NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594
April 18, 1997

SYSTEMS GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION ADDENDUM

Main Rudder PCU Dynamic Testing

A. ACCIDENT DCA-94-MA-076

Location: Aliquippa, Pennsylvania
Date: September 8, 1994
Time: 1904 Eastern Daylight Time
Aircraft: Boeing 737-300, N513AU

B. SYSTEMS GROUP

Chairman: Greg Phillips
National Transportation Safety Board
Aviation Engineering Division
Washington, DC

Member: Captain John Cox
Air Line Pilots Association/USAir
Coraopolis, PA

Member: Ken Frey
Federal Aviation Administration
Aircraft Certification Office
Seattle, WA

Member: Dale A. Hoth
Federal Aviation Administration
Flight Standards District Office
Coraopolis, PA

Member: Richard Krantz
Boeing Commercial Airplane Group
Seattle, WA

Member: Richard Kullberg
Boeing Commercial Airplane Group
Seattle, WA

Member: Thomas C. Nicastro
USAir-Engineering
Pittsburgh, PA

Member: Steve Weik
Parker Hannifin
Irvine, CA

Member: Jack A. Wurzel
USAir-IAMAW
Pittsburgh, PA

C. SUMMARY

On September 8, 1994, at 1904 Eastern Daylight time, USAir flight 427, a Boeing 737-3B7 (B-737-300), N513AU, crashed while maneuvering to land at Pittsburgh International Airport, Pittsburgh, Pennsylvania. The airplane was being operated on an instrument flight rules (IFR) flight plan under the provisions of Title 14, Code of Federal Regulation (CFR), Part 121, on a regularly scheduled flight from Chicago, Illinois, to Pittsburgh. The airplane was destroyed by impact forces and fire near Aliquippa, Pennsylvania. All 132 persons on board were fatally injured.

D. DETAILS OF THE INVESTIGATION

General

The systems group, performed a series of tests at Boeing in Seattle, Washington, on September 16-20, 1996, to examine the effects of dynamic external loads applied to the Boeing 737 main rudder power control unit (PCU).

The testing was designed to explore the response of the main rudder PCU to external loads applied to the PCU output ram while applying different input commands to the manual input crank and the yaw damper system. Normal PCU operation and pressurization failures of the hydraulic system were explored during the tests.

A test fixture was used to hold the PCU for the tests. The test fixture schematic is shown in Figure 1. Five different test series were conducted. They were: (1) wake encounter simulation tests (dynamic load application during yaw damper sinusoidal response with no manual input to the PCU), (2) yaw damper hardover tests, (3) manual input with no yaw damper input, (4) manual input with no yaw damper input along with hydraulic system pressurization failures, and (5) a high load test performed only on the production PCU.

The PCU's input arm position, input arm force, output ram position, output ram force, yaw damper input command, yaw damper response command were continuously recorded during the testing. The hydraulic return system pressure and inlet temperature were manually recorded.

The test results were recorded on a strip-recorder and can be found in Attachment 1-Production Unit Test Data, and Attachment 2-Accident Unit Test Data. The test condition identifiers are noted on the data sheets.

The loads used for the testing came from an estimation[1] that USAir flight 427's main rudder PCU output rod would be subjected to a 600 lb load as a result of its encounter with wake turbulence from a Boeing 727 ahead of its flight path. The 1200 lb load testing was performed to establish a margin of confidence for the test loads by doubling the calculated load. The B-737 main rudder PCU is designed to output a force of about 6000 lbs (with both hydraulic systems pressurized).

The dynamic tests were conducted on the production PCU (s/n 2203A)[2] and then repeated on the accident PCU (s/n 1596A). Both PCUs responded normally throughout all tests. There were no abnormal motions of either PCU.

Test Matrix

Test matrix column label definitions

Test: test (condition) number, load/direction/type: load applied to ram in lbs./direction of load applied/impulse or delayed input[3], y/d command: externally applied yaw damper signal, input: direction of input to PCU input arm, hyd: hydraulic system operation; all = both systems, 2203A: production PCU-test result, 1596A: accident PCU-test result

Wake encounter simulation tests

Test	Load/direction/type	y/d command	input	hyd	2203A	1596A
1	600/ret/imp	±3° @ 3 Hz	none	all	normal	normal
2	600/ext/imp	±3° @ 3 Hz	none	all	normal	normal
3	600/ext/imp	±3° @ 1 Hz	none	all	normal	normal
4	1200/ret/imp	±3° @ 1 Hz	none	all	normal	normal
5	1200/ext/imp	±3° @ 1 Hz	none	all	normal	normal

Yaw damper hardover tests

Test	Load/direction/type	y/d command	input	hyd	2203A	1596A
6	600/ret/imp	right (retract)	none	all	normal	normal
7	600/ext/imp	right	none	all	normal	normal
8	600/ret/imp	left (extend)	none	all	normal	normal
9	600/ext/imp	left	none	all	normal	normal
10	1200/ret/imp	right	none	all	normal	normal
11	1200/ext/imp	right	none	all	normal	normal
12	1200/ret/imp	left	none	all	normal	normal
13	1200/ext/imp	left	none	all	normal	normal

[1] Estimate provided by NTSB performance group evaluation of flight test data

[2] Identified on data sheet as "engineering unit." This PCU was procured through Boeing engineering and the term engineering unit has no other meaning. The PCU was representative of production stock.

[3] Ret=retract load, ext=extend load, imp=impulse load, del=delayed or slowly applied load

Manual input with no yaw damper input

Test	Load/direction/type	y/d command	input	hyd	2203A	1596A
14	600/ext/del	none	ext	all	normal	normal
15	600/ret/del	none	ret	all	normal	normal
16	600/ext/del	none	ret	all	normal	normal
17	600/ret/del	none	ext	all	normal	normal
18	1200/ext/del	none	ext	all	normal	normal
19	1200/ret/del	none	ret	all	normal	normal
20	1200/ext/del	none	ret	all	normal	normal
21	1200/ret/del	none	ext	all	normal	normal

Manual input with no yaw damper and simulated hydraulic system failures (pressure)

Test	Load/direction/type	y/d command	input	hyd	2203A	1596A
22	600/ext/del	none	ext	A only	normal	normal
23	600/ret/del	none	ret	A only	normal	normal
24	600/ext/del	none	ret	A only	normal	normal
25	600/ret/del	none	ext	A only	normal	normal
26	600/ext/del	none	ext	*A 1500	normal	normal
27	600/ret/del	none	ret	*A 1500	normal	normal
28	1200/ext/del	none	ext	*A 1500	normal	normal
29	1200/ret/del	none	ret	*A 1500	normal	normal

*B system pressure 3000 psi

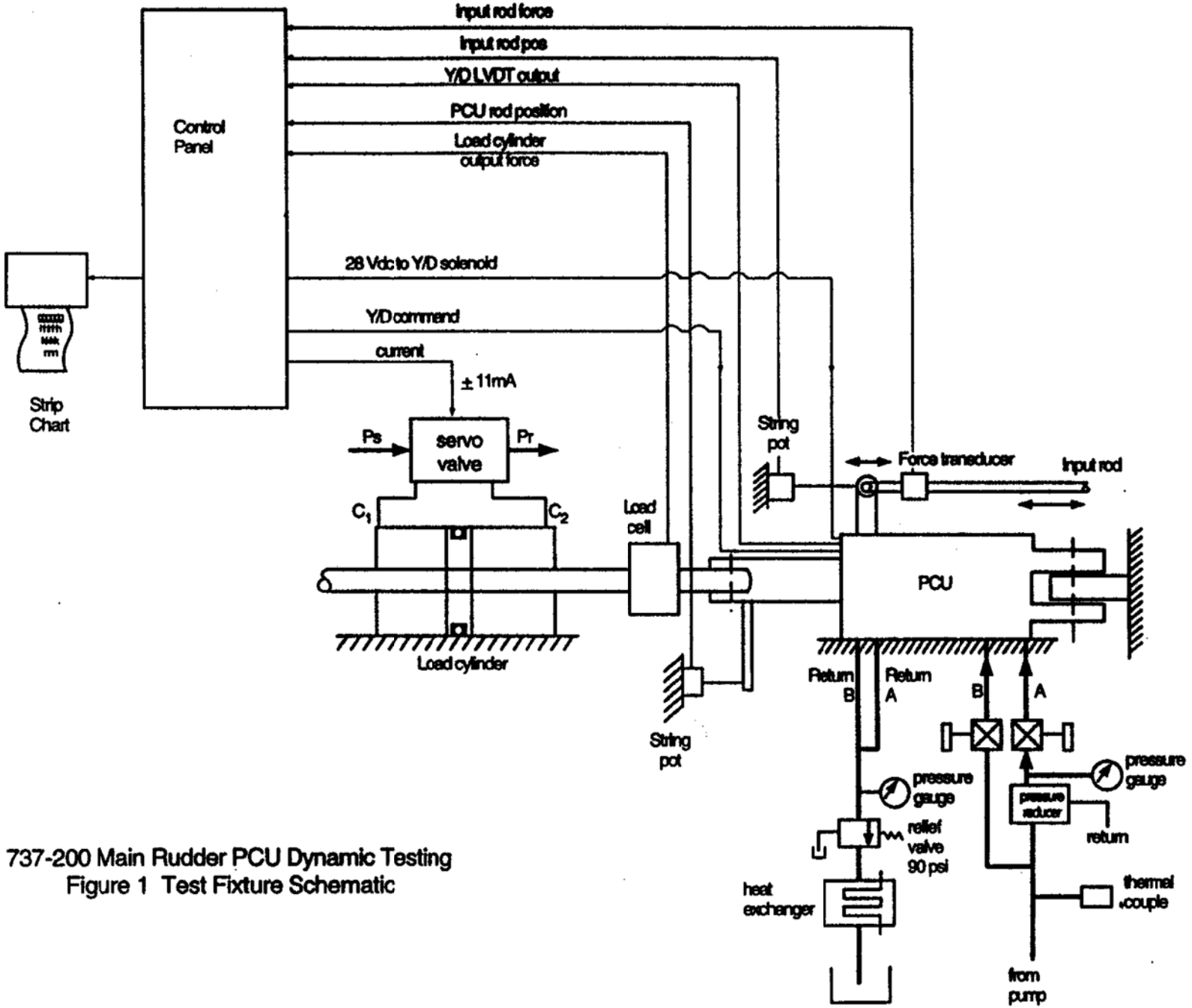
High load test (performed only on production PCU)

Test	Load/direction/type	y/d command	input	hyd	2203A
30	3500/ext/imp	none	ret	all	normal
31	3500/ext/imp	none	ext	all	normal

[redacted]

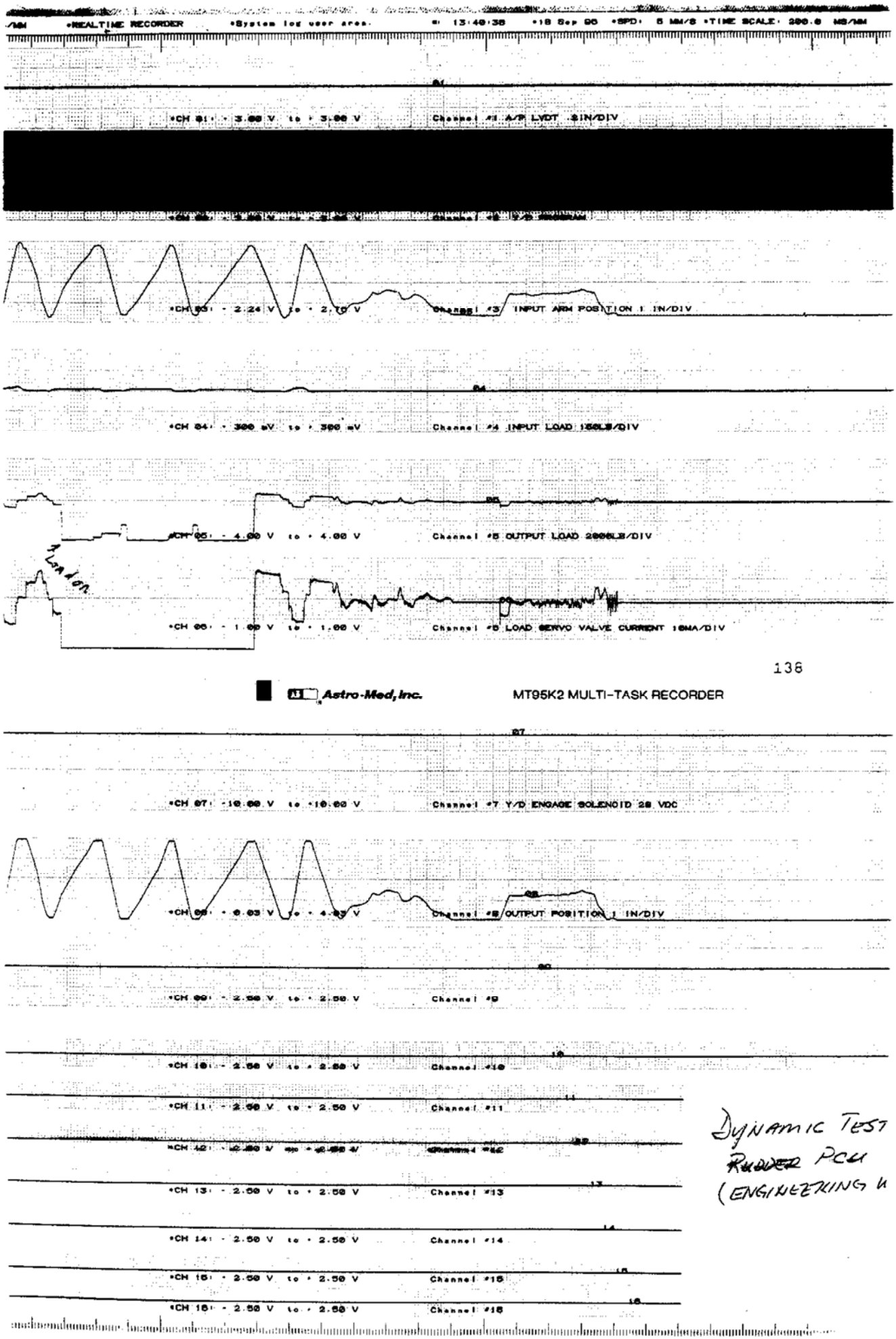
Gregory Phillips
Systems Group Chairman
National Transportation Safety Board

4/16/97

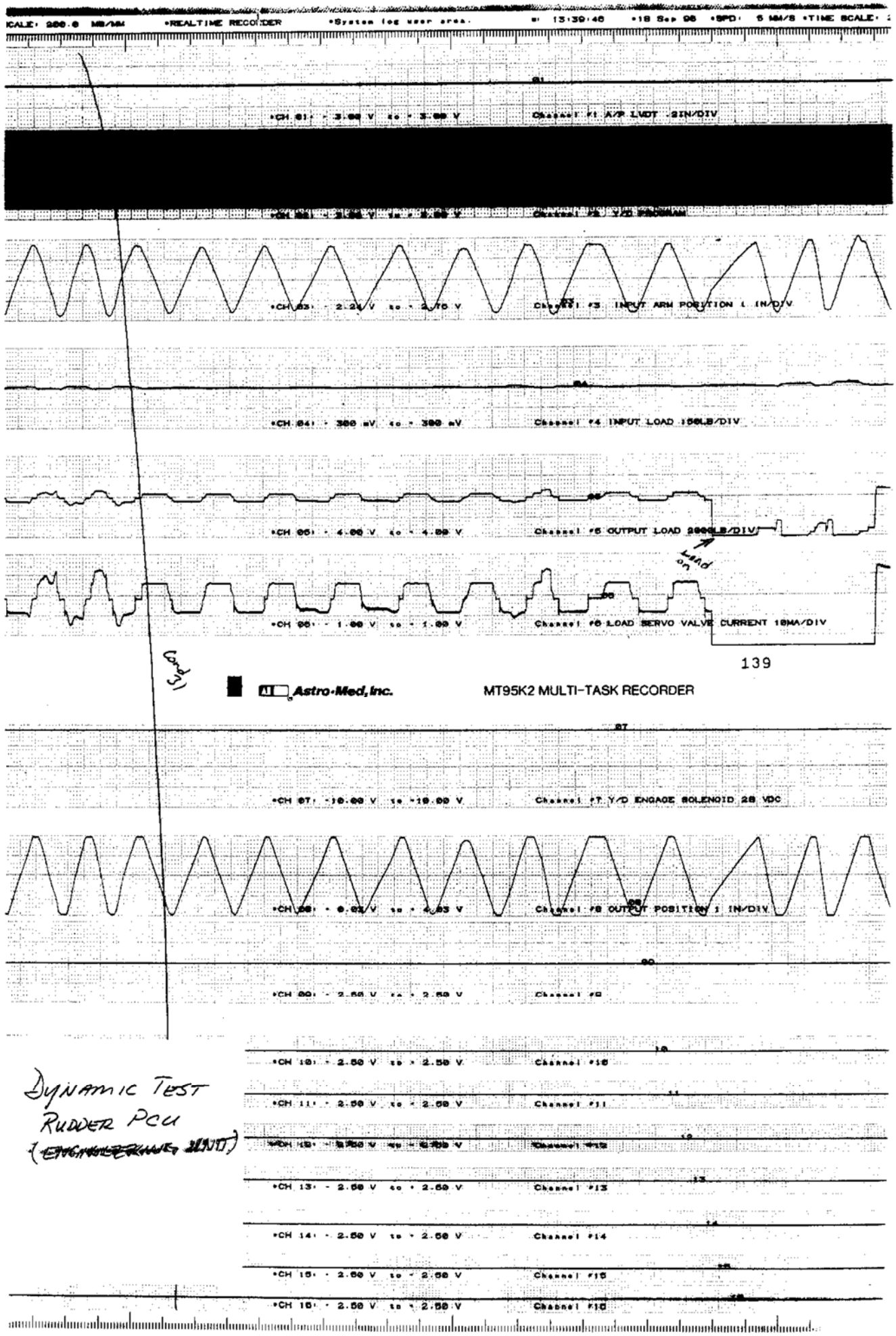


737-200 Main Rudder PCU Dynamic Testing
Figure 1 Test Fixture Schematic

Attachment 1
Production Unit Test Data



Dynamic Test
Rudder PCU
(Engineering



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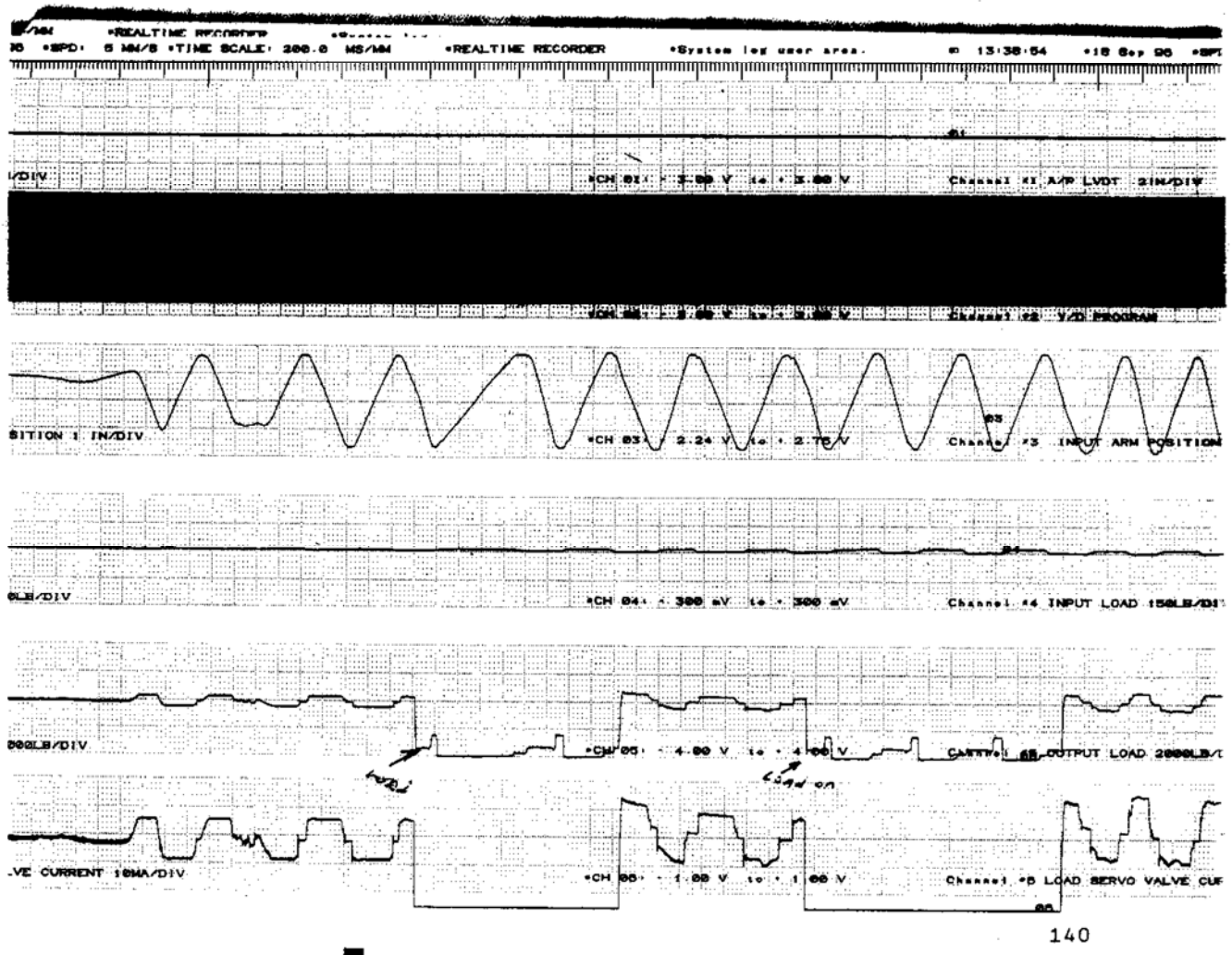
Dynamic Test
Rudder PCU
(Engineering Unit)



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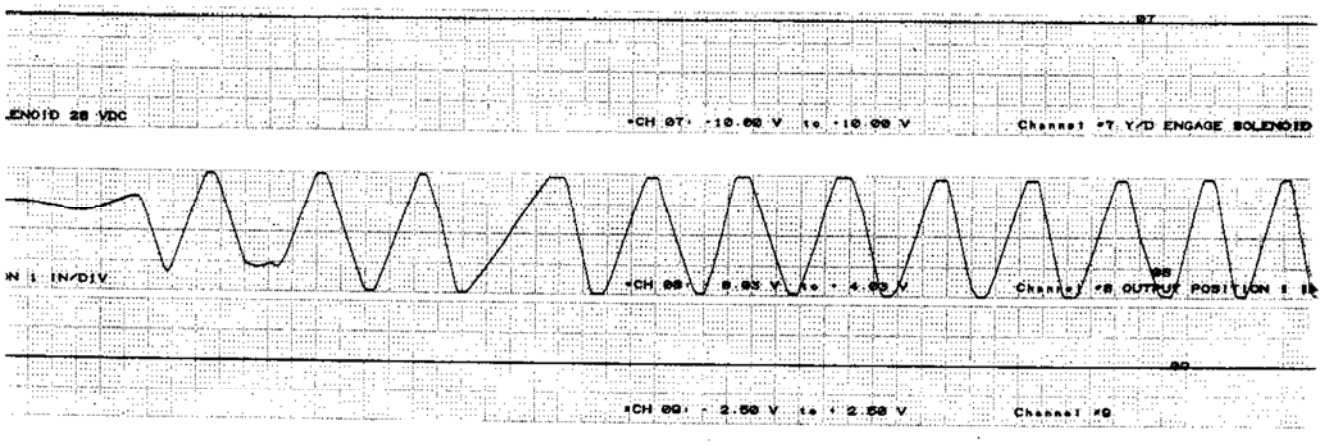
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



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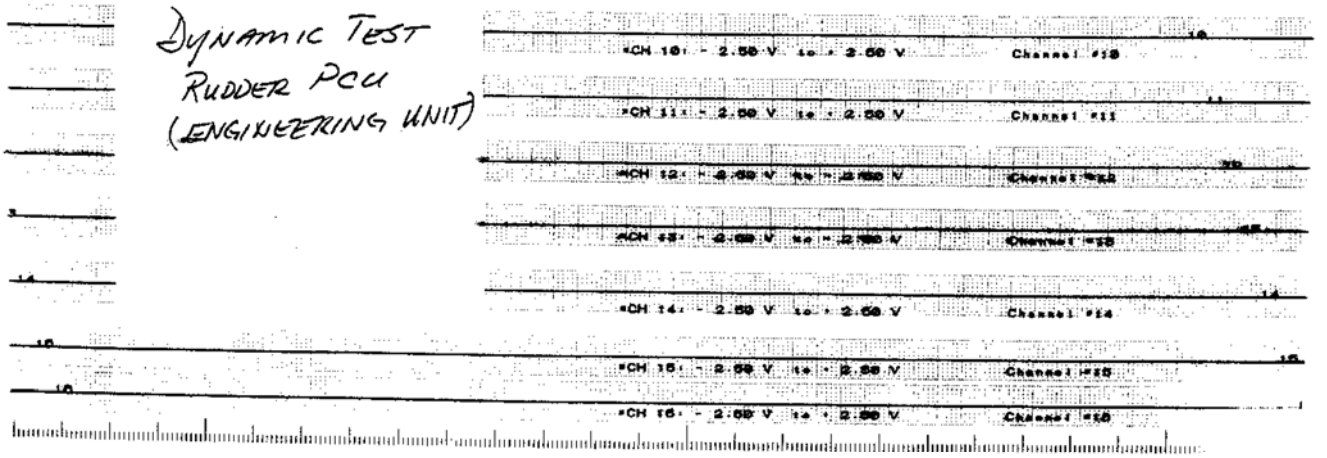
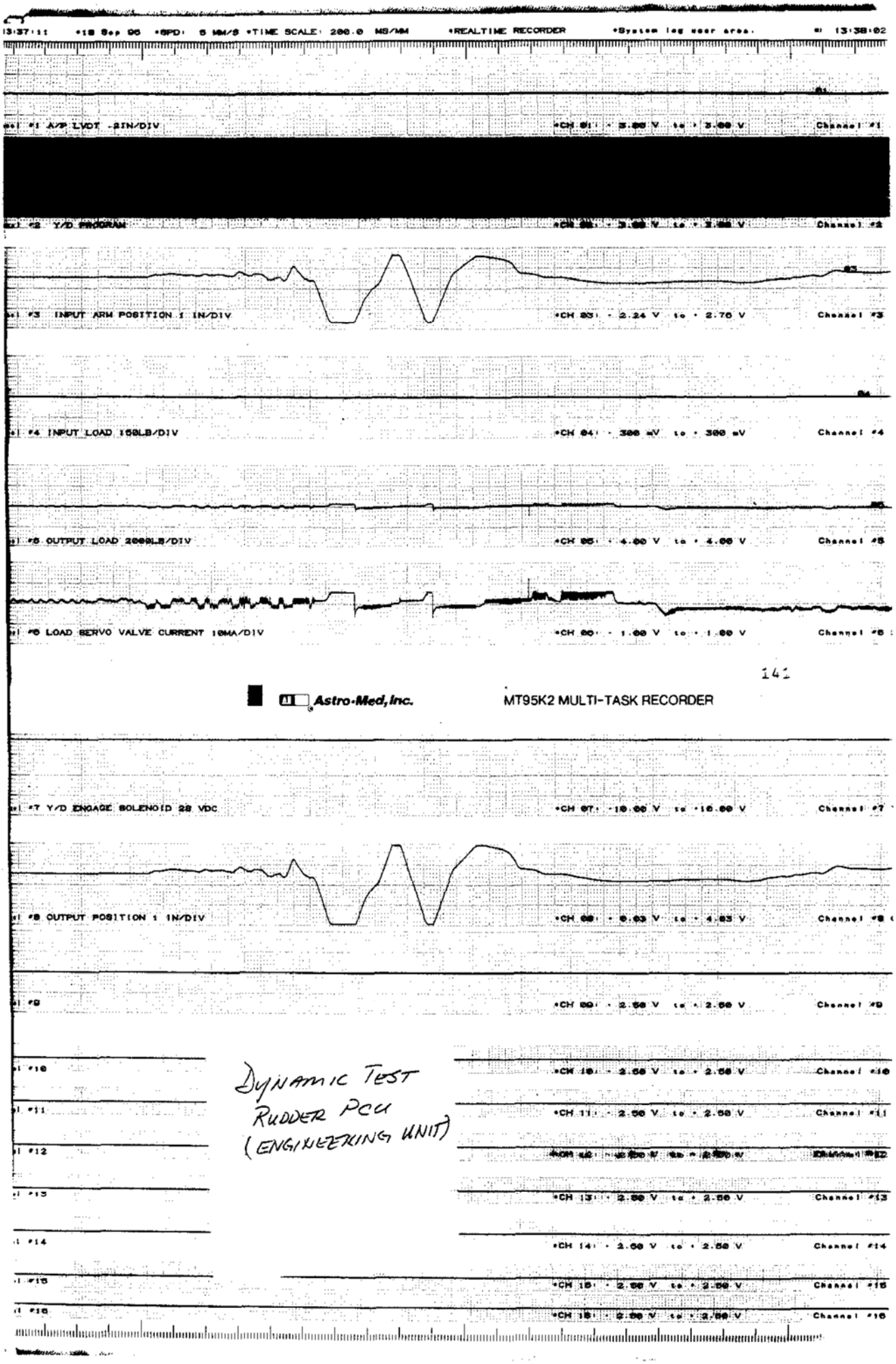
Rudder PCU
(Engineering Unit)

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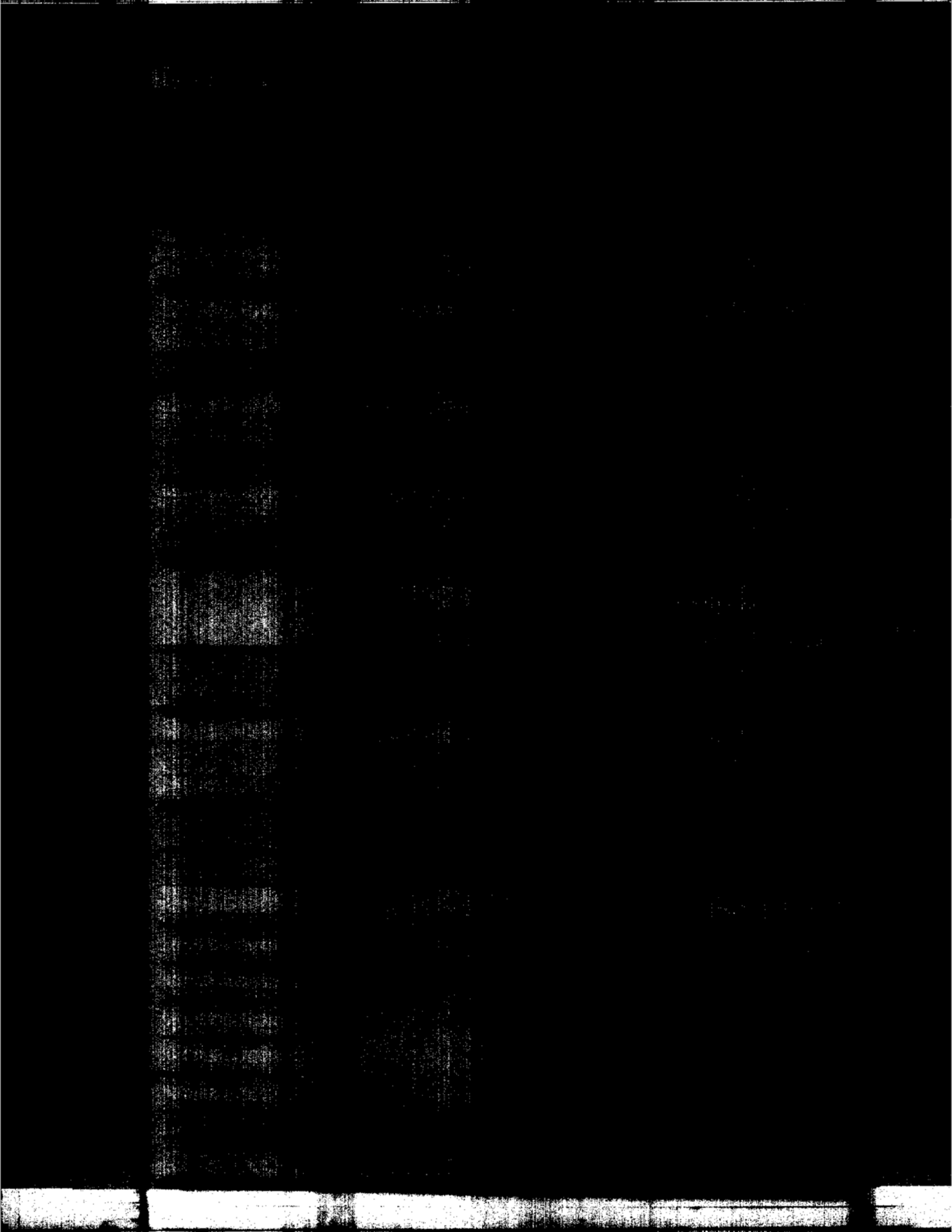
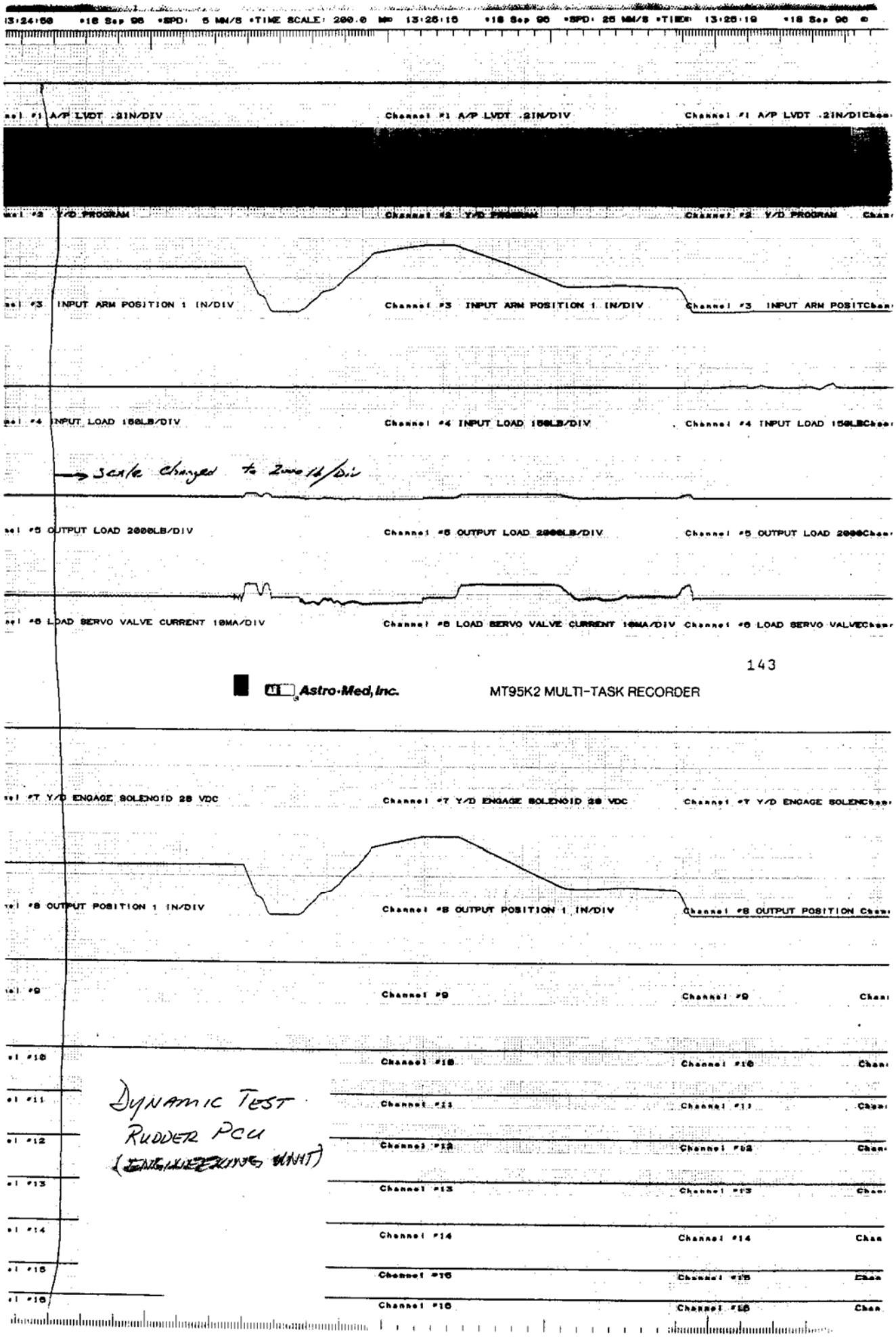
•CH 01: • 3.00 V to • 3.00 V
Channel #1
#2 Y/D PROGRAM
Channel #2
#3 INPUT ARM POSITION 1 IN/DIV
•CH 03: • 2.24 V to • 2.76 V
Channel #3
#4 INPUT LOAD 150LB/DIV
•CH 04: • 300 mV to • 300 mV
Channel #4
#5 OUTPUT LOAD 2000LB/DIV
•CH 05: • 4.00 V to • 4.00 V
Channel #5
#6 LOAD SERVO VALVE CURRENT 10MA/DIV
•CH 06: • 1.00 V to • 1.00 V
Channel #6
141
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
#7 Y/D ENGAGE SOLENOID 28 VDC
•CH 07: •10.00 V to •10.00 V
Channel #7
#8 OUTPUT POSITION 1 IN/DIV
•CH 08: • 0.83 V to • 4.83 V
Channel #8
#9
•CH 09: • 2.50 V to • 2.50 V
Channel #9
#10
•CH 10: • 2.50 V to • 2.50 V
Channel #10
#11
•CH 11: • 2.50 V to • 2.50 V
Channel #11
#12
Channel #12
#13
•CH 13: • 2.50 V to • 2.50 V
Channel #13
#14
•CH 14: • 2.50 V to • 2.50 V
Channel #14
#15
•CH 15: • 2.50 V to • 2.50 V
Channel #15
#16
•CH 16: • 2.50 V to • 2.50 V
Channel #16
Dynamic Test
Rudder PCU
(Engineering Unit)





143

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

Dynamic Test
Rudder PCU
(Engineering Unit)

log user area. 13:22:47 *18 Sep 95 *SPD: 5 MM/S *TIME SCALE: 200.0 MS/MM *REALTIME RECORDER *System log u

01

to + 3.00 V Channel #1 A/P LVDT .2IN/DIV *CH 01: + 3.00 V to +

[redacted]

to + 3.00 V Channel #2 Y/D PROGRAM *CH 02: + 3.00 V to +

03

to + 2.75 V Channel #3 INPUT ARM POSITION 1 IN/DIV *CH 03: - 2.24 V to +

04

to + 300 mV Channel #4 INPUT LOAD 150LB/DIV *CH 04: - 300 mV to +

to + 2.00 V Channel #5 OUTPUT LOAD 1000LB/DIV *CH 05: - 2.00 V to +

05

to + 1.00 V Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV *CH 06: - 1.00 V to +

06

144

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

07

to +10.00 V Channel #7 Y/D ENGAGE SOLENOID 28 VDC *CH 07: -10.00 V to +1

08

to + 4.03 V Channel #8 OUTPUT POSITION 1 IN/DIV *CH 08: + 0.03 V to +

09

to + 2.50 V Channel #9 *CH 09: - 2.50 V to +

10

to + 2.50 V Channel #10 *CH 10: - 2.50 V to +

11

to + 2.50 V Channel #11 *CH 11: - 2.50 V to +

12

to + 2.50 V Channel #12 *CH 12: - 2.50 V to +

13

to + 2.50 V Channel #13 *CH 13: - 2.50 V to +

14

to + 2.50 V Channel #14 *CH 14: + 2.50 V to +

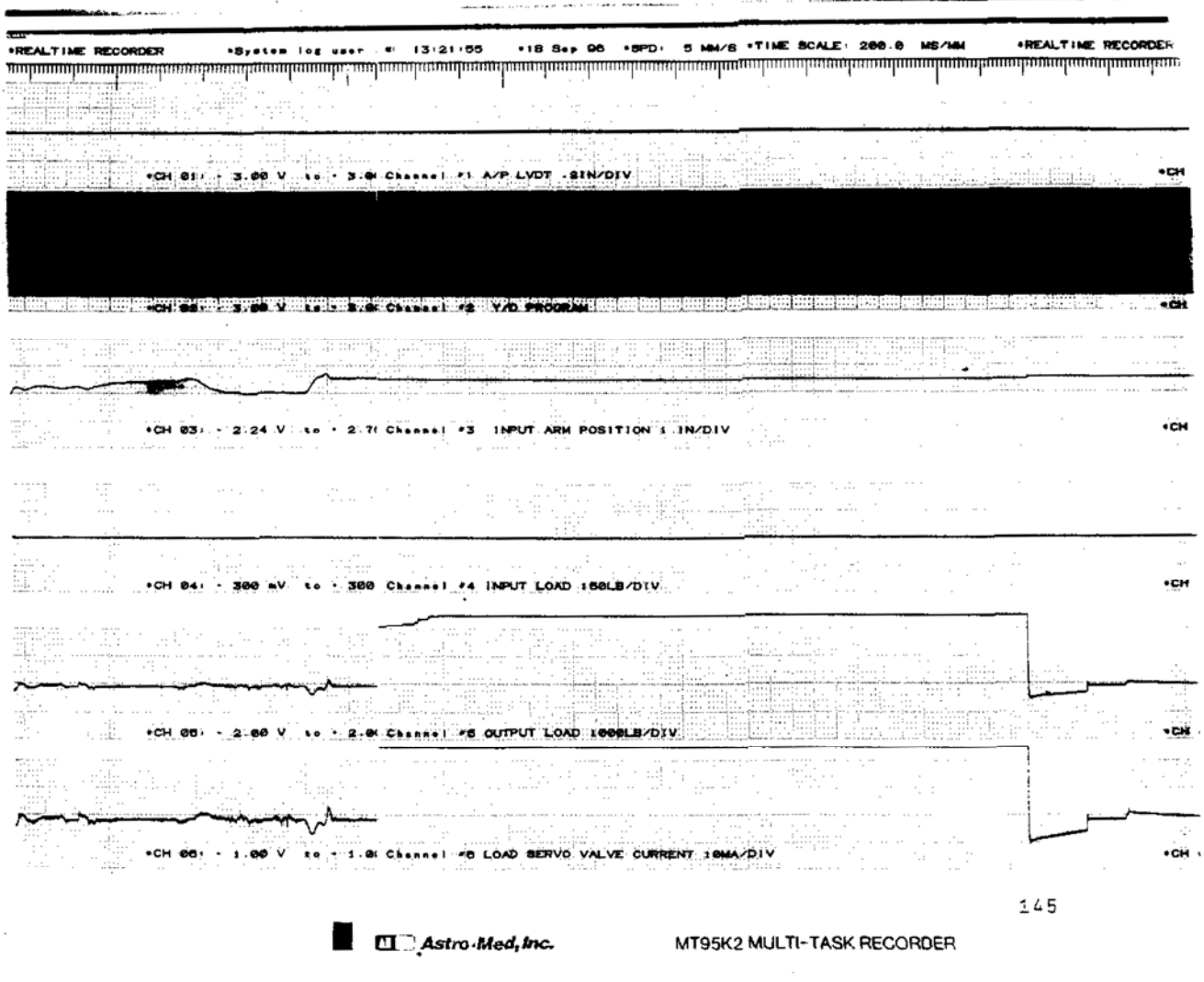
15

to + 2.50 V Channel #15 *CH 15: + 2.50 V to +

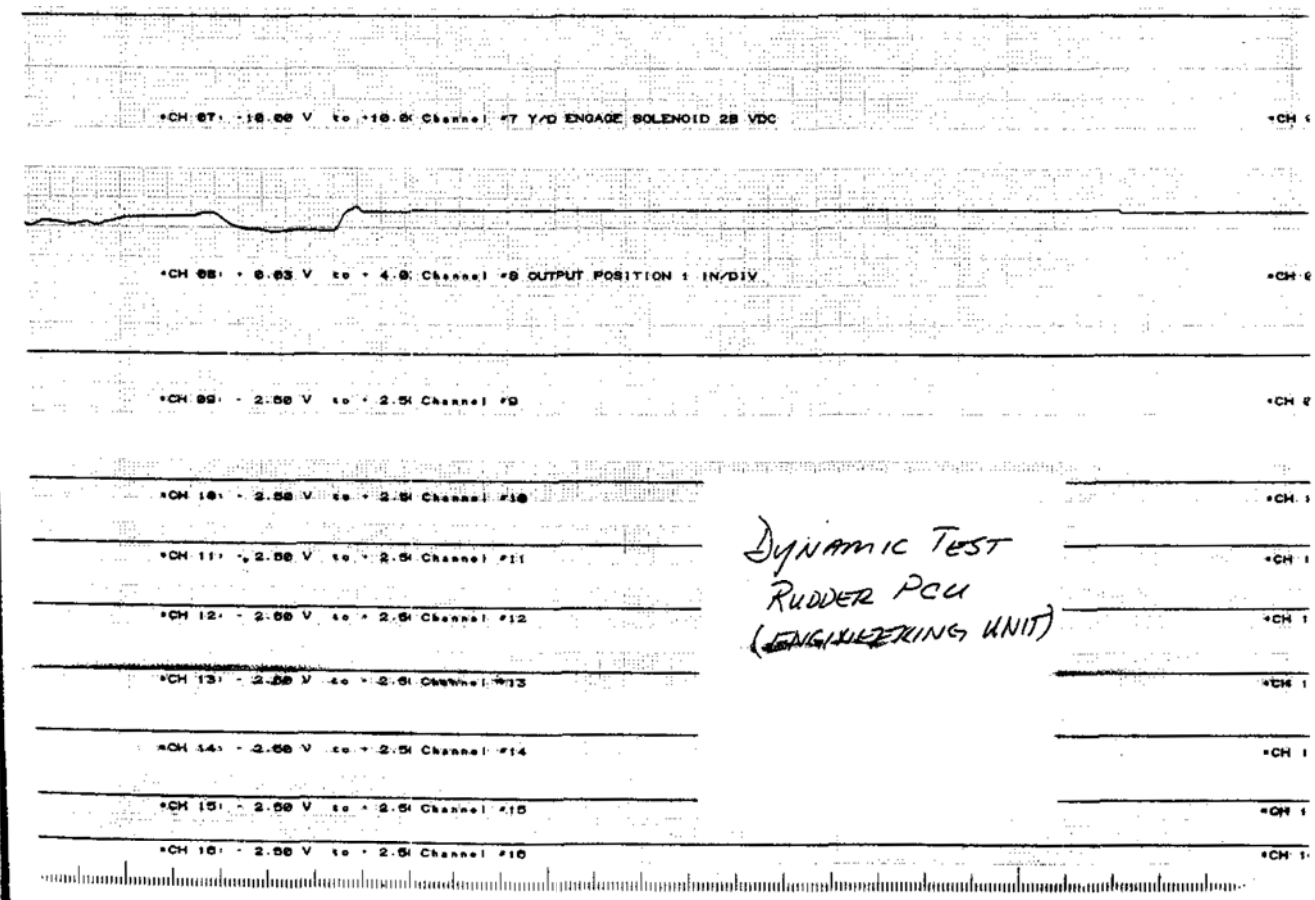
16

to + 2.50 V Channel #16 *CH 16: - 2.50 V to +

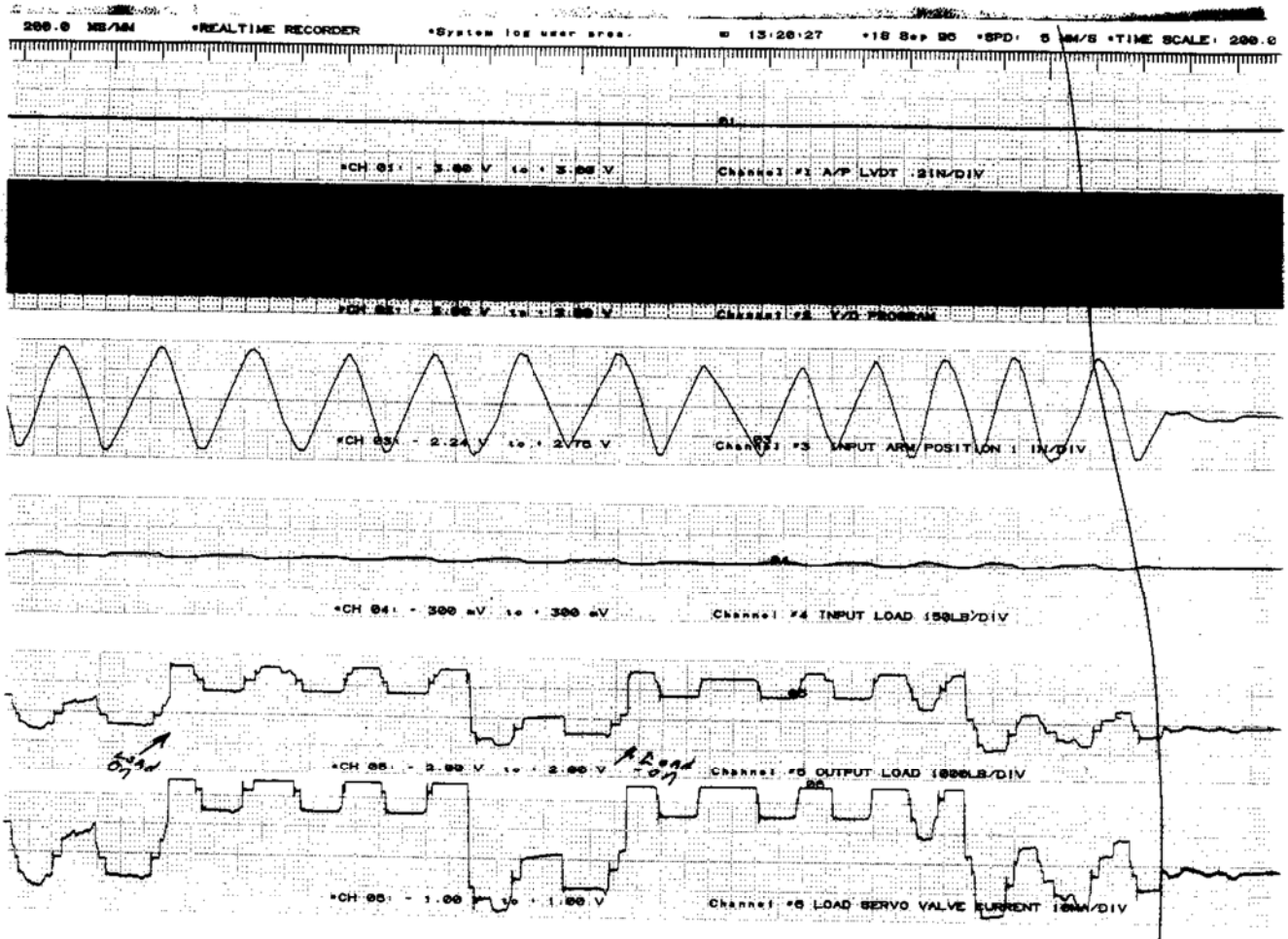
Dynamic Test
Rudder PCU
(Engineering Unit)

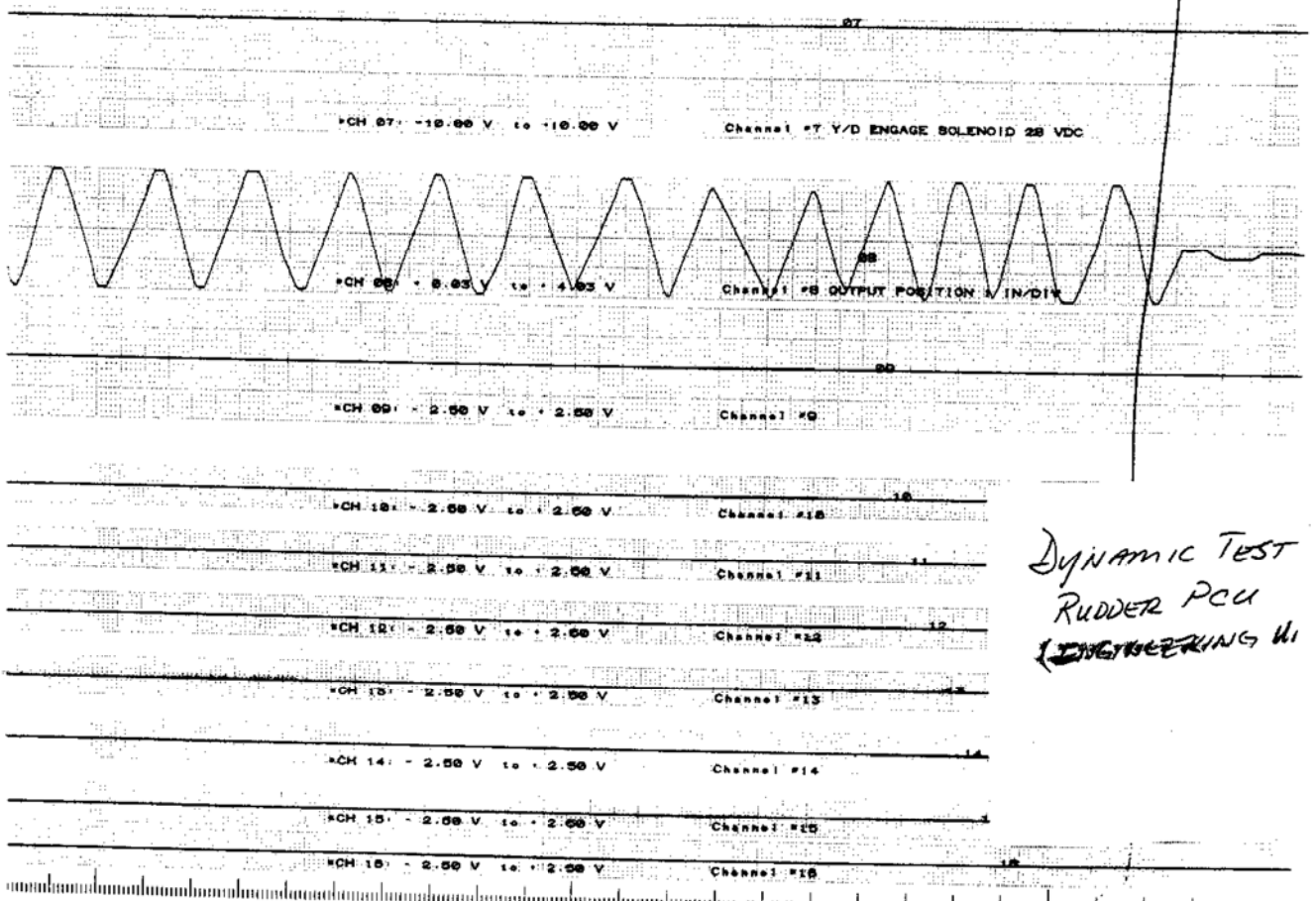


Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

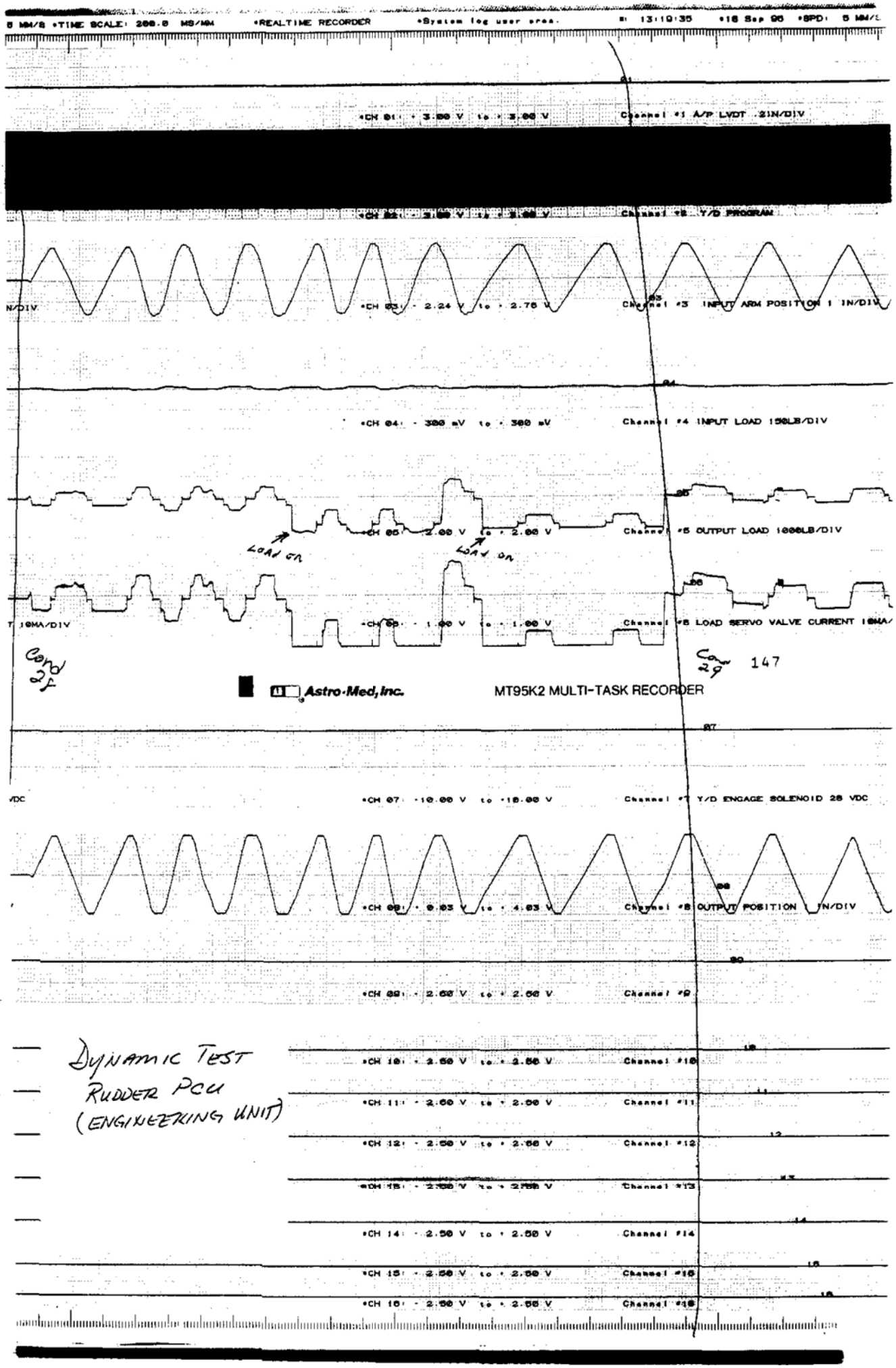


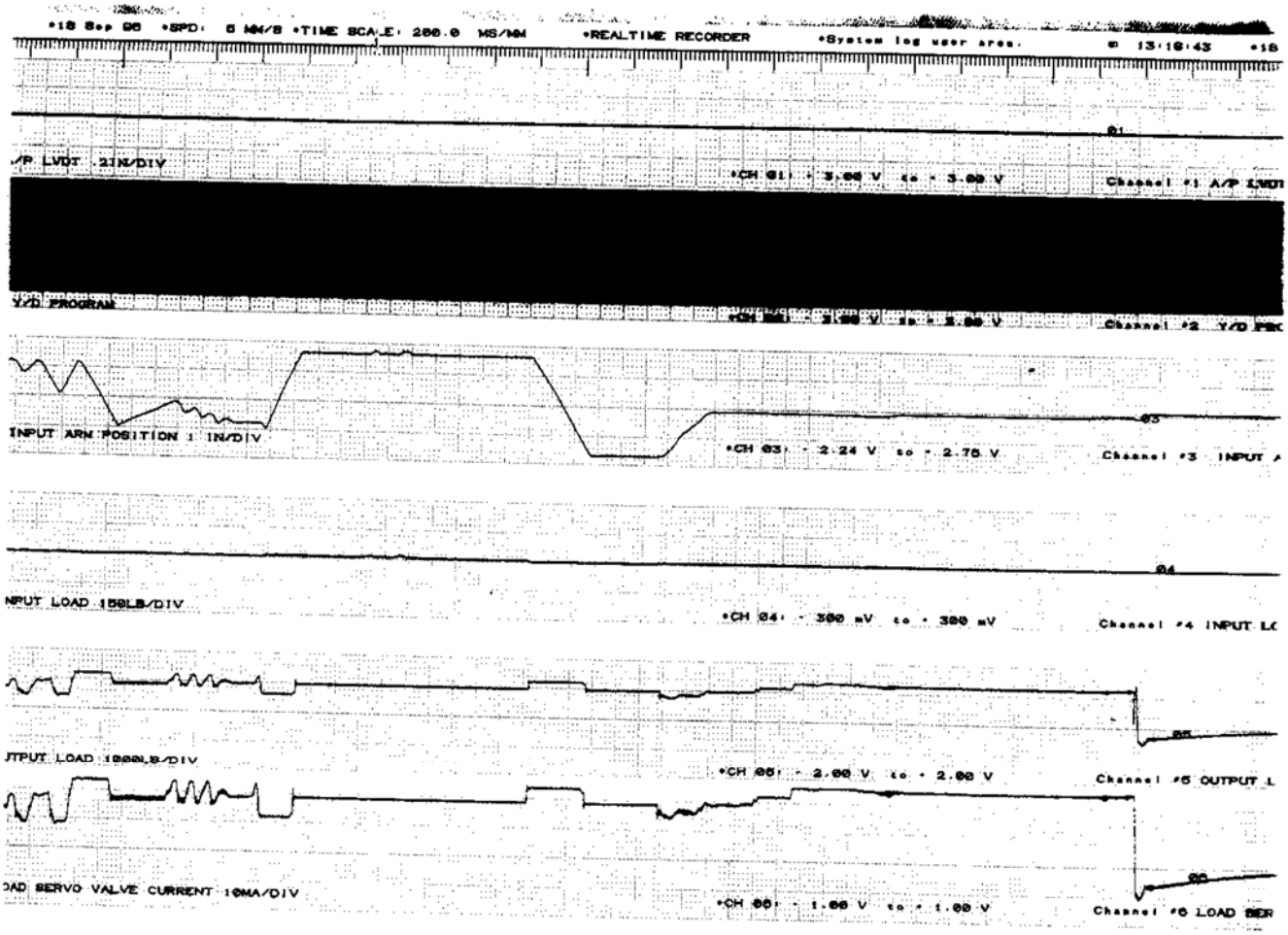
Dynamic Test
Rudder PCU
(Engineering Unit)



