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AEROBEE 350
FLIGHT 17.03 GE
INSTRUMENTATION INFORMATION AND CALIBRATION DATA

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GSFC
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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SUMMARY

This document contains a compilation of calibration data and curves for the airborne instrumentation system used on the Aerobee 350, Flight 17.03GE.

Also included are the telemetry allocations, equipment orientation drawings, component data, a listing of significant planned flight events, and data resulting from preflight tests performed at Goddard Space Flight Center and Wallops Island, Virginia.

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ILLUSTRATIONS (Continued)

TABLES

AEROBEE 350, FLIGHT 17.03 GE
INSTRUMENTATION INFORMATION AND CALIBRATION DATA

INTRODUCTION

This document contains a compilation of pre-flight calibration data for the airborne instrumentation system on the Aerobee 350 sounding rocket, Flight 17.03 GE.

Section I contains the basic information pertaining to the airborne instrumentation system.

Section II contains calibration data pertaining to vehicle aspect and attitude.

Sections III, IV, and V contain acceleration, pressure, and temperature calibration data. These sections are identified according to the functions of the devices contained therein, and are accompanied where applicable, by diagrams showing sensor orientation of pitch, yaw, and thrust directions in reference to the rocket axes.

Section VI contains test data and impedance charts for the antennas used for the rocket instrumentation and command control.

SECTION I

SYSTEM INFORMATION

Figure 1 identifies the vehicle coordinates to which all flight sensors are oriented.

Figure 2 is a graphic presentation of Input-Current/Output-Voltage for the collector logarithmic amplifier.

Figure 3 is a graphic presentation of Input-Voltage/Output-Voltage for the collector current amplifier.

Table 1 lists the telemetry systems, their frequency, measured power, frequency deviation, mode of transmission, and system location in the vehicle.

Table 2 lists the band allocations of Telemetry System 1.

Table 3 lists the band allocations of Telemetry System 2.

Table 4 lists the commutator allocations for Telemetry System 1.

Table 5 lists the commutator allocations for Telemetry System 2.

Table 6 is a listing of the flight instrumentation components and their manufacturer, model number, serial number, range, and function.

Table 7 lists the weights, dimensions, and location of specific flight items.

Table 8 is a sequential listing of significant planned flight events.

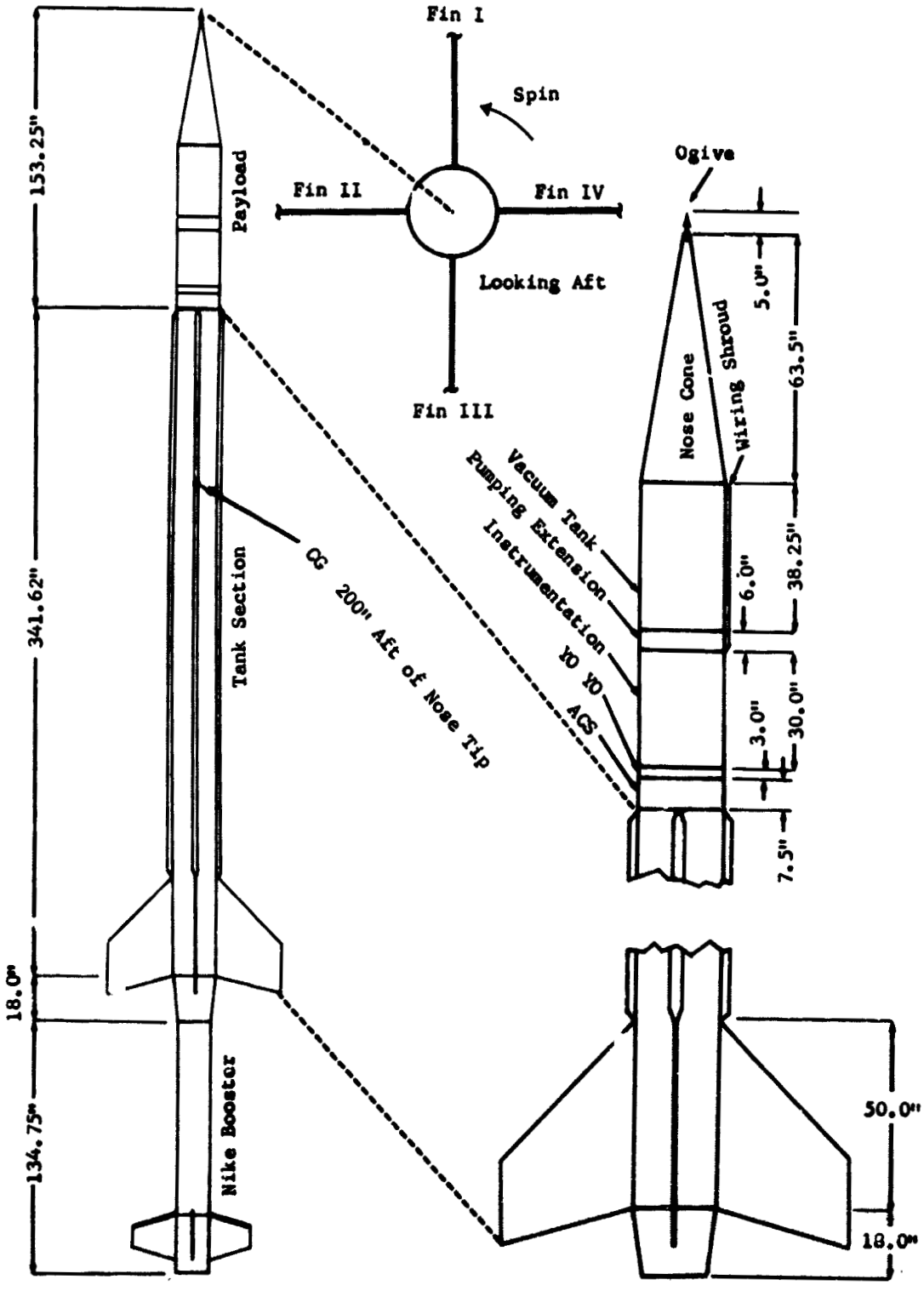


Figure 1. Vehicle Configuration for Aerobee 350, Flight 17.03GE

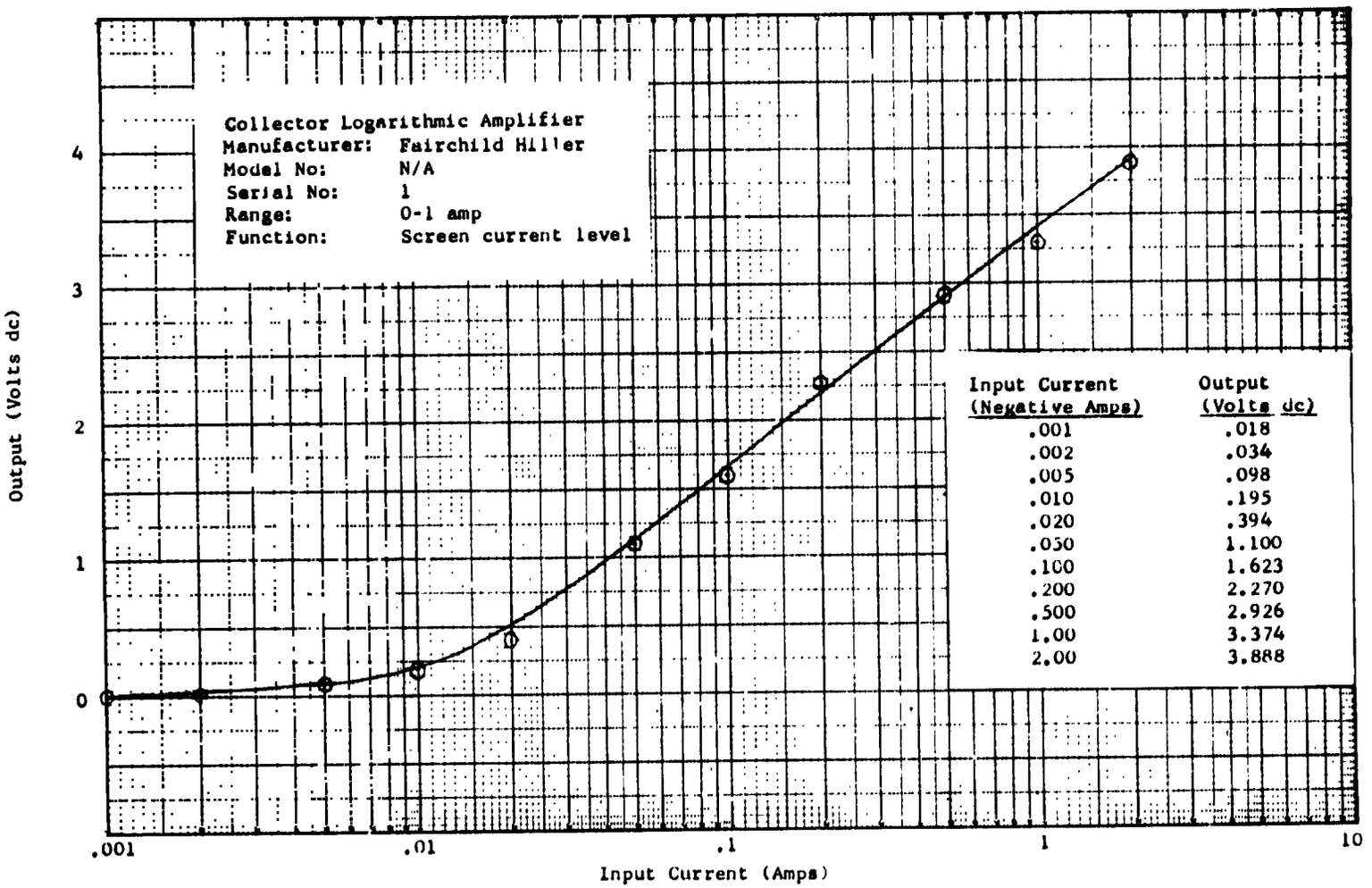


Figure 2. Collector Logarithmic Amplifier Calibration

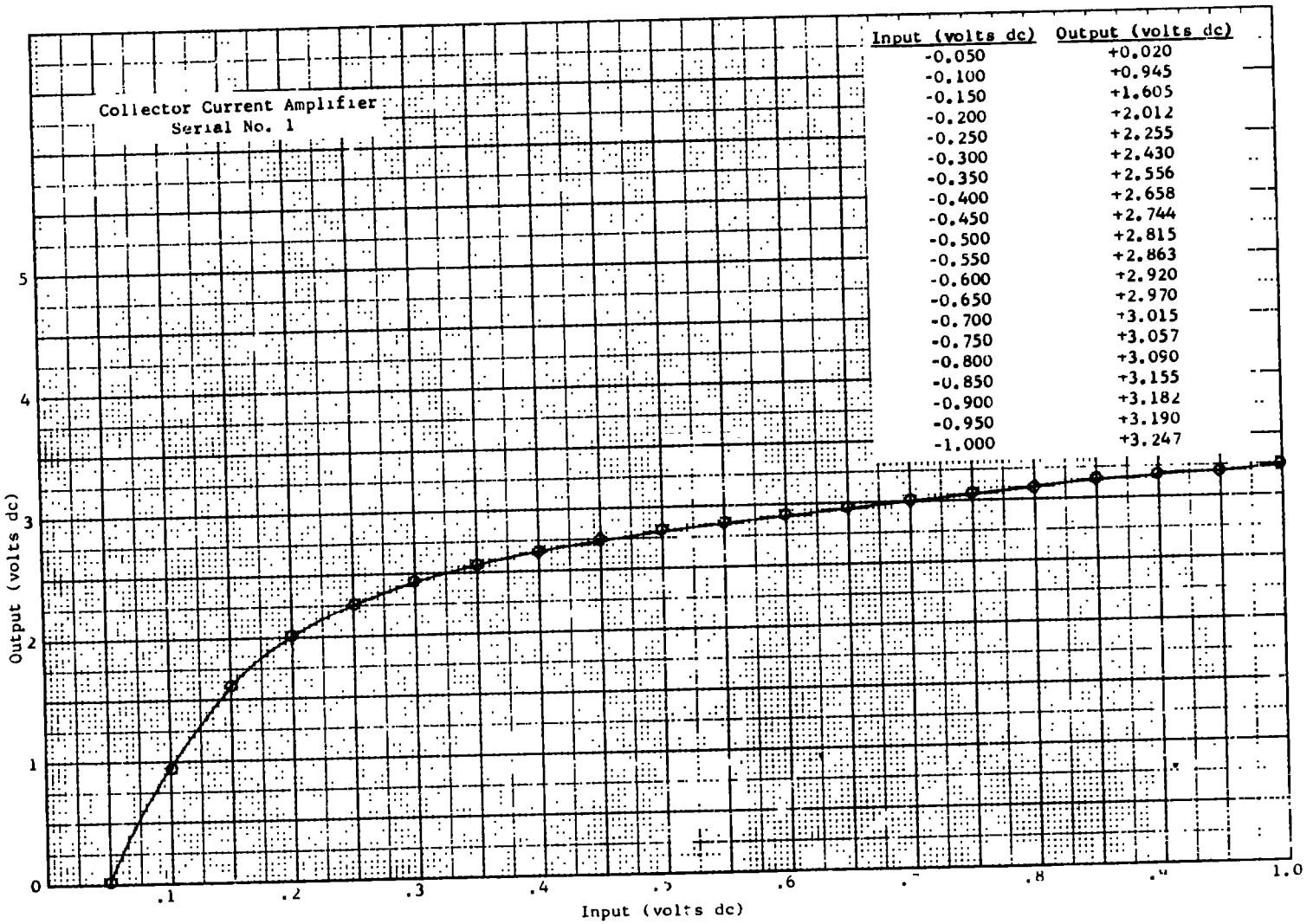


Figure 3. Collector Current Amplifier Calibration

Table 1
TELEMETRY SYSTEM INFORMATION

Telemetry No.	Frequency (MHz)	Power	Deviation (kHz)	Mode of Transmission	Location
1	244.3	4.0 Watts	125.0	FM/FM	Payload
2	256.2	2.0 Watts	125.0	FM/FM	Payload

Table 2
TELEMETRY SYSTEM 1, BAND ALLOCATIONS (244.3 MHz)

Channel	IRIG Frequency (kHz)	Data Frequency (Hz)	Allocation	
			Prior to Channel Switch	After Channel Switch
18	70.00	1,050	Payload Acceleration, thrust (Z)	Electron Collector (current)
17	52.50	790	Payload Acceleration, pitch (Y)	Commutator Temperature (inflation press. after +150 sec.)
16	40.00	600	Payload Acceleration, yaw (X)	Electrometer (L. V. sweep)
15	30.00	450	Electrometer - (H. V. current)	Electrometer (H. V. current)
14	22.00	330	Stable Platform, yaw	Electrometer (L. V. current)
13	14.50	220	Stable Platform, roll	Electron Gun (voltage)
12	10.50	160	Commutator (temperature)	Commutator (housekeeping)
11	7.35	110	Stable Platform, pitch	Electron Gun (current)
10	5.40	80	Chamber Pressure, PcI	Electrometer (H. V. sweep)
9	3.90	60	Chamber Pressure, PcII	ACS Roll Position
8	3.00	45	Chamber Pressure, PcIII	ACS Pitch Position

Note: Real Time - Channels 2 through 18
Playback - Channels 4 through 15

Table 2 (Continued)

Channel	IRIG Frequency (kHz)	Data Frequency (Hz)	Allocation	
			Prior to Channel Switch	After Channel Switch
7	2.30	35	Chamber Pressure, PcIV	ACS Yaw Position
6	1.70	25	Gas Regulator Pressure, Pgr	Magnetometer, lateral
5	1.30	20	Gas Bottle Pressure, Pgb	Magnetometer, longitudinal
4	0.96	14	"g" Reduction Timer-Monitor	Timing (28 bit)
3	0.73	11	Ogive, pitch	Squib Current
2	0.56	8	Ogive, yaw	Squib Current

Note: Real Time - Channels 2 through 18
Playback - Channels 4 through 15

Table 3
TELEMETRY SYSTEM 2, BAND ALLOCATIONS (256.2 MHz)

Channel	IRIG Frequency (kHz)	Data Frequency (Hz)	Allocation
15	30.00	450	Electrometer (H. V. current)
14	22.00	330	Electrometer (L. V. current)
13	14.50	220	Electron Gun (voltage)
12	10.50	160	Commutator (housekeeping)
11	7.35	110	Electron Gun (current)
10	5.40	80	Electrometer (H. V. sweep)
9	3.90	60	ACS Valve, roll
8	3.00	45	ACS Valve, pitch
7	2.30	35	ACS Valve, yaw
6	1.70	25	Magnetometer, lateral
5	1.30	20	Magnetometer, longitudinal
4	0.96	14	Timing (28 bit)

Note: Playback - Channels 4 through 15

Table 4
COMMUTATOR 1, TELEMETRY SYSTEM 1,
244.3 MHz (10.5 kHz), 2.5 r/s

Segment	Allocation
1	Ground
2	Temperature Calibrate, 50 ohms
3	Temperature Calibrate, 100 ohms
4	Temperature Calibrate, 130 ohms
5	T1
6	T2
7	T3
8	T4
9	T5
10	T6
11	T7
12	T8
13	Squib Switch
14	BLH Monitor, yaw
15	BLH Monitor, thrust
16	BLH Monitor, pitch
17	Electron Collector Shell Separation Monitor
18	Electron Collector Bottle Pressure

Note: Temperature is measured until Channel Switch

Table 4 (Continued)

Segment	Allocation
19	Magnetometer, lateral
20	Magnetometer, longitudinal
21	Nose Cone Pin Puller-Monitor
22	±18 Volt Monitor
23	Cutoff Valve Monitor
24	Electron Collector Inflator Pressure
25	Command Receiver 1 (Channel 4 monitor)
26	Command Receiver 2 (Channel 4 monitor)
27	Command Receiver 1 (signal strength)
28	Command Receiver 2 (signal strength)
29	Frame Sync
30	Frame Sync

Note: Temperature is measured until Channel Switch

Table 5
COMMUTATOR 2, TELEMETRY SYSTEM 1,
244.3 MHz (10.5 kHz), 2.5 r/s

Segment	Allocation
1	Ground
2	ACS (+30 volt monitor)
3	ACS (roll valves)
4	ACS (pitch valves)
5	ACS (yaw valves)
6	ACS (roll rate)
7	ACS (Ledex monitor)
8	Gas Bottle Pressure, Pgb
9	Gas Regulator Pressure, Pgr
10	Stable Platform, pitch
11	Stable Platform, yaw
12	Stable Platform, roll
13	Electron Collector (current)
14	Pin Puller
15	Electron Collector Shell Separation Monitor
16	Squib Switch
17	Electron Collector Bottle Pressure
18	Electron Collector Inflation Pressure

Note: Housekeeping is measured after burnout.

Table 5 (Continued)

Segment	Allocation
19	Electron Experiment Battery 1 Monitor
20	Electron Experiment Battery 2 Monitor
21	Experiment Break Seal Monitor
22	Electron Experiment Pack Pressure
23	Temperature (high voltage)
24	Temperature (current)
25	Filament Current
26	Tape Recorder Monitor
27	Command Receiver 1 (signal strength)
28	Command Receiver 2 (signal strength)
29	Frame Sync
30	Frame Sync

Note: Housekeeping is measured after burnout.

Table 6
FLIGHT 17.03 COMPONENTS DATA

Component	Manufacturer	Model No.	Serial No.	Range	Function and/or Comment
Accelerometer	CEC	4-204-0001	1145		3 Axis Acceleration
Yaw Axis (X)	CEC		1402	±5 g	Yaw Axis Acceleration
Signal Conditioning Unit	BLH	950-003A	024	0 to +5.0 vdc	
Pitch Axis (Y)	CEC		1403	±5 g	Pitch Axis Acceleration
Signal Conditioning Unit	BLH	950-003A	002	0 to ±5.0 vdc	
Thrust Axis (Z)	CEC		1295	±25 g	Thrust Axis Acceleration
Signal Conditioning Unit	BLH	950-003A	104	0 to +5.0 vdc	
Antennas, Telemetry System 1	N. Mex. State	2.041	N29, N30		244.3 MHz
	N. Mex. State	2.045	W52, W53		244.3 MHz
Antennas, Telemetry System 2	N. Mex. State	2.052	B60, B62		256.2 MHz
Antennas, Command Receivers	N. Mex. State	4.003	N55, N56		412.0 MHz
Battery Box/Batteries		165-28/HR-1			26 HR-1 Batteries
Battery Pack 1	Yardney				20 HR-1.5 Batteries (instrumentation)
Battery Pack 2	Yardney				20 HR-1.5 Batteries (experiment)
Calibrator	Tempo	91510		0 to +5.0 vdc	
Collector Screen	Schjeldahl Co.				
Collector Current Amplifier			1	0 to +5.0 vdc	
Gyroscope	Whittaker	518025-EC	62-75		
Intervalometer	Tempo	92209	0013	T1=3 to 120 sec. T2=3 to 5 sec.	
Magnetometer, Lateral Axis	Schonstedt	RAM-5-C	943	±600 Milligau.	
Magnetometer, Longitudinal Axis	Schonstedt	RAM-5-C	939	±600 Milligau.	
Ogive, Angle of Attack Indicator	Giannini	2519P	515	0 to +5.0 vdc	Pitch-Yaw Axis
Pressure Gauge	Servonic	2091-8002	1001	0 to 400 psia	Chamber Pressure, Pcl

Table 6 (Continued)

Component	Manufacturer	Model No.	Serial No.	Range	Function and/or Comment
Pressure Gauge	Servonic	2091-8002	1002	0 to 400 psia	Chamber Pressure, PcII
Pressure Gauge	Servonic	2091-3002	1003	0 to 400 psia	Chamber Pressure, PcIII
Pressure Gauge	Servonic	2091-8002	1004	0 to 400 psia	Chamber Pressure, PcIV
Pressure Gauge	Servonic	2091-6702	1005	0 to 4000 psia	Gas Bottle Pressure, Pgb
Pressure Gauge	Servonic	2091-6701	1075	0 to 600 psia	Regulated Gas Pressure, Pgr
Receiver 1, Command	Cont. Sc. Corp.	CR-5	112	412 MHz	10 Channels
Receiver 2, Command	Cont. Sc. Corp.	CR-5	113	412 MHz	10 Channels
Recorder	Leach Corp.	MTR-2260			
Recorder, Mixer-Amplifier	Vector	TA-59A			Performance Recording
Recorder, Mixer-Amplifier	Vector	TA-59A			Experiment Recording
Regulator, +5.0 volts dc	Vector	TV-53X-A			
Regulator, ±18.0 volts dc	Vector	TV-56A			
Relay, K103	Filtor	VL26AAK18A			Channel Switch Relay
Relay, K104	Filtor	VL26AAK18A			Channel Switch Relay
Relay, K105	Filtor	VL26AAK18A			Channel Switch Relay
Relay, K107	Amphenol	Dynaform 360		SPDT Switch	Antenna Relay
Relay, K108	Amphenol	Dynaform 360		SPDT Switch	Antenna Relay
Relay, K161	Babcock	AG856-2			Instrumentation and Performance Relay
Relay, K162	Babcock	AG856-2			Experimental System Relay
Relay, K163	Babcock	AG855-6			System Relay
Relay, K165	Babcock	AG856-2			System Relay

