# TEST REPORT

EVALUATION OF THE

# LBD-SERIES, DIGITAL TRANSMITTER SYSTEMS

LBD-025C, LBD-025C-N1,
LBD-025DV, LBD-025DV-N1
LBD-050C, LBD-050C-N1,
LBD-050DV, LBD-050DV-N1
LBD-100C, LBD-100C-N1,
LBD-100DV, LBD-100DV-N1
LBD-125C, LBD-125C-N1,
LBD-125DV, LBD-125DV-N1
LBD-200C, LBD-200C-N1,
LBD-200DV, LBD-200DV-N1

PERFORMED BY:

THALES BROADCAST & MULTIMEDIA, INC.
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# 1.0 INTRODUCTION

FCC Section 2.901 (a) (b), 2.902 (a) (b), 2.907 (a) (b), 2.908, 2.911, 2.913 (c), 2.924

This report contains all the required data for certification of Thales Affinity® LBD-series digital transmitter system for use in "Flexible Use Fixed and Mobile Service" applications. In accordance with section 2.924 "Marketing of electrically identical equipment having multiple trade names and models or type numbers under the same FCC Identifier" Thales wishes to certify its LBD-series transmitter family comprised of several models of identical construction. The models vary in number of identical parallel amplifiers dependent on the RF output power of the particular model, also in redundancy schemes for power supplies. The equipment's operating power range is scalable between 25-200W average RMS power. The spectral shaping filter is designed for compliance of a 200W transmitter and is the same for all models. System design and antenna gain is set to ensure an EIRP of no more than 2kW as per part 27.51 of the rules. The data presented was taken from tests performed on a production transmitter system model LBD-200C-N1 having a 200W maximum rated output power, tuned to operate on a fixed 1670-1675MHz (5MHz BW) channel. All products perform identical to the DUT herein, within section 2.908 limits. Other information required for certification, such as circuit diagrams and descriptions, photographs, tune-up and maintenance procedures, and the technical manual are separately enclosed.

# 2.0 TEST EQUIPMENT

FCC Section 2.947 (d)

The following is a list of major test equipment, which was used in testing the transmitter for this report:

| | | |
|---|---|---|
| 1. | Spectrum Analyzer(s) | HP Model 8564E & 8593E |
| 2. | Power Meter | HP Model 436A |
| 3. | Frequency Counter | HP Model 5350B |
| 4. | Digital Multimeter | Fluke Model 87 |
| 5. | Vector Signal Analyzer | Agilent E8404A |
| 6. | COFDM analysis software | Agilent E9285A |

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# 3.0 MEASUREMENTS

FCC Section 2.947(b) (c), 2.1033 (c)(14)

## 3.1 RF POWER OUTPUT

FCC Section 2.1046 (a) (c)

| | |
|---|---|
| Output Power: | 200 watts average |
| Method of Measurement: | Per FCC 2.1046 (a) (c) |

The transmitter was operated into a dummy load of substantially zero reactance with a resistance equal to the transmission line characteristic impedance. Average power was indirectly measured using an HP 436A microwave power meter by means of a directional coupler which coupling factor was previously determined. The transmitter's % power meter was found to be within 2% of the indications provided by the external average power meter with output variations of 80% to 110% of the transmitter's rated output.

Figure 1 shows the test setup

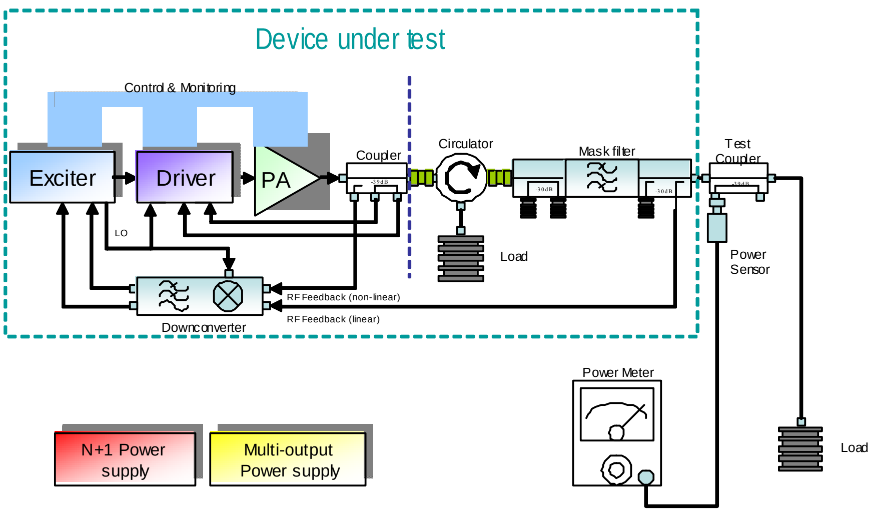


**Figure 1: Test setup for RF power output measurement.**

| | |
|---|---|
| Output Power Calibration | See document 36-0024, tune-up information; section 1.2.2 forward power calibration |

## 3.2 MODULATION CHARACTERISTICS

FCC Section 2.1047 (d), subpart-C Emissions 2.201 (a) (b) (c)(6) (d)(8) (e)(8)

The digital modulation format is Coded Orthogonal Frequency Division Multiplexing (COFDM) Modulation with a QPSK, 16-QAM, or 64-QAM constellation with the symbol rate and occupied bandwidth optimized for a 5 MHz DVB-H/DVB-T channel. DVB Modulation techniques applied in use with this product adhere to the ETSI EN302 304 v1.1.1 and EN300 744 v1.5.2 industry standards for Digital Video Broadcast.

Forward Error Correction (FEC) uses a concatenated coding approach that produces high coding gain at moderate complexity and overhead. The system FEC is optimized for quasi-error free operation; with a threshold dependant on the modulation format chosen. The FEC goal is to positively affect Doppler performance in the mobile channel and to improve the tolerance to impulse interference.

To achieve the appropriate level of error protection required for transmission of digital data, an FEC based on Reed-Solomon coding is used. Protection against burst errors is achieved by use of byte interleaving. Time slicing is also utilized to extend battery life on the handheld receiving device. Refer to ETSI TR 102 377 V1.1.1 for more detailed information regarding guidelines of the DVB-H implementation.

The digital input stream is organized in fixed length packets following the MPEG-2 transport multiplexer. To ensure adequate binary transitions for clock recovery, the data at the MPEG-2 transport multiplexer output is randomized according to the Pseudo Random Binary Sequence (PRBS) generator. The randomization process is also active when the modulator input bit stream is non-existent, or when it is non-compliant with the MPEG-2 transport stream format. This avoids emission of an unmodulated carrier from the modulator.

