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Passive Microwave Measurements of Sea Surface Temperature

by D.G. Shipley
K.J. Torok

Final Report
Contract No. N00014-69-C-0245
NR-387-043

Prepared for:

GEOGRAPHY BRANCH
OFFICE OF NAVAL RESEARCH

RCA

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SECTION I

ABSTRACT

RCA Astro Electronics Division under Contract Number N00014-69-C-0245, sponsored by the Geography Branch of the Office of Naval Research (ONR), conducted a field experiment to verify a theoretical approach toward remote sensing of sea surface temperature using passive microwave radiation.

There is a correspondence between the radiometric temperature of sea water and its thermometric temperature. This correspondence is influenced by the horizontal and vertical emissivity, the incidence angle at which the radiometric measurement is made, contaminants on the water surface, and by the sea surface roughness.

This experiment addressed itself to two questions.

I Can one measure the vertically and/or horizontally polarized radiometric emissions from the sea water and obtain an accurate measure of the thermometric temperature

II Can one also make a determination of the sea state from such measurements

Radiometric measurements of sea water temperatures were made from a site on the Chesapeake Bay during July and August 1969. The bulk of the measurements were made at a frequency of 16.5 GHz.

The following conclusions are drawn from an analysis of the data collected during these measurements.

I There is a correlation between the thermometric temperature and the vertically polarized radiometric temperature. In this particular experiment a sea state invariant angle was observed to fall in the zenith angle range of 103^0 to 114^0.

II There was no observed correlation of thermometric temperature with the horizontally polarized radiometric temperatures.

III While theoretical considerations strongly indicate that the horizontally polarized radiometric temperatures should have a strong dependency on sea state, no definitive trends were found in the measured data.

SECTION II

INTRODUCTION AND SUMMARY

A. Introduction

RCA Astro Electronics Division under Office of Naval Research Contract Number N00014-69-C-0245 conducted an experiment to verify a theoretical approach of remote sea surface temperature sensing. The passive radiometric radiation from the sea surface is partially dependent on the thermometric temperature. The vertically and horizontally polarized components of the radiation can be measured separately and from these measurements it should be possible to derive the thermometric temperature. Passive microwave measurements were made with a microwave radiometer from a site on the Chesapeake Bay. The analysis and results of these measurements are presented in this report.

Remote sensing of ocean surface and subsurface features is of interest to a large number of ocean and marine users. Scientists, meterologists, engineers, fishermen and commercial shippers all have requirements which makes remote sensing by aircraft or satellite economically practical.

Measurement of ocean surface roughness, i.e. sea state, surface temperature, biological growth, current, floating objects and pollutants has been shown to be possible. Fish schools leave characteristic oily patches and other patterns which aid in their detection. Kelp beds and algae blooms have been detected by radar and infrared photographic techniques. Mapping of sea-ice distribution has been achieved by aircraft and satellite observations. Ocean currents, thermal distribution, mud and silt deposits and movements, saline and fresh water distribution in deltas and estuaries, and atmosphere-sea interaction are of interest. These also may be measured or inferred from remote observations.

These remote observations may be made by a number of methods. To date the bulk of aircraft and satellite observations have been made with photographic and infrared techniques. Other techniques are available including active and passive radar and microwave radiometry. Microwave radiometry has been shown theoretically capable of performing as a competent sensor for many of the aforementioned applications. Aircraft tests have proven feasibility with existing equipment. Microwave radiometers have flown on earth orbiting and planetary exploration spacecraft. Microwave radiometry has the capability of seeing through cloud cover, and frequencies can be chosen where the atmospheric absorption is low. These advantages provide all weather day-and-night capability in remote sensing. This experiment used a radiometric receiver and the passive microwave radiation from the sea to determine sea surface temperature.

Environmental scientists and meteorologists have demonstrated that long range weather prediction and determination of the atmospheric and oceanic circulation must treat the total fluid envelope of the earth, air and water, as a continuous physical entity. The transfer of momentum, mass, and heat through the sea-air interface is the key process whereby the oceans, as storehouses of heat and moisture, influence longer term atmospheric circulation changes; the atmosphere, in turn, drives the ocean currents and mixes the upper layers of the sea.

An important parameter in the description of these vital dynamical and physical processes is the sea surface temperature. It delineates the heat sources and sinks at the ocean surface and hence, the regions of moisture and heat flux within the atmospheric boundary layer. This, in turn, influences low-level atmospheric stability and bears heavily on the occurrence of cloudiness and the development of weather systems over the oceans. To an oceanographer, knowledge of sea surface temperature, provides a means of locating and tracking ocean currents and regions of upwelling and, as such, is an additional input to the definition of the three-dimensional ocean circulation and its seasonal variation. In addition, sea surface temperatures mark surface water anomalies such as eddies, ocean fronts, estuary effluents, plankton blooms, and extensive areas of seaweed. The biological reflections of sea surface temperature seem to account for the importance of these data to the fishing industry. Sea surface thermal anomalies have also been found to be associated with underwater volcanic eruptions.

Currently, sea surface temperature data that are routinely available are concentrated along the heavily travelled shipping routes of the North Atlantic and North Pacific Oceans. Extensive areas of the Northern Hemisphere and essentially all of the Southern Hemisphere have very sparse, if not nonexistent, regular coverage. For many of the Navy's and ESSA's needs, full global sea surface temperature data are required from one to four times per day. The Navy's mission is clearly a global one. Sea surface temperature data are vitally needed to forecast the temperature structure of the thermoclime and the many aspects of sound propagation throughout the oceans. Global sea surface temperature data are an integral requirement for the World Weather Watch, now being implemented by all the member nations of the World Meteorological Organization.

Earth orbiting satellites have proven themselves to be efficient platforms for frequent observations of all of the earth's surface. Indeed, each TIROS Operational Meteorological Satellite is capable of viewing all of the earth's surface twice each day. It would be most desirable to place a sensor for observation of sea surface temperature on these satellite platforms to provide vital data to environmental scientists. Some experimental sea surface data have been obtained from TIROS and Nimbus weather satellites using infrared sensors operating in the major atmospheric window at wavelengths from 8 to 12 microns. However, infrared sensors are severely limited in their capability to view the earth's surface from space in that almost all clouds are opaque in this part of the spectrum. Thus, the earth's surface can be seen only in cloud-free areas. The cloud cover pictures from TIROS have shown us that this would be a severe limitation over the oceans; the earth is indeed a cloudy planet. Some high-level cirrus clouds, being composed of ice crystals, are partly transparent to infrared radiation, but their effect at any given time or place could not be known, and, therefore the correction necessary to determine the actual radiance from the sea surface could not be known.

The problems of viewing the earth in the infrared spectrum has suggested the possible use of passive microwave radiometers. In much of the lower microwave region of the spectrum, only the relatively restricted areas of heavy precipitation would prevent a spaceborne radiometer from "seeing" the earth's surface. The complication that arises in using passive microwaves for remotely sensing the sea surface temperature is that the emissivity of the surface is a function of both the thermometric temperature and the roughness of the sea surface. The two effects must be separated without prior knowledge of the sea state. The purposes of this experiment was to verify experimentally a theoretical approach to remote radiometric sensing of sea surface temperatures.

The implementation of the experiment and the subsequent data analysis was directed toward two basic questions:

A. Can the thermometric temperature of the surface of the sea be determined in a sufficiently accurate manner by radiometric measurements and would the method of measurement be applicable to aircraft or satellite systems?

B. Can a sufficiently accurate measure of the surface roughness of the sea i.e., sea state, be determined by similar radiometric means?

To implement this experiment a mobile radiometric van was subleased from GCA Corporation, Bedford, Mass. This van had radiometric equipment designed for operation at 9.5, 16.5 and 94 GHz. This equipment, supported by additional ground truth observation instrumentation was set up on an island site in the Chesapeake Bay and a series of radiometric measurements were made. The operation of the equipment and subsequent data reduction and analysis was performed by personnel from RCA Astro Electronics Division.

In co-operation with RCA, personnel from the National Environmental Satellite Center (NESC) of the Environmental Science Services Administration (ESSA) supplied and operated an infrared radiometer in conjunction with the microwave radiometric measurements. The IR radiometer was a Barnes Engineering Company Model PRT-5 which has a spectral response from 8 to 16 micrometers. Its temperature range is 212^0K to 338^0K with a long term stability of $\pm 0.5^0$K.

B. Summary of Results

The bulk of the radiometric measurements were made at 16.5 GHz using both horizontal and vertical polarization. The radiometric temperature of the vertically polarized runs correlates with the thermometric temperature of the sea water and shows a sea state invariant zenith angle range from about 103^0 to 114^0. At 109^0, the median zenith angle of this range, the average radiometrically derived temperature of the vertical runs is 299^0K with a standard deviation of about 5^0K. The nominal average thermometric temperature of the sea water was 299^0K.

The horizontally polarized radiometric measurements were used to derive apparent water temperature and horizontal emissivity. Neither of these shows any direct correlation with sea surface roughness (sea state). This is in contradiction with accepted theory and may be due to equipment sensitivity limitations and restrictions on the viewing angle at the site.

The horizontal runs do not shown any direct correlation with sea water temperature.

SECTION III

BASIC THEORY

A. Radiometric Principles

Radiometric measurements of sea water are based on the principle that thermally emitted and reflected radiation from the sea are partially polarized. The amount of radiation received from the sea will be dependent upon the polarization, temperature of the sea, angle of observation and the temperature of any source reflected by the sea.

For a specular sea water surface the relationship between these parameters is expressed by:

$$T_b = \epsilon T_w + (1-\epsilon)T_r \tag{1}$$

where

T_b = measured radiometric brightness temperature

T_w = thermometric sea water temperature

T_r = temperature of reflected source

ϵ = emissivity

Equation (1) could be subscripted with either H or V to denote horizontally or vertically polarized conditions.

The relationship between emissivity, reflectivity, dielectric permittivity, (i.e. dielectric constant and loss factor) and observation angle is developed in Appendix A.

A non-specular surface would be expected to behave somewhat differently than indicated in equation (1). This would be inferred if one considers the surface of a rough sea. In this case, the observation angle of the sea surface is a function of the slope of the wave fronts and may best be described as a "cone" of angles about an average value. The size of the cone will be dependent upon the height and period of the wave and of the observation time. This indicates that the "apparent" emissivity of non-specular water should differ from that of specular sea water. It is also possible that there may be a range of observation angles (or a specific angle) where the specular emissivity and the non-specular "apparent" emissivity coincide. If this condition existed one could define an invariant observation angle where the "sea state' has no effect on the observed temperature. As a corollary to this it would appear that the observed brightness temperature at other than an invariant angle should be dependent upon the roughness of the sea. Thus it should be possible to derive sea state from a series of radiometric measurements.

B. Emissivity of Sea Water

The equations for the vertical and horizontal emissivities of sea water are developed in Appendix A. These equations show the emissivity to be a function of the dielectric permittivity and the observation angle. The horizontal and vertical emissivities of sea water are shown in Figure III-1 for a frequency of 16.5 GHz.

The dielectric permittivity of sea water is a function of frequency, salinity, and temperature. The relationship of dielectric permittivity, frequency, salinity and temperature is developed in Appendix B.

C. Temperature Determination

Referring to equation (1), sky radiation is the dominant contributor to T_r in sea water radiometric measurements. Thus equation (1) can be rewritten:

$$T_{b\phi} = \epsilon_\phi T_W + (1-\epsilon_\phi) T_{s\theta} \tag{2}$$

where

T_S = the sky temperature
ϕ = observation angle
θ = 180 - ϕ

For purposes of definition the angle ϕ will henceforth be referred to as the zenith angle, that is the angle measured from the upward pointing local vertical. This angle and definition will be used throughout this report.

At a given zenith angle, assuming the salinity to be constant, the emissivity becomes only a function of water temperature. If values of T_b and T_S were measured then there would be only one unique value of T_W which would satisfy equation (2). This type of calculation is easily accomplished with a computer by iterating values of T_W, calculating the value of ϵ and then using T_W, ϵ and T_S to calculate the value of T_b. This process is repeated until a value of T_b is calculated which is sufficiently close to the measured value of T_b. The final value of T_W is then the unique value which satisfies equation (2). This value of T_W would be equal to the thermometric temperature of the sea water only at the angle where there was an invariance

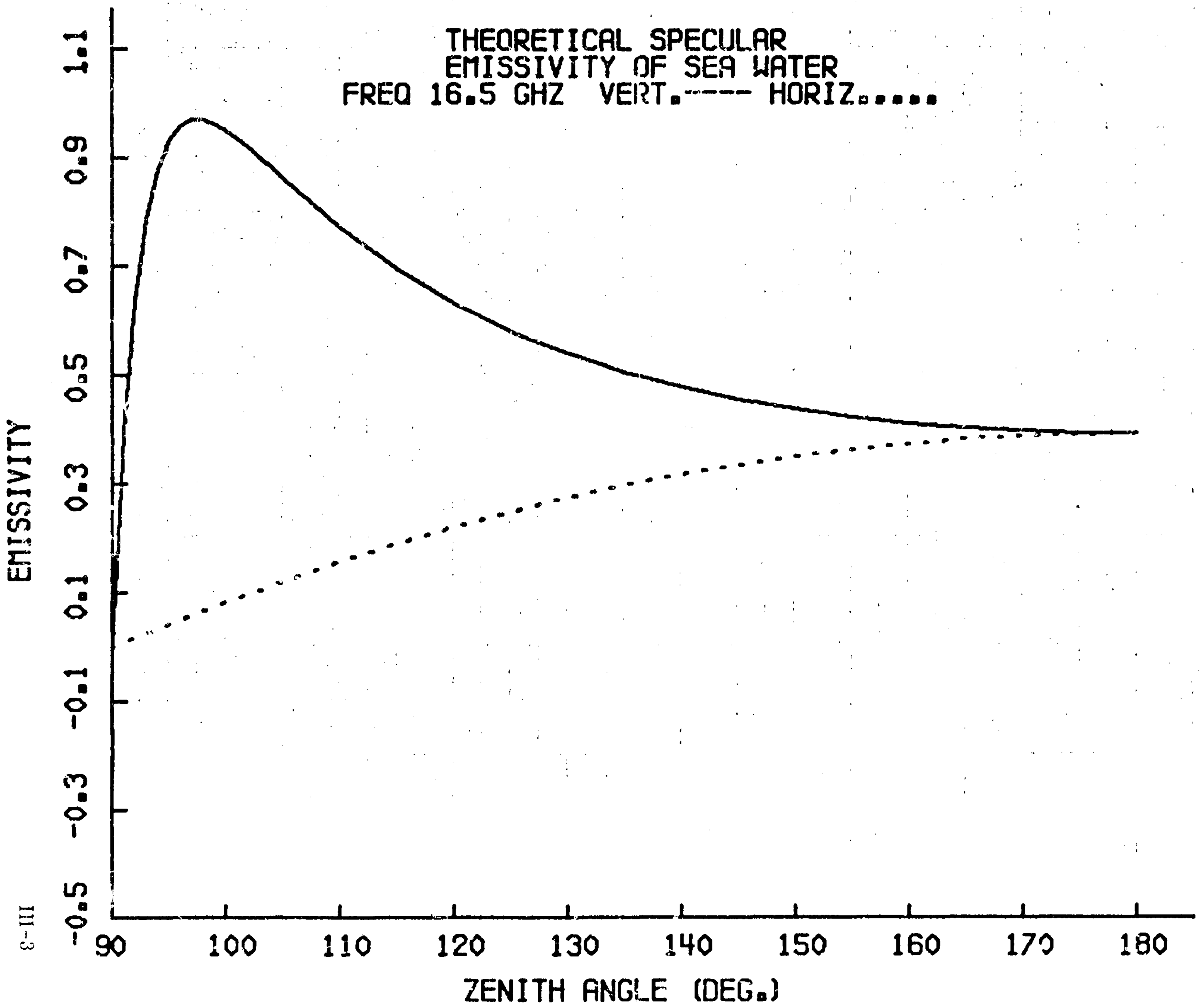

THEORETICAL SPECULAR
EMISSIVITY OF SEA WATER
FREQ 16.5 GHZ VERT.---- HORIZ.....
EMISSIVITY
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
90
100
110
120
130
140
150
160
170
180
ZENITH ANGLE (DEG.)

FIGURE III-1

with sea state. (This temperature determination method is described in detail in Appendix C, Paragraph C.) Other investigators (Stogryn Ref. 1) have developed curves showing the theoretical dependency of the horizontally and vertically polarized radiometric temperatures upon sea state. Stogryn's work also suggests a stronger dependency of the horizontally polarized temperature on sea state. Thus one would anticipate a correlation of sea water temperature with the vertically polarized radiometric measurements and a correlation of sea state with the horizontally polarized radiometric measurements.

Other methods for deriving water temperature from radiometric measurements have been suggested. Some of these are discussed in Appendix C.

SECTION IV

SITE AND EQUIPMENT DESCRIPTION

A. Field Site Location and Description

The measurements were taken from North Island of the Chesapeake Bay Bridge and Tunnel District. The Chesapeake Bay Bridge-Tunnel is the world's longest bridge and tunnel complex. It links the city of Norfolk and Cape Charles, Virginia, across 17.6 miles of water. North Island is at the northern end of the Thimble Shoal Channel Tunnel.

This is a man made island and is about 1,200 feet long with a maximum width of 220 feet at the channel end. It is approximately 30 feet above mean low water and is surrounded by large rip-rap boulders. The nominal water depth around the island is 30 feet. A large thirty foot high vent building is located above the tunnel entrance at the southern end of the island. This island is black-topped and has a concrete retaining wall around the periphery with the rip-rap boulders sloping outward toward sea level. A two foot high fence about eight feet from the edge of the concrete retaining wall, encircles the island.

The radiometric van was positioned against this fence on the west or bay side of North Island. The side of the van faced Chesapeake Bay. The vent building was on the opposite side of the van about eighty feet away. The azimuth of the radiometric measurements was 310^0 and the antenna had a zenith angle capability of 0^0 to 180^0. Radiometric observations of the water were possible through zenith elevation angles of 90^0 to about 125^0 because the main beam of the antenna intercepted the boulders at about 125^0. Figure IV-1, 2 and 3 show three views of the van at the site.

A marker buoy was placed on an azimuth of approximately 280^0 about a hundred feet from shore. The buoy was held in position with two Danforth anchors and two lines from shore. The shore lines were attached to the buoy through pulleys One of the pulley lines was used to deploy a series of floating temperature thermistors while the other was used in obtaining surface water samples. Figure IV-4 shows the buoy and the floating temperature sensors in place.

The water depth at the field test site varies from about 30 feet at the near vicinity of the island to nearly 50 feet in the Thimble Shoal Channel. This depth of water permitted a wide range of wave height conditions.

Figure IV-5 shows the field site location and its relationship to other land areas. The prime measurement azimuth of 310^0 is marked on this figure. A plan view of the island lay-out is shown in Figure IV-6.

B. Equipment Description

The radiometric van was a WW-II model SCR-584 radar trailer that had been converted to a mobile radiometric station in 1964-65. It basically consisted of three r-f heads designed to operate at 9.5, 16.5 and 94 GHz working into a common i-f, video and data recording section. The van equipment included an elevator for raising and lowering the radiometer antenna pedestal. A gasoline-driven primary power generator provided line power. Air conditioning provided for interior temperature control. Two close-up views of the van are shown in Figure IV-7 and IV-8.

The remotely controlled radiometer antenna pedestal permitted positioning of the radiometer antenna beams to an accuracy of 0.2 degrees, over a total useful vertical angle of 180 degrees from zenith to nadir. The pedestal could be turned through 360^0 in azimuth. Two r-f heads are mounted back-to-back on the pedestal, at opposite ends of a horizontal shaft. A motor, located on the pedestal yoke, permits remote control of antenna polarization by turning the shaft through 90 degrees about the antenna axis. A third r-f head could be readily installed after removal of one of the previously installed heads. Figure IV-9 shows a view of the 16.5 GHz r-f head on the antenna pedestal.

Each r-f head consisted of an antenna, mixer, klystron local oscillator, ambient and hot loads, pre i-f amplifier, and switching networks. The i-f output and thermistor temperature information were coupled to the interior van electronics by cables. The interior electronics consisted of the required power supplies, an i-f amplifier and detector, a video amplifier, a synchronous video detector, output voltmeter and recorder, and the antenna positioning controls. The radiometric output signal was measured with an HP 3440A Digital Voltmeter and was recorded on an HP 562A Digital Printer.

The pertinent design parameters and performance characteristics of the radiometric equipment are summarized in Table IV-1.

TABLE IV-1 RADIOMETER CHARACTERISTICS

Radiometer Type	Double-side band superhetrodyne, chopper stabilized, absolute type.
Antenna Type	Prime focus paraboloids
Antenna Polarization	Horizontal and Vertical (Polarization changed by mechanical rotation)
Antenna Diameter and 3dB Beamwidths	

Frequency	Diameter	3dB Beamwidth
9.5 GHz	19 inches	5.5^0
16.5 GHz	16 inches	3.7^0
94 GHz	6 inches	1.6^0

IF 3dB Bandwidth	100 MHz
Internal Calibration	Two waveguide terminations whose temperatures can be measured to within $\pm 0.2^0$ by internal thermistors. Nominal temperatures are: Hot Load 400^0K, Cold Load 300^0K
Video Amplifier and Detector	Locked video amplifier and synchronous detector
Integration Time	1.0 second (other integration times were available)

Radiometric Sensitivity

9.5 GHz	16.5 GHz	94 GHz
0.92^0K	1.13^0K	Not measured

Figure IV-1. Experiment Site

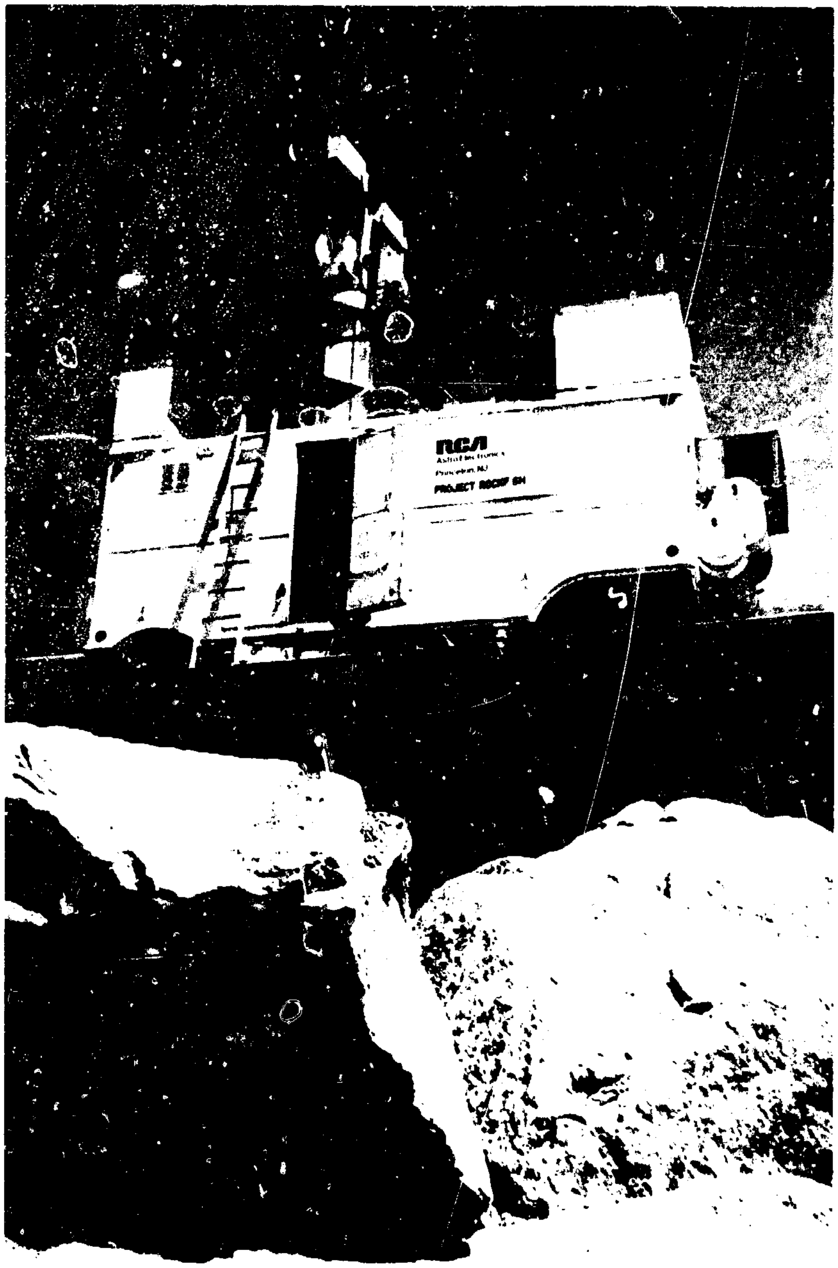


Figure IV-2. Radiometric Van at the Site

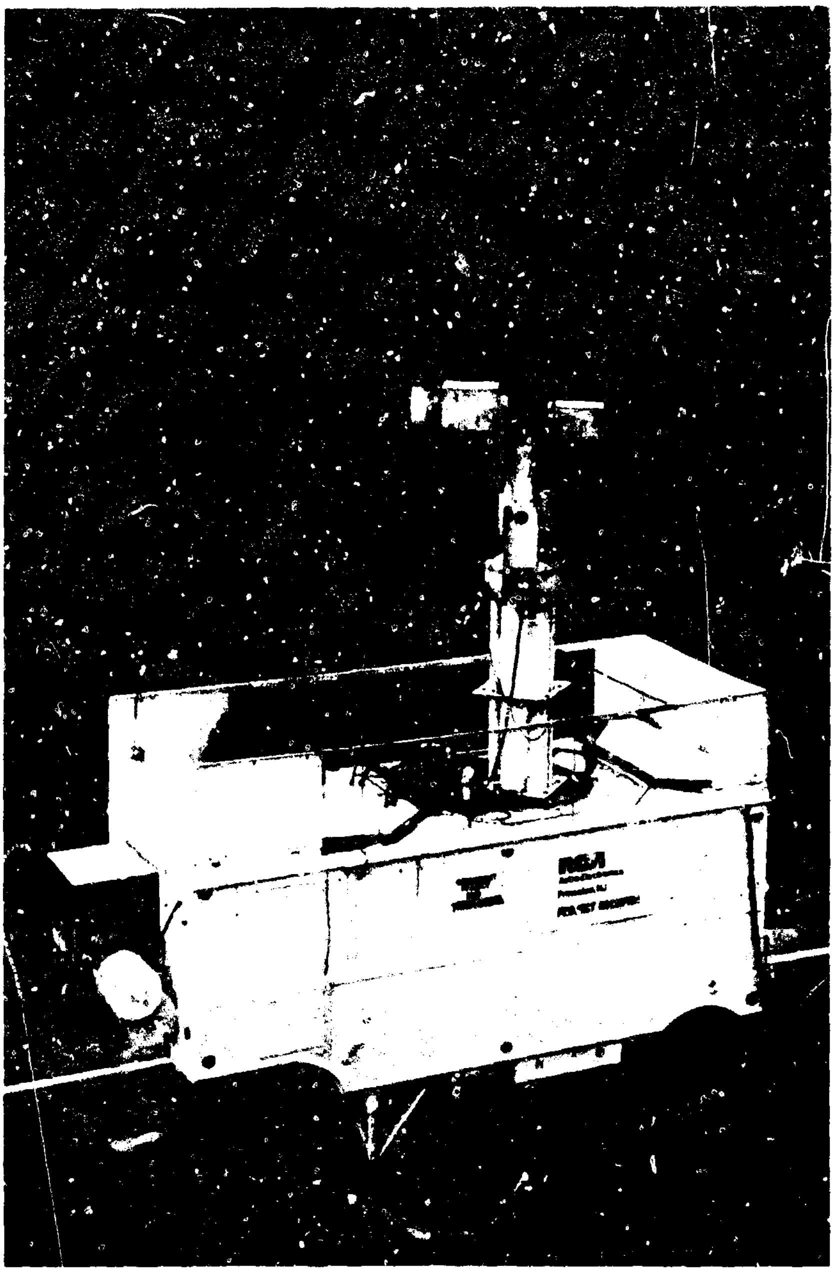


Figure IV-3. Radiometric Van

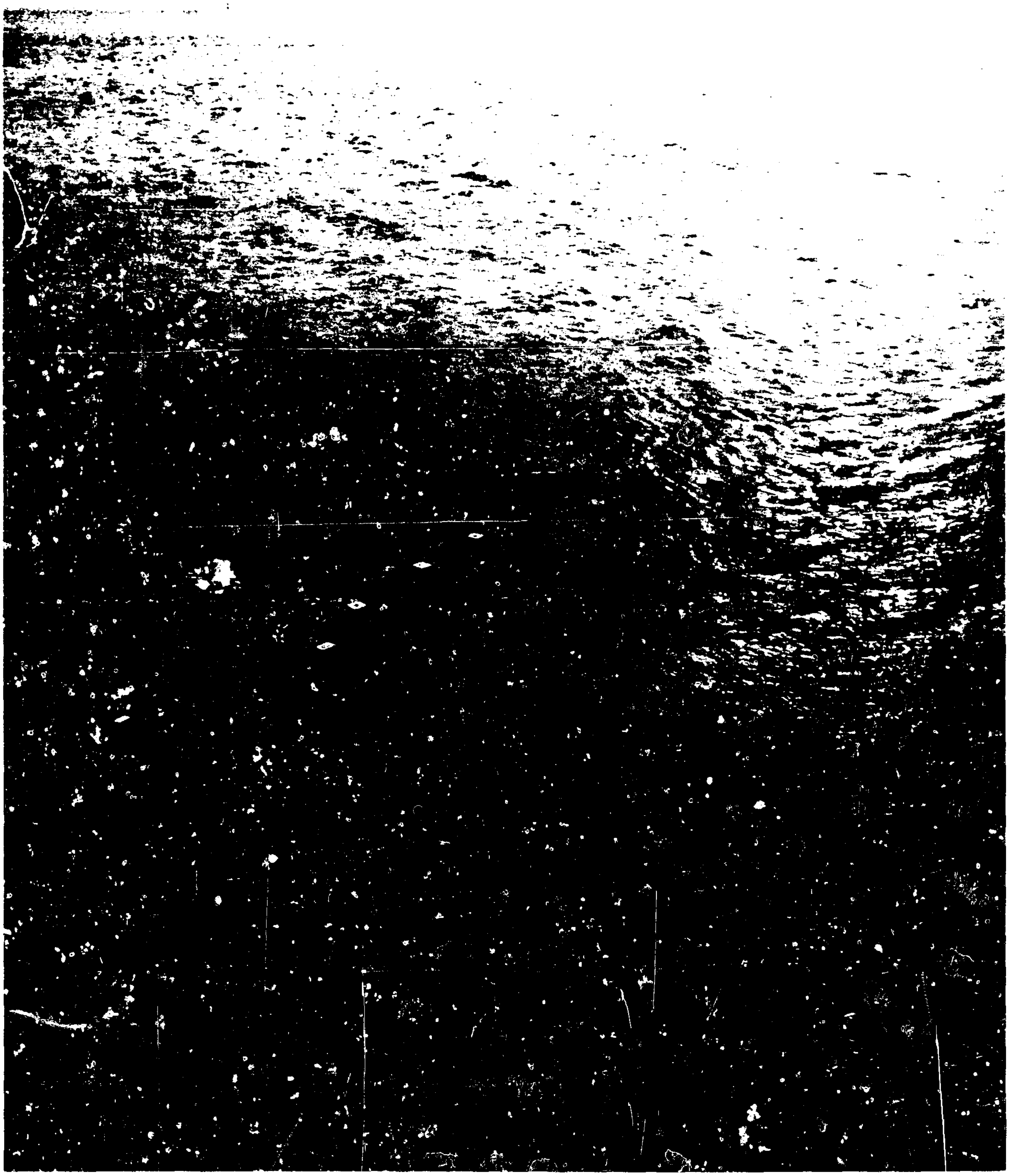


Figure IV-4. Marker Buoy and Floating Temperature Sensors

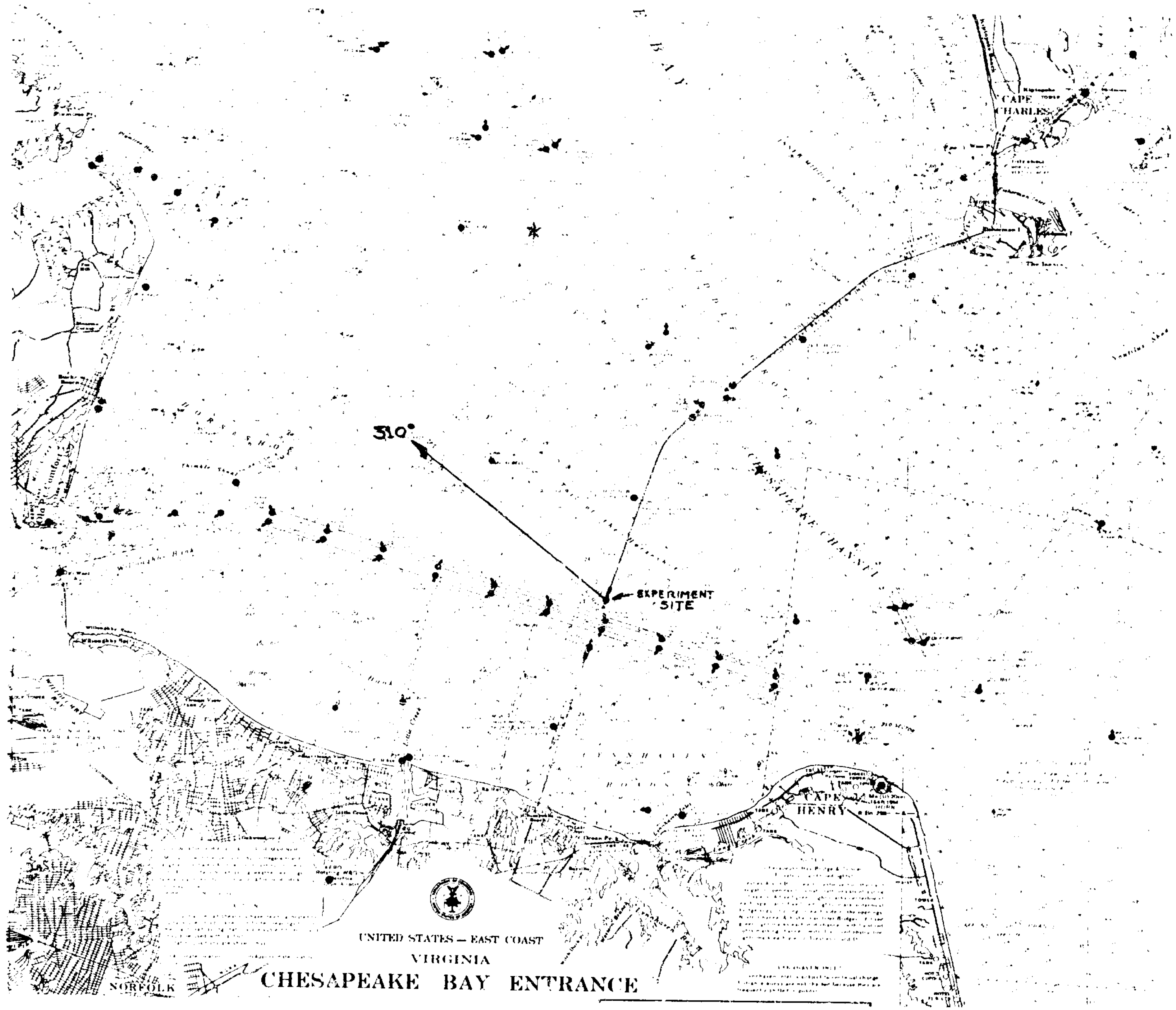


Figure IV-5. Field Test Site Location

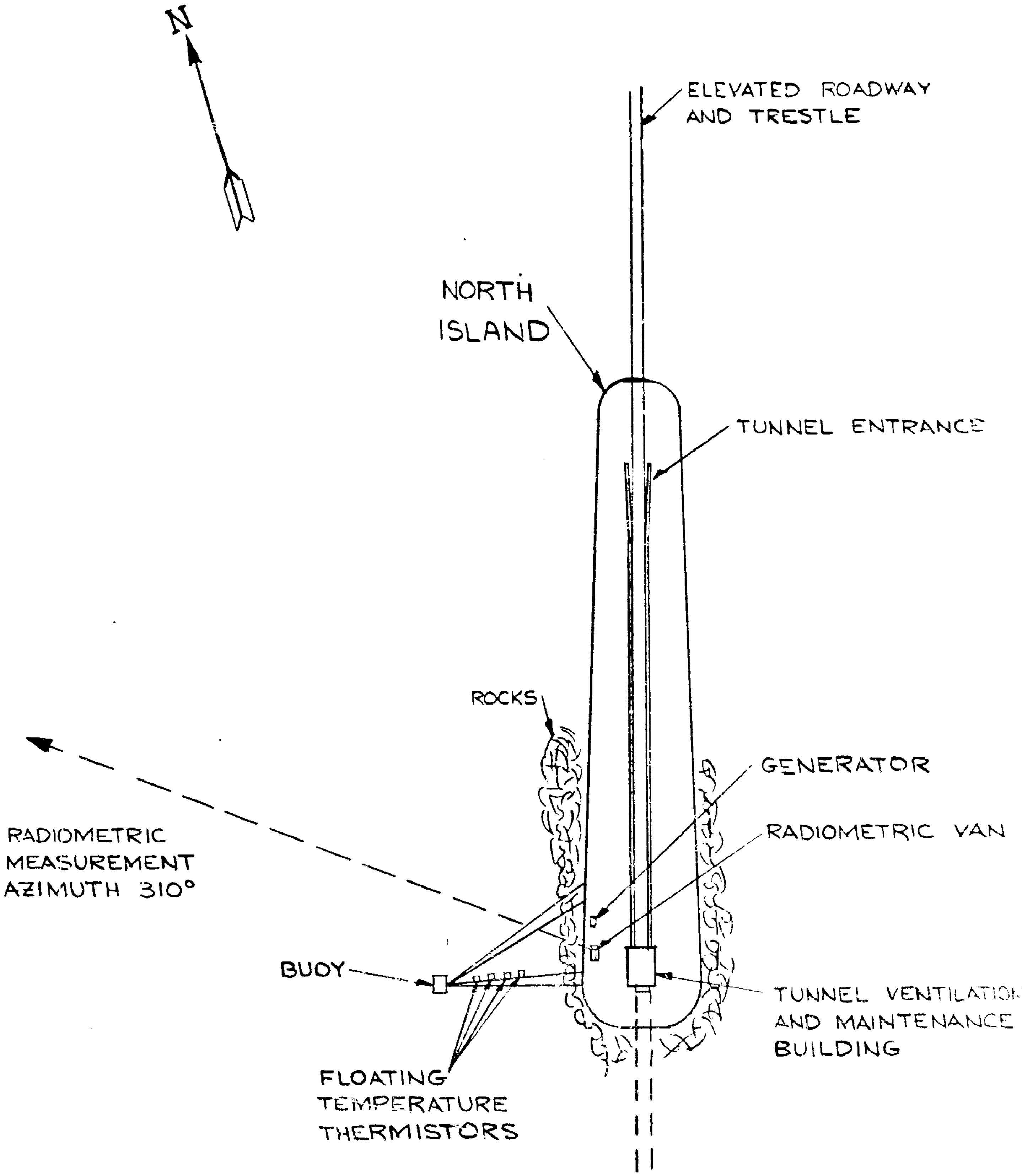


FIGURE IV-6. MEASUREMENT SITE PLAN VIEW

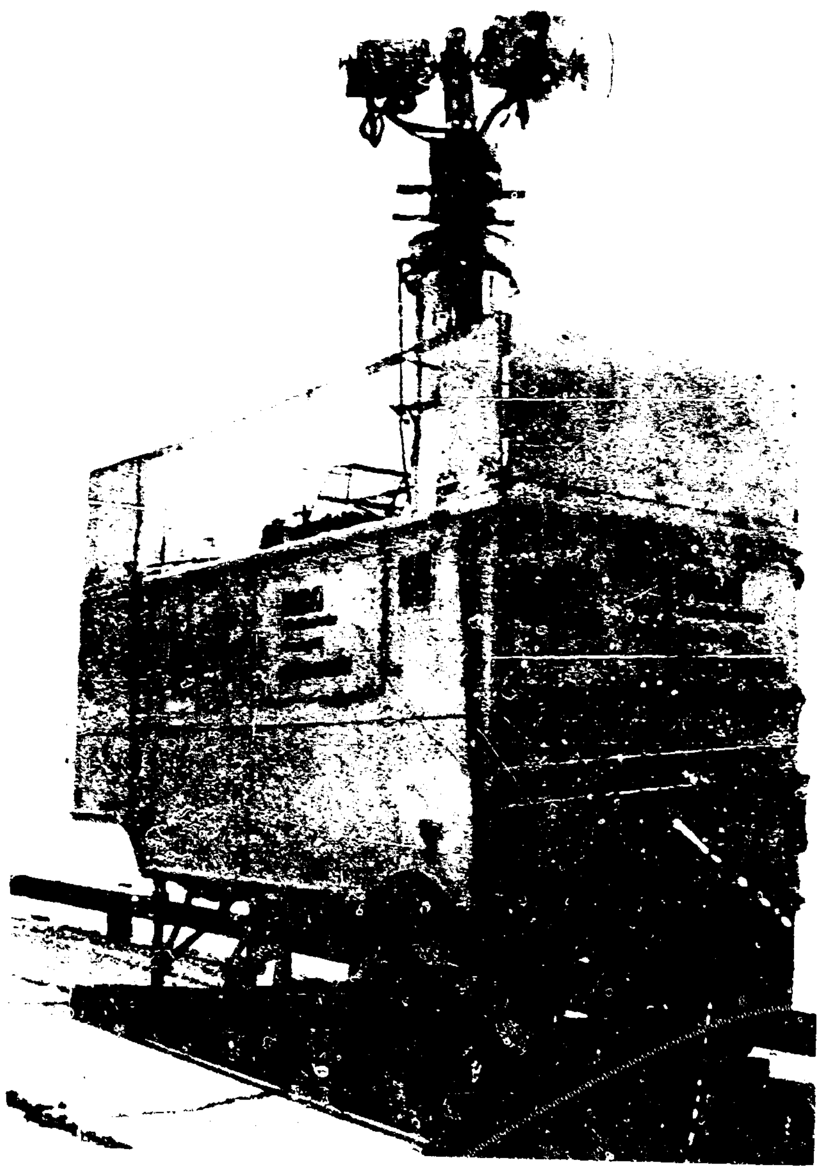


Figure IV-7. Close-up View of Radiometric Van

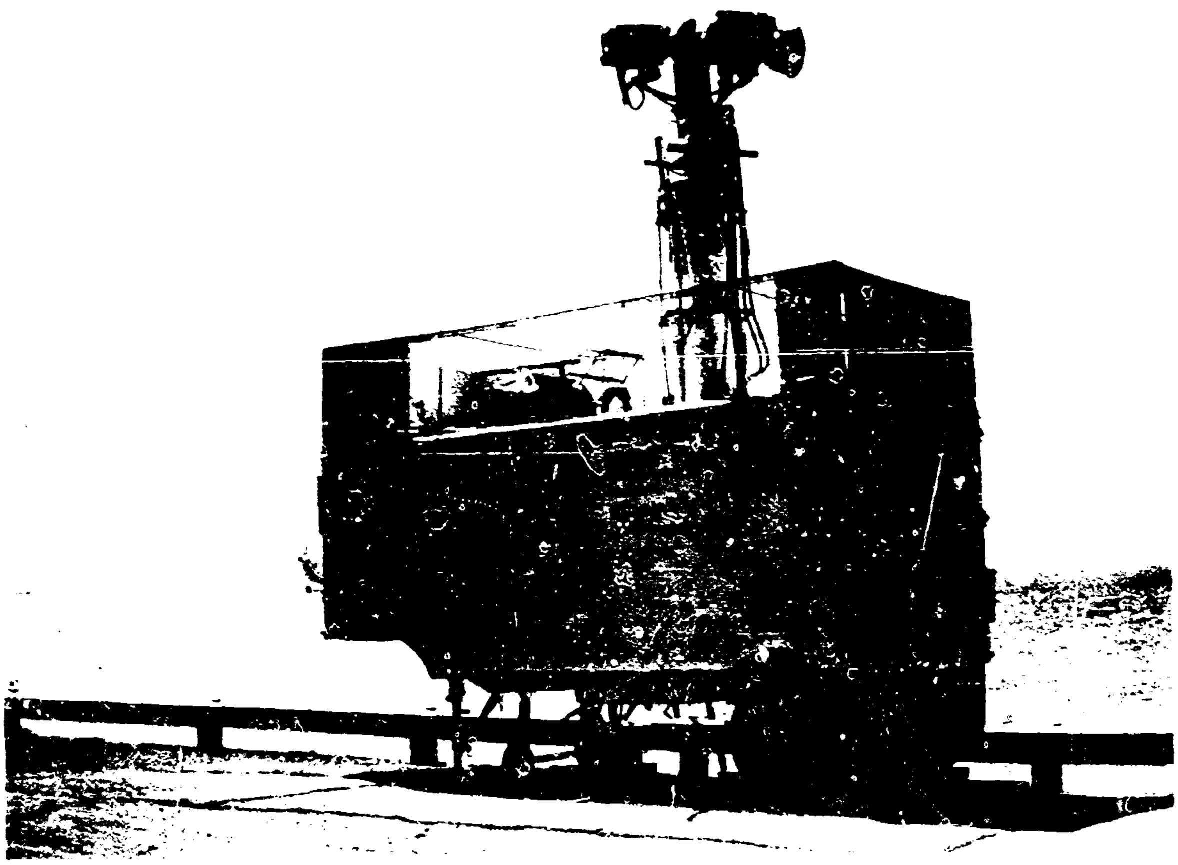


Figure IV-8. Antenna Pedestal and R. F. Heads

Figure IV-9. Close-up of 16.5 GHz R.F. Head and Infrared Sensor

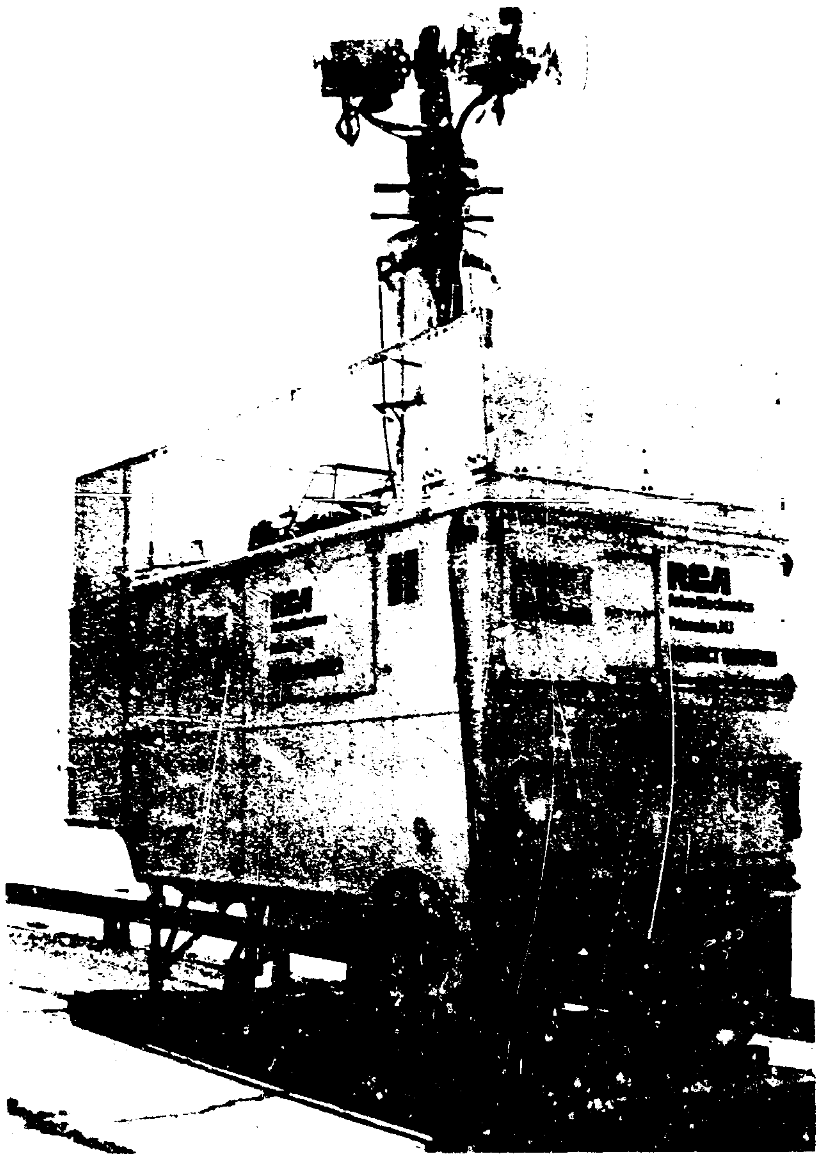


Figure IV-7. Close-up View of Radiometric Van

SECTION V

DATA MEASUREMENTS

A. Radiometric Measurements

Radiometric measurements were made at the site from July 17 through August 14, 1969. Both vertically and horizontally polarized measurements were made. Fifty-six data runs were made during the months of July and August, 1969. Of these, 46 were made at a frequency of 16.5 GHz and 10 were made at a frequency of 9.5 GHz. No measurements were made at 94 GHz because of equipment failure. There was observable interference at 9.5 GHz and therefore the data at this frequency is considered questionable.

The data runs can be divided into three types. The first type are designated standard data runs and consisted of measuring data at a sufficient number of zenith angles to adequately describe the elevation temperature profile along a fixed azimuth. The second type consisted of a series of measurements made with a fixed zenith angle and a fixed azimuth angle. These are further classified as stability runs, where the polarization was held constant for a long period of time and as switched polarization runs where the polarization was switched from vertical to horizontal every 50 to 100 seconds. The third type of run was a horizontal environment check where the zenith angle was held constant at 90^0 and the azimuth was slowly swept from 0^0 to 360^0. These runs gave an indication of any possible interference and also a check on the temperature variation of the environment. The measured radiometric temperature is the resultant of the energy received by the main beam of the antenna and the side lobes. This measured temperature is called the apparent temperature (T_a). By providing an antenna pattern correction this apparent temperature is converted to brightness temperature (T_b). The brightness temperature is the radiated temperature of the observed source. The conversion from apparent temperature to brightness temperature requires a knowledge of the total radiometric environment. One of the prime reasons for taking sufficient data on a run was to describe a complete elevation profile. This in turn was used to define the total radiometric environment. In converting from apparent to brightness temperature, the elevation profile was assumed to be symmetrical around 360 degrees of azimuth.

B. Supplementary Observations

In addition to the radiometric measurements a large amount of supplementary and supporting data was obtained.

1. Sea Water Thermometric Temperature

The surface water temperature was measured using both mercury bulb thermometers and floating thermistors. The mercury bulb readings were taken at the waters edge by immersing the thermometer in the water. The thermistor measurements were accomplished by placing the thermistors on specially designed floats and deploying these floats on a pulley line between shore and the marker buoy. This enabled surface temperature measurements to be made at varying distances from the shore to a distance of about 100 feet. The floats were 12 x 12 inch squares of 1 inch thick styrofoam with a 3 or 4 inch diameter hole in the center. The thermistor was attached in the center of a doughnut shaped piece of styrofoam which was in turn confined to the hole in the square float. A second type placed the thermistor on the bottom of a ping-pong ball which was in turn confined to the hole in the square float. At the site the floats, when first placed, had a tendency to flip over in rough seas. This was eliminated by attaching short one foot pieces of nylon thread to each corner of the square float and suspending one or two B-B shots from each thread.