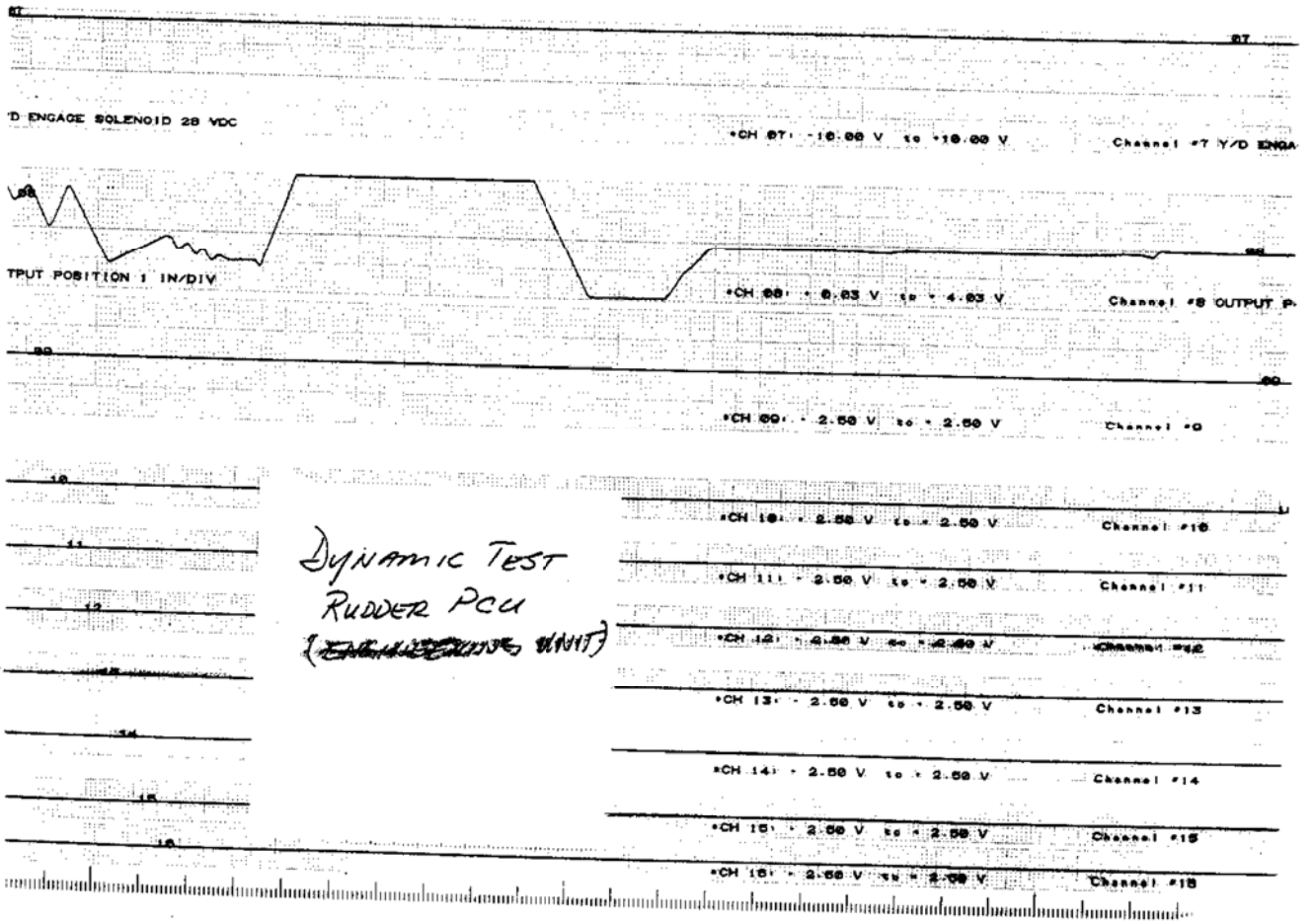


Dynamic Test
Rudder PCU
Engineering Ui

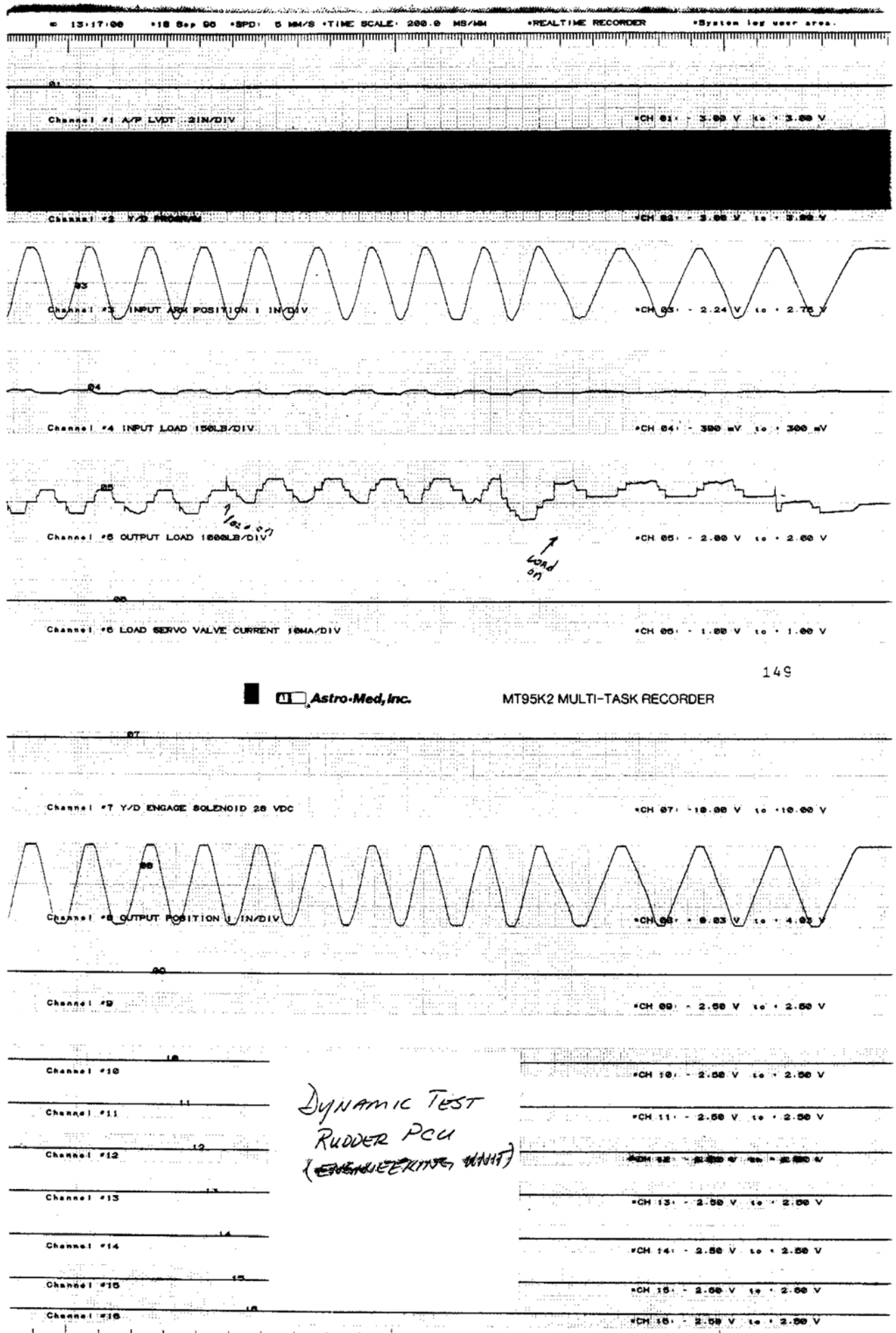

5 MM/S *TIME SCALE: 200.0 MS/MM
*REALTIME RECORDER
*System log user area.
13:19:35 *18 Sep 96 *SPD: 5 MM/S
*CH 01: + 3.00 V to + 3.00 V
Channel #1 A/P LVDT .2IN/DIV
*CH 02: - 2.13 V to + 1.88 V
Channel #2 Y/D PROGRAM
IN/DIV
*CH 03: - 2.24 V to + 2.76 V
Channel #3 INPUT ARM POSITION 1 IN/DIV
*CH 04: - 300 mV to + 300 mV
Channel #4 INPUT LOAD 150LB/DIV
*CH 05: - 2.00 V to + 2.00 V
Channel #5 OUTPUT LOAD 1000LB/DIV
LOAD ON
LOAD ON
T 10MA/DIV
*CH 06: - 1.00 V to + 1.00 V
Channel #6 LOAD SERVO VALVE CURRENT 10MA/
Cond 2f
Cond 29
147
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
VDC
*CH 07: -10.00 V to +10.00 V
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 08: - 0.03 V to + 4.03 V
Channel #8 OUTPUT POSITION IN/DIV
*CH 09: - 2.00 V to + 2.00 V
Channel #9
*CH 10: - 2.00 V to + 2.00 V
Channel #10
*CH 11: - 2.00 V to + 2.00 V
Channel #11
*CH 12: - 2.00 V to + 2.00 V
Channel #12
*CH 13: - 2.00 V to + 2.00 V
Channel #13
*CH 14: - 2.00 V to + 2.00 V
Channel #14
*CH 15: - 2.00 V to + 2.00 V
Channel #15
*CH 16: - 2.00 V to + 2.00 V
Channel #16
Dynamic Test
Rudder PCU
(Engineering Unit)



Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



Dynamic Test
Rudder PCU
(Engineering Unit)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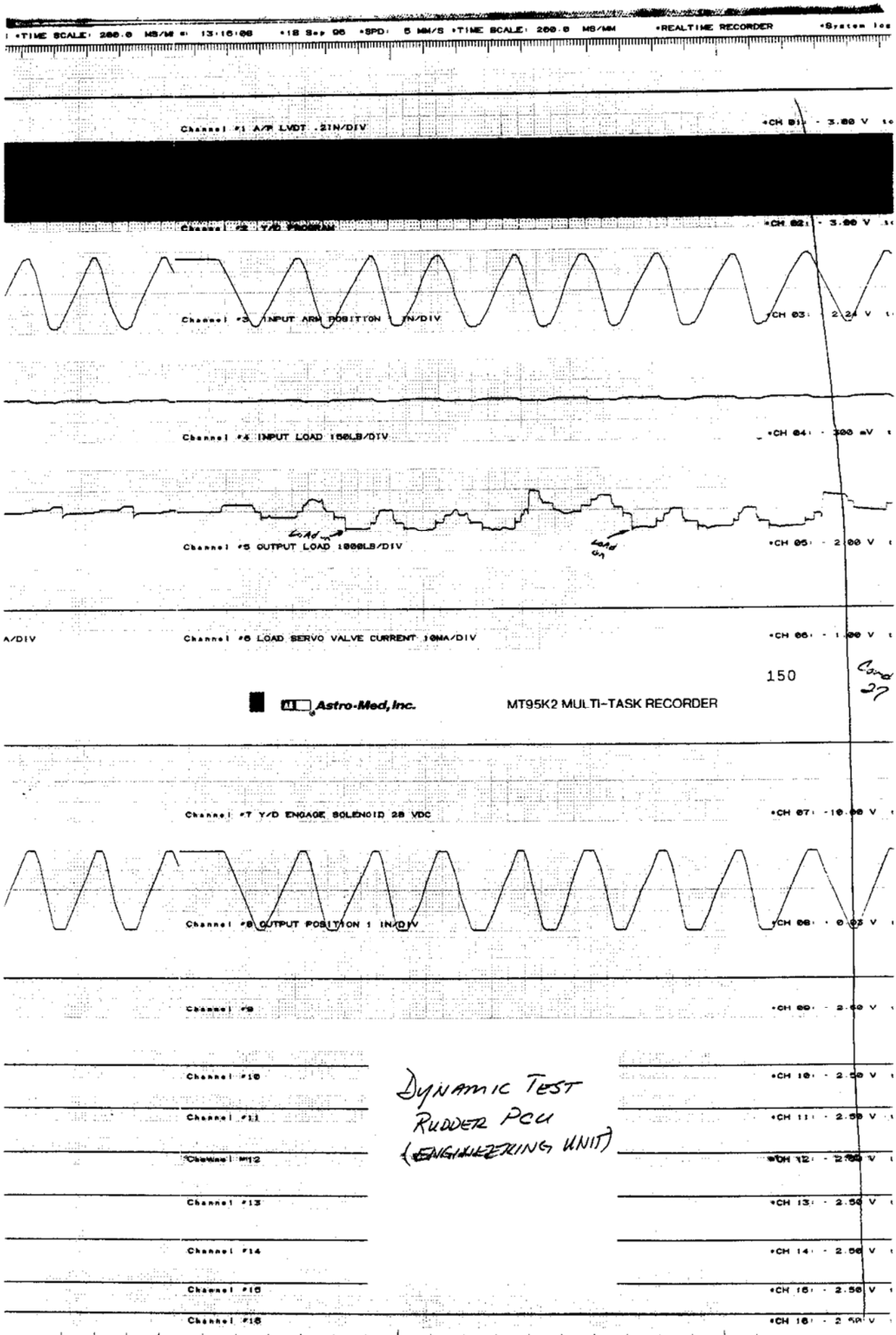
01
Channel #1 A/P LVDT .2IN/DIV
*CH 01: - 3.00 V to + 3.00 V
Channel #2 Y/D PROGRAM
*CH 02: - 3.00 V to + 3.00 V
03
Channel #3 INPUT ARM POSITION 1 IN/DIV
*CH 03: - 2.24 V to + 2.76 V
04
Channel #4 INPUT LOAD 150LB/DIV
*CH 04: - 300 mV to + 300 mV
05
Channel #5 OUTPUT LOAD 1000LB/DIV
*CH 05: - 2.00 V to + 2.00 V
Load on
06
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
*CH 06: - 1.00 V to + 1.00 V
149
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
07
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 07: -10.00 V to +10.00 V
08
Channel #8 OUTPUT POSITION 1 IN/DIV
*CH 08: - 8.03 V to + 4.03 V
09
Channel #9
*CH 09: - 2.50 V to + 2.50 V
10
Channel #10
*CH 10: - 2.50 V to + 2.50 V
11
Channel #11
*CH 11: - 2.50 V to + 2.50 V
12
Channel #12
*CH 12: - 2.50 V to + 2.50 V
13
Channel #13
*CH 13: - 2.50 V to + 2.50 V
14
Channel #14
*CH 14: - 2.50 V to + 2.50 V
15
Channel #15
*CH 15: - 2.50 V to + 2.50 V
16
Channel #16
*CH 16: - 2.50 V to + 2.50 V
Dynamic Test
Rudder PCU
(Engineering Unit)



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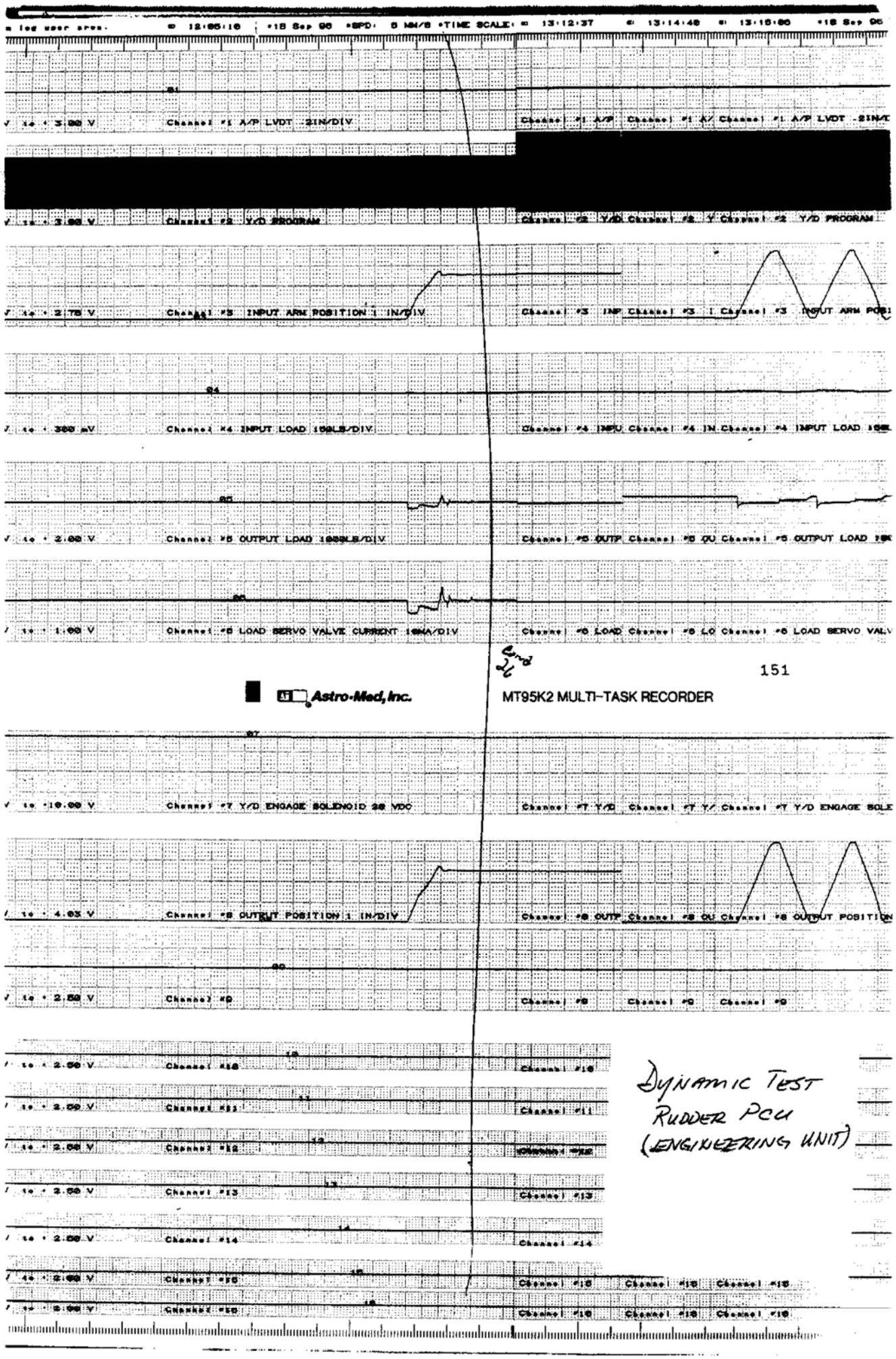
(Engineering Unit)



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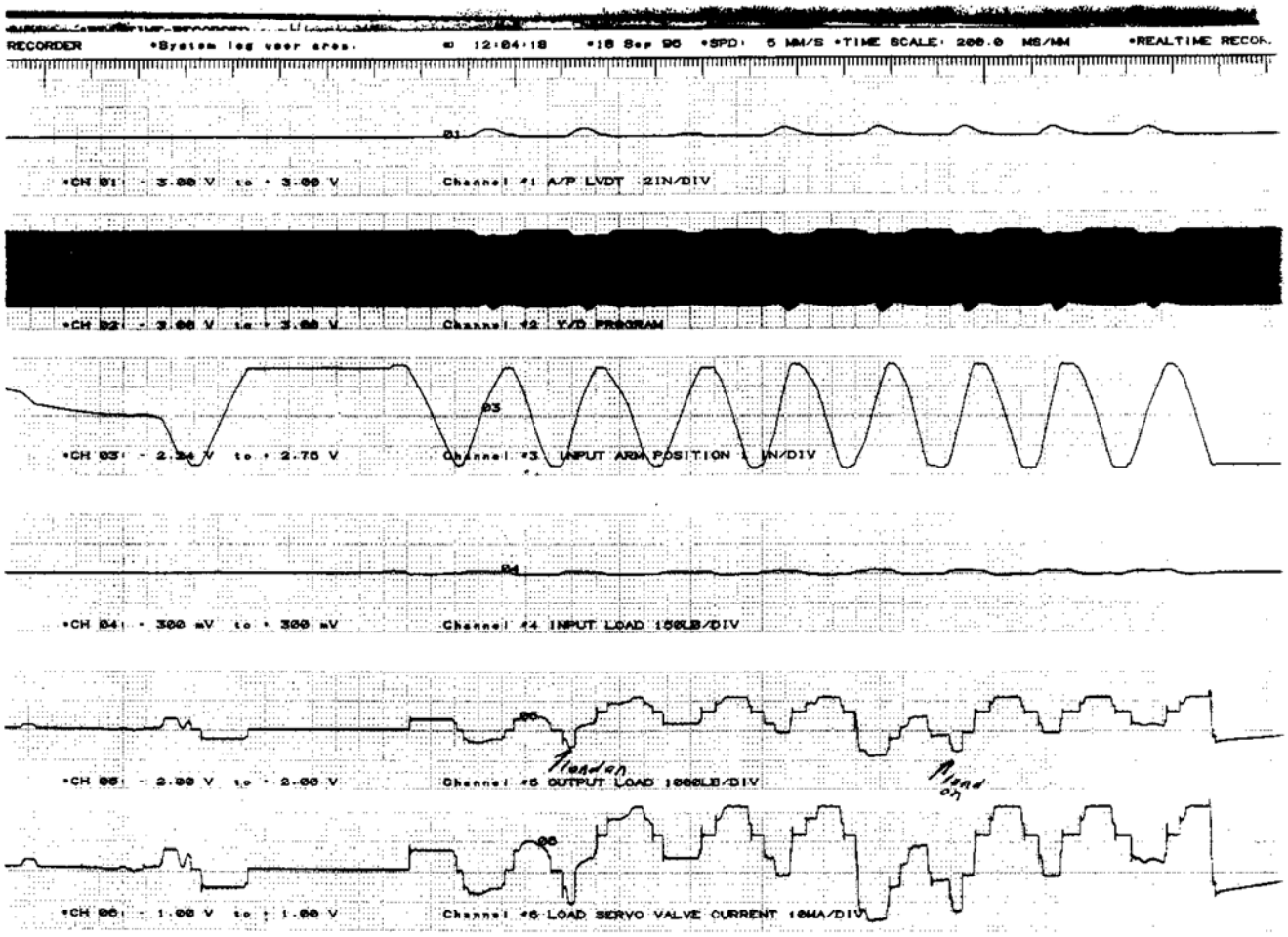
MT95K2 MULTI-TASK RECORDER

Dynamic Test
Rudder PCU
(Engineering Unit)



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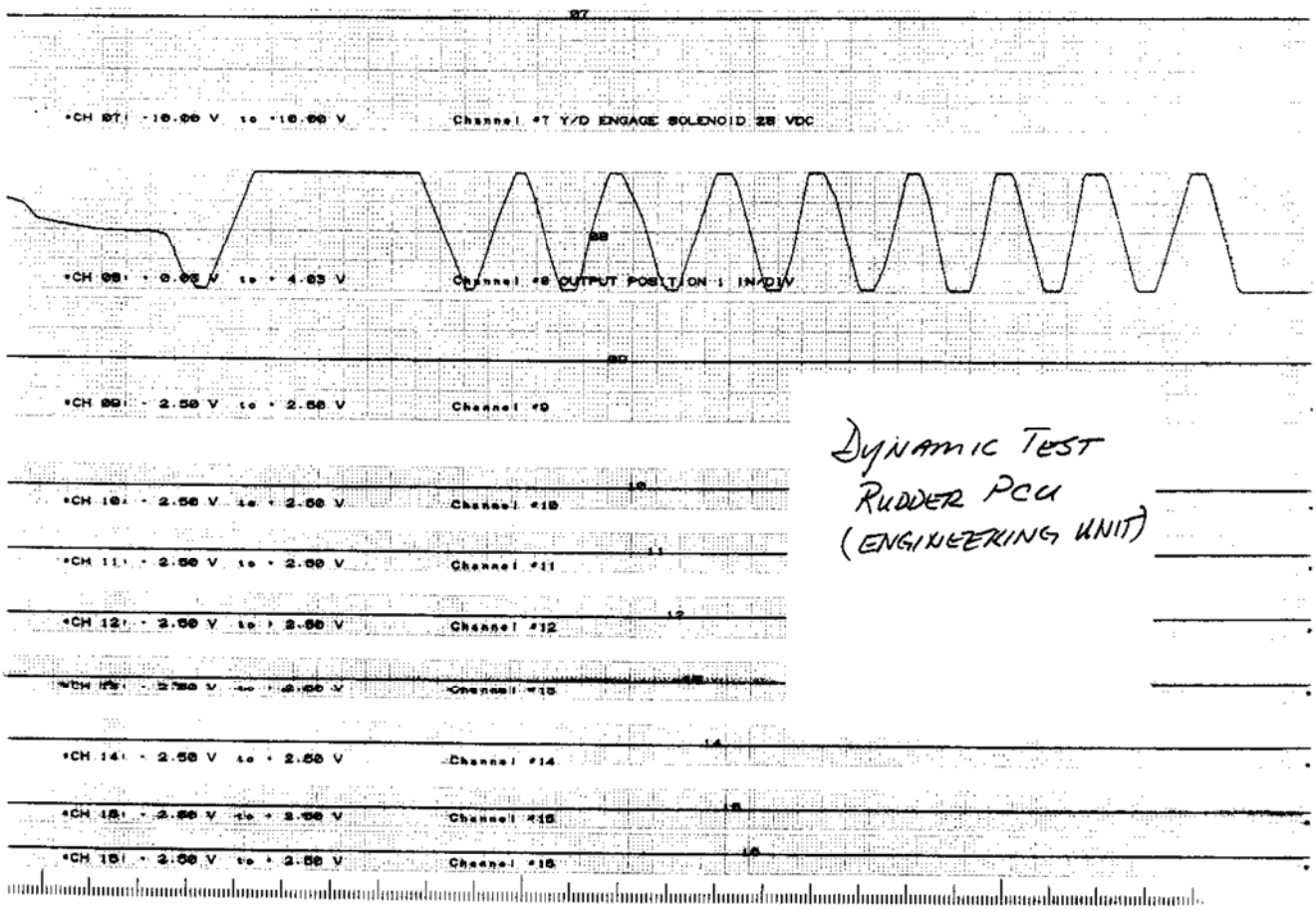
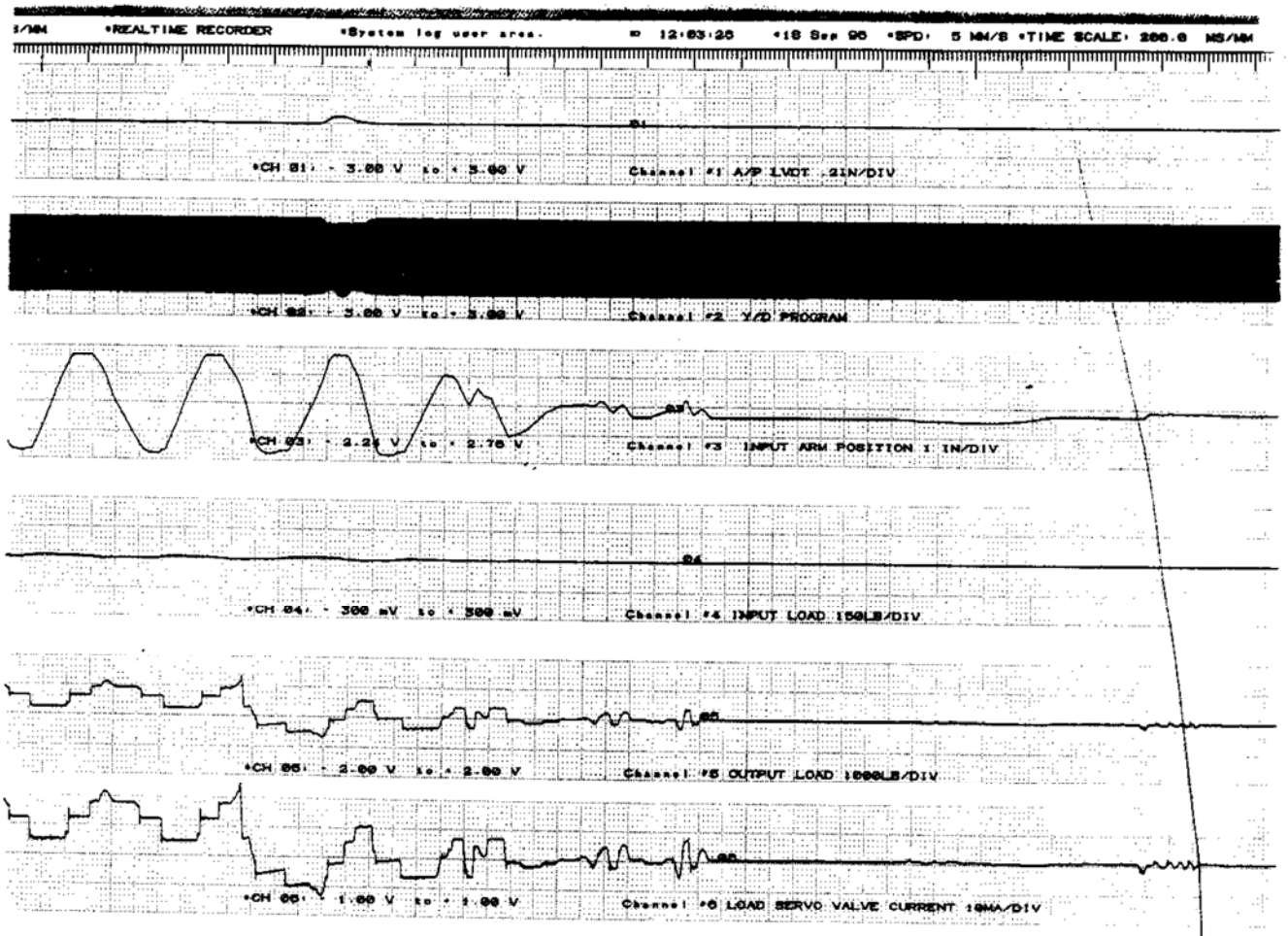
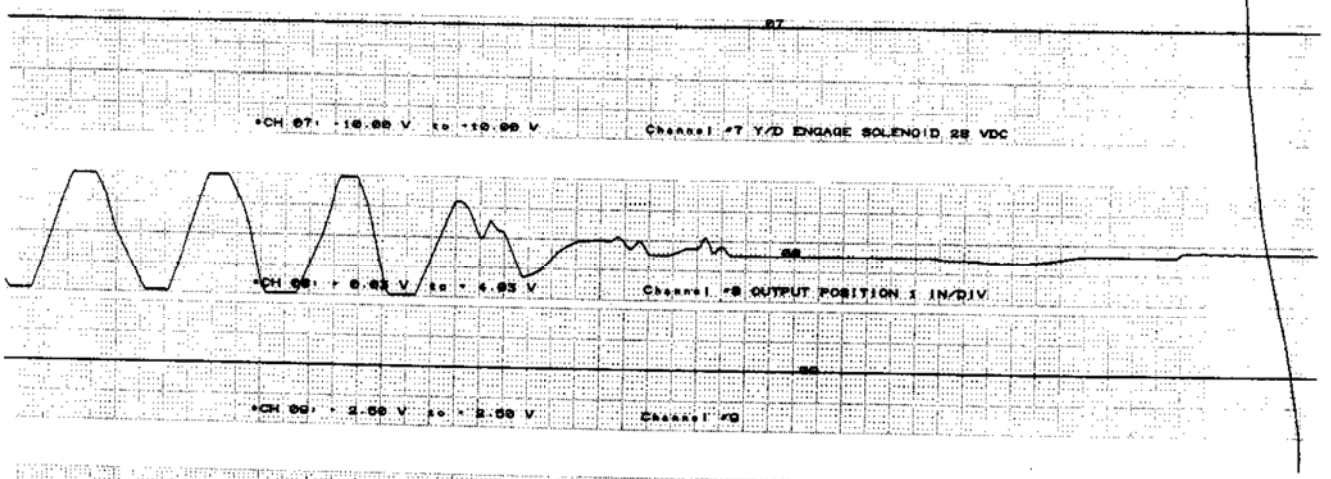
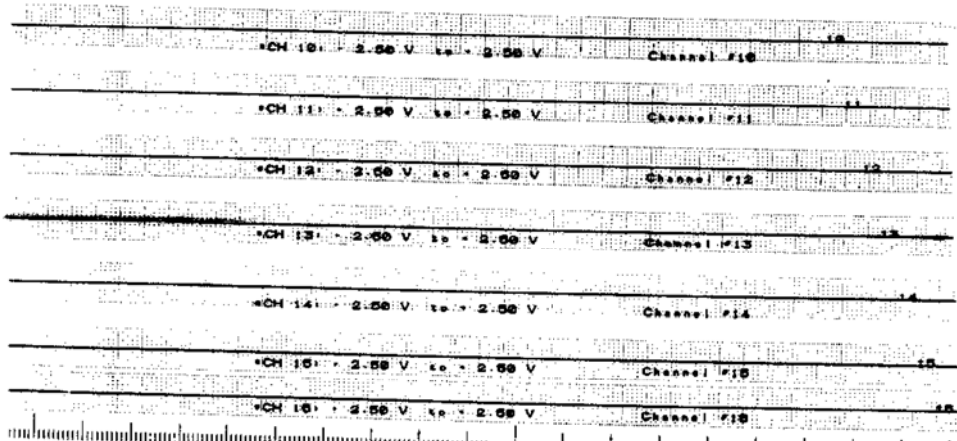


Dynamic Test
Rudder PCU
(Engineering Unit)

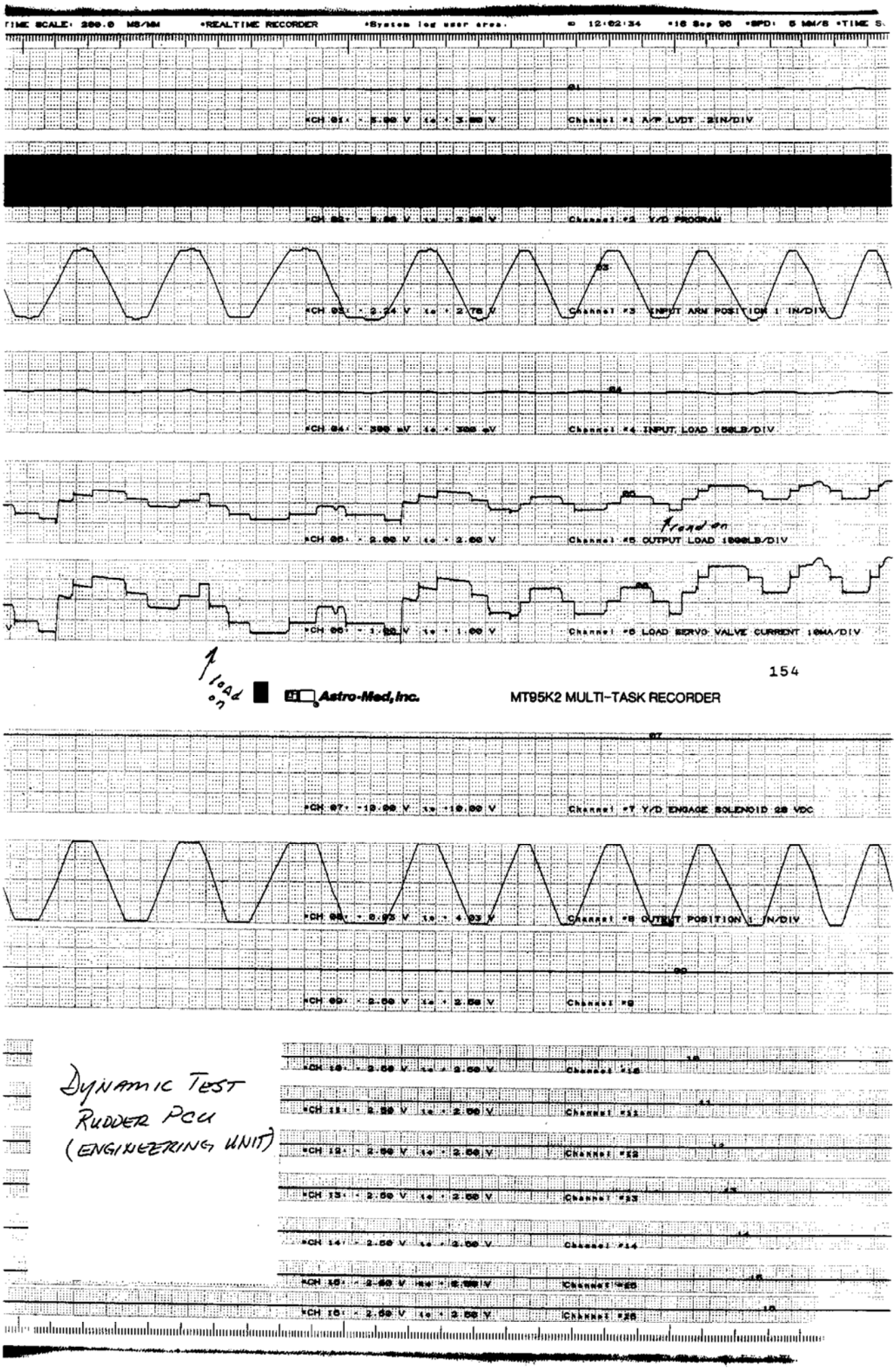


Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER





Dynamic Test
Rudder PCU
(Engineering Unit)



load on

Astro-Med, Inc.

MT95K2 MULTI-TASK RECORDER

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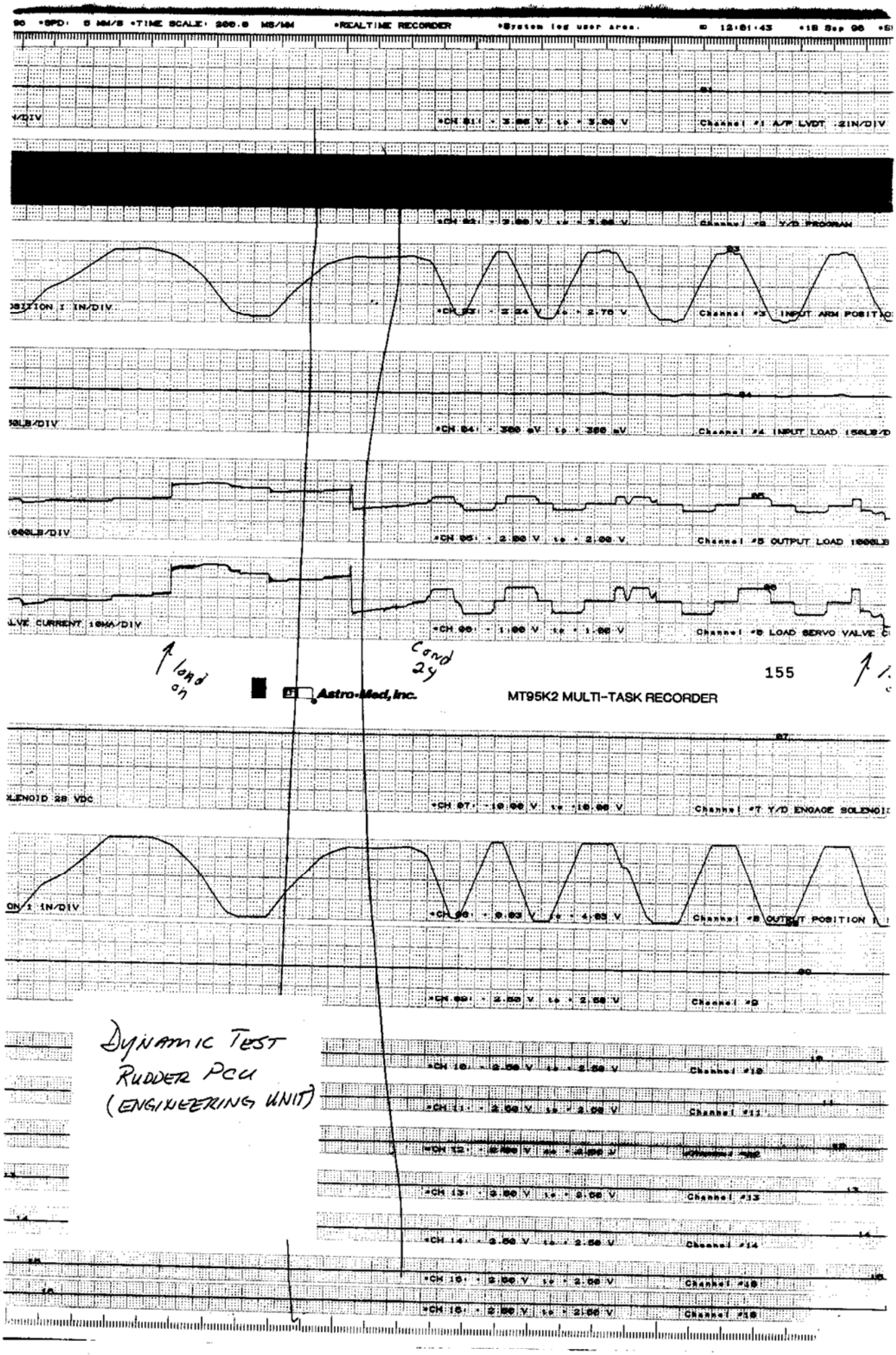
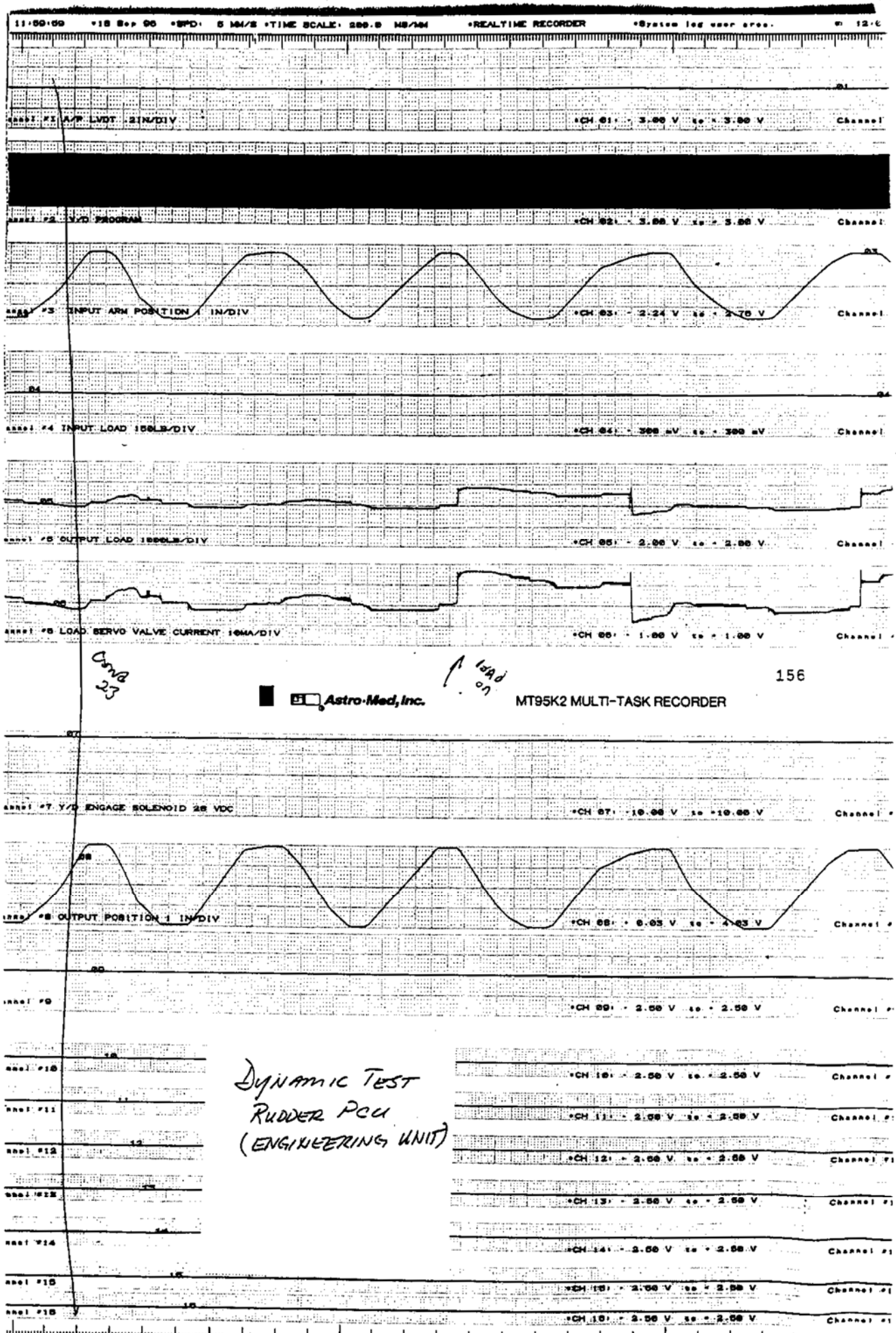
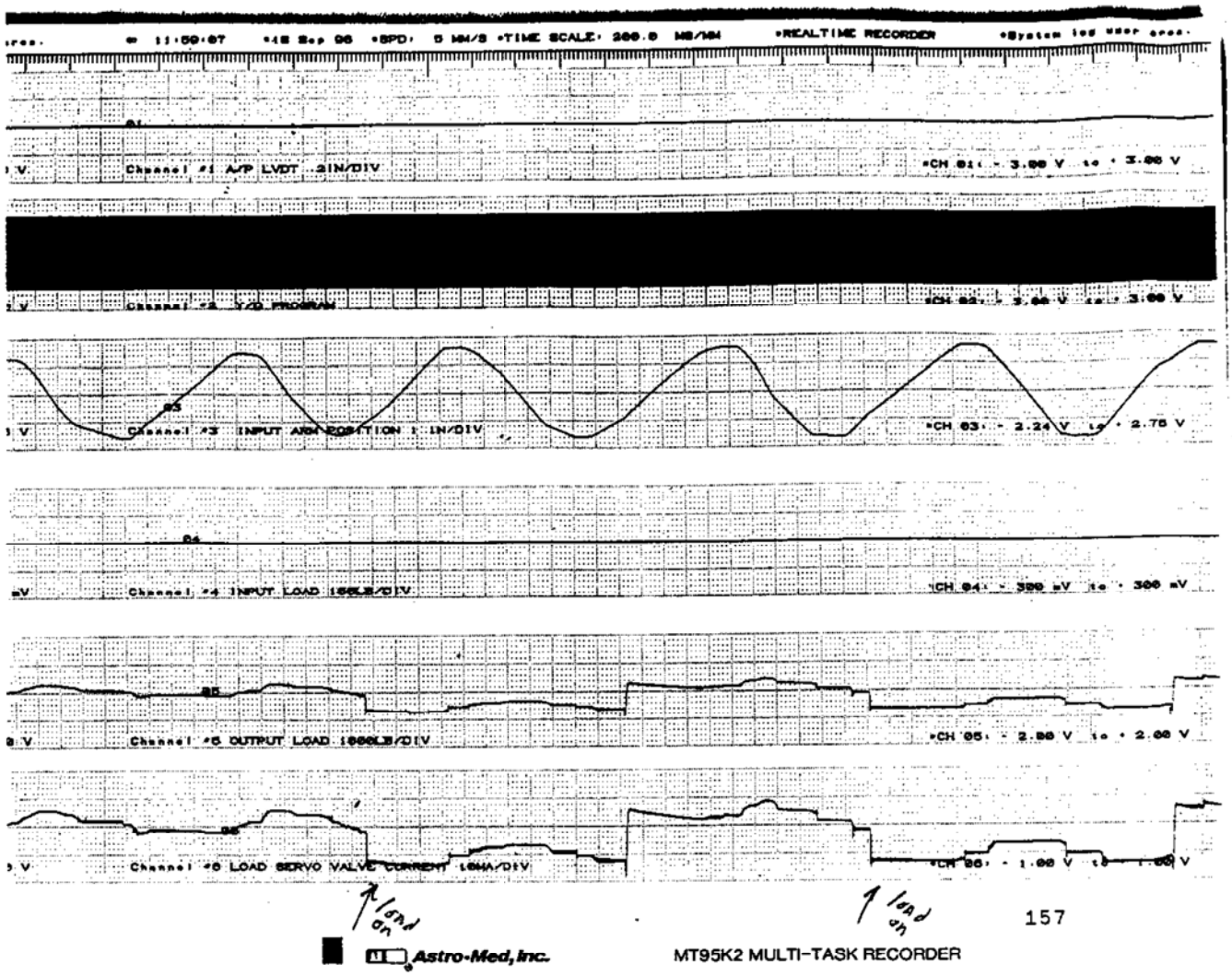
Dynamic Test
Rudder PCU
(ENGINEERING UNIT)

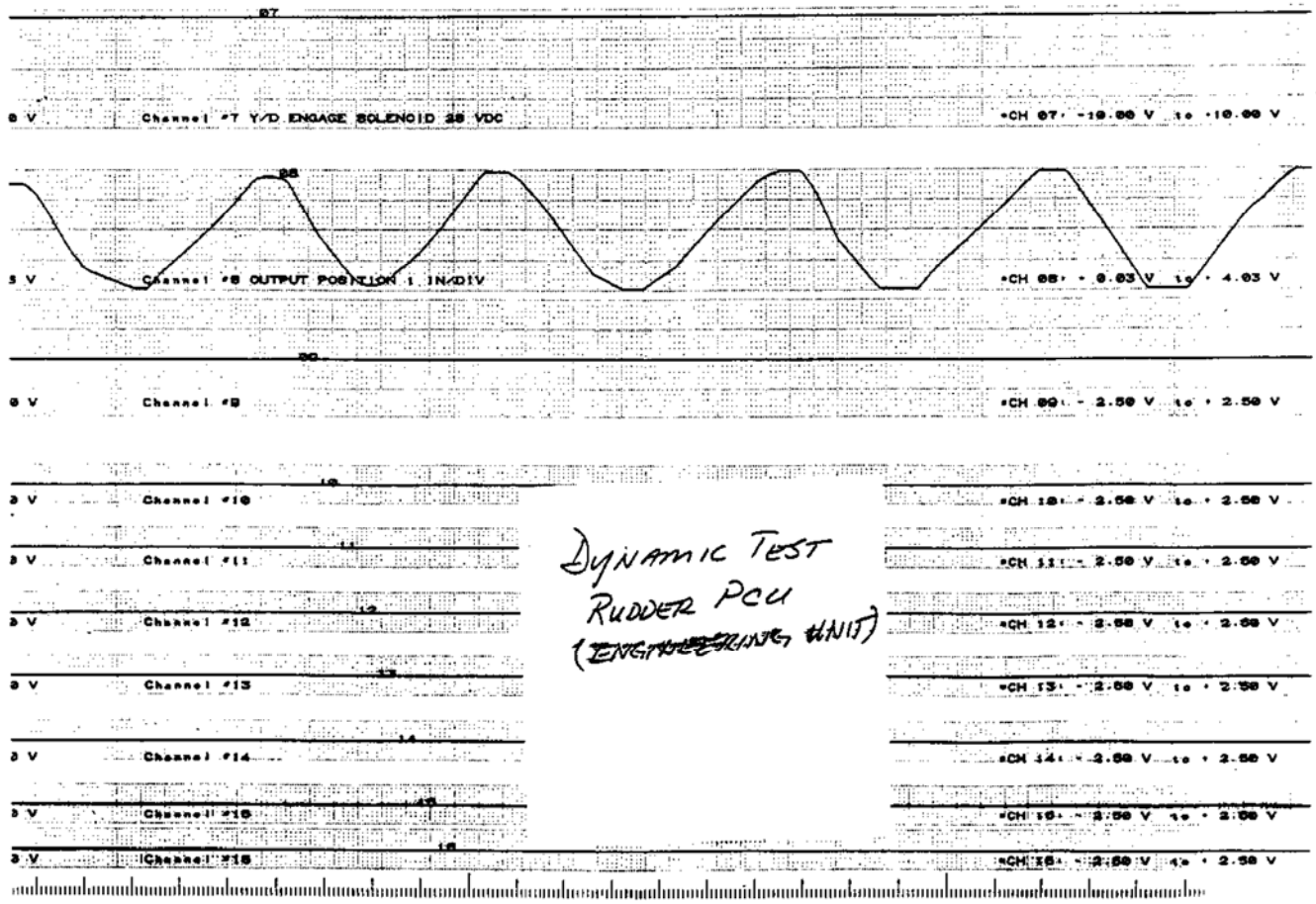

*SPD: 5 MM/S *TIME SCALE: 200.0 MS/MM *REALTIME RECORDER *System log user area. 12:01:43 *18 Sep 96
Channel #1 A/P LVDT .2IN/DIV
Channel #3 INPUT ARM POSITIO
Channel #4 INPUT LOAD (50LB/D
Channel #5 OUTPUT LOAD 1000LB
Channel #6 LOAD SERVO VALVE C
Channel #7 Y/D ENGAGE SOLENOI
Channel #8 OUTPUT POSITION
Channel #10
Channel #11
Channel #13
Channel #14
Channel #15
Channel #16
Land on
Cond 29
155
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNIT)


11:59:09 *18 Sep 96 *SPD: 5 MM/S *TIME SCALE: 200.0 MS/MM *REALTIME RECORDER *System log user area.
*CH 01: - 3.00 V to + 3.00 V
*CH 02: - 3.00 V to + 3.00 V
*CH 03: - 2.24 V to + 2.76 V
*CH 04: - 300 mV to + 300 mV
*CH 05: - 2.00 V to + 2.00 V
*CH 06: - 1.00 V to + 1.00 V
*CH 07: -10.00 V to +10.00 V
*CH 08: + 0.03 V to + 4.03 V
*CH 09: - 2.50 V to + 2.50 V
*CH 10: - 2.50 V to + 2.50 V
*CH 11: - 2.50 V to + 2.50 V
*CH 12: - 2.50 V to + 2.50 V
*CH 13: - 2.50 V to + 2.50 V
*CH 14: - 2.50 V to + 2.50 V
*CH 15: - 2.50 V to + 2.50 V
*CH 16: - 2.50 V to + 2.50 V
Channel 1
Channel 2
Channel 3
Channel 4
Channel 5
Channel 6
Channel 7
Channel 8
Channel 9
Channel 10
Channel 11
Channel 12
Channel 13
Channel 14
Channel 15
Channel 16
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
156
Dynamic Test
Rudder PCU
(Engineering Unit)

