TEST REPORT

Report Number: 3069664.011
Project Number: 3069664
January 10, 2005

Application
For Class II Permissive Changes
OPICOM GPS Radio 1012
FCC ID: DGF-OPTICOMGPS1

To
FCC 15, Subpart C, Section 15.247

For
3M Traffic Safety Systems

Test Performed by:
Intertek
7250 Hudson Blvd. Suite 100
Oakdale, MN 55128

Test Authorized by:
3M Traffic Safety Systems
3M Center, 235-3W-52
Saint Paul, MN 55144

Prepared by: _____ Date: January 10, 2005
Norman Shpilsher

Approved by: _____ Date: January 10, 2005
Uri Spector

CONTENTS

1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is a class II permissive change application of the *OPTICOM GPS Radio 1012* for Certification under FCC Part 15, Subpart C. There are no other simultaneous applications.

1.2 Product Description

The *OPTICOM GPS Radio 1012* is a part of the Traffic Light Control System. The *OPTICOM GPS Radio 1012* is a Frequency Hopping System Transmitter operating within 2400-2483.5 MHz frequency band under Section 15.247. The intended use of the *OPTICOM GPS Radio 1012* unit is to generate a RF signal, deliver the signal to the antenna in order to communicate with the *OPTICOM GPS Receiver*. During testing the *OPTICOM GPS Radio 1012* is connected to the support DC power supply. During normal operation the *Radio* is powered by a vehicle or intersection power supply.

RF Power Output:

1 Watt maximum (30dBm)

Antenna Description:

The GPS Model 1012 radio uses a combined 2.4GHz / GPS antenna manufactured by Mobile Mark, part number is DM2-2400/1575.

Gain: 2.5dBi
Impedance: 50 Ohm
Connectors: SMA Standard Plug (2.4GHz Antenna) and Reverse Polarity SMA Plug (GPS Antenna)
Antenna can be used with 15’ or 6’ cables length

Sample Submitted: December 21, 2004
Test Work Started: December 21, 2004
Test Work Completed: December 23, 2004

1.3 Test Methodology

Emission measurements were performed according to the procedures in ANSI C63.4-2001. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in Appendices D and E were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on March 2003 submitted to FCC. Please reference the site registration number: 90706, dated April 18, 2003.

2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

The manufacturer on the Radio made the following changes from the initial application:

1. The GPS Model 1012 radio uses a combined Mobile Mark 2.4GHz / GPS antenna, part number DM2-2400/1575, and Antenna can be used with 15' or 6' cables length sets.
2. The GPS Model 1012 radio uses a new enclosure: the enclosure is an extruded aluminum housing with screw mounted end plates.
3. The GPS Model 1012 radio uses a Modified power / signal interface wiring: the radio uses slightly different interface wiring, the wiring harness includes a DB15 connector for ease of installation.

Based on modifications made by the *Radio* manufacturer the following measurements were made during Class II Permissive Change Certification:

1. Verification of the level of the Output Power at channel 40 at Antenna Terminal
2. Spurious Radiated Emissions for low transmitting frequency (channel 1), center transmitting frequency (channel 40), and high transmitting frequency (channel 81) at both 6' and 15' antenna cables sets in frequency range from 30MHz up to 10th harmonics.
3. Unintentional Radiated emissions in receiving mode from 30MHz up to 5th harmonics.

2.2 EUT Setup

For simplicity of testing, the transmitter was run to transmit continuously

2.3 EUT Exercising Software

The *OPTICOM GPS Radio 1012* was operated in continuous frequency hopping transmission mode and in continuous single channel transmission mode for testing purposes. The support DC power supply was used to control these modes of operation by cycling the power.

2.4 Special Accessories

There are no special accessories necessary for compliance of these products.

2.5 Equipment Modification

No modifications were installed on the EUT during testing.

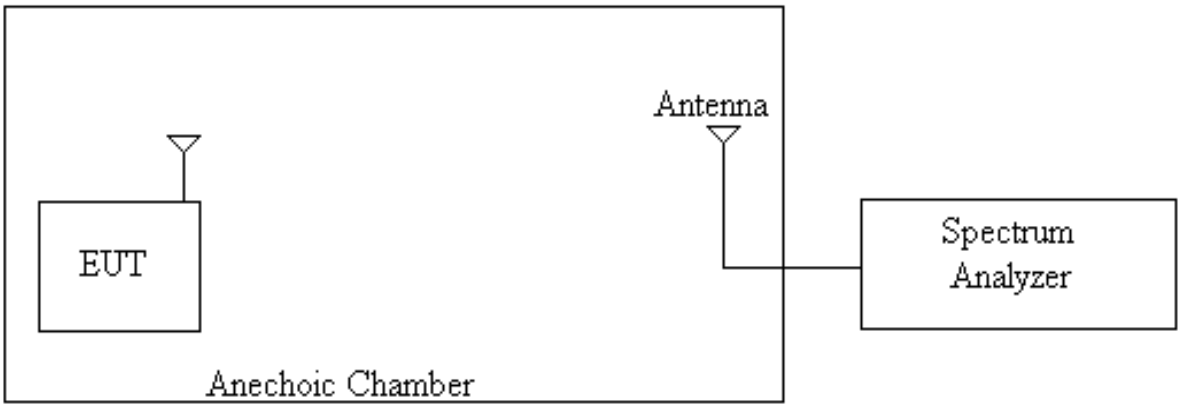
2.6 Support Equipment List and Description

TENMA Laboratory DC power supply, model: 72-2010

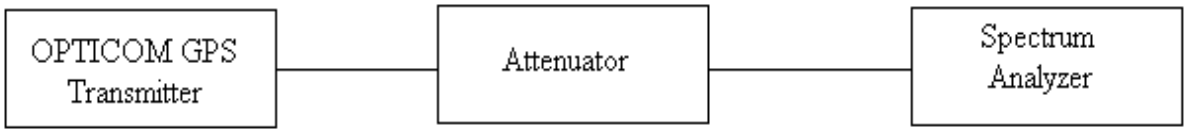
2.7 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.
The EUT was powered at 8VDC from TENMA Laboratory DC power supply, model: 72-2010. During normal operation the *OPTICOM GPS is powered via car battery*.

Field Strength Measurements



Measurements at Antenna Terminal



Note: Attenuator was not used during measurements at Antenna Terminal.

3.0 TEST RESULTS

Data is included for the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements for Class II Permissive Change Certification include the following:

47 CFR 15.247(b)(1)	Peak Output Power verification
47 CFR 15.247(c), 15.205(a), 15.209(a)	Radiated Spurious Emissions
47 CFR 15.109, Class A	Radiated Emissions

3.1 Peak Output Power, FCC 15.247(b)(1) (Verification)

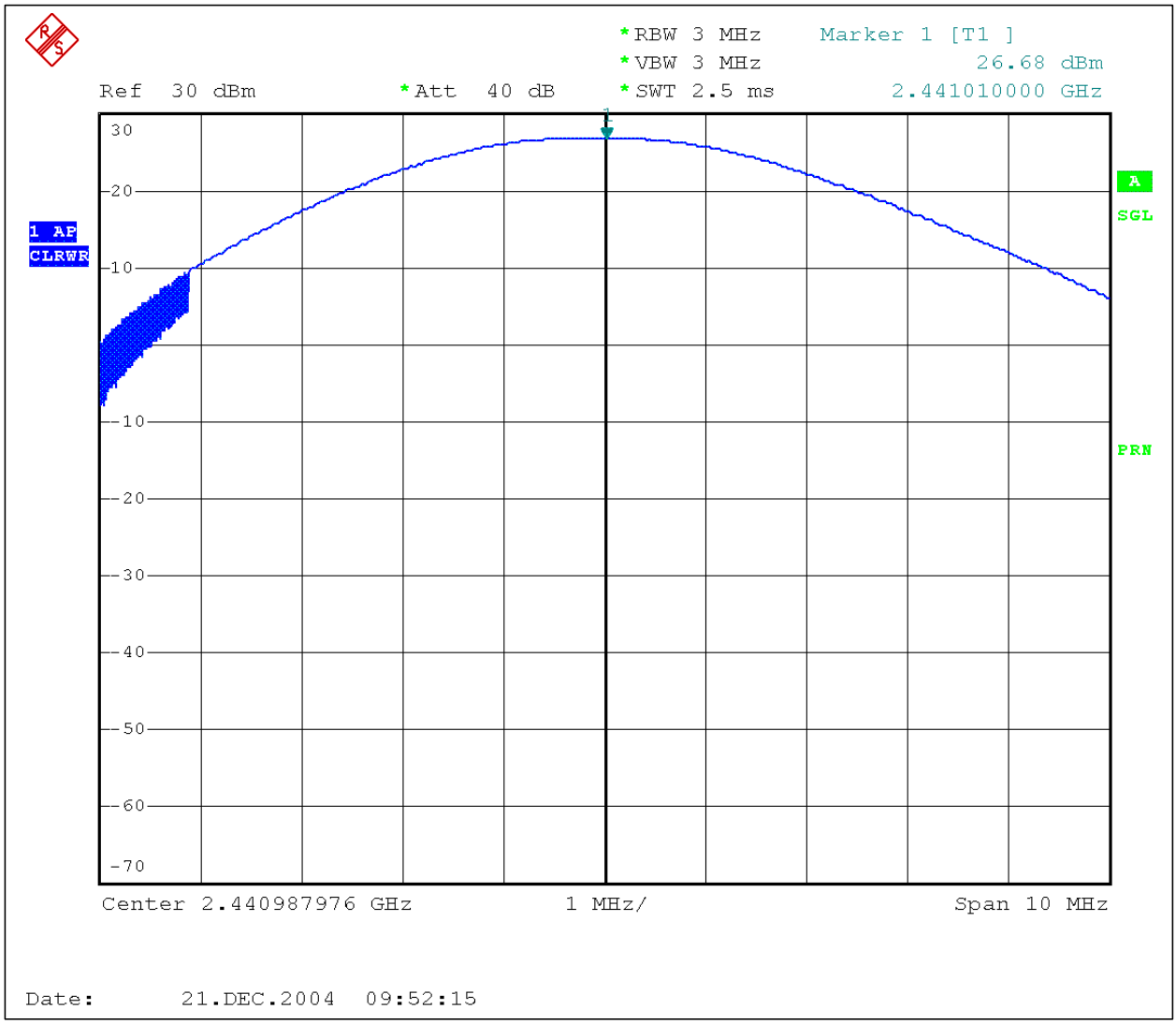
Peak Output verification measurements were made at channel 40 at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum analyzer.

Total Peak Power was calculated from Measured Power adding 1.2dB cable factor

Total Power = Measured Power + Cable Factor = 26.68dBm + 1.2dB = 27.88dBm, or 0.614W

Graphs 3-1-1 below show the Peak Output Power at the antenna terminal at channel 40.

Graph # 3-1-1
Peak Output Power



3.2 Radiated Spurious Emissions, FCC 15.247(c), 15.205(a), 15.209(a)

Field Strength of Spurious Emissions measurements were made from 30MHz up to 10th harmonic at low transmitting frequency (channel 1), center transmitting frequency (channel 40), and high transmitting frequency (channel 81) at both 6' and 15' antenna cables sets.

The Tables 3-2-1 to 3-2-4 and Graphs 3-2-1 show the Field Strength of Spurious Emissions.
No emissions above ambient was found at 6th and harmonics.

Spurious Emissions above 1GHz with peak readings above and close to FCC 15.209 limits were measured with peak detector and RBW = VBW = 1MHz and compared with FCC 15.209 limits + 20db that equal 74dBµV/m (see Tables 3-2-1 and 3-2-2).
Than emissions were measured with peak detector and RBW = 1MHz and VBW = 10Hz and compared with FCC 15.209 limits, and then the reading obtained with VBW = 10Hz were adjusted by a "Duty cycle correction factor", in an effort to demonstrate compliance with the 15.209 limit (see Tables 3-2-3 and 3-2-4).
A "Duty cycle correction factor" was measured and calculated from the initial certification of –20dB.

The EUT complies with the Standard requirements for Spurious Emissions with minimum margin –15.1dB.

Notes: 1. Emission level shown on the Graph includes the Antenna Factor, Cable Loss, and Pre-amplifier gain.
2. The Antenna Factors in the Tables below include a Cable Loss.

Radiated Spurious Emissions (Peak Readings) **Date:** 12/21-23/2004

Company: 3M Corp., Traffic Safety Systems
Model: Opticom GPS Radio 1012
Test Engineer: Norman Shpilsher
Special Info: Transmitter with 6' antenna cables set
Standard: FCC Part 15.247 and 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: Measurements were taken with Peak Detector and RBW = VBW = 1MHz

Table # 3-2-1

Frequency MHz	Antenna Polar.	Ant. Factor dB1/m	Pre-Amp Gain (dB)	Reading dBµV	Total Emissions dBµV/m	Limit dBµV/m	Margin dB	Comments
				Channel 1				
4802.80	V	38.4	33.9	51.7	56.2	74.0	-17.8	
7200.00	V	42.8	34.5	40.8	49.08	74.0	-24.9	
12003.04	V	48.3	34.4	41.0	54.8	74.0	-19.2	
4802.80	H	38.4	33.9	47.6	52.1	74.0	-22.0	
				Channel 40				
4882.30	V	38.7	33.9	53.4	58.1	74.0	-15.9	
7322.30	V	43.2	34.5	43.3	52.0	74.0	-22.0	
12205.74	V	48.1	34.4	41.5	55.2	74.0	-18.8	
4882.30	H	38.7	33.9	52.7	57.4	74.0	-16.6	
				Channel 81				
4966.21	V	38.6	33.9	56.2	60.9	74.0	-13.1	
7449.26	V	43.6	34.5	51.9	61.0	74.0	-13.0	
4966.21	H	38.6	33.9	56.8	61.5	74.0	-12.5	
7449.26	H	43.6	34.5	47.1	56.2	74.0	-17.8	

Comments:

Radiated Spurious Emissions (Peak Readings) **Date:** 12/21-23/2004

Company: 3M Corp., Traffic Safety Systems
Model: Opticom GPS Radio 1012
Test Engineer: Norman Shpilsher
Special Info: Transmitter with 15' antenna cable
Standard: FCC Part 15.247 and 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: Measurements were taken with Peak Detector and RBW = VBW = 1MHz

Table # 3-2-2

Frequency MHz	Antenna Polar.	Ant. Factor dB1/m	Pre-Amp Gain (dB)	Reading dBµV	Total Emissions dBµV/m	Limit dBµV/m	Margin dB	Comments
				Channel 1				
4802.80	V	38.4	33.9	46.2	50.73	74.0	-23.3	
7200.00	V	42.8	34.5	40.9	49.2	74.0	-24.8	
12003.04	V	48.3	34.4	44.4	58.2	74.0	-15.8	
4802.80	H	38.4	33.9	47.5	52.0	74.0	-22.0	
12003.04	H	48.3	34.4	43.1	56.9	74.0	-17.1	
				Channel 40				
4882.30	V	38.7	33.9	50.8	55.5	74.0	-18.5	
7322.30	V	43.2	34.5	49.8	58.5	74.0	-15.5	
12205.74	V	48.1	34.4	43.3	57.0	74.0	-17.0	
4882.30	H	38.7	33.9	52.8	57.5	74.0	-16.5	
7322.30	H	43.2	34.5	43.1	51.8	74.0	-22.2	
				Channel 81				
4966.21	V	38.6	33.9	56.2	60.9	74.0	-13.1	
7449.26	V	43.6	34.5	51.1	60.2	74.0	-13.8	
9934.00	V	45.9	34.5	41.5	52.9	74.0	-21.2	
4966.21	H	38.6	33.9	56.1	60.8	74.0	-13.2	
7449.26	H	43.6	34.5	46.5	55.6	74.0	-18.4	

Comments:

Radiated Spurious Emissions (Average Value) **Date:** 12/21-23/2004

Company: 3M Corp., Traffic Safety Systems
Model: Opticom GPS Radio 1012
Test Engineer: Norman Shpilsher
Special Info: Transmitter with 6' antenna cable
Standard: FCC Part 15.247 and 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: Measurements were taken with Peak Detector and RBW = 1MHz and VBW = 10Hz

