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CoolPlay 1670 DVM Transmitter FCC Certification Application

EXHIBIT M

Test Report

The following test report contains the test data to demonstrate compliance.



Certification of Compliance
Cool Play 1670 Digital TV Transmitter
for
FCC Title 47

This document is compiled to provide the data and records supporting a Certification of Compliance with FCC Rules set forth in 47CFR Parts 2 and 27. Certification as described in Part 2, Subpart J applies to all subsequent identical units marketed.

Use of the Certification method requires that the required records are filed accompanying FCC Form 731. The test record shall be retained as required by 2.938(c).

The transmitter tested is referred to by Harris as:

Trade Name	COOLPLAY™ 1670	
FCC Identifier	BOIDVM	
Frequency	1672.5 MHz	
Model:	Rated Power	
DVM-50	50 Watts	
DVM-100	100 Watts	
DVM-200	200 Watts	
DVM-400 (Tested)	400 Watts	
DVMD-50	2 x 25 Watts	
DVMD-100	2 x 50 Watts	
DVMD-200	2 x 100 Watts	
DVMD-400	2 x 200 Watts	
Sample Tested:		
DVM-400	400 Watts	Serial Number OPD0001-060806

The person responsible for testing is:

Karl Black
Compliance Engineer

May 7, 2007
(Date)



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Rules and Standards Applied in these Measurements

Requirement:	Standard / Procedure
2.1046(a), (c) Carrier Output	The output power at the transmitter output flange and at the output from the output bandpass filter were both measured while operating into a standard test load, using a calibrated RF power meter.
2.1047 27.53(j) Emission Limits Adjacent Bands	Measured and calculated as directed by 27.53(j). Output power from the bandpass filter was used as the reference output power for measurement of out of band emissions.
2.1049 Occupied Bandwidth	Measured directly at the output of the bandpass filter. The displayed signal with markers at the limits of modulation is included in the report.
2.1057 Frequency Spectrum	Measure spectrum below and above the transmitted channel for presence of any spurious emissions.
2.1047 27.53(j) Emission Limits 2.1051 Spurious Emissions	Measured directly and the results are tabulated. The minimum Resolution Bandwidth specified in 27.53(j) was used to optimize sensitivity of the instrument. Output power from the bandpass filter was used as the reference output power for measurement of spurious emissions. A results table calculates together the coupler loss, measuring cable loss and the measured spurious level, or the instrument noise baseline level at the expected harmonics, to calculate the corrected levels. The spurious levels are referenced to the carrier level. The Pass Margins of each spurious and of the noise floor at each expected harmonic to the tenth are included in the result table.
2.1053 Field Strength of Spurious Radiation 27.53(j)	Output power from the transmitter, before the output filter was used as the reference output power to calculate the radiated spurious emissions. The measurements required by 2.1053(a) were conducted in a large, open factory area, which is documented with photos in the report. The required limit in relation to the reference carrier level was calculated according to the method given in 27.53(j). The calculation of the reference transmitted field, and of the required spurious radiation limit, are given in the report, and the measurements and the calculated result are shown in tabular form.
2.1055 Frequency Stability	Measurements were conducted as directed by 2.1055(a)(1), (b) and(d).

Test Equipment Used in these Measurements

Equipment:	Manufacturer & Model	Serial Number	Calibrated
Power Meter	Agilent 4419B	10434	9-07-07
High Power RF Attenuator	Bird Tenuline 8327-300	2286	N/R
Spectrum Analyzer	Agilent E4443B	11777	8-28-07
Spectrum Analyzer	Tektronix 492PGM	B010288	1-29-08
EMI Antenna	ETS-Lundgren 3115	00028914	N/R
GPS Receiver	Trimble Thunderbolt	832576657	N/R
Multimeter	Fluke 87	00906	8-27-07

2.938 Retention of records.

(a) Records to be maintained

(a) For each equipment subject to the Commission's equipment authorization standards, the responsible party shall maintain the records listed as follows:



(1) Original Design Drawings and Specifications

(1) A record of the original design drawings and specifications and all changes that have been made that may affect compliance with the standards and the requirements of Sec. 2.931.

(2) Production Testing and Inspection Procedures

(2) A record of the procedures used for production inspection and testing to ensure conformance with the standards and the requirements of Sec. 2.931.

(3) Test Results Demonstrating Compliance

(3) A record of the test results that demonstrate compliance with the appropriate regulations in this chapter.

(c) Record retention period

(c) The records listed in paragraph (a) of this section shall be retained for one year for equipment subject to authorization under the certification procedure or former type acceptance procedure, or for two years for equipment subject to authorization under any other procedure, after the manufacture of said equipment has been permanently discontinued, or until the conclusion of an investigation or a proceeding if the responsible party (or, under paragraph (b) of this section, the manufacturer) is officially notified that an investigation or any other administrative proceeding involving its equipment has been instituted.



2.1033 Application for certification.

(a) Filed on FCC Form 731

An application for certification shall be filed on FCC Form 731 with all questions answered. Items that do not apply shall be so noted.

Form 731 with the required information is filed along with this report.

(c) Contents of Technical Report

Applications for equipment other than that operating under parts 15 and 18 of the rules shall be accompanied by a technical report containing the following information:

(1) Name and address of manufacturer

The full name and mailing address of the manufacturer of the device and the applicant for certification.

Harris Broadcast Communications 3200 Wismann Lane Quincy, Illinois 62305 (217) 222-8200
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(2) FCC Identifier

FCC identifier	BOIDVF
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(3) Installation and operating instructions

A copy of the installation and operating instructions to be furnished the user. A draft copy of the instructions may be submitted if the actual document is not available. The actual document shall be furnished to the FCC when it becomes available.

Supplied with Form 731.

(4) Type or Types of emission,

5M00W7W	Single Frequency Network
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(5) Frequency Range

One 5 MHz channel, 1670 - 1675 MHz



(6) Range of operating power

Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power.

A series of transmitter models of identical design except for the power levels is submitted by this application. Operating powers of the DVM models will be from 50 Watts to 400 Watts average power. Operating powers of the DVMD models will be from 2x25 Watts to 2x200 Watts average power.

(7) Maximum Power

Maximum power rating as defined in the applicable part(s) of the rules.

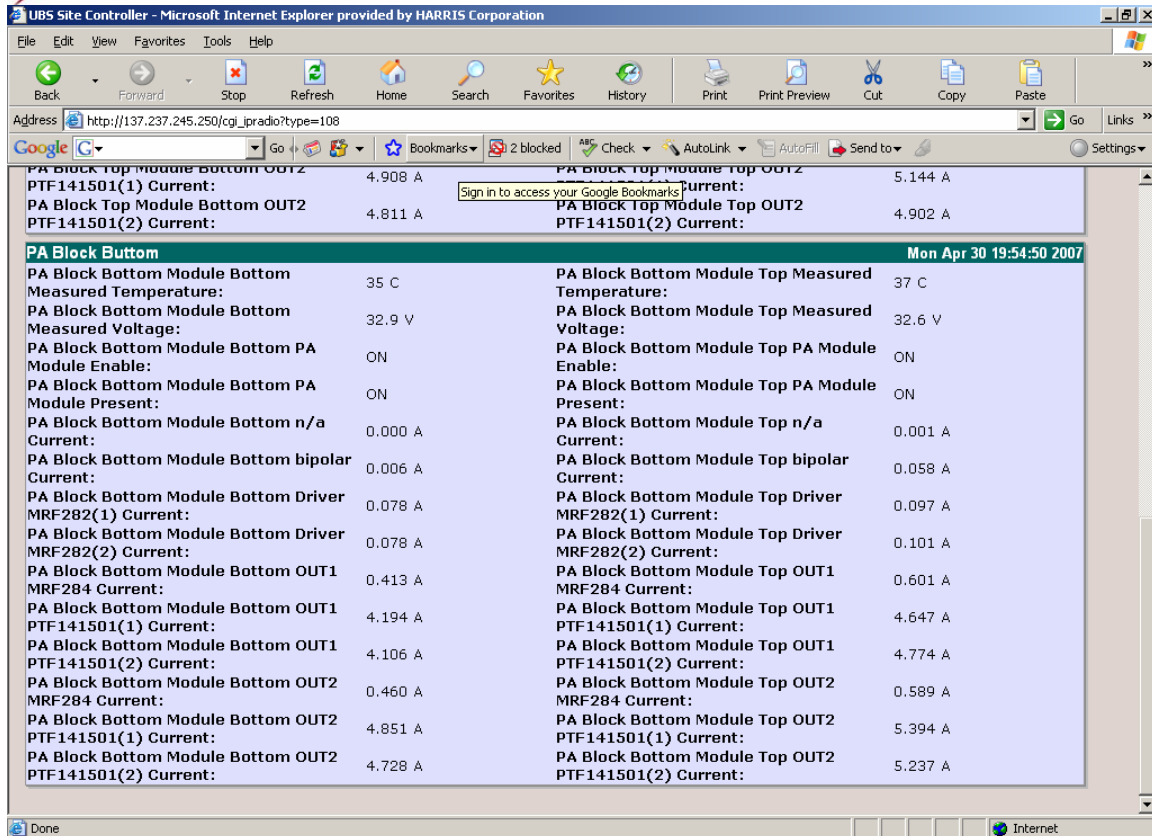
For this series of transmitters, the maximum rated power is 400 Watts.

