CHAPMAN
TECHNOLOGIES, INC.

FCC Type Acceptance Application

EXHIBIT 4

TEST REPORT

"Chapman Vehicle Locator"

FCC ID – N6TVLACES

SUMMARY OF TEST REPORT

The Chapman Vehicle Locator was tested to all the relevant FCC requirements.

The Radiated Emission Testing was carried out at the EMI Research and Development Laboratory of Florida Atlantic University. Their Report, "Technical Report 00-002" is appended to this Exhibit.

The Frequency Stability Testing was carried out using the Temperature Test Chamber at Amitek Corporation, in Boca Raton, Florida.

All other testing was carried out in the laboratory at Chapman Technologies, Boca Raton, Florida.

The Test Results demonstrate that the Chapman Personal Safeguard Companion satisfies the relevant FCC requirements.

Report Complied by:

G K Smith, Ph.D Date: 2/27/00

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1 General Information

1.1 PURPOSE

The purpose of this document is to provide the Test Results on the Chapman Vehicle Locator (also marketed under the name "TRAPS 3000") product for submission to the FCC for Type Acceptance as requested in "EXHIBIT 4 – TEST REPORT".

1.2 GLOSSARY OF TERMS

Acronym	Description
FCC	Federal Communications Commission
§	Code of Federal Regulations Part.
AMPS	Advanced Mobile Phone System
GPS	Global Positioning System
LED	Light Emitting Diode

2 Safeguard Companion

2.1 GENERAL

The Chapman Vehicle Locator (CVL) is intended to be fitted in the front of a vehicle or out of sight, as desired. The CVL has an internal loudspeaker and microphone, used for "handsfree" voice communications, and is fitted with a CALL button, a keychain receiver, a battery monitoring circuit and several indicators. Connections are provided for external cellular and GPS antennas, external loudspeaker, external microphone, external Call button, input from an external vehicle alarm system or sensor(s) and one relay contacts output. It consists of a fully functional AMPS cellular phone (IS-19 and IS 91) and a 12-channel GPS receiver packaged, together with a micro-controller interface board, in a plastic case.

The AMPS cellular phone is based on a reference design using the ACE Chipset manufactured by Mitel (formally GEC-Plessey).
The AMPS board is identical to that used in the Chapman "Personal Safeguard Companion" FCC ID – N6TSCACEJ, Grant of Equipment Authorization, 5/24/99.
The device uses the analog AMPS cellular network for all communications between the user and the Central Control Station.

The device uses the 12-channel GPS receiver for determining its location. The GPS Receiver is based on a reference design using the Zodiac Chipset manufactured by Rockwell Semiconductors

3 Test Specifications

3.1 FCC REGULATIONS

3.1.1 General

The specific tests required for FCC Type Acceptance are contained within "FCC Code of Federal Regulations, Title 47".

§2.985 to §2.997 specify the required data, in general, and §2.999 adds the specific data for the particular type of equipment.

The Chapman Vehicle Locator consists of two main boards: the AMPS Cellular Controller and the GPS Receiver. The two functions performed by these boards are those of public cellular radio communications and GPS reception.

3.1.2 Relevant FCC Parts

3.1.2.1 AMPS Board

The AMPS Cellular board conforms to Part 22 Subpart K – Domestic Public Cellular Radio Telecommunication Service, §22.900.

3.1.2.2 GPS Board

The GPS receiver conforms to Part 15 Subpart B "Unintentional Radiator", §15.101. The GPS Receiver operating at 1575MHz, as per §15.101 (b), is exempt from complying with the technical provisions of §15. ET Docket No.97-94, on April 1998, eliminated the Notification requirement of §15.101 and the GPS receiver requires only Declaration of Conformity.

As the GPS receiver forms an integral part of the device, it was switched on during all the tests, including Radiation Emission Limits. Hence the GPS receiver, as well as the complete device, was tested to §15.109. The results of this testing is given in this report.

3.1.2.3 Interface Board

The Interface Board includes a micro-controller and an RF Receiver used for remote control. As the Interface board forms an integral part of the device, it was switched on during all the tests, including §15.109.

3.2 RELEVANT SPECIFICATIONS

3.2.1 FCC and EIA/IS-19-B

A list of the tests required by FCC is given in the following Table. Where applicable, EIA Interim Standard "Recommended Minimum Standards for 800-MHZ Cellular Subscriber Units", EIA/IS-19-B, is used as the reference for the measurements and results.

TEST	FCC Part	IS-19-B Clause	Specification
Radiated Emission Limits	§15.109(a)		§15.109(a)
RF Power Output		3.2.1	-2dBW, +2dB –4dB
Modulation Characteristics Modulation Deviation Limiting	§2.987(a)	3.3.2.3	Modulation Response NGT 12kHz peak deviation.
Occupied Bandwidth Spectrum Noise Suppression		3.4.1	Voice + SAT 20-45kHz <-26dBc >45kHz <-(63+10logP)dBc SAT + ST 20-45kHz <-26dBc 45-60kHz <-45dBc 60-90kHz <-60dBc >90kHz <-(63+10logP)dBc Wideband Data 20-45kHz <-26dBc 45-60kHz <-45dBc 60-90kHz <-60dBc >90kHz <-(63+10logP)dBc All Modulation 869-894MHz <-80dBm
Spurious Emissions at antenna terminal Harmonic and Spurious Emissions (Conducted) - Discrete		3.4.2.	Voice + SAT >-(43+10logP)dBc Wideband Data >-(43+10logP)dBc
Field Strength of Spurious Radiation	§2.993		
Frequency Stability	§2.995		–30 to +50°C +/- 2.5ppm

3.3 METHOD OF MEASUREMENT

The Method of Measurement, where appropriate, is as given in the following document:

EIA INTERIM STANDARD

"Recommended Minimum Standards for 800-MHZ Cellular Subscriber Units"

