FCC Certification Test Report

FCC Certification Test Report
for
Communications International, Inc.
FCC ID: SA8MARKII-CII-DMD

August 20, 2004

Prepared for:

Communications International, Inc.
44500 US 1
Vero Beach, FL 32967

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC Certification Test Program

FCC Certification Test Report
for the
Communications International, Inc.
Mark II Power Amplifier Upgrade Kit
SA8MARKII-CII-DMD

August 20, 2004

WLL JOB# 8188

Prepared by: Michael Violette
President

Reviewed by: Greg Snyder
Chief EMC Engineer

Abstract

This report has been prepared on behalf of Communications International, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Power Amplifier under Part 90 of the FCC Rules and Regulations. This Federal Communications Commission (FCC) Certification Test Report documents the test configuration and test results for a Communications International, Inc. Mark II Power Amplifier.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Communications International, Inc. Mark II Power Amplifier Upgrade Kit complies with the limits for a Power Amplifier device under Part 90 of the FCC Rules and Regulations.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Communications International, Inc. Mark II Power Amplifier Upgrade Kit complies with the limits for a Power Amplifier device under Part 90 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2001 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Communications International, Inc. 44500 US 1 Vero Beach, FL 32967
Quotation Number:	61385

1.4 Test Dates

Testing was performed on June 20 and June 21, 2004

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter

Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

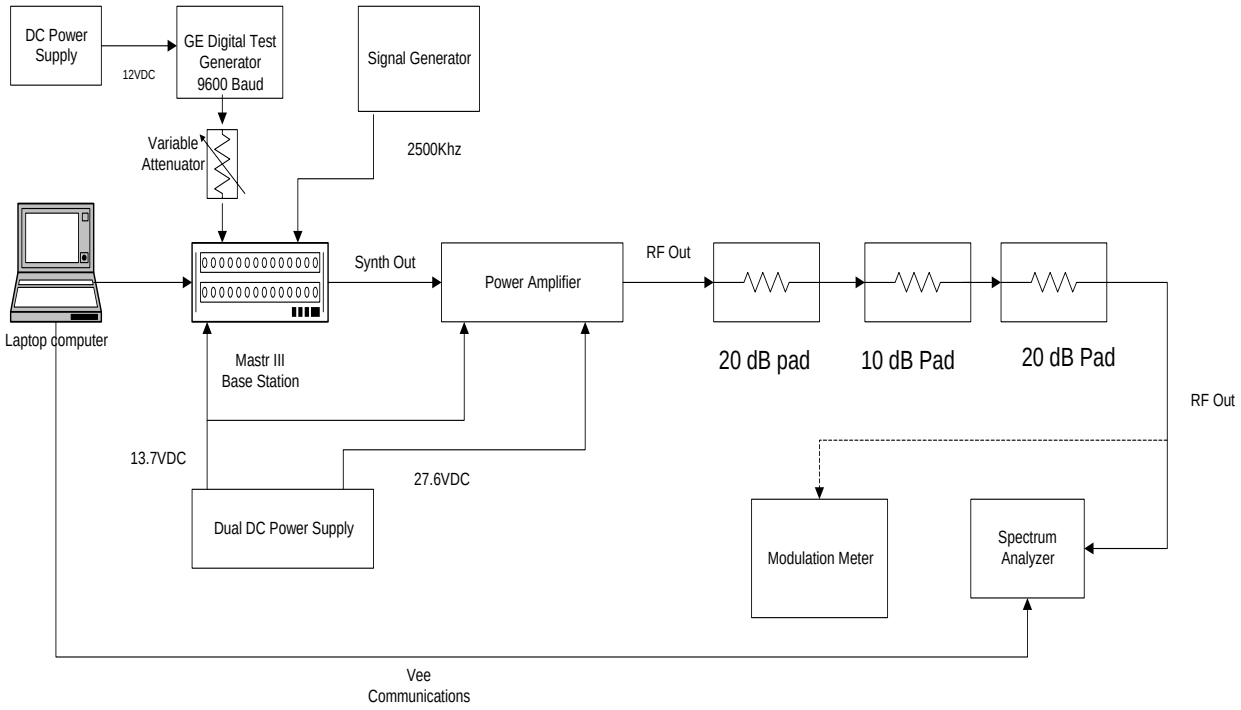
The Communications International, Inc. Mark II Power Amplifier Upgrade Kit is a 110W RF power amplifier that is to be used in the MASTRIII Base Stations manufactured by M/A-COM (FCC ID: OWDTR-329-A2). The PA is a replacement amplifier that is being introduced in this line of Land Mobile Base Stations.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Communications International, Inc.
FCC ID Number	SA8MARKII-CII-DMD
EUT Name:	Power Amplifier Upgrade Kit
Model:	Mark II
FCC Rule Parts:	§90
Frequency Range:	851-870 MHz
Maximum Output Power:	110W
Modulation:	Based on source
Necessary Bandwidth:	N/A
Keying:	N/A
Type of Information:	N/A
Number of Channels:	N/A
Power Output Level	Set by MASTRIII Base Station
Antenna Type	Connector
Frequency Tolerance:	N/A
Emission Type(s):	F3E, F1D, F1E, F2D, F2B
Interface Cables:	None
Power Source & Voltage:	27VDC

2.2 Test Configuration

The Mark II was configured with a MASTRIII chassis, which supplied the excitation signal. A drawing of the test configuration is shown in the following figure.



2.3 Testing Algorithm

The Mark II was operated continuously by providing a modulated signal from the MASTRIII basestation to the power amplifier.

Three frequencies were tested:

- 851 MHz
- 860 MHz
- 870 MHz

The power amplifier was tested using two Analog and Digital modulations provided by the MASTRIII base station.

Worst-case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 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

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Site 2 List:

Manufacturer	Model/Type	Function	Identification	Cal. Due
HP	8568B	Spectrum Analyzer	2634A02888	7/07/04
HP	85650A	Quasi-Peak Adapter	3303A01786	7/08/04
HP	Spectrum Analyzer	HP 8593A	3009A00739	6/25/04
HP	8449B	Microwave Preamp	3008A00385	9/29/05
HP	83640B	Signal Generator	Rental	7/31/04
HP	8563A	Spectrum Analyzer	63	9/29/05
ARA	LPB-2520	BiconiLog Antenna	1044	6/20/04
ARA	DRG118/A	Microwave Horn Antenna	1236	4/17/04
HP	85685A	RF Preselector	3221A01395	7/07/04
EMCO	3110B	Biconical Antenna	9808-1078	6/20/04
EMCO	3146A	Log Periodic Antenna	8912-1129	6/20/04
HP	438A	Power Meter	3048U02786	3/10/05
HP	8481B	Power Sensor	331BA06133	4/15/05

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046)

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

CW Power was measured and the results are provided in the following table.

Table 3. RF Power Output

Frequency	Level	Level (Watts)
Low Channel: 851MHz	50.48 dBm	111.7
Mid Channel: 860MHz	50.50 dBm	112.2
High Channel: 870MHz	50.45 dBm	110.9

4.2 Modulation Characteristics: (FCC Part §2.1047); Audio Frequency Response

Not applicable for an amplifier.

4.3 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

At full modulation, the occupied bandwidth was measured at the –20dBc levels for each of the frequencies measured.

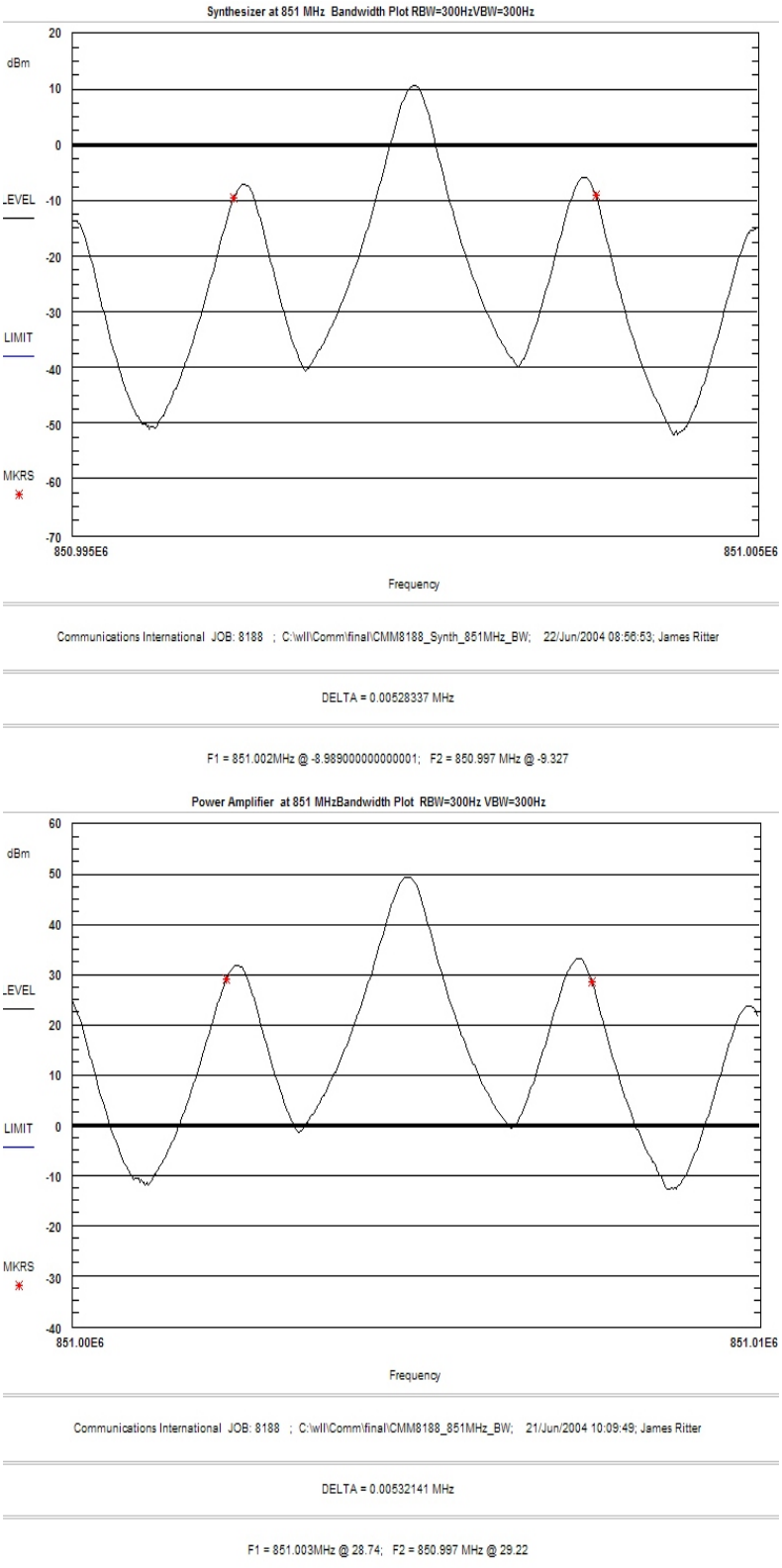
Digital modulation was provided by a 9600 BAUD digital test generator while analog modulation was provided via an audio generator set at 2500Hz. These inputs were supplied to the MASTR III Basestation for covering the emission designations of F1D, F1E, F2D, F2B, and F3E.

Table 4 provides a summary of the Occupied Bandwidth Results. Data are provided in Figure 1 through Figure 6.

Table 4. Occupied Bandwidth Results

Frequency	Occupied Bandwidth kHz
ANALOG MODULATION	
Low Channel: 851MHz	5.3
Mid Channel: 860MHz	5.3
High Channel: 870MHz	5.3
DIGITAL MODULATION	
Low Channel: 851MHz	12.2
Mid Channel: 860MHz	19.9
High Channel: 870MHz	11.6

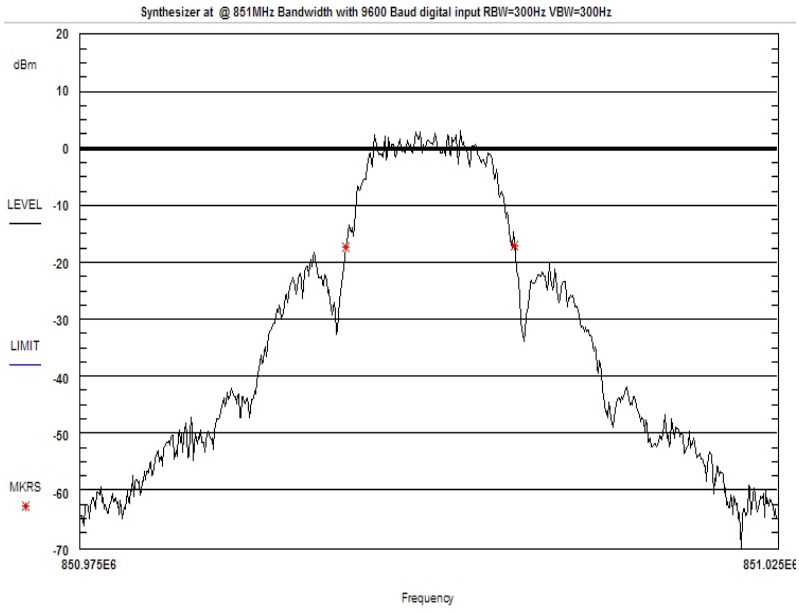
Amplifier Input:



Amplifier Output:

Figure 1. Occupied Bandwidth: 851 MHz Analog Modulation, F3E

Amplifier Input:



Amplifier Output:

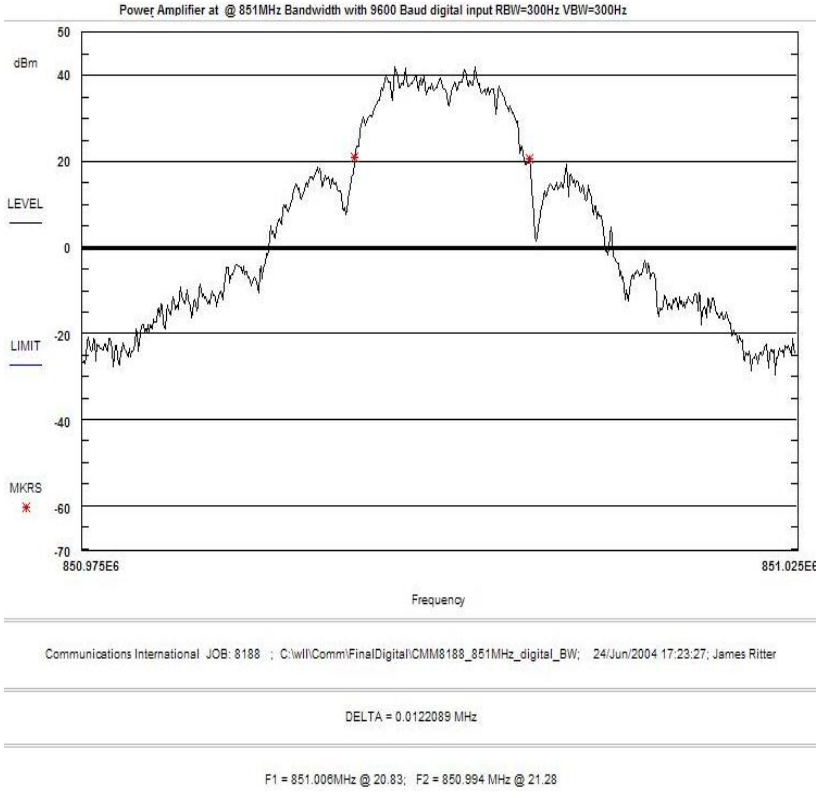
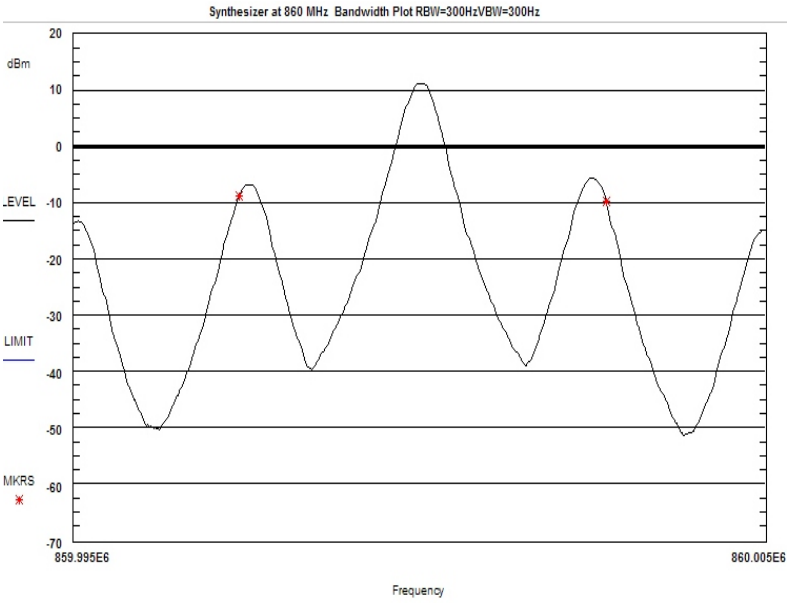


Figure 2. Occupied Bandwidth 851 MHz Digital Modulation, F1D, F1E, F2D, F2B

Amplifier Input:



Amplifier Output:

