPS 30kHz; (2) Digital I/Q modulations - TDMA 30kHz; CDMA 1.23 MHz. The input signals were supplied from an HP M/N E4432B Signal Generator.

The RF Power Output, the occupied Bandwidth and the Spurious Emissions at Antenna Terminal tests were performed with AMPS, TDMA, and CDMA modulated input signals. The preliminary Field Strength of Spurious Emissions tests were performed with CW, AMPS, TDMA and CDMA modulated input signals. The final Field Strength of Spurious Emissions tests were performed with CW and CDMA modulated input signals.

2.5 FREQUENCY SELECTION: For test purposes, only the Uplink frequencies were tested because the test item has an antenna connection to the Uplink side only. Three test frequencies, one at the low edge, one in the middle and one at the high edge, were selected for each frequency block pair. The frequencies were one channel spacing from the low or high edge of the frequency range edge. The specified channel spacings used for each modulation type are shown below:

Modulation	Channel Spacing
FM (AMPS)	30kHz
TDMA (NADC)	30kHz
CDMA	1.23MHz

The specific test frequencies are designated as follows:

Uplink:

Block	Modulation Type	Low Edge Frequency (MHz)	Middle Frequency (MHz)	High Edge Frequency (MHz)
A-D	AMPS	1850.03	1860	1869.97
B-E	AMPS	1870.03	1880	1889.97
F-C	AMPS	1890.03	1900	1909.97
A-D	NADC	1850.03	1860	1869.97
B-E	NADC	1870.03	1880	1889.97
F-C	NADC	1890.03	1900	1909.97
A-D	CDMA	1851.23	1860	1868.77
B-E	CDMA	1871.23	1880	1888.77
F-C	CDMA	1890.23	1900	1908.77

2.6 RF POWER OUTPUT: The input levels were adjusted to reach the rated output levels shown below:

Modulation	Rated Power (dBm)	Rated Power (Watts)
AMPS	27	0.5
TDMA	27	0.5
CDMA	27	0.5

3.0 TEST EOUIPMENT:

3.1 TEST EQUIPMENT LIST: A list of the test equipment used can be found on Table 1. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

3.2 CALIBRATION TRACEABILITY: Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.0 REOUIREXENTS, PROCEDURES AND RESULTS:

4.1 RF POWER OUTPUT MEASUREMENTS:

4.1.1 REQUIREMENTS: In accordance with paragraph 24.323, mobile/portable stations are limited to 2 Watts e.i.r.p. peak power and the equipment must employ means to limit the power of the minimum necessary for successful communications.

4.1.2 PROCEDURES: The test item was adjusted for the rated gain. The test item was operated to measure the output for the uplink path.

(a) The input signal was set to 1860MHz.

(b) The input signal was FM (AMPS) modulated.

(c) The HP 437B Power Meter was connected to the output of the test item and the output of the test item was monitored.

(d) The amplitude of the input signal was adjusted until the rated output level was measured. The output power level was measured and recorded.

(e) Steps (b) through (d) were repeated separately with the input signal TDMA and CDMA modulated.

(f) Steps (b) through (d) were repeated separately with the input frequency set to 1880MHz and 1900MHz.

4.1.3 RESULTS: The output power measurements are presented on data page 18. The power outputs achieved for the uplink path were 0. 5 watts (AMPS Modulation), 0.5 watts (TDMA Modulation) and 0.5 watts (CDMA Modulation) .The remainder of the tests were performed at these power levels. The power output complies with the FCC requirements.

The EIRP limit does not apply to the power output alone, but the combination of the power output and the antenna. Compliance to the power output will be based on the system configuration. Therefore, the EIRP requirement cannot be directly applied to the test item.

4.2 OCCUPIED BANDWIDTH MEASUREMENTS:

4.2.1 REQUIREMENTS: In accordance with Paragraph 24.238, on any frequency outside the authorized frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P)dB. For a rated power level of 0.5W, the emissions outside of the emission bandwidth shall be attenuated at least 4OdB below the transmitter power.

In the IMHZ bands immediately outside and adjacent to the frequency range a resolution of at least one percent of the emission bandwidth shall be used. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency where the emissions are 26dB down.

4.2.2 PROCEDURES:

The test was performed using each of the modulation types listed in paragraph 2.2 (AMPS, TDMA, CDMA).

(a) The input signal was set separately to 1850.03MHz, 1869.97MHz, 1870.03MHz, 1889.97MHz, 1890.03MHz and 1909.97. The input signal level was adjusted to provide the rated level at the test item

output. The reference level was recorded.

(b) The input signal was FM (AMPS) modulated.

(c) A spectrum analyzer was connected to the output of the test item. With a bandwidth of the spectrum analyzer set to 300 Hz, the output of the test item was measured and recorded.

(d) The input signal from the signal generator was measured with the spectrum analyzer and recorded over the same frequency range.

