Request For Proposal
for
Maintenance Parts for
LDS V964 Shaker

April 2016

Space Test Division

Korea Aerospace Research Institute

169-84 Gwahangno, Yuseong-gu, Daejeon, 305-806, KOREA
Phone : 82(42)860-2562, Fax : 82(42)860-2234

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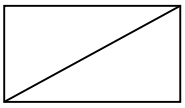

IMPORTANT

1. This RFP should be kept in confidentiality and should neither be copied nor distributed to the third parties.

2. The questions and opinions on this RFP can be asked or suggested to Korea Aerospace Research Institute before submission of the proposal.

3. This RFP shall be legal bind after the contract is awarded unless the bidder explicitly expresses the differences from the RFP in the compliance sheet.

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169-84 Gwahangno, Yuseong-gu

DAEJEON, 34133 KOREA

Phone : 82(42)860-2562, FAX : 82(42)860-2234
e-mail :acoust@kari.re.kr

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I. OVERVIEW

1. Overview of the project

1.1 Korea Aerospace Research Institute (hereinafter referred to as “KARI”) is located at Daeduk Research Complex, 140 km south of Seoul.

1.2 KARI has a satellite assembly, integration and test center (hereinafter referred to as “AITC”) for joint use by corporations and research institutes for the purpose of the effective development of domestic satellites. And basic facilities and equipment for satellite assembly and test have been supplied, installed and used.

1.3 To maintain the vibration shaker capability, KARI would like to procure maintenance parts for existing shaker system of LDS V964 shaker.

1.4 The purposes of this project are ;

1.4.1 To supply all related cable set between shaker body and cooling unit & amplifier system of LDS V964

1.4.2 To supply connection of cable lines & acceptance test

The performance of the installed shaker system shall meet the requirements as detailed in the II Technical requirement.

2. Work description

2.1 WP S1000 Maintenance Part Manufacturing

2.1.1 General

An effective and economical management of the Project shall be conducted. A Project Manager shall be responsible for the management and execution of the work to be performed.

2.1.2 Manufacturing

The system hardware shall be manufactured to satisfy the shaker performance described in this RFP All manufacturing operations shall be planned in co-ordination with inspections and tests.

2.2 WP S2000 Installation

During this work package the following tasks shall be performed:

2.2.1 Mechanical Installation

The mechanical installation comprises the installation and connection of the cable set at KARI site.

2.3 WP S3000: Acceptance testing

Upon completion of the installation of the cable set, the acceptance testing of the LDS V964 shaker shall be took place according to the acceptance test sequence.
The acceptance tests shall be performed in accordance with formal test procedures.
During this work package the following tasks shall be performed:

2.3.1 Acceptance test sequence

The acceptance tests shall verify the capability of shaker in compliance with LDS V964 shaker specification. The following tests have to be performed:

2.3.1.1 *Drag force measurement test for slip table configuration*

2.3.1.2 *Bare condition performance tests*

2.3.1.3 *Loaded condition performance tests with dummy load*

2.3.1.4 *Abort sequence verification*

3. Management reporting Meetings and Deliverables

The hardware deliveries shall include, as a minimum, the following:

Item No.	Part name	Qty	Description
1	Maintenance Part	1	- Degauss cable 40m - Field drive cable 40m - Distilled water supply cable 40m - Cooling hose return cable 40m - Oil hose return cable 40m - Oil hose supply 40m - Armature over travel cable 40m - Bearing oil pressure cable 40m - Armature support cable 40m - Armature cooling (Thermocouple) cable 40m - Field coil (Upper) cooling (Thermocouple) cable 40m - Field coil (Lower) cooling (Thermocouple) cable 40m - Vertical/Horizontal switch cable 40m - Body temperature cable 40m - Over travel (Slip table) cable 40m - BRG. Oil pressure (Slip table) cable 40m - BRG. Oil pressure (Head expander) cable 40m - Load support head expander cable 40m - Earth cable 40m - Armature drive cable 40m - Fiber optic cable Tri axial BNC cable and Emergency stop 55m - Amplifier energize/Body over travel Command / Control console cable 40m - External Emergency stop cable 40m - Field data link 15m - Cooling unit data link 15m - RCP 9 cables - Other miscellaneous cables

4. Warranty

4.1 The system shall be warranted for a duration of 1 years from the date of definitive acceptance on the site against any operational faults.