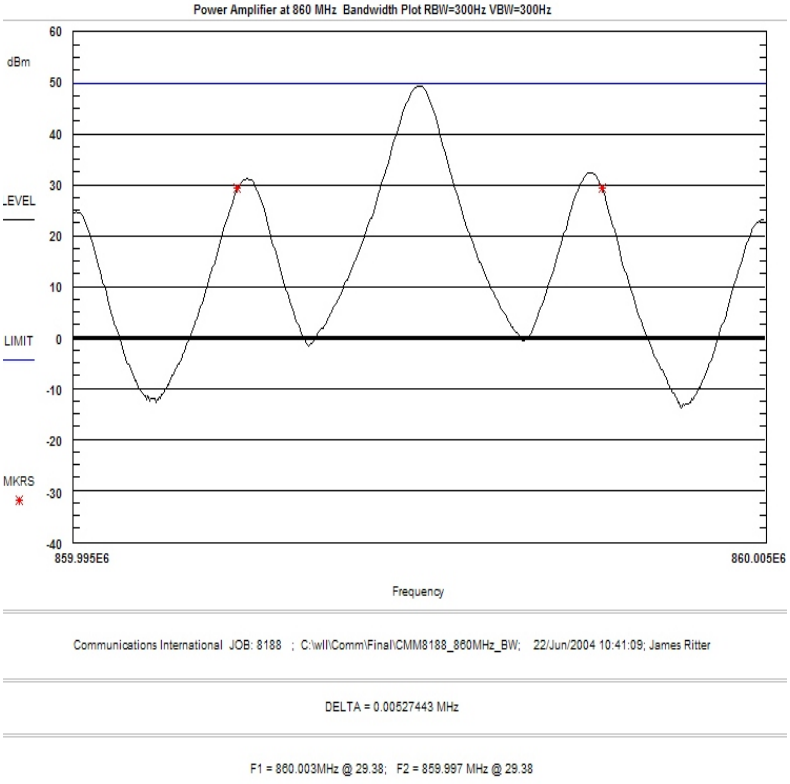
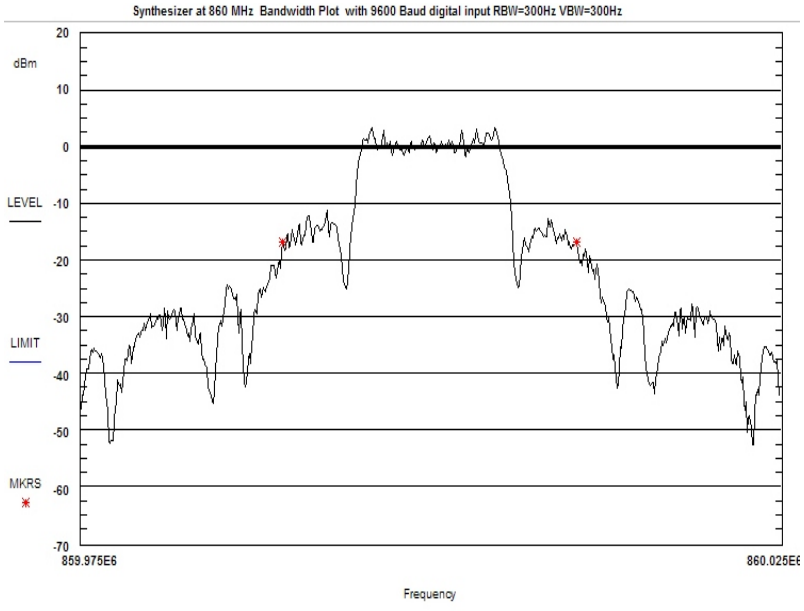


Figure 3. Occupied Bandwidth 860 MHz Analog Modulation, F3E

Amplifier Input:



Amplifier Output:

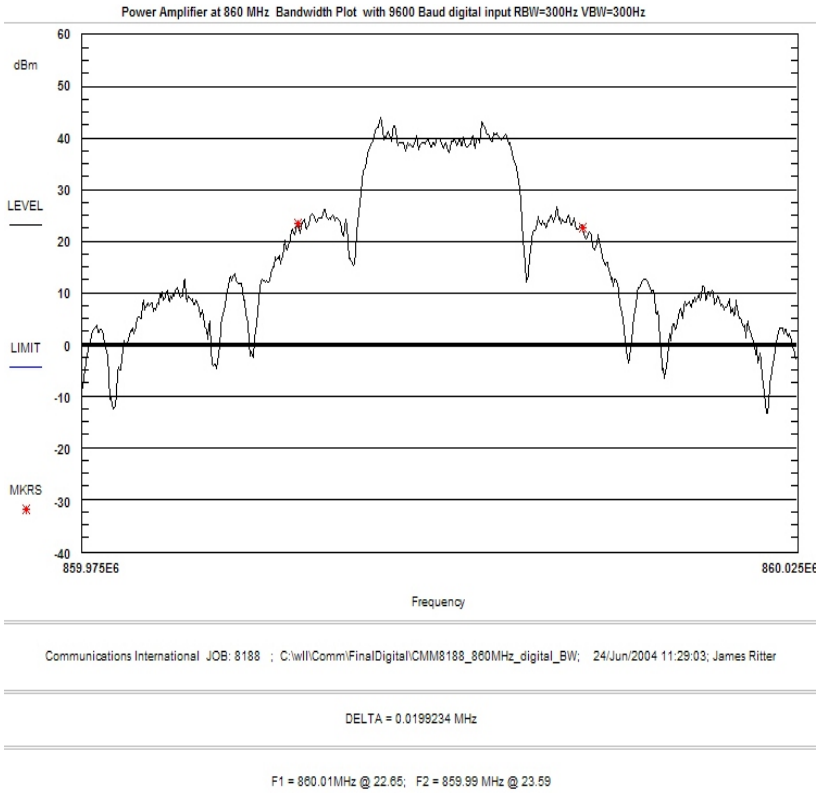
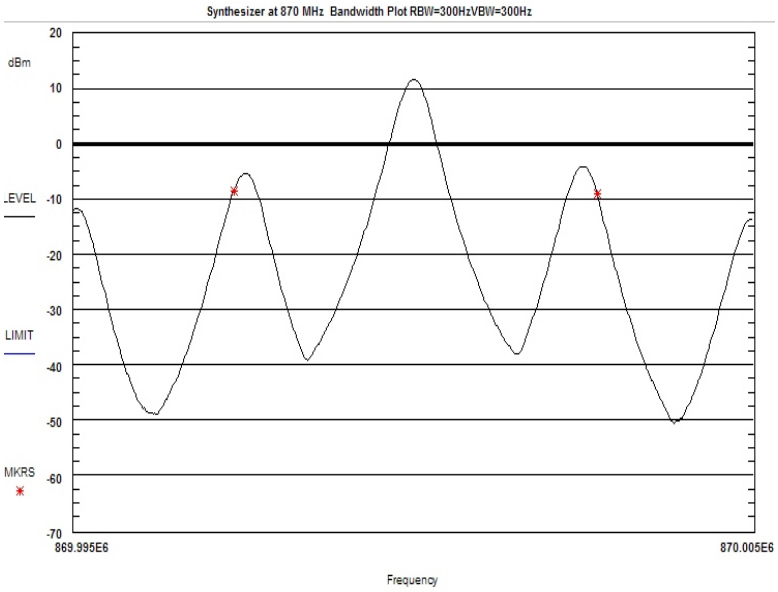


Figure 4. Occupied Bandwidth 860 MHz Digital Modulation F1D, F1E, F2D, F2B

Amplifier Input:



Amplifier Output:

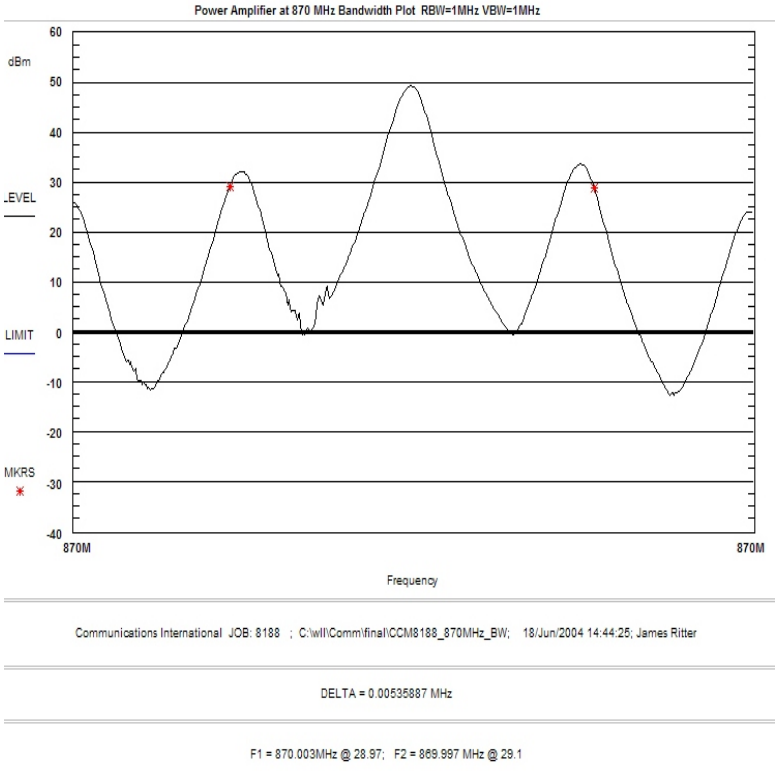
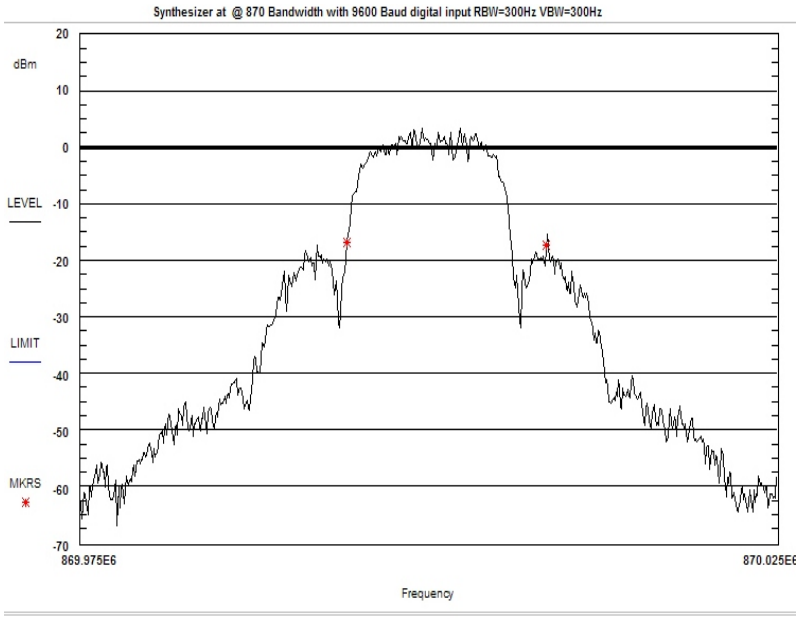


Figure 5. Occupied Bandwidth 870 MHz Analog Modulation, F3E

Amplifier Input:



Amplifier Output:

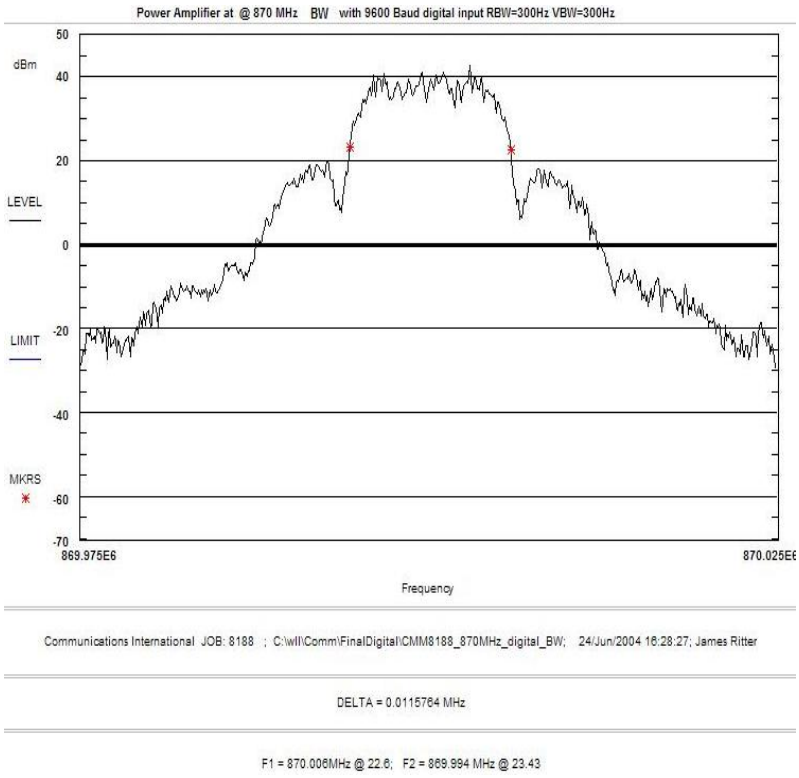


Figure 6. Occupied Bandwidth 870 MHz Digital Modulation F1D, F1E, F2D, F2B

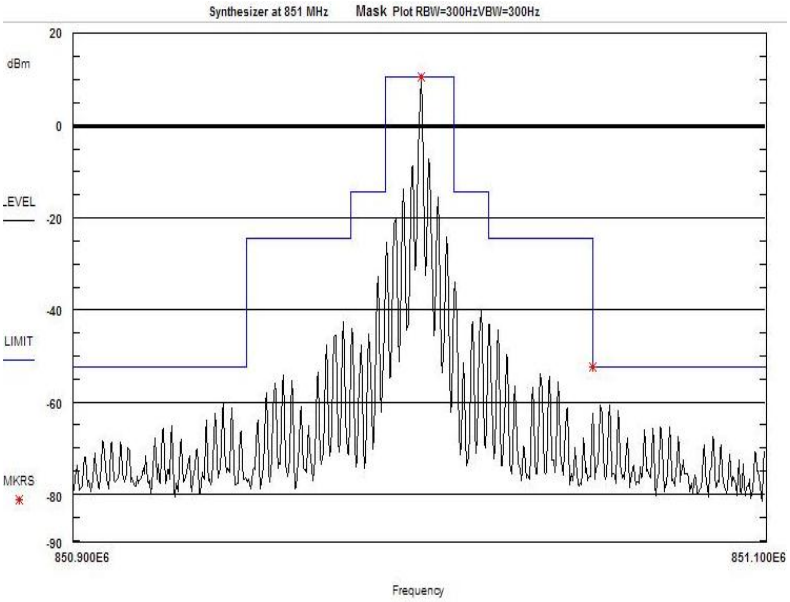
4.4 Spurious Emissions at Antenna Terminals (FCC Part §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals. The limits are shown in the following table.

For spurious emissions, bandreject and/or high pass filters were installed to suppress the carrier to assure that measuring instrumentation would remain linear and that dynamic range requirements were met.

For analog modulation Mask B of 90.210 was used. Mask G was used for the digital modulation. Plots are included for both the input to and the output of the power amplifier.

Amplifier Input:



Amplifier Output:

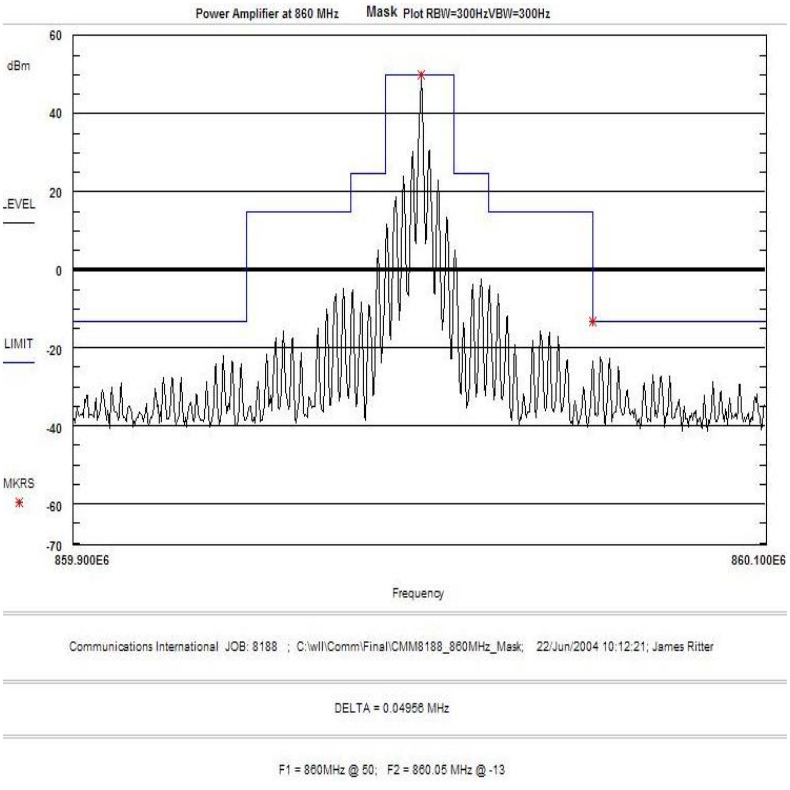


Figure 7. Mask, 851 MHz Analog Modulation, F3E

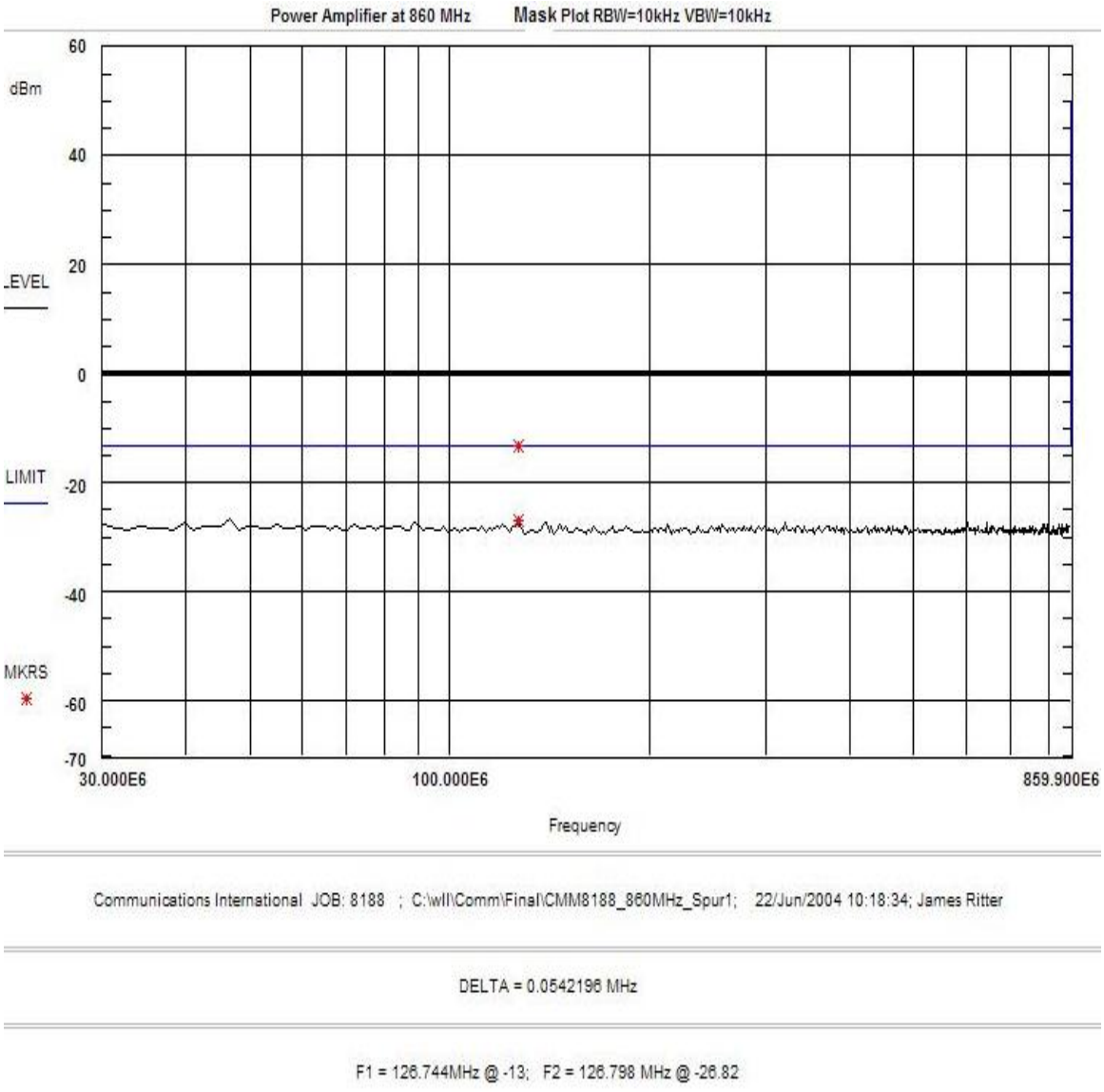


Figure 8. Conducted Spurious Emissions, 851 MHz Analog Modulation, F3E

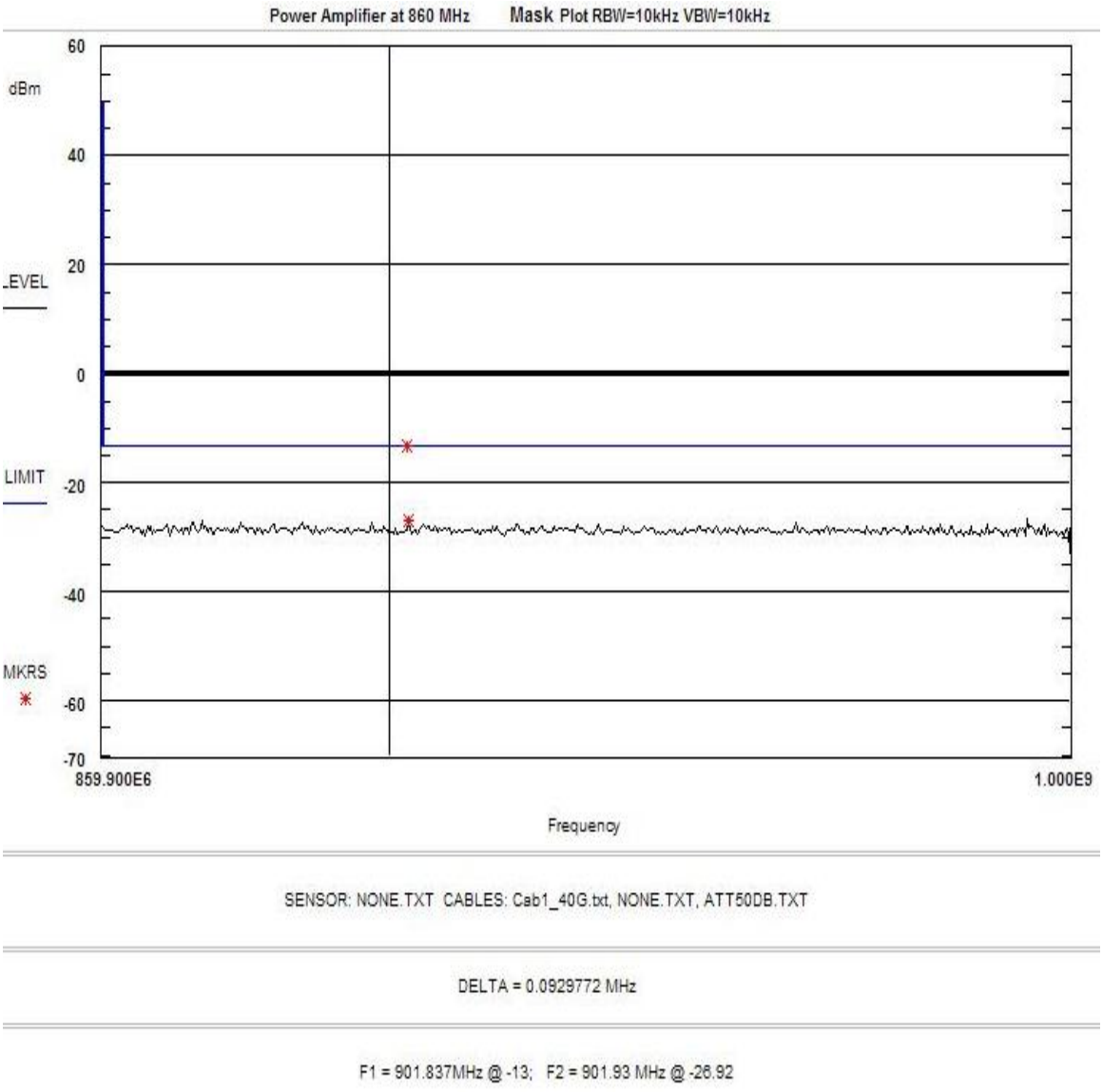


Figure 9. Conducted Spurious Emissions, 851 MHz Analog Modulation, F3E

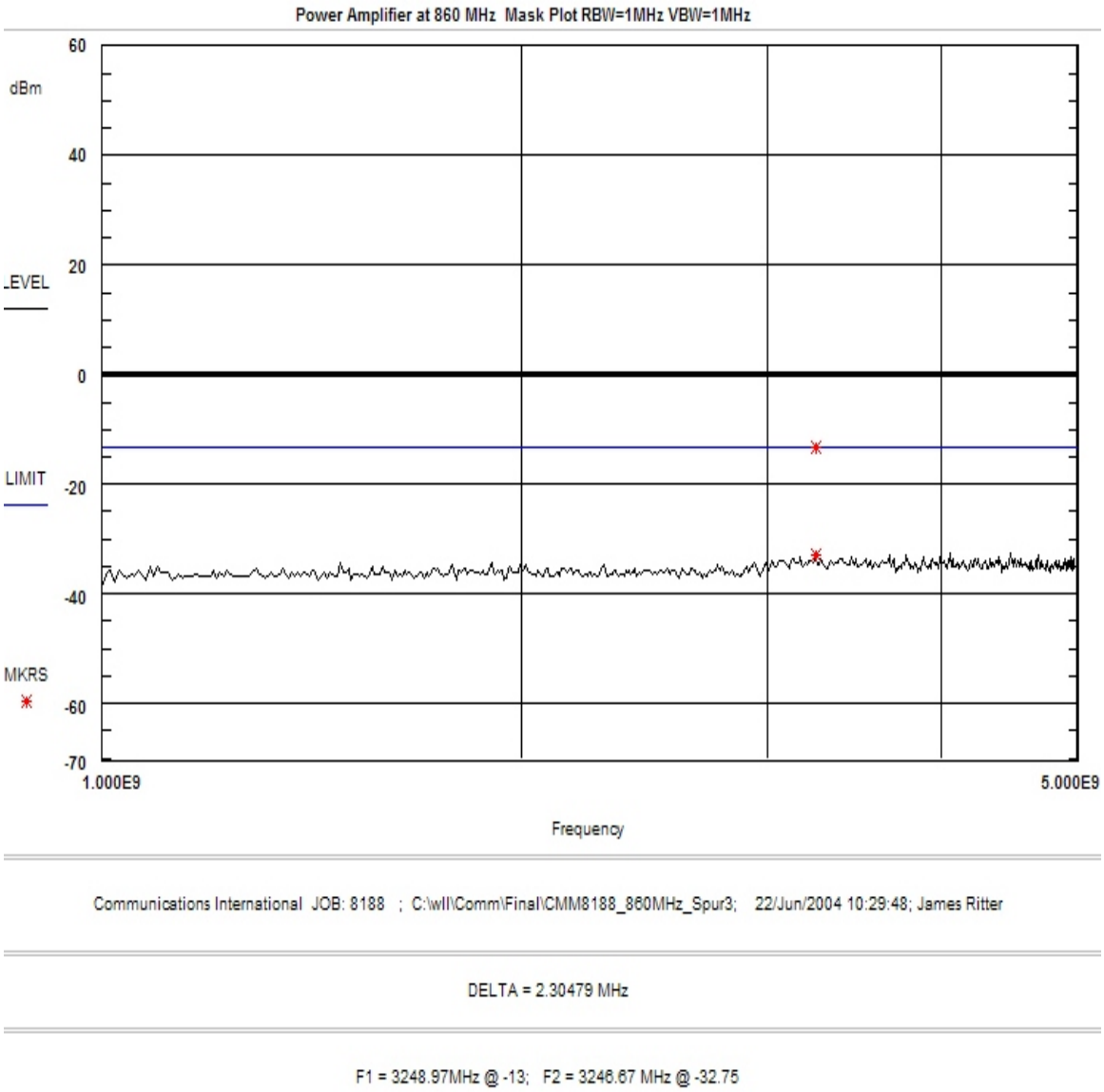


Figure 10. Conducted Spurious Emissions, 851 MHz Analog Modulation, F3E

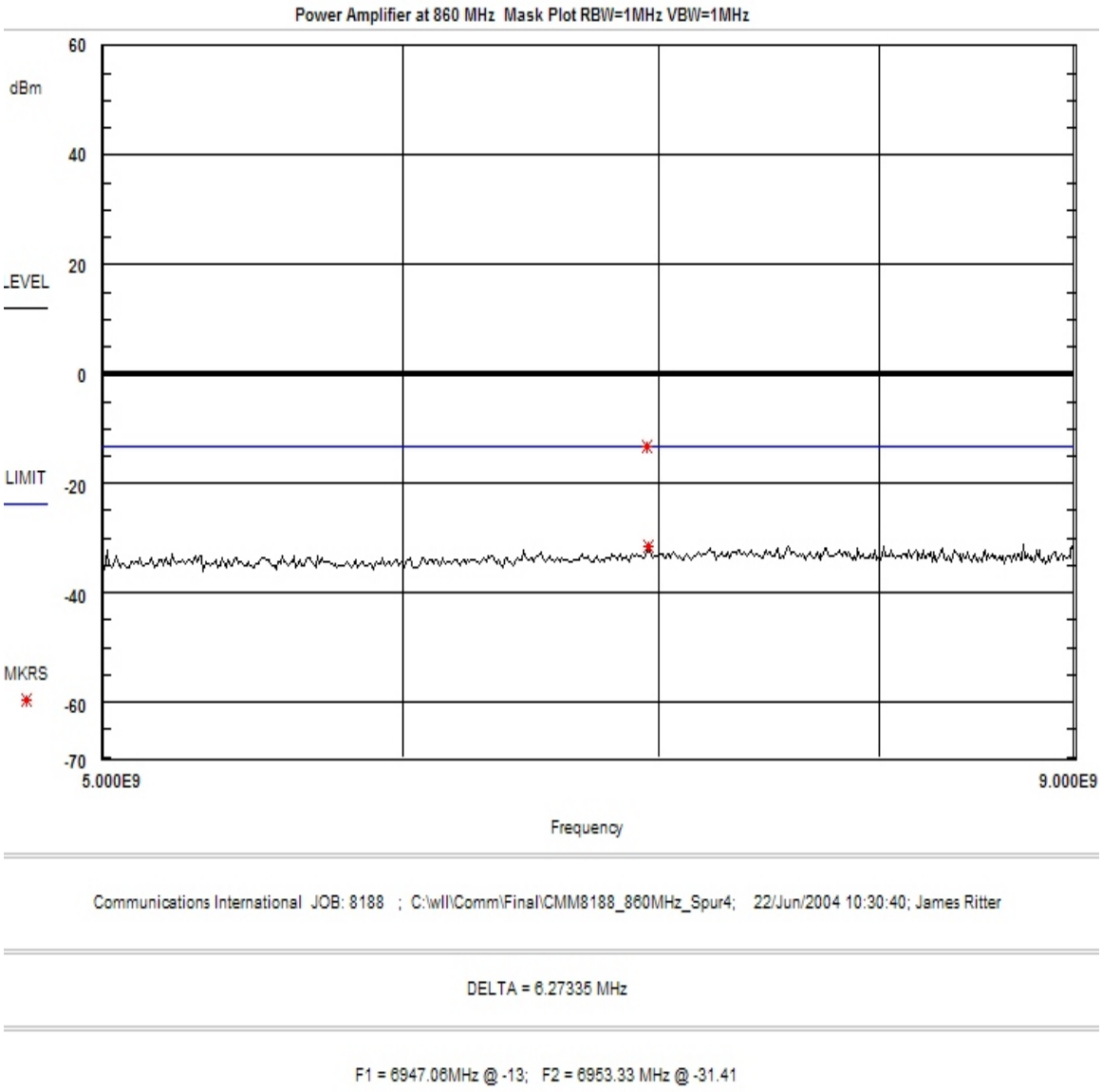
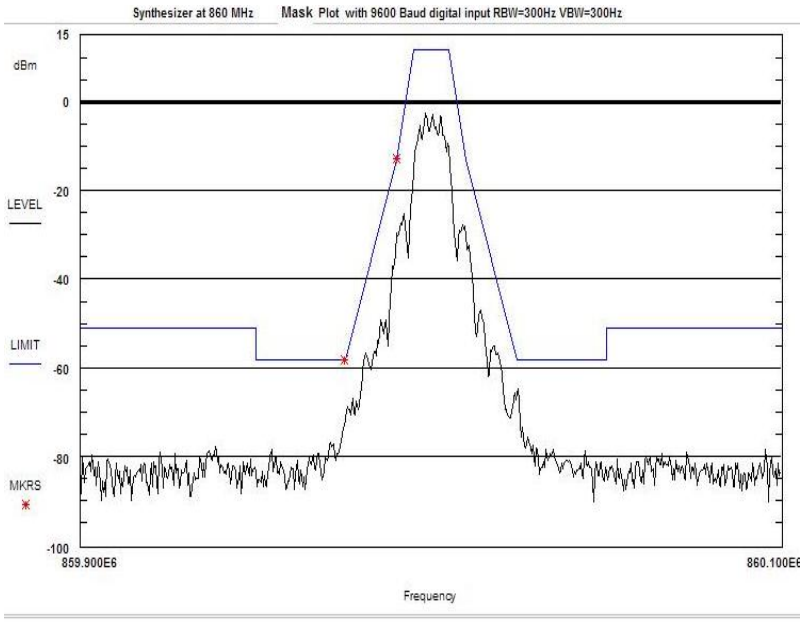


Figure 11. Conducted Spurious Emissions, 851 MHz Analog Modulation, F3E

Amplifier Input:



Amplifier Output:

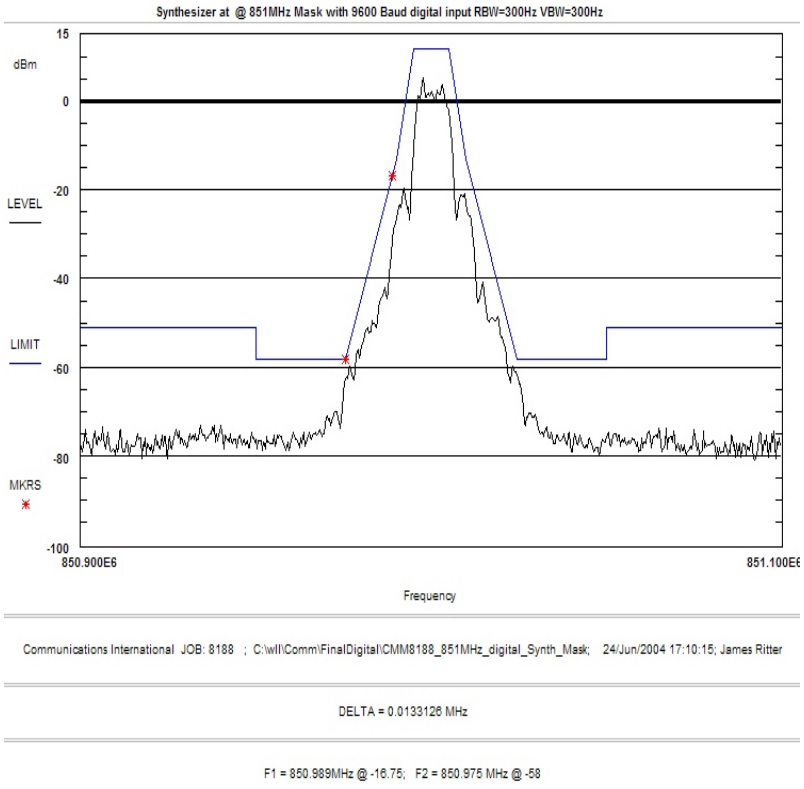


Figure 12. Mask, 851 MHz Digital Modulation F1D, F1E, F2D, F2B

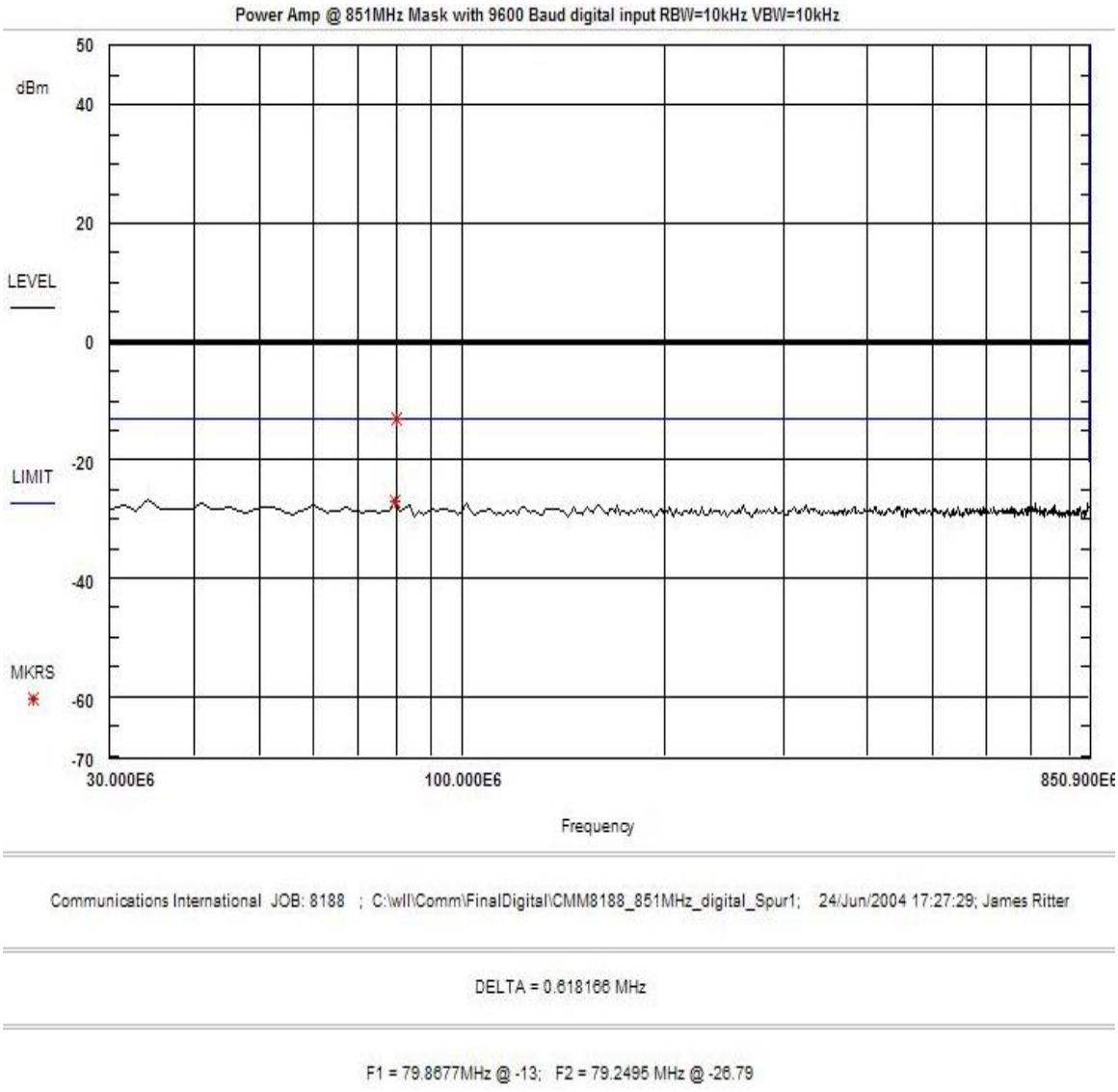


Figure 13. Conducted Spurious Emissions, 851 MHz Digital Modulation F1D, F1E, F2D, F2B

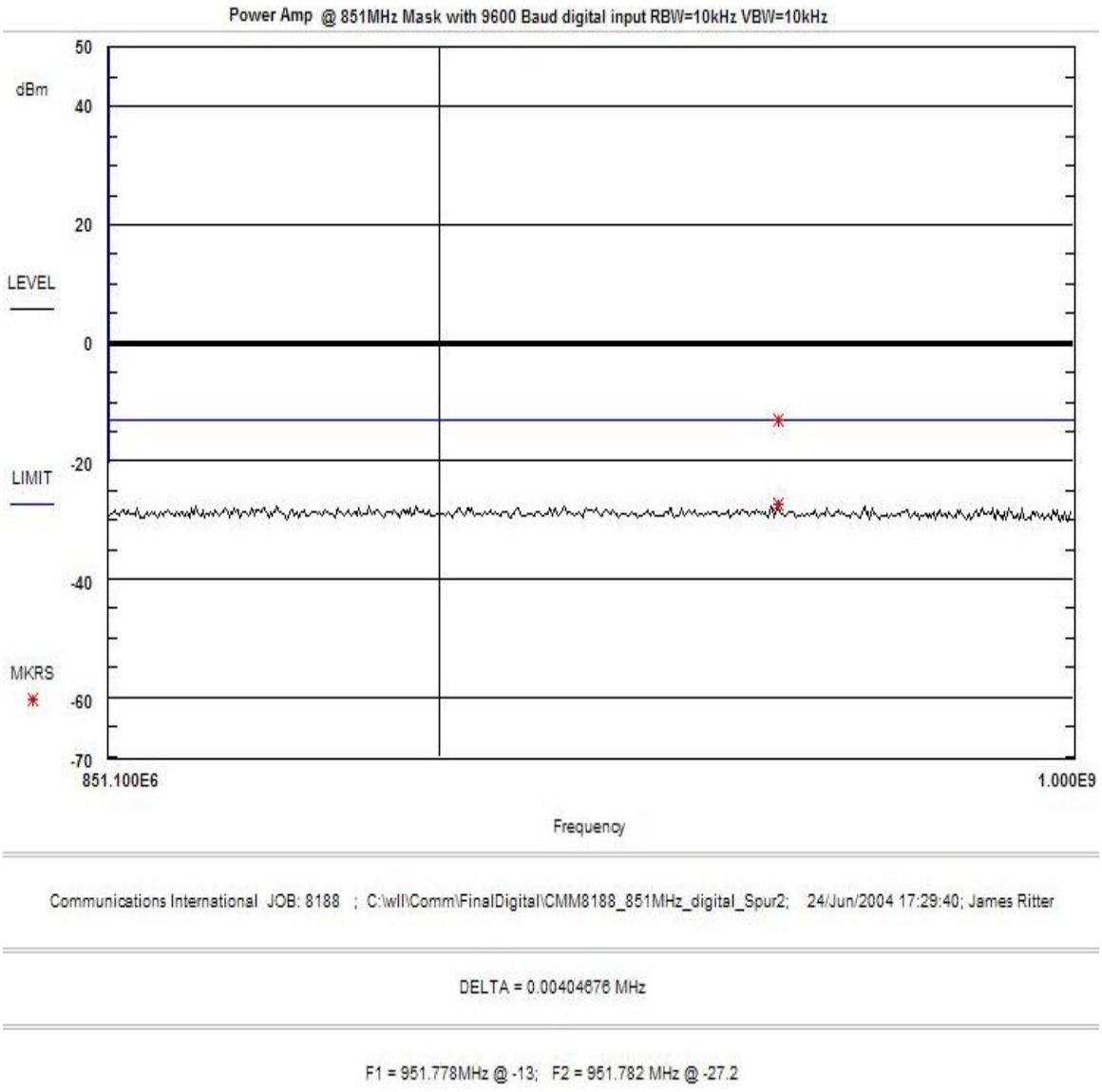


Figure 14. Conducted Spurious Emissions, 851 MHz Digital Modulation F1D, F1E, F2D, F2B

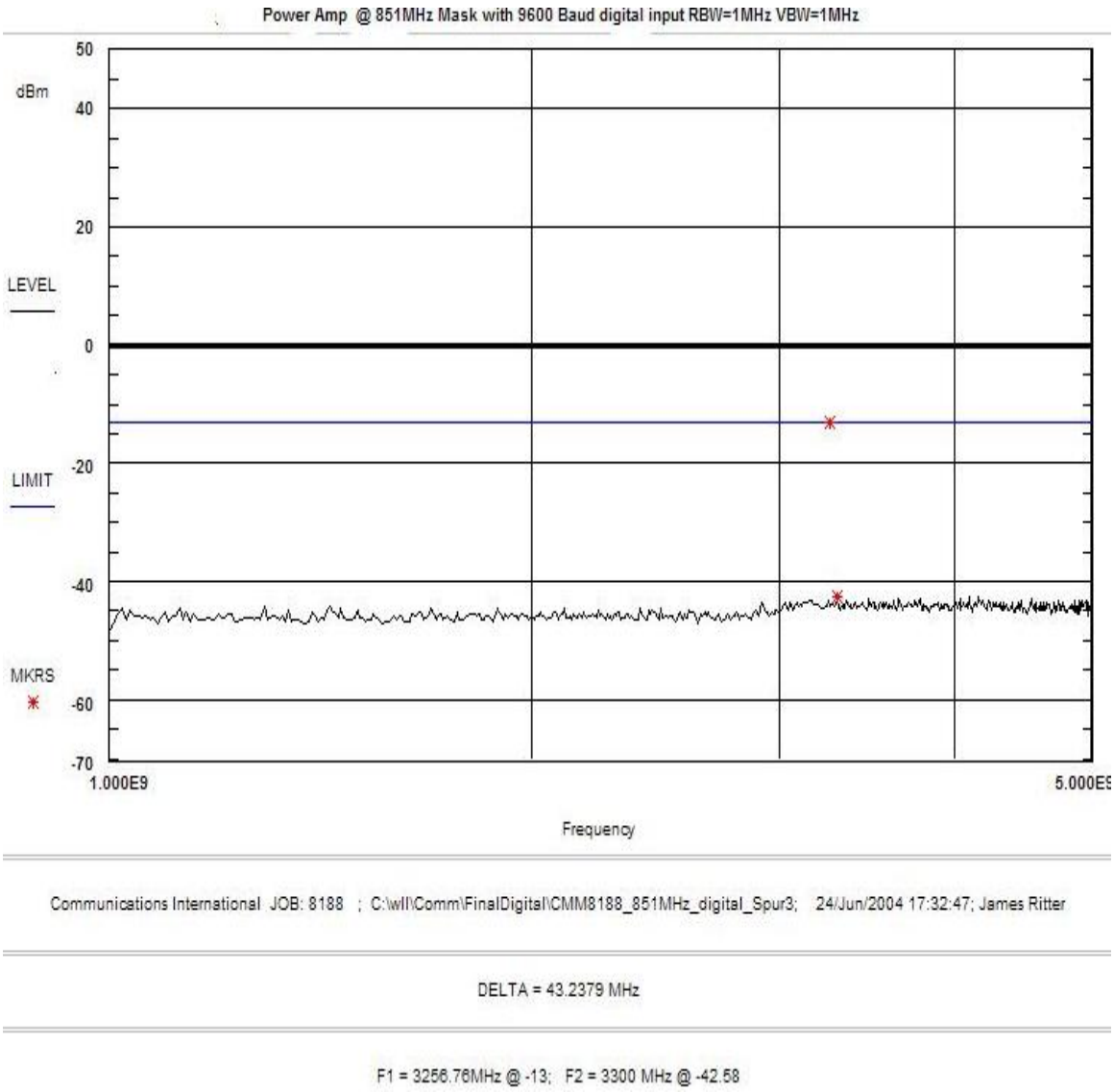


Figure 15. Conducted Spurious Emissions, 851 MHz Digital Modulation F1D, F1E, F2D, F2B

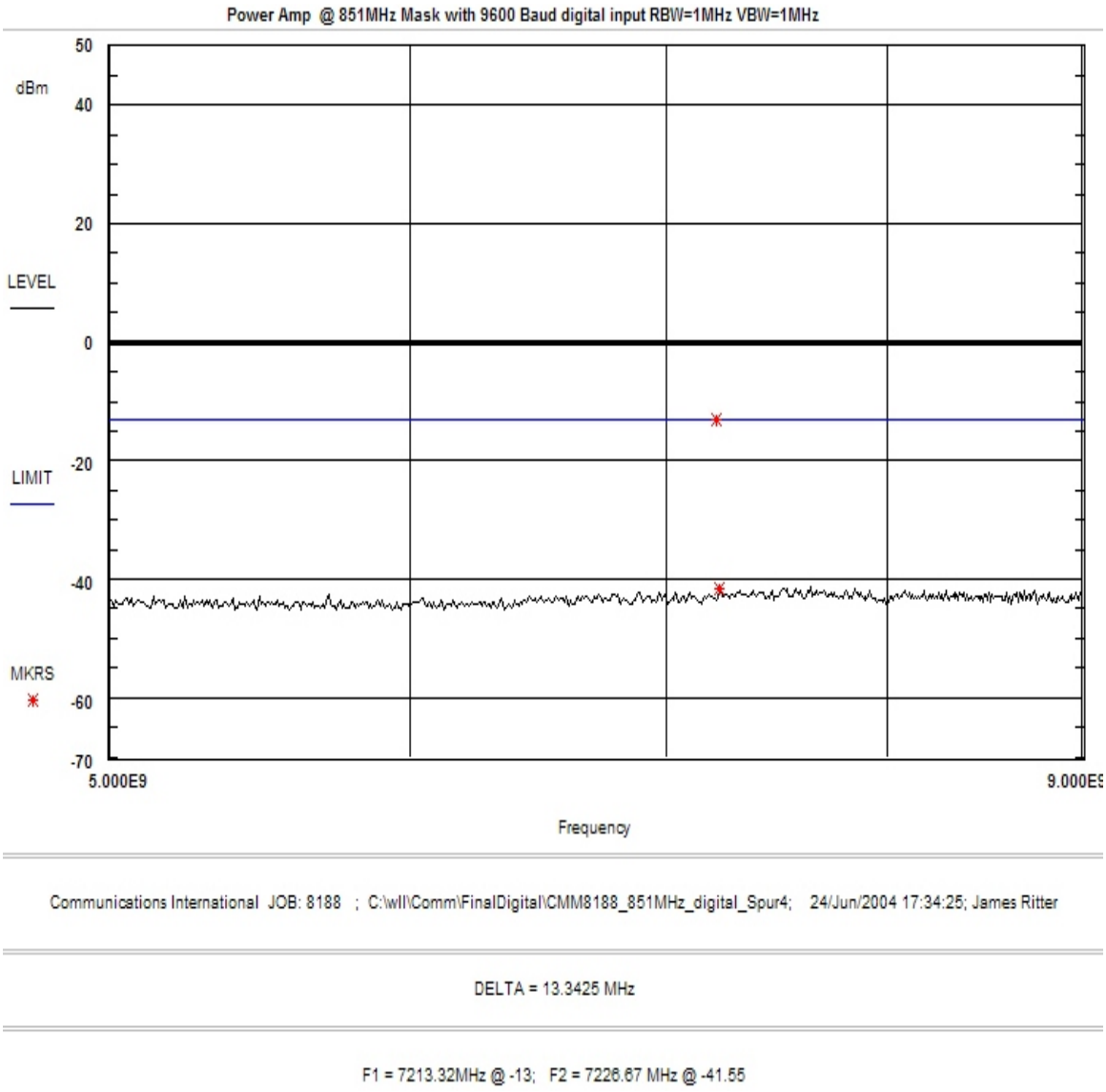
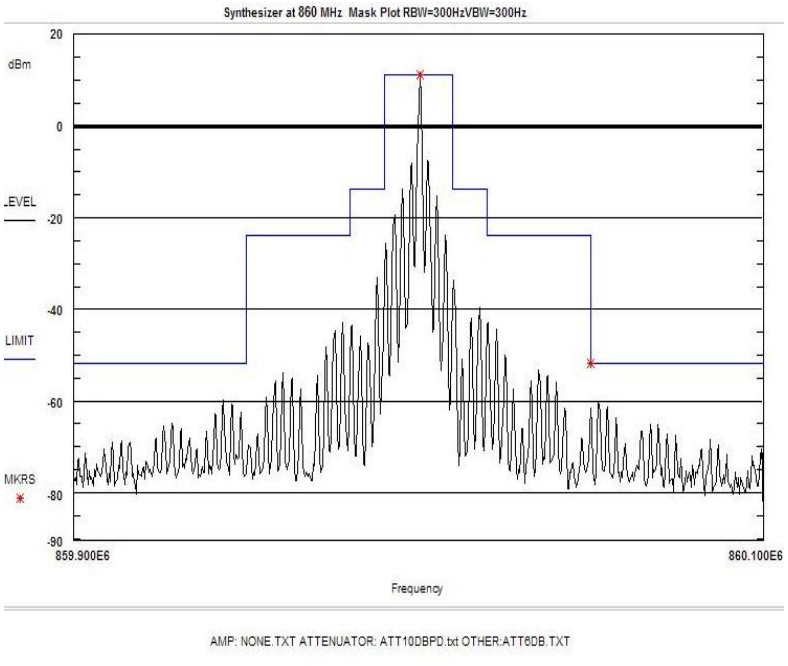


