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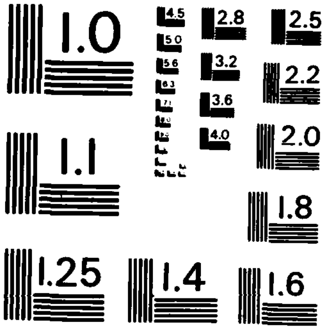
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AVRADCOM
Report No. 83-F-14

AD

MANUFACTURING METHODS AND TECHNOLOGY (MANTECH) PROGRAM

Qualification Testing of Infrared Detectors

Hans G. Sippach
Perkin-Elmer Corporation
Electro-Optical Division
100 Wooster Heights Road
Danbury, Connecticut 06810

December 1984

Supplement to Final Report
Contract No. DAAK20-82-C-0878

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United States Army
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20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

The addition of optical filters and window assemblies to interdigitated Indium Arsenide detectors fabricated during the pilot run and the subsequent environmental testing of the hermetically-sealed devices are described.
The information in this supplement to the final report is to be used in conjunction with the Final Report issued in December 1983.

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PREFACE

The purpose of the main program was to develop manufacturing methods and techniques for producing interdigitated Indium Arsenide detectors at a rate of 50 detectors per 40-hour week and thereby establish a source capable of meeting the anticipated needs of electro-optical systems. The devices fabricated during the program were not hermetically sealed and contained neither an optical filter nor a window assembly, both of which have to be added to complete the detector assembly. The results of this effort were reported in the Final Report, AVRADCOM Report No. 83-F-14.

The purpose of the CLIN 0009 option to the contract was to fabricate optical filters and window assemblies, add them to detectors fabricated during the pilot run and thereby produce completed detector assemblies. These assemblies were then to be qualification tested to demonstrate "MIL qualified" detector assemblies. The results of this effort are documented in a supplement to the final report referenced above.

This project was accomplished as part of the U.S. Army Aviation Research and Development Command Manufacturing Technology Program. The project was sponsored by the Army AVRADCOM MANTECH office with contractual performance through the Army Electronic Warfare Laboratory (ERADCOM). The primary objective of this program is to develop, on a timely basis, manufacturing processes, techniques, and equipment for use in production of Army material. Comments are solicited on the potential utilization contained herein as applied to present and/or future production programs. Such comments should be sent to:

U.S. Army Aviation Research and Development Command
Attn: DRSAV-PEC
P.O. Box 209
St. Louis, Mo 63166

MANUFACTURING METHODS AND TECHNOLOGY
(MANTECH) PROGRAM
QUALIFICATION TESTING OF INFRARED DETECTORS

1. INTRODUCTION

The purpose of the CLIN 0009 option to the main program was to fabricate optical filters and window assemblies and combine them with detectors fabricated during the pilot run to produce complete hermetically-sealed interdigitated Indium Arsenide detectors. These assemblies underwent qualification testing as per the applicable sections of Specification Number DV890-6111, Revision A, dated 16 June 1981.

[illegible]

During the course of the effort, 15 detectors were assembled, capped and sealed. The devices were screened and acceptance tested and thereafter subjected to Group C inspection but for the 1000-hour operating life test. The data acquired are summarized in this Supplement to the Final Report with the detailed data being on file at Perkin-Elmer.

2. TECHNICAL DISCUSSION

2.1 PREPARATION OF SAMPLE DETECTORS

The detector samples fabricated during the pilot run are not hermetically-sealed and do not contain optical filters or windows. The Infrasil windows and their associated window rings are purchased parts and, in general, present no problems. The optical filters start with a purchased 60 μm thick polished silicon substrate with each substrate accommodating 2 filters. The silicon substrate have to be ion-milled to very precise specifications and success depended on both the quality of the as-received substrate and the subsequent ion-milling. At present the fabrication process is in a laboratory stage and only limited yield data are available.

When ordering silicon substrates we had assumed that 20 substrates would, at 2 filters per substrate, yield 29 acceptable optical filters. 8 of the 20 substrates received had to be rejected and the remaining 12 substrates yielded only 17 filters. Of these 17, 2 were rejected after mounting.

The assembly procedure of the detectors consists of the following steps.

- Pretest (pilot run samples)
- Mount Optical Filter
- Visually Inspect
- Measure Transmission versus Incidence Angle
- Bakeout
- Mount Window in Window Ring
- Seal Window Assembly to Header.

The pilot run yielded 86 devices that met the acceptance criteria of the electrical and optical parameters of Table II of the specification. 25 of these were selected and designated pilot run samples. 15 of the remaining 61 samples were selected for the assembly of hermetically-sealed detectors for qualification testing. The serial numbers of these samples are 1008, 1022, 1025, 1032, 1041, 1044, 1058, 1059, 1101, 1113, 1114, 1115, 1123, 1125 and 1127.

After mounting the optical filters on the detectors and before capping, the transmission vs. incidence angle characteristics must be measured at two laser wavelengths. From these data, four sets of parameters are derived: Modulation of Frequency, Modulation Peak to Valley, Modulation Peak Phase Ratio, and Modulation Cross-Talk Ratio. The results of these measurements are presented in Table 1.

It must be remembered that the acceptance criteria of the optical parameters listed on Table II of the specification apply to the detector without an optical filter and window. In order to have a means to judge effects of environment on optical parameters, one runs a standard test prior to and after the installation of the filter and uses the latter as a reference for subsequent tests.

2.2 APPROACH TO TESTING

The semi-automated test setup described in detail in the Report of Test on Confirmatory Samples (Perkin-Elmer Report No. 15594) was used for acquiring the data listed in Table II of the specification which corresponds to Group A testing. In addition to the parameters listed in Table II, the test setup measured the I(V) characteristic and calculated zero-bias impedance.

The chronological sequence of the tests was as follows:

- Select detectors
- Test per Table II
- Mount filters
- Measure Transmittance vs. Incidence Angle
- Cap and seal
- Test per Table II
- Screen per Table I
- Electrical Test I
- Burn-in per Table I
- Electrical Test 2

TABLE 1

TRANSMISSION VS. INCIDENCE ANGLE DATA

DEVICE			Number of Peaks				Modulation				θ_1/θ_2	ϕ_1/ϕ_2				
S/N	Optical Filter	λ	A	B	C	D	A	B	C	D	(A-B)	(C-D)	A/B	B/A	C/D	D/C
1008	Batch 5, Filter 10A	1	18	18	18	18	2.3	2.4	2.2	2.3	0.33	0.30	0.69	0.54	0.52	0.62
		2	6	6	8	6	3.4	3.5	3.8	3.5	0.25	0.26	0.66	0.74	0.51	0.59
1022	Batch 5, Filter 1A	1	18	18	18	18	2.3	2.4	2.1	2.3	0.33	0.30	0.48	0.52	0.52	0.41
		2	6	6	6	6	3.8	3.8	4.8	3.2	0.30	0.22	0.41	0.63	0.55	0.53
1025	Batch 5, Filter 1B	1	18	18	18	18	2.3	2.2	2.2	2.2	0.30	0.30	0.52	0.56	0.56	0.54
		2	6	6	6	6	3.9	3.9	3.9	3.4	0.23	0.25	0.68	0.64	0.53	0.50
1032	Batch 3, Filter 41A	1	20	20	20	20	2.6	2.6	2.6	2.7	0.33	0.44	0.60	0.50	0.54	0.63
		2	8	6	8	6	3.6	3.3	3.2	3.3	0.30	0.25	0.80	0.70	0.81	0.87
1041	Batch 5, Filter 2A	1	18	18	18	18	2.3	2.4	2.2	2.3	0.40	0.22	0.62	0.44	0.58	0.59
		2	6	6	6	6	3.3	3.2	3.6	3.5	0.24	0.26	0.53	0.64	0.71	0.71
1044	Batch 5, Filter 10B	1	18	18	18	18	2.3	2.2	2.0	2.4	0.27	0.33	0.52	0.59	0.57	0.46
		2	6	6	6	6	4.6	4.1	3.5	4.1	0.26	0.29	0.47	0.67	0.56	0.63
1058	Batch 5, Filter 4B	1	18	18	18	18	2.5	2.4	2.4	2.4	0.33	0.30	0.50	0.55	0.50	0.45
		2	6	6	6	6	5.0	3.6	3.4	3.7	0.25	0.22	0.56	0.50	0.82	0.58
1059	Batch 5, Filter 6A	1	18	18	18	18	2.5	2.5	2.4	2.3	0.30	0.30	0.56	0.55	0.67	0.42
		2	6	6	6	6	3.5	3.4	3.2	3.8	0.25	0.27	0.57	0.77	0.61	0.52
1101	Batch 5, Filter 9B	1	18	18	18	18	2.3	2.3	2.2	2.3	0.40	0.30	0.60	0.48	0.47	0.63
		2	6	8	7	6	2.4	4.7	3.0	3.2	0.23	0.27	0.68	0.53	0.45	0.64
1113	Batch 5, Filter 6B	1	18	18	18	18	2.3	2.3	2.1	2.3	0.45	0.43	0.53	0.50	0.56	0.73
		2	6	6	6	6	3.9	3.4	3.4	3.2	0.27	0.26	0.57	0.50	0.71	0.73
1114	Batch 5, Filter 12B	1	18	18	18	18	2.4	2.4	2.5	2.2	0.33	0.30	0.48	0.62	0.46	0.57
		2	6	6	6	6	3.7	3.1	6.0	5.9	0.29	0.26	0.47	0.67	0.67	0.42
1115	Batch 5, Filter 7A	1	18	18	18	18	2.4	2.4	2.3	2.1	0.33	0.33	0.46	0.62	0.71	0.57
		2	6	6	6	6	3.4	3.4	3.4	3.3	0.26	0.29	0.52	0.75	0.71	0.59
1123	Batch 3, Filter 41B	1	18	18	18	18	2.3	2.3	2.2	2.3	0.30	0.27	0.61	0.45	0.48	0.52
		2	6	6	6	6	3.9	3.8	3.5	3.4	0.26	0.27	0.67	0.48	0.63	0.62
1125	Batch 5, Filter 11A	1	18	18	18	18	2.3	2.3	2.2	2.3	0.30	0.30	0.50	0.52	0.45	0.53
		2	6	6	6	6	2.5	3.1	3.3	3.2	0.30	0.22	0.64	0.58	0.64	0.56
1127	Batch 5, Filter 7B	1	18	18	18	18	2.2	2.3	2.2	2.3	0.33	0.30	0.58	0.48	0.58	0.67
		2	6	6	6	6	3.5	3.7	3.6	3.1	0.25	0.26	0.57	0.61	0.69	0.69

- Storage Life per Table IV
- Test per Table IV - Subgroups 1 and 2.

Our test equipment was set up for measuring spectral response and rise and fall times on the bare detector without optical filter or window. When we attempted to use this equipment with a temperature chamber as required for Table III tests (Group B Inspection) we realized that the signal-to-noise ratios were much too low to attain meaningful data. Group B inspection was therefore not carried out.

The test for operating life, Subgroup 3 of Table IV, required 1000 hours or 42 days and could not be accommodated within the available time frame.

2.3 TEST RESULTS

2.3.1 Initial Test

All 15 devices were tested per Table II of the specification plus I(V) curve and zero-bias impedance before mounting of the optical filter and after window seal. This was done because the acceptance criteria of the optical parameters listed in Table II apply to the detector proper and not to the detector assembly which *includes the optical filter and* the window. Group C inspection requires that the Table II parameters be remeasured after the inspection and one needs to know the values of these parameters as affected by the filter and the window.

S/N 1008 represents an average device of the group of 15 and the effect of the filter and window on the measured responsivity is shown below.

TABLE 2
EFFECT OF FILTER AND WINDOW ON RESPONSIVITY

	RESPONSIVITY (AW^{-1}) at COMB							
Wavelength	A		B		C		D	
(μm)	W/O	W	W/O	W	W/O	W	W/O	W
1.0	0.41	0.18	0.44	0.19	0.40	0.16	0.41	0.17
2.0	0.74	0.46	0.75	0.47	0.73	0.45	0.73	0.45
3.4	1.25	0.75	1.26	0.77	1.23	0.74	1.23	0.74

Note: W/O - Bare detector, W - Detector Assembly

As can be seen from the table, the measured responsivities are affected significantly by the optical filter and one has to use the Table II measurement after capping as the reference for data acquired after Group C inspection.

2.3.2 Screening

All environmental testing was done by Acton Environmental Testing Corporation, Acton, MA. The devices were inspected prior to screening per Table I of the referenced specification. They were thereafter exposed to:

- Thermal shock per 4.7.2
- Shock per 4.7.3.1
- Fine Leak per 4.7.4.1
- Gross Leak per 4.7.4.2.

Details of these tests are presented in Acton's report, Appendix A. The results of the visual inspection after these tests are given in Table 3.

TABLE 3
VISUAL INSPECTION AFTER SCREENING

S/N	Window Seal	Wire Bonds	Filter	Header/Lid Seal	Lead Seals
1008	OK	OK	OK	OK	OK
1022	OK	OK	OK	OK	OK
1025	OK	OK	OK	OK	OK
1032	OK	Note 1	OK	OK	OK
1041	OK	OK	OK	OK	OK
1044	OK	OK	OK	OK	OK
1058	OK	OK	OK	OK	OK
1059	OK	OK	OK	Note 2	OK
1101	OK	OK	OK	OK	OK
1113	OK	OK	OK	Note 3	OK
1114	OK	OK	OK	OK	OK
1115	OK	OK	OK	OK	OK
1123	OK	OK	OK	OK	OK
1125	OK	OK	OK	OK	OK
1127	OK	OK	OK	OK	OK

NOTES

1. One band off post of element D
2. Some bubbles on inside around base
3. One void on inside around base
4. S/N 1058: Some gold flaked off on outside of header near case pin.

None of the devices failed the gross leak test but serial numbers 1022, 1041, 1101 and 1127 failed the fine leak test. The maximum fine leak rate was measured on serial number 1101 and it was 1.4×10^{-6} std. cc./sec which is 40% above the allowed maximum value. These data are in our opinion somewhat questionable because the devices were not blown off with dry nitrogen before leak testing. Dry nitrogen blowoff was used for leak testing in Group C inspection and the observed leak rates were generally lower.

All devices were then tested per 3.5.3 - detector impedance and I(V) curve - and then subjected to burn-in per 4.7.10. The electrical test after burn-in showed no changes in the I(V) curves and the detector impedance had changed by less than 10%.

Serial numbers 1008, 1025, 1044, 1058, 1059, 1113, 1114, 1115, 1123 and 1125 were entered in Group C inspection.

2.3.3. Group C Inspection

The 10 samples entered in Group C inspection were divided in two subgroups. Subgroup 1 consisted of serial numbers 1008, 1114, 1115, 1123 and 1125 and subgroup 2 of serial numbers 1025, 1044, 1058, 1059 and 1113. Subgroup 2 was subjected to 340 hours at 85°C - storage life per 4.7.7 - and Table II data plus impedance per 3.5.3 were measured and recorded.

Subgroup 1 was then subjected to

- Thermal cycling per 4.7.1
- Thermal shock per 4.7.2
- Sine Vibration per 4.7.8
- Fine leak per 4.7.4.1
- Gross leak per 4.7.4.2

and subgroup 2 to

- Thermal shock per 4.7.2
- Shock per 4.7.3.2
- Acceleration per 4.7.5
- Fine leak per 4.7.4.1
- Gross leak per 4.7.4.2.

Go-no-go tests were performed after each environment.

The results of the visual inspection after Group C inspection are presented in Table 4.

TABLE 4

VISUAL INSPECTION AFTER GROUP C

S/N	Window Lid Seal	Lid-Header Seal	Glass-Metal Seal	Chip-Ceramic Bonds	Ceramic Pin Bonds	Filters
1008	OK	OK	NC	OK	OK	OK
1114	OK	OK	NC	OK	OK	OK
1115	OK	OK	NC	OK	OK	OK
1123	OK	OK	NC	OK	OK	OK
1125	OK	OK	NC	OK	OK	OK
1025	OK	OK	NC	Note 1	OK	OK
1044	OK	OK	NC	OK	OK	OK
1058	OK	OK	NC	OK	OK	OK
1059	OK	OK	NC	OK	OK	OK
1113	OK	OK	NC	OK	OK	OK

NOTES

1. One band separated on chip at element D.
2. More gold peeled on the outside of header on S/N 1058
3. NC implies no change since inspection for screening.

Subgroup 2 showed noticeable discoloration of the epoxy at the window-to-lid seal. All ten devices passed the Fine and Gross leak tests.

3. CONCLUSIONS

Detector samples produced during the pilot run and optical filters fabricated during the CLIN 0009 option were used to assemble the hermetically-sealed devices used during environmental testing. The actual testing was limited to

- Screening per Table I
- Acceptance Test (Group A) per Table II plus Detector Impedance and I-V Curve
- Group C inspection per Table IV, subgroups 1 and 2.

It had been assumed that, based on the limited yield data available for the optical filters, 20 substrates would, at 2 filters per substrate, yield 29 optical filters. However, 8 of the 20 silicon substrates received had to be rejected and the remaining 12 substrates yielded only 17 acceptable filters. 2 of these had to be rejected after mounting on detectors and measuring the modulation characteristics, and this left 15 hermetically-sealed detector assemblies for environmental testing.

Environmental testing was done by Acton Environmental Test Corporation, Acton, MA, and the tests were witnessed by Mr. V. A. Soares, a Perkin-Elmer Associate Engineer who had been executing most of the testing of the devices fabricated during the MM&T program.

15 devices entered screening and 10 of them passed the test. Serial numbers 1022, 1041, 1101 and 1127 failed the Fine Leak Test and serial number 1032 lost one bond, thus the screening yield was 10/15 or about 67%. The 10 devices which passed screening were then divided into two groups of 5 devices each and entered as subgroups 1 and 2 into Group C Inspection. There were no failures in Subgroup 1 but serial number 1025 of subgroup 2 had one pad lifted.