EIA/IS-19-B

3.4 STANDARD TEST CONDITIONS

The Standard Test Conditions are as given in Section 6 of the following document:

EIA INTERIM STANDARD

"Recommended Minimum Standards for 800-MHZ Cellular Subscriber Units"

EIA/IS-19-B

3.5 TEST EQUIPMENT

For the Tests carried out at Chapman Technologies, the following Test Equipment was used:

3.5.1 AMPS Test Set

MARCONI INSTRUMENTS Radio Communications Test Set 2955B, S/N 132423/078
with adapter AMPS Radio Test System 2957B, S/N 132451/064

3.5.2 Modulation Analyzer

HEWLETT PACKARD 8901A. S/N 2324A02790

3.5.3 Spectrum Analyzer

HEWLETT PACKARD 8590B, 9kHz to 1.8GHz. S/N 2932A00221

3.5.4 Multimeter

HEWLETT PACKARD 3468A. S/N 2137A13790

3.5.5 Plotter

HEWLETT PACKARD HP7470A Plotter. S/N 2210A10932 FCC ID BSD8537470A

3.5.6 10dB Fixed Attenuator

PASTERNACK PE1070-10.

3.5.7 Dummy Load

WEINSCHEL ENGINEERING M1413 S/N 3443, 10W AVG, 1KW Peak.

For the Frequency Stability Test, carried out at Amitek, Corporation, the following test equipment was also used:

3.5.8 Temperature Test Chamber

RANSCO 16000 Series Model 16219 S/N 235-009130

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4 TESTING

4.1 RADIATED EMISSION LIMITS

This test was carried out at EMI Research and Development Laboratory at Florida Atlantic University.

Details of the measurements are given in Florida Atlantic University Technical report No. 00-002, Page 3, which is appended to this Exhibit.

4.2 RF POWER OUTPUT

4.2.1 Specification

FCC regulations and OST Bulletin No. 53 control the effective Radiated power (ERP).
The ERP of the Safeguard Companion is as defined in EIA/IS-19-B para. 3.2.1. and Table 4.
The CVL is provided with an antenna connector for use with an external antenna. The CVL is a Class III subscriber device with a maximum nominal power level of 0.6W ERP, +2dB, -4dB.

4.2.2 Measurement

The output from the cellular antenna terminal was connected to the input of the AMPS Test Set (para. 3.5.1). The unit under test was set to transmit at Power Level 0, the maximum output. The Transmit Power is measured at Channels #991, #331, #799 corresponding to the lowest, center and highest frequencies.

4.2.3 Results

Measurement	Standard	Result	Remarks
Channel #991	27.8dBm +2 –4 dB	26.0dBm	PASS
Channel #331	27.8dBm +2 –4 dB	26.2dBm	PASS
Channel #799	27.8dBm +2 –4 dB	25.0dBm	PASS

Date Tested: 1/26/00

Test Engineer

G K Smith

4.3 MODULATION CHARACTERISTICS

4.3.1 Audio Frequency Response

The Audio Frequency Responses are controlled by the ACE9040 Audio Processor IC. The typical audio responses are given in the ACE9040 specification. These are reproduced below.

