Ionosphere Research

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Scientific Report

on

"The Mother-Daughter Ionospheric Experiment Payload Description and Performance"

by

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ABSTRACT

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The detailed design of a complete rocket payload suitable for measuring electron densities in the F region of the ionosphere by a separating capsule technique is described.

In the experiment a rocket payload is separated into two sections in the ionosphere. Signals are propagated between the two at approximately 6, 12, and 72 Mc/s and phase measurements made on the received signals. In this way the wavelengths at 6 and 12 Mc/s and hence the electron density in the intervening region can be calculated.

Instruments included in the payload allow the separation velocity and payload attitude to be determined. Other instruments included in the payload for the direct measurements of ionospheric parameters have been described in a separate report Scientific Report No. 223(E). Author

1. INTRODUCTION

Several problems arise in the accurate measurement of electron densities in the upper ionosphere using rockets. These problems are of particular importance when measurements are made of non-diffusion equilibrium distributions in the region of the layer maximum, irregularities in the upper ionosphere, vertical gradients in the electron density, and in the calibration of direct measurement gages.

A method was proposed by The Pennsylvania State University which avoids many of the disadvantages of other rocket techniques. In this method phase measurements are made on signals propagated between two sections of a high altitude rocket. These measurements allow the wavelengths in the intervening medium and hence the electron density to be determined. A study grant was awarded by NASA and as a result of this work Nisbet et. al. (1961) showed that the method was practical, that the accuracy and sensitivity were adequate, and discussed the design specifications for equipment necessary to conduct the experiment.

A grant Ns.G.-134-61 was awarded to The Pennsylvania State University for theoretical studies related to the project, technical direction of the design and testing of flight hardware and the design and construction of a probe assembly for the direct measurement of ionospheric parameters.

A contract NAS 5-3059 was awarded to Space Craft Inc., of Huntsville, Alabama to design, develop and test the flight hardware to conduct the experiment. This report describes the final payload design developed by

Space Craft Inc., under the above contract, considerations which resulted in this design and calibration curves of the flight hardware for the initial experiment.

2. GENERAL APPROACH TO THE PROBLEM

A pair of separating payloads to accomplish the desired objectives must be performance-characterized by the following minimum parameters: relative phase shifts of propagated waves, separation velocity between payloads, relative payload spin rates, and payload trajectory. All measurements except trajectory must be made in the payloads or be inferred from reduced telemetry data. The trajectory is obtained from radar data and single-station Doppler information (Reference 2). Ancillary measurements, or "housekeeping" data, must also be monitored and transmitted.

An assembly drawing of the system which was devised is shown in Figure 2-1. The Mother and Daughter payloads are depicted as assembled payloads, and a third subdivision of the payload—the "yo" mechanism—is also shown. A photograph of the three payload sections is shown in Figure 2-2, and a close-in photograph of the mother payload instrument compartment is shown in Figure 2-3.

During flight, the sequence of events after fourth stage burnout is as follows: The Mother-Daughter combination payload separates from the fourth stage, leaving behind the yo mechanism attached to the spent motor. The yo mechanism deploys, imparting a lateral velocity to the motor case; finally, mother and daughter payloads separate from each other, at which time the experiment begins.

Transmitters in the daughter payload propagate CW signals on 6.13333 mc, 12.26667 mc, and 73.60000 mc nominal frequencies. Receiving antennas in the mother payload pick up the signals, which are amplified and compared in phase. AGC and phase information is then telemetered back to ground receiving stations. Reduced data relates phase shift data to electron density.

3. ESTABLISHMENT OF SYSTEM PARAMETERS

Successful accomplishment of this experiment requires predictable performance in both mechanical and electronic operation. Certain minimum performance parameters were established by calculation or past history and are summarized in this section.

3.1 Timing Criteria

Using t = 0 for lift-off, events are timed as follows: (1) 115 seconds—separation of integrated payload from fourth-stage motor; (2) 117.3 seconds—actuation of "yo" mechanism; (3) 135 seconds—separation of daughter from mother; (4) 1100 seconds (approximately)—completion of experiment at reentry and burnout.

3.2 Environmental Criteria

All environmental specifications for prototype and flight model payloads are listed in Goddard Specifications for the Mother-Daughter Ionosphere Experiment, July 1962. The performance criteria are essentially those for all Javelin flights.

3.3 Mechanical Design Criteria

Parameters established for mechanical performance are as follows:

(1) Launch vehicle - Argo D-4 Javelin.

(2) Rate of spin - 9 revolutions/second.

(3) Separation velocity between integrated payload and fourth-stage motor- 6 feet/second.

(4) Separation velocity between mother and daughter payloads - 6 meters/second.

(5) No coning or nutation introduced by either of the two separations.

(6) Payload weight at launch - less than 100 lbs.

The above requirements, coupled with environmental specifications, comprise the basic criteria governing mechanical design of all payloads.

3.4 Electronic Design Criteria

Certain aspects of electronic design are affected by mechanical constraints; the most obvious example is antenna design. The payload antennas are limited in size and therefore in efficiency; this in turn demands higher transmitter power and better receiver sensitivity. Trade-offs among these and other parameters resulted in the performance criteria below:

(1)	Transmitter Power Output (73.60000 mc)	1 watt
(2)	Transmitter Power Output (12.26667 mc)	30 milliwatts
(3)	Transmitter Power Output (6.13333 mc)	600 milliwatts
(4)	Receiver Sensitivity (73.60000 mc)	-90 dbm
(5)	Receiver Sensitivity (12.26667 mc)	-110 dbm
(6)	Receiver Sensitivity (6.13333 mc)	-120 dbm
(7)	Telemetry Transmitter Power Output	2 watts
(8)	Accuracy of Phase Shift Detection	30 degrees
(9)	Closeness of Reduced Data to Actual Data	5% or better
(10)	Experiment Time Duration (Determines Power Needed)	20 minutes
(11)	Launch Elevation	80 degrees
(12)	Payload Spin Rate	9 rps
(13)	Temperature Range	$-4^{o}C$ to $+47^{o}C$

4. PAYLOAD DESIGN, GENERAL

4.1 General Construction

The mother payload assembly is shown in Figure 4-1. An adapting cylinder, also called an extension tube, forms the base of the mother assembly and serves as the mounting device for securing the payload to the fourth-stage motor and the mother section to the daughter section. The instrument compartment, containing most of the electronics, is located above the adapting cylinder. Within the large truncated conical section above the instrument compartment are located the experiment receiving antennas and the telemetry transmitting antenna. Finally, atop the mother payload are a magnetometer, an electron and ion current probe, and an axially located separation guide containing the mother-daughter separation velocity measuring device.

The daughter payload assembly is shown in Figure 4-2. Here are located the experiment transmitter and transmitting antennas. The transmitter, with its separate power supply, is located in the forward end of the nose cone. Four loop antennas directly beneath the transmitter are used to send out elliptically polarized CW signals on 73.600 megacycles. A metallic braid, together with the metal locking ring at the base of the nose cone, forms the 6.133 and 12.266 mc transmitting loop. A hollow center shaft, located along the daughter spin axis, acts as a separation guide and supports interconnect cabling.

The yo mechanism assembly, shown in Figure 4-3, consists of a transition cone, an electronic timer with cable cutters, the yo cable and weight, and a spring-actuated separation cylinder located on the spin axis.

4.2 Mother Payload

Design of the mother payload was governed by the need to obtain maximum area for the 6 and 12 mc receiving loop antennas. Therefore, only a relatively small volume was allocated to electronics. In addition, stability during flight demanded careful arrangement of electronics boxes within the instrument compartment so that a minimum amount of balance weights would have to be added.

In the section where antennas are located, a fairly light (2-3 pounds per cubic foot) foam is used to fill in all space and add structural strength at minimum weight. The foam also rigidly fixes the center axis of the mother payload; therefore, it is necessary to establish the axis accurately before pouring the foam.

Separation guides are located near the base of the foamed-in section, at 90° apart. These are Nylatron slabs which fit against mating surfaces inside the nose cone. In order to obtain an effectively long guide for alignment during separation, another cylinder at the top center of the mother payload also serves as an alignment device. With the two sets of guide surfaces located nearly three feet apart and on different diameters, a clean non-binding separation of daughter from mother is assured. The device for measurement of separation velocity is located inside the guide cylinder on top of the mother payload.

Location of the magnetometer at the top of the mother payload provides maximum distance from magnetic materials and from current-carrying wires. The Pennsylvania State University ion current and electron temperature probe is also located on top so that it has a clear view after separation of the nose cone.

The solar aspect sensor used on Flight Payload #1 protrudes from the side of the mother payload so that it has about 160° of view angle in a plane through the spin axis. The view aft of the payload is restricted by the position of the locking ring and flange just below the sensor, thus preventing a full 180° sensing angle. For Flight Payloads #2 and #3, a night launch is anticipated; therefore, the solar sensor is not used and an infrared sensor is located on top of the mother payload. The infrared detector is tilted at an angle of 15° to 20° downward from a perpendicular to the spin axis so that it may cut a sufficiently large angle through the earth during each spin period.

Payload and nose cone separation methods are basically the same as those for many other NASA Javelin payloads. Two pin-pusher pyrotechnic devices for separation of payload from fourth stage motor are located on the outside surface of the extension tube. A pin-puller device for separating mother and daughter is located inside the extension tube. Payload separation from the motor occurs by means of releasing a band which holds spring-loaded locking lugs in place. Mother-daughter separation follows after a timed interval, when a spring-loaded locking ring on the mother is released and rotates to a position that allows disengagement of nose cone locking teeth.

4.3 Daughter Payload

The daughter payload is an integral part of the nose cone and consists of a stable three-frequency CW transmitter and associated antennas. The toroidal canister which holds the transmitter electronics is made in two sections; one section is carefully aligned and foamed in place in the nose cone tip, and the other section is used as a handling fixture for transmitter P. C. boards. The hole in the center of the transmitter case accepts the alignment shaft containing the mother-daughter separation spring and interconnect wiring.

Foaming the upper transmitter housing in place provides maximum strength with minimum weight. Because of high vibration levels caused by nose cone resonances, the loop antennas attached on one side to the transmitter case are secured by epoxy-bonding the opposite side to the inner nose cone wall. The antennas are thus rigidly mounted and are not affected by vibration. The other antenna, a metallic braid connected to the nose cone locking ring, is also epoxy-bonded to the inner nose cone surface.

Because vibration levels are rather high during motor burning, a vibration accelerometer is mounted inside the daughter transmitter to monitor thrust axis "g" levels. Aside from analyzing motor performance, knowledge of vibration levels is also important in determining effectiveness of the vibration-isolation mounting provided for the stable crystal-controlled oscillator within the transmitter.

4.4 "Yo" Assembly

The "yo" mechanism mounts rigidly atop the fourth-stage X-248 motor. Its conical section is made of spun aluminum, and at the upper truncation is mounted a hollow separation shaft containing the payload separation spring. On the top of the shaft is a point-contact pushoff surface which thrusts against the center of a shallow cone mounted across the base of the mother payload; the point-contact pushoff assures maximum stability during separation.

Mounted on a supporting channel near the base circumference of the conical section is the yo cable and weight assembly with associated wiring and timing circuits for squib actuation. After payload separation occurs, the yo timer initiates a 2.3 second delay before firing cable-cutter squibs to release the yo cable. The weighted end of the cable unwinds, imparting a sideward velocity to the motor case; and when the cable is fully extended, it is released, removing angular momentum from the burned-out motor. The motor case, thus removed from the normal payload trajectory, cannot collide with either payload even if "chuffing" should occur.

5. DESCRIPTION OF SUB-SYSTEMS, DAUGHTER PAYLOAD

5.1 Transmitter

A block diagram of the daughter transmitter is shown in Figure 5-1. The basic frequency of 6.133333 mc is derived from a stable oscillator and then amplified and multiplied to produce the desired power levels at all three frequencies. The main difficulty in obtaining signals at the three frequencies is to maintain phase stability throughout all amplifying and multiplying processes, as well as over the temperature range. Circuits used in the transmitter beyond the oscillator are shown in Figures 5-2 through 5-9.

The crystal-controlled basic frequency source is housed in a vacuum-type dewar, and thermal control is achieved by a heater wire into which current is switched upon command from a mercury-column thermostat. Since the mercury switch and the crystal itself are affected by vibration, the entire oscillator assembly is shock-mounted within the transmitter by means of soft rubber damping pads on each end. Effective isolation is provided at higher vibration frequencies, where "g" levels are extremely high.

Figure 5-10 shows a photograph of the daughter transmitter mounted in the lower half of its canister. The cylindrical shell of the oscillator can be seen. A temperature sensor (thermistor) is mounted inside the transmitter to monitor temperature up to the time of separation.

5.2 Accelerometer

The accelerometer mounted inside the transmitter will be set to read to levels as high as 500 g's peak-to-peak for flight payload number one. Data received from the first flight will govern the accelerometer settings for payloads 2 and 3. Qualification tests on payload 1 showed a maximum of 300 g's peak-to-peak at certain frequencies.

The accelerometer is a piezoelectric type, with electronics and sensor built into the same case, and is made by Gulton Industries (Model No. AT1206F).

5.3 Power Supply

The daughter battery pack is made of sealed nickel-cadmium cells and is foam potted for strength and light weight. A photograph of batteries mounted on the transmitter is shown in Figure 5-11. Batteries for the pack are carefully selected after several closely monitored charge and discharge cycles. The pack is made in a toroidal shape so as to mount directly on top of the transmitter and thus fit into the canister in the nose cone.

Battery power is sufficient to operate the transmitter for up to two hours. Up to the time of mother-daughter umbilical ejection, means are provided for recharging batteries from the blockhouse, using the control console provided for payload check-out.

5.4 Antennas and Matching Circuits

Although extremely inefficient because of their small areas, the loop antennas used in the daughter are relatively insensitive to detuning and can be rigidly mounted. (Refer to Figure 4-2.)

Four loops in a phased array form the 73.6 mc transmitting antenna. Three db elliptical polarization for the antenna is achieved by feeding the transmitter's 73.6 mc output through a circuit which matches impedances and shifts phases; that is, polarization is obtained by proper phasing of two equal-amplitude signals. This approach provides a higher output power in this case than would be obtained by using normal quadrature phasing of unequal amplitude signals. Elliptical polarization of the 73.6 mc signal is provided because the signal is used for SSD (single-station-Doppler) tracking, and vehicle spin rate can be obtained from receiver AGC records.

The 6 and 12 mc signals are diplexed through phasing and trapping circuits onto the single linearly polarized loop antenna composed of metal braid and nose cone locking ring. Power is gained for this antenna when it is driven unbalanced rather than balanced; therefore, one side of the antenna is connected to circuit ground.

Antennas are severely detuned when mother and daughter payloads are assembled together, and transmitter circuits must be able to operate into the mismatched impedances without damage.

5.5 Center Shaft

The central shaft which aligns nose cone and mother payload and houses the mother-daughter separation spring also contains wiring which allows the daughter payload to be controlled from an external console. Microswitches on the shaft are held in a closed position when the two payloads are joined; and during separation the microswitches open, switching power to the daughter internal battery. The shaft and separation spring remain with the nose cone after separation. Interconnections of the shaft, transmitter, and battery pack are shown in Figure 5-12.

6. DESCRIPTION OF SUB-SYSTEMS, MOTHER PAYLOAD

6.1 Antennas

Loop antennas used for receiving the experiment transmissions in the mother payload are the maximum area possible. Quadrature loops, diplexed for receiving 6 and 12 mc signals, provide circular polarization for the two lower frequencies. A linearly polarized single loop is used to receive the 73.6 mc signal. Outputs of these antennas are fed through matching networks into the experiment receiver inputs.

A summary of signal strength calculations, giving expected system margins using measured antenna and receiver parameters, is given on the following page.

A turnstile antenna, capacitively loaded and resonated at the operating frequency, emits a circularly polarized pattern for telemetry. Figure 6-1 shows how antennas are located in the mother payload. The large rectangular loops are for 6 and 12 mc, the small circular loop for 73.6 mc, and the turnstile for 240.2 mc, the telemetry frequency.

M-D PAYLOAD

FLIGHT #1

SIGNAL STRENGTH EVALUATION

System	Field Strength at 5 Km	Rec. Antenna Effective Length	Signal Input	Receiver Input Sensitivity	System Margin
6 mc	8 μv/m	2.05 cm	.164 μv	7.07×10^{-3} μv	+27.3 db
12 mc	1.07 μv/m	4.1 cm	.044 μv	7.07×10^{-3} μv	+15.9 db
73 mc	84 μv/m	2.82 cm	2.37 μv	.224 μv	+20.5 db

6.2 Receiver and DC Amplifiers

Figure 6-2 is a schematic of the experiment receiver. It is a TRF type with a unique low-phase-shift AGC control for each of the three frequencies. Less than seven degrees phase shift at 73.6 mc is achieved with the AGC diode bridge. Over the entire dynamic range (about 50-60 db) of the receiver, a constant output voltage is delivered to the phase comparators. Throughout the receiver, low circuit Q's have been used to keep phase shifts to a minimum. Sensitivities for the three sections of the receiver are nominally -120 dbm for 6 mc, -110 dbm for 12 mc, and -90 dbm for 73.6 mc. The entire receiver assembly is shown in Figure 6-3.

Crystal filters tuned to the input frequencies are used to improve signal-to-noise ratio in the three receiver sections. Filter bandwidth is restricted to a minimum of about 1.5 KC because of phase shift during temperature variations. Wider bandwidth filters are used following the multiplied 6 and 12 mc outputs; they need only reject the anticipated harmonics of the original frequency.

Phase comparison is made at 73.6 mc; therefore, the 6 and 12 mc signals are multiplied to 73.6 mc prior to phase comparison. Quadrature phase detectors, diode type, produce two phase outputs for each comparison, thereby eliminating ambiguity and providing a certain amount of redundancy. The four phase detector outputs are fed to DC amplifiers to provide signals of zero to five volts for the telemetry. A schematic of the amplifiers is given in Figure 6-4.

A voltage regulator within the receiver eliminates the effects of battery supply voltage variation and smooths noise spikes induced by other circuits.

6.3 Telemetry System

The telemetry transmitter operates at 240.2 mc and is a 2 watt PM type, Vector Model No. TRPT-2W.

Information is fed into the transmitter from twelve frequency-modulated subcarrier oscillators. The subcarrier outputs are fed into a summing amplifier whose output directly modulates the transmitter. Figure 6-5 is a photograph of the subcarrier assembly.

Channel assignments are made according to anticipated data rates. A list of channels and functions is included on the following page.

MOTHER-DAUGHTER

TELEMETRY CHANNEL ASSIGNMENT

TM Channel	Subcarrier Frequency, cps	Function and Description
5	1,300	Magnetometer
6	1,700	6 mc AGC
7	2,300	12 mc AGC
8	3,000	73.6 mc AGC
9	3,900	6 mc phase 1
10	5,400	6 mc phase 2
11	7,350	12 mc phase 1
12	10,500	12 mc phase 2
13	14,500	Ion Current
14	22,000	Electron Temperature
15	30,000	Commutator
D	52,500	Vibration before Separation
		Separation Position and Velocity during Separation
		Optical Aspect after Separation

6.4 Power and Power Distribution

Power for the mother payload is supplied by silver zinc cells assembled and encapsulated in two battery packs inside the instrument compartment. For the positive voltages, from which most of the payload power is supplied, cells of two ampere-hour capacity are used. Negative voltages are supplied by a string of cells of 200 milliampere-hour capacity.

The silver-zinc cells are carefully checked and then assembled with a fiberglas "manifold" over the terminal area to allow discharge of evolved gases. A small pressure relief tube vents the manifold to the outside and can be sealed with a screw-in plug prior to launch. Each battery assembly is coated with RTV and then encapsulated within the battery box in a hard epoxy.

As can be seen in preceding figures showing the instrument compartment, the wiring harness is routed around the inner compartment circumference. A distributor assembly serves as a main junction box for all power input and output lines.

A special umbilical connector was developed to provide capability for separating all control connections remotely from the blockhouse. The connector contains a small squib which can be fired from the payload control console. When the connector is removed, the payload automatically operates on internal power.

All explosive devices are fired by separate batteries so as to prevent possible damage to the main power source. Nickel-cadmium cells operate the yo mechanism and mother-daughter squibs, and separate silver-zinc cells provide squib power for payload separation.

6.5 Commutator

The commutator is completely solid-state, with 26 channels, and operates at a frame rate of 1.1 seconds per frame. A block diagram is shown in Figure 6-6. Commutator channel assignments are allocated below;

Commutator Channel	Measurement
1	5.0 V cal.
2	2.5 V cal.
3	0V cal.
4	Pin 7 PSU Exp. (ramp)
5	Temp Batt #1
6	Temp Mother Rear
7	Temp Rec and Phase Comp
8	Pin 8 PSU Exp. (Ramp)
9	Separation Pulse, M-D
10	+26.6 V meas
11	+16.8 V meas

Commutator Channel	Measurement
12	Pin 9 PSU Exp. (ramp)
13	+28.8 V meas
14	+20.4 V meas
15	+14.4 V meas
16	Pin 10 PSU Exp. (ramp)
17	+10.8 V meas
18	-4.8 V meas
19	-9.6 V meas
20	-14.4 V meas
21	Aft aspect
22	Temp Dau Inst Comp
23	Temp Mother Front
24	Temp Oven
25	Temp P.A.
26	Pin 11 PSU Exp. (sq. wave)

6.6 Signal Conditioning and Thermal Sensors

Temperature sensors located at various points within mother and daughter are all thermistors with 50K ohms nominal value, General Electric type 4D103.

A very simple voltage translation method is used in signal conditioning circuitry to provide full-scale voltage swings from each temperature sensor and to allow conversion of various positive and negative monitored voltages to positive voltages of the proper amplitude for telemetry subcarrier inputs. The signal conditioner schematic is given in Figure 6-7.

6.7 Timers and Squib Circuits

Actuation of the yo mechanism and initiation of both separations are brought about by pyrotechnic devices. All pyrotechnics are fired through silicon-controlled-rectifiers after completion of a timer period. Timers are of two types: mechanical timers for payload separation from the rocket, and electronic timers for deployment of the yo mechanism and separation of daughter from mother. Timers, squibs, and squib bridge wires are all redundant.

Figure 6-8 shows the block diagram of the mother payload timers. A schematic of the mother-daughter electronic timer is shown in Figure 6-9.

Safing connectors are used until final vehicle arming; they are then removed and replaced by arming connectors. Inadvertent squib actuation is also prevented by inclusion of barometric safety switches which do not close until the payload passes through 50,000 feet altitude. These barometric switches take the place of the inertia switches first intended for use and shown in Figure 6-8.

The mechanical timers are actuated on liftoff by a steady acceleration of 5 g's or more and are therefore safe under most handling conditions. Either of the two redundant mechanical timers will initiate all pyrotechnic events in the payload.

6.8 Magnetometer

A magnetometer is mounted on top of the mother payload to determine the direction of the local magnetic field and to assist in determining attitude in conjunction with the optical aspect sensor. The magnetometer is a Schonstedt type RAM-5A and is aligned with the payload spin axis so that the axial component is directly read out.

6.9 Optical Aspect Sensor

Since payload number 1 will be launched near midday and payloads 2 and 3 will be launched at night, optical aspect determination has been approached in two ways. For the daytime flight, a sun sensor is used, with pulse width output proportional to payload attitude with respect to the sun. For the night launches, an infrared earth sensor will be used; it will produce pulses whose width is proportional to payload attitude with respect to the earth.

The solar aspect sensor is shown in Figure 6-10. Its circuit is given in Figure 6-11. A silicon photodiode is used as the sensor; since it is a lens-focused device and is therefore somewhat directional, the lens is coated with a thin layer of Teflon spray to reduce directivity.

The infrared sensor, although not originally designed for payloads with high spin rates, is adaptable to this application because the frequency response is sufficient to allow accurate interpretation of attitude data. The sensor is an immersed thermistor behind two germanium lenses, and its output is amplified so that a pulse results when a thermal discontinuity, such as an earth-space transition , is sensed.

6.10 Velocity Measuring Device

The relative speed between mother and daughter payloads, during and immediately after separation, is measured by a simple device which transmits a train of pulses. Figure 6-12 shows the complete unit.

A fiberglas tape is folded, accordion fashion, in a small receptacle. One end of the tape, connected to the nose cone, is fed between pairs of metallic contacts connected through signal-conditioning circuits to the telemetry. Conductive stripes painted across the tape at $1\frac{1}{2}$ inch intervals cause momentary shorting of the contacts as the payloads separate, thereby superimposing pulses on a telemetry channel. Spacing of the pulses (time between contacts) determines the separation speed; rate of change of pulse spacing gives acceleration.

6.11 Pennsylvania State University Compatible Experiment

An instrument has been designed to measure ion current and electron temperature as a supporting experiment. It is mounted on top of the mother payload with its aperture looking in the flight direction.

A voltage swept across the control grid permits detection of particles by the Langmiur probe technique. More complete documentation of this instrument is available. Hale (1964)

7. DESCRIPTION OF SUB-SYSTEMS, YO MECHANISM ASSEMBLY

7.1 Timer

Actuation of the yo release timer occurs when the payload separates from the fourth-stage motor. After a delay of 2.3 seconds, the timer fires cable-cutting squibs to release the yo weight. A schematic and block diagram of the timer and pyrotechnics are shown in Figures 7-1 and 7-2. As with the other electronic timer, delay is achieved by the charge time on a capacitor which fires a trigger circuit at a predetermined voltage level. Silicon-controlled-rectifiers are used to fire the squibs, and all circuits are redundant.

8. GROUND SUPPORT EQUIPMENT

External payload control is made possible by a test console, shown in Figure 8-1. Provision is made for monitoring and controlling all functions through the umbilical connector.

Simulated loads can be applied to the payload internal batteries to insure proper battery voltages and currents. Charging of payload batteries is accomplished through jacks on the console; one section of batteries can be charged without affecting other sections in the same string. Normal operation of the payload is on external power provided through the console. A switch on the panel provides current to fire the umbilical connector squib.

To facilitate receiver checkout during fabrication and to allow independent testing of the mother receiver in the integrated flight payload, small portable test transmitters have been constructed. Capable of transmitting on the three experiment frequencies with adjustable attenuation for each frequency, the test transmitters also provide selectable phase shift delays for adjusting and checking the phase comparator circuits in the receiver.

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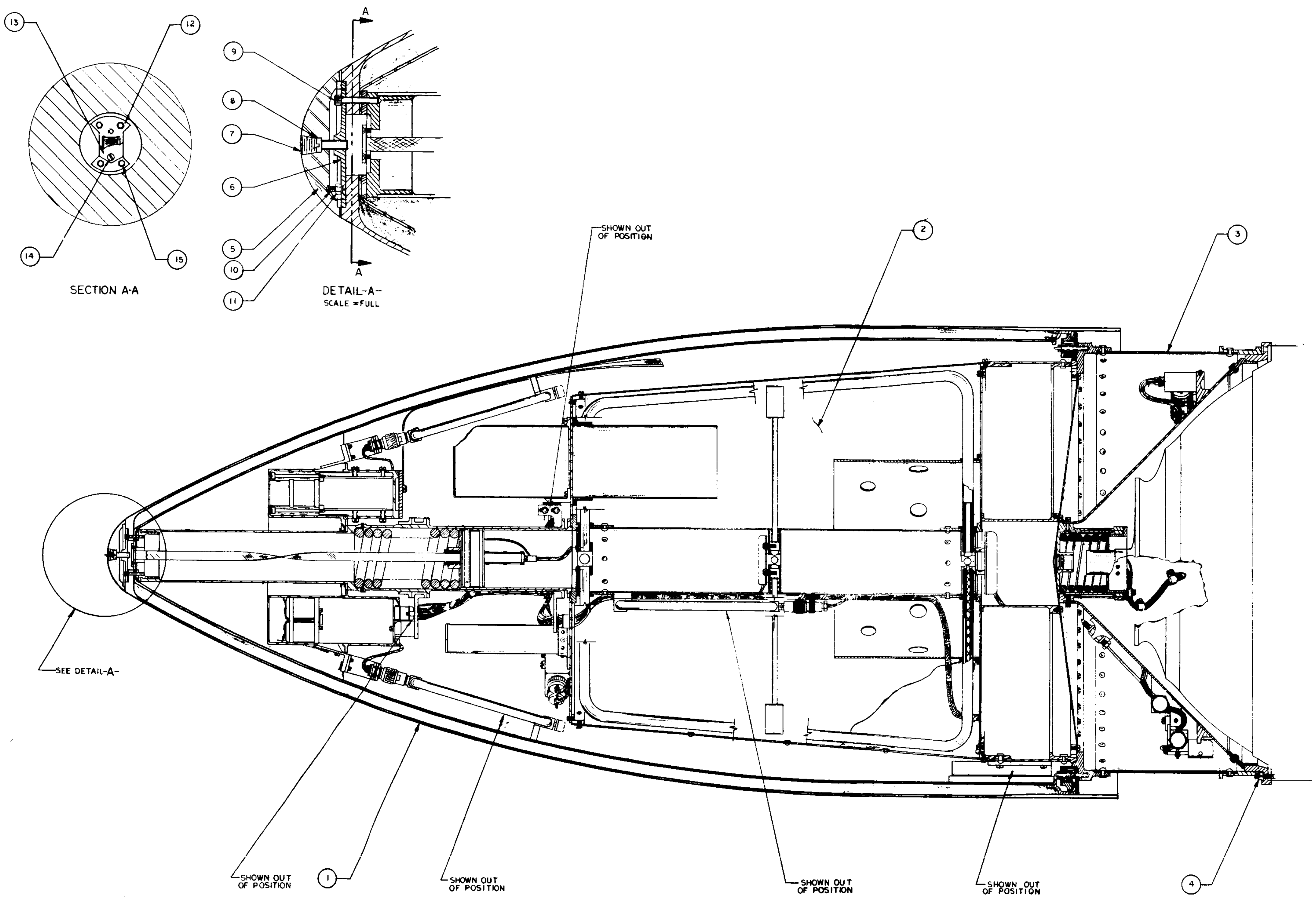
10. FIGURES



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			15				
			14				
			13	CLAMP, VELOCITY TAPE		SCIM226233	
			12	SCREW CAD PL CARBON STEEL PAN HD #4-40NC-2A X (.434) LG.		MS-35223-16	
			11	NUT PLAIN HEX CAD PL MACH. SCREW #10-32NC-2B		MS35650-102	
			10	SCREW, CAD PL., CARBON STEEL FL HD #10-32NC-2 X (.434) LONG		MS-35240-71	
			9	SCREW CAP SOCKET HD HEX STEEL CAD PL #8-32NC-2 X (.750) LONG			
			8	SCREW CAP SOCKET HD HEX STEEL CAD PL #10-24NC-2		MS-16997-45	
			7	PIPE PLUG (.125) ANPT CORROSION RESISTANCE		AN932-S2	
			6	PLATE ANCHOR NOSE CAP MOTHER DAUGHTER		SCI-M226120	
			5	NOSE CAP		13157	AEROLAB 99336
			4	WRENCHING NUT		13170	AEROLAB 99336
			3	EXTENSTION TUBE ASS'Y		SCI M226291	
			2	MOTHER ASSEMBLY		SCI M226324	
			1	DAUGHTER ASSEMBLY		SCI M226323	

NO. REQ'D. PER ASS'Y.

LIST OF MATERIALS

UNLESS OTHERWISE SPECIFIED	DIMENSIONS ARE IN INCHES, TOLERANCES ON: FRACTIONS, DECIMALS, ANGLES
MATERIAL	
HEAT TREATMENT	
FINAL PROTECTIVE FINISH	
NEXT ASSY.	W.O. 226
USED ON	
APPLICATION	
DRAWN	MWG
DATE	27 May 64
CHECKED	
DATE	
APPROVED	
DATE	
TITLE	MOTHER DAUGHER ASSEMBLY
SPACE CRAFT Inc.	Huntsville, Alabama
DWG. SIZE	C
DRAWING NO.	SCI-M226000
REV.	
SCALE	
UNIT WT.	
SHEET	OF

FIGURE 2-1

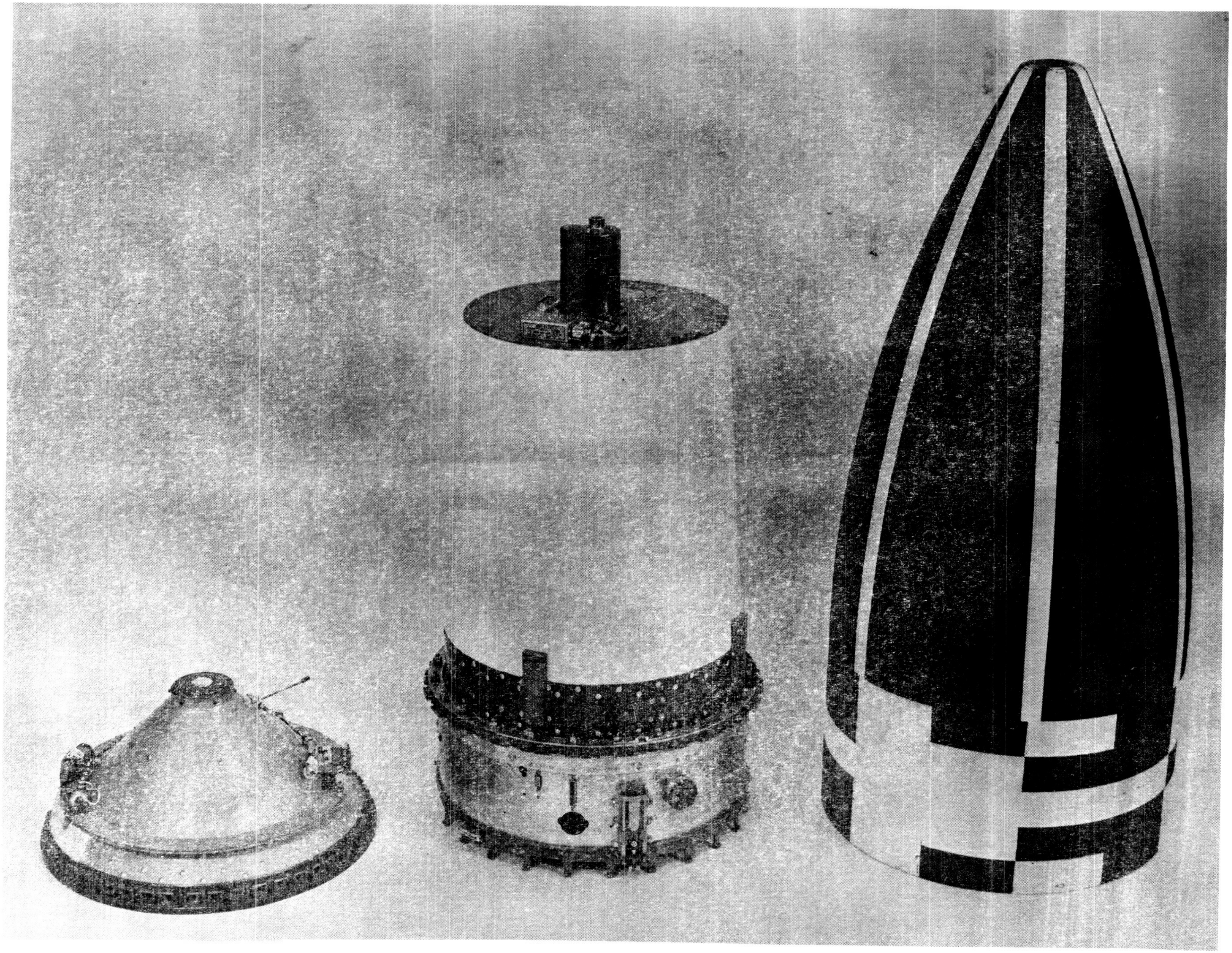


FIGURE 2-2

BASIC ASSEMBLIES, MOTHER-DAUGHTER EXPERIMENT

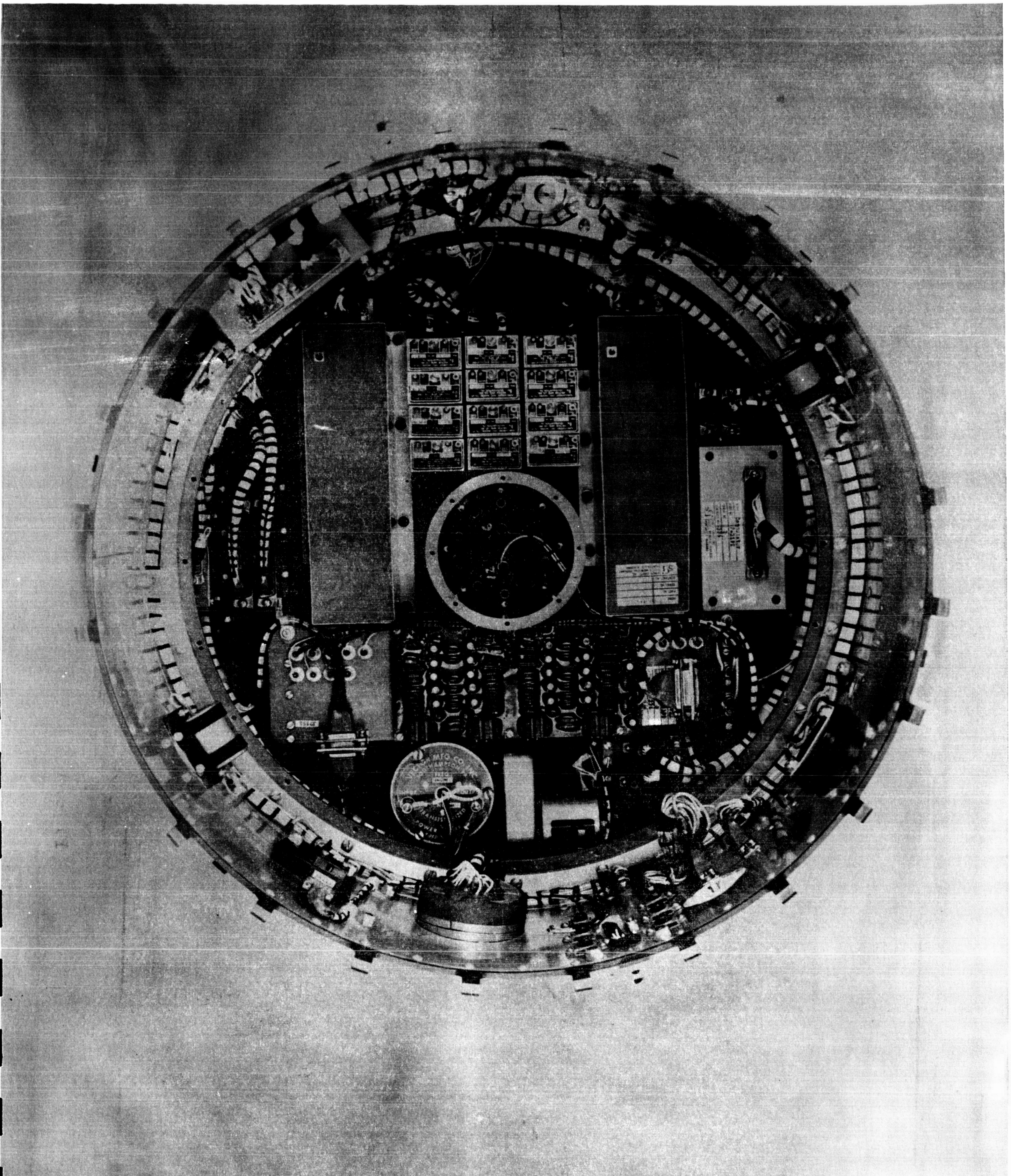
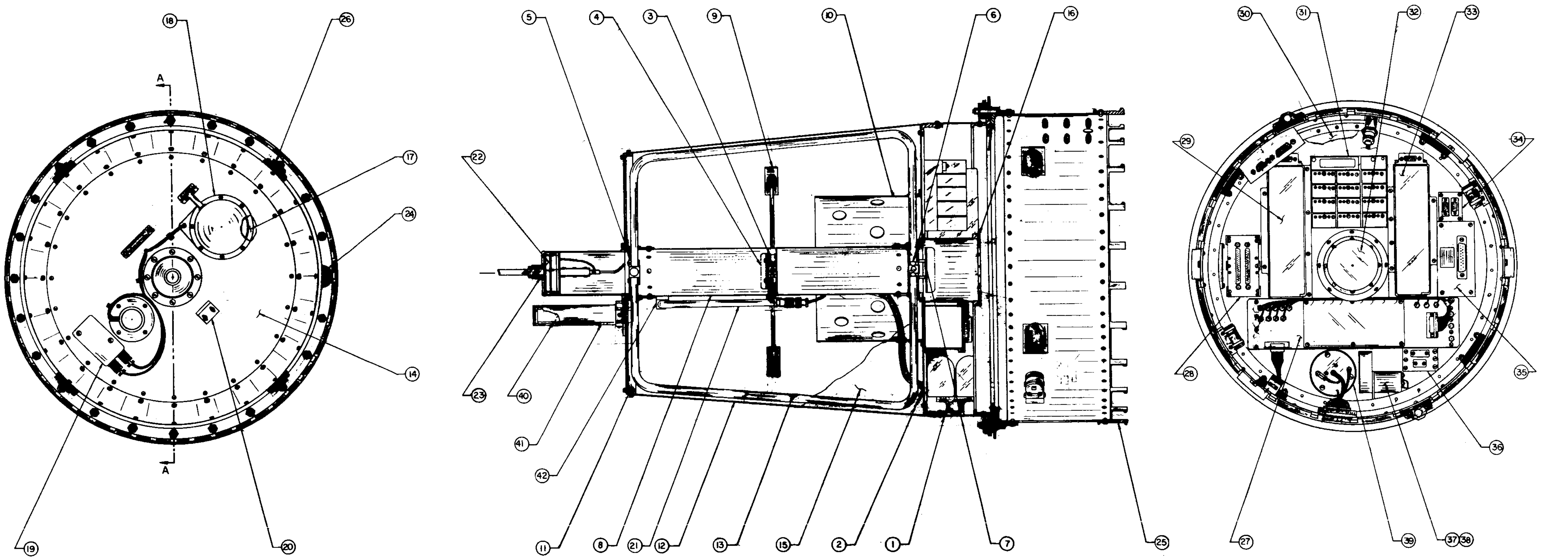


FIGURE 2-3

MOTHER PAYLOAD INSTRUMENT COMPARTMENT



SECTION A-A

FIGURE 4-1

—3	—2	—1	ITEM NO.	DESCRIPTION	MIL. SPEC.	MFR'S PT. NO. / DRAWING NO.	REMARKS/ MFR'S CODE
			43.				
		1	42.	BLOCK ANTENNA MOUNT MOTHER PACKAGE		SCI-M226029	
		1	41.	SENSOR HOUSING ASS'Y		SCI-M226103	
		A/R	40.	RUBBER CUSHIONER			
		1	39.	TRANSMITTER 240.2MC			VECTOR MFR CO
		1	38.	SUPPORT TIMER		SCI-M226161	
		2	37.	TIMER		10S05G1B0SDOP	RAMOND
		1	36.	SIGNAL CONDITIONER # 1			
		1	35.	COMMUATOR			
		1	34.	SIGNAL CONDITIONER # 2			
		1	33.	BATTERY PACK # 1			
		1	32.	ANTENNA MATCHING NETWORK			
		1	31.	SUBCARRIER OSCILLATOR ASSEMBLY		SCI-M226295	
		1	30.	COVER PLATE INSTRUMENT PACK		SCI-M226123	
		1	29	BATTERY PACK#2			
		1	28	DISTRIBITOR			
		1	27.	RECEIVER ASS'Y			
		4	26.	GUIDE RAIL, MOTHER PAYLOAD		SCI-M226167	
		1	25.	EXTENSION TUBE ASS'Y MOTHER PAYLOAD		SCI-M226291	
		1	24.	ASPECT SENSOR ASSY MOTHER PAYLOAD		SCI-E226144	
		1	23.	BASE SEFARATION SPRING MOTHER DAUGHTER		SCI M226058	
		1	22.	VELOCITY MEASUREMENT DEVICE ASSEMBLY		SCI-M226267	
		1	21.	72 MC ANTENNA ASS'Y		SCI-M226017	
		1	20.	BRACKET SWITCH ACTUATOR MOTHER DAUGHTER PAYLOAD		SCI-M226231	
		1	19.	MAGNETOMETER		RAM-5C	SCHONSTEDT
		1	18	ELECTRON TEMPERATURE GAGE			
		1	17.	SUPPOPT TUBE ASS'Y ANTENNA PACKAGE MOTHER PAYLOAD		SCI-M226063	
		1	16.	TUBE COVER BRACE MOTHER INSTRUMENT PACK MOTHER PAYLOAD		SCI-M226053	
		A/R	15.	ECCO FOAM PF WITH A DENSITY OF 2LBS PER CU.FT.		FF	EMMERSON CUMINGS
		1	14.	PLATE TOP ANTENNA PACKAGE MOTHER PAYLOAD		SCI-M226022	
		4	13.	ANTENNA SEGMENT ASS'Y 6&12MC MOTHER DAUGHTER PAYLOAD		SCI-M226020	
		1	12.	ANTENNA SHROUD, MOTHER PAYLOAD		SCI-M226049	
		1	11.	RING TOP, ANTENNA PACKAGE MOTHER DAUGHTER PAYLOAD		SCI-M226030	
		1	10.	PLATE SUPPORT ASS'Y MOTHER DAUGHTER PAYLOAD		SCI-M226166	
		4	9.	SEGMENT ASSEMBLY TELEMETERING ANTENNA M.D. PAYLOAD		SCI-M226041	
		1	8.	COMPRESION TUBE ASS'Y, MOTHER PAYLOAD		SCI-M226028	
			7.	SPACER			
		1	6.	BLOCK ANTENNA TIE MOTHER DAUGHTER PAYLOAD		SCI-M226036-1	
		1	5.	BLOCK, ANTENNA TIE, MOTHER DAUGHER PAYLOAD		SCI-M226042	
		1	4.	ANTENNA MATCHING NETWORK			
		1	3.	BLOCK ANTENNA TIE MOTHER DAUGHTER PAYLOAD		SCI-M226036-2	
		1	2.	PLATE, TOP COVER MOTHER INSTRUMENT PACKAGE		SCI-M226007	
		1	1.	HOUSING ASS'Y, MOTHER INSTRUMENT HOUSING		SCI-M226010	

NO. REQ'D. PER ASS'Y.

