Figure 5.2.1 - 1:
RF Output Power and Emission Bandwidth of the EUT, as viewed from the "OUTSIDE ANTENNA" port.

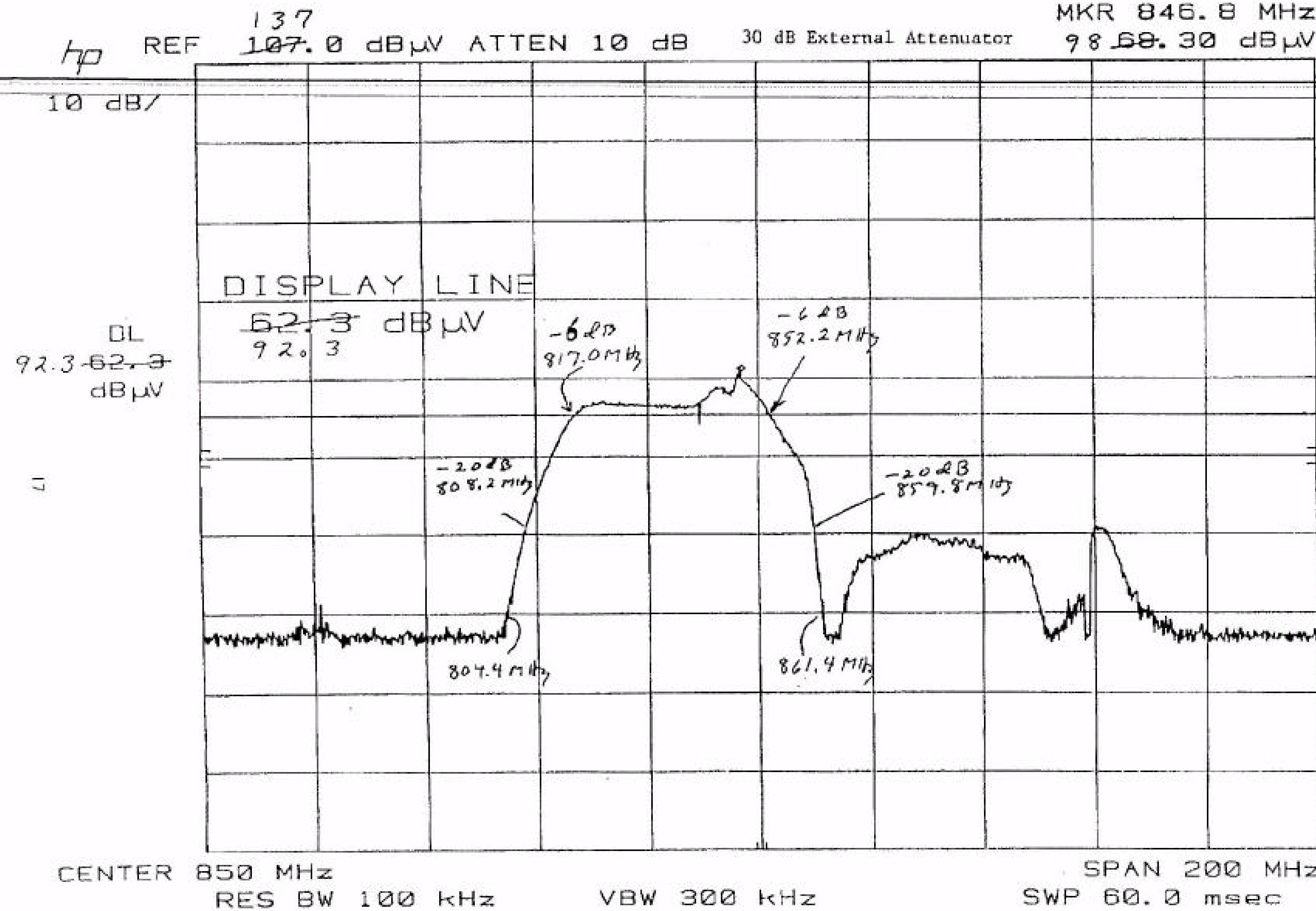


Figure 5.2.1 - 2:
RF Power Output of the EUT, as viewed from the "OUTSIDE ANTENNA" port over a 50 kHz frequency span at an f_0 = 850.0 MHz .