ACE9040

TYPICAL FREQUENCY RESPONSES

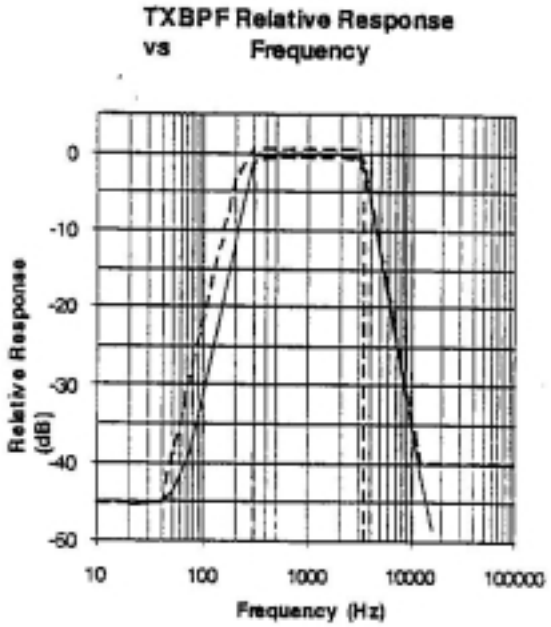


Figure 4

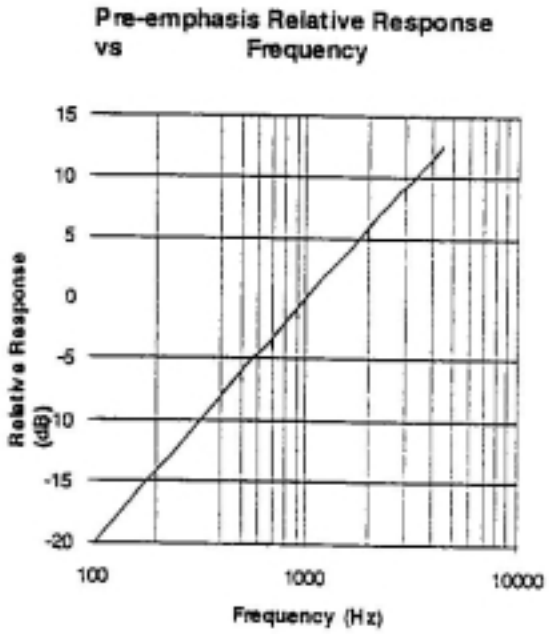


Figure 5

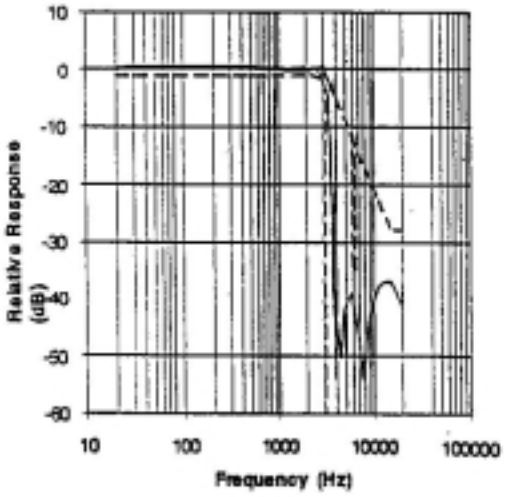


Figure 6

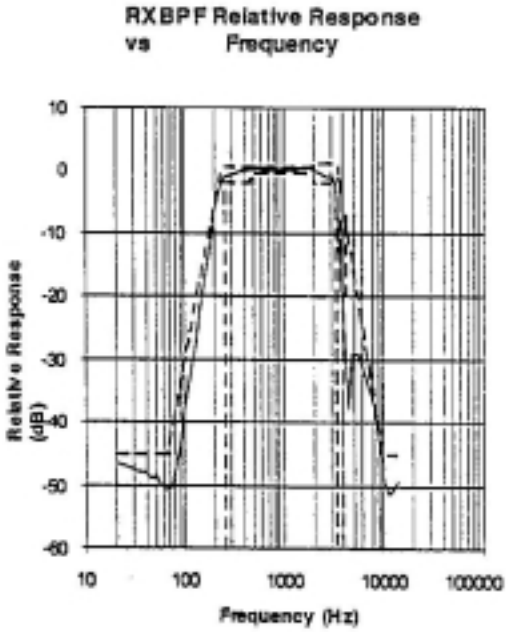


Figure 7

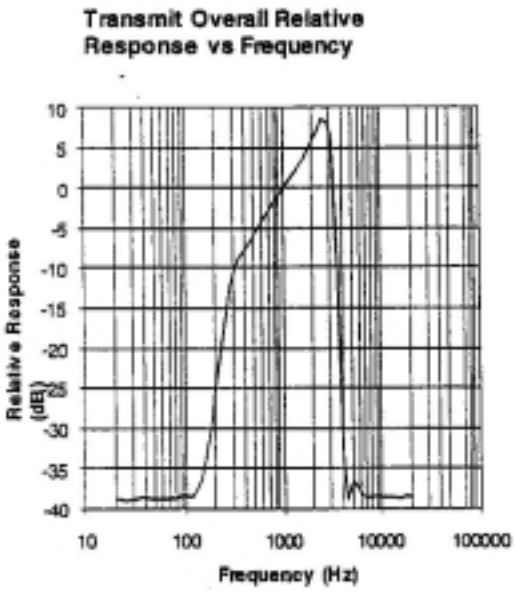


Figure 8

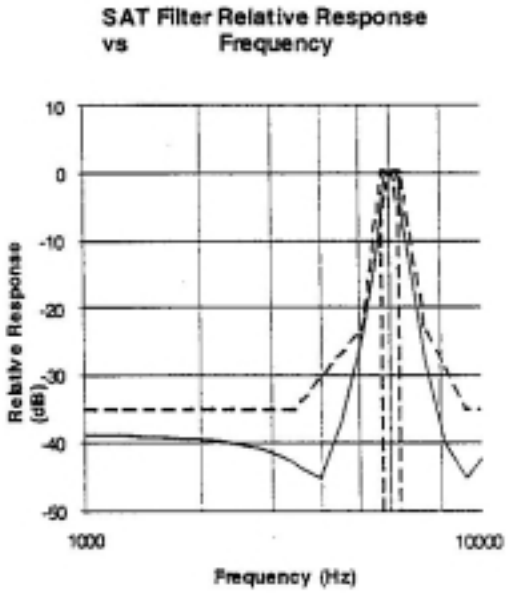


Figure 9

4.3.2 Modulation Deviation Limiting

Modulation limiting refers to the ability of the transmitter circuits to prevent the transmitter from producing deviation in excess of rated system deviation.
The output from the antenna terminal is connected to the input of the Modulation Analyzer (para. 3.5.2). The Deviation Limiting is tested in accordance with Clause 3.3.2.3. of IS-19-B.

4.3.2.1 Specification

The instantaneous peak and steady state deviation shall not exceed ±12kHz at any audio frequency.

4.3.2.2 Measurement

Set transmitter to channel #991 (lowest frequency). With compressor enabled and the SAT disabled, adjust the audio input for ±8kHz peak deviation at 1000Hz. Increase the audio input level by 20dB. Vary the frequency and observe the deviation for all frequencies between 300 and 3000Hz. Record the highest deviation and corresponding frequency. Repeat for channels #331 (center frequency) and #799 (highest frequency).

4.3.3 RESULTS

Measurement	**Standard**	**Result**	**Remarks**
		Max. Deviation	
Channel #991	NMT ±12kHz 300 to 3000Hz	11.36kHz	PASS
Channel #331	NMT ±12kHz 300 to 3000Hz	11.21kHz	PASS
Channel #799	NMT ±12kHz 300 to 3000Hz	11.20kHz	PASS

Date Tested: 1/27/00

Test Engineer

G K Smith

4.4 OCCUPIED BANDWIDTH

The Occupied Bandwidth was tested in accordance with Clause 3.4.1. of IS-19-B.

The output from the antenna terminal is connected to the input of the Spectrum Analyzer, (para. 3.5.3) via a 10dB fixed attenuator (para. 3.5.6). The Spectrum Analyzer display is plotted on a Hewlett Packard 7470A Plotter. (para. 3.5.5).