4.2 The warranty covers the replacement of faulty parts, the labor required for repair, traveling cost, living fees and all associated necessary costs.

II. Technical Requirements

1. Total System Configuration

This document covers the technical requirements applicable to maintenance parts for LDS V964 shaker system

- **Single electro-dynamic vibrator with slip table**
  - Max. sine force : 80 kN
  - Half sine bump : 267 kN
  - Displacement : 50.8 mm (pk-pk)
  - Armature resonance : 2200 Hz

Figure 1 LDS V964 system of KARI

2. Technical Requirements

The work scope for procurement is

- To supply all related cable set between shaker body and cooling unit & amplifier system of LDS V964
- To supply installation of cable lines & acceptance test

2.1 List of Maintenance Parts

The supplied maintenance part shall have the following requirement as minimum:

- Degauss cable 40m
- Field drive cable 40m
- Distilled water supply cable 40m
- Cooling hose return cable 40m
- Oil hose return cable 40m
- Oil hose supply 40m
- Armature over travel cable 40m
- Bearing oil pressure cable 40m
- Armature support cable 40m
- Armature cooling (Thermocouple) cable 40m
- Field coil (Upper) cooling (Thermocouple) cable 40m

- Field coil (Lower) cooling (Thermocouple) cable 40m
- Vertical/Horizontal switch cable 40m
- Body temperature cable 40m
- Over travel (Slip table) cable 40m
- BRG. Oil pressure (Slip table) cable 40m
- BRG. Oil pressure (Head expander) cable 40m
- Load support head expander cable 40m
- Earth cable 40m
- Armature drive cable 40m
- Fiber optic cable Tri axial BNC cable and Emergency stop 55m
- Amplifier energize/Body over travel Command / Control console cable 40m
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- Field data link 15m
- Cooling unit data link 15m
- RCP 9 cables
- Other miscellaneous cables

