Annex-A: Emissions Variations Over a Wide Range of Input Power Levels

1. Purpose

The purpose of this annex is to demonstrate that Hyperlink Technologies' HA2401-AGCXXXX AGC amplifiers have no emissions variations over a wide range of input power levels.

2. Amplifier Construction

The HA2401-AGCXXXX amplifiers can be broken down into two categories, each with a different construction and schematic. The low power type, HA2401-AGC010 to HA2401-AGC250, and the higher power HA2401-AGC-250 to HA2401-AGC1000. (The extra dash in the HA2401-AGC-250 is used to discriminate it from the equivalent powered HA2401-AGC250 at this time.) Depending on the filing, one or the other type of amplifier is of concern; both are included herein.

A detailed block diagram and schematic, *Exh 05 – Schematics(Amplifiers).pdf*, has been filed as a confidential part of this submission. Detailed information regarding the construction of these amplifiers and an explanation of their implementation relating to this matter is included in that portion of the filing. This information has been deemed CONFIDENTIAL by Hyperlink Technologies, and is therefore not included here.

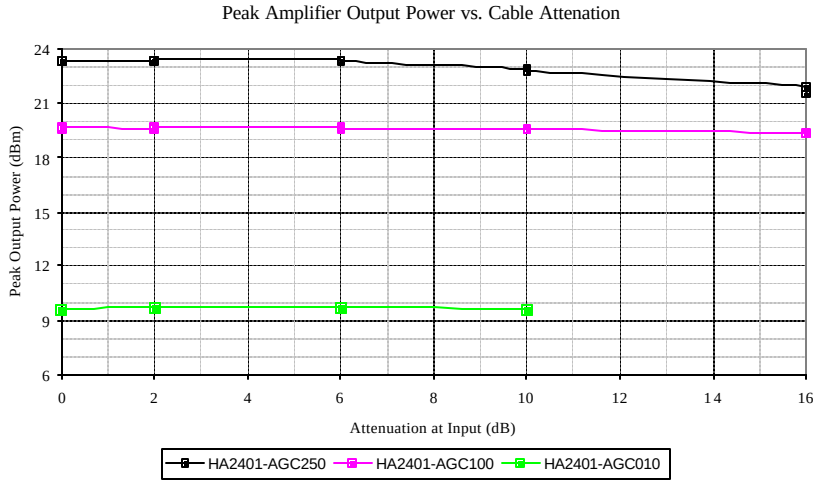
3. Measurements

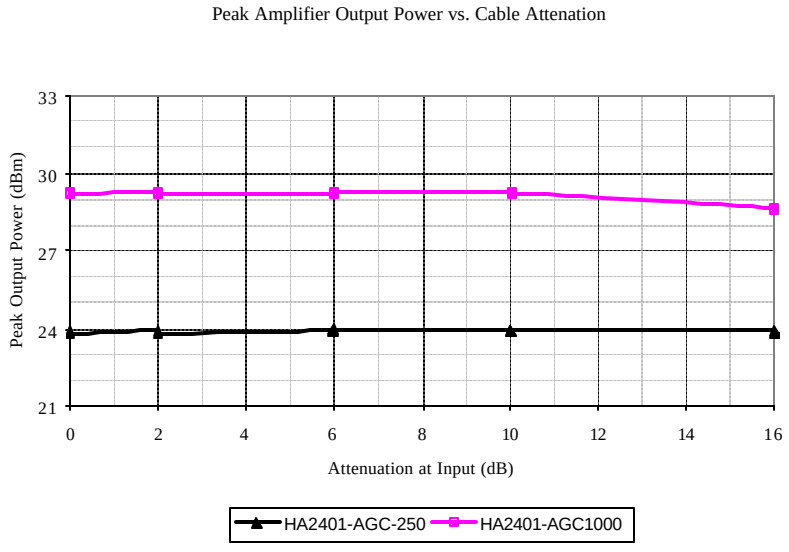
For six configurations of the HA2401-AGCXXX amplifiers, the devices were tested for output power and conducted emissions with regards to the FCC and IC limits. The flowing graphs and tables include the results of these measurements. Plots of the conducted measurements follow. (All tests in this ANNEX were performed using the LUCENT Radio, FCC ID: IMRWLPCEL4H.)

Because of the physical construction of the amplifiers, as described in Section 2 of this annex, amplifiers intermediate to those tested will also demonstrate the characteristics measured below.

1.1 Antenna Output Power vs. Cable Attenuation / Cable Length

For this measurement, the configurations were set in a test mode for continuous data transmission. A peak (diode detector) power meter was connected where the antenna attaches to the system. Since the DUT transmits in continuous mode, there is no adjustment needed to the readings. As seen in the following figures, the HA2401-AGCXXX amplifiers' output power ratings remain within 0.5 dB of there initial value for up to 10 dB cable attenuation between the LUCENT radio and the amplifier. A measurement of the WBC400 cable used in testing maintains a 3dB/50ft loss at 2.437 GHz, thus permitting 150 ft of WBC400 cable between the radio and the power amplifier before amplifier output power is compromised. Amplifier power is always maximum when no additional cable is used in the system.





2. Conducted Emissions Measurements

Configurations Tested:

The six configurations in Table 1 were determined to be a representative sample because of the physical construction of the amplifiers, as described in Section 2 of this annex. Again, amplifiers intermediate to those tested will also demonstrate the characteristics measured.