Table # 3-2-3

Frequency MHz	Antenna Polar.	Ant. Factor dB1/m	Pre-Amp Gain (dB)	Reading dBµV	Duty Cycle CF (dB)	Total dBµV/m	Limit dBµV/m	Margin dB	Comments
				Channel 1					
4802.80	V	38.4	33.9	43.0	20.0	27.5	54.0	-26.5	
12003.04	V	48.3	34.4	35.7	20.0	29.5	54.0	-24.5	
				Channel 40					
4882.30	V	38.7	33.9	49.7	20.0	34.4	54.0	-19.6	
7322.30	V	43.2	34.5	36.6	20.0	25.3	54.0	-28.7	
12205.74	V	48.1	34.4	31.7	20.0	25.4	54.0	-28.6	
4882.30	H	38.7	33.9	48.3	20.0	33.0	54.0	-21.0	
				Channel 81					
4966.21	V	38.6	33.9	53.6	20.0	38.3	54.0	-15.7	
7449.26	V	43.6	34.5	47.4	20.0	36.5	54.0	-17.5	
4966.21	H	38.6	33.9	54.2	20.0	38.9	54.0	-15.1	
7449.26	H	43.6	34.5	41.9	20.0	31.0	54.0	-23.0	

Comments:

Radiated Spurious Emissions (Average Value) **Date:** 12/21-23/2004

Company: 3M Corp., Traffic Safety Systems
Model: Opticom GPS Radio 1012
Test Engineer: Norman Shpilsher
Special Info: Transmitter with 15' antenna cable
Standard: FCC Part 15.247 and 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: Measurements were taken with Peak Detector and RBW = 1MHz and VBW = 10Hz

Table # 3-2-4

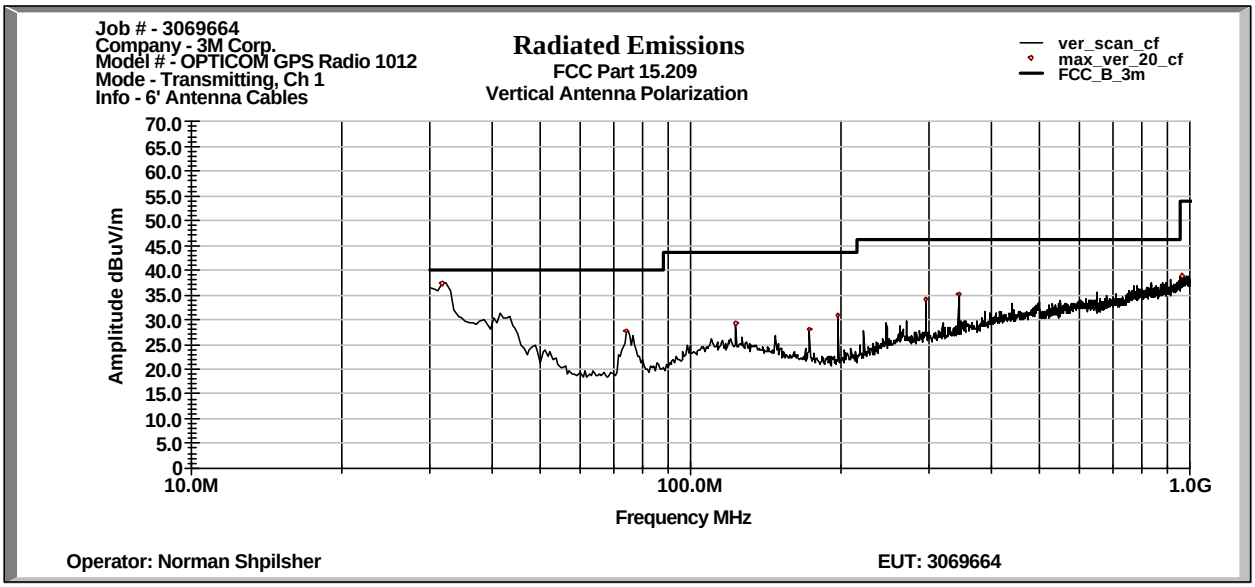
Frequency MHz	Antenna Polar.	Ant. Factor dB1/m	Pre-Amp Gain (dB)	Reading dBµV	Duty Cycle CF (dB)	Total dBµV/m	Limit dBµV/m	Margin dB	Comments
				Channel 1					
12003.04	V	48.3	34.4	34.3	20.0	28.1	54.0	-25.9	
12003.04	H	48.3	34.4	33.0	20.0	26.8	54.0	-27.2	
				Channel 40					
4882.30	V	38.7	33.9	41.7	20.0	26.4	54.0	-27.6	
7322.30	V	43.2	34.5	39.4	20.0	28.1	54.0	-25.9	
12205.74	V	48.1	34.4	32.1	20.0	25.8	54.0	-28.2	
4882.30	H	38.7	33.9	43.9	20.0	28.6	54.0	-25.4	
				Channel 81					
4966.21	V	38.6	33.9	52.5	20.0	37.2	54.0	-16.8	
7449.26	V	43.6	34.5	44.9	20.0	34.0	54.0	-20.0	
4966.21	H	38.6	33.9	52.3	20.0	37.0	54.0	-17.0	
7449.26	H	43.6	34.5	40.2	20.0	29.3	54.0	-24.7	

Comments:

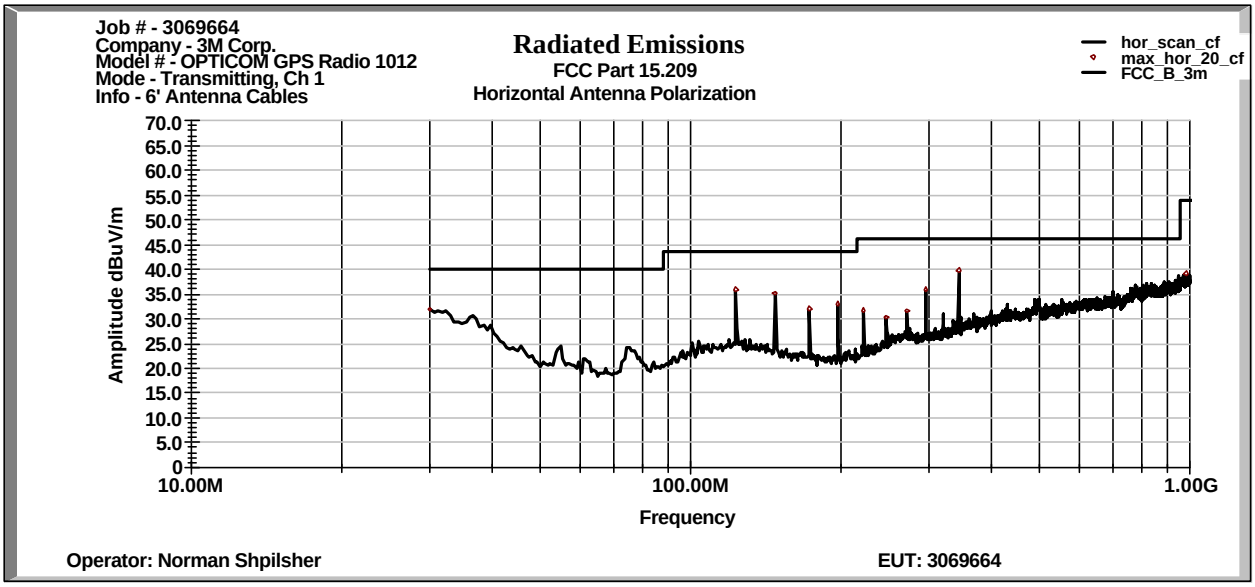
Graph # 3-2-1

Peak Radiated Spurious Emissions from 30MHz to 1GHz, Channel 1, 6' Antenna Cables

Vertical Antenna Polarization



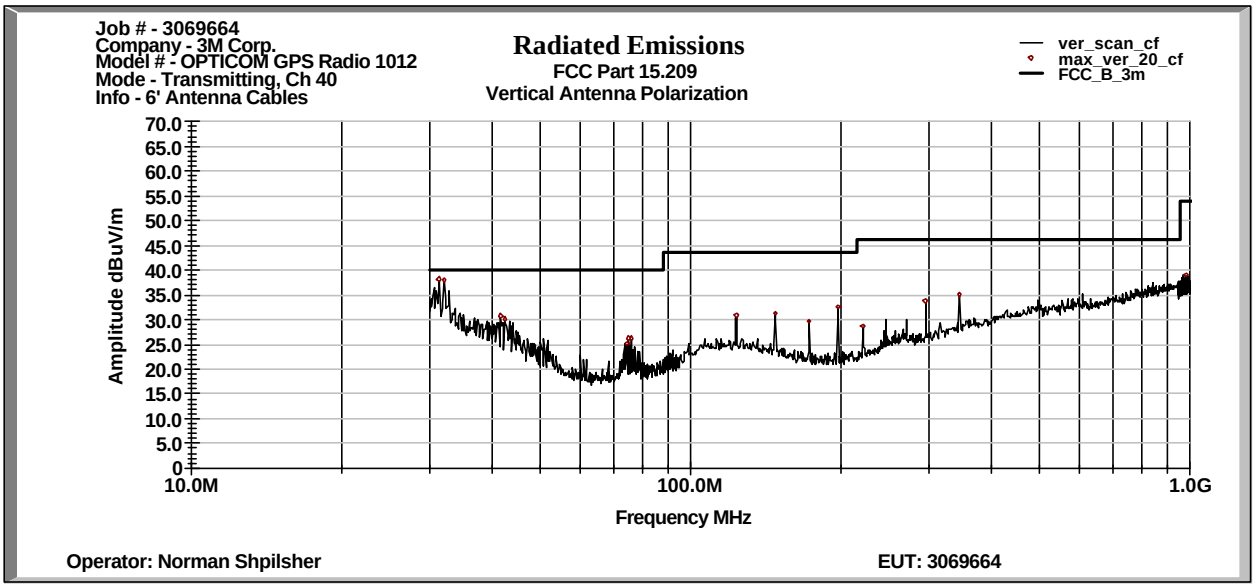
Horizontal Antenna Polarization



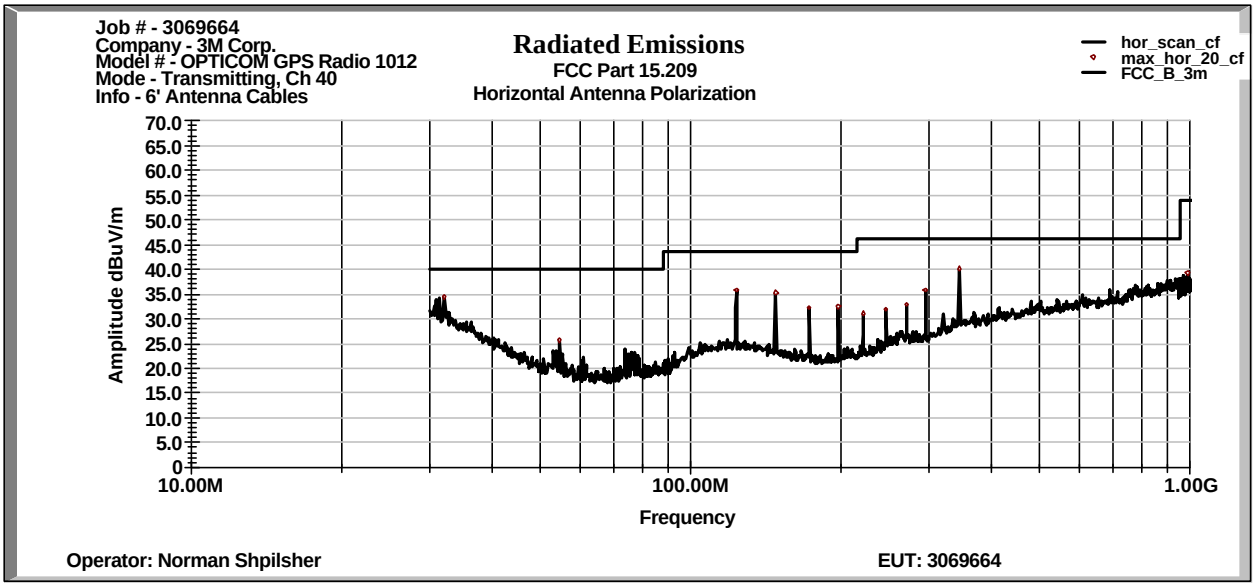
Graph # 3-2-2

Peak Radiated Spurious Emissions from 30MHz to 1GHz, Channel 40, 6' Antenna Cables

Vertical Antenna Polarization



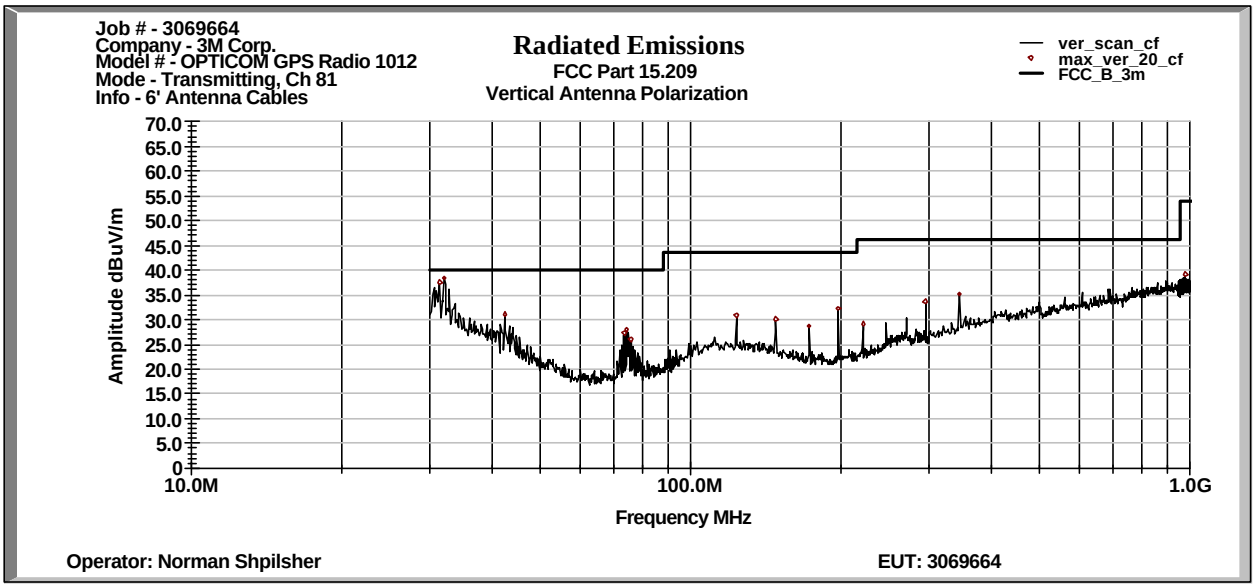
Horizontal Antenna Polarization



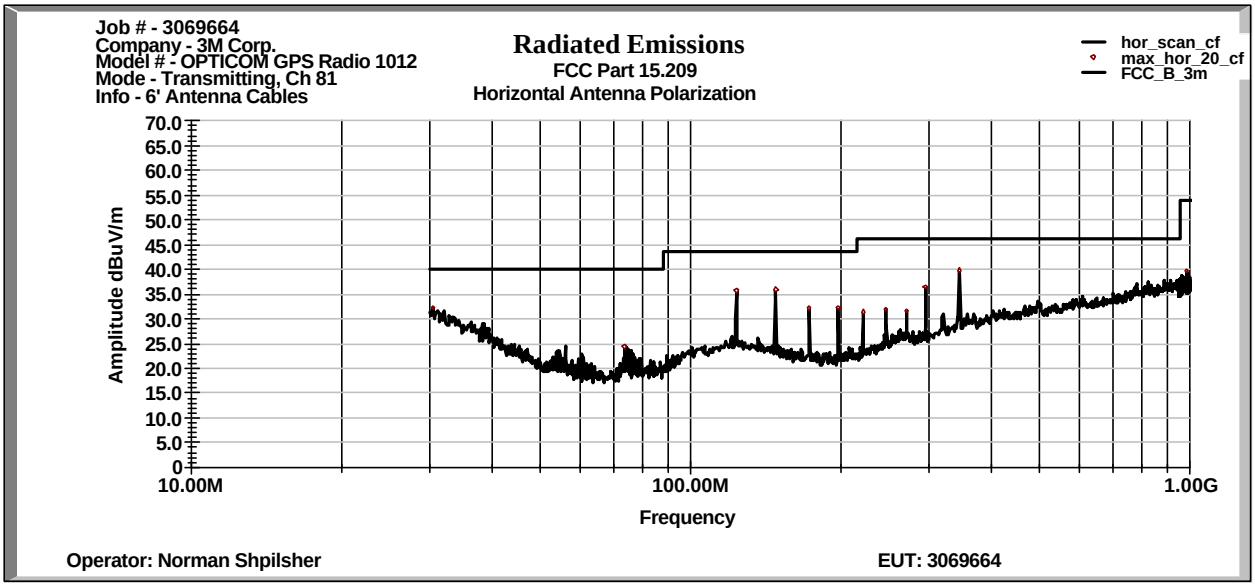
Graph # 3-2-3

Peak Radiated Spurious Emissions from 30MHz to 1GHz, Channel 81, 6' Antenna Cables