These limited data indicate an overall yield of 9/15 or about 60% for the environmental tests conducted. It is felt that optimization of the assembly procedure which was not part of the MM&T program would reduce the number of Fine Leak Test failures. The detector samples used for assembling the hermetically-sealed devices had been fabricated during June through August 1983 and been stored in dry-nitrogen cabinets until used for the CLIN 0009 option. While there was no evidence that the samples had changed during this prolonged storage in unprotected chip form, it represents an atypical manufacturing sequence.

Based on the overall results of the test, it appears that the hermetically-sealed devices are a viable design that meets all the requirements tested.

APPENDIX A

ACTON TEST REPORT

ER-670

ENVIRONMENTAL
ACTON
TESTING
CORPORATION

Test Report No. 20116-84D

No. of Pages 46

Report of Test

FOR

FIFTEEN (15) DETECTOR HEADERS
TYPE 80010, THIRTEEN PIN

PERKIN-ELMER
100 WOOSTER HEIGHTS
DANBURY, CT 06856

Purchase Order No. 90667TJ

Prepared by: Date 12-20-1984

George Jakubowicz, Project Engineer
NTS/Acton
533 Main Street, Acton, MA 01720

Reviewed & Approved by: William C McGinnis Date 12-20-1984

William C. McGinnis, Chief Dynamics Test Engineer
NTS/Acton

GJ/lr:238

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ADMINISTRATIVE DATA

1.0 PURPOSE OF TEST: Screening of samples.

2.0 MANUFACTURER: Perkin-Elmer

3.0 MANUFACTURER'S TYPE OR MODEL NO.: 13 Pin Detector Header, Type 80010

4.0 DRAWING, SPECIFICATION OR EXHIBIT: Drawing No. 46555-899-1100, Revision B

5.0 QUANTITY OF ITEMS TESTED: Fifteen (15)

6.0 SECURITY CLASSIFICATION OF ITEMS: None

7.0 DATE TEST COMPLETED: December 16, 1984

8.0 TEST CONDUCTED BY: D. Boivin, N. James, N. Stewart, P. McDermott

9.0 DISPOSITION OF SPECIMENS: Hand carried back to Perkin-Elmer by customer.

10.0 ABSTRACT: Refer to information within.

1.0 SCOPE

NTS/Acton received fifteen detector headers, Type 80010, from Perkin-Elmer for the purpose of screening. The following sample serial numbers were used: 1032, 1022, 1041, 1059, 1044, 1113, 1058, 1008, 1101, 1114, 1115, 1127, 1125, 1123, and 1025.

A Perkin-Elmer representative was present to perform functional tests after each test. Following completion of testing, the items were hand carried by the representative back to Perkin-Elmer where, after analysis of the data and further functional tests, ten samples were selected and then resubmitted to NTS/Acton in the form of two subgroups which underwent two separate sets of tests.

Subgroup 1: S/N's 1025, 1059, 1044, 1113, and 1058
Subgroup 2: S/N's 1115, 1125, 1123, 1008, and 1114

A representative from Perkin-Elmer was at NTS/Acton to perform functional tests as well as witness the NTS/Acton tests. All data and results are included within. The final analysis will be performed by Perkin-Elmer.

2.0 THERMAL SHOCK (FIFTEEN SAMPLES)

In order to perform this test, a chamber was set to 0°C (32°F) and a beaker with FC-77 electronic fluid was placed inside and allowed to stabilize.

A similar beaker was filled with distilled water and placed on a laboratory hot plate which was preset to maintain 100°C (312°F). The fifteen samples were broken up in to four groups. While one group was immersed in the 0°C liquid, another was in the 100°C liquid. These groups were then switched. The test was conducted in accordance with MIL-STD-750B, Method 1056, Condition "B", except that five cycles were implemented.

After the test, the samples were subjected to functional tests by the Perkin-Elmer representative.

3.0 SHOCK (FIFTEEN SAMPLES)

The units were potted in paraffin wax in an NTS/Acton supplied fixture. The fixture was then bolted on the seismic shaker, PE314. The fixtures were I.D. Nos. 1 and 2. The units were subjected to the following test:

15g, 11 milliseconds pulse
Y_1, Y_2, and X_1 axis (see Figure 1)
Two shocks per axis
Total of six shocks

Testing was done in accordance with MIL-STD-750B, Paragraph 4.2, Figure 2 and in the following sequence:

Test No. 1

Y_2 Axis, Fixture No. 1
15g, 11 milliseconds, 2 pulses
Nonoperating
Results: Test completed

Test No. 2

Fixture No. 2
15g, 11 milliseconds, 2 pulses
Nonoperating
Results: Test completed

Test No. 3

Y_2 Axis, Fixture No. 2
15g, 11 milliseconds, 2 pulses
Nonoperating
Results: Test completed

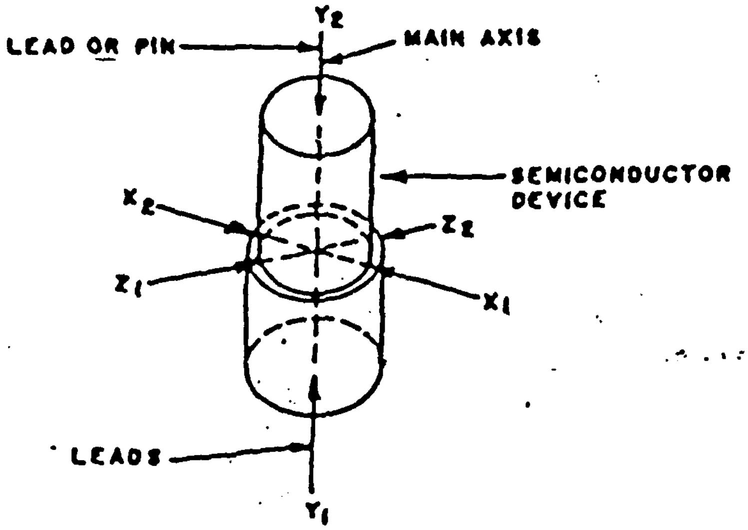


Figure 1 - Orientation of cylindrical semiconductor device to direction of accelerating force.

3.0 SHOCK (FIFTEEN SAMPLES) (continued)

Test No. 4

Y_1 Axis, Fixture No. 2
15g, 11 milliseconds, 2 pulses
Nonoperating
Results: Test completed

Test No. 5

X_1 Axis, Fixture Nos. 1 and 2
15g, 11 milliseconds, 2 pulses
Nonoperating
Results: Test completed

The samples were then depotted and subjected to the functional test.

4.0 FINE LEAK (FIFTEEN SAMPLES)

All fifteen samples were mounted on a narrow strip of styrofoam and then placed in a hermetically sealed container. The samples were then "bombed" at 45 psig with helium for one hour. After the "bombing" was completed, the samples were leak tested one at a time using the mass spectrometer and the results were recorded on a data sheet which is included in this report.

5.0 GROSS LEAK (FIFTEEN SAMPLES)

The samples were then subjected to a gross leak test which was done using FC 40 fluorocarbon at 85°C and not with mineral oil as per MIL-STD-750B. This was done at the request of the customer.

Each sample was submersed, one at a time, and observed for evidence of bubbles. None were noticed and the results were so recorded.

All testing, except as noted, were conducted in accordance with MIL-STD-750B. This completed the testing of the fifteen sample group.

6.0 THERMAL SHOCK (SUBGROUP 1 AND 2)

A glass beaker with 1500 ml of electronic fluid (FC-40) was placed on a hot plate which was controlled by a temperature controller connected to a thermal bridge. The fluid temperature was maintained at 100°C (212°F).

Simultaneously, a similar beaker was placed in a thermal chamber and maintained at 0°C (32°F). Both groups were subjected to this test over a 10-cycle period. Each cycle lasted five minutes.

7.0 THERMAL CYCLING (SUBGROUP ONE)

For this test two chambers were preconditioned to the required temperature. One chamber was set to 85°C (185°F) and the other to -65°C (-85°F).

The samples were cycled five times between cold and hot with each cycle lasting ten minutes.

Following completion of the test, the samples were subjected to a functional test performed by Perkin-Elmer personnel.

8.0 SINE VIBRATION (SUBGROUP ONE)

Subgroup One was potted in wax in an NTS/Acton fixture. The fixture was bolted to the PE314 shaker. The samples were then subjected to the following test specifications:

5 - 14 Hz @ .2" of amplitude
14 - 33 Hz @ 2g
33 - 52 Hz @ .036" of amplitude
52 - 2000 Hz @ 5g
1 sweep
3 minutes/octave
Three axes

The test was run in the following sequence:

Test No. 1

Sine 5 - 2000 Hz
Z axis
1 sweep
Nonoperating
Results: Test completed

The fixture was rotated to the next axis.

Test No. 2

Sine 5 - 2000 Hz
X axis
1 sweep
Nonoperating
Results: Test completed

The fixture was rotated to the next axis.

8.0 SINE VIBRATION (SUBGROUP ONE) (continued)

Test No. 3

Sine 5 - 2000 Hz
Y axis
1 sweep
Nonoperating
Results: Test completed

Subgroup One was removed and depotted.

9.0 SHOCK (SUBGROUP TWO)

Subgroup Two was potted in wax in an NTS/Acton fixture. The fixture was then bolted to the PE314 shaker. The samples were then subjected to the following test specifications:

15g, 11 milliseconds
3 shocks/axis, positive and negative
3 axes
Total of 18 shocks

Test No. 1

Shock
15g, 11 milliseconds, Z axis positive
3 shocks/axis, positive
Nonoperating
Results: Test completed

Test No. 2

Shock
15g, 11 milliseconds, Z axis negative
Nonoperating
Results: Test completed

The fixture was rotated to the next axis.

Test No. 3

Shock
15g, 11 milliseconds, X axis positive
3 shocks/axis, positive
Nonoperating
Results: Test completed

9.0 SHOCK (SUBGROUP TWO) (continued)

Test No. 4

Shock
15g, 11 milliseconds, X axis negative
3 shocks/axis, negative
Nonoperating
Results: Test completed

The fixture was rotated to the next axis

Test No. 5

Shock
15g, 11 milliseconds, Y axis positive
3 shocks/axis, positive
Nonoperating
Results: Test completed

Test No. 6

Shock
15g, 11 milliseconds, Y axis negative
3 shocks/axis, negative
Nonoperating
Results: Test completed

There were no anomalies or deviations. The samples were depotted and prepared for the next test.

10.0 ACCELERATION (SUBGROUP TWO)

Subgroup Two was subjected to acceleration. The samples wre mounted in a PVC fixture machined by NTS/Acton. Three samples and then two samples were run. All the samples of Subgroup Two were run up to 6g and held at that level for one minute in each required axis (see Figure 1), X_1, X_2, Y_1, Y_2, Z_1, and Z_2.

Visual inspections were performed after each axis. No damage or anomalies were noticed.

11.0 FINE LEAK (SUBGROUP ONE AND TWO)

All ten samples (Subgroup One and Two) were mounted on a narrow strip of styrofoam and then placed in a hermetically sealed container. The samples were then "bombed" at 45 psig with helium for one hour. After the "bombing", the samples were leak tested one at a time using a mass spectrometer and the results were recorded on a data sheet which is included in this report.

12.0 GROSS LEAK (SUBGROUP ONE AND TWO)

After fine leak testing was completed, the samples were placed into a beaker with FC-40 fluorocarbon at a temperature of 100°C. The samples were observed for evidence of bubbles. None were notices and the results were so recorded. This completed all testing of Subgroup One and Two.

13.0 TEST EQUIPMENT LIST

TEST EQUIPMENT LIST

Test Report # 20116-84D
Page 13-2

NAME	MFR.	MODEL	SER.NO.	RANGE	ACCURACY	INV.#	CAL FREQ.
Accelerometer	PCB	302A	1820	1 Hz to 5 KHz	±5%	AC436	6 months
Accelerometer	PCB	302A	1983	1 Hz to 5 KHz	±5%	AC440	6 months
High-Low Temperature Chamber	ALI		CH316	-100°F to +300°F	±2°F	CH316	6 months
High-Low Temperature Chamber	Tenney	Junior	128	-120°F to +350°F	Control 0.25°F	CH349	6 months
Amplifier Exciter	Ling	MPA-16 A300	167 59	5 Hz to 5 KHz 7,500 lbs. force 1" P/P disp.	±2%	PE314	6 months
Digital Controller	Time Data	TDV-20		70 dB voltage DC to 6 KHz	±1 dB	PE392	1 year
Power Supply	PCB	483A04	872	4 Channel Gain: X1	±2%	PE401	6 months
Signal Analysis System	General Radio	2502	2931-9767	5 Hz to 5000 Hz		PE419	1 year
Leak Detector	NRC	925-20	MER0013 AVR0027	1 x 10^{-9} std cc of helium/second	2.3 x 10^{-7}	PI322	UWCE
Calibrated Leak	Varian	GG-F84730-01	71E555	Leak Rate 2.8 x 10-7 std cc/sec.	N/A	PI446	1 year
Ten Channel Digital Thermometer	Fluke	2176A	2649003	-328 to 752°F -200 to 400°C	±1.5°F ±1°C	TI325	6 months

ER-670

ACTON
ENVIRONMENTAL TESTING CORPORATION
533 Main Street Acton, Massachusetts

DATA SHEET

Type

Report No. 20116-84D

Operator P MCDERMOTT

Test METHOD 1071.1

Conditions

Time

Customer PERKIN-ELMER

P.O.

Spec. MIL-STD-750

Date 11-14-84

			S/N		STD cc/SEC LEAKAGE FINE		GROSS
			1008		6.2×10^{-7}		NONE
			1101		1.4×10^{-6}		NONE
			1114		6.2×10^{-7}		NONE
			1115		7.6×10^{-7}		NONE
			1127		1.3×10^{-6}		NONE
			1125		1×10^{-6}		NONE
			1123		8×10^{-7}		NONE
			1025		6.8×10^{-7}		NONE
			1032		9×10^{-7}		NONE
			1022		1.1×10^{-6}		NONE
			1041		1.2×10^{-6}		NONE
			1059		6.8×10^{-7}		NONE
			1044		9×10^{-7}		NONE
			1113		9.5×10^{-7}		NONE
			1058		8.3×10^{-7}		NONE
							14-2

ER-670

ACTON
ENVIRONMENTAL TESTING CORPORATION
533 Main Street Acton, Massachusetts

DATA SHEET

Type DETECTORS

Customer PERKIN ELMER

Report No. 20116

P. O.

Operator P. MCDERMOTT

Spec. MIL-STD-750

Test FINE + GROSS LEAK

Date 12-6-84

Conditions

~~Time~~ GROSS LEAK W/100°C FLUOROCARBON

					STD CC/SEC		BUBBLES
	UNIT S/N		BOMBING		FINE LEAK		GROSS LEAK
	1025		HELIUM 45PSI 1HR		5.8×10^{-7}		NONE
	1059				9.4×10^{-7}		NONE
	1044				6.1×10^{-7}		NONE
	1113				5×10^{-7}		NONE
	1058				5×10^{-7}		NONE
	1008				7.2×10^{-7}		NONE
	1114				7.6×10^{-7}		NONE
	1115				7.6×10^{-7}		NONE
	1125				5.5×10^{-7}		NONE
	1123		↓		5.8×10^{-7}		NONE

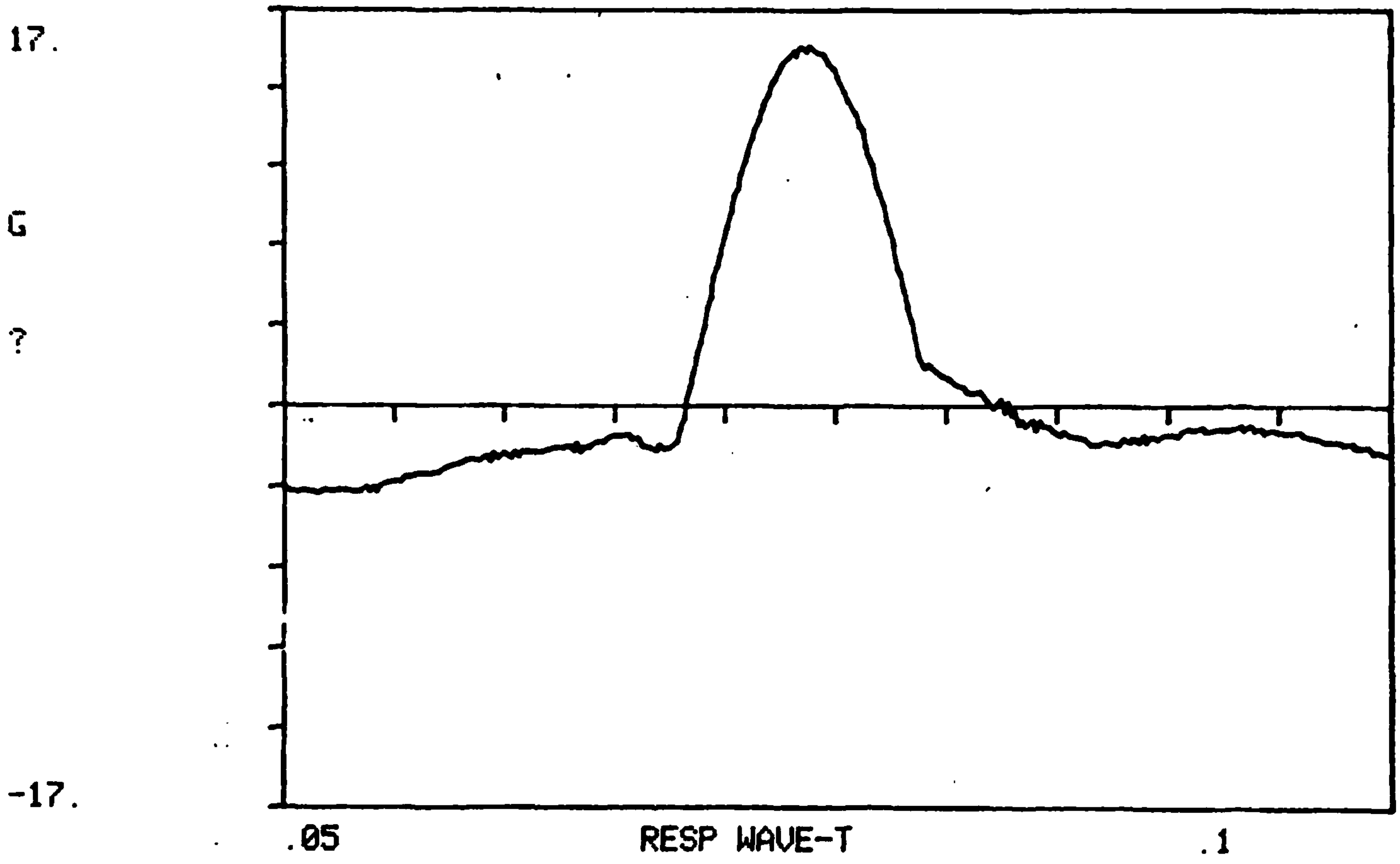
14-3

```
1 HEADING #20116
2 SENSITIVITY(MV/G):10.
3 WAVE TYPE: 0=HS 1=SQ 2=ST 3=TR 4=DP 5=ANALOG 6=DIGITAL:0
4 PULSE DURATION(MS):11.
5 % IN TAILS:15.
6 MAX FREQ:1000
7 AMPLITUDE(G):15.
10 CAL PULSE AMPL(V):.1
11 AUTO MODE LEVEL SEQ 0=FULL 1=1/2 2=1/4 3=1/8 4=1/16 5=DONE
  FIRST 5
12 SHOCK RESP DEFN 0=ABS ACCEL 1=REL DISPL:0
13 DAMPING COEFF:.05

CORRECTIONS 0=NO 1=YES:0

         MIN                MAX
ACC      -2.25              14.99      G
VEL     -20.21              20.32      IN/S
DISP      -.4399              .0275    IN
```

