INTERIM REPORT ON MAGNETIC FIELD TESTING OF TR07 MAGLEV VEHICLE AND SYSTEM, CONDUCTED AUGUST 1990

ELECTRIC RESEARCH & MANAGEMENT, INC.

INTERIM REPORT ON MAGNETIC FIELD TESTING OF TR07 MAGLEV VEHICLE AND SYSTEM, CONDUCTED AUGUST 1990

prepared for:

FEDERAL RAILROAD ADMINISTRATION

CONTRACT NO. DTFR53-91-C-00047

prepared by:

ELECTRIC RESEARCH AND MANAGEMENT, INC.
P.O. BOX 165
STATE COLLEGE, PA 16804

MAY 1991

(REVISED AUGUST 1991)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

APPENDICES

INTERIM REPORT ON MAGNETIC FIELD TESTING OF TR07 MAGLEV VEHICLE AND SYSTEM, CONDUCTED AUGUST 1990

1.0 EXECUTIVE SUMMARY

1.1 Background

As part of the United States National Maglev Initiative, the Departments of Transportation and Energy and the Army Corps of Engineers are working together to evaluate and clarify the role of Magnetically Levitated Ground Transportation Systems in the nation's transportation future. Among the technical issues being addressed in the ongoing initiative is an assessment of the environmental and health aspects of Maglev vehicle technology. As part of that analysis, the participants in the initiative have funded a set of measurements by Electric Research and Management, Inc. (ERM) to quantify and characterize the magnetic field environment within and in the vicinity of the Transrapid TR07 Maglev vehicle operating on the Emsland, FRG Transrapid Test Facility.

1.2 Scope

This interim report describes the magnetic field measurements made by ERM within and in the vicinity of the TR07 vehicle operating at the Emsland Transrapid Test Facility from August 6-10, 1990. The measurements were intended to document the temporal and frequency spectral characteristics of the magnetic field (from static to 2 kHz) at the vehicle operators position, at the vehicle passengers' positions, at the station, near the guideway, and near the electrical substation. The interim report describes measurement procedures and equipment, tabulates the various conditions under which measurements were made, and reports some tentative observations of magnetic field characteristics based on a preliminary look at a small subset of the data.

Although a small portion of the data (approximately 20%) collected during the measurement program have been reviewed and are reported within this document, complete analysis of the magnetic field data from the August 1990 tests is still ongoing and a final report will be issued covering the analysis and resulting conclusions at a later date.

1.3 Summary

The Transrapid Maglev System makes use of magnetic fields to levitate, propel, power, and control a transit vehicle without physical contact with its guideway or a third rail. This extensive use of magnetism ranges in frequency from static fields used for levitation, through extreme low frequency (ELF) fields of tens or hundreds of Hertz used for propulsion, guidance, and power transfer to the vehicle to higher frequencies used for communication. The static and ELF magnetic fields are very intense in the gaps between the vehicle and the guideway where they provide their critical functions necessary for Maglev transportation but it is impossible to completely contain the magnetic fields in the desired locations. Some of the magnetic field finds its way into the transit vehicle or to areas of possible public access near the guideway. These stray fields are of course much weaker than the intense fields between the vehicle and its guideway, but their intensities and characteristics are poorly defined. Since the health significance of exposure to ELF magnetic fields is a current subject of both scientific research and public policy debate, it is incumbent that these stray fields in areas of worker and public access be quantified.

Electric Research and Management, Inc. (ERM) used a sophisticated digital magnetic field measurement system called *MultiWave*™ to record the temporal, spatial, and frequency distributions of the stray static and ELF magnetic fields in areas onboard or near the

Transrapid TR07 facility where workers or the general public could be exposed to stray magnetic fields from the Transrapid Maglev System. The computer based *MultiWave*™ System captured the 0 to 2 kHz portion of the magnetic field present at each of its ten sensor locations and recorded the field waveform digitally. These waveform recordings were either converted to frequency spectra at the time of measurement or saved on computer tape for later analysis. The technical characteristics of the *MultiWave*™ System are discussed in more detail in the body of this document.

Throughout the five day measurement program, numerous magnetic field characteristics were recorded at several locations within the operators' compartment and the passengers' compartment as the TR07 vehicle sat still on the guideway, levitated, or travelled at various speeds around the track at the Emsland Transrapid Test Facility. In addition to measurements on the vehicle, magnetic fields were recorded at the passenger station, near the high and low guideway, in the passenger station and near the electrical substation which powers the Transrapid System. Section 3 of this interim report catalogs the many measurements made in the test program, identifies measurement locations with appropriate drawings and photographs, and tabulates vehicle operating conditions at the time of the measurements.

Approximately 80% of the magnetic field data collected during the measurement program was recorded and saved as digital recordings of the magnetic field waveforms. Due to the large volume of these data, they require extensive computer aided processing and analysis to reduce the extensive data set to an interpretable body of information. That analysis is currently in progress and the analysis results, along with appropriate conclusions, will be presented in a final report on the measurement program. However, in order to expedite a preliminary analysis of the magnetic field characteristics in and near the TR07 vehicle and guideway, a small

portion of the measured data was converted to frequency spectra at the time of the measurements. These converted data sets represent "snapshots" of the magnetic field characteristics which existed for a brief period of time when the measurement was made. Many of these spectral snapshots and a few time domain waveforms were reviewed as a preliminary analysis of the TR07 magnetic field data as reported in Section 4 and Appendices B through J of this interim report.

The reader is reminded that this is an interim report covering only a preliminary analysis of less than 20% of the magnetic field data collected on or near the Transrapid TR07 Maglev transit vehicle. Rigorous analysis of the entire data set is underway. Nevertheless, the preliminary analysis of the "spectral snapshot" data appears sufficiently consistent to yield several tentative conclusions about the stray magnetic fields which workers, passengers, or the general public may encounter on the vehicle or near the guideway and substation. These conclusions are stated in Section 5 of the report. A capsule presentation of the relative intensities of ELF magnetic fields associated with the TR07 System compared to ELF fields from other sources in the environment is provided in Figure 28 and shows that the ELF magnetic fields associated with the Transrapid Maglev Transportation System are well within the range of fields encountered from other common sources.

1.4 Acknowledgements

This work was sponsored by the Department of Energy/Office of Energy Management and the Federal Railroad Administration/Office of Research and Development. Also participating in the tests and providing coordination were Don Gray of FRA/Washington, D. C., and Rüdiger Wiedenmann of TÜV/Koln, FRG. Herr Wiedenmann's multilingual abilities were most helpful. Special thanks are due

to the TVE facility director, Walter Merklinghaus of iABG for providing the test team with full TVE facility access.

2.0 MEASUREMENT DISCUSSION

2.1 Overview

The magnetic field measurement and data collection setup used at TVE is shown in Figure 1. Two types of 3-axis magnetic field sensors were used. The B-dot (dB/dt) type ac field sensor/amplifier measured 60 Hz magnetic flux densities up to 1 G (100 μT) rms on each axis and had a -3 dB passband from approximately 4 Hz to 4 kHz. The fluxgate sensor measured magnetic flux densities up to 1 G peak from dc to 1 kHz on each axis. This provided overlapping frequency coverage with the ac sensor. The 30 signal inputs from these sensors were multiplexed to 15 channels that were sampled virtually simultaneously (i.e. interleaved and corrected for time skew). The data could be examined in near real time or stored on the hard disk of an 80386-based portable PC for later transfer to magnetic tape.

Note: Because the data sets processed and plotted thus far have used the cgs unit of gauss (G) for magnetic flux density, the remainder of this report will use flux densities in gauss. The cgs units of gauss and milligauss (mG) can be converted to the MKS units of Tesla (T or Webers/m^2) and microTesla (μT) using the relation: 1 G = 10^{-4} T = 100 μT = 1000 mG.

2.2 B-dot Sensor

The B-dot sensor coil output is proportional to the time derivative of the component of the magnetic flux density normal to the coil plane (dB/dt = $\dot{B}$, pronounced "B-dot"). Integration of each orthogonal axis output produces the vector magnetic flux density $\vec{B}$, except for an integration constant. Preamplifier saturation limited the linear range of the B-dot probe to 1000 mG rms (100 μT) for each axis at 60 Hz. Since the derivative field sensor output voltage increases linearly with frequency, the

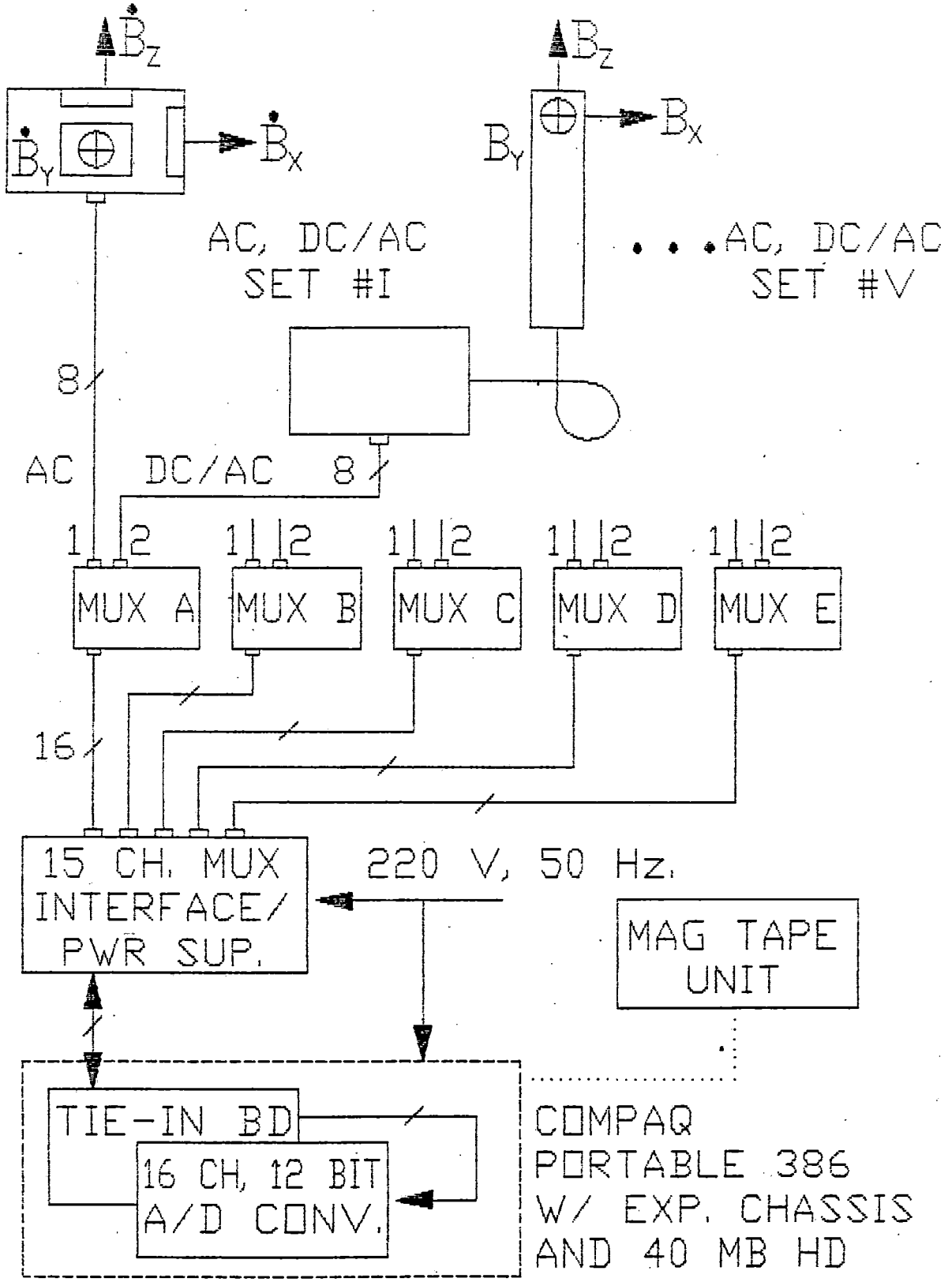


FIGURE 1 INTERCONNECT DIAGRAM FOR TVE TEST

maximum flux density that can be handled without saturation decreases at higher frequencies (i.e. at 240 Hz, the B-dot sensor amplifiers will saturate at 250 mG). Conversely, the B-dot probe saturates at higher field levels at lower frequencies. Hereafter the 3-axis ac B-dot sensors and amplifiers will be called the ac probe.

2.3 Fluxgate Magnetic Field Probe

The fluxgate sensor is able to measure static or slowly varying magnetic fields as well as moderate frequency ac fields up to about 1 kHz. The fluxgate uses sensor coils with high permeability cores which are switched from their linear to saturation regions at approximately a 15 kHz rate. The resulting core flux change is detected and converted to a signal proportional to the normal component of the magnetic flux density. A Bartington MAG-03MC triaxial fluxgate unit was used for this work. Each axis had a magnetic flux density range of 1000 mG peak and a -1 dB bandwidth from dc to 1 kHz. The -3 dB cutoff was approximately 2 kHz, with at least 12 dB/octave roll-off above 2 kHz. Even though the fluxgate sensor handles ac as well as dc signals, it will be called the dc probe hereafter to distinguish it from the ac probe.

2.4 Multiplexing

To accommodate the inputs from ten 3-axis probes (30 channels of information), the 16 input channel Analog-to-Digital Converter required a multiplexing function. The multiplexer (MUX) scheme employed for the TVE measurements used five 8-to-1 MUXes with the ac probes connected to input #1 of each MUX and the dc probes connected to input #2 of each MUX. Although this required more than the minimum number of MUXes and resulted in many unused MUX inputs, this connection technique provided simultaneous sampling for each of the ac probes during the first 0.2 seconds of the

measurement and simultaneous sampling of the dc probes during the next 1, 2 or 5 second intervals.

2.5 Sampling

The ac probe time window (the interval over which 1024 samples were taken) was always kept at 0.2 s. The dc probe time window was made longer to allow better resolution of the low frequency field structure and provide some transient evolution information. In some cases this caused aliasing of the dc probe signals. (Aliasing is a change of the apparent frequency of a signal, caused by undersampling, in which high frequency components appear in the digital code as erroneous low frequency components). For example, with t_{window} = 2 s and a dc probe sampling frequency of 512 Hz, "significant" frequency components above 256 Hz would cause aliasing. "Significant" components would have levels well above the quantization and thermal noise floors and produce aliasing (erroneous or spurious signals) in frequency regions not dominated by the actual signal.

Most of the dominant fields for the TR07 Maglev System appeared to fall off with frequency at about 40 dB per decade. Therefore, aliasing of the dc probes was a minor effect for most of the lower speed measurements. For those cases where aliasing did occur, such as with the dc probe time window of 5 s (which corresponded to a sampling frequency of about 205 Hz) and the TR07 travelling at high speed (e.g., 320 km/hr, corresponding to an excitation frequency of about 160 Hz), the ac probe can be used to deduce aliased signals in the frequency domain (at least for steady state conditions). In principle, correction of the data in such cases is possible, but this has not been done and is not easily accomplished. In the above example, the alias would occur at the difference between the sampling frequency of 205 Hz and the excitation frequency of 160 Hz, producing a spurious signal at 45 Hz. Despite the aliasing problem, the longer dc

probe time window did provide valuable time domain field envelope information from which peak magnetic field levels could be inferred. It would be very desirable to have both long duration time windows and high sample rates, but this would have resulted in very large data packets (> 64 KBytes) which the *MultiWave*™ System was not equipped to handle,

2.6 Other Equipment

The computer used for data collection for the TR07 Maglev System magnetic field measurements was a COMPAQ Portable 386 with 1 MByte RAM, a 40 Mbyte hard disk, and a 1.2 Mbyte, 5¼" floppy disk drive. When the expansion chassis was added, containing the Analog-to-Digital (A/D) converter board and interface buffer card, the control unit weighed about 30 lb. It was basically "luggable" or "transportable" but hardly "portable". The control unit was quite rugged, however, and survived several tipovers and a few bounces without loss of data. Although the top heaviness, weight, and power consumption of the COMPAQ Portable were severe handicaps, little else was available at the time with the combination of features needed.

Copying data from the hard disk to magnetic tapes was done with an Irwin Model 720A Mag Tape Unit. Although it did operate from 50 or 60 Hz, it would only accept 110 V ac power. A stepdown transformer had to be provided, which was inconvenient. This was further compounded by the need to install a special interface card in the expansion chassis to enable the control unit to transfer data to the tape. Data was usually downloaded to tape twice a day, and back-up copies of the tapes were made each evening.

A portable Hall-effect Gaussmeter, Bell Model 9200, was also part of the test equipment used. It had a single axis magnetic field

measuring capability with a 20 G range as the lowest scale. Although its resolution was supposed to be 0.01 G (10 mG or 1μT), the 9200 Gaussmeter actually drifted several tenths of Gauss (100's of mG) over a few minutes. Even its ac mode (10 Hz to 10 kHz bandwidth) was unstable. This unit was intended as a back-up probing device to "sniff" (manually survey) any higher level magnetic fields throughout the volume of the TR07. The 9200 turned out to be basically useless at magnetic flux density levels below 0.5 G, which were the levels typical in the accessible areas of the TR07 Maglev System. (The manufacturer claims to have improved the stability of the Model 9200 since this earlier unit was made).

2.7 Modifications of the Basic *MultiWave*™ System to Perform TR07 Maglev Measurements

The *MultiWave*™ Monitoring System was developed by Electric Research & Management, Inc., under the sponsorship of the Electric Power Research Institute (EPRI). The original function of the equipment was to measure and record magnetic field data associated with 60 Hz electric power systems and residential environments. To minimize data storage requirements, the standard data sample set for the *MultiWave*™ System consists of 64 analog samples taken over one cycle of a 60 Hz waveform (16⅔ ms) that are digitized with 12 bit quantization. This has proven to be a useful technique for steady state system characterization involving periodic waveforms.

For the Maglev measurements, a larger number of data points per sample interval was needed because the excitation frequency was not, in general, power system frequency related. (The speed of the TR07 is proportional to the excitation frequency, which can vary from dc to 215 Hz.) The length of the sample time window for the ac probes was chosen as 200 ms, and the number of sample

points per interval was chosen as 1024. This gave a sampling frequency of 5120 Hz per channel. With 15 simultaneous input channels (5 probes with 3 axes each), an overall sampling rate for the A/D Converter Board of 76.8 kHz resulted. This provided some margin for the 100 kHz maximum rate specified for the Metrabyte DAS-16F A/D Converter Board used for this test.

The dc probes were also sampled with 1024 points per time window, but the length of the time window used was 1, 2, or 5 seconds. This meant that the sampling frequency was correspondingly lower (i.e. 512 Hz per channel with a 2 second time window).

Although the data collection software was modified to accommodate the 1024 point sample storage and real time processing, the analysis software modifications needed to recover the stored time waveform samples were much more involved and therefore were not completed until recently.

2.8 Condensed TVE Trip Report

This is only a brief overview of the TVE visit. Appendix A has a more detailed, "at-the-time" account of the TR07 testing; Section 4 of this report has additional "after-the-fact" technical details.

A trip was made in early August 1990 to the Emsland, Germany Transrapid Test Facility to measure magnetic flux densities on the TR07 vehicle before it went out of service. Participating in the tests were David Robertson and Derald Cummings of Electric Research and Management, Inc./State College, PA; Donald Gray of the Federal Railroad Administration/Washington, DC; and Rüdiger Wiedenmann of TÜV Rheinland/Köln, FRG. The Transrapid Facility director, Walter Merklinghaus of iABG, also assisted in some tests and was instrumental in making the wide range of TR07 Maglev System measurements possible.

The TR07 vehicle did not run on Monday, August 6, but was operating some or most of the time the rest of the week. Final preparations for making on-vehicle and off-vehicle tests for the TR07 were made, including construction of 1 m height tripod platforms to hold the magnetic field sensors for the outdoor measurements.

On Tuesday, August 7, extensive on-board measurements were taken of vertical, lateral and longitudinal magnetic flux density profiles within the passenger and engineering compartment areas. About 2000 km of travel on the TR07 were logged. Fifty-seven (57) sets of on-vehicle data were taken with eight different on-board set-ups.

On Wednesday, August 8, high and low guideway measurements were made. The TR07 logged approximately 1000 km. Thirty-two (32) sets of data were recorded with three different set-ups.

Thursday, August 9, was the most productive day. The TR07 logged over 2400 km. Station (passenger terminal) and high guideway data sets were taken. Also, substation (control center and maintenance area) measurements were made at the transformer bank area, the braking resistor bank and at the low guideway near the maintenance building entrance. The approximate location of the underground feeder cables was determined. Late Thursday a severe thunderstorm caused loss of 110 kV power for nearly an hour. The TR07 was towed to the maintenance building by the diesel powered service vehicle. Twenty-eight (28) sets of data were accumulated with four different set-ups.

Friday, August 10, the TR07 ran only a few hundred km. Data sets were taken at the substation outside the inverter building and above the buried feeder cables near the inverter building. A tour of the inverter complex was arranged. A second feeder cable location just outside the substation was tested late in the day.

A total of fifteen (15) sets of data were taken with four different set-ups. Around 5 P.M. Friday the testing was completed. The equipment was packed, and the American members of the measurement team traveled to Bremen and then returned to the United States on Saturday, August 11.

The data presented here follows the chronological order in which it was taken, as outlined above. This order roughly corresponds to the priority assigned to various data items before the trip was made. The pre-trip test outline, with on-site revisions, is included in the detailed trip account of Appendix A.

3.0 CATALOG OF MEASUREMENTS

An overview of the TVE Complex and the TR07 System test locations are shown in Figure 2. A compilation of all the data taken at the Transrapid Test Facility is provided on the following pages. This includes the frequency domain (spectral snapshot) data, denoted by an "F" in the remarks column, and the time waveform sample data, denoted by a "T" in the remarks column. Wherever possible, the TR07 operating conditions are indicated for the data set.

All the spectral snapshots are plotted, as indicated by the parenthesis, (F). Only a few time waveform files have been plotted.

The time waveform samples provide information on the time evolution of the fields. Generally, each time waveform file contains many captured waveforms. Each of these can be processed using a Fast Fourier Transform (FFT) to provide a frequency domain spectral snapshot. Since 2304 time waveform samples were recorded, about 30 times more information is available from these files than is contained in all 67 spectral snapshots plotted to date. The 67 valid spectral snapshots recorded on site are included as an appendix to this report.

3.1 TR07 System Test Overview

The Emsland Transrapid Test Facility is a 31 km, double loop track with a long straightaway (about 12 km) in the middle portion (see Figure 2). Most of the off-vehicle testing was done in a 1.5 km portion of the track near the control center. One remote test was conducted in the south loop, about 6 km from the control center. The dates in parenthesis in Figure 2, coded in the German date convention (DAY. MONTH. YEAR), indicate the dates tests were performed. A detailed general overview and

chronological description of the test are included in the original trip report contained in Appendix A.

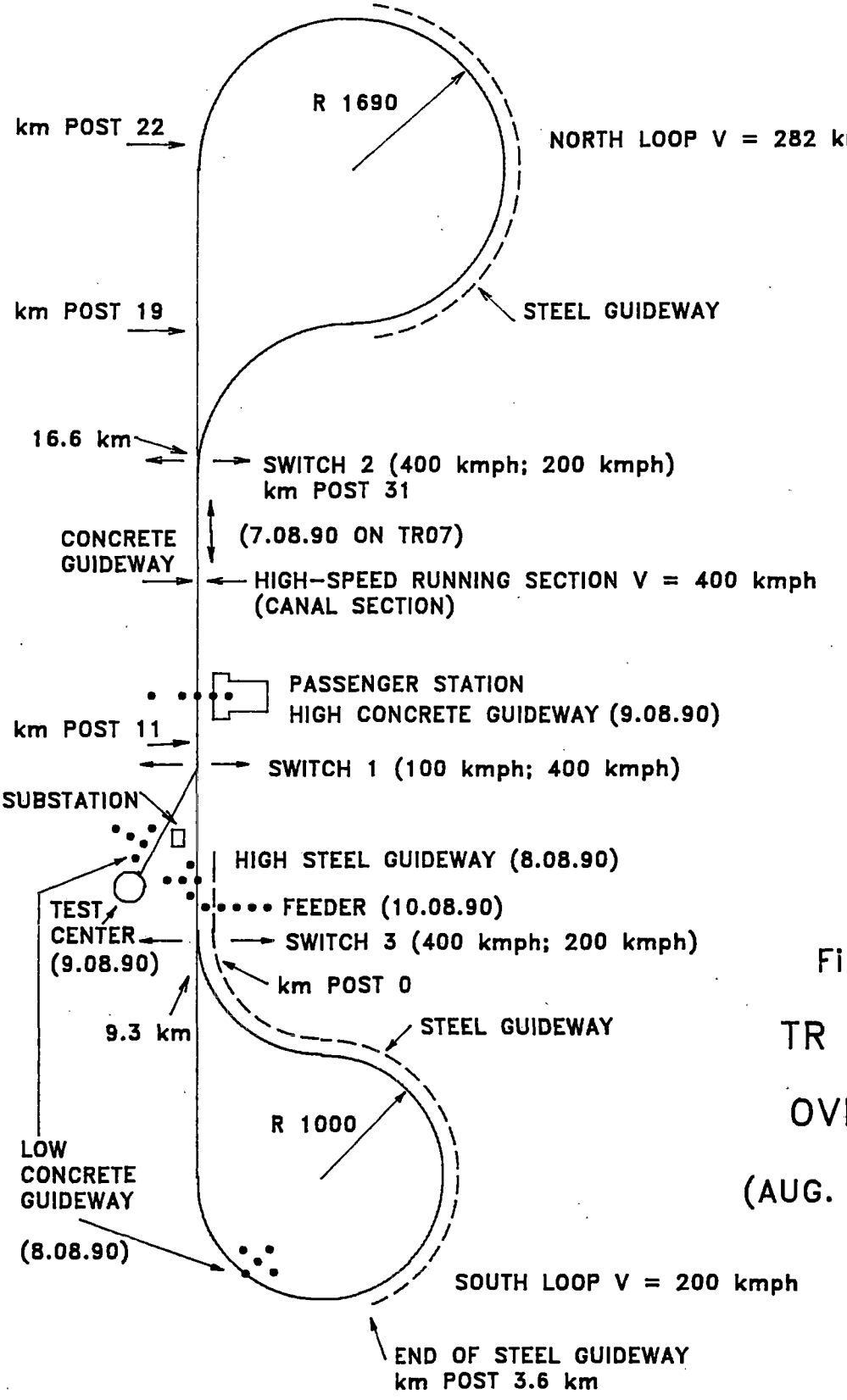


Figure 2

TR 7 TEST

OVERVIEW

(AUG. 6–10, '90)

DATA INDEX FOR EMSLAND TVE MAGNETIC FIELD TESTING, AUG.6-10,'90

DATA FILE # [SIZE,KB]	DATE/ HHMM	VEL.* KM/HR	PROBE LOC. AC	PROBE LOC. DC	t_{s-DC} **,s	REMARKS F=FFT DATA; T=TIME DATA (PARENTHESIS⇒DATA PLOTTED)
	AUG.7					ON TR07, ON TEST TRACK
TR700101	0949	168	2'	1'	1.0	(F) AC_m = 84 mG, DC/AC_m = 80 mG
[578, 02	0956	170	2'	1'	1.0	(F) AC_m =174 mG, DC/AC_m =127 mG
EA.] 03	1000	270+	4	3	1.0	(F) AC_m = 61 mG, DC/AC_m =263 mG
04	1004	194	4	3	1.0	(F) AC_m =109 mG, DC/AC_m =298 mG
TR7001##	1020-	308/	4	3	1.0	T,21 SAMPLES, 30 s APART
[1,330]	1030	171				(T-21); MID CAR #2, WINDOWS
TR7002##	1038-	396/	2	1	1.0	T,21 SAMPLES, 30 s APART
[1,330]	1048	162				LOC. MID CAR #2, AISLE
TR7003##	1332-	302/	2	1	5.0	T,17 SAMPLES, 30 s APART
[1,079]	1340	168				LOC MID CAR #2, AISLE
TR700301	1356	-				INVALID, 1.8K DATA ONLY
TR700302	1401	168	2	1	5.0	(F) AC_m =117 mG, DC/AC_m =157 mG
[578]						
	AUG.7					ON TR07, IN MAINT.FAC., NO LEV.
TR700401	1114	0	2	1	1.0	(F) AC_m =154 mG, DC/AC_m = 7 mG
[578, 02	1115	0	2	1	1.0	(F) AC_m =162 mG, DC/AC_m = 7 mG
EA.] 03	1203	0	2	1	5.0	(F) AC_m =135 mG, DC/AC_m = 9 mG
04	1204	0	2	1	5.0	(F) AC_m =126 mG, DC/AC_m = 9 mG
	AUG.7					ON TR07, ON TEST TRACK
TR700501	1411	220	4	3	5.0	(F) AC_m =162 mG, DC/AC_m =192 mG
[1156,02	1421	300	4	3	5.0	(F) AC_m =155 mG, DC/AC_m =179 mG
EA.] 03	1441	300+	6	5	5.0	(F) AC_m = 71 mG, DC/AC_m =184 mG
04	1452	350	6	5	5.0	(F) AC_m = 80 mG, DC/AC_m = 94 mG
05	1500	100-	12	12	5.0	(F) AC_m =149 mG, DC/AC_m =210 mG
[578, 06	1503	170-	12	12	5.0	(F) AC_m = 70 mG, DC/AC_m =179 mG
EA.] 07	1513	165	16	15	5.0	(F) AC_m = 81 mG, DC/AC_m =130 mG
[1156,08	1517	260	14	13	5.0	(F) AC_m = 55 mG, DC/AC_m =196 mG
EA.] 09	1530	300	16	15	5.0	(F) AC_m =109 mG, DC/AC_m = 85 mG
	AUG.7					TR07 PARKED AT STATION, NO LEV.
TR700601	1534	0	16	15	5.0	(F) AC_m =1.4 mG, DC/AC_m =1.6 mG
[578]						
	AUG.7					TR07 PARKED IN MAINT. FAC. †
TR700602	1603	0	16	15	5.0	(F) A_m =7.4 mG, D_m =2.5 mG, LEV.
[578]						
TR7006##	1607-					UNKNOWN
[444]	1608					
TR7007##	1709		15	16	5.0	T,1 SAMPLE, TR07 PARKED, NO LEV.
[63]						INCOMPLETE

DATA FILE # [SIZE,KB]	DATE/ HHMM	VEL.* KM/HR	PROBE LOC. AC	PROBE LOC. DC	t_{S-DC} **,s	REMARKS F=FFT DATA; T=TIME DATA (PARENTHESIS→DATA PLOTTED)
	AUG.7					TR07 STARTUP AND RUN
TR7008## [1,206]	1735-1744	300/168	12	11	5.0	T,19 SAMPLES, 30 s APART LOC PASSENGER BULKHEAD (REAR)
	AUG.7					TR07 ON TRACK, CONTINUOUS
TR7009## [1,079]	1752 1800	320/170	14	13	5.0	T,17 SAMPLES LOC VIP SECTION
TR7010## [1,270]	1802-1812	340/170	16	15	5.0	T,20 SAMPLES LOC REAR ENGR. AREA
TR7011## [381]	1817-1822	180/0	17	17	5.0	T,6 SAMPLES, 30 s APART PROBES ON FLOOR, DECEL., STOP
	AUG.7					HIGH STEEL G/W NEAR CTL CTR †
TR701201 [578, 02 EA.] 03	2048 2051 2104		18 18 18	18 18 18	2.0 2.0 2.0	(F)TR07 IN N. END, A_m=4.1,D_m=1.0 (F)TR07 PASS BY, A_m=10.4,D_m=40.0 (F)TR07 IN S.LOOP, A_m=2.1,D_m=1.1
	AUG.8					HIGH STEEL G/W NEAR CTL CTR †
TR701204 [578, 05 EA.] 06 07	1034 1035 1037 1038		18 18 18 18	18 18 18 18	2.0 2.0 2.0 2.0	(F)TR07 PASS N→S,A_m=10.7,D_m=53.0 (F)TR07 IN S. LOOP,A_m=0.5,D_m=1.0 (F)TR07 PASS S→N,A_m=5.2,D_m=65.9 (F)TR07 IN N. END,A_m=0.6,D_m=1.0
TR7012## [1,333]	1042-1047		18	18	2.0	T,21 SAMPLES, ≈ 12 s APART AUTORANGE ON
TR7013## [14,029]	1050-1112		18	18	2.0	T,221 SAMPLES, ≈ 6 s APART AUTORANGE ON
TR7014## [2,539]	1226-1237		18	18	2.0	T,116 SAMPLES, ≈ 6 s APART AUTORANGE ON
TR7015## [825]	1239-1240		18	18	2.0	T,13 SAMPLES, < 6 s APART
TR7016##						SKIPPED NUMBER
TR7017## [1,016]	1246-1254		18	18	2.0	T,16 SAMPLES, < 6 s APART
TR7018## [3,303]	1256-1301		19	19	2.0	T,52 SAMPLES, < 6 s APART REF PROBE NEAR TRANSFORMER YARD
	AUG.8					LOW CONCRETE GUIDEWAY, S. LOOP †
TR701901 [578, 02 EA.] 03	1551 1552 1555		20 20 20	20 20 20	2.0 2.0 2.0	(F) BACKGROUND, A_m=0.3, D_m=0.8 (F) BACKGROUND, A_m=0.3, D_m=0.8 (F) A_m=0.3, D_m=0.9
TR7019## [12,316]	1600-1620		20	20	2.0	T,194 SAMPLES, ≈ 6 s APART

DATA FILE # [SIZE,KB]	DATE/ HHMM	VEL.* KM/HR	PROBE LOC. AC	PROBE LOC. DC	t_{S-DC} **,s	REMARKS F=FFT DATA; T=TIME DATA (PARENTHESIS⇒DATA PLOTTED)
	AUG.9					PASSENGER STATION,HIGH CONC.G/W†
TR702001	0959		21	21	5.0	(F)TR07 IN S. LOOP,A_m=0.4,D_m=1.0
[578, 02	1002		21	21	5.0	(F)TR07 PASS S→N,A_m=16.0,D_m=327
EA.] 03	1005	300	21	21	5.0	(F)TR07 IN N. LOOP,A_m=0.4,D_m=1.0
04	1006	300	21	21	5.0	(F)TR07 IN N. LOOP,A_m=0.4,D_m=1.0
05	1009		21	21	5.0	(F)TR07 PASS N→S,A_m=20.6,D_m=245
06	1011		21	21	5.0	(F)TR07 IN S. LOOP,A_m=0.4,D_m=1.0
07	1012	174	21	21	5.0	(F)TR07 IN N. LOOP,A_m=0.4,D_m=1.0
08	1018	231	21	21	5.0	(F)TR07 PASS N→S,A_m=5.6,D_m=260
09	1020		21	21	5.0	(F)TR07 IN S. LOOP,A_m=0.4,D_m=1.0
10	1022	180	21	21	5.0	(F)TR07 PASS S→N,A_m=8.6,D_m=315
TR7020##	1026-	300/	21	21	2.0	T,229 SAMPLES, 4 s APART
[14,539]	1046	170				LOC:STATION, HIGH CONCRETE G/W
TR7021##	1051-	250/	21	21	2.0	T,229 SAMPLES, 5 s APART
[14,539]	1110	173				LOC:STATION, HIGH CONCRETE G/W
	AUG.9					TRANSFORMER YARD AT CTL CTR † ‡
TR702201	1448		22	22	2.0	(F)TR07 IN N. ST.-AWAY (3.8,4.6)
[578, 02	1451		22	22	2.0	(F)TR07 IN S. LOOP (1.8,2.1)
EA.] 03	1455		22	22	2.0	(F)TR07 IN N. LOOP (1.6,1.9)
04	1457		22	22	2.0	(F)TR07 ACCEL. IN N.END(2.9,4.1)
05	1500		22	22	2.0	(F)TR07 PASS N→S,SLOWNG(2.5,6.1)
06	1505		22	22	2.0	(F)TR07 IN S. LOOP (1.6,2.6)
TR7022##	1508-		22	22	2.0	T,230 SAMPLES, 4 s APART
[14,602]	1528					TRANSFORMER YARD PROFILE
	AUG.9					BRAKING RESISTOR BANK † ‡
TR702301	1642		23	23	2.0	(F) TR07 IN N. LOOP (0.2,1.0)
[578, 02	1644		23	23	2.0	(F) TR07 BRAKING (5.2,12.4)
EA.] 03	1647		23	23	2.0	(F) TR07 BRAKING (20.8,4.9)
04	1648		23	23	2.0	(F) TR07 BRAKING (47.6,8.1)
TR7023##	1618-		23	23	2.0	T,255 TIME SAMPLES, 4 s INT.
[16,189]	1638					BRAKING RES. BANK PROFILE
TR7024##	1649-		23	23	2.0	T,68 TIME SAMPLES, 4 s INT.
[4,317]	1655					ATTEMPT TO CATCH BRAKING
	AUG.9					ENTRANCE TO MAINTENANCE FACILITY
TR702401	1727		24	24	2.0	(F)BACKGROUND AT LOW G/W, MAINT.
02	1728		24	24	2.0	(F)BACKGROUND AT SERV. ENTR.
TR7025##	1731-		24	24	2.0	T,10 TIME SAMPLES, 4 s APART
[635]	1732					TR07 LEVITATING, LOW CONC. G/W
TR7026##	1806-		24	24	2.0	T,39 TIME SAMPLES, 4 s APART
[2,476]	1810					TR07 LEVITATING AT SERVICE ENT.

DATA FILE # [SIZE,KB]	DATE/ HHMM	VEL.* KM/HR	PROBE LOC. AC	PROBE LOC. DC	t_{S-DC} **,s	REMARKS F=FFT DATA; T=TIME DATA (PARENTHESIS⇒DATA PLOTTED)
	AUG10					INVERTER BLDG. N.SIDE,LOC. 1 † ‡
TR702701	0924		25	25	2.0	(F)TR07 IN MAINT. FAC. (3.1,1.1)
[578] 02	0941				2.0	(F)TR07 IN N. LOOP (145,131)
TR7027##	1806-		25	25	2.0	T,39 TIME SAMPLES, 4 s APART
[?]	1810					LOC.#1 OUTSIDE INVERTER BLDG.
	AUG10					INVERTER BLDG,4m N. OF 1st LOC†‡
TR702801	1003		26	26	2.0	(F)LOC#2,TR07 NOT OPER.(3.9,1.5)
[578] 02	1004		26	26	2.0	(F)BKGRND.,TR07 N.LOOP(3.1,1.4)
TR7028##	1005-		26	26	2.0	T,6 TIME SAMPLES, 4 s APART
[381]	1006					TR07 ON TRACK
TR7029##						SKIPPED NUMBER
TR703001	1229		26	26	2.0	(F)LOC#2,TR07 ON TRACK (22,18.4)
[578] 02	1230		26	26	2.0	(F)LOC#2,TR07 IN N.LOOP(4.2,1.8)
TR7030##	1207-		26	26	2.0	T,219 TIME SAMPLES, 4 s APART
[13,904]	1227					TR07 ON TRACK
	AUG10					SOUTH FEEDER NEAR CTL CTR † ‡ ◊
TR703101	1302		27	27	2.0	(F)BKGRND, H=0m, (0.6,1.2)
[578, 02	1554		28	28	2.0	(F)TR07 IN S.LOOP,H=1m,(8.9,1.3)
EA.] 03	1557		27	27	2.0	(F)TR07 PULL OUT,H=0m,(21.6,1.2)
04	1603		27	27	2.0	(F)TR07 PASS N→S,H=0m(10.8,35.3)
05	1605		27	27	2.0	(F)TR07 IN N.LOOP,H=0m,(1.6,1.2)
06	1607		27	27	2.0	(F)TR07 PASS S→N,H=0m(29.9,45.8)
07	1611		28	28	2.0	(F)TR07 IN N.LOOP,H=1m,(0.2,1.5)
08	1614		28	28	2.0	(F)TR07 OVERHEAD,H=1m(11.8,63.8)
TR7031##	1304-		27	27	2.0	T,6 TIME SAMPLES, 4 s APART
[381]	1305					H=0m AT SOUTH FEEDER
TR703201	1614		28	28	2.0	(F)TR07 OVERHEAD,H=1m(15.1,53.2)
[578] 02	1615		28	28	2.0	(F)TR07 IN S. LOOP,H=1m(0.3,5.6)
TR7032##	1620-		28	28	2.0	T,219 TIME SAMPLES, 4 s APART
[13,903]	1640					H=1m, TR07 ON TRACK

* VELOCITY CODE: + = SPEED INCREASING; - = SPEED DECREASING;
/ INDICATES RANGE OF VALUES, MAX/MIN;
NO POSTFIX INDICATES CONSTANT SPEED.

** SAMPLE TIME FOR DC PROBE IS TABULATED (ALL AC PROBES, t_{S-AC} = 0.2 s).

† $A_m = AC_m$ = MAXIMUM AC RMS B (FLUX DENSITY) FROM B-DOT PROBES, mG.
$D_m = DC/AC_m$ = MAXIMUM AC RMS VALUE FROM FLUXGATES, mG.

‡ NUMBER PAIR IN PARENTHESIS INDICATES (AC_m, DC/AC_m).

◊ H = PROBE HEIGHT ABOVE LOCAL GROUND SURFACE.

4.0 DISCUSSION OF TR07 MAGLEV MEASUREMENTS AND INTERIM RESULTS.

The August 1990 TVE magnetic field measurements and interim results of the TR07 Maglev System testing are briefly discussed by measurement location. This section gives samples of the data obtained in the form of spectral snapshots and includes some time waveform plots recently produced. Complete sets of spectral snapshot plots are provided in the appendices, along with a mechanical sketch of the probe locations for each test. Where available, various photographs of the test setups are shown to aid in post-test data analysis. For simplicity, the B-dot ac probe will be called the ac probe and the dc-1 kHz fluxgate probe will be called the dc probe.

4.1 Onboard TR07 Measurement and Data Discussion

The 16 vertical profile measurement points on board the TR07 are shown in Appendix B. The initial mid-TR07 setup is shown in Figure 3A. The vertical profile consisted of FLOOR (probes actually centered 12.7cm (5") above the floor), SEAT (47.0cm (18.5") above the floor surface), HEADREST (1.12m (44") above the floor) and STANDING HEAD (1.74m (68.5") above the floor). A set of reference probes was placed near the rear bulkhead (Figure 3B). The ac reference probe was at seat level, under the armrest between the two starboard seats just in front of the rear bulkhead. The dc reference probe was placed at headrest level, wedged between the headrests of the seats holding the ac reference probe.

The vertical profile probe array deployment and the reference probes are shown in Figures 4A and 4B for a late Tuesday setup. The multiplexers were located on the floor under the table holding the computer. The computer table was near the rear bulkhead on the port side, about 2 meters across the aisle from the reference probes. The computer was powered from the 220 V,

FIGURE 3 ONBOARD TR07 SETUP

FIGURE 3A
INITIAL AISLE PROFILES
AT MIDDLE OF CAR #2:
AC (LEFT, #2'), DC (RIGHT, #1')
AS SEEN FROM REAR
BULKHEAD, LOOKING IN
THE DIRECTION OF TRAVEL.
COMPUTER TABLE IS
ON PORT SIDE, FOREGROUND.

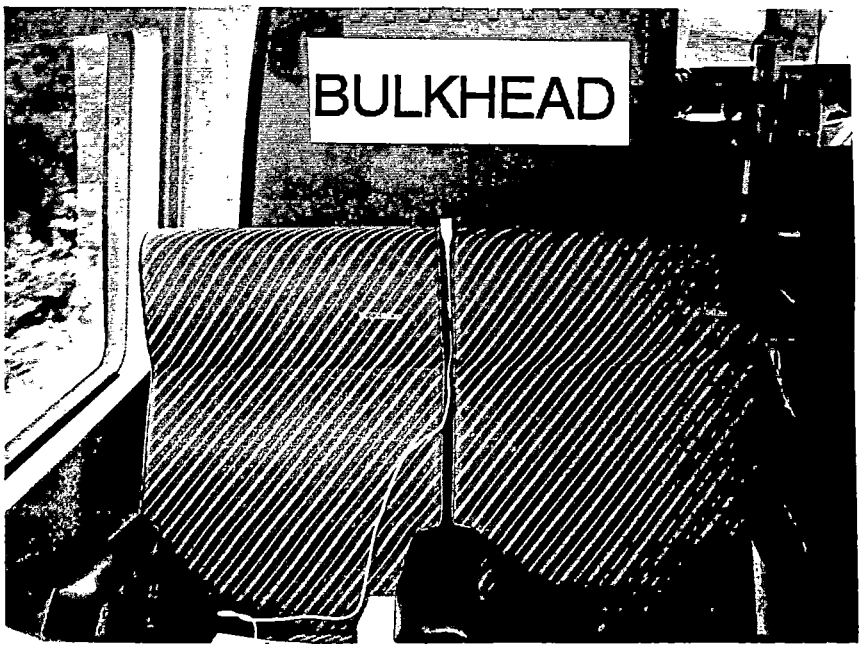
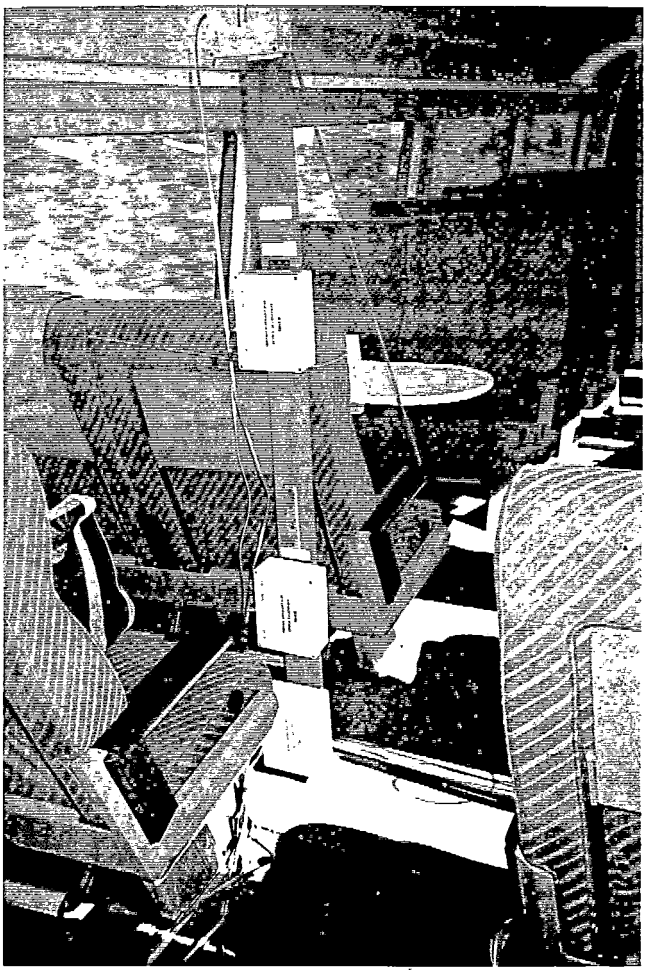


FIGURE 3B
REAR BULKHEAD
REFERENCE PROBES, V,
STARBOARD SIDE.
V-DC/AC → HEADREST

V-AC → SEAT

FIGURE 3C
CAR #2
ENGINEERING AREA

CAR #2 VERTICAL PROFILES @ ST. HEAD



AC (LEFT) DC (RIGHT)

@ MIDDLE AISLE SEAT

FIGURES 4A AND 4B
AC AND DC
VERTICAL PROFILE PROBE
CONFIGURATION (LOC. #2,1,
RESPECTIVELY; PROBES
90° ROTATED FR. 1',2')

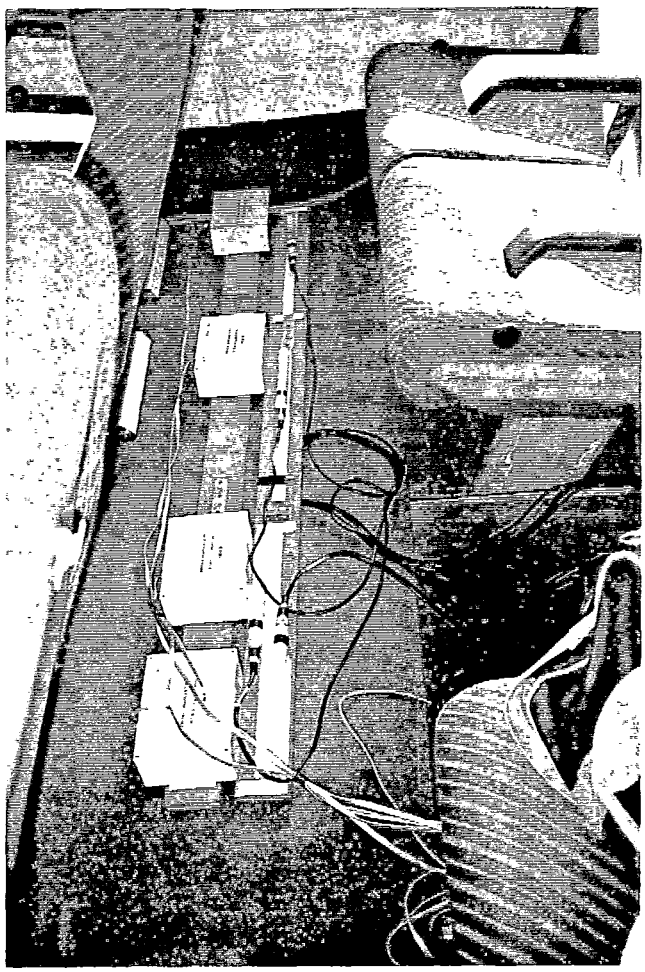


FIGURE 4C FLOOR LEVEL TRANSVERSE PROFILE IN MIDDLE OF CAR #2 (SETUP #17).

50 Hz inverted ac onboard the TR07. This ac also powered other onboard equipment and the overhead fluorescent lights.

A lateral profile was also taken at the floor level near the middle of Car #2, as shown in Figure 4C. Only time waveforms were recorded for these lateral profiles (TR7011) and these have not yet been examined (Setup 17).

The Compaq 386 Portable Computer performed well during the test. There appeared to be no adverse effects from TR07 travel on the TVE test track. The TR07 ride was relatively smooth most of the time but sharp jerks were occasionally experienced, especially in the right turn at the northern switch, going north. It is believed that the effects of the ac probe coil vibration were negligible. Several sensor vibration reduction techniques were used, including hand holding the poles and "Bungi cord" elastic damping. The (slow) turning in the earth's magnetic field in the north and south loops were well below the noise level of the measuring system. There was no field produced by the vehicle translational movement, because simple translation without any rotation gives no induced EMF output for a fixed geometry coil.

4.1.1 Discussion of Spectral Snapshot Data Presentation

The frequency domain "spectral snapshots" are Fast Fourier Transforms (FFTs) of a single time segment of data from each of the sensors. The FFT processed data is stored for the magnitude and phase of each of 1024 spectral components (for positive and negative frequency, 512 points of one sided spectrum) for each axis of each probe (30 channels total). This takes 578 KBytes of storage space. The data tabulation for all probes takes 94 pages for printout of <u>one</u> spectral snapshot. The first page only of the TR700101 spectral snapshot file is shown in Appendix B-2. While this gives all the information of the file (magnitude and phase of each

frequency component for every axis of every probe), it is not easily understandable and would require 6298 pages of printout just to tabulate the data of the 67 spectral snapshots. The "RMS" version of this file is shown in Appendix B-3, (first page only, of 10) which has the rms "resultant" field magnitude (the square-root-of-the-sum-of-squares of the field components) for each spectral cell (one sided spectrum). Although this is a significant reduction in printout volume, it is still not easy to understand the tabulated contents of the RMS file. A graphical presentation of the RMS files is shown in Figures 5 and 6. Nearly all the ac probe data (500 of 512 points) is in Figure 5 and a portion of the dc probe data (101 of 512 points) is in Figure 6.

The ac probe output frequency spectrum (integrated, since it is a B-dot sensor) is shown in Figure 7 with a linear frequency axis having a 2 kHz span. As can be seen, the "significant" magnetic field energy is below 500 Hz. Although there is some energy out to 2000 Hz, it is close to the noise floor and > 60 dB down from the dominant energy at 100 Hz and below.

The dc probe partial output frequency spectrum is shown in Figure 8 with a "quasi log" frequency axis from dc to 100 Hz. This enables seeing the 1 to 20 Hz region with better resolution than a 2 kHz plot can give and enables distinguishing the dc response of one probe from another.

The data set TR700101 was taken in the aisle near the middle of the TR07 car #2, travelling at 168 km/hr. The probe locations are described by Roman Numerals with "I" being floor level and "IV" the standing head level. Since the ac and dc probe vertical arrays were symmetrically located (but physically separated), the corresponding ac probe location

Figure 5 AC PROBE SPECTRAL SNAPSHOT, 2 KHZ LINEAR SPAN

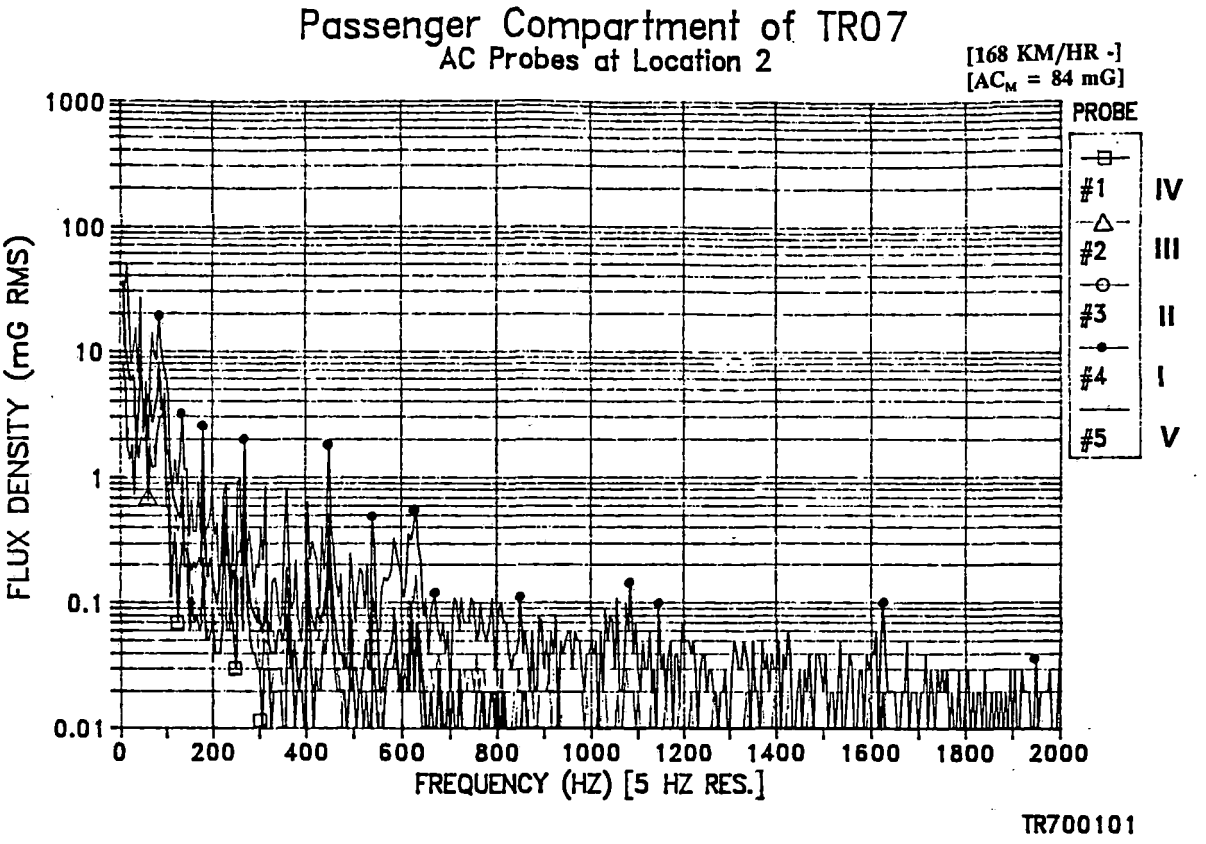


Figure 6 DC PROBE SPECTRAL SNAPSHOT, 100 HZ QUASI-LOG

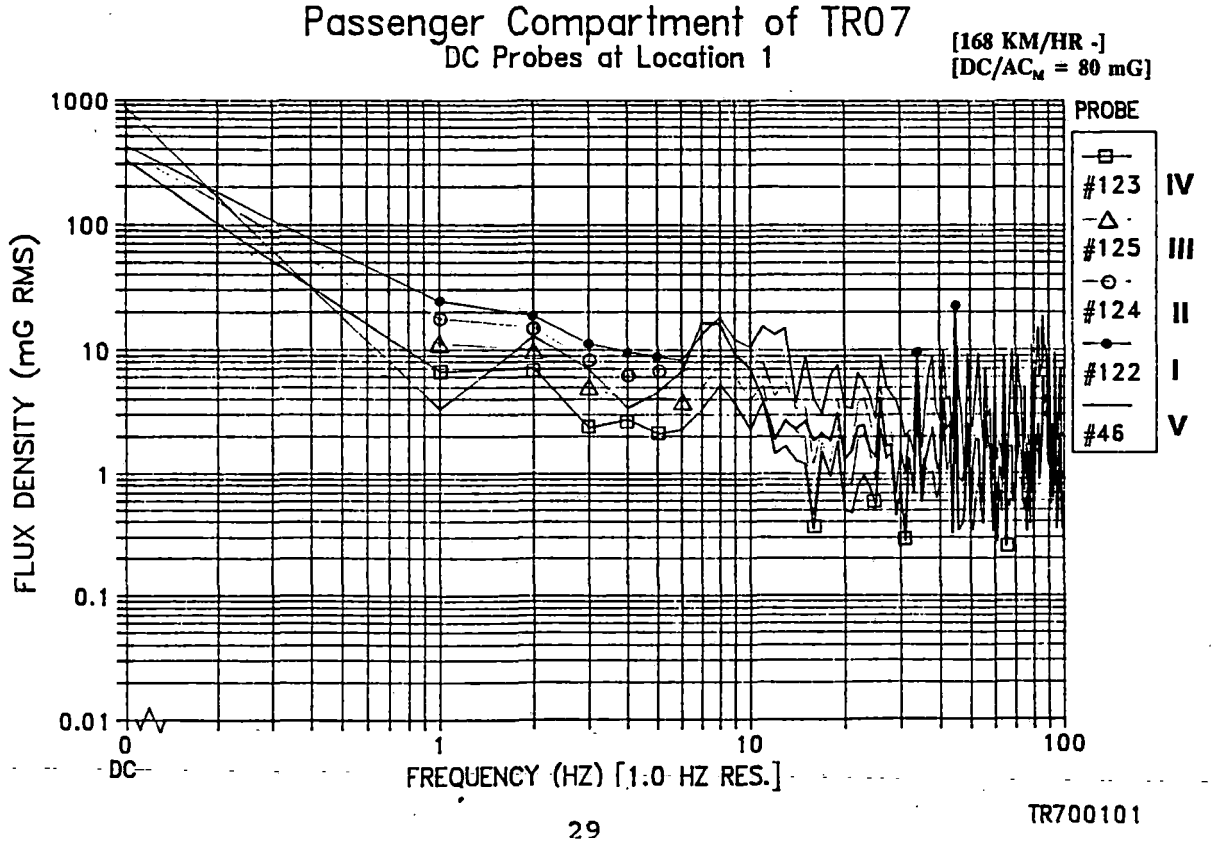


Figure 7 AC PROBES, SSN TR700101, 500 HZ SPAN

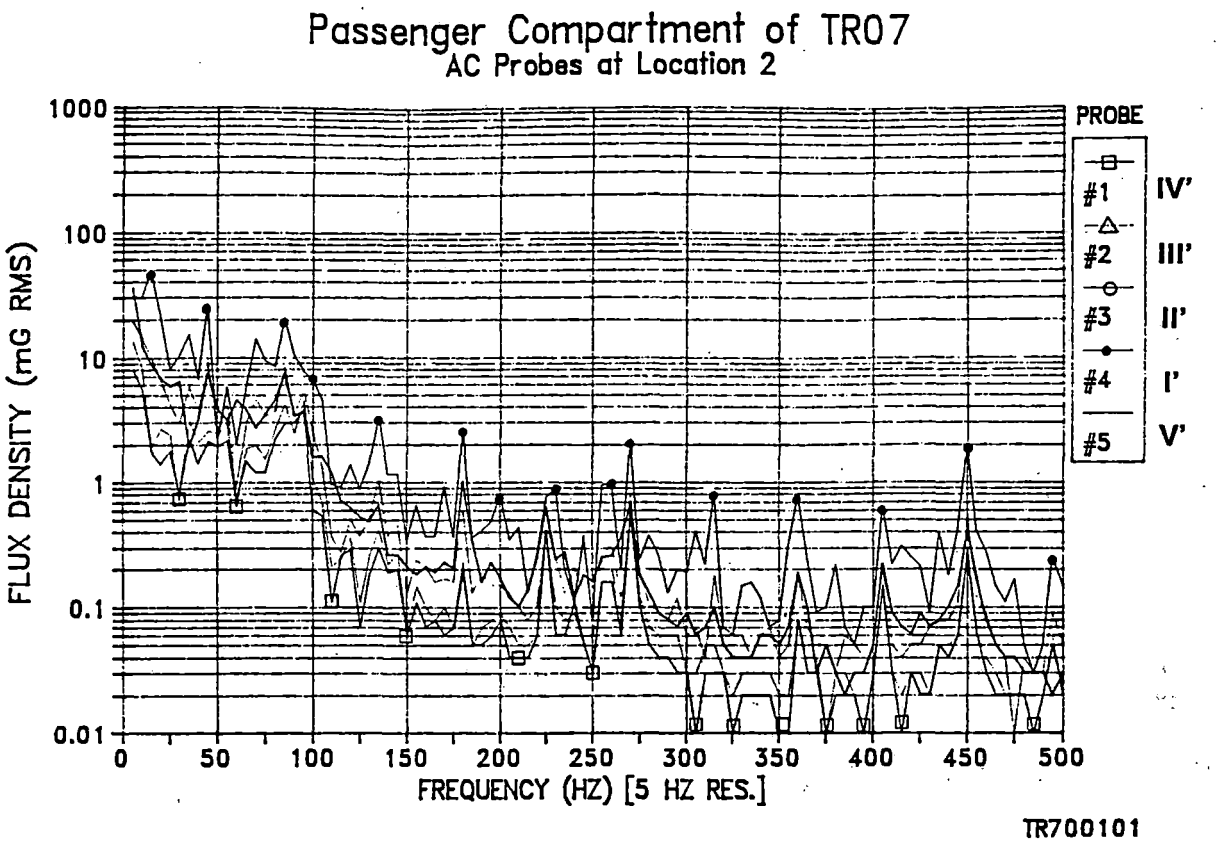
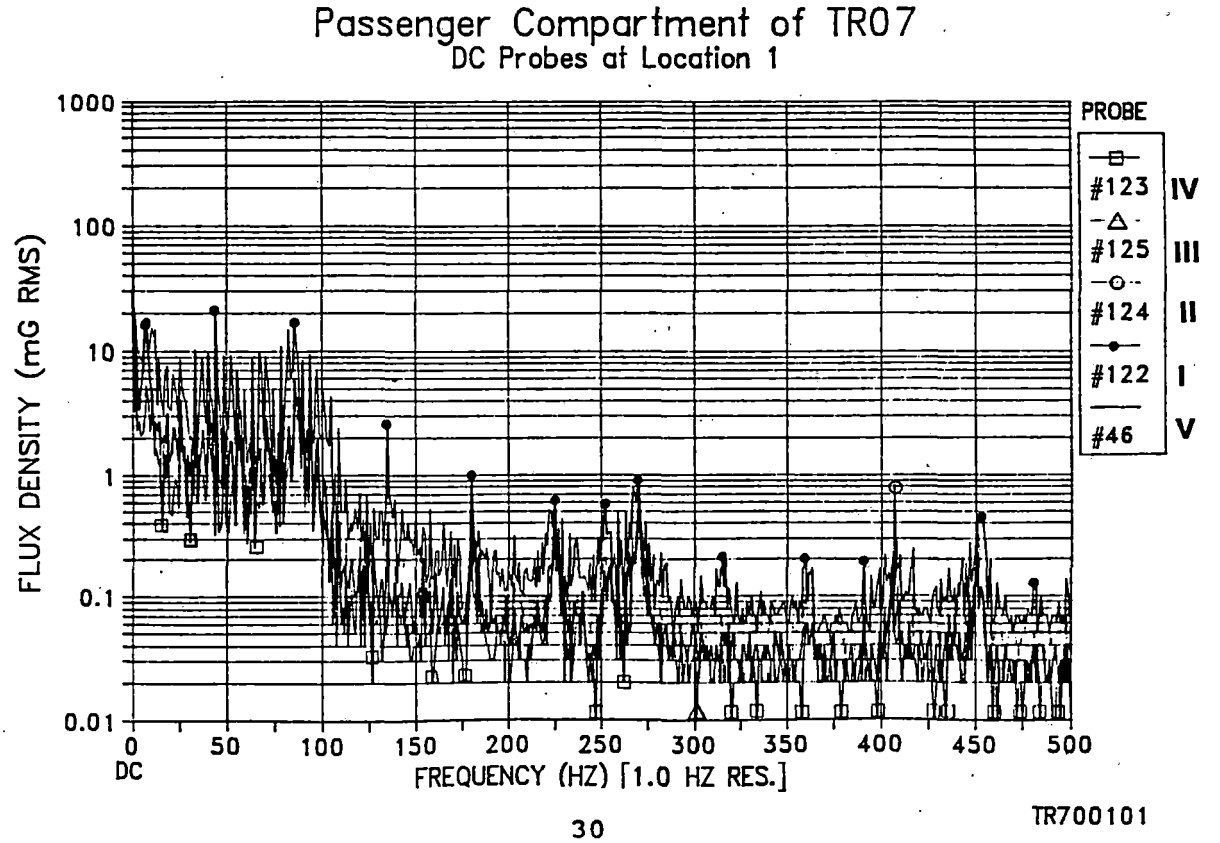


Figure 8 DC PROBES, SSN TR700101, 500 HZ SPAN



is primed, i.e. "II" denotes the dc seat level probe and "II'" denotes the ac seat level probe.

These same data files are plotted in Figures 7 and 8 with a linear frequency axis from 0 to 500 Hz. The ac coupled nature of the ac probe is evident from the 5 Hz starting point (Figure 7 plot, containing 100 of 512 points). Figure 8 shows the dc probe frequency data (501 of 512 points) for the 1 second time interval just after the 0.2 s snapshot of the ac probe. The noticeably better resolution of the dc probe data (1 Hz) compared to the ac probe data (5 Hz) is apparent. Unfortunately, the linear frequency scale for the dc probe does not allow distinguishing the dc to 20 Hz portion of the spectral response as well as the log frequency plot does. The information that the dc probe sample duration was 1.0 s is also conveyed, since if it had been a 2 s sample duration, the file would have ended at 255 Hz.

Although the 500 Hz linear span plots show that the frequency response of the ac and dc probes is comparable, it is not identical. This is because the time interval over which the ac and dc probe data was taken was not the same. (But all ac probes were sampled over the same 0.2 s interval and likewise for all dc probes over the 1 second interval.) Even though the TR07 speed over the combined 1.2 s interval (ac probe plus dc probe time waveforms), is approximately constant (at 168 km/hr for TR700101) the fields due to the lateral guidance controls and the levitation coils are transient in nature and some differences in ac and dc probe data are to be expected. Since most of the data taken would not be expected to have a 1 to 1 correspondence in the fields of the ac and dc probes (except possibly the "background" data which should be a "stationary" signal), there may seem no advantage to showing the ac and dc fields

on the same frequency scale. Because of the potential for dc probe data aliasing and the improved ac spectral readability, however, it seems a worthwhile and pertinent addition.

Accordingly, the frequency domain plots in this report are presented in the appendices (with all four plots on one page) as follows: ac linear frequency, 2000 Hz span and dc quasi-log, with dc plus approximately 3 decade frequency coverage to 100 Hz on the left half page, above and below each other; ac linear and dc linear frequency plot with 500 Hz span on the right half page. This allows easy correspondence of 50 Hz or other steady state frequency components and enables verification of whether any "significant" aliasing components fall above one half the sampling frequency, (particularly within 100 Hz of the sampling frequency or its harmonics). These alias components would appear as extraneous signals in the 100 Hz span, dc quasi-log frequency plot. DC probe data with known aliasing is so marked. Since the ac probes were always sampled first, the ac probe spectral snapshot always appears on the top part of the page. This convention will be carried through in the time waveform samples, as well.

4.1.2 Discussion of Time Waveform Sample Data on TR07

Extensive time domain waveform sample sequences were taken at most locations. These waveforms have only recently been examined and, as yet, only in a very cursory manner. These files generally contain a dozen or more time samples, each with 1024 data points taken over 0.2 s for ac probes and 1, 2, or 5 s intervals for dc probes. Each axis of each of these data sets could have an FFT performed and the frequency domain results combined on a square-root-of-the-sum-of-squares basis for each frequency cell to produce an

RMS frequency domain spectral snapshot, as previously discussed.

It is informative, however, to examine the time domain waveforms directly. The last sample (#21) of the data set TR7001 on board the TR07 travelling at 188 km/hr, is typical of the time waveform files. The captured time waveforms of all 3 axes of each probe (L, T, and V in Figures A, B, and C, respectively), plus the calculated resultant scalar fields (Figure D), are shown in Figures 9 to 13. Similar plots of the X, Y, and Z axes of the dc probes are in Figures E, F, and G, with the calculated dc probe resultant field in Figure H. The four ac probe plots are shown on the upper half page and the dc probe signals are on the lower half. The scales for plotting were chosen as $\pm$ 5 mG for the ac probes and $\pm$ 1000 mG for the dc probes. Some of the data goes beyond these values but it was not clipped in the actual data file.

It should be noted that all the dc data taken and displayed includes the magnetic field of the earth (about 0.5 G) and it is not subtracted from any plots.

The time waveforms for the reference probes (starboard side near the bulkhead, between seats for ac and between headrests for dc probes) are shown in Figure 9. The standing head level (near ceiling) waveforms are shown in Figure 10. Even for the same time interval, the field differs from one part of the TR07 to another (compare Figures 9 and 10). The vertical profile for standing head level, headrest, seat level and floor level is depicted in Figures 10, 11, 12, and 13, respectively. AC and DC probes were located in the aisle, symmetrically from the TR07 longitudinal centerline, to obtain this vertical profile.

Figure 9 A-D ON TR07: AC PROBES, REF. (BULKHEAD, STARBOARD SIDE), BETWEEN SEATS

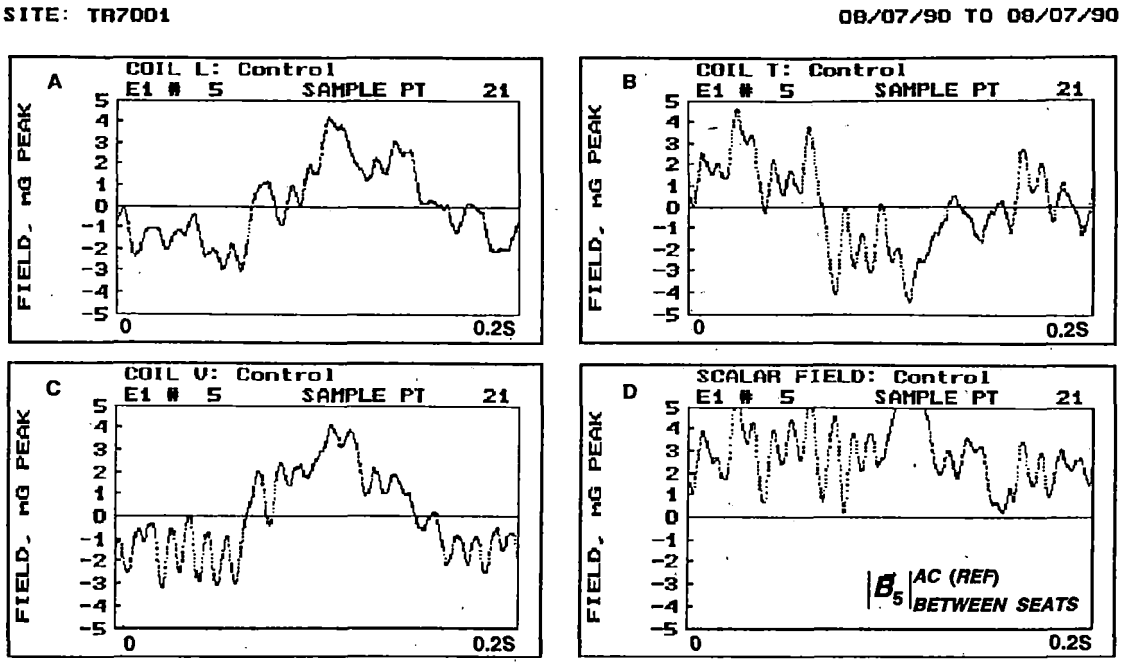


Figure 9 E-H ON TR07: DC PROBES, REF. (BULKHEAD, STARBOARD SIDE), BETWEEN HEADRESTS

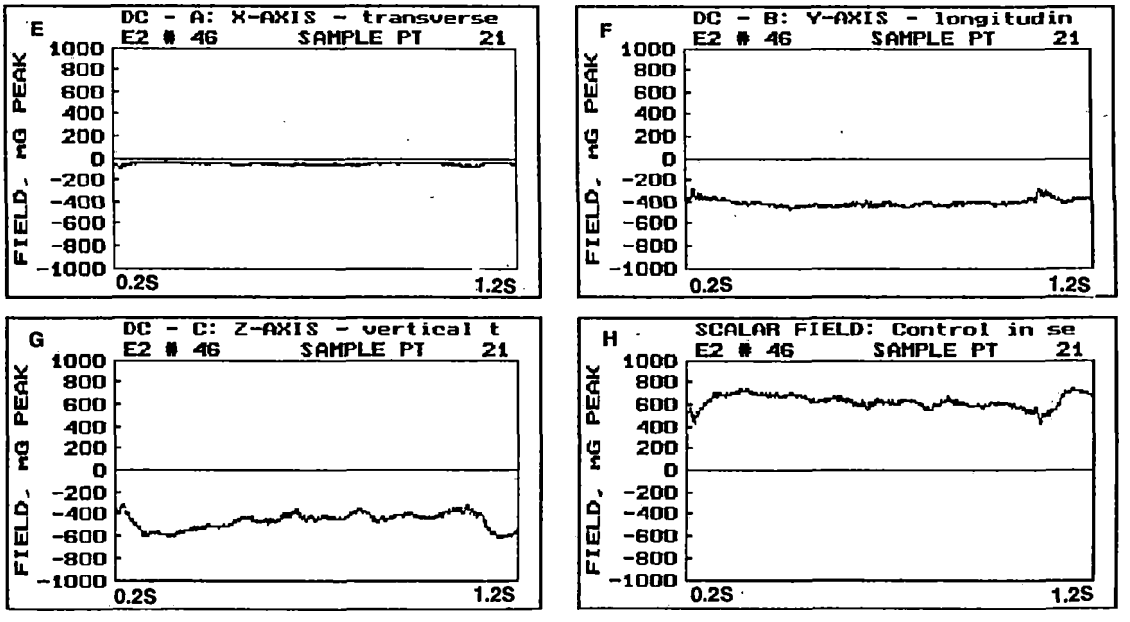


Figure 10 A-D ON TRO7: AC PROBES, LOC. #4 (MIDTRAIN, PORT WINDOW), NEAR CEILING

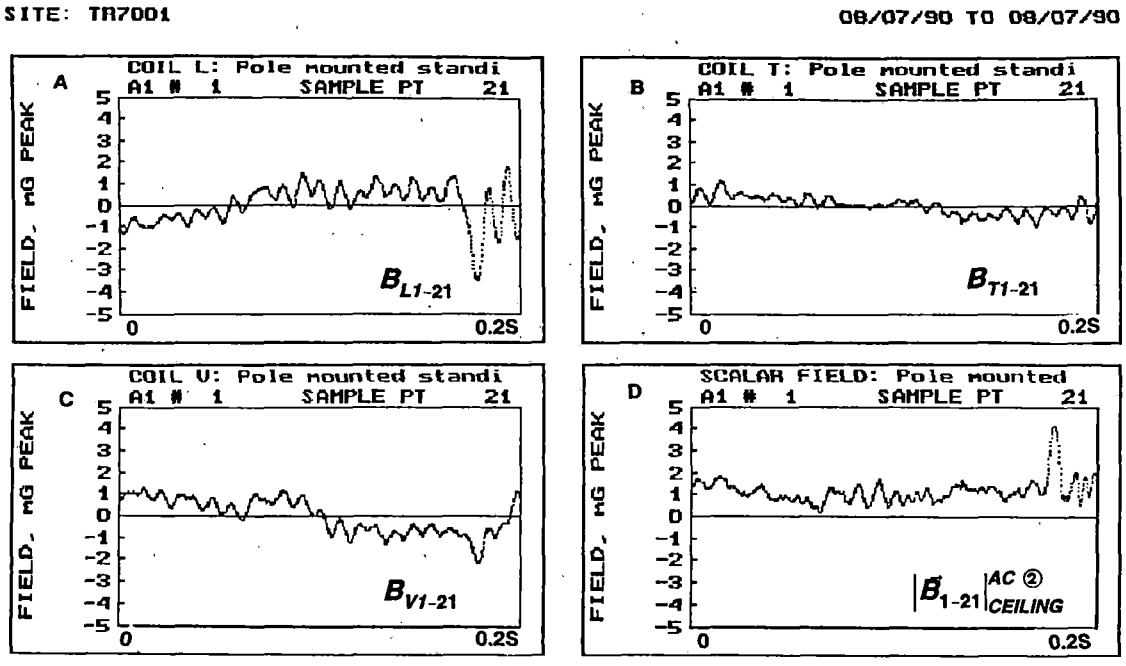


Figure 10 E-H ON TR07: DC PROBES, LOC. #3 (MIDTRAIN, STARBOARD WINDOW), NEAR CEILING

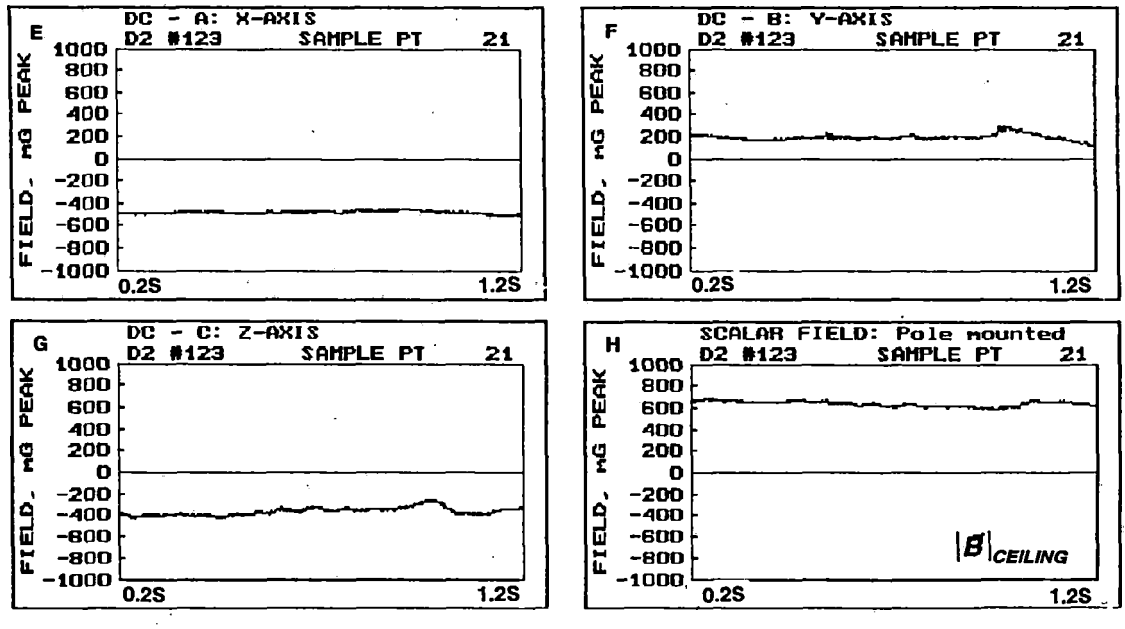


Figure 11 A-D ON TR07: AC PROBES, LOC #4 (MIDTRAIN, PORT WINDOW), HEADREST

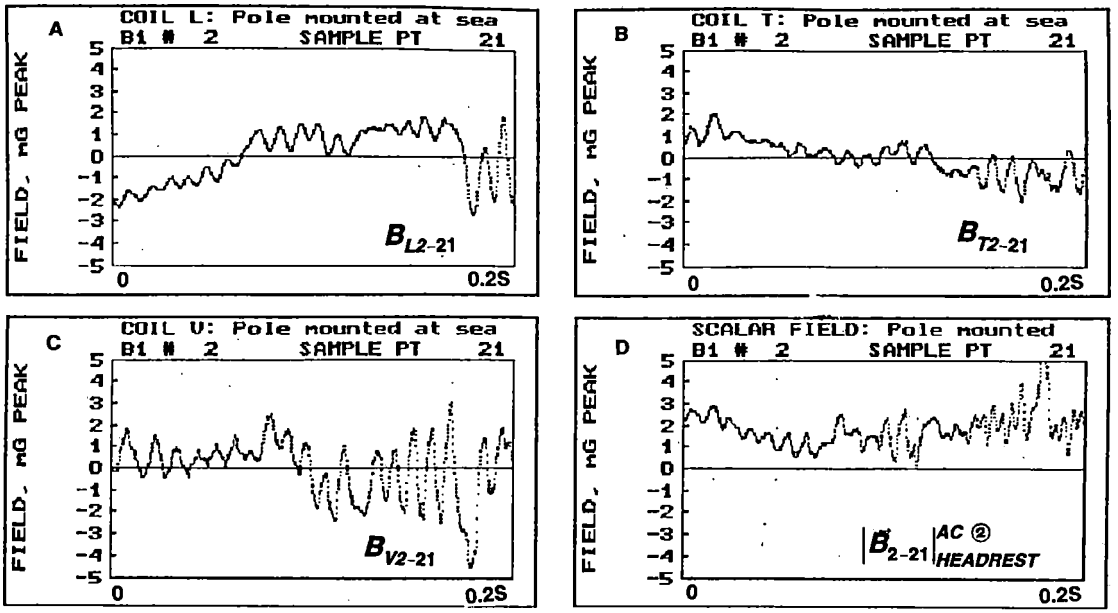


Figure 11 E-H ON TR07: DC PROBES, LOC #3 (MIDTRAIN, STARBOARD WINDOW), HEADREST

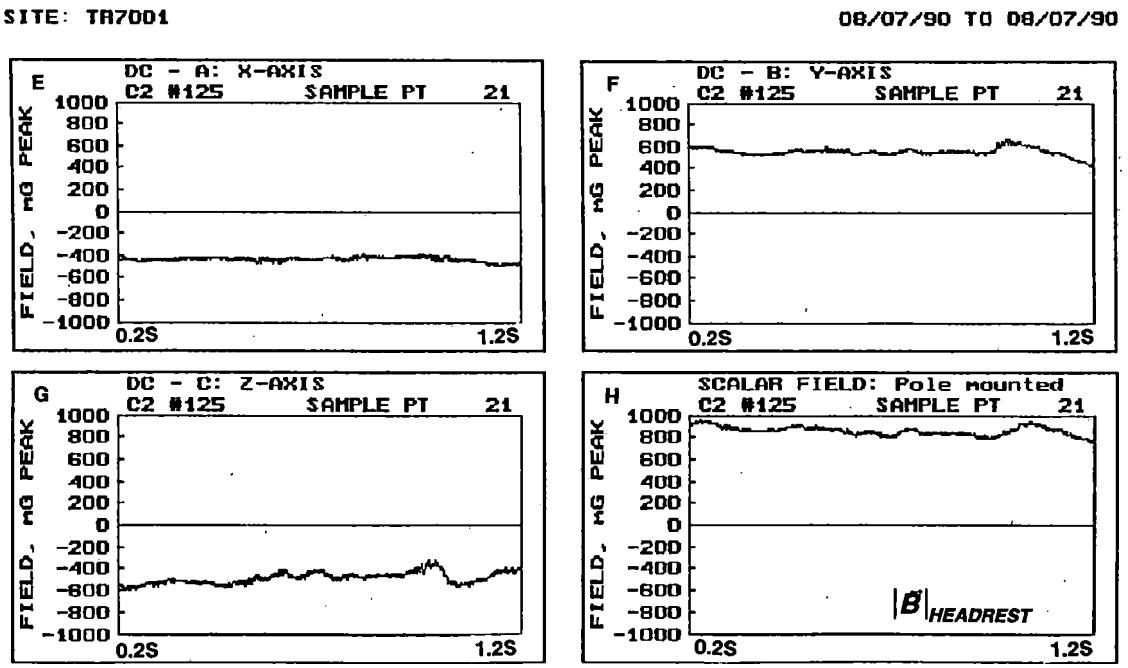


Figure 12 A-D ON TR07: AC PROBES, LOC. #4 (MIDTRAIN, PORT WINDOW), SEAT LEVEL

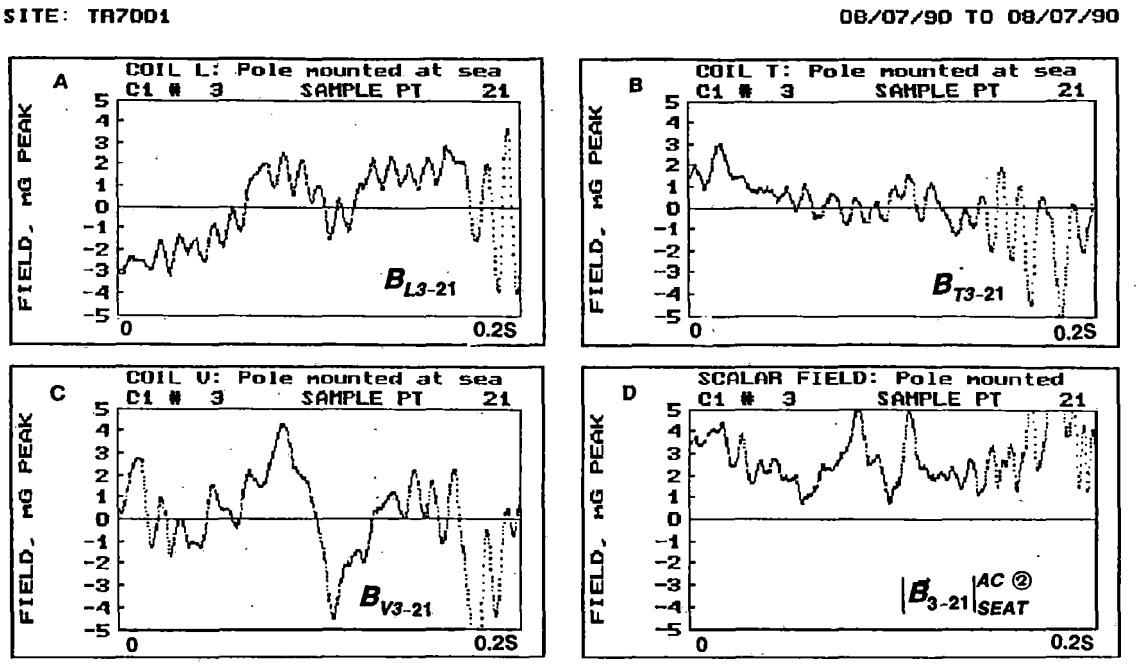


Figure 12 E-H ON TR07: DC PROBES, LOC. #3 (MIDTRAIN, STARBOARD WINDOW), SEAT LEVEL

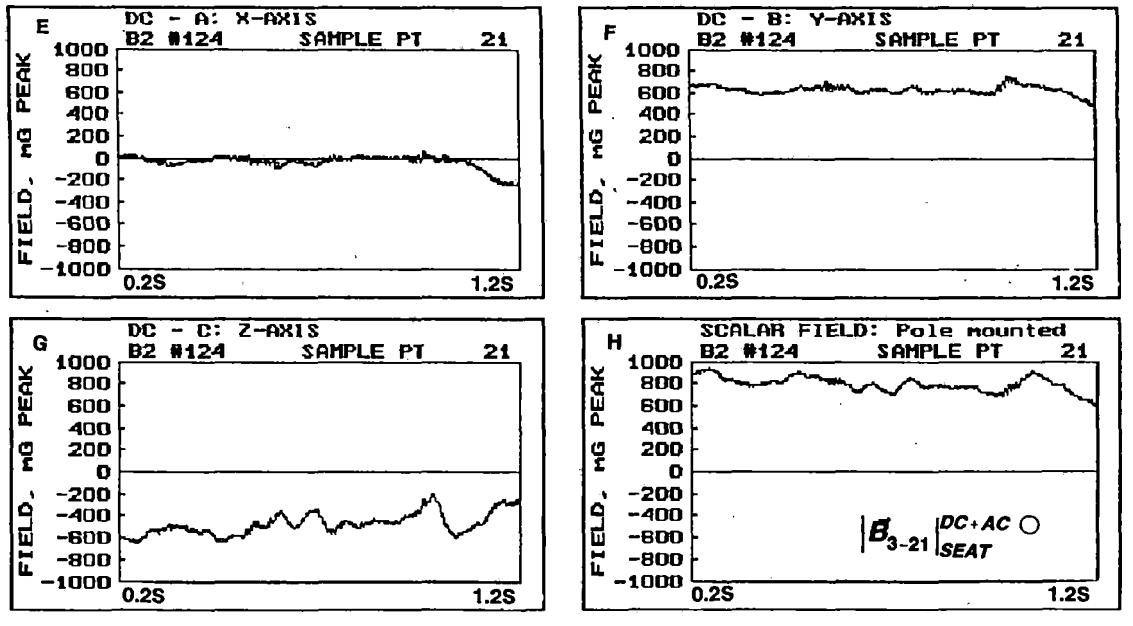


Figure 13 A-D ON TR07: AC PROBES, LOC. #4 (MIDTRAIN, PORT WINDOW), FLOOR

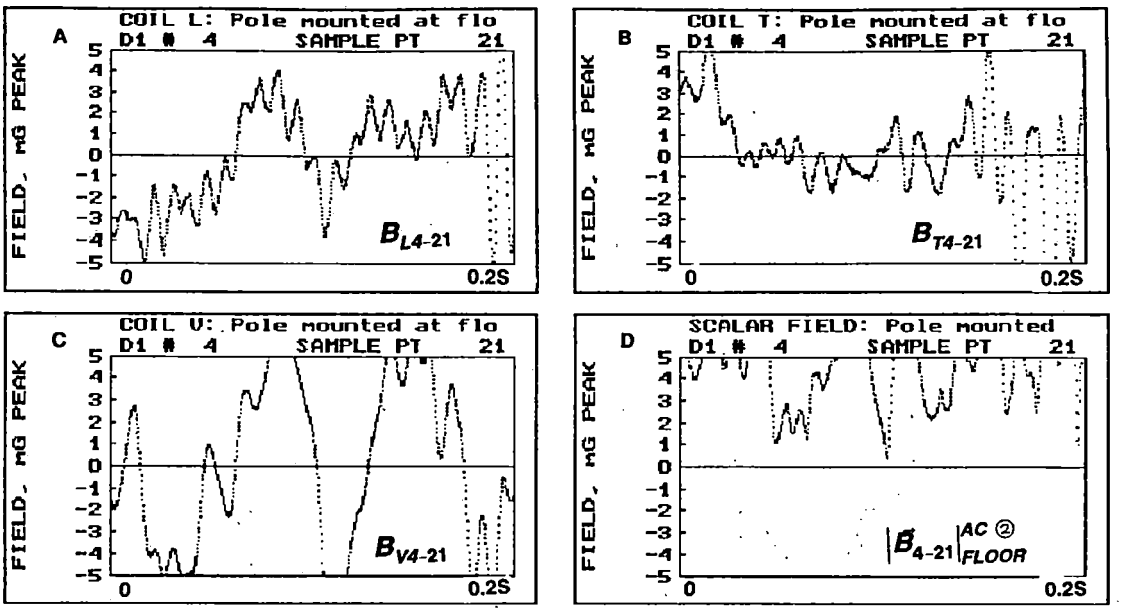
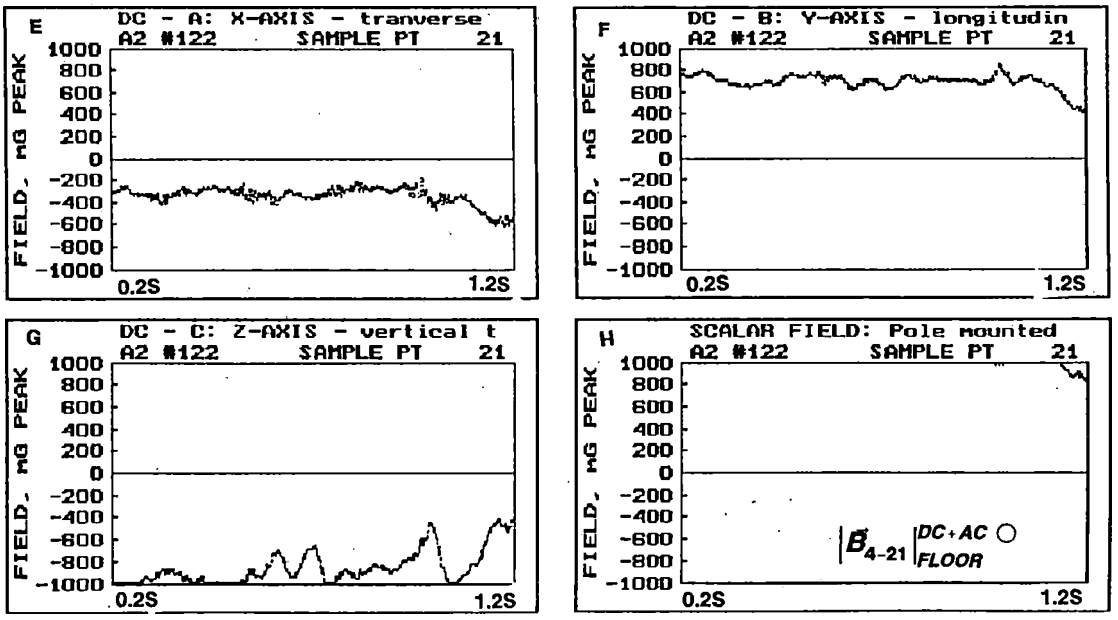


Figure 13 E-H ON TR07: DC PROBES, LOC. #3 (MIDTRAIN, STARBOARD WINDOW), FLOOR



Again, the actual data is not clipped; the plot scales were chosen all the same and some data values are simply outside the peak scale values chosen. These plots are only meant to give insight into the complex nature of the fields that were measured. This plot set represents only one time sample interval out of 21 recorded in the TR7001 file. It is not known how "typical" this file is, but it is likely a reasonable representative of those onboard the TR07.

4.2 High Steel Guideway Measurement Discussion (at Pillar 2423)

The high steel guideway near the control center (about 5 m above ground level) was chosen for the first off-vehicle measurements. 220 V, 50 Hz ac power was provided by a long extension cord from the control center. It was routed so as to be >10 m from any probe. The initial setup and practice runs were made Tuesday evening using the rented station wagon to house the computer (Setup 18). The AC and DC probes were located 1 meter above ground level on wooden tripod platforms with aluminum nails as fasteners (Figure 14A). The 3 m offset probes were located just inside a chain link fence surrounding the control center. Only a few sets of data were taken before dark. The transient nature of the fields at fixed points along the guideway made it necessary to use only manual gain control (autoranging was disabled). The need for a triggered mode of operation was obvious, although the timed mode used did occasionally catch the TR07 during passby when data was taken every 5 s.

The setup was redeployed Wednesday morning using the TÜV Mobile Lab truck to contain the computer and multiplexers (Setup 18'). The probes were at the same locations as before but the lab truck was used to house the computer and was positioned about 10 m south of the 10 m offset probe. It is believed (but not proven) that the truck had negligible effect on the data.

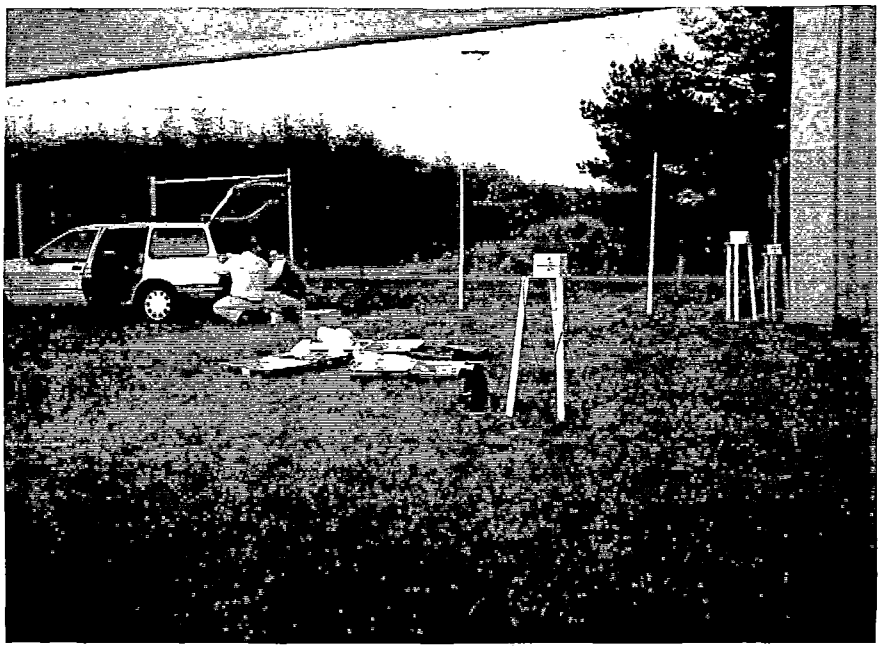


FIGURE 14A
HIGH STEEL GUIDEWAY TUE. PM, PROFILE AT 2423. (SETUP 18)
PROBES AT 1M HEIGHT A UNDER ℄, OFFSET 3M AND 10M FROM ℄. LEFT SIDE REFERENCE PROBE IS AT PILLAR 2424.

FIGURE 14B
SETUP 18 (WED. AM) REVISED SETUP AT HIGH STEEL G/W WITH COMPUTER IN TEST TRUCK. SAME PROBE LOCATIONS AS ABOVE. -10M OFFSET PROBE IN FOREGROUND. RIGHT SIDE REFERENCE PROBE AT -3M OFFSET AT PILLAR 2422 BEHIND TRUCK.

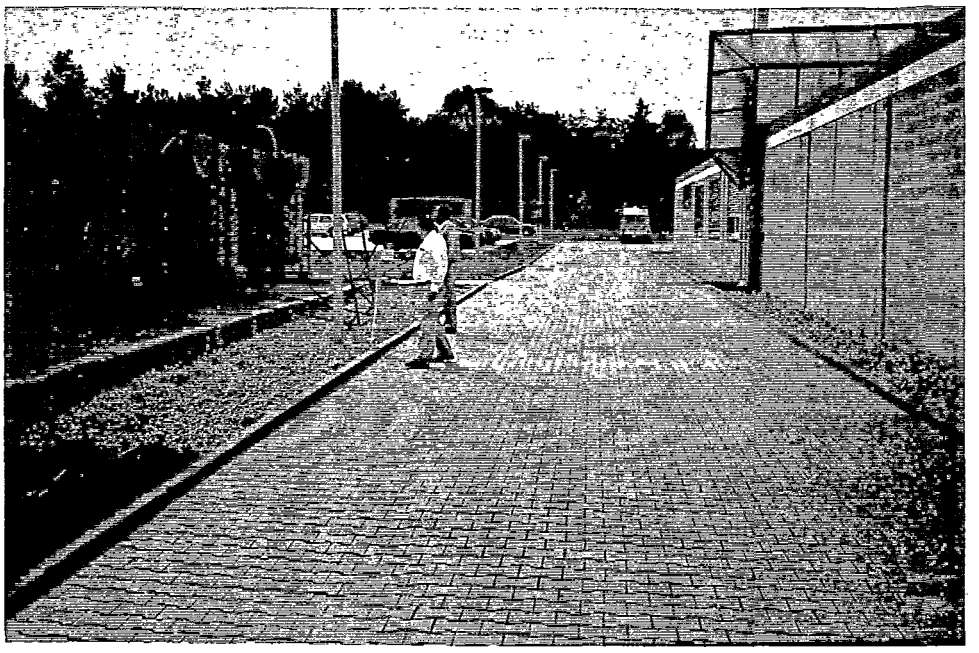


FIGURE 14C SETUP 19
(SAME AS #18 EXCEPT
RIGHT SIDE REFERENCE
PROBE AT LOCATION
BETWEEN OUTPUT
TRANSFORMER BANK AND
INVERTER BLDG.)
(TR7017,018)

We did not know the location of the feeder cables at the time. We later found out that the main feeder cables went within a few meters of the 10 m offset probe and were buried 0.8 m deep. Because the three-phase current was carried by three closely spaced conductors (~ 4 cm equilateral triangle between cable centers), it was believed that the feeder cables (4 sets of 3 conductor cables per set) had a negligible effect on these measurements. This was later verified at known feeder cable locations at a height of 1 m above ground level. (See Feeder Cable Measurement Discussion, 4.5.4 and 4.5.5).

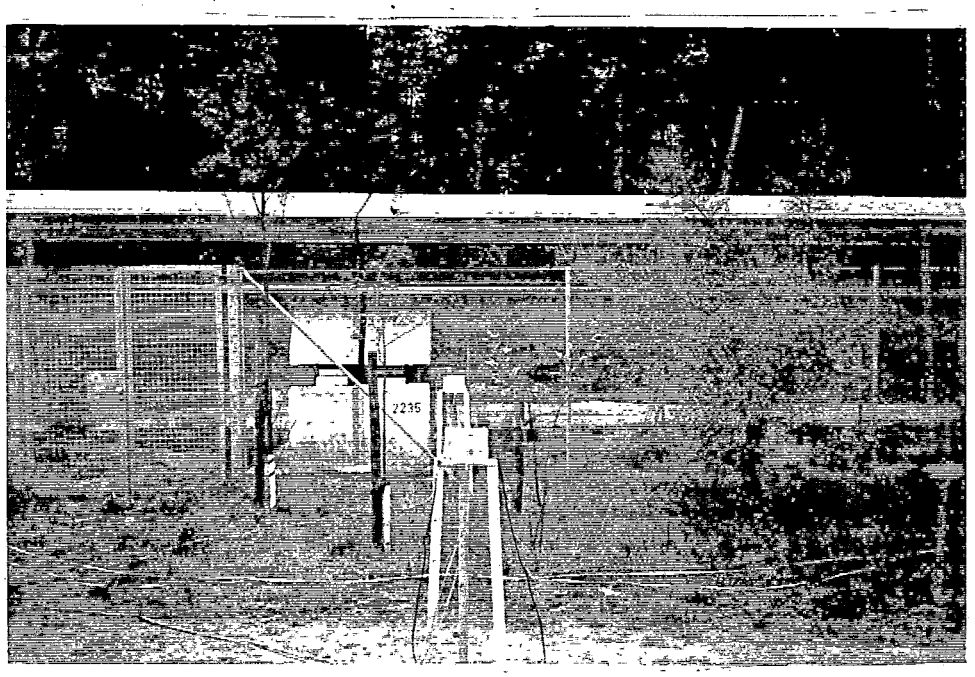
Later Wednesday morning, the high steel guideway setup was modified by moving the right side reference probe set to the vicinity of the output transformer yard, across a driveway from the inverter building (Setup 19). The very audible whine of the transformers gave a good indication of the TR07 operating conditions (speed, acceleration or deceleration) and it was felt that the fields of the inverter output transformer would convey this same information. The transformer yard right side reference was available for data sets TR7017 and TR7018.