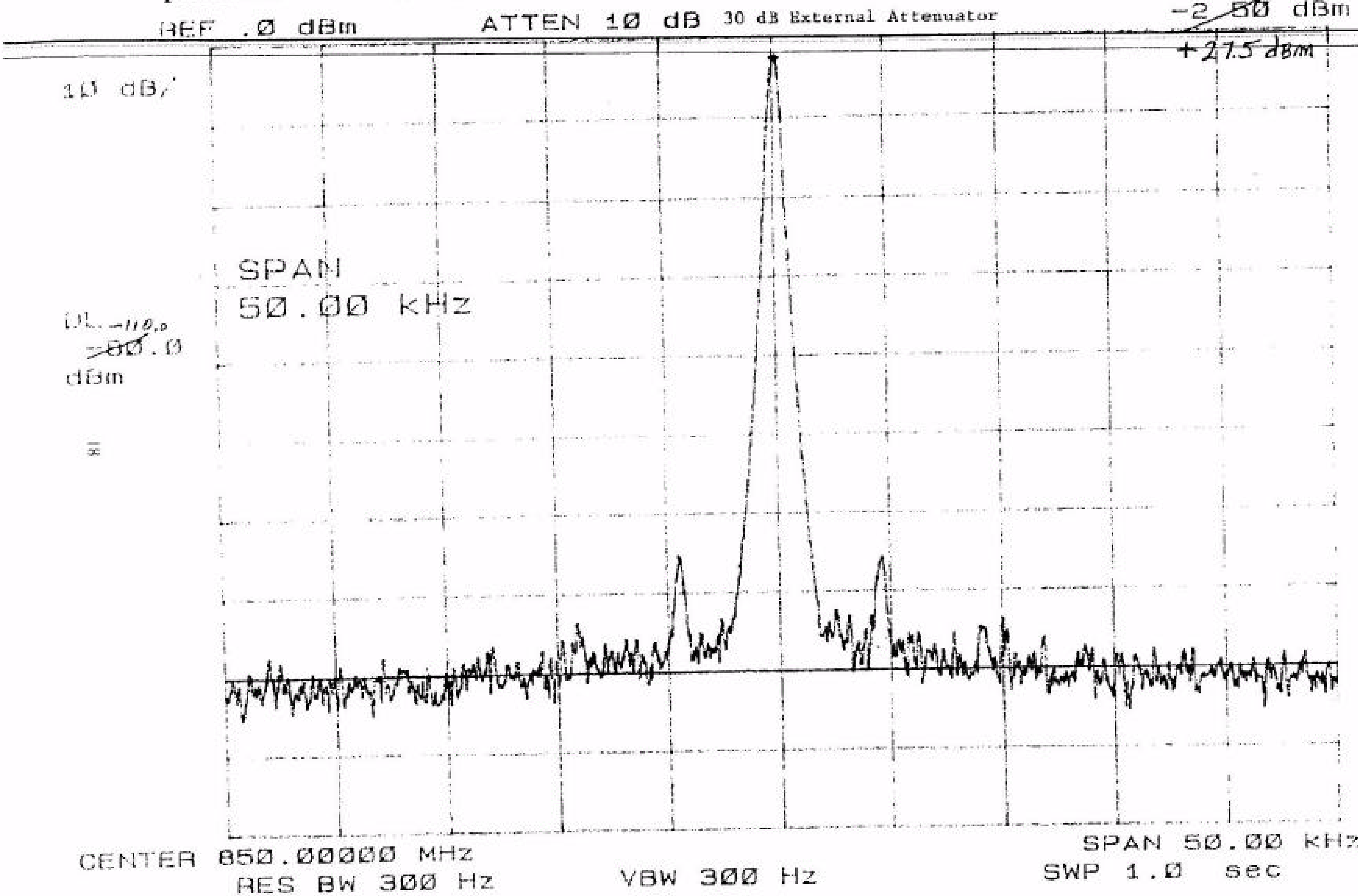


Figure 5.2.1 - 3:
RF Power Output of the EUT, as viewed from the "OUTSIDE ANTENNA" port over the frequency range of 300 MHz to 1500 MHz, with an f_o of 850 MHz.

