A. INTRODUCTION

The following data are submitted in connection with this request for Type Acceptance of the GMT-20 transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The GMT-20 is a 20 watt transmitter that can generate both CW and GSM modulated test signals in the broadband PCS bands. It is used to establish signal propagation modeling from potential base station sites and refine calculated coverage predictions.

B. GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE (Paragraph 2.983 of the Rules)

1. Name of applicant: Grayson Electronics Co.

2. Identification of equipment:

   a. The equipment identification label is shown in Appendix 1.

   b. Photographs of the equipment are included in Appendix 2.

3. Quantity production is planned.

4. Technical description:

   a. NON, 300kGXD emission.
   b. Frequency range: 1.85 - 1.99 GHz.
   c. Operating power of transmitter is fixed at the factory at 20 watts and can be reduced to 2 milliwatts.
   d. The GMT-20 fully complies with applicable power limits under Part 24.
   e. The dc voltage and dc currents at each final amplifier:

      Collector voltage: 12.0 Vdc
      Collector current: 3.6 A

   f. Function of each active semiconductor device: See Appendix 3.
   g. Complete circuit diagram is included in Appendix 4.
   h. A draft instruction book is submitted as Appendix 5.
   i. The transmitter tune-up procedure is included in Appendix 6.
   j. A description of circuits for stabilizing frequency is included in Appendix 7.

B. GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE (cont'd)

k. A description of circuits and devices employed for suppression of spurious radiation in Appendix 8.
l. Not applicable.

5. Data for 2.985 through 2.997 follow this section.

C. RF POWER OUTPUT (Paragraph 2.985(a) of the Rules)

RF power output was measured with a HP 432A/HP478A RF power meter and a Narda 765-20 attenuator as a 50 ohm dummy load. Maximum power measured was 20 watts; minimum power was 2 milli-watts. (The transmitter was tuned by the factory according to the procedure of Exhibit 4.)

D. MODULATION CHARACTERISTICS

The GMT-20 transmitter modulation linearity was tested under GSM formats.

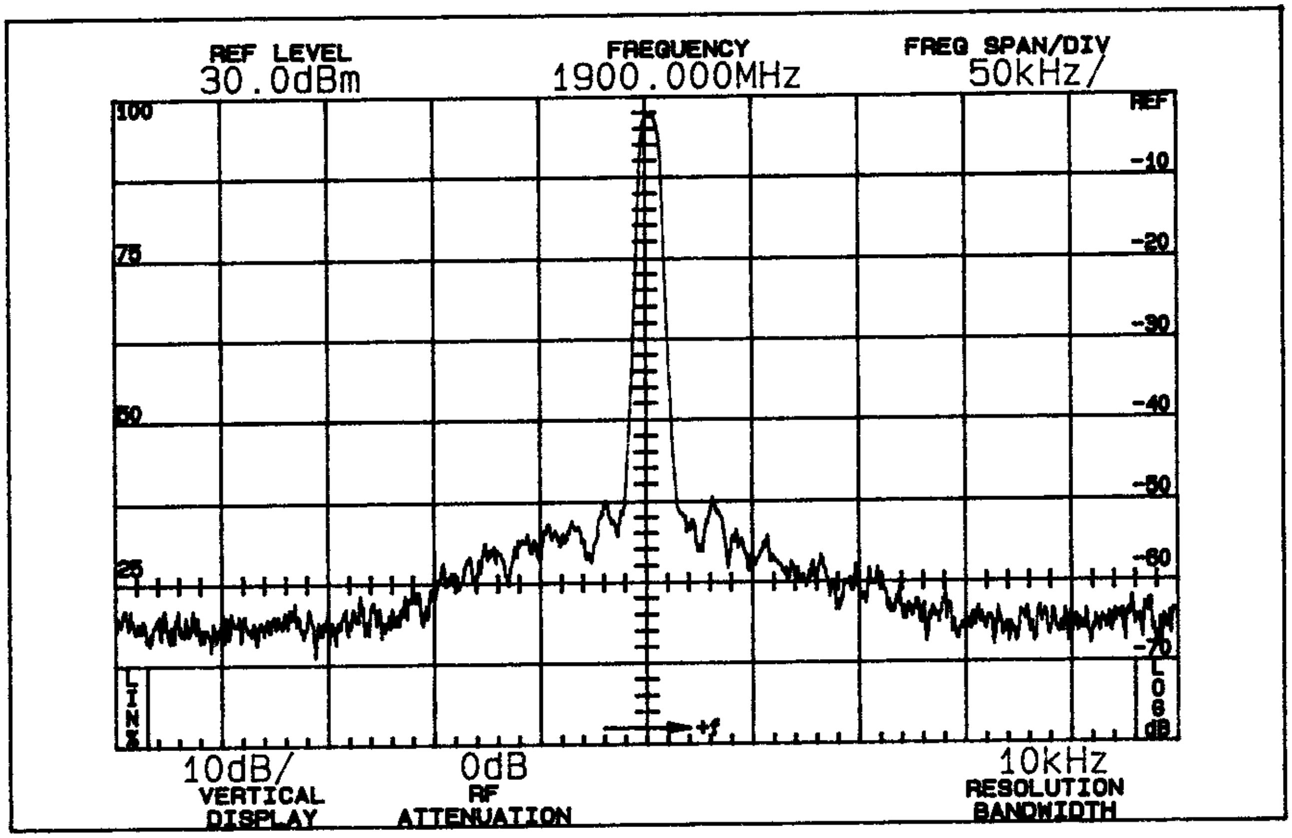
GSM signal source was an Tektronix model 2021 Arbitrary Waveform Generator (AWG) .