Vertical Antenna Polarization



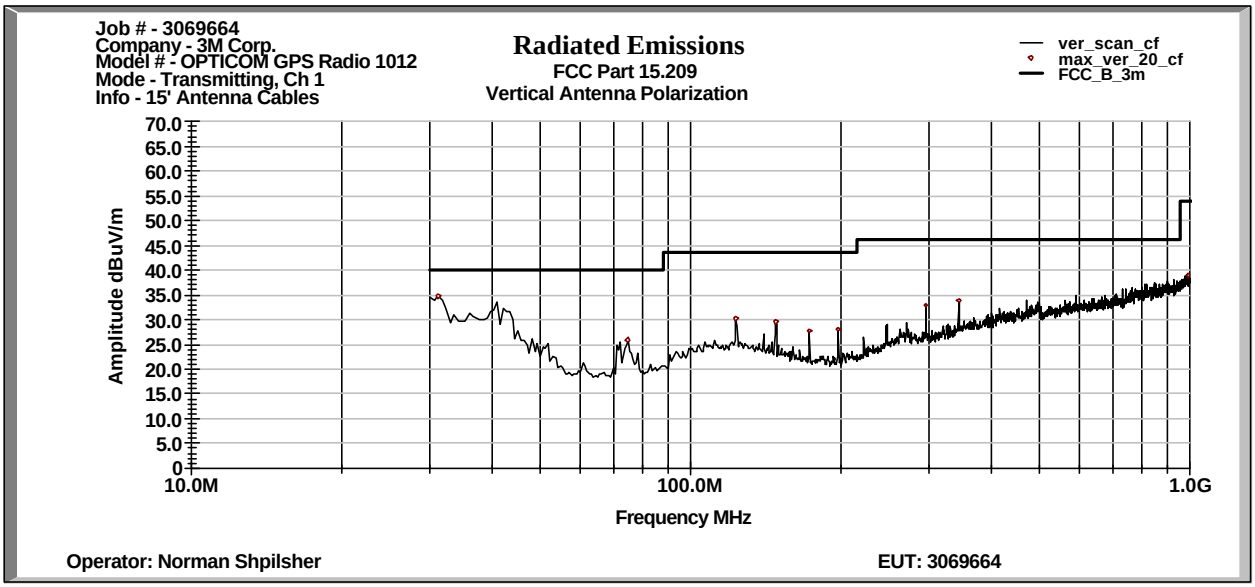
Horizontal Antenna Polarization



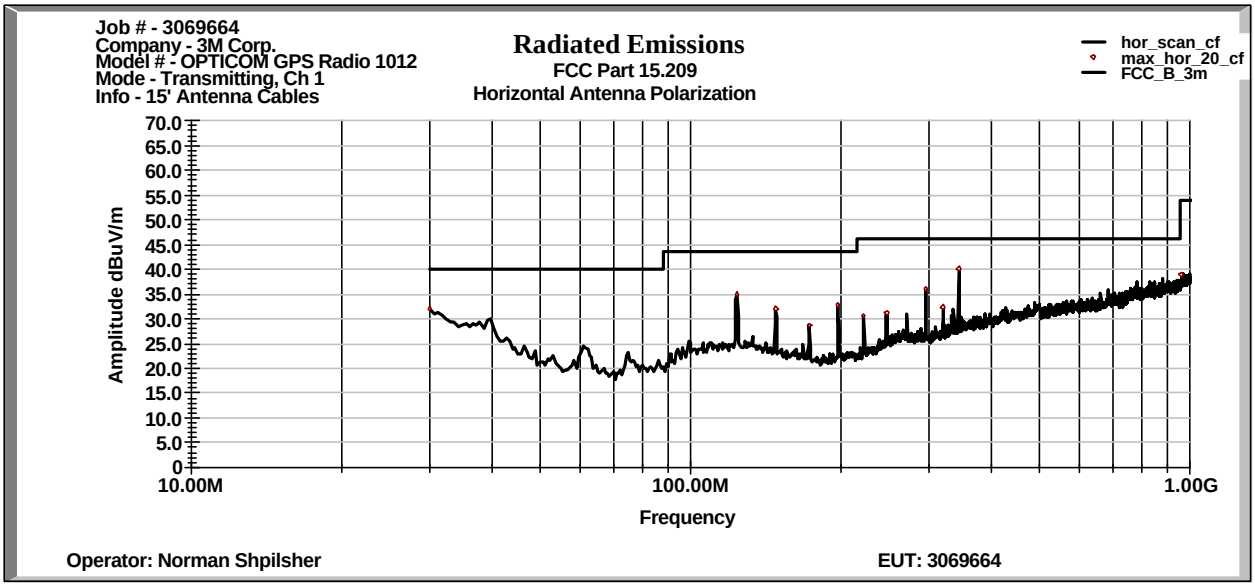
Graph # 3-2-4

Peak Radiated Spurious Emissions from 30MHz to 1GHz, Channel 1, 15' Antenna Cables

