

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower and upper 1st adjacent channel interferers

Receiver : DELCO
 Model # : 16192463
 Serial # : 1000039
 Date Tested : 10/04/99

Receiver Settings: Balance, Bass and Treble set to center positions
 Graphic Equalizer set to center positions
 AM Stereo set to OFF position
 Loudness set to OFF position

Audio output power level for -47 dBm = 1.2 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer	Upper 1st adjacent channel interferer	Analog Interferer	Hybrid Interferer
	D/U level (dB)	D/U level (dB)	SNR (dB)	SNR (dB)
-47 (Strong)	6	6	15.3	14.7
	12	12	22.1	21.3
	18	18	29.1	28.3
	24	24	35.6	34.9
	30	30	41.3	40.8
-62 (Moderate)	6	6	15.4	14.8
	12	12	22	21.3
	18	18	29	28.3
	24	24	35.5	34.8
	30	30	41.4	40.8
-77 (Weak)	6	6	15.4	14.9
	12	12	22.1	21.6
	18	18	29.3	28.6
	24	24	35.9	35.3
	30	30	41.4	40.9

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower and upper 1st adjacent channel interferers

Receiver : FORD
 Model # : F4XF-19B132-CB
 Serial # : 28115 0B700
 Date Tested : 10/04/99

Audio output power level for -47 dBm = 1.1 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer	Upper 1st adjacent channel interferer	Analog Interferer	Hybrid Interferer
	D/U level (dB)	D/U level (dB)	SNR (dB)	SNR (dB)
-47 (Strong)	6	6	14.3	13.9
	12	12	20.3	19.8
	18	18	26.2	25.8
	24	24	32.2	31.8
	30	30	38.2	37.7
-62 (Moderate)	6	6	14.2	13.8
	12	12	20.1	19.6
	18	18	26.1	25.7
	24	24	32	31.7
	30	30	38	37.6
-77 (Weak)	6	6	14.1	13.6
	12	12	20	19.6
	18	18	26	25.6
	24	24	31.8	31.4
	30	30	37.3	37.1

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower and upper 1st adjacent channel interferers

Receiver : PANASONIC
 Model # : RX-FS430
 Serial # : WP8JE52506
 Date Tested : 10/15/99

Receiver Settings: Tone Control set to center position
 Tuning adjusted until optimal combination of low distortion and high output power level at the volume setting obtained at test frequency & RF level

Audio output power level for -47 dBm = 0.25 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer	Upper 1st adjacent channel interferer	Analog Interferer	Hybrid Interferer
	D/U level (dB)	D/U level (dB)	SNR (dB)	SNR (dB)
-47 (Strong)	6	6	18	17.4
	12	12	23.9	23.2
	18	18	29.8	29.3
	24	24	35.8	35.3
	30	30	41.7	41.2
-62 (Moderate)	6	6	18.3	17.8
	12	12	24.2	23.7
	18	18	30.2	29.6
	24	24	36	35.6
	30	30	41.1	40.5
-77 (Weak)	6	6	18.1	17.3
	12	12	23.7	23.2
	18	18	28.8	28
	24	24	32.4	31.7
	30	30	33.9	33

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower and upper 1st adjacent channel interferers

Receiver : PIONEER
 Model # : VSX-D307
 Serial # : SKDI083167US
 Date Tested : 10/05/99

Receiver Settings: Balance, Bass and Treble set to center positions
 Dolby Pro-Logic set to OFF position
 Dolby Virtual set to OFF position
 Surround Sound set to OFF position
 DSP mode set to OFF position
 Loudness set to OFF position
 MPX mode turned ON to "mono" for AM and mono FM testing
 MPX mode turned OFF to "stereo" for stereo FM testing

Audio output power level for -47 dBm = 1.0 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer D/U level (dB)	Upper 1st adjacent channel interferer D/U level (dB)	Analog Interferer	Hybrid Interferer
			SNR (dB)	SNR (dB)
-47 (Strong)	6	6	16.9	16.3
	12	12	22.9	22.3
	18	18	28.9	28.2
	24	24	34.8	34.1
	30	30	40.5	39.9
-62 (Moderate)	6	6	17	16.2
	12	12	22.9	22.1
	18	18	28.8	28.1
	24	24	34.7	34.1
	30	30	40.3	39.5
-77 (Weak)	6	6	16.6	5.2-6.9
	12	12	22.5	11.3-12.5
	18	18	28.1	16.2-18.3
	24	24	32.9	20.1-22.2
	30	30	36.1	22.3-25.1

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower and upper 1st adjacent channel interferers

Receiver : SONY
 Model # : STR-DE425
 Serial # : 8839190
 Date Tested : 10/05/99

Receiver Settings: Balance, Bass and Treble set to center positions
 5.1 DVD input set to OFF position
 Bass Boost set to OFF position
 Surround Sound set to OFF position
 Setup mode set to NORMAL

Audio output power level for -47 dBm = 1.0 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer	Upper 1st adjacent channel interferer	Analog Interferer	Hybrid Interferer
	D/U level (dB)	D/U level (dB)	SNR (dB)	SNR (dB)
-47 (Strong)	6	6	13.6	13.2
	12	12	19.6	19.1
	18	18	25.5	25.1
	24	24	31.5	31.1
	30	30	37.4	37
-62 (Moderate)	6	6	13.4	13.1
	12	12	19.4	19
	18	18	25.3	25
	24	24	31.3	31
	30	30	37	36.8
-77 (Weak)	6	6	12.9	13.1
	12	12	18.2-20.9	19
	18	18	24.6	24.9
	24	24	27.4-30.4	30.2
	30	30	34.1	34.5

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower 1st adjacent and co-channel interferers

Receiver : DELCO
 Model # : 16192463
 Serial # : 1000039
 Date Tested : 10/04/99

Receiver Settings: Balance, Bass and Treble set to center positions
 Graphic Equalizer set to center positions
 AM Stereo set to OFF position
 Loudness set to OFF position

Audio output power level for -47 dBm = 1.2 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer D/U level (dB)	Co-channel interferer D/U level (dB)	Analog Interferer SNR (dB)	Hybrid interferer SNR (dB)
-47 (Strong)	6	18	16.3	11.8-15.6
	12	24	23.1	22.3
	18	30	30.1	29.3
	24	36	36.4	35.6
-62 (Moderate)	6	18	16.3	12.9-15.7
	12	24	23.1	22.3
	18	30	30.1	29.2
	24	36	36.5	35.7
-77 (Weak)	6	18	16.5	12.2-16.4
	12	24	23.5	22.5
	18	30	30.3	29.6
	24	36	36.7	35.9

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower 1st adjacent and co-channel interferers

