MEASUREMENT AND TECHNICAL REPORT

HM ELECTRONICS INCORPORATED
14110 Stowe Drive
Poway, CA 92064

DATE: 07 May 2003

This Report Concerns:	Original Grant: X	Class II Change:
Equipment Type:	HS400 Headset, Model HS400	
Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?	Yes: **Defer until:**	No: X
Company Name **agrees to notify the Commission by:** **of the intended date of announcement of the product so that the grant can be issued on that date.**	N/A	
Transition Rules Request per 15.37?	Yes:	No: X*

(*) FCC Part 2, Paragraph(s) **2.1046, 2.1047, 2.1049, 2.1053, 2.1055**
(*) FCC Part 90, Paragraph(s) **90.217**

Report Prepared by:

TÜV AMERICA, INC
10040 Mesa Rim Road
San Diego, CA 92121-2912
Phone: 858 546 3999
Fax: 858 546 0364

TABLE OF CONTENTS

TÜV AMERICA, INC. 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 546 3999 FAX 858 546 0364

1.0 GENERAL INFORMATION

1.1 Product Description

General Equipment Description -- *NOTE: This information will be input into your test report as shown below.*

EUT Description: Wireless Headset

EUT Name: HS400 Headset

Model No.: HS400 Serial No.: --

Product Options: --

Configurations to be tested: TX,RX

Power Requirements

Regulations require testing to be performed at typical power ratings in the countries of intended use. (i.e., European power is typically 230 VAC 50 Hz or 400 VAC 50 Hz, single and three phase, respectively)

Voltage: 3.6V Battery (If battery powered, make sure battery life is sufficient to complete testing.)

# of Phases: --

Current (Amps/phase(max)): -- Current (Amps/phase(nominal)): --

Other: --

Other Special Requirements

--

Typical Installation and/or Operating Environment

(ie. Hospital, Small Business, Industrial/Factory, etc.)

Industrial, used in quick service restaurants as a drive thru order intercom device.

EUT Power Cable

☐ Permanent OR ☐ Removable Length (in meters): --
☐ Shielded OR ☐ Unshielded
■ Not Applicable

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EUT Interface Ports and Cables

Interface				Shielding								
Type	Analog	Digital	Qty	Yes	No	Type	Termination	Connector Type	Port Termination	Length (In meters)	Removable	Permanent
EXAMPLE:												
RS232	☐	☒	*2*	☒	☐	*Foil over braid*	*Coaxial*	*Metallized 9-pin D-Sub*	*Characteristic Impedance*	*6*	☒	☐
--	☐	☐		☐	☐						☐	☐

EUT Software.

Revision Level: 1.0

Description: Main functional control firmware.

EUT Operating Modes to be Tested -- list the operating modes to be used during test. It is recommended the equipment be tested while operating in a typical operation mode. FCC testing of personal computers and/or peripherals requires that a simple program generate a complete line of upper case H's. Provide a general description of all software, firmware, and PLD algorithms used in the equipment. List all code modules as described above, with the revision level used during testing.
Consult with your TÜV Product Service Representative if additional assistance is required.

1. Receive only (RX frequency range is 457.5125 - 457.6125 MHz)

2. Receive and Transmit (TX frequency range is 468.4875 - 469.8875 MHz)

EUT System Components -- List and describe all components which are part of the EUT. For FCC testing a minimum configuration is required. (ie. Mouse, Printer, Monitor, External Disk Drive, Motherboard, etc.)

Description	**Model #**	**Serial #**	**FCC #**
Headset	HS400	--	BYMHS400
Battery	BAT40	--	--

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Support Equipment -- List and describe all support equipment which is not part of the EUT. (i.e. peripherals, simulators, etc)

Description	Model #	Serial #	FCC #
--			

Oscillator Frequencies

Frequency	Derived Frequency	Component # / Location	Description of Use
12.800 MHz	--	Y1	Reference Oscillator for U4
4.000 MHz	--	Y2	Reference Oscillator for U8
7.160 MHz	--	Y3	Reference Oscillator for U6, U10
--	3.580 MHz	--	Reference Oscillator for U11

Power Supply

Manufacturer	Model #	Serial #	Type		
--			☐ Switched-mode	(Frequency)	
			☐ Linear	☐ Other	

Power Line Filters

Manufacturer	Model #	Location in EUT
--		

Critical EMI Components (Capacitors, ferrites, etc.)

