

WAVE CORPORATION

T E S T   R E P O R T

REPORT NO. : E-1833

REFERENCE DOCUMENTS : FCC 15 CFR

TEST SITE FILE NO. : 31040/SIT  
1300F2

DATE TESTED : March 16, 1998

EQUIPMENT TESTED :  
•

PET NAME : DIGITIZER

MODEL NUMBER : GD-0405-A

FCC ID : HV4GD0405A

TESTED FOR COMPLIANCE WITH : FCC 15 CFR FOR CLASS B  
DIGITAL DEVICES OF SUBPART B and C

APPLICANT : WACOM Co., Ltd.  
2-510-1 Toyonodai, Otone-machi,  
Kitasaitama-gun, Saitama  
349-1148, JAPAN

TEST RESULT : The above mentioned product has  
been tested and passed.

REPORTED : April 2, 1998

WAVE CORPORATION

Oosawa 575, Yoshii-cho,  
Tano-gun, Gunma, 370-2125,  
JAPAN

PRESIDENT

Katsuyuki Arai

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## 1.0 SCOPE

The test data contained in this report was obtained utilizing test procedures, equipment, and sites which were either approved by or prescribed by the Federal Communications Commission (FCC). The test procedures described herein are the established methods for the measurement of radio noise emitted from digital devices as defined in Section 15.3 of the FCC Rules. The technical standards for digital devices are set forth in Section 15.31 of FCC Rules ( 47 CFR 15 ). Methods for the measurement of radiated and powerline conducted radio noise are covered herein. These methods of measurement are those used by the FCC in testing digital systems, intended to be used with digital devices.

## 1.1 DESCRIPTION OF EQUIPMENT

The GD-0405-A is an electronic device that transmits coordinate data to software running on a host computer.

This device typically includes a flat drawing surface called a "tablet", a drawing tool called "stylus" or "puck" which is referred to generally as "pointing device".

# WAVE CORPORATION

## 1.2 GENERAL INFORMATION

APPLICANT	WACOM Co., Ltd. 2-510-1 Toyonodai, Otone-machi, Kitasaitama-gun, Saitama 349-1148, JAPAN
MANUFACTURER	WACOM Co., Ltd. 2-510-1 Toyonodai, Otone-machi, Kitasaitama-gun, Saitama 349-1148, JAPAN
EQUIPMENT TESTED	
PET NAME	DIGITIZER
MODEL NUMBER	GD-0405-A
FCC ID	HV4GD0405A
HIGHEST FREQUENCY USED IN THE EQUIPMENT	18.432MHz
RADIATED FREQUENCIES FROM THE INTENTIONAL RADIATOR	384.0KHz 460.8KHz
TEST SITE	FCC FILE NO. : 31040/SIT 1300F2  WAVE CORPORATION Oosawa 575, Yoshii-cho, Tano-gun, Gunma, 370-2125, JAPAN
TESTED FOR COMPLIANCE WITH	FCC 15 CFR FOR CLASS B DIGITAL DEVICES OF SUBPART B and C
Measuerment Standard	ANSI C63.4(1992)
FREQUENCY RANGE INVESTIGATED	0.009MHz To 1GHz

## 2.0 REFERENCE DOCUMENTS

The following documents of the dates indicated are referenced in this report and form a part of this document to the extent specified herein.

### 2.1 FCC DOCUMENTS

FCC 15 CFR ( 1989 )

### 2.2 OTHER DOCUMENTS

ANSI 63.4 ( 1992 )      ANSI C63.2 ( 1987 )

## 3.0 DEFINITIONS

The definitions set in Section 15.3 of FCC 15 CFR are applicable to this document.

## 4.0 GENERAL TEST CONDITIONS

### 4.1 TEST SITES

WAVE CORPORATION maintains one test site, an open field test site located at YOSHII-CHO, GUNMA, JAPAN.

#### 4.1.1 OPEN FIELD TESTS

A description of the open field test site maintained by WAVE CORPORATION has been submitted to the FCC pursuant to Section 2.948 of the FCC Rules. A letter of acceptance from FCC is on file at FCC.      FCC 31040/SIT    4/3/1996  
1300F2

#### 4.1.2 SHIELDED ENCLOSURE ( SCREEN ROOM )

All conducted radio noise measurements are made in the shielded enclosure in accordance with the cited applicable standard and procedures.

#### 4.1.3 INDIVIDUAL EQUIPMENT TEST REQUIREMENTS

Refer to Section 7.0

### 4.2 MEASUREMENT INSTRUMENTATION

All measurements were made using equipment which conforms to the American National Standard Specifications for Electromagnetic Interference and Field Strength Instrumentation 10 KHz to 1 GHz, C63.2 (1987).

#### 4.2.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment which was utilized in performing the tests documented herein has been calibrated in accordance with the manufacturer's recommendations utilizing calibration equipment which are traceable to recognized national standards.

#### 4.2.2 DETECTOR FUNCTION SELECTION AND BANDWIDTH

All conducted and radiated radio noise emission testing was performed utilizing Spectrum Analyzer and radio noise meters incorporating CISPR quasi peak function, if a weighting circuit was employed in that instrument.

#### 4.2.3 UNIT OF MEASUREMENT

Measurements of radiated interference are reported in microvolts per meter of dB(uV/m) at the specified distance. Measurements of conducted radio noise interference are reported in terms of microvolts or dB(uV).

#### 4.2.4 ANTENNAS

Measurements are made using calibrated, tuned halfwave dipole antennas, biconical and log periodic antennas. Heights and positioning of antennas for specific tests are indicated in Section 7.0.

#### 4.3 FREQUENCY RANGE TO BE SCANNED

The frequency range from 9 KHz to 1,000 MHz is searched for radiated emissions. The frequency range from 450 KHz to 30 MHz was searched for conducted emission. Test set-ups were as diagramed in section 7.0.

#### 4.4 DATA REPORTING FORMAT

All data is recorded and reported in accordance with part 15 and other applicable documents.

#### 4.5 CONFIGURATION OF EQUIPMENT UNDER TEST (EUT)

For digital devices designed to be part of a multi-unit system, the EUT shall be installed in a typical system and configured in accordance with the manufacturer's instructions. It shall also be operated in a manner that is representative of the typical usage for that EUT. During all tests, the EUT and all system components shall be manipulated within the confines of typical usage to maximize each emission.