Modulation consisted of a pseudo-random bit stream at 270.833 kB/s that had a length of 2047 bits, using 800 samples with a sample rate of 2.167 MHz. Symbol rate was > 50 kHz.

Based on Para. 24.238, measured emission bandwidth at 26 dB points was 300 kHz.

A: \GRAYCW.GEM

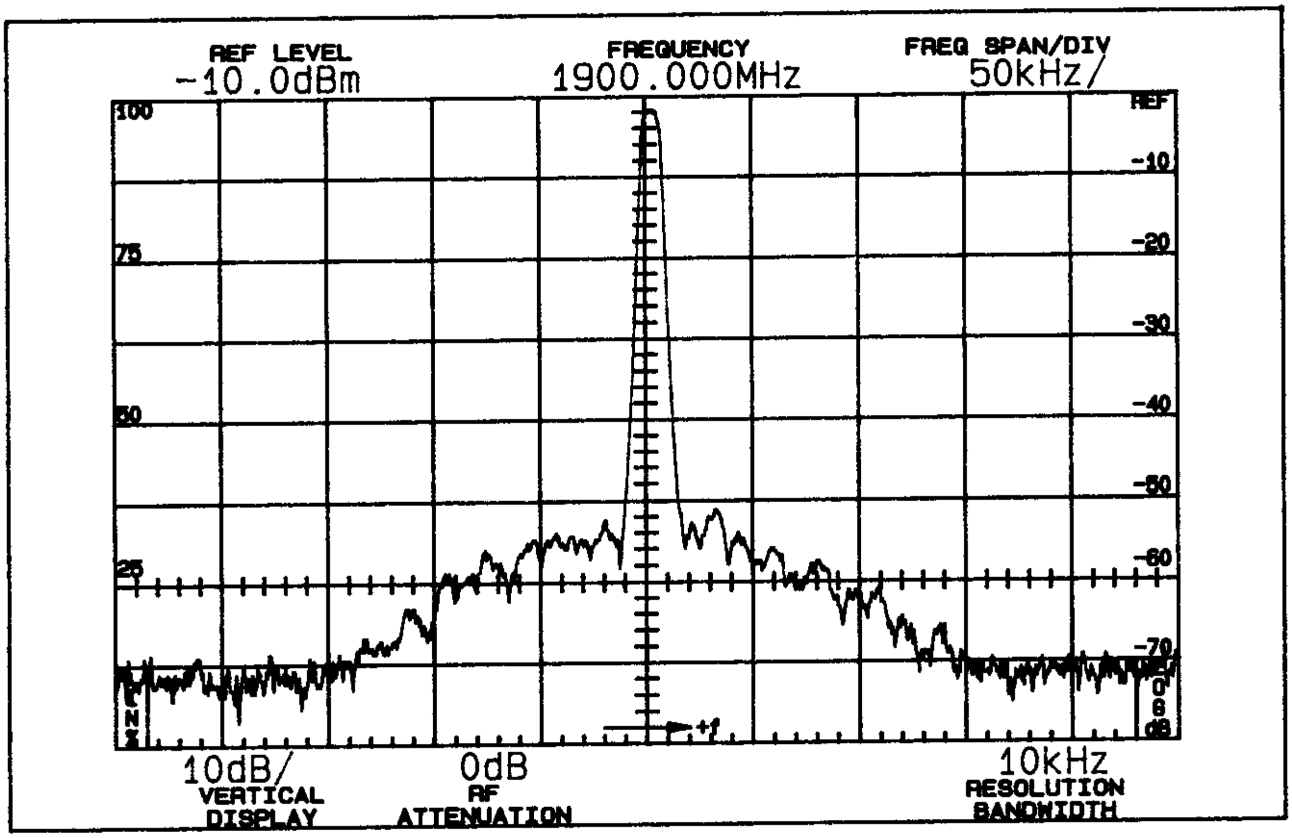
FIGURE 1



CW Carrier 20W
FCC ID: JTE-GMT20

FIGURE 1

FIGURE 2

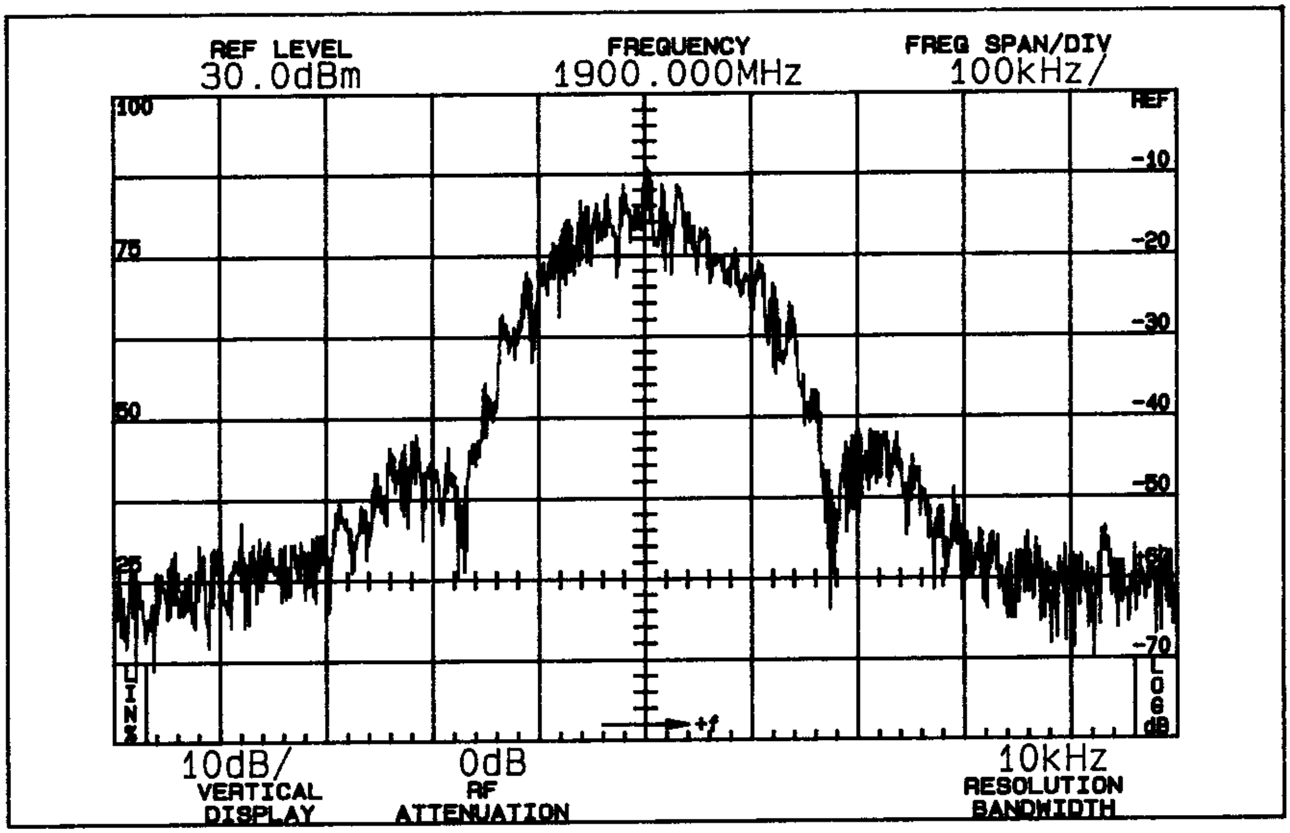


CW Carrier 2 mW
FCC ID: JTE-GMT20

FIGURE 2

A:\GRAYS.CGM

FIGURE 3

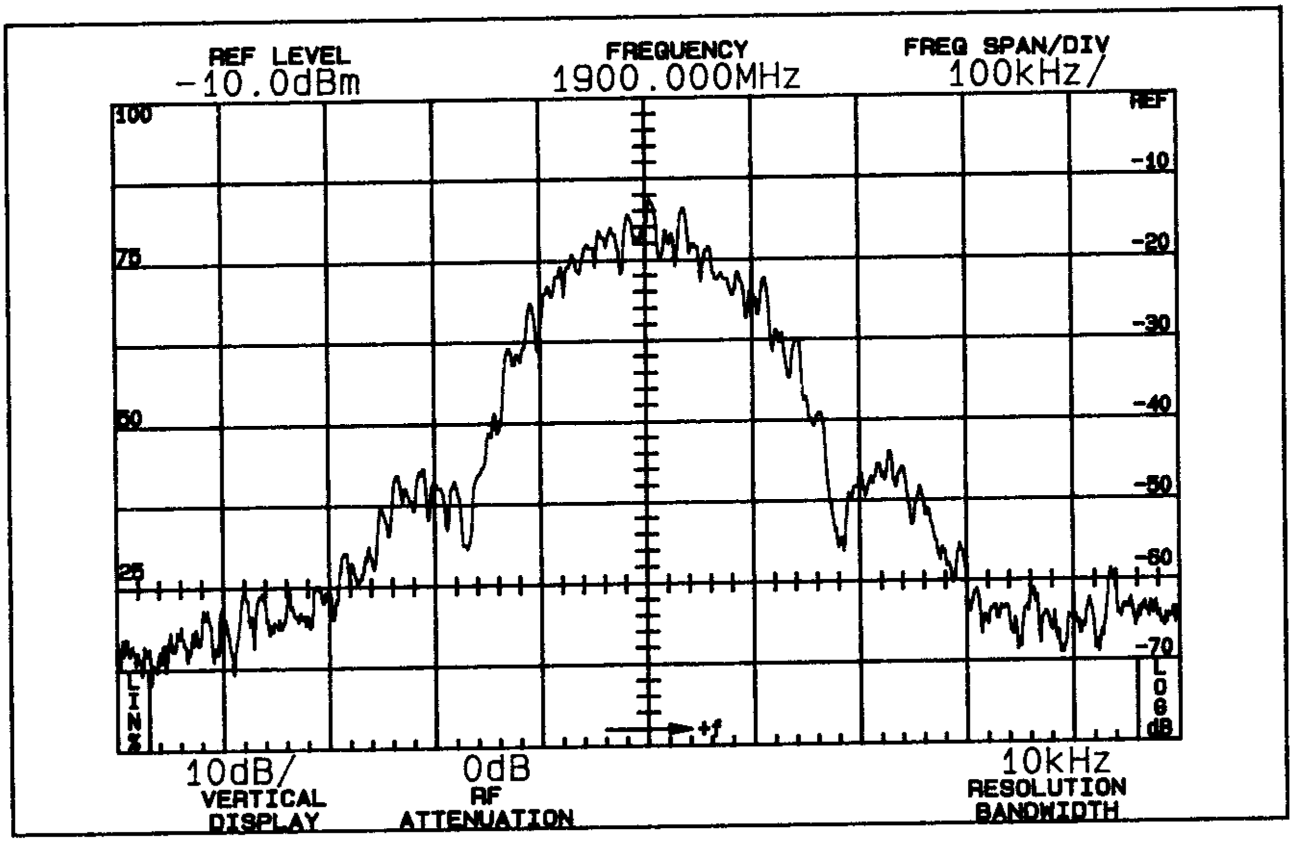


GSM, 20 W
FCC ID: JTE-GMT20

FIGURE 3

A:\GRAY1B.GSM

FIGURE 4



GSM, 2 mW
FCC ID: JTE-GMT20

FIGURE 4

E. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS (Paragraph 2.991 of the Rules)