Description	Manufacturer	Part # or Value	Qty	Component # / Location
--				

EMC Critical Detail -- Describe other EMC Design details used to reduce high frequency noise.

--

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1.2 Related Submittal Grant

None

1.3 Tested System Details

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system are:

None

1.4 Test Methodology

Purpose of Test: To demonstrate compliance with the following tests.

TEST	FCC CFR 47#	PASS/FAIL
Power Output	2.1046	Pass
Modulation Characteristics	2.1047	Pass
Occupied Bandwidth	2.1049, 90.217	Pass
Spurious Emissions Antenna Ports	2.1051	N/A
Field Strength Spurious	2.1053, 90.217	Pass
Frequency Stability	2.1055	Pass
Substitution	--	Pass

Both Conducted and Radiated testing were performed according to the procedures in FCC/ANSI C63.4 and CSA 108.8-M1983. Radiated testing was performed at an antenna-to-EUT distance of 3 meters (1 - 25 GHz).

1.5 Test Facility

The open area test site and conducted measurement data were tested by:

TÜV AMERICA, INC
10040 Mesa Rim Road
San Diego, CA 92121-2912
Phone: 858 546 3999
Fax: 858 546 0364

The Test Site Data and performance comply with ANSI C63.4 and are registered with the FCC, 7435 Oakland Mills Road, Columbia Maryland 21046. All Measurement Data is acquired according to the content of FCC Measurement Procedure and ANSI C63.4, unless supplemented with additional requirements as noted in the test report.

1.6 Part 2 Requirements

Range of operating power values:
250uW(-6 dBm) to 1mW(0 dBm) factory set (fixed).

Maximum Power Level:
1mW(0 dBm)

DC Voltage and Current into final RF amplifier (U15):
Pin 4; Vcc = 2.827VDC, Icc = 24.9mA
Pin 3 ; Vcc = 2.781VDC, Icc = 3.0mA

2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was initially tested for FCC emissions in the following configuration:

See Block Diagram

2.2 EUT Exercise Software

None

2.3 Special Accessories

None

2.4 Equipment Modifications

None

2.5 Configuration of Test System

See Block Diagram

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3.0 POWER OUTPUT EQUIPMENT/DATA
MODULATION CHARACTERISTICS EQUIPMENT/DATA
OCCUPIED BANDWIDTH EQUIPMENT/DATA
FIELD STRENGTH SPURIOUS EQUIPMENT/DATA
FREQUENCY STABILITY EQUIPMENT/DATA
SUBSTITUTION EQUIPMENT/DATA

See following page(s).

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Test Conditions: POWER OUTPUT EQUIPMENT/DATA: FCC Part 2.1046
MODULATION CHARACTERISTICS EQUIPMENT/DATA: FCC Part 2.1047
OCCUPIED BANDWIDTH EQUIPMENT/DATA: FCC Parts 2.1049 and 90.217
FIELD STRENGTH SPURIOUS EQUIPMENT/DATA: FCC Parts 2.1053 and 90.217
FREQUENCY STABILITY EQUIPMENT/DATA: FCC Part 2.1055
SUBSTITUTION EQUIPMENT/DATA

The following measurements were performed at the San Diego Testing Facility:

☐ **- Test not applicable**

■ - Roof (Small Open Area Test Site)
(Date of listing July 27, 2001. Site Verification Valid for 3 years from listing.)

Test Equipment Used:

Model No.	Prop. No.	Description	Manufacturer	Serial No.	Date Cal'ed
HP8566B	743	Spectrum Analyzer	Hewlett Packard	2618A02913	11/02
Cable 1	731	30' cable	United Microwave Pro	--	NCR*
Cable 2	756	10' Cable	United Microwave Pro	--	NCR*
Cable 3	6788	3' Cable	United Microwave Pro	--	NCR*
3146	243	Log Periodic Antenna	EMCO	106X	04/02
3115	251	Double Ridge Horn Antenna	EMCO	2495	12/02
FF6548-2	777	900 MHz High Pass Filter	Sage	006	NCR*
AMF-5D-010180-35-10P	719	PreAmplifier	Miteq	549460	NCR*
8445B	6677	Preselector	Hewlett Packard	1442A01127	NCR*
HP8566B	720	Spectrum Analyzer	Hewlett Packard	2115A00842	09/02
3146	244	Log Periodic Antenna	EMCO	1063	06/02
Cable 4	733	30' Cable	United Microwave Pro	--	NCR*
HP8648C	6586	Signal Generator	Hewlett Packard	3642U01074	12/02
DM-105-T3	6666	Dipole Antenna	EMCO	223	02/03
Cable 5	6790	40' Cable	United Microwave Pro	--	NCR*
HP8482A	574	Power Sensor	Hewlett Packard	3318A27679	04/02
HP436A	472	Power Meter	Hewlett Packard	2101A11117	04/02