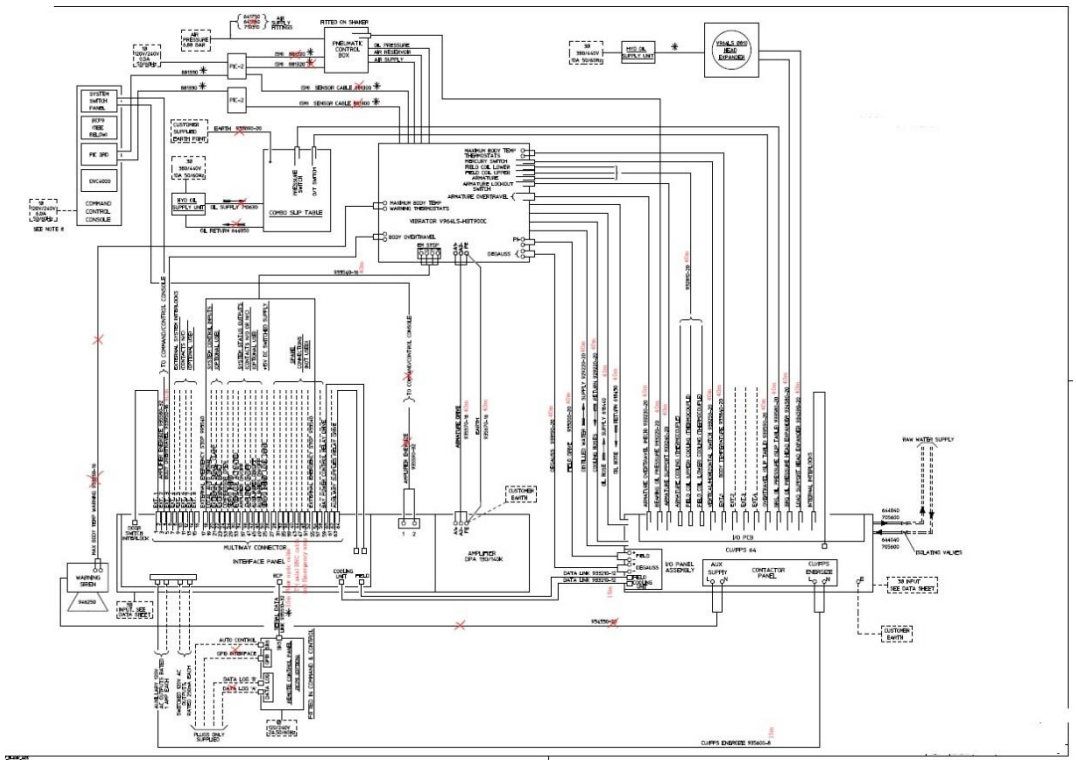

Figure 2 Cable diagram of shaker system

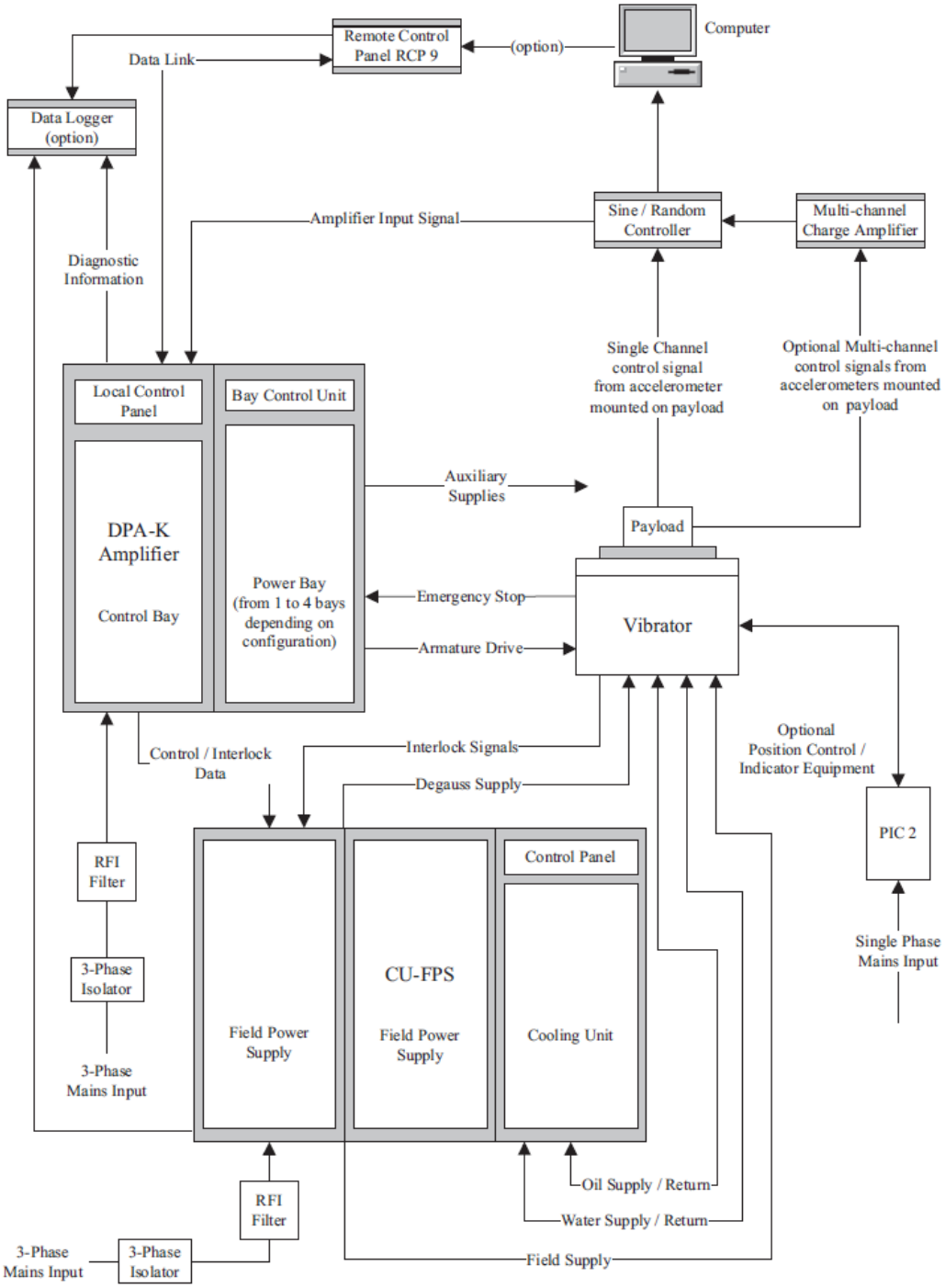

Figure 3 Configuration of shaker system

2.2 Performance Requirement

The supplied maintenance parts shall be compatible to V964 shaker system of KARI.

After the installation of supplied maintenance part, the vibration system shall have the performance of described ones of Manual of LDS V964 shaker system.

In the tables & Figures as shown at below, the typical requirements are described.

Table 1 Specification of V964 shaker system

Armature resonance (f_n), nominal ±5% Useable frequency range	2250 Hz 5 to 2500 Hz
Velocity, sine, peak (Note 1)	2.0 m/s (78.7 in/s)
Acceleration Sine, peak Random, rms Shock, peak	 981 m/s² (100 g_n) 686 m/s² (70 g_n) 2059 m/s² (210 g_n)
Stray magnetic field (Note 3) With low gauss option	< 1.0 mT (< 10 gauss) < 0.6 mT (< 6 gauss)
Armature suspension stiffness Axial(nominal) Cross-axial at insert level Rotational	 61.3 N/mm (350 lbf/in) 21000 N/mm (120 000 lbf/in) 565 kN m/rad (5 x 10^6 lbf in/rad)
Vibrator body mass (M_b) Trunnion-mounted	 2820 kg (6217 lb)
Internal load support capability	907 kg (2000 lb)
Vibrator compressed air supply requirements: Internal load support Lin-E-Air suspension	 0.69 bar (10 lbf/in²) 6.9 bar (100 lbf/in²)

Table 2 Field power requirement

Field coils	