Receiver : **FORD**
 Model # : **F4XF-19B132-CB**
 Serial # : **28115 0B700**
 Date Tested : 10/04/99

Audio output power level for -47 dBm = 1.1 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer D/U level (dB)	Co-channel interferer D/U level (dB)	Analog Interferer SNR (dB)	Hybrid interferer SNR (dB)
-47 (Strong)	6	18	15.5	14.6
	12	24	21.5	20.7
	18	30	27.6	26.7
	24	36	33.5	32.6
-62 (Moderate)	6	18	11.7-17.7	14.5
	12	24	21.5	20.7
	18	30	27.5	26.6
	24	36	33.4	32.5
-77 (Weak)	6	18	11.7-17.7	14.5
	12	24	21.4	20.5
	18	30	27.3	26.5
	24	36	33.1	32.4

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower 1st adjacent and co-channel interferers

Receiver : PANASONIC
 Model # : RX-FS430
 Serial # : WP8JE52506
 Date Tested : 10/18/99

Receiver Settings: Tone Control set to center position
 Tuning adjusted until optimal combination of low distortion and high output power level at the volume setting obtained at test frequency & RF level

Audio output power level for -47 dBm = 0.25 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer D/U level (dB)	Co-channel interferer D/U level (dB)	Analog Interferer SNR (dB)	Hybrid interferer SNR (dB)
-47 (Strong)	6	18	19.5	18.6
	12	24	25.9	25
	18	30	31.2	30.5
	24	36	37.2	36.4
-62 (Moderate)	6	18	19.5	18.8
	12	24	26.2	25.5
	18	30	32.2	31.5
	24	36	38	37.3
-77 (Weak)	6	18	19.6	18.5
	12	24	25.6	25
	18	30	30.7	30.4
	24	36	34.3	34.4

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower 1st adjacent and co-channel interferers

Receiver : PIONEER
 Model # : VSX-D307
 Serial # : SKDI083167US
 Date Tested : 10/05/99

Receiver Settings: Balance, Bass and Treble set to center positions
 Dolby Pro-Logic set to OFF position
 Dolby Virtual set to OFF position
 Surround Sound set to OFF position
 DSP mode set to OFF position
 Loudness set to OFF position
 MPX mode turned ON to "mono" for AM and mono FM testing
 MPX mode turned OFF to "stereo" for stereo FM testing

Audio output power level for -47 dBm = 1.0 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer D/U level (dB)	Co-channel interferer D/U level (dB)	Analog Interferer SNR (dB)	Hybrid interferer SNR (dB)
-47 (Strong)	6	18	18.3	17.4
	12	24	24.1	23.4
	18	30	30.1	29.5
	24	36	36	35.4
-62 (Moderate)	6	18	18.2	17.7
	12	24	24.2	23.4
	18	30	30.2	29.3
	24	36	35.9	35.4
-77 (Weak)	6	18	17.7	17.1
	12	24	23.6	23.1
	18	30	29.2	28.5
	24	36	33.6	33.4

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

AM Tests - Analog Performance in the presence of interferers

Simultaneous lower 1st adjacent and co-channel interferers

Receiver : SONY
 Model # : STR-DE425
 Serial # : 8839190
 Date Tested : 10/05/99

Receiver Settings: Balance, Bass and Treble set to center positions
 5.1 DVD input set to OFF position
 Bass Boost set to OFF position
 Surround Sound set to OFF position
 Setup mode set to NORMAL

Audio output power level for -47 dBm = 1.0 Watts				
Desired Signal				
RF Level (dBm)	Lower 1st adjacent channel interferer D/U level (dB)	Co-channel interferer D/U level (dB)	Analog Interferer SNR (dB)	Hybrid interferer SNR (dB)
-47 (Strong)	6	18	14.7	13.9
	12	24	20.5	19.9
	18	30	26.5	25.9
	24	36	32.5	31.8
-62 (Moderate)	6	18	14	13.7
	12	24	20.2	19.7
	18	30	26.2	25.8
	24	36	32	31.7
-77 (Weak)	6	18	11.6	13.8
	12	24	17.6	19.8
	18	30	18.3-19.5	25.6
	24	36	23.8	30.8

- Notes:
- Desired Signal: USADR AM Exciter Module - 1660 kHz, modulated with a 1 kHz tone, set to 100% modulation.
 - Undesired #1 Analog and Hybrid Signals: Xetron Upconverter #1, HP3325B Function Generator #1, Summer Ckt #1 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1670 kHz, set to 100% modulation using a 1 kHz tone.
 - Undesired #2 Analog and Hybrid Signals: Xetron Upconverter #2, HP3325B Function Generator #2, Summer Ckt #2 to add DC carrier, For the analog interferer, the analog only 9.5 kHz BW CD used and for the hybrid interferer, the hybrid with 4.5 kHz analog and 140% peak clip CD used. - 1650 kHz, set to 100% modulation using a 1 kHz tone.
 - SNR measurements performed with a 1 kHz tone, 100% modulation.
 - The SNR for the desired signal was measured by taking the ratio of the audio output with the desired signal and interferers present, where the desired signal was modulated using a 1 kHz tone, to the audio output level with an unmodulated desired signal and interferers present.
 - The modulation level of the desired and interfering signals set using an oscilloscope.
 - Measurements made using a CCIR weighting filter and a quasi-peak detector.
 - All measurements made using the 30 kHz LPF on the HP 8903B turned on.

4. Conclusions

The results show that introduction of hybrid signals in co-, first, and second adjacent channels do not have a significant impact on analog AM receivers.

Appendix N

AM Receiver Characterizations

1. Introduction

To complement its AM compatibility testing, Xetron ran several characterization measurements on the five receivers used. The specific radios that were tested are listed in Table N-1. The receiver characterization consisted of measuring the frequency response, THD, and SNR of the AM portion of each receiver. These characterization measurements are important because they provide a detailed understanding of the receivers under test and help to interpret the compatibility data presented in Appendix M.

Table N-1 Receivers used in AM compatibility tests.