Vertical Antenna Polarization



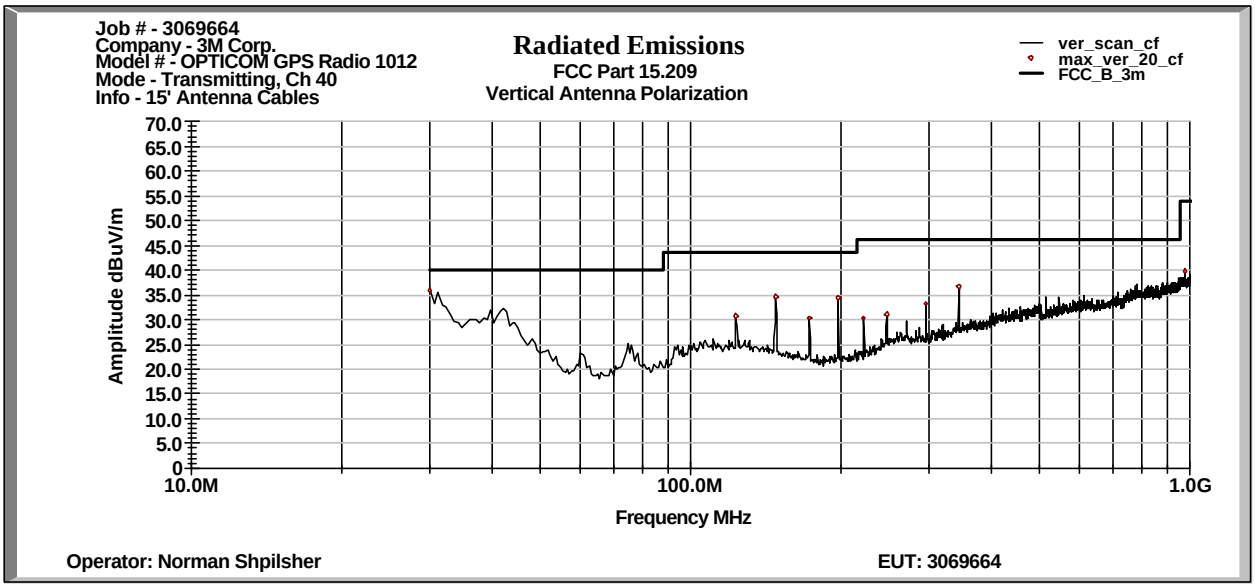
Horizontal Antenna Polarization



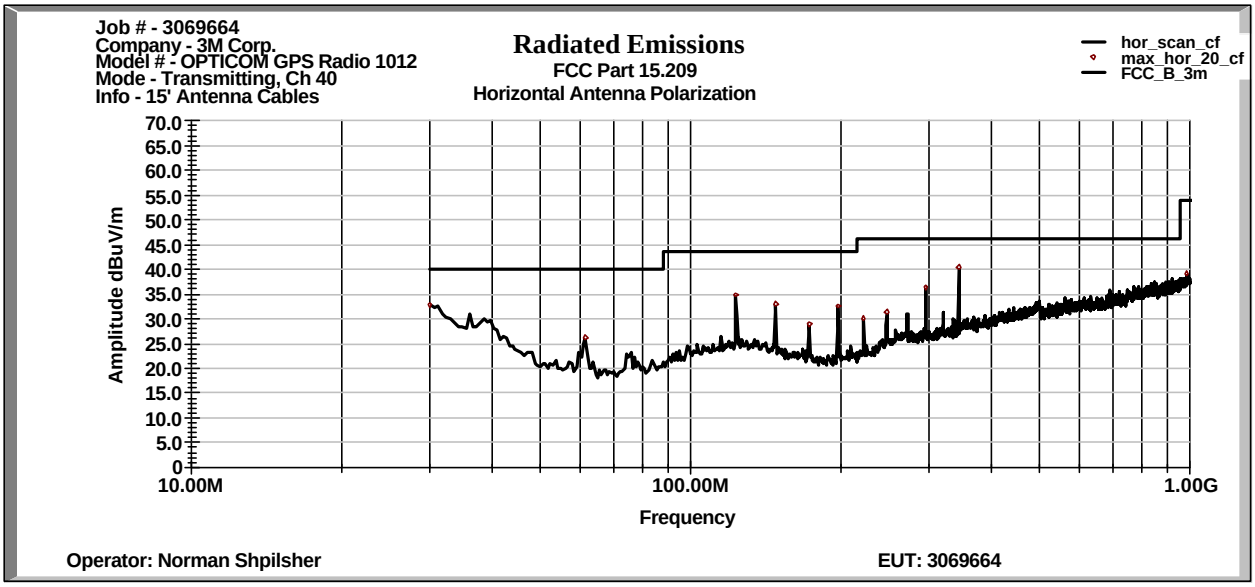
Graph # 3-2-5

Peak Radiated Spurious Emissions from 30MHz to 1GHz, Ch. 40, 15' Antenna Cables

Vertical Antenna Polarization



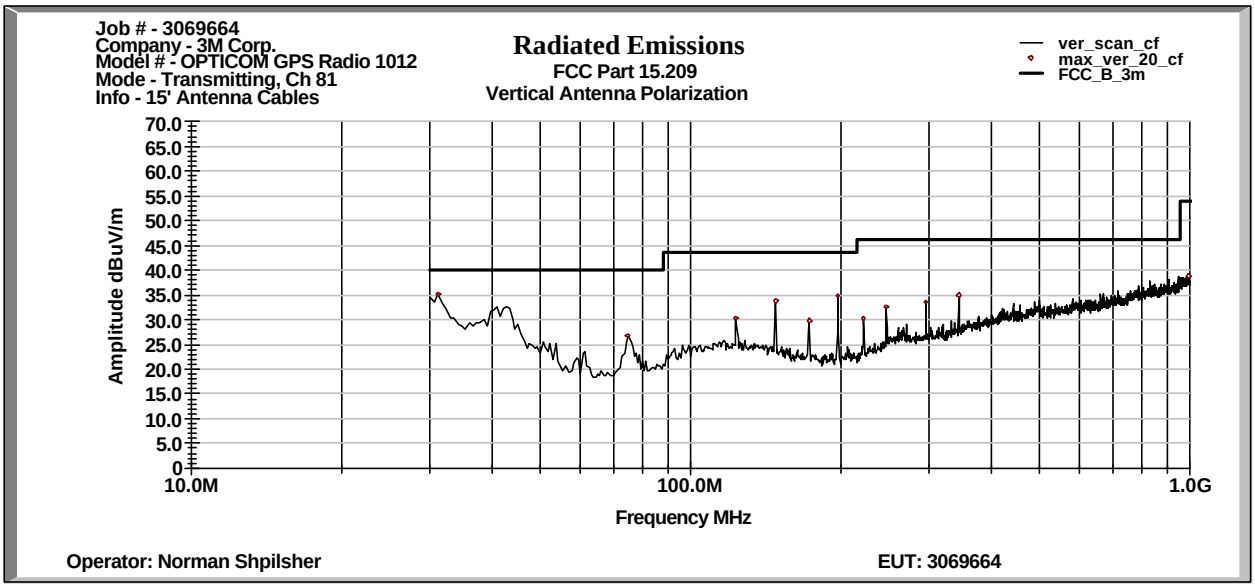
Horizontal Antenna Polarization



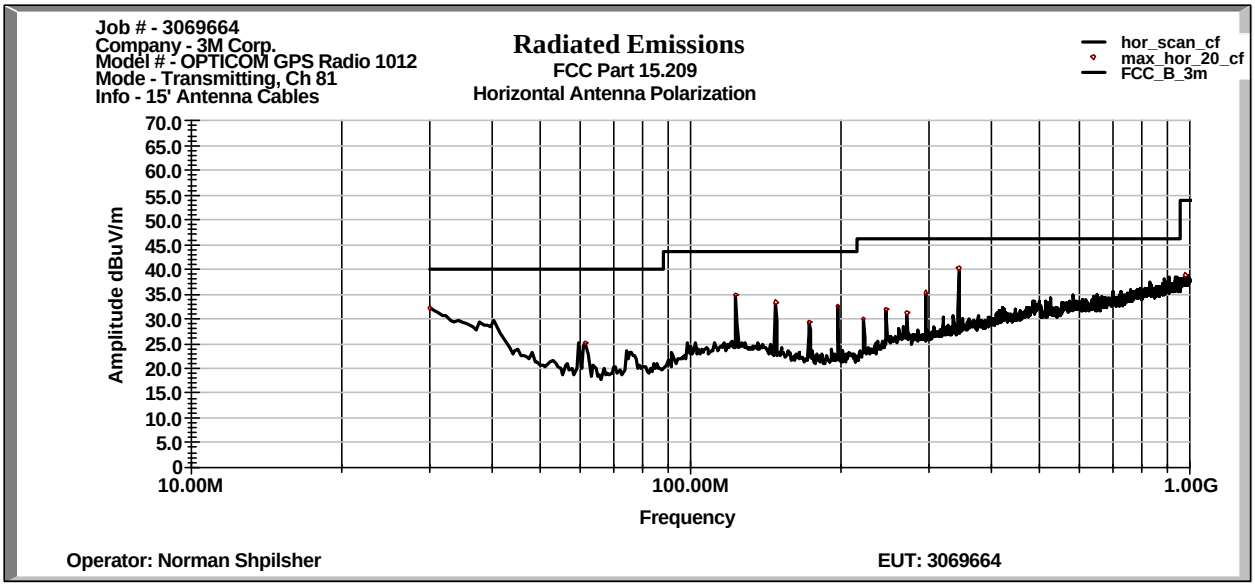
Graph # 3-2-6

Peak Radiated Spurious Emissions from 30MHz to 1GHz, Ch. 81, 15' Antenna Cables

Vertical Antenna Polarization

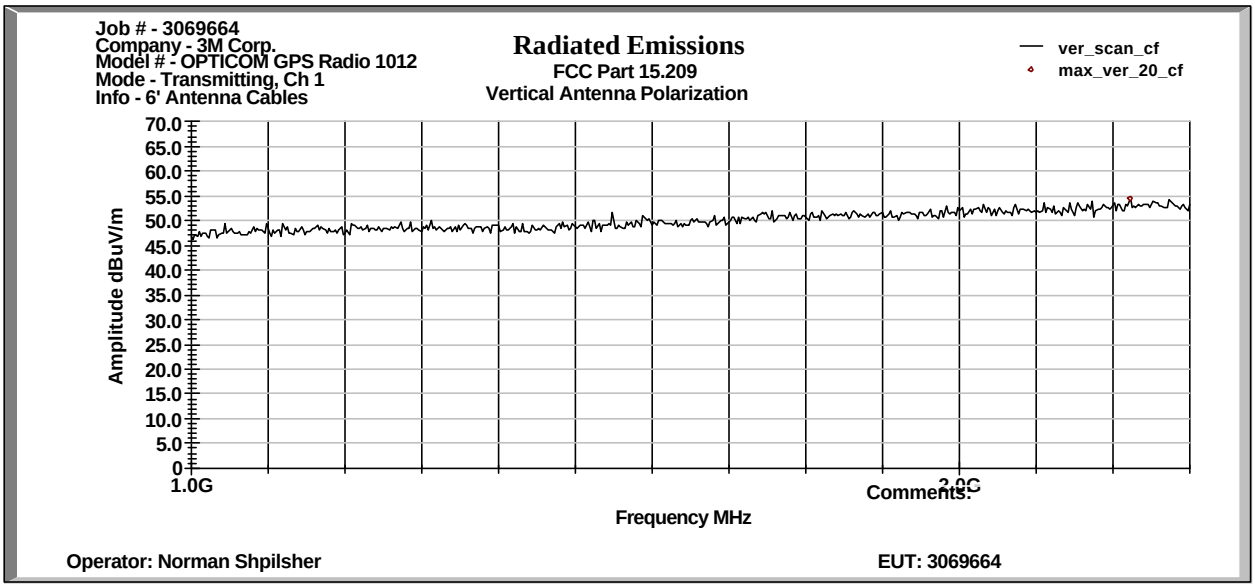


Horizontal Antenna Polarization

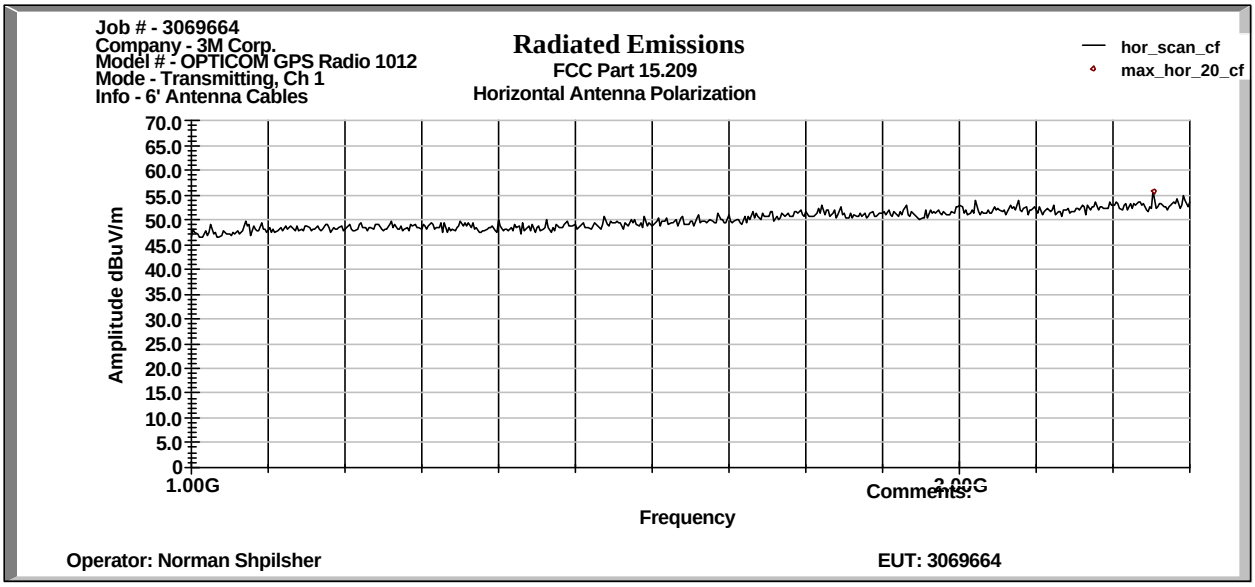


Graph # 3-2-7
Peak Radiated Spurious Emissions from 1 to 2.3GHz, Channel 1, 6' Antenna Cables