Table 6 (Continued)

Component	Manufacturer	Model No.	Serial No.	Range	Function and/or Comment
Relay, K166	Filtor	V14WDK18F			Take-Off Relay
Relay, K168	Struthers Dunn	FC-1-407W			System Relay
Relay, K169	Filtor	VZ6WDK18F			Altitude Switches Relay
Relay, K172	Installed - But Not Used				System Relay
Relay, K174	Filtor	PLR26HIM6A-1			System Relay
Relay, K175	Filtor	PLR26HIM6A-1			System Relay
Relay	Filtor	JR26J2P6A-1			Real Time to Tape Relay, 244.3 MHz
Switch (altitude) 1	Senflex	262-A	102	20,000 Feet	
Switch (altitude) 2	Senflex	262-A	002433	20,000 Feet	
Switch (altitude) 3	Senflex	262-A	002419	20,000 Feet	
Switch (g)	Raymond		7602		6 Pole Switch
Switch (rotary)	Ledex	BR18AX-C2-V3			
Temperature Transducer	Temtech	4415-3	2537	0 to 1000° F	Temperature T1
Temperature Transducer	Temtech	4415-3	2582	0 to 1000° F	Temperature T2
Temperature Transducer	Temtech	4415-3	2559	0 to 1000° F	Temperature T3
Temperature Transducer	Temtech	4415-3	2541	0 to 1000° F	Temperature T4
Temperature Transducer	Temtech	4415-3	2587	0 to 1000° F	Temperature T5
Temperature Transducer	Temtech	4415-3	2476	0 to 1000° F	Temperature T6
Temperature Transducer	Temtech	4415-3	2609	0 to 1000° F	Temperature T7
Temperature Transducer	Temtech	4415-3	2481	0 to 1000° F	Temperature T8

Table 6 (Continued)

Component	Manufacturer	Model No.	Serial No.	Range	Function and/or Comment
Temperature Amplifier	GSFC		1		
Timer (g)	Raymond	1488G	9970		
Timer (events)	Haydon	5800			Consists of 15 Cams
Transmitter, Telemetry System 1	Vector	T-1127		244.3 MHz	FM/FM, Performance Telemetry
Transmitter, Telemetry System 2	Vector	T-2125		256.2 MHz	FM/PM, Experiment Telemetry
VCO, 0.56 kHz, TM 1	Vector	TS-54			
VCO, 0.73 kHz, TM 1	Vector	TS-54			
VCO, 0.96 kHz, TM 1	Vector	TS-54			
VCO, 1.30 kHz, TM 1	Vector	TS-54			
VCO, 1.70 kHz, TM 1	Vector	TS-54			
VCO, 2.30 kHz, TM 1	Vector	TS-54			
VCO, 3.00 kHz, TM 1	Vector	TS-54			
VCO, 3.90 kHz, TM 1	Vector	TS-54			
VCO, 5.40 kHz, TM 1	Vector	TS-54			
VCO, 7.35 kHz, TM 1	Vector	TS-54			
VCO, 10.50 kHz, TM 1	Vector	TS-54			
VCO, 14.5 kHz, TM 1	Vector	TA-54			
VCO, 22.0 kHz, T M 1	Vector	TA-54			
VCO, 30.0 kHz, TM 1	Vector	TA-54			
VCO, 40.0 kHz, TM 1	Vector	TA-54			

Table 6 (Continued)

Component	Manufacturer	Model No.	Serial No.	Range	Function and/or Comment
VCO, 52.5 kHz, TM 1	Vector	TA-54			
VCO, 70.0 kHz, TM 1	Vector	TA-54			
VCO, Mixer Amplifier	Vector	TA-59			
VCO, Mixer Amplifier	Vector	TA-59			
VCO, Mixer Amplifier	Vector	TA-59			
VCO, 30.0 kHz, TM 2	Vector	TA-54			
VCO, 22.0 kHz, TM 2	Vector	TA-54			
VCO, 14.5 kHz, TM 2	Vector	TA-54			
VCO, 10.5 kHz, TM 2	Vector	TA-54			
VCO, 7.35 kHz, TM 2	Vector	TA-54			
VCO, 5.40 kHz, TM 2	Vector	TA-54			
VCO, 3.90 kHz, TM 2	Vector	TA-54			
VCO, 3.00 kHz, TM 2	Vector	TA-54			
VCO, 2.30 kHz, TM 2	Vector	TA-54			
VCO, 1.70 kHz, TM 2	Vector	TA-54			
VCO, 1.30 kHz, TM 2	Vector	TA-54			
VCO, 0.96 kHz, TM 2	Vector	TA-54			

Table 7
WEIGHTS AND DIMENSIONS

Component	Weight (Pounds)	Length (Inches)	CG Station (Inches)
Pitch-Yaw Indicator and Adapter	2.0	8.5	-40.0
Nose Cone	87.0	63.5	-24.5
Vacuum Vessel		37.0	
Electron Accelerator and Spectrum Analyzer Experiments	127.5		23.6
Pumping Extention Assembly	40.0	6.0	63.0
Separate Ring	6.5	1.2	62.0
Spool Assembly	25.5	—	45.5
Nose Cone Switches	1.0	—	33.5
Load Spreader, Rod, and Pressure Cap	3.0	—	9.5
Cone Ejection Spring	13.0	—	7.2
Fairing	1.0	—	45.5
Electron Collector	62.5	—	45.5
Instrumentation and Command Deck	160.0	30.0	84.5
YO-YO Despin Unit	17.0	3.0	100.0
ACS	66.8	7.5	107.0
Destruct System	10.0	—	175.0
Roll Valves and Plumbing	7.0	—	170.0
Pitch-Yaw Valves and Plumbing	15.0	—	418.0

Table 7 (Continued)

Component	Weight (Pounds)	Length (Inches)	CG Station (Inches)
Miscellaneous	10.0	—	280.0
Sustainer	859.2	—	311.1
Total Dry Weight	1,514.0	—	—
Dry CG	—	—	207.3
Total Length	498.3	—	—
Effective Net Payload	611.0	156.7	—
Equivalent Extension Length	—	46.7	—
Body Diameter (nominal)	—	22.0	—
Fin Span	—	100.4	—
Booster Body Diameter	—	16.5	—
Booster Fin Span	—	59.6	—

Table 8
SIGNIFICANT PLANNED EVENTS IN FLIGHT

No.	Main or Initiating Event	Time (sec.)	Range (ft.)	Altitude (ft.)	Velocity (f/s)
1	Launch "g" Timers started. Lift-off switch closed.	0.0			
2	Burnout "g" Reduction switch closed. Shut off valves closed. ACS started.	52.0		138,626	7,165
3	Backup shut off. (command)	54.0			
4	Backup ACS started. (Hayden timer)	55.0			
5	Start Yo-Yo despin. (ACS)	68.0			
6	Erect vehicle to local vertical.	71.0			
7	Stabilization period.	83.0			
8	Roll remote adjusted.	85.0			
9	Pitch remote adjusted.	88.0			
10	Yaw remote adjusted.	91.0			
11	Stabilization period.	94.0			
12	Pitch maneuver.	98.0			

Table 8 (Continued)

No.	Main or Initiating Event	Time (sec.)	Range (ft.)	Altitude (ft.)	Velocity (f/s)
13	On Target. Hold attitude.	128.0	968,880		
14	Tip eject. (ACS)	133.0			
15	Backup tip eject. (Hayden timer) Collector deployment. (Tip eject release)	152.0			
16	ACS timer stopped.	158.0			
17	Collector deployed.	188.0			
18	ACS jets off. Tape recorder started. Start Ion Gun program: a. Programmer started. b. Simultaneous Break Seal relay sequence started. c. Filaments turned on by programmer. Cut off bias to control grids.	190.0			
19	d. First set of four guns opened. (automatic sequence to second set)	193.2			
20	e. Second set of four guns opened. (automatic sequence to third set)	196.4			
21	f. Third set of two guns opened. (automatic shutdown)	199.6			

Table 8 (Continued)

No.	Main or Initiating Event	Time (sec.)	Range (ft.)	Altitude (ft.)	Velocity (f/s)
22	g. Filament warmup completed. Experiment sequence begins. h. High voltage turned on. (pulse 1) 5 kv nominal. 800 volt converter turned on. (800 volts dc to second grid) Guns biased beyond cutoff.	205.0			
23	i. Beam current controller turned on. (1.5 ma.)	205.1			
24	j. Beam current controller turned off. Beam off. High voltage turned off. 800 volt converter turned off.	205.2			
25	k. High voltage turned on. (pulse 2) 5 kv nominal.	208.5			
26	l. Same as i, except controlled to 5 ma.	208.6			
27	m. Same as j. n. Items h, i, j repeated. (Time interval between the start of pulses is 3.5 seconds)	208.7			
28	Stop experimental programmer.	465.0			
29	Start recorder playback.	470.0			
30	Recorder playback completed.	515.0			
31	Impact Azimuth = 37° 0.6' N, 75° 9.5' W	547.4	320,41[illegible]		

SECTION II

VEHICLE ASPECT ANGLE DATA

This section contains the vehicle aspect-angle sensors data. The instrumentation used to obtain the vehicle aspect information includes an ogive angle-of-attack transducer to indicate changes in pitch and yaw axes, a stable platform having yaw-pitch-roll axes, and magnetic aspect sensors for the lateral and longitudinal axes.

Table 9 is a listing of the vehicle aspect sensors, including their manufacturer, model number, serial number, and range.

Figures 4, 7, and 11 show the sensor-vehicle orientation of the ogive, stable platform, and magnetometers, respectively.

Figures 5 and 6 are the calibration data curves for the ogive sensor, for the pitch and yaw axes.

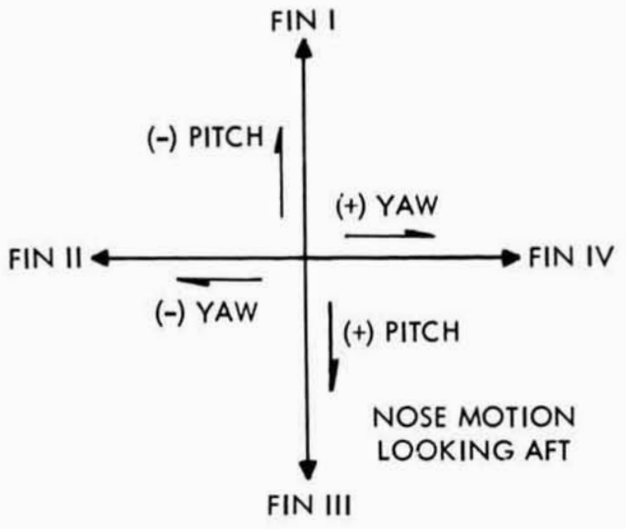
Figures 8, 9, and 10 are the calibration curves for the stable platform, in the yaw, pitch, and roll axes, respectively.

Figures 12 and 13 are the calibration curves for the lateral and the longitudinal magnetometers, respectively.

Table 9
VEHICLE ASPECT SENSORS

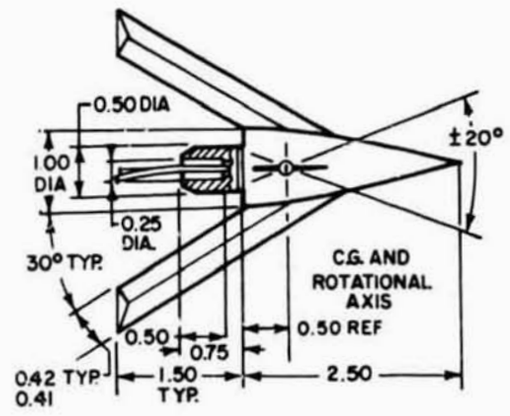
Aspect Sensor	Manufacturer	Model No.	Serial No.	Range
Ogive				
Stable Platform	Whittaker	518025-EC	62-75	Yaw - Left 87° 00' Right 86° 15' Pitch - 360° Roll - 360° 30'
Magnetometers:				
Lateral	Schonstedt	RAM-5C	943	±600 milligauss
Longitudinal	Schonstedt	RAM-5C	939	±600 milligauss