4.4.1 Specification

The mean power of emissions from the transmitter with modulated carrier shall be attenuated below the mean power of the unmodulated carrier in accordance with the following:

Modulation	Frequency removed from carrier	Attenuation
All modulation	20kHz up to 45kHz	At least 26dBc
Voice and SAT	>45kHz	At least (63 + 10 log P) dBc
Signaling Tone plus SAT	>45kHz to 60kHz >60kHz to 90kHz >90kHz	At least 45dBc At least 60dBc At least (63 + 10 log P) dBc
Wideband Data	>45kHz to 60kHz >60kHz to 90kHz >90kHz	At least 45dBc At least 60dBc At least (63 + 10 log P) dBc

NOTE: P is mean output power in watts.

In the band 869MHz to 894MHz, the mean power of emissions from the transmitter with modulated carrier shall not exceed –80dBm.

4.4.2 Measurement

Set the transmitter to channel #1 (to avoid interference).
For combined audio and SAT measurements, disable compressor and modulate transmitter with 1000Hz tone at a level to produce ±8kHz peak deviation. Increase audio level by 13.5dB and change audio frequency to 2500kHz. Switch on SAT tone of 6000Hz with ±2kHz peak deviation. Adjust Spectrum Analyzer and record display accordingly.
For combined SAT and Signaling Tone (ST) measurements, the transmitter is modulated with a 10kHz ST frequency with ±8kHz peak deviation in addition to the SAT tone of 6000Hz with ±2kHz peak deviation.
For Wideband data measurements, the transmitter is modulated with a quasi-random 10kilobit/second data pattern at ±8kHz peak deviation.

4.4.3 RESULTS:

The results of the measurements are given in Spectrum Analyzer plots #1 to #9.

4.4.3.1 Voice (2500Hz limiting), and SAT 6000H)

CONDITION	PLOT	SPEC	RESULTS	REMARKS
20kHz to 45kHz	#1	<-26dBc	-50dBc	PASS
>45kHz, up to 1st Harmonic	#1 & #2	<-59dBc	-69dBc	PASS

NOTE: Assuming Mean output power of unmodulated carrier = –4dBW

4.4.3.2 Signaling Tone (10kHz), and SAT 6000Hz

CONDITION	PLOT	SPEC	RESULTS	REMARKS
20kHz to 45kHz	#3	<-26dBc	-38dBc	PASS
45kHz to 60 kHz	#4	<-45dBc	-66dBc	PASS
60kHz to 90 kHz	#4	<-65dBc	<-70dBc	PASS
>90kHz, up to 1st Harmonic	#4 & #5	<-59dBc	-70dBc	PASS

NOTE: Assuming Mean output power of unmodulated carrier = –4dBW

4.4.3.3 Wide Band Data

CONDITION	PLOT	SPEC	RESULTS	REMARKS
20kHz to 45kHz	#6	<-26dBc	-32dBc	PASS
45kHz to 60 kHz	#7	<-45dBc	-67dBc	PASS
60kHz to 90 kHz	#7	<-65dBc	-70dBc	PASS
>90kHz, up to 1st Harmonic	#7 & #8	<-59dBc	-70dBc	PASS

NOTE: Assuming Mean output power of unmodulated carrier = –4dBW

In all Plots, the unmodulated carrier is shown at level 16dBm. A 10dB fixed attenuator was used on the input of the Spectrum Analyzer, hence, level of unmodulated carrier assumed to be 26dBm or –4dBW.

4.4.3.4 All Modulation

CONDITION	PLOT	SPEC	RESULTS	REMARKS
869MHz to 894MHz	#9	-80dBm	<-94dBm	PASS

NOTES:

1) Resolution bandwidth 10kHz in order to reduce noise floor of Spectrum Analyzer below –95dBm

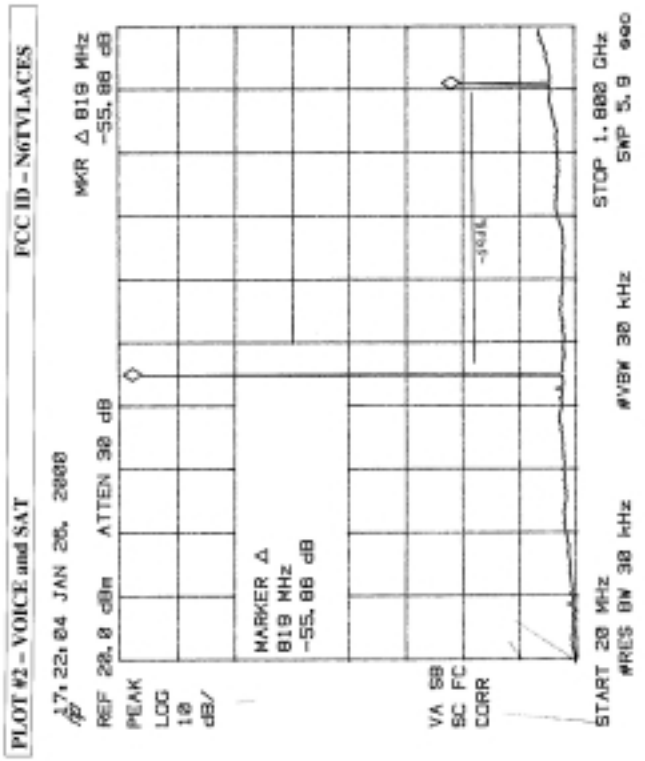
2) 10dB fixed attenuator on input of Spectrum Analyzer, hence 10dB added to reading.