#### 4.5.1 TEST CONDITIONS FOR EUT

Part 15 provides that the (EUT) shall be configured and operated in a manner which will tend to maximize its emission characteristics in a typical application. Power and signal distribution, grounding, interconnecting cabling and physical placement of equipment or equipments of a test system shall simulate the typical application and usage to maximize the emission characteristics in so far as practicable. The EUT shall be furnished with rated (nominal) voltage as specified in the individual-equipment power requirements. The power supplied to the EUT may need to be filtered to meet the requirements of 4.6.1. (refer to Section 7.0 for actual test conditions.)

#### 4.5.2 OPERATING CONDITIONS

Part 15 provides that the EUT shall be operated at the specified load conditions (mechanical and / or electrical), to maximize the emission characteristics, for which it is designed. Section 7.0 describes the actual test conditions during this test.

#### 4.5.3 CONDITIONS OF THE EUT

The EUT was operated prior to testing to allow it to stabilize to a normal operating condition.

#### 4.5.4 INTERFACING PORTS

A digital device containing interface ports shall have each port connected to an appropriate peripheral for the purposes of testing a typical configuration. If the EUT incorporates multiple interface ports for connection of identical peripherals, only one external peripheral of each type needs to be attached to the EUT during testing, provided it can be shown through testing that the use of any additional peripherals would not take the system out of compliance. Otherwise, all interface ports on the EUT shall have an external peripheral connected to it. Refer to paragraph 7.1 for a description of the test setup.

#### 4.5.5 EUT GROUNDING

The EUT was grounded in accordance with the manufacturer's instructions.

#### 4.6 TEST ENVIRONMENT

The environment at the test site satisfied the requirements of FCC 47 CFR, Part 15 with respect to ambient radio noise and signals.

##### 4.6.1 AMBIENT RADIO NOISE AND SIGNALS

The ambient levels during this test were at or below the limits prescribed in FCC Part 15 CFR and related documents.

##### 4.6.2 TEMPERATURE

The ambient temperature during this test was within the recommended limits for this equipment. The actual conditions are described in paragraph 8.1.

#### 4.7 ARRANGEMENT OF EUT (on test site)

The EUT unit or units and interconnecting cables were placed in the worst case positions. The actual test set-up is diagrammed in section 7.0.

#### 4.8 GROUND PLANE

A ground screen is used for open field site testing when required to meet the FCC quality requirements.

#### 5.0 CONDUCTED POWERLINE MEASUREMENTS

Conducted powerline measurements were made in compliance with Part 15 utilizing a LISN.

##### 5.1 CONDUCTED POWERLINE TEST CONFIGURATIONS

The EUT was configured as illustrated in Section 8.0.

##### 5.2 LINE IMPEDANCE STABILIZATION NETWORK (LISN)

A LISN with characteristics which conform to the requirements of Part 15 was used for the measurement of conducted powerline noise. Any correction factors used are indicated in Section 8.0.

5.3 GROUNDING

All conducted powerline measurements were performed with the LISN housing, measurement instrumentation case, ground planes, etc., electrically bonded together in such a manner that they were at the same RF potential.

5.4 MEASUREMENT PROCEDURE

Powerline conducted radio noise measurements were made at the plug end of the EUT power cord by the use of mating plugs and receptacles on the EUT and LISN.

5.4.1 EUT POWER LEADS

Refer to Section 8.0. for power lead configuration.

5.4.2 SHIELDED POWER LEADS

Equipment shall be connected to the LISN and tested with leads belonging to the equipment.

## 6.0 RADIATED EMISSION MEASUREMENTS

Measurements of radiated radio-noise were made using the measuring instrumentation and antenna specified in 4.2 and 4.2.4 respectively. Radiation from the EUT including radiation from all signal and power cabling was measured. Consistent with Section 4, above, the EUT was set up and operated to maximize the emission characteristics in a manner representative of actual use.

### 6.1 DETERMINATION OF TEST RADIAL

Radiated emission magnitudes were obtained in the azimuthal direction of maximum field strength for each predominant emission. Primarily, tests were made to determine the system spectrum signature, the strengths of the stronger emissions, and the directions in which these emerge from the system. During this testing, EUT arrangement was varied within the scope of expected usage to maximize radiations.

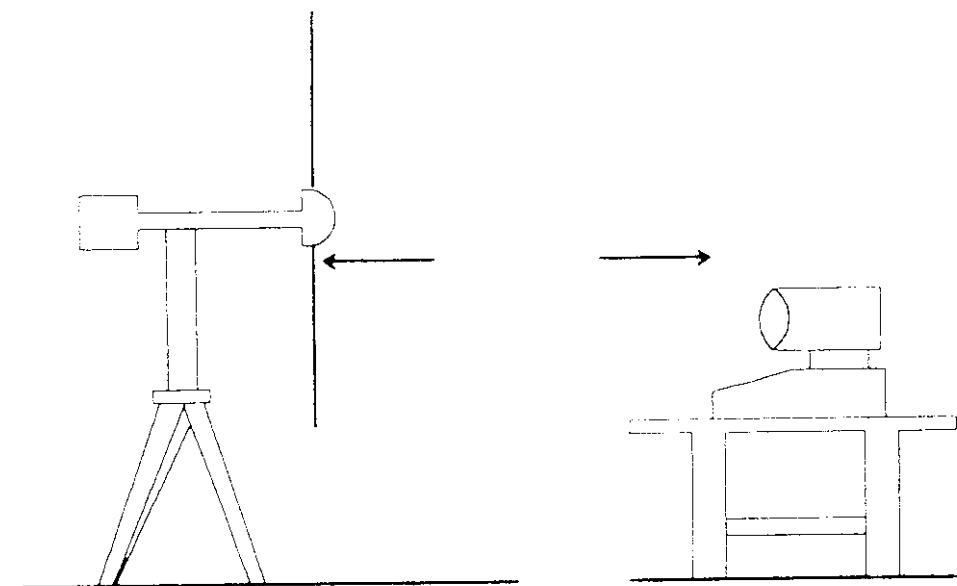
### 6.2 RADIATED RADIO NOISE TESTS

Radiated radio noise measurements are made at the test site described in 4.1 above. The EUT subject to radiated limit at 3 meters, shall be measured at a distance of 3 meters. Equipment subject to a limit at 10 meters would be measured at a distance of from 3 to 10 meters provided that the results are extrapolated to equivalent signals at 10 meters utilizing an inverse distance extrapolation factor (20 dB/decade). At test distances between 3 meters and 10 meters, the antenna is varied in height between 1 meter and 4 meters above ground, to determine the maximum level of emissions with this range. Both horizontal and vertical orientation of the search antenna were employed and maximum values reported. For vertical polarization, the bottom end of the dipole is kept at least 25 cm above site ground.