4.3 Low Concrete Guideway in South Loop

A remote location, far away from possible influences of the control center, was chosen at pillar 2235 in the South Loop. A profile was done at pillar 2235 with one probe under the concrete guideway, another 4 m offset and a third 10 m offset (Figure 15A). Right and left reference probes $\pm$ 25 meters up and down the track were also set up, offset 4 meters from centerline, at pillars 2236 and 2234. A four meter offset from centerline was used rather than the planned 3 m because of the chain link fence location. Access at pillar 2235 was possible through a gate but only a few minutes working time inside the fence was allowed between visits by the TR07. Location information on the TR07 was only available by radio contact with the control center. Power

FIGURE 15 SOUTH LOOP TESTING (TR7019)

LOW GUIDEWAY SOUTHERN LOOP PILLAR 2235



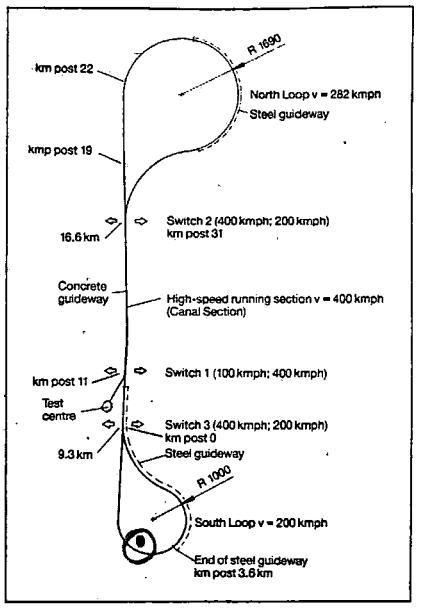
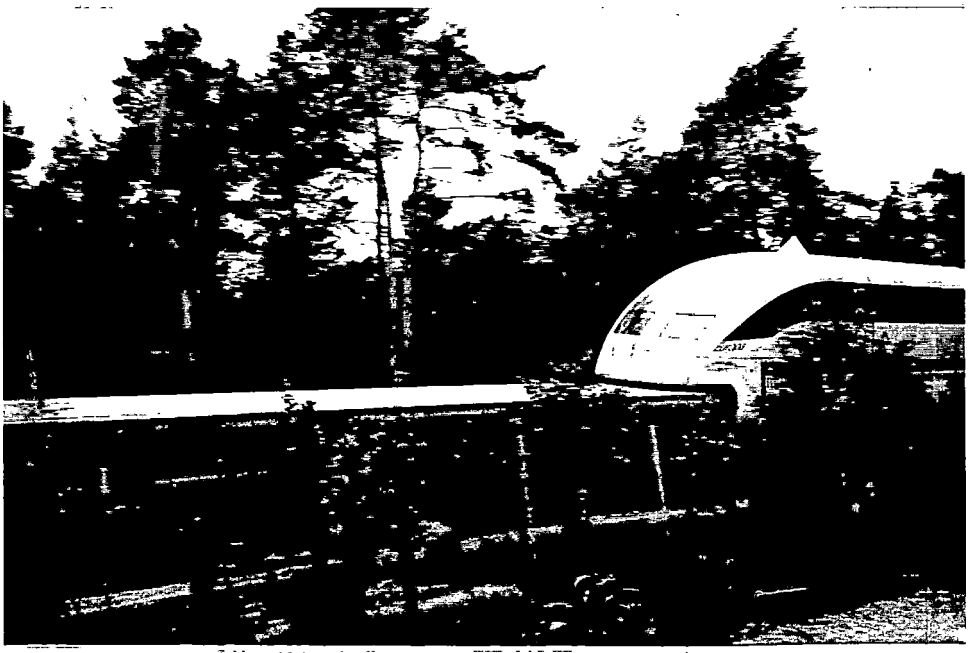


Fig. 2: TVE guideway, specified speeds

PROBES AT ℄, 4M, 10M OFFSET AT H=1M



PROBES ALSO AT PILLARS 2234 AND 2236
AT 4M OFFSET, H=1M

(PORTABLE 50 Hz, 2 kW GENERATOR USED FOR POWER)

at this isolated location was provided by a gasoline powered 220 V, 50 Hz generator.

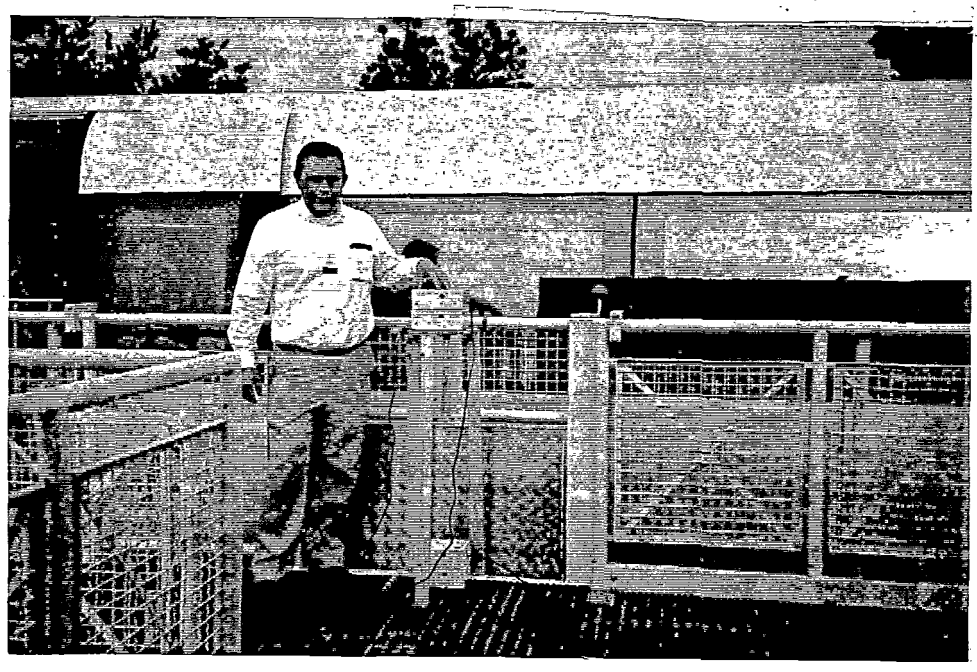
This was not a very convenient or interesting place to take data. The background fields were quite low (< ≈ 1 mG, mainly due to pickup from the power cord to the 50 Hz generator), in the absence of the TR07. There were some unexplained, low level background signals around 380 to 390 Hz. (These same low level signals were observed in the background at some other locations, as well (< ≈ 0.1 mG).

The gasoline powered generator ran very rough and could not be adjusted for smooth operation. Finally it ran out of gas (after adequate data were taken). Most of the data recorded at the pillar 2235 low guideway were time waveform samples which have not yet been examined. Most of this data, however, was of background fields since the track was only energized for 5 or 10 seconds (when the TR07 was nearby) every 8 to 10 minutes.

4.4 Passenger Station

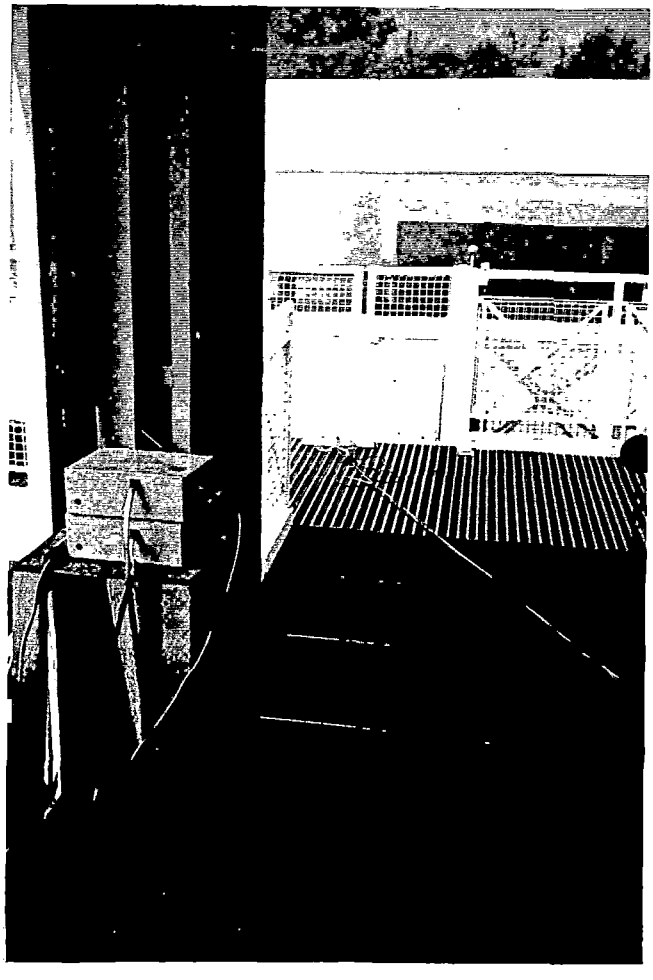
Extensive data were taken at the passenger station. The passenger terminal platform was at a high concrete section of guideway (≈ 5 m above ground level). Two probe sets were placed at the elevated terminal platform area. One was just inside the waiting area door, 1 meter off the floor and about 8 m from the guideway edge. A second probe set was placed (tied securely) on the floor of the passenger loading gate, behind an aluminum flip-down bridge treadway (Figure 16). The majority of the framing members on the platform were steel and may have affected the measurements to some degree. The "background" fields (without the TR07 nearby) were measured and can be subtracted from the net field with the TR07 present. This is best done with the time domain data and has not yet been performed. The platform floor was an aluminum grid-like structure with anti-skid material

FIGURE 16 SETUP #20 AT PASSENGER STATION



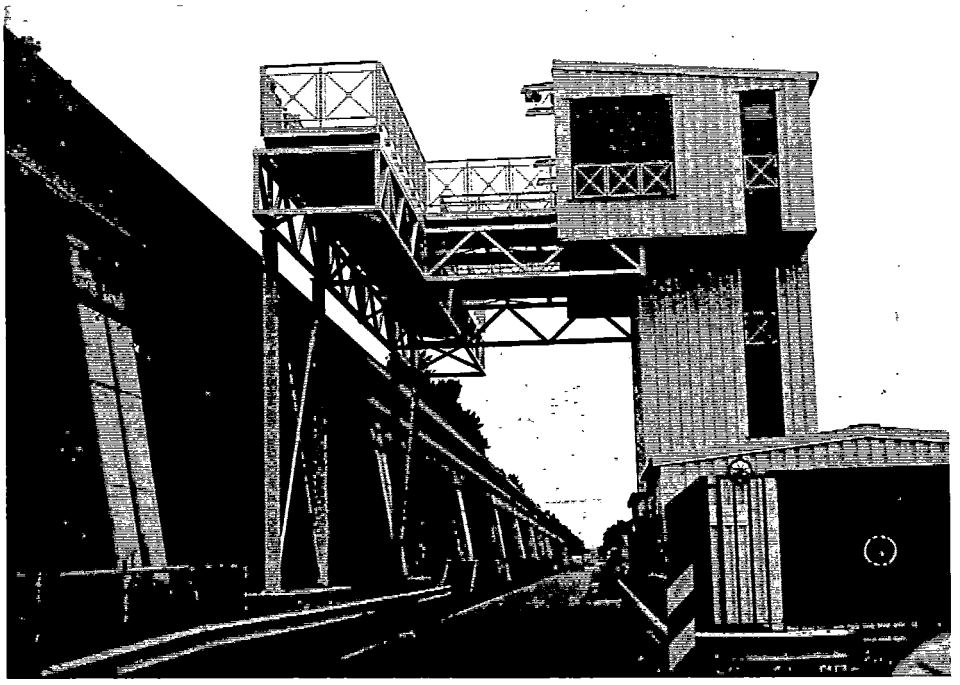
PASSENGER STATION LOADING AREA (PARKED TR07 IN BACKGROUND)

(FLOOR ONLY USED SECURELY TIED)



PASSENGER STATION WAITING AREA (H=1M)

FIGURE 16 SETUP #20
AT PASSENGER STATION



PASSENGER HIGH
GUIDERAIL (CONCRETE)
PROBES @ ℄, 3M, 9M, H=1M

(similar to a "car tire strip" floor mat) protruding above the metal surface. Whether shorted loops (eddy current paths) existed in the floor grid is not known.

High guideway measurements were also made on the opposite side of the guideway from the passenger terminal. Probes were located at the guideway centerline (and 1 m above local ground level), 3 m offset and 9 m offset. A probe at 10 m offset was not possible because of a deep ditch at 10 to 12 m offset.

A paved road ran under the passenger platform and along the guideway. It is believed (but not proven) that vehicles passing by had little effect on the measurements. (The closest the vehicles were able to get to any of the probes was about 4 meters removed.) The proximity of the steel framing members supporting the terminal platform may have had some effect on the guideway centerline probes but it is believed the station frame had negligible effect on the 3m and 9m offset probes.

In addition to being a comfortable equipment and personnel shelter, the passenger station had a TR07 location display and velocity readout so we could correlate data taken with speed (Figure 17).

A Blaupunkt PAL format (not NTSC compatible) video camera was used to record critical aspects of the testing and was time synchronized (within a few seconds) with the computer clock. It recorded the sound of outside vehicles and verbal notes of test personnel, as well as, the speed and location of the TR07 indicated by the LED display.

4.4.1 Passenger Station Time Waveforms

The data at the passenger platform was quite complex and of a transient type. This is illustrated by a time waveform

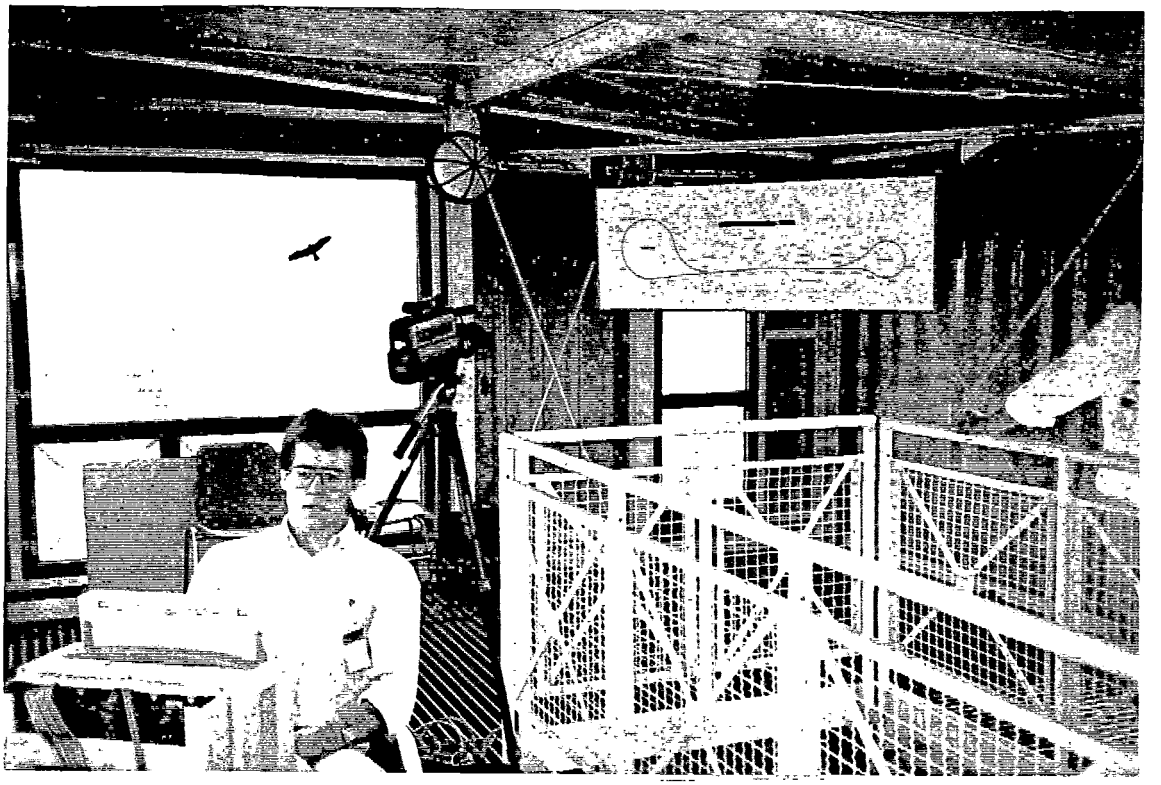


FIGURE 17A PASSENGER PLATFORM INTERIOR

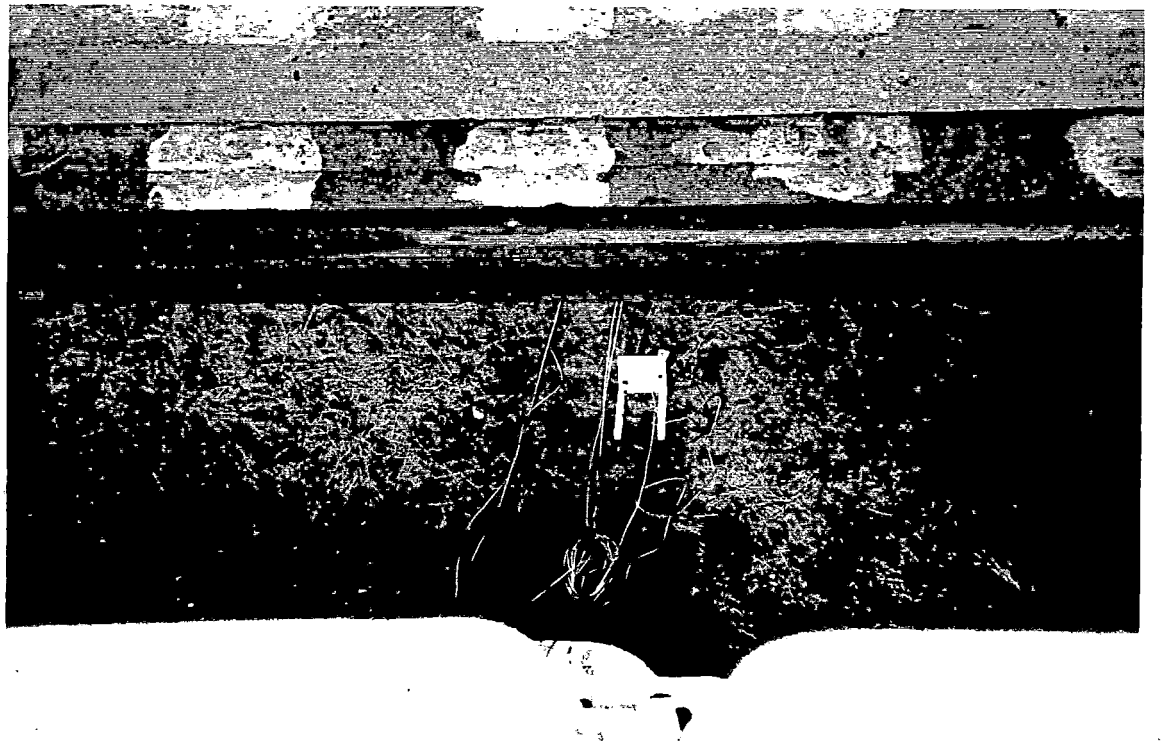


FIGURE 17B GUIDEWAY EDGE NEAR LOADING GATE, LOOKING DOWN AT PROBE UNDER G/W ℄

sample set recently examined.

Time waveform samples were collected every 5 seconds. The raw data from the ac probe are shown in Figure 18A for the 0.2 s interval 5 seconds before the TR07 passed by (#24), within about 1 second of pass by (#25), and 5 seconds after pass by (#26). The TR07 speed was 301 km/hr at sample point #25 and slowing. The magnetic field was quite low both before and after pass by ($< \approx 1$ mG). Within 1 second of pass by, one component of the ac magnetic field was as shown in Figure 18C (except for an integration constant (here assuming the value at t=0 is zero). All three ac components are shown in Figure 19A-C. Here 19B is done with an integration constant set by letting the average value over the 0.2 s interval be zero (different from 18C). Figure 19D shows the instantaneous resultant ac scalar field versus time found from: $|B| = \sqrt{(B^2_x + B^2_y + B^2_z)}$. The resultant rms flux density is about 2 mG at the ac probe on the load area floor, just before the TR07 passes by.

For the 1 second time interval immediately following the ac probe waveform sample, the excitation frequency of the TR07 is discernable on the dc probe (even at 1000 mG full scale). The TR07 appears to start pass by about 0.7 seconds after the beginning of the dc probe sample #25. Since the TR07 is about 50 m in length (overall, both cars), at 300 km/hr the entire vehicle passes a point in about 0.6 s. Thus, about half of this TR07 pass by was captured by the dc probe data of sample #25 of TR7020. The excitation frequency (approximately 165 Hz) is observed before TR07 pass by because the next section of track (about 300 m to a section) is energized several seconds before the vehicle actually uses it.

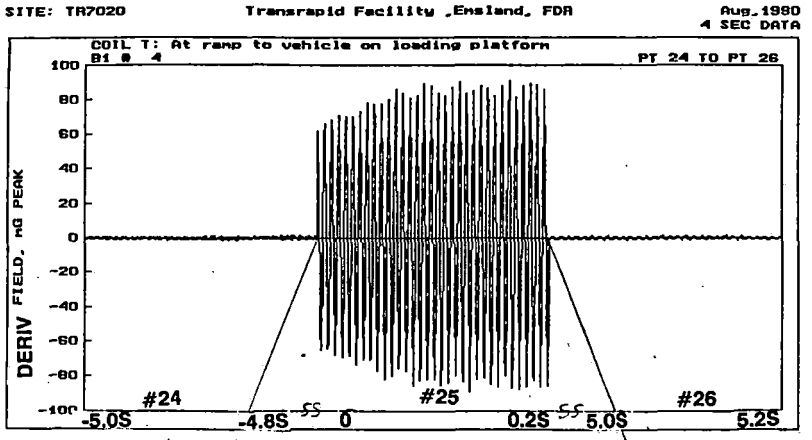


Figure 18A TR07 PASS BY N → S, V ≈ 330 KM/HR AND SLOWING SAMPLES #24, 25, AND 26 TRANSVERSE COIL RAW DATA

NOTE: THERE IS A 4.8S GAP BETWEEN SAMPLES

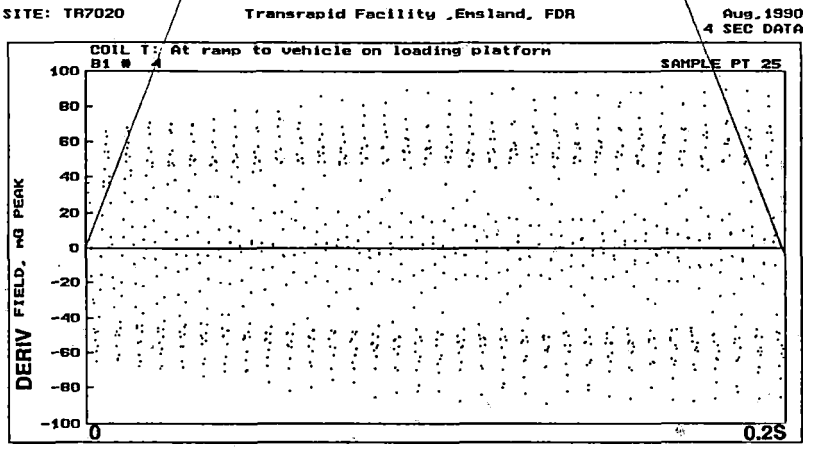


Figure 18B SAMPLE #25 TRANSVERSE COIL RAW DATA TRACK ENERGIZED WITH EXCITATION FREQUENCY OF APPROX. 165 HZ

$$\frac{dB_T}{dt} = \dot{B}_T \quad \textit{RAW DATA (AC)}$$

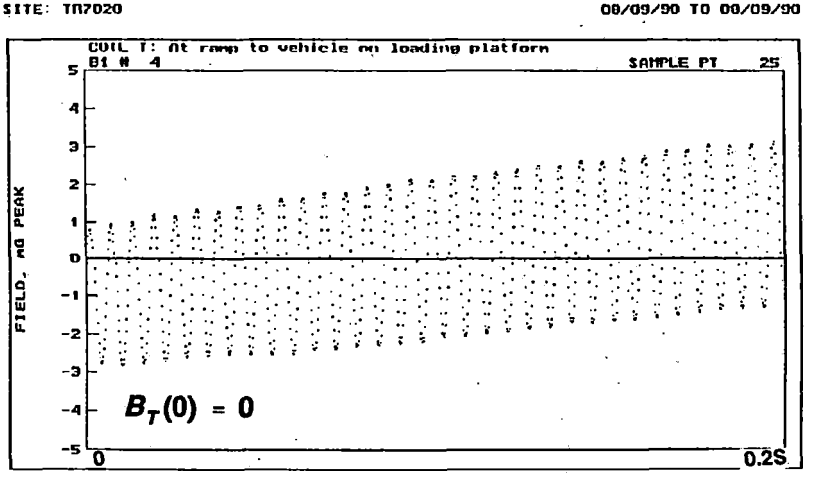


Figure 18C SAMPLE #25 TRANSVERSE COIL INTEGRATED DATA $B_T(O) = 0$ INSTEAD OF $\langle B_T \rangle = 0$ APPROX. 0.7S BEFORE START OF PASS BY

$$B_T = \int \dot{B}_T \, dt$$

TR7020: 4 SECOND INTERVALS, 2 SECOND WINDOW

NOTE: 19B SAME AS 18C EXCEPT

$$\int_0^{0.2} \dot{B}_T \, dt = 0 = \langle B_T \rangle$$

SITE: TR7020 AC PROBE, LOAD FLOOR

08/09/90 TO 08/09/90

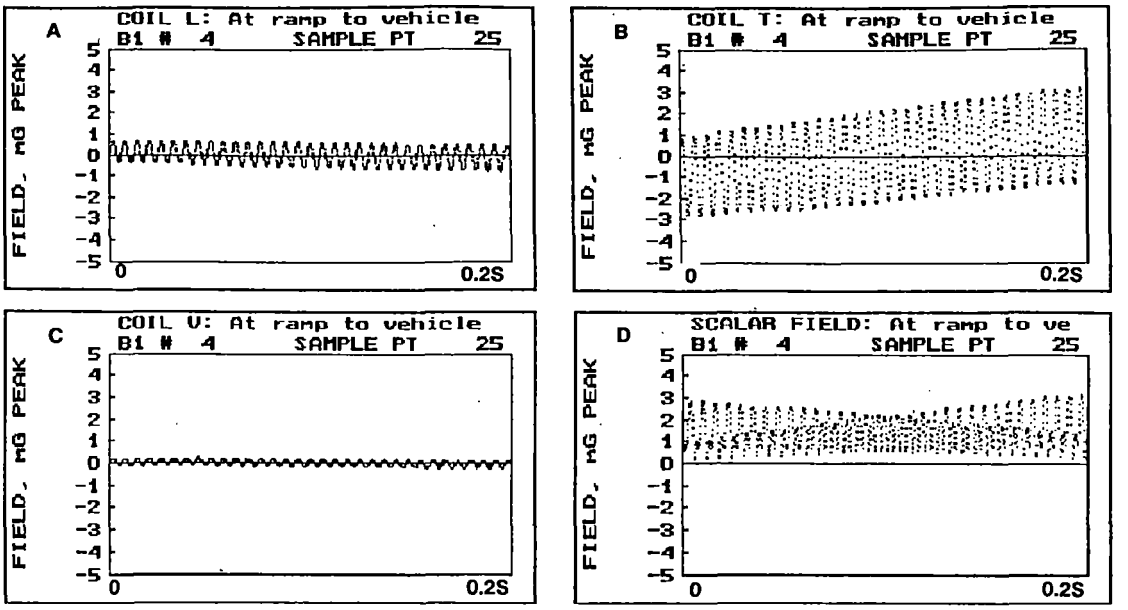
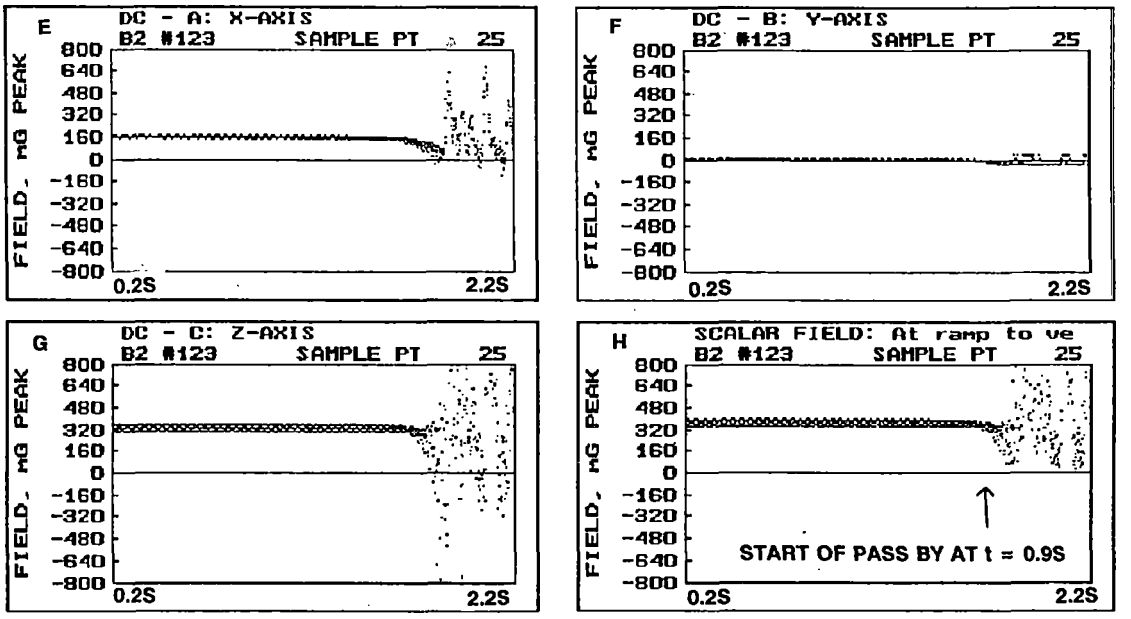


Figure 19 LOADING AREA OF PASSENGER STATION, TR07 PASS BY N → S, V ≈ 330 KM/HR & SLOWING

SITE: TR7020 DC PROBE, LOAD FLOOR, ALIASED

08/09/90 TO 08/09/90



The waveforms at the outdoor loading platform floor have rather large amplitude swings (several hundred mG peak to peak) since these sensors are quite close to the vehicle levitation/propulsion magnets. It should be pointed out that this test point is off limits to passengers when the TR07 passes by. Further, the wind gust created by the wake of a 300 km/hr (180 mph) TR07 pass by definitely encourages people to stay clear. Even the passenger terminal platform buffeted sharply when the TR07 passed by. A 1 meter height probe was originally planned at the loading area but was simply not practical. The loading area floor level probe set was tied securely in place and withstood the buffeting of over 30 pass bys of the TR07.

The rest of the time sample #25 data is plotted in Figures 20 to 23 for the other probe locations. The waiting area fields are quite low (< 20 mG), even during pass by, as indicated in Figure 20. The ac magnetic field at the guideway centerline and 3 m offset are comparable (a few hundred mG peak to peak is indicated by Figures 21H and 22H), as would be expected, while the field at 9 m offset is significantly lower (tens of mG peak to peak). There is some difference in the evolution of the individual spatial components, but the overall magnetic field behavior is basically as expected.

4.5 Control Center/Power Substation

Several locations at the control center were tested, including the output transformer yard, the braking resistor bank, and the low concrete guideway at the entrance to the maintenance facility. These were felt important as they are accessible to personnel working at the facility. In addition, the main feeder cables near the inverter building and feeder cables to the south

SITE: TR7020 AC PROBE, WAITING AREA 08/09/90 TO 08/09/90

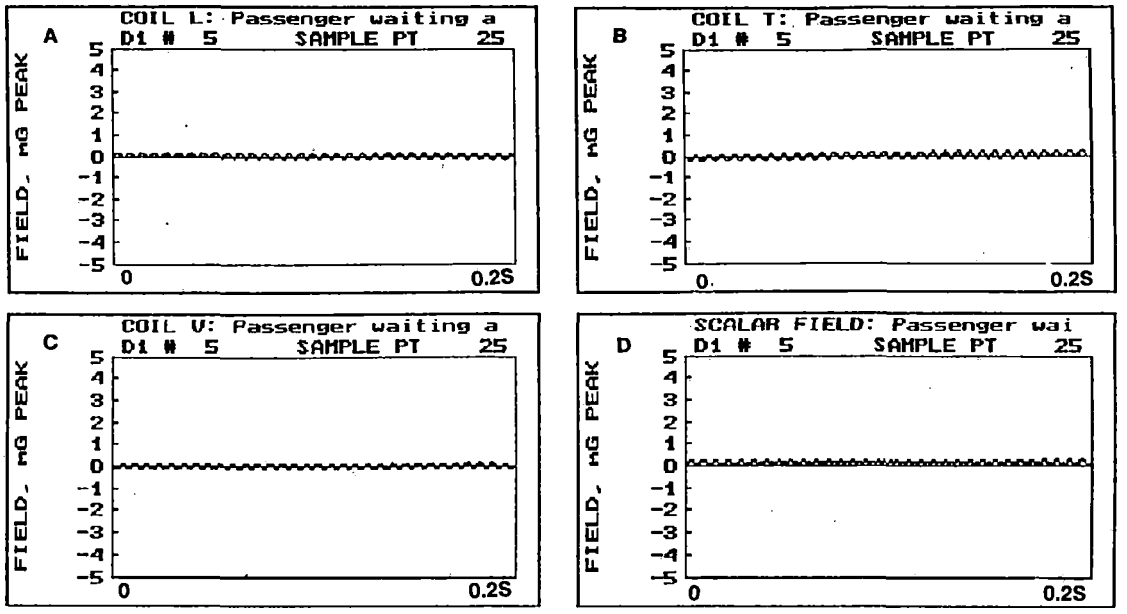
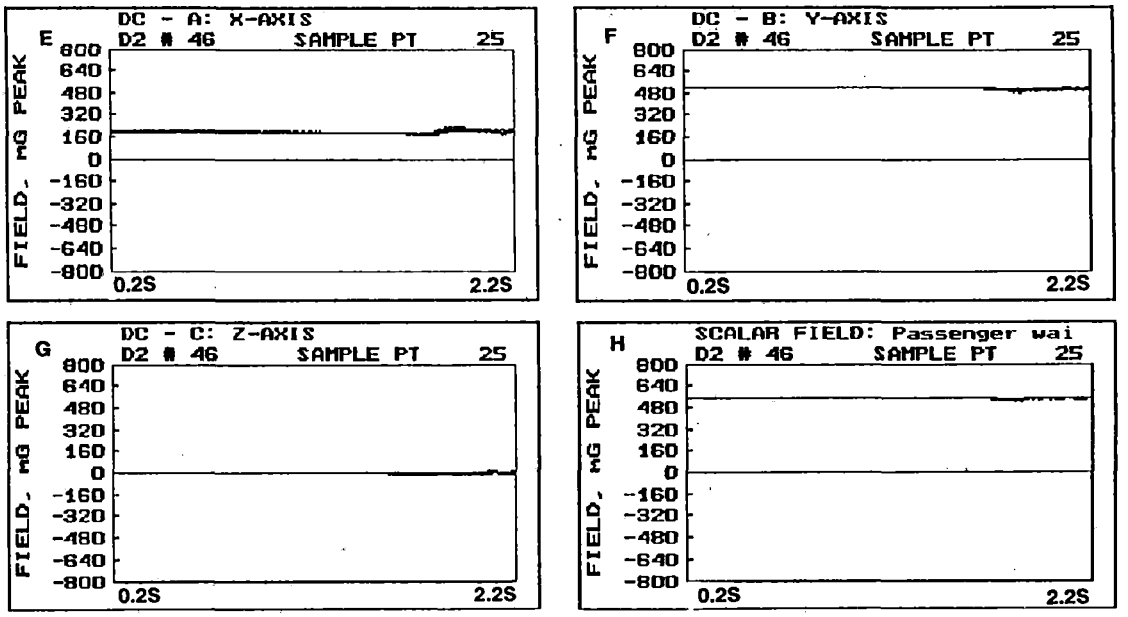


Figure 20 WAITING AREA TIME WAVEFORMS, TR07 PASS BY N → S

SITE: TR7020 DC PROBE, WAITING AREA 08/09/90 TO 08/09/90



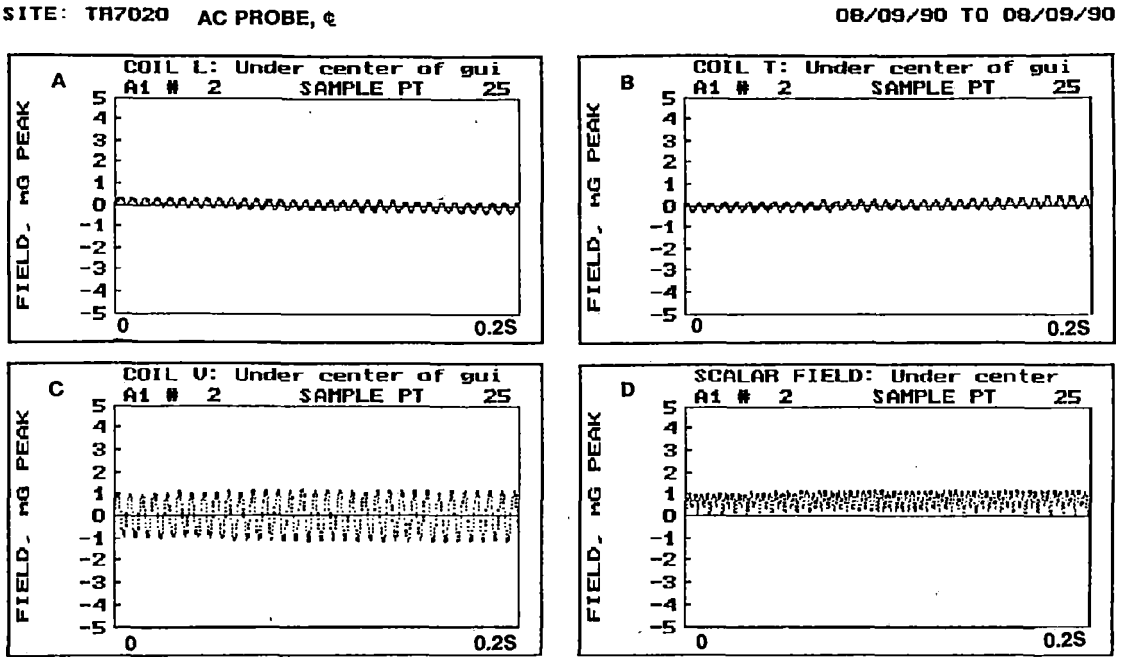
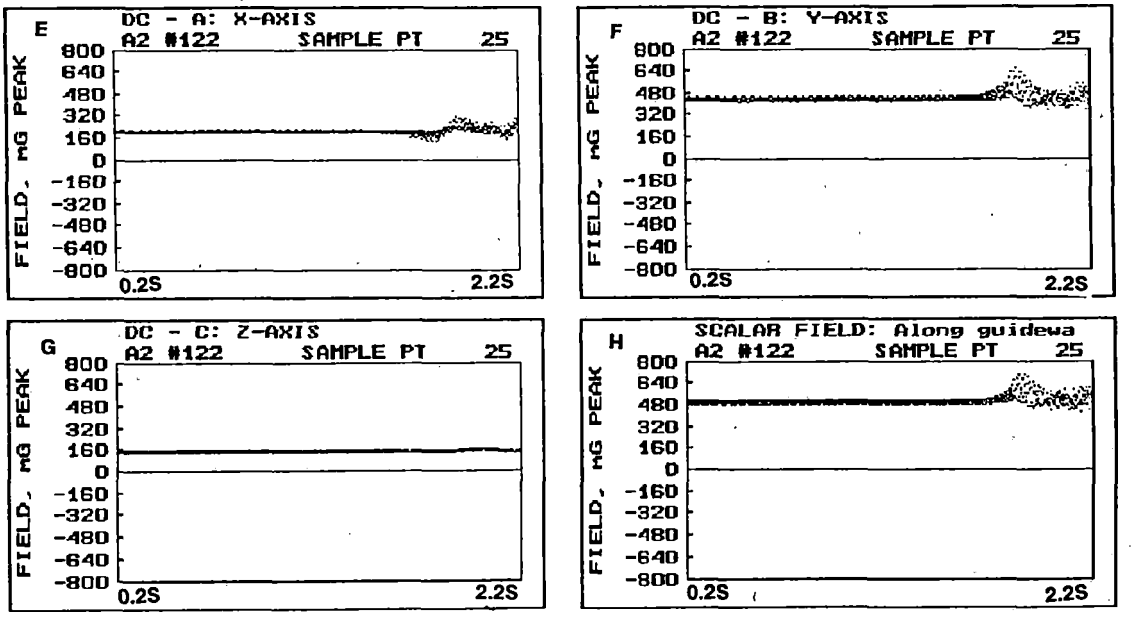


Figure 21 GUIDEWAY CENTERLINE TIME WAVEFORMS, TR07 PASS BY N → S, APPROX. 4 M BELOW G/W, 1 M ABOVE GROUND LEVEL



SITE: TR7020 AC PROBE, -3 M 08/09/90 TO 08/09/90

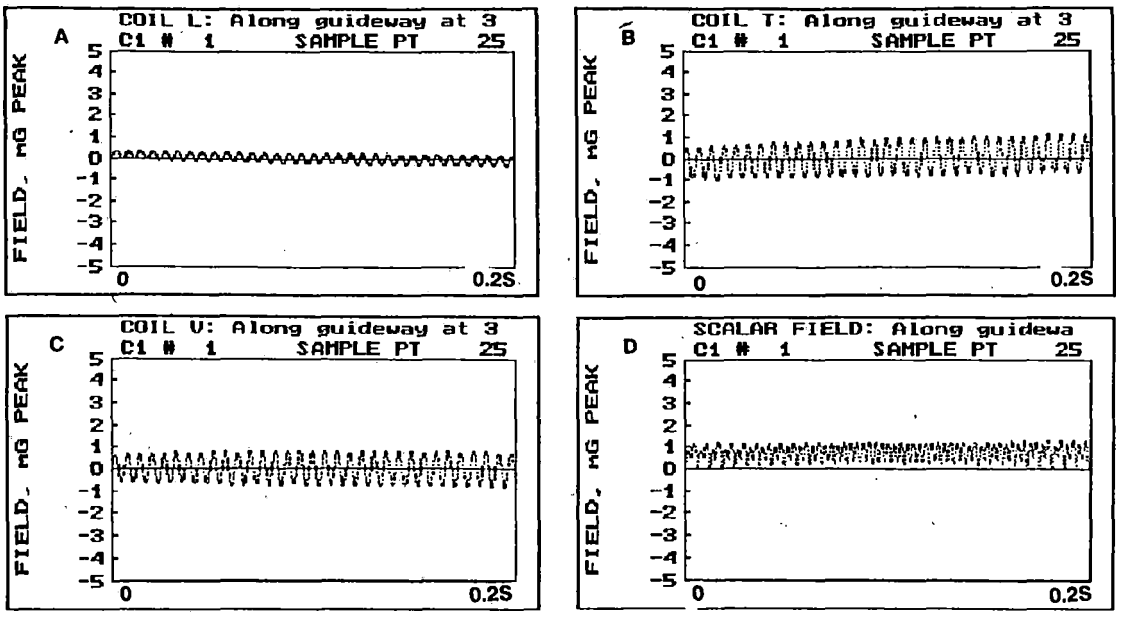
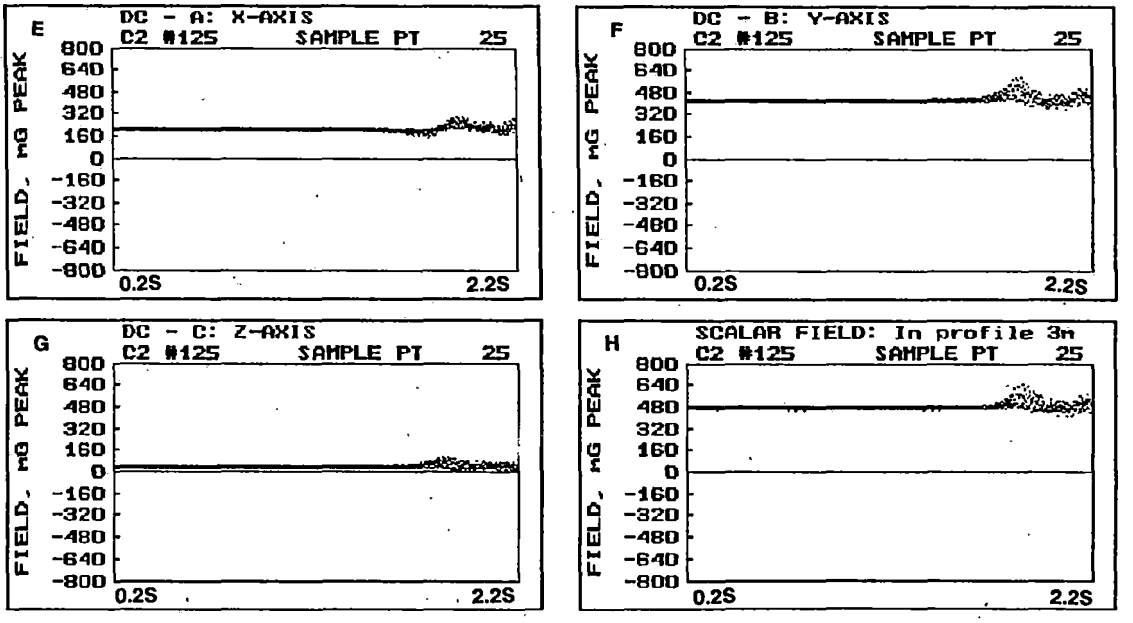


Figure 22 3 M OFFSET FROM G/W ¢, 1 M ABOVE GROUND

SITE: TR7020 DC PROBE, -3 M 08/09/90 TO 08/09/90



SITE: TR7020 AC PROBE, -9 M 08/09/90 TO 08/09/90

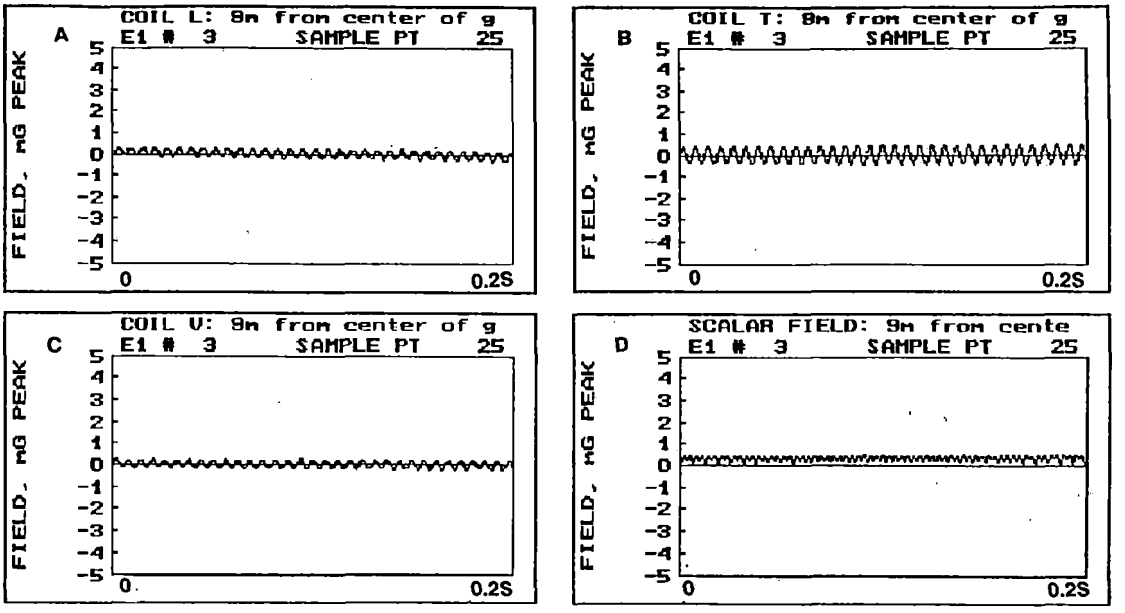
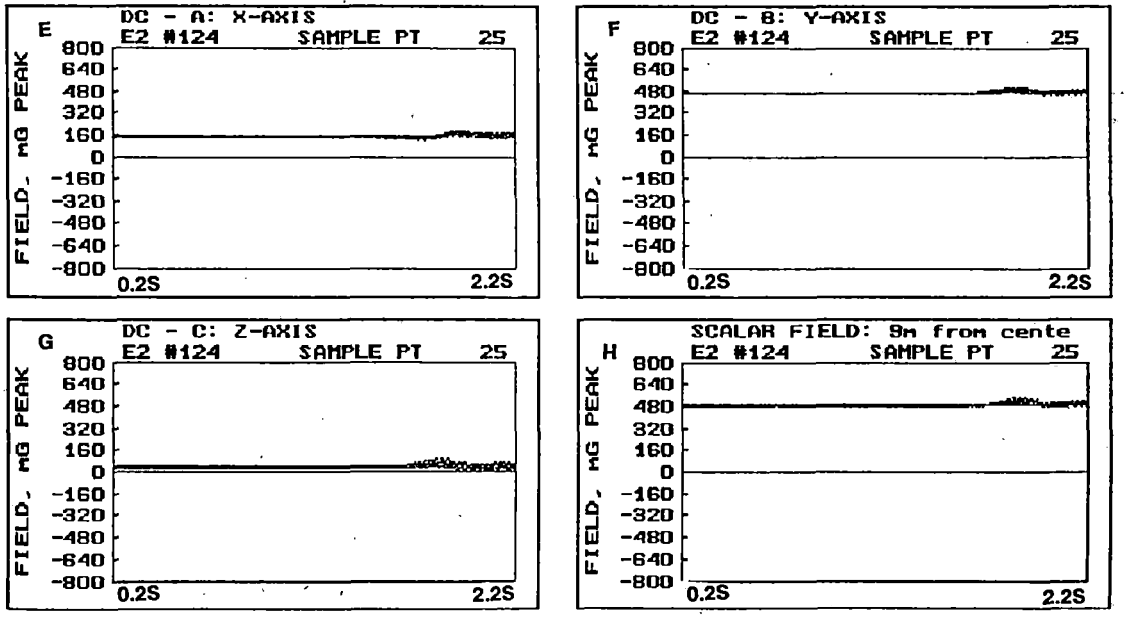


Figure 23 9 M OFFSET FROM G/W ¢, 1 M ABOVE GROUND

SITE: TR7020 DC PROBE, -9 M 08/09/90 TO 08/09/90



loop beside the high steel guideway near the control center were tested.

An overall diagram of the control center/power substation is shown in Figure 24, with the various test locations indicated by letter designators. The feeder cable locations were determined late Thursday and are indicated by the heavy dashed lines. The long dashes indicate main feeder cables which go to a North-South feeder switch at track switch #1. The shorter dashes show the south feeder cables. The feeder cables are buried 80 cm deep in a trench between the TR07 guideway and the road on the east side of the guideway.

The TR07 Maglev System is powered by a 50 Hz, 110 kV line which enters on the west side of the facility. This is stepped down at the west side switch yard to 20 kV and carried by underground cable to the transformer yard east of the control center. The 20 kV power is then stepped down to 2.6 kV and supplied to the inverter room where it is converted to dc and reconverted (inverted) to dc-215 Hz power for TR07 excitation/control. A backup 20 kV line (to power the test center only) came in by an underground path on the south side of the facility.

4.5.1 **Output Transformer Yard** (Setup 22)

A field profile was done south of the output transformer yard, as shown in Figure 25. The 20 kV stepdown transformers are located on the east side of the yard, farther from the control center than the inverter output transformers. The magnetic flux density at this location was ≈ 10 mG and was dominated by the 50 Hz ac primary power rather than the variable inverter output excitation frequency (dc to 215 Hz). The operating conditions of the TR07 were readily discernable from the audible "whine" of the output transformers which should also be reflected in

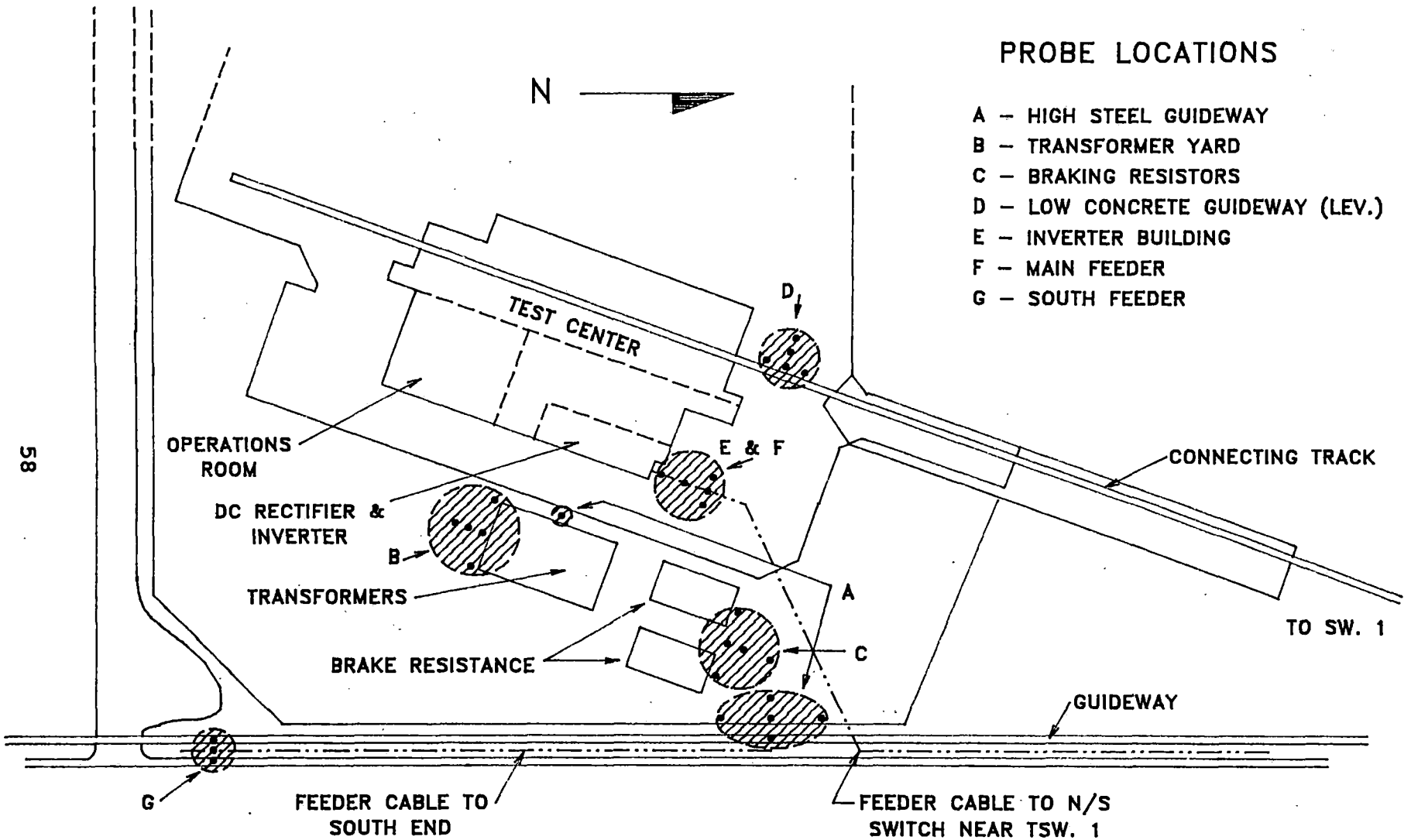


Figure 24 SUBSTATION TESTS (AUG. 8–10, '90)

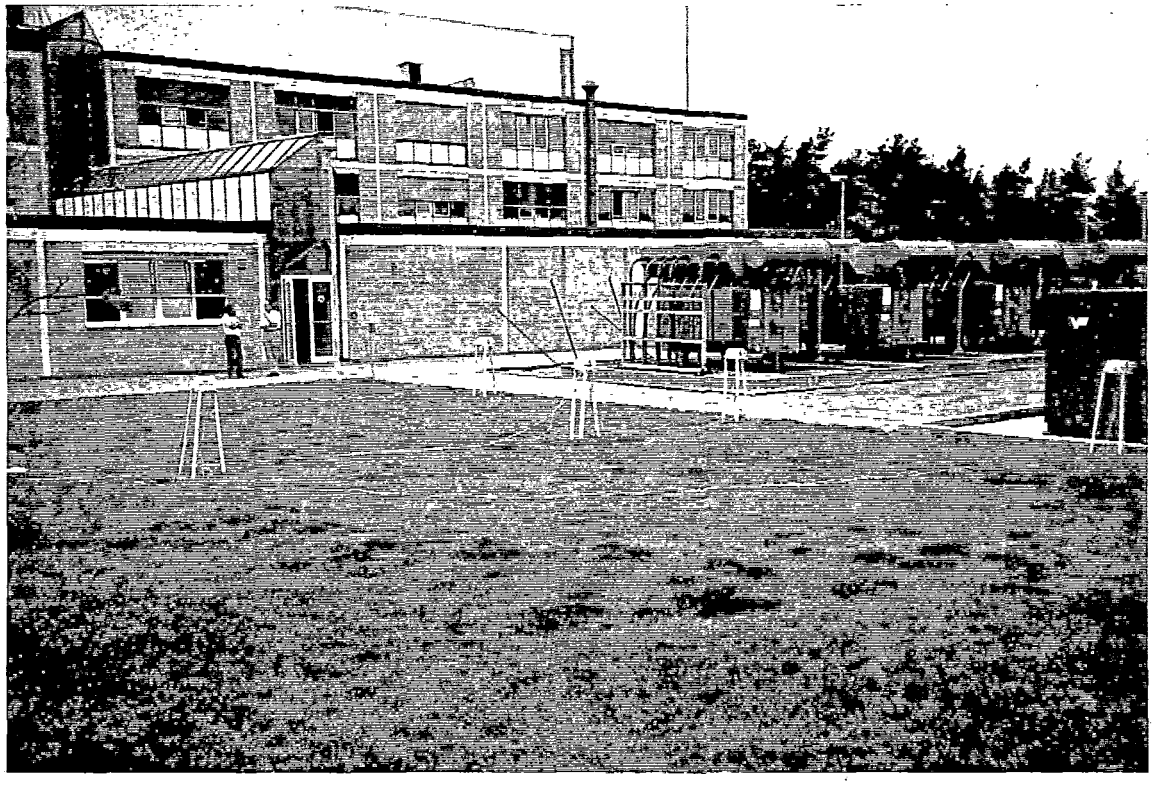


FIGURE 25A TRANSFORMER YARD PROFILE LOOKING NW (INVERTER BLDG. AND CONTROL CENTER IN BACKGROUND

FIGURE 25B TRANSFORMER YARD, LOOKING NORTH. BRAKING RESISTOR BANKS IN SHELTERS BEHIND TRX YARD

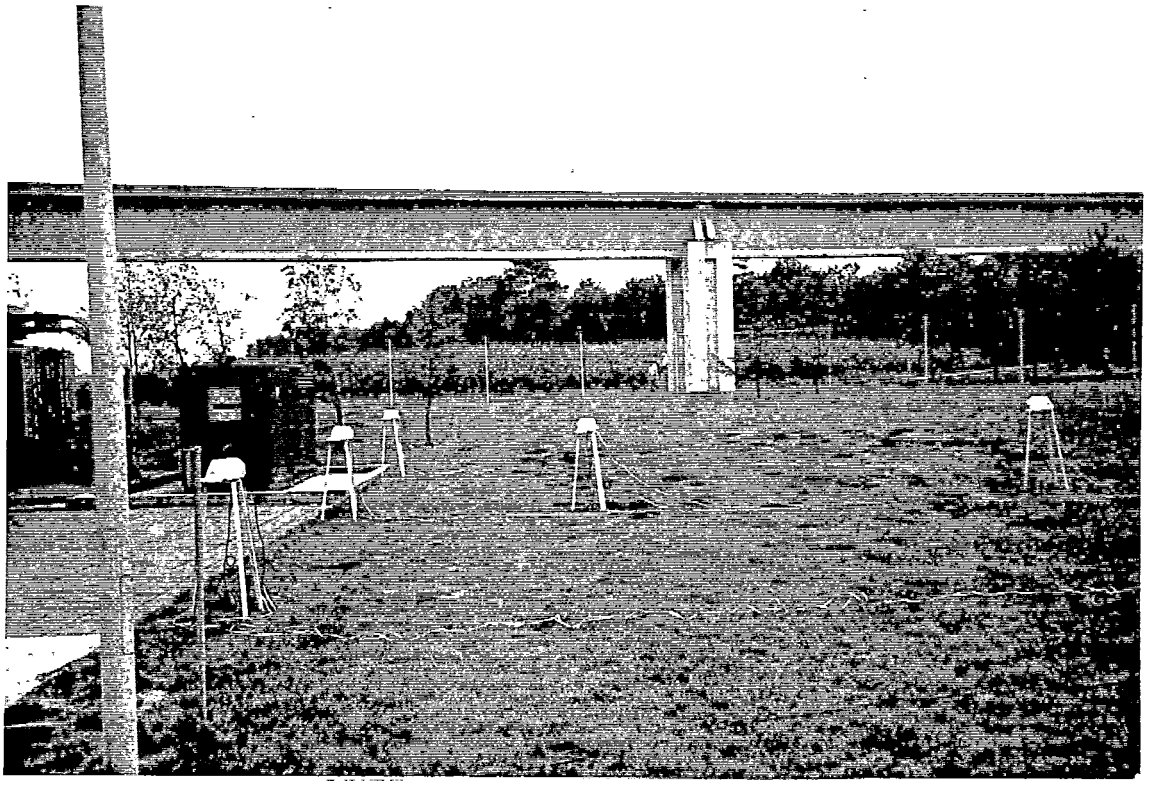


FIGURE 25C
TRX YARD PROFILE LOOKING EAST (PILLAR 2421 IN BACKGROUND IS WHERE SOUTH FEEDER CABLE MEASUREMENTS WERE MADE.)

the magnetic field data, particularly from the left side reference probe set, closest to the inverter output.

4.5.2 Braking Resistor Bank

Two 4-MW convection cooled braking resistor banks were located in ventilated shelters just north of the transformer yard. A profile was done on the north side of the fence surrounding this area as shown in Figure 26. The left and right reference probes were centered on the axis of each individual resistor bank and one meter offset from the chain link fence. A lateral profile was done along a centerline between the two resistor banks. The first centerline probe was located at 1 m offset from the fence, the second 4 m from the fence and the third 10 m from the fence.

Most of this data was time waveform samples and has not yet been examined. The few spectral snapshots taken are included in Appendix G and indicate a much greater excitation frequency harmonic content than any other measurements had. Whether this is due to probe saturation or the actual field waveforms will not be known until the time waveforms are examined.

4.5.3 Low Concrete Guideway at Facility Entrance - Levitation Measurements

A few runs of data were taken at the low concrete guideway at the service facility entrance. The probes were located in a "T" configuration, 1 m above ground level and about 1 m below the levitation magnet area, as shown in Figure 27. Most of this data was time waveform samples and has not yet been analyzed. The few background spectral snapshots taken

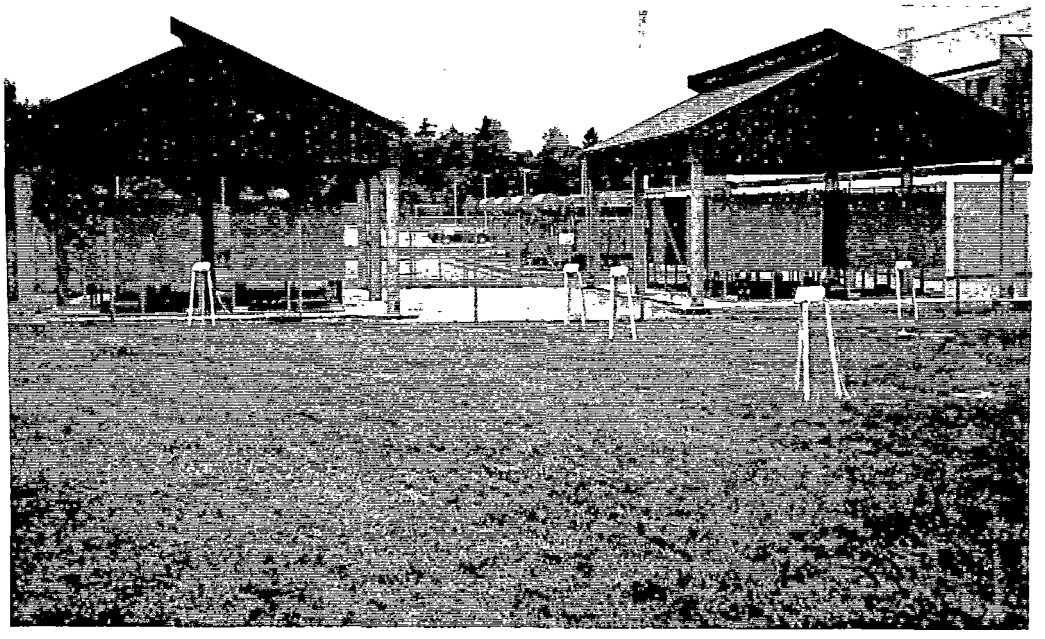


FIGURE 26A BRAKING RESISTOR BANK PROFILE, LOOKING SOUTH (TRANSFORMER YARD IN BACKGROUND)

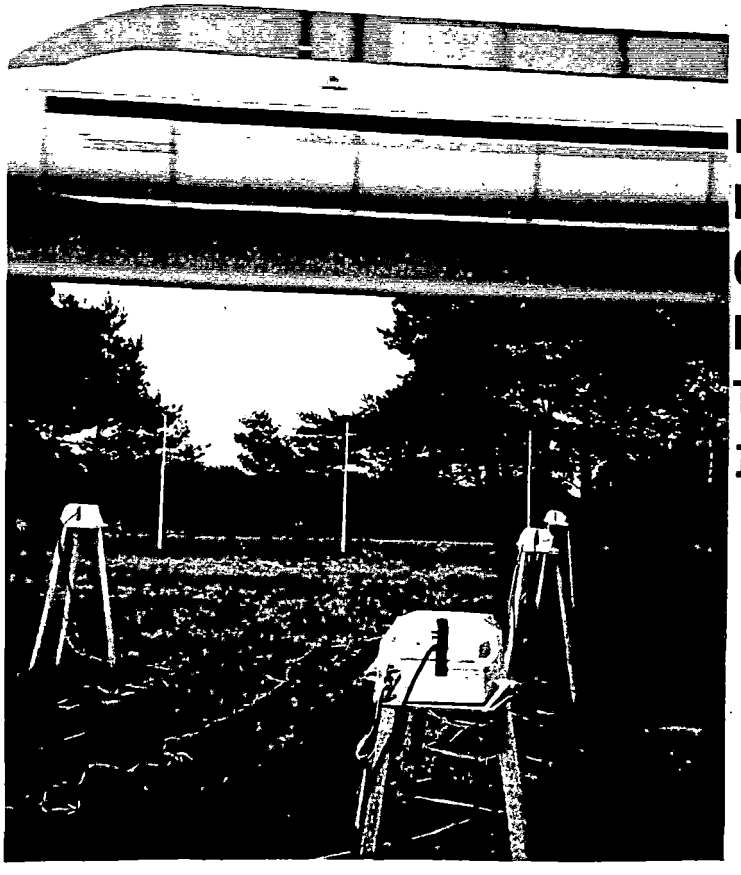


FIGURE 26 B 1M OFFSET PROBES (3 SETS) AND 4M OFFSET PROBES AT BRAKING RESISTOR BANK, LOOKING EAST. TR07 PASSING BY SOUTH TO NORTH IN BACKGROUND.

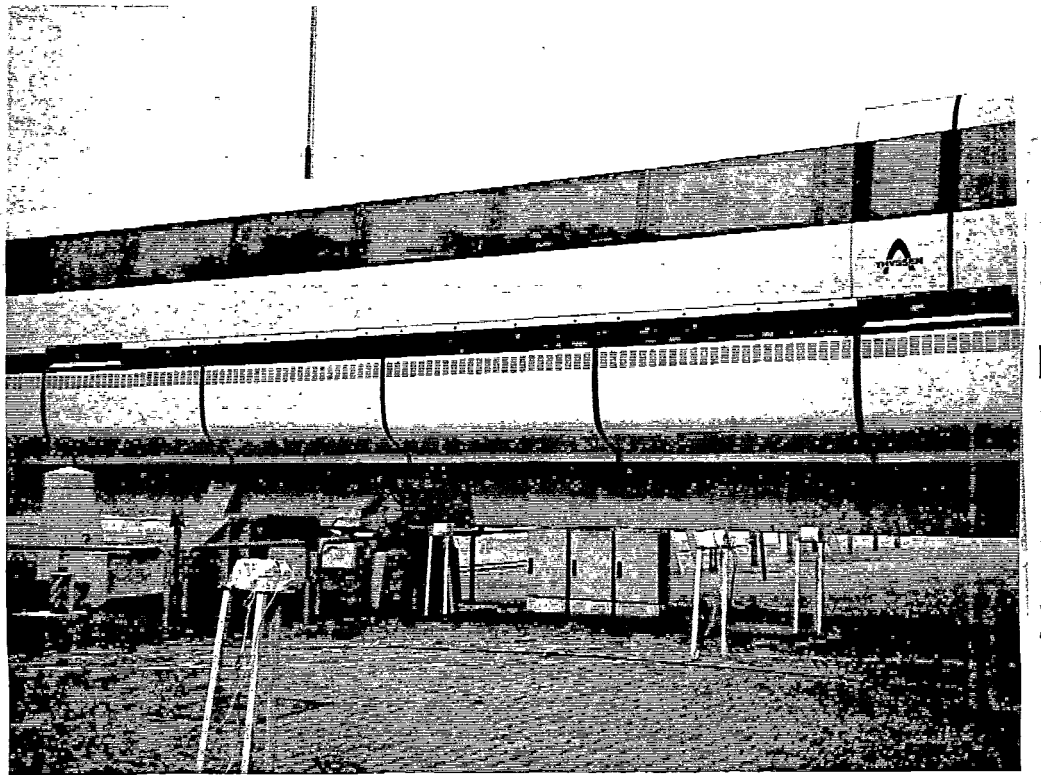


FIGURE 27A
LOW GUIDEWAY
NEAR
MAINTENANCE
BLDG.
(LEVITATION
PROFILE WITH
ZERO VELOCITY)

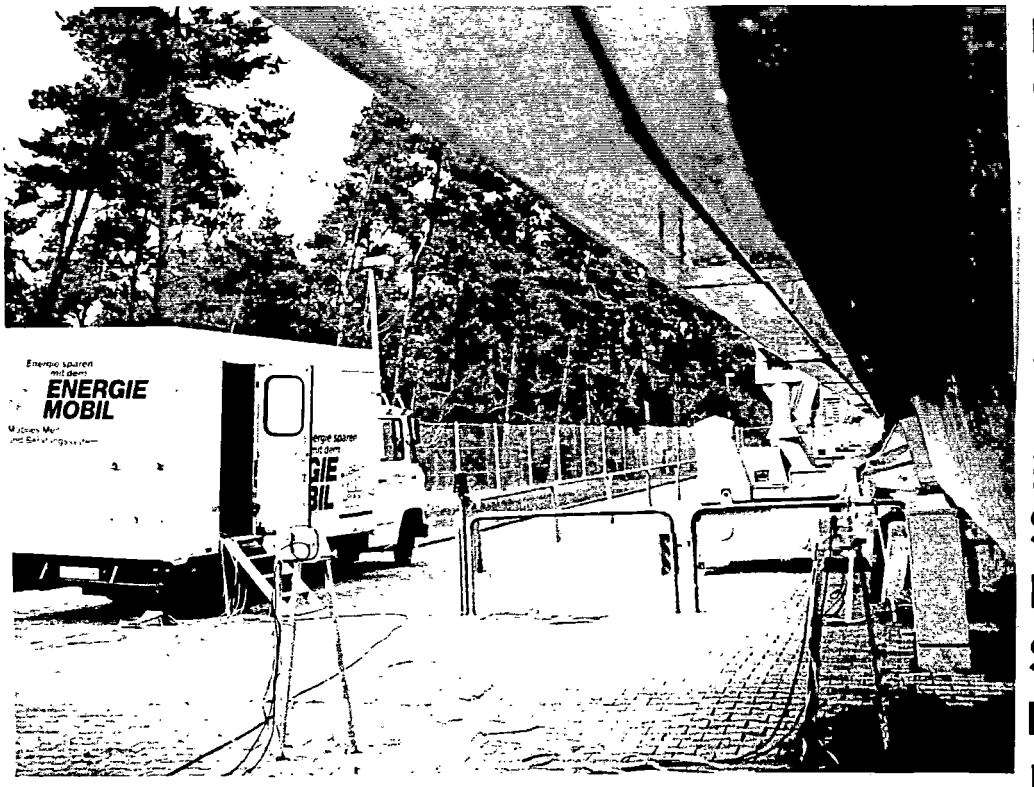


FIGURE 27B
LOW G/W
LEVITATION
FIELD
MEASUREMENT
SETUP, LOOKING
NORTH FROM
RIGHT
SIDE REFERENCE
PROBE SET (NOT
SHOWN) AT
MAINTENANCE
FACILITY
ENTRANCE.

when the TR07 was on the test track (and the service facility guideway deenergized) are shown in Appendix H.

4.5.4 Main Feeder Cable Measurements Outside Inverter Building

Several feeder cable locations were tested once the approximate feeder routing was obtained Thursday evening. Herr Brameier, the electrician at the facility for about 10 years, provided the approximate location shown on Figure 24 based on his recollection of the facility construction period. The initial data with a first probe 1 m offset from the inverter building indicated quite high fields partly caused by the air handling equipment located just inside the north side wall. When the TR07 was running, the magnetic flux density 1 m outside the inverter building north wall was ≈ 100 mG. A revised setup was made with all probes moved north by 4 m gave much reduced field levels for the probe set closest to the building (at 5 m away from the inverter building the levels were ≈ 10 to 20 mG). There was some pickup from the buried feeder cables (probes at 1 m above ground level) but this was typically around 1 mG or below.

4.5.5 South Feeder Cable Measurements (Along High Steel Guideway, Near Control Center)

Two test setups were implemented at pillar 2421 to determine magnetic fields due to feeder cables. One setup used the probe array at 1 m above ground, the other had the same lateral locations, but with probes at ground level. This was done to get a better idea of the vertical variation of the feeder field and to obtain higher signal levels. Additional high steel guideway information was also obtained, although the probes were clustered near the edge

of the guideway and gave very similar readings (as expected). Spectral snapshots of the magnetic flux density at this location are shown in Appendix J.

5.0 INTERIM REPORT CONCLUSIONS

This report catalogs the magnetic flux density measurement data taken at the Emsland Transrapid Test Facility in August 1990. It includes plots of all 67 spectral snapshots taken, as well as, 2 time waveform samples (out of 2304). About 40 Megabytes of the more than 200 MBytes of magnetic field data obtained on the TR07 Maglev System has been examined. On the basis of the data examined so far, the following conclusions are justified:

1. Onboard TR07 Vehicle
   a) The magnetic flux density level decreases with height above the TR07 floor.
   b) The dominant magnetic field frequencies are usually the excitation frequency, f_e, one half f_e and a nearly uniform spectral density cluster in the 1-15 Hz range.
   c) At 5" above floor level, the ac magnetic flux density is typically 100-300 mG rms.
   d) At standing head level (5'9"), the ac magnetic flux density is typically 10-30 mG.
   e) The magnetic flux density at the aisle is generally lower than at the window locations.
   f) The engineering area at the end of the TR07 has a somewhat lower magnetic field than the passenger area.

2. TR07 Maglev Guideway
   a) The AC magnetic flux density under the high guideway centerline is typically 50 mG rms when the TR07 passes overhead (for a time of 1 second or so).
   b) The under centerline magnetic flux density is typically less than 10 mG for the several seconds the local guideway is energized.
   c) The magnetic flux density returns to background levels (typically < 1 mG) after local guideway deenergization.

d) The magnetic flux density decreases with distance from the guideway. At 10 m offset from guideway centerline 2-20 mG is typical during TR07 approach and pass by.

3. Transrapid Passenger Station
   a) Passenger waiting area flux density is typically 5-20 mG during TR07 pass by.
   b) The outdoor loading area next to the guideway is typically 100-500 mG at TR07 pass by (about 1 second).
   c) AC magnetic flux density returns to background levels (< 1 mG) after local guideway deenergization.

4. Transrapid Power Substation/Control Center
   a) The transformer yard periphery typically has < 10 mG rms magnetic flux density, dominated by 50 Hz primary power rather than the TR07 excitation frequency.
   b) Buried three-phase feeder cable bundles have relatively low magnetic flux density at 1 m above ground (typically < 2 mG).
   c) Magnetic flux density 1 m outside the inverter room is typically 100 to 150 mG. At 5 m away it is < 20 mG.
   d) Magnetic flux density at the braking resistor bank is typically 5-50 mG when braking is performed, based on very limited spectral snapshot data.

5.1 General Observations and Recommendations for Future Work

The above conclusions are based on the spectral snapshots only. Time waveform samples have barely been looked at and should provide a more complete description of the magnetic fields in the TR07 Maglev System. Peak magnetic fields are likely to be significantly greater than the rms values noted above. Both the on-board TR07 and off-vehicle guideway data contain significant low frequency "noise-like" perturbations occupying the 1-15 Hz range. Often (but not always) the low frequency fluctuation

noise dominates the spectrum (the amplitude depends on the frequency resolution bandwidth). Often (but not always) the spectral density was approximately uniform, depending on operating conditions.

The maximum AC values obtained from the AC and DC probes were in good agreement for low level background fields (generally within about 10% or so) but were sometimes different by a factor of 10 or more under transient conditions (e.g. TR07 pass by). Even some seemingly steady state conditions, such as on-board the TR07 at constant speed, gave a factor of 2 or 3 difference in ac magnetic fields for dc and ac probes. This is due to the fact that ac and dc probes were sampled at different times. Future work should have at least one set of ac and dc probes sampled at the same time, so that easier cross checking and performance verification is possible.

Anti-aliasing filters are needed for future work. Also, a means of continuous sampling over at least several seconds is needed to accurately depict transient behavior for the TR07 Maglev system (and probably other transportation systems, as well).

5.2 Condensed Spectral Snapshot Result Summary

A one page summary of the spectral snapshot results is contained in the graph of Figure 28 showing the range of TR07 Maglev test results compared with typical 60 Hz electric power system fields (adapted from the EPRI Journal, October/November 1987). While some caution should be observed in making comparisons solely of "mG levels", an overall conclusion is apparent. On the basis of the spectral snapshot data examined so far the magnetic flux density levels of the TR07 Maglev system are comparable to those commonly encountered in residential and commercial surroundings due to 60 Hz electric power systems.

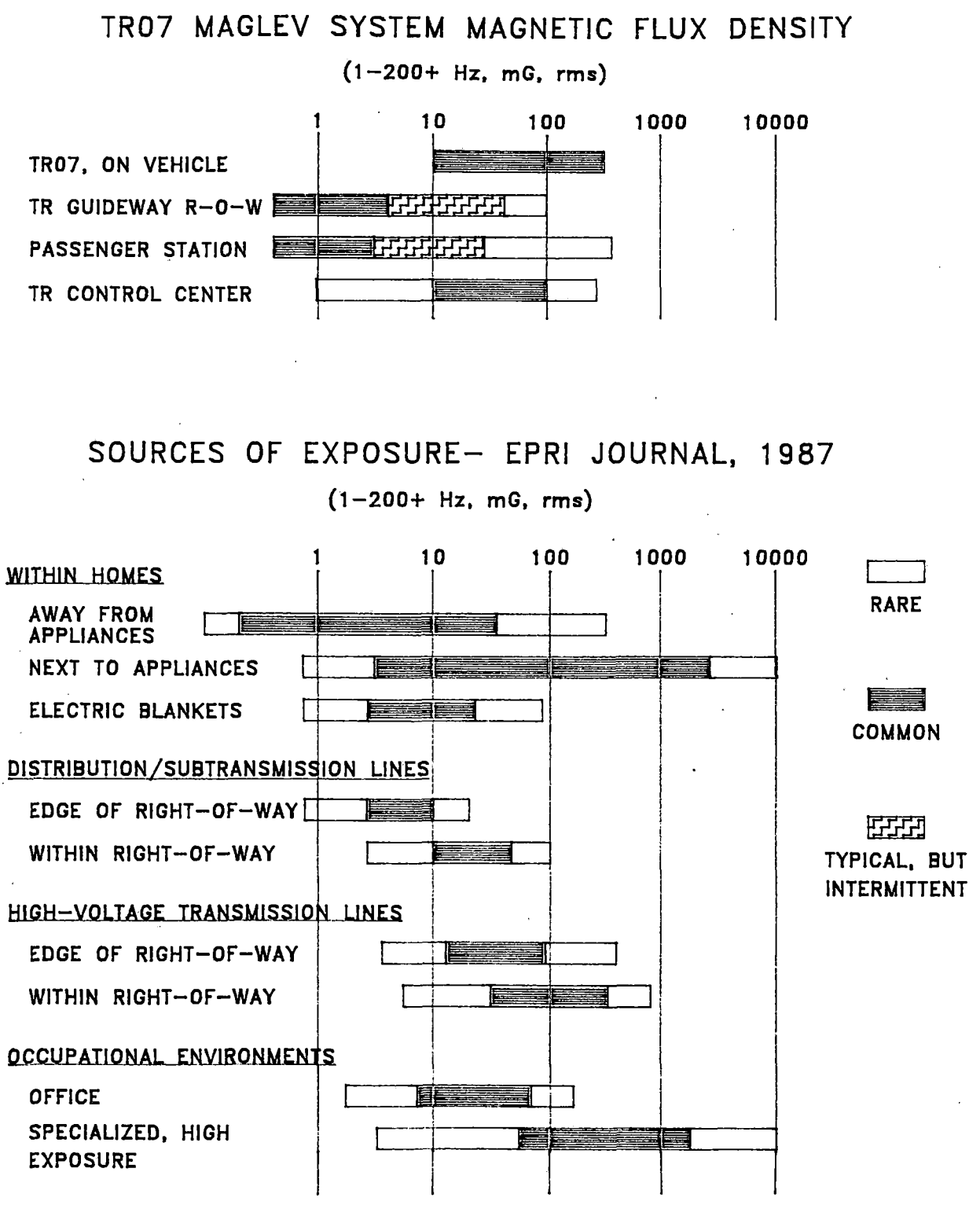


Figure 28 MAGNETIC FLUX DENSITY COMPARISONS– TRANSRAPID (TR) AND 60 Hz POWER RELATED

APPENDIX A

TRIP REPORT ON MAGLEV FIELD MEASUREMENTS AT EMSLAND TRANSRAPID TEST FACILITY AUGUST 6-10, 1990

by:
Electric Research & Management, Inc., State College, PA

Travel to the Emsland Transrapid Test Facility (TVE) was on Saturday and Sunday, Aug. 4-5. We arrived at Bremen, FRG about 1 P.M. and traveled with Don Gray (from the Office of R&D of the Federal Railroad Administration, Washington DC) 120 km west to Dörpen, about halfway to the Dutch border. At 6 P.M. we met Rüdiger Wiedenmann of TÜV Rheinland (he drove a test van from Köln that afternoon). We drove around the middle and southern sections of the MAGLEV guideway to see if there were obvious places to perform the magnetic flux density measurements. Possible sites for high guideway tests were identified near the northern switch (pillar 307) and near the substation building (pillar 2423). A low guideway site was identified in the southern loop at pillar 2235, near a fence gate (See Figure A-1, attached). The central control/maintenance building area was closed for the weekend, so there was little else that could be done on-site. We discussed the test plan over supper and tried to learn as much about the system as we could from Herr Wiedenmann, who has been involved with the system for the past 8 years. Most of his work has been with the control system and computers at the facility. Although he knew little of the power feed system, he did know where to find out any information we needed. He also spoke very good English and was most helpful in making the week a success.

Monday, August 6. We arrived at the facility shortly after 9 A.M. The TR07 vehicle was still in the Maintenance Building. Our 9:30 A.M. meeting with the facility director, Herr Merklinghaus, was postponed until 2 P.M. We did what planning we could from the information in the MAGLEV system description book. We also designed 1 meter high test stands and bought lumber to implement them, using aluminum nails.

We met with Herr Merklinghaus at mid-afternoon and went over the test plan. He told us that the vehicle would not be going out at all on Monday, but would be out the first thing Tuesday morning (7 A.M.). He asked us to show up after 7 A.M. and assured us that we could do all the on-vehicle measurements we desired. He also authorized us to use a video camera and/or a snapshot camera for recording test setups and vehicle conditions (cameras are normally prohibited at the facility).

Tuesday, August 7. When we arrived at 7:30 A.M., the vehicle was indeed on the track but it was being slowly towed by the diesel powered maintenance vehicle around the entire track. This apparently is a weekly start up procedure to check out all of the sections and search for any loose linear stator segments. Around 9 A.M. we were allowed to board the TR07 vehicle and set up the magnetic flux density monitoring equipment. The on-board dc to 220 V ac, 50 Hz inverter power source was used.

Tests were conducted at several locations along the vehicle (both at aisle and window seats) and at various heights (floor, seat, headrest, and standing head level). A reference set of dc an ac probes were set up on seats near the bulkhead between the passenger and engineer's compartment (at headrest and seat level, respectively). Data from these probes were recorded simultaneously with two vertical profile sets (ac and dc) equally offset from the TR07 centerline (e.g. sets 1 & 2, etc.). These were done at a variety of speeds from 0 to over 400 km/hr and under conditions of steady speed, acceleration and deceleration. In all, about 2000 km was traveled on Tuesday with the magnetic flux density measurement test equipment on board. A total of 57 sets of test data were collected, occupying about 60 M bytes.

The vehicle was brought into the maintenance building several times during the day for repairs and crew breaks. Toward evening, we had all the on-vehicle data needed, including on-board fields during levitation in the maintenance area. We removed the test equipment from TR07 and chose a location just north of the braking resistor bank (pillar 2423, setup A in Figure A-3) for making high guideway magnetic field measurements. We set up the recording equipment in the TÜV test van brought by Herr Wiedenmann and used 220 V, 50 Hz power from the control/maintenance building via long extension cords (≈100 m). Little data was accumulated, except to check that everything still worked and to verify the proper range settings for long duration samples.

Wednesday A.M., August 8. We arrived at the test facility at 8 A.M. and the TR07 was running. We took magnetic flux density data at various passby speeds from about 50 to 200 km/hr at pillar 2423 (See Figure A-3, Setup A) and at 1 m, 3 m and 10 m away from centerline, as well as 3 m offset from the pillars 25 m up and down the track. Data was obtained with the vehicle close by (section energized) and far away (section deenergized). In all, 13 sets of test data were taken at pillar 2423.

Unfortunately, we did not know where the underground feeder cables were and the only person who did (Brameyer, the electrician) was on vacation until later in the week. We guessed wrong on where the feeder cables were but the actual location was such that it should have negligible effect on the data taken. The braking resistor bank was nearby, but we had 2 reference

probes with which to determine its effect (at one pillar north and south of 2423). Further, we only expected current to be flowing in the braking resistors during deceleration and we could easily tell the approximate velocity of the TR07 from the whine of the inverter output transformers, which were about 50 m away.

Wednesday P.M., August 8. A portable 2 kW generator was borrowed and the test equipment moved to a low guideway location (pillar 2235) in the south loop (See Figure A-1). Logistically, this was much more difficult than expected. Travel to the site was time consuming and performing set up under the guideway could only begin when gate was unlocked and access time was restricted to a few minutes at a time after the train passed. Herr Merklinghaus accompanied us to the site and assisted with his 2-way radio. Additionally, the train was only in view for a few seconds and only passed by once every 8 minutes or so. Despite the difficulties, the data obtained should be adequate. After the generator ran out of gas, we appreciated the luxury of fixed power outlets.

In view of the logistical problems with remote measurements, we decided not to use the Northern switch (Switch #2) as another high guiderail section. Instead, we examined the passenger station (it did have exactly one ac power outlet and a few lights, but no other electrical equipment) and configured the setup to give a high guideway measurement profile, as well as passenger loading and waiting area data. The station was a steel frame structure with corrugated metal siding and roof, and aluminum treadways. Since the vehicle had extensive maintenance to be performed, we decided to break early (6 P.M.) and get ready for a long Thursday.

Thursday A.M., August 9. We arrived at the test facility before 8 A.M. The vehicle was running. With the help of Herr Wiedenmann we obtained access to the passenger terminal but had severe restrictions on when we could set up sensors on the loading platform. Because of the wind gusts created when the vehicle passed by at 200+ km/hr, we only put one sensor pair on the loading platform at floor level (where it could be tied down). The other sensor pair was on a 1 m high tripod just inside the passenger waiting area doors. The other 3 sensor pairs were placed 1 m above ground level at guideway center, 3 m offset and 10 m offset on the opposite side of the guideway from the passenger platform. The guideway clearance was about 4.5 m at the passenger terminal (station), similar to the elevation near the substation (power source and control center/maintenance area). It is believed that the passenger station had negligible influence on the ground level measurements. The area opposite the station had deep drainage ditches and a raised "dike" area which at first we thought might contain the buried feeder cables. We later found out that the feeder cables were on the road side

of the guideway, opposite from where the 1 m above ground level measurements were made.

The test conditions at the station were the most comfortable and informative of our setups. We could see the train coming from the north straightaway bend over 2 km away and to the south switch, about 2 km toward the southern loop. In addition, we had a track display in the station which showed the vehicle location on an LED display (to about 125 m resolution) and gave a readout of the instantaneous velocity in km/hr. Once we got set up, data taking at the station was very fast and conditions easy to verify. In all, 12 sets of data that were taken at the station.

Thursday P.M., August 9. Additional testing near the central control/maintenance area (substation) was done Thursday afternoon. A profile on the south side of the inverter output transformers was done (Setup B, Figure A-3), collecting 7 sets of data with the train passing nearby, as well as North loop operation (including straightaway acceleration) and southern loop operation (including braking).

A profile on the north side of the resistor bank was also done (Setup C, Figure A-3), collecting 5 sets of data involving braking in the north and south loops and a 20 minute time profile as the train traversed the course twice.

The final measurements of the day were done after the train came back to the maintenance area, following a VIP special run of over 1½ hours. A concrete guideway section just outside the maintenance bay (with < 1 m clearance) was instrumented for a field profile (Setup D, Figure A-3). Four test sets were collected, including a background at the track with the vehicle and track deenergized (parked). The TR07 ran a great deal Thursday, accumulating over 2400 km of travel. It rained on and off during the day but we had protected the probe sets with plastic bags and had no testing problems due to the weather.

Herr Brameyer, the electrician who has been at the facility about 10 years, returned from vacation Thursday evening. He showed us the feeder cable routing from the inverter room to the output transformers and back under the inverter room. The main feeders then went northward to a north/south switch feeder switch located at Switch 1, about 300 m north of the substation. According to Brameyer, there are no as-built drawings and his memory is the only documentation of the underground cables!

Herr Brameyer took us through the tunnels from the inverter building to the transformer banks where we could see the 3-phase power cables. The output cables consist of four sets of 3 conductor insulated cables (2 sets for each output supply, 12 conductors total). Each 3 conductor set is sheathed in a heavy plastic covering that is at least 1½" to 2" outside diameter.

These 4 sets carry the current toward Switch 1 by an underground path (buried about 80 cm deep) from the inverter building north about 20 m, then northeast toward pillar 2424 (See dashed lines on Figure A-3). The feeder cables then go under the guideway and continue north between the guideway and the paved road to a north/south section switch near Guideway Switch 1. The north section is fed by similar feeder cables (as from the substation) which are buried between the road and guideway. The south section is fed from near Switch 1 by buried cable between the road and guideway also. What this meant was that if there was a feeder cable magnetic field, it should fall off very rapidly with distance and we probably did not detect it during our first guideway measurement (at pillar 2423) or in the passenger terminal measurements. It might have been detected on the south loop test since the measurement setup was on the same side of the guideway as the feeder cables. We felt it necessary to try to quantify the feeder cable magnetic fields and made plans to do this on Friday.

Friday A.M., August 10. We arrived at the substation around 8 A.M. and set up for measurements of the feeder cable on the north side of the inverter building. Two different setups were tried and 4 sets of data were taken (Setup E & F, Figure A-3). The train did not run much on Friday. We spent most of the morning waiting. We took advantage of the shutdown to get a tour of the inverter building by Herr Hoffman, an iABG power engineer who has been at Lathen since April. He told us that there is also an auxiliary source of power to the Control Center/Maintenance building of 20 kV 3-phase which comes in by underground conduit. We think this comes in along the road in front of the facility (perpendicular to the guideway). This should not have interfered with any of our measurements and the current should be much less than that of the TR07 feeder cables. It is rectified and used to charge a battery bank in the basement of the building. Uninterruptable 50 Hz 220 V ac single-phase and 380 V 3-phase is generated from this dc source to provide power at the control center. The auxiliary diesel generator in the transformer yard provides power to maintain the batteries if the outage lasts for more than a few minutes.

[We did have a severe lightning storm Thursday night around 7 P.M. which knocked out the 110 kV power feeding the train. The auxiliary tow vehicle had to retrieve TR07 and bring it to the maintenance area Thursday night. New skids were being installed on the TR07 Friday morning. Whether the surge associated with the storm was a factor in TR07 running very little on Friday is not known, but only a few hundred km of running was accomplished on the final day.]

Toward noon the TR07 began running again and we set up a feeder cable profile measurement near pillar 2421 (Setup G, Figure A-3). Both ground level and 1 m above ground measurements were planned.

At 12:30 P.M. the vehicle came back to the maintenance bay for repairs. We went to lunch and when we came back, TR07 was on the track but apparently a defective module had been installed and had to be replaced again. We met with Herr Merklinghaus for a wrapup meeting at 3 P.M. We briefly covered the tests done and thanked him for his cooperation. He said there was a report done on the TR06 vehicle for magnetic fields. Don Gray should have a copy (in German). As we finished the meeting (around 4 P.M.), the TR07 began working again. We concluded the feeder data at Setup G around 5 P.M. We then packed, went to Bremen overnight and came home Saturday.

Attachments:

- Figure A-1, Test Track
- Figure A-2, On-Vehicle Measurement Points
- Figure A-3, Substation Site Plan
- Marked Copy of Test Plan (2 Pages)
- Test Plan Summary and Actual Measurement Overview (1 Page)

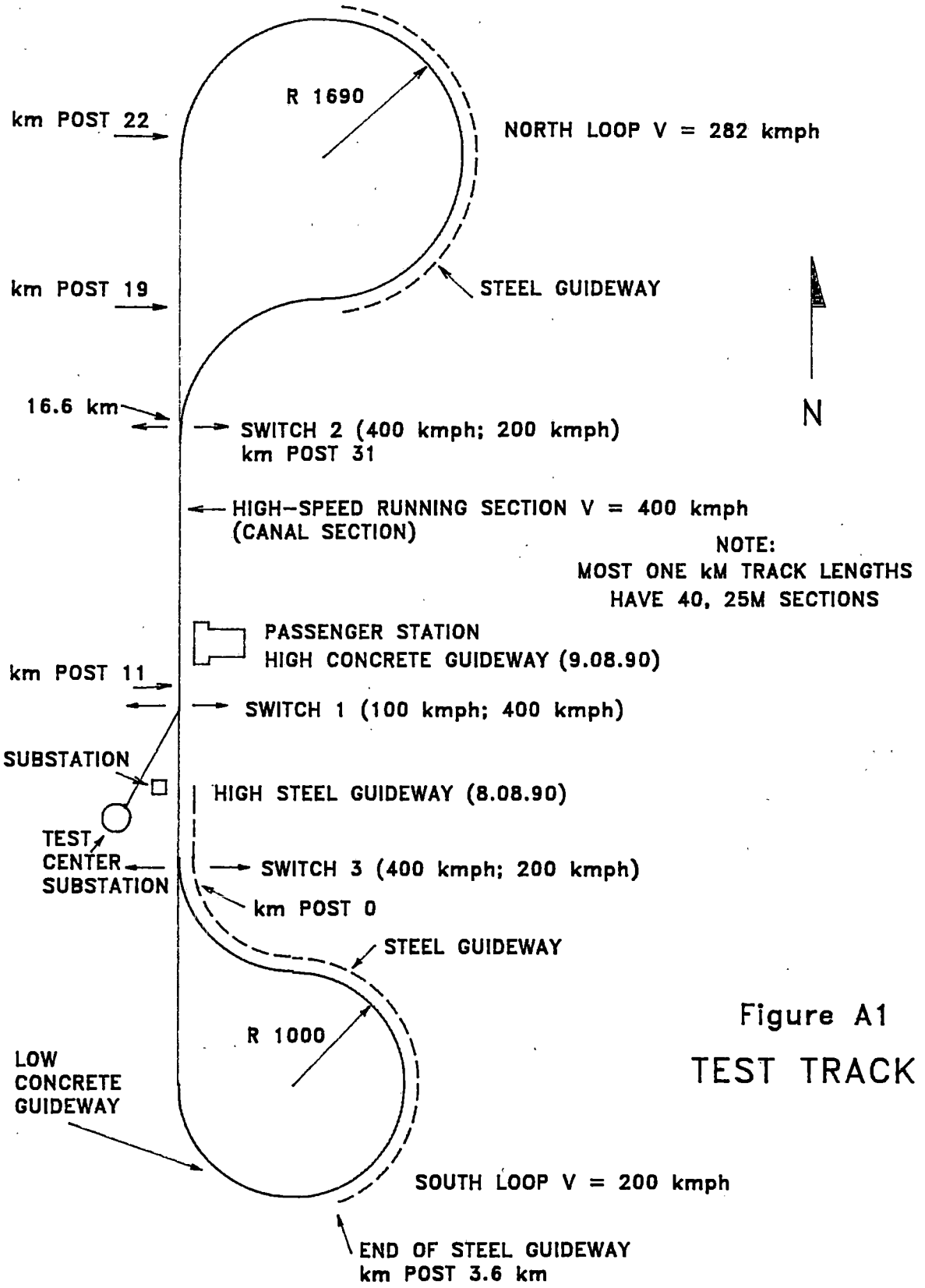
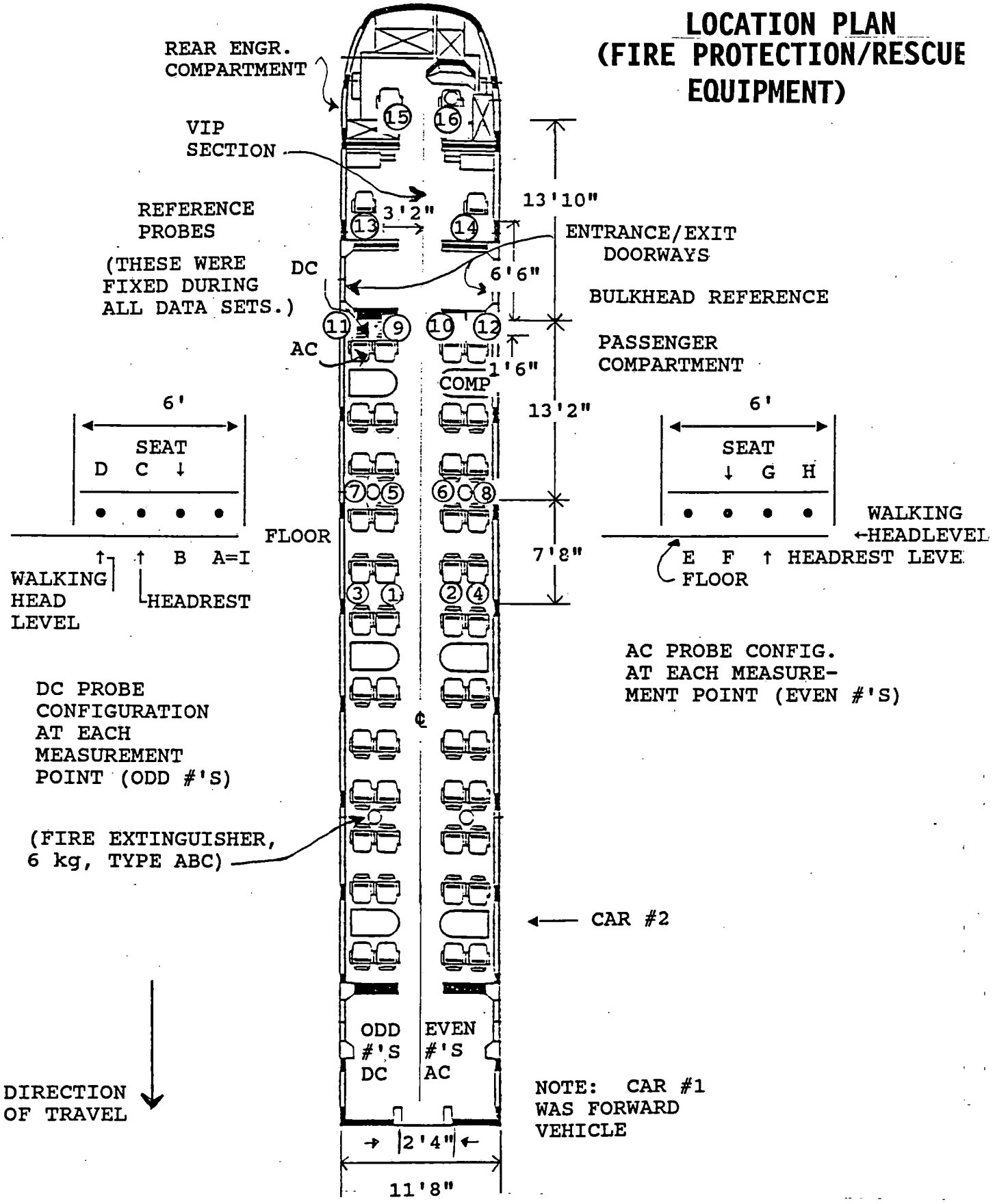


Figure A1

TEST TRACK

FIGURE A2
ON-VEHICLE MEASUREMENT POINTS (AUGUST 7, 1990)
(REVISED SEPTEMBER 15, 1990)



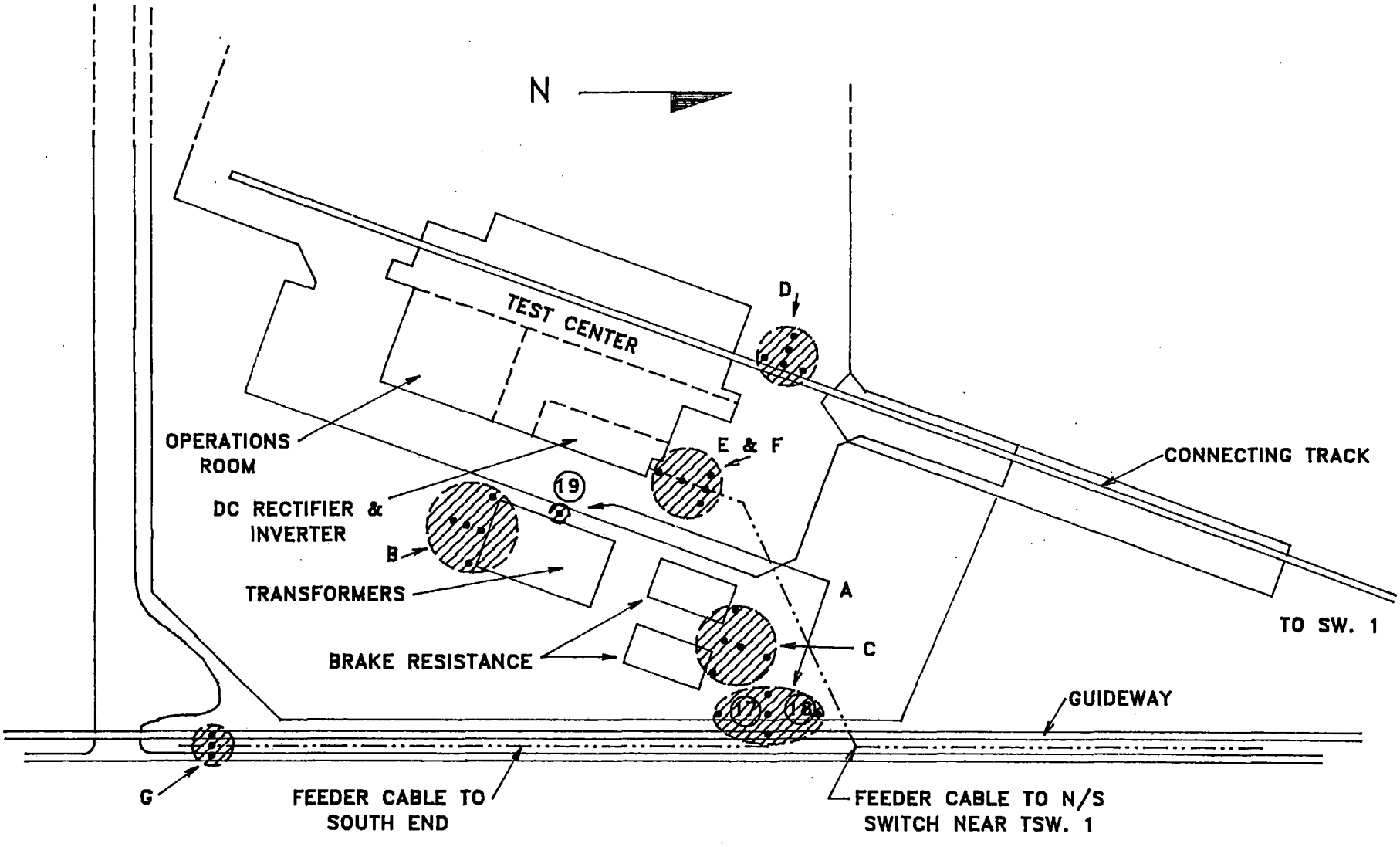


Figure A3 SUBSTATION SITE PLAN

TEST OUTLINE FOR MAGLEV FIELD MEASUREMENTS AT EMSLAND, FRG
DOC August 3, 1990 (pg. 1 of 2)
(Revised August 17, 1990)

This outline is arranged by test location, in order of priority. DC and AC magnetic flux density (0.01 to 1000 mG, 3 components) are to be measured in the frequency range dc-2000 Hz using the EPRI WAVE System developed by Electric Research and Management, Inc. Higher resolution measurements in the dc-200 Hz range are planned as deemed necessary. In addition, a portable Gaussmeter (Bell 9200) will be used to manually "sniff" the test area. This can also serve as an auxiliary monitor input for high flux measurements. The first one and one-half days are planned for on-vehicle measurements in the passenger and engineer compartments. During this time specific locations will be selected in guideway and substation measurements. The guideway measurements are mandatory. (Editorial comments below in parenthesis and bolded were done during and after the test to indicate actual measurement conditions.)