Rated current DC	400 A
Rated voltage	145 V
DC winding resistance (at 20° C)	0.29 Ω
Degauss coil	
Rated current	4.5 A
Rated voltage	145 V

Table 3 Requirement of Armature

Displacement	
Continuous pk-pk	38 mm (1.5 in)
Transient (shock operation)	50.8 mm (2.0 in)
Rated travel between overtravel protection limits	56 mm (2.2 in)
Rated current (sine wave)	1250 A
DC winding resistance at 20° C	0.015 Ω
Effective mass	59.0 kg (130 lb)
Maximum load	
10 g_n vector	848 kg (1870 lb)
50 g_n vector	122.5 kg (270 lb)
100 g_n vector	31.8 kg (70 lb)

Table 3 Specification of cooling unit/Field power supply

	CU/FPS64
Supply Voltage Range	380, 400, 415, 440V 50/60Hz 480, 500, 520V 60Hz
Overall Dimensions	Height1905 mm (75 in.) Width1500 mm (61.4 in.) Depth 825 mm (32.4 in.)
Audible noise (for all 3 units)	89 dBA
Ambient Working Temperature	+5^{o}C to +40^{o}C
Relative Humidity	0 - 95% non-condensing
Weight (approximate)	718 Kg (1583 lbs)
Supply input Power (Full Level FPS) Supply input Power (Economy FPS)	66.15 kW 35.17 kW
Supply input kVA (Full Level FPS) Supply input kVA (Economy FPS)	70.26 kVA 37.74 kVA
Heat Rejected to Air: a. Cooling Unit total b. FPS (Full Level Setting) c. FPS (Economy Level Setting) d. Degauss	 1.684 kW 2.55 kW 1.72 kW 0.072 kW
Total Unit Heat Rejected * (FPS Full Level) Total Unit Heat Rejected * (FPS Economy Level)	2.76 kW 1.93 kW

