GTCO CALCOMP

REPORT TO FCC PART 15 SUBPART C:

GTCO CALCOMP TRANSDUCER PEN

[redacted]

PREPARED FOR:

GTCO CALCOMP
14555 North 82nd Street
Scottsdale, AZ 85260

PREPARED BY:

Kenneth B. Jacobson
Product Support Engineer
GTCO CALCOMP
14555 North 82nd Street
Scottsdale, AZ 85260

DATE OF REPORT:

03/31/99

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I. OVERVIEW OF TEST REPORT

The procedures used for the conducted and radiated tests were derived from the American National Standard ANSI C63.4-1991 as stated in FCC CFR 47, Part 15, Paragraph 15.31. The test site attenuation and layout was done in accordance with ANSI C63.4-1991 and is on file with the FCC as required in FCC CFR 47, Part 2, Paragraph 2.948.

PRODUCT TESTED:	GTCO CALCOMP Transducer Pen
TRADE NAME:	None
APPLICANT:	GTCO CALCOMP 14555 North 82nd Street Scottsdale, AZ 85260
MANUFACTURER:	Same as Applicant
TEST FACILITY LOCATION:	Same as Applicant
TEST DATE:	03/24/99

The measurement data contained in this report reflects an accurate representation of the emission characteristics of the produce mentioned above.

REPORT PREPARED AND APPROVED BY: _____

Kenneth B. Jacobson
Product Support Engineer
GTCO CALCOMP

II. STATEMENT OF COMPLIANCE

Under the test configuration as described in this test report, the product tested has shown that it complies to the requirements of:

FCC RULES, PART 15, SUBPART C

We, GTCO CALCOMP, assume full responsibility to manufacture the product as shown in the enclosed photographs to uphold compliance to the FCC rules.

SIGNED: _____
Randy Crutchfield

TITLE: Manager of Engineering

DATE: 4/1/99

III. DESCRIPTION OF TEST SAMPLE

The GTCO CALCOMP Pen is a transducer which radiates a nominal radio frequency of 1.84MHz. Due to the tolerance of the components of the LC circuit ("antenna"), the radiated frequency may vary ±5%.

When the transducer is placed on a digitizer, the digitizer receives the transmitted frequency through a grid and determines the X-Y position of the transducer.

IV. SUBASSEMBLIES OF TEST SAMPLE

The GTCO CALCOMP Transducer Pen has only one PCB and is a stand-alone transducer with no attachments or subassemblies. See attached photographs.

V. TEST EQUIPMENT AND CALIBRATION

The following is a list of equipment and calibration dates that are used at GTCO CALCOMP'S test site.

TEST EQUIPMENT	MODEL	CALIBRATION DATE	FREQUENCY
Com-Power Log Periodic Antenna	CPAL-100	06/08/98	1 Year
Com-Power Biconical Antenna	AB-100	05/28/98	1 Year
Com-Power Loop Antenna	AL-130	06/26/98	1 Year
EMCO LISN	3825/2	09/25/98	1.5 Year
EMCO LISN	3825/2	09/25/98	1.5 Year
HP Spectrum Analyzer with Quasi-Peak Adapter	8568B 85650A	11/10/98	1 Year
HP Signal Generator	HP8656B	09/15/98	1 Year
EMCO Turntable	1060	N/A	N/A
HP Plotter	HP7470	N/A	N/A
Cable	RG-59/U	05/13/98	1 Year

VI. CABLE LOSS AND ANTENNA FACTORS

Com-Power Corporation

(949) 587-9800

Antenna Calibration

Antenna Type:	Biconical
Model:	AB-100
Serial Number:	14069
Calibration Date:	5/28/98

Frequency MHz	Gain dBi	Factors dB/m
30	-14.6	14.4
40	-9.8	12.1
50	-8.0	12.2
60	-5.7	11.5
70	-3.3	10.4
80	0.8	7.5
90	3.0	6.3
100	4.1	6.1
125	-0.9	13.0
150	5.1	8.6
175	-1.8	16.9
200	-1.9	18.1
250	-2.0	20.2
300	-1.4	21.2

Trans. Antenna Height	2 meter
Receiving Antenna Height	1 to 4 meter
Calibration	3 meter
Spectrum Analyzer	
Resolution Bandwidth	100 kHz
Video Bandwidth	100 kHz
Signal Generator Output	120 dBuV