Following the energy dispersal randomization process, systematic shortened Reed-Solomon encoding is performed on each randomized MPEG-2 transport packet with T=8. This means that 8 erroneous bytes per transport packet can be corrected. This process adds 16 parity bytes to the MPEG-2 transport packet to give a codeword.

Convolutional interleaving with depth I=12 is applied to error protected packets. This results in an interleaved frame. The convolutional interleaving process is based on the Forney approach, which is compatible with the Ramsey type III approach. The interleave frame is composed of overlapping error protected packets and is delimited by MPEG-2 sync bytes.

After convolutional interleaving, an exact mapping of bytes into symbols is performed. The mapping relies on the use of byte boundaries in the modulation system. The two most significant bits of each symbol are differentially encoded in order to obtain a p/2 rotation-invariant Quadrature Amplitude Modulation constellation.

Digital modulation adheres to Coded Orthogonal Frequency Division Multiplexing with a QPSK,16-QAM, or 64-QAM constellation diagram. Constellation points in Quadrant 1 are converted to Quadrants 2, 3 and 4 by changing the two MS ($I_k$ and $Q_k$) and by rotating the qLSBs according to the following table.

**Table 1: Quadrant Conversion Constellation.**

| *Quadrant* | *MSBs* | *LSBs rotation* |
|---|---|---|
| 1 | 00 | |
| 2 | 10 | $+\pi/2$ |
| 3 | 11 | $+\pi$ |
| 4 | 01 | $+3\pi/2$ |

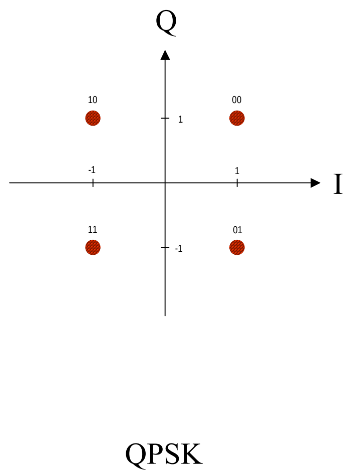


**Figure 2: QPSK Constellation Diagram (α =1).**

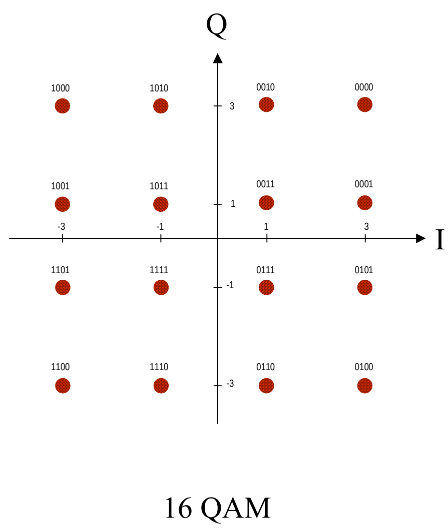


**Figure 3: 16-QAM Constellation Diagram (α =1).**

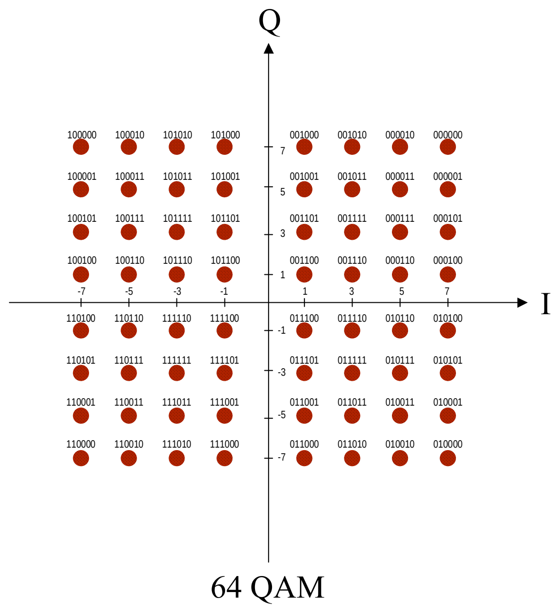


**Figure 4: 64-QAM Constellation Diagram (α =1).**

The digital modulation format is summarized in the following table:

**Table 2: Digital Transmission Format.**

| ***Parameter*** | ***Format*** |
|---|---|
| Standard | DVB-H |
| Modulation | QPSK, 16-QAM, 64-QAM |
| Format | COFDM |
| IFFT Length | 2k, 4k, 8k |
| Guard Interval | 1/4, 1/8, 1/16, & 1/32 |
| Code Rate | 1/2, 2/3, 3/4, 5/6, & 7/8 |
| Transmission Band | 1670 - 1675 MHz |
| Channel Bandwidth | 5 MHz |

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**Measure of digital transmission quality:**

Figure 5 shows the test setup for measuring a demodulated signal performance.