LIST OF MATERIALS

MOTHER ASSEMBLY
MOTHER DAUGHTER
ASSEMBLY

SPACE CRAFT Inc.
Huntsville, Alabama

SCI-226324

C

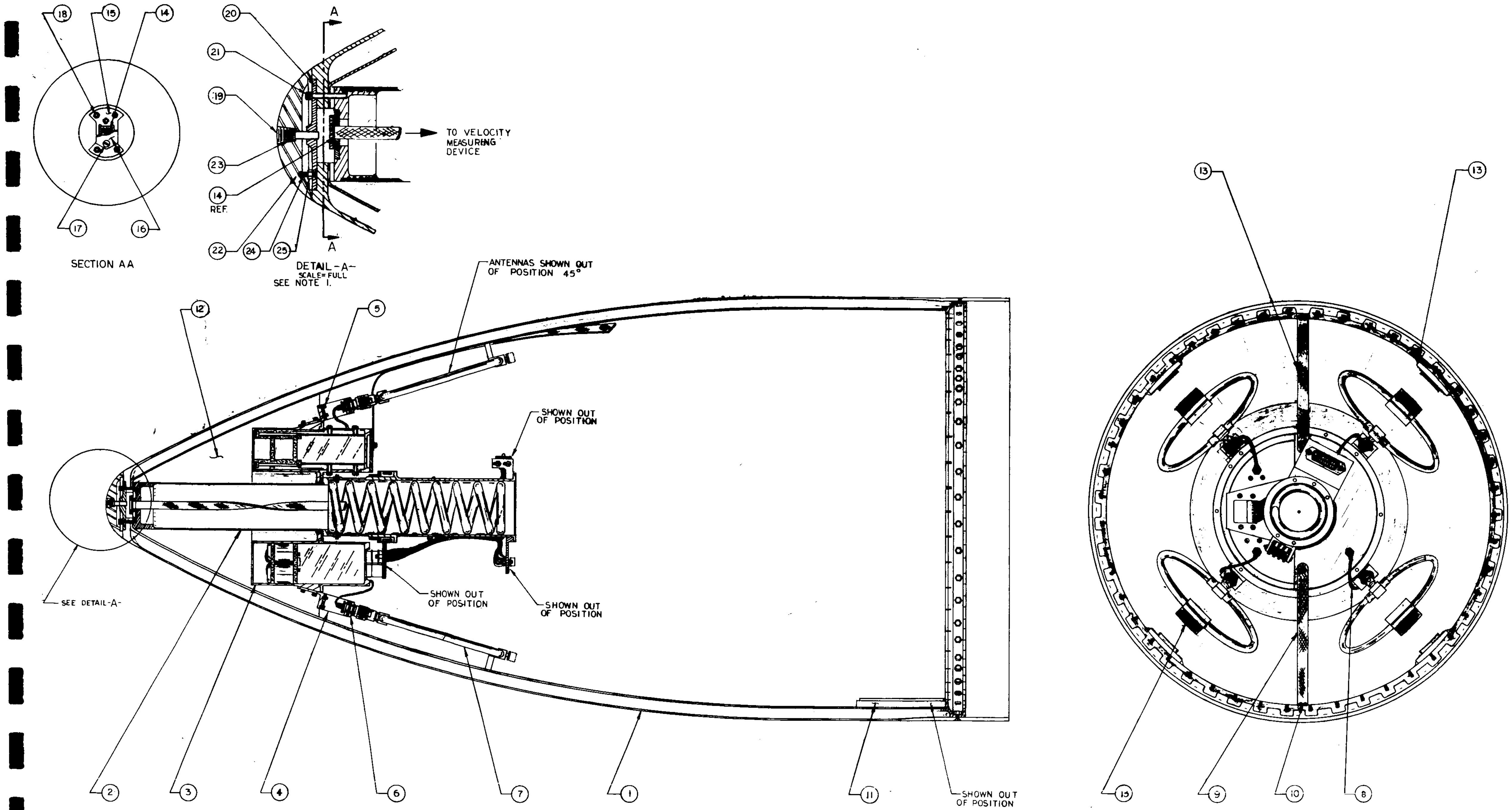


FIGURE 4-2

NO. REQ'D. PER ASS'Y. —3	—2	—1	ITEM NO.	DESCRIPTION	MIL. SPEC.	MFR'S. PT. NO. / DRAWING NO.	REMARKS/ MFR'S CODE
		1	25.	NUT, PLAIN HEX. CAD. PL. MACH SCREW #10-32NC-2B		MS35650-102	
		1	24.	SCREW, CAD PL. CARBON STEEL FL. HD. #10-32 NC-2 X (.434) LG.		MS35240-71	
		1	23.	SCREW, CAP, SOCKET HD. HEX STEEL CAD PL 10-24NC		MS16997-45	
		1	22.	NOSE CAP		13157	AEROLAB/ 99336
		5	21.	SCREW, CAP, SOCKET HD, HEX STEEL CAD. PL., 6-32 NC 2 X (.750) LG.		MS16997-34	
		1	20.	PLATE ANCHOR NOSE CAP MOTHER DAUGHTER		SCI-M226120	
		1	19.	PIPE PLUG (.125) ANPT CORROSION RESISTANCE		AN932-S2	
		4	18.	SCREW, CAD. PL., CARBON STEEL, PAN. HD. #4-40NC 2A X (.434) LG.		MS-35223-16	
		2	17.	SCREW, CADMINUM PLATED, CARBON STEEL, FL. HD. #2-56NC-2 X (.186)		MS-35239-9	
		1	16.	CLAMP, VELOCITY TAPE		SCI-M226233	
		1	15.	SUPPORT, VELOCITY TAPE		SCI-M226232	
		1	14.	VELOCITY TAPE			
		A/R	13.	EPOXY RESIN		C-1	ARMSTRONG/ 98911
		A/R	12.	ECCO FOAM, FP, WITH A DENSITY OF 6LBS. PER CU. FT.		FP	EMMERSON/ CUMINGS
		4	11.	GUIDE RAIL ASS'Y		SCI-M226045	
		4	10.	SCREW, CAD. PL., CARBON STEEL, FL. HD. #1-64NC-2 X (.175) LG.			
		2	9.	ANTENNA CABLE (.625)		8672	BELDED/ 70903
		4	8.	73 MC TRANSMITION CABLE		SCI-M226330	
		4	7.	ANTENNA & BRIDGE SUPPORT		SCI-M-226329	
		4	6	CONNECTOR, ANTENNA		6RFF2016B	MICRO DOT INC. 98278
		16	5.	SCREW, CAP, SOCKET HD. HEX., CAD. PL., STEEL #4-40NC UNC3A X (.250		MS-16997	
		4	4.	YOKE ANTENNA SUPPORT		SCI-M226091	
		1	3.	TRANSMITTER AND BATTERY PACK ASSEMBLY		SCI-M226327	
		1	2.	SPRING GUIDE TUBE, SPRING, CONNECTOR & SWITCH ASS'Y		SCI-M226328	
		1	1.	NOSE CONE ASS'Y, FIBERGLAS		R13070	AEROLAB/ 99336

LIST OF MATERIALS

UNLESS OTHERWISE SPECIFIED

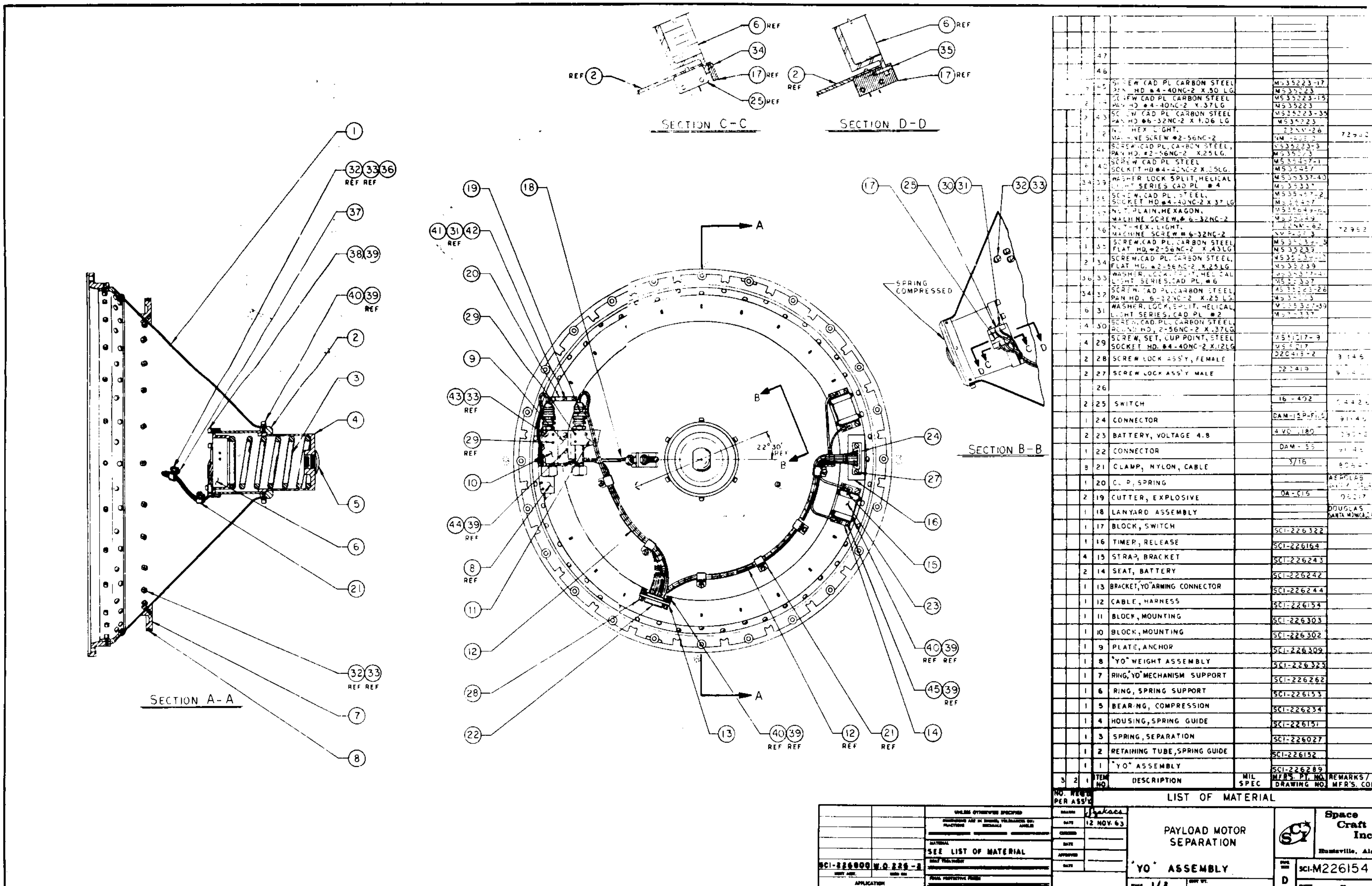
DRAWN MWG
DATE 27 May 64

DAUGHTER ASS'Y
MOTHER DAUGHTER ASS'Y

SPACE CRAFT Inc.
Huntsville, Alabama

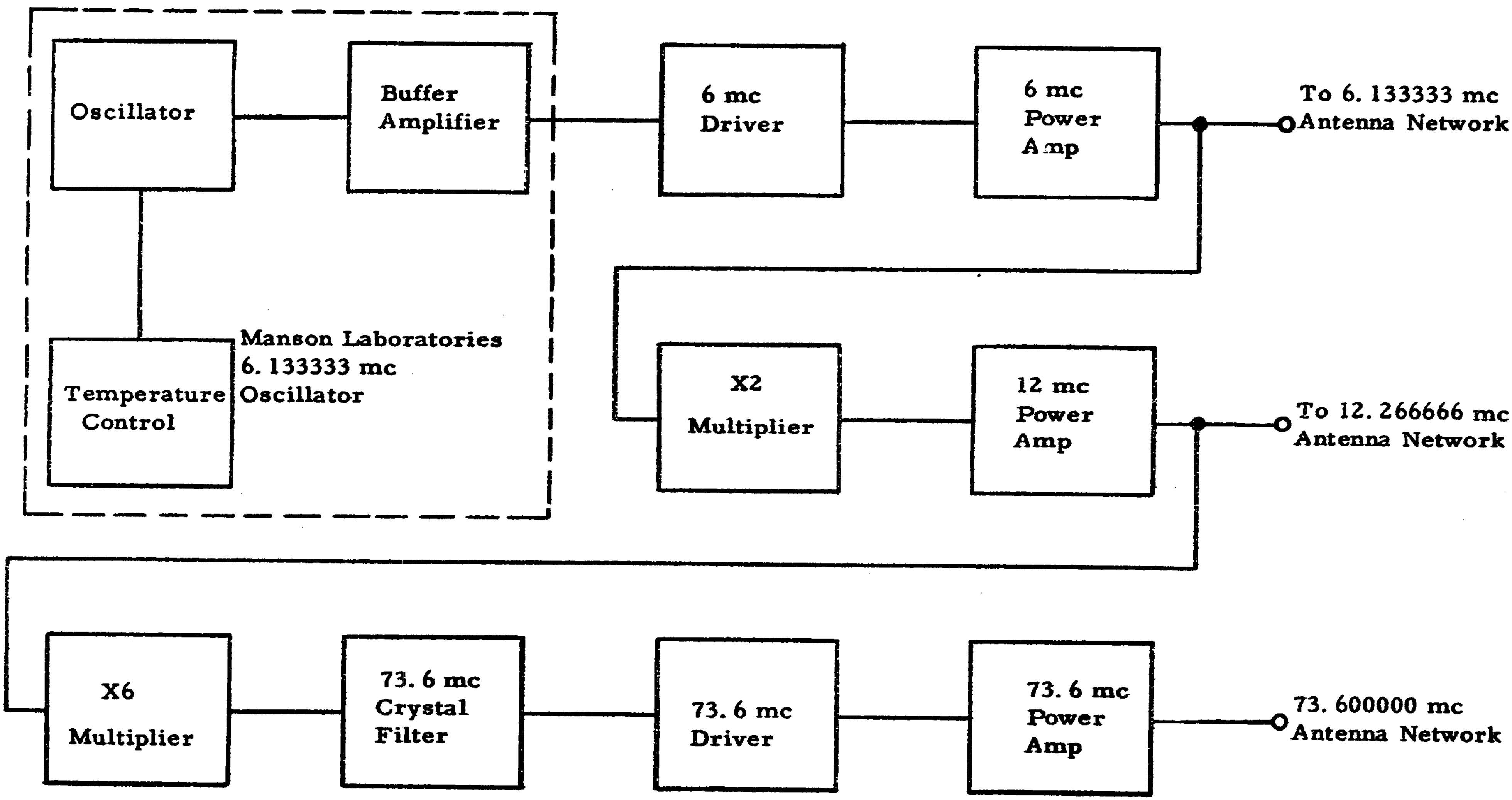
SCI-M226323
SIZE C
SCALE 1/2

W.O. 226
APPLICATION



SECTION C-C
SECTION D-D
SECTION A-A
SECTION B-B
SPRING COMPRESSED
2 28 SCREW LOCK ASS'Y, FEMALE
2 27 SCREW LOCK ASS'Y MALE
2 25 SWITCH 16-492
1 24 CONNECTOR
2 23 BATTERY, VOLTAGE 4.8
1 22 CONNECTOR
8 21 CLAMP, NYLON, CABLE 3/16
1 20 C. P. SPRING
2 19 CUTTER, EXPLOSIVE
1 18 LANYARD ASSEMBLY
1 17 BLOCK, SWITCH SCI-226322
1 16 TIMER, RELEASE SCI-226164
4 15 STRAP, BRACKET SCI-226243
2 14 SEAT, BATTERY SCI-226242
1 13 BRACKET, 'YO' ARMING CONNECTOR SCI-226244
1 12 CABLE, HARNESS
1 11 BLOCK, MOUNTING SCI-226303
1 10 BLOCK, MOUNTING SCI-226302
1 9 PLATE, ANCHOR SCI-226309
1 8 'YO' WEIGHT ASSEMBLY SCI-226323
1 7 RING, 'YO' MECHANISM SUPPORT SCI-226262
1 6 RING, SPRING SUPPORT SCI-226153
1 5 BEARING, COMPRESSION SCI-226234
1 4 HOUSING, SPRING GUIDE SCI-226151
1 3 SPRING, SEPARATION SCI-226027
1 2 RETAINING TUBE, SPRING GUIDE SCI-226152
1 1 'YO' ASSEMBLY SCI-226289
NO. REQ'D PER ASS'Y
ITEM NO.
DESCRIPTION
MIL SPEC
MFR'S PT. NO. DRAWING NO.
REMARKS/ MFR'S CODE
LIST OF MATERIAL
12 NOV. 63
SEE LIST OF MATERIAL
PAYLOAD MOTOR SEPARATION
'YO' ASSEMBLY
Space Craft Inc.
Huntsville, Ala.
SCI-M226154
D
1/8

FIGURE 4-3



BLOCK DIAGRAM

DAUGHTER TRANSMITTER

FIGURE 5-1

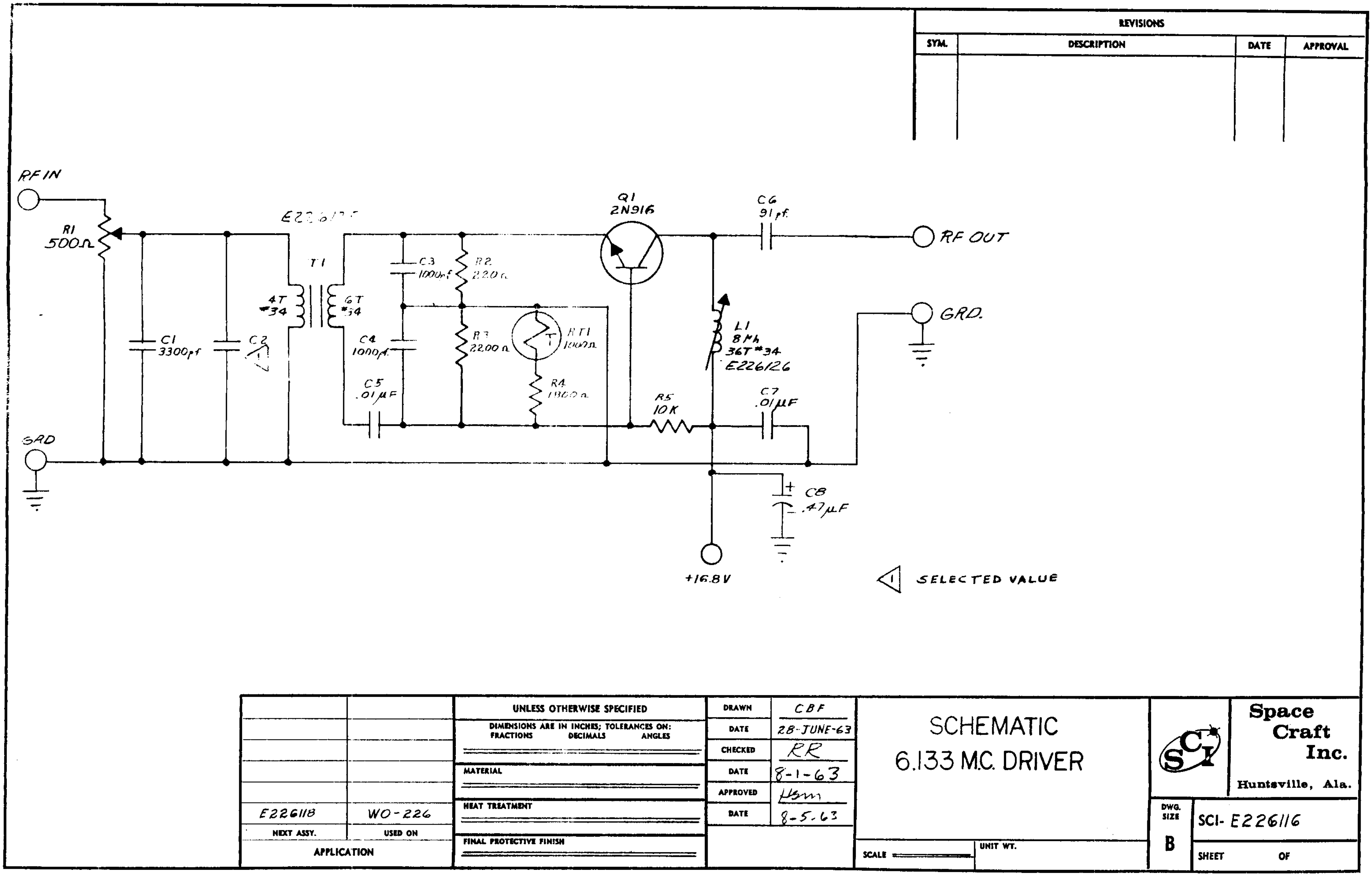

REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
RF IN
R1
500Ω
C1
3300pf
C2
T1
4T
#34
6T
#34
C3
1000pf
C4
1000pf
C5
.01μF
R2
220Ω
R3
2200Ω
RT1
R4
Q1
2N916
R5
10K
C6
91pf
RF OUT
L1
8 Mh
36T #34
E226126
C7
.01μF
GRD.
C8
.47μF
+16.8V
GRD
SELECTED VALUE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
E226118
WO-226
NEXT ASSY.
USED ON
APPLICATION
DRAWN
CBF
DATE
28-JUNE-63
CHECKED
RR
DATE
8-1-63
APPROVED
DATE
8-5-63
SCHEMATIC
6.133 M.C. DRIVER
SCALE
UNIT WT.
Space
Craft
Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI- E226116
SHEET
OF

FIGURE 5-2

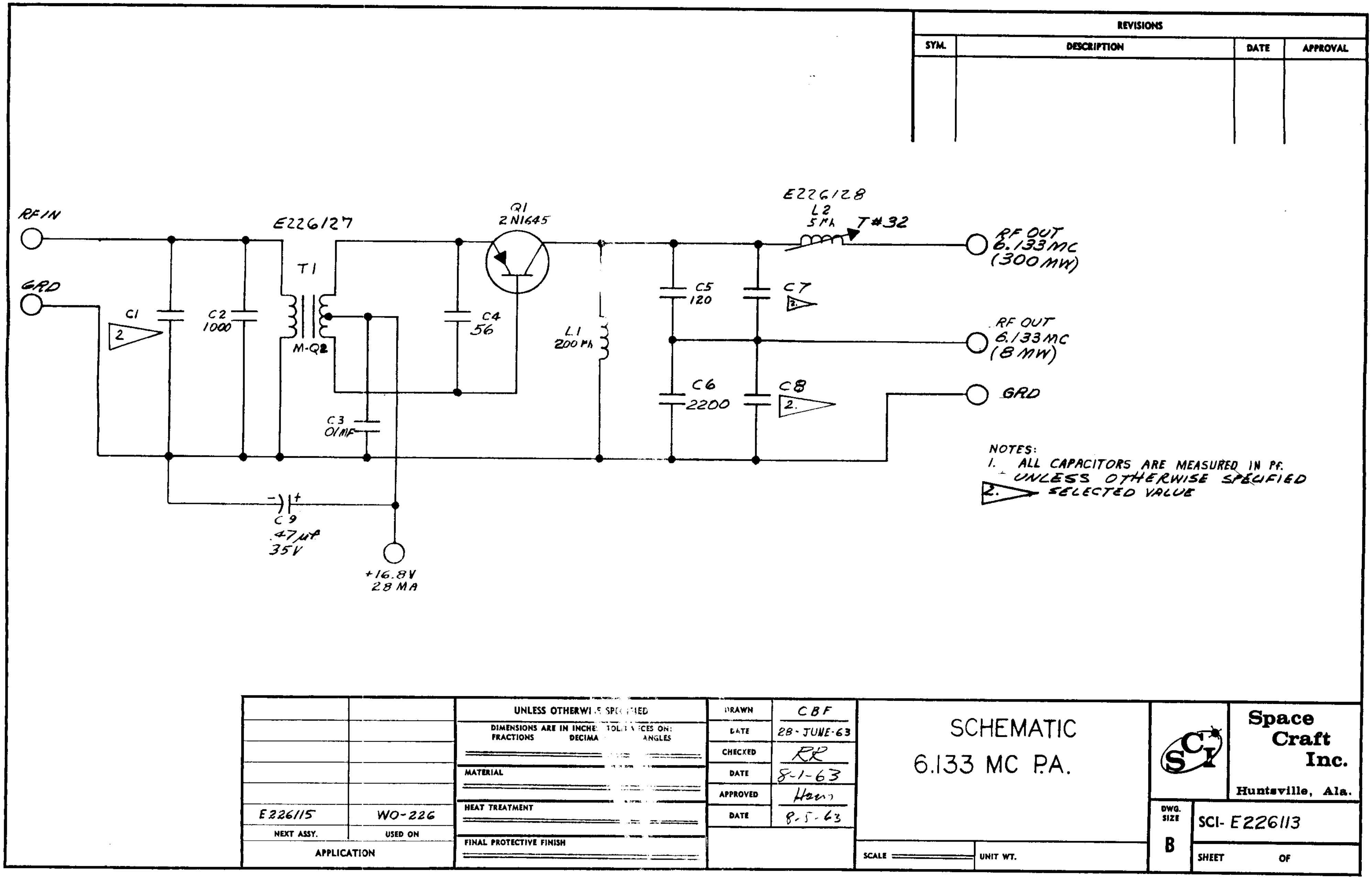
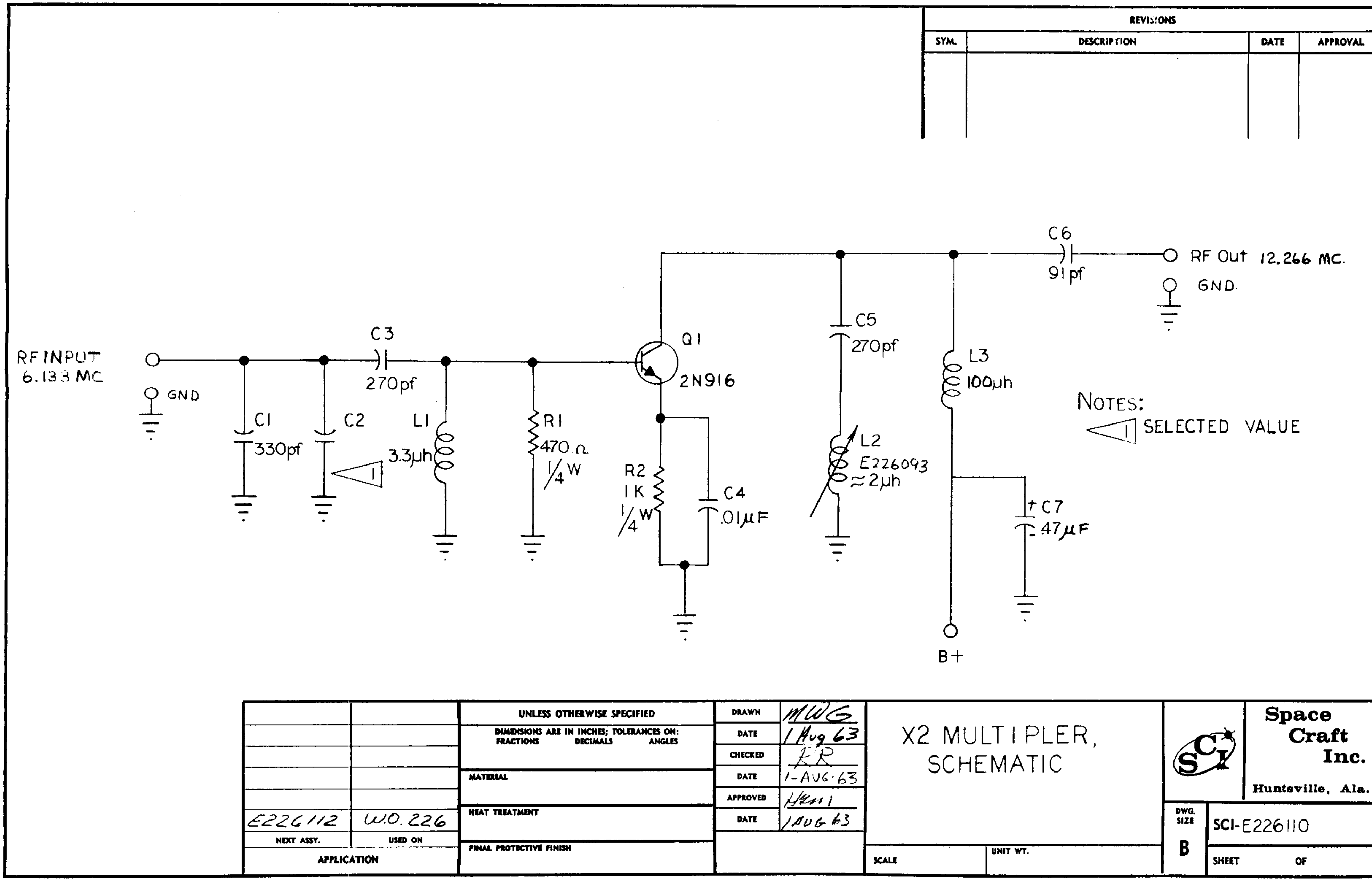

REVISIONS
SYM. DESCRIPTION DATE APPROVAL
RF IN
GRD
C1
2
C2
1000
E226127
T1
M-Q2
C3
.01MF
C9
.47μf
35V
+16.8V
28 MA
C4
56
Q1
2N1645
L1
200 μh
C5
120
C6
2200
C7
C8
2.
E226128
L2
5 μh
T#32
RF OUT
6.133MC
(300MW)
RF OUT
6.133MC
(8MW)
GRD
NOTES:
1. ALL CAPACITORS ARE MEASURED IN Pf. UNLESS OTHERWISE SPECIFIED
2. SELECTED VALUE
E226115
NEXT ASSY.
WO-226
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
DRAWN CBF
DATE 28-JUNE-63
CHECKED RR
DATE 8-1-63
APPROVED
DATE 8-5-63
SCHEMATIC
6.133 MC P.A.
SCALE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI- E226113
SHEET OF

FIGURE 5-3



REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
RF INPUT
6.133 MC
GND
C1
330pf
C2
C3
270pf
L1
3.3µh
R1
470 Ω
1/4 W
Q1
2N916
R2
1K
1/4 W
C4
.01µF
C5
270pf
L2
E226093
≈2µh
L3
100µh
C6
91pf
RF Out 12.266 MC.
GND.
+ C7
47µF
B+
NOTES:
1 SELECTED VALUE
E226112
W.O. 226
NEXT ASSY.
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
DRAWN MWG
DATE 1 Aug 63
CHECKED
DATE 1-AUG-63
APPROVED
DATE 1 AUG 63
X2 MULTIPLER,
SCHEMATIC
SCALE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI-E226110
SHEET
OF

FIGURE 5-4

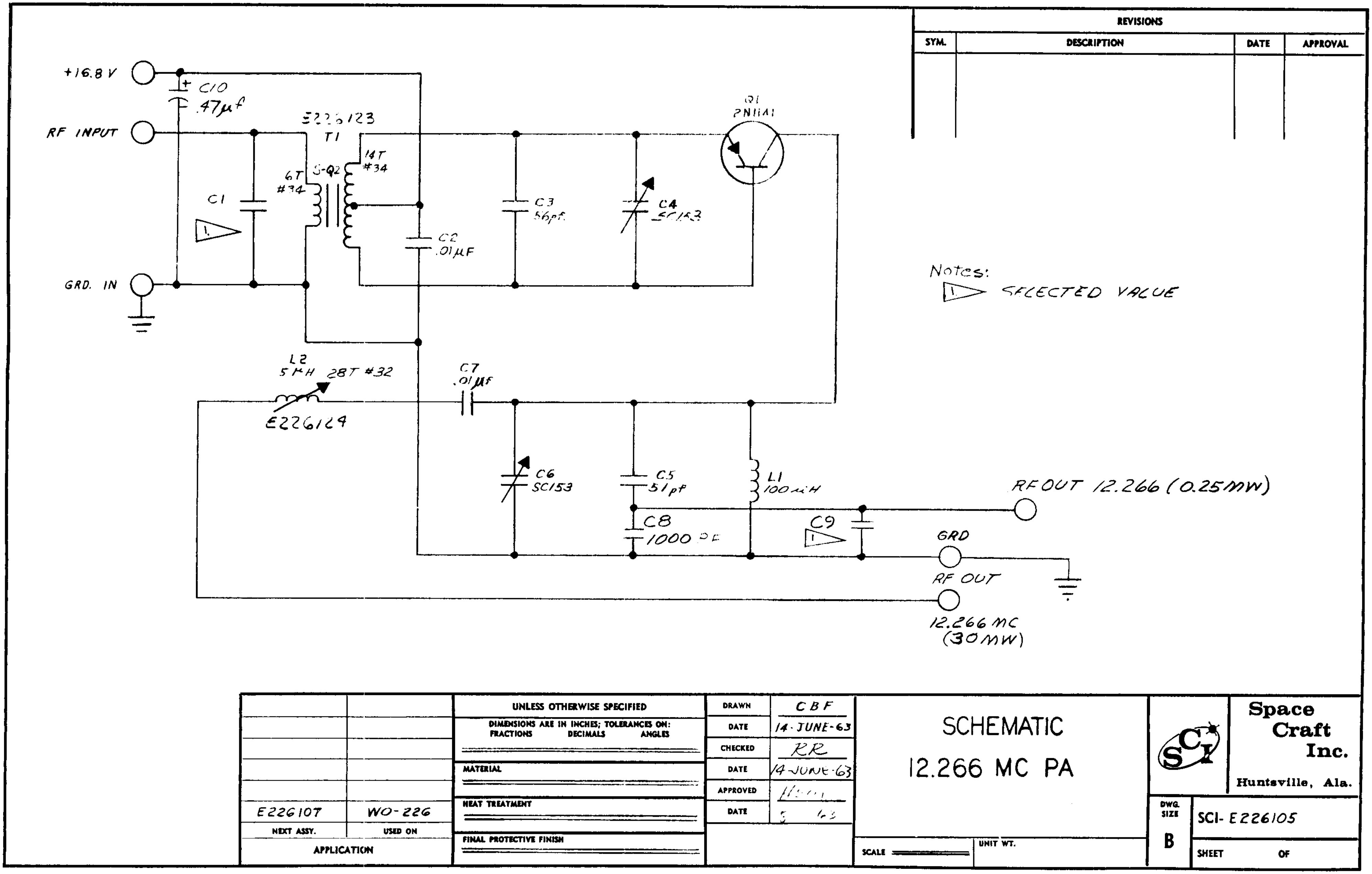
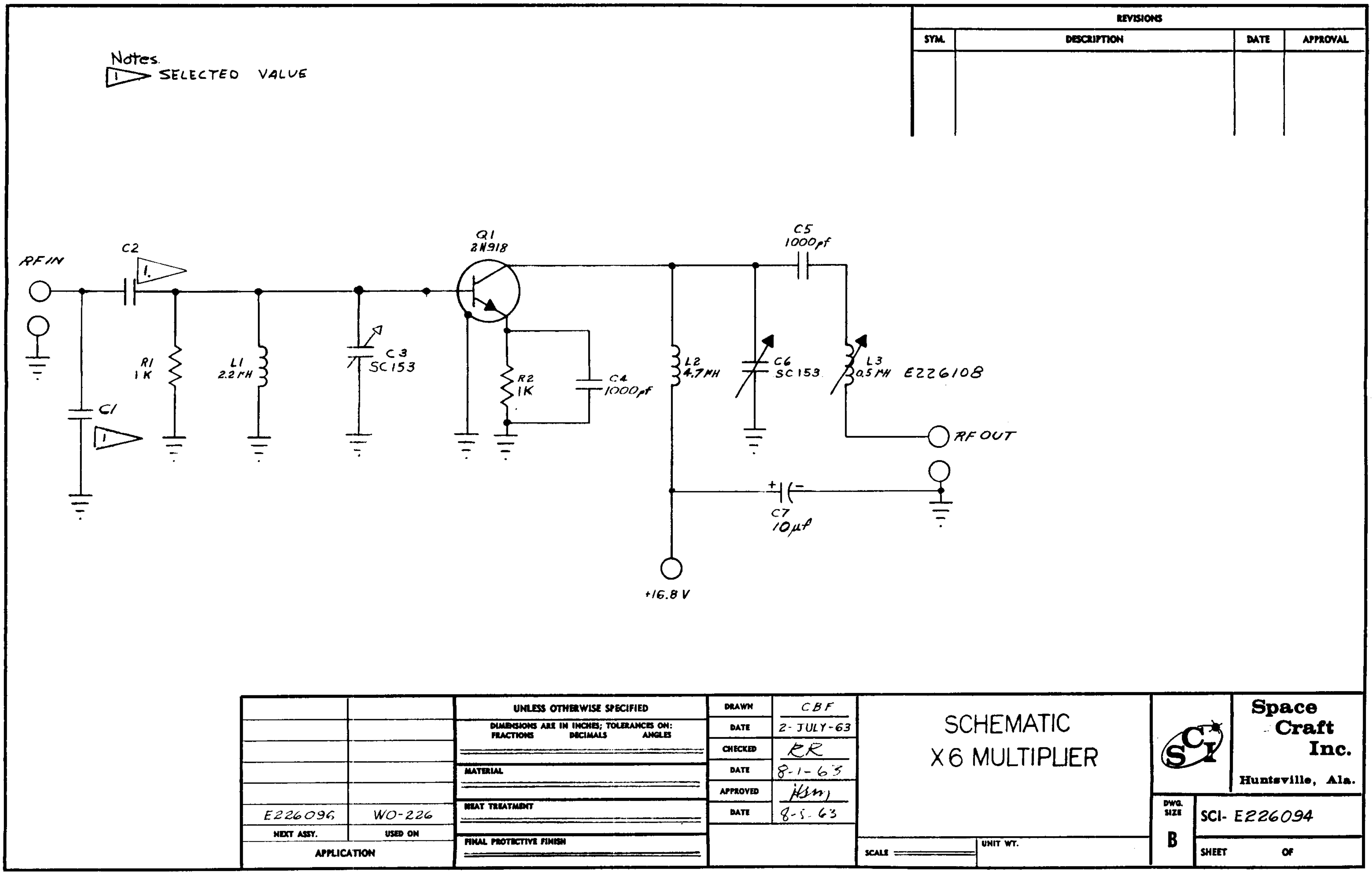

REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
+16.8 V
RF INPUT
GRD. IN
C10
.47μf
C1
T1
6T
#34
14T
#34
C2
.01μF
C3
56pf
C4
SC153
Q1
2N1141
Notes:
1 SELECTED VALUE
L2
5 μH 28T #32
E226124
C7
.01μf
C6
SC153
C5
51pf
C8
1000 pf
L1
100 μH
C9
RF OUT 12.266 (0.25MW)
GRD
RF OUT
12.266 MC
(30MW)
E226107
WO-226
NEXT ASSY.
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
DRAWN
CBF
DATE
14-JUNE-63
CHECKED
RR
DATE
14-JUNE-63
APPROVED
DATE
SCHEMATIC
12.266 MC PA
SCALE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI- E226105
SHEET
OF

FIGURE 5-5



Notes.
1 SELECTED VALUE
REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
RF IN
C2
1.
C1
1
R1
1K
L1
2.2 μH
C3
SC153
Q1
2N918
R2
1K
C4
1000pf
L2
4.7 μH
C5
1000pf
C6
SC153
L3
0.5 μH
E226108
RF OUT
C7
10μf
+16.8 V
E226096
WO-226
NEXT ASSY.
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
DRAWN CBF
DATE 2-JULY-63
CHECKED RR
DATE 8-1-63
DATE 8-5-63
APPROVED
SCHEMATIC
X6 MULTIPLIER
SCALE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI- E226094
SHEET
OF

FIGURE 5-6

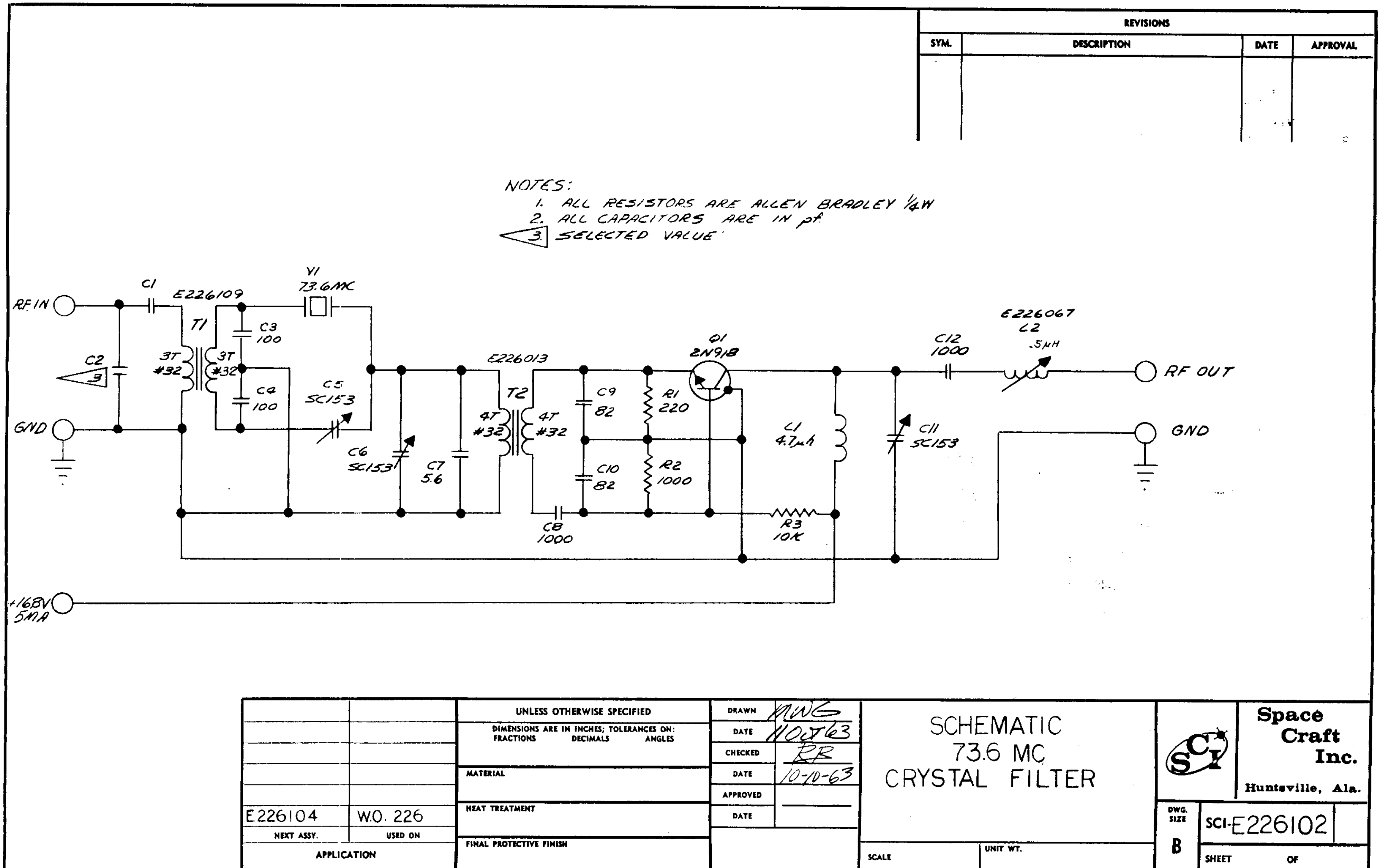

REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
NOTES:
1. ALL RESISTORS ARE ALLEN BRADLEY ¼W
2. ALL CAPACITORS ARE IN pf
3 SELECTED VALUE
RF IN
GND
+16.8V 5MA
C1
C2
3
E226109
T1
3T #32
3T #32
C3 100
C4 100
Y1 73.6MC
C5 SC153
C6 SC153
C7 5.6
E226013
T2
4T #32
4T #32
C8 1000
C9 82
C10 82
R1 220
R2 1000
Q1 2N918
L1 4.7µh
R3 10K
C11 SC153
C12 1000
E226067 L2 .5µH
RF OUT
GND
E226104
NEXT ASSY.
W.O. 226
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON: FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
DRAWN
DATE
CHECKED
DATE
10-10-63
APPROVED
DATE
SCHEMATIC
73.6 MC
CRYSTAL FILTER
SCALE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI-E226102
SHEET
OF

FIGURE 5-7

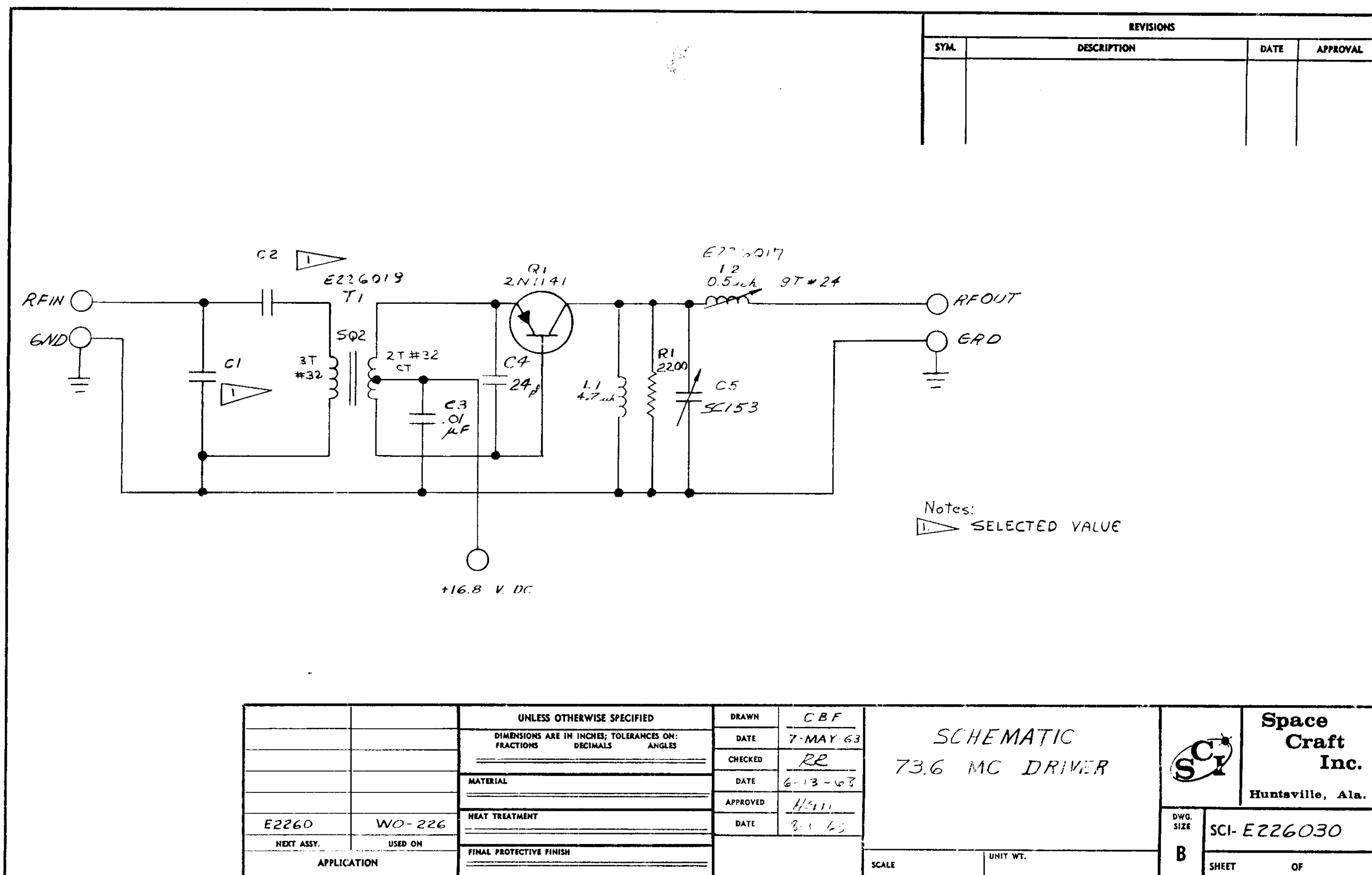

REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
RFIN
GND
C2
C1
E226019
T1
3T
#32
SQ2
2T #32
CT
C3
.01
μF
Q1
2N1141
C4
24pf
L1
4.7μh
R1
2200
C5
SC153
0.5μh
9T #24
RFOUT
GRD
+16.8 V. DC
Notes:
1 SELECTED VALUE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
E2260
WO-226
NEXT ASSY.
USED ON
APPLICATION
DRAWN
CBF
DATE
7-MAY-63
CHECKED
RR
DATE
6-13-63
APPROVED
DATE
SCHEMATIC
73.6 MC DRIVER
Space
Craft
Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI- E226030
SCALE
UNIT WT.
SHEET
OF

FIGURE 5-8

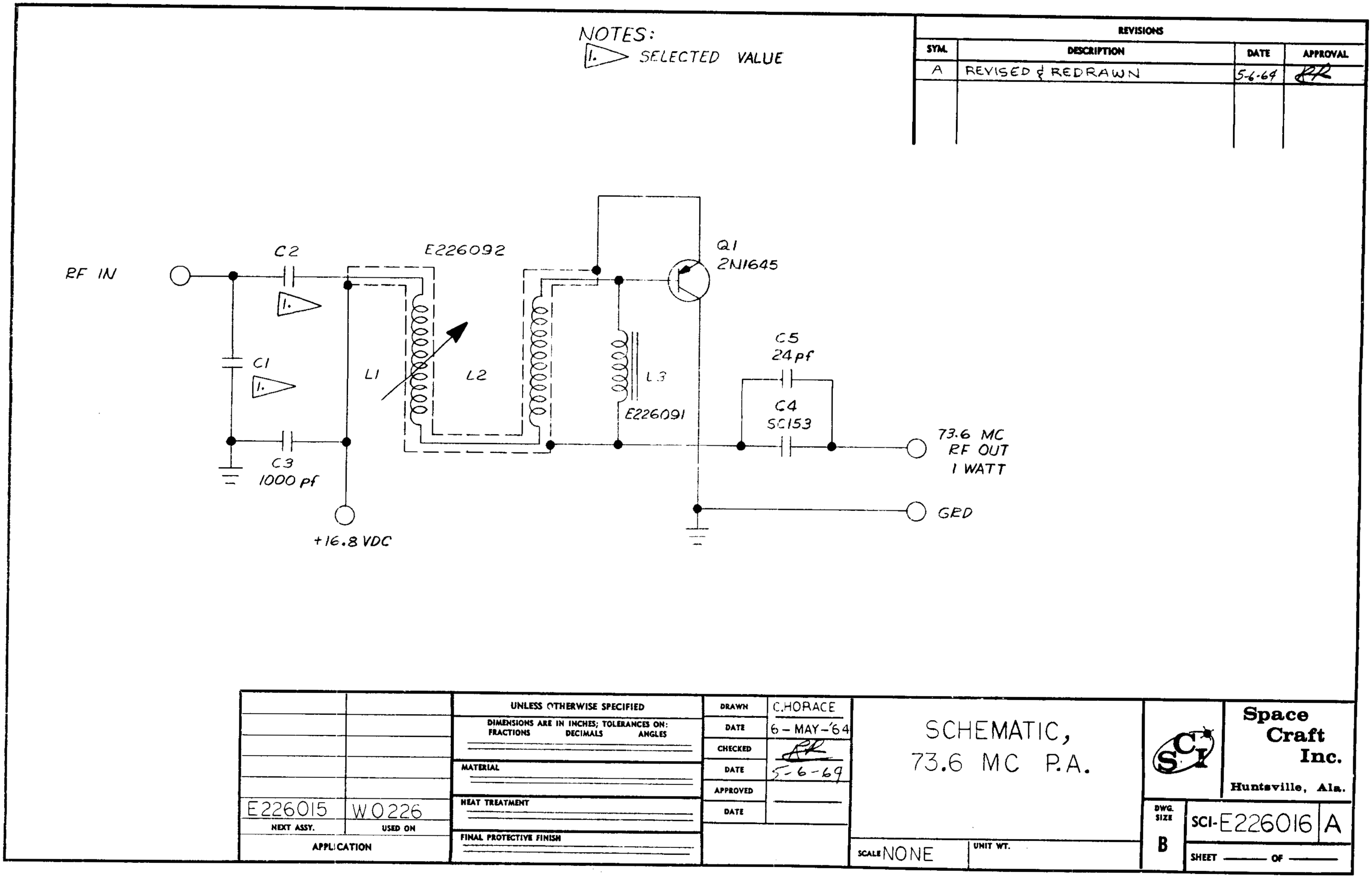

NOTES:
1. SELECTED VALUE
REVISIONS
SYM. | DESCRIPTION | DATE | APPROVAL
A | REVISED & REDRAWN | 5-6-69
RF IN
C2
C1
C3
1000 pf
E226092
L1
L2
L3
E226091
Q1
2N1645
C5
24 pf
C4
SC153
73.6 MC
RF OUT
1 WATT
GRD
+16.8 VDC
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
E226015
W0226
NEXT ASSY.
USED ON
APPLICATION
DRAWN C.HORACE
DATE 6-MAY-'64
CHECKED
DATE 5-6-69
APPROVED
DATE
SCHEMATIC,
73.6 MC P.A.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE B
SCI-E226016 A
SCALE NONE
UNIT WT.
SHEET OF