14-4

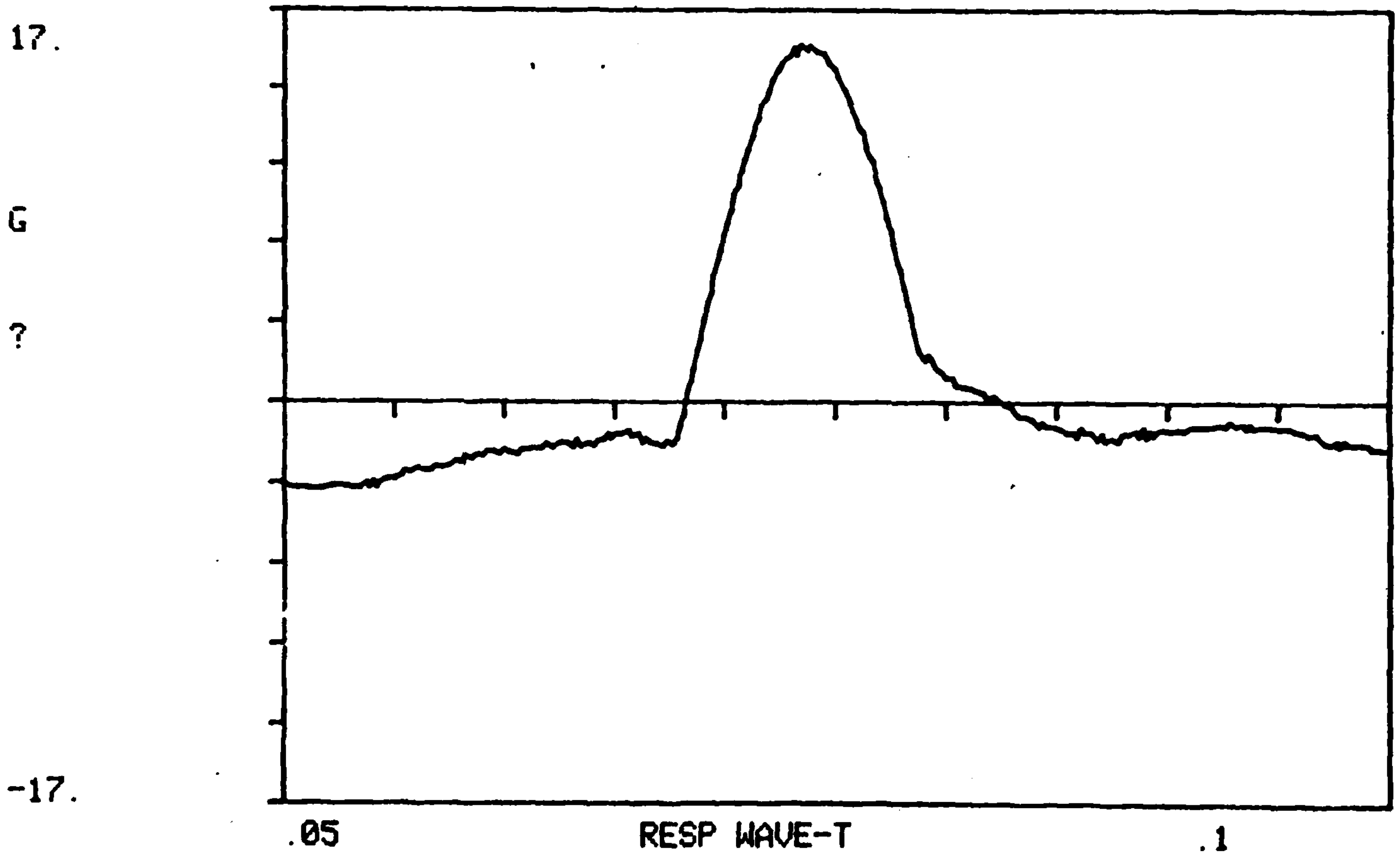
```
1 TEST ID  #20116
  COMMENTS  PERKIN ELMER
2 HEADING  TEST#    AXIS-

SWEEP PARAMETERS
3 MODE  2=LOG(DEC), 1=LOG(OCT), 0=LIN  1
4 START, END FREQ, HZ  5.000,2000.
FREQ RANGE, OCT=8.643
5 SPECIFICATION  1=RATE, 0=DURATION  0
  SWEEP DURATION -- HRS, MIN, SEC  0,25,8
RATE, OCT/MIN   3438

TEST LENGTH
6 SPECIFICATION  1=TIME, 0=SWEEP CYCLES  0
  CYCLES  1.000
TEST TIME -- HRS, MIN, SEC  0,25,8
7 START-UP TIME, SEC  15.00
8 SHUT-DOWN TIME, SEC  4.000

REFERENCE SPECTRUM
9 UNITS 1=METRIC, 0=NON-METRIC  0
10 SPECTRUM LIMITS
   DISPLACEMENT, IN(P-P): 1.000

   ACCELERATION, G  100.0

11 TYPE, VALUE, FREQ  0, 2000,14.00
   ALARM LIMIT +DB, -DB  1.000,-1.000
   ABORT LIMIT +DB, -DB  6.000,-6.000

12 TYPE, VALUE, FREQ  2,2.000,33.00
   ALARM LIMIT +DB, -DB  1.000,-1.000
   ABORT LIMIT +DB, -DB  6.000,-6.000

13 TYPE, VALUE, FREQ  0, 03600,52.00
   ALARM LIMIT +DB, -DB  1.000,-1.000
   ABORT LIMIT +DB, -DB  6.000,-6.000

14 TYPE, VALUE, FREQ  2,5.000,2000
   ALARM LIMIT +DB, -DB  1.000,-1.000
   ABORT LIMIT +DB, -DB  6.000,-6.000

15 TEST LEVEL (DB BELOW REF)  0

16 CONTROL CHANNELS  1
   PROCESS 3=AVG ABS, 2=FUND, 1=PEAK, 0=RMS  1
17 LIMIT CHANNELS  0
18 AUXILIARY CHANNELS  0

   CH 1  10.00
20 NO TRACKING FILTER

21 REFERENCE CHANNEL  1
22 RESPONSE CHANNEL  1
23 MONITOR CHANNEL  1

24 COMPRESSION SPEED  2=HIGH, 1=NORMAL, 0=LOW  1
25 LOOP-CHECK FREQ(HZ), MAX DRIVE(VOLTS)   06000,0

REFERENCE LEVELS
 MAX DISPLACEMENT, IN(P-P)   2000
 MAX VELOCITY, IN/SEC  8.799
 MAX ACCELERATION, G  5.000
 MIN ACCELERATION, G   2555
 ACCELERATION RANGE  DB  25.37

REPETITIONS? 0
CH ST 0
```