The GMT-20 transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a GSM signal previously described.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through a Narda 765-20 power attenuator and general radio 874-GAL variable attenuator. A notch filter was used to attenuate the carrier.

During the tests, the transmitter was terminated in the 50 ohm attenuator, dc supply was 117 volts throughout the tests.

Spurious emissions were measured at 2 mW and 20 watts output throughout the RF spectrum from 10 to the tenth harmonic of the carrier.

Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

F. DESCRIPTION OF RADIATED SPURIOUS MEASUREMENT FACILITIES

A description of the Hyak Laboratories' radiation test facility is a matter of record with the FCC. The facility was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS
1.850 MHz, 117 Vac Input, 2 mW and 20 watts

	Spurious Frequency MHz	dB Below Carrier Reference
20W		
	3700.000	>103*
	5550.000	>102*
	7400.000	>90*
	9250.000	>90*
	11100.000	>88*
	12950.000	>86*
	14800.000	>86*
	16650.000	>84*
	18500.000	>82*
	Required:[1]	56
2 mW		
	3700.000	>100*
	5550.000	>97*
	7400.000	>82*
	9250.000	>81*
	11100.000	>84*
	12950.000	>77*
	14800.000	>79*
	16650.000	>77*
	18500.000	>74*
	Required:[1]	16

All other emissions from 10 MHz to the tenth harmonic were 20 dB or more below FCC limit.