(8) Final amplifier DC voltages & currents

The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

The DVM400 transmitter uses four solid state power amplifiers per cabinet. The operating RF output power per amplifier is ~140W. The voltages and currents for one Power Amplifier Block on the DVM400 is shown below,

UBS Site Controller - Microsoft Internet Explorer provided by HARRIS Corporation			
Address: http://137.237.245.250/cgi_ipradio?type=108			
ALC Channel A Forward power (in dBm): 56.1		ALC Channel A Reflected power (in dBm): 26.5	
ALC Channel A ALC Target (in dBm): 33.0		ALC Channel A ALC: OFF	
PA Block Top PA Block Forward power (in dBm): 54.6		PA Block Bottom PA Block Forward power (in dBm): 53.8	
Mon Apr 30 19:54:15 2007			
PA Block Top		PA Block Bottom	
PA Block Top Module Bottom Measured Temperature:	36 C	PA Block Bottom Module Top Measured Temperature:	35 C
PA Block Top Module Bottom Measured Voltage:	32.8 V	PA Block Bottom Module Top Measured Voltage:	33.0 V
PA Block Top Module Bottom PA Module Enable:	ON	PA Block Bottom Module Top PA Module Enable:	ON
PA Block Top Module Bottom PA Module Present:	ON	PA Block Bottom Module Top PA Module Present:	ON
PA Block Top Module Bottom n/a Current:	0.000 A	PA Block Bottom Module Top n/a Current:	0.000 A
PA Block Top Module Bottom bipolar Current:	0.009 A	PA Block Bottom Module Top bipolar Current:	0.079 A
PA Block Top Module Bottom Driver MRF282(1) Current:	0.076 A	PA Block Bottom Module Top Driver MRF282(1) Current:	0.013 A
PA Block Top Module Bottom Driver MRF282(2) Current:	0.074 A	PA Block Bottom Module Top Driver MRF282(2) Current:	0.082 A
PA Block Top Module Bottom OUT1 MRF284 Current:	0.425 A	PA Block Bottom Module Top OUT1 MRF284 Current:	0.568 A
PA Block Top Module Bottom OUT1 PTF141501(1) Current:	4.387 A	PA Block Bottom Module Top OUT1 PTF141501(1) Current:	5.342 A
PA Block Top Module Bottom OUT1 PTF141501(2) Current:	4.403 A	PA Block Bottom Module Top OUT1 PTF141501(2) Current:	5.236 A
PA Block Top Module Bottom OUT2 MRF284 Current:	0.433 A	PA Block Bottom Module Top OUT2 MRF284 Current:	0.467 A
PA Block Top Module Bottom OUT2 PTF141501(1) Current:	4.684 A	PA Block Bottom Module Top OUT2 PTF141501(1) Current:	4.810 A
PA Block Top Module Bottom OUT2 PTF141501(2) Current:	4.520 A	PA Block Bottom Module Top OUT2 PTF141501(2) Current:	4.673 A



(9) Tune-up procedure

Tune-up procedure over the power range, or at specific operating power levels.

The amplifiers and signal generating equipment are solid-state and are not tuned. Operational and maintenance adjustments available to the user are described in the technical manuals

(10) Schematics & Circuit descriptions

A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.

Stabilizing Frequency

The frequency of operation is locked to an external GPS receiver and is therefore extremely stable. If the source is lost temporarily, the internal frequency stability is ± 1 ppm. The submitted draft user manual for the exciter provides a description of the frequency control method.

Suppressing Spurious Radiation

Spurious emissions through the output port of the transmitter are limited by the bandwidth shaping of the COFDM exciter, by an output bandpass filter, as well as a harmonic filter. The specification for the output filter is submitted separately with this test report.

Limiting Modulation

Modulation of the COFDM signal is inherently constant. Limiting is not applicable.



Limiting Power


Power output is variable by an operating adjustment from 0 to the rated power, either by an operator at the transmitter, or by a remotely-connected control system. The power is regulated by the transmitter's control system to $\pm 3\%$ of the level set by the operator.

Drawings and circuit descriptions are provided in the technical manual.

(11) Identification Plate

A photograph or drawing of the equipment identification plate or label showing the information to be placed thereon.

Example of Identification Plate to be Attached to Each Transmitter

	
MODEL:	DVM-400
DATE:	6/8/2006
PART NO:	995 0032 001
FCC ID:	BOIDVM
SERIAL NO:	OPD0001-060806
OTHER ID:	
FREQUENCY:	1670 - 1675 MHZ
CHANNEL:	CCI SFN
POWER OUT:	0.4 KW X AVG PK
208 VAC	Single PHASE 60 HZ

(12) Photographs of equipment

Photographs (8 x 10) of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Insofar as these requirements are met by photographs or drawings contained in instruction manuals supplied with the certification request, additional photographs are necessary only to complete the required showing.

The photo below illustrates the CoolPlay 1670 DVM400 transmitter model.



**Smoke Detector
GPS Receiver**

Customer Samples

Satellite Receiver



Smoke Detector
Exhaust/Intake

Satellite Receiver
Exciter/Controller
Compartment

Power Block 1

Filter Compartment

RF Out
Two Way Power Divider

Power Block 2

UPS Batteries

Cabinet Heaters



The DVM400 transmitter was used for these tests. This single-cabinet transmitter is also typical of the DVM400D, DVM200, DVM200D, DVM100, DVM100D, DVM50, and the DVM50D, each of which is housed in the single cabinet identical to the DVM400, except for the removal of amplifier modules not needed at the lower powers and in some cases two outputs running through identical components.

Transmitter Models in the DVM series are:

Model	Cabinets	PA Blocks	PA Modules	Power Out Watts	Power Out dBm	Outputs
DVM-50	1	1	1	50	47	1
DVM-100	1	1	1	100	50	1
DVM-200	1	1	2	200	53	1
DVM-400 (tested)	1	2	4	400	56	1
DVM-50D	1	1	2	2x25	2x44	2
DVM-100D	1	1	2	2x50	2x47	2
DVM-200D	1	1	2	2x100	2x50	2
DVM-400D	1	2	4	2x200	2x53	2

The intention of these tests is to demonstrate, by tests conducted on a DVM400, the compliance of this whole series of transmitters. Our basis for this is that the performance of each of the transmitters is entirely governed by the performance of the individual modules. Therefore, measurements of the DVM400 do provide a sound basis to project the performance which will be shown by other models.

The reason this can be projected with confidence, is that the PA modules used in the DVM series of transmitters are the output device for the transmitter. The modules, which exhibit very uniform performance, produce the same levels of intermodulation distortion and harmonic distortion whether operated individually, or in combinations of two or more. The intermodulation distortions are reduced by using a digital pre-correction technique.

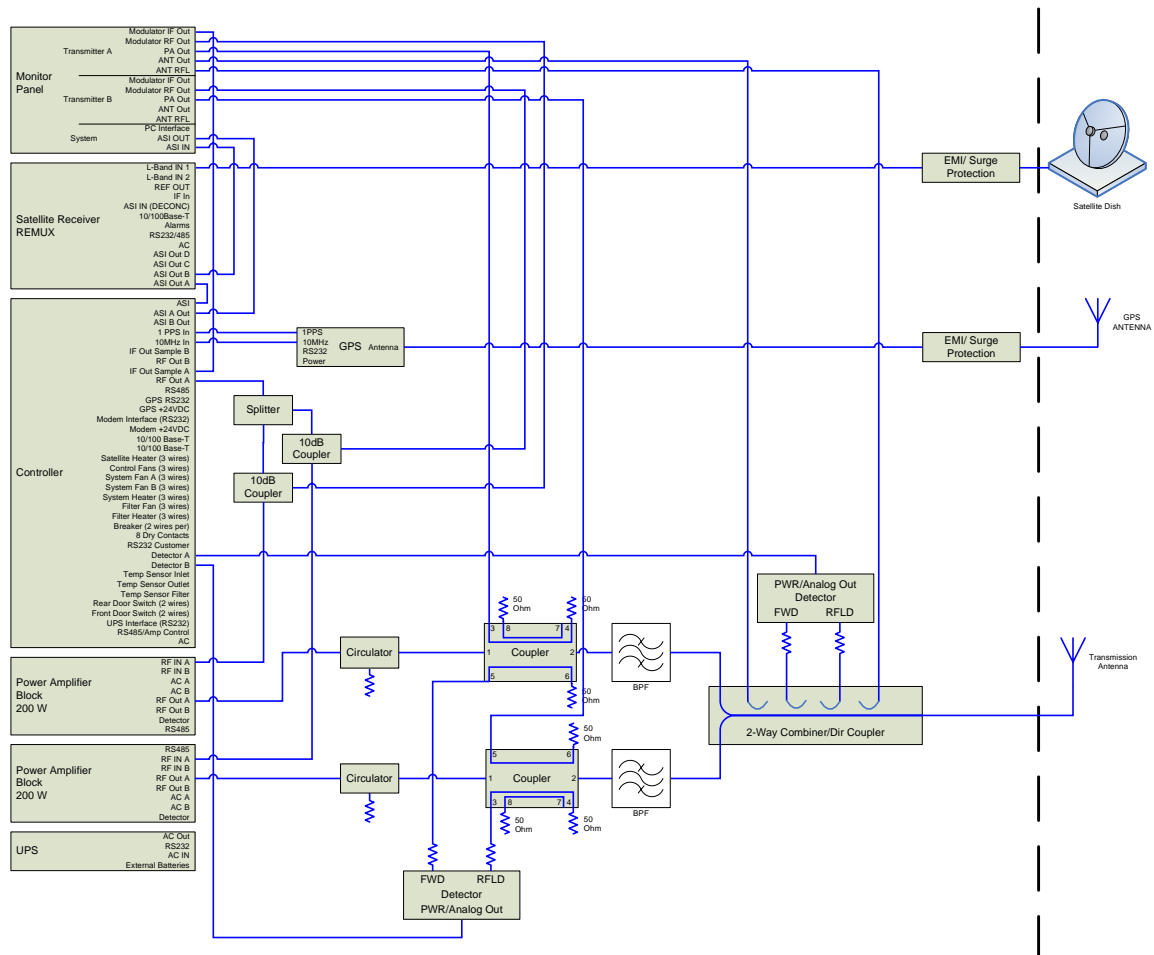
All the PA modules in a transmitter receive identical input drives. All deliver their outputs into 3dB hybrid coupling networks, whether two, four, or eight modules are combined. The 3dB hybrid networks combine the outputs while maintaining the correct load match to the amplifier modules. Circulators are used on amplifier outputs to protect amplifiers from VSWR conditions and provide good 50 Ohm match across wide frequency range.