Figure 16. Conducted Spurious Emissions, 851 MHz Digital Modulation F1D, F1E, F2D, F2B

Amplifier Input:



Amplifier Output:

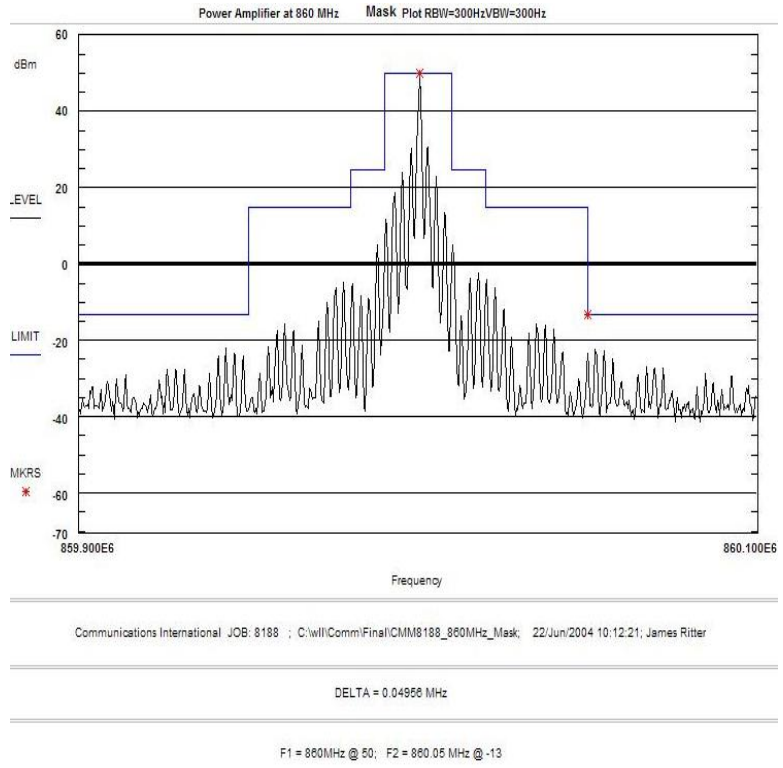


Figure 17. Mask, 860 MHz Analog Modulation, F3E

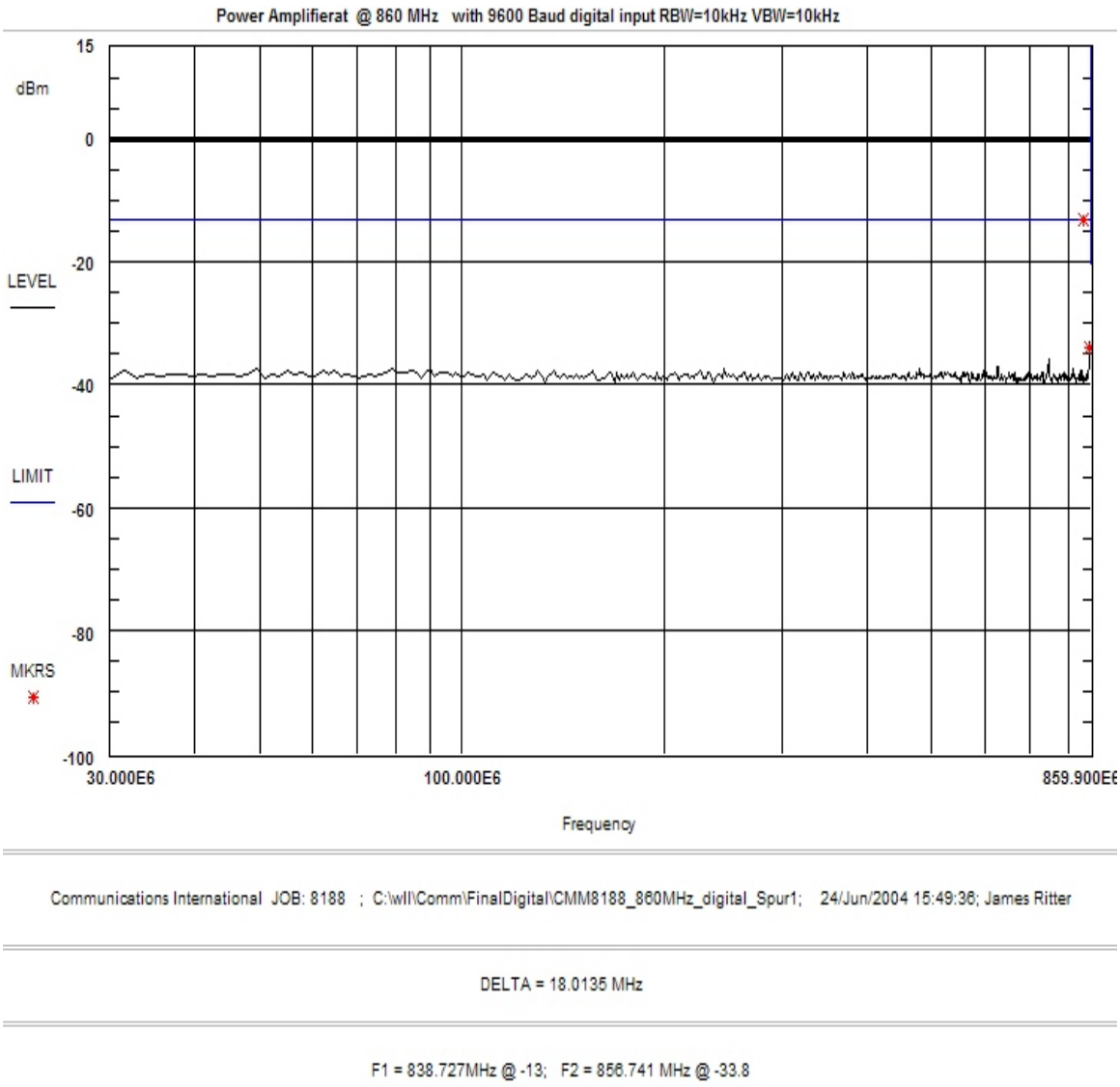


Figure 18. Conducted Spurious Emissions, 860 MHz Analog Modulation,F3E

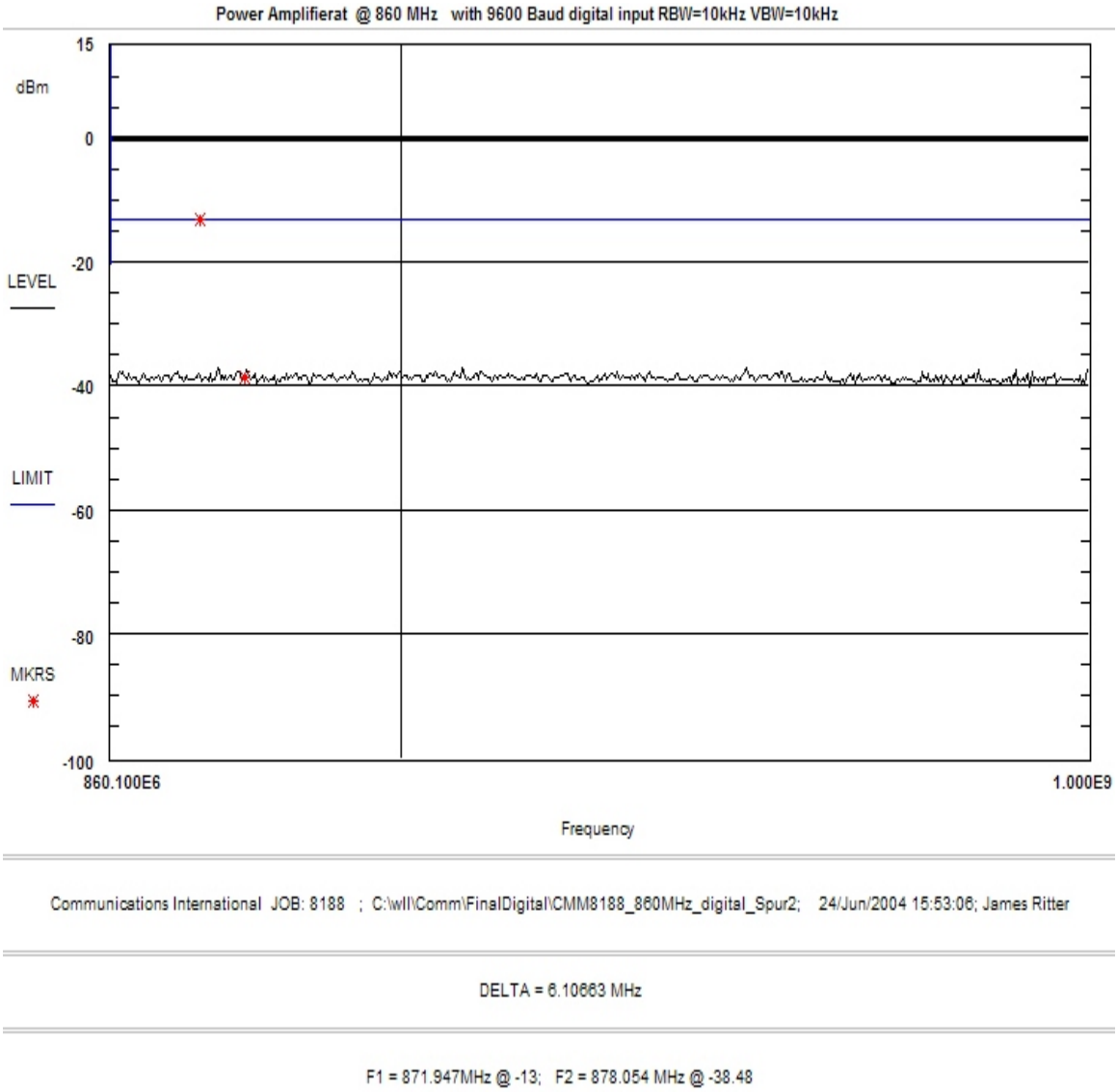


Figure 19. Conducted Spurious Emissions, 860 MHz Analog Modulation, F3E

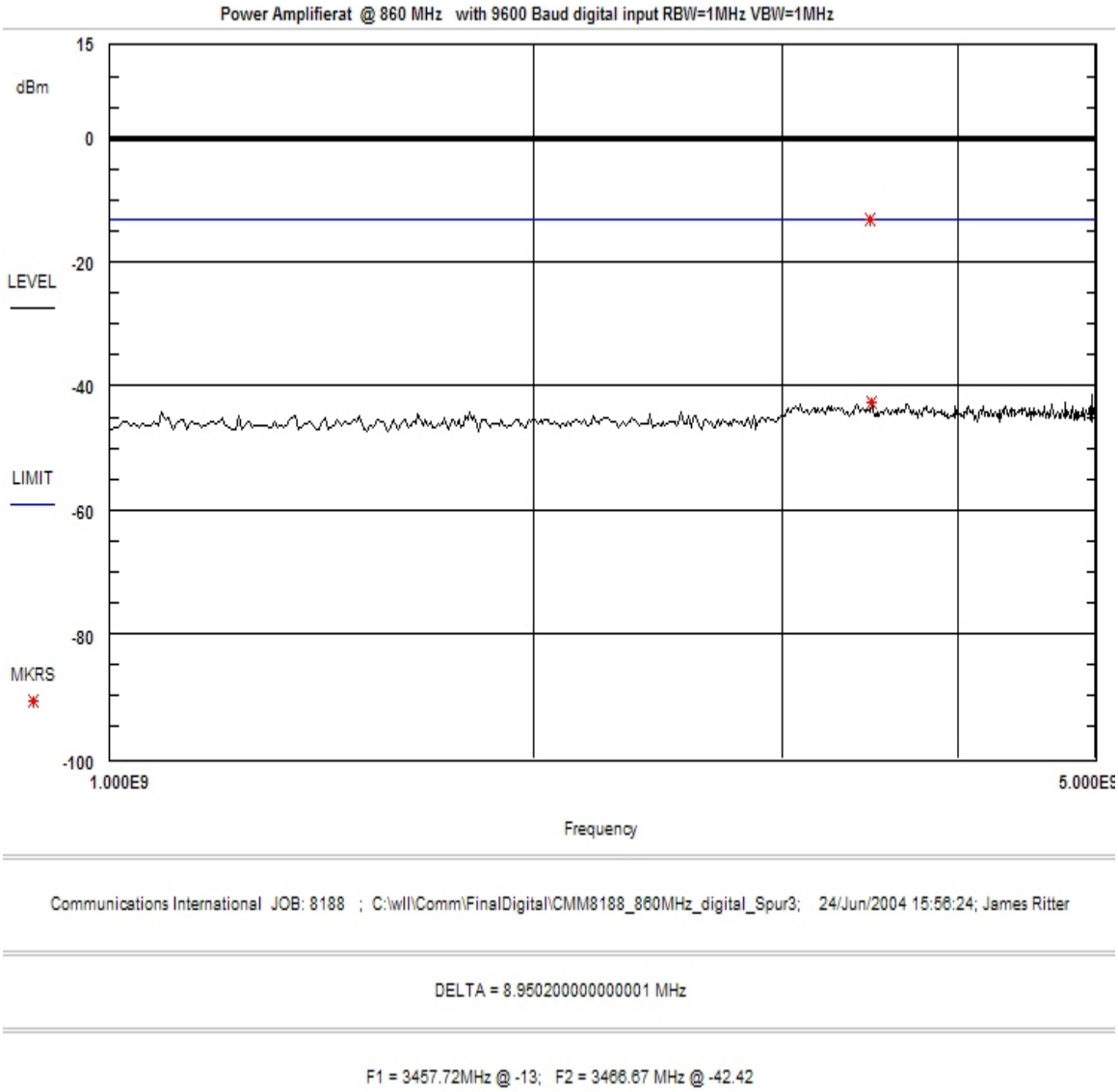


Figure 20. Conducted Spurious Emissions, 860 MHz Analog Modulation, F3E

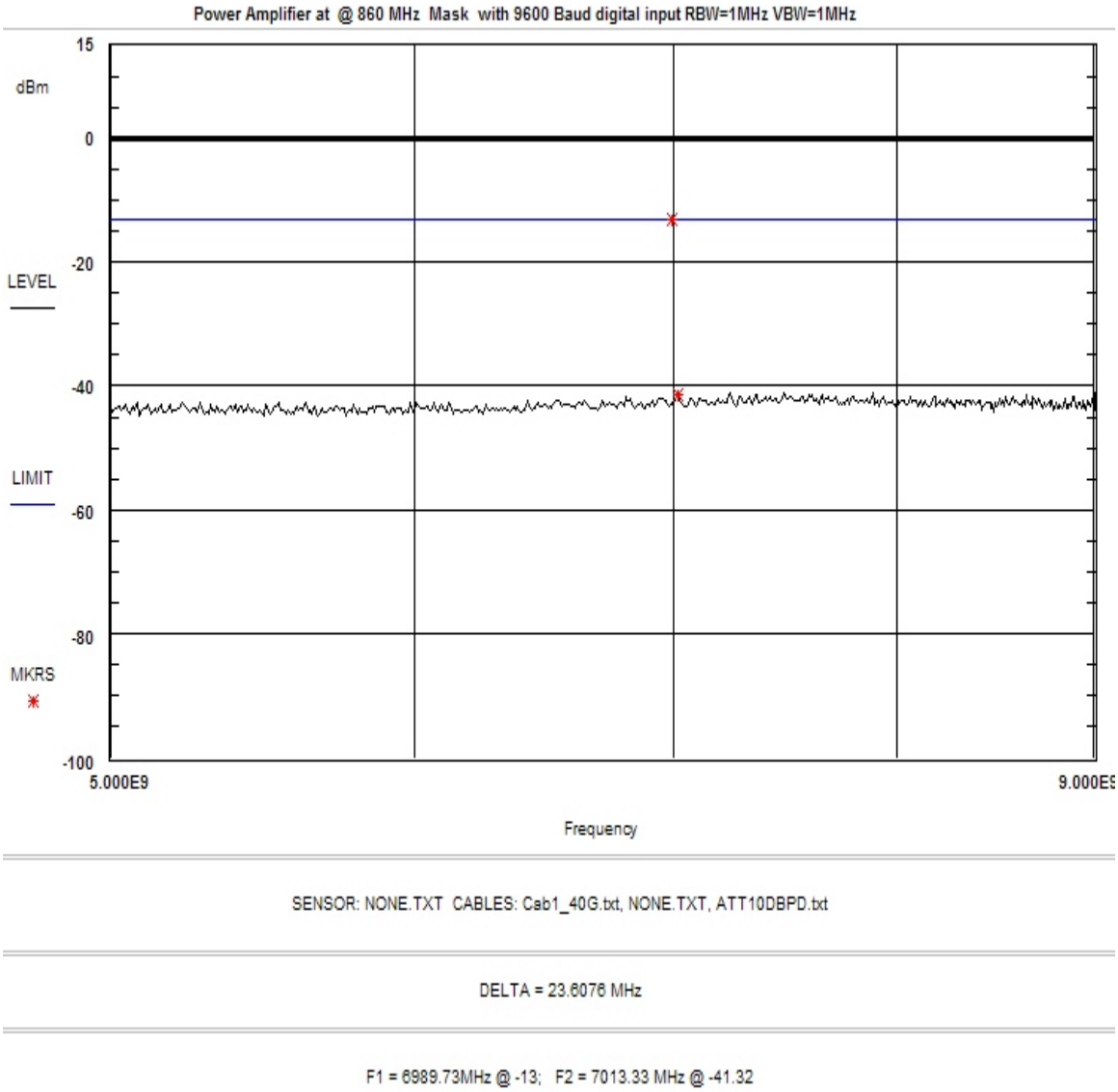
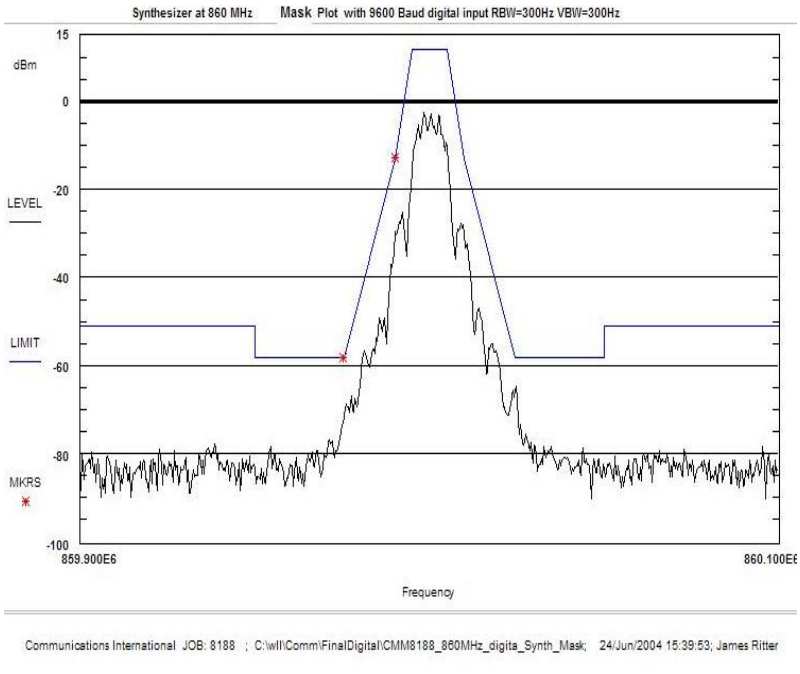