14



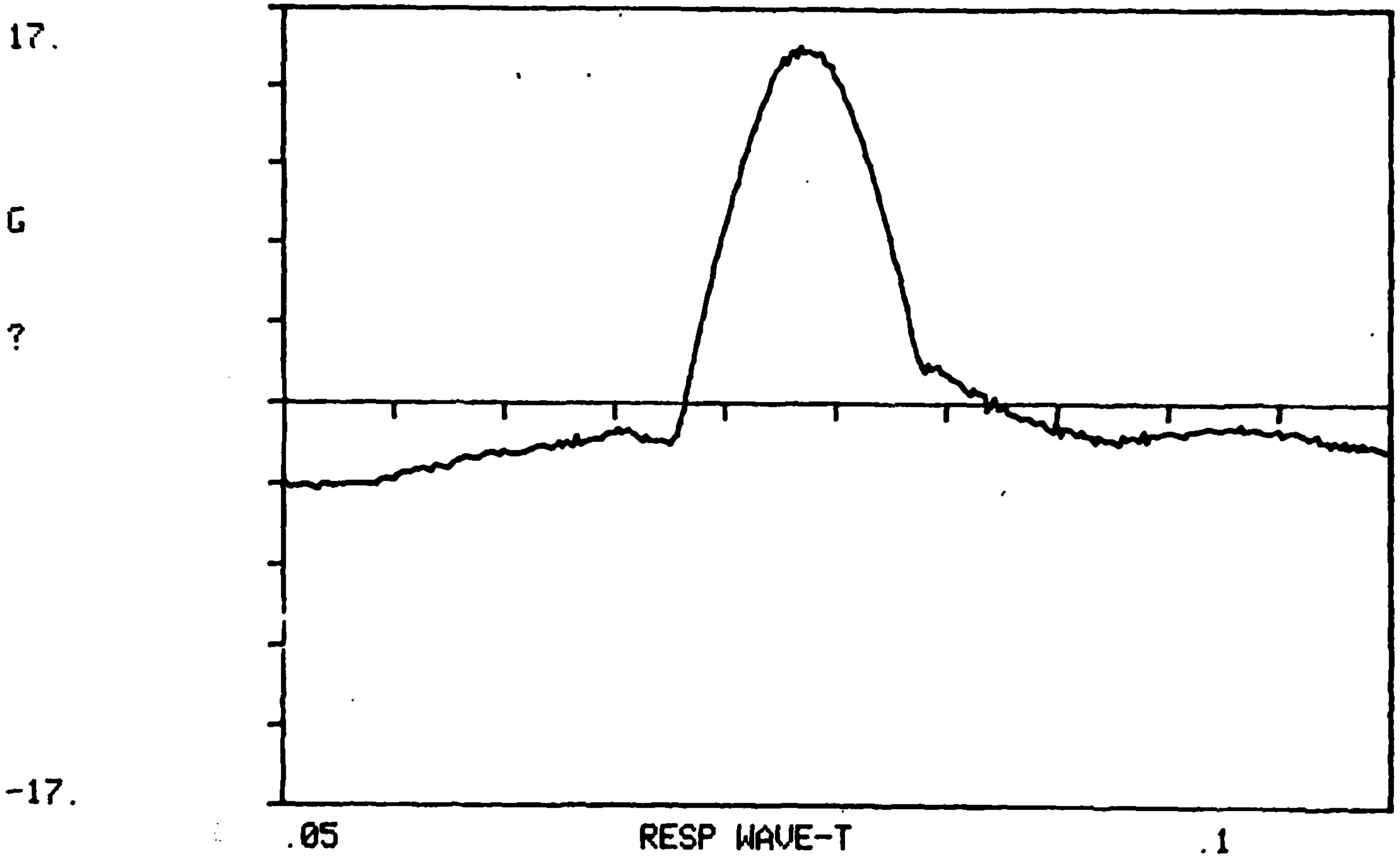
Test # 5 Second pulse
X1 AXIS

14-(



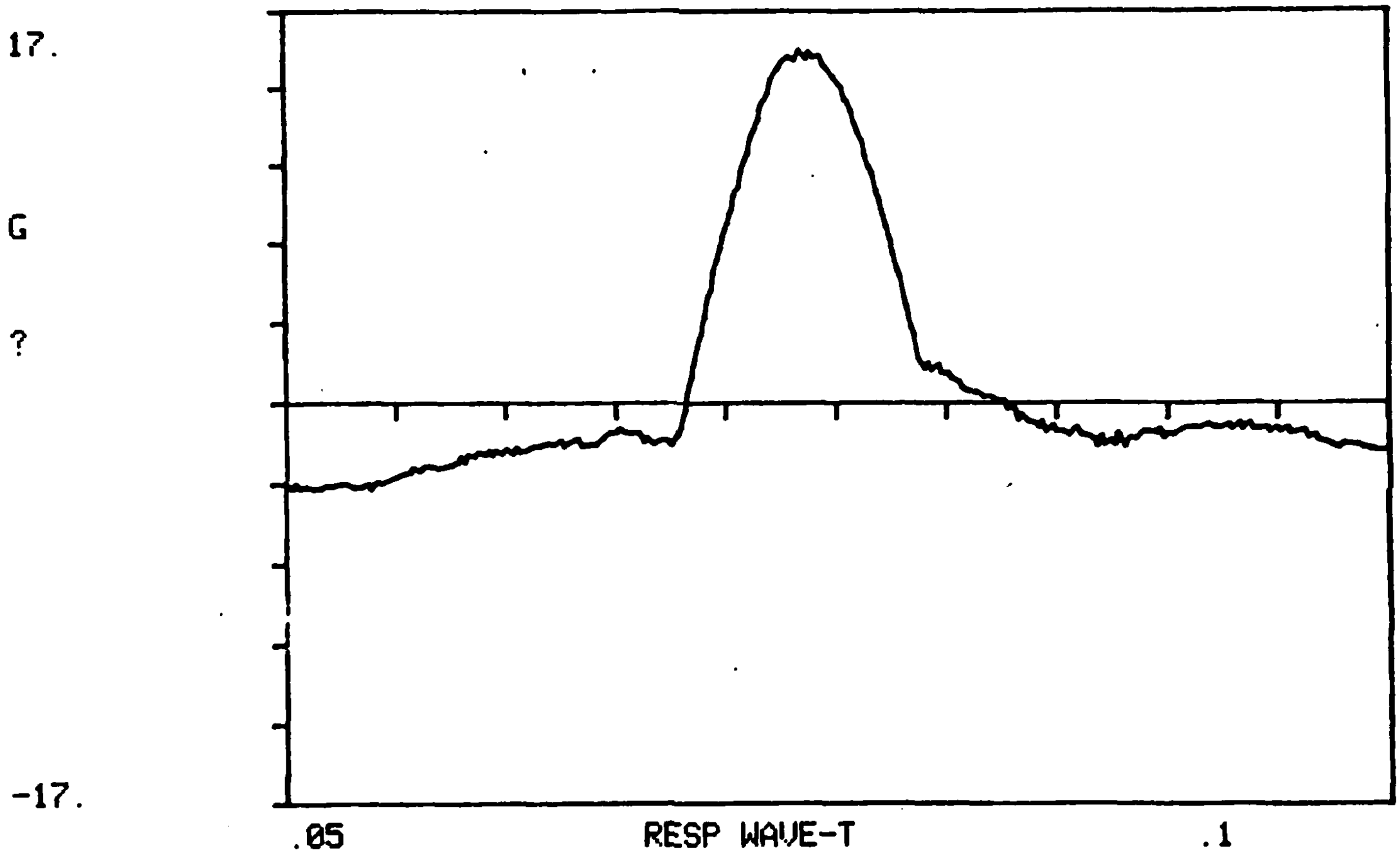
Test # 5 First pulse
X1 AXIS

14-7



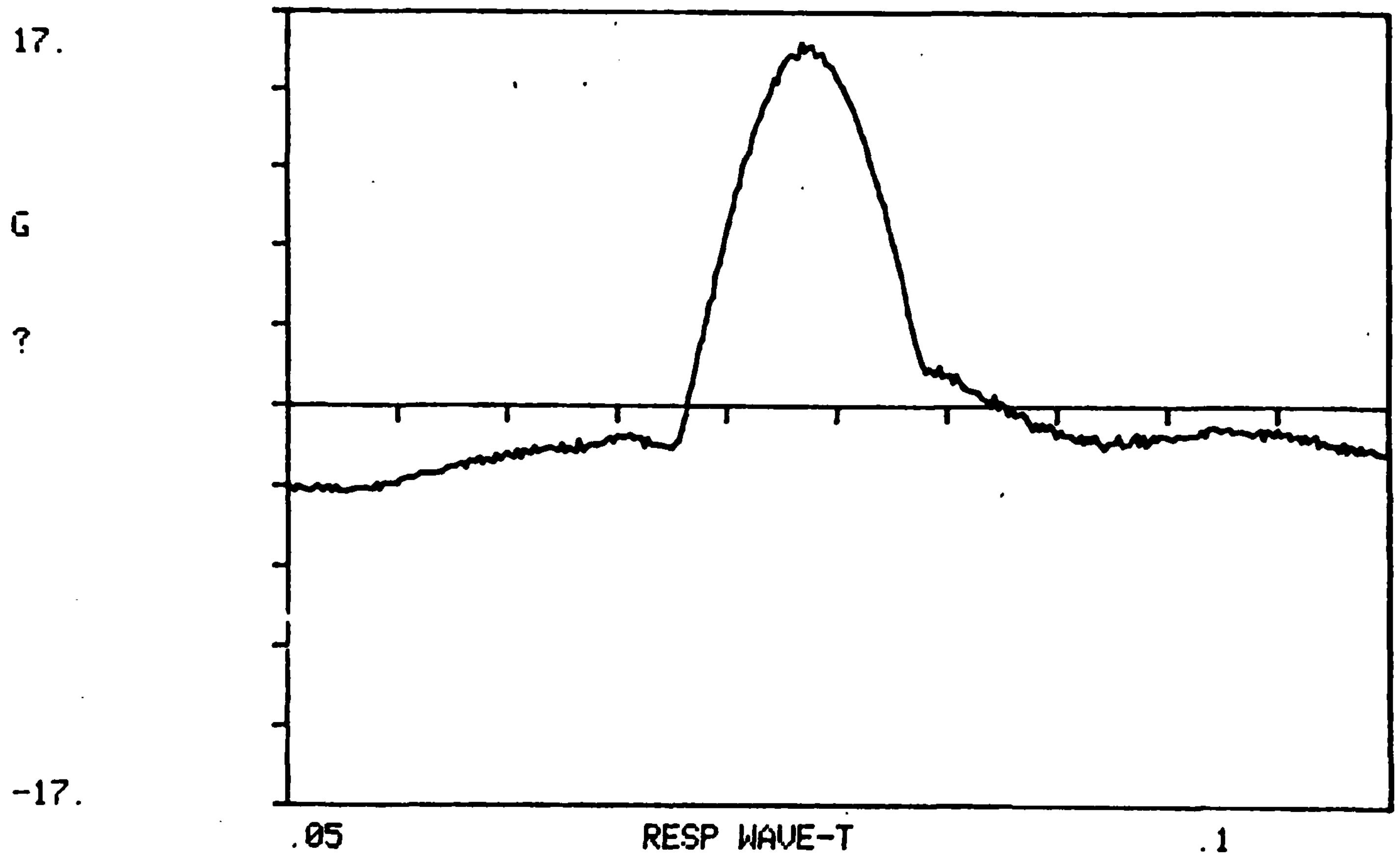
Test # 4 second pulse
y1 AXIS

14-0



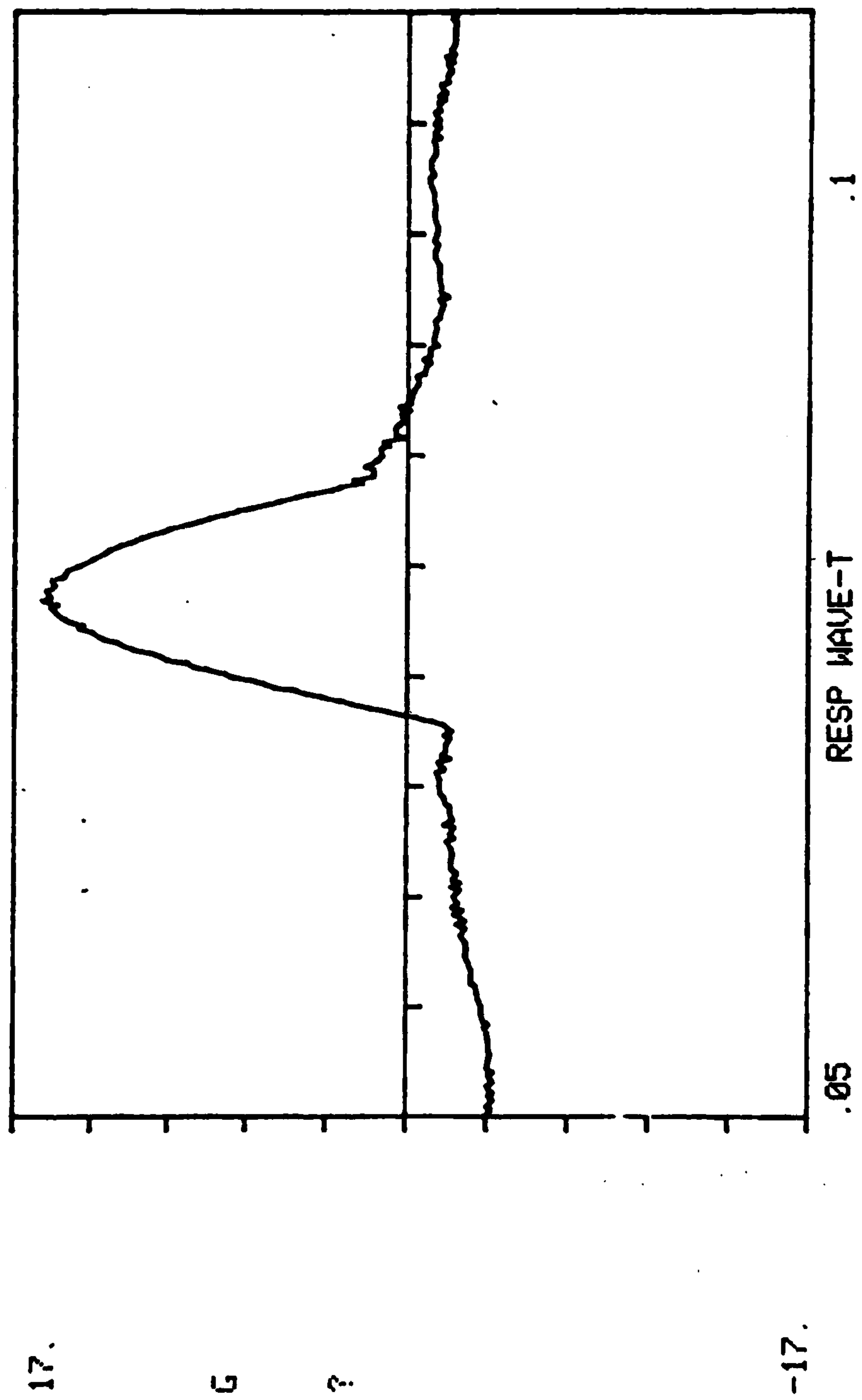
Test # 4 first pulse
Y1 Axis

14-7



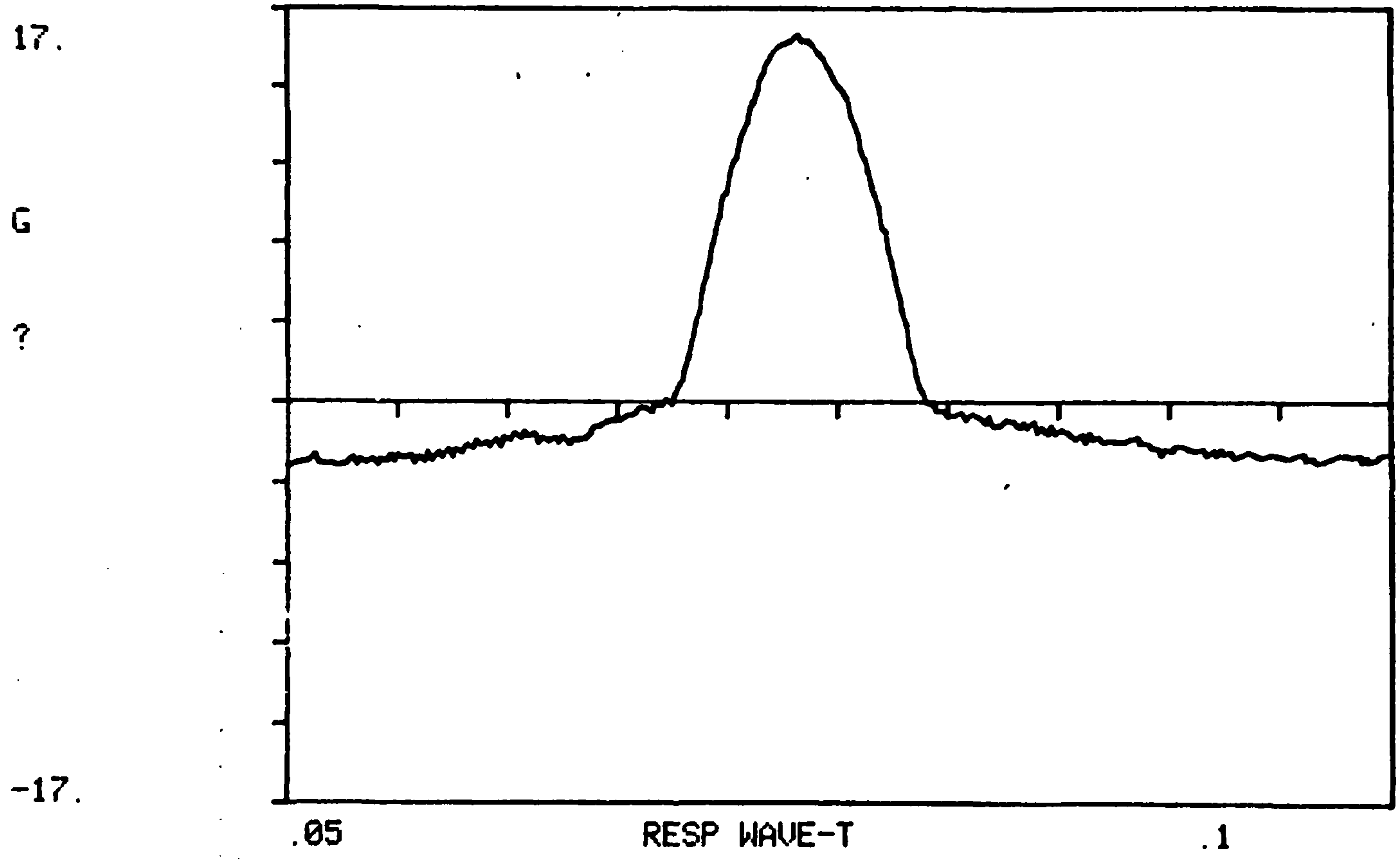
Test # 3 second pulse
Y2 Axis

14-10



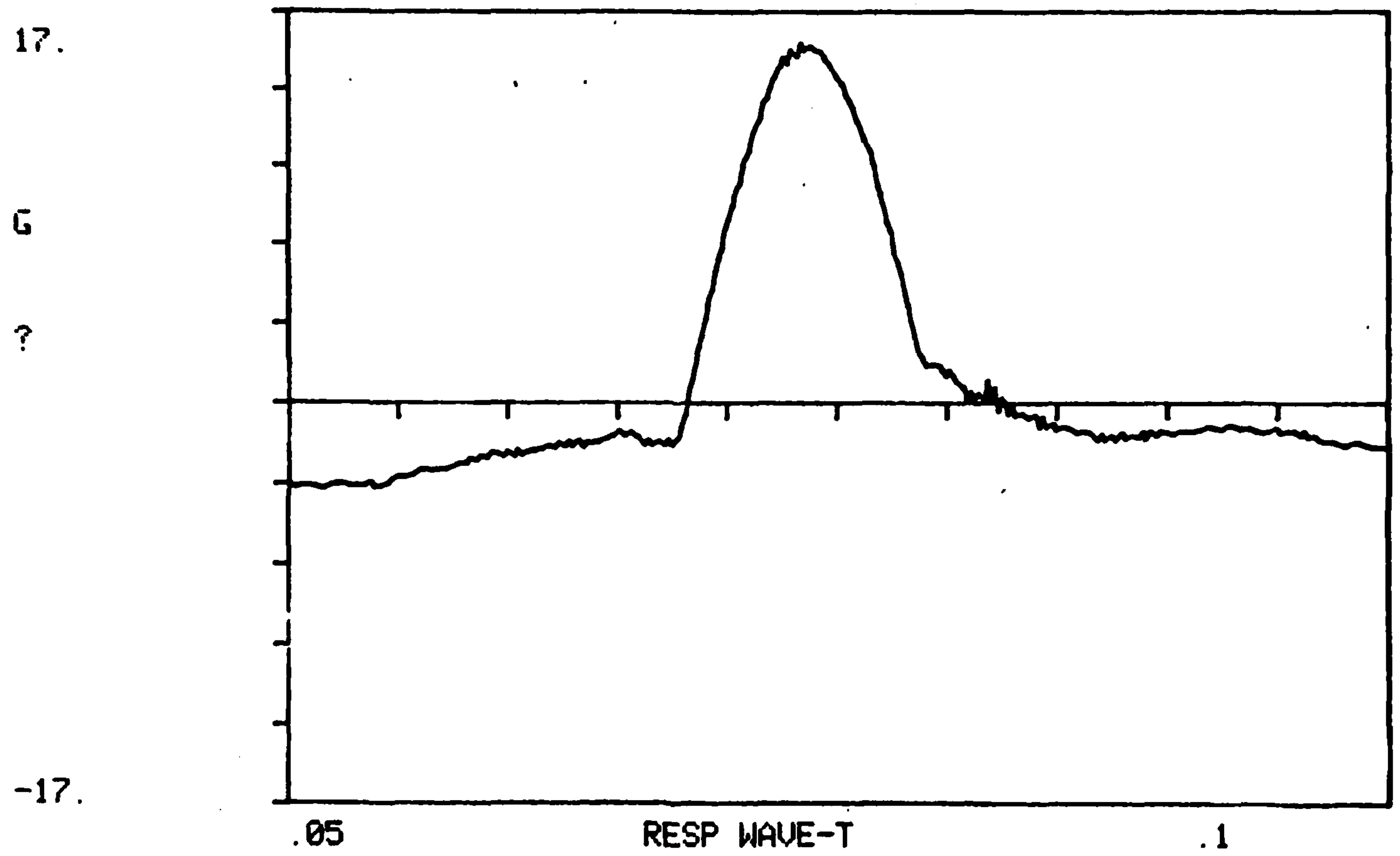
Test #3 First pulse
Yd AXIS

14-11



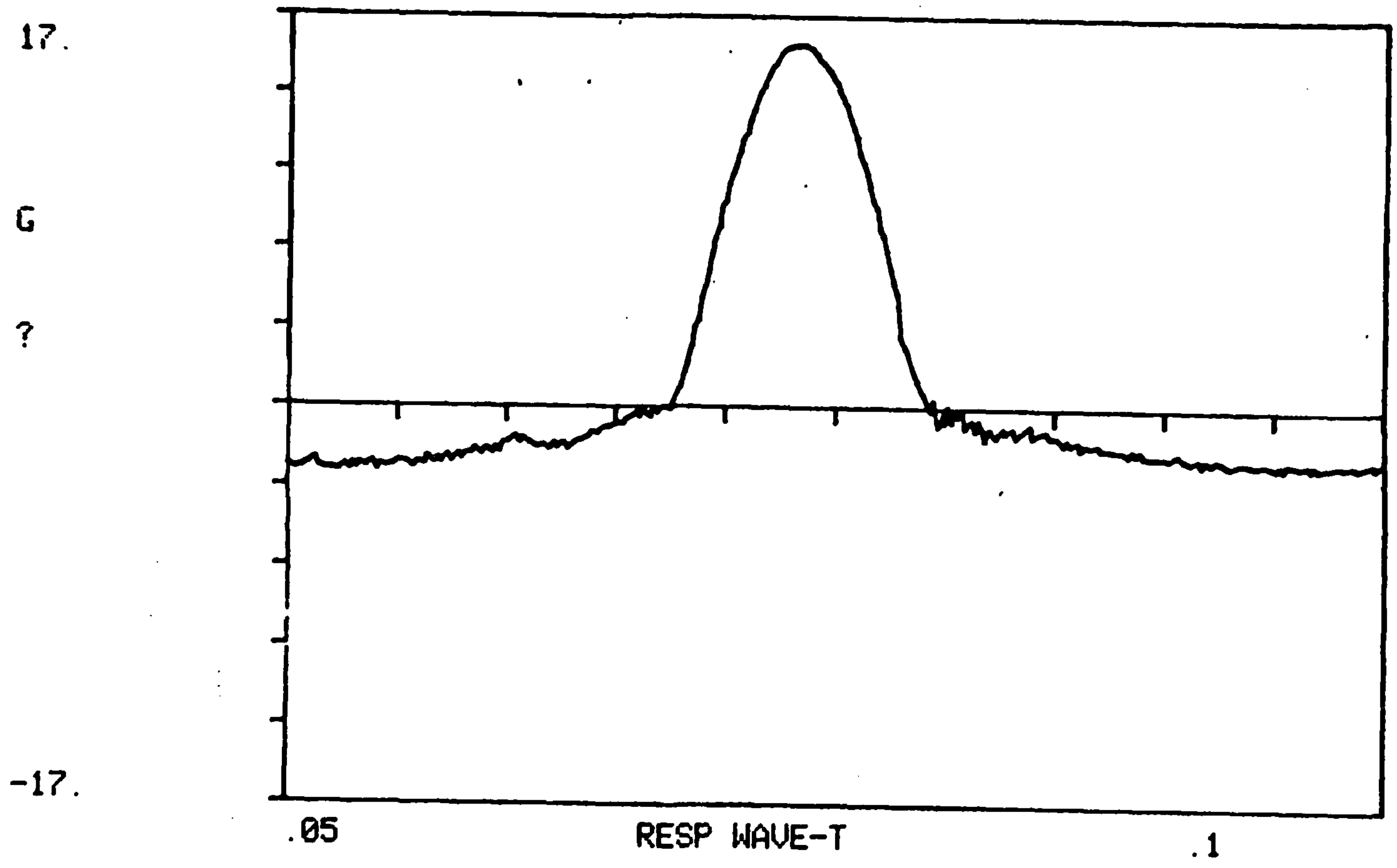
Test # 2 pulse #1
Y1 Axis

14-.2



