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## APPLICATION NOTE 1745

## The MAX3510/MAX3514/MAX3516 Cable Upstream Amplifiers ACPR (Adjacent Channel Power Ratio) Performance

Provides performance data for MAX3510/MAX3514/MAX3516 cable upstream driver amplifiers. ACPR and gain data are provided in graphical and tabular form. Units meet DOCSIS 2.0 standards with margin. Data is taken from 5MHz to 65MHz.

### Additional Information

- [Wireless Product Line Page](#)
- [Quick View Data Sheet for the MAX3510](#)
- [Quick View Data Sheet for the MAX3514, MAX3516](#)
- [Applications Technical Support](#)

The MAX3510/MAX3514/MAX3516 were tested for adjacent channel power ratio (ACPR). The test conditions were 5.0V supply and an input of +34dBmV. A set of plots was made to show the test results. The following data meets DOCSIS 2.0 with margin.

ACPR is an important parameter in cable amplifiers because a transmitted carrier may occur in an adjacent channel that could be occupied by a carrier of the same or different modulation rate. ACPR is defined as channel power ratio between the primary channel and adjacent channel. According to DOCSIS a 160kHz measurement bandwidth is used with 200kHz channel spacing.

The MAX3510/MAX3514/MAX3516 are a family of programmable-gain upstream amplifiers designed for use in CATV upstream applications. They operate over a frequency range of 5MHz to 65MHz and drives up to +64dBmV QPSK (MAX3516). Since both input and output ports are differential, an external balun at the output port is required. The variable gain feature provides greater than 56dB of dynamic range (MAX3514/MAX3516) and is controlled by a SPI 3-wire interface. Gain control is available in 0.5dB steps (MAX3514/MAX3516) or 1dB step (MAX3510).

### Test Conditions

- All tests at room temperature.
- $V_{CC} = 5.0V$  -  $P_{IN} = -13dBm$  (+34dBmV in 50 $\Omega$  system)
- Input signal: QPSK modulation with 20bit PRBS, root cosine filter,  $\alpha = 0.25$
- High power mode
- Input ACPR -66dBc
- 200kHz channel spacing
- 160kHz measurement bandwidth

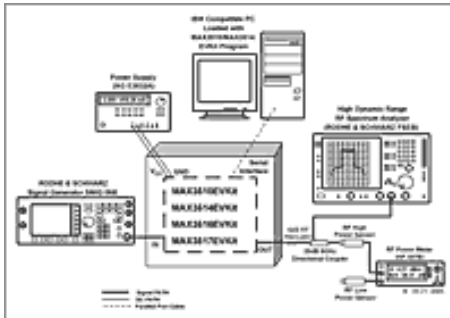
### Corrections and Unit Conversion

- In 50 $\Omega$  system,  $P_{IN/OUT}$  (dBmV) =  $P_{IN/OUT}$  (dBm) + 47dB
- In 75 $\Omega$  system,  $P_{IN/OUT}$  (dBmV) =  $P_{IN/OUT}$  (dBm) + 49dB
- The MAX3510EVMKit board has 3.5dB loss at the output, so  $P_{OUT}$  (dBmV) =  $P_{OUT}$  (dBm) + 47dB + 3.5dB + cable loss

- The MAX3514/MAX3516EVM boards have 7.5dB minimum loss pad at the output, so  $P_{OUT} \text{ (dBmV)} = P_{OUT} \text{ (dBm)} + 47\text{dB} + 7.5\text{dB} + \text{cable loss}$

## Test Equipment List

- Signal generator capable of generating QPSK signals (RODHE & SCHWARZ SMIQ 06B)
- Spectrum analyzer (RODHE & SCHWARZ FSEB)
- Power meter (HP437B)
- Power sensor (HP8482A)
- Power supply (Agilent E3632A)
- DMM (HPE3631A)



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Figure 1. Test equipment set up.