## 7.0 RADIATED EMISSION MEASUREMENT TEST RESULTS

## 7.1 TEST SET-UP

All measurements were made as described in Section 6.0. The diagram below shows the test set-up which was utilized to make these measurements.



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## 7.2 TEST EQUIPMENT

The following equipment was utilized in making the measurements contained in this reports.

MANUFACTURER OR TYPE	MODEL NO.	SERIAL NO.	CALIBRATION DUE
H. P. PLOTTER	7550A	2407A01925	
NEC COMPUTER	PC9801BA2	21	
H. P. SPECTRUM ANALYZER	8567A	2841A00585	04 / 98
ROHDE & SCHWARZ TEST RECEIVER	ESV	892564/024	08 / 98
H. P. PREAMPLIFIER	8447D	1937A03312	04 / 98
SCHWARZBECK BICONICAL ANTENNA	BBA9106	07	06 / 98
EMCO LOG PERIODIC ANTENNA	3146	9212-3483	06 / 98
SCHWARZBECK DIPOLE ANTENNA	VHAP	409	11 / 98
SCHWARZBECK DIPOLE ANTENNA	UHAP	409	11 / 98
H. P. SPECTRUM ANALYZER	8593E	3639A0254	11 / 98
H. P. 50GHz PREAMPLIFIER	83051A	332A00353	07 / 98
EMCO DOUBLE RIDGED GUIDE ANTENNA	3116	9610-2321	06 / 98
ADVANTEST DOUBLE RIDGED GUIDE ANTENNA	TR17206	23370003	06 / 98
ABSORBING CLAMP	MDS-21	871603	04 / 98
H. P. SPECTRUM ANALYZER	8564E	070203000	05 / 98
EMCO Line Probe	3701	1165	05 / 98
ACTIVE ROD ANTENNA	3301B	9609-3764	10 / 98
ROHDE & SCHWARZ TEST RECEIVER	ESH2	892237/017	08 / 98

\* Calibration performed in accordance with manufacturer specifications.

## 7.3 TEST PROCEDURE

The device under test was placed on a rotatable table, if the device was floor-standing equipment. The devices under test were placed on a rotatable table top 80 cm above ground, if the devices were table-top equipments. The E.U.T. was rotated 360 degrees to determine the position of highest radiation. At 3 or 10 meters distance away, the interference receiving antenna was mounted on top of a variable height tripod. The antennas used were a tunable dipole, biconical and log periodic antennas. The height was varied between one meter and four meters above ground. Both horizontal and vertical polarization of the antenna was used to make the measurements. Refer to figure 1 for measuring conditions.

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## FIGURE 1. MEASURING CONDITION

EQUIPMENT DIGITIZER

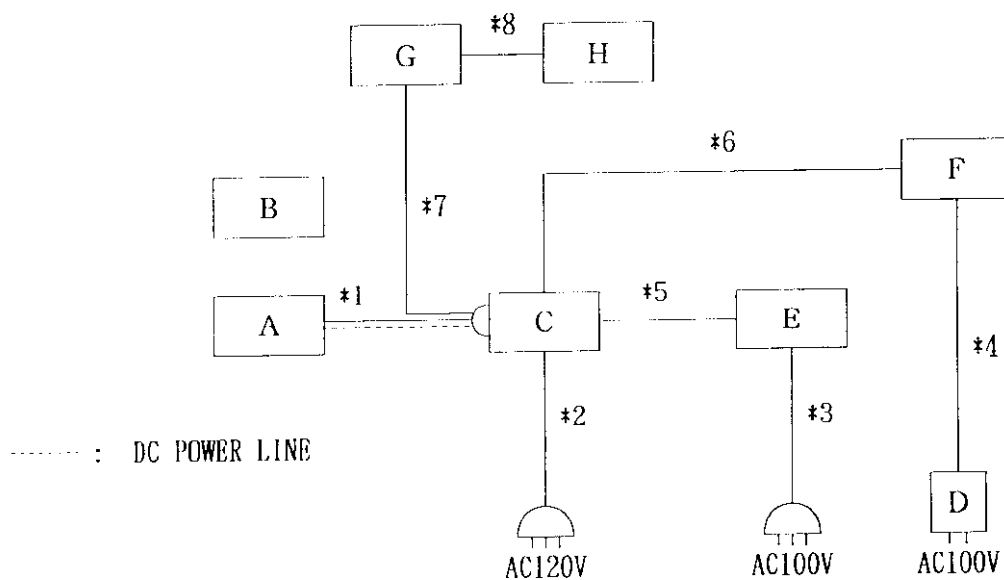
MODEL GD-0405-A

POWER SUPPLY AC120V, 60Hz

### SYSTEM CONFIGURATION

SIGN	MANUFACTURER	DESCRIPTION	MODEL NO.	SERIAL NO.	FCC ID	OPERATING CONDITION
A	WACOM Co., Ltd.	DIGITIZER	GD-0405-A	8AJS00001	HV4GD0405A	Normal mode
B	WACOM Co., Ltd.	General pen	GP-300E-00	_____	_____	_____
C	Apple Computer, Inc.	Personal Computer	M3076	SG4338 232LX	BCGM3076	Running mode of test program
D	Apple Computer, Inc.	AC Adaptor	M3366	_____	_____	_____
E	Apple Computer, Inc.	Display	M2978	CY4374 NC3CV	BEJCA500	Display mode of "H" pattern
F	Apple Computer, Inc.	Printer	M3362	VC709M 2V65Q	AZDM3362	Print mode of "H" pattern
G	Apple Computer, Inc.	Keyboard	M0116J	029082	BCG5K5 M0116	_____
H	Apple Computer, Inc.	Mouse	M2706	LC508 LAKT18	BCGM2706	_____

### FIGURE OF SYSTEM CONFIGURATION





— WAVE CORPORATION —

NO.	CABLE	PIN NO.	LENGTH	SHIELDED
*1	ADB I/F CABLE	4P	2.5m	Yes
*2	AC CABLE	3P	1.8m	No
*3	AC CABLE	3P	2.0m	No
*4	DC CABLE	2P	1.9m	No
*5	VIDEO SIGNAL CABLE	15P	1.5m	Yes
*6	Printer CABLE	8P	1.9m	Yes
*7	ADB I/F CABLE	4P	1.4m	Yes
*8	ADB I/F CABLE	4P	0.8m	Yes

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## 7.4 RADIATION LIMIT (REF. SECTION 15.109 and 15.209 Radiated emission limits)

All emanations from a Class B Digital Device or System of Subpart B and C, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified below.