Vertical Antenna Polarization



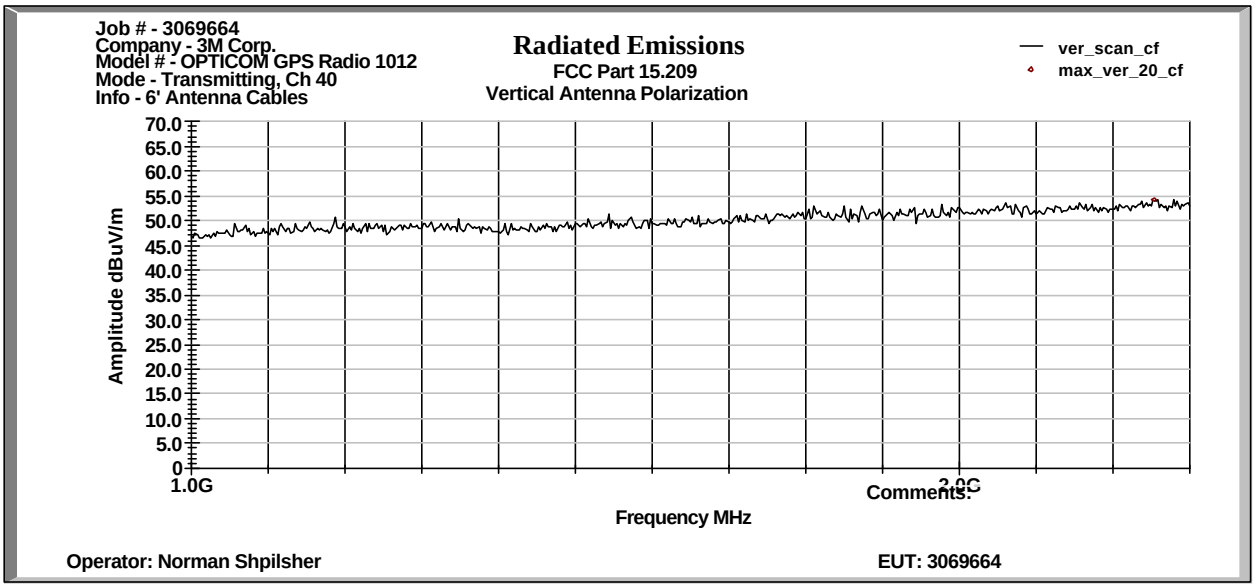
Horizontal Antenna Polarization



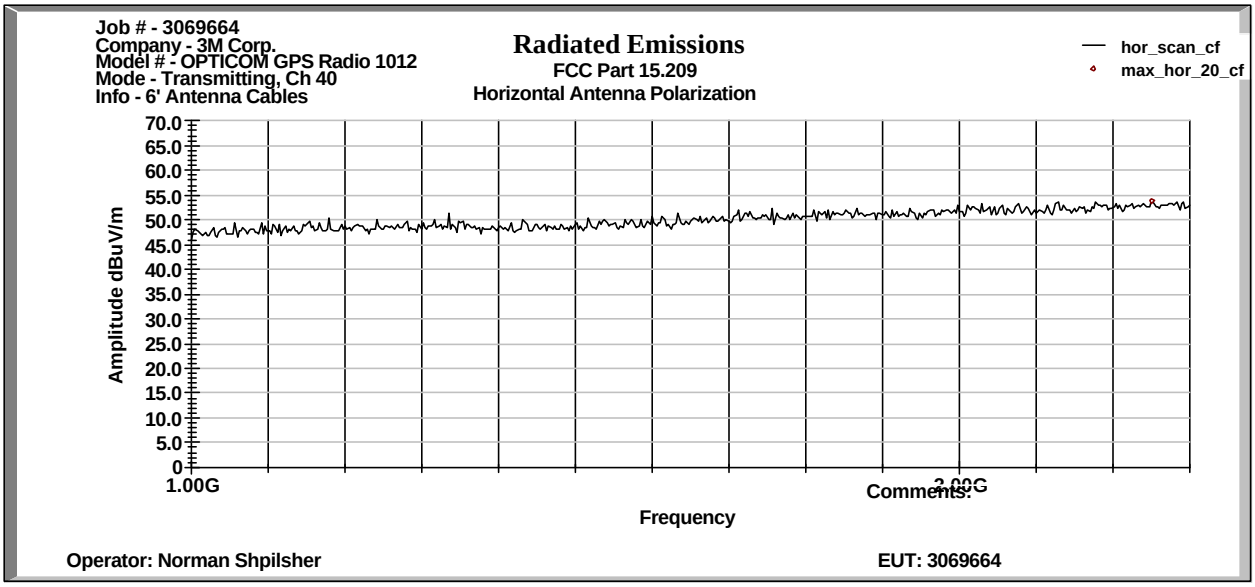
Graph # 3-2-8

Peak Radiated Spurious Emissions from 1 to 2.3GHz, Channel 40, 6' Antenna Cables

Vertical Antenna Polarization



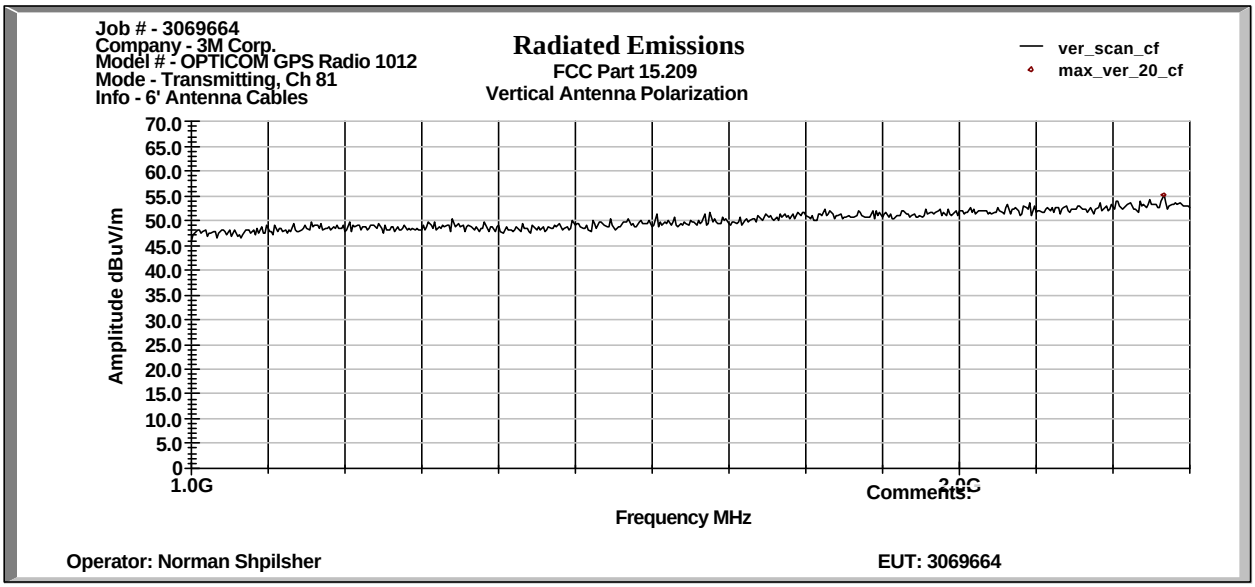
Horizontal Antenna Polarization



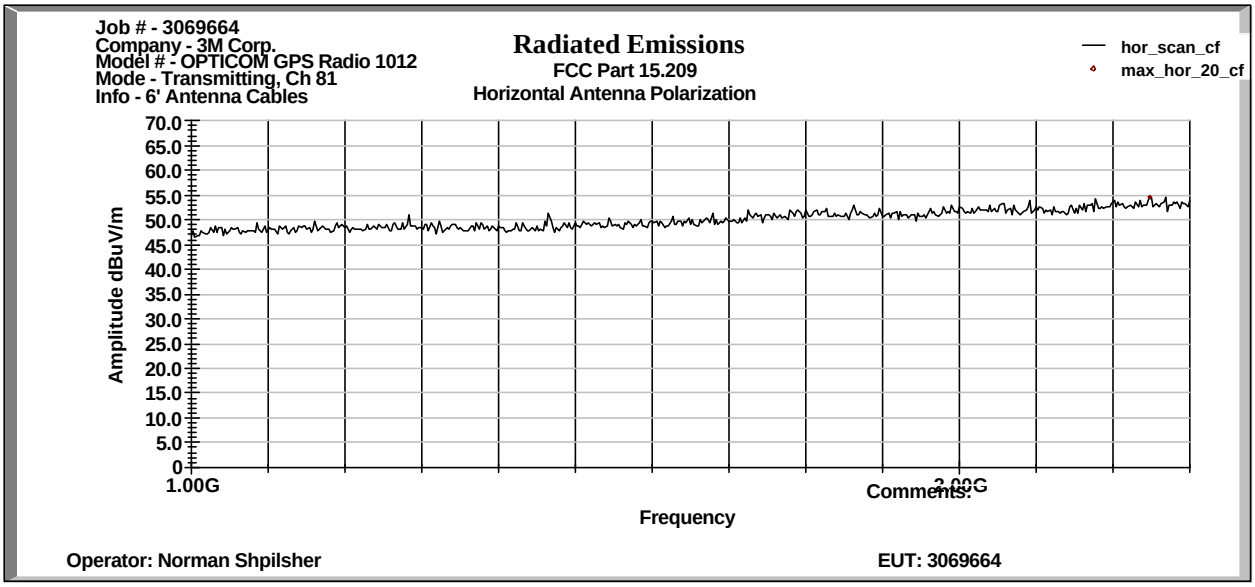
Graph # 3-2-9

Peak Radiated Spurious Emissions from 1 to 2.3GHz, Channel 81, 6' Antenna Cables

Vertical Antenna Polarization



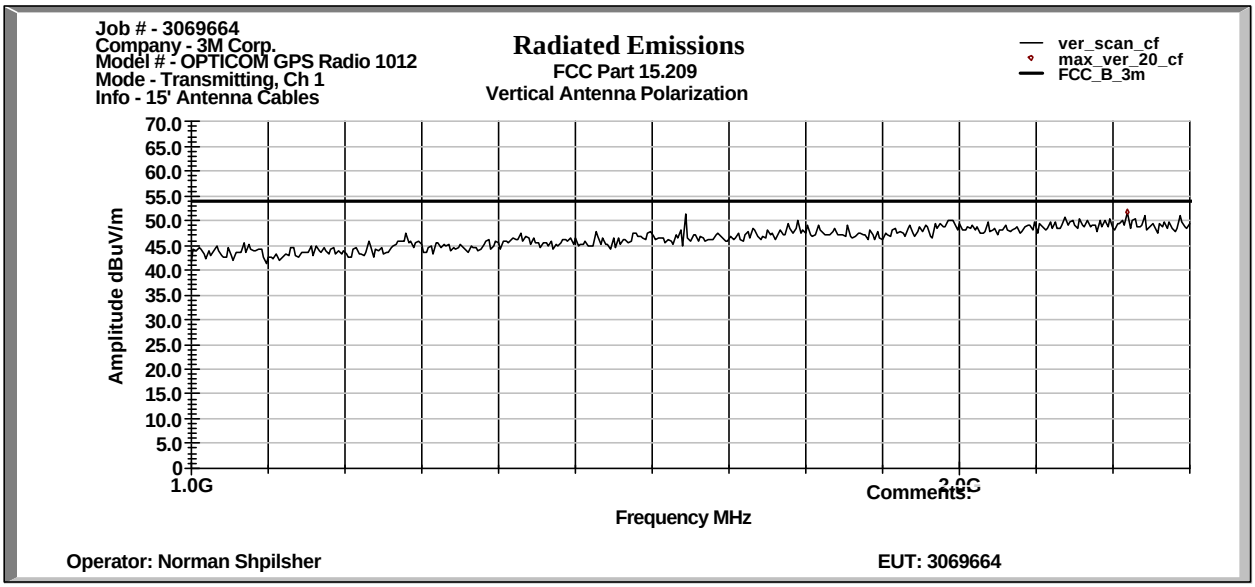
Horizontal Antenna Polarization



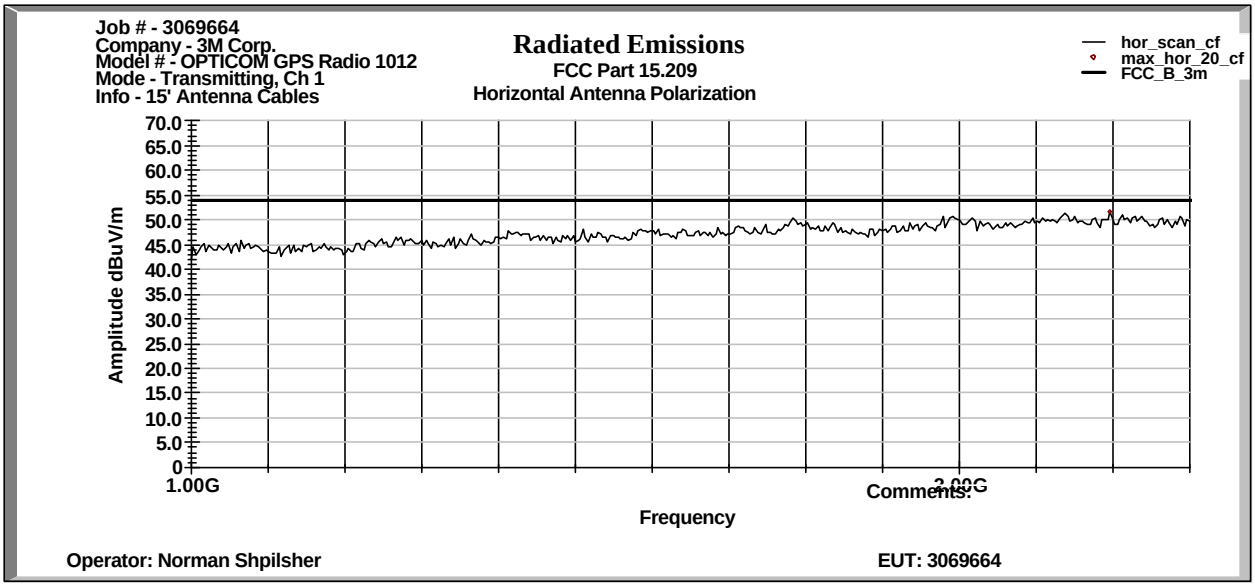
Graph # 3-2-10

Peak Radiated Spurious Emissions from 1 to 2.3GHz, Channel 1, 15' Antenna Cables

Vertical Antenna Polarization



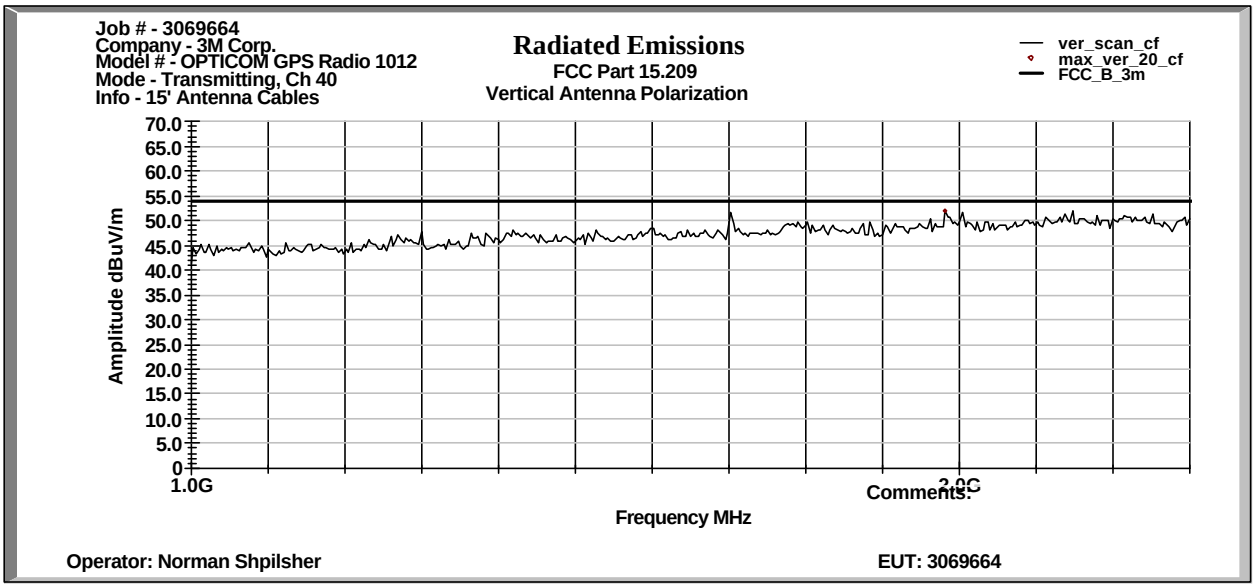
Horizontal Antenna Polarization



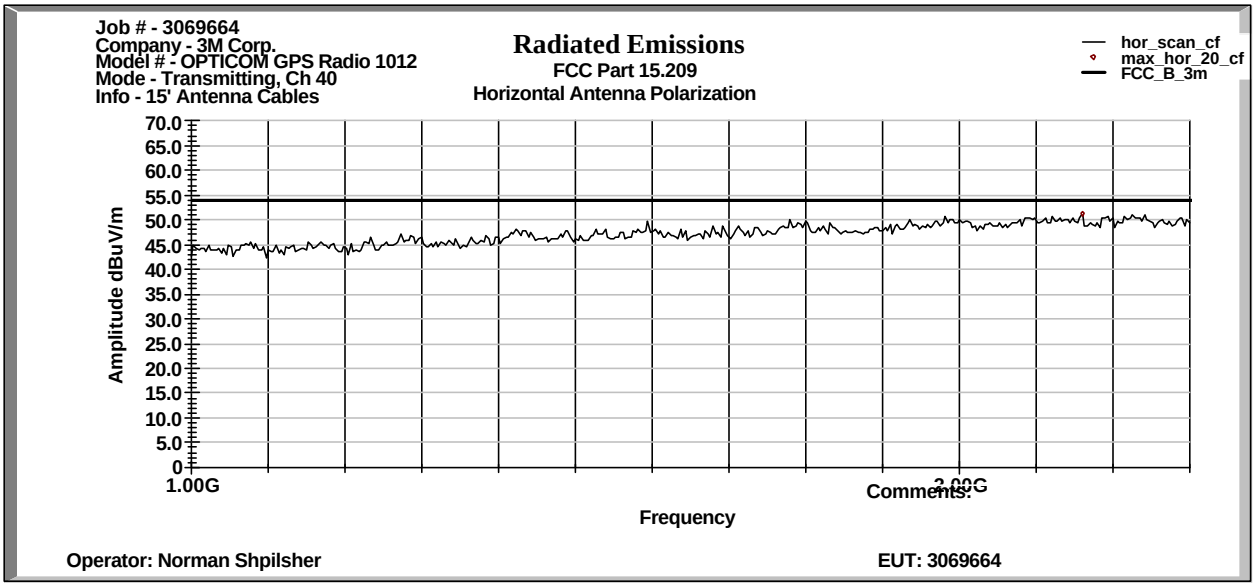
Graph # 3-2-11

Peak Radiated Spurious Emissions from 1 to 2.3GHz, Channel 40, 15' Antenna Cables

Vertical Antenna Polarization



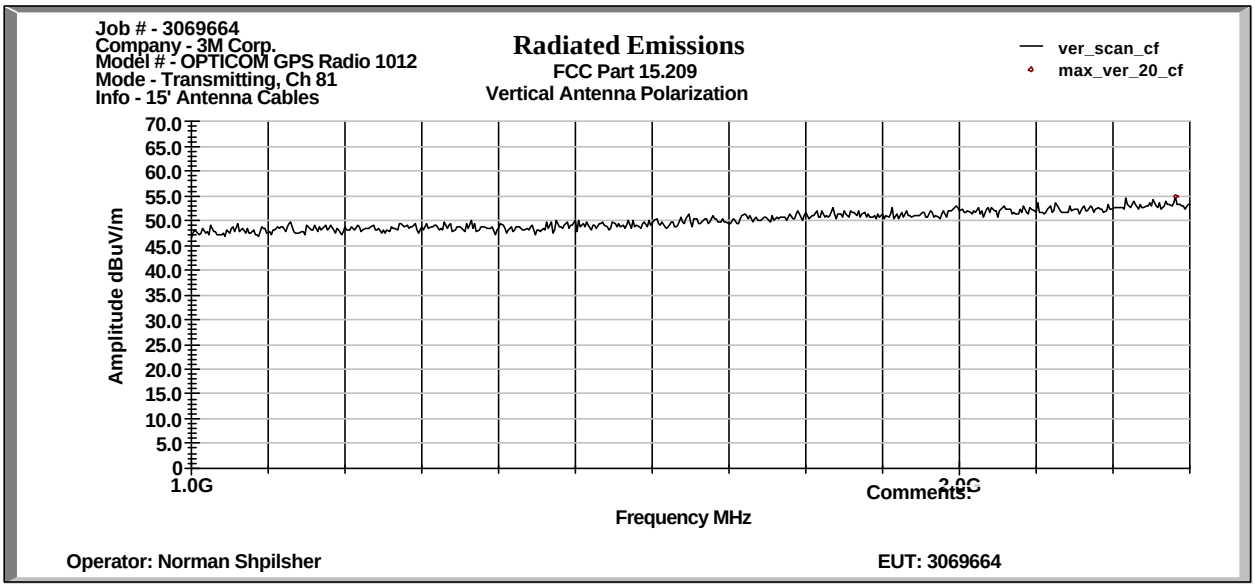
Horizontal Antenna Polarization



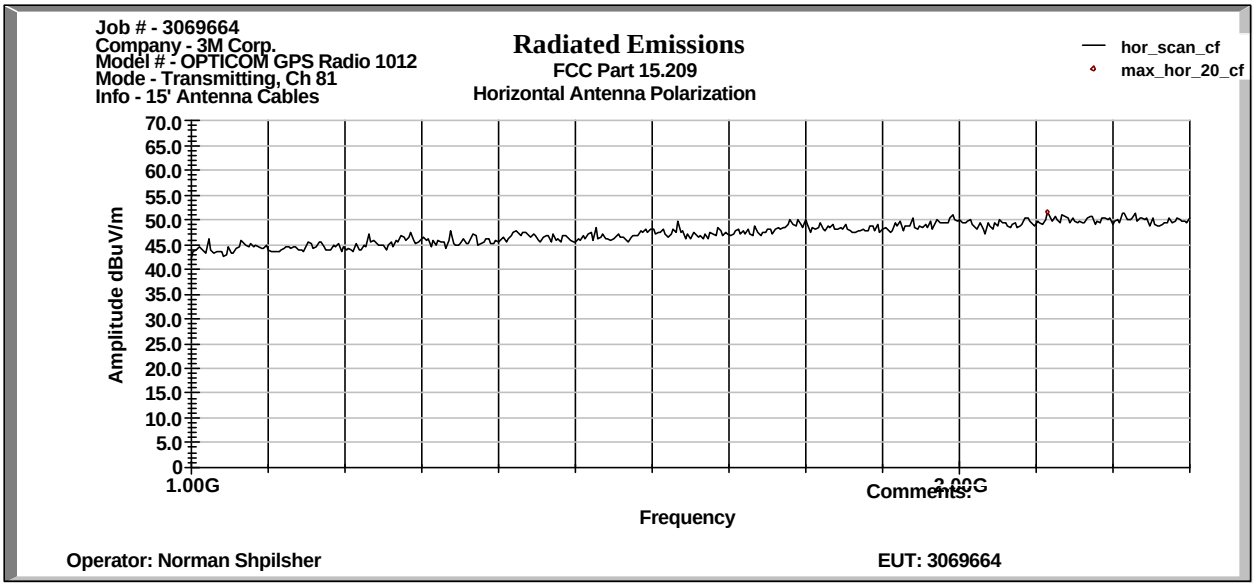
Graph # 3-2-12

Peak Radiated Spurious Emissions from 1 to 2.3GHz, Channel 81, 15' Antenna Cables

Vertical Antenna Polarization

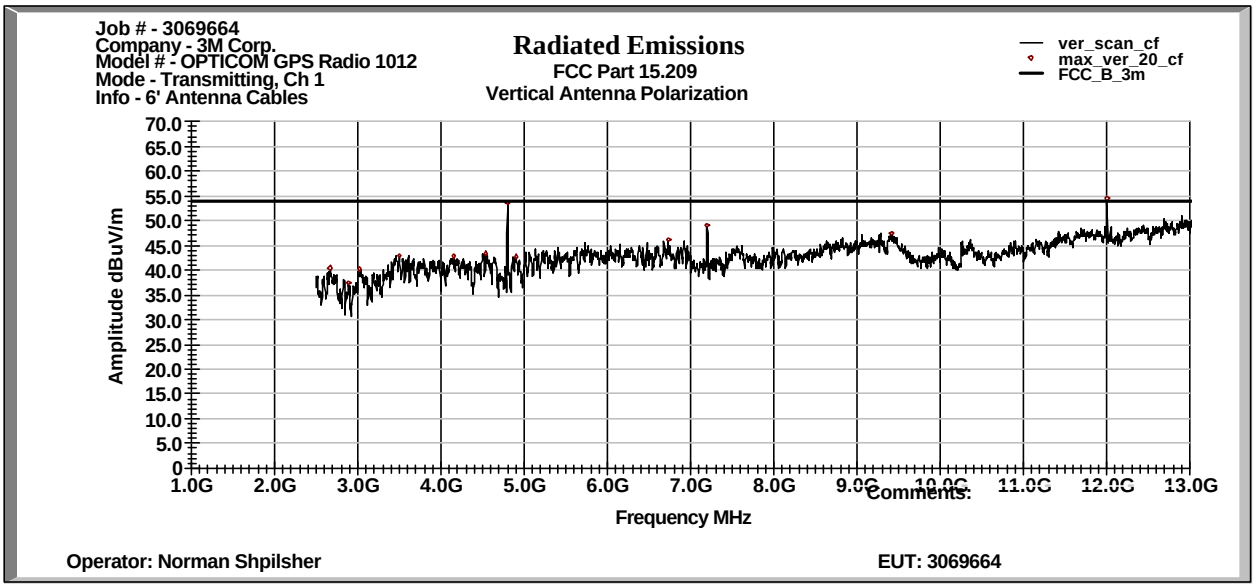


Horizontal Antenna Polarization

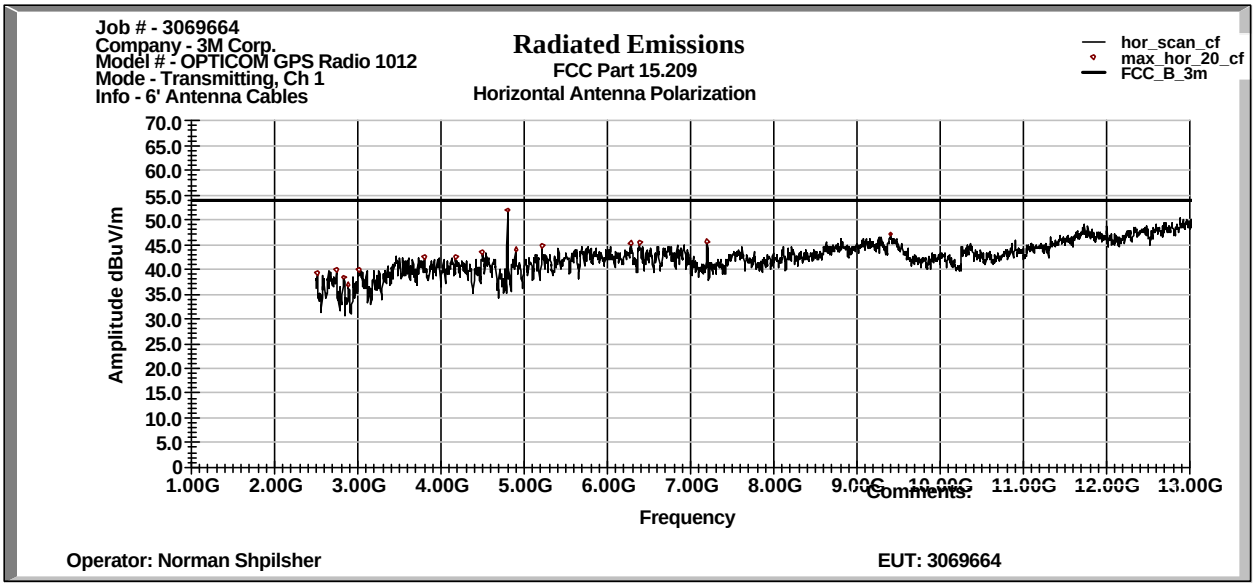


Graph # 3-2-13
Peak Radiated Spurious Emissions from 2.5 to 13GHz, Channel 1, 6' Antenna Cables