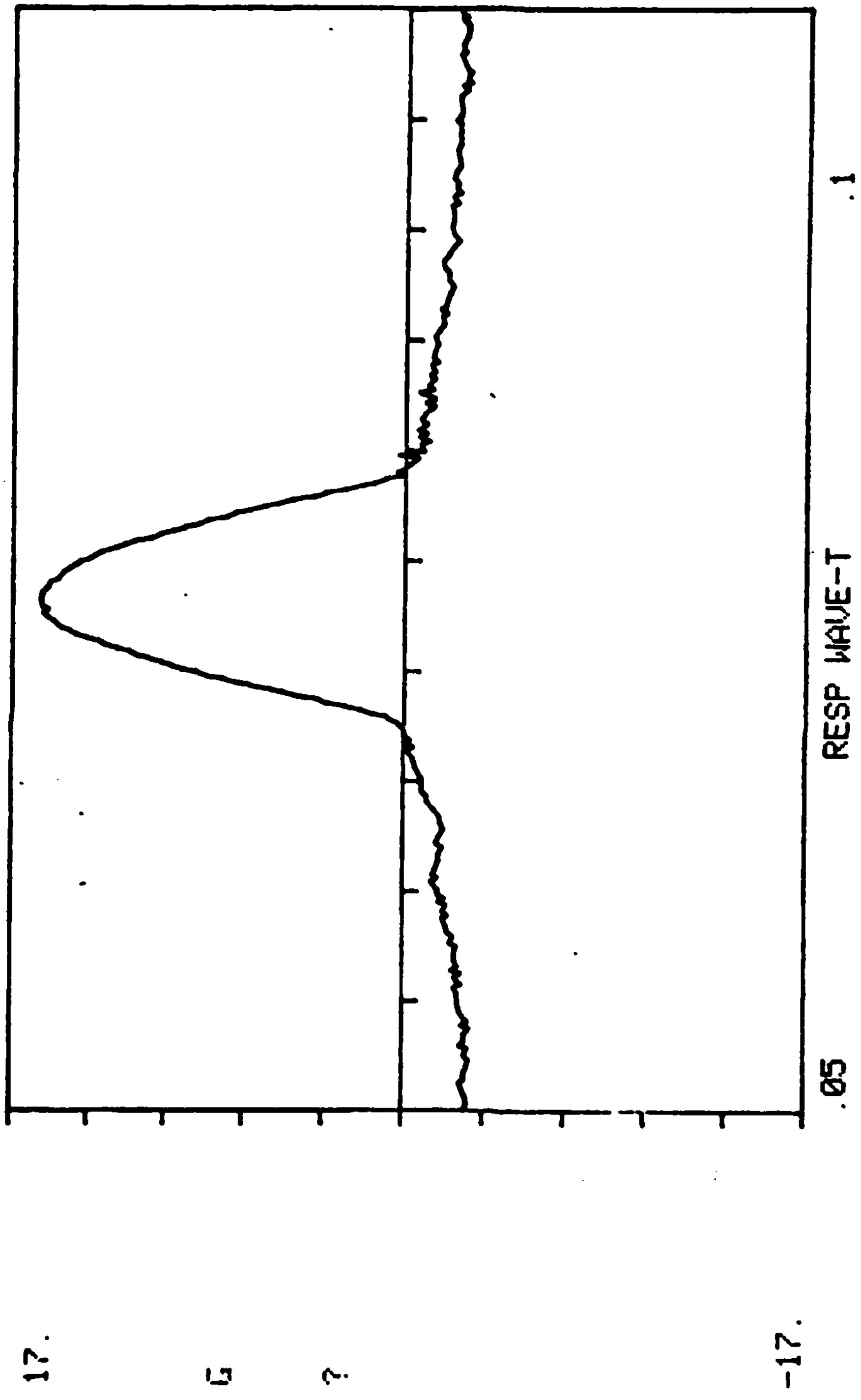
Test # 2 second pulse
Y1 AXIS

14-



Test # 1 First pulse
y2 Axis

- 14 -

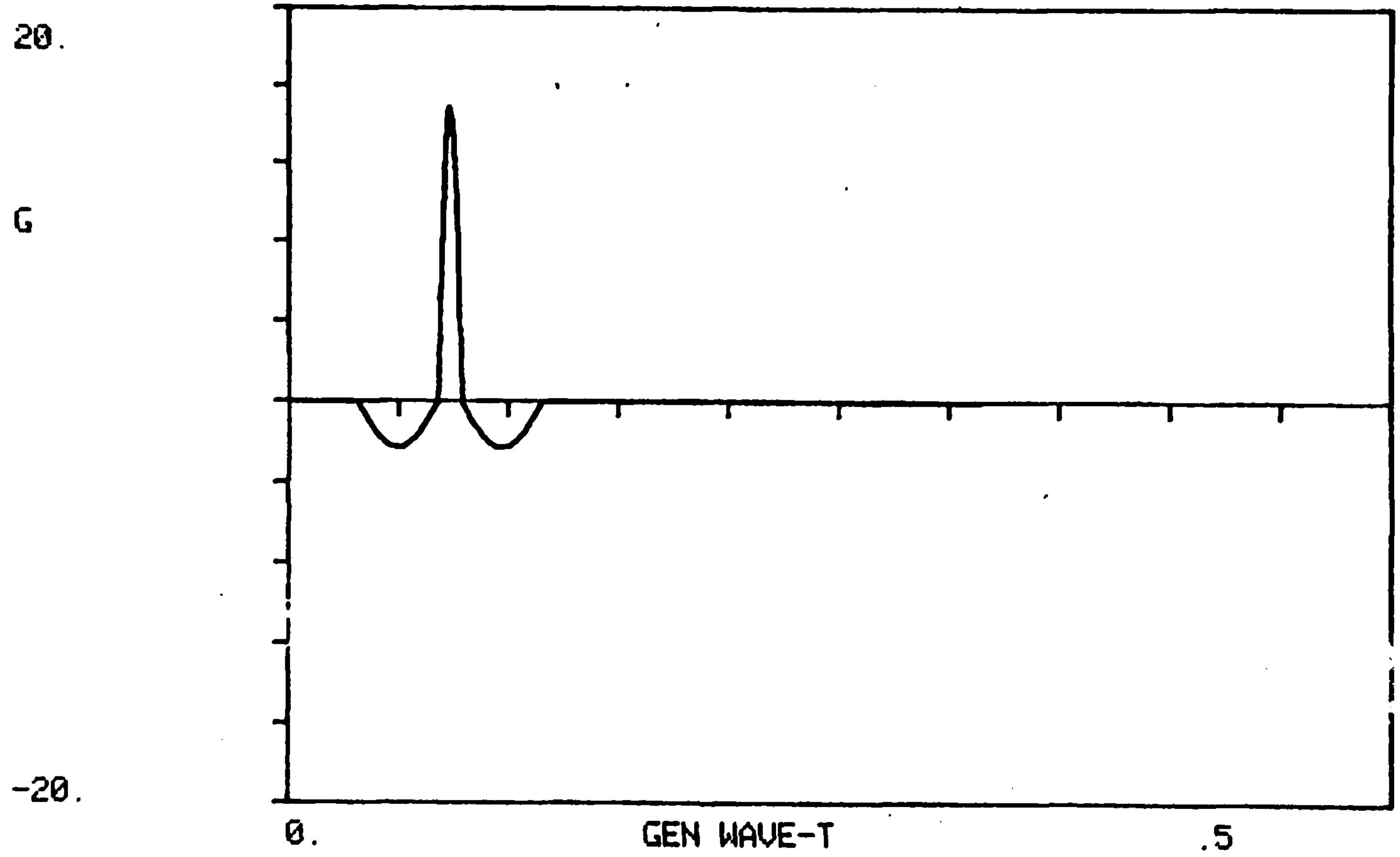


Test #1 Second pulse
y2 axis

14-5

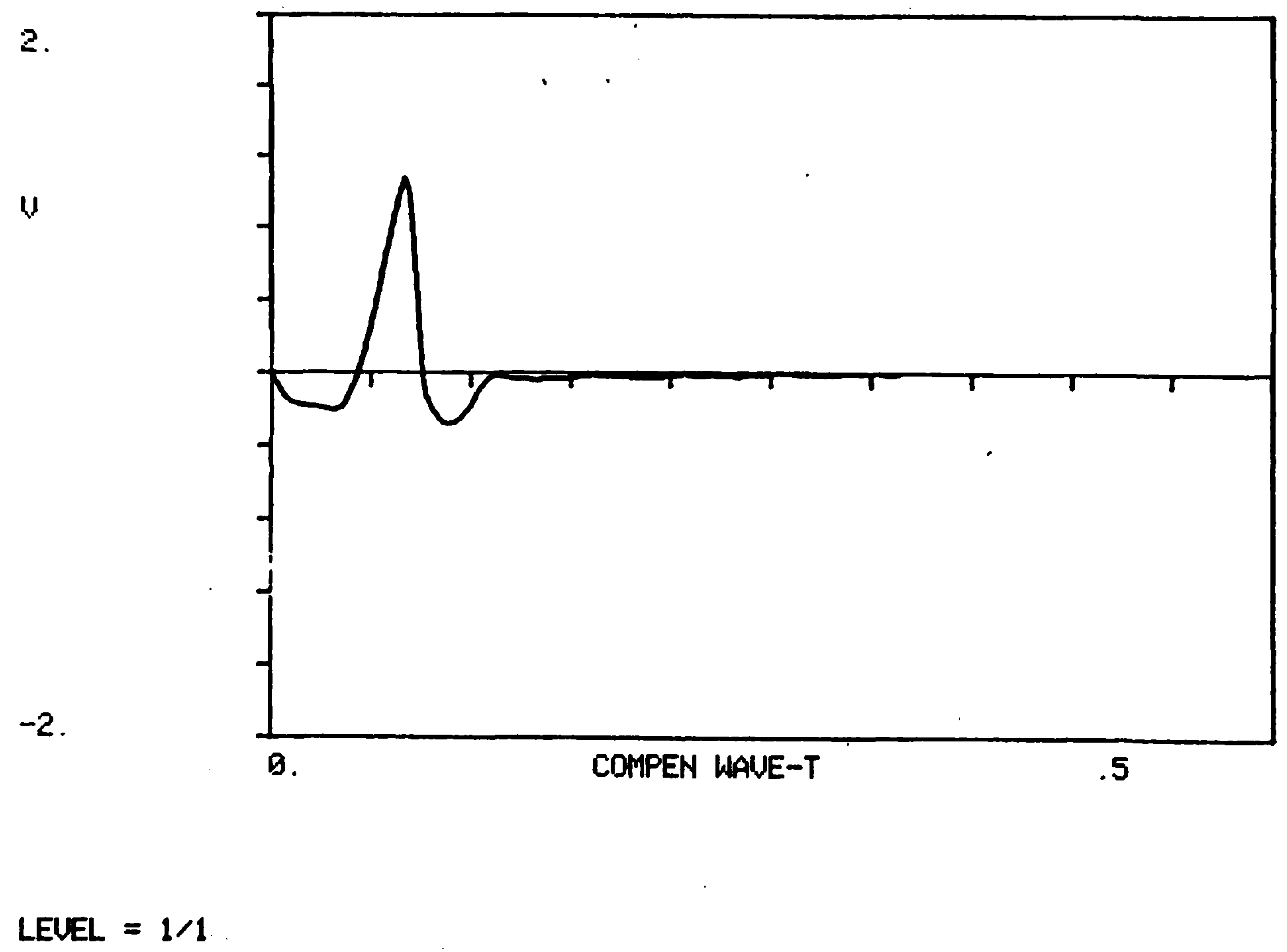
```
1 HEADING:
2 SENSITIVIIY(MV/G):10.
3 WAVE TYPE: 0=HS 1=SQ 2=ST 3=TR 4=DP 5=ANALOG 6=DIGITAL:0
4 DURATION(MS):11.
5 AMPLITUDE(G):15.
6 % IN TAILS:15.
9 CAL PULSE AMPL(V):.1
10 AUTO MODE LEVEL SEQ 0=FULL 1=1/2 2=1/4 3=1/8 4=1/16 5=DONE
  FIRST:5
11 SHOCK RESP DEFN 0=ABS ACCEL 1=REL DISPL:0
12 DAMPING COEFF:.05

CORRECTIONS 0=NO 1=YES:
```