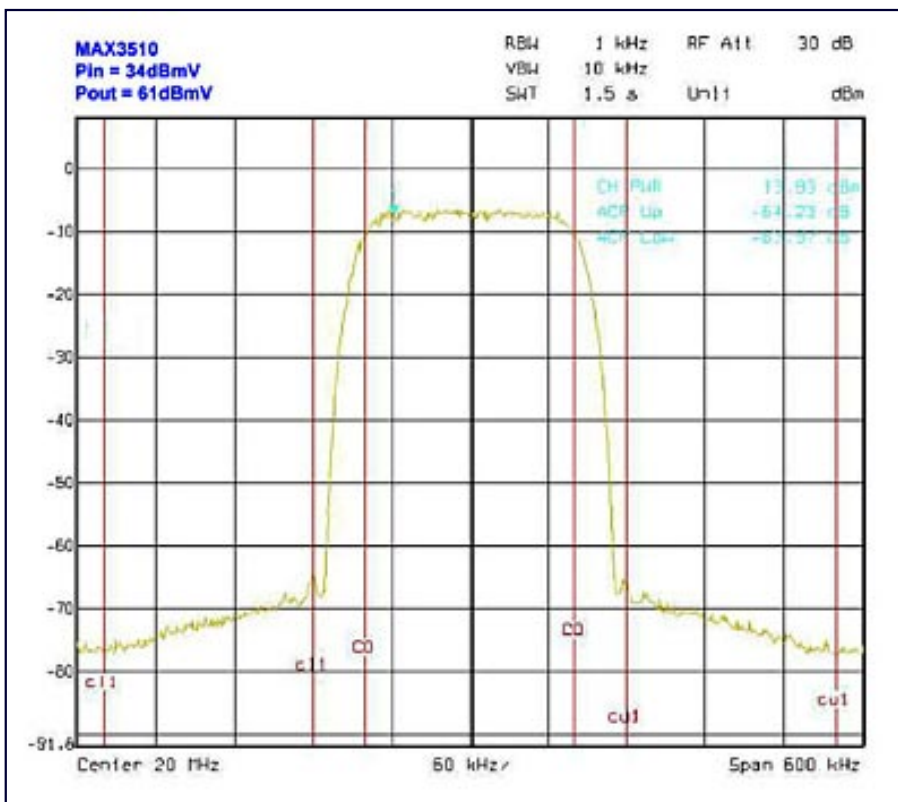


Figure 2.

Table 1. The MAX3510 ACPR vs. Output Power and Frequency

	Input (dBm)	GCW	Output (dBm)	Output (dBmV)	ACPR (dBc)
5MHz	-13	49	4.41	51.41	-66
	-13	52	7.16	54.16	-66
	-13	55	9.92	56.92	-64.5
	-13	59	13.59	60.59	-61.2

	-13	61	15.5	62.5	-51.8
	-13	63	17.03	64.03	-42
20MHz	-13	49	4.03	51.03	-66
	-13	52	6.82	53.82	-65.3
	-13	55	9.59	56.59	-64
	-13	59	13.29	60.29	-60.3
	-13	61	15.19	62.19	-51.7
	-13	63	16.72	63.72	-42.2
	42MHz	-13	50	4.30	51.30
-13		53	7.29	54.29	-63.6
-13		56	10.06	57.06	-61.5
-13		59	12.81	59.81	-58.6
-13		61	14.76	61.76	-50.1
-13		63	16.29	63.29	-41.8
65MHz	-13	50	3.95	50.95	-65.5
	-13	53	6.73	53.73	-62.6
	-13	56	9.5	56.5	-59.6
	-13	59	12.26	59.26	-56.9
	-13	61	14.24	61.24	-50.1
	-13	63	15.76	62.76	-40.5

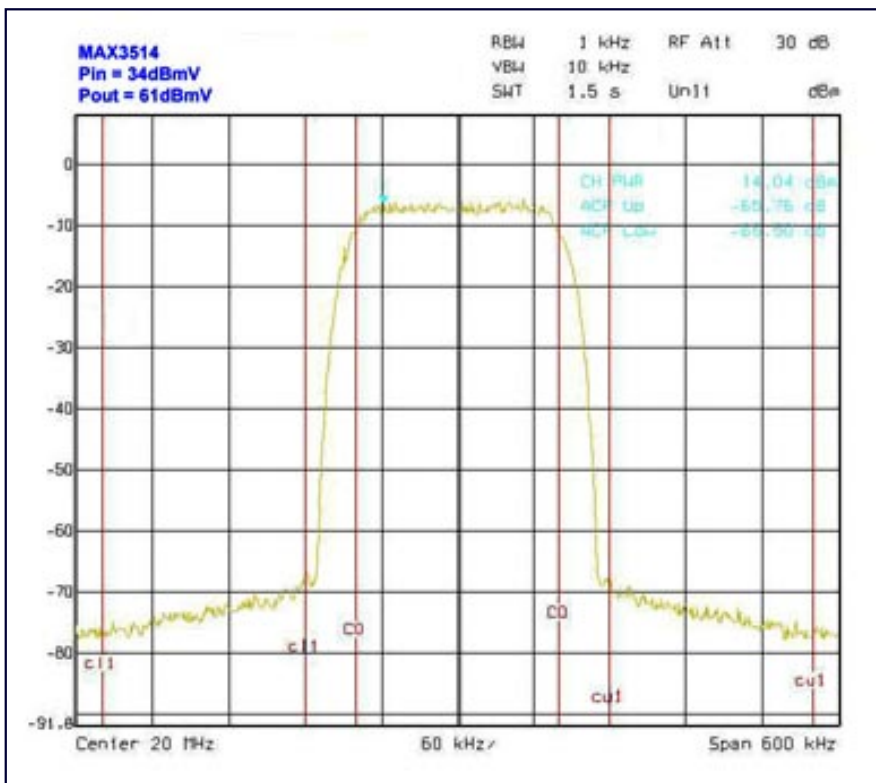


Figure 3.