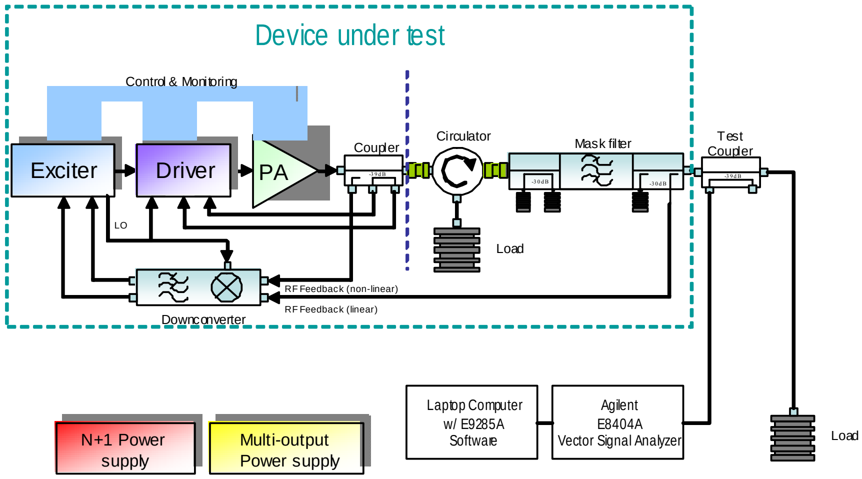


**Figure 5: Test setup for digital transmission quality**

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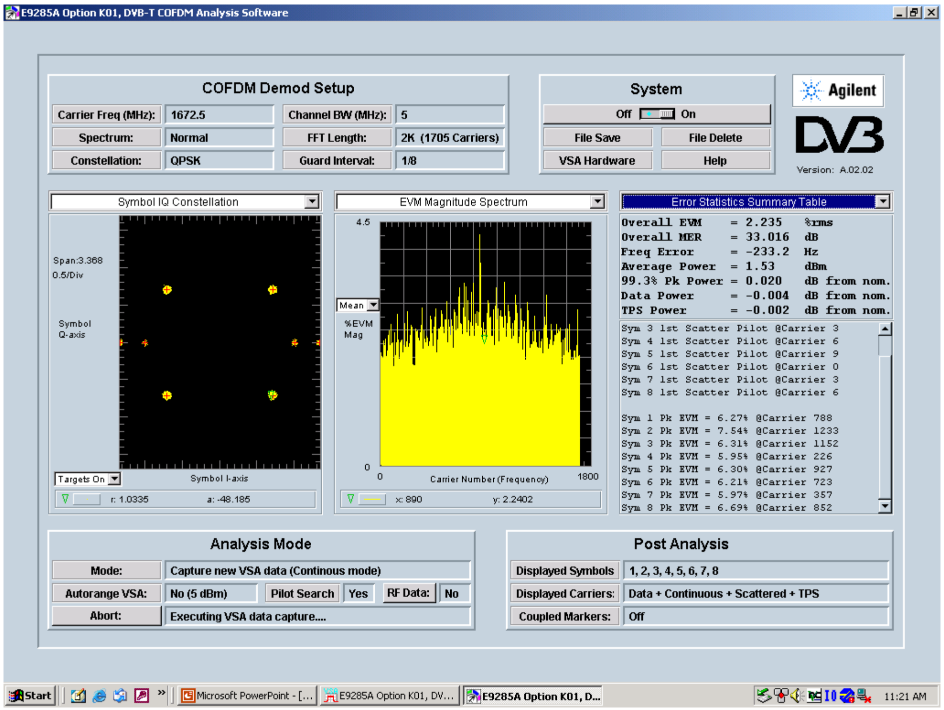
The following plot shows the demodulated performance of the digital transmitter's output, at full rated power, as measured with an Agilent E8404A Vector Signal Analyzer and E9285A COFDM analysis software. Note: Modulation Error Ratio (MER) = 33.0dB




**PLOT 1: Demodulation performance of the DVB-H transmitter.**

## 3.3 OCCUPIED BANDWIDTH / EMISSIONS

FCC Section 2.1049 (h), 2.202 (a), 2.1047, 27.53 (a)(4) (j)

**Occupied bandwidth:**

The transmitter is operated at maximum output power, while connected to the spectrum analyzer as shown in Figure 6 below.

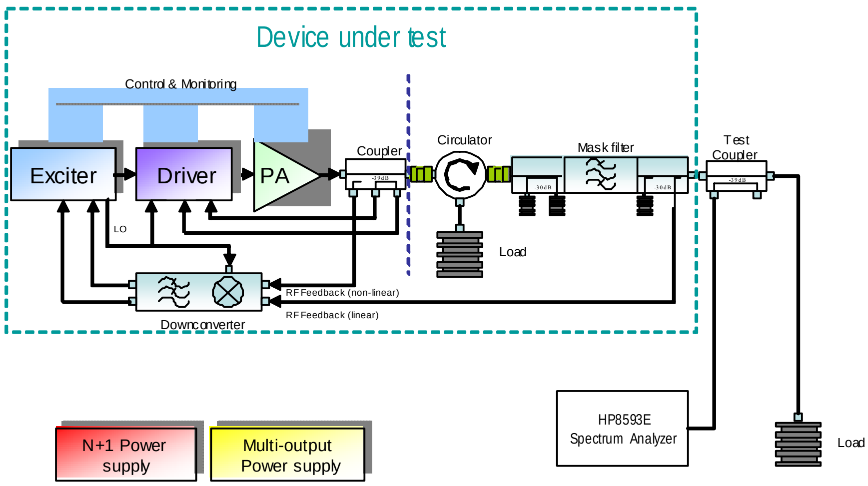
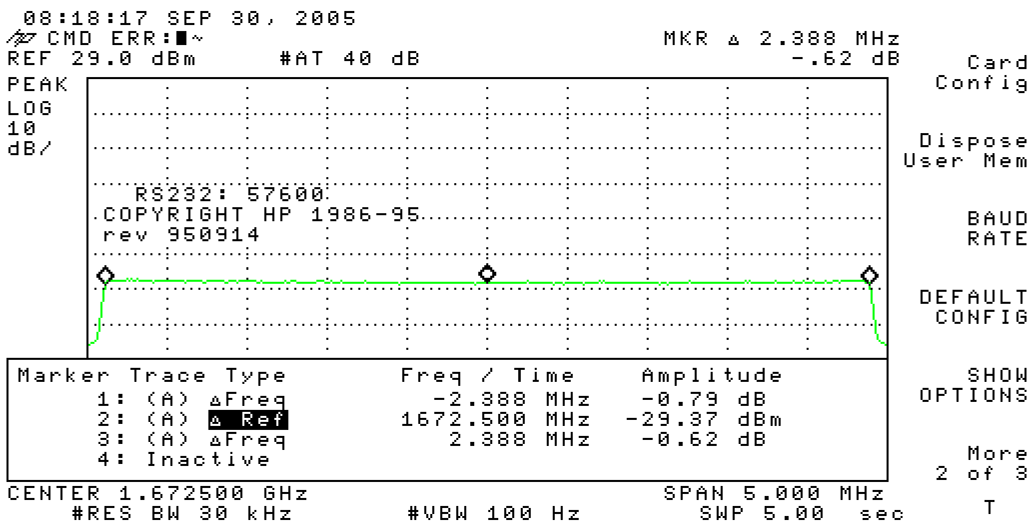



**Figure 6: Test setup for occupied bandwidth analysis**

| | |
|---|---|
| Average Output Power: | 200 watts |
| Type Modulation: | COFDM w/QPSK constellation |
| Spectrum Analyzer setting: | The spectrum analyzer setting used in conducting the occupied bandwidth at the equipment output terminals was as follows: |
| Frequency Span: | 0.5 MHz per Division |
| Center Frequency: | 1672.5MHz |
| Resolution Bandwidth: | 30 KHz |
| Video Bandwidth: | 100Hz |
| Video Filter: | Out |

The in-band occupied bandwidth is recorded in the following spectral plot, which shows a 4.776MHz BW effective for the DVB-H channel.