Customer Provided Equipment:

8920A	HME 03650	RF Communication Test Set	--	3438A05630	03/02
1000	HME 02882	Audio Amplifier and Speaker	--	--	NCR*

Remarks: One year calibration cycle for all test equipment and sites. (*) No Calibration Required.

REPORT No: SC301157 TESTER: Alan Laudani SPEC: FCC CFR 47 Part 90.217(b)
Canadian RSS119 Clause 6.7
Parts 2.1046 & 2.1053

CUSTOMER: HM Electronics Inc. TEST DIST: 3 Meters

E U T: HS 400 TEST SITE: Roof

EUT MODE: Transmit BICONICAL: N/A
Power Level with 50% Modulation of 2.5 kHz Tone + 16 dB

DATE: Mar. 11, 2003 ERP Factor 7 LOG: 244

NOTES: HORN: 251

CF = Antenna Factor + Cable Loss for measurements < 1 GHz
CF = Antenna Factor + Cable Loss - Preamplifier Gain + Preselector Loss

v.beta1a

FREQ (MHz)	VERTICAL (dBuv) pk	HORIZONTAL (dBuv) pk	CF (dB/m)	MAX LEVEL (dBm) pk	SPEC LIMIT (dBm) pk	MARGIN (dB) pk	EUT Rotation	Antenna Height	Notes
468.48	74.1	73	17.5	**-5.8**	20.8	-26.6	110	1.1	Fundamental (channel 0)
936.96	33.0	36.0	23.1	**-38.3**	-9.2	-29.1	340	1.1	
1405.44	59.4	59.8	-10.0	**-47.6**	-9.2	-38.4	139	1.2	
1873.92	44.3	43.9	-2.6	**-55.6**	-9.2	-46.4	122	1.4	
2342.4	41.7	42.3	0.7	**-54.3**	-9.2	-45.1	100	1.3	
2810.88	40.9	38.3	2.8	**-53.7**	-9.2	-44.5	150	1.1	
3279.36	40.5	38.2	4.3	**-52.5**	-9.2	-43.3	180	1.2	
3747.84	34.9	35.7	5.6	**-56.1**	-9.2	-46.9			noise floor
4216.32	35.1	34.8	5.6	**-56.7**	-9.2	-47.5			noise floor
4684.8	35.4	34.8	5.4	**-56.5**	-9.2	-47.3			noise floor
469.9	74.9	74.7	17.5	**-4.9**	20.8	-25.7	55	1.2	Fundamental (Channel 7)
939.8	29.0	35.6	23.1	**-38.7**	-9.2	-29.5	114	1.1	
1409.7	63.1	58.6	-10.0	**-44.3**	-9.2	-35.1	5	1.6	
1879.6	50.7	43.6	-2.5	**-49.1**	-9.2	-39.9	342	1.0	
2349.5	43.3	38.0	0.7	**-53.3**	-9.2	-44.1	25	1.1	
2819.4	41.8	37.8	2.8	**-52.8**	-9.2	-43.6	341	1.2	
3289.3	38.5	38.2	4.3	**-54.5**	-9.2	-45.3	42	1.3	
3759.2	35.1	35.4	5.6	**-56.3**	-9.2	-47.1			noise floor
4229.1	34.8	35.8	5.5	**-56.0**	-9.2	-46.8			noise floor
4699	36.5	34.8	5.5	**-55.4**	-9.2	-46.2			noise floor

FCC Parts 2.1047 and 2.1055 **FCC ID: BYMHS400**

1. Modulation Limiting:

If the assigned frequency is between 400 MHz to 512 MHz then the Channel Spacing is 25 KHz, the Rated System Deviation is +/-5 KHz, the Authorized Bandwidth is 20 KHz, the Test Bandwidth is +/-50 KHz. The HP8920A was set at Detector: Pk- & Pk+, AFGen1 Lvl: 74 mV

Voltage:

Specification Limit: no DFS, Conditions: +/-10%

Minimum (Peak Negative Deviation) / Maximum (Peak Positive Deviation)