Com-Power Corporation

(949) 587-9800

Antenna Calibration

Antenna Type:	Log Periodic
Model:	AL-100
Serial Number:	1011
Calibration Date:	6/8/98

Frequency MHz	Gain dBi	Factors dB/m
300	5.2	14.6
400	6.9	15.4
500	5.2	19.0
600	3.2	22.6
700	5.4	21.7
800	5.6	22.7
900	7.6	21.7
1000	3.4	26.8

Trans. Antenna Height		2 meter
Receiving Antenna Height		1 to 4 meter
Spectrum Analyzer		
	Resolution Bandwidth	100 kHz
	Video Bandwidth	100 kHz
Signal Generator Output		114 dBuV

Com-Power Corporation

(714) 587-9800

Antenna Calibration

Antenna Type:	Loop Antenna
Model:	AL-130
Serial Number:	17000
Calibration Date:	6/26/98

Frequency MHz	Magnetic (dB/m)	Electric dB/m
0.01	-41.3	10.2
0.02	-42.3	9.2
0.03	-40.6	10.9
0.04	-40.6	10.9
0.05	-41.8	9.7
0.06	-41.4	10.1
0.07	-41.5	10.0
0.08	-41.8	9.7
0.09	-41.9	9.6
0.1	-41.9	9.6
0.2	-44.0	7.5
0.3	-41.6	9.9
0.4	-41.6	9.9
0.5	-41.5	10.0
0.6	-41.3	10.2
0.7	-41.2	10.3
0.8	-41.2	10.3
0.9	-41.1	10.4
1	-40.4	11.1
2	-39.7	11.8
3	-40.3	11.2
4	-40.6	10.9
5	-40.2	11.3
6	-40.3	11.2
7	-40.7	10.8
8	-41.1	10.4
9	-40.3	11.2
10	-40.5	11.0
12	-41.1	10.4
14	-41.5	10.0
15	-41.7	9.8
16	-42.0	9.5
18	-42.0	9.5
20	-42.0	9.5
25	-43.4	8.1
30	-46.7	4.8

Trans. Antenna Height	2 meter
Receiving Antenna Height	2 meter

CERTIFICATE OF CALIBRATION CONFORMANCE

COM-POWER CORPORATION
20621 Pascal Way
Lake Forest, CA 92630
TEL: (949) 587-9800
FAX: (949) 587-9960

This antenna has been individually calibrated using ANSI C63.5, American National Standard for Calibration of Antennas used for radiated emission measurement in EMI control.

Certificate Number	1001
Client	Calcomp
Manufacturer	Com-Power
Model Number	AB-100
Serial Number	14069
Date of Calibration	05/28/98

Calibration Accuracy: ± 1 dB

Calibration Traceability:

All measurement instrumentation is traceable to the United States National Institute of Standards and Technology (NIST). Supporting Documentation relative to traceability is on file and is available for examination upon request.

Measurement procedure per Military Handbook-52A as guidance for Military Standard 45662A, ANSI/NCSL Z540-1-1994 and ISO Guide 25.

Notes:

Re-Certification Date: 1 Year from Calibration Date.

COM-POWER CORPORATION

Calibration Engineer

CERTIFICATE OF CALIBRATION CONFORMANCE

COM-POWER CORPORATION
20621 Pascal Way
Lake Forest, CA 92630
TEL: (949) 587-9800
FAX: (949) 587-9960

This antenna has been individually calibrated using ANSI C63.5, American National Standard for Calibration of Antennas used for radiated emission measurement in EMI control.

Certificate Number	1005
Client	CalComp Inc.
Manufacturer	Com-Power
Model Number	AL-130
Serial Number	17000
Date of Calibration	06/26/98

Calibration Traceability:

All measurement instrumentation is traceable to the United States National Institute of Standards and Technology (NIST). Supporting Documentation relative to traceability is on file and is available for examination upon request.

Measurement procedure per Military Handbook-52A as guidance for Military Standard 45662A, ANSI/NCSL Z540-1-1994 and ISO Guide 25.

Notes:

Re-Certification Date: 1 Year from Calibration Date.