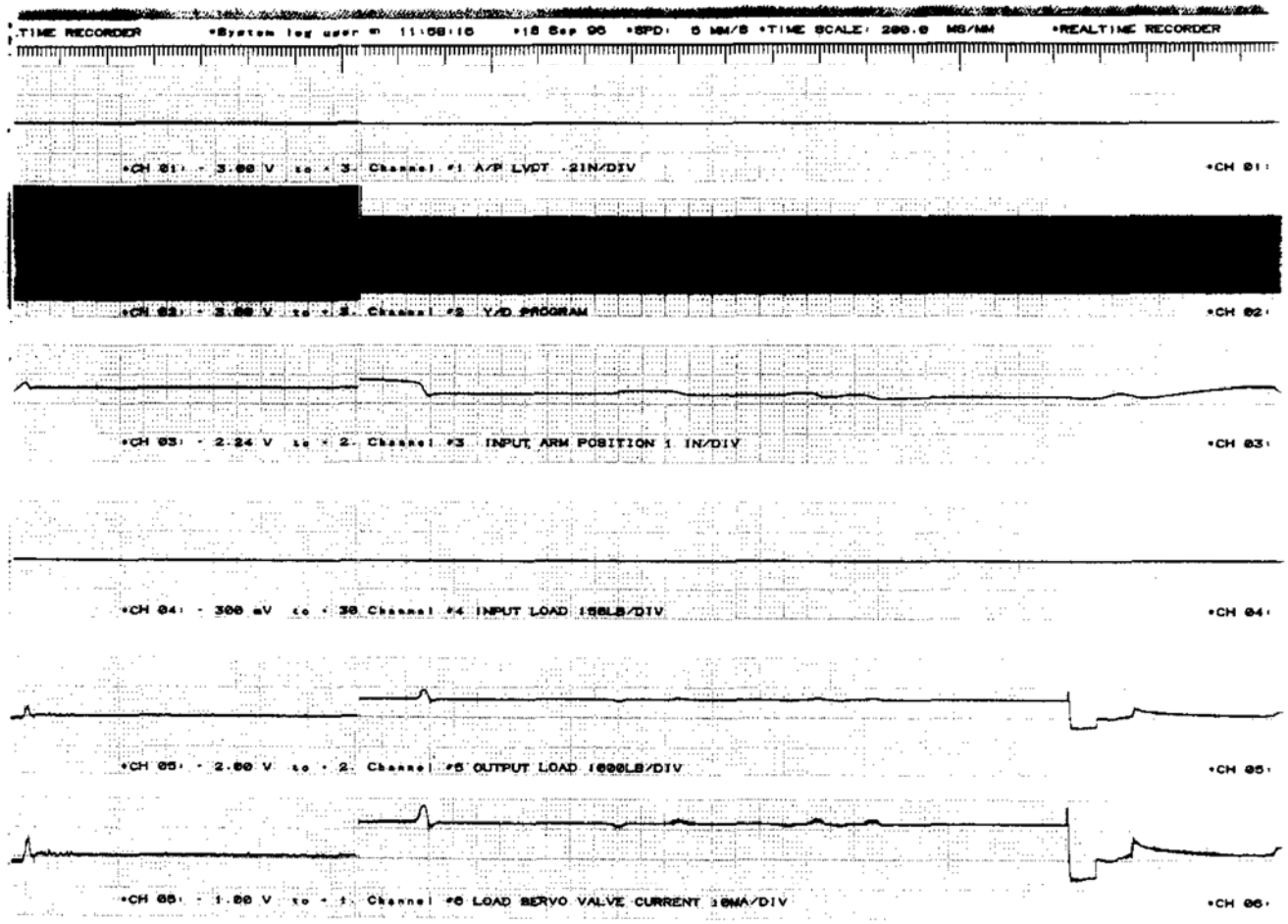


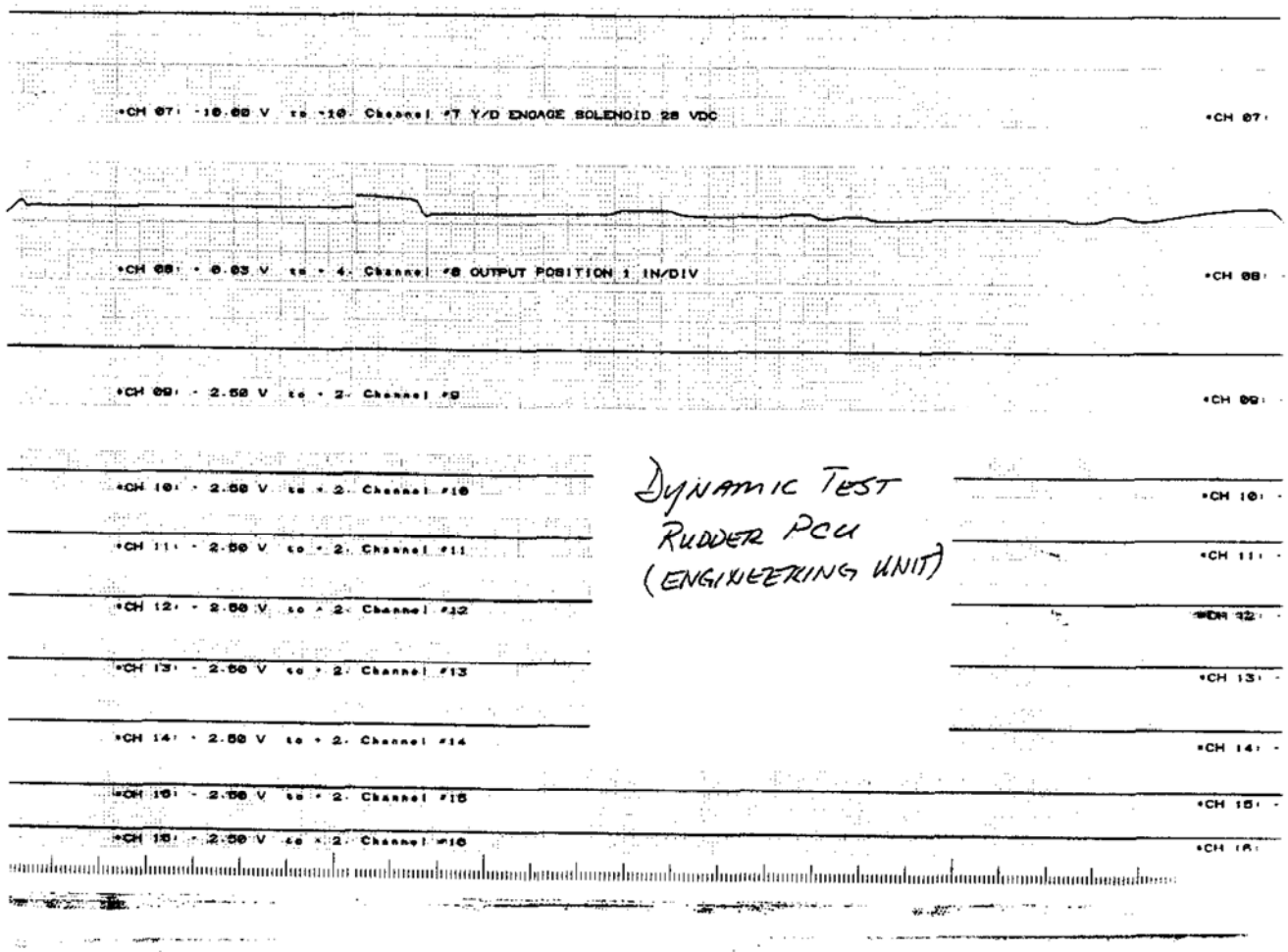
157

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

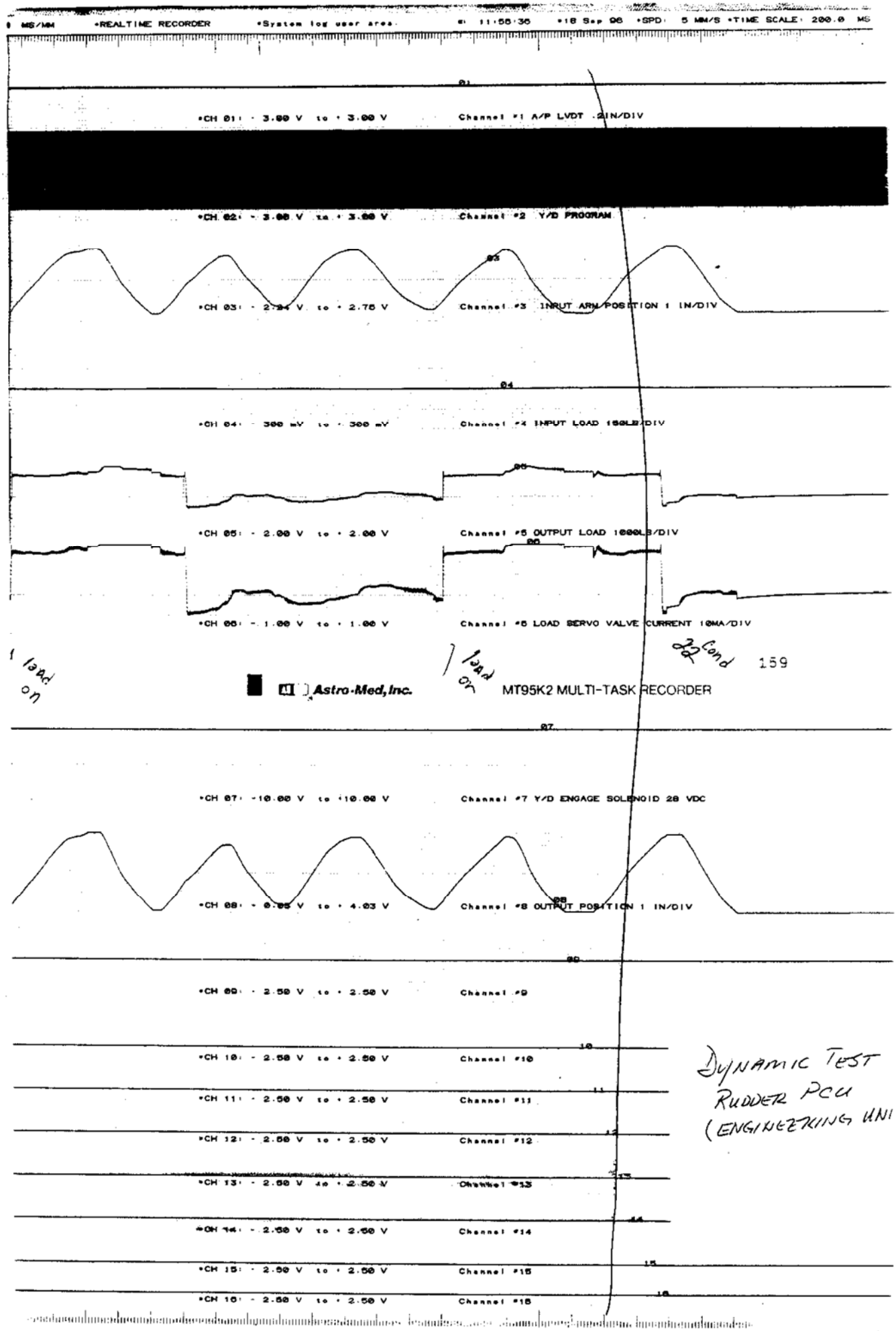


Dynamic Test
Rudder PCU
(Engineering Unit)





Dynamic Test
Rudder PCU
(ENGINEERING UNIT)

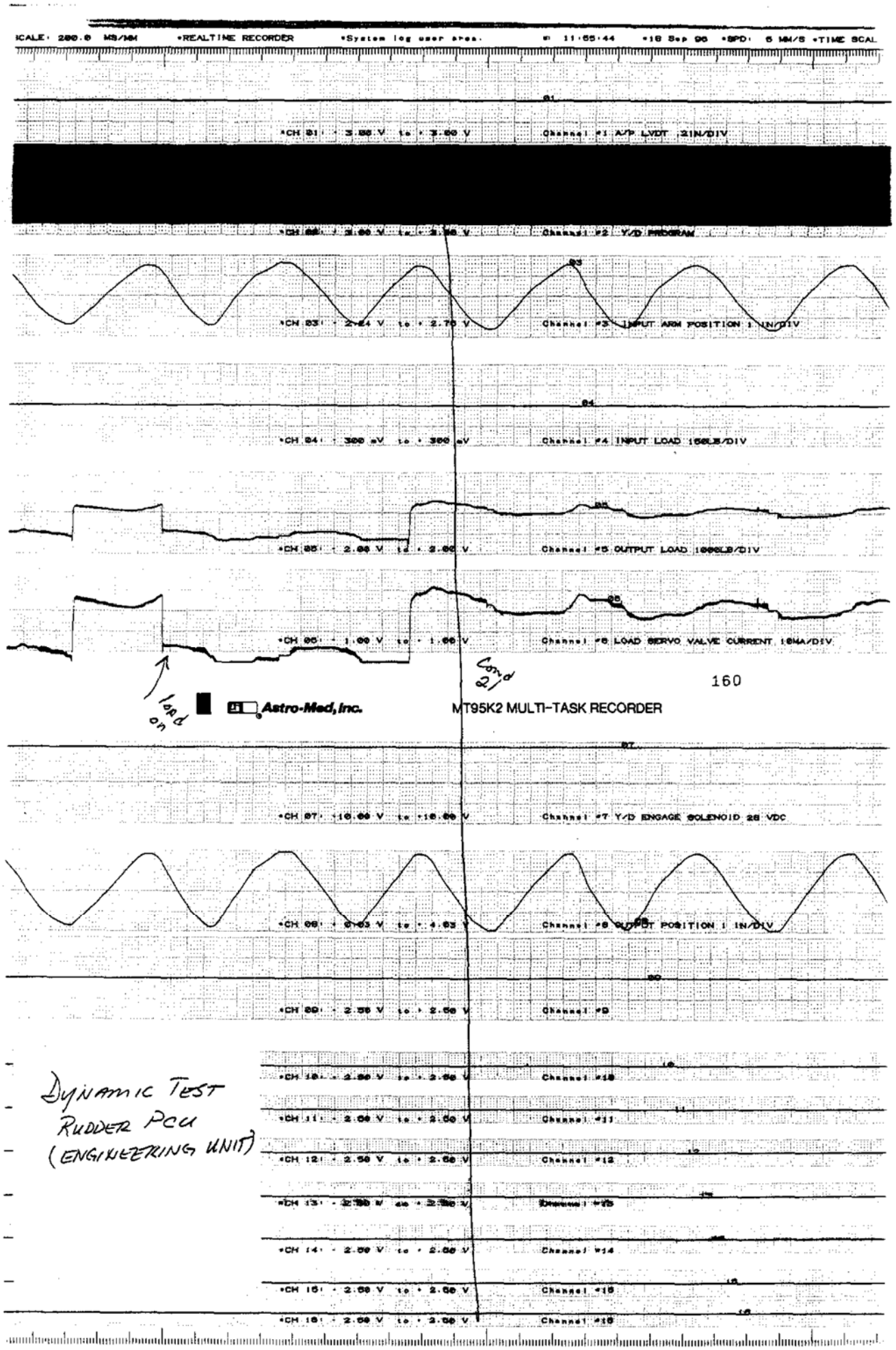


load on

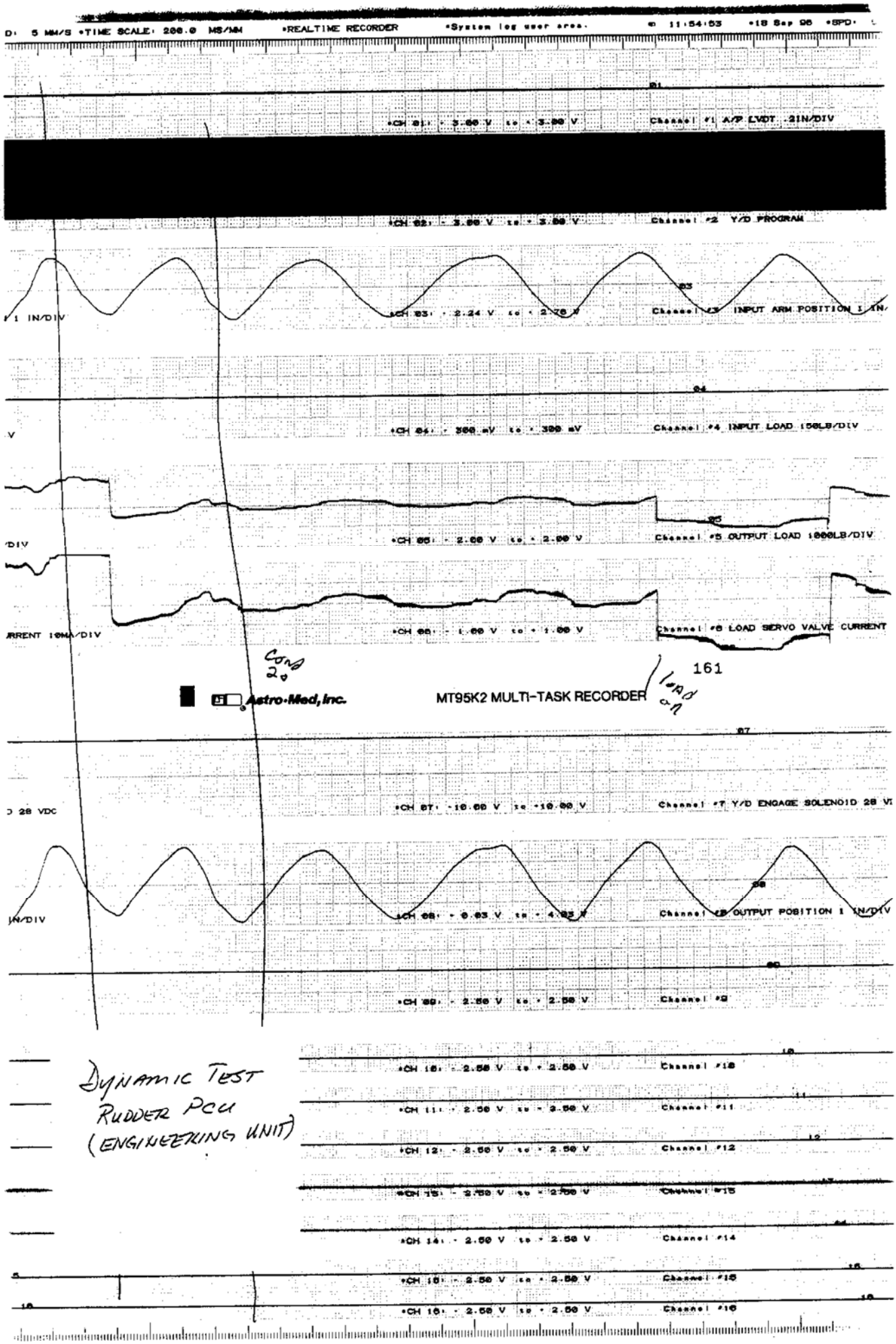
load off

22 cond 159

DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNI



Dynamic Test
Rudder PCU
(Engineering Unit)

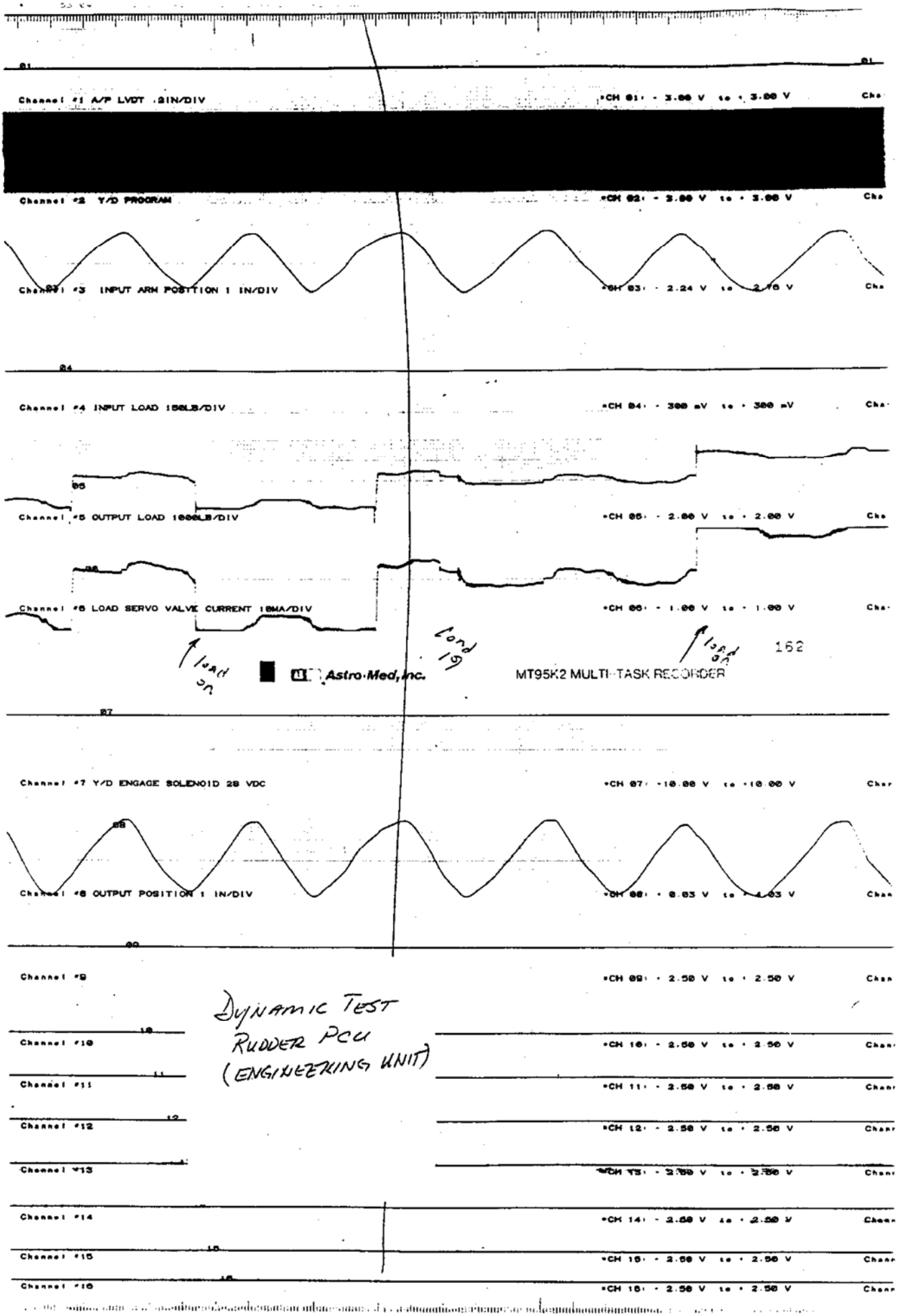


Cond 2

161

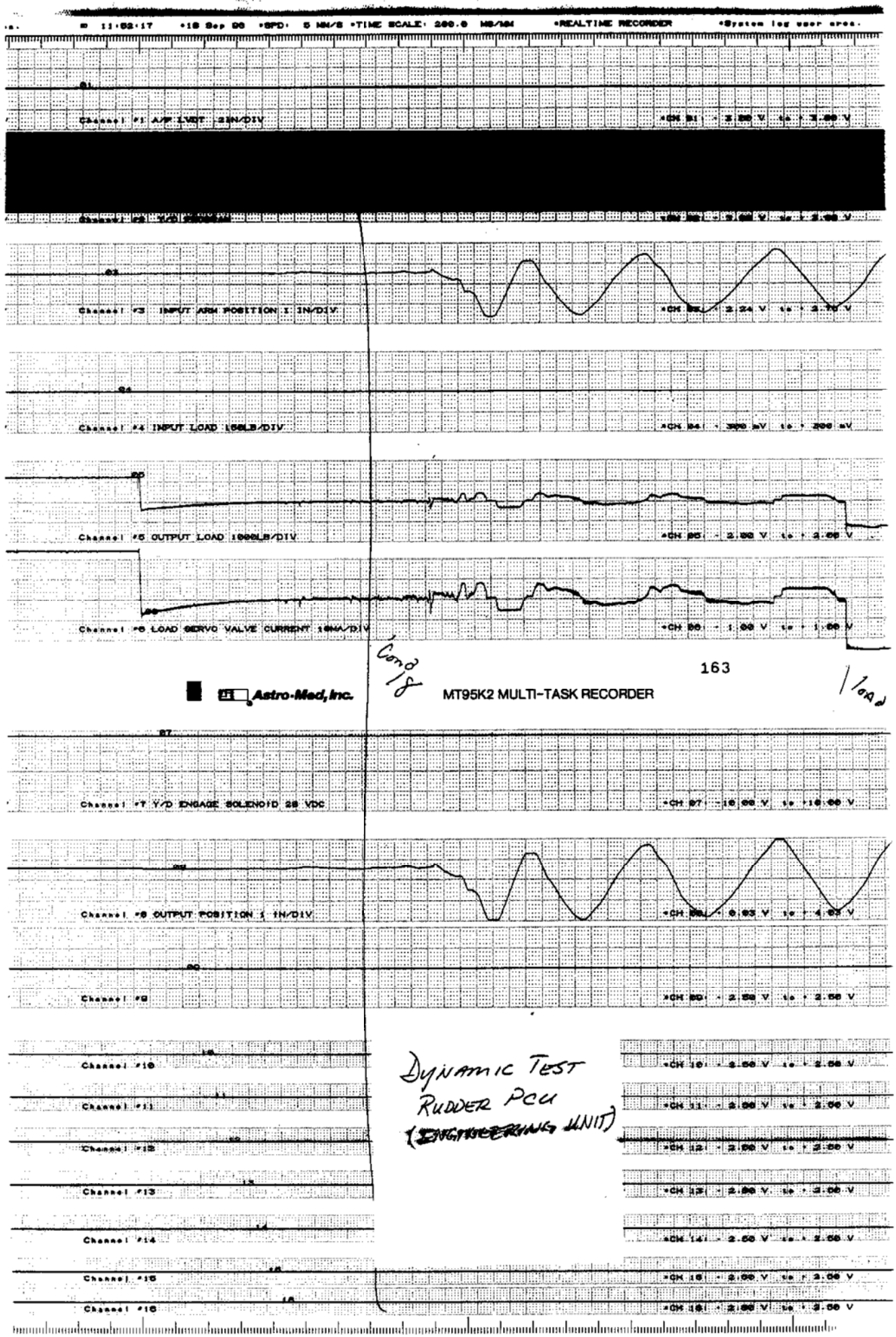
Load on

Dynamic Test
Rudder PCU
(Engineering Unit)



162

Dynamic Test
Rudder PCU
(Engineering Unit)



163

Dynamic Test
Rudder PCU
(Engineering Unit)

RDER *System log user area. 11:51:26 *18 Sep 96 *SPD: 5 MM/S *TIME SCALE: 200.0 MS/MM *REAL-TIME RECORDER

*CH 01: - 3.00 V to + 3.00 V Channel #1 A/P LVDT .2IN/DIV *CH

*CH 02: - 3.00 V to + 3.00 V Channel #2 Y/D PROGRAM *CH

*CH 03: + 2.24 V to + 2.76 V Channel #3 INPUT ARM POSITION 1 IN/DIV *CH

*CH 04: - 300 mV to + 300 mV Channel #4 INPUT LOAD 150LB/DIV *CH

*CH 05: - 2.00 V to + 2.00 V Channel #5 OUTPUT LOAD 1000LB/DIV *CH

*CH 06: - 1.00 V to + 1.00 V Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV *CH

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

*CH 07: -10.00 V to +10.00 V Channel #7 Y/D ENGAGE SOLENOID 28 VDC *CH

*CH 08: - 0.03 V to + 4.03 V Channel #8 OUTPUT POSITION 1 IN/DIV *CH

*CH 09: - 2.50 V to + 2.50 V Channel #9 *CH

*CH 10: - 2.50 V to + 2.50 V Channel #10 *CH

*CH 11: - 2.50 V to + 2.50 V Channel #11 *CH

*CH 12: - 2.50 V to + 2.50 V Channel #12 *CH

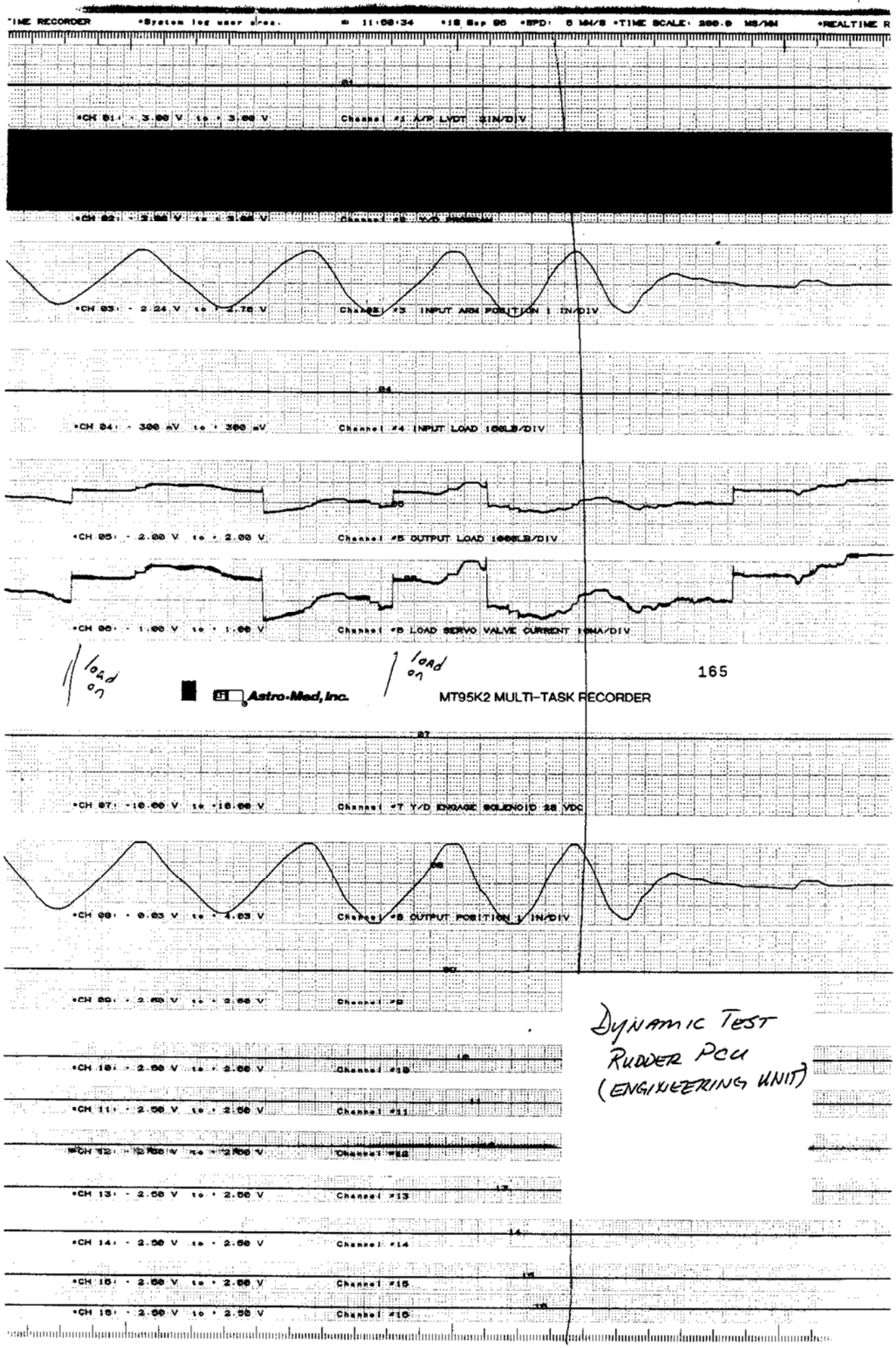
*CH 13: - 2.50 V to + 2.50 V Channel #13 *CH

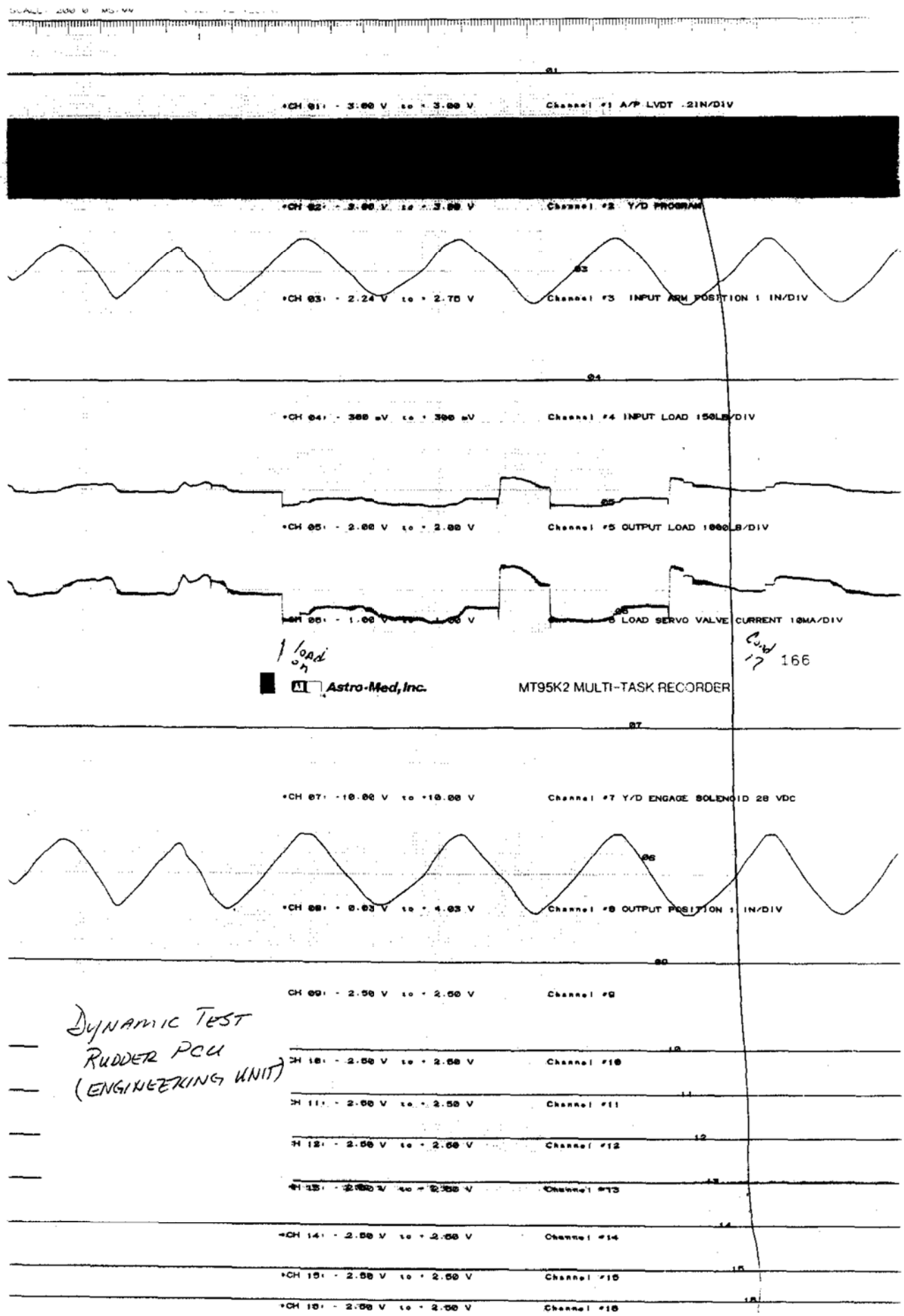
*CH 14: - 2.50 V to + 2.50 V Channel #14 *CH

*CH 15: - 2.50 V to + 2.50 V Channel #15 *CH

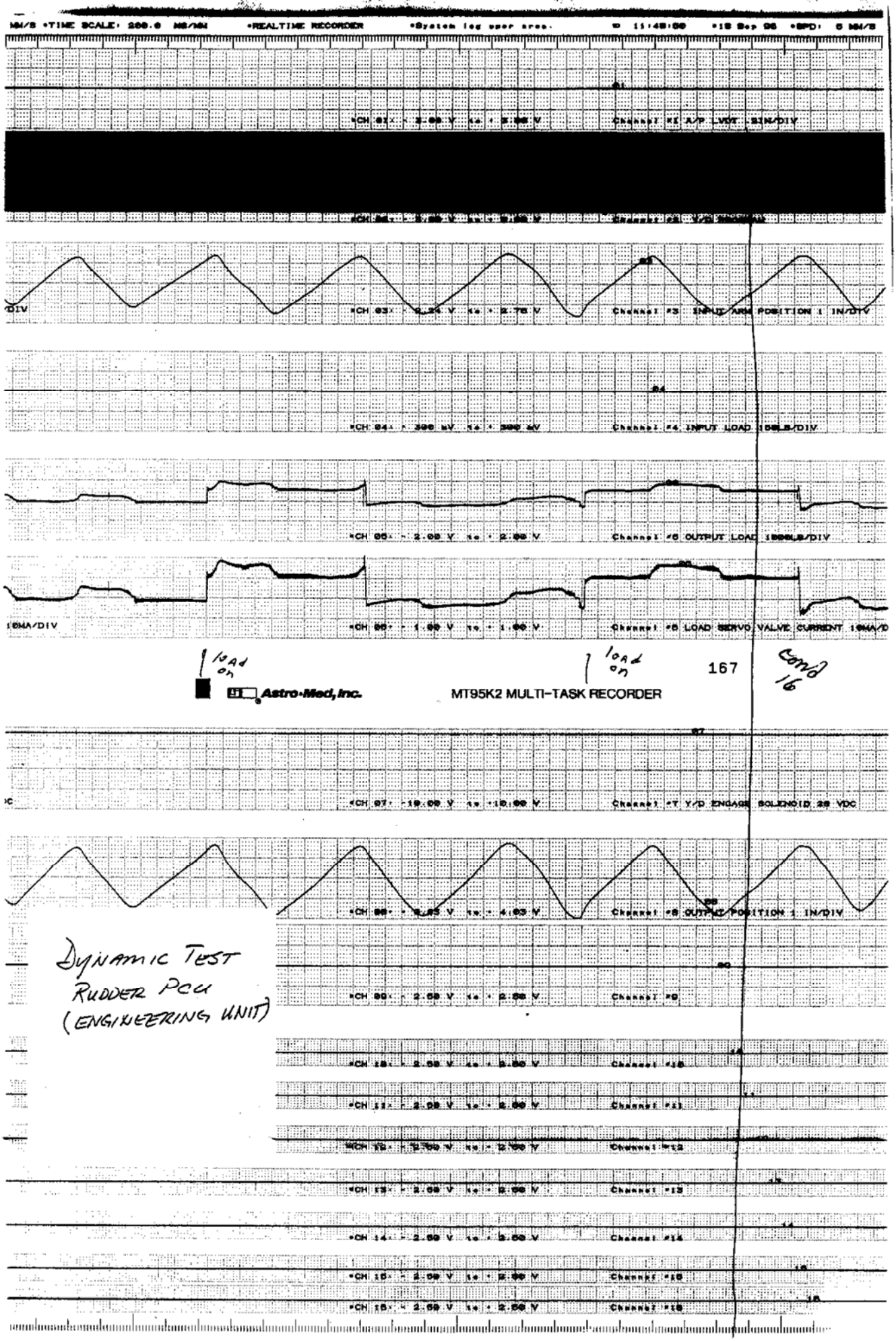
*CH 16: - 2.50 V to + 2.50 V Channel #16 *CH

DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNIT)


TIME RECORDER
*System log user area.
11:00:34
*18 Sep 96
*SPD: 6 MM/S
*TIME SCALE: 200.0 MS/MM
*REALTIME R
*CH 01: - 3.00 V to + 3.00 V
Channel #1 A/P LVDT 2IN/DIV
*CH 02: - 3.00 V to + 3.00 V
Channel #2 Y/D PROGRAM
*CH 03: - 2.24 V to + 2.76 V
Channel #3 INPUT ARM POSITION 1 IN/DIV
*CH 04: - 300 mV to + 300 mV
Channel #4 INPUT LOAD 100LB/DIV
*CH 05: - 2.00 V to + 2.00 V
Channel #5 OUTPUT LOAD 1000LB/DIV
*CH 06: - 1.00 V to + 1.00 V
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
load on
load on
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
165
*CH 07: -10.00 V to +10.00 V
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 08: - 0.03 V to + 4.03 V
Channel #8 OUTPUT POSITION 1 IN/DIV
*CH 09: - 2.50 V to + 2.50 V
Channel #9
*CH 10: - 2.50 V to + 2.50 V
Channel #10
*CH 11: - 2.50 V to + 2.50 V
Channel #11
*CH 12: - 2.50 V to + 2.50 V
Channel #12
*CH 13: - 2.50 V to + 2.50 V
Channel #13
*CH 14: - 2.50 V to + 2.50 V
Channel #14
*CH 15: - 2.50 V to + 2.50 V
Channel #15
*CH 16: - 2.50 V to + 2.50 V
Channel #16
Dynamic Test
Rudder PCU
(Engineering Unit)



Dynamic Test
Rudder PCU
(Engineering Unit)


MM/S *TIME SCALE: 200.0 MS/MM
*REALTIME RECORDER
*System log user area.
*18 Sep 96
*SPD: 5 MM/S
*CH 01 - 2.00 V to + 2.00 V
Channel #1 A/P LVDT 2IN/DIV
*CH 02 - 0.24 V to + 2.76 V
Channel #2 INPUT ARM POSITION 1 IN/DIV
*CH 04 - 300 mV to + 300 mV
Channel #4 INPUT LOAD 100LB/DIV
*CH 06 - 2.00 V to + 2.00 V
Channel #6 OUTPUT LOAD 1000LB/DIV
10MA/DIV
*CH 08 - 1.00 V to + 1.00 V
Channel #8 LOAD SERVO VALVE CURRENT 10MA/D
load on
load on
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
167
cond 16
*CH 07 - 10.00 V to +10.00 V
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 09 - 4.00 V to + 4.00 V
Channel #9 OUTPUT POSITION 1 IN/DIV
*CH 09 - 2.00 V to + 2.00 V
Channel #9
*CH 10 - 2.00 V to + 2.00 V
Channel #10
*CH 11 - 2.00 V to + 2.00 V
Channel #11
*CH 12 - 2.00 V to + 2.00 V
Channel #12
*CH 13 - 2.00 V to + 2.00 V
Channel #13
*CH 14 - 2.00 V to + 2.00 V
Channel #14
*CH 15 - 2.00 V to + 2.00 V
Channel #15
*CH 16 - 2.00 V to + 2.00 V
Channel #16
Dynamic Test
Rudder PCU
(Engineering Unit)

#1 A/P LVDT .2IN/DIV

•CH 01: - 3.00 V to + 3.00 V

Channel #1 A/P

#2 Y/D PROGRAM

•CH 02: - 3.00 V to + 3.00 V

Channel #2 Y/D

#3 INPUT ARM POSITION 1 IN/DIV

•CH 03: - 2.24 V to + 2.76 V

Channel #3 IN

#4 INPUT LOAD 150LB/DIV

•CH 04: - 300 mV to + 300 mV

Channel #4 INP

#5 OUTPUT LOAD 1000LB/DIV

•CH 05: - 2.00 V to + 2.00 V

Channel #5 OUT

1 load on

#6 LOAD SERVO VALVE CURRENT 10MA/DIV

•CH 06: - 1.00 V to + 1.00 V

Channel #6 LOA

Astro-Med, Inc.

MT95K2 MULTI-TASK RECORDER

#7 Y/D ENGAGE SOLENOID 28 VDC

•CH 07: -10.00 V to +10.00 V

Channel #7 Y/D

#8 OUTPUT POSITION 1 IN/DIV

•CH 08: + 0.03 V to + 4.03 V

Channel #8 OUT

#9

•CH 09: - 2.50 V to + 2.50 V

Channel #9

Dynamic Test
Rudder PCU
(Engineering Unit)

#10

•CH 10: - 2.50 V to + 2.50 V

Channel #10

#11

•CH 11: - 2.50 V to + 2.50 V

Channel #11

#12

•CH 12: - 2.50 V to + 2.50 V

Channel #12

#13

•CH 13: - 2.50 V to + 2.50 V

Channel #13

#14

•CH 14: - 2.50 V to + 2.50 V

Channel #14

#15

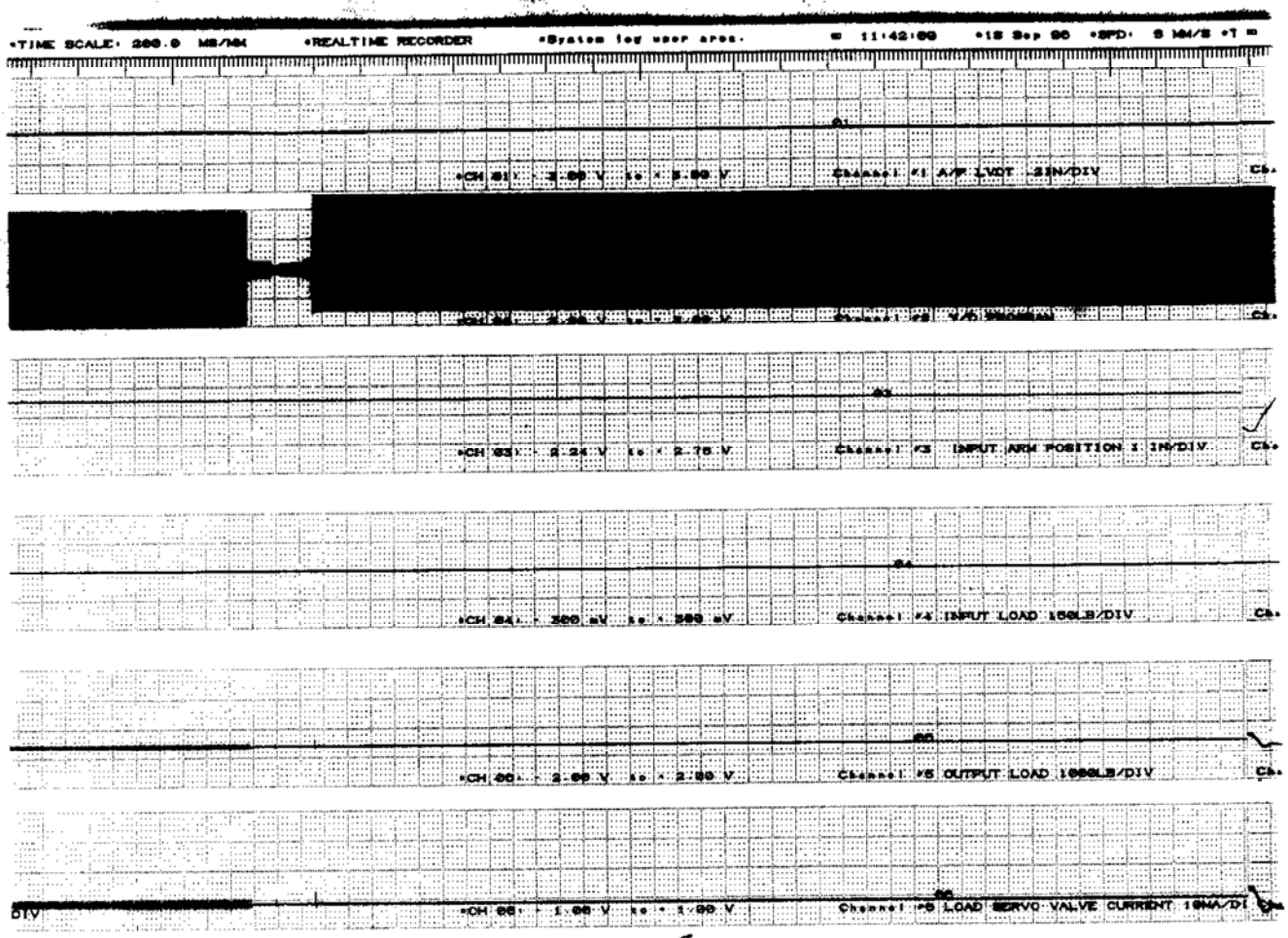
•CH 15: - 2.50 V to + 2.50 V

Channel #15

#16

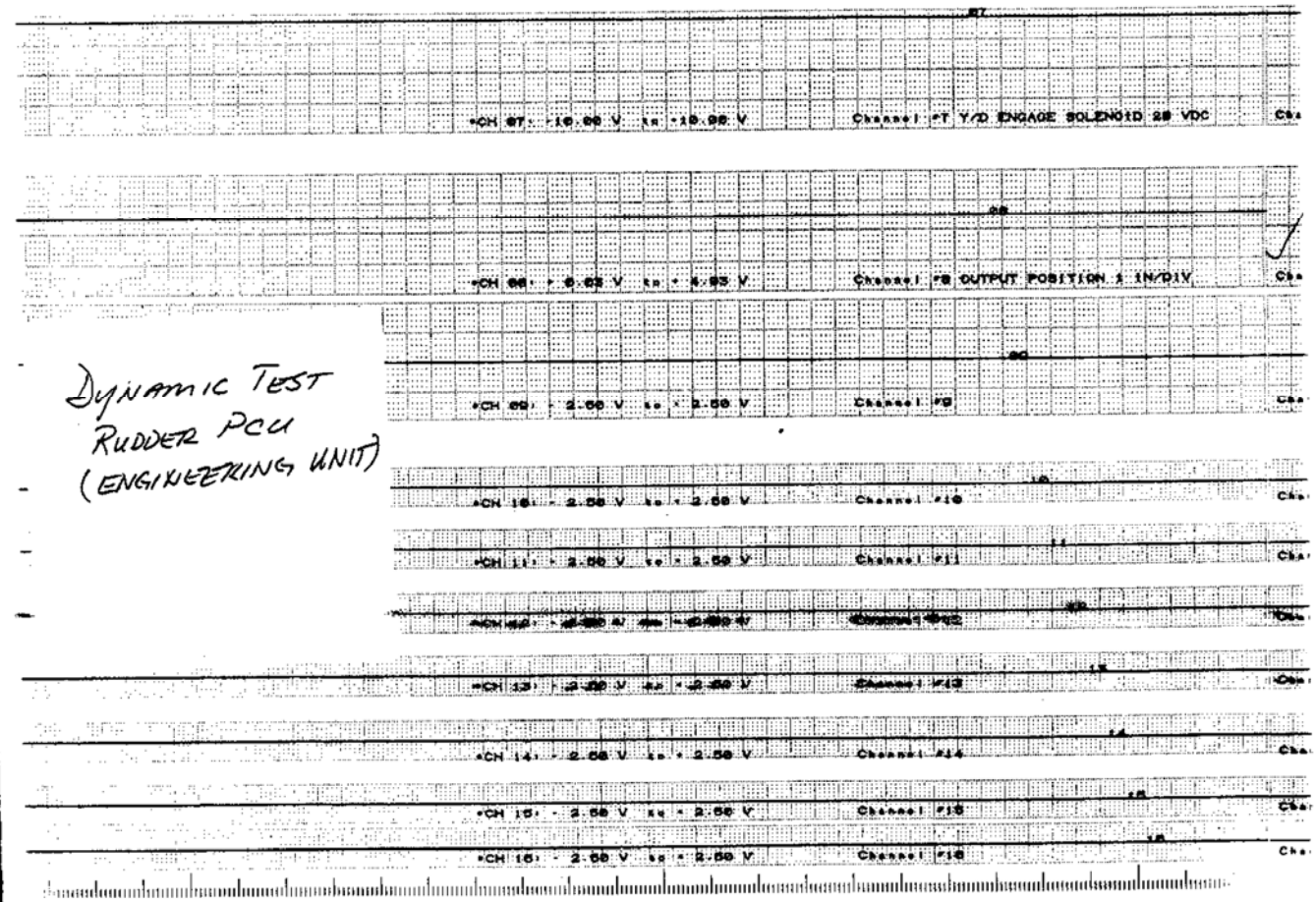
•CH 16: - 2.50 V to + 2.50 V

Channel #16



Cond 14

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



Dynamic Test
Rudder PCU
(Engineering Unit)

•18 Sep 96 •SPD: 5 MM/S •TIME SCALE: 200.0 MS/MM •REAL TIME RECORDER •System log user area

01

A/P LVDT .2IN/DIV •CH 01: - 3.00 V to + 3.00 V Channel #1 A/P LVI

03

INPUT ARM POSITION 1 IN/DIV •CH 03: - 2.24 V to + 2.76 V Channel #3 INPUT

04

INPUT LOAD 150LB/DIV •CH 04: - 300 mV to + 300 mV Channel #4 INPUT

05

OUTPUT LOAD 1000LB/DIV •CH 05: - 2.00 V to + 2.00 V Channel #5 OUTPUT

06

LOAD SERVO VALVE CURRENT 10MA/DIV •CH 06: - 1.00 V to + 1.00 V Channel #6 LOAD S

Setup 170

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

07 07

Y/D ENGAGE SOLENOID 28 VDC •CH 07: -10.00 V to +10.00 V Channel #7 Y/D EN

08 08

OUTPUT POSITION 1 IN/DIV •CH 08: + 0.03 V to + 4.03 V Channel #8 OUTPUT

DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNIT)

09 0

•CH 09: - 2.50 V to + 2.50 V Channel #9

10

•CH 10: - 2.50 V to + 2.50 V Channel #10

11

•CH 11: - 2.50 V to + 2.50 V Channel #11

12

•CH 12: - 2.50 V to + 2.50 V Channel #12

13

•CH 13: - 2.50 V to + 2.50 V Channel #13

14

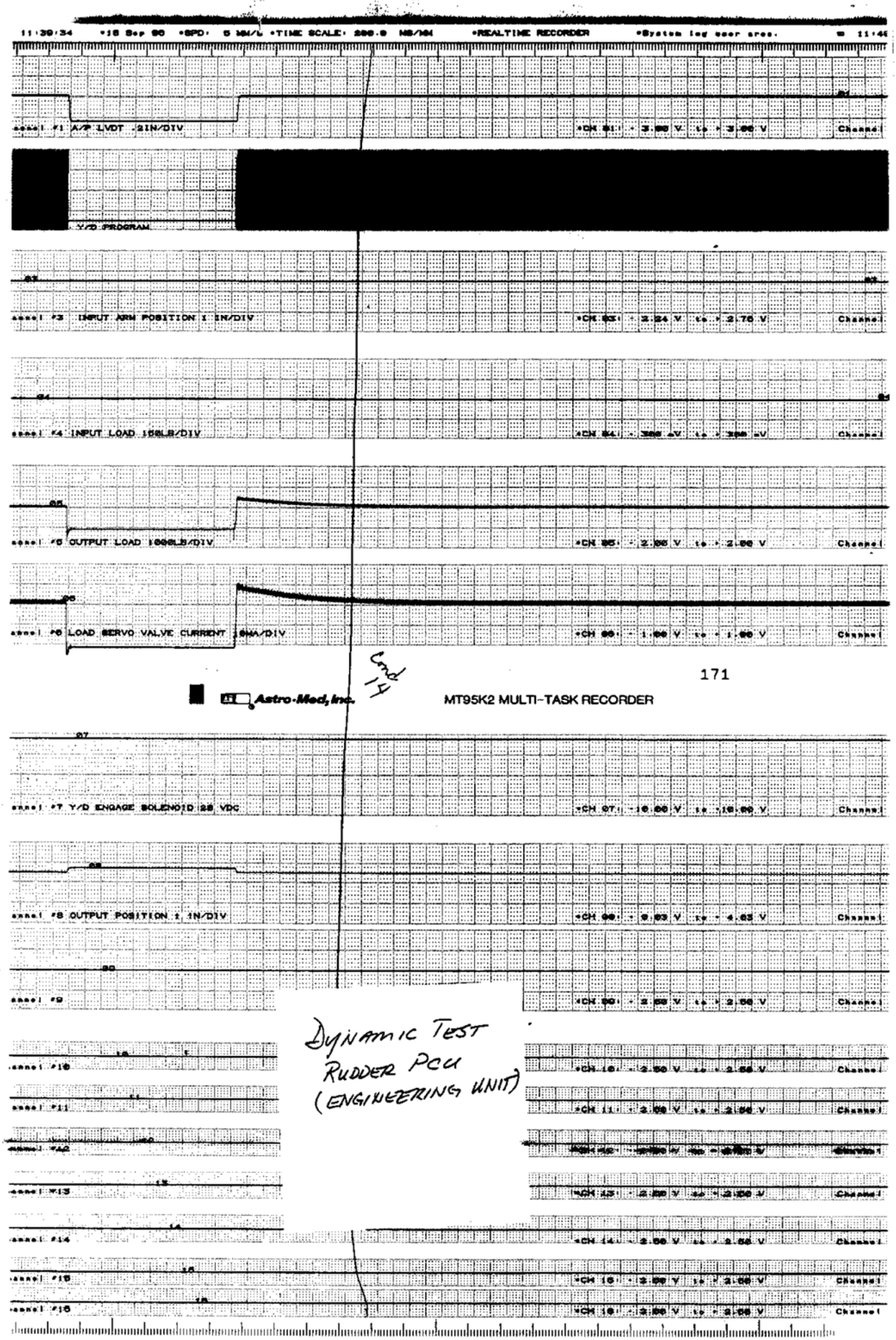
•CH 14: - 2.50 V to + 2.50 V Channel #14

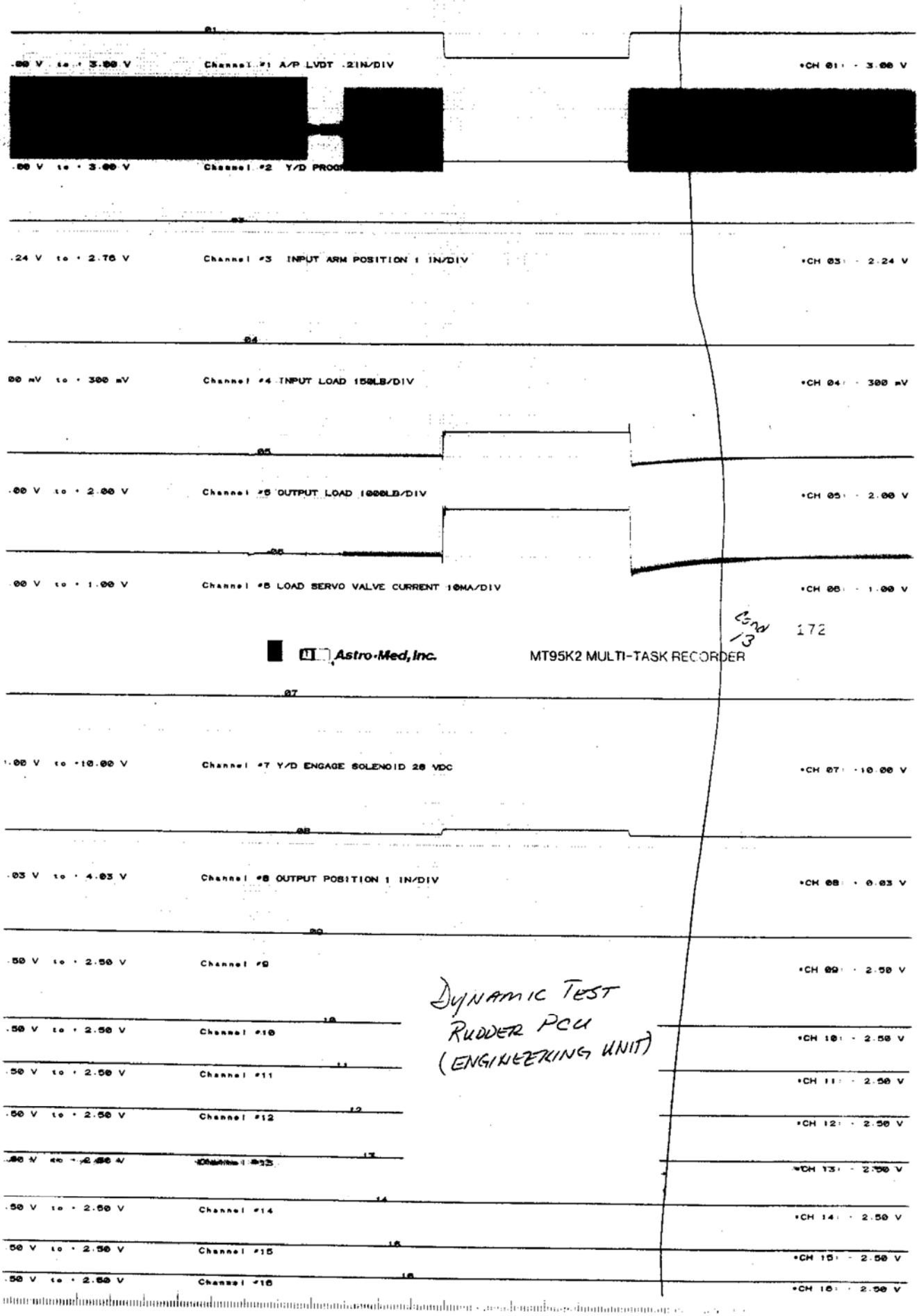
15

•CH 15: - 2.50 V to + 2.50 V Channel #15

16

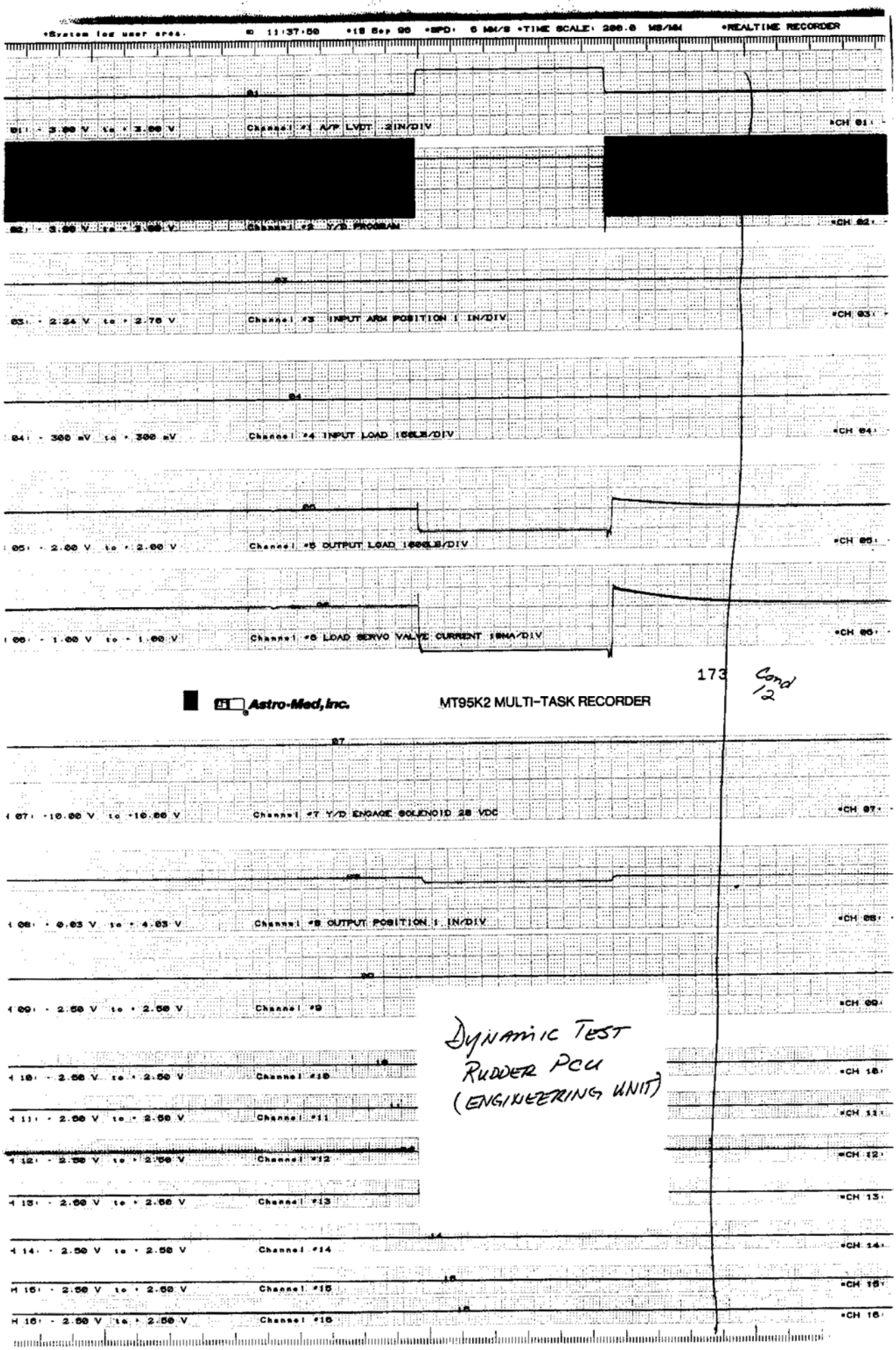
•CH 16: - 2.50 V to + 2.50 V Channel #16


Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Dynamic Test
Rudder PCU
(ENGINEERING UNIT)



172

DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNIT)



173 Cond 12

Dynamic Test
Rudder PCU
(ENGINEERING UNIT)

11:35:27 *18 Sep 96 *SPD: 5 MM/S *TIME SCALE: 200.0 MS 11:35:59 *18 Sep 96 *SPD: 5 MM/S *TIME SCALE:

01

Channel #1 A/P LVDT .2IN/DIV

Channel #1 A/P LVDT .2IN/DIV

[redacted]

Channel #2 Y/D PROGRAM

Channel #2 Y/D PROGRAM

03

Channel #3 INPUT ARM POSITION 1 IN/DIV

Channel #3 INPUT ARM POSITION 1 IN/DIV

04

Channel #4 INPUT LOAD 150LB/DIV

Channel #4 INPUT LOAD 150LB/DIV

05

Channel #5 OUTPUT LOAD 1000LB/DIV

Channel #5 OUTPUT LOAD 1000LB/DIV

06

Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV

Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV

Cond 10

174

[redacted] Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

07

Channel #7 Y/D ENGAGE SOLENOID 28 VDC

Channel #7 Y/D ENGAGE SOLENOID 28 VDC

08

Channel #8 OUTPUT POSITION 1 IN/DIV

Channel #8 OUTPUT POSITION 1 IN/DIV

09

Channel #9

Channel #9

10

Channel #10

Channel #10

11

Channel #11

Channel #11

12

Channel #12

Channel #12

13

Channel #13

Channel #13

14

Channel #14

Channel #14

15

Channel #15

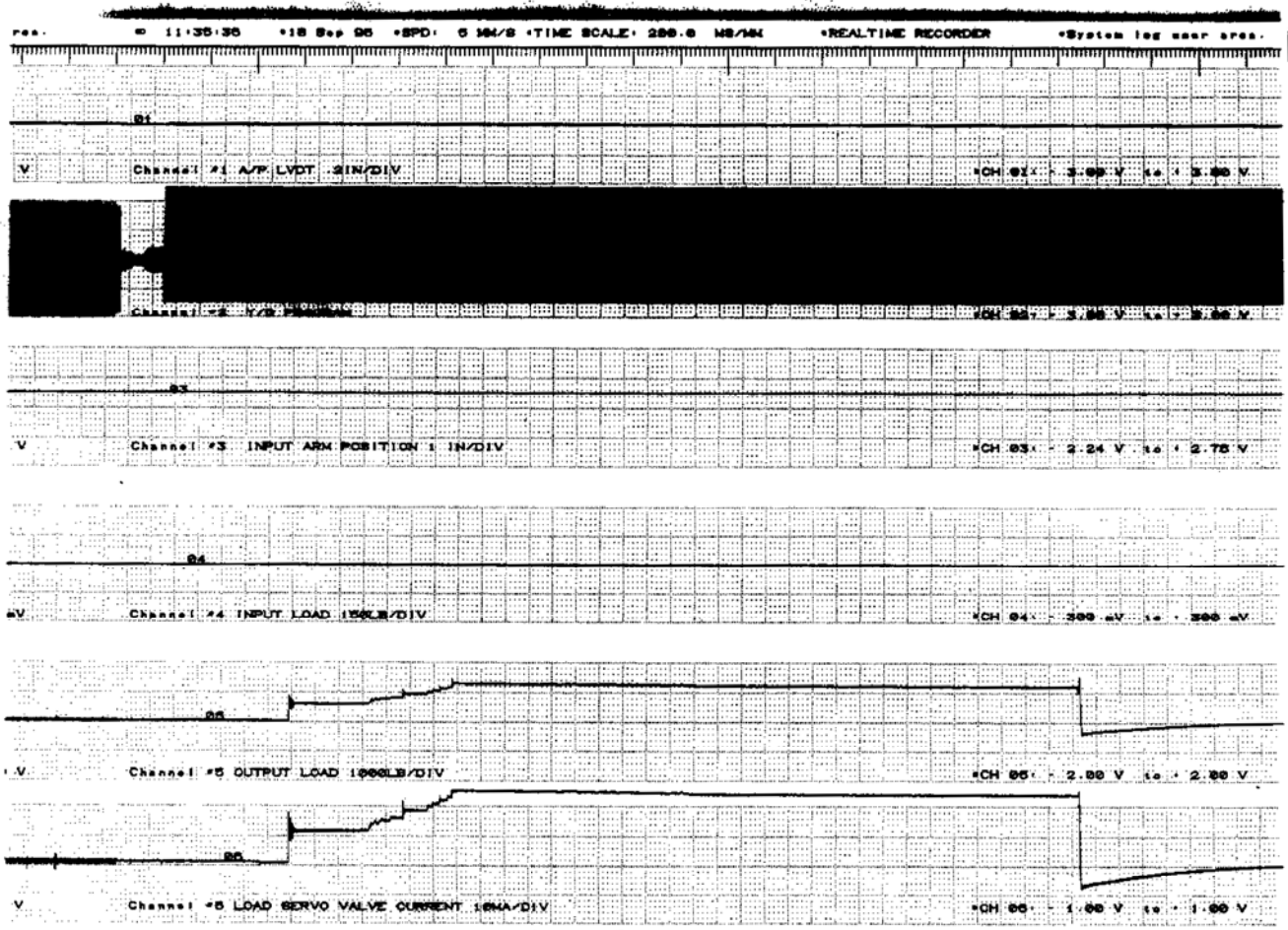
Channel #15

16

Channel #16

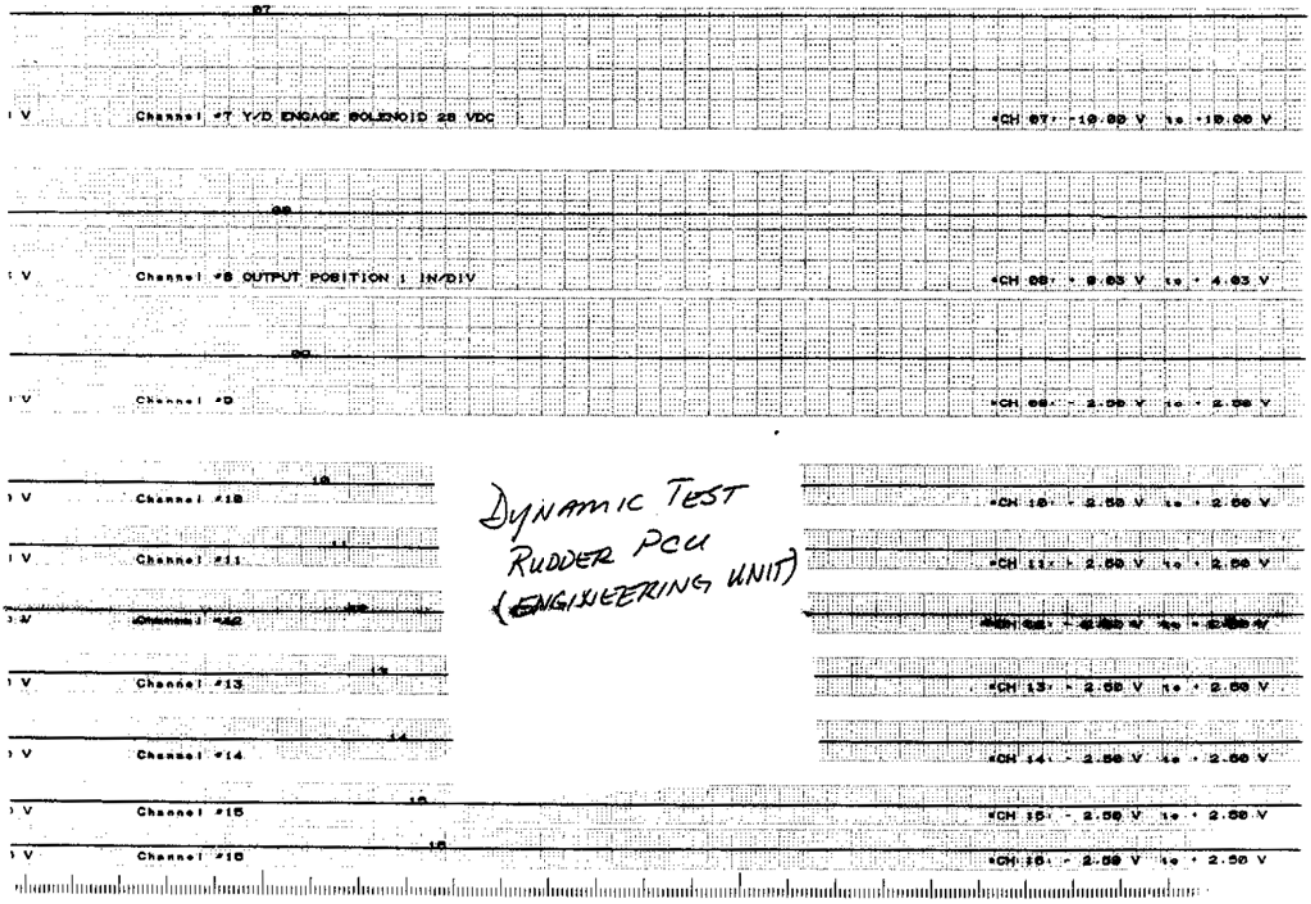
Channel #16

Dynamic Test
Rudder PCU
(Engineering Unit)

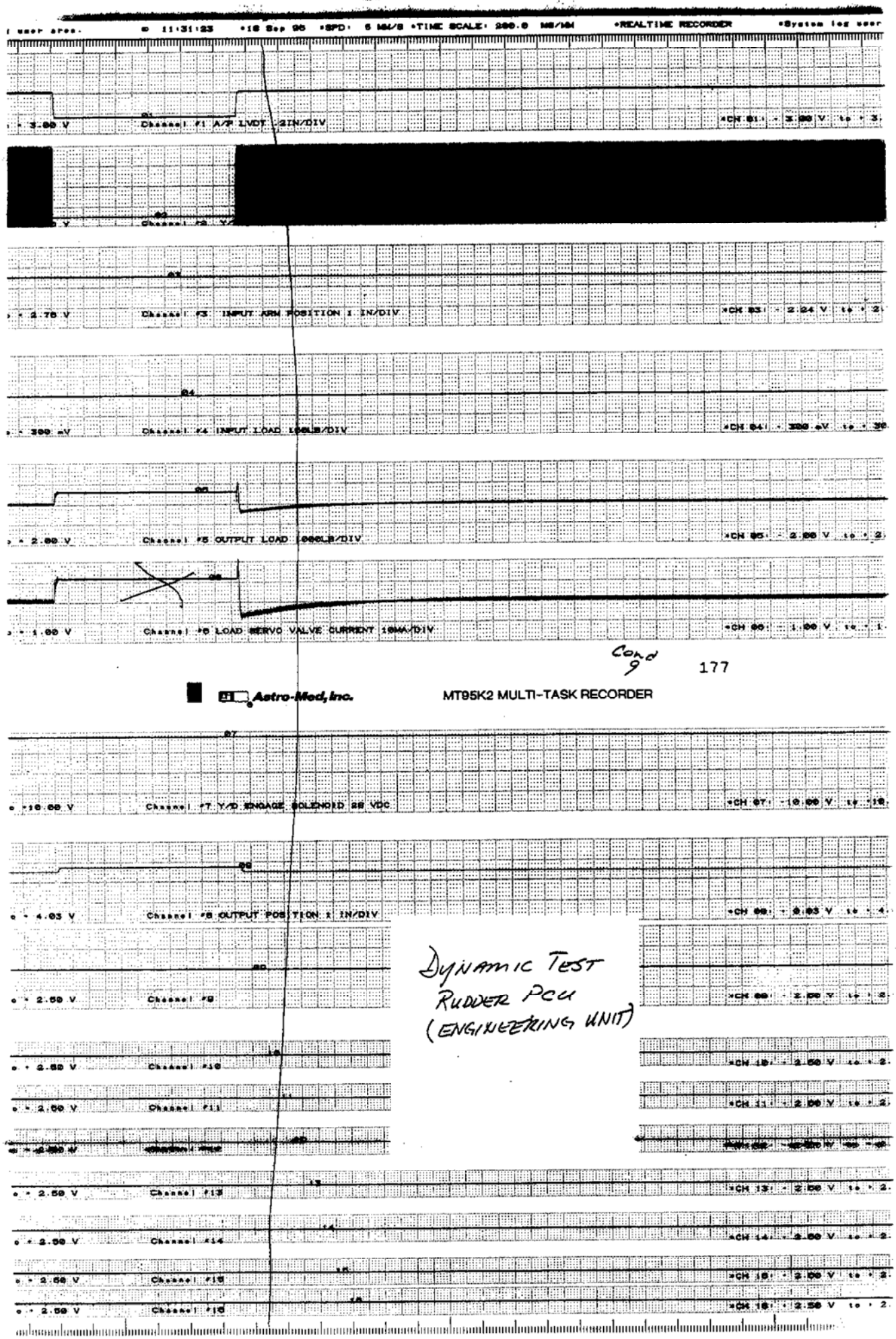


Setup

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



Dynamic Test
Rudder PCU
(Engineering Unit)

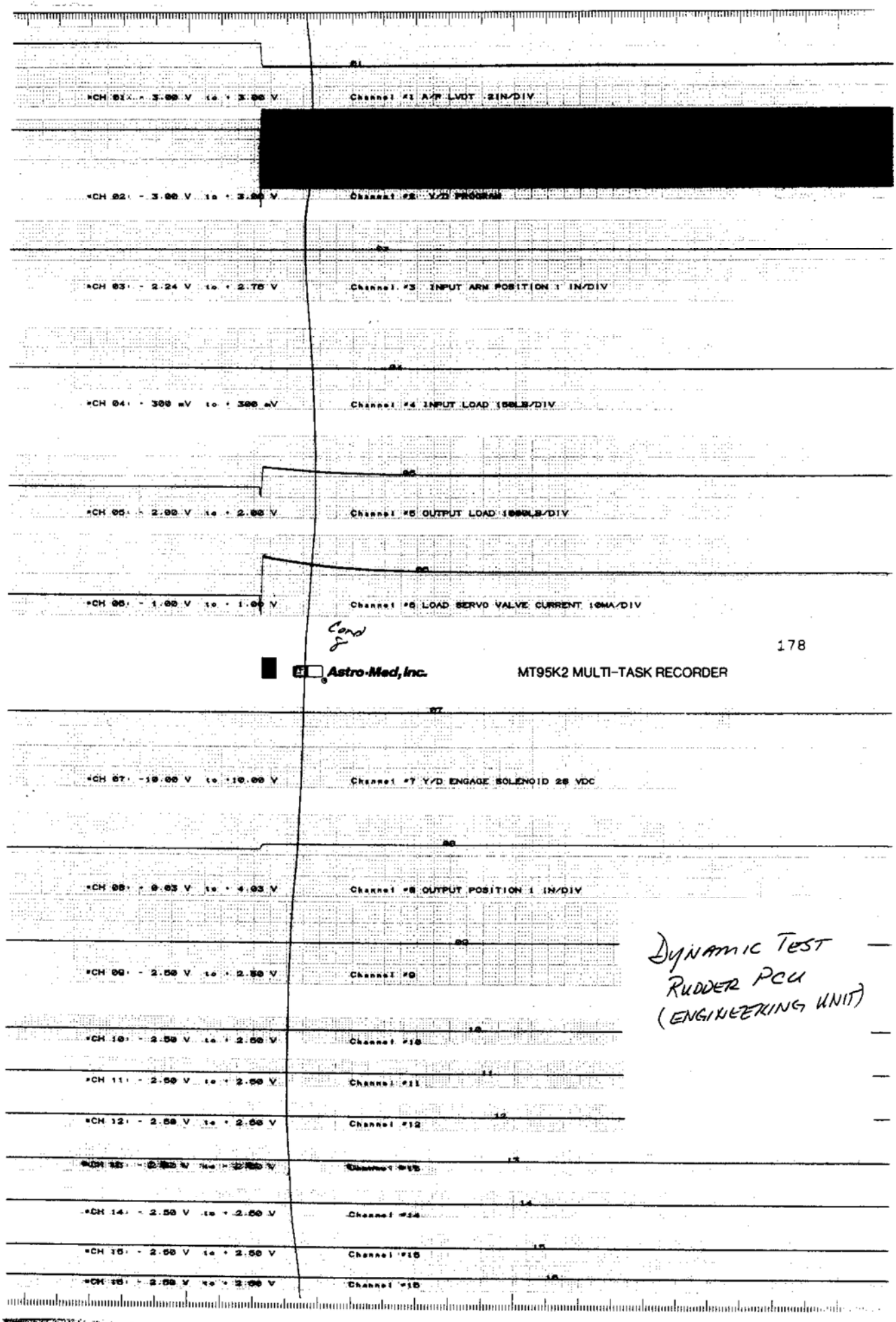


Cond 9

177

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

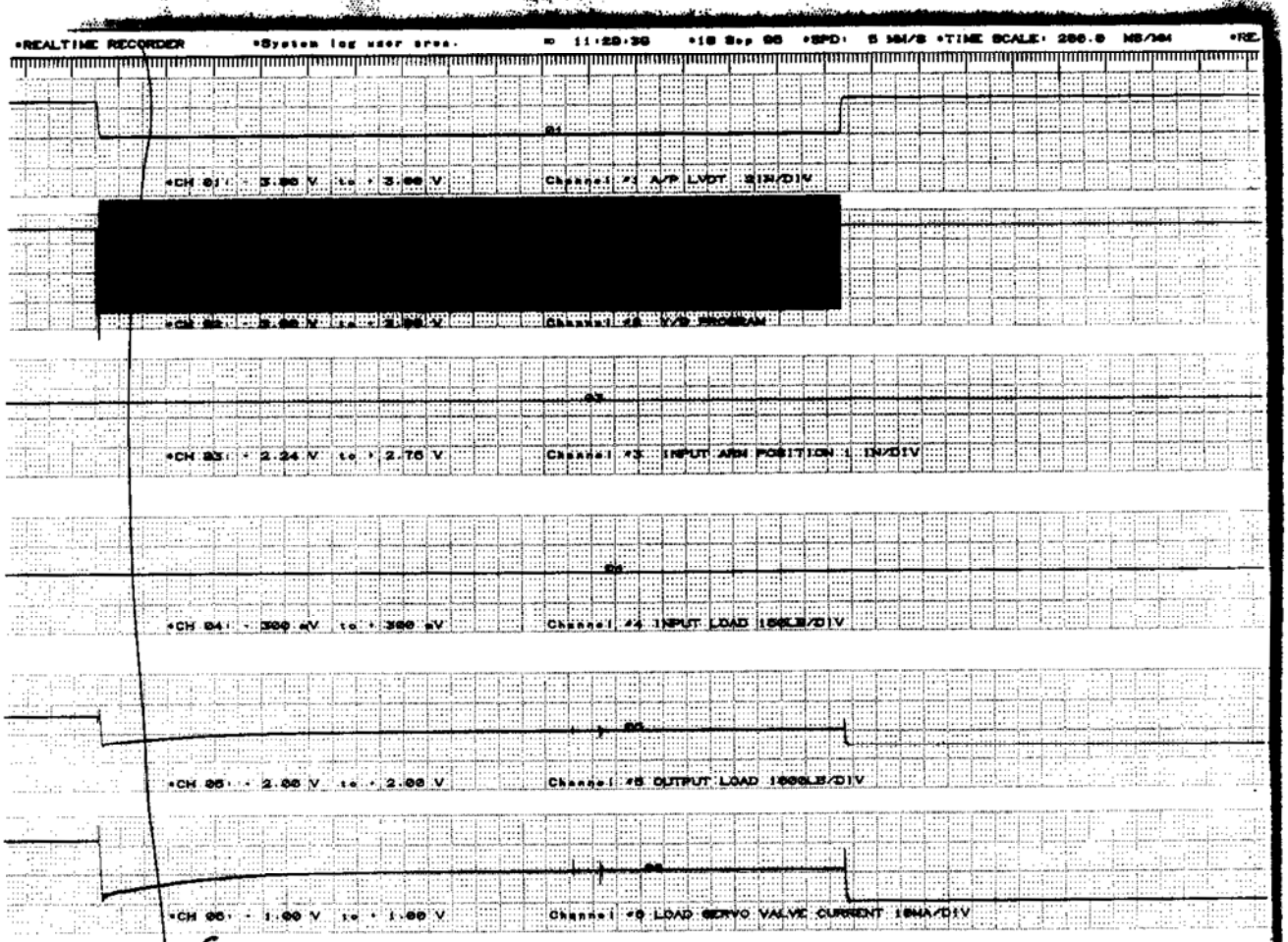
Dynamic Test
Rudder PCU
(ENGINEERING UNIT)



Cond 2

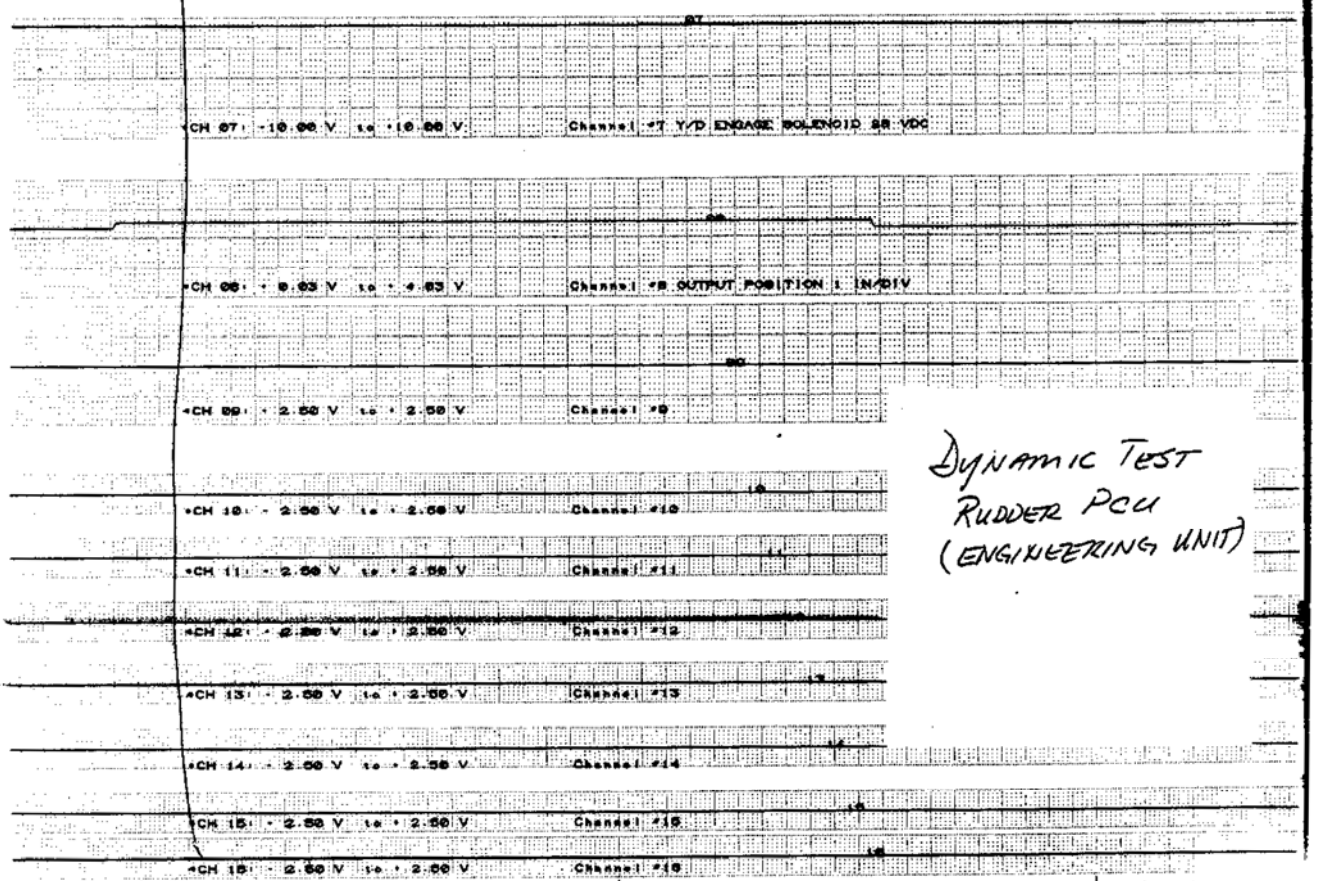
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

Dynamic Test — Rudder PCU (ENGINEERING UNIT)

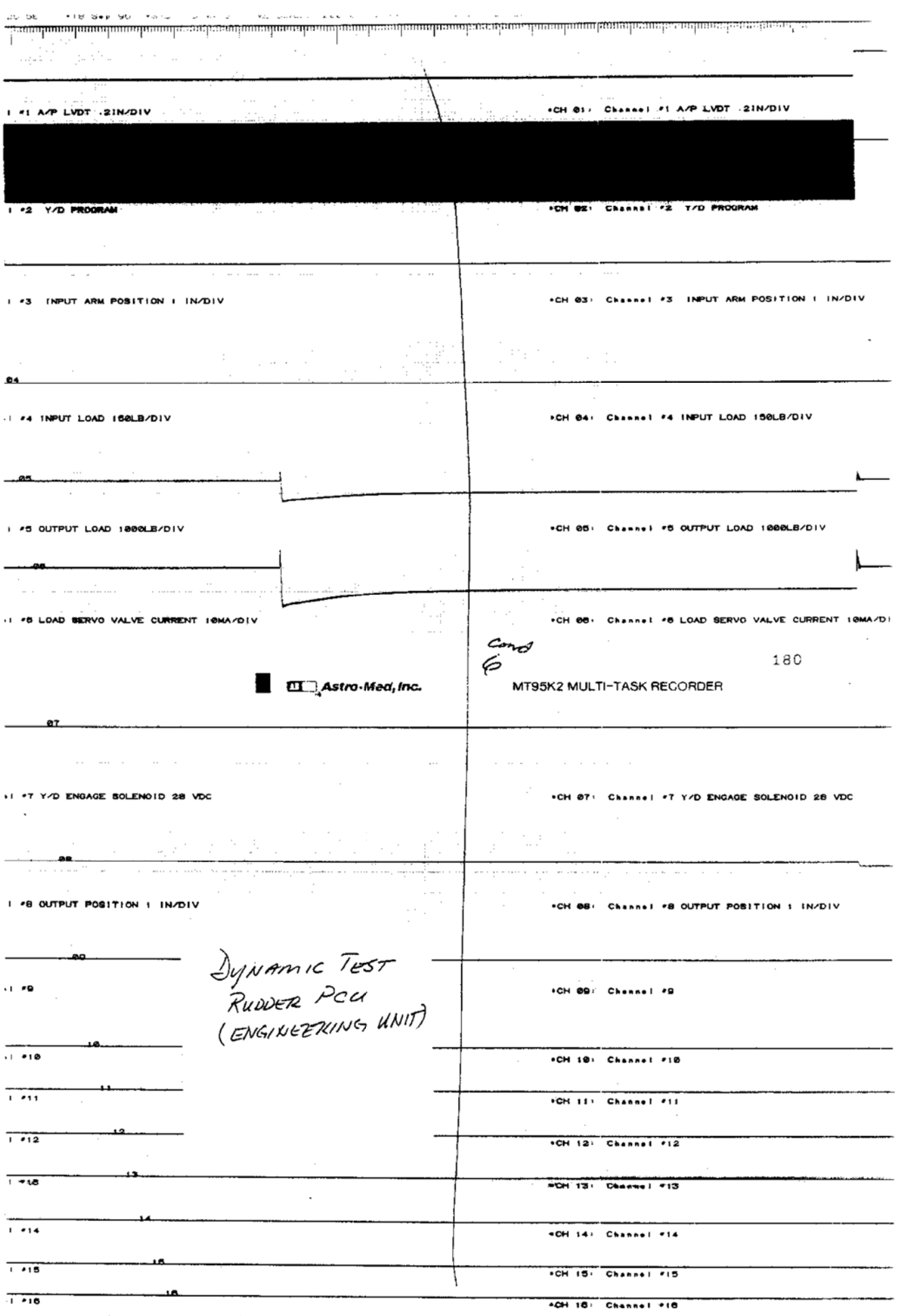


Cond 7.

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



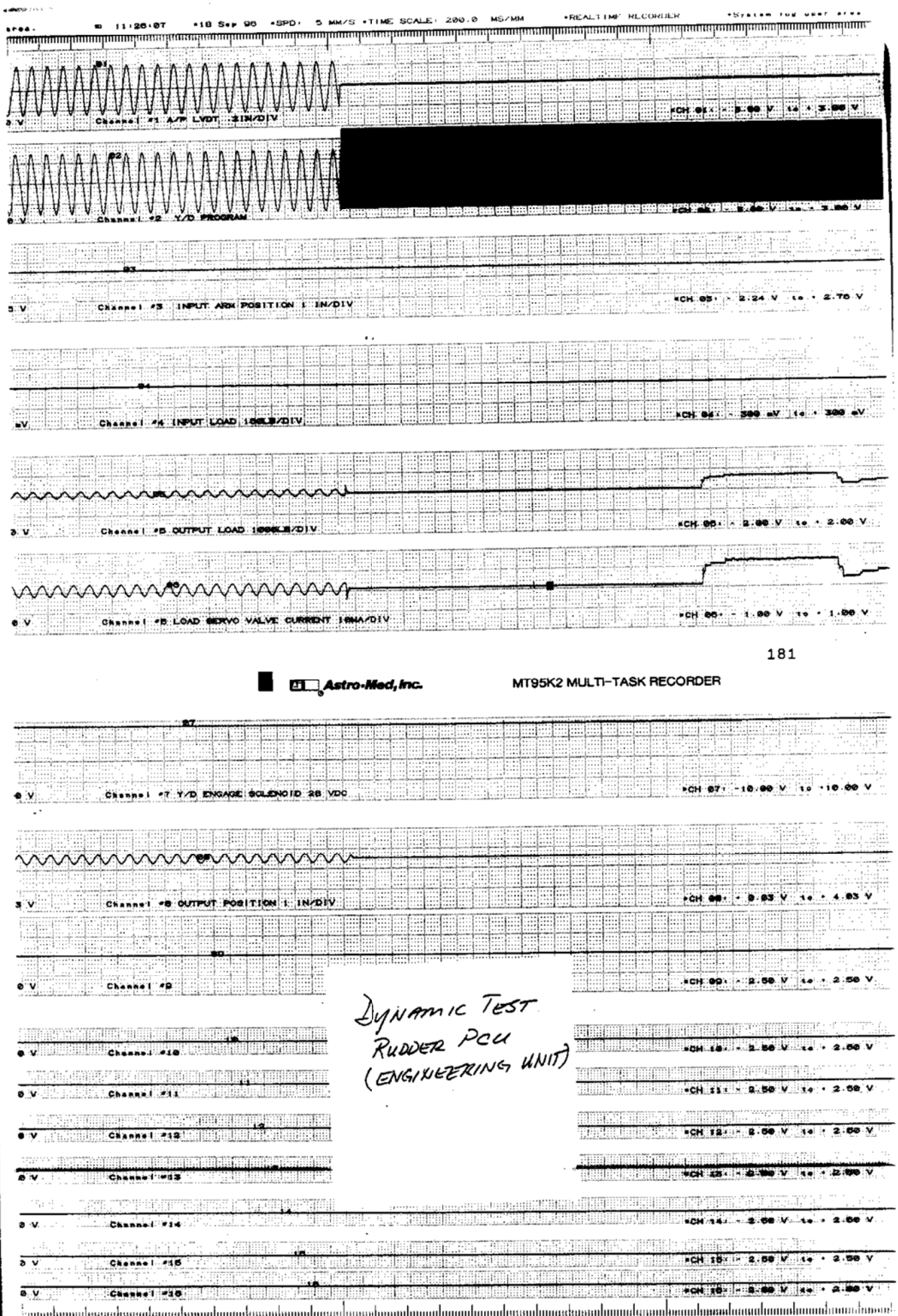
Dynamic Test
Rudder PCU
(Engineering Unit)



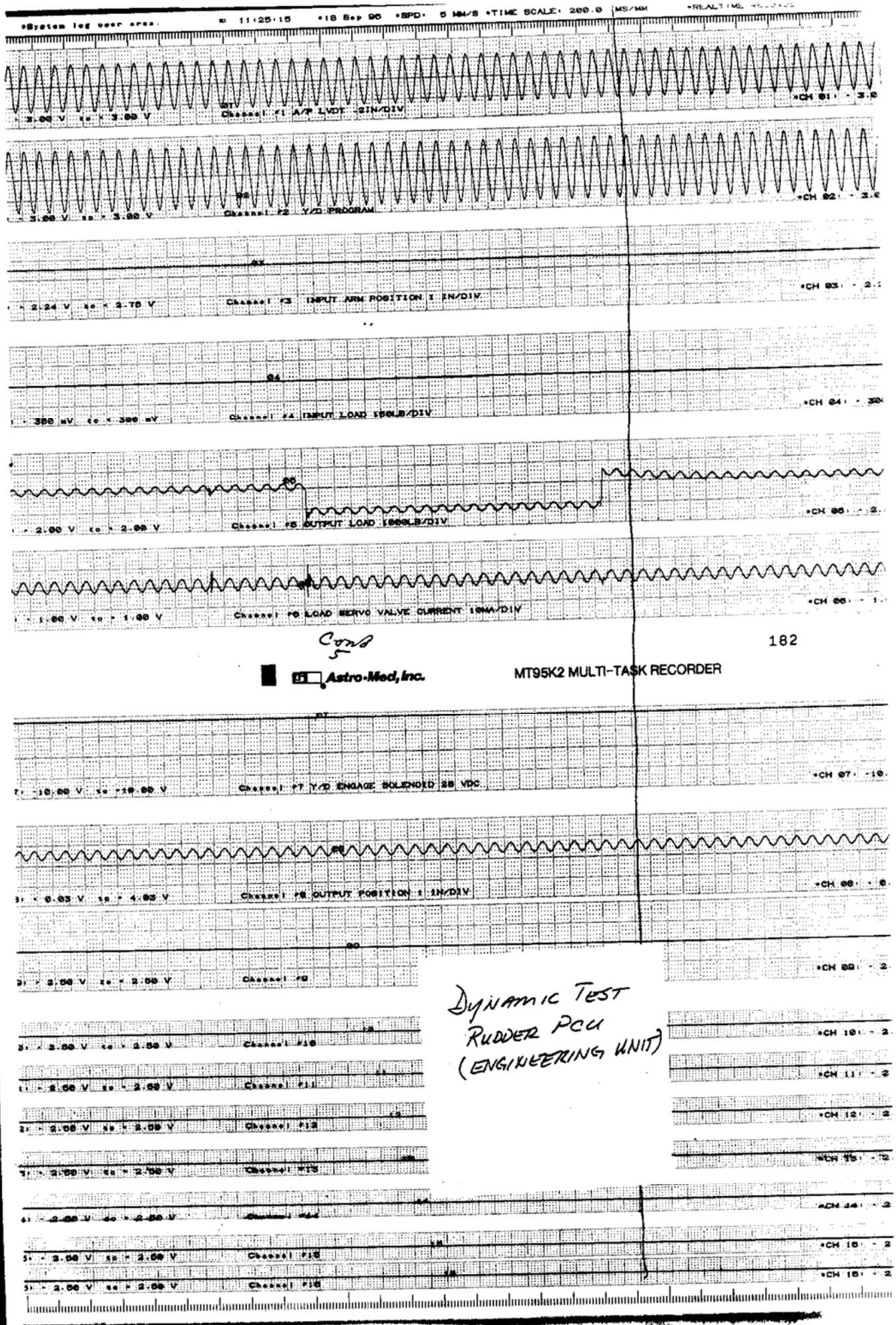
Cond 6

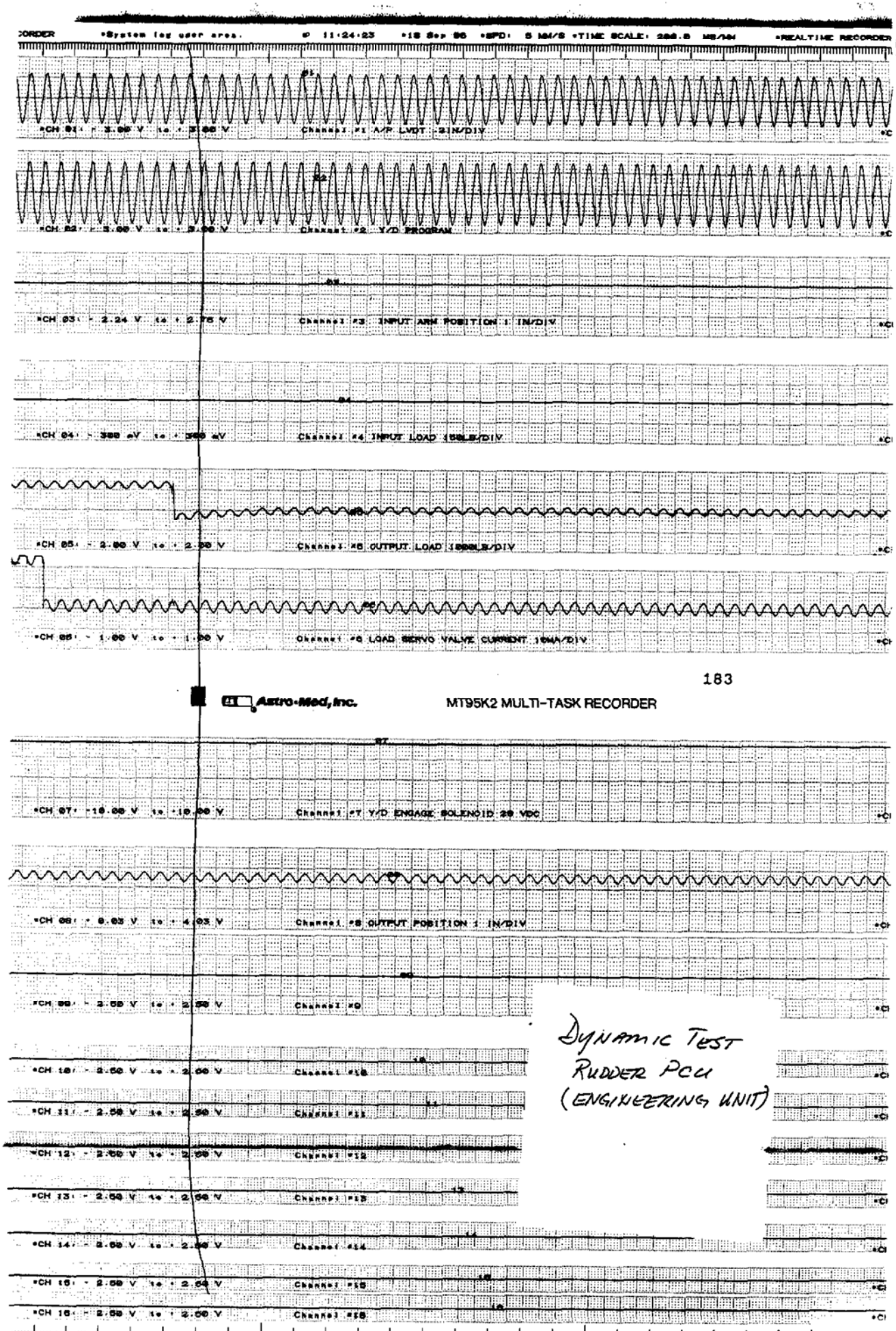
180

Dynamic Test
Rudder PCU
(Engineering Unit)



Dynamic Test
Rudder PCU
(ENGINEERING UNIT)


*System log user area.
11:25:15
*18 Sep 96
*SPD: 5 MM/S
*TIME SCALE: 200.0 MS/MM
*REALTIME
*CH 01: - 3.0
- 3.00 V to + 3.00 V
Channel #1 A/P LVDT 2IN/DIV
*CH 02: - 3.0
- 3.00 V to + 3.00 V
Channel #2 Y/D PROGRAM
*CH 03: - 2.
- 2.24 V to + 2.75 V
Channel #3 INPUT ARM POSITION 1 IN/DIV
*CH 04: - 30
- 300 mV to + 300 mV
Channel #4 INPUT LOAD 150LB/DIV
*CH 05: - 2.
- 2.00 V to + 2.00 V
Channel #5 OUTPUT LOAD 1000LB/DIV
*CH 06: - 1.
- 1.00 V to + 1.00 V
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
Cond 5
182
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
*CH 07: -10.
-10.00 V to +10.00 V
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 08: - 0
- 0.03 V to + 4.03 V
Channel #8 OUTPUT POSITION 1 IN/DIV
*CH 09: - 2
+ 2.50 V to + 2.50 V
Channel #9
Dynamic Test
Rudder PCU
(ENGINEERING UNIT)
*CH 10: - 2
- 2.50 V to + 2.50 V
Channel #10
*CH 11: - 2
- 2.50 V to + 2.50 V
Channel #11
*CH 12: - 2
- 2.50 V to + 2.50 V
Channel #12
*CH 13: - 2
- 2.50 V to + 2.50 V
Channel #13
*CH 14: - 2
- 2.50 V to + 2.50 V
Channel #14
*CH 15: - 2
- 2.50 V to + 2.50 V
Channel #15
*CH 16: - 2
- 2.50 V to + 2.50 V
Channel #16



183

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

Dynamic Test
Rudder PCU
(Engineering Unit)

200.0 MS/MM *REALTIME RECORDER *System log user area

01

*CH 01: - 3.00 V to + 3.00 V Channel #1 A/P LVDT .2IN/DIV

[redacted]

*CH 02: - 3.00 V to + 3.00 V Channel #2 Y/D PROGRAM

03

*CH 03: + 2.24 V to + 2.76 V Channel #3 INPUT ARM POSITION 1 IN/DIV

04

*CH 04: - 300 mV to + 300 mV Channel #4 INPUT LOAD 150LB/DIV

05

*CH 05: - 2.00 V to + 2.00 V Channel #5 OUTPUT LOAD 1000LB/DIV

06

*CH 06: - 1.00 V to + 1.00 V Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV

184

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

07

*CH 07: -10.00 V to +10.00 V Channel #7 Y/D ENGAGE SOLENOID 28 VDC

08

*CH 08: + 0.83 V to + 4.03 V Channel #8 OUTPUT POSITION 1 IN/DIV

09

*CH 09: - 2.50 V to + 2.50 V Channel #9

10

*CH 10: - 2.50 V to + 2.50 V Channel #10

11

*CH 11: - 2.50 V to + 2.50 V Channel #11

12

*CH 12: - 2.50 V to + 2.50 V Channel #12

13

*CH 13: - 2.50 V to + 2.50 V Channel #13

14

*CH 14: - 2.50 V to + 2.50 V Channel #14

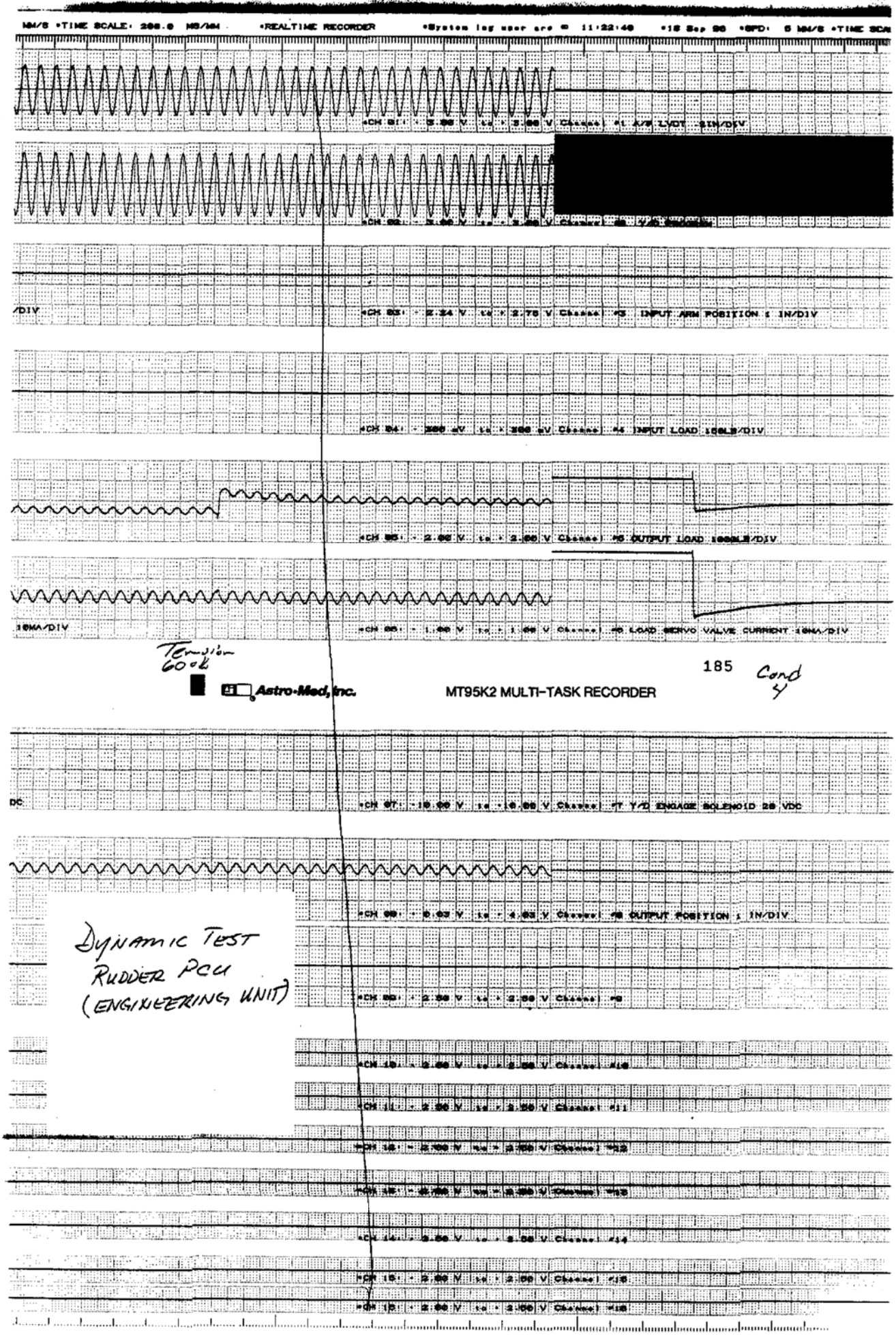
15

*CH 15: - 2.50 V to + 2.50 V Channel #15

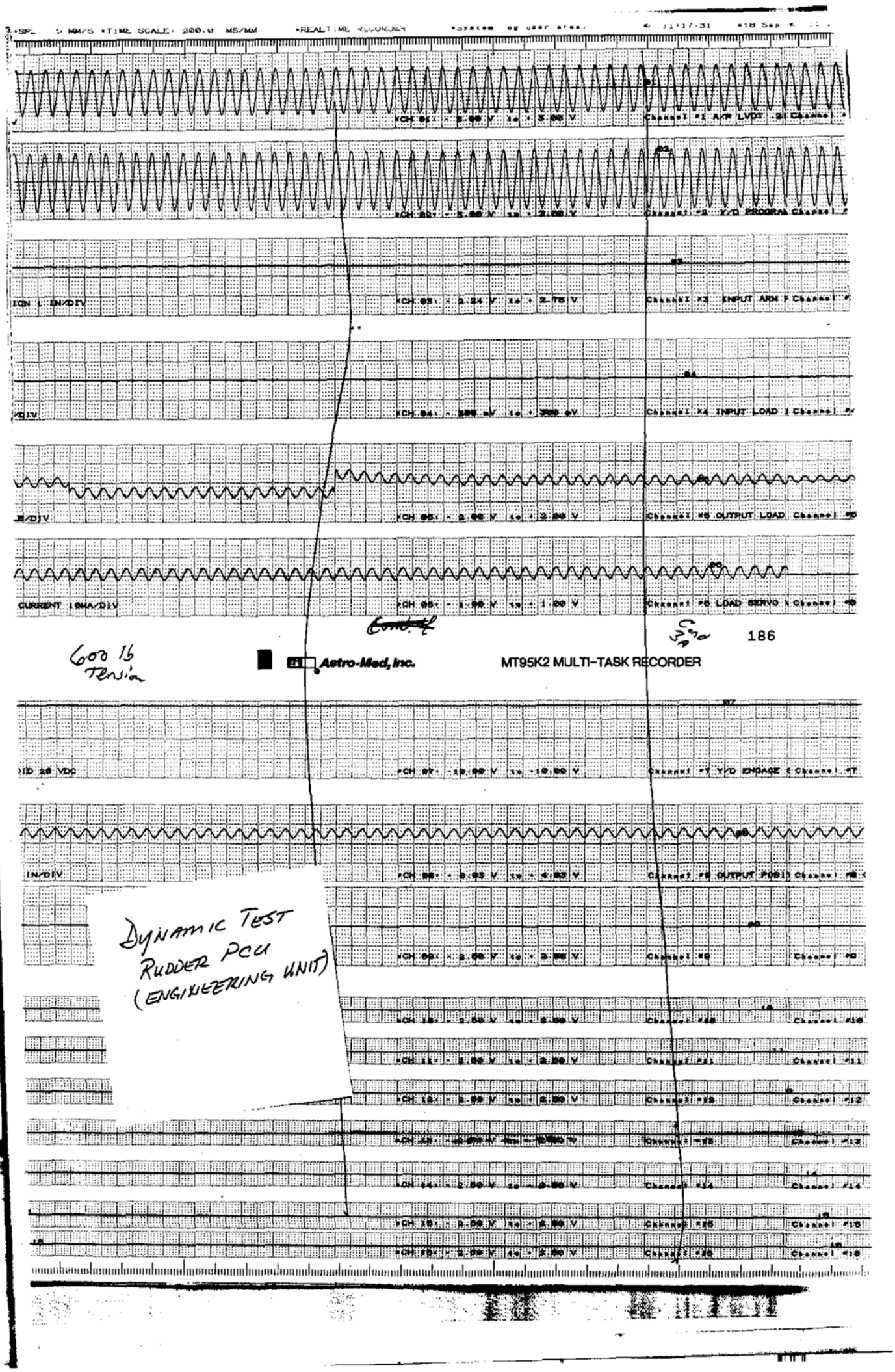
16

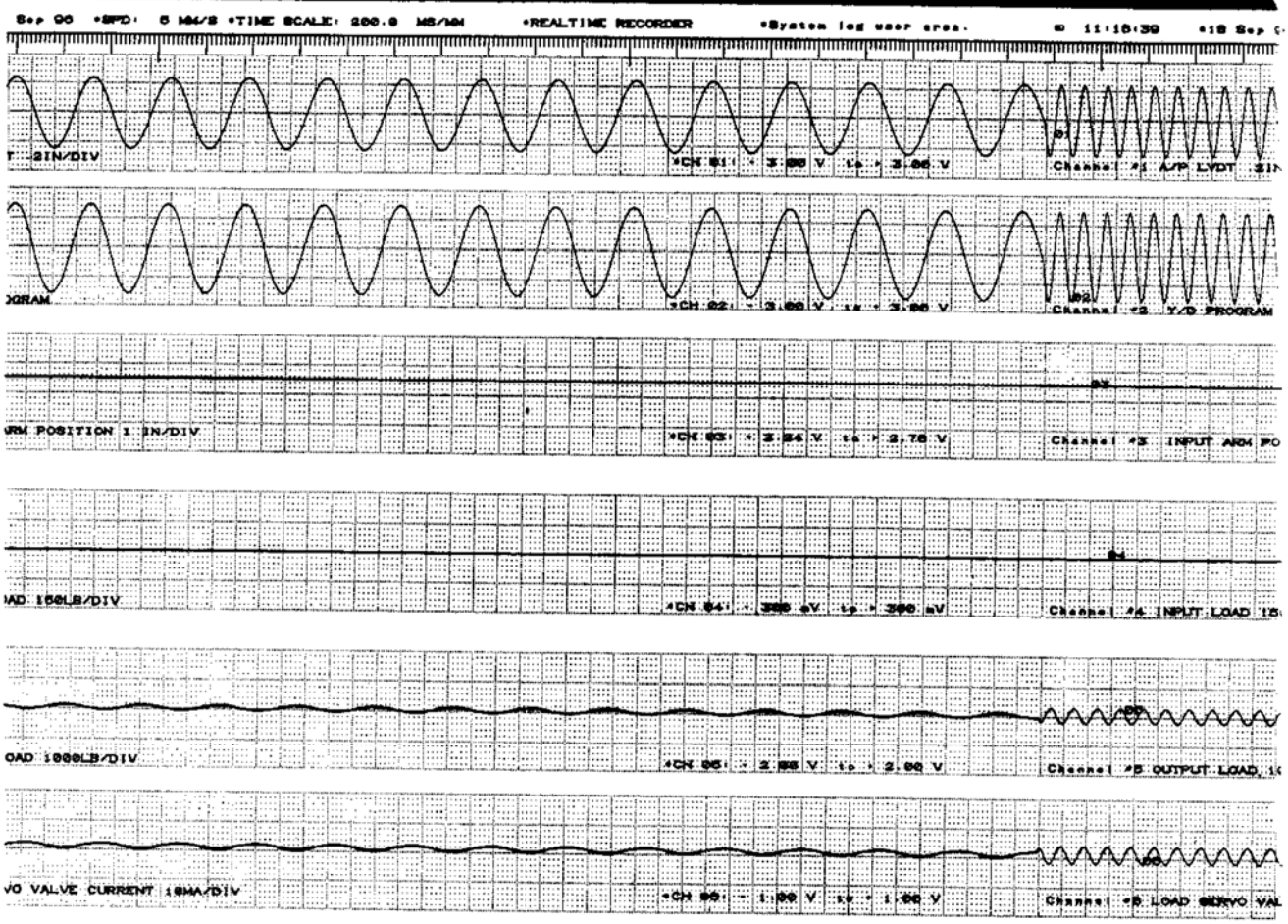
*CH 16: - 2.50 V to + 2.50 V Channel #16

DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNIT

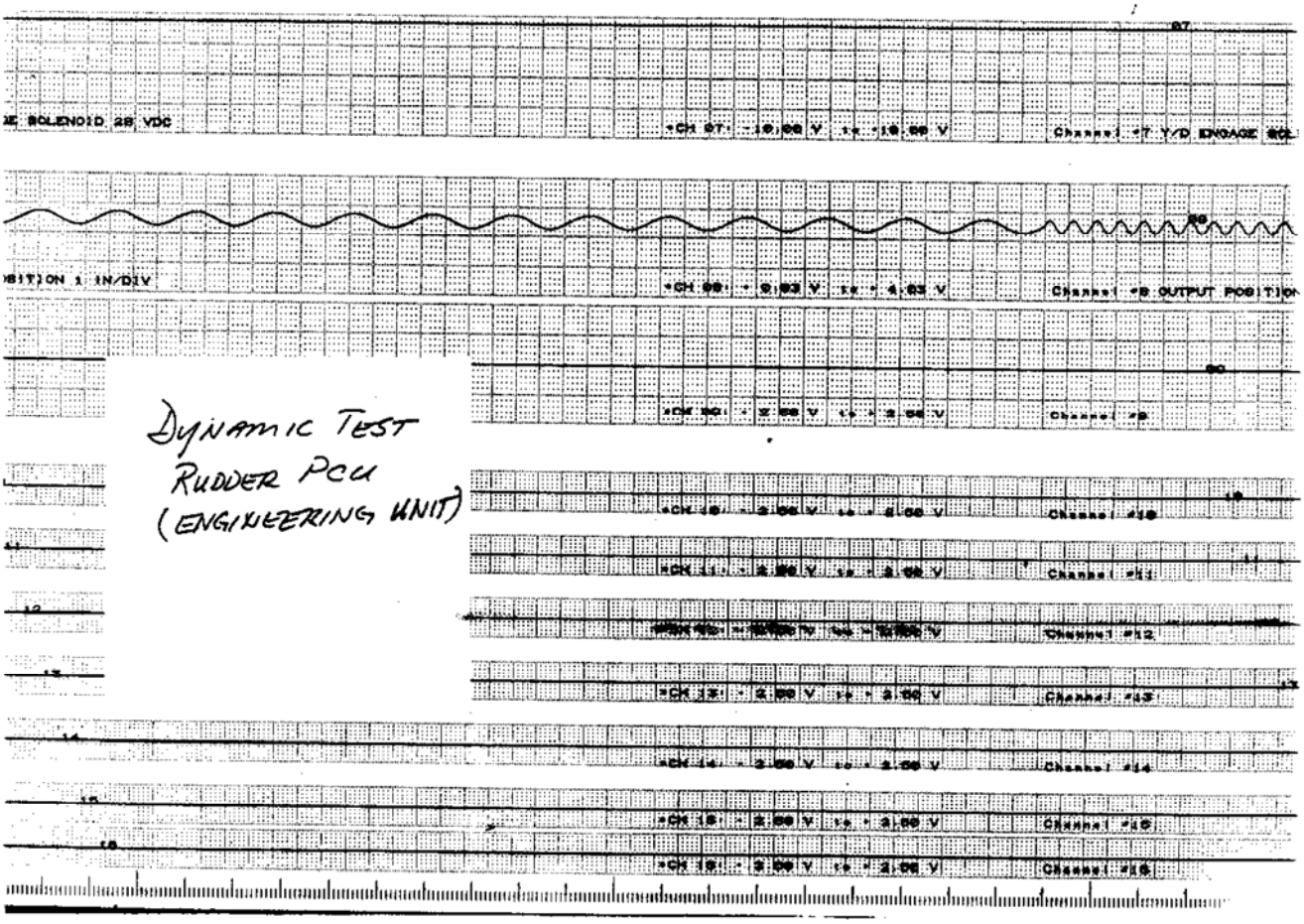


Dynamic Test
Rudder PCU
(Engineering Unit)