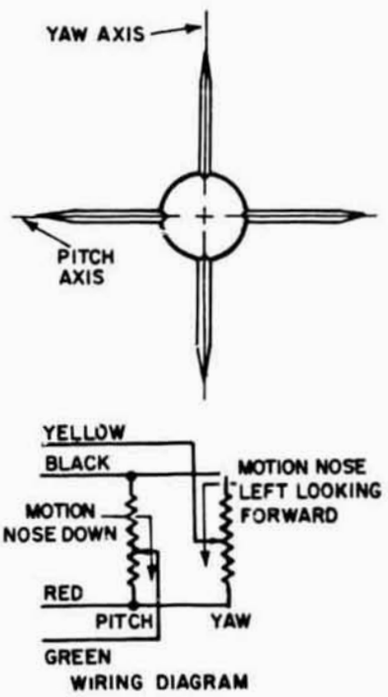
OGIVE INSTRUMENT



ORIENTATION

DIMENSIONS AND SCHEMATIC DIAGRAM





WIRING DIAGRAM

Figure 4. Angle of Attack Indicator (Ogive) Orientation

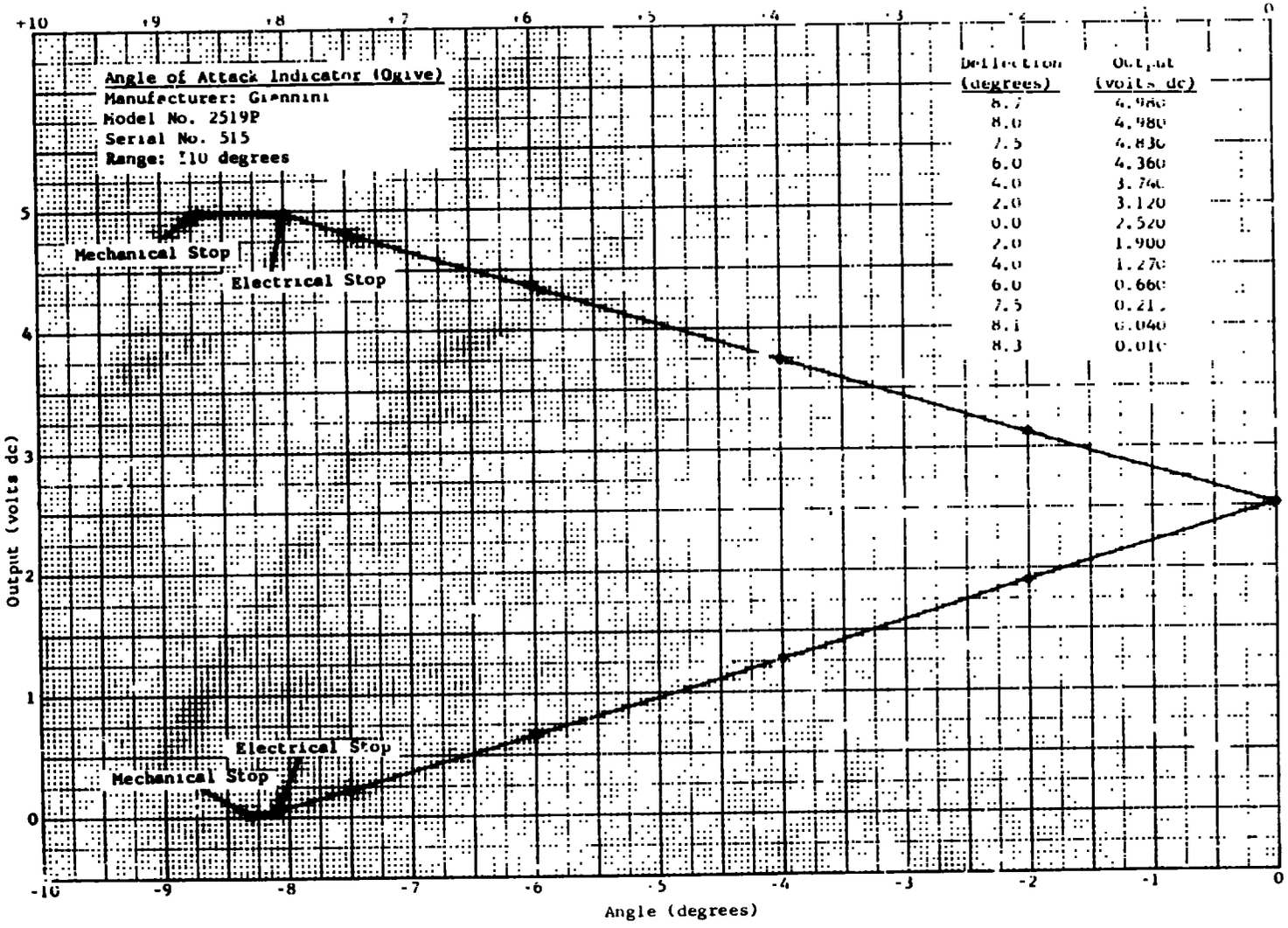


Figure 5. Angle of Attack Indicator (Ogive) Calibration - Pitch

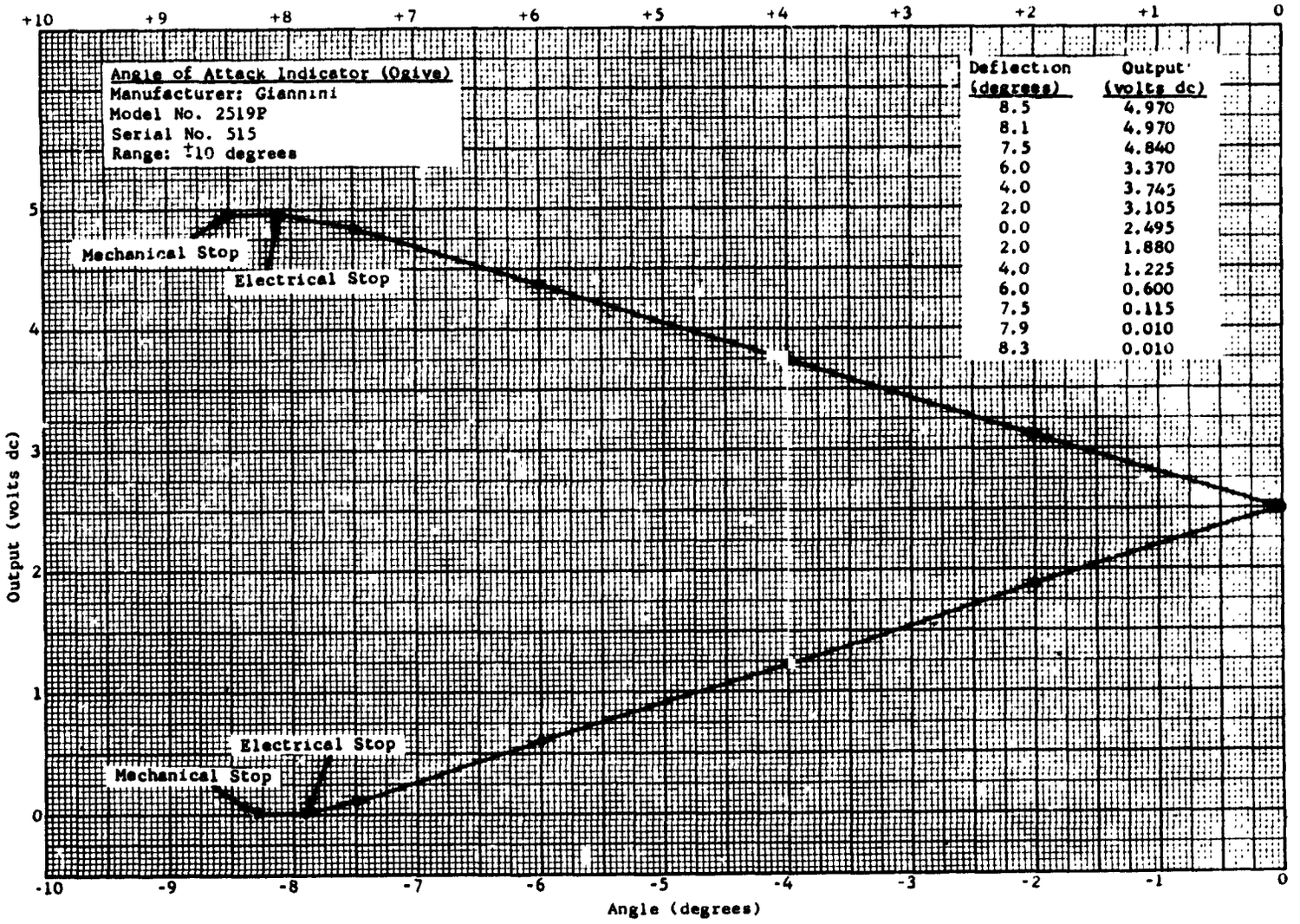


Figure 6. Angle of Attack Indicator (Ogive) Calibration - Yaw

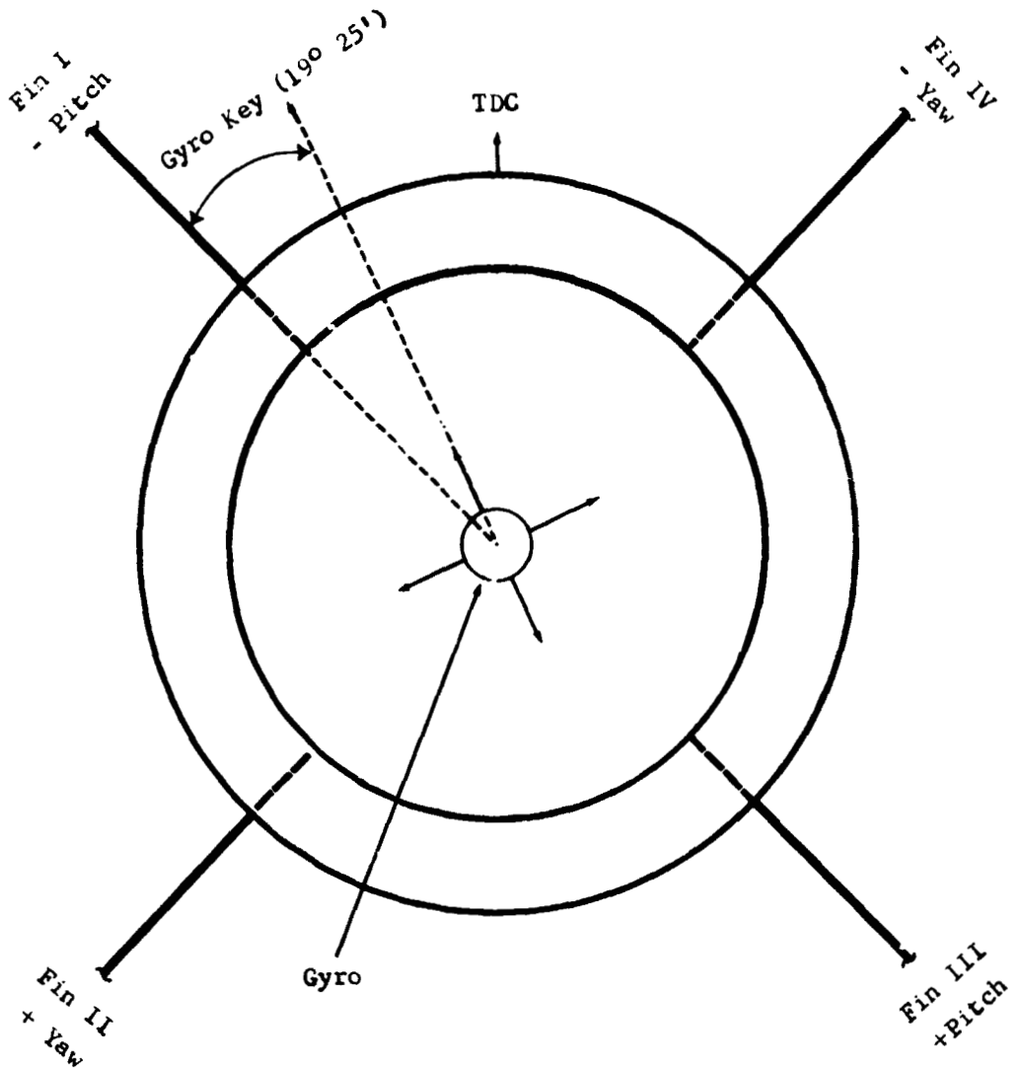


Figure 7. Stable Platform Orientation

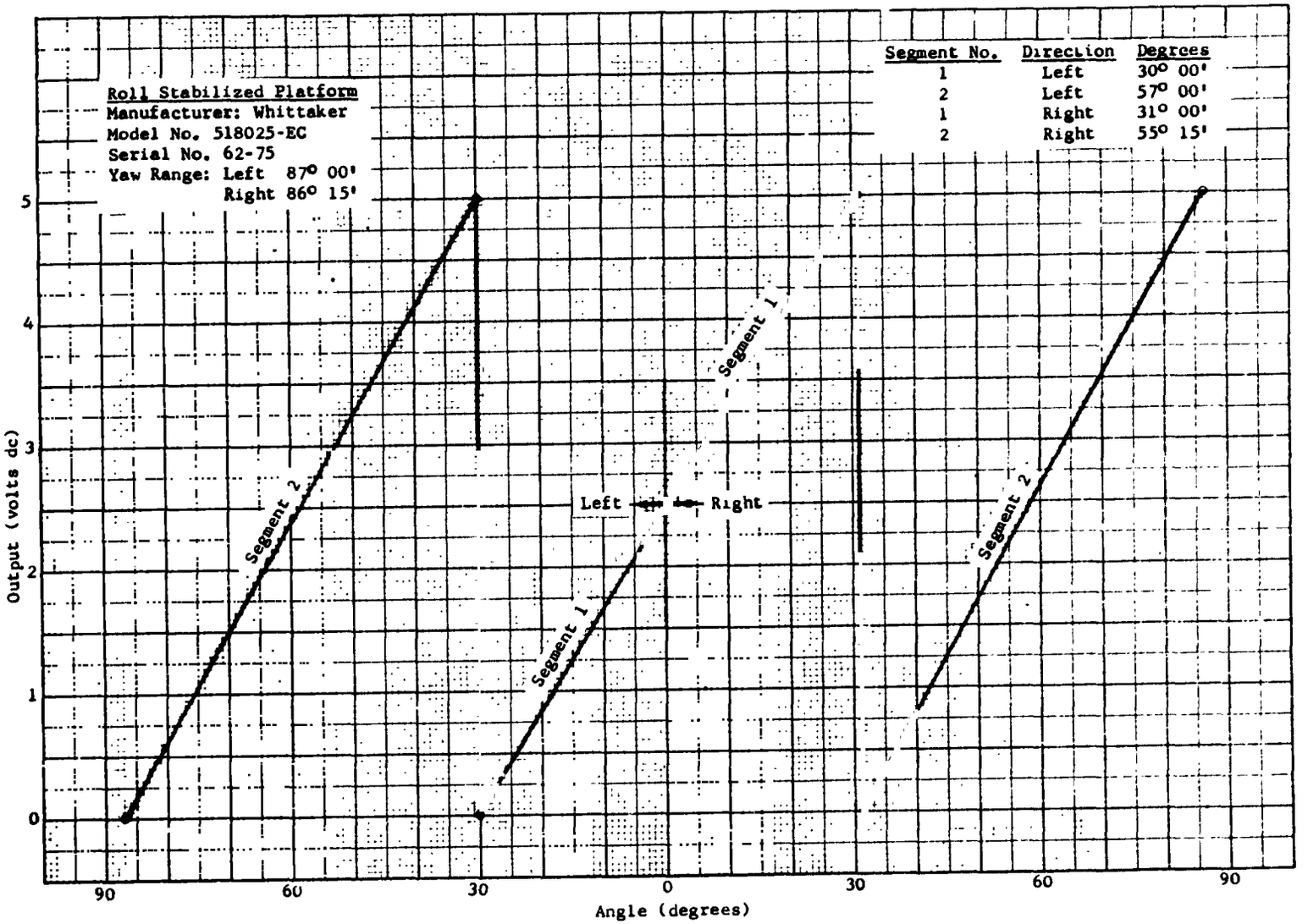


Figure 8. Stable Platform Calibration, Yaw Axis

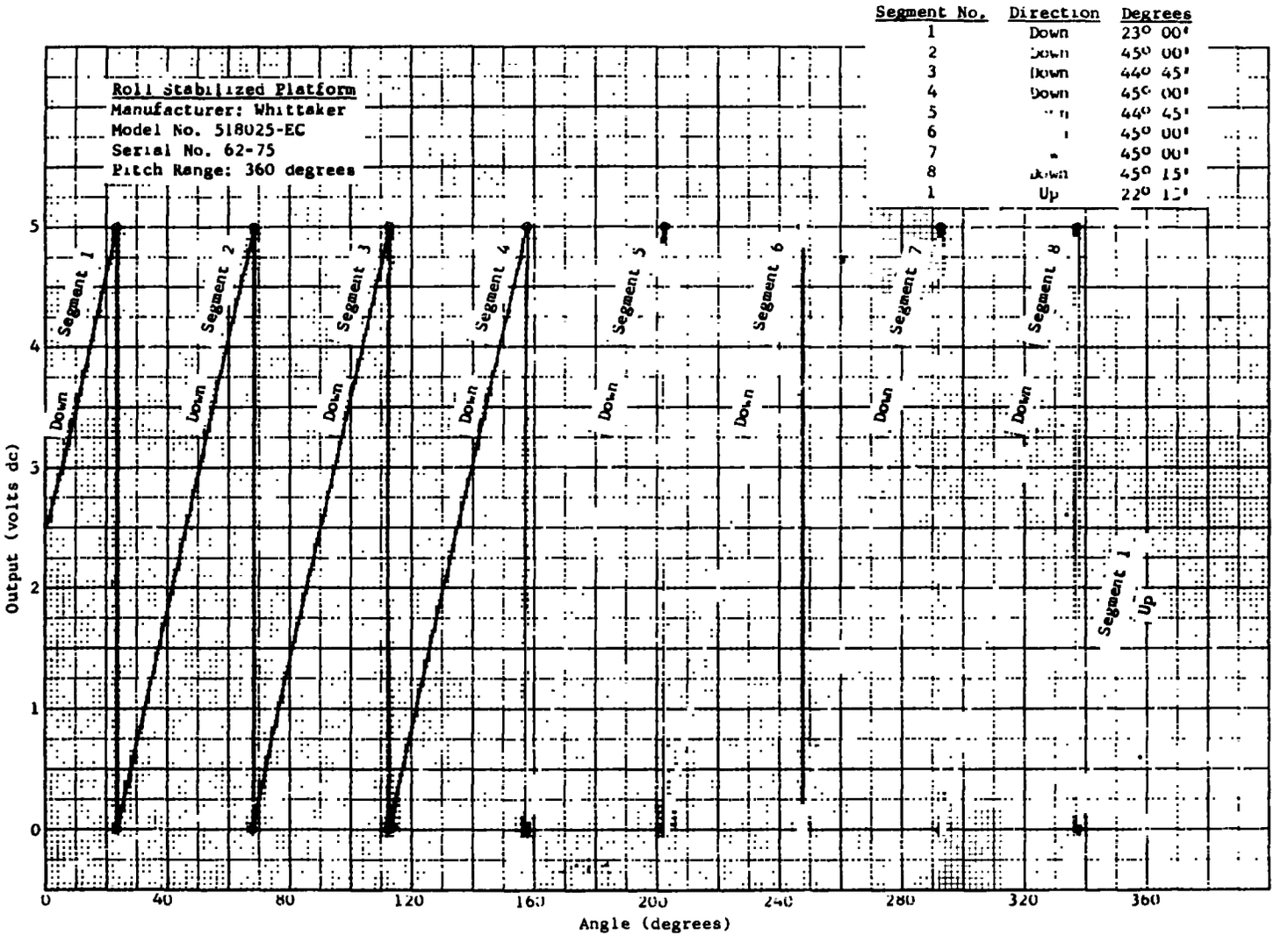


Figure 9. Stable Platform Calibration, Pitch Axis

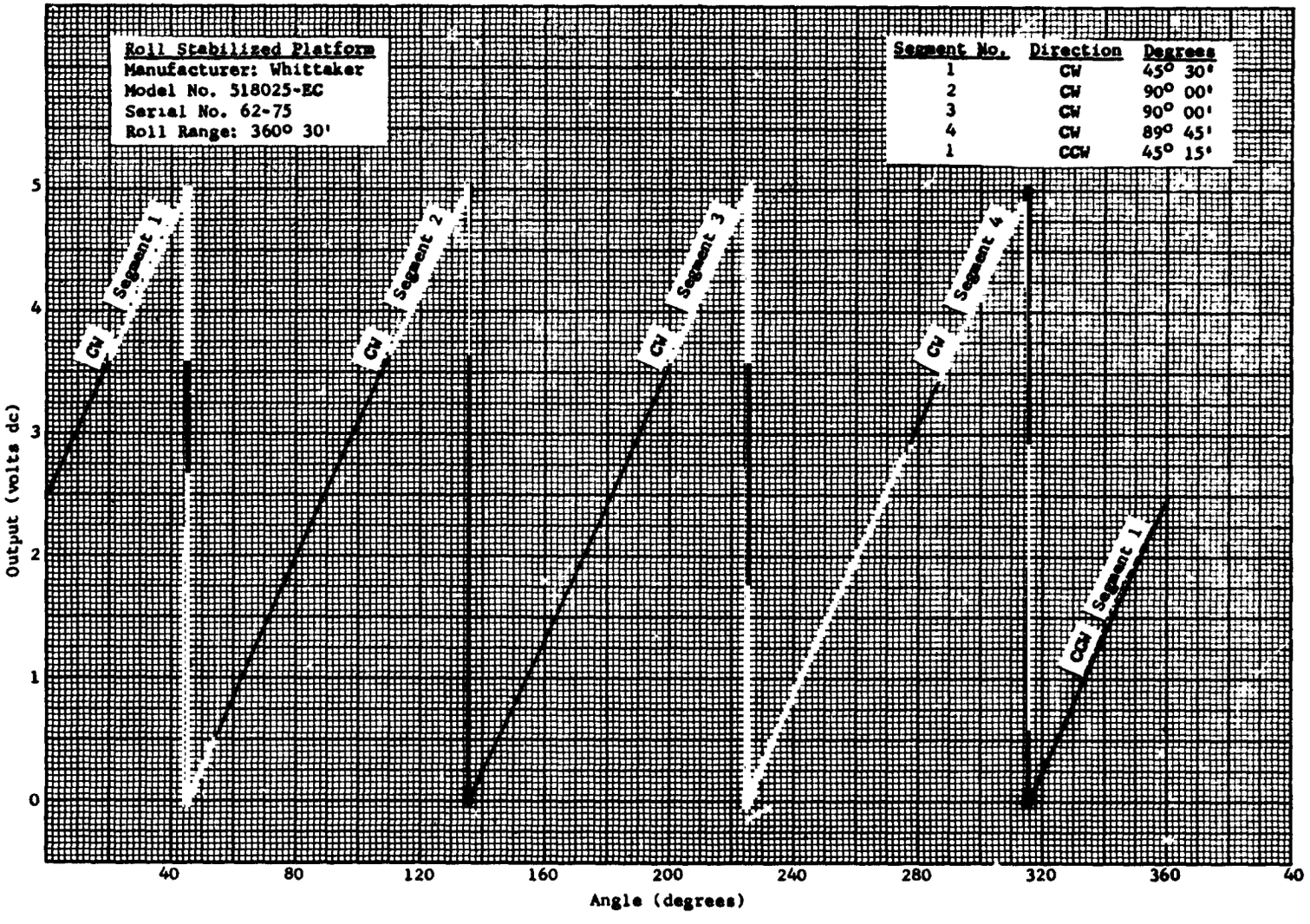


Figure 10. Stable Platform Calibration, Roll Axis

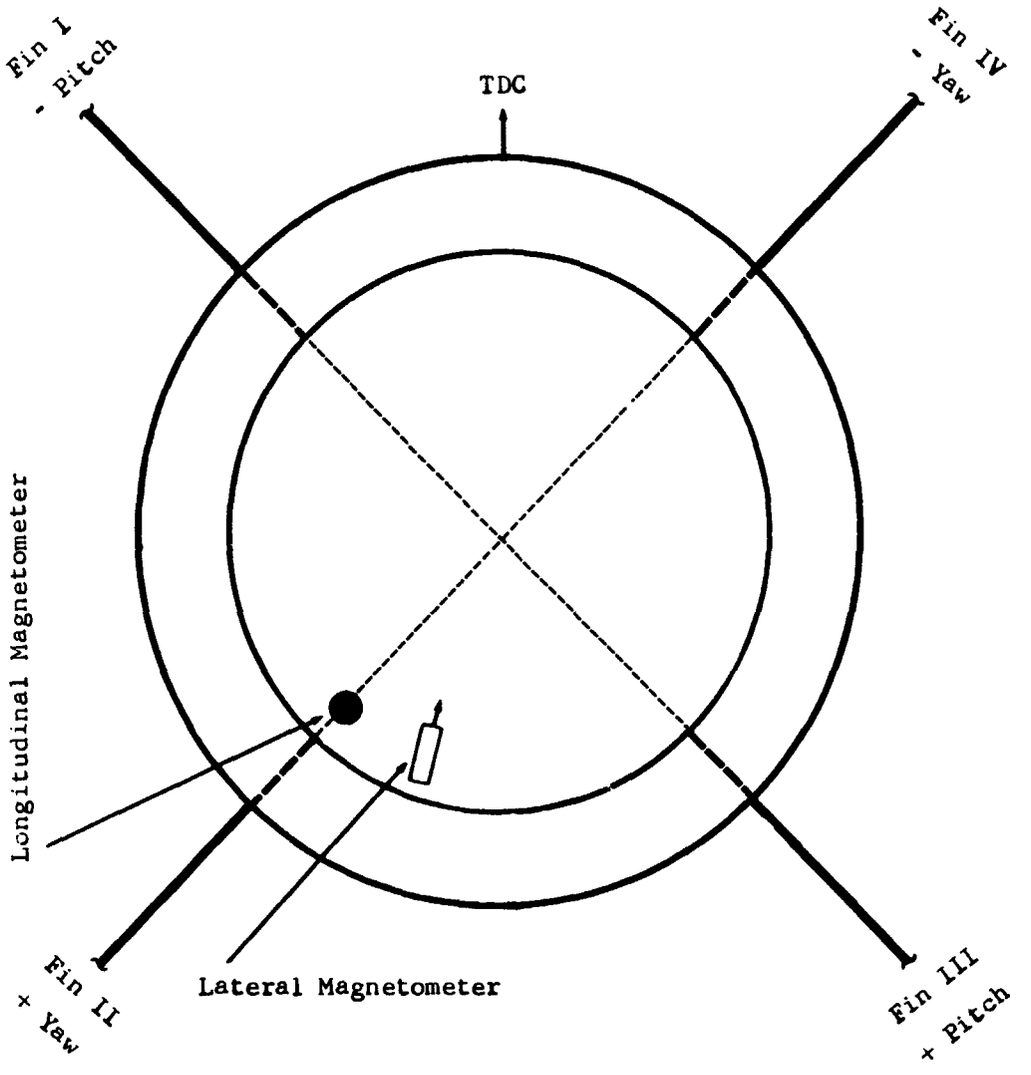


Figure 11. Magnetometer Orientation

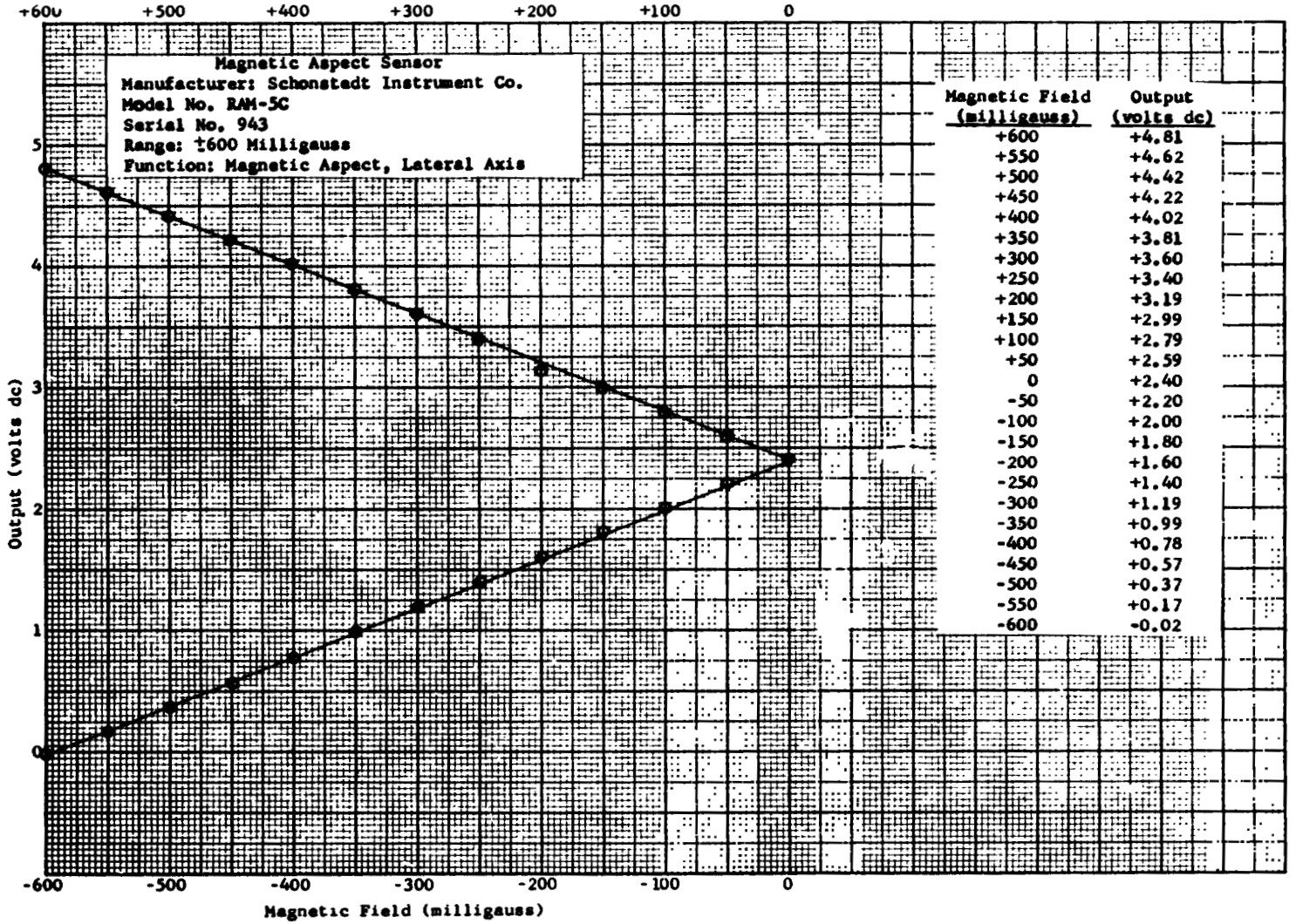
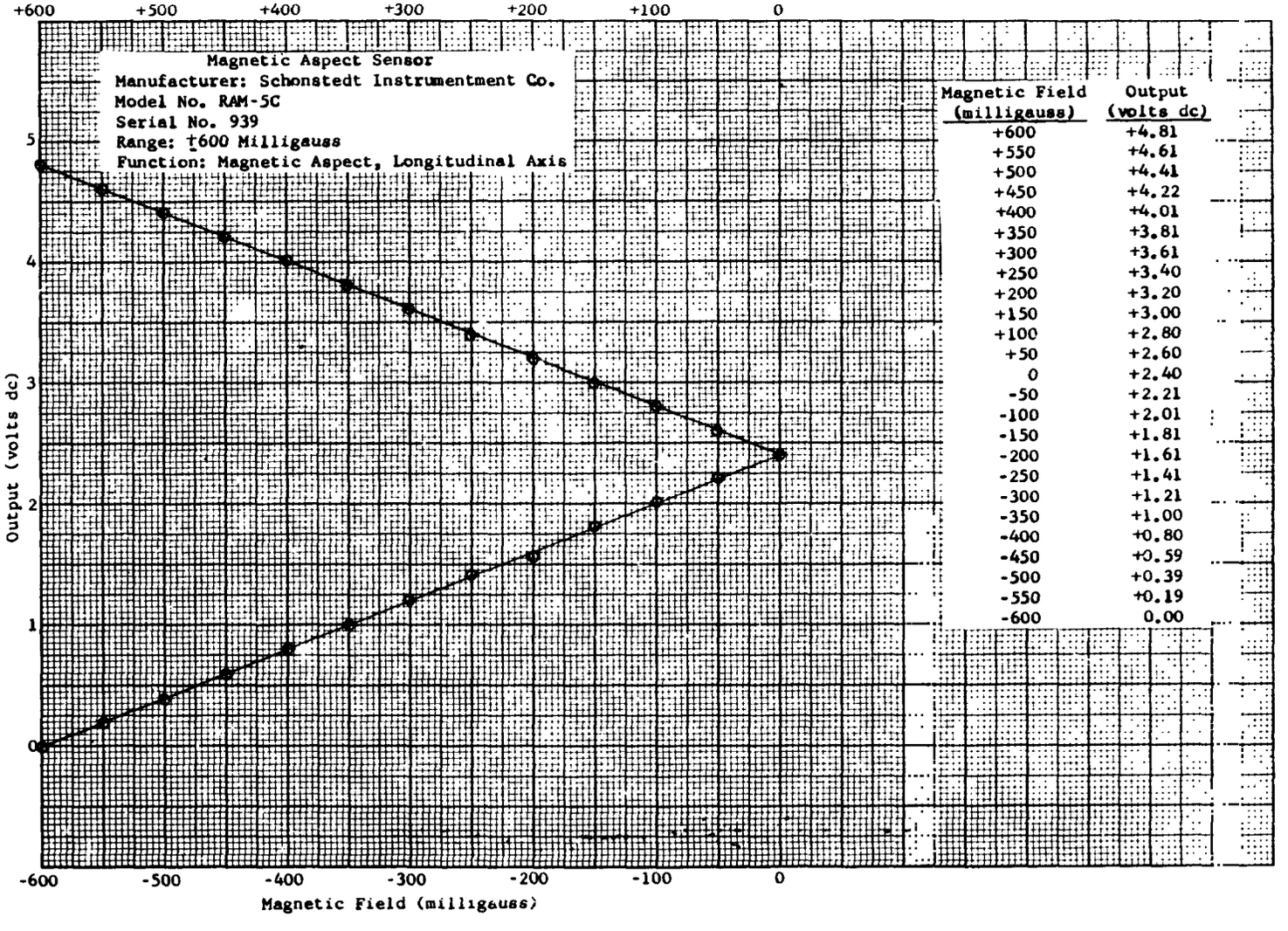


Figure 12. Magnetometer Calibration, Lateral Axis



Magnetic Field (milligauss)	Output (volts dc)
+600	+4.81
+550	+4.61
+500	+4.41
+450	+4.22
+400	+4.01
+350	+3.81
+300	+3.61
+250	+3.40
+200	+3.20
+150	+3.00
+100	+2.80
+50	+2.60
0	+2.40
-50	+2.21
-100	+2.01
-150	+1.81
-200	+1.61
-250	+1.41
-300	+1.21
-350	+1.00
-400	+0.80
-450	+0.59
-500	+0.39
-550	+0.19
-600	0.00

Figure 13. Magnetometer Calibration, Longitudinal Axis

SECTION III

VEHICLE ACCELERATION DATA

This section contains the vehicle acceleration instrumentation data. The instrumentation to obtain acceleration data consists of a three-axis accelerometer to measure the vehicle acceleration in the yaw, pitch, and thrust axes.