2. Sea Water Samples

Samples of the sea water were taken at various times during the course of the program. In general, samples were obtained near the time of the high and low tides and following any rainfall. The sea water samples were obtained by skimming a container along the water surface using the second shore-to-buoy pulley line. Care was exercised to obtain a representative sample of the water close to the surface. This was somewhat dependent on the roughness state of the sea, but most samples were obtained from water within 3 to 4 inches of the surface. The water samples were stored in special air-tight bottles, marked with the sample time, date and other pertinent information.

The salinity of the samples was measured at the Virginia Institute of Marine Science. The dielectric constant and loss tangent of representative samples was measured at the MIT Insulation Laboratory. These measurements were made at 8.5 and 14 GHz.

3. Weather Observations

Weather and meteorological observations were made at various times throughout each days operation. The observations included percent sky cover, cloud types, air temperature - both dry and wet bulb, visibility, and weather comments. Additional weather observations were available from the Chesapeake Bay Bridge and Tunnel Authority which kept a regular weather log on an adjacent island.

4. Sea State Observations

Observations of the sea state were made with each data run and at other appropriate times. These observations included the swell and wind chop height and sometimes the wave period and wind speed and direction. These were visual observations made by inexperienced observers but the relative accuracy of the observations is considered good. Sea state conditions at the site, during the period of measurement varied from a smooth, calm sea to a sea with a three to three and one-half foot swell.

5. Photographs

Photographic records were made with each data run. The pictures generally were taken along the azimuth of the radiometric measurements and included pictures at zenith angles of 0^0, 45^0, 90^0, 115^0 and 135^0. This provided a fairly complete coverage of the elevation profile. Additional pictures were taken to record sea conditions. These in general included the marker buoy which had orange and white vertical sections alternating every six inches. Most of the pictures were taken with a 86 mm telephoto lens. A representative sample set of pictures taken in conjunction with run 7 and 8 are included as Figures V-1 thru V-6. The first five pictures are at the measurement azimuth of 310^0 with zenith elevation angles of 0^0, 60^0, 90^0, 110^0 and 135^0. The sixth picture is of the marker buoy and thermistor sensors.

6. Radiosonde Data

Radiosonde data was obtained from daily observations made at Wallops Island, Va. This is about 70 miles north of the experiment site and the atmospheric conditions were considered similar. This radiosonde data was used to determine radiometric zenith sky temperatures which were used for a third calibration point.

7. Wave Gage Recorder

The Army's Coastal Engineering Research Center (CERC) has a wave gage mounted on the adjacent South Island. This is about 1800 yards from the measurement site. It consists of a series of vertically spaced electrodes which when shorted by the conducting sea water provide an output signal proportional to the wave height. This wave gage is one of a network of similar gages along the Atlantic seaboard. It is automatically sequenced on for ten minutes out of each hour.

During this period a paper chart record is made at the wave gage location and data recordings are made at a central location in Washington, D.C. Facilitation was arranged to operate the local strip chart recorder on a continuous basis for eight hour periods. Several such recordings were made.

It was anticipated that the wave height and period at the test site and at the wave gage site would be representative of each other. However, visual observations showed that this was not true. There were wide variations in the surface conditions at the two sites most of the time. Apparently the water turbulence created by the island and the tidal currents, together with difference in local wind parameters degraded the correlation. As a result, the wave gage has not been used as an analysis tool.

8. Infra-red Radiometer Measurements

As previously mentioned, personnel from the National Environmental Satellite Center (NESC) supplied and operated an infra-red radiometer in conjunction with the microwave measurements. The results of the measurements and their analysis are treated in an internal NESC report (Ref 2). For a comparison to the microwave radiometric measurements a summary of the results of some of the infra-red radiometric data is contained in Appendix F of this report.

C. Site Operations and Data Measurements

The types of radiometric data runs have been described in Section V-A. The standard runs were numbered Run 1 thru Run 36.

Normally four calibrations were performed during a run. Each calibration consisted of measuring ten 1-second samples of the radiometer output voltage of first the zenith sky (nominally 10^0K), second the ambient load (nominally 300^0K), and last the hot load (nominally 400^0K). A data measurement consisted of taking ten 1-second samples of the radiometer output voltage at the antenna zenith angle of interest. Each run had data points taken at zenith angles of 0^0, 20^0, 40^0, 50^0, 60^0, 70^0, 80^0, 85^0, 90^0, 95^0, 100^0, 102^0, 104^0, ... , 128^0, 130^0, 140^0, 150^0, 160^0, 170^0 and 180^0. The four calibrations were taken at the beginning of the run, before the 100^0 data point, after the 130^0 data point, and at the end of the run. The total time for a run was about 25 minutes. Comments pertinent to each run were written on the run log sheet. The calibration determination is described in Appendix E.

The 16.5 GHz stability runs and switched polarization runs were numbered Run 301 thru Run 313.

Runs 201 thru 206 consist of a preliminary 9.5 GHz data run, a 9.5 GHz zenith stability run and the horizon check runs.

Runs 101 and 102 are two preliminary 9.5 GHz standard runs.

Printouts of the comments accompanying or adjacent to each run are tabulated in Tables V-1 thru V-12. The first line on each of the run listings gives the month, date and year as a six digit number; the start time as a six digit number in hour, minutes, and seconds; the measurement azimuth angle in degrees; the polarization either H or V; the frequency in GHz times 10, as a 3 digit number; the integration time in seconds; and the apparent zenith sky temperature used as a third calibration point. The time is EDST expressed in a 24 hour format. The run comments sometimes include calibration data which is referenced only for programming use.

The thermometric water temperature was measured by a mercury bulb and by RCA and ESSA floating thermistors. The average daily temperature readings from the various devices is tabulated in Table V-13. It can be noted that the average temperature as measured by the various devices varied from a low of 297.5^0K to a high 300.7^0K, a variation of 3.2^0K. Supplementary water temperature data was obtained from the United States Coast Guard from their Wolf Trap Light Station. Wolf Trap Light is located about 25 miles from the test site on an azimuth of about 351 degrees. This is representative of the water temperature further up the Chesapeake Bay and would indicate the temperature variations that might be expected as the horizon was approached. The Wolf Trap Light measurements were recorded every three hours. A tabulation of the daily temperature is in Table V-14. The readings were made in degrees Fahrenheit, but are presented in the table in degrees Kelvin for ease of comparison to other data. The temperature range of this data is from 297.6^0 to 299.8^0K, and is in reasonable agreement with the site temperatures. This tends to support the basic contention that the water under observation had a relatively constant thermometric temperature along the line-of-sight.

Table V-15 tabulates the measured dry bulb air temperatures and the calculated relative humidity. The air temperatures varied about 11^0 during the course of the measurements.

Table V-16 tablates the salinity, in parts per thousand, of the sea water samples. The date and time of the sample plus the tide condition and other pertinent comments are also tabulated. The salinity variation was from a low of 21.41 to a high of 25.95 parts per thousand. Low salinity readings, after a rain, were obtained only if the sea was relatively calm. No explanation of the low readings on 8/7/69 and 8/8/69 is offered. The three samples which do not have salinity measurements were used for dielectric constant evaluation. In the computer programs the average salinity value of 24.17 parts per thousand was used in calculating the permittivity.

The permittivity is not strongly dependent on the salinity. The permittivity of salt water has been caluclated for a water temperature of 300°K and for salinity values from 20 to 30 parts per thousand. The results are tabulated in Table V-17. These permittivity values have been used to calculate the vertical and horizontal emissivity. Representative values of the calculated emissivity are tabulated in Table V-18. The theoretical emissivity variation is quite small over the salinity range that was measured from the water samples.

Three of the sea water samples were sent to the MIT Insulation Laboratory for dielectric constant measurements. It was intended to have these measurements made at 8.5 and 14 GHz. The measurements at 8.5 GHz were completed, but because of instrumentation problems the 14 GHz measurements were not completed at the time this report is being written. The results of the 8.5 GHz measurements are tabulated in Table V-19, along with theoretical values computed for 8.5 GHz using a salinity value of 24.167 parts per thousand. The intent of the measurement was to verify the accuracy of the theoretical calculations of dielectric parameters. The agreement between the measured and theoretical data at 8.5 GHz supports the contention that the derived theoretical formulas for permitivity are adequate. (Reference Appendix B)

The values of the radiometric zenith sky temperatures as computed from the radiosonde data, is tabulated in Table V-20. These are brightness temperatures and were used to determine the third calibration point.

A rain gage was installed at the site. A tabulation of the rain gage measurements is in Table V-21. This data was not used in the data analysis, but may provide some correlation with the salinity variations. It is of interest to note that the low salinity readings of 8/7/69 and 8/8/69 were preceeded by heavy rains on 8/5/69.

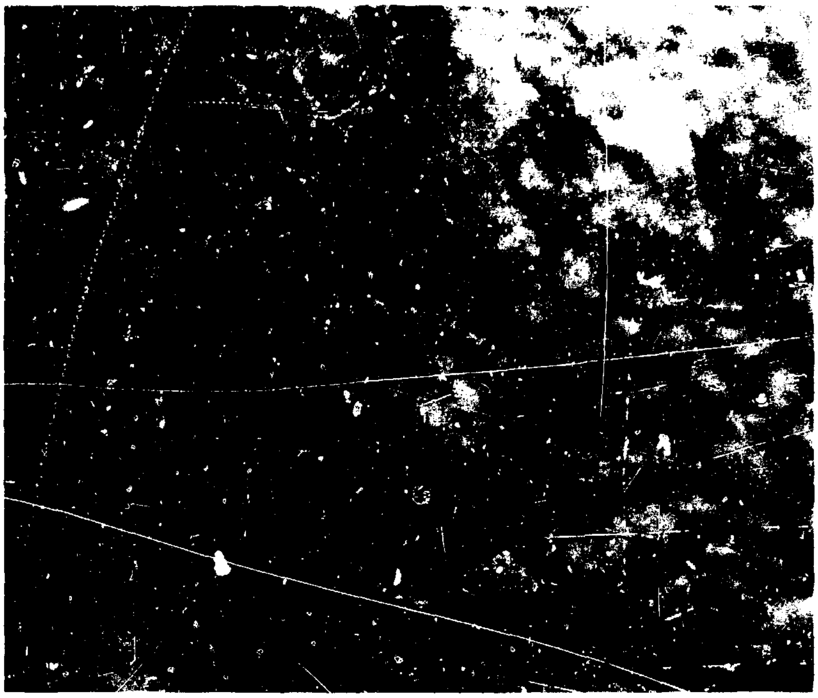


Figure V-1. Zenith Sky
Runs 7 and 8

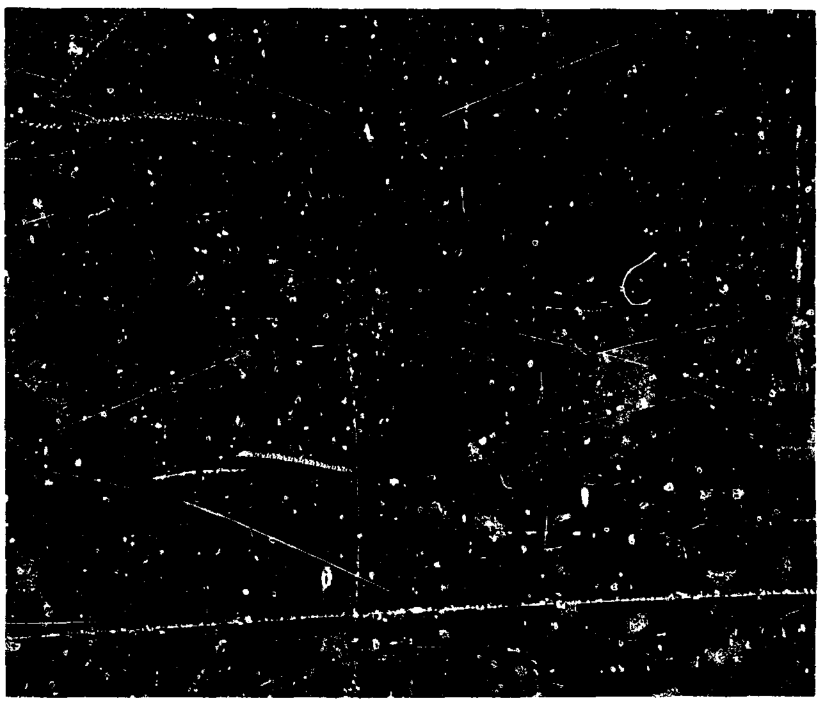


Figure V-2. Azimuth 310^0, Zenith Angle 60^0
Runs 7 and 8

Figure V-3. Horizon, Azimuth 310^0
Runs 7 and 8

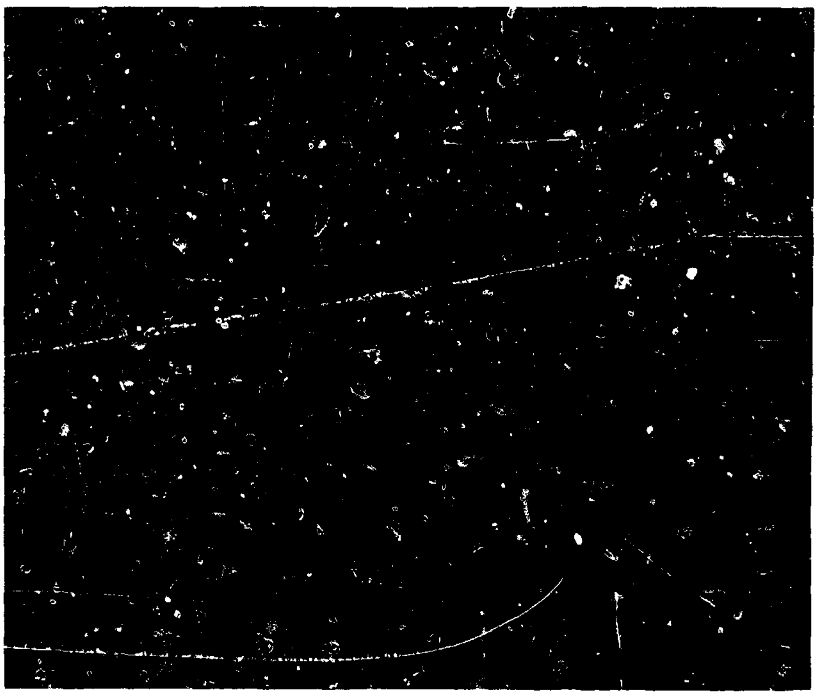


Figure V-4. Azimuth 310^0, Zenith Angle 110^0
Runs 7 and 8

Figure V-5. Azimuth 310^0, Zenith Angle 135^0
Runs 7 and 8

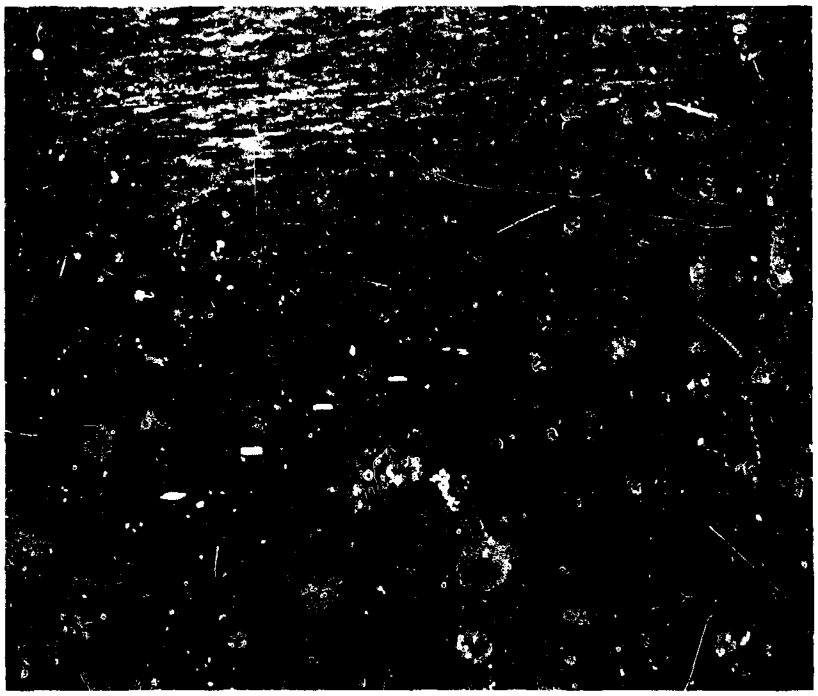


Figure V-6. Buoy and Sensors
Runs 7 and 8

TABLE V-1. RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO.    1
    072569 124800 310 H 095 01 10.1
    XTAL I L25  R33.5  BV-300  I-29.5
    INTERMEDIATE CAL AT MID POINT  WITH ZENITH
    THIS RUN SEQUENCE IS 90 TO 0 DEGREES, THEN 90 TO 178 DEGREES

RUN NO.    2
    072569 134545 310 V 095 01 23.6
    SEA CALM  SLIGHT  SWELL   77.5DEGREE WATER TEMP (BULB)
    AT 1430 VISIBILITY 10+,CLOUDS 90%

RUN NO.    4
    072969 200230 310 V 165 01 27.7
    DIGITAL PRINTER WAS NOTED TO MISPRINT OCCASIONALLY

RUN NO.    5
    080169 113200 310 V 165 01 18.9
    XTAL  L24.5  R32.5
    INTERMEDIATE  CAL POINTS DURING RUN
    AT 1030 SLIGHT CHOP,LESS THAN 1FT SWELL, 10-12 VIS, 80-90% DIS CUM

RUN NO.    6
    080169 120630 310 H 165 01 13.8
    ISLAND CURRENT CHANGED SOUTH TO NORTH FROM RUN 05 TO 06
    H2O SAMPLE AFTER RUN AT 1235     NO. 5
    NOTE INT TA - SUN NEAR ZENITH
    ADD'L CAL AT INTERMEDIATE POINTS DURING RUN
    AT 1230 LESS THAN 1FT SWELL, SLIGHT CHOP

RUN NO.    7
    080169 134700 310 H 165 01 14.1
     SLIGHT SWELL , 3 TO 6 INCHES- NO CHOP - GLASSY SURFACE
     SCAT.  CLOUDS  AT  ZENITH
     INTERMEDIATE   CAL   POINTS  DURING  RUN
    AT 1330 10-12MILE VIS, 60-70% SKY COVER

RUN NO.    8
    080169 141700 310 V 165 01 15.0
    SLIGHT SWELL 3 TO 6 INCHES - NO CHOP - GLASSY SURFACE
    SCAT. CLOUDS AT ZENITH
    INTERMEDIATE  CAL  POINTS DURING  RUN
```

TABLE V-2. RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO.   9
   080169 161000 310 V 165 01 18.1
   XTAL I  L25 R34
   SEA WHITE CAPS - GOOD 3 FOOT SWELL  PLUS 1 TO 2 FOOT CHOP
   100 %  CLOUD COVER   WIND SW
   INTERMEDIATE CAL POINTS DURING RUN

RUN NO.  10
   080169 163700 310 H 165 01 23.6
   SEA WHITE CAPS - GOOD 3 FOOT SWELL PLUS  1 TO 2 FOOT CHOP
   100 % CLOUD COVER - WIND SW
   XTAL I  L26  R34
   INTERMEDIATE  CAL POINTS DURING RUN
   AT 1700 10-12MILE VIS, CLOUDS 100%, CUM THUNDERHEADS

RUN NO.  11
   080569 155500 310 V 165 01 120.
   XTAL I  L21  R33.5
   HEAVY OVERCAST - DRIZZLE    3 FT  SWELL SLIGHT WIND RIPPLE
   INTERMEDIATE  CAL POINTS

RUN NO.  12
   080569 162830 310 H 165 01 104.
   XTAL I  L22 R33.5
   HEAVY OVERCAST - DRIZZLE    2-3 FOOT SWELL  1-2 INCH WIND RIPPLE
   INTERMEDIATE CAL POINTS
   AT 1630 3FT HEAVE, SKY OVERCAST & RAIN

RUN NO.  13
   080569 130900 310 V 165 01 13.5
   HL-0-401.2 CL-0-308.0 INIT // HL-0-402.1 CAL2 //
   HL-0-403.2 CL-0-307.5 CAL3 // HL-0 404.7  CL-0-307.2 FINI //
   SEA 1-2 FOOT SWELL  8-12 INCH WIND CHOP

RUN NO.  14
   080569 155000 310 H 165 01 18.2
   XTAL I  L25.5 R34.0  BEAM VOLTS 322  I=22.5
   SEA  1-2 FOOT SWELL  6-10 INCH WIND CHOP
   HL-0-402.1 CL-0-306.9 INIT // HL-0-401.8 CL-0-308.2 CAL2 //
   ELEV HANGUP 1610 TO 1621 // HL-0-403.5 CL-0-309.8 CAL3 //
   HL-0-400.8 CL-0-309.4 FINI //
   WATER SAMPLE AT 1545- CLEAR SKY, 2-3FT WAVES
```

TABLE V-3

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO.  15
    080769 121600 310 V 165 01 13.5
    CLEAR SKY EXCEPT 5-10 % CUM CLOUDS ON HORIZON
    APPROX ONE FOOT SWELL - LONG PERIOD -20FT-   3-4 INCH WIND CHOP
    BRIGHT-SUNNY-HAZY  WNW WIND 1-2 MPH  VIS 6-8 MI.
    XTAL I L24.5 R32.5   BEAM V 321  I22 MA.
    HL-0-403.5 CL-0-309.4 INIT //
    HL-0-402.7 CL-0-310.5 CAL2 // HL-0-402.3 CL-0-310.7 CAL3 //
    HL-0-404.2 CL-0-311.1 FINI //
    WATER SAMPLE AT 1200- CLEAR SKY, APPROX 1FT SEA

RUN NO.  16
    080769 125500 310 H 165 01 13.2
    CLEAR SKY EXCEPT 5-10% CUMULUS CLOUDS ON HORIZON
    APPROX ONE FOOT SWELL- LONG PERIOD-20FT-   3-4 INCH WIND CHOP
    BRIGHT-SUNNY-HAZY WNW WIND 1-2 MPH VIS 6-8 MI.
    XTAL I L24.5  R32.5  BEAM V 321 I=22 MA // HL-0-402.0 CL-0-311.6 INIT//
    HL-0-404.0 CL-0-311.7 CAL2 // HL-0-403.0 CL-0-312.5 CAL3 //
    HL-0-404.2 CL-0-313.0 FINI //
     SAME COMMENTS AS RUN NO 15
    AT 1330 10% HORIZON CUM,1FT SWELL,LONG PERIOD 3-4IN WIND CHOP
    AT 1330 WNW WIND 1-2, 6-8MILE VIS

RUN NO.  17
    080769 165500 310 H 165 01 18.0
    2-5 % CIRRUS CLOUDS DRIFTING OVERHEAD
    1 FOOT SWELL    6-8 INCH CHOP   WIND SOUTH  5-10 MPH
    HL-0-401.5 CL-0-307.0 INIT // HL-0-400.9 CL-0-306.6 CAL2 //
    HL-0-403.5 CL-0-306.5 CAL3 // HL-0-402.0 CL-0-306.4 FINI //
    APPOX 1700 SKY CLEAR WITH HAZE,6MILE VIS,WIND S 5-10,1-1.5FT SWELLS

RUN NO.  18
    080769 172900 310 V 165 01 13.0
    OVERHEAD CLEAR   1 FOOT SWELL 6-8 INCH CHOP  VERY HAZY - SUNNY
    WIND S  5-10 MPH
    XTAL I L26.5 R34.5  BEAM V 323 I 22.2 MA
    HL-0-404.6 CL-0-307.0 INIT //HL-0-404.6 CL-0-307.2 CAL2 //
    HL-0-404.0 CL-0-307.3 CAL3 //HL-0-401.4 CL-0-307.1 FINI //
    AT 1725 10-15% CLOUDS
```

TABLE V-4

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO.  19
   080769 191500 310 V 165 01 8.7
   WATER SENSORS  1-299.2   2-298.6   3-298.6   4-298.6    AT 19145100
   HL-0-401.6 CL-0-302.6 INIT //HL-0-401.5 CL-0-302.9 CAL2 //
   HL-0-401.2 CL-0-303.0 CAL3 //HL-0-403.5 CL-0-302.9 FINI //
   AT 1810 10% CLOUDS,OH CLEAR,WIND S 5-10,1FT SWELL,10FT PERIOD
   AT 1810 6-8IN CHOP, 6-9MILE VIS


RUN NO.  20
   080769 194930 310 H 165 01 10.5
   HL-0-405.0 CL-0-302.8 INIT // HL-0-405.0 CL-0-302.5 CAL2  //
   HL-0-403.5 CL-0-302.4 CAL3 // HL-0-401.6 CL-0-302.3 FINI //
   WATER SENSORS #1-298.8 #2-298.1 #3-298.1 #4-298.1
   AT 2025 WIND SE 10-15,10MILE VIS, 10% CLOUDS, OH CLEAR


RUN NO.  21
   080869 113200 310 V 165 01 14.2
   HL-0-405.0 CL-0-303.0 INIT // HL-0-404.5 CL-0-306.0 CAL2 //
   SENSORS #1-301.6 #2-301.7 #3-299.4 #4-298.5 ALL UPSIDE DOWN TIME 1155
   HL-0-402.0 CL-0-304.5 CAL3 //
   SENSORS #1-301.0 #2-301.0 #3-298.9 #4-299.4 TIME 1205
   HL-0-402.5 CL-0-306.7 FINI //
   SENSORS #1-302.6 #2-301.5 #3-302.5 #4-299.5 TIME 1225
   AT 1100 1-1.5FT SEA, CLEAR SKY, 6MILE VIS


RUN NO.  22
   080869 124000 310 H 165 01 16.0
   HL-0-401.5 CL-0-307.0 INIT //HL-0-405.8 CL-0-307.2 CAL2 //
   HL-0-404.7 CL-0-307.1 CAL3 //HL-0-401.0 CL-0-307.3 FINI //


RUN NO.  23
   080869 145500 310 V 165 01 11.4
   1-2 PERCENT CUMULUS SCATTERED AND DRIFTING OVERHEAD
   HL-0-405.0 CL-0-309.0 INIT // HL-0-401.1 CL-0-309.2 CAL2 //
   HL-0-402.1 CL-0-308.7 CAL3 // HL-0-403.5 CL-0-308.5 FINI //
```

TABLE V-5

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO.  24
   080869 153100 310 H 165 01 11.7
   5-10 PERCENT SCATTERED CUMULUS CLOUDS OVERHEAD
   1.5 - 2 FOOT SWELL  12-18 INCH CHOP QUITE ROUGH, VERY FEW WHITE CAPS
   HL-0-403.0 CL-0-308.8 INIT // HL-0-401.0 CL-0-309.0 CAL2 //
   HL-0-403.5 CL-0-308.8 CAL3 //HL-0-401.5 CL-0-309.0 FINI //
   AT 1600 10% OH CUM & HORIZON, 6-8MILE VIS

RUN NO.  25
   081269 122500 310 V 165 01 10.5
   XTAL I INIT L=26.5 R=35.0 KLY 315V 23MA // HL-0-404.0 CL-0-301.4 INIT
   HL-0-405.0 CL-0-302.1 CAL2 // TIDE LINE BTWN ROUGH & CALM WATER FL110
   HL-0-404.0 CL-0-302.0 CAL3 // HL-0-402.0 CL-0-302.0 FINI
   2-3FT SWELL FROM NW 6-12IN WIND RIPPLE  80-90 OVERCAST VAR OVERHEAD
   SENSORS 1-297.6 2-298.0 3-298.0
   AT 0900 90% SKY COVER
   AT 1030 MOD SEA, SUNNY

RUN NO.  26
   081269 131300 310 H 165 01 6.9
   HL-0-402.0 CL-0-302.2 INIT // HL-0-401.5 CL-0-302.5 CAL2
   HL-0-404.3 CL-0-302.5 CAL3 // HL -0-401.1 CL-0-302.7 FINI
   2-3FT SWELL FROM NW 8-12IN WIND RIPPLE 80-90 % OVERCAST OVERHEAD
   SENSORS 1-297.5 2-298.0 3-297.9
   AT 1300 2-3FT SWELL

RUN NO.  27
   081269 162100 310 V 165 01 11.5
   HL-0-401.5 CL-0-302.6 INIT // HL-0-402.8 CL-0-303.2 CAL2
   HL-0-401.5 CL-0-303.1 CAL3 // HL-0-404.5 CL-0-303.0 FINI
   21/2-31/2FT SWELL 4-8IN CHOP NW SEA NE WIND 10-15
   AT 1555 2-3FT SWELL FROM NW,WIND NE 10-15, 90% SKY COVER

RUN NO.  28
   081269 165500 310 H 165 01 16.5
   HL-0-404.5 CL-0-302.8 INIT // HL-0-403.1 CL-0-303.0 CAL2
   HL-0-404.5 CL-0-303.0 CAL3 // HL-0-401.0 CL-0-303.4 FINI
   2-3FT SWELL 4-8IN CHOP PARTLY CLOUDY HAZY BUT BLUE SKY WITH SUN THRU
   SENSORS 1-298.4 2-298.5 3-298.3 @ 17:25:00
```

TABLE V-6

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO.  29
   081269 184500 310 H 165 01 14.3
   HL-0-403.1 CL-0-302.1 INIT // HL-0-405.0 CL-0-301.8 CAL2
   HL-0-405.0 CL-0-301.1 CAL3 // HL-0-401.1 CL-0-301.0 FINI
   11/2-2FT SWELL 6-8IN CHOP
   SENSORS 1-297.3 2-299.0 3-298.1

RUN NO.  30
   081269 191500 310 V 165 01 11.7
   HL-0-403.0 CL-0-301.0 INIT // HL-0-405.0 CL-0-301.0 CAL2
   HL-0-401.3 CL-0-300.5 CAL3 // HL-0-404.0 CL-0-300.5 FINI
   1-11/2FT SWELL 6-8IN CHOP

RUN NO.  31
   081369 103800 310 H 165 01 12.4
   1-2FT SWELL 15-20FT PERIOD 4-8IN CHOP WIND N 5-10
   SENSORS 1-297.6 2-298.4 3-298.4
   AT 1030 80-90% SKY COVER,HAZY LIGHT TRANPARENT OH CLOUDS,VIS 6-8
   AT 1030 SUNNY SLIGHT HAZE

RUN NO.  32
   081369 111500 310 V 165 01 14.8
   EL 116 SMALL BOAT PASSED BY  // OVERHEAD PATCHY -50% SOME LARGE CLOUDS
   SENSORS- TIME 11:38:00 1-297.1 2-298.4 3-298.4
   AT 1110 1-2FT SWELL
   AT 1340 99% SKY COVER, LOW BIG SCAT CLOUDS PLUS HIGH OH ALMOST COMPLETE
   AT 1340 VIS 6-7MILES, NO SUN
   AT 1630 HEAVY SWELL FROM NW 3-3.5FT, 15-20FT PERIOD

RUN NO.  33
   081469 101000 310 V 095 01 21.1
   HL & CL MV READINGS WERE TAKEN AT NUMEROUS ELEVATION ANGLES
   SEA CALM PERCEPTABLE SWELL VERY SMALL WIND RIPPLE
   DATA RUN BEGAN AT 10:20:00
   AT 0830 60-70% SKY COVER VIS 10-15 STRATO CUM N,LOW STRATUS & CUM W
   AT 0830 CIR & CIR-STRATUS S&E
   AT 0840 SEA CALM 1-2IN WIND RIPPLE, 6IN SWELL
```

TABLE V-7

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO. 34
   081469 104700 310 H 095 01 15.5
   HL & CL MV READINGS TAKEN AT SEVERAL ELEVATION ANGLES
   SEA CALM OVERHEAD CLEAR
   DATA RUN BEGAN AT 10:59:00
   AT 1005 SEA CALM,SLIGHT WIND RIPPLE, 6IN SLOW SWELL

RUN NO. 35
   081469 132500 310 H 165 01 24.0
   SCATTERED CUMULUS CLOUDS OVERHEAD VERY CLEAR WHEN NO CLOUDS
   PICTURES TAKEN AT 13:46:00
   AT 1130 SEA CALM
   AT 1300 40-50% SKY COVER, CUM MOSTLY, SUNNY

RUN NO. 36
   081469 141500 310 V 165 01 14.8
   CLEAR OH AT START  // XTAL I  L-23.5  R-32.4
   TIME-14:45:00 THUNDER SQUALLS IN VICINITY OH IS NOW OVERCAST
                 TO NORTH OH IS CLEAR
   AT 1500 THUNDERHEADS & STORM TO SW, DARK CLOUDS W, SEA CALM
   AT 1500 SLIGHT SWELL WITH WIND RIPPLE
   AT 1510 HEAVY RAIN STARTED. VIS LESS THAN 1 MILE
   AT 1532 100% CLOUDS HEAVY RAIN
   AT 1715 SEA DEAD CALM, AFTER BIG RAIN SHOWER, STILL RAINING LIGHTLY
   AT 1930 SEA CALM, AFTER RAIN STOPPED
```

TABLE V-8

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO. 101
   072169 144500 310 V 095 01 31.7
   RUNS 101 AND 102 ARE THE FIRST CONSECUTIVE HORIZ & VERT POL RUNS
   VENT BLDG LOG @ 1500:WIND NE 10-15,CLOUDY,SEA CALM
   WEATHER BUREAU WATER TEMP- 298.5

RUN NO. 102
   072169 151000 310 H 095 01 10.9
   RUNS 101 AND 102 ARE THE FIRST CONSECUTIVE HORIZ & VERT POL RUNS
   STARTED TO RAIN AS RUN BEGAN//CLOUD COVER NEAR 100%
```

TABLE V-9

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO. 201
    071769 175000 310 V 095 01 19.4
    AIRPLANES FLEW OVER AT ELEVATION ANGLES OF 90 AND 95 DEGREES //
    THIS RUN WAS A VERY PRELIMINARY CHECK OF AZIMUTH 310 //
    USE INIT CAL TEMPERATURES IF COMPUTER NEEDS THEM FOR THE FINI POSITIONS

RUN NO. 202
    072269 140000 310 V 095 01 4.56
    ZENITH STABILITY RUN //USE FINI CAL TEMPERATURES IF COMPUTER NEEDS THEM
    FOR THE INIT POSITIONS//

RUN NO. 203
    072769 181500       V 095 01 4.56
    HORIZON (EL ANGLE 90 DEGREES) CHECK WITH 360 DEG AZIMUTH ROTATION

RUN NO. 204
    072269 183130       H 095 01 4.56
    HORIZON (ELEV ANGLE  90 DEGREES) CHECK WITH 360 DEG AZIMUTH ROTATION

RUN NO. 205
    072969 203000       V 165 01 27.7
    HORIZON(ELEVATION ANGLE 90 DEGREES)CHECK WITH 360 DEG AZIMUTH ROTATION

RUN NO. 206
    080569 164930 310 H 165 01 104.
    HOT LOAD CAL RUN AND ZENITH TEMP STABILITY
    THIS WAS FIRST RUN WHERE WE NOTED THAT HL TEMP WAS VARYING
    ZENITH TEMP STABILITY DATA TAKEN END OF RUN 12. DATA IS ON RUN 12 TAPE
```

TABLE V-10

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO. 301
   080169 153200 310 V 165 01
   SEA WATER TEMP STABILITY AT ELEV. OF 115 DEGREE ZENITH ANGLE
   1-1.5 FOOT SWELL AND CHOP//NO FINAL ZENITH READING,STARTED TO POUR RAIN
   RAINED FROM 1555 TO 1605 LESS THAN  0.02 ACCUMULATED

RUN NO. 302
   080869 095000 310 V 165 01
   VERTICAL STABILITY CHECK AT 120 DEGREES ELEVATION
   XTAL I AT START APPROX L22 R3.
   XTAL I DROPPED OFF DURING RUN - AT END WAS L16  R23
   HL-0-403.7 CL-0-299.4 INIT // HL-0-404.5 CL-0-301.6 FINI //
   AT 0900 1.5-2FT SWELL,ROUGH 12-18IN CHOP,5-10% WHITECAPS

RUN NO. 303
   080869 133200 310   165 01
   RUN AT 122 DEGREES ELEV - SWITCHING BETWEEN HORIZ AND VERTICAL
   SEA WATER SENSORS  #3-299.4  #4-299.6
   FIRST 8 DATA POINTS ARE HORIZONTAL.NEXT 6 VERTICAL,NEXT 5 H,NEXT 7 V
   NO CAL TAKEN FOR HL0,CL0,00

RUN NO. 304
   080869 161500 310   165 01 11.7
   THIS RUN HAS BOTH VERT AND HORIZ MEAS AT 115,120,AND 125 DEGREES ELEV//
   START AT 115 DEG HORIZ // TIME 1620 115 DEG VERT //
   TIME 16:22:30 115 DEG HORIZ // TIME 1625 115 DEG VERT //
   TIME 16:26:30 120 DEG VERT // TIME 1628 120 DEG HORIZ //
   TIME 16:29:30 120 DEG VERT // TIME 1631 120 DEG HORIZ //
   TIME 16:32:30 125 DEG HORIZ // TIME 1634 125 DEG VERT //
   TIME 16:35:30 125 DEG HORIZ // TIME 1637 125 DEG VERT //
   HL-0-402.5 CL-0-308.9 INIT // HL-0-403.9 CL-0-308.3 FINI //

RUN NO. 305
   080869 163830 310 V 165 01
   THIS RUN IS A ZENITH STABILITY CHECK
   STARTED RIGHT AFTER RUN 304  THERFORE USE 304 FINAL CAL AS 305 INT CAL
   HL-0-403.9 CL-0-308.3 INIT //
   AT 1705 CHOPPY SEA-2FT, SUNNY, HUMID
```

TABLE V-11

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO. 306
    081169 122200 310    165 01
    SPECIAL RUN ELEVATION ANGLE 105 DEG//CHANGE BTWN H & V POLARIZATION
    HL-180-403.0 CL-180-309.5 INIT // FIRST V RUN LG CG SHIP POSSIBLY IN
    FIELD OF VIEW  HL-105-402.0 CL-105-308.0 // START TIME FIRST H RUN 1307
    HL-180-403.4 CL-180-305.5 CAL2 //SWELL INCREASING & CHOPPIER AFTER 1315
    SECOND V 1324 HL-180-402.0 CL-180-306.4 CAL3 // SECOND H COMPLETE 1356
    AT 1030 SLIGHT SWELL FROM NW, CLOUDS 90% CS AC
    AT 1200 WIND NW 5-10, CLOUDS 80% CS CC
    AT 1300 SWELL DEVELOPING, SLIGHT CHOP,CLOUDS 90% CI SCAT CU


RUN NO. 307
    081169 140000 310    165 01
    SPECIAL RUN ELEVATION ANGLE 110 DEG//CHANGE BTWN H & V POLARIZATION
    HL-180-405.0 CL-180-311.6 INIT //HL-180-402.5 CL-180-306.7 CAL2
    TIME-1430 START SECOND VERTICAL POL // TIME 1436 START SECOND HORIZ POL
    GENTLE BUT DISTINCT CHOP IN WATER //HL-180-404.6 CL-180-307.0 FINI
    AT 1330 CHOP INCREASING SINCE NOON UNDER STEADY NW WIND SOME WHITECAPS
    AT 1330 SWELL PERIOD 15-20FT
    AT 1400 CLOUDS 80% CI CS, VIS 6MILES
    AT 1433 DISTINCT TIDAL LINE BTWN WHITE & CALM WATER.(NEAR MEASUREMENTS)
    AT 1450 2FT SWELL
    AT 1500 CLOUDS 70% CI,CS,CU MED, CU BUILDING TO WEST & NW


RUN NO. 308
    081169 161700 310    165 01
    SPECIAL RUN ELEVATION ANGLE 115 DEG // CHANGE BTWN H & V POLARIZATION
    HL-180-402.2 CL-180-302.8 INIT // TIME 1626 START FIRST H POL RUN
    HL-180-405.0 CL-180-304.0 CAL2 // TIME 1640 END FIRST V POL RUN & BEGIN
    SECOND V POL RUN // TIME 1647 START SECOND H POL RUN //
    HL-180-404.7 CL-180-304.0 FINI //


RUN NO. 309
    081169 165700 310    165 01
    SPECIAL RUN ELEVATION ANGLE 120 DEG // CHANGE BTWN H & V POLARIZATION
    HL-180-404.1 CL-180-304.5 INIT // TIME 1704 START FIRST H POL RUN
    HL-180-403.3 CL-180-303.6 CAL2 // TIME 1717 START SECOND V POL RUN
    WATER MUCH CALMER // TIME 1722 END SECOND H POL RUN
    HL-180-405.0 CL-180-303.6 FINI
    1700 CLOUDS 40% CI, NO CU EVIDENT
```

TABLE V-12

RADIOMETRIC RUN COMMENT PRINTOUT

```
RUN NO. 310
    091169 175500 310     165 01
    SPECIAL RUN ELEVATION ANGLE 125 DEG // CHANGE BTWN H & V POLARIZATION
    HL-180-404.9 CL-180-304.0 INIT //TIME 1800 START FIRST H POL RUN
    TIME1806 END FIRST V POL RUN // HL-180-404.0 CL-180-303.2 CAL2 //
    TIME1815 START SECOND V POL RUN // TIME 1823 START SECOND H POL RUN  //
    HL-180-405.0 CL-180-302.7  FINI //
    AT 1730 WIND HAS DIED DOWN, WATER BECOMING QUITE CALM
    AT 1800 CLOUDS 10% CI
    AT 1900 1FT SWELL

RUN NO. 311
    091269 143000 310     165 01
    SPECIAL RUN 120 DEG ELEVATION STABILITY WITH FIRST H THEN V POLARIZ
    HL-0-401.0 CL-0-304.5 INIT // START TIME H POL 14:37:00 STOP AT15:40:00
    HL-0-403.5 CL-0-301.9 CAL2 // XTAL I L26.5 R35 // START V POL 15:49:00
    SAILBOAT IN BEAM APPROX 15:48:00  // STOP V POL AT 16:13:00  //
    HL-0-404.8 CL-0-302.1 FINI //
    AT 1400 APPROX 3FT SWELL

RUN NO. 312
    091269 194500 310 V 165 01
    ZENITH STABILITY RUN // INIT CAL DATA IS SAME AS FINI CAL DATA ON RUN30
    USE COMMENTS ON RUN 30 // HL-0-404.0 CL-0-300.5 INIT //
    2000 1-1.5FT SWELL, 6-8IN CHOP
    2015 40-80% SKY COVER, HIGH HAZY STRATUS