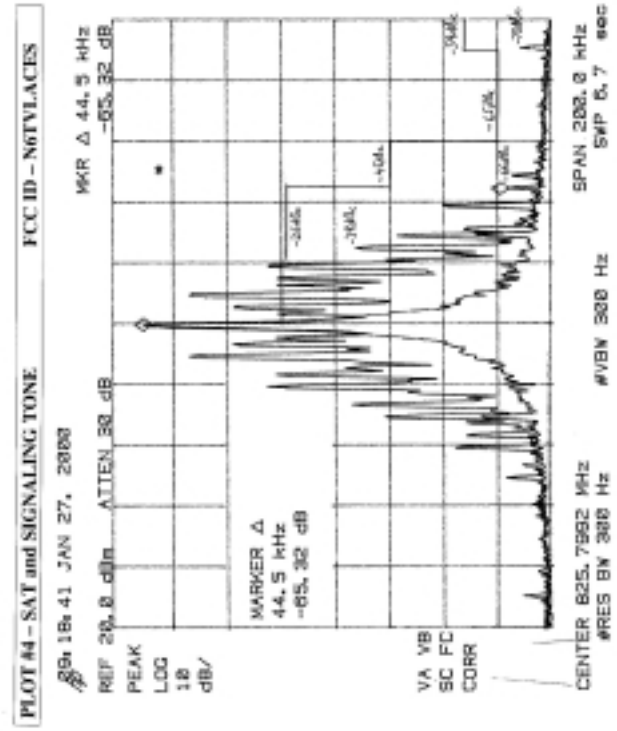
3) All forms of modulation were applied to unit, in all cases no discrete signals were observed above the Spectrum Analyzer noise, hence just one plot given.