1.0 ON CAR MEASUREMENTS (Vehicle parked [unlevitated], levitated [no motion], and travelling)
(Vertical, lateral and longitudinal profiles were taken with various conditions from 0 to 400 km/hr.)

1.1 Passenger Compartment **(See locations 1-12 on following Transrapid vehicle drawing.)**

1.1.1 Two (2) seats in a row over magnet **

1.1.2 Two (2) seats in a row between magnets **

** **(Magnets on TR07 were ≈ uniformly distributed.)**

1.1.3 A search will be made (manually) to find areas of highest flux in the various operating modes (stop, levitated, and travelling). Snapshots of flux during acceleration and braking are desired.

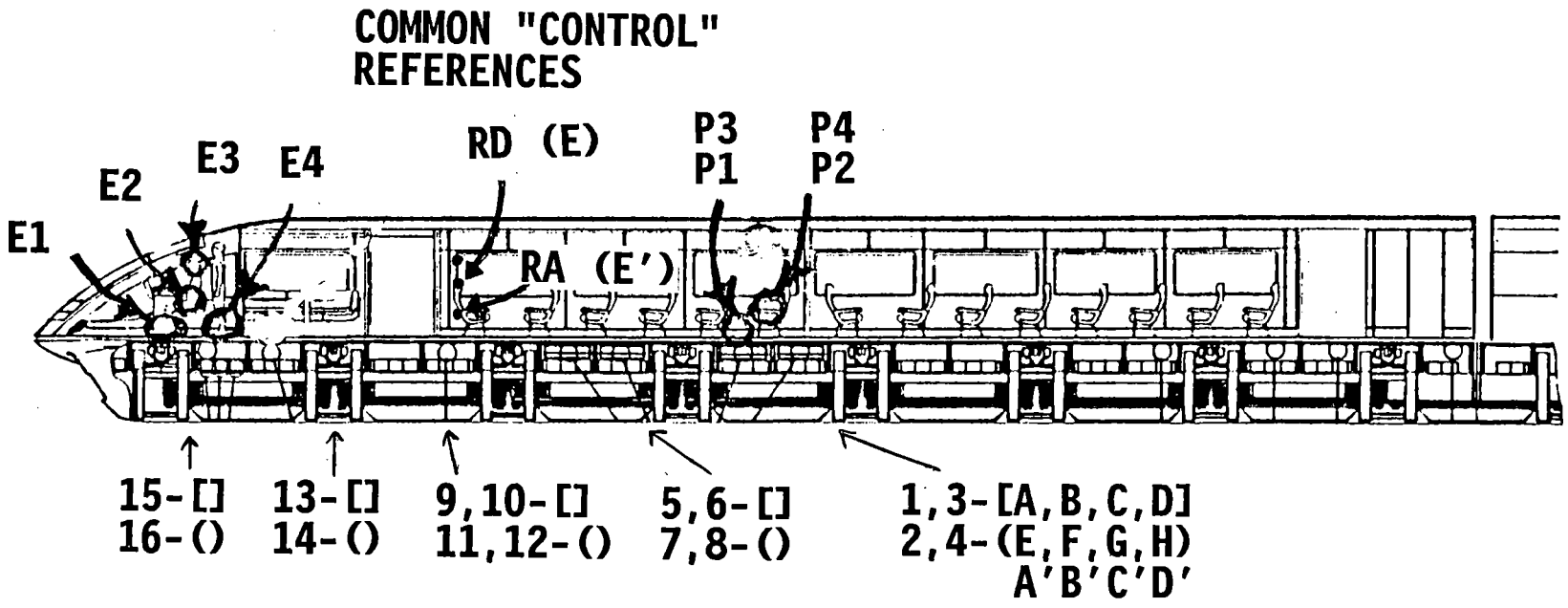
1.2 Engineer Compartment **(See locations 13-16 on following Transrapid vehicle drawing.)**

1.2.1 At foot position, seat head level, and two others of opportunity (E5 and P5 may be chosen as a single location as a "control" point, common to both the passenger and engineer compartment measurements. **(Reference ac probe at RA, reference dc probe at RD.)**

1.2.2 Manual search for maximum field intensity. **(Inconclusive due to Bell 9200 Gaussmeter fluctuations.)**

(NOTE: ACTUAL TR07 CONFIGURATION DIFFERS FROM THIS PRELIMINARY INFORMATION.)

(PROPOSED)



(ACTUAL)

(FOR MORE COMPLETE DESCRIPTION OF ON-VEHICLE TEST LOCATIONS, SEE FIGURE A2)

2.0 GUIDEWAY (Vehicle levitated, slow and fast speed, near, and far)

2.1 Measurements at a low guideway **(At pillar 2235 and outside maintenance area at substation location D)** removed from the passenger station but near substation (a power conversion/feedpoint)

2.1.1 Lateral profile from guide outward (1m, 3m, 10m radials and two other points ~30m **(25 m actual)** up and down the track from the primary point).

2.1.2 Lateral profile from power feed (directly over, 1m, 3m and 10m removed from center line of feeder) **(Done at substation and pillar 2421, location G.)**

2.2 Measurement at a high guideway height away from a substation **(Done at 2423, location A and across from passenger station.)**

3.0 SUBSTATION (vehicle far away and nearby)

3.1 Measurements to use one point of guideway set-up above and four (4) others

3.1.1 Lateral profile at **(1 m above)** ground level and at end of overhead line **(Done at 20 kV stepdown transformer bank, location B.)**

3.1.2 Lateral profile from feedpoint **(Done just north of inverter room, locations E and F.)**

3.1.3 Brake resistor bank location **(North side, location C.)**

4.0 STATION PLATFORM (vehicle levitated [no motion], parked) **(Only moving data at station due to TR07 battery life.)**

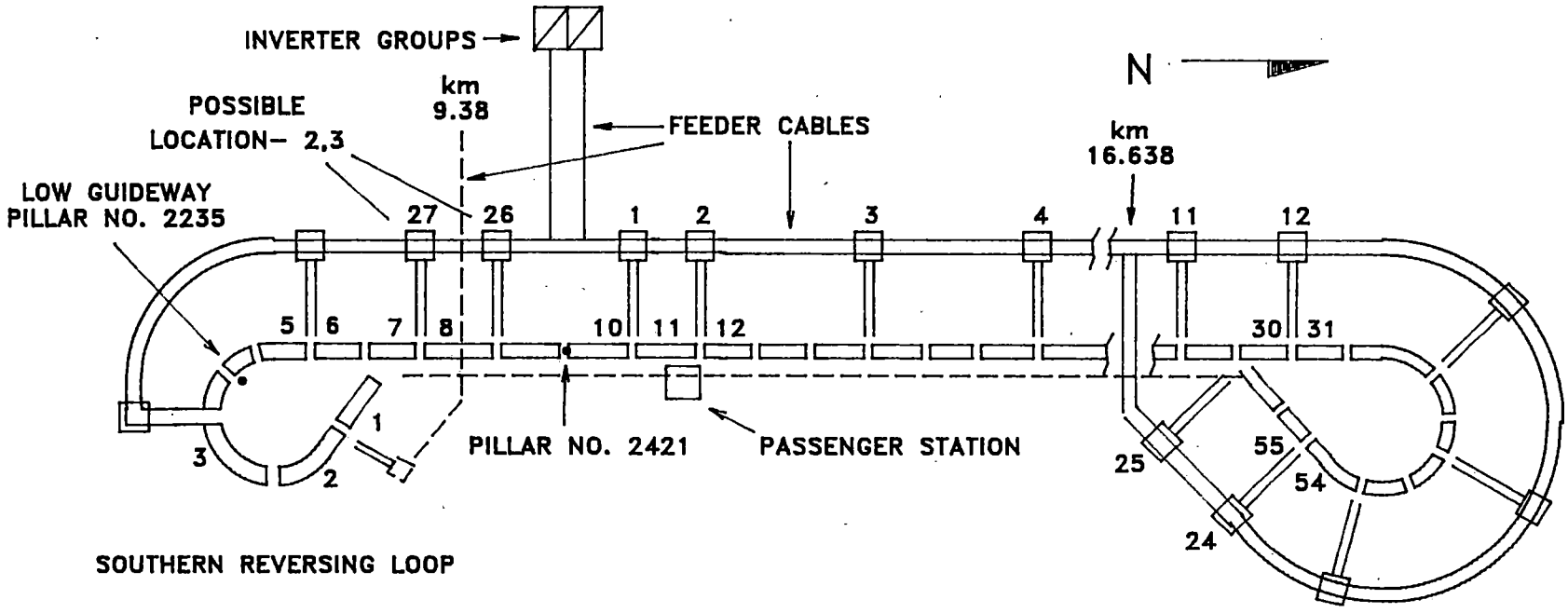
4.1 At floor level 1m, 3m, 10m from middle **(at 4 m away, 1 m height from side)** of train.

4.2 Vertical profile at middle of train, 1m offset at floor waist and head level **(Done in maintenance building Tuesday, locations 1 and 2, plus floor lateral profile.)**

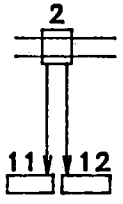
5.0 MAINTENANCE AREA (vehicle parked, de-energized) **(And levitated.)**

5.1 At center of car in maintenance area: head level, waist, and foot location **(Done with on-vehicle tests at locations 1 and 2, Tuesday.)**

5.2 Profile field intensity along axis of the car from front to back radially outward at 1m, 3m, and 10m from middle **(Done at low concrete guideway tower, location D.)**



LEGEND



SWITCH STATION NO. 2

INCOMING FEEDER

MOTOR SECTION NO. 11 & 12

GRADIENT 35%

– – HIGH SPEED SECTION

EMSLAND TVE PLAN

TEST PLAN SUMMARY AND ACTUAL MEASUREMENT OVERVIEW OF TESTING AUGUST 6-10, 1990 AT TVE, FRG

DOC/DCR Aug 17, '90

1.0 On Vehicle Measurements (57 sets of data)
Dc and ac fields at floor, seat, headrest and ceiling level; at the aisle and window seats at several points along the axis of TR07, from the vehicle center to the engineer's compartment, 57 data sets, 60 MB of data.

2.0 Guideway (33 sets of data)
- 2.1 Low Guideway - Two places: a) south loop (4), b) just outside maintenance bay (4).
- 2.2 High Guideway - Two places: a) near substation (13), b) across from passenger station (12).

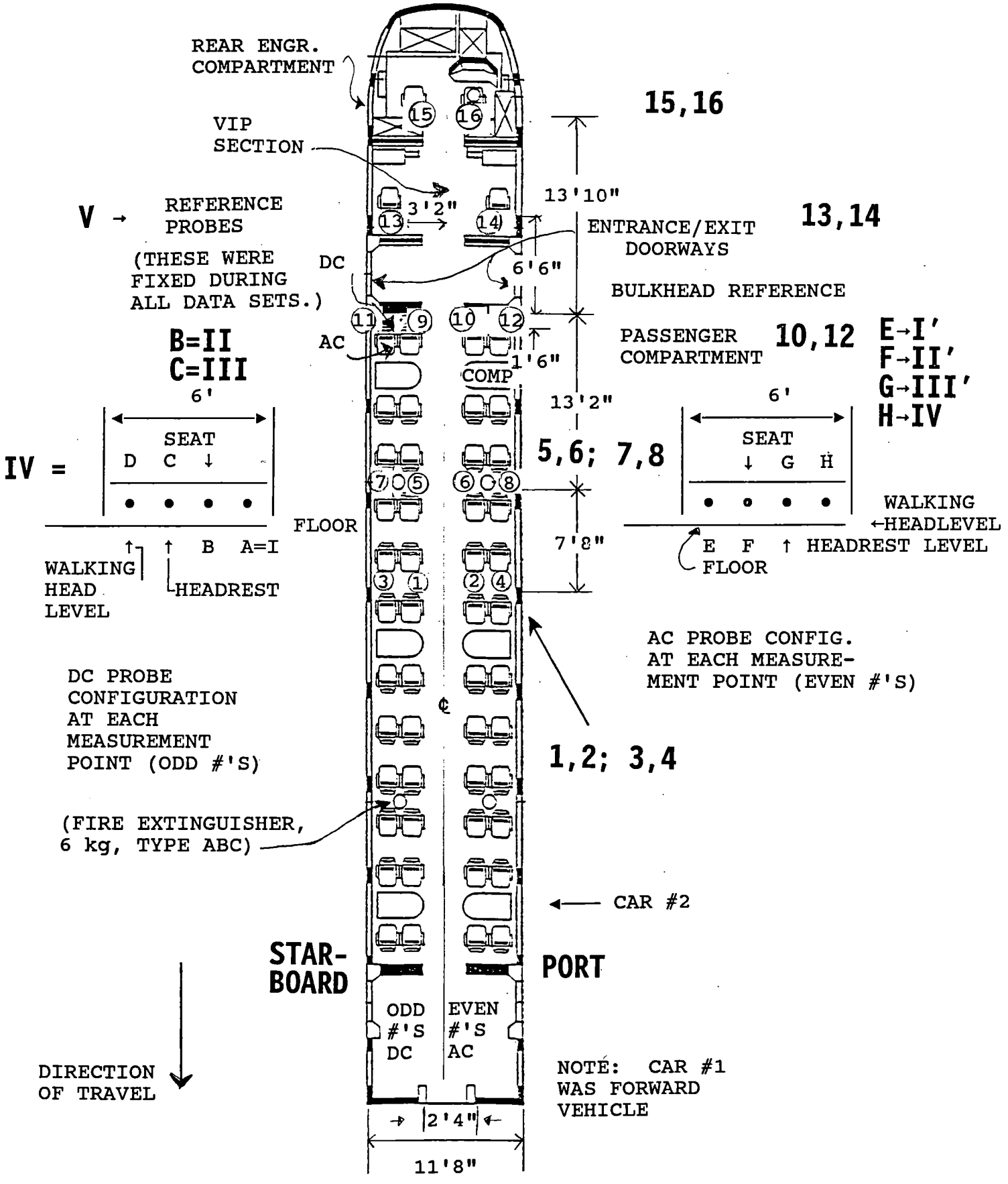
3.0 Substation (26 sets of data)
- 3.1 Profile at end of overhead line - 110 kV input line was stepped down to 20 kV and fed to transformer bank - measurements were done at the transformer bank (7).
- 3.2 Guideway feeder line from inverter building (4).
- 3.3 Braking resistor bank (5).
- 3.4 Feeder lines just outside substation, south loop (10).

4.0 Station Platform (24 sets of data)
- 4.1 Floor level at loading platform entrance gate (12). In addition, the waiting area had ac and dc probes 1 m high at the entrance doorway.
- 4.2 Vertical profile outside middle of train - not done for logistical reasons - TR07 battery life (0).
- 4.3 Ground level profile opposite to station (12). Note: This was done simultaneous with platform measurements.

5.0 Maintenance Area (4 sets of data)
- 5.1 and 5.2 Lateral and longitudinal profiles just outside maintenance building (4). Vertical profiles not done because of logistics and time.

APPENDIX B

ON-VEHICLE MEASUREMENT POINTS (AUG. 7, '90)



TR700101 TOTAL FILE PRINTOUT

SITE: TR7001 Transrapid Facility ,Emsland, FDR
> 168km/h, constant speed, loc and 2, 5/1Hz 1024pts

SNAPSHOT: 01/01/88 (Friday) AT 12:00:01 am

PAGE 1 OF 94

NOTE: HERE

$RMS = \sqrt{L^2+T^2+V^2}$

FIELD mG RMS

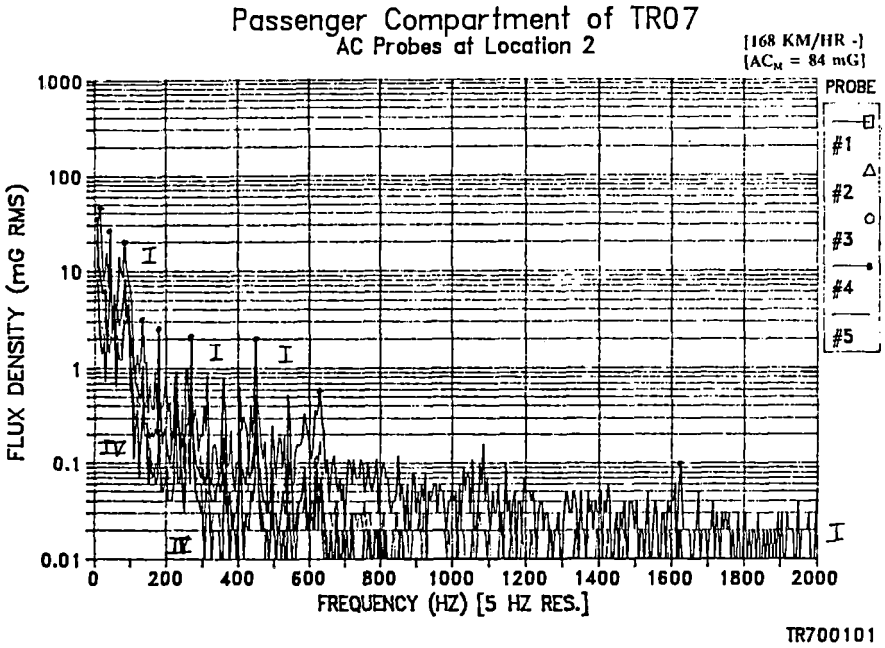
PROBE	COIL L		COIL T		COIL V		MAX COMPONENT		MIN COMPONENT		RMS	TOT RMS	FREQ
A1 # 1	5.552	123.11°	2.605	38.64°	5.196	144.41°	7.477	46.35°	2.950	-43.65°	8.04	12.96	5.00 Hz
	4.619	-67.93°	2.575	168.80°	1.318	-33.73°	5.025	-122.92°	2.108	147.08°	5.45	12.96	10.00 Hz
	1.673	73.68°	0.194	93.41°	0.490	-55.34°	1.713	-76.34°	0.379	-166.34°	1.75	12.96	15.00 Hz
	0.416	12.51°	1.295	-148.37°	0.271	-99.80°	1.365	148.92°	0.245	58.92°	1.39	12.96	20.00 Hz
	1.478	85.09°	0.770	-11.73°	0.679	-85.27°	1.628	90.84°	0.766	0.84°	1.80	12.96	25.00 Hz
	0.700	79.77°	0.376	-108.77°	0.036	154.83°	0.793	102.11°	0.061	12.11°	0.80	12.96	30.00 Hz
	1.724	9.77°	1.033	118.49°	0.842	14.68°	1.952	175.52°	0.969	85.52°	2.18	12.96	35.00 Hz
	1.105	-73.45°	0.227	-124.56°	0.849	153.00°	1.293	58.58°	0.567	-31.42°	1.41	12.96	40.00 Hz
	1.771	103.45°	0.225	1.96°	1.168	68.04°	2.038	86.42°	0.630	-3.58°	2.13	12.96	45.00 Hz
	1.597	-132.37°	0.644	-55.83°	0.901	-75.27°	1.709	119.01°	0.925	29.01°	1.94	12.96	50.00 Hz
	1.669	164.85°	1.178	65.18°	0.717	53.82°	1.739	-3.02°	1.290	-93.02°	2.17	12.96	55.00 Hz
	0.518	49.89°	0.329	-68.89°	0.386	-118.06°	0.672	118.22°	0.272	28.22°	0.72	12.96	60.00 Hz
	1.126	99.92°	0.889	-171.72°	0.338	103.45°	1.176	-102.78°	0.888	167.22°	1.47	12.96	65.00 Hz
	0.637	-18.18°	0.566	-62.43°	0.816	-147.71°	0.958	-6.46°	0.690	-96.46°	1.18	12.96	70.00 Hz
	1.010	70.06°	0.661	147.10°	0.196	82.43°	1.047	-78.75°	0.633	-168.75°	1.22	12.96	75.00 Hz
	2.014	-78.56°	0.754	40.44°	0.579	-14.71°	2.064	-99.70°	0.838	170.30°	2.23	12.96	80.00 Hz
	2.669	60.18°	0.322	13.98°	1.201	-92.88°	2.890	-63.97°	0.561	-153.97°	2.94	12.96	85.00 Hz
	2.234	-65.11°	1.044	-138.82°	1.769	145.75°	2.754	54.45°	1.274	-35.55°	3.03	12.96	90.00 Hz
	3.593	3.51°	0.665	93.27°	1.113	81.19°	3.602	-4.82°	1.272	-94.82°	3.82	12.96	95.00 Hz
	0.120	-147.99°	0.570	-162.74°	0.127	96.33°	0.582	161.58°	0.127	71.58°	0.60	12.96	100.00 Hz
	0.492	9.94°	0.019	66.30°	0.227	39.67°	0.532	-14.67°	0.105	-104.67°	0.54	12.96	105.00 Hz
	0.032	-129.76°	0.108	-83.68°	0.016	176.84°	0.110	86.01°	0.027	-3.99°	0.11	12.96	110.00 Hz
	0.227	37.10°	0.091	-136.86°	0.074	123.83°	0.245	141.65°	0.075	51.65°	0.26	12.96	115.00 Hz
	0.262	-36.39°	0.006	-34.08°	0.125	13.35°	0.276	29.83°	0.091	-60.17°	0.29	12.96	120.00 Hz
	0.031	80.54°	0.056	-3.33°	0.038	-55.95°	0.062	20.32°	0.041	-69.68°	0.07	12.96	125.00 Hz
	0.143	-5.31°	0.076	126.71°	0.076	-10.35°	0.171	-167.34°	0.053	102.66°	0.18	12.96	130.00 Hz
	0.283	109.86°	0.090	-128.83°	0.035	-161.61°	0.287	72.85°	0.083	-17.15°	0.30	12.96	135.00 Hz
	0.138	49.49°	0.122	-114.13°	0.023	-76.61°	0.183	122.88°	0.031	32.88°	0.19	12.96	140.00 Hz
	0.084	16.24°	0.159	-19.71°	0.082	16.95°	0.189	7.62°	0.059	-82.38°	0.20	12.96	145.00 Hz
	0.028	108.27°	0.033	134.58°	0.045	76.05°	0.057	-96.81°	0.026	173.19°	0.06	12.96	150.00 Hz
	0.085	-4.07°	0.062	50.79°	0.043	27.98°	0.104	-14.78°	0.047	-104.78°	0.11	12.96	155.00 Hz
	0.015	-66.33°	0.060	-154.47°	0.023	-28.95°	0.061	159.01°	0.024	69.01°	0.07	12.96	160.00 Hz
	0.034	-19.84°	0.057	-103.79°	0.043	-24.95°	0.060	70.73°	0.051	-19.27°	0.08	12.96	165.00 Hz
	0.036	85.45°	0.046	-83.76°	0.010	65.86°	0.059	88.44°	0.007	-1.56°	0.06	12.96	170.00 Hz
	0.066	81.54°	0.023	147.55°	0.008	112.84°	0.067	-84.86°	0.021	-174.86°	0.07	12.96	175.00 Hz
	0.114	164.68°	0.100	-30.33°	0.177	-57.45°	0.222	43.13°	0.072	-46.87°	0.23	12.96	180.00 Hz
	0.042	1.14°	0.010	-107.39°	0.018	-8.05°	0.046	179.47°	0.010	89.47°	0.05	12.96	185.00 Hz
	0.045	36.08°	0.019	136.81°	0.010	29.48°	0.046	146.27°	0.018	56.27°	0.05	12.96	190.00 Hz
	0.045	-10.80°	0.038	-12.97°	0.027	-1.68°	0.064	9.99°	0.004	-80.01°	0.06	12.96	195.00 Hz
	0.070	-14.93°	0.027	17.54°	0.017	145.65°	0.075	12.40°	0.015	-77.60°	0.08	12.96	200.00 Hz
	0.034	40.14°	0.025	-175.46°	0.015	7.15°	0.043	154.44°	0.013	64.44°	0.04	12.96	205.00 Hz
	0.026	-77.37°	0.032	103.14°	0.017	22.76°	0.041	-100.87°	0.017	169.13°	0.04	12.96	210.00 Hz
	0.034	23.12°	0.022	-175.32°	0.014	89.32°	0.040	159.80°	0.014	69.80°	0.04	12.96	215.00 Hz
	0.046	22.38°	0.009	66.93°	0.029	32.06°	0.055	-26.02°	0.007	-116.02°	0.06	12.96	220.00 Hz
	0.389	75.34°	0.037	52.21°	0.136	-49.31°	0.399	-78.52°	0.111	-168.52°	0.41	12.96	225.00 Hz
	0.027	-14.68°	0.050	61.40°	0.017	-106.09°	0.053	-58.23°	0.027	-148.23°	0.06	12.96	230.00 Hz
	0.054	165.75°	0.025	-41.78°	0.014	8.68°	0.060	17.32°	0.012	-72.68°	0.06	12.96	235.00 Hz
	0.099	-24.81°	0.038	-151.81°	0.041	175.90°	0.109	-161.79°	0.032	108.21°	0.11	12.96	240.00 Hz
	0.024	122.15°	0.039	150.90°	0.009	33.84°	0.045	-144.10°	0.013	125.90°	0.05	12.96	245.00 Hz
	0.020	99.39°	0.020	-73.30°	0.012	101.55°	0.030	77.16°	0.002	-12.84°	0.03	12.96	250.00 Hz

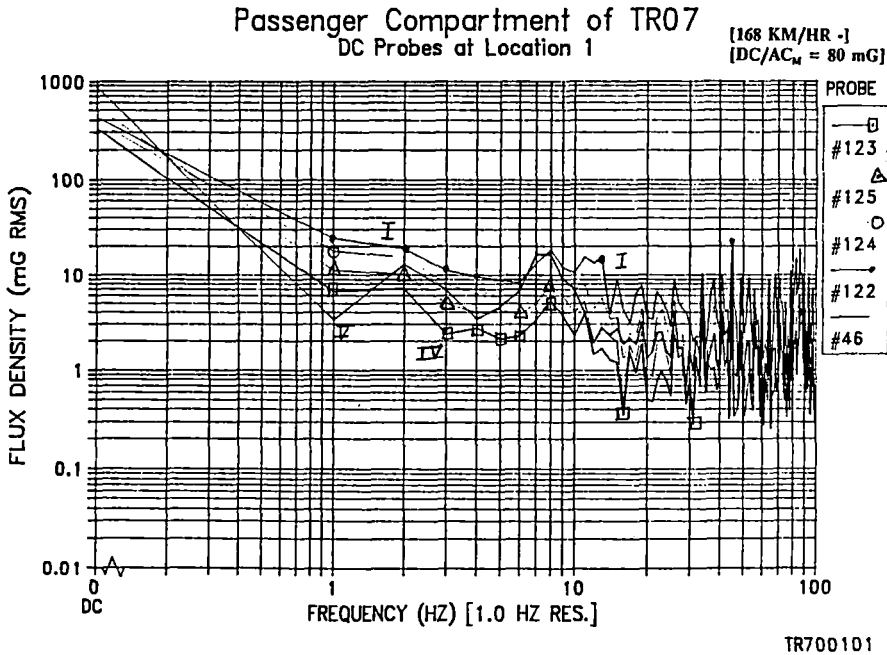
"RMS" RESULTANT FLUX DENSITY PRINTOUT OF TR700101

"TR700101"
"Transrapid Facility ,Emsland, FDR"
"168km/h, constant speed, loc and 2, 5/1Hz 1024pts"

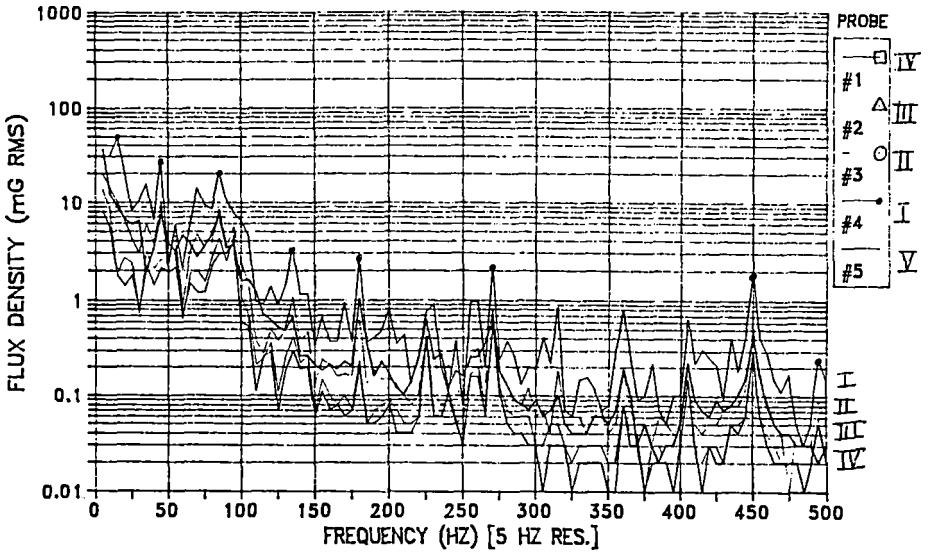
"RESULTANT FLUX DENSITY (mG RMS)"

"Hz"	"A1 # 1"	"B1 # 2"	"C1 # 3"	"D1 # 4"	"E1 # 5"	"Hz"	"A2 #122"	"B2 #124"	"C2 #125"	"D2 #123"	"E2 # 46"
0	0	0	0	0	0	0	423.68	377.71	533.74	329.49	860.34
5.00	8.04	13.48	19.70	30.65	36.25	1.00	24.04	17.63	11.12	6.63	3.31
10.00	5.45	8.18	14.28	29.83	12.39	2.00	18.84	14.91	10.23	7.27	12.92
15.00	1.75	1.90	10.03	49.82	8.71	3.00	11.02	8.11	4.99	2.31	6.89
20.00	1.39	2.70	6.51	20.92	6.79	4.00	9.63	6.14	4.04	2.76	3.34
25.00	1.80	2.41	4.20	8.09	5.86	5.00	8.78	6.74	4.17	2.11	4.61
30.00	0.80	0.73	2.96	10.36	6.46	6.00	8.19	6.67	3.86	2.30	6.82
35.00	2.18	3.14	5.91	15.27	1.93	7.00	13.15	8.55	5.04	3.36	16.54
40.00	1.41	2.08	3.68	6.59	3.20	8.00	18.35	13.04	8.12	5.35	16.22
45.00	2.13	2.58	9.57	26.78	7.60	9.00	12.11	9.14	6.21	3.68	9.18
50.00	1.94	2.46	2.36	2.24	3.84	10.00	10.32	6.86	4.04	2.27	7.09
55.00	2.17	3.06	4.61	5.86	3.11	11.00	15.25	8.08	5.32	3.90	3.95
60.00	0.72	0.63	0.90	2.04	4.54	12.00	13.36	4.27	1.88	1.46	1.94
65.00	1.47	1.89	3.03	5.90	3.78	13.00	14.94	5.71	2.82	1.69	2.72
70.00	1.18	2.00	4.70	14.03	2.69	14.00	3.73	3.39	2.22	1.27	2.26
75.00	1.22	1.53	3.38	9.45	3.54	15.00	8.95	3.36	1.95	1.20	2.74
80.00	2.23	2.70	3.79	8.35	4.57	16.00	4.08	1.21	0.46	0.35	1.85
85.00	2.94	4.33	8.34	20.88	7.31	17.00	3.12	2.38	1.85	1.52	2.15
90.00	3.03	2.47	3.48	10.40	3.36	18.00	6.33	2.26	1.24	0.93	1.84
95.00	3.82	4.56	5.54	7.65	3.65	19.00	7.73	4.28	2.56	1.83	3.18
100.00	0.60	1.06	2.46	6.51	1.57	20.00	3.55	1.71	0.81	0.50	1.31
105.00	0.54	0.70	1.37	4.48	1.63	21.00	3.38	1.56	0.84	0.47	1.54
110.00	0.11	0.21	0.37	0.97	1.19	22.00	6.66	3.74	1.87	0.79	2.43
115.00	0.26	0.25	0.27	0.89	0.71	23.00	5.54	4.27	2.21	0.99	2.49
120.00	0.29	0.36	0.51	1.38	0.62	24.00	4.32	2.85	1.50	0.77	1.57
125.00	0.07	0.11	0.37	0.88	0.52	25.00	2.78	1.73	0.92	0.55	1.37
130.00	0.18	0.26	0.51	1.41	0.48	26.00	8.72	5.27	3.27	2.33	4.06
135.00	0.30	0.42	1.06	3.37	0.66	27.00	5.07	2.50	1.73	1.32	1.64
140.00	0.19	0.22	0.37	1.15	0.26	28.00	4.34	2.27	1.78	1.48	1.73
145.00	0.20	0.27	0.47	1.17	0.26	29.00	3.91	1.18	0.52	0.45	0.69
150.00	0.06	0.07	0.13	0.34	0.21	30.00	2.94	1.49	0.82	0.71	1.52
155.00	0.11	0.15	0.24	0.67	0.18	31.00	1.98	0.84	0.41	0.28	1.03
160.00	0.07	0.10	0.21	0.37	0.21	32.00	2.22	1.40	1.36	1.34	2.03
165.00	0.08	0.08	0.16	0.37	0.19	33.00	2.23	1.15	0.83	0.69	1.47
170.00	0.06	0.10	0.17	0.93	0.23	34.00	10.50	6.21	4.38	3.41	4.28
175.00	0.07	0.07	0.16	0.36	0.20	35.00	1.63	0.98	0.77	0.60	0.58
180.00	0.23	0.19	0.67	2.77	1.03	36.00	3.54	2.50	1.65	1.14	1.26
185.00	0.05	0.05	0.13	0.36	0.35	37.00	6.62	3.34	1.80	1.00	1.72
190.00	0.05	0.07	0.19	0.41	0.16	38.00	8.96	4.54	2.26	1.07	2.40
195.00	0.06	0.08	0.15	0.49	0.23	39.00	3.37	1.88	1.07	0.62	1.26
200.00	0.08	0.09	0.15	0.81	0.17	40.00	2.64	1.90	1.32	0.84	0.97
205.00	0.04	0.07	0.13	0.35	0.12	41.00	9.85	5.30	3.50	2.53	3.97
210.00	0.04	0.05	0.10	0.44	0.10	42.00	3.99	2.16	1.41	1.08	2.26
215.00	0.04	0.05	0.08	0.13	0.14	43.00	4.33	2.01	1.64	1.47	2.67
220.00	0.06	0.06	0.10	0.27	0.25	44.00	1.88	0.64	0.56	0.58	0.32
225.00	0.41	0.42	0.48	0.76	0.63	45.00	23.33	8.76	2.70	2.27	7.16
230.00	0.06	0.10	0.25	0.91	0.24	46.00	5.26	1.59	0.54	0.34	0.94
235.00	0.06	0.08	0.13	0.20	0.28	47.00	3.01	1.10	0.48	0.39	0.85
240.00	0.11	0.09	0.21	0.11	0.12	48.00	0.99	0.62	0.57	0.51	1.02


Passenger Compartment of TR07
AC Probes at Location 2
[168 KM/HR -]
[AC$_M$ = 84 mG]
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700101

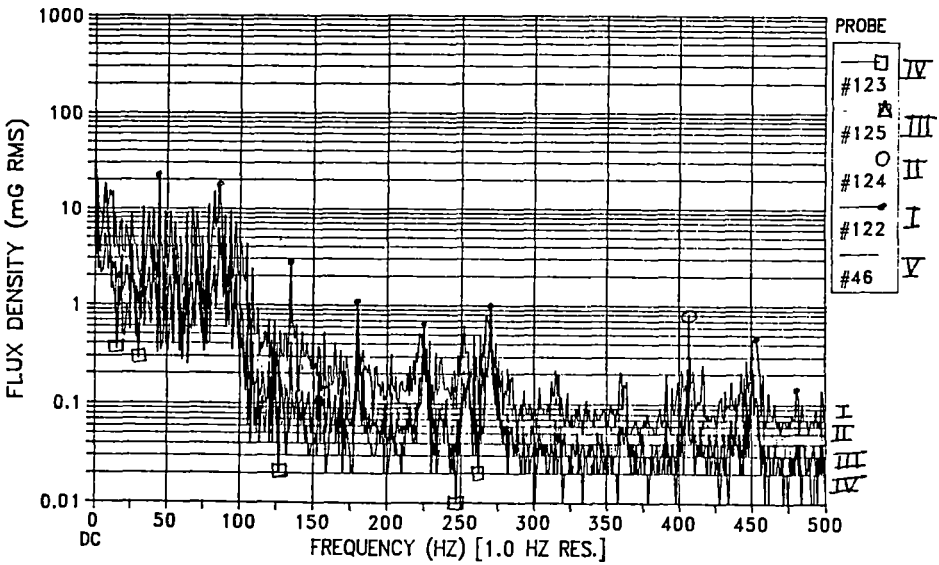

Passenger Compartment of TR07
DC Probes at Location 1
[168 KM/HR -]
[DC/AC$_M$ = 80 mG]
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [1.0 HZ RES.]
TR700101

Passenger Compartment of TR07
AC Probes at Location 2

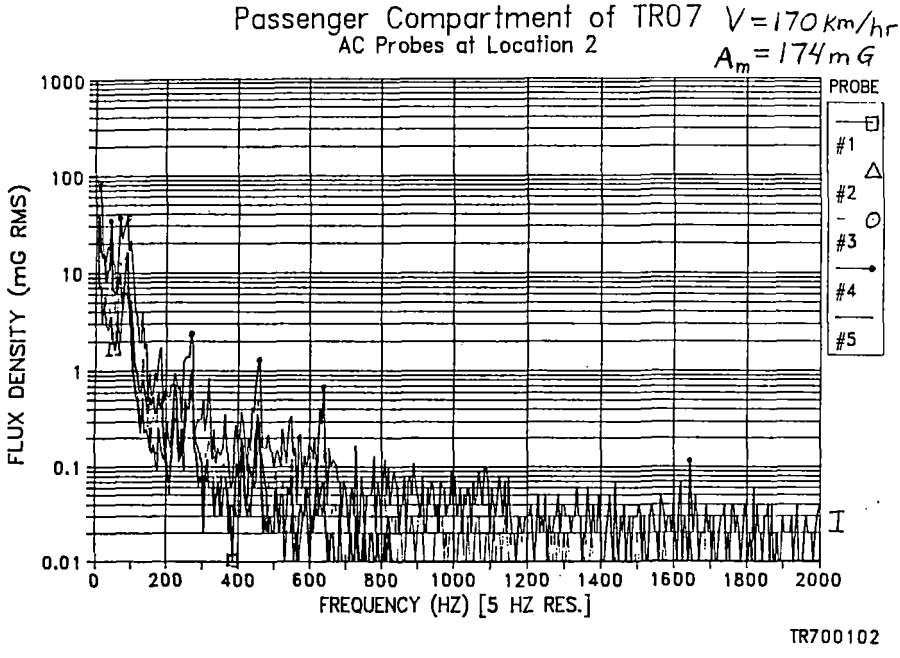


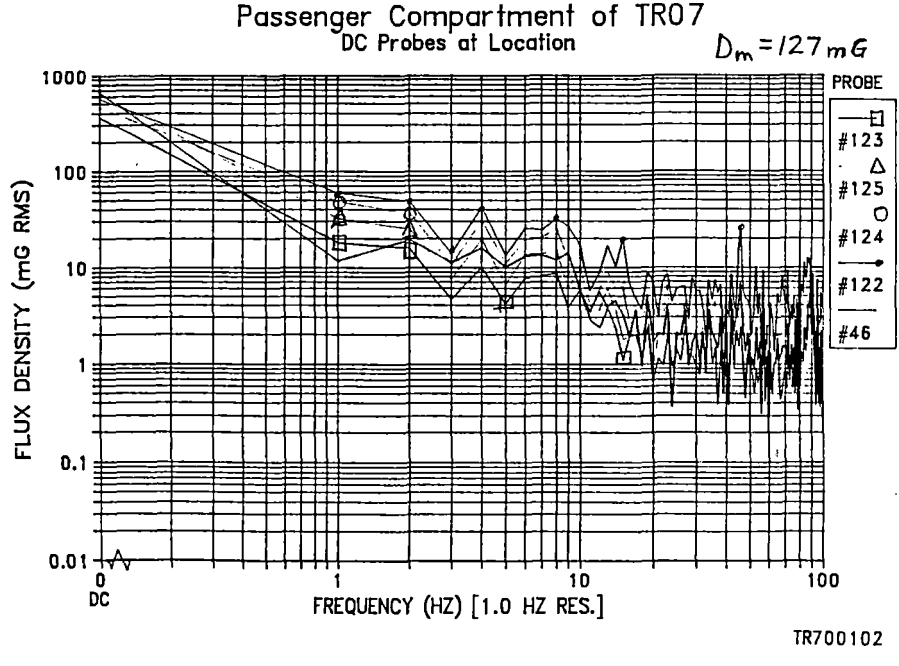
TR700101

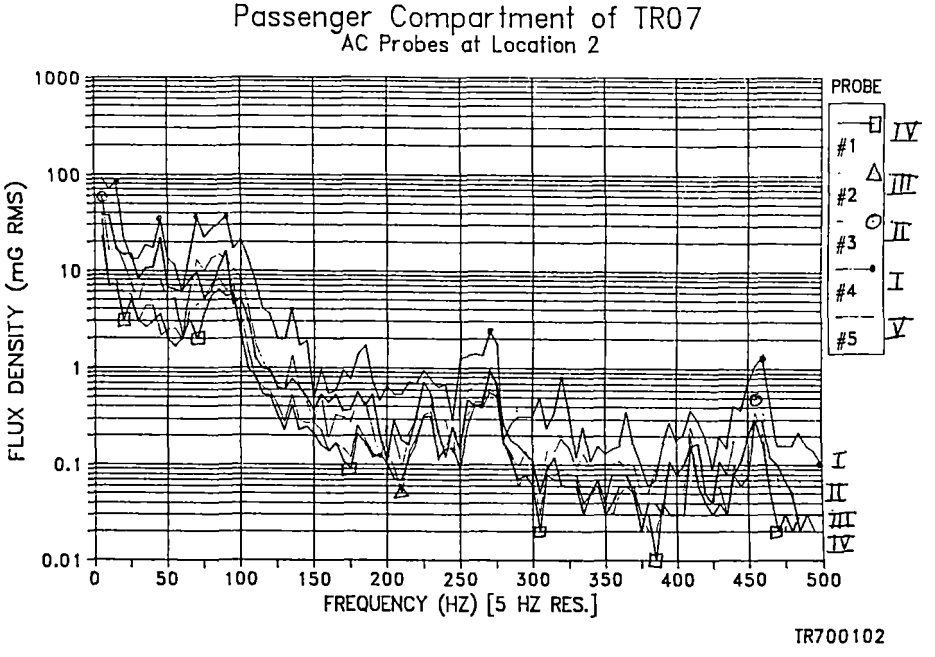
Passenger Compartment of TR07
DC Probes at Location 1

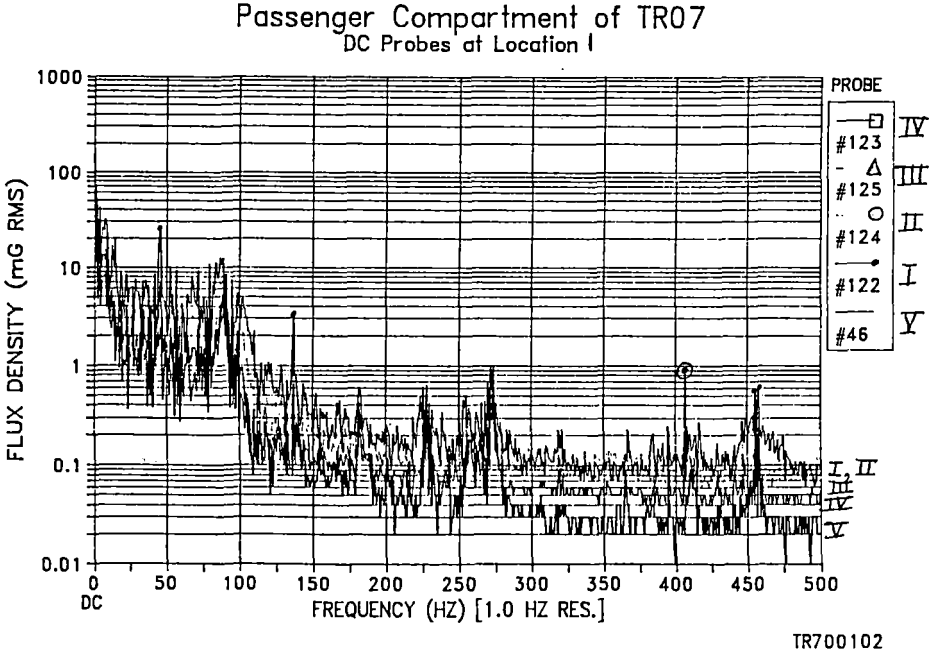


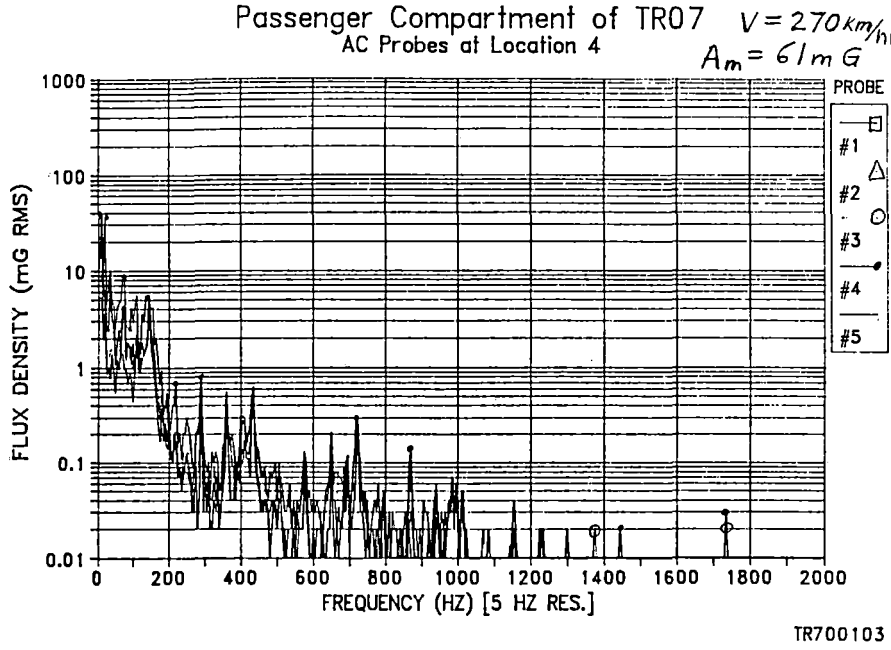
TR700101

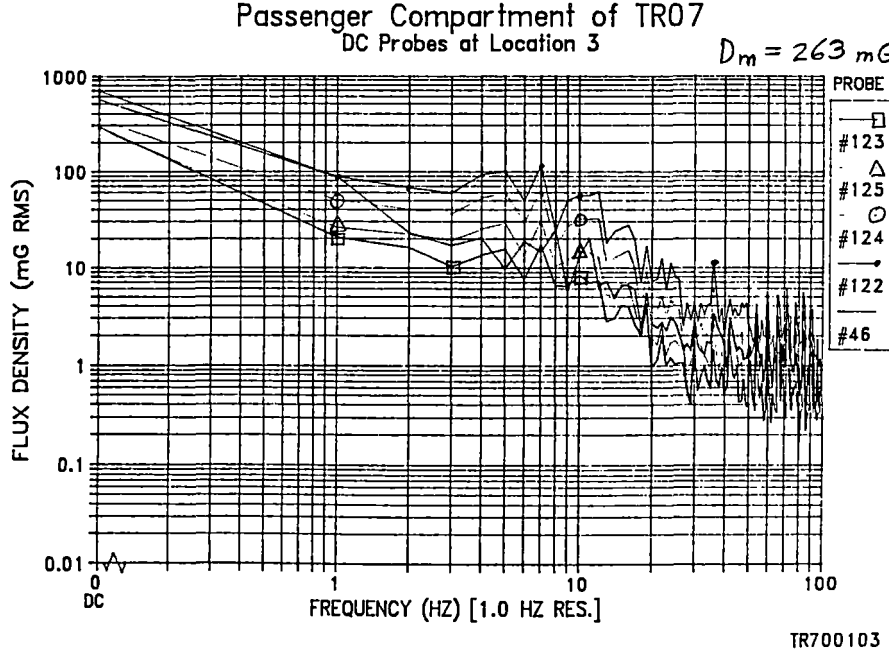

Passenger Compartment of TR07 V=170 km/hr
AC Probes at Location 2
Am=174 mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700102


Passenger Compartment of TR07
DC Probes at Location
Dm=127 mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [1.0 HZ RES.]
TR700102

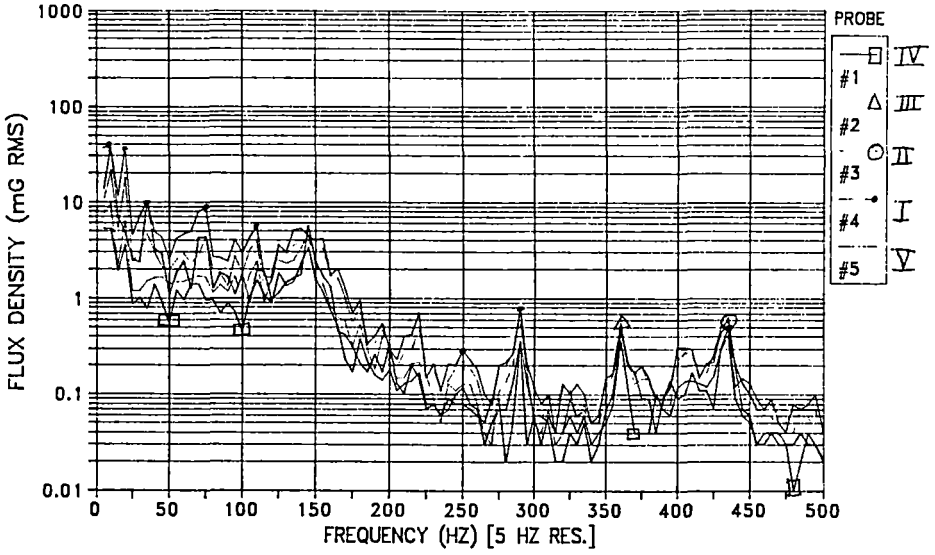

Passenger Compartment of TR07
AC Probes at Location 2
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV
III
II
I
V
TR700102


Passenger Compartment of TR07
DC Probes at Location 1
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [1.0 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
TR700102


Passenger Compartment of TR07
AC Probes at Location 4
V = 270 km/hr
Am = 61 mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700103

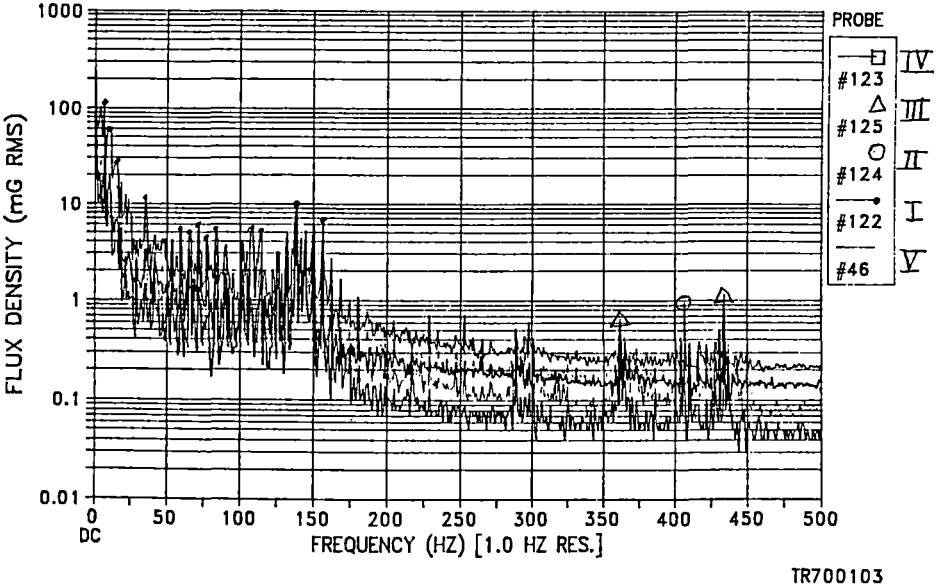

Passenger Compartment of TR07
DC Probes at Location 3
Dm = 263 mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [1.0 HZ RES.]
TR700103

Passenger Compartment of TR07
AC Probes at Location 4



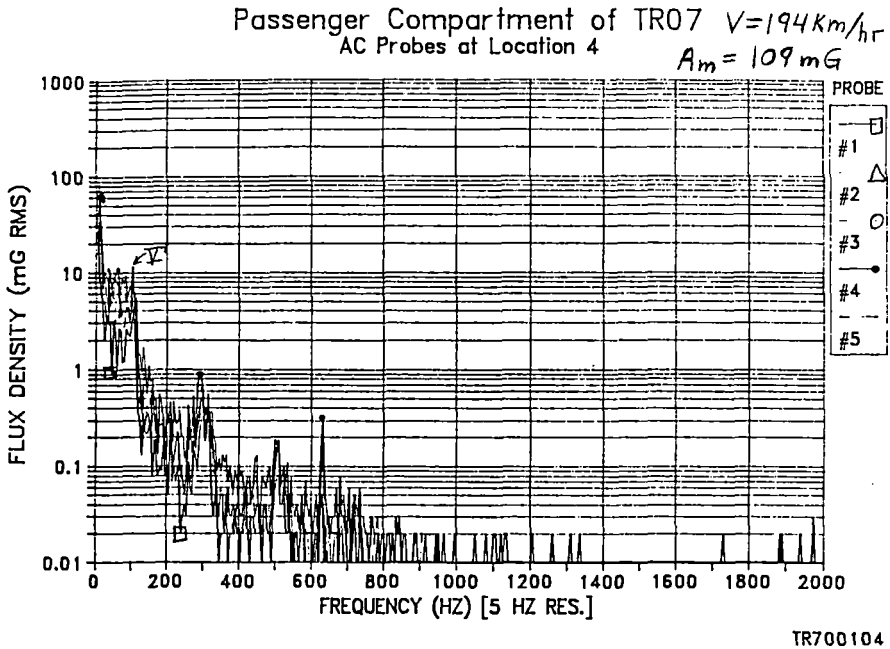
TR700103

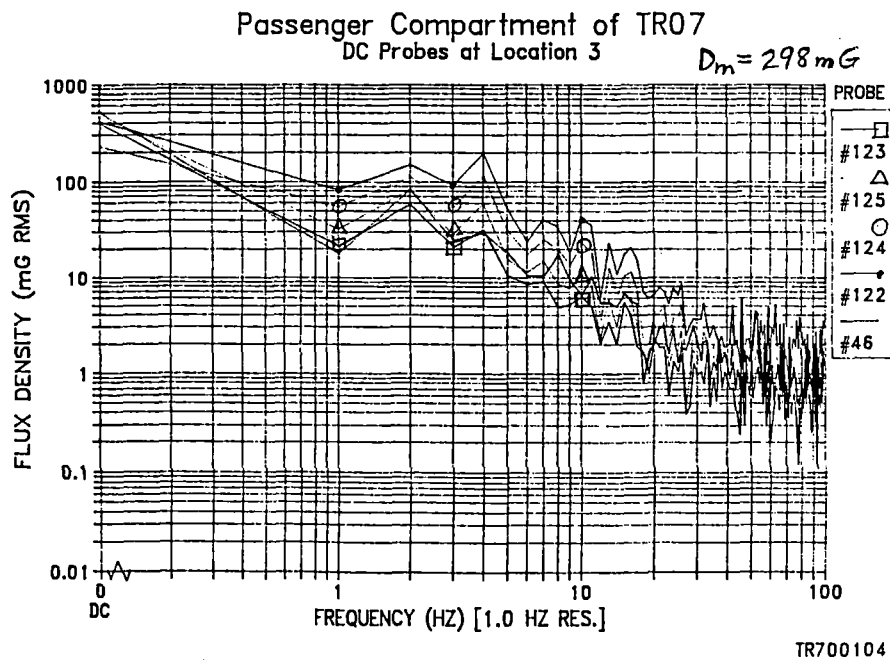
Passenger Compartment of TR07
DC Probes at Location 3



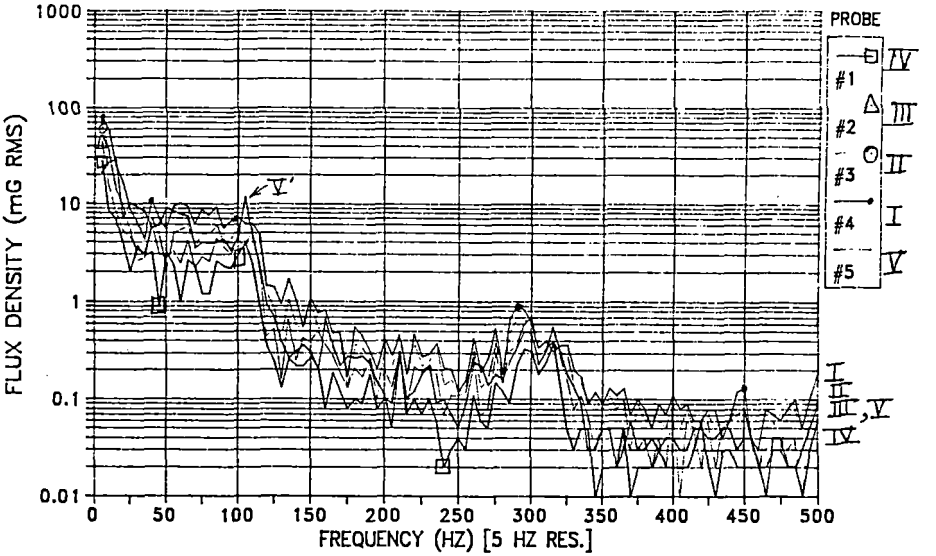
TR700103

[redacted]


Passenger Compartment of TR07 V=194Km/hr
AC Probes at Location 4
Am = 109mG
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700104

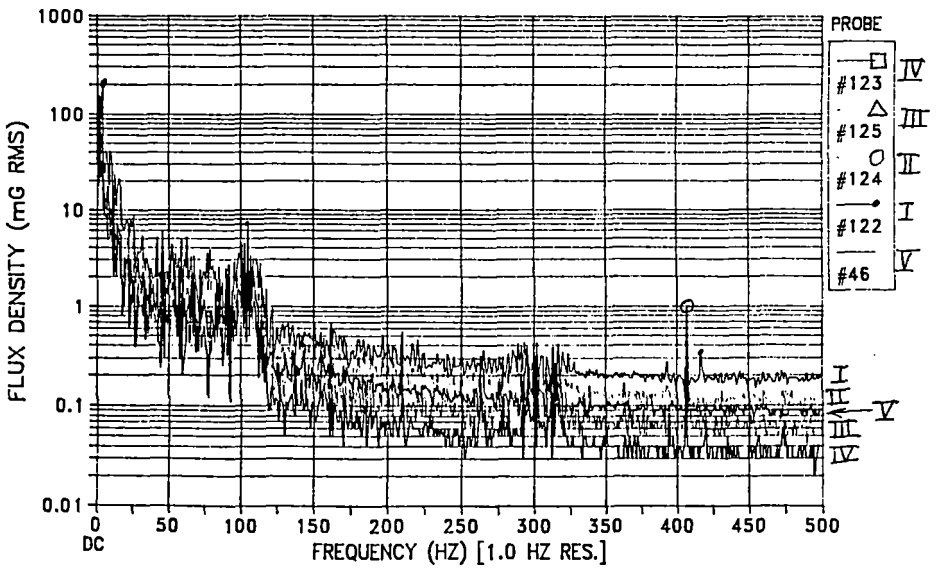

Passenger Compartment of TR07
DC Probes at Location 3
Dm = 298mG
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [1.0 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700104

Passenger Compartment of TR07
AC Probes at Location 4



TR700104

Passenger Compartment of TR07
DC Probes at Location 3



TR700104

TR7001

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 001
> On board magnetic field measurements
> ac loc #4 1 Hz dc loc #3 5 Hz
> continuous run full track
Start: 08/07/90 (Tuesday) AT 10:20:00
End: 08/07/90 (Tuesday) AT 10:30:00
Recorded   21 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	1.00	1024.00

RANGE SETTINGS:

A1 # 1	Pole mounted standing head level- 5-'9	
	COIL L:	30.0mG
	COIL T:	30.0mG
	COIL V:	30.0mG
B1 # 2	Pole mounted at seated head level- 3'-8"	
	COIL L:	30.0mG
	COIL T:	100mG
	COIL V:	100mG
C1 # 3	Pole mounted at seat level- 1'-6.5"	
	COIL L:	100mG
	COIL T:	100mG
	COIL V:	100mG
D1 # 4	Pole mounted at floor level- 5"	
	COIL L:	100mG
	COIL T:	300mG
	COIL V:	100mG
E1 # 5	Control	
	COIL L:	100mG
	COIL T:	300mG
	COIL V:	100mG
A2 #122	Pole mounted at floor level - 5"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
B2 #124	Pole mounted at seat level - 1'-6.5"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
C2 #125	Pole mounted at seated head level - 3'8"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
D2 #123	Pole mounted standing head level - 5'9"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
E2 # 46	Control in seat near bulkhead	
	DC - A:	300mG
	DC - B:	1000mG
	DC - C:	1000mG

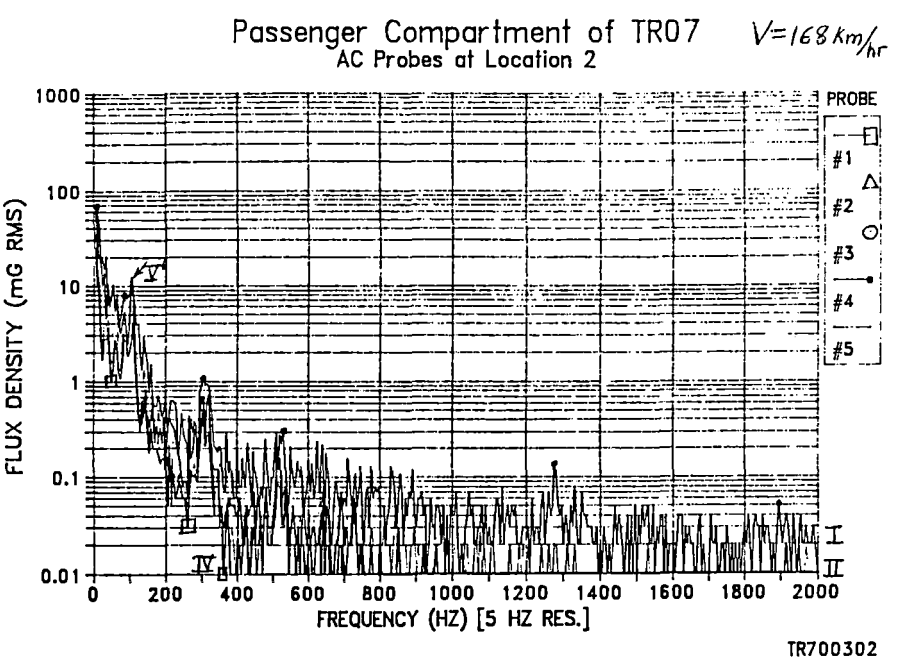
TR7002

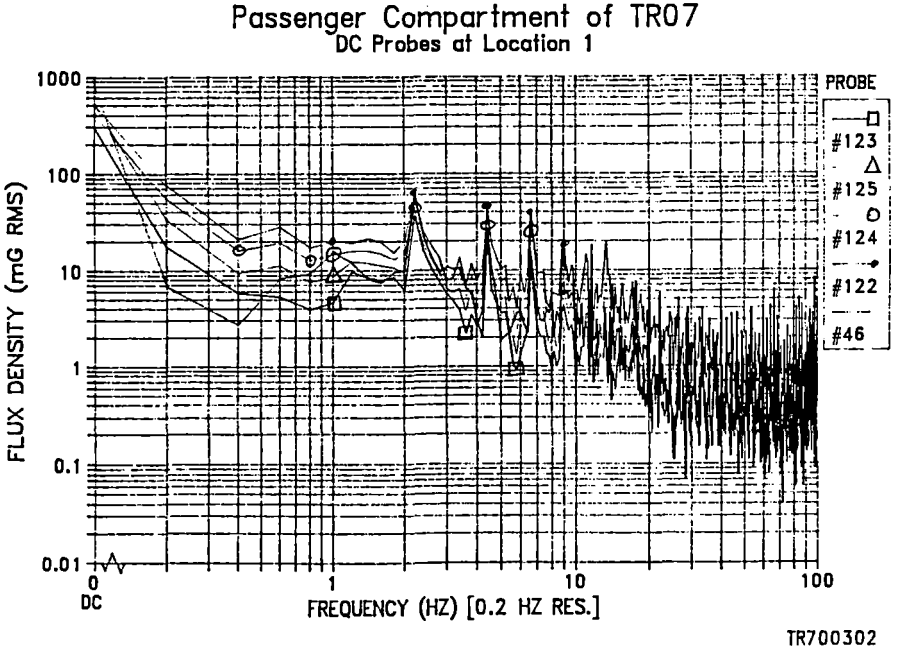
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 002
> On board magnetic field measurements
> ac loc #2 1 Hz dc loc #1 5 Hz/1Hz
> continuous run full track
Start: 08/07/90 (Tuesday) AT 10:38:00
End: 08/07/90 (Tuesday) AT 10:48:00
Recorded   21 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

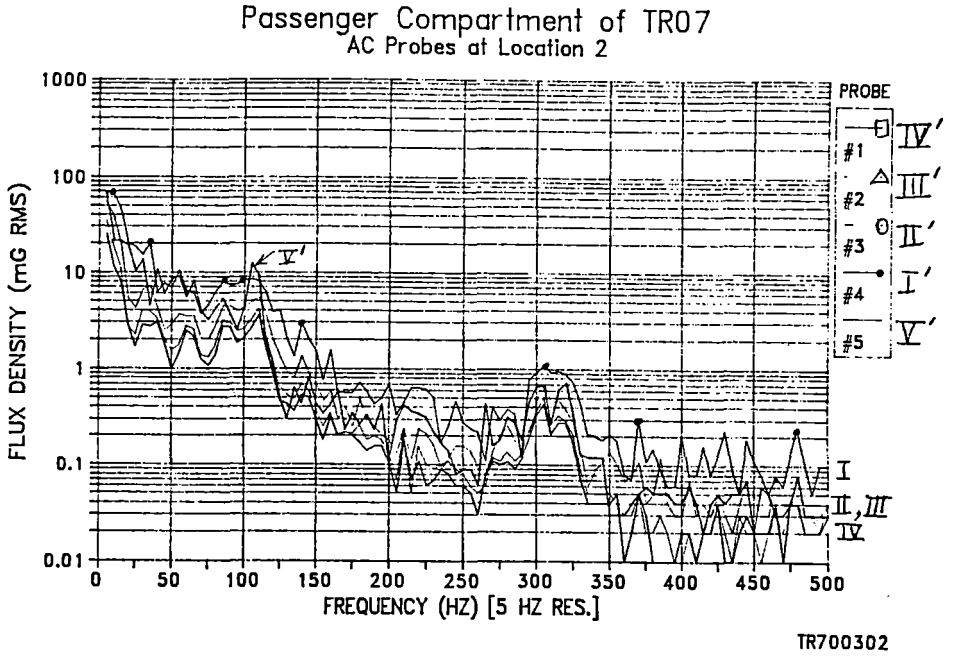
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	1.00	1024.00

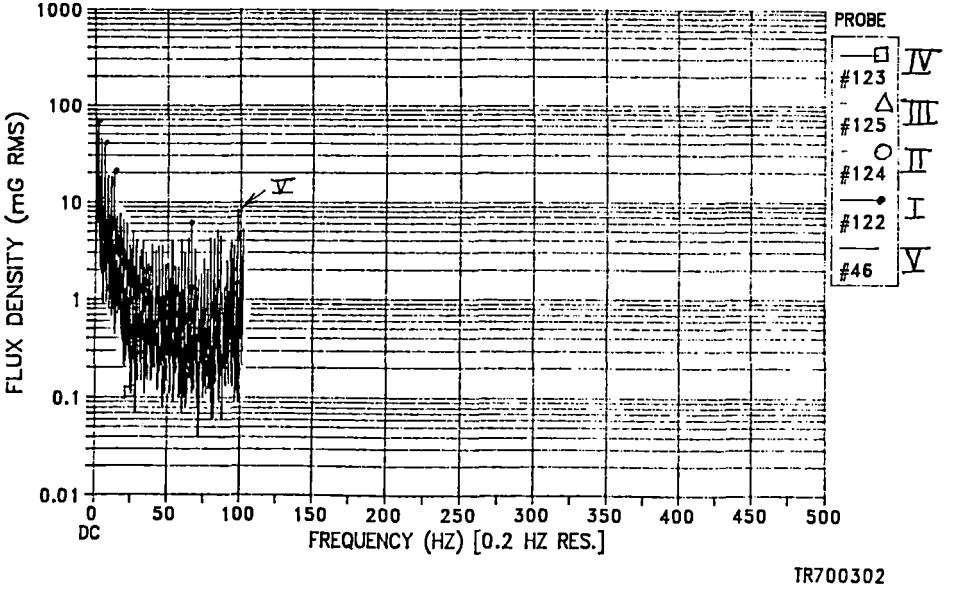
RANGE SETTINGS:

A1 # 1 Pole mounted standing head level- 5-'9
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
B1 # 2 Pole mounted at seated head level- 3'-8"
COIL L: 100mG
COIL T: 30.0mG
COIL V: 30.0mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
COIL L: 300mG
COIL T: 100mG
COIL V: 100mG
D1 # 4 Pole mounted at floor level- 5"
COIL L: 300mG
COIL T: 300mG
COIL V: 300mG
E1 # 5 Control
COIL L: 30.0mG
COIL T: 300mG
COIL V: 100mG
A2 #122 Pole mounted at floor level - 5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
DC - A: 1000mG
DC - B: 300mG
DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG


Passenger Compartment of TR07
V=168 km/hr
AC Probes at Location 2
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
I
II
III
IV
V
TR700302


Passenger Compartment of TR07
DC Probes at Location 1
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700302


Passenger Compartment of TR07
AC Probes at Location 2
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV′
III′
II′
I′
V′
V′
I
II, III
IV
TR700302


Passenger Compartment of TR07
DC Probes at Location 1
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
V
TR700302

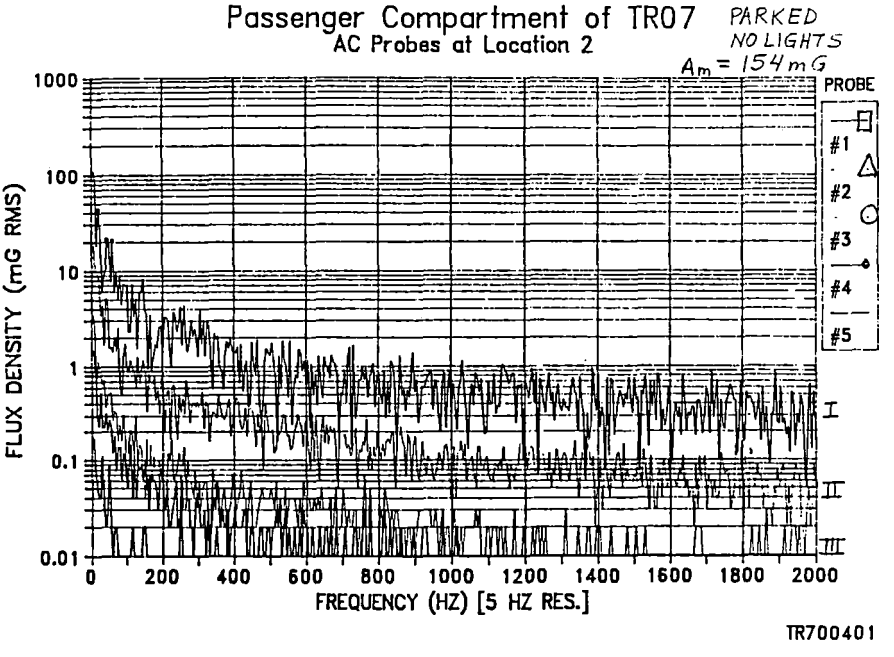
TR7003

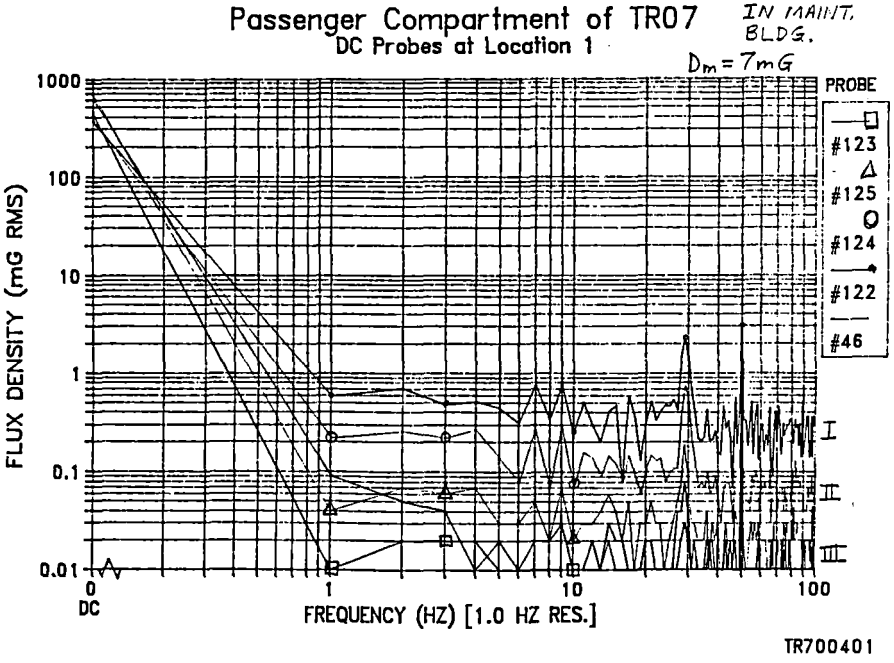
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 003
> On board magnetic field measurements
> ac loc #2 .2 Hz dc loc #1 5 Hz/1Hz
> continuous run - afternoon run
Start: 08/07/90 (Tuesday) AT 13:30:00
End: 08/07/90 (Tuesday) AT 13:40:00
Recorded   17 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

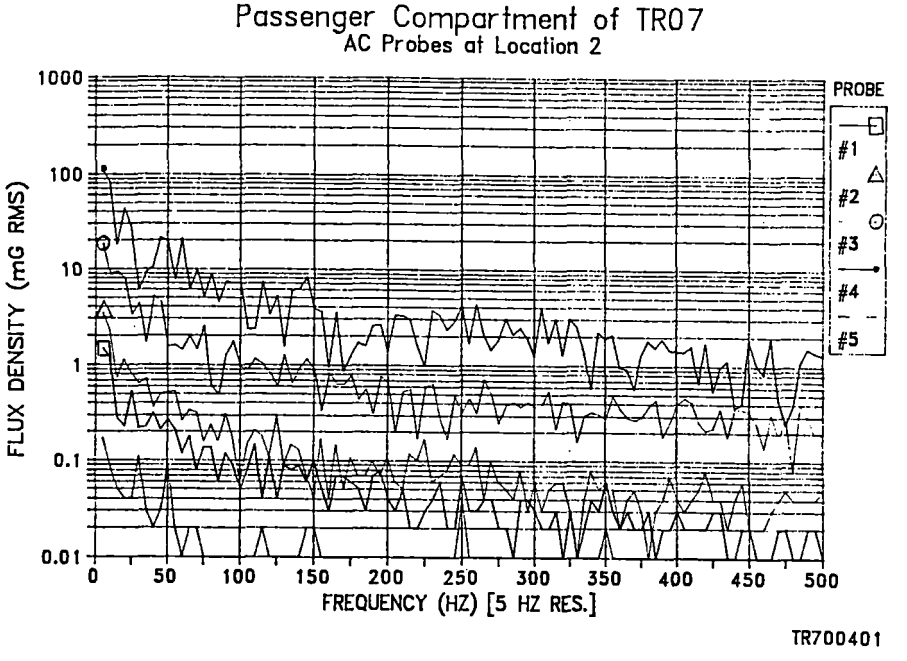
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

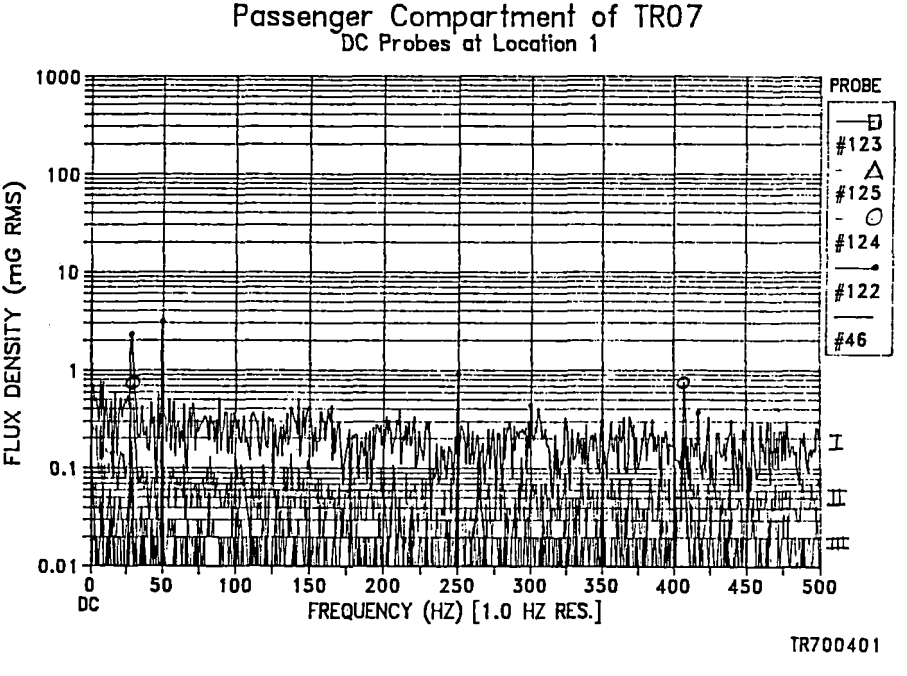
RANGE SETTINGS:

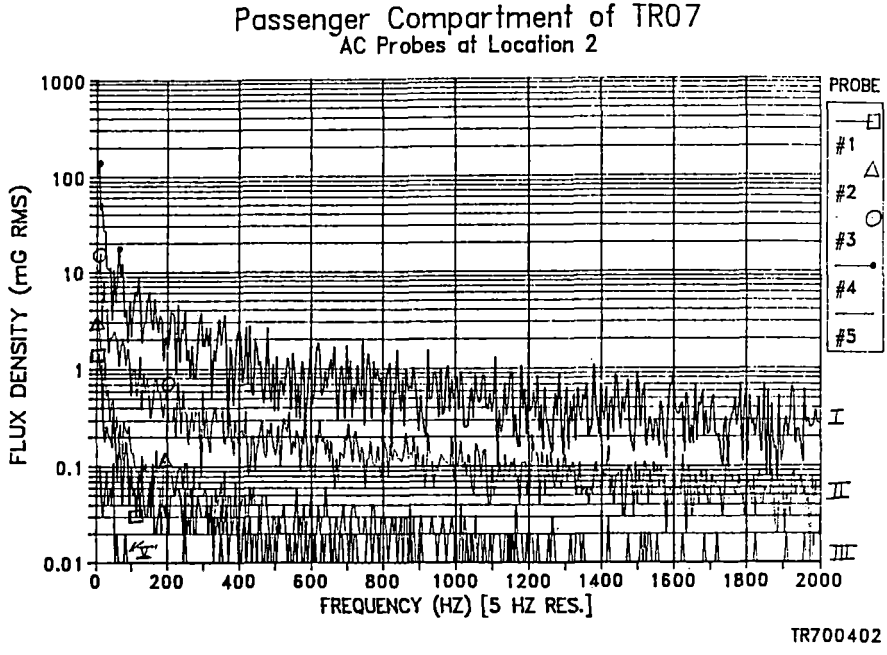
A1 # 1 Pole mounted standing head level- 5-'9
COIL L: 100mG
COIL T: 30.0mG
COIL V: 30.0mG
B1 # 2 Pole mounted at seated head level- 3'-8"
COIL L: 100mG
COIL T: 30.0mG
COIL V: 100mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
COIL L: 300mG
COIL T: 100mG
COIL V: 100mG
D1 # 4 Pole mounted at floor level- 5"
COIL L: 300mG
COIL T: 300mG
COIL V: 1000mG
E1 # 5 Control
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #122 Pole mounted at floor level - 5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

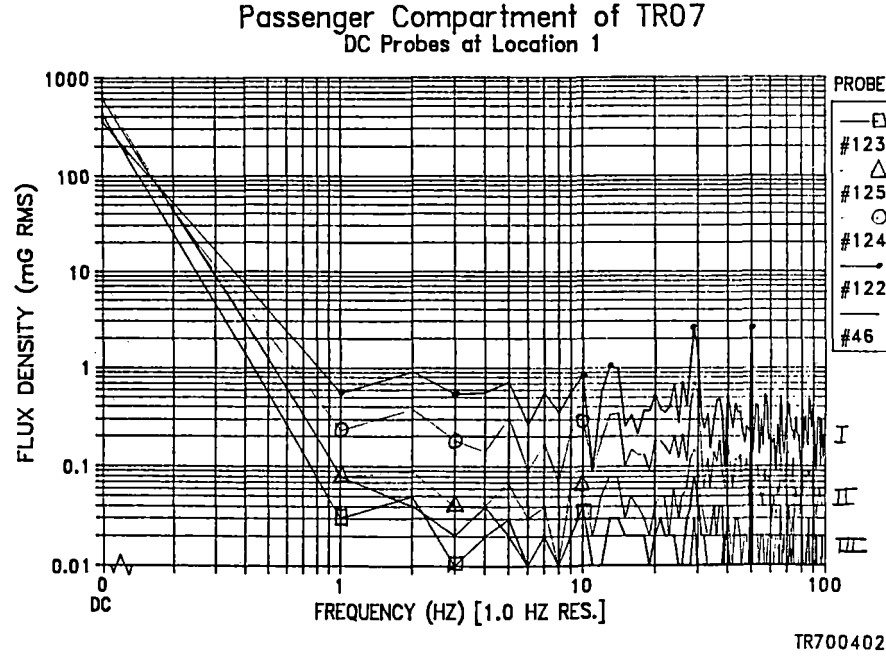

Passenger Compartment of TR07
AC Probes at Location 2
PARKED
NO LIGHTS
Am = 154mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
I
II
III
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700401


Passenger Compartment of TR07
DC Probes at Location 1
IN MAINT. BLDG.
Dm = 7mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
I
II
III
0
DC
1
10
100
FREQUENCY (HZ) [1.0 HZ RES.]
TR700401

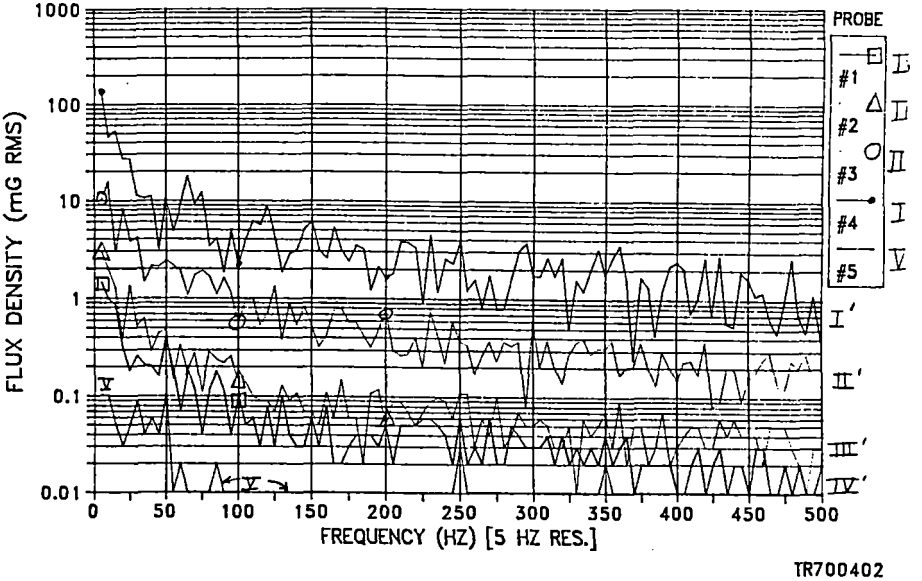

Passenger Compartment of TR07
AC Probes at Location 2
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700401


Passenger Compartment of TR07
DC Probes at Location 1
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
DC
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [1.0 HZ RES.]
PROBE
#123
#125
#124
#122
#46
I
II
III
TR700401


Passenger Compartment of TR07
AC Probes at Location 2
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
I
II
III
TR700402

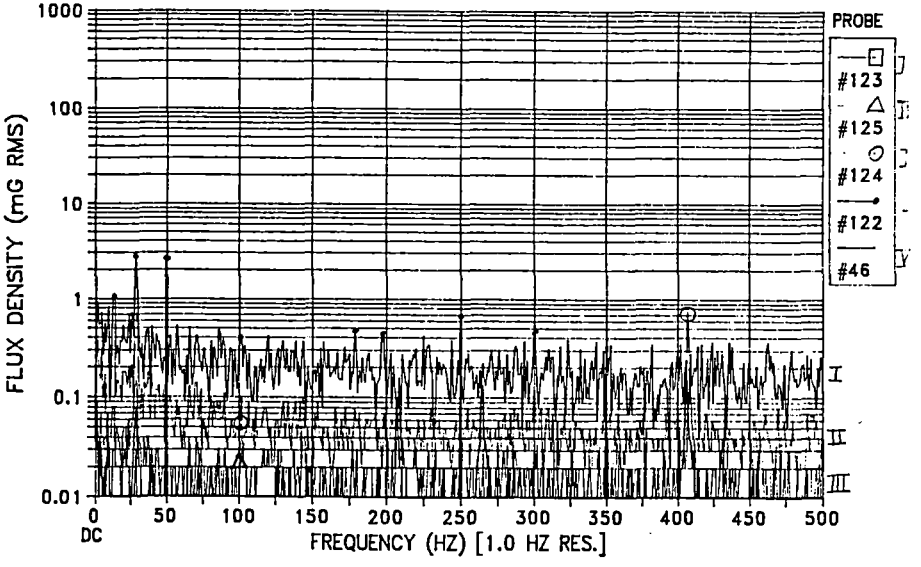

Passenger Compartment of TR07
DC Probes at Location 1
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [1.0 HZ RES.]
PROBE
#123
#125
#124
#122
#46
I
II
III
TR700402

Passenger Compartment of TR07
AC Probes at Location 2



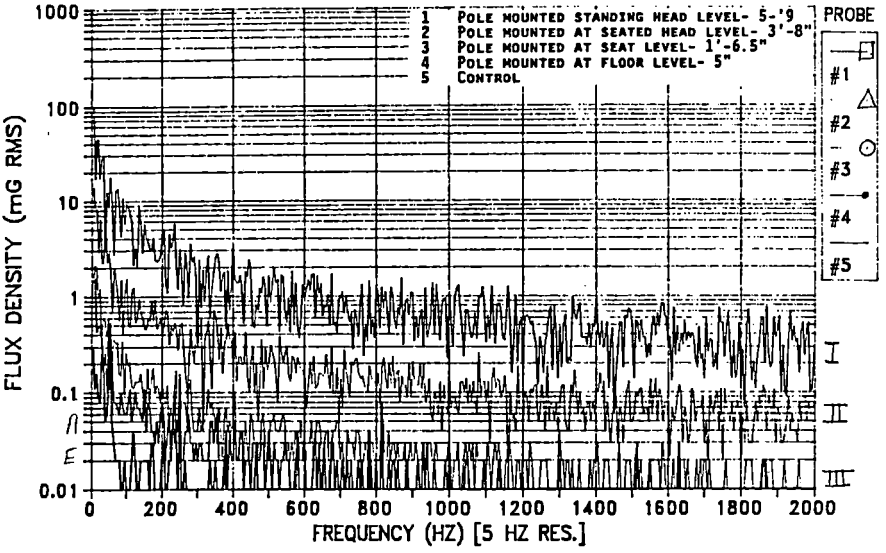
TR700402

Passenger Compartment of TR07
DC Probes at Location 1



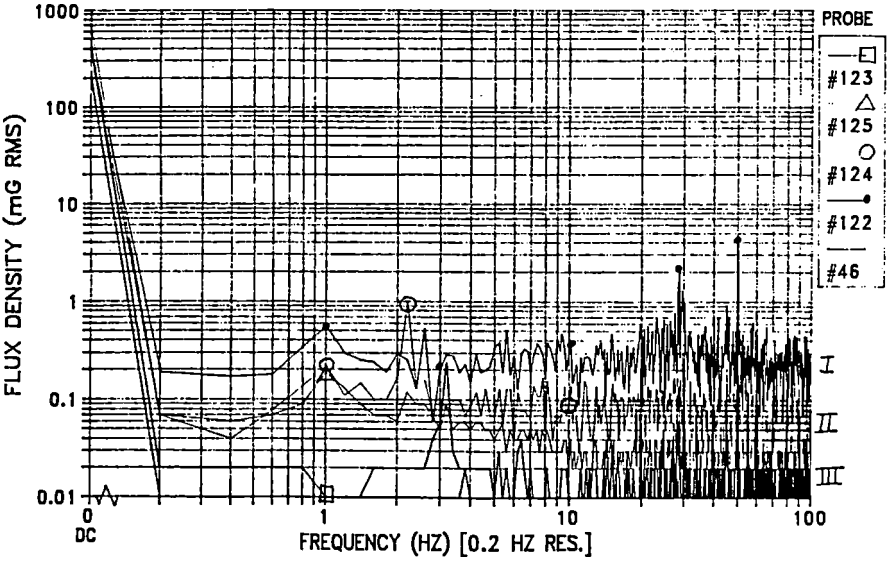
TR700402

Passenger Compartment of TR07
AC Probes at Location 2

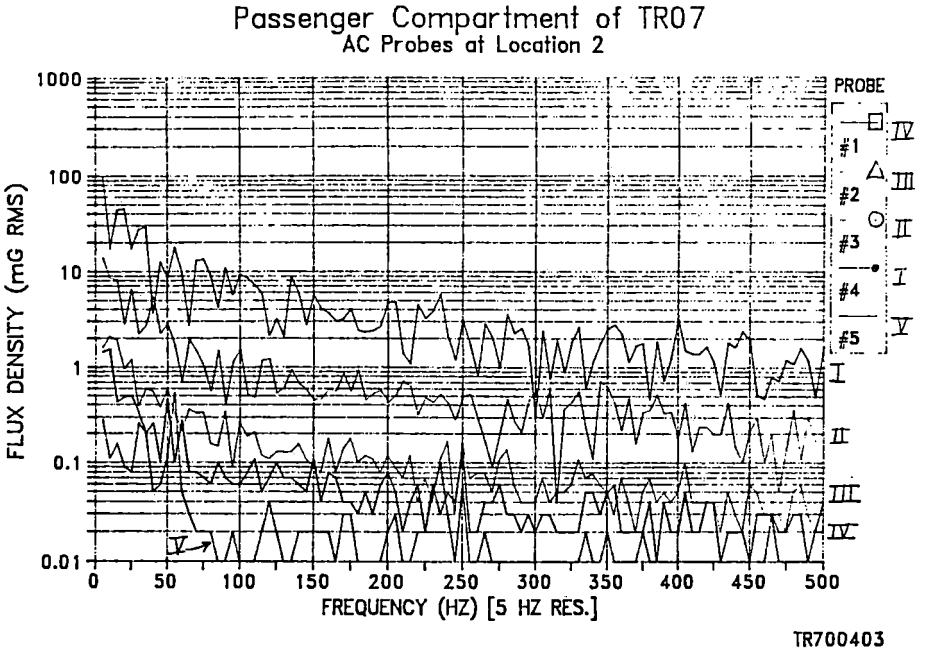


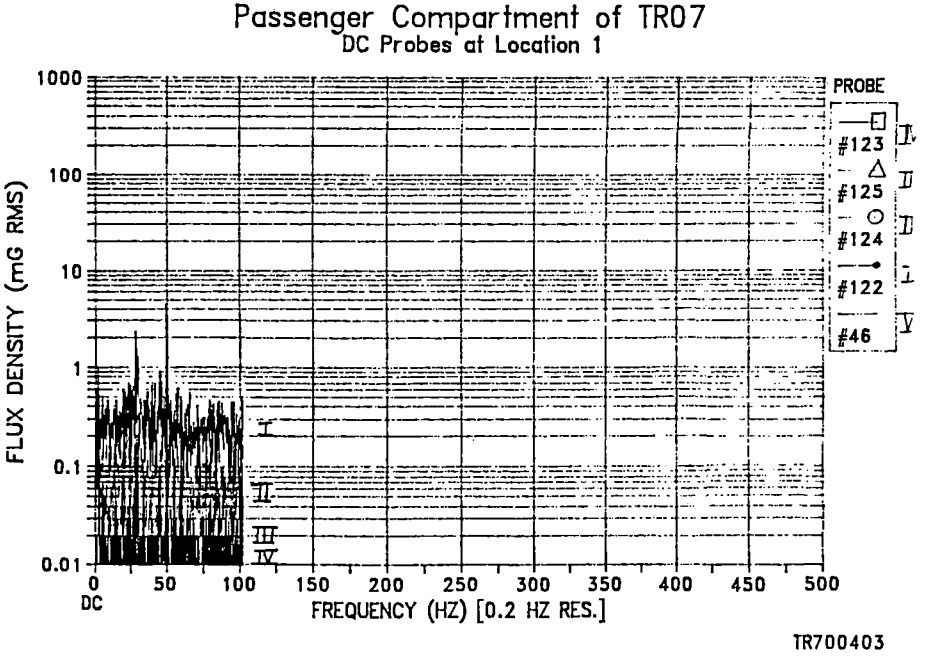
TR700403

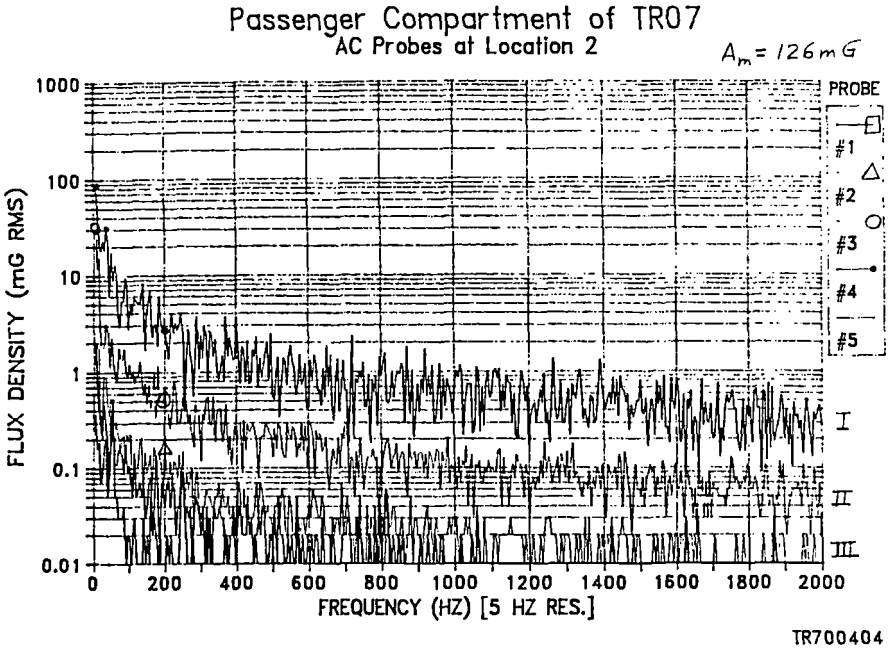
Passenger Compartment of TR07
DC Probes at Location 1

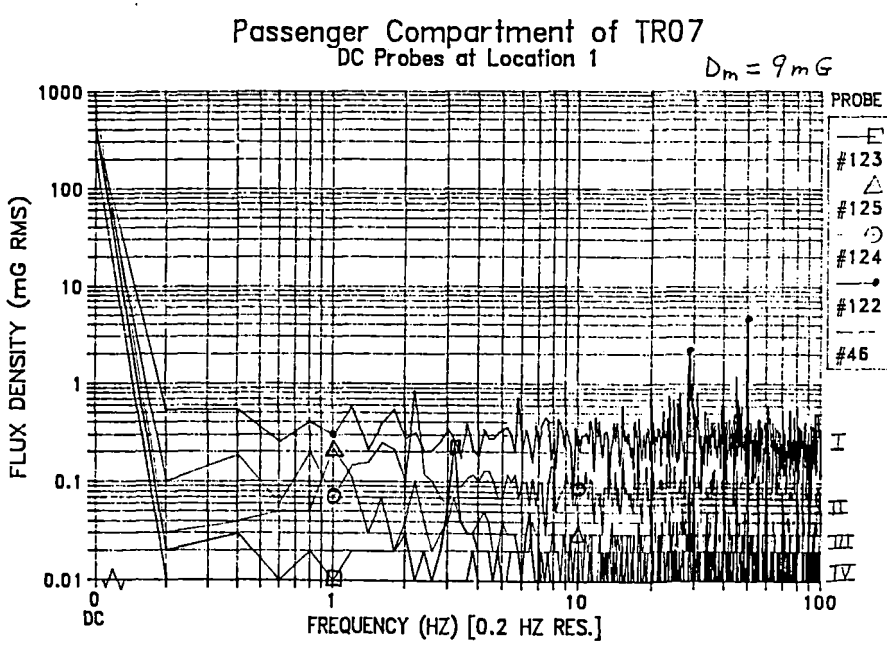


TR700403

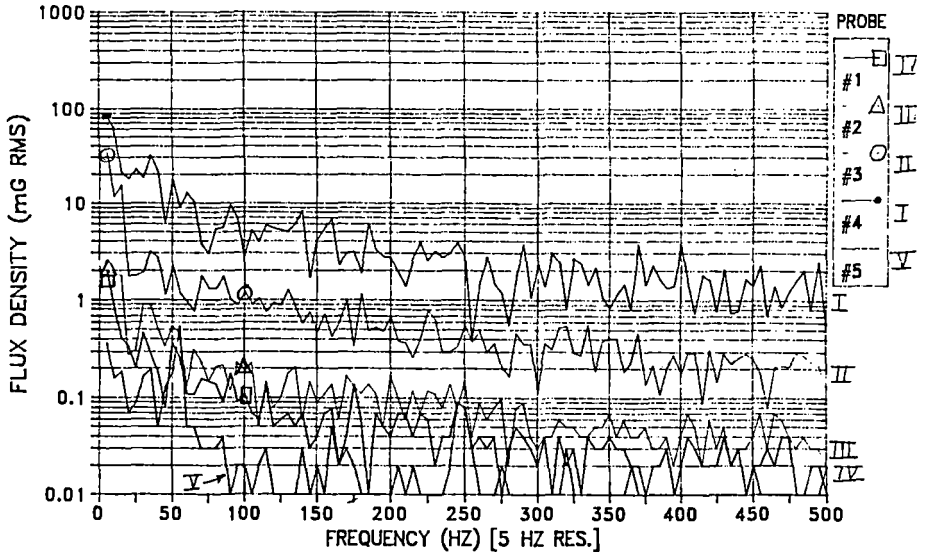

Passenger Compartment of TR07
AC Probes at Location 2
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
I
II
III
IV
V
TR700403


Passenger Compartment of TR07
DC Probes at Location 1
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
I
II
III
IV
V
TR700403


Passenger Compartment of TR07
AC Probes at Location 2
A_m = 126 mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
I
II
III
TR700404

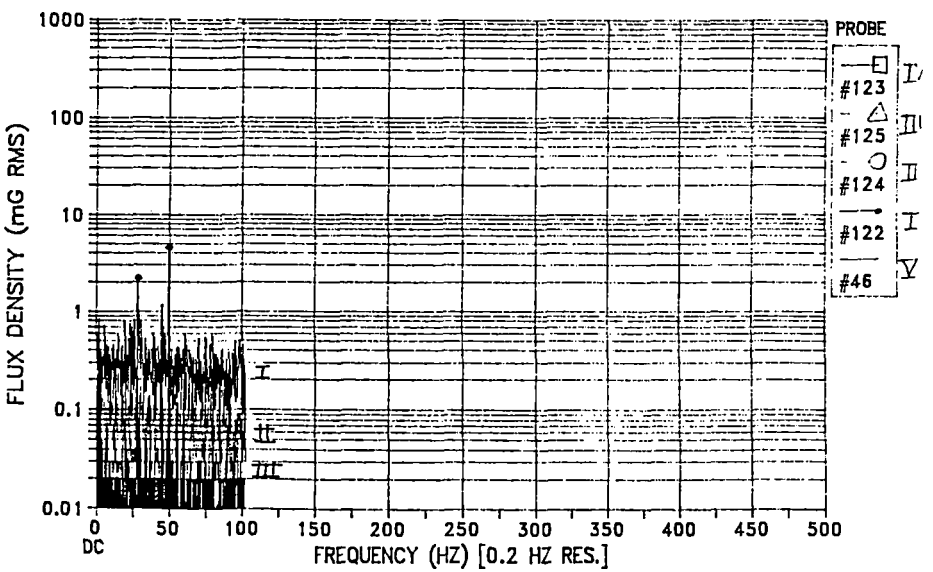

Passenger Compartment of TR07
DC Probes at Location 1
D_m = 9 mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
I
II
III
IV
TR700404

Passenger Compartment of TR07
AC Probes at Location 2



TR700404

Passenger Compartment of TR07
DC Probes at Location 1



TR700404

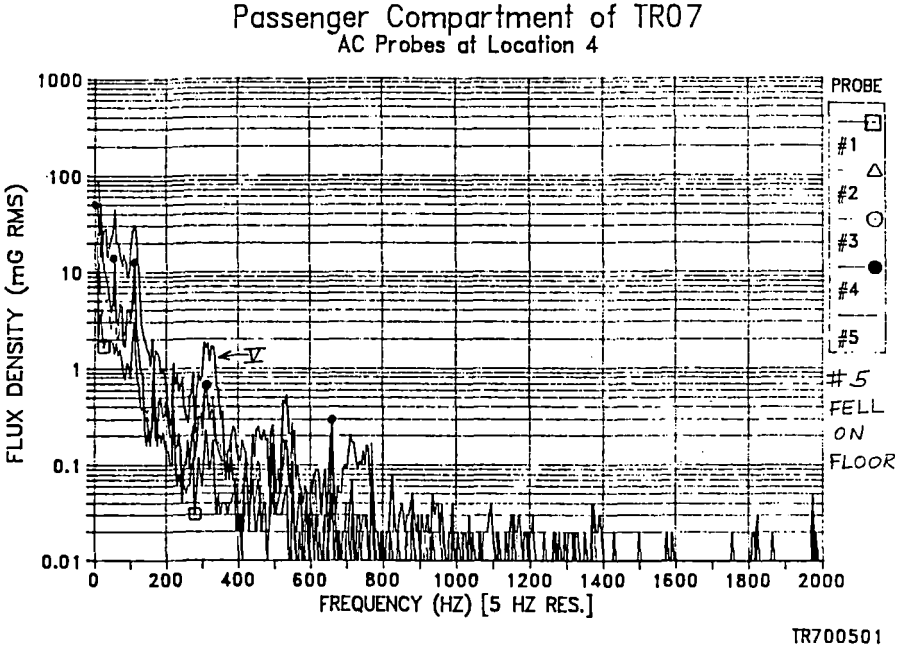
TR7004

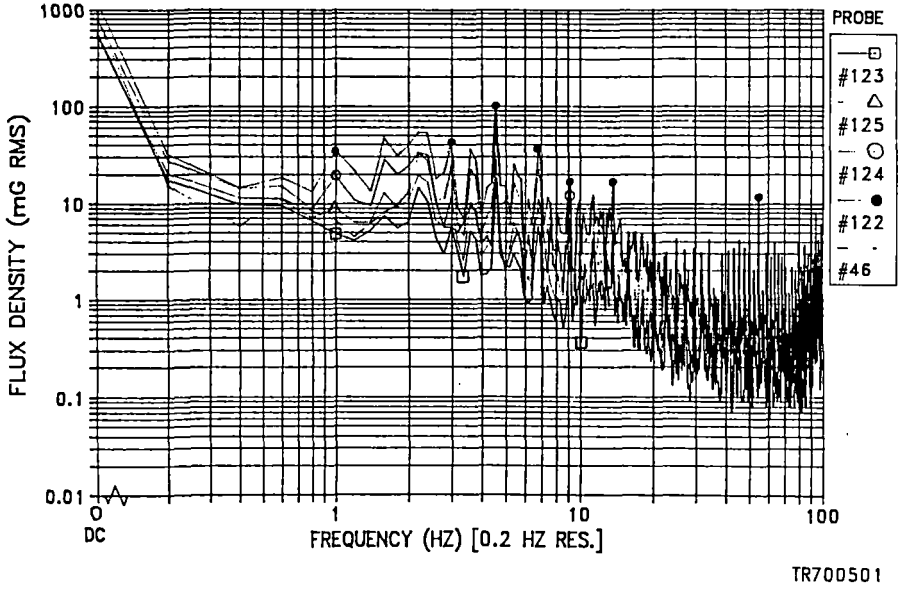
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 004
> On board magnetic field measurements
> ac loc #2 .2 Hz dc loc #1 5 Hz/1Hz
> 0km/h, facility, no ligts
Start: 08/07/90 (Tuesday) AT 10:38:00
End: 08/07/90 (Tuesday) AT 10:48:00
Recorded   21 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