RUN NO. 313
    091369 093000 310     165 01
    SPECIAL RUN V & H STABILITY AT 120 DEG ELEVATION ANGLE
    HL-0-404.5 CL-0-298.6 INIT // START V POL AT 09:36:00 STOP AT 10:20:30/
    START H POL AT 10:27:00 STOP AT 10:30:30 // XTAL I L24.5 R35
    AT 0915 60-70% SKY COVER,HORIZON COVERED,OH LIGHT WISPY CLOUDS, VIS 6-8
    AT 0915 1-2FT SWELL
```

TABLE V-13

BEST AVERAGE WATER TEMPERATURE EACH RUN DAY

DATE	HG BULB	RCA THERM	ESSA THERM	WEATHER BUREAU
7-17-69	299.5		300.7	
7-21-69				298.5
7-22-69				
7-25-69			298.3	
7-29-69				
7-30-69	299.5		299.7	
8-01-69	299.5	300.4		
8-05-69				
8-06-69	299.0			
8-07-69	300.4	298.8		
8-08-69	299.6	299.0		
8-11-69	298.5			
8-12-69		298.2		
8-13-69	297.5	298.4		
8-14-69	298.3	298.6		

TABLE V-14

SEA WATER TEMPERATURE DATA FROM WOLFTRAP LIGHT

TIME - EDST

Date	0200	0500	0800	1100	1400	1700	2000	2300
July 14	297.6							→
15	297.6							→
16	297.6							→
17	297.6	→	298.7					→
18	298.7							→
19	298.7							→
20	298.7							→
21	298.7							→
22	298.7					→	299.3	→
23	299.3							→
24	299.3							→
25	299.3		→	299.8				→
26	299.8							→
27	299.8							→
28	299.8							→
29	299.8							→
30	299.8							→
31	299.8							→
August 1	299.8							→
2	299.8							→
3	299.8							→
4	299.8							→
5	299.8							→
6	299.8							→
7	299.8							→
8	299.8							→
9	299.8							→
10	299.8							→
11	298.7		→	299.8	298.7			→
12	298.7							→
13	298.7							→
14	298.7							→

TABLE V-15

AIR TEMPERATURE AND RELATIVE HUMIDITY

DATE	TIME	AIR TEMP-F	R.H.%
7-16-69	1315	86	63
7-17-69	1130	81	75
7-21-69	1800	77	83
7-25-69	1430	79	71
8-01-69	1030	79	79
8-01-69	1330	82.5	60
8-01-69	1700	79	83
8-07-69	1330	85	59
8-07-69	1810	82	65
8-07-69	2025	78	77
8-08-69	1100	82	72
8-08-69	1600	86	63
8-11-69	1030	77	72
8-11-69	1200	79	71
8-11-69	1300	79	66
8-11-69	1400	83	69
8-11-69	1500	83	69
8-11-69	1700	81	72
8-11-69	1900	78	79
8-12-69	0900	75	82
8-12-69	1600	81	70
8-12-69	2015	75	84
8-13-69	0915	77	83
8-13-69	1030	78.5	81
8-13-69	1340	77	87
8-14-69	0830	77.2	91
8-14-69	1300	80.5	83
8-14-69	1500	77	91

TABLE V-16

WATER SAMPLE SALINITY

DATE	TIME	TIDE	SALINITY	COMMENTS
7-15-69	1530	@LT		LOW TIDE
7-17-69	1730	LT+42MIN	24.05	NONE
7-21-69	1800	LT-1HR	25.03	RIGHT AFTER 1.17IN RAIN
7-25-69	1500	HT-2HR42MIN	25.95	NONE
8-01-69	1230	HT+54MIN	25.04	NONE
8-01-69	1600	LT-1HR48MIN		RIGHT AFTER LINE SQUALL
8-05-69	1745	HT+2HR33MIN	25.45	AFTER 11&12 RAIN ALL DAY
8-06-69	1545	HT-21MIN	25.42	CLEAR SKY, 2-3FT WAVES
8-07-69	1200	LT+[illegible]HR36MIN	21.41	SKY CLEAR,APPROX 1FT SEA
8-07-69	1815	HT+1HR9MIN	24.57	WEATHER CLEAR
8-08-69	1100	LT-24MIN	22.88	1-1.5FT SEA,CLEAR SKY
8-08-69	1705	HT-55MIN	21.90	SUNNY,HUMID,CHOPPY 2FTSEA
8-11-69	1450	LT+56MIN	25.30	2FT SWELL,PARTLY CLOUDY
8-11-69	1700	HT-18MIN	24.78	1FT SWELL,SCAT CIRRUS
8-12-69	1030	HT+1HR54MIN	25.52	SUNNY,MOD SEA
8-12-69	1550	LT+1HR14MIN	24.34	2-3FT SEA SWELL
8-13-69	0910	HT-2MIN	24.59	1-2FT SEA SWELL
8-13-69	1630	LT+[illegible]HR19MIN	25.04	HEAVY FROM NW,3-3.5FT
8-14-69	0840	HT-1HR8MIN	23.90	SEA CALM, RAIN EARLY AM
8-14-69	1005	HT+17MIN		SEA CALM, 6IN SLOW SWELL
8-14-69	1715	LT+1HR27MIN	22.11	SEA CALM AFTER HEAVY RAIN
8-14-69	1930	LT+3HR42MIN	21.89	CALM,AFTER RAIN STOPPED

NOTE 1- SALINITY IS EXPRESSED IN PARTS PER THOUSAND

NOTE 2- SALINITY AVERAGE OF ALL MEASUREMENTS = 24.17

TABLE V-17

CALCULATED PERMITTIVITY VS SALINITY

Frequency = 16.5 GHz
Temperature = 300^0K

Salinity (Parts per Thousand)	Calculated Permittivity	
	Real Part	Imaginary Part
20	45.384	36.480
22	45.076	36.532
24	44.761	36.583
26	44.439	36.631
28	44.110	36.677
30	43.775	36.720

TABLE V-18 EMISSIVITY VS SALINITY
FREQUENCY = 16.5 GHz
TEMPERATURE = 300°K

Salinity (Parts per Thousand)	Zenith Angle	Emissivity	
		Horizontal	Vertical
20	95^0	.0424	.9326
24.167	95^0	.0425	.9312
30	95^0	.0426	.9290
20	100^0	.0827	.9513
24.167	100^0	.0828	.9511
30	100^0	.0831	.9508
20	105^0	.1206	.8629
24.167	105^0	.1209	.8633
30	105^0	.1213	.8638
20	110^0	.1562	.7719
24.167	110^0	.1566	.7726
30	110^0	.1570	.7736
20	115^0	.1893	.6946
24.167	115^0	.1897	.6953
30	115^0	.1903	.6965

TABLE V-19 MEASURED AND THEORETICAL PERMITTIVITY

Sample No.	Measured Dielectric Constant (K')	Measured Loss Tangent (tan ζ)	Computed Loss Factor (K''=K' tan ζ)	Theoretical	
				Dielectric Constant K'	Loss Factor K''
1	57.0	.505	28.79	60.50	32.77
6	57.2	.517	29.57	60.50	32.77
20	58.9	.503	29.63	60.50	32.77

TABLE V-20

ZENITH SKY TEMPERATURE AS CALCULATED FROM RADIOSONDE DATA

DATE	16.5 GHZ 8AM	16.5 GHZ NOON	16.5 GHZ 8PM	9.5 GHZ 8AM	9.5 GHZ NOON	9.5 GHZ 8PM
7-17-69			9.72			3.76
7-20-69			13.06			4.41
7-21-69			7.76			3.52
7-22-69	11.67		13.81	4.16		4.56
7-23-69			13.69			4.54
7-24-69			10.35			3.91
7-25-69			9.82			3.73
7-28-69			14.62			4.71
7-29-69			12.88			4.39
7-30-69			10.90			4.01
7-31-69			9.59			3.77
8-01-69	11.25		12.49	4.09		4.33
8-05-69			13.04			4.44
8-06-69	10.05	10.13	10.60	3.85	3.83	3.97
8-07-69	8.41	8.47	8.74	3.54	3.53	3.59
8-08-69	10.20		11.37	3.89		4.01
8-11-69	8.93		8.35	3.64		3.51
8-12-69	7.28		6.87	3.32		3.17
8-13-69	9.31		12.63	3.72		4.36
8-14-69	12.78	11.47	12.50	4.40	4.11	4.34

TABLE V-21

RAIN GAGE DATA

DATE	TIME	GAGE READING
7-21-69	1800	1.17
7-22-69	1300	1.35
7-23-69	0900	0.05
7-24-69	1030	0.125
7-25-69	0930	0.00
7-29-69	1300	4.25
8-01-69	0800	0.10
8-01-69	1605	<0.02(TRACE)(AFTER SHOWER)
8-05-69	1710	2.45
8-06-69	0900	0.42
8-07-69	0900	0.00
8-11-69	0900	0.30
8-12-69	0900	0.00
8-13-69	0900	0.00
8-14-69	0900	(TRACE)RAINED LIGHTLY EARLY AM
8-15-69	0815	1.35

NOTE- GAGE WAS EMPTIED AFTER EACH READING BUT NOT IN BETWEEN.

SECTION VI

DATA FLOW AND RESULTS

A. Data Analysis Flow

The data flow is shown on Figure VI-1A. The raw radiometric voltages were recorded, as previously described, on a HP562 Digital Recorder. This unit provided one printout per second of the integrated radiometric output voltage. Ten, 1-second samples were recorded for each data observation point. The printout was on HP folded paper tape. The data on these tapes was later key punched onto IBM cards which were run through a computer program that converted the radiometric voltages to apparent temperatures. This program, named MODROD, also processed the calibration data and required a zenith temperature for a third calibration point. By utilizing radiosonde data and a computer program called SKYTEM, the zenith radiometric temperature was calculated. The calculated temperature was a brightness temperature and the calibration point at this data level required an apparent temperature. An iteration was performed to provide a correction to accomodate this difference.

The apparent temperature data from MODROD was processed through a program called APCOR4 which provided the required pattern corrections to correct the apparent temperatures to brightness temperatures. APCOR4 required an antenna correction matrix which was obtained from ANTPT2, a program which converted actual antenna patterns to a matrix format.

The output from APCOR4 consisted of brightness temperatures at 69 angles, whose angular value was dependent on the mesh size of the antenna matrix. The calculated brightness temperature at zenith (i.e. at an angle of 0^0) was then compared to the zenith temperature as calculated by the SKYTEM program. If the agreement was not sufficiently close (generally 0.5^0 was considered to be adequate), the apparent temperature used as a calibration point was adjusted and the program MODROD and APCOR4 were re-run. These iterations were continued until agreement was reached.

The outputs of APCOR4 for all of the standard runs were plotted for the complete elevation profile and expanded plots were made for those zenith angles which included the sea water observations. The brightness temperatures calculated from APCOR4 were used to obtain the radiometric sea water temperature for the vertically polarized runs. This was done by the method described in Section III-C using a computer program named ROCK 3.

This program iterates on water temperature until a value is found which gives a calculated brightness temperature in agreement with the measured brightness temperature. The criteria for "agreement" was a brightness temperature within $\pm 1^0$ of the measured brightness temperature. The "error" that this allows in the computed value of water temperature is $\pm$ (1/emissivity). Thus over the zenith angles of interest (i.e. 91.69^0 to 130.32^0) the error that will be allowed by this agreement criteria varies from a high of $\pm 2^0$ maximum to a low of about $\pm 1^0$. ROCK 3 was used only to obtain the water temperatures of the vertical runs. It was not used for the horizontal runs since the error due to the agreement criteria would be excessive at angles near the horizon and since the apparent emissivity varied too much from the true emissivity. Those few horizontal runs which were tried in this computer program would not finalize in a reasonable number of iterations.

ROCK 3 determines a value of water temperature which satisfies the basic radiometric equation

$$T_b = \epsilon T_W + (1-\epsilon)T_s$$

Since it calculates a corresponding value of emissivity for each water temperature, the value of the emissivity will change each time the water temperature value is changed. The printout for ROCK 3 includes the computed emissivity and the real and imaginary parts of the computed permittivity. Since it was felt that the horizontally polarized measurements would contain sea state information these runs were processed in a slightly different fashion. The iteration process was not feasible because of limitations previously described, therefore a method was required which would restrain the horizontal emissivity within reasonable bounds. This was accomplished by using the permittivity values, computed in ROCK 3 for the adjacent vertical runs, to calculate the horizontal emissivity. Using this value of emissivity, the horizontal radiometric water temperature was calculated using a computer program named ROCKFN. These computed, restrained emissivity, values of water temperature were not expected to be representative of the thermometric water temperature, but the shape or displacement of the curves might be expected to correlate with the observed sea state.

In order to get a set of "reference" curves, ROCKET was also used to compute the radiometric water temperature based on the theoretical values of permittivity and emissivity for sea water at 299 K.

A more direct approach to determine the sea state dependency of the horizontally polarized measurements would be to calculate the emissivity directly from the measured data. The basic radiometric equation can be used to solve for the emissivity as follows:

$$T_b = \epsilon T_w + (1 - \epsilon) T_s \tag{3}$$

$$T = \epsilon T_w + T_s - \epsilon T_s$$

$$T_b = \epsilon (T_w - T_s) + T_s$$

$$\epsilon = \frac{T_b - T_s}{T_w - T_s} \tag{4}$$

The derived emissivity for both the horizontal and vertical runs was calculated using equation (4) in computer program EMISS. The brightness temperatures and sky temperatures are obtained from the APCOR4 output. An arbitrary value of water temperature (T_w) of 299^0K was used.

In order to allow for the non-specular surface of the actual sea water, the value of sky temperature (T_s) was actually an average over a cone of angles about the nominal angle. In order to easily accomodate the input data format this angular cone was defined in terms of a constant cosine differential. This cosine difference was in turn defined in terms of the antenna mesh size (m).

Thus

$$\begin{aligned}
\Delta \theta &= \theta_{max} - \theta_{min} \\
\cos\theta_{min} - \cos\theta &= 2(\tfrac{1}{m}) \\
\cos\theta - \cos\theta_{max} &= 2(\tfrac{1}{m}) \\
\cos\theta_{min} - \cos\theta_{max} &= 4(\tfrac{1}{m}) \\
\cos\theta_{min} - \cos\theta_{max} &= 4(\tfrac{1}{34}) = 0.11765
\end{aligned}$$

where

θ = nominal angle of reflected source

$\Delta\theta$ = cone of angles

θ_{max} = upper limit of angular cone

m = mesh size = 34

θ_{min} = lower limit of angular cone

The cosine differential used was this value of 0.11765 which defined the cone size.

The stability runs and the switched polarization runs, do not contain measurements at angles other than that of the particular observation. Thus the elevation profile for these runs is not defined. Therefore they were only processed to determine the apparent temperatures corresponding to the measured data. This processing was accomplished in a modification of the MODROD program, called RODMOD.

B. Data Tables and Plots

A typical computer printout of the MODROD program is shown in Tables VI-1A and 1B. Page 1 of this output lists the run information and the calibration parameters. The minimum and maximum calibration temperature are the cold and hot load temperatures referred to the antenna input. The k factor is the slope of the best fit straight line between the three calibration points. The calculated maximum, minimum and zenith temperatures are the temperatures represented by the calibration data points for the hot load, cold load and zenith sky. The amount by which these values differ from the maximum and minimum calibration temperatures and the zenith sky temperature is indicative of the fit of the best straight line calibration curve. The comments for the run are also printed out on this page.

Page 2 of this output tabulates the radiometric voltage, and the computed apparent temperature for each of the zenith angle measurements. Each radiometric voltage is the average of ten one second readings. The tabulated tolerances represent the maximum and minimum of these ten readings converted to a temperature difference. This tolerance was used for a variety of purposes. First it highlights any key punching errors, second it identifies points of possible interference and third it is a gross representation of the sensitivity of the equipment.

Tables VI-2 through VI-41 are the computer printouts from the APCOR4 program. These provide a tabulation of the apparent and brightness temperatures as a function of zenith angle. Figures VI-2 through VI-39 are standard plots of the apparent and brightness temperature and Figures VI-40 through VI-77 are expanded plots showing the temperature variation over the water. These plots may be analyzed more readily if the environment profile is known. Figure VI-1B describes the profile and shows the observation zenith angles. The sea water observations were limited to a zenith angle range between 90^0 and approximately 126^0. Near the zenith angle of 126^0 the antenna beam intercepted the large rip-rap boulders which surrounded the island.

The 9.5 GHz curves are included in the standard plots (Figures VI-33 thru VI-39), but as previously discussed their value is questioned as there was interference present at this frequency. Three other curves merit special mention at this point. Runs 11 and 12 (Figures VI-9 and VI-10) were taken while it was raining. The general shape of the curves and the high sky temperatures cast doubt on their validity. The second set of curves in these figures represent a two point calibration (the first set uses a three point calibration). Run 35 (Figure VI-31) was taken when there were heavy thunder squall clouds on the observation azimuth and probably some heavy rain 3 to 5 miles from the observation site. This accounts for the relatively high temperature just above the horizon.

The expanded plots of the 9.5 GHz runs are shown in Figures VI-71 thru VI-77. The 16.5 GHz expanded plots are shown in Figures VI-40 thru VI-70. The temperature rise as the antenna beam intercepts the large boulders at the island edge is observable on all these plots at a zenith angle of about 126^0. The computer printouts from ROCK 3 are reproduced in Tables VI-42 thru VI-61. The computed sea water temperatures from ROCK 3 are plotted on Figures VI-78 thru VI-96. The thermometric water temperature over the total period of measurements was within about $\pm 1.5^0$ of 299.5^0K. The computed water temperatures are in agreement with this thermometric temperature on all of the 16.5 GHz plots (with the exception of Run 11) at a zenith angle that falls in the range of 103^0 to 114^0. Thus a possible range of the invariant angle is suggested. The average value of this invariant angle is 109^0.

ROCKFN computed the apparent sea water temperature for the horizontal runs using the permittivity values calculated in the adjacent vertical runs by ROCK 3. This restrained the allowable horizontal emissivity values and hence the output plots are referred to as restrained emissivity curves. The output data for the 16.5 GHz horizontal runs is plotted in Figure VI-97 thru VI-111. The apparent sea water temperature is quite different than the thermometric temperature. Examinations of these curves has shown no correlation with sea state.

ROCKFN also computed the apparent sea water temperature for both the horizontal and vertical runs using the theoretical value of permittivity for sea water at 299^0K. This set of reference curves is plotted in Figure VI-112 thru VI-126.

The derived emissivities from the computer program EMISS are plotted in Figures VI-127 thru VI-163. The computer printouts for the derived emissivity are reproduced in Tables VI-62 thru VI-99. No direct correlation with sea state has been found in either the horizontal or vertical emissivity plots.

The radiometric measurements from the stability runs and the switched polarization runs have only been converted to apparent radiometric temperatures. These are plotted on Figures VI-164 thru VI-182 for the stability runs and on Figures VI-183 thru VI-191 for the switched polarization runs. Figures VI-192 and VI-193 are plots of a 9.5 GHz zenith stability run. These 9.5 GHz curves show severe interference toward the end of the run. These runs are plotted as a function of time, each plot presenting a total time interval of 1000 seconds or about 16-2/3 minutes. Those stability runs which took longer than that were plotted on successive plots.