Vertical Antenna Polarization



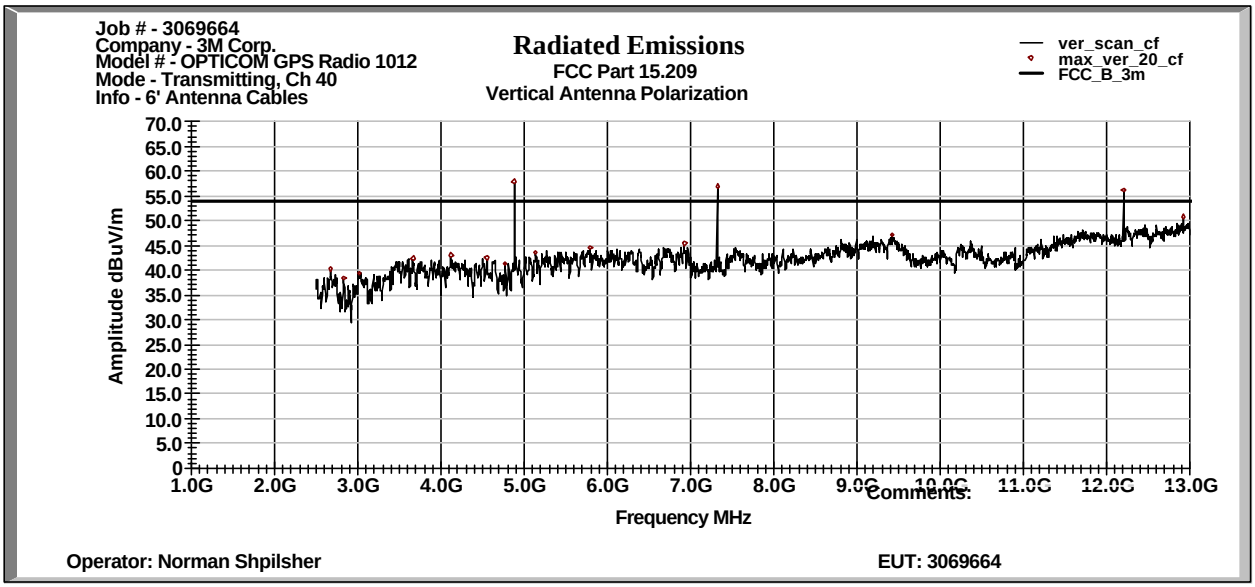
Horizontal Antenna Polarization



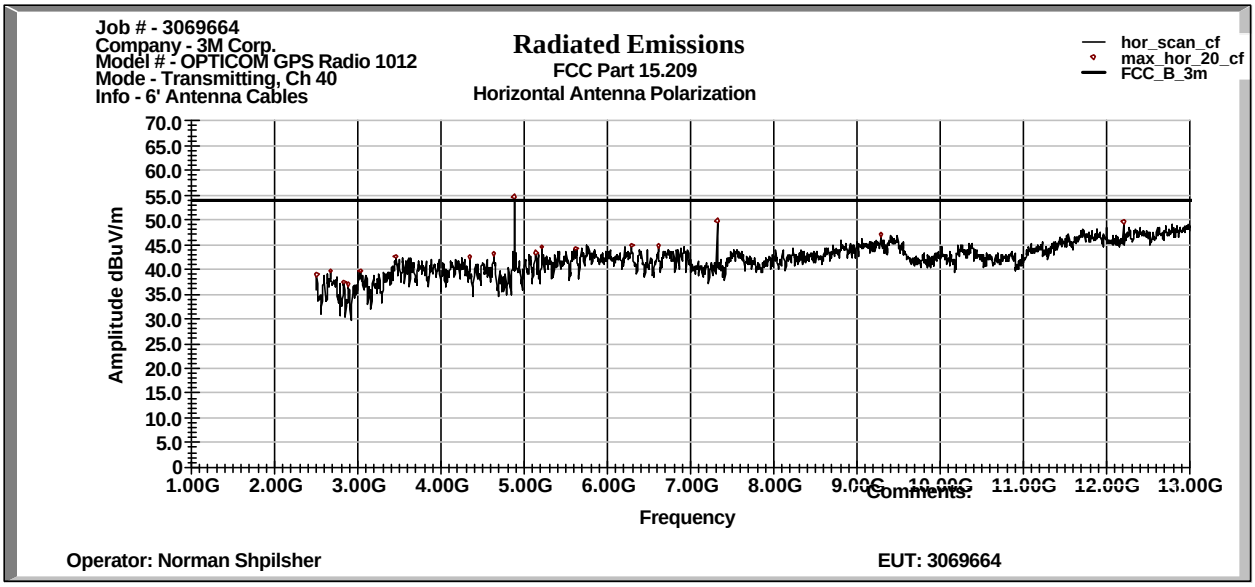
Graph # 3-2-14

Peak Radiated Spurious Emissions from 2.5 to 13GHz, Channel 40, 6' Antenna Cables

Vertical Antenna Polarization



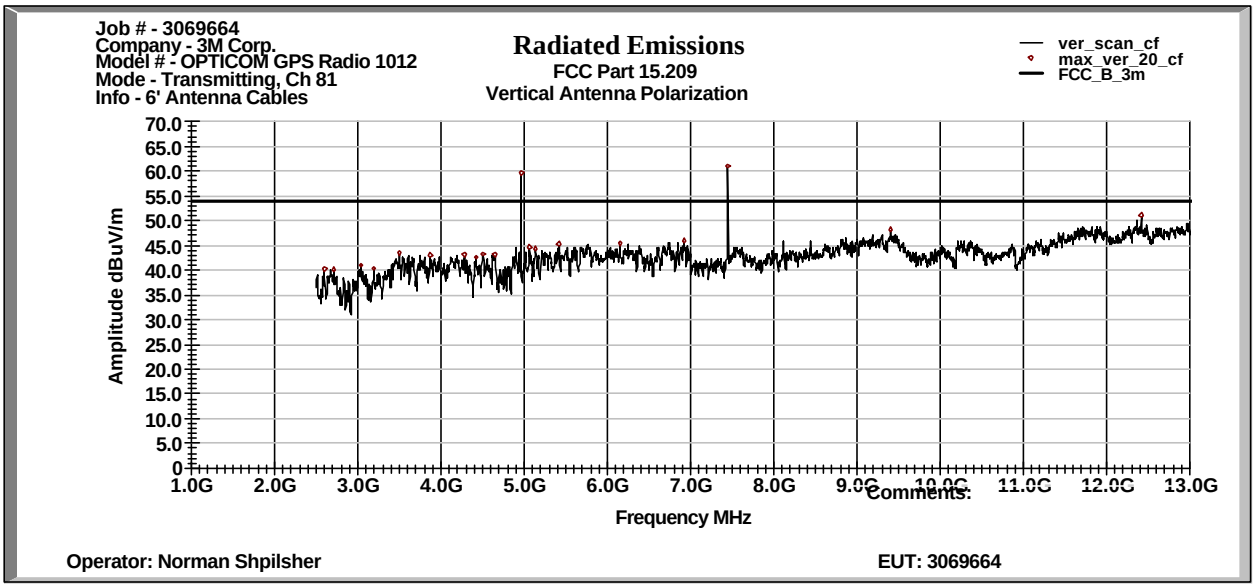
Horizontal Antenna Polarization



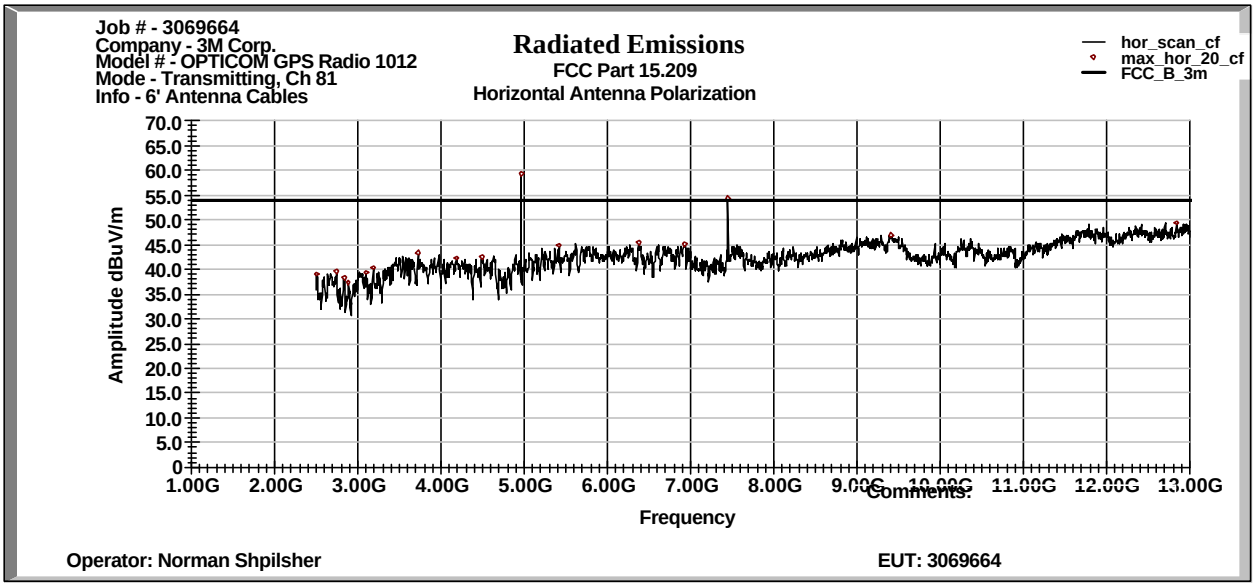
Graph # 3-2-15

Peak Radiated Spurious Emissions from 2.5 to 13GHz, Channel 81, 6' Antenna Cables

Vertical Antenna Polarization



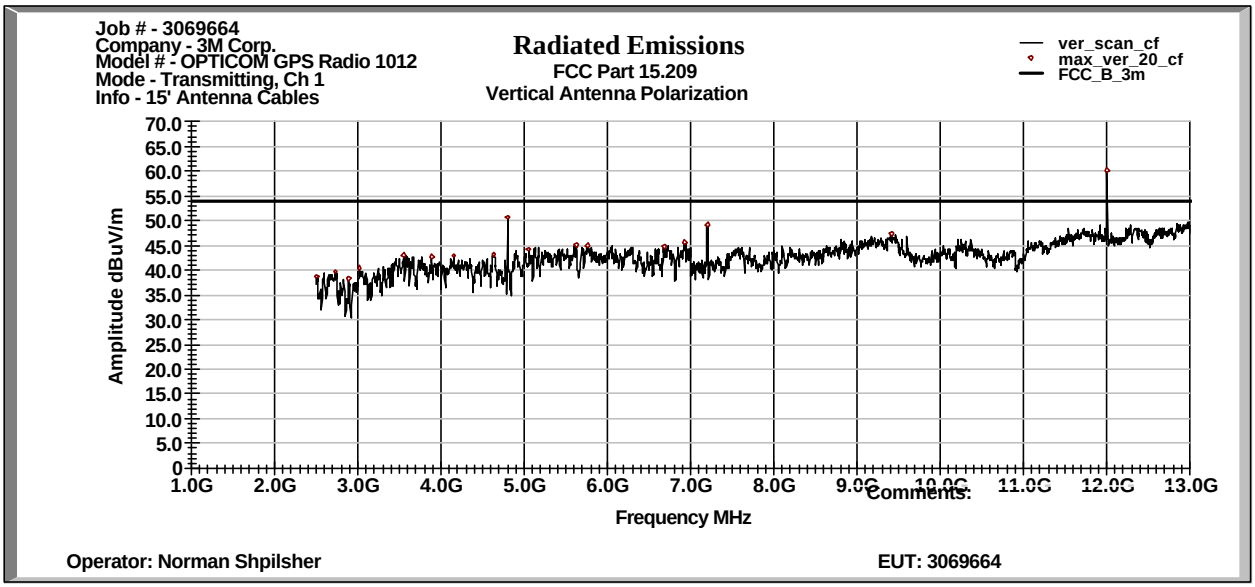
Horizontal Antenna Polarization



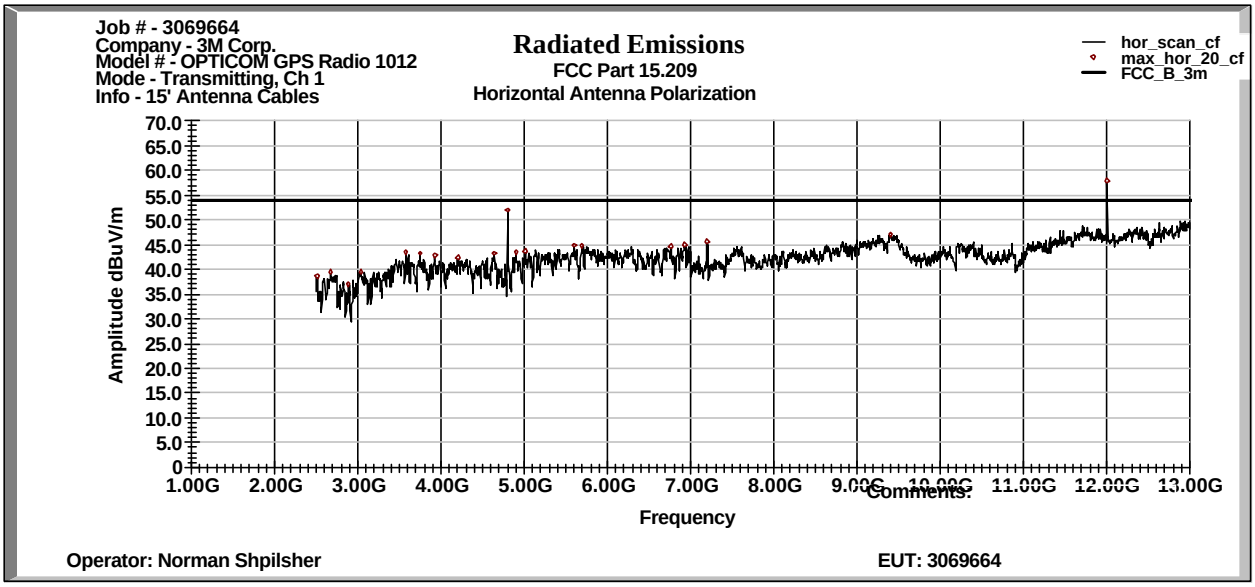
Graph # 3-2-16

Peak Radiated Spurious Emissions from 2.5 to 13GHz, Channel 1, 15' Antenna Cables