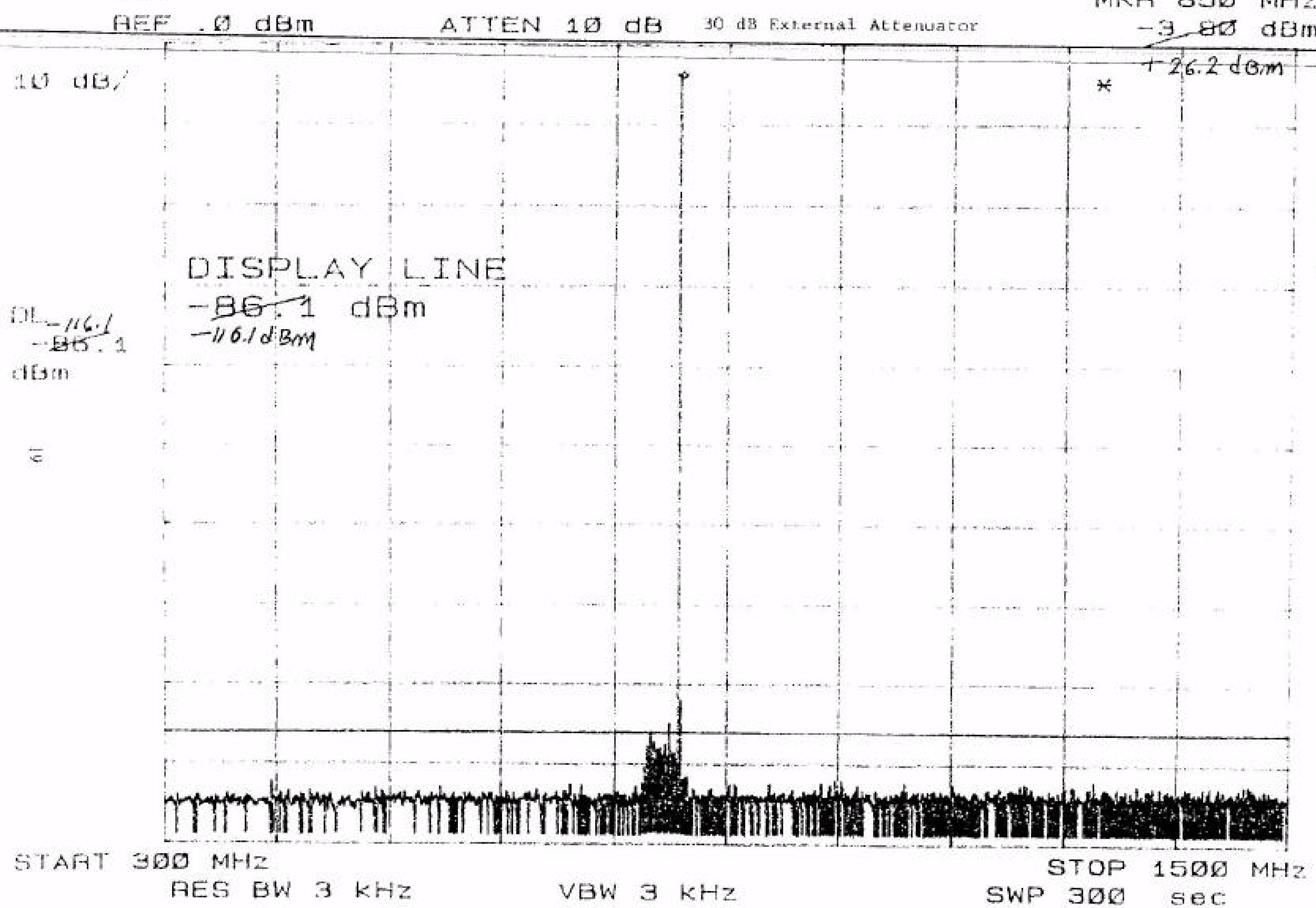
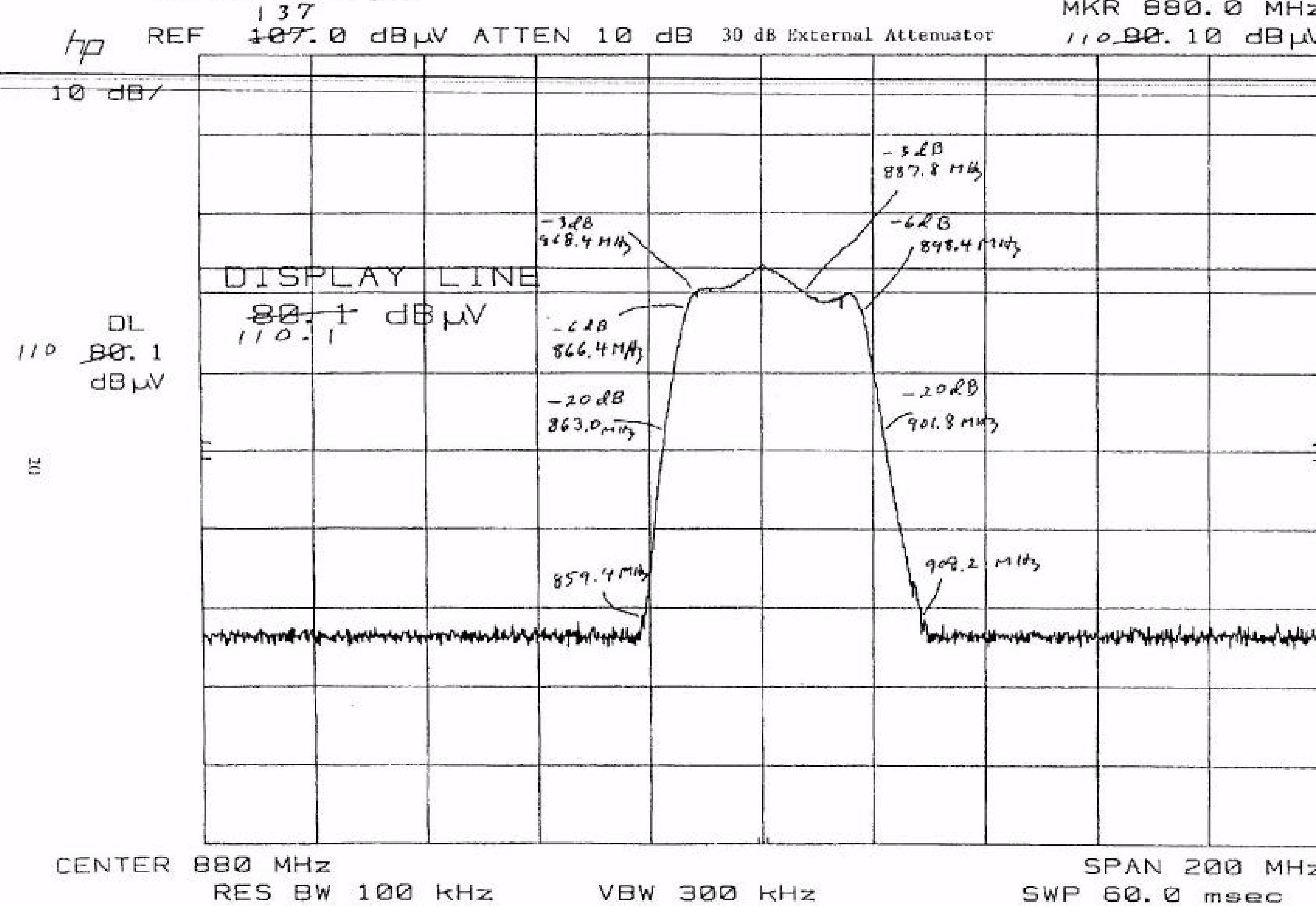