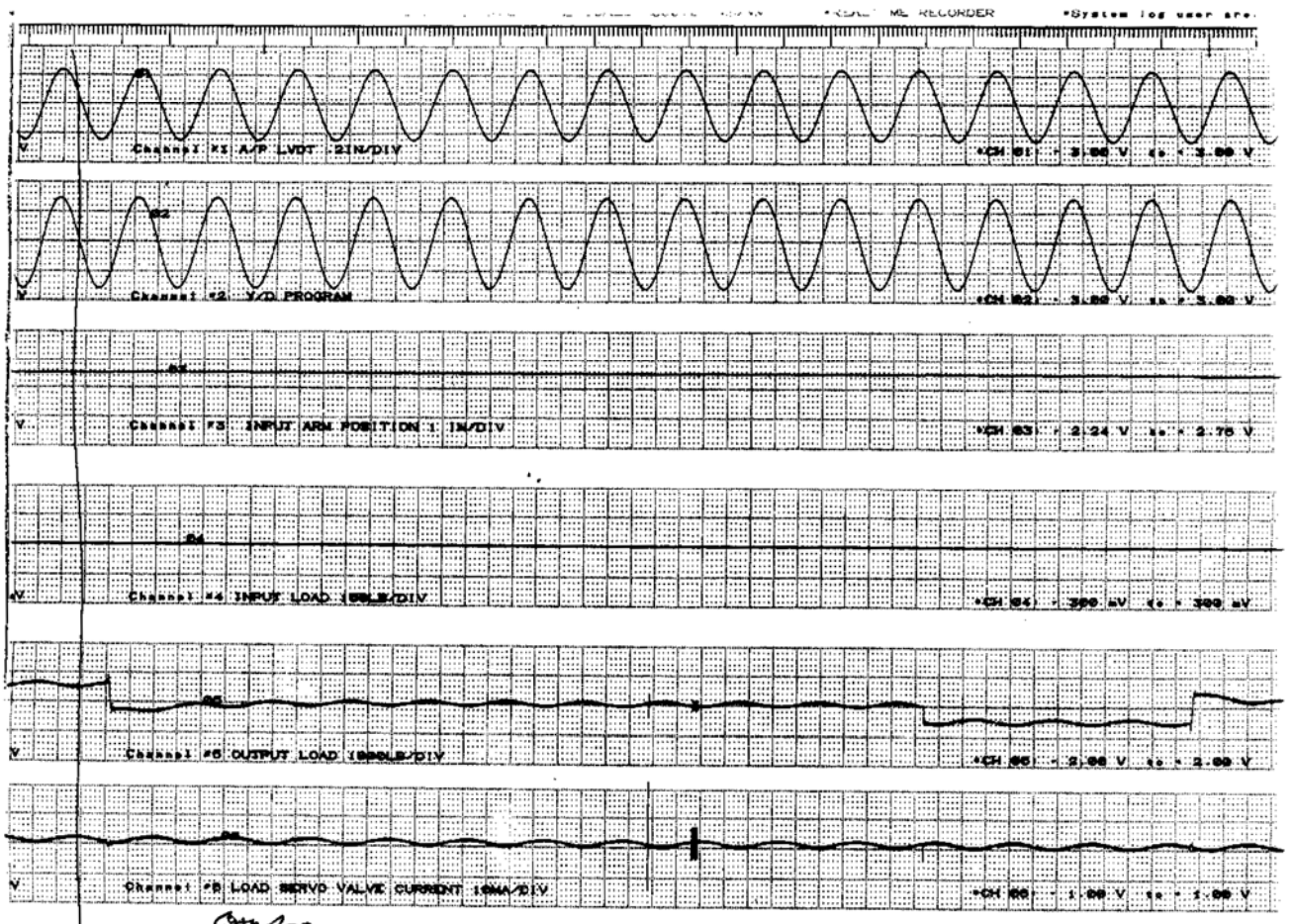

Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
186
600 lb Tension
Dynamic Test
Rudder PCU
(Engineering Unit)



Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



Dynamic Test
Rudder PCU
(ENGINEERING UNIT)

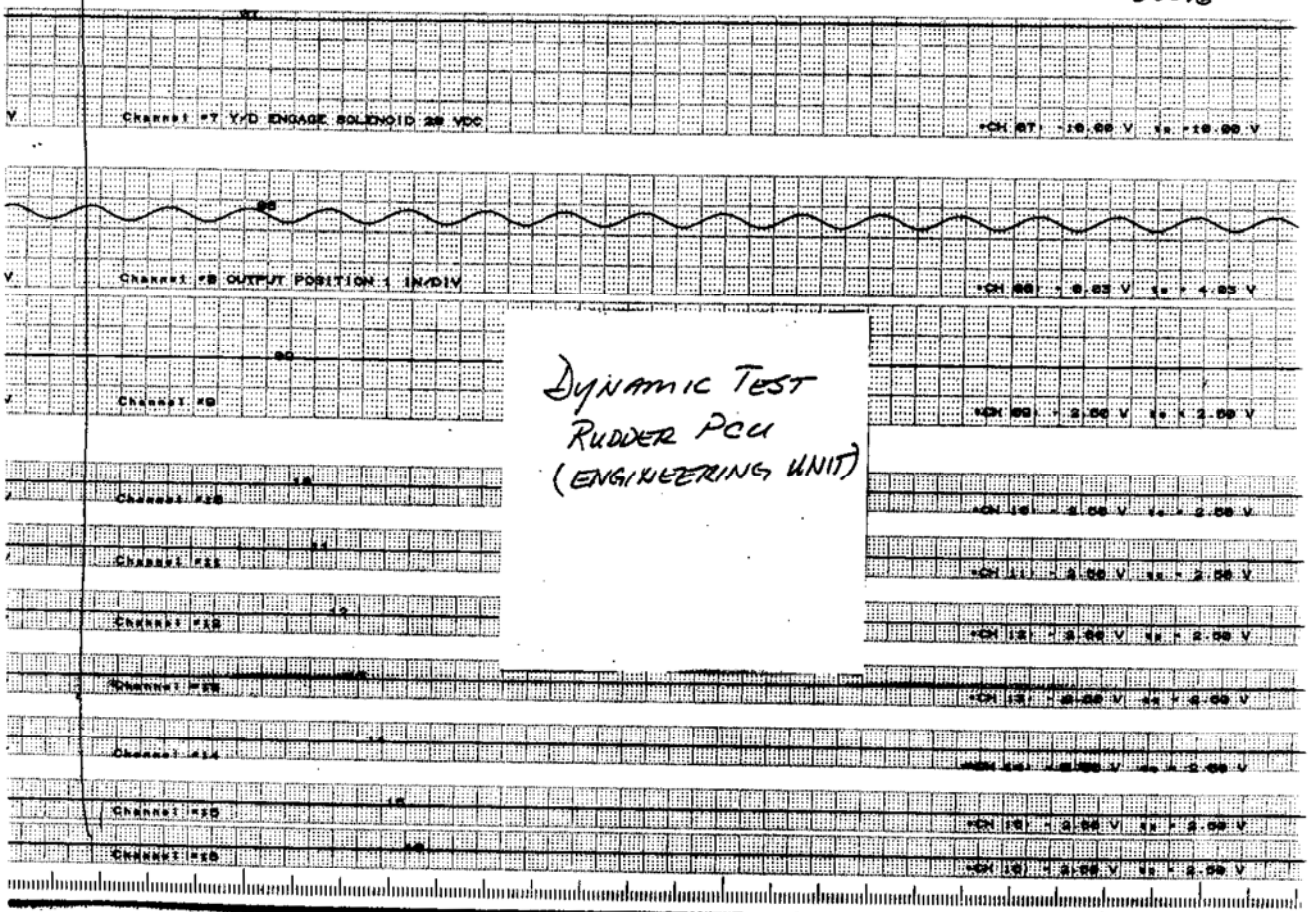


Conn 2

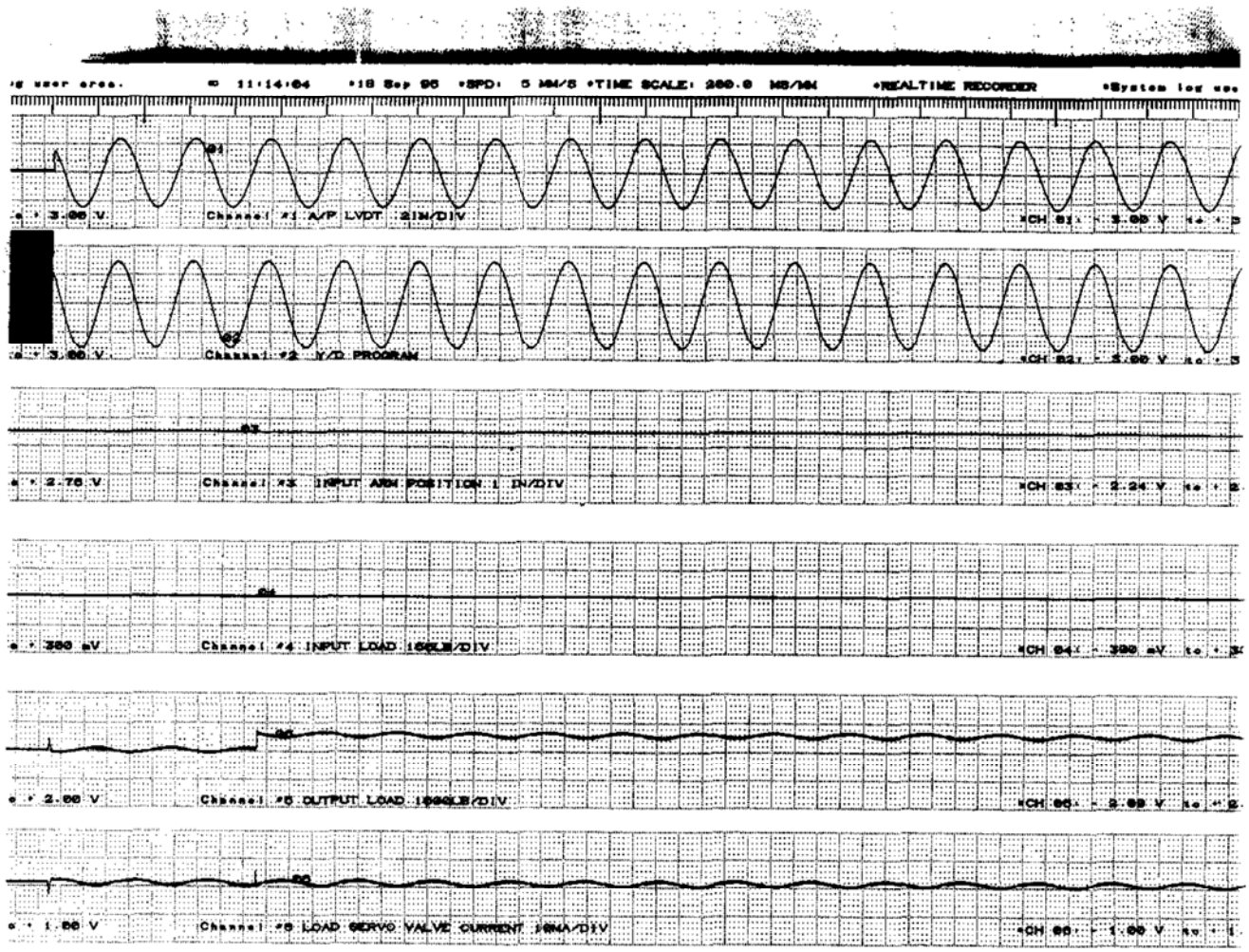
188

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

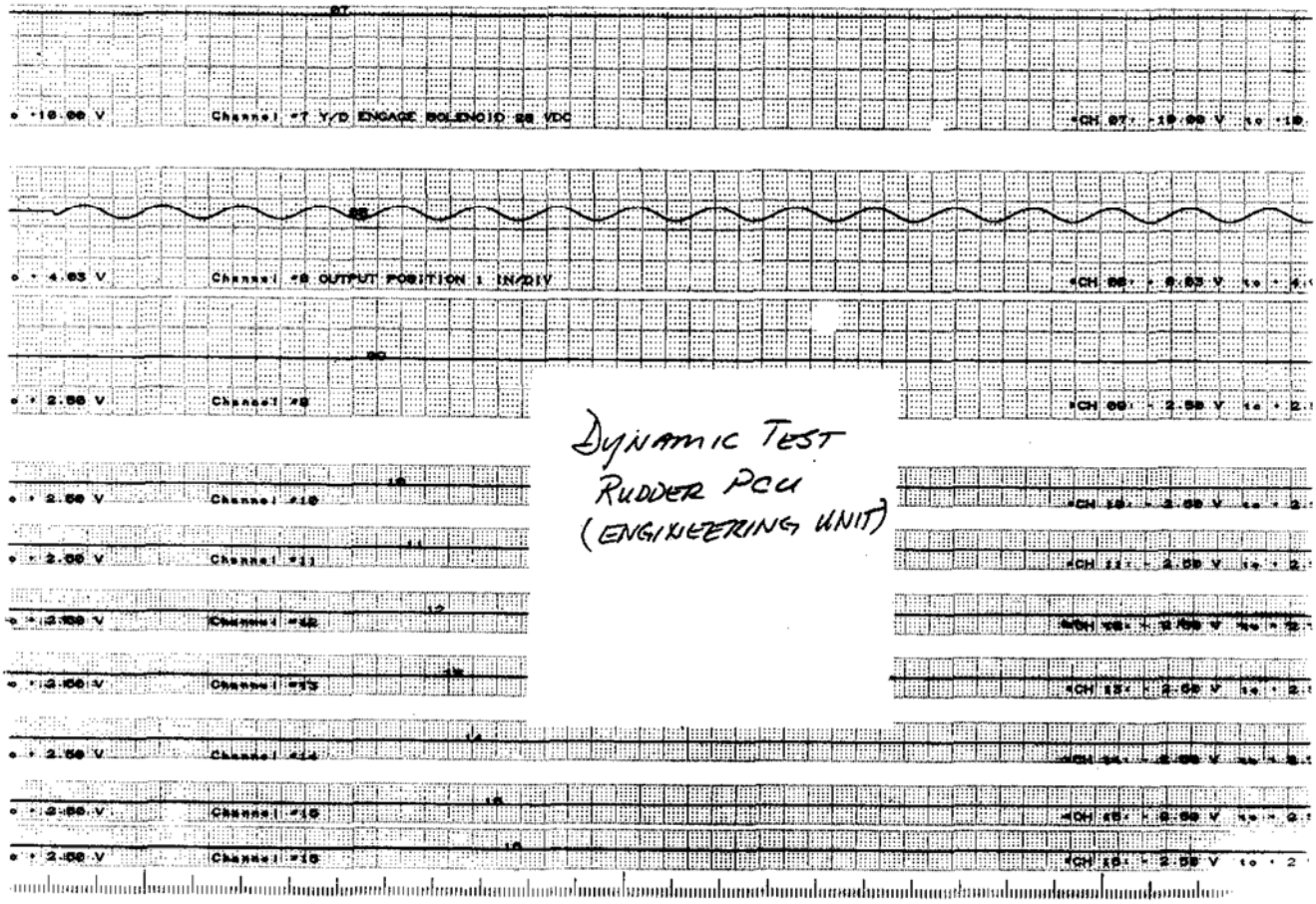
Tension 600 lb



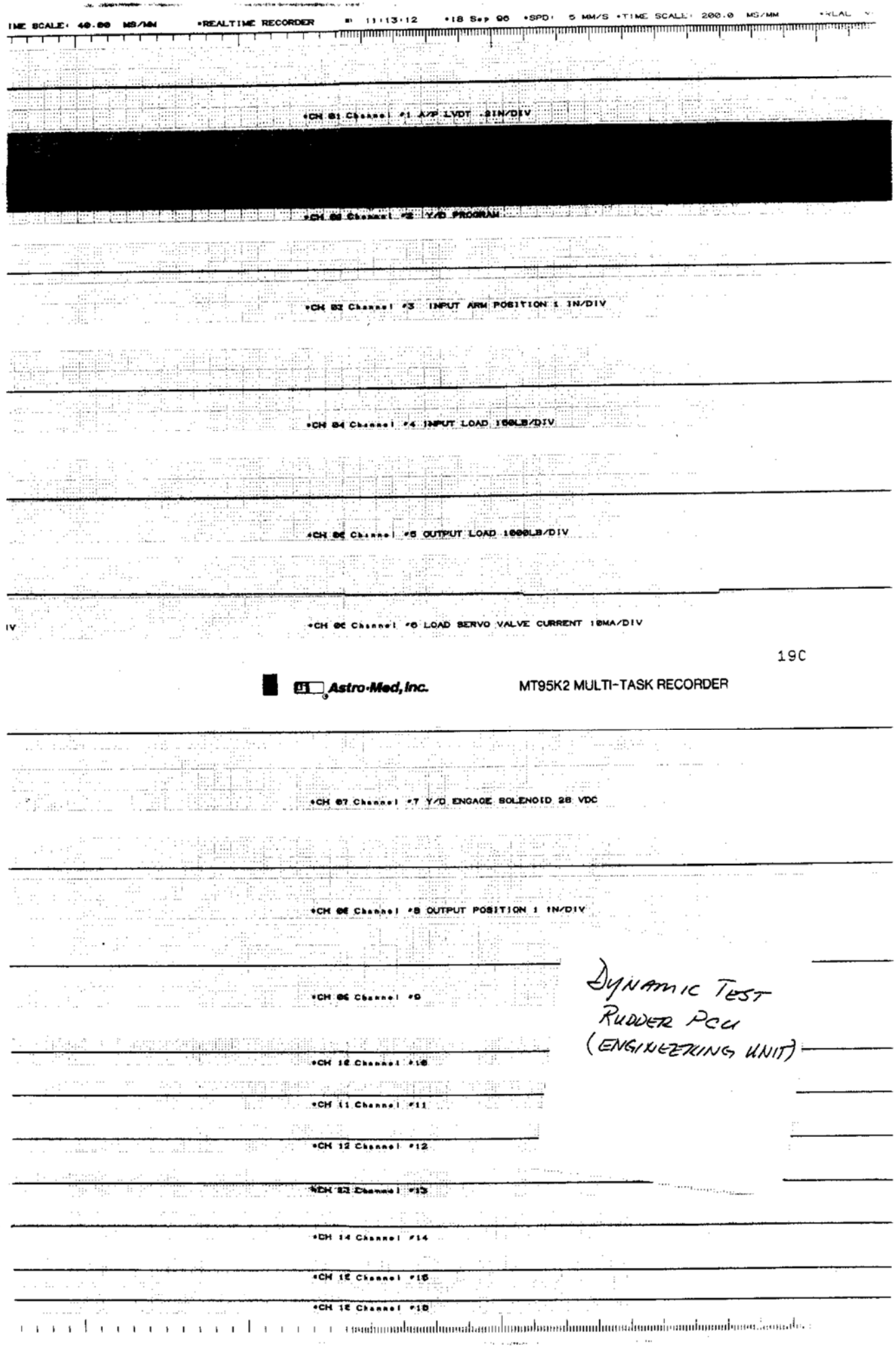
Dynamic Test
Rudder PCU
(Engineering Unit)



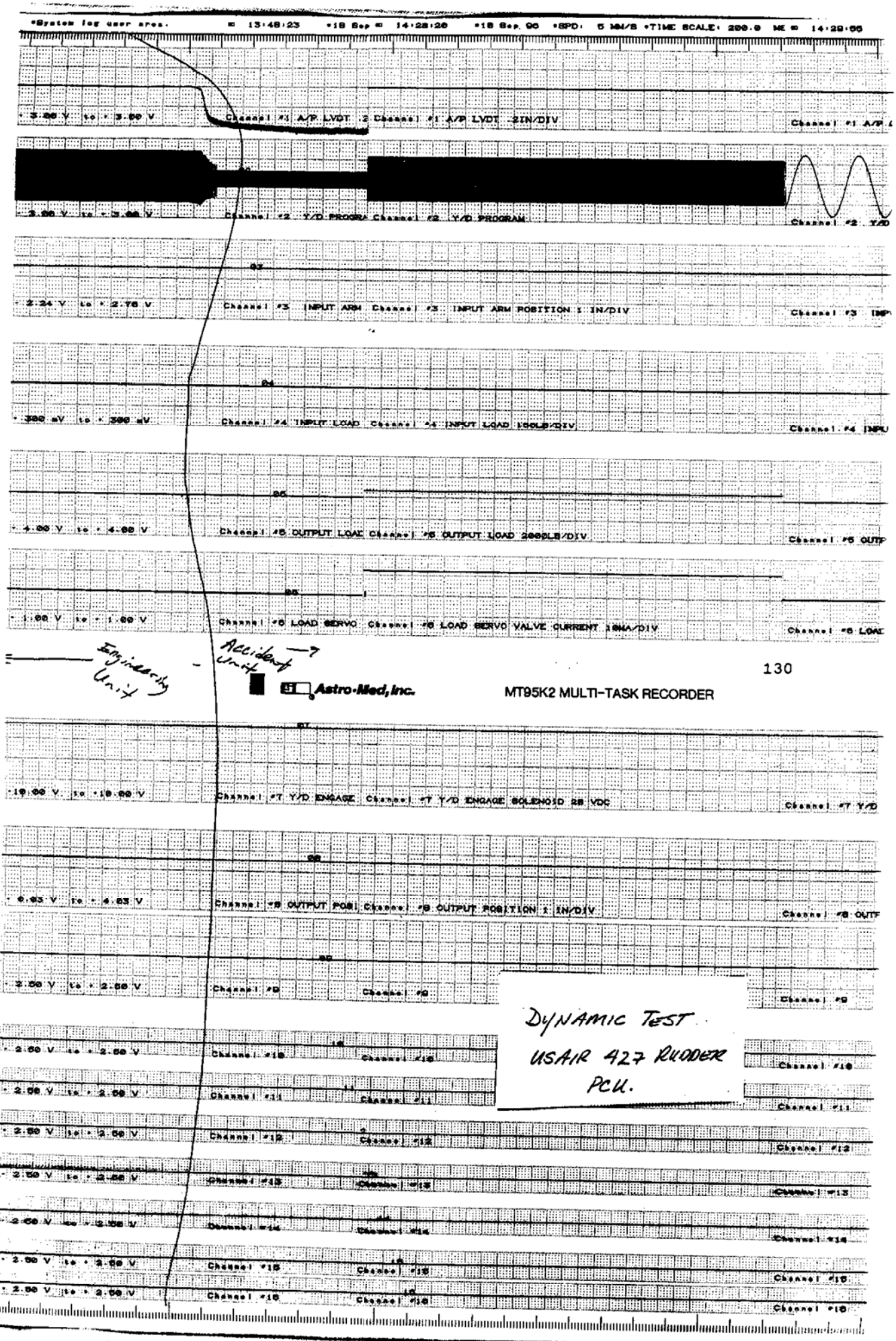
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

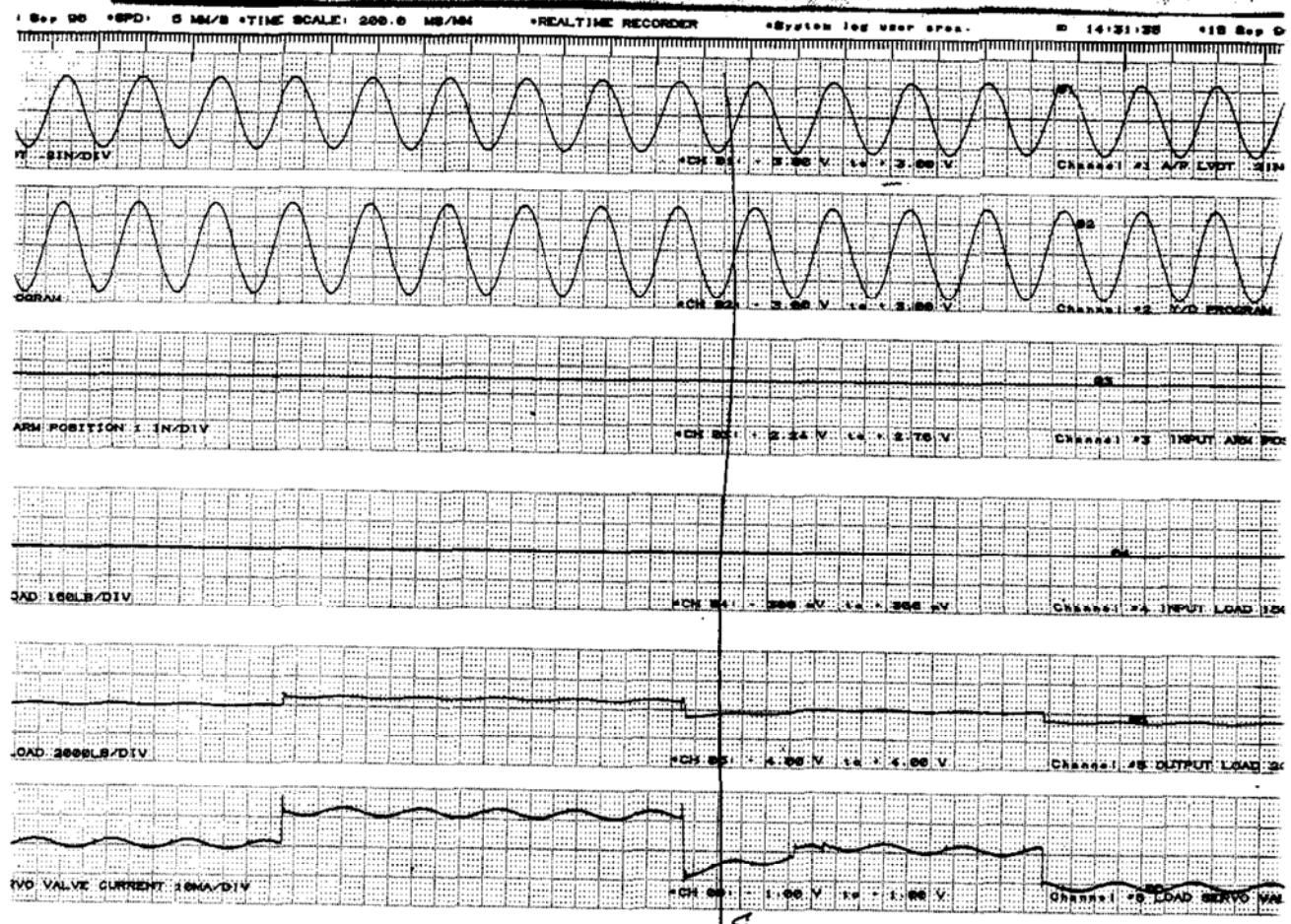


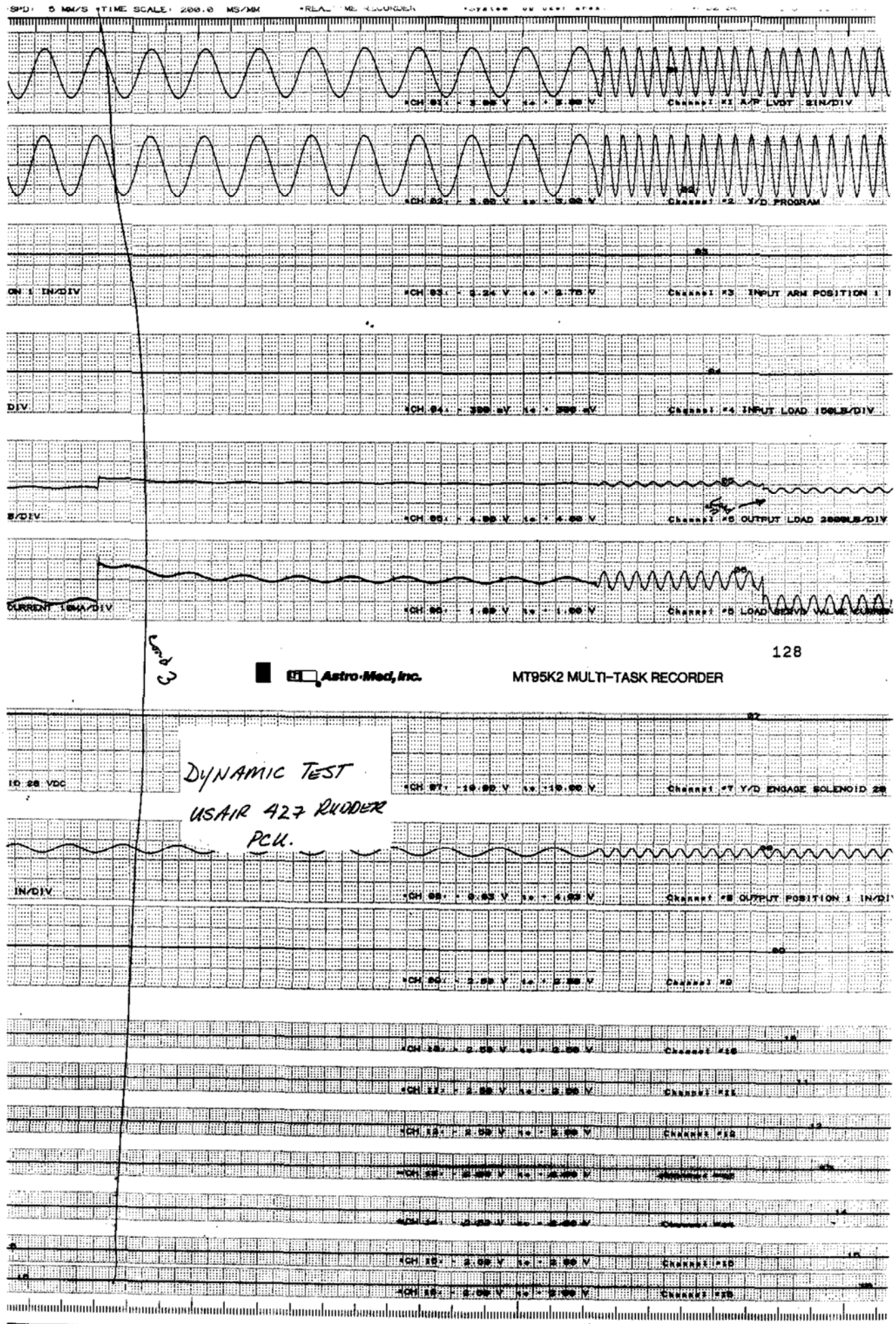
Dynamic Test
Rudder PCU
(Engineering Unit)


TIME SCALE: 40.00 MS/MM
*REALTIME RECORDER
11:13:12
18 Sep 96
*SPD: 5 MM/S
*TIME SCALE: 200.0 MS/MM
*CH 01 Channel #1 A/P LVDT .2IN/DIV
*CH 02 Channel #2 Y/D PROGRAM
*CH 03 Channel #3 INPUT ARM POSITION 1 IN/DIV
*CH 04 Channel #4 INPUT LOAD 100LB/DIV
*CH 05 Channel #5 OUTPUT LOAD 1000LB/DIV
*CH 06 Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
19C
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
*CH 07 Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 08 Channel #8 OUTPUT POSITION 1 IN/DIV
*CH 09 Channel #9
*CH 10 Channel #10
*CH 11 Channel #11
*CH 12 Channel #12
*CH 13 Channel #13
*CH 14 Channel #14
*CH 15 Channel #15
*CH 16 Channel #16
DYNAMIC TEST
RUDDER PCU
(ENGINEERING UNIT)

Attachment 2
Accident Unit Test Data


*System log user area.
= 13:48:23
*18 Sep =
14:28:20
*18 Sep 96
*SPD: 5 MM/S *TIME SCALE: 200.0 ME =
14:29:06
Channel #1 A/P LVDT .2IN/DIV
Channel #2 Y/D PROGRAM
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #4 INPUT LOAD 100LB/DIV
Channel #5 OUTPUT LOAD 2000LB/DIV
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #9
Channel #10
Channel #11
Channel #12
Channel #13
Channel #14
Channel #15
Channel #16
Engineering Unit
Accident Unit
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
130
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

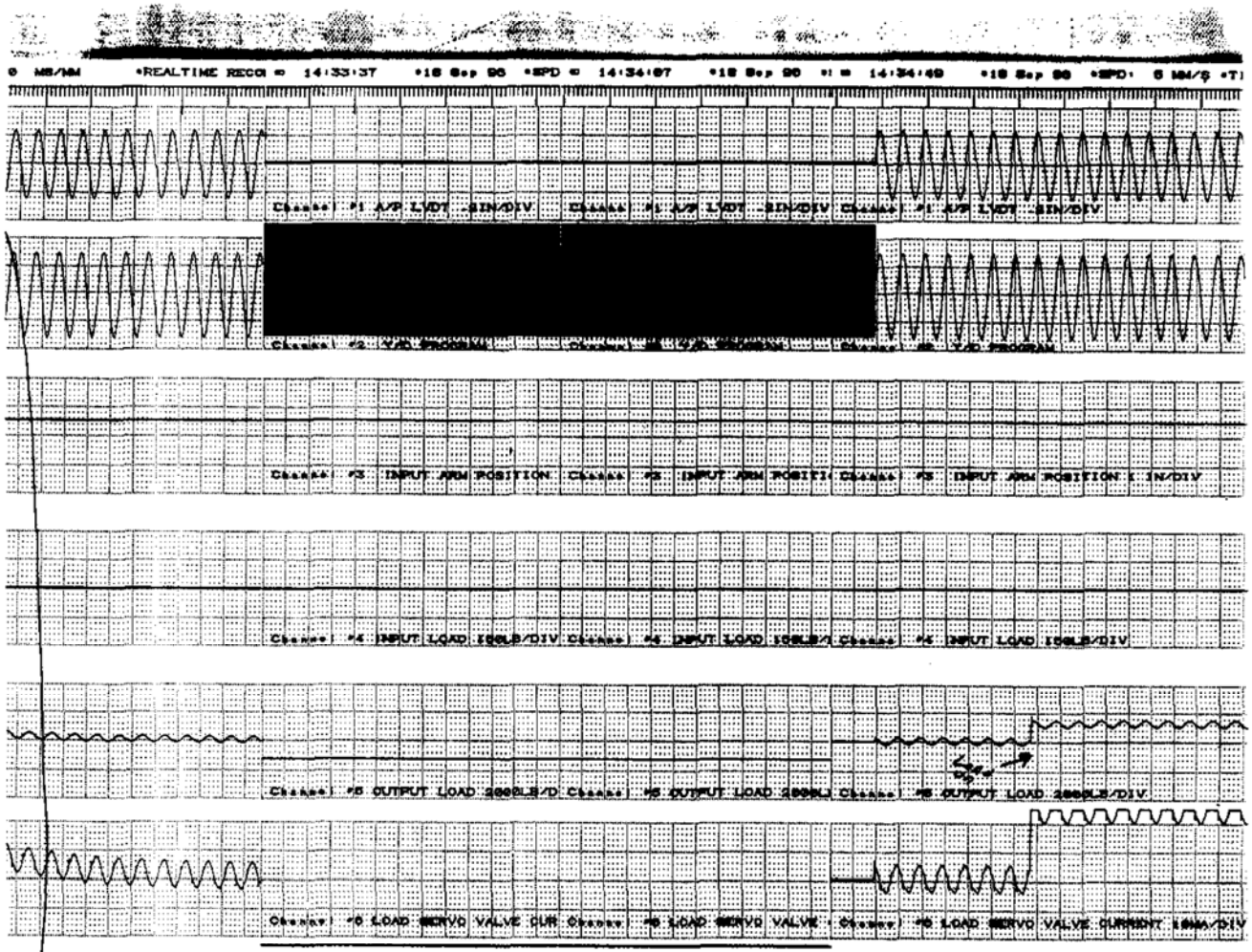

*REALTIME RECORDER
*System log user area.
Channel #1 A/P LVDT
Channel #2 Y/D PROGRAM
Channel #3 INPUT ARM
Channel #4 INPUT LOAD
Channel #5 OUTPUT LOAD
Channel #6 LOAD SERVO
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Channel #7 Y/D ENGAGE
Channel #8 OUTPUT POSITIO
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



128

Page 3

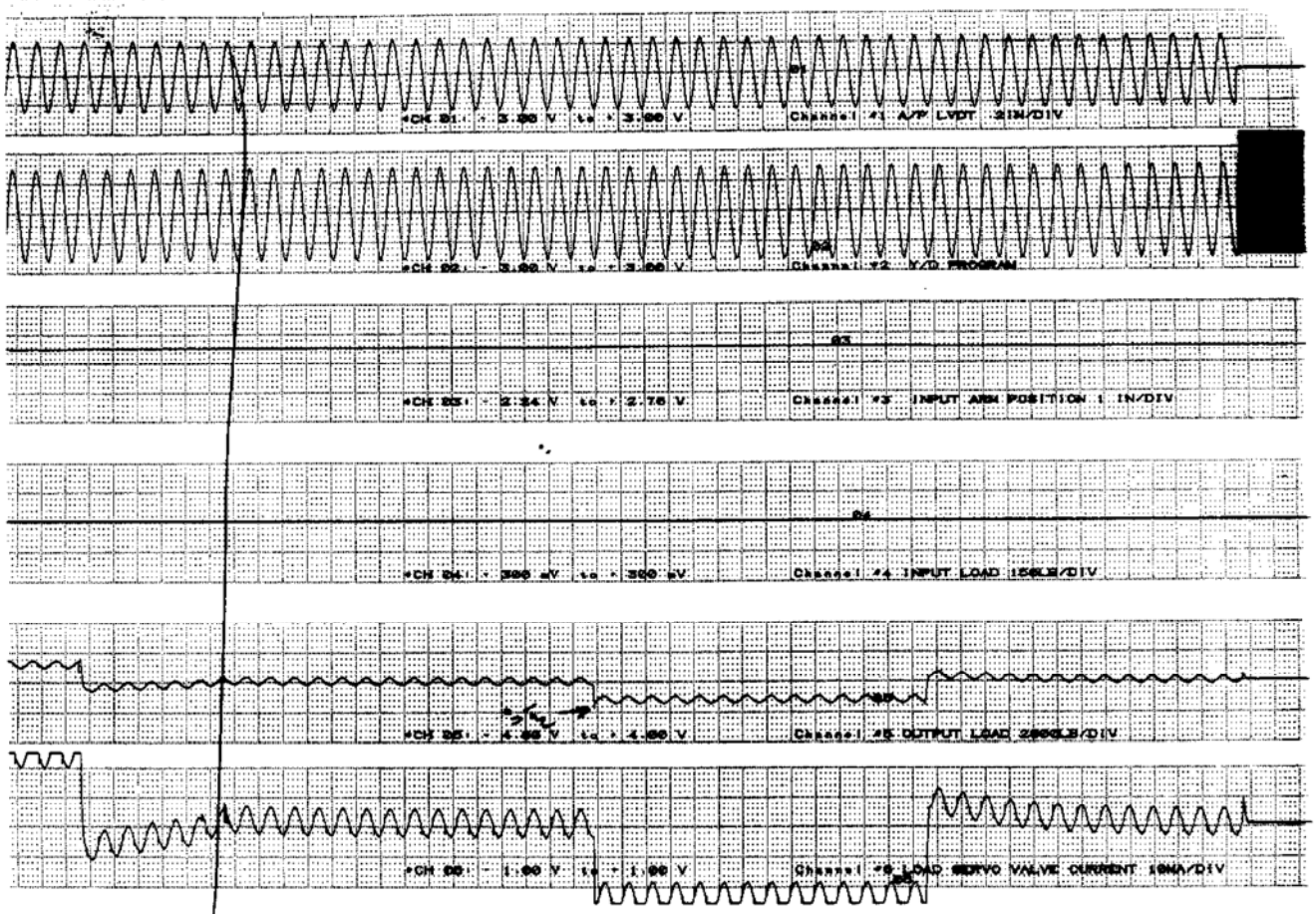
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



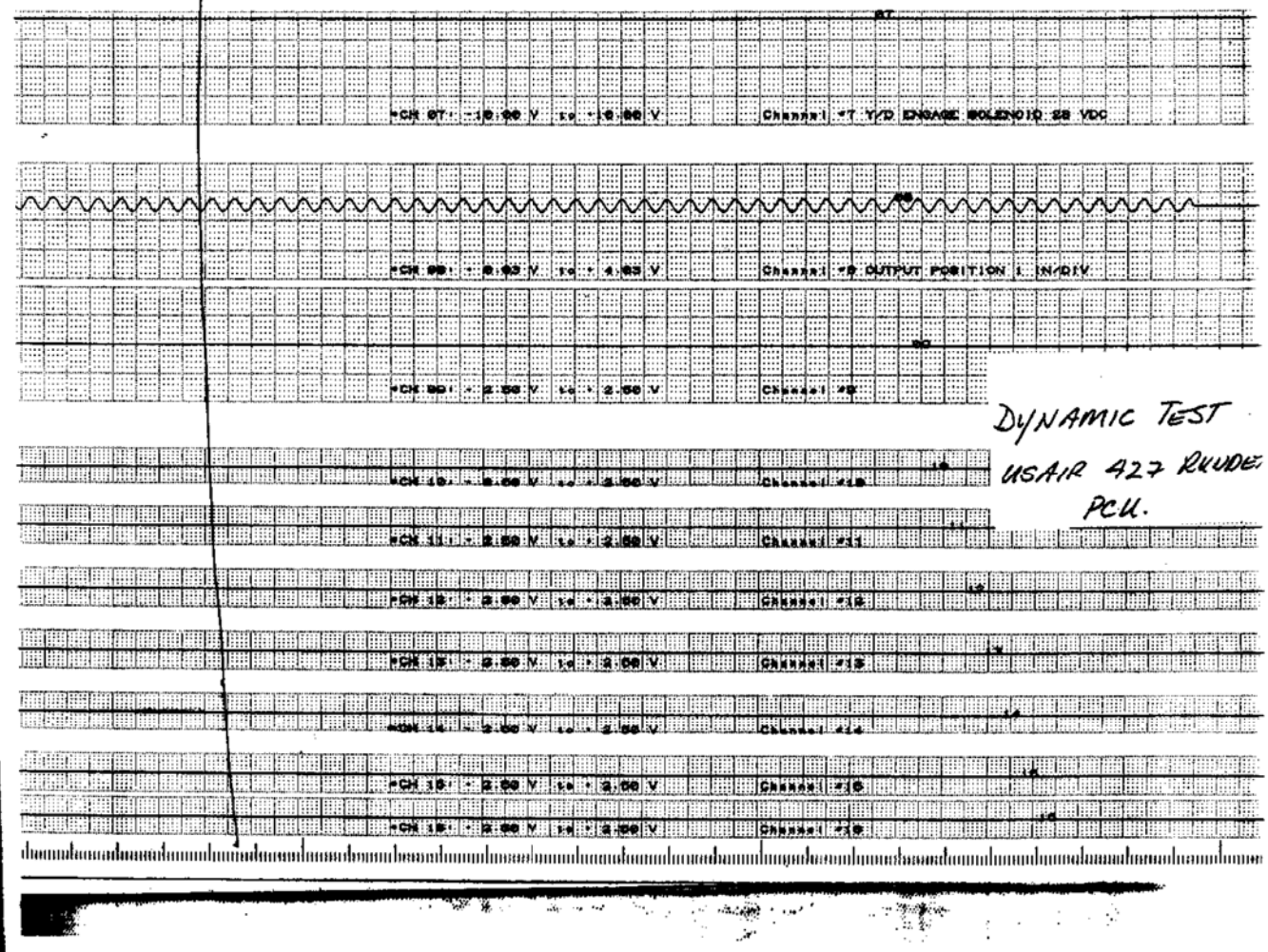
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

Card 4

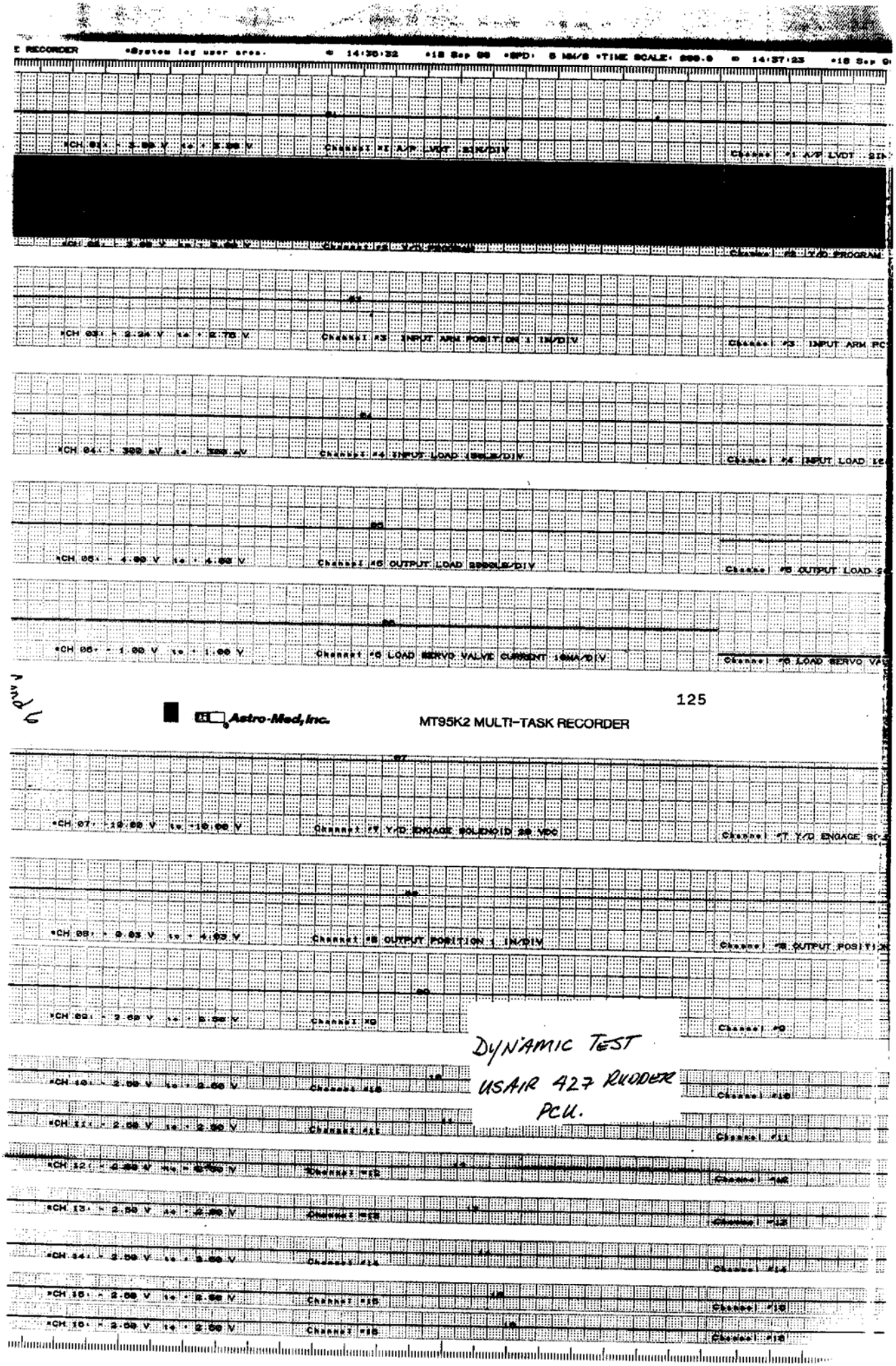
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

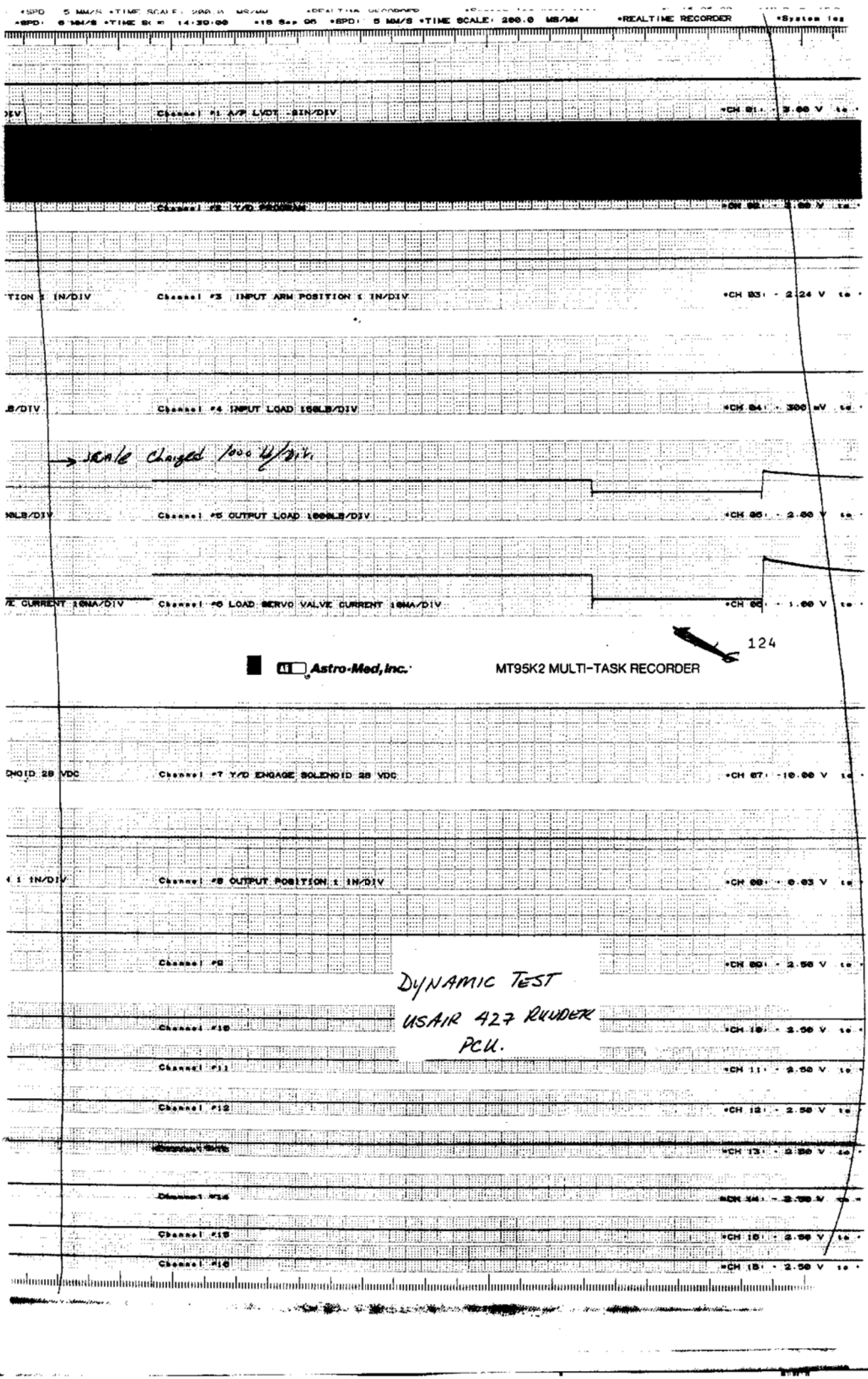


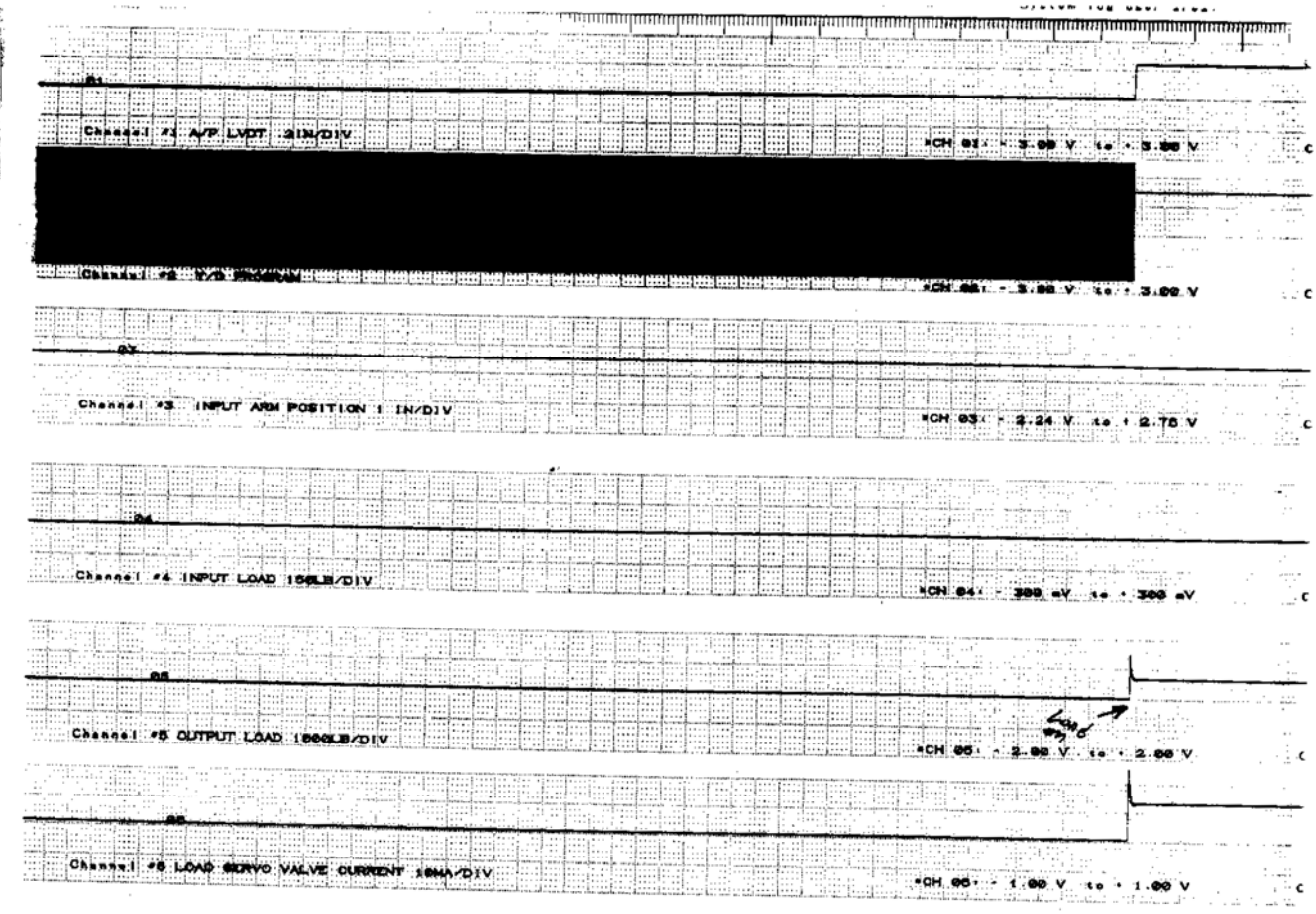
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

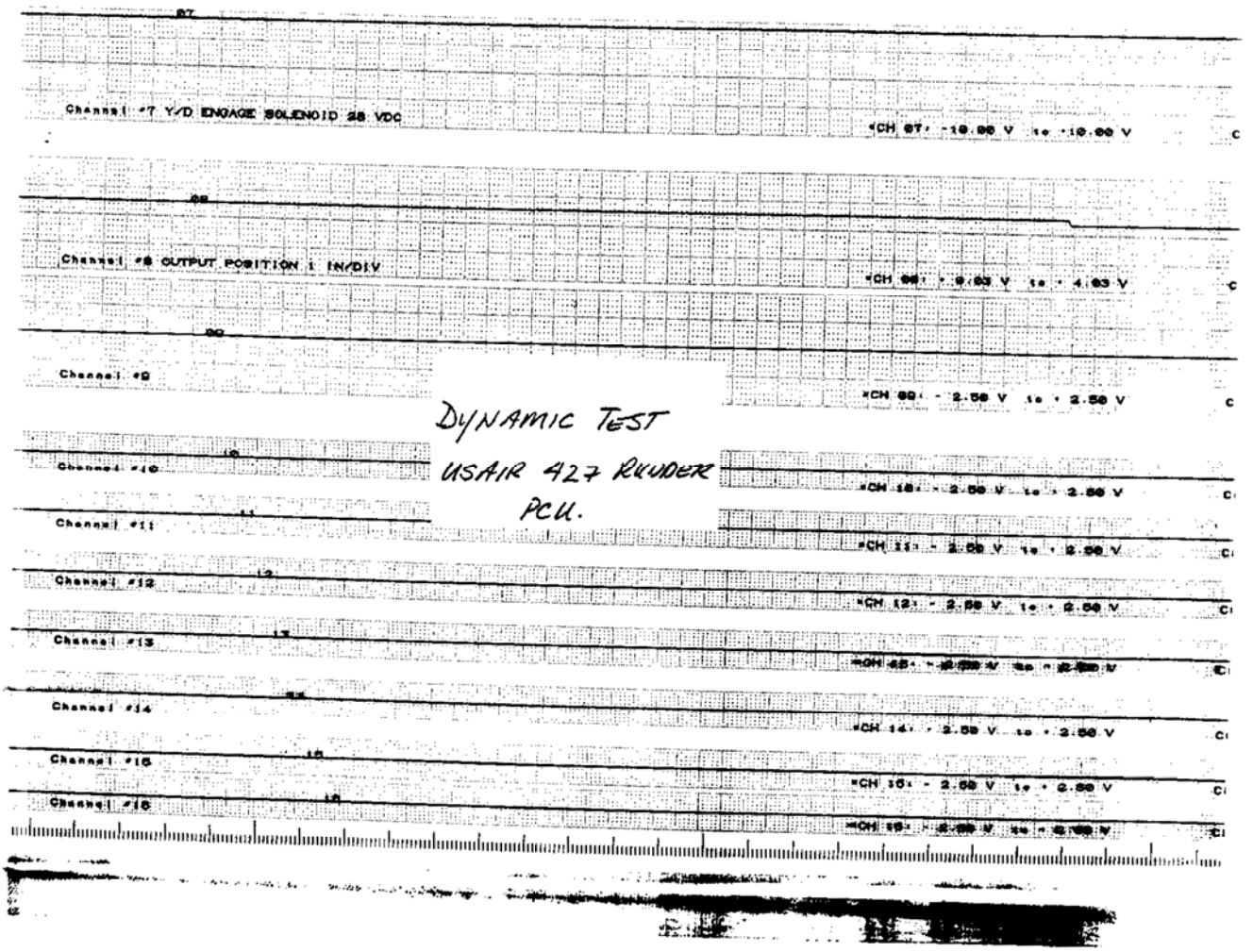


DYNAMIC TEST
USAIR 427 RUDDER
PCU.