FREQUENCY(F) (MHz)	DISTANCE (METERS)	FIELD STRENGTH (dBuV/m)
0.009 — 0.49	300	$7.6 - 20 \log F$
0.49 — 1.705	30	$27.6 - 20 \log F$
1.705 — 30	30	29.5
30 — 88	3	40.0
88 — 216	3	43.5
216 — 960	3	46.0
Above 960	3	54.0

- Note:
- (1) The tighter limit shall apply at the edge between two frequency bands.
  - (2) Distance refers to the distance in meters between the measuring instrument antenna and the closest point of any part of the device or system.
  - (3) F is the frequency in megahertz of the emission under investigation.

## 7.5 AMBIENT CONDITIONS

The ambient conditions at the time the test was conducted were as follows:

TEMPERATURE 17 DEGREES CENTIGRADE

RELATIVE HUMIDITY 52 %

The EUT was allowed to stabilize at its normal operating temperature prior to commencing these tests.

## 7.6 TEST RESULTS

Test result, operating condition is Normal mode, is indicated as follows.

\*\*\*\*\* EMISSION LEVEL of EUT \*\*\*\*\*

WAVE No.WE-2088

COMPANY NAME : WACOM Co., Ltd.  
 EQUIPMENT TESTED : DIGITIZER  
 MODEL NUMBER : GD-0405-A  
 OPERATING CONDITIONS : NORMAL MODE  
 TESTED FOR COMPLIANCE WITH: FCC 15 CFR FOR CLASS B DIGITAL DEVICES of SUBPART C  
 ANTENNA DISTANCE : 3.0m  
 POWER SUPPLY : AC120V  
 ANTENNA : Rod Active Antenna 3301B  
 RECEIVER : ROHDE & SCHWARZ ESH-2  
 DATE TESTED : 03/16/1998  
 TEMPERATURE : 17 Deg C  
 HUMIDITY : 52 %  
  
 TEST SITE : WAVE CORPORATION  
 TEST ENGINEER : ATSUSHI OKUYAMA

----- Quasi-Peak Mode -----

Freq.	Reading Level Vertical (dBuV)	Amp. Gain (dB)	Corr. Fact (dB)	Cable Loss (dB)	Emission Level Vertical (dBuV/m)	Limit (dBuV/m)	Margin (dB)
105.800KHz	71.70	0.0	4.5	0.0	76.2	107.1	-30.9
141.000KHz	71.70	0.0	4.5	0.0	76.2	104.6	-28.4
174.400KHz	66.40	0.0	4.5	0.0	70.9	102.8	-31.9
524.600KHz	51.50	0.0	4.4	0.0	55.9	73.2	-17.3
2.274MHz	27.40	0.0	4.7	0.2	32.3	69.5	-37.2

Note :

The above limit is calculated with a measurement distance, 3m.  
 Assuming, it is proportion to  $1/R^2$  (40dB/decade).  
 R is a measurement distance.

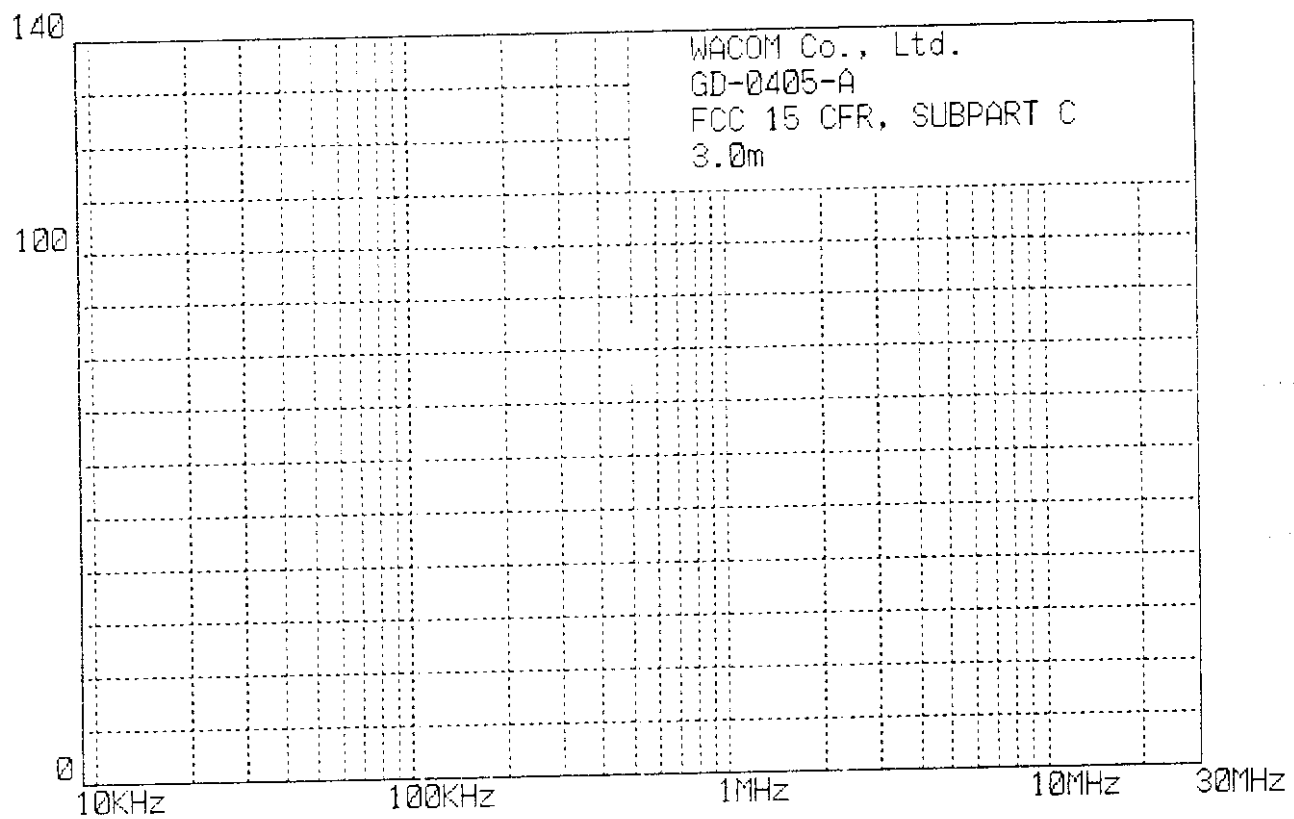
\*\*\*\*\* EMISSION LEVEL of EUT \*\*\*\*\*  
 TEST No.WE-2089