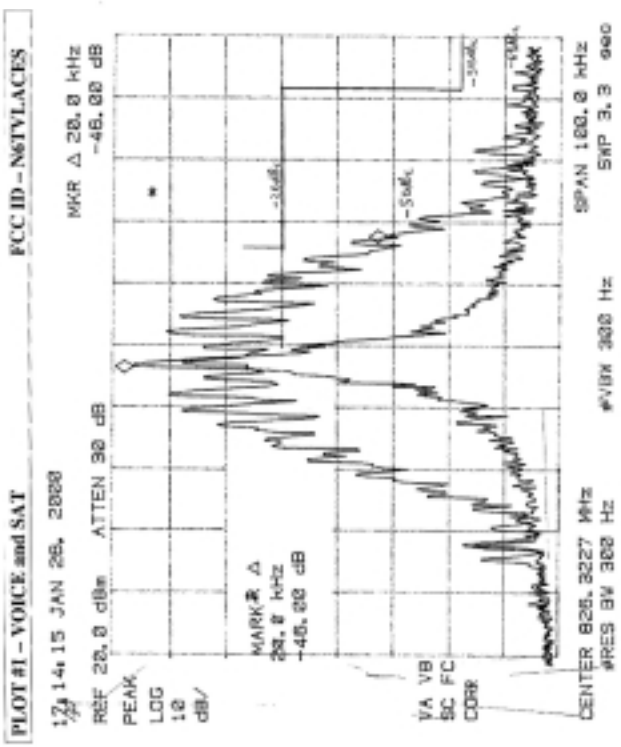
Date Tested: 1/27/00

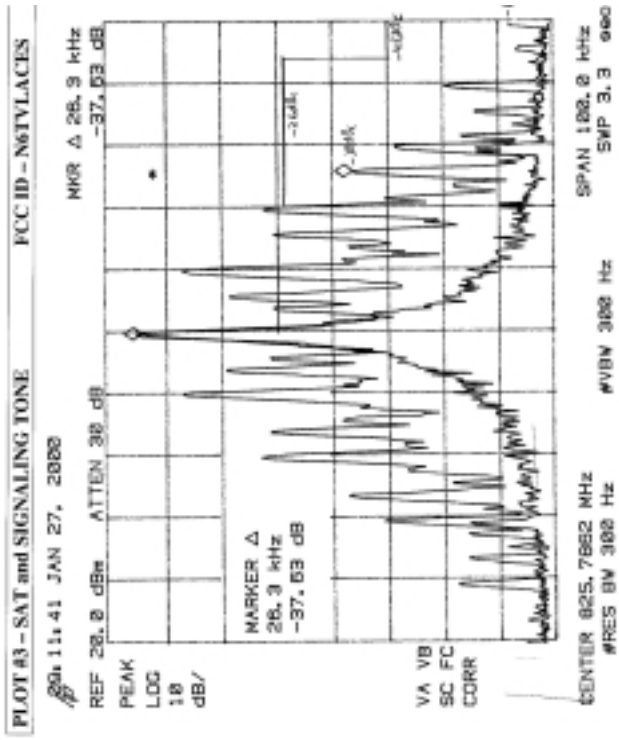
Test Engineer

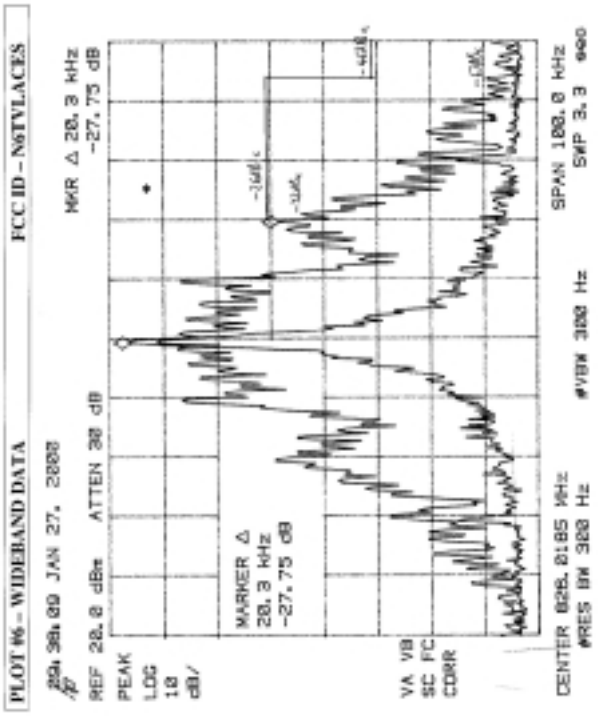
G K Smith

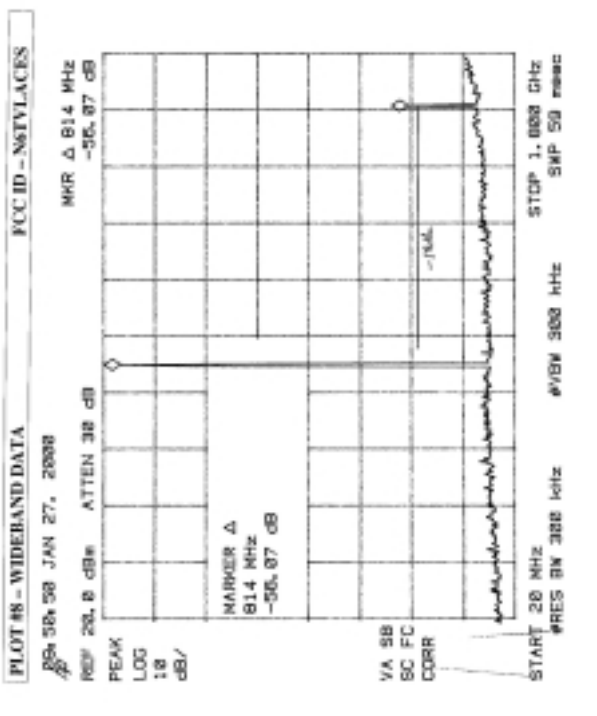

PLOT #2 – VOICE and SAT
FCC ID – N6TVLACES
17: 22: 04 JAN 26, 2000
REF 28.0 dBm
ATTEN 30 dB
MKR Δ 819 MHz
-55.86 dB
PEAK
LOG
10
dB/
MARKER Δ
819 MHz
-55.86 dB
VA SB
SC FC
CORR
START 20 MHz
#RES BW 30 kHz
#VBW 30 kHz
STOP 1.880 GHz
SWP 5.8 sec

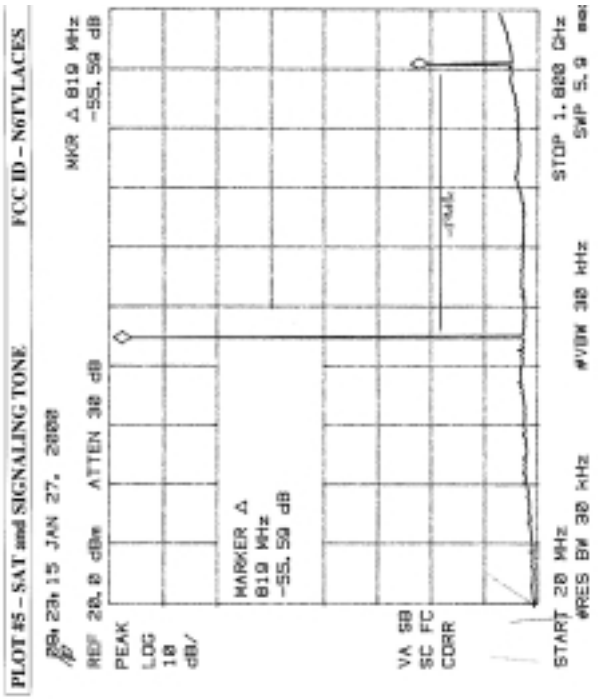

PLOT #4 – SAT and SIGNALING TONE
FCC ID – N6TVLACES
09: 18: 41 JAN 27, 2000
REF 28.0 dBm
ATTEN 30 dB
MKR Δ 44.5 kHz
-65.32 dB
PEAK
LOG
10
dB/
MARKER Δ
44.5 kHz
-65.32 dB
VA VB
SC FC
CORR
CENTER 825.7992 MHz
#RES BW 300 Hz
#VBW 300 Hz
SPAN 200.0 kHz
SWP 6.7 sec

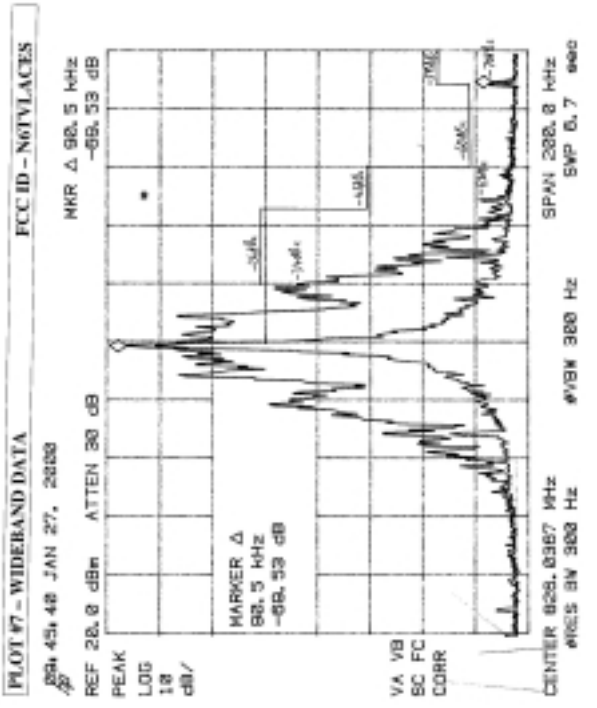

PLOT #1 – VOICE and SAT
FCC ID – N6TVLACES
17: 14: 15 JAN 26, 2000
REF 28.0 dBm
ATTEN 30 dB
MKR Δ 28.0 kHz
-46.00 dB
PEAK
LOG
10
dB/
MARKER Δ
28.0 kHz
-46.00 dB
VA VB
SC FC
CORR
CENTER 826.3227 MHz
#RES BW 300 Hz
#VBW 300 Hz
SPAN 100.0 kHz
SWP 3.3 sec