14 - 6

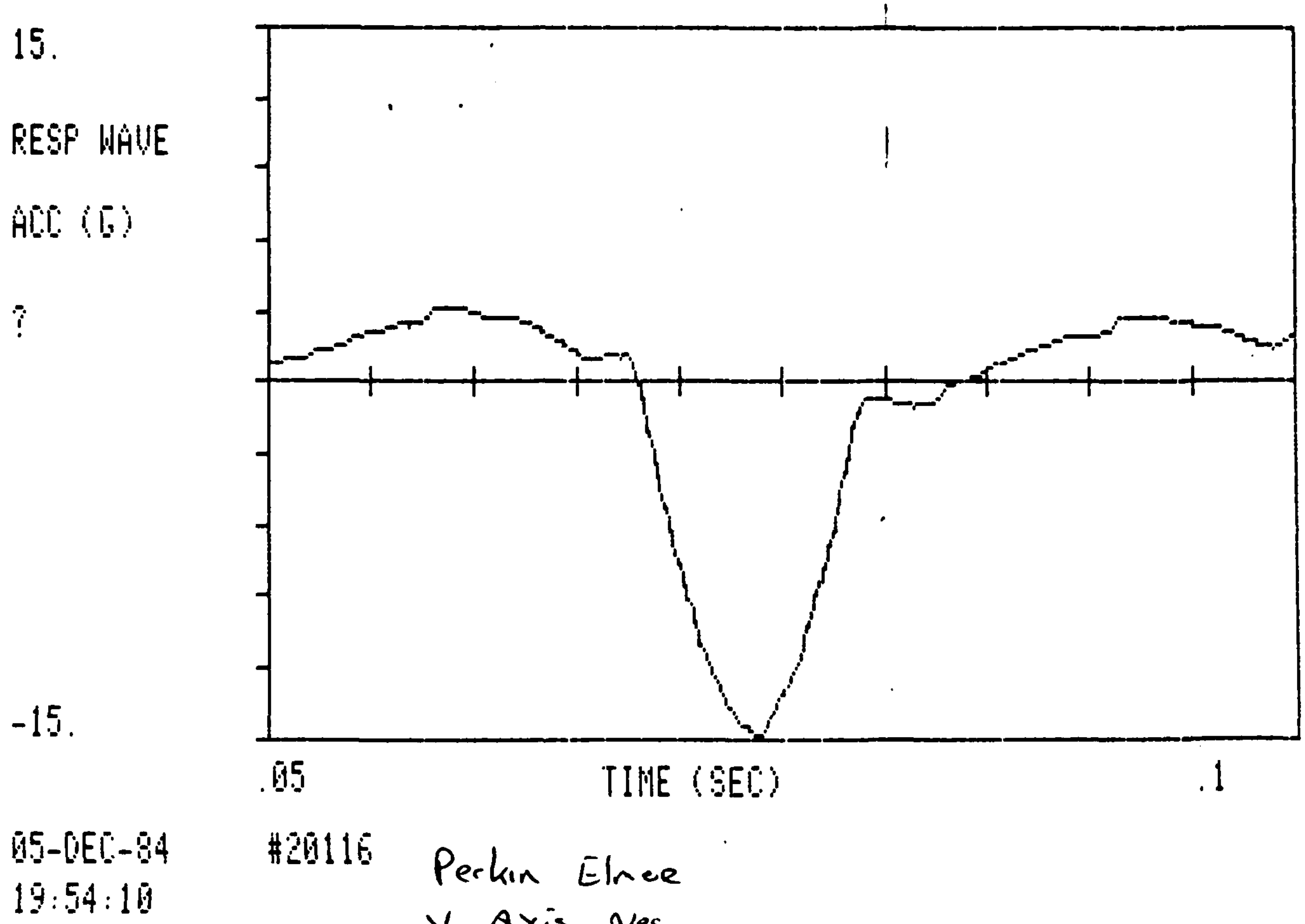


ACCEL	-2.25	14.99	G
VELOC	-20.21	20.32	IN/S
DISPL	-.4399	.0275	IN

14 -

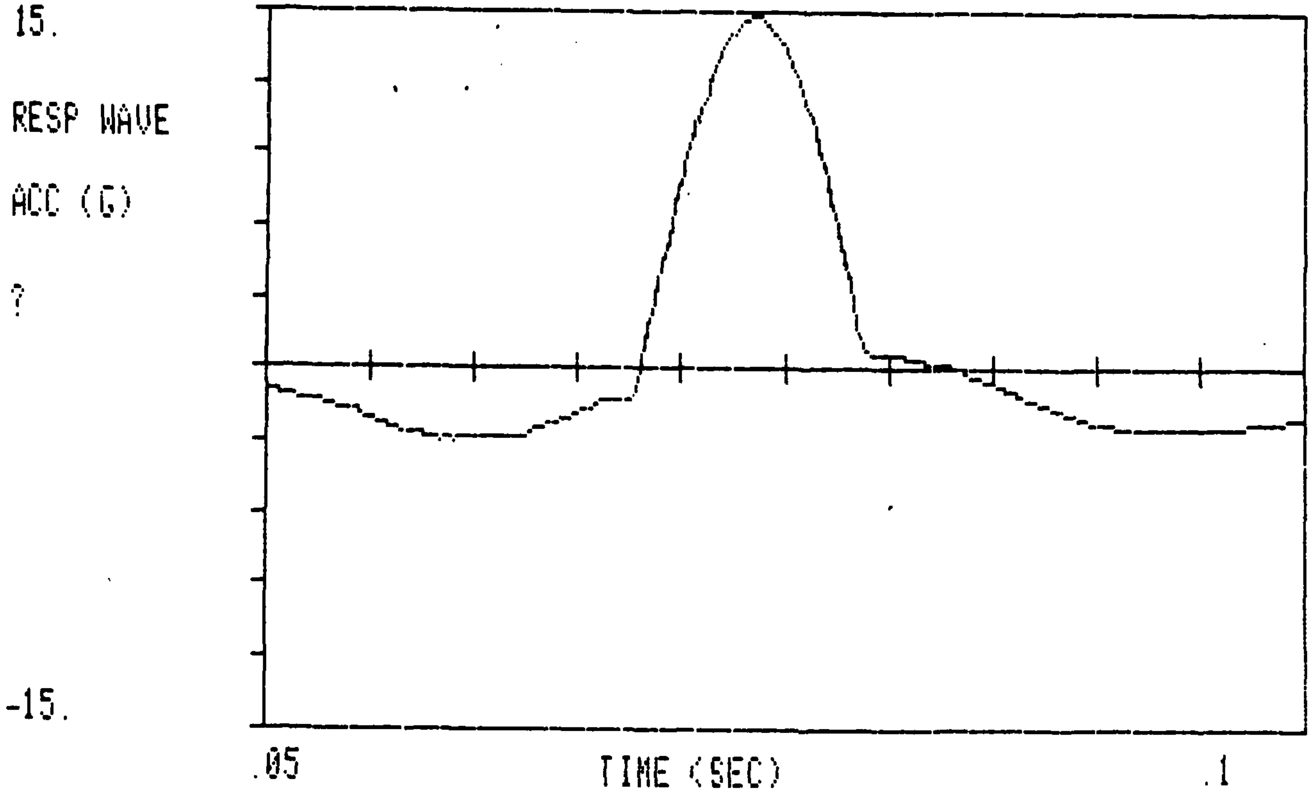


14-16



Perkin Elmer
Y Axis Neg
Typical Response all pulses

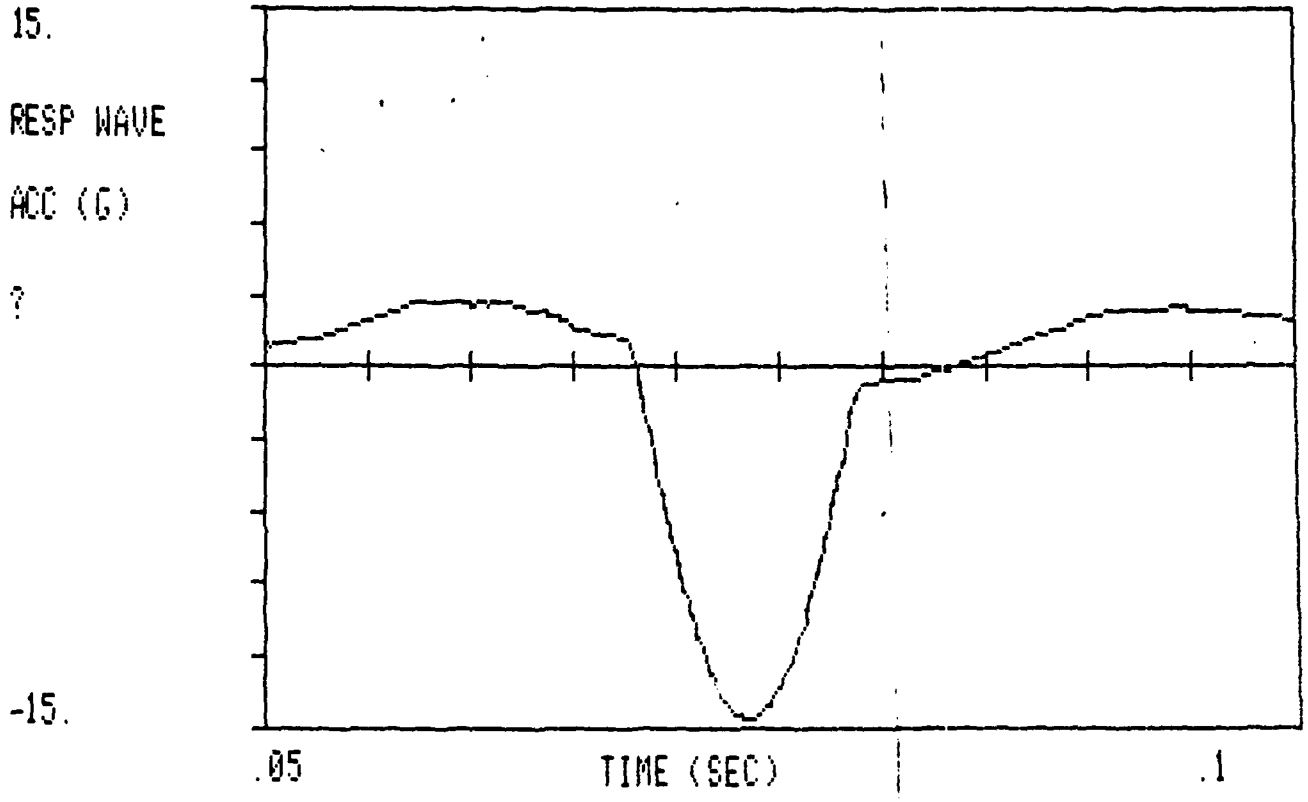
14-



05-DEC-84
19:49:50

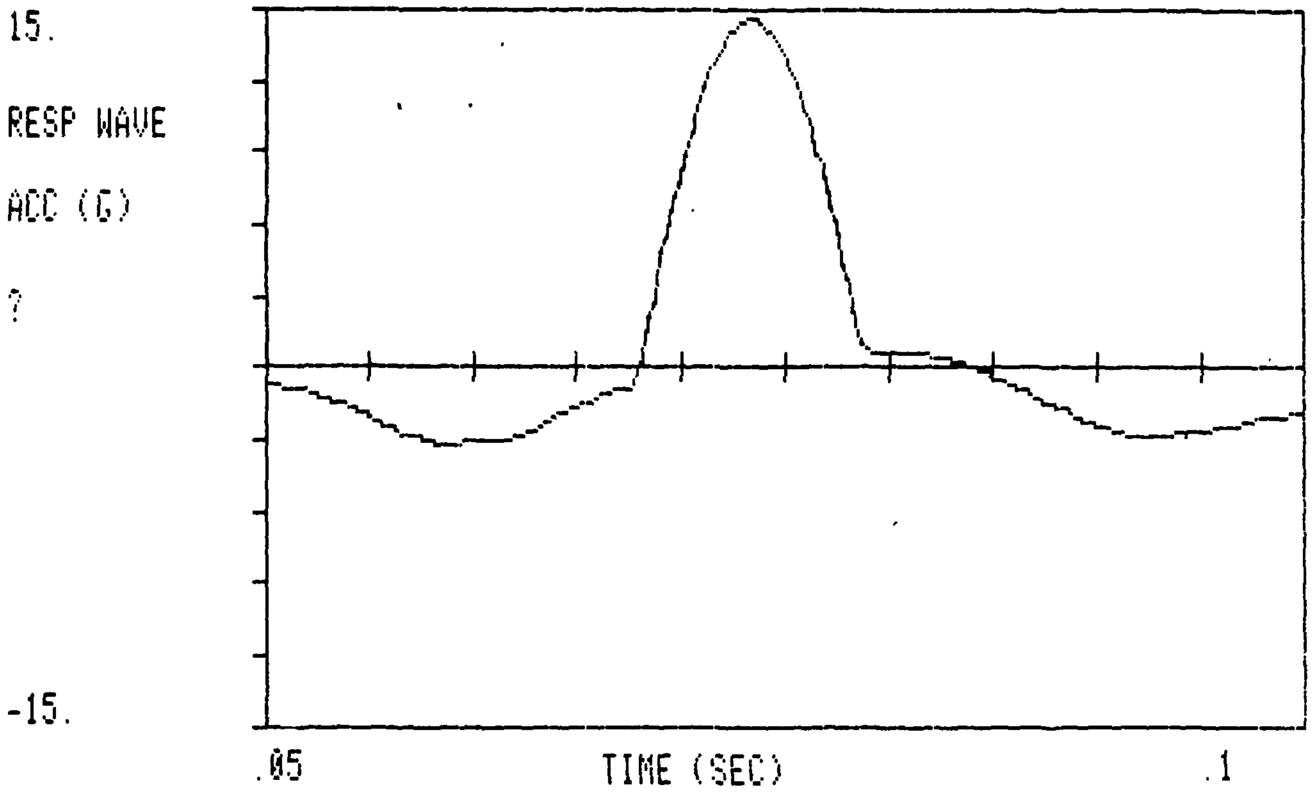
#20116

Perkin Elmer
y Axis pos
Typical Response all pulses



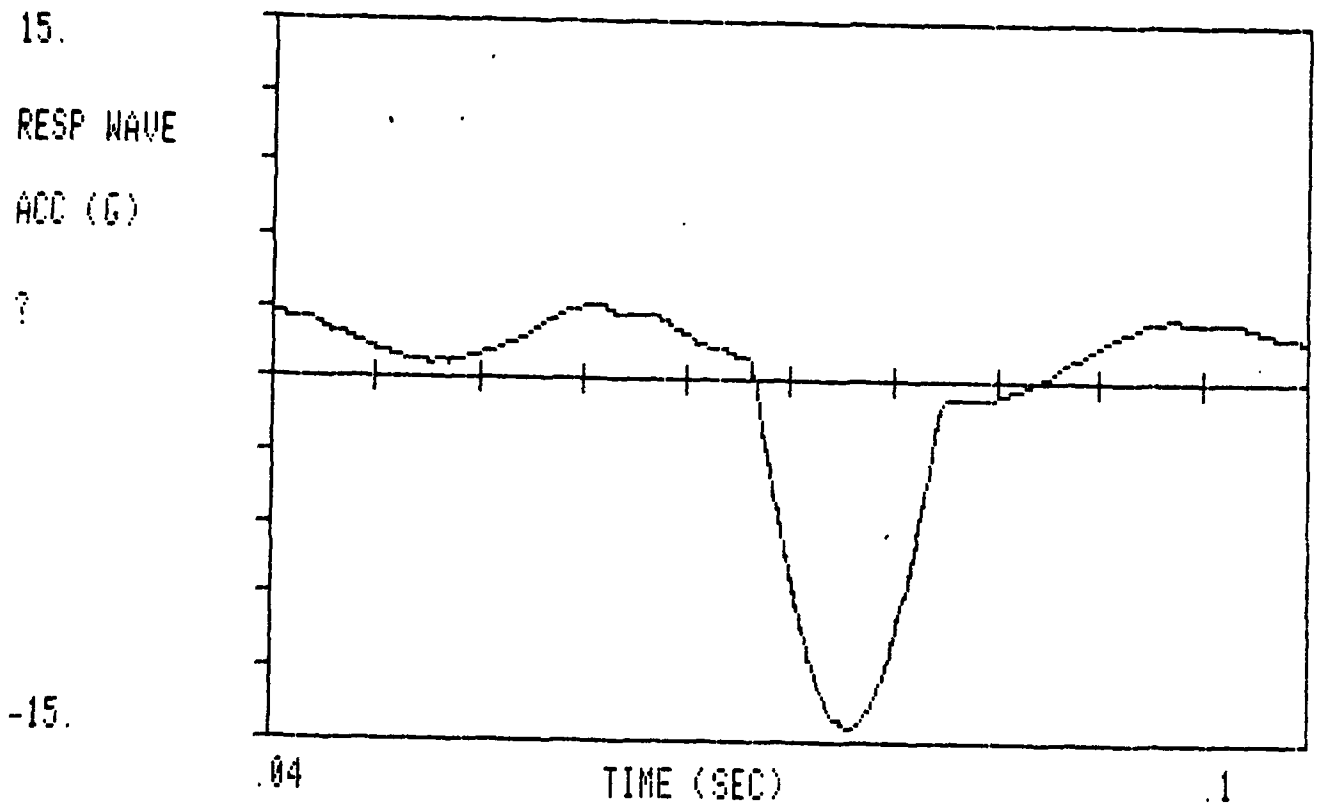
Perkin Elmer
X Axis Neg
Typical Response All pulses