Voltage (Actual)	Instantaneous	Steady-State	300 to 3000 Hz Sweep
-10% (3.24 VDC)	2.91 K / 2.89 KHz	2.8 K / 2.79 KHz	3.37 K / 3.28 KHz
Norm (3.6 VDC)	2.89 K / 2.95 KHz	2.83 K / 2.79 KHz	3.37 K / 3.29 KHz
+10% (3.96 VDC)	2.92 K / 2.9 KHz	2.81 K / 2.78 KHz	3.38 K / 3.31 KHz

Temperature:

Specification Limit: no DFS, Conditions: -5 ° C to +50 ° C

Minimum (Peak Negative Deviation) / Maximum (Peak Positive Deviation)

Temperature (+/-5 ° C)	Instantaneous	Steady-State	300 to 3000 Hz Sweep
-5 ° C	3.32 K / 3.27 KHz	3.22 K / 3.21 KHz	3.84 K / 3.79 KHz
0 ° C	3.24 K / 3.21 KHz	3.12 K / 3.1 KHz	3.74 K / 3.66 KHz
+10 ° C	3.07 K / 3.04 KHz	2.98 K / 2.97 KHz	3.58 K / 3.51 KHz
+20 ° C	2.99 K / 2.92 KHz	2.85 K / 2.82 KHz	3.41 K / 3.33 KHz
+30 ° C	2.84 K / 2.81 KHz	2.72 K / 2.7 KHz	3.25 K / 3.24 KHz
+40 ° C	2.72 K / 2.68 KHz	2.61 K / 2.58 KHz	3.16 K / 3.07 KHz
+45 ° C	2.69 K / 2.69 KHz	2.59 K / 2.56 KHz	3.14 K / 3.03 KHz
+50 ° C	2.65 K / 2.65 KHz	2.55 K / 2.53 KHz	3.07 K / 2.98 KHz

Humidity:

Specification Limit: no DFS, Conditions: 90-95% @ 50 ° C

N/A

Vibration:

Specification Limit: no DFS, Conditions: During

N/A

FCC Part 2.1047 **FCC ID: BYMHS400**

2. Audio Frequency Response:
The audio frequency response from 300 Hz to 3000 Hz shall not vary more than +1 dB or –3 dB from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000 Hz level, except from 500 Hz to 300 Hz an additional 6 dB per octave roll-off is allowed. However, permissible exceptions of: an additional 6 dB per octave attenuation is allowed from 2500 Hz to 3000 Hz in equipment operating in the 25 MHz to 869 MHz.

Frequency	dB Measured
300 Hz	-9.8 dB
400 Hz	-7.1 dB
500 Hz	-5.2 dB
600 Hz	-3.8 dB
700 Hz	-2.6 dB
800 Hz	-1.6 dB
900 Hz	-0.7 dB
1000 Hz	**0 dB**
1500 Hz	+2.9 dB
2000 Hz	+4.6 dB
2500 Hz	+5.0 dB
3000 Hz	+5.3 dB

The HP8920A was at AFGen1 Lvl: 30 mV to obtain 2000 Hz deviation at the frequency of 1000 Hz, the frequency was then changed and the data in dB was then recorded off the HP8920A.

FCC Part 2.1047 **FCC ID: BYMHS400**

3. Audio Low Pass Filter Response:
For audio frequencies above 3000 Hz the audio response of the post limiter low-pass filter shall meet or exceed the following requirements: For equipment operating on channels between 450 MHz through 896 MHz and between 929 MHz through 930 MHz: At frequencies from 3000 Hz through 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: $60\log_{10}(f/3000)$ dB. At frequencies above 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least 50 dB.

Frequency	dB Measured	Maximum Allowed
1000 Hz	**0 dB**	**N/A**
1500 Hz	-0.31 dB	N/A
2000 Hz	-1.14 dB	N/A
2500 Hz	-1.96 dB	N/A
3000 Hz	-2.66 dB	< 0 dB
4000 Hz	-8.78 dB	< -7.5 dB
5000 Hz	-20.5 dB	< -13.3 dB
6000 Hz	-30.16 dB	< -18 dB
7000 Hz	-38.12 dB	< -22 dB
8000 Hz	-44.70 dB	< -25.6 dB
9000 Hz	-49.80 dB	< -28.6 dB
10000 Hz	-53.10 dB	< -31.4 dB
15000 Hz	-55.00 dB	< -41.9 dB
20000 Hz	-55.00 dB	< -49.3 dB
25000 Hz	-53.00 dB	< -50.0 dB
30000 Hz	-52.00 dB	< -50.0 dB

The attenuation to the signals above 30000Hz is limited by the signal level at 1000Hz and the noise floor.