**PLOT 2: Channel occupied bandwidth of the DVB-H transmitter.**

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**Emissions:**
The following measurement demonstrates the occupied bandwidth as related to the emissions of the COFDM signal at the output of the spectral mask filter at the maximum rated average power. Emissions compliance 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. The signal meets the requirements wherein the power of any emission outside the 1670-1675MHz band of operation shall be attenuated below the transmitter power (P) by at least 43+ 10 log (P) dB in accordance to section 27.53 of the FCC rules.

The measurement method presented, evaluates the out-of-band emissions by comparing the power spectral density (PSD) of the channel with the PSD of the two most adjacent 1MHz slots. Note that the two immediate adjacent 1MHz slots are the most critical and present the most difficulty for compliance with commission regulations in section 27.53. Therefore these are the focus of the plots that show out of band emissions. First step is to determine the power of the channel [1670-1675MHz] and of the adjacent 1MHz slots [1669-1670 and 1675-1676MHz] before the spectral shaping filter. This step uses the vector signal analyzer and its channel power feature. Second step is to capture punctual attenuation data of the filter in 10KHz increments throughout the same frequency interval [1669-1676MHz], using a Network Analyzer. The instrument will generate a table of attenuation values automatically. The attenuation data is then mathematically processed in order to achieve integrated values, both for the 5MHz channel and adjacent 1MHz slots. Third step is to apply integrated attenuation numbers of step two to respective PSD numbers of step one. Fourth and last step is to compose two relations: one with the resulting PSD's of the 5MHz channel against the lower frequency 1MHz slot, and the other with the same 5MHz channel frequency against the higher 1MHz slot.

The setup for conducting emissions limits tests is shown in Figure 7:

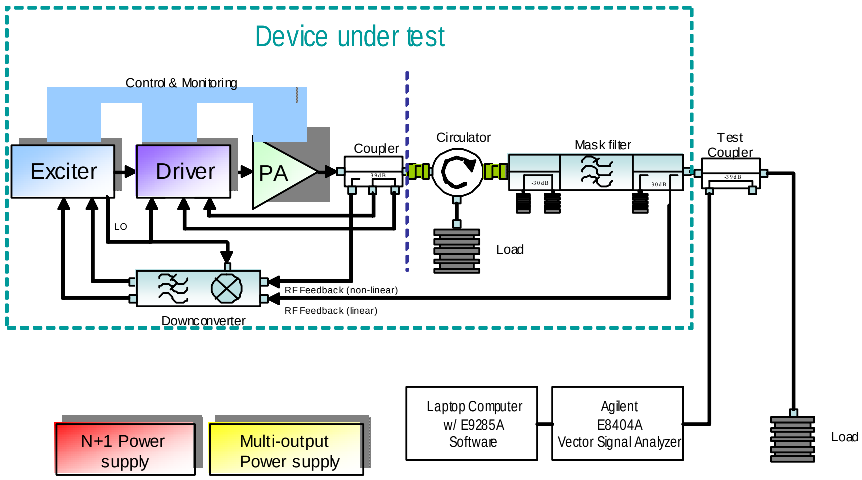


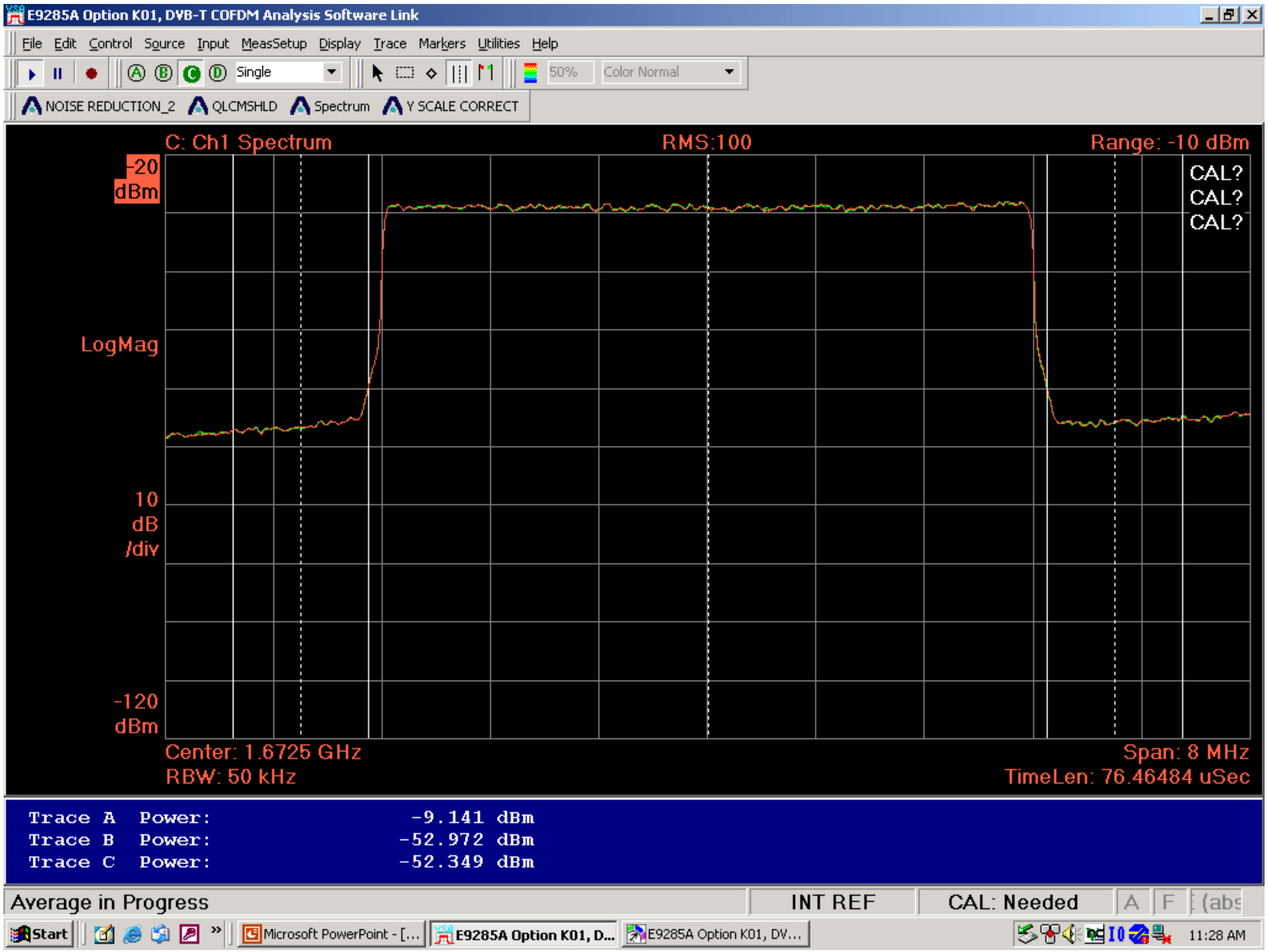

**Figure 7: Test setup for out-of-band emissions measurement**

Equipment setup/Measurement

**First step:**

1) Vector Signal Analyzer measurements
   a) Proper input attenuation to accept 1672.5MHz signal from directional coupler after the channel filter.
   b) Record of CHANNEL POWER at 1672.5MHz center frequency and 5MHz bandwidth
   c) Record of CHANNEL POWER at 1669.5MHz center frequency and 1MHz bandwidth
   d) Record of CHANNEL POWER at 1675.5MHz center frequency and 1MHz bandwidth

Refer to PLOT 3 below, which shows the direct measurement of the signal in each case.




Trace A = PSD of the 5MHz channel
Trace B = PSD of the lower 1MHz slot
Trace C = PSD of the higher 1MHz slot

**PLOT 3: Occupied bandwidth of the DVB-H transmitter.**

**Second step:**

2) Using a network analyzer the filter response data is recorded. The data is taken in 10kHz intervals, which is directly logged in a file from the network analyzer output. This file is attached as exhibit A.

TXT205.CSV

EXHIBIT A

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The recorded data is then transferred to the worksheet below, where the following numerical integration process is applied:

$$\frac{1}{f_2 - f_1} \sum_{i=1}^{n-1} (f_{i+1} - f_i) \left( \frac{\left(10^{\frac{Att_{i+1}}{10}} + 10^{\frac{Att_i}{10}}\right)}{2} \right)$$

Where:

$f_1$ = Low frequency limit of integration
$f_2$ = High frequency limit of integration
n = $(f_2 - f_1)$ /10kHz
$f_i$ = $f_1$ +10kHz, $f_1$+20kHz, $f_1$+30kHz … $f2$,
$Att_i$ = Attenuation relative to $f_i$

754573-01_TX200W_FCC.xls

EXCEL WORKSHEET

***Note: Example of worksheet is shown below, to access actual spreadsheet data see link to excel file above.***

| Frequency (MHz) | Filter Transfer Function (dB) | | | | Filter Integrated Rejection at Lower 1MHz adjacent Slots (dB). | Filter Integrated Rejection at Higher 1MHz adjacent Slots (dB). | Filter Integrated In-Band Insertion Loss (dB). |
|---|---|---|---|---|---|---|---|
| 1669 | -33.193 | 0.000479 | | | 27.7 | 27.6 | 0.9003635 |
| 1669.01 | -33.061 | 0.000494 | 4.87E-06 | 0.001698 | | | |
| 1669.02 | -32.953 | 0.000507 | 5E-06 | | | | |
| 1669.03 | -32.854 | 0.000518 | 5.12E-06 | | | | |
| 1669.04 | -32.861 | 0.000517 | 5.18E-06 | | | | |
| 1669.05 | -33.087 | 0.000491 | 5.04E-06 | | | | |
| 1669.06 | -32.786 | 0.000527 | 5.09E-06 | | | | |

The resulting outputs from the spreadsheet provide the integrated rejection of the filter for the high and low 1MHz adjacent slots 27.7dB and 27.6dB respectively, as well as, the integrated in-band insertion loss of 0.9dB. These values will be used in our final calculations for out of band emissions.

Figure 8 illustrates the filter response reproduced from the network analyzers data file. It is shown as a reference only.