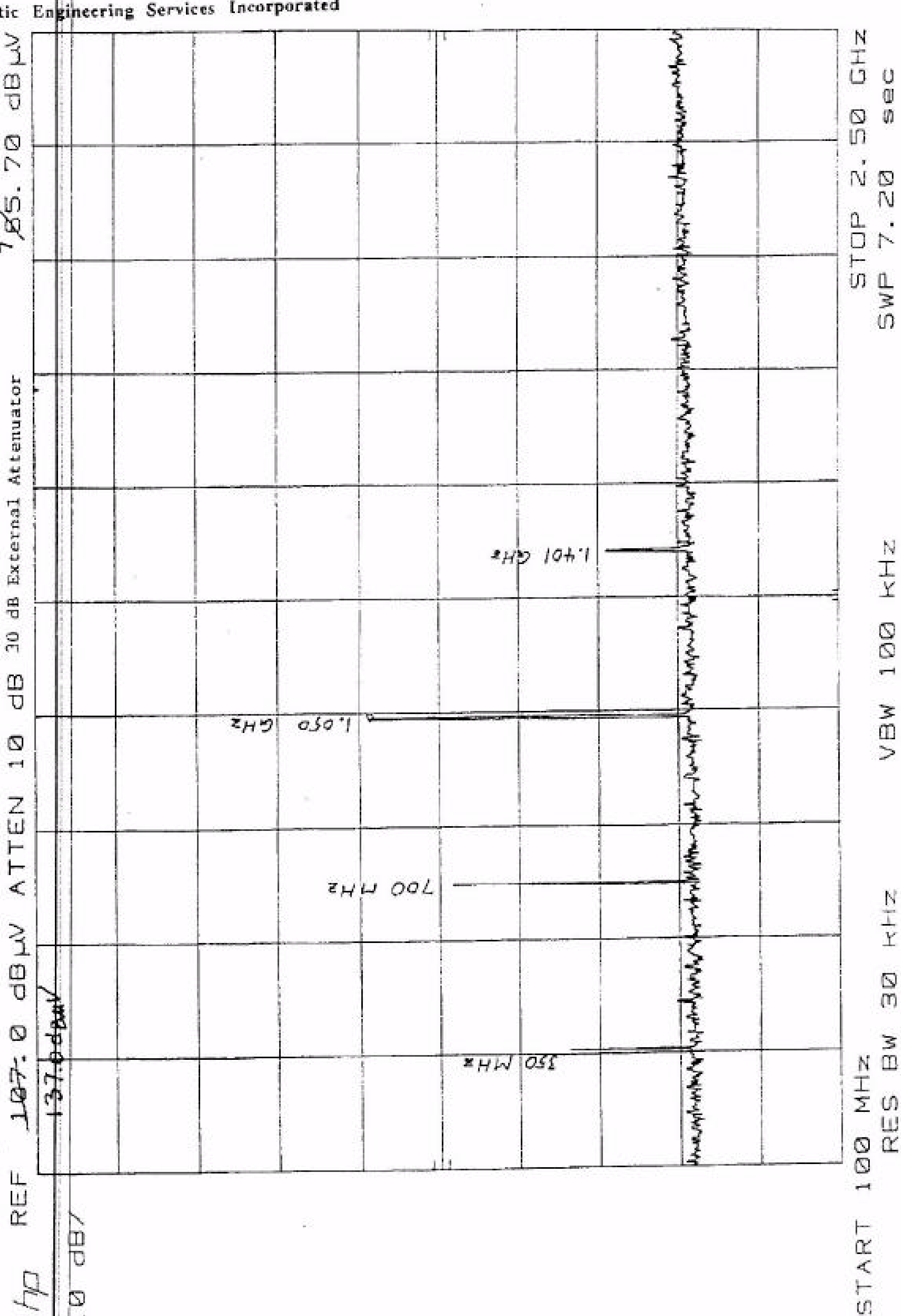
Figure 5.2.1 - 4:
RF Output Power and Emission Bandwidth of the EUT, as viewed from the "INSIDE ANTENNA" port.