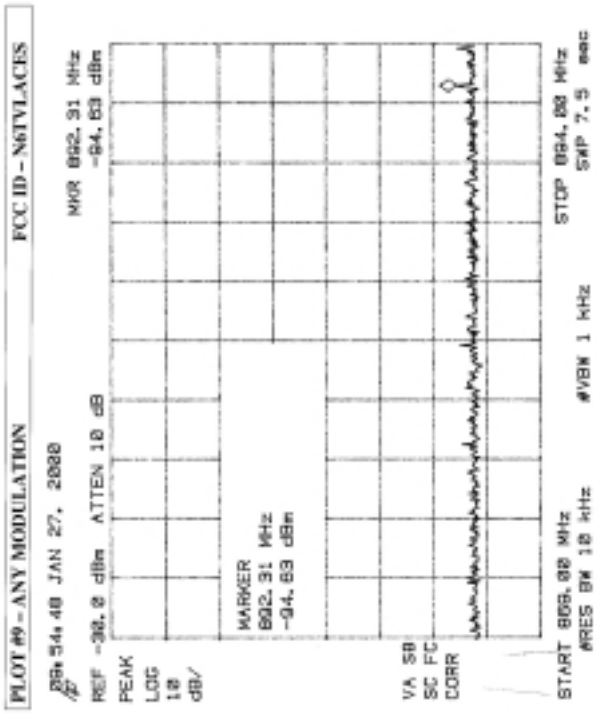

PLOT #3 – SAT and SIGNALING TONE
FCC ID – N6TVLACES
09: 11: 41 JAN 27, 2000
REF 28.0 dBm
ATTEN 30 dB
MKR Δ 26.3 kHz
-37.63 dB
PEAK
LOG
10
dB/
MARKER Δ
26.3 kHz
-37.63 dB
VA VB
SC FC
CORR
CENTER 825.7882 MHz
#RES BW 300 Hz
#VBW 300 Hz
SPAN 100.0 kHz
SWP 3.3 sec


PLOT #6 – WIDEBAND DATA
FCC ID – N6TVLACES
MKR Δ 28.3 kHz
-27.75 dB
REF 28.0 dBm
ATTEN 30 dB
PEAK
LOG
10
dB/
MARKER Δ
28.3 kHz
-27.75 dB
VA VB
SC FC
CORR
CENTER 826.8185 MHz
#RES BW 300 Hz
#VBW 300 Hz
SPAN 100.0 kHz
SWP 3.3


PLOT #8 – WIDEBAND DATA
FCC ID – N6TVLACES
MKR Δ 814 MHz
-56.87 dB
REF 28.0 dBm
ATTEN 30 dB
PEAK
LOG
10
dB/
MARKER Δ
814 MHz
-56.87 dB
VA SB
SC FC
CORR
START 20 MHz
#RES BW 300 kHz
#VBW 300 kHz
STOP 1.800 GHz
SWP 50 msec


PLOT #5 – SAT and SIGNALING TONE
FCC ID – N6TVLACES
MKR Δ 819 MHz
-55.59 dB
REF 28.0 dBm
ATTEN 30 dB
PEAK
LOG
10
dB/
MARKER Δ
819 MHz
-55.59 dB
VA SB
SC FC
CORR
START 20 MHz
#RES BW 30 kHz
#VBW 30 kHz
STOP 1.800 GHz
SWP 5.9


PLOT #7 – WIDEBAND DATA
FCC ID – N6TVLACES
MKR Δ 98.5 kHz
-58.53 dB
REF 28.0 dBm
ATTEN 30 dB
PEAK
LOG
10
dB/
MARKER Δ
98.5 kHz
-58.53 dB
VA VB
SC FC
CORR
CENTER 826.8367 MHz
#RES BW 300 Hz
#VBW 300 Hz
SPAN 200.0 kHz
SWP 6.7


PLOT #9 – ANY MODULATION
FCC ID – N6TVLACES
MKR 892.31 MHz
-94.63 dBm
REF -32.0 dBm ATTEN 10 dB
PEAK
LOG
10
dB/
MARKER
892.31 MHz
-94.63 dBm
VA SB
SC FC
CORR
START 869.00 MHz
#RES BW 10 kHz
#VBW 1 kHz
STOP 894.00 MHz
SWP 7.5 sec

4.5 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

This test was carried out at EMI Research and Development Laboratory at Florida Atlantic University. The Details given in Technical report No. 00-002.

The Spurious Emissions at Antenna Terminals is tested in accordance with Clause 3.4.2. of IS-19-B.3., "Harmonic and Spurious Emissions (Conducted) – Discrete".

4.5.1 Specification

The transmitter shall be alternately modulated with combined voice and SAT and with wideband data. The conducted spurious emissions shall be attenuated below the level of emissions of the carrier frequency by at least 43 + 10 [log10 (mean output power in Watts)] dB.

4.5.2 Measurement

Set the transmitter to channel #331 (center), full power.
For combined audio and SAT measurements, disable compressor and modulate transmitter with 1000Hz tone at a level to produce ±8kHz peak deviation. Increase audio level by 13.5dB and change audio frequency to 2500kHz. Switch on SAT tone of 6000Hz with ±2kHz peak deviation. Adjust Spectrum Analyzer and set display accordingly..
For Wideband data measurements, the transmitter is modulated with a quasi-random 10kilobit/second data pattern at ±8kHz peak deviation.
Record up to the tenth harmonic.

4.5.3 RESULTS

The measured results are contained in Florida Atlantic University Technical Report No. 00-002, Page 37, which is appended to this Exhibit.

4.6 FIELD STRENGTH OF SPURIOUS RADIATION

This test was carried out at EMI Research and Development Laboratory at Florida Atlantic University.