Make and Model	Type
Delco, Model 16192463	Automotive
Ford, Model F4XF-19B132-CB	Automotive
Panasonic, Model Rx-FS430	Portable
Pioneer, Model VSX-D307	Home
Sony, Model STR-DE425	Home

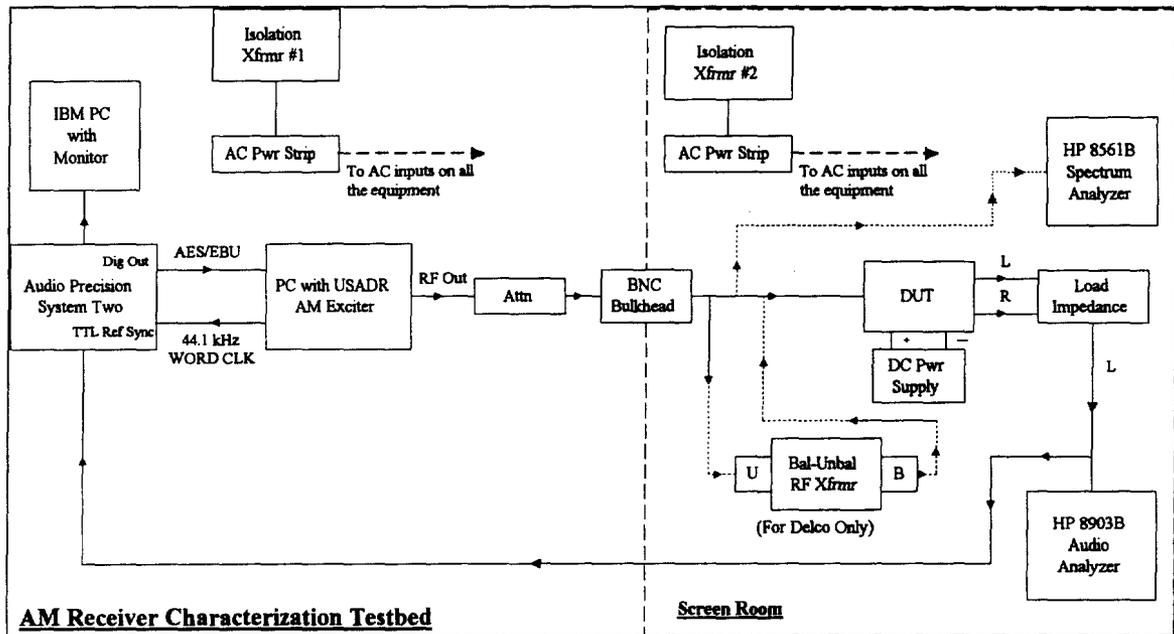
2. Analysis and Conclusions

From the results of these measurements, the following general conclusions can be drawn. First, for all the receivers tested the frequency response begins to roll off at approximately 2 kHz and is attenuated by about 20 dB by 5 kHz. Secondly, for all the receivers tested the THD is less than 10% for the 100 Hz to 5 kHz frequency range and then increases sharply above 5 kHz. These receiver characterizations indicate that increasing the AM bandwidth beyond 5 kHz may actually decrease sound quality; thus, validating the current AM IBOC hybrid system design limiting the analog radio to ± 5 kHz bandwidth.

3. Test Procedures

The following sections describe the test procedures used for each portion of the AM receiver characterization performed by Xetron.

The equipment set-up used to perform the AM receiver characterization is shown in the figure below.



As shown in the above figure, isolation transformers were used to power all the equipment in the test bed so that ground loops could be prevented. The digital output from an Audio Precision System Two, in AES/EBU format, was input to the USADR AM exciter. A 44.1 kHz signal from the exciter was used to synchronize the data from the sound card to the exciter clock. The RF signal from the exciter was input to an attenuator so that the proper signal level could be set. The attenuator output was input to a screen room where the receivers were located. The screen room served to attenuate unwanted signals. To test the Delco receiver, a Mini Circuits FTB1-1 RF transformer was used to prevent the shorting of the DC power supply powering the radio. The signal input to the radios could be input to an HP 8591E Spectrum Analyzer to set the power levels of the signals and to monitor the spectrums of the signals. The desired and interfering signals were input to the Device Under Test (DUT). The receiver outputs were input to load impedances of 4 ohms for the automobile and portable receivers and 8 ohms for the home receivers. The signal from the load impedances was input to either a HP 8903B Audio Analyzer or the Audio Precision System Two, depending on the receiver parameter being measured.

The modification made to the antenna of the Panasonic radio, described in the Xetron AM Compatibility Testing section (Appendix M), was also used during AM receiver characterization.

RF level refers to the available RF power at the input to the DUT. To set these levels, the signal was input to the spectrum analyzer with an input impedance of 50 Ω . The final RF attenuator settings were adjusted until the unmodulated AM carrier, as measured by the spectrum analyzer, was at the desired RF level. The spectrum analyzer and the receiver were not simultaneously connected to the RF signal.

For all measurements, the following test conditions were used:

RF input power level of -47 dBm was used unless otherwise noted.

SNR measurements were made using unweighted and CCIR-468 weighting. Automobile and portable receivers were connected to 4 Ω loads. Home receivers were connected to 8 Ω loads. Tone controls were set to center positions. Balance and fade controls were set to center positions. Loudness control, if available, was set to off position. All measurements were taken using the left channel unless otherwise noted. The 30 kHz LPF on the Audio Analyzer was turned on. The receiver tuning frequency was 1660 kHz.

3.1. Frequency Response

The frequency response for each receiver was measured using an RF level of -47 dBm and 80% modulation set with a 1 kHz tone. The frequency response was measured from 20 Hz to 10 kHz. The audio output power for each receiver was measured using a 1 kHz tone. Measurements of the frequency response were made using the Audio Precision System Two Analyzer.

3.2. THD

The THD of each receiver was measured using a 400 Hz tone at 80% modulation. The measurements were made at an RF level of -47 dBm. At this RF level, measurements were taken over a range of volume settings, including the maximum audio power output setting. Measurements were taken using the HP 8903B Audio Analyzer. In addition to these measurements, the Audio Precision System Two was used to plot the THD, as a function of frequency, of each receiver at an RF level of -47 dBm. The plots were made over a frequency range of 20 Hz to 10 kHz and the audio output level was set to a mid-range level.

3.3. Signal-to-Noise Ratio

The SNR versus RF level of each receiver was measured using a 400 Hz tone at 80% modulation. The RF level was swept from -40 dBm to -130 dBm, in 5 dB steps. The audio output power level was set to a mid-range level when the RF level was set to -40 dBm. Measurements were made with and without CCIR 468 weighting. Measurements were taken using the HP 8903B Audio Analyzer. The audio output level, with and without modulation present, was measured. The ratio of the audio output with modulation to the audio output without modulation was used to calculate the SNR.