Table 10 is a listing of the three accelerometers, including the manufacturer, model number, serial number, and full scale range.

Figure 14 shows the sensor-vehicle orientation of the three accelerometers.

Figures 15, 17, and 19 are the calibration curves for the accelerometers in the yaw, pitch, and thrust axes, respectively.

Figures 16, 18, and 20 are the frequency response curves for the accelerometers in the yaw, pitch, and thrust axes, respectively.

Table 10
VEHICLE ACCELEROMETERS

Accelerometer	Manufacturer	Model No.	Serial No.	Range
Tri-axis:	CEC	4-204-0001	1145	
Yaw	CEC	4-204-0001	1402	±5g
Sig. Cond.	BLH	950-003A	024	
Pitch	CEC	4-204-0001	1403	±5g
Sig. Cond.	BLH	950-003A	002	
Thrust	CEC	4-204-0001	1295	±25g
Sig. Cond.	BLH	950-003A	104	

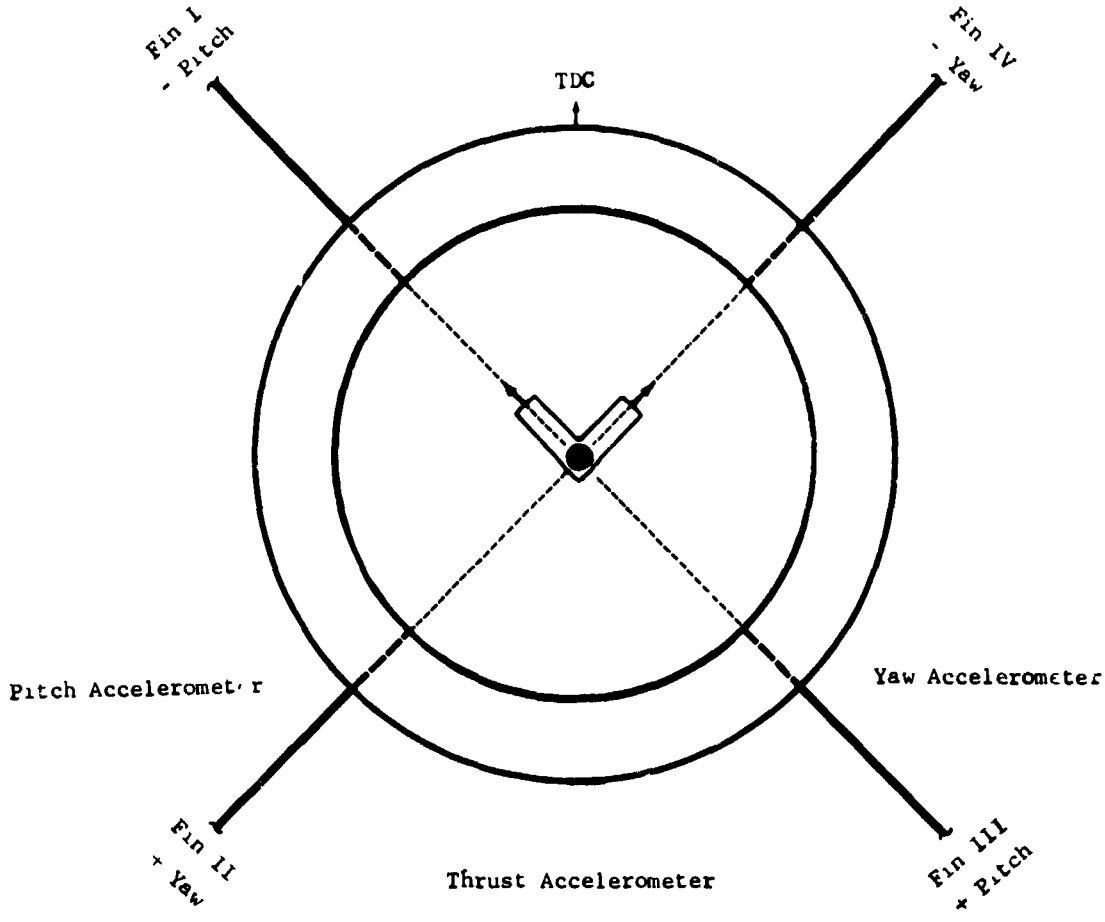


Figure 14. Accelerometer Orientation

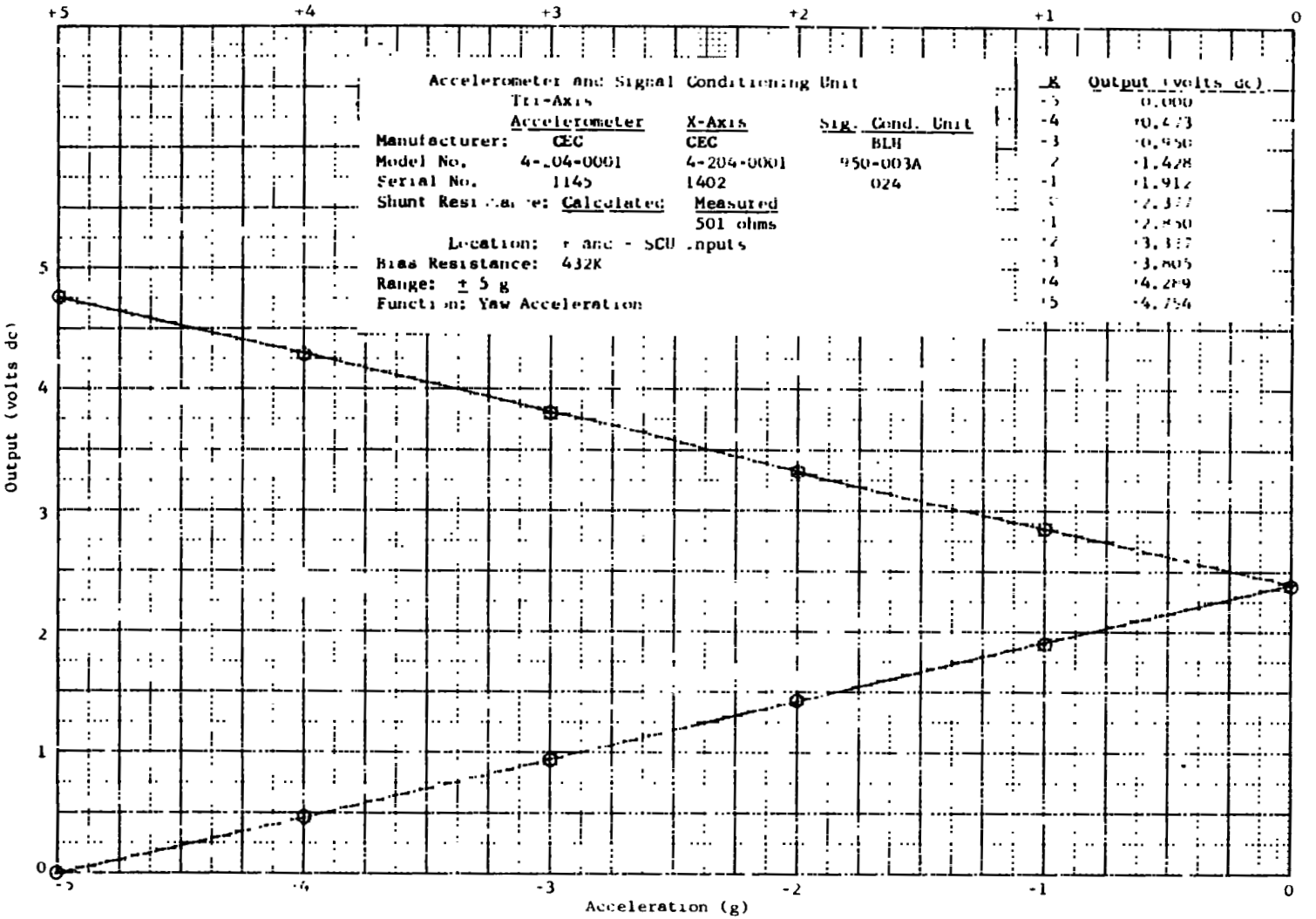


Figure 15. Accelerometer Calibration, Yaw Axis

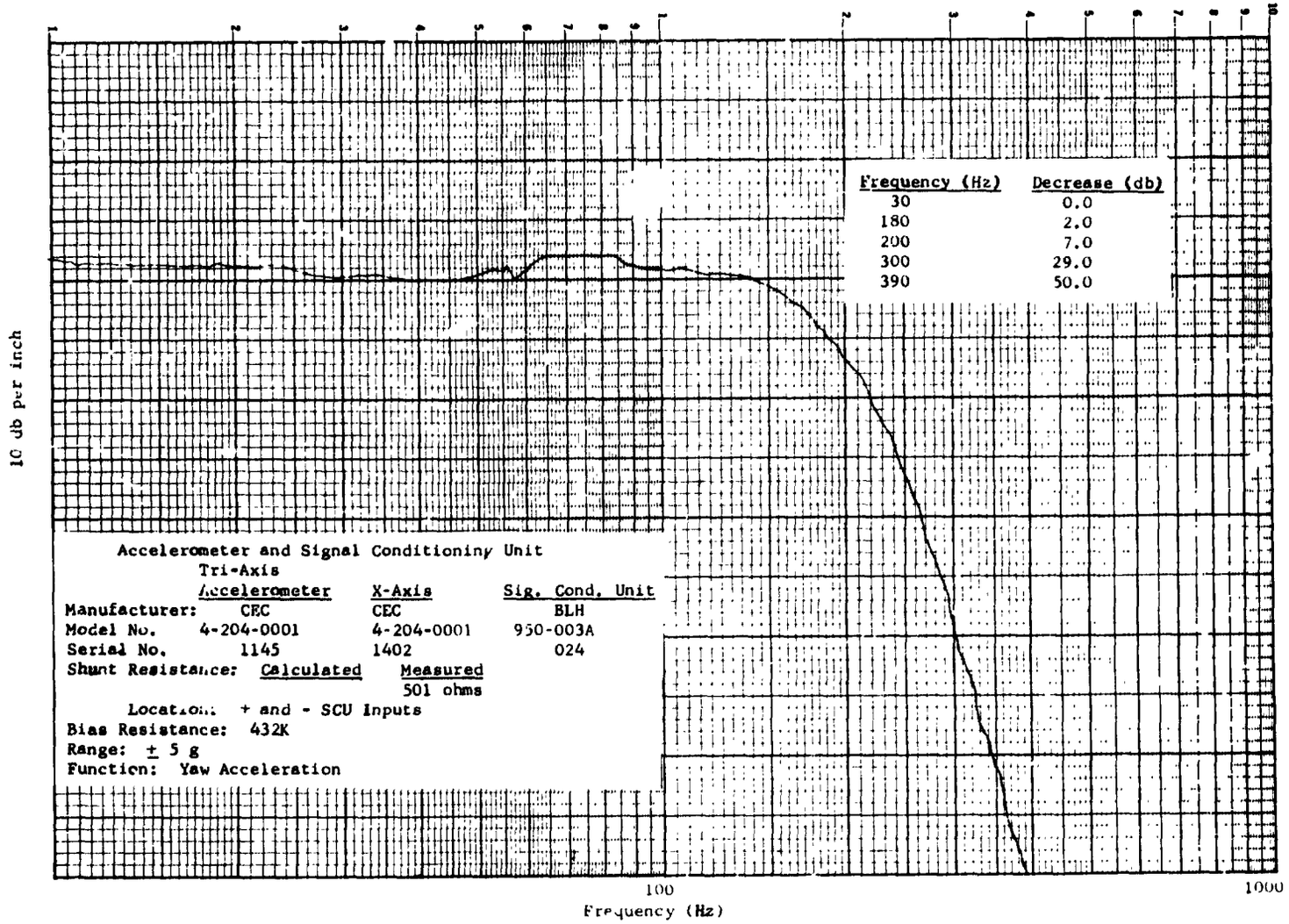


Figure 16. Accelerometer Frequency Response, Yaw Axis

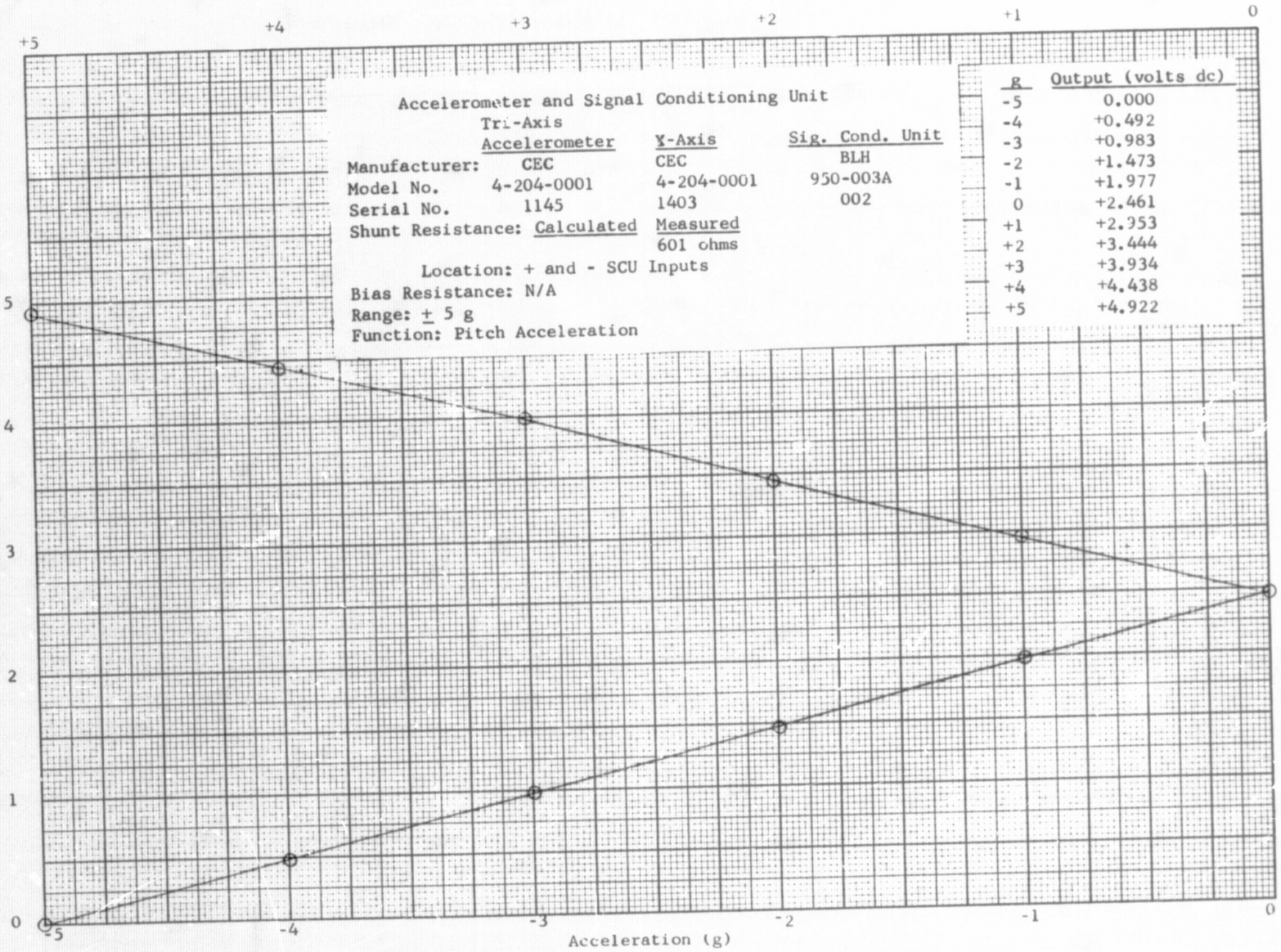


Figure 17. Accelerometer Calibration, Pitch Axis

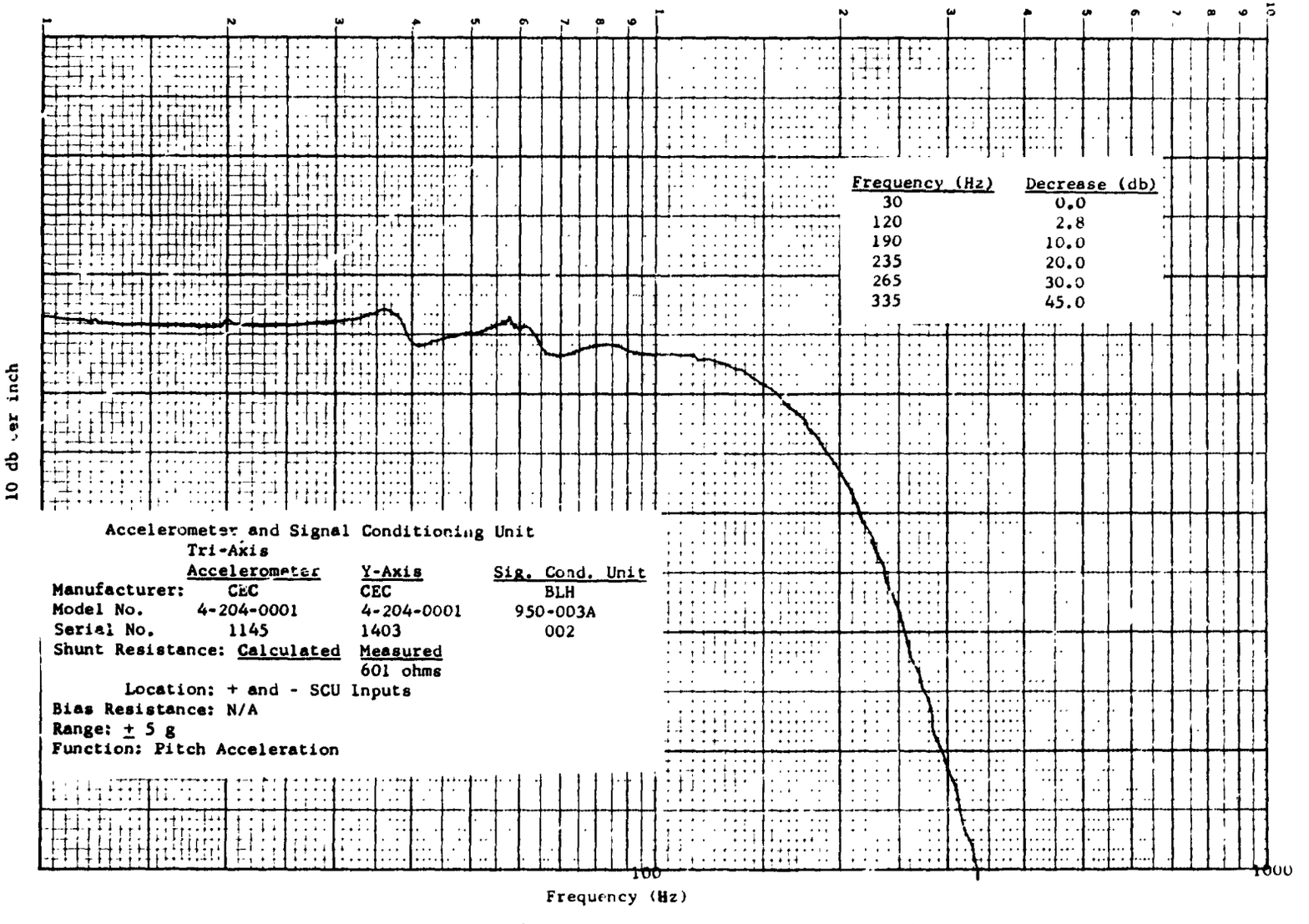


Figure 18. Accelerometer Frequency Response, Pitch Axis

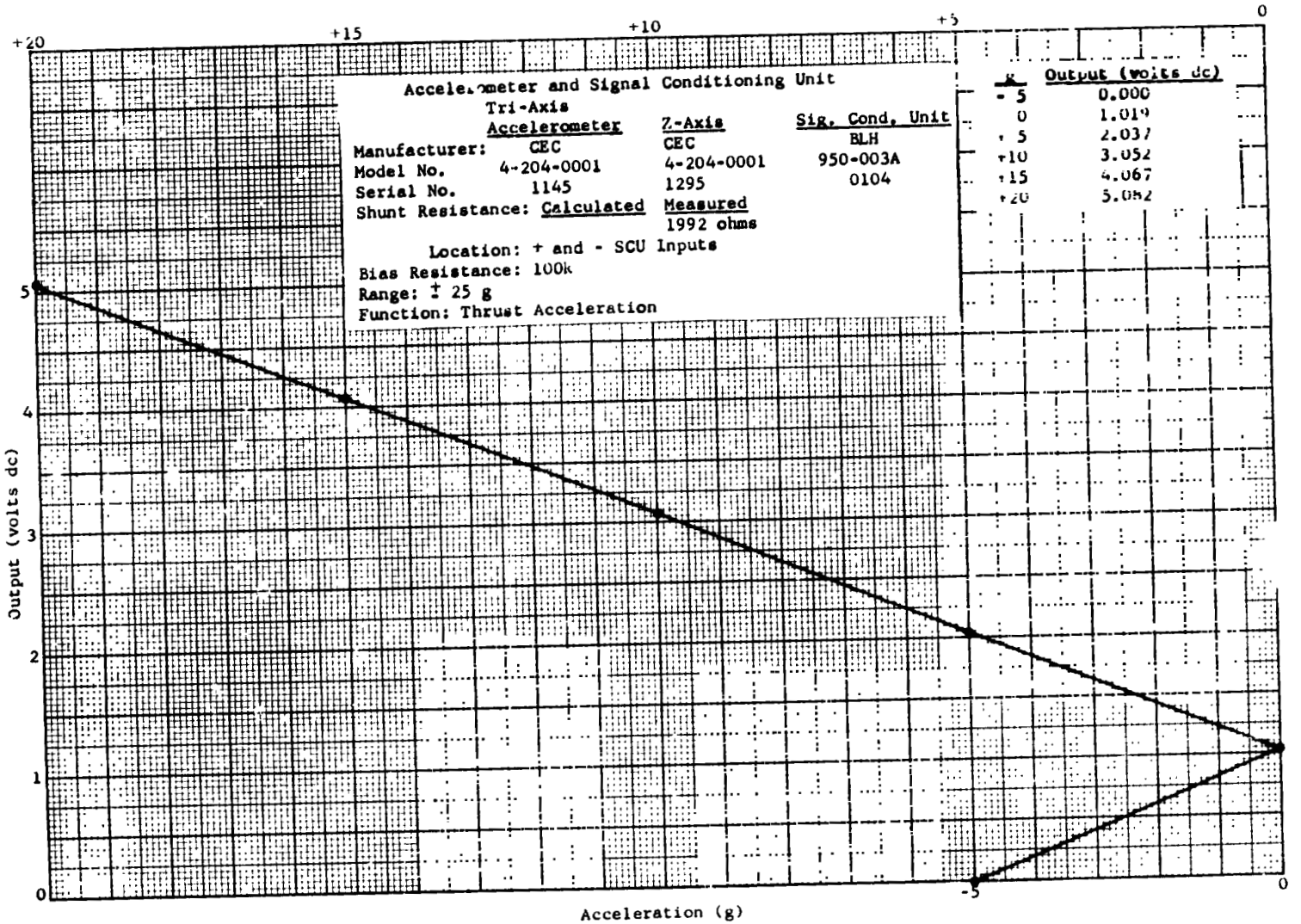


Figure 19. Accelerometer Calibration, Thrust Axis

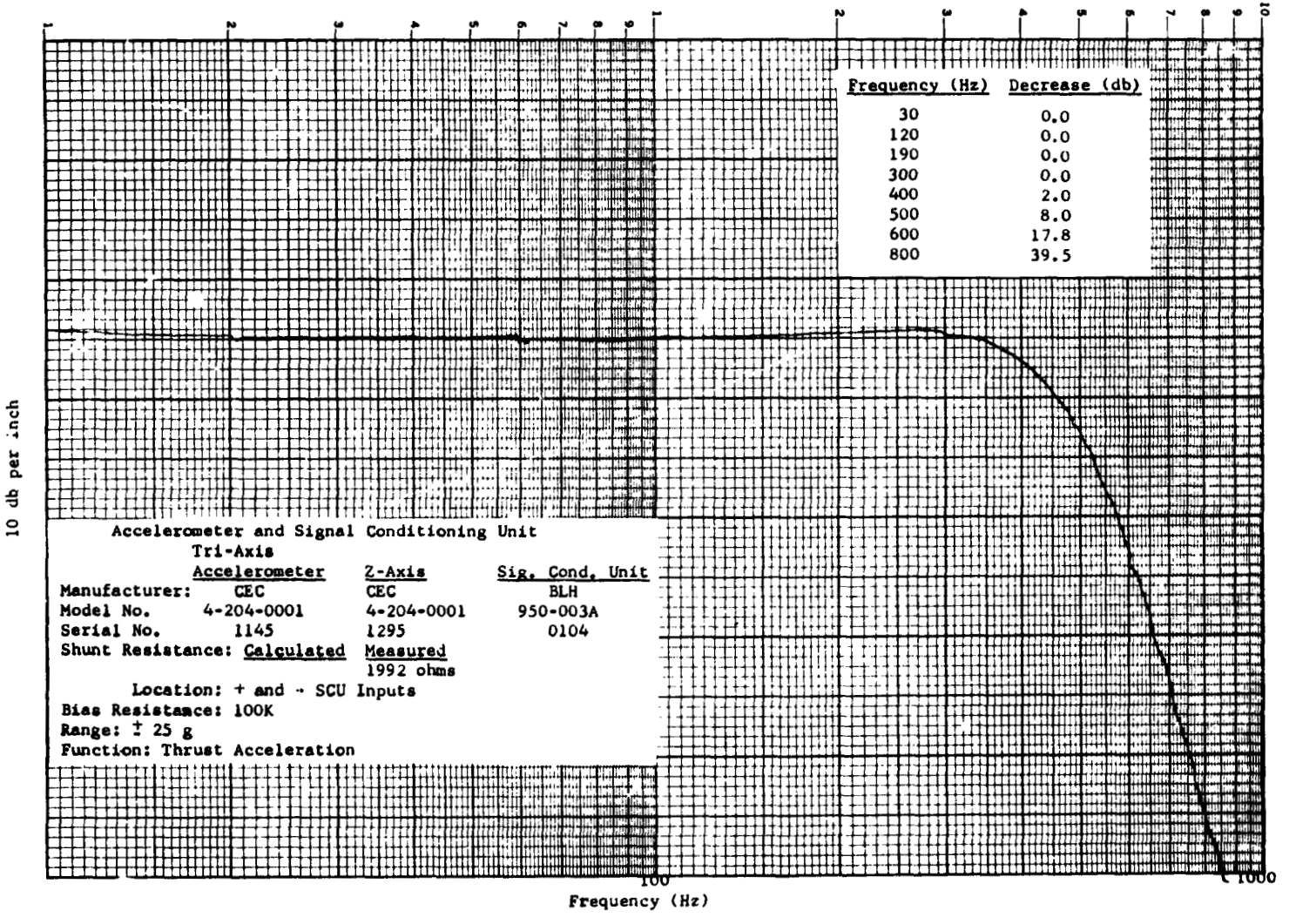


Figure 20. Accelerometer Frequency Response, Thrust Axis

SECTION IV

PRESSURE DATA

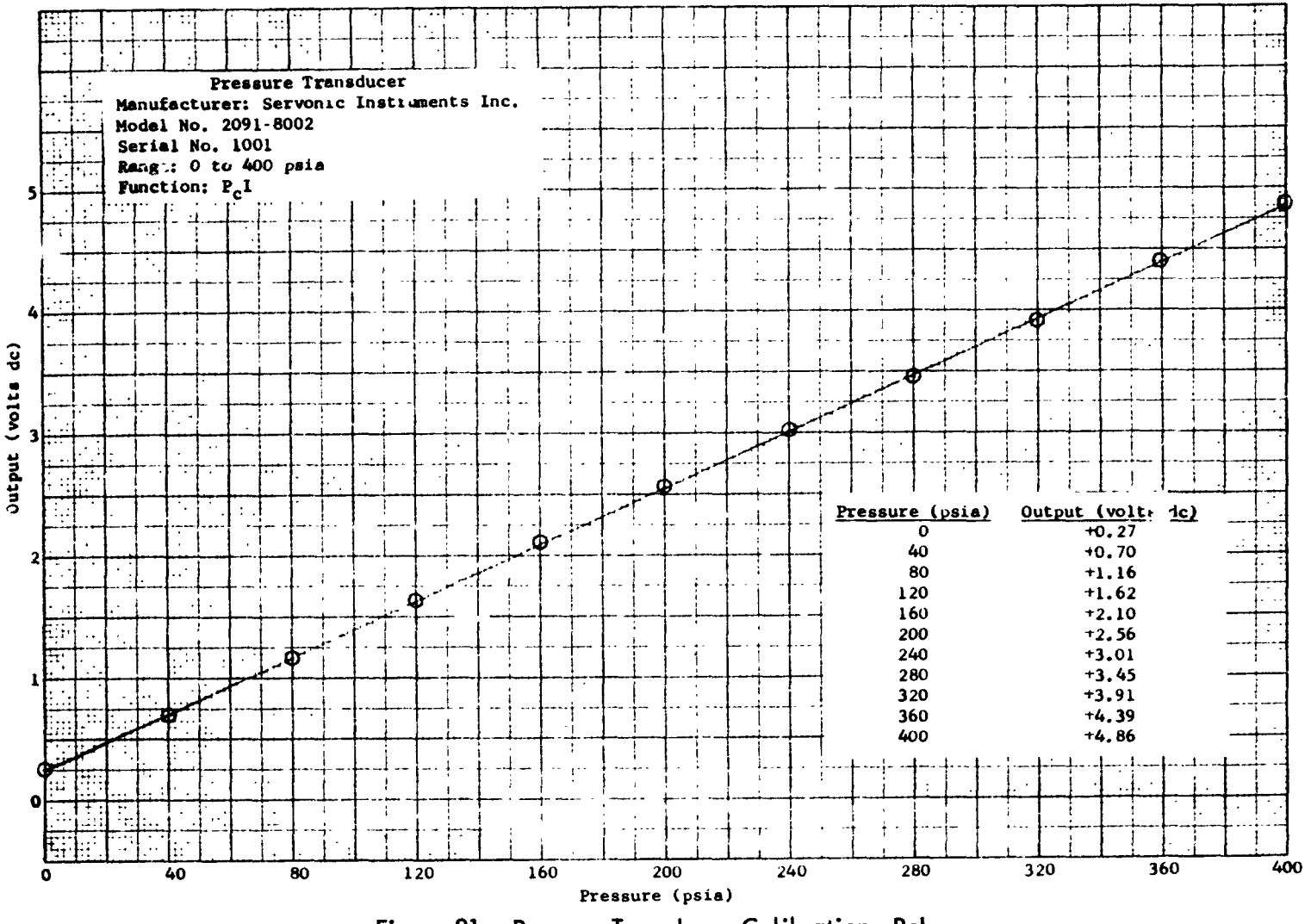