COMPANY NAME : WACOM Co., Ltd.  
 EQUIPMENT TESTED : DIGITIZER  
 MODEL NUMBER : GD-0405-A  
 OPERATING CONDITIONS : NORMAL MODE  
 TESTED FOR COMPLIANCE WITH: FCC 15 CFR FOR CLASS B DIGITAL DEVICES of SUBPART B  
 ANTENNA DISTANCE : 3m  
 POWER SUPPLY : AC120V  
 ANTENNA : SCHWARZBECK Biconical BBA9106 or Dipole VHAP,UHAP  
 : EMCO Log-Peri 3146  
 RECEIVER : ROHDE & SCHWARZ ESV  
 DATE TESTED : 03/16/1998  
 TEMPERATURE : 17 Deg C  
 HUMIDITY : 52 %  
 TEST SITE : WAVE CORPORATION  
 TEST ENGINEER : ATSUSHI OKUYAMA

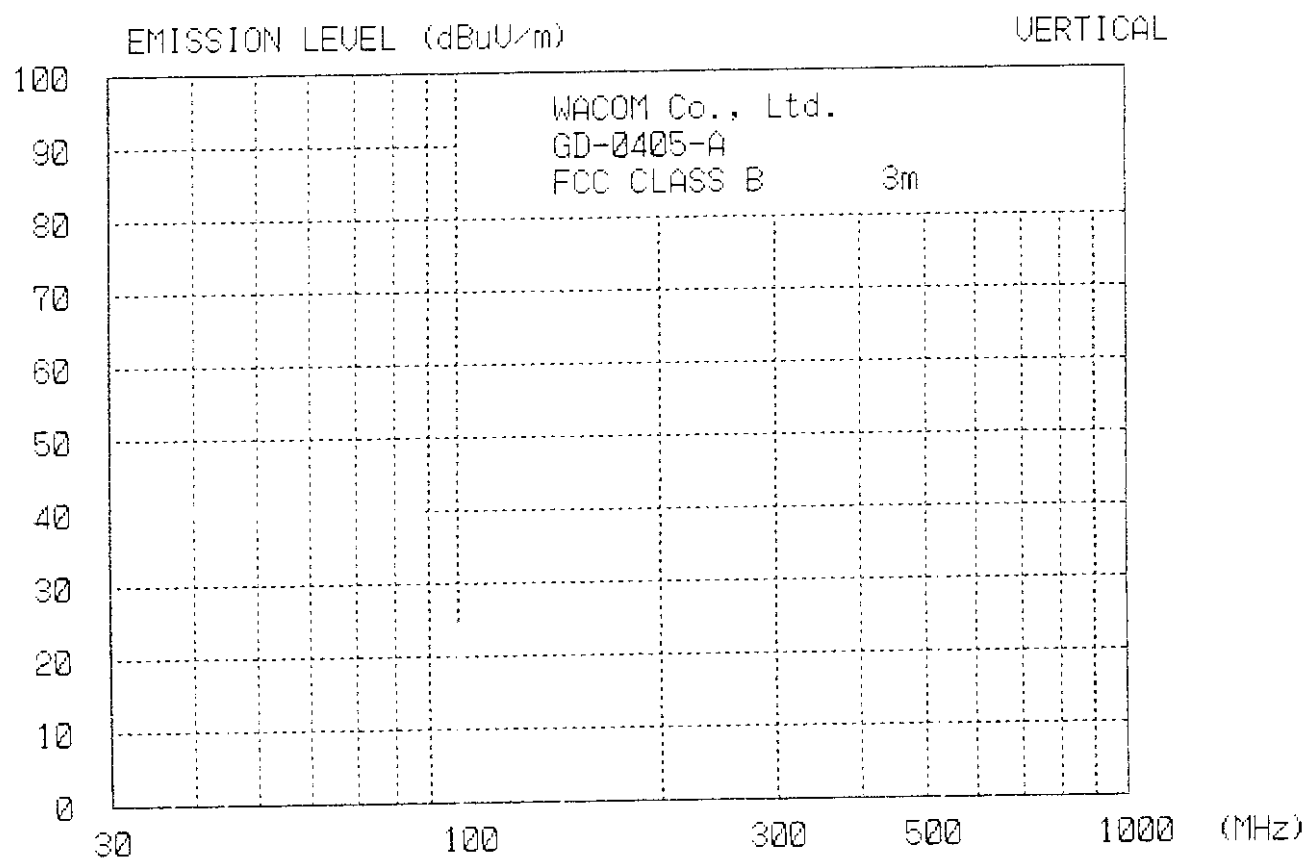
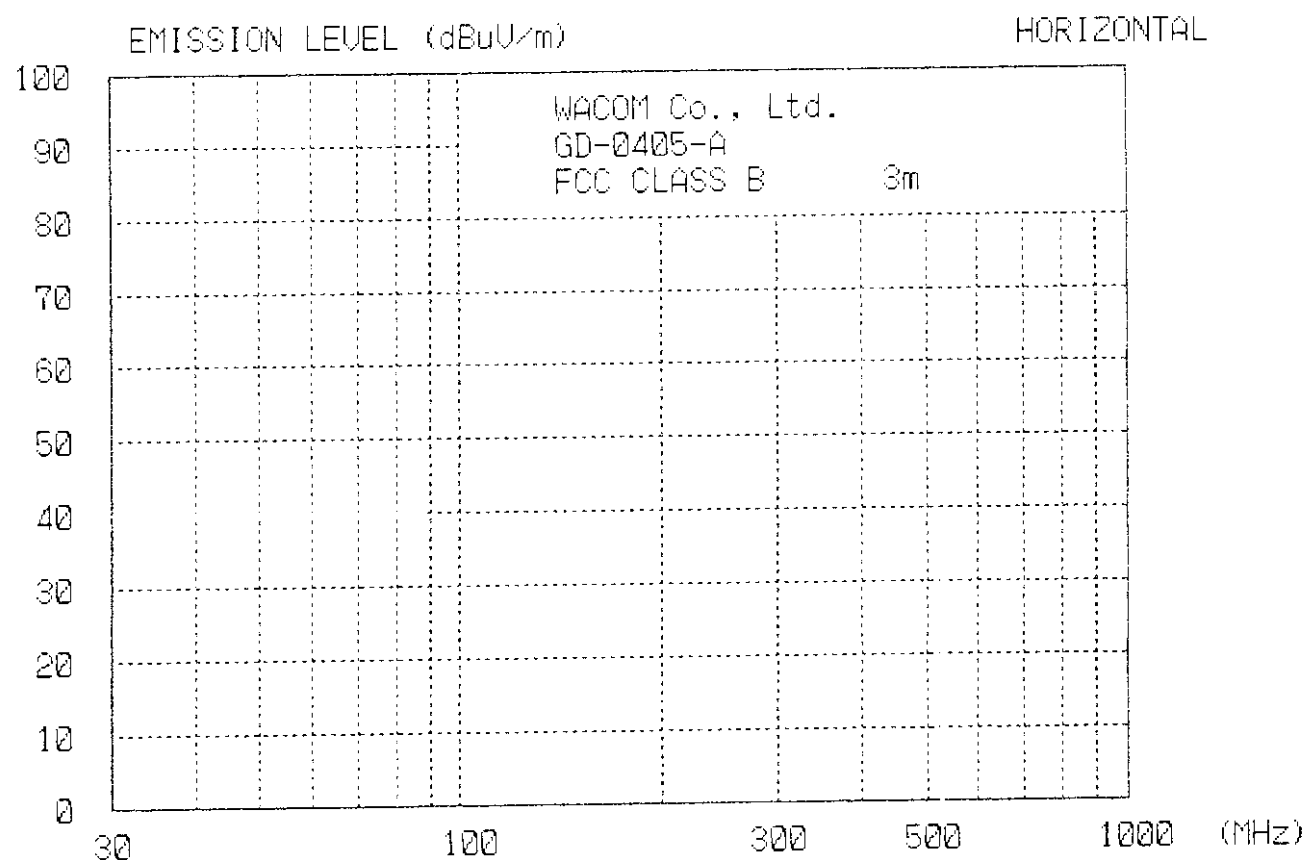
----- Quasi - Peak Mode -----