4. Receiver Characterization Results

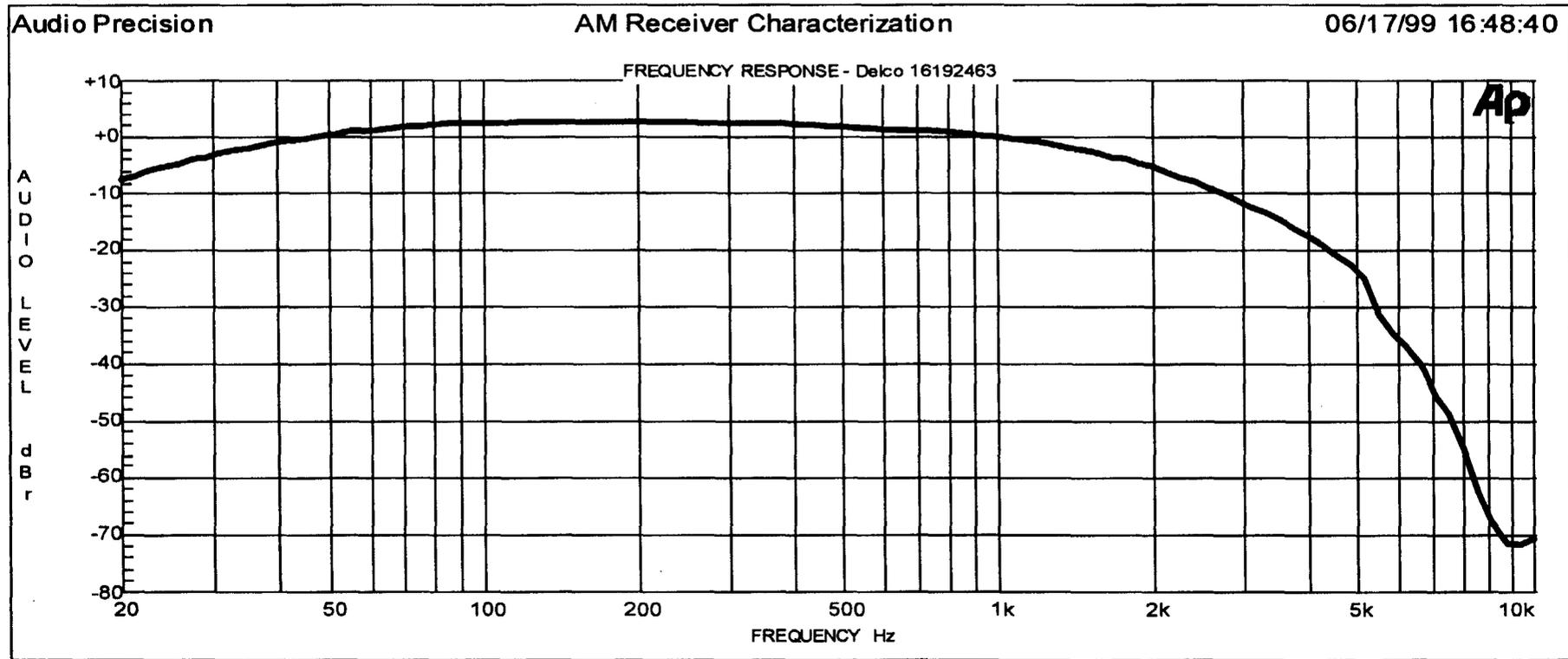
The following graphs and tables present the results of the AM receiver characterization measurements. The results are presented in the following order: Frequency Response; THD; and SNR vs. RF Level.

Receiver Characterization - For AM
Frequency Response

Receiver : **DELCO**
Model # : **16192463**
Serial # : **1000039**
Date Tested : **06/17/99**

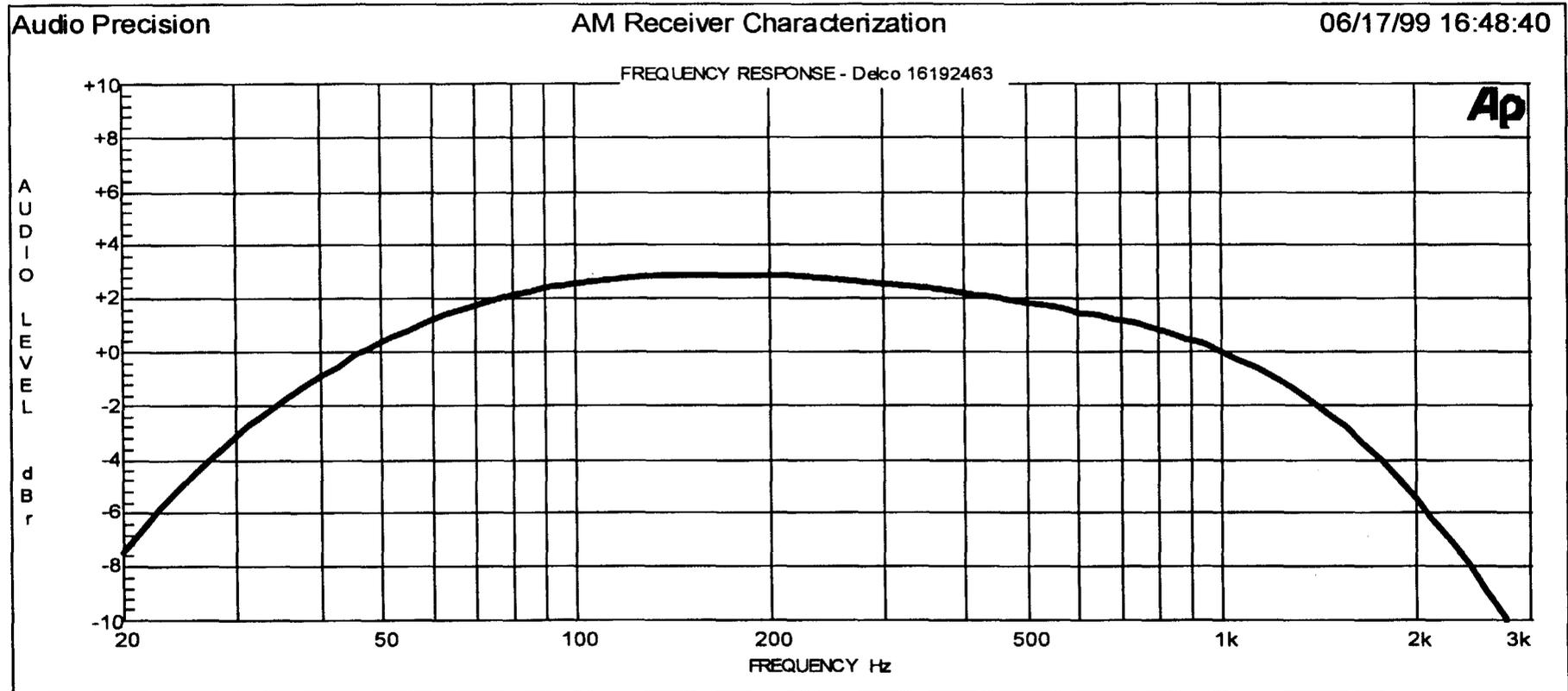
Receiver Settings: Balance, Bass and Treble set to center positions
Graphic Equalizer set to center positions
AM Stereo set to OFF position
Loudness set to OFF position