In order to preserve battery life, the Safeguard Companion was set for a transmit duty cycle of 1 second ON, 2 seconds OFF. The antenna output was loaded by the Dummy Load (para. 3.5.7).

Details of the measurements are given in Florida Atlantic University Technical report No. 00-002, Page 42, which is appended to this Exhibit.

4.7 FREQUENCY STABILITY

This Test is carried out at AMITEK Corporation, Clint Moore Road, Boca Raton, Florida.
The output from the antenna terminal is connected to the input of the AMPS Test Set (para. 3.5.1).
The unit was placed into the Temperature Test Chamber (para 3.5.8).

4.7.1 Specification

The Carrier Frequency shall be maintained within ±2.5ppm of any assigned channel frequency.

4.7.2 Measurement

The Frequency Stability is tested in accordance with the following:

Paragraph	Description
§2.995 (a) (1)	-30^{o} to $+50^{o}$ centigrade
§2.995 (b)	10^{o} steps
§2.995 (d) (2)	Supply voltage set to battery operating end point.

The CVL uses an external supply, nominal 12V as supplied by a vehicle. The nominal voltage range of a vehicle supply is 11 to 16V. The supply voltage, in accordance with §2.995 (d) (1) was therefore set to 9.35V and 18.4V, measured at the supply input to the device, using the Multimeter (para 3.5.4). The voltage supplied to the frequency determining circuits on the AMPS board, is regulated on the Interface Board and further regulated on the AMPS board itself, so no determinable difference was actually observed due to supply voltage.

The unit was placed in the Environmental Chamber. The unit was set to channel #991, receive mode. An input signal, for channel #991, at –80dBm was applied to the antenna. The temperature of the Environmental Chamber was then set to -30^{o}C and increased, in 10-degree steps over the range, allowing time for the temperature to be stable at each step. At each step, the unit was set to channels #991, #331 and #799 in turn, the supply voltage set, in turn, to 9.3V and 18.4V, and the transmitter was switched on and the frequency recorded.

4.7.3 RESULTS

Comment on Test Results: The Automatic Frequency Control system worked throughout the temperature range. Hence at each temperature reading, the frequency error was noted to vary over a small range of –110 to +60Hz, less than 0.2ppm max error. The recorded frequency was that of the first reading shown on the Marconi Test Set. The voltage supplied to the frequency determining circuits on the AMPS board, is regulated on the Interface Board and further regulated on the AMPS board itself, so no determinable difference was actually observed due to supply voltage.

Supply Voltage 9.35V and 18.4V

TEMP Degrees C	Channel #991 824.04000MHz		Channel #991 834.93000MHz		Channel #991 848.97000MHz	
	Frequency	Error ppm	Frequency	Error ppm	Frequency	Error ppm
-30	824.04002	0.02	834.93006	0.07	848.96992	0.09
-20	824.04007	0.08	834.93005	0.06	848.96999	0.01
-10	824.03998	0.02	834.93006	0.07	848.97004	0.05
0	824.03996	0.05	834.93002	0.02	848.97003	0.04
10	824.03999	0.01	834.92998	0.02	848.97000	0.00
20	824.03996	0.05	834.92994	0.07	848.96995	0.06
30	824.03995	0.06	834.92991	0.11	848.96997	0.04
40	824.03990	0.12	834.92993	0.08	848.96990	0.12
50	824.03994	0.07	834.92992	0.10	848.96995	0.06
60	824.03995	0.06	834.92990	0.12	848.96992	0.09

Maximum error recorded less than 0.2ppm

Date Tested: 1/27/00

Test Engineer

……..G K Smith……..(Printed)

5 SAR

5.1 MOUNTING

The Chapman Vehicle Locator is designed to be mounted in a vehicle, usually in a hidden location, but also under the Dash. The unit is designed to be a "Hands-Free" device and, by using the "Keychain" transmitter, it can be located several feet from the user. The CVL does not have any integral antennas. External cellular and GPS antennas are used, usually in a combined form. The external antenna is usually situated under the dash, as far forward as possible so that the GPS part of the antenna is looking upwards through the windscreen. The alternative is to use an overt antenna that is magnetically mounted to the roof of the vehicle, or an "on-glass" cellular antenna.

In all positions, therefore, the external CVL antenna is at least 2 feet from the person's body, driver or front seat passenger, or has the metal roof of the vehicle in between the antenna and the person. It is physically impossible, in a vehicle installation, for the antenna to be within 20cms of the person

5.2 FCC LIMITS

FCC §2.1093 (d) references *"IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz."*, IEEE C95.1-1991. This specification lists the "Maximum Permissible Exposure for Uncontrolled Environments", in Section 4.1.2, Table 2. For 300 to 3000 MHz, the MPE Power Density is given as f/1500 mW/cm^2.

The highest transmitting frequency is 849MHz, corresponding to 0.566 $mW/cm^{2.}$.

FCC §2.1093 (d) (3) references *"IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields-RF and Microwave"*, IEEE Std C95.3-1991.

5.3 ANALYSIS

Assuming plane-wave conditions, the formula $P = Pt/4\pi R^2$ can be used,
where P is power density in watts/$meter^2$
Pt is transmitted power in watts
R is distance in meters.

Given P and Pt we can calculate R
$R^2 = Pt/4\pi P$

The maximum measured power output of the CVL is 26.2dBm, Clause 4.2. Usually a dipole antenna is used with 0dBd gain. Worst case would be to use a 3dBd gain, collinear antenna (5/8 wavelength upper whip plus 1/4 wavelength lower section), giving a maximum power of 29.2dBm, say 1W.

For P = 5.66 W/m^2, Pt = 1W
R = 0.12m = 4.67inches

5.4 RESULT

For worst case scenario, at any distance equal or greater that 4.67 inches, the external antenna produces a power density less that the MPE specification. The antenna will always be located at least 2 feet away from a person. The CVL can therefore be considered to meet SAR requirements.