Figure 21. Conducted Spurious Emissions, 860 MHz Analog Modulation, F3E

Amplifier Input:



Amplifier Output:

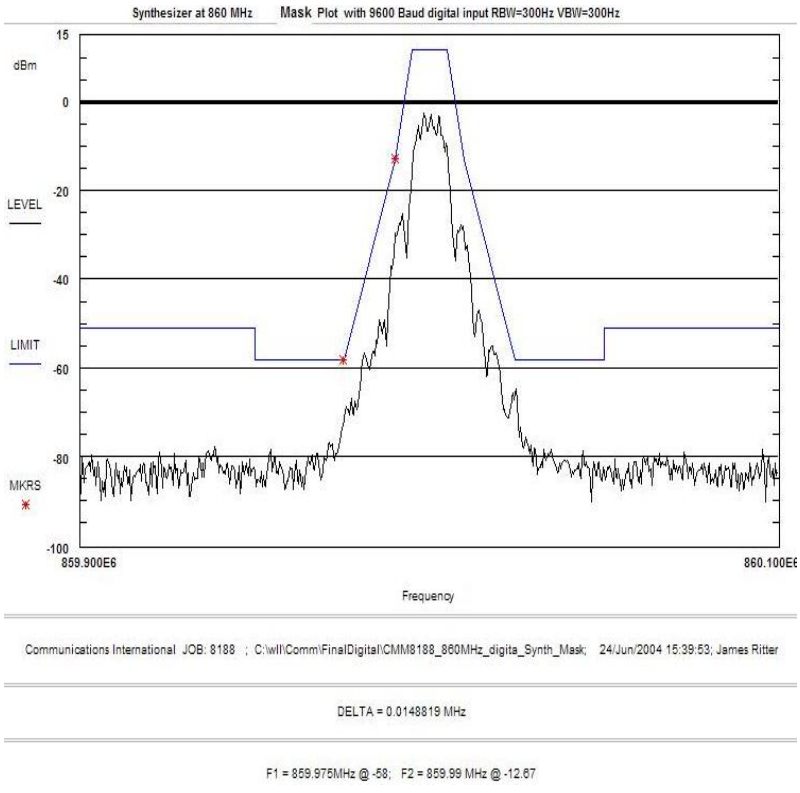


Figure 22. Mask, 860 MHz Digital Modulation F1D, F1E, F2D, F2B

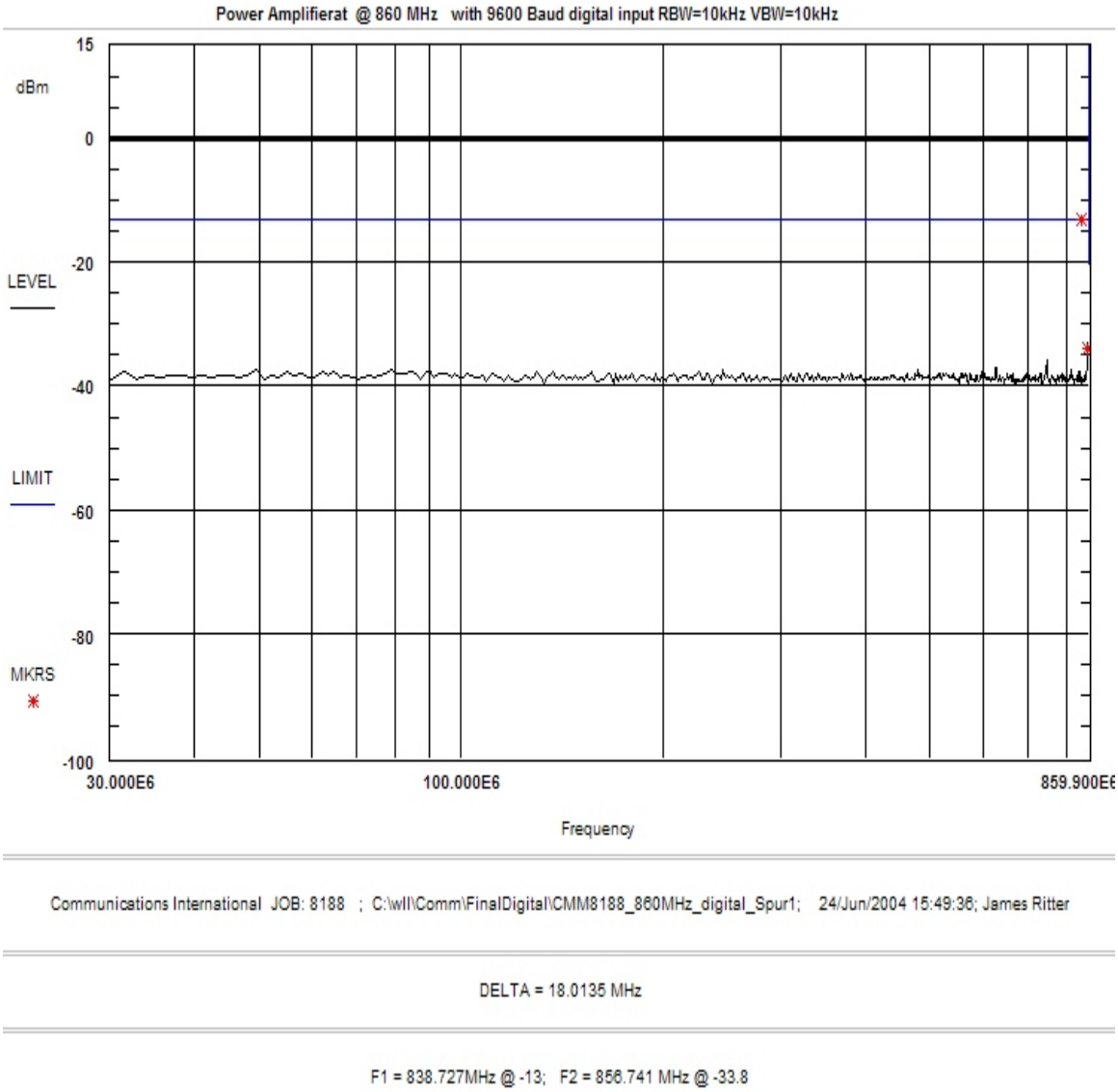


Figure 23. Conducted Spurious Emissions, 860 MHz Digital Modulation F1D, F1E, F2D, F2B

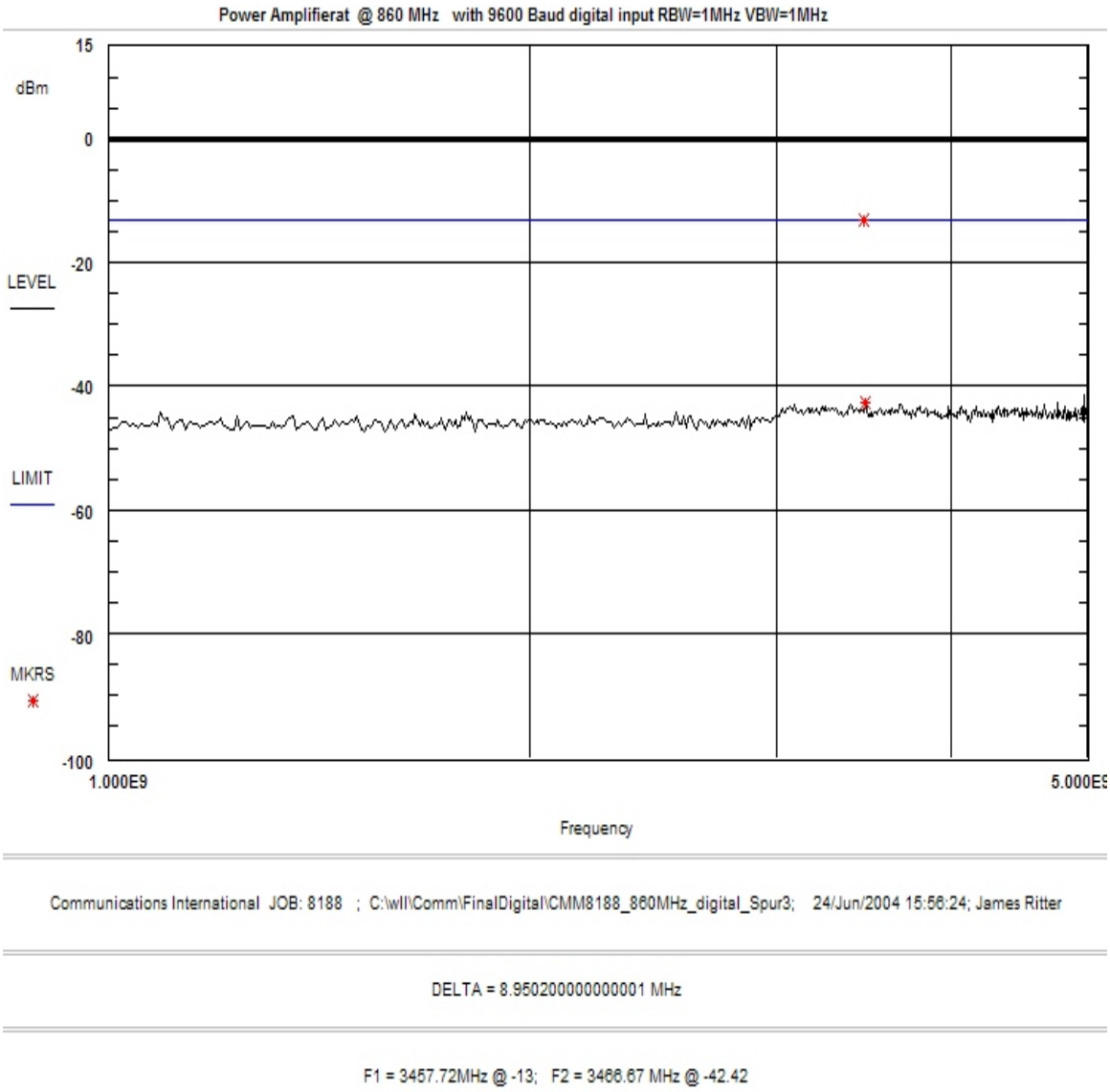


Figure 24. Conducted Spurious Emissions, 860 MHz Digital Modulation F1D, F1E, F2D, F2B

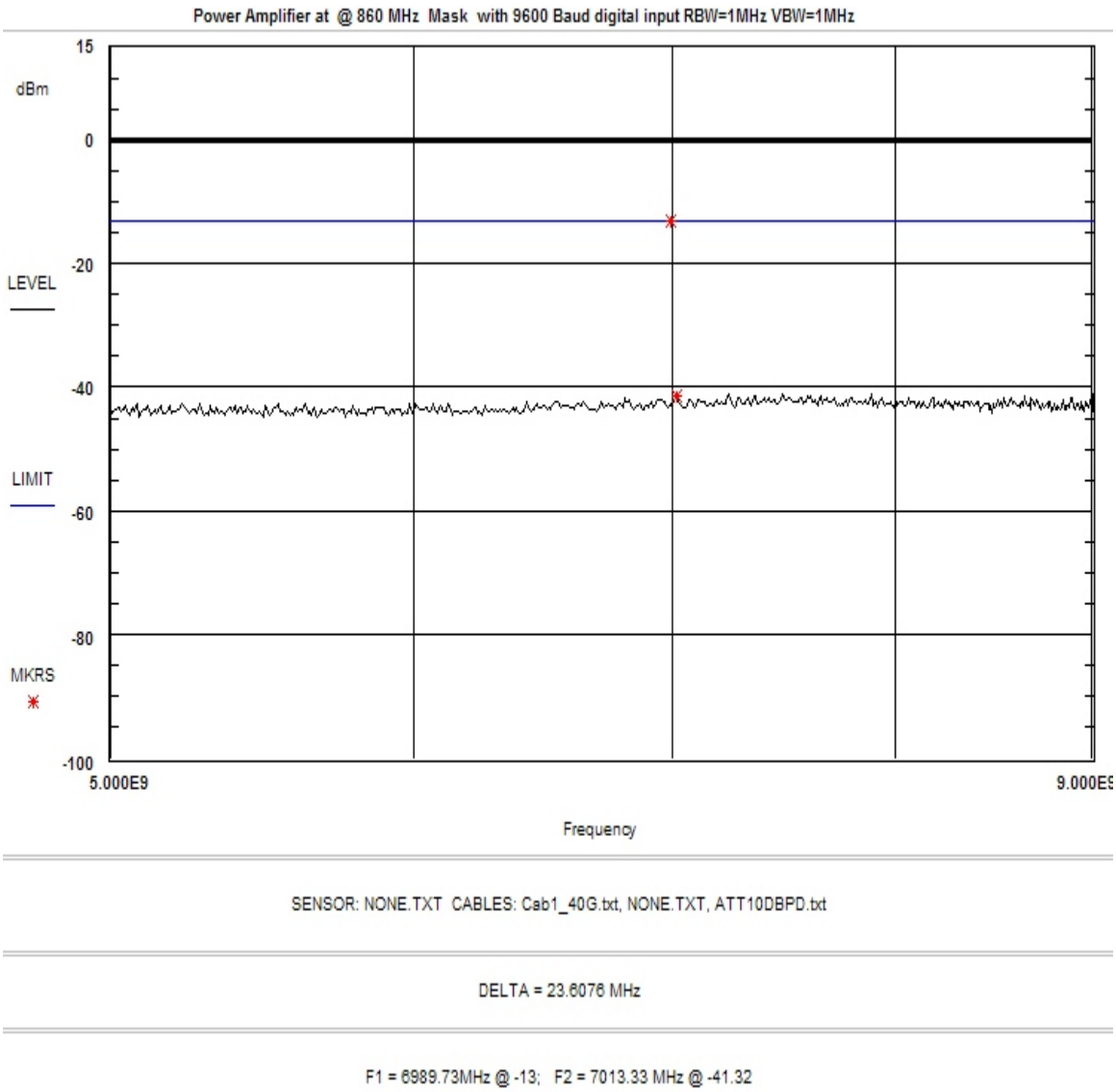
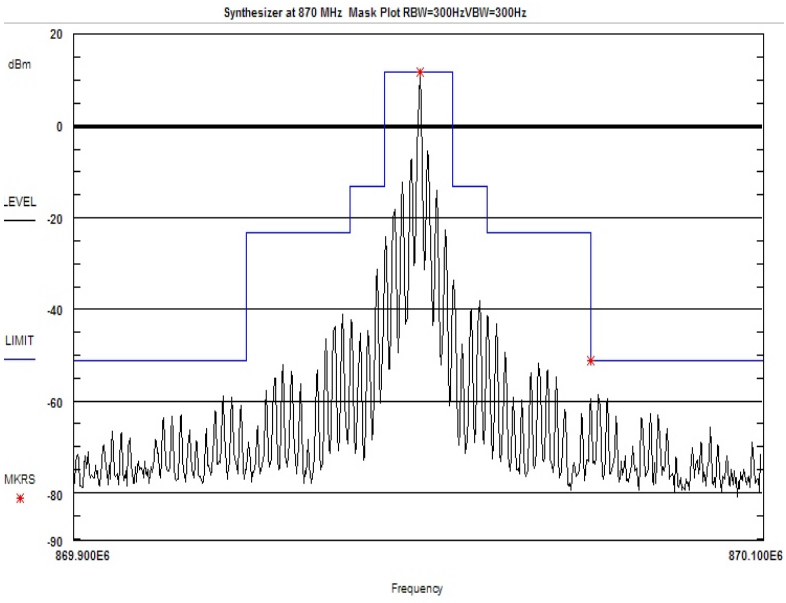


Figure 25. Conducted Spurious Emissions, 860 MHz Digital Modulation F1D, F1E, F2D, F2B

Amplifier Input:



Amplifier Output:

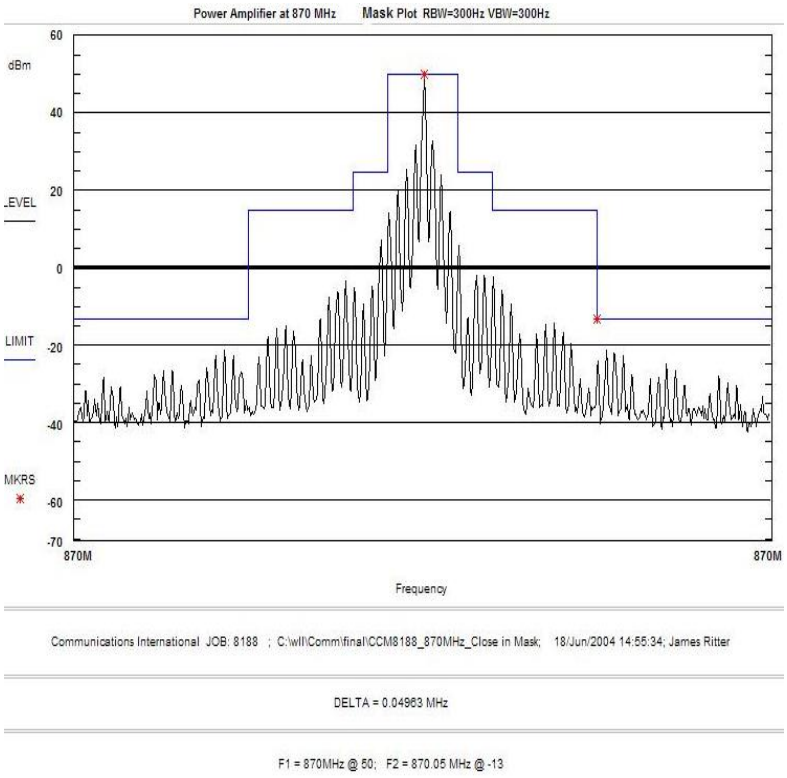


Figure 26. Mask, 870 MHz Analog Modulation, F3E

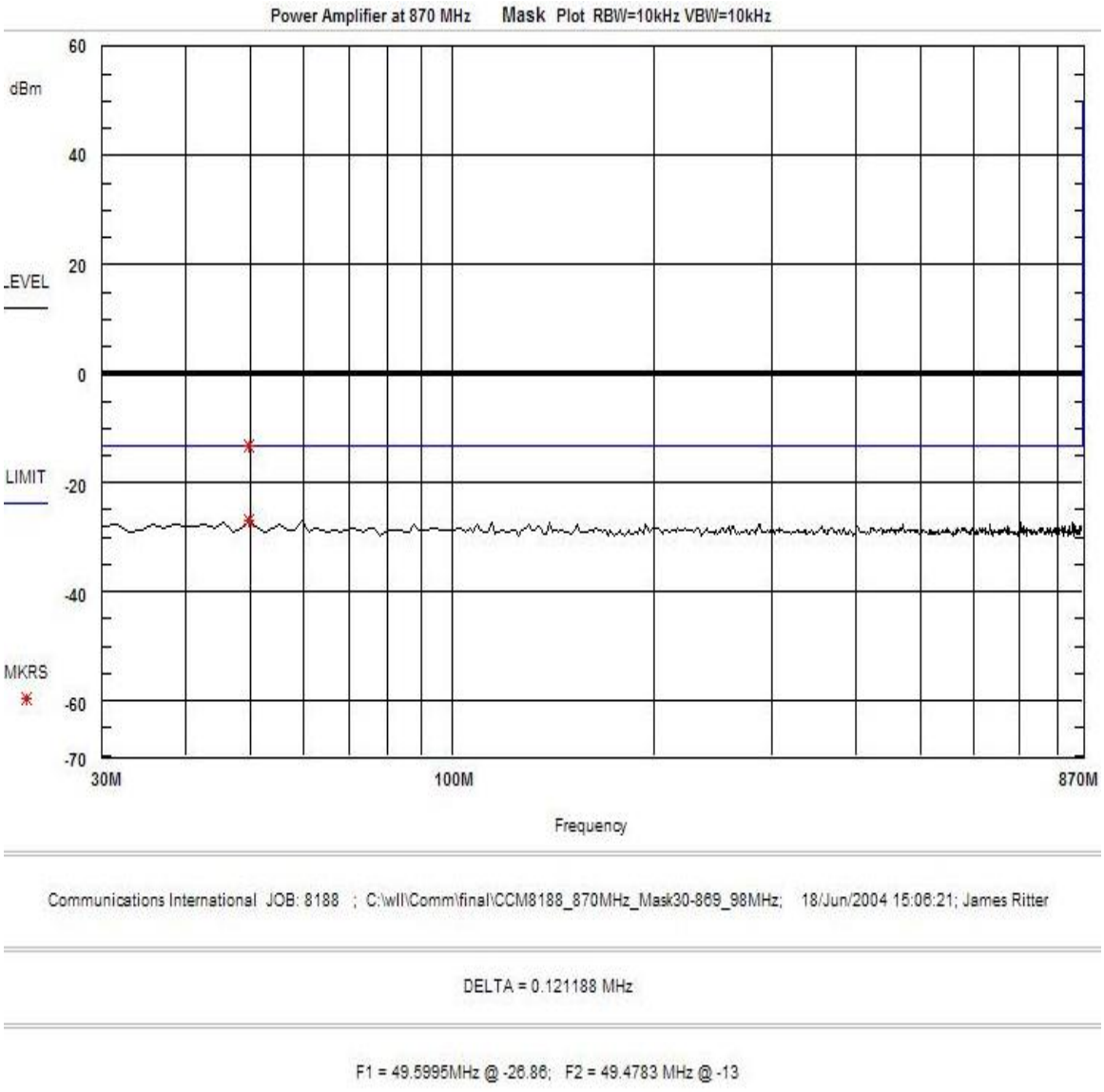


Figure 27. Conducted Spurious Emissions, 870 MHz Analog Modulation,F3E

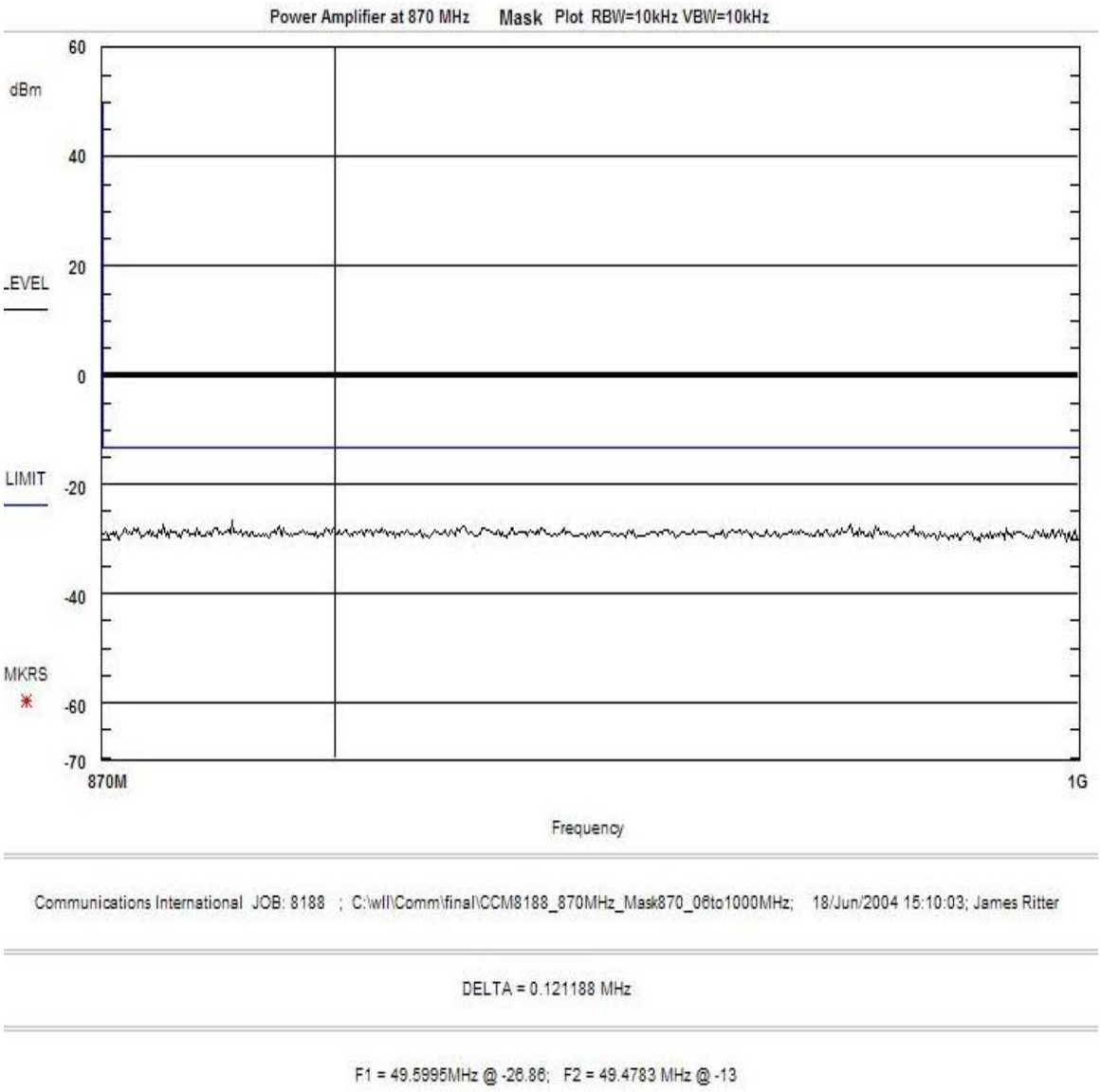


Figure 28. Conducted Spurious Emissions, 870 MHz Analog Modulation, F3E

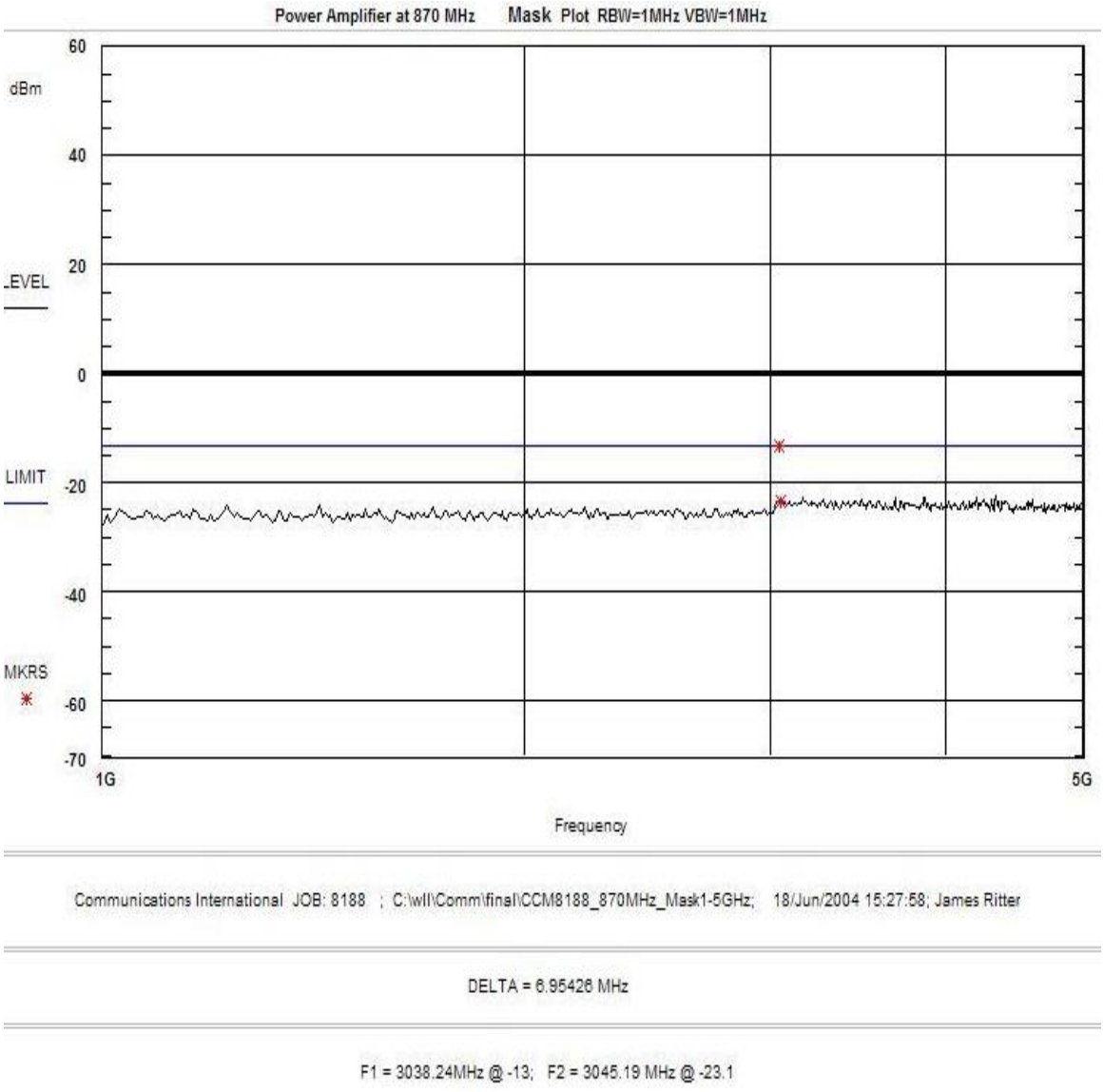


Figure 29. Conducted Spurious Emissions, 870 MHz Analog Modulation, F3E

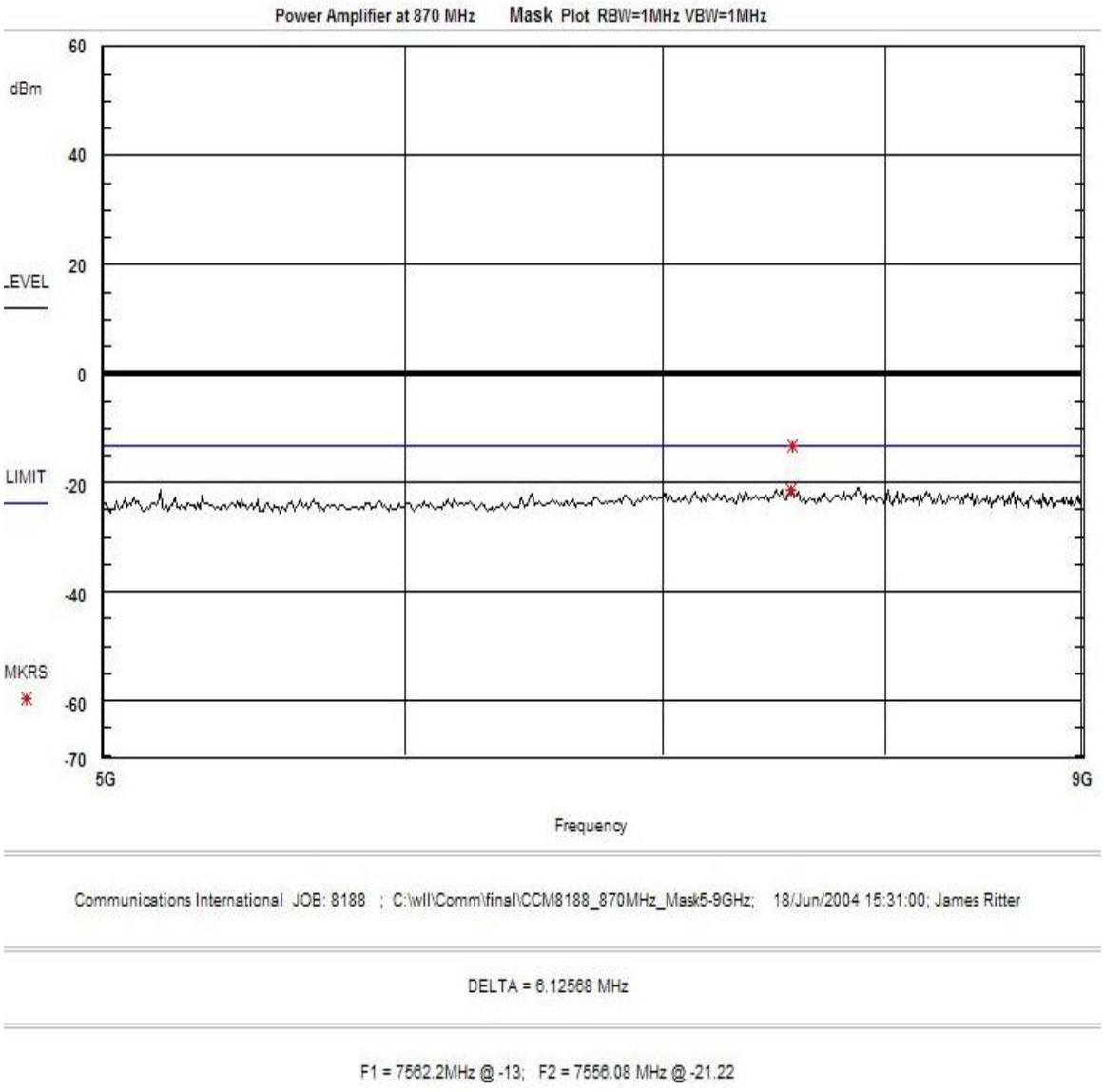
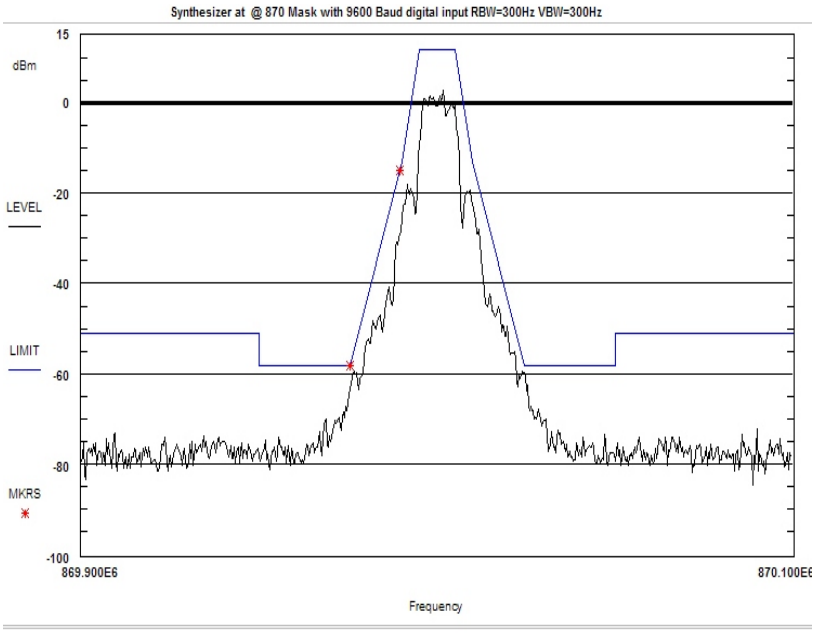