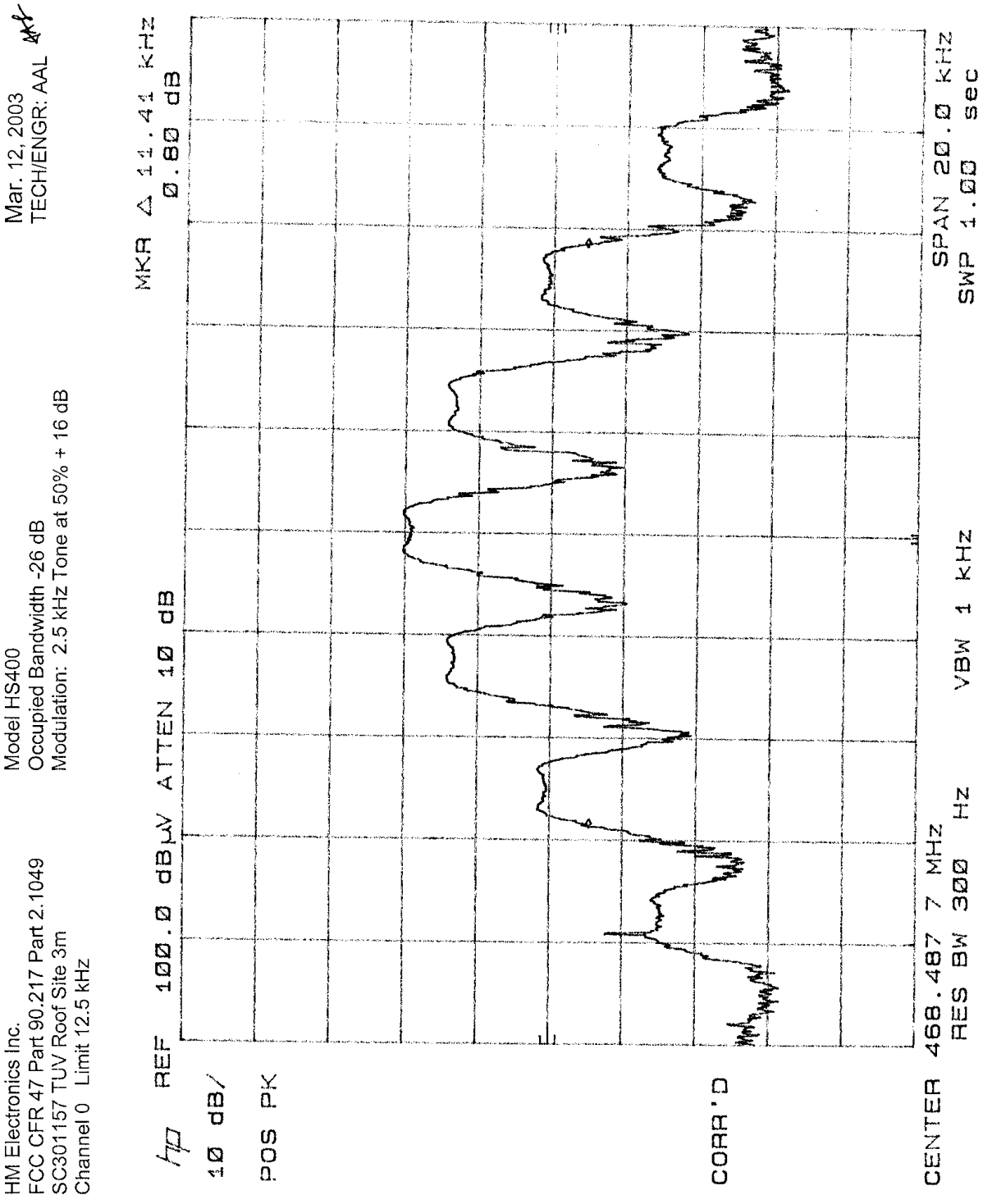
ACF = Assigned Carrier Frequency

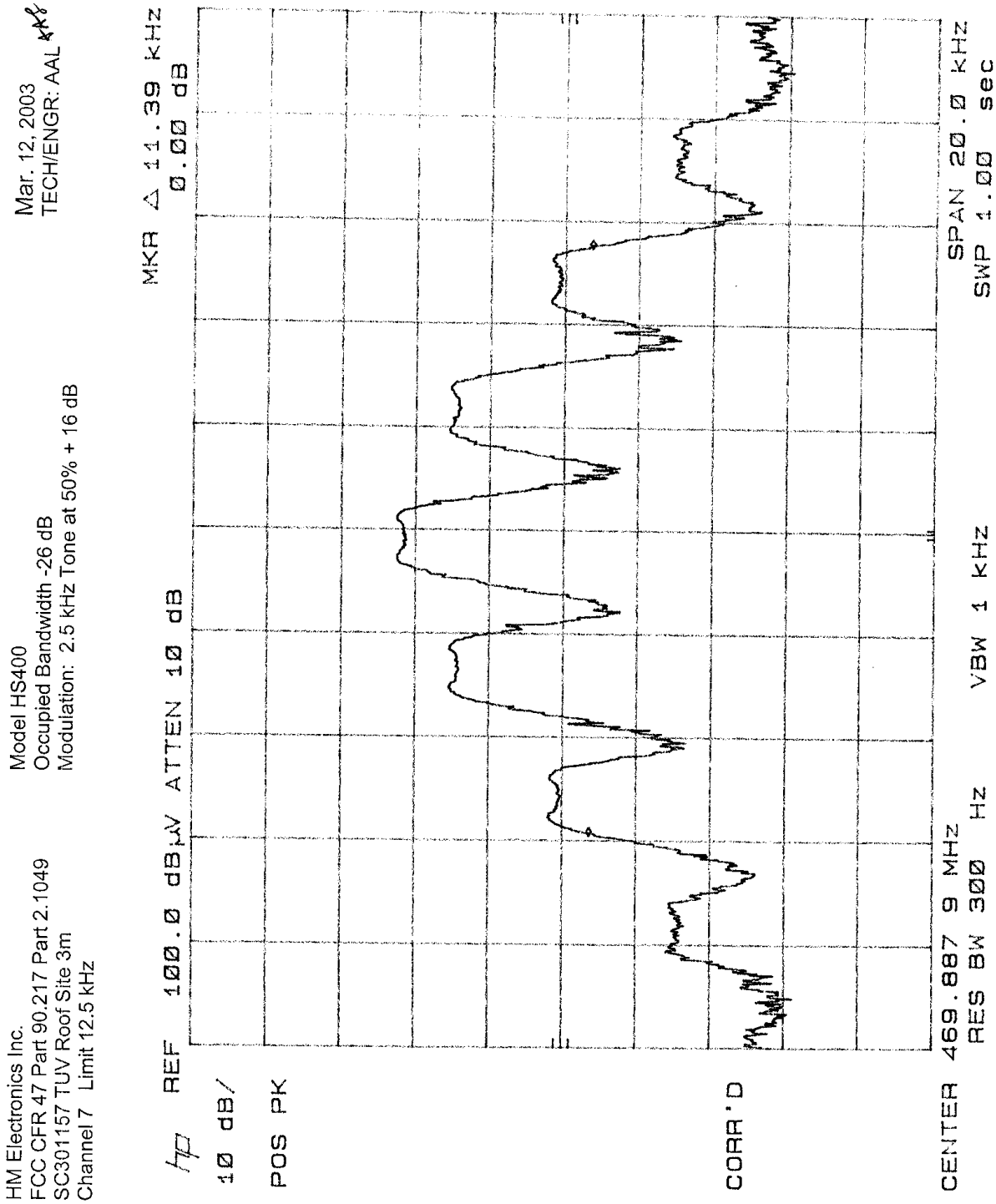
Equipment Used:
HP8920A, Serial # 3438A05630, Asset # 03650, RF Communication Test Set
HP8594E, Serial # 3325A00532, Asset # 03764, Spectrum Analyzer
Leader LPS-151, Serial # 5070095, Asset # 01998, Power Supply
Fluke 85, Asset # 03734, Multimeter
Thermotron, Serial # 24289, Asset # 03653, Temperature Chamber

Electronic Technician: E.J. Rollo

Engineering Service Manager: Tom Riches 3/10/03

TÜV AMERICA, INC. 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 546 3999 FAX 858 546 0364