The horizon check runs were made at both 16.5 and 9.5 GHz. These runs were made at a zenith angle of 90^0 and through a full 360^0 rotation in azimuth. These runs were plotted on the computer but are not included in this report since they are quite long.

The 9.5 GHz run showed severe interference at many points. Some of these were concentrated near the Norfolk Navy Yard and the Norfolk Municipal Airport, others were in areas where no specific local source could be identified. The apparent radiometric temperatures over the 360^0 azimuth rotation varied from a high of 498.9^0K to a low of 178.8^0K for vertical polarization and from 456.4K to 123.6^0K for horizontal polarization.

The 16.5 GHz horizon check produced a much smoother curve, indicating much less interference. The apparent radiometric temperature ranges from 239.3^0K to 166.7^0K with the highest consistent temperatures being observed when the antenna was viewing the brick ventilation building on the island. The nominal building temperature was about 220^0K, about 50^0K above the nominal horizon temperature of 170^0K.

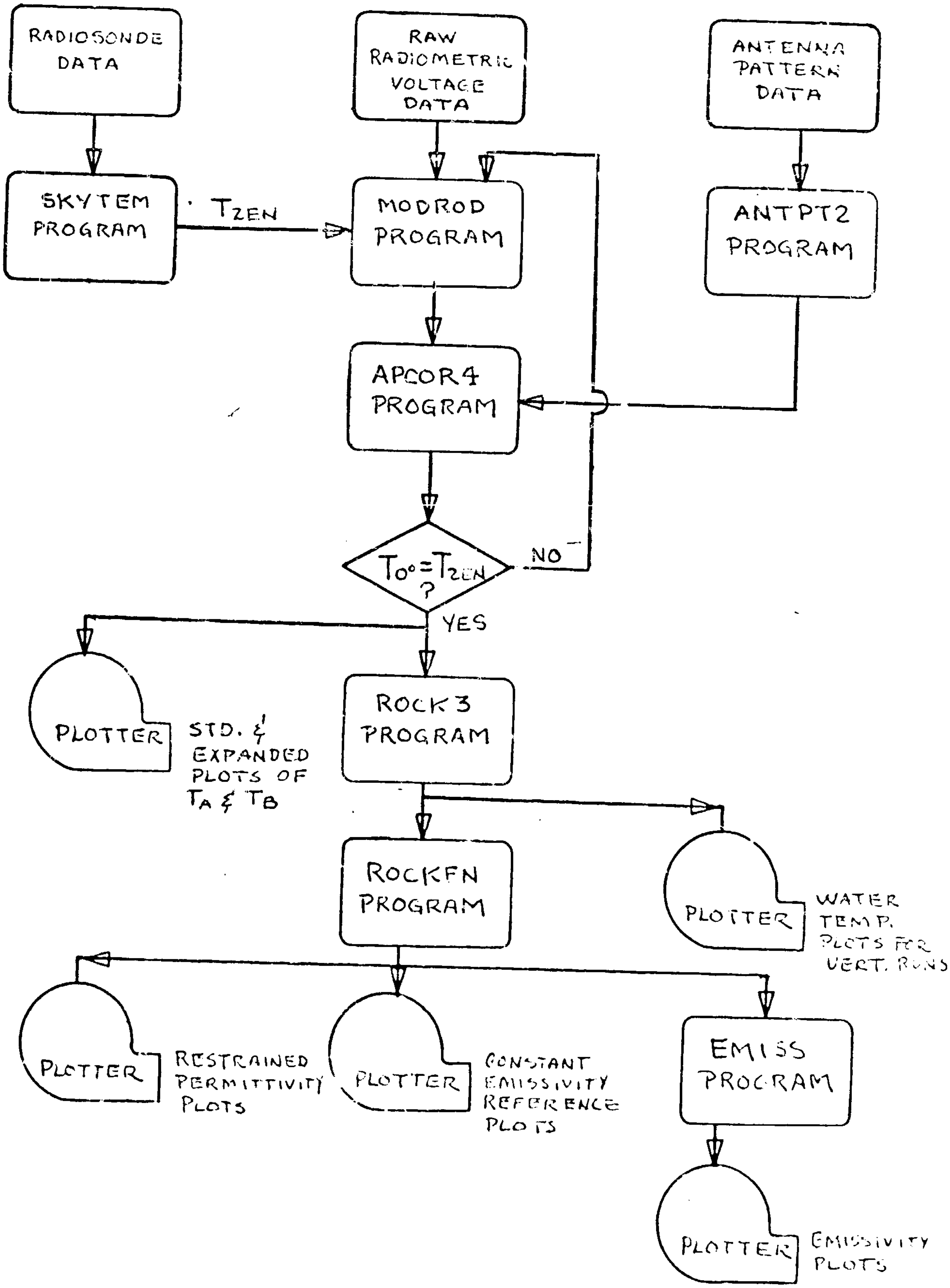


FIGURE VI-1A DATA ANALYSIS FLOW

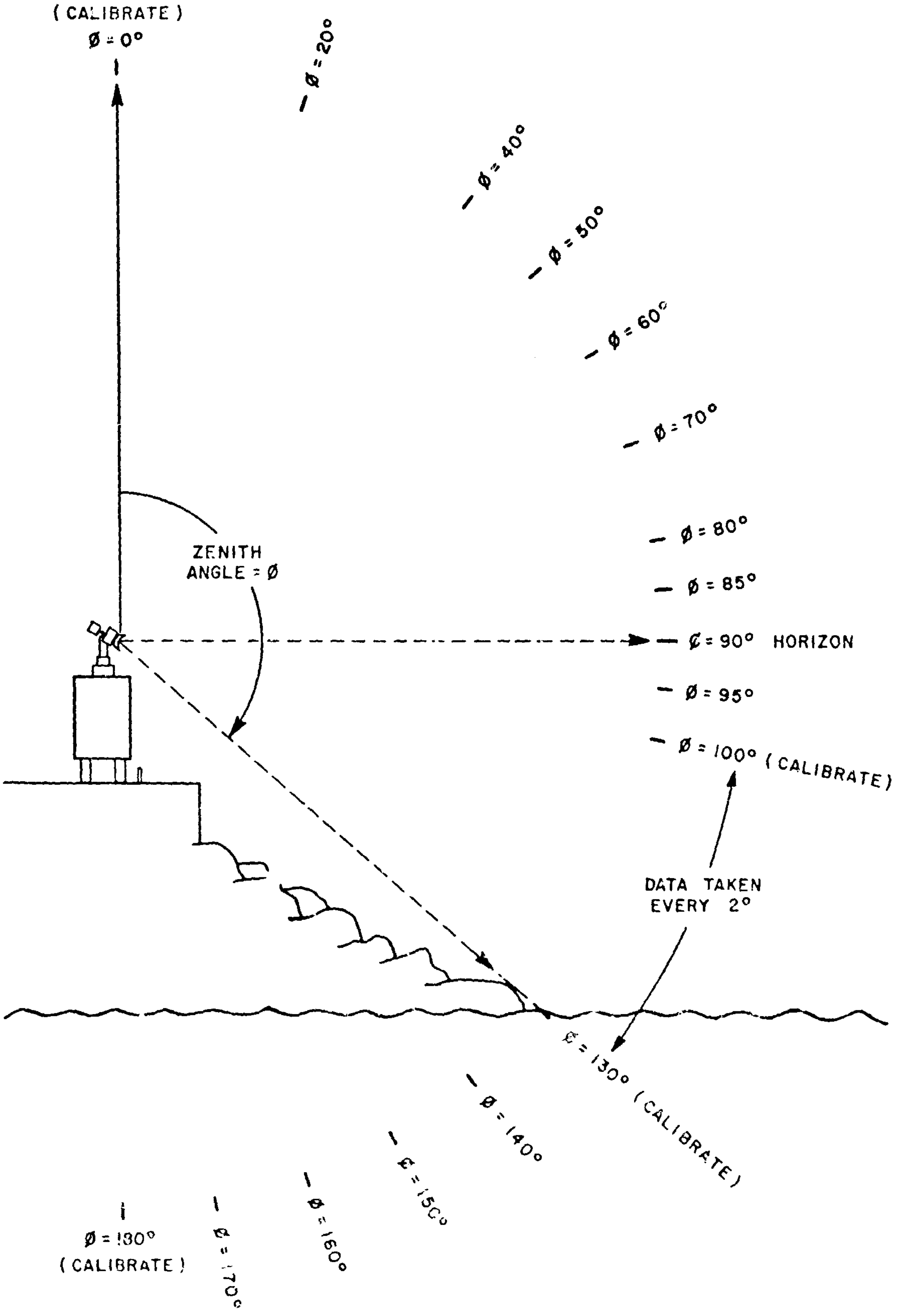


FIGURE VI-1B. MEASUREMENT SITE ENVIRONMENTAL PROFILE

PAGE 1 RUN 17

DATA DATE	08/07/69
START TIME	165500
FREQUENCY,GHZ	16.5
POLARIZATION	H
ANTENNA AZIMUTH,DEG	310
INTEGRATION TIME,SEC	01
ZENITH SKYTEMP	18.0

CALIBRATION DATA	INITIAL	CAL2	CAL3	FINAL
MIN. CAL. TEMP,DEG.K	307.91	307.35	307.19	307.09
MAX, CAL. TEMP,DEG.K	408.81	408.04	410.75	409.15
K-FAC.,DEG.K/MV.	0.2498	0.2494	0.2491	0.2487
Y-INTERCEPT, DEG.K	-1372.22	-1370.22	-1369.19	-1363.43

CALIBRATION CONSTANTS	INITIAL	CAL2	CAL3	FINAL
HOT LOAD	401.50	400.90	403.50	402.00
CAL WGS - MIN	317.40	317.30	317.00	317.00
CAL WGS - MAX	317.80	317.70	317.50	317.50
WAVE GUIDE SWITCH	313.00	314.00	314.50	315.10
ANTENNA	300.90	301.50	301.50	301.00
COLD LOAD	307.00	306.60	306.50	306.40
AVERAGE CAL.DATA-MAX.	7130.90	7127.20	7146.50	7128.80
-MIN.	6726.00	6729.70	6728.50	6717.70
-ZENITH	5566.00	5565.10	5569.20	5555.60
CALC. MAX TEMP.	408.91	407.38	410.99	409.22
CALC. MIN TEMP.	307.78	308.24	306.87	306.99
CALC. ZENITH TEMP.	18.04	17.77	18.09	18.02

COMMENTS
2-5 % CIRRUS CLOUDS DRIFTING OVERHEAD
1 FOOT SWELL 6-8 INCH CHOP WIND SOUTH 5-10 MPH
HL-0-401.5 CL-0-307.0 INIT // HL-0-400.9 CL-0-306.6 CAL2 //
HL-0-403.5 CL-0-306.5 CAL3 // HL-0-402.0 CL-0-306.4 FINI //

TABLE VI-1A SAMPLE MODROD OUTPUT

PAGE 2 RUN 17

DATA DATE 08/07/69
START TIME 1655
FREQUENCY,GHZ 16.5
POLARIZATION H

ZENITH ANGLE DEG	APPARENT TEMP DEG K	READINGS MV	TOLERANCE +DEG	-DEG
0.0	13.8	5549.	1.9	2.5
20.0	20.7	5577.	2.6	1.6
40.0	27.7	5605.	1.3	1.5
50.0	32.8	5625.	1.2	2.0
60.0	42.9	5666.	1.5	1.9
70.0	56.5	5720.	1.7	3.1
80.0	83.0	5826.	3.1	2.3
85.0	120.2	5976.	2.8	2.4
90.0	162.9	6147.	1.6	1.9
95.0	116.3	5960.	2.7	3.5
100.0	112.6	5945.	2.0	2.3
102.0	113.8	5950.	2.4	2.3
104.0	115.5	5957.	3.9	2.3
106.0	115.8	5959.	2.8	4.2
108.0	120.2	5977.	1.6	1.6
110.0	123.5	5990.	0.9	1.6
112.0	126.8	[illegible]04.	3.1	3.1
114.0	129.1	6013.	1.0	1.7
116.0	134.3	6034.	3.7	2.1
118.0	137.3	6046.	1.9	1.1
120.0	141.7	6064.	1.9	3.1
122.0	144.4	6076.	2.1	2.1
124.0	150.5	6100.	2.9	2.3
126.0	161.2	6143.	2.9	1.8
128.0	201.8	6306.	3.4	5.3
130.0	249.9	6500.	0.0	0.0
140.0	283.7	6633.	0.9	0.8
150.0	287.8	6647.	1.7	2.0
160.0	279.7	6613.	1.8	1.4
170.0	213.6	6344.	3.4	2.3
180.0	196.4	6273.	2.5	1.5

TABLE VI-1B SAMPLE MODROD OUTPUT

RUN NO. 1 07/25/69 H POLAR. 9.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	3.91	10.68	-6.8690
13.93	10.35	14.85	-4.5023
19.75	13.08	17.55	-4.4724
24.25	15.69	20.03	-4.3377
28.07	18.74	22.39	-3.6482
31.47	15.81	21.58	-5.7704
34.56	19.38	24.44	-5.0592
37.43	23.05	27.78	-4.7283
40.12	27.09	31.52	-4.4310
42.67	31.12	35.59	-4.4696
45.10	41.25	42.91	-1.6549
47.43	45.29	46.85	-1.5631
49.68	48.54	49.85	-1.3280
51.85	50.94	52.03	-1.0907
53.97	52.75	53.44	-0.6851
56.03	47.15	50.90	-3.7462
58.03	48.58	52.06	-3.4792
60.00	50.19	53.64	-3.4510
61.93	52.03	55.63	-3.5961
63.82	54.04	58.00	-3.9569
65.68	62.31	63.65	-1.3534
67.52	64.34	66.05	-1.7158
69.33	65.98	68.00	-2.0212
71.12	67.25	69.53	-2.2801
72.90	68.50	70.65	-2.1644
74.65	70.03	71.40	-1.3671
76.39	52.59	62.55	-9.9820
78.12	57.35	65.65	-8.3155
79.84	63.43	70.72	-7.2916
81.54	71.24	77.72	-6.4796
83.24	92.07	91.54	0.5339
84.94	99.00	97.73	1.2711
86.63	102.30	100.91	1.3862
88.31	93.97	97.42	-3.4540
90.00	94.77	98.34	-3.5708
91.69	96.57	100.04	-3.4757
93.37	95.76	100.97	-5.2082
95.06	101.31	105.89	-4.5830
96.76	109.75	113.24	-3.4935
98.45	126.65	125.51	1.1380
100.16	138.16	134.95	3.2127
101.88	153.16	144.44	8.7216
103.61	165.41	149.49	15.9222
105.35	96.89	112.23	-15.3364
107.10	96.31	110.49	-14.1748
108.38	116.24	122.38	-6.1421
110.67	134.32	135.41	-1.0924
112.48	147.23	145.53	1.7022
114.32	171.57	158.75	12.8056
116.18	136.28	138.71	-2.4347
118.07	102.14	118.44	-16.3042
120.00	93.07	114.10	-21.0265
121.97	127.51	136.57	-9.0567
123.97	140.61	152.62	-12.0120
126.03	208.00	198.57	9.4207
128.14	235.37	225.17	10.1994
130.32	286.08	262.39	23.6906
132.57	316.16	285.89	30.2666
134.90	330.34	294.99	35.3470
137.33	264.98	259.03	5.9412
139.88	272.27	260.59	11.6778
142.57	274.64	262.88	11.7609
145.44	286.13	270.69	15.4431
148.53	287.34	272.65	14.6833
151.93	284.13	271.71	12.4115
155.75	294.58	275.81	18.7650
160.25	275.37	254.69	20.6805
166.07	140.06	167.62	-27.5621
180.00	146.89	160.50	-13.6076

ABS. CORRECTION = 7.90E 00 DEG. K

TABLE VI-2. APCOR4 OUTPUT

RUN NO. 2 07/25/69 V POLAR, 9.[illegible] GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	3.67	21.64	-17.9661
13.93	42.50	44.55	-2.0475
19.75	49.19	52.26	-3.0736
24.25	54.65	57.49	-2.8286
28.07	58.71	61.40	-2.6941
31.47	60.07	63.61	-3.5399
34.56	62.59	66.27	-3.6846
37.43	64.63	68.61	-3.9830
40.12	66.43	70.70	-4.2752
42.67	67.94	72.58	-4.6450
45.10	71.30	75.30	-4.0072
47.43	72.32	76.62	-4.2995
49.68	72.86	77.41	-4.5465
51.86	72.92	77.71	-4.7851
53.97	72.61	77.57	-4.9532
56.03	68.21	75.25	-7.0388
58.03	67.59	74.93	-7.3431
60.00	66.99	74.83	-7.8430
61.93	66.50	74.93	-8.4334
63.82	66.21	75.22	-9.0133
65.68	66.21	75.74	-9.5261
67.[illegible]	66.30	76.37	-10.0769
69.33	66.52	77.17	-10.6504
71.12	67.01	78.11	-11.1066
72.90	68.36	79.20	-10.8467
74.65	70.98	80.44	-9.4625
76.39	45.15	57.69	-12.5469
78.12	54.27	73.98	-19.7135
79.84	66.65	84.00	-17.3588
81.54	82.81	97.70	-14.8933
83.24	100.40	113.74	-13.3384
84.96	126.33	135.89	-9.5660
86.63	158.10	152.93	-4.8300
88.31	220.41	205.97	14.4371
90.00	250.58	231.65	18.9318
91.69	273.04	250.93	22.1133
93.37	286.04	262.87	23.1667
95.06	294.82	270.35	24.4756
96.76	296.92	272.38	24.5462
98.46	279.20	263.07	16.1249
100.16	276.50	260.78	15.7188
101.88	276.14	259.48	16.6554
103.61	267.29	253.50	13.7873
105.35	260.00	247.72	12.2813
107.10	245.70	238.23	7.4730
108.88	237.62	232.17	5.4536
110.67	236.79	230.12	6.6684
112.48	232.44	226.09	6.3539
114.32	227.18	220.65	6.5241
116.18	196.79	201.95	-5.1654
118.07	190.25	195.75	-5.5025
120.00	186.39	192.15	-5.7562
121.97	176.91	187.41	-10.4979
123.97	178.24	190.99	-12.7512
126.03	208.66	212.88	-4.2201
128.14	253.71	244.07	9.6440
130.[illegible]	275.36	262.66	12.7007
132.57	290.70	275.38	15.3172
134.90	299.12	281.37	17.7572
137.33	273.10	267.65	5.4466
139.88	276.51	268.83	7.6772
142.57	276.80	269.31	7.4914
145.44	277.17	269.68	7.4860
148.33	274.53	267.91	6.6177
151.93	268.00	264.09	3.9049
155.75	280.85	268.59	12.2628
160.25	259.91	245.30	14.6043
166.07	116.73	152.17	-35.4363
180.00	117.76	140.56	-22.7780

ABS CORRECTION = 1.06E 01 DEG. K

TABLE VI-3. APCOR4 OUTPUT

RUN NO. 4 07/29/69 V POLAR. 16.5 GHZ. SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	12.85	27.13	-14.2759
13.93	31.37	38.50	-7.1222
19.75	34.73	42.61	-7.8792
24.25	37.18	45.54	-8.3570
28.07	37.55	47.25	-9.6990
31.47	40.62	50.41	-9.9024
34.56	43.69	53.94	-10.2431
37.43	45.40	56.86	-11.4539
40.12	50.62	61.91	-11.2844
42.67	56.29	67.76	-11.4677
45.10	70.22	78.09	-7.8713
47.63	76.71	84.38	-7.6677
49.68	82.35	89.71	-7.3579
51.86	86.89	94.18	-7.2961
53.97	90.82	97.88	-7.0650
56.03	86.91	97.37	-10.4590
58.03	90.68	100.91	-10.2322
60.00	94.78	104.96	-10.1805
61.93	99.51	109.50	-9.9916
63.82	105.04	114.50	-9.4656
65.68	108.13	118.43	-10.3052
67.52	115.24	124.68	-9.4440
69.33	123.26	131.76	-8.4927
71.12	132.33	139.63	-7.3052
72.90	142.39	148.30	-5.9092
74.65	153.25	157.72	-4.4746
76.35	169.97	170.36	-0.3808
78.12	181.66	180.46	1.1965
79.84	193.75	190.69	3.0624
81.54	206.13	201.05	5.0[illegible]7
83.24	218.85	211.58	7.2690
84.94	231.63	222.16	9.4490
86.63	244.46	232.89	11.5705
88.31	264.15	246.84	17.3059
90.00	273.27	254.69	18.5851
91.69	276.64	259.51	19.1308
93.37	274.91	258.91	15.9997
95.06	275.72	260.21	15.5166
96.76	275.75	260.97	14.7839
98.46	275.90	261.56	14.3445
100.16	27[illegible].05	260.79	13.2575
101.88	270.99	259.08	11.9090
103.61	264.11	25[illegible].34	8.7603
105.35	264.94	255.51	9.4384
107.10	261.51	253.42	8.0816
108.88	257.02	250.58	6.4490
110.67	252.58	247.56	5.0189
112.48	247.21	243.91	3.2995
114.32	241.34	240.03	1.8056
116.18	231.25	233.46	-2.2066
118.07	228.55	231.05	-2.5064
120.00	223.09	227.42	-4.3284
121.97	216.69	223.36	-6.6704
123.97	208.58	218.83	-10.2448
126.03	207.17	218.74	-11.5692
128.14	211.19	223.50	-12.3135
130.32	245.90	245.86	0.0407
132.57	269.1[illegible]	253.71	6.4097
134.90	285.14	274.28	10.8625
137.33	277.25	272.14	5.10[illegible]
139.88	283.32	278.30	8.0215
142.37	291.93	282.59	9.3375
145.44	292.29	283.44	8.8444
148.53	292.15	283.35	8.7927
151.93	288.83	280.85	7.9813
155.75	281.16	274.88	6.2741
160.25	268.45	264.10	4.3352
166.07	236.16	239.94	-3.7821
180.00	170.04	200.98	-30.9427

ABS. CORRECTION = 8.95E 00 DEG. K

TABLE VI-4. APCOR4 OUTPUT

RUN NO. 5 08/01/69 V POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	12.60	19.37	-6.7699
13.93	20.94	24.62	-3.6812
19.75	23.38	27.22	-3.8381
24.25	25.41	29.40	-3.9864
28.07	27.13	31.36	-4.2315
31.47	28.10	32.90	-4.8015
34.56	29.55	34.69	-5.1381
37.43	30.91	36.46	-5.5518
40.12	32.10	38.22	-6.1162
42.67	33.11	39.97	-6.8631
45.10	34.16	41.78	-7.6212
47.43	35.08	43.52	-8.4370
49.68	36.01	45.23	-9.2204
51.86	36.97	46.97	-9.9618
53.97	38.10	48.62	-10.5241
56.03	37.10	49.23	-12.1279
58.03	38.66	51.26	-12.6043
60.00	40.51	53.64	-13.1345
61.93	42.78	56.34	-13.5582
63.82	45.58	59.34	-13.7568
65.68	47.17	61.82	-14.6473
67.52	50.98	65.39	-14.6107
69.33	55.32	69.86	-14.5419
71.12	60.25	74.61	-14.3559
72.90	65.89	79.83	-13.9384
74.65	72.39	85.50	-13.1137
76.39	72.69	88.28	-15.5947
78.12	81.59	95.99	-14.3951
79.84	91.80	104.99	-13.1931
81.54	103.84	115.27	-11.4261
83.24	107.20	121.86	-14.6592
84.94	128.89	139.37	-10.4736
86.63	158.19	163.10	-4.9073
88.31	223.55	206.03	17.5220
90.00	252.22	229.18	23.0359
91.69	272.23	245.35	26.8799
93.37	274.81	250.74	24.0733
95.06	281.53	256.96	24.5663
96.76	284.15	260.14	24.0048
98.46	276.65	257.42	19.2329
100.16	275.80	257.70	18.1059
101.88	275.00	257.94	17.0623
103.61	276.97	259.21	17.7615
105.33	267.36	255.17	13.1947
107.10	262.27	251.26	11.0[illegible]4
108.88	260.35	250.10	10.2526
110.67	258.66	248.95	9.7084
112.48	250.87	244.44	6.4260
114.32	244.04	240.31	3.7256
116.18	241.26	238.24	3.0221
118.07	232.55	233.25	-0.6983
120.00	228.12	230.70	-2.5754
121.97	227.53	230.41	-2.886[illegible]
123.97	220.47	226.99	-6.5235
126.03	211.59	223.59	-11.9908
128.14	219.19	231.36	-12.1682
130.32	267.96	262.90	5.0577
132.57	298.82	285.50	13.3198
134.90	318.24	299.30	18.9345
137.33	293.67	288.21	5.4572
139.68	304.44	295.03	9.4067
142.57	311.13	300.35	10.7726
145.44	313.79	303.02	10.7714
148.53	315.73	304.82	10.9077
151.93	314.65	304.64	10.0126
155.75	316.15	304.56	11.5952
160.25	304.67	294.35	10.3254
166.07	256.12	260.21	-4.0872
180.00	180.40	215.09	-34.6918

ABS. CORRECTION = 1.15E 01 DEG, K

TABLE VI-5. APCOR4 OUTPUT

RUN NO. 6 08/01/69 H POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	12.51	16.35	-3.8527
13.93	13.64	17.51	-3.8755
19.75	14.74	18.89	-4.1514
24.25	15.9[illegible]	20.31	-4.3945
28.07	17.34	21.77	-4.4382
31.47	16.62	22.14	-5.5177
34.56	18.22	23.86	-5.6361
37.43	19.88	25.79	-5.9106
40.12	21.73	27.89	-6.1626
42.67	23.78	30.13	-6.3511
45.10	25.60	32.26	-6.6581
47.43	28.21	34.81	-6.6046
49.68	31.15	37.57	-6.4221
51.86	34.31	40.52	-6.2101
53.97	37.63	43.65	-6.0232
56.03	42.68	47.74	-5.0597
58.03	45.99	50.93	-4.9384
60.00	49.23	54.02	-4.7921
61.93	52.42	57.02	-4.5952
63.82	55.73	59.93	-4.2012
65.68	54.28	60.43	-6.1514
67.52	58.04	63.76	-5.7204
69.33	62.29	67.66	-5.3749
71.12	67.18	72.11	-4.9237
72.90	73.02	77.08	-4.0678
74.65	80.15	82.58	-2.4341
76.39	73.40	81.34	-7.9340
78.12	85.07	90.30	-5.2318
79.84	98.79	101.61	-2.8255
81.54	114.91	115.24	-0.3273
83.24	143.24	135.51	7.7278
84.94	159.66	149.58	10.0728
86.63	173.29	161.57	11.7230
88.31	198.37	177.87	20.4968
90.00	199.39	179.36	20.0301
91.69	190.29	172.32	17.9678
93.37	143.26	144.22	-0.9588
95.06	129.48	133.28	-3.7958
96.76	120.79	126.77	-5.9826
98.46	124.88	128.14	-3.2583
100.16	122.10	126.69	-4.5902
101.88	120.59	126.07	-5.4815
103.61	120.07	126.17	-6.0944
105.35	119.53	126.57	-7.0362
107.10	122.74	129.19	-6.4518
108.88	126.04	132.04	-6.0055
110.67	127.90	134.15	-6.2663
112.48	127.91	135.37	-7.4584
114.32	131.39	138.43	-7.0410
116.18	135.24	141.72	-6.4796
118.07	133.00	141.98	-8.9804
120.00	135.87	145.07	-9.1950
121.97	140.54	149.60	-9.0637
123.97	140.65	153.12	-12.4676
126.03	147.99	163.76	-15.7683
128.14	195.61	199.95	-4.3334
130.32	277.09	256.46	20.6377
132.57	325.36	293.96	32.3997
134.90	353.17	311.73	41.4346
137.33	273.45	269.10	4.3439
139.88	288.49	275.35	13.1316
142.57	296.11	281.64	14.4698
145.44	308.83	291.21	17.6229
148.53	313.55	296.03	17.5165
151.93	314.42	297.97	16.4576
155.75	319.29	300.20	19.0922
160.25	306.14	287.37	18.7743
166.07	234.65	237.39	-2.7318
180.00	155.28	189.42	-34.1447

ABS. CORRECTION = 9.11E 00 DEG. K

TABLE VI-6. APCOR4 OUTPUT

RUN NO. 7 08/01/69 H POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	12.58	15.70	-3.1248
13.93	12.08	15.97	-3.8947
19.75	13.29	17.36	-4.0758
24.25	14.68	18.95	-4.2674
28.07	16.00	20.65	-4.6545
31.47	19.28	23.44	-4.1659
34.56	20.41	25.10	-4.6848
37.43	21.47	26.65	-5.1771
40.12	22.46	28.12	-5.6562
42.67	23.55	29.51	-5.9687
45.10	22.70	29.84	-7.1392
47.43	24.16	31.38	-7.2174
49.68	26.10	33.29	-7.1918
51.85	28.43	35.55	-7.1201
53.97	31.07	38.12	-7.0513
56.03	35.65	41.80	-6.1558
58.03	38.53	44.66	-6.1256
60.00	41.46	47.51	-6.0535
61.93	44.46	50.36	-5.8977
63.82	47.70	53.22	-5.5173
65.68	45.90	53.55	-7.6495
67.52	49.83	57.03	-7.2031
69.33	54.36	61.19	-6.8295
71.12	59.74	66.02	-6.2875
72.90	66.49	71.50	-5.0146
74.65	75.38	77.61	-2.2272
76.39	55.74	59.67	-13.9392
78.12	72.79	81.98	-9.1881
79.84	93.38	98.62	-5.2396
81.54	118.22	119.53	-1.3132
83.24	173.39	156.30	17.0928
84.94	195.07	174.67	20.3986
86.63	207.64	185.60	22.0434
88.31	210.16	188.64	21.5195
90.00	205.54	185.35	20.1869
91.69	192.65	175.23	17.4216
93.37	146.91	147.17	-0.2629
95.06	131.47	135.03	-3.5511
96.76	121.45	127.52	-6.0710
98.46	124.93	128.28	-3.3505
100.16	121.20	126.05	-4.8565
101.88	118.79	124.70	-5.9143
103.61	115.13	123.12	-7.9915
105.35	117.25	125.05	-7.8021
107.10	125.45	130.42	-4.9714
108.88	126.38	132.08	-5.7007
110.67	122.02	131.13	-9.1109
112.48	131.88	137.58	-5.6985
114.32	139.07	142.48	-3.4098
116.18	124.04	136.07	-12.0347
118.07	137.28	144.46	-7.1772
120.00	142.80	149.40	-6.6044
121.97	142.56	151.48	-8.9145
123.97	144.44	155.58	-11.1347
126.03	145.85	162.88	-17.0250
128.14	200.13	201.72	-1.5883
130.32	268.70	250.46	18.2392
132.57	311.85	283.69	28.1645
134.90	336.57	300.59	35.9844
137.33	273.97	267.89	6.0769
139.88	288.46	274.88	13.5820
142.57	296.52	281.59	14.9384
145.46	308.23	290.60	17.6303
148.53	312.88	295.33	17.5527
151.93	313.65	297.15	16.4954
155.75	317.86	298.99	18.8658
160.25	304.87	286.29	18.5824
166.07	232.46	236.69	-4.2282
180.00	169.11	197.45	-28.3368

ADJ. CORRECTION = 9.66E 00 DEG. K

TABLE VI-7. APCOR4 OUTPUT

RUN NO. 8 08/01/69 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	14.52	16.85	-2.3305
13.95	10.01	14.88	-4.86[illegible]3
19.75	10.93	15.92	-4.9910
24.25	12.05	17.47	-5.4262
28.07	13.34	19.31	-5.9722
31.47	15.97	21.90	-5.9330
34.56	17.50	23.97	-6.4624
37.43	19.01	26.05	-7.0464
40.12	20.39	28.17	-7.7780
42.67	21.71	30.31	-8.5944
45.10	22.62	32.24	-9.6231
47.43	24.14	34.49	-10.3441
49.68	25.89	36.85	-10.9633
51.85	27.79	39.34	-11.5516
53.97	29.90	41.93	-12.0293
56.03	31.22	44.15	-12.9359
58.03	33.79	47.10	-13.3129
60.00	36.60	50.29	-13.6932
61.93	39.73	53.71	-13.9762
63.82	43.36	57.35	-13.9938
65.68	44.69	59.87	-15.1857
67.52	49.37	64.26	-14.8941
69.33	54.59	69.20	-14.6147
71.12	60.38	74.69	-14.3137
72.90	67.09	80.71	-13.6210
74.65	75.31	87.25	-11.7422
76.39	60.38	82.18	-21.7934
78.12	75.76	93.84	-18.0816
79.84	94.57	109.09	-14.5210
81.54	117.67	127.88	-10.2123
83.24	151.67	153.00	-1.3333
84.94	180.71	176.11	4.6017
86.63	210.29	199.87	10.4236
88.31	258.25	232.51	25.7471
90.00	278.61	249.39	29.2207
91.69	289.33	258.61	30.7178
93.37	274.68	253.08	21.6011
95.05	275.18	254.47	20.7157
96.75	275.20	255.54	19.6518
98.46	271.67	254.79	16.8861
100.16	274.01	257.01	17.0014
101.88	279.86	260.84	19.0136
103.61	275.59	259.05	16.5320
105.35	272.54	257.23	15.3094
107.10	264.45	252.35	12.1053
108.88	254.18	246.11	8.0701
110.6[illegible]	245.39	240.81	4.5816
112.48	245.42	240.22	5.2049
114.32	238.35	236.07	2.2852
116.18	233.17	232.77	0.3927
118.07	229.50	230.24	-0.7421
120.00	219.27	224.57	-5.2987
121.97	217.16	223.46	-6.3044
123.97	215.73	223.19	-7.4698
126.03	205.25	219.54	-14.2892