Figure 30. Conducted Spurious Emissions, 870 MHz Analog Modulation, F3E

Amplifier Input:



Amplifier Output:

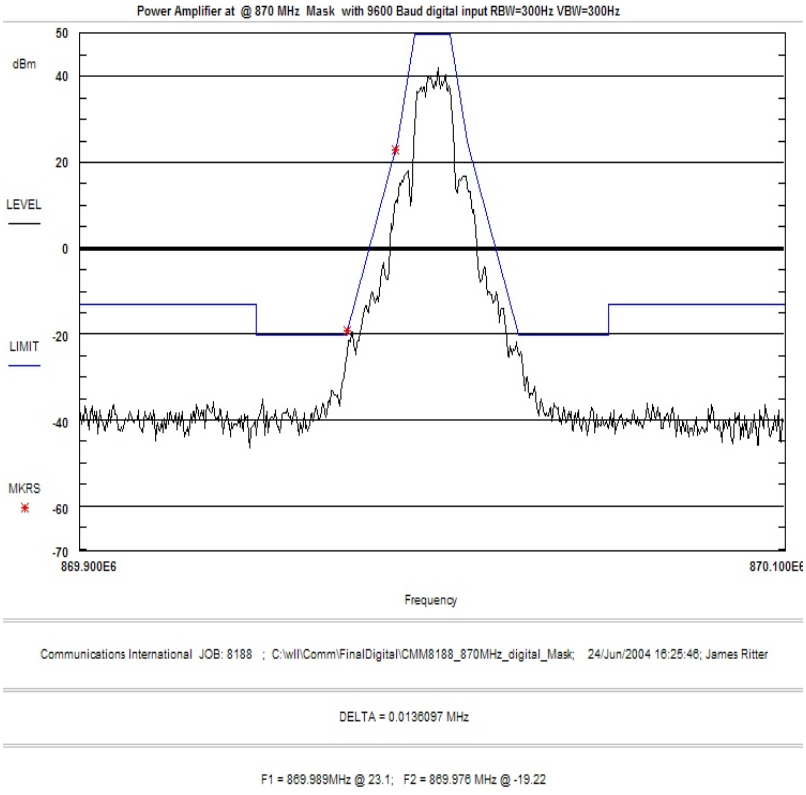


Figure 31. Mask, 870 MHz Digital Modulation F1D, F1E, F2D, F2B

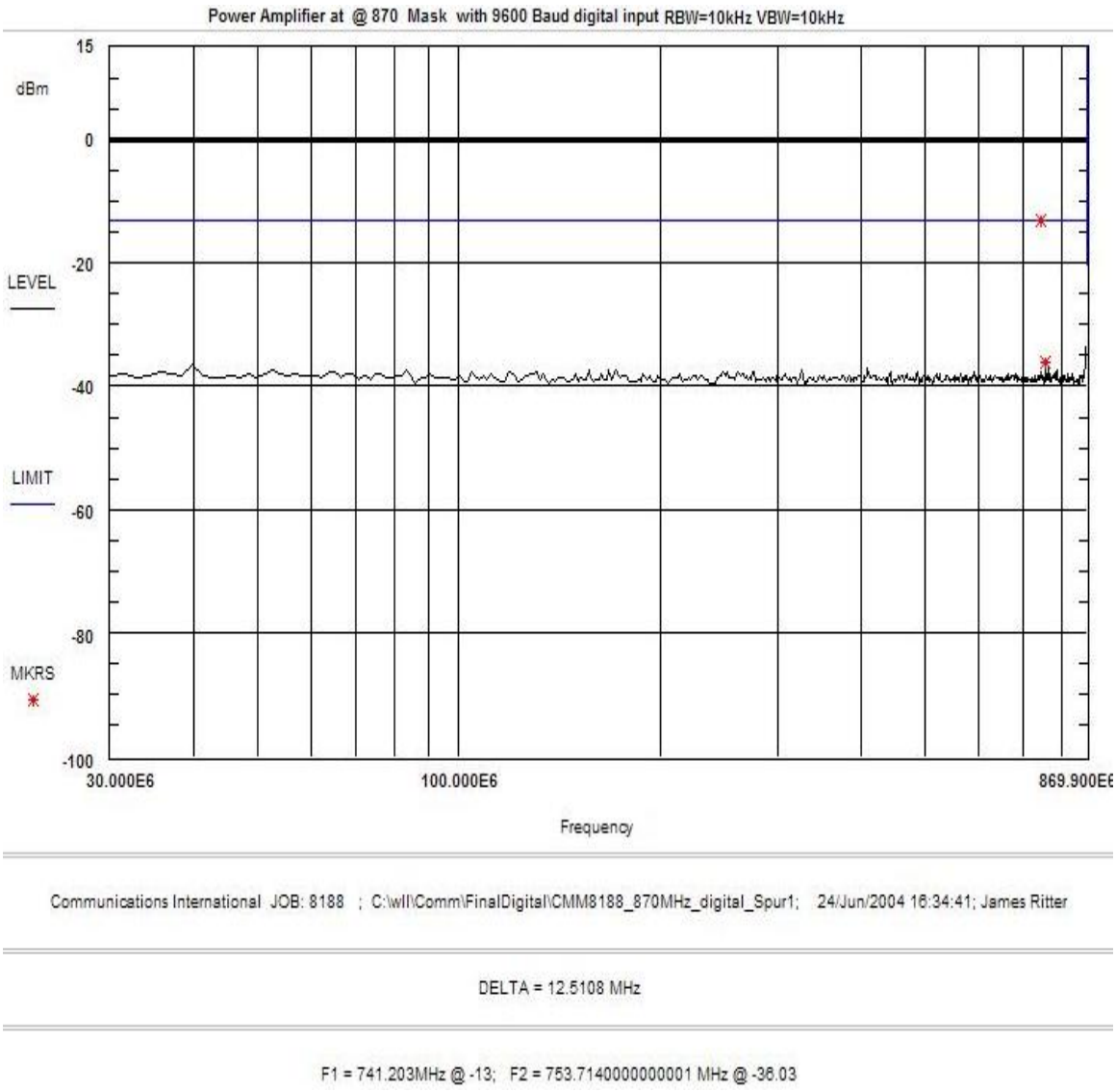


Figure 32. Conducted Spurious Emissions, 870 MHz Digital Modulation F1D, F1E, F2D, F2B

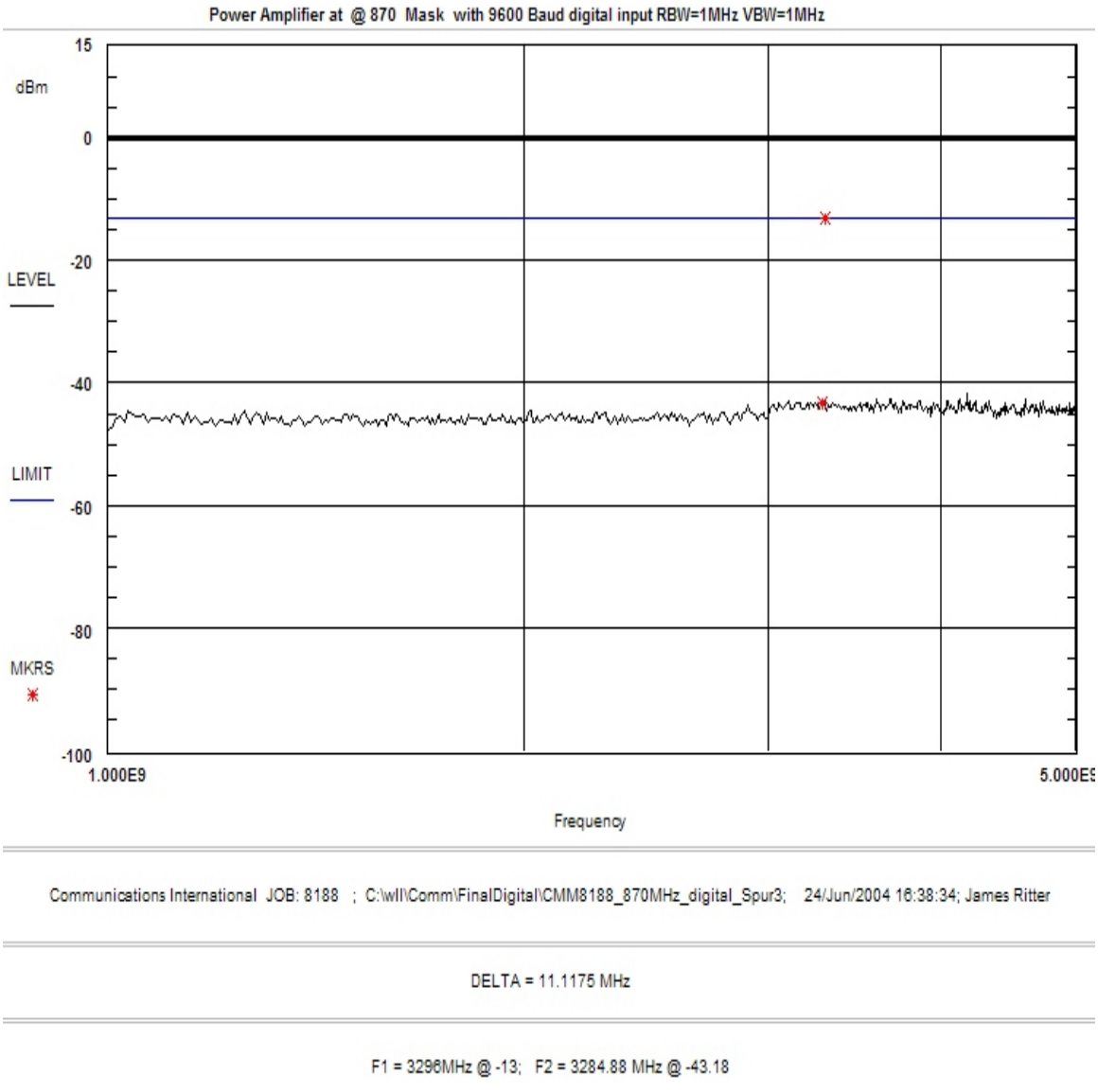


Figure 33. Conducted Spurious Emissions, 870 MHz Digital Modulation F1D, F1E, F2D, F2B

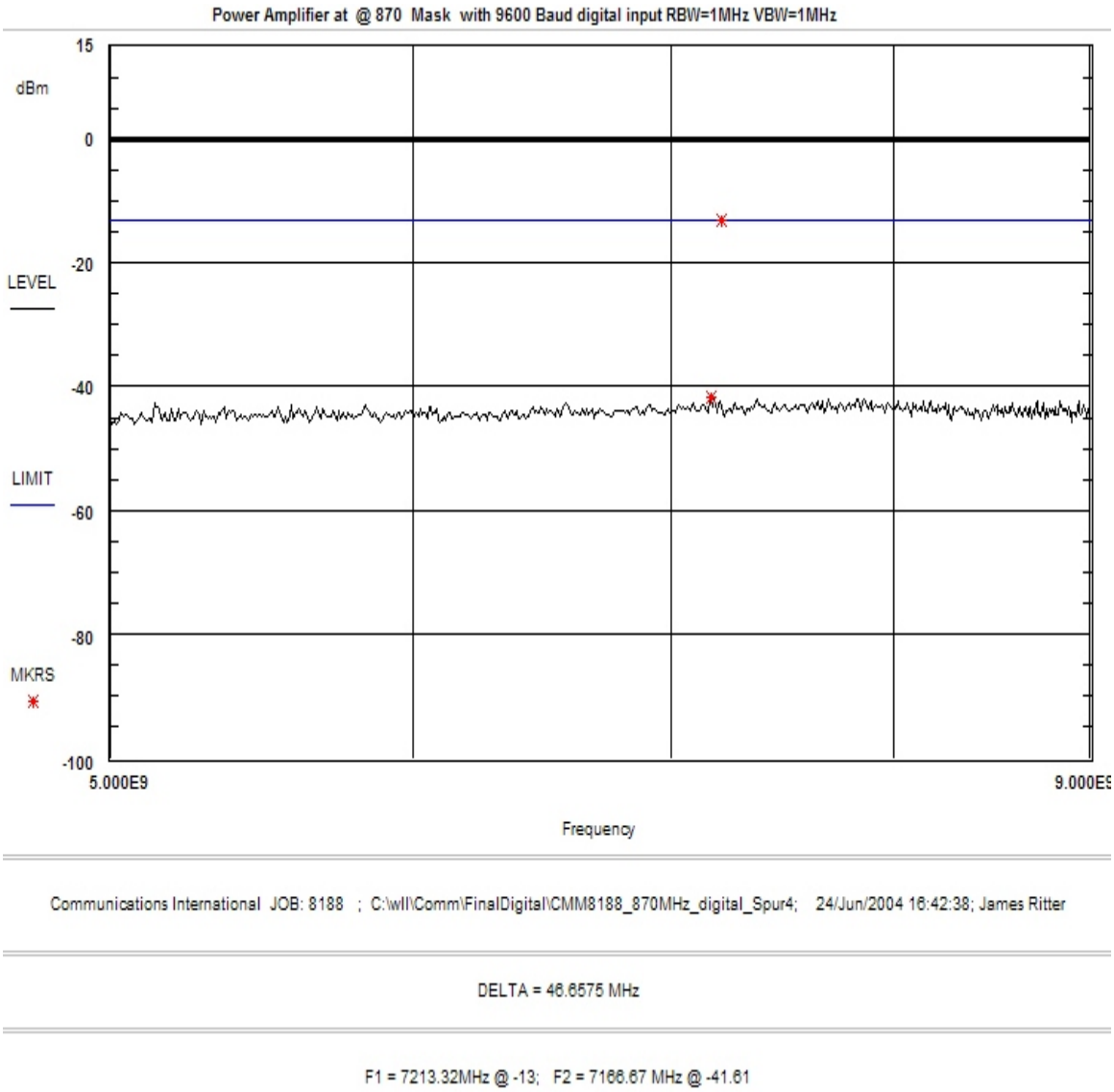


Figure 34. Conducted Spurious Emissions, 870 MHz Digital Modulation F1D, F1E, F2D, F2B

4.5 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions according to FCC Part §2.1053.

4.5.1 Test Procedure

The EUT antenna output was terminated in a 50 ohm load.

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Emissions data were collected and the EIRP values determined using the substitution method.

Table 5: Radiated Emission Test Data

CLIENT:	Communications International	DATE:	6/21/2004
TESTER:	James Ritter	JOB #:	8188
EUT Information:		**Test Requirements:**	
EUT:	Mark II Power Amplifier	TEST STANDARD:	FCC 90
CONFIGURATION:	860 MHz TX to Dummy Load	DISTANCE:	3m
S/N:	PA2		

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (dBµV)	Ant. Gain dBi	Sig. Gen. Level dBm	EIRP Level dBm	Limit (dBm)	Margin dB
49.670	H	145.0	3.0	14.5	-3.8	-38.0	-41.8	-13.0	-28.8
746.420	H	290.0	1.3	22.1	3.9	-42.0	-38.1	-13.0	-25.1
859.993	H	145.0	1.0	75.4	4.7	4.0	8.7	50.0	-41.3
1720.000	H	180.0	1.0	67.7	7.1	-47.6	-40.5	-13.0	-27.5
2580.000	H	0.0	1.0	80.3	8.3	-27.3	-19.0	-13.0	-6.0
3440.000	H	0.0	1.0	75.0	9.8	-28.6	-18.8	-13.0	-5.8
4300.000	H	10.0	1.0	62.8	10.8	-38.3	-27.5	-13.0	-14.5
5160.000	H	0.0	1.0	48.2	11.1	-54.3	-43.2	-13.0	-30.2
6020.000	H	20.0	1.0	54.7	10.8	-47.3	-36.5	-13.0	-23.5
8600.000	H	0.0	1.0	48.7	10.1	-43.0	-32.9	-13.0	-19.9
49.67	V	270.0	1.3	16.7	-3.8	-36.1	-39.9	-13.0	-26.9
746.42	V	260.0	2.3	20.8	3.9	-39.8	-35.9	-13.0	-22.9
859.99	V	270.0	2.1	73.6	4.7	3.1	7.8	50.0	-42.2
1720.000	V	0.0	1.0	74.8	7.1	-38.3	-31.2	-13.0	-18.2
2580.000	V	45.0	1.0	82.2	8.3	-25.6	-17.3	-13.0	-4.3
3440.000	V	0.0	1.0	84.0	9.8	-26.2	-16.4	-13.0	-3.4
4300.000	V	0.0	1.0	63.2	10.8	-42.8	-32.0	-13.0	-19.0
5160.000	V	10.0	1.0	50.7	11.1	-51.6	-40.5	-13.0	-27.5
6020.000	V	0.0	1.0	60.2	10.8	-38.6	-27.8	-13.0	-14.8
8600.000	V	45.0	1.0	54.7	10.1	-42.7	-32.6	-13.0	-19.6

4.6 Frequency Stability: (FCC Part §2.1055)

Not applicable to this unit.

4.7 Transient Frequency Response (Part 90.214)

Not applicable to this unit.