Vertical Antenna Polarization



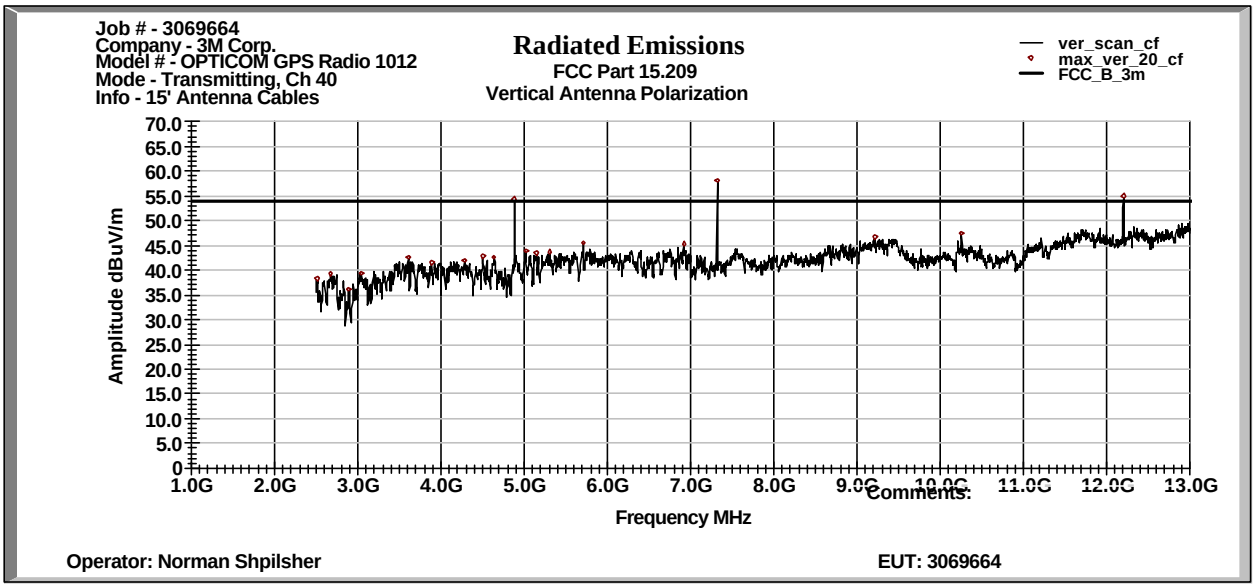
Horizontal Antenna Polarization



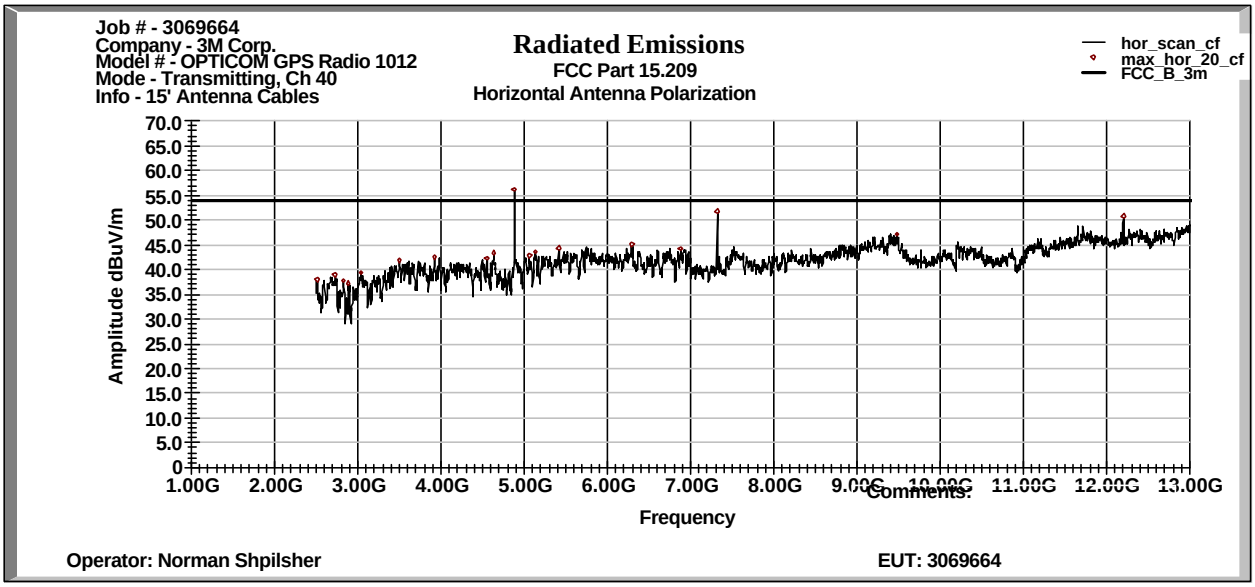
Graph # 3-2-17

Peak Radiated Spurious Emissions from 2.5 to 13GHz, Channel 40, 15' Antenna Cables

Vertical Antenna Polarization



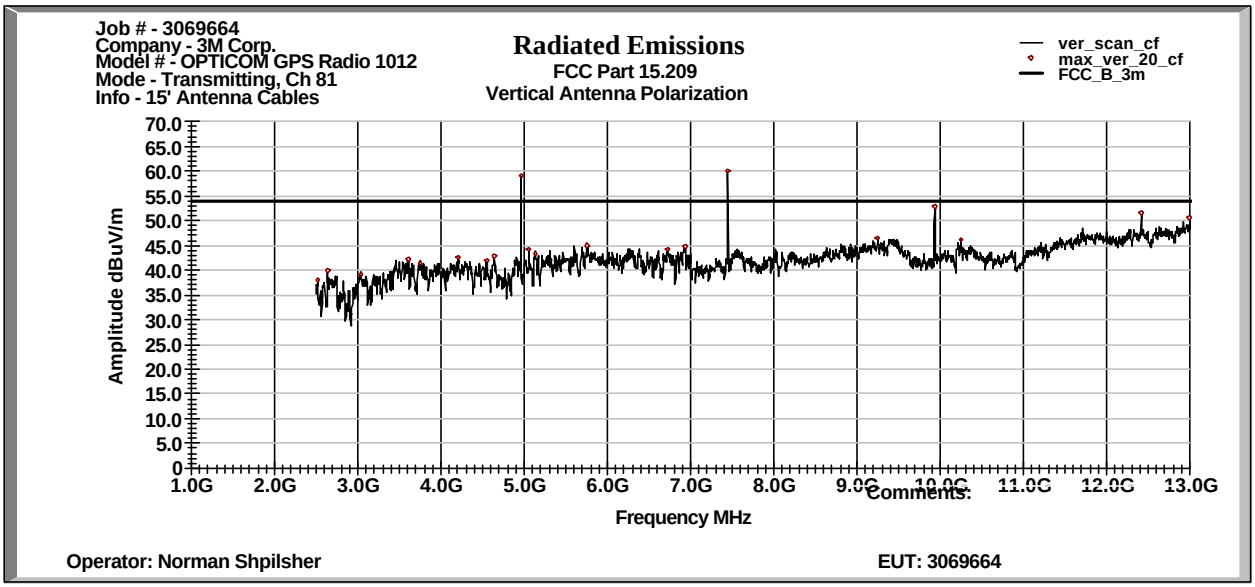
Horizontal Antenna Polarization



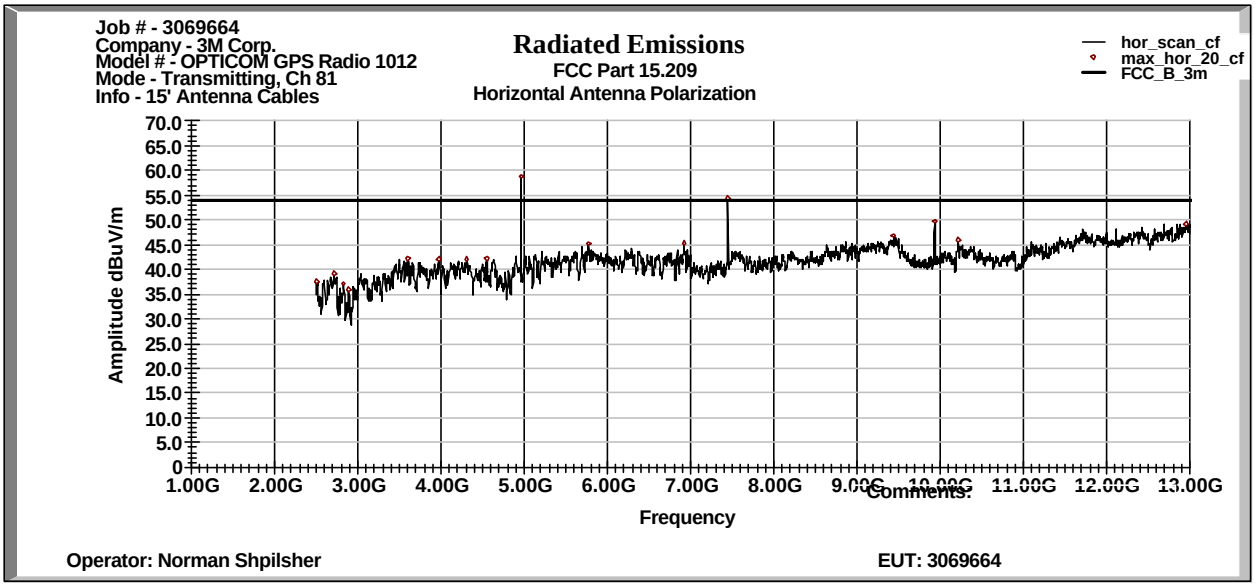
Graph # 3-2-18

Peak 40Radiated Spurious Emissions from 2.5 to 13GHz, Channel 81, 15' Antenna Cables

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.3 Radiated Emissions, FCC 15.109, Class A

The *Radio* was tested as a digital device in receiving mode according to FCC Part 15.109, Class A in frequency range from 30MHz to 12.5GHz. Radiated Emissions testing was performed in Anechoic Chamber with 3m-measurement distance.

Per client request two *Radios* were tested for FCC 15.109, Class A Radiated Emissions:

- with pre-installed Ferrite core (with no turns) at Interface Cable Connector inside the unit
- with pre-installed filtered Interface Cable Connector

Table 3-3-1 shows maximum emissions with both Radios.
Graphs 3-3-1 to 3-3-4 show radiated emissions with pre-installed Ferrite core (with no turns) at Interface Cable Connector inside the unit.

Radiated Emissions **Date:** 12-21-2004

Company: 3M Corp., Traffic Safety Systems
Model: Opticom GPS Radio 1012
Test Engineer: Norman Shpilsher
Special Info:
Standard: FCC Part 15.109, Class A
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: The table shows the worst case radiated emissions
All measurements were taken using a CISPR Quasi-peak detector

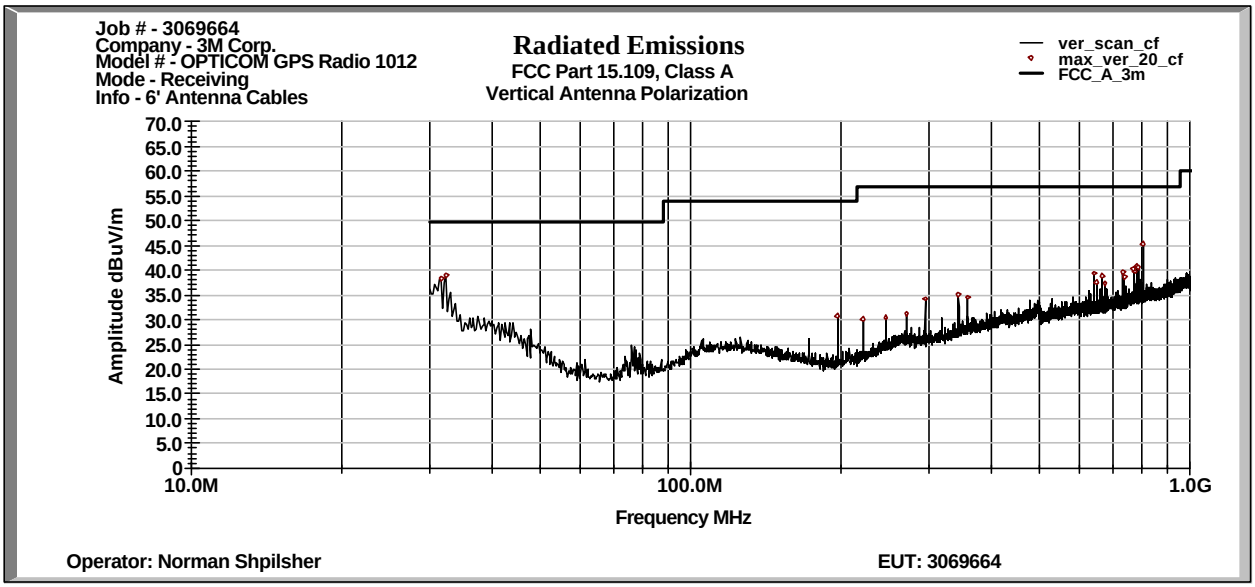
Table # 3-3-1

Frequency	Antenna			Total QP	QP Limit	Margin	Comments
MHz	Polarity	Hts(cm)	Factor (dB1/m)	dBµV/m	dBµV/m	dB	
		With Pre-installed Ferrite					
172.03	H	189	11.3	34.5	54.0	-19.5	
245.76	H	164	14.1	31.0	56.9	-25.9	
270.33	V	181	14.9	30.2	56.9	-26.7	
270.33	H	100	14.9	29.7	56.9	-27.2	
	With Pre-installed Filtered Connector						
172.03	H	189	11.3	24.5	54.0	-29.5	
245.76	H	164	14.1	30.1	56.9	-26.8	
270.33	V	181	14.9	28.4	56.9	-28.5	
270.33	H	100	14.9	27.4	56.9	-29.5	

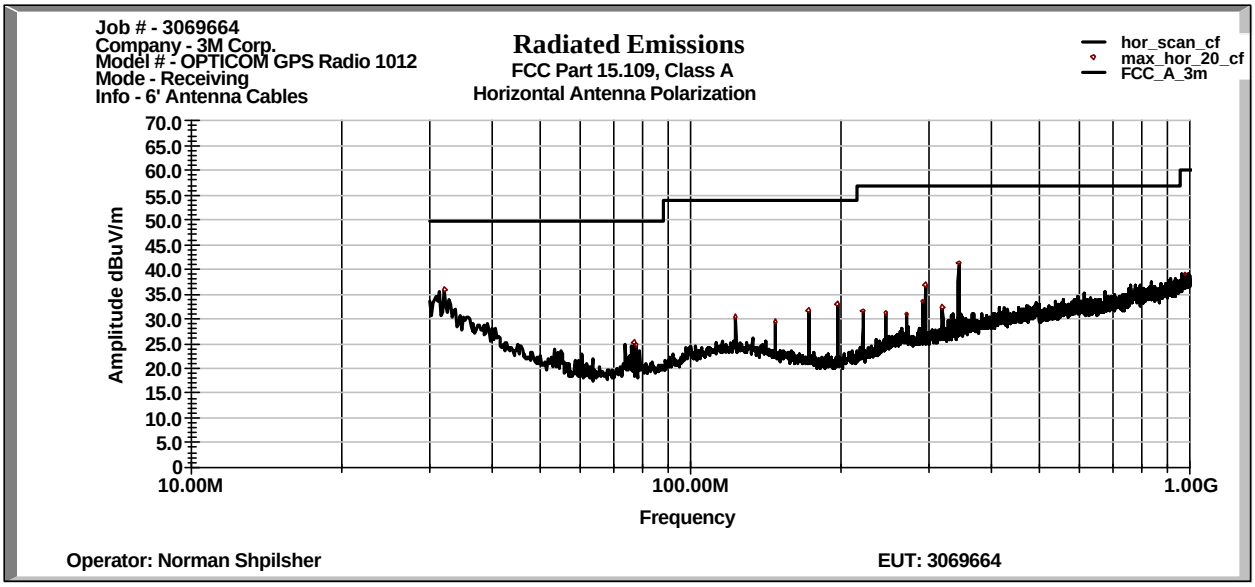
Comments:

Graph # 3-3-1
FCC 15.109, Class A Peak Radiated Emissions from 30MHz to 1GHz, 6' Cables Set