Table 2. The MAX3514 ACPR vs. Output Power and Frequency

	Input (dBm)	GCW	Output (dBm)	Output (dBmV)	ACPR (dBc)
5MHz	-13	114	9.17	56.17	-66
	-13	120	12.15	59.15	-66
	-13	122	13.14	60.14	-66
	-13	125	14.61	61.61	-66
20MHz	-13	114	9.1	56.1	-66

	-13	120	12.1	59.1	-65
	-13	122	13.09	60.09	-64.5
	-13	125	14.56	61.59	-63.4
42MHz	-13	110	6.85	53.85	-66
	-13	114	8.9	55.9	-64.2
	-13	120	11.87	58.87	-62.9
	-13	122	12.86	59.86	-62.9
	-13	125	14.32	61.32	-61.2
65MHz	-13	112	7.13	54.13	-66
	-13	116	9.11	56.11	-61.5
	-13	122	12.04	59.04	-59.8
	-13	124	13.01	60.01	-58.5
	-13	125	13.5	60.5	-58.2

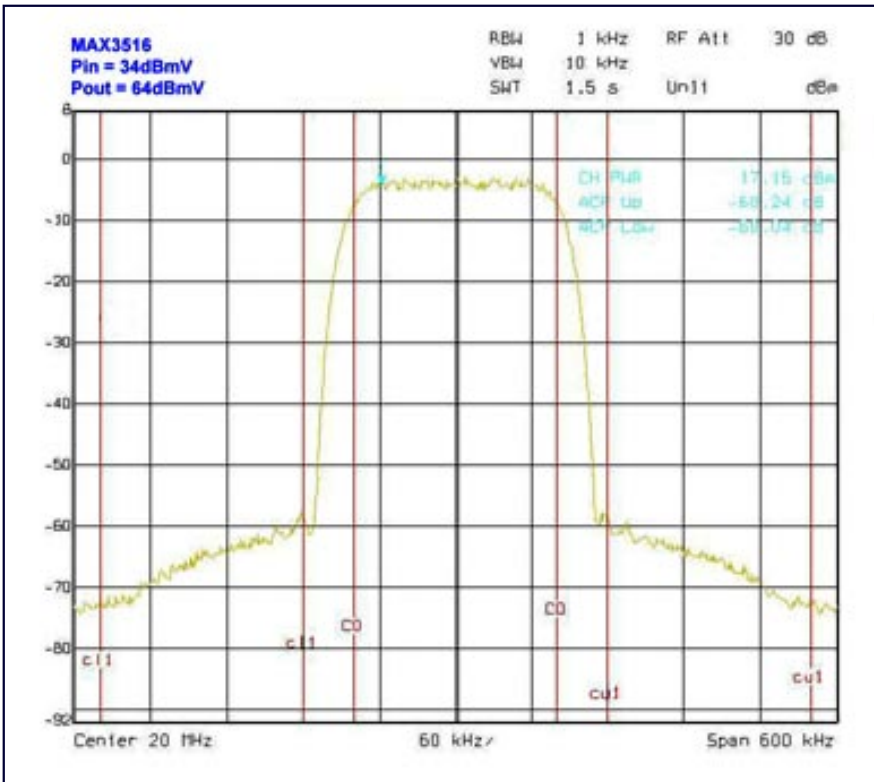


Figure 4.

Table 3. The MAX3516 ACPR vs. Output Power and Frequency

	Input (dBm)	GCW	Output (dBm)	Output (dBmV)	ACPR (dBc)
5MHz	-13	116	13.39	60.39	-66
	-13	120	15.34	62.34	-64.2
	-13	122	16.31	63.31	-63.8
	-13	125	17.68	64.68	-51.6
20MHz	-13	116	13.41	60.41	-66
	-13	120	15.38	62.38	-64.4
	-13	122	16.38	63.36	-61.9
	-13	125	17.74	64.74	-51.2
42MHz	-13	12	11.01	58.01	-66
	-13	116	12.94	59.94	-63.2
	-13	120	14.9	61.9	-61
	-13	122	15.87	62.87	-58.7

	-13	125	17.23	64.23	-48.7
65MHz	-13	112	10.10	57.10	-65
	-13	116	12.18	59.18	-59.4
	-13	120	14.11	61.11	-57.7
	-13	122	15.07	62.07	-55.3
	-13	125	16.42	63.42	-47.4

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### More Information

APP 1745: Sep 25, 2002

<a href="#">MAX3510</a> Upstream CATV Amplifier	<a href="#">Full Data Sheet</a> (PDF, 192kB)
<a href="#">MAX3514</a> Upstream CATV Amplifiers	<a href="#">Full Data Sheet</a> (PDF, 532kB)
<a href="#">MAX3516</a> Upstream CATV Amplifiers	<a href="#">Full Data Sheet Free</a> (PDF, 532kB) <a href="#">Samples</a>



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AN1745, AN 1745, APP1745, Appnote1745, Appnote 1745

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