This section contains the vehicle pressure instrumentation data. The instrumentation to obtain pressure data consists of a total of six pressure transducers. Four of the transducers are used to measure chamber pressure, and are designated PcI, PcII, PcIII, and PcIV. The other two transducers are used to measure bottle pressure (Pgb), and gas regulator pressure (Pgr).

Table 11 is a listing of the pressure transducers, including the manufacturer, model number, serial number, and range.

Figures 21 through 26 are the calibration curves for PcI, PcII, PcIII, PcIV, Pgb, and Pgr, respectively.

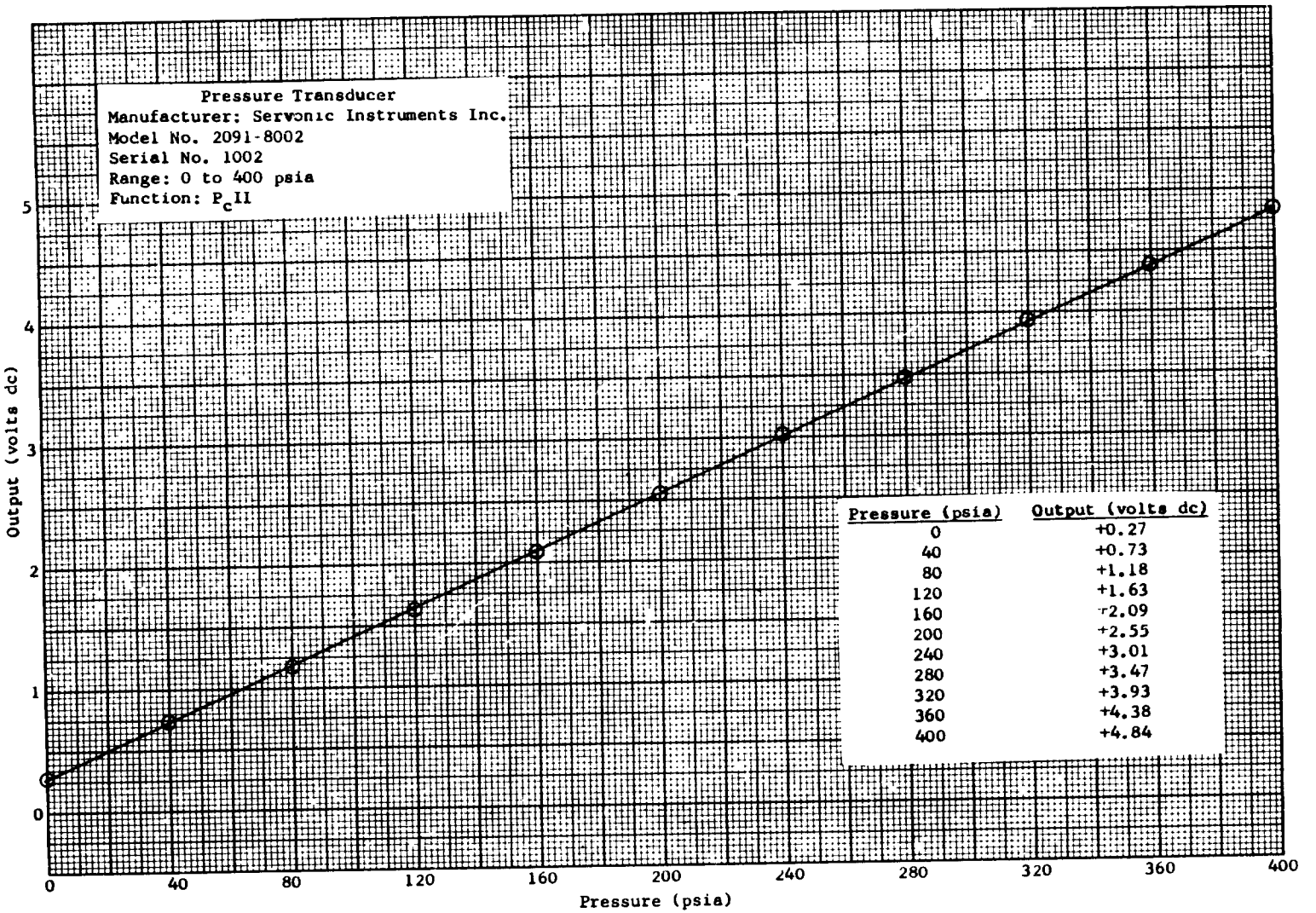
Table 11
VEHICLE PRESSURE TRANSDUCERS

Pressure Transducer	Manufacturer	Model No.	Serial No.	Range
PcI	Servonic Inst.	2091-8002	1001	0 to 400 psia
PcII	Servonic Inst.	2091-8002	1002	0 to 400 psia
PcIII	Servonic Inst.	2091-8002	1003	0 to 400 psia
PcIV	Servonic Inst.	2091-8002	1004	0 to 400 psia
Pgb	Servonic Inst.	2091-6702	1005	0 to 4000 psia
Pgr	Servonic Inst.	2091-6701	1075	0 to 600 psia



Pressure (psia)	Output (volts dc)
0	+0.27
40	+0.70
80	+1.16
120	+1.62
160	+2.10
200	+2.56
240	+3.01
280	+3.45
320	+3.91
360	+4.39
400	+4.86

Figure 21. Pressure Transducer Calibration, Pcl



Pressure (psia)	Output (volts dc)
0	+0.27
40	+0.73
80	+1.18
120	+1.63
160	+2.09
200	+2.55
240	+3.01
280	+3.47
320	+3.93
360	+4.38
400	+4.84

Figure 22. Pressure Transducer Calibration, PcII

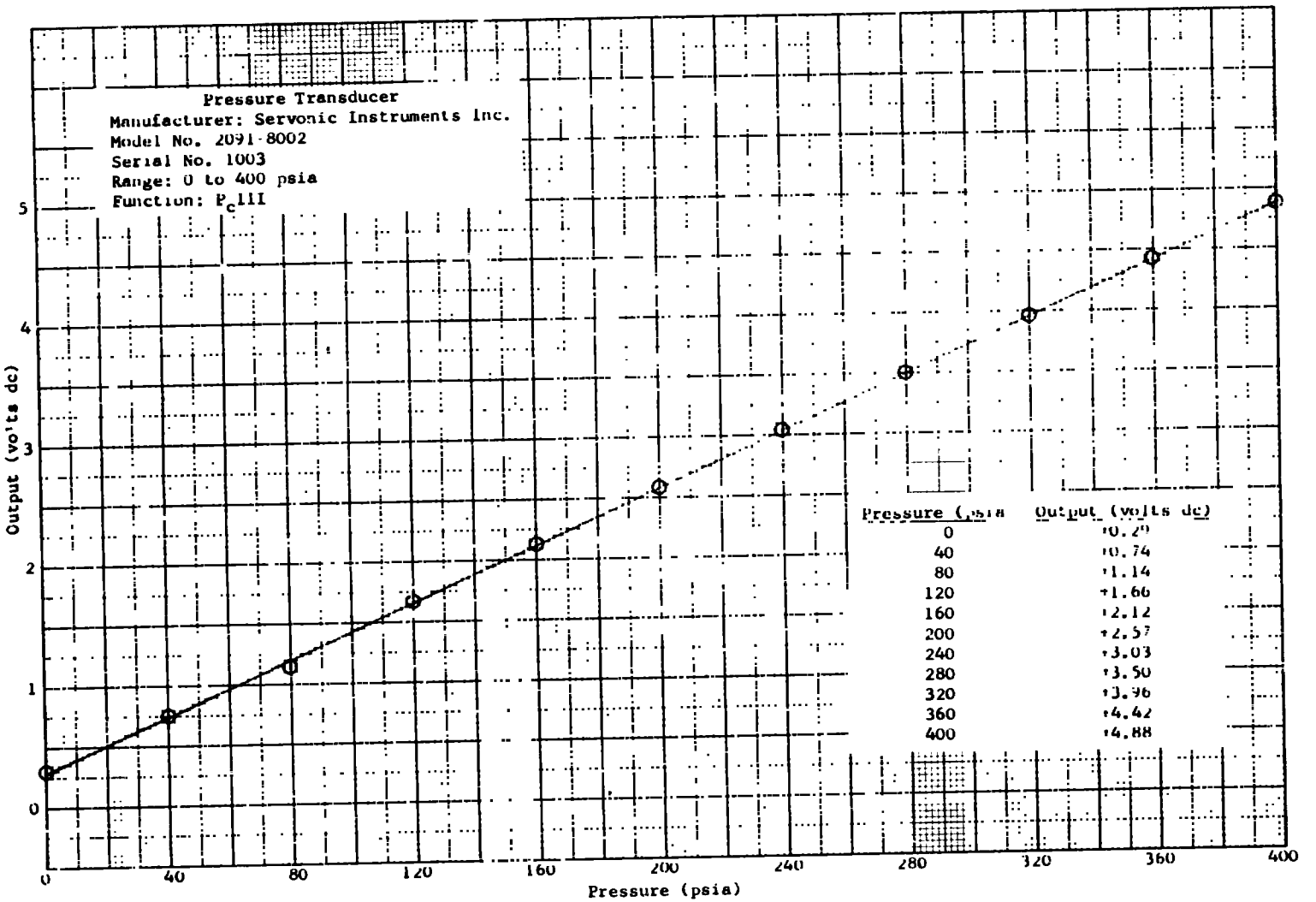
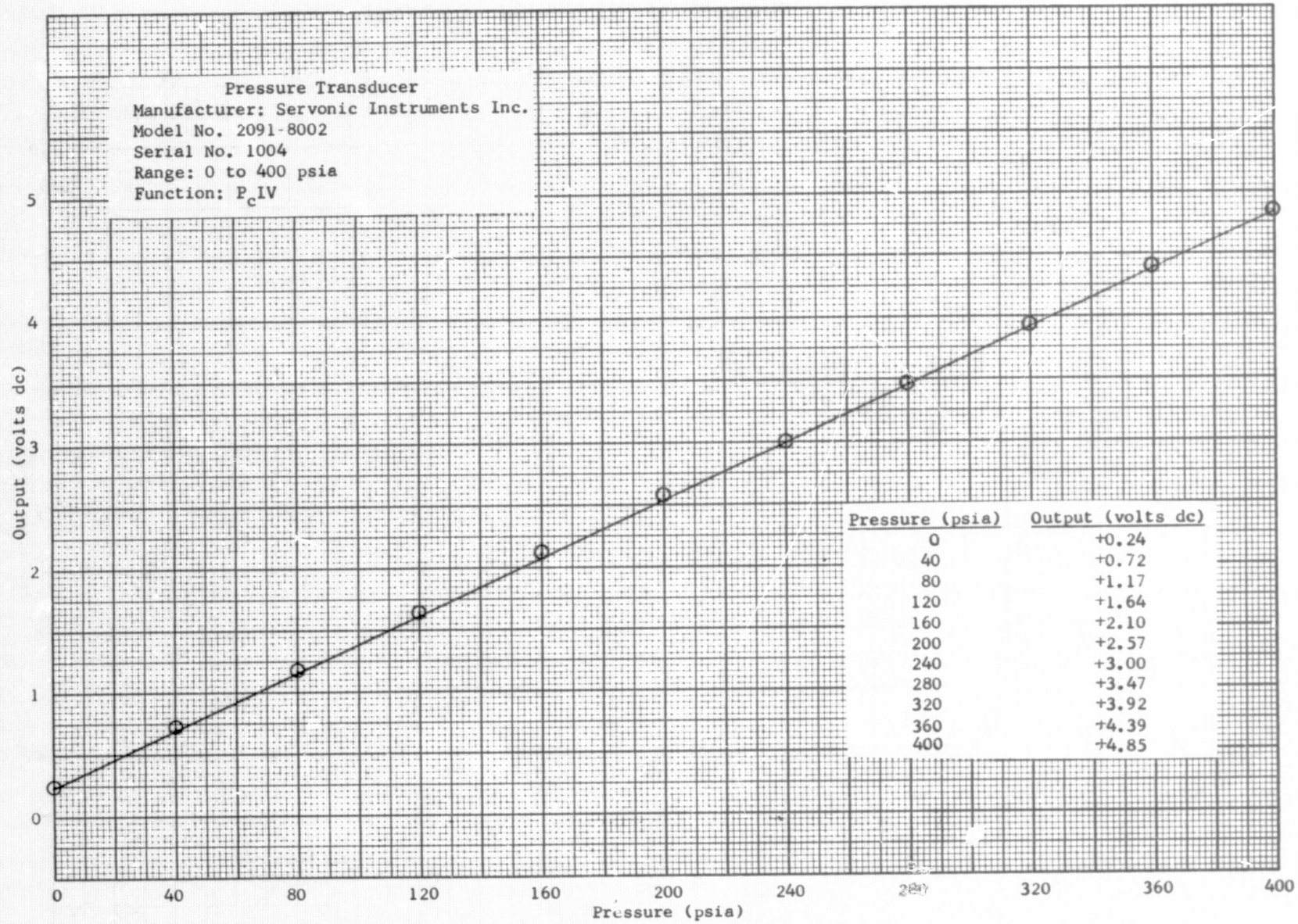
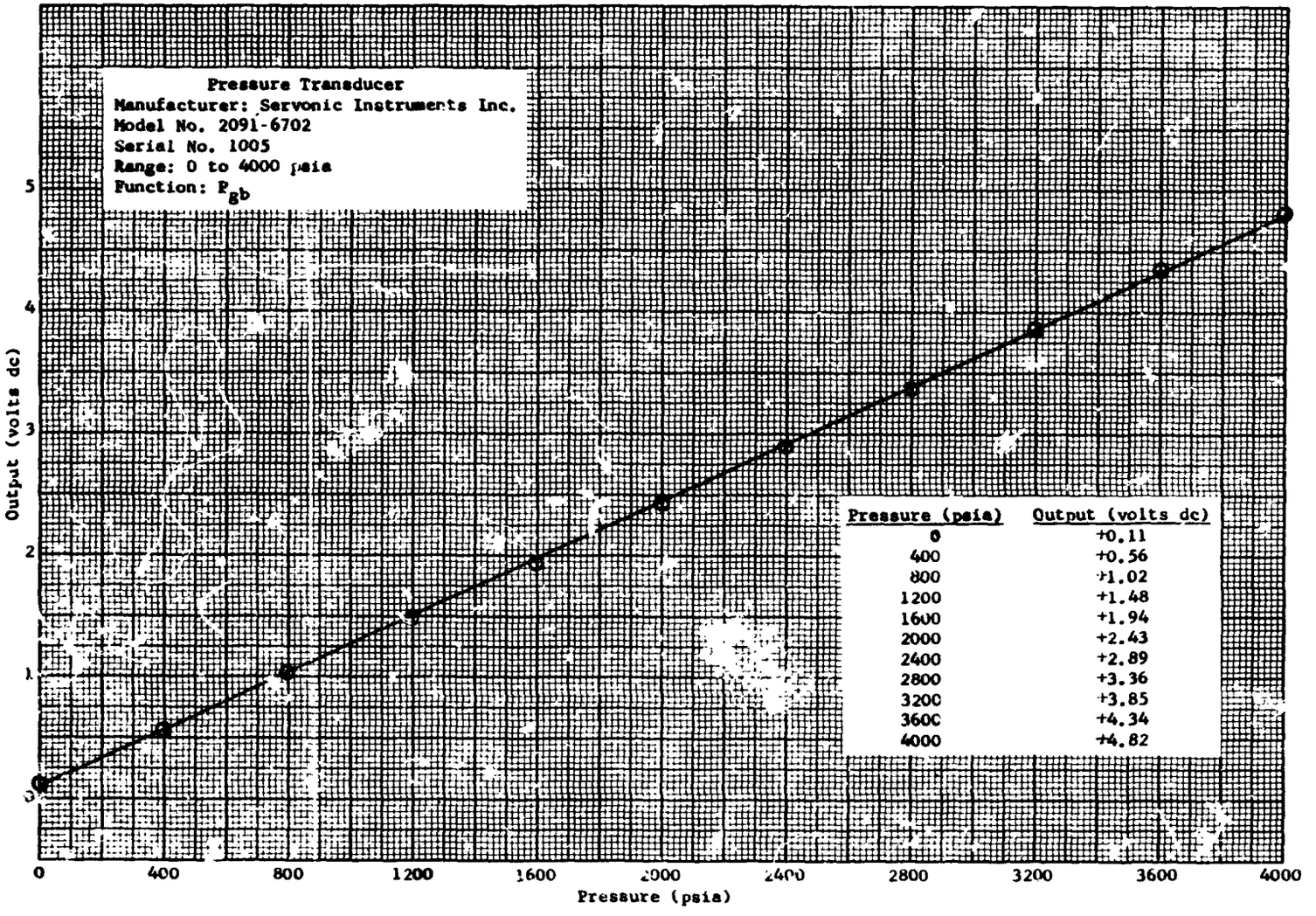