(e) The modulation was changed to TDMA (NADC) and steps (c) and (d) were repeated separately with the input signal set to 1850.03MHz, 1869.97MHz, 1870.03MHz, 1889.97MHz, 1890.03MHz and 1909.97.

(f) The modulation was changed to CDMA and steps (c) and (d) were repeated separately with the input signal set to 1851.23MHz, 1868.77MHz, 1871.23MHz, 1888.77MHz, 1891.23MHz and 1908.77MHz. The bandwidth of the spectrum analyzer was set to 30kHz.

4.2.3 RESULTS: The plots of the occupied bandwidth measured with the FM (AMPS) modulation of the carrier are presented on data pages 19 through 31. The plots of the occupied bandwidth measured with the TDMA (NADC) modulation of the carrier are presented on data pages 32 through 44. The plots of the occupied bandwidth measured with the CDMA modulation of the carrier are presented on data pages 45 through 57.

The limits, shown on the plots, are referenced to the power measured from the unmodulated carrier.

As can be seen from the data, the test item output met the occupied bandwidth requirements with the FM, TDMA and CDMA modulations of the carrier. The sideband emissions measured at the test item output were similar to the sideband emissions measured from the input signals.

4.3 SPURIOUS EMISSIONS AT ANTENNA TERMINAL:

4.3.1 REQUIREMENTS: This test determines whether the test item produces excessive spurious emissions.

In accordance with Paragraph FCC 24.238, the spurious emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P)dB. FCC requirements apply only to frequencies outside the authorized frequency block. For 0.5W, the spurious emissions shall be attenuated by a minimum of 40 dB. This requirement translates to a limit of -13dBm. The peak power of the emissions shall be measured at the antenna terminal from 30MHz up to the 10th harmonic of the fundamental frequency.

4.3.2 PROCEDURES: In general, this test will measure spurious emissions at the antenna terminals. The test was performed using each of the modulation types listed in paragraph 2.2 (FM, TDMA, CDMA).

(a) The input signal was set to 1860.OMHz. The input signal level was adjusted to provide the rated level at the test item output.

(b) The input signal was FM modulated.

(c) A spectrum analyzer was connected to the output of the test item. The frequency span was adjusted to cover 30 MHz up to 1 GHz. With a bandwidth of the spectrum analyzer set to 100 kHz, the output of the test item was measured and recorded.

(d) The frequency span was adjusted to cover 1 GHz up to 2 GHz. With a bandwidth of the spectrum analyzer set to 1 MHz, the output of the test item was measured and recorded.

(e) The frequency span was adjusted to cover 2 GHz up to 20 GHz. With a bandwidth of the spectrum analyzer set to 1 MHz, the output of the test item was measured and recorded. This range covers up through

the 10th harmonic.

(f) Steps (c) through (e) were repeated on the input signal from the signal generator.

(g) The modulation was changed to TDMA and steps (c) through (f) were repeated separately with the input signal set to 1860.0MHz.

(i) The modulation was changed to CDMA and steps (c) through (f) were repeated separately with the input signal set to 1860.0MHz.

(j) Steps (a) through (i) were repeated separately with the signal generator set to 1880.0MHz and 1900.0MHz.

4.3.3 RESULTS: The plots of the antenna conducted output measurements are presented on data pages 58 through 111. As can be seen from the data, the test item did not produce spurious emissions in excess of the –13 dBm limit.

4.4 FIELD STRENGTH OF SPURIOUS EMISSIONS:

4.4.1 PRELIMINARY RADIATED MEASUREMENTS:

4.4.1.1 REQUIREXENTS: Because emission levels in the open field may be masked by interference from sources other than the test item, preliminary radiated measurements are first performed in the low ambient environment of a shielded enclosure. The radiated emissions from the test item were first measured using peak detection. This data was then automatically plotted. The frequencies with significant emission levels were measured in the open field.

4.4.1.2 PROCEDURES: All preliminary tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4 1992 for site

attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All power lines and signal lines entering the enclosure pass through filters on the enclosure wall. The power line filters prevent extraneous signals from entering the enclosure on these leads.

The test was performed using each of the modulation types listed in paragraph 2.2 (AMPS, TDMA, CDMA) and CW.

(a) The preliminary measurements were performed with the test item operating separately with an input signal at 1860.0MHZ, 1880.0MHZ and 1900MHz, with CW modulation. The broadband measuring antennas were positioned at a 3 meter distance from the test item. The frequency range from 3OMHz to ISGHZ was investigated. The readings were taken with a peak detector function and recorded.

(b) Step (a) was repeated with the modulation changed to FM (AMPS).

(c) Step (a) was repeated with the modulation changed to TDMA (NADC).

(d) Step (a) was repeated with the modulation changed to CDMA.

4.4.1.3 RESULTS: The preliminary plots are presented on data pages 112 through 135. Factors for the antennas and cables were added to the data before it was plotted.