*Reference data only, more than 20 dB below FCC limit.

NOTE: Carrier notch filter used to increase dynamic range.

1 Required dBC = $43+10 \, Log_{10}P$

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurements of radiated spurious emissions from the GMT-20 were made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated dipole antennas below 1 GHz, and EMCO 3115 or 3116 horn antennas over 1 GHz.

The transmitter and dummy load were located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 117 Vac.

Output power was 20 watts at the 1850.00 MHz operating frequency. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antennae polarization were employed.

Reference level for the spurious radiations was taken as an ideal dipole excited by 20 watts, the output power of the transmitter according to the following relationship:*

$$E = \frac{(49.2P_t)^{1/2}}{R}$$

where E = electric-field intensity in volts/meter

P_t = transmitter power in watts

R = distance in meters

for this case $E = \frac{(49.2x20)^{1/2}}{3} = 10.5$ V/m

Since the spectrum analyzer is calibrated in decibels above one milliwatt (dBm), a conversion, for convenience, was made from dBu to dBm.

10.5 volts/meter = $10.5x10^6$ uV/m

dBu/m = 20 $\text{Log}_{10}(10.5x10^6)$

= 140 dBu/m

Since 1 uV/m = -107 dBm, the reference becomes

140 - 107 = 33 dBm

*Reference Data for Radio Engineers, Fourth Edition, International Telephone and Telegraph Corp., p. 676.

G. FIELD STRENGTH MEASUREMENTS (Continued)

The measurement system was capable of detecting signals 66 dB or more below the reference level. Measurements were made from 10 MHz to 10 times operating frequency. Data after application of antenna factors and line loss corrections are shown in Table 2.

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS

1850.000 MHz, 117 Vac, 20 watts

Spurious Frequency MHz	dB Below Carrier Reference[1]
3700.000	75
5550.000	>74**
7400.000	>72**
9250.000	>70**
11100.000	>67**
12950.000	>66**
14800.000	>65**
16650.000	>58**
18500.000	>55**

Required: 43+10Log(P) = 56

[1]Worst-case polarization, H-Horizontal, V-Vertical.

* Reference data only, more than 20 dB below FCC limit.

** Measuring system noise floor.

Frequencies > 4 GHz measured at 1 m, extrapolated to 3m.

All other spurious from 10 MHz to 18.5 GHz were 20 dB or more below FCC limit.

H. FREQUENCY STABILITY
(Paragraph 2.995(a)(2) and 90.213 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30^{o}C to +50^{o}C. At each temperature, the unit was exposed to test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within $\pm 2^{o}$ of the desired test temperature. Following the 1 hour soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes. Test temperature was sequenced in the order shown in Table 3, starting with -30^{o}C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital thermometer. The transmitter output stage was terminated in a dummy load. Primary supply was 117 Vac. Frequency was measured with a Textronix 494P spectrum analyzer connected to the transmitter through a power attenuator. Measurements were made at 1850.000 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE

1850.000 MHz; 117 Vac; 20 W

Temperature, ^{o}C	Output Frequency, MHz	ppm
-30.3	1850.000471	0.25
-20.6	1850.000458	0.25
-11.3	1850.000121	0.07
- 0.1	1849.999874	-0.07
10.6	1849.999964	-0.02
20.4	1850.000057	-0.03
30.3	1850.000213	-0.12
40.1	1849.999674	-0.18
50.1	1849.999686	-0.17

Maximum frequency error: 1850.000471
1850.000000

\+ .000471 MHz

Rated stability is ± 0.5 ppm or a maximum of ± .000925 MHz, which corresponds to:

High Limit	1850.000925 MHz
Low Limit	1849.999075 MHz

I. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE (Paragraph 2.995(d)(2) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with a HP 5385A frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied from ±15% above the nominal 117 Vac rating. A Fluke 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 4

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE

1850.000 MHz, 117 Vac Nominal, 20 W

%	Supply Voltage	Output Frequency, MHz
115	134.55	1850.000059
110	128.70	1850.000058
105	122.85	1850.000057
100	117.00	1850.000057
95	111.15	1850.000058
90	105.30	1850.000057
85	99.45	1850.000058

Maximum frequency error: 1850.000059
1850.000000

\+ .000059 MHz

Rated stability is ± 0.5 ppm or a maximum of ± .000925 MHz, which corresponds to:

High Limit	1850.000925 MHz
Low Limit	1849.999075 MHz