For this reason, there is little or no basis for RF signal reflection to take place. The RF output circuits of each DVM series transmitter, beginning with the output connections of the individual module pallets, is one large passive binary hybrid combining network, with substantial isolation between power generating devices. This provides solid foundation for minimum intermodulation distortions, especially the part of distortions that is influenced by non-optimum or frequency dependent load impedance.

Therefore, the performance of the whole transmitter will be very close to the performance of any single module. Performance of all models will be the same as that of the fully populated 4 module DVM400.

Transmitter Block Diagram

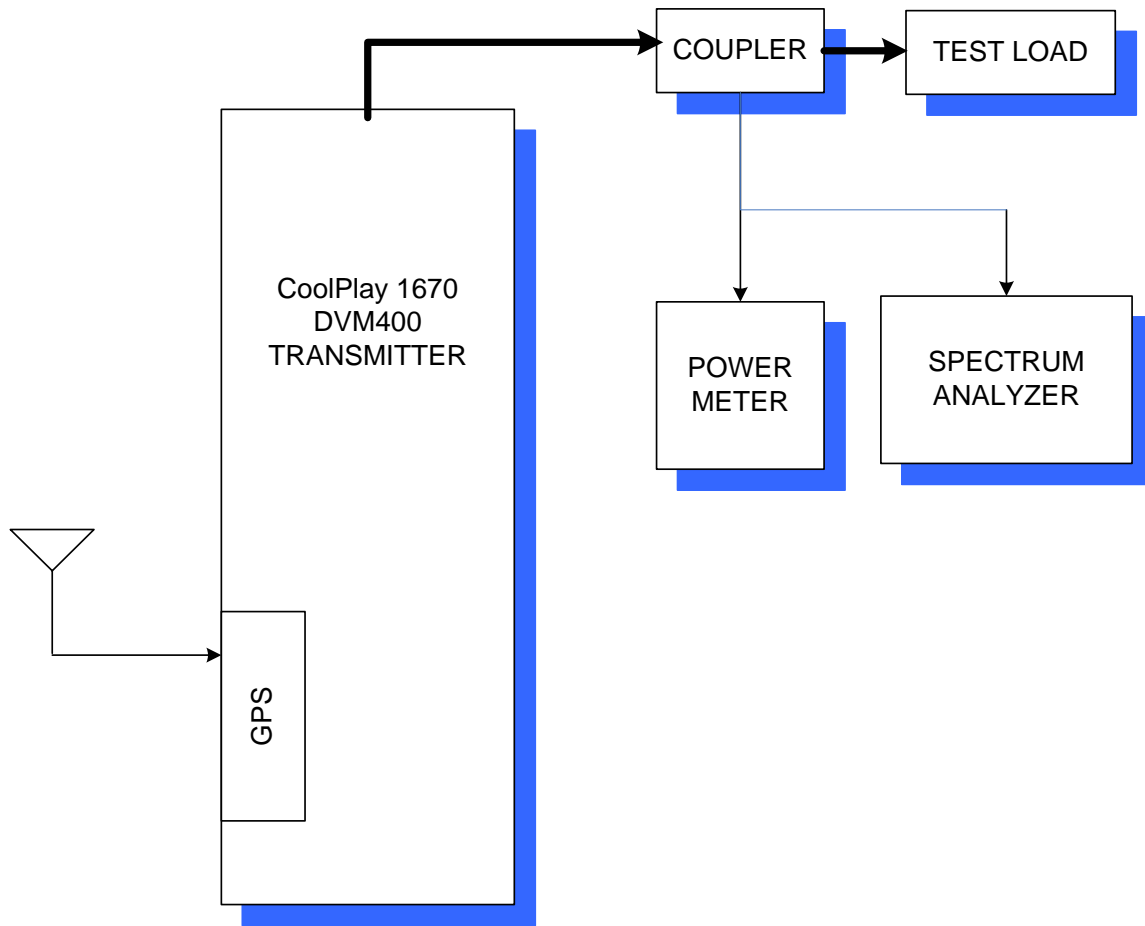
DVM400 – 400W RF Block Diagram



Transmitter RF Block Diagram



LAB TEST SETUP



Test set-up block diagram



Test Area Photos



Back and One side of the CoolPlay 1670 DVM400 transmitter in the test area



Front and interface side of the CoolPlay 1670 DVM400 transmitter in the test area



Close-up of Front and interface side of the CoolPlay 1670 DVM400 transmitter in the test area



(13) Description of digital modulation

For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (**frequency**, phase and amplitude) of any filters provided, and a description of the modulating wavetrain, shall be submitted for the maximum rated conditions under which the equipment will be operated.

The modulation is a 5 MHz DVB-H signal. This is a COFDM signal, designated 5M00W7W. Filter characteristics will be included in the application.

(14) Required Data, 2.1046 through 2.1057

All data required by Sec. 2.1046 through 2.1057, inclusive, will be provided in the Report.



2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in Sec. 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

Harris Response

The transmitter was operated into a test load for the purpose of measuring the RF output at the transmitter output flange.

A calibrated RF power meter was connected to a calibrated RF sample taken at the input to the load. The calibrated RF coupling ratio in dB of the sample at the operating frequency was added to the measured RF level at the power meter and the transmitter output was adjusted to produce the rated output level of 400 Watts.

The Bird 50 Ohm dummy load is rated at 1 kW maximum, with a maximum VSWR of 1.2:1. The calibrated RF coupling ratio (offset) in dB of the sample at the operating frequency was added to the measured RF level at the power meter. The results are shown in the table below,

RF level measured by meter:	6.54 dBm
Calibrated coupling ratio:	49.5 dB
Calculated transmitter RF output:	56.04 dBm
	= 401.7 Watts

Equipment used for this test:				
Equipment	Mfr.	Model:	Serial Number:	Calibration due:
Power Meter	Agilent	E4419B	10434	7 Sept 2007
RF Load	Bird	Termaline 8890-300	054900030	N/A

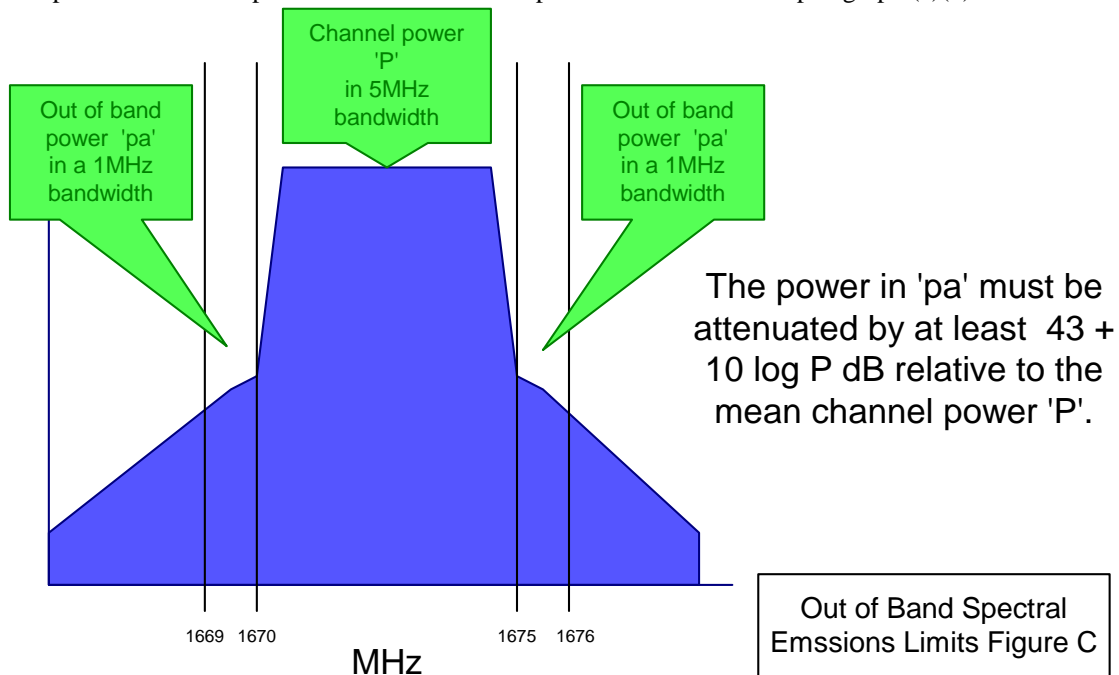
27.53 Emission limits.