Figure 23. Pressure Transducer Calibration, PcIII



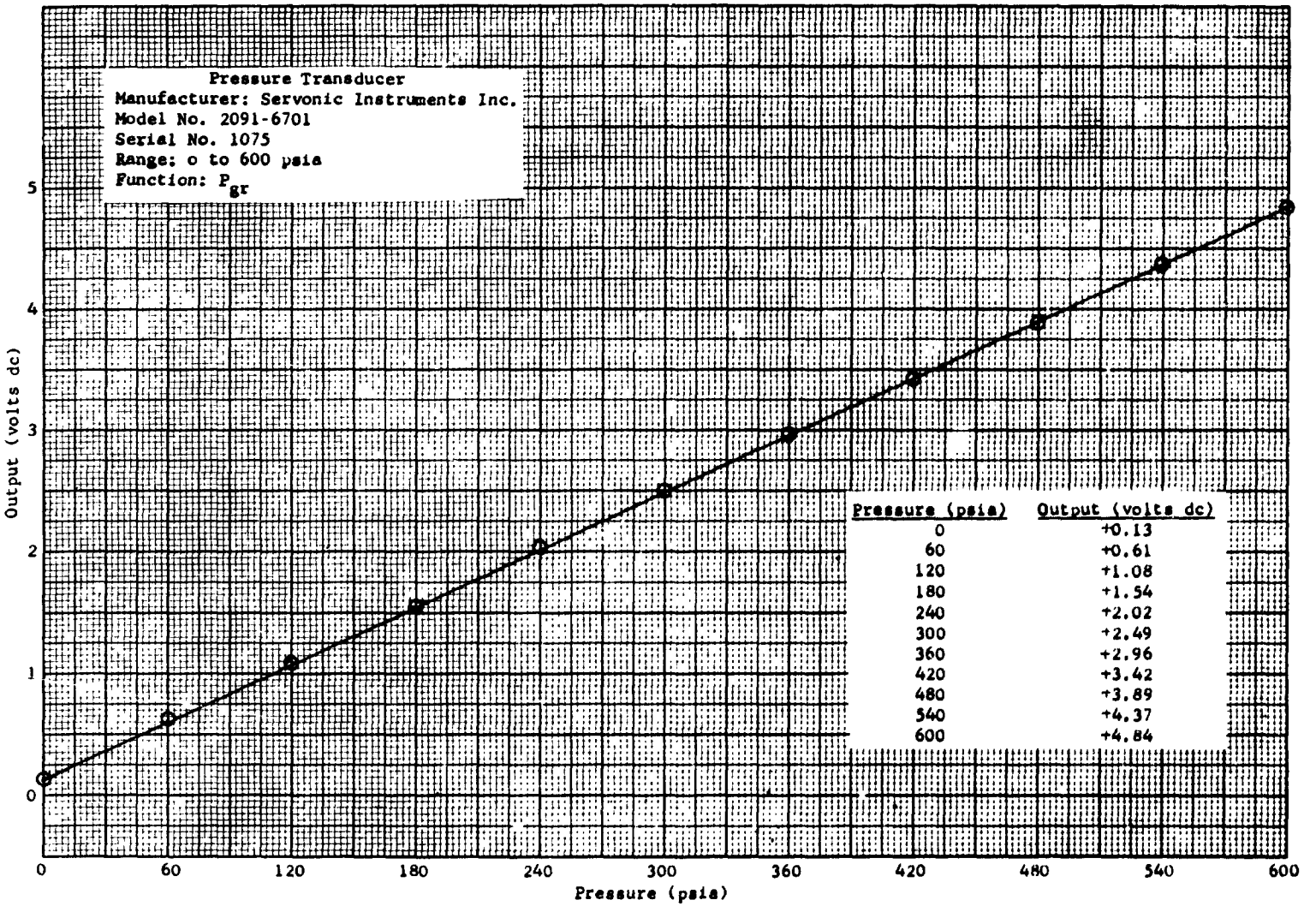
Pressure (psia)	Output (volts dc)
0	+0.24
40	+0.72
80	+1.17
120	+1.64
160	+2.10
200	+2.57
240	+3.00
280	+3.47
320	+3.92
360	+4.39
400	+4.85

Figure 24. Pressure Transducer Calibration, PcIV



Pressure (psia)	Output (volts dc)
0	+0.11
400	+0.56
800	+1.02
1200	+1.48
1600	+1.94
2000	+2.43
2400	+2.89
2800	+3.36
3200	+3.85
3600	+4.34
4000	+4.82

Figure 25. Pressure Transducer Calibration, Pgb



Pressure (psia)	Output (volts dc)
0	+0.13
60	+0.61
120	+1.08
180	+1.54
240	+2.02
300	+2.49
360	+2.96
420	+3.42
480	+3.89
540	+4.37
600	+4.84

Figure 26. Pressure Transducer Calibration, Pgr

SECTION V

TEMPERATURE DATA

This section contains the vehicle temperature instrumentation data. The temperature instrumentation consists of a total of eight temperature transducers. In addition, there is a high temperature amplifier, which is used to amplify and condition the temperature transducer signals for telemetry transmission.

Table 12 is a listing of the temperature transducers, including their manufacturer, model number, serial number, and range.

Figure 27 shows the location of the temperature instrumentation transducers in the vehicle.

Figures 28 through 36 are the calibration curves for the temperature transducers T1 through T8, respectively.

Figure 36 is the high temperature amplifier schematic diagram.

Figure 37 is the high temperature amplifier calibration curve.

Table 12
VEHICLE TEMPERATURE TRANSDUCERS

Temperature Transducer	Manufacturer	Model No.	Serial No.	Range
T1	Temtech	4415-3	2537	0 to 1000°F
T2	Temtech	4415-3	2852	0 to 1000°F
T3	Temtech	4415-3	2559	0 to 1000°F
T4	Temtech	4415-3	2541	0 to 1000°F
T5	Temtech	4415-3	2587	0 to 1000°F
T6	Temtech	4415-3	2476	0 to 1000°F
T7	Temtech	4415-3	2609	0 to 1000°F
T8	Temtech	4415-3	2481	0 to 1000°F
High Temperature Amplifier	GSFC	N/A	1	0 to 5 Volts dc