Vertical Antenna Polarization



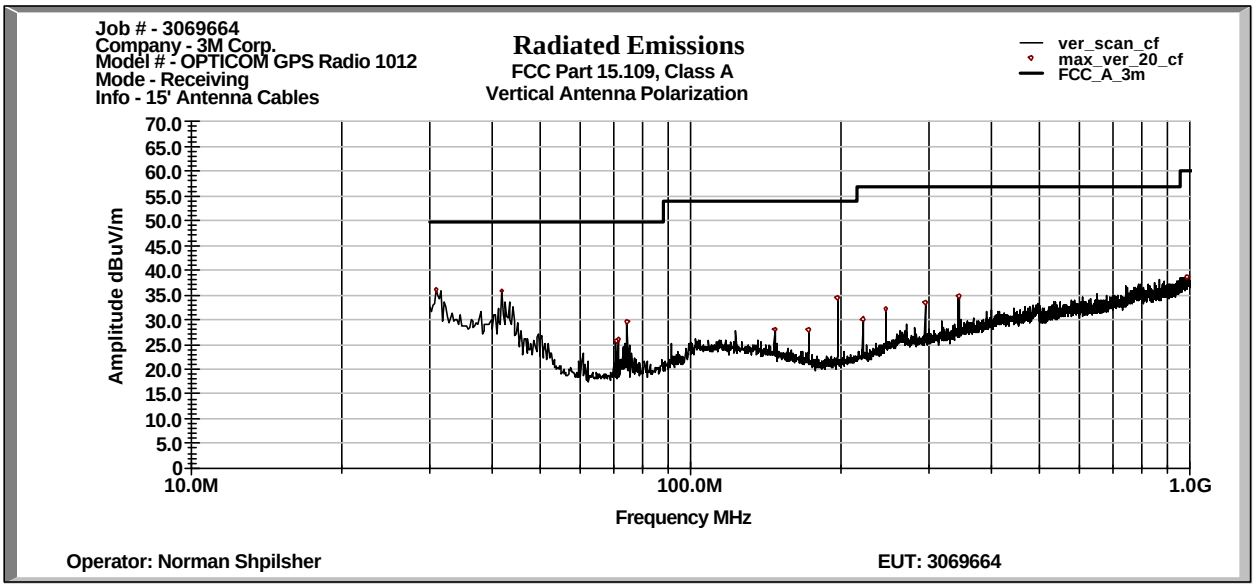
Horizontal Antenna Polarization



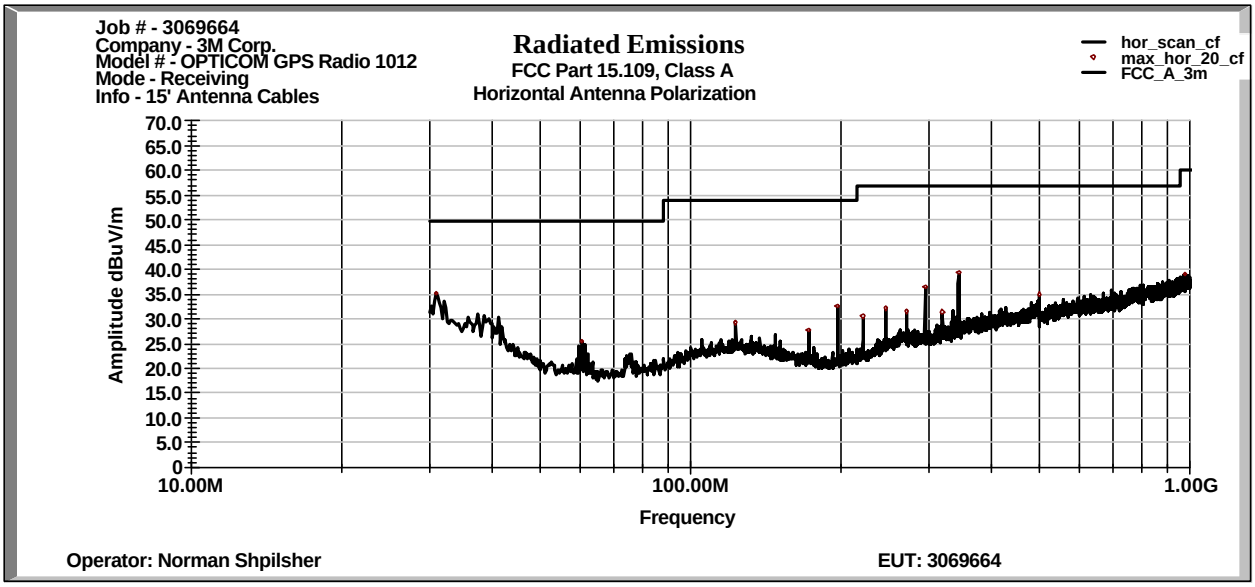
Graph # 3-3-2

FCC 15.109, Class A Peak Radiated Emissions from 30MHz to 1GHz, 15' Cables Set

Vertical Antenna Polarization

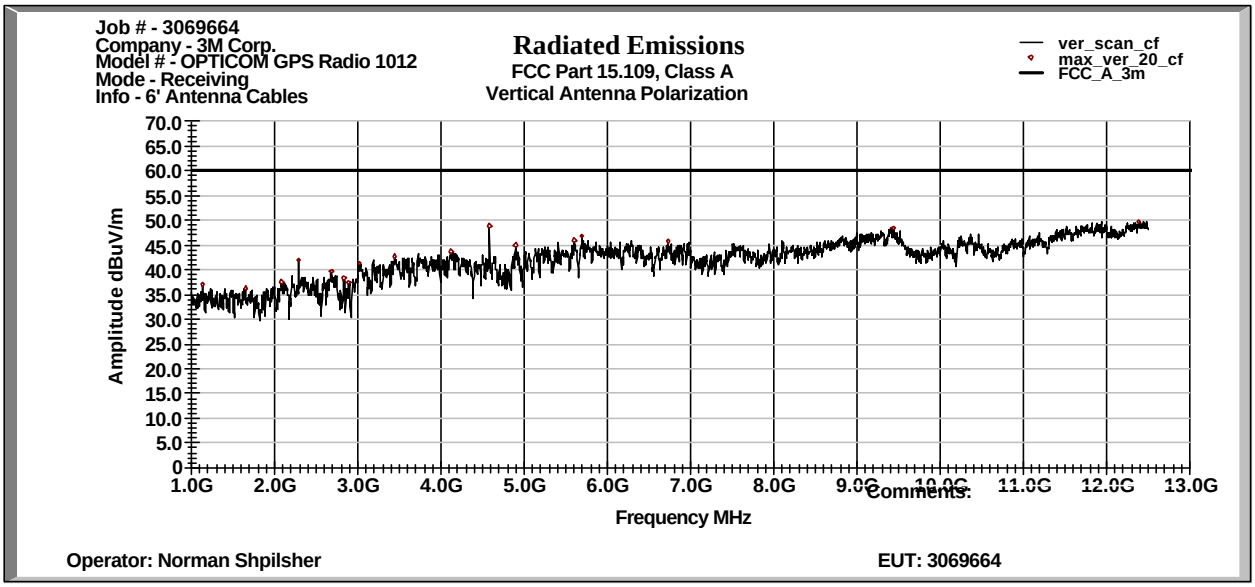


Horizontal Antenna Polarization

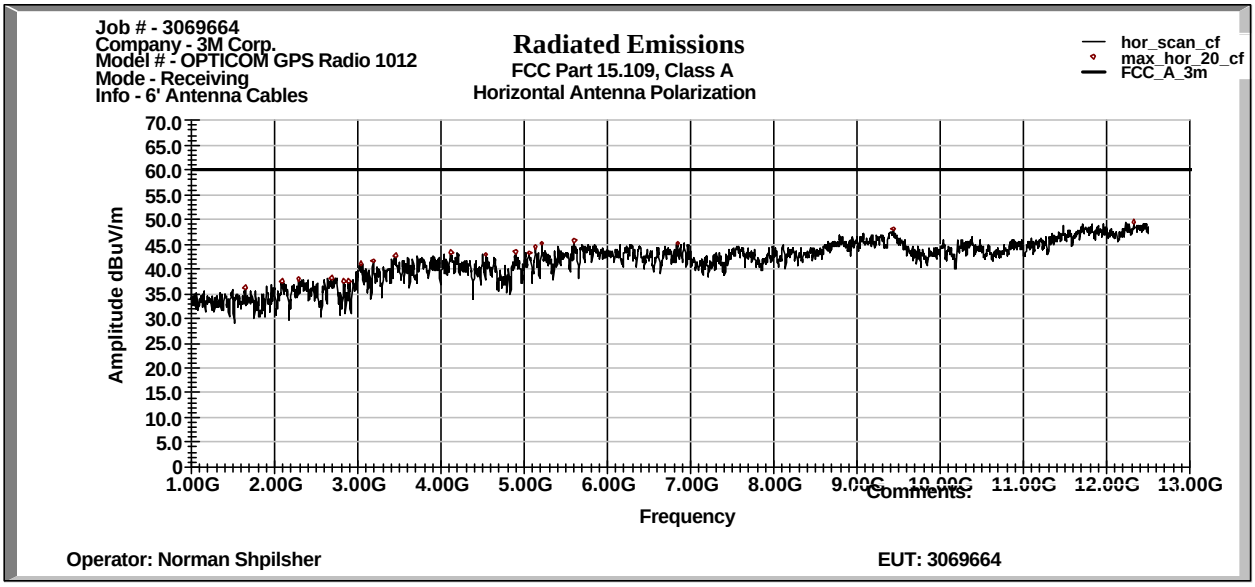


Graph # 3-3-3
FCC 15.109, Class A Peak Radiated Emissions from 1 to 12.5GHz, 6' Cables Set

Vertical Antenna Polarization



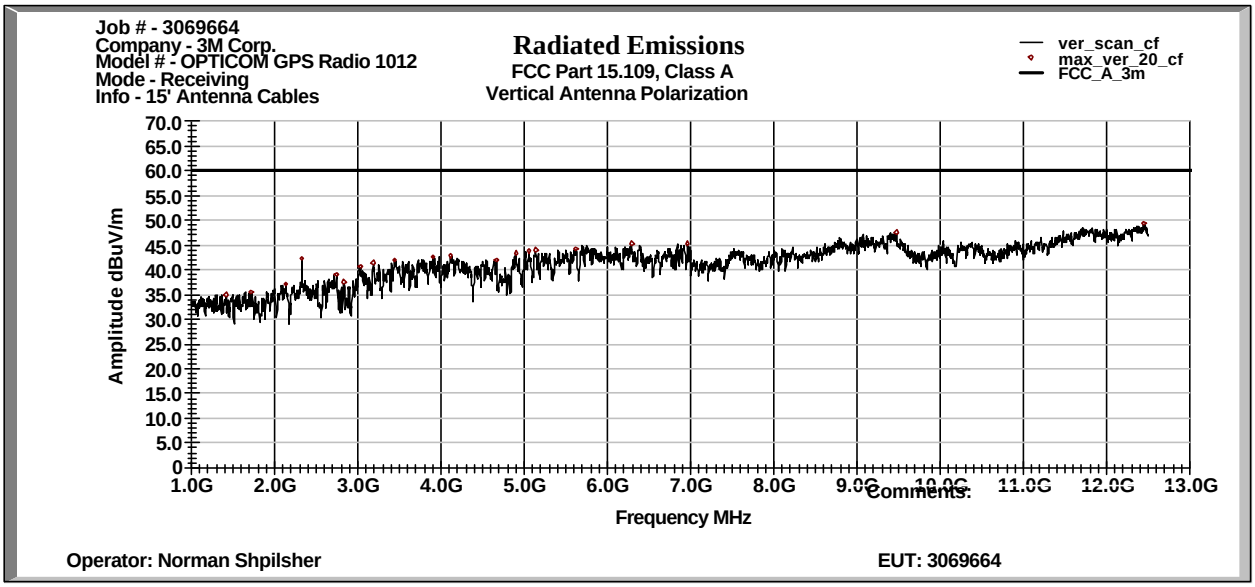
Horizontal Antenna Polarization



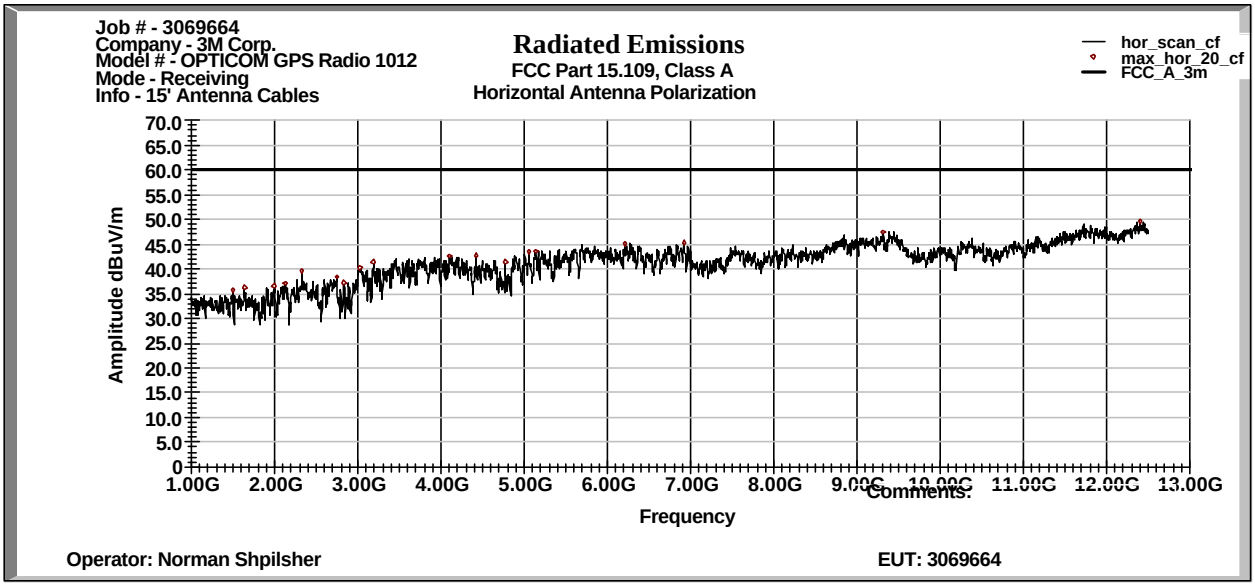
Graph # 3-3-2

FCC 15.109, Class A Peak Radiated Emissions from 1 to 12.5GHz, 15' Cables Set

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.4 Test Procedure

Field Strength Measurements

The EUT was placed on a non-conductive table 0.8m above the ground plane inside the Anechoic Chamber. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at 3m distance. The Bicono-Log antenna was used in frequency range from 30MHz to 1GHz, and the Horn antenna was used in frequency range above 1GHz. The radiated emissions were maximized by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m. Method of the Field Strength Calculation is shown in the Section 3.5.

Measurements at Antenna Terminal

The Measurements at Antenna Terminal were made at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum Analyzer Input.

3.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength in dB(µV/m)
RA = Receiver Amplitude in dB(µV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(m^{-1})
AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(µV) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(µV/m).

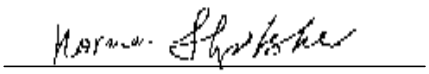
RA = 48.1 dB(µV)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dB
FS = RA + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(µV/m)

In the tables the Cable correction factors are included to the Antenna Factors.

Tested by:

Norman Shpilsher
Sr. EMC Engineer
Intertek ETL SEMKO

Signature



Date: January 10, 2005

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3549A00306	01/04	01/05	X
HP85460A RF Filter Section	3448A00276	01/04	01/05	X
Rohde & Schwarz FSP Spectrum Analyzer	100024	03/04	03/05	X

Antennas/Pre-Amplifiers/Signal Generator/Filters

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	01/04	01/05	X
EMCO Horn Antenna 3115	6579	01/04	01/05	X
EMCO Horn Antenna 3116	9904-2423	06/04	06/05	X
HP 83017A Pre-Amplifier	3123A00475	05/04	05/05	X
Rohde & Schwarz SMT 03 Signal Generator	DE12157	08/04	08/05	X
Reactel 7HS-4G-S12 Filter	0223	01/04	01/05	X