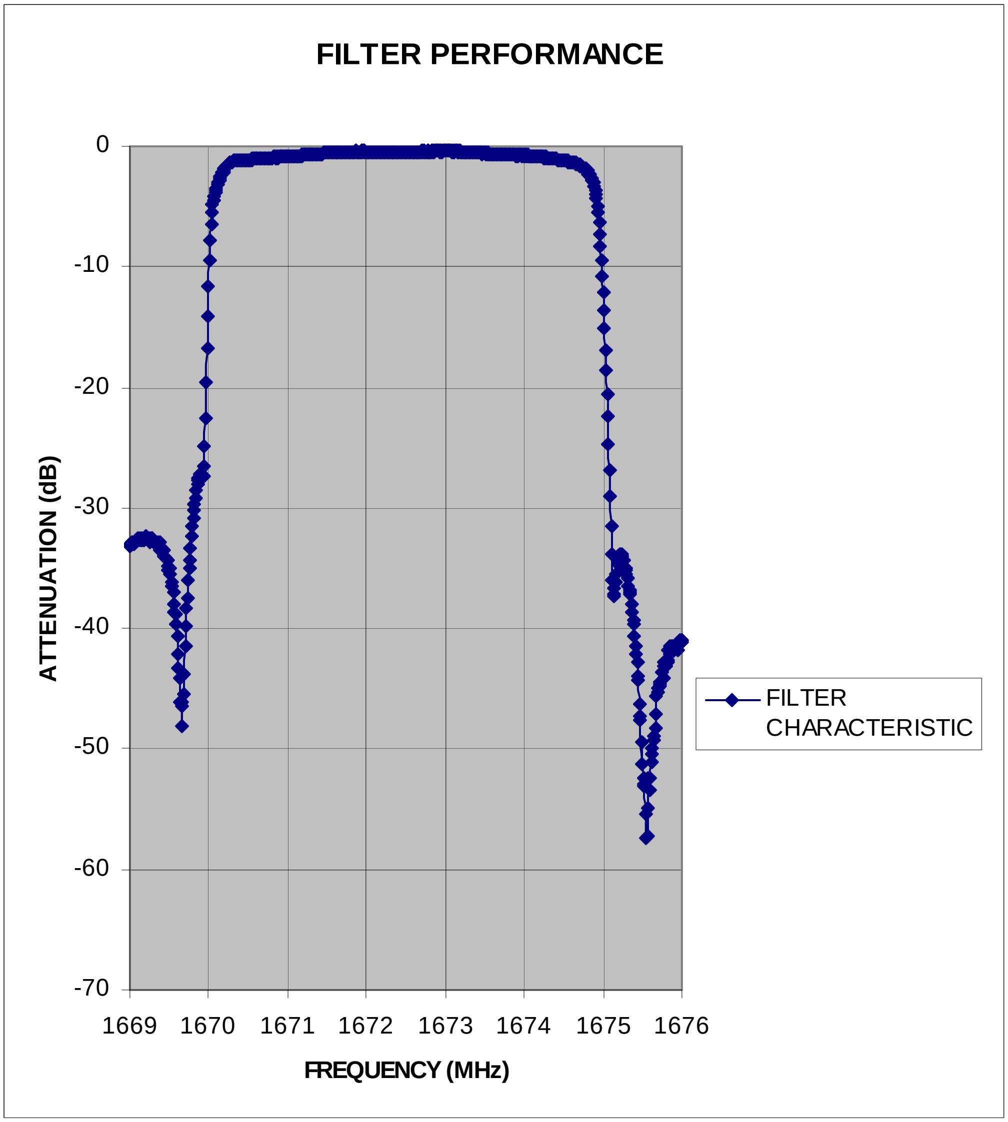


**Figure 8 Filter response plot derived from worksheet data**

**Third step:**

3) The filter's integrated rejection or loss from the previous step is applied to the transmitter's output signal, shown in PLOT3, which is taken prior to the spectral shaping filter.

a) The 1670-1675MHz channel PSD, recorded as –9.141dBm is attenuated by the integrated in-band filter loss of 0.9dB; yielding: -9.141dBm – 0.9dB = -10.041dBm ***(Channel power)***

b) The lower adjacent 1MHz slot, recorded as –52.972dBm is attenuated by the integrated rejection of the filter 27.7dB; yielding: –52.972dBm – 27.7dB = -80.672dBm ***(Power in 1MHz lower adjacent)***

c) The upper adjacent 1MHz slot, recorded as –52.349dBm is attenuated by the integrated rejection of the filter 27.6dB; yielding: –52.349dBm – 27.6dB = -79.949dBm ***(Power in 1MHz upper adjacent)***

**Fourth step:**

4) To extract the final result for the upper and lower 1MHz slot rejection the following method is applied.

a) Channel power – power in 1MHz lower adjacent = lower side rejection ratio
-10.041dBm – (-80.672dBm) = 70.631dB

b) Channel power – power in 1MHz upper adjacent = upper side rejection ratio
-10.041dBm – (-79.949dBm) = 69.908dB

Applying the method as described in section 27.53 of the FCC rules for a 200W transmitter, which represents the device under test we obtain:

**200W transmitter:**
43 + 10 log (200) = 66.010dB

Comparing this result.

Lower side rejection ratio – FCC limit = low side margin
70.631dB - 66.010dB = 4.621dB

Upper side rejection ratio – FCC limit = high side margin
69.908dB - 66.010dB = 3.898dB

The method described above is employed because of dynamic range limitation of current analyzers (most of them will not have more than 60dB dynamic range, not including the noise floor effect), a direct comparison between the channel power and the 1MHz adjacent slots is not always feasible, especially for 200W TPO. The method presented here evaluates the out-of-band emissions using a numerical integration process coupled with a direct measurement of the channel power and adjacent slots, made prior to the spectrum shaping filter, where the signal relationships fall within the instrument dynamic range.

This method of measurement also minimizes the spill over caused by the resolution bandwidth filter within the instrument, which can cause the adjacent power measured to be greater then the real power due to this effect, and consequently introduce error into the actual out of band rejection measurement.

In conclusion, the results show compliance with out of band emissions limits set forth by the commission with enough margins to ensure long term stability.

## 3.4 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC Section 2.1051/2.1057 (a)(1) (b) (c)

The setup for conducting the spurious emissions test is shown in Figure 9, note that the directional coupler is removed for this test. A directional coupler is a device which is frequency selective. Therefore a high power -30dB broadband attenuator is used to sample the output. The attenuator is characterized across the measurement band of 10MHz to 17GHz. The results of this measurement can be seen in Table 3.

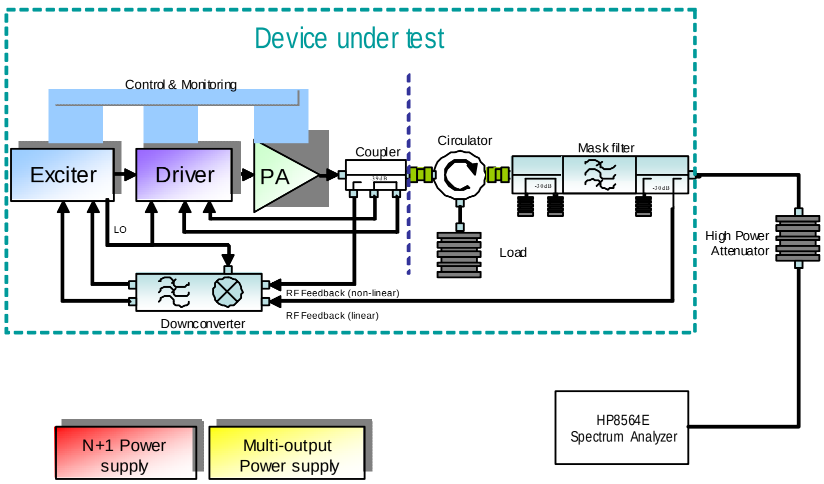


**Figure 9: Test setup for spurious emissions measurement**

| | |
|---|---|
| Average Output Power: | 200 watts |
| Type Modulation: | COFDM w/QPSK constellation |
| Spectrum Analyzer Setting: | The Spectrum Analyzer setting used in conducting the spurious emissions test at the equipment output terminals was as follows |
| Frequency Span: | 2 MHz per Division |
| Center Frequency: | Adjusted continuously for 10 MHz to 17 GHz |
| Resolution Bandwidth: | 100 KHz |
| Video Bandwidth: | 30kHz |
| Video Filter: | Out |
| Input Attenuator Setting: | Input level was set for a full-scale calibration of the average digital power. All other frequencies were referenced to this point. |
| Spurious Emissions: | See chart; measured values account for attenuator curve. |

**Table 3: Spurious emissions.**

| Frequency (MHz) | Amplitude (dBc) | |
|---|---|---|
| 1672.50 | 0 | Carrier Reference |
| 27.50 | <-70 | 1st IF |
| 700.00 | <-70 | Local Oscillator #1 |
| 672.50 | <-70 | 2nd IF |
| 1000.00 | <-70 | Local Oscillator #2 |
| 3345.00 | <-70 | 2nd Harmonic |
| 5017.50 | <-70 | 3rd Harmonic |
| 6690.00 | <-70 | 4th Harmonic |
| 8362.50 | <-70 | 5th Harmonic |
| 10035.00 | <-70 | 6th Harmonic |
| 11707.50 | <-70 | 7th Harmonic |
| 13380.00 | <-70 | 8th Harmonic |
| 15052.50 | <-70 | 9th Harmonic |
| 16725.00 | <-70 | 10th Harmonic |

No other spurious emissions detected.