FIGURE 5-9

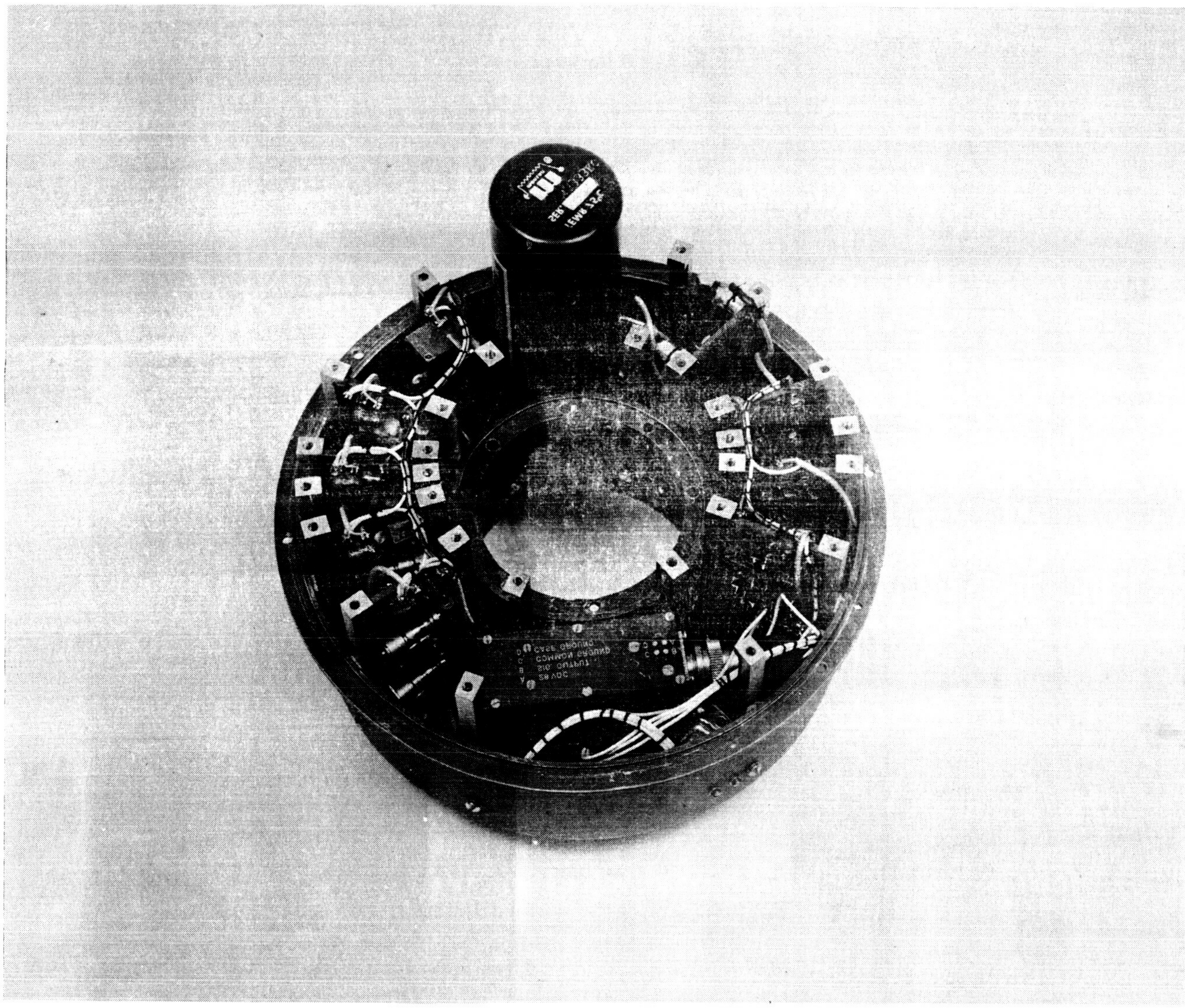


FIGURE 5-10

DAUGHTER TRANSMITTER

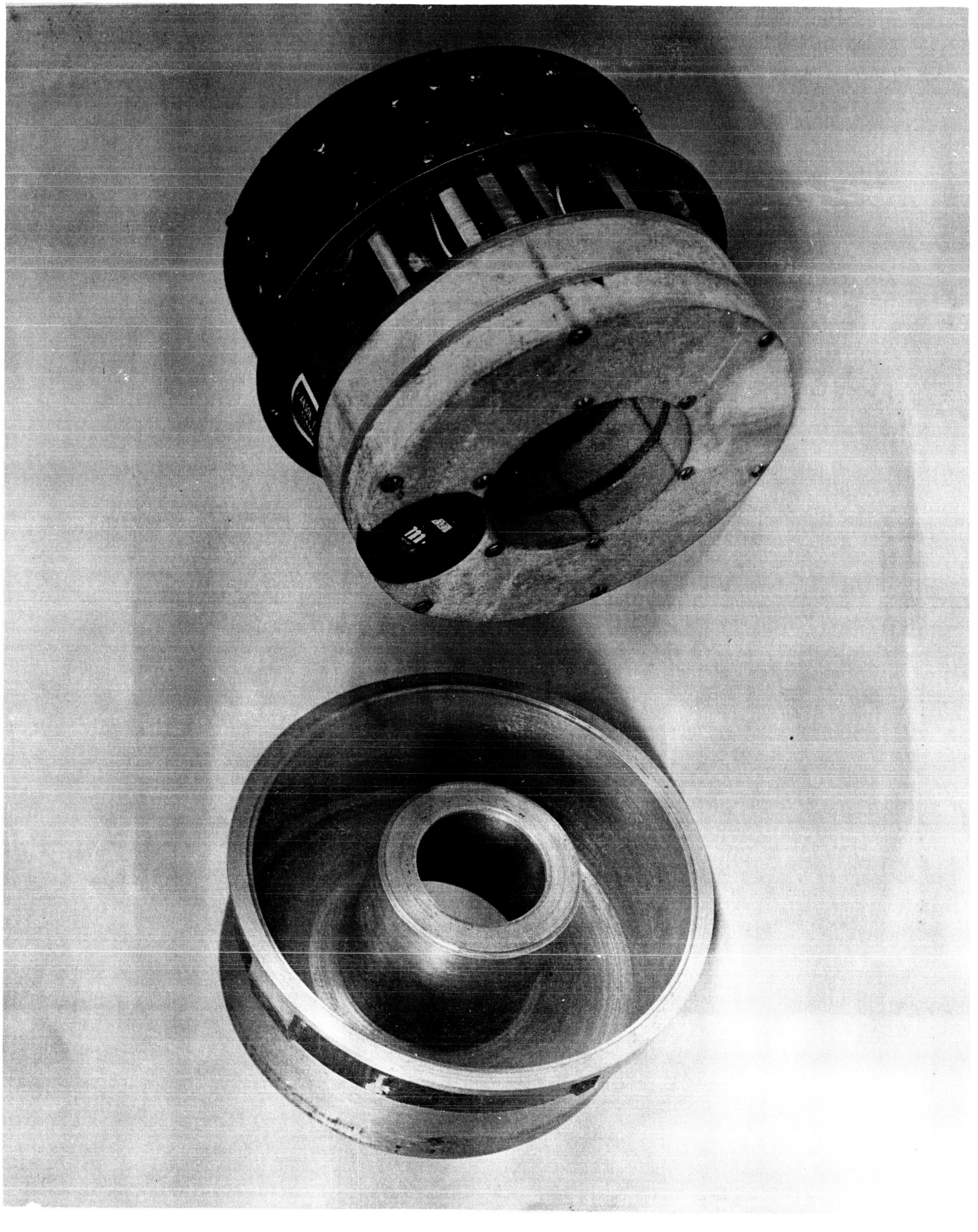
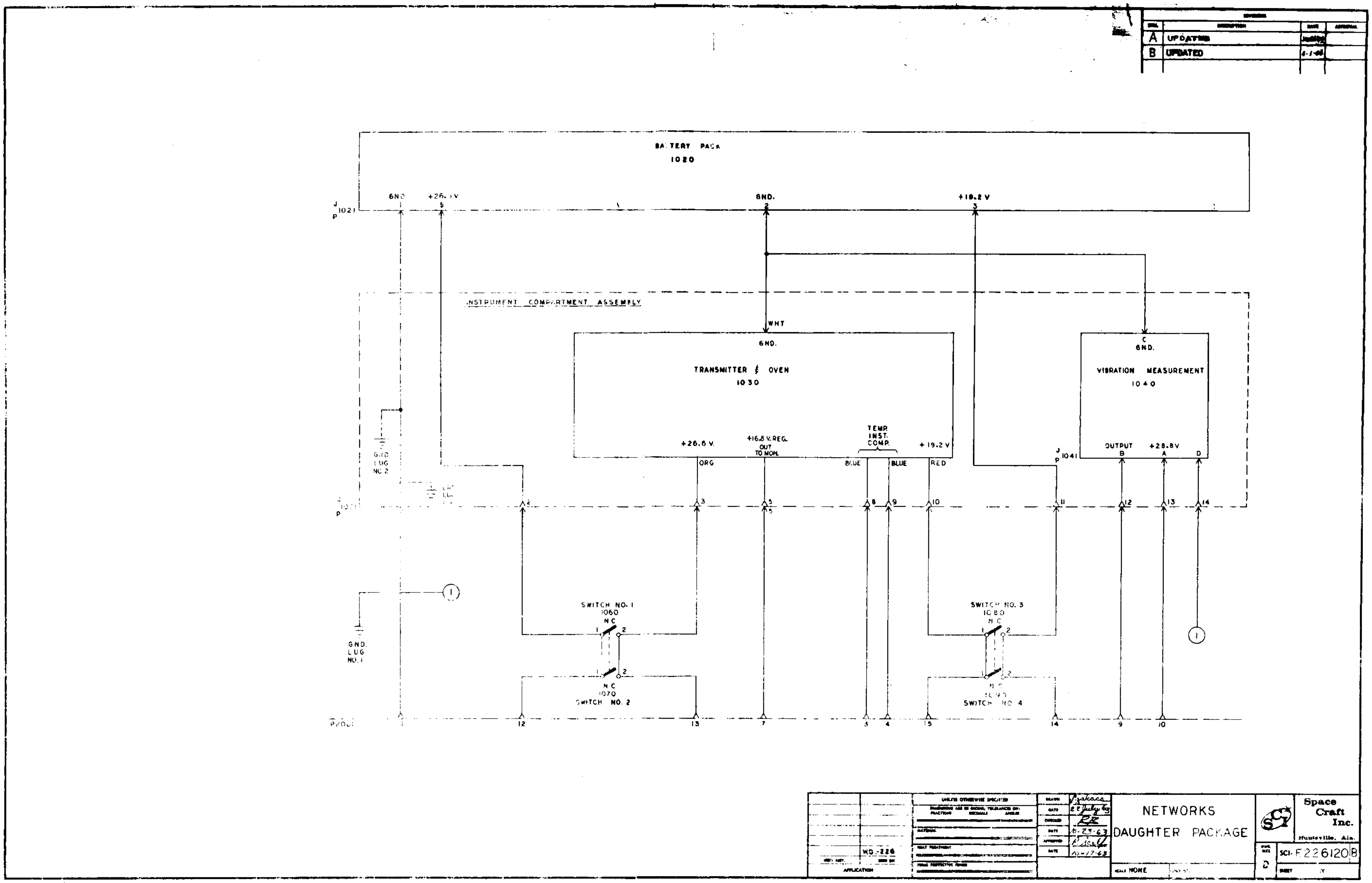


FIGURE 5-11

BATTERY PACK WITH DAUGHTER TRANSMITTER



A UPDATED
B UPDATED
BATTERY PACK
1020
GND
+26.V
GND.
+19.2 V
INSTRUMENT COMPARTMENT ASSEMBLY
WHT
GND.
TRANSMITTER & OVEN
1030
+26.6 V.
+16.8 V. REG. OUT TO MON.
TEMP. INST. COMP.
+19.2 V
ORG
BLUE
BLUE
RED
C
GND.
VIBRATION MEASUREMENT
1040
OUTPUT
+28.8V
J 1041 P
GND. LUG NO. 2
GND. LUG NO. 1
SWITCH NO. 1
1060
NC
NC
1070
SWITCH NO. 2
SWITCH NO. 3
SWITCH NO. 4
NETWORKS
DAUGHTER PACKAGE
Space Craft Inc.
Huntsville, Ala.
SCI-F226120B
NO.-226
SCALE NONE

FIGURE 5-12

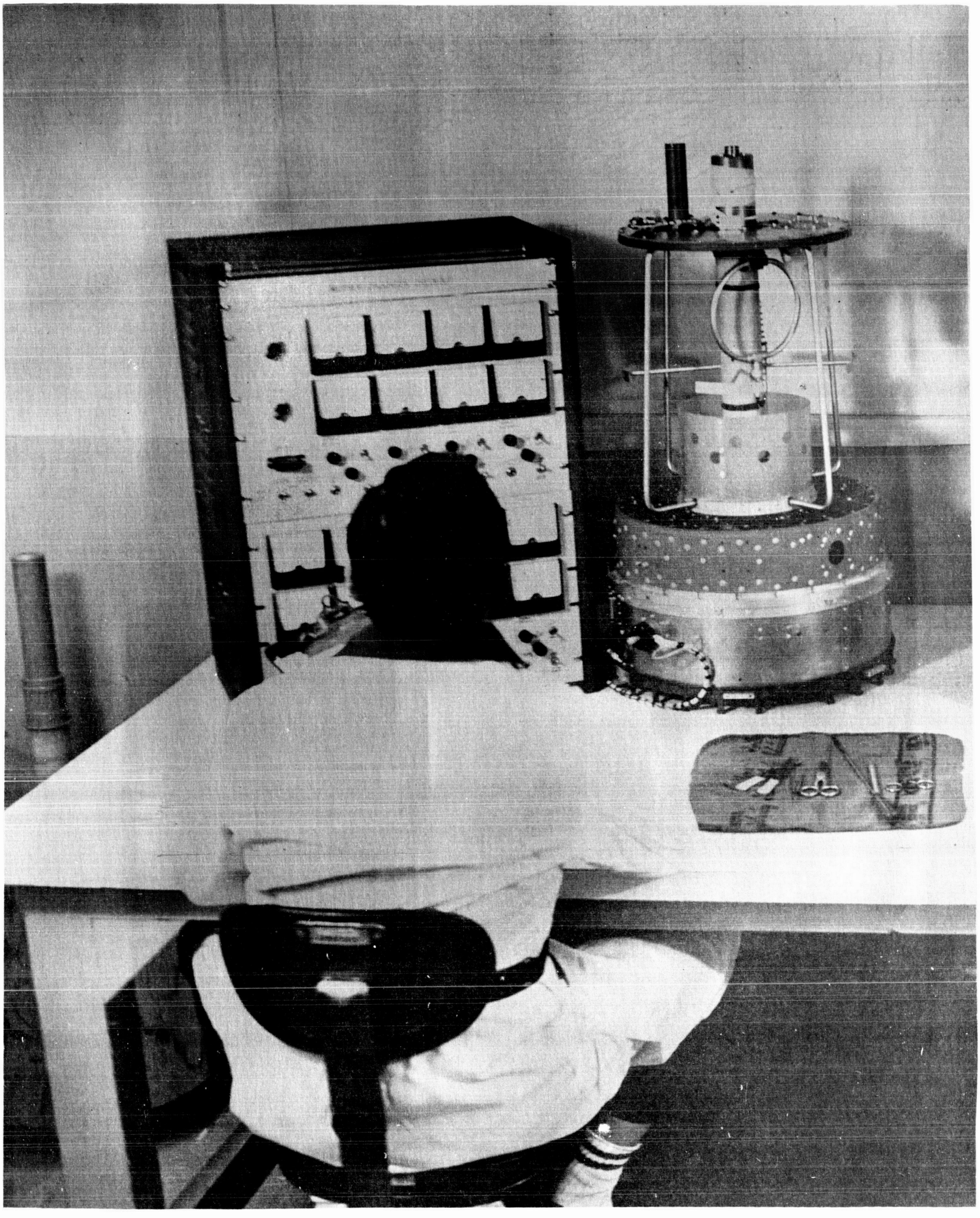
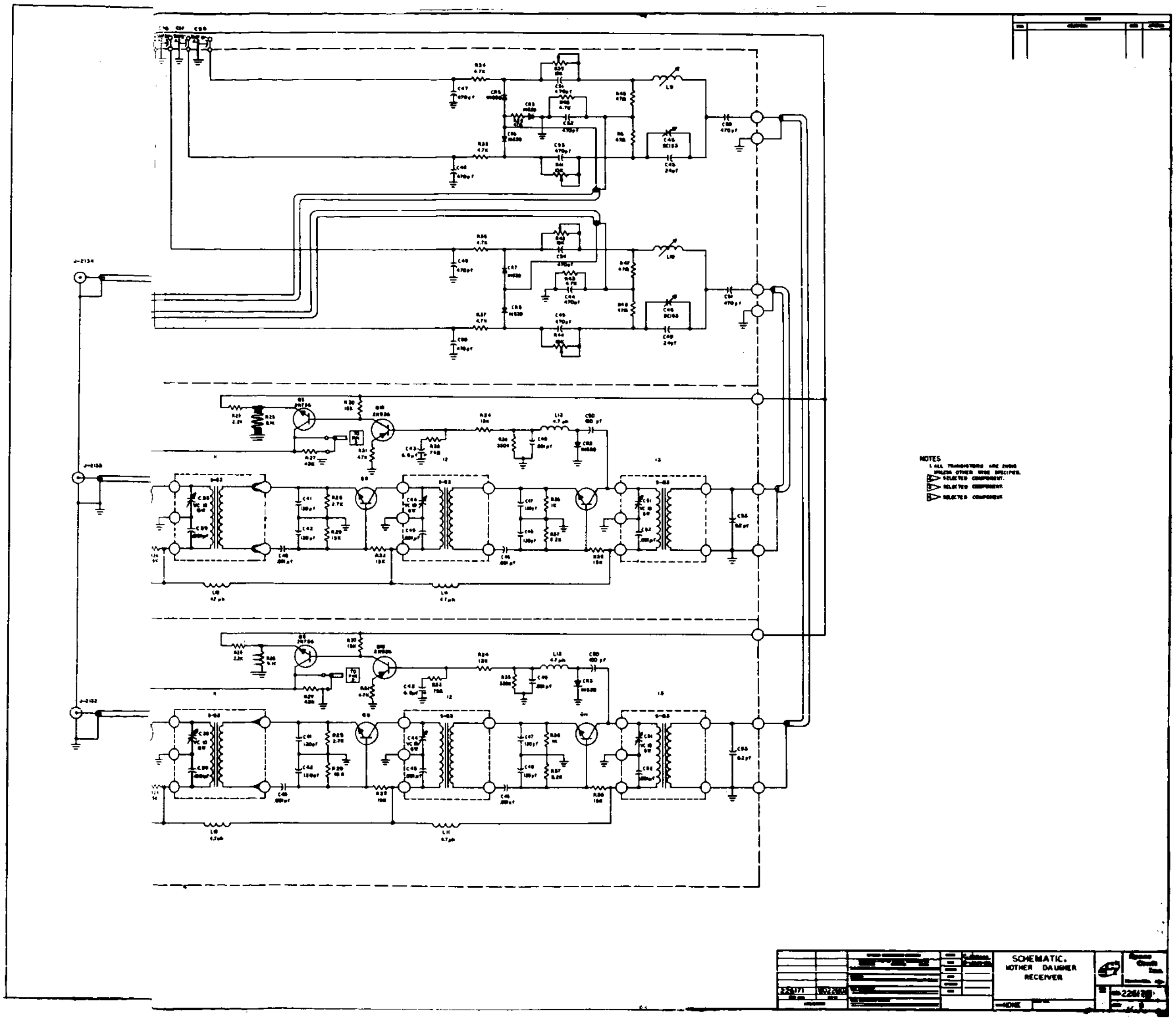


FIGURE 6-1

MOTHER PAYLOAD ANTENNA CONFIGURATION


NOTES
1. ALL TRANSISTORS ARE
UNLESS OTHER WISE SPECIFIED.
SELECTED COMPONENT.
SELECTED COMPONENT
SELECTED COMPONENT
SCHEMATIC,
MOTHER DAUGHER
RECEIVER
NONE

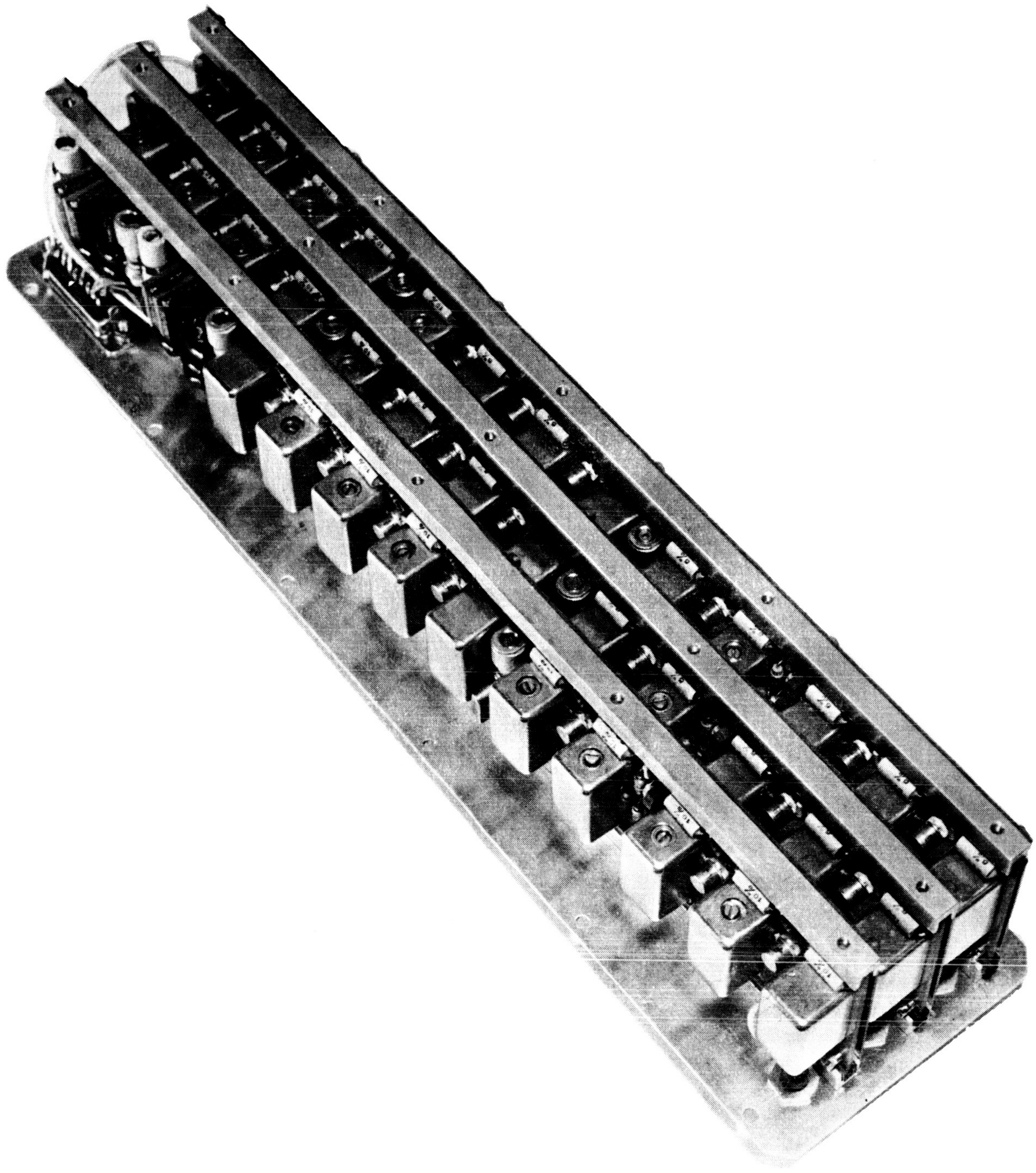


FIGURE 6-3

MOTHER RECEIVER ASSEMBLY, LESS CASE

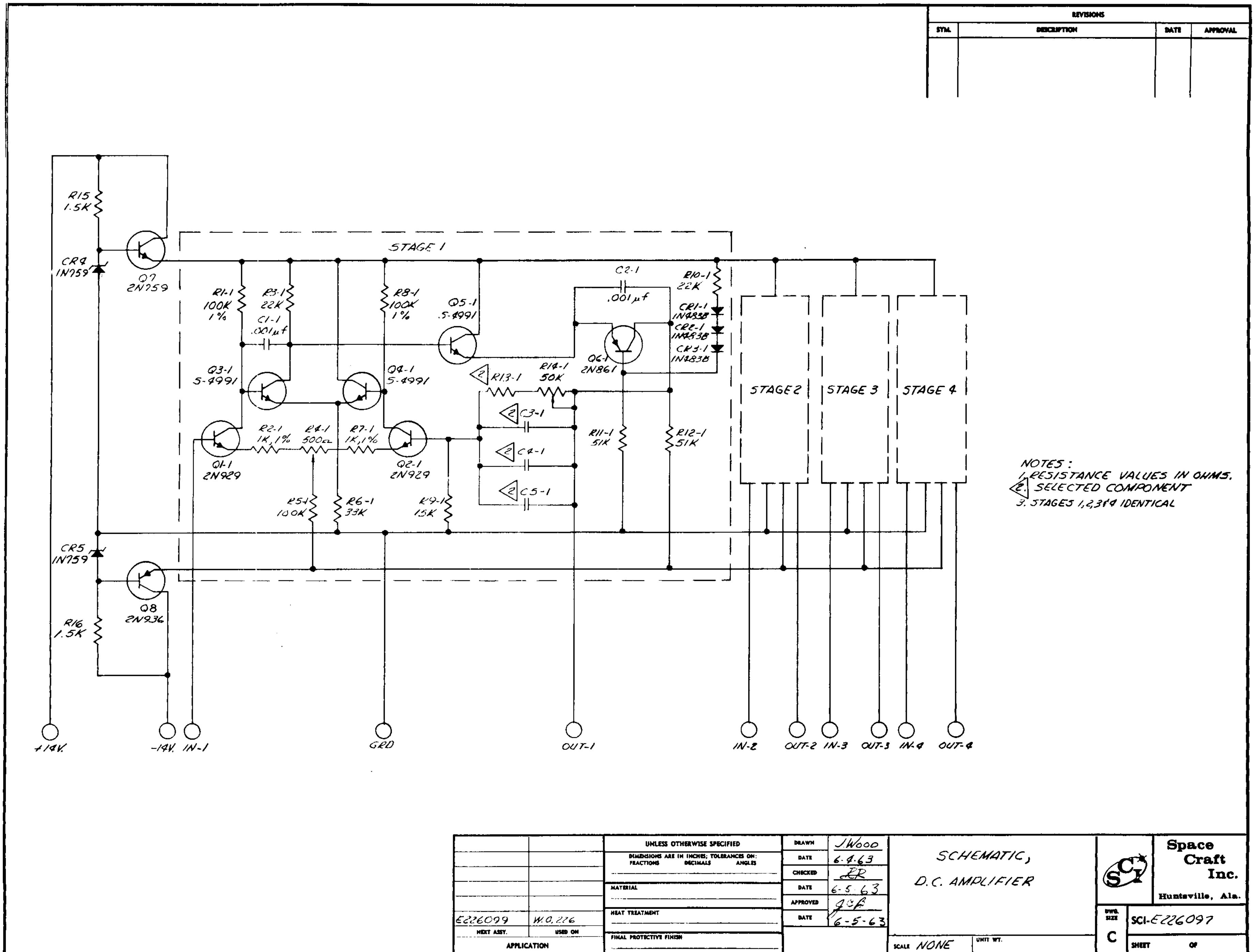

STAGE 1
STAGE 2
STAGE 3
STAGE 4
R15 1.5K
CR4 1N759
Q7 2N759
CR5 1N759
Q8 2N936
R16 1.5K
R1-1 100K 1%
R3-1 22K
C1-1 .001μf
R8-1 100K 1%
Q5-1 S-4991
Q3-1 S-4991
Q4-1 S-4991
Q1-1 2N929
Q2-1 2N929
R2-1 1K, 1%
R4-1 500Ω
R7-1 1K, 1%
R5-1 100K
R6-1 33K
R9-1 15K
C2-1 .001μf
R10-1 22K
CR1-1 1N483B
CR2-1 1N483B
CR3-1 1N483B
Q6-1 2N861
R13-1
R14-1 50K
C3-1
C4-1
C5-1
R11-1 51K
R12-1 51K
+14V.
-14V.
IN-1
GRD
OUT-1
IN-2
OUT-2
IN-3
OUT-3
IN-4
OUT-4
NOTES:
1. RESISTANCE VALUES IN OHMS.
2. SELECTED COMPONENT
3. STAGES 1,2,3 & 4 IDENTICAL
REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
E226099
W.O. 226
NEXT ASSY.
USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS
DECIMALS
ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
DRAWN
J. Wood
DATE
6-4-63
CHECKED
DATE
6-5-63
APPROVED
DATE
6-5-63
SCHEMATIC,
D.C. AMPLIFIER
SCALE NONE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
C
SCI-E226097
SHEET
OF

FIGURE 6-4

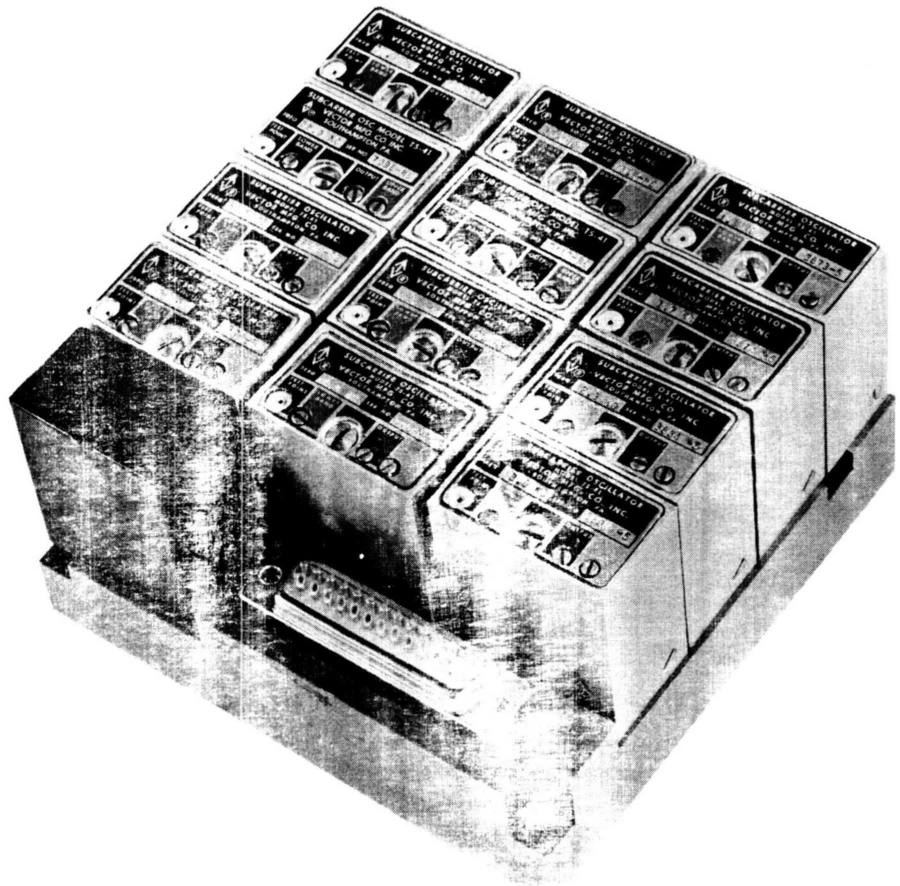


FIGURE 6-5

VCO CHASSIS ASSEMBLY

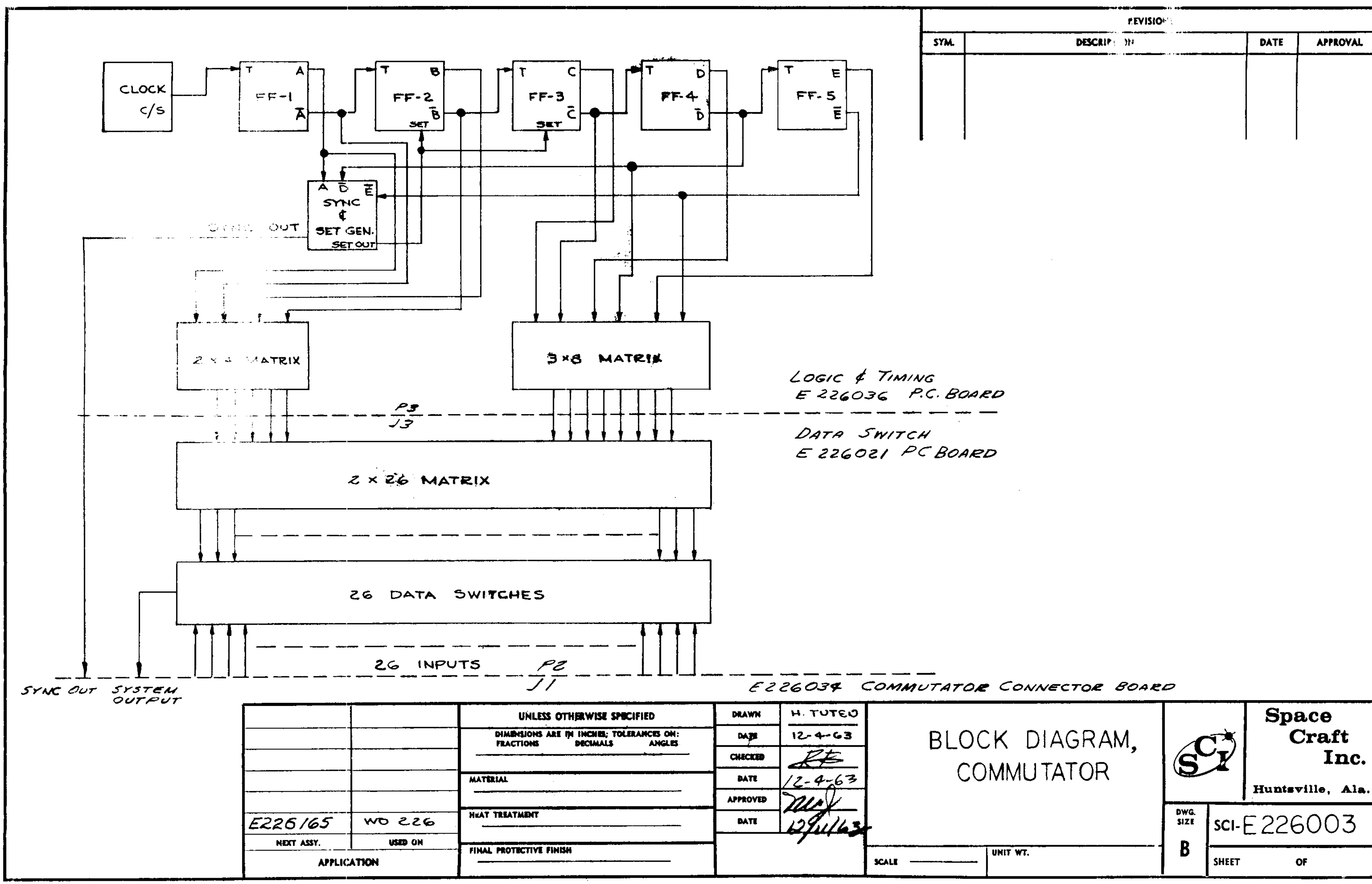
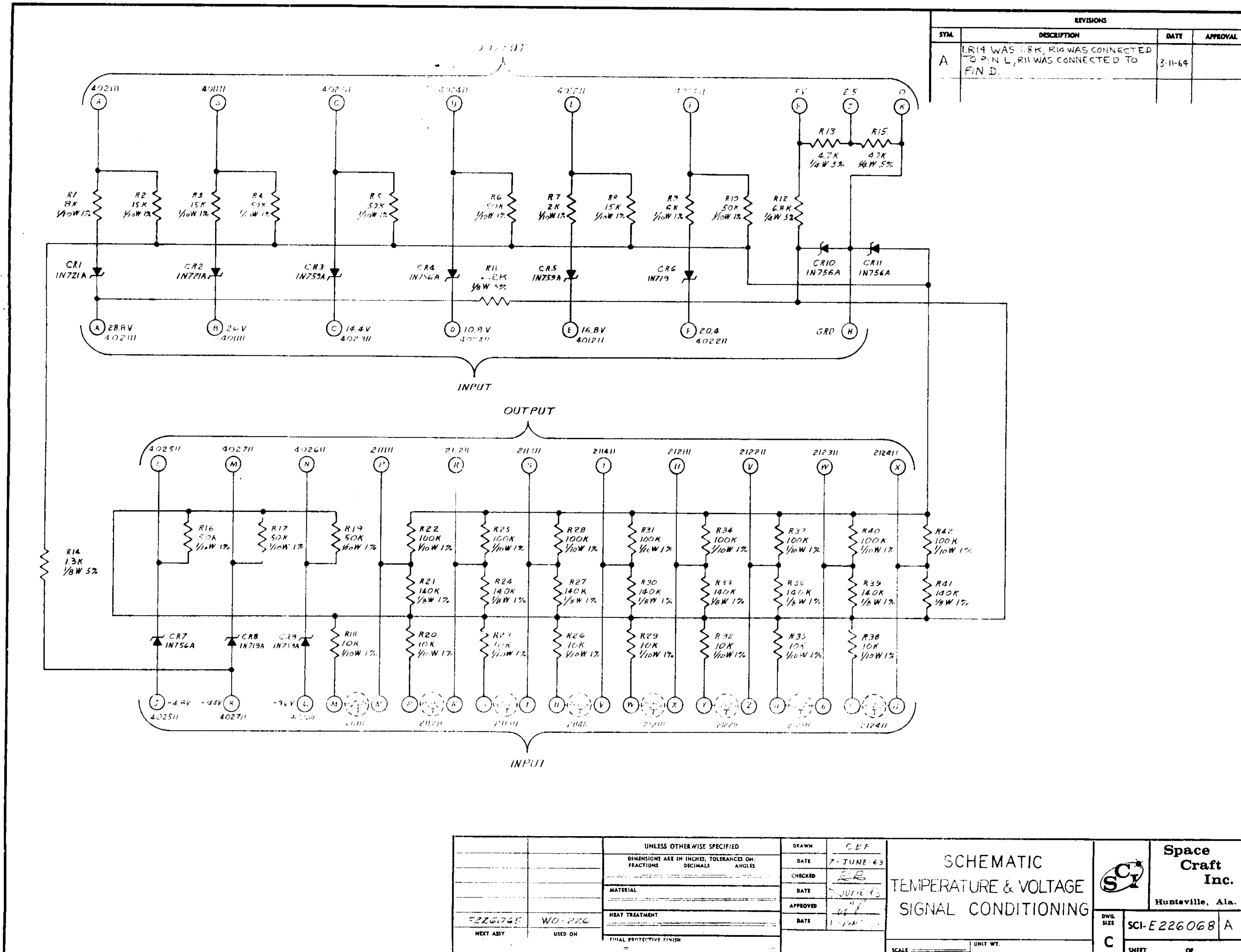

CLOCK
C/S
FF-1
FF-2
FF-3
FF-4
FF-5
SET
SYNC & SET GEN.
SET OUT
OUT
2 × 4 MATRIX
3 × 8 MATRIX
P3
J3
LOGIC & TIMING
E 226036 P.C. BOARD
DATA SWITCH
E 226021 PC BOARD
2 × 26 MATRIX
26 DATA SWITCHES
26 INPUTS
P2
J1
SYNC OUT
SYSTEM OUTPUT
E226034 COMMUTATOR CONNECTOR BOARD
REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON:
FRACTIONS
DECIMALS
ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
E226165
WO 226
NEXT ASSY.
USED ON
APPLICATION
DRAWN
H. TUTEO
DATE
12-4-63
CHECKED
DATE
12-4-63
APPROVED
DATE
BLOCK DIAGRAM,
COMMUTATOR
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI-E226003
SCALE
UNIT WT.
SHEET
OF

FIGURE 6-6



REVISIONS
SYM. | DESCRIPTION | DATE | APPROVAL
A | 1.R14 WAS 1.8K, R14 WAS CONNECTED TO PIN L, R11 WAS CONNECTED TO PIN D. | 3-11-64
INPUT
OUTPUT
INPUT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES, TOLERANCES ON: FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
NEXT ASSY
USED ON
WO-226
DRAWN C.B.F.
DATE 7-JUNE-63
CHECKED
DATE
APPROVED
DATE
SCHEMATIC
TEMPERATURE & VOLTAGE
SIGNAL CONDITIONING
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE C
SCI-E226068
A
SCALE
UNIT WT.
SHEET OF

FIGURE 6-7

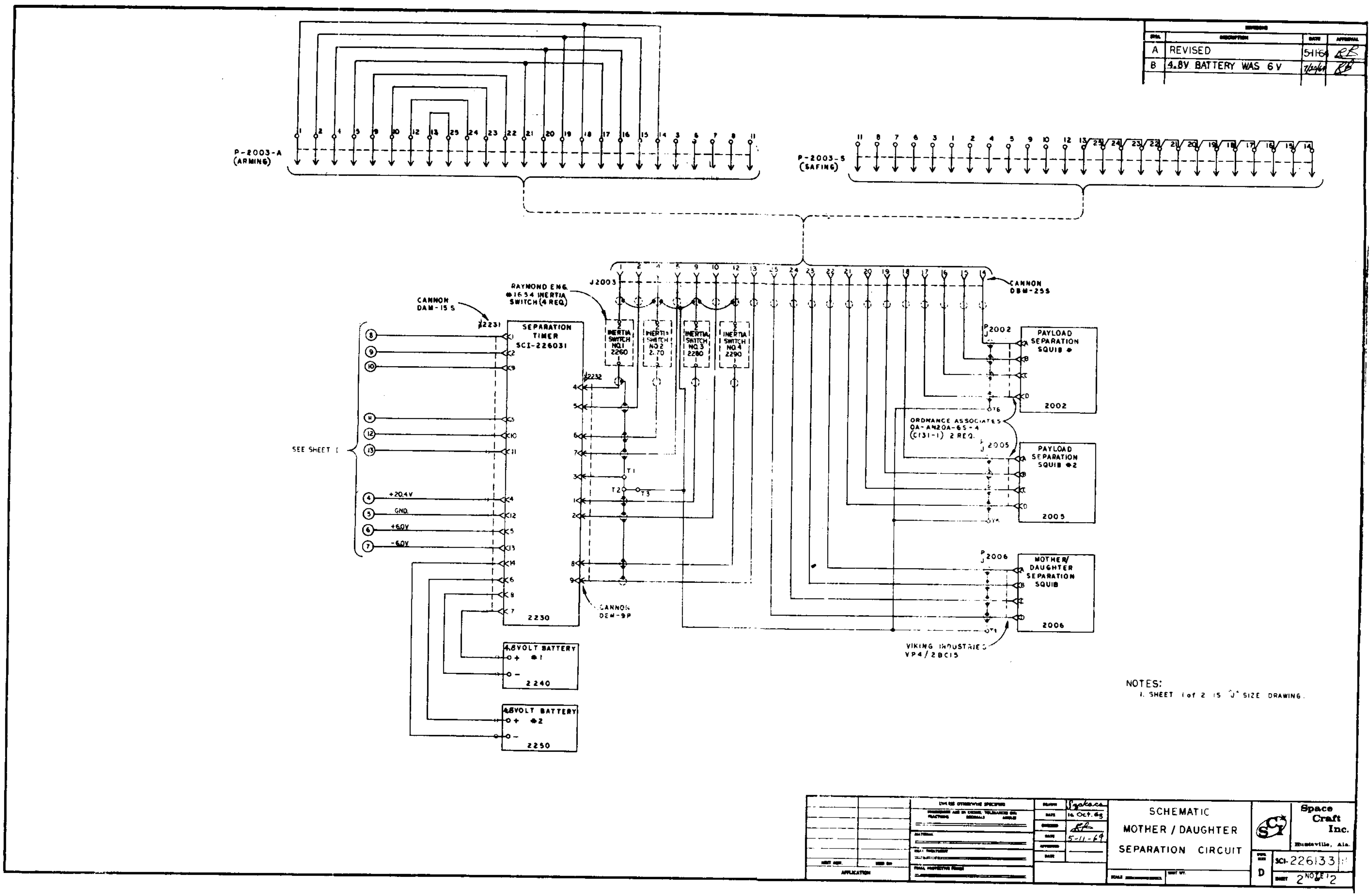

A REVISED 5/1/64
B 4.8V BATTERY WAS 6V
P-2003-A (ARMING)
P-2003-S (SAFING)
J2003
CANNON DBM-25S
CANNON DAM-15S
RAYMOND ENG. #1634 INERTIA SWITCH (4 REQ.)
SEPARATION TIMER SCI-226031
INERTIA SWITCH NO.1 2260
INERTIA SWITCH NO.2 2270
INERTIA SWITCH NO.3 2280
INERTIA SWITCH NO.4 2290
J2231
J2232
2230
CANNON DEM-9P
SEE SHEET 1
+20.4V
GND.
+60V
-60V
4.8VOLT BATTERY #1
2240
4.8VOLT BATTERY #2
2250
PAYLOAD SEPARATION SQUIB #1
2002
PAYLOAD SEPARATION SQUIB #2
2005
MOTHER/DAUGHTER SEPARATION SQUIB
2006
P2002 J
P2005 J
P2006 J
ORDNANCE ASSOCIATES OA-AN20A-6S-4 (C131-1) 2 REQ.
VIKING INDUSTRIES VP4/2BC15
NOTES:
1. SHEET 1 of 2 IS "D" SIZE DRAWING.
SCHEMATIC
MOTHER / DAUGHTER
SEPARATION CIRCUIT
Space Craft Inc.
Huntsville, Ala.
SCI-226133
D
SHEET 2 OF 2

FIGURE 6-8

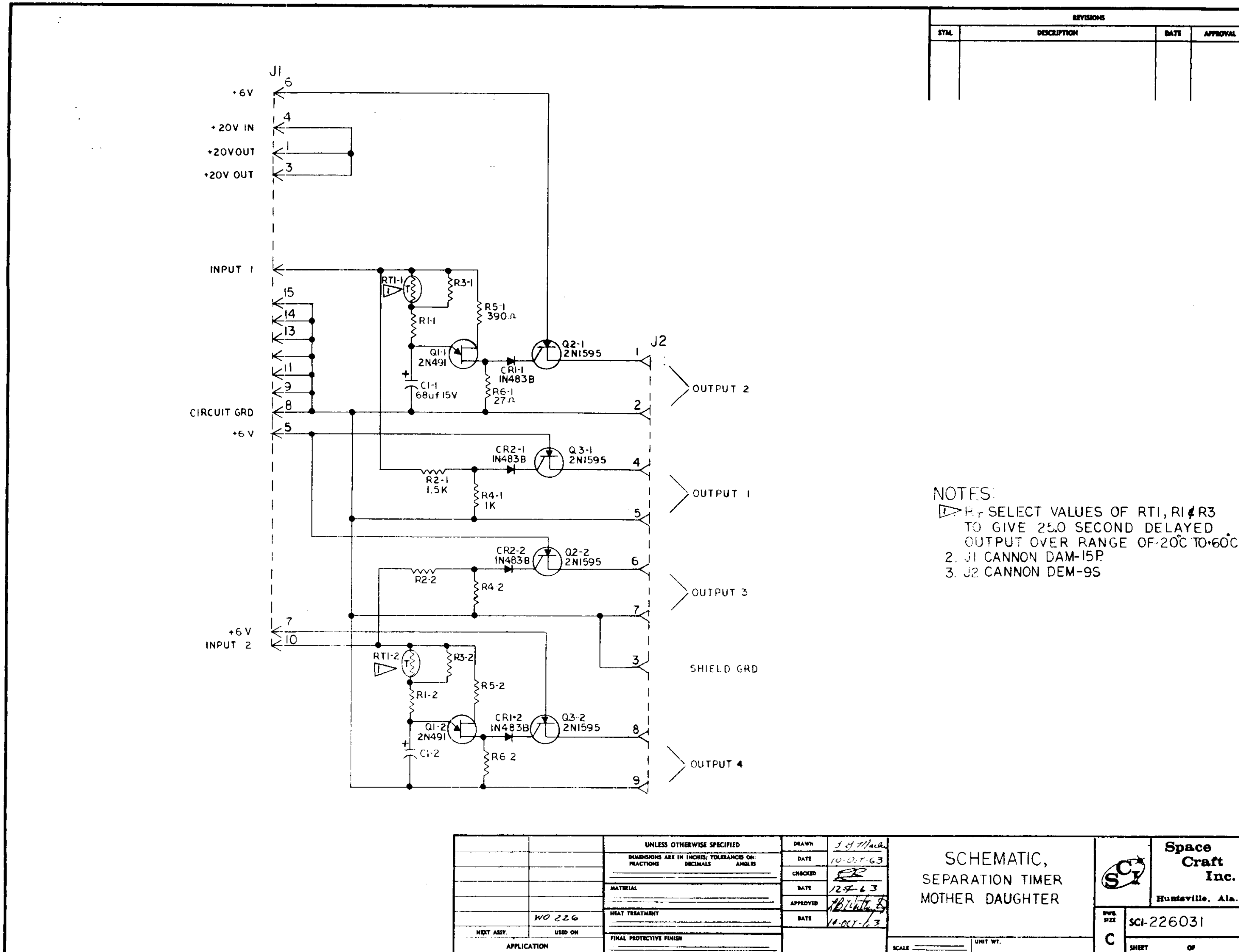
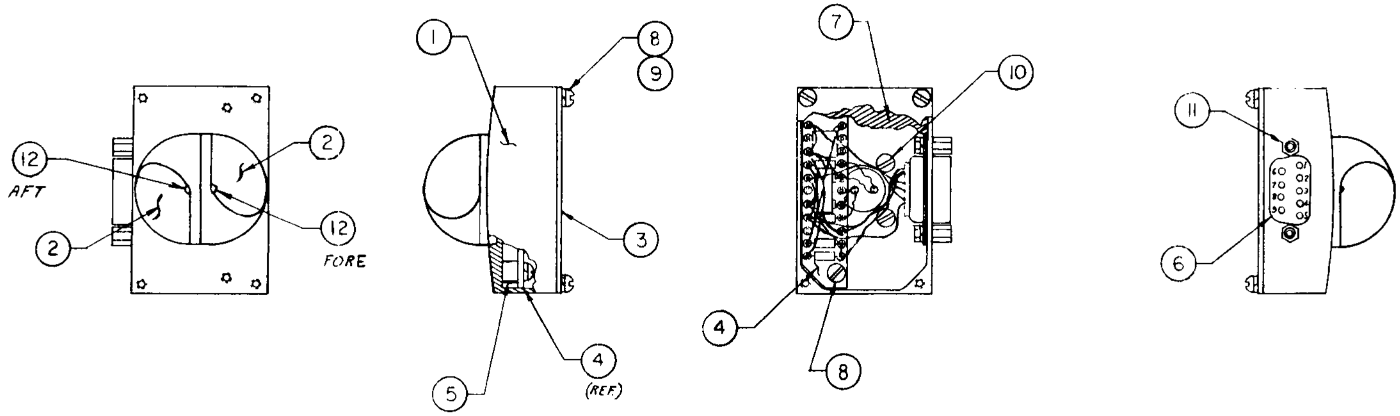

J1
+6V
+20V IN
+20VOUT
+20V OUT
INPUT 1
CIRCUIT GRD
+6 V
+6 V
INPUT 2
RT1-1
R3-1
R5-1 390 Ω
R1-1
Q1-1 2N491
C1-1 68uf 15V
CR1-1 1N483B
R6-1 27 Ω
Q2-1 2N1595
CR2-1 1N483B
Q3-1 2N1595
R2-1 1.5K
R4-1 1K
CR2-2 1N483B
Q2-2 2N1595
R2-2
R4-2
RT1-2
R3-2
R5-2
R1-2
Q1-2 2N491
C1-2
CR1-2 1N483B
Q3-2 2N1595
R6 2
J2
OUTPUT 2
OUTPUT 1
OUTPUT 3
SHIELD GRD
OUTPUT 4
NOTES:
1. R_T SELECT VALUES OF RT1, R1 & R3 TO GIVE 25.0 SECOND DELAYED OUTPUT OVER RANGE OF -20°C TO +60°C.
2. J1 CANNON DAM-15P
3. J2 CANNON DEM-9S
REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON: FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
WO 226
NEXT ASSY.
USED ON
APPLICATION
DRAWN
DATE 10-OCT-63
CHECKED
DATE 12-4-63
APPROVED
DATE 14-OCT-63
SCHEMATIC,
SEPARATION TIMER
MOTHER DAUGHTER
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE C
SCI-226031
SCALE
UNIT WT.
SHEET OF

FIGURE 6-9

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

NOTES:

1. SPRAY LENS TO MILKY WHITE WITH TEFLON PAINT.



NO REQ'D PER ASS'Y -3	-2	-1	ITEM NO.	DESCRIPTION	MIL SPEC	MFR'S PT. NO. / DRAWING NO.	REMARKS/ MFR'S CODE
			13				
			12	LIGHT SENSOR (1.)		LS400	TI
		2	11	SCREW ASS'Y		D20418-2	CANNON 71468
		4	10	SCREW, MACH, CAD. PL., PAN HD. #4-40 NC-2 3/16 LONG			
		10	9	LOCK WASHER #4-40			
		6	8	SCREW, MACH. CAD PLATED, PAN HD. #4-40 NC-2 3/8 LONG			
		A/R	7	ECCOFOAM			E & C 04552
		1	6	CONNECTOR, 9 PIN		DE-9P	CANNON 71468
		2	5	SPACER		M226176-1 / M226176	SCI
		1	4	COMPONENT ASS'Y, TERMINAL		E226143-1 / E226143	SCI
		1	3	COVER PLATE		M226183-1 / M226183	SCI
		2	2	DOME		M226184-1 / M226184	SCI
		1	1	HOUSING		M226185-1 / M226185	SCI

LIST OF MATERIALS

NEXT ASSY.	224
USED ON	
APPLICATION	
UNLESS OTHERWISE SPECIFIED	DIMENSIONS ARE IN INCHES; TOLERANCES ON: FRACTIONS DECIMALS ANGLES
MATERIAL	
HEAT TREATMENT	
FINAL PROTECTIVE FINISH	
DRAWN	CBF
DATE	11-15-63
CHECKED	[illegible]
DATE	1-2-64
APPROVED	
DATE	

ASSEMBLY
ASPECT SENSOR
MOTHER DAUGHTER

Space Craft Inc.
Huntsville, Ala.