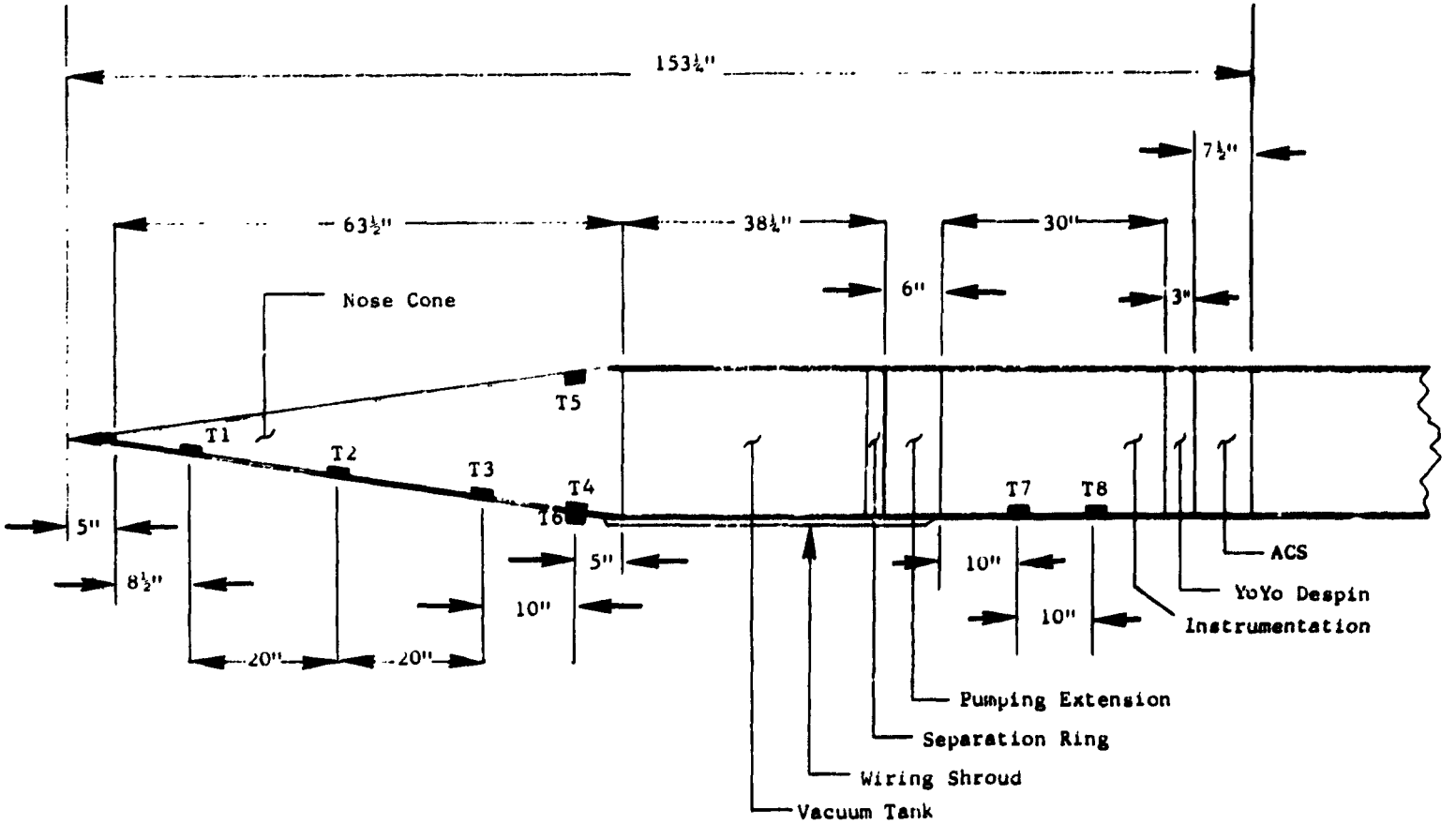


Figure 27. Temperature Sensor Locations

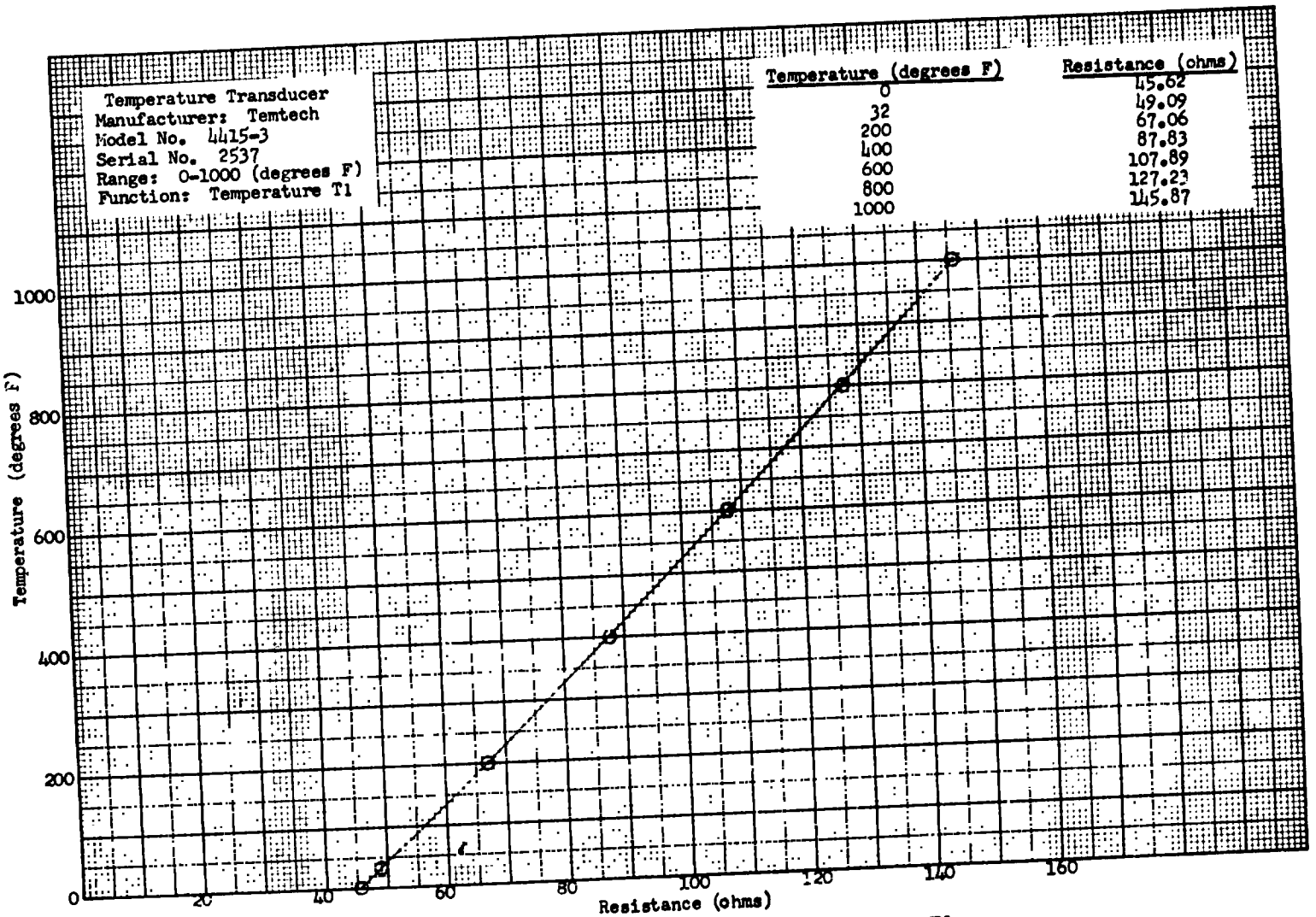


Figure 28. Temperature Sensor Calibration, T1

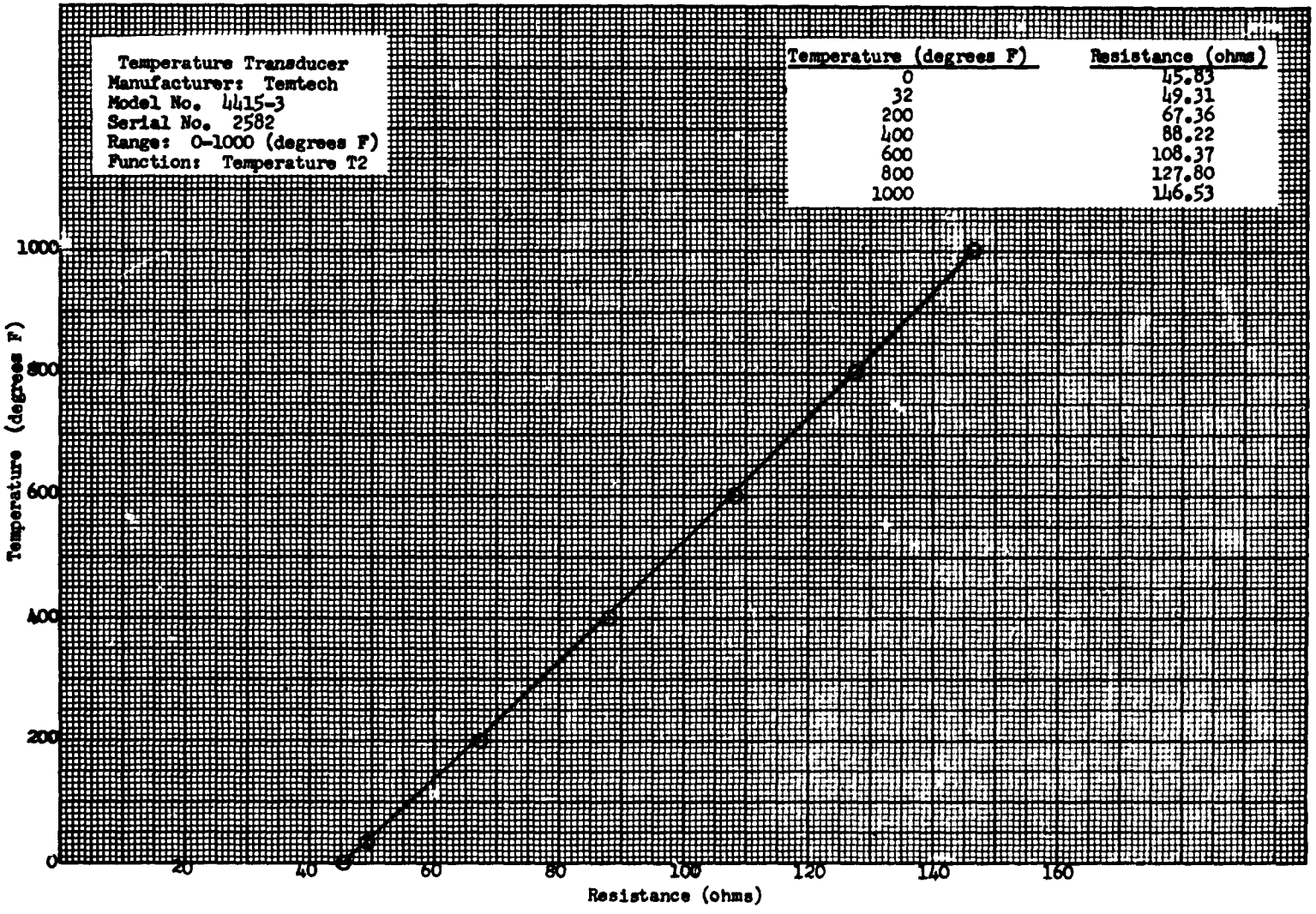


Figure 29. Temperature Sensor Calibration, T2

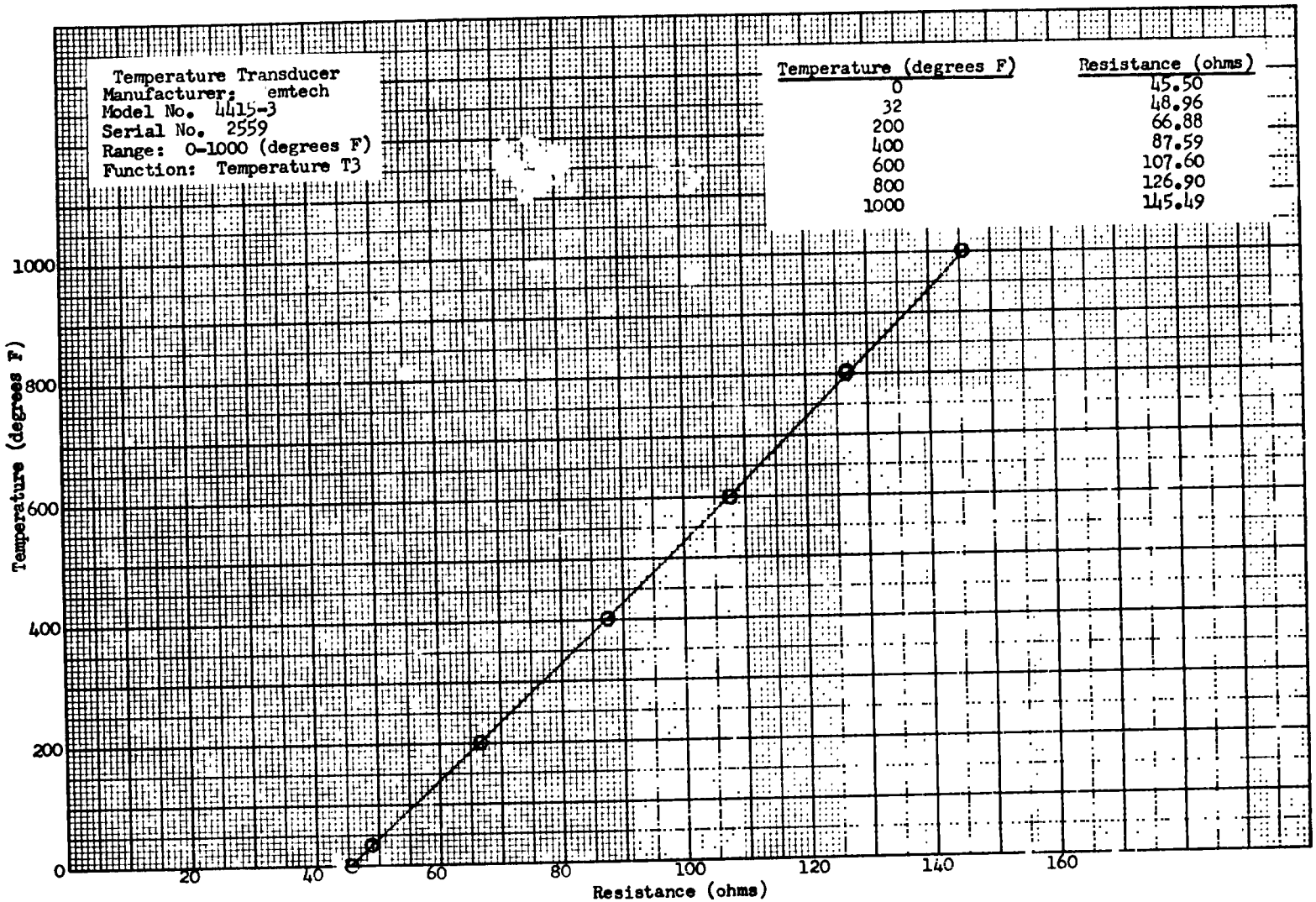


Figure 30. Temperature Sensor Calibration, T3

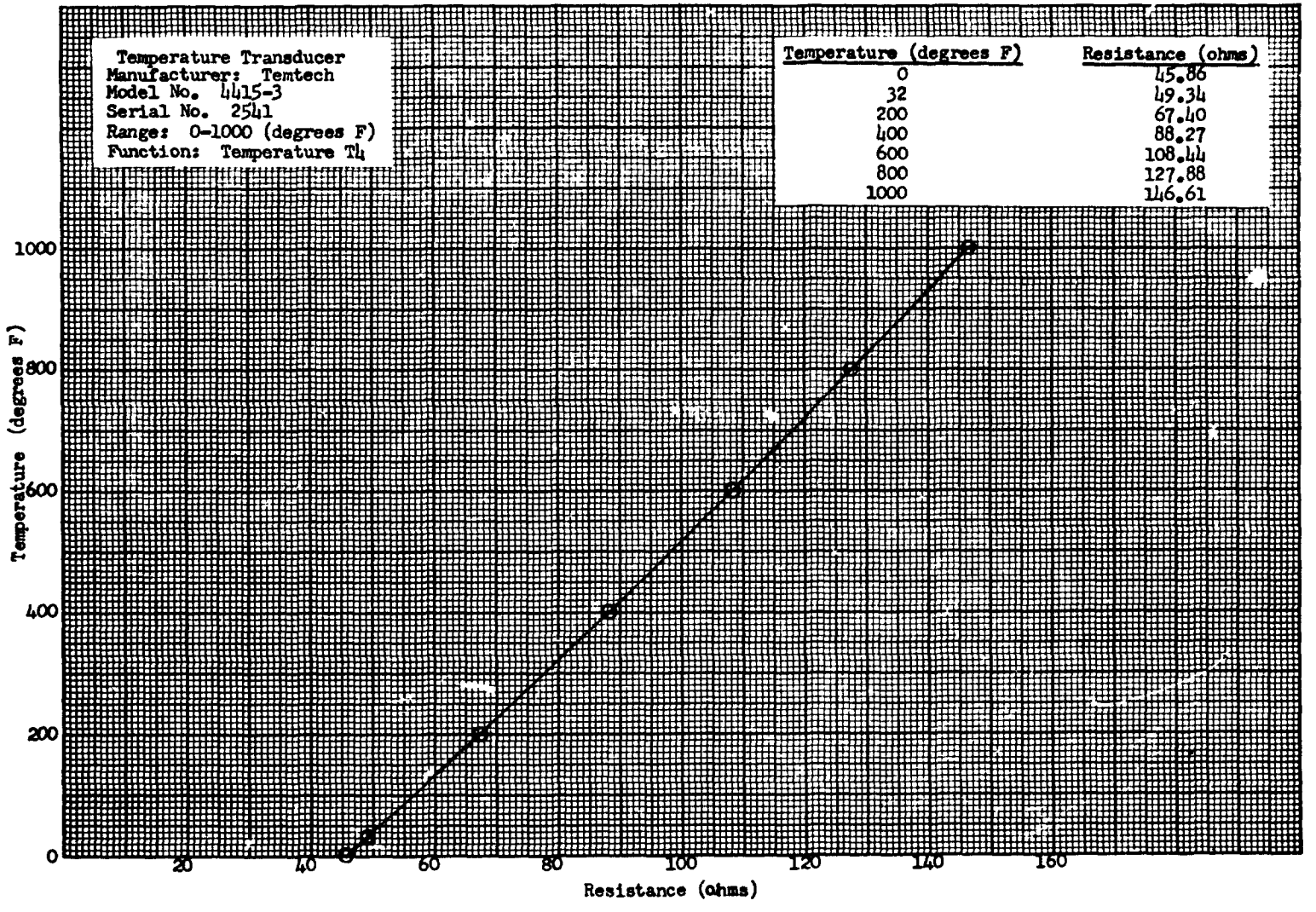


Figure 31. Temperature Sensor Calibration, T4

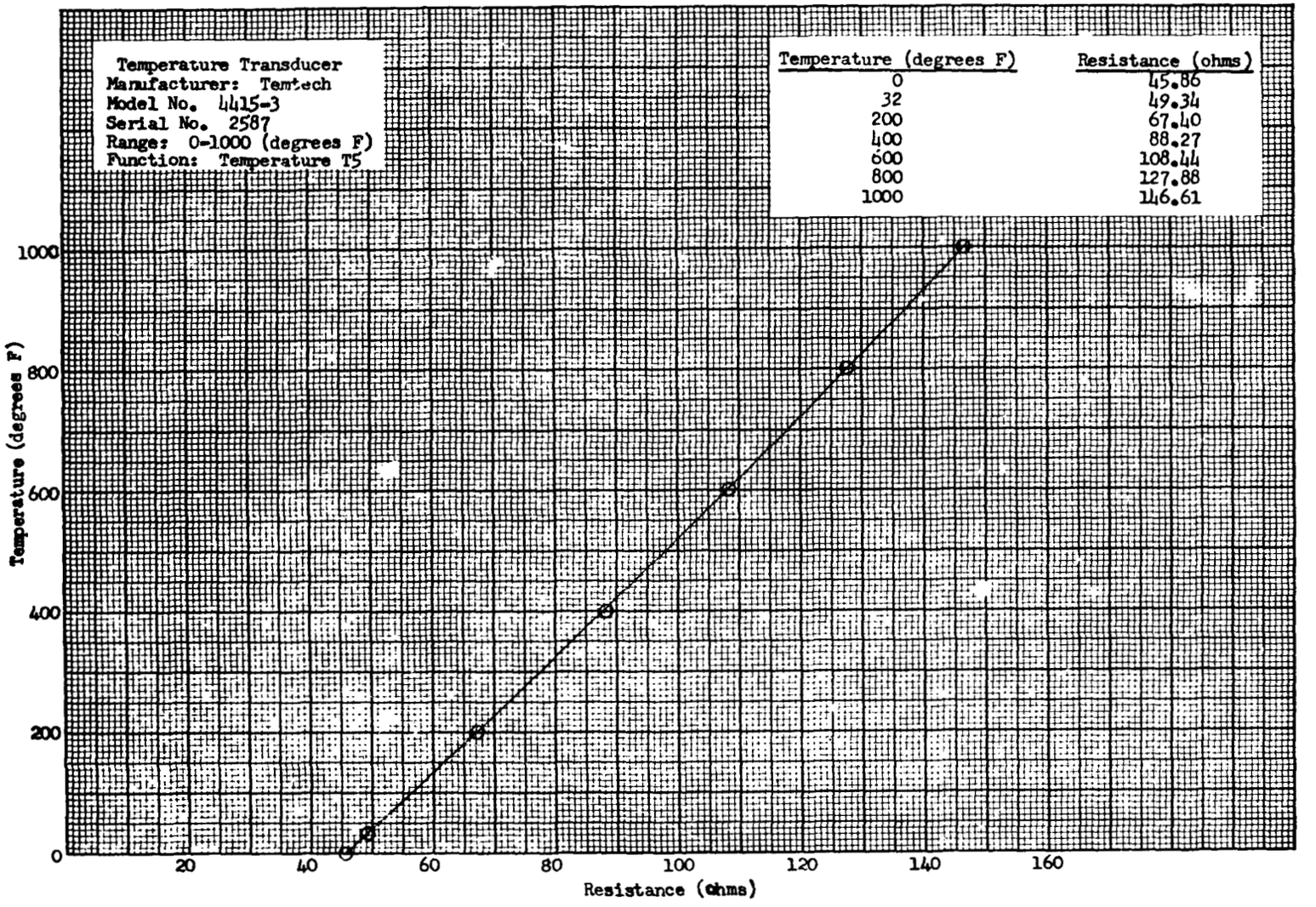


Figure 32. Temperature Sensor Calibration, T5

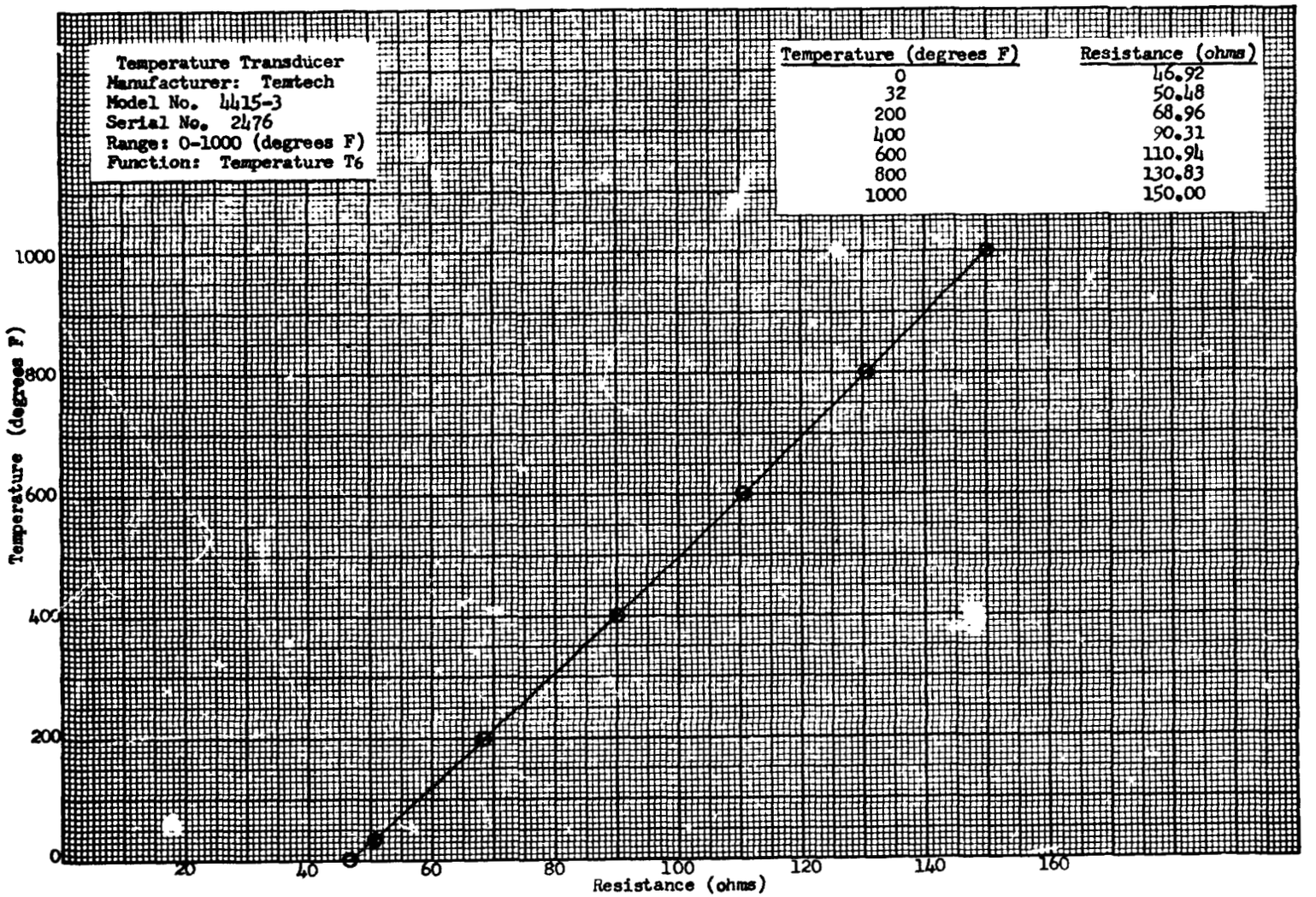


Figure 33. Temperature Sensor Calibration, T6

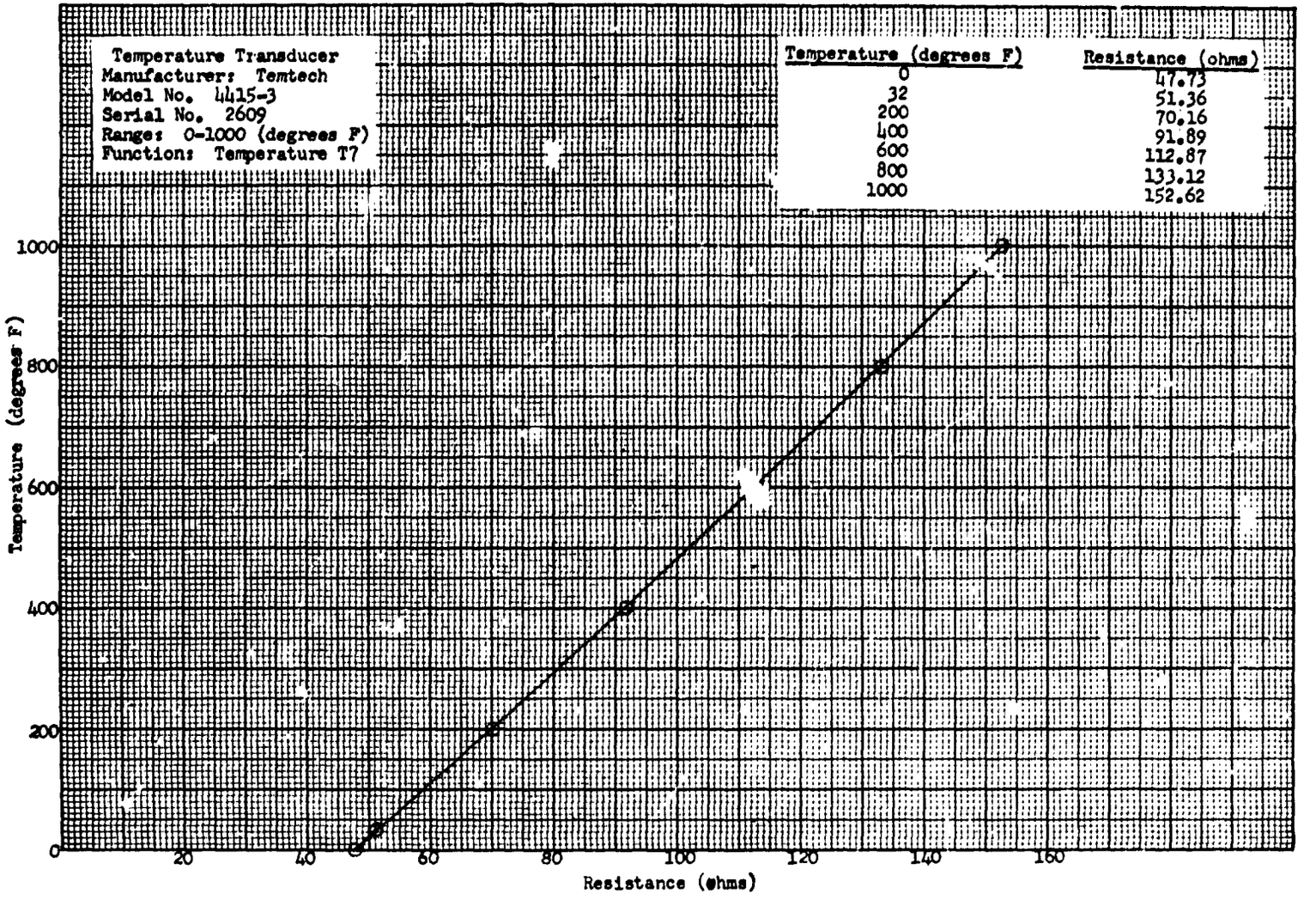


Figure 34. Temperature Sensor Calibration, T7

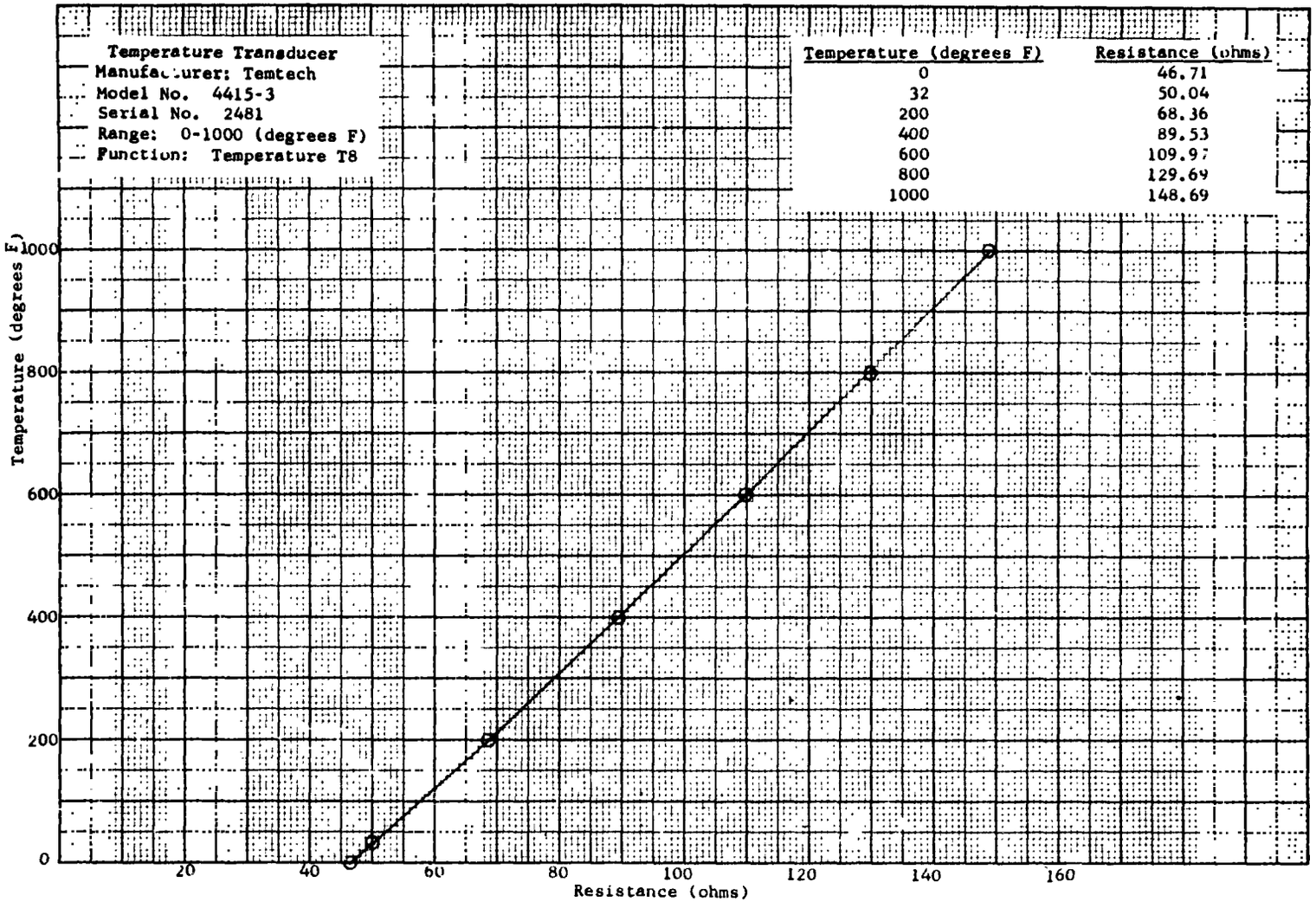
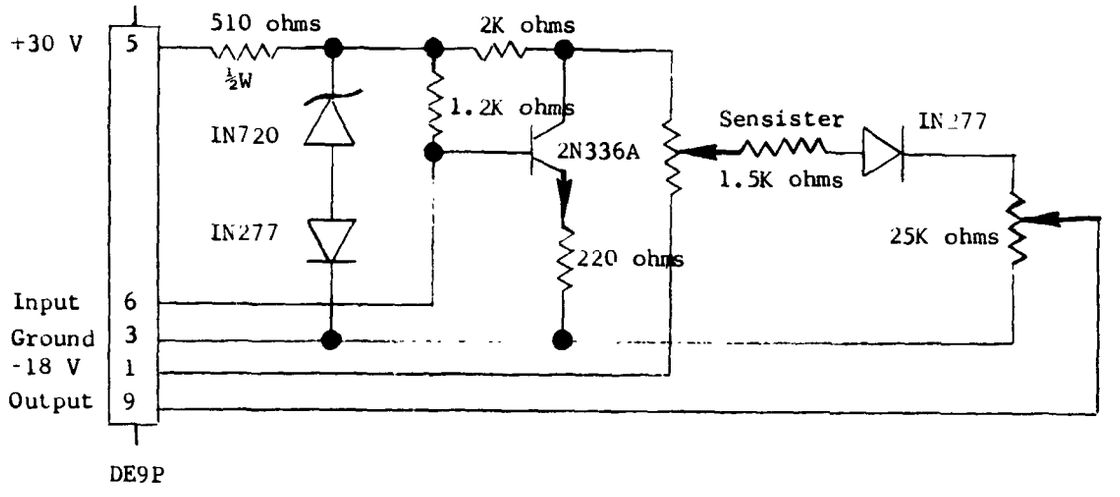


Figure 35. Temperature Sensor Calibration, T8



Note: All resisters are metal film, unless otherwise noted.