Table 4 Performance Specification of field power supply

		CU/FPS64
FPS Full Level Setting		
Nominal Load	ohms	0.363
DC Rated Output	Volts	145
DC Rated Output	Amps	400
DC Rated Output	kVA	58
Supply Input Power	kW	60.56
Supply Input kVA	kVA	63.6
Heat Rejected to Air	kW	2.55
Initial Switch on DC overload current (amps) Decaying to rated current within 5 minutes		480
FPS Economy Level Setting		
Nominal Load	ohms	0.363
DC Rated Output	Volts	101.5
DC Rated Output	Amps	280
DC Rated Output	kVA	29
Supply Input Power	kW	29.85
Supply Input kVA	kVA	31.34
Heat Rejected to Air	kW	1.72
Degauss Supply		
Nominal Load	ohms	19.1
DC Rated Output (Adjustable Volts)		0 - 145
DC Rated Output (Adjustable Amps)		0 - 7.6
DC Rated Output	kVA max	1.102
Supply Input Power	kW max	1.174
Supply Input kVA	kVA max	1.23
Heat Rejected to Air	kW max	0.072

Table 5 Specification of Amplifier

Amplifier	**DPA70K, 140K, 210K, 280K**
Classification	Class D switching amplifier, air cooled
Power range	40 to 280 kVA in 8 kVA increments
Input supply: 50/60 Hz 60 Hz	 380V, 400V, 415V, 440V line to line 380V, 400V, 415V, 440V, 480V, 500V, V520 line to line
Input Sensitivity (400 Hz) (400 Hz, Master Gain fully CW)	1.1 V +/-0.1 V rms input for 100 V rms output at rated sinusoidal Volt Amp output
Nominal Sine Output Voltage at rated power output	100 V rms
Differential Input Signal (10 Hz - 5 kHz)	+/-10 V rms (before limiting)
Common Mode Input Signal	+/-7 V rms (still allowing 100 V rms output without limiting if driven differentially)
Common Mode Rejection (DC - 5 kHz)	100 dB
Maximum No Load Voltage	110 V rms
Voltage Regulation 0 - 100 % rated power into rated resistive load	<45 % (measured at 400 Hz)
Input Impedance	10 KΩ nominal
Signal to Noise Ratio relative to 100 V rms output, 10K input termination. Rated resistive load connected. (100 kHz BW)	< 65 dB