DWG. SIZE	
C	SCI-E226144
SCALE	UNIT WT.
SHEET	OF

FIGURE 6-10

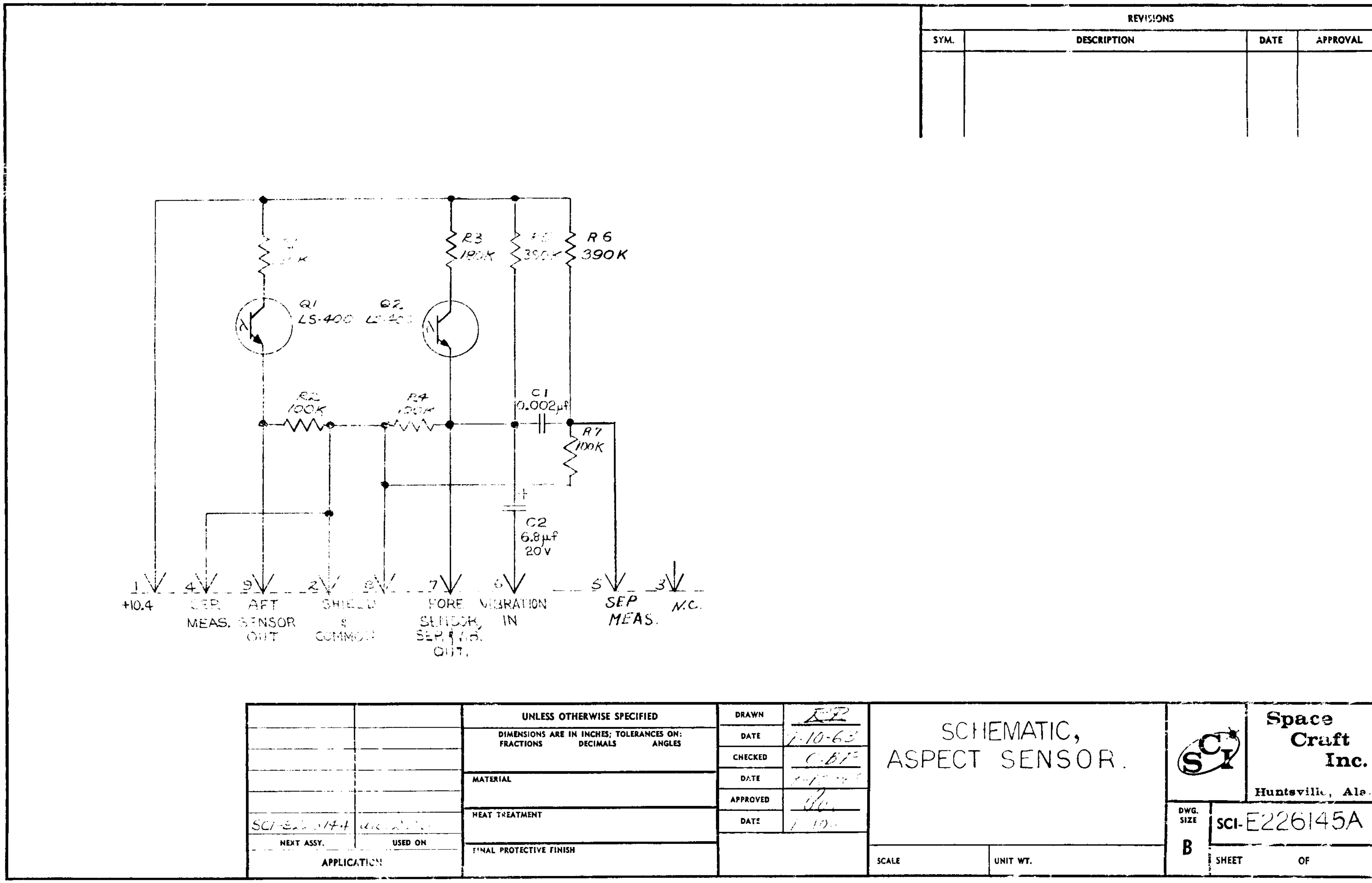

REVISIONS
SYM.
DESCRIPTION
DATE
APPROVAL
R3 180K
R6 390K
Q1 LS-400
R2 100K
C1 0.002µf
R7 100K
C2 6.8µf 20V
1 +10.4
4 SEP MEAS.
9 AFT SENSOR OUT
2 SHIELD & COMMON
8
7 FORE SENSOR, SEP. & V.B. OUT.
6 VIBRATION IN
5 SEP MEAS.
3 N.C.
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON: FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH
NEXT ASSY.
USED ON
APPLICATION
DRAWN
DATE
CHECKED
DATE
APPROVED
DATE
SCHEMATIC, ASPECT SENSOR.
SCALE
UNIT WT.
Space Craft Inc.
Huntsville, Ala.
DWG. SIZE
B
SCI-E226145A
SHEET
OF

FIGURE 6-11

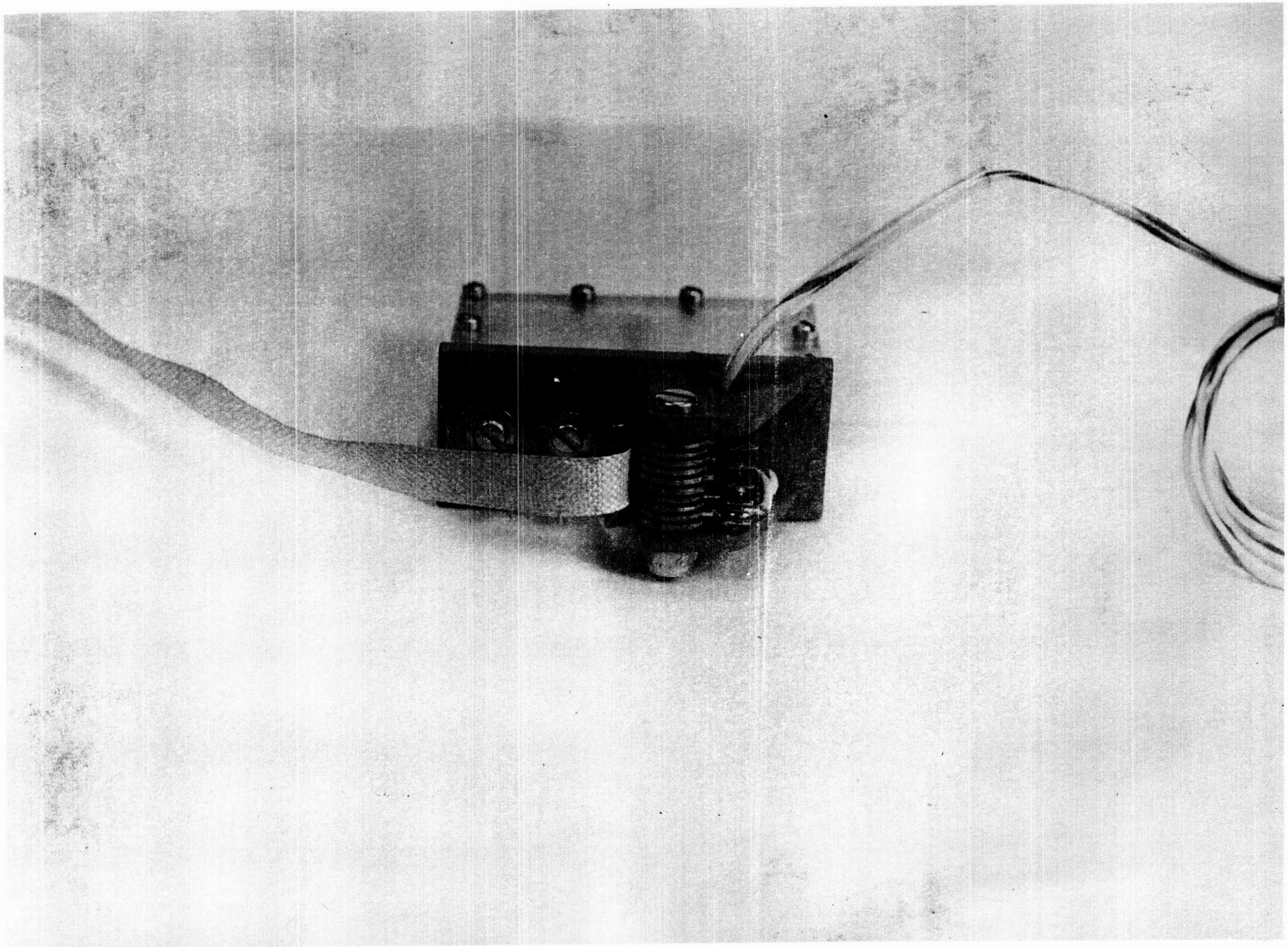
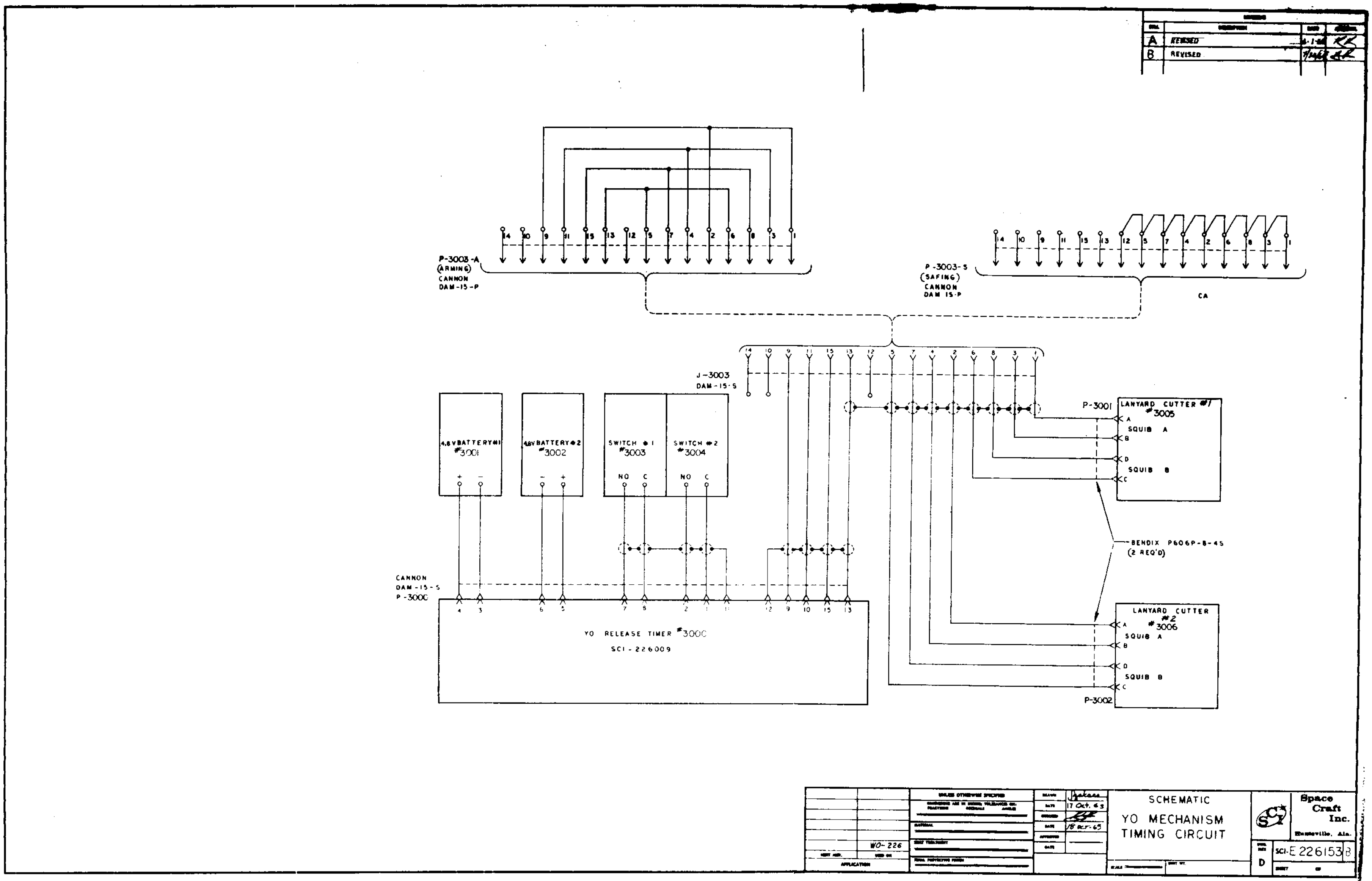


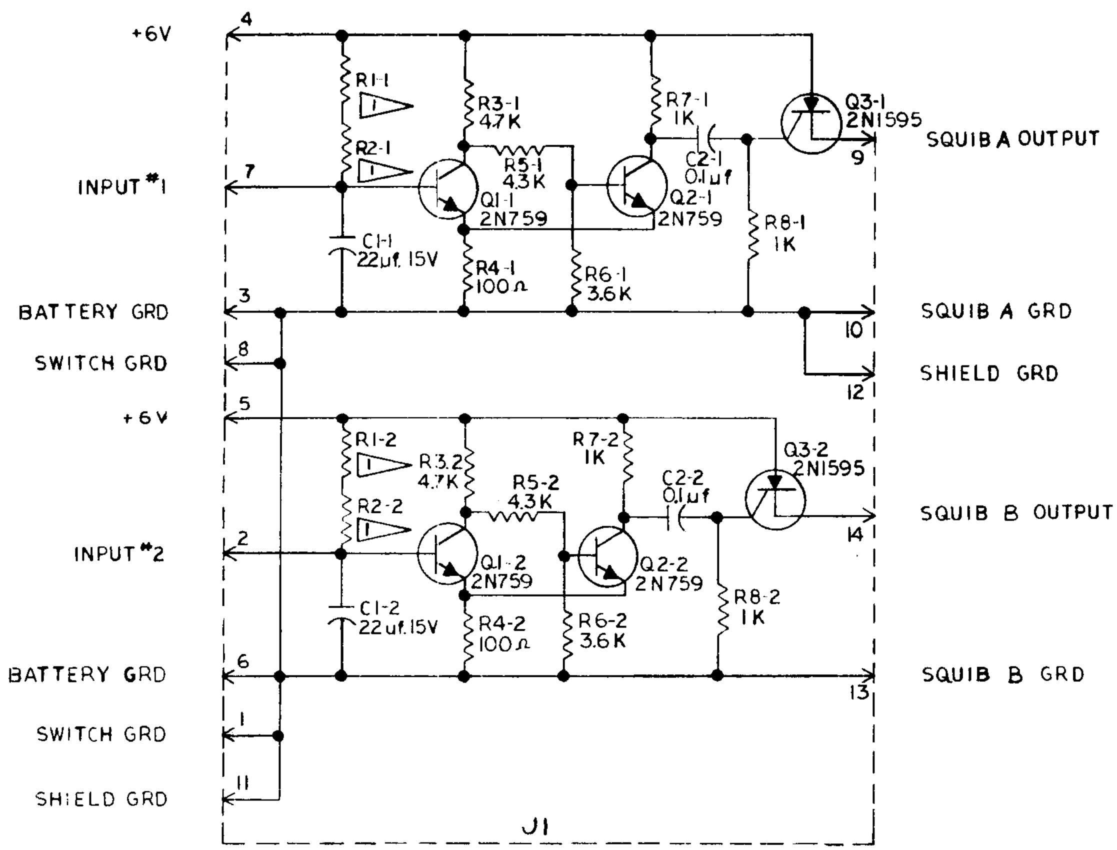
FIGURE 6-12

SEPARATION VELOCITY MEASURING DEVICE



A REVISED
B REVISED
P-3003-A (ARMING) CANNON DAM-15-P
P-3003-S (SAFING) CANNON DAM 15-P
CA
J-3003 DAM-15-S
P-3001
LANYARD CUTTER #1 #3005
SQUIB A
SQUIB B
4.8V BATTERY #1 #3001
4.8V BATTERY #2 #3002
SWITCH #1 #3003
SWITCH #2 #3004
NO C
BENDIX P606P-8-45 (2 REQ'D)
CANNON DAM-15-S P-3000
YO RELEASE TIMER #3000
SCI-226009
LANYARD CUTTER #2 #3006
P-3002
WO-226
17 Oct. 65
18 Oct. 65
SCHEMATIC
YO MECHANISM
TIMING CIRCUIT
Space Craft Inc.
Huntsville, Ala.
D
SCI-E 226153 B

FIGURE 7-1



NOTES:

1. SELECT R_T FOR PROPER TIMING.
2. J1 CANNON DAM-15P.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

NEXT ASSY.	USED ON
	226
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES; TOLERANCES ON: FRACTIONS DECIMALS ANGLES
MATERIAL
HEAT TREATMENT
FINAL PROTECTIVE FINISH

DRAWN	J. A. Maclin
DATE	10-Oct-63
CHECKED	[signature]
DATE	12-4-63
APPROVED	[signature]
DATE	14 Oct 63

SCHEMATIC,
YO MECHANISM
RELEASE TIMER
MOTHER DAUGHTER

SCALE
UNIT WT.

Space Craft Inc.
Huntsville, Ala.

DWG. SIZE B
SCI-E226032
SHEET OF

FIGURE 7-2

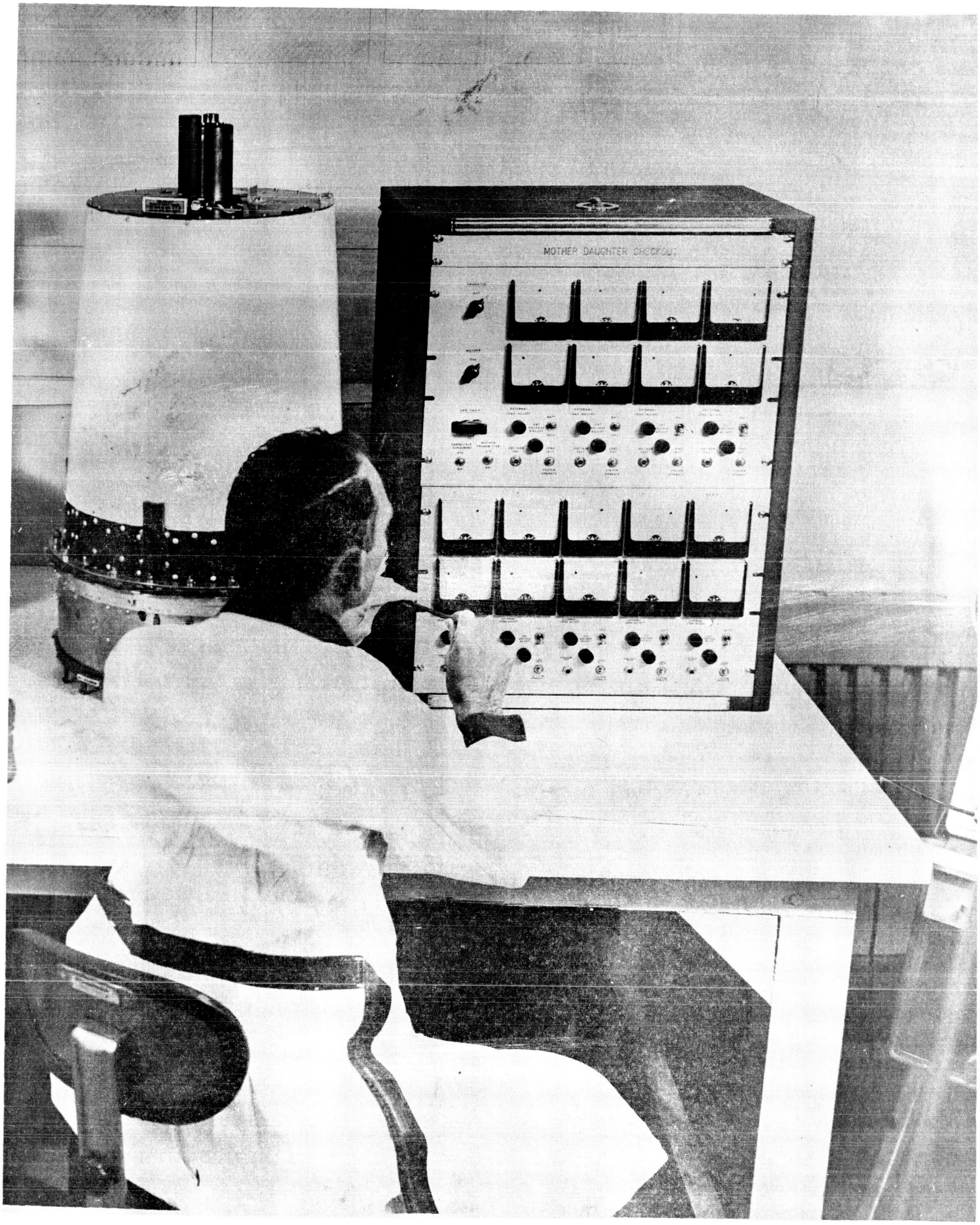
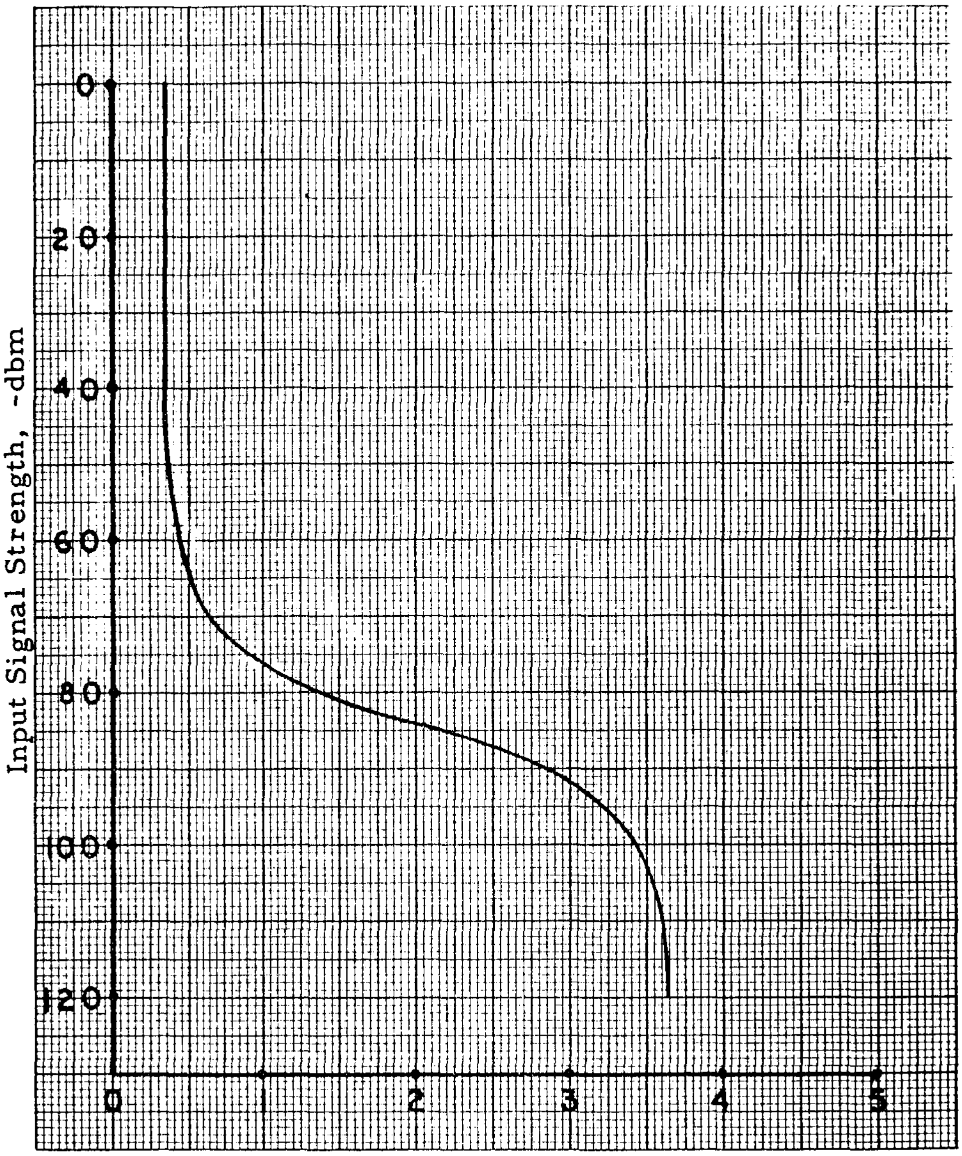