## 3.5 FIELD STRENGTH OF SPURIOUS RADIATION

FCC Section 2.1053, 2.1057 (a)(1) (b) (c)

The setup for conducting radiated emissions test is shown in Figure 10. The transmitter is operated at full rated power into a 50-ohm terminating load, while a dipole antenna connected to the spectrum analyzer is used to measure radiated emissions at a distance of 10-meters away from the transmitter on all sides. The receiving antenna is a set to measure each of the following internally generated frequencies: intermediate frequency(s), local oscillator(s), carrier frequency, and 2nd and 3rd harmonics of the DVB-H L-Band transmitter. The measurement results are depicted in Table 4.

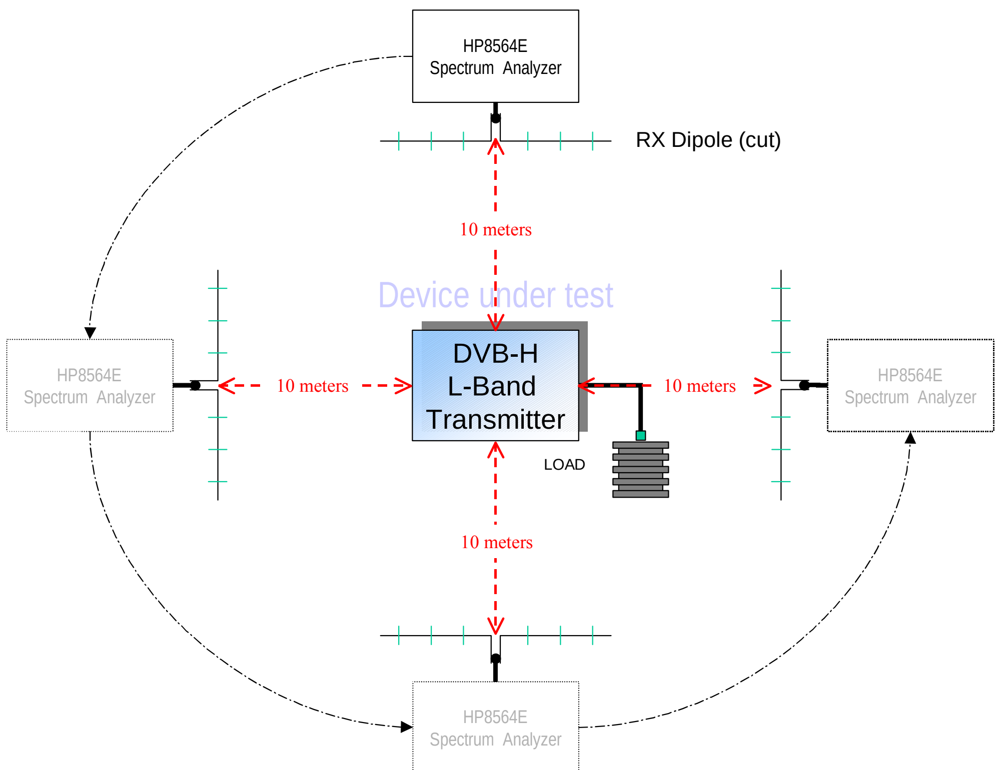


**Figure 10: Test setup for radiated emissions measurement**

Average Output Power: 200 watts

Type Modulation: COFDM w/QPSK constellation

Spectrum Analyzer Settings: A spectrum analyzer used to measure the spurious emissions at a distance of 10 meters from the transmitter was set as follows:

| | |
|---|---|
| Reference Level: | 0 dBm |
| Attenuation: | 10 dB |
| Frequency Span: | 1.5 MHz per division |
| Center Frequency: | Adjusted continuously from 10 MHz to 10 GHz |
| Resolution Bandwidth: | 100 KHz |
| Video Bandwidth: | 30 KHz |
| Video Average: | ON |
| Analyzer Noise Threshold: | <-77 dBm |

Method of Measurement:

Absolute power of the spurious radiation was measured on a spectrum analyzer at a distance of 10 meters from the transmitter. The radiation was received with a half-wave dipole antenna (gain = 2.15 dB) and measured as an absolute power level; therefore, all measurements include the dipole gain. The relative levels of the received spurious signals were calculated with respect to the absolute power level of the transmitter's output received with a dipole at 10 meters. The received power level was calculated as shown:

| | Parameter | Value | Units |
|---|---|---|---|
| | ***Data Input*** | | |
| **System Parameters** | Antenna feed loss | 0.5 | dB |
| | Operating Frequency | 1672.5 | MHz |
| | Transmit Antenna Gain | 2.15 | dBi |
| | Transmitter Output Power | 53.01 | dBm |
| | Receive Antenna Gain | 2.15 | dBi |
| **Link Parameters** | Link Distance | 0.01 | Km |
| **Constants** | Speed of light | 3.00E+08 | m/s |
| | ***Link Calculation*** | | |
| **Transmitted ERP Calculation** | Transmitted Signal Power | 53.01 | dBm |
| | Antenna Feed Loss | 0.5 | dB |
| | TX Antenna Gain | 2.15 | dB |
| | Effective Radiated Power(ERP) | 54.66 | dBm |
| **Path Loss Calculation** | Link Frequency | 1672.5 | MHz |
| | Link Distance | 0.01 | Km |
| | Path Loss *(for line of sight with no fade)* | -56.91 | dB |
| **Received Power Calculation** | Receiver Antenna Gain | 2.15 | dBi |
| | Antenna Feed Loss | 0.5 | dB |
| | Received Signal Power | -0.60 | dBm |

Spurious Radiation:

The following measurements of radiation were taken and are given in terms of absolute and relative dBm to the average digital signal power.