HM Electronics Inc.
FCC CFR 47 Part 90.217 Part 2.1049
SC301157 TUV Roof Site 3m
Channel 0 Limit 12.5 kHz
Model HS400
Occupied Bandwidth -26 dB
Modulation: 2.5 kHz Tone at 50% + 16 dB
Mar. 12, 2003
TECH/ENGR: AAL
MKR Δ 11.41 kHz
0.80 dB
REF 100.0 dBµV ATTEN 10 dB
10 dB/
POS PK
CORR'D
CENTER 468.487 7 MHz
RES BW 300 Hz
VBW 1 kHz
SPAN 20.0 kHz
SWP 1.00 sec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Mar. 12, 2003
TECH/ENGR: AAL
MKR Δ 11.39 kHz
0.00 dB
REF 100.0 dBµV ATTEN 10 dB
10 dB/
POS PK
CORR'D
CENTER 469.887 9 MHz
RES BW 300 Hz
VBW 1 kHz
SPAN 20.0 kHz
SWP 1.00 sec

Radiated Method

i). On an Open Air Test Site the equipment shall be placed at the specified height on a non-conducting support and in the position closest to normal use as declared by the manufacturer.

ii). The transmitter antenna connector shall be connected to an artificial antenna, which shall be a substantially non-reactive non-radiating load of 50 Ω.

iii). The test antenna shall be orientated for vertical polarization and the output of the test antenna shall be connected to a spectrum analyzer.

iv). The transmitter shall be switched on and the spectrum analyzer shall be tuned over the frequency range required.

v). At each frequency at which a spurious component is detected, the test antenna shall be raised and lowered through the specified range of heights until a maximum signal level is detected on the spectrum analyzer.

vi). The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the spectrum analyzer.

vii). The maximum signal level detected by the spectrum analyzer shall be recorded.

viii). Steps iv) to vii) shall be repeated with the test antenna in the horizontal plane.

ix). The transmitter shall be replaced by a substitution antenna (See note 1).

x). The substitution antenna shall be orientated to coincide with the polarization of the test antenna that gave the highest detected level of emission. The length of the substitution antenna shall be adjusted to correspond to the frequency of the spurious component detected.

xi). The substitution antenna shall be connected to a calibrated signal generator and the frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected.

xii). The test antenna shall be raised and lowered through the specified range of heights to ensure that the maximum signal is received.

xiii). The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the spectrum analyzer, that is equal to the level noted in step vii).

xiv). The input level to the substitution antenna shall be recorded as power level, corrected for the change of any input attenuator setting of the spectrum analyzer and cable loss.
Power Level = generator level – cable loss – impedance coupler attenuation + antenna gain

Note 1:
For measurements in the frequency band 80 MHz to 1,000 MHz, the substitution antenna should be a tuned dipole antenna.
Below 80 MHz a calibrated biconical antenna should be used. For measurements above 1,000 MHz, a calibrated waveguide horn is recommended.

TÜV AMERICA, INC. 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 546 3999 FAX 858 546 0364

HME Substitution SC301157

4/23/03
Location: Roof Site

Temperature 22 C, Rel. Hum. 40%

Frequency MHz	target level dBuV/m	Ant Gain dBd	cable loss dB	Signal Generator dBm	Total (ERP) dBm	Spec* dBm	Margin dBm	
468.48	74.1	2.05	2.59	-3.90	-4.44	20.79	-25.23	complies
469.90	74.9	2.06	2.65	-3.00	-3.59	20.79	-24.38	complies

*20.79 dBm = 120 milliWatts

Tested by A. Laudani
A. Laudani

TÜV AMERICA, INC. 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 546 3999 FAX 858 546 0364

4.0 ATTESTATION STATEMENT

GENERAL REMARKS:

SUMMARY:

All tests were performed per CFR 47, Part(s) 2.1046, 2.1047, 2.1049, 2.1053, 2.1055, 90.217

■ - Performed

The Equipment Under Test

■ - **Fulfills** the requirements of CFR 47, Part(s) 2.1046, 2.1047, 2.1049, 2.1053, 2.1055, 90.217

Testing Start Date: 11 March 2003

Testing End Date: 12 March 2003

- TÜV AMERICA, INC. -

Responsible Engineer:

Jim Owen
(EMC Chief Engineer)

Responsible Engineer:

Alan Laudani
(EMC Engineer)

TÜV AMERICA, INC. 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone 858 546 3999 FAX 858 546 0364