FIGURE 8-1

PAYLOAD TEST AND CONTROL CONSOLE

11. PERFORMANCE CHARACTERISTICS OF PAYLOAD NO. 1

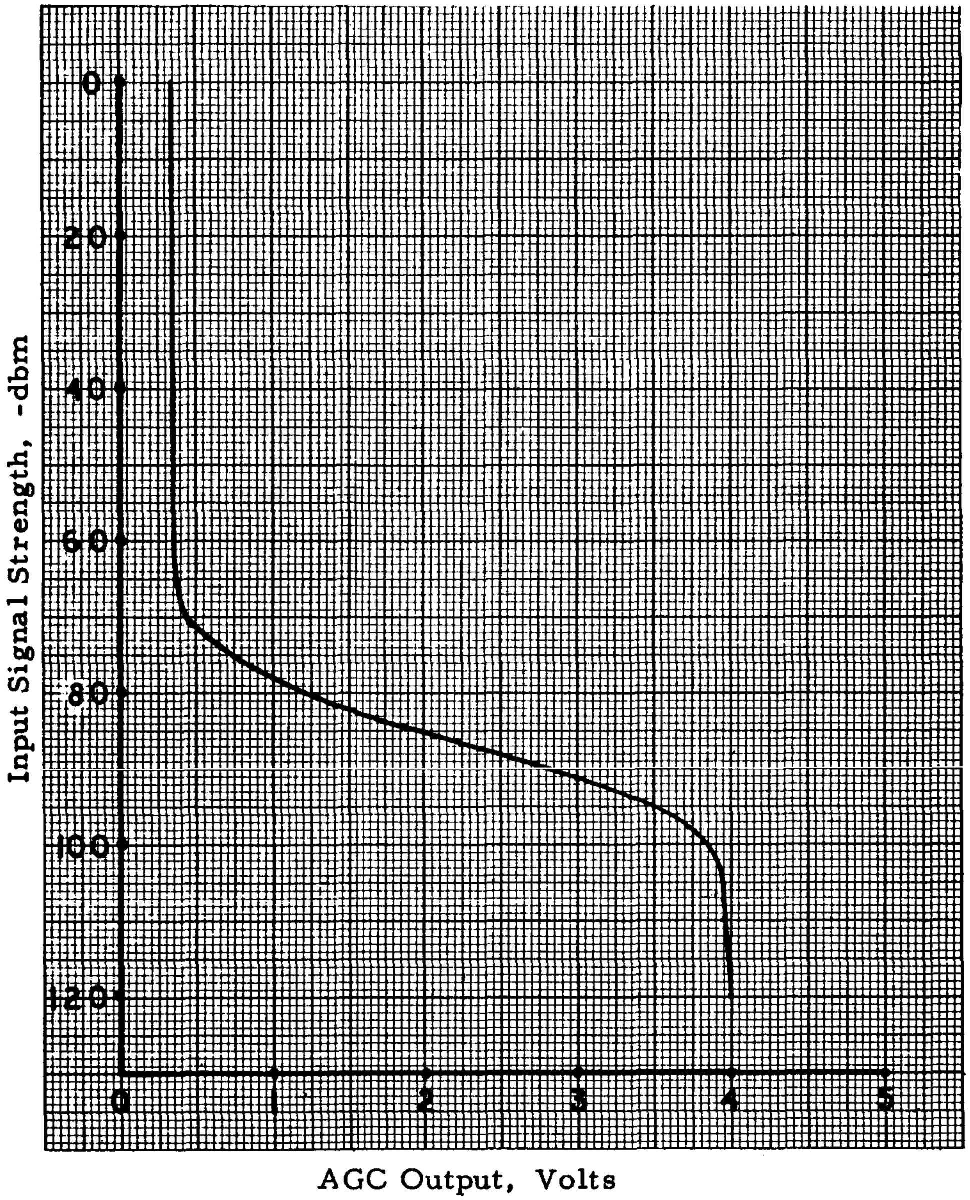
CONTENTS



AGC Output, Volts

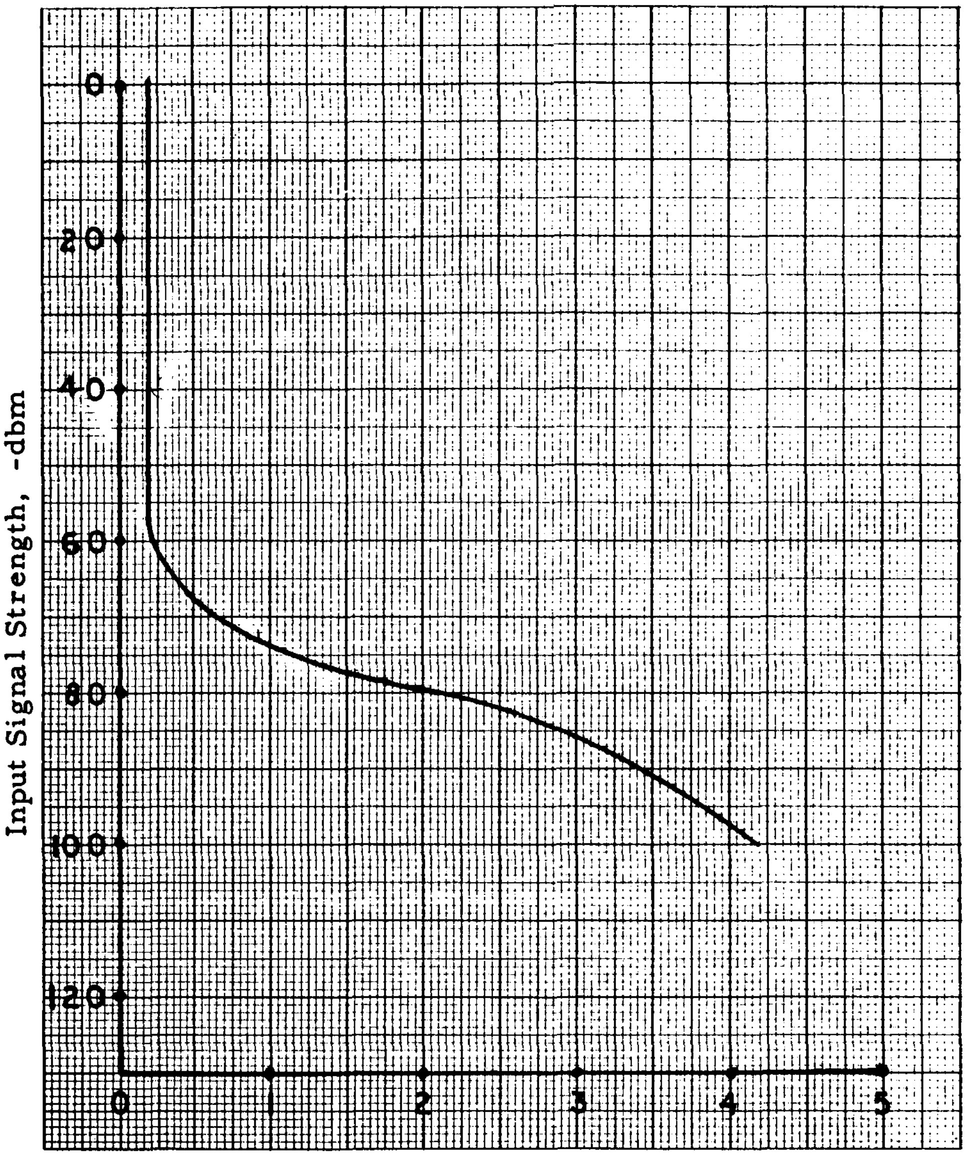
RECEIVER INPUT VS. AGC,

6. 133 MC SECTION



RECEIVER INPUT VS. AGC,

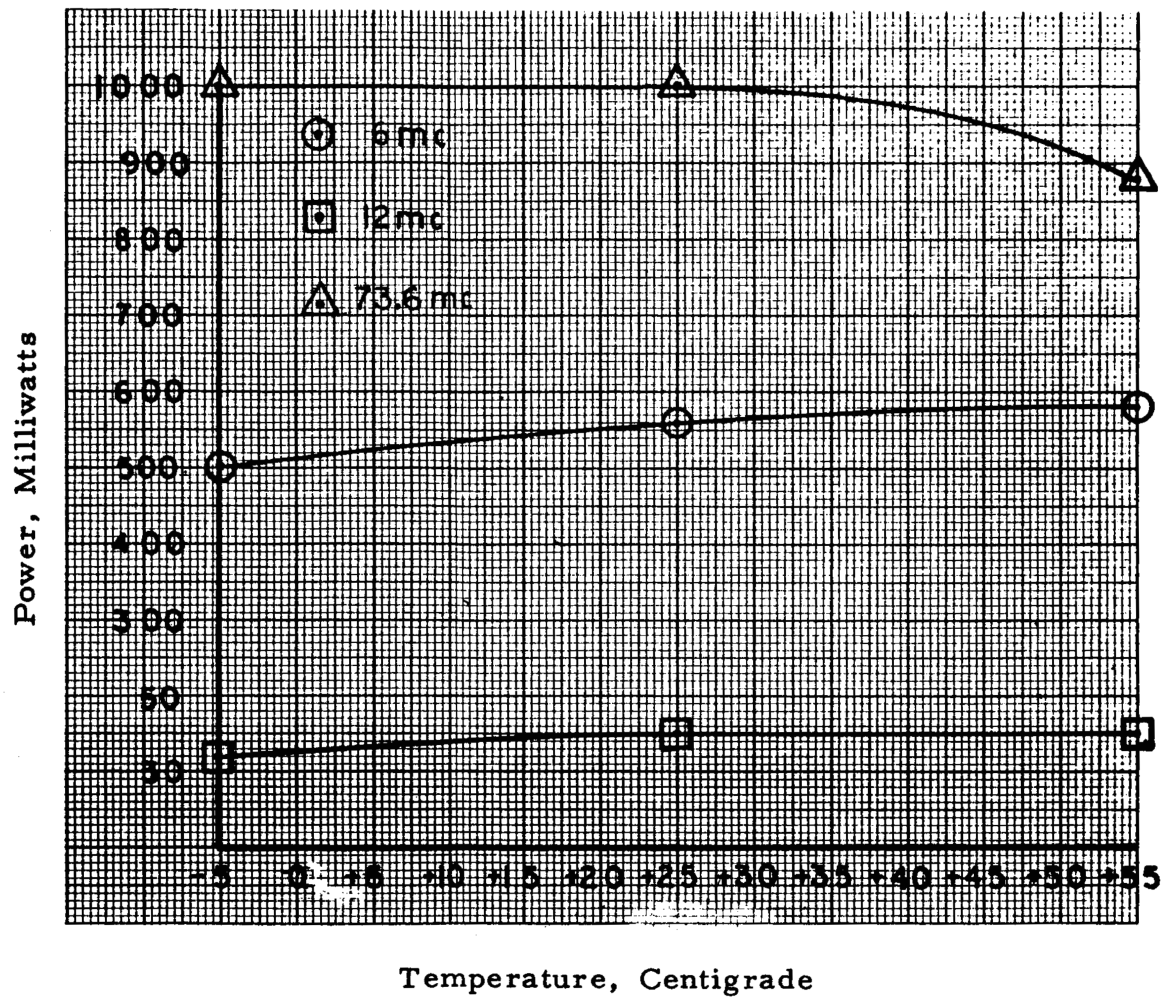
12.266 MC SECTION



AGC Output, Volts

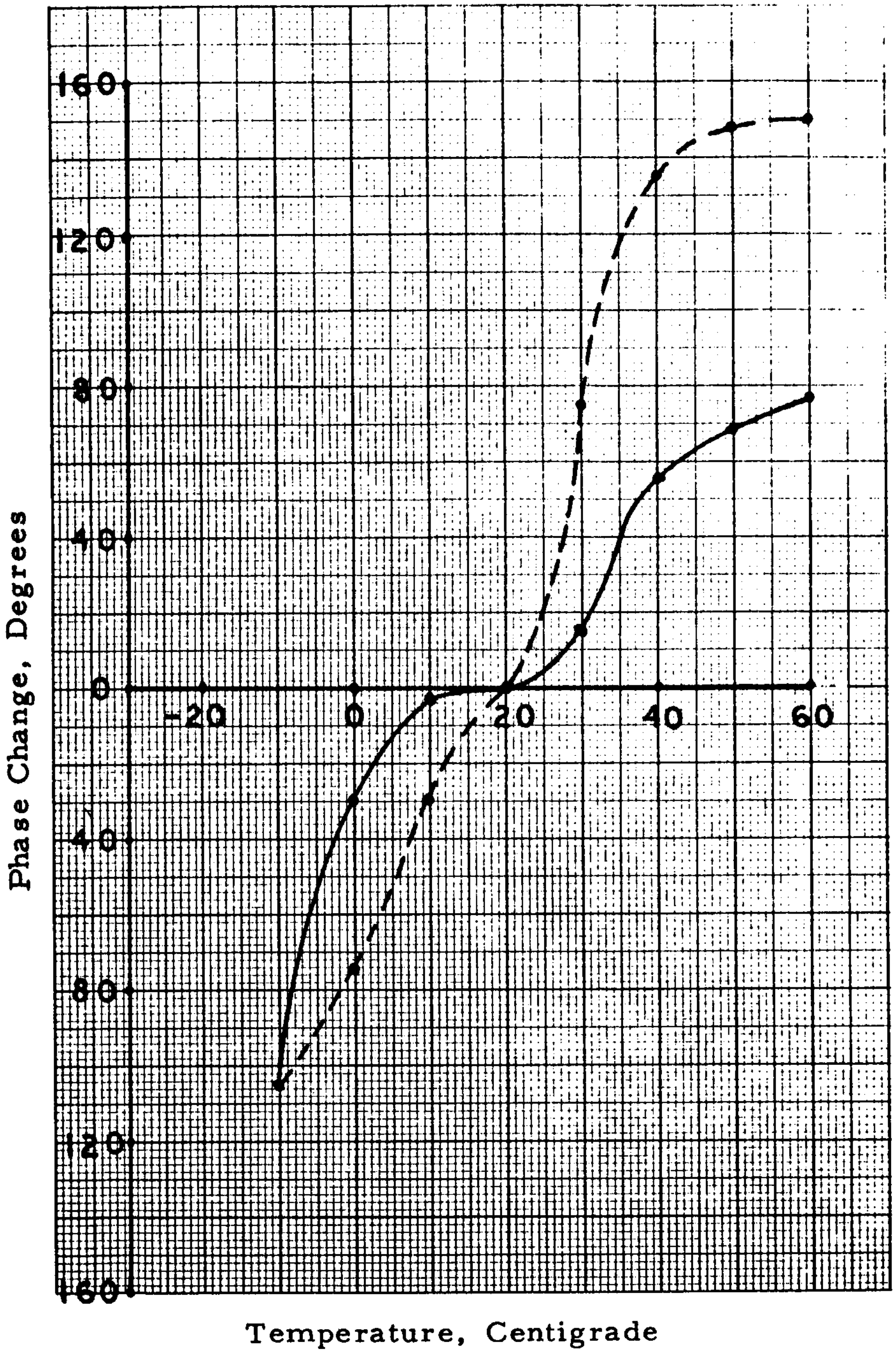
RECEIVER INPUT VS. AGC,

73.6 MC SECTION



DAUGHTER TRANSMITTER POWER

OUTPUT VS. TEMPERATURE

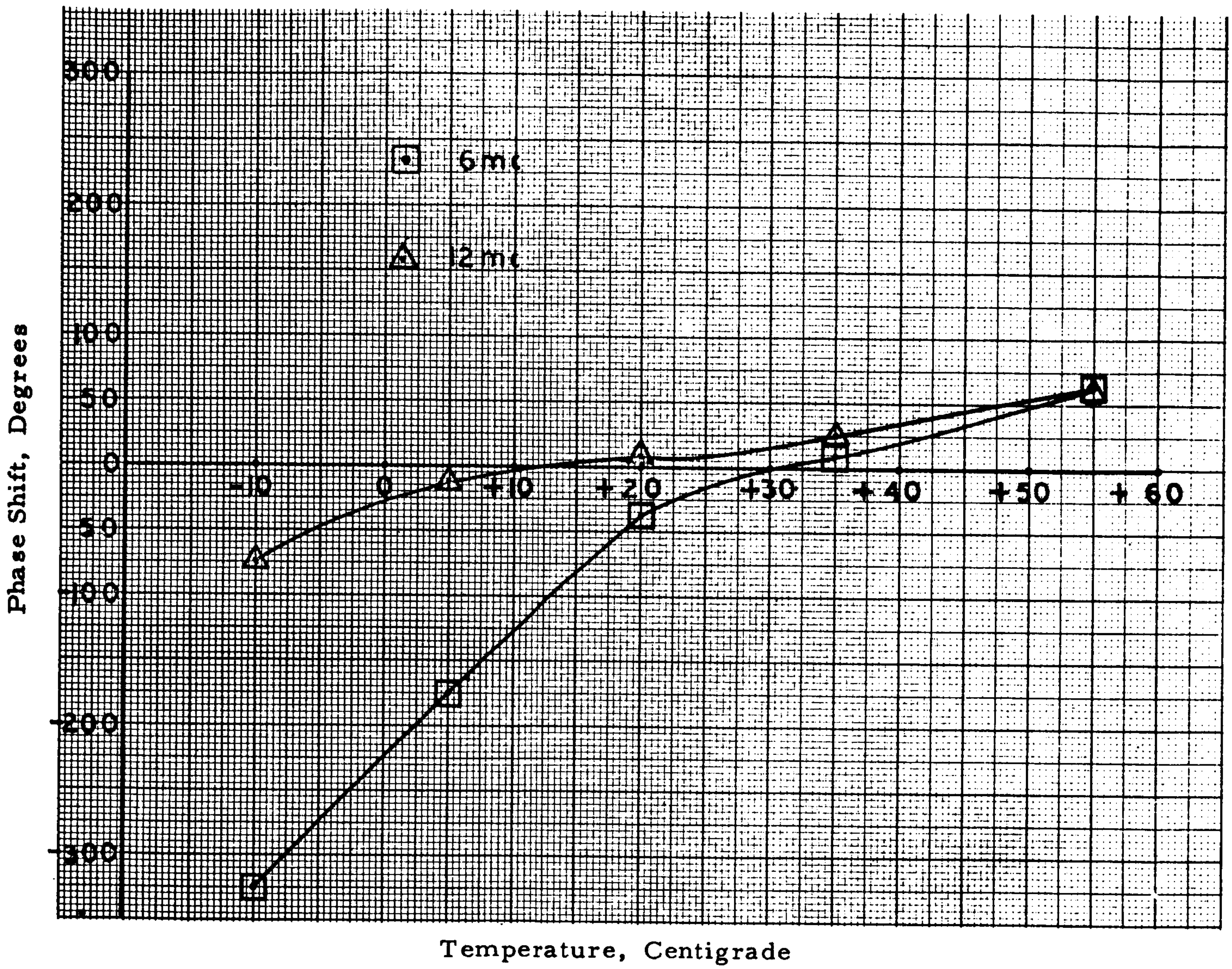


MOTHER PAYLOAD RECEIVER PHASE CHANGE

RELATIVE TO 73.6 MC VS. TEMPERATURE

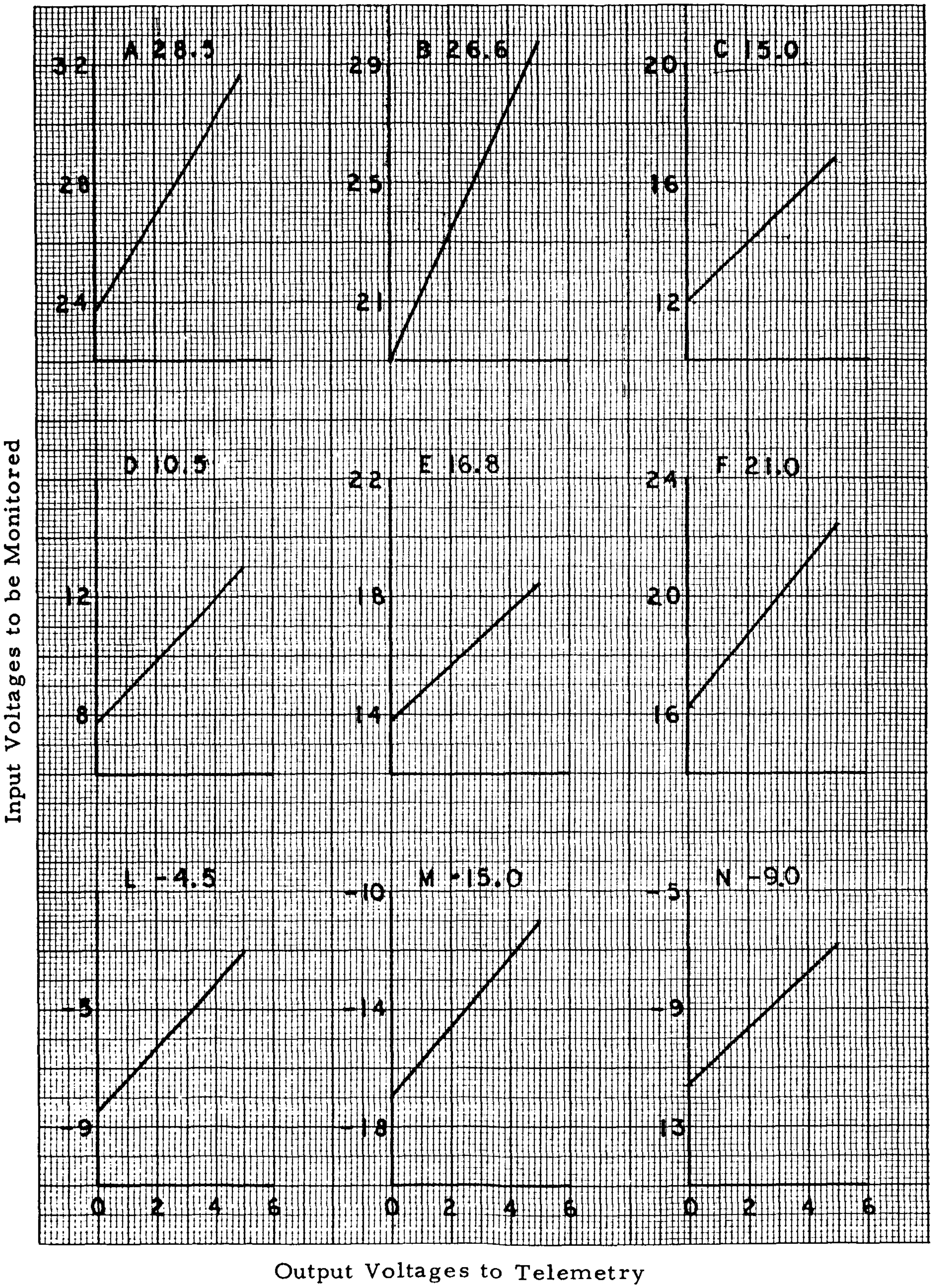
DOTTED LINE: 12 MC

SOLID LINE: 6 MC



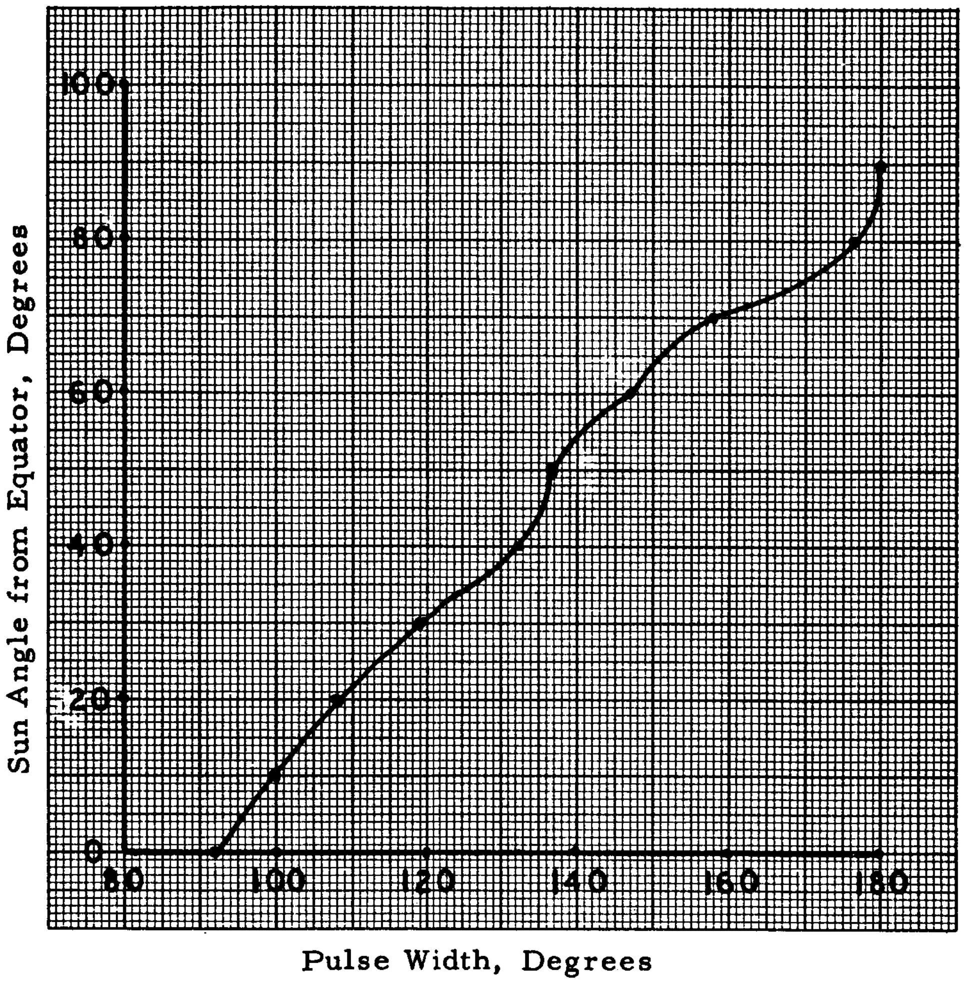
DAUGHTER TRANSMITTER PHASE CHANGE

RELATIVE TO 73.6 MC VS. TEMPERATURE

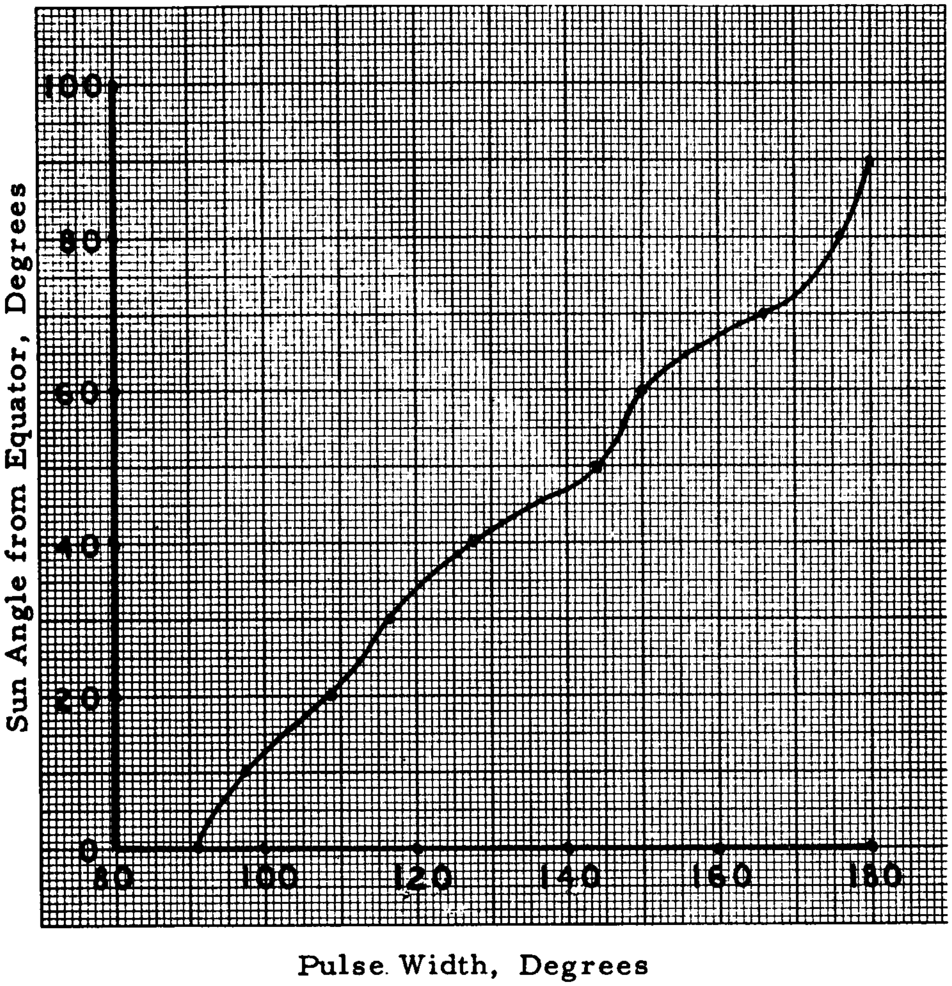


SIGNAL CONDITIONER VOLTAGE

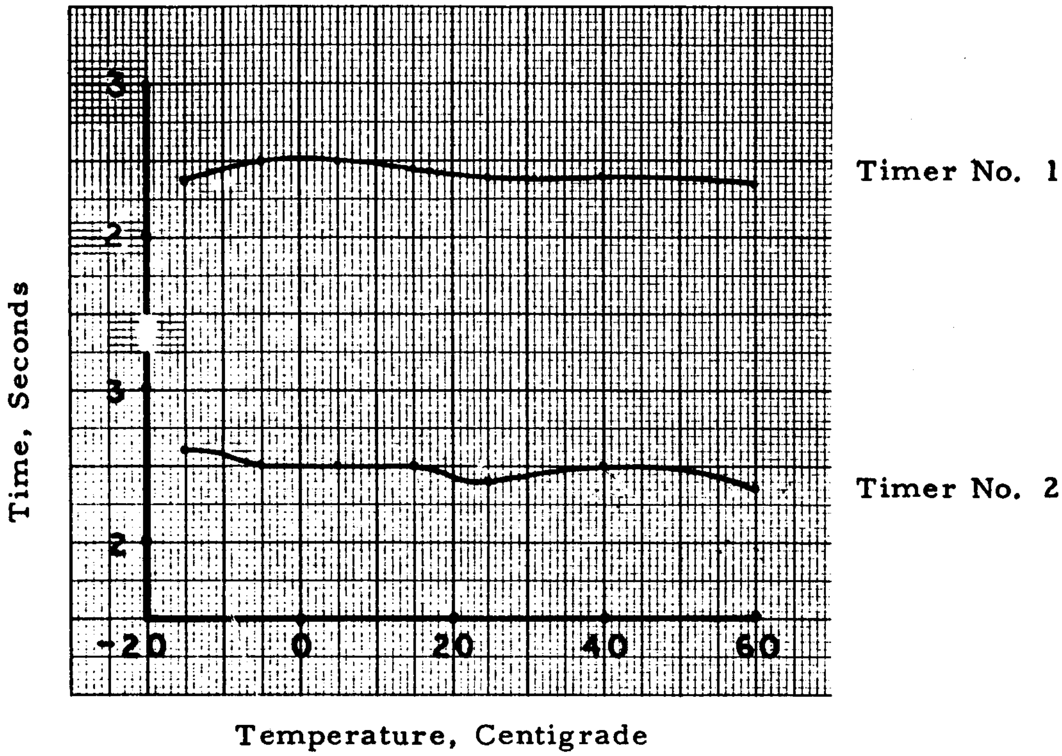
MONITOR CALIBRATION CURVES



FORWARD SOLAR ASPECT SENSOR CALIBRATION

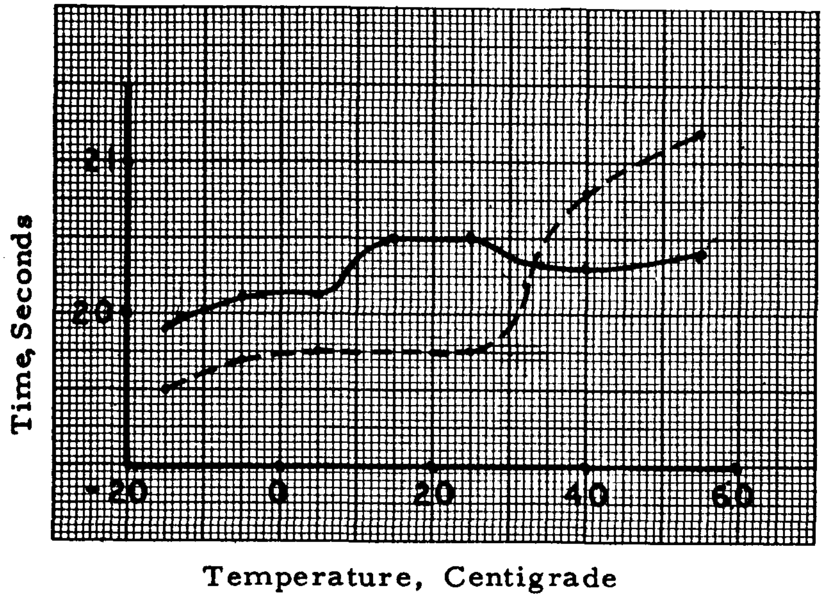


AFT SOLAR ASPECT SENSOR CALIBRATION



TEMPERATURE VARIATION IN

YO MECHANISM DELAY TIMER

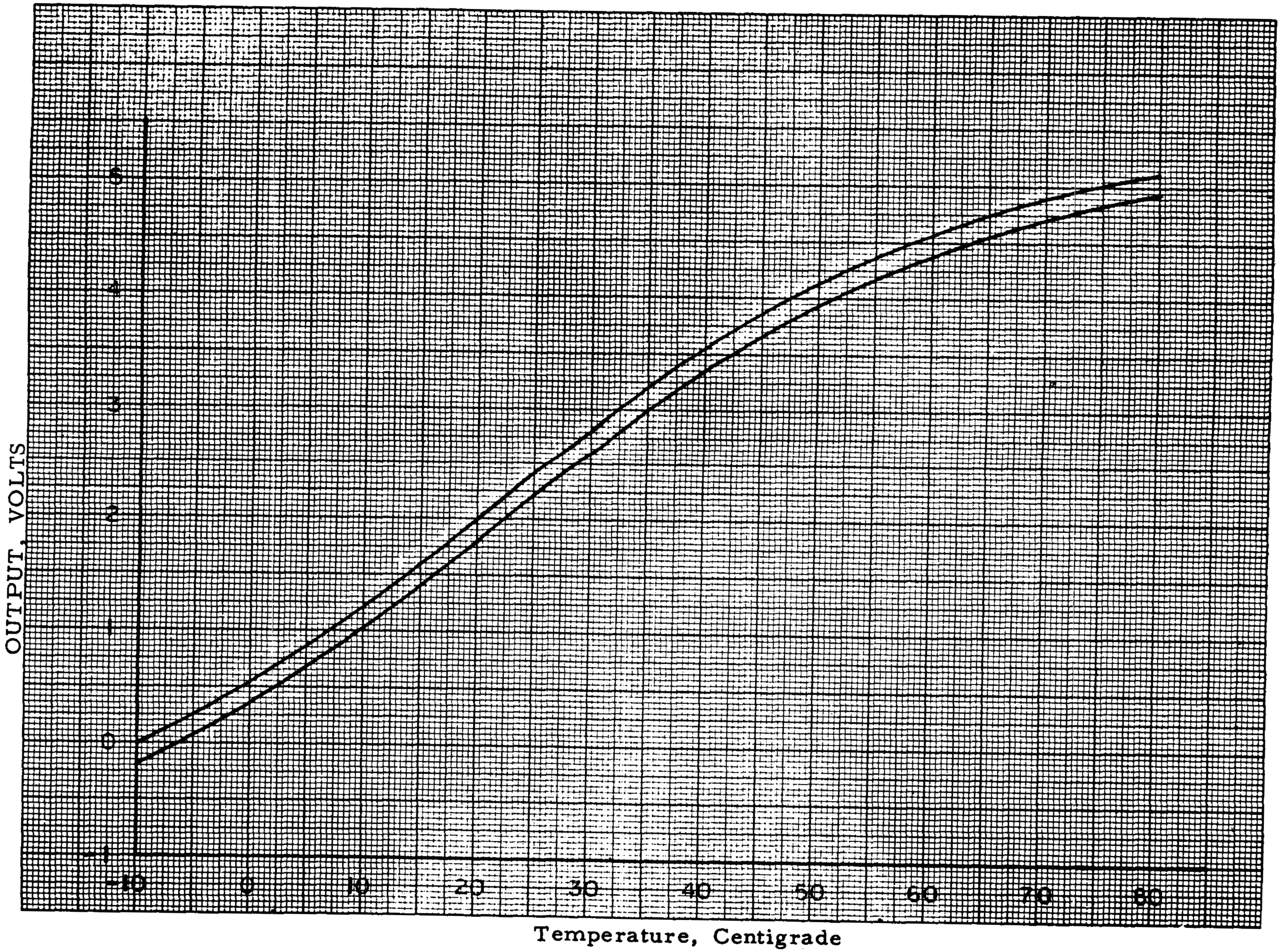


MOTHER-DAUGHTER SEPARATION TIMER

VARIATION WITH TEMPERATURE

DOTTED LINE: TIMER NO. 1

SOLID LINE: TIMER NO. 2



UNIVERSAL TEMPERATURE SENSOR CALIBRATION
(All measurements fall within the limits shown)

CALIBRATION DATA

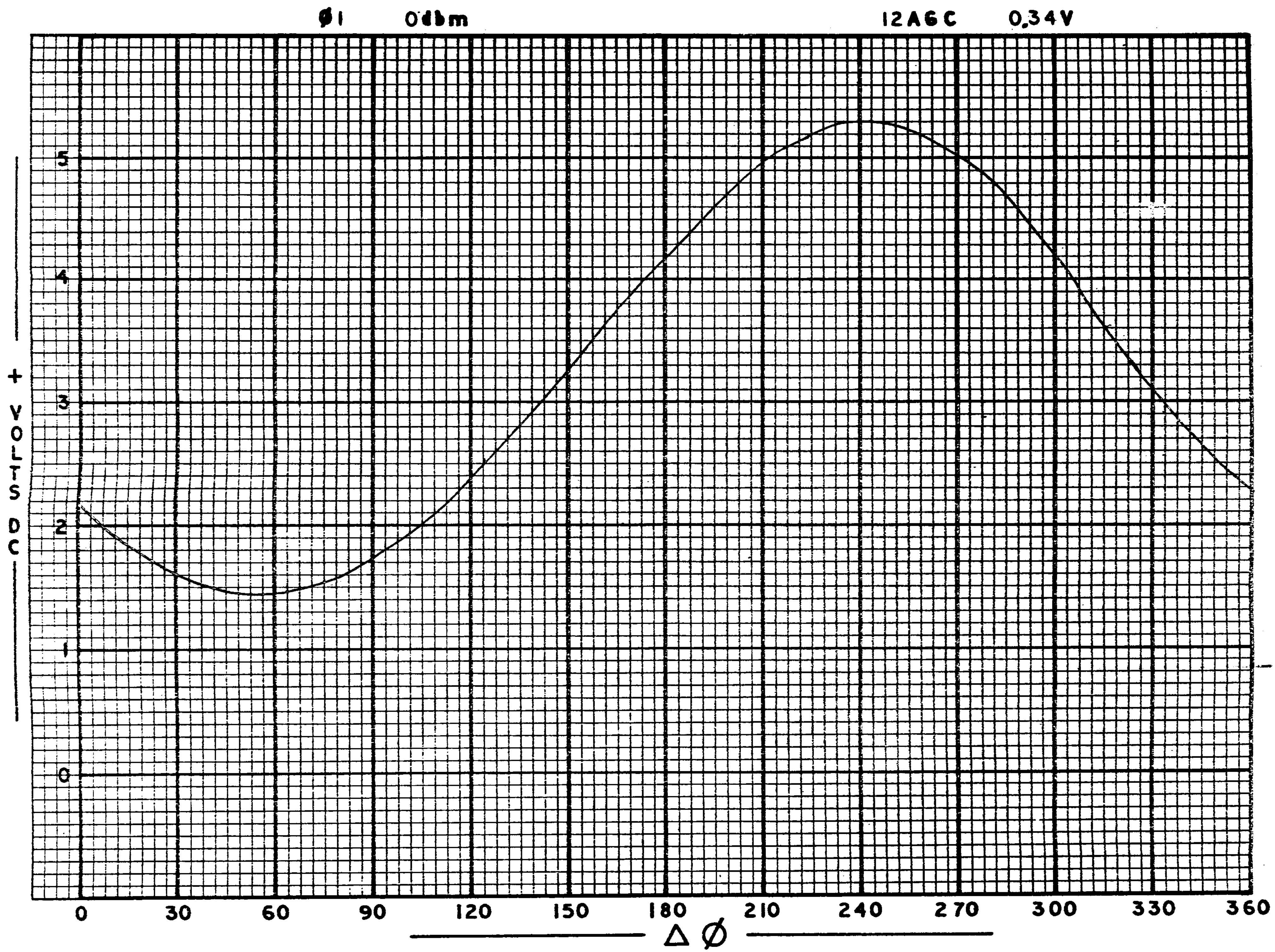
MAGNETIC ASPECT SENSOR

FLIGHT PAYLOAD NO. 1

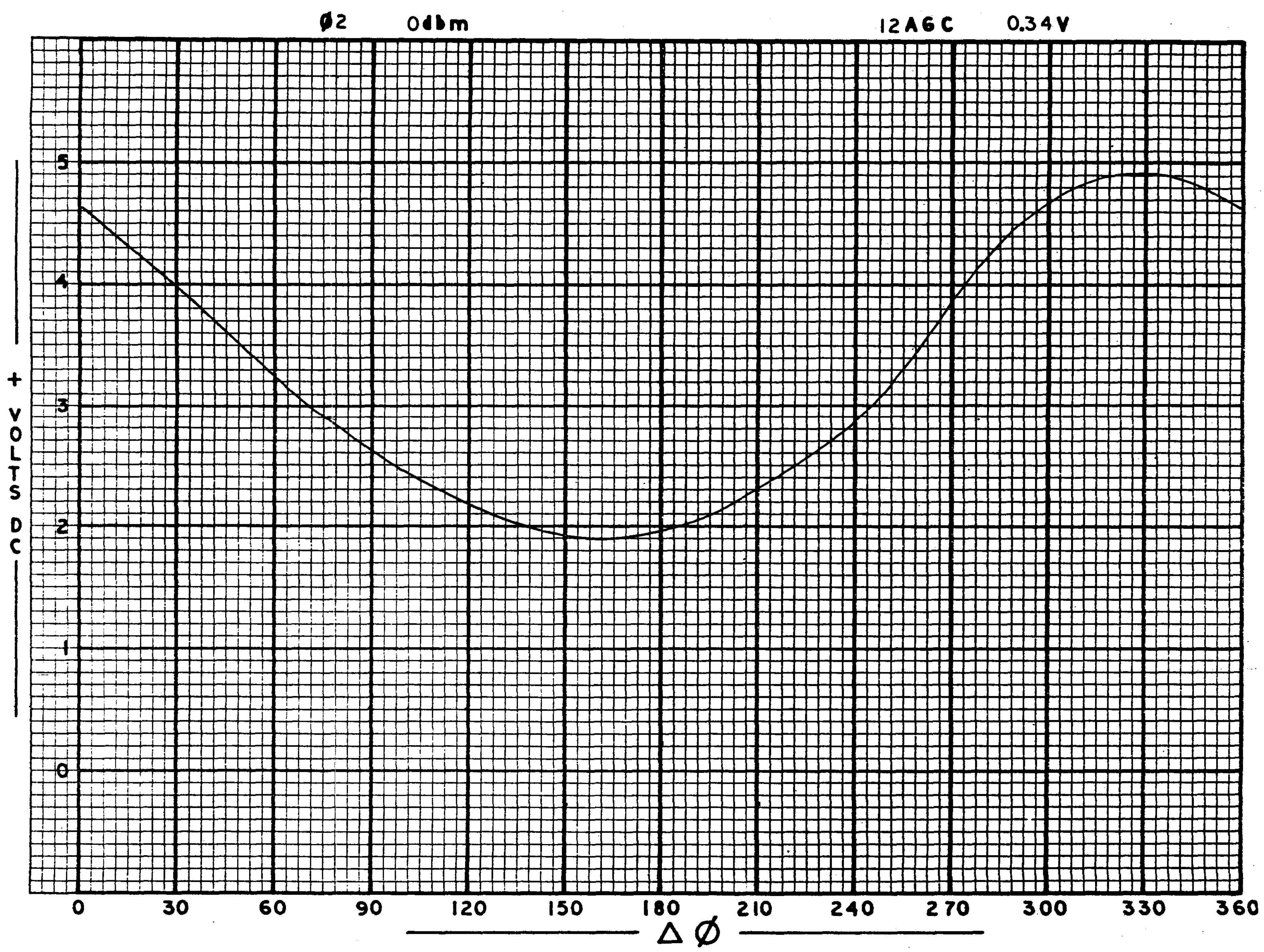
Field in Milligauss	Output Signal DC Volts
600	4.82
550	4.64
500	4.46
450	4.25
400	4.04
350	3.81
300	3.58
250	3.35
200	3.14
150	2.94
100	2.75
50	2.57
0	2.40
-50	2.23
-100	2.05
-150	1.86
-200	1.67
-250	1.45
-300	1.23
-350	1.00
-400	0.78
-450	0.56
-500	0.36
-550	0.17
-600	.00

PHASE DETECTOR CALIBRATION CURVES

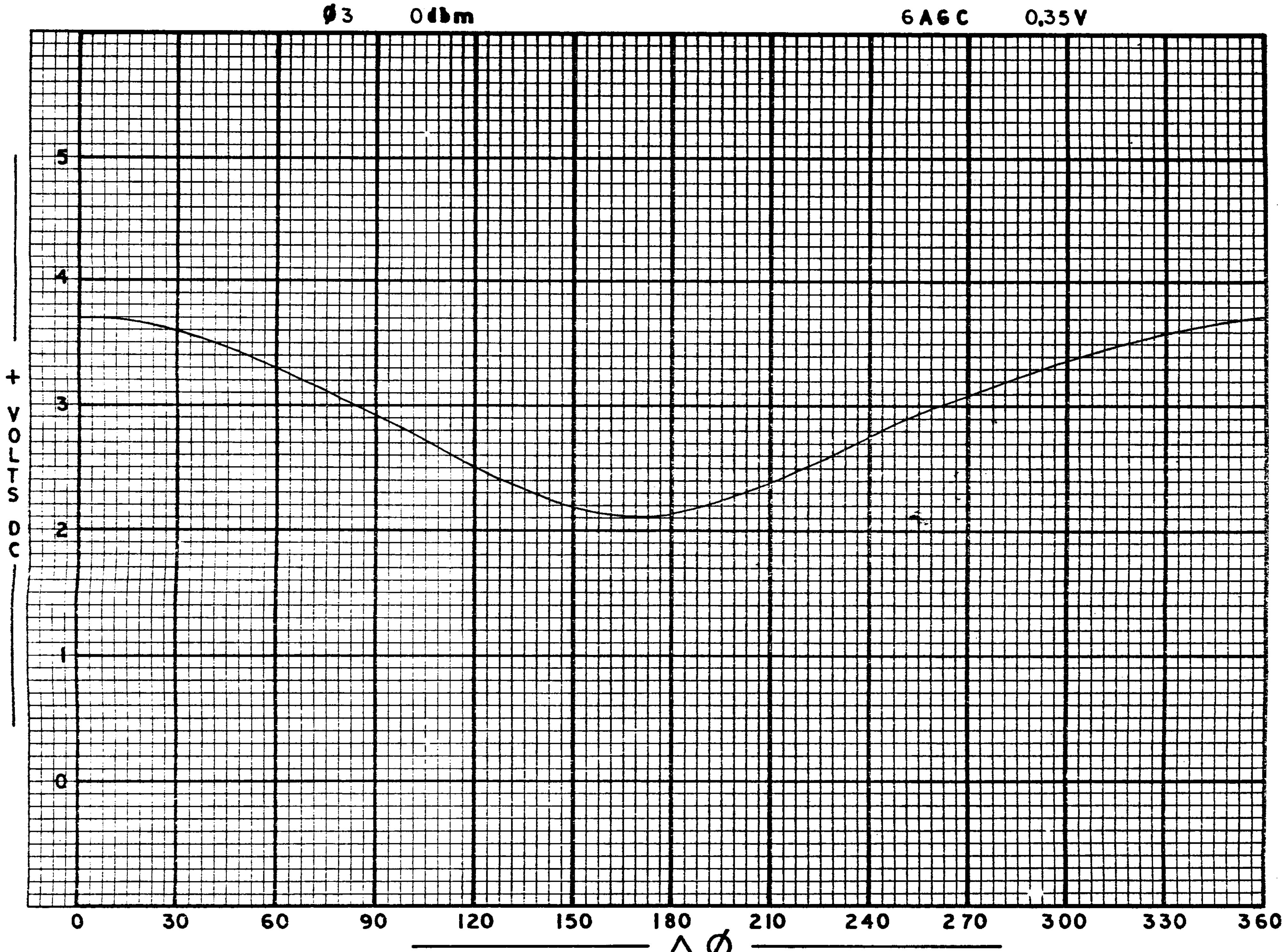
On the following pages, the calibration curves for receiver phase detectors are given. With these curves, any voltage levels from a pair of detectors can be converted unambiguously to a relative phase. Input signal levels are given and are identified with AGC levels for 6 and 12 mc signals.



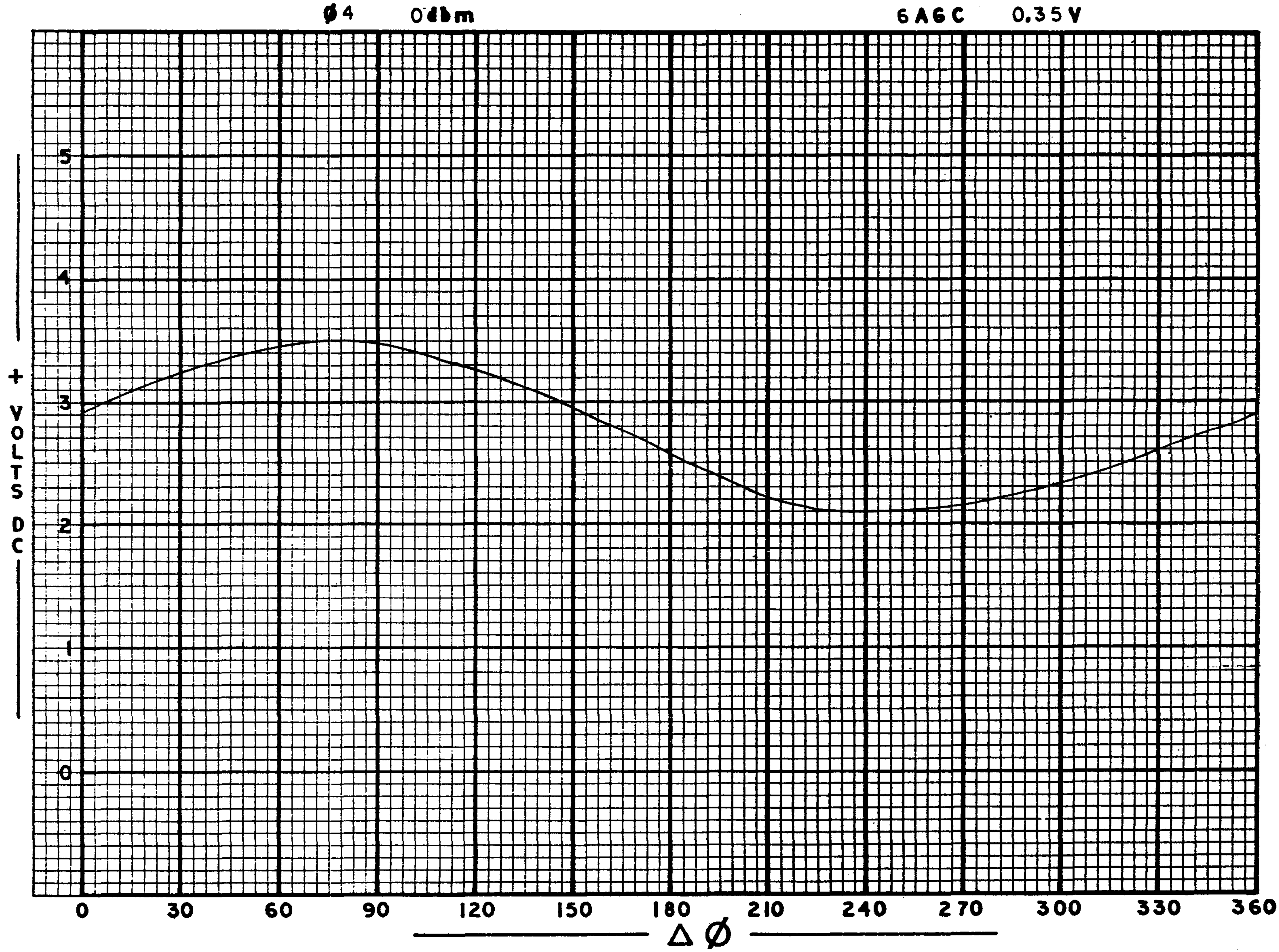
Ø1 0dbm
12A6C 0.34V
+ VOLTS DC
5
4
3
2
1
0
0 30 60 90 120 150 180 210 240 270 300 330 360
ΔØ

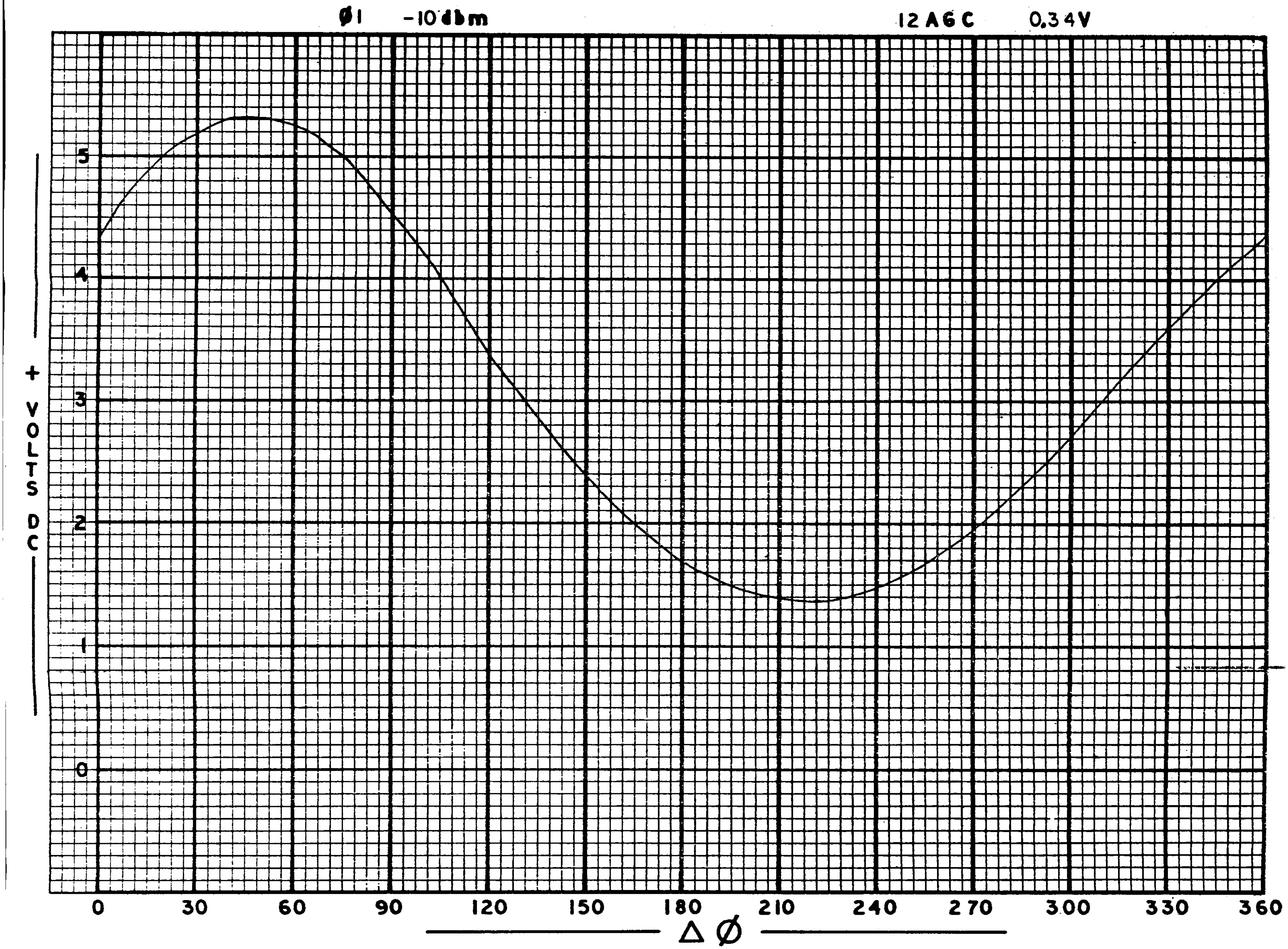


Ø2 0dbm
12A6C 0.34V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ



Ø3
0dbm
6A6C
0,35V
+ VOLTS DC
0
1
2
3
4
5
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ


Ø4
0 dbm
6A6C
0.35V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ



Ø1 -10dbm
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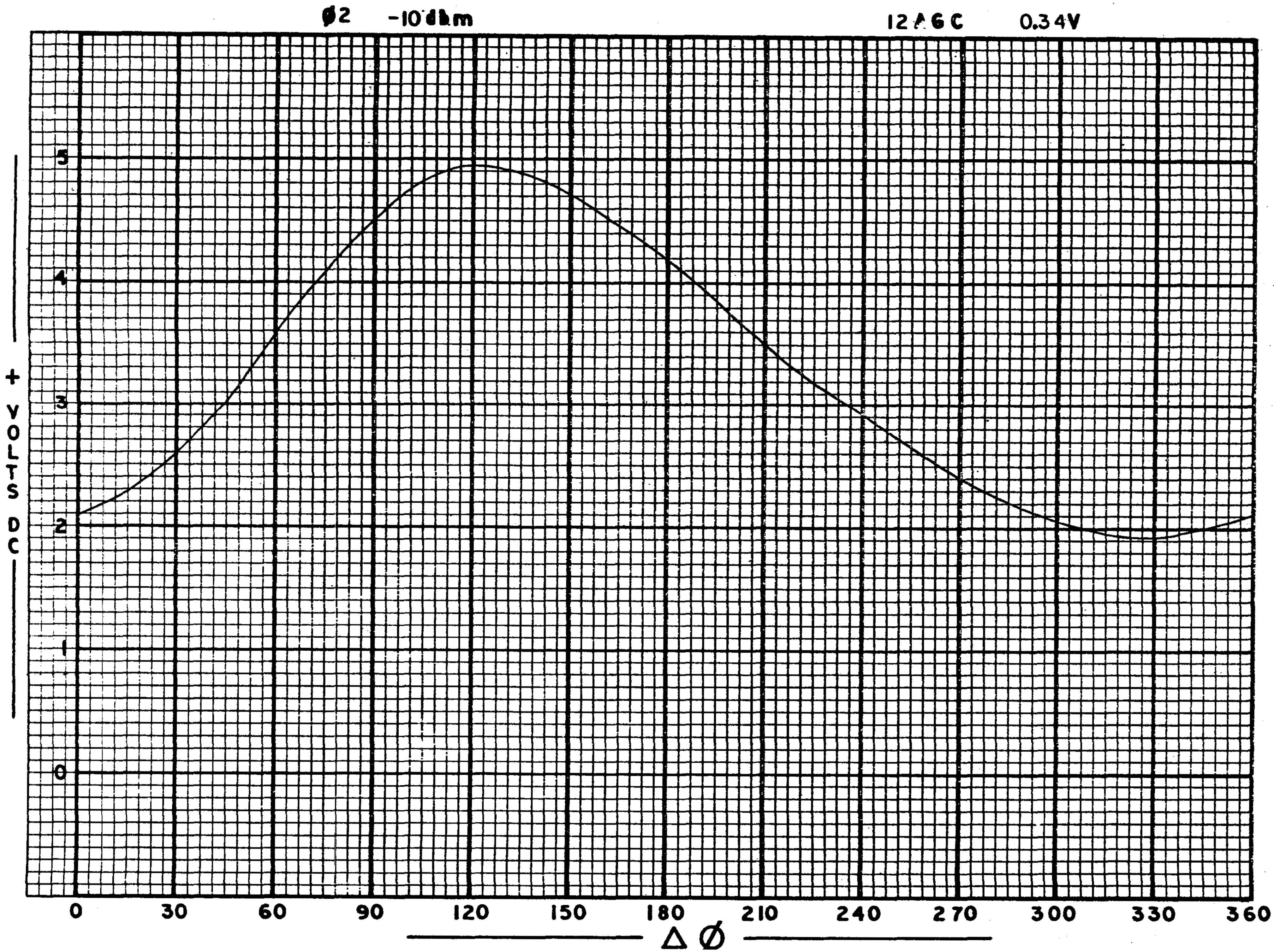
+ VOLTS DC
0
1
2
3
4
5
0 30 60 90 120 150 180 210 240 270 300 330 360
ΔØ


Ø2 -10 dbm
12 A6 C 0.34V
+ VOLTS DC
0
1
2
3
4
5
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120
150
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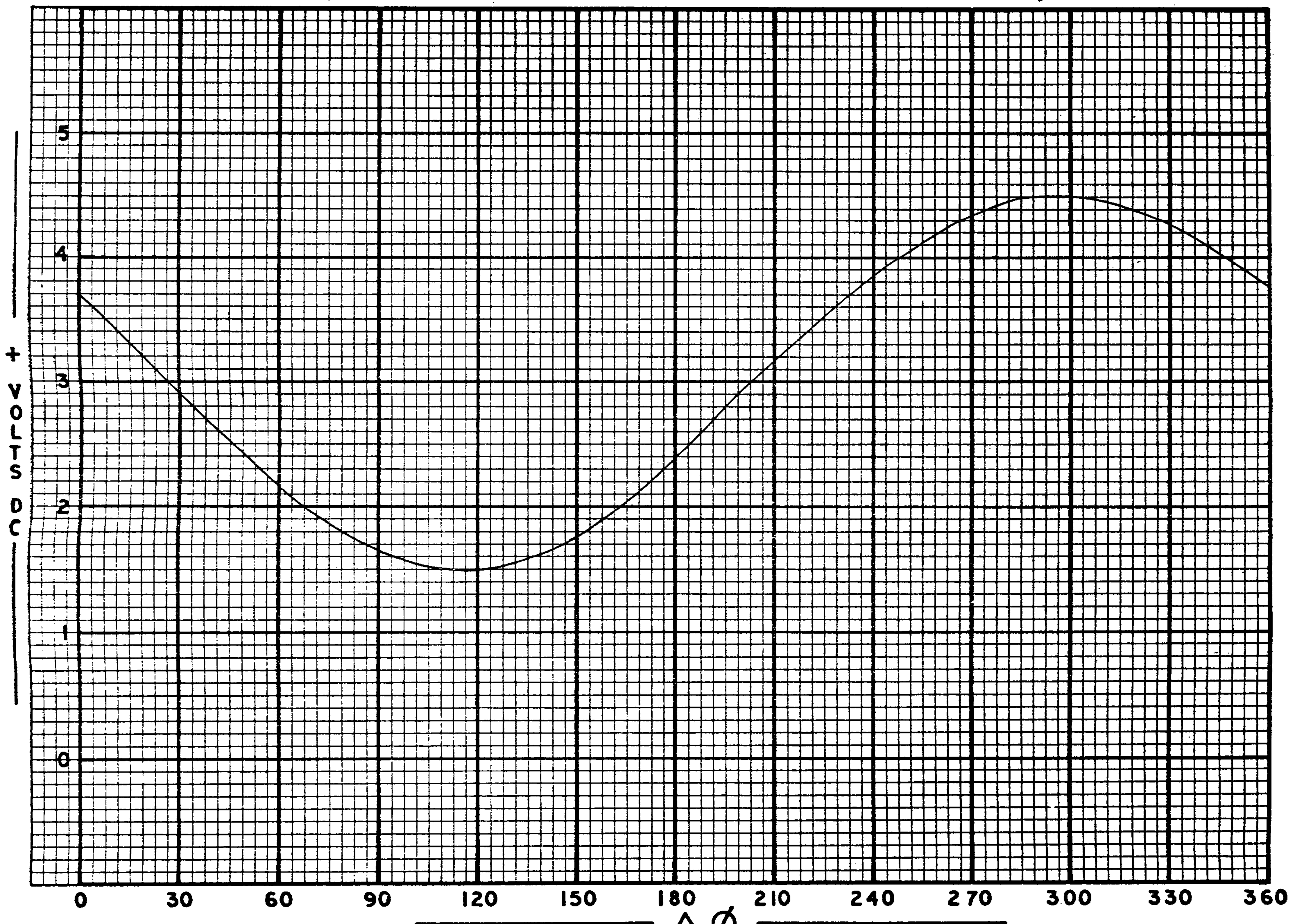
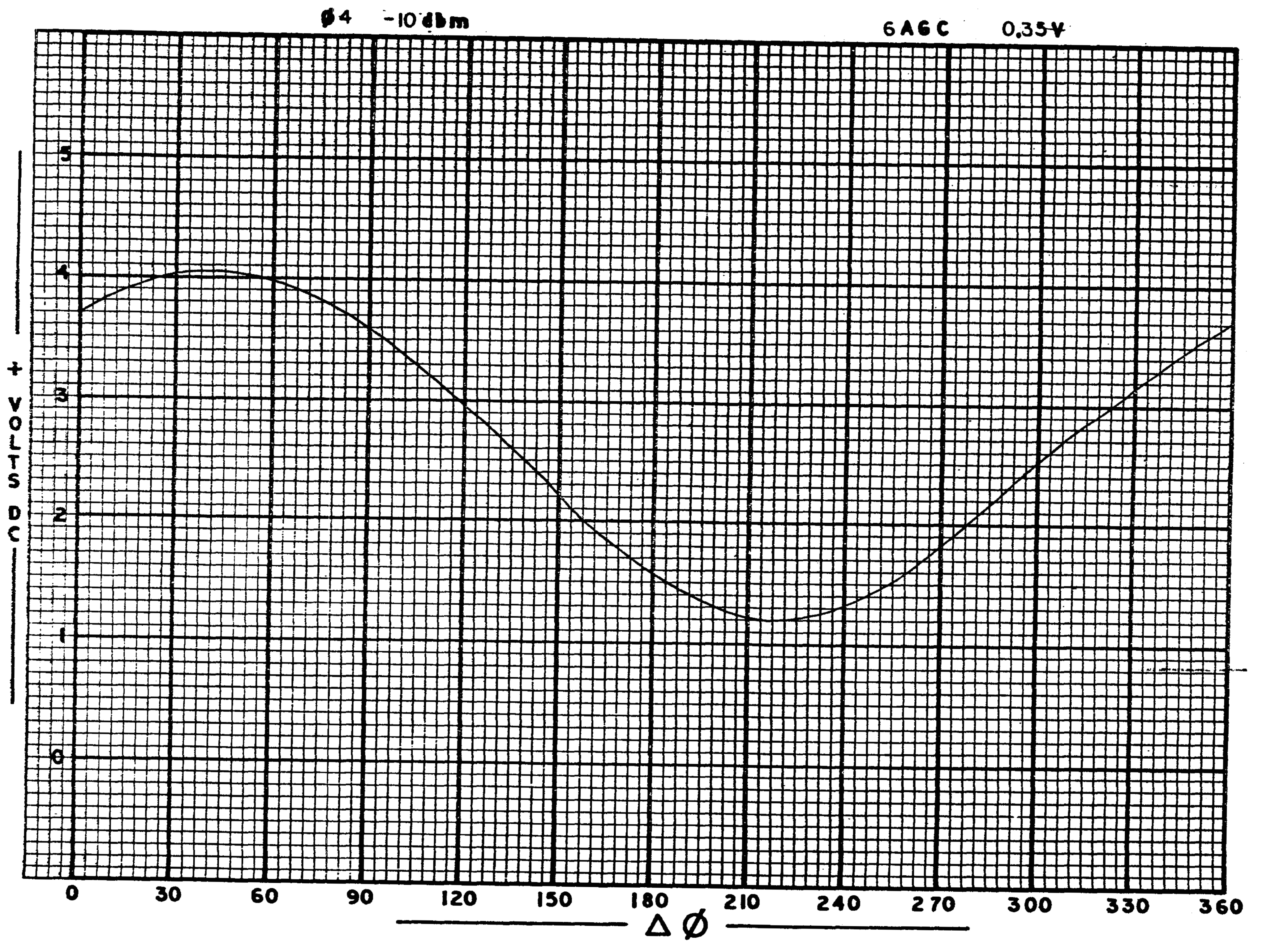
210
240
270
300
330
360
Δ Ø