COM-POWER CORPORATION

Calibration Engineer

RG-59/U 3 METER CABLE LOSS

MHz	LOSS (db)	MHz	LOSS (db)
		280	1.30
30	.47	290	1.37
35	.31	300	1.61
40	.64	310	1.28
45	.77	320	1.53
50	.70	330	1.71
55	.69	340	1.99
60	.76	350	1.84
65	.67	360	2.11
70	.48	370	2.06
75	.36	380	1.82
80	.23	390	2.29
85	.16	400	2.02
90	.12	410	2.18
95	.19	420	2.12
100	.24	430	2.31
105	.31	440	2.43
110	.48	450	2.57
115	.71	460	2.62
120	.45	470	3.03
125	.46	480	3.04
130	.50	490	3.18
135	.61	500	3.21
140	.61	525	2.95
145	.46	550	2.54
150	.58	575	2.85
155	.87	600	3.18
160	.95	625	3.15
165	.48	650	3.54
170	.48	675	3.71
175	.75	700	3.93
180	1.23	725	4.08
185	1.07	750	3.70
190	.43	775	3.65
195	.38	800	3.52
200	.58	825	4.41
210	.46	850	4.51
220	.58	875	4.33
230	.61	900	4.29
240	.90	925	4.78
250	.80	950	4.91
260	1.17	975	4.93
270	1.13	990	4.87

VII. DESCRIPTION OF EQUIPMENT/CABLES USED FOR TESTING

Since the GTCO CALCOMP Transducer Pen is a stand-alone intentional radiator, no additional equipment was used and/or needed during the radiated tests.

DESCRIPTION OF CABLE

No cabling was used during the radiated tests.

VIII. RADIATED TEST PROCEDURE

Testing in the field as specified in ANSI C63.4, Section 8, the EUT was evaluated from the range of 9 KHz - 1000 MHz. The EUT was placed on a wooden turntable .8 meters above the ground plane and at a distance of 3 meters from the search antenna.

Maximum emissions were obtained by rotating the turntable and raising and lowering the search antenna. Appendix D in ANSI C63.4 was used for a reference. Since the radiated tests used a active loop antenna, only the vertical polarization was scanned. Worst case configuration is shown in photographs 1 and 2.

All emission levels were measured with a spectrum analyzer and represent peak readings at 100 KHz bandwidth resolution. Converting the spectrum analyzer readings of dbm to dbμv/m proceeds as follows:

A. Convert dbm to dbμv by adding 107db to the reading in dbm. This is derived from the voltage for a power level into a 50 ohm load.

B. Finally, adding the antenna factor with any cable loss to the dbμv reading yields dbμv/m.
   By formula: dbμv/m = dbm (reading) + 107db + AF + CL
   Where: AF = Antenna Factor in db
   CL = Cable Loss in db

C. Since the transducer radiates a nominal frequency of 1.84 MHz, field strength limits were given for 30 meters. Measurement was done at 3 meters and extrapolated to 30 meters by using the square of an inverse linear distance extrapolation factor of 40db/decade as outlined in the FCC rules 15.31. Therefore, a total of 40db was subtracted from the measured readings at 3 meters.

   The field strength limit for an intentional radiator at 1.84 MHz is 30 μv/m per FCC rules in Paragraph 15.209. Therefore:

   Limit @ 30m =30μv/m or 20 LOG 30μv/m = 29.54dbμv/m

   Since the intentional radiator (transducer) is incorporated with a digital device, the frequency scanned was beyond the 10th harmonic up to 1000 MHz as described in FCC rules Paragraph 15.33.

   The transducer has such low power, the only frequency recorded through the scanned spectrum was the fundamental frequency, 1.84MHz. The transducer does, however, emit harmonics which was detected by a close field probe. These harmonics are so weak they cannot be detected at 3 meters. Graph 1 indicates the fundamental frequency of 1.84MHz and it's harmonics.

IX. RADIATED TEST DATA/PHOTOGRAPHS

COMPANY NAME: GTCO CALCOMP DATE: 3-24-99

TEST SAMPLE: GTCO CALCOMP Transducer pen

SERIAL NUMBER: N/A

ANTENNA TYPE: DIPOLE _____ BICONICAL _____ LOG PER _____ LOOP X

TEST DISTANCE: 3M PEN X CURSOR _____

NOTE:

MHz EMISSION FREQUENCY	ANT. POL.	ANT. HEIGHT (M)	*AZIMUTH DEGREES	METER READ dbµv	ANTENNA FACTOR & CABLE LOSS	**FINAL READING dbµv/m	FCC LIMIT dbµv/m	MARGIN
1.770	V	1.0	180	37.50	12.3	9.80	29.54	+19.74

* A 0-degree reading means the front of the EUT is facing the antenna. 180 degrees would mean the back of the EUT is facing the antenna. Rotation is clockwise from 0 degrees.