protect the Preselector Front End) at "OUTSIDE ANTENNA" port. The results of this test are plotted in Figure 5.2.1 - 5. This plot shows that there are four harmonically related parasitics (e.g. at 350 MHz with an output power level of 71 dBμV, at 700 MHz with an power output level of 86 dBμV, at 1050 MHz with an output power level of 94 dBμV, and at 1401 MHz with an output power level of 66 dBμV). These parasitics disappear when the EUT is attached to a cellular telephone (even when the cellular phone is in "standby" mode [i.e. is not transmitting]).

The purpose of fourth "bench test" was to check for parasitic oscillations in the EUT that could result in spurious signals being emitted from the "INSIDE ANTENNA" port. The fourth test was performed in a manner similar to the third test, except that the 50 ohm dummy load was place on the "OUTSIDE ANTENNA" port, and the monitoring was performed at the "INSIDE ANTENNA" port. No evidence of parasitic (or other spurious) emissions was found.

Figure 5.2.1 - 5:
Parasitic Oscillations emitted from the "OUTSIDE ANTENNA" port of the EUT when the "INSIDE ANTENNA" port is terminated in a 50 ohm dummy load.



5.2.2 Radiated Emissions Tests

The EUT was tested in two configurations to determine if unintentional radiated emissions were occurring. These tests were made in accordance with the method of ANSI C63.4. Testing was performed at EESI's FCC-approved Open Area Test Site (at a 3 meter range), with the amplifier placed on a test table at a height of 80 cm above the OATS Ground Plane. The equipment used to perform these tests is listed in Table 5.2.2 - 1.