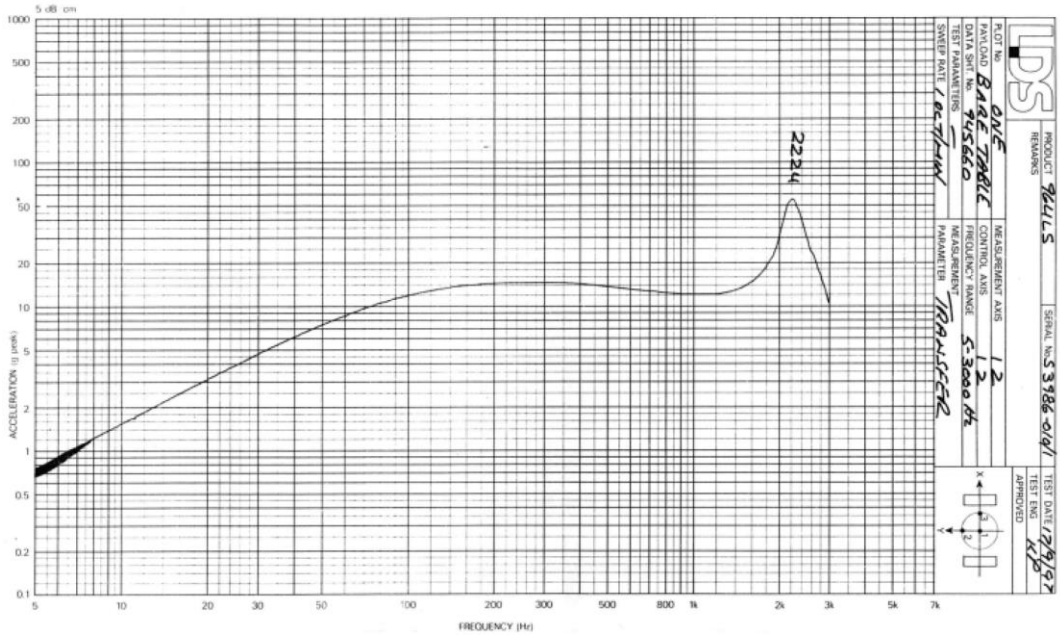

Figure 4 Performance-Transverse in bare condition

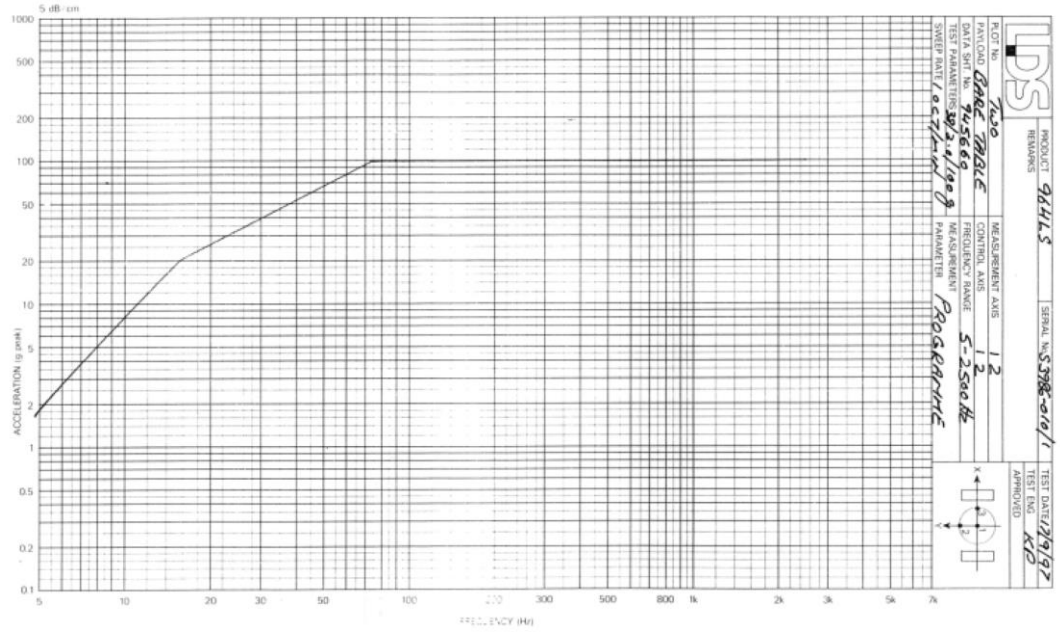

Figure 5 Performance-Normal in bare condition