** Final reading is after a -40db extrapolation factor was taken for a 3-meter reading as outlined in FCC Rules 15.31.

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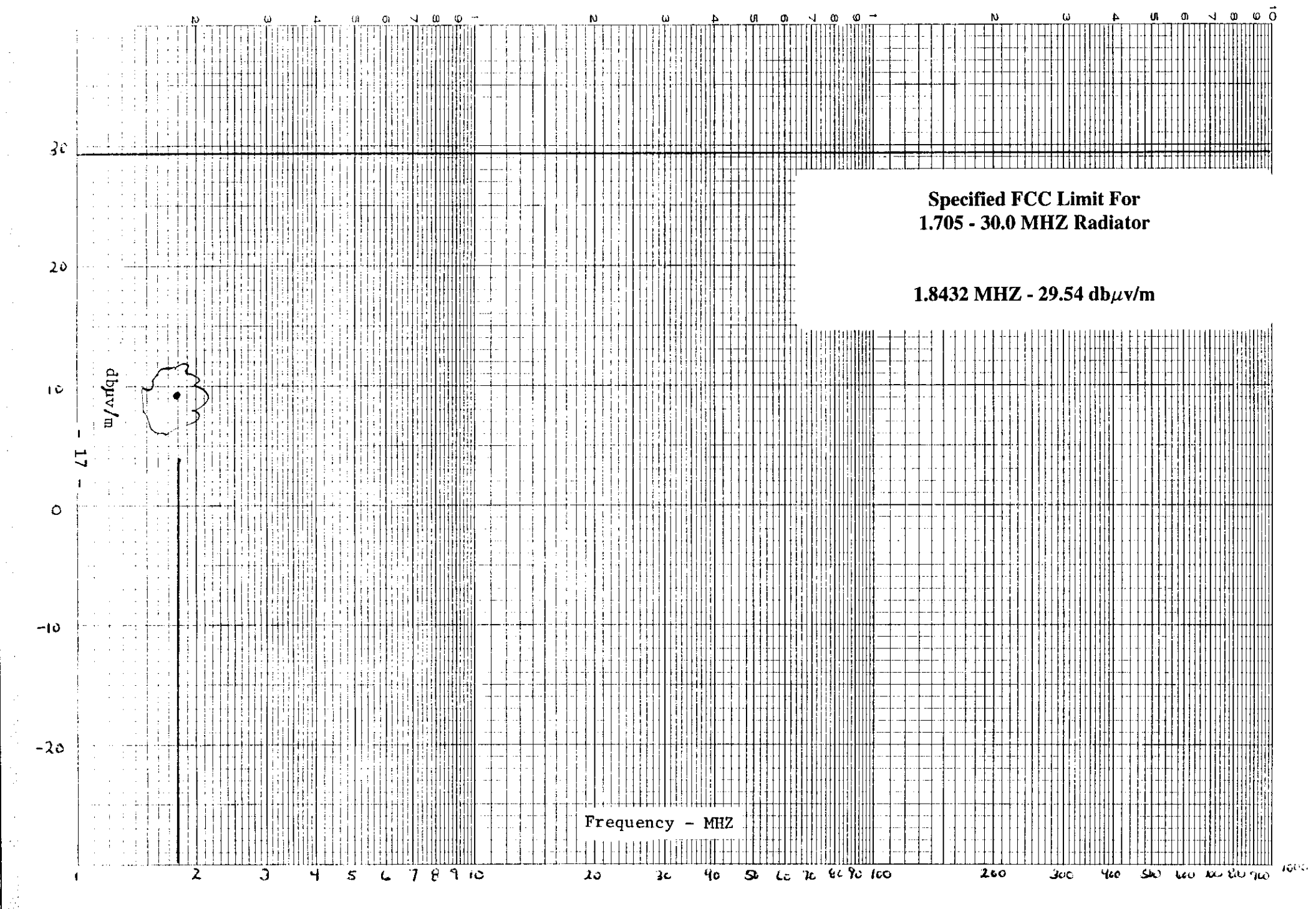