128.14	222.46	232.54	-10.0825
130.32	265.02	260.83	4.1955
132.57	293.18	281.62	11.5657
134.90	311.61	294.89	16.7213
137.33	292.81	2[illegible]7.05	5.7655
139.88	303.61	294.15	9.4475
142.57	310.73	299.84	10.6836
145.44	313.49	302.76	10.7347
148.53	316.28	305.22	11.0560
151.93	316.31	306.04	10.2716
155.75	322.99	309.13	13.8629
160.25	312.30	299.22	13.0746
166.07	256.00	260.12	-4.1186
180.00	172.47	210.06	-37.5930

ABS. CORRECTION = 1.15E 01 DEG. K

TABLE VI-8. APCOR4 OUTPUT

RUN NO. 9 08/01/69 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0.

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	12.93	17.63	-5.0966
13.93	13.46	18.97	-5.5134
19.75	14.94	20.95	-6.0108
24.25	16.46	23.05	-6.5915
28.07	17.83	25.23	-7.3950
31.47	19.86	27.89	-8.0272
34.56	21.01	30.09	-9.0837
37.43	22.22	32.27	-10.0453
40.12	23.47	34.44	-10.9699
42.67	24.84	36.60	-11.7528
45.10	24.64	37.92	-13.2765
47.43	26.24	40.27	-14.0335
49.68	28.25	42.96	-14.7101
51.86	30.72	45.97	-15.2431
53.97	33.72	49.26	-15.5375
56.03	35.42	51.98	-16.5656
58.03	39.50	56.08	-16.5731
60.00	44.15	60.68	-16.5287
61.93	49.53	65.76	-16.2312
63.82	56.36	71.31	-14.9536
65.68	46.64	68.67	-22.0278
67.52	56.97	77.16	-20.1875
69.33	70.07	88.36	-18.2906
71.12	86.58	102.20	-15.6188
72.90	106.09	118.59	-12.5003
74.65	127.30	137.48	-10.1834
76.39	187.72	176.89	10.8364
78.12	206.86	194.52	12.3345
79.84	224.95	209.94	15.0102
81.54	240.72	223.20	17.5187
83.24	253.80	234.41	19.3868
84.94	263.94	243.40	20.5406
86.63	271.43	250.27	21.1635
88.31	274.86	254.38	20.4830
90.00	277.89	257.69	20.1998
91.69	279.14	259.57	19.5690
93.37	275.98	258.82	17.1572
95.06	275.29	259.12	16.1729
96.76	274.38	259.23	15.1480
98.46	273.93	259.46	14.4675
100.16	272.14	258.86	13.2822
101.88	269.66	257.73	11.9328
103.61	267.60	256.58	11.0206
105.35	260.33	252.66	7.6638
107.10	259.68	252.00	7.6719
108.88	255.61	249.51	6.1045
110.67	248.18	245.22	2.9503
112.48	247.61	244.34	3.2674
114.32	239.89	239.77	0.1135
116.18	234.75	236.40	-1.6526
118.07	227.94	232.43	-4.4966
120.00	227.07	231.84	-4.7696
121.97	223.32	230.12	-6.8015
123.97	221.90	229.82	-7.9213
126.03	216.08	228.28	-12.2052
128.14	229.36	233.63	-9.2757
130.32	267.68	263.73	3.9467
132.57	292.67	281.92	10.7468
134.90	308.63	293.19	15.4443
137.33	290.47	285.13	5.3361
139.88	299.17	290.65	8.5197
142.57	304.22	294.78	9.4369
145.46	310.45	298.90	11.5414
148.53	309.82	298.56	11.2659
151.93	304.57	294.08	10.4883
155.75	282.04	278.97	3.0656
160.25	265.09	265.46	-0.3689
166.07	237.50	246.31	-8.8159
180.00	220.03	235.06	-15.0316

ABS. CORRECTION = 1.16E 01 DEG. K

TABLE VI-9. APCOR4 OUTPUT

RUN NO. 10 08/01/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	12.70	19.79	-7.0901
13.93	18.86	24.18	-5.3225
19.75	21.01	26.81	-5.8012
24.25	23.12	29.16	-6.0405
28.07	25.11	31.37	-6.2612
31.47	25.03	32.55	-7.5267
34.56	26.88	34.82	-7.9413
37.43	28.71	37.21	-8.4987
40.12	30.82	39.70	-8.8727
42.67	33.43	42.27	-8.8416
45.10	32.95	43.22	-10.2675
47.43	36.40	46.35	-9.9565
49.68	40.76	50.27	-9.5111
51.86	45.77	54.88	-9.1102
53.97	51.08	60.13	-9.0483
56.03	65.57	70.25	-4.6886
58.03	70.39	75.20	-4.8098
60.00	74.62	79.31	-4.6902
61.93	78.44	82.64	-4.1997
63.82	82.69	85.24	-2.5496
65.68	61.28	74.61	-13.3231
67.52	67.38	78.85	-11.4764
69.33	75.70	85.80	-10.0982
71.12	86.84	95.36	-8.5239
72.90	100.88	107.45	-6.5777
74.65	117.53	122.02	-4.4891
76.39	148.99	144.86	4.1318
78.12	169.06	162.24	6.8240
79.84	190.51	180.47	10.0384
81.54	212.86	199.57	13.2870
83.24	260.30	230.59	29.7165
84.94	272.17	240.95	31.2169
86.63	271.75	241.13	30.6242
88.31	241.39	223.13	18.2681
90.00	226.19	211.14	15.0517
91.69	208.57	197.25	11.3186
93.37	175.57	175.59	-0.0217
95.05	160.68	164.02	-3.3423
96.76	150.82	156.60	-5.7808
98.46	151.76	155.92	-4.1519
100.16	148.66	153.9[illegible]	-5.2905
101.88	147.67	153.48	-5.8098
103.61	147.85	153.96	-6.1179
105.35	152.97	157.08	-4.1075
107.10	150.74	156.37	-5.6349
108.88	149.42	156.00	-6.5784
110.67	149.84	156.54	-6.7014
112.48	146.66	155.47	-8.8064
114.32	150.30	158.12	-7.8235
116.18	150.98	159.55	-8.5703
118.07	153.13	161.87	-8.7328
120.08	151.18	162.49	-11.3071
121.97	158.05	168.41	-10.3595
123.97	164.52	175.70	-11.1781
126.03	173.74	187.47	-13.7273
128.14	231.32	226.94	4.3804
130.32	277.56	261.59	15.9680
132.57	307.89	285.27	22.6265
134.90	325.19	296.99	28.1922
137.33	278.44	272.37	6.0561
139.88	288.28	276.90	11.3785
142.57	293.40	281.27	12.1311
145.46	302.31	287.91	14.3969
148.53	304.73	290.68	14.1051
151.	304.05	290.89	13.1630
155	304.31	290.11	14.2002
160.	292.39	278.65	13.7401
166.07	232.60	238.43	-5.8313
180.00	194.35	213.[illegible]	-19.3889

ABS. CORRECTION = 1.01E 01 DEG. K

TABLE VI-10. APCOR4 OUTPUT

RUN NO. 11 08/05/69 V POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG. K)
0.00	153.52	154.00	-0.4751
13.93	158.92	157.07	1.8501
19.75	157.47	156.53	0.9394
24.25	155.60	155.37	0.2335
28.07	154.01	153.88	0.1287
31.47	142.80	147.29	-4.4848
34.56	141.70	146.34	-4.6363
37.43	140.69	146.04	-5.3557
40.12	140.21	146.27	-6.0568
42.67	140.10	145.94	-6.8367
45.10	142.37	148.97	-6.6065
47.43	142.95	150.13	-7.1754
49.68	143.52	151.18	-7.6654
51.86	143.95	152.16	-8.1955
53.97	144.38	153.05	-8.6680
56.03	143.12	153.06	-9.9399
58.03	143.79	154.11	-10.3124
60.00	144.64	155.35	-10.7078
61.93	145.76	156.79	-11.0294
63.82	147.33	156.40	-11.0781
65.68	144.95	158.07	-13.1128
67.52	147.68	160.54	-12.8643
69.33	151.14	163.75	-12.6128
71.12	155.38	157.66	-12.2845
72.90	160.67	172.26	-11.5967
74.65	167.59	177.54	-9.9455
76.39	157.44	174.47	-17.0266
78.12	170.37	184.09	-13.7198
79.84	186.21	196.65	-10.4428
81.54	205.40	212.10	-6.7015
83.24	238.86	235.30	3.5579
84.94	259.60	251.84	7.7611
86.63	277.73	256.34	11.3943
88.31	293.83	279.12	14.7132
90.00	306.15	289.28	16.8661
91.69	315.43	297.14	18.2939
93.37	320.81	302.27	18.5386
95.06	324.79	305.98	18.8067
96.76	326.42	307.83	18.5913
98.46	322.41	306.31	16.0989
100.16	321.59	306.09	15.5031
101.88	320.97	305.69	15.2872
103.61	312.88	301.24	11.6417
105.35	314.36	301.26	13.1022
107.10	302.55	294.34	8.2033
108.88	296.41	290.35	6.0666
110.67	297.64	290.21	7.4320
112.48	289.88	285.41	4.4647
114.32	283.03	281.02	2.0077
116.18	282.54	279.95	2.5733
118.07	276.93	276.28	0.6542
120.00	269.07	271.38	-2.3133
121.97	262.90	267.71	-4.8026
123.97	264.19	268.29	-4.1003
126.03	259.90	266.65	-6.8667
128.1[illegible]	[illegible]3.68	270.59	-6.9085
130.32	29[illegible]	288.30	4.9445
132.57	289.51	288.30	1.2072
134.90	286.39	288.30	-1.9149
137.33	305.99	301.[illegible]	5.9154
139.88	309.01	304.16	4.8541
142.57	311.88	307.35	4.5310
145.44	329.63	318.04	11.5930
148.53	329.05	317.92	11.1350
151.[illegible]	322.27	311.17	11.1079
155.[illegible]	276.87	282.13	-5.2532
160.25	256.41	256.67	-10.2610
166.07	252.03	253.95	-11.9194
180.00	293.98	286.88	7.0972

ABS. CORRECTION = 8.56E 00 DEG. K

TABLE VI-12. APCOR 4 OUTPUT
TWO POIN[illegible]

RUN NO. 11 08/05/69 V POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	123.53	124.22	-0.6895
13.93	129.89	127.84	2.0418
19.75	128.29	127.28	1.0072
24.25	126.22	126.01	0.2097
28.07	124.45	124.35	0.0995
31.47	111.70	116.86	-5.1611
34.56	110.50	115.82	-5.3245
37.43	109.38	115.52	-6.1355
40.12	108.89	115.82	-6.9249
42.67	108.81	116.62	-7.8043
45.10	111.45	118.98	-7.5268
47.43	112.16	120.33	-8.1658
49.68	112.85	121.57	-8.7145
51.86	113.40	122.71	-9.3098
53.97	113.92	123.75	-9.8398
56.03	112.53	123.81	-11.2792
58.03	113.33	125.03	-11.6966
60.00	114.33	126.47	-12.1404
61.93	115.63	128.13	-12.5009
63.82	117.45	130.00	-12.5528
65.68	114.81	129.66	-14.8479
67.52	117.93	132.49	-14.5635
69.33	121.88	136.16	-14.2757
71.12	126.72	140.62	-13.9013
72.90	132.74	145.86	-13.1204
74.65	140.61	151.86	-11.2486
76.39	129.14	148.40	-19.2659
78.12	143.81	159.33	-15.5200
79.84	161.76	173.57	-11.8082
81.54	183.52	191.09	-7.5708
83.24	221.43	217.38	4.0512
84.94	244.94	236.13	8.8101
86.63	265.47	252.55	12.9225
88.31	283.70	257.02	16.6736
90.00	297.65	278.54	19.1082
91.69	308.17	287.45	20.7220
93.37	314.24	293.26	20.9892
95.06	318.76	297.47	21.2918
96.76	320.62	299.57	21.0476
98.46	316.11	297.88	18.2345
100.16	315.20	297.64	17.5602
101.88	314.52	297.20	17.3138
103.61	305.38	292.19	13.1937
105.35	307.06	292.23	14.8352
107.10	293.76	284.45	9.3124
108.88	286.86	279.95	6.9042
110.67	288.25	279.81	8.4410
112.48	279.30	274.42	5.0852
114.32	271.81	269.49	2.3192
116.18	271.29	268.33	2.9662
118.07	264.97	264.19	0.7993
120.00	256.15	250.69	-2.5440
121.97	249.24	254.58	-5.3401
173.97	250.69	255.25	-4.5555
126.03	245.80	[illegible]	-7.6547
128.14	250.20	257.90	-7.6998
130.32	283.48	277.84	5.6435
132.57	279.27	277.84	1.4339
134.90	275.75	277.84	-2.0622
137.33	298.74	292.09	6.6532
139.88	301.01	295.54	5.4717
142.57	304.23	299.12	5.1030
145.44	324.26	311.18	13.0812
148.53	323.59	311.03	12.5595
151.93	313.90	303.38	12.5214
155.75	264.59	270.56	-5.9640
160.25	241.45	253.06	-11.6251
166.07	236.39	249.92	-13.5242
180.00	283.63	275.73	7.9021

ABS. CORRECTION = 9.70E 00 DEG. K

TABLE VI-12. APCOR4 OUTPUT
THREE POINT CALIBRATION

RUN NO. 12 08/05/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	147.04	137.92	9.1173
13.93	123.58	124.73	-1.1472
19.75	119.39	120.73	-1.3385
24.25	115.95	118.25	-2.2960
28.07	113.56	116.56	-2.9930
31.47	109.32	114.11	-4.7917
34.56	108.14	113.54	-5.3937
37.43	107.37	113.45	-6.0809
40.12	107.12	113.76	-6.6419
42.67	107.35	114.40	-7.0500
45.10	107.72	115.18	-7.4554
47.43	108.81	116.39	-7.5794
49.68	110.31	117.90	-7.5909
51.86	112.13	119.67	-7.5347
53.97	114.27	121.68	-7.4065
56.03	116.41	123.89	-7.2014
58.03	119.22	126.34	-7.1175
60.00	122.08	129.00	-6.9204
61.93	125.29	131.86	-6.5663
63.82	129.13	134.90	-5.7725
65.68	125.15	134.07	-8.9229
67.52	130.58	138.45	-7.8744
69.23	137.19	144.09	-6.8973
71.12	145.16	150.94	-5.7742
72.90	154.56	158.97	-4.4069
74.65	16[illegible].35	158.15	-2.7998
76.39	179.18	179.26	-0.0769
78.12	192.46	190.42	2.0462
79.84	206.81	202.48	4.3349
81.54	222.10	215.43	6.6767
83.24	249.88	234.51	13.3656
84.94	261.32	244.29	17.0294
86.63	267.46	249.72	17.7330
88.31	266.76	250.12	16.6382
90.00	263.28	247.65	13.6343
91.69	255.48	241.61	13.8614
93.37	232.37	227.05	5.3111
95.06	222.11	219.07	3.0391
96.76	213.60	212.63	0.9763
98.46	210.12	209.19	0.9355
100.16	203.07	204.16	-1.0891
101.88	195.29	199.01	-3.7246
103.61	190.08	195.75	-5.6652
105.35	196.21	198.70	-2.4935
107.10	191.96	196.65	-4.6884
108.88	191.01	196.38	-5.3674
110.67	194.76	198.64	-3.8799
112.48	192.15	197.86	-5.6945
114.32	193.96	199.48	-5.5167
116.18	197.78	202.36	-4.5741
118.07	198.57	203.73	-5.1635
120.00	201.43	206.03	-4.5957
121.97	195.93	204.34	-8.4096
123.97	200.14	208.74	-8.6056
126.03	205.90	216.65	-10.7515
128.14	251.49	247.04	4.4495
130.32	288.33	272.40	15.9263
132.57	281.45	272.40	9.0539
134.90	278.40	272.40	5.9961
137.33	287.83	278.86	8.9769
139.88	291.09	282.48	8.6072
142.57	294.50	286.76	7.7475
145.44	316.41	300.70	15.7121
148.53	317.30	302.36	14.9350
151.93	312.41	297.01	15.3999
155.75	268.78	268.64	0.1384
160.25	249.88	253.50	-3.6183
166.07	238.84	248.50	-9.6581
180.00	298.63	281.23	17.4046

ABS. CORRECTION = 7.13E 00 DEG. K

TABLE VI-13. APCOR4 OUTPUT
TWO POINT CALIBRATION

RUN NO. 12 08/05/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	117.49	107.67	9.8243
13.93	91.71	93.20	-1.4842
19.75	87.16	88.86	-1.7031
24.25	83.43	86.20	-2.7685
28.07	80.89	84.41	-3.5249
31.47	76.06	81.67	-5.6084
34.56	74.89	81.14	-6.2572
37.43	74.16	81.18	-7.0135
40.12	74.03	81.65	-7.6281
42.67	74.45	82.53	-8.0741
45.10	75.09	83.58	-8.4856
47.43	76.48	85.10	-8.6122
49.68	78.32	86.93	-8.6095
51.86	80.52	89.05	-8.5337
53.97	83.06	91.44	-8.3785
56.03	85.84	94.05	-8.2193
58.03	88.91	96.93	-8.0252
60.00	92.24	100.03	-7.7938
61.93	95.95	103.34	-7.3878
63.82	100.37	106.85	-6.4924
65.68	96.07	106.05	-9.9917
67.52	102.25	111.06	-8.8129
69.33	109.75	117.46	-7.7143
71.12	118.75	125.20	-6.4533
72.90	129.36	134.26	-4.9199
74.65	141.48	144.60	-3.1182
76.39	156.98	157.07	-0.0906
78.12	171.70	169.61	2.2871
79.84	189.01	183.15	4.8481
81.56	205.17	197.70	7.4683
83.24	236.27	219.09	17.1730
84.94	249.14	230.10	19.0385
86.63	256.08	236.25	19.8342
88.31	255.34	236.75	18.5807
90.00	251.61	234.12	17.4870
91.69	243.07	227.54	15.5340
93.37	217.58	211.51	6.0636
95.06	206.34	202.78	3.5594
96.76	197.05	195.76	1.2876
98.46	193.48	192.15	1.3339
100.16	185.73	186.65	-0.9140
101.88	177.09	180.96	-3.8667
103.61	171.33	177.35	-6.0296
105.35	178.10	180.63	-2.5335
107.10	173.39	178.36	-4.9724
108.88	172.33	178.07	-5.7334
110.67	176.48	180.58	-4.0943
112.48	173.61	179.71	-6.0988
114.32	175.59	181.51	-5.9198
116.18	179.80	184.69	-4.8860
118.07	180.68	186.22	-5.5367
120.00	183.86	188.77	-4.9101
121.97	177.78	186.90	-9.1274
123.97	182.41	191.77	-9.3585
126.03	188.80	200.52	-11.7164
128.14	239.16	234.09	5.0699
130.32	279.86	262.11	17.7514
132.57	272.29	262.11	10.1789
134.90	269.03	262.11	6.9174
137.33	278.38	268.60	9.7759
139.88	282.00	272.54	9.4553
142.57	285.71	277.22	8.4923
145.44	310.18	292.76	17.4193
148.53	311.03	294.50	16.5327
151.93	305.40	288.36	17.0362
155.75	256.35	256.43	-0.0791
160.25	234.96	239.27	-4.3070
166.07	222.13	233.32	-11.1831
180.00	288.70	269.70	18.9994

ABS. CORRECTION = 7.96E 00 DEG. K

TABLE VI-14. APCOR4 OUTPUT
THREE POINT CALIBRATION

RUN NO. 13 08/06/69 V POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	10.55	15.52	-4.9578
13.93	16.17	19.13	-2.9602
19.75	17.37	20.83	-3.2623
24.25	18.71	22.23	-3.5195
28.07	19.85	23.47	-3.6206
31.47	17.08	22.65	-5.5810
34.55	18.39	24.11	-5.7198
37.43	19.76	25.83	-6.0659
40.12	21.27	27.75	-6.4928
42.67	22.76	29.89	-7.1309
45.10	25.74	32.89	-7.1503
47.43	27.31	35.15	-7.8454
49.68	28.77	37.27	-8.5049
51.85	30.09	39.25	-9.1700
53.97	31.42	41.12	-9.6968
56.03	30.64	41.85	-11.2205
58.03	32.16	43.85	-11.6922
60.00	33.86	46.07	-12.2323
61.93	35.85	48.54	-12.6988
63.82	38.21	51.21	-13.0068
65.68	39.70	53.51	-13.6076
67.52	42.76	56.72	-13.9537
69.33	46.19	50.27	-14.0843
71.12	50.03	54.17	-14.1375
72.90	54.39	58.39	-14.0033
74.65	52.46	72.94	-13.4787
76.39	57.59	74.18	-14.5853
78.12	64.85	80.59	-15.7365
79.84	73.30	88.24	-14.9406
81.54	83.48	97.12	-13.6323
83.24	84.13	101.92	-17.7936
84.94	104.10	118.22	-14.1206
86.63	132.10	141.01	-8.9113
88.31	192.70	151.45	11.2451
90.00	223.23	206.01	17.2243
91.69	247.73	225.68	22.0452
93.37	265.47	240.35	25.1283
95.05	277.08	250.42	26.6671
96.76	282.45	255.73	26.7237
98.46	274.04	252.79	21.2478
100.16	272.18	252.45	19.7162
101.88	268.59	251.00	17.5949
103.61	264.21	249.24	15.6654
105.35	261.08	247.15	13.9196
107.10	255.46	243.95	11.4970
108.89	250.22	240.78	9.4350
110.67	244.21	237.12	7.0863
112.48	234.61	231.89	2.7296
114.32	238.50	233.75	4.7381
116.18	232.30	230.65	1.6337
118.07	230.20	229.59	0.6162
120.00	228.16	228.51	-0.3454
121.97	215.76	222.51	-6.7470
123.97	222.97	226.85	-3.8819
126.03	208.59	221.47	-12.8783
128.16	222.99	233.54	-10.5485
130.32	277.20	258.89	8.3222
132.57	311.13	293.81	17.3205
134.90	331.69	308.35	23.3340
137.33	300.10	293.39	6.7152
139.88	310.45	299.77	10.8665
142.57	316.56	304.53	12.0634
145.44	316.89	305.65	11.2365
148.53	317.82	306.65	11.1559
151.93	316.05	305.95	10.0967
155.75	315.44	304.81	10.6335
160.25	305.01	295.92	9.0896
166.07	266.06	268.48	-2.4227
190.00	202.74	231.28	-28.5305

ABS. CORRECTION = 1.14E 01 DEG. K

TABLE VI-15. APCOR4 OUTPUT

RUN NO. 14 08/06/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	10.51	16.01	-5.4971
13.93	16.37	19.81	-3.4399
19.75	18.41	22.05	-3.6402
24.25	20.33	24.05	-3.7199
28.07	22.12	25.93	-3.8101
31.47	23.90	27.80	-3.8927
34.55	25.45	29.55	-4.0970
37.43	26.95	31.25	-4.3107
40.12	28.40	32.95	-4.5430
42.67	29.83	34.61	-4.7806
45.10	30.82	36.02	-5.1926
47.43	32.41	37.71	-5.3020
49.65	34.17	39.50	-5.3371
51.86	36.06	41.38	-5.3190
53.97	38.09	43.33	-5.2442
56.03	39.93	45.25	-5.3128
58.03	42.12	47.39	-5.2689
60.00	44.40	49.65	-5.2471
61.93	46.83	52.01	-5.1853
63.82	49.51	54.48	-4.9670
65.68	49.15	55.45	-6.3121
67.52	52.49	58.51	-6.0196
69.33	56.32	62.07	-5.7460
71.12	60.74	66.13	-5.3963
72.90	65.84	70.69	-4.8466
74.65	71.75	75.72	-3.9787
76.39	73.15	78.70	-5.5500
78.12	81.35	85.53	-4.1758
79.85	90.69	93.45	-2.7670
81.54	101.31	102.49	-1.1786
83.24	112.44	112.24	0.1914
84.94	125.75	123.77	1.9808
86.63	140.47	136.73	3.7385
88.31	177.64	151.52	18.1219
90.00	185.35	156.96	18.3945
91.69	180.30	153.28	17.0212
93.37	137.90	138.50	-0.6005
95.06	125.09	129.15	-3.0600
96.76	117.93	123.07	-5.1436
98.46	118.47	122.52	-4.0444
100.16	114.91	120.47	-5.6629
101.88	111.97	119.26	-7.3872
103.61	114.27	121.28	-7.0095
105.35	119.68	125.18	-5.4967
107.10	120.93	127.05	-6.1245
108.88	121.98	128.85	-6.8632
110.67	124.47	131.52	-7.0473
112.48	128.68	135.23	-6.5519
114.32	131.35	138.27	-6.9235
116.18	135.17	141.97	-6.8012
118.07	137.86	145.22	-7.3641
120.00	137.56	147.41	-9.8475
121.97	150.06	156.79	-6.7267
123.97	153.74	162.92	-9.1789
126.03	163.48	174.90	-11.4182
128.14	203.97	206.87	-2.9026
130.32	280.18	259.91	20.2733
132.57	327.56	296.25	31.3005
134.90	354.92	315.43	39.4859
137.33	295.22	284.75	10.4702
139.88	309.08	291.30	17.7805
142.57	315.08	295.75	19.3216
145.44	311.24	296.82	14.4174
148.53	311.00	295.20	15.8030
151.93	308.19	294.38	13.8123
155.75	314.39	297.29	17.0928
160.25	303.00	286.33	16.6685
166.07	23[illegible].32	242.17	-5.8433
180.00	198.13	217.77	-19.6363

ABS. CORRECTION = 8.25E 00 DEG. K

TABLE VI-16. APCOR4 OUTPUT

RUN NO. 15 08/07/69 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	8.45	12.93	-4.4793
13.93	12.50	15.64	-3.1450
19.75	14.09	17.36	-3.2635
24.25	15.50	18.92	-3.4227
28.07	15.77	20.41	-3.6462
31.47	17.14	21.44	-4.2963
34.56	18.37	22.94	-4.5706
37.43	19.58	24.50	-4.9189
40.12	20.69	26.09	-5.4038
42.67	21.65	27.73	-6.0818
45.10	22.88	29.58	-6.6916
47.43	23.77	31.25	-7.4828
49.68	24.56	32.82	-8.2562
51.85	25.50	34.51	-9.0078
53.97	26.46	36.11	-9.6420
56.03	26.42	37.18	-10.7528