Ø3 -10dbm 6AGC 0,35V





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6AGC 0.35V
+ VOLTS DC
5
4
3
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1
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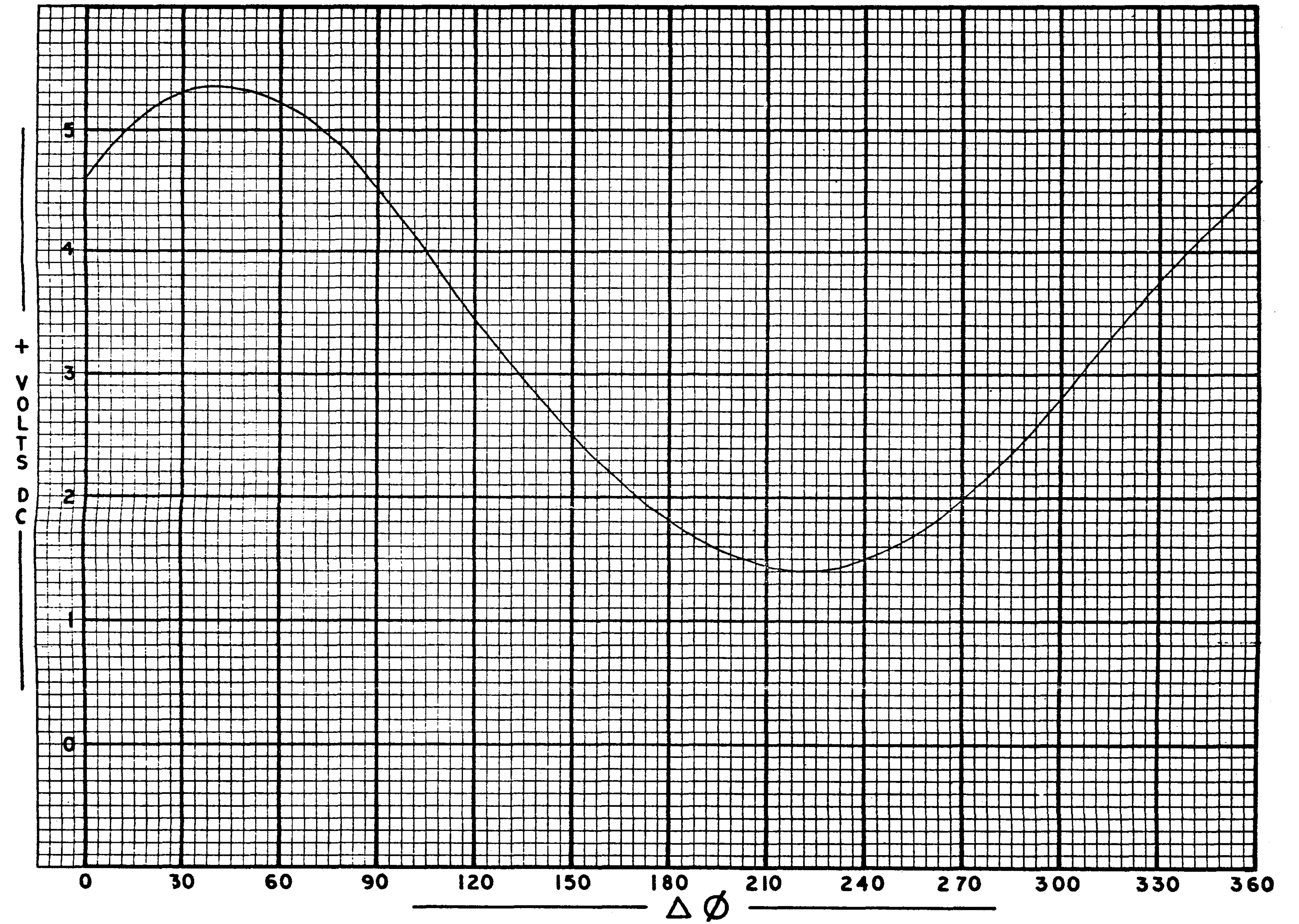
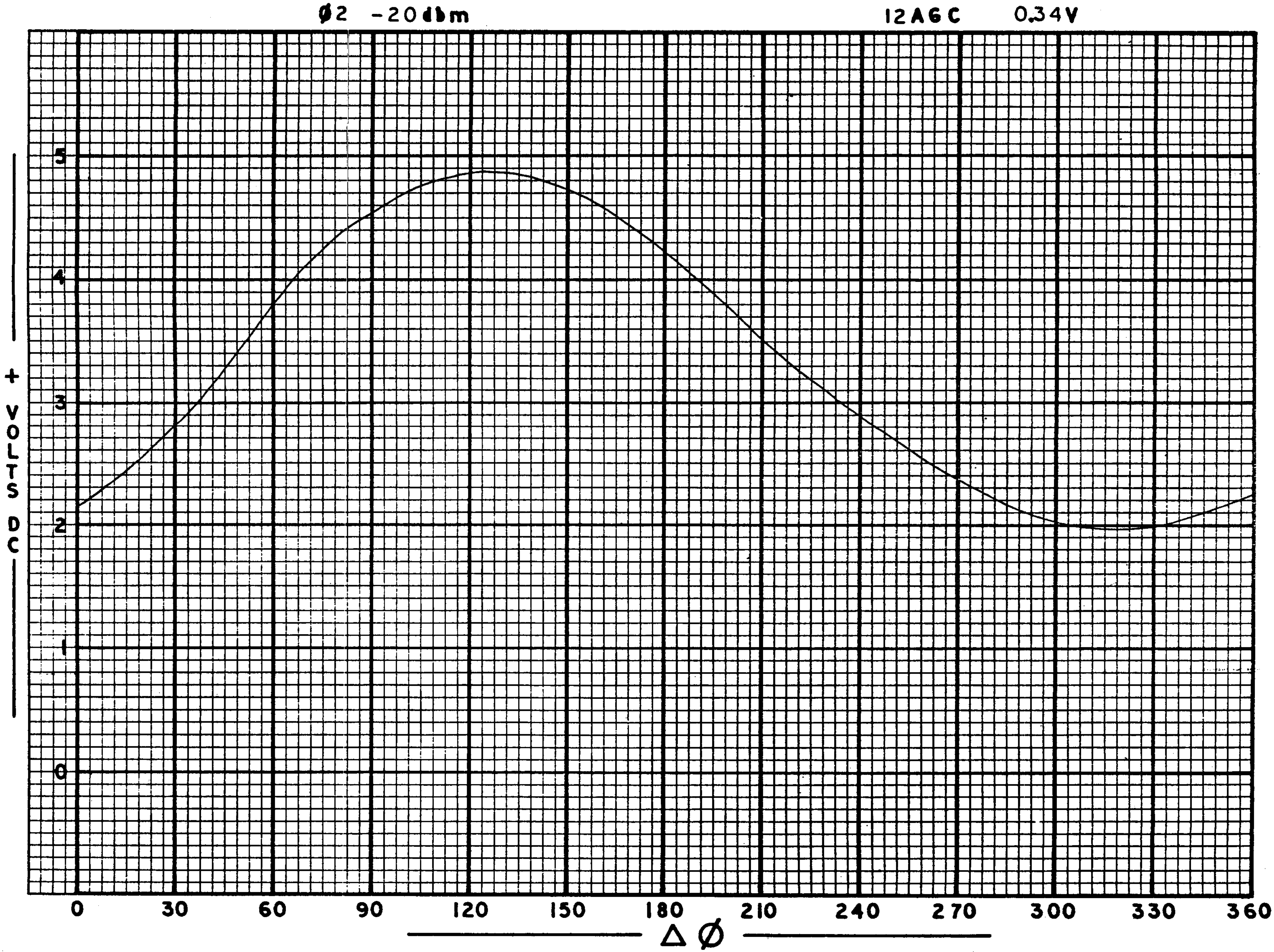
210
240
270
300
330
360
ΔØ

Ø1 -20 dbm 12A6C 0.34V





Ø2 -20dbm
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+ VOLTS DC
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1
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300
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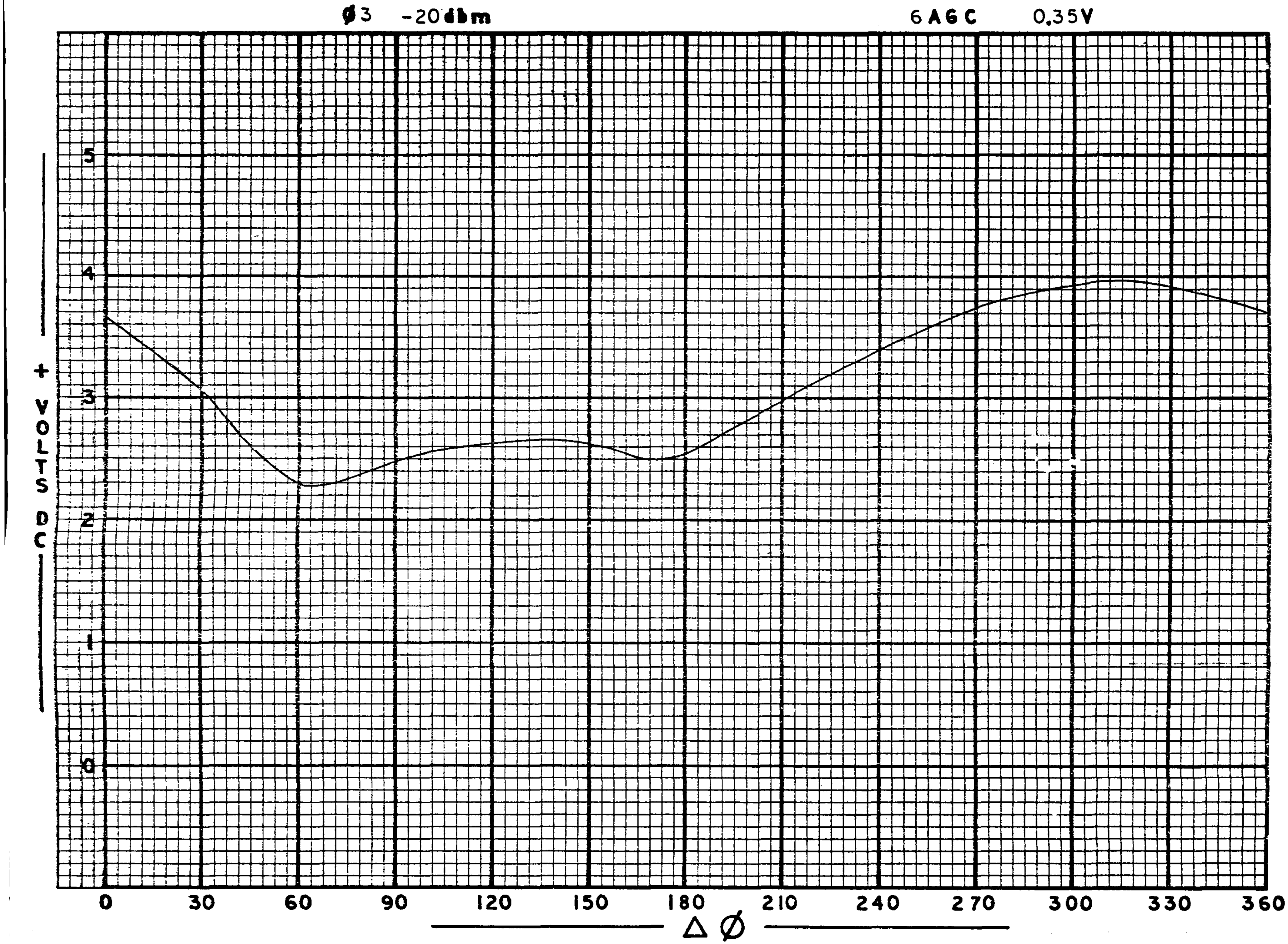
360
Δ Ø



Ø3 -20dbm
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+ VOLTS DC
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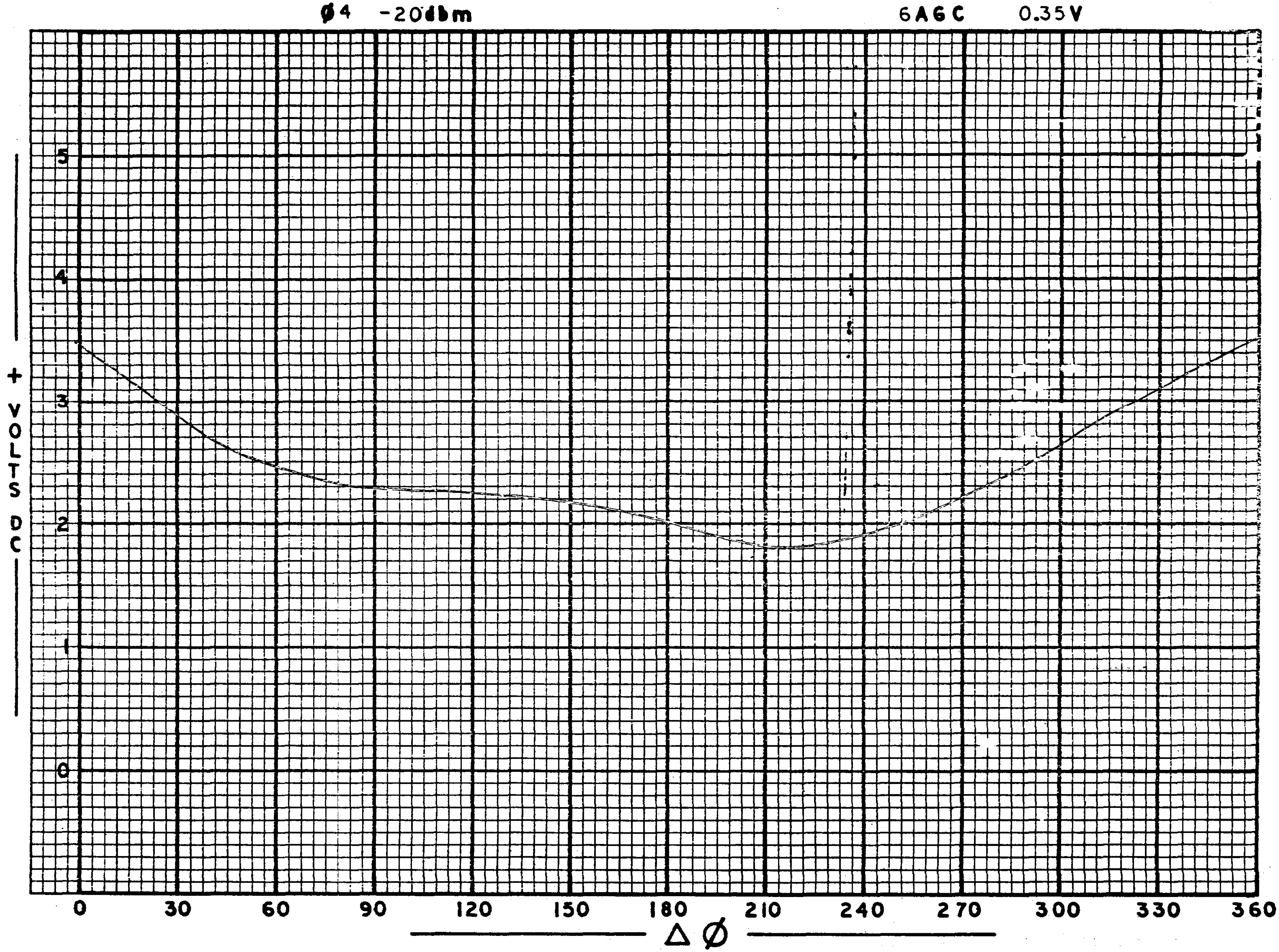
360
ΔØ


Ø4 -20dbm
6A6C 0.35V
+ VOLTS DC
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1
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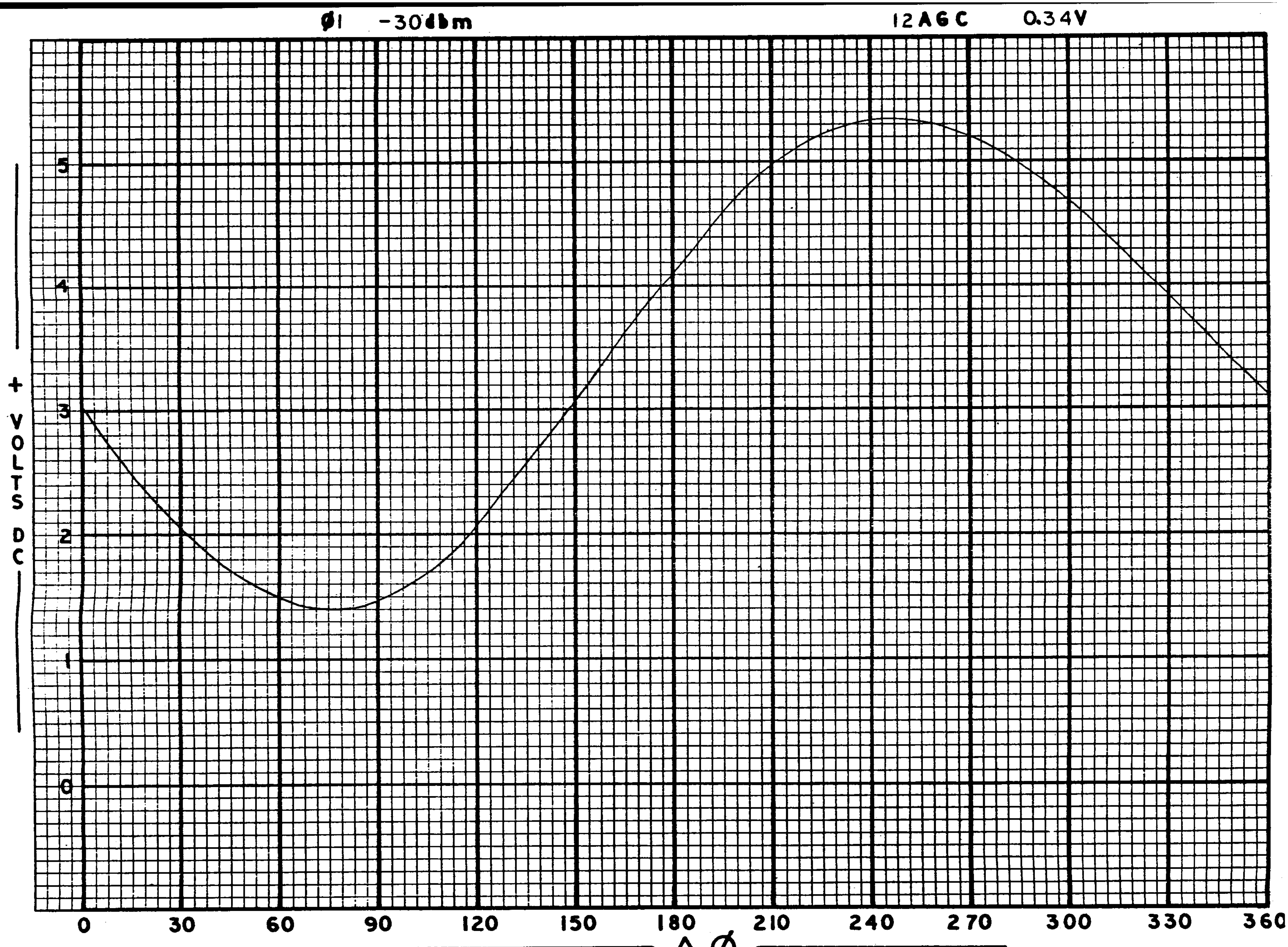
330
360
Δ Ø



Ø1 -30dbm
12AGC 0.34V
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4
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+ VOLTS DC
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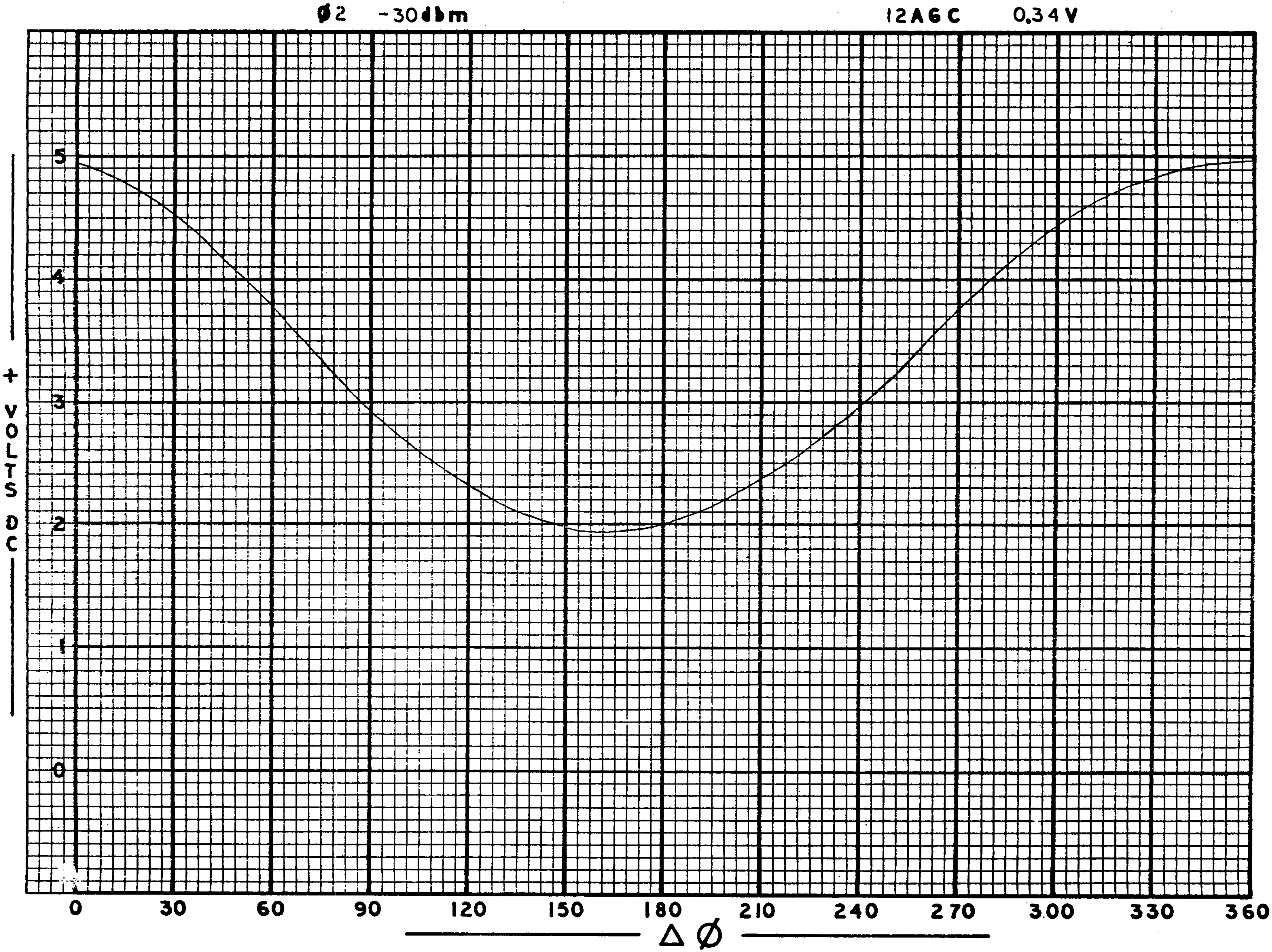
ΔØ



Ø2 -30dbm
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+ VOLTS DC
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1
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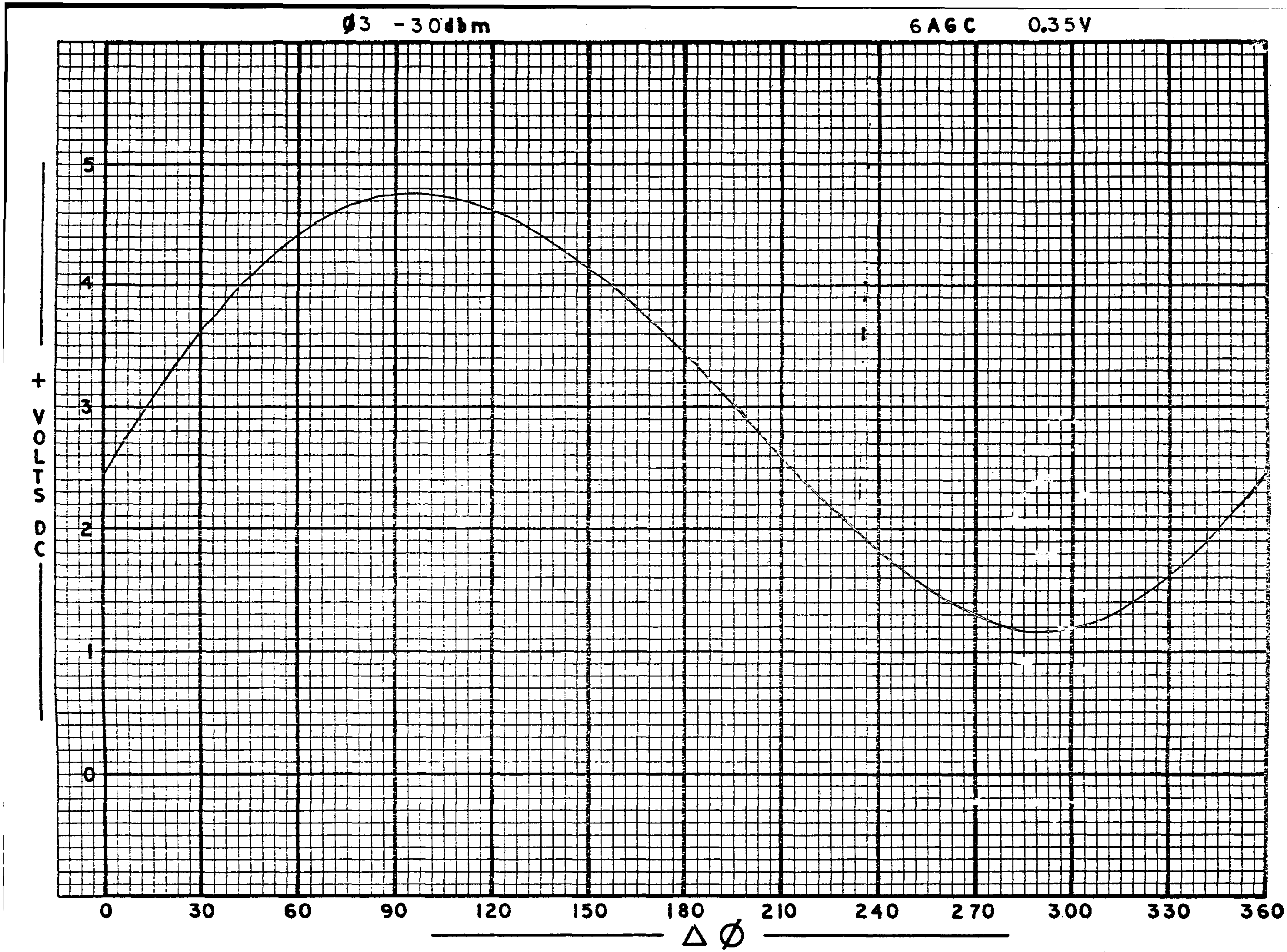
ΔØ



Ø3 -30dbm
6AGC 0.35V
+ VOLTS DC
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1
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60
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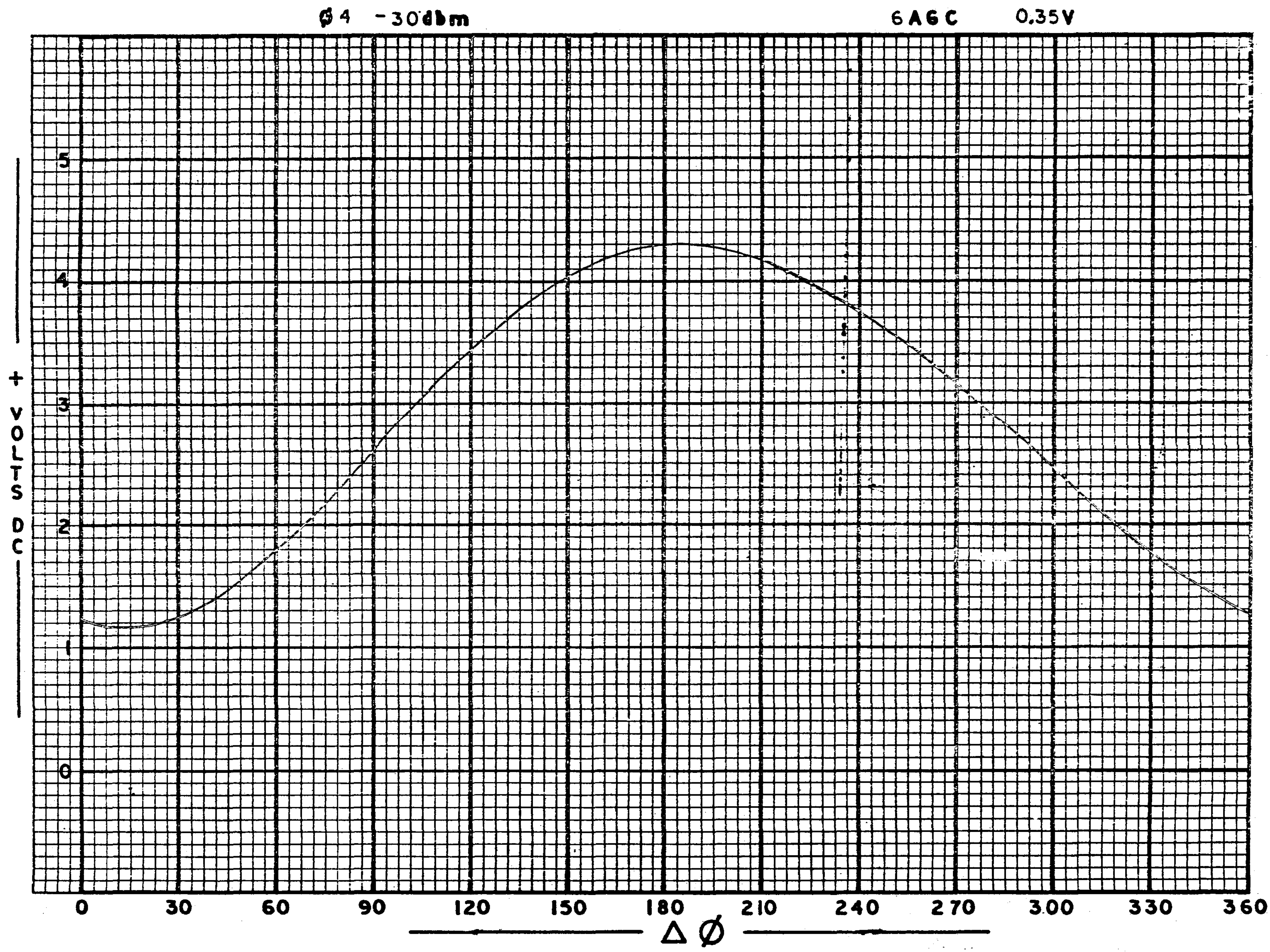
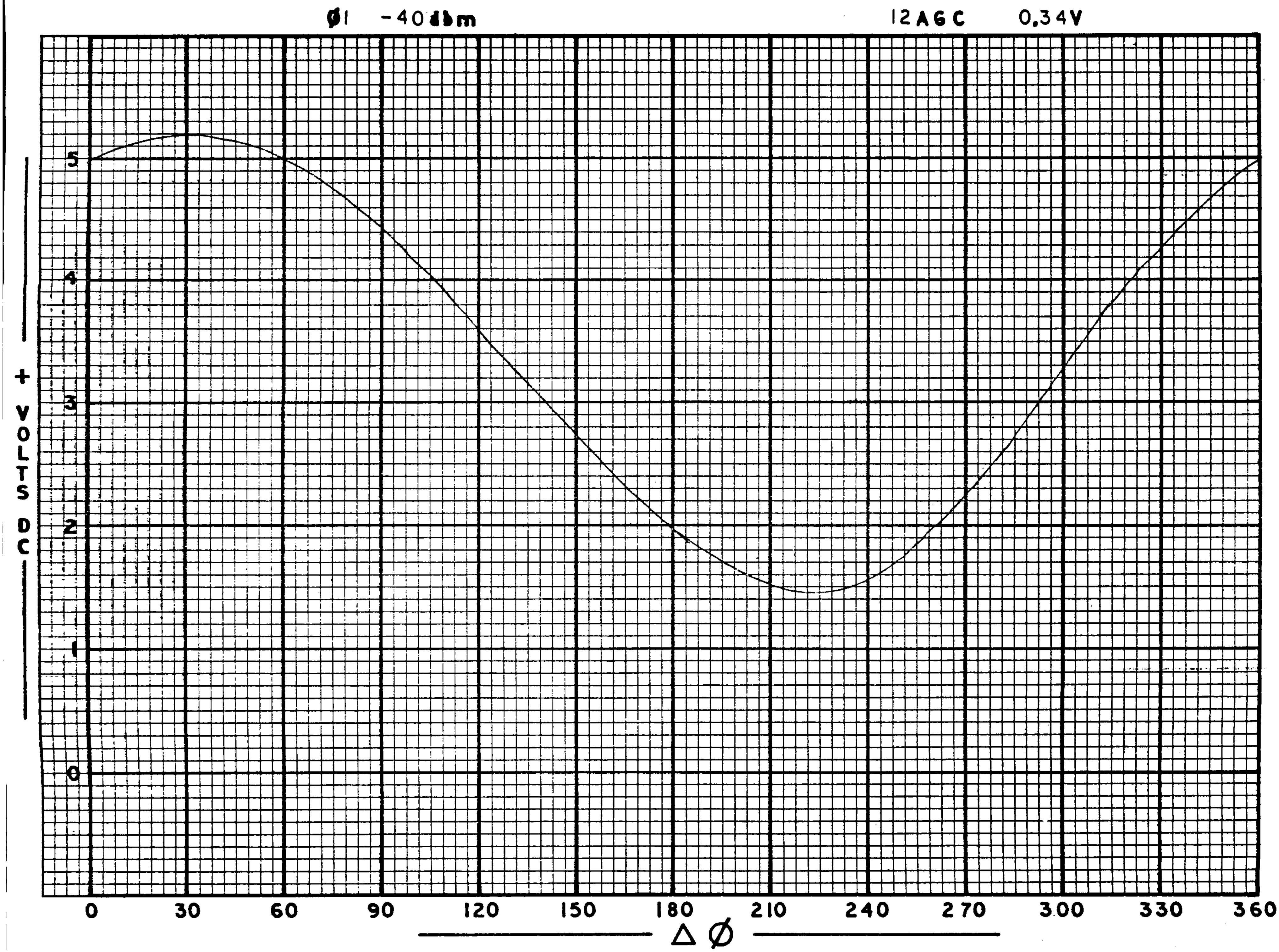
330
360
Δ Ø



Ø4 -30dbm
6AGC 0.35V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
3.00
330
360
ΔØ



Ø1 -40 dbm
12AGC 0.34V
+ VOLTS DC
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4
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2
1
0
0
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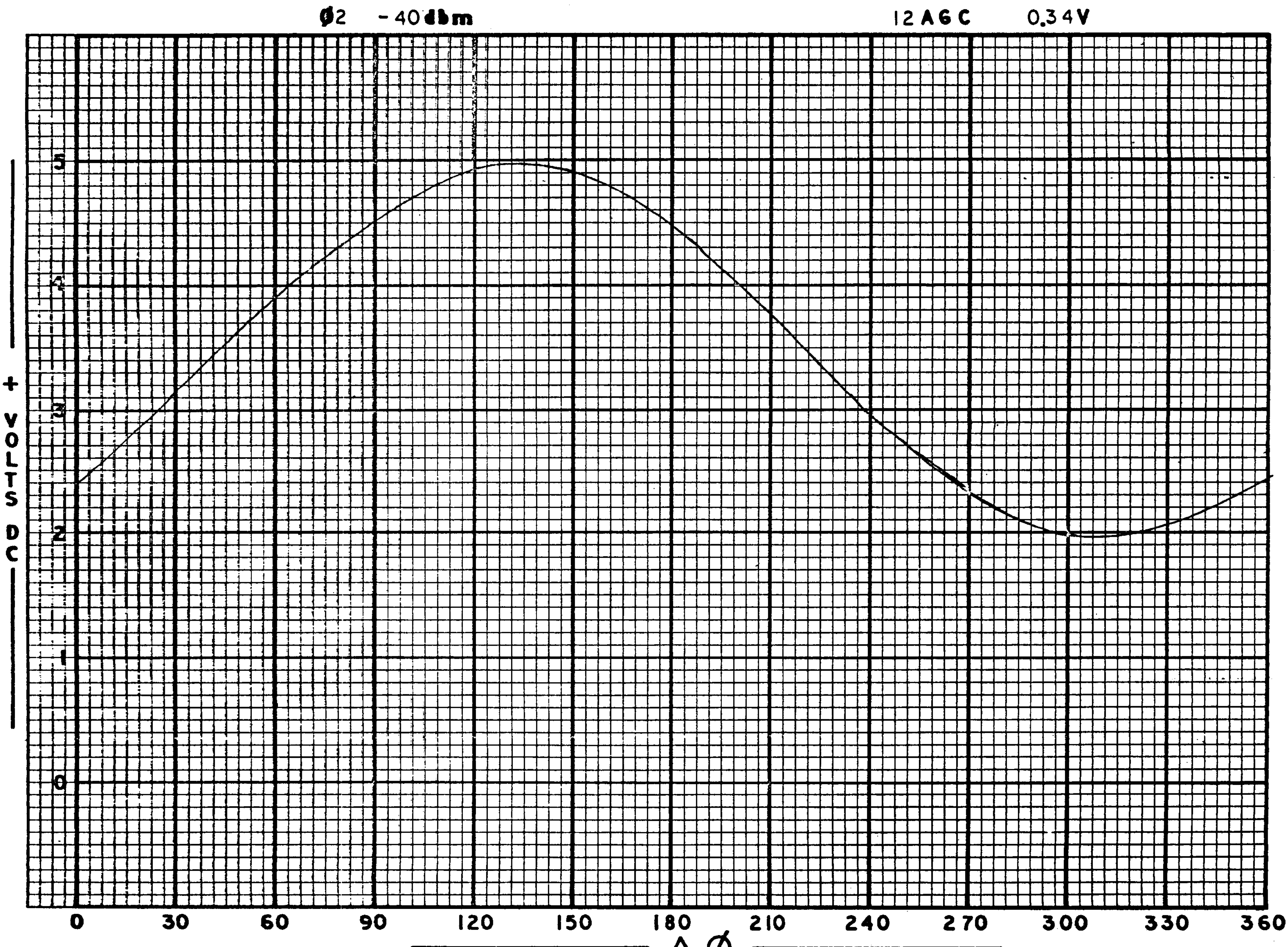
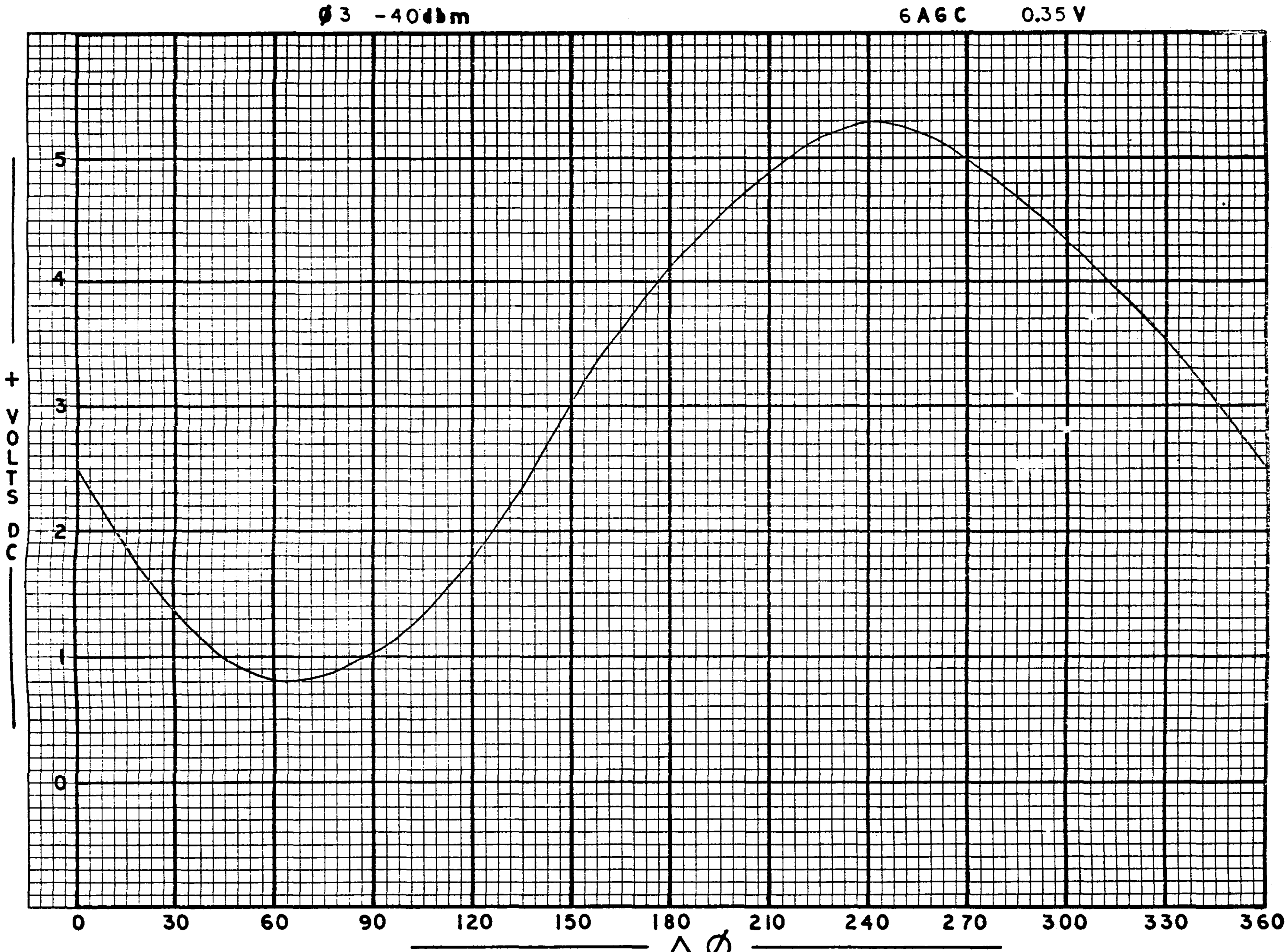
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



Ø2 -40 dbm
12 AGC 0.34V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



Ø3 -40dbm
6A6C 0.35V
+ VOLTS DC
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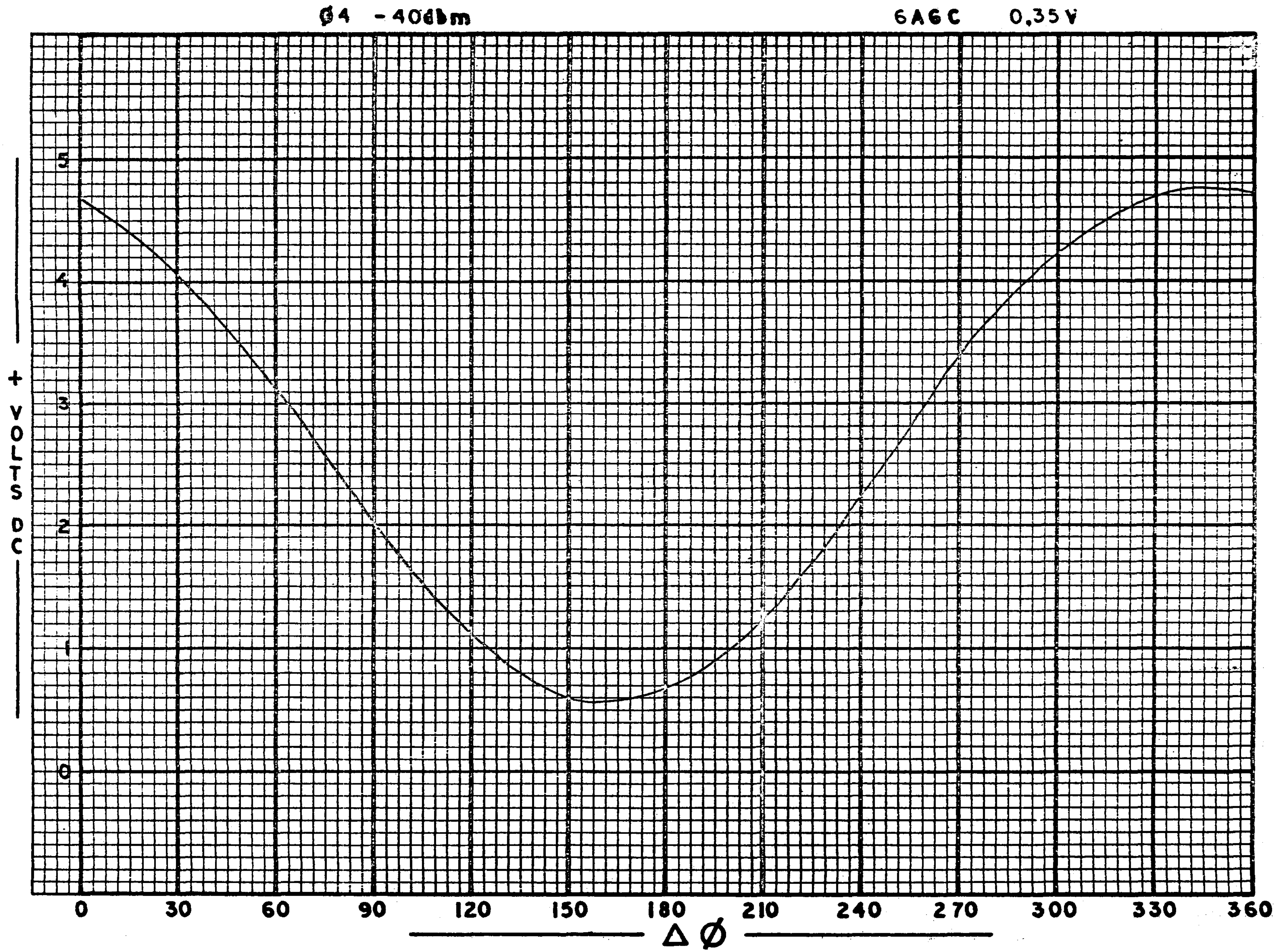
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ


Ø4 -40dbm
6A6C 0,35V
+ VOLTS DC
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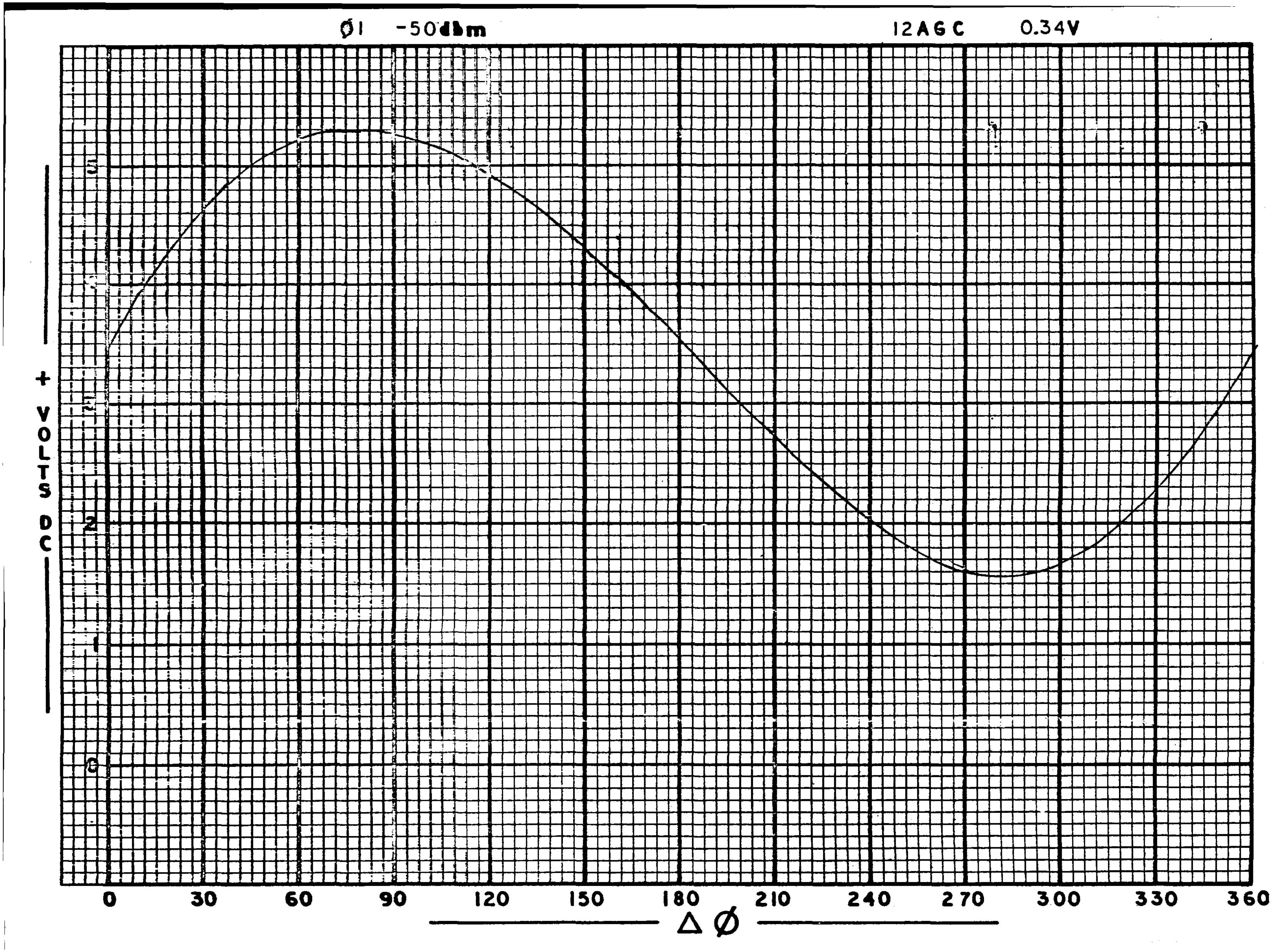
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ


Ø1 -50dbm
12AGC 0.34V
+ VOLTS DC
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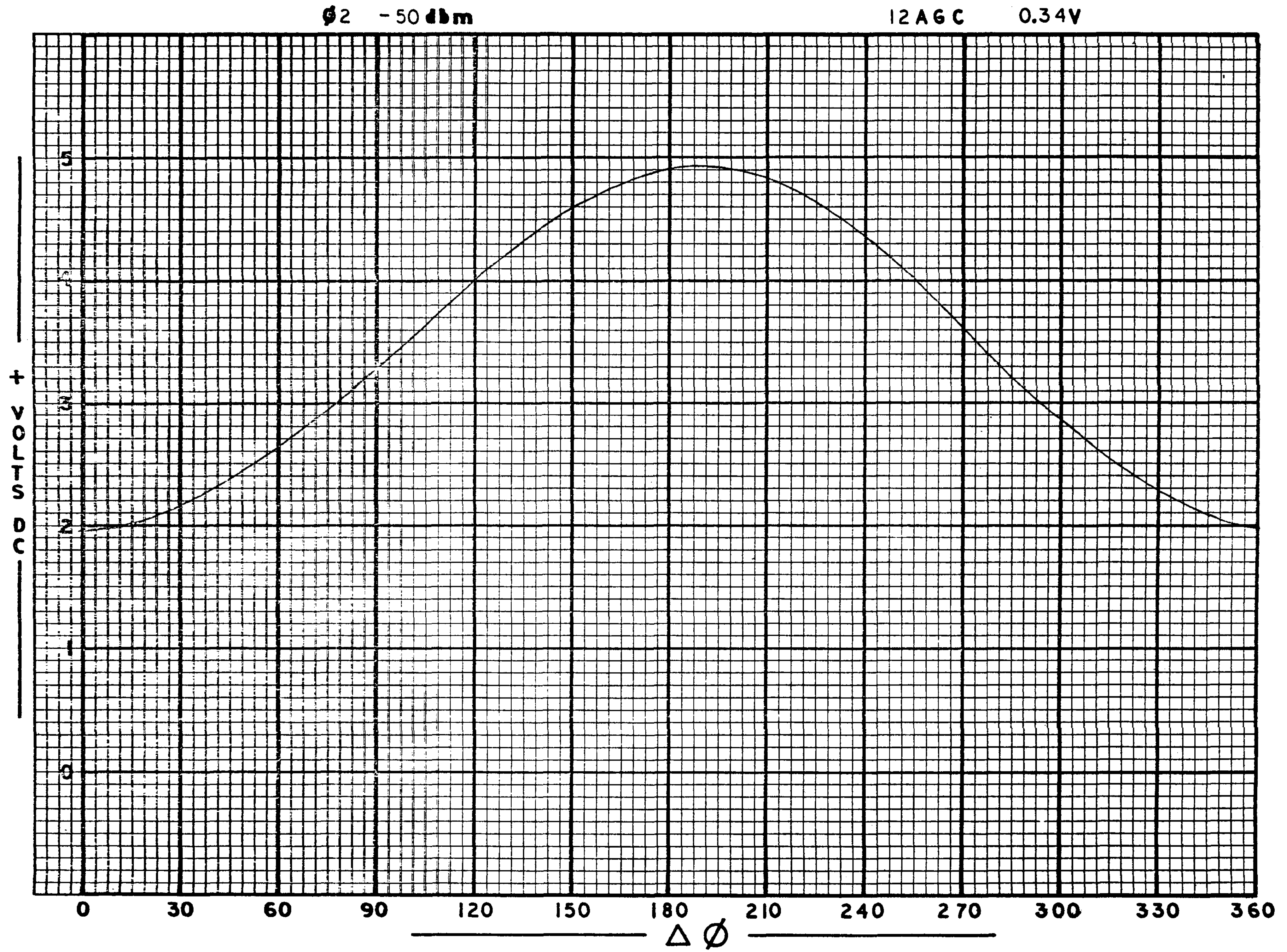
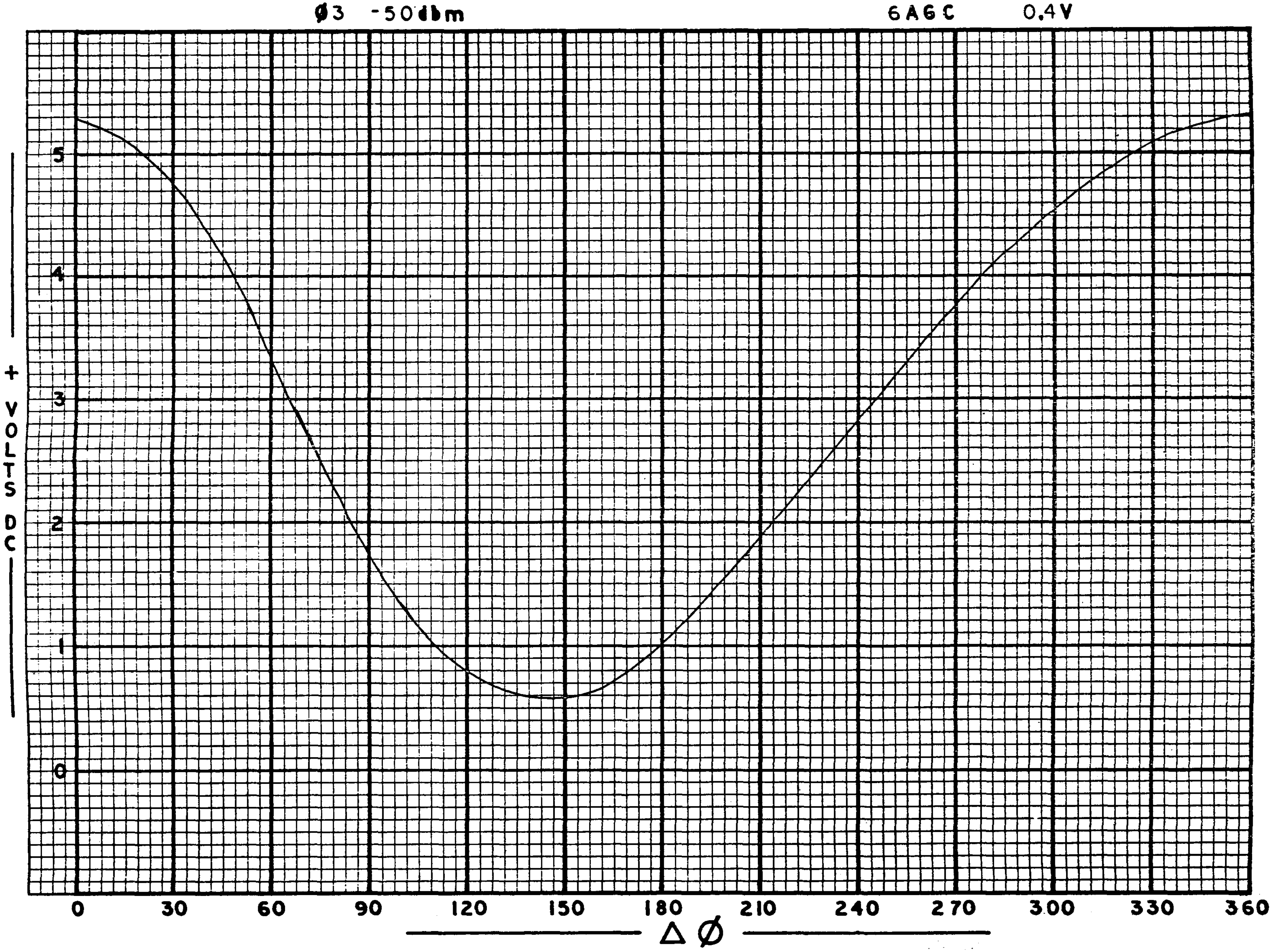
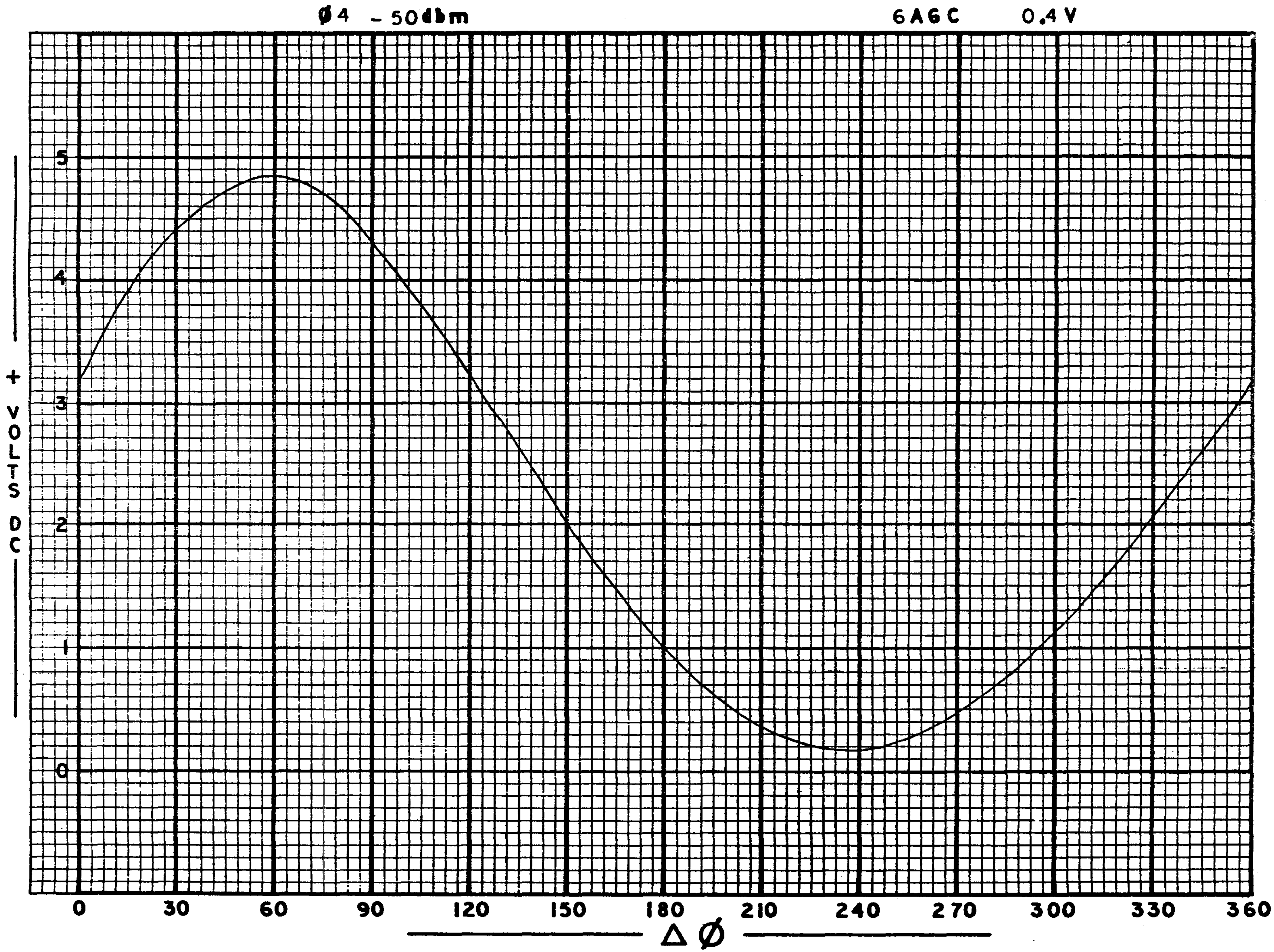
1
2
3
4
5
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ

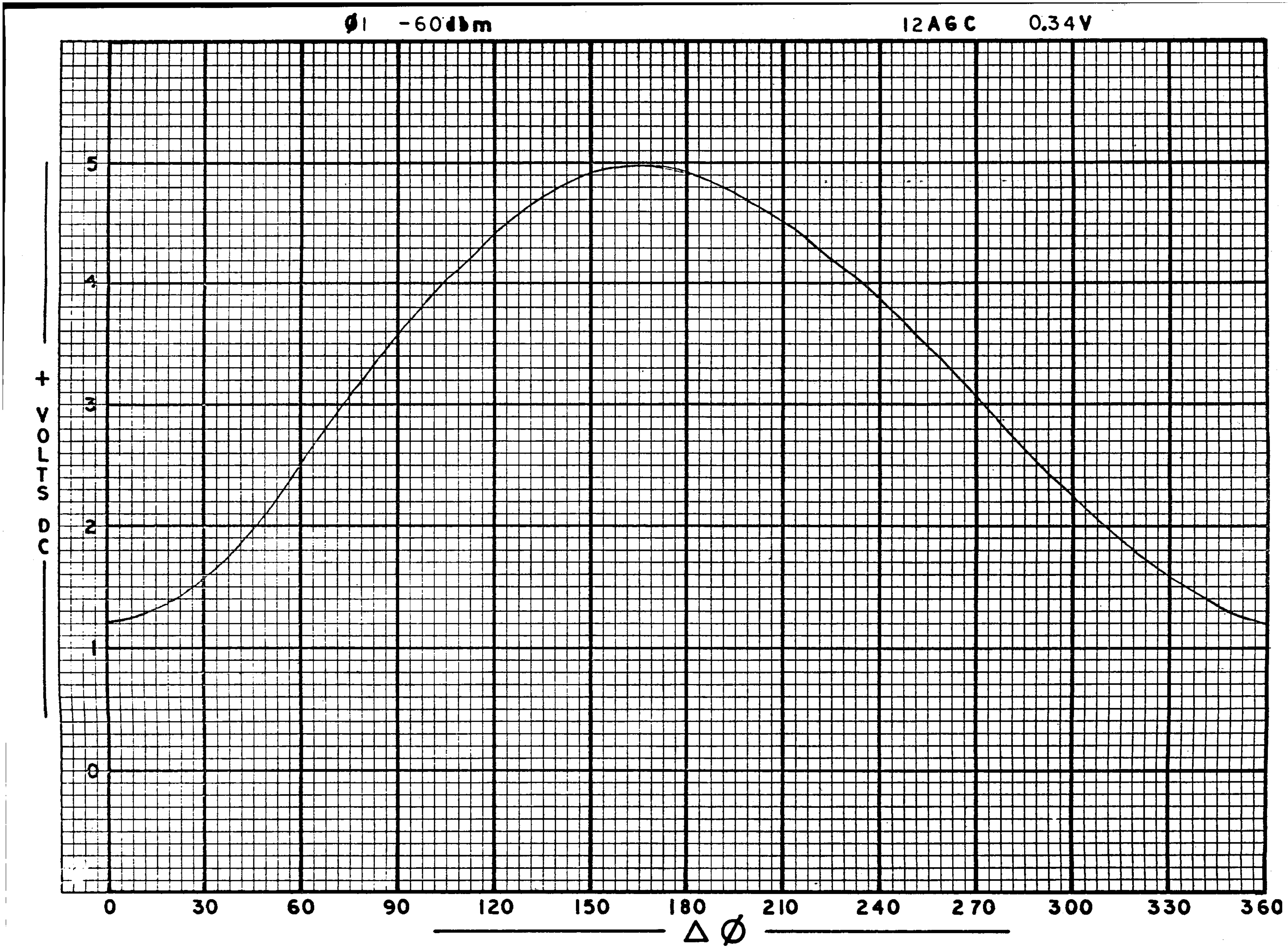


Ø2 -50 dbm
12 AGC 0.34V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



Ø3 -50dbm
6AGC 0.4V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ


Ø4 - 50dbm
6A6C 0.4V
+ VOLTS DC
5
4
3
2
1
0
0 30 60 90 120 150 180 210 240 270 300 330 360
ΔØ



Ø1 -60dbm
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+ VOLTS DC
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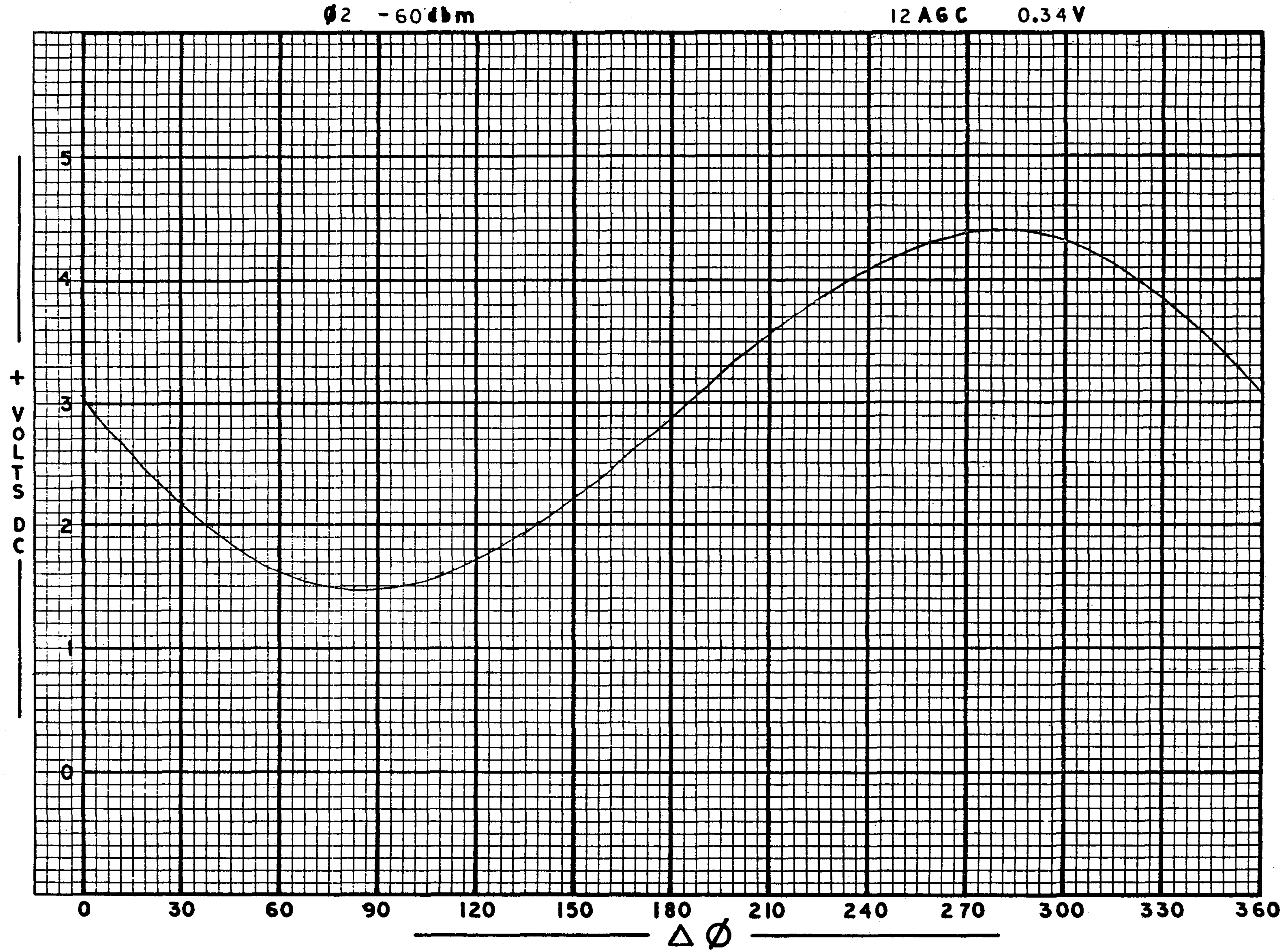
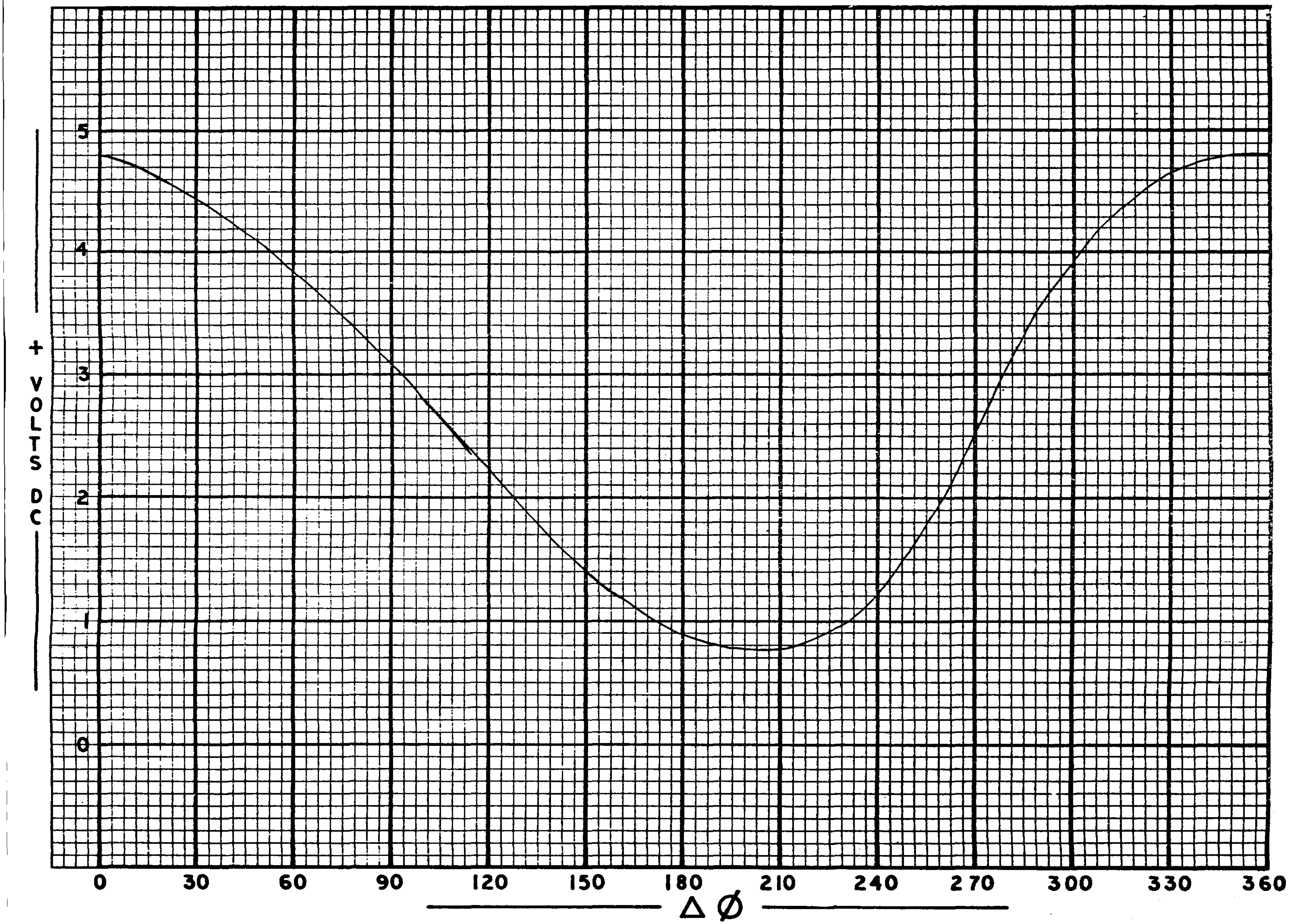
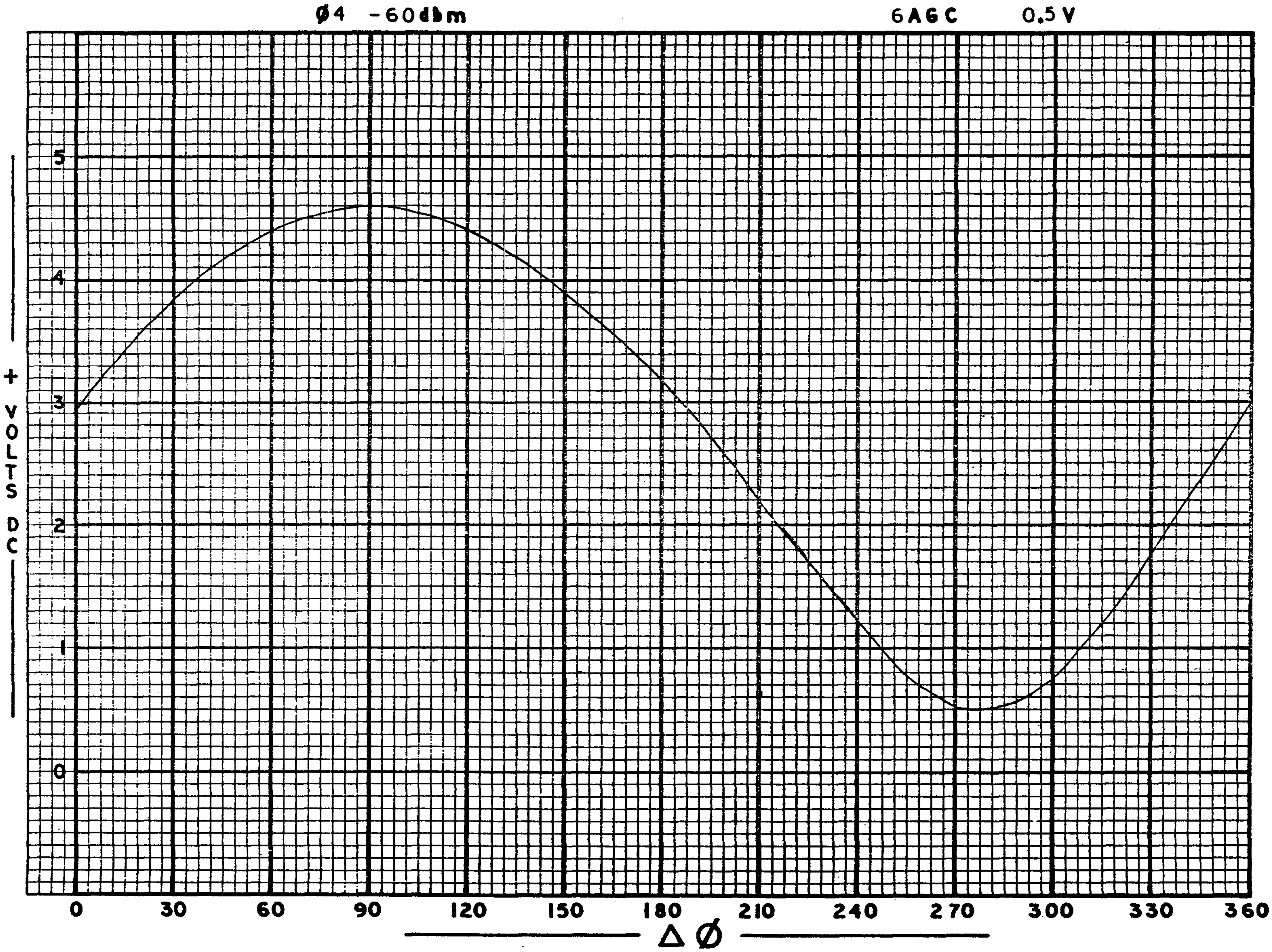
4
3
2
1
0
0 30 60 90 120 150 180 210 240 270 300 330 360
ΔØ



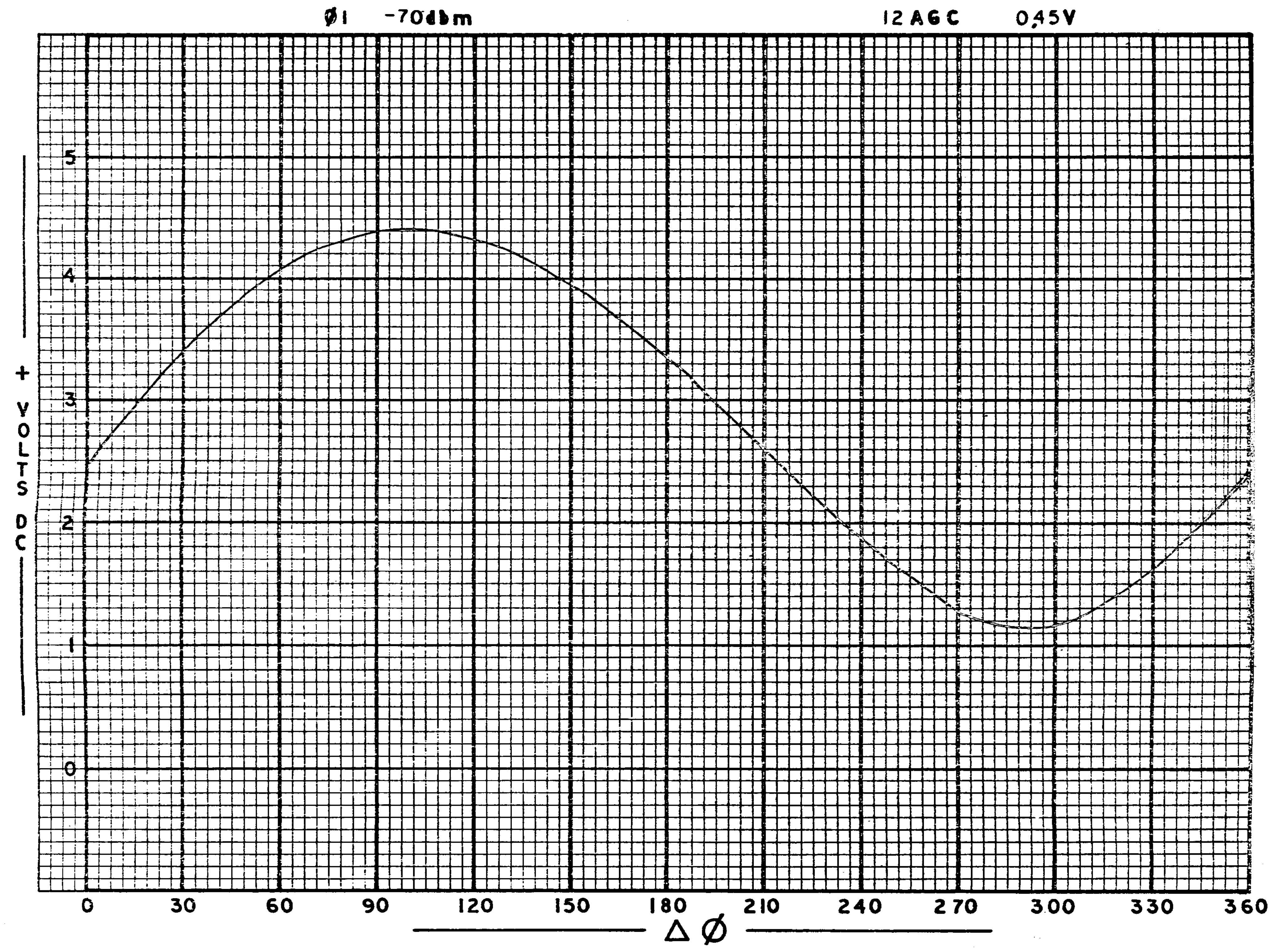
Ø2 -60 dbm
12 AGC 0.34 V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø

Ø3 -60 dbm 6AGC 0.5V





Ø4 -60dbm
6AGC 0.5V
5
4
3
2
1
0
+ VOLTS DC
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ



Ø1 -70dbm
12AGC 0,45V
+ VOLTS DC
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4
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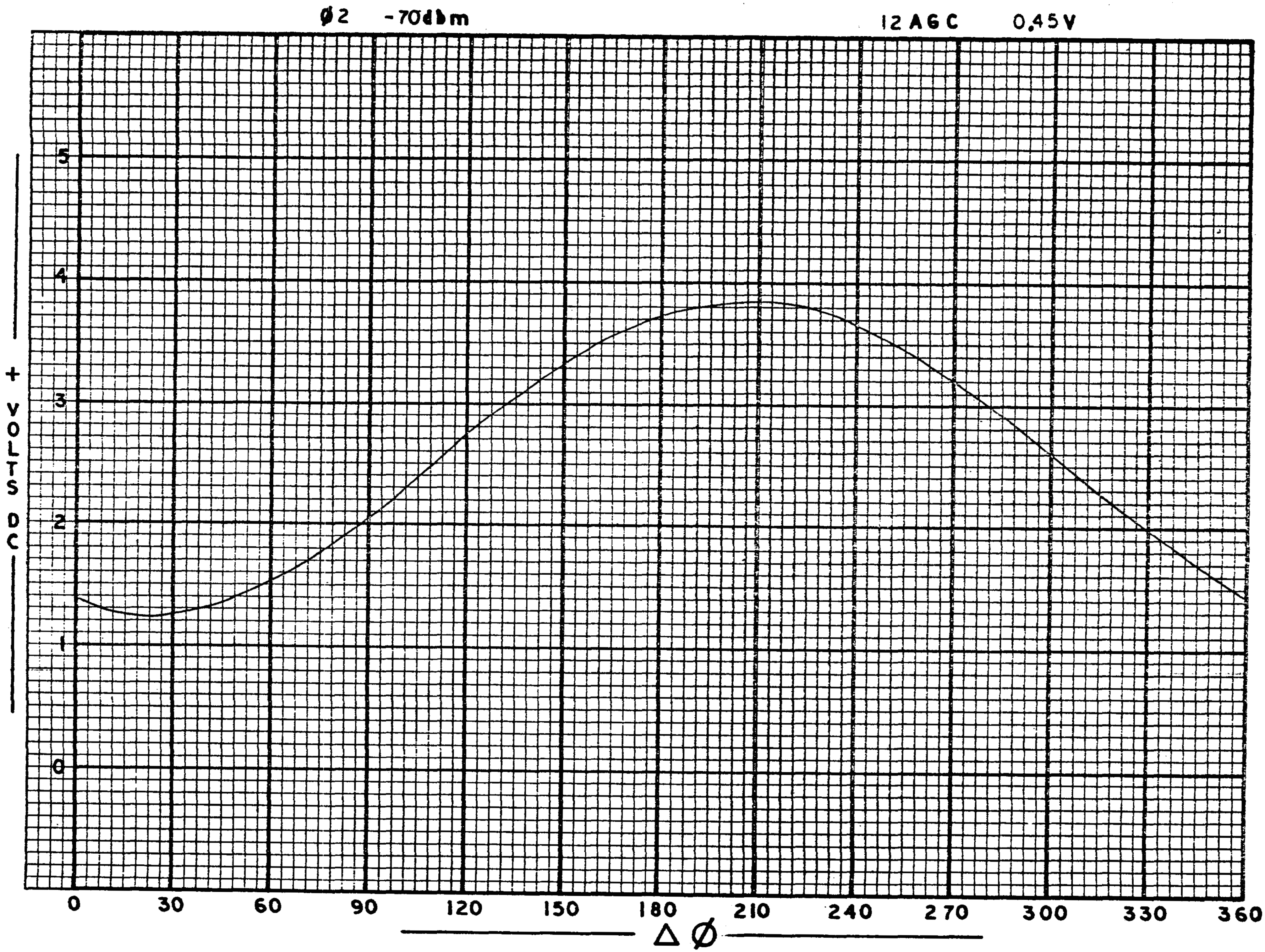
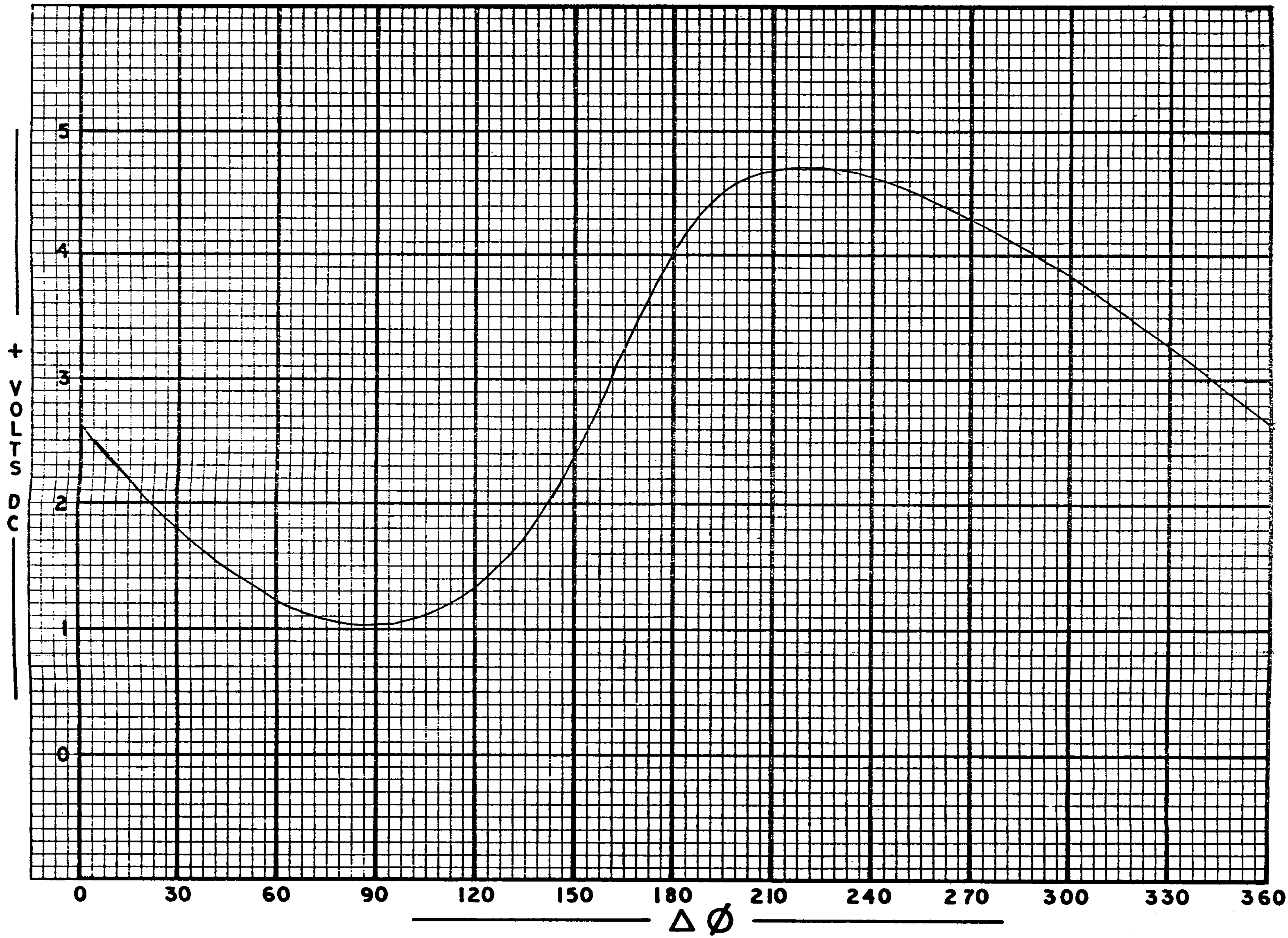
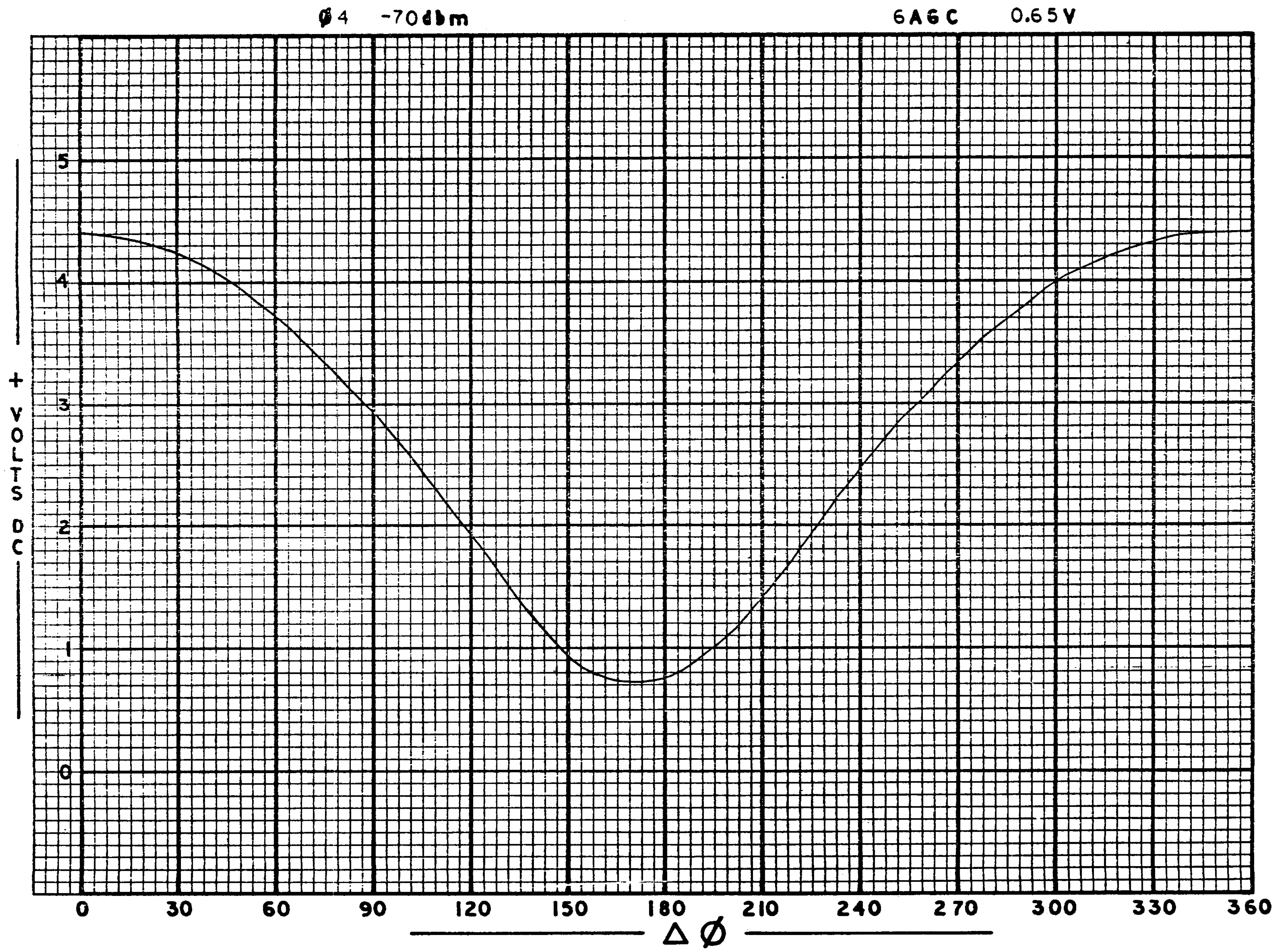
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ



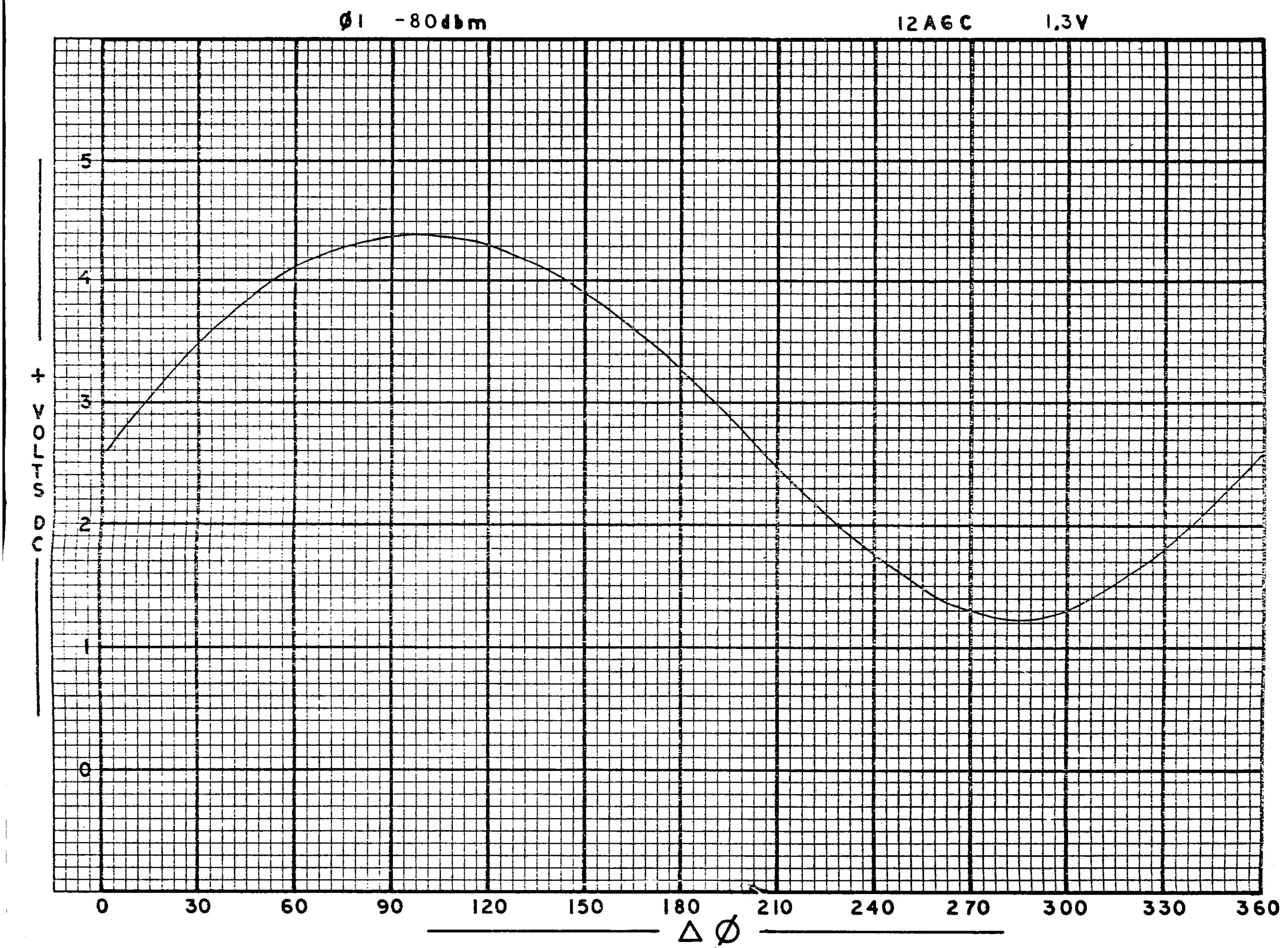
Ø2 -70dbm
12 AGC 0,45V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ

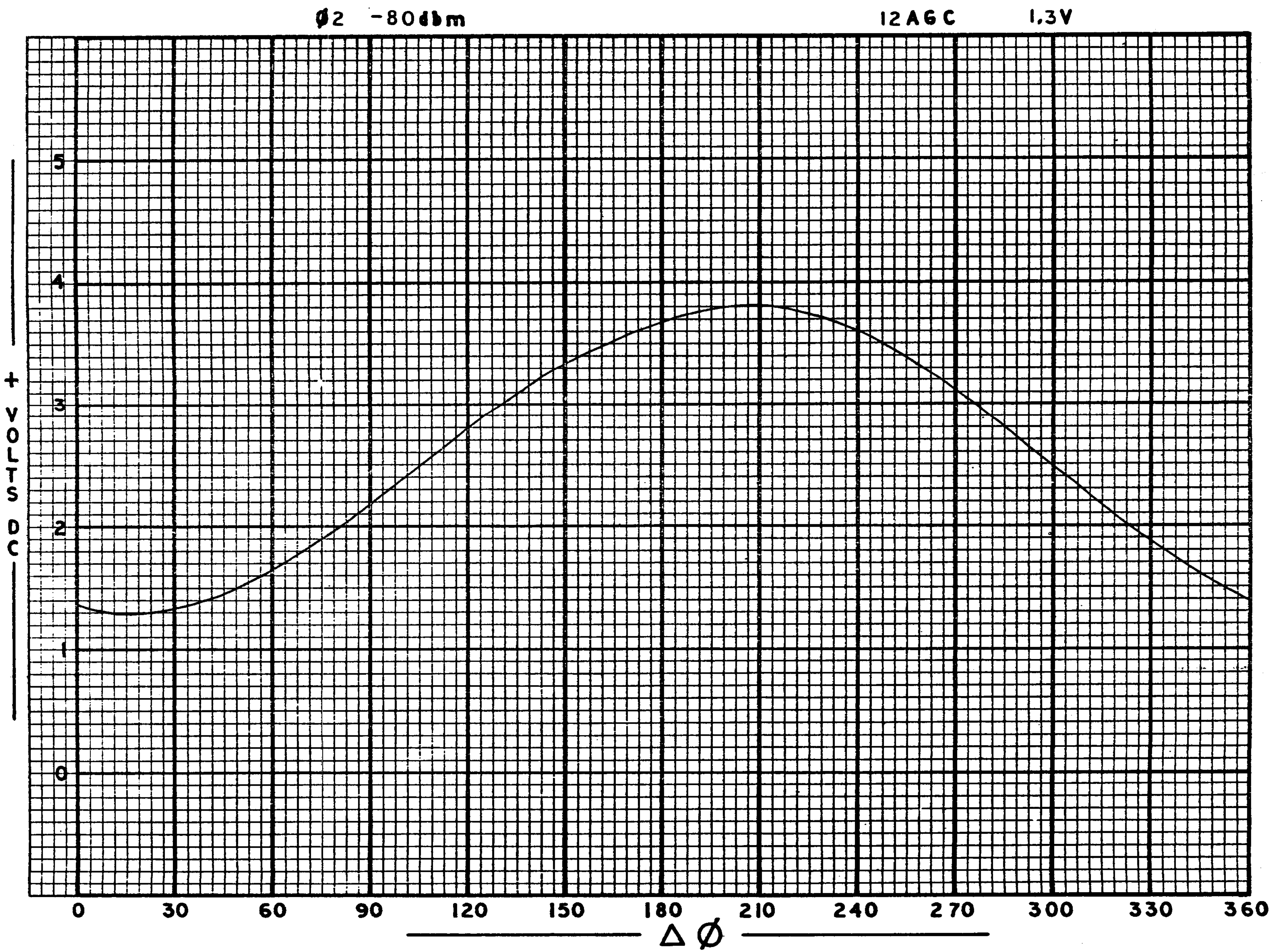
Ø3 -70dbm 6AGC 0,65V



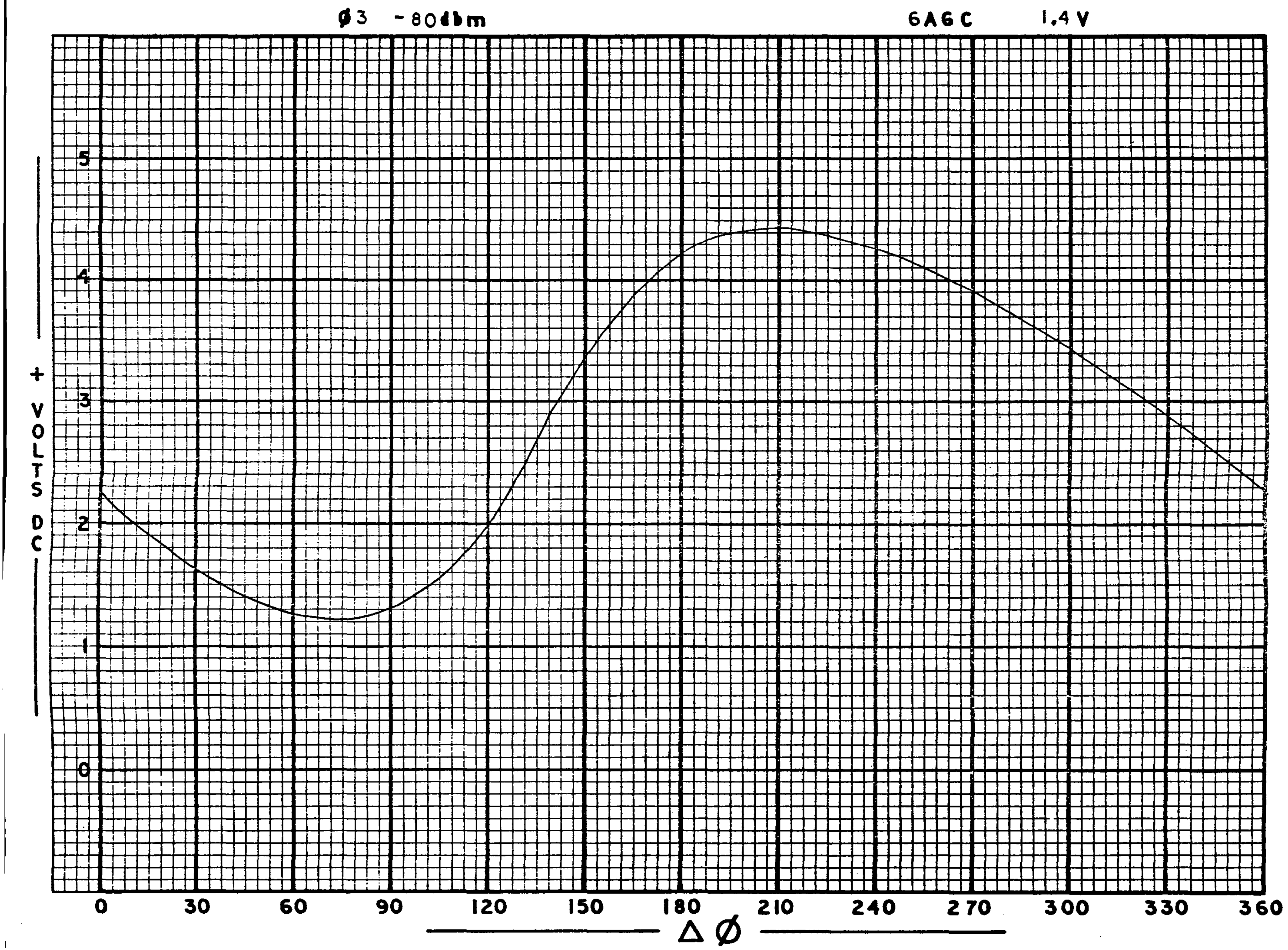


Ø4 -70dbm
6A6C 0.65V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ

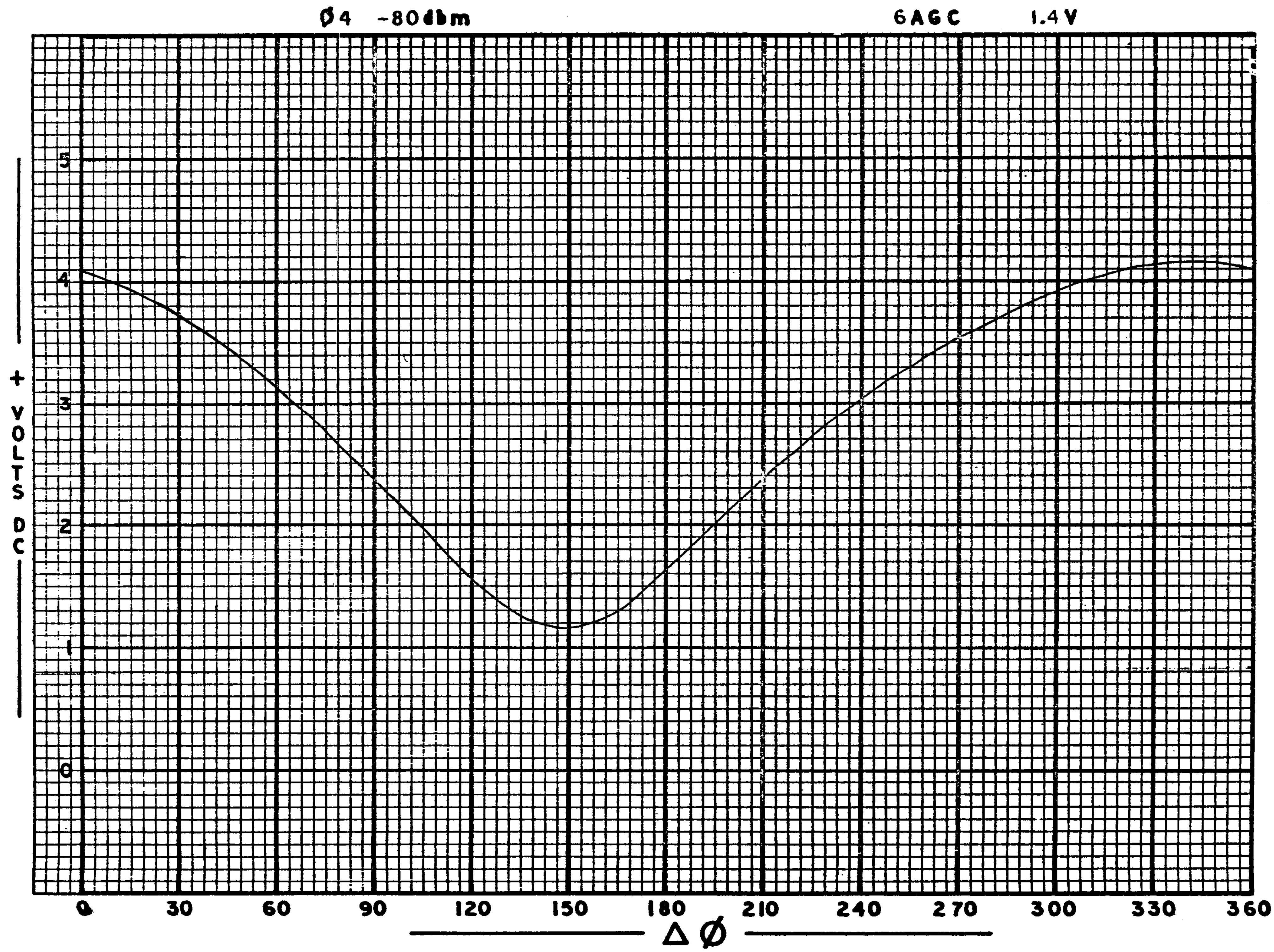

Ø1 -80dbm
12A6C 1,3V
+ VOLTS DC
5
4
3
2
1
0
0 30 60 90 120 150 180 210 240 270 300 330 360
ΔØ



Ø2 -80dbm
12A6C
1.3V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



ø3 -80dbm
6A6C 1.4V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ ø


Ø4 -80dbm
6AGC 1.4V
+ VOLTS DC
5
4
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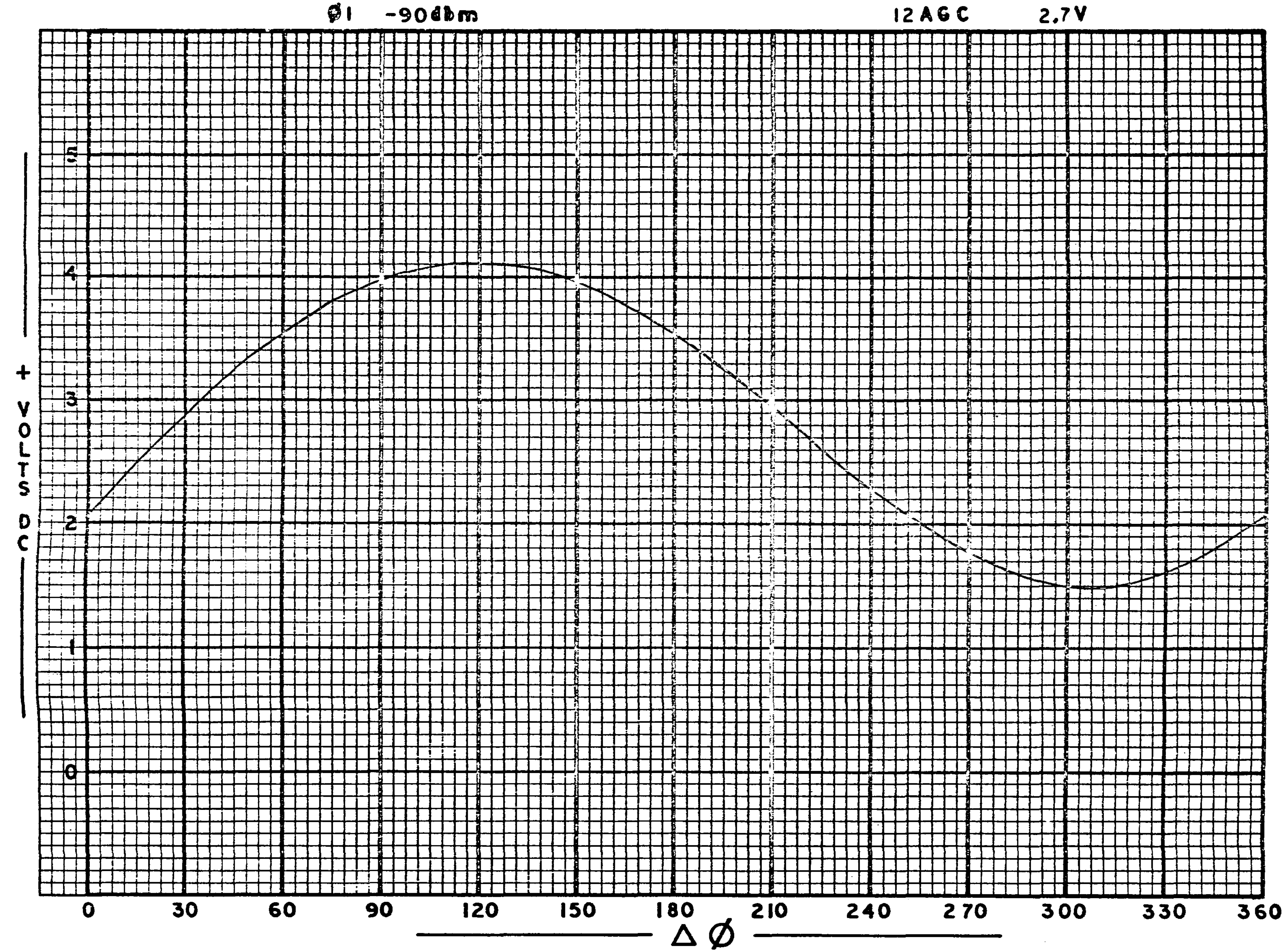
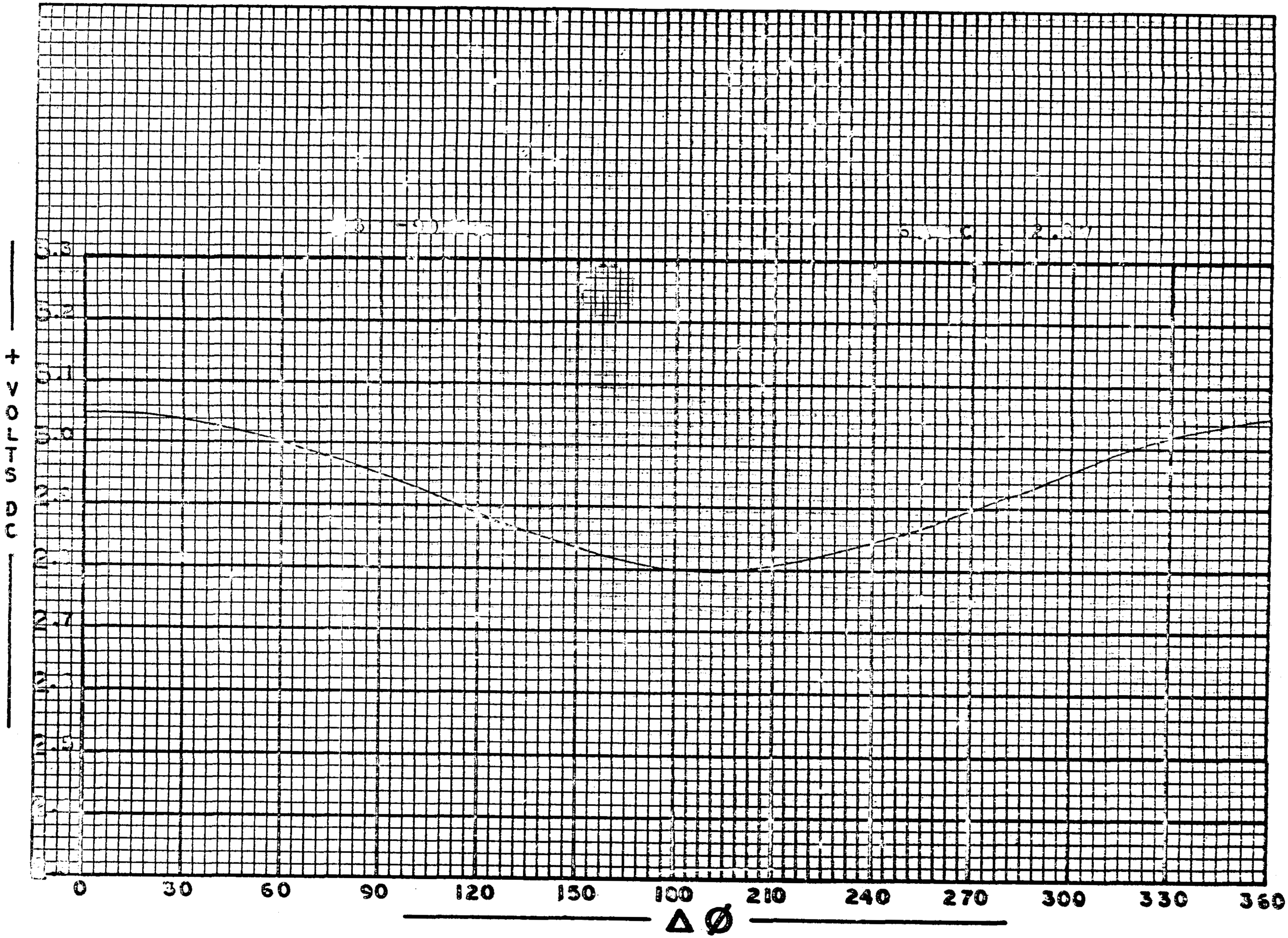
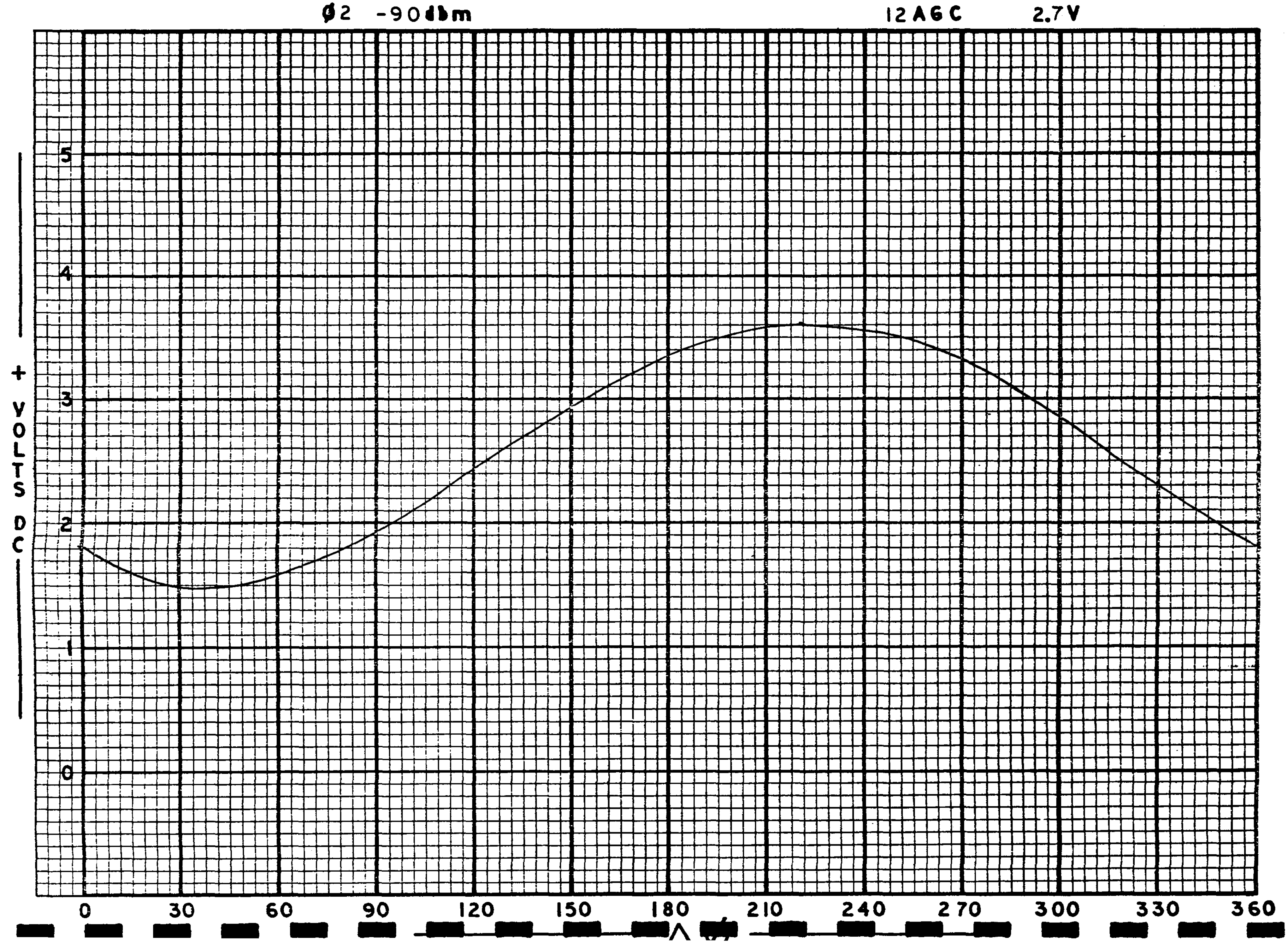
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ

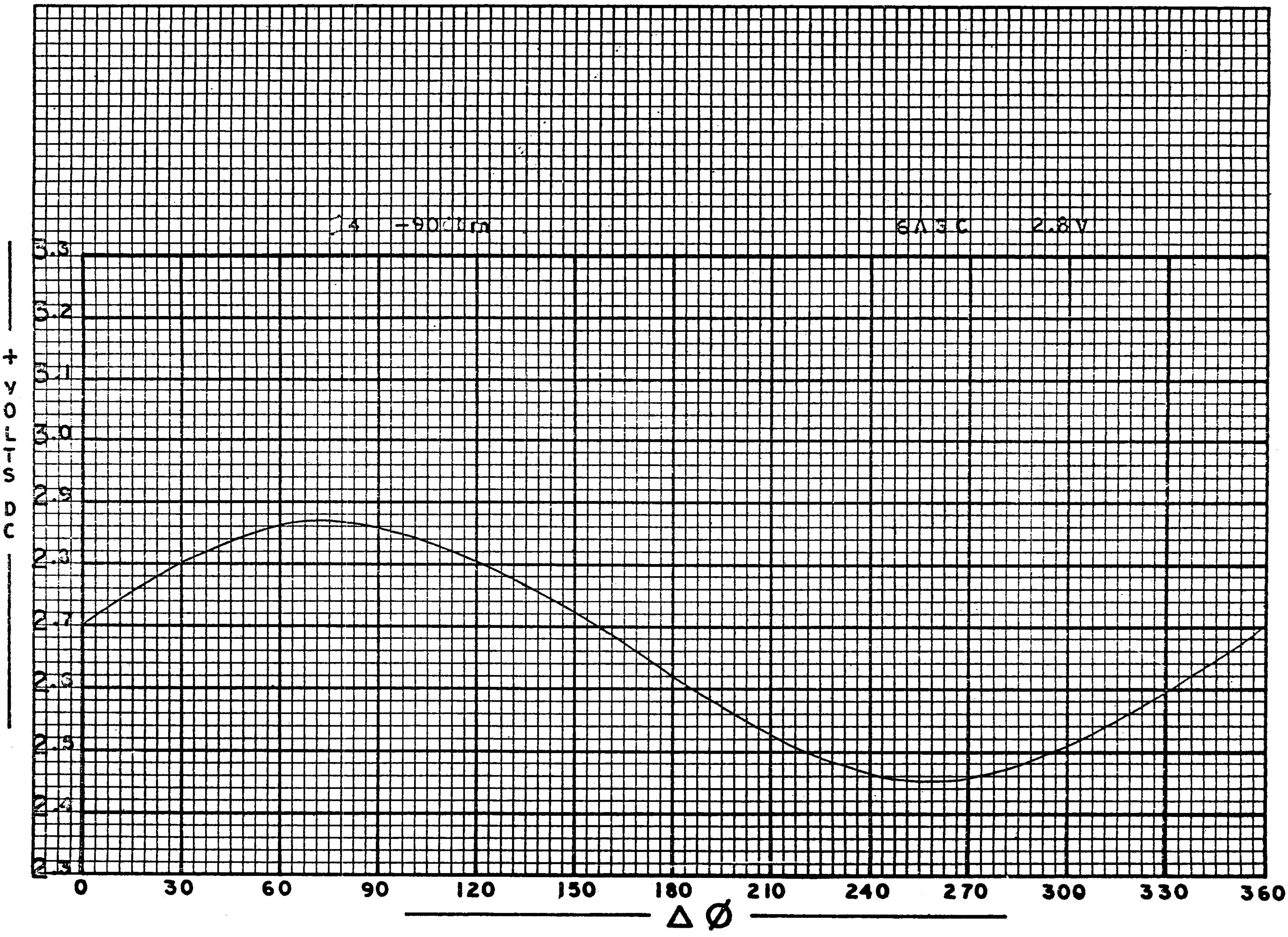


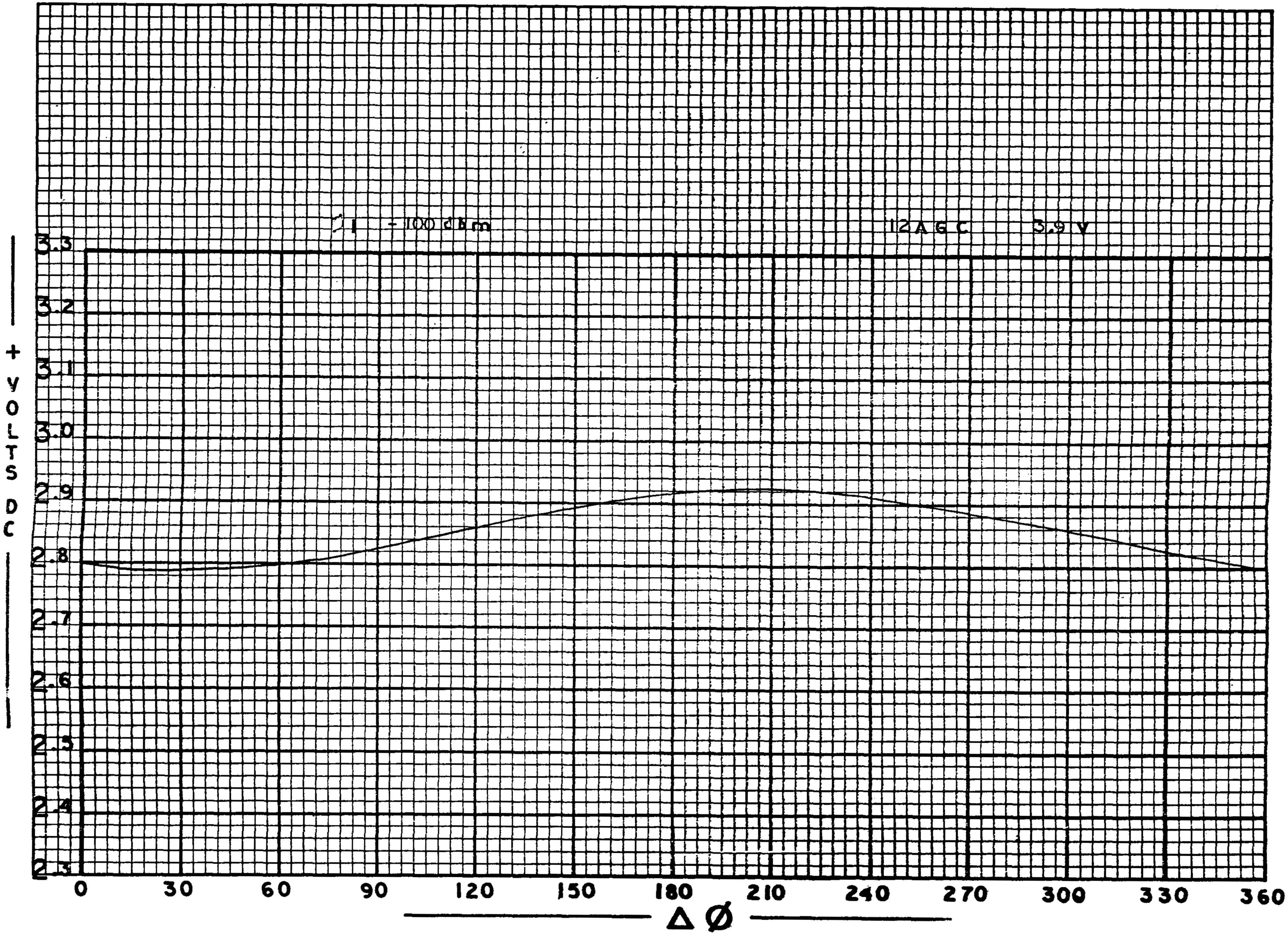
Ø1 -90dbm
12 AGC 2.7V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



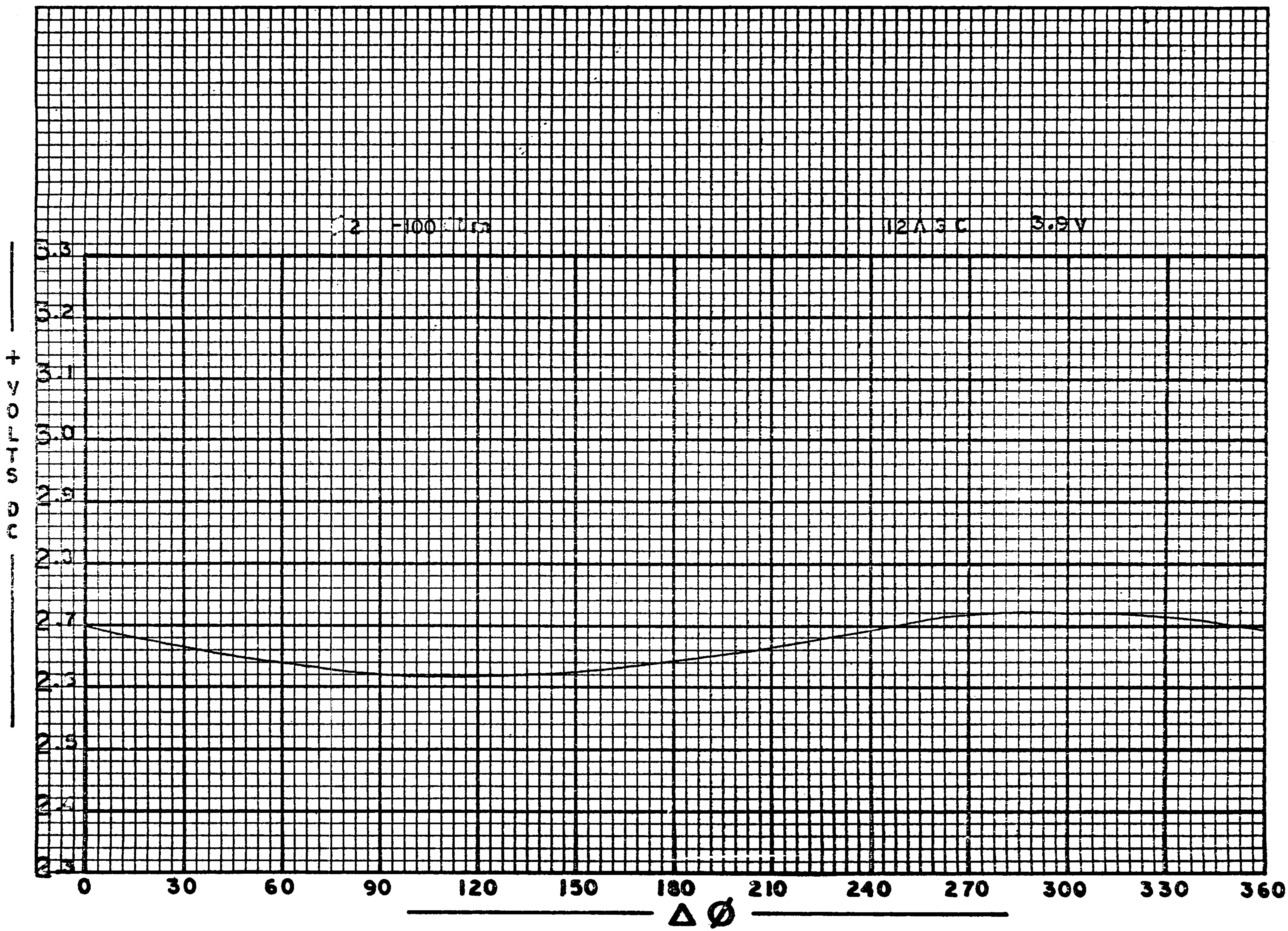
+ VOLTS DC
0
30
60
90
120
150
100
210
240
270
300
330
360
Δ Ø


ø2 -90dbm
12A6C
2.7V
+ VOLTS DC
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
330
360

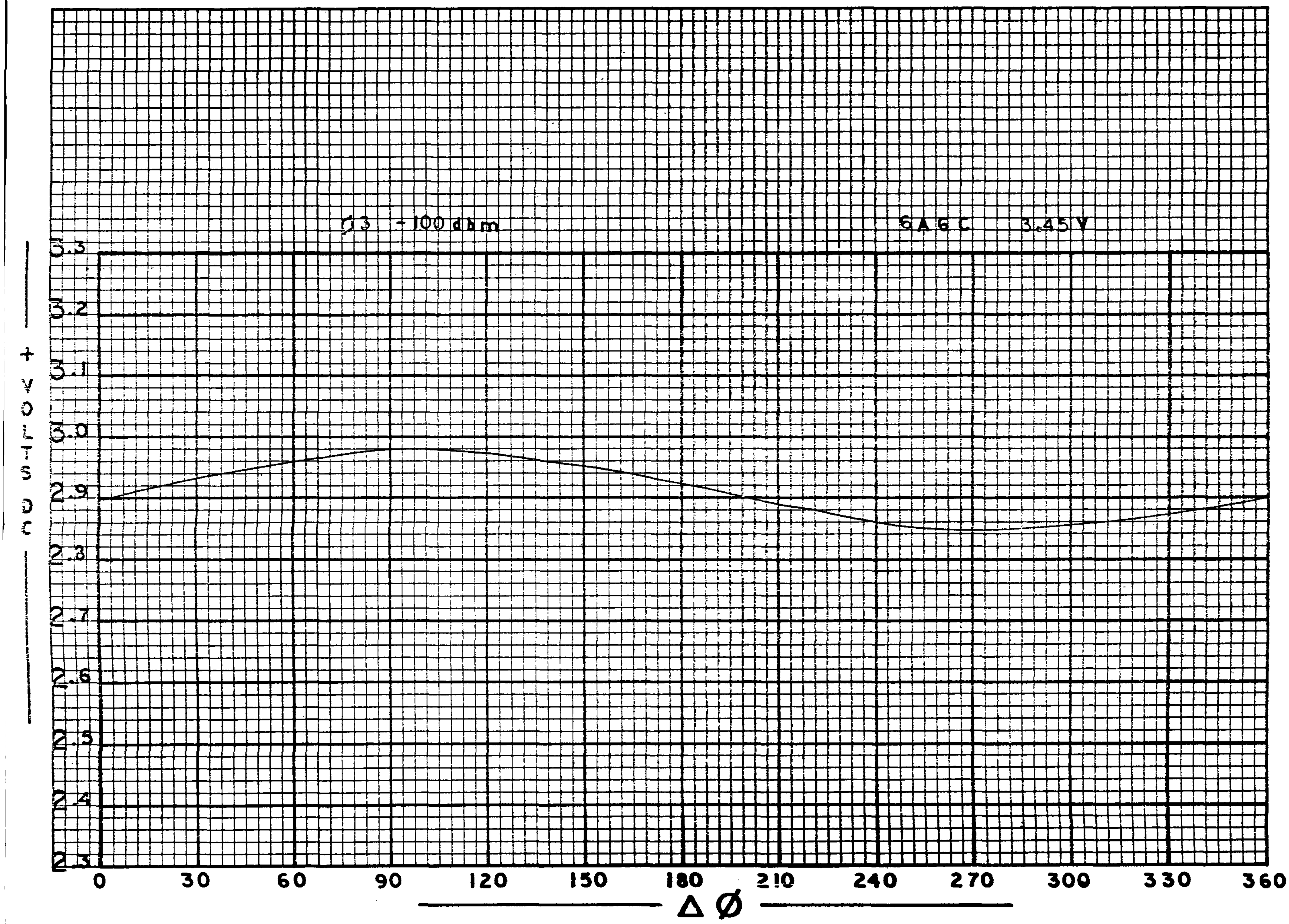

6A3C
2.8V
+ VOLTS DC
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



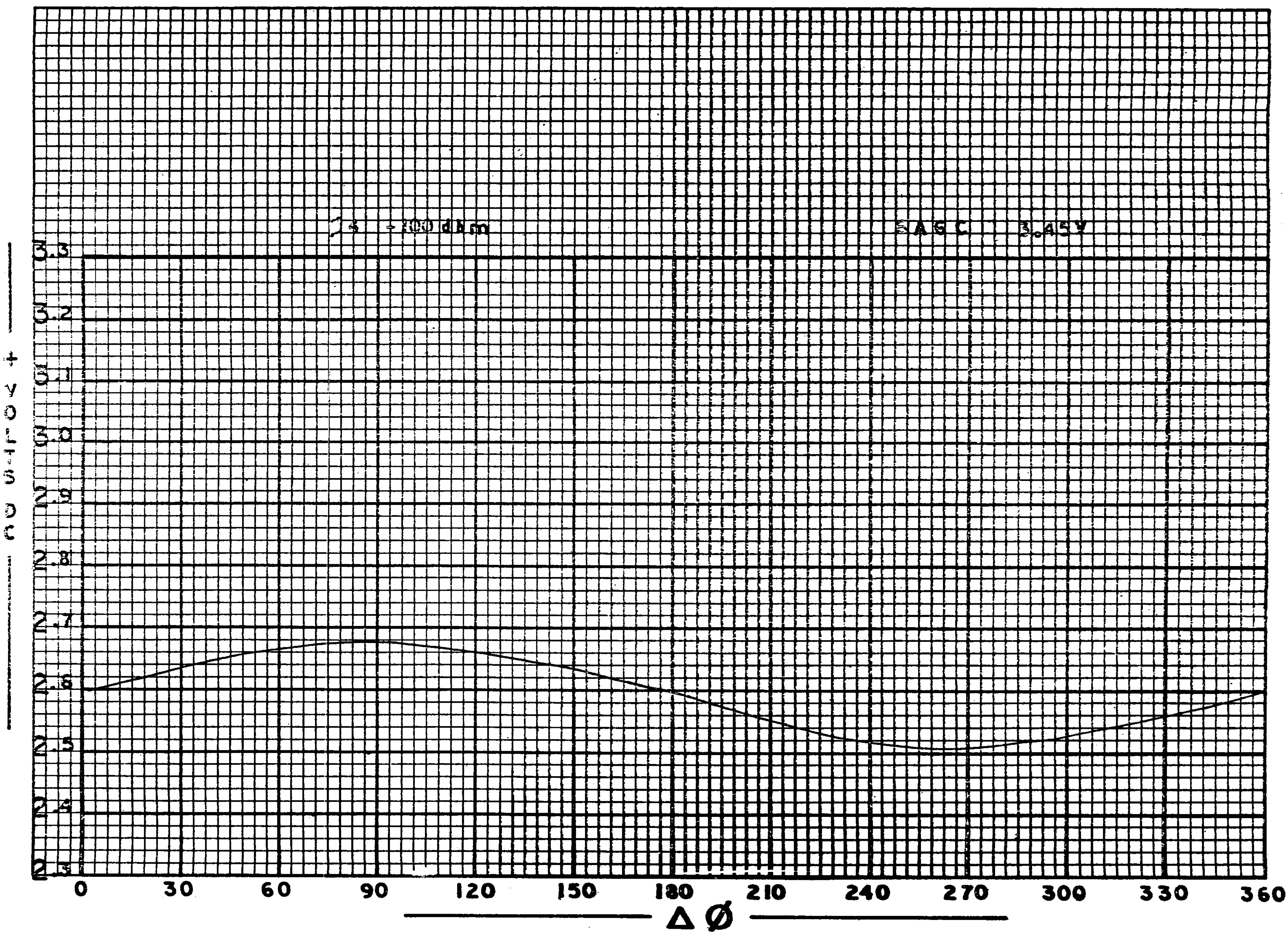
Σ1 -100 dbm
12 AGC 3.9 V
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
+ VOLTS DC
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ

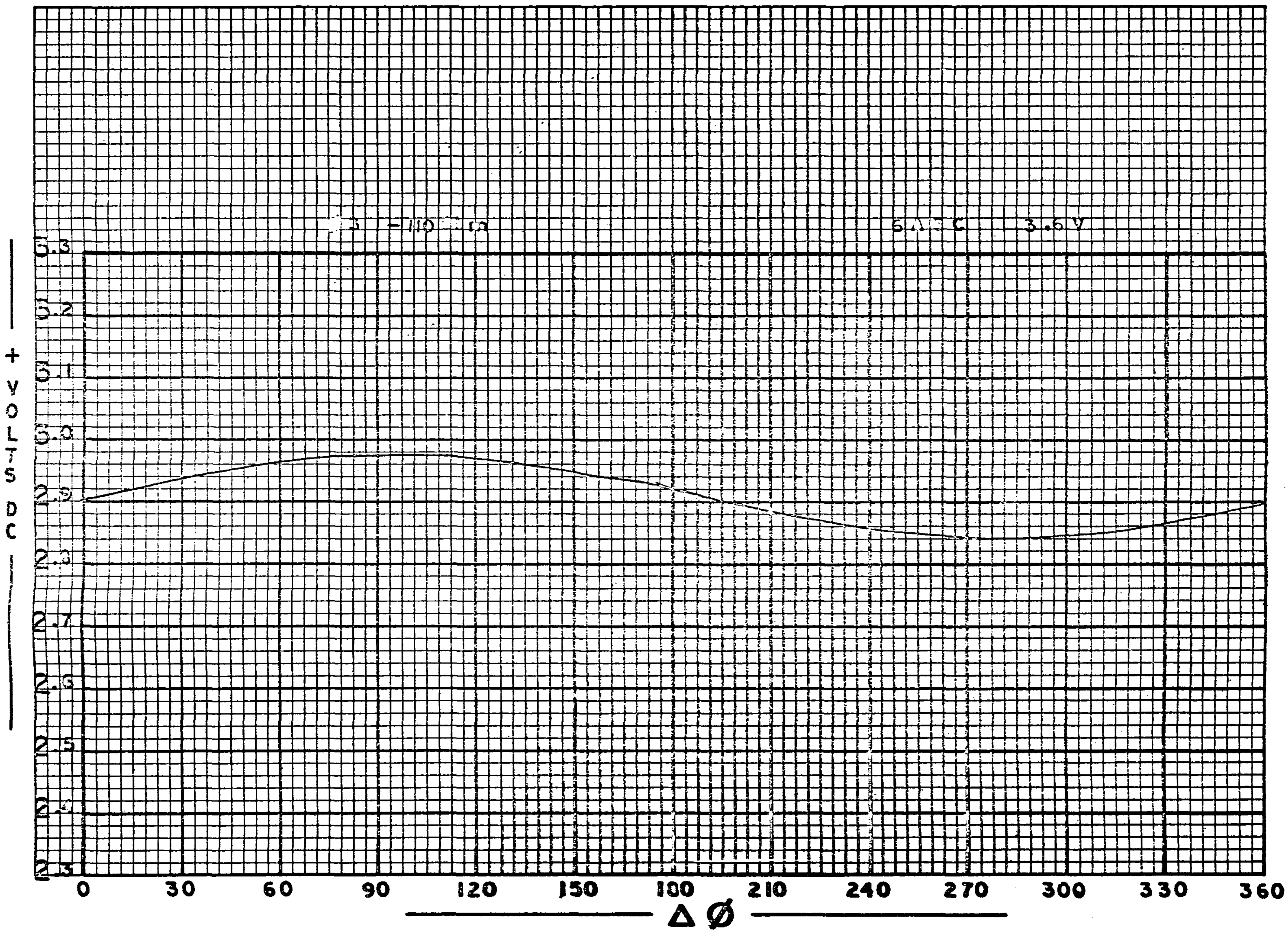


2 -100
12A3C
3.9V
3.3
3.2
3.1
3.0
2.9
2.7
+ VOLTS DC
0
30
60
90
120
150
180
210
240
270
300
330
360
ΔØ

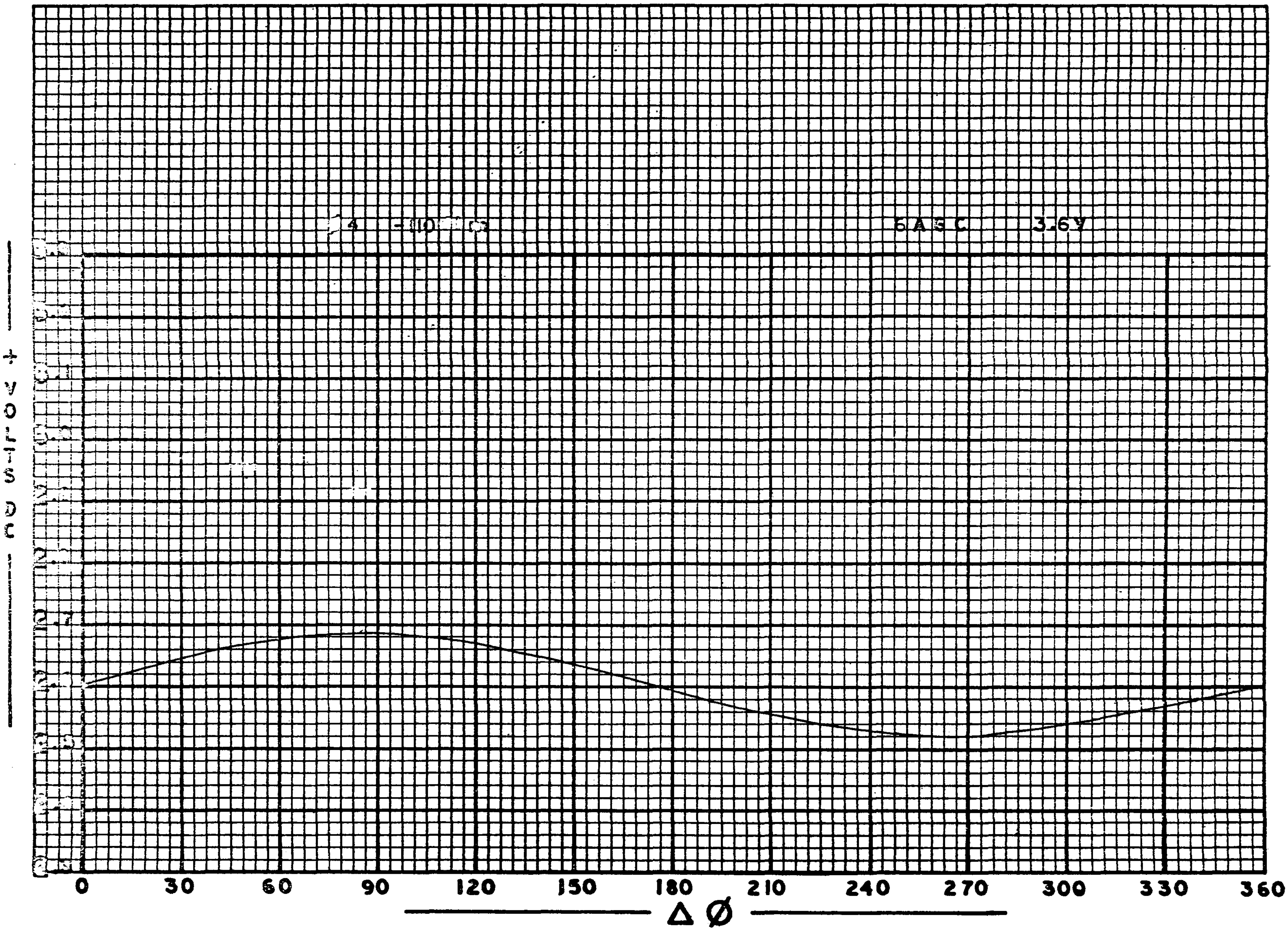


f3 -100 dbm
6AGC 3.45V
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
+ VOLTS DC
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø

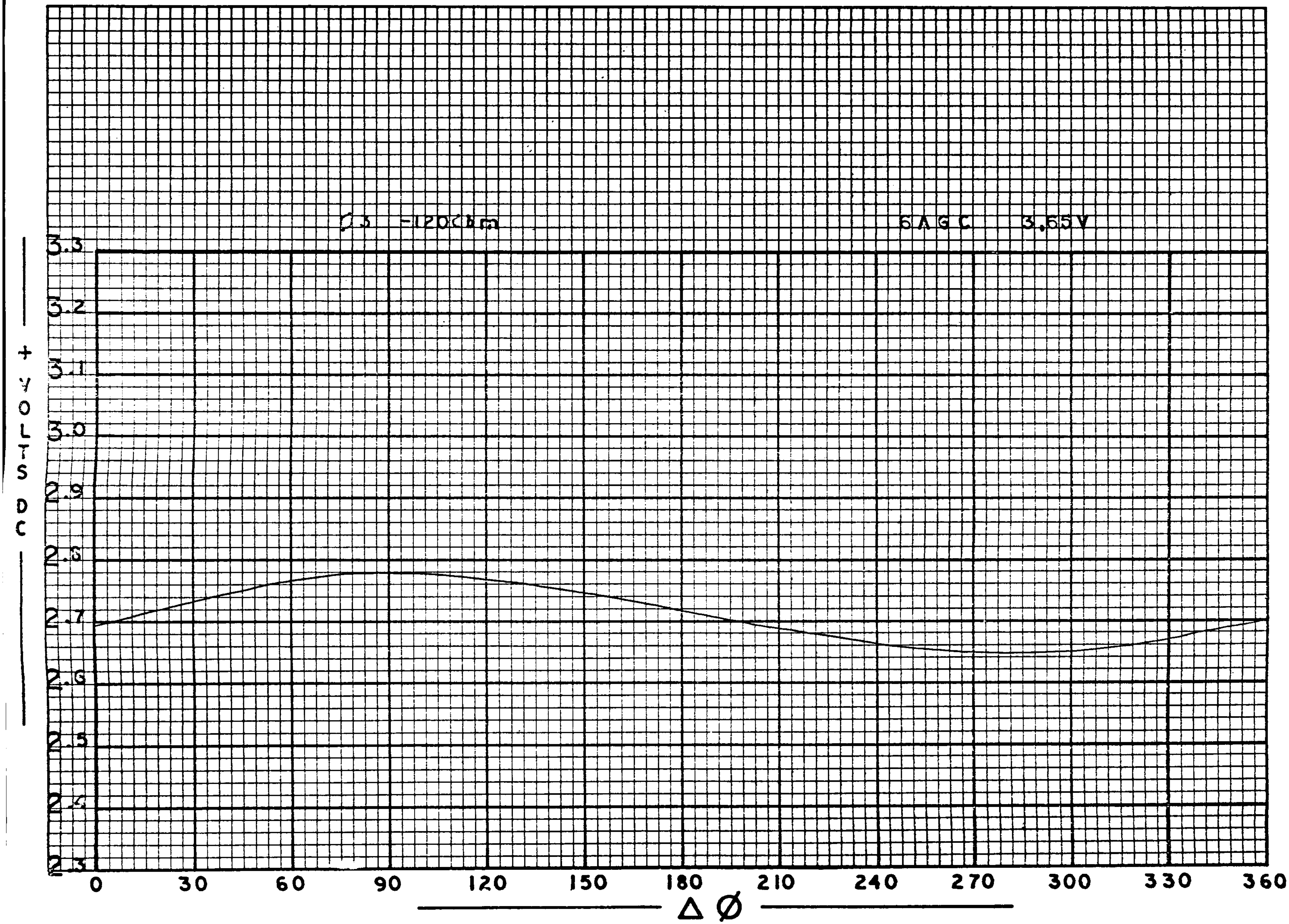

-100 dbm
AGC 3.45V
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



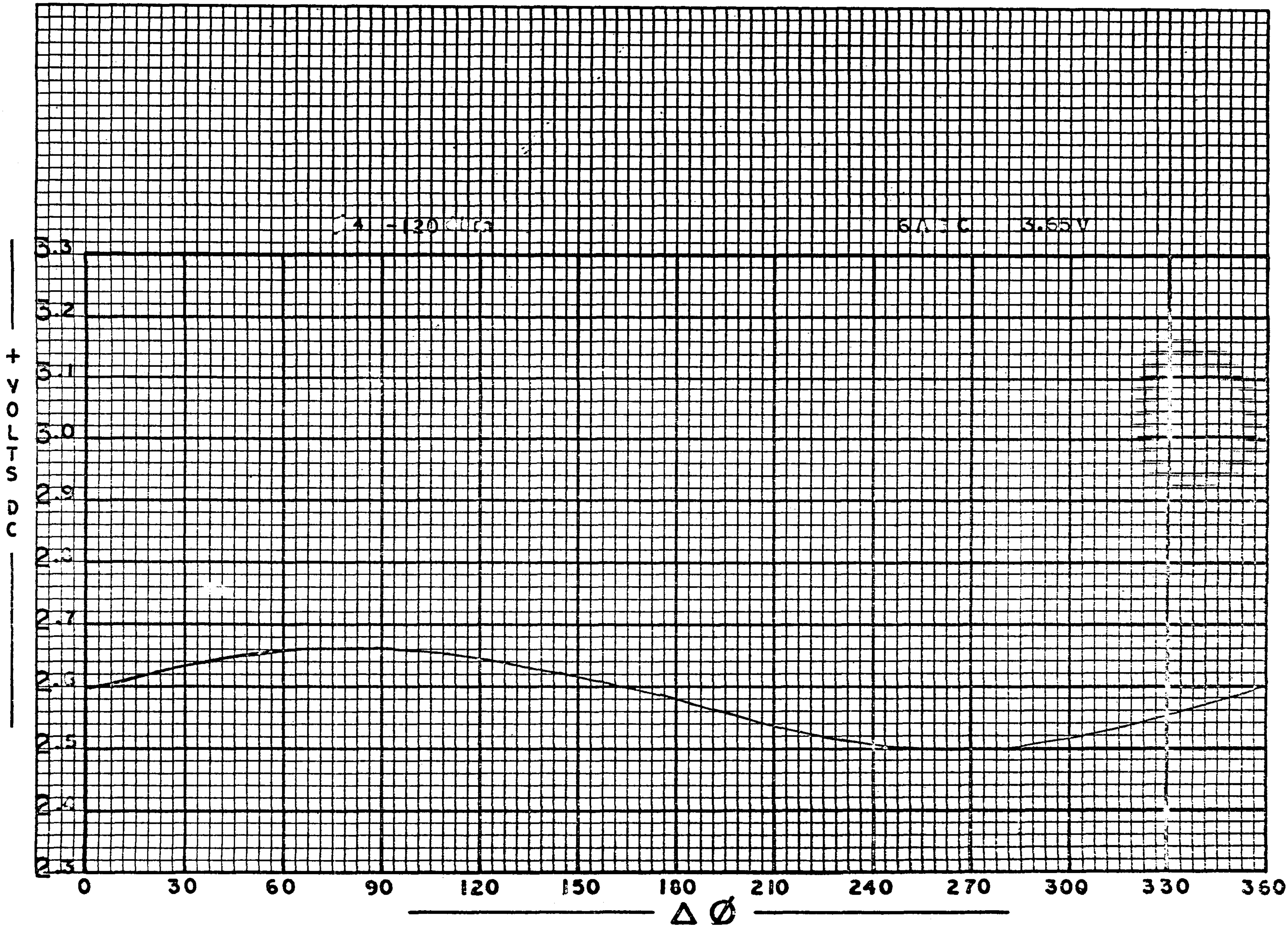
3.6 V
+ VOLTS DC
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
0
30
60
90
120
150
100
210
240
270
300
330
360
Δ Ø



4 -10
6AS C 3.6V
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø
+ VOLTS DC



Ø3 -120 Ohm
6 AGC 3.65V
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
+ VOLTS DC
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø



3.65V
+ VOLTS DC
3.3
3.2
3.1
3.0
2.7
2.5
2.3
0
30
60
90
120
150
180
210
240
270
300
330
360
Δ Ø