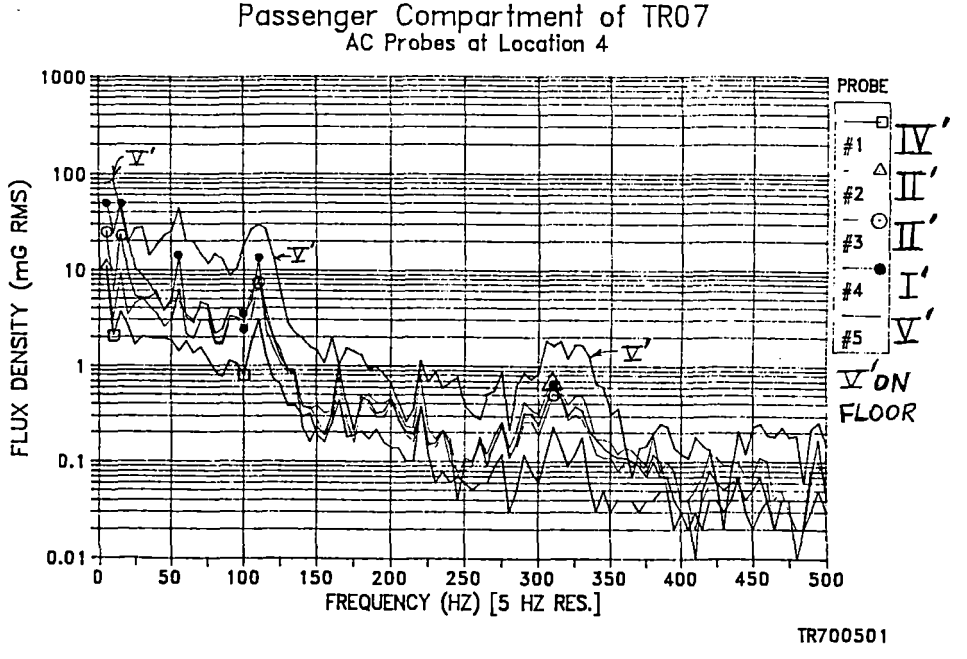
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

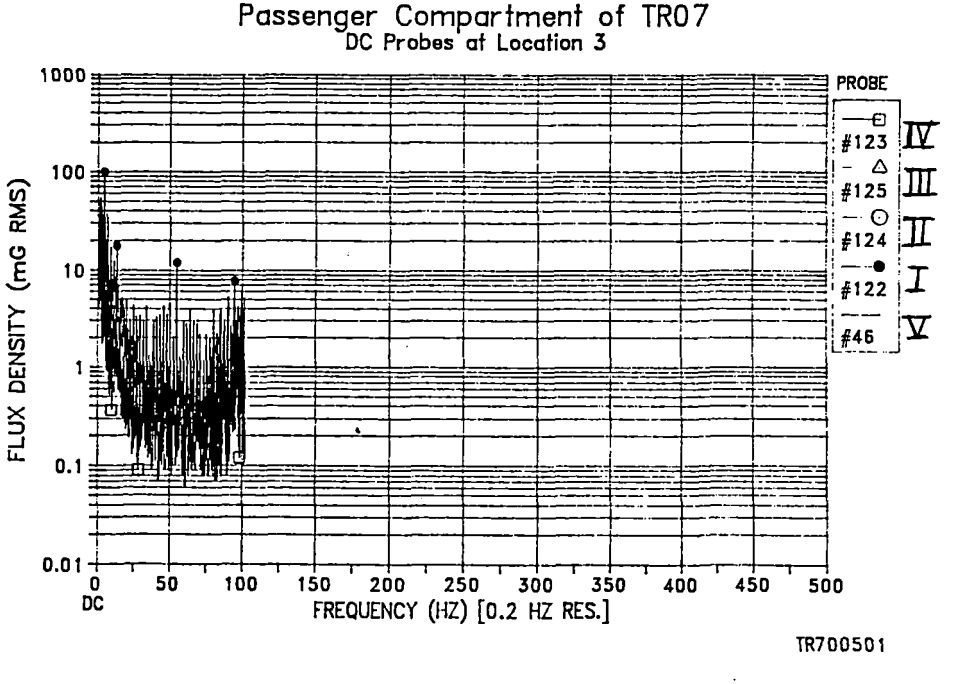
RANGE SETTINGS:

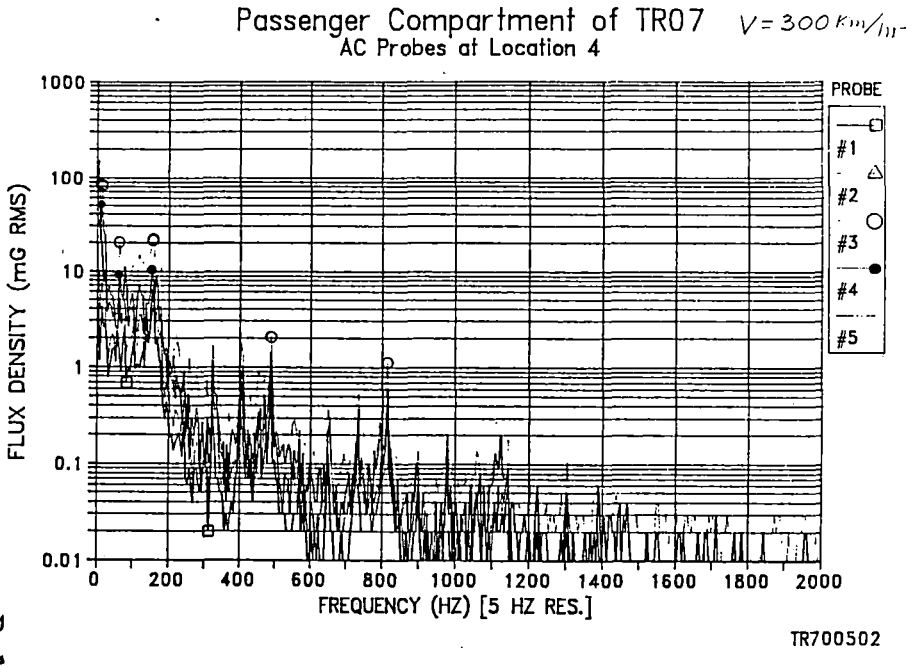
A1 # 1	Pole mounted standing head level- 5-'9	
	COIL L:	30.0mG
	COIL T:	10.0mG
	COIL V:	10.0mG
B1 # 2	Pole mounted at seated head level- 3'-8"	
	COIL L:	30.0mG
	COIL T:	10.0mG
	COIL V:	100mG
C1 # 3	Pole mounted at seat level- 1'6.5"	
	COIL L:	100mG
	COIL T:	30.0mG
	COIL V:	300mG
D1 # 4	Pole mounted at floor level- 5"	
	COIL L:	300mG
	COIL T:	300mG
	COIL V:	1000mG
E1 # 5	Control	
	COIL L:	10.0mG
	COIL T:	30.0mG
	COIL V:	10.0mG
A2 #122	Pole mounted at floor level - 5"	
	DC - A:	300mG
	DC - B:	300mG
	DC - C:	1000mG
B2 #124	Pole mounted at seat level - 1'-6.5"	
	CHAN A:	100mG
	DC - B:	100mG
	DC - C:	1000mG
C2 #125	Pole mounted at seated head level - 3'8"	
	DC - A:	100mG
	DC - B:	1000mG
	DC - C:	1000mG
D2 #123	Pole mounted standing head level - 5'9"	
	DC - A:	1000mG
	DC - B:	300mG
	DC - C:	1000mG
E2 # 46	Control in seat near bulkhead	
	DC - A:	100mG
	DC - B:	100mG
	DC - C:	300mG

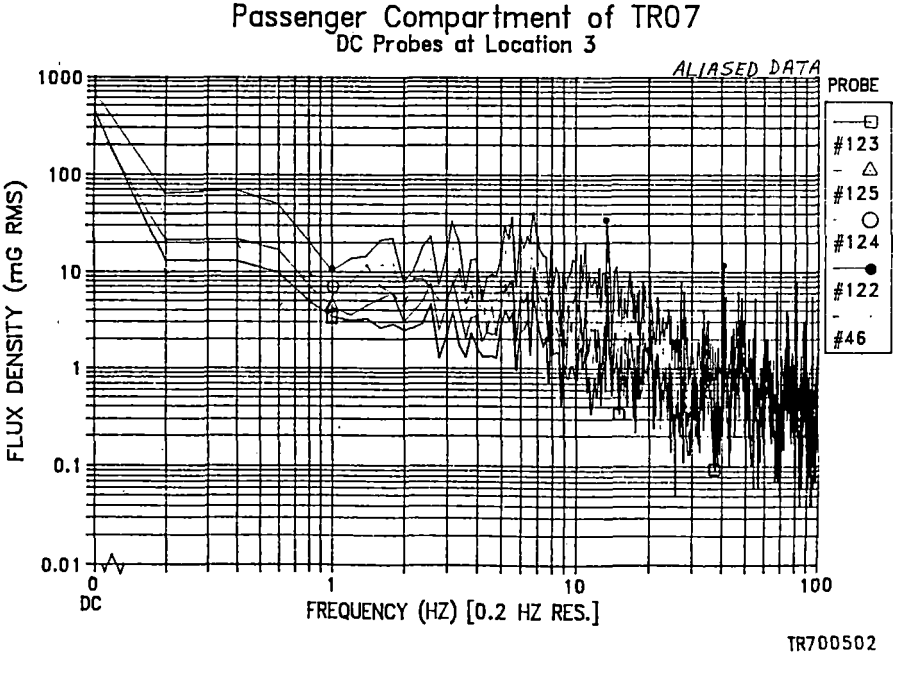

Passenger Compartment of TR07
AC Probes at Location 4
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
#5 FELL ON FLOOR
TR700501

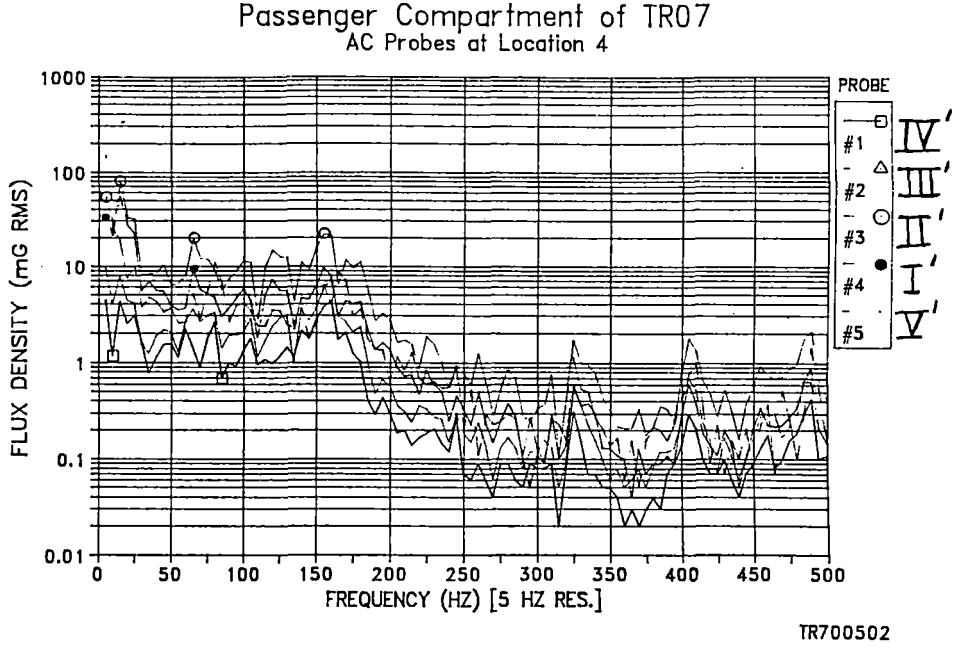

Passenger Compartment of TR07
DC Probes at Location 3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700501

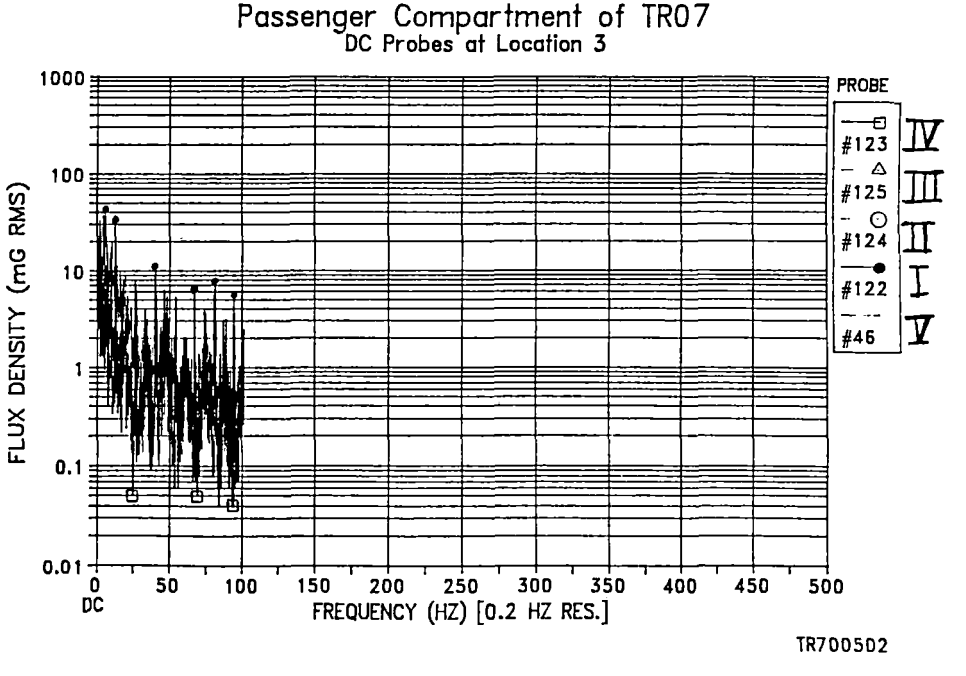

Passenger Compartment of TR07
AC Probes at Location 4
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV'
II'
II'
I'
V'
V' ON FLOOR
V'
V'
V'
TR700501

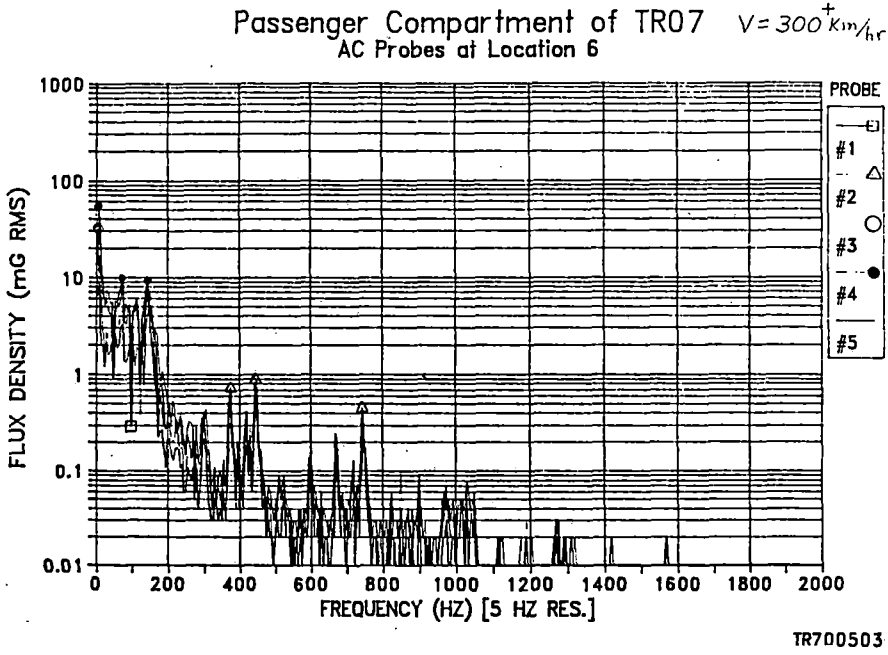

Passenger Compartment of TR07
DC Probes at Location 3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
TR700501

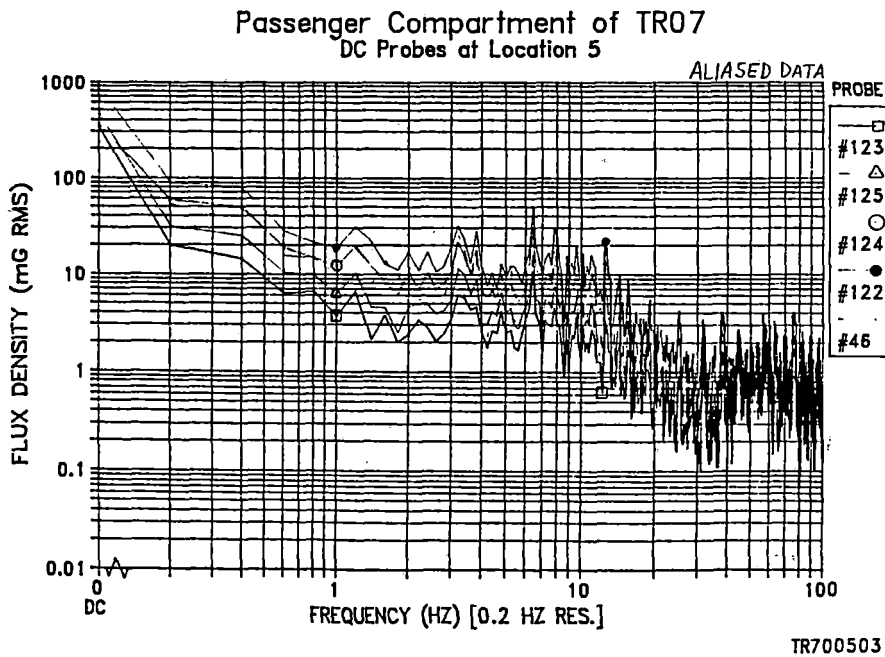

Passenger Compartment of TR07 V = 300 Km/hr
AC Probes at Location 4
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700502

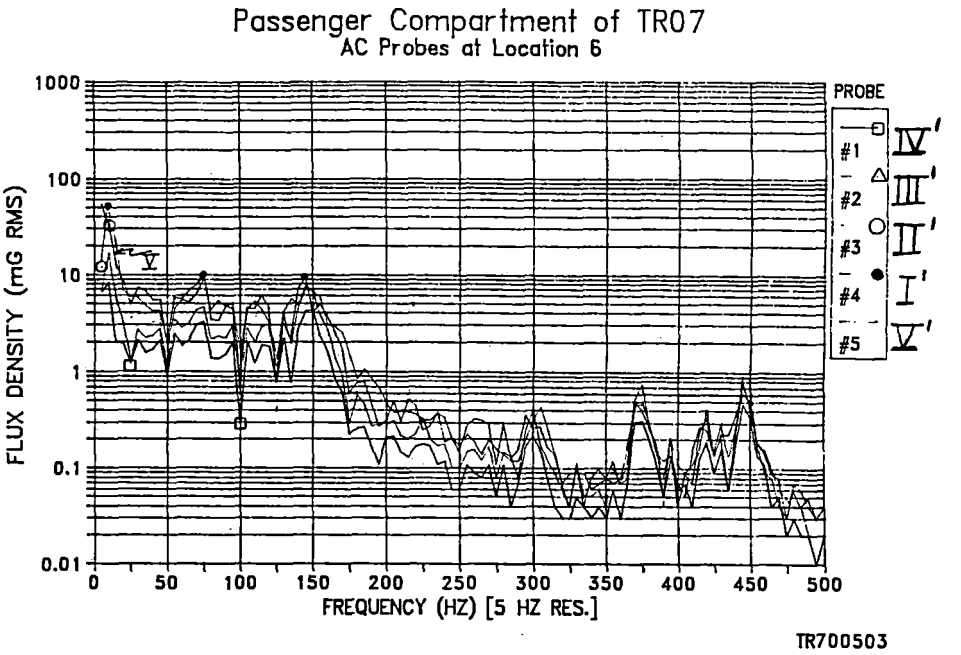

Passenger Compartment of TR07
DC Probes at Location 3
ALIASED DATA
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700502

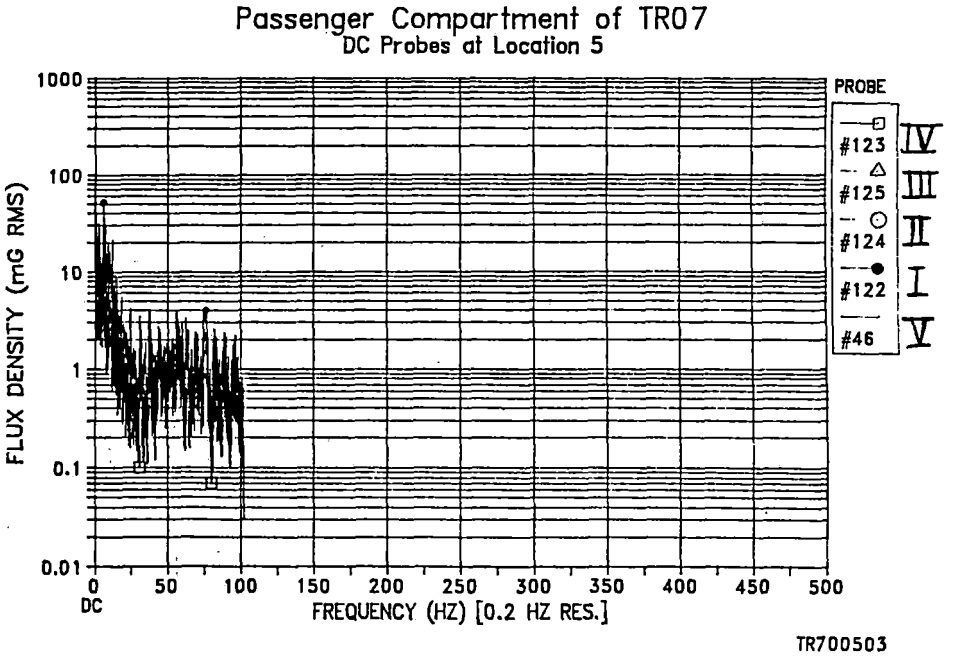

Passenger Compartment of TR07
AC Probes at Location 4
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV'
III'
II'
I'
V'
TR700502

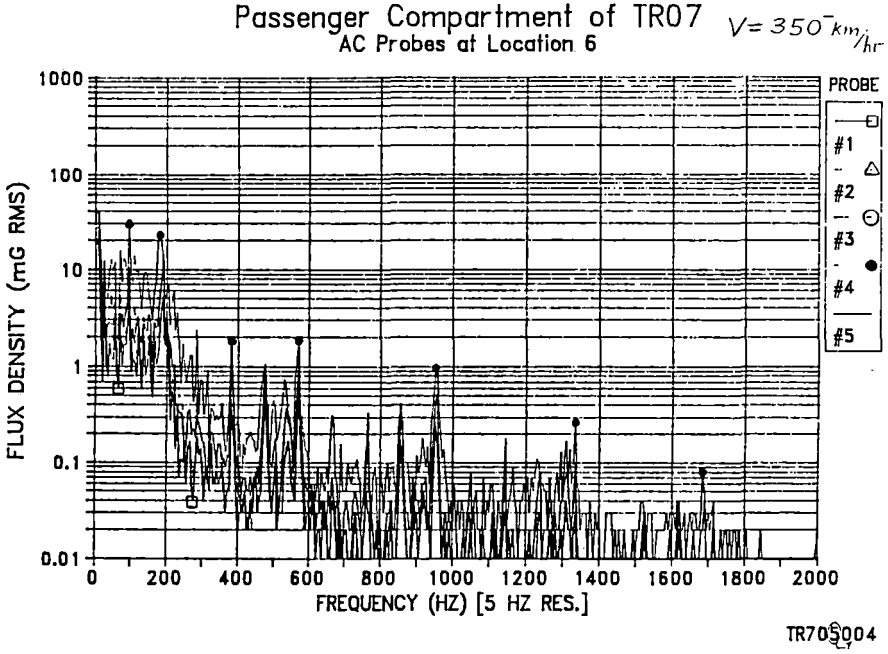

Passenger Compartment of TR07
DC Probes at Location 3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
TR700502

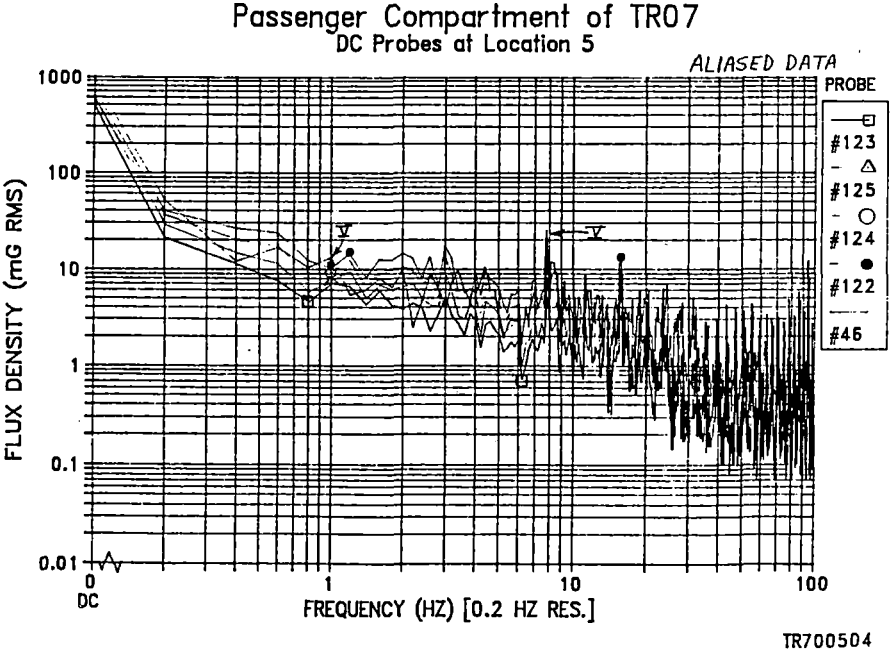

Passenger Compartment of TR07 V=300+ km/hr
AC Probes at Location 6
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700503


Passenger Compartment of TR07
DC Probes at Location 5
ALIASED DATA
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700503

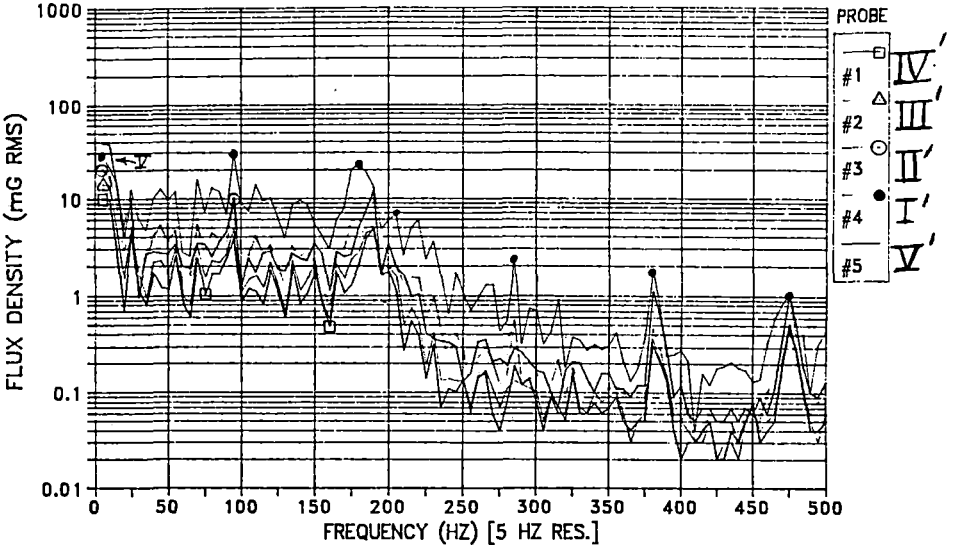

Passenger Compartment of TR07
AC Probes at Location 6
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV'
III'
II'
I'
V'
V
TR700503


Passenger Compartment of TR07
DC Probes at Location 5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
TR700503


Passenger Compartment of TR07
AC Probes at Location 6
V = 350 km/hr
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700504

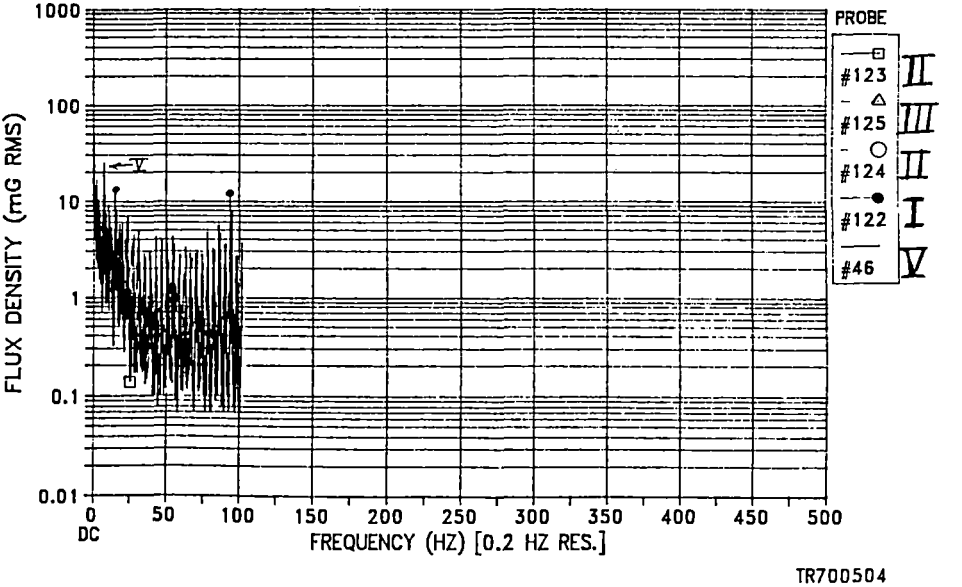

Passenger Compartment of TR07
DC Probes at Location 5
ALIASED DATA
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700504

Passenger Compartment of TR07
AC Probes at Location 6

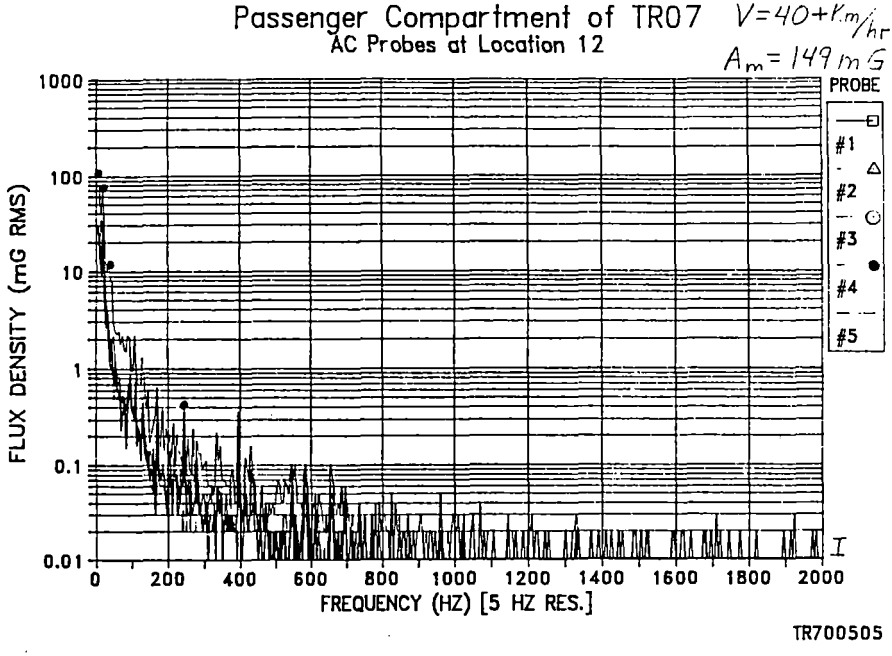


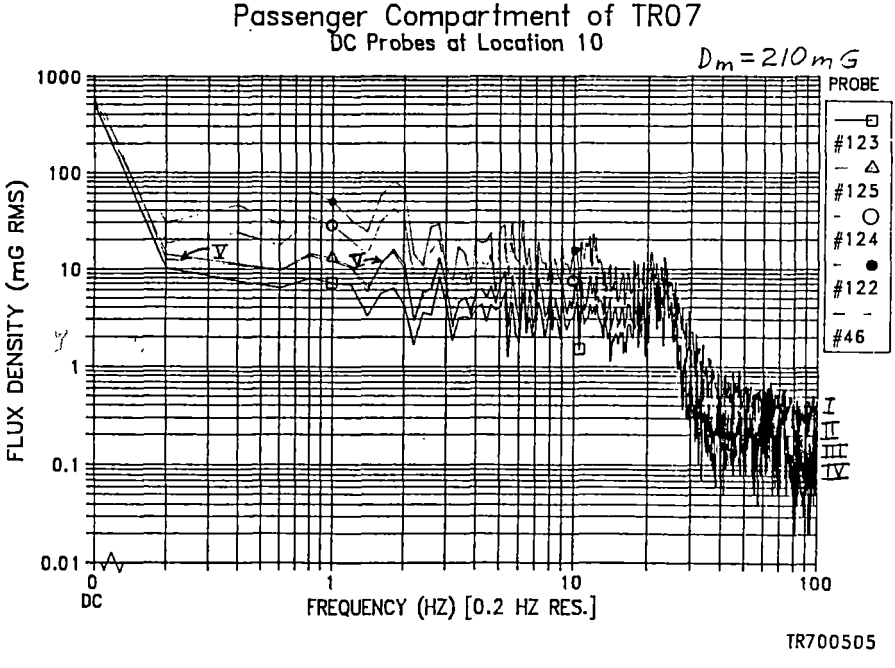
TR700504

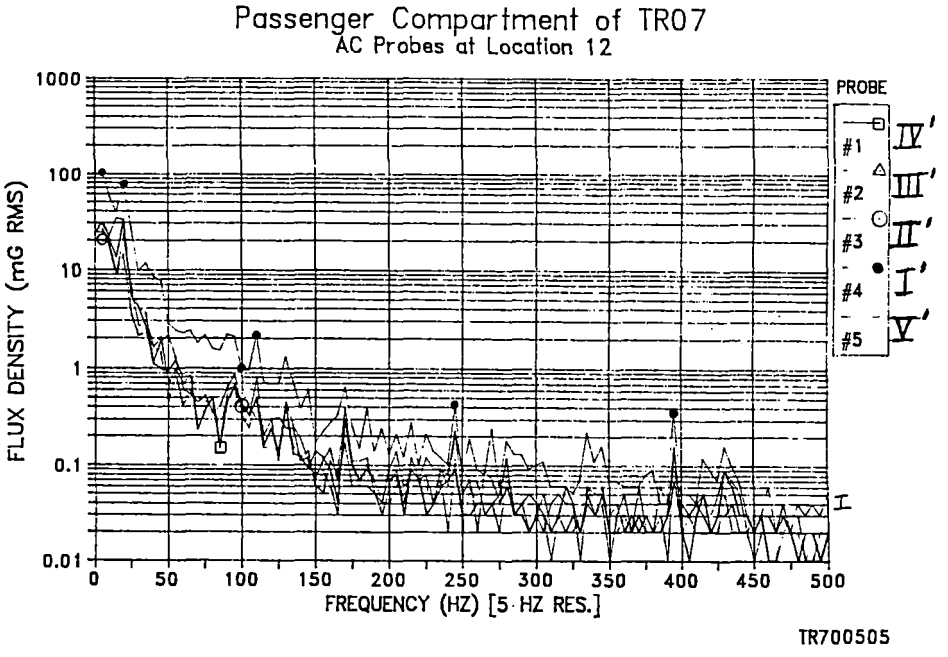
Passenger Compartment of TR07
DC Probes at Location 5

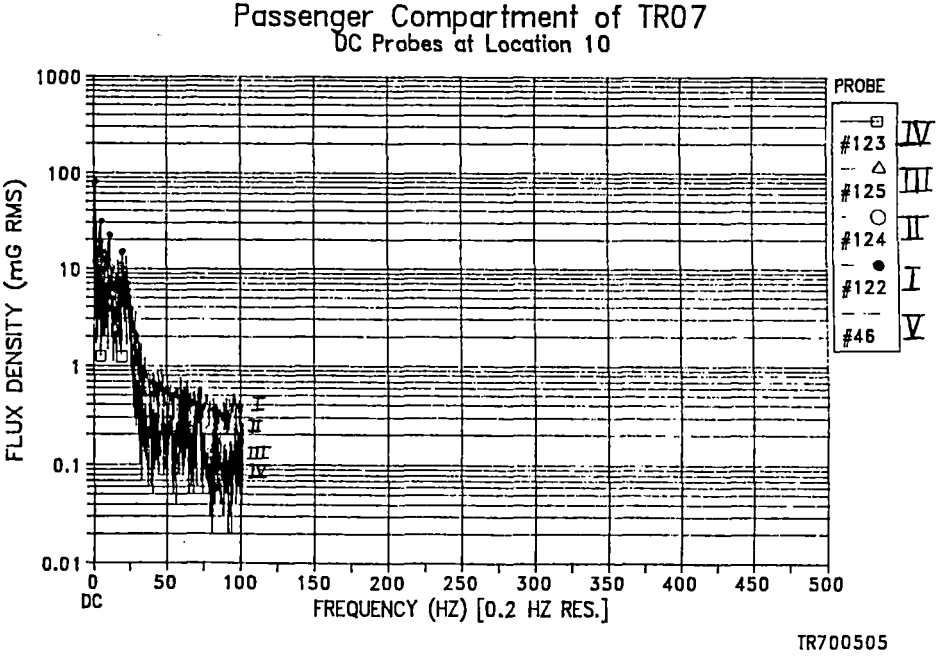


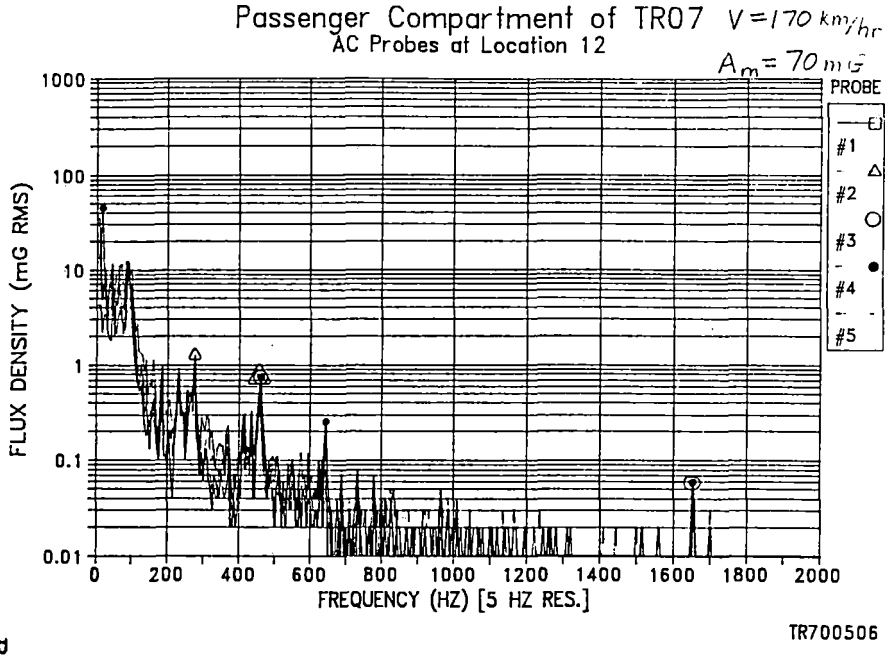
TR700504

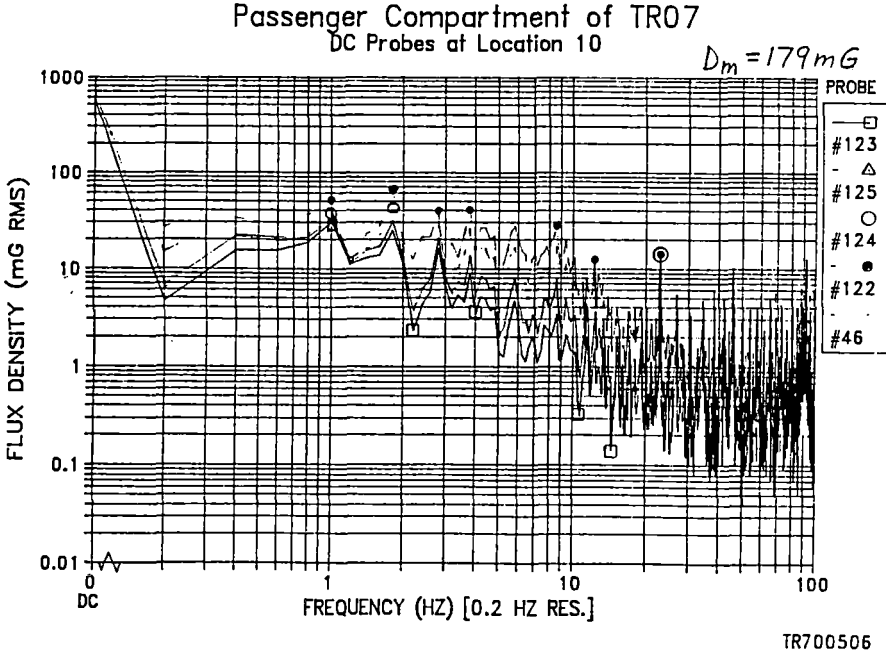

Passenger Compartment of TR07
AC Probes at Location 12
V=40+Km/hr
Am=149mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
I
TR700505

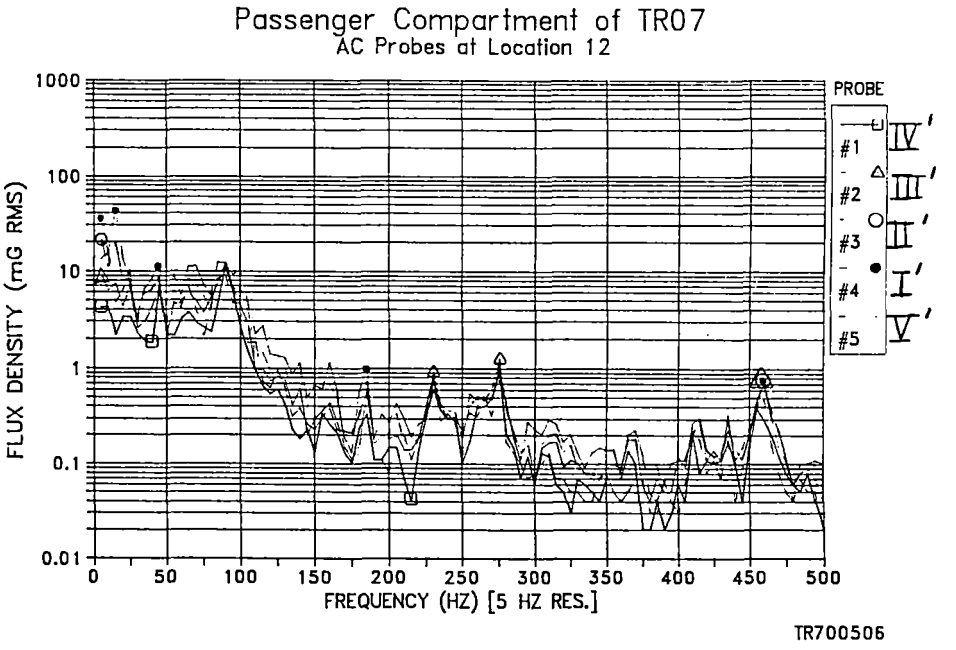

Passenger Compartment of TR07
DC Probes at Location 10
Dm=210mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
I
II
III
IV
V
TR700505

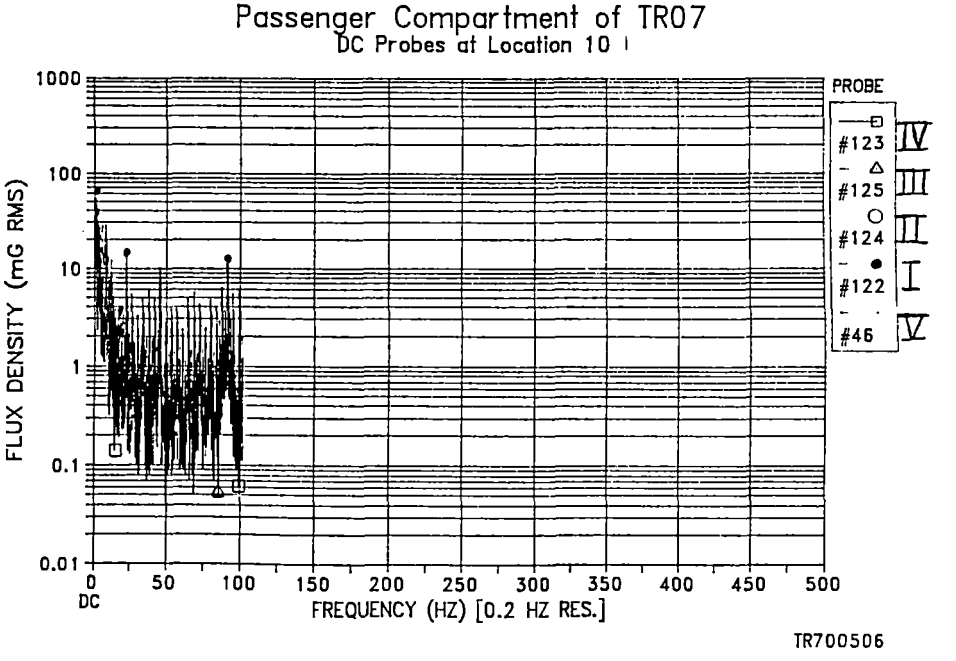

Passenger Compartment of TR07
AC Probes at Location 12
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV'
III'
II'
I'
V'
I
TR700505

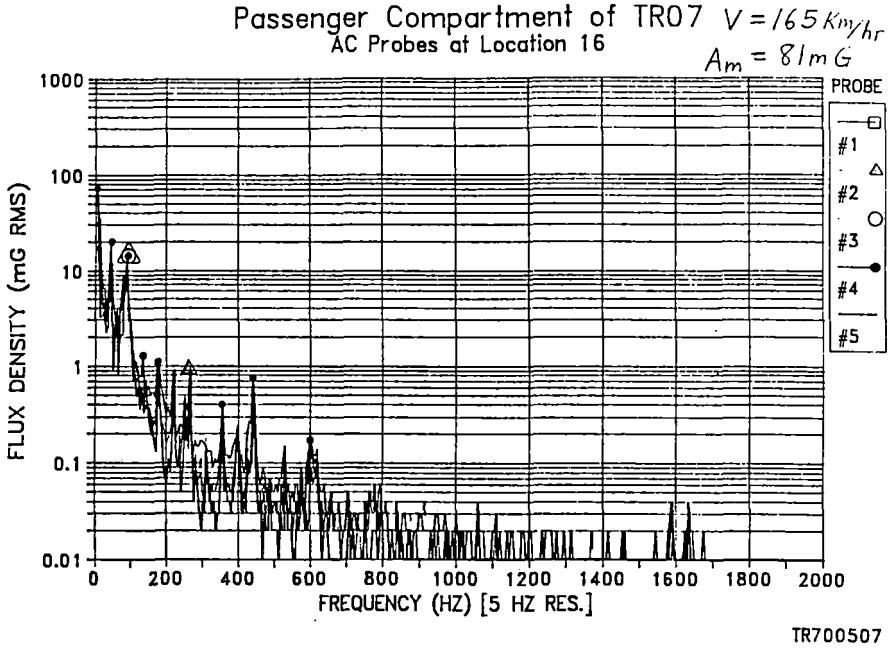

Passenger Compartment of TR07
DC Probes at Location 10
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
I
II
III
IV
TR700505

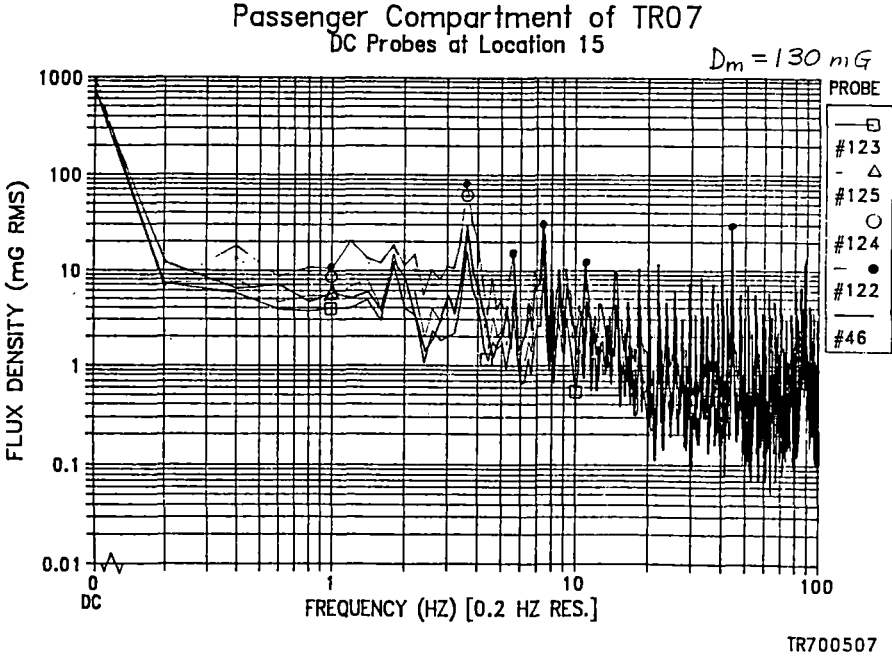

Passenger Compartment of TR07 V=170 km/hr
AC Probes at Location 12
Am=70 mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700506

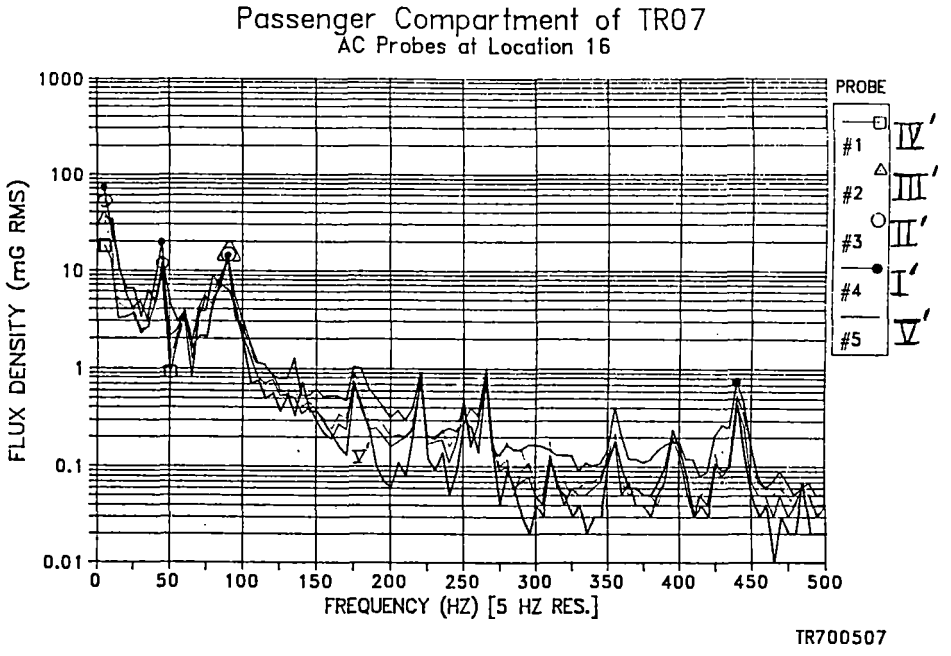

Passenger Compartment of TR07
DC Probes at Location 10
Dm=179mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
TR700506

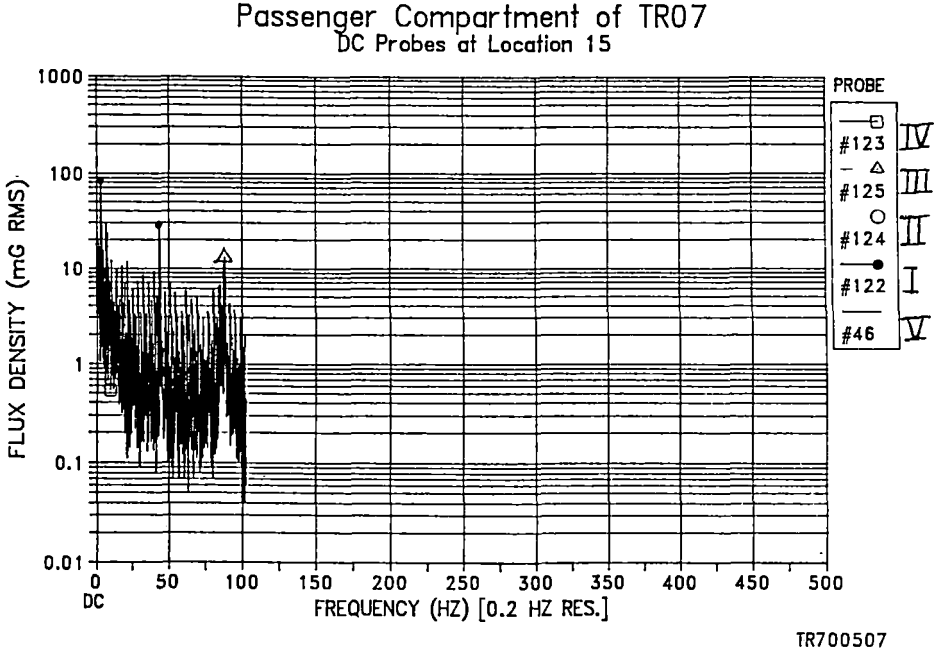

Passenger Compartment of TR07
AC Probes at Location 12
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV'
III'
II'
I'
V'
TR700506

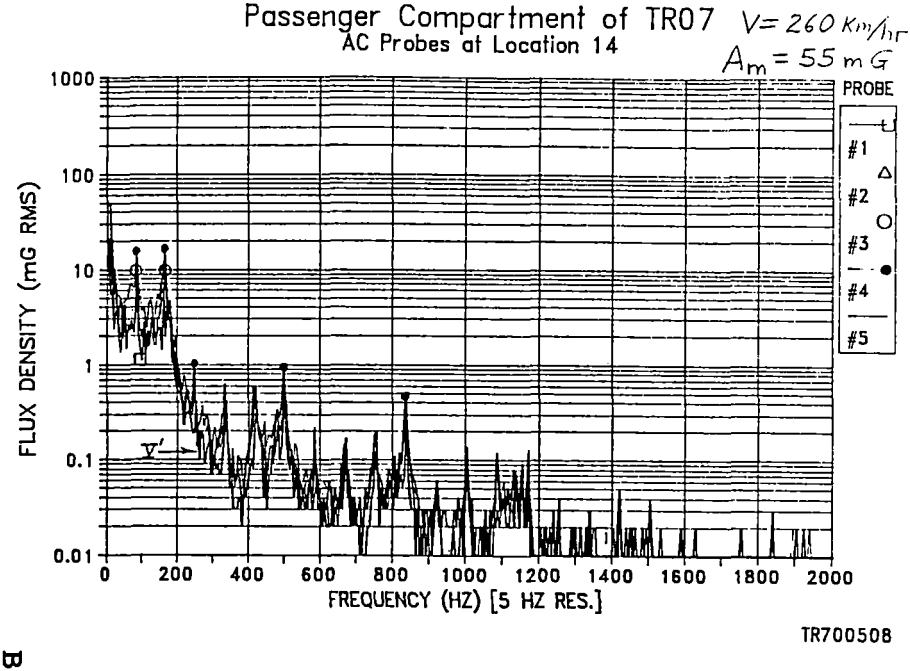

Passenger Compartment of TR07
DC Probes at Location 10
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
TR700506

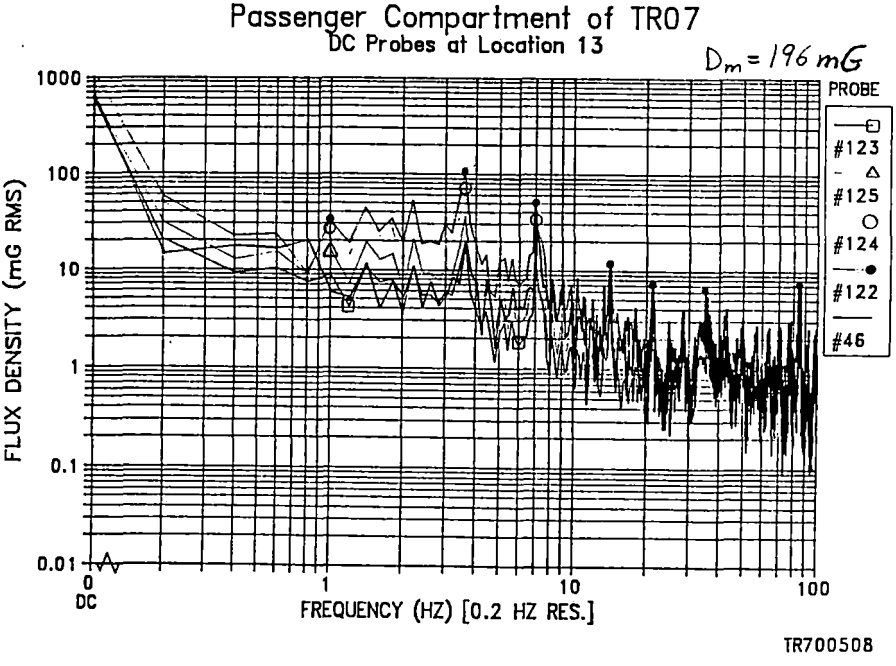

Passenger Compartment of TR07 V = 165 Km/hr
AC Probes at Location 16
Am = 81 mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700507


Passenger Compartment of TR07
DC Probes at Location 15
Dm = 130 mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
TR700507

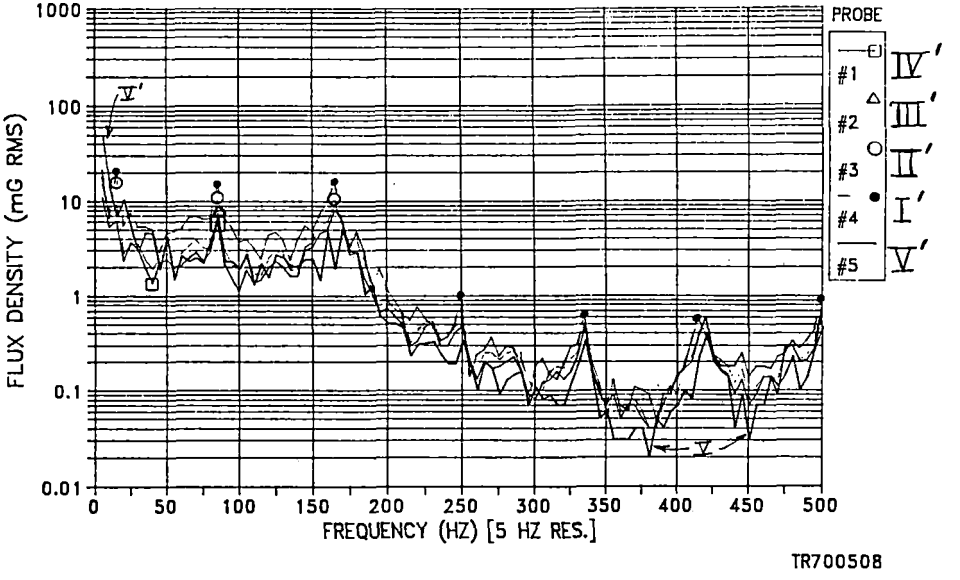

Passenger Compartment of TR07
AC Probes at Location 16
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV′
III′
II′
I′
V′
TR700507


Passenger Compartment of TR07
DC Probes at Location 15
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
TR700507


Passenger Compartment of TR07
AC Probes at Location 14
V= 260 Km/hr
Am = 55 mG
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
V'
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700508

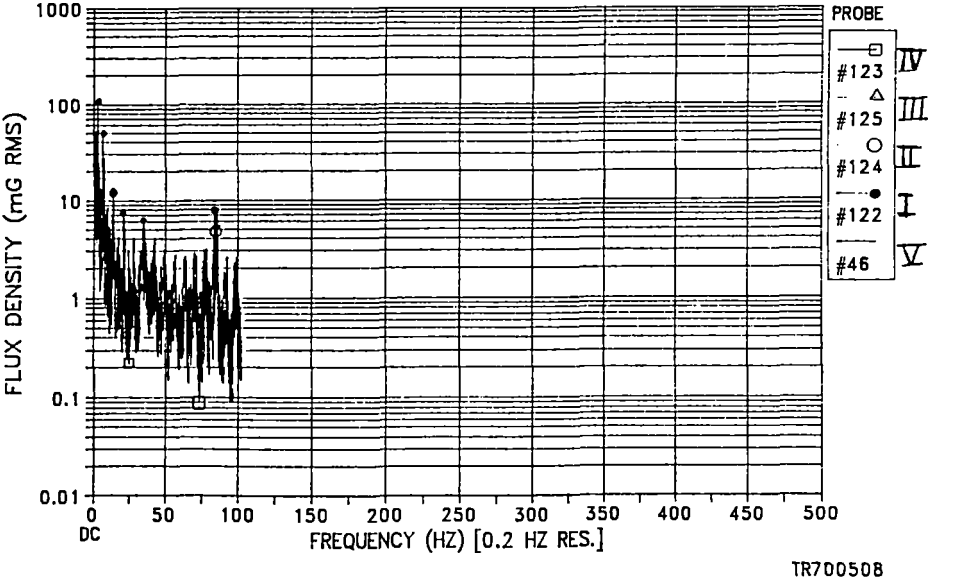

Passenger Compartment of TR07
DC Probes at Location 13
Dm = 196 mG
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
TR700508

Passenger Compartment of TR07
AC Probes at Location 14

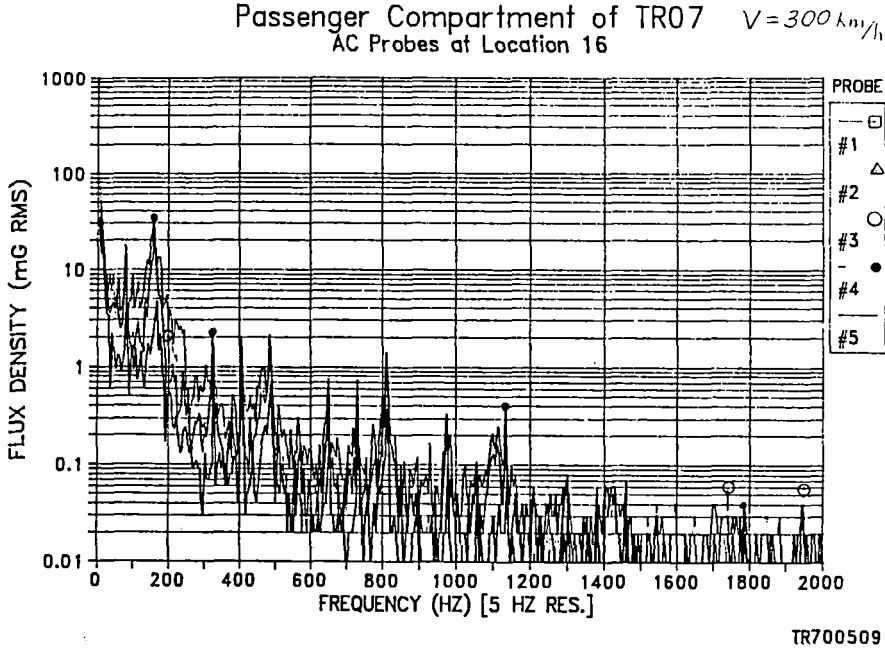


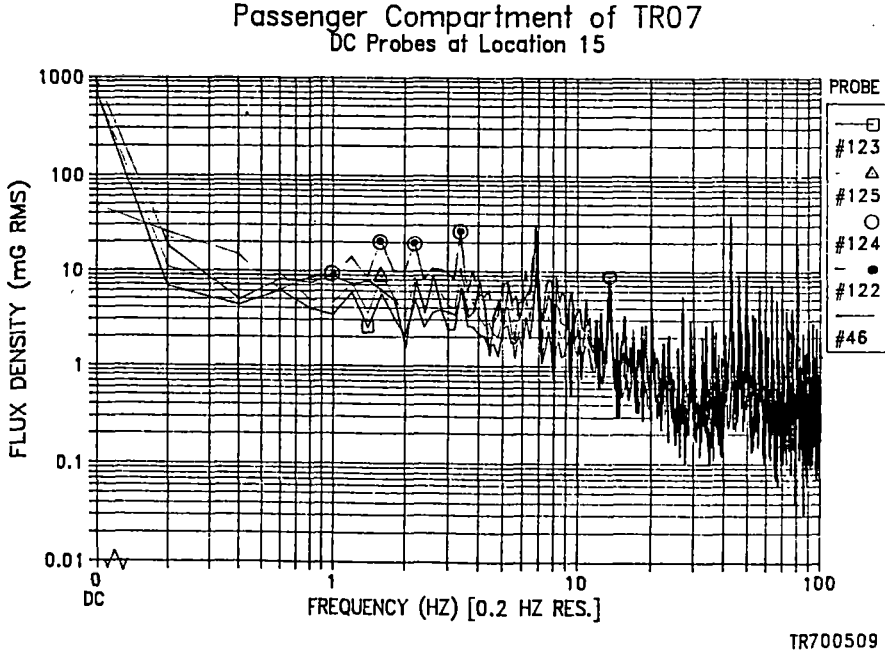
TR700508

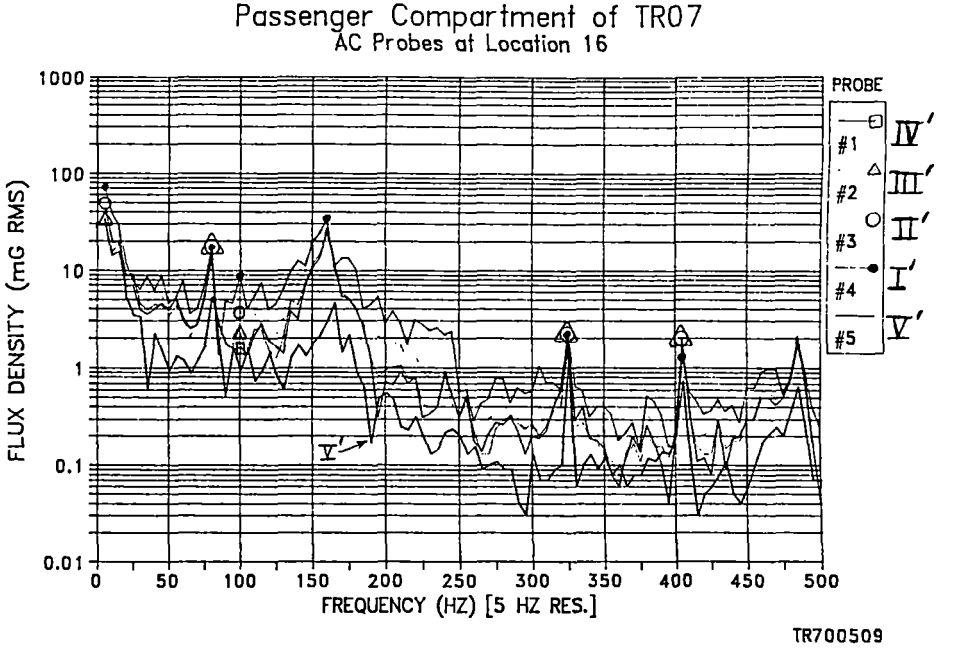
Passenger Compartment of TR07
DC Probes at Location 13

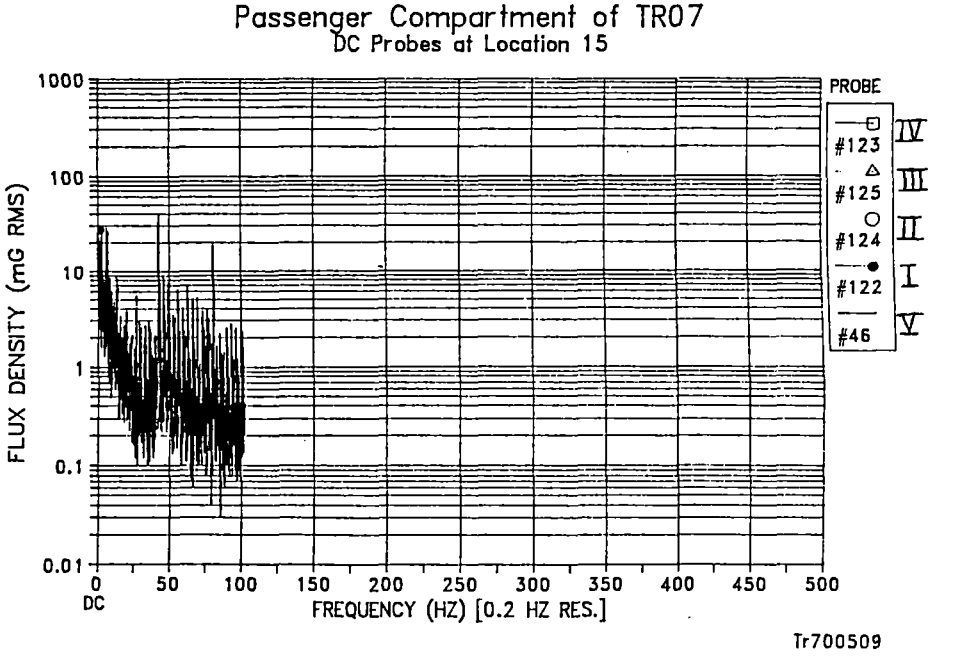


TR700508


Passenger Compartment of TR07 V = 300 km/hr
AC Probes at Location 16
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700509


Passenger Compartment of TR07
DC Probes at Location 15
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700509


Passenger Compartment of TR07
AC Probes at Location 16
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
IV′
III′
II′
I′
V′
V′
TR700509


Passenger Compartment of TR07
DC Probes at Location 15
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
IV
III
II
I
V
Tr700509

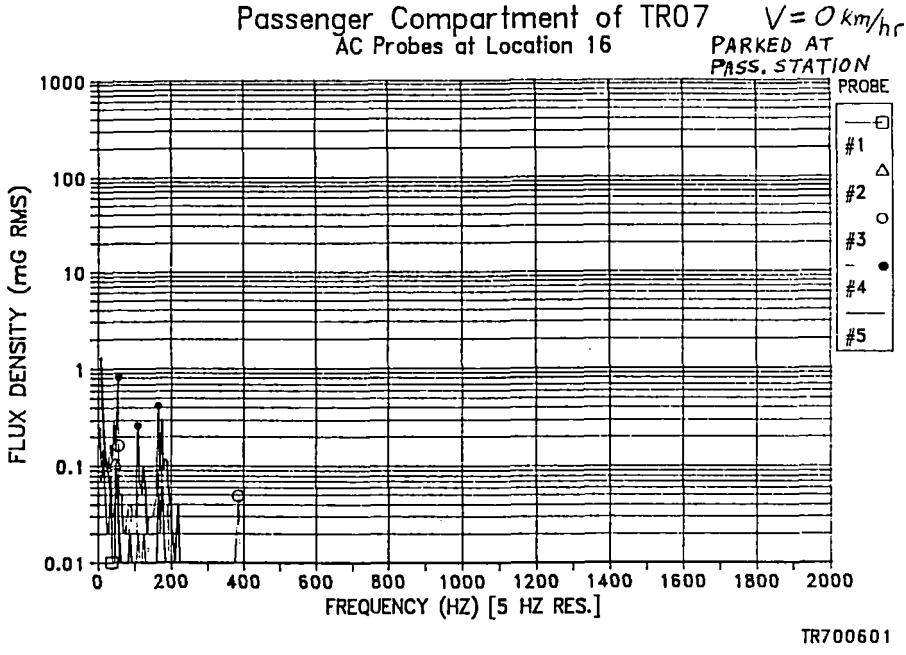
TR7005

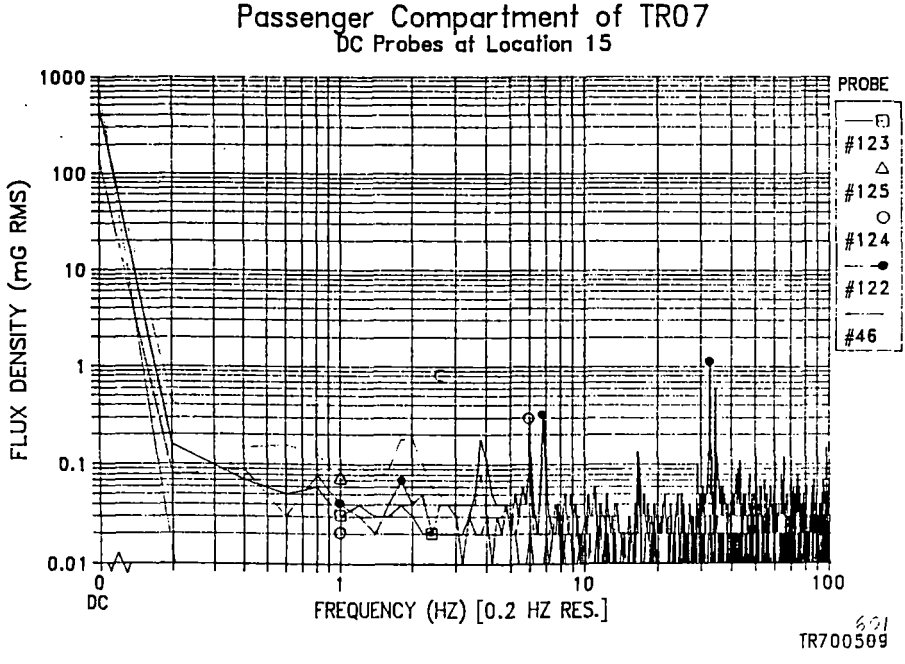
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 005
> On board magnetic field measurements
> ac loc #4 .2 Hz dc loc #3 5 Hz/1Hz
> continuous run - afternoon run
Start: 08/07/90 (Tuesday) AT 13:30:00
End: 08/07/90 (Tuesday) AT 13:40:00
Recorded   17 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

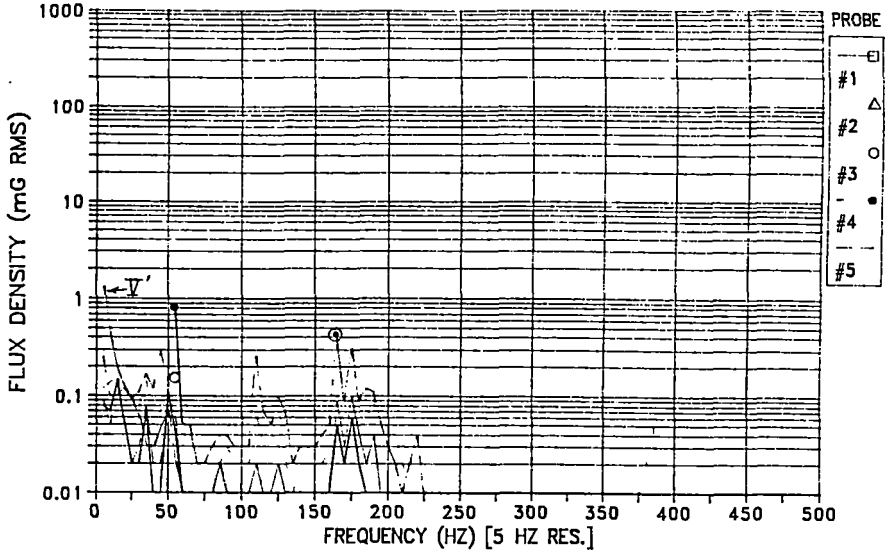
RANGE SETTINGS:

A1 # 1 Pole mounted standing head level- 5-'9
COIL L: 100mG
COIL T: 30.0mG
COIL V: 30.0mG
B1 # 2 Pole mounted at seated head level- 3'-8"
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
COIL L: 100mG
COIL T: 300mG
COIL V: 100mG
D1 # 4 Pole mounted at floor level- 5"
COIL L: 100mG
COIL T: 300mG
COIL V: 100mG
E1 # 5 Control
COIL L: 100mG
COIL T: 300mG
COIL V: 100mG
A2 #122 Pole mounted at floor level - 5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG


Passenger Compartment of TR07
V = 0 km/hr
AC Probes at Location 16
PARKED AT PASS. STATION
PROBE
#1
#2
#3
#4
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR700601

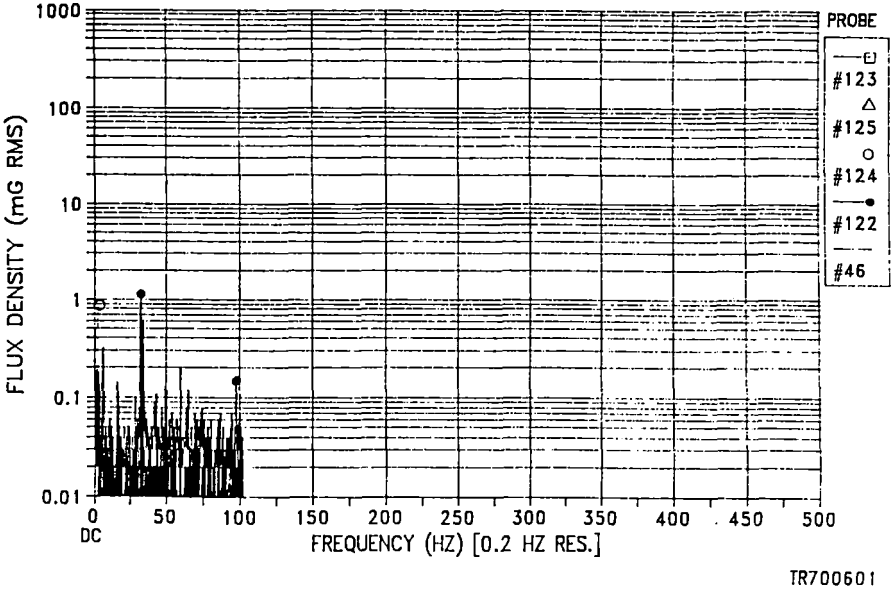

Passenger Compartment of TR07
DC Probes at Location 15
PROBE
#123
#125
#124
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
TR700509

Passenger Compartment of TR07
AC Probes at Location 16

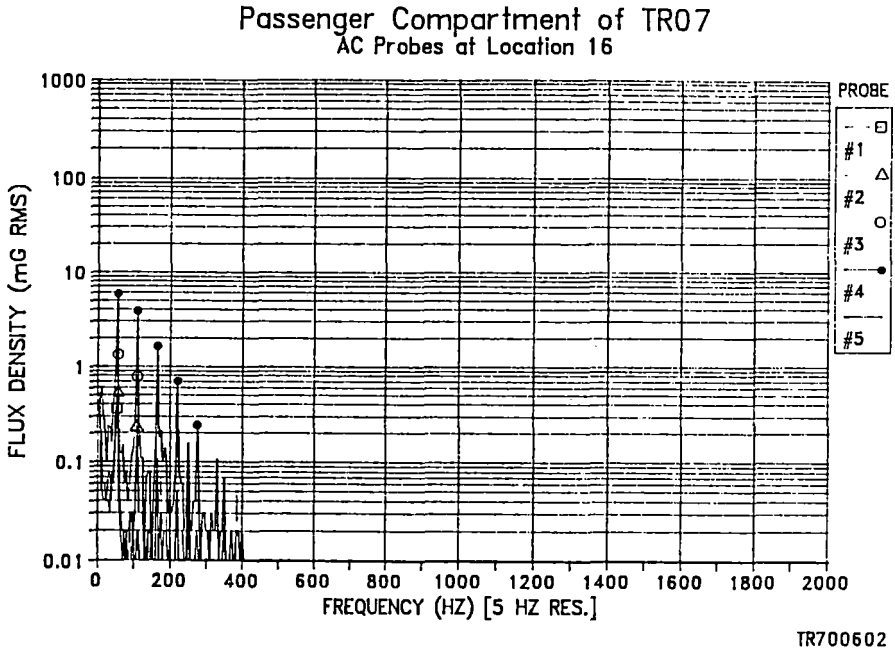


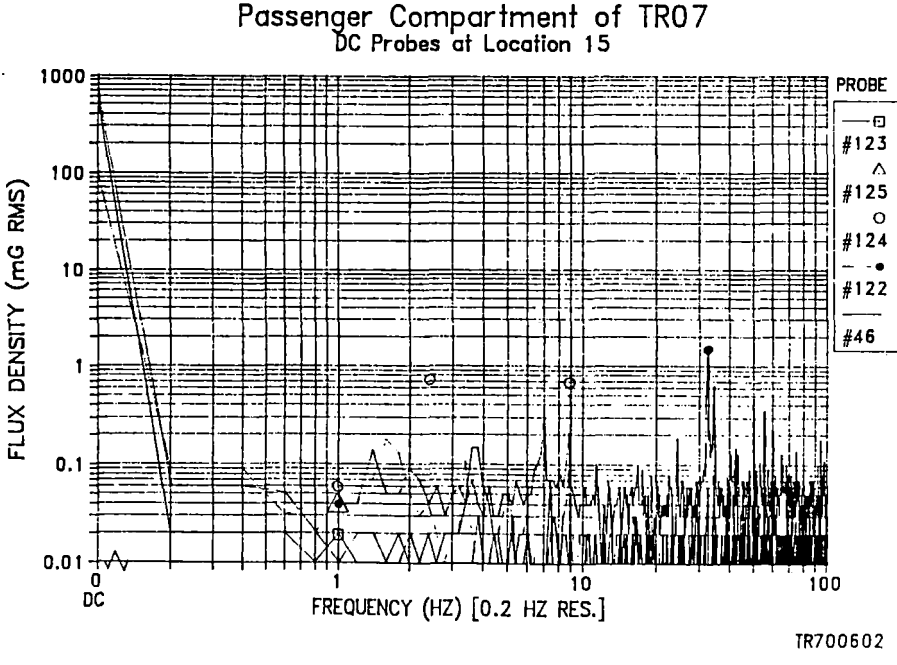
TR700601

Passenger Compartment of TR07
DC Probes at Location 15

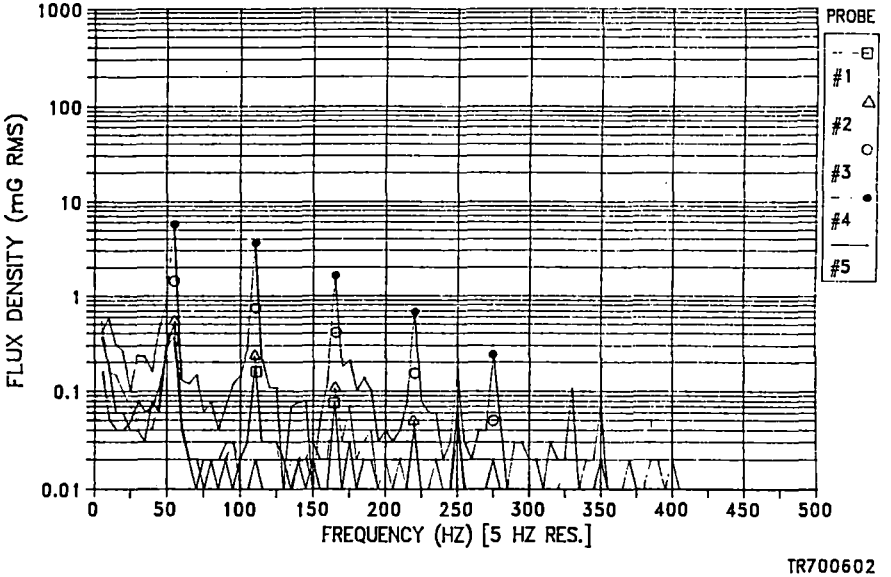


TR700601


Passenger Compartment of TR07
AC Probes at Location 16
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#1
#2
#3
#4
#5
TR700602

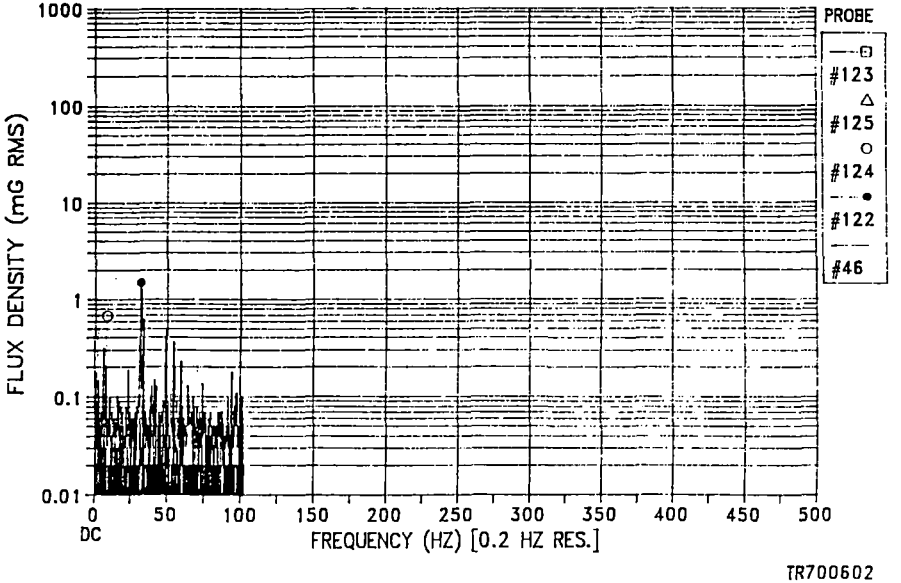

Passenger Compartment of TR07
DC Probes at Location 15
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#123
#125
#124
#122
#46
TR700602

Passenger Compartment of TR07
AC Probes at Location 16



TR700602

Passenger Compartment of TR07
DC Probes at Location 15



TR700602

[redacted]

TR7006

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 006
> On board magnetic field measurements
> ac loc #15 .2 Hz dc loc #16 5 Hz/1Hz
> levitating no lights, facility, #16,#15
Start: 08/07/90 (Tuesday) AT 16:05:00
End: 08/07/90 (Tuesday) AT 16:08:00
Recorded   7 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

RANGE SETTINGS:

A1 # 1 Pole mounted standing head level- 5-'9
          COIL L: 10.0mG
          COIL T: 3.00mG
          COIL V: 3.00mG
B1 # 2 Pole mounted at seated head level- 3'-8"
          COIL L: 10.0mG
          COIL T: 3.00mG
          COIL V: 3.00mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
          COIL L: 10.0mG
          COIL T: 10.0mG
          COIL V: 30.0mG
D1 # 4 Pole mounted at floor level- 5"
          COIL L: 10.0mG
          COIL T: 30.0mG
          COIL V: 100mG
E1 # 5 Control
          COIL L: 3.00mG
          COIL T: 3.00mG
          COIL V: 3.00mG
A2 #122 Pole mounted at floor level - 5"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG

TR7007

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 007
> On board magnetic field measurements
> ac loc #15 .2 Hz dc loc #16 5 Hz/1Hz
> resting no levitation
Start: 08/07/90 (Tuesday) AT 17:09:15
End: 08/07/90 (Tuesday) AT 17:09:15
Recorded   1 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

RANGE SETTINGS:

A1 # 1 Pole mounted standing head level- 5-'9
COIL L: 100mG
COIL T: 300mG
COIL V: 30.0mG
B1 # 2 Pole mounted at seated head level- 3'-8"
COIL L: 100mG
COIL T: 300mG
COIL V: 30.0mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
COIL L: 100mG
COIL T: 300mG
COIL V: 30.0mG
D1 # 4 Pole mounted at floor level- 5"
COIL L: 100mG
COIL T: 300mG
COIL V: 30.0mG
E1 # 5 Control
COIL L: 100mG
COIL T: 300mG
COIL V: 30.0mG
A2 #122 Pole mounted at floor level - 5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7008

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 008
> On board magnetic field measurements
> ac loc #12 .2 Hz dc loc #11 5 Hz/1Hz
> run from halt out of facility
Start: 08/07/90 (Tuesday) AT 17:35:00
End: 08/07/90 (Tuesday) AT 17:44:00
Recorded   19 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

RANGE SETTINGS:

A1 # 1	Pole mounted standing head level- 5-'9	
	COIL L:	10.0mG
	COIL T:	10.0mG
	COIL V:	3.00mG
B1 # 2	Pole mounted at seated head level- 3'-8"	
	COIL L:	1000mG
	COIL T:	1000mG
	COIL V:	1000mG
C1 # 3	Pole mounted at seat level- 1'-6.5"	
	COIL L:	1000mG
	COIL T:	1000mG
	COIL V:	1000mG
D1 # 4	Pole mounted at floor level- 5"	
	COIL L:	1000mG
	COIL T:	1000mG
	COIL V:	1000mG
E1 # 5	Control	
	COIL L:	1000mG
	COIL T:	1000mG
	COIL V:	1000mG
A2 #122	Pole mounted at floor level - 5"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
B2 #124	Pole mounted at seat level - 1'-6.5"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
C2 #125	Pole mounted at seated head level - 3'8"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
D2 #123	Pole mounted standing head level - 5'9"	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
E2 # 46	Control in seat near bulkhead	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG

TR7009

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 009
> On board magnetic field measurements
> ac loc #14 .2 Hz dc loc #13 5 Hz/1Hz
> continuous run
Start: 08/07/90 (Tuesday) AT 17:50:00
End: 08/07/90 (Tuesday) AT 18:00:00
Recorded   17 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

RANGE SETTINGS:

A1 # 1 Pole mounted standing head level- 5-'9
          COIL L: 100mG
          COIL T: 100mG
          COIL V: 100mG
B1 # 2 Pole mounted at seated head level- 3'-8"
          COIL L: 100mG
          COIL T: 100mG
          COIL V: 100mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
          COIL L: 100mG
          COIL T: 100mG
          COIL V: 100mG
D1 # 4 Pole mounted at floor level- 5"
          COIL L: 100mG
          COIL T: 100mG
          COIL V: 100mG
E1 # 5 Control
          COIL L: 100mG
          COIL T: 100mG
          COIL V: 100mG
A2 #122 Pole mounted at floor level - 5"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG

TR7010

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 010
> On board magnetic field measurements
> ac loc #16 .2 Hz dc loc #15 5 Hz/1Hz
> continuous run
Start: 08/07/90 (Tuesday) AT 18:02:00
End: 08/07/90 (Tuesday) AT 18:12:00
Recorded   20 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024
Mux Input   Base Freq Sample Freq (Hz)
        1   5.00   5120.00
        2   0.20   204.80
RANGE SETTINGS:

A1 # 1   Pole mounted standing head level- 5-'9
          COIL L: 100mG
          COIL T: 100mG
          COIL V: 300mG
B1 # 2   Pole mounted at seated head level- 3'-8"
          COIL L: 300mG
          COIL T: 100mG
          COIL V: 300mG
C1 # 3   Pole mounted at seat level- 1'-6.5"
          COIL L: 300mG
          COIL T: 300mG
          COIL V: 300mG
D1 # 4   Pole mounted at floor level- 5"
          COIL L: 1000mG
          COIL T: 300mG
          COIL V: 300mG
E1 # 5   Control
          COIL L: 100mG
          COIL T: 300mG
          COIL V: 100mG
A2 #122   Pole mounted at floor level - 5"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
B2 #124   Pole mounted at seat level - 1'-6.5"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
C2 #125   Pole mounted at seated head level - 3'8"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
D2 #123   Pole mounted standing head level - 5'9"
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG
E2 # 46   Control in seat near bulkhead
          DC - A: 1000mG
          DC - B: 1000mG
          DC - C: 1000mG

TR7011

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 011
> On board magnetic field measurements
> floor level tranverseon poles laid flat
> continuous run around track
Start: 08/07/90 (Tuesday) AT 18:17:30
End: 08/07/90 (Tuesday) AT 18:22:00
Recorded 6 samples at 30 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

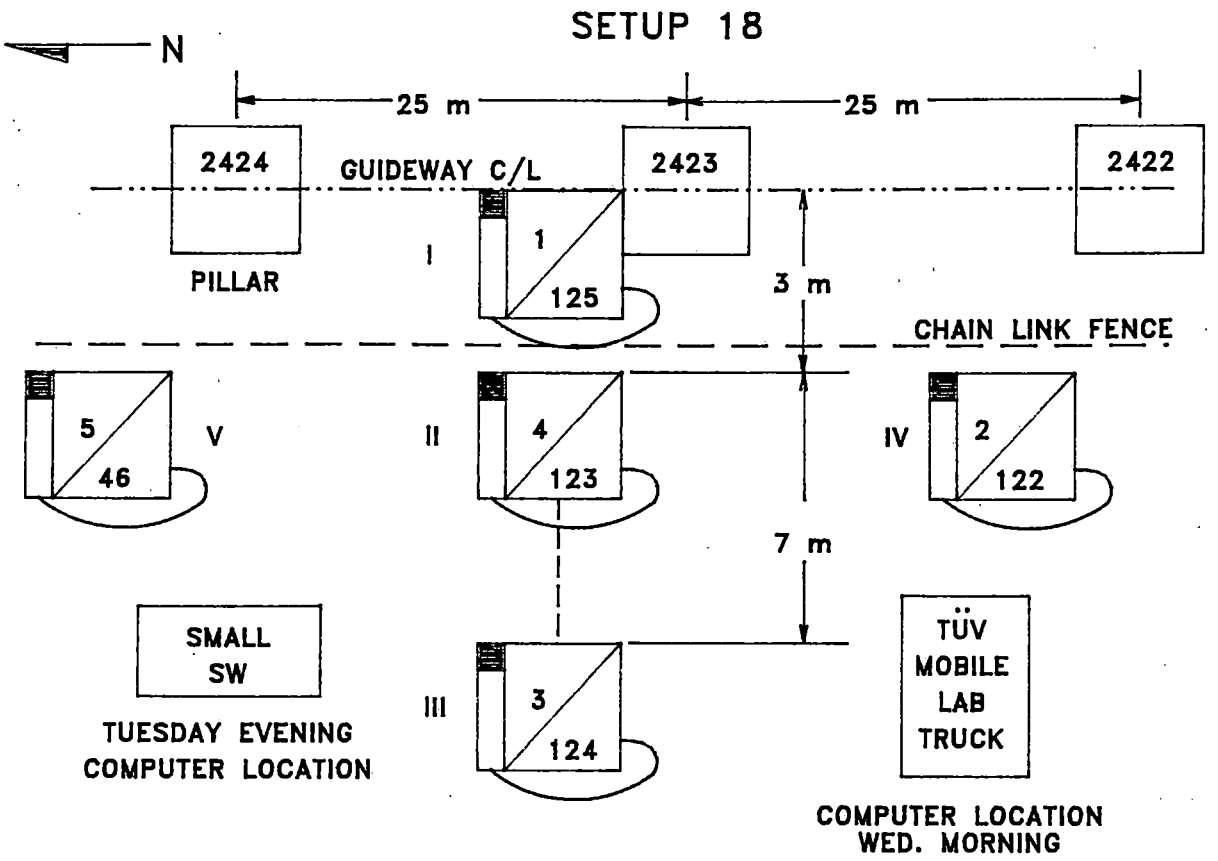
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.20	204.80

RANGE SETTINGS:

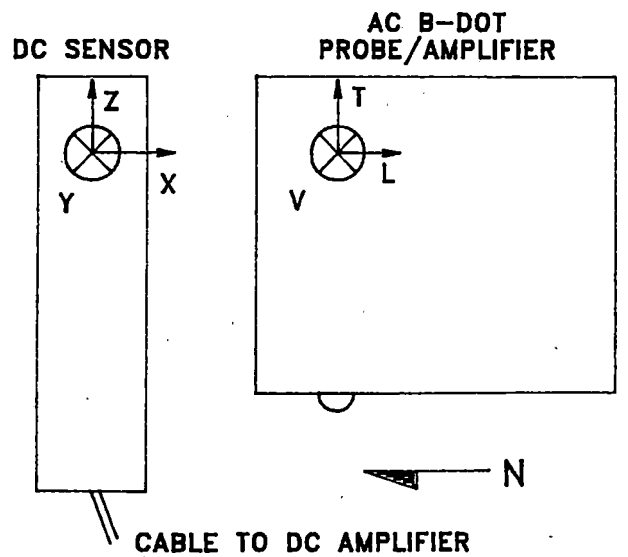
A1 # 1 Pole mounted standing head level- 5-'9
COIL L: 300mG
COIL T: 300mG
COIL V: 1000mG
B1 # 2 Pole mounted at seated head level- 3'-8"
COIL L: 300mG
COIL T: 300mG
COIL V: 100mG
C1 # 3 Pole mounted at seat level- 1'-6.5"
COIL L: 100mG
COIL T: 300mG
COIL V: 100mG
D1 # 4 Pole mounted at floor level- 5"
COIL L: 100mG
COIL T: 300mG
COIL V: 100mG
E1 # 5 Control
COIL L: 100mG
COIL T: 300mG
COIL V: 100mG
A2 #122 Pole mounted at floor level - 5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #124 Pole mounted at seat level - 1'-6.5"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #125 Pole mounted at seated head level - 3'8"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #123 Pole mounted standing head level - 5'9"
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Control in seat near bulkhead
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

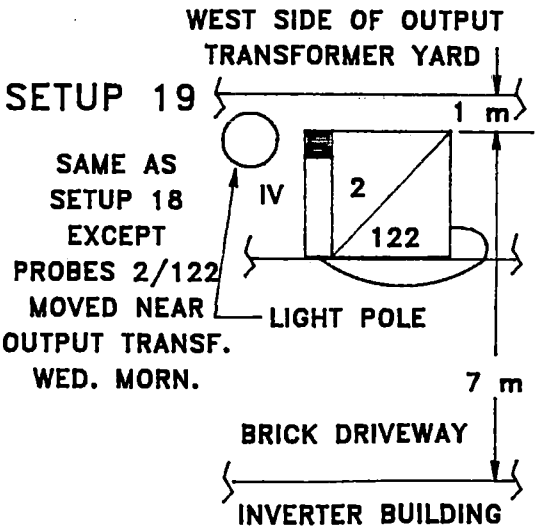
APPENDIX C

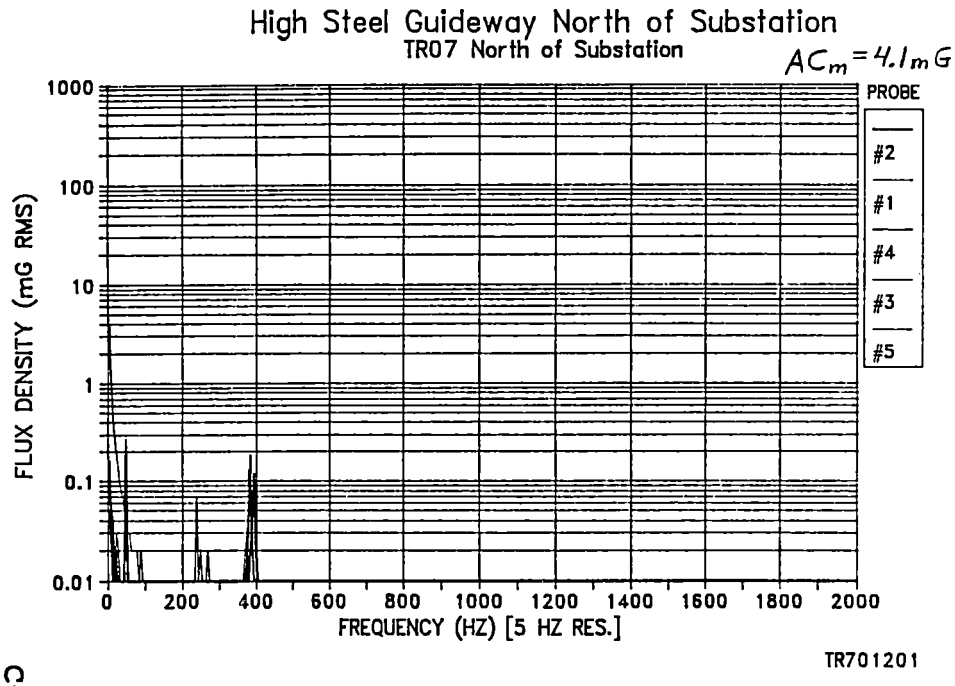
SETUP 18, 19: HIGH STEEL GUIDEWAY, PILLAR 2423 NEAR CONTROL CENTER