Freq. (MHz)	Reading Level		Amp. Gain (dB)	Ant. Factor (dB)	Cable Loss (dB)	Emission Level		Limit (dBuV/m)	Margin	
	Hor. (dBuV)	Ver.				Hor.	Ver.		Hor.	Ver.
36.862		35.2	26.1	15.2	4.4		28.7	40.0		-11.3
44.300		37.2	26.1	11.8	4.6		27.5	40.0		-12.5
99.260		34.5	26.1	10.9	5.4		24.7	43.5		-18.8
141.011		29.5	26.2	14.3	6.0		23.6	43.5		-19.9
529.237	31.4	36.2	26.5	18.3	9.1	32.3	37.1	46.0	-13.7	-8.9
628.479		31.8	26.3	20.0	9.7		35.2	46.0		-10.8

DATE TESTED : 03/16/1998 TEST SITE : WAVE CORPORATION  
EMISSION LEVEL (dBuV/m) VERTICAL



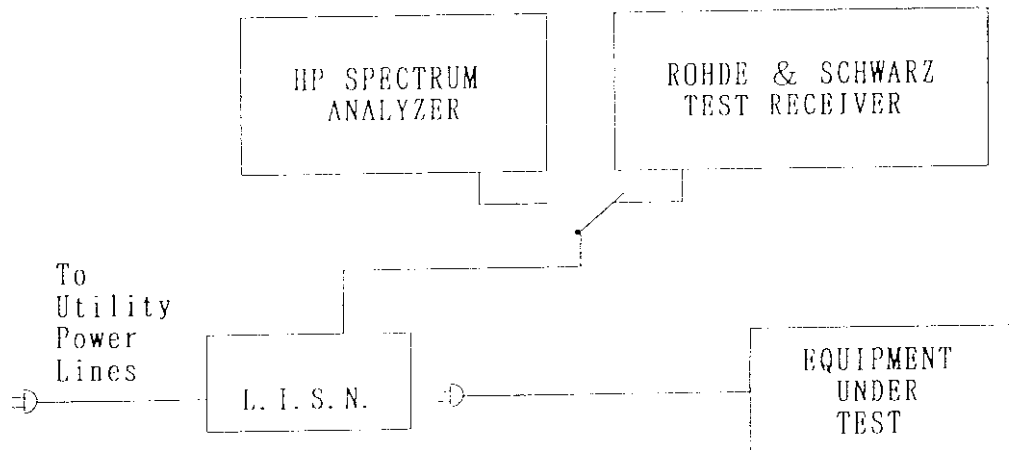
DATE TESTED : 03/16/1998 TEST SITE : WAVE CORPORATION



# WAVE CORPORATION

## 8.0 CONDUCTED POWERLINE TEST RESULTS

### 8.1 TEST SETUP



### 8.2 TEST EQUIPMENT

The test equipment described below was used to conduct these tests.

MANUFACTURER OR TYPE	MODEL NO.	SERIAL NO.	CALIBRATION DUE
H. P. PLOTTER	7550A	2407A01925	
NEC COMPUTER	PC9801BA2		
H. P. SPECTRUM ANALYZER	8567A	2841A00585	04 / 98
ROHDE & SCHWARZ TEST RECEIVER	ESH2	892237/017	08 / 98
ROHDE & SCHWARZ LISN	ESH2-Z5	893606/019	06 / 98
H. P. SPECTRUM ANALYZER	8593E	3639A02541	11 / 98
EMCO Line Probe	3701	1165	05 / 98

\* Calibration performed in accordance with manufacturer specifications.

## 8.3 TEST PROCEDURE

Each unit of the EUT was also checked individually for maximum conducted interference.

The EUT was connected to the power mains through a line impedance stabilization network (LISN). This provides 50 ohm coupling impedance for the measuring instrument. The FCC states that a LISN with 50 ohm impedance characteristic shall be used. Both sides of AC line were checked.

The frequency range of 450 kHz to 30 MHz was searched.

## 8.4 MAXIMUM VOLTAGE, RADIO FREQUENCY ( REF. SECTION 15.107 Conducted Limits )

The maximum allowable conducted Radio Frequency voltage is 250 uV(48.0 dBuV).

## 8.5 AMBIENT CONDITIONS

The ambient conditions at the time the test was conducted were as follows:

TEMPERATURE 17 DEGREES CENTIGRADE

RELATIVE HUMIDITY 52 %

The EUT was allowed to stabilize at its normal operating temperature prior to commencing these tests.