In the first test configuration, the EUT's "OUTSIDE ANTENNA" port was terminated in a 50 ohm resistive termination (i.e. a dummy load). A frequency synthesizer was then used to provide (via a coaxial cable) a signal input to the EUT. The synthesizer was set to produce a CW signal of +15 dBm at a frequency of f_0 = 850 MHz. A search was made for radiated emissions. Specifically, this test was performed over the (extended) frequency range 30 MHz to 1500 MHz. The combined Spectrum Analyzer/Preselector kTBFL noise floor was at -125 dBm (-18 dBμV) for a 30 MHz to 1500 MHz Frequency Span with 1 kHz resolution bandwidth. Unsurprisingly, (given the results of the "bench tests" reported in the previous section), there were no "case leakage" radiated emissions detected from the EUT.

Additionally, the first ten harmonically-related frequencies (i.e. 2 X f_0 , 3 X f_0, etc. up to 8500 MHz) were also checked for evidence of radiated emissions at a 1 meter range, and (unsurprisingly), none were found. While checking for harmonics, the Spectrum Analyzer kTBFL noise floor was at -105 dBm (+2 dBμV) for a 1 MHz Frequency Span with 1 kHz resolution bandwidth.

In the second test configuration, a magnetic-mount "pigtail" cellular antenna (i.e. a base-fed whip with a spiral-coiled segment) was then connected to the "OUTSIDE ANTENNA" port of the EUT, and the frequency synthesizer was set to the same power level as previous. A search was then made for radiated emissions using the ANSI C63.4 test methodology at a 3 meter range. The combined Spectrum Analyzer/Preselector kTBFL noise floor was at -125 dBm (-18 dBμV) for a 30 MHz to 1500 MHz Frequency Span with 1 kHz resolution bandwidth. As in the previous test, no radiated emissions were detected from the EUT (other than the 850 MHz intentionally radiated signal) over the (extended) frequency range from 30 MHz to 1500 MHz. Finally, the first ten harmonically-related frequencies (i.e. 2 X f_0 , 3 X f_0 , etc. up to 8500 MHz) were also checked for evidence of radiated emissions at a range of 1 meter, and again, as in the previous test for harmonics, none were found. While checking for harmonics, the Spectrum Analyzer kTBFL noise floor was at -105 dBm (+2 dBμV) for a 1 MHz Frequency Span with 1 kHz resolution bandwidth.

Table 5.2.2-1: List Of Equipment Used For Radiated Emissions Testing

Spectrum Analyzer: HP Model 8566B, S/N 2747A04729
Cal Due 3-30-95

Spectrum Analyzer Display Unit: HP Model 85662A, S/N 2648A15448
Cal Due 3-30-95

Quasi-Peak Adapter: HP Model 85650A, S/N 2521A00618.
Cal Due 8-20-94

RF Preselector: HP Model 85685A, S/N 2648A00410
Cal Due 8-12-94

Biconical Antenna: EMCO Model 3104, S/N 3020,
Cal Due 10-20-94

Log Periodic Antenna: EMCO Model 3146, S/N 1382,
Cal Due 10-20-94

Double-Ridge Guide Horn Antenna: EMCO Model 3115, S/N 2551,
Cal Due 11-15- 94

Mast, Dielectric, 4-meter, motorized: EESI (self-constructed asset)
Calibration Not Required

Ground Plane, 10-meter and 3-meter OATS, raised deck, with flush-deck mounted, 2.4 meter dia., 3 metric ton capacity Turntable:
EESI (self-constructed asset)
Normalized Site Attenuation [NSA] Remeasurement Due 8-23-96