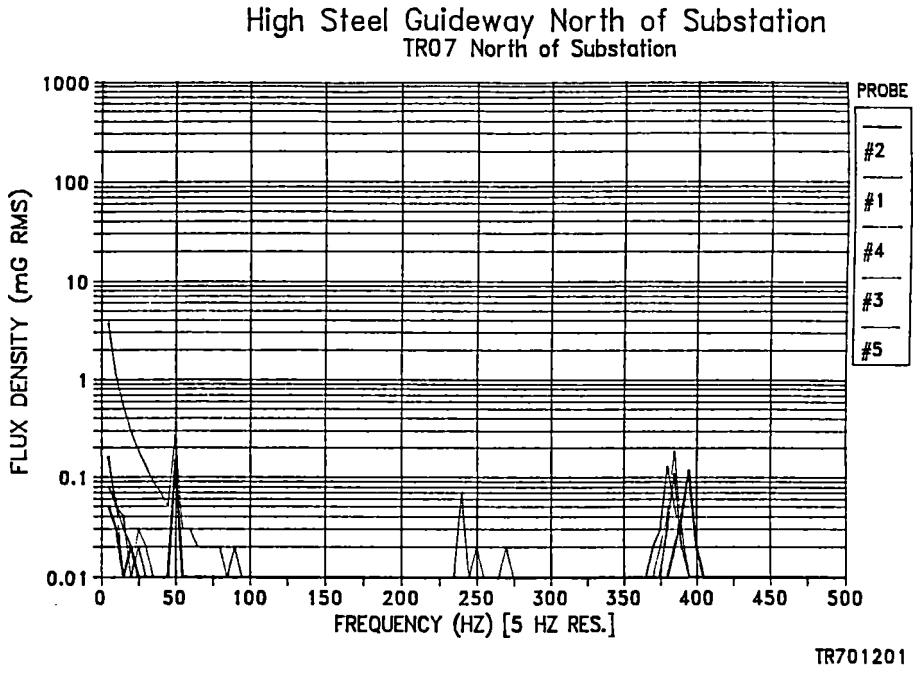


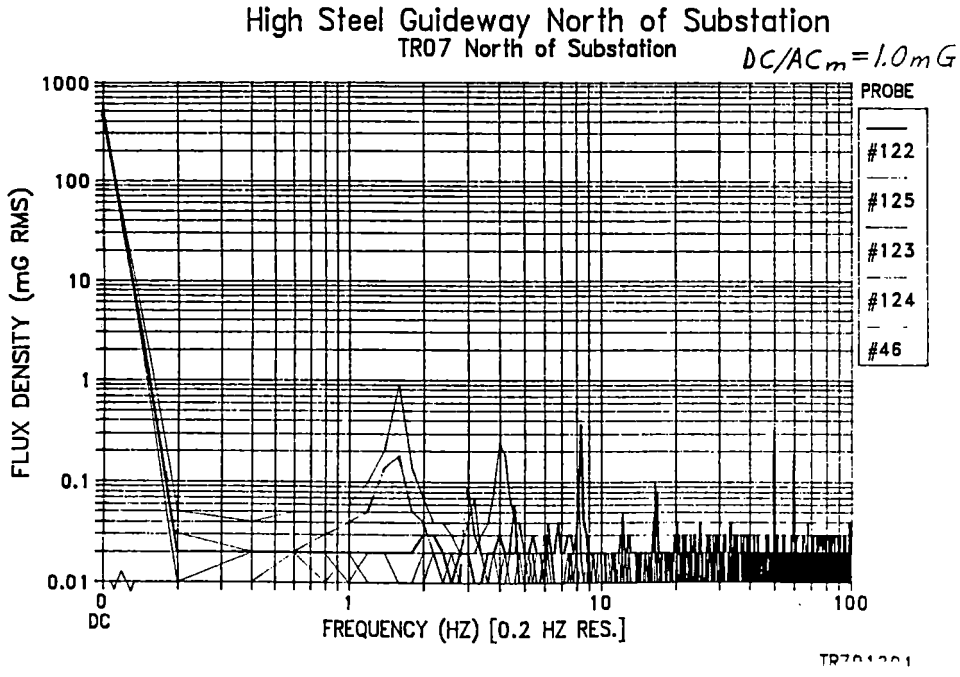
TOP VIEW OF ALL PROBE ORIENTATIONS

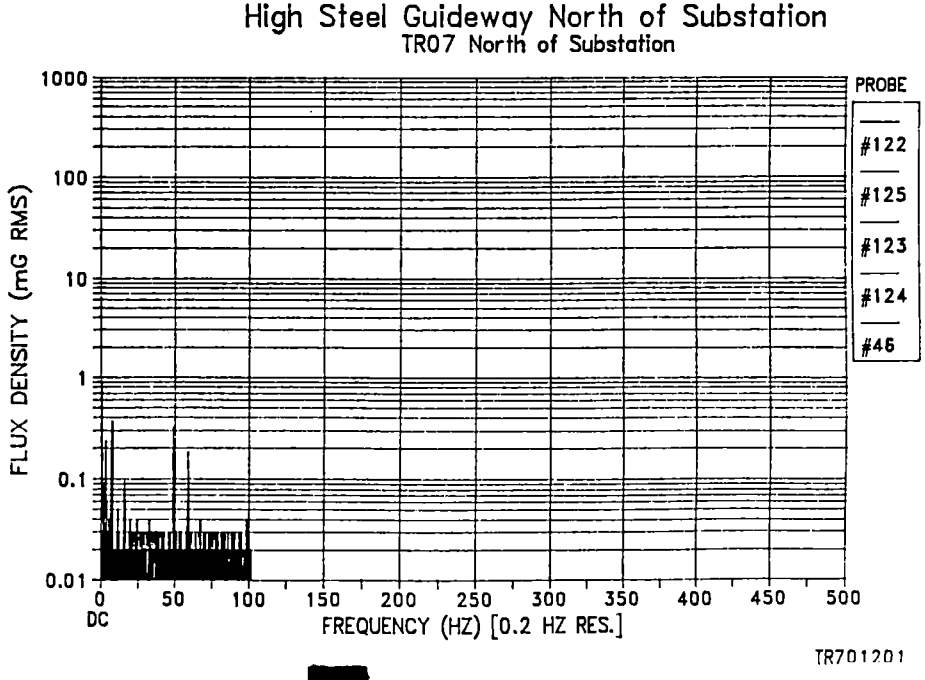


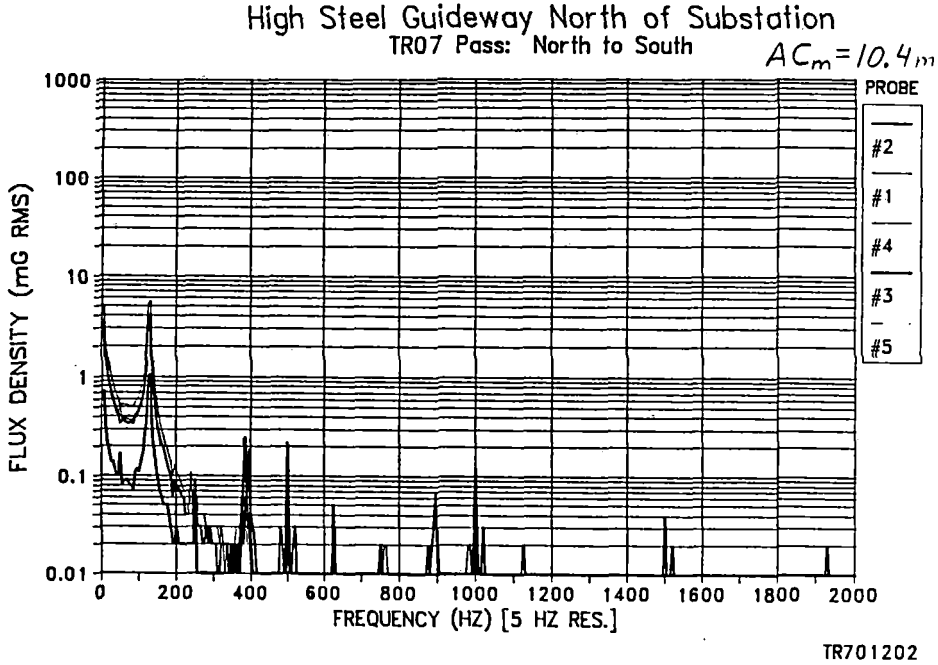


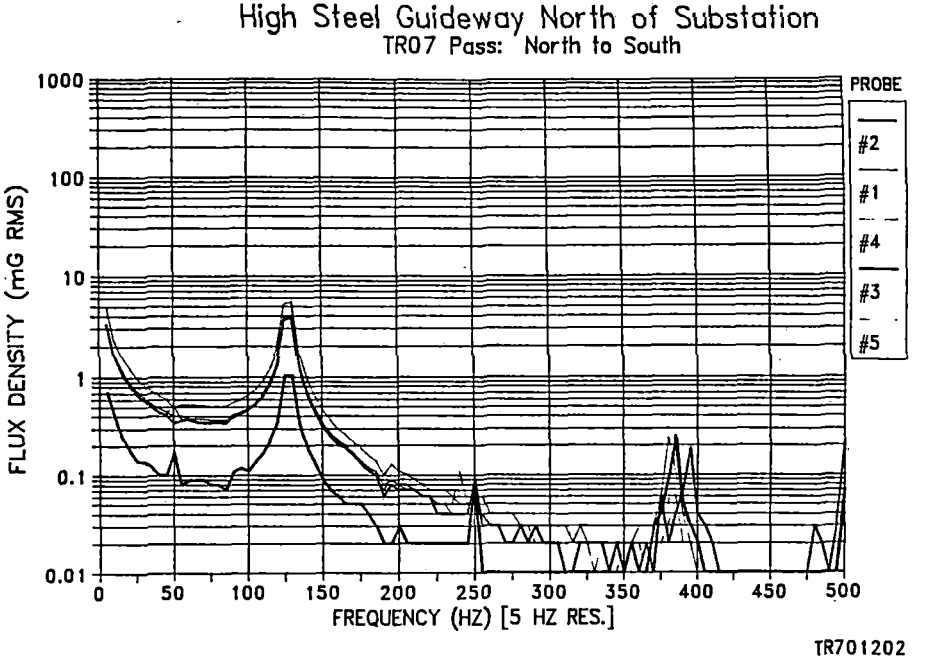

High Steel Guideway North of Substation
TR07 North of Substation
$AC_m = 4.1 mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701201


High Steel Guideway North of Substation
TR07 North of Substation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701201

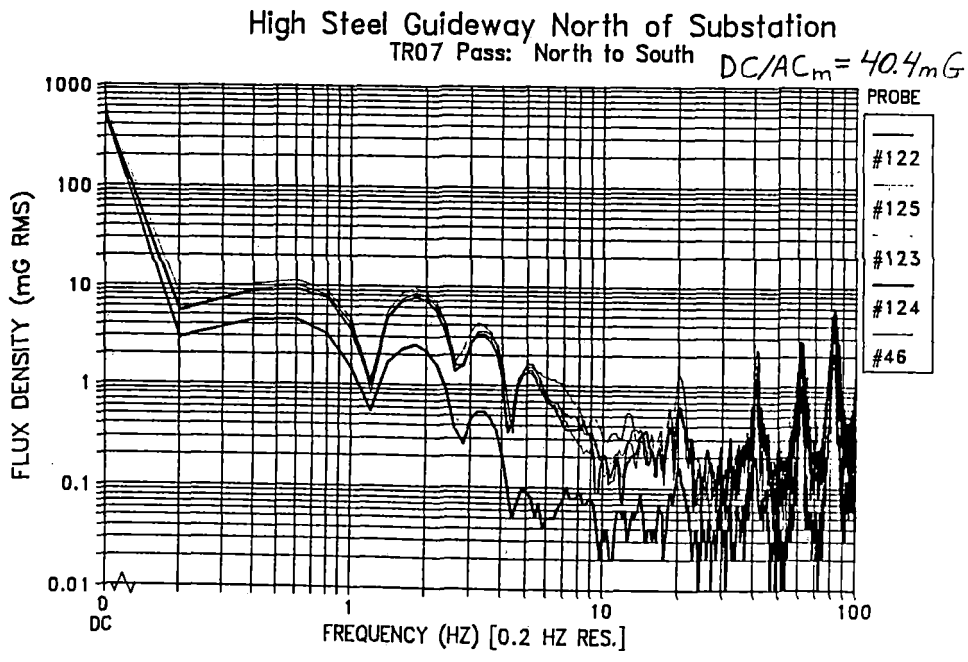

High Steel Guideway North of Substation
TR07 North of Substation
$DC/AC_m = 1.0 mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#122
#125
#123
#124
#46

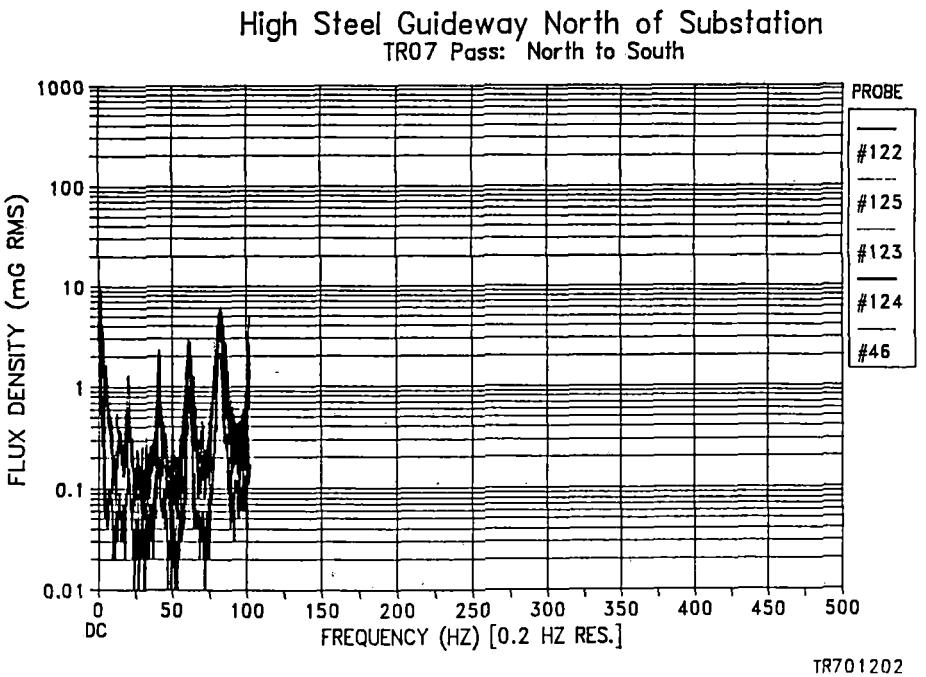

High Steel Guideway North of Substation
TR07 North of Substation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701201

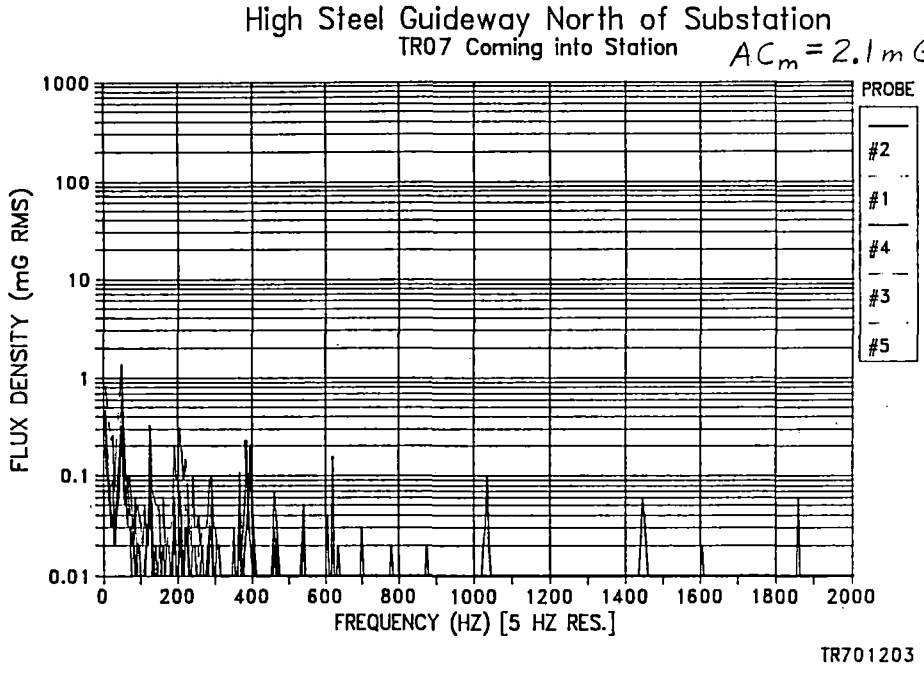

High Steel Guideway North of Substation
TR07 Pass: North to South
$AC_m = 10.4 mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701202

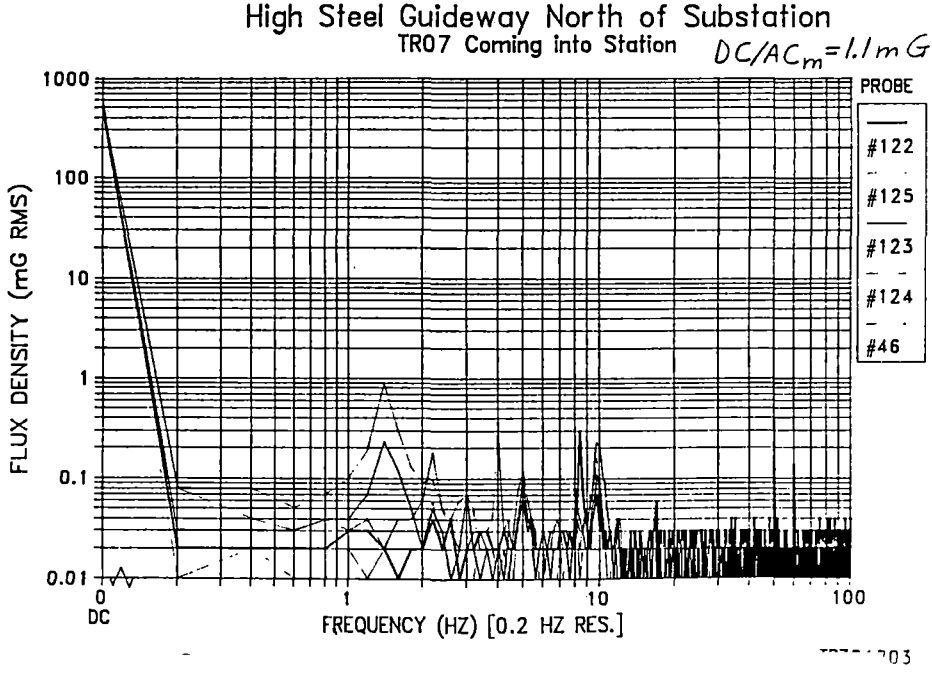

High Steel Guideway North of Substation
TR07 Pass: North to South
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701202

C-3


High Steel Guideway North of Substation
TR07 Pass: North to South
$DC/AC_m = 40.4 mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701202

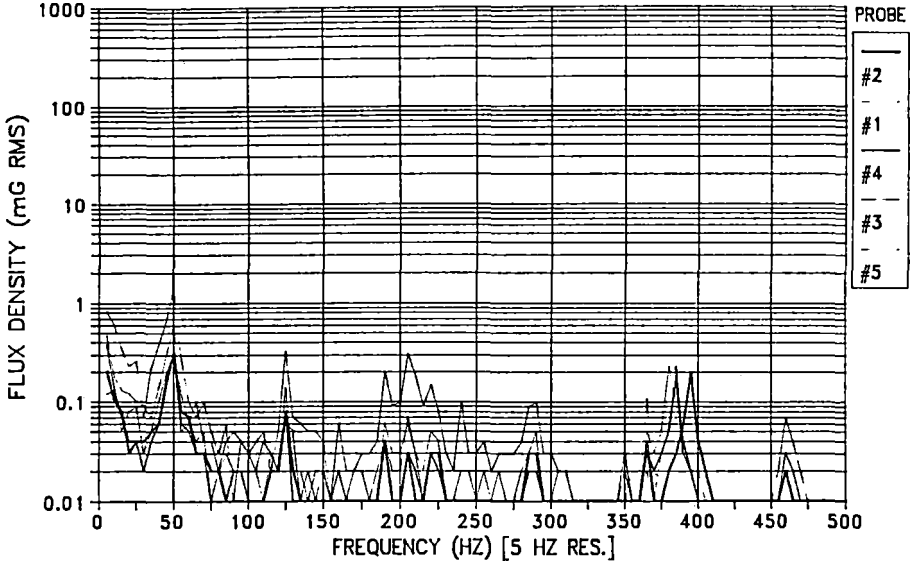

High Steel Guideway North of Substation
TR07 Pass: North to South
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701202


High Steel Guideway North of Substation
TR07 Coming into Station
$AC_m = 2.1 mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701203


High Steel Guideway North of Substation
TR07 Coming into Station
$DC/AC_m = 1.1 mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.2 HZ RES.]
PROBE
#122
#125
#123
#124
#46

High Steel Guideway North of Substation

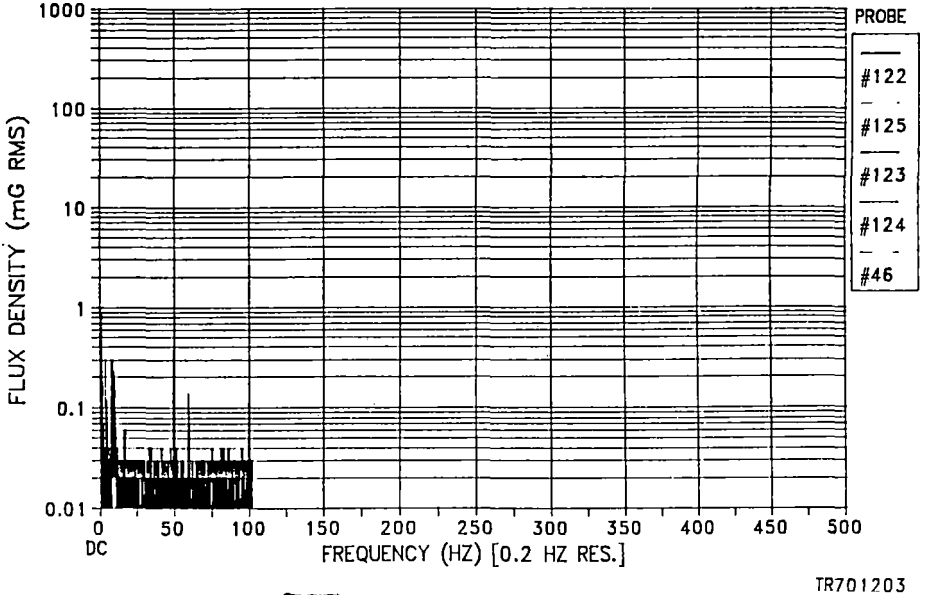
TR07 Coming into Station



TR701203

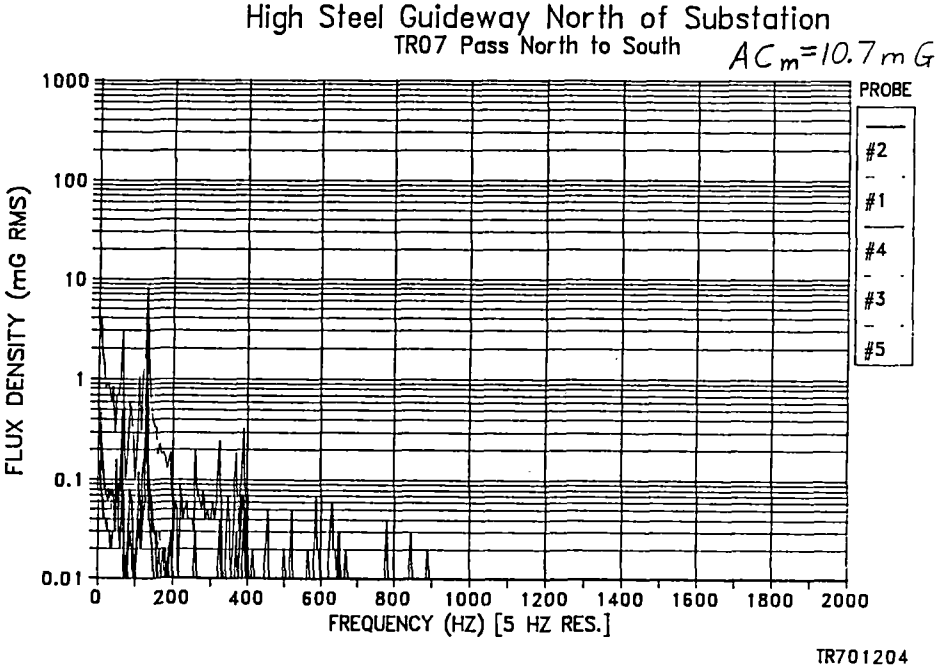
High Steel Guideway North of Substation

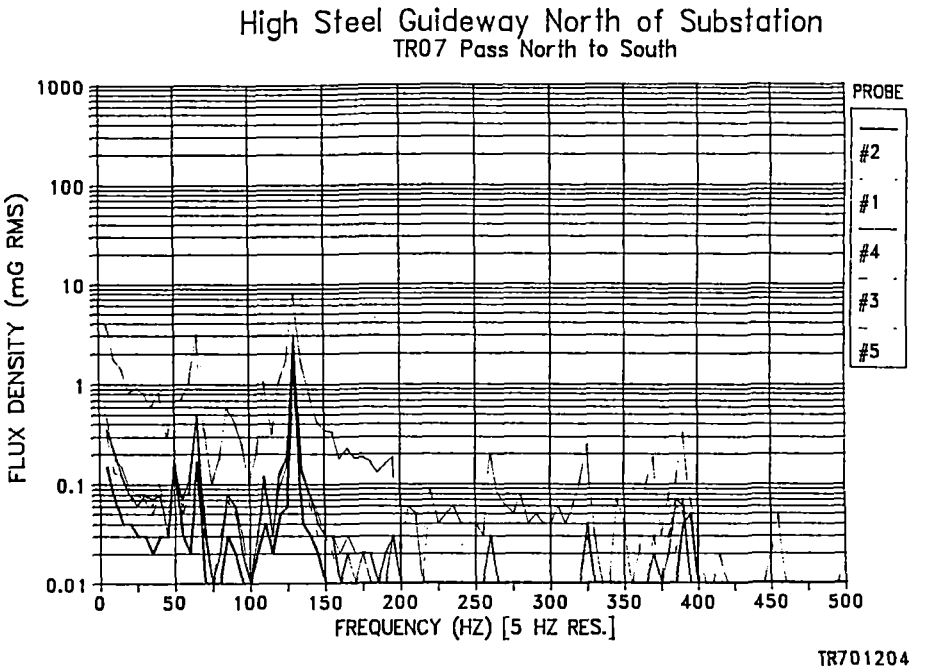
TR07 Coming into Station

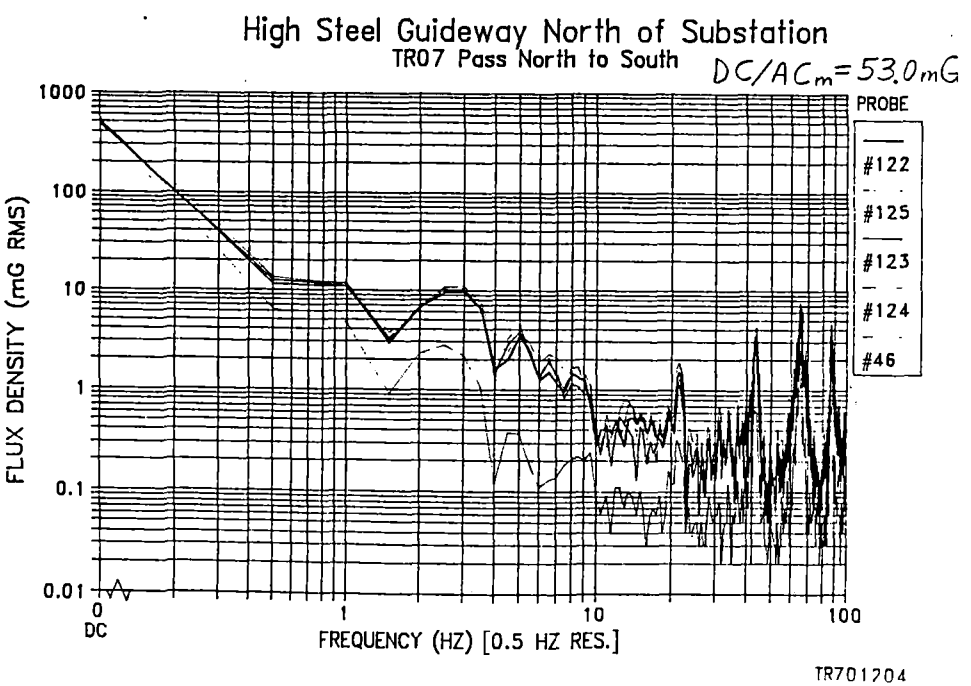


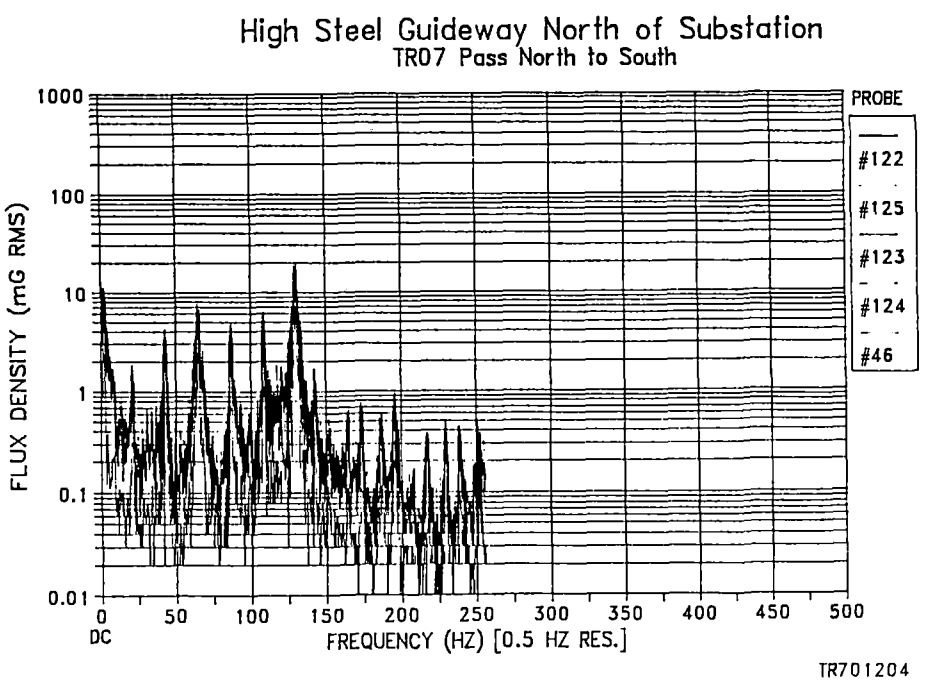
TR701203

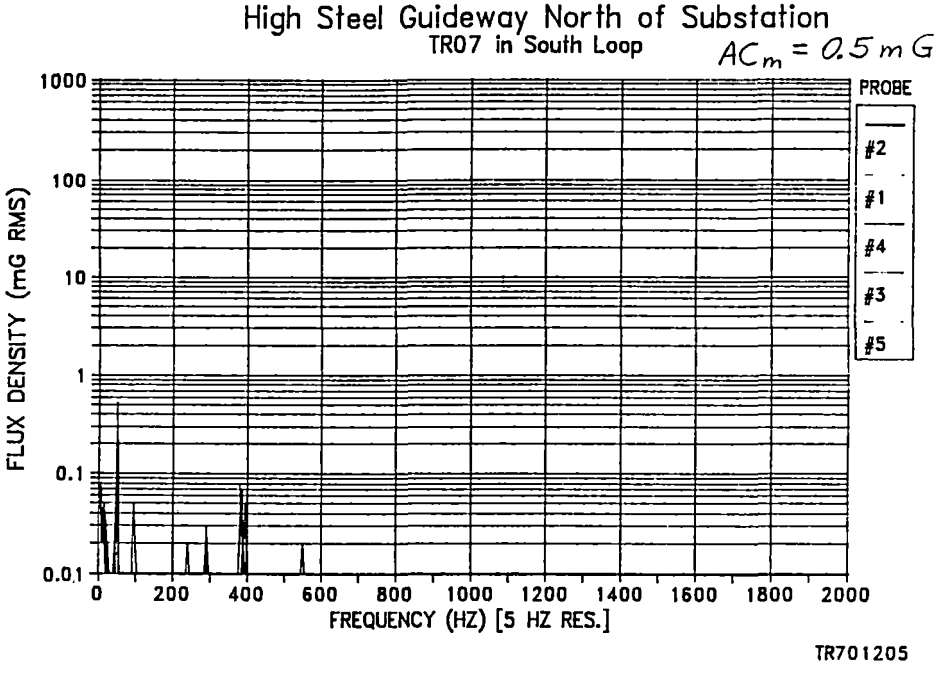
[redacted]

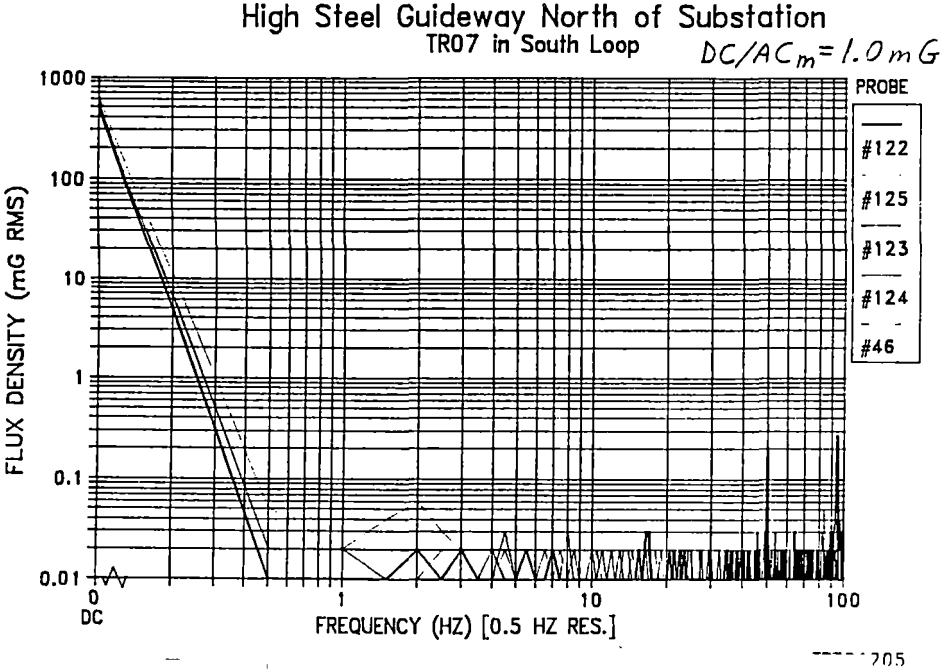

High Steel Guideway North of Substation
TR07 Pass North to South
ACm=10.7mG
FLUX DENSITY (mG RMS)
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701204

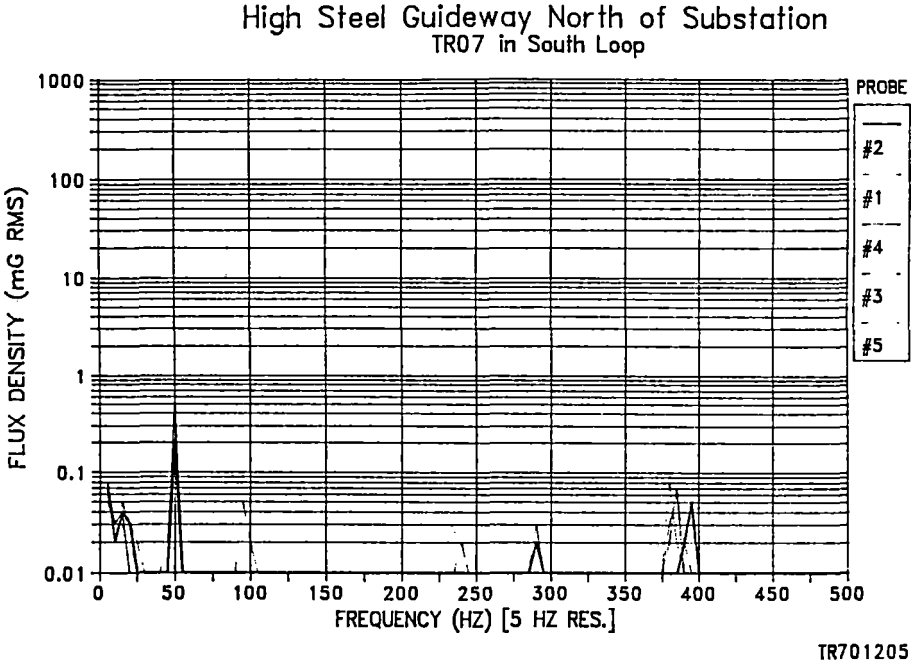

High Steel Guideway North of Substation
TR07 Pass North to South
FLUX DENSITY (mG RMS)
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701204

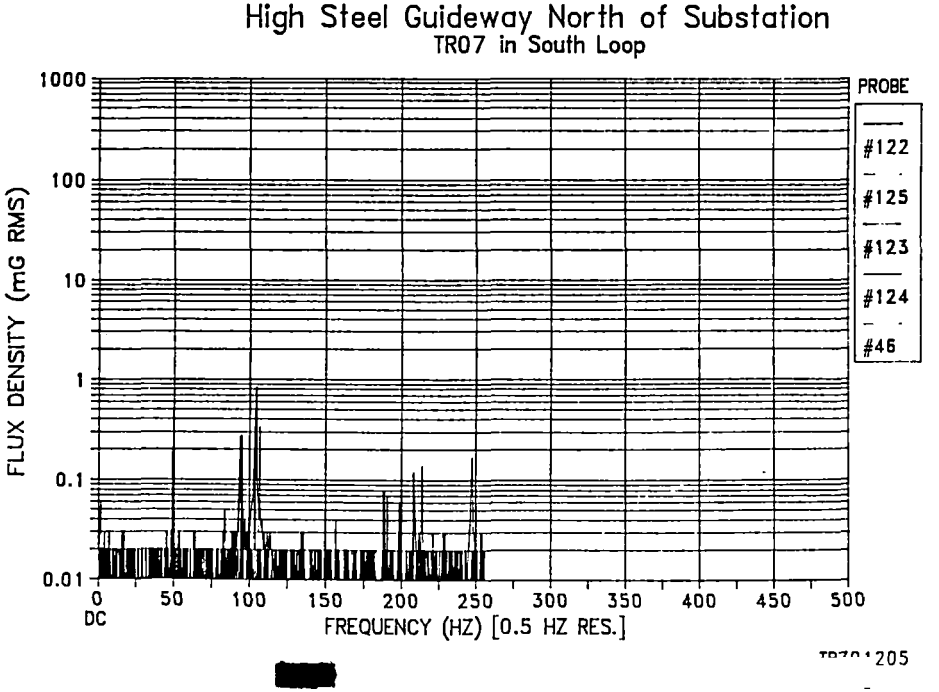

High Steel Guideway North of Substation
TR07 Pass North to South
DC/ACm=53.0mG
FLUX DENSITY (mG RMS)
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701204

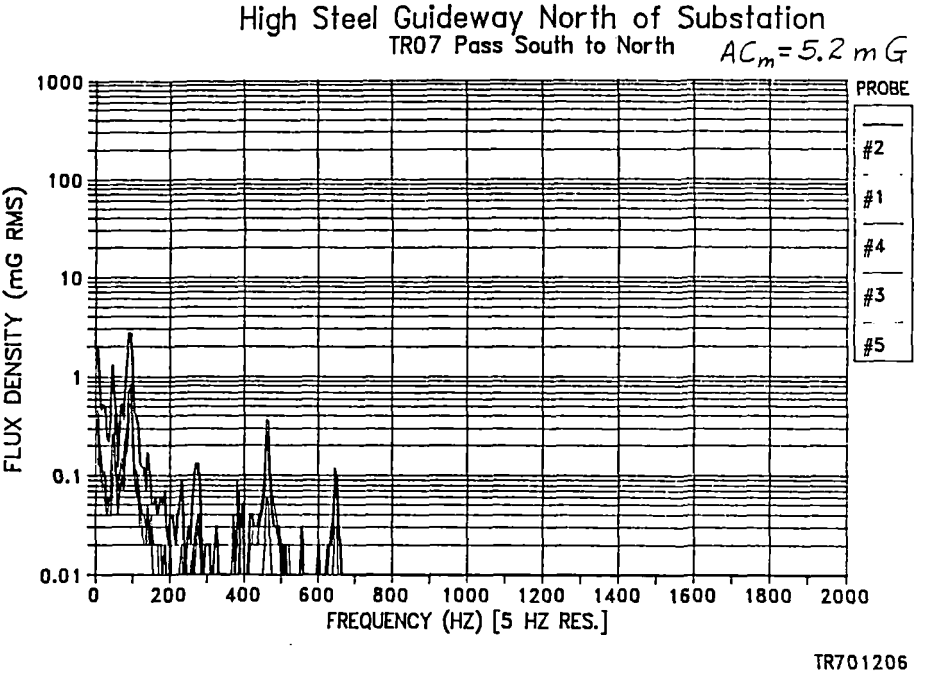

High Steel Guideway North of Substation
TR07 Pass North to South
FLUX DENSITY (mG RMS)
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701204

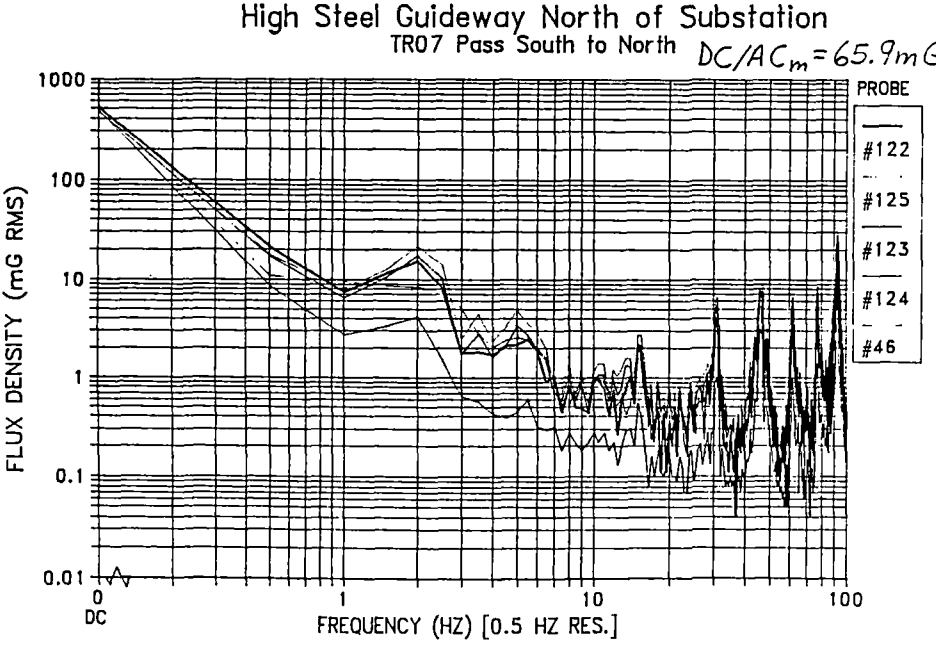

High Steel Guideway North of Substation
TR07 in South Loop
$AC_m = 0.5\,mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701205


High Steel Guideway North of Substation
TR07 in South Loop
$DC/AC_m = 1.0\,mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
205


High Steel Guideway North of Substation
TR07 in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701205

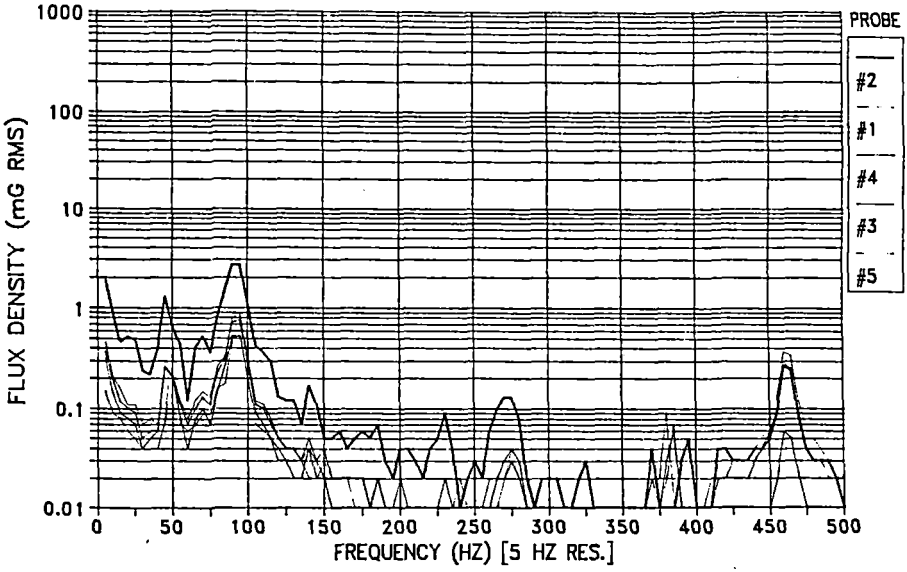

High Steel Guideway North of Substation
TR07 in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46


High Steel Guideway North of Substation
TR07 Pass South to North
$AC_m = 5.2\ mG$
PROBE
#2
#1
#4
#3
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR701206


High Steel Guideway North of Substation
TR07 Pass South to North
$DC/AC_m = 65.9mG$
PROBE
#122
#125
#123
#124
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR701206

High Steel Guideway North of Substation

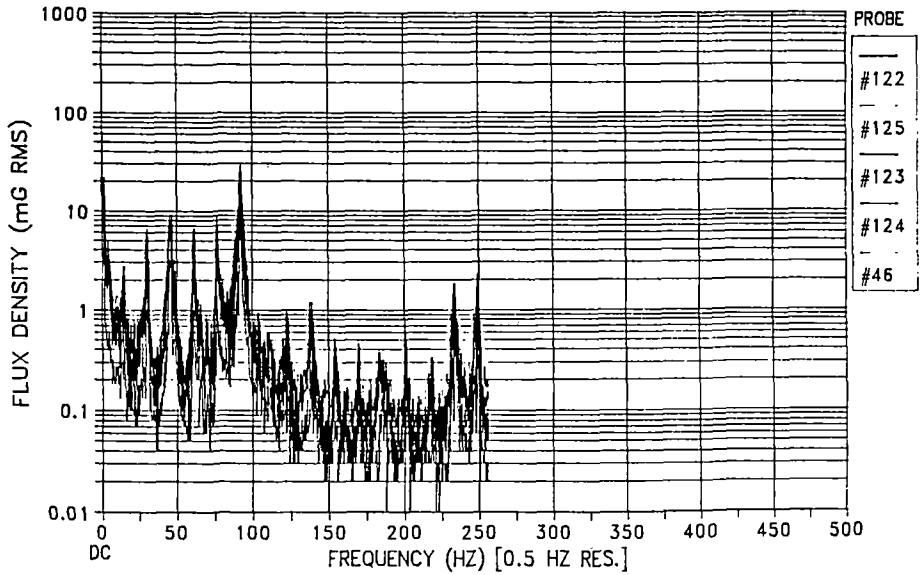
TR07 Pass South to North



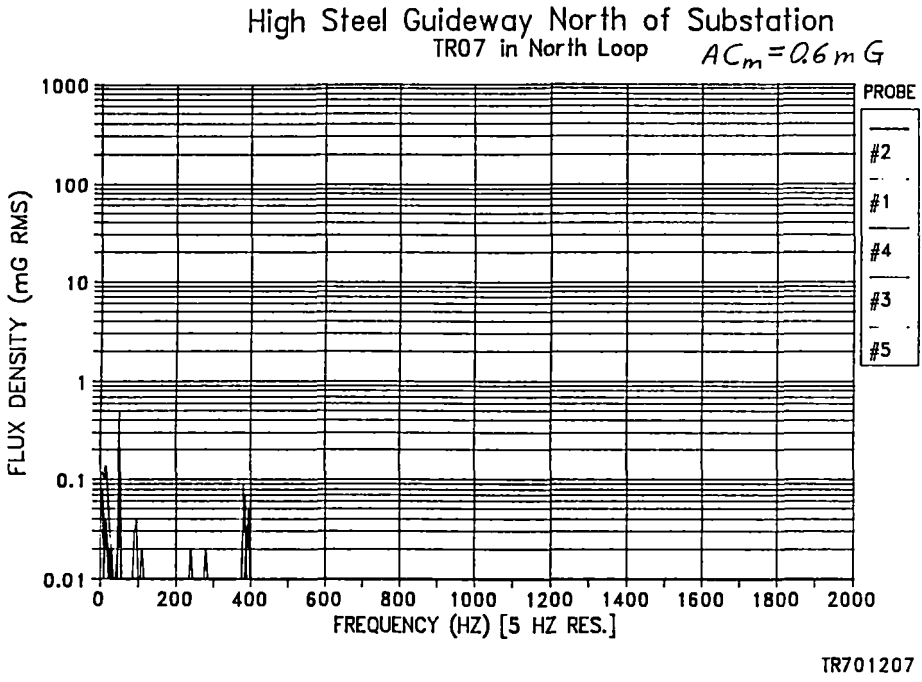
TR701206

High Steel Guideway North of Substation

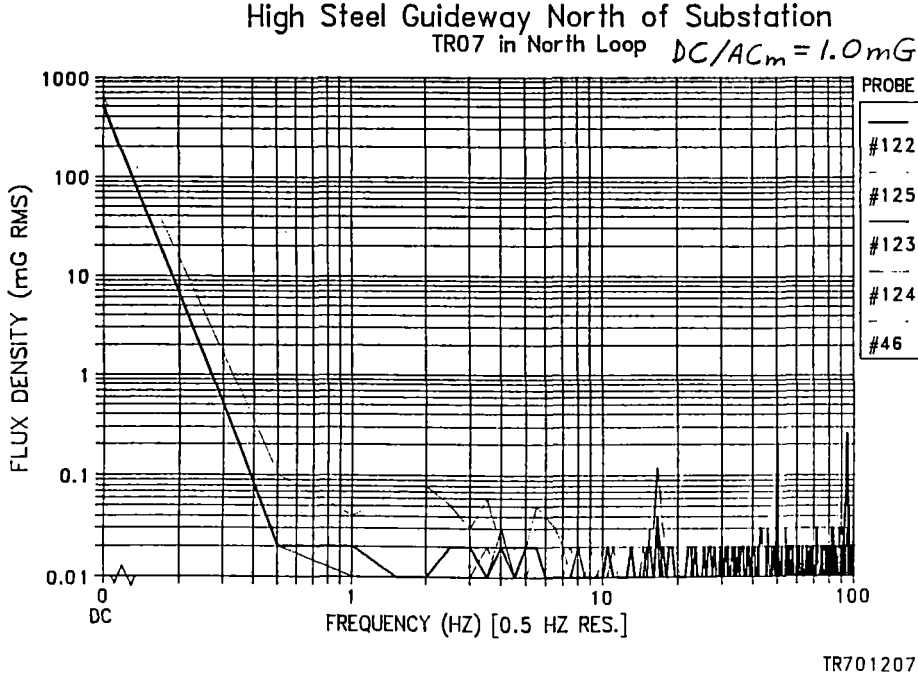
TR07 Pass South to North



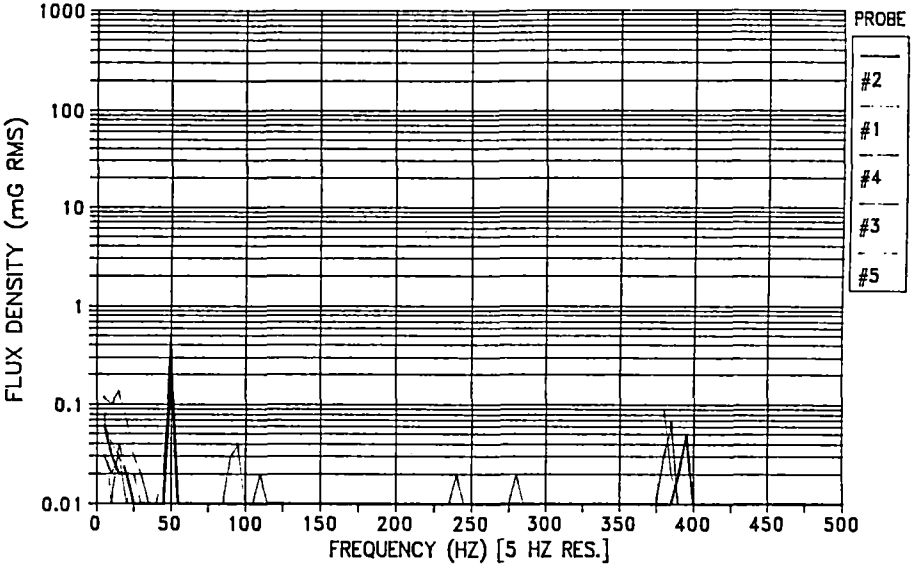
TR701206


High Steel Guideway North of Substation
TR07 in North Loop
$AC_m = 0.6\,mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701207

C-8

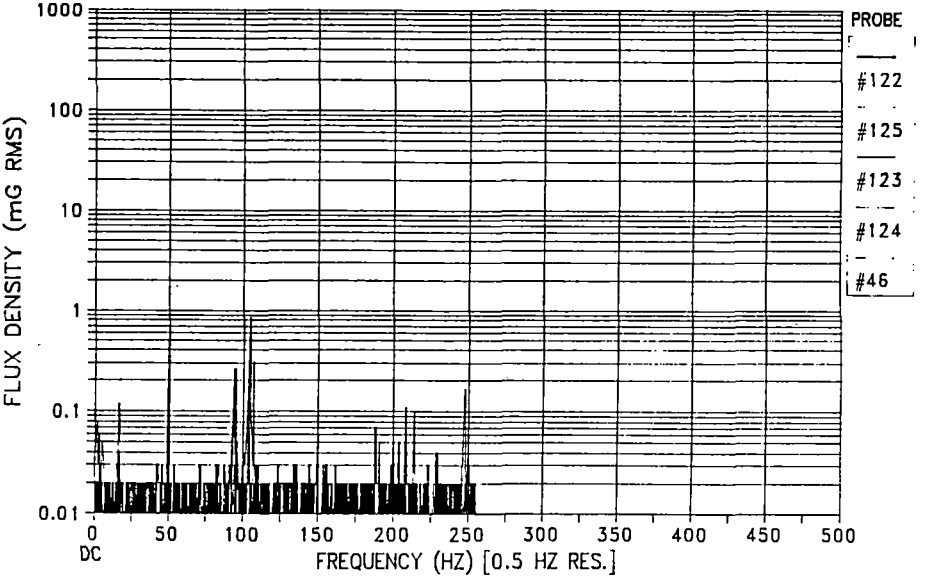

High Steel Guideway North of Substation
TR07 in North Loop
$DC/AC_m = 1.0\,mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701207

High Steel Guideway North of Substation
TR07 in North Loop



TR701207

High Steel Guideway North of Substation
TR07 in North Loop



TR701207

TR7012

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 012
> Guideway measurements
> profile of guideway near facility
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 10:42:50
End: 08/08/90 (Wednesday) AT 10:47:12
Recorded 21 samples at 2 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 2 Along guideway at 3m from center at far
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 1 Under center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 4 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 3 In profile 10m from center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 5 Along guideway, 3m from center, far end
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #122 Along guideway to right side of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of guideway in profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #123 In profile 3m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #124 In profile 10m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Along guideway to left of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7013

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 013
> Guideway measurements
> profile of guideway near facility
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 10:50:00
End: 08/08/90 (Wednesday) AT 11:12:00
Recorded 221 samples at 3 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 2 Along guideway at 3m from center at far
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

B1 # 1 Under center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

C1 # 4 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

D1 # 3 In profile 10m from center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

E1 # 5 Along guideway, 3m from center, far end
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

A2 #122 Along guideway to right side of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

B2 #125 Center of guideway in profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

C2 #123 In profile 3m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

D2 #124 In profile 10m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

E2 # 46 Along guideway to left of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7014

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 014
> Guideway measurements
> profile of guideway near facility
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 12:26:00
End: 08/08/90 (Wednesday) AT 12:37:30
Recorded 116 samples at 3 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 2 Along guideway at 3m from center at far
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 1 Under center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 4 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 3 In profile 10m from center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 5 Along guideway, 3m from center, far end
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #122 Along guideway to right side of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of guideway in profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #123 In profile 3m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #124 In profile 10m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Along guideway to left of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7015

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 015
> Guideway measurements
> profile of guideway near facility
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 12:39:20
End: 08/08/90 (Wednesday) AT 12:40:32
Recorded 13 samples at 3 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 2 Along guideway at 3m from center at far
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 1 Under center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 4 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 3 In profile 10m from center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 5 Along guideway, 3m from center, far end
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #122 Along guideway to right side of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of guideway in profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #123 In profile 3m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #124 In profile 10m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Along guideway to left of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7017

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 017
> Guideway measurements
> profile of guideway near facility
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 12:46:00
End: 08/08/90 (Wednesday) AT 12:54:57
Recorded 16 samples at 3 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 2 Along guideway at 3m from center at far
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

B1 # 1 Under center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

C1 # 4 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

D1 # 3 In profile 10m from center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

E1 # 5 Between transformer bank, inverter bldg
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

A2 #122 Along guideway to right side of profile
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG

B2 #125 Center of guideway in profile
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG

C2 #123 In profile 3m from center of guideway
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG

D2 #124 In profile 10m from center of guideway
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG

E2 # 46 Between transformers and inverter bldg
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG

TR7018

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 018
> Guideway measurements
> profile of guideway near facility
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 12:56:00
End: 08/08/90 (Wednesday) AT 13:01:06
Recorded 52 samples at 3 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

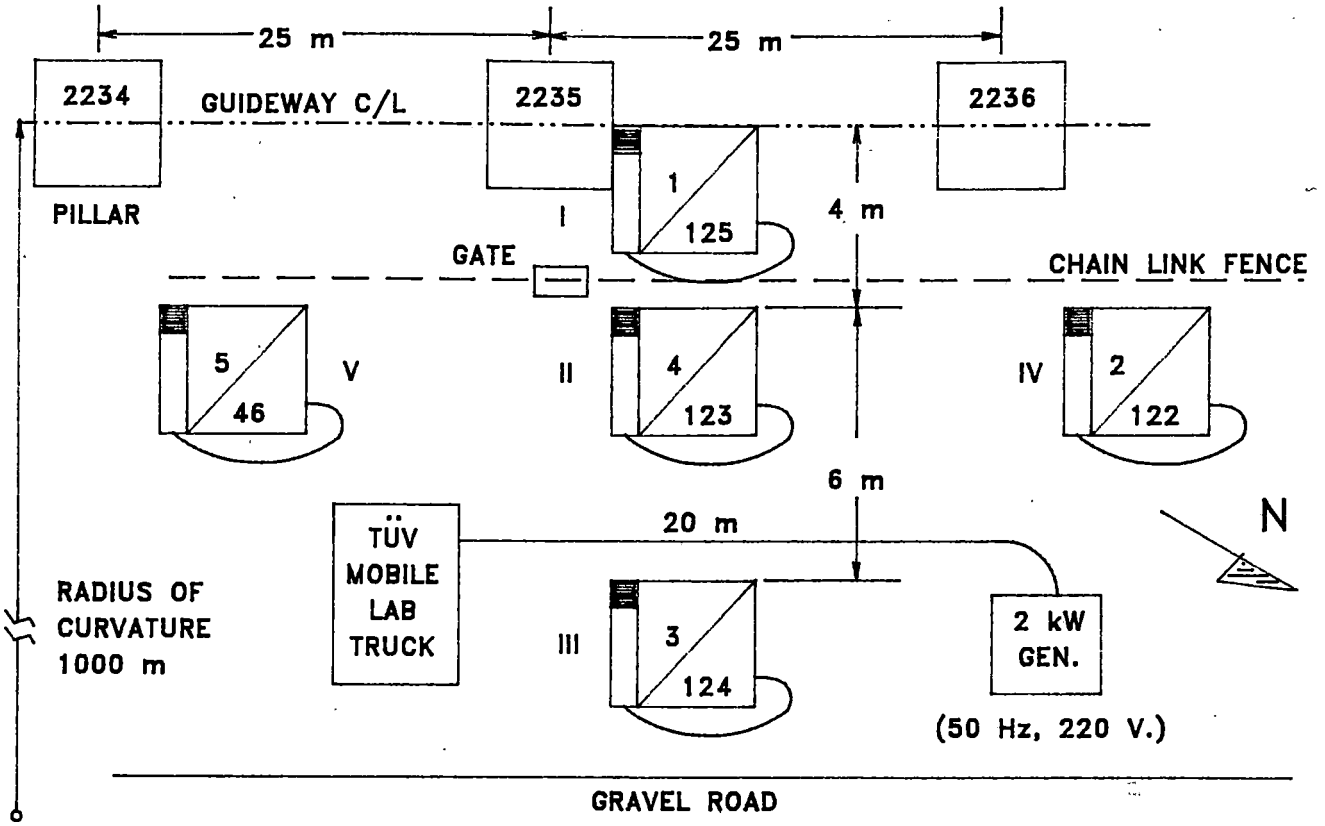
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

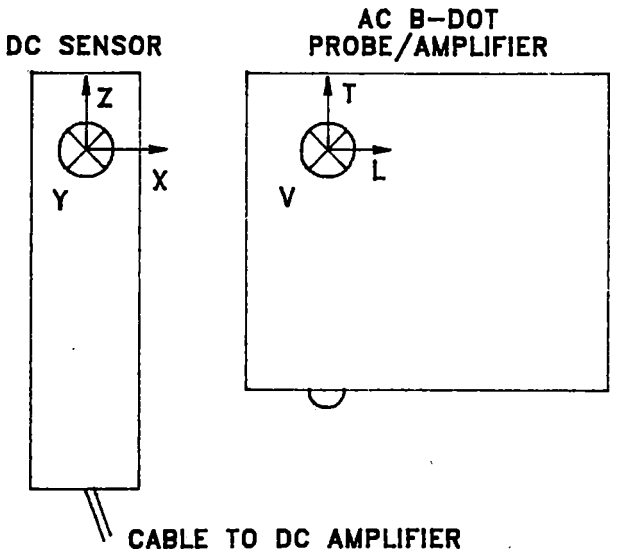
A1 # 2 Along guideway at 3m from center at far
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 1 Under center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 4 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 3 In profile 10m from center of guideway
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 5 Between transformer bank, inverter bldg
COIL L: 10.0mG
COIL T: 100mG
COIL V: 100mG
A2 #122 Along guideway to right side of profile
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG
B2 #125 Center of guideway in profile
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG
C2 #123 In profile 3m from center of guideway
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG
D2 #124 In profile 10m from center of guideway
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG
E2 # 46 Between transformers and inverter bldg
X DC - A: 1000mG
Y DC - B: 1000mG
Z DC - C: 1000mG

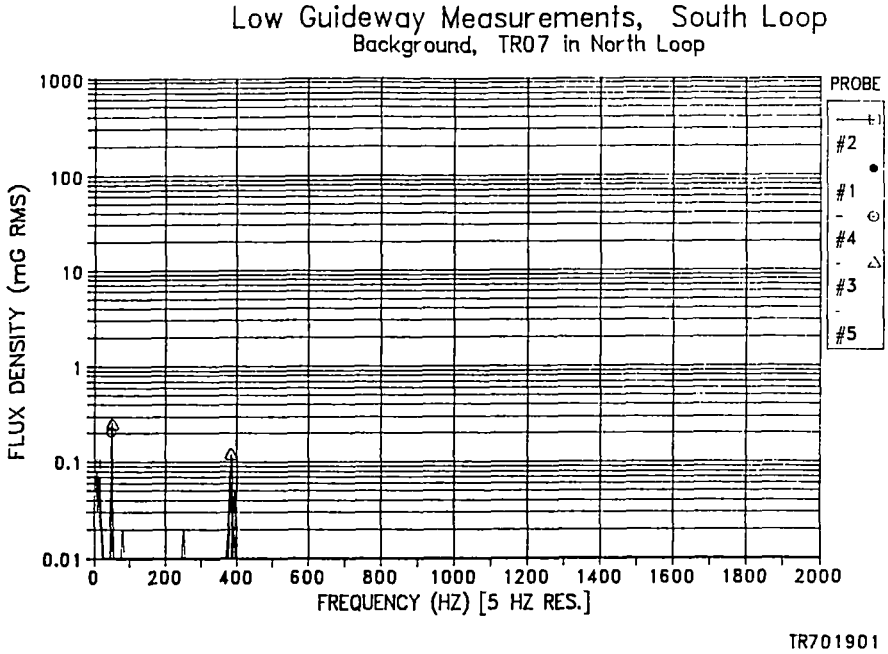
APPENDIX D

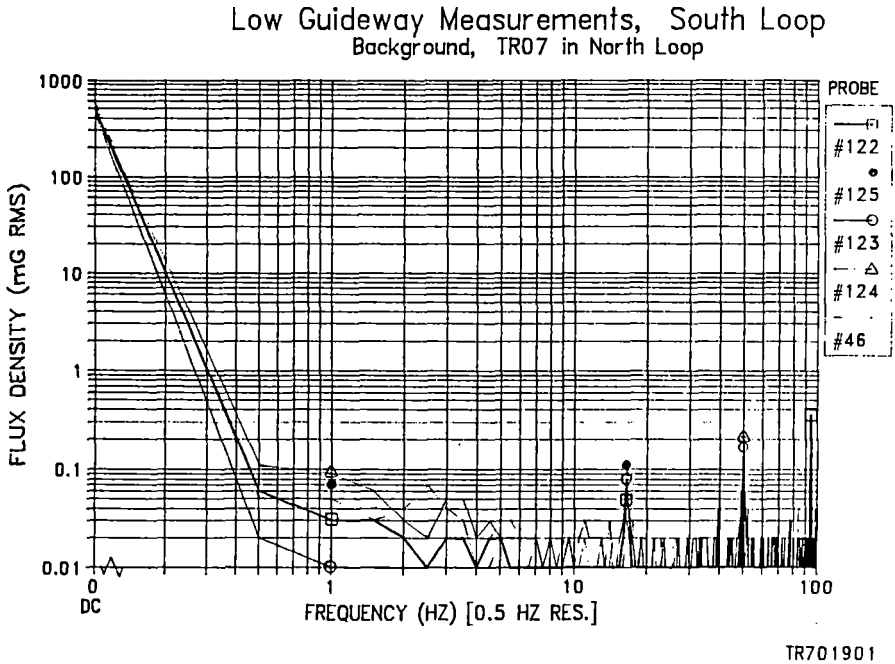
SETUP 20: LOW CONCRETE GUIDEWAY IN SOUTH LOOP

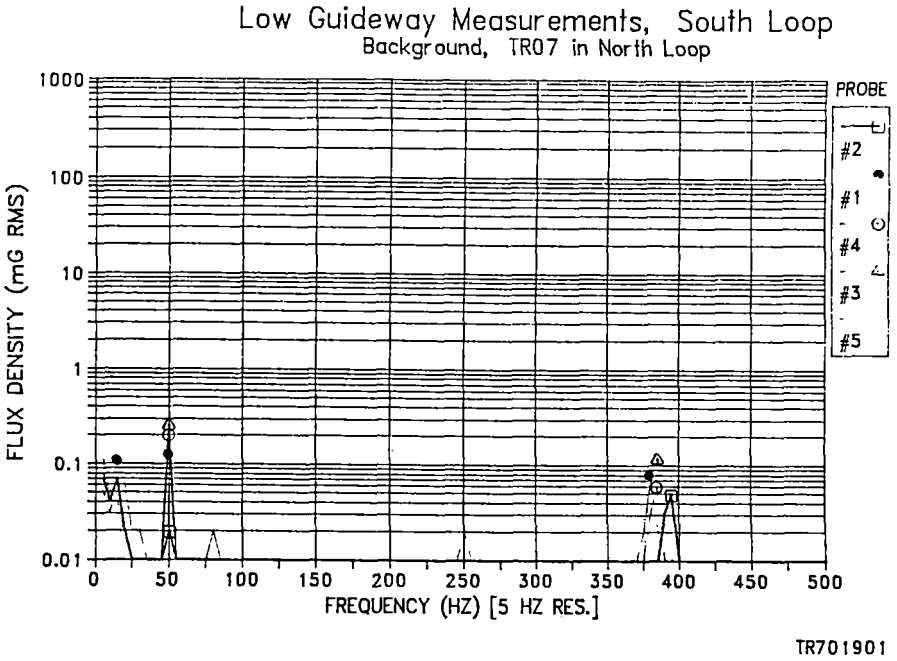


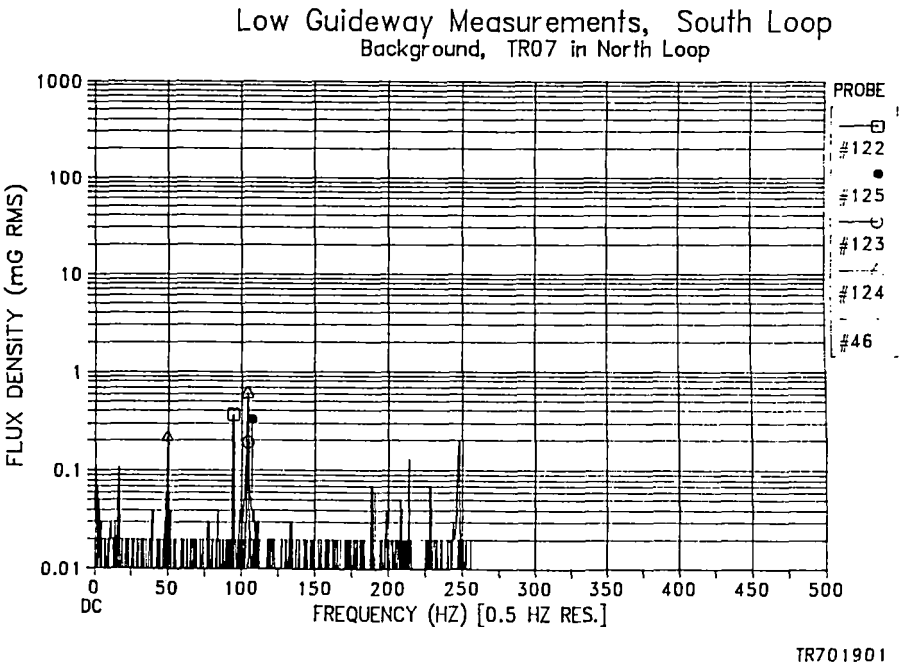
TOP VIEW OF ALL PROBE ORIENTATIONS

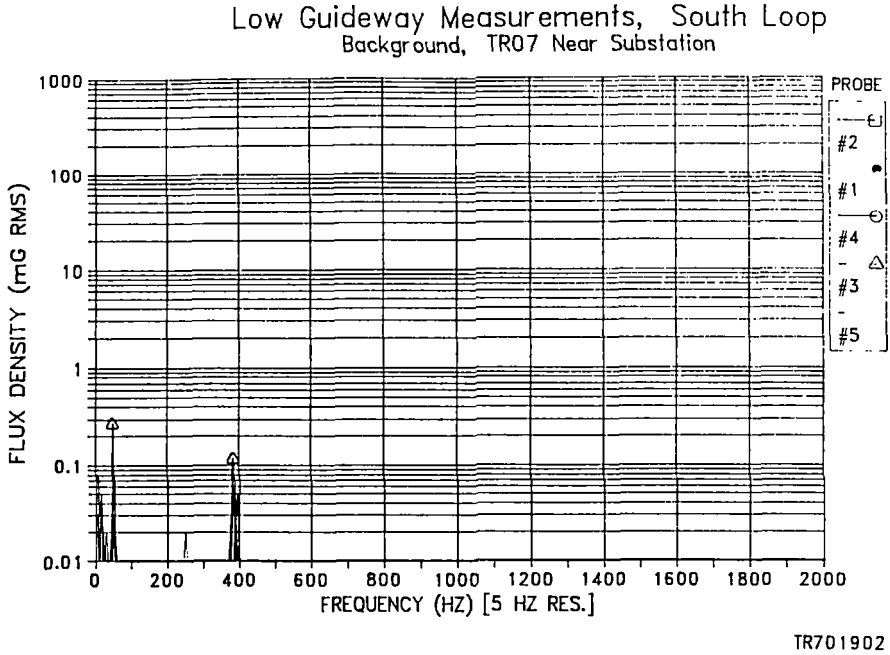


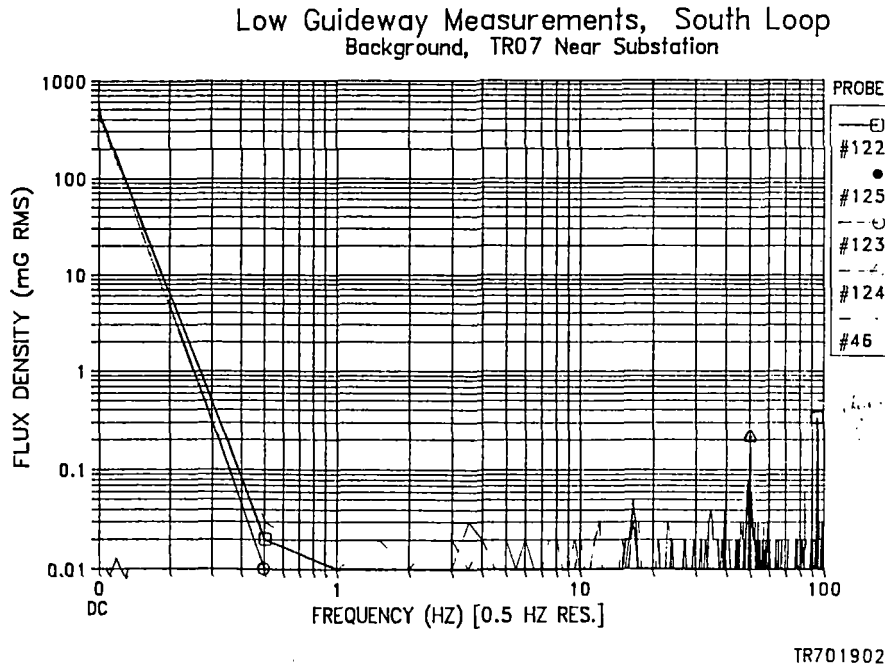

Low Guideway Measurements, South Loop
Background, TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701901

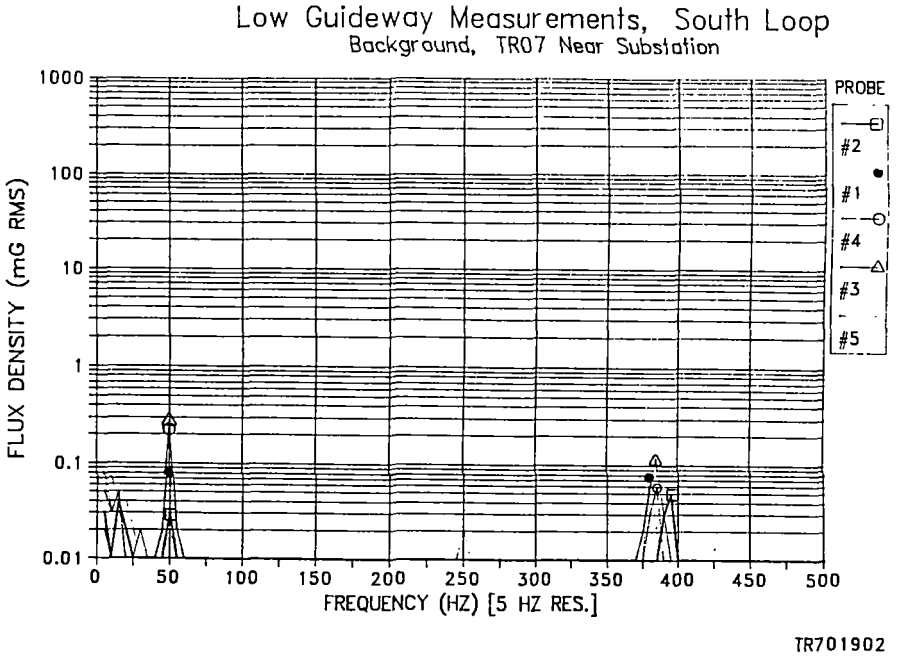

Low Guideway Measurements, South Loop
Background, TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701901

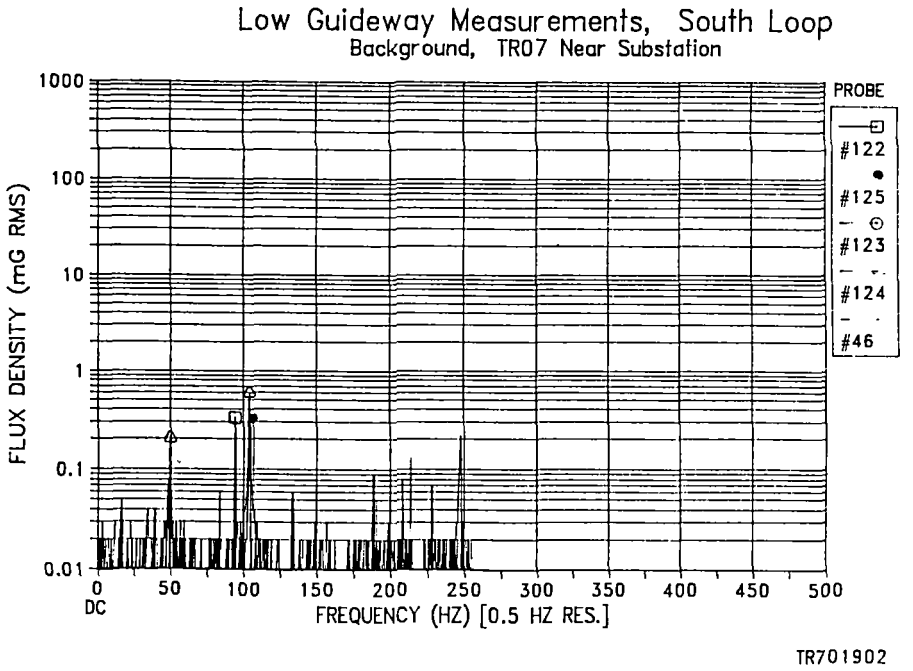

Low Guideway Measurements, South Loop
Background, TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701901


Low Guideway Measurements, South Loop
Background, TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701901

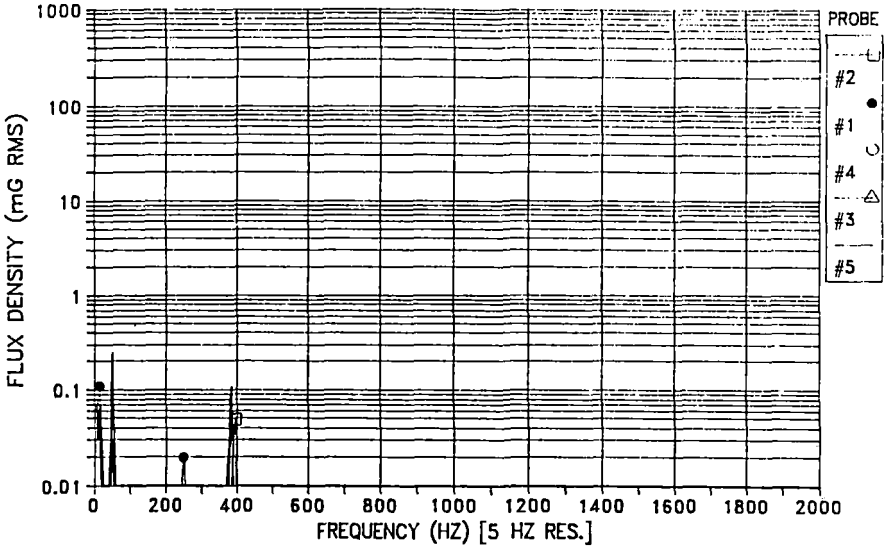

Low Guideway Measurements, South Loop
Background, TR07 Near Substation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701902


Low Guideway Measurements, South Loop
Background, TR07 Near Substation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701902


Low Guideway Measurements, South Loop
Background, TR07 Near Substation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR701902

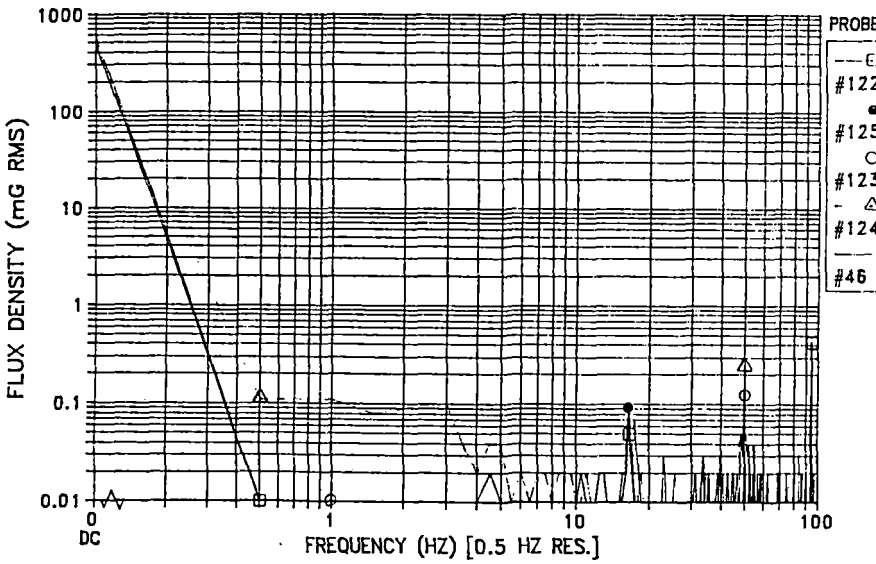

Low Guideway Measurements, South Loop
Background, TR07 Near Substation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR701902

Low Guideway Measurements
Background at Low Guideway



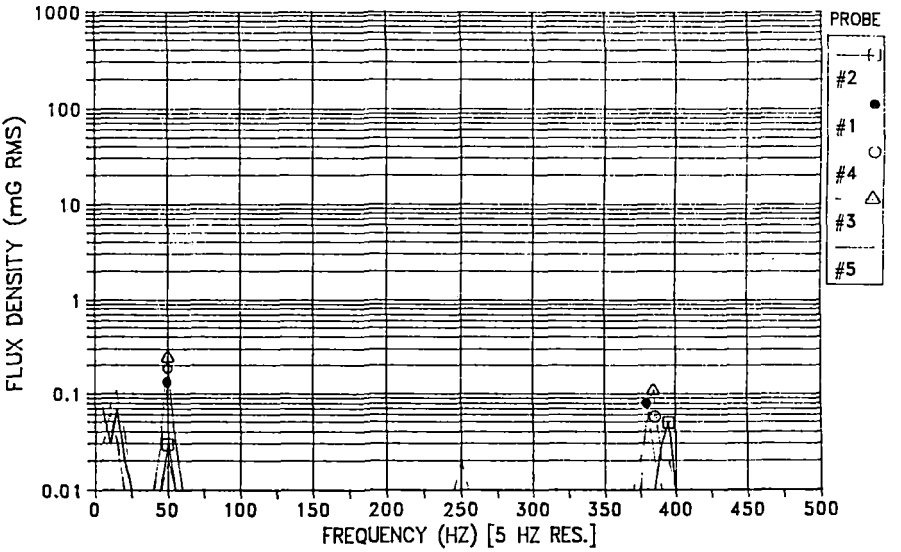
TR701903

Low Guideway Measurements
Background at Low Guideway



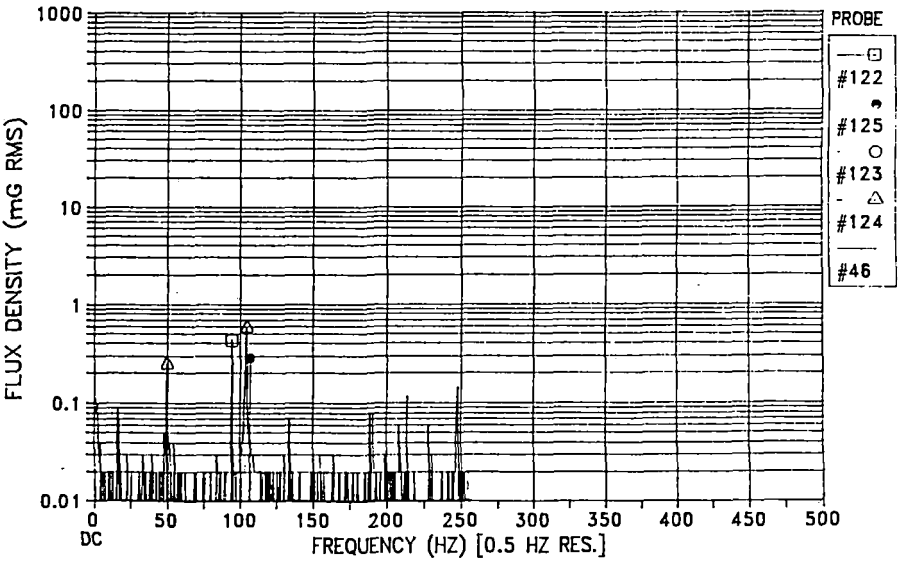
TR701903

Low Guideway Measurements
Background at Low Guideway



TR701903

Low Guideway Measurements
Background at Low Guideway



TR701903

[redacted]

TR7019

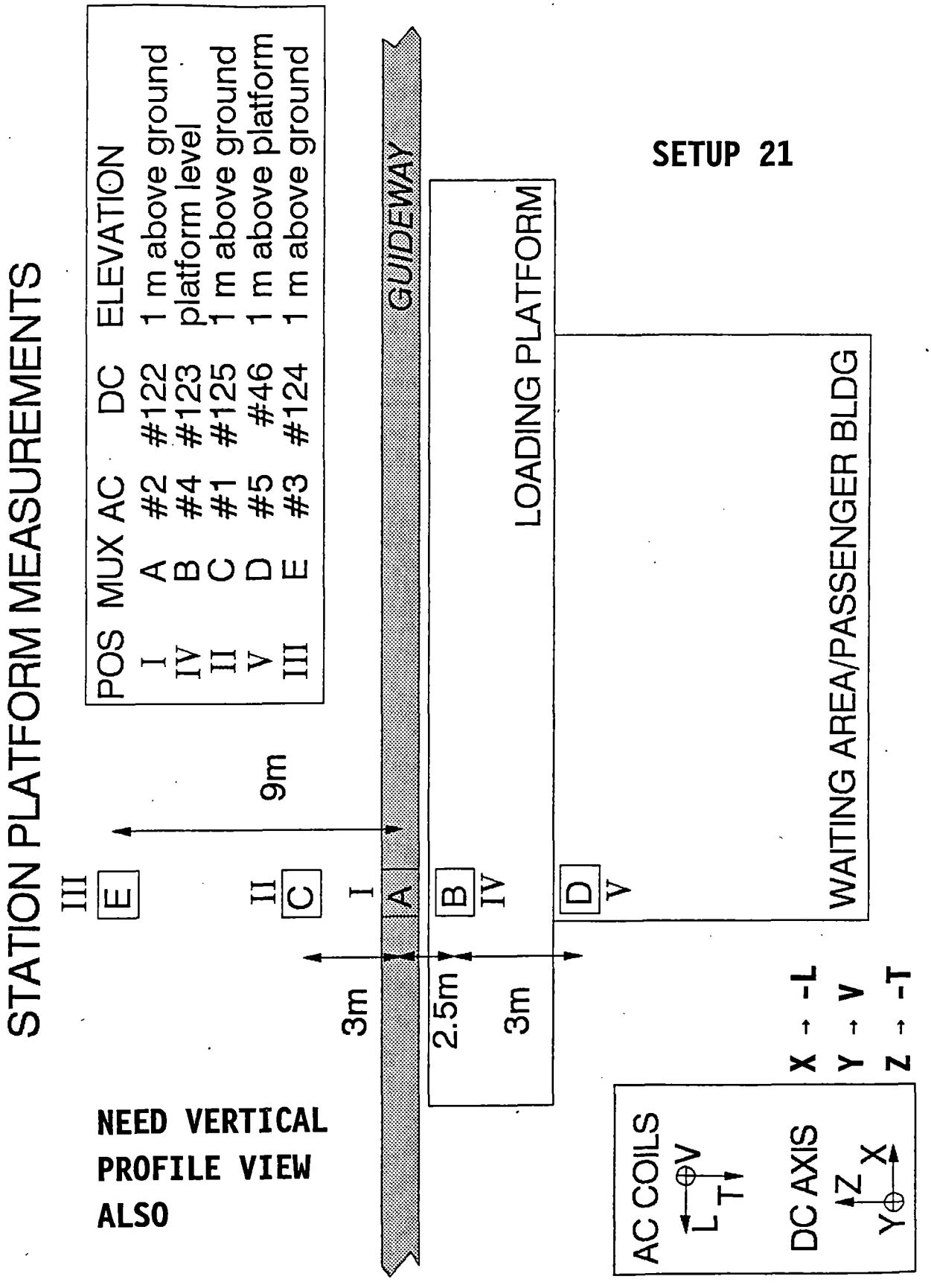
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 019
> Guideway measurements
> profile of guidewayat low guideway sect.
> TR07 operating on track
Start: 08/08/90 (Wednesday) AT 16:00:00
End: 08/08/90 (Wednesday) AT 16:20:04
Recorded 194 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

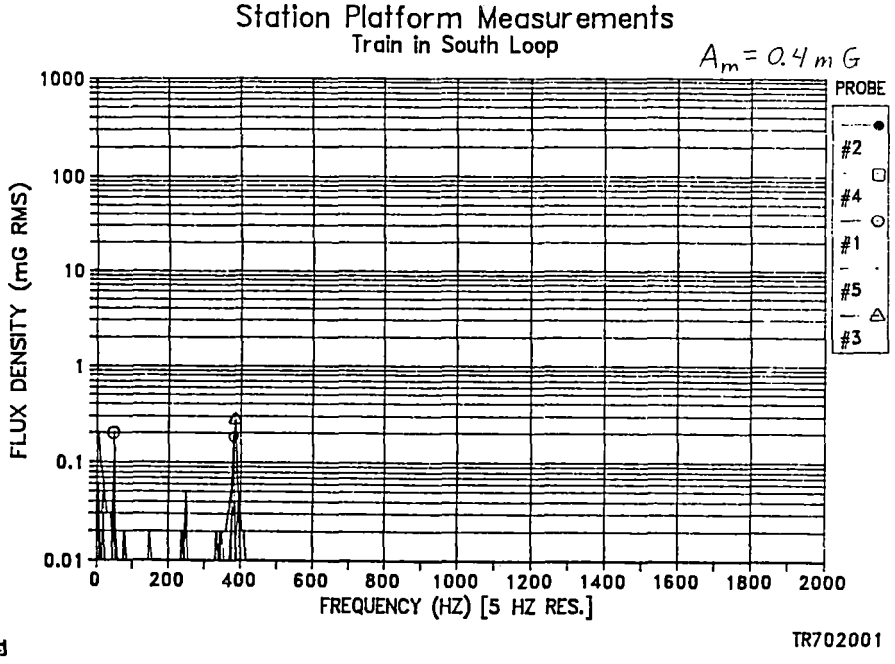
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

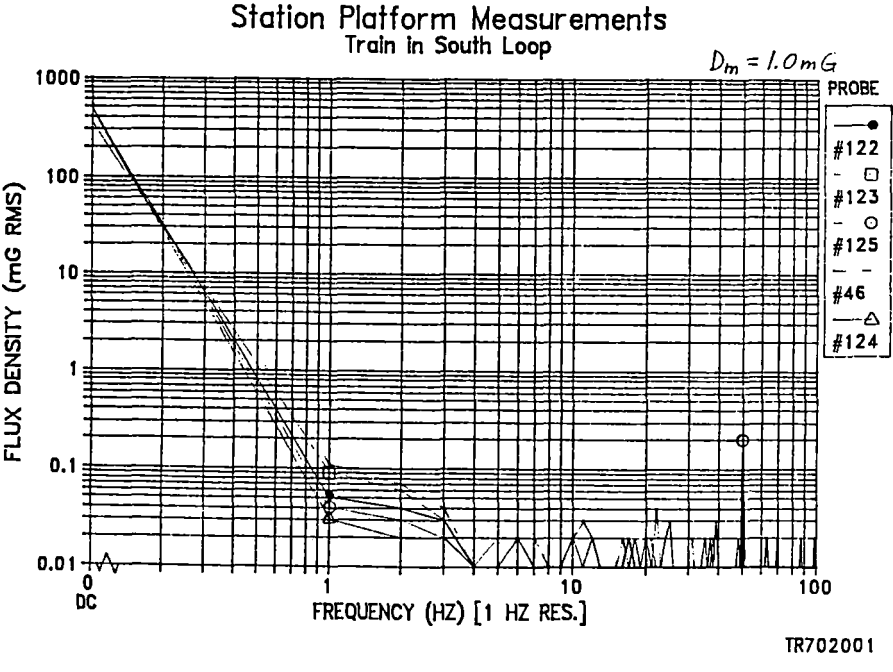
RANGE SETTINGS:

A1 # 2 Along guideway at 4m from center at far right
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
B1 # 1 Under center of guideway
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
C1 # 4 Along guideway at 4m in profile
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
D1 # 3 In profile 10m from center of guideway
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
E1 # 5 Along guideway to left of profile
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
A2 #122 Along guideway to right side of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of guideway in profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 300mG
C2 #123 In profile 4m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 100mG
D2 #124 In profile 10m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 100mG
E2 # 46 Left side, 4m offset
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

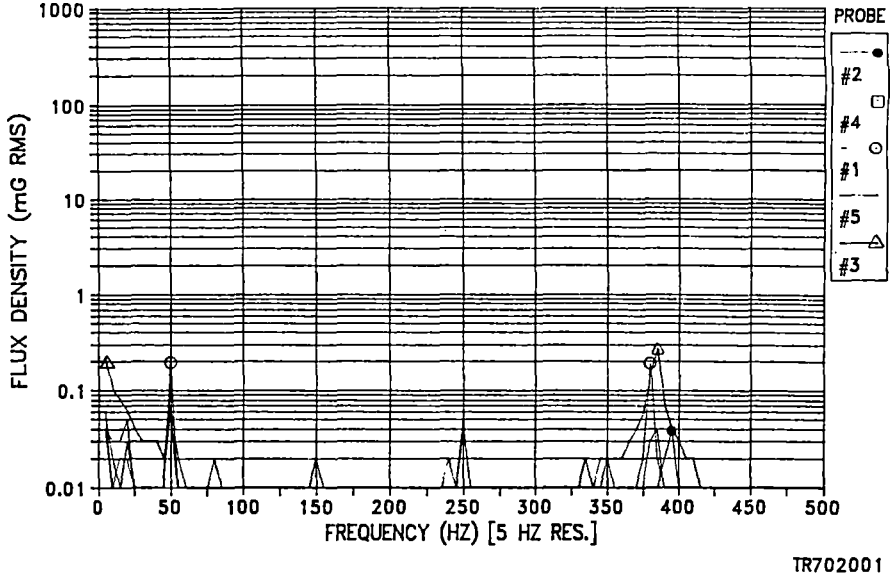
APPENDIX E


STATION PLATFORM MEASUREMENTS
POS MUX AC DC ELEVATION
I A #2 #122 1 m above ground
IV B #4 #123 platform level
II C #1 #125 1 m above ground
V D #5 #46 1 m above platform
III E #3 #124 1 m above ground
SETUP 21
GUIDEWAY
LOADING PLATFORM
WAITING AREA/PASSENGER BLDG
9m
3m
2.5m
3m
III E
II C
I A
IV B
V D
NEED VERTICAL
PROFILE VIEW
ALSO
AC COILS
DC AXIS
X → -L
Y → V
Z → -T


Station Platform Measurements
Train in South Loop
A_m = 0.4 m G
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702001

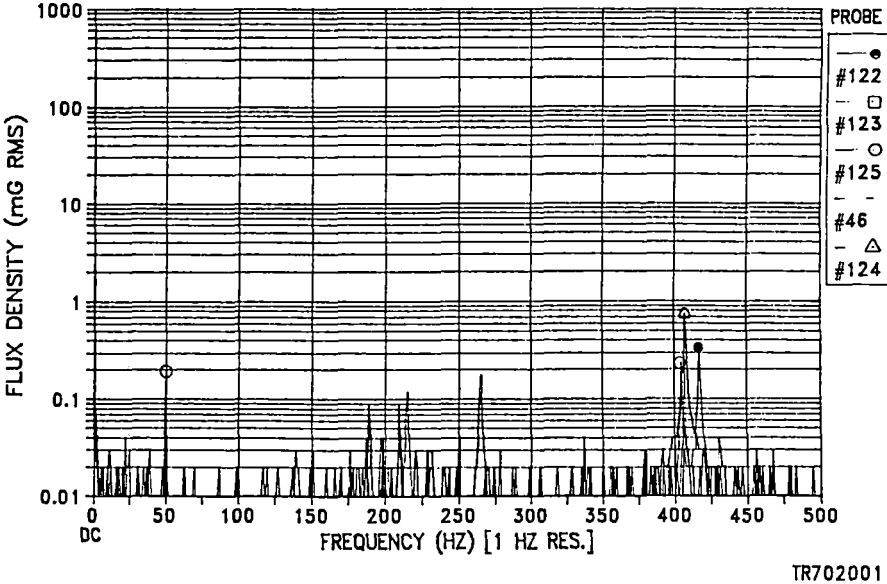

Station Platform Measurements
Train in South Loop
D_m = 1.0 m G
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [1 HZ RES.]
TR702001

Station Platform Measurements
Train in South Loop



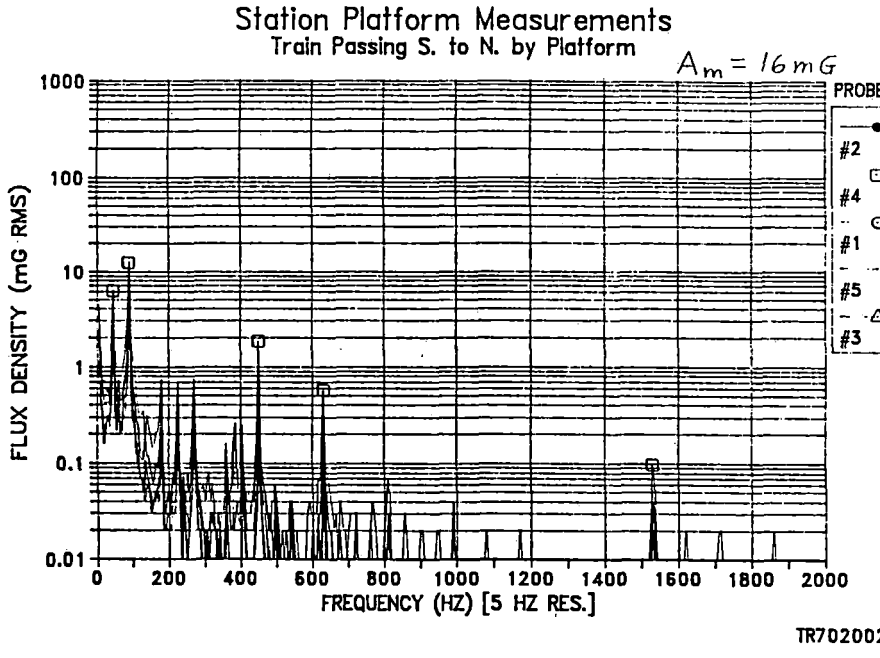
TR702001

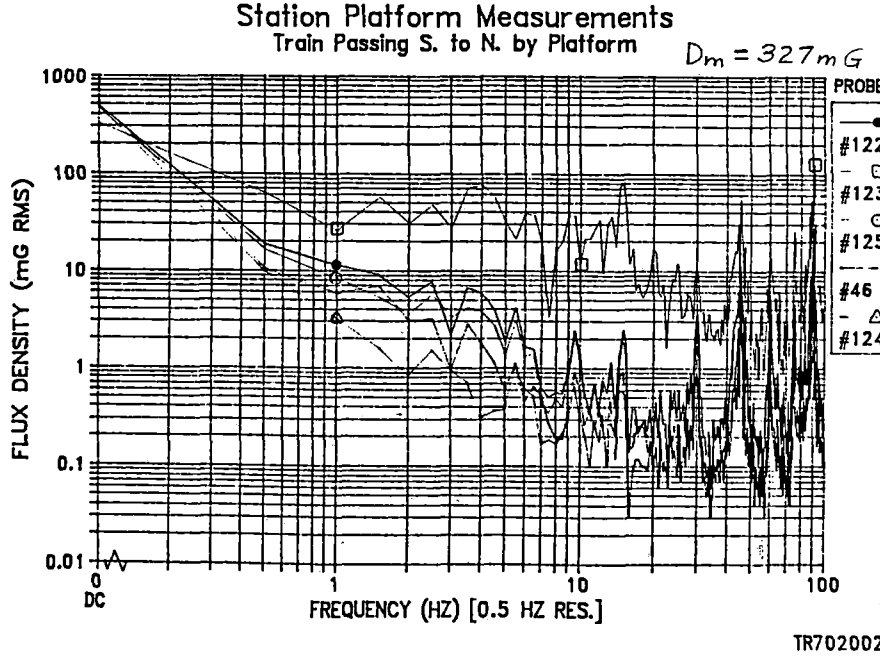
Station Platform Measurements
Train in South Loop



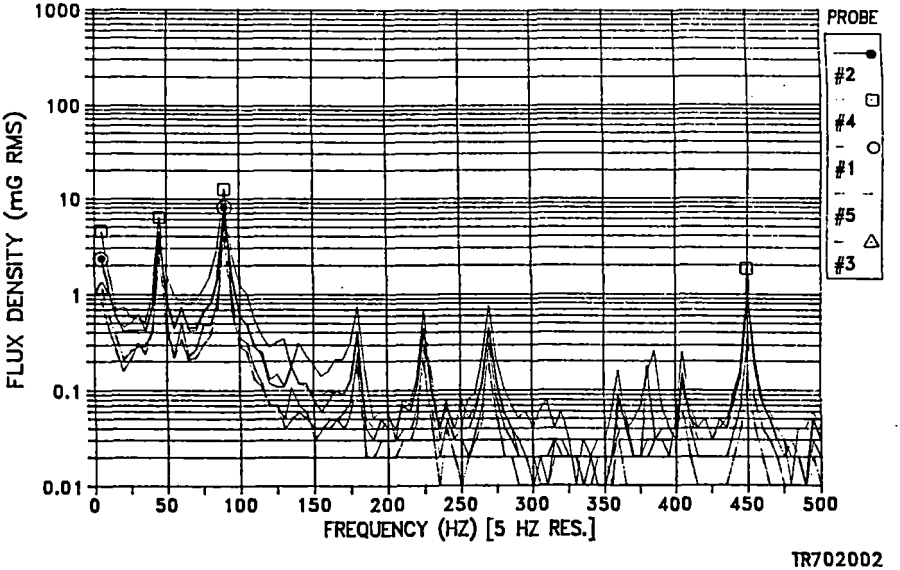
TR702001

[redacted]


Station Platform Measurements
Train Passing S. to N. by Platform
A_m = 16 mG
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#4
#1
#5
#3
TR702002

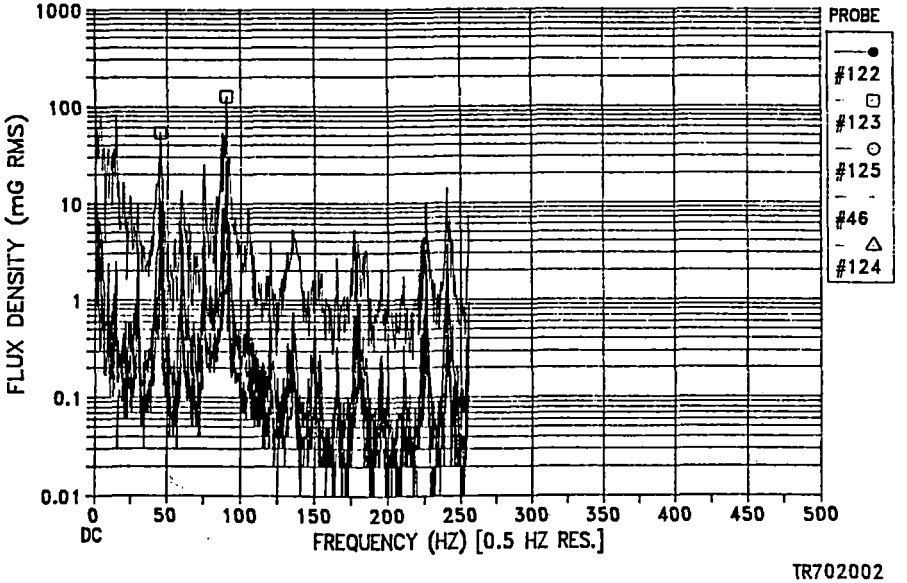

Station Platform Measurements
Train Passing S. to N. by Platform
D_m = 327 mG
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#123
#125
#46
#124
TR702002

Station Platform Measurements
Train Passing S. to N. by Platform

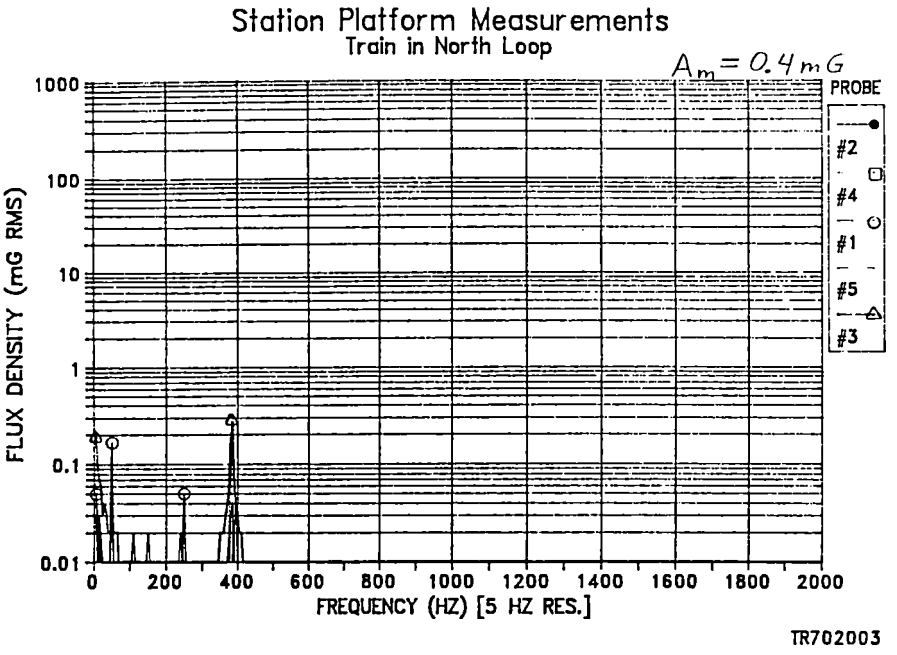


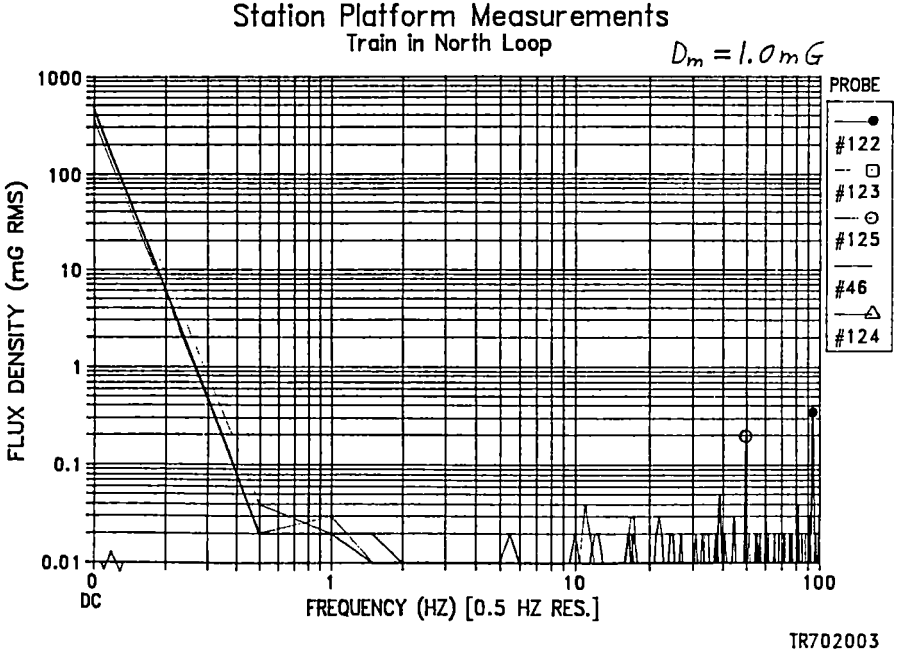
TR702002

Station Platform Measurements
Train Passing S. to N. by Platform

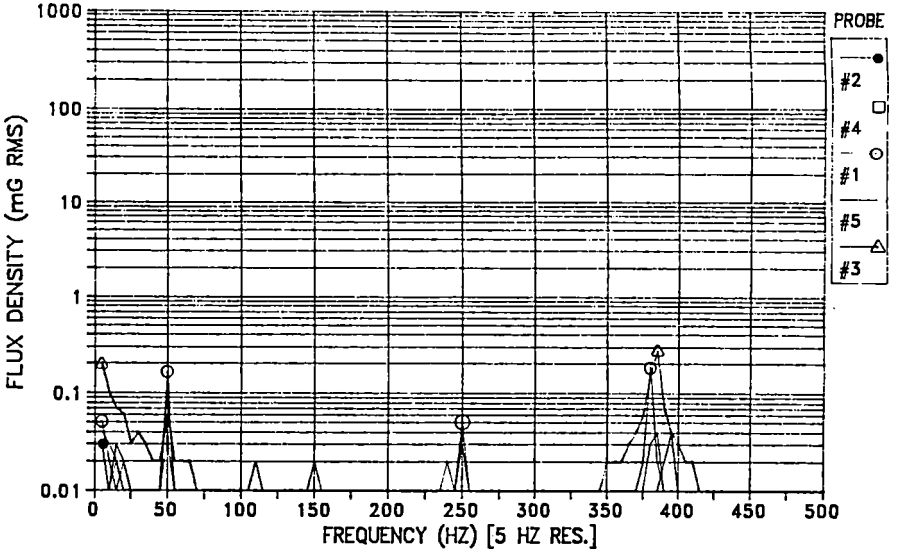


TR702002


Station Platform Measurements
Train in North Loop
$A_m = 0.4$ mG
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702003