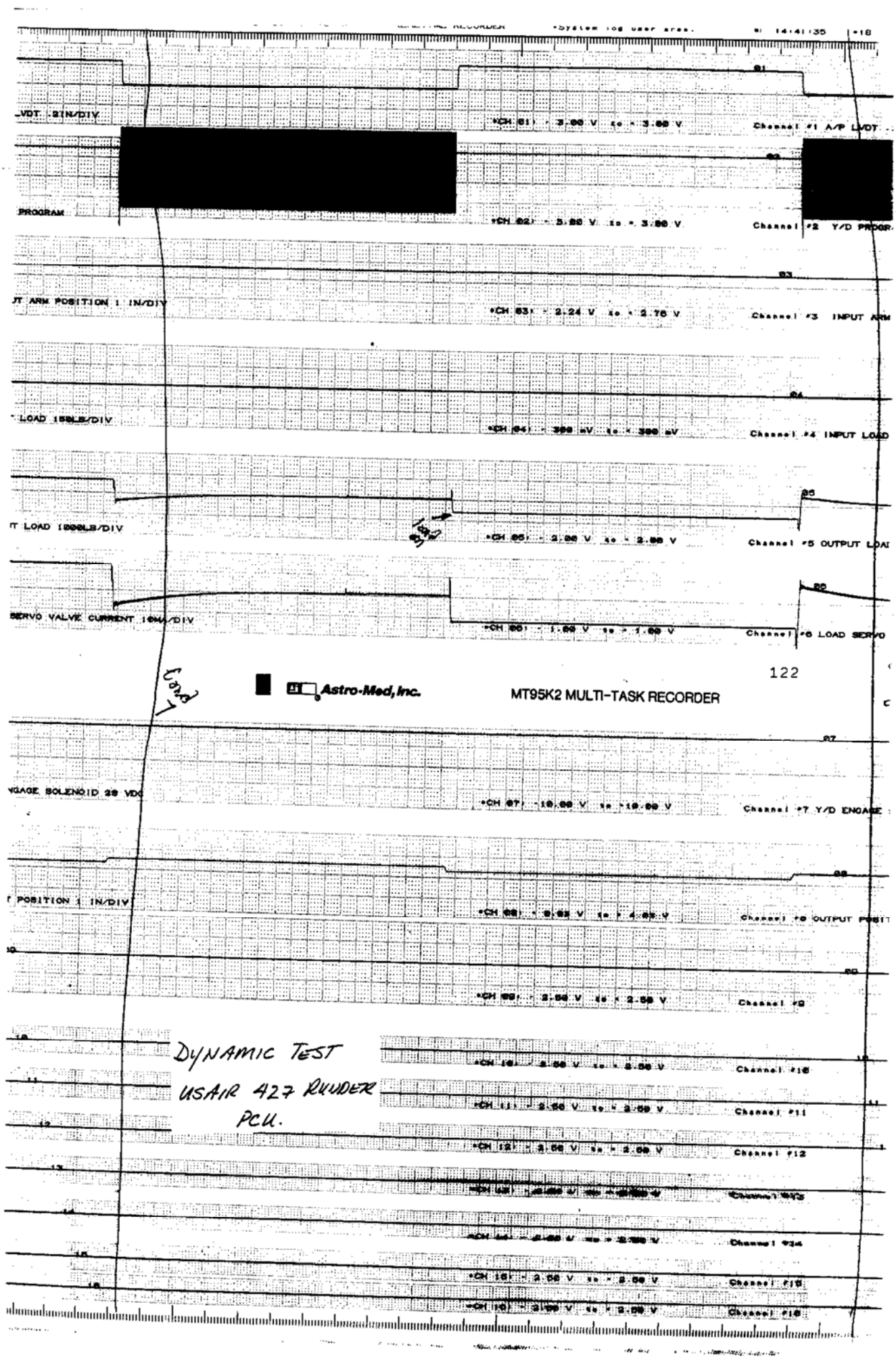

RECORDER
*System log user area.
14:36:32
18 Sep 96
SPD: 8 MM/S
TIME SCALE: 900.0
14:37:23
18 Sep 9
*CH 01: - 5.00 V to + 5.00 V
Channel #1 A/P LVDT 2.5V/DIV
Channel #1 A/P LVDT 2.5
Channel #2 Y/D PROGRAM
*CH 03: - 2.24 V to + 2.75 V
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #3 INPUT ARM PO
*CH 04: - 300 mV to + 300 mV
Channel #4 INPUT LOAD 100LB/DIV
Channel #4 INPUT LOAD LO
*CH 05: - 4.00 V to + 4.00 V
Channel #5 OUTPUT LOAD 2000LB/DIV
Channel #5 OUTPUT LOAD 2
*CH 06: - 1.00 V to + 1.00 V
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
Channel #6 LOAD SERVO VA
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
125
*CH 07: -10.00 V to +10.00 V
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #7 Y/D ENGAGE SO
*CH 08: - 0.63 V to + 4.93 V
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #8 OUTPUT POSITIO
*CH 09: - 2.50 V to + 2.50 V
Channel #9
Channel #9
DYNAMIC TEST
USAIR 427 RUDDER
PCU.
*CH 10: - 2.00 V to + 2.00 V
Channel #10
Channel #10
*CH 11: - 2.00 V to + 2.00 V
Channel #11
Channel #11
*CH 12: - 2.00 V to + 2.00 V
Channel #12
Channel #12
*CH 13: - 2.00 V to + 2.00 V
Channel #13
Channel #13
*CH 14: - 2.00 V to + 2.00 V
Channel #14
Channel #14
*CH 15: - 2.00 V to + 2.00 V
Channel #15
Channel #15
*CH 16: - 2.00 V to + 2.00 V
Channel #16
Channel #16


Channel #1 A/P LVDT .8IN/DIV
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #4 INPUT LOAD 150LB/DIV
Scale Changed 1000 #/DIV.
Channel #5 OUTPUT LOAD 1000LB/DIV
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
124
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #8 OUTPUT POSITION 1 IN/DIV
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



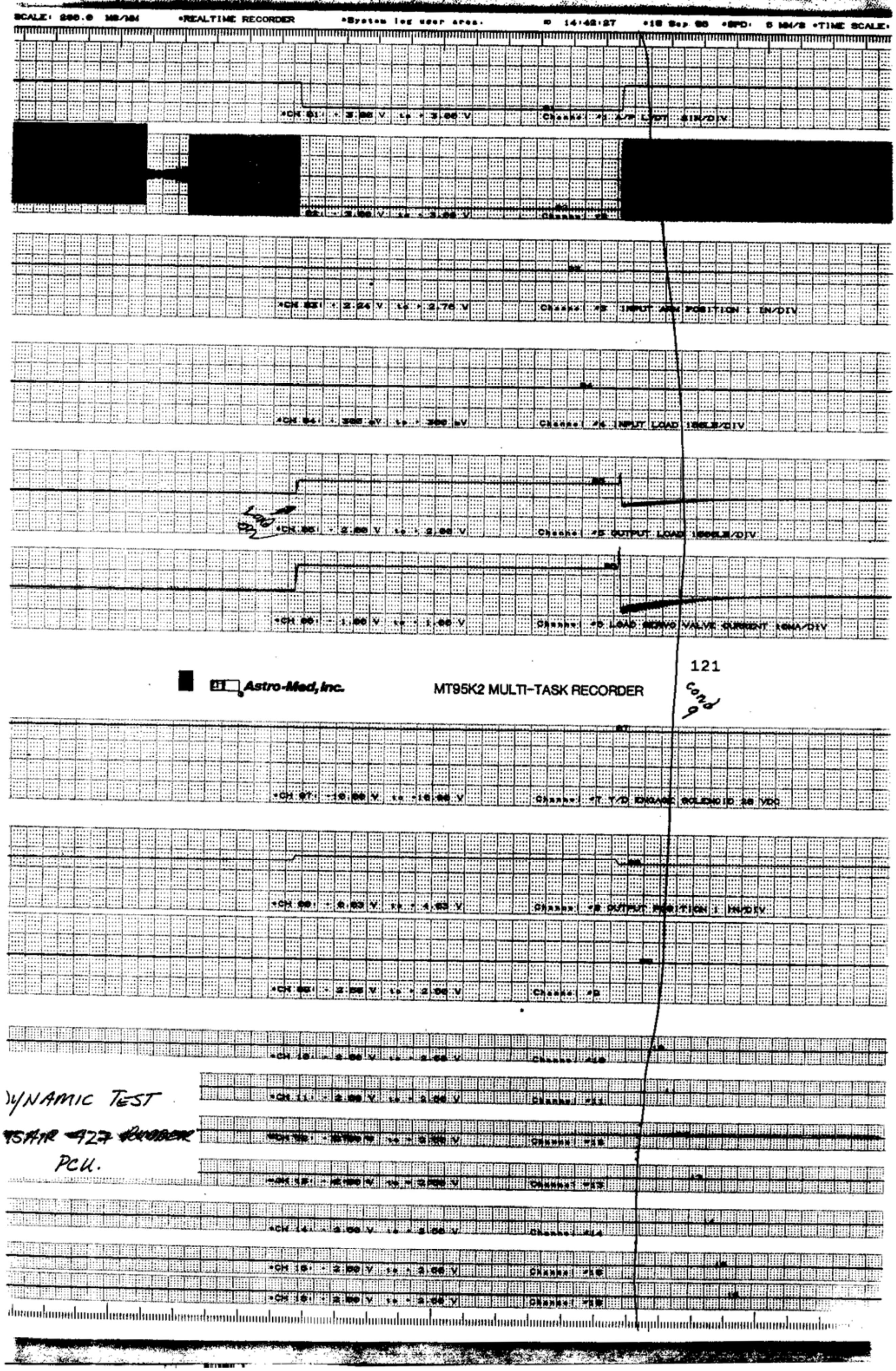


DYNAMIC TEST
USAIR 427 RUDDER
PCU.



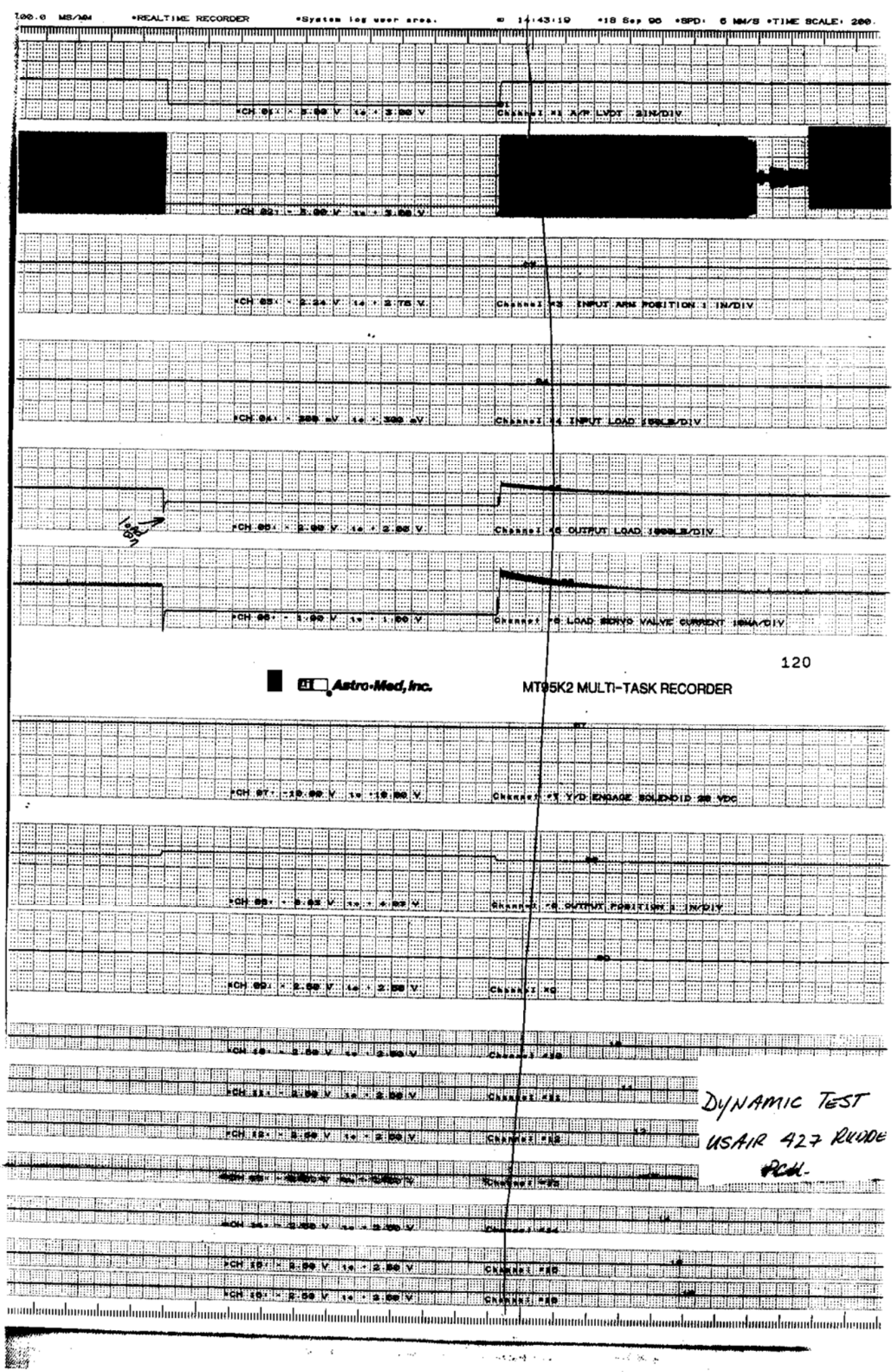
Load 1

DYNAMIC TEST
USAIR 427 RUDDER
PCU.



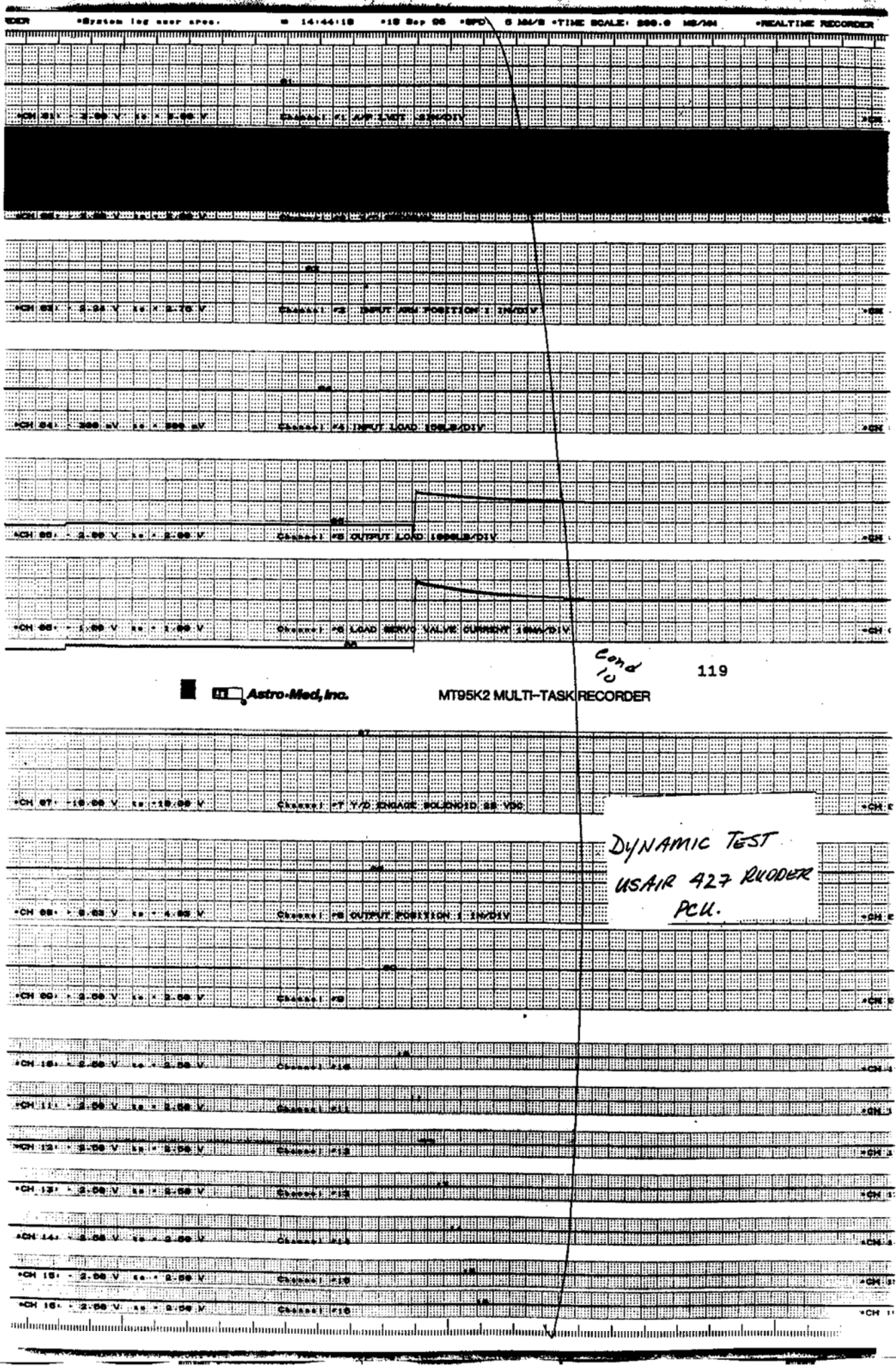
121
cond 9

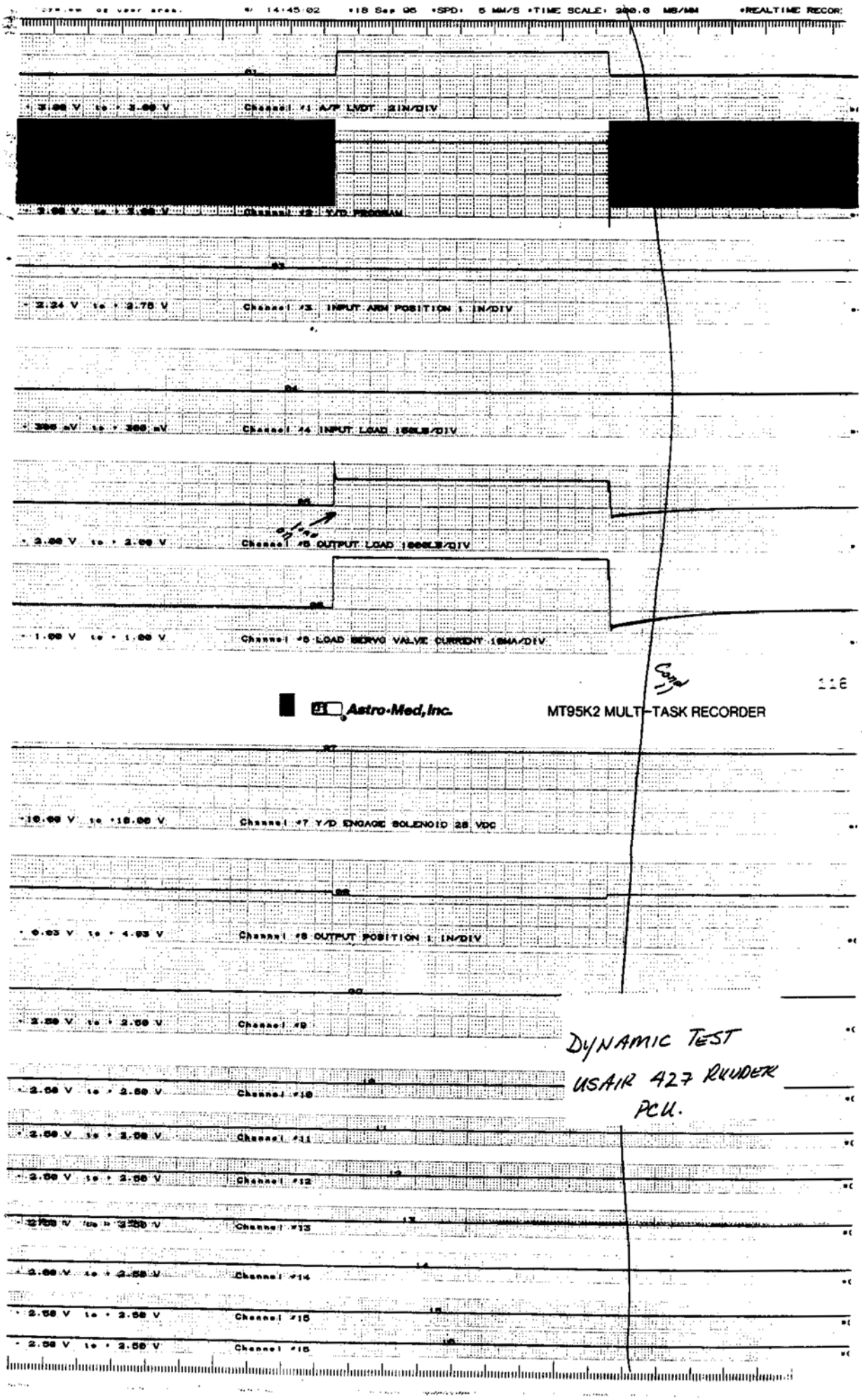
DYNAMIC TEST
PCU.



120

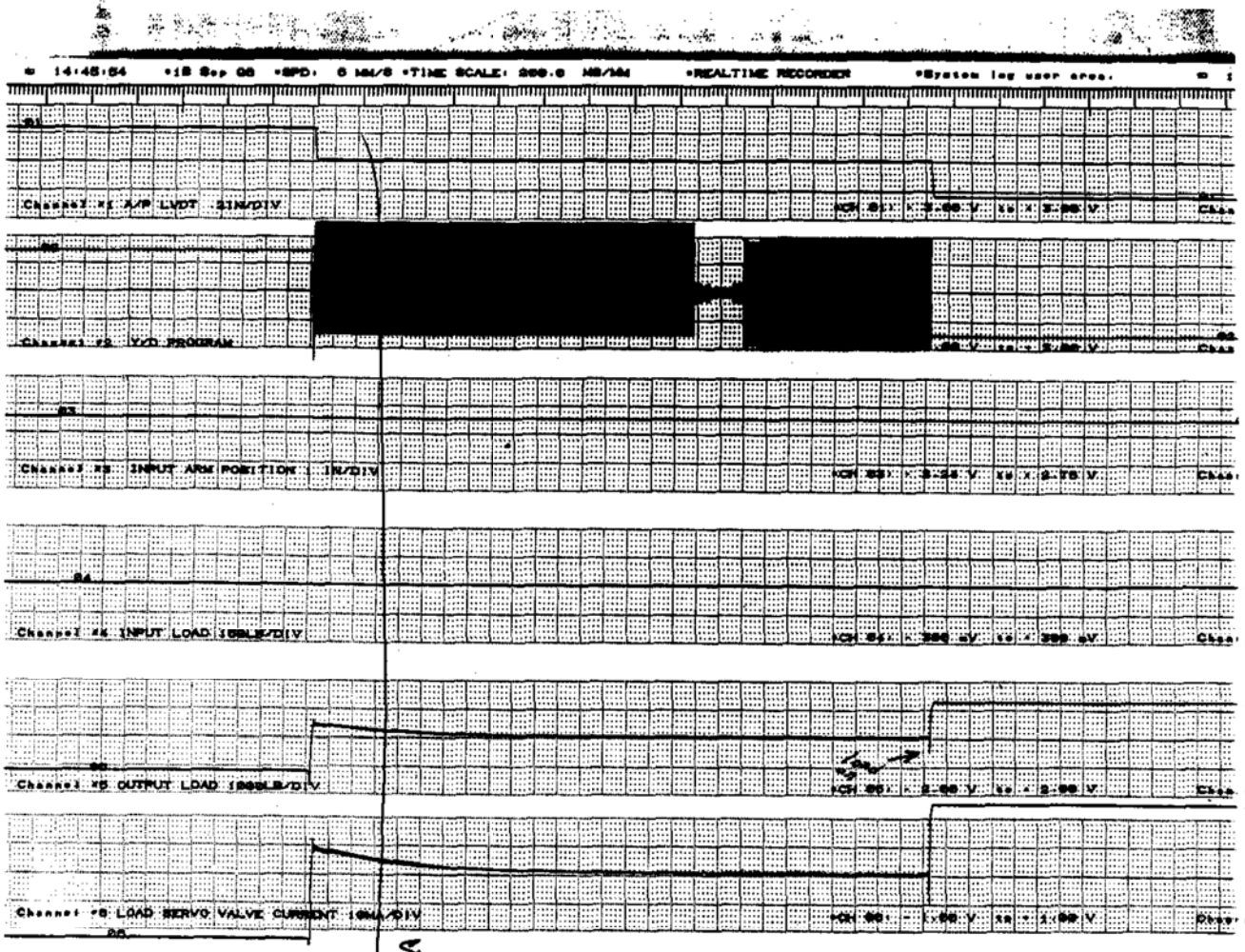
DYNAMIC TEST
USAIR 427 RUDDER
PCM.

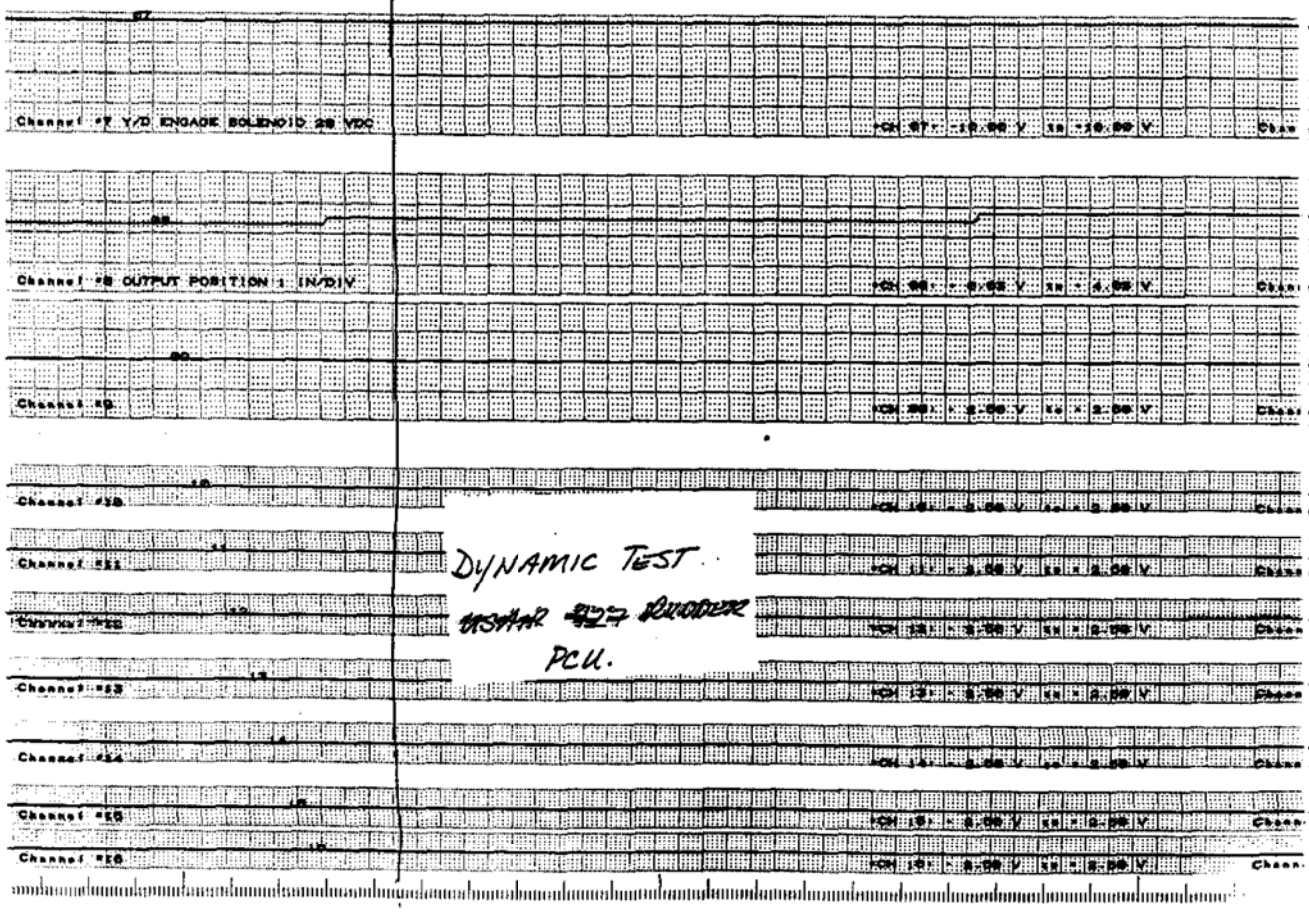

Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Cond 10
119
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



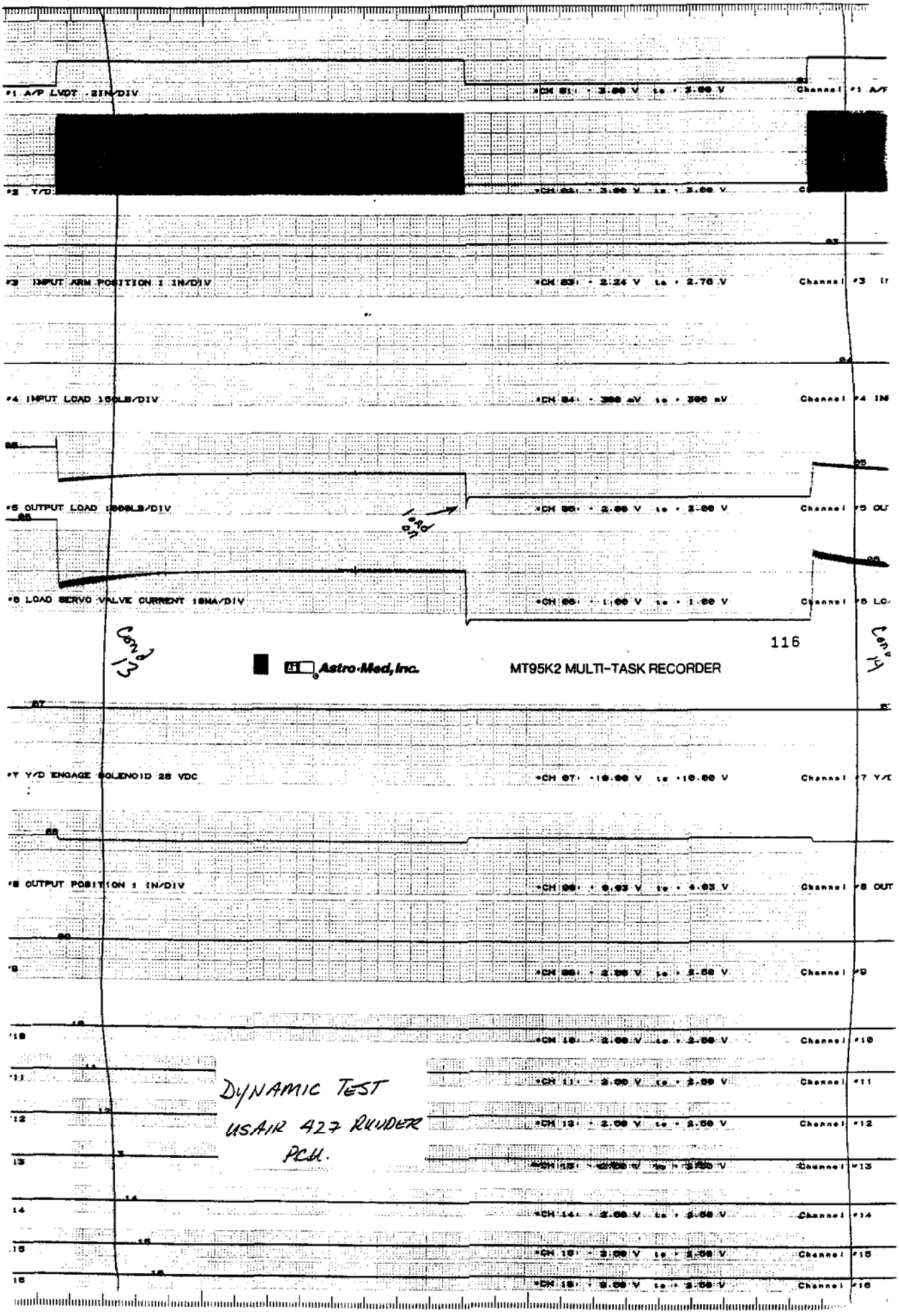
116

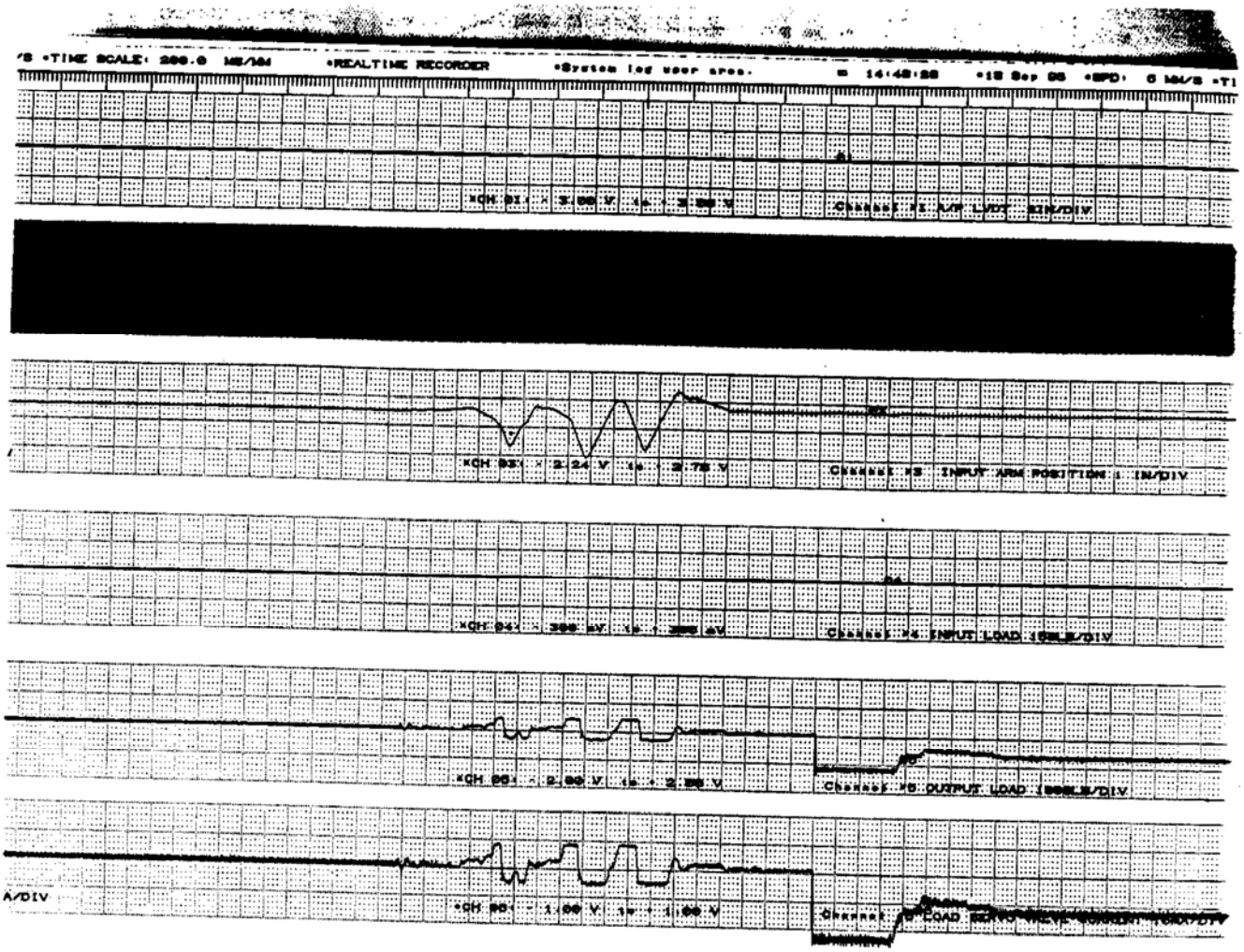
DYNAMIC TEST
USAIR 427 RUDDER PCU.





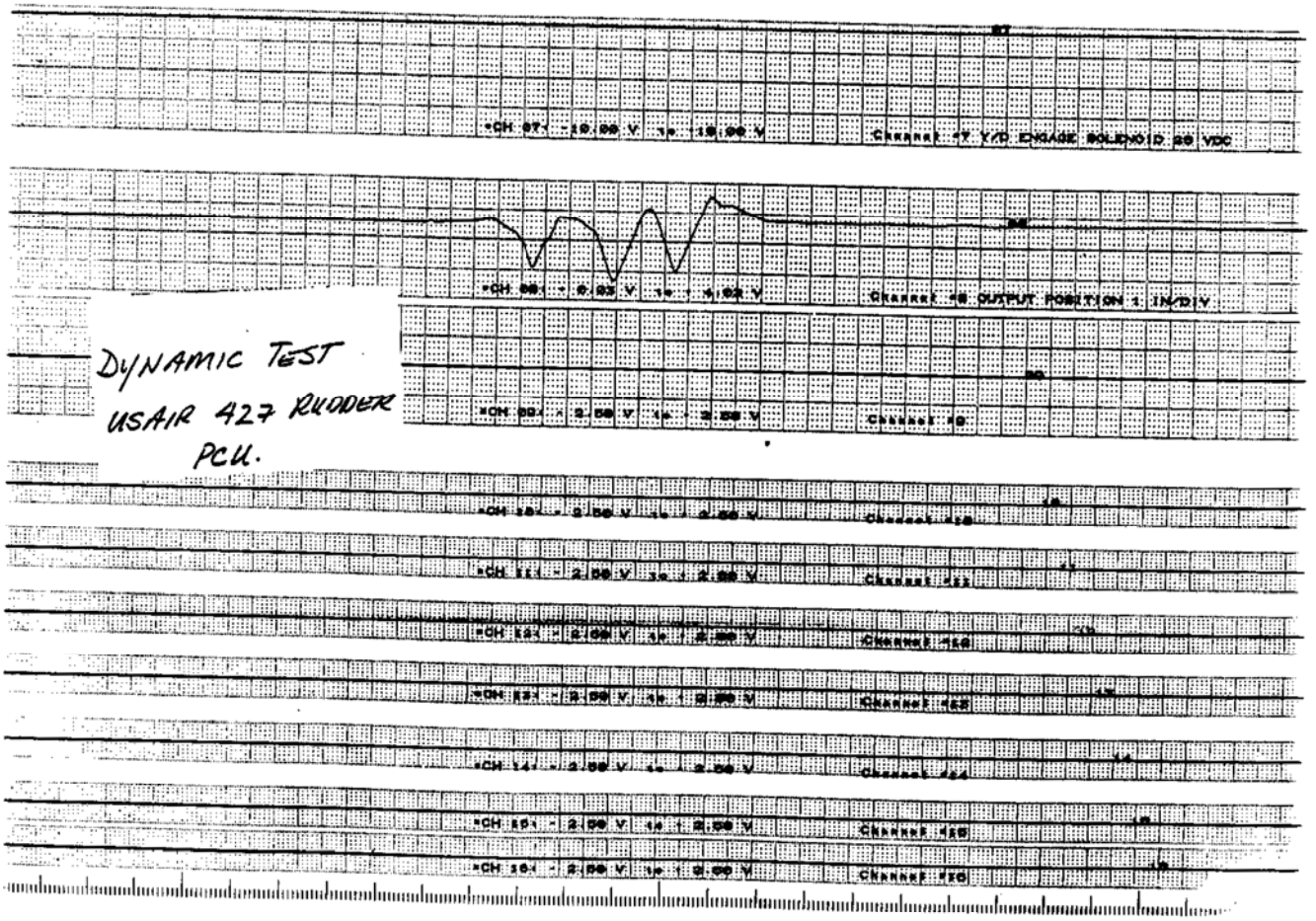
DYNAMIC TEST
USHAR 427 BUILDER
PCU.


#1 A/P LVDT .2IN/DIV
#2 Y/D
#3 INPUT ARM POSITION 1 IN/DIV
#4 INPUT LOAD 150LB/DIV
#5 OUTPUT LOAD 1000LB/DIV
load on
#6 LOAD SERVO VALVE CURRENT 10MA/DIV
Cond 13
116
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Cond 14
#7 Y/D ENGAGE SOLENOID 28 VDC
#8 OUTPUT POSITION 1 IN/DIV
#9
#10
#11
#12
#13
#14
#15
#16
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

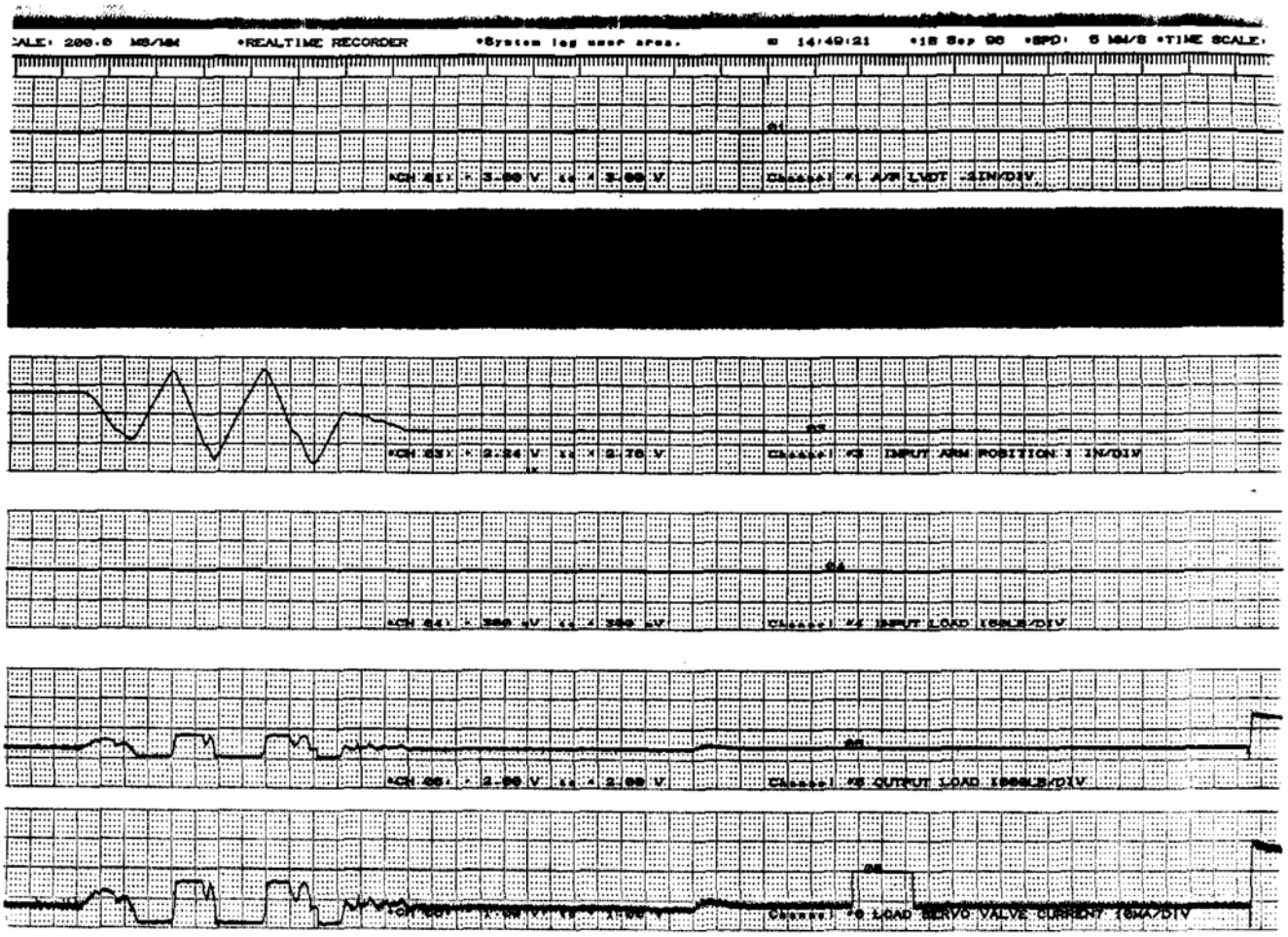


115

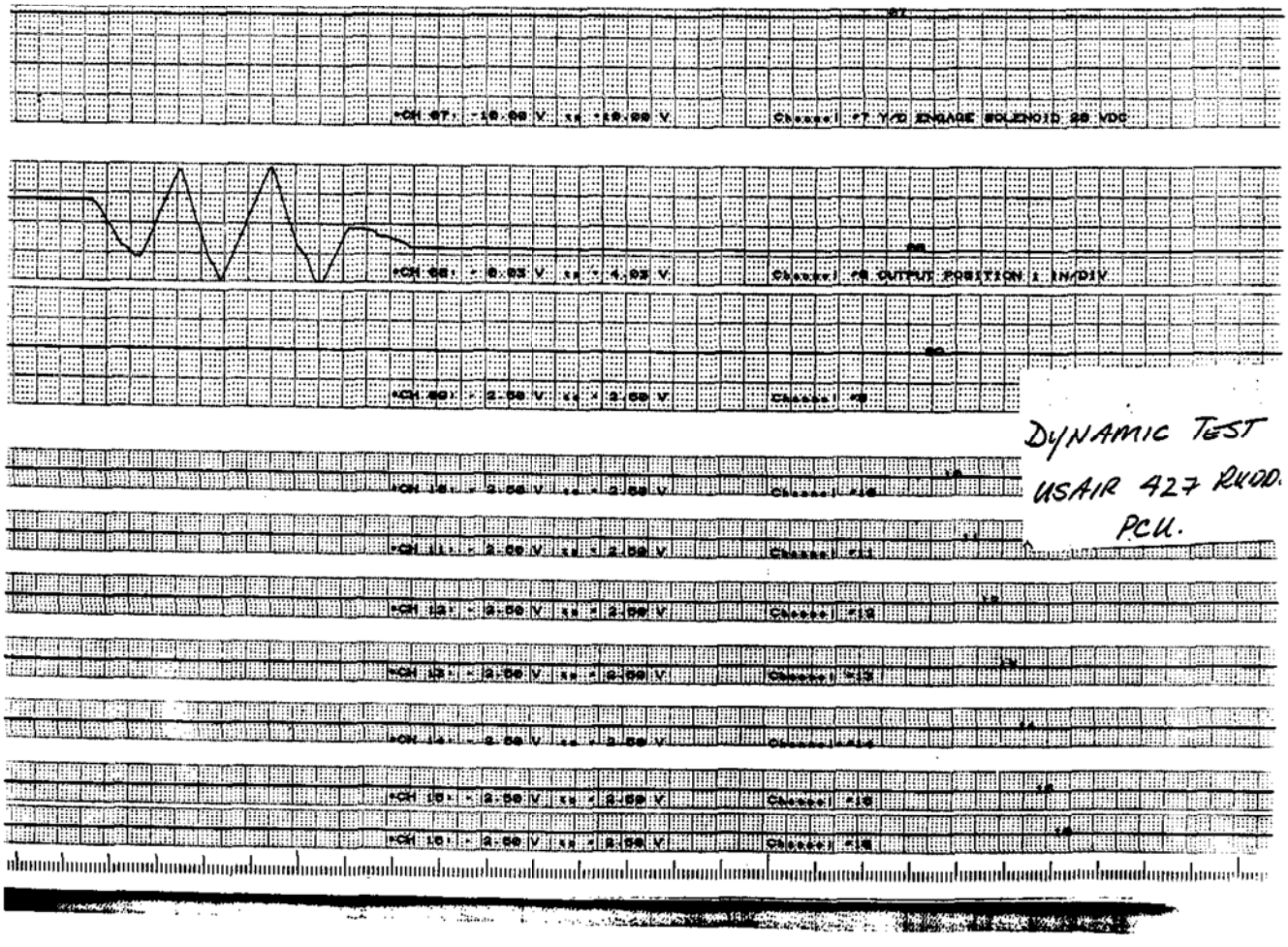
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



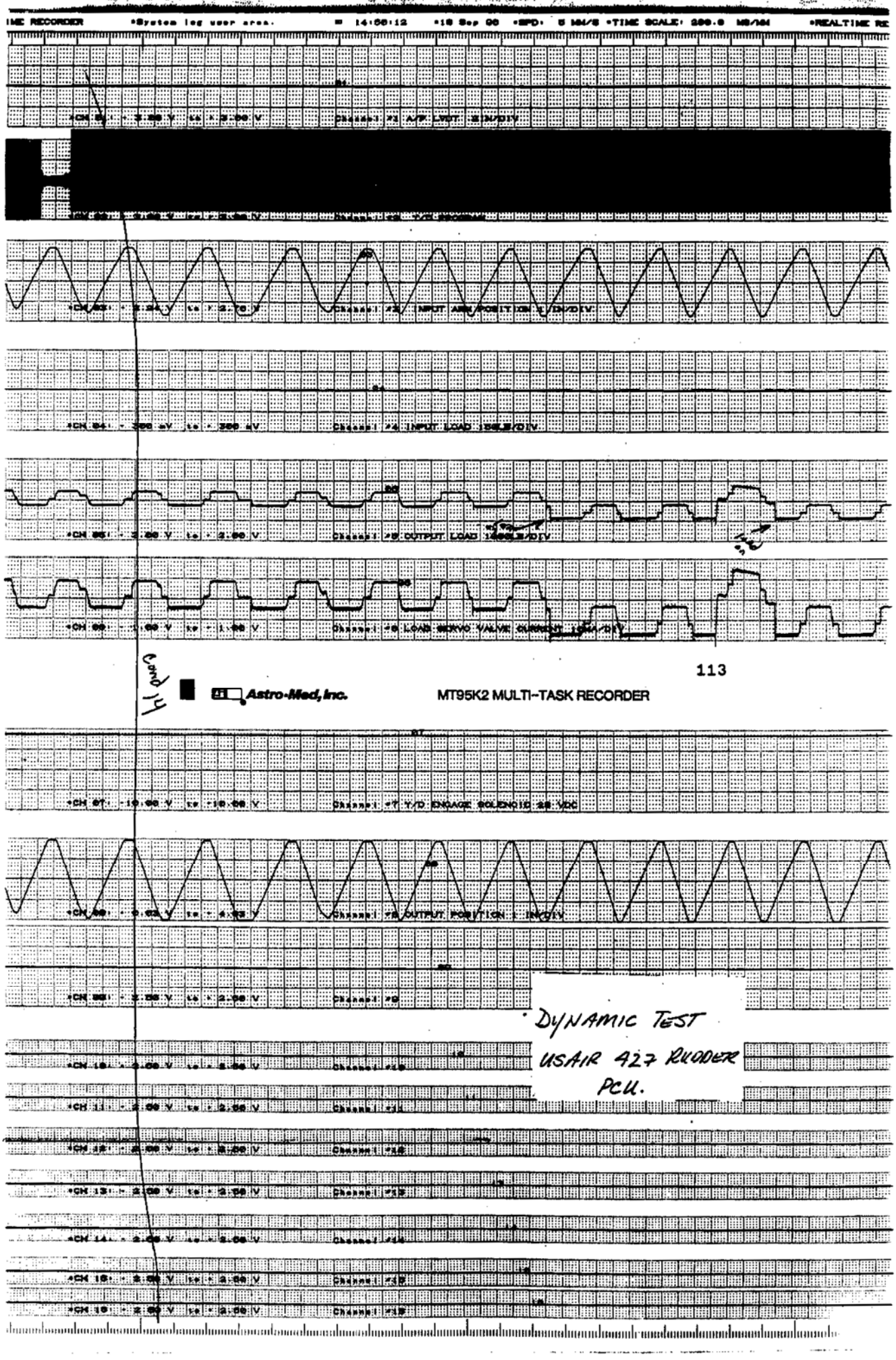
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



DYNAMIC TEST
USAIR 427 RUDD.
PCU.



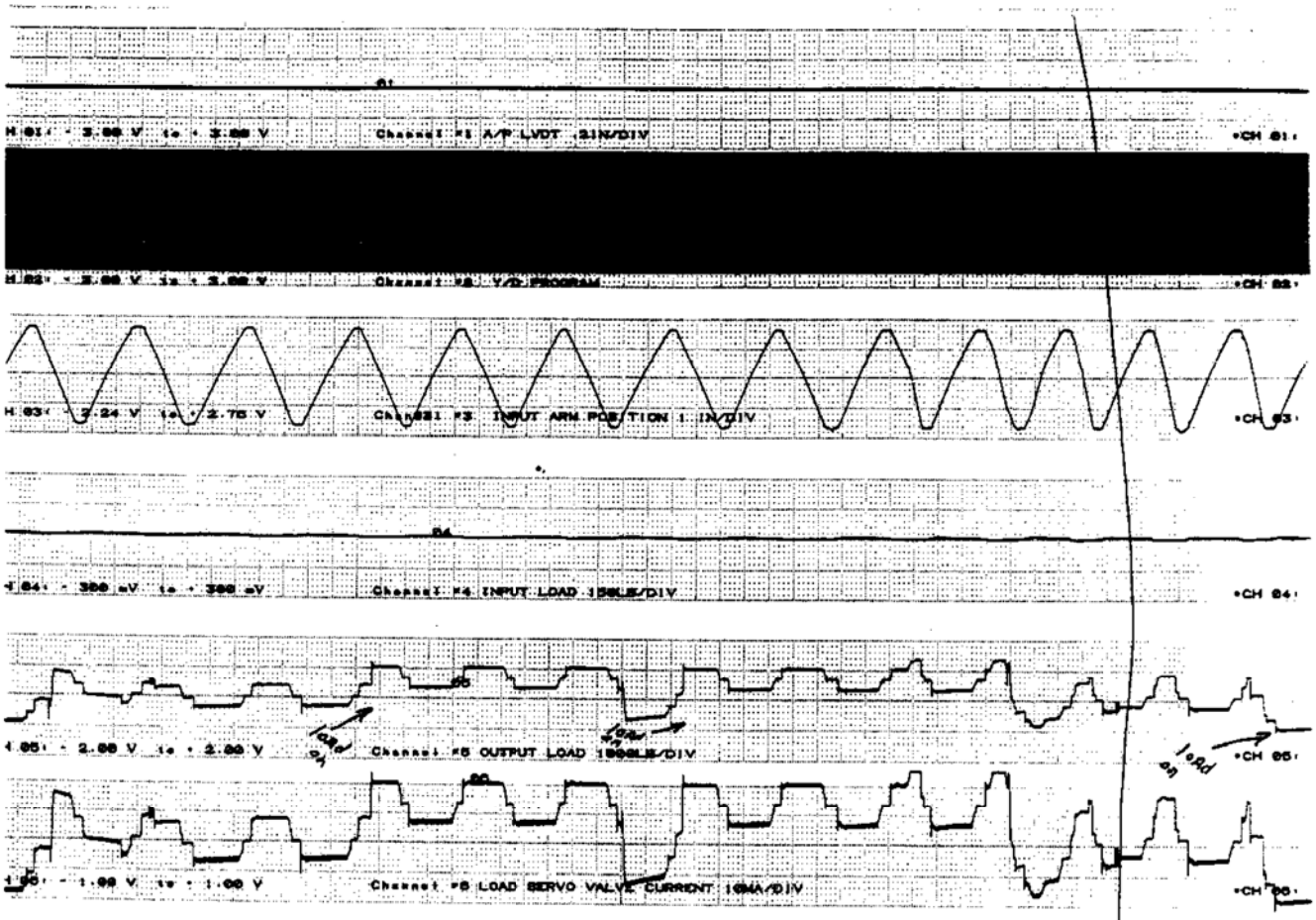
Astro-Med, Inc.

MT95K2 MULTI-TASK RECORDER

113

Card 14

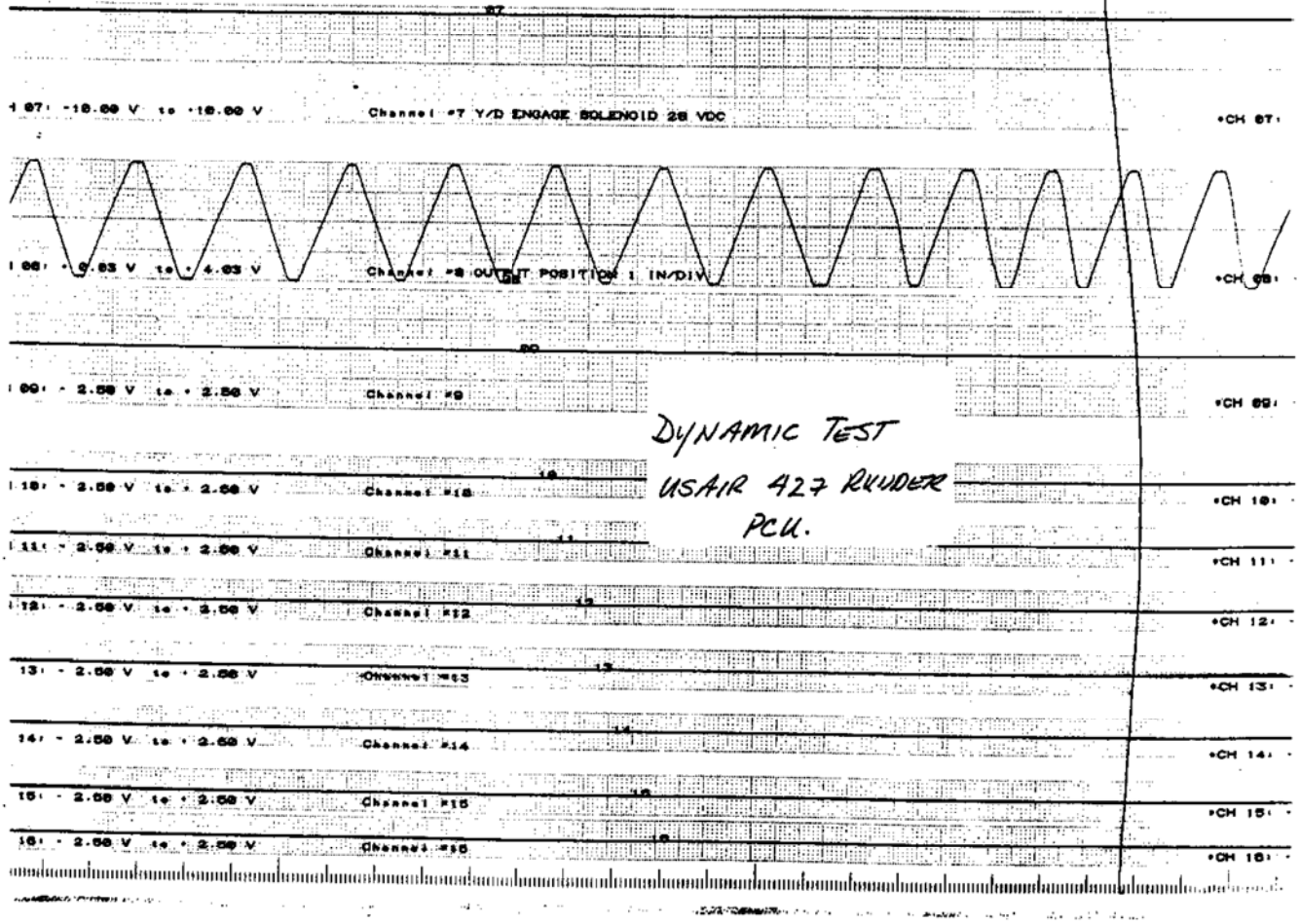
* DYNAMIC TEST
USAIR 427 RUDDER
PCU.