58.03	27.58	38.91	-11.3362
60.00	28.83	40.80	-11.9704
61.93	30.29	42.83	-12.5386
63.82	32.05	45.00	-12.9456
65.65	32.56	46.57	-14.0045
67.52	34.91	49.17	-14.2690
69.33	37.57	52.10	-14.5367
71.12	40.60	55.34	-14.7401
72.90	44.15	58.89	-14.7439
74.65	48.43	62.73	-14.3020
76.39	44.28	62.51	-18.2370
78.12	50.99	68.42	-17.4335
79.84	59.01	75.73	-16.7188
81.54	68.98	84.41	-15.4347
83.24	68.59	88.69	-20.0979
84.94	89.42	105.57	-16.1544
86.63	119.06	129.60	-10.5428
88.31	185.01	173-29	11.7185
90.00	217.06	199.03	18.0303
91.69	242.20	219.17	23.0338
93.37	256.55	232.13	24.4121
95.05	268.97	242.75	26.2085
96.76	276.15	249.42	26.7289
98.45	271.71	249.12	22.5894
100.15	273.28	251.16	22.1245
101.88	274.48	252.53	22.1491
103.61	265.91	248.13	17.7720
105.35	262.20	245.80	16.3971
107.10	254.31	241.13	13.1714
108.89	247.18	236.75	10.4184
110. 7	242.06	233.42	8.6460
112.48	236.50	229.82	6.6795
114.32	229.44	225.40	4.0392
116.18	222.24	220.95	1.2907
118.07	217.46	217.93	-0.4752
120.00	210.97	214.38	-3.4089
121.97	209.05	213.48	-4.4245
123.97	203.94	211.39	-7.4495
126.03	196.44	209.57	-13.1252
128.14	212.39	225.85	-6.4630
130.32	256.66	251.47	5.1903
132.57	282.76	271.15	11.6088
134.90	300.82	284.76	16.0535
137.33	291.25	282.51	8.7344
139.89	301.88	290.13	11.7550
142.57	308.82	295.75	13.0727
145.44	310.06	297.64	12.4233
148.53	310.94	298.65	12.2904
151.93	308.42	297.17	11.2501
155.75	303.91	293.34	10.5779
160.25	290.69	282.01	8.6759
166.07	244.62	250.35	-5.7236
180.00	189.79	217.06	-27.2675

ABS. CORRECTION = 1.17E 01 DEG. K

TABLE VI-17. APCOR4 OUTPUT

RUN NO. 16 08/07/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	8.47	12.15	-3.4872
13.93	10.92	13.84	-2.9236
19.75	12.20	15.30	-3.0936
24.25	13.48	16.73	-3.2475
28.07	14.72	18.15	-3.4323
31.47	16.40	19.83	-3.4254
34.55	17.47	21.21	-3.7420
37.43	18.51	22.55	-4.0495
40.12	19.51	23.89	-4.3779
42.67	20.49	25.20	-4.7136
45.10	21.00	26.23	-5.2324
47.43	22.20	27.59	-5.3898
49.69	23.59	29.05	-5.4607
51.85	25.14	30.61	-5.4700
53.97	26.82	32.25	-5.4345
56.03	28.46	33.94	-5.4819
58.03	30.27	35.77	-5.4993
60.00	32.16	37.70	-5.5429
61.93	34.17	39.72	-5.5457
63.82	36.45	41.82	-5.3742
65.69	35.20	42.20	-6.9937
67.52	38.16	44.91	-6.7408
69.33	41.65	48.18	-6.5329
71.12	45.78	52.01	-6.2303
72.90	50.76	56.37	-5.6088
74.65	55.86	51.25	-4.3901
76.39	52.76	51.24	-8.4778
78.12	62.56	58.97	-6.4128
79.84	74.11	78.58	-4.4676
81.54	87.72	90.04	-2.3167
83.24	105.22	104.12	1.1023
84.94	122.00	118.50	3.4970
86.63	139.64	133.93	5.7098
88.31	185.54	152.75	22.7892
90.00	190.92	157.93	22.9936
91.69	182.75	151.62	21.1261
93.37	125.49	127.81	-2.3257
95.05	110.02	115.34	-5.3178
96.75	100.35	107.95	-7.6026
98.46	102.65	108.38	-5.7271
100.16	101.80	108.19	-6.3943
101.88	105.18	110.45	-5.2788
103.61	102.29	109.72	-7.4336
105.33	106.18	112.52	-6.3390
107.10	106.02	113.45	-7.4279
108.88	107.23	115.30	-8.0676
110.67	111.71	119.06	-7.3522
112.49	116.89	123.24	-6.3538
114.32	114.83	123.79	-8.9583
116.19	122.17	129.18	-7.0138
118.07	121.34	130.67	-9.3238
120.00	127.21	135.78	-8.5717
121.97	126.18	138.38	-12.2034
123.97	137.40	149.45	-12.0510
126.03	158.99	159.90	-10.9004
128.14	223.34	215.88	7.4596
130.32	285.05	261.65	23.4058
132.57	325.05	292.99	32.0615
134.90	347.75	308.83	38.9136
137.33	290.85	279.15	11.6865
139.88	307.12	284.14	17.9811
142.57	305.57	287.65	18.9152
145.44	305.34	288.11	17.2296
148.53	304.81	288.40	16.4081
151.93	301.47	287.17	14.2968
155.75	306.96	289.40	17.5605
160.25	293.68	276.67	16.9905
166.07	221.28	228.15	-6.8633
180.00	172.11	197.21	-25.0979

ABS. CORRECTION = 9.21E 00 DEG. K

TABLE VI-18. APCOR4 OUTPUT

RUN NO. 17 08/07/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	8.54	13.84	-5.2998
13.93	16.16	18.58	-2.4167
19.75	17.78	20.59	-2.8170
24.25	19.20	22.16	-2.9646
28.07	20.46	23.50	-3.0414
31.47	20.66	24.24	-3.5797
34.55	21.63	25.42	-3.7961
37.43	22.50	26.61	-4.1033
40.12	23.36	27.79	-4.4312
42.67	24.26	28.99	-4.7259
45.10	24.24	29.67	-5.4353
47.43	25.43	31.00	-5.5658
49.68	26.93	32.54	-5.6139
51.86	28.68	34.[illegible]8	-5.6[illegible]0
53.97	30.65	36.20	-5.5503
56.03	33.17	38.48	-5.3125
58.03	35.38	40.65	-5.2836
60.00	37.68	42.93	-5.2530
61.93	40.08	45.28	-5.1979
63.82	42.68	47.72	-5.0362
65.68	43.06	49.08	-6.0177
67.52	46.16	51.96	-5.7993
69.33	49.62	55.22	-5.6055
71.12	53.54	58.86	-5.3265
72.90	58.13	62.87	-4.7451
74.65	63.68	67.24	-3.5529
76.39	57.85	66.05	-8.2139
78.12	66.93	73.13	-6.2014
79.84	77.67	82.05	-4.3773
81.54	90.39	92.79	-2.4020
83.24	107.88	106.55	1.3312
84.94	123.23	119.74	3.4834
86.63	138.92	133.52	5.4012
88.31	178.41	158.45	19.9615
90.00	182.90	162.85	20.0395
91.07	175.43	157.14	18.2935
93.37	123.85	126.79	-2.9424
95.05	110.41	116.03	-5.6251
96.75	102.51	110.14	-7.6287
98.45	108.16	112.68	-4.5217
100.16	107.10	112.59	-5.4896
101.88	108.00	113.68	-5.6864
103.61	109.63	115.24	-5.6112
105.35	107.82	115.23	-7.4124
107.10	111.61	118.34	-6.7259
108.85	115.59	121.78	-6.1925
110.67	118.28	124.64	-6.3592
112.48	120.80	127.41	-6.6195
114.32	122.10	129.70	-7.6061
116.18	128.39	134.70	-6.3056
118.07	129.91	137.41	-7.5003
120.00	134.51	141.73	-7.2203
121.97	134.94	144.36	-9.4200
123.97	139.24	150.42	-11.1845
126.03	146.09	161.65	-15.5584
128.16	206.68	204.98	1.6936
130.32	278.[illegible]	256.38	21.9076
132.57	323.76	291.58	32.1752
134.90	349.74	309.65	40.0882
137.33	288.16	277.65	10.5151
139.88	301.20	283.52	17.6741
142.57	306.62	287.63	18.9955
145.44	304.07	287.42	16.6500
148.53	303.88	287.91	15.9690
151.93	301.10	287.14	13.9558
155.75	307.71	290.25	17.4623
160.25	295.73	278.79	16.9350
166.07	229.98	233.73	-3.7529
180.00	168.60	196.41	-27.8072

ABS. CORRECTION = 8.74E 00 DEG. K

TABLE VI-19. APCOR4 OUTPUT

RUN NO. 18 08/07/69 V POLAR. 16.5 GHZ

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	8.97	11.86	-2.8804
13.93	8.70	12.13	-3.4358
19.75	9.85	13.35	-3.5028
24.25	11.03	14.74	-3.7184
28.07	12.11	16.23	-4.1203
31.47	14.28	18.34	-4.0518
34.56	15.35	19.85	-4.4949
37.43	16.41	21.31	-4.9065
40.12	17.29	22.75	-5.4601
42.67	18.01	24.17	-6.1631
45.10	18.09	25.31	-7.2174
47.43	18.70	26.75	-8.0617
49.68	19.43	28.32	-8.8855
51.85	20.31	29.95	-9.6505
53.97	21.40	31.69	-10.2899
56.03	22.19	33.28	-11.0990
58.03	23.58	35.25	-11.6563
60.00	25.10	37.36	-12.2576
61.93	26.83	39.61	-12.7761
63.82	28.88	41.99	-13.11[illegible]
65.68	29.17	43.52	-14.3529
67.52	31.85	46.40	-14.5461
69.33	34.91	49.65	-14.7473
71.12	38.42	53.29	-14.8647
72.90	42.51	57.28	-14.7762
74.65	47.34	61.63	-14.2975
76.39	45.46	62.81	-17.3533
78.12	52.48	69.05	-16.5786
79.84	60.70	76.55	-15.8436
81.54	70.70	85.26	-14.5623
83.24	70.20	89.45	-19.2551
84.94	90.59	106.04	-15.4498
86.63	119.57	129.59	-10.0177
88.31	183.71	172.18	11.5304
90.00	215.20	197.50	17.7017
91.69	240.10	217.47	22.6346
93.37	255.16	230.80	24.3563
95.05	267.54	241.45	26.0929
96.76	274.54	248.08	26.4671
98.45	272.09	248.74	23.3548
100.15	271.39	249.43	21.9583
101.88	267.33	247.98	19.3476
103.61	265.67	247.41	18.2648
105.35	262.91	245.83	17.0823
107.17	253.49	240.45	13.0405
108.89	246.06	235.90	10.1588
110.67	241.61	232.89	8.7219
112.48	234.55	228.58	5.9750
114.32	227.80	224.51	3.2861
116.18	224.47	222.35	2.1150
118.07	221.72	220.51	1.2133
120.00	211.34	214.83	-3.4911
121.97	208.59	213.37	-4.7799
123. 7	203.99	211.56	-7.5776
126.03	200.37	211.34	-10.9748
128.14	205.65	218.33	-12.6863
130.32	256.28	251.21	5.0715
132.57	288.93	275.29	13.6427
134.90	310.29	290.83	19.4582
137.33	290.61	283.00	7.6102
139.88	302.53	290.97	11.5533
142.57	309.91	296.85	13.0489
145.44	310.50	298.42	12.0794
148.53	311.80	299.71	12.0898
151.93	309.96	298.82	11.1436
155.75	306.60	295.94	10.6635
160.25	295.21	286.33	8.8797
166.07	260.02	250.28	-0.2589
180.00	182.50	215.23	-32.7277

ABS. CORRECTION = 1.18E 01 DEG. K

TABLE VI-20. APCOR4 OUTPUT

RUN NO. 19 08/07/69 V POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	8.72	11.75	-3.0391
13.93	9.93	12.85	-2.9169
19.75	10.81	13.95	-3.1445
24.25	11.63	15.07	-3.4375
28.07	12.45	16.20	-3.7501
31.47	11.85	16.61	-4.7626
34.56	12.80	17.90	-5.0989
37.43	13.80	19.32	-5.5207
40.12	14.80	20.85	-6.0530
42.67	15.73	22.47	-6.7488
45.10	16.84	24.27	-7.4327
47.43	17.81	26.03	-8.2217
49.68	18.85	27.83	-8.9748
51.86	19.97	29.65	-9.6853
53.97	21.24	31.51	-10.2719
56.03	21.86	33.04	-11.1777
58.03	23.39	35.09	-11.6985
60.00	25.02	37.29	-12.2586
61.93	26.87	39.61	-12.7490
63.82	29.04	42.09	-13.0458
65.68	29.24	43.60	-14.3512
67.52	32.10	46.59	-14.4935
69.33	35.36	50.00	-14.6408
71.12	39.12	53.82	-14.6941
72.90	43.49	58.03	-14.5422
74.65	48.61	62.63	-14.0122
76.39	47.58	64.33	-16.7516
78.12	54.86	70.80	-15.9360
79.84	63.32	78.47	-15.1495
81.54	73.52	87.34	-13.8185
83.24	73.29	91.69	-18.4042
84.94	93.75	108.31	-14.5605
86.63	122.70	131.81	-9.1111
88.31	186.84	174.33	12.5013
90.00	218.00	199.38	18.6156
91.69	242.37	218.93	23.4399
93.37	256.48	231.60	24.8895
95.05	268.13	241.64	26.4966
96.76	274.40	247.62	26.7860
98.46	269.19	246.67	22.5187
100.16	269.29	247.69	21.5973
101.88	268.41	247.72	20.6912
103.61	261.21	244.07	17.1368
105.35	256.85	241.53	15.3227
107.10	251.71	238.42	13.2899
108.88	245.40	234.55	10.8523
110.67	238.45	230.26	8.1834
112.48	232.65	226.58	6.0679
114.32	227.52	223.25	4.2681
116.18	220.24	218.87	1.3710
118.07	214.24	215.41	-1.1689
120.00	214.12	215.23	-1.1069
121.97	208.53	212.42	-3.8902
123.97	201.83	209.30	-7.4729
126.03	198.10	208.84	-10.7329
128.14	205.20	216.46	-11.2608
130.32	249.66	245.61	4.0554
132.57	279.10	267.42	11.6758
134.90	298.98	282.11	16.8758
137.33	286.15	278.03	8.1193
139.89	297.26	285.72	11.5373
142.57	304.14	291.11	13.0367
145.44	301.56	290.72	10.8363
148.53	302.28	291.51	10.7643
151.93	300.54	290.81	9.7323
155.75	301.22	290.39	10.8302
160.25	291.33	281.86	9.4718
166.07	256.55	255.77	0.7847
180.00	170.85	206.08	-35.2306

ABS. CORRECTION = 1.16E 01 DEG. K

TABLE VI-21. APCOR4 OUTPUT

RUN NO. 20 08/07/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	9.34	11.65	-2.3070
13.93	8.34	11.50	-3.1611
19.75	9.21	12.48	-3.2783
24.25	10.17	13.66	-3.4925
28.07	11.20	14.95	-3.7497
31.47	13.01	16.69	-3.6875
34.54	14.01	18.05	-4.0384
37.43	15.05	19.39	-4.3454
40.12	16.08	20.73	-4.6460
42.67	17.16	22.07	-4.9071
45.10	17.29	22.88	-5.5951
47.43	18.65	24.35	-5.7030
49.68	20.30	26.03	-5.7320
51.85	22.19	27.91	-5.7128
53.97	24.29	29.95	-5.6777
56.03	27.22	32.53	-5.3136
58.03	29.50	34.80	-5.3065
60.00	31.83	37.12	-5.2887
61.93	34.26	39.48	-5.2207
63.82	36.92	41.88	-4.9633
65.68	35.67	42.34	-6.6708
67.52	38.98	45.31	-6.3316
69.33	42.81	48.86	-6.0450
71.12	47.29	52.97	-5.6770
72.90	52.54	57.61	-5.0750
74.65	58.72	62.79	-4.0728
76.39	59.18	65.32	-6.1417
78.12	68.08	72.61	-4.5329
79.84	78.28	81.22	-2.9434
81.54	89.95	91.14	-1.1902
83.24	104.50	102.98	1.5292
84.94	118.27	114.89	3.3766
86.63	132.49	127.47	5.0211
88.31	169.42	150.74	18.6812
90.00	173.30	154.66	18.6437
91.69	166.00	149.09	16.9184
93.37	116.59	120.08	-3.4855
95.05	104.17	110.15	-5.9839
96.76	97.40	105.16	-7.7666
98.46	104.41	108.73	-4.3179
100.16	104.73	109.62	-4.8881
101.88	107.49	111.78	-4.2876
103.61	105.90	111.67	-5.6764
105.35	105.63	112.50	-6.8656
107.10	109.29	115.62	-6.3255
108.88	113.86	119.45	-5.5871
110.67	117.72	122.90	-5.1772
112.48	118.29	124.56	-6.2776
114.32	119.26	126.47	-7.2260
116.18	122.85	130.00	-7.1467
118.07	127.40	134.26	-6.8638
120.00	130.40	137.91	-7.5087
121.97	132.38	141.60	-9.2146
123.97	137.04	148.42	-11.3741
126.03	152.46	164.55	-12.0972
128.14	212.80	207.70	5.0982
130.32	276.78	254.36	22.4212
132.57	317.70	286.22	31.4802
134.90	340.81	302.29	38.5179
137.33	283.45	272.31	11.1368
139.88	294.50	277.02	17.4710
142.57	298.50	280.00	18.4944
145.44	294.07	278.41	15.6609
148.53	292.87	278.04	14.8273
151.93	289.46	276.76	12.6945
155.75	296.47	280.07	16.3968
160.25	285.00	269.13	15.8791
166.07	221.48	225.81	-4.3273
180.00	164.77	191.25	-26.4806

ABS. CORRECTION = 8.47E 00 DEG. K

TABLE VI-22. APCOR4 OUTPUT

RUN NO. 21 08/08/69 V POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	11.53	14.33	-2.8000
13.93	11.28	14.61	-3.3300
19.75	12.40	15.80	-3.4040
24.25	13.53	17.16	-3.6264
28.07	14.56	18.61	-4.0512
31.47	16.92	20.80	-3.8746
34.56	17.90	22.24	-4.3338
37.43	18.86	23.61	-4.7518
40.12	19.62	24.94	-5.3160
42.57	20.21	26.23	-6.0158
45.10	19.85	27.05	-7.2104
47.43	20.35	28.40	-8.0442
49.68	21.04	29.88	-8.8461
51.86	21.94	31.51	-9.5608
53.97	23.09	33.25	-10.1679
56.03	24.24	35.04	-10.8013
58.03	25.74	37.05	-11.3164
60.00	27.36	39.21	-11.8545
61.93	29.18	41.50	-12.3239
63.82	31.28	43.91	-12.6359
65.68	31.85	45.59	-13.7362
67.52	34.55	48.45	-13.9081
69.33	37.58	51.67	-14.0852
71.12	41.03	55.22	-14.1931
72.90	45.01	59.11	-14.0992
74.65	49.75	63.32	-13.5672
76.39	46.49	63.69	-17.1983
78.12	53.65	69.94	-16.2941
79.84	62.10	77.57	-15.4695
81.56	72.45	86.55	-14.1005
83.24	73.50	91.61	-18.1078
84.94	94.00	108.25	-14.2503
86.63	122.65	131.50	-8.8553
88.31	185.73	173.32	12.4147
90.00	216.12	197.75	18.3674
91.69	239.59	216.60	22.9900
93.37	252.91	228.58	24.3249
95.06	263.27	237.63	25.6473
96.76	268.06	242.40	25.6537
98.46	258.31	238.76	19.5482
100.16	258.51	239.65	18.8570
101.88	259.94	240.85	19.0885
103.61	252.08	236.87	15.2122
105.35	246.36	233.62	12.7474
107.10	241.78	230.93	10.8438
108.88	238.16	228.76	9.3926
110.67	234.46	226.44	8.0136
112.48	227.37	222.33	5.0455
114.32	222.91	219.60	3.3173
116.18	219.57	217.53	2.0412
118.07	212.97	213.93	-0.9511
120.00	210.38	212.51	-2.1346
121.97	201.89	208.70	-6.8137
123.97	206.32	212.34	-6.0262
126.03	207.54	215.87	-8.3321
128.16	223.79	229.42	-5.6348
130.32	271.86	261.27	10.5849
132.57	302.27	283.78	18.4871
134.90	320.58	296.88	23.7026
137.33	292.87	283.78	9.0905
139.88	301.56	288.97	12.5895
142.57	305.42	292.19	13.2342
145.44	307.04	293.42	13.6239
148.53	303.95	291.25	12.6992
151.93	296.14	285.05	11.0780
155.75	272.88	269.15	3.7239
160.25	253.06	253.39	-0.3313
166.07	219.88	229.74	-9.8538
180.00	183.06	207.53	-24.4670

ABS. CORRECTION = 1.19E 01 DEG. K

TABLE VI-23. APCOR4 OUTPUT

RUN NO. 22 00/08/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	11.31	15.36	-4.0499
13.93	16.28	18.55	-2.2781
19.75	17.31	19.99	-2.6779
24.25	18.22	21.14	-2.9130
28.07	19.15	22.14	-2.9868
31.47	18.04	22.05	-4.0051
34.56	18.89	23.09	-4.1964
37.43	19.72	24.24	-4.5242
40.12	20.64	25.49	-4.8517
42.67	21.66	26.82	-5.1608
45.10	22.45	28.02	-5.5732
47.43	23.85	29.54	-5.6870
49.68	25.48	31.20	-5.7158
51.86	27.29	32.99	-5.7006
53.97	29.26	34.90	-5.6476
56.03	31.32	36.94	-5.6181
58.03	33.46	39.07	-5.6119
60.00	35.69	41.31	-5.6189
61.93	38.07	43.65	-5.5776
63.82	40.72	46.08	-5.3608
65.69	40.01	46.86	-5.8550
67.52	43.36	49.90	-6.5372
69.33	47.24	53.50	-6.2553
71.12	51.75	57.63	-5.8833
72.90	57.06	62.29	-5.2343
74.65	53.38	57.45	-4.0838
76.39	61.69	68.83	-7.1412
78.12	71.19	76.47	-5.2806
79.84	82.17	85.69	-3.5201
81.54	94.88	96.49	-1.6099
83.24	112.66	110.32	2.3371
84.94	127.11	122.82	4.2934
86.63	141.31	135.37	5.9350
88.31	176.27	157.46	18.8096
90.00	179.33	150.70	18.6350
91.69	171.16	154.41	16.7535
93.37	119.99	124.27	-4.2820
95.06	107.05	113.95	-6.9008
96.76	103.17	108.92	-5.7512
98.46	109.12	113.54	-4.4211
100.16	108.89	114.24	-5.3482
101.98	109.71	115.63	-5.9176
103.61	111.31	117.64	-6.3364
105.35	117.16	122.00	-4.8406
107.10	119.01	124.42	-5.4168
108.88	122.21	127.51	-5.2955
110.67	125.34	130.96	-4.6235
112.48	124.95	131.54	-6.5891
114.32	129.48	135.05	-5.5732
116.18	125.40	134.50	-9.0997
118.07	134.15	140.85	-6.7034
120.00	136.00	144.26	-8.2386
121.97	139.94	149.63	-9.6946
123.97	150.19	150.44	-10.2528
126.03	177.12	183.29	-6.1724
128.14	231.65	223.38	8.2707
130.32	288.92	265.64	23.2748
132.57	325.69	294.42	31.2718
134.90	346.29	308.77	37.5215
137.33	293.21	280.96	12.2482
139.88	302.93	285.04	17.8947
142.57	306.04	287.62	18.4175
145.46	305.79	288.28	17.5086
148.53	303.23	286.95	16.2780
151.93	296.97	282.92	14.0446
155.75	291.76	277.85	13.8928
160.25	273.91	261.37	12.5399
166.07	197.08	211.85	-14.7634
180.00	186.64	202.05	-15.4088

ABS. CORRECTION = 8.56E 00 DEG. K

TABLE VI-24. APCOR4 OUTPUT

RUN NO. 23 08/08/69 V POLAR.

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	11.39	12.45	-1.0522
13.93	5.41	9.49	-4.0577
19.75	6.28	10.21	-3.9326
24.25	7.45	11.57	-4.1255
28.07	8.62	13.27	-4.6556
31.47	13.48	17.00	-3.5158
34.55	14.72	18.75	-4.0376
37.43	15.96	20.37	-4.4121
40.12	16.90	21.67	-4.7675
42.67	17.55	23.25	-5.7077
45.10	17.59	24.35	-6.7556
47.43	18.02	25.66	-7.6377
49.68	18.51	27.00	-8.4933
51.85	19.08	28.39	-9.2765
53.97	19.83	29.78	-9.9474
56.03	19.43	30.61	-11.1776
58.03	20.50	32.28	-11.7815
60.00	21.75	34.18	-12.4319
61.93	23.29	36.29	-13.0038
63.82	25.18	38.61	-13.4274
65.68	26.67	40.77	-14.1029
67.52	29.19	43.56	-14.3[illegible]7
69.33	31.99	46.62	-14.6213
71.12	35.11	49.96	-14.8515
72.90	38.70	53.53	-14.8339
74.65	43.06	57.38	-14.3206
76.39	36.89	56.11	-19.2192
78.12	44.03	62.28	-18.2560
79.84	52.67	70.08	-17.4113
81.54	63.55	79.47	-15.9189
83.24	64.09	84.51	-20.4232
84.94	86.65	102.69	-16.0296
86.63	118.42	128.37	-9.9563
88.31	191.51	176.20	15.3010
90.00	223.83	202.21	21.6157
91.69	246.99	220.82	26.1555
93.37	252.08	228.20	23.8740
95.04	260.84	236.09	24.7539
96.76	264.99	240.55	24.4435
98.46	257.97	238.46	19.5061
100.16	258.10	239.57	18.5279
101.88	258.01	240.53	17.4735
103.61	262.06	243.24	18.8269
105.35	255.89	240.10	15.7863
107.10	245.78	234.54	11.2401
108.88	241.47	231.97	9.4988
110.67	240.90	231.37	9.5339
112.48	230.87	225.94	4.9206
114.32	230.55	225.41	5.1409
116.18	223.61	221.61	2.0017
118.07	220.61	219.83	0.7847
120.00	216.08	217.25	-1.1809
121.97	206.50	212.36	-5.8578
123.97	204.83	212.14	-7.3097
126.03	202.48	212.95	-10.4767
128.14	212.55	222.62	-10.0699
130.32	258.25	252.87	5.3846
132.57	288.69	275.55	13.1471
134.90	309.26	290.82	18.4331
137.33	296.43	286.88	9.5452
139.88	307.62	294.65	12.9623
142.57	314.33	299.84	14.4977
145.44	307.91	297.29	10.6258
148.52	308.37	297.91	10.4562
151.93	307.24	298.01	9.2342