(a) (4) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth;

...



(j) For operations in the 1670–1675 MHz band, the power of any emission outside the licensee’s frequency band(s) of operation shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB. Compliance with these provisions is based on the procedures described in paragraph (a)(4) of this section.



Harris Response

27.53(j) provides emission limits for measurements specified by 2.1047.

2.1047 Measurements required: Modulation characteristics.

...
(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Harris Response to 2.1047

This measurement has been made in accord with 2.1047, with limits and methodology defined by 27.53(j).

Harris interprets this requirement to mean the power of emissions at any frequency outside the licensed channel, measured and integrated over 1MHz frequency band, must be lower than

$$\text{Limit} = - (43 + 10 \log(P))$$

where (P) is the total power (W) emitted inside the channel.

Use of a lesser resolution bandwidth, but no lower than 30 kHz, may be used immediately adjacent to the channel edges.

The EUT operates with a Necessary Bandwidth of 5 MHz. Conducted Out of Band and Spurious Emission Measurements are taken using an output sample after the output bandpass filters. With $P = 400$ Watts, the out of band limit required is -69.0dB .

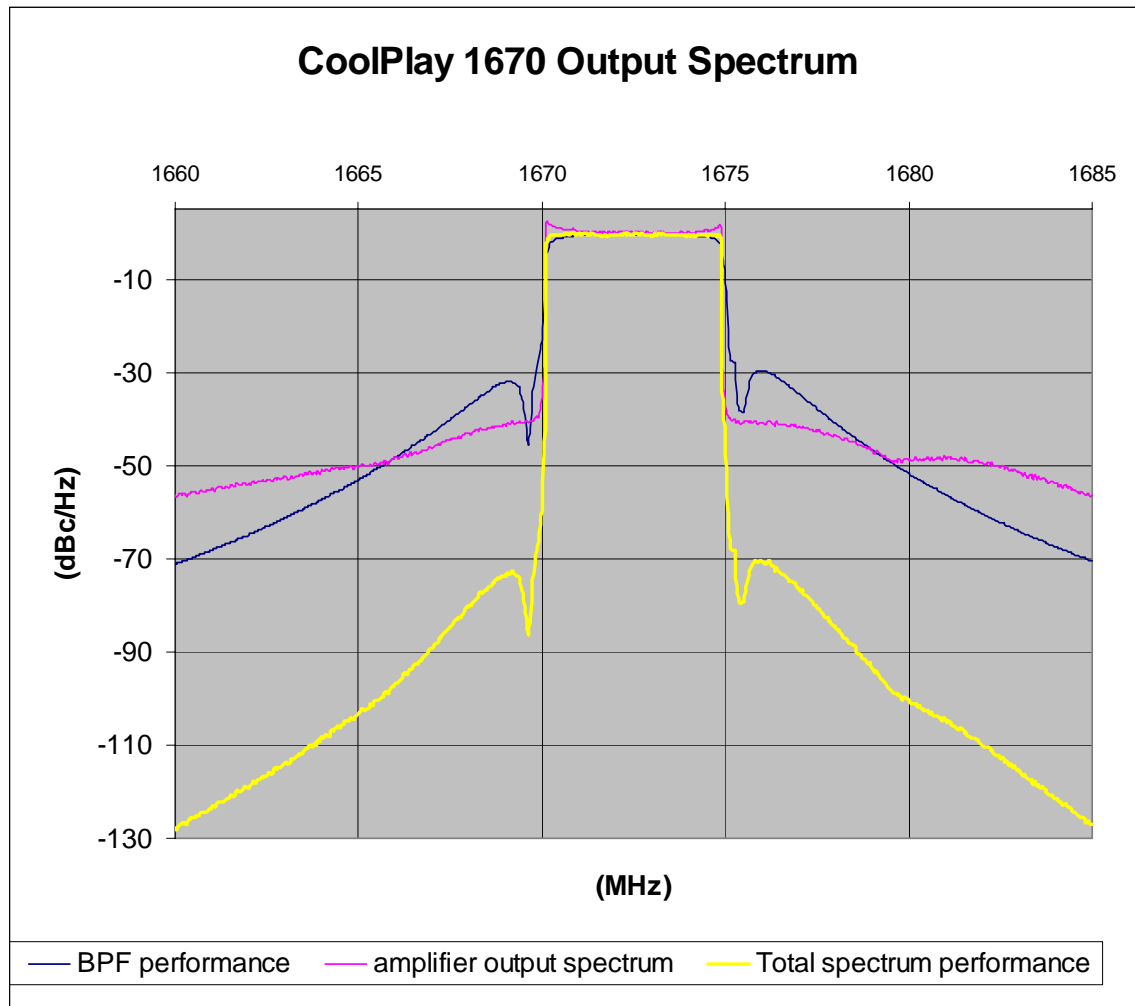
Therefore, total power of RF emissions generated by the transmitter and integrated over any 1MHz frequency band outside designated channel frequency band should be at least 69dB below the total output of the transmitter.

Out-of-Band Emissions Measurements.

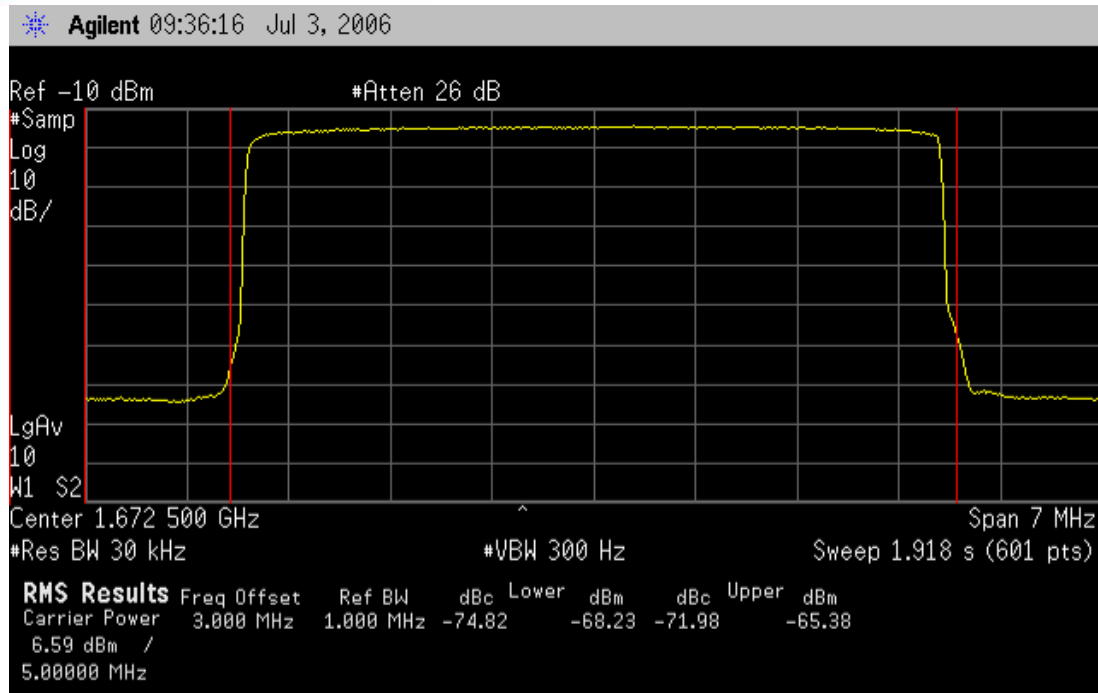


The chart below shows measured response of CoolPlay 1670 Transmitter before the filter (magenta line). It is normalized to zero dBc at the center of designated channel. The slight increase in spectral density at the edges of the band is the result of linear frequency response correction to compensate for reciprocal Band Pass Filter droop. The blue line is a measured response of Output Band Pass Filter. The yellow curve is a sum of two other curves. It shows the resulting conductive emissions of the transmitter. The frequency range of the measurements includes 10MHz below the signal band and 10MHz above it. It is apparent that most of out-of-band emissions fall into 1MHz bands adjacent to the passband. Therefore, the focus of the test was 1MHz frequency band adjacent to broadcast channel.