80% Modulation
RF Level : -47dBm
Audio output power level: 1.1 Watts (=0 dB, set at 1 kHz)
Load impedance: 4 ohms



Receiver Characterization - For AM
Frequency Response - Zoom

Receiver : **DELCO**
Model # : **16192463**
Serial # : **1000039**
Date Tested : 06/17/99



Receiver Characterization - For AM

Frequency Response

Receiver : **FORD**

Model # : **F4XF-19B132-CB**

Serial # : **28115 0B700**

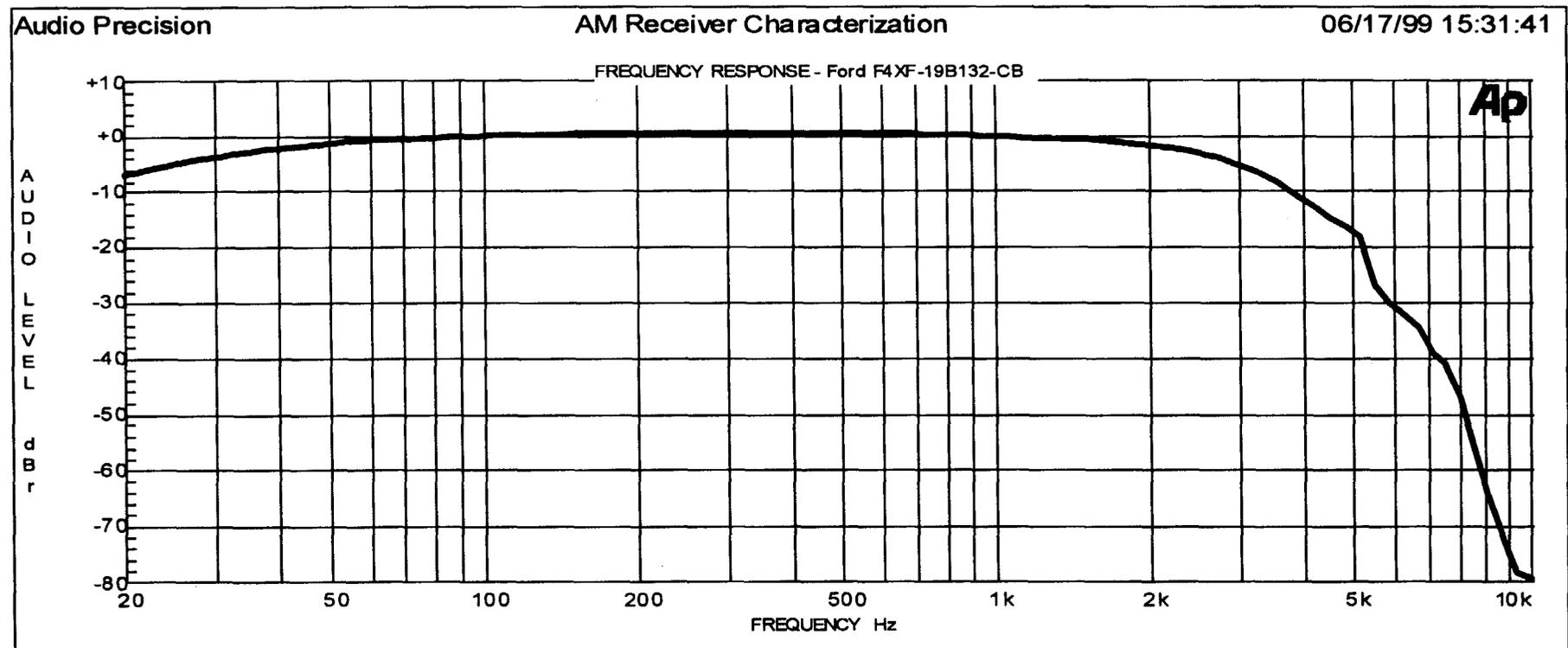
Date Tested : 06/17/99

80% Modulation

RF Level : -47dBm

Audio output power level: 1.1 Watts (=0 dB, set at 1 kHz)