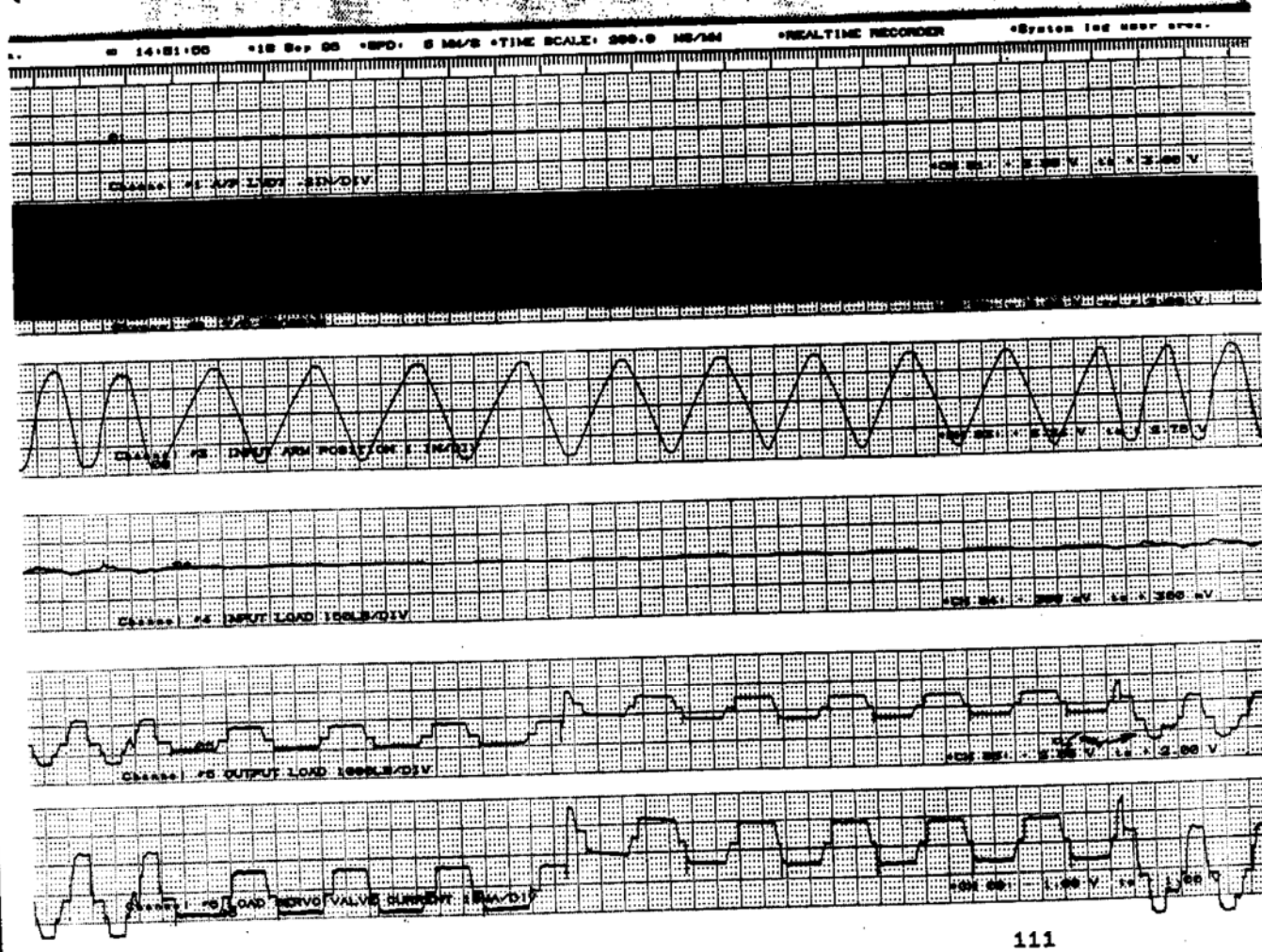
Astro-Med, inc. MT95K2 MULTI-TASK RECORDER

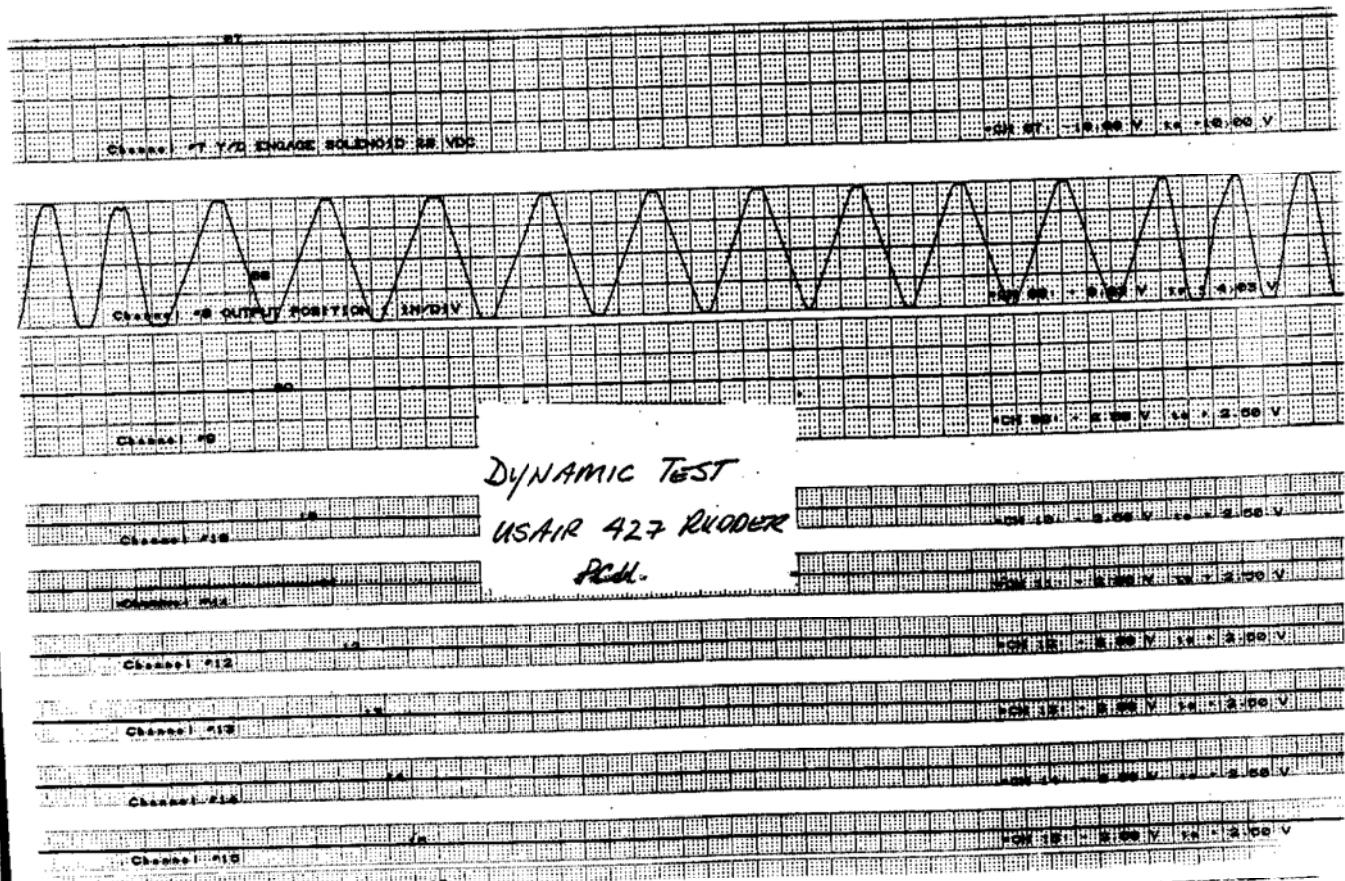
112

Cond 16

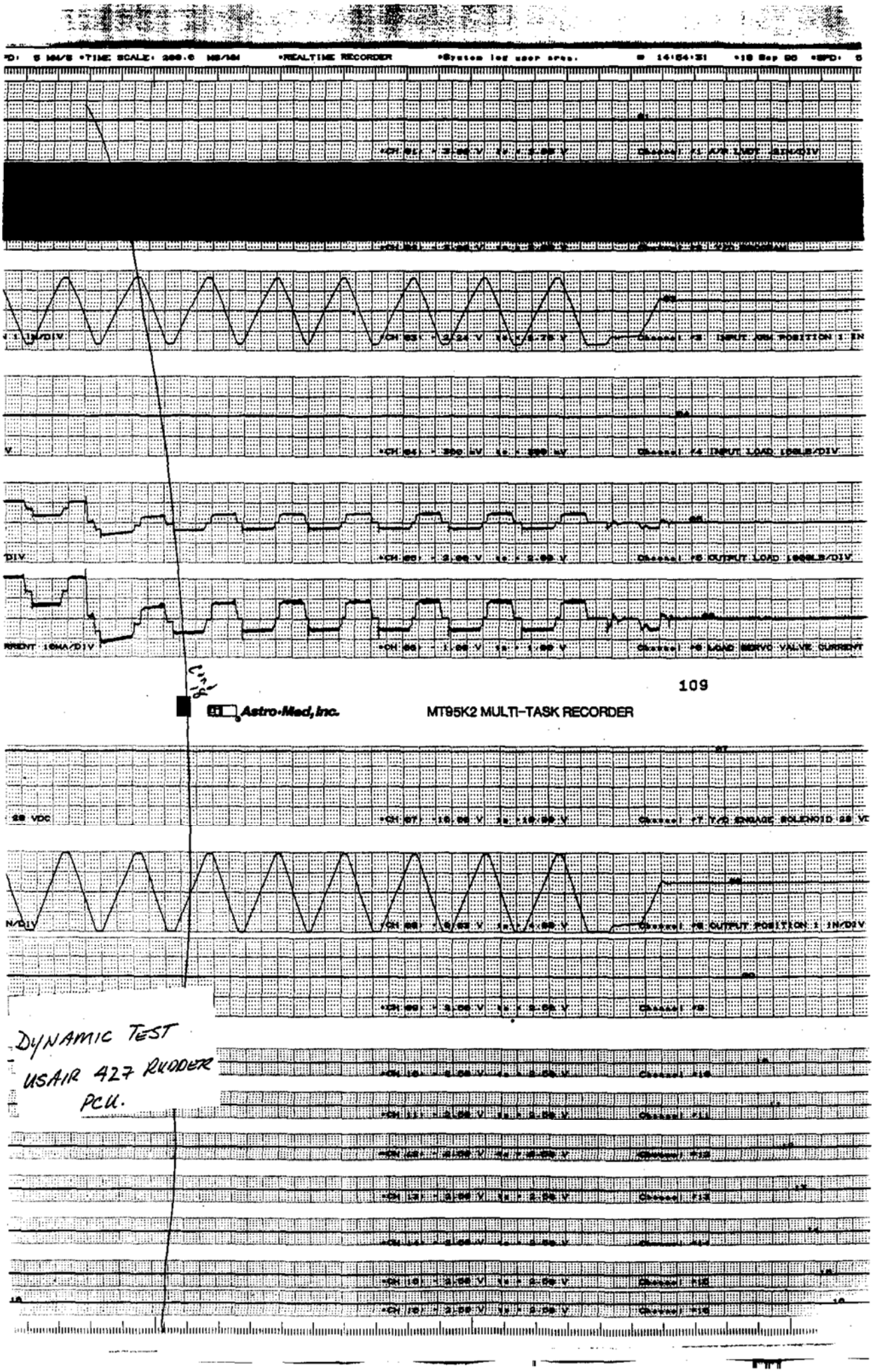


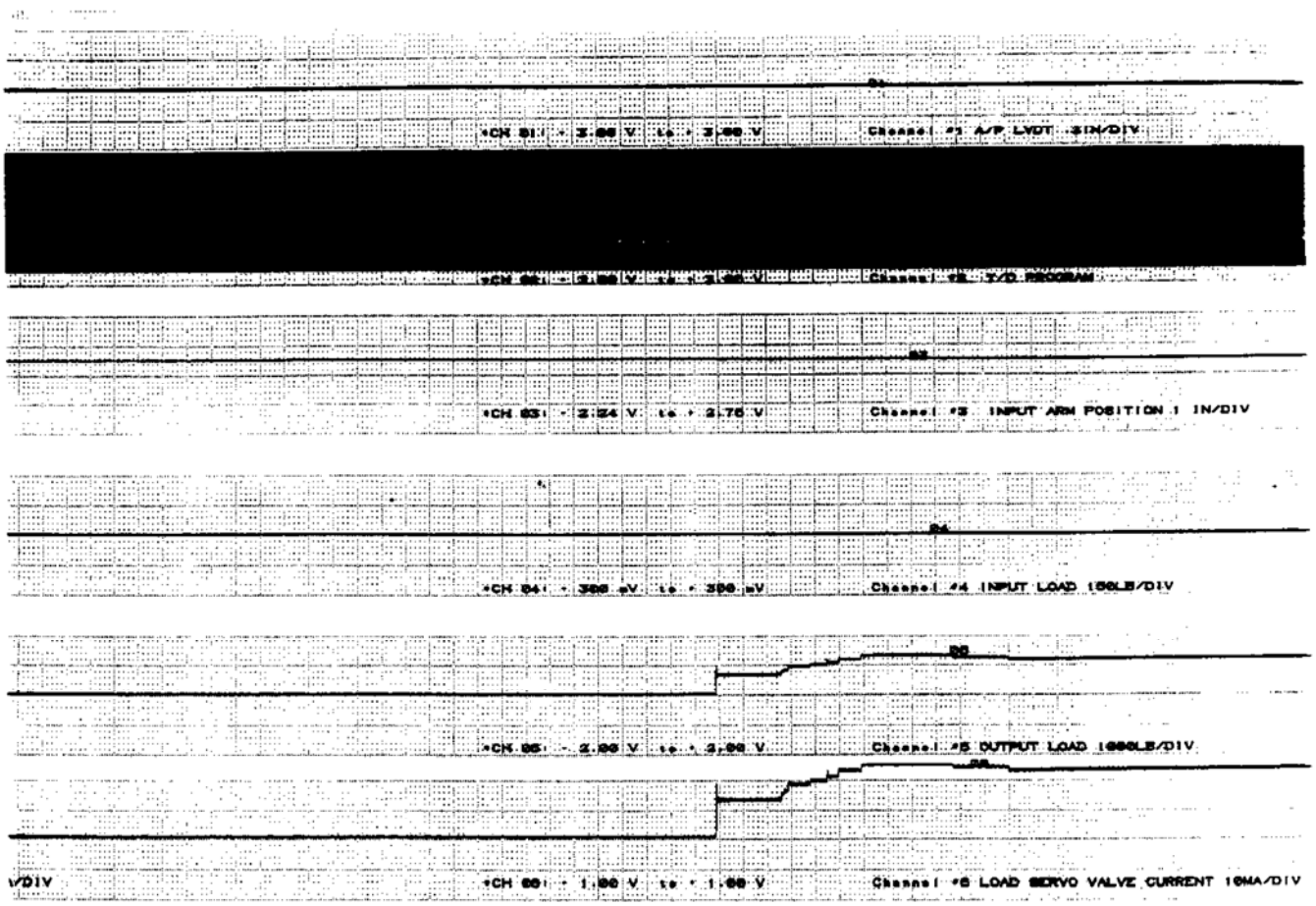
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

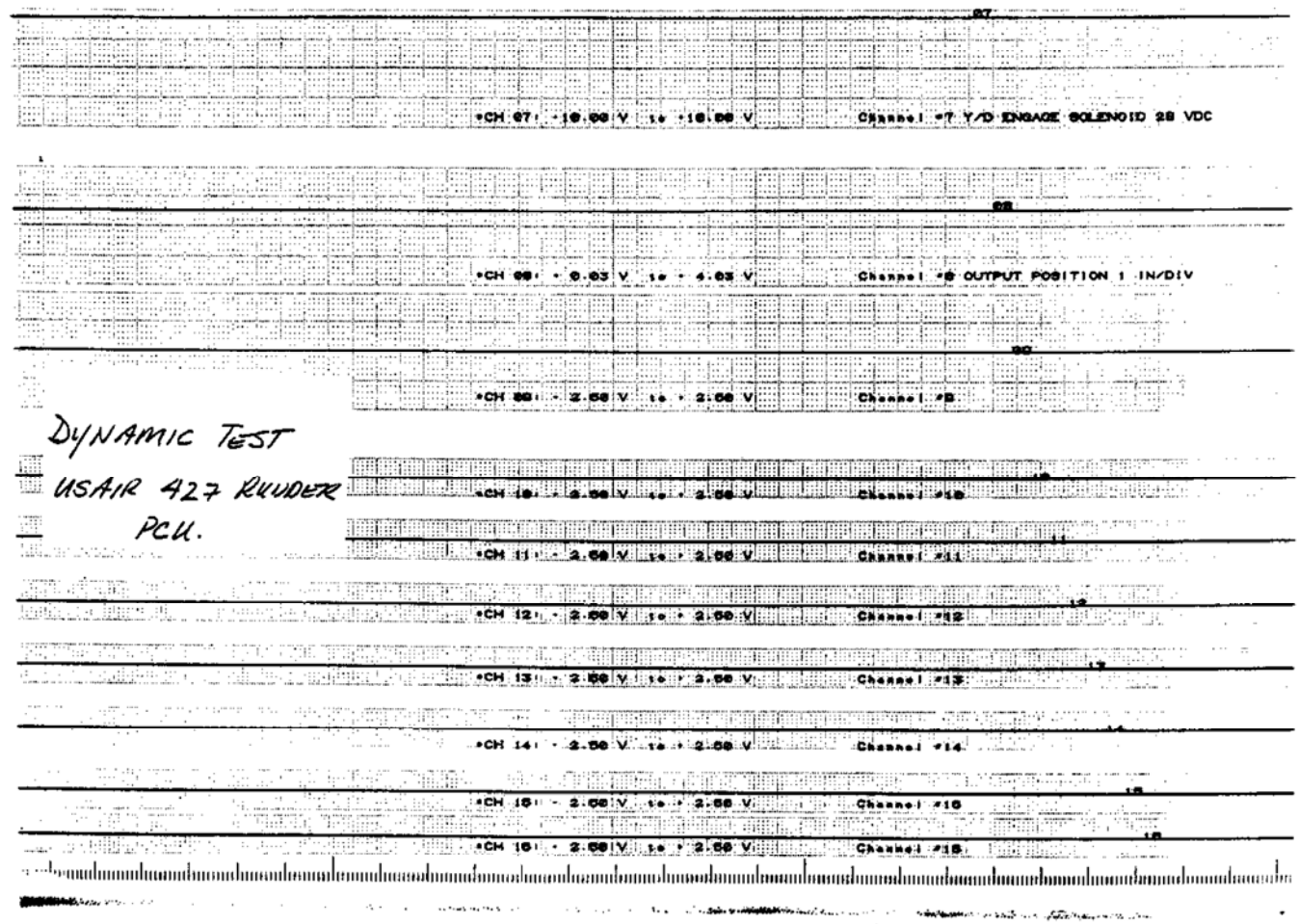




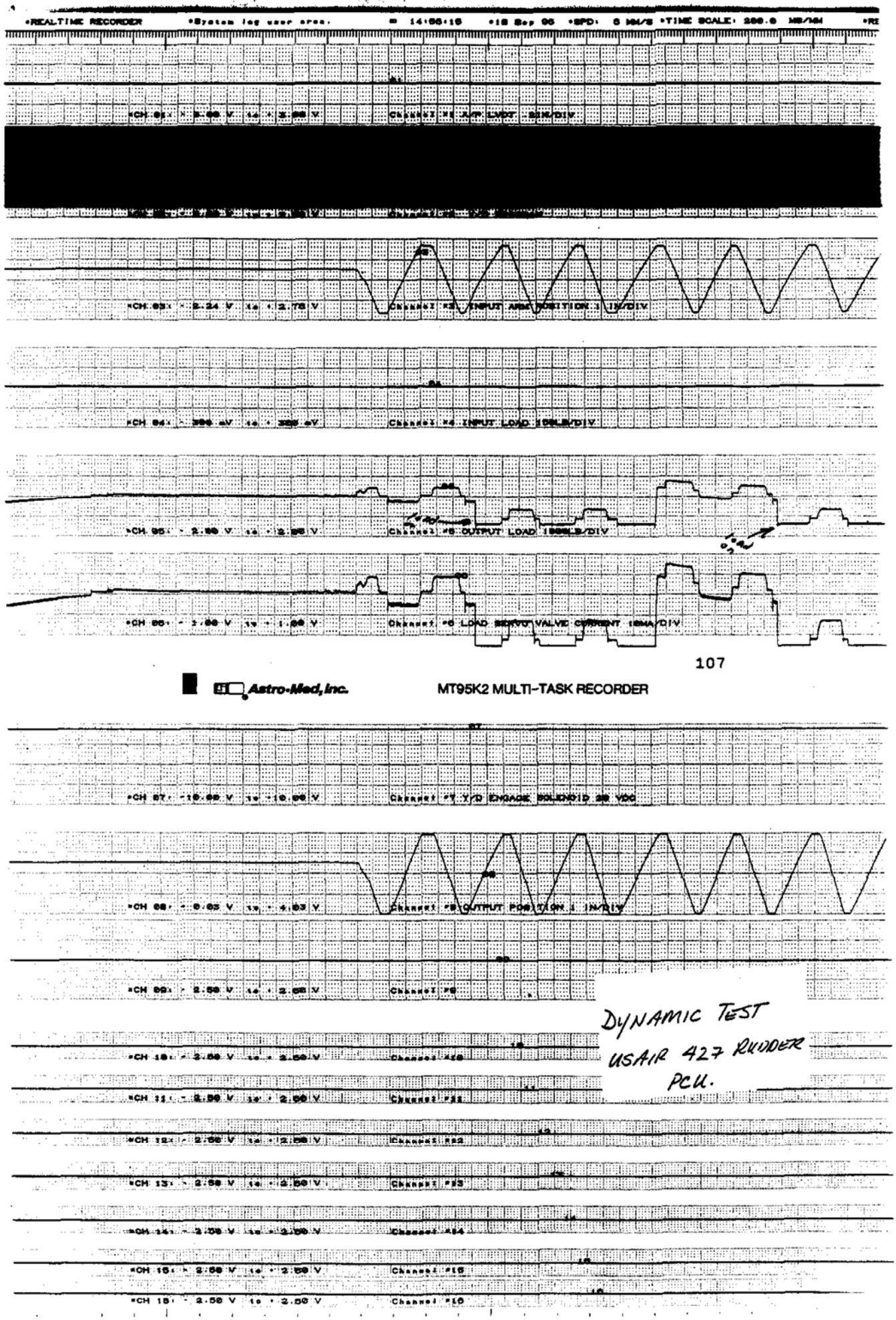
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

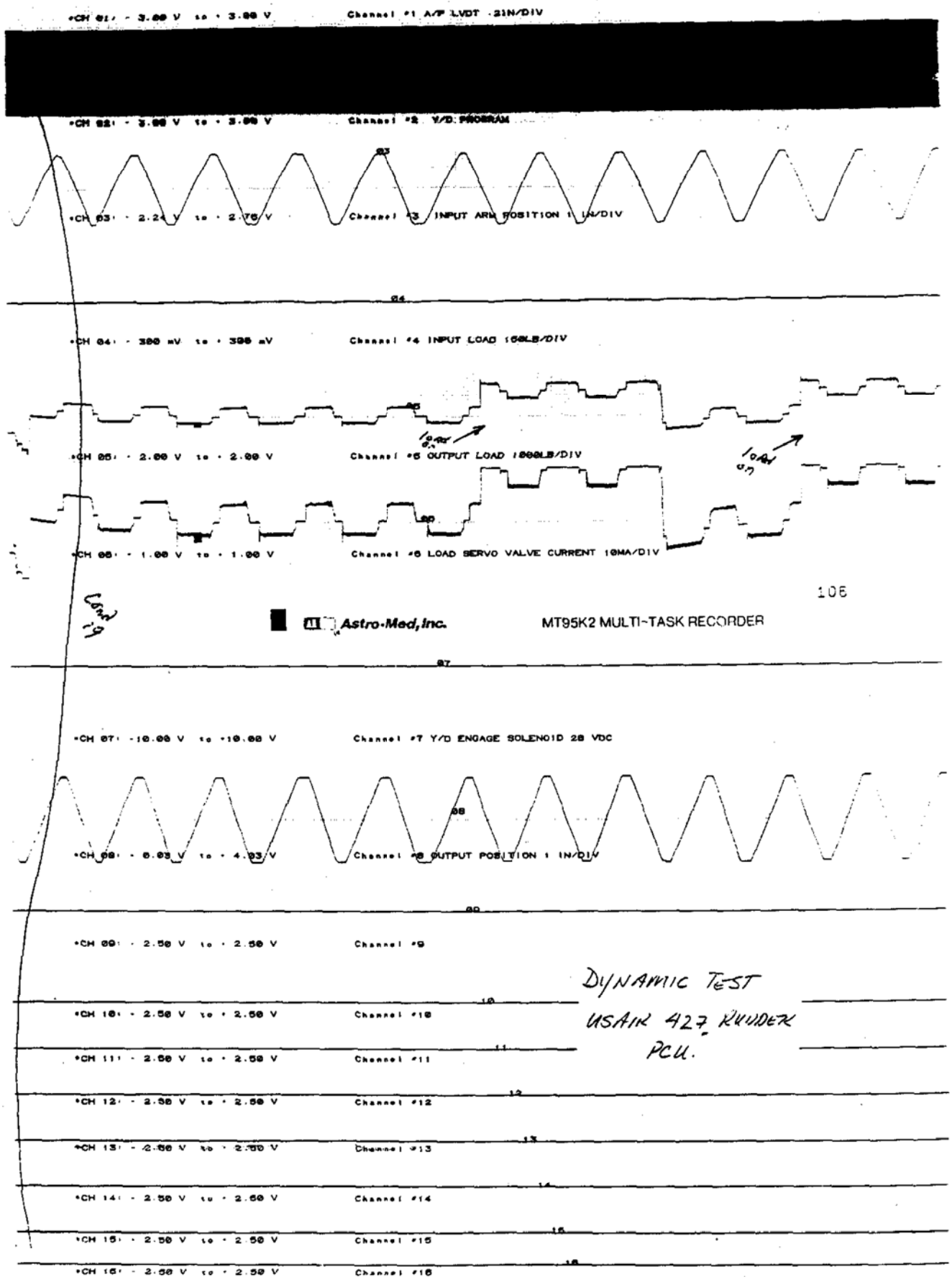

109
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
DYNAMIC TEST
USAIR 427 RUDDER
PCU.





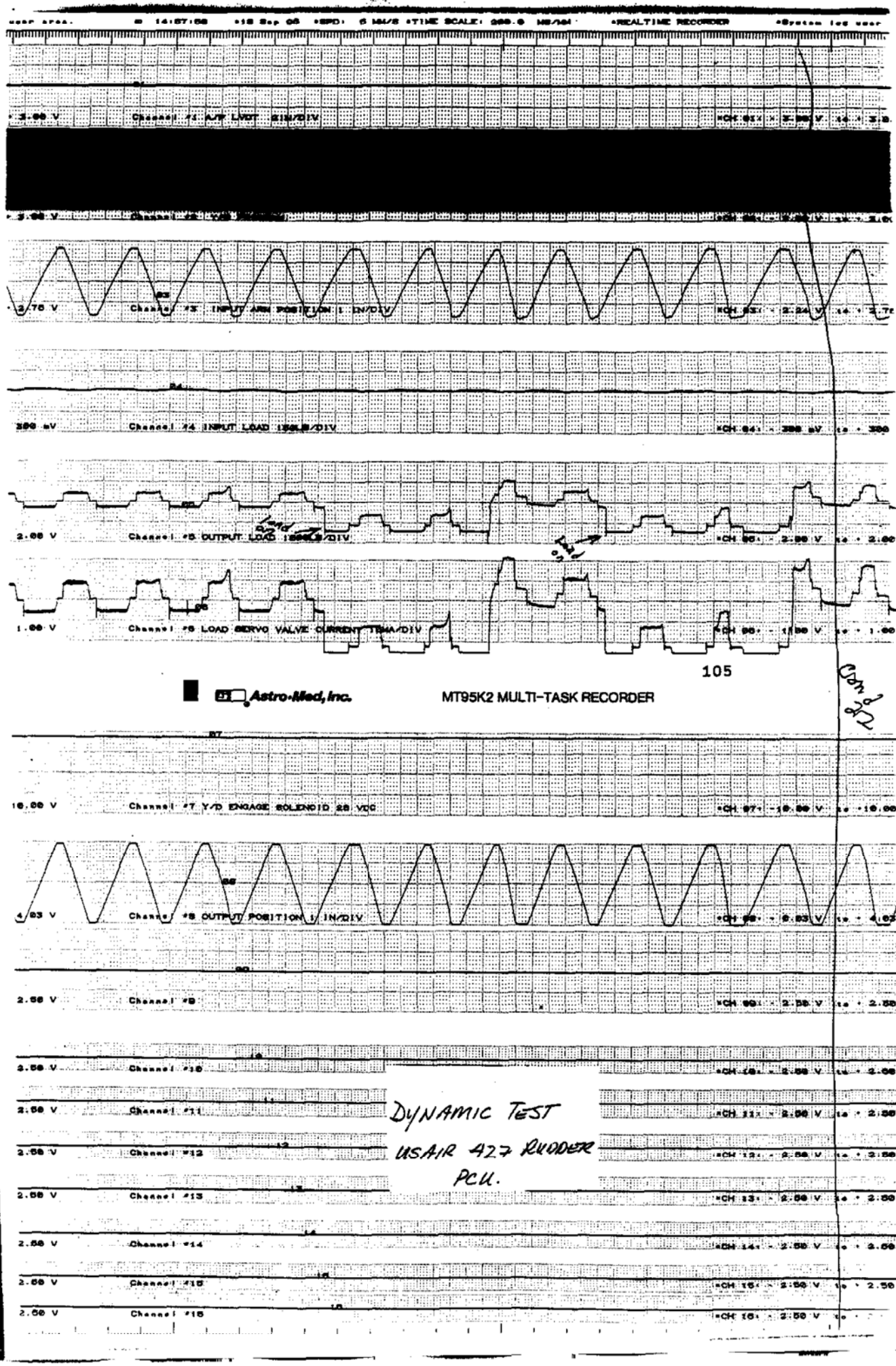
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

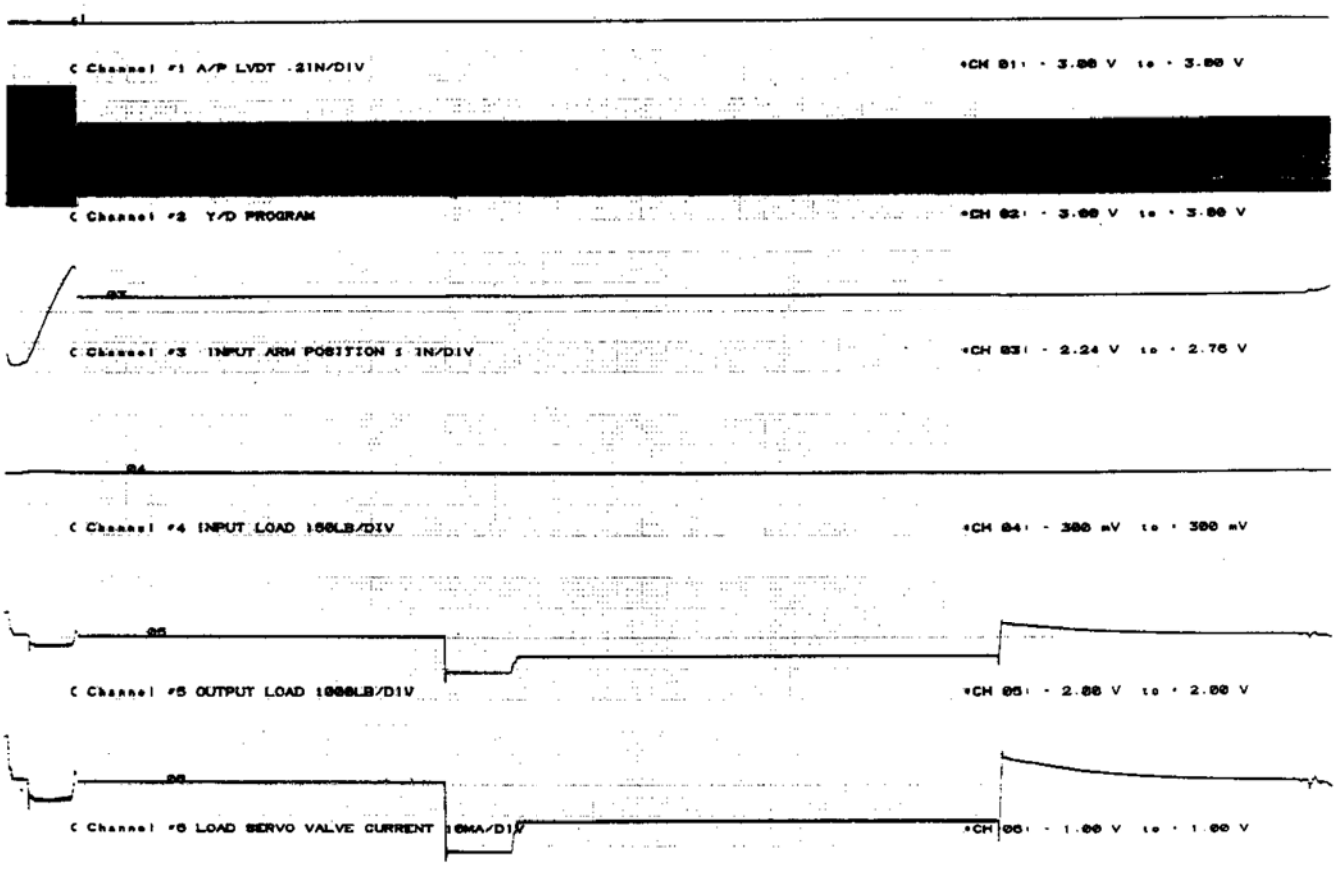

*REAL TIME RECORDER
*System log user area.
14:06:16
*18 Sep 96
*SPD: 5 MM/S
*TIME SCALE: 200.0 MS/MM
*CH 01: + 2.50 V to + 3.50 V
Channel #1 INPUT LVDT 50%/DIV
*CH 03: + 2.24 V to + 2.76 V
Channel #3 INPUT ARM POSITION 1 IN/DIV
*CH 04: + 300 mV to + 300 mV
Channel #4 INPUT LOAD 100LB/DIV
*CH 05: + 2.50 V to + 2.50 V
Channel #5 OUTPUT LOAD 100LB/DIV
*CH 06: + 1.00 V to + 1.00 V
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
107
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
*CH 07: +10.00 V to +10.00 V
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
*CH 08: + 0.03 V to + 4.03 V
Channel #8 OUTPUT POSITION 1 IN/DIV
*CH 09: + 2.50 V to + 2.50 V
Channel #9
*CH 10: + 2.50 V to + 2.50 V
Channel #10
*CH 11: + 2.50 V to + 2.50 V
Channel #11
*CH 12: + 2.50 V to + 2.50 V
Channel #12
*CH 13: + 2.50 V to + 2.50 V
Channel #13
*CH 14: + 2.50 V to + 2.50 V
Channel #14
*CH 15: + 2.50 V to + 2.50 V
Channel #15
*CH 16: + 2.50 V to + 2.50 V
Channel #16
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



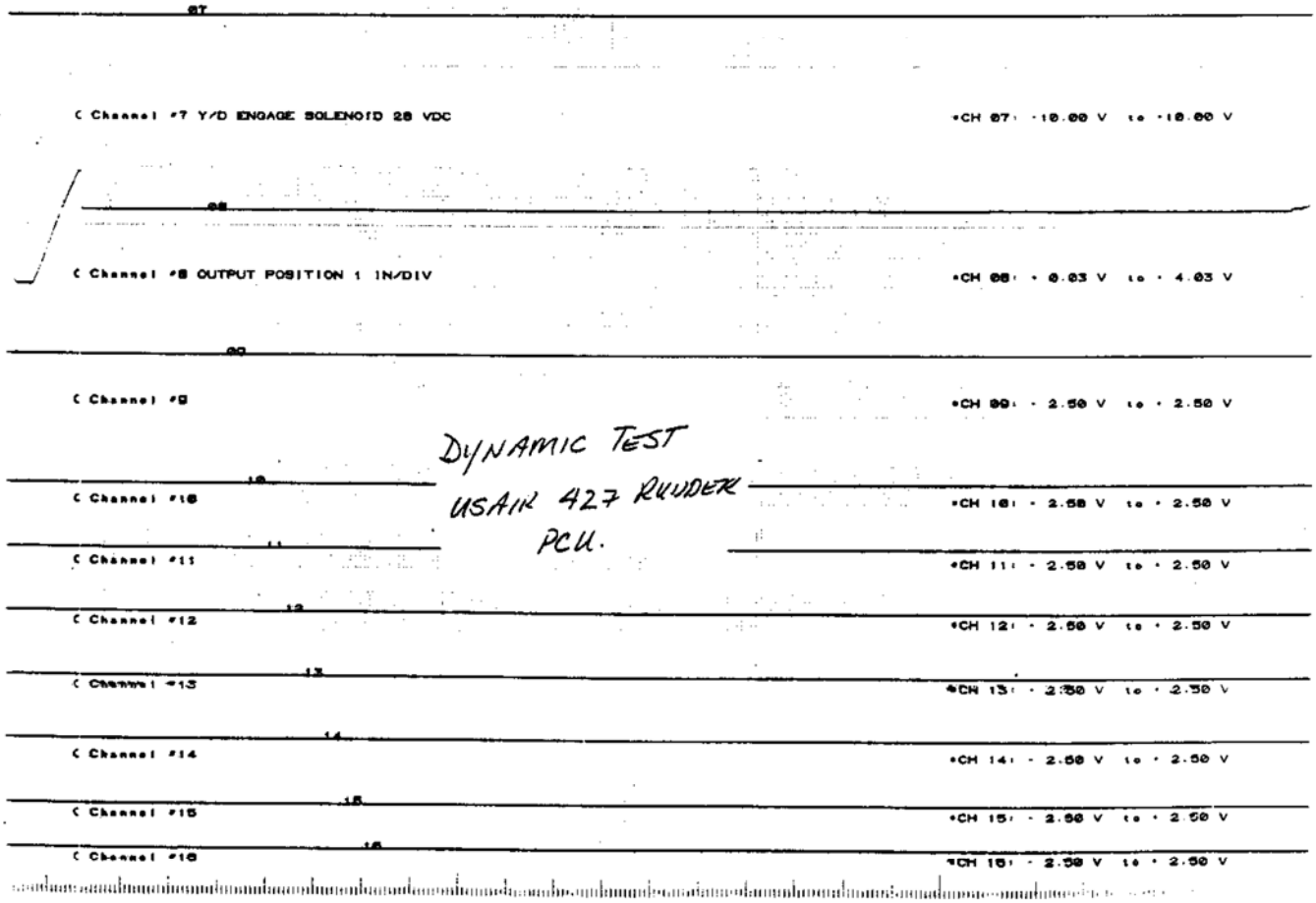
106

DYNAMIC TEST
USAIR 427 RUDDER
PCU.

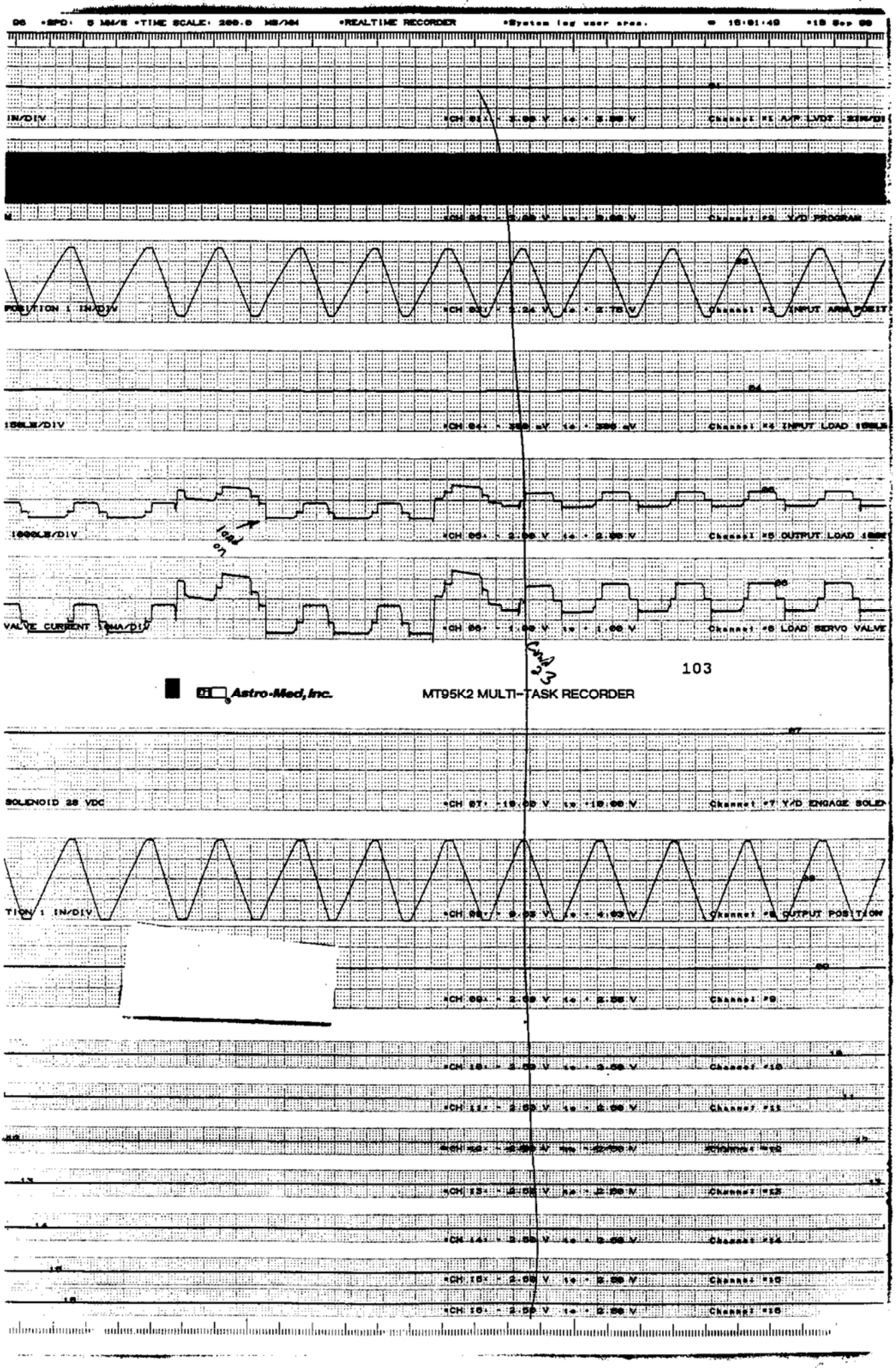

Channel #4 A/P LVDT
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #4 INPUT LOAD
Channel #5 OUTPUT LOAD
Channel #6 LOAD SERVO VALVE CURRENT
105
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #9
Channel #10
Channel #11
Channel #12
Channel #13
Channel #14
Channel #15
Channel #16
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

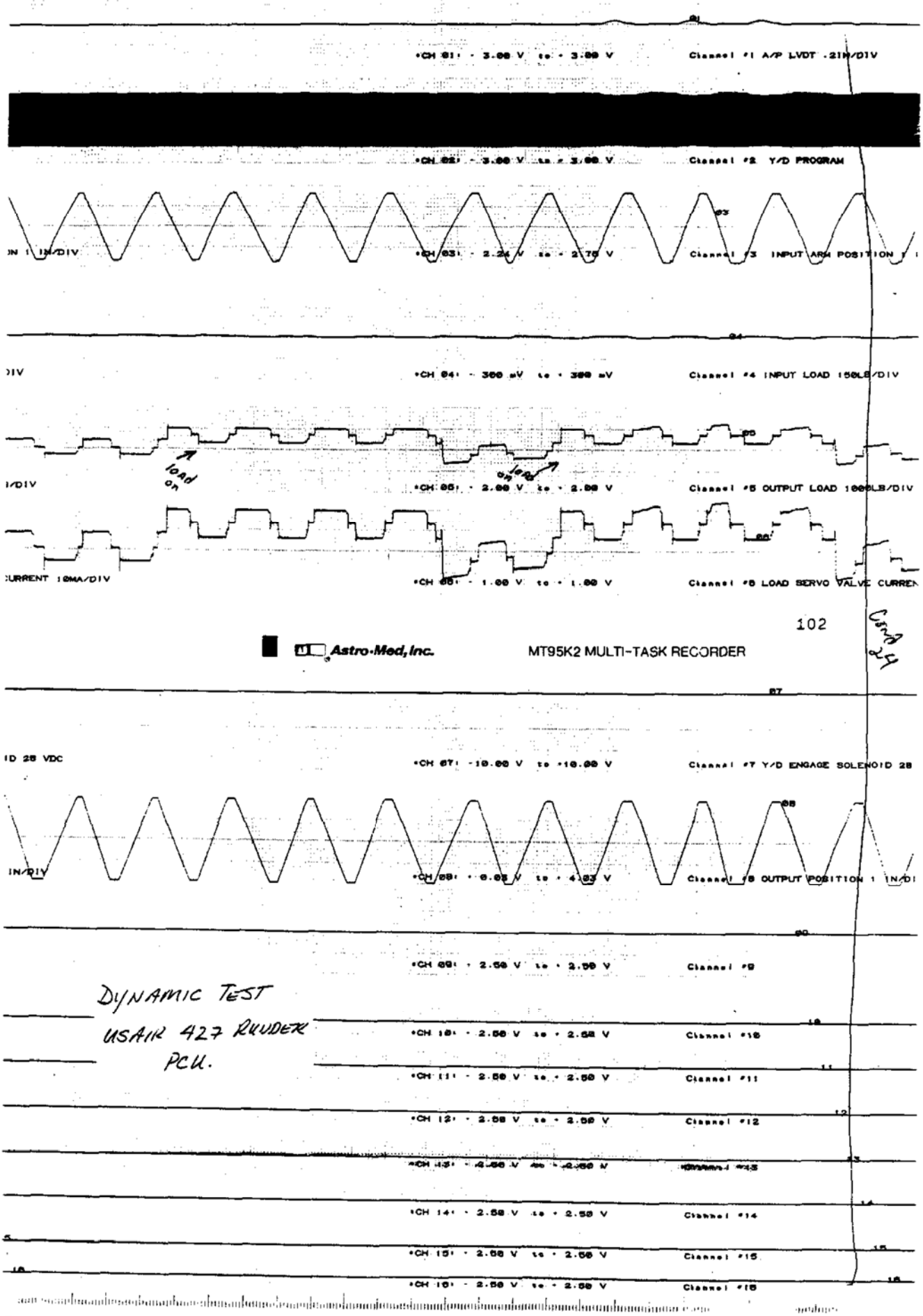


Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



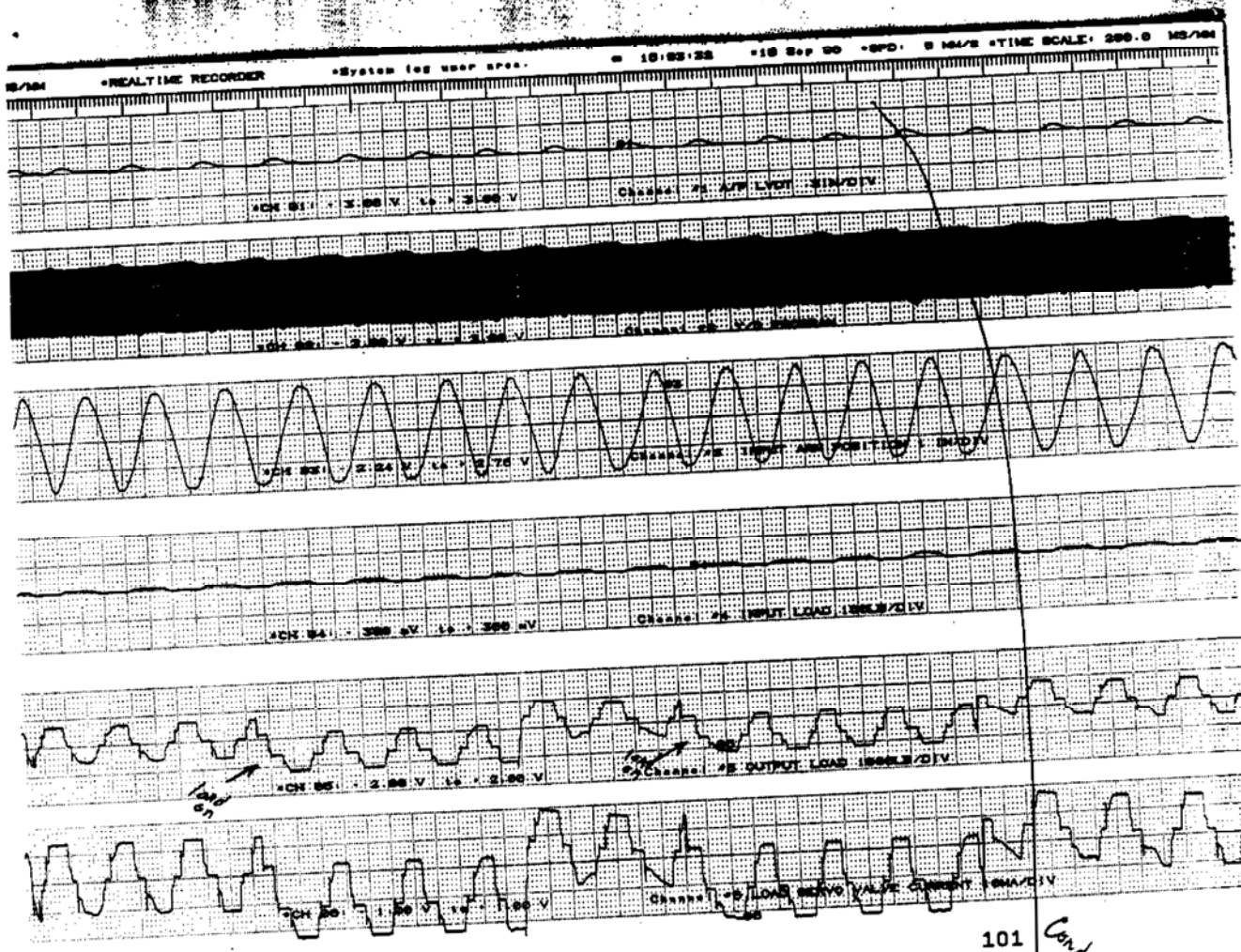
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

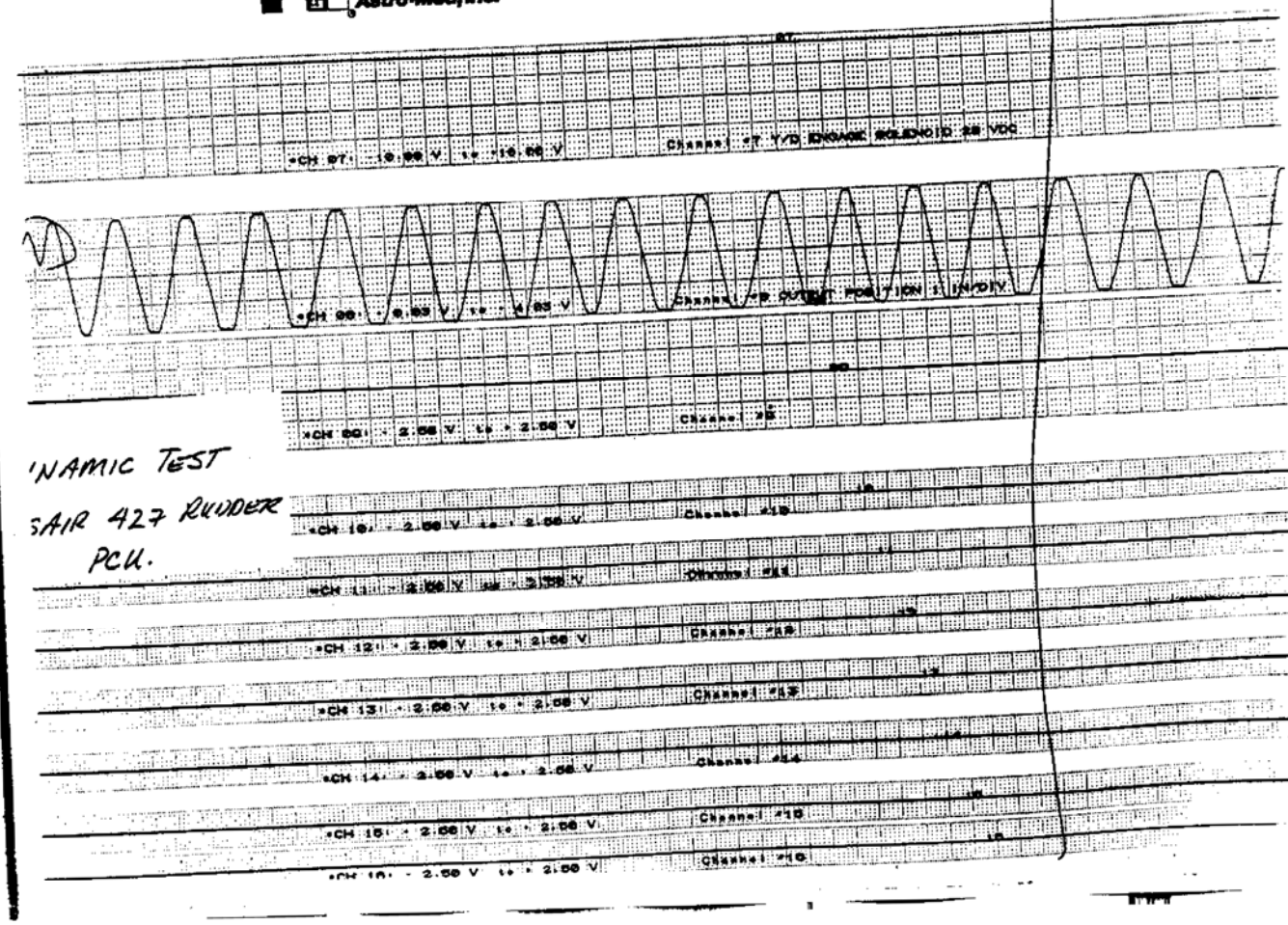

IN/DIV
Channel #1 A/P LVDT
Channel #2 V/D PROGRAM
POSITION 1 IN/DIV
Channel #3 INPUT ARM POSIT
Channel #4 INPUT LOAD
Channel #5 OUTPUT LOAD
load on
VALVE CURRENT
Channel #6 LOAD SERVO VALVE
103
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
SOLENOID 28 VDC
Channel #7 V/D ENGAGE SOLEN
TION 1 IN/DIV
Channel #8 OUTPUT POSITION
Channel #9
Channel #10
Channel #11
Channel #12
Channel #13
Channel #14
Channel #15
Channel #16



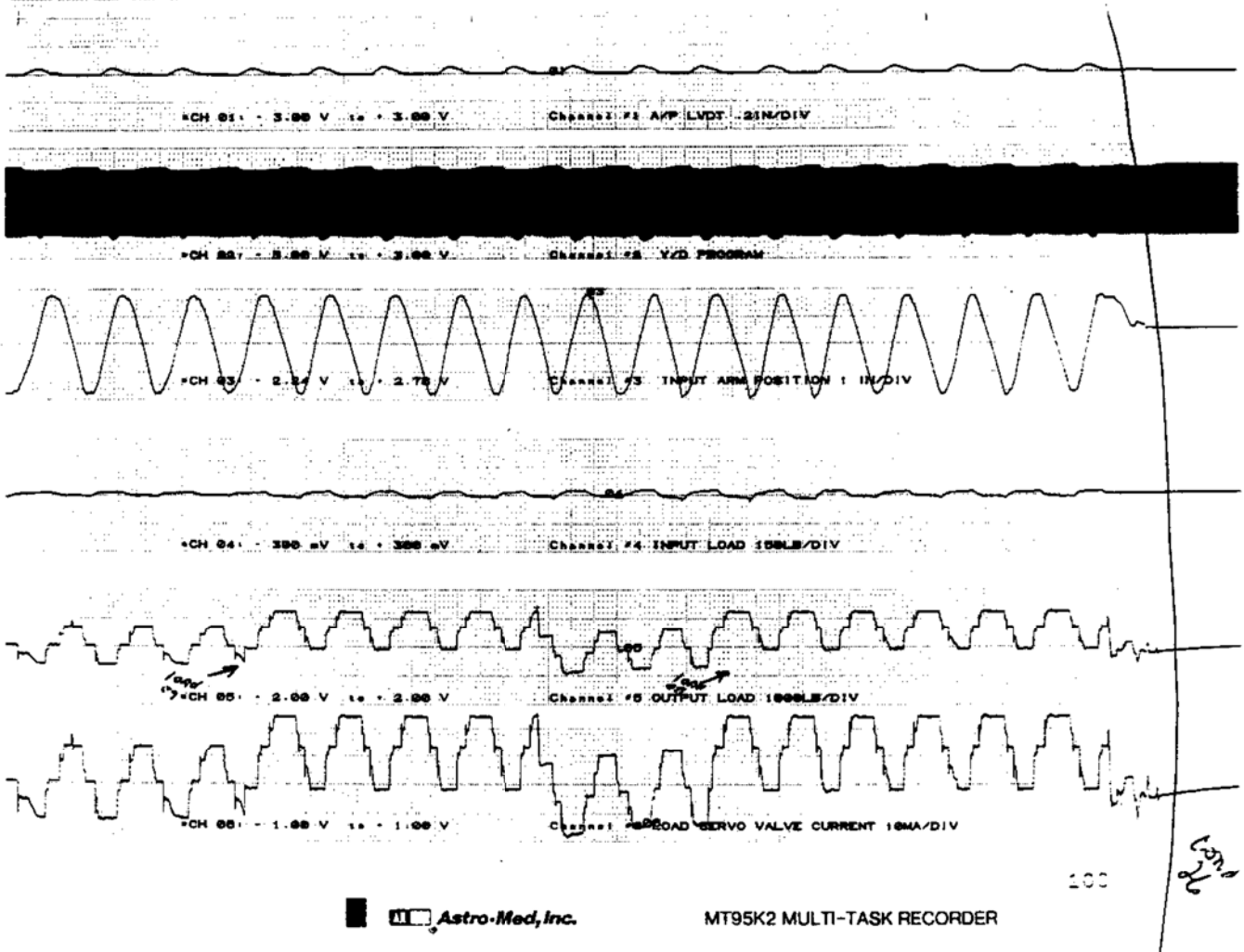
102

DYNAMIC TEST
USAIR 427 RUDDER
PCU.



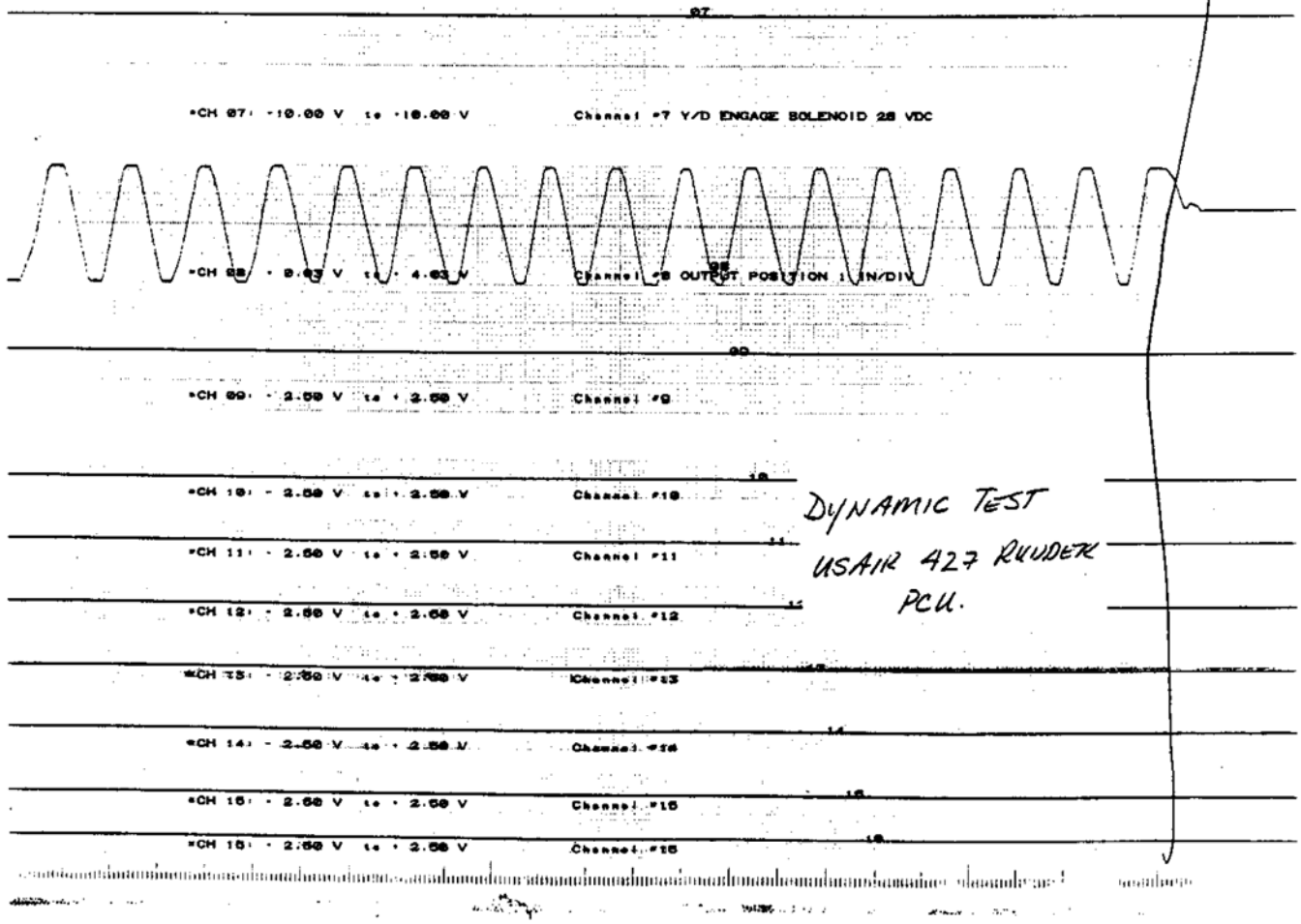


DYNAMIC TEST
SAIR 427 RUDDER
PCU.