This data is only presented for a reference, and is not used as official data. All significant radiated emissions were subsequently measured at an open field test site.

4.4.2 FINAL RADIATED EMISSIONS:

4.4.2.1 REQUIREMENTS: In accordance with paragraph 24.238, on any frequency twice or more than twice the fundamental frequency, the emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P)dB. This requirement translates to a limit of -13dBm. The peak power of the emissions shall be measured from 30MHz up to the 10th harmonic of the fundamental frequency.

4.4.2.2 PROCEDURES: Final open field measurements were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4 1992 for site attenuation.

The final open field emission test procedure is as follows:

a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.

b) The antenna output was terminated in 50 ohms for the tests.

c) A double ridged waveguide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.

d) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization.

e) The maximum meter reading was recorded. Measurement BW was 1 MHz and Video of 3MHz. Peak reading were recorded. No averaging methods or corrections were applied.

f) Measurements were performed with the input signal modulated with CW and CDMA.

g) Measurements were performed separately at each frequency used during the preliminary measurements.

The equivalent power into a dipole antenna was calculated from

the field intensity levels measured at 3 meters using the equation shown below:

$$Pg = E^2 4\pi d^2/120\pi = E^2 d^2/30$$

where P = power in watts
g = arithmetic gain of transmitting antenna over isotropic radiator.
E = maximum field strength in volts/meter
d = measurement distance in meter

Using a dipole gain of 1.67 or 2.2 dB and a test distance of 3 meters, this equation reduces to:

P(dBm) = E(dBuV/m) - 97.2dB

4.4.2.3 RESULTS OF OPEN FIELD RADIATED TEST: The final open field radiated levels are presented on data pages 136 through 141. The radiated emissions were measured through the 10th harmonic. All emissions measured from the test item were within the specification limits.

4.5 FREQUENCY STABILITY:

4.5.1 REQUIREMENTS: This requirement does not apply to the test item because it has no frequency conversion.

5.0 CONCLUSION:

It was found that the TRL Technologies model SYN8486A Single Carrier Dual Band RP Linear Compensator, complies with the RF Power Output, the Occupied Bandwidth, the Spurious Emissions at Antenna Terminal and the Field Strength of Spurious Emissions requirements of the FCC Part 24. The Frequency Stability requirements were deemed to be not applicable.

6.0 CERTIFICATION:

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specification.

The data presented in this test report pertains only to the test item at the test date as operated by TRL Technologies personnel. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

7.0 ENDORSEMENT DISCLAIMER:

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

TABLE I: TEST EQUIPMENT LIST

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XZGO	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---	01/29/99	N/A	
Equipment Type: AMPLIFIERS								
APKO	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	01/31/00	12	01/31/01
Equipment Type: ANTENNAS								
NTAO	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	.03-2GHZ	04/10/99	12	04/10/00
NWIO	DOUBLE RIDGED WAVEGUIDE	AEL	H1498	153	2-18GHZ	08/26/99	12	08/26/00
Equipment Type: ATTENUATORS								
T2D2	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-43	AV5815	DC-18GHZ	03/01/00	12	03/01/01
T2DC	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-34	BH5448	DC-18GHZ	11/24/99	12	11/24/00
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	US61654645	---		N/A	
CMAO	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
Equipment Type: METERS								
MPAO	POWER METER	HEWLETT PACKARD	432A	1141A08696	0.01-40GHZ	08/05/99	12	08/05/00
MPAA	THERMISTOR MOUNT	HEWLETT PACKARD	8478B	1144A08340	0.01-18GHZ	08/09/99	12	08/09/00
Equipment Type: PRINTERS AND PLOTTERS								
HRG2	LASERJET 2100XI	HEWLETT PACKARD	C4170A	USCD047796	---		N/A	
Equipment Type: RECEIVERS								
RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	01/19/00	12	01/19/01
RACC	RF PRESELECTOR	HEWLETT PACKARD	85685A	2648A00507	20HZ-2GHZ	01/10/00	12	01/10/01
RAF3	QUASIPEAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	01/19/00	12	01/19/01

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

ENGINEERING TEST REPORT NO. 22536

DATA SHEET

MANUFACTURER : TRL Technologies
TEST ITEM : Single Carrier RF Linear Compensator
MODEL NO. : SYN8486A
SPECIFICATION : FCC-24
TEST DESCRIPTION : RF POWER OUTPUT
TEST EQUIPMENT : See Table I
DATE TESTED : March 13, 2000

FREQUENCY MHz	POWER READING dBm	Watts
FM (AMPS) Modulation		
1860.0	27	0.5
1880.0	27	0.5
1900.0	27	0.5
NADC (TDMA) Modulation		
1860.0	27	0.5
1880.0	27	0.5
1900.0	27	0.5
CDMA Modulation		
1860.0	27	0.5
1880.0	27	0.5
1900.0	27	0.5

CHECKED BY: _____