Load impedance: 4 ohms

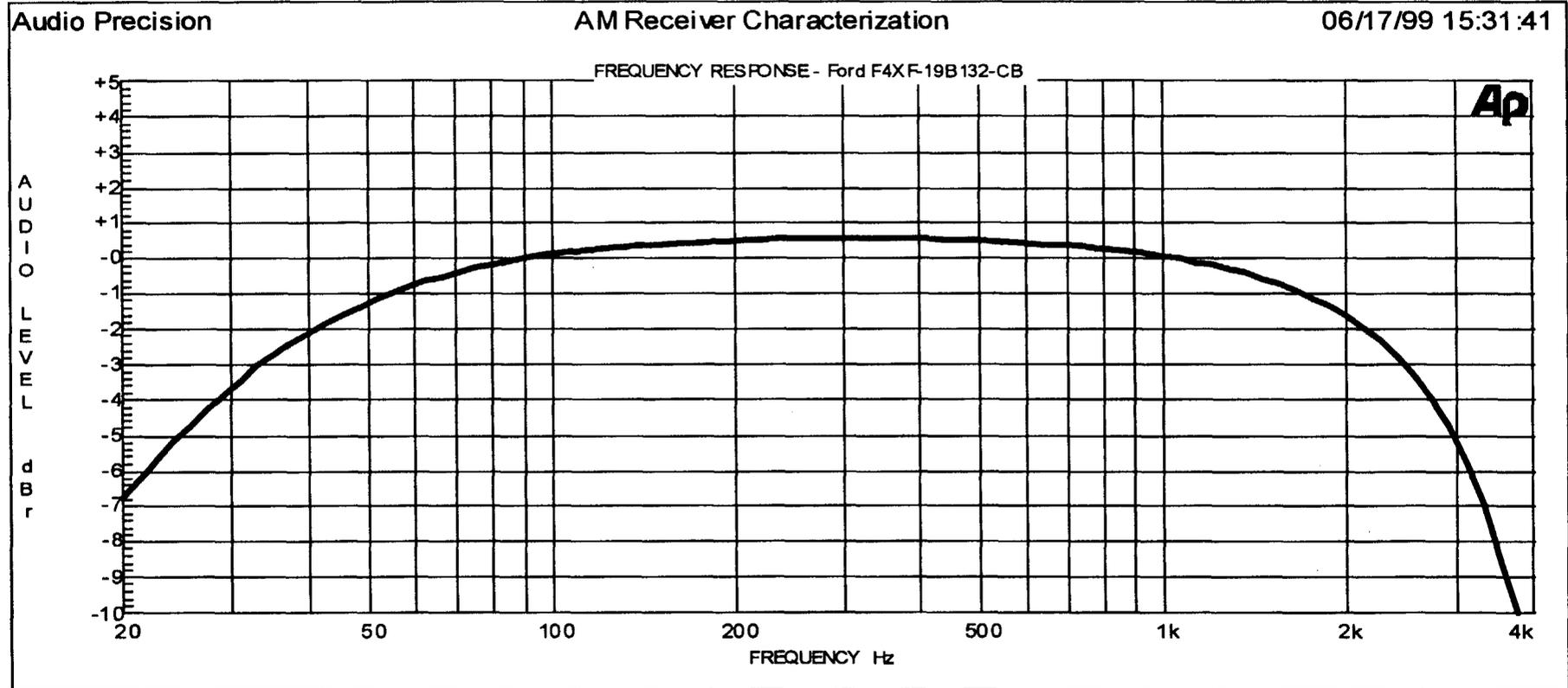


Receiver Characterization - For AM

Frequency Response - Zoom

Receiver : **FORD**
Model # : **F4XF-19B132-CB**
Serial # : **28115 0B700**

Date Tested : 06/17/99



Receiver Characterization - For AM

Frequency Response

Receiver : PANASONIC

Model # : RX-FS430

Serial # : WP8JE52506

Date Tested : 06/17/99

Receiver Settings: Tone Control set to center position

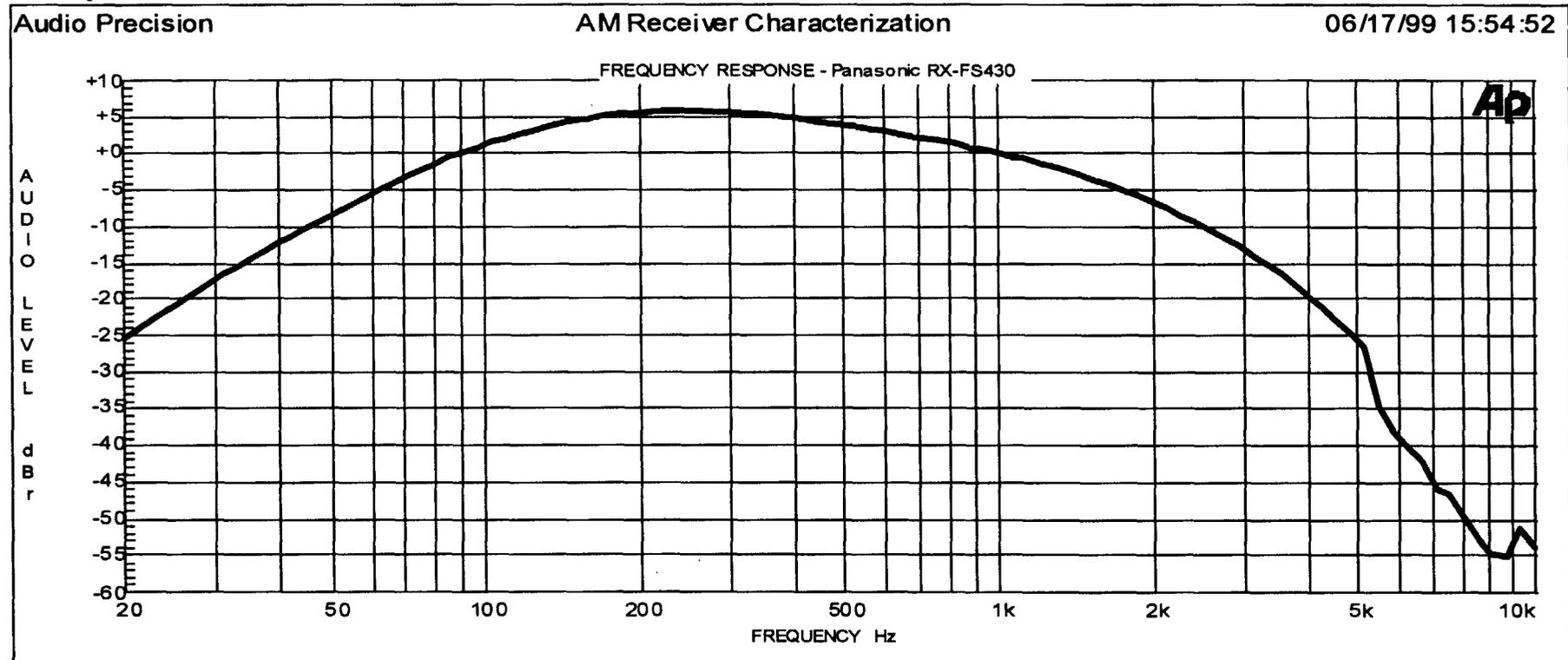
Tuning adjusted until minimum distortion obtained at RF level

80% Modulation

RF Level : -47dBm

Audio output power level: 0.25 Watts (=0 dB, set at 1 kHz)