## 8.6 TEST RESULTS

Test result, operating condition is Normal mode, is indicated as follows.



\*\*\*\*\* CONDUCTION LEVEL of EUT \*\*\*\*\*

TEST No.WE-2090

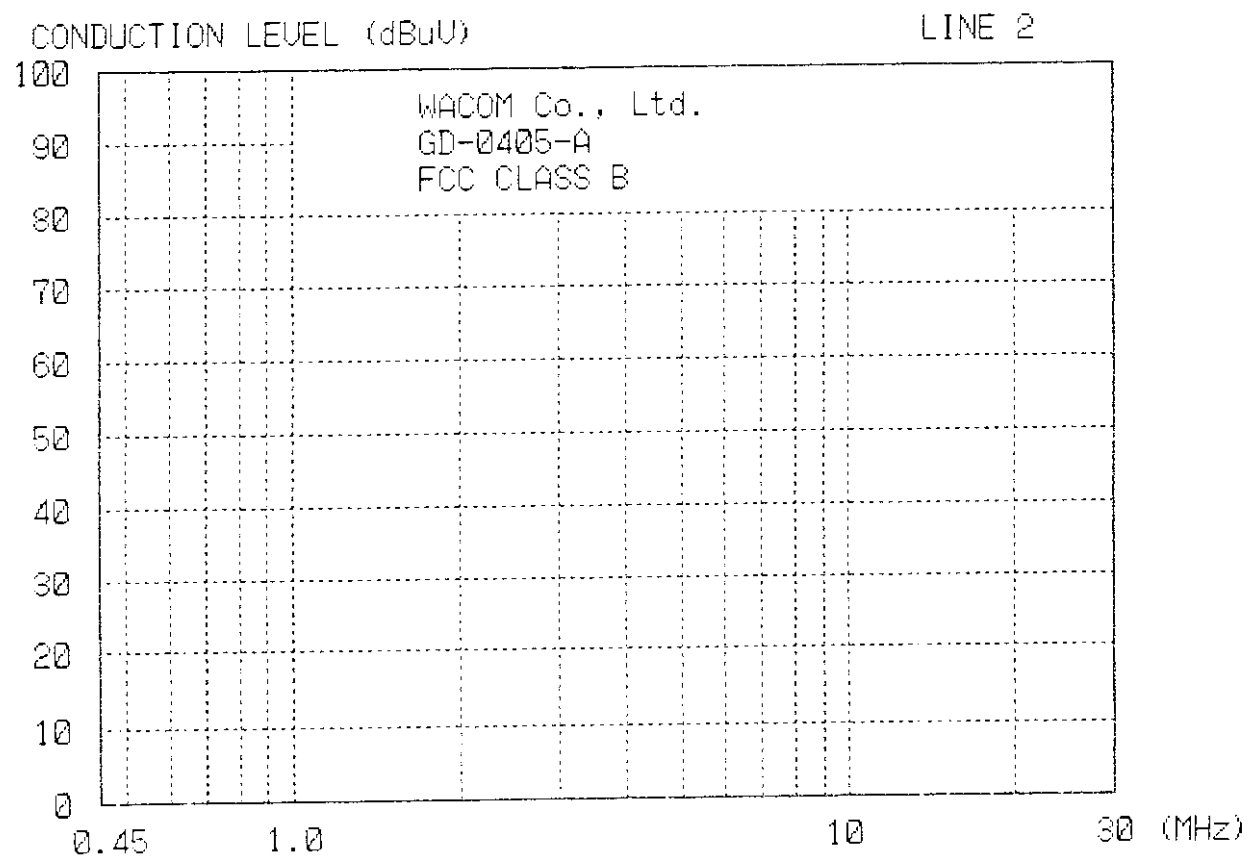
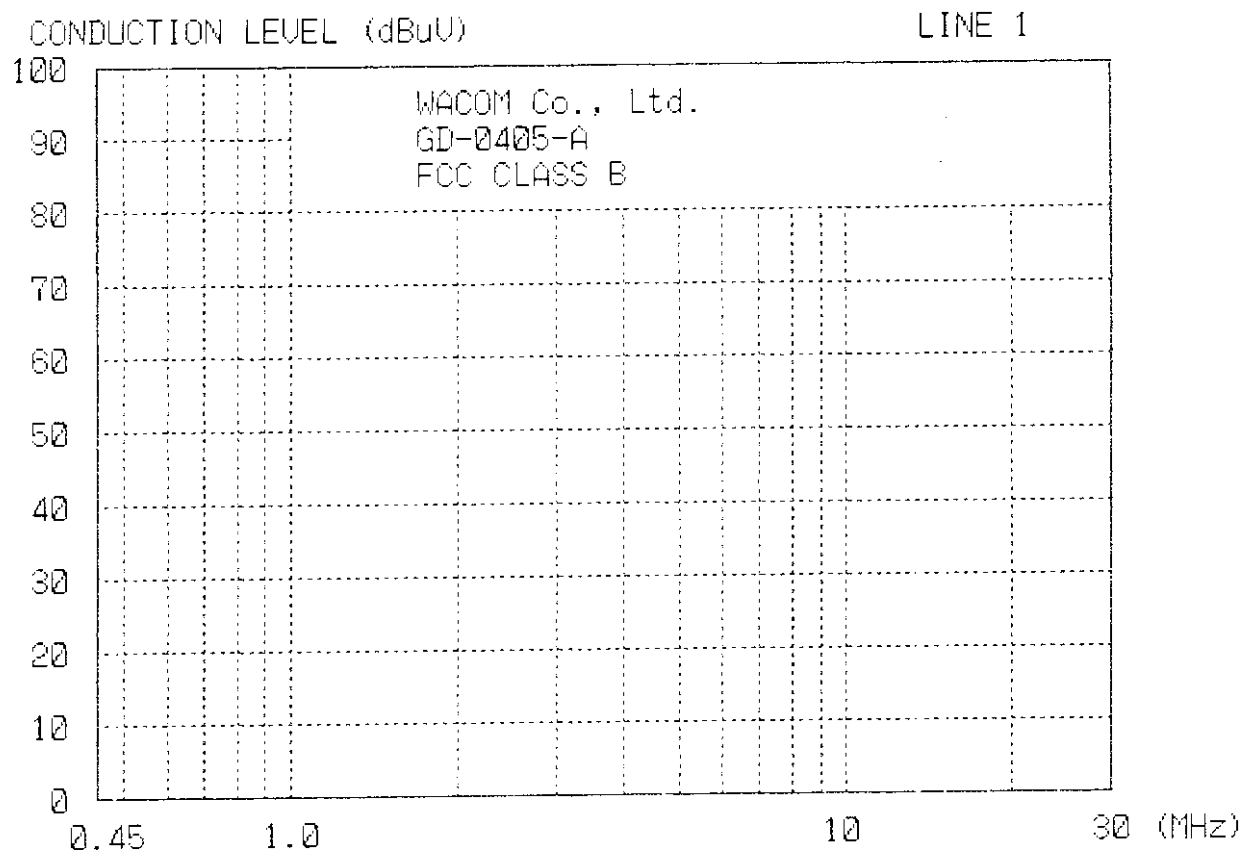
COMPANY NAME : WACOM Co., Ltd.  
EQUIPMENT TESTED : DIGITIZER  
MODEL NUMBER : GD-0405-A  
OPERATING CONDITIONS : NORMAL MODE  
TESTED FOR COMPLIANCE WITH: FCC 15 CFR FOR CLASS B DIGITAL DEVICES  
POWER SUPPLY : AC120V  
RECEIVER : ROHDE & SCHWARZ ESH2  
LISN : ROHDE & SCHWARZ ESH2-Z5, EMCO 3825/2  
DATE TESTED : 03/16/1998  
TEMPERATURE : 17 Deg C  
HUMIDITY : 52 %  
  