Table 1. Configurations Tested

Amplifier Model	Power Rating	Category/Type	Attenuation from Radio to Amplifier Input (dBm)
HA2401-AGC010	10 mW	Low Power	0
HA2401-AGC250	250 mW	Low Power	0
HA2401-AGC250	250 mW	Low Power	10
HA2401-AGC-250	250 mW	High Power	0
HA2401-AGC1000	1000 mW	High Power	0
HA2401-AGC1000	1000 mW	High Power	10
No amplifier	11.75 mW	Radio alone	0

Note: Some 60 pages of plots were taken during testing, and the data below summarizes the results of this testing.

2.1 Bandwidth (15.247(a)(2))

For this test, each configuration was put in a test mode for continuous data transmission. The spectrum analyzer was connected where the antenna attaches to the system. The analyzer was set for RBW=VBW=100 kHz, SPAN=100 MHz. The 6-dB bandwidth was measured for lowest, middle, and highest channels available for use. The results for the configurations measured are summarized below.

HA2401-AGC010 with 0 dB attn.

Frequency	6 dB Bandwidth
2.412 GHz	10.0 MHz
2.437 GHz	9.6 MHz
2.462 GHz	10.1 MHz

HA2401-AGC250 with 0 dB attn.

Frequency	6 dB Bandwidth
2.422 GHz	10.3 MHz
2.437 GHz	11.3 MHz
2.452 GHz	10.4 MHz

HA2401-AGC250 with 10 dB attn.

Frequency	6 dB Bandwidth
2.412 GHz	9.5 MHz
2.437 GHz	10.0 MHz
2.462 GHz	9.9 MHz

HA2401-AGC-250 with 0 dB attn.

Frequency	6 dB Bandwidth
2.412 GHz	10.1 MHz
2.437 GHz	10.3 MHz
2.462 GHz	10.4 MHz

HA2401-AGC1000 with 0 dB attn.

Frequency	6 dB Bandwidth
2.412 GHz	11.4 MHz
2.437 GHz	10.3 MHz
2.462 GHz	11.3 MHz

HA2401-AGC1000 with 10 dB attn.

Frequency	6 dB Bandwidth
2.412 GHz	10.1 MHz
2.437 GHz	10.1 MHz
2.462 GHz	9.5 MHz

Radio Alone.

Frequency	6 dB Bandwidth
2.412 GHz	10.2 MHz
2.437 GHz	10.1 MHz
2.462 GHz	10.1 MHz

The introduction of attenuation between the radio and the AGC amplifier(s) does not affect the Channel Bandwidth in such a way as to cause a violation of FCC or IC guidelines.

2.2 RF Antenna Conducted Spurious Emissions (15.247(c))

For this test, each configuration was put in a test mode for continuous data transmission. The spectrum analyzer was connected where the antenna attaches to the system. The analyzer was set for RBW=100 kHz, VBW=300 kHz, the frequency was swept from 0 to 25 GHz. In the plots, only the fundamental is seen, the rest is noise. In all cases, the noise is at least 35 dB below the carrier. (Limit -20.0 dB below carrier).

The introduction of attenuation between the radio and the AGC amplifier(s) does not affect the Conducted Spurious Emissions in such a way as to cause a violation of FCC or IC guidelines.

2.3 Power Spectral Density and Line Spacing (15.247(d))

For this test, each configuration was put in a test mode for continuous data transmission. The spectrum analyzer was connected where the antenna attaches to the system. The spectrum was first scanned for the maximum spectrum peaks and then at these peaks the sweep was repeated with RBW=3 kHz, VBW=300 kHz, SPAN=300 kHz, and RBW=1 kHz, VBW=300 kHz, SPAN=100 kHz. The results for the configurations measured are summarized below.

HA2401-AGC010 with 0 dB attn.

Frequency	Analyzer Reading	Line Spacing
2.41035 GHz	-16.8 dBm (Limit 8.0 dBm)	4.8 kHz
2.46685 GHz	-16.0 dBm (Limit 8.0 dBm)	4.5 kHz

HA2401-AGC250 with 0 dB attn.

Frequency	Analyzer Reading	Line Spacing
2.42134 GHz	0.2 dBm (Limit 8.0 dBm)	4.8 kHz
2.45135 GHz	0.6 dBm (Limit 8.0 dBm)	4.5 kHz

HA2401-AGC250 with 10 dB attn.

Frequency	Analyzer Reading	Line Spacing
2.41134 GHz	-6.7 dBm (Limit 8.0 dBm)	4.5 kHz
2.46134 GHz	-2.0 dBm (Limit 8.0 dBm)	4.5 kHz

HA2401-AGC-250 with 0 dB attn.

Frequency	Analyzer Reading	Line Spacing
2.41103 GHz	-2.1 dBm (Limit 8.0 dBm)	4.5 kHz
2.46683 GHz	-0.6 dBm (Limit 8.0 dBm)	4.5 kHz

HA2401-AGC1000 with 0 dB attn.

Frequency	Analyzer Reading	Line Spacing
2.41135 GHz	5.6 dBm (Limit 8.0 dBm)	4.5 kHz
2.46428 GHz	6.8 dBm (Limit 8.0 dBm)	4.5 kHz

HA2401-AGC1000 with 10 dB attn.

Frequency	Analyzer Reading	Line Spacing
2.41135 GHz	5.2 dBm (Limit 8.0 dBm)	4.5 kHz
2.46435 GHz	7.1 dBm (Limit 8.0 dBm)	4.5 kHz

Radio alone

Frequency	Analyzer Reading	Line Spacing
2.41283 GHz	-11.4 dBm (Limit 8.0 dBm)	4.5 kHz
2.40347 GHz	-10.6 dBm (Limit 8.0 dBm)	4.5 kHz

The introduction of attenuation between the radio and the AGC amplifier(s) does not affect the Power Spectral Density or Line Spacing in such a way as to cause a violation of FCC or IC guidelines.