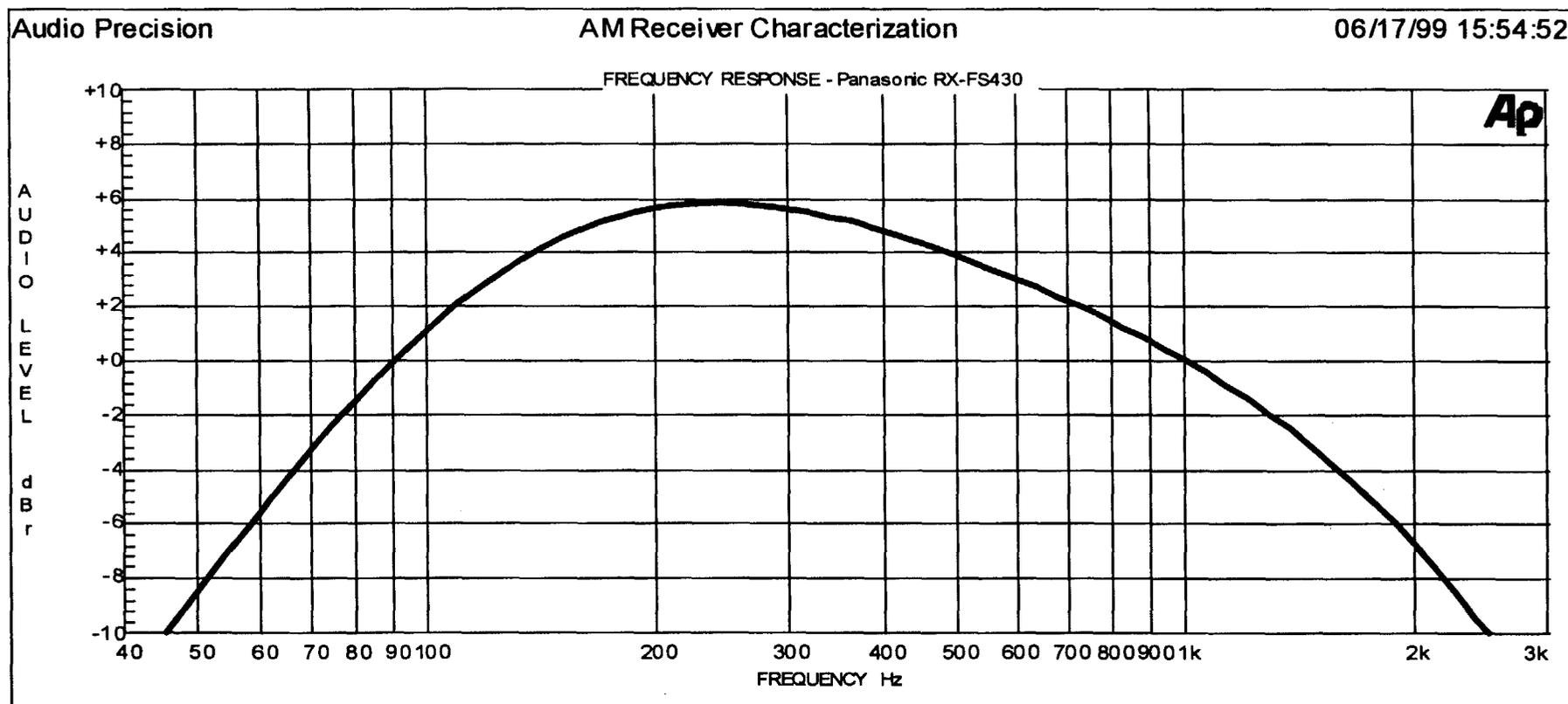
Load impedance: 4 ohms



Receiver Characterization - For AM

Frequency Response - Zoom

Receiver : PANASONIC
Model # : RX-FS430
Serial # : WP8JE52506
Date Tested : 06/17/99



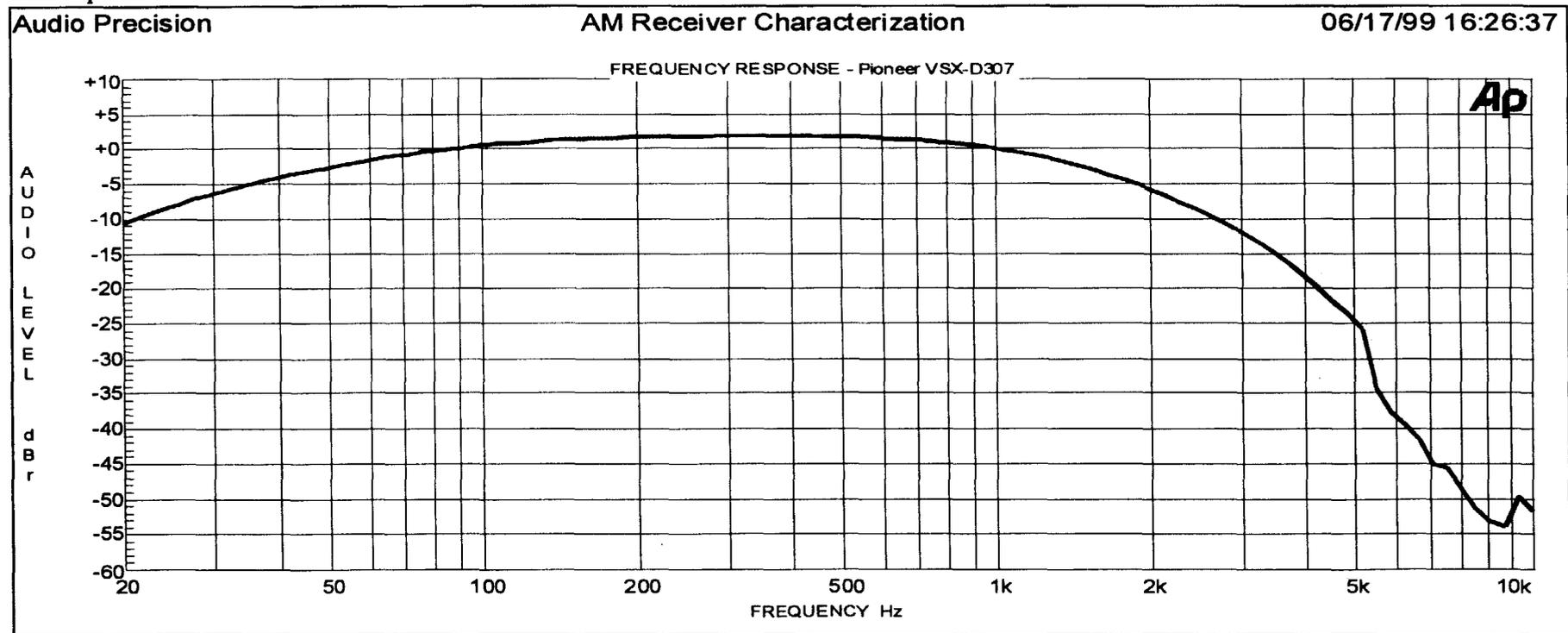
Receiver Characterization - For AM

Frequency Response

Receiver : **PIONEER**
Model # : **VSX-D307**
Serial # : **SKDI083167US**
Date Tested : 06/17/99

Receiver Settings: Balance, Bass and Treble set to center positions
Dolby Pro-Logic set to OFF position
Dolby Virtual set to OFF position
Surround Sound set to OFF position
DSP mode set to OFF position
Loudness set to OFF position
MPX mode turned ON to "mono" for AM and mono FM testing
MPX mode turned OFF to "stereo" for stereo FM testing