Transmitter Response after Channel Filter (25 MHz span)



Out-of-Band Emissions Measurement. Transmitter Response after output Channel Filter (7MHz span)

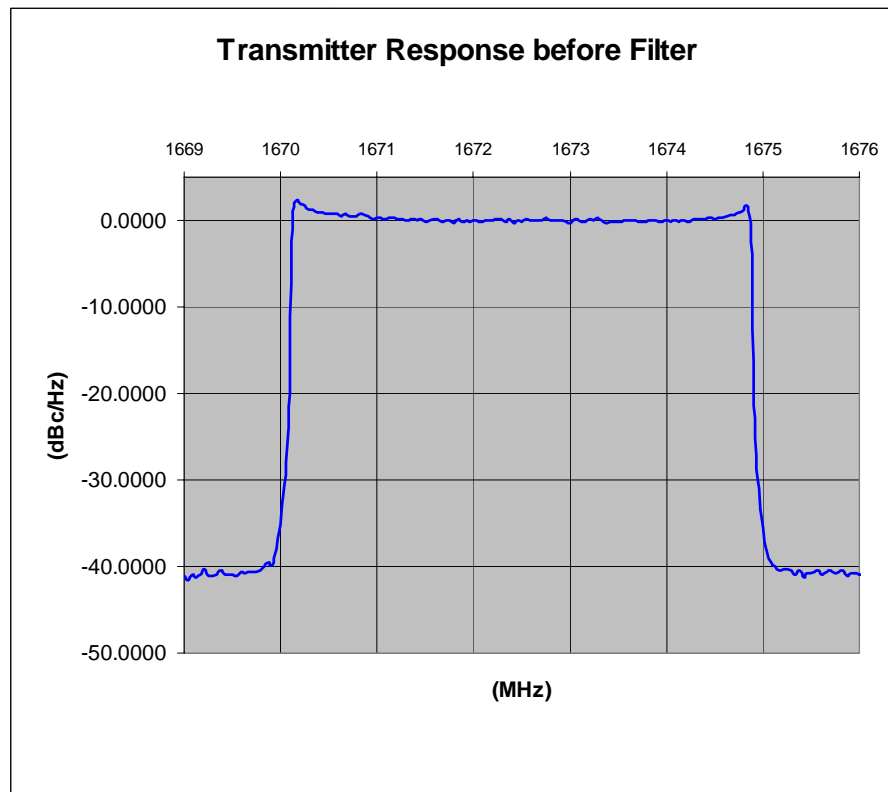


Equipment used for this test:				
Equipment	Mfr.	Model:	Serial Number:	Calibration due:
Spectrum Analyzer	Agilent	E4443B	11777	8-28-07

Measured at Transmitter Filter Output Coupler						
Transmitter Power (mW)	Transmitter Power in 5Mhz BW (dBm)	FCC Limit 43+10*LOG(P) in dB	Absolute Power Limit of out-of-band emissions (dBm)	Measured Power in 1MHz at low side band (dBm)	Measured Power in 1MHz at high side band (dBm)	Pass Margin (dB)
4.56	6.59dBm	-69.00	-62.41	-68.23		5.82
					-65.38	2.97

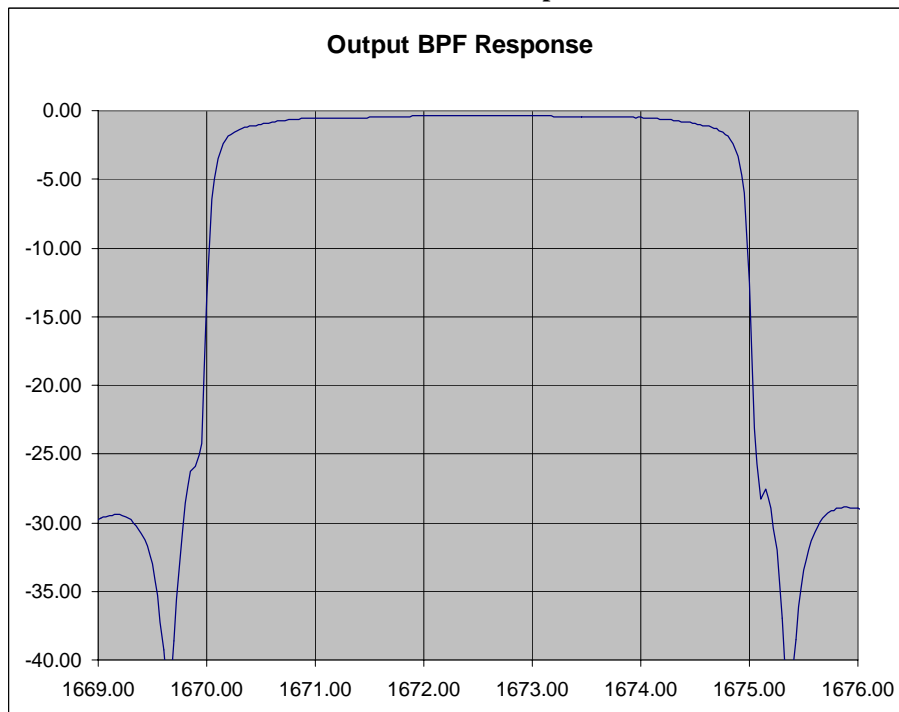
Note that the measured power in 1MHz band adjacent to the channel edge is limited by the analyzer noise floor. This can be seen from the plot above. The true spectral density is slightly different than the one measured by the analyzer. The following calculations attempt to provide alternative and purely calculating method to the level of out-of-band emissions.

Transmitter response before output channel filter.



The level of intermodulation sidebands at ± 2.62 MHz offset from 1672.5 MHz fall below -40 dB.

Band Pass Filter Response.



The idea is to tabulate spectral performance of Transmitter response before the filter and Channel Filter response and use the power of electronic spreadsheet to calculate overall performance of the system by integrating in-band and out-of-band power level. The response of the filter and Transmitter before the filter



is tabulated with frequency increment of 10kHz to provide as many points over 1MHz for integration as practical.

The overall performance of the system is calculated by superimposing Transmitter and Channel Filter Response like this:

$$1. \quad IE = \sum_{i=1}^{100} PSD_i \cdot FSP_i,$$

IE is Integrated Out-of-Band Emissions in mW,

PSD_i is Power Spectral Density of output RF signal before Channel Filter, taken at each of 100

equally spaced points over 1MHz frequency range. $PSD_i = 10^{\frac{PSD(dBm)_i}{10}}$ (mW)

FSP_i is Filter Spectral Performance (or simply Power Insertion Loss) at corresponding 100 points

over 1MHz frequency range. $FSP_i = 10^{\frac{FSP(dB)_i}{10}}$

$$2. \quad IPL = \sum_{k=1}^{500} PSD_k \cdot FSP_k,$$

IPL is overall In-Band Integrated Power Reference in mW.

PSD_k is Power Spectral Density of Output signal in each of 500 points equally spaced over 5MHz

channel bandwidth. $PSD_k = 10^{\frac{PSD_k(dBm)_i}{10}}$ (mW)

FSP_k is Filter Spectral Performance (or simply Power Insertion Loss) at corresponding 500 points

over 5MHz frequency range. $FSP_k = 10^{\frac{FSP_k(dB)_i}{10}}$

$$3. \quad OBE = 10 \cdot \log(IE / IPL),$$

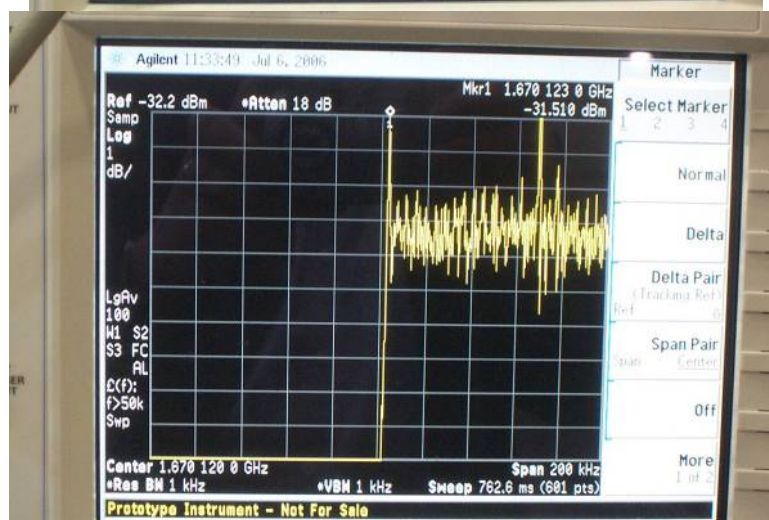
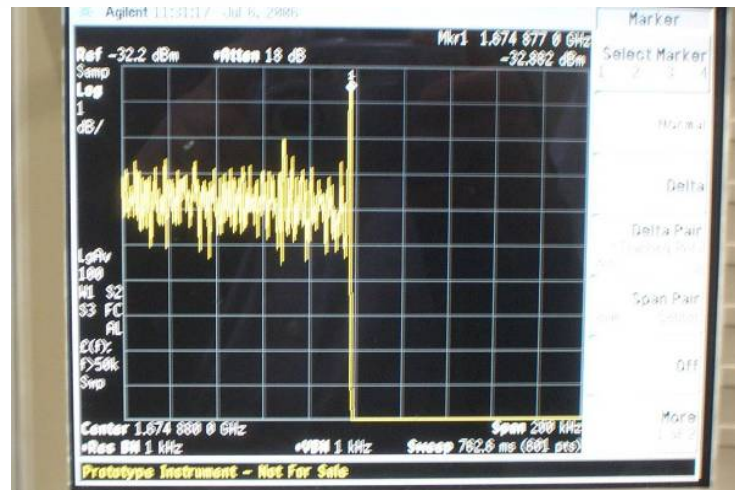
OBE is Out-of-band Emissions in dB.