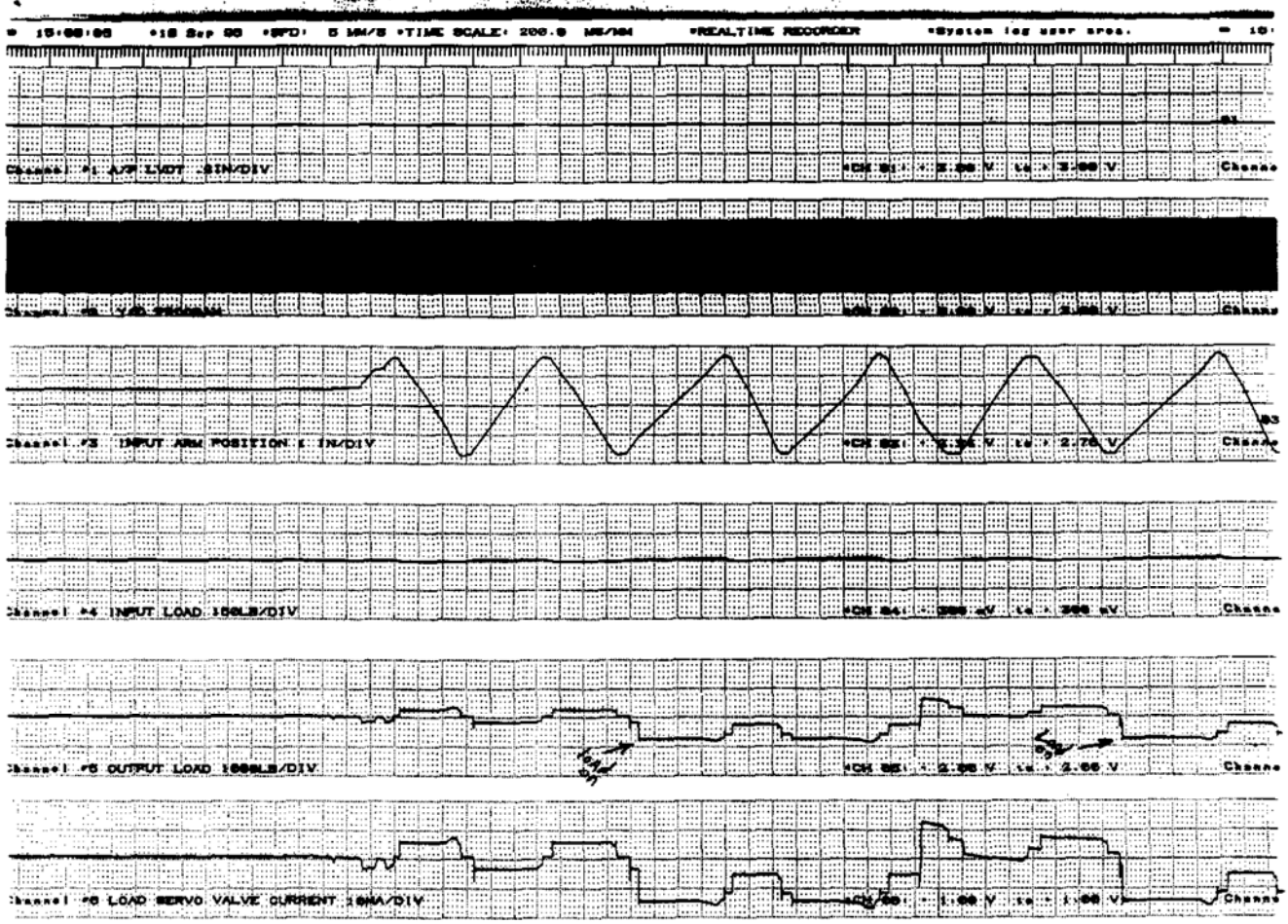


100

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER

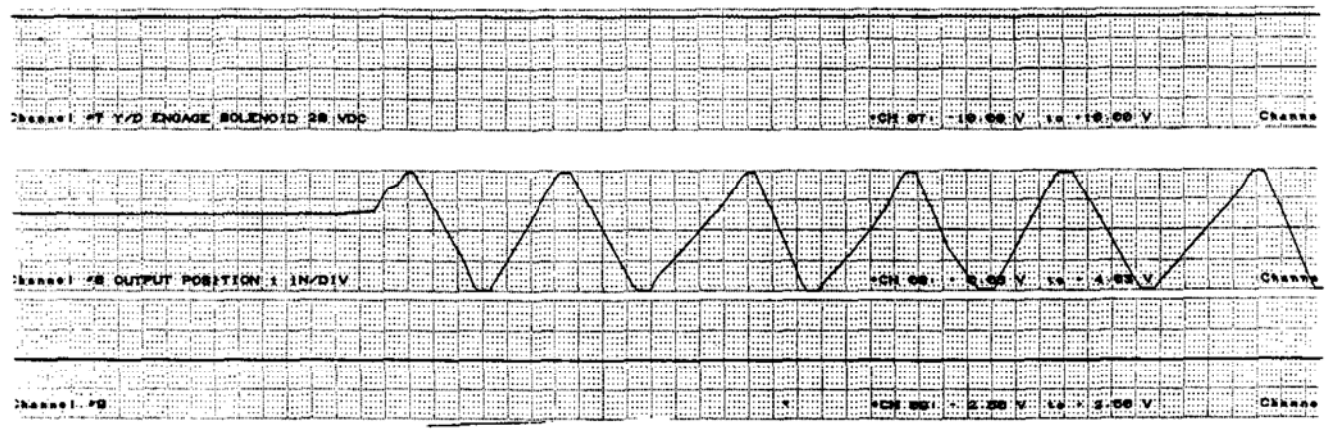


DYNAMIC TEST
USAIR 427 RUDDER
PCU.

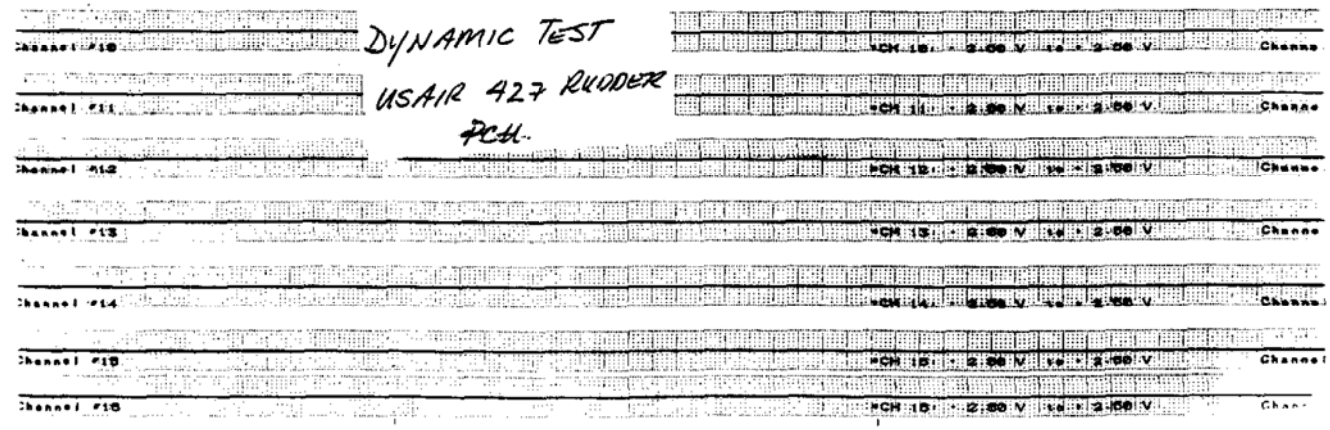


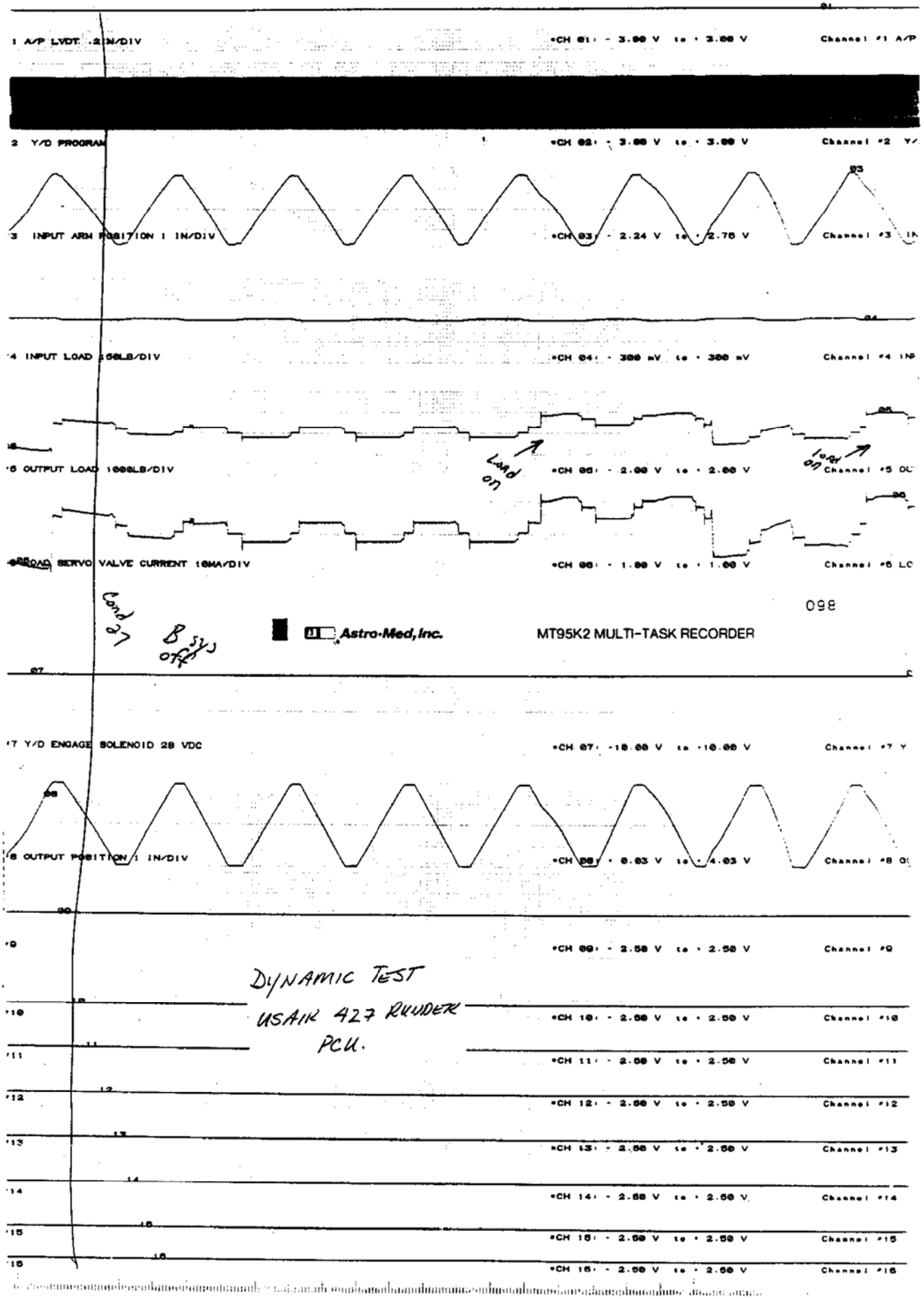
099

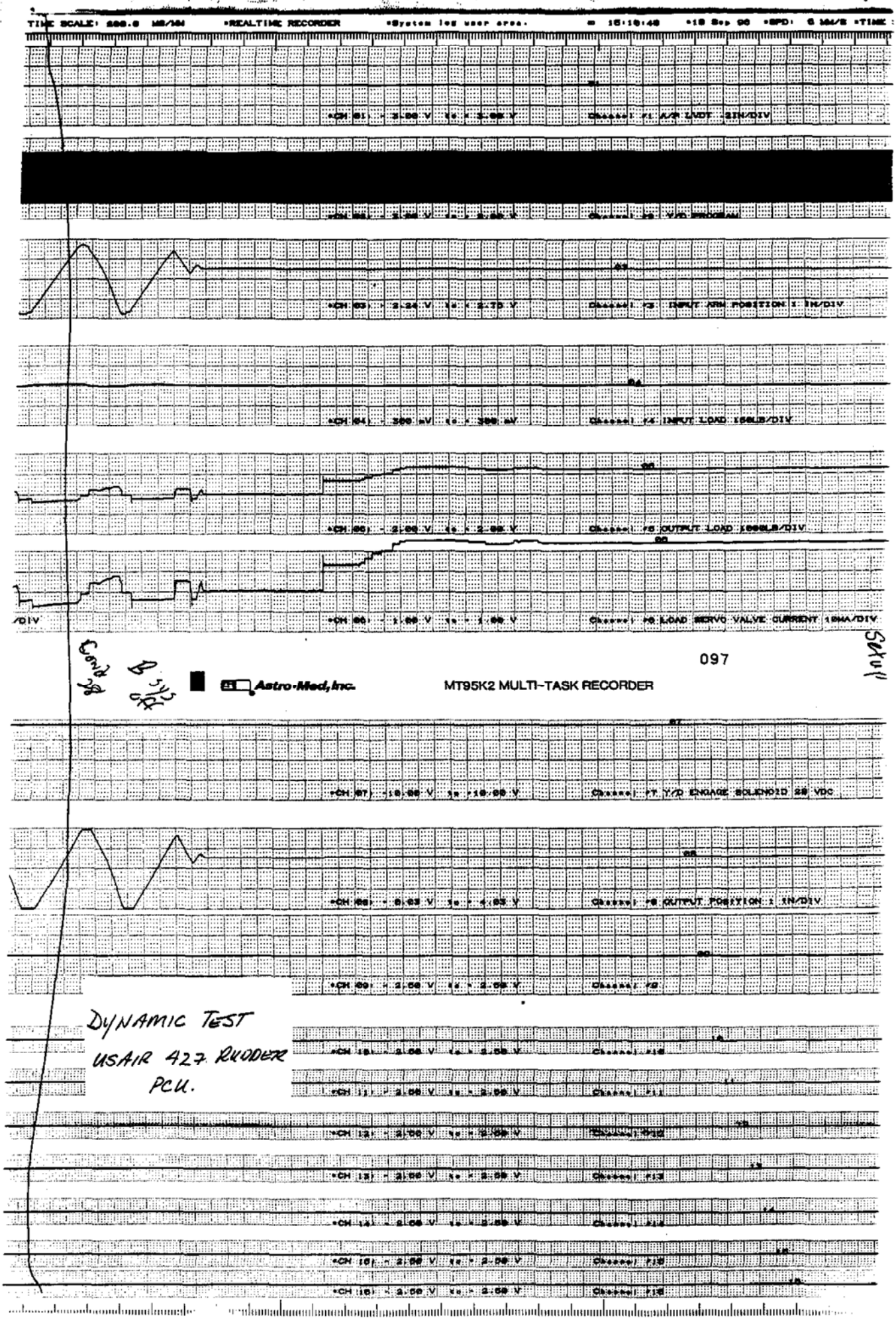
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



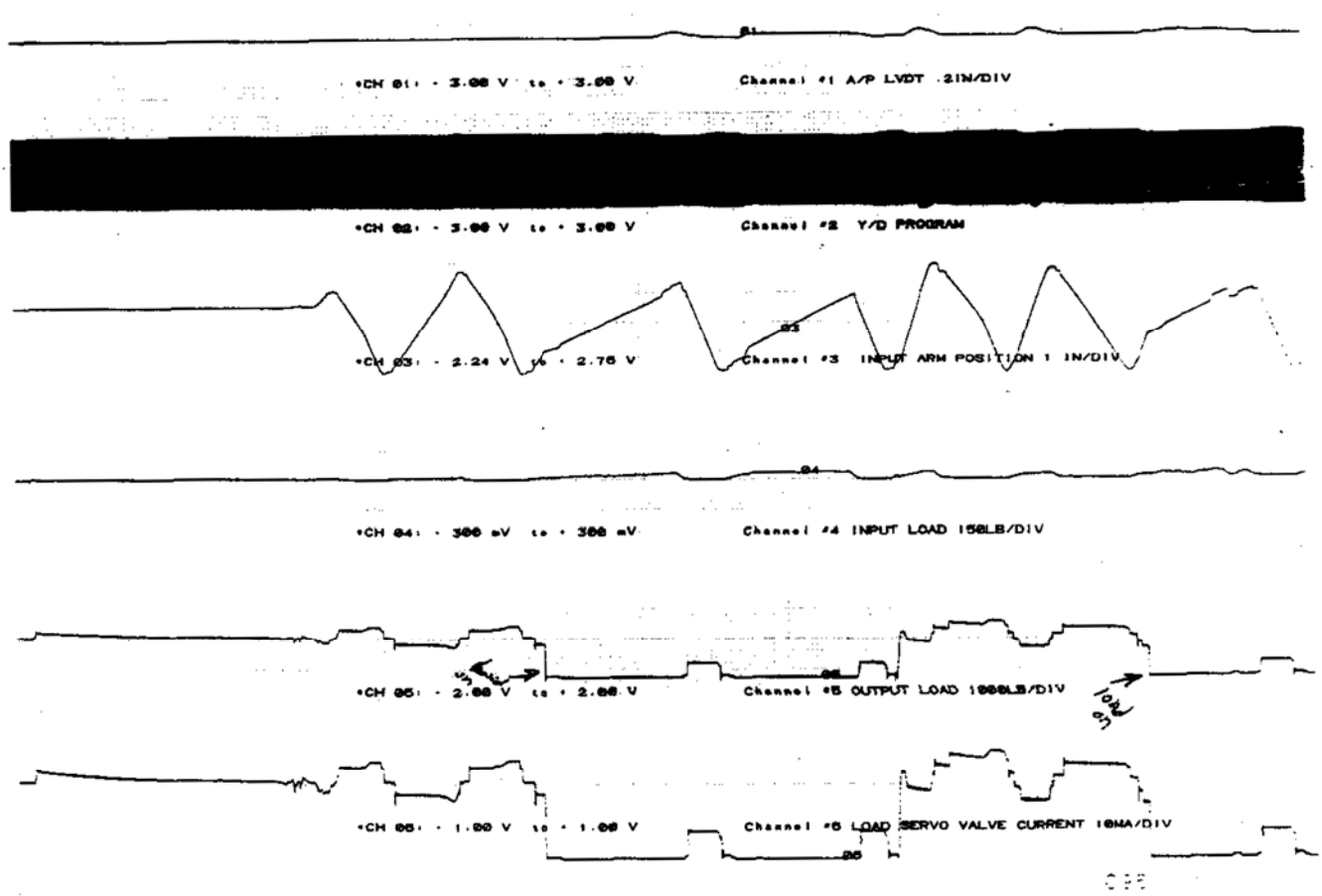
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



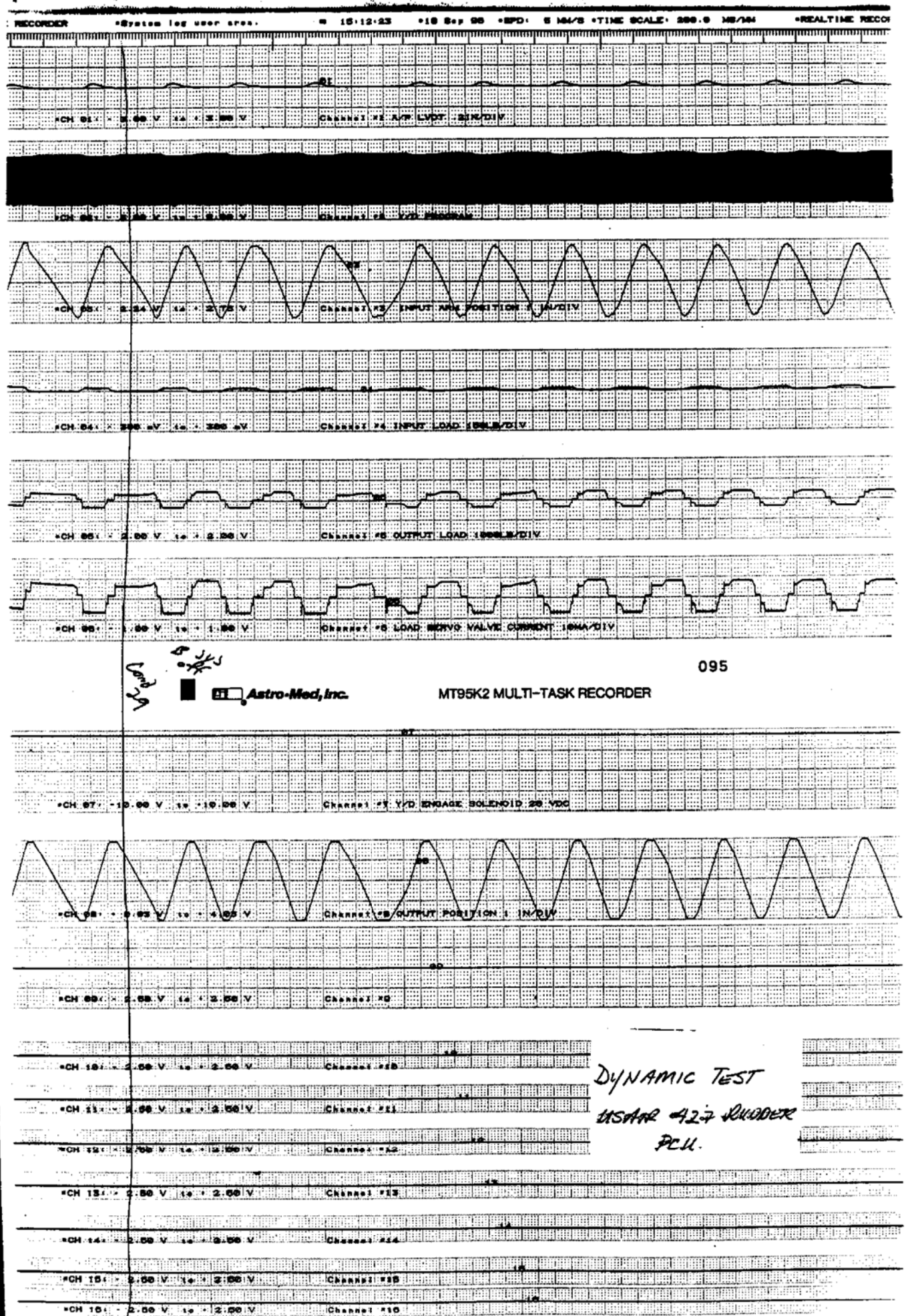

1 A/P LVDT .2IN/DIV
•CH 01: - 3.00 V to + 3.00 V
Channel #1 A/P
2 Y/D PROGRAM
•CH 02: - 3.00 V to + 3.00 V
Channel #2 Y/
3 INPUT ARM POSITION 1 IN/DIV
•CH 03: - 2.24 V to + 2.76 V
Channel #3
4 INPUT LOAD 100LB/DIV
•CH 04: - 300 mV to + 300 mV
Channel #4 IN
5 OUTPUT LOAD 1000LB/DIV
Load on
Load off
•CH 05: - 2.00 V to + 2.00 V
Channel #5 OU
6 LOAD SERVO VALVE CURRENT 10MA/DIV
•CH 06: - 1.00 V to + 1.00 V
Channel #6 LO
Load on
B 52's off
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
860
7 Y/D ENGAGE SOLENOID 28 VDC
•CH 07: -10.00 V to +10.00 V
Channel #7 Y
8 OUTPUT POSITION 1 IN/DIV
•CH 08: + 0.03 V to + 4.03 V
Channel #8 O
9
•CH 09: - 2.50 V to + 2.50 V
Channel #9
DYNAMIC TEST
USAIR 427 RUDDER
PCU.
10
•CH 10: - 2.50 V to + 2.50 V
Channel #10
11
•CH 11: - 2.50 V to + 2.50 V
Channel #11
12
•CH 12: - 2.50 V to + 2.50 V
Channel #12
13
•CH 13: - 2.50 V to + 2.50 V
Channel #13
14
•CH 14: - 2.50 V to + 2.50 V
Channel #14
15
•CH 15: - 2.50 V to + 2.50 V
Channel #15
16
•CH 16: - 2.50 V to + 2.50 V
Channel #16



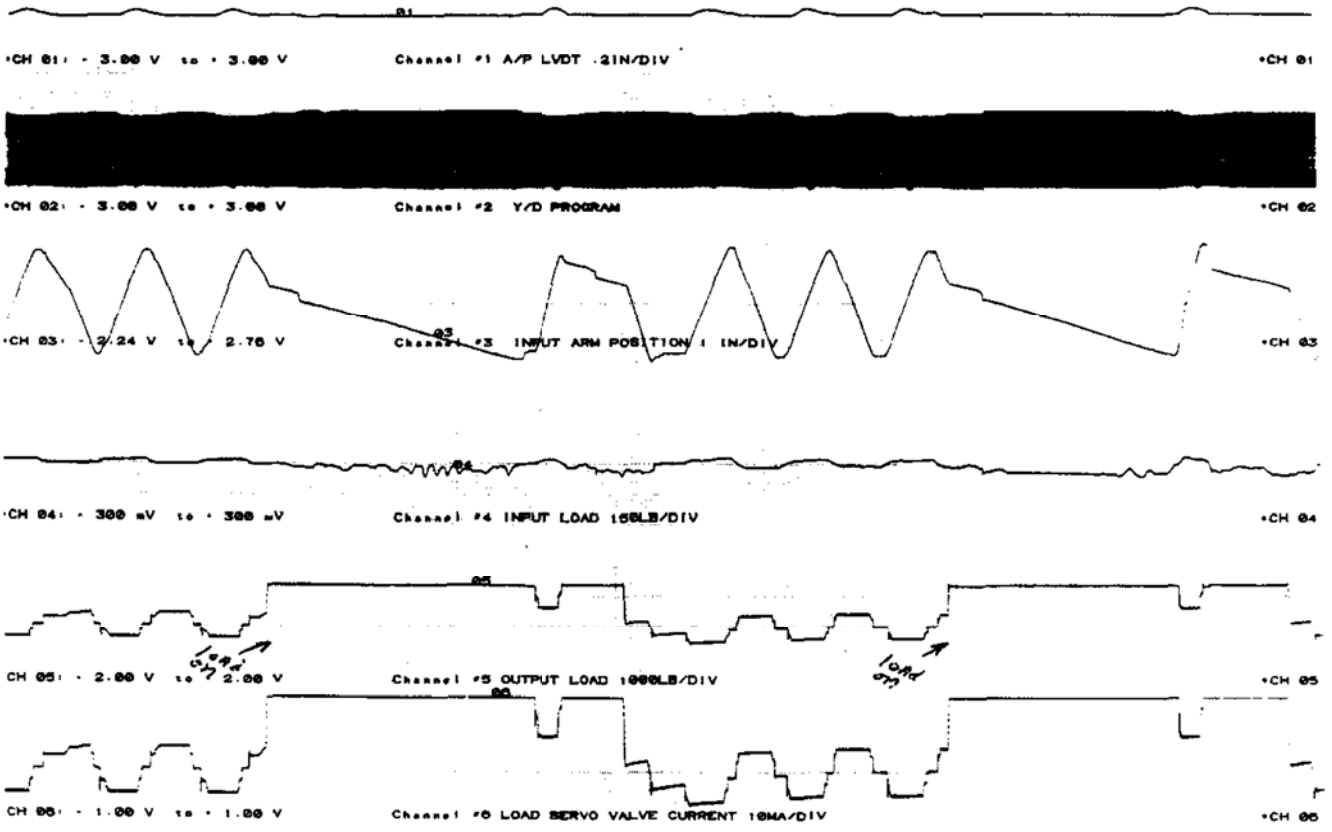
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



DYNAMIC TEST
USAIR 427 RUDDER
PCU.

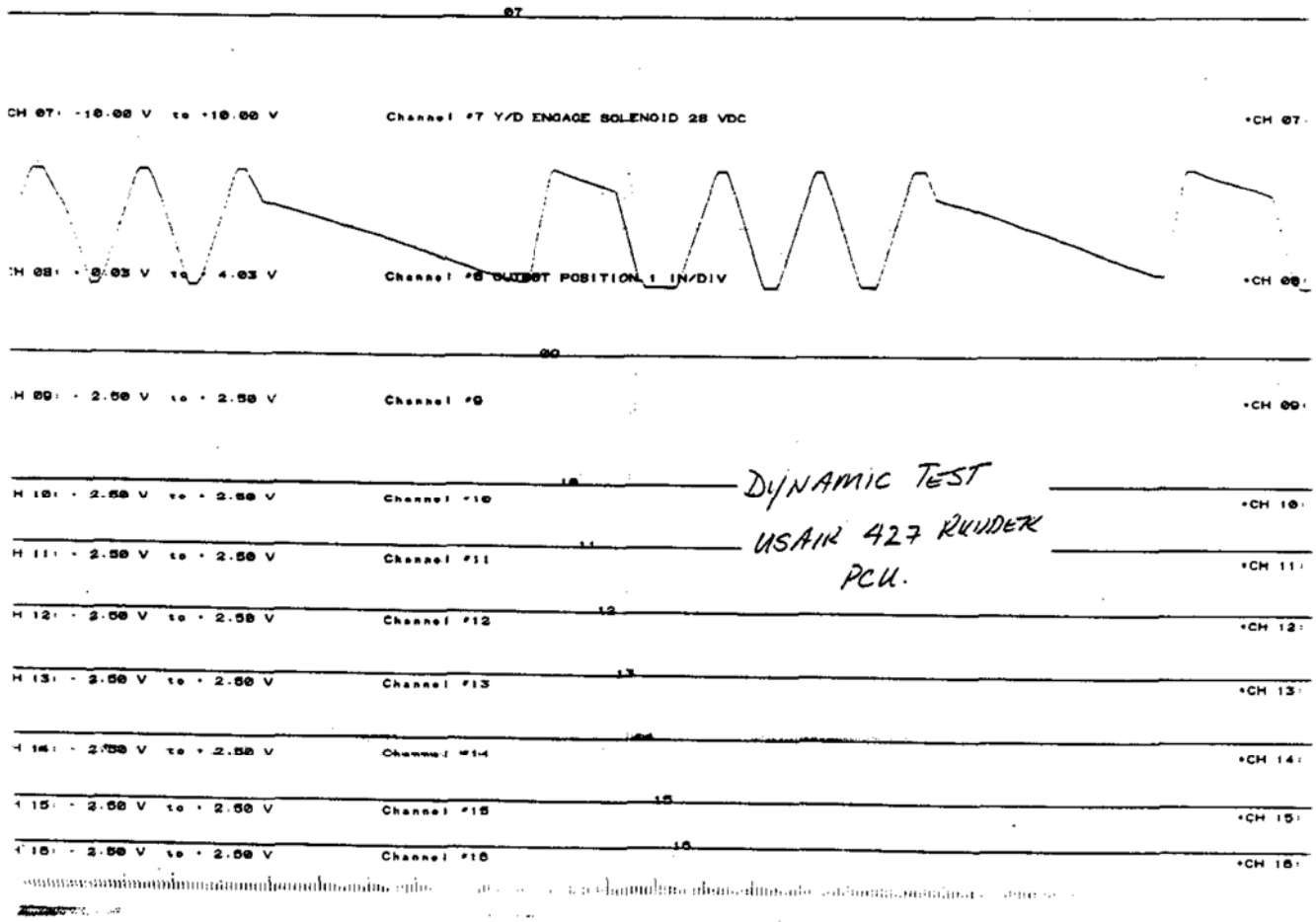


DYNAMIC TEST
USAAR #427 RECORDER
PCU.

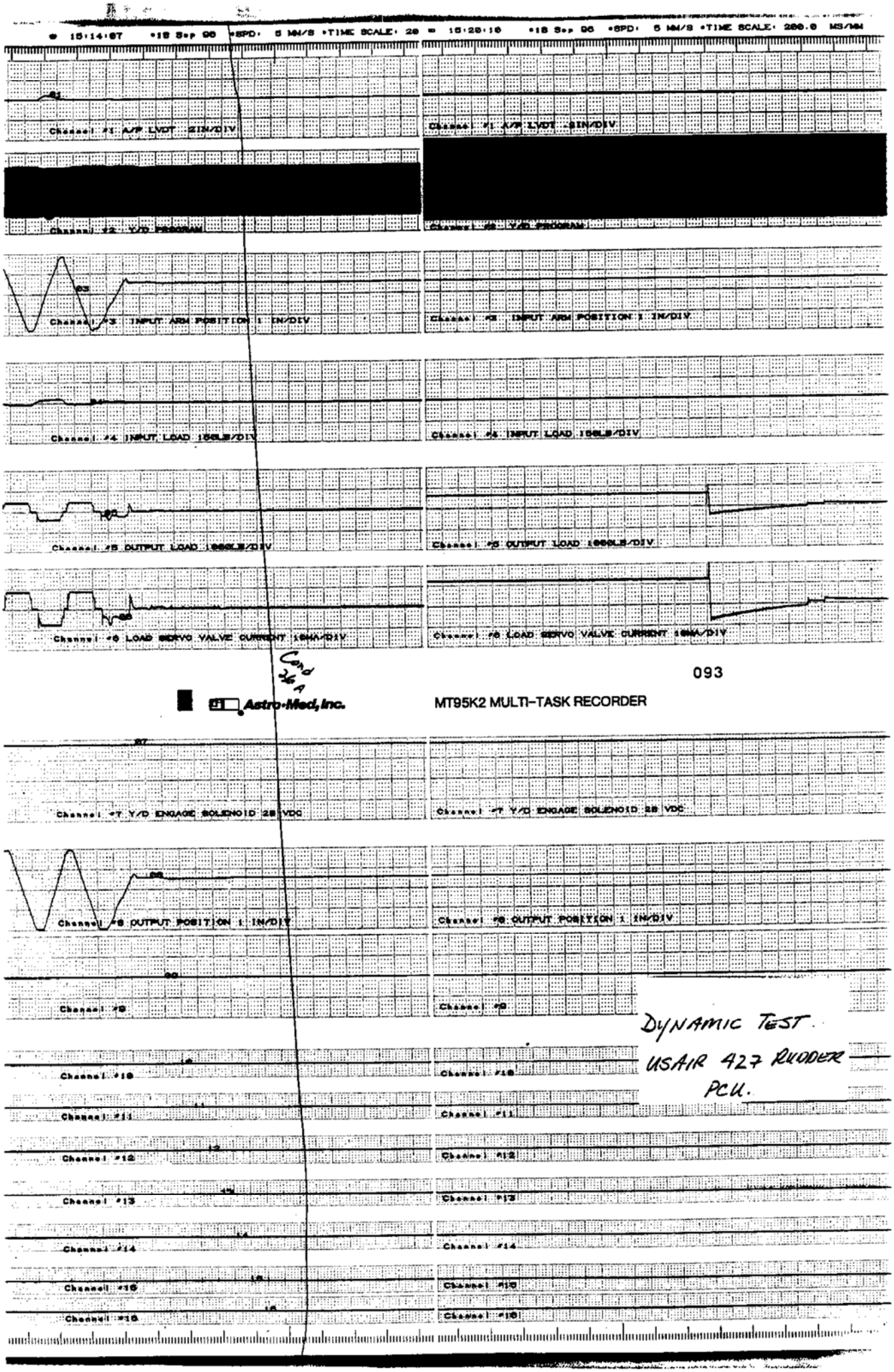


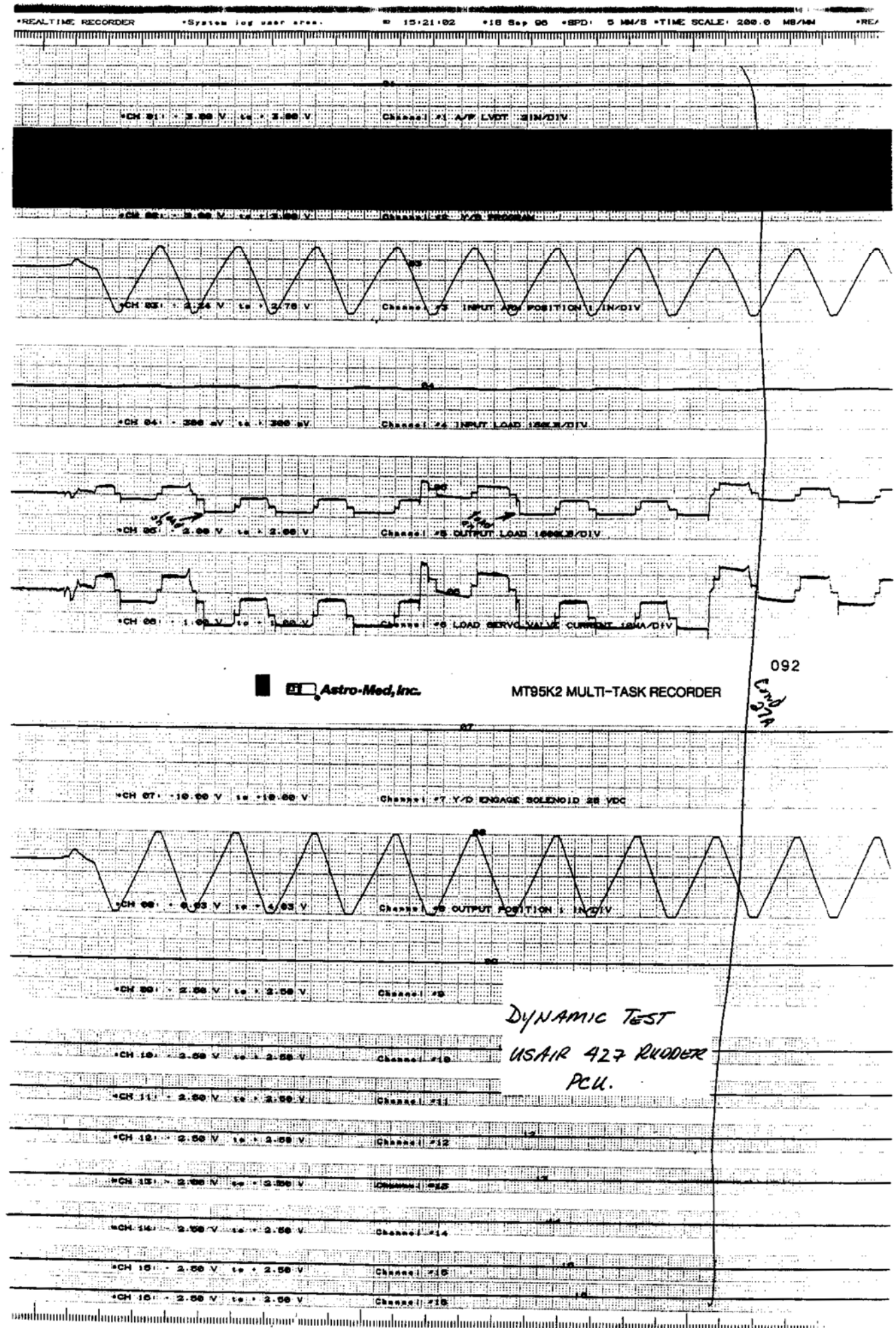
094

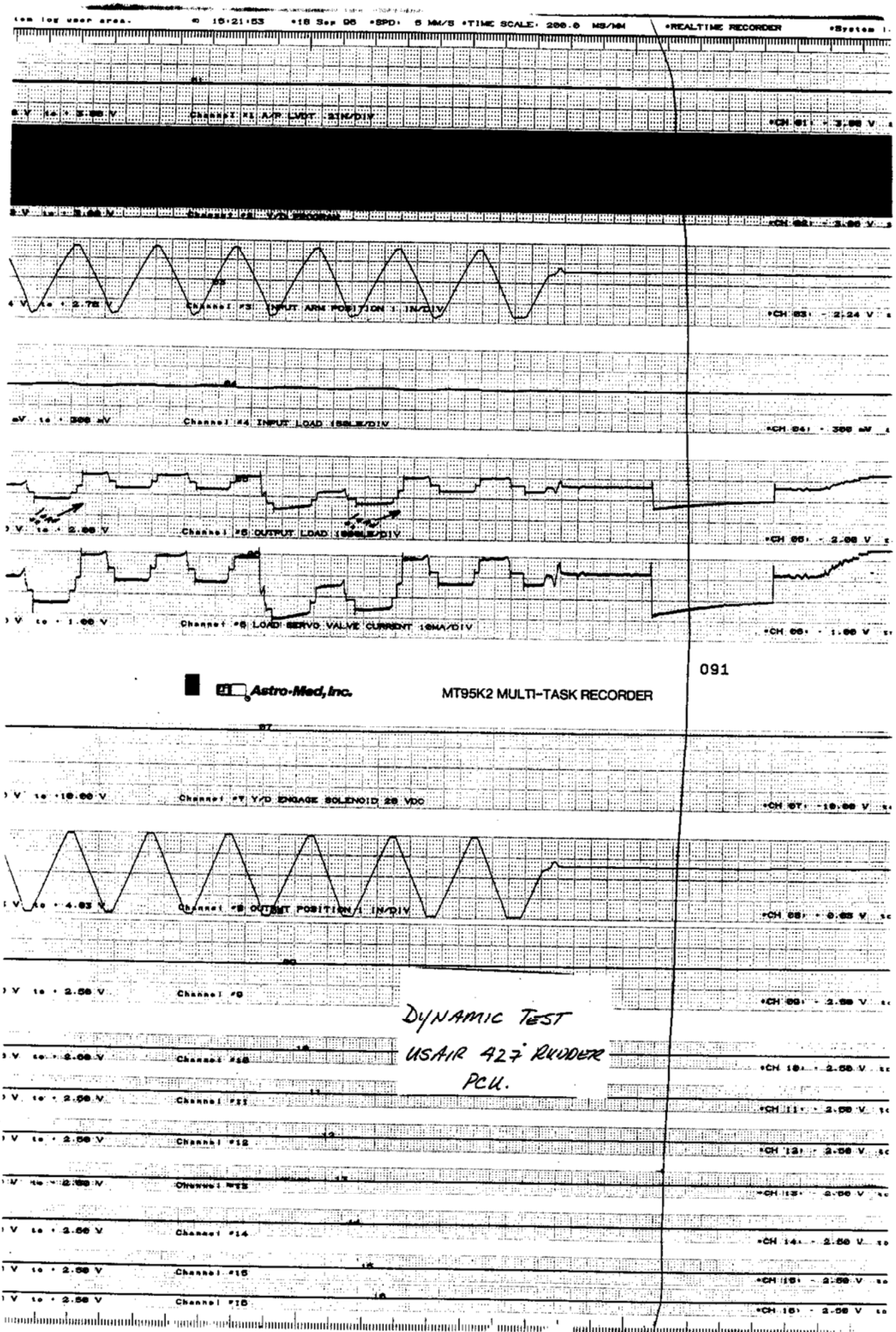
Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



DYNAMIC TEST
USAIR 427 RUDDER
PCU.

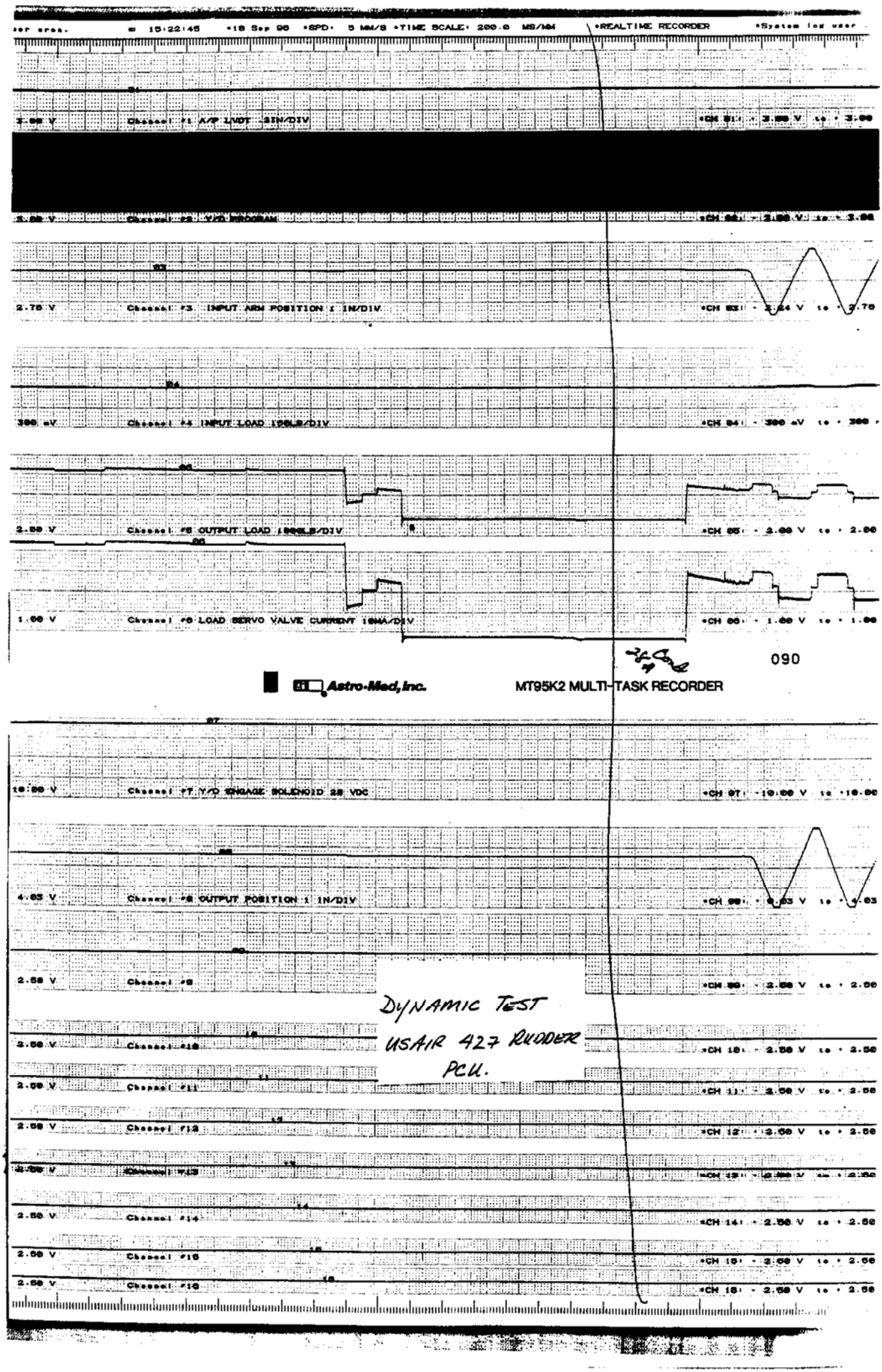

15:14:07 18 Sep 96 SPD: 5 MM/S TIME SCALE: 20
15:20:16 18 Sep 96 SPD: 5 MM/S TIME SCALE: 200.0 MS/MM
Channel #1 A/P LVDT .2IN/DIV
Channel #1 A/P LVDT .2IN/DIV
Channel #2 Y/D PROGRAM
Channel #2 Y/D PROGRAM
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #4 INPUT LOAD 150LB/DIV
Channel #4 INPUT LOAD 150LB/DIV
Channel #5 OUTPUT LOAD 1000LB/DIV
Channel #5 OUTPUT LOAD 1000LB/DIV
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
Cond 26 A
093
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #9
Channel #9
Channel #10
Channel #10
Channel #11
Channel #11
Channel #12
Channel #12
Channel #13
Channel #13
Channel #14
Channel #14
Channel #15
Channel #15
Channel #16
Channel #16
DYNAMIC TEST.
USAIR 427 RUDDER
PCU.

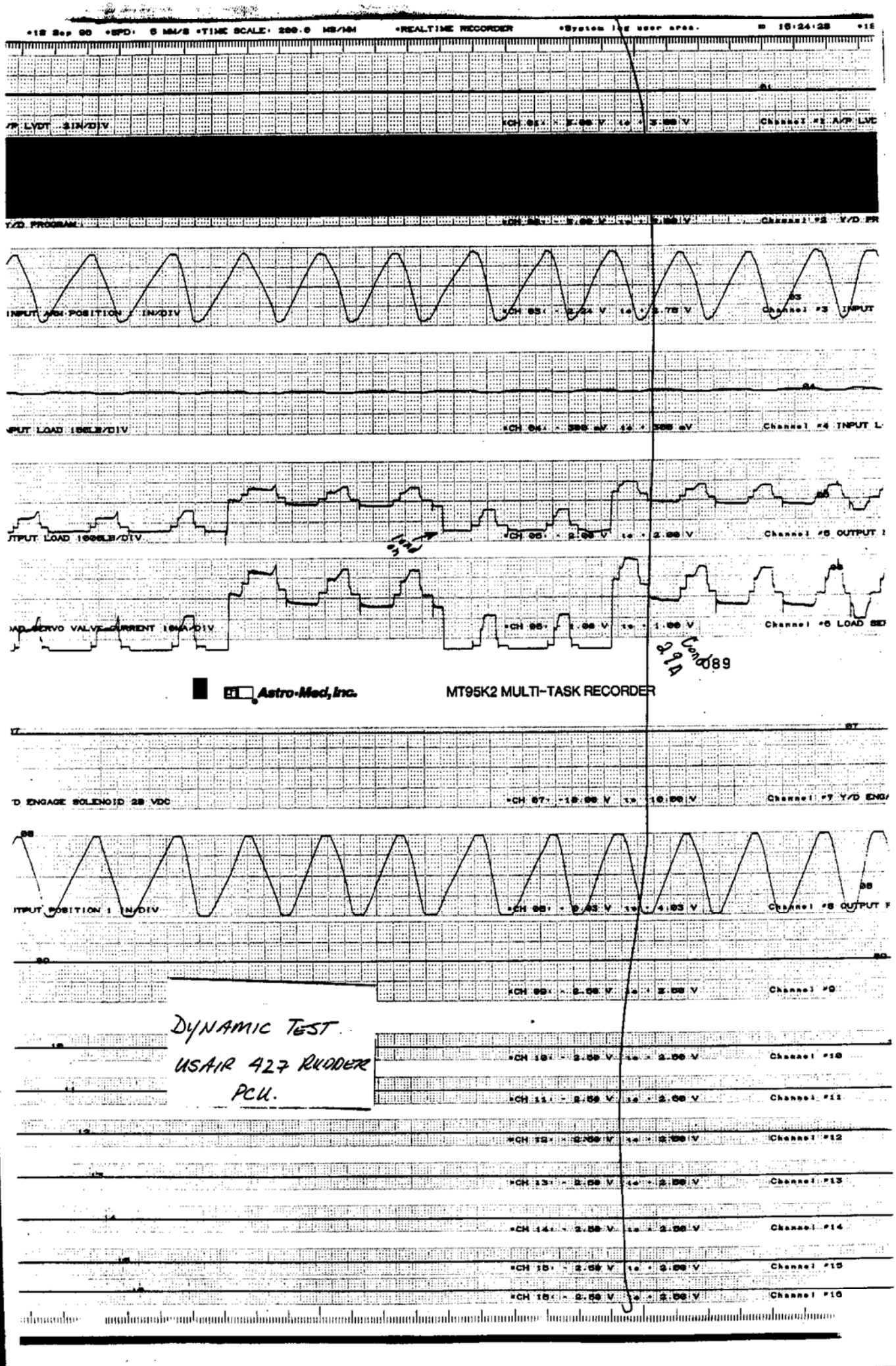

*REALTIME RECORDER
*System log user area.
15:21:02
*18 Sep 96
*SPD: 5 MM/S *TIME SCALE: 200.0 MS/MM
Channel #1 A/P LVDT 2IN/DIV
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #4 INPUT LOAD 100LB/DIV
Channel #5 OUTPUT LOAD 100LB/DIV
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
092
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #9
Channel #10
Channel #11
Channel #12
Channel #13
Channel #14
Channel #15
Channel #16
DYNAMIC TEST
USAIR 427 RUDDER
PCU.

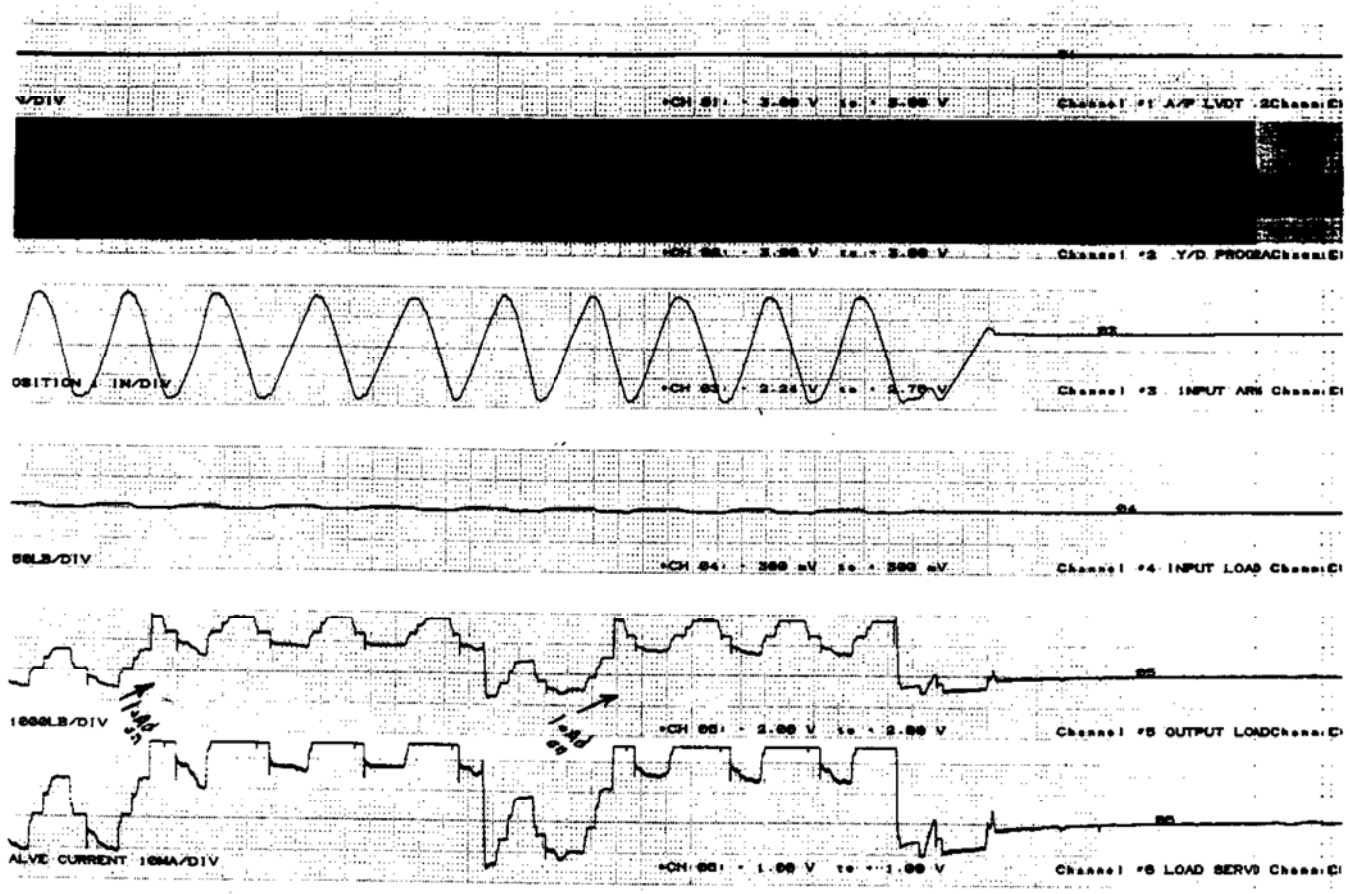


091

DYNAMIC TEST
USAIR 427' RUDDER
PCU.

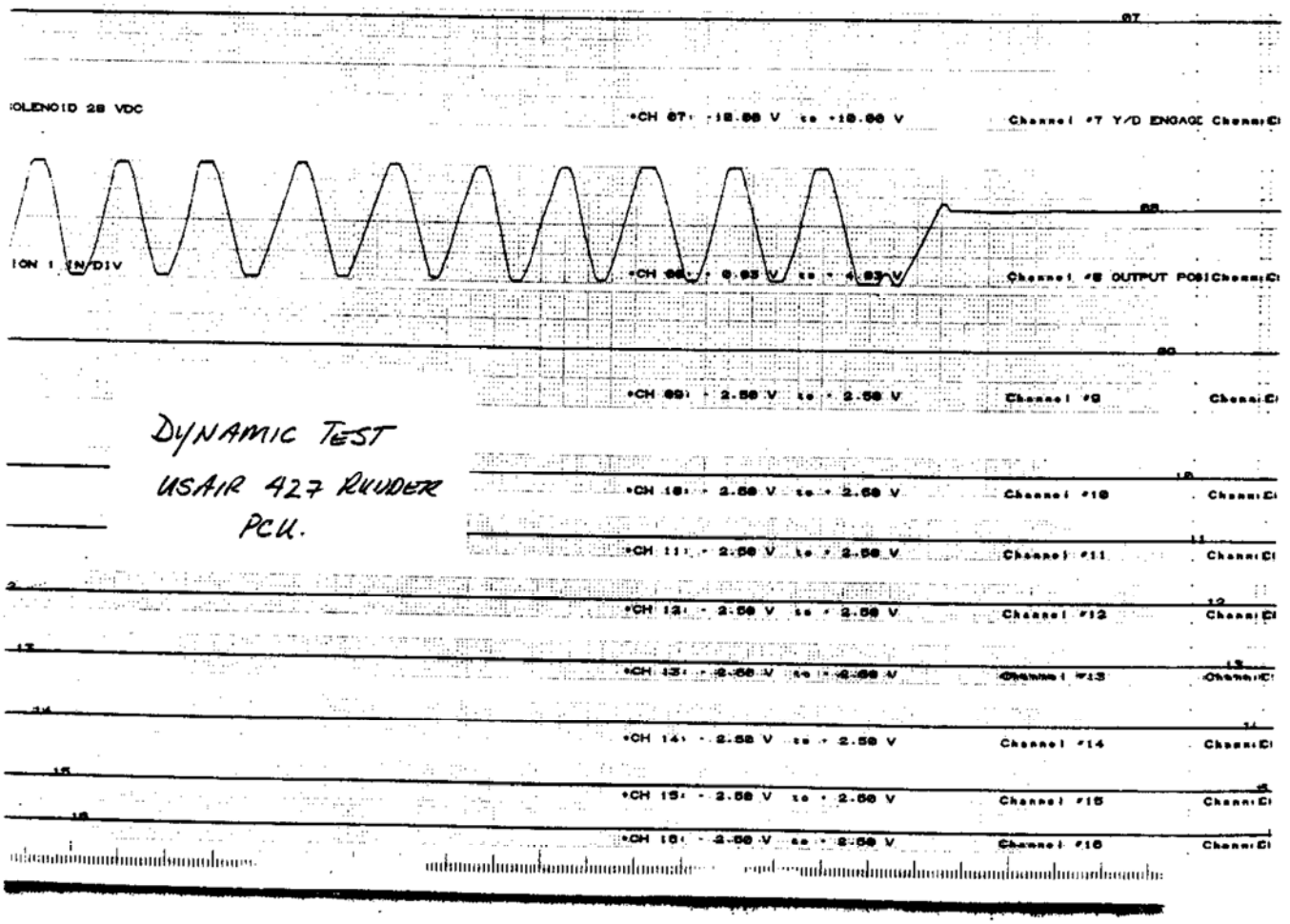

15:22:45 18 Sep 96 SPD: 5 MM/S TIME SCALE: 200.0 MS/MM REALTIME RECORDER
Channel #1 A/P LVDT .5IN/DIV
Channel #3 INPUT ARM POSITION 1 IN/DIV
Channel #4 INPUT LOAD 100LB/DIV
Channel #5 OUTPUT LOAD 100LB/DIV
Channel #6 LOAD SERVO VALVE CURRENT 10MA/DIV
090
Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
Channel #7 Y/D ENGAGE SOLENOID 28 VDC
Channel #8 OUTPUT POSITION 1 IN/DIV
Channel #9
Channel #10
Channel #11
Channel #12
Channel #13
Channel #14
Channel #15
Channel #16
DYNAMIC TEST
USAIR 427 RUDDER
PCU.


Astro-Med, Inc.
MT95K2 MULTI-TASK RECORDER
DYNAMIC TEST
USAIR 427 RUDDER
PCU.



088

Astro-Med, Inc. MT95K2 MULTI-TASK RECORDER



DYNAMIC TEST
USAIR 427 RUDDER
PCU.