14-21



05-DEC-84 #20116 Perkin Elmer
19:35:40 X Axis pos

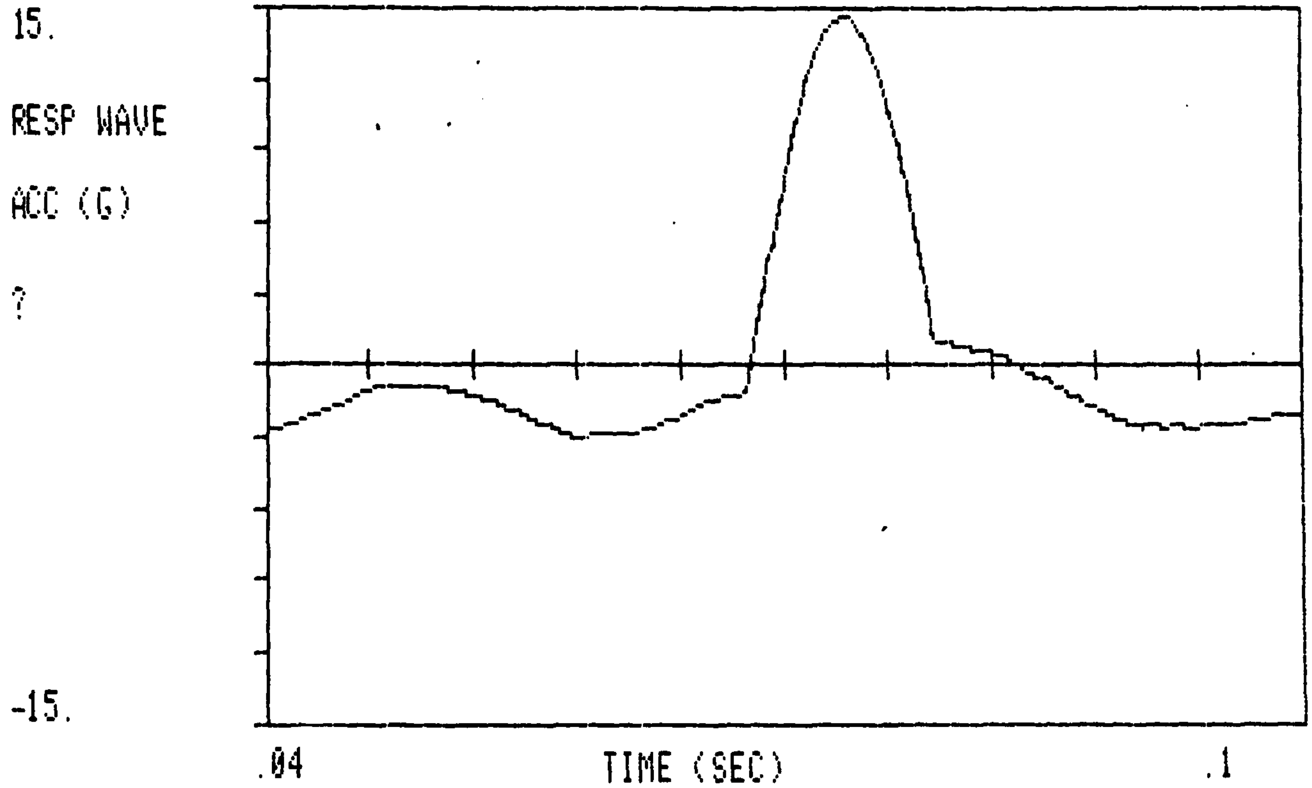
Typical Response All pulses



05-DEC-84 #20116 Perkin Elmer.
19:26:30

2 Axis Neg

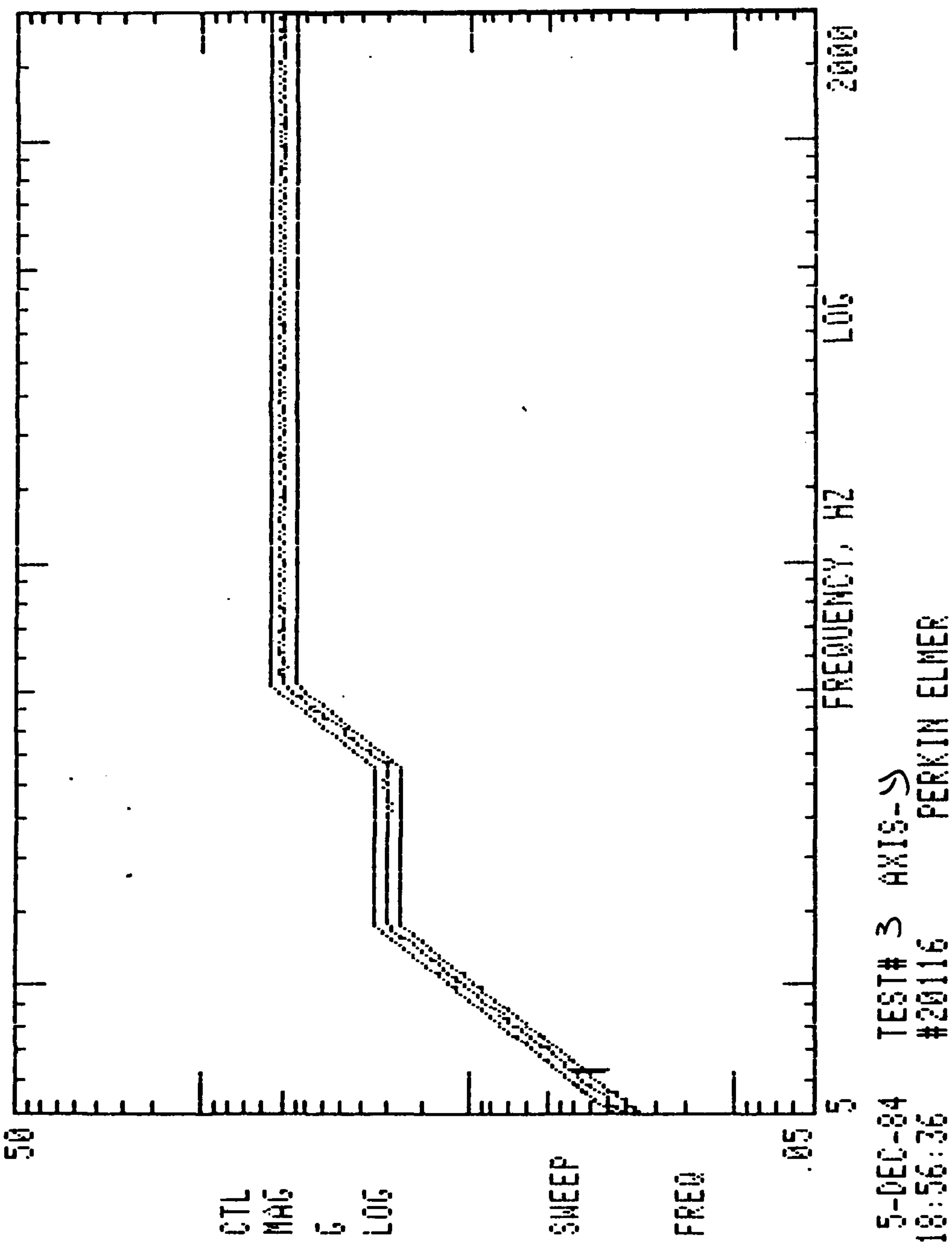
Typical Response All pulses



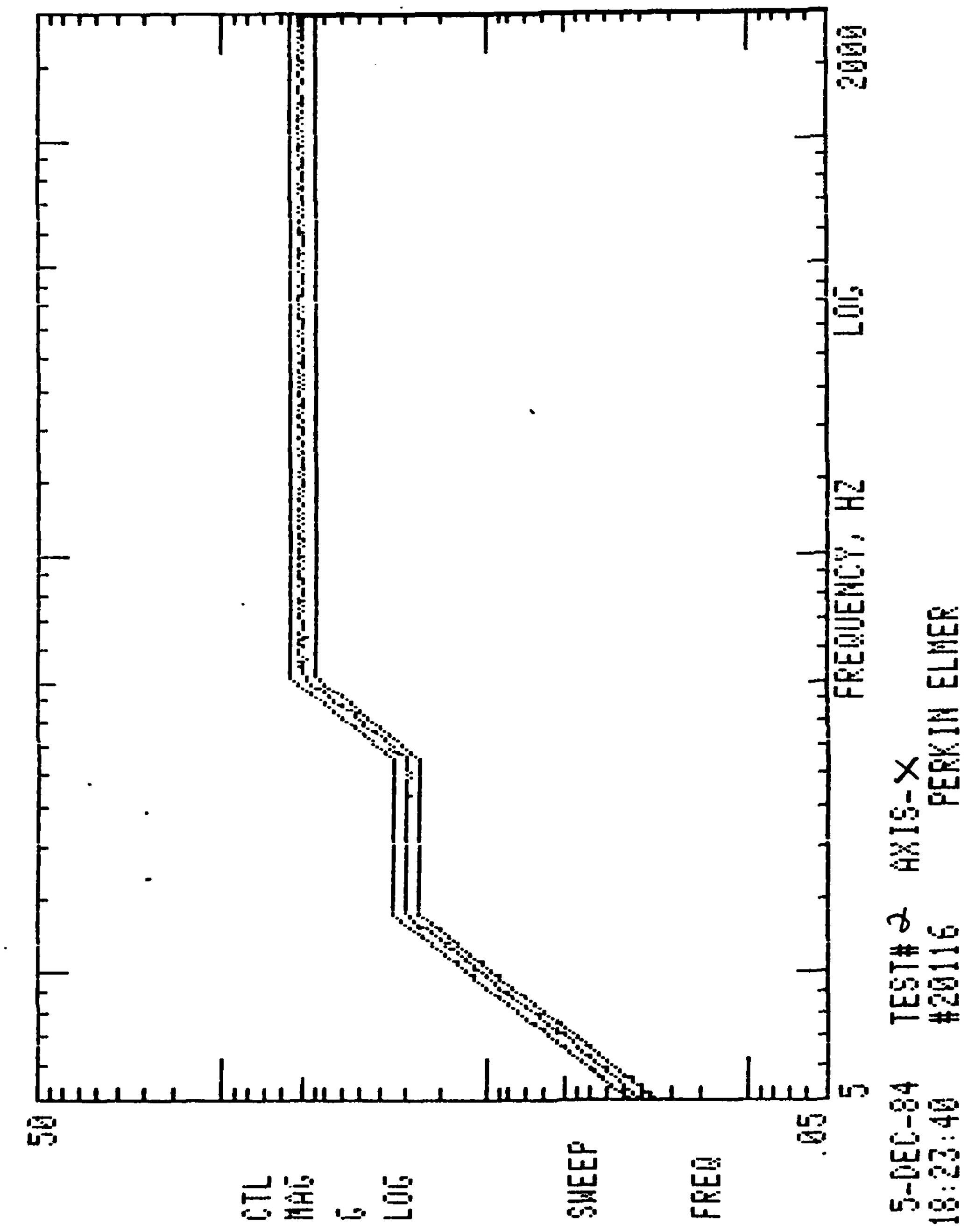
05-DEC-84 #20116 Perkin Elmer
19:21:30

Z Axis pos

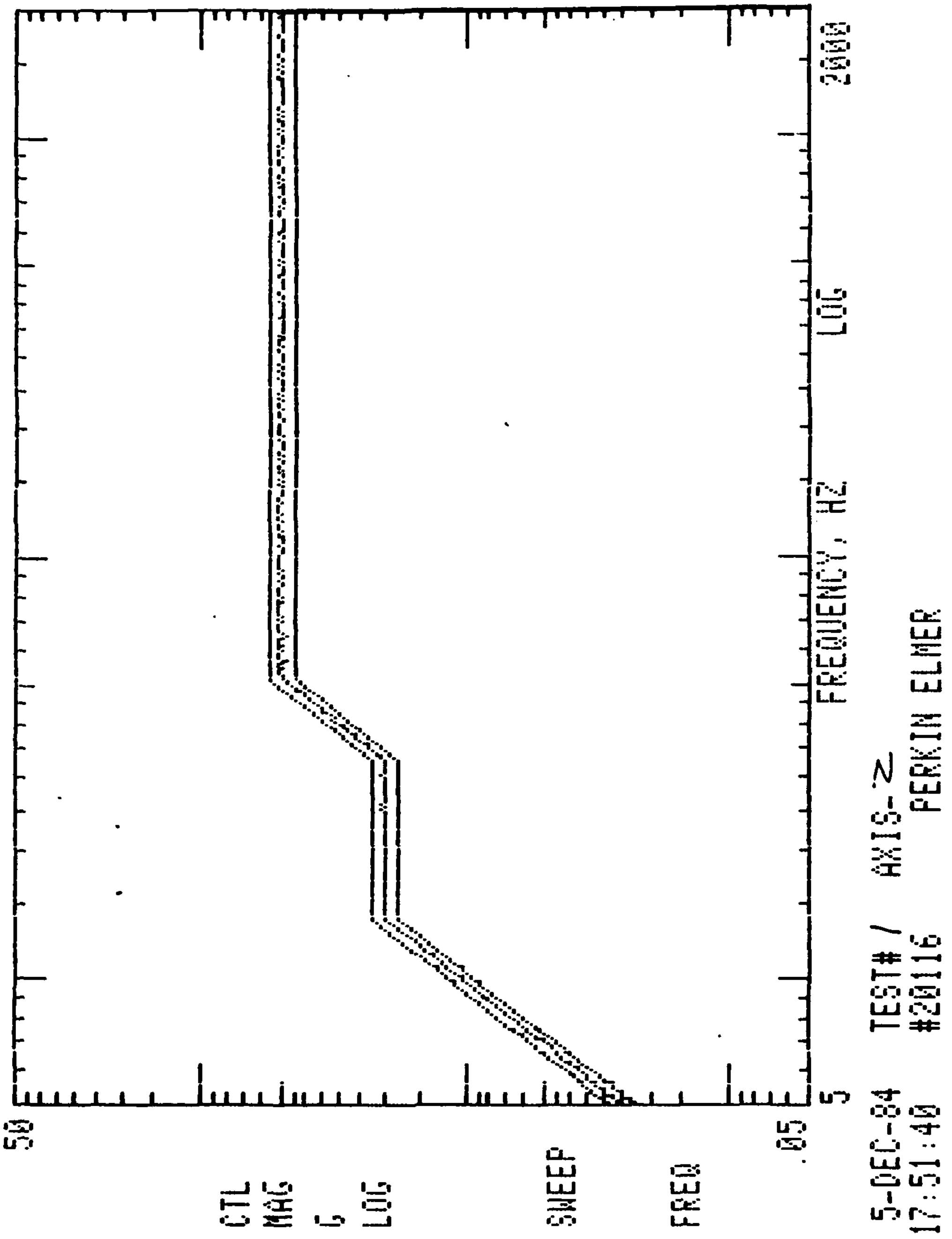
Typical Response All pulses


50
.05
5
2000
FREQUENCY, HZ
LOG
CTL
MAG
G
LOG
SWEEP
FREQ
5-DEC-84
18:56:36
TEST# 3 AXIS-Y
#20116
PERKIN ELMER

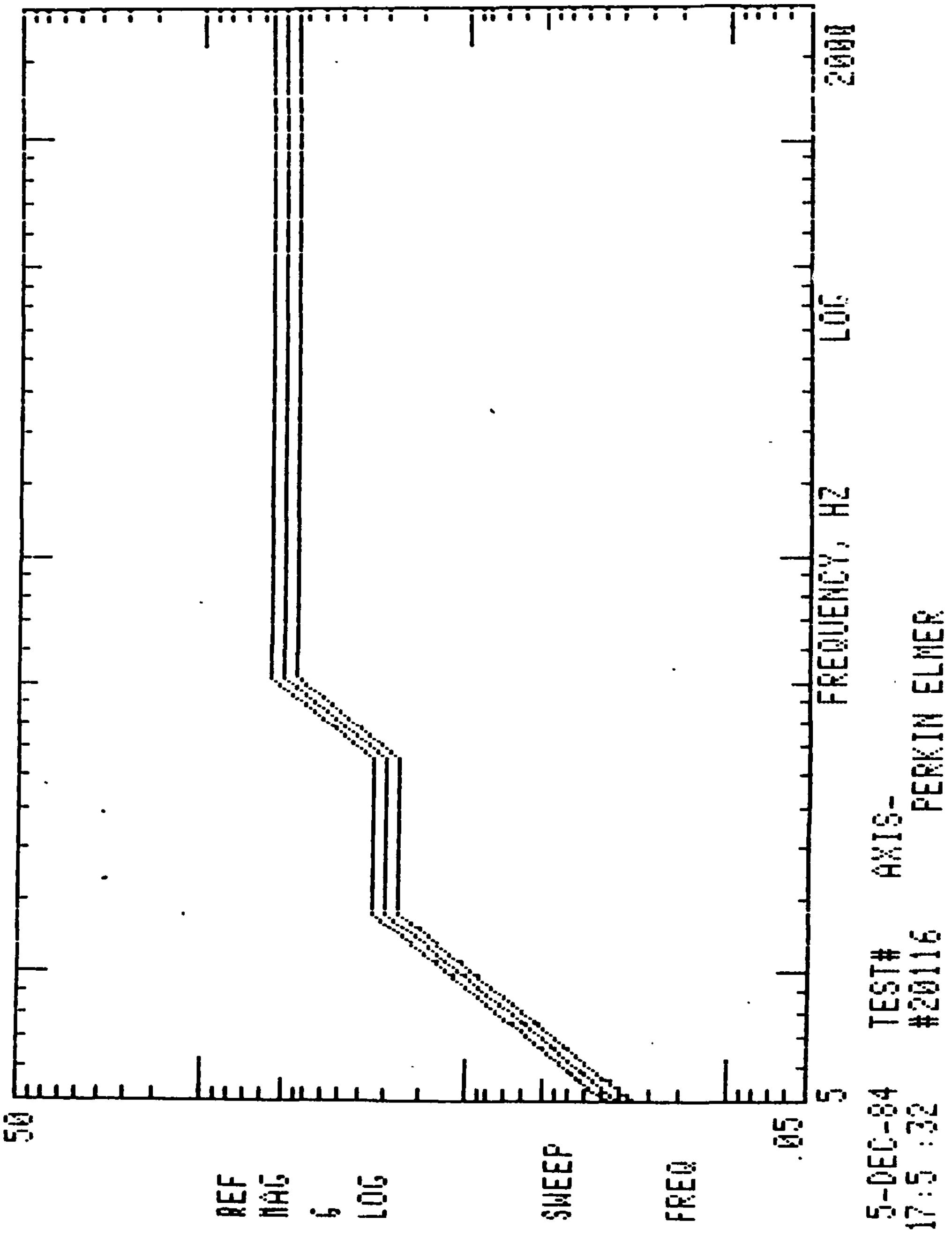
14-25


50
.05
CTL
MAG
G
LOG
SWEEP
FREQ
5
2000
FREQUENCY, HZ
LOG
5-DEC-84
18:23:40
TEST# 2 AXIS-X
#20116 PERKIN ELMER

14 -26


50
CTL
MAG
G
LOG
SWEEP
FREQ
.05
5
2000
FREQUENCY, HZ
LOG
5-DEC-84
17:51:40
TEST# / AXIS-Z
#20116
PERKIN ELMER

14-21


50
.05
REF
MAG
&
LOG
SWEEP
FREQ
5
2000
FREQUENCY, HZ
LOG
5-DEC-84
17:5 :32
TEST#
#20116
AXIS-
PERKIN ELMER

14-20

APPENDIX B

SPECIFICATION NO DV 890-6111A
SMALL InAs DETECTORS

PERKIN-ELMER
ELECTRO-OPTICAL DIVISION, NORWALK, CONN.

SPECIFICATION NUMBER DV890-6111
CODE IDENT 49555
REVISION LETTER A
DATE 16 June 81
PAGE 1

SPECIFICATION SMALL InAs DETECTOR

PREPARED BY: C. Neuner/J. Hunczak

APPROVED BY:

ENGINEERING:

PRODUCT ASSURANCE:

STANDARDS J. Hunczak 1/27/21

PERKIN-ELMER
ELECTRO-OPTICAL DIVISION, NORWALK, CONN.

SPECIFICATION NUMBER DV890-6111
CODE IDENT 46535
REVISION LETTER A
DATE 16 June 81
PAGE ii

SPECIFICATION REVISION RECORD

REVISION	DATE	SCN NO.	ECP NO.	PAGES	APPROVAL
Original	16 Jan. 81	—	—	1-14	
Rev. A	16 June 81	0425	--	1,2,7,8	

PAGE NO.																				
REV. LETTER*																				

PAGE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14						
REV. LETTER*	A	A	-	-	-	-	A	A	-	-	-	-	-	-						

*REFLECTS LAST INDIVIDUAL PAGE CHANGE

PERKIN-ELMER
ELECTRO-OPTICAL DIVISION, NORWALK, CONN.

SPECIFICATION NUMBER DV890-6111
CODE IDENT 46555
REVISION LETTER A
DATE 16 June 81
PAGE 1

INTERDIGITATED INFRARED DETECTOR

1.0 SCOPE

1.1 This specification establishes the requirements for a dual two element interdigitated infrared detector for use from 1.1 to 3.5 microns, enclosed in a circular package.

2.0 APPLICABLE DOCUMENTS

The following documents of the issue in effect on date of invitation to bids, form a part of this specification. In the event of conflict, the requirements of this specification shall take precedence.

Specifications:

Military:

MIL-C-45662	Calibration System Requirements
MIL-I-45208	Inspection System Requirements

Standards:

Military:

MIL-STD-750	Test Methods for Semiconductor Devices

3.0 REQUIREMENTS

3.1 Configuration - Each detector shall consist of two pairs of interdigitated comb-like photovoltaic elements formed by diffusion and/or mesa etching in an Indium Arsenide (InAs) wafer. Each comb element consists of nine parallel bars 0.225 mm wide x 5.0 mm long as shown in Drawing C5072420. The detector bars shall be interconnected at one end by wire bonding to a metalized ceramic substrate as shown. The bars of comb A alternate with bars of comb B to produce an interdigitated structure. The detector shall be mounted on a standard integrated circuit header, TEKFORM 80010 or equivalent. A small optical element will also be mounted inside the package.

3.2 Mask Design

3.2.1 Comb Elements - Referring to C5072420, each comb element consists of nine parallel bars spaced alternately with the bars of a second comb. Two pairs of combs are required and the bars for all four combs are shown in the drawing.

3.2.2 Mask Design tolerances, conductor line widths, bonding pad areas, alignment marks, etc., may be adjusted to condorm with the detector manufacturer's normal practice. Mask designs shall be approved by Perkin-Elmer prior to fabrication.

3.3 Packaging

3.3.1 Package - The detector shall be mounted on an integrated circuit header (Tekform type 80010 or equivalent). The package window must allow an unvignetted field of view of ± 0.873 radians. The window shall be made from infrasil and shall have a wedge of 15 milliradians oriented parallel to the detector bars ± 0.0873 radians. The pins must protrude a minimum of 0.140" from the back of the package. See Assembly Drawing C5072405.

3.3.2 Detector Mounting & Wirebonding - The detector shall be mounted on a thin ceramic insulator so as to be isolated from the package at least two parallel redundant wire bonds. This requirement may be waived for leads to individual bar elements.

3.4 Optical Element Mounting - A thin optical filter 12.00 mm x 5.20 mm x 0.060 mm, will be mounted on and aligned to the detector array. Examine the detector surface for any "high" points of material and any other foreign particles. Remove any foreign material. Examine the optical filter surface which will contact the detector surface and remove any foreign particles. The optical element will be as shown in Drawing C5072419. The optical filter shall be positioned symmetrically on the detector pattern so that the center line of the optical filter coincides with the center line of the detector pattern. This will locate the optical filter such that an equal portion of the optical filter will extend beyond the detector pattern on each side. Alignment tolerances will be ± 500 microns for the axis parallel to the detector bars and ± 5.0 microns across the bars. Alignment marks on the filter will register directly with patterns on the detector. The filter will rest directly on the detector and be fastened to the detector surface, the optical filter must be examined to determine that the space between the optical filter and detector surface be < .020 millimeters or a dimension not exceeding one-third the thickness of the optical filter.

3.5 Performance Requirements - Each comb element (9 bars connected together) shall meet the following performance requirements measured at 25°C.

3.5.1 Normal operating bias is 0 volts.

3.5.2 Responsivity:

R = 0.2 A/W minimum @ 1.1μm
R = 0.4 A/W minimum @ 2.0μm
R = 0.6 A/W minimum @ 3.4μm

3.5.3 Impedance Z_J of each comb element shall be greater than or equal to 2.0 ohms at zero bias and 25°C, after separation from the gold conductor resistance.

3.5.4 D*(3.4, 900, 1) = 3 x 10^9 cm $Hz^{½}$/W minimum

3.5.5 Response Time - Rise and fall (10% to 90% points) times shall be measured using a GaAs LED or Laser Diode.

Required:	$t_r \leq$ 500ns	$t_f \leq$ 500ns
Design Goal:	$t_r \leq$ 50ns	$t_s \leq$ 50ns

3.5.6 Crosstalk between intermeshed comb elements shall be less than 10%, as demonstrated by a blackbody spot scan approved by Perkin-Elmer. With the optical element mounted, crosstalk shall be limited to 25% at 45° angle of incidence.