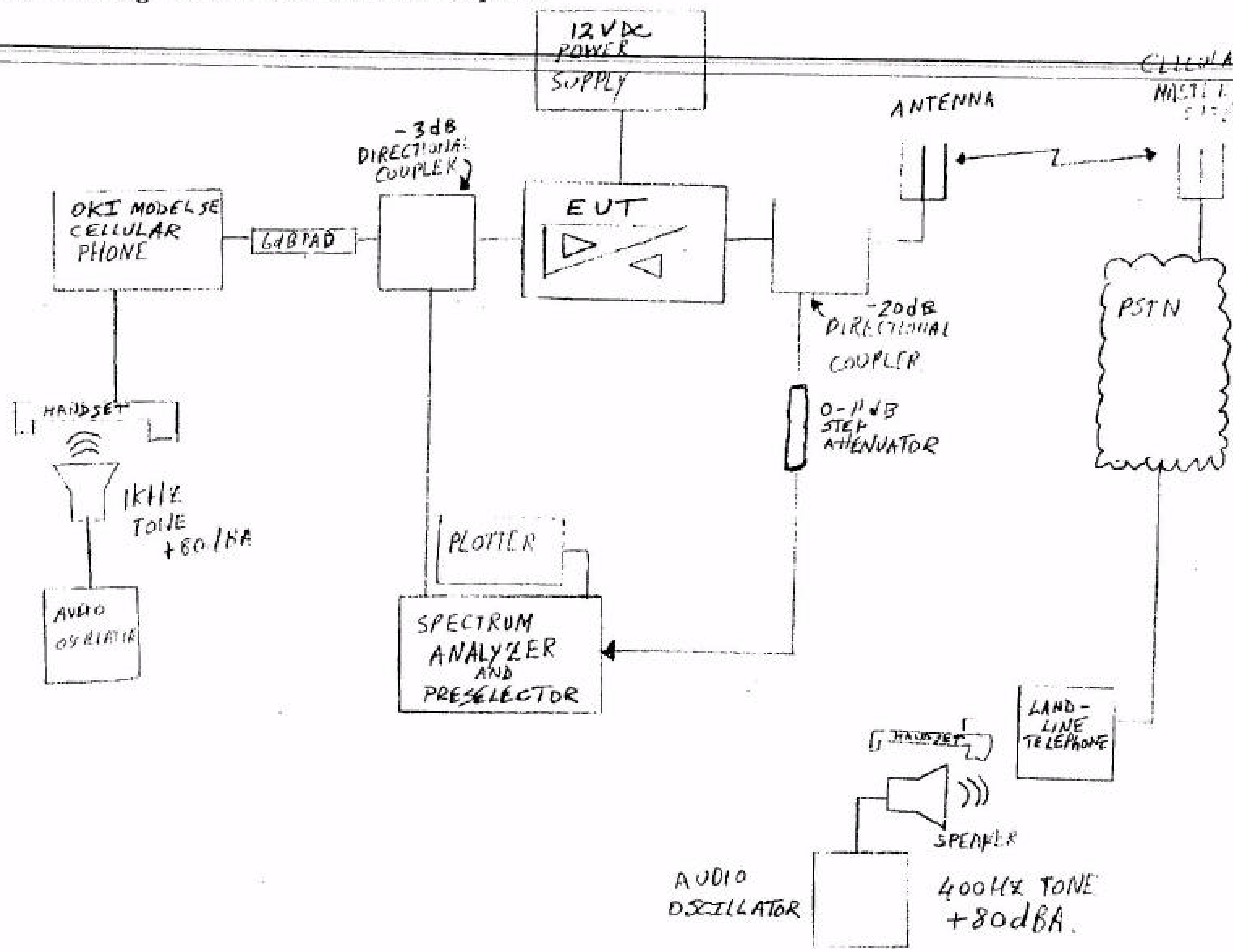
5.2.3 Emission Tests On The Outputs Resulting From Driving The EUT With A Cellular Telephone

As indicated previously in this Report, discussions with the FCC indicated that measurements of the intentional emission spectrum of the EUT that result from the amplification of *actual cellular radio transmissions* (as opposed to those signals produced by the simple modulations typically output by most signal generators) needed to be made. There are actually two concerns that must be addressed for this class of EUT (i.e. a bi-directional amplifier that is neither a carrier-frequency source nor a modulation source). The first concern is whether the actual F3E modulation emitted by a cellular telephone could cause a severe distortion in the output of the EUT such that the resulting emission spectrum would be so broadened (or so narrowed) as to cause a mobile-station to land-station (i.e. master site or repeater site) incompatibility. 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).

In the absence of a cellular telephone master cell site simulator, it is both difficult and expensive to make intentional emission spectrum measurements of the EUT that result from the amplification of *actual cellular radio transmissions*. The difficulties result from the "random hopping" nature of cellular channel assignments for any particular cellular telephone call, and from the fact that cellular channels are typically released whenever transmission cease for more than a brief interval (i.e. due to operation of the VOX control circuitry in the cellular system). The expense arises from the duration (and number) of cellular telephone calls that must be place in order to make an adequate set of measurements.