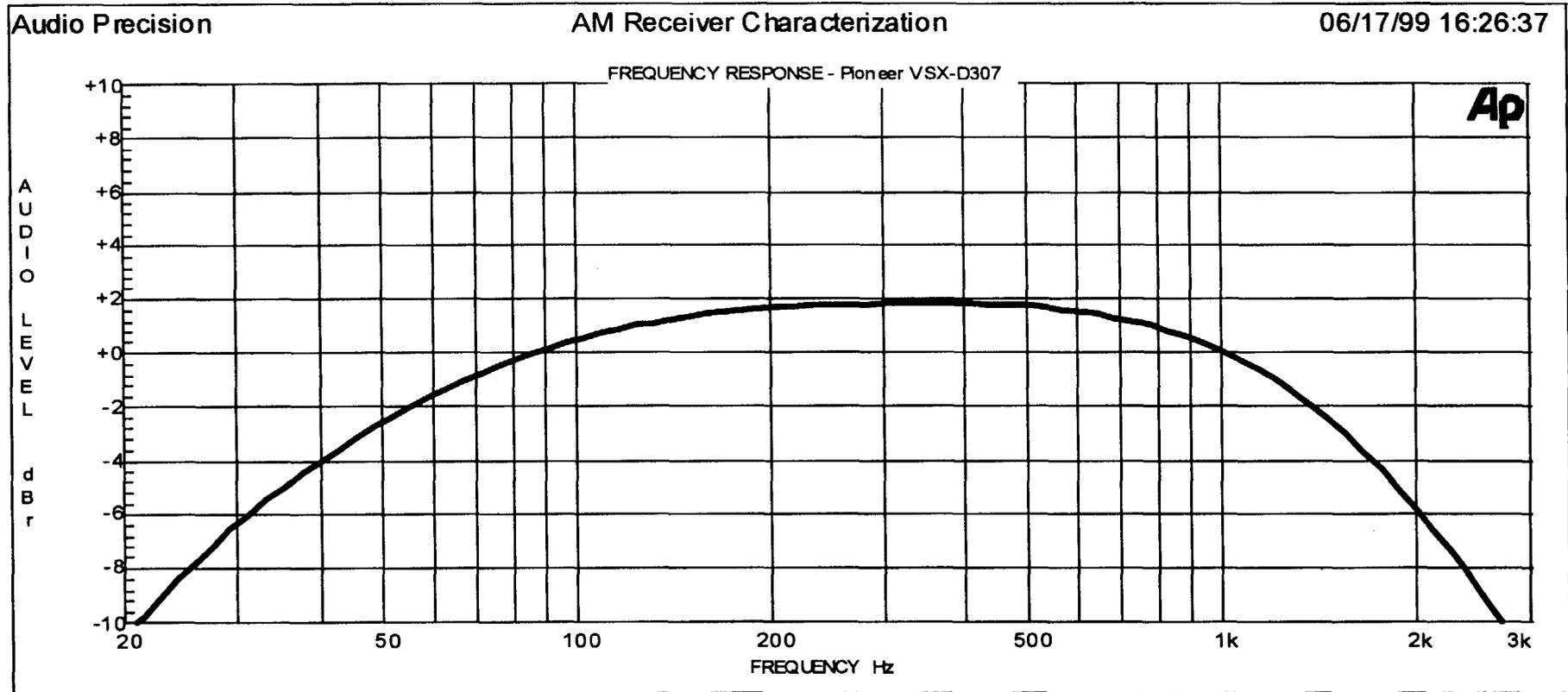
80% Modulation
RF Level : -47dBm
Audio output power level: 1.0 Watts (=0 dB, set at 1 kHz)
Load impedance: 8 ohms



Receiver Characterization - For AM

Frequency Response - Zoom

Receiver : PIONEER
Model # : VSX-D307
Serial # : SKDI083167US
Date Tested : 06/17/99



Receiver Characterization - For AM

Frequency Response

Receiver : SONY
Model # : STR-DE425
Serial # : 8839190

Date Tested : 06/17/99

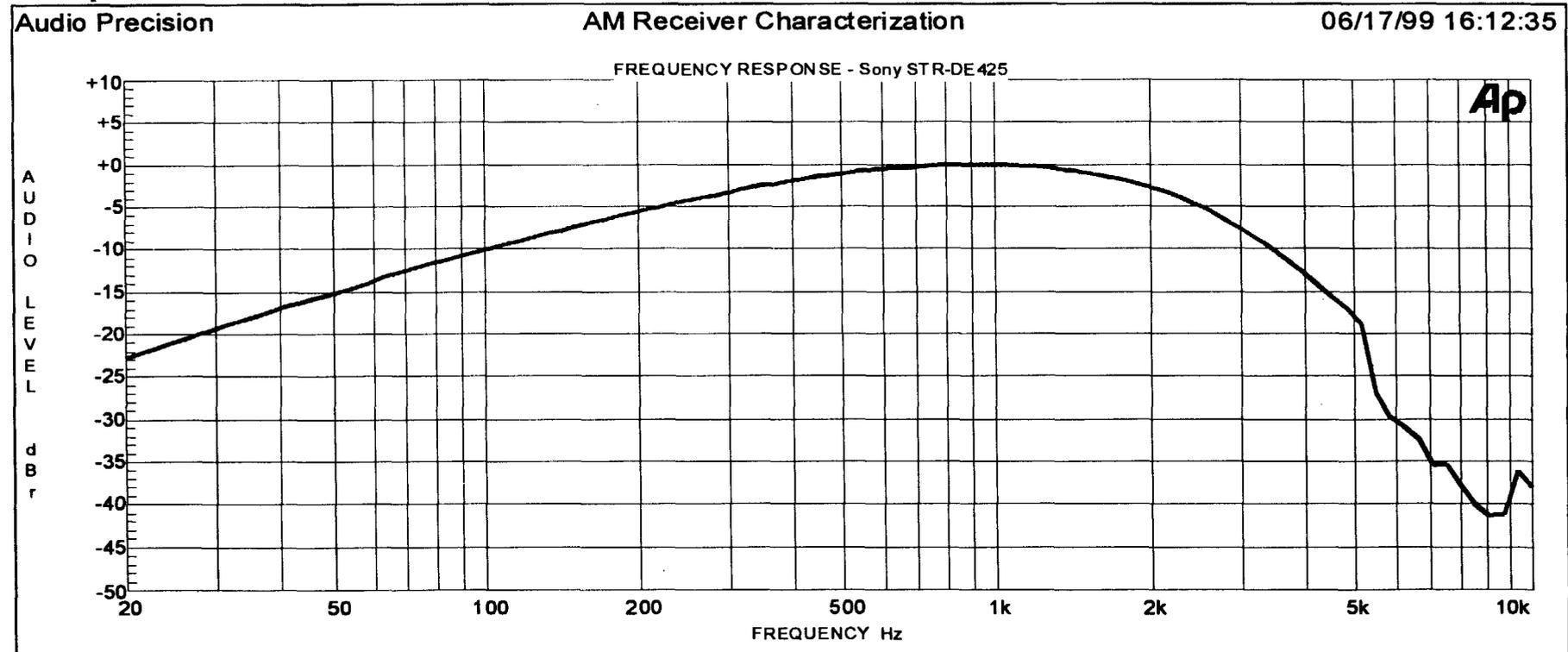
80% Modulation

RF Level : -47dBm

Audio output power level: 1.0 Watts (=0 dB, set at 1 kHz)

Load Impedance: 8 ohms

Receiver Settings: Balance, Bass and Treble set to center positions
5.1 DVD input set to OFF position
Bass Boost set to OFF position
Surround Sound set to OFF position
Setup mode set to NORMAL



Receiver Characterization - For AM

Frequency Response - Zoom

Receiver : SONY
Model # : STR-DE425
Serial # : 8839190
Date Tested : 06/17/99