3.5.7 Responsivity Matching - When the detector is uniformly illuminated, the output of the two comb elements in a pair shall be equal with a maximum difference of 5%.

3.5.8 Uniformity of Responsivity - Shall be measured by illuminating the detector thru a 1,0 mm wide slit oriented perpendicular to the bars and located immediately in front of the detector package. As the slit is scanned from one end of the array to the other, the outputs of the two elements in a pair shall vary less than ± 15% and shall remain matched so the maximum difference is less than 10% over the central 4mm section.

3.5.9 Absolute Maximum Ratings:

DC Photo Current: 10 MA

Pulsed Photo Current (PW=10 S, 1% Duty Cycle): 0.3 AMP

Max FWD Current: 0.1 AMP

Max Pulsed Laser Irradiance: 10^{-3} J/cm^2, P.W. = 20ns

3.6 Environmental Requirements

The units shall be capable of being subjected to the following tests and conditions, and still meet the requirements of Tables II & III.

3.6.1 Operating Temperature

The units shall be capable of being operated in an ambient temperature range of -54°C to +85°C.

3.6.2 Storage Temperature

The unit shall be capable of being stored in an ambient temperature range of -62°C to +85°C for three years.

3.6.3 Barometric Pressure

The units shall be capable of being stored and operated in a barometric pressure range of room ambient to 225.8mm of mercury.

3.6.4 Vibration-Sine

The unit shall be capable of operating during and after exposure to the following vibration levels on each of three mutually perpendicular axes. The range shall be swept at 3 min. per octave.

a) 5 Hz to 14 Hz at 0.2" double amplitude.
b) 14 Hz to 33 Hz at 2g peak.
c) 33 Hz to 52 Hz at 0.036 double amplitude.
d) 52 Hz to 2000 Hz at 5g peak.
e) Single sweep starting at lowest frequency.

3.6.5 Shock

The unit shall not suffer damage of subsequently fail to provide the performance specified in this DVS when subjected to 1500g, 5 shocks in opposite firections along each of 3 mutually perpendicular axes. Each shock impulse shall have a time duration of 0.5m sec.

3.6.6 Acceleration

The unit shall be operable prior to, during, and following exposure to 5000g steady state/acceleration in all axes without degradation to performance. No physical damage shall be sustained by this exposure.

3.6.7 Thermal Cycling

The units shall be capable of surviving a thermal cycling of -65°C to +85°C per MIL-STD-750, Method 1051, Condition A.

3.6.8 Transient Non-Operating Temperature

The unit shall be capable of being stored for six hour periods at 95°C without degradation, and capable of withstanding normal soldering operations such as attachment to a PC board.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

The supplier shall provide an inspection system in accordance with MIL-I-45208. Except as otherwise specified, the supplier shall utilize his own inspection facility or obtain Buyer's approval for use of required inspection facilities not associated with Seller's facility. The Buyer reserves the right to perform or witness any of the inspections set forth in the specification at the Seller's facility when such inspections are deemed necessary to assure that supplier and services conform to the specified requirement.

4.2 Classification of Tests

The inspections and testing of the detector assembly shall be classified as follows:

a) Qualification Inspection (See paragraph 4.4)
b) Acceptance Inspection (See paragraph 4.5.1)
c) Accelerated Life Tests (See paragraph 4.5.2.3)

4.3 Test Conditions

4.3.1 Standard Test Conditions

Unless otherwise specified herein, all measurements and tests shall be made at an ambient temperature of +25°C ± 3°C and at an atmospheric pressure of 28 to 32 inches of mercury and at a relative humidity of 80% or less. The tolerance on all other temperatures shall be ±5°C. When test temperatures higher than +35°C are specified, adequate circulation of air shall be provided to maintain the temperature within their specified tolerances. During all electrical measurements, the units shall be in temperature equilibrium at the specified temperature.

4.3.2 Instrument Calibration

All inspection, measuring and test equipement shall be controlled per calibration controls outlined in MIL-C-45662.

4.3.3 Tolerances

The tolerance on test conditons and measuring equipment shall include all inherent instrumentation errors and shall be specified in the test plan.

4.3.4 Test Sequence

Tests shall be performed in the order specified in the applicable tables. Deviations to the prescribed test sequence require Buyer concurrence prior to commencement of test phase.

4.3.5 Alternate Test Methods

Other test methods may be substituted for those specified herein provided the manufacturer demonstrates that the results obtained correlate with those obtained with the methods specified herein and Buyer concurrence is obtained prior to implementation.

4.4 Qualification Inspection

4.4.1 Sample

Sample size for qualification inspection shall be as specified in Table IV.

4.4.2 Inspection Procedure

The sample groups shall be divided into subgroups as specified in Table IV, and shall be tested in accordance with the requirements of Table IV in the order shown unless approval is obtained from the Buyer for an alternate sequence of testing. All devices submitted for qualification shall have been subjected to the screening procedure and Group "A" test requirements.

4.4.3 Defectives

Maximum number of defectives allowable for successful completion of qualification testing shall be as specified in Table IV. Failure of a device in one or more tests of a group shall be considered a single failure. Group C inspection shall consist of the mechanical, environmental, and life tests specified in Table IV and shall be performed on a random sample, as specified in Table IV. Units subjected to Group C inspection shall be delivered with Group C test report and certified test data. The report format shall be acceptable to the Buyer. The test samples shall be submitted with the report.

4.4.4 Visual Examination, Internal

All detectors supplied to this DVS shall be subjected to 100% internal visual examination under 20 power minimum magnification for header inspection, die attach, bonding defects, lead defects, and contamination prior to final sealing. This inspection shall be made by Perkin-Elmer Quality Assurance or an authorized Perkin-Elmer Representative at Seller's facility.

4.5 Acceptance Inspection

4.5.1 Screening

Prior to submission for acceptance test, each lot shall be screened by subjecting each unit in the lot to the lot tests and conditioning specified in Table I, in the order shown, as minimum requirements (other tests may be performed at the option of the manufacturer with prior Buyer approval). Units not conforming to the specified screening end points shall be rejected from the lot and those so rejected shall not be included in further recording of defectives. Actual measured value shall be recorded by serial number.

TABLE I. SCREENING

DVS TEST PARA.	TEST AND SYMBOL	CONDITIONS	ACCEPTANCE CRITERIA
4.4.4	Internal Visual	Visual and Mechanical	
4.7.9	Visual and Mechanical Electrical and Mechanical Test Go-No-Go		
4.7.2	Thermal Shock		No Shorts or Opens
4.7.3.1	Shock		No Shorts or Opens
4.7.4.1	Fine Leak	Helium Bomb at 40 PSI for eight hours	10^{-6} cc/sec.
4.7.4.2	Gross Leak		No Bubbles
	Electrical Test 1		
3.5.3	Detector Impedance and I-V Curve	Para. 4.6	$Z_J \geq 2.0$ ohm
	Read and Record	($T_A = 25°C$)	I-V Curve Normal
		$V_{Bias} = 0$ V	
4.7.10	Burn-In	$V_{Bias} = 0$ V $T_A = 70°C$ time = 168 hrs.	
	Electrical Test 2	Para. 4.6	
	Read and Record	Para. 4.6	$Z_J \geq 2.0$ ohm
	Detector Impedance and I-V Curve	$T_A = 25°C$ $V_{Bias} = 0$ V	$\Delta Z < 10\%$ I-V Curve Unchanged

4.5.2 Acceptance Test

The acceptance test shall consist of Group A and, when specified by the subcontract, Groups B and C.

4.5.2.1 Group A Inspection

Group A inspection shall consist of the test specified in Table II and shall be performed on a 100% basis. Units which fail shall be removed from the lot and shall not be shipped to the Buyer. Actual measured value shall be recorded by serial number.

TABLE II. GROUP A (T_A = 25°C UNLESS OTHERWISE STATED)

DVS TEST PARA.	TEST AND SYMBOL	CONDITIONS	ACCEPTANCE CRITERIA		
			MIN.	MAX.	UNITS
3.5.2	Spectral Responsivity (R_λ)	V_{Bias} = 0 V R_L=1 ohm			
		λ = 1.1 µm	0.2		Amps/Watt
		λ = 2.0 µm	0.4		
		λ = 3.4 µm	0.6		
3.5.4	D* (3.4, 900, 1)	V_{Bias} = 0 V	3×10^9		$\text{cmHz}^{1/2}\text{W}^{-1}$
3.5.5	Rise Time, t_r	V_{Bias} = 0 V R_L = 1 ohm λ = 0.9 microns		500	nsec
3.5.6	Crosstalk	R_L = 1 ohm λ = 1.1-3.5µ		10	%
3.5.7	Responsivity Matching	V_{Bias}=0 V, White Light		±5%	
3.5.8	Uniformity of Response	1mm SLIT SCAN λ = 1.1-3.5µm		10%	Difference
3.5.9	Isolation Resistance	Anode (A) to case Gn'd Vapplied = 100 VDC	≤	1	Microamp
		Cathode (C) to case Gn'd Vapplied = 100 VDC	≤	1	Microamp

4.5.5.2 Group B Inspection

Sample size: 5 units or 10% of the lot, whichever is greater. Perform only when required by subcontract. Actual measured value shall be recorded by serial number.

TABLE III. GROUP B (T_A = 25°C UNLESS OTHERWISE SPECIFIED)

DVS TEST PARA.	TEST AND SYMBOL	CONDITIONS	ACCEPTANCE CRITERIA		
			MIN.	MAX.	UNITS
3.5.2	Spectral Response at High & Low Temperature	T = -54°C			A/W
		λ = 1.1μm	0.2		
		λ = 2.0μm	0.4		
		λ = 3.4μm	0.6		
		T = +71°C			
		λ = 1.1μm	0.1		
		λ = 2.0μm	0.25		
		λ = 3.4μm	0.35		
3.5.5	Rise and Fall Time at High & Low Temperature	T = -54°C			
		t_r=		500	nsec
		t_r=		500	nsec
		T = +71°C			
		t_r=		500	nsec
		t_f=		500	nsec
3.5.3	Impedance at High & Low Temperature	T = -54°C		2.0	OHMS
		T = +71°C		1.0	OHMS

4.5.2.3 Group C Inspection

Perform only when required by the subcontract. One defect allowed in each subgroup.

TABLE IV

DVS TEST PARA.	TEST AND SYMBOL	CONDITIONS
	Subgroup 1. Sample Size: 6 Units	Go-No-Go Test 1) Room Ambient Sensitivity Test
4.7.1	Thermal Cycling	
4.7.2	Thermal Shock	
4.7.8	Sine Vibration	
4.7.4.1	Fine Leak	
4.7.4.2	Gross Leak	

Subgroup 1 and 2 End Points: Shall be Table II Plus Impedance per 3.5.3
All data read and recorded
Perform go-no-go Tests after each Environment

	Subgroup 2 Sample Size: 6 Units	
4.7.7	Storage Life	T_D = 85°C P_D = 0 t = 340 hrs.
4.7.2	Thermal Shock	
4.7.3.2	Shock	
4.7.5	Acceleration	
4.7.4.1	Fine Leak	
4.7.4.2	Gross Leak	
	Subgroup 3. Sample Size: 6 Units plus the remaining units from subgroup 1 above. Defects will only be considered of the 6 devices of this subgroup.	H = 10-30 mw/cm^2 V_{Bias} = NONE T_D = 85°C
4.7.8	Operating Life	t = 1000 hrs.

Subgroup 3. End Points:
Shall be Table II and Detector Impedance per 3.5.3

4.5.3 Lot - A lot shall consist of units which are submitted for acceptance and which have been manufactured on the same production line or lines provided the manufacturer demonstrates that a homogeneous lot has resulted from use of the same materials, processes, personnel, and assembly equipment.

4.5.4 Lot Failure - Failure of the manufacturer to perform to the requirements of this specification or to meet the requirements of paragraph 4.5.2.3 is cause for rejection of the lot.

4.6 Test Plan & Data Sheets

The vendor shall prepare a test plan and data sheets for the tests required in Tables I, II, III, and IV. The test plan and data sheets shall be submitted to Perkin-Elmer for approval at least 4 weeks prior to start of testing. The test plan shall include simplified drawings of each test set up, model numbers of commercial test equipment and an outline of the test procedure, data to be recorded and any calculations required.

4.7 Test Procedures

4.7.1 Thermal Cycling

Same as Paragraph 3.6.7.

4.7.2 Thermal Shock

Thermal shock shall be according to MIL-STD-750, Method 1056, Condition B, except that the number of cycles is 10 for Group C Test Units and 5 for all units going through screening.

4.7.3 Shock

4.7.3.1 Shock (Screening)

Each diode shall be exposed to two shocks along the Y1, Y2, and X1 axes (6 shocks total). Refer to Paragraph 4.2 and Figure 2 of MIL-STD-750 for axis orientation. The stock shall consist of a 15g, 11msec. pulse.

4.7.3.2 Shock (Group C)

Same as paragraph 4.6.10.1, except that each diode shall be exposed to 3 shocks along each of three axes of both directions (18 shocks total).

4.7.4 Hermetic Seal

4.7.4.1 Fine leak test each diode per MIL-STD-750B, Method 1071.1. Test Condition H. Prebomb in helium at 45 psig for one hour.

4.7.4.2 Gross leak test each diode per MIL-STD-750B, Method 1071.1, Test Condition F. Repeat the helium prebomb unless the gross leak test is initiated within ½hour of completion of fine leak test.

4.7.5 Acceleration

Shall be in accordance with Method 2006, MIL-STD-750. G level shall be 6 g minimum, in the Y1 direction. Refer to Paragraph 6.2 for axis of orientation.

4.7.6 Vibration

See Paragraph 3.6.4. Refer to Paragraph 6.2 for axis of orientation.

4.7.7 Storage Life

The detectors shall be maintained at the temperature specified for a period of 340 hours. The temperature shall be controlled to within ±5°C of that specified. End point measurement must be taken at 0, 170, and 340 hours.

4.7.8 Operating Life

The detectors shall be maintained at voltage, temperature, and time levels specified, and according to Table IV. The voltage shall remain applied to all units until the devices have stabilized to room temperature. End point measurements shall be made at 100, 250, 500, 1000 and every 1000 hours thereafter. In the event of any failure, the Buyer shall be notified within 24 hours and the failure analysis or corrective action will be performed by the Seller.

4.7.9 Visual and Mechanical Inspection

The diodes shall be inspected to verify that the materials, design, construction, physical dimensions, marking and workmanship are in accordance with the applicable requirements.

4.7.10 Burn-In

The devices shall be maintained at the time, temperature, and voltage stated in Table I. The voltage shall remain applied to all units until the devices have stabilized to room temperature.

4.8 Documentation

The manufacturer shall submit a Group C inspection test plan and shall obtain approval of the plan from the Buyer prior to start of Group C tests. He shall also submit screening test data, Group A and Group B data per serial number and a test report with shipment of parts and shall maintain on file all acceptance inspection data by serial number for 5 years after completion of program.

4.8.1 A test report shall be submitted to the Buyer. The report format shall be acceptable to the Buyer. The test samples shall be submitted with the report.

4.9 Failure and Failure Analysis Reporting

The manufacturer shall report to the cognizant Buyer on any failure which occurs during Group C testing within 24 hours of occurrence of such failure. A report of the cause of failure and corrective action initiated to prevent recurrence of such failure shall be submitted to the Buyer within ten days after the failure. Failures which occur during screening or Group A and B testing shall be reported with the data accompanying the lot. Analysis of the later shall be by request of the Buyer. In the event of a field failure, the Buyer will return the failed unit to the manufacturer, who shall conduct a failure analysis on the unit and submit a report of cause of failure and corrective action initiated to prevent recurrences of such failure. This report shall be submitted within two weeks after receipt of the failed unit from the Buyer.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging

The units shall be packaged in such a manner that they will be protected during shipment and storage. Packages shall be suitable to provide maximum protection in a minimum size package without distortion of the leads of the device.

5.2 Packing

Units, packaged as specified, shall be packed in containers of the type, size and kind commonly used for the purpose, in a manner that will ensure acceptance by common carrier and safe delivery at destination.

5.3 Marking - The detector assembly shall be marked with the assembly drawing number and the detector shall be serial numbered sequentially. Non-conducting epoxy shall be used for marking. The markings shall be placed on the outside surface of the header and on the cover.

6.0 NOTES

6.1 Abbreviations

DVS - Development Specification

DUT - Device Inder Test

APPENDIX C

DISTRIBUTION LIST

DISTRIBUTION LIST

	QTY
Director US Army Electronic Warfare Laboratory(ERADCOM) ATTN: DELEW-P/Mr. R. Brady Fort Monmouth, NJ 07703	5
Commander USAAVRADCOM ATTN: DRCPM-ASE-TM/D. Dunlap 4300 Goodfellow Blvd. Building 105 St. Louis, MO 63120	2
Commander USAAVRADCOM ATTN: DRSAV-PEC/F. Reed 4300 Goodfellow Blvd. Building 105 St. Louis, MO 63120	30
Mr. Larry Falberg Santa Barbara Research Center 75 Coramar Drive Goleta, CA 93117	2
Mr. Joe White Honeywell E.O.D. Number 2 Forbes Road, M/S 146 Lexington, MA 02173	2
HQ DARCOM ATTN: DRCMT/G. Schuck 5001 Eisenhower Ave. Alexandria, VA 22333	1
US Army IBEA ATTN: DRXIB-MT/C. McBurney Rock Island, IL 61299	1
US Army IBEA ATTN: DRXIB-MT/F. Anderson ock Island, IL 61299	1
ir Force Wright Aeronautics Laboratories TTN: AFWAL/AAWD/R. Cunningham vionics Laboratory right Patterson AFB, OH 45433	1
irector ight Vision & E-O Laboratory TTN: DELNV-IRD/R. Longshore ort Belvoir, VA 22060	1