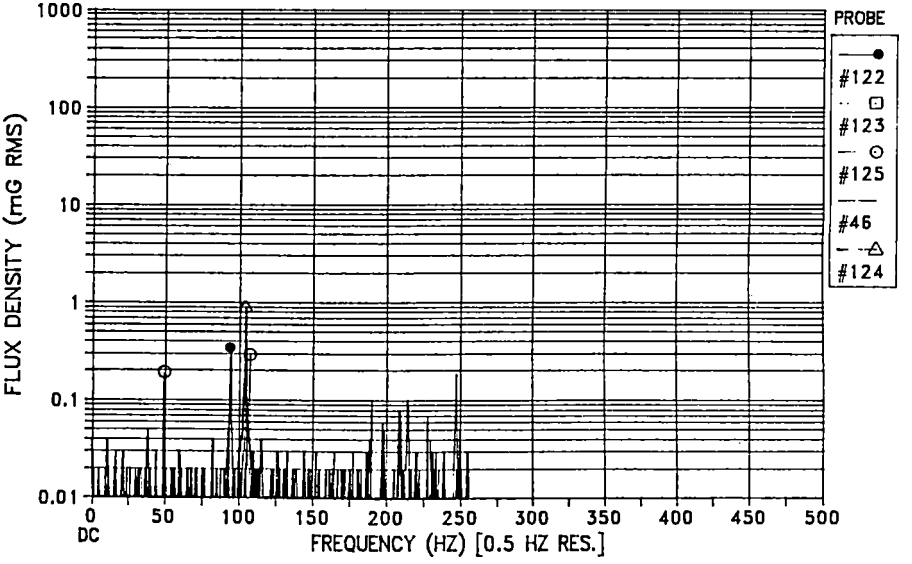

Station Platform Measurements
Train in North Loop
$D_m = 1.0$ mG
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702003

Station Platform Measurements
Train in North Loop

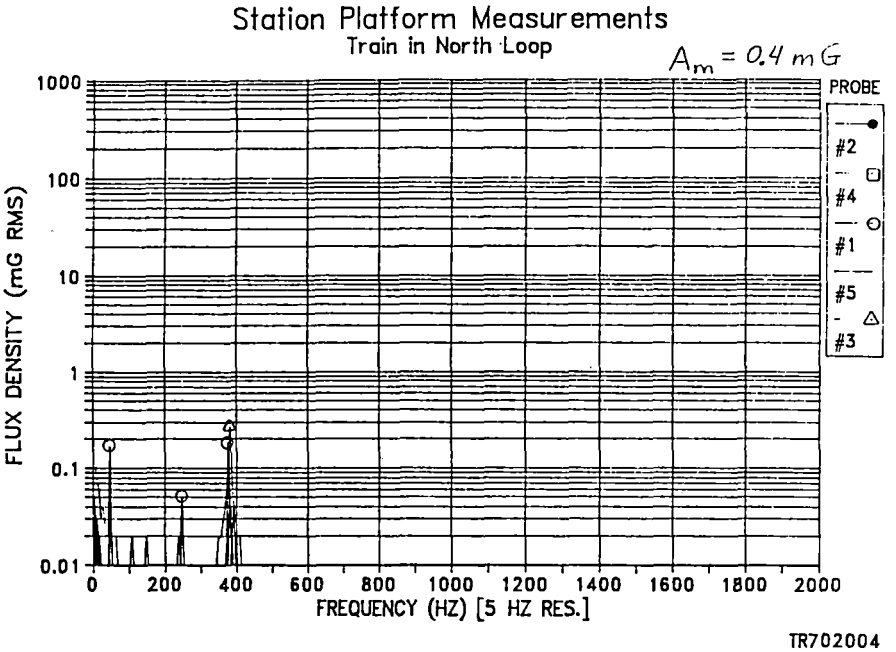


TR702003

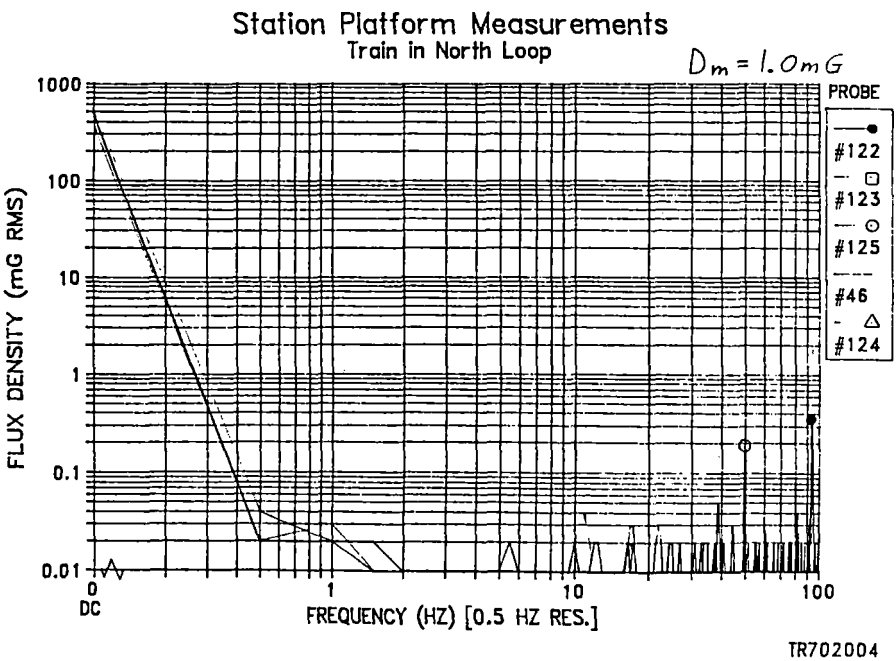
Station Platform Measurements
Train in North Loop



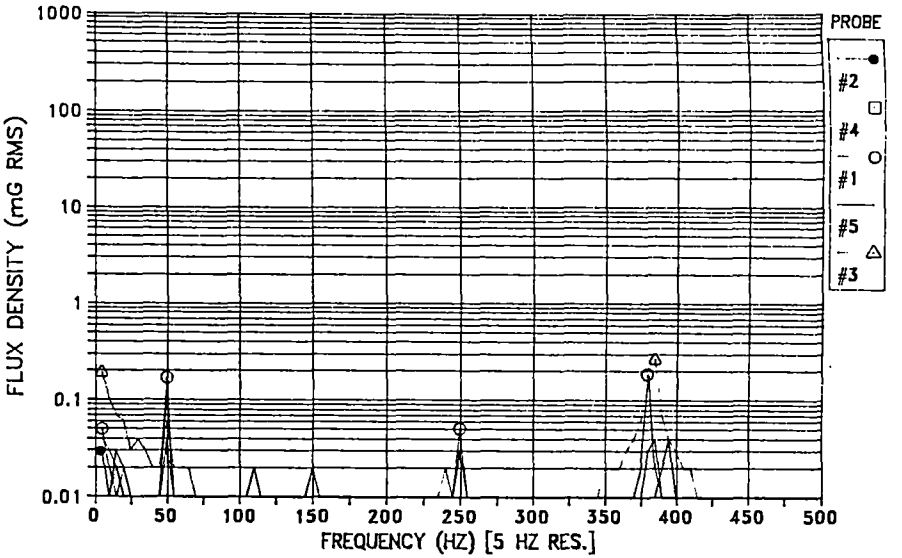
TR702003


Station Platform Measurements
Train in North Loop
A_m = 0.4 mG
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#4
#1
#5
#3
TR702004

E-5

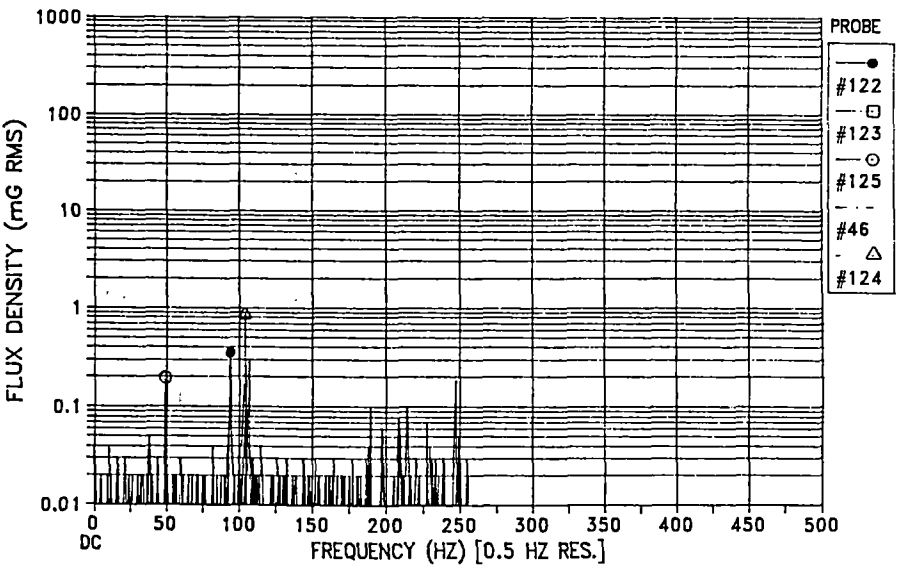

Station Platform Measurements
Train in North Loop
D_m = 1.0 mG
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#123
#125
#46
#124
TR702004

Station Platform Measurements
Train in North Loop

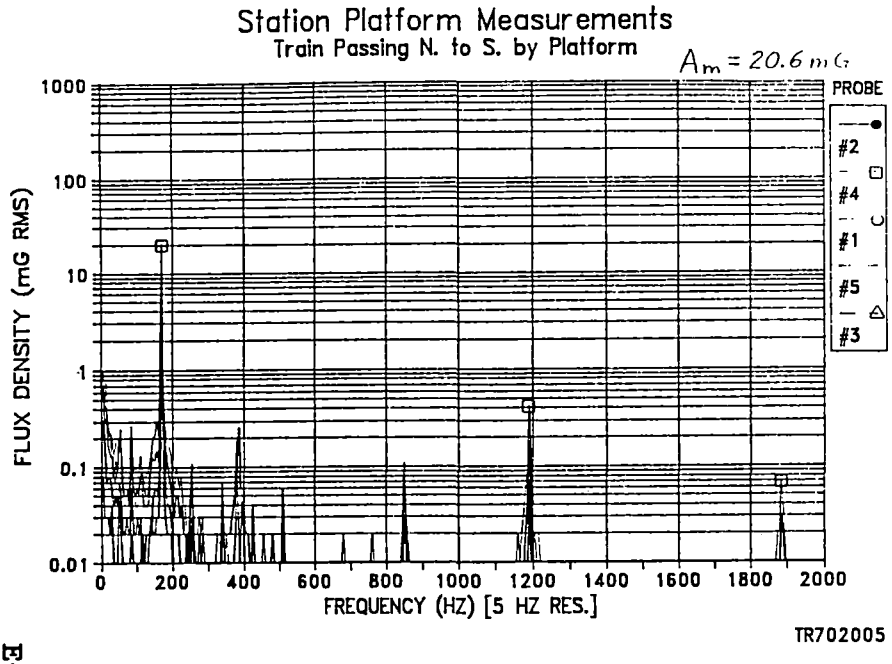


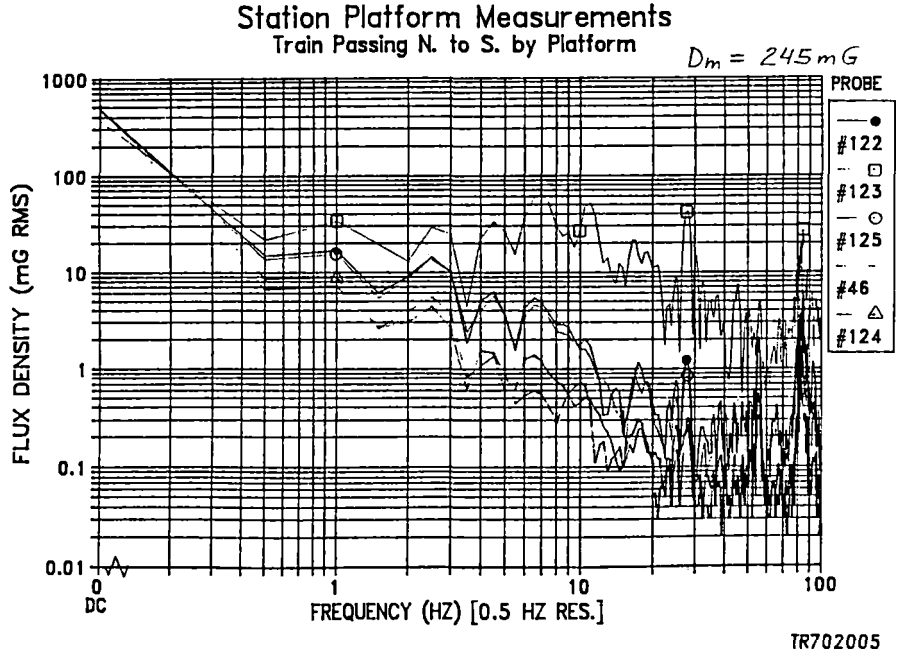
TR702004

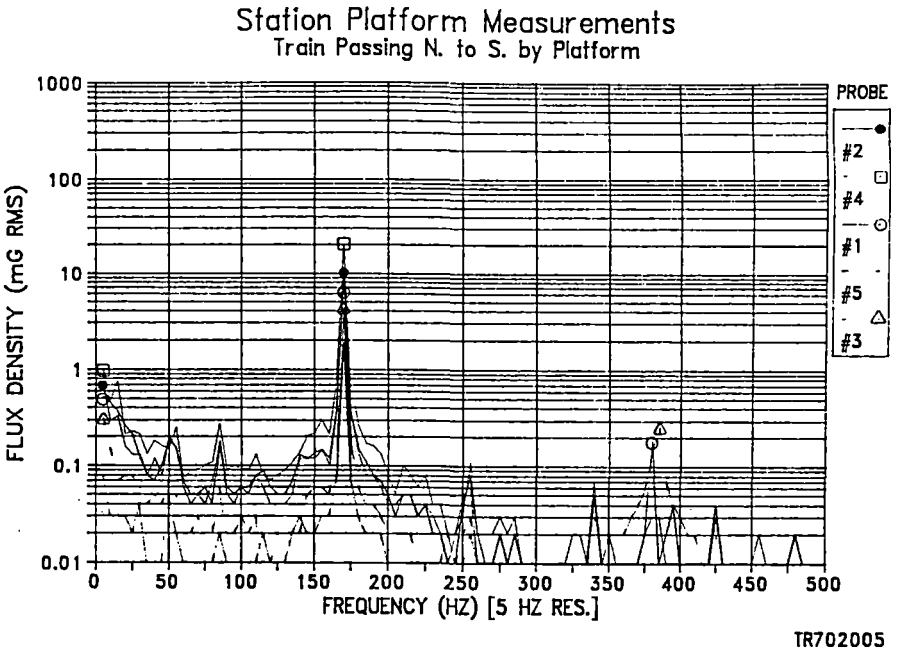
Station Platform Measurements
Train in North Loop

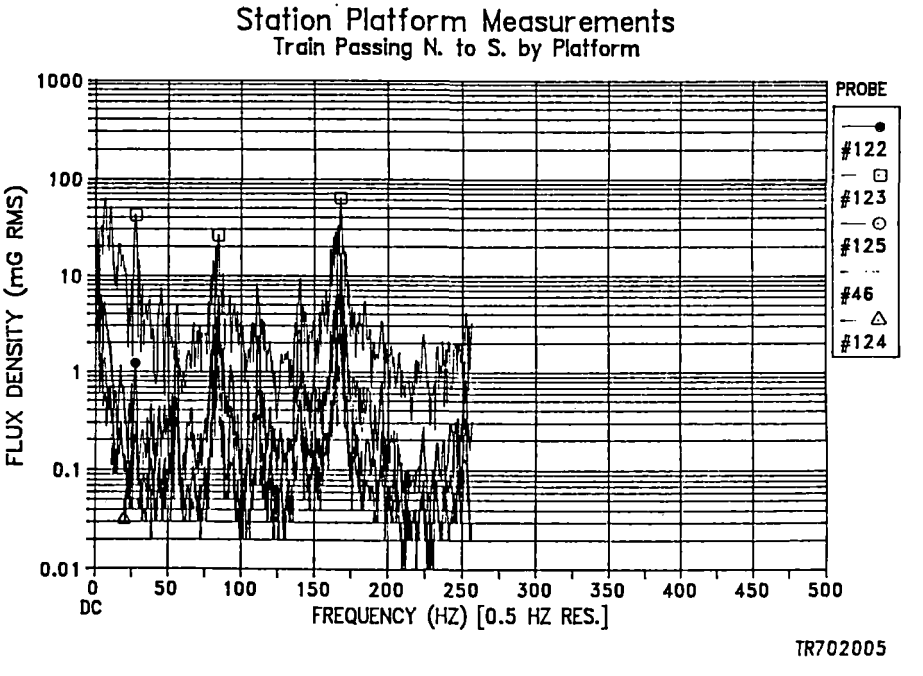


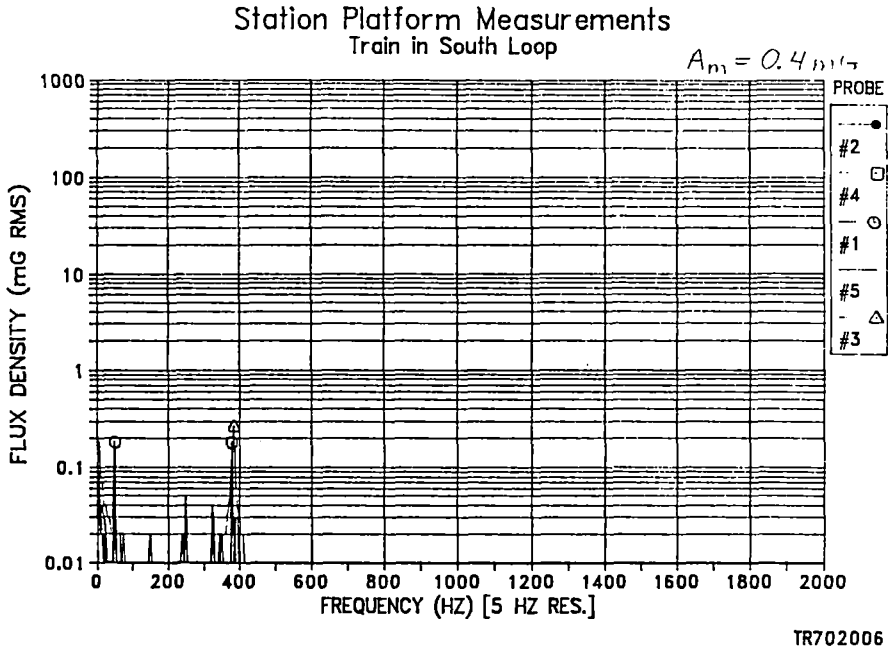
TR702004

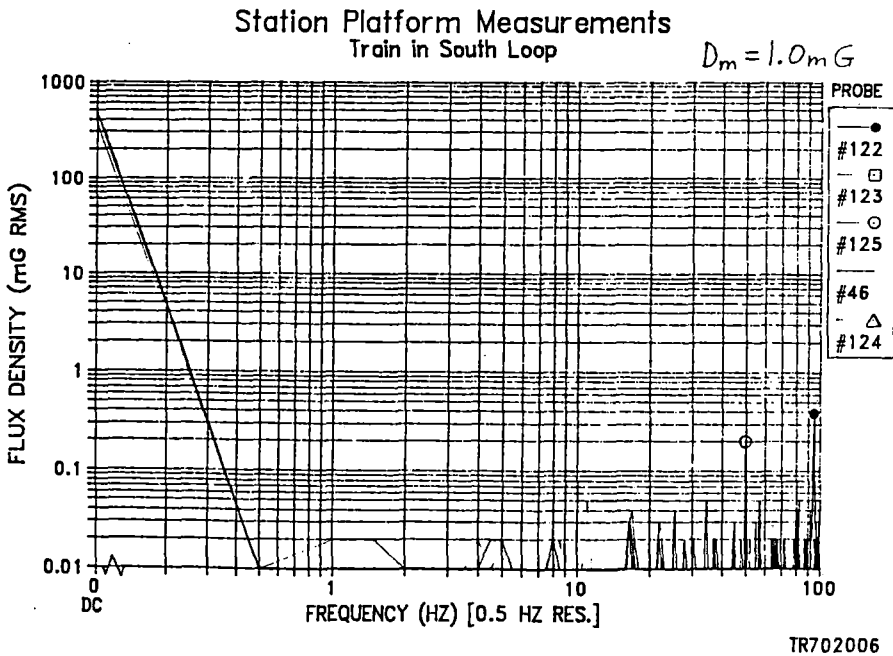

Station Platform Measurements
Train Passing N. to S. by Platform
A_m = 20.6 mG
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702005

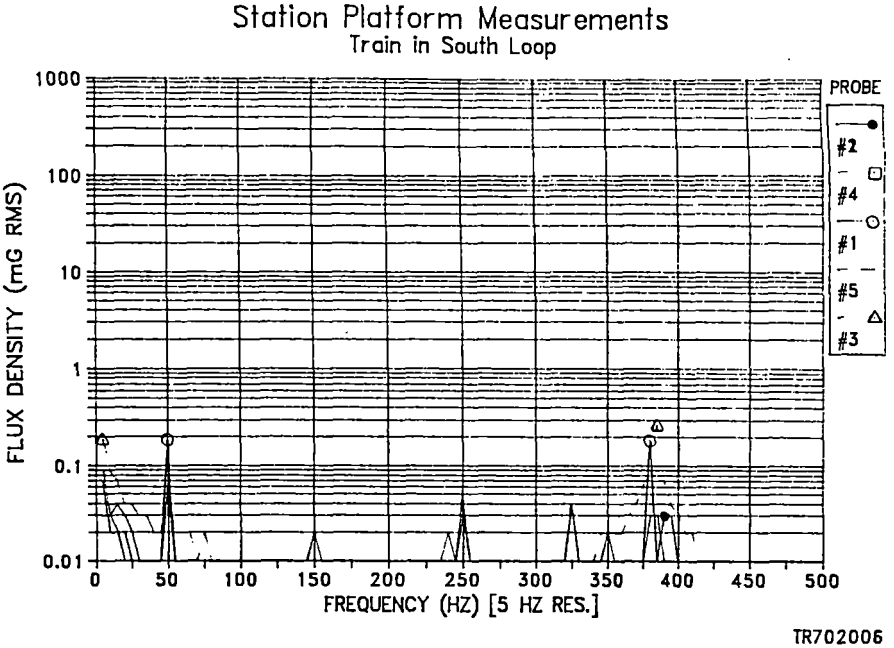

Station Platform Measurements
Train Passing N. to S. by Platform
D_m = 245 mG
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702005

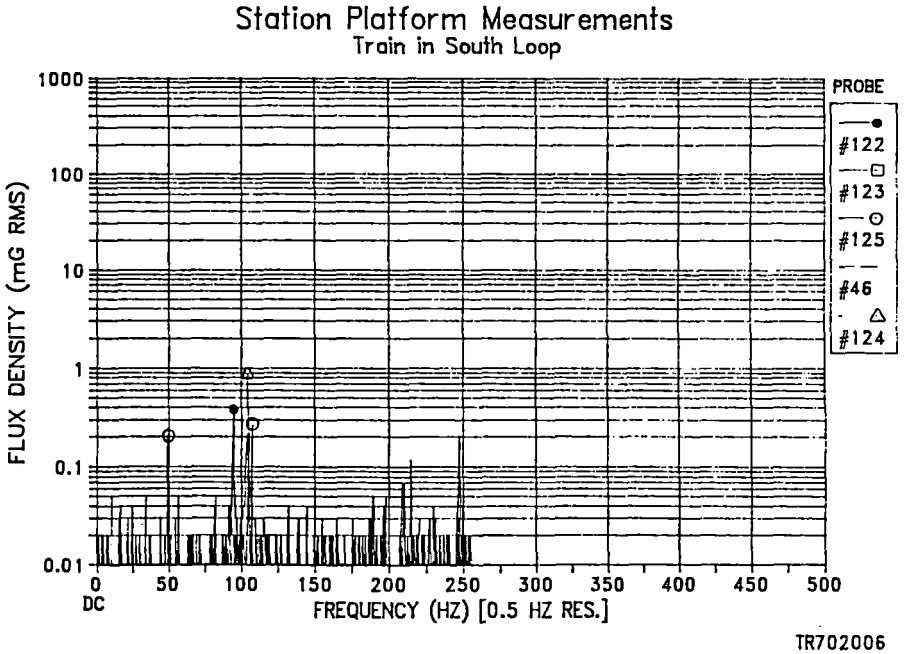

Station Platform Measurements
Train Passing N. to S. by Platform
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#4
#1
#5
#3
TR702005

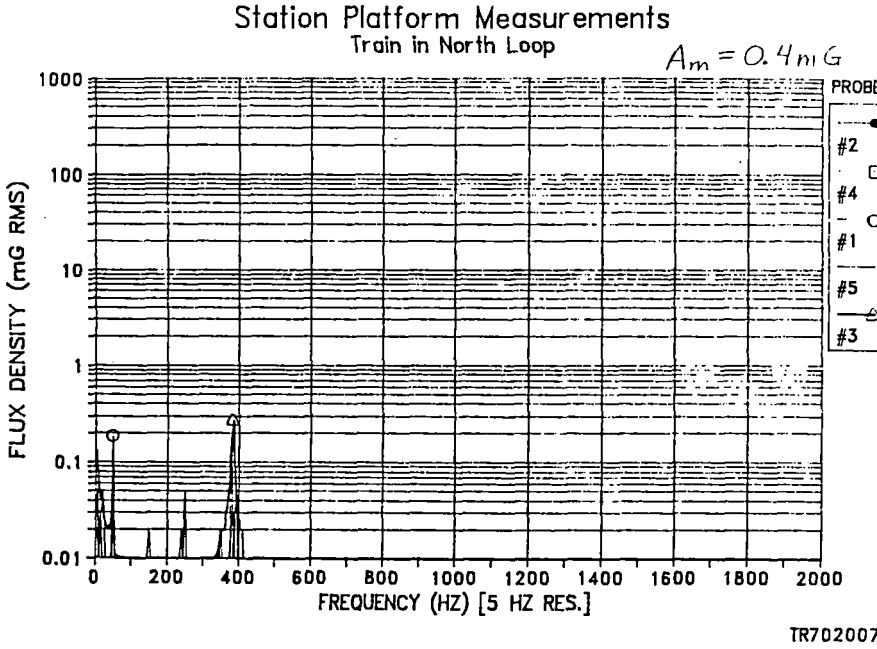

Station Platform Measurements
Train Passing N. to S. by Platform
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#123
#125
#46
#124
TR702005

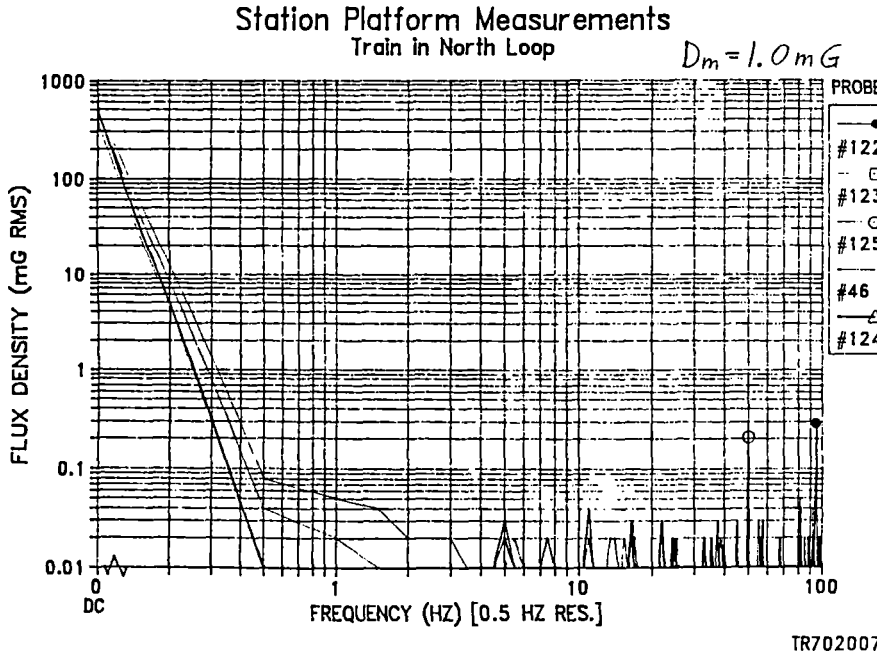

Station Platform Measurements
Train in South Loop
$A_m = 0.4$ mG
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702006


Station Platform Measurements
Train in South Loop
$D_m = 1.0$ mG
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702006

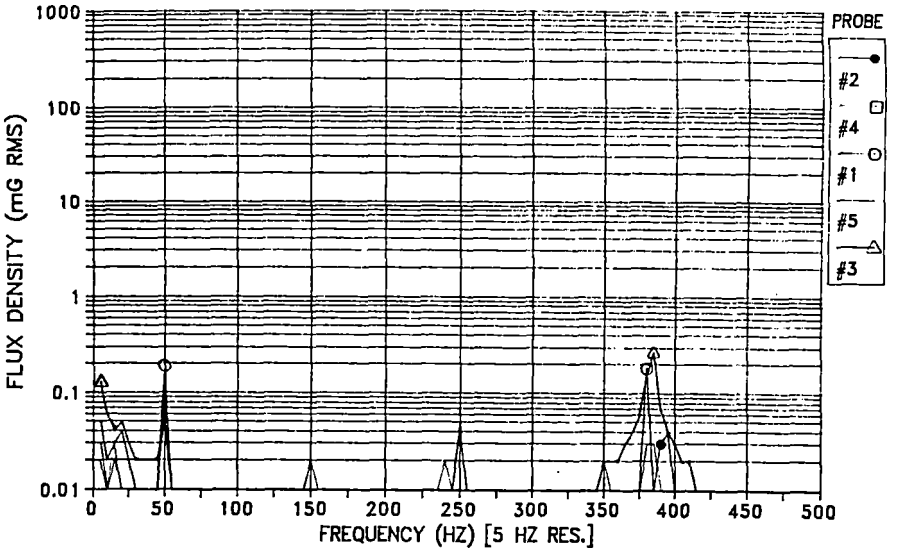

Station Platform Measurements
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#4
#1
#5
#3
TR702006


Station Platform Measurements
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#123
#125
#46
#124
TR702006


Station Platform Measurements
Train in North Loop
$A_m = 0.4$ mG
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702007

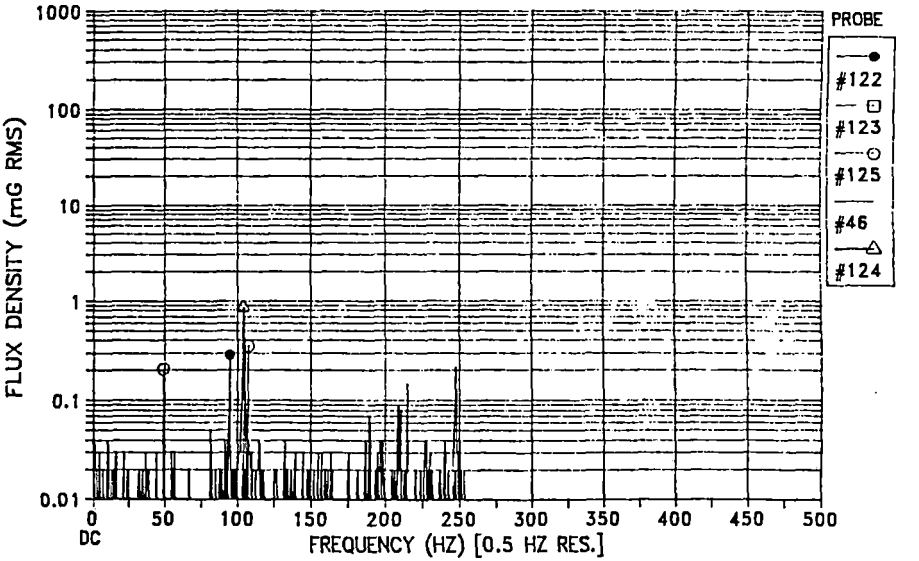

Station Platform Measurements
Train in North Loop
$D_m = 1.0$ mG
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702007

Station Platform Measurements
Train in North Loop

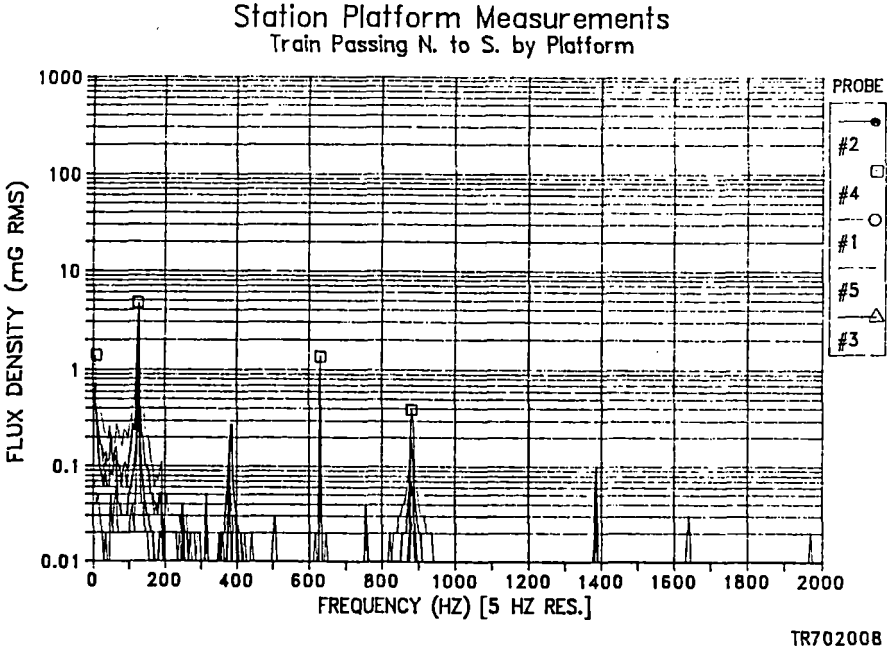


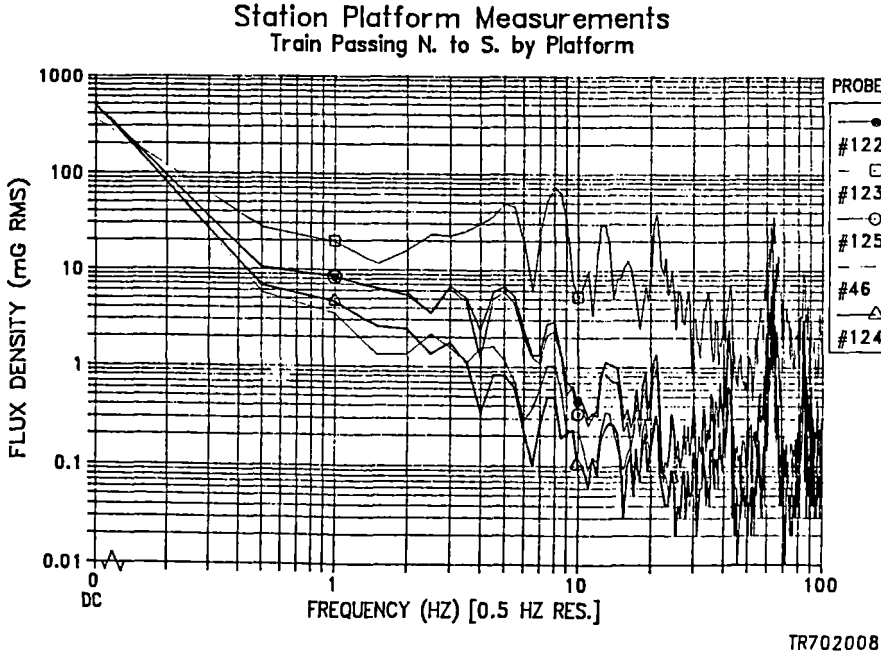
TR702007

Station Platform Measurements
Train in North Loop

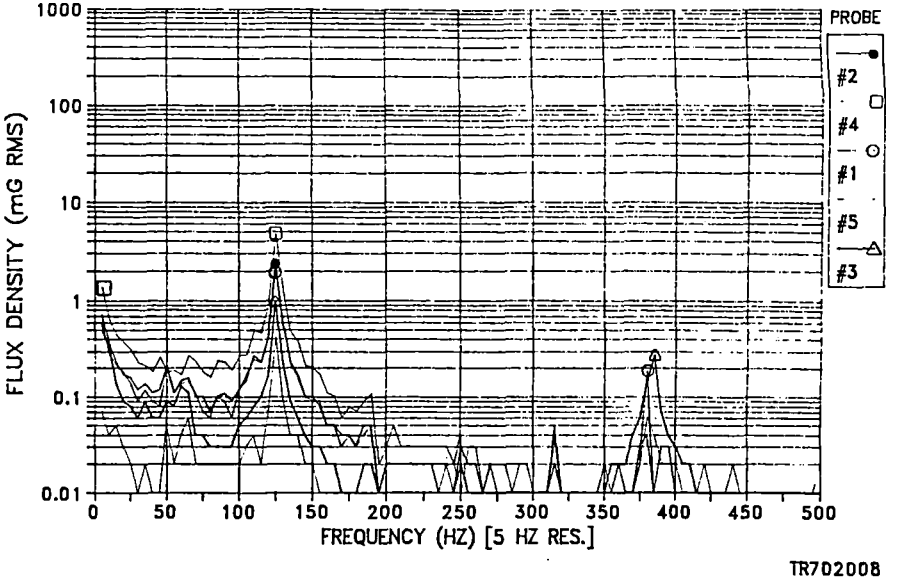


TR702007


Station Platform Measurements
Train Passing N. to S. by Platform
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#4
#1
#5
#3
TR702008

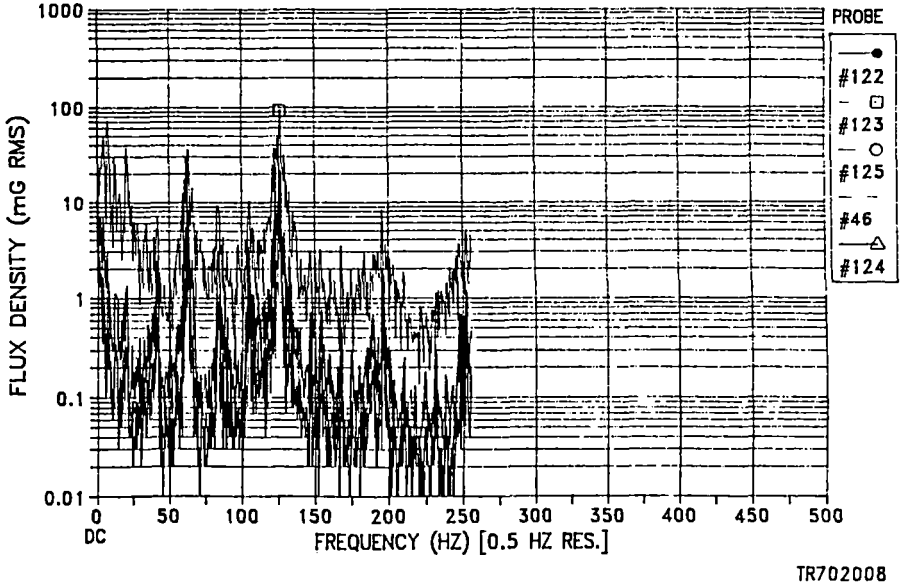

Station Platform Measurements
Train Passing N. to S. by Platform
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#123
#125
#46
#124
TR702008

Station Platform Measurements
Train Passing N. to S. by Platform

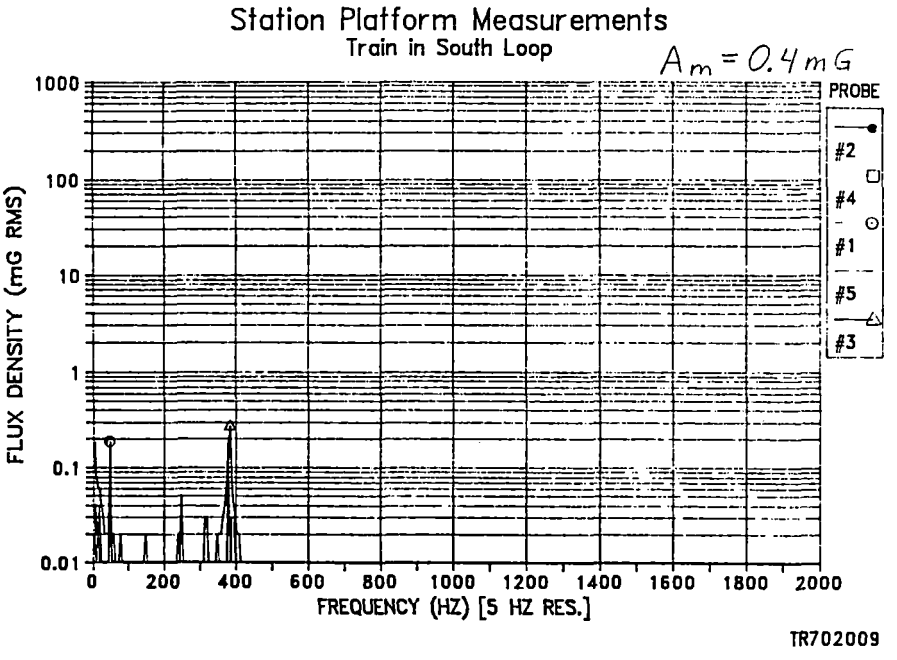


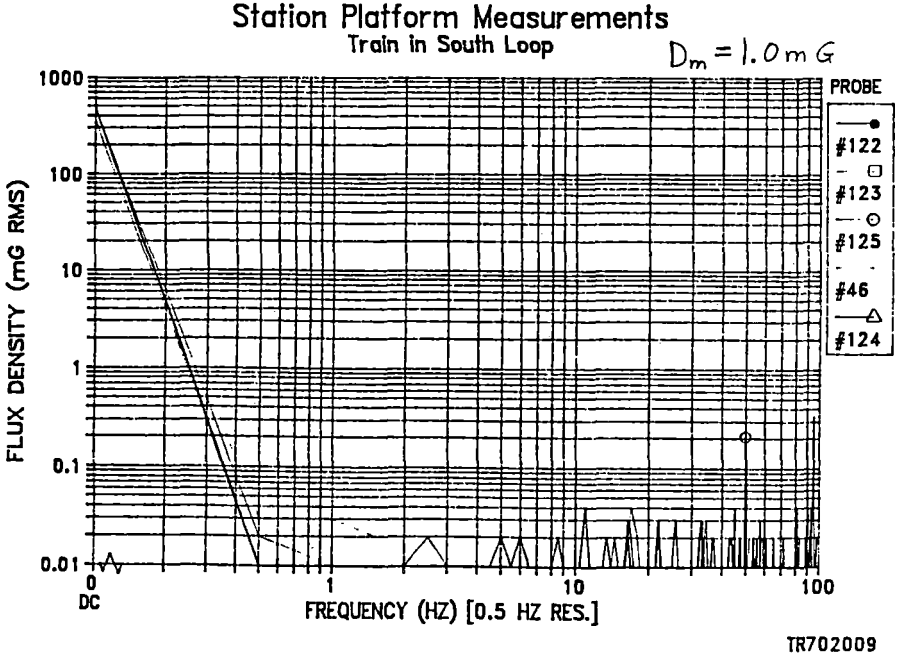
TR702008

Station Platform Measurements
Train Passing N. to S. by Platform

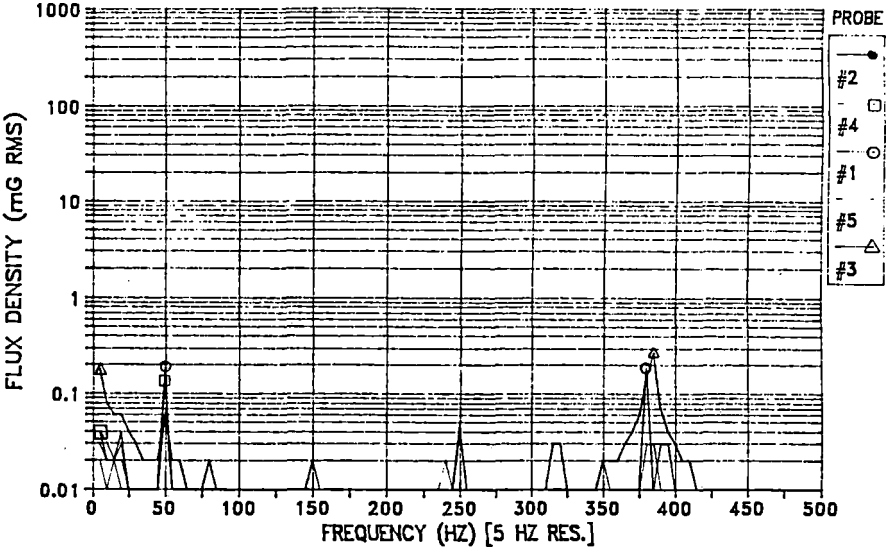


TR702008


Station Platform Measurements
Train in South Loop
$A_m = 0.4$ mG
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702009

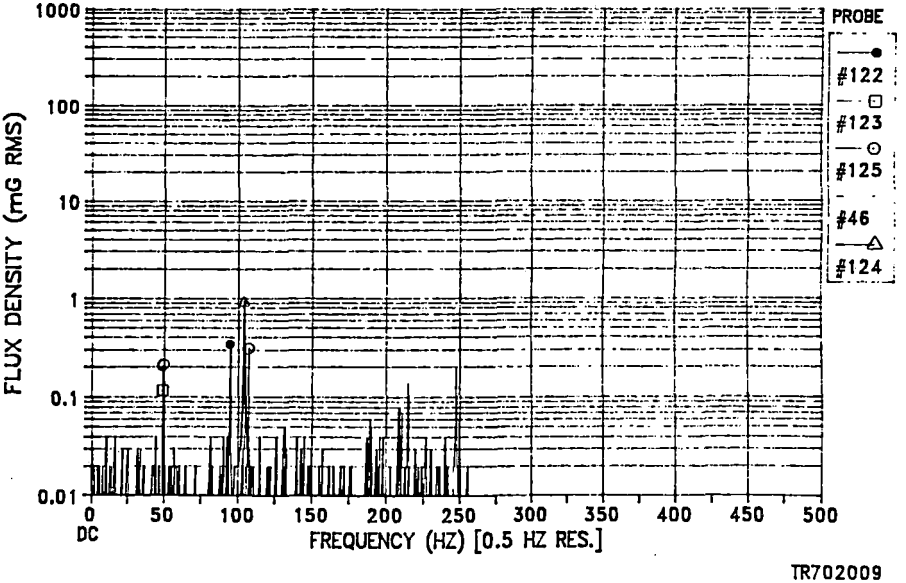

Station Platform Measurements
Train in South Loop
$D_m = 1.0$ mG
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702009

Station Platform Measurements
Train in South Loop



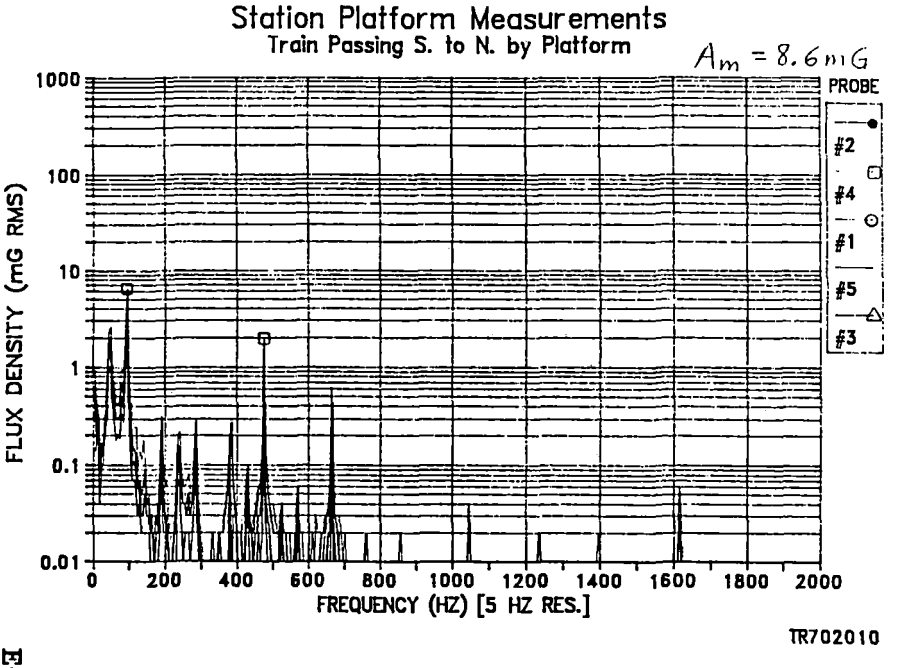
TR702009

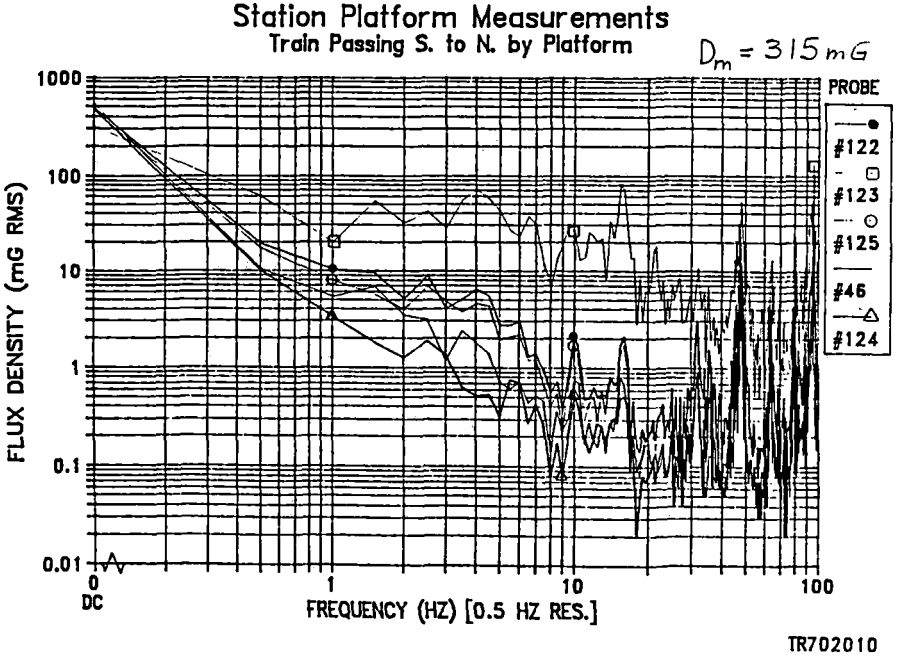
Station Platform Measurements
Train in South Loop



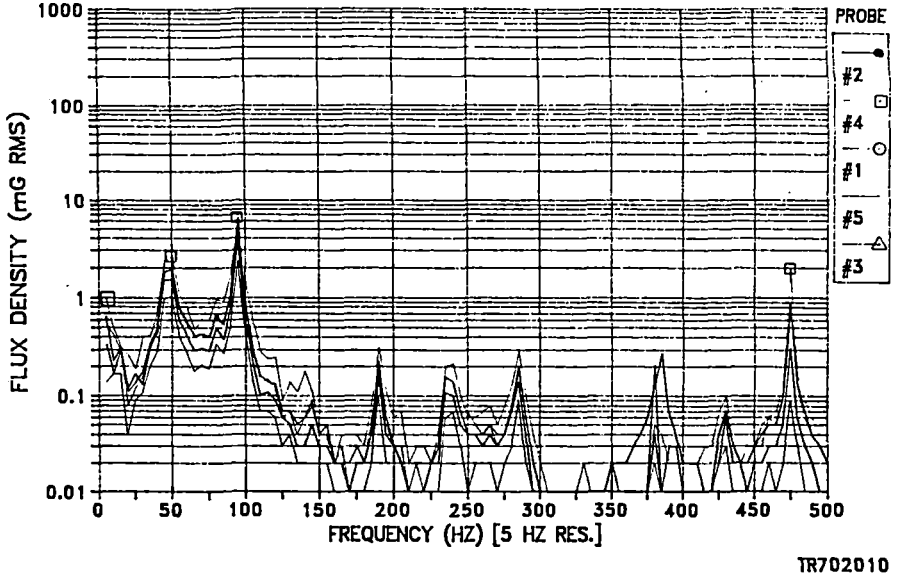
TR702009

[redacted]


Station Platform Measurements
Train Passing S. to N. by Platform
A_m = 8.6 mG
PROBE
#2
#4
#1
#5
#3
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702010


Station Platform Measurements
Train Passing S. to N. by Platform
D_m = 315 mG
PROBE
#122
#123
#125
#46
#124
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702010

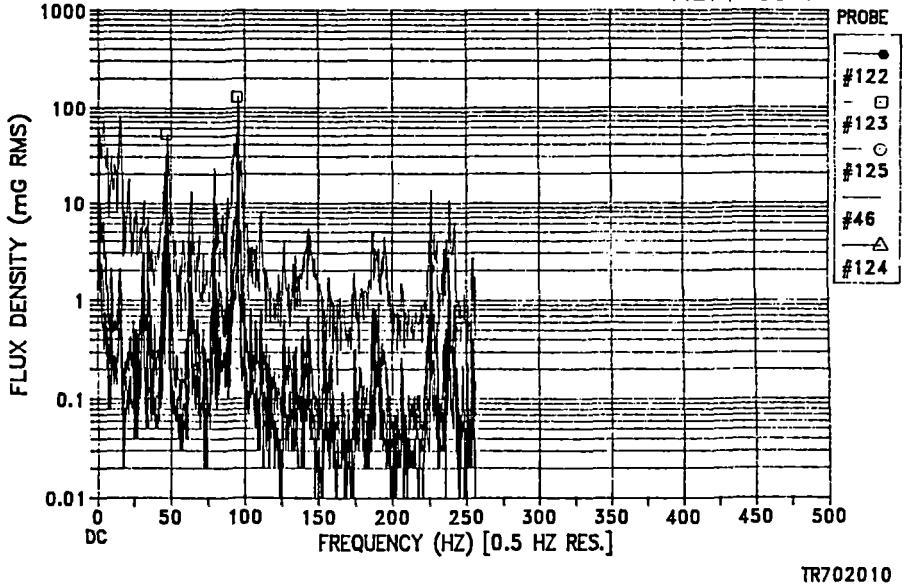
Station Platform Measurements
Train Passing S. to N. by Platform



TR702010

Station Platform Measurements
Train Passing S. to N. by Platform

ALIASED DATA



TR702010

TR7020

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 020
> Station platform measurements
> passenger loading plaform
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 10:26:00
End: 08/09/90 (Thursday) AT 10:46:00
Recorded 229 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 2 Under center of guideway
COIL L: 100mG
COIL T: 30.0mG
COIL V: 100mG
B1 # 4 At ramp to vehicle on loading platform
COIL L: 100mG
COIL T: 100mG
COIL V: 30.0mG
C1 # 1 Along guideway at 3m in profile
COIL L: 100mG
COIL T: 30.0mG
COIL V: 30.0mG
D1 # 5 Passenger waiting area
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
E1 # 3 9m from center of guideway
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
A2 #122 Along guideway to right side of profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #123 At ramp to vehicle on loading platform
DC - A: 1000mG
DC - B: 30.0mG
DC - C: 1000mG
C2 #125 In profile 3m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 300mG
D2 # 46 Passenger waiting area
DC - A: 1000mG
DC - B: 1000mG
DC - C: 10.0mG
E2 #124 9m from center of guideway
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7021

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 021
> Station platform measurements
> passenger loading plaform
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 10:51:00
End: 08/09/90 (Thursday) AT 11:10:00
Recorded 229 samples at 5 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

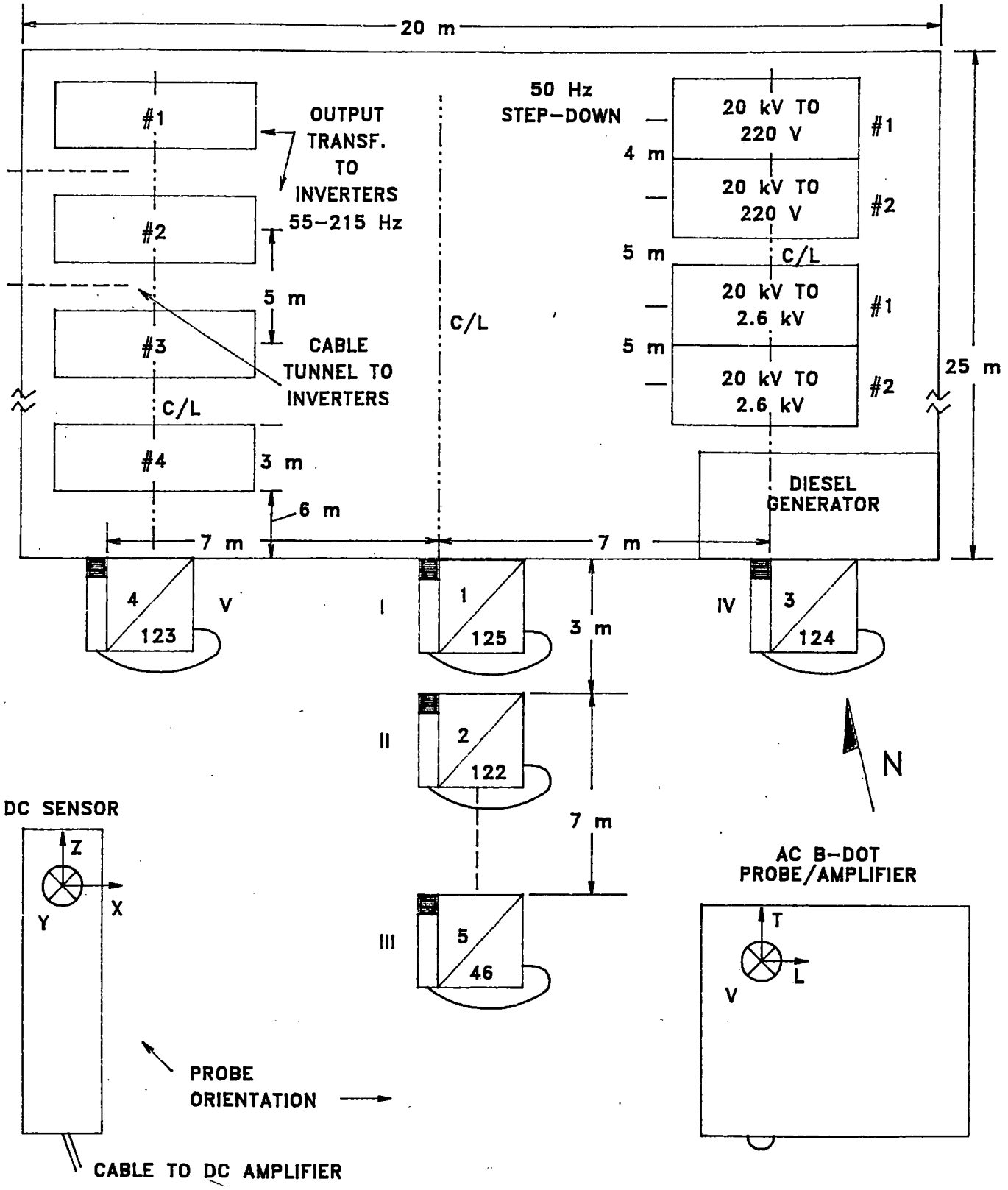
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

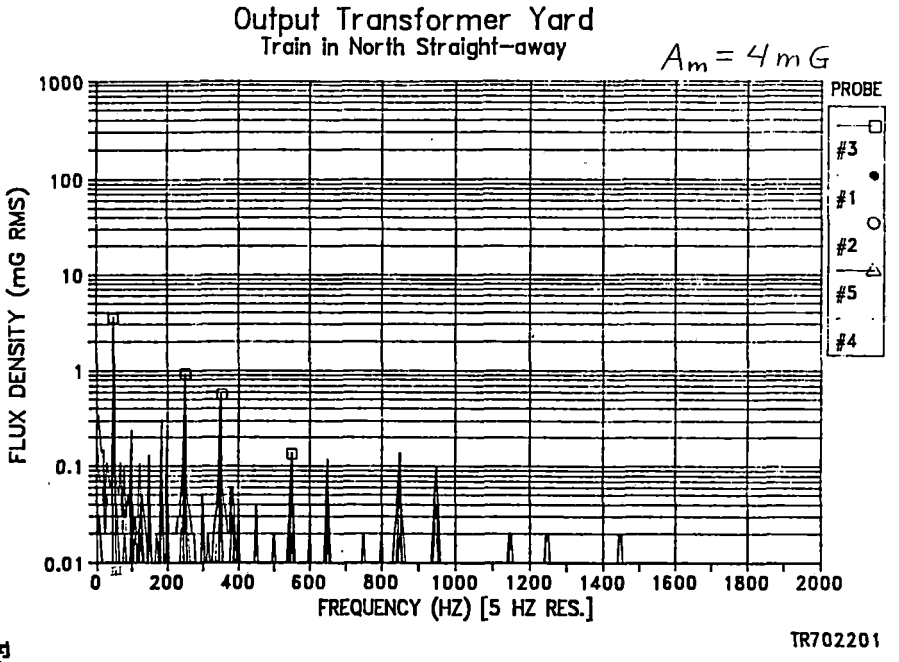
RANGE SETTINGS:

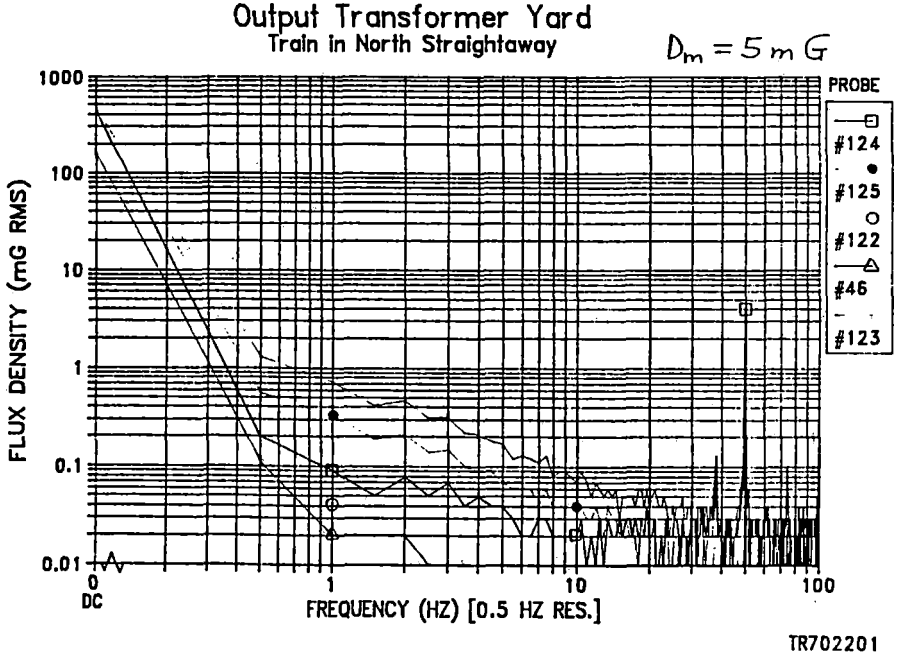
A1 # 2	Under center of guideway	
	COIL L:	100mG
	COIL T:	30.0mG
	COIL V:	100mG
B1 # 4	At ramp to vehicle on loading platform	
	COIL L:	100mG
	COIL T:	100mG
	COIL V:	30.0mG
C1 # 1	Along guideway at 3m in profile	
	COIL L:	100mG
	COIL T:	30.0mG
	COIL V:	30.0mG
D1 # 5	Passenger waiting area	
	COIL L:	30.0mG
	COIL T:	30.0mG
	COIL V:	30.0mG
E1 # 3	9m from center of guideway	
	COIL L:	30.0mG
	COIL T:	30.0mG
	COIL V:	30.0mG
A2 #122	Along guideway to right side of profile	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
B2 #123	At ramp to vehicle on loading platform	
	DC - A:	1000mG
	DC - B:	30.0mG
	DC - C:	1000mG
C2 #125	In profile 3m from center of guideway	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	300mG
D2 # 46	Passenger waiting area	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	10.0mG
E2 #124	9m from center of guideway	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG

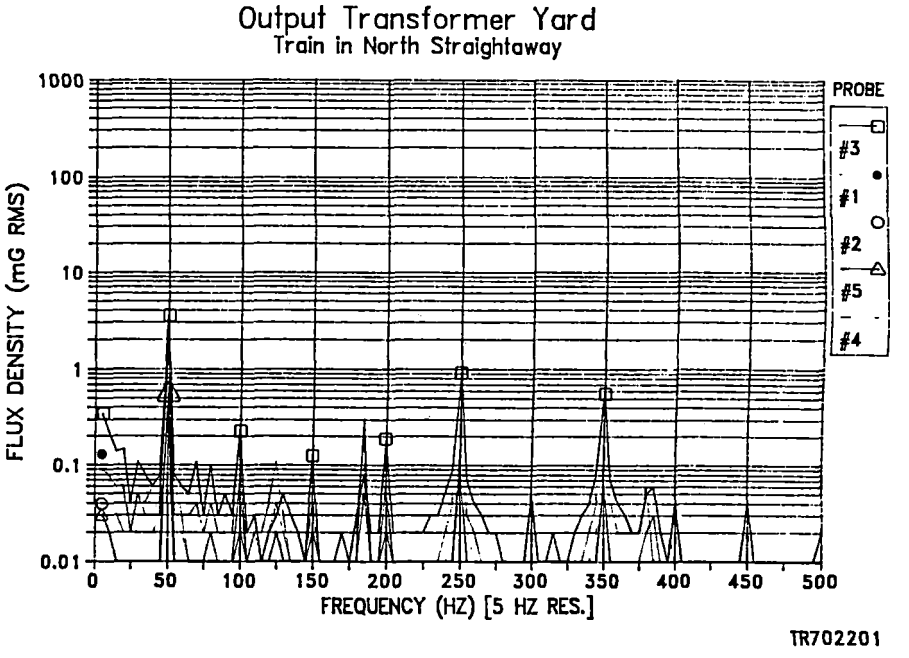
APPENDIX F

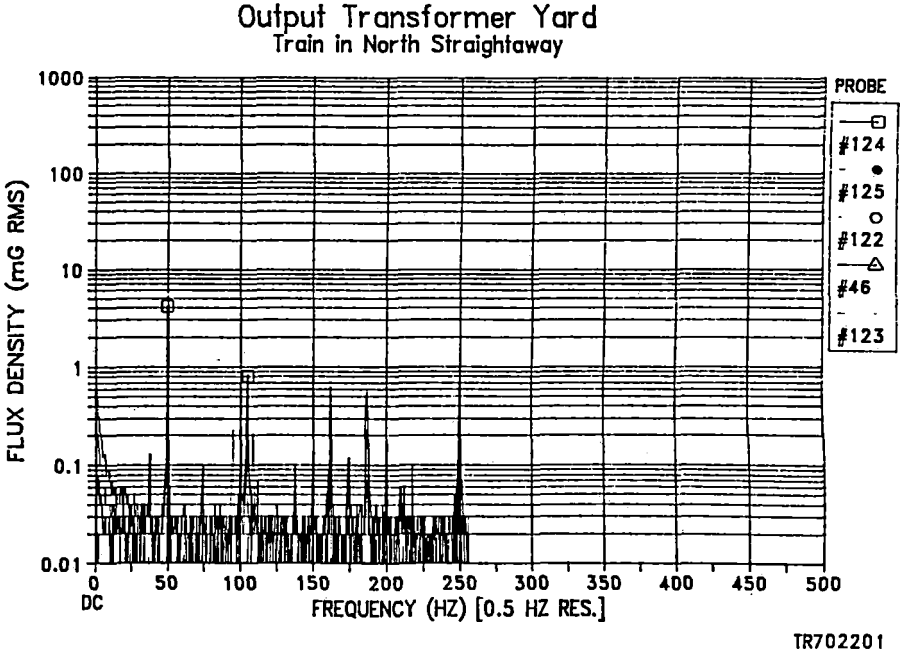
SETUP 22: OUTPUT TRANSFORMER YARD

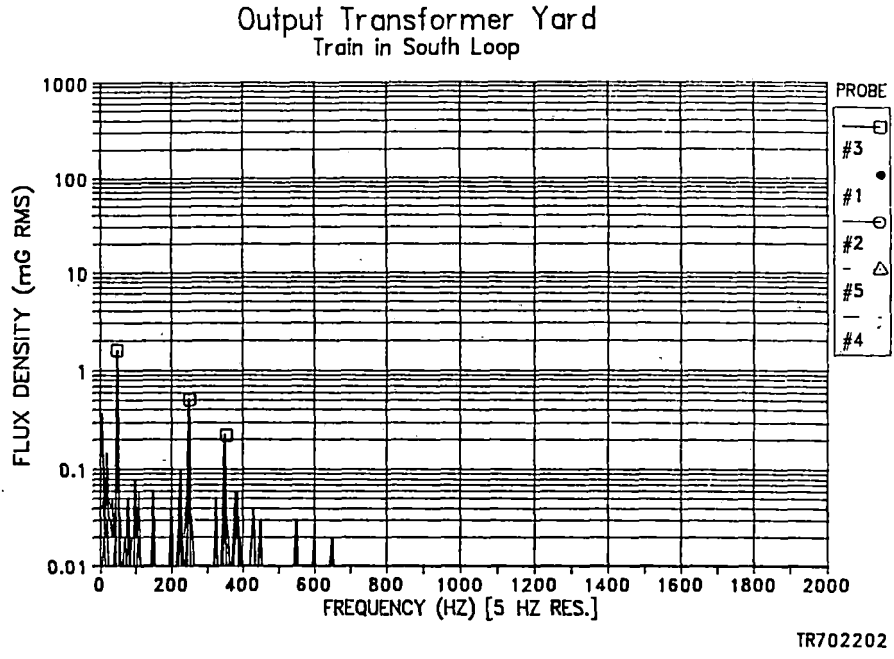


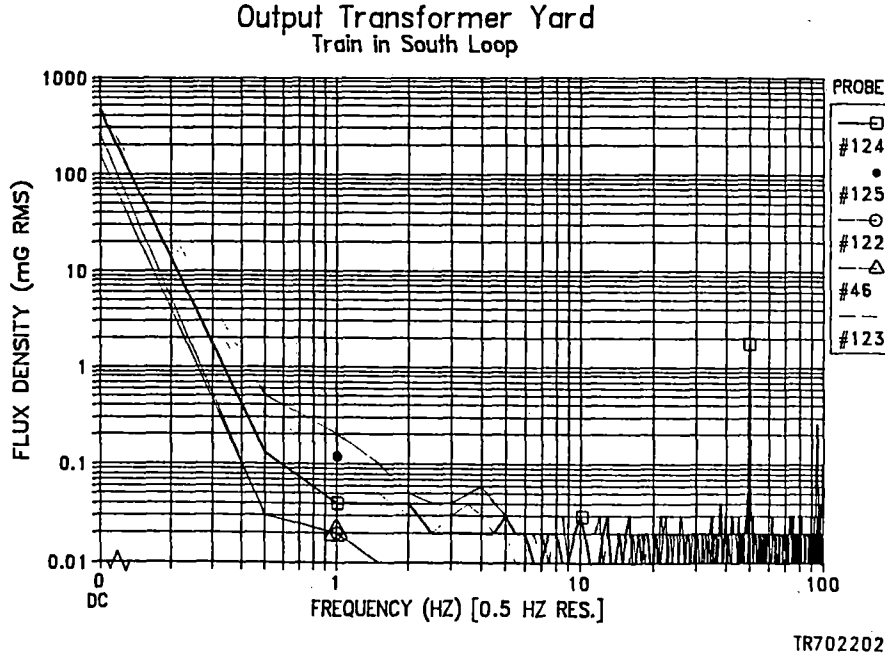

Output Transformer Yard
Train in North Straight-away
$A_m = 4\,mG$
PROBE
#3
#1
#2
#5
#4
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702201

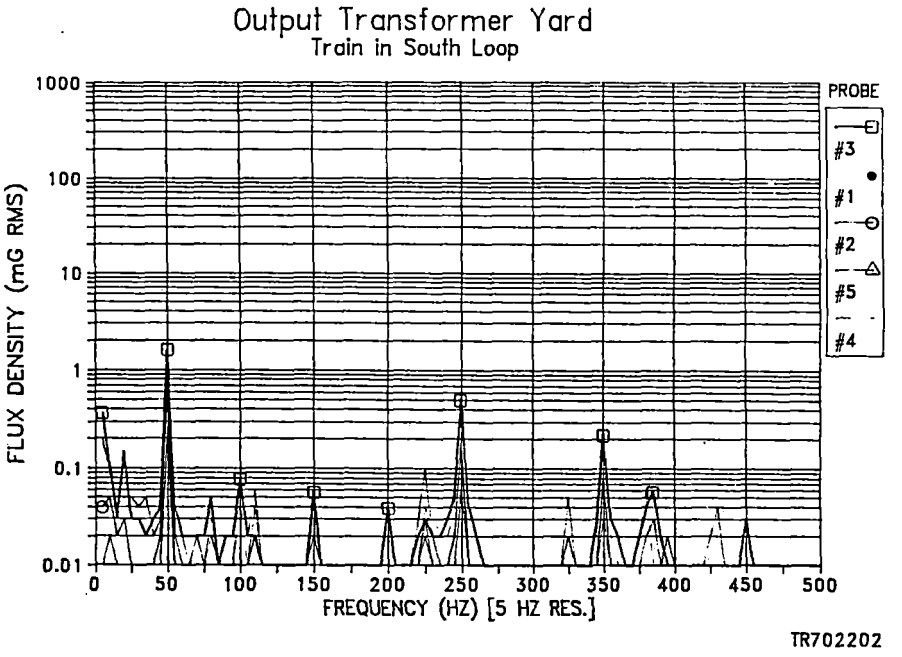

Output Transformer Yard
Train in North Straightaway
$D_m = 5\,mG$
PROBE
#124
#125
#122
#46
#123
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702201

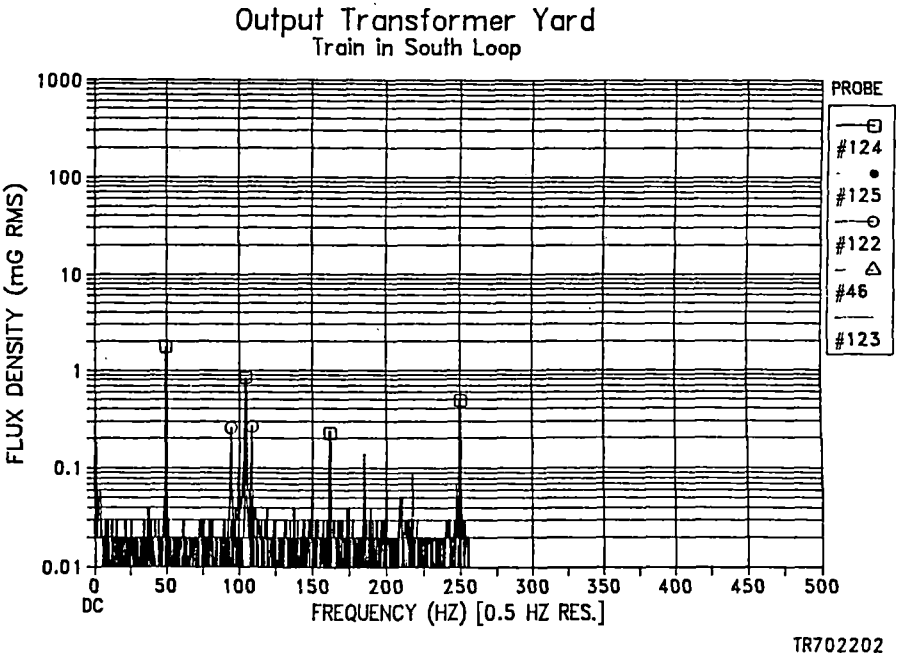

Output Transformer Yard
Train in North Straightaway
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702201

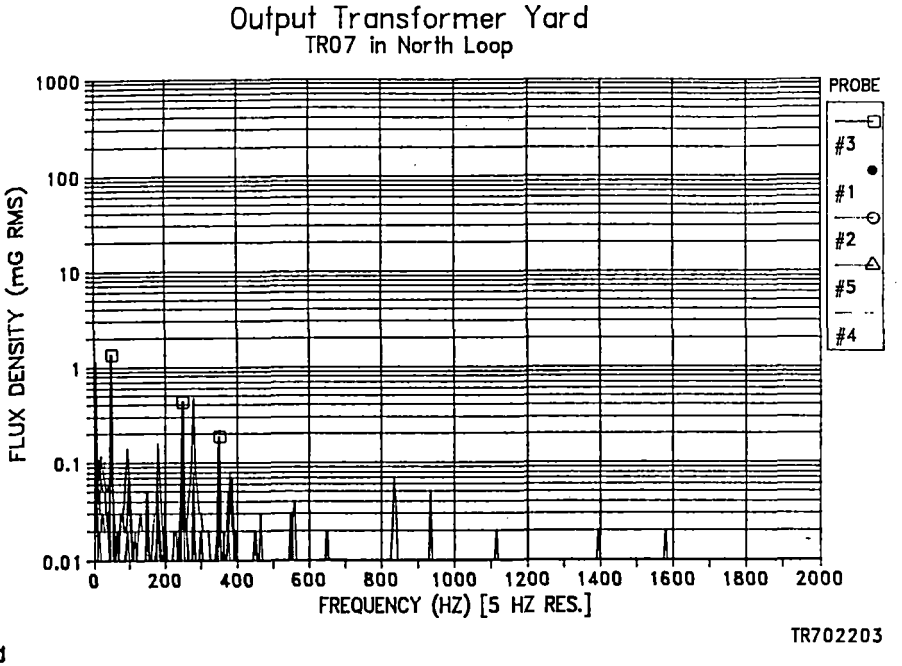

Output Transformer Yard
Train in North Straightaway
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702201

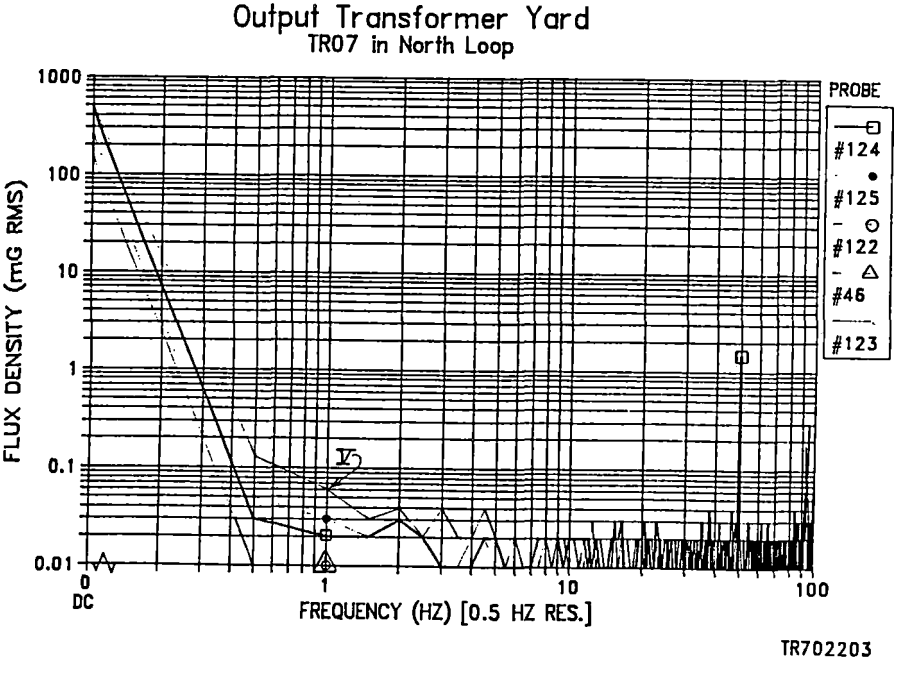

Output Transformer Yard
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702202

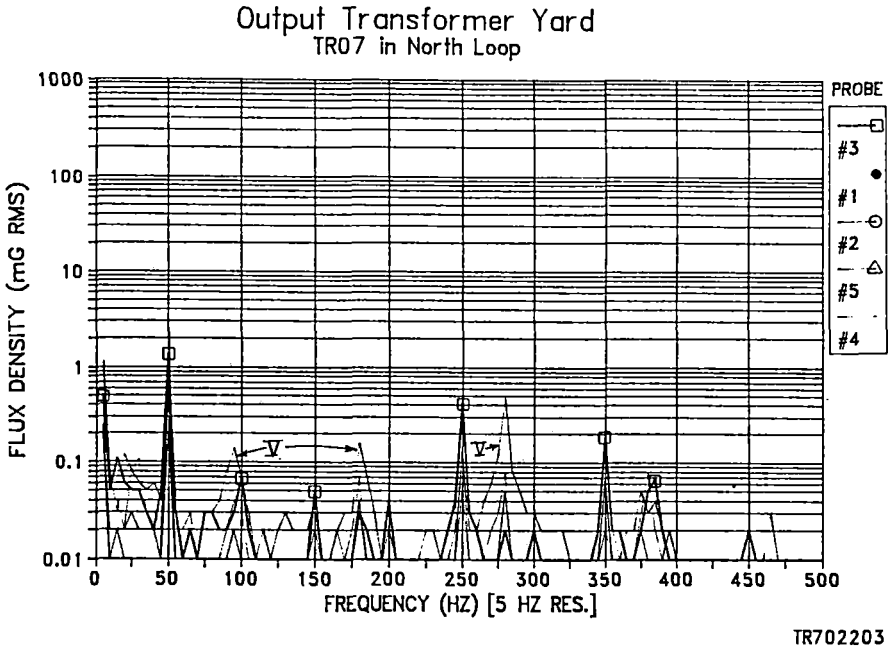

Output Transformer Yard
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702202

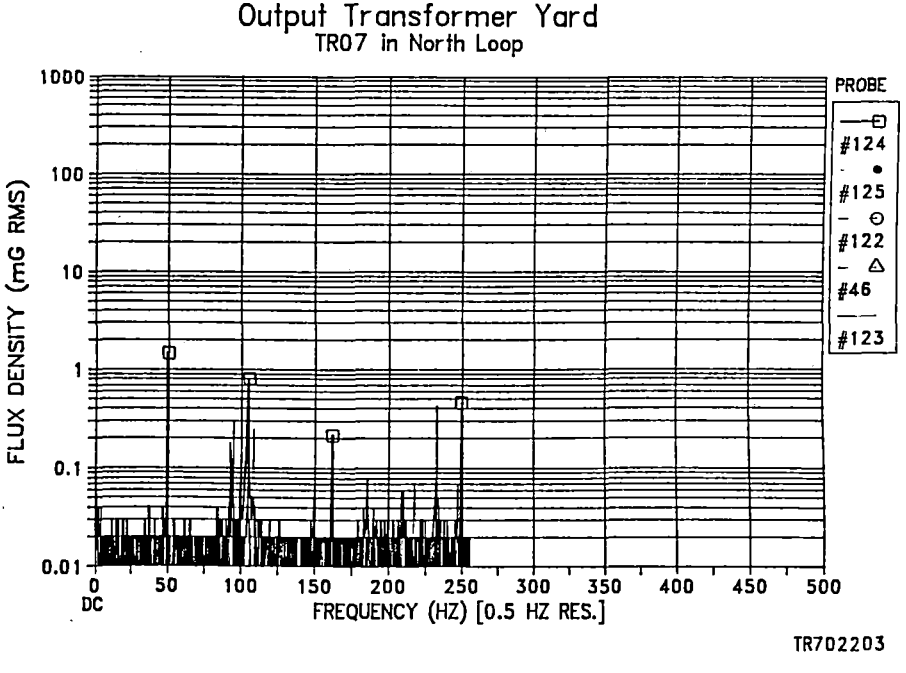

Output Transformer Yard
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702202

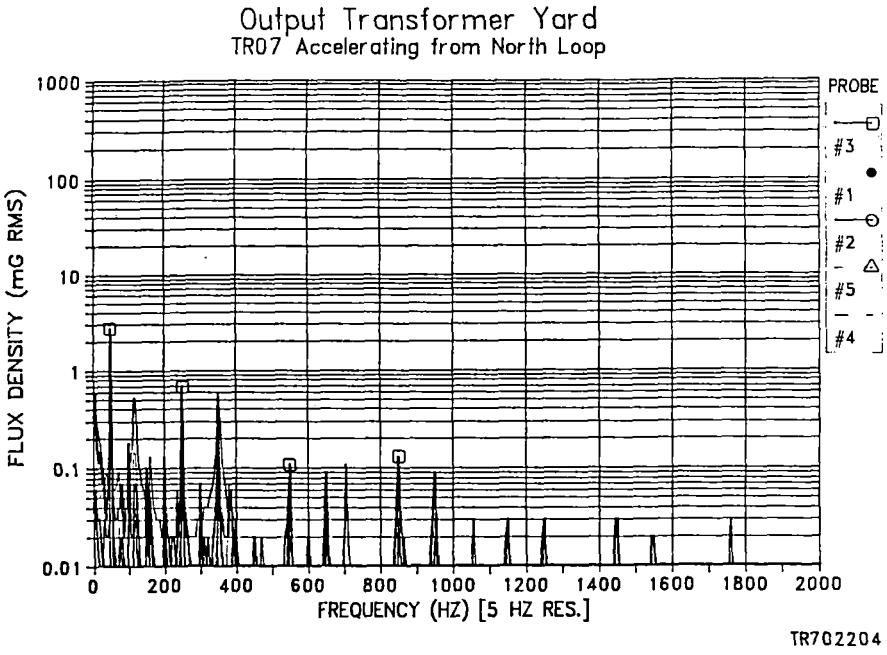

Output Transformer Yard
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702202


Output Transformer Yard
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702203

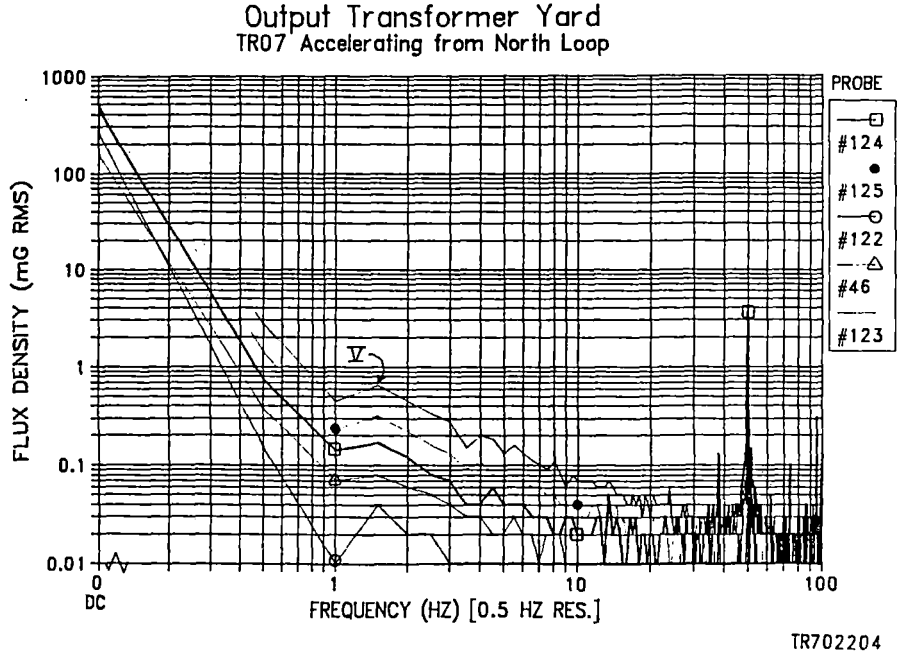

Output Transformer Yard
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702203

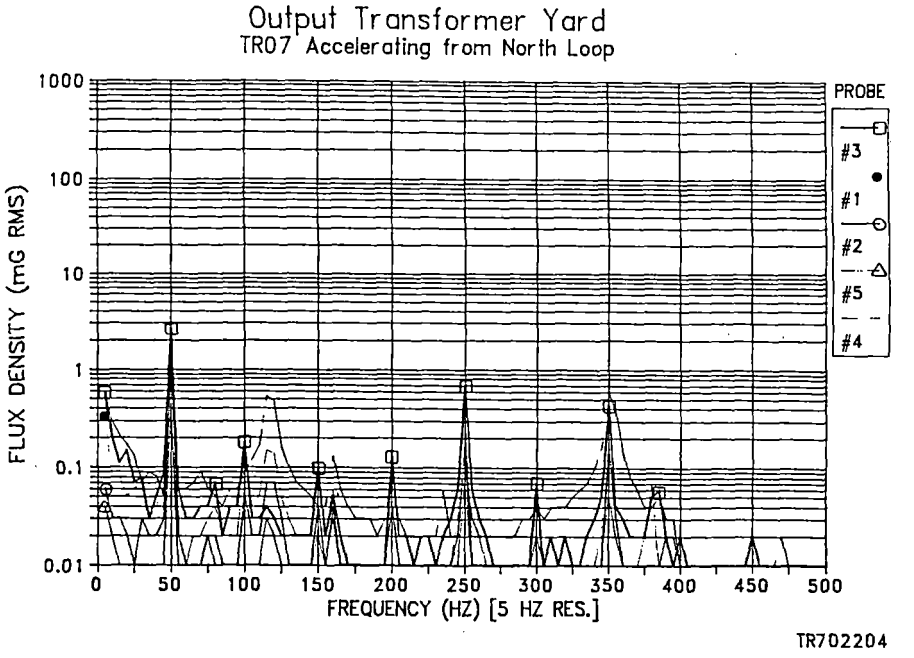

Output Transformer Yard
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702203

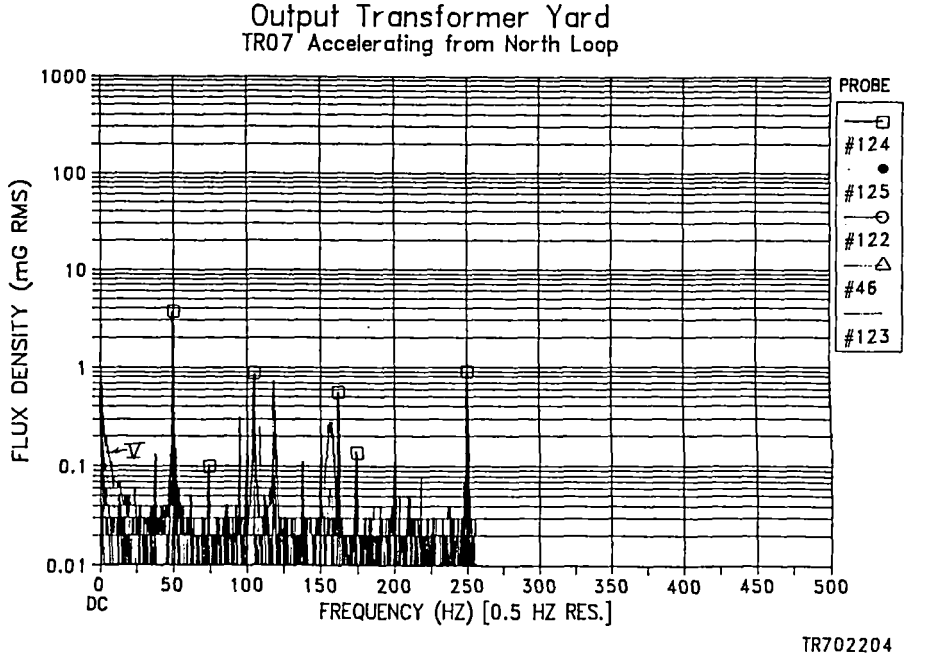

Output Transformer Yard
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702203

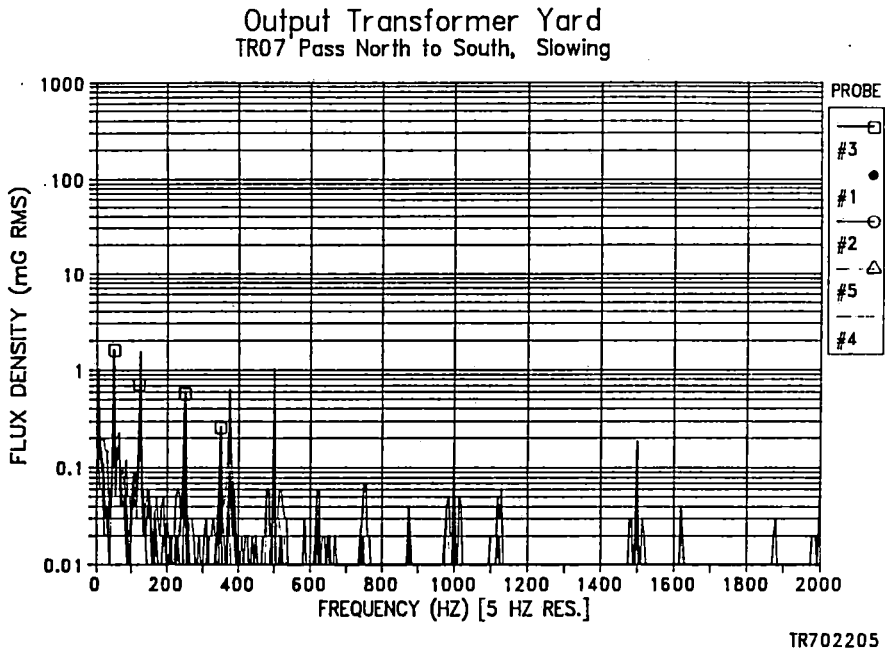

Output Transformer Yard
TR07 Accelerating from North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702204

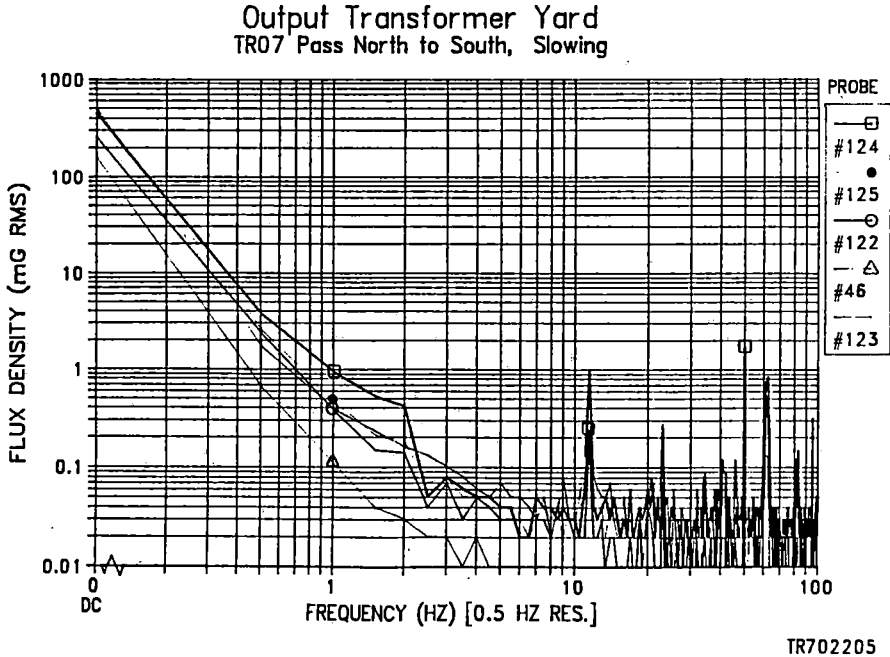
F-5

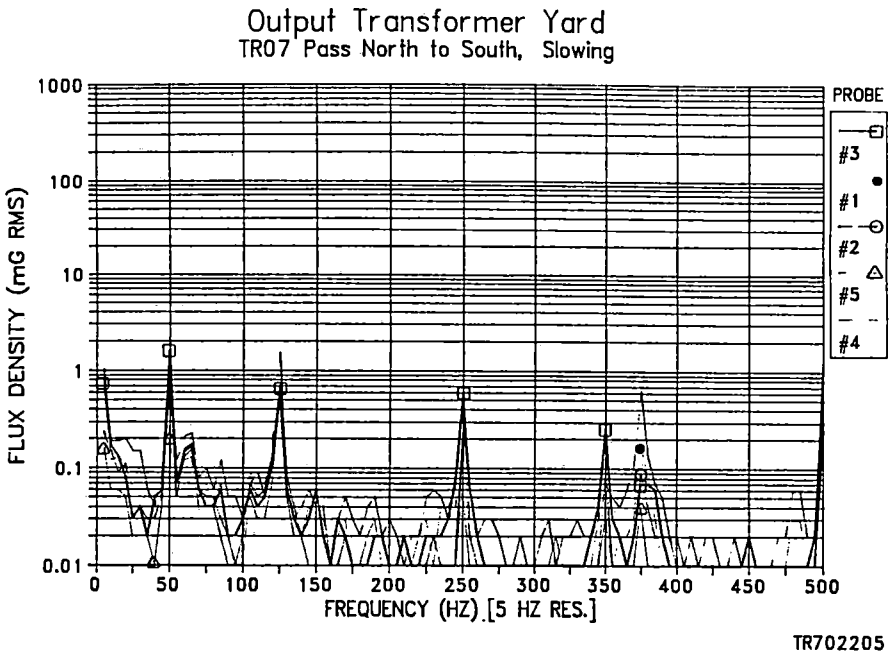

Output Transformer Yard
TR07 Accelerating from North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702204

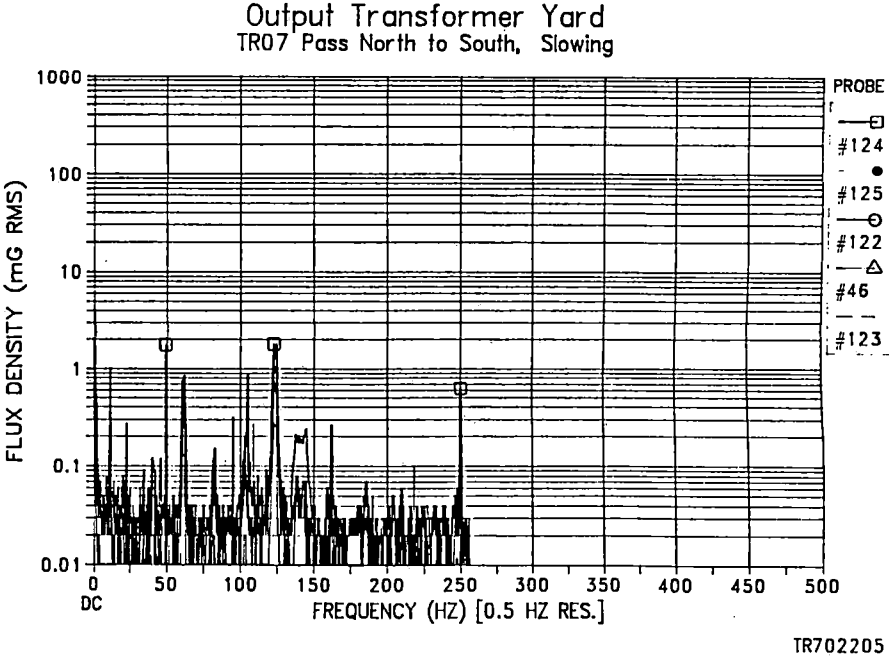

Output Transformer Yard
TR07 Accelerating from North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702204

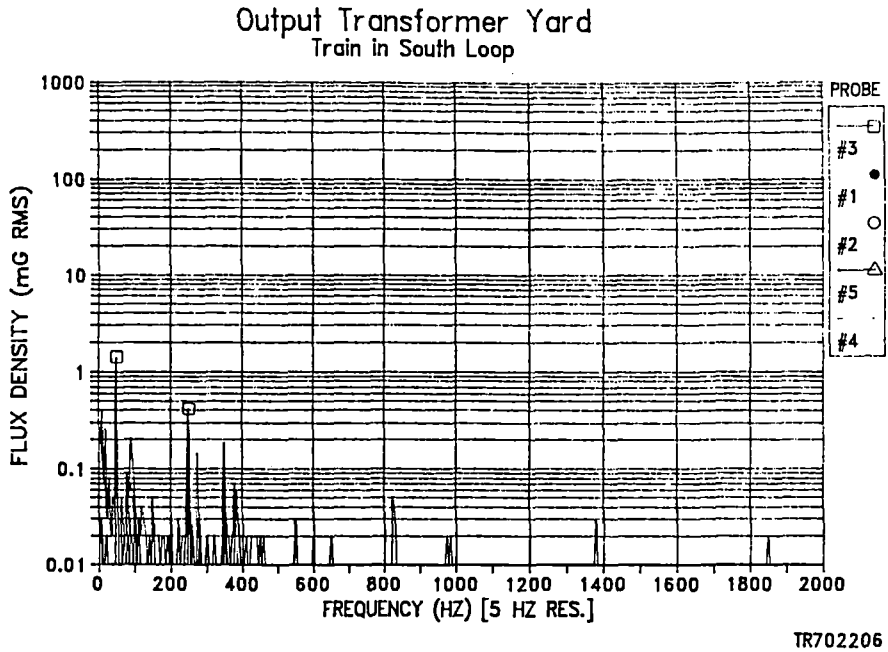

Output Transformer Yard
TR07 Accelerating from North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702204

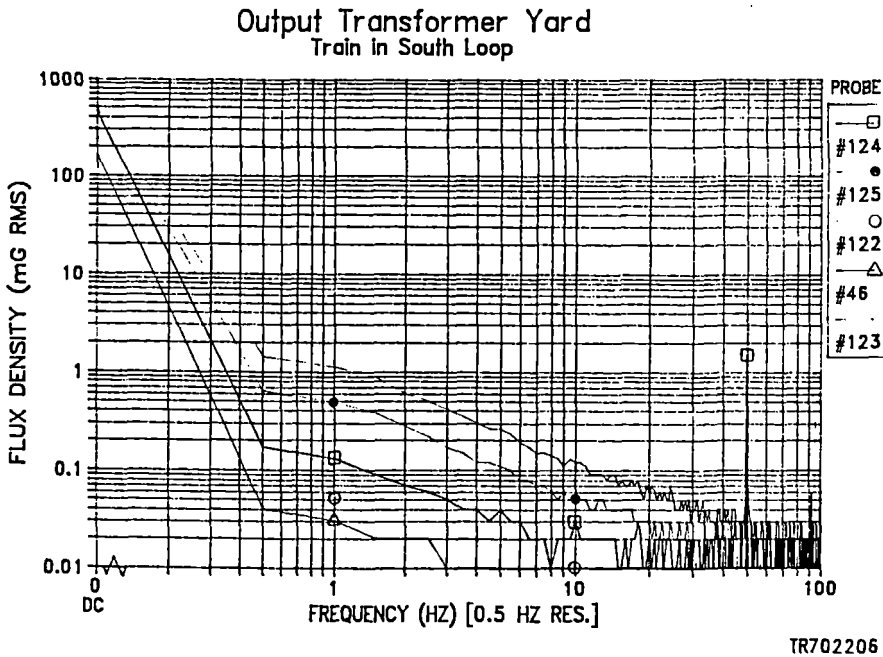

Output Transformer Yard
TR07 Pass North to South, Slowing
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702205