**Table 4: Spurious Products/Harmonics Field Measurements.**

| | Absolute Received (dBm) | Relative to Level (dBm) |
|---|---|---|
| 1672.5 MHz | -0.60dBm | reference |
| 10.00 MHz | *Below analyzer threshold | <-77 |
| 27.5 MHz | *Below analyzer threshold | <-77 |
| 700 MHz | *Below analyzer threshold | <-77 |
| 672.5 MHz | *Below analyzer threshold | <-77 |
| 1000 MHz | *Below analyzer threshold | <-77 |
| Harmonics | *Below analyzer threshold | <-77 |

* Analyzer threshold = -77 dBm

## 3.6 FREQUENCY STABILITY

FCC Section 2.1055 (a) (1) (b)(c)(d), 27.54

Method of Measurement: The upconverter was tested per FCC guideline, wherein measuring each of the local oscillator frequencies in the double conversion RF chain across both temperature and AC line variation derives the on-channel frequency stability.

### Transmitter frequency plan

**First conversion:**

| | |
|---|---|
| UHF L.O. (Synthesized) | 700.00 MHz |
| 1st IF Frequency | -27.50 MHz |
| 2nd IF Frequency (Modulator Output) | 672.5MHz |

**Second conversion:**

| | |
|---|---|
| Microwave L.O. (Synthesized) | 1000.00 MHz |
| 2nd IF Frequency (Modulator Output) | +672.50 MHz |
| On Channel Frequency | 1672.50 MHz |

Frequency Stability over Temperature: The unit was place inside a temperature chamber to control the ambient temperature; each measurement was recorded after approx 1 hour at each temperature interval. The channel frequency is derived by the method shown above. The measured results of each stage are compared to the nominal channel frequency of 1672.5MHz and are recorded in Table 5; where the right most column reflects the total channel error at each temperature.

**Table 5: Frequency stability measured over temperature -30° to +50°C.**

| Temperature ( C ) | Modulator I.F. | | Local Oscillator #1 | | Local Oscillator #2 | | Total channel Error (Hz) |
|---|---|---|---|---|---|---|---|
| | Frequency (Hz) | Error (Hz) | Frequency (Hz) | Error (Hz) | Frequency (Hz) | Error (Hz) | |
| +25 | 27,500,001 | 1 | 700,000,003 | 3 | 1,000,000,004 | 4 | 6 |
| -30 | 27,500,011 | 11 | 700,000,102 | 102 | 1,000,000,154 | 154 | 245 |
| -20 | 27,500,009 | 9 | 700,000,078 | 78 | 1,000,000,114 | 114 | 183 |
| -10 | 27,500,006 | 6 | 700,000,047 | 47 | 1,000,000,079 | 79 | 120 |
| 0 | 27,500,004 | 4 | 700,000,032 | 32 | 1,000,000,049 | 49 | 77 |
| +10 | 27,500,003 | 3 | 700,000,018 | 18 | 1,000,000,024 | 24 | 39 |
| +20 | 27,500,001 | 1 | 700,000,002 | 2 | 1,000,000,009 | 9 | 10 |
| +30 | 27,499,999 | -1 | 699,999,993 | -7 | 999,999,995 | -5 | -11 |
| +40 | 27,499,998 | -2 | 699,999,981 | -19 | 999,999,975 | -25 | -42 |
| +50 | 27,499,996 | -4 | 699,999,976 | -24 | 999,999,962 | -38 | -58 |

**NOTE:**
Frequency stability of the transmitter system during this test was totally dependent on the accuracy and stability of the internal 10 MHz reference oscillator. This is a purchased item with ±0.15 ppm stability over temperature range. The worse case condition is presented in these measurements. In normal operation the transmitter will be phase-locked to a GPS receiver source, eliminating the drift of the internal OCXO.

Frequency Stability over AC Input Voltage: The error due to AC line variation was measured, while the unit was stabilized at room temperature of 23°C. Table 6 shows the measured results.

**Table 6: Frequency stability measured over AC input voltage 200 to 253VAC**

| AC Line (V) | Modulator I.F. | | Local Oscillator #1 | | Local Oscillator #2 | | Total channel Error (Hz) |
|---|---|---|---|---|---|---|---|
| | Frequency (Hz) | Error (Hz) | Frequency (Hz) | Error (Hz) | Frequency (Hz) | Error (Hz) | |
| 200 | 27,500,000 | 0 | 700,000,005 | 5 | 1,000,000,005 | 5 | 10 |
| 205 | 27,500,000 | 0 | 700,000,004 | 4 | 1,000,000,006 | 6 | 10 |
| 210 | 27,500,000 | 0 | 700,000,004 | 4 | 1,000,000,006 | 6 | 10 |
| 215 | 27,500,001 | 1 | 700,000,005 | 5 | 1,000,000,006 | 6 | 10 |
| 220 | 27,500,000 | 0 | 700,000,004 | 4 | 1,000,000,005 | 5 | 9 |
| 225 | 27,500,001 | 1 | 700,000,004 | 4 | 1,000,000,005 | 5 | 8 |
| 230 | 27,500,000 | 0 | 700,000,004 | 4 | 1,000,000,005 | 5 | 9 |
| 235 | 27,500,000 | 0 | 700,000,005 | 5 | 1,000,000,006 | 6 | 11 |
| 240 | 27,500,001 | 1 | 700,000,004 | 4 | 1,000,000,006 | 6 | 9 |
| 245 | 27,500,000 | 0 | 700,000,004 | 4 | 1,000,000,005 | 5 | 9 |
| 250 | 27,500,000 | 0 | 700,000,005 | 5 | 1,000,000,005 | 5 | 10 |
| 253 | 27,500,001 | 1 | 700,000,004 | 4 | 1,000,000,005 | 5 | 8 |

* Total deviation of 2Hz error with AC line voltage

# 4.0 SUMMARY

This report demonstrates that the LBD-series digital television transmitter meets or exceeds the FCC certification criteria. The specified is based upon DVB-H/DVB-T compliant COFDM modulation with a QPSK, 16 or 64 point signal constellation. The occupied bandwidth conforms to the required emissions limits of 27.53 wherein the power of any emission outside the 1670-1675MHz band of operation shall be attenuated below the transmitter power (P) by at least 43+ 10 log (P) dB. Measurement of spurious emissions at the RF output revealed no emissions above -66 dBc. Field strength measurements of spurious emissions revealed no detectable emissions down to the analyzer noise threshold of < - 77 dBm. Frequency stability tests of the synthesizer and modulator over variations in temperature or input AC line voltage showed a maximum worst-case frequency shift of 256 hertz.