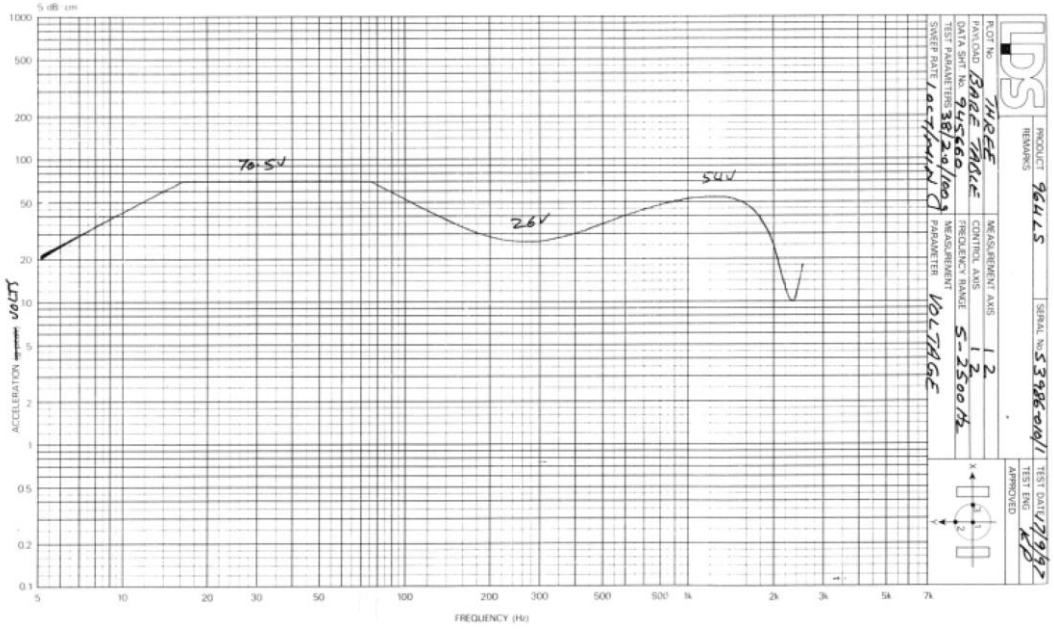

Figure 6 Voltage of V964 in bare condition

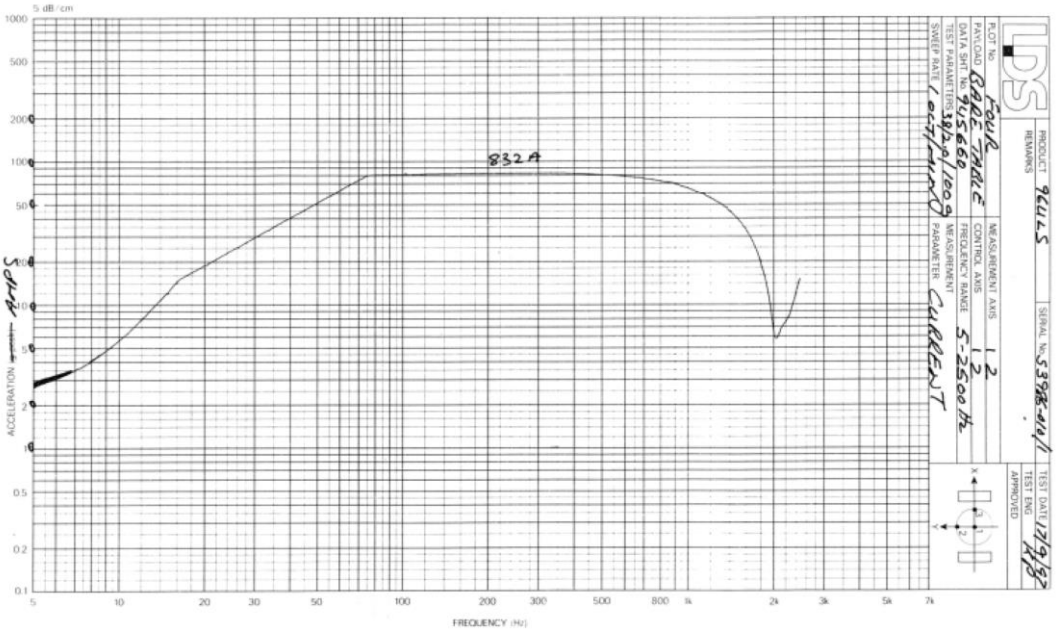

Figure 7 Current of V964 in bare condition