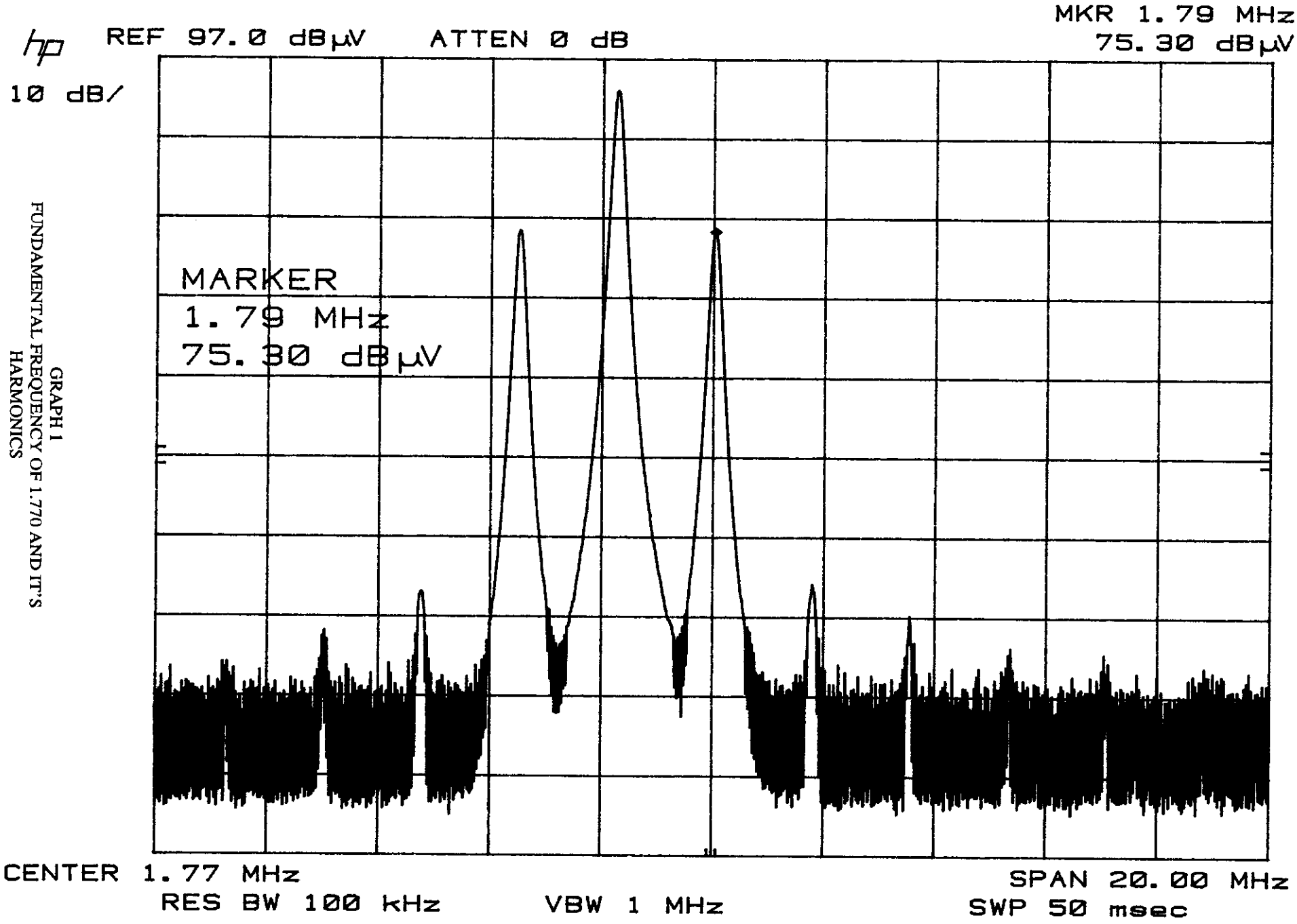

GRAPH 1
FUNDAMENTAL FREQUENCY OF 1.770 AND IT'S HARMONICS

X. CONDUCTED TEST PROCEDURE

Since the GTCO CALCOMP transducer pen is powered by batteries, the conducted tests were not necessary.

XI. SUMMARY OF RESULTS

The GTCO CALCOMP transducer pen has shown that it passes the radiated test limits in FCC's CFR 47, Part 15, Subpart C, Paragraph 15.209. As noted before, only the fundamental frequency was noted at 3 meters which is 1.770 MHz. Therefore, the worse case margin would be the fundamental and has a margin of +19.74db.

The product tested had no specific modifications done to it to pass the above limits.