A separate spreadsheet called "ACPR.xls" is submitted with this report. It contains the data and calculations. Here is the link: [ACPR.xls](#)

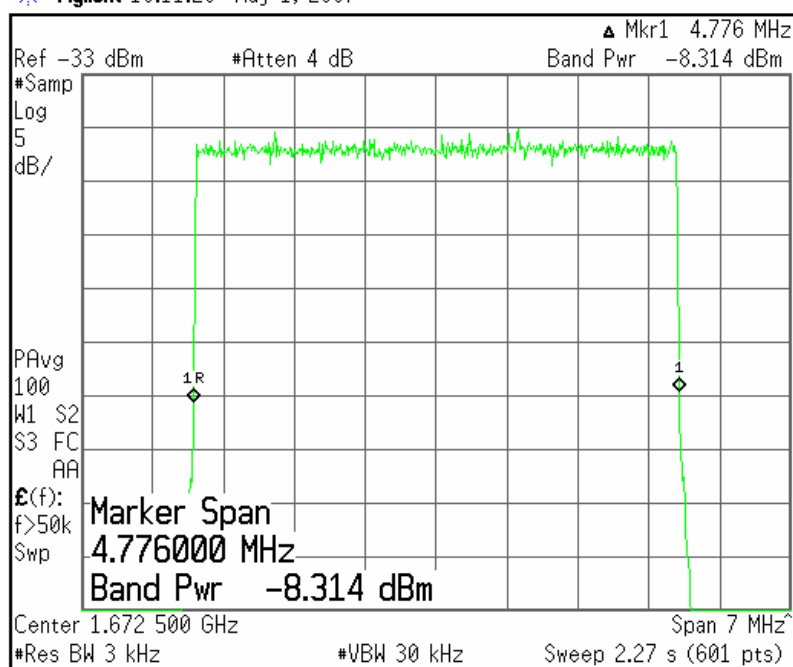
The calculated Out-of-Band performance is slightly different from measured performance and provides a similar margin relative to the target performance spec.

	Left sideband (dBm)	In-band (dBm)	Right Sideband (dBm)
Intergated value (dB)	-47.39	26.25	-45.28
Ratio = (In-Band/Out-of-Band) (dB)	-73.64		-71.52
FCC permissable level	-69		-69
Margin (dB)	4.64		2.52

2.1049 Measurements required: Occupied bandwidth.



✱ Agilent 10:11:29 May 1, 2007





The occupied bandwidth can be determined from spectrum analyzer screenshots above. The upper two screenshots are made by zooming in on each edge of the band to provide accurate measurements of occupied frequency spectrum.

Frequency Resolution = 20kHz/div

Amplitude Resolution = 1dB/div

Resolution Bandwidth = 1kHz

Video Bandwidth = 1kHz

Marker at each of the band ends points to the last pilot carrier in the band. The difference between marker frequency readings corresponds to the occupied frequency band.

Spacing between two edge carriers = 1,674,877MHz – 1,670,123MHz = 4,754MHz.

The bottom screen shot is made with markers placed at the edge of the spectrum 23dB below channel spectral density level. Total occupied frequency band is measured with 30kHz resolution bandwidth of the analyzer is 4.776MHz.

2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

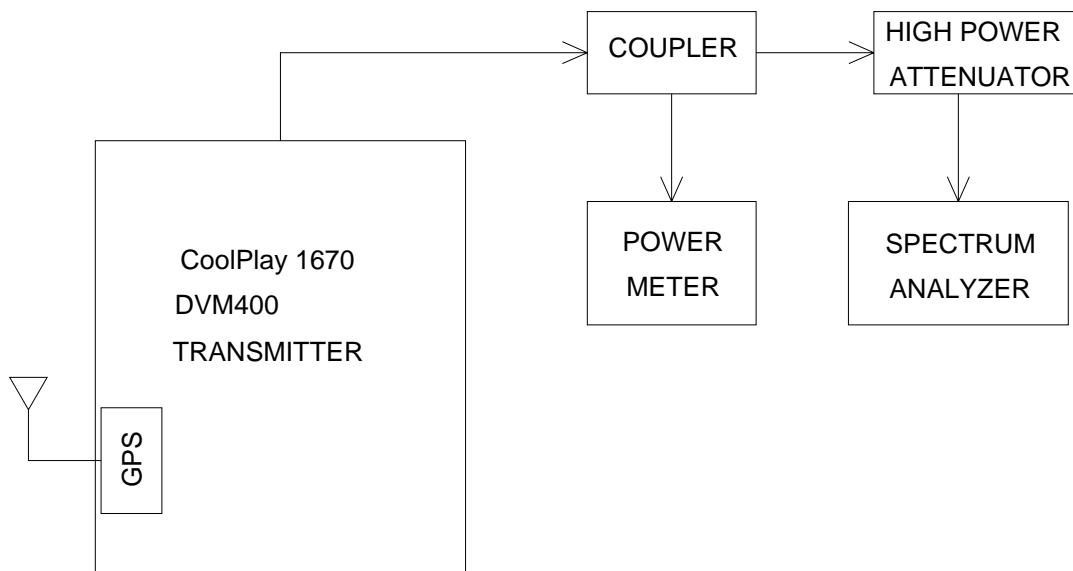
...

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

Harris Response.

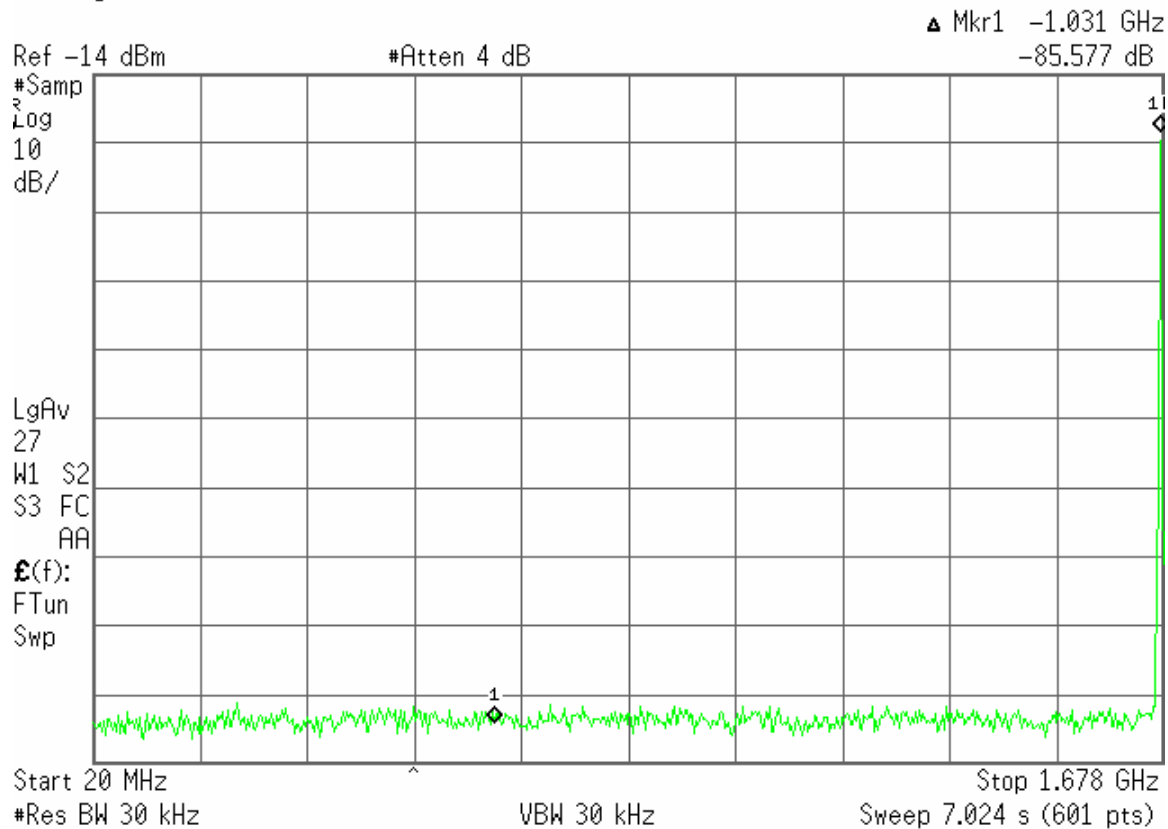
The block diagram below shows Test Setup to measure Conducted Out-of-Band emission at Antenna Terminals. Spectrum Analyzer was used to measure spurious emissions. To extend measurements bandwidth the broadband power attenuator was used instead of directional coupler. The directional coupler was used only to verify output power level during measurements.