155.75	314.49	301.80	12.6915
160.25	307.08	295.18	11.8952
166.07	271.82	268.63	3.1820
180.00	175.62	213.23	-37.6055

ABS. CORRECTION = 1.19E 01 DEG. K

TABLE VI-25. APCORI OUTPUT

RUN NO. 24 08/08/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 5

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	11.38	15.39	-4.0121
13.93	14,21	17.42	-3.2027
19.75	15.85	19.18	-3.3299
24.25	17,48	20.92	-3.4330
28.07	18,98	22.65	-3.6702
31.47	22,09	25.23	-3.1415
34.56	23,34	26.81	-3.4726
37.43	24,51	28.25	-3.7431
40.12	25,56	29.60	-4.0442
42.67	26,51	30.86	-4.3561
45.10	26,99	31.83	-4.8346
47.43	28,00	33.02	-5.0171
49.58	29,11	34.25	-5.1437
51.86	30,33	35.54	-5.2084
53.97	31,73	36.85	-5.1256
56.03	30,89	37.09	-6.1928
58.03	32,77	38.86	-6.0922
60.00	34,97	41.03	-6.0594
61.93	37,54	43.57	-6.0346
63.82	40,44	46.47	-6.0327
65.68	45,05	50.39	-5.3268
67.52	48,57	53.79	-5.2177
69.33	52,31	57.34	-5.0316
71.12	56,28	61.02	-4.7434
72.90	60,76	64.85	-4.0961
74.65	66,16	68.81	-2.6523
76.39	54,58	64.35	-9.7665
78.12	64,17	71.48	-7.3122
79.84	75,65	80.93	-5.2862
81.54	89,47	92.67	-3.1956
83.24	113,22	109.99	3.2302
84.94	128,46	123.10	5.3603
86.63	142,12	135.12	7.0016
88.31	170,09	153.21	16.8824
90.00	172,65	155.97	16.6821
91.69	165,37	150.43	14.9490
93.37	120,81	124.20	-3.3943
95.06	109,21	115.04	-5.8335
96.76	102,77	110.39	-7.6168
98.46	109,71	113.91	-4.1951
100.16	108,95	114.17	-5.2217
101.88	109,04	115.04	-5.9997
103.61	112,33	117.69	-5.3596
105.35	111,66	118.58	-6.9217
107.10	118,14	123.25	-5.1102
108.88	121,17	126.16	-4.9925
110.67	119,80	126.80	-6.9947
112.48	123,09	129.93	-6.8385
114.32	127,08	133.66	-6.5792
116.18	132,21	138.08	-5.8668
118.07	132,01	139.93	-7.9180
120.00	135,99	144.30	-8.3120
121.97	144,96	151.98	-7.0265
123.97	146,57	157.66	-11.0888
126.03	169,67	177.45	-7.7872
128.14	218,78	213.93	4.8456
130.32	275,73	255.68	20.0527
132.57	313,25	285.08	28.1681
134.90	335,82	301.41	34.4079
137.33	293,43	280.42	13.0132
139.68	305,06	286.59	18.4578
142.57	310,36	290.73	19.6309
145.44	306,01	289.45	16.5623
148.53	305,50	289.66	15.8432
151.93	302,44	288.81	13.6255
155.75	311,46	293.29	18.1737
160.25	299,06	281.29	17.7746
166.07	227,03	232.02	-4.9813
180.00	161,28	191.60	-30.3265

ABS. CORRECTION = 8.52E 00 DEG. K

TABLE VI-26. APCOR4 OUTPUT

RUN NO. 25 08/12/69 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	6.52	9.79	-3.2749
13.93	7.87	10.98	-3.1123
19.75	9.07	12.29	-3.2254
24.25	10.22	13.64	-3.4230
28.07	11.23	15.01	-3.7828
31.47	12.93	16.77	-3.8440
34.56	13.84	18.11	-4.2744
37.43	14.71	19.41	-4.7003
40.12	15.41	20.68	-5.2639
42.67	16.00	21.92	-5.9185
45.10	15.19	22.48	-7.2980
47.43	15.75	23.86	-8.1035
49.68	16.61	25.48	-8.8730
51.86	17.79	27.35	-9.5612
53.97	19.22	29.43	-10.2105
56.03	22.73	32.62	-9.8826
58.03	24.30	34.78	-10.4768
60.00	25.77	36.83	-11.0595
61.93	27.17	38.78	-11.6137
63.82	28.69	40.64	-11.9502
65.69	25.90	40.27	-14.3720
67.52	27.86	42.47	-14.6129
69.33	30.25	45.17	-14.9208
71.12	33.21	48.35	-15.1401
72.90	36.88	52.00	-15.1231
74.65	41.46	56.11	-14.6498
76.39	38.64	56.71	-18.0700
78.12	45.91	63.04	-17.1277
79.84	54.59	70.81	-16.2162
81.54	65.21	80.00	-14.7895
83.24	68.38	86.19	-17.8067
84.94	88.21	102.35	-14.1530
86.63	115.24	124.36	-9.1237
88.31	171.03	161.99	9.0455
90.00	200.56	185.77	14.7866
91.69	224.93	205.39	19.5405
93.37	243.34	220.63	22.7084
95.06	256.92	232.16	24.7608
96.76	265.39	239.75	25.6399
98.46	261.97	240.25	21.7135
100.16	265.08	243.43	21.6522
101.88	268.36	246.11	22.2564
103.61	262.61	243.41	19.2076
105.35	252.76	238.05	14.7002
107.10	249.84	236.02	13.8221
108.88	243.63	232.14	11.4887
110.67	233.11	225.95	7.1467
112.48	227.74	222.58	5.1617
114.32	227.52	221.94	5.5749
116.18	217.52	216.41	1.4139
118.07	212.73	213.18	-0.4467
120.00	205.08	209.01	-3.9278
121.97	203.83	208.51	-4.6724
123.97	197.36	205.92	-8.5567
126.03	194.95	206.78	-11.8298
128.14	210.62	219.51	-8.8967
130.32	254.80	249.05	5.7529
132.57	284.14	270.95	13.1918
134.90	303.48	285.24	18.2423
137.33	286.47	278.80	7.6758
139.88	297.39	286.27	11.1203
142.57	304.36	291.83	12.5284
145.44	302.99	292.35	10.6481
148.53	304.98	294.20	10.7778
151.93	305.07	295.05	10.0219
155.75	309.19	297.24	11.9541
160.25	302.64	291.55	11.0945
166.07	275.39	270.29	5.0995
180.00	186.73	219.68	-32.9531

ABS. CORRECTION = 1.15E 01 DEG. K

TABLE VI-27. APCOR4 OUTPUT

RUN NO. 27 08/12/69 V .POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	6.70	10.05	-3.3628
13.93	7.32	10.88	-3.5591
19.75	8.72	12.33	-3.6104
24.25	10.10	13.91	-3.8053
28.07	11.27	15.55	-4.2812
31.47	14.79	18.45	-3.6743
34.55	15.76	19.97	-4.2123
37.43	16.56	21.32	-4.6624
40.12	17.26	22.54	-5.2800
42.67	17.58	23.67	-5.9895
45.10	16.08	23.77	-7.6955
47.43	16.38	24.95	-8.5745
49.65	17.04	26.46	-9.4161
51.86	18.10	28.24	-10.1429
53.97	19.52	30.29	-10.7716
56.03	22.50	33.20	-10.7015
58.03	24.26	35.51	-11.2449
60.00	26.06	37.84	-11.7766
61.93	27.93	40.19	-12.2572
63.87	30.02	42.57	-12.5470
65.68	29.31	43.52	-14.2133
67.52	31.91	46.29	-14.3876
69.33	34.58	49.48	-14.5972
71.12	38.34	53.05	-14.7218
72.90	42.40	57.03	-14.6256
74.65	47.28	61.38	-14.1042
76.39	44.84	62.25	-17.4244
78.12	52.11	68.66	-16.5486
79.84	60.69	76.41	-15.7209
81.54	71.15	85.48	-14.3338
83.24	71.95	90.45	-18.5081
84.94	92.69	107.29	-14.5999
86.63	121.74	130.87	-9.1294
88.31	185.90	173.34	12.4572
90.00	216.57	198.18	18.4911
91.69	240.58	217.38	22.2034
93.37	253.38	229.24	24.1420
95.06	264.59	238.95	25.6321
96.76	270.60	244.79	25.8180
98.46	266.19	244.25	21.9384
100.16	265.77	245.02	20.7573
101.88	263.61	244.45	19.1525
103.61	259.72	242.60	17.1255
105.35	253.28	239.15	14.1214
107.10	250.26	237.28	12.9777
108.85	244.74	233.99	10.7491
110.67	236.96	229.46	7.5013
112.48	233.87	227.31	6.5584
114.32	227.68	223.64	4.0373
116.18	222.33	220.40	1.9335
118.07	217.22	217.39	-0.1734
120.00	212.61	214.78	-2.1655
121.97	205.03	211.02	-5.9859
123.97	205.24	211.78	-6.5368
126.03	197.30	209.97	-12.6670
128.14	220.45	226.51	-6.0640
130.32	259.90	253.43	6.4758
132.57	286.68	273.55	13.1325
134.90	304.41	286.74	17.6730
137.33	289.38	281.20	8.1836
139.88	299.38	288.06	11.3196
142.57	305.62	293.05	12.5536
145.44	305.06	293.85	11.2112
148.53	306.06	294.95	11.1163
151.93	304.56	294.45	10.1159
155.75	304.90	293.91	10.9884
160.25	295.02	285.44	9.5764
166.07	262.28	260.14	2.1426
180.00	167.19	205.39	-38.1984

ABS. CORRECTION = 1.16E 01 DEG. K

TABLE VI-29. APCOR4 OUTPUT

RUN NO. 29 08/12/69 H POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	6.85	12.18	-5.3323
13.93	14.24	16.75	-2.5232
19.75	15.95	18.81	-2.8579
24.25	17.47	20.45	-2.9757
28.07	18.87	21.88	-3.0144
31.47	19.01	22.61	-3.6060
34.55	20.18	23.93	-3.7496
37.43	21.28	25.27	-3.9907
40.12	22.38	26.63	-4.2480
42.67	23.50	28.02	-4.5174
45.10	24.63	29.39	-4.7617
47.43	25.93	30.82	-4.8906
49.68	27.32	32.29	-4.9708
51.86	28.80	33.80	-4.9997
53.97	30.39	35.33	-4.9400
56.03	30.69	36.25	-5.5622
58.03	32.56	38.07	-5.5128
60.00	34.62	40.13	-5.5070
61.93	36.74	42.42	-5.4799
63.82	39.55	44.92	-5.3700
65.68	41.17	47.02	-5.8463
67.52	44.45	50.08	-5.6314
69.33	48.12	53.51	-5.3922
71.12	52.22	57.29	-5.0642
72.90	56.71	51.41	-4.4960
74.69	62.40	55.87	-3.4624
76.39	59.42	56.22	-6.8061
78.12	67.71	72.84	-5.1296
79.84	77.31	80.92	-3.6053
81.54	86.45	90.43	-1.9850
83.24	104.71	102.95	1.7513
84.94	117.21	113.81	3.3956
86.63	129.26	124.50	4.7525
88.31	156.34	142.05	14.3914
90.00	159.72	145.42	14.3042
91.69	154.41	141.51	12.9028
93.37	116.93	119.72	-2.7405
95.06	107.62	112.40	-4.7764
96.76	102.49	108.77	-6.2841
98.46	108.21	111.81	-3.5972
100.16	107.86	112.30	-4.4464
101.88	108.39	113.39	-4.9947
103.61	110.23	115.28	-5.0424
105.35	111.98	117.29	-5.3034
107.10	114.40	119.81	-5.4139
108.88	117.95	123.02	-5.1486
110.67	121.57	126.34	-4.7693
112.48	123.00	128.43	-5.4376
114.32	125.76	131.07	-5.3138
116.18	124.93	131.52	-7.4929
118.07	125.98	134.25	-8.2737
120.00	134.25	140.64	-6.3932
121.97	136.50	144.44	-7.9411
123.97	140.03	150.07	-10.0368
126.03	149.53	151.97	-12.4421
128.14	196.54	197.38	-0.8468
130.32	268.60	248.14	20.4653
132.57	313.71	292.36	30.8486
134.90	339.53	300.82	38.6610
137.33	280.22	270.18	10.0346
139.88	293.20	276.17	17.0313
142.57	298.72	280.32	18.4065
145.44	295.35	279.64	15.7084
148.53	295.33	290.23	15.0980
151.93	293.04	279.83	13.2069
155.75	300.38	253.58	16.7989
160.25	290.01	273.64	16.3757
166.07	230.34	232.67	-2.3380
180.00	171.53	197.19	-25.6571

ABS. CORRECTION = 7.90E 00 DEG. K

TABLE VI-31. APCOR4 OUTPUT

RUN NO. 30 08/12/67 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	6.65	10.93	-4.2843
13.93	10.39	13.50	-3.1129
19.75	11.80	15.11	-3.3178
24.25	13.04	16.58	-3.5430
28.07	14.12	17.97	-3.8506
31.47	14.55	19.03	-4.4872
34.56	15.56	20.42	-4.8612
37.43	16.56	21.83	-5.2724
40.12	17.48	23.28	-5.7945
42.67	18.31	24.75	-6.4360
45.10	18.39	25.90	-7.5017
47.43	19.20	27.50	-8.2975
49.68	20.20	29.25	-9.0605
51.35	21.43	31.17	-9.7461
53.97	22.91	33.23	-10.3154
56.03	24.72	35.48	-10.7518
58.03	26.53	37.75	-11.2311
60.00	28.42	40.14	-11.7203
61.93	30.46	42.61	-12.1519
63.82	32.77	45.18	-12.4077
65.69	32.86	46.65	-13.7841
67.52	35.76	49.67	-13.9112
69.33	39.06	53.11	-14.0425
71.12	42.86	56.93	-14.0684
72.90	47.22	61.14	-13.9168
74.65	52.21	65.72	-13.5073
76.39	53.71	68.74	-15.0297
78.12	60.20	74.71	-14.5105
79.86	67.54	81.53	-13.9898
81.54	76.18	89.20	-13.0129
83.24	73.53	91.84	-18.3083
84.94	91.58	106.73	-15.0479
86.63	118.13	128.32	-10.1590
88.31	176.07	167.10	8.9676
90.00	206.57	191.57	15.0053
91.69	232.20	212.07	20.1252
93.37	254.57	229.54	25.0283
95.06	268.24	241.15	27.0880
96.76	275.42	247.82	27.6010
98.46	269.45	246.47	22.9817
100.16	268.26	246.65	21.6110
101.88	264.68	245.11	19.5691
103.61	256.18	240.80	15.3793
105.35	255.60	240.41	15.1945
107.10	252.42	238.56	13.8612
108.85	246.49	234.97	11.5162
110.67	238.71	230.15	8.5492
112.48	231.20	225.45	5.7431
114.32	224.53	221.35	3.1686
116.15	221.70	219.35	2.3449
118.07	214.74	215.38	-0.6360
120.00	210.45	212.95	-2.5033
121.97	206.26	211.02	-4.7670
123.97	206.03	211.53	-5.4983
126.03	198.91	209.55	-10.6553
128.14	209.83	219.10	-9.2743
130.32	251.28	246.53	4.7451
132.57	278.74	266.99	11.7519
134.90	297.11	280.59	16.5199
137.33	283.39	275.83	7.5557
139.88	293.78	283.00	10.7803
142.57	300.31	288.19	12.1244
145.44	299.43	288.78	10.6464
148.53	300.50	289.87	10.6265
151.93	299.09	289.36	9.7266
155.75	299.36	288.25	10.1165
160.25	289.14	280.41	8.7266
166.07	260.98	258.23	2.7516
180.00	172.12	207.23	-35.1141

ABS. CORRECTION = 1.13E 01 DEG. K

TABLE VI-32. APCOR4 OUTPUT

RUN NO. 31 08/13/69 H POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	10.60	13.32	-2.7186
13.93	9.67	13.27	-3.5977
19.75	10.69	14.42	-3.7298
24.25	11.83	15.77	-3.9416
28.07	13.04	17.25	-4.2105
31.47	15.02	19.18	-4.1637
34.56	16.22	20.73	-4.5140
37.43	17.44	22.28	-4.8443
40.12	18.67	23.83	-5.1616
42.67	19.98	25.38	-5.3989
45.10	20.24	26.35	-6.1126
47.43	21.87	28.05	-6.1870
49.68	23.82	30.00	-6.1767
51.86	26.05	32.17	-6.1193
53.97	28.50	34.54	-6.0412
56.03	32.02	37.55	-5.5303
58.03	34.68	40.15	-5.4762
60.00	37.39	42.79	-5.3994
61.93	40.20	45.46	-5.2589
63.82	43.25	48.17	-4.9191
65.68	42.16	48.82	-6.6531
67.52	45.98	52.11	-6.2244
69.33	50.14	56.00	-5.8571
71.12	55.07	60.47	-5.4000
72.90	60.90	65.51	-4.6060
74.65	67.93	71.10	-3.1684
76.39	64.50	71.66	-7.1614
78.12	75.42	80.22	-4.8053
79.84	88.07	90.73	-2.6591
81.54	102.73	103.16	-0.4359
83.24	127.72	121.21	6.5065
84.96	142.57	133.95	8.6204
86.63	155.03	144.87	10.1545
88.31	177.25	159.48	17.7749
90.00	178.79	161.36	17.4284
91.69	171.59	155.91	15.6829
93.37	132.44	132.65	-0.2083
95.06	120.77	123.52	-2.7469
96.76	113.03	117.89	-4.8624
98.46	116.50	119.07	-2.5709
100.16	112.28	116.96	-4.6770
101.88	111.67	117.00	-5.3256
103.61	113.35	118.55	-5.1942
105.35	116.54	121.04	-4.5023
107.[illegible]	117.50	122.41	-4.9147
108.88	117.31	123.20	-5.8889
110.67	117.58	124.40	-6.8197
112.48	121.94	127.93	-5.9871
114.32	125.20	131.08	-5.8796
116.18	126.67	133.46	-6.7958
118.07	132.35	138.03	-5.6793
120.00	133.14	140.15	-7.0143
121.97	132.82	142.22	-9.3992
123.97	139.12	149.36	-10.2248
126.03	150.99	162.83	-11.8373
128.14	209.11	203.00	6.1109
130.32	269.27	243.53	25.7449
132.57	257.94	243.53	14.4086
134.90	249.84	243.53	6.3121
137.33	294.76	271.41	23.3431
139.88	296.29	276.36	19.9317
142.57	298.87	279.40	19.4660
145.44	293.26	277.15	16.1135
148.53	291.87	276.65	15.2249
151.93	288.43	275.38	13.0498
155.75	295.49	278.79	16.7087
160.25	284.82	258.53	16.2983
166.07	222.22	226.73	-4.5090
180.00	182.42	200.94	-18.5155

ABS. CORRECTION = 7.96E 00 DEG. K

TABLE VI-33. APCOR4 OUTPUT

RUN NO. 32 08/13/69 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	10.68	14.70	-4.0192
13.93	13.66	16.84	-3.1846
19.75	14.73	18.22	-3.4917
24.25	15.67	19.49	-3.8146
28.07	16.66	20.70	-4.0320
31.47	14.58	20.30	-5.7197
34.55	15.81	21.75	-5.9468
37.43	17.09	23.45	-6.3599
40.12	18.48	25.35	-6.8655
42.67	19.88	27.42	-7.5355
45.10	22.11	30.00	-7.8964
47.43	23.70	32.28	-8.5737
49.68	25.34	34.52	-9.1890
51.86	26.97	36.75	-9.7855
53.97	28.70	38.98	-10.2764
56.03	29.69	40.81	-11.1197
58.03	31.59	43.15	-11.5598
60.00	33.56	45.61	-12.0467
61.93	35.72	48.19	-12.4680
63.82	38.21	50.87	-12.6640
65.68	37.98	52.21	-14.2264
67.52	41.22	55.46	-14.2416
69.33	44.94	59.21	-14.2703
71.12	49.25	63.45	-14.1992
72.90	54.28	68.15	-13.8714
74.65	60.28	73.31	-13.0241
76.39	57.37	74.21	-16.8405
78.12	66.43	81.85	-15.4259
79.84	77.10	91.15	-14.0495
81.54	89.98	102.07	-12.0863
83.24	96.96	110.73	-13.7699
84.94	119.03	128.50	-9.4695
86.63	147.78	151.73	-3.9525
88.31	208.48	191.95	16.5279
90.00	236.42	214.51	21.9109
91.69	256.56	230.78	25.7795
93.37	261.22	237.43	23.7906
95.05	269.32	244.64	24.6735
96.76	273.62	249.03	24.5955
98.46	268.58	247.89	20.6926
100.16	269.96	249.43	20.5254
101.88	267.50	248.62	18.8736
103.61	264.42	246.98	17.4351
105.35	256.89	242.70	14.1971
107.10	250.23	238.75	11.4760
108.88	246.42	236.31	10.1019
110.67	243.09	234.04	9.0474
112.48	233.25	228.44	4.8143
114.32	233.66	228.01	5.6444
116.18	225.23	223.12	2.1130
118.07	218.81	219.28	-0.4650
120.00	214.69	216.84	-2.1477
121.97	211.67	215.12	-3.4494
123.97	201.60	210.48	-8.8861
126.03	208.78	216.25	-7.4758
128.14	229.98	230.89	-0.9085
130.32	252.16	245.95	6.2103
132.57	247.29	245.95	1.3419
134.90	240.39	245.95	-5.5579
137.33	292.54	277.76	14.7768
139.88	297.61	284.65	12.9599
142.57	303.03	289.31	13.7135
145.44	300.95	289.26	11.6922
148.53	300.19	289.09	11.0960
151.93	296.79	286.70	10.0921
155.75	288.75	280.83	7.9230
160.25	276.97	271.10	5.8697
166.07	253.80	251.81	1.9921
180.00	169.08	202.83	-33.7542

ABS. CORRECTION = 1.10E 01 DEG. K

TABLE VI-34. APCOR4 OUTPUT

33 08/14/69 V POLAR, 9.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP. (DEG K)
0.00	4.44	20.94	-16.4982
15.93	33.97	38.51	-4.5358
19.75	39.65	44.98	-5.3355
24.25	44.37	49.64	-5.2652
28.07	48.53	53.36	-4.8237
31.47	45.71	53.19	-7.4806
34.56	49.30	56.50	-7.1982
37.43	52.71	60.02	-7.3117
40.12	56.35	63.71	-7.3541
42.67	60.10	67.56	-7.4533
45.10	66.16	72.61	-6.4457
47.43	70.07	76.47	-6.3959
49.68	73.82	80.01	-6.1892
51.86	77.22	83.28	-6.0515
53.97	80.28	86.30	-6.0165
56.03	83.66	89.41	-5.7556
58.03	85.98	91.90	-5.9155
60.00	87.94	94.09	-6.1493
61.93	89.62	96.01	-6.3931
63.82	91.15	97.68	-6.5336
65.68	89.21	97.52	-8.3127
67.52	90.59	99.11	-8.5216
69.33	92.01	100.90	-8.8880
71.12	93.68	102.90	-9.2194
72.90	95.24	105.09	-9.8505
74.65	100.14	107.48	-7.3438
76.39	76.37	96.27	-19.9026
78.12	86.80	103.69	-16.8957
79.84	100.42	114.81	-14.3937
81.54	117.76	129.57	-11.8037
83.24	140.14	148.28	-8.1445
84.94	165.31	169.87	-4.5576
86.63	194.26	194.65	-0.3861
88.31	249.56	232.74	16.8135
90.00	274.34	253.82	20.5165
91.69	280.68	257.85	22.8304
93.37	286.96	269.51	17.4507
95.05	293.30	275.04	18.2615
96.73	297.57	279.00	18.5686
98.45	303.54	283.14	20.4010
100.16	301.08	281.95	19.1230
101.88	294.22	277.17	17.0499
103.61	287.81	271.38	16.4325
105.35	256.32	252.73	3.5887
107.10	257.00	250.97	6.0307
108.88	258.43	250.46	7.9911
110.67	252.73	246.37	6.3671
112.48	249.46	242.77	6.6925
114.32	235.18	232.83	2.3484
116.18	217.41	220.93	-3.5172
118.07	207.69	213.87	-6.1765
120.00	210.64	214.28	-3.6406
121.97	200.33	209.41	-9.0874
123.97	198.91	211.59	-12.6739
126.03	233.24	235.28	-2.0484
128.14	265.92	260.68	5.2428
130.32	305.46	289.67	15.7953
132.57	329.09	308.05	21.0297
134.90	340.13	315.17	24.9595
137.33	295.12	290.04	5.0820
139.88	297.01	288.39	8.6241
142.57	293.54	284.95	8.5927
145.44	280.89	276.32	4.5606
148.53	272.81	269.61	3.1930
151.93	262.26	262.31	-0.0529
155.75	271.85	264.58	7.2661
160.25	252.25	243.63	8.6206
166.07	135.17	166.71	-31.5391
180.00	131.34	154.21	-22.8746

ABS. CORRECTION = 9.96E 00 DEG. K

TABLE VI-35. APCOR4 OUTPUT

RUN NO. 34 08/14/69 H POLAR, 9.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP, (DEG K)	APPARENT TEMP, (DEG K)	CORRECTION TEMP, (DEG K)
0.00	4.36	13.65	-9.1046
13.93	14.96	20.33	-5.3690
19.75	17.13	24.63	-5.4974
24.25	23.12	28.53	-5.4086
28.07	26.46	32.24	-5.7836
31.47	34.92	38.5[illegible]	-3.6648
34.56	37.68	41.6[illegible]	-3.9200
37.43	40.30	44.12	-3.8189
40.12	42.58	46.25	-3.6836
42.87	44.60	48.08	-3.4757
45.10	44.48	48.69	-4.2150
47.43	46.05	50.22	-4.1619
49.69	47.78	51.92	-4.1380
51.86	49.64	53.77	-4.1303
53.97	51.68	55.77	-4.0914
56.03	53.54	57.75	-4.2134
58.03	55.88	60.05	-4.1707
60.00	57.42	62.53	-4.1086
61.93	61.24	65.17	-3.9245
63.87	64.45	67.95	-3.5041
65.68	63.75	68.86	-5.1097
67.52	67.84	72.43	-4.5990
69.33	72.53	76.70	-4.1664
71.12	77.92	81.62	-3.7027
72.90	84.25	87.20	-2.9495
74.65	91.67	93.41	-1.7395
76.39	92.99	96.78	-3.8901
7[illegible].12	103.28	105.40	-2.0146
79.84	115.13	115.50	-0.3745
81.54	128.39	127.08	1.3121
83.24	157.32	146.41	10.9082
84.94	167.17	154.95	12.2122
86.63	171.16	158.65	12.5008
88.31	163.29	154.74	8.5496
90.00	159.30	151.64	7.6586
91.69	152.89	146.60	6.2875