TEST SITE : WAVE CORPORATION  
TEST ENGINEER : ATSUSHI OKUYAMA

----- Quasi - Peak Mode -----

Freq. (MHz)	Corr. Factor (dB)	Reading Level (dBuV)		Conduction Level (dBuV)		Limit (dBuV)	Margin (dB)	
		Line1	Line2	Line1	Line2		Line1	Line2
0.485	0.1	21.0	29.8	21.1	29.9	48.0	-26.9	-18.1
0.645	0.1		29.0		29.1	48.0		-18.9
4.678	0.4	23.1	26.2	23.5	26.6	48.0	-24.5	-21.4
13.438	1.0	33.7	33.7	34.7	34.7	48.0	-13.3	-13.3
15.040	1.1	35.9	35.6	37.0	36.7	48.0	-11.0	-11.3
18.027	1.3	34.8	34.8	36.1	36.1	48.0	-11.9	-11.9
24.036	1.5	31.8	31.3	33.3	32.8	48.0	-14.7	-15.2

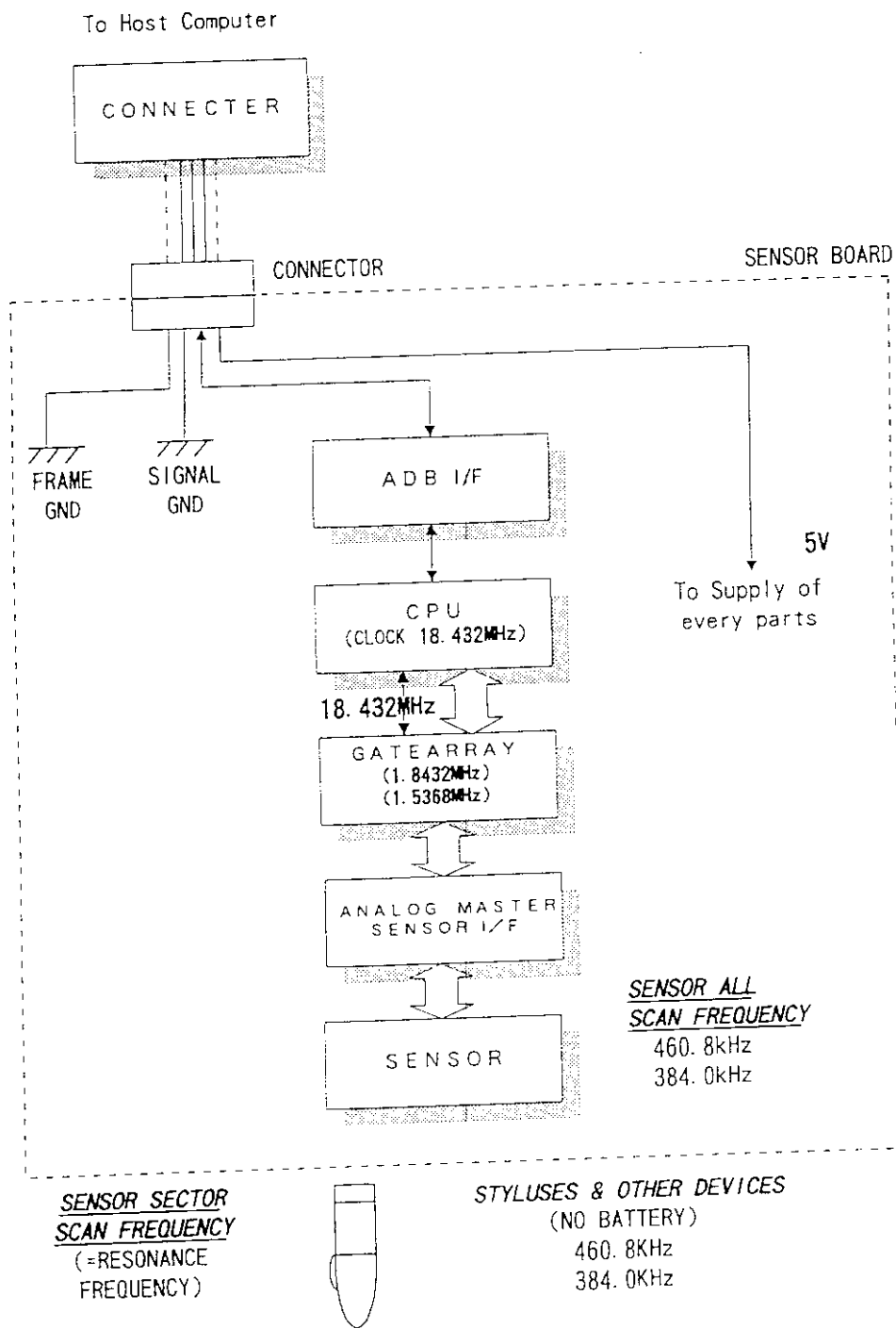
DATE TESTED : 03/16/1998

TEST SITE : WAVE CORPORATION



# WAVE CORPORATION

## 11.0 GD-0405-A BLOCK DIAGRAM



PWB PartNo. PWB-A390