Measured Low-Side Wideband Spectrum from 20MHz to 1678 MHz

Agilent 19:56:04 Apr 30, 2007

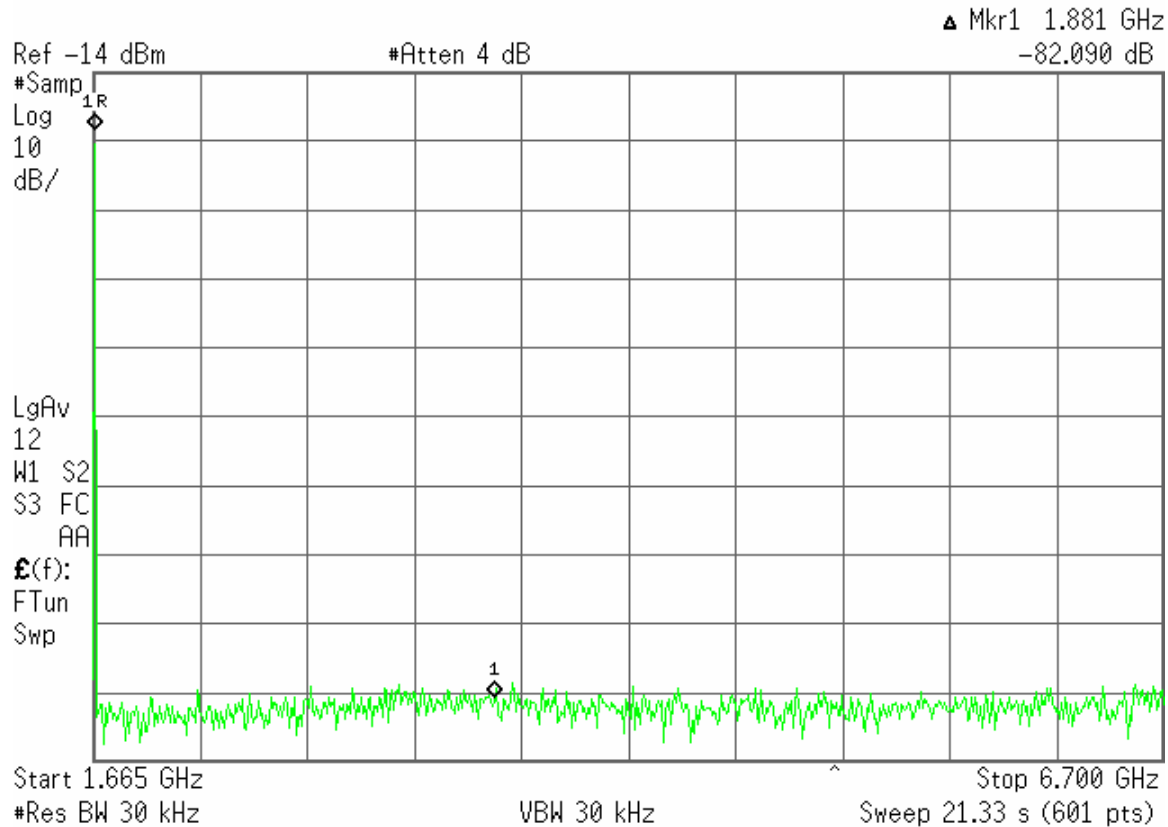


The spectrum analyzer plot above was taken with 30kHz resolution bandwidth instead of 100kHz. Therefore the noise floor was reduced and ability to measure lower level spurious was gained. Still the spurious are not distinguishable from the noise floor. The delta marker shows difference between signal and noise spectral density of 85.577dB. For the flat spectrum requirement to satisfy $43\text{dB} + 10 \log(P)$ over any 1MHz section at $P_{\text{out}} = 400\text{W}$ is 62dBc. The pass margin is therefore more than 23dB.

Measured High-Side Wideband Spectrum from 1665MHz to 6700 MHz



Agilent 20:02:11 Apr 30, 2007



The plot above shows noise like spectrum with no spurious approaching in-band spectral density with signal to noise ratio lower than 80dBc. This presents pass margin of at least 18dBc.

Spectrum Analyzer used for this measurement:

Manufacturer: Agilent

Model: 4443A

Serial Number: 10434

Calibration Date: 8-28-07



2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec. 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

27.53 Emission limits.

(a) (4) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth

...

(j) For operations in the 1670–1675 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB. Compliance with these provisions is based on the procedures described in paragraph (a)(4) of this section.

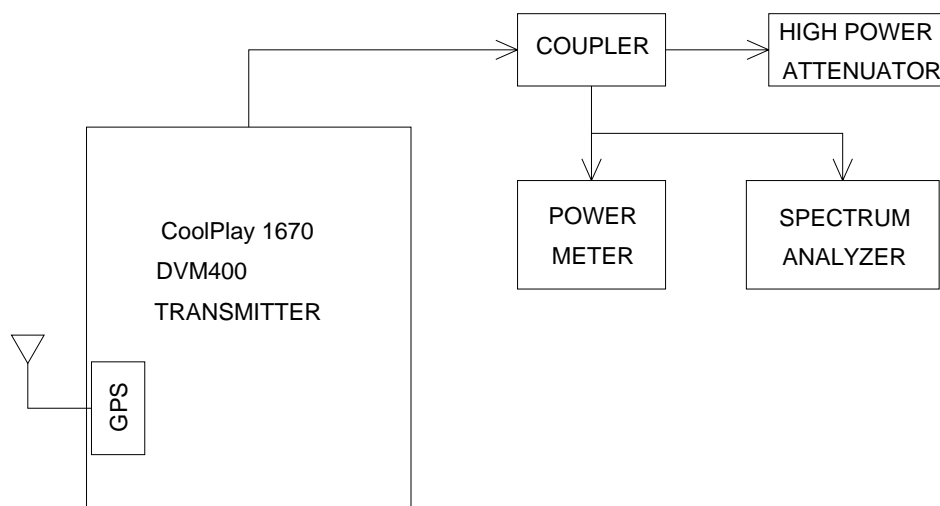
Harris Response:

These tests were conducted in accord with 2.1051, using limits defined by 27.53(j).

The harmonic content was measured with RBW (resolution bandwidth) of spectrum analyzer set at 10kHz to reduce noise floor and improve harmonics visibility.

Transmitter Harmonics.

A block diagram of the set up is shown below,



Spectrum Analyzer used for this measurement:

Manufacturer: Tektronix

Model: 492PGM

Serial Number: B010288

Calibration Date: 1-29-08

Average Output Power:

400W

Modulation Type:

COFDM with 2000 carriers

The transmitter harmonic performance was measured and summarized in the table below:



	Frequency MHz	Coupler + Cable Loss dB	Spectral Density Measured with 10kHz BW dBm	Offset relative to Fundamental (dB)	Measurements relative to Fund dBc	Spurious Level dBc	FCC Requirement (-69.00 + 5)dB	Pass Margin (dB)
Fundamental	1672.5	-50.2	-22	0	-22	Reference	Reference	Reference
2nd Harmonic	3345.0	-60	-100.2	-9.8	-90.4	-68.4	-62	6.40
3rd Harmonic	5017.5	-49.8	-100.3	0.4	-100.7	-78.7	-62	16.70
4th Harmonic	6690.0	-54.7	-100.1	-4.5	-95.6	-73.6	-62	11.60
5th Harmonic	8362.5	-48.3	-88.7	1.9	-90.6	-68.6	-62	6.60
6th Harmonic	10035.0	-45.8	-87	4.4	-91.4	-69.4	-62	7.40
7th Harmonic	11707.5	-48.2	-87	2	-89	-67	-62	5.00
8th Harmonic	13380.0	-45.5	-85.7	4.7	-90.4	-68.4	-62	6.40
9th Harmonic	15052.5	-43.5	-84.5	6.7	-91.2	-69.2	-62	7.20
10th Harmonic	16725	-45.4	-82.2	4.8	-87	-65	-62	3.00

The harmonic spurious were not visible over most of the spectrum range due to analyzer noise floor. The spectrum analyzer was operated with resolution bandwidth of 10 kHz. The selected frequency span was 1MHz centered over each given harmonic frequency.



2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single side band, independent side band, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of Sec. 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half wave dipole antennas.

- (b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
 - (2) All equipment operating on frequencies higher than 25 MHz.
 - (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
 - (4) Other types of equipment as required, when deemed necessary by the Commission.

Harris Response

The required spurious radiation level limit is given in 27.53:

(j) For operations in the 1670 - 1675 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with these provisions is based on the procedures described in paragraph (a)(4) of this section.

The calculated reference level of the theoretical radiated carrier is found as follows:

CP_W	=	400	Watts
R	=	3	meters
$FI_{dBV/m}$	=	33.4	dBV/m
$FL_{dBuV/m}$	=	153.4	dBuV/m
FP_{dBm}	=	20.40	dBm

Terms:	CP_W	Transmitter carrier power output, expressed in Watts.
	R	Distance from transmitter to receiving antenna, in meters
	FI_{dBV}	Field Intensity of theoretical spurious carrier output $FL_{dBV} = 20 \times \log(\sqrt{49.2 \times CP_W / R})$
	RBW	Resolution Bandwidth. Due to the extremely low harmonic content during measurements the resolution bandwidth of spectrum analyzer was reduced to 10kHz. This would allow reducing the noise floor during measurements and distinguishing harmonic content among the surrounding noise.
	Limit _{dB}	is updated to compensate for reduction of RBW relative to FCC specified 1MHz. The corrected value is $-69dB + 10\log(10kHz/1MHz) = -69dB - 20dB = -89dB$.
	$FL_{dBuV/m}$	Field Intensity level expressed in dBuV/m; equals $FI_{dBV} + 120$ dB $FL_{dBuV/m} = FL_{dBV/m} + 120$
	$AFF_{dB/m}$	Antenna Factor at frequency of Fundamental Carrier.



CableF_{dB} the measured attenuation of the test cable at the frequency of fundamental carrier connecting the antenna to the Spectrum Analyzer.

FP_{dBm} Fundamental Power Reference in dBm = FL_{dBuV/m} - AFF_{dB/m} - 107 dB.