Figure 36. High Temperature Amplifier Schematic Diagram

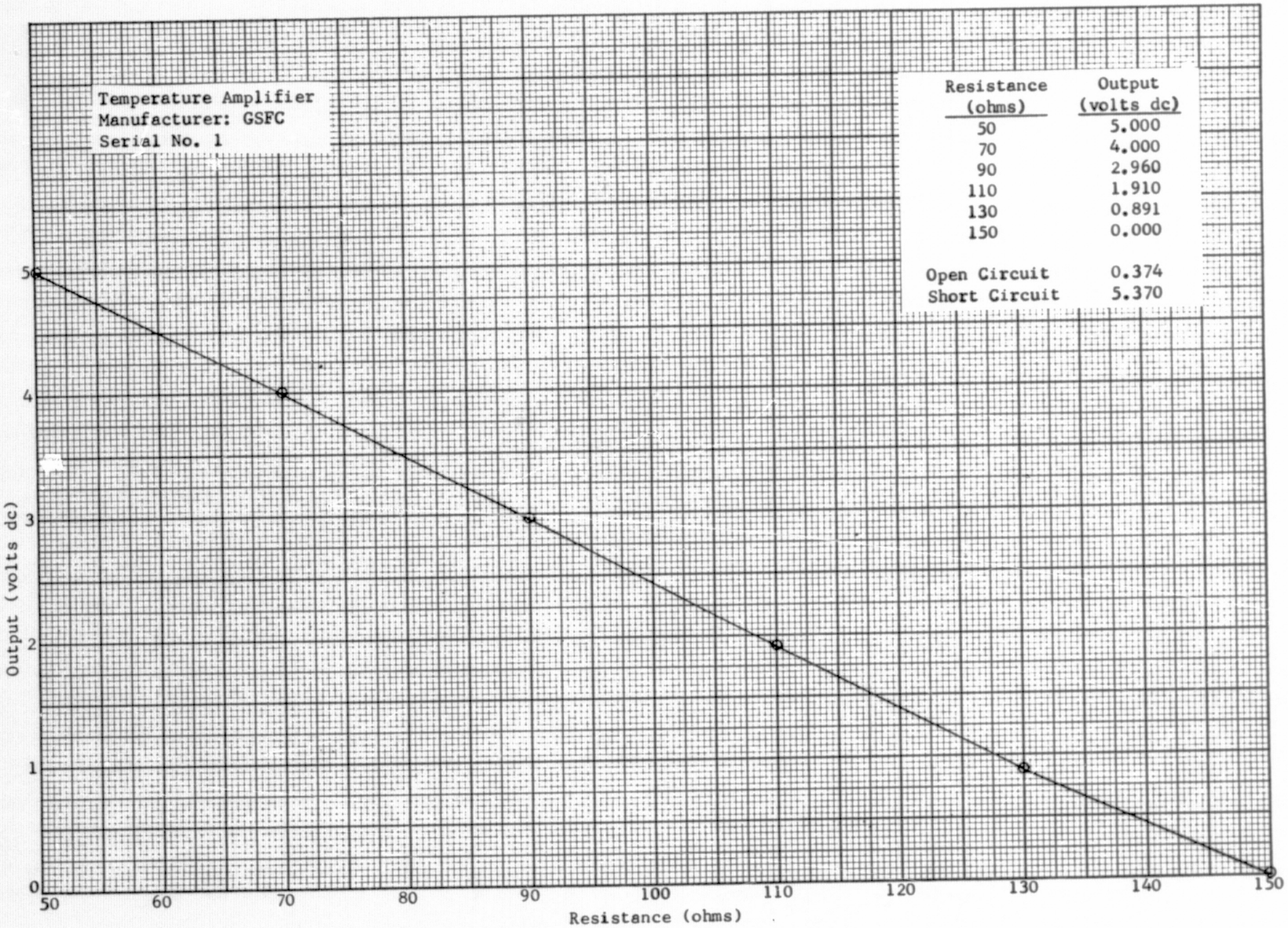


Figure 37. High Temperature Amplifier Calibration

SECTION VI

ANTENNA DATA

This section contains the vehicle instrumentation and command-receivers antenna data. Telemetry System 1 uses two pairs of quadraloop antennas. The first pair (Serial No's N29, N30) is used prior to channel switching, and the second pair (Serial No's W52, W53) is used after channel switching. Telemetry System 2 uses one pair of quadraloop antennas (Serial No's B60, B62). The command-receivers use one pair of quadraloop antennas (Serial No's N55, N56).

Table 13 is a listing of the telemetry systems and command-receivers and their antennas, including their manufacturer, model number, serial number, and frequency.

Figure 38 is the antenna impedance chart for Telemetry System 1 (Serial No's N29, N30) prior to channel switching.

Figure 39 is the antenna impedance chart for Telemetry System 1 (Serial No's W52, W53) after channel switching.

Figure 40 is the antenna impedance chart for Telemetry System 2 (Serial No's B60, B62).

Figure 41 is the antenna impedance chart for the command-receivers (Serial No's N55, N56).

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Table 13

VEHICLE TELEMETRY AND COMMAND RECEIVER ANTENNAS

Antenna	Manufacturer	Model No.	Serial No.	Frequency
Telemetry System 1	N. Mex. State	2.041	N29, N30	244.3 MHz
Telemetry System 1	N. Mex. State	2.045	W52, W53	244.3 MHz
Telemetry System 2	N. Mex. State	2.052	B60, B62	256.2 MHz
Command Receivers	N. Mex. State	4.003	N55, N56	412.0 MHz

VSWR Measurements at Launch Site: TM1 VSWR = 1.42
TM2 VSWR = 1.05

TITLE Model No. 2.041
Serial No. N29 and N30

Tuned to 244.3 MHz
Parallel Tuned Curve at "Tee"

DATE May 2, 1967

IMPEDANCE COORDINATES—50-OHM CHARACTERISTIC IMPEDANCE

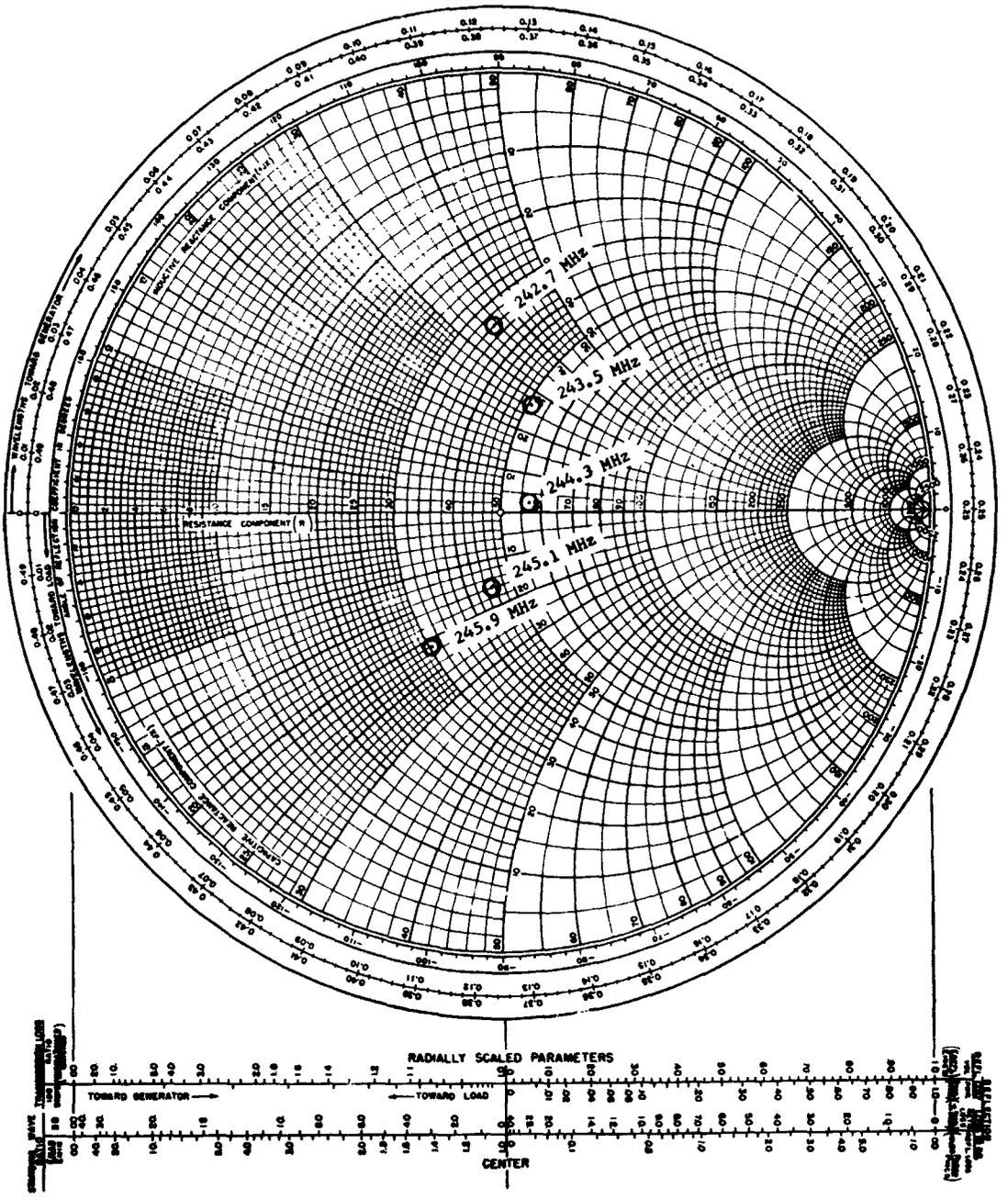

Figure 38. Telemetry System 1 Antenna Impedance Chart, 244.3 MHz, (N29, N30)

TITLE Model No. 2.045
Serial No. W52 and W53

Tuned to 244.3 MHz
Parellel Tuned Curve at "Tee"

DATE May 24, 1968

IMPEDANCE COORDINATES—50-OHM CHARACTERISTIC IMPEDANCE

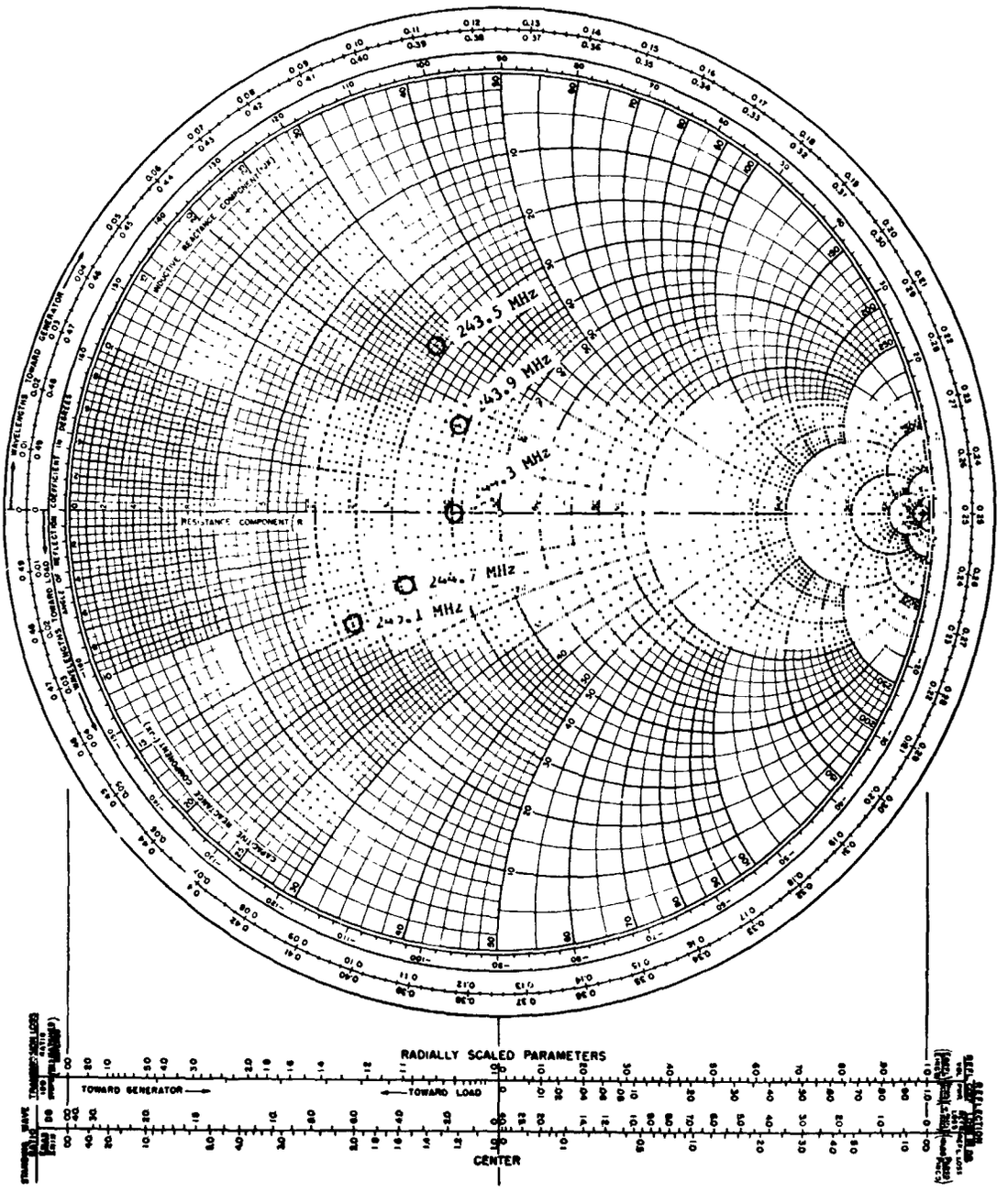

Figure 39. Telemetry System 1 Antenna Impedance Chart, 244.3 MHz, (W52, W53)

TITLE Model No. 2.052 Tuned to 256.2 MHz DATE May 24, 1968
Serial No. B60 and B62 Parallel Tuned Curve at "Tee"

IMPEDANCE COORDINATES—50-OHM CHARACTERISTIC IMPEDANCE

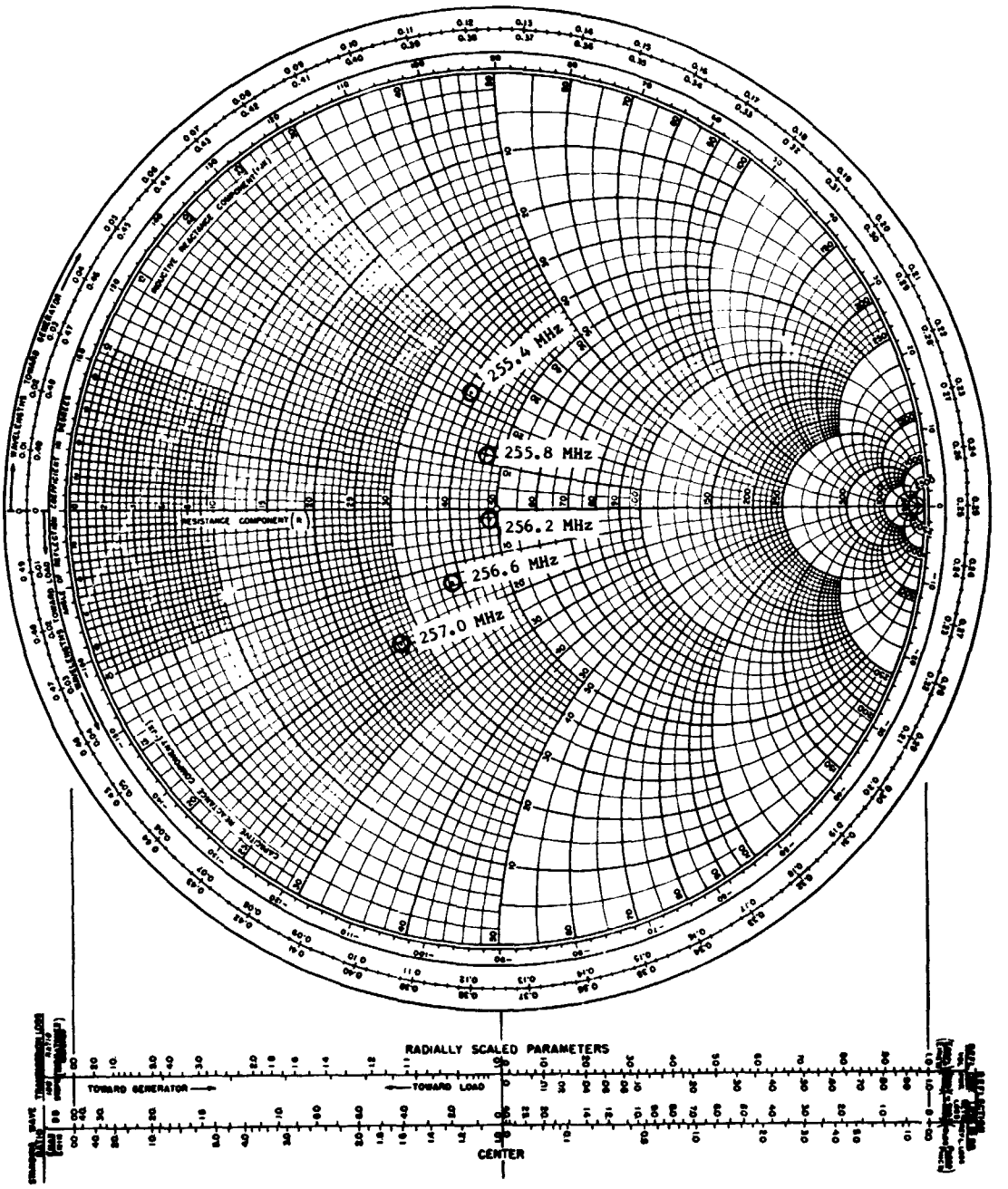

Figure 40. Telemetry System 2 Antenna Impedance Chart, 256.2 MHz, (B60, B62)

TITLE Model No. 4.003
Serial No. N55 and N56

Tuned to 412.0 MHz
Parallel Tuned Curve at "Tee"

DATE May 2, 1967

IMPEDANCE COORDINATES—50-OHM CHARACTERISTIC IMPEDANCE

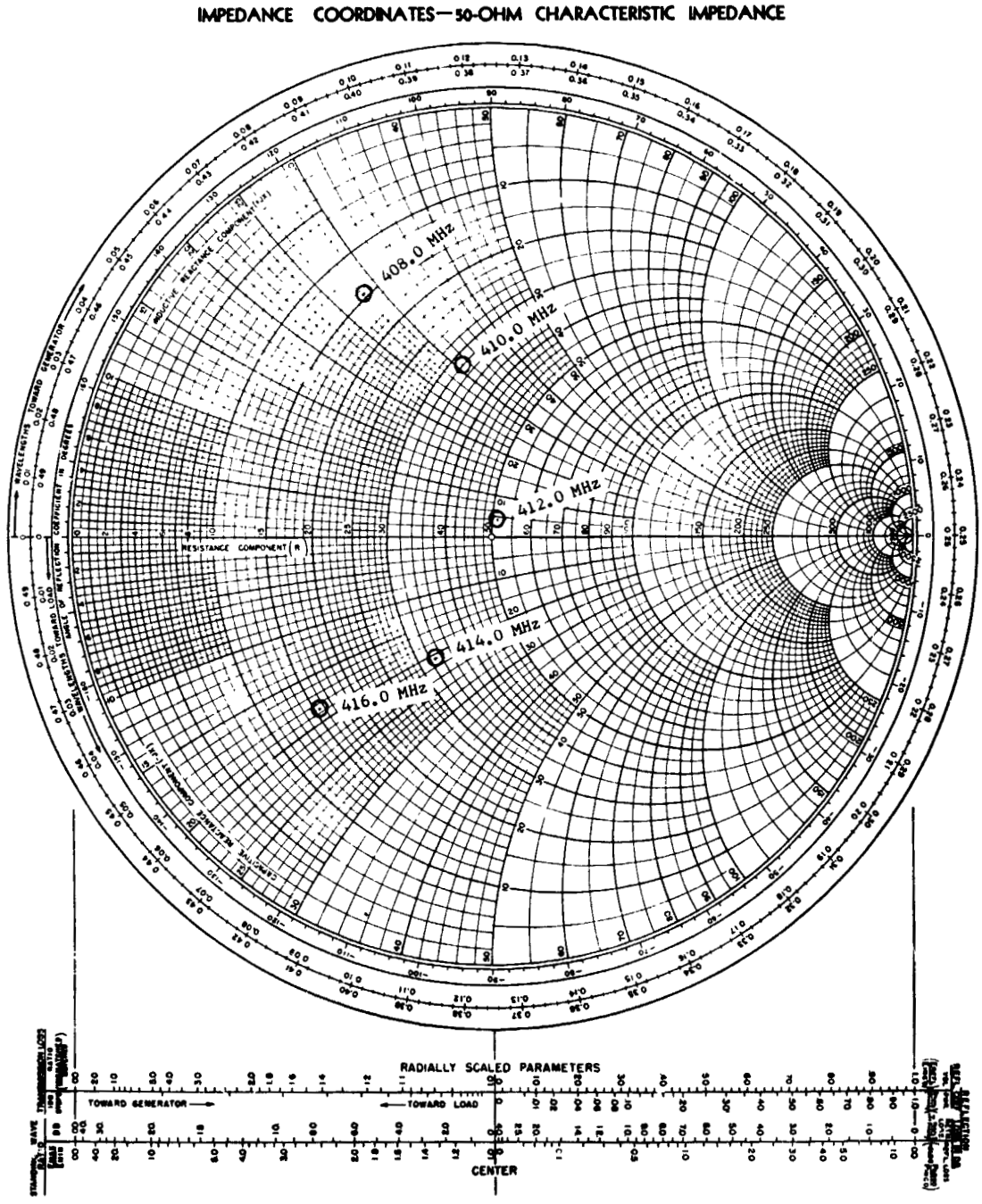

Figure 41. Command-Receiver Antenna Impedance Chart, 412.0 MHz, (N55, N56)