93.37	137.66	136.78	0.8889
95.06	130.02	130.82	-0.7995
96.75	123.59	125.85	-2.2591
98.46	118.82	122.15	-3.3307
100.16	113.46	118.83	-5.3924
101.88	106.61	115.82	-9.2100
103.61	124.84	126.08	-1.2478
105.35	130.57	129.60	0.9785
107.10	122.87	124.85	-1.9859
108.88	107.23	114.99	-7.7625
110.67	90.56	104.88	-14.3158
112.48	94.28	106.20	-11.9225
114.32	101.84	110.38	-8.5467
116.18	93.43	106.93	-13.4980
118.07	92.91	108.01	-15.1003
120.00	105.83	116.89	-11.0637
121.97	101.00	118.95	-17.9532
123.97	114.05	134.25	-20.2125
126.03	185.63	183.97	1.6579
128.16	246.08	230.74	17.3386
130.32	284.69	262.17	22.5270
132.57	310.82	283.85	26.9697
134.90	325.55	294.54	31.0118
137.33	285.16	273.53	11.6289
139.89	291.46	275.93	15.5577
142.57	293.17	276.80	16.3718
145.44	282.74	271.10	11.6312
148.53	281.61	270.30	11.3100
151.93	279.11	271.07	8.0458
155.75	315.03	291.73	23.3080
160.25	305.78	278.41	27.3679
166.07	160.32	187.85	-27.5314
180.00	195.57	196.07	-0.4956

ABS. CORRECTION = 8.37E 00 DEG. K

TABLE VI-36. APCOR4 OUTPUT

RUN NO. 35 08/14/69 H POLAR, 16.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	12.31	24.20	-11.8880
13.93	21.37	30.74	-9.3637
19.75	22.97	34.00	-11.0360
24.25	24.59	36.74	-12.1582
28.07	27.08	39.22	-12.1362
31.47	19.11	36.00	-16.8898
34.56	22.79	39.25	-16.4672
37.47	26.66	43.32	-16.6561
40.12	31.38	48.05	-16.6708
42.67	37.36	53.34	-15.9780
45.10	36.19	55.14	-18.9451
47.43	44.20	62.32	-18.1106
49.68	54.49	71.51	-17.0189
51.86	66.83	82.53	-15.7016
53.97	81.05	95.24	-14.1858
56.03	102.03	111.94	-9.9113
58.03	119.07	126.85	-7.7795
60.00	137.11	142.37	-5.2593
61.93	155.52	158.49	-2.9672
63.82	173.37	175.18	-1.8152
65.69	216.12	204.68	11.4349
67.32	232.14	219.57	12.5667
69.33	245.90	231.75	14.1426
71.12	256.93	241.35	15.5737
72.90	265.32	248.45	16.8693
74.65	271.61	253.14	18.4745
76.39	255.31	245.64	9.6708
78.12	260.26	249.01	11.2556
79.84	264.42	252.63	11.7894
81.54	268.34	256.50	11.8338
83.24	278.24	263.27	14.9720
84.94	279.79	265.15	14.6357
86.63	278.55	264.65	13.8916
88.31	268.09	258.89	9.1982
90.00	264.66	256.58	8.0790
91.69	261.92	254.87	7.0468
93.37	261.33	254.42	6.9108
95.06	259.17	253.20	5.9636
96.76	256.91	251.89	5.0179
98.46	254.17	250.39	3.7850
100.16	251.27	249.11	2.1625
101.88	254.28	251.22	3.0590
103.61	259.28	254.44	4.8388
105.35	262.39	256.15	6.2379
107.10	253.90	251.14	2.7624
108.86	247.04	246.22	0.8165
110.67	242.37	241.31	0.5668
112.48	227.24	231.66	-4.4167
114.32	207.67	219.72	-12.0490
116.18	217.28	223.48	-6.2021
118.07	212.76	220.57	-7.8115
120.00	205.07	216.05	-10.9820
121.97	196.32	212.09	-15.7685
123.97	214.24	223.66	-9.4124
126.03	212.91	228.67	-15.7576
128.14	274.98	267.88	7.1068
130.32	303.47	289.10	14.3695
132.57	297.05	289.10	7.9519
134.90	293.45	289.10	4.3513
137.33	311.96	300.63	11.3304
139.88	312.40	302.62	9.7772
142.57	313.03	303.91	9.1144
145.44	316.90	306.40	10.4962
148.53	314.42	304.80	9.6222
151.93	308.67	299.95	8.7186
155.75	293.09	288.35	4.7436
160.25	277.32	274.58	2.7345
166.07	246.41	250.57	-4.1606
180.00	193.85	219.05	-25.2022

ABS. CORRECTION = 1.02E 01 DEG. K

TABLE VI-37. APCOR4 OUTPUT

RUN NO. 36 08/14/69 V POLAR. 16.5 GHZ SEA WATER

ITERATION NUMBER 0

[illegible] (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	12.57	17.15	-4.5757
13.93	11.62	17.44	-5.8220
19.75	12.65	19.04	-6.3945
24.25	13.78	20.87	-7.0986
28.07	15.15	22.84	-7.6956
31.47	14.48	23.80	-9.3148
34.56	16.26	26.14	-9.8802
37.43	18.18	28.73	-10.3467
40.12	20.32	31.52	-11.1980
42.67	22.70	34.48	-11.7886
45.10	24.43	37.17	-12.7410
47.43	27.30	40.53	-13.2345
49.68	30.60	44.20	-13.5997
51.86	34.28	48.15	-13.8730
53.97	38.49	52.37	-13.8771
56.03	40.18	55.41	-15.2220
58.03	45.63	60.58	-14.9505
60.00	51.82	66.43	-14.6066
61.93	58.84	72.92	-14.0761
63.82	66.73	80.03	-13.2906
65.68	74.79	87.43	-12.6383
67.32	84.29	95.77	-11.4816
69.33	94.55	104.74	-10.1920
71.12	105.63	114.33	-8.7031
72.90	117.49	124.53	-7.0411
74.65	130.03	135.34	-5.3054
76.39	145.96	148.06	-2.0919
78.12	159.40	159.60	-0.1975
79.84	173.30	171.39	1.9107
81.54	187.64	183.45	4.1944
83.24	201.89	195.52	6.3703
84.94	217.37	208.36	9.0110
86.63	233.43	221.74	11.6859
88.31	259.00	239.77	19.2270
90.00	271.15	250.16	20.9948
91.69	278.85	256.95	21.9055
93.37	274.60	256.75	17.8445
95.06	277.66	259.90	17.7571
96.76	280.57	262.96	17.6150
98.46	283.45	265.82	17.6211
100.16	286.85	268.52	18.3327
101.88	284.30	267.60	16.7001
103.61	278.35	264.49	13.8662
105.35	276.73	263.22	13.5181
107.10	270.09	259.02	11.0745
108.88	260.42	252.90	7.5210
110.67	250.46	246.57	3.8885
112.48	245.24	243.30	2.9453
114.32	240.10	239.13	0.9682
116.18	232.44	234.22	-1.7816
118.07	227.64	230.92	-3.2787
120.00	220.75	226.84	-6.0848
121.97	217.51	224.94	-7.4244
123.97	211.77	222.43	-10.6583
126.03	214.18	225.57	-11.3922
128.14	229.98	238.02	-8.0479
130.32	280.06	268.64	11.4220
132.57	273.40	268.64	4.7646
134.90	267.91	268.64	-0.7295
137.33	304.90	291.31	13.5951
139.88	306.98	295.38	11.6036
142.57	309.61	298.02	11.5841
145.44	311.55	299.67	11.8918
148.53	309.24	298.19	11.0454
151.93	303.42	293.37	10.0489
155.75	283.42	279.85	3.5726
160.25	268.04	267.81	0.2235
166.07	259.60	256.35	3.2458
180.00	163.34	202.07	-38.7272

ABS. CORRECTION = 1.04E 01 DEG. K

TABLE VI-33. APCOR4 OUTPUT

RUN NO. 301 07/21/69 V POLAR. 9.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP (DEG K)
0.00	3.86	28.70	-24.8396
13.93	60.44	61.88	-1.4332
19.75	68.67	72.02	-3.3578
24.25	75.41	78.37	-2.9550
28.07	80.09	82.73	-2.6430
30.47	79.09	83.59	-4.5032
34.56	81.75	86.17	-4.4197
37.43	83.73	88.40	-4.6703
40.12	85.43	90.35	-4.9198
42.67	86.98	92.07	-5.0875
45.10	88.42	93.59	-5.1705
47.43	89.84	94.96	-5.1067
49.68	91.67	96.15	-4.4744
51.86	84.61	92.75	-8.1427
53.97	86.74	94.27	-7.5289
56.03	88.60	96.07	-7.4738
58.03	90.59	98.13	-7.5359
60.00	92.92	100.43	-7.5143
61.93	95.47	102.96	-7.4906
63.82	98.20	105.71	-7.5163
65.68	101.46	108.68	-7.2190
67.32	107.30	111.85	-4.5513
69.33	117.96	115.22	2.7386
71.12	45.92	76.35	-30.4267
72.90	60.75	83.17	-22.4242
74.65	74.46	92.82	-18.3595
76.39	89.24	105.23	-15.9876
78.12	106.91	120.34	-13.4310
79.84	127.68	138.12	-10.4303
81.54	151.63	158.52	-6.8926
83.24	189.25	186.31	2.9359
84.94	214.07	207.43	6.6427
86.63	236.24	226.37	9.8689
88.31	258.40	244.28	14.1222
90.00	274.24	257.87	16.3671
91.69	286.15	268.25	17.8992
93.37	294.90	275.73	19.1667
95.06	298.75	279.34	19.4079
96.76	298.28	279.38	18.8967
98.46	286.76	272.86	13.8980
100.16	281.71	269.09	12.6251
101.88	276.27	264.90	11.3723
103.61	270.46	260.28	10.1873
105.35	259.09	252.66	6.4364
107.10	252.74	247.57	5.1742
108.88	246.42	242.64	3.7735
110.67	240.26	237.88	2.3755
112.48	234.77	233.29	1.4781
114.32	230.39	228.86	1.5326
116.18	205.49	214.24	-8.7506
118.07	206.10	213.69	-7.5960
120.00	209.77	216.62	-6.8475
121.97	216.59	223.23	-6.6432
123.97	226.19	233.76	-7.5704
126.03	279.20	267.68	11.5246
128.14	290.63	279.92	10.7003
130.32	300.78	289.48	11.2972
132.57	308.35	296.10	12.2527
134.90	312.46	299.46	12.9973
137.33	300.61	293.62	6.9897
139.88	302.11	294.39	7.7217
142.57	301.95	294.59	7.3608
145.44	301.91	294.67	7.2425
148.53	299.51	293.09	6.4233
151.93	294.08	289.89	4.1912
155.75	304.33	293.35	10.9804
160.23	286.79	274.72	12.0672
166.07	189.29	205.53	-16.2461
180.00	105.25	149.63	-44.3806

ABS. CORRECTION = 9.75E 00 DEG. K

TABLE VI-39. APCOR4 OUTPUT

RUN NO. 102 07/21/69 H POLAR. 9.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	3.56	12.50	-8.9446
13.93	-1.85	11.81	-13.6605
19.75	9.11	20.87	-11.7559
24.25	21.03	31.65	-10.6110
28.07	30.62	43.39	-12.7723
31.47	80.26	76.54	3.7205
34.56	87.26	85.54	1.7198
37.43	94.01	91.65	2.3565
40.12	98.45	95.43	3.0258
42.67	100.54	97.26	3.2803
45.10	100.60	97.43	3.1712
47.43	100.09	96.14	3.9522
49.68	101.73	93.55	8.1739
51.86	48.51	62.28	-13.7735
53.97	51.56	60.95	-9.3908
56.03	52.58	60.98	-8.3984
58.03	53.81	62.27	-8.4553
60.00	56.41	64.73	-8.3213
61.93	60.37	68.30	-7.9367
63.82	65.58	72.93	-7.3538
65.68	71.95	78.56	-6.6162
67.52	79.58	85.16	-5.5816
69.33	88.43	92.69	-4.2564
71.12	95.78	99.82	-4.0422
72.90	106.85	109.24	-2.3884
74.65	118.99	119.61	-0.6159
76.39	132.27	130.90	1.3624
78.12	146.68	143.12	3.5637
79.84	162.01	156.25	5.7554
81.54	178.37	170.29	8.0780
83.24	210.06	191.69	18.3683
84.94	221.27	201.45	19.8235
86.63	225.67	205.66	20.0121
88.31	226.25	205.55	20.7012
90.00	216.56	197.60	18.9639
91.69	198.84	182.98	15.8649
93.37	148.63	150.71	-2.0879
95.06	128.57	134.22	-5.6471
96.76	114.00	122.37	-8.3625
98.46	113.05	118.90	-5.8476
100.16	104.18	112.16	-7.9838
101.88	96.43	106.11	-9.6822
103.61	89.94	100.75	-10.8123
105.35	80.31	94.06	-13.7509
107.10	75.89	90.47	-14.5828
108.88	72.74	88.13	-15.3878
110.67	71.08	87.07	-15.9863
112.48	71.49	87.33	-15.8353
114.32	74.52	88.96	-14.4426
116.18	57.02	80.95	-23.9304
118.07	68.40	89.31	-20.9116
120.00	84.64	102.78	-18.1363
121.97	105.52	121.68	-16.1562
123.97	130.19	146.37	-16.1761
126.03	223.92	208.11	15.8040
128.14	250.12	234.45	15.6770
130.32	273.57	255.84	17.7296
132.57	292.72	271.85	20.3721
134.90	304.52	281.90	22.6186
137.33	288.18	275.33	12.8557
139.88	295.71	280.42	15.2941
142.57	301.04	284.30	16.7353
145.44	291.18	280.06	11.1220
148.53	295.99	284.09	11.9033
151.93	300.68	292.16	8.5289
155.75	368.99	333.86	35.1343
160.25	367.10	325.08	42.0208
166.07	190.43	211.45	-21.0242
180.00	154.61	177.62	-23.0060

ABS. CORRECTION = 1.21E 01 DEG. K

TABLE VI-40. APCOR4 OUTPUT

RUN NO. 201 07/17/69 V POLAR. 9.5 GHZ SEA WATER

ITERATION NUMBER 0

ZENITH ANGLE (DEG)	BRIGHTNESS TEMP. (DEG K)	APPARENT TEMP. (DEG K)	CORRECTION TEMP. (DEG K)
0.00	3.71	23.12	-19.4062
13.93	33.12	41.17	-8.0476
19.75	42.69	50.68	-7.9865
24.25	51.42	58.82	-7.4063
28.07	58.49	66.29	-7.7977
31.47	73.55	77.84	-4.2936
34.55	78.90	83.75	-4.8534
37.43	83.88	88.74	-4.8534
40.12	88.21	92.98	-4.7737
42.67	91.93	96.61	-4.6779
45.10	95.16	99.73	-4.5697
47.43	98.00	102.39	-4.3908
49.68	100.90	104.65	-3.7628
51.85	96.16	102.89	-6.7379
53.97	98.76	104.97	-6.2107
56.03	100.90	107.05	-6.1667
58.03	102.92	109.19	-6.2667
60.00	104.95	111.34	-6.3912
61.93	106.90	113.52	-6.6165
63.82	108.80	115.73	-6.9239
65.68	111.00	117.96	-6.9625
67.52	115.09	120.23	-5.1422
69.33	122.77	122.53	0.2426
71.12	66.75	92.24	-25.4842
72.90	77.33	96.95	-19.6286
74.65	86.81	103.73	-16.9266
76.39	96.85	112.52	-15.6731
78.12	109.02	123.28	-14.2644
79.84	123.91	135.98	-12.0665
81.54	141.45	150.60	-9.1473
83.24	148.35	151.26	-12.9115
84.94	176.29	185.22	-8.9352
86.63	213.36	216.94	-3.5782
88.31	304.69	276.70	27.9865
90.00	336.16	303.57	32.5925
91.69	352.18	317.54	34.6466
93.37	333.06	309.53	23.5296
95.06	330.32	307.23	23.0925
96.76	323.03	301.38	21.6523
98.46	300.50	287.30	13.2056
100.16	290.47	279.58	10.8915
101.89	281.81	273.29	8.5181
103.61	274.13	268.45	5.6740
105.35	284.61	273.27	11.3399
107.10	279.20	270.00	9.1983
108.88	273.76	266.21	7.5529
110.67	268.11	251.65	6.2329
112.48	262.37	256.98	5.3879
114.32	257.00	251.49	5.5126
116.18	225.20	232.52	-7.3204
118.07	224.07	230.14	-6.0624
120.00	225.71	231.15	-5.4386
121.97	230.29	235.75	-5.4686
123.97	237.58	244.18	-6.6043
126.03	286.93	275.28	11.6572
128.14	296.04	285.42	10.6201
130.32	303.93	292.98	10.9529
132.57	309.33	297.72	11.6110
134.90	311.40	299.34	12.0555
137.33	299.38	292.73	6.6504
139.88	298.13	291.27	6.8624
142.57	294.95	288.78	6.1655
145.44	288.78	284.34	4.4412
148.33	282.63	279.44	3.1929
151.93	273.57	273.22	0.3472
155.75	282.78	275.14	7.6392
160.25	262.49	253.18	9.3185
166.07	138.17	171.93	-33.7523
180.00	137.11	160.76	-23.6516

ABS. CORRECTION = 1.04E 01 DEG. K

TABLE VI-41. APCOR4 OUTPUT

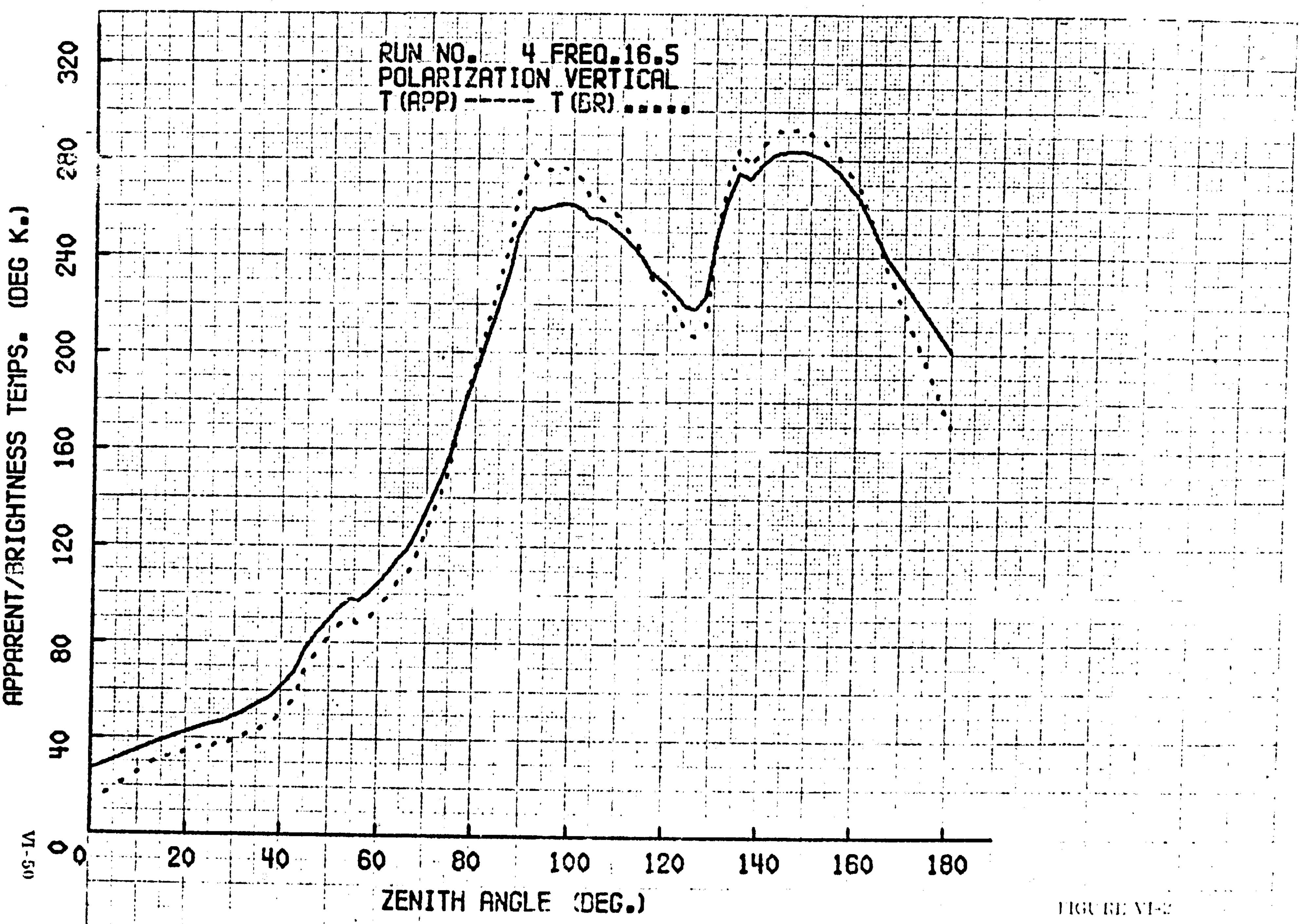

RUN NO. 4 FREQ. 16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-2

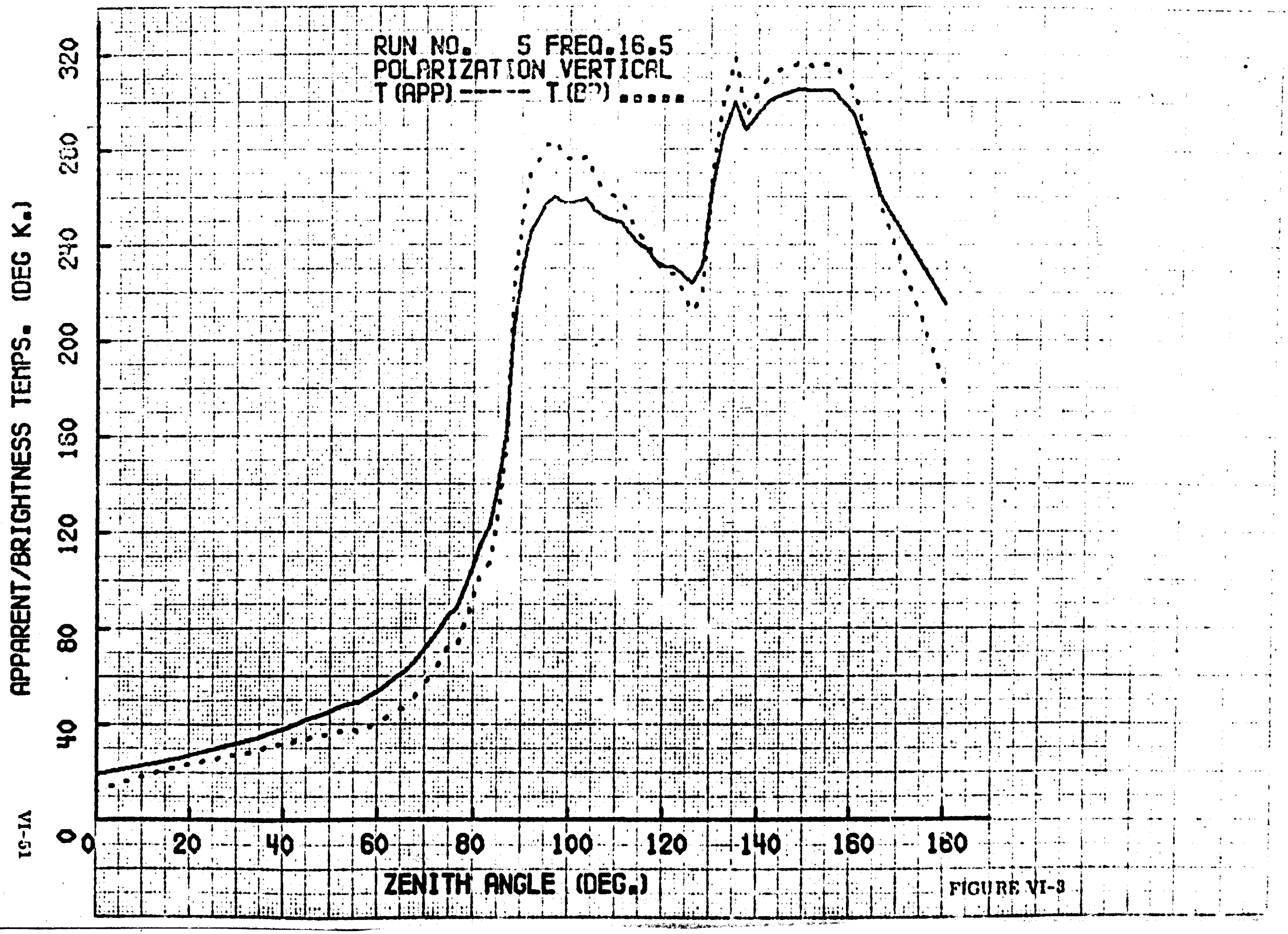

RUN NO. 5 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (B?) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
ZENITH ANGLE (DEG.)
0
20
40
60
80
100
120
140
160
180

FIGURE VI-3

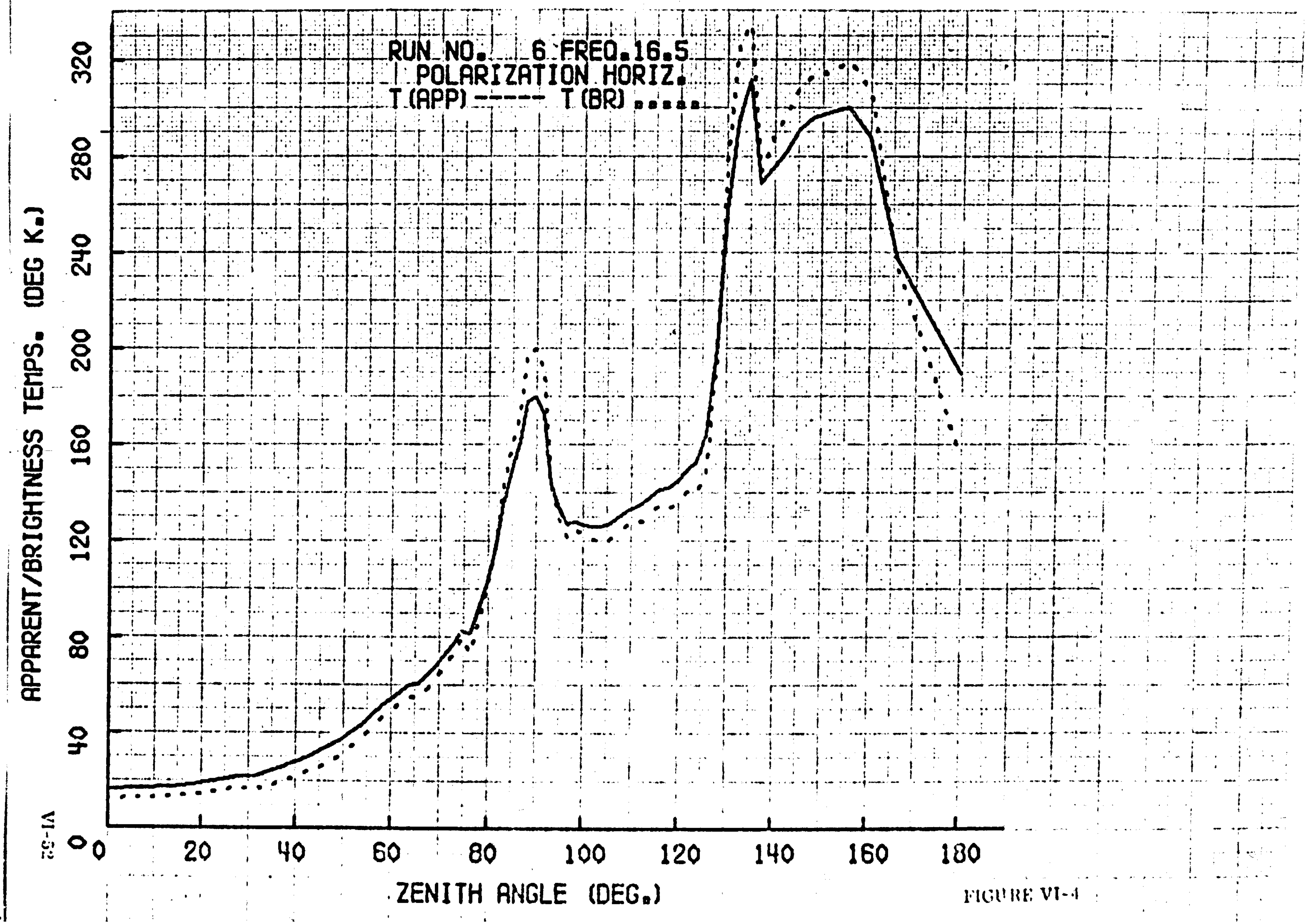

RUN NO. 6 FREQ. 16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
ZENITH ANGLE (DEG.)
0
40
80
120
160
200
240
280
320
20
60
100
140
180

FIGURE VI-4

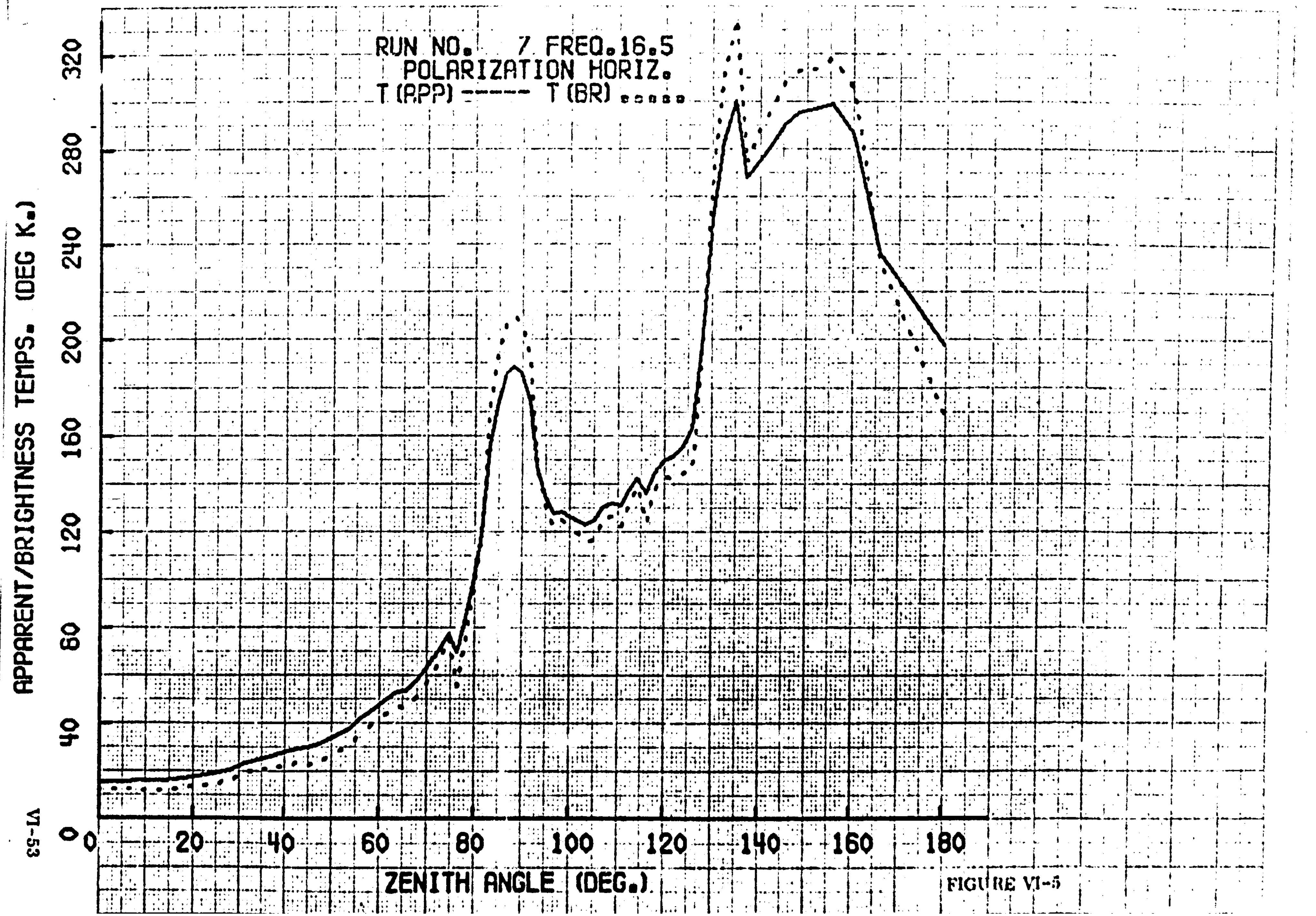
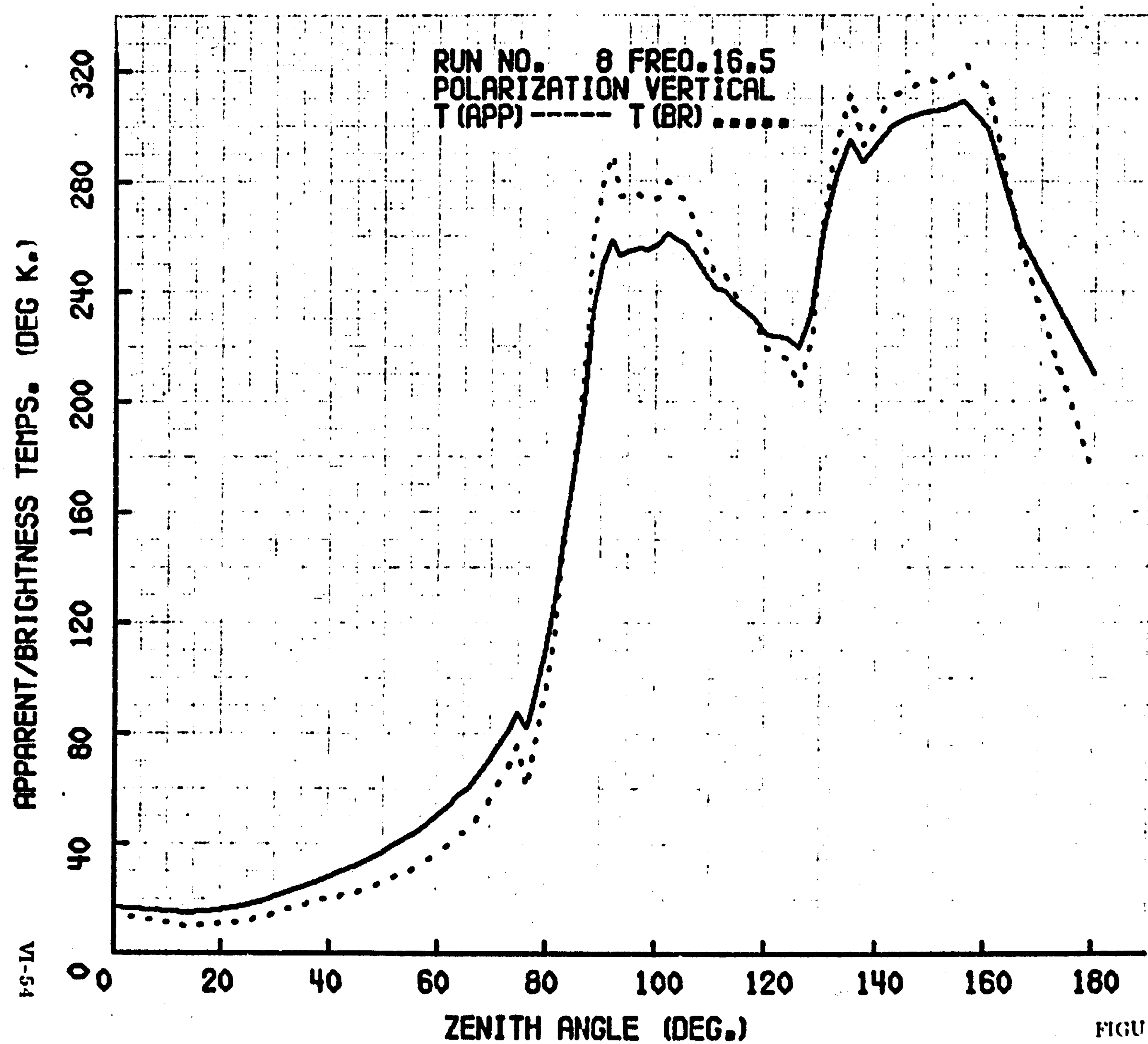

RUN NO. 7 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-5



RUN NO. 8 FREQ.16.5
POLARIZATION VERTICAL
T(APP)----- T(BR).....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-6

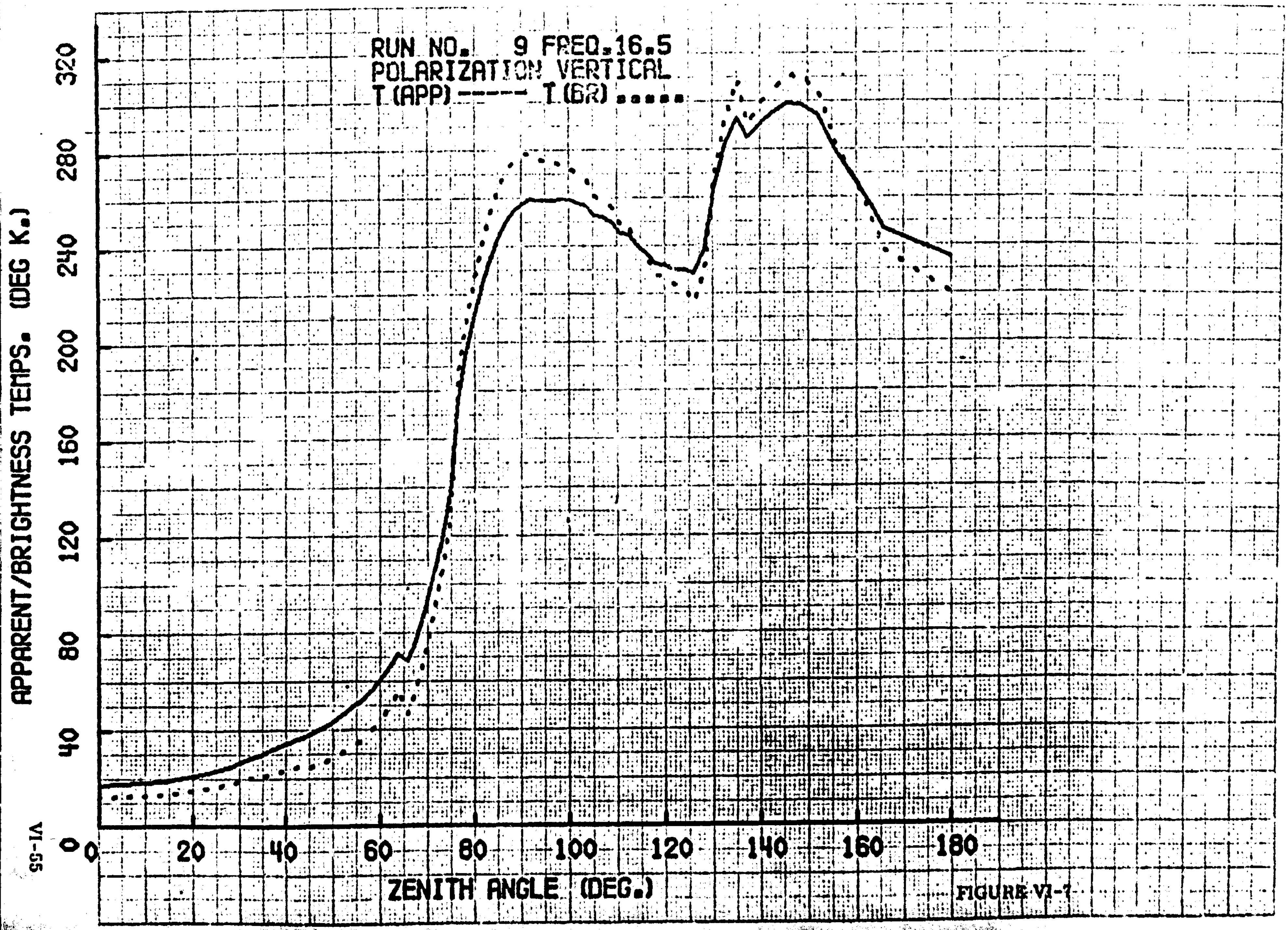
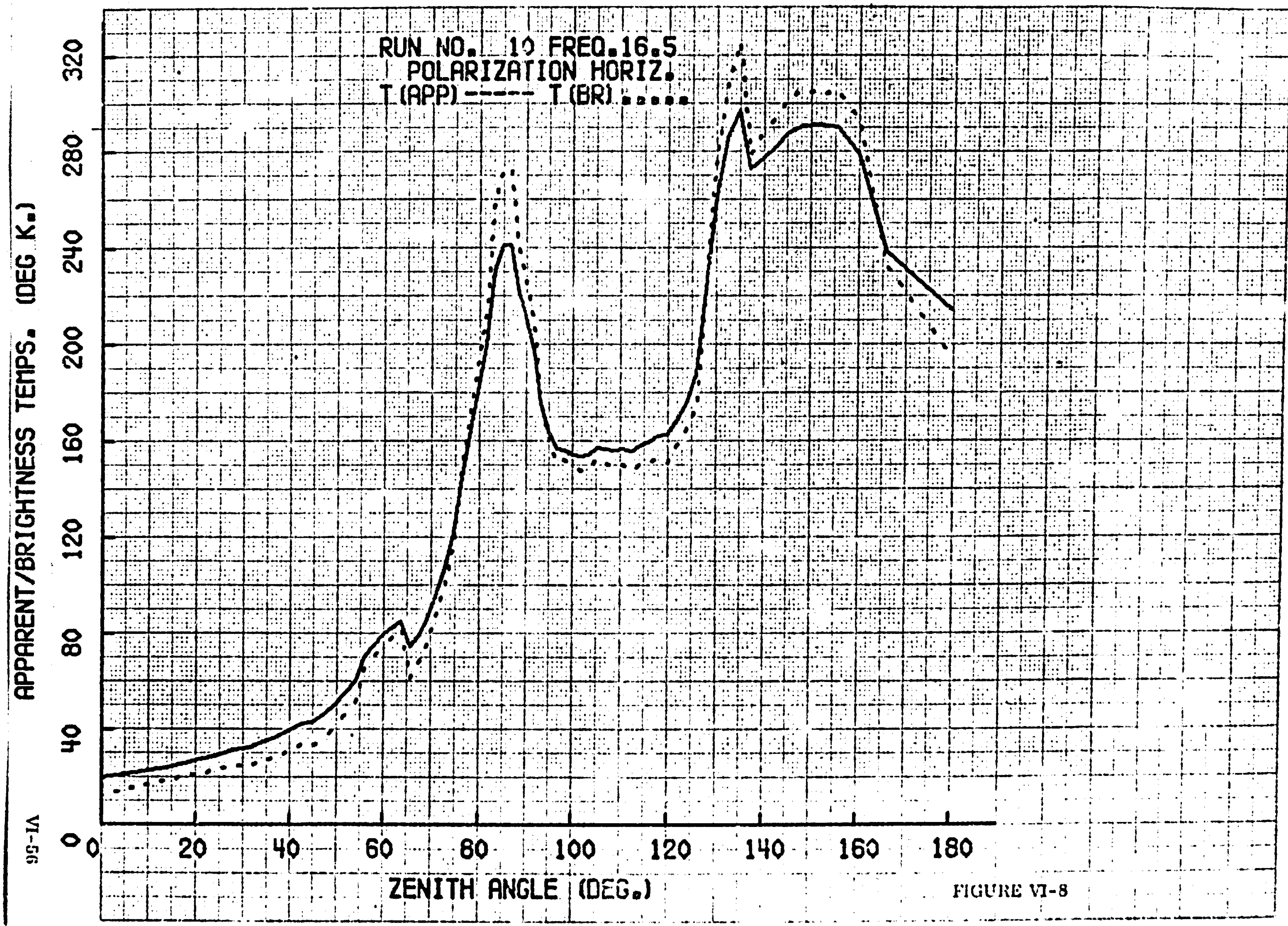

RUN NO. 9 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-7



RUN NO. 10 FREQ.16.5
POLARIZATION HORIZ.
T(APP)----- T(BR).....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-8

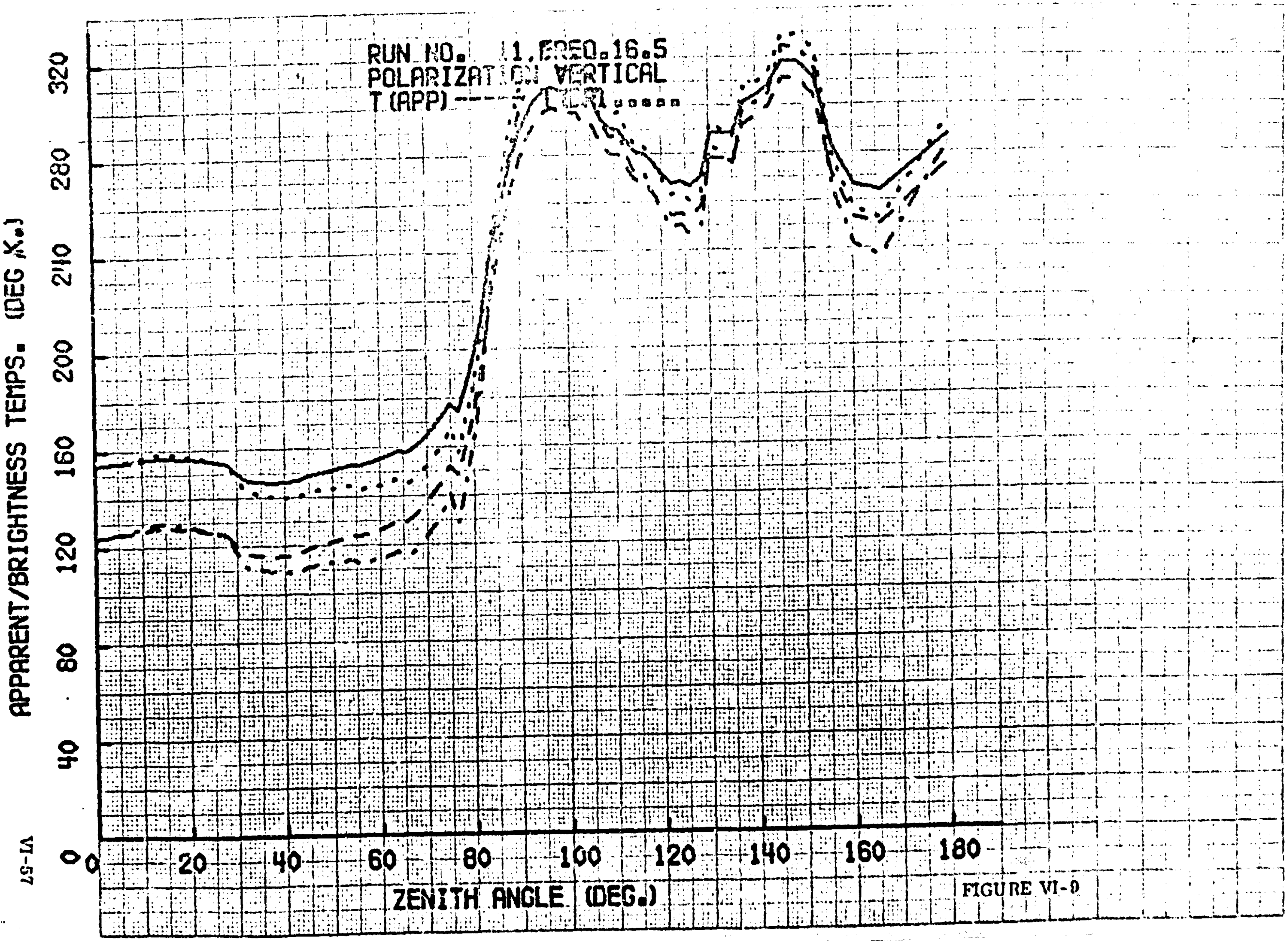

RUN NO. 11, FREQ. 16.5
POLARIZATION VERTICAL
T(APP) ----
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
ZENITH ANGLE (DEG.)
20
40
60
80
100
120
140
160
180

FIGURE VI-9

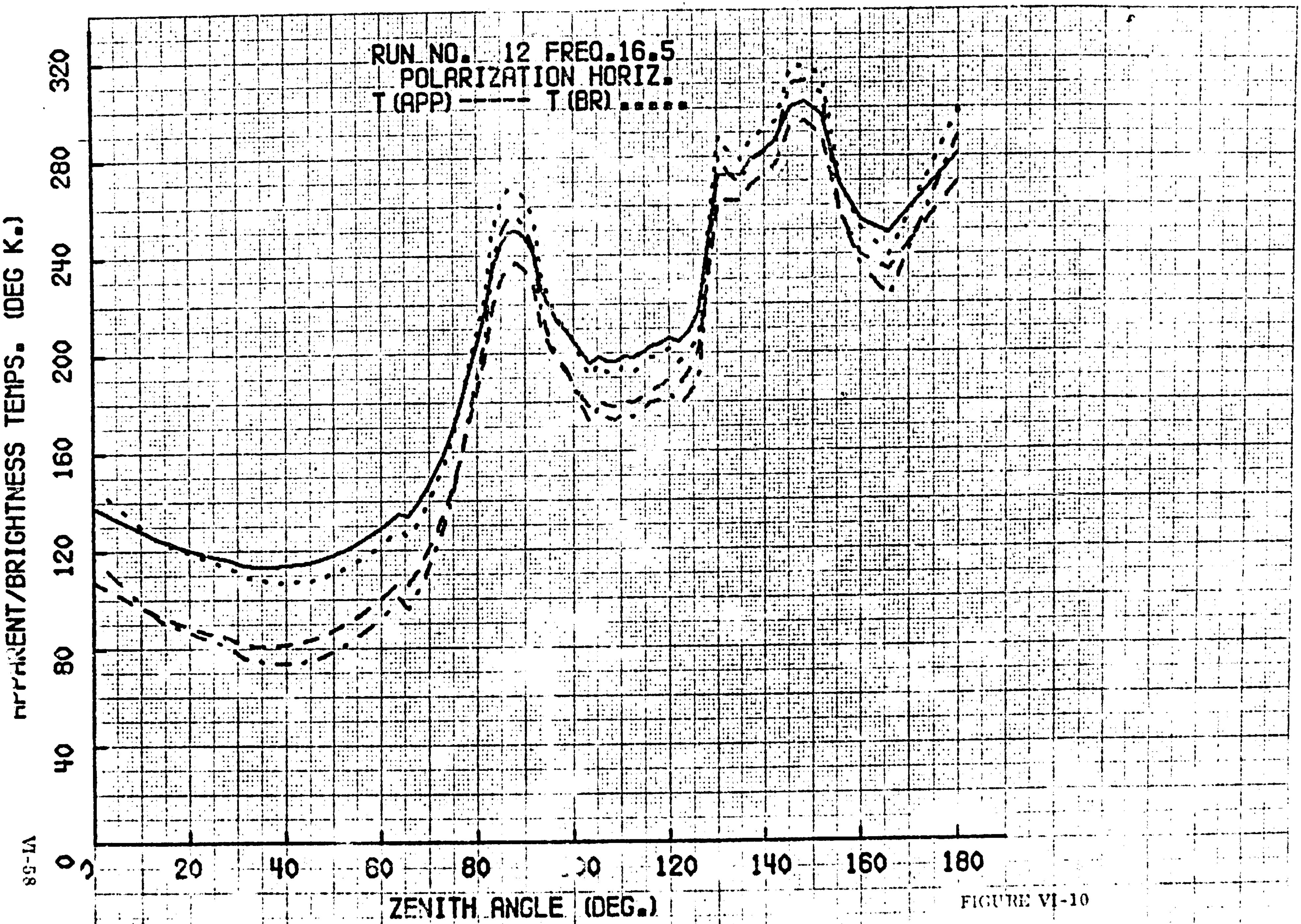

RUN NO. 12 FREQ. 16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
20
60
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-10

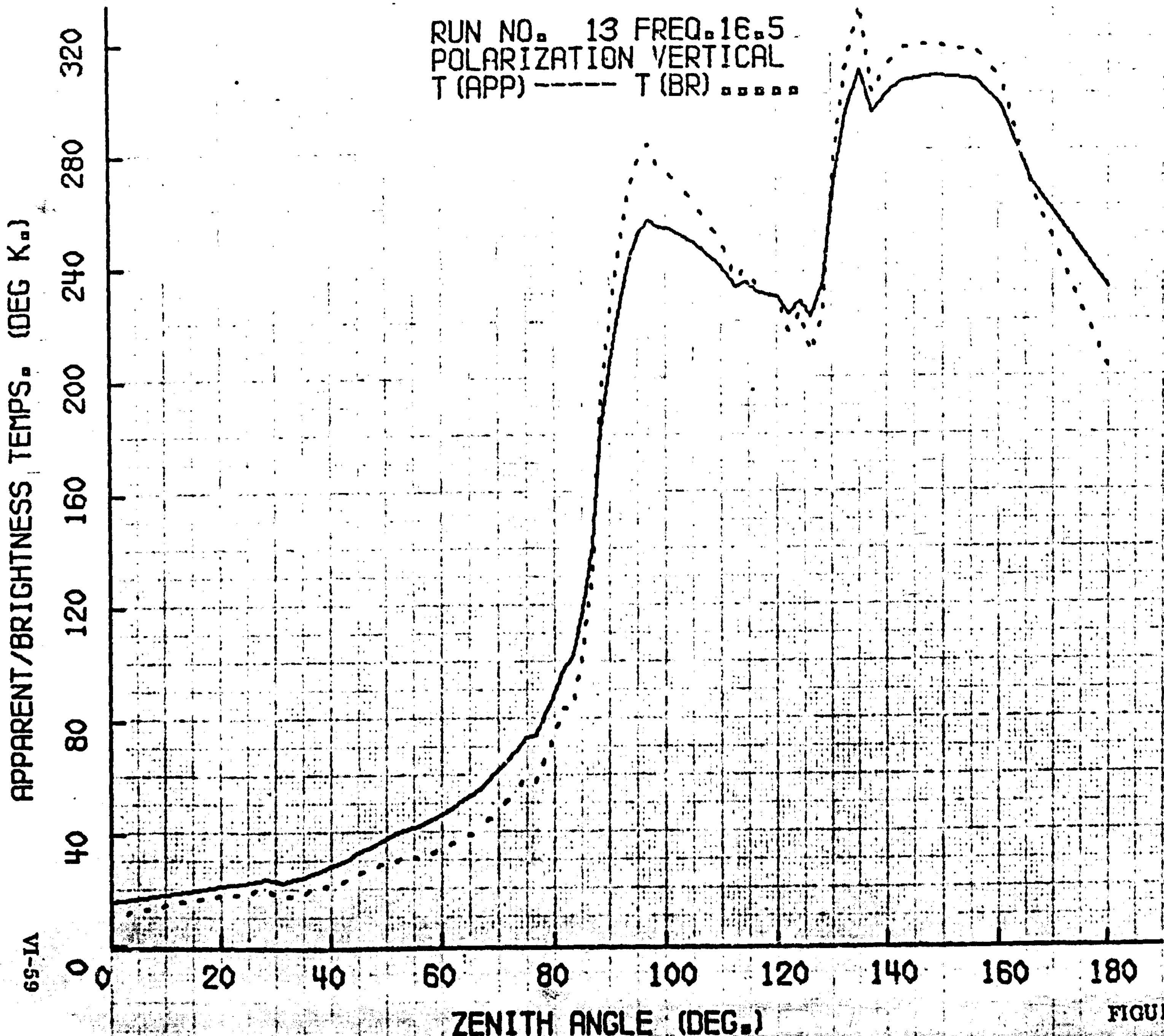
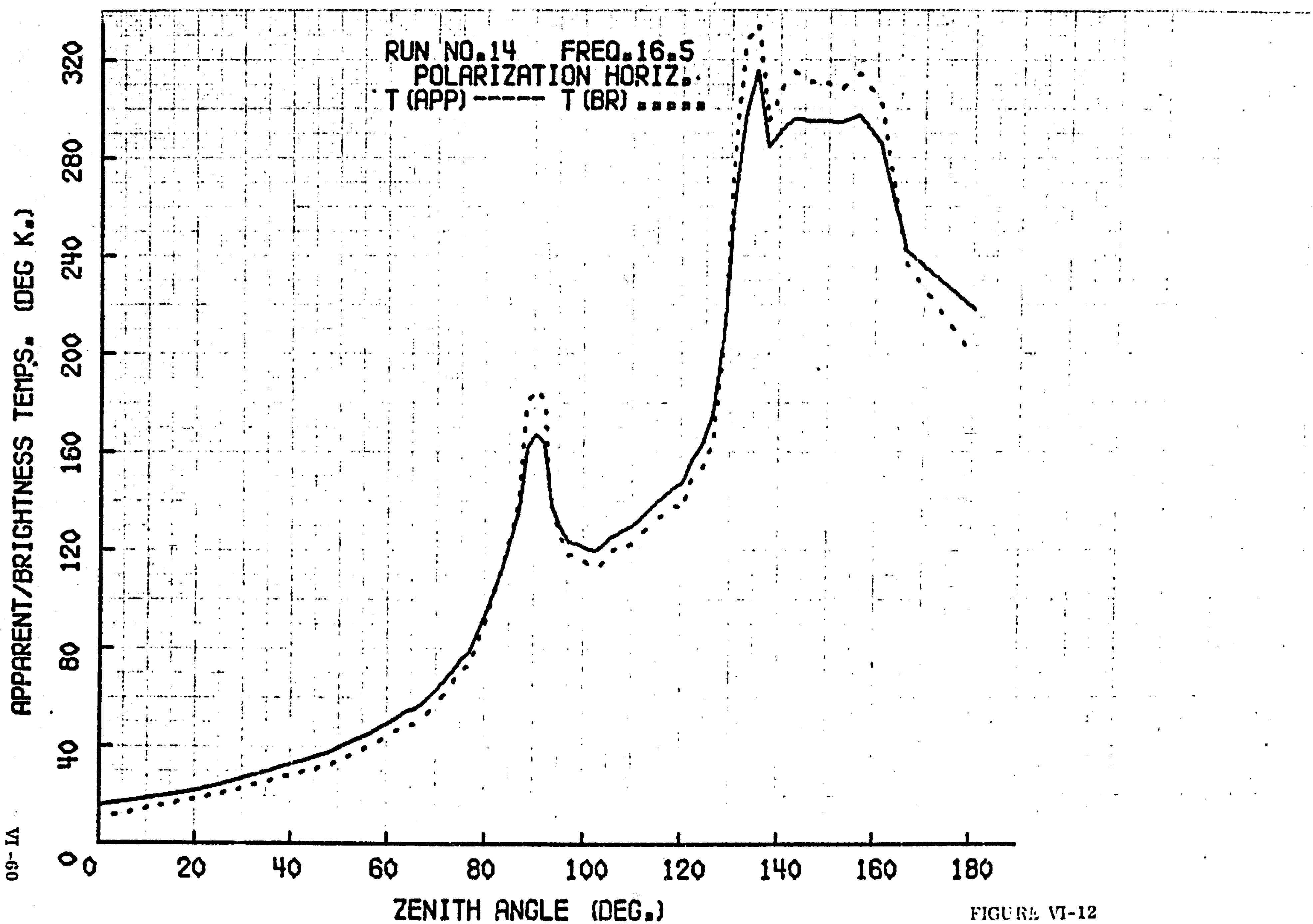

RUN NO. 13 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-11



RUN NO.14 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-12

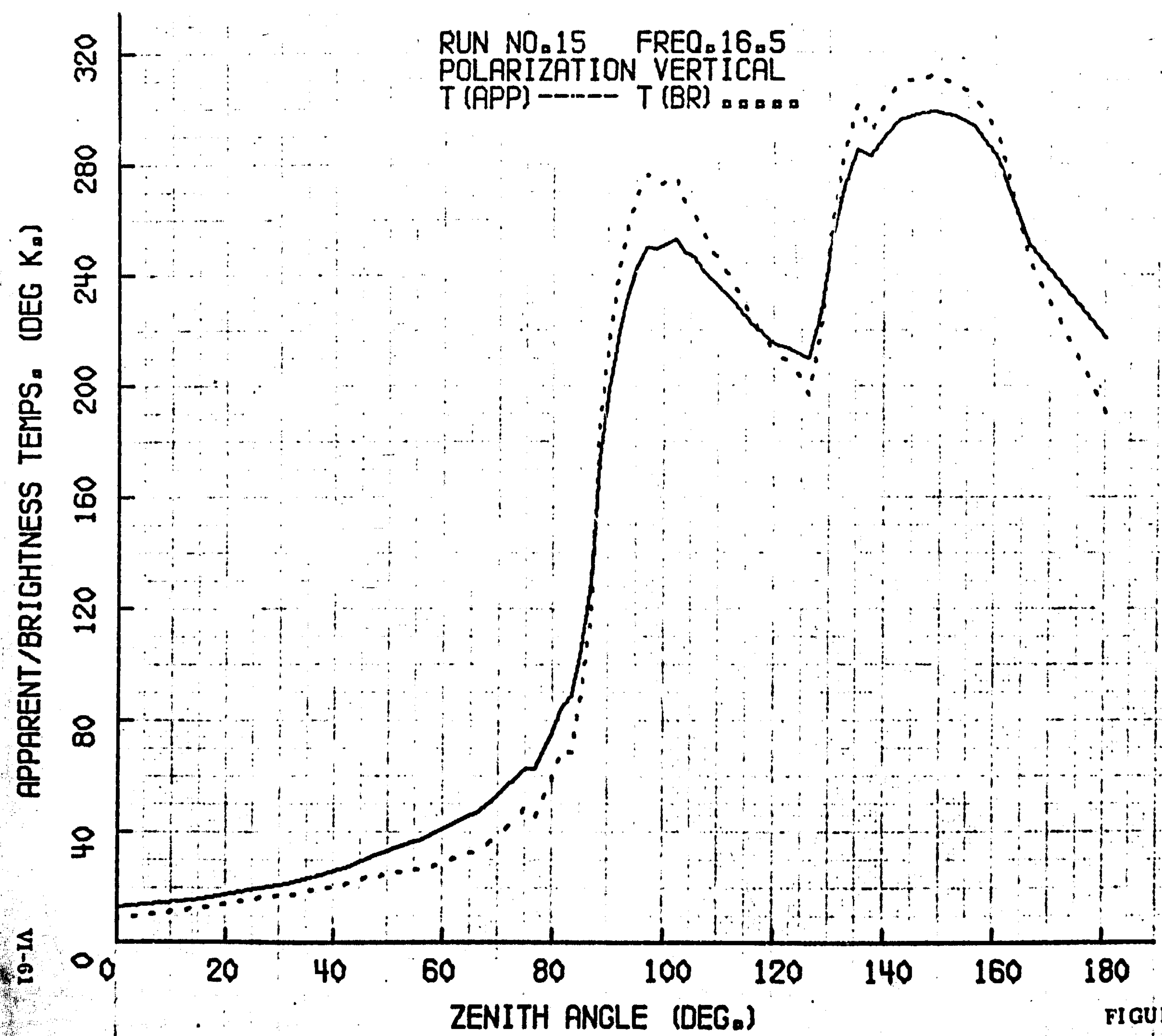

RUN NO.15 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-13

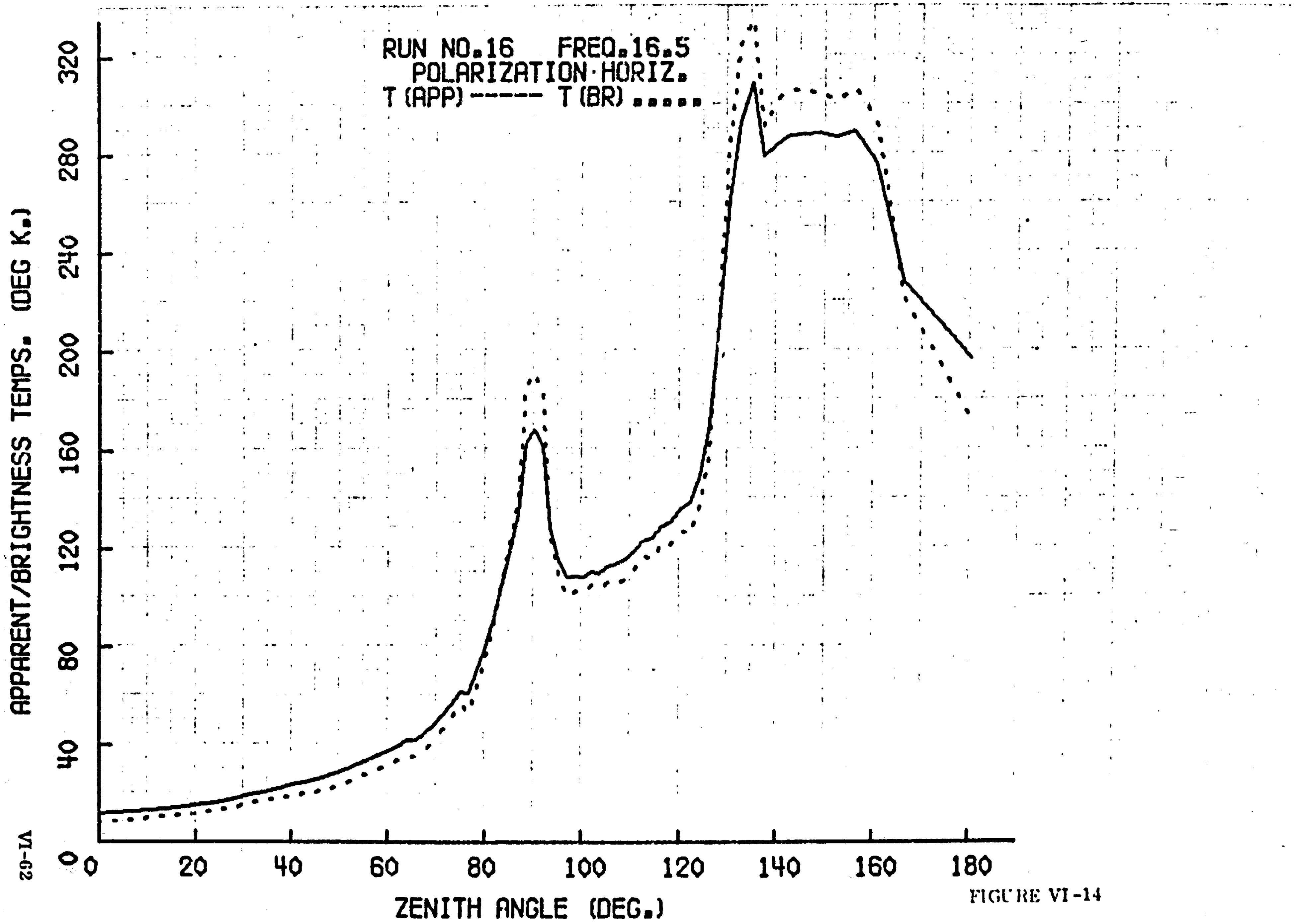
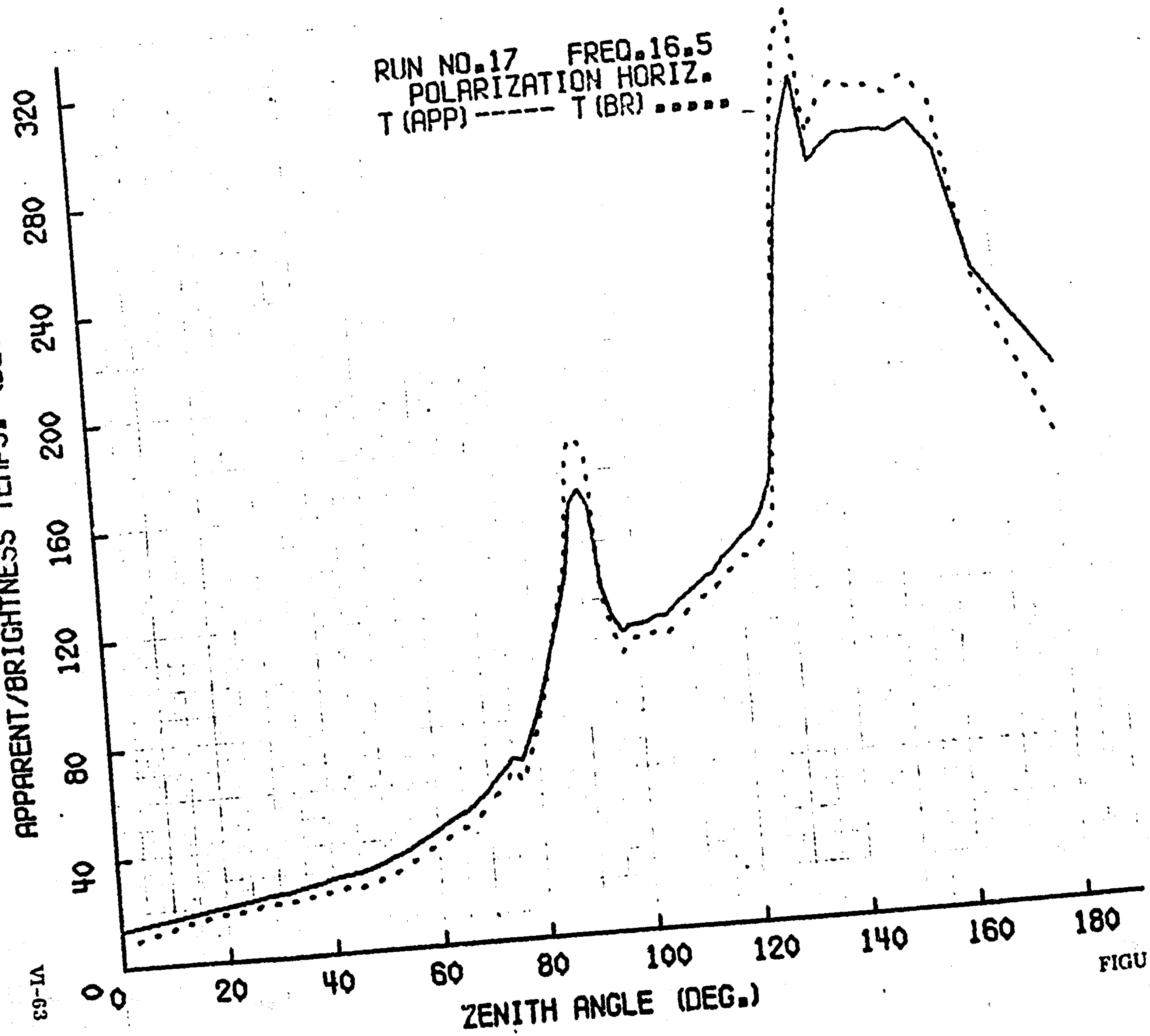
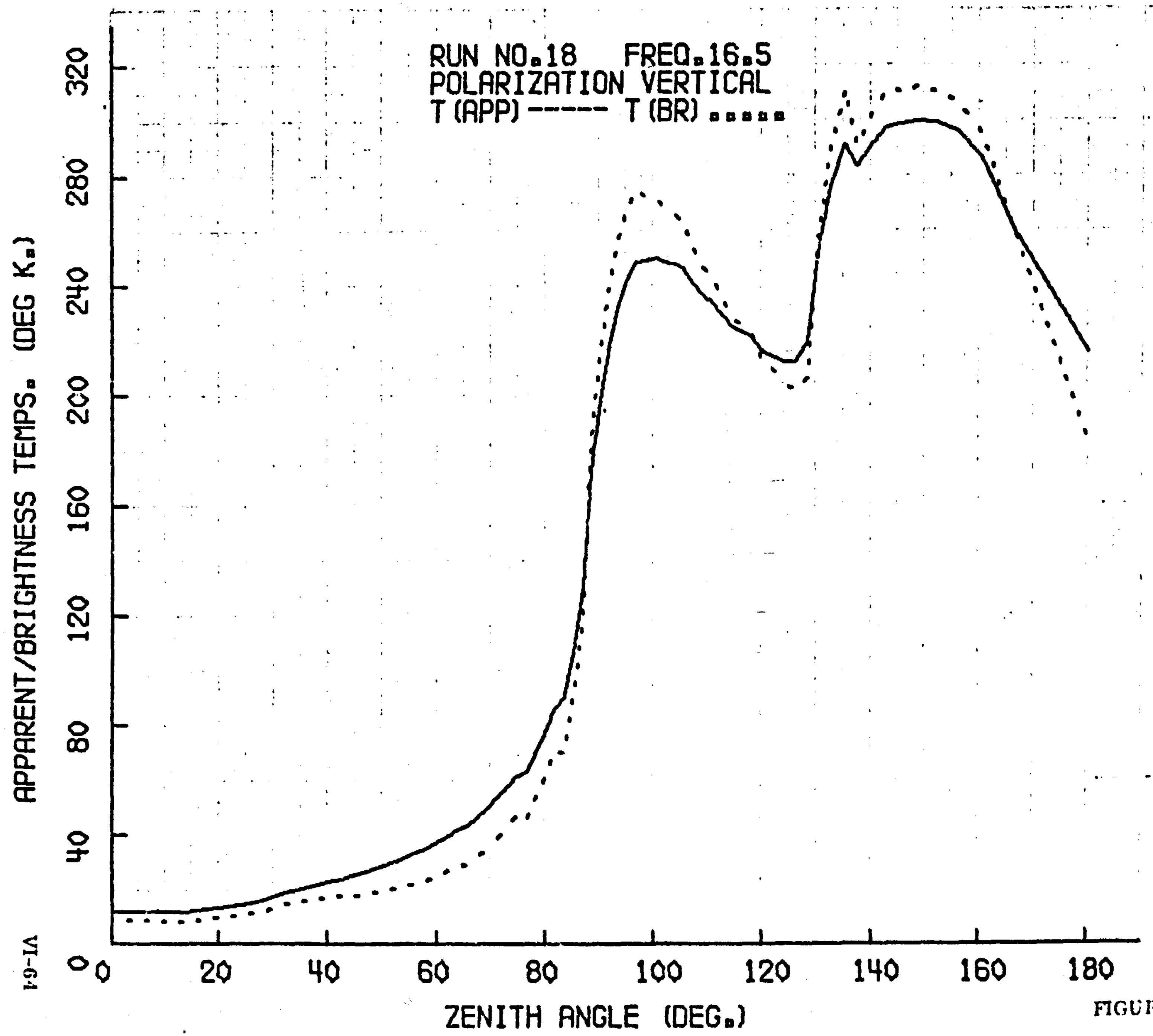

RUN NO.16 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-14



RUN NO.17 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-15



RUN NO.18 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-16

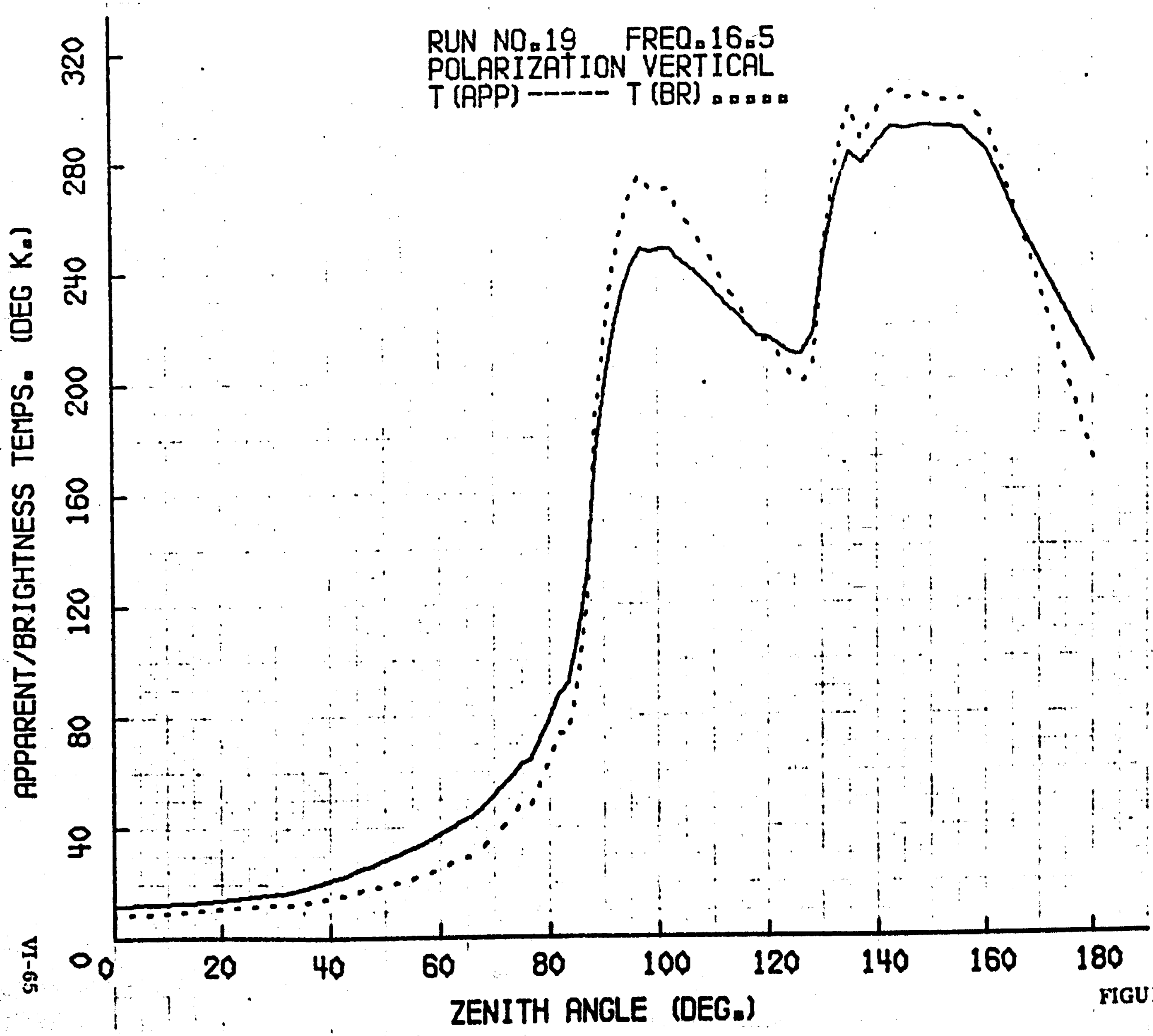

RUN NO.19 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-17

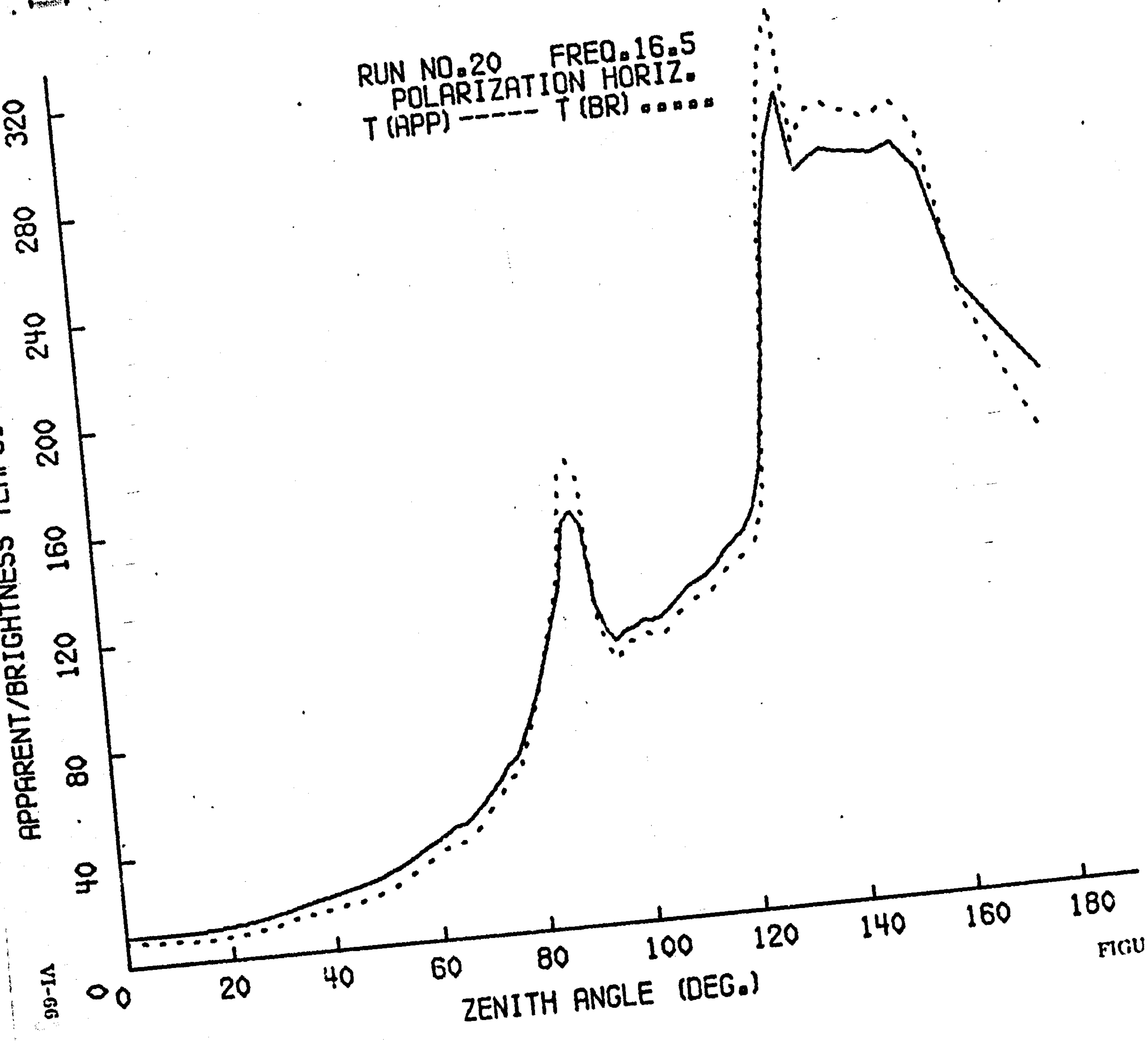
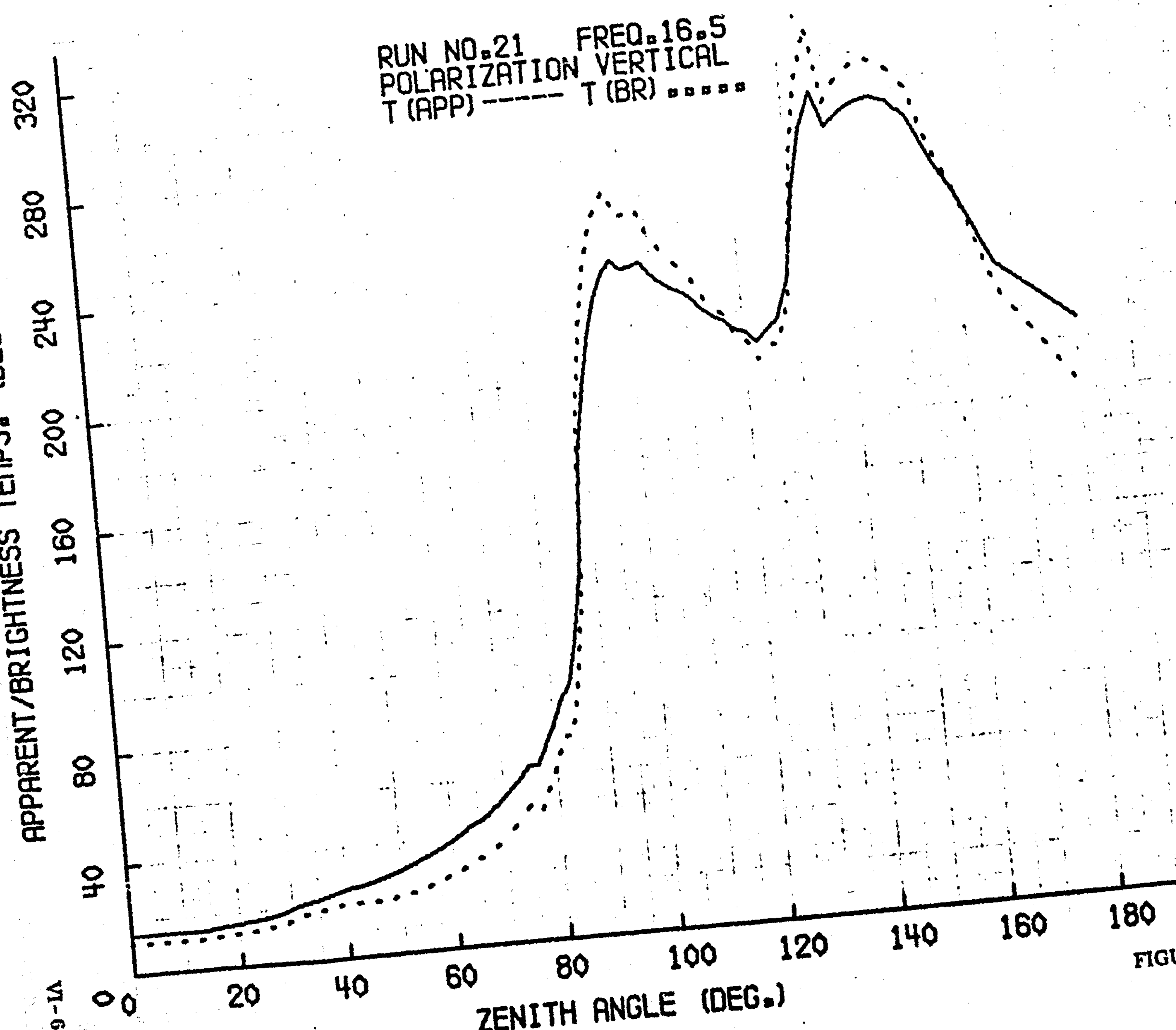

RUN NO.20 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
ZENITH ANGLE (DEG.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180

FIGURE VI-18



RUN NO.21 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-19

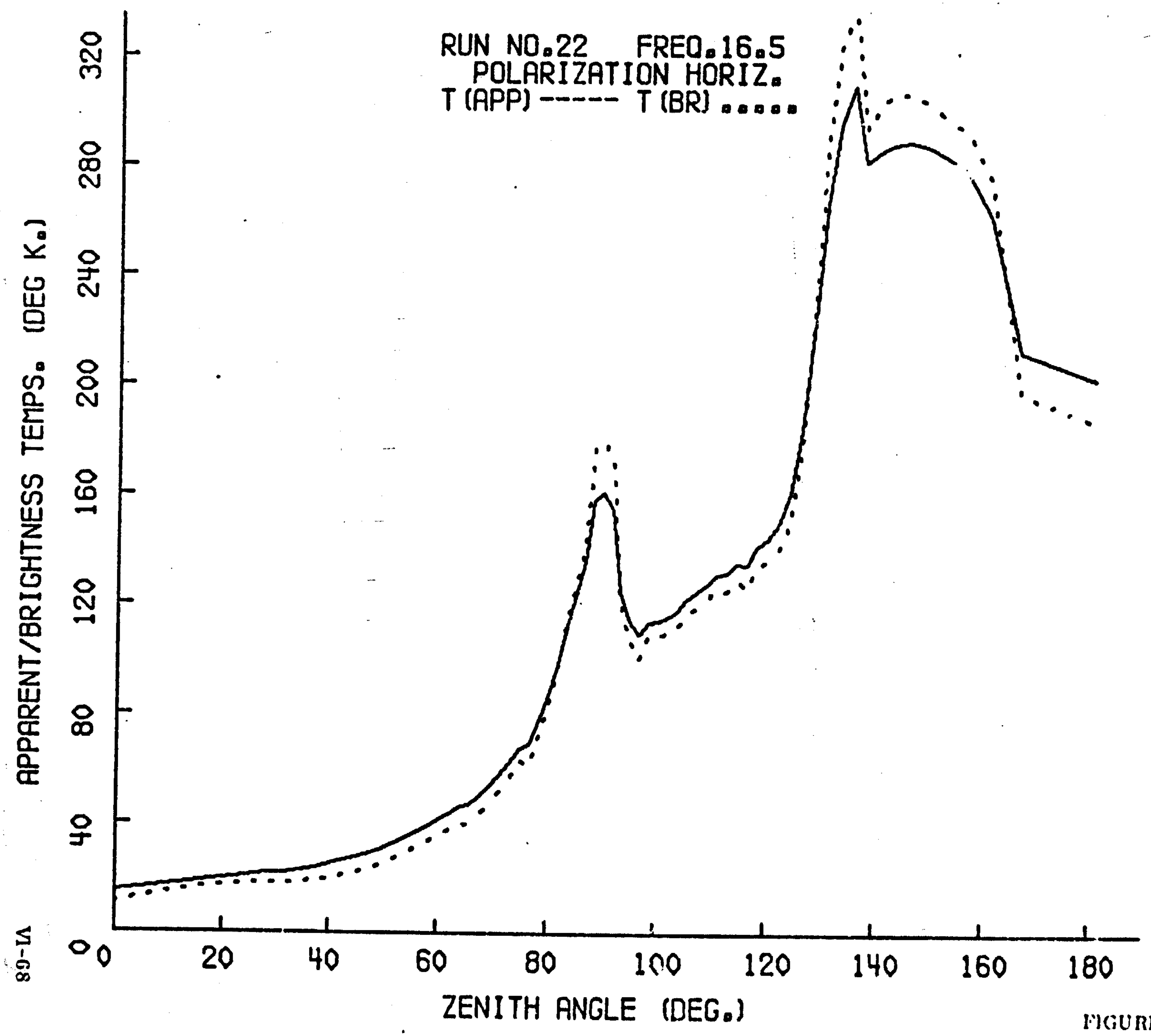
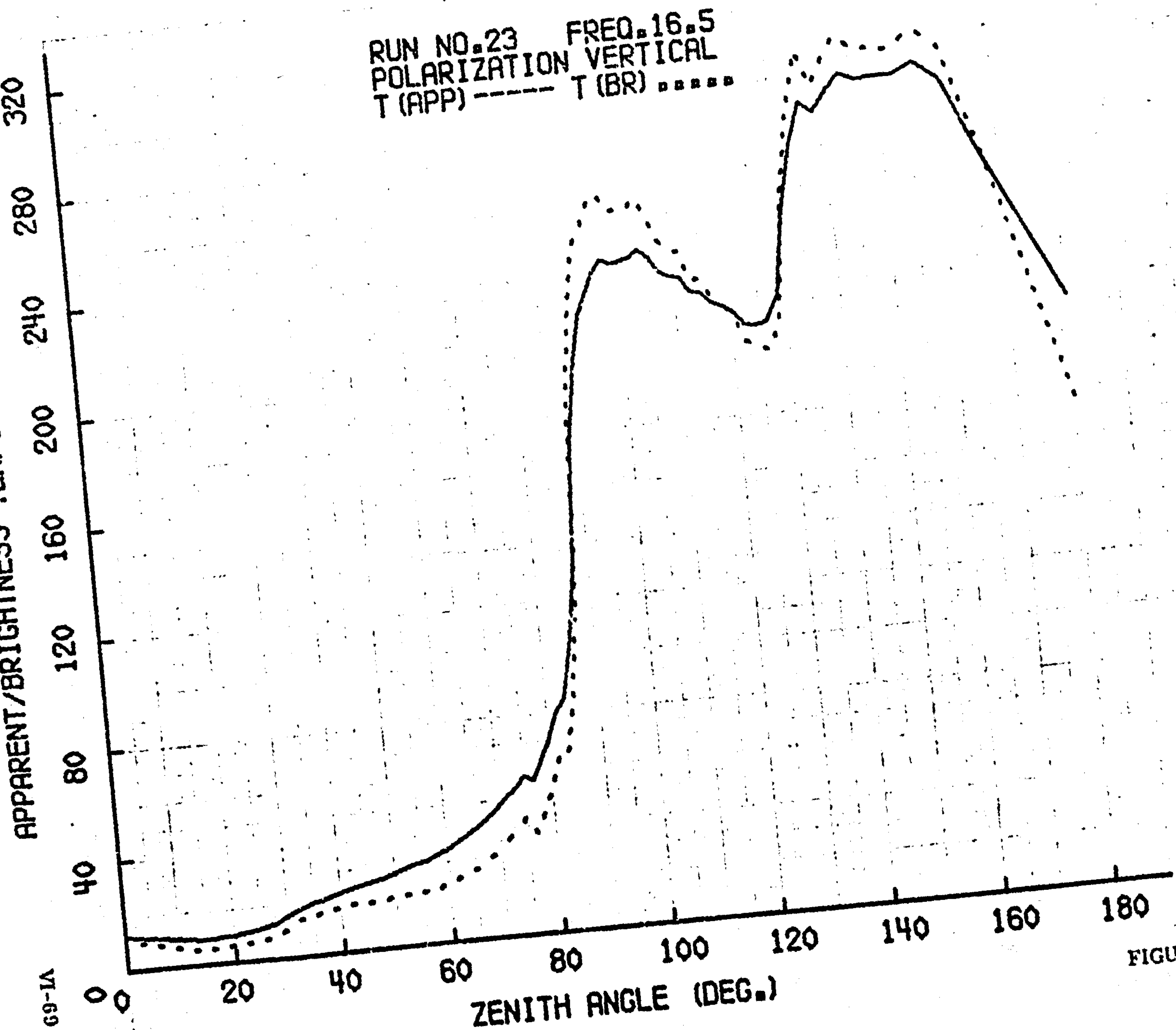

RUN NO.22 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-20



RUN NO.23 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-21

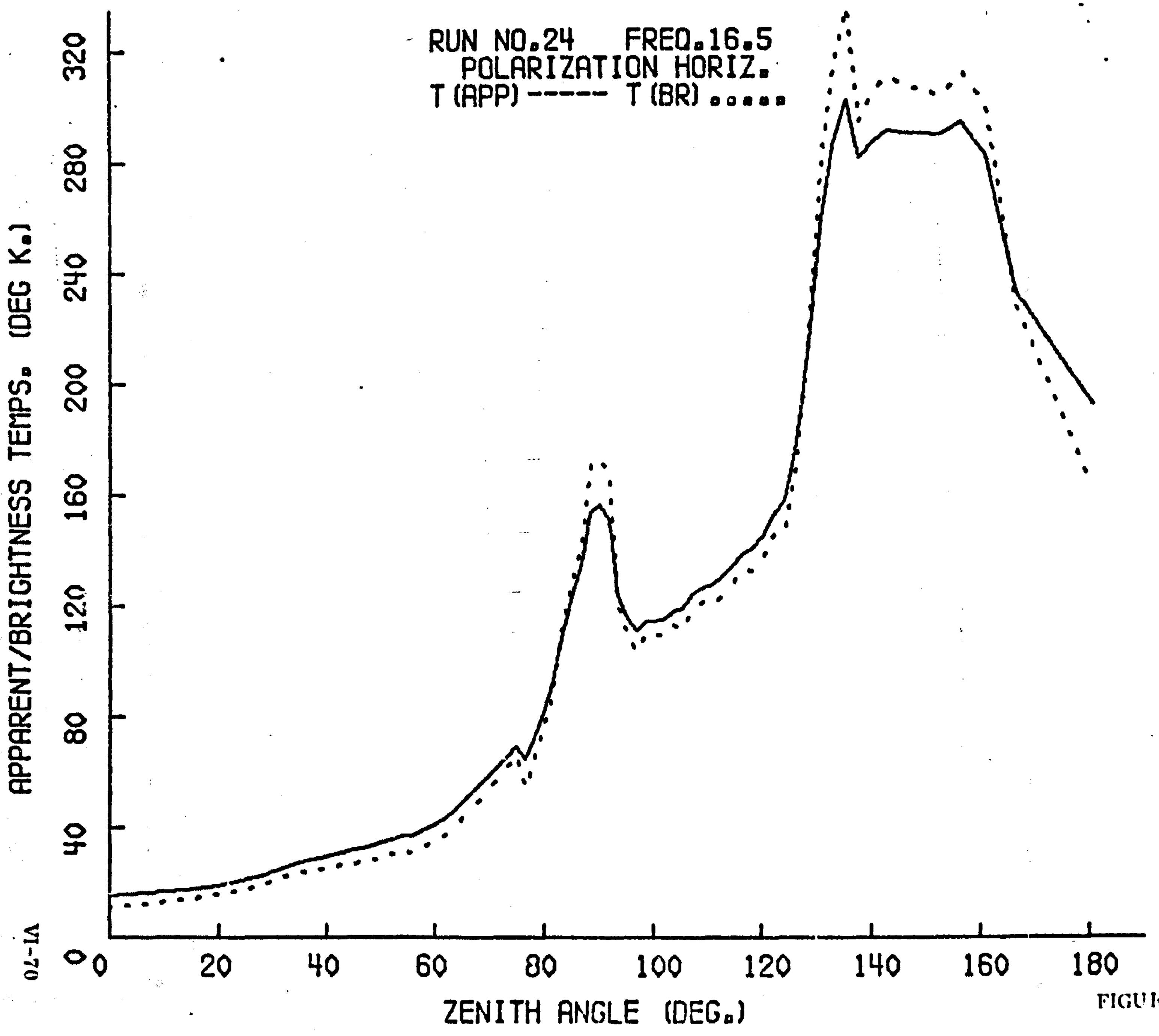

RUN NO.24 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-22

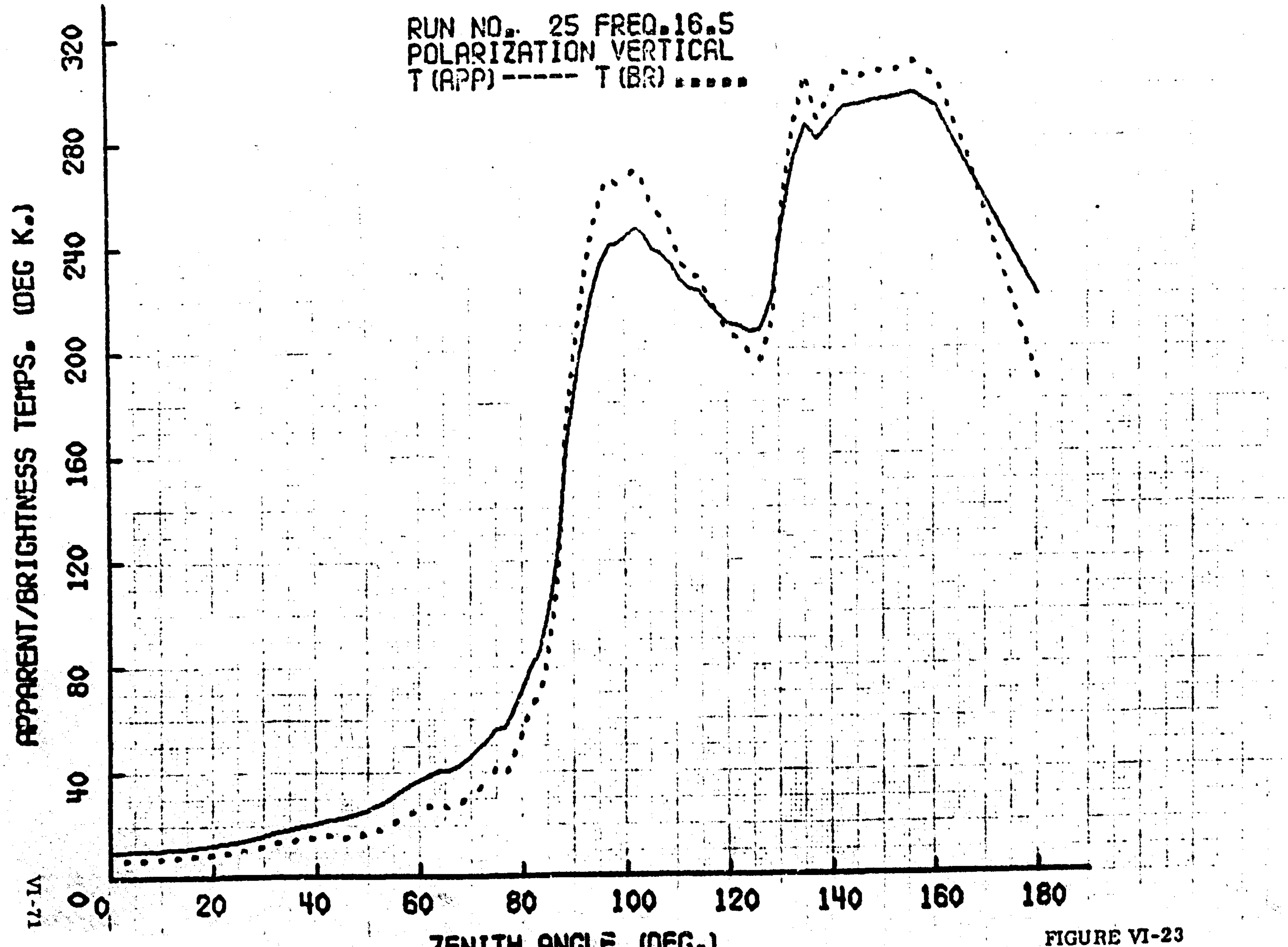

RUN NO. 25 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-23

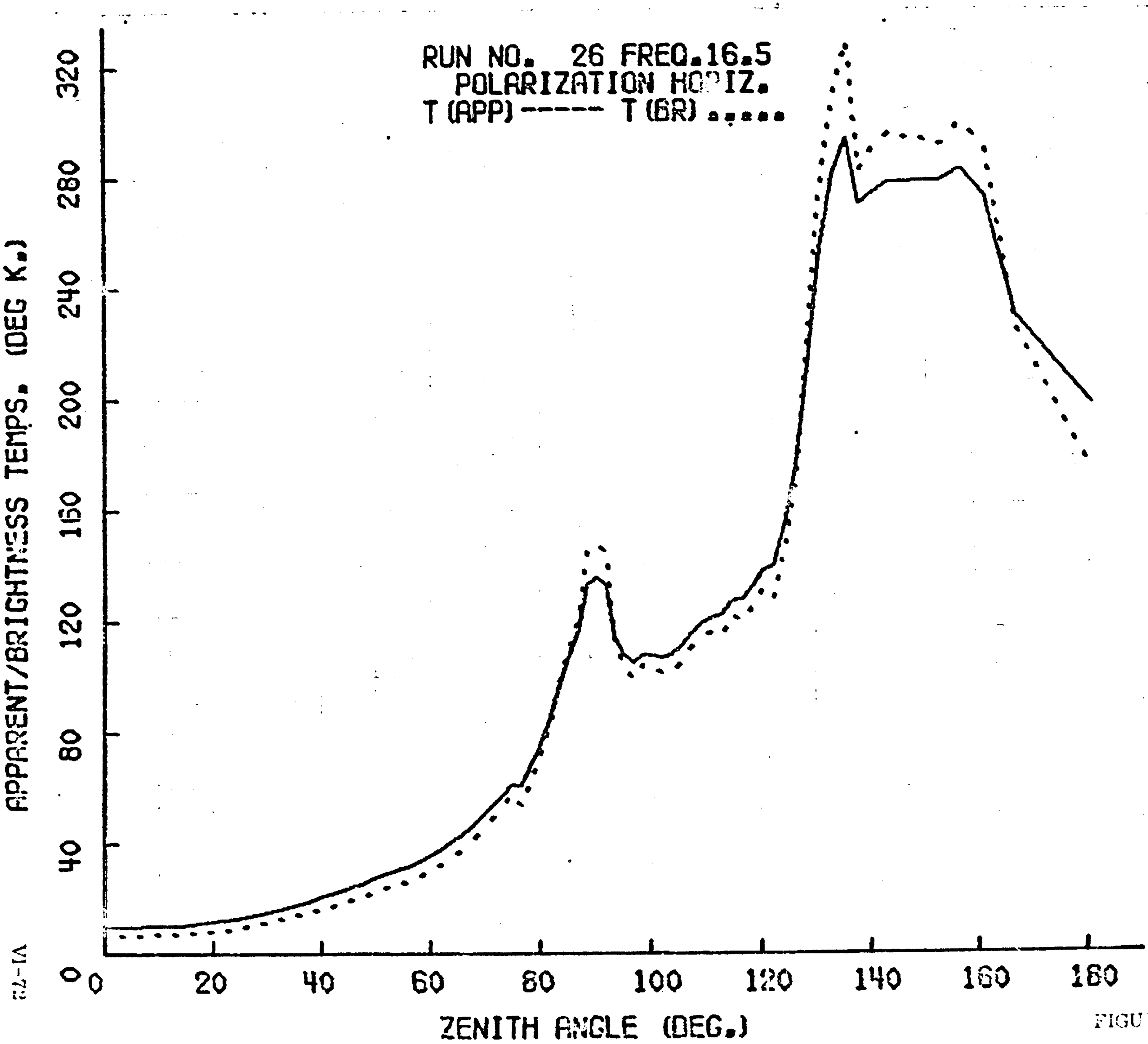

RUN NO. 26 FREQ. 16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
ZENITH ANGLE (DEG.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180

FIGURE VI-24

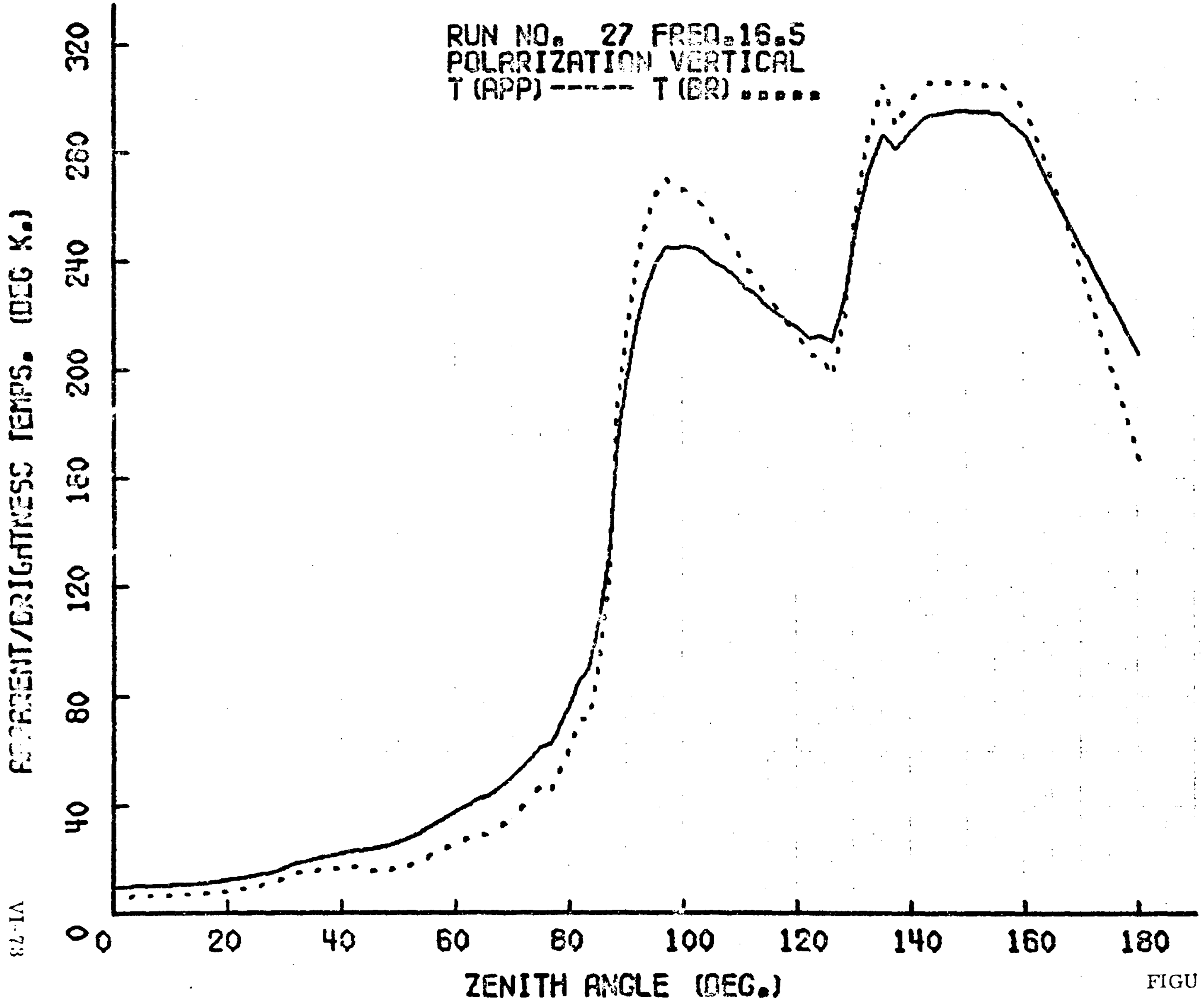

RUN NO. 27 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-25

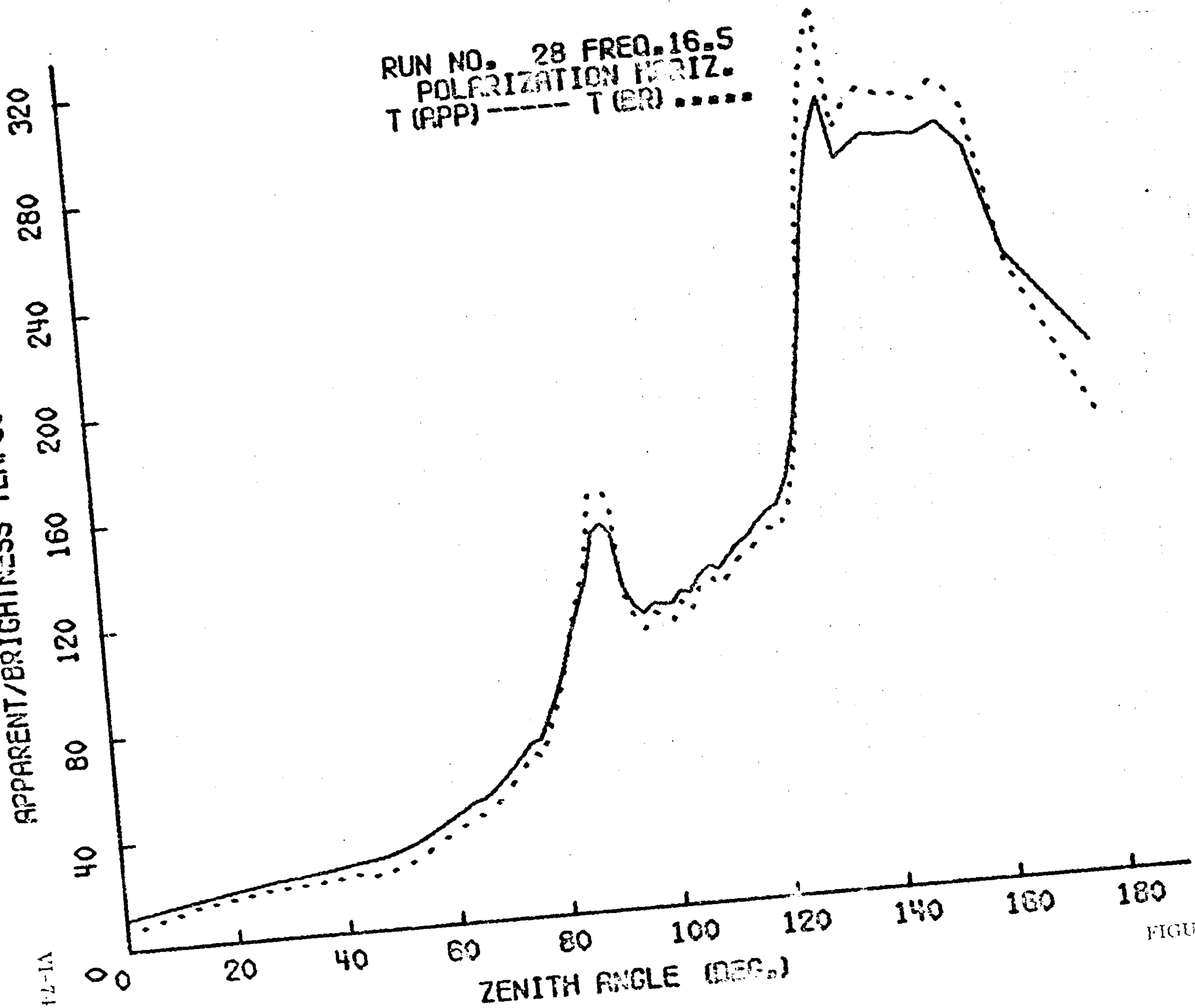

RUN NO. 28 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-26

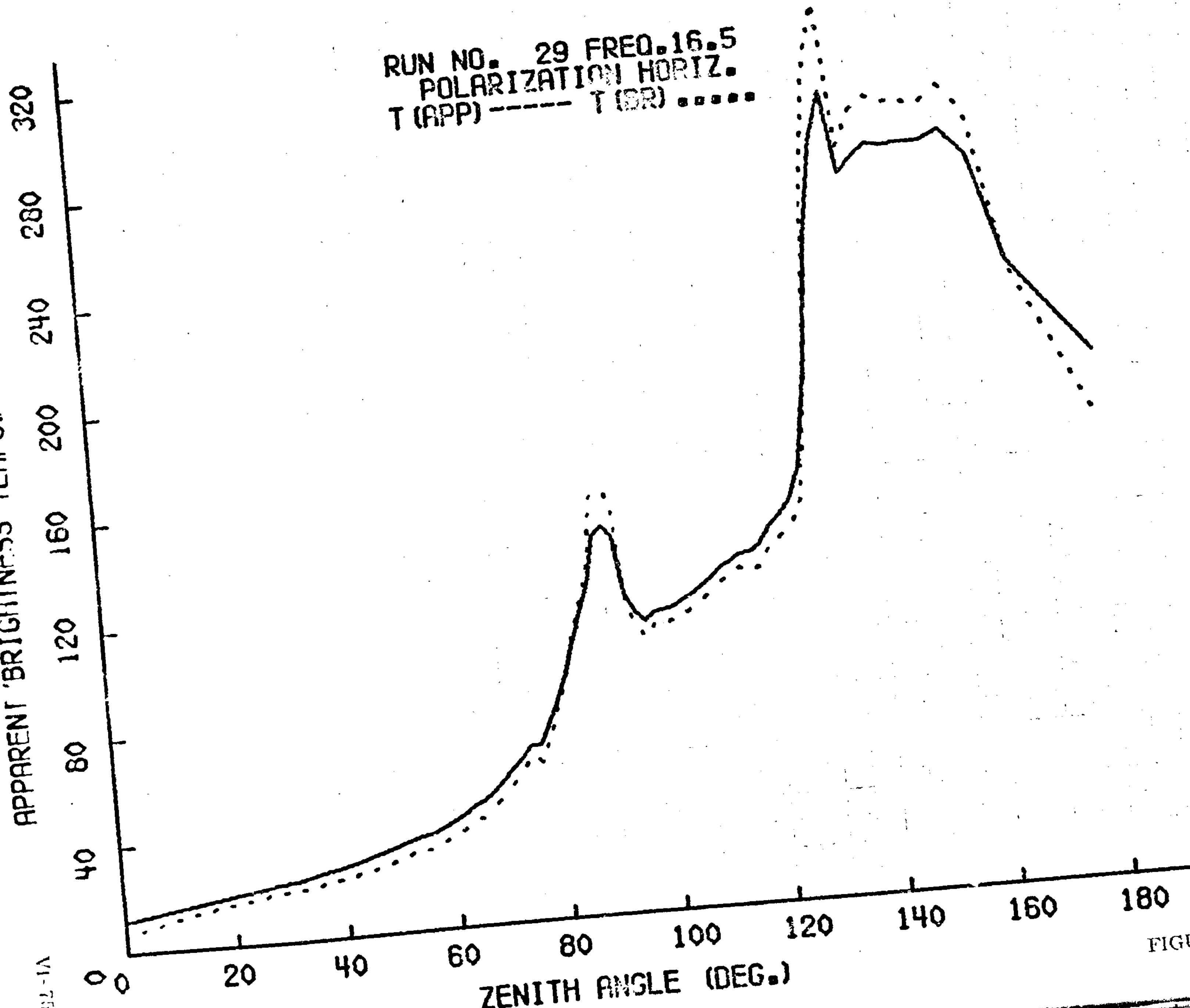

RUN NO. 29 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT BRIGHTNESS TEMPS. (DEG K.)
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-27

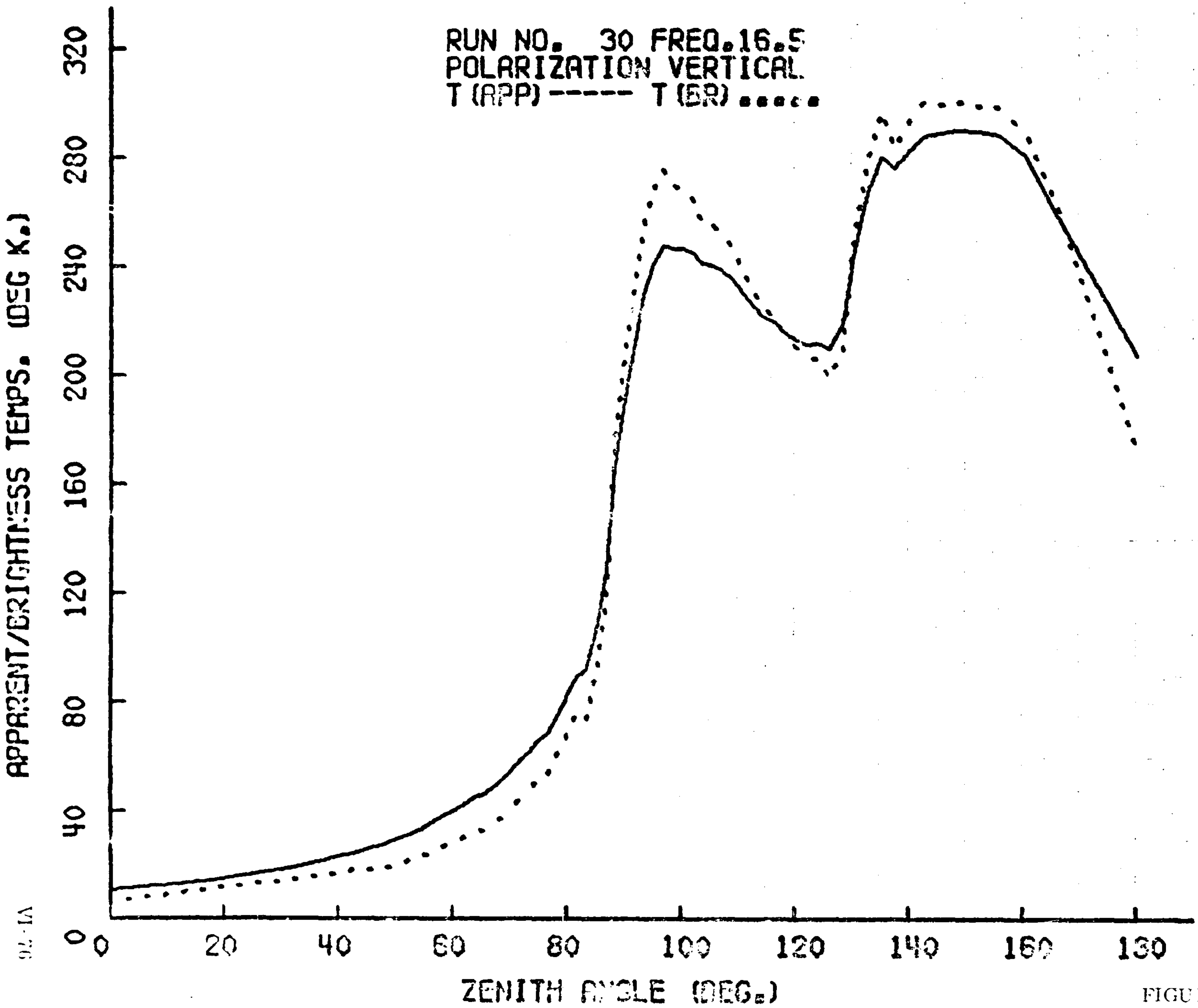

RUN NO. 30 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
ZENITH ANGLE (DEG.)

FIGURE VI-28

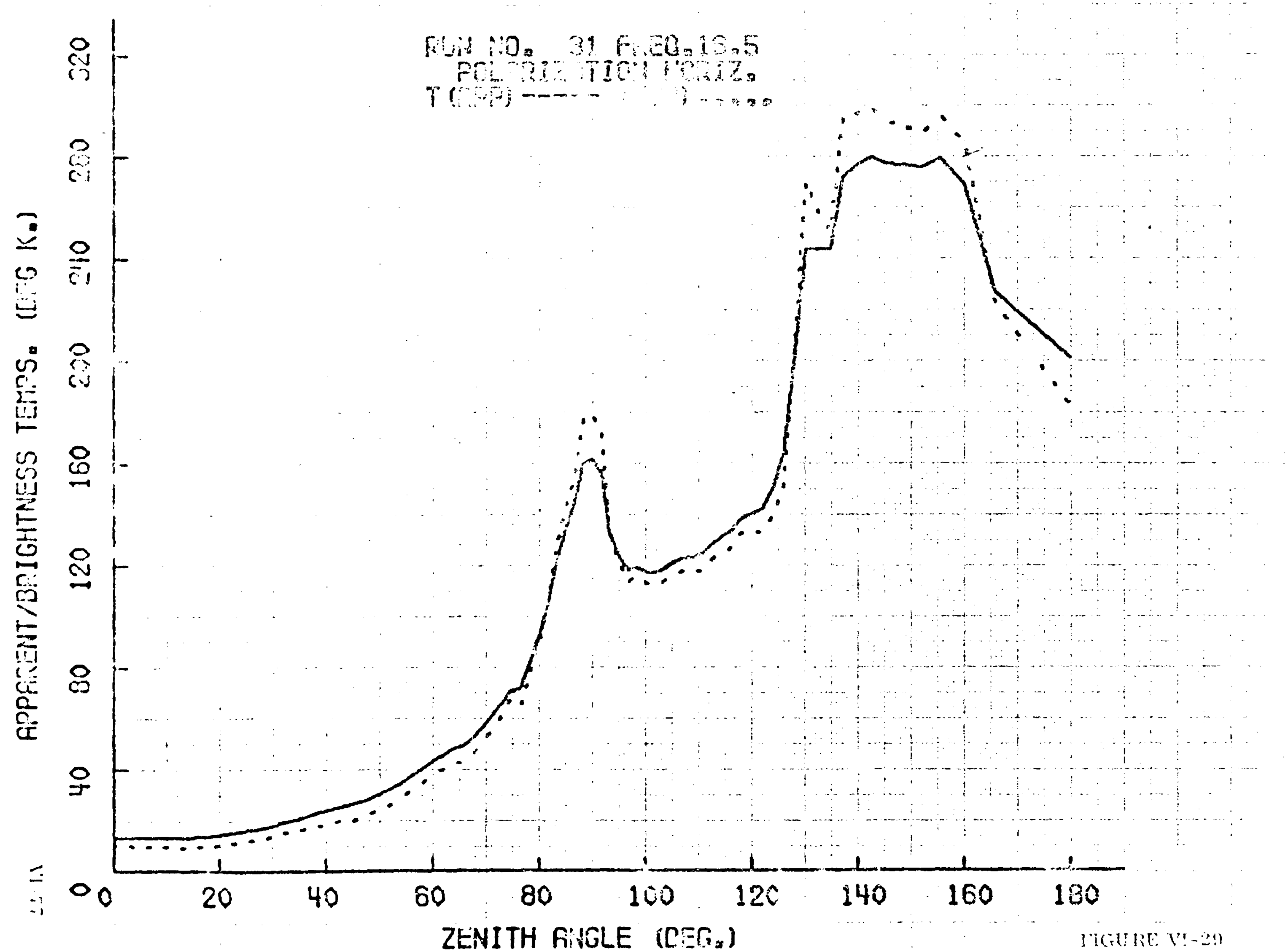
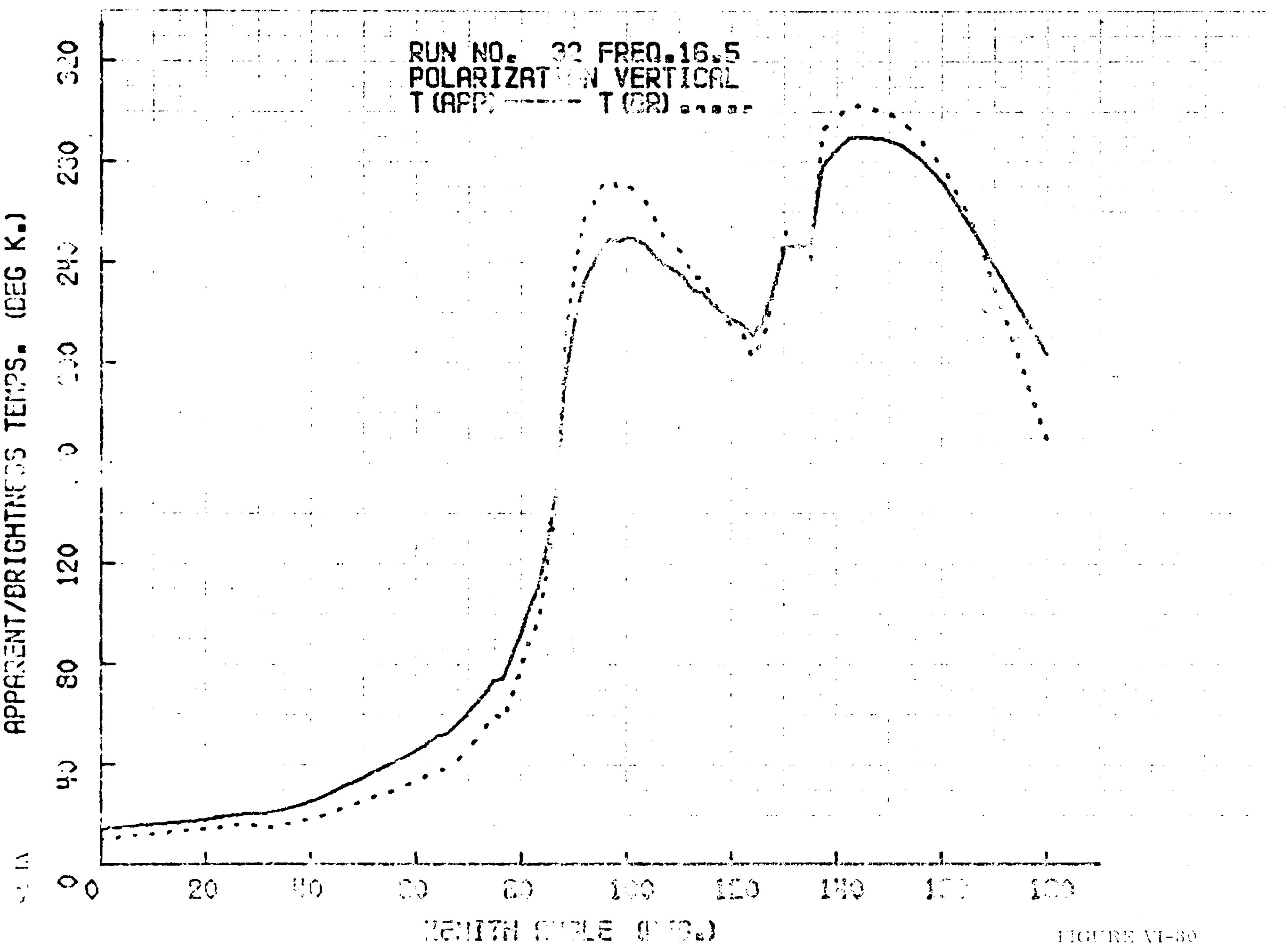


FIGURE VI-29



RUN NO. 32 FREQ.16.5
POLARIZAT N VERTICAL
T (APP) T (BR)
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
240
230
20
100
140

FIGURE VI-30

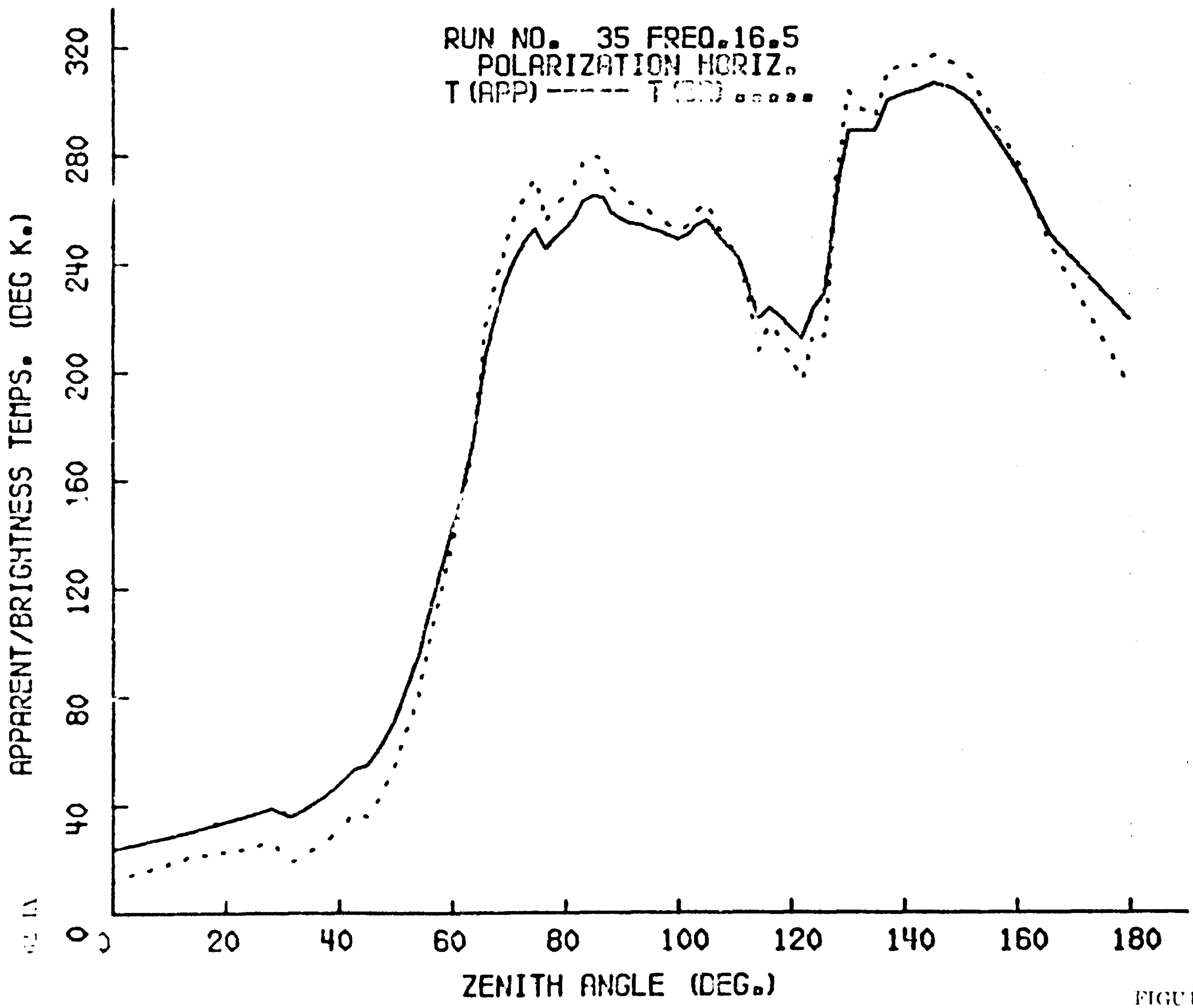

RUN NO. 35 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-31

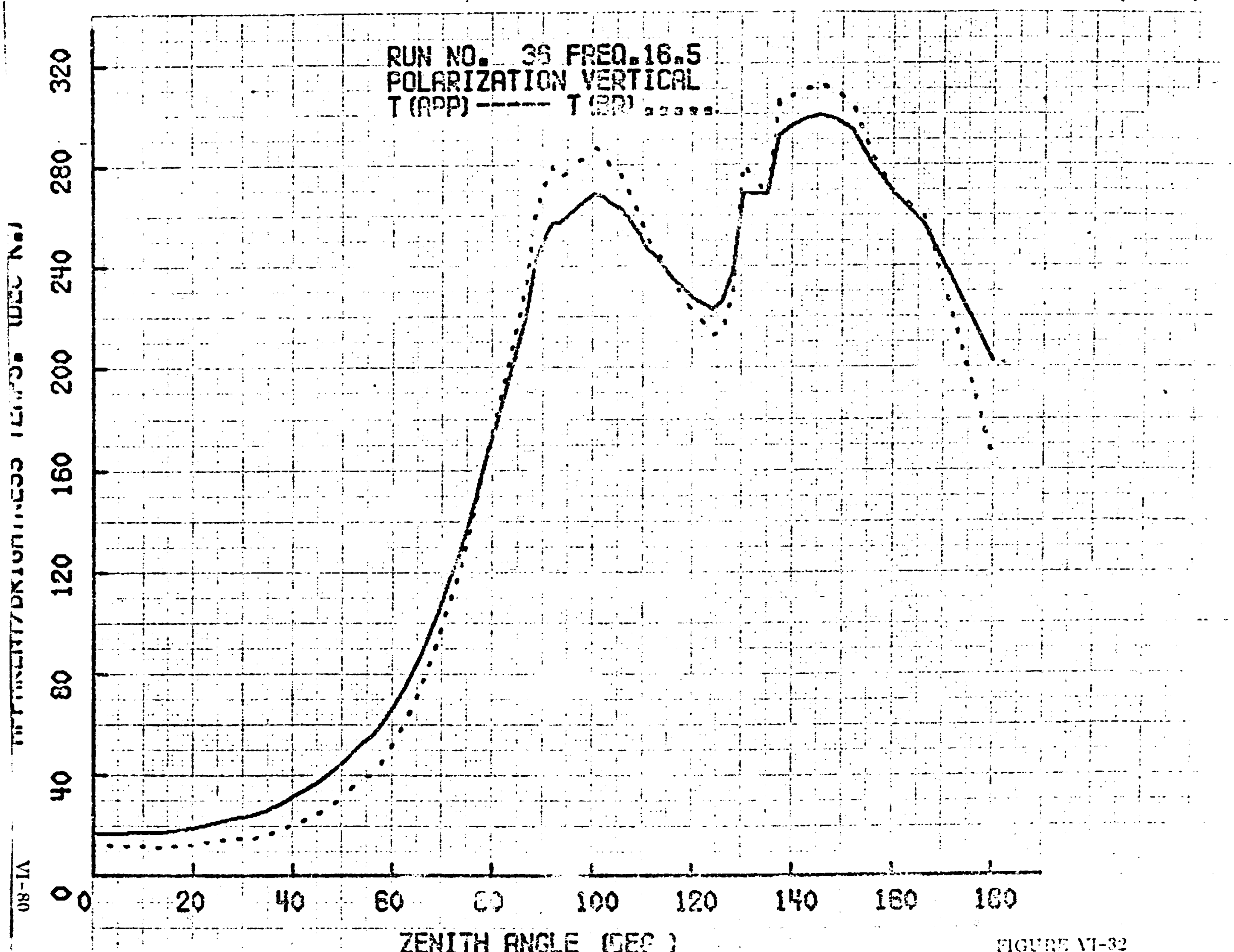

RUN NO. 36 FREQ. 16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR)
320
280
240
200
160
120
80
40
0
0
20
40
60
100
120
140
160
180
ZENITH ANGLE (DEG)

FIGURE VI-32

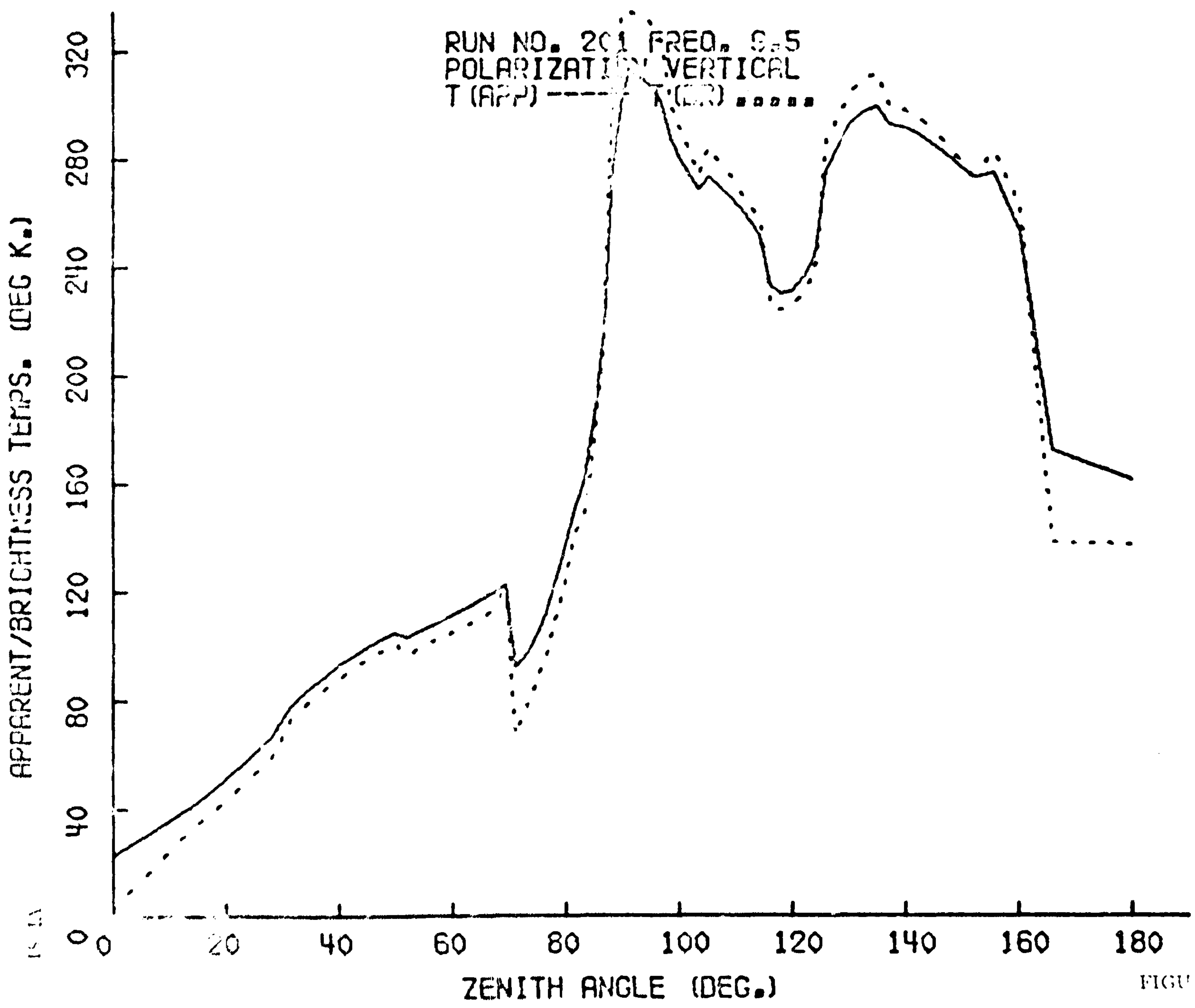
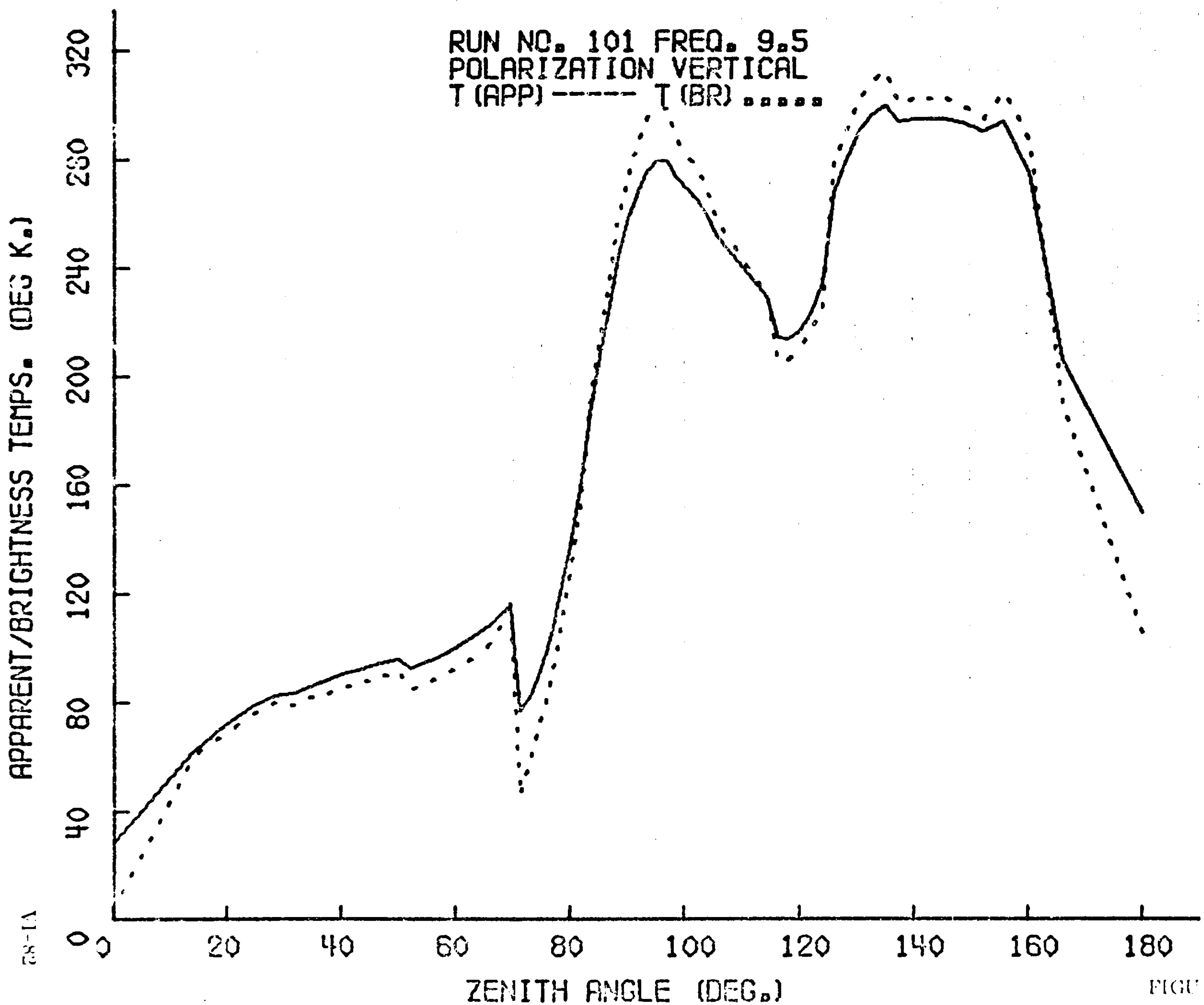

RUN NO. 201 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-33



RUN NO. 101 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
ZENITH ANGLE (DEG.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180

FIGURE VI-34

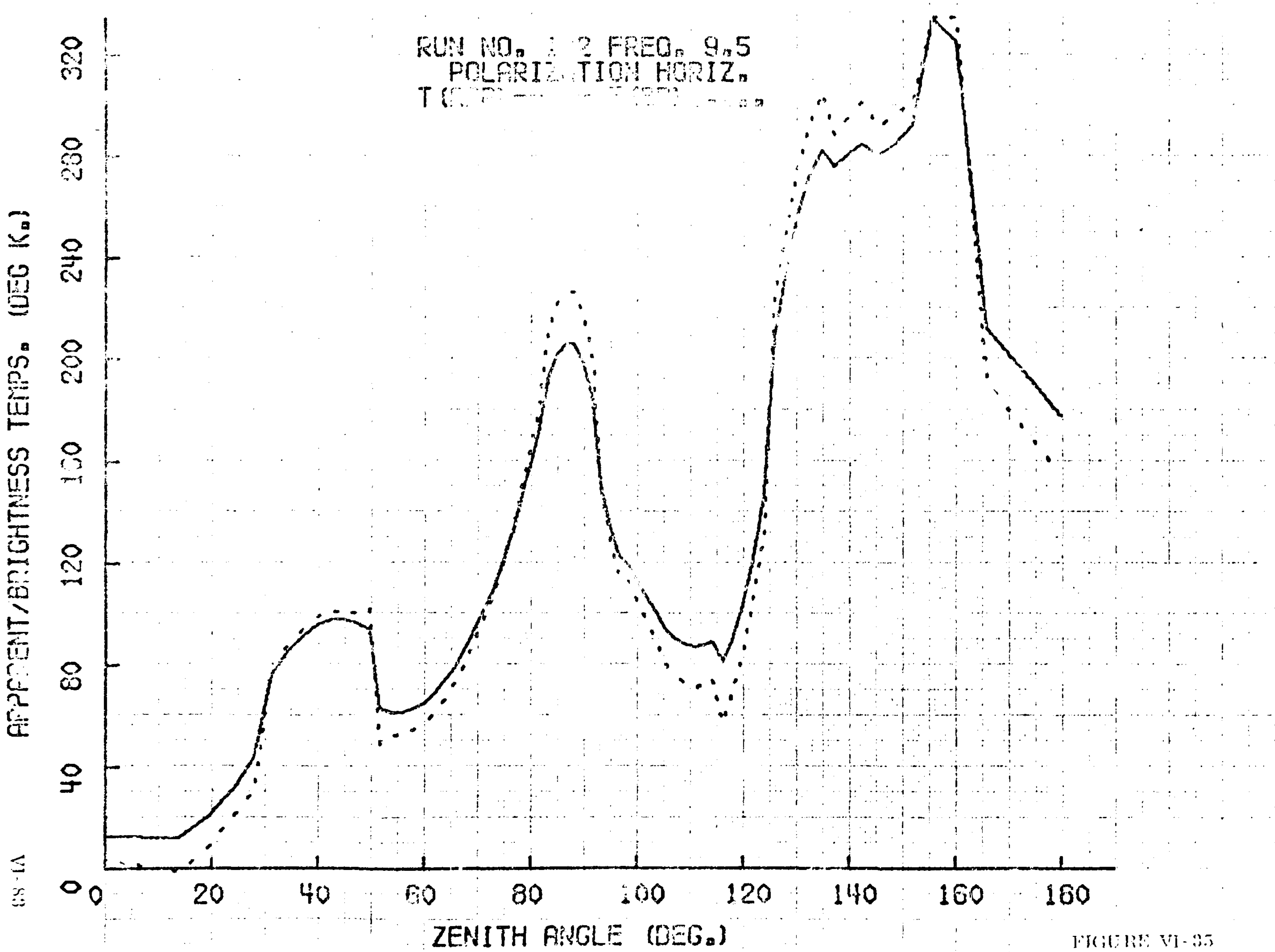

RUN NO. 2 FREQ. 9.5
POLARIZ TION HORIZ.
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-85

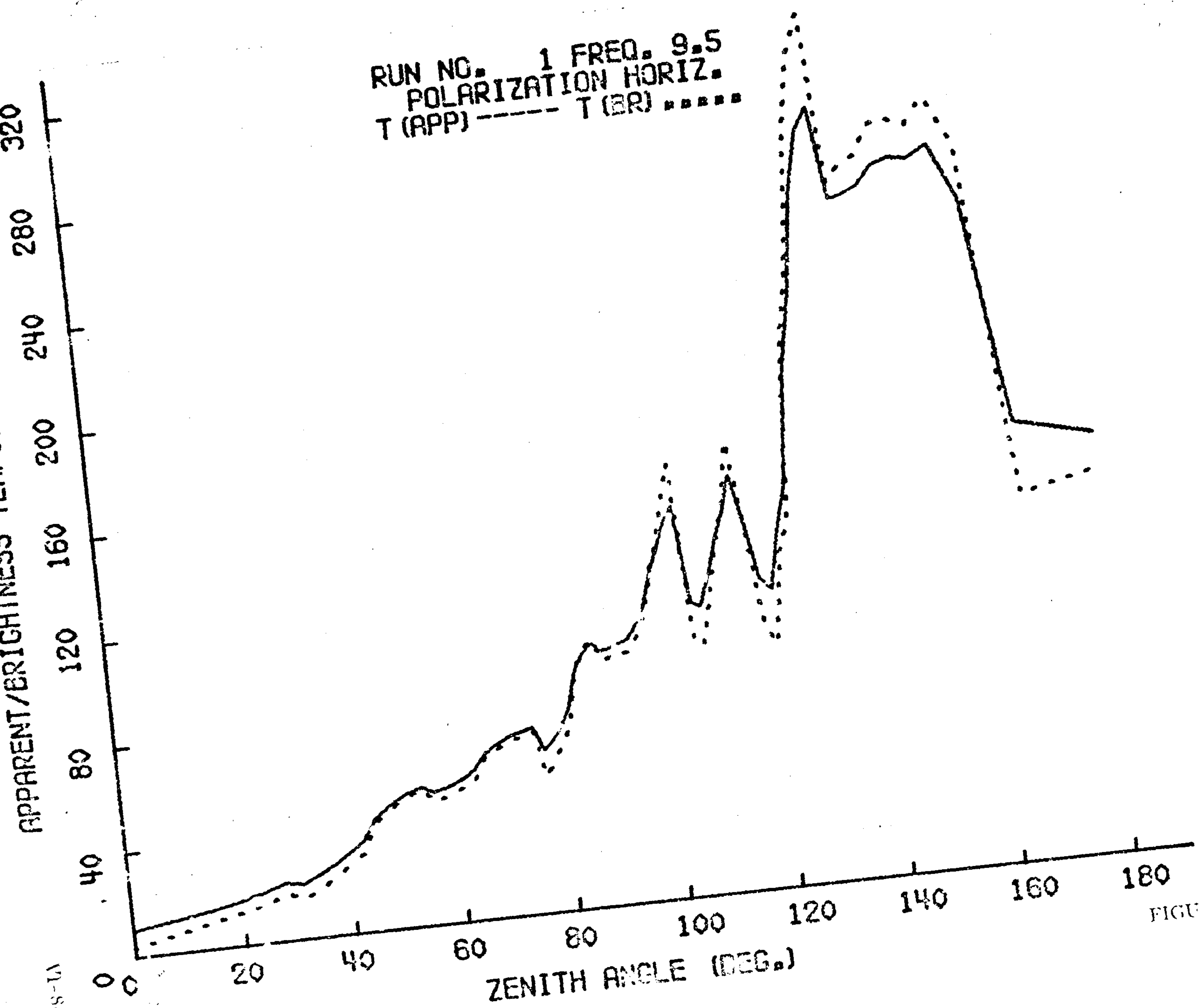

RUN NO. 1 FREQ. 9.5
POLARIZATION HORIZ.
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
ZENITH ANGLE (DEG.)
0
20
40
60
80
100
120
140
160
180

FIGURE VI-36

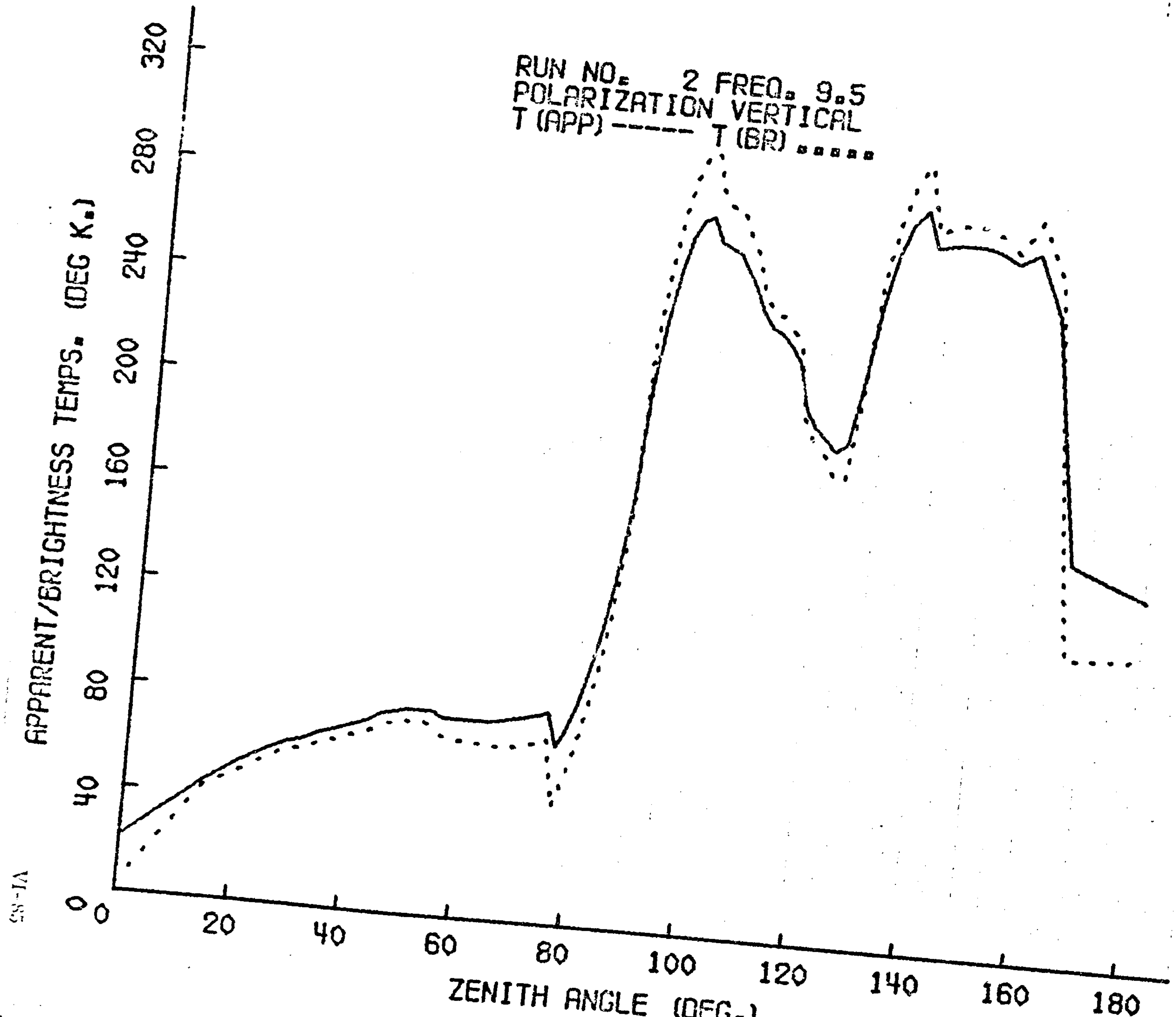

RUN NO. 2 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
ZENITH ANGLE (DEG.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180

FIGURE VI-37

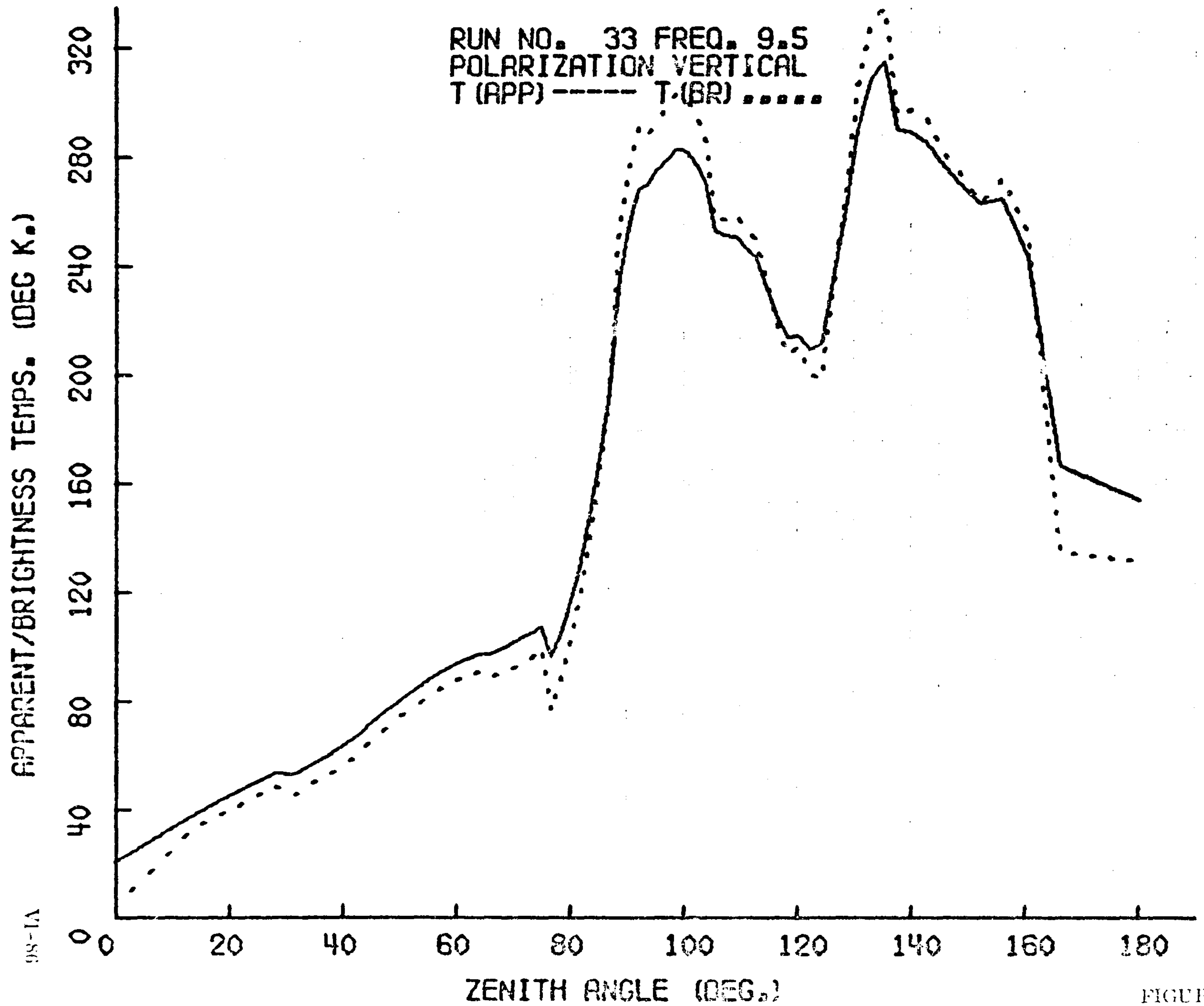

RUN NO. 33 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-38

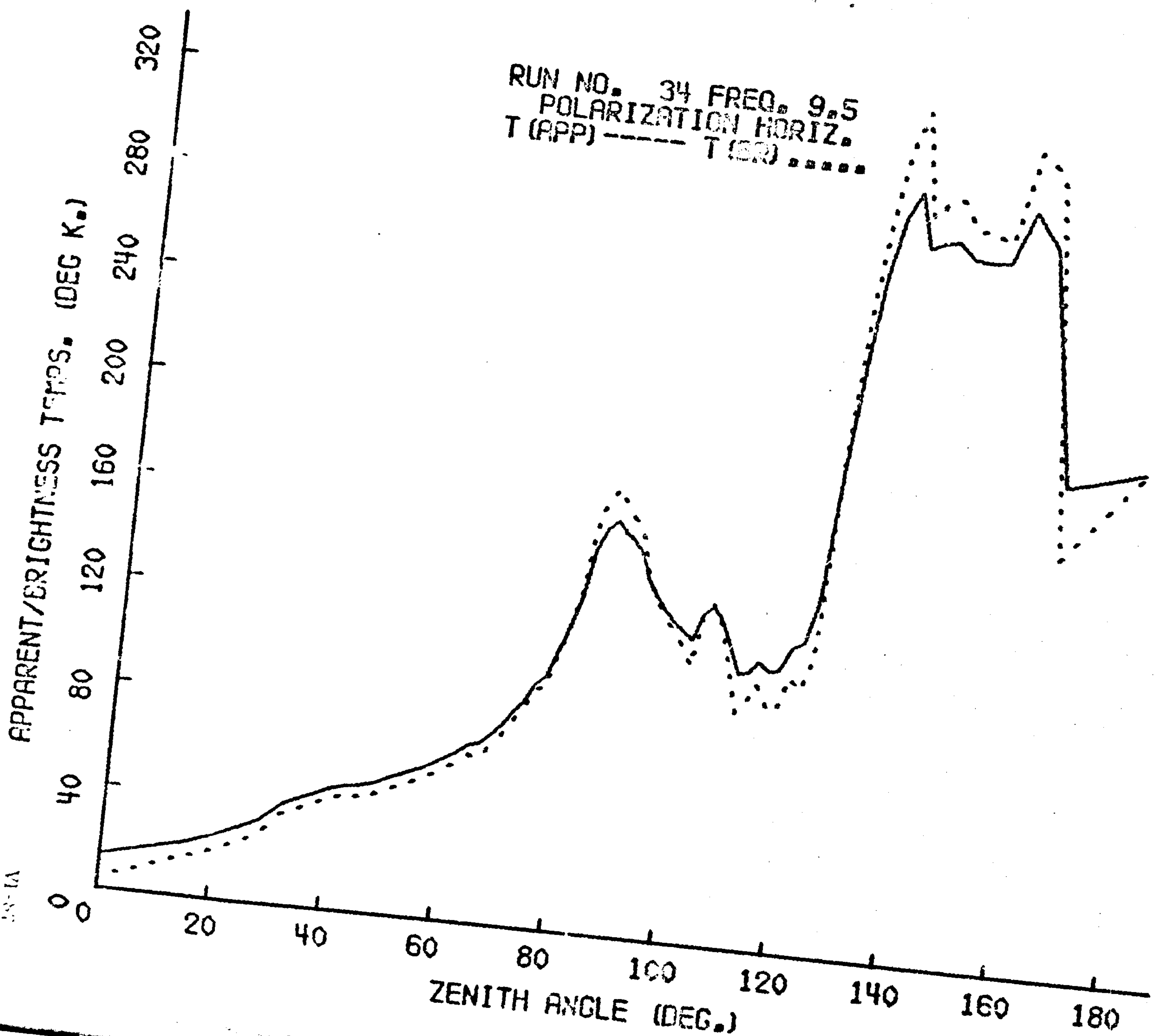

RUN NO. 34 FREQ. 9.5
POLARIZATION HORIZ.
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
0
40
80
120
160
200
240
280
320
0
20
40
60
80
100
120
140
160
180
ZENITH ANGLE (DEG.)

FIGURE VI-39

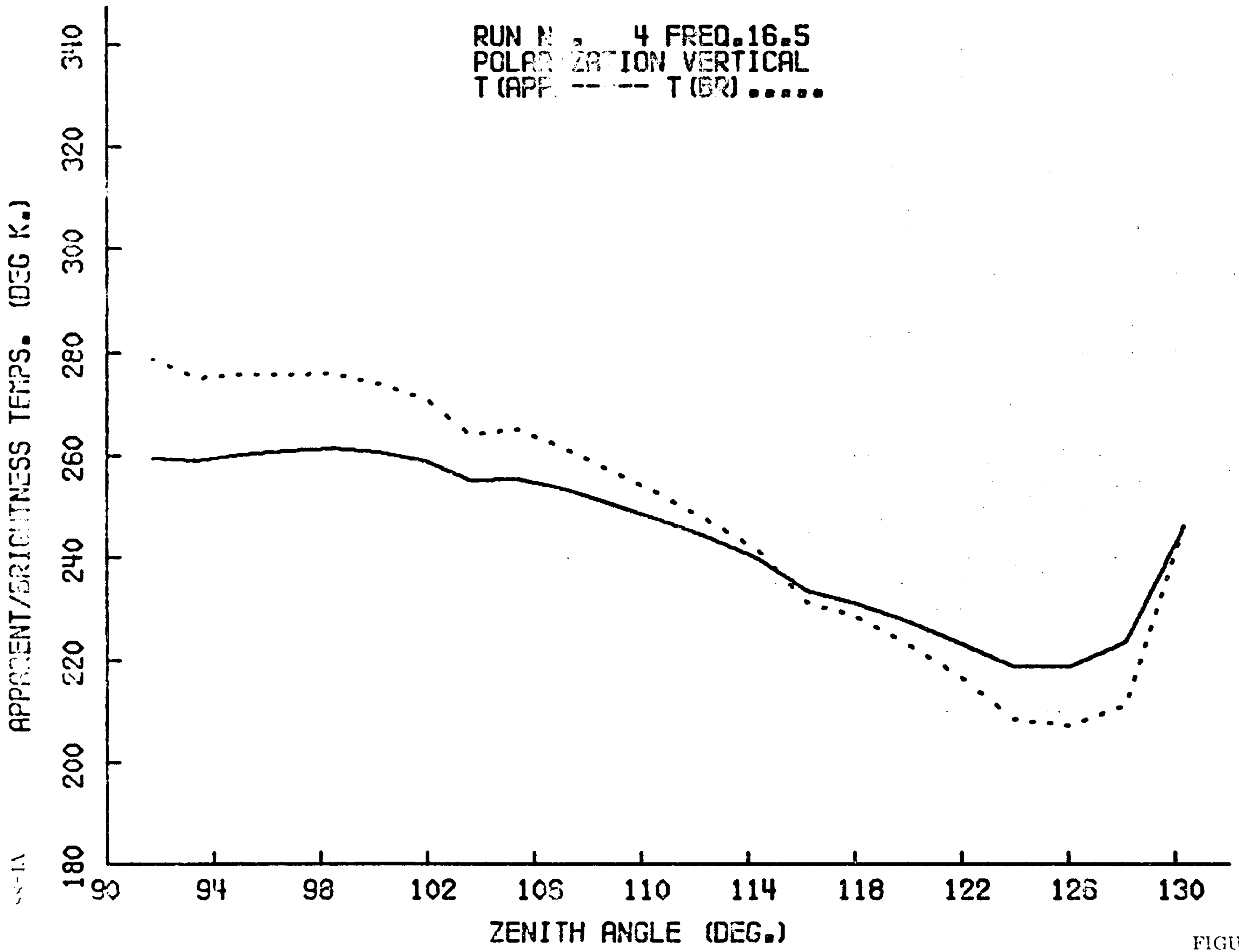

RUN N . 4 FREQ.16.5
POLAR ZATION VERTICAL
T(APP ---- T(BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
310
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-40

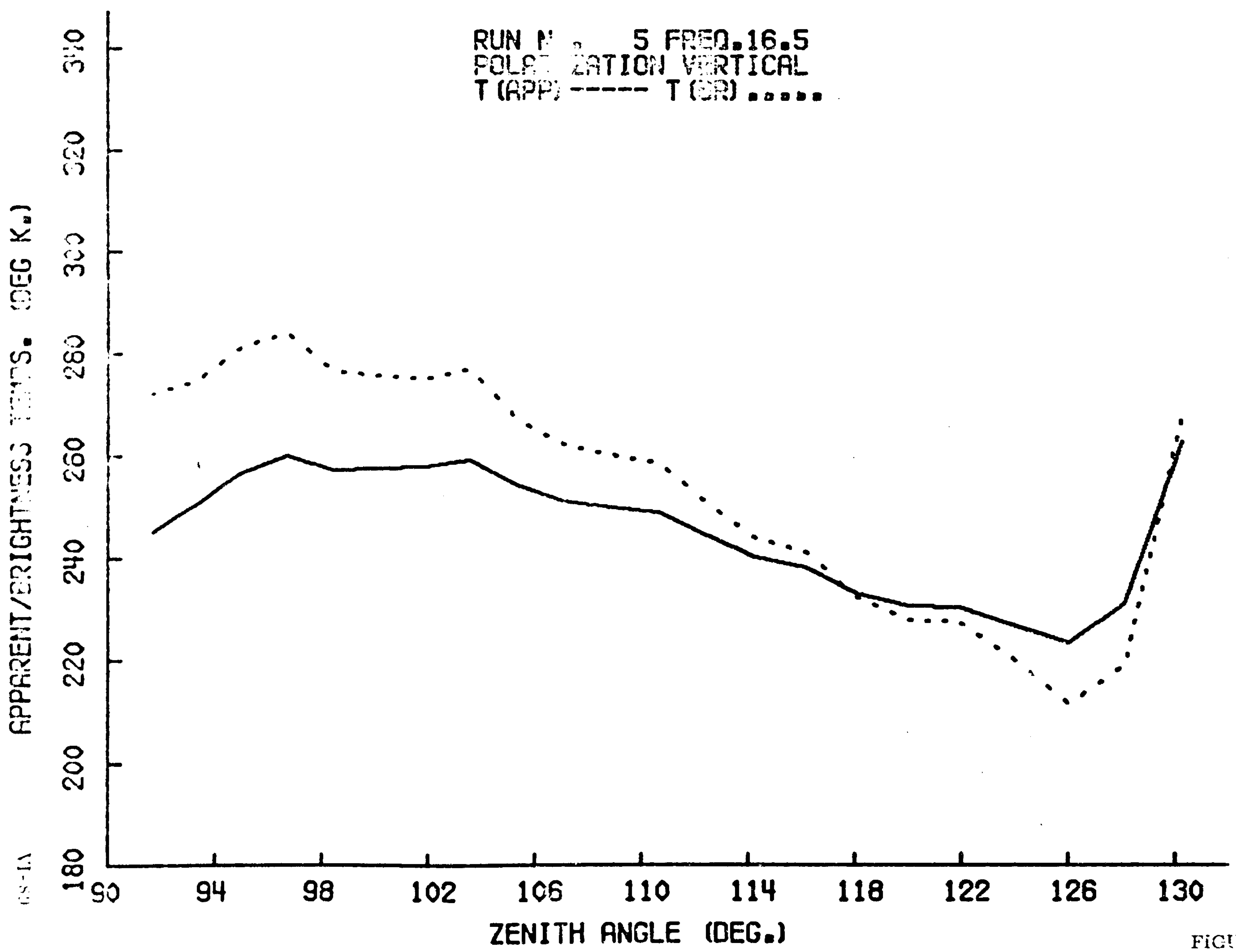
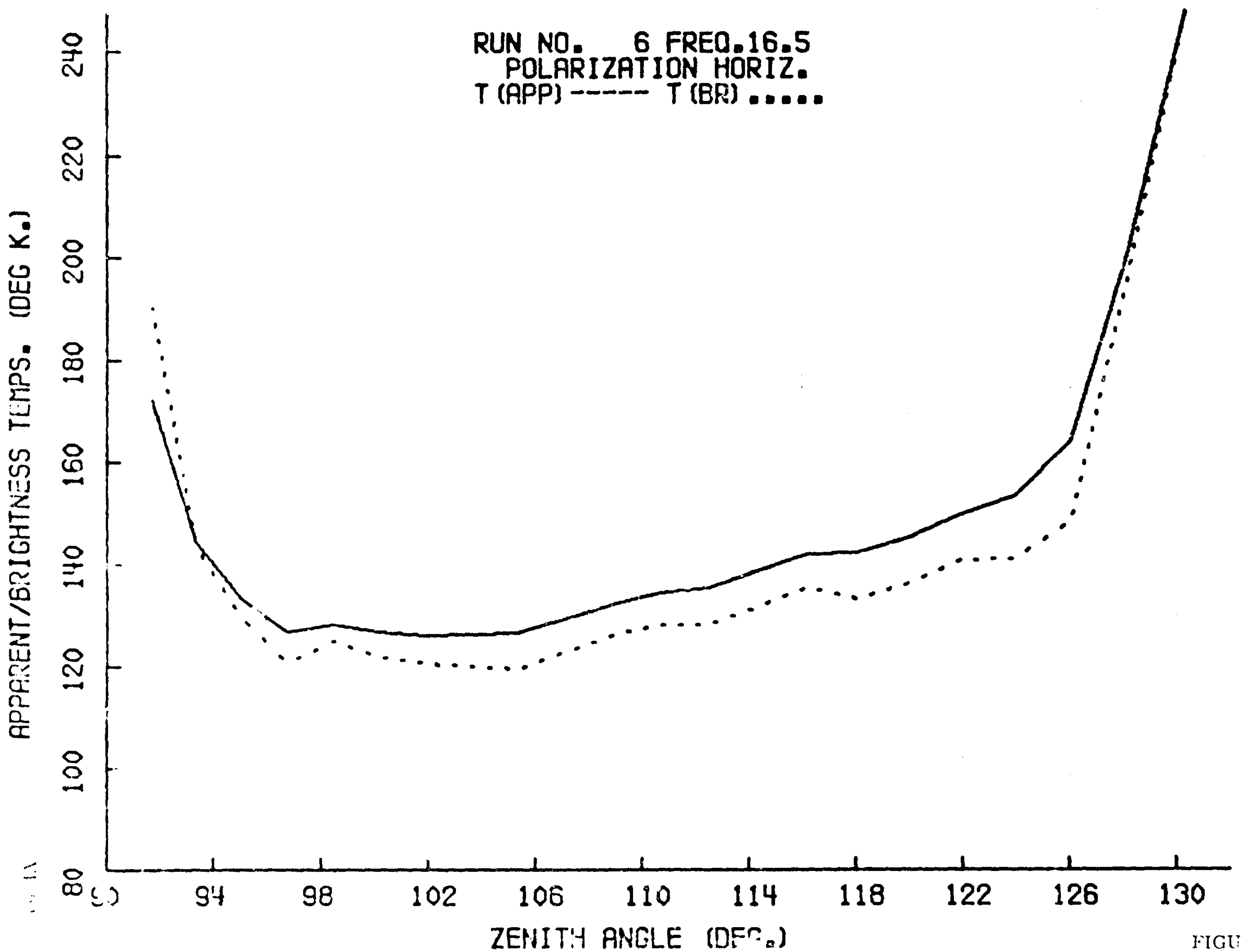

RUN N 5 FREQ.16.5
POLARIZATION VERTICAL
T(APP) ----- T(GR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-41



RUN NO. 6 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-42

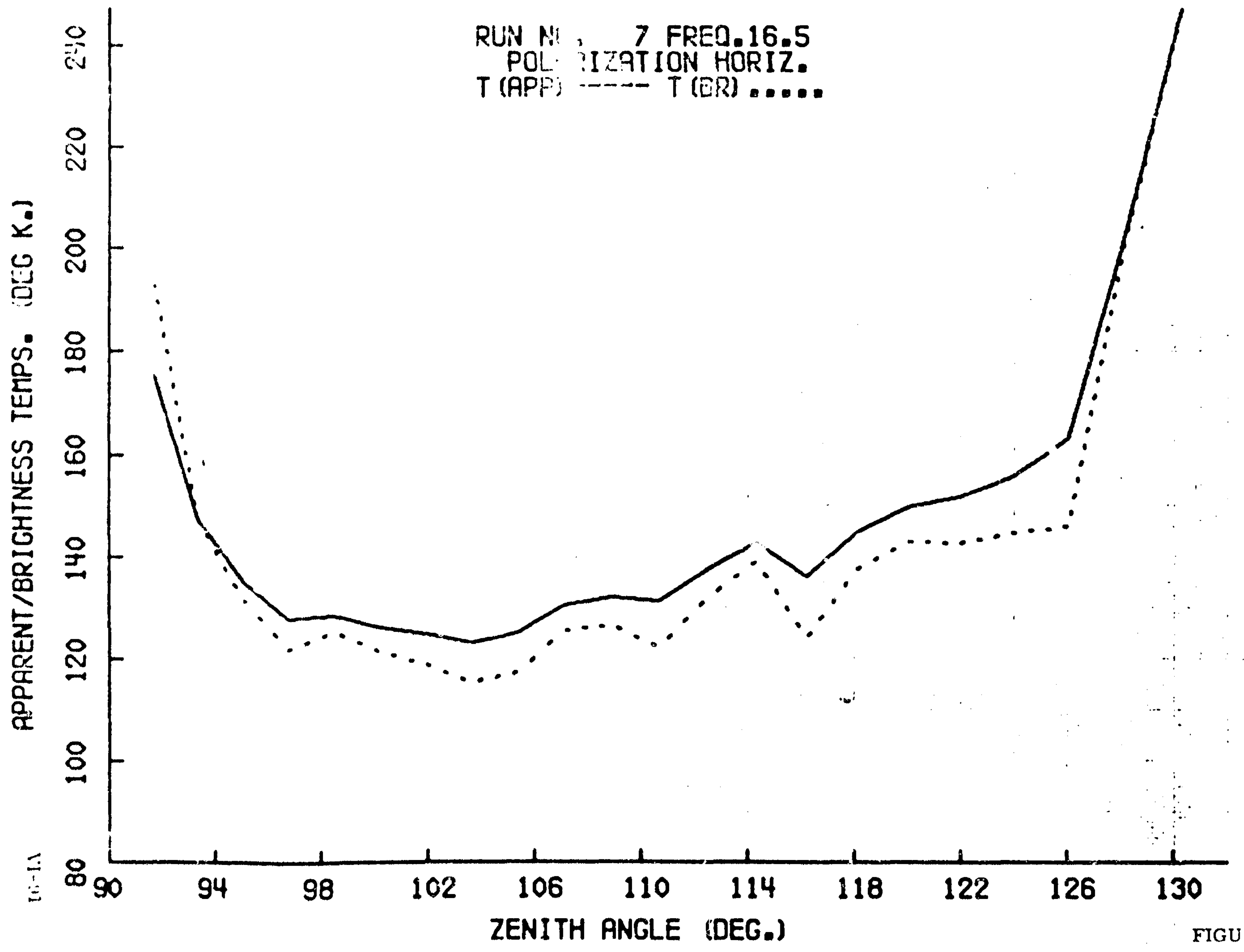
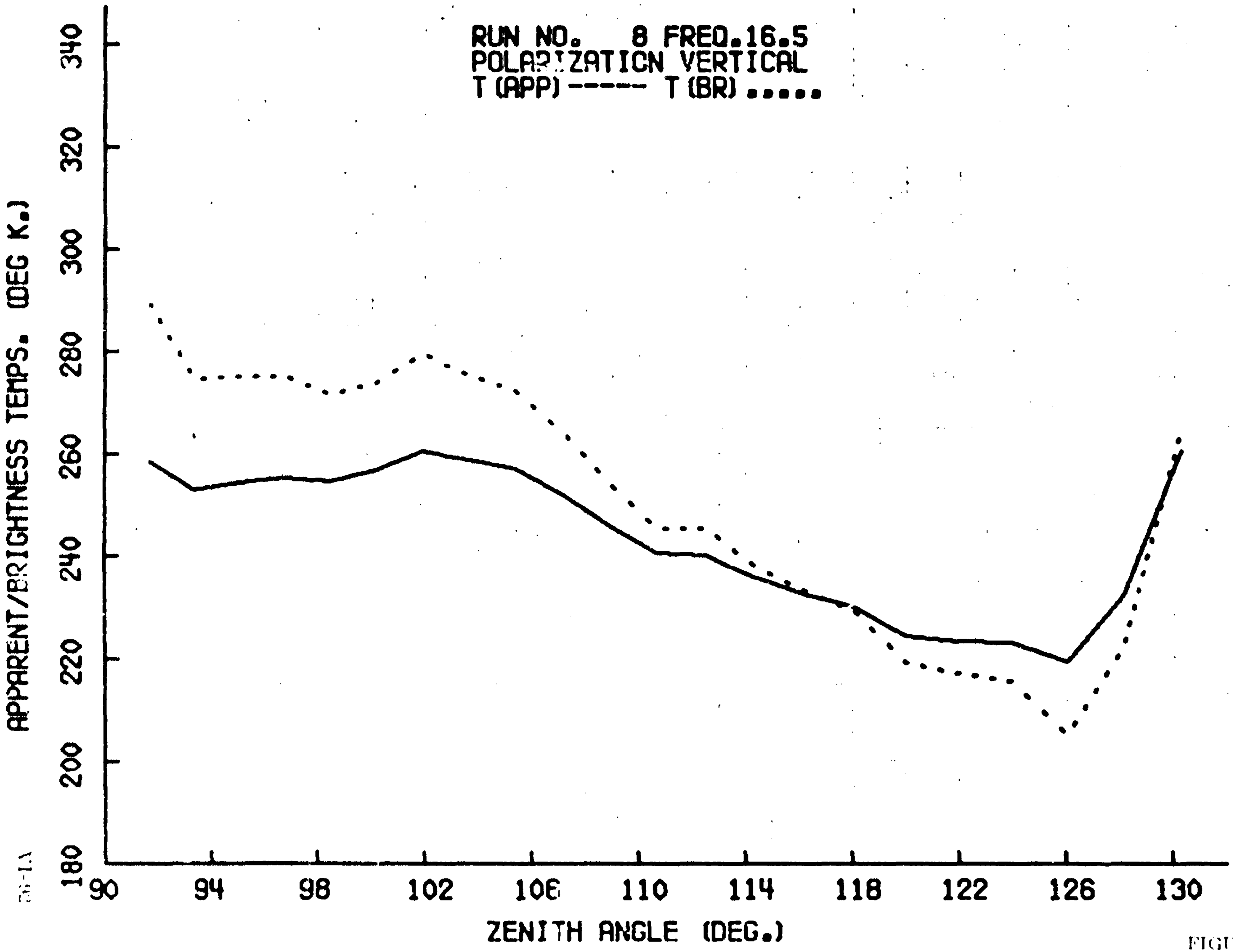
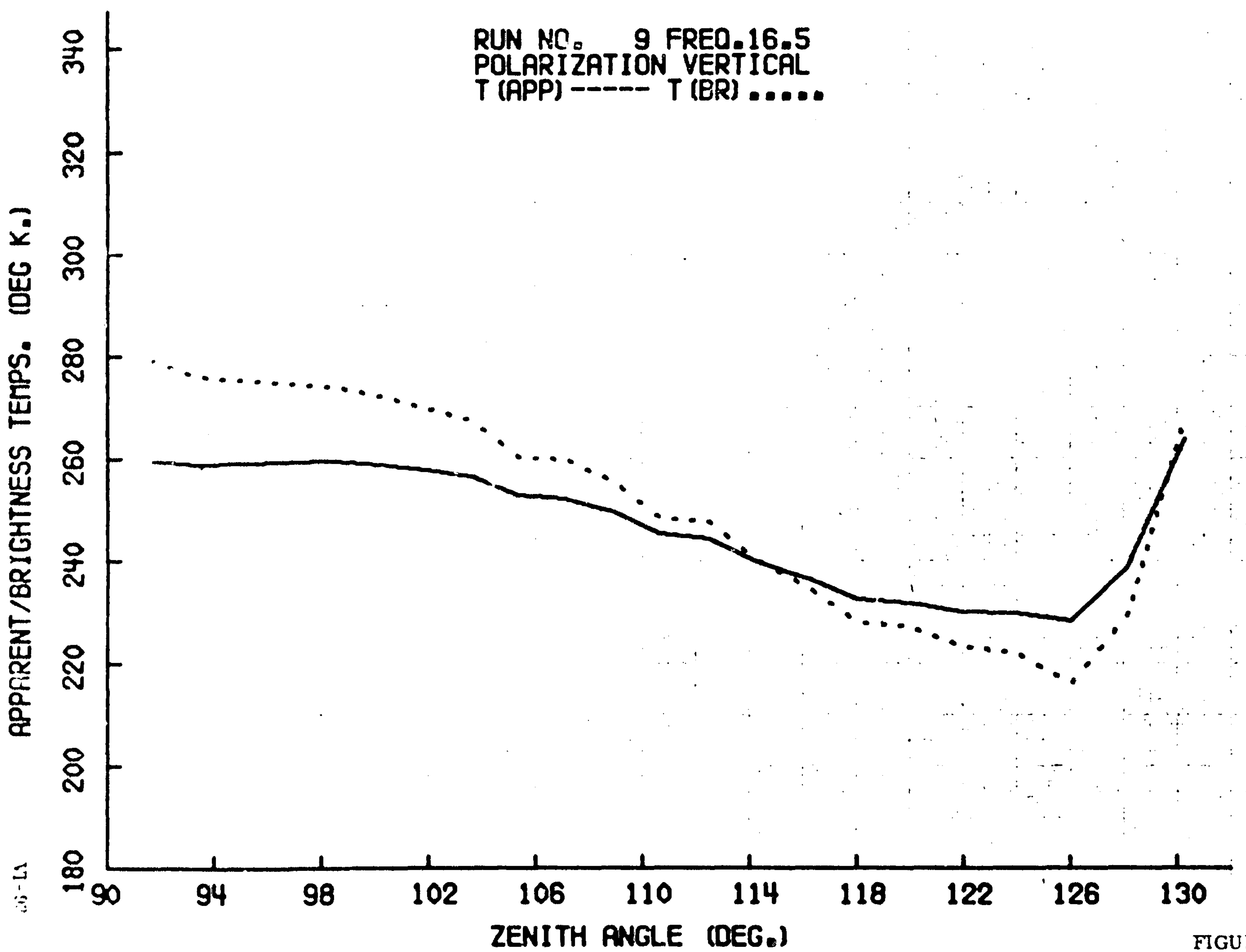

RUN N 7 FREQ.16.5
POL IZATION HORIZ.
T (APP) ---- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-43