Therefore, the spurious radiation limit is 64.4dBuV/m, at a measuring distance of 3 meters. The data in the following Table are taken as evidence of compliance. The data are organized as measurements taken using Vertical Polarization and measurements taken using Horizontal Polarization, and according to the antenna position in relation to the transmitter. In each grouping of data:

Frequency	the frequency in MHz of the observed emission
Meas _{dBuV}	the measured emission signal level at the instrument input terminal
AF _{dB}	the calibrated antenna factor of the test antenna in dB at a given harmonic frequency.
Cable _{dB}	the measured attenuation of the test cable connecting the antenna to the instrument at a given harmonic frequency.
Spur _{dBm}	Spurious Radiation in dBm:

$$\text{Spur}_{\text{dBm}} = \text{Meas}_{\text{dBuV}} + (\text{AF}_{\text{dB}} + \text{Cable}_{\text{dB}}) - (\text{AFF}_{\text{dB/m}} + \text{CableF}_{\text{dB}}) - 107$$

Test Site:

The use of an OATS site to test this product is precluded by the size and the service requirements of the product. Therefore, a suitable indoor space is used, of sufficient size to allow adequate separation between the transmitter and surrounding objects. The photos on pages 13 – 15 of this report illustrate the open nature space used. The space was chosen because it has a very high ceiling (35 feet high), a large open area, and the ability to place the Equipment Under Test so that no large reflecting objects are close to the test area.

The test was conducted according to the requirements of ANSI/TIA/EIA-603-C-2004 standard as follows: The EUT was placed at the center of a clear space with area large enough to enable positioning the antenna at a 3 meter measuring distance. The transmitter was operated at 400 watts cabinet output power, and the antenna was positioned at each of four measuring locations, with the antenna at a height equal to the vertical centerline of the PA modules, which is the approximate center of radiation of the transmitter cabinet.

During four measurements the receiving antenna was positioned in Front, Left side, Right side and directly behind the Transmitter Under Test. Data were taken using Vertical and Horizontal polarization.

The Transmitter Reference Carrier Power at the 3 meter distance, if radiated from a dipole, was calculated.

The relative levels of the received spurious signals (dBc) were calculated from the measured Spurious Radiations at 3 meters, and the Transmitter Reference Carrier Power, to arrive at the relative spurious radiation levels (dBc). The results were tabulated as shown on the following pages.

Test Equipment Used:

Spectrum Analyzer
Manufacturer: Tektronix
Model: 492
S/N: B010288
Calibration due: 1-29-08

Doubled Ridge Guide Antenna



Manufacturer: ETS-LINDGREN
 Model: 3115
 S/N: 00028914
 Calibrated: 1/27/2004

Transmitter output power 400 Watts
 Measuring distance 3 Meters
 Reference carrier power 153.40 dBuV/m
 Reference carrier power 20.4 dBm
 Required Spurious Offset -89.0 dB
 Max Allowed Spurious level in dBuV.m 64.40 dBuV/m
 Max Allowed Spurious level in dBm -68.60 dBm

Tabulated Measurements and Results - Horizontal Polarization															
Position 1 Transmitter Front Side								Position 1 Transmitter Left Side							
Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)	Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)
3345.00	10.5	31.9	-90.6	-111.0	20.40	-89.0	22.0	3345.00	10.0	31.9	-91.1	-111.5	20.40	-89.0	22.5
5017.50	9.0	34.4	-89.6	-110.0			21.0	5017.50	9.3	34.4	-89.3	-109.7			20.7
6690.00	8.1	36.9	-88.0	-108.4			19.4	6690.00	8.4	36.9	-87.7	-108.1			19.1
8362.50	19.0	38.7	-75.3	-95.7			6.7	8362.50	19.0	38.7	-75.3	-95.7			6.7
10035.00	20.2	39.3	-73.5	-93.9			4.9	10035.00	18.8	39.3	-74.9	-95.3			6.3
11707.50	20.6	40.3	-72.1	-92.5			3.5	11707.50	19.7	40.3	-73.0	-93.4			4.4
Position 3 Transmitter Rear Side								Position 4 Transmitter Right Side							
Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)	Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)
3345.00	10.5	31.9	-90.6	-111.0	20.40	-89.0	22.0	3345.00	10.5	31.9	-90.6	-111.0	20.40	-89.0	22.0
5017.50	9.3	34.4	-89.3	-109.7			20.7	5017.50	8.9	34.4	-89.7	-110.1			21.1
6690.00	8.0	36.9	-88.1	-108.5			19.5	6690.00	7.3	36.9	-88.8	-109.2			20.2
8362.50	18.7	38.7	-75.6	-96.0			7.0	8362.50	19.4	38.7	-74.9	-95.3			6.3
10035.00	19.6	39.3	-74.1	-94.5			5.5	10035.00	18.8	39.3	-74.9	-95.3			6.3
11707.50	21.2	40.3	-71.5	-91.9			2.9	11707.50	20.7	40.3	-72.0	-92.4			3.4
Tabulated Measurements and Results - Vertical Polarization															
Position 1 Transmitter Front Side							Position 2 Transmitter Left Side								
Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)	Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)
3345.00	10.6	31.9	-90.5	-110.9	20.40	-89.0	21.9	3345.00	9.9	31.9	-91.2	-111.6	20.40	-89.0	22.6
5017.50	9.7	34.4	-88.9	-109.3			20.3	5017.50	9.4	34.4	-89.2	-109.6			20.6
6690.00	8.0	36.9	-88.1	-108.5			19.5	6690.00	8.3	36.9	-87.8	-108.2			19.2
8362.50	19.0	38.7	-75.3	-95.7			6.7	8362.50	18.9	38.7	-75.4	-95.8			6.8
10035.00	19.0	39.3	-74.7	-95.1			6.1	10035.00	18.0	39.3	-75.7	-96.1			7.1
11707.50	21.5	40.3	-71.2	-91.6			2.6	11707.50	21.8	40.3	-70.9	-91.3			2.3
Position 3 Transmitter Rear Side							Position 4 Transmitter Right Side								
Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)	Frequency (MHz)	Measured (dBuV)	Antenna Factor + Cable Loss (dB)	Spurious Radiation (dBm)	Spurious Radiation (dBc)	Fundamental Power (dBm)	FCC Limit (dBc)	Pass Margin (dB)
3345.00	10.4	31.9	-90.7	-111.1	20.40	-89.0	22.1	3345.00	10.3	31.9	-90.8	-111.2	20.40	-89.0	22.2
5017.50	9.4	34.4	-89.2	-109.6			20.6	5017.50	9.2	34.4	-89.4	-109.8			20.8
6690.00	8.1	36.9	-88.0	-108.4			19.4	6690.00	8.8	36.9	-87.3	-107.7			18.7
8362.50	18.7	38.7	-75.6	-96.0			7.0	8362.50	18.6	38.7	-75.7	-96.1			7.1
10035.00	19.8	39.3	-73.9	-94.3			5.3	10035.00	18.7	39.3	-75.0	-95.4			6.4
11707.50	21.6	40.3	-71.1	-91.5			2.5	11707.50	21.8	40.3	-70.9	-91.3			2.3

Note: Yellow highlighted cells show the pass margin for the second and third harmonics which were still distinguishable above the noise floor of the Spectrum Analyzer. The pass margin provided by these measurements is more than 20dBc relative to FCC limit. Therefore those spurious are not required to be reported. For the rest of harmonic sidebands the Spectrum Analyzer noise floor was the limiting factor in providing exact levels for radiated harmonic spurs.

No spurs were observed at frequencies above the third harmonic frequency, 5017.5 MHz.



2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30[deg] to +50[deg] centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

NOTE: Paragraphs (a) (2) and (3) do not apply to this Part 27 equipment.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10[deg] centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

....

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Harris Response

Setup:

The exciter is operating in test mode generating a CW signal with carrier centered in the middle of the broadcasting channel. The frequency is locked by 10MHz reference signal that is delivered by GPS receiver. The Exciter and GPS receiver are placed in environmental chamber and operated over designated temperature range. At each temperature the AC line voltage is varied via a variable autotransformer from nominal 208V to 85% (176.8V) to 115% (240V).

Note: Equipment is intended to operate over temperature range from 0°C to +45°C. Special provisions are made to disallow frequency generation and signal radiation below 0°C. That is why the measurements are limited within 0°C to 50°C temperature range.

Equipment:	Manufacturer & Model	Serial Number	Calibration Due
GPS Receiver	Trimble Thunderbolt P/N 48050-61	83257657	N/A
Spectrum Analyzer	Agilent E4443A	11777	8-28-07
Multimeter:	Fluke 87	00906	8-27-07
Environmental Chamber:	Tenny Versa Tenn Model T30RC	12437-51	N/A
Variac:	Powerstat 3PN216B	None	N/A
Exciter:	UBS DVB-H	06063305	N/A



The table below shows deviation of CW signal frequency generated by the Exciter from target frequency of 1,672,500MHz. The frequency deviation is in Hz.

Temp in C	AC Line Voltage		
	176.8	208	240
0	<2Hz.	<2Hz.	<2Hz.
10	<2Hz.	<2Hz.	<2Hz.
20	<2Hz.	<2Hz.	<2Hz.
30	<2Hz.	<2Hz.	<2Hz.
40	<2Hz.	<2Hz.	<2Hz.
50	<2Hz.	<2Hz.	<2Hz.

Conclusion:

There was not any sensible change in CW frequency deviation. This Exciter and the transmitter using it are capable of maintaining it within the designated broadcast channel, as required by Part 27. It also complies with the specification provided by Modeo.