A Block Diagram of the test set-up used to address both concerns is shown in Figure 5.2.3 - 1. During test, an OKI Model SE portable cellular "bagphone" (S/N 336CM01907570) was connected to the "INSIDE ANTENNA" port of the EUT via a short length of coaxial cable and a 6 dB Fixed Pad Attenuator. (The Pad was used to prevent the 4 watt RF output of the cellular telephone from damaging the EUT). A -3 dB Directional Coupler was used to sample the inputs to the EUT, and a -20 dB Directional Coupler was used to sample the outputs from the EUT. The Directional Couplers were connected as shown in Figure 5.2.3 - 1 . Both the cellular telephone RF signal outputs and the EUT's RF signal outputs were monitored simultaneously (using the A and B Channel inputs on the HP8566B Spectrum Analyzer/HP85685A RF Preselector). The final output (transmitted signal) from the "OUTSIDE ANTENNA" port on the EUT was presented to a magnetic base-mount pigtail type cellular telephone antenna *via* a 2 meter long coaxial cable.

Figure 5.2.3 - 1:
Block Diagram Of Test Set-up Used To Measure RF Emissions Resulting From Driving The EUT With A Cellular Telephone



In order to create a repeatable test condition, an "audio simulation" (of cellular telephone to/from landline telephone voice traffic) was employed. Specifically, an audio oscillator and loudspeaker were set-up to produce a 1 kHz tone at +80 dBA. audio output level. The loudspeaker was placed immediately adjacent to the cellular telephone's handset. The cellular telephone was used to dial a landline telephone within EESI's test facility. (The landline telephone was interfaced to the Public Switched Telephone Network [PSTN] via our local Bell Operating Company's CENTREX™ services). One the connection was completed, an audio oscillator and loudspeaker were set up and set to produce a 400 Hz tone at +80 dBA. The loudspeaker was placed immediately adjacent to the landline's telephone's handset. The effect of this arrangement was to "lock in" the cellular telephone transmit and receive channels for the duration of the call.

As stated earlier, both the cellular telephone's outputs and the EUT's outputs were monitored using the Spectrum Analyzer/RF Preselector. An A - B comparison of these signals provided a convenient means of measuring the differences in emission spectrum outputs produced by the cellular telephone and the EUT. (Note: When A - B comparisons were being made, the A Channel inputs were further padded down as needed so that the peak power levels of the two channels were identical. In this way, the amount of any spectral broadening would be immediately apparent). Direct readings (i.e. measurements from either Spectrum Analyzer Channel A or Channel B separately) provided a convenient means for measuring the emission spectrum outputs produced by the cellular phone and the EUT.

Relative to the first concern (i.e. the potential for cellular system incompatibility caused by excessive spectral broadening or narrowing), measurements were made at three different audio frequencies - viz. 3 kHz, 1 kHz, and 0 kHz (i.e. no audio). These three audio frequencies represent the two limiting frequency cases of voice modulation; 3 kHz represents the required limit of audio intelligibility in the cellular telephone service [as per Subsection 22.906 (a)(3)], and, "no audio modulation [0 kHz]" represents the case of background noise (with no speech being transmitted) that is just loud enough to defeat the operation of the VOX. The 1 kHz audio modulation case is assumed to be representative of a "typical" speech modulation). In the 1 kHz and 3 kHz cases, an audio power level of + 80 dBA (nominal) was used as a representation of a "shouting voice" level.

For the case of a 1 kHz audio tone being transmitted by the cellular phone, the Channel A (i.e. the EUT output without additional padding-down after the directional coupler), Channel B (i.e. OKI Cellular Telephone output), and the results of the "Channel A (padded-down after the directional coupler) - Channel B" comparison tests are plotted in Figures 5.2.3 - 2, 5.2.3 - 3, and 5.2.3 - 4, respectively. These plots show that after compensating for transit-side power amplifier gain effects, the amount of EUT-caused spectral broadening of the cellular telephone's RF signal is extremely small (i.e. typically on the order of - 80 dB). Figures 5.2.3 - 5, 5.2.3 - 6, and 5.2.3 -7 show similar results for the case of a 3 kHz audio tone being transmitted by

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Figure 5.2.3 - 2:
EUT Output resulting from a 1 kHz Audio Tone