Output Transformer Yard
TR07 Pass North to South, Slowing
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702205

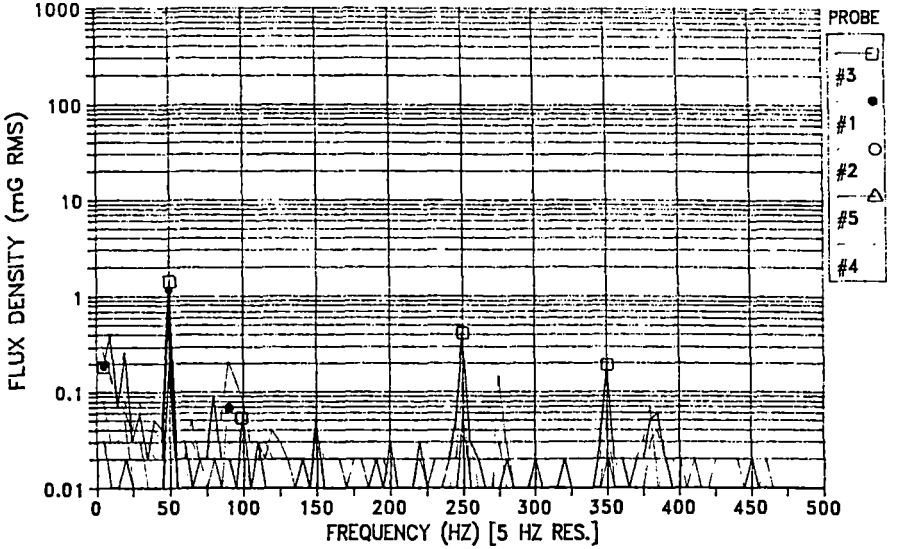

Output Transformer Yard
TR07 Pass North to South, Slowing
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702205


Output Transformer Yard
TR07 Pass North to South, Slowing
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702205


Output Transformer Yard
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702206

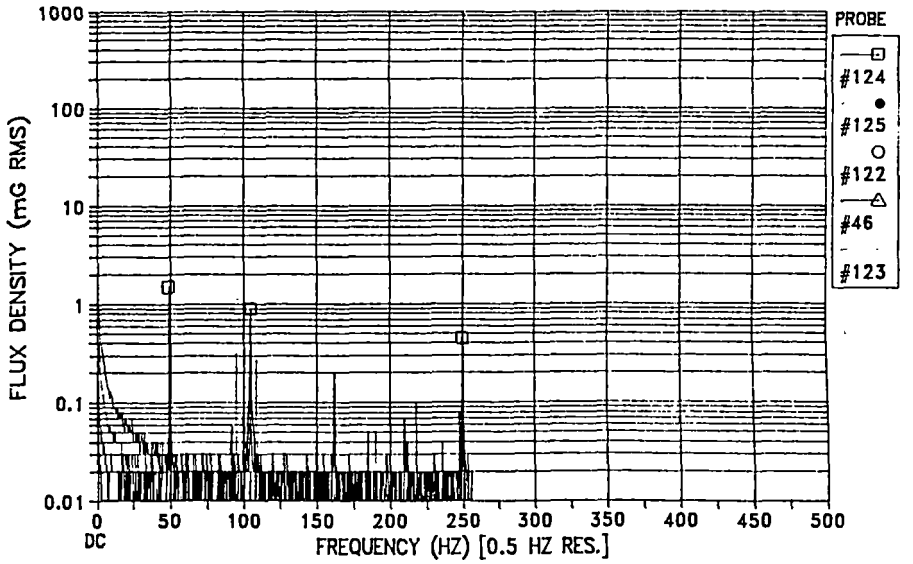

Output Transformer Yard
Train in South Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702206

Output Transformer Yard
Train in South Loop



TR702206

Output Transformer Yard
Train in South Loop



TR702206

TR7022

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 022
> Output Transformer Yard measurements
>
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 15:08:00
End: 08/09/90 (Thursday) AT 15:28:00
Recorded 230 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

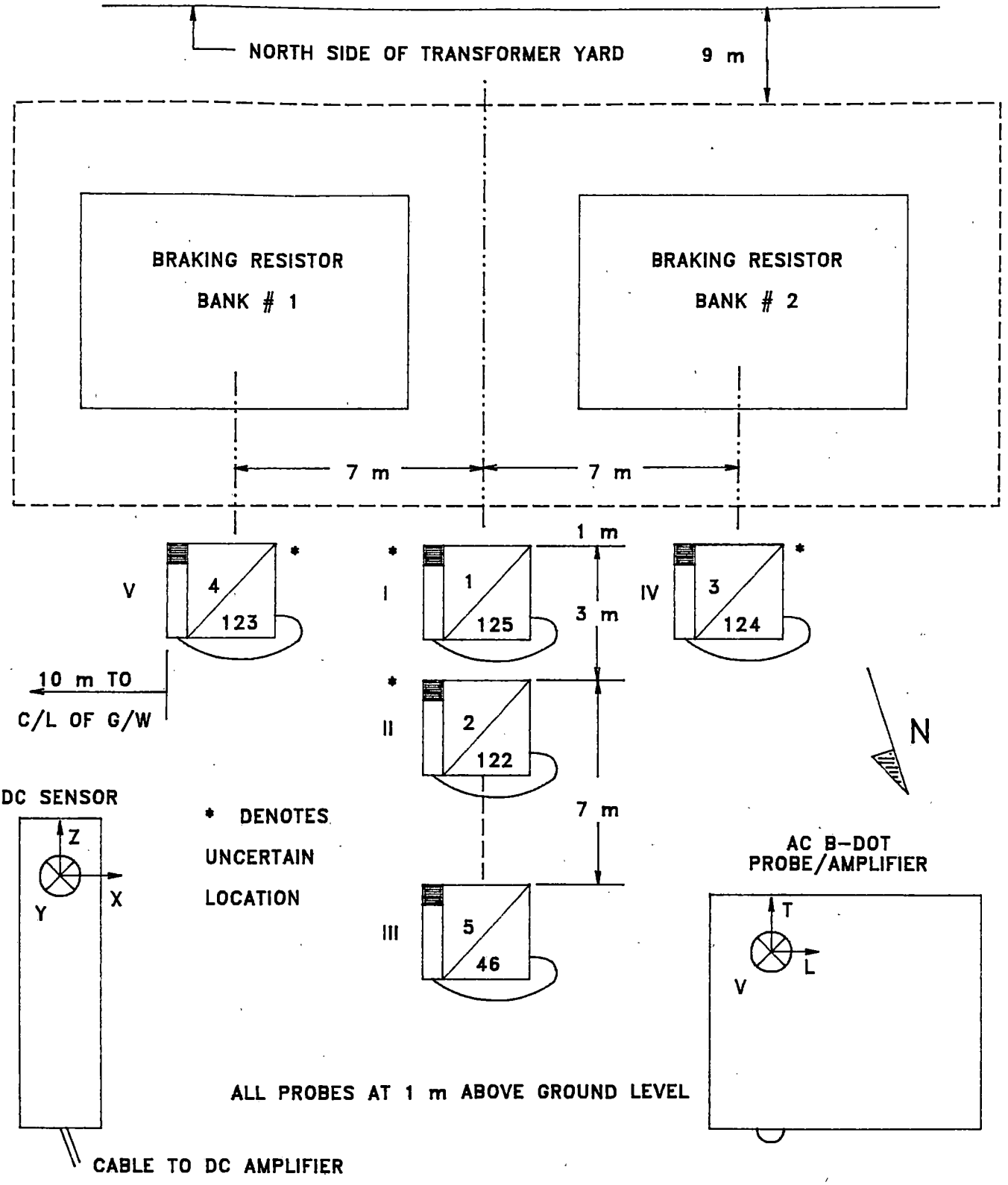
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

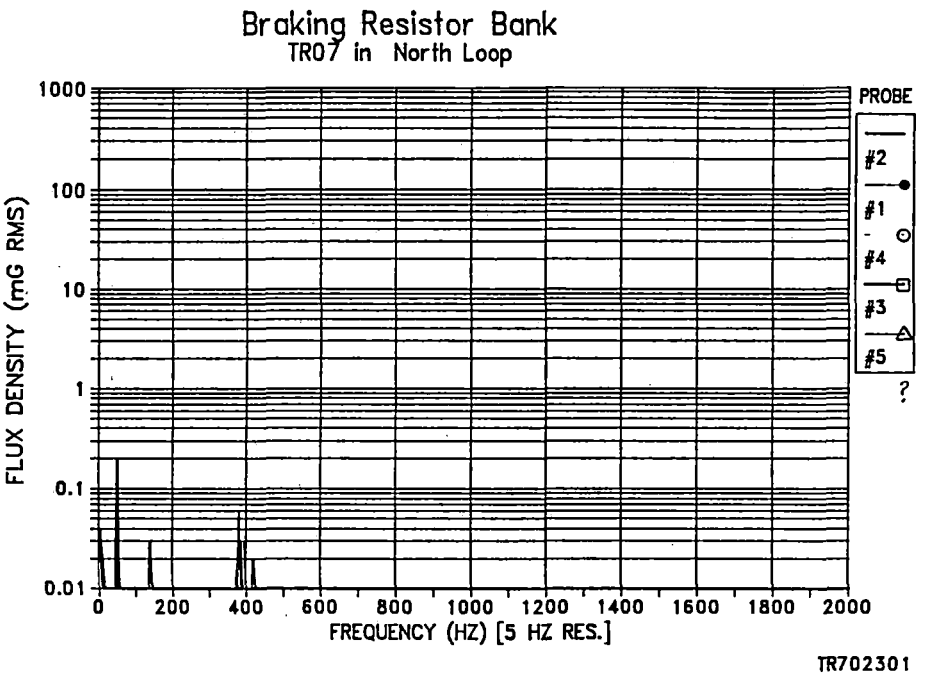
RANGE SETTINGS:

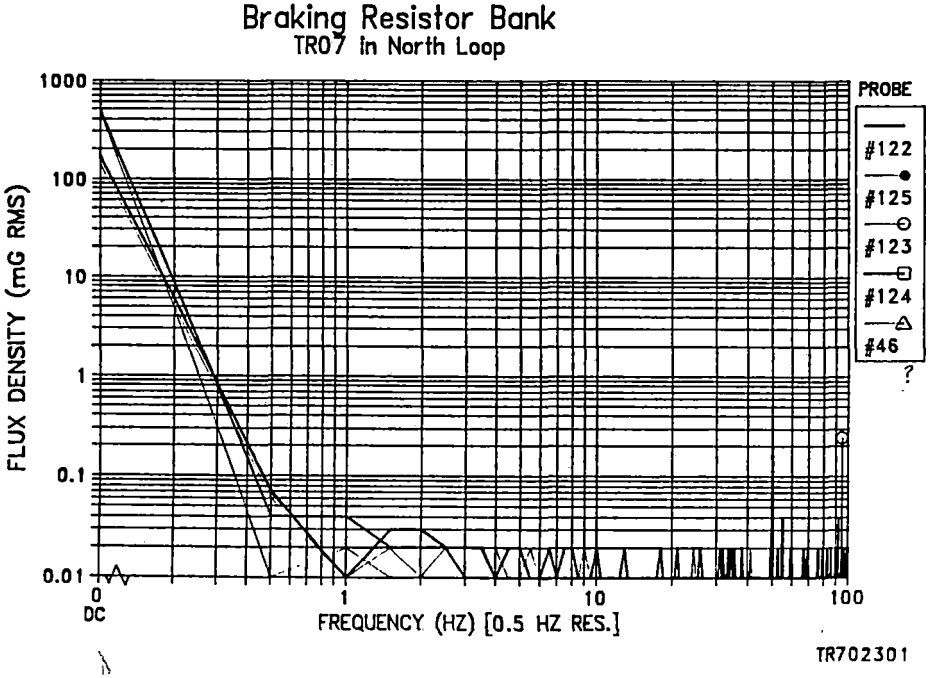
A1 # 3 To right of profile at yard edge
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
B1 # 1 Center of transformers at yard edge
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
C1 # 2 3m from center of trans. along profile
COIL L: 10.0mG
COIL T: 10.0mG
COIL V: 10.0mG
D1 # 5 10m along profile
COIL L: 3.00mG
COIL T: 3.00mG
COIL V: 3.00mG
E1 # 4 To left of profile at yard edge
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
A2 #124 To right of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of transformers at yard edge
DC - A: 100mG
DC - B: 1000mG
DC - C: 300mG
C2 #122 3m from center of trans. along profile
DC - A: 300mG
DC - B: 0.30mG
DC - C: 300mG
D2 # 46 10m along profile
DC - A: 300mG
DC - B: 300mG
DC - C: 300mG
E2 #123 To left of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

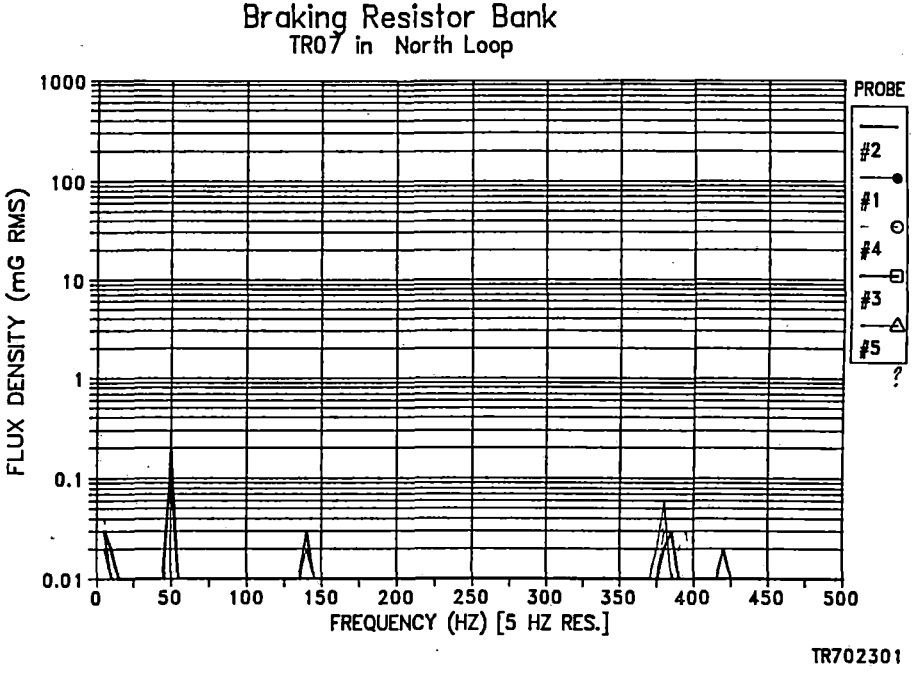
APPENDIX G

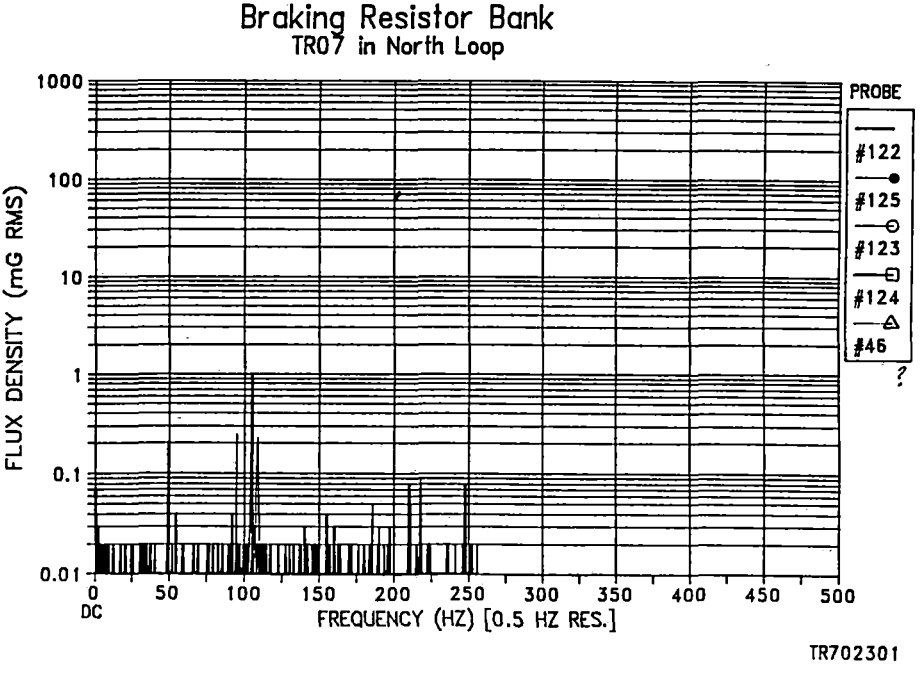
SETUP 23: BRAKING RESISTOR BANK

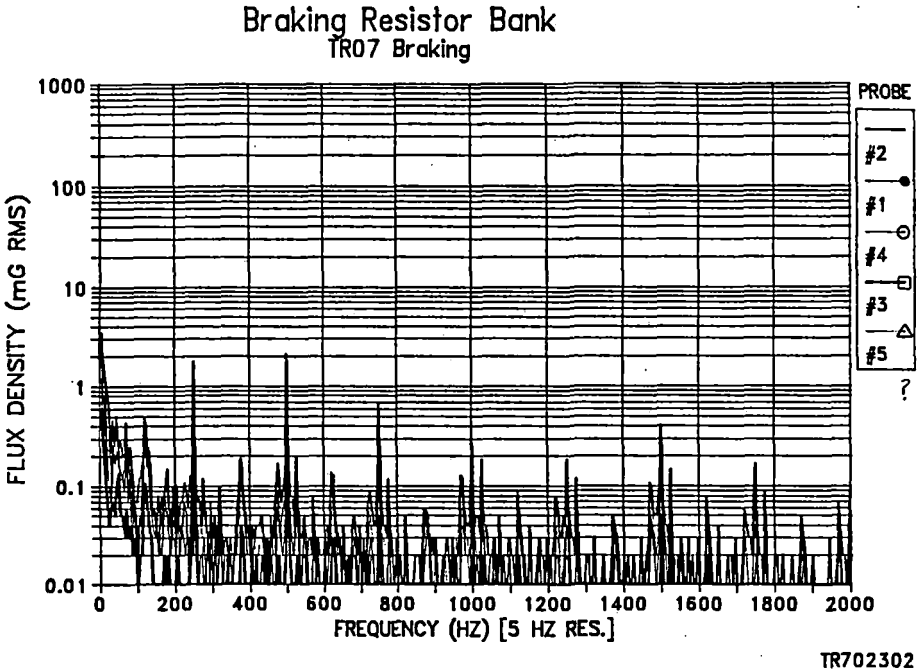



Braking Resistor Bank
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
?
TR702301

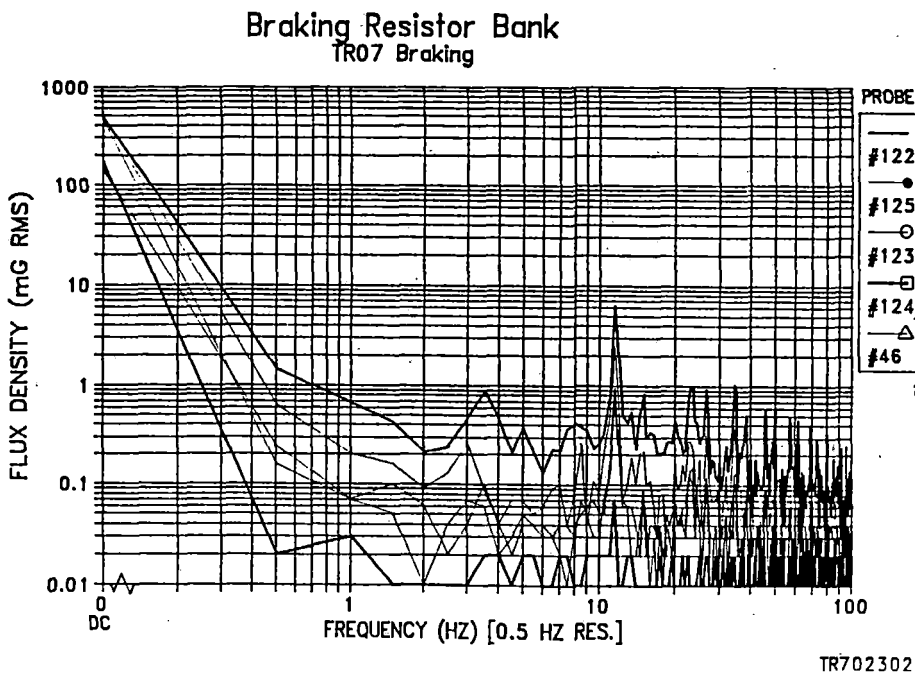

Braking Resistor Bank
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
?
TR702301

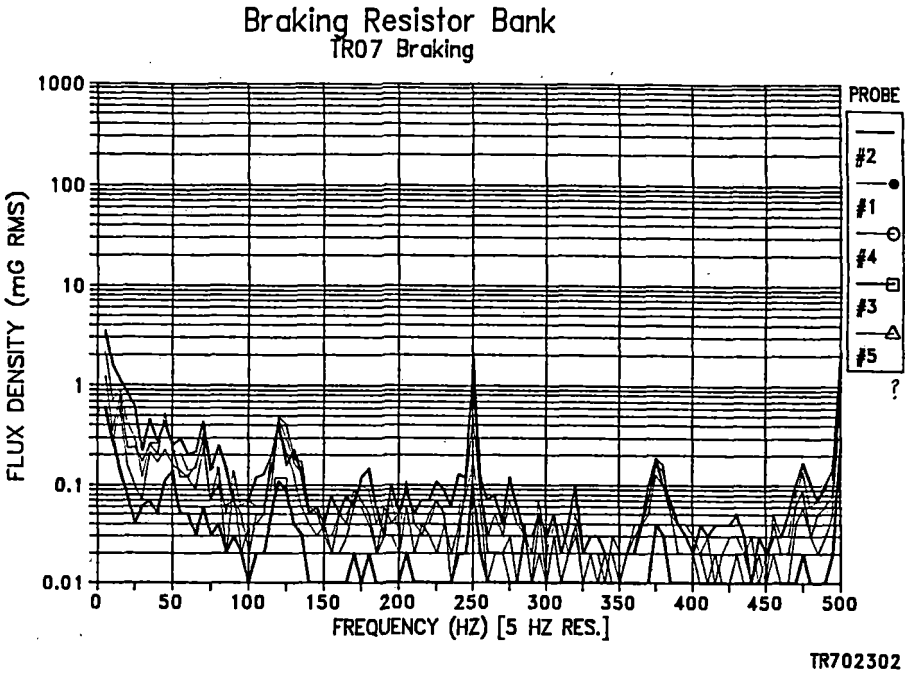

Braking Resistor Bank
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
?
TR702301

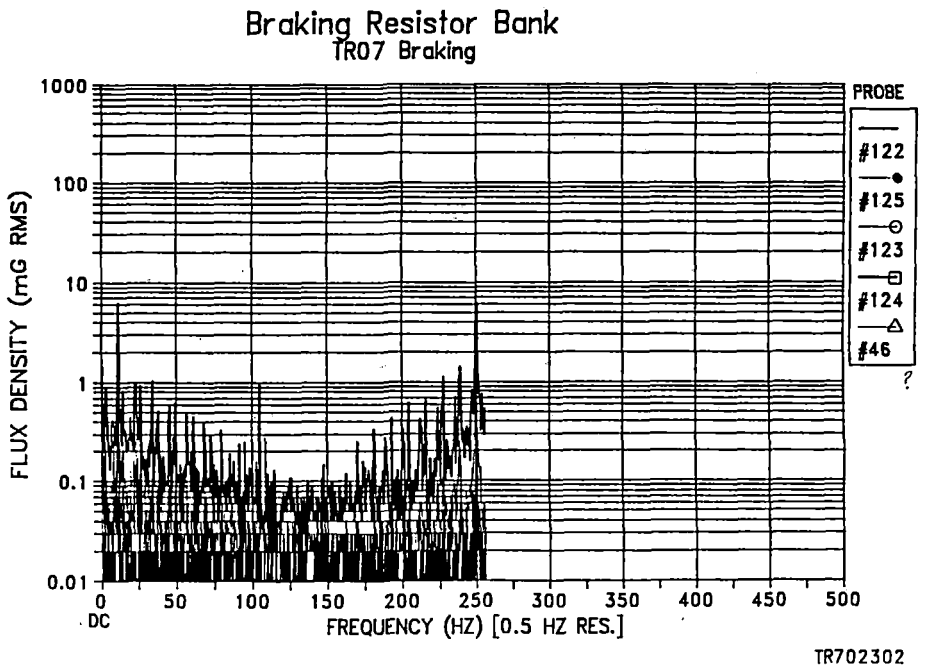

Braking Resistor Bank
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
?
TR702301

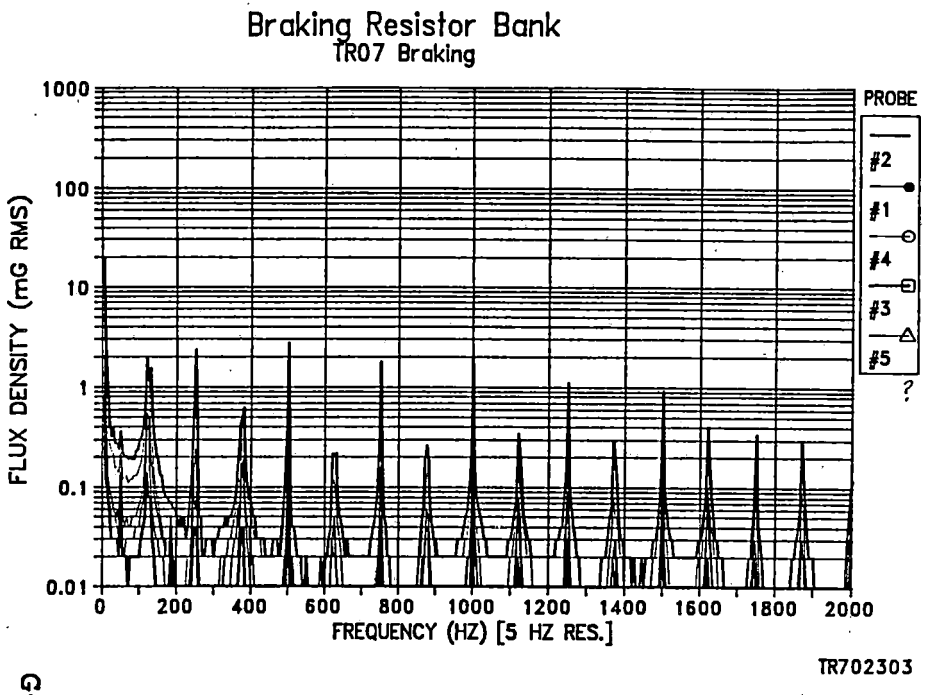

Braking Resistor Bank
TR07 Braking
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
?
TR702302

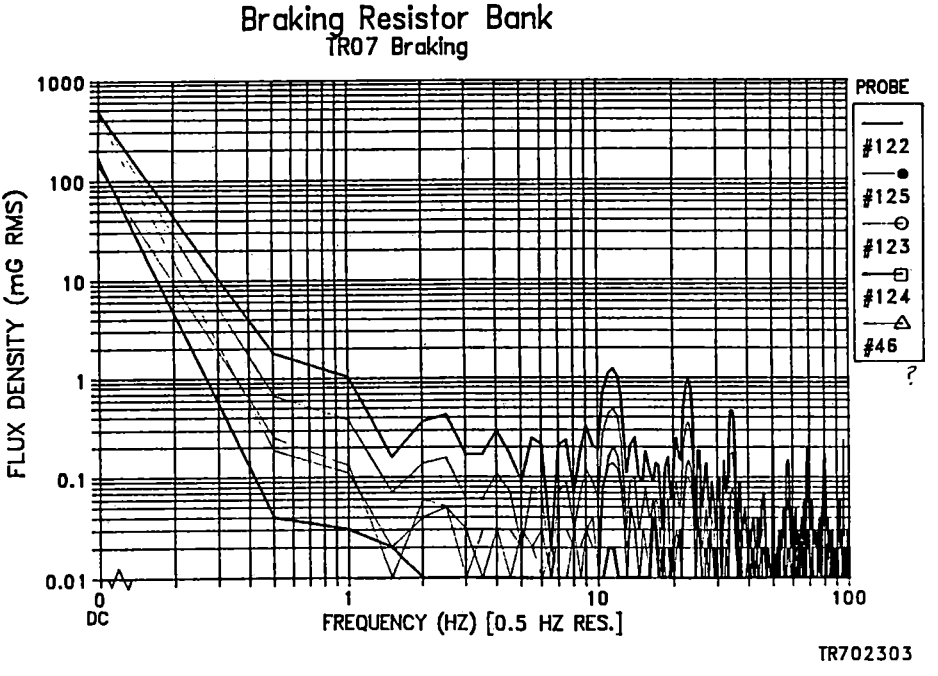
G-3

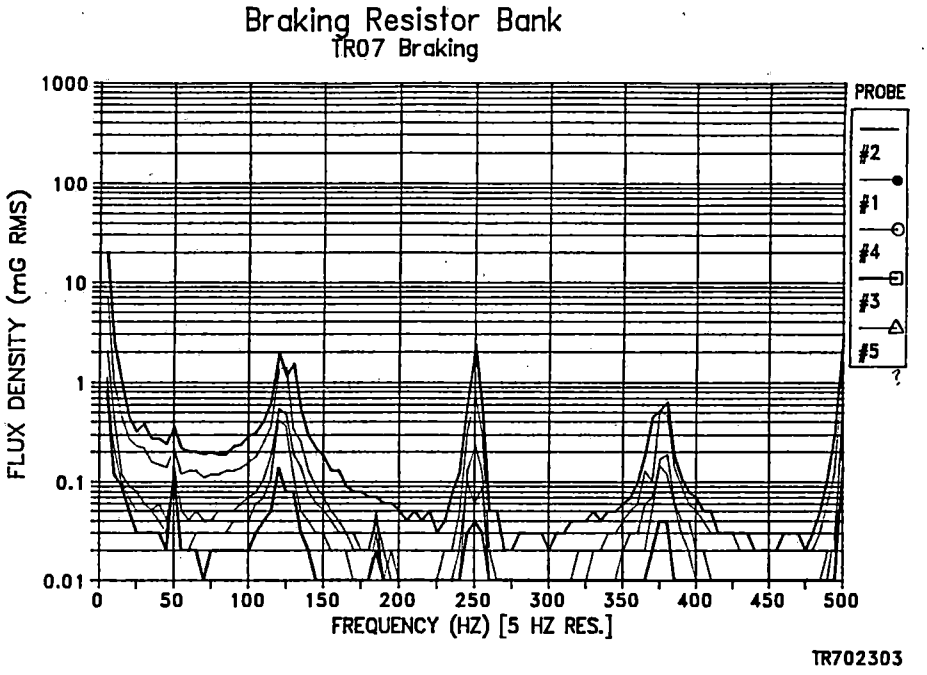

Braking Resistor Bank
TR07 Braking
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
?
TR702302

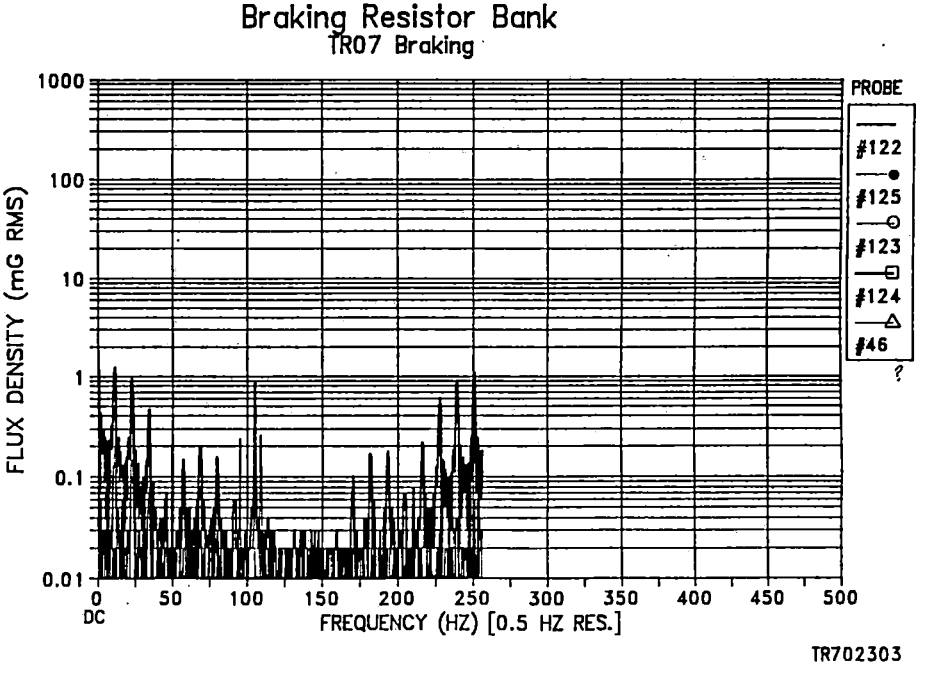

Braking Resistor Bank
TR07 Braking
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702302

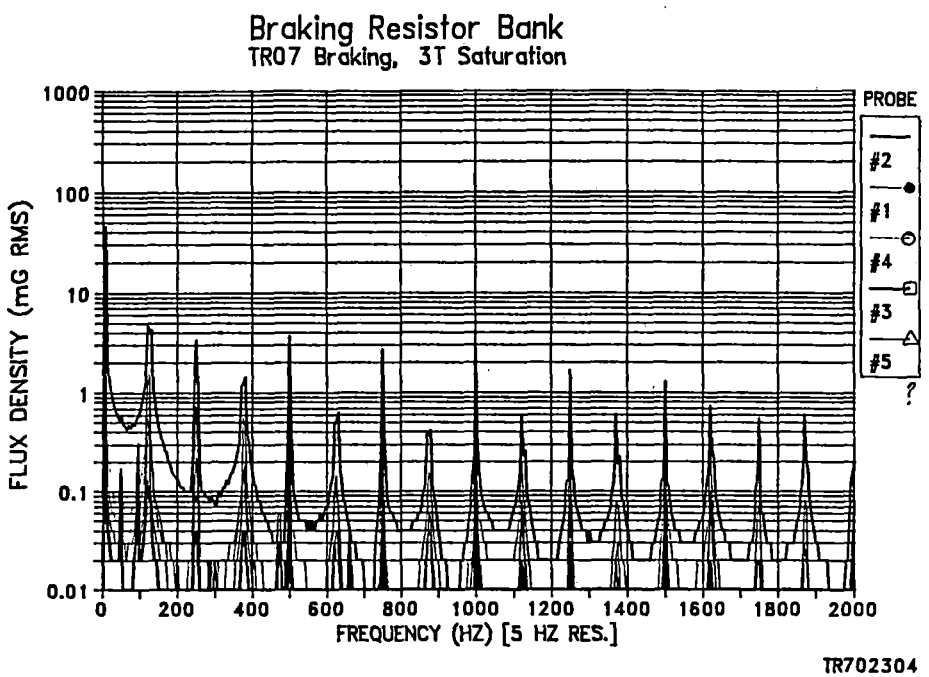

Braking Resistor Bank
TR07 Braking
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702302

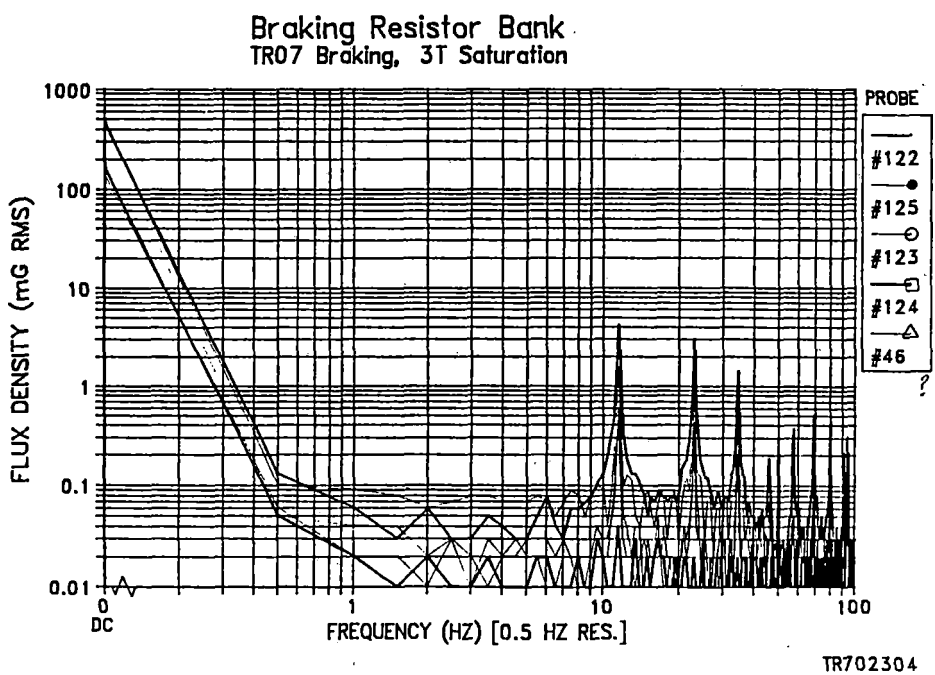

Braking Resistor Bank
TR07 Braking
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
?
TR702303

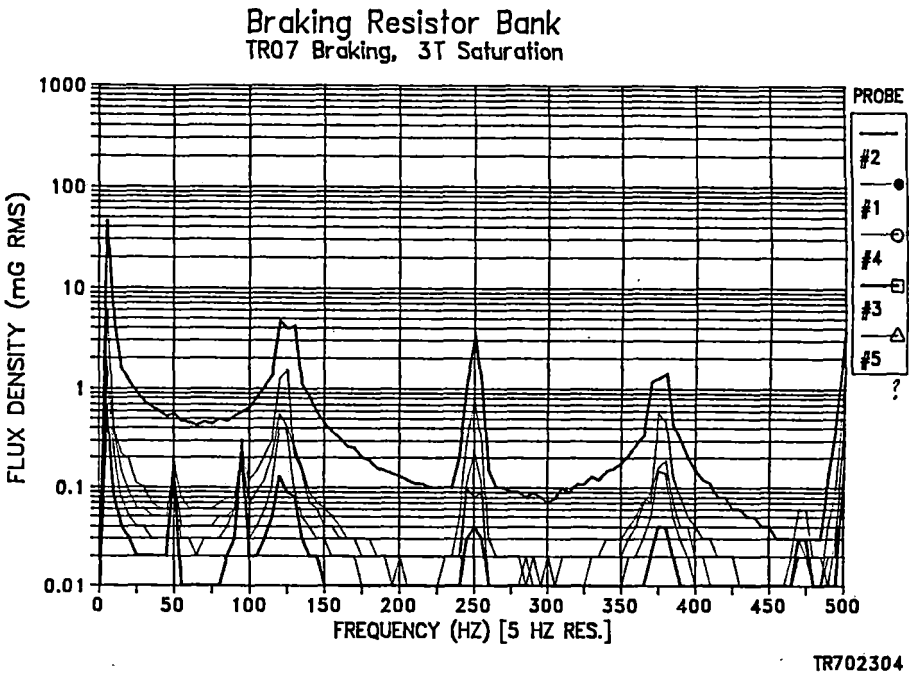

Braking Resistor Bank
TR07 Braking
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
?
TR702303

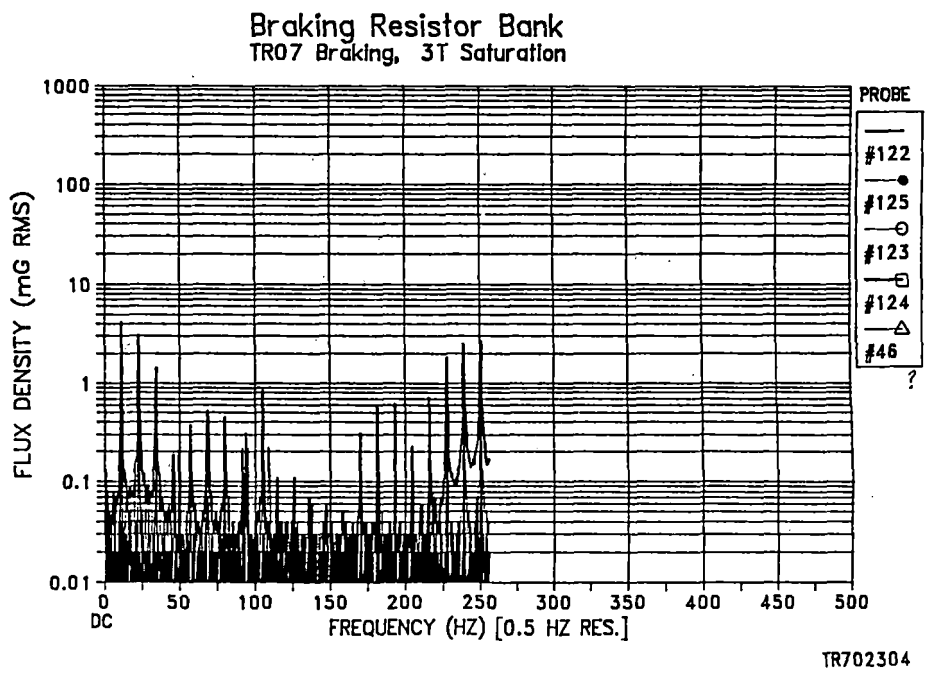

Braking Resistor Bank
TR07 Braking
1000
100
10
1
0.1
0.01
FLUX DENSITY (mG RMS)
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702303


Braking Resistor Bank
TR07 Braking
1000
100
10
1
0.1
0.01
FLUX DENSITY (mG RMS)
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702303


Braking Resistor Bank
TR07 Braking, 3T Saturation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702304


Braking Resistor Bank
TR07 Braking, 3T Saturation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702304


Braking Resistor Bank
TR07 Braking, 3T Saturation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
?
TR702304


Braking Resistor Bank
TR07 Braking, 3T Saturation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
?
TR702304

TR7023

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 023
> Braking Resistor Banks measurements
>
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 16:18:00
End: 08/09/90 (Thursday) AT 16:38:00
Recorded 255 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 3 To right of profile at yard edge
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
B1 # 1 Center of transformers at yard edge
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
C1 # 2 3m from center of trans. along profile
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
D1 # 5 10m along profile
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
E1 # 4 To left of profile at yard edge
COIL L: 30.0mG
COIL T: 30.0mG
COIL V: 30.0mG
A2 #124 To right of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of transformers at yard edge
DC - A: 300mG
DC - B: 1000mG
DC - C: 300mG
C2 #122 3m from center of trans. along profile
DC - A: 30.0mG
DC - B: 3.00mG
DC - C: 300mG
D2 # 46 10m along profile
DC - A: 10.0mG
DC - B: 300mG
DC - C: 300mG
E2 #123 To left of profile at yard edge
DC - A: 300mG
DC - B: 1000mG
DC - C: 300mG

TR7024

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 024
> Braking Resistor Banks measurements
> Attempt to catch braking waveform
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 16:49:10
End: 08/09/90 (Thursday) AT 16:55:30
Recorded 68 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

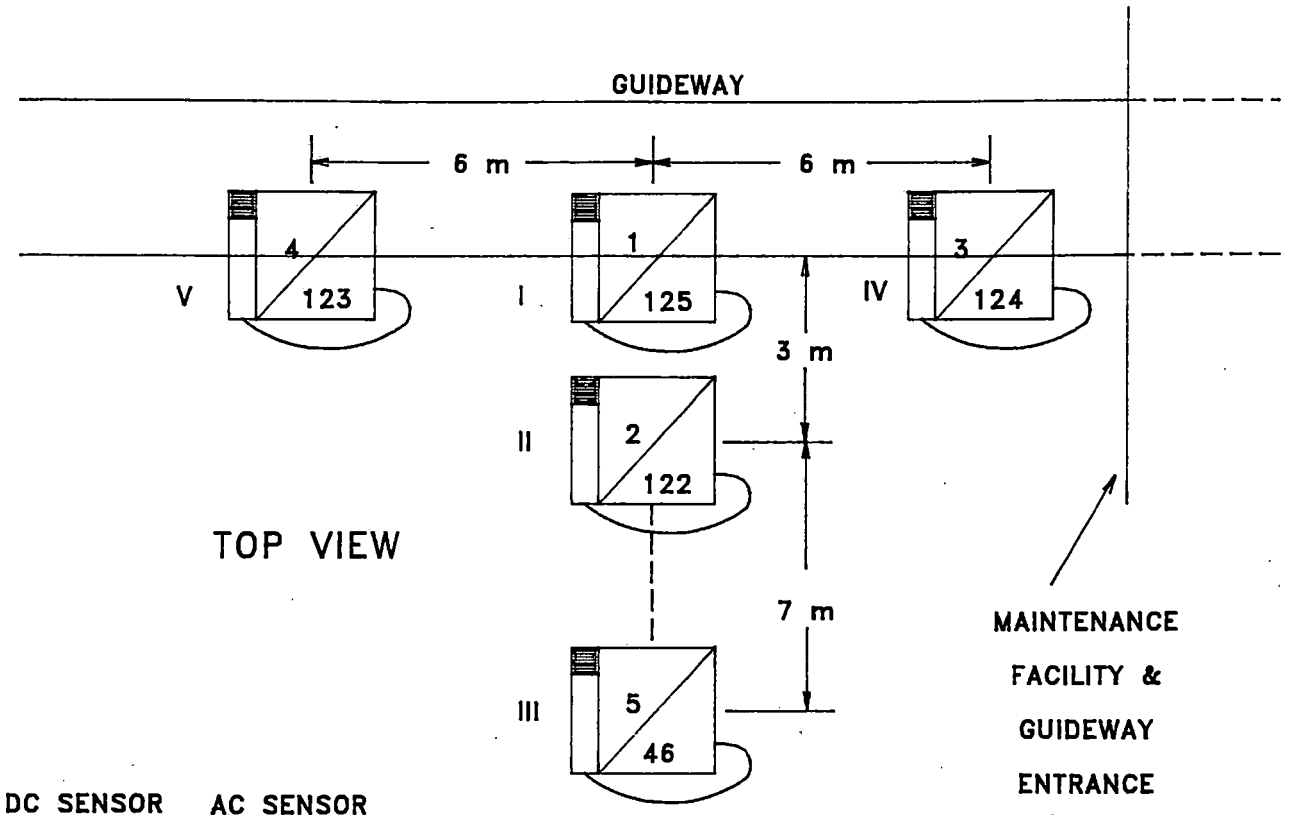
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

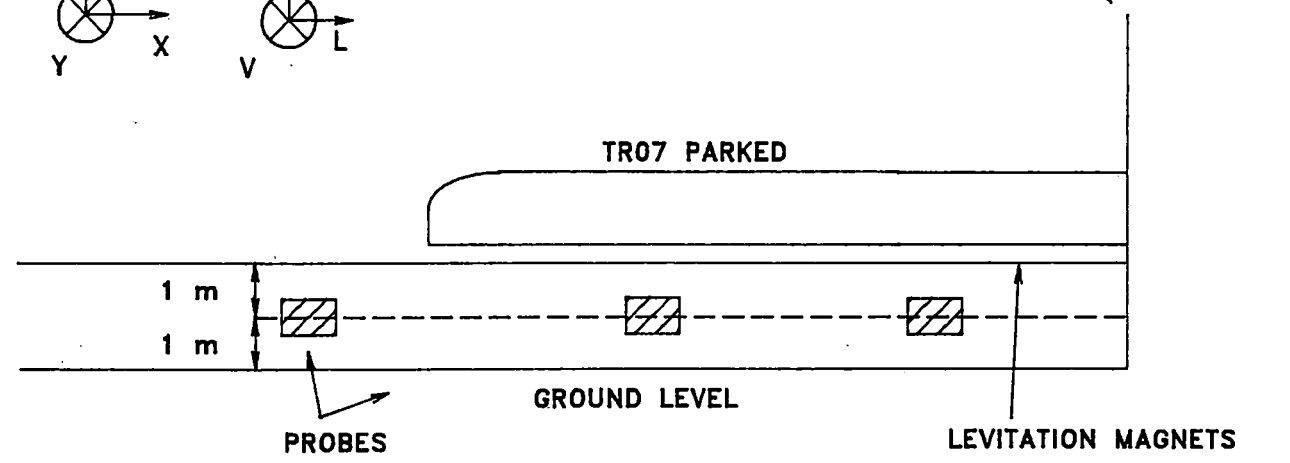
RANGE SETTINGS:

A1 # 3	To right of profile at yard edge	
	COIL L:	300mG
	COIL T:	300mG
	COIL V:	300mG
B1 # 1	Center of transformers at yard edge	
	COIL L:	30.0mG
	COIL T:	100mG
	COIL V:	100mG
C1 # 2	3m from center of trans. along profile	
	COIL L:	30.0mG
	COIL T:	100mG
	COIL V:	30.0mG
D1 # 5	10m along profile	
	COIL L:	30.0mG
	COIL T:	30.0mG
	COIL V:	30.0mG
E1 # 4	To left of profile at yard edge	
	COIL L:	30.0mG
	COIL T:	30.0mG
	COIL V:	30.0mG
A2 #124	To right of profile at yard edge	
	DC - A:	1000mG
	DC - B:	1000mG
	DC - C:	1000mG
B2 #125	Center of transformers at yard edge	
	DC - A:	300mG
	DC - B:	1000mG
	DC - C:	300mG
C2 #122	3m from center of trans. along profile	
	DC - A:	30.0mG
	DC - B:	3.00mG
	DC - C:	300mG
D2 # 46	10m along profile	
	DC - A:	10.0mG
	DC - B:	300mG
	DC - C:	300mG
E2 #123	To left of profile at yard edge	
	DC - A:	300mG
	DC - B:	1000mG
	DC - C:	300mG

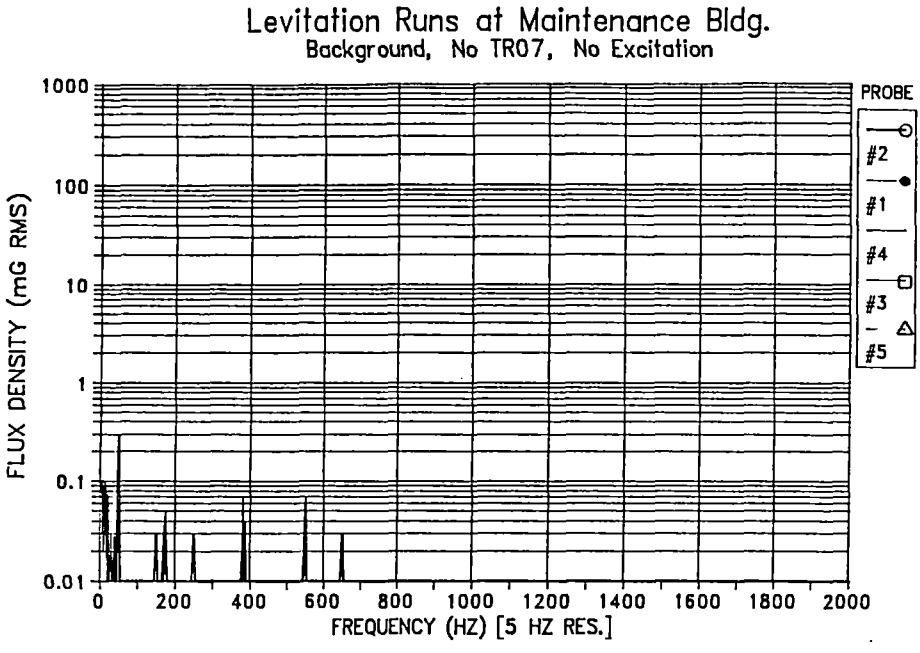
APPENDIX H

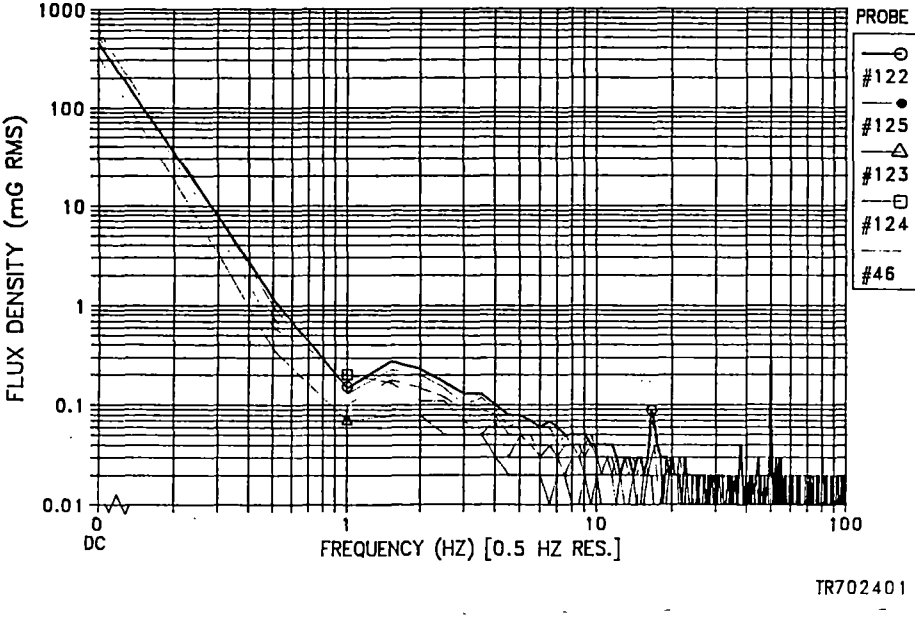
SETUP 24: LOW CONCRETE GUIDEWAY OUTSIDE MAINTENANCE FACILITY

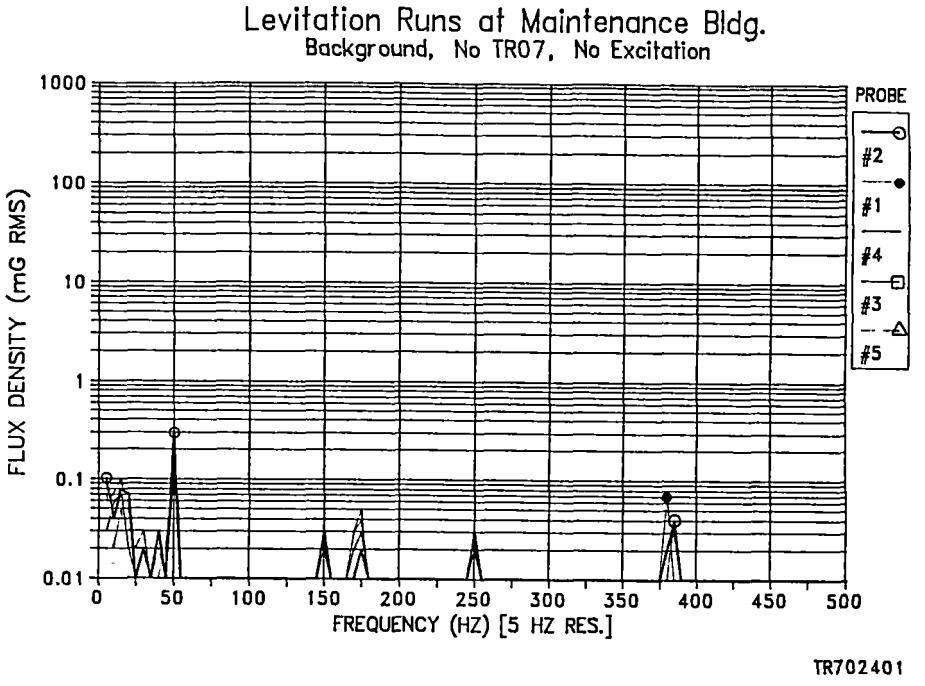


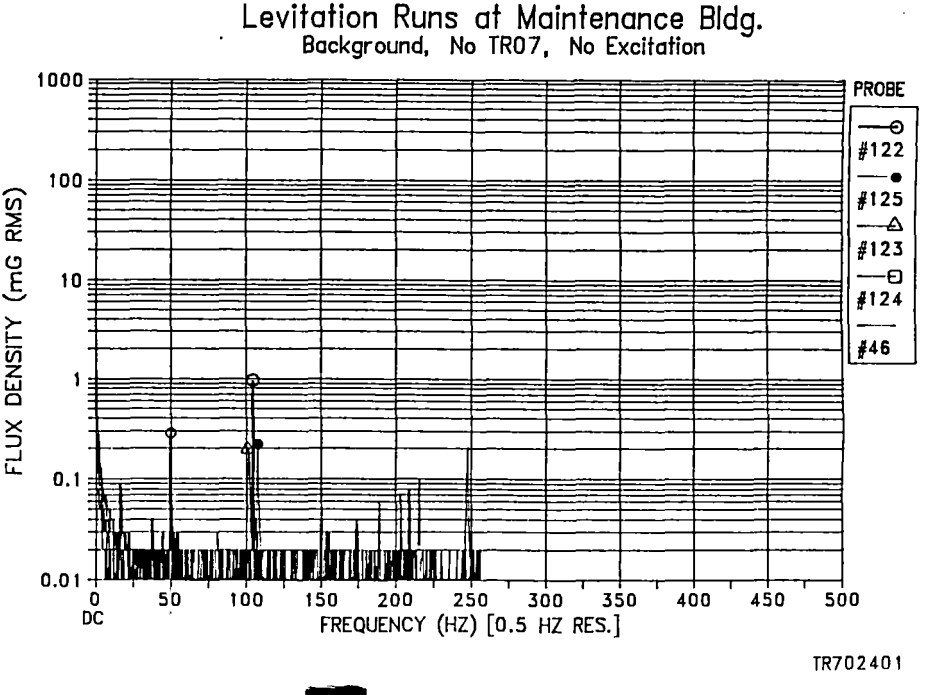


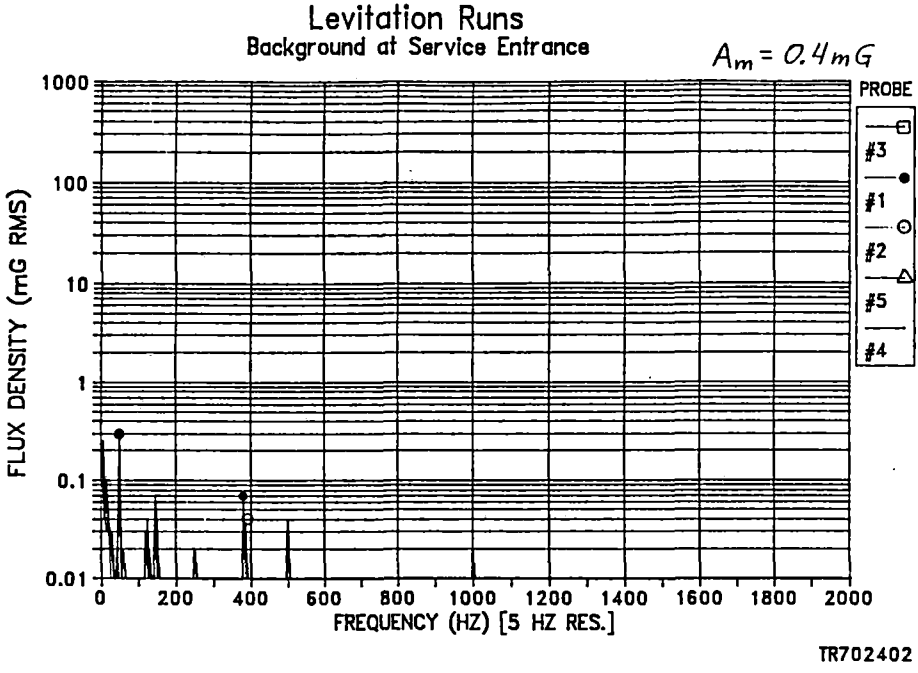
SIDE VIEW

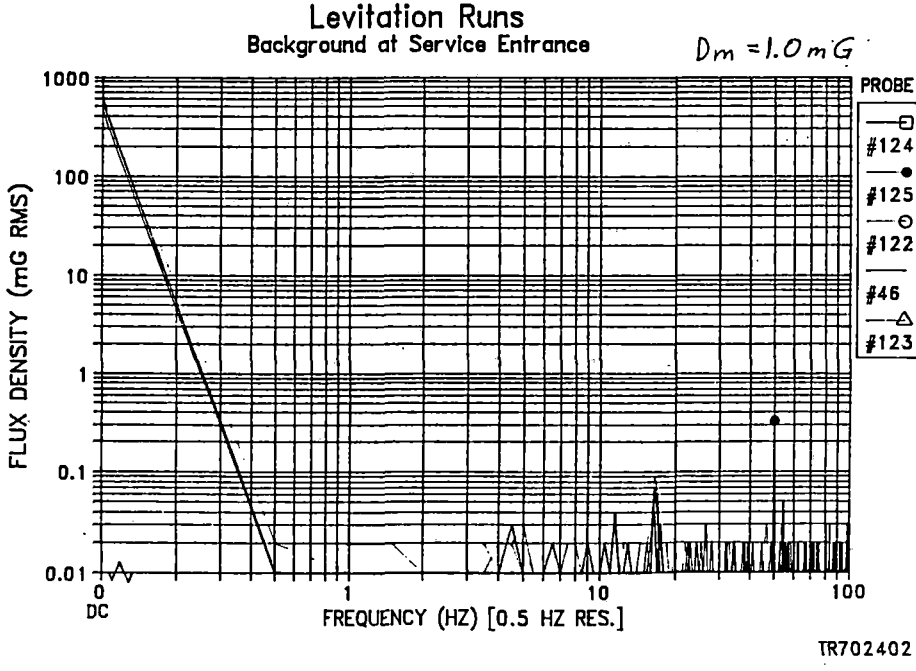

Levitation Runs at Maintenance Bldg.
Background, No TR07, No Excitation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702401

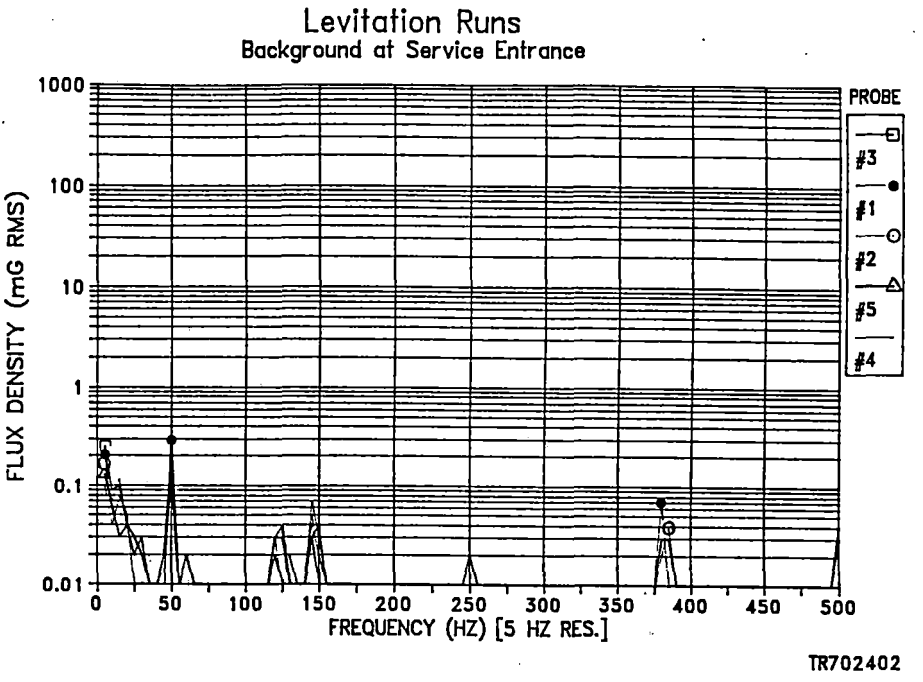

Levitation Runs at Maintenance Bldg.
Background, No TR07, No Excitation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702401

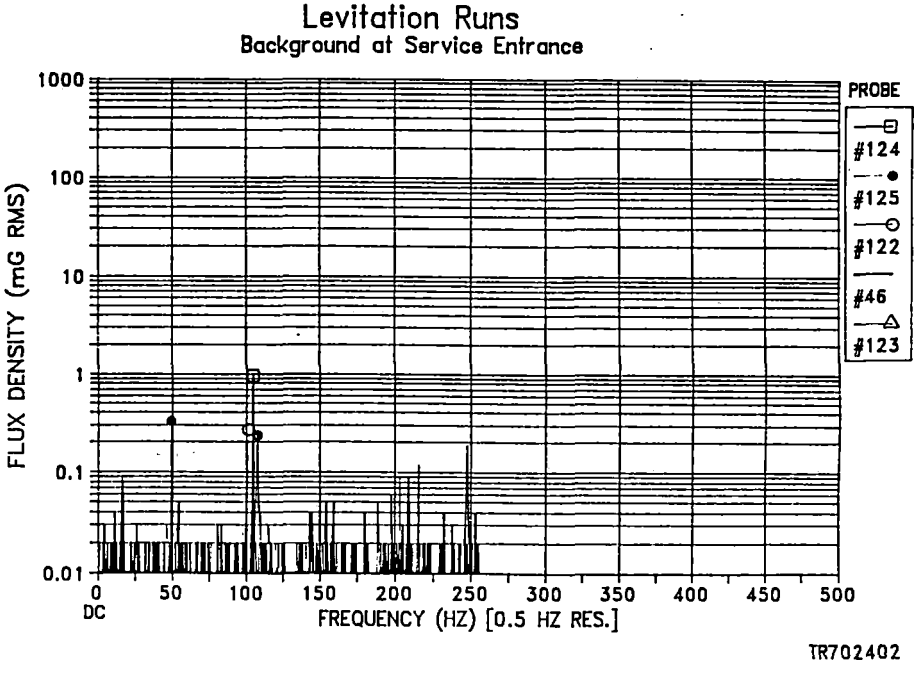

Levitation Runs at Maintenance Bldg.
Background, No TR07, No Excitation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702401


Levitation Runs at Maintenance Bldg.
Background, No TR07, No Excitation
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702401


Levitation Runs
Background at Service Entrance
$A_m = 0.4mG$
PROBE
#3
#1
#2
#5
#4
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702402


Levitation Runs
Background at Service Entrance
$Dm = 1.0mG$
PROBE
#124
#125
#122
#46
#123
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702402


Levitation Runs
Background at Service Entrance
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#3
#1
#2
#5
#4
TR702402


Levitation Runs
Background at Service Entrance
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#124
#125
#122
#46
#123
TR702402

TR7025

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 025
> Levitation runs
> Practice run - no train, track not energ
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 17:31:00
End: 08/09/90 (Thursday) AT 17:32:44
Recorded 10 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 3 To right of profile at yard edge
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

B1 # 1 Center of transformers at yard edge
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

C1 # 2 3m from center of trans. along profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

D1 # 5 10m along profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

E1 # 4 To left of profile at yard edge
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

A2 #124 To right of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

B2 #125 Center of transformers at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

C2 #122 3m from center of trans. along profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

D2 # 46 10m along profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

E2 #123 To left of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

TR7026

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 026
> Levitation runs
> Train leviating and returning to rest
> TR07 operating on track
Start: 08/09/90 (Thursday) AT 18:06:10
End: 08/09/90 (Thursday) AT 18:10:34
Recorded 39 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

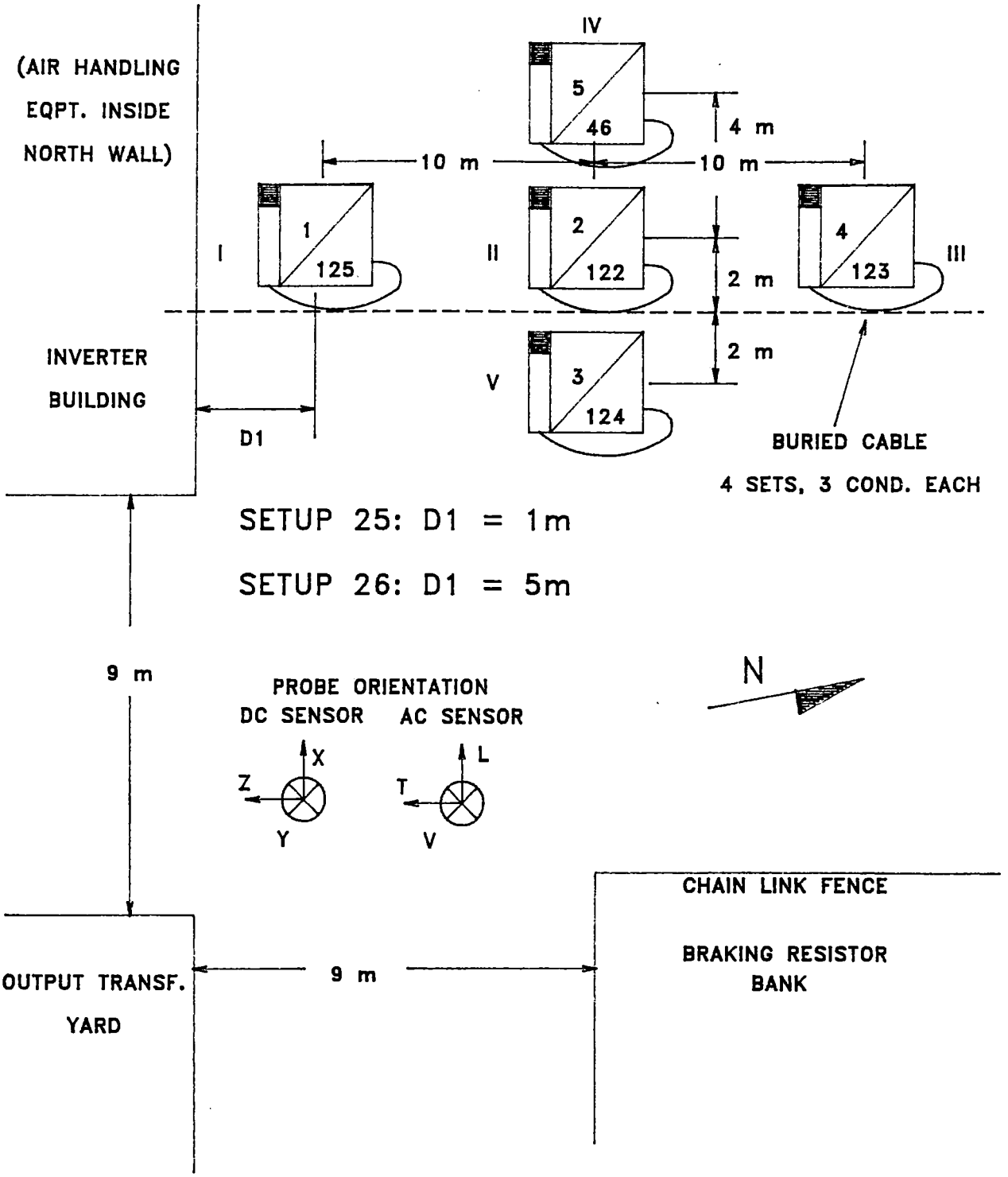
Mux Input	Base Freq	Sample Freq (Hz)
1	3.00	3072.00
2	0.50	512.00

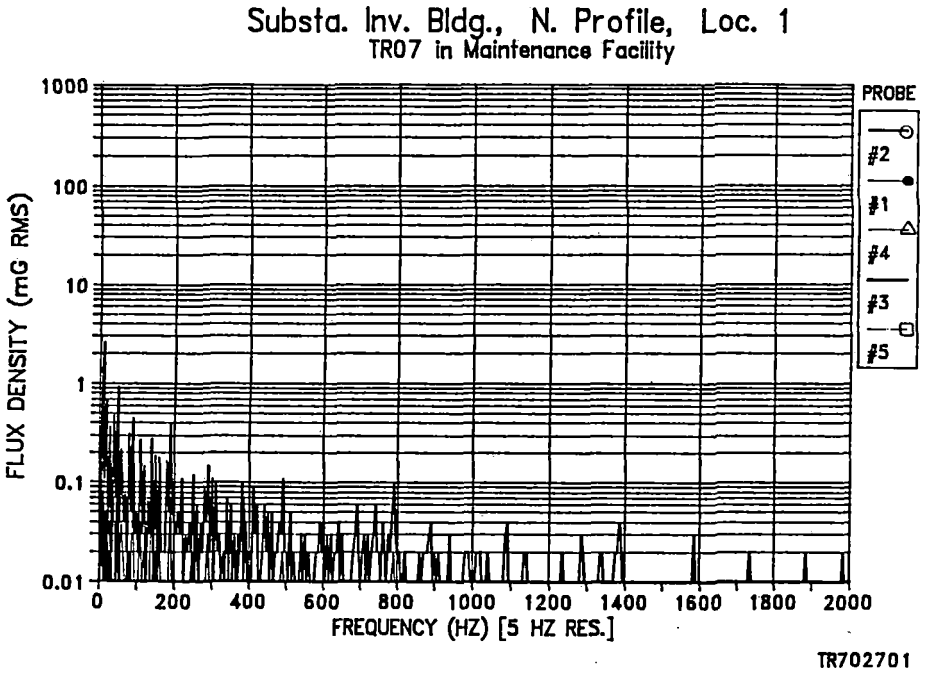
RANGE SETTINGS:

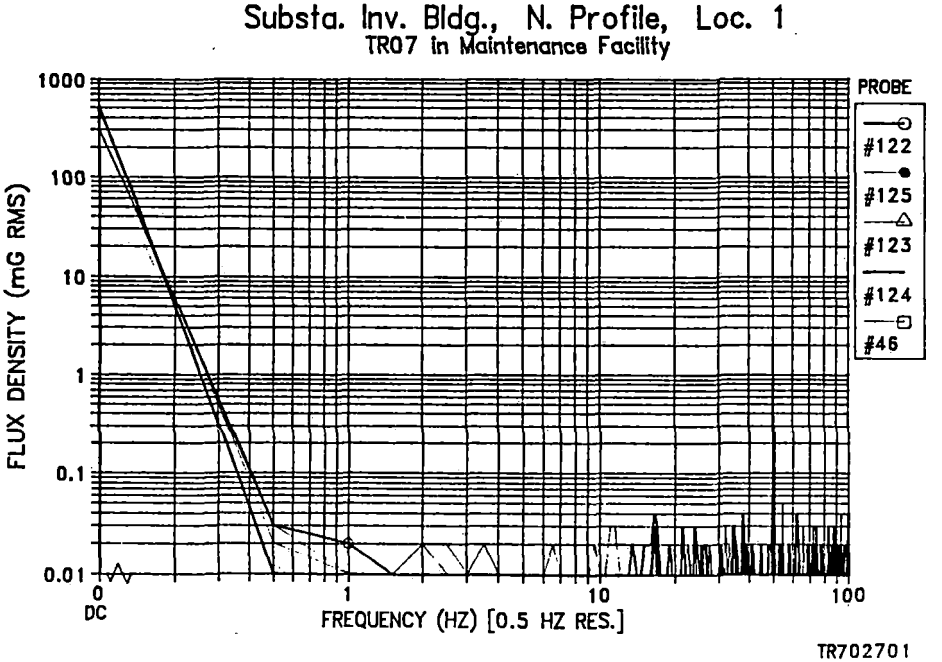
A1 # 3 To right of profile at yard edge
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 1 Center of transformers at yard edge
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 2 3m from center of trans. along profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 5 10m along profile
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 4 To left of profile at yard edge
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #124 To right of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #125 Center of transformers at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #122 3m from center of trans. along profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 # 46 10m along profile
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 #123 To left of profile at yard edge
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

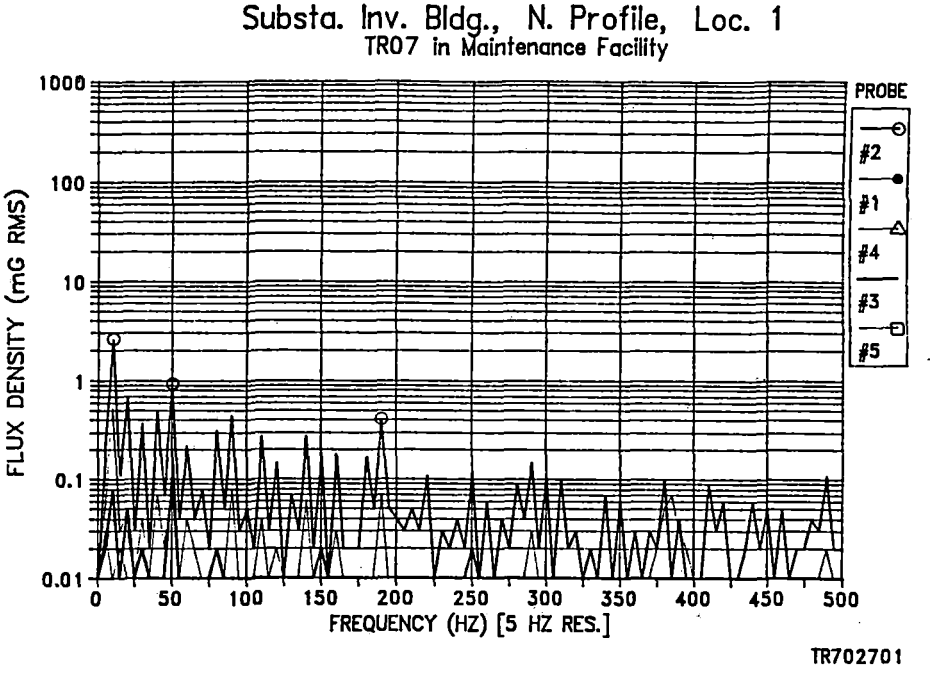
APPENDIX I

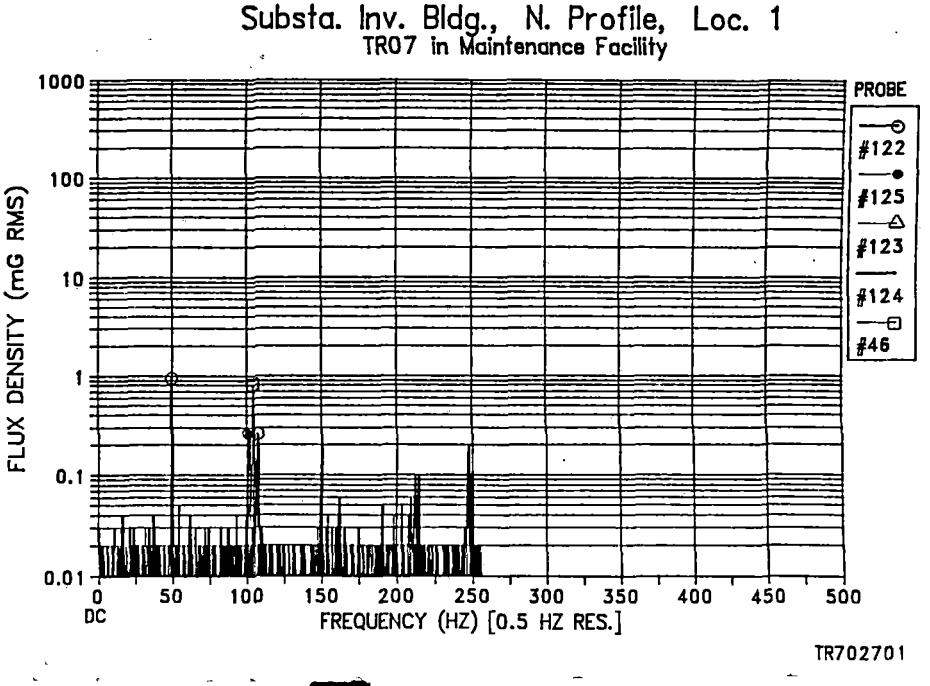
SETUP 25 AND 26: OUTSIDE INVERTER BUILDING ALONG MAIN FEEDER CABLES

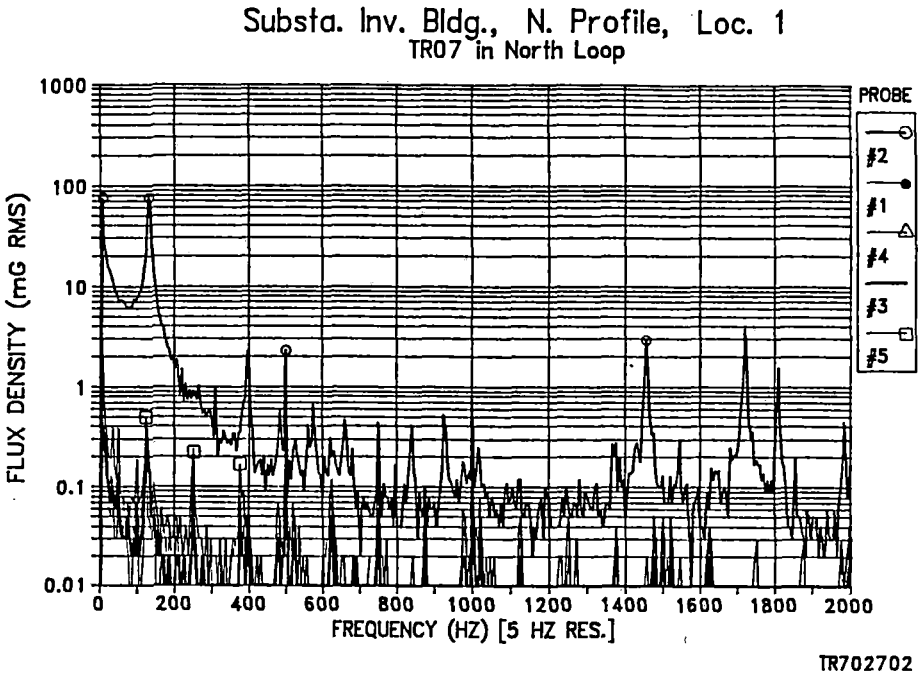


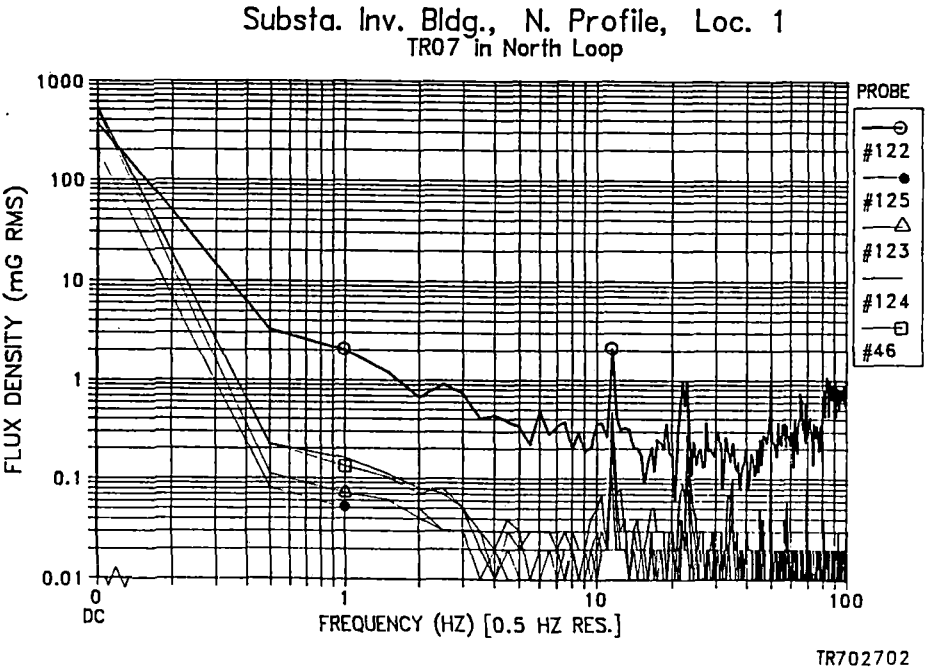

Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in Maintenance Facility
PROBE
#2
#1
#4
#3
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR702701


Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in Maintenance Facility
PROBE
#122
#125
#123
#124
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR702701

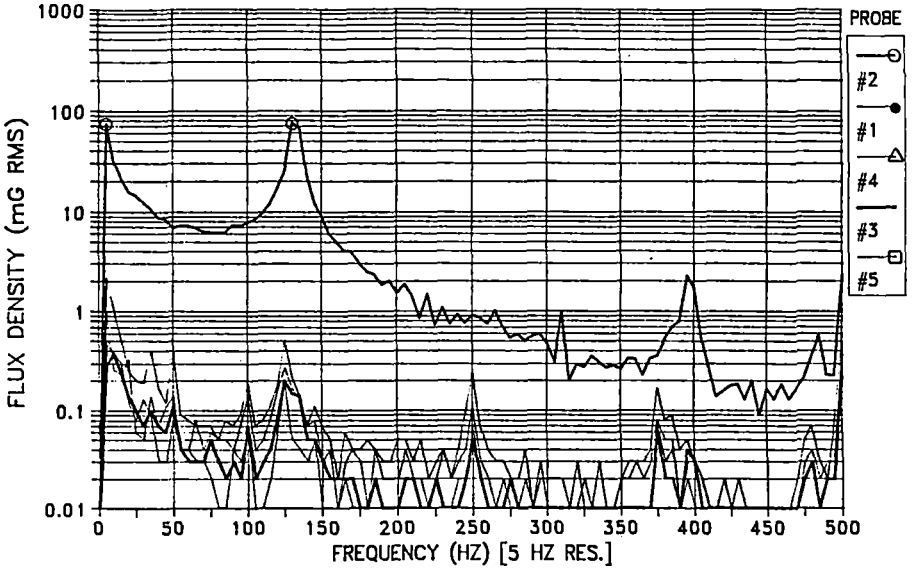

Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in Maintenance Facility
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702701


Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in Maintenance Facility
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702701


Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702702

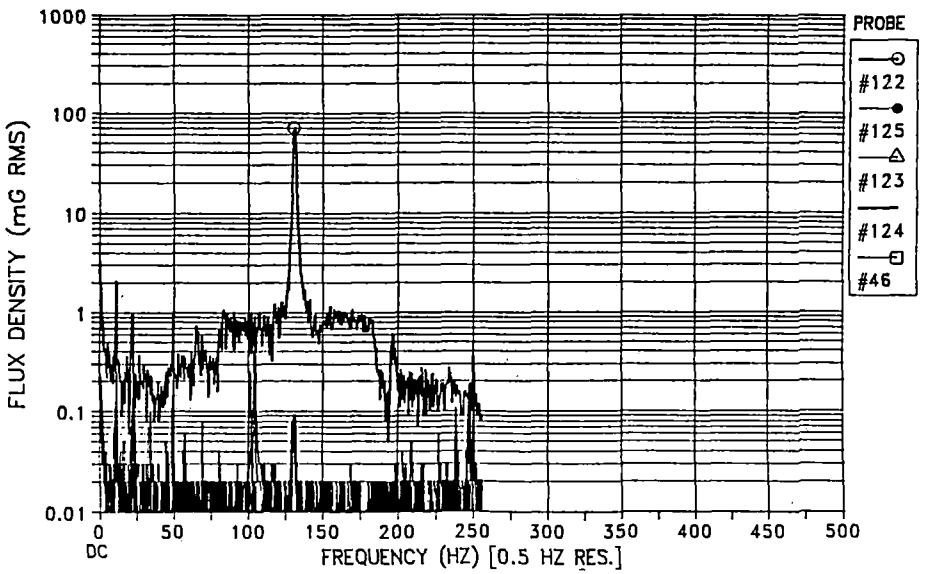

Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702702

Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in North Loop



TR702702

Substa. Inv. Bldg., N. Profile, Loc. 1
TR07 in North Loop



TR702702

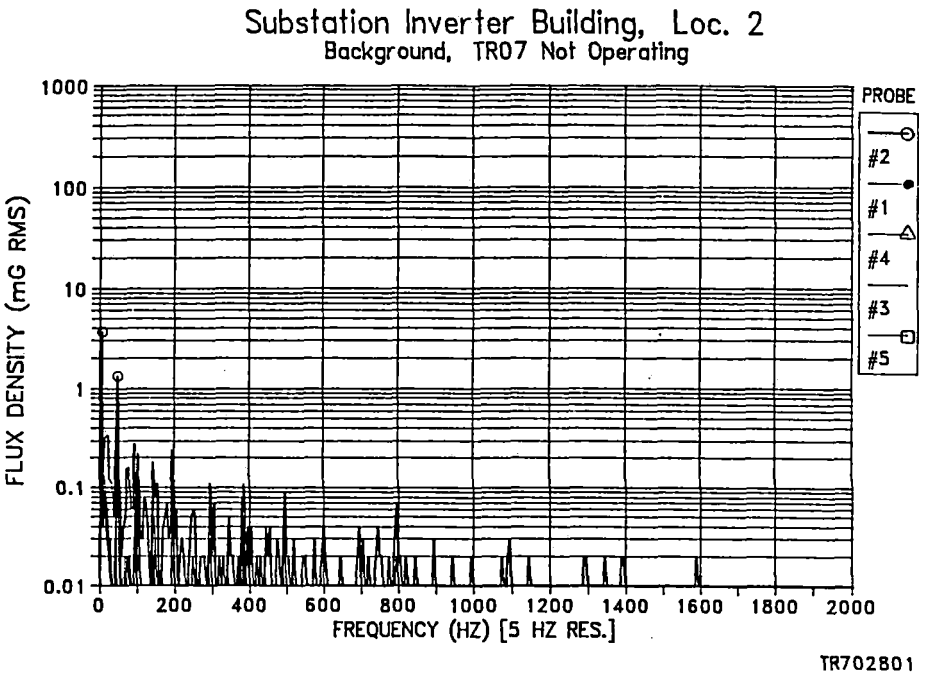
TR7027

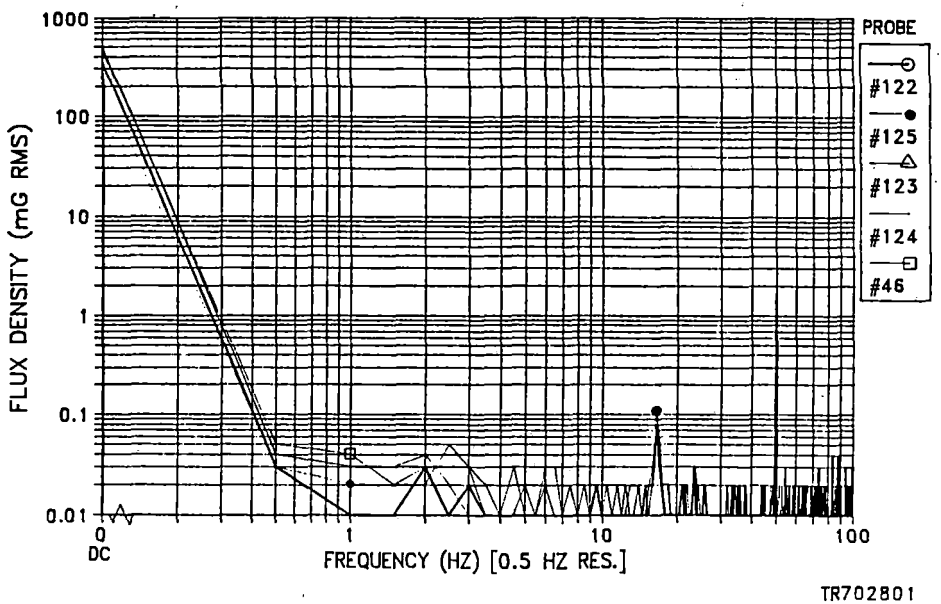
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 027
> Inverter Building measurements
>
>
Start: 08/09/90 (Thursday) AT 18:06:10
End: 08/09/90 (Thursday) AT 18:10:34
Recorded 39 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

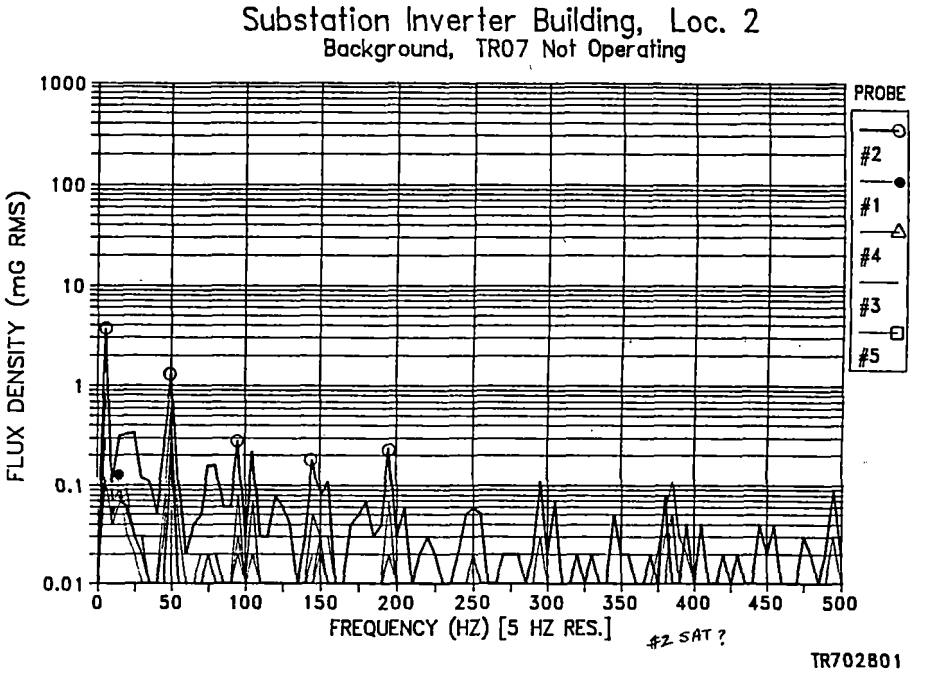
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

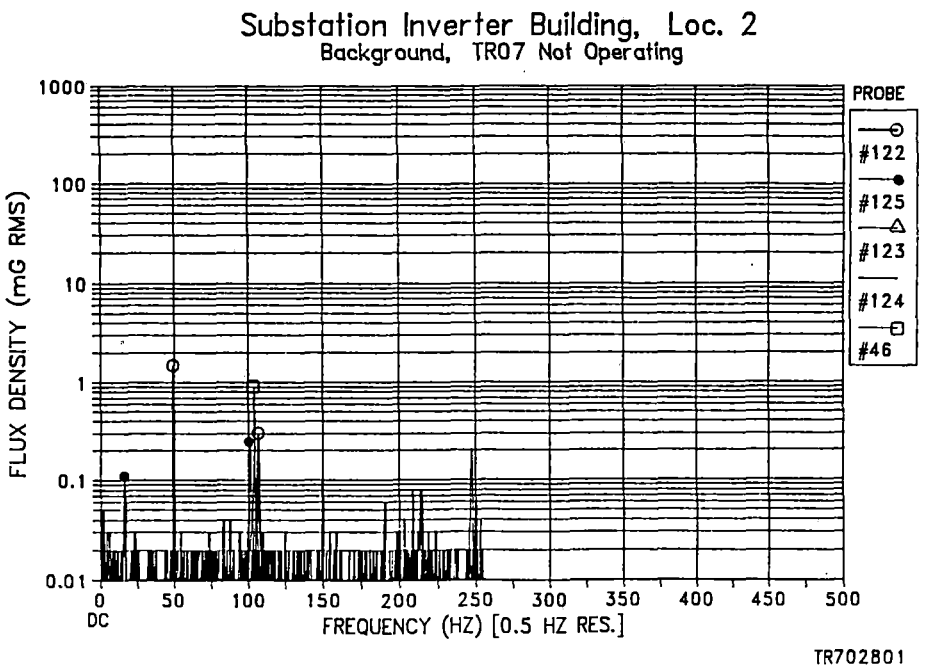
RANGE SETTINGS:

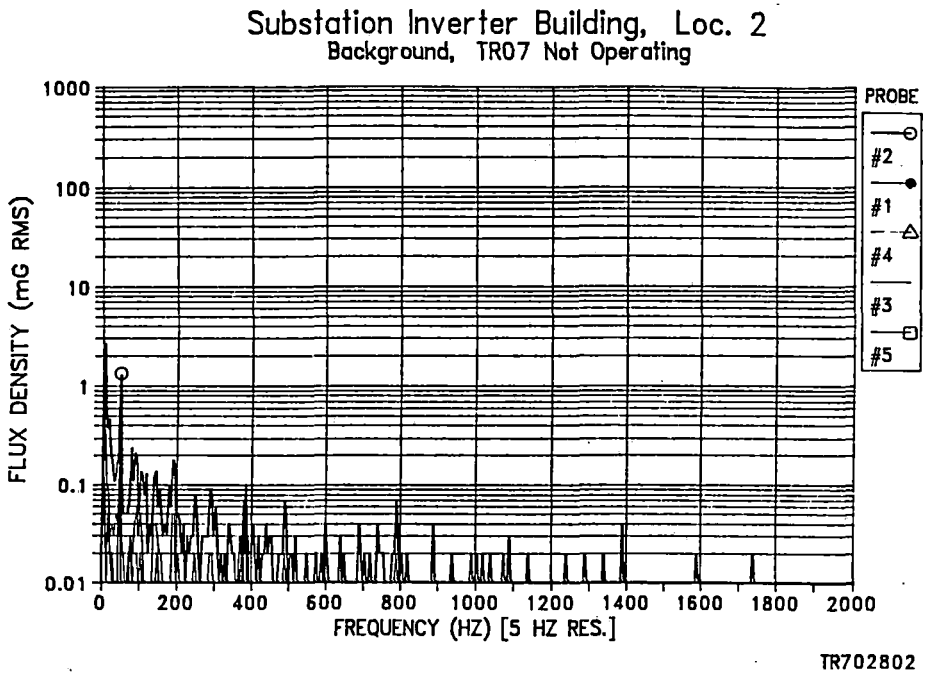
A1 # 1 In profile at building wall
COIL L: 10.0mG
COIL T: 30.0mG
COIL V: 10.0mG
B1 # 2 Center of profiles
COIL L: 1.00mG
COIL T: 1.00mG
COIL V: 1.00mG
C1 # 4 In profile furthest from inverter bldg
COIL L: 0.30mG
COIL T: 0.30mG
COIL V: 0.30mG
D1 # 5 In resist. bank profile furthest from bank
COIL L: 1.00mG
COIL T: 1.00mG
COIL V: 3.00mG
E1 # 3 Resistor bank profile nearest banks
COIL L: 1.00mG
COIL T: 1.00mG
COIL V: 10.0mG
A2 #125 In profile at building wall
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG
B2 #122 Center of profiles
DC - A: 300mG
DC - B: 300mG
DC - C: 1000mG
C2 #123 In profile furthest from inverter bldg
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG
D2 # 46 Resistor bank profile furthest from bank
DC - A: 100mG
DC - B: 1000mG
DC - C: 1000mG
E2 #124 Resistor bank profile nearest banks
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

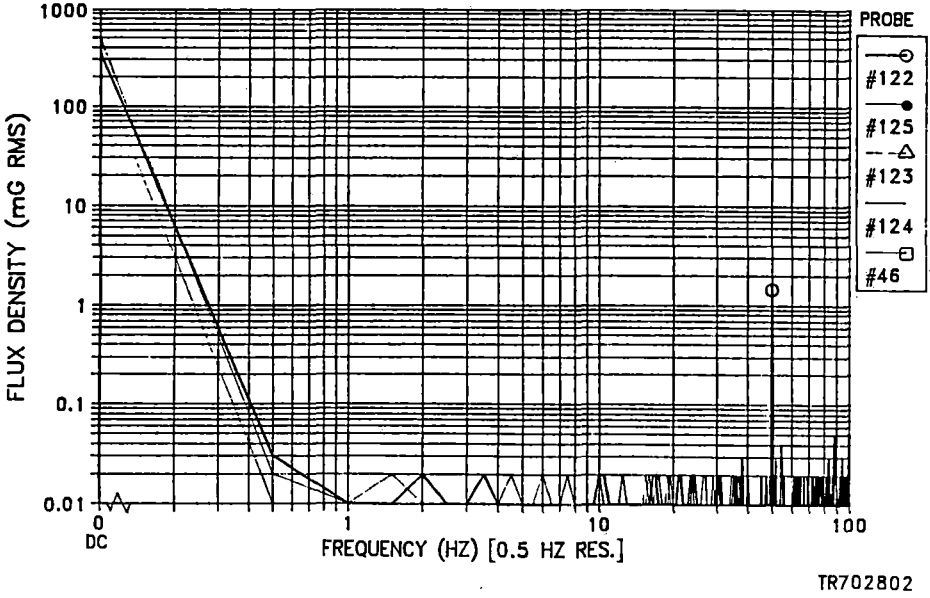

Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702801

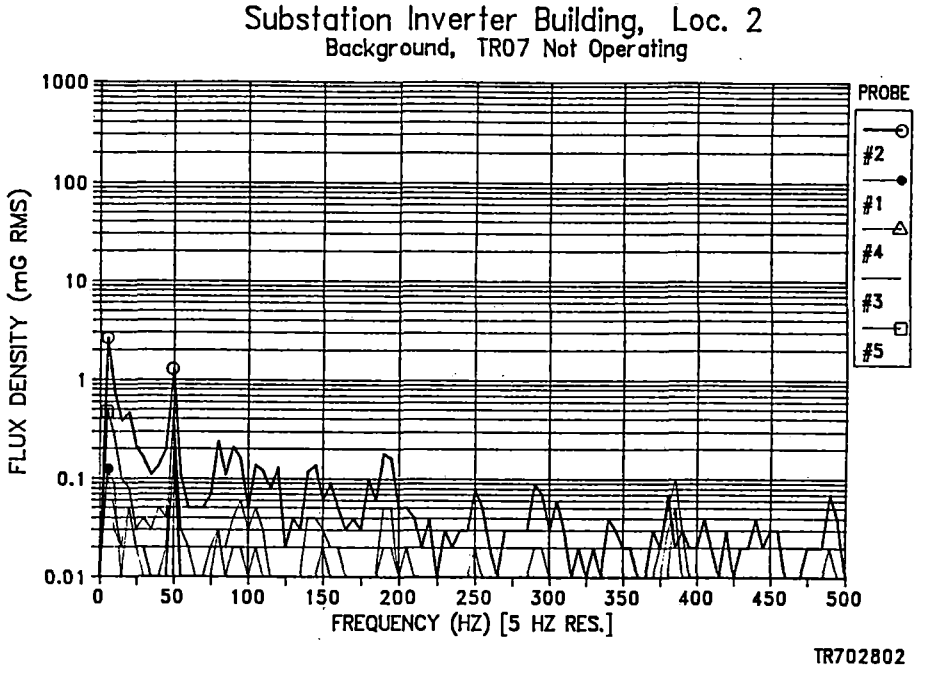

Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702801

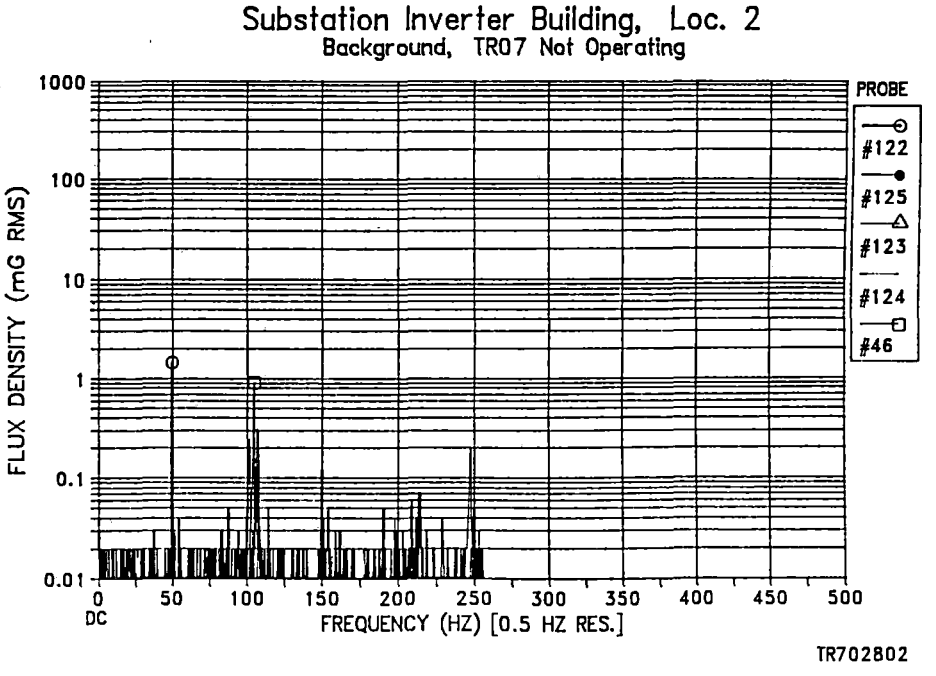

Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
#2 SAT ?
PROBE
#2
#1
#4
#3
#5
TR702801


Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702801


Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702802


Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702802


Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR702802


Substation Inverter Building, Loc. 2
Background, TR07 Not Operating
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR702802

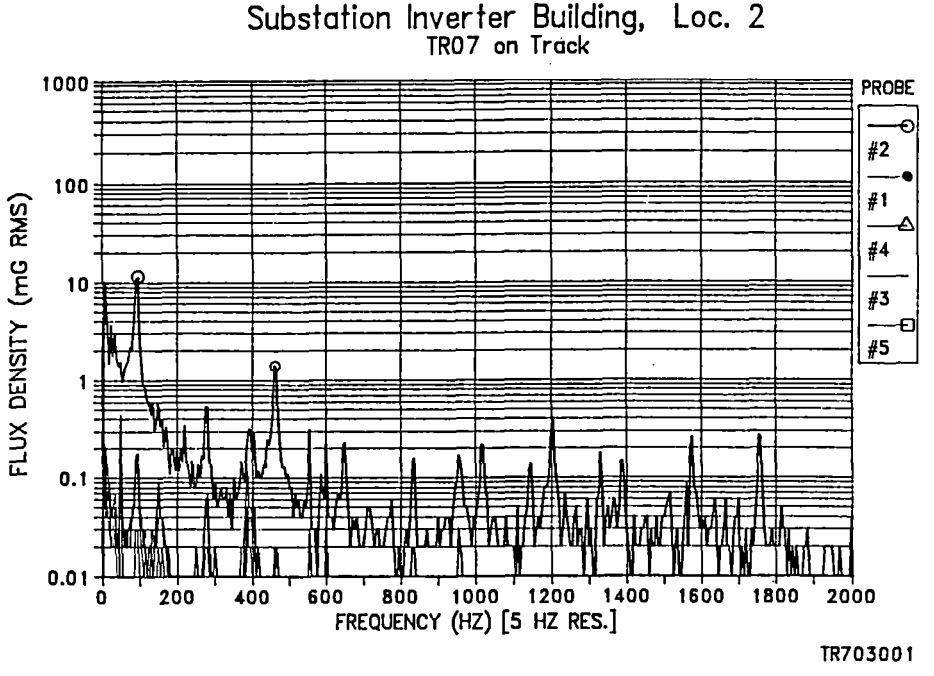
TR7028

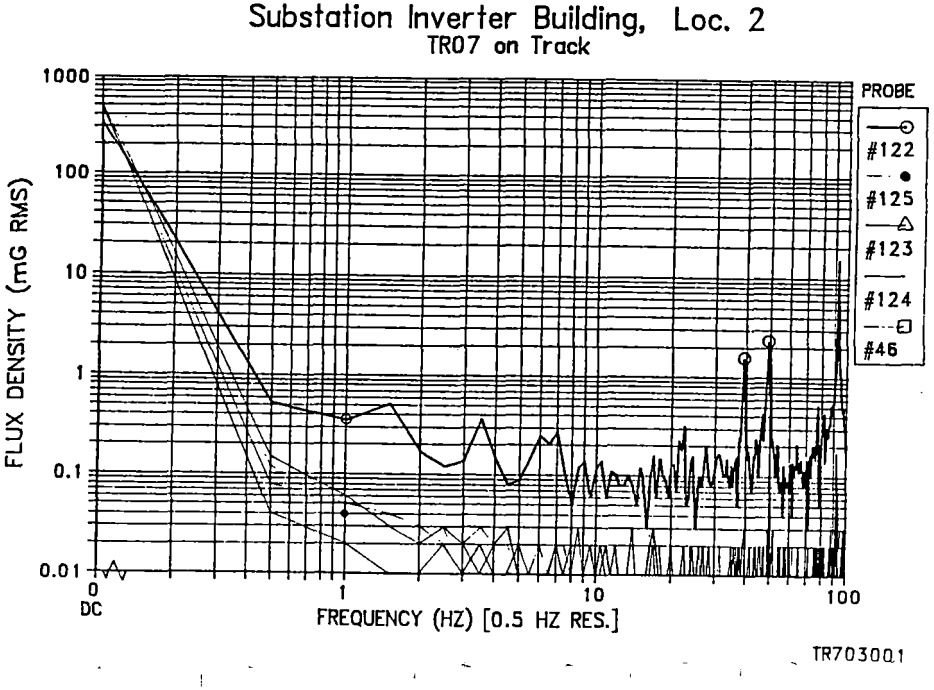
Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 028
> Inverter Building measurements
> background
> Second profile location - moved 4m
Start: 08/10/90 (Friday) AT 10:05:30
End: 08/10/90 (Friday) AT 10:05:58
Recorded 6 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

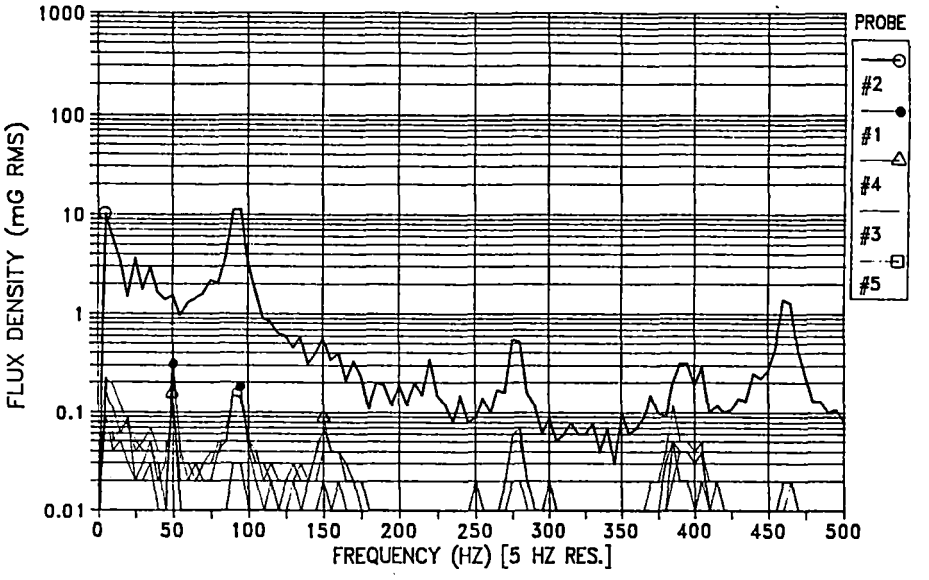
A1 # 1 In profile at building wall
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 2 Center of profiles
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 4 In profile furthest from inverter bldg
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 5 In resist. bank profile furthest from bank
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 3 Resistor bank profile nearest banks
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #125 In profile at building wall
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG
B2 #122 Center of profiles
DC - A: 300mG
DC - B: 300mG
DC - C: 1000mG
C2 #123 In profile furthest from inverter bldg
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG
D2 # 46 Resistor bank profile furthest from bank
DC - A: 100mG
DC - B: 1000mG
DC - C: 1000mG
E2 #124 Resistor bank profile nearest banks
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG


Substation Inverter Building, Loc. 2
TR07 on Track
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703001


Substation Inverter Building, Loc. 2
TR07 on Track
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703001

Substation Inverter Building, Loc. 2

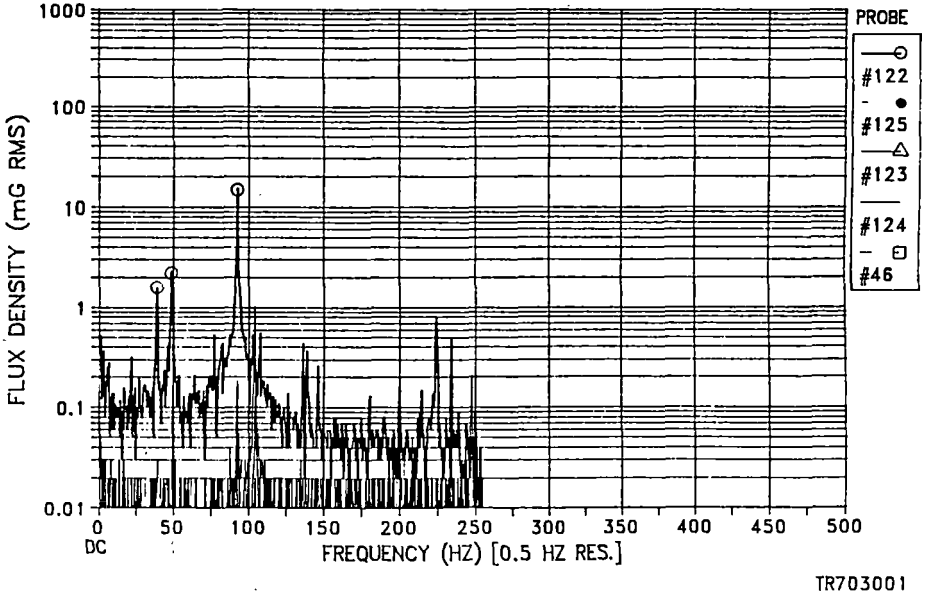
TR07 on Track



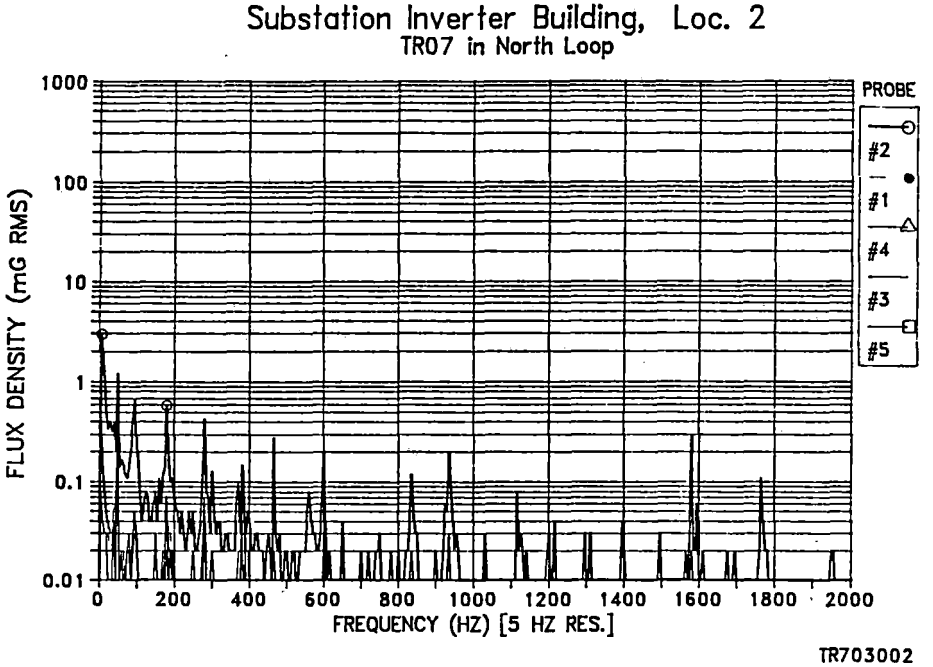
TR703001

Substation Inverter Building, Loc. 2

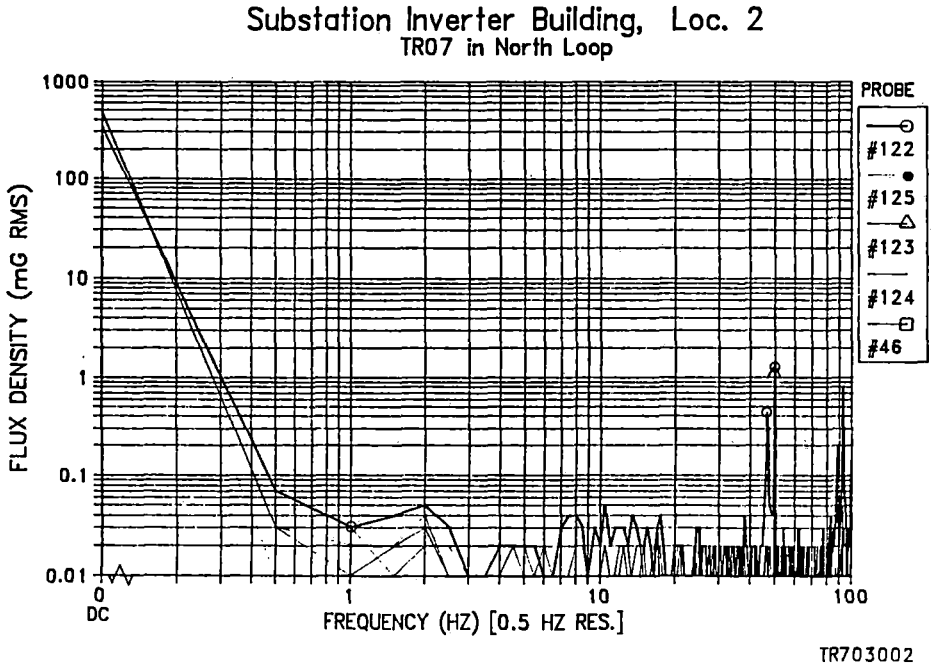
TR07 on Track



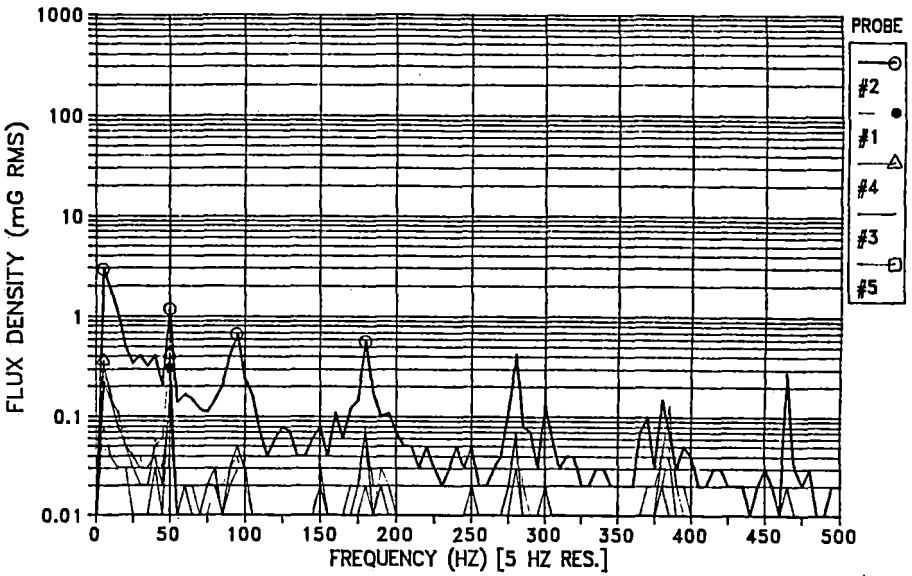
TR703001


Substation Inverter Building, Loc. 2
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703002

6-I

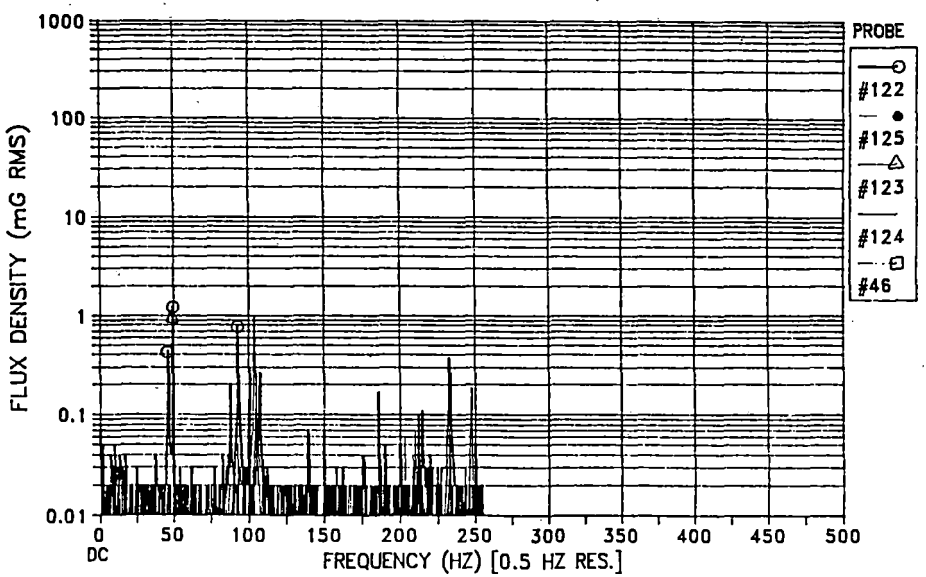

Substation Inverter Building, Loc. 2
TR07 in North Loop
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703002

Substation Inverter Building, Loc. 2
TR07 in North Loop



TR703002

Substation Inverter Building, Loc. 2
TR07 in North Loop



TR703002

TR7030

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 030
> Inverter Building measurements
> Train leaving facility and on track
> Second profile location - moved 4m
Start: 08/10/90 (Friday) AT 12:07:30
End: 08/10/90 (Friday) AT 12:27:38
Recorded 219 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

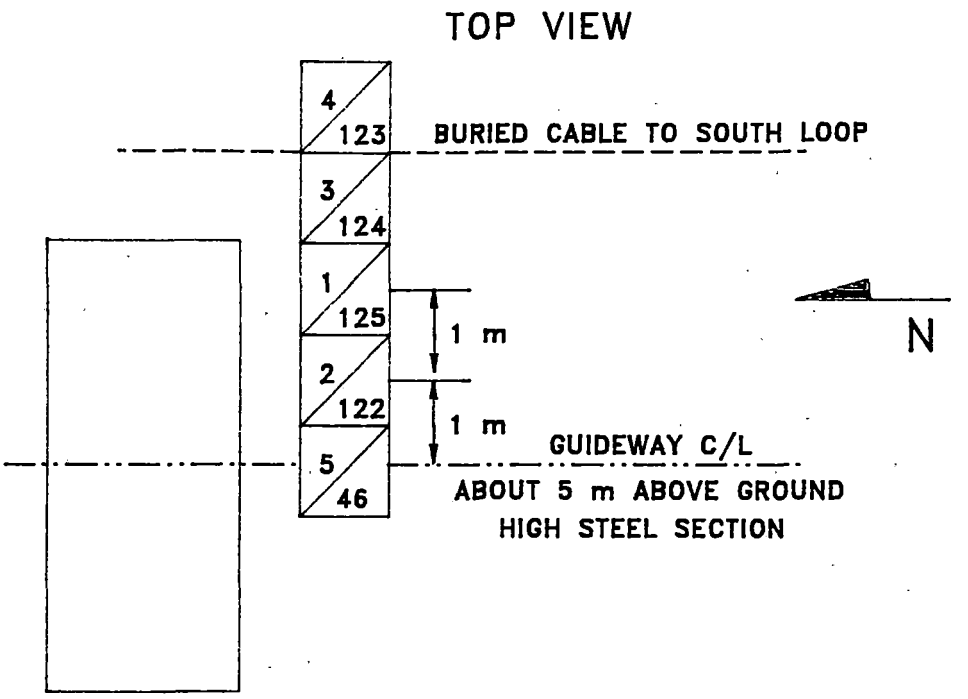
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

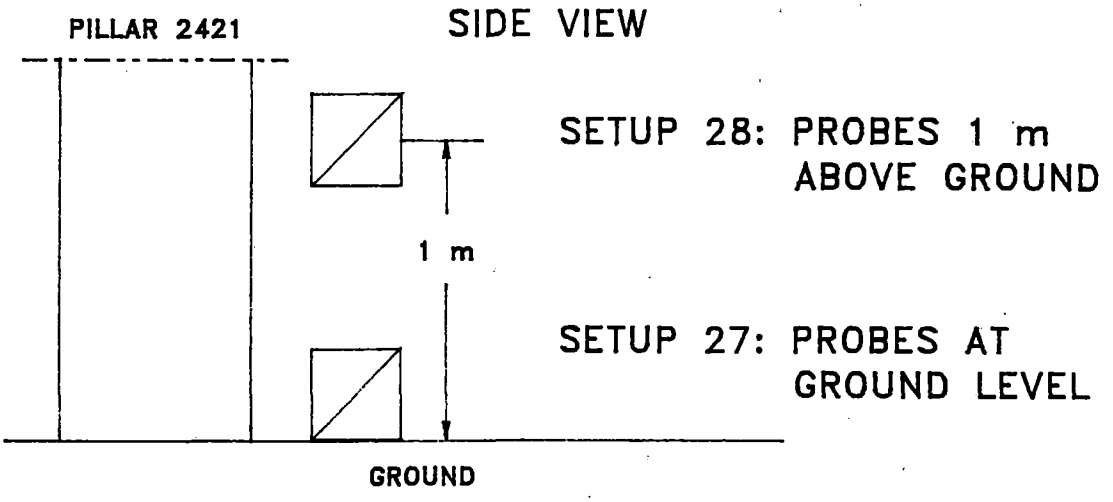
RANGE SETTINGS:

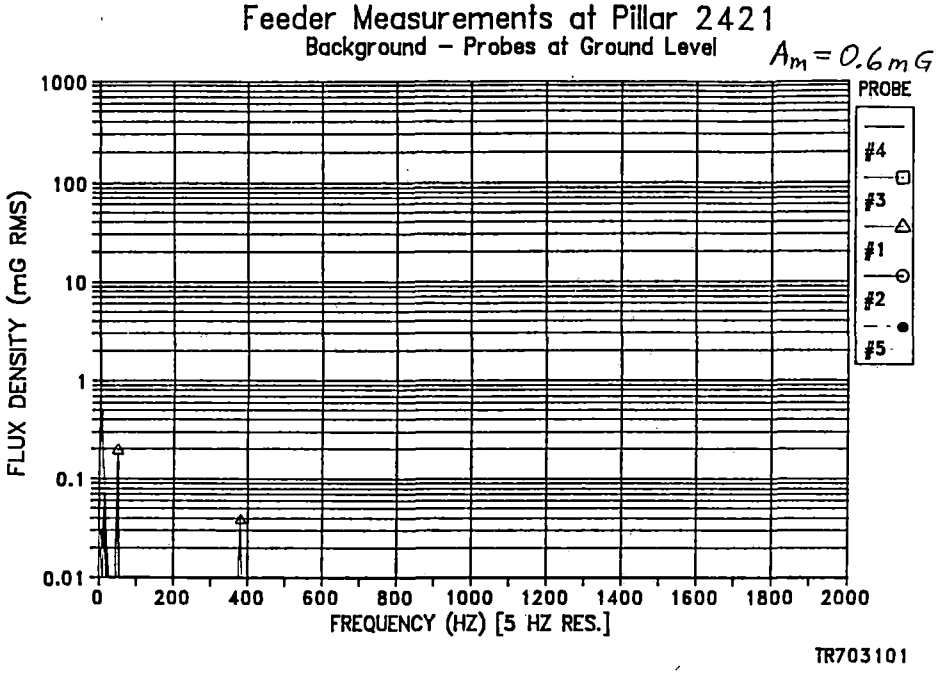
A1 # 1 In profile at building wall
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
B1 # 2 Center of profiles
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
C1 # 4 In profile furthest from inverter bldg
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
D1 # 5 In resist. bank profile furthest from bank
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
E1 # 3 Resistor bank profile nearest banks
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG
A2 #125 In profile at building wall
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG
B2 #122 Center of profiles
DC - A: 300mG
DC - B: 300mG
DC - C: 1000mG
C2 #123 In profile furthest from inverter bldg
DC - A: 300mG
DC - B: 1000mG
DC - C: 1000mG
D2 # 46 Resistor bank profile furthest from bank
DC - A: 100mG
DC - B: 1000mG
DC - C: 1000mG
E2 #124 Resistor bank profile nearest banks
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

APPENDIX J

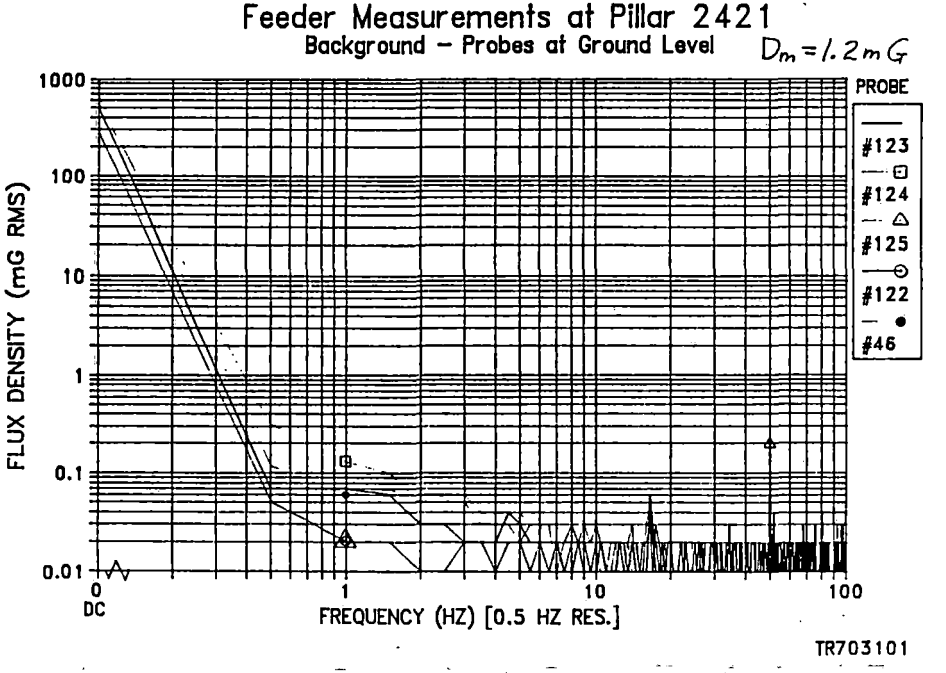
SETUP 27 AND 28: FEEDER CABLE





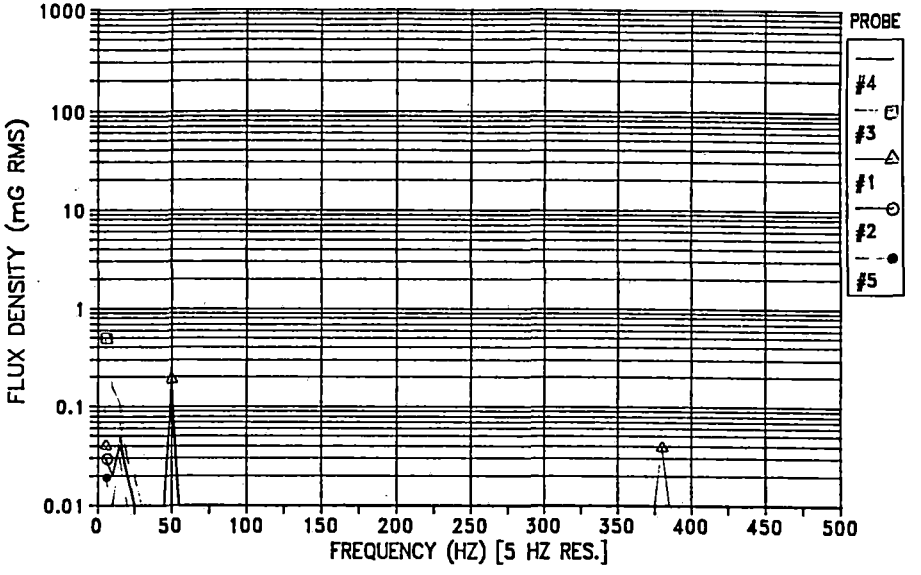

Feeder Measurements at Pillar 2421
Background – Probes at Ground Level
$A_m = 0.6mG$
PROBE
#4
#3
#1
#2
#5
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
TR703101

J-2


Feeder Measurements at Pillar 2421
Background – Probes at Ground Level
$D_m = 1.2mG$
PROBE
#123
#124
#125
#122
#46
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
TR703101

Feeder Measurements at Pillar 2421

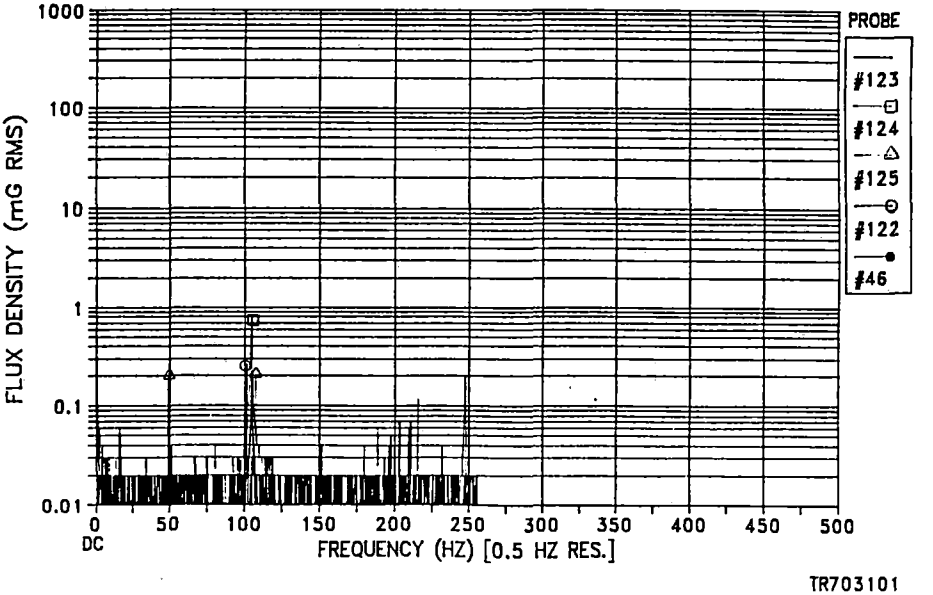
Background – Probes at Ground Level



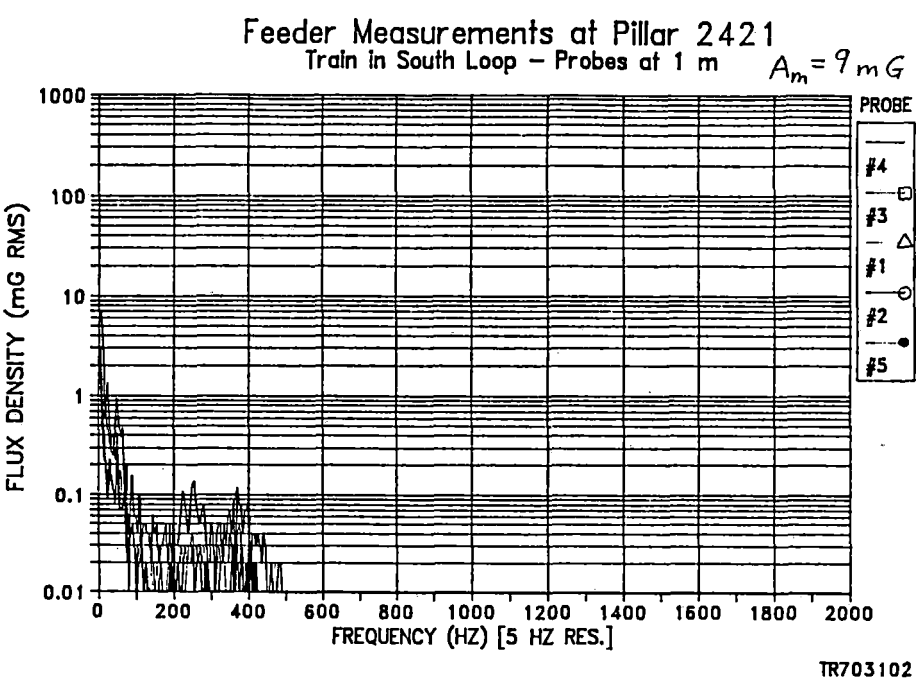
TR703101

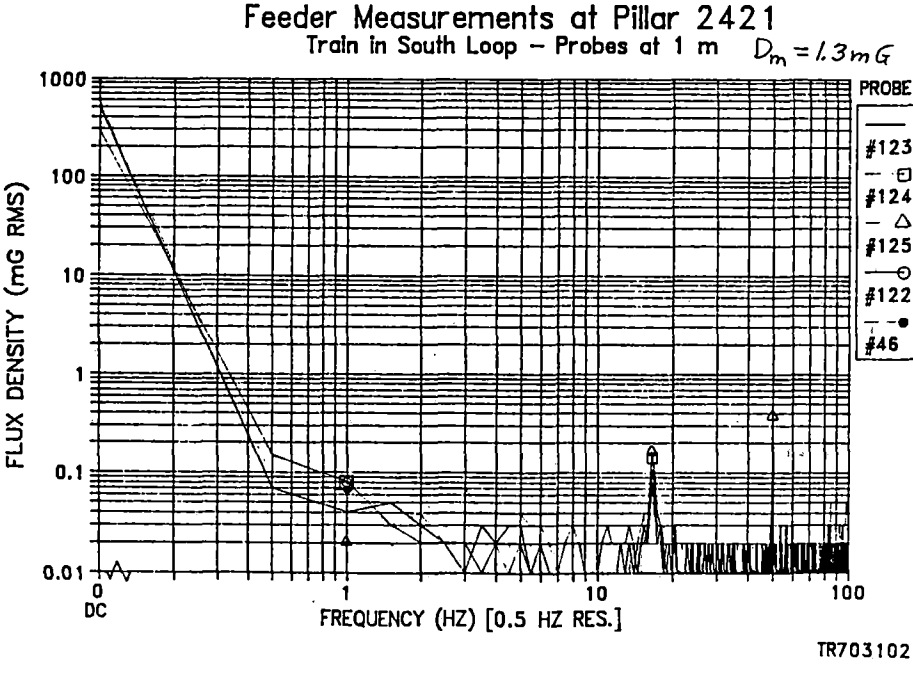
Feeder Measurements at Pillar 2421

Background – Probes at Ground Level



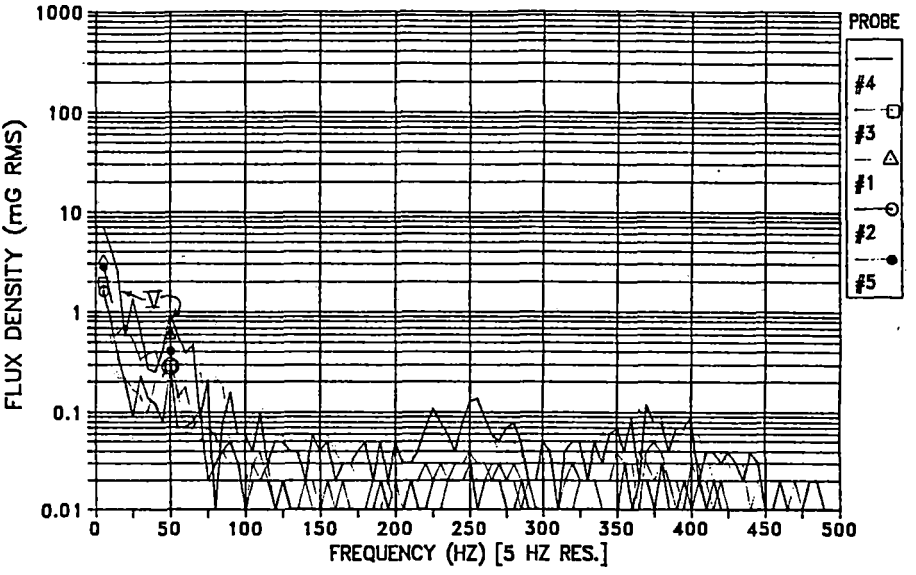
TR703101


Feeder Measurements at Pillar 2421
Train in South Loop – Probes at 1 m
$A_m = 9\,mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#4
#3
#1
#2
#5
TR703102


Feeder Measurements at Pillar 2421
Train in South Loop – Probes at 1 m
$D_m = 1.3\,mG$
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#123
#124
#125
#122
#46
TR703102

Feeder Measurements at Pillar 2421

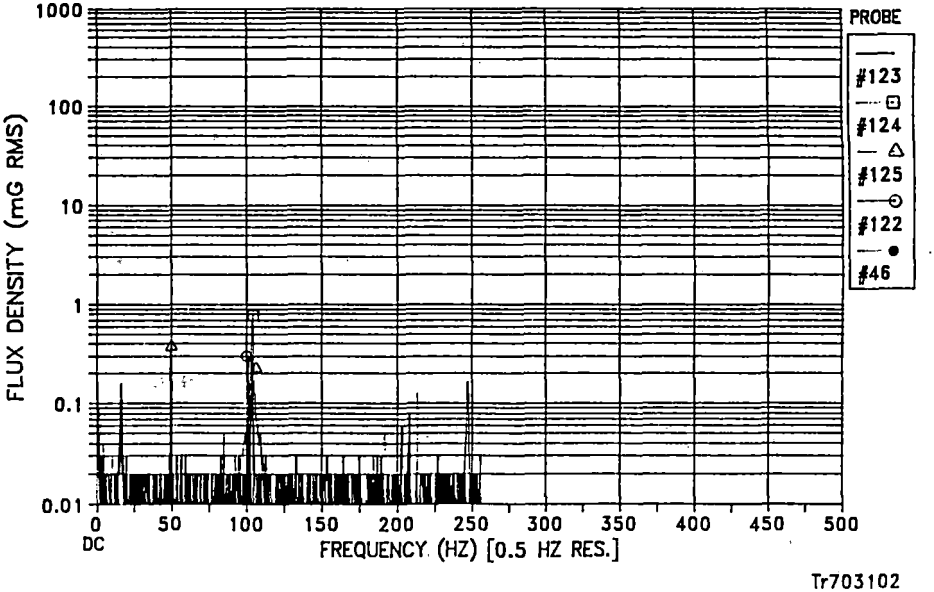
Train in South Loop – Probes at 1 m



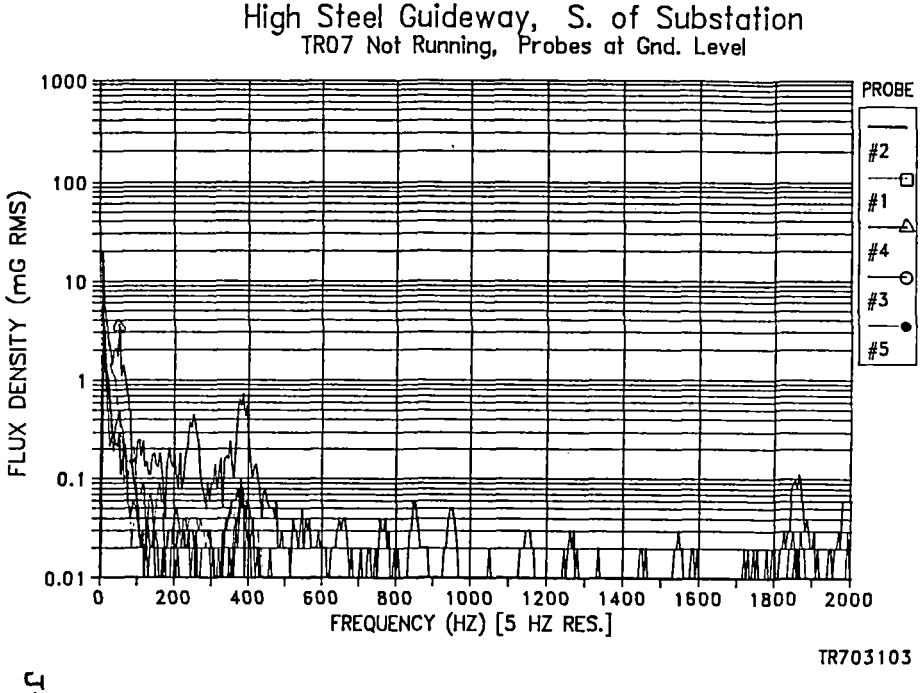
TR703102

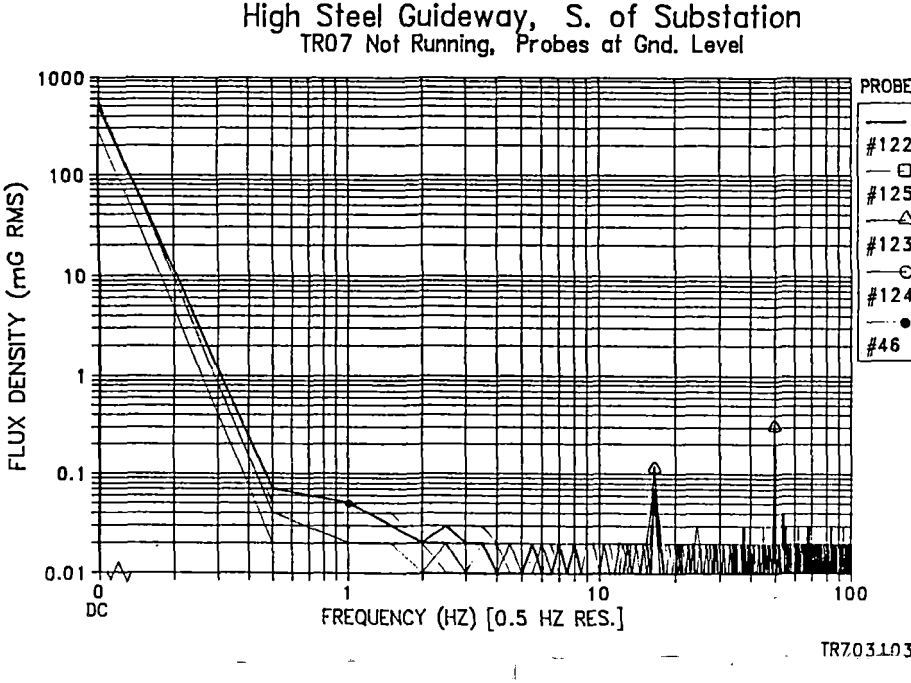
Feeder Measurements at Pillar 2421

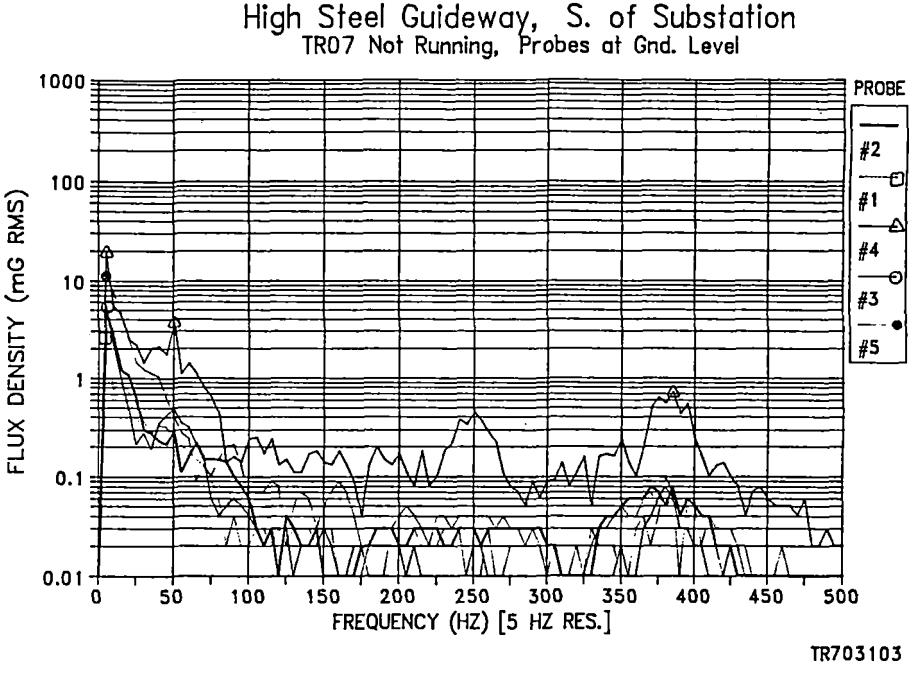
Train in South Loop – Probes at 1 m

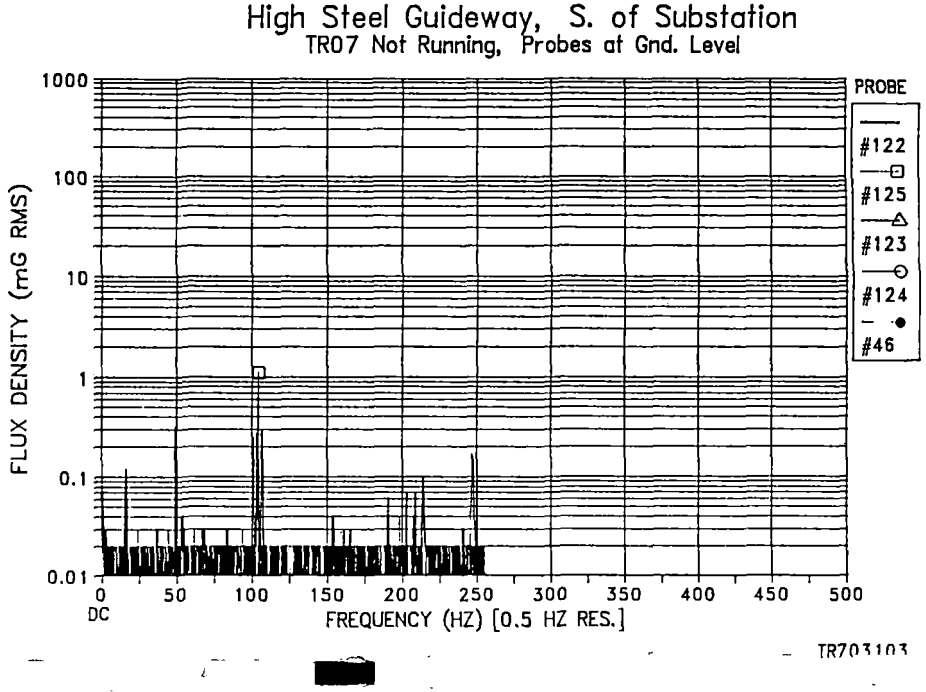


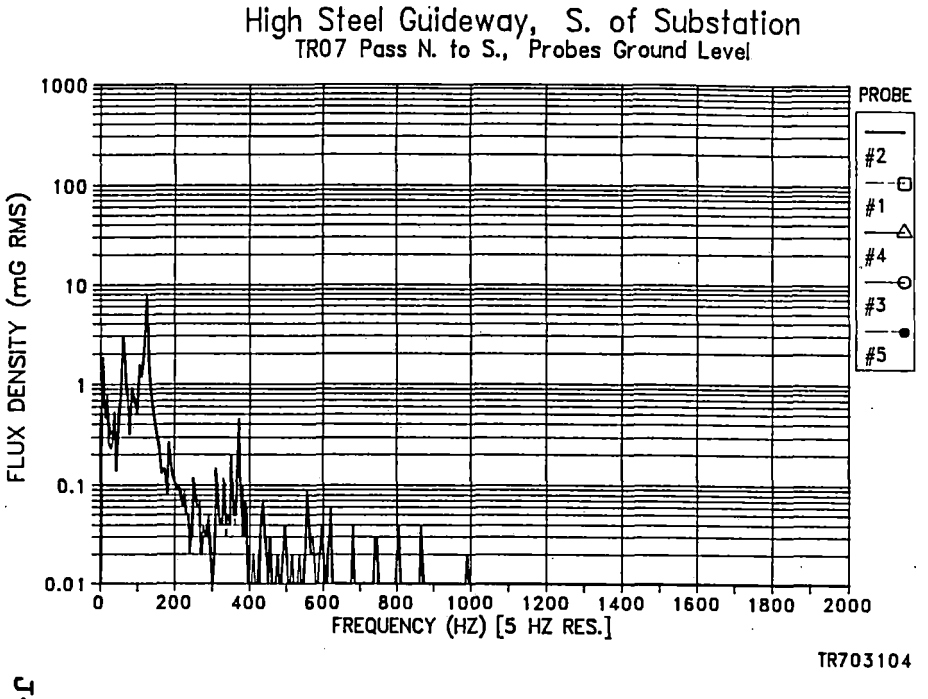
Tr703102


High Steel Guideway, S. of Substation
TR07 Not Running, Probes at Gnd. Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703103

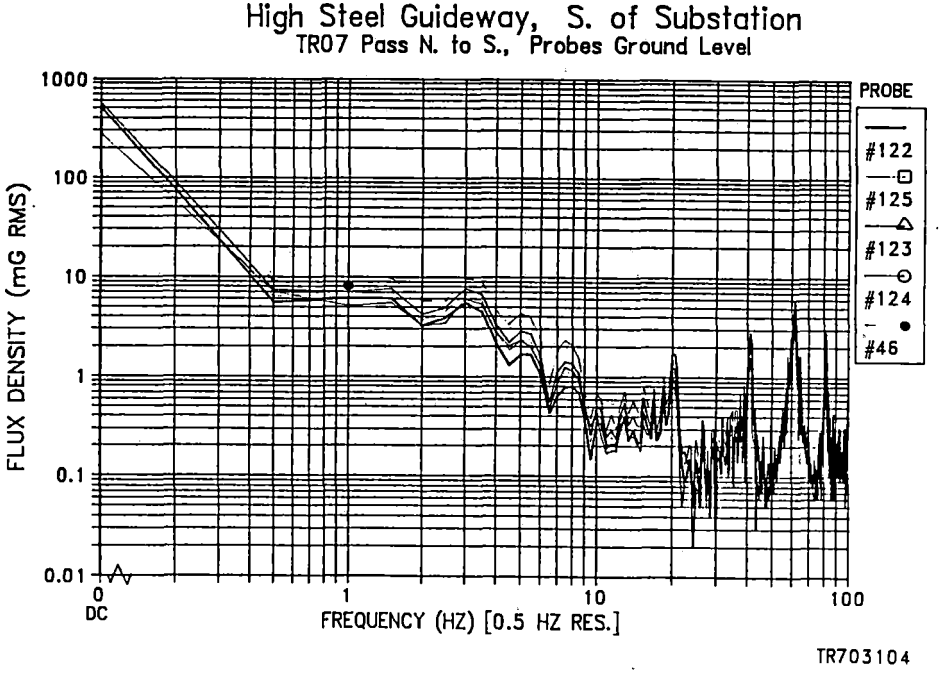

High Steel Guideway, S. of Substation
TR07 Not Running, Probes at Gnd. Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703103

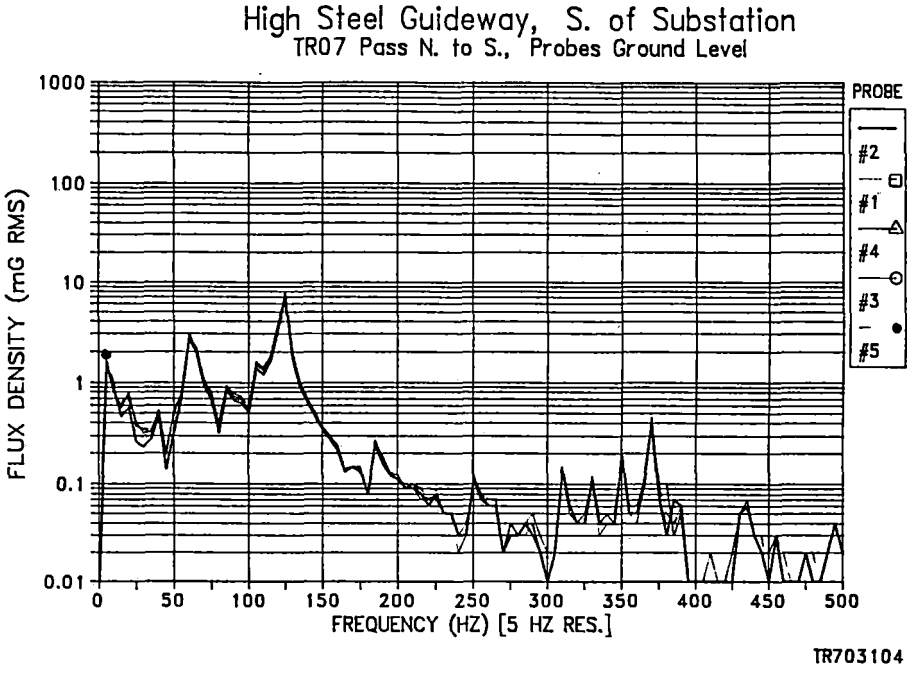

High Steel Guideway, S. of Substation
TR07 Not Running, Probes at Gnd. Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703103

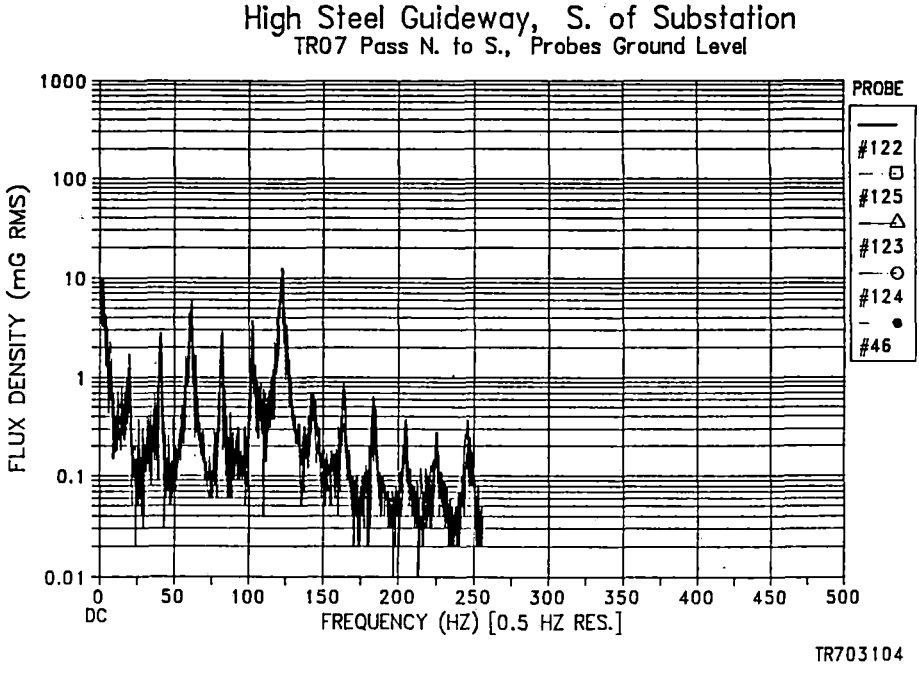

High Steel Guideway, S. of Substation
TR07 Not Running, Probes at Gnd. Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703103

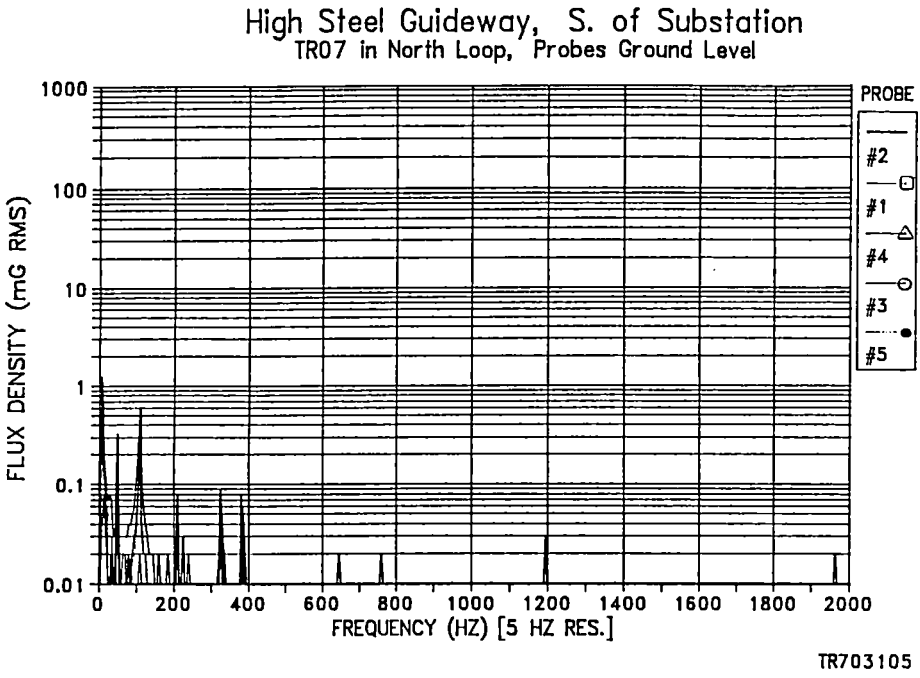

High Steel Guideway, S. of Substation
TR07 Pass N. to S., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703104

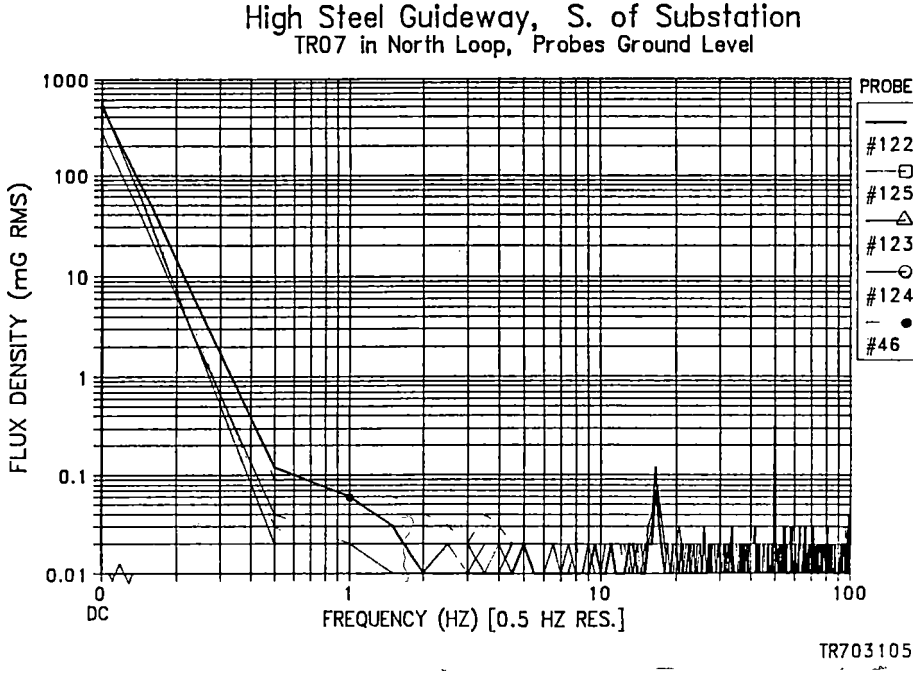
J-5


High Steel Guideway, S. of Substation
TR07 Pass N. to S., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703104


High Steel Guideway, S. of Substation
TR07 Pass N. to S., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703104

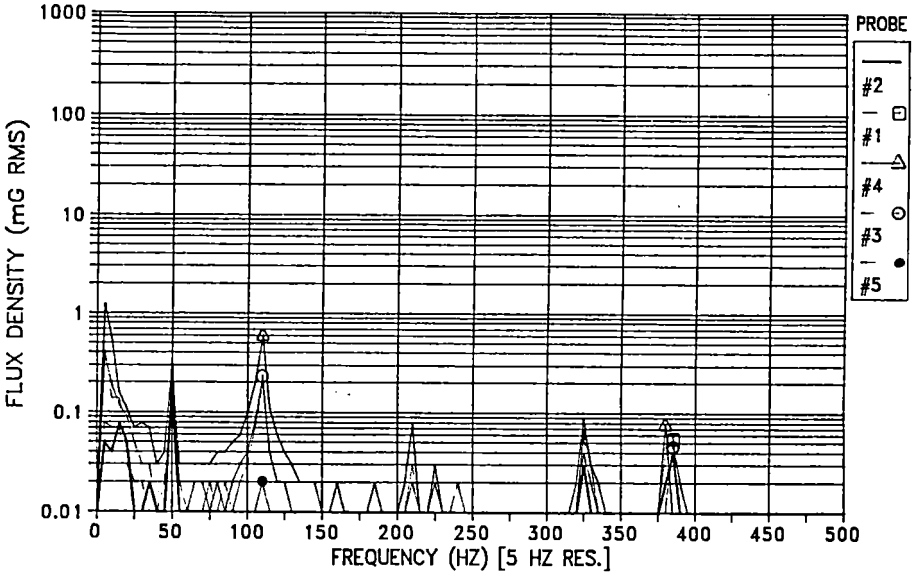

High Steel Guideway, S. of Substation
TR07 Pass N. to S., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703104


High Steel Guideway, S. of Substation
TR07 in North Loop, Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703105


High Steel Guideway, S. of Substation
TR07 in North Loop, Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703105

High Steel Guideway, S. of Substation

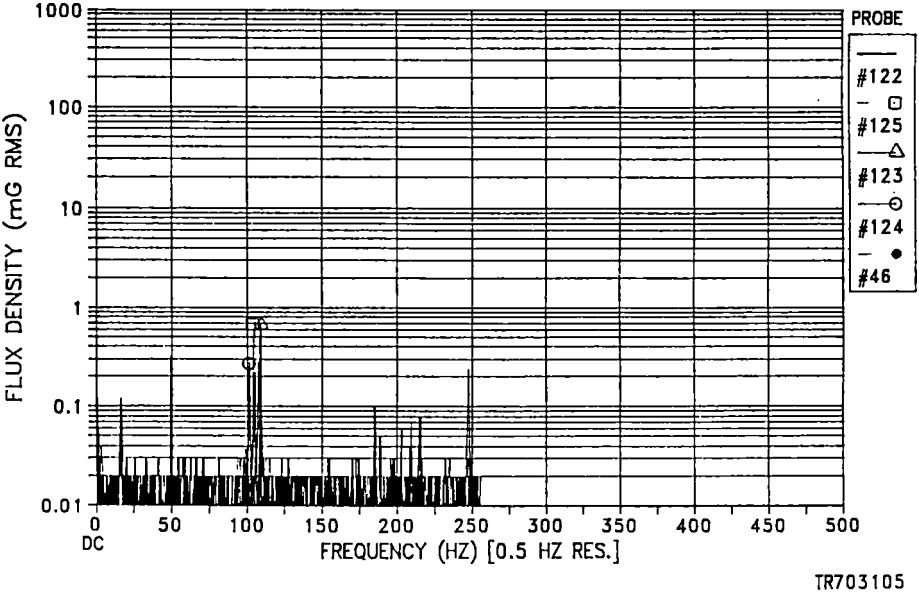
TR07 in North Loop, Probes Ground Level



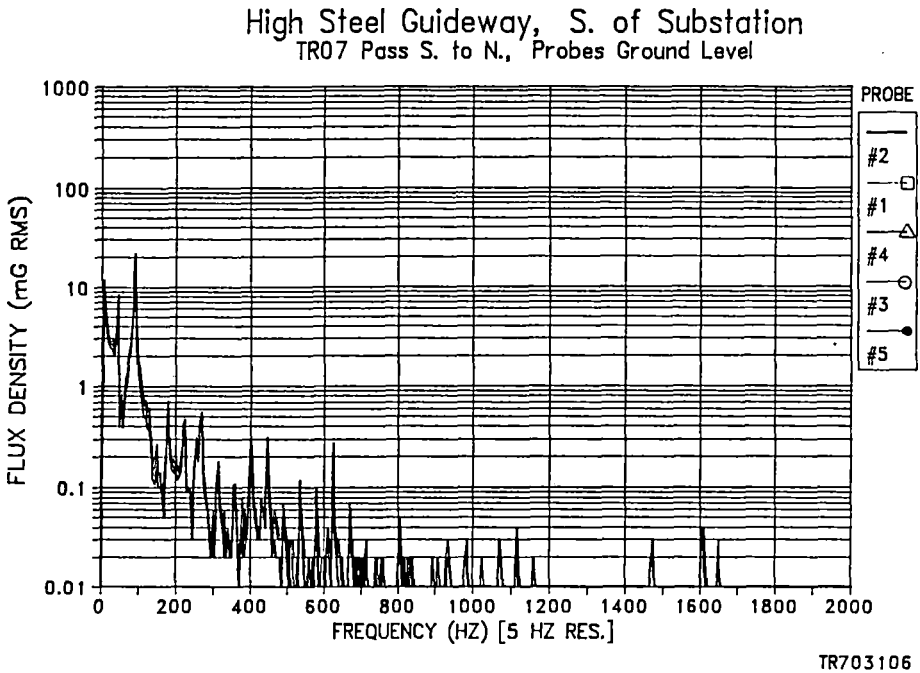
TR703105

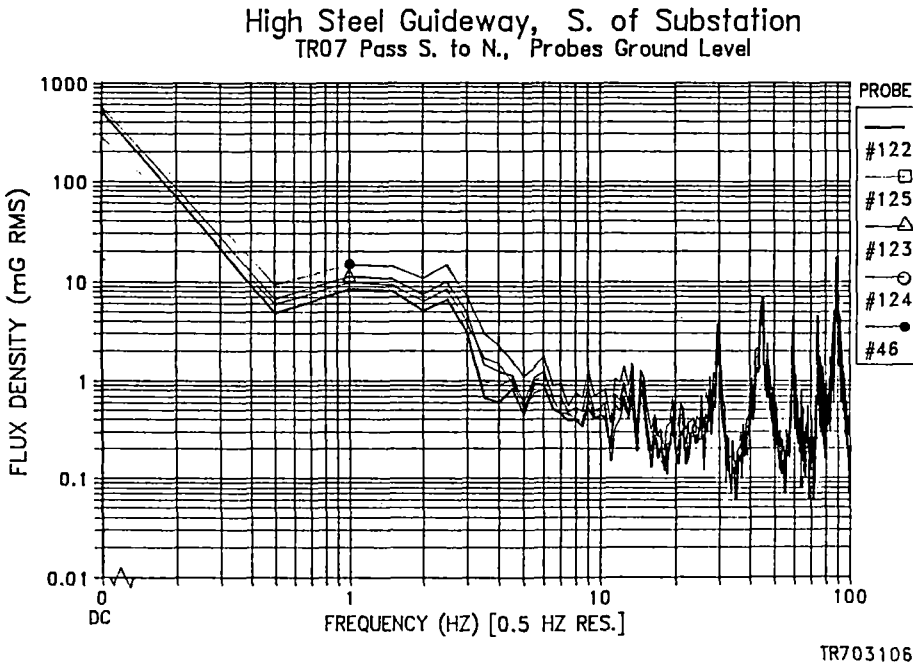
High Steel Guideway, S. of Substation

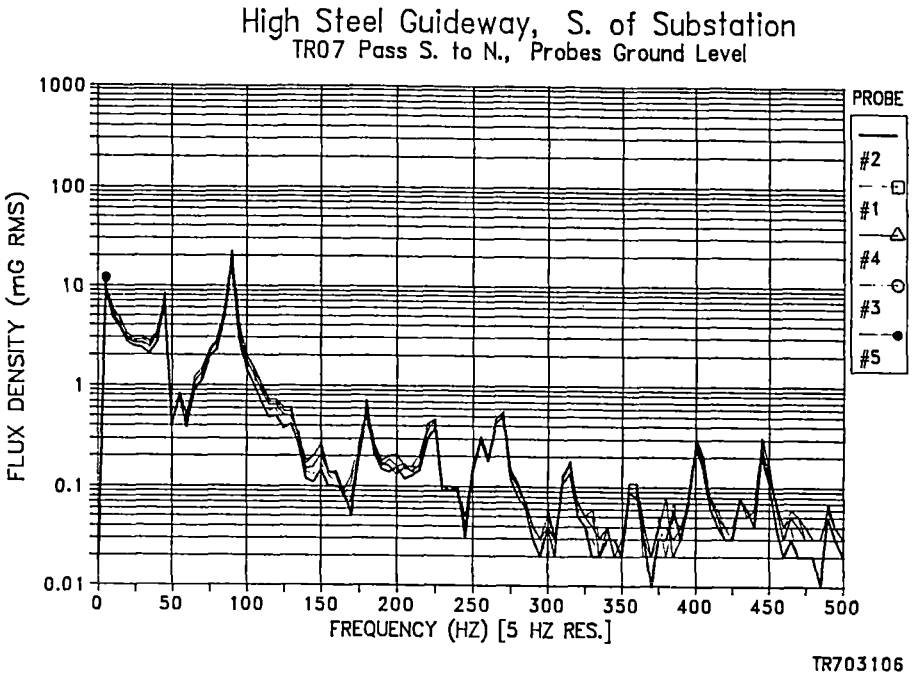
TR07 in North Loop, Probes Ground Level

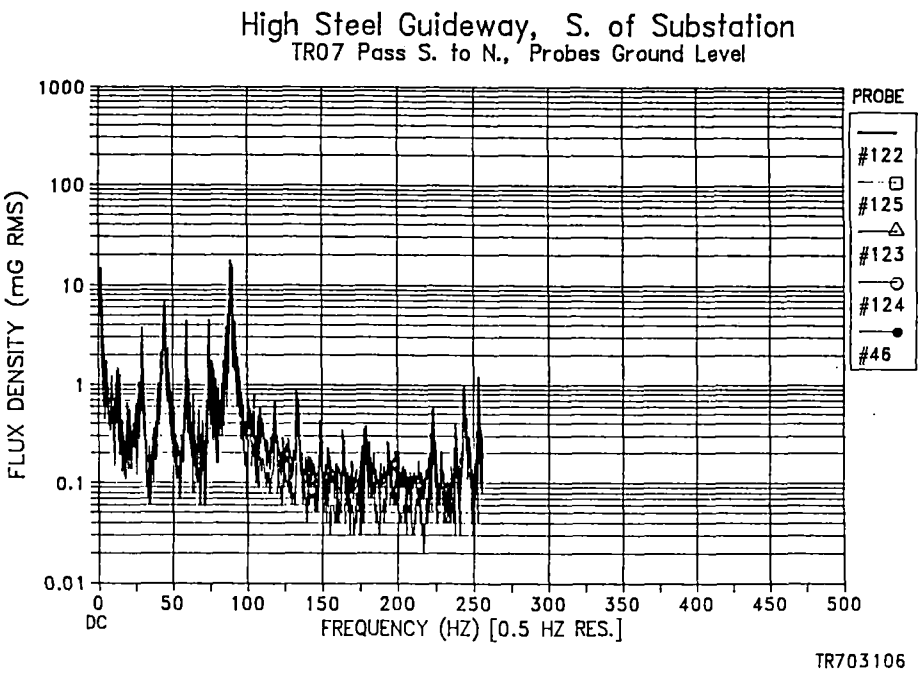


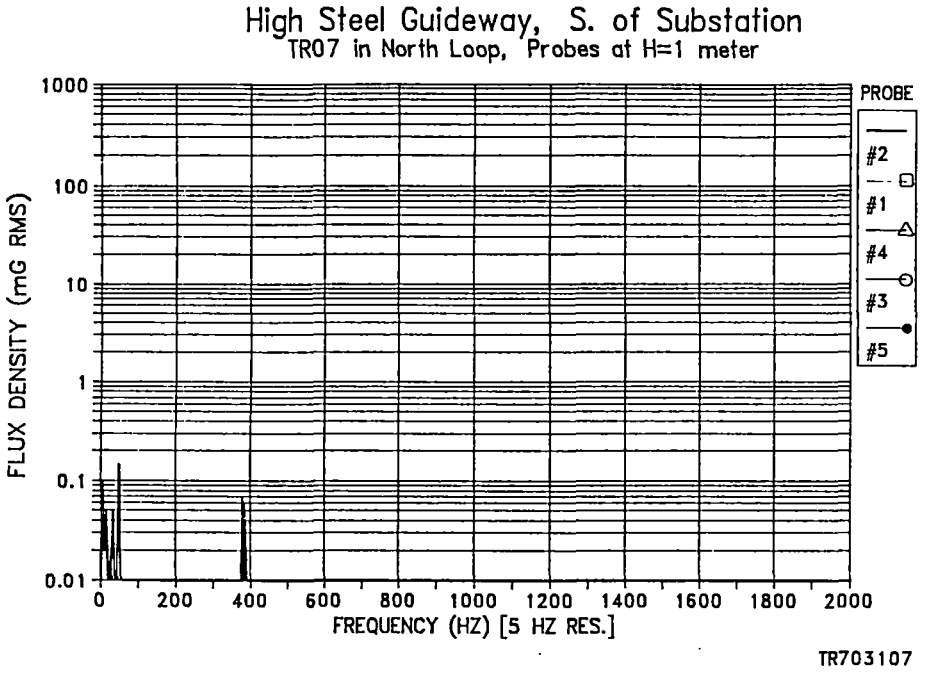
TR703105

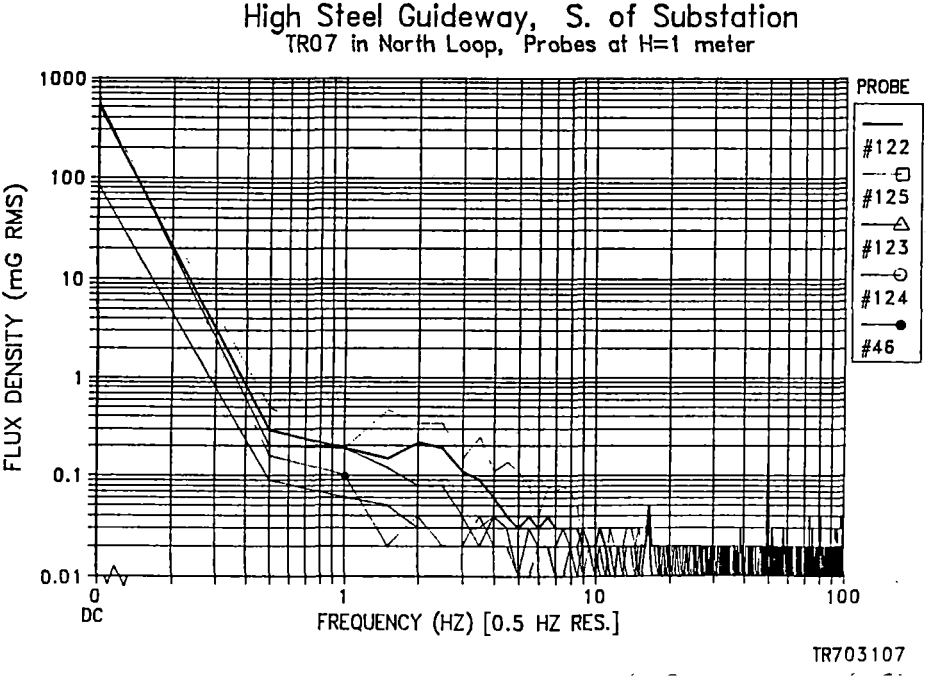

High Steel Guideway, S. of Substation
TR07 Pass S. to N., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703106

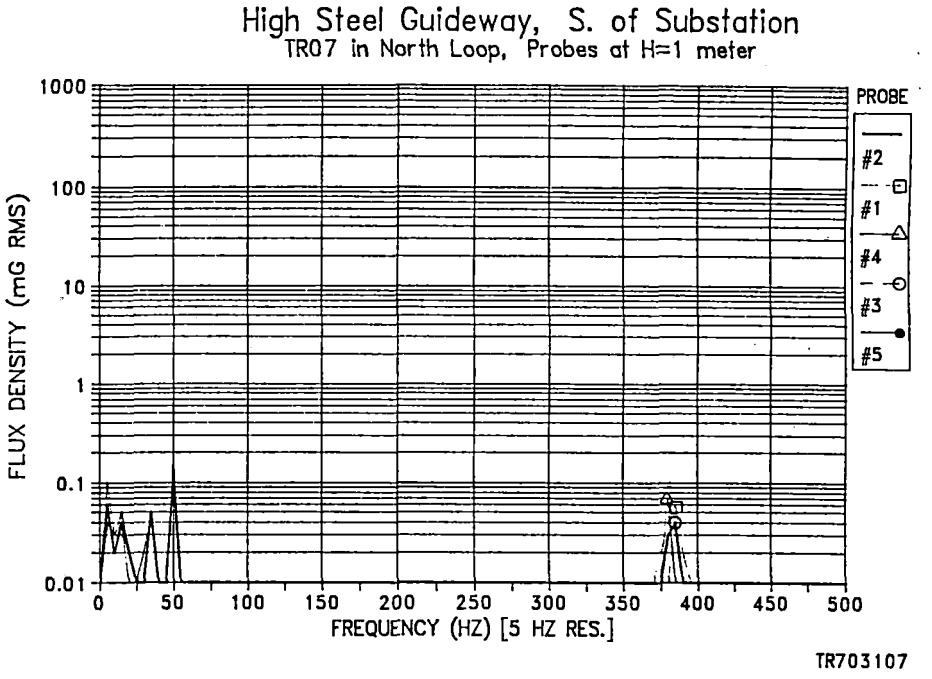

High Steel Guideway, S. of Substation
TR07 Pass S. to N., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703106

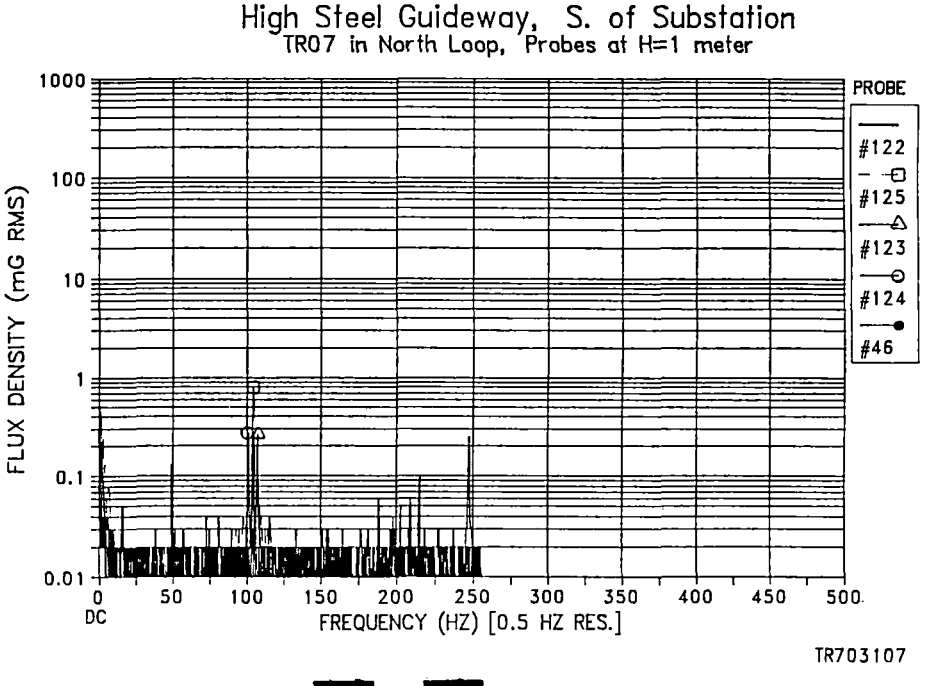

High Steel Guideway, S. of Substation
TR07 Pass S. to N., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703106

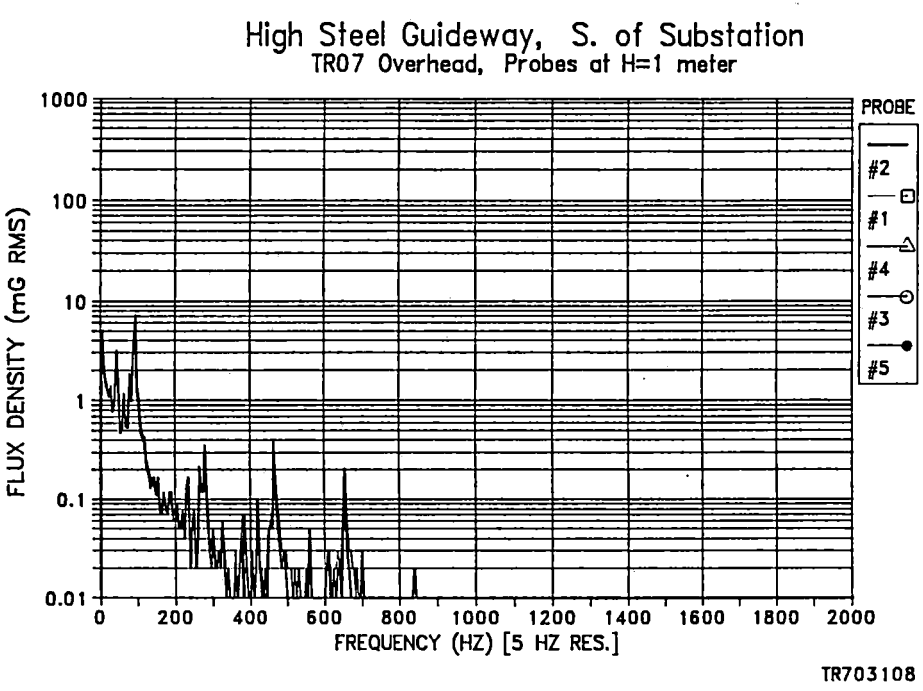

High Steel Guideway, S. of Substation
TR07 Pass S. to N., Probes Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703106

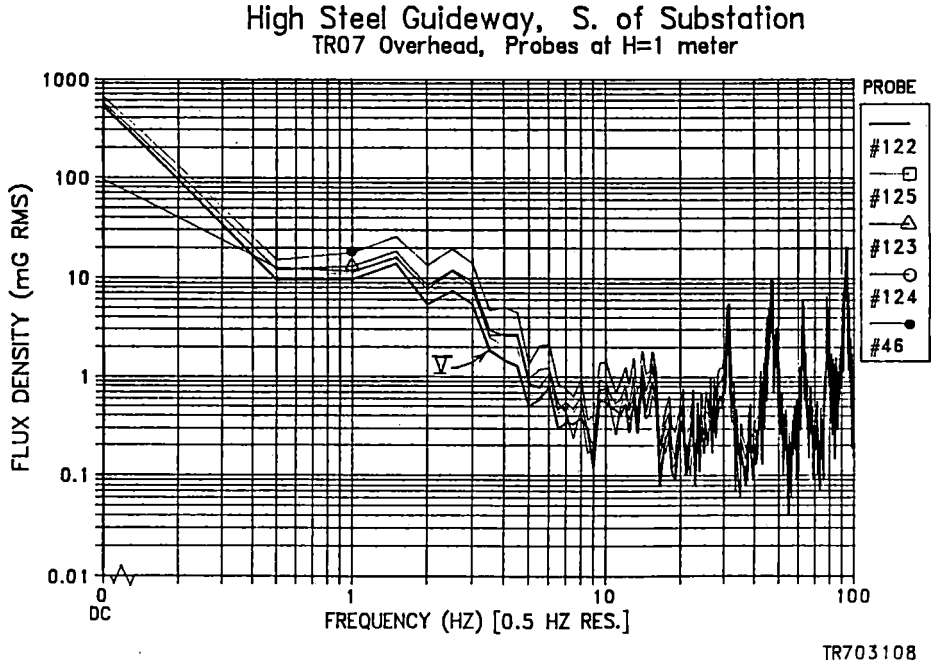

High Steel Guideway, S. of Substation
TR07 in North Loop, Probes at H=1 meter
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703107


High Steel Guideway, S. of Substation
TR07 in North Loop, Probes at H=1 meter
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703107


High Steel Guideway, S. of Substation
TR07 in North Loop, Probes at H=1 meter
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703107

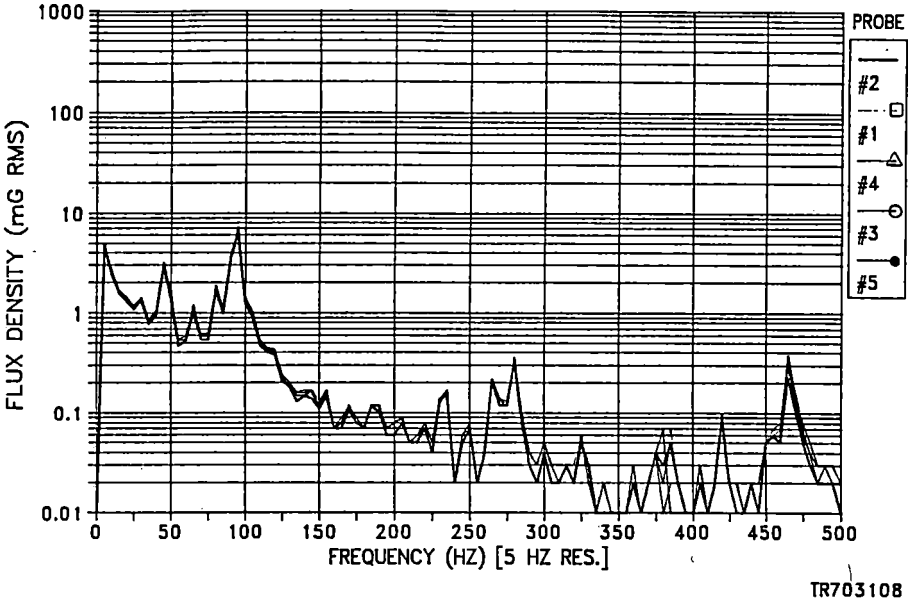

High Steel Guideway, S. of Substation
TR07 in North Loop, Probes at H=1 meter
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
50
100
150
200
250
300
350
400
450
500
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703107


High Steel Guideway, S. of Substation
TR07 Overhead, Probes at H=1 meter
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703108


High Steel Guideway, S. of Substation
TR07 Overhead, Probes at H=1 meter
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703108

High Steel Guideway, S. of Substation

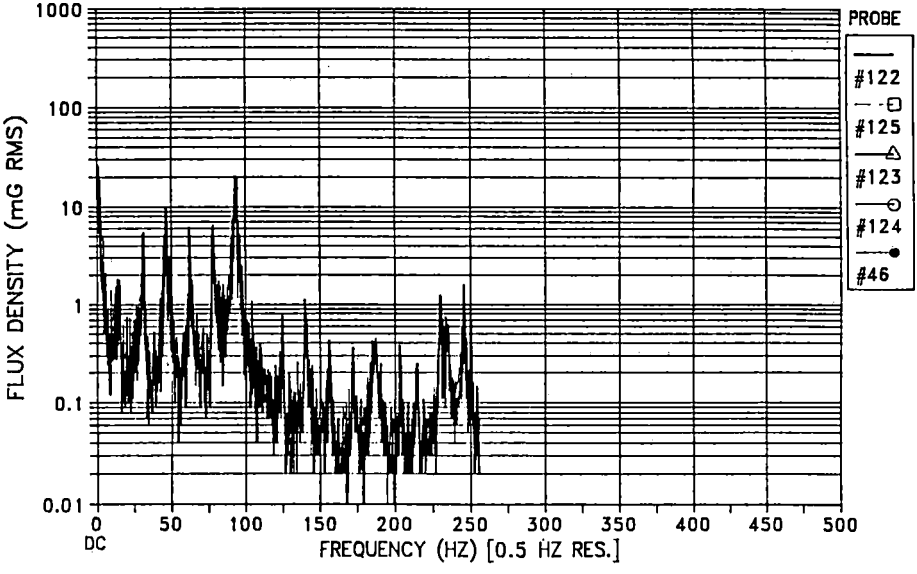
TR07 Overhead, Probes at H=1 meter



TR703108

High Steel Guideway, S. of Substation

TR07 Overhead, Probes at H=1 meter



TR703108

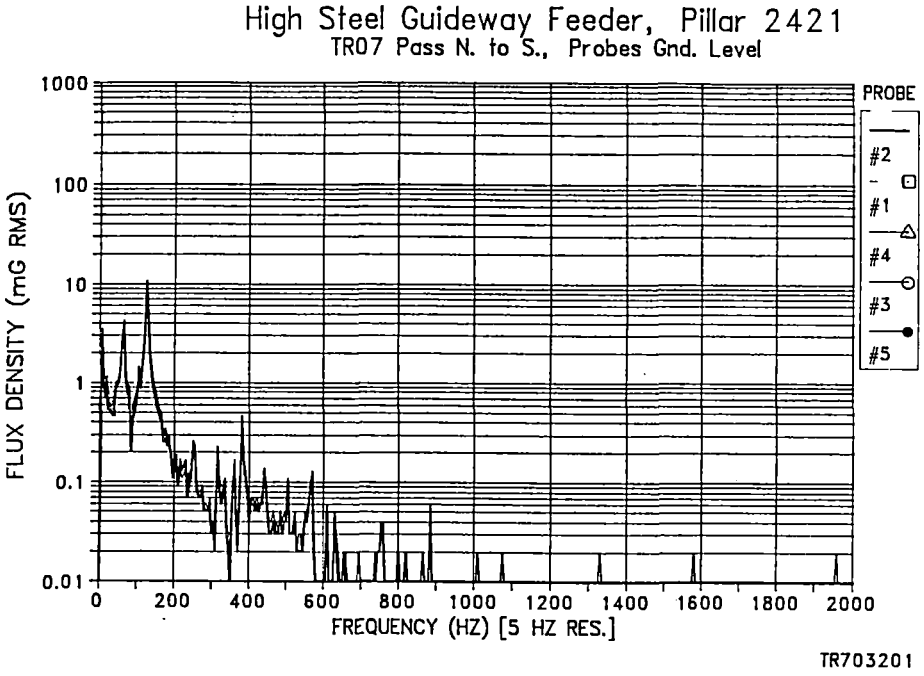
TR7031

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 031
> Feeder measurements
> background measurements
> probes at ground level, no train
Start: 08/10/90 (Friday) AT 13:04:00
End: 08/10/90 (Friday) AT 13:05:00
Recorded 6 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

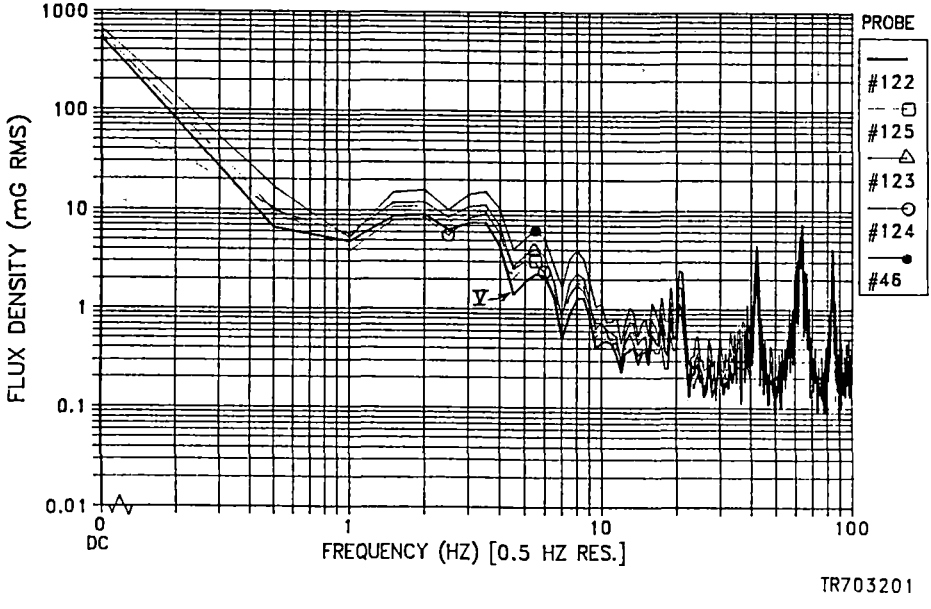
Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 4 In profile at building wall
COIL L: 0.30mG
COIL T: 1.00mG
COIL V: 1.00mG
B1 # 3 Center of profiles
COIL L: 1.00mG
COIL T: 1.00mG
COIL V: 1.00mG
C1 # 1 In profile furthest from inverter bldg
COIL L: 0.30mG
COIL T: 1.00mG
COIL V: 3.00mG
D1 # 2 In resist. bank profile furthest from bank
COIL L: 1.00mG
COIL T: 1.00mG
COIL V: 1.00mG
E1 # 5 Resistor bank profile nearest banks
COIL L: 3.00mG
COIL T: 0.30mG
COIL V: 10.0mG
A2 #123 In profile at building wall
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
B2 #124 Center of profiles
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
C2 #125 In profile furthest from inverter bldg
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
D2 #122 Resistor bank profile furthest from bank
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG
E2 # 46 Resistor bank profile nearest banks
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

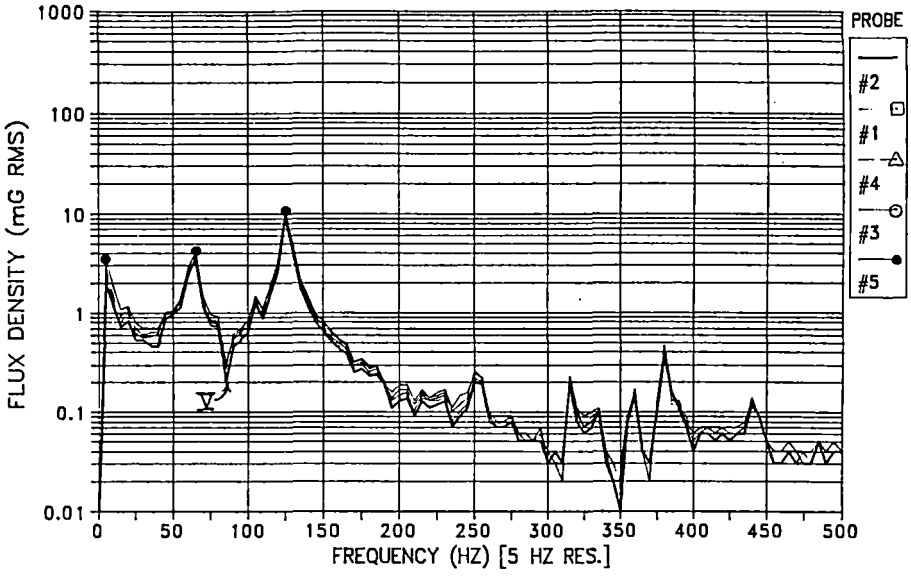

High Steel Guideway Feeder, Pillar 2421
TR07 Pass N. to S., Probes Gnd. Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703201

J-11


High Steel Guideway Feeder, Pillar 2421
TR07 Pass N. to S., Probes Gnd. Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703201

High Steel Guideway Feeder, Pillar 2421

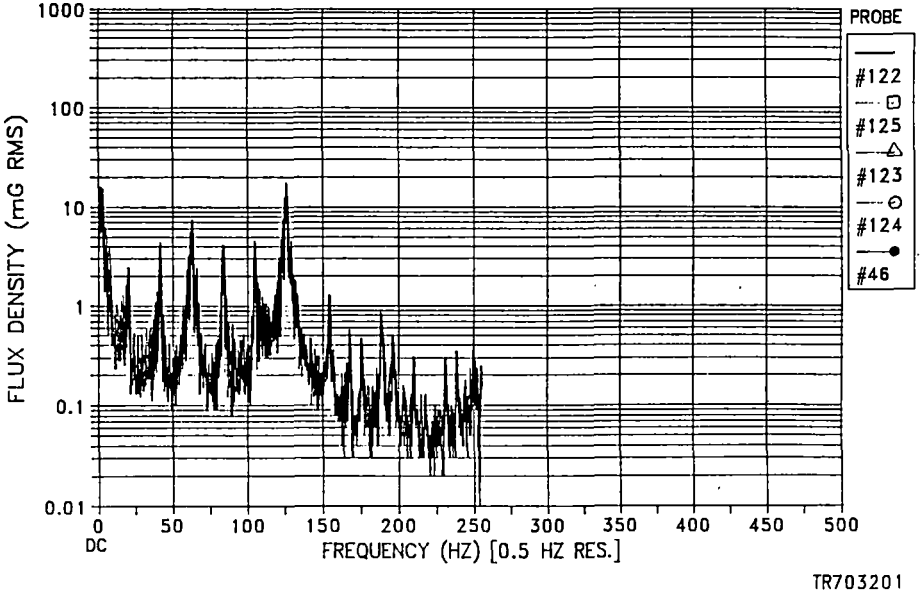
TR07 Pass N. to S., Probes Gnd. Level



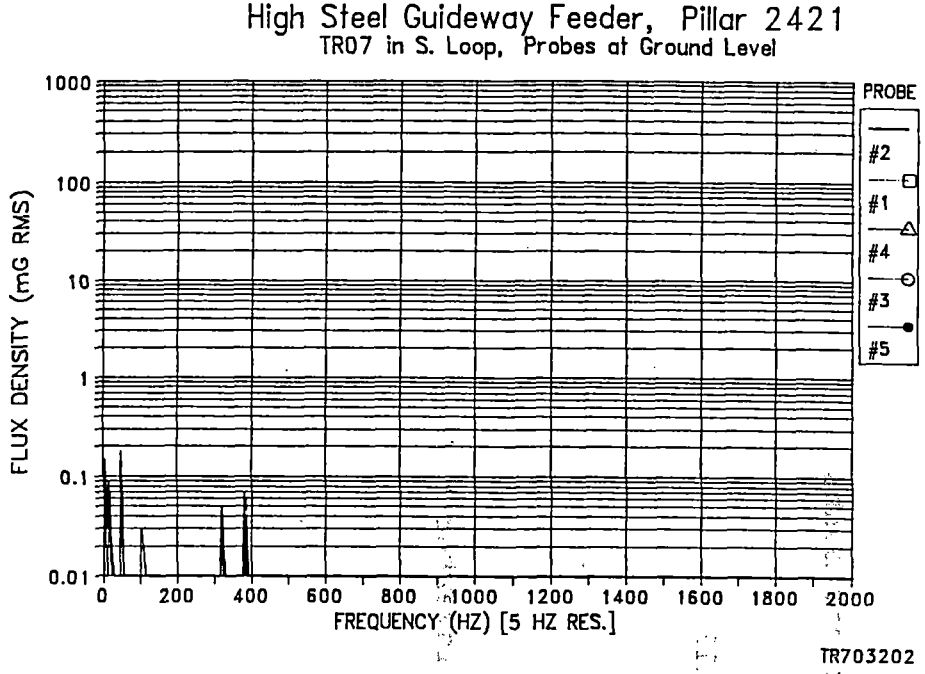
TR703201

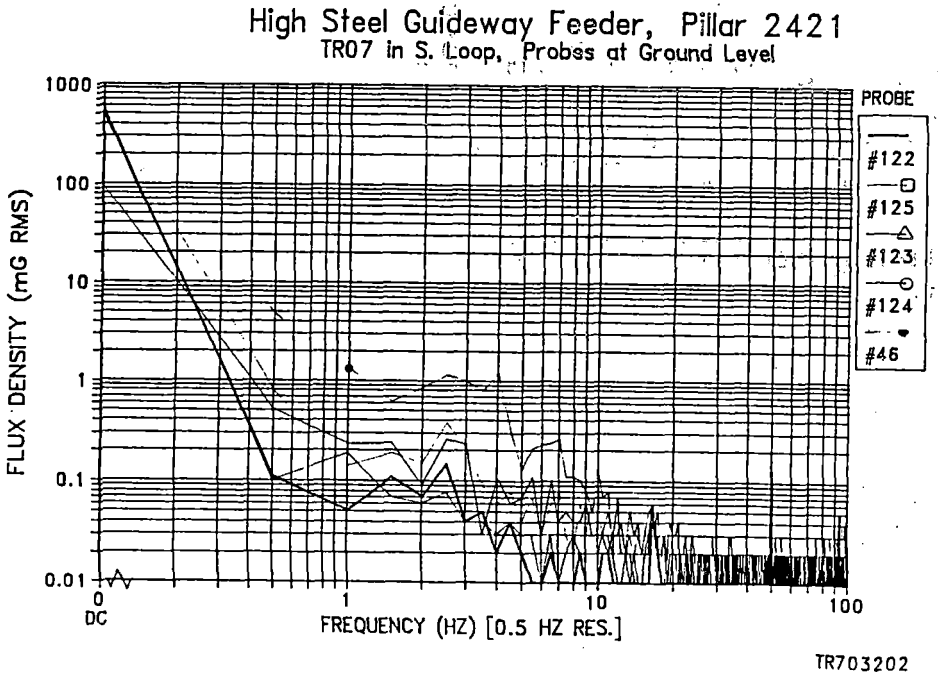
High Steel Guideway Feeder, Pillar 2421

TR07 Pass N. to S., Probes Gnd. Level



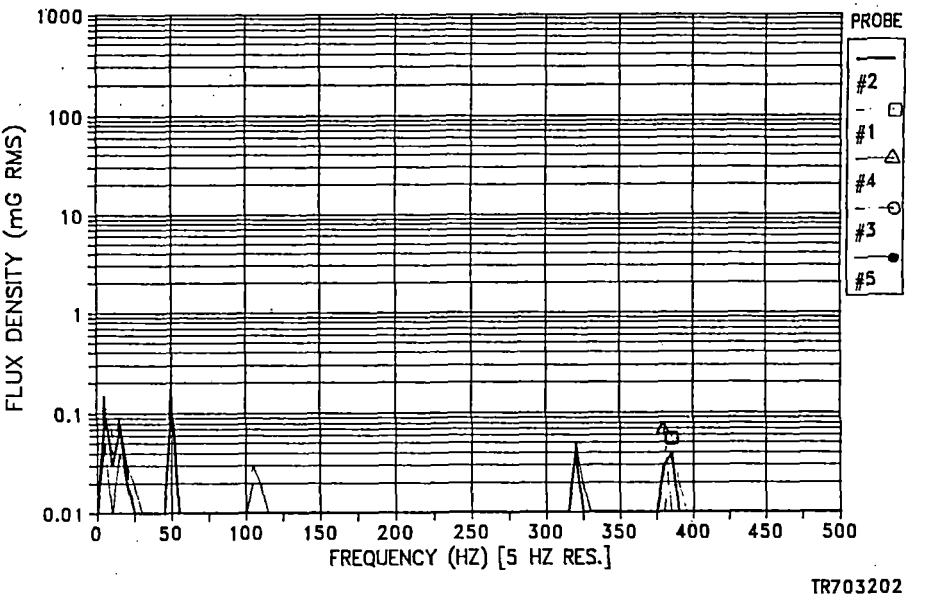
TR703201


High Steel Guideway Feeder, Pillar 2421
TR07 in S. Loop, Probes at Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
FREQUENCY (HZ) [5 HZ RES.]
PROBE
#2
#1
#4
#3
#5
TR703202


High Steel Guideway Feeder, Pillar 2421
TR07 in S. Loop, Probes at Ground Level
FLUX DENSITY (mG RMS)
1000
100
10
1
0.1
0.01
0
DC
1
10
100
FREQUENCY (HZ) [0.5 HZ RES.]
PROBE
#122
#125
#123
#124
#46
TR703202

High Steel Guideway Feeder, Pillar 2421

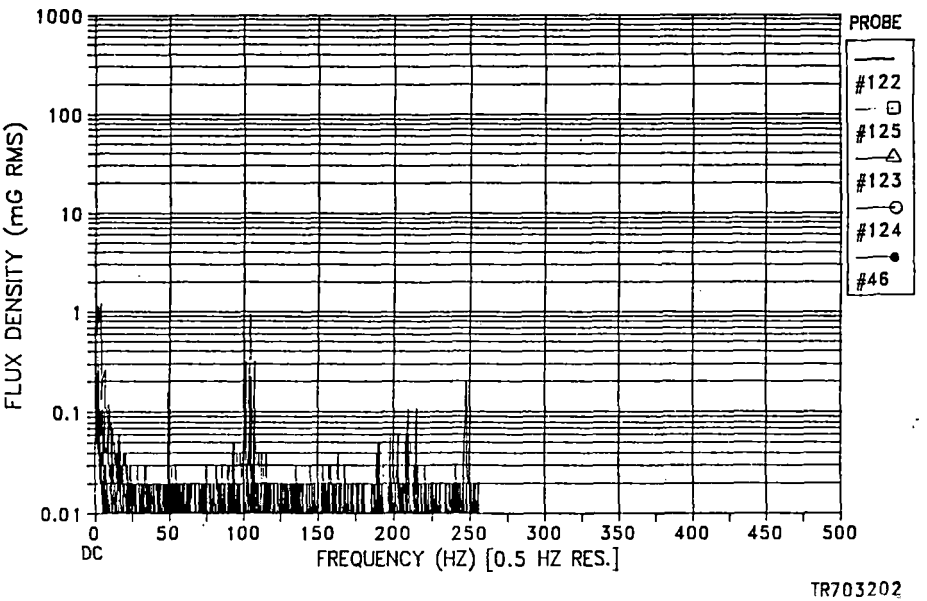
TR07 in S. Loop, Probes at Ground Level



TR703202

High Steel Guideway Feeder, Pillar 2421

TR07 in S. Loop, Probes at Ground Level



TR703202

TR7032

Site: Transrapid Facility ,Emsland, FDR
Prefix: TR7
Dataset: 032
> Feeder measurements
> train operation on track
> one meter along profile of feeder cable
Start: 08/10/90 (Friday) AT 16:20:30
End: 08/10/90 (Friday) AT 16:40:34
Recorded 219 samples at 4 seconds intervals
Trigger source: INTERNAL
Sample points per waveform: 1024

Mux Input	Base Freq	Sample Freq (Hz)
1	5.00	5120.00
2	0.50	512.00

RANGE SETTINGS:

A1 # 4 In profile at building wall
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

B1 # 3 Center of profiles
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

C1 # 1 In profile furthest from inverter bldg
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

D1 # 2 In resist. bank profile furthest from bank
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

E1 # 5 Resistor bank profile nearest banks
COIL L: 100mG
COIL T: 100mG
COIL V: 100mG

A2 #123 In profile at building wall
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

B2 #124 Center of profiles
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

C2 #125 In profile furthest from inverter bldg
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

D2 #122 Resistor bank profile furthest from bank
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG

E2 # 46 Resistor bank profile nearest banks
DC - A: 1000mG
DC - B: 1000mG
DC - C: 1000mG