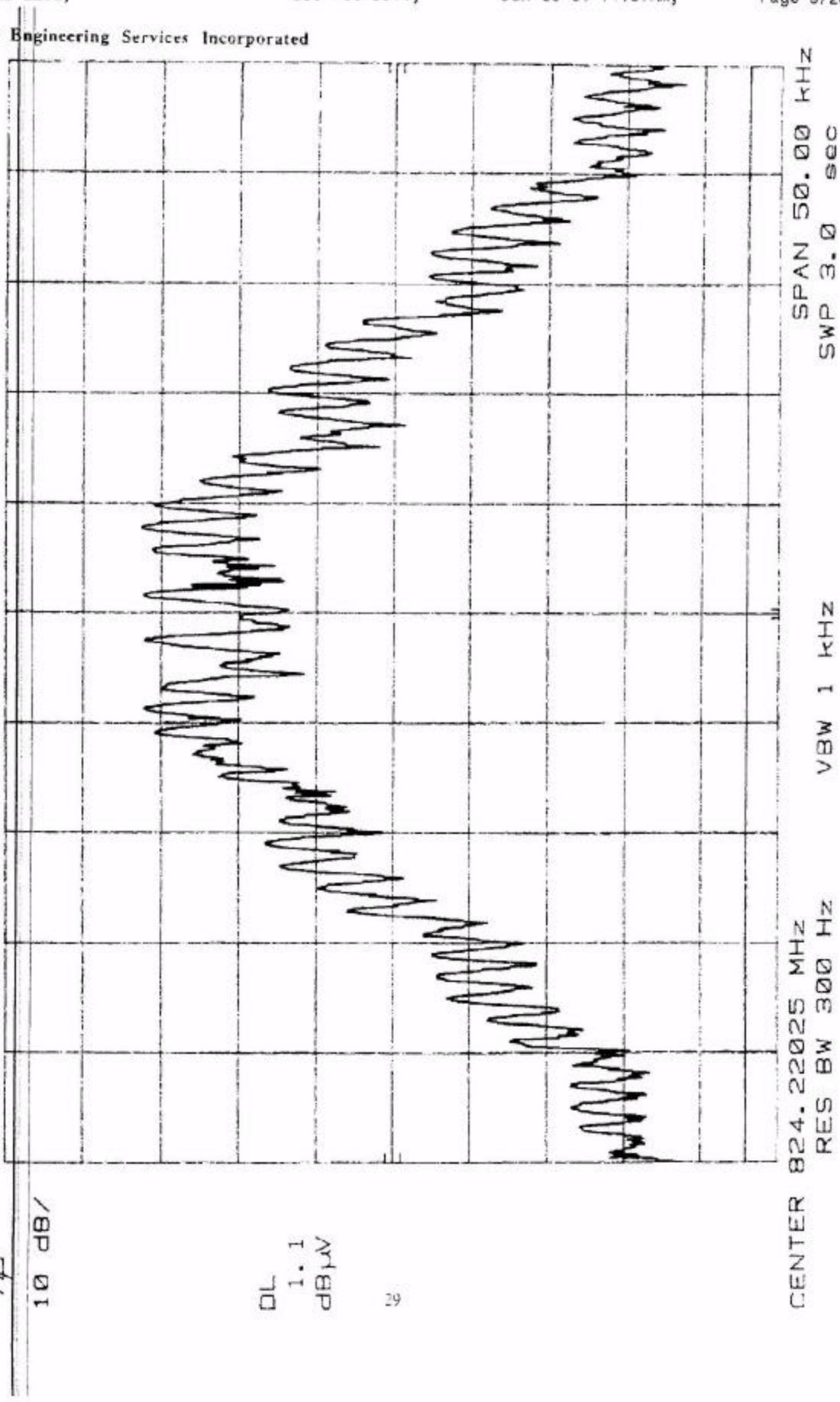

Figure 5.2.3 - 3:
Cellular Phone Output resulting from a 1 kHz Audio Tone
(this signal was the input to the EUT)

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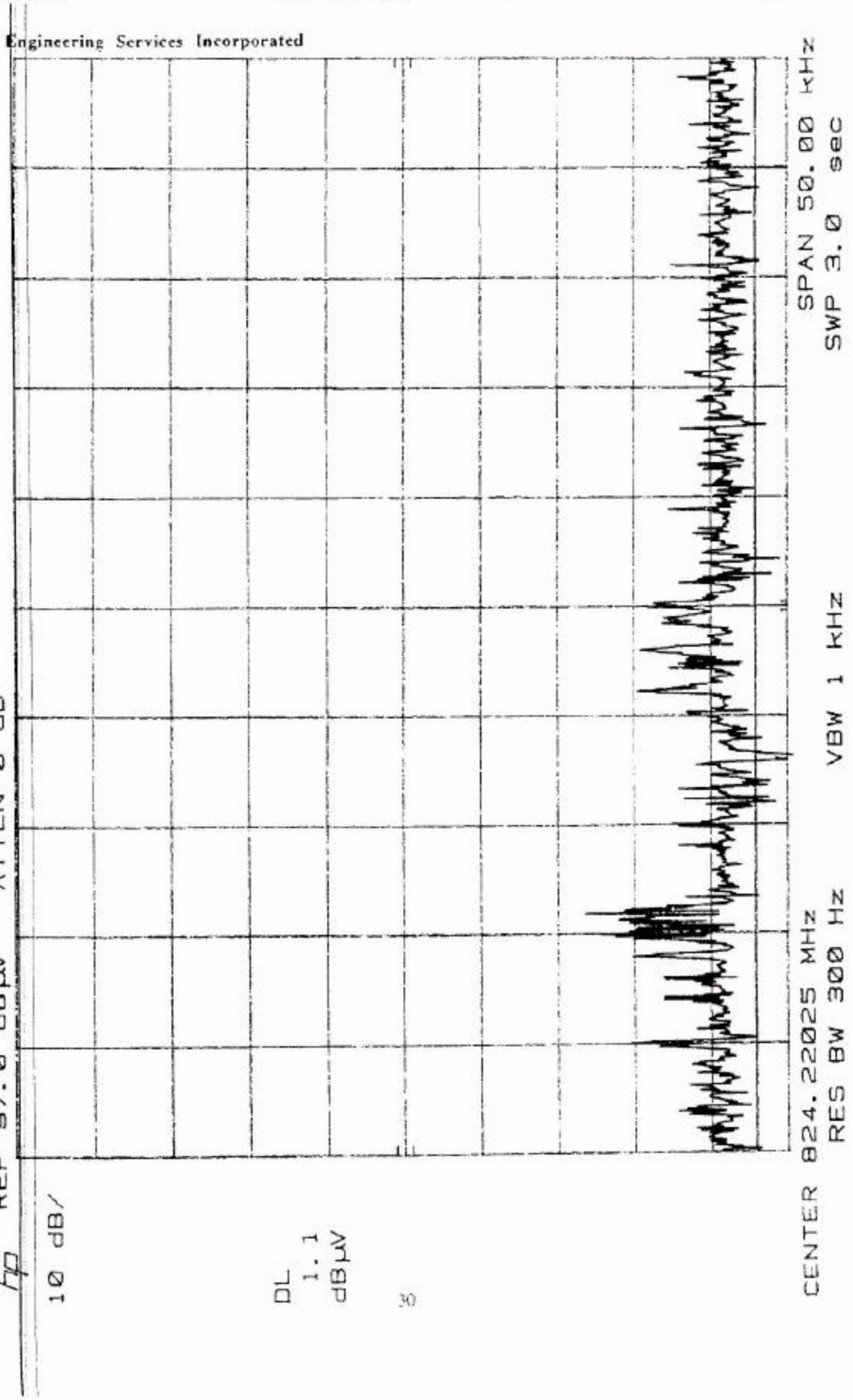

Figure 5.2.3 - 4:
EUT Output (padded down) MINUS Cellular Phone Output
(1 kHz Audio Tone Case)

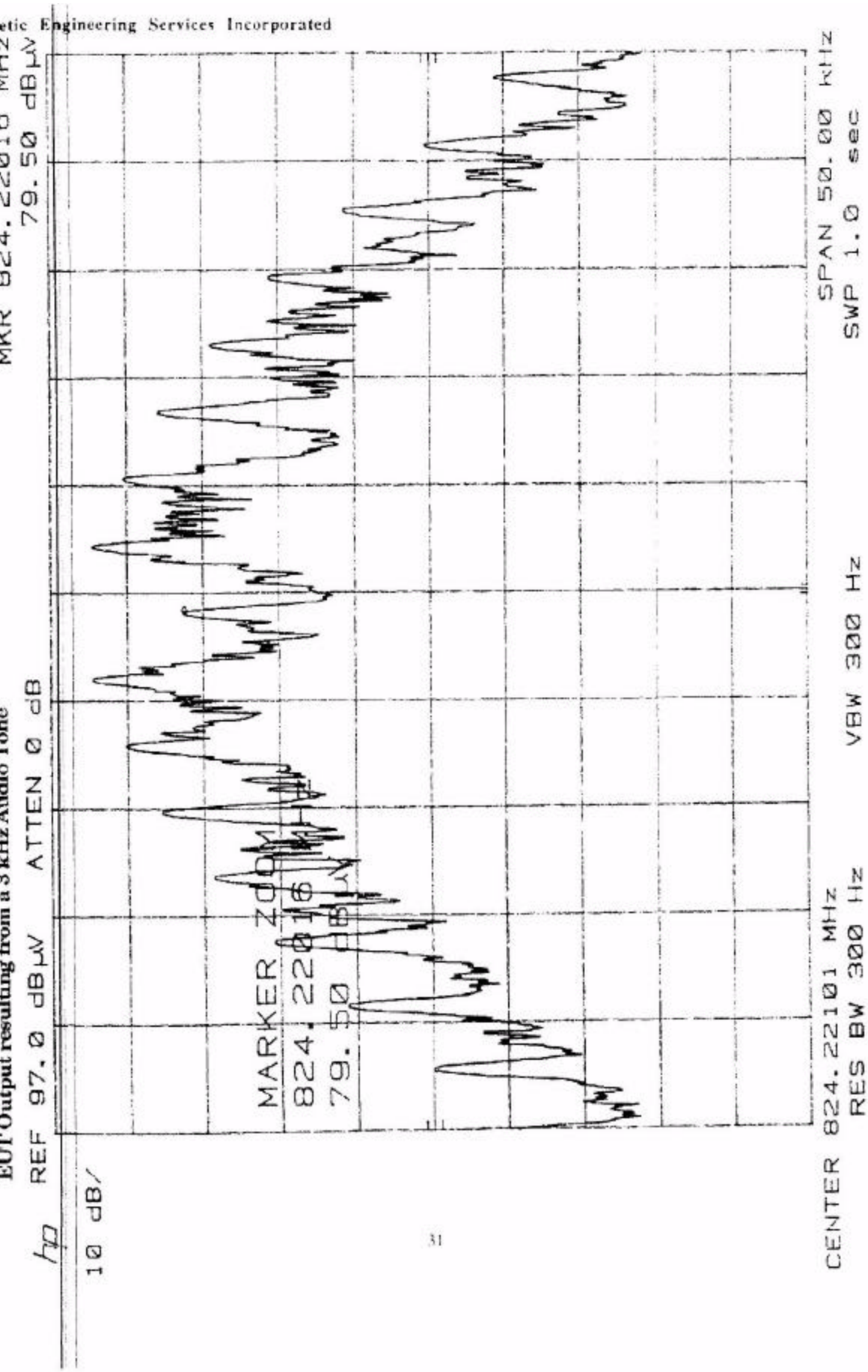

Figure 5.2.3 - 5:
EUT Output resulting from a 3 kHz Audio Tone

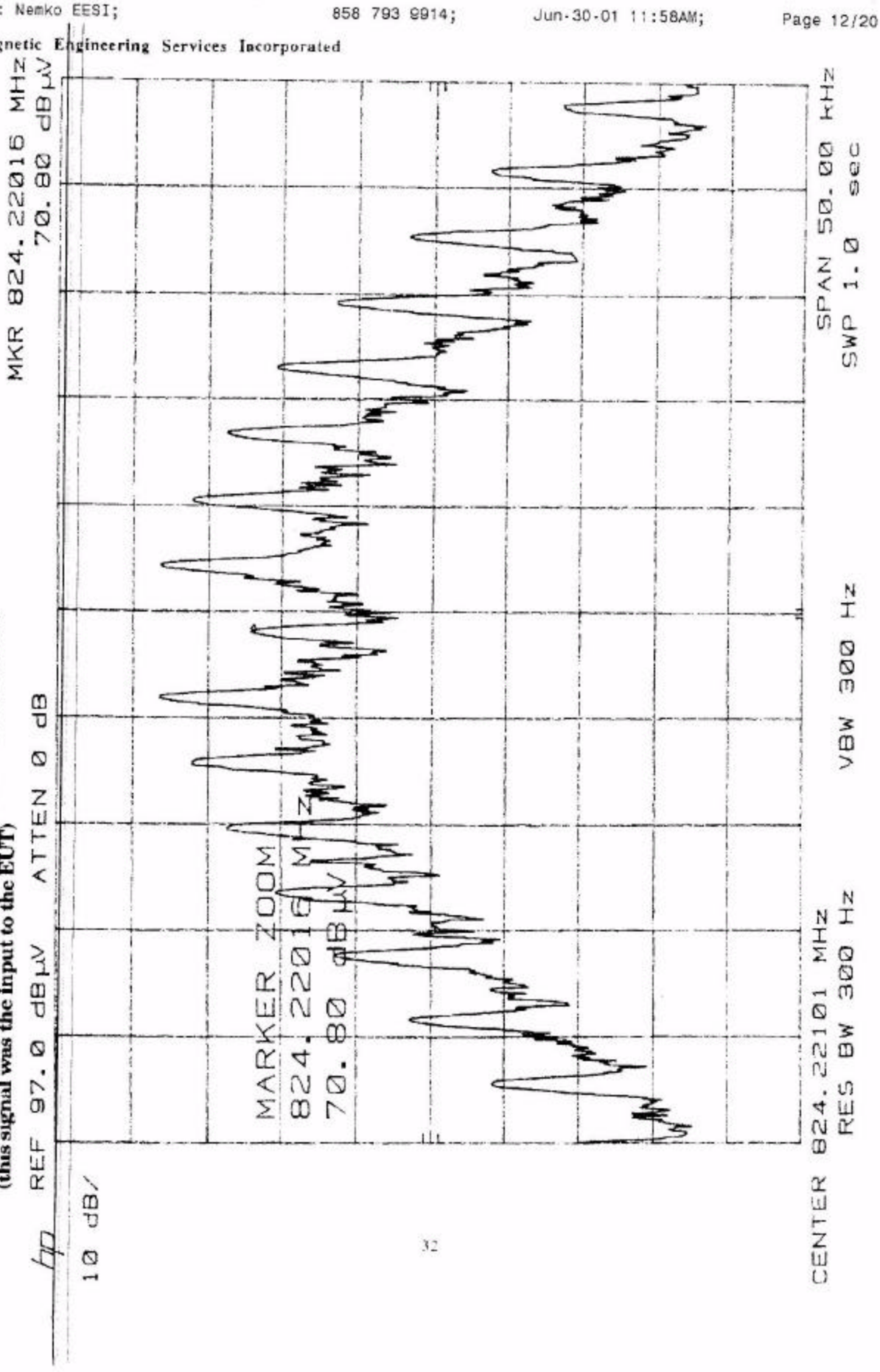

Figure 5.2.3 - 6:
Cellular Phone Output resulting from a 3 kHz Audio Tone
(this signal was the input to the EUT)

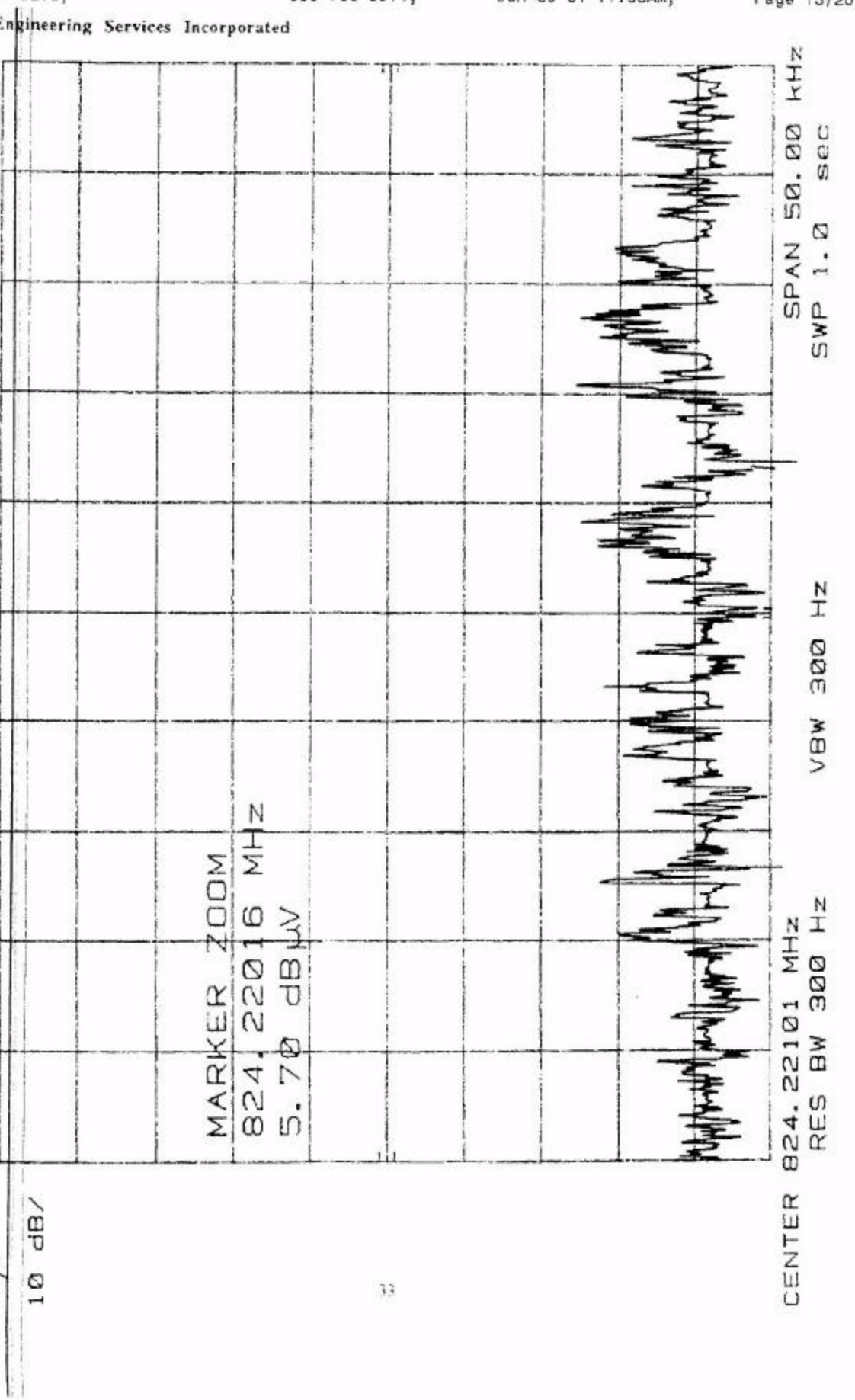

Figure 5.2.3 - 7:
EUT Output (padded down) MINUS Cellular Phone Output
(3 kHz Audio Tone Case)

the cellular phone. Figures 5.2.3 - 8, 5.2.3 - 9, and 5.2.3 - 10 show similar results for the case of no audio tone (i.e. only low-level "background" audio noise would have been modulating the cellular phone). It is concluded that the EUT does not cause any significant spectral broadening (or narrowing) of the transmit-side outputs of the cellular telephone to which it is attached. Consequently, mobile-station to land-station (i.e. cellular system) compatibility problems will not occur when the EUT is in use.

As stated above, the second concern is to demonstrate compliance with the broadband emission limit requirements of 47 CFR Part 22 Section K, Subsection 22.907 Paragraph (a) (1). These requirements apply to F3E radiotelephony operation from mobile stations. Specifically:

> Signals shall be attenuated, relative to the attenuation at 1 kHz removed from f_0, as follows:
>
> a. from 3 kHz to 5.9 kHz, the signals shall be attenuated by at least 40 $\log_{10}$ (f/3) dB, where f is the frequency in kHz [cf. Subsection 22.907 (a)(1)(i)];
>
> b. from 5.9 kHz to 6.1 kHz, the signals shall be attenuated by at least 35 dB [cf. Subsection 22.907 (a)(1)(ii)];
>
> c. from 6.1 kHz to 15 kHz, the signals shall be attenuated by at least 40 $\log_{10}$ (f/3) dB, where f is the frequency in kHz [cf. Subsection 22.907 (a)(1)(i)];
>
> d. above 15 kHz, the signals shall be attenuated at least 28 dB [cf. Subsection 22.907 (a)(1)(iii)];

Requirement "b", above is meant to allow the F3D modulated "selective signalling and control function" signals of the cellular network to function appropriately (see Subsection 22.906(b), and Subsection 22.915). In normal mobile use, a mobile cellular telephone will transmit the F3D modulated supervisory audio tones at 5.9 to 6.1 kHz removed from the carrier for only a brief instant, during cell-to-cell handoff (i.e. when crossing cell boundaries). However, when a mobile cellular telephone is within the service area boundaries of a given cell, the F3D modulated supervisory audio tones (at 5.9 to 6.1 kHz removed from the carrier) are *never* transmitted, and that section of the emission spectrum is used by the skirts of the normal F3E voice modulated signals (i.e. ordinary speech) being transmitted.

Because EESI performed these tests at its EMC Test Laboratory Facility, which is at a fixed location that is well with the boundaries of a single cell, (and because an actual cellular telephone was used as the transmission signal source rather than a cellular telephone simulator), it was impossible to "force" the cellular telephone (i.e. the OKI Model SE Cellular Telephone S/N 336CM01907570) to produce a transmitted signal that was in compliance with requirement "b".

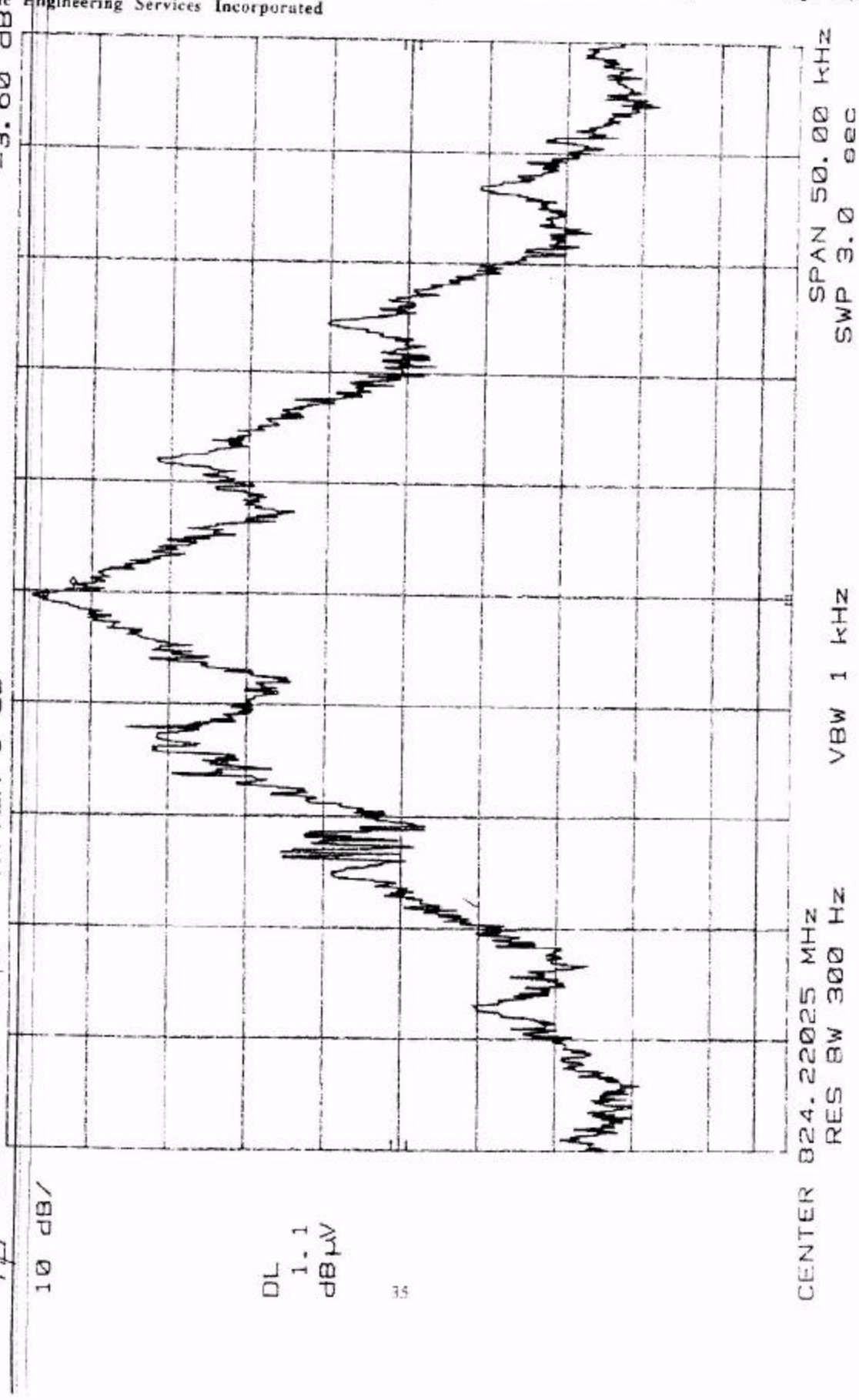

Figure 5.2.3 - 8:
EUT Output resulting from no audio input
(a "0 kHz Audio Tone")

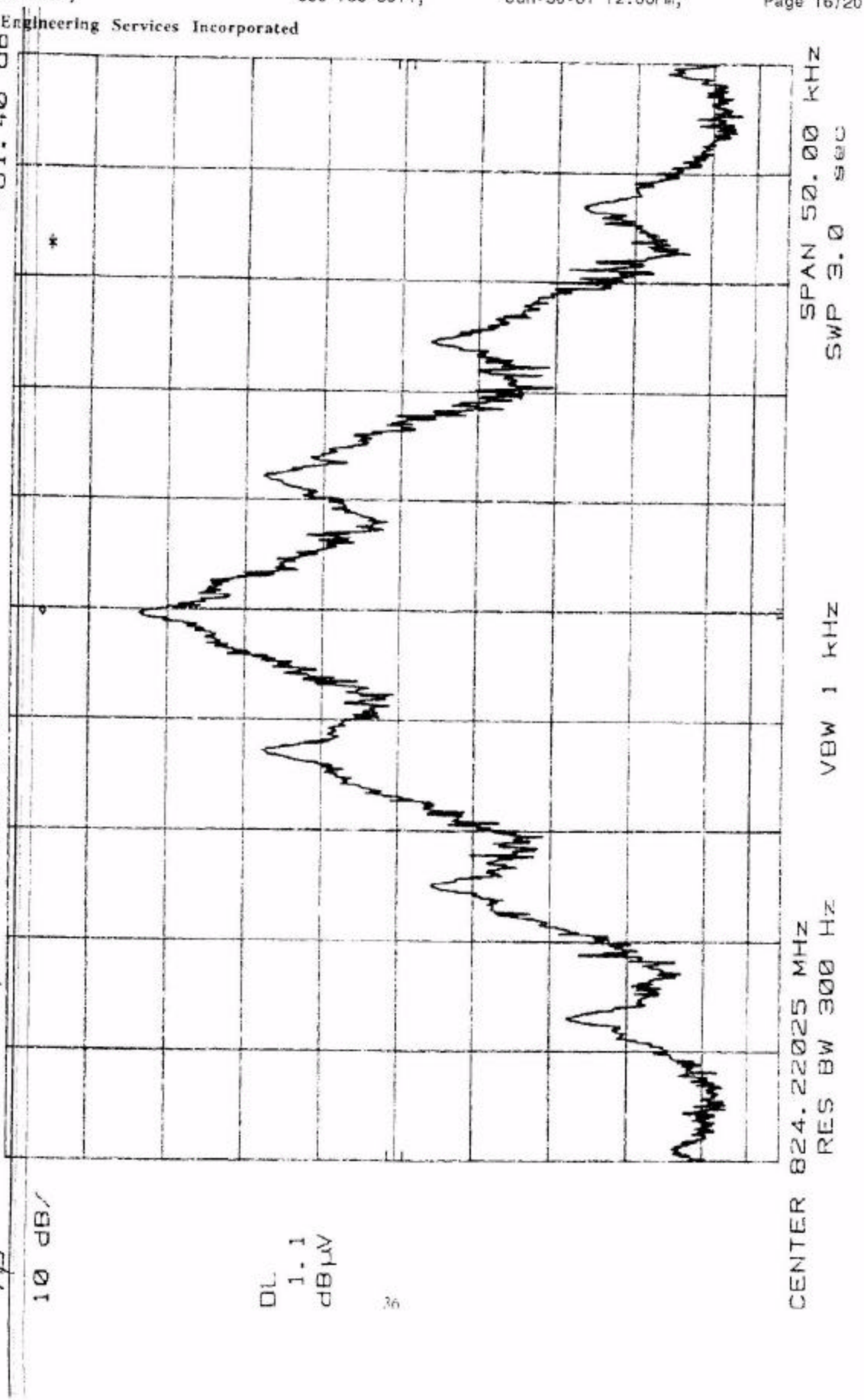

Figure 5.2.3 - 9:
Cellular Phone Output resulting from no audio (a "0 kHz Audio Tone")
(this signal was the input to the EUT)

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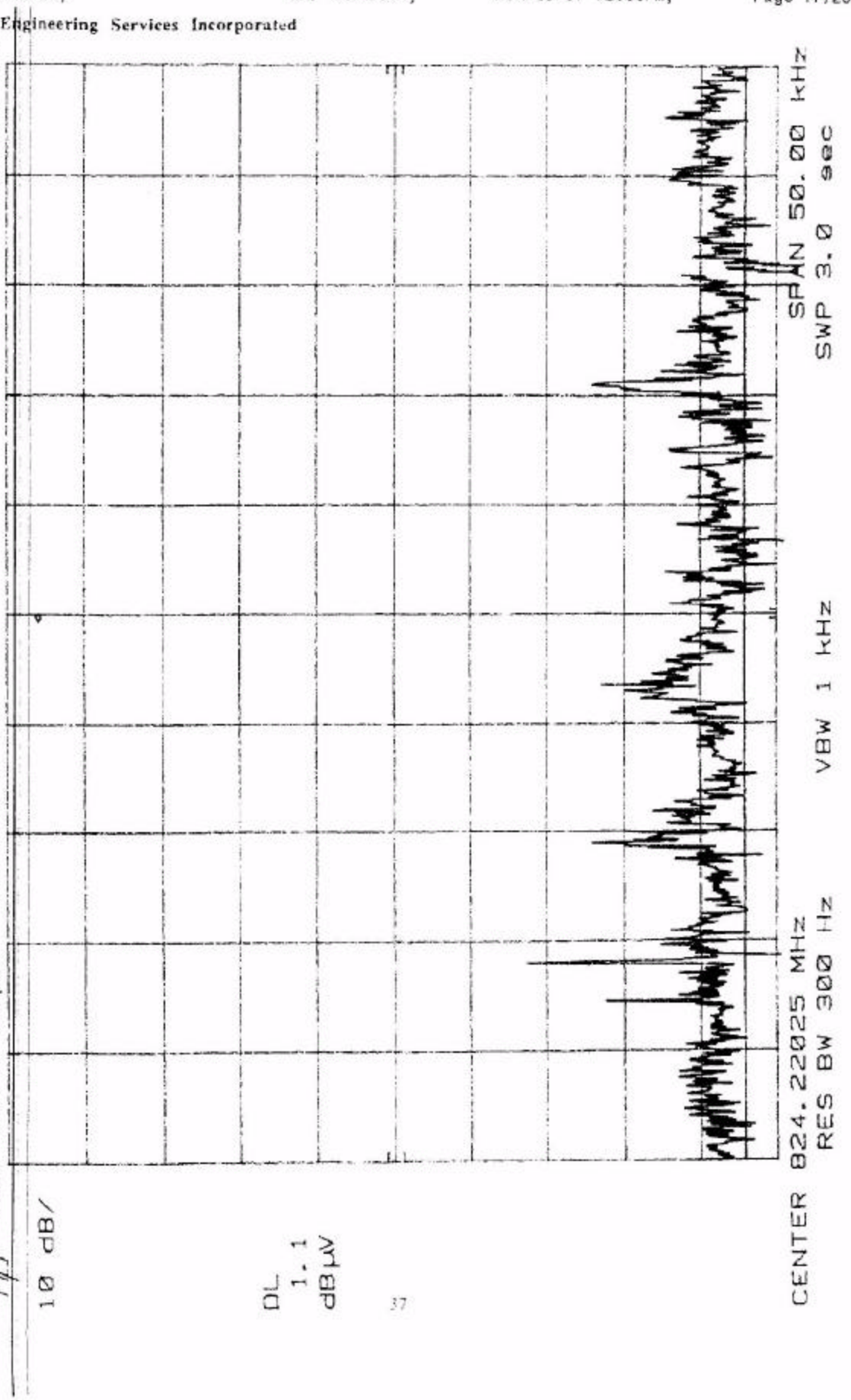


Figure 5.2.3 - 10:
EUT Output (padded down) MINUS Cellular Phone Output
("0 kHz Audio Tone" Case)

An additional complexity arising from the use of a cellular telephone as an input device is the procedure for the measurement of "transmit-audio response". Specifically, the January 1993 edition of TIA/EIA Interim Standard IS-90 ("Recommended Minimum Standard for 800 MHz Dual-Mode Narrowband Analog Cellular Units") states (in Section 3.3.2.2.1) that "transmit-audio response" is defined in terms of the degree of closeness to which the frequency deviation of the transmitter follows the prescribed 6 dB/octave characteristic over a specified continuous audio frequency range *while conforming to the required band-limiting conditions outside that range* [emphasis added]. Section 3.3.2.2.2 of TIA/EIA-IS-90 indicates that "transmit-audio response" is to be measured using a high intensity 1 kHz audio tone as the input frequency. Section 3.3.2.2.3 of TIA/EIA-IS-90 restates (in Table 7) the FCC Part 22, Section K, Subsection 22.907, Paragraph (a) (1) emission bandwidth limits.

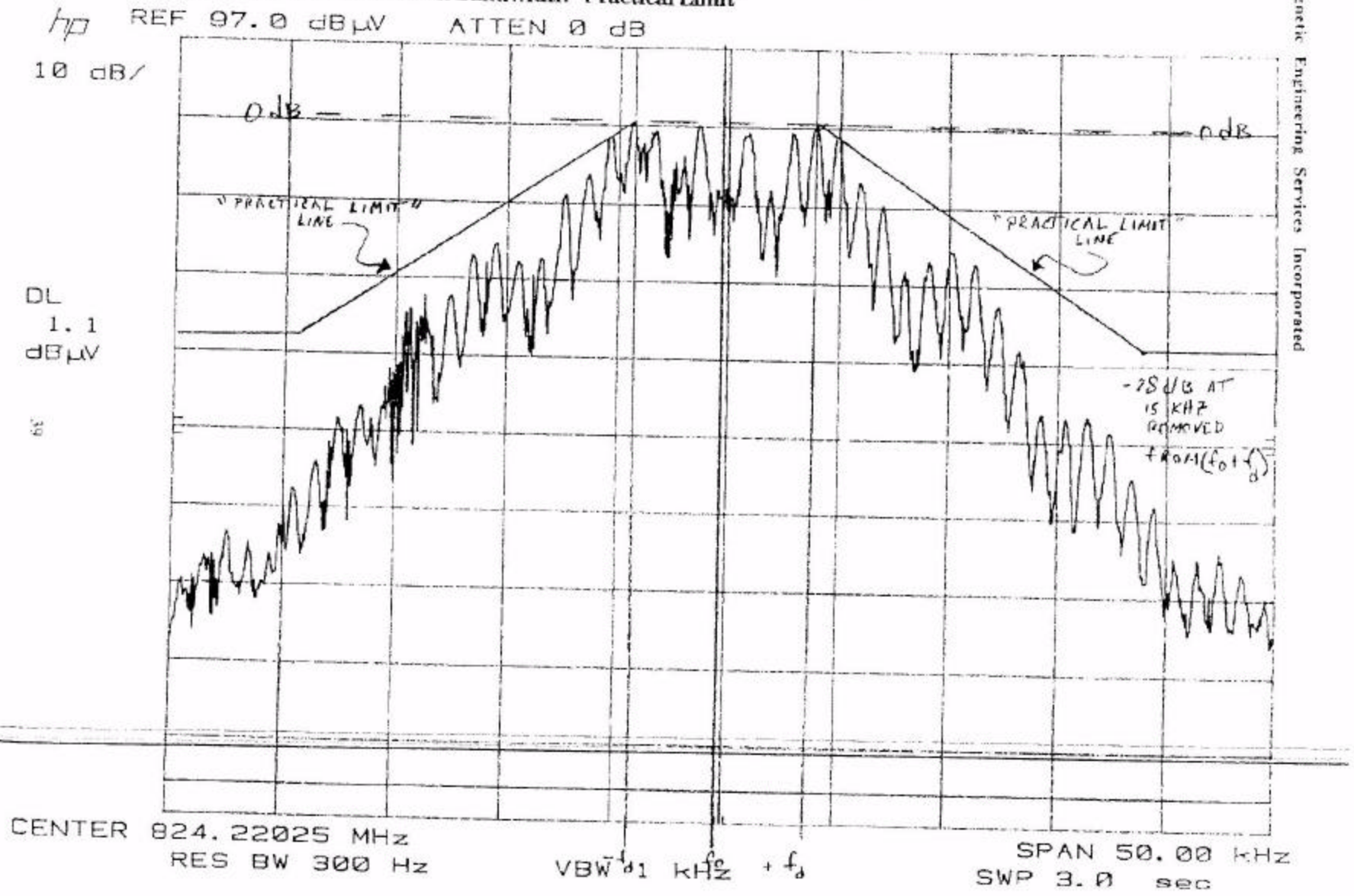
Using a spectrum analyzer as a measurement device, experiments were performed that showed that when a "loud" (i.e. +80 dBA) 1 kHz audio tone was input to a cellular telephone, the resulting RF outputs from the cellular telephone had a nominal spectrum deviation of +/- 4 kHz (i.e. the sum of the maximum allowable FM deviation of 3 kHz from f_o *plus* the nominal 1 kHz audio tone skirt width). Thus, with a +80 dBA 1 kHz audio tone as input, the OKI Model SE cellular telephone actually produced emissions that (when measured on a Spectrum Analyzer) comply with the following "practical limits":

> Relative to the attenuation at f_d = 4 kHz removed from f_o, the signals are attenuated, as follows:
>
> a. from 0 kHz to 15 kHz removed from (f_o + f_d), signals are attenuated by at least 40 $\log_{10}$ (f/3) dB, where f is the frequency in kHz;
>
> b. beyond 15 kHz removed from (f_o + f_d), the signals are attenuated at least 28 dB.

It is these "practical limits" which must apply to the EUT.

Figures 5.2.3 -11 is a reprint of Figure 5.2.3 - 2, but with the above described "practical limit" lines overplotted. This figure shows the EUT's RF emissions as measured at the "OUTSIDE ANTENNA" port for the case of 1 kHz audio modulation (at +80 dBA). As can be seen from this figure, the EUT's RF outputs are within the "practical limits". It is therefore concluded that the EUT is in compliance with the relevant portions of the broadband emission limit requirements of 47 CFR Part 22 Section K, Subsection 22.907 Paragraph (a) (1), when measured using a high intensity 1 kHz audio input tone as per Section 3.3.2.2.2 of TIA/EIA-IS-90.

Figure 5.2.3 - 11
EUT Output (padded down) resulting from a 1 kHz Audio Tone relative to the Subsection 22.907 Emission Bandwidth "Practical Limit"



6.0 SUMMARY AND CONCLUSIONS

During the period 26 May through August 1, 1994, a series of tests were performed on the ORA Electronics "CB - 15AMP" Bi-directional Amplifier (i.e. the EUT) for the purpose of demonstrating compliance with the relevant requirements of 47 CFR Part 22, Subpart K (for Domestic Public Cellular Telecommunications devices), and of EIA/TIA IS-90 (Recommended Minimum Standards for 800 MHz Dual-Mode Narrowband Analog Cellular Subscriber Units).

These tests included:

- a series of "bench tests" to measure EUT output power and emission bandwidth (as seen from both the "INSIDE ANTENNA" and the "OUTSIDE ANTENNA" ports);

- ANSI C63.4 (3 meter range) radiated emissions tests of the EUT (with the "OUTSIDE ANTENNA" port terminated in a dummy load, and, with the "OUTSIDE ANTENNA" port connected to an antenna);

- a radiated test (using an actual cellular telephone as a signal source) to measure the emission bandwidth and emission spectrum properties of the EUT.

As discussed in Sections 5.2.1, 5.2.2, and 5.2.3 of this Report, it is concluded that the EUT:

- is functionally compatible, operationally compatible, and emission-bandwidth compatible with the operation of a cellular telephone system;

- radiates no spurious emissions outside the normal passband of operation, and radiates no harmonic emissions (up to at least 10 X f_0); also, the "close in" spurious emission within the passband of operation were measured to be at least 62 dB below the level of the carrier;

- is in conformity with relevant broadband emission limit requirements of 47 CFR Part 22, Subpart K, Subsection 22.907, when measured using a high intensity 1 kHz audio input tone as per Section 3.3.2.2.2 of TIA/EIA-IS-90.

Based upon the data and conclusions contained in the Report, it is requested that Type Acceptance be granted for the ORA Electronics Model "CB - 15AMP" Bi-directional Amplifier, under the provisions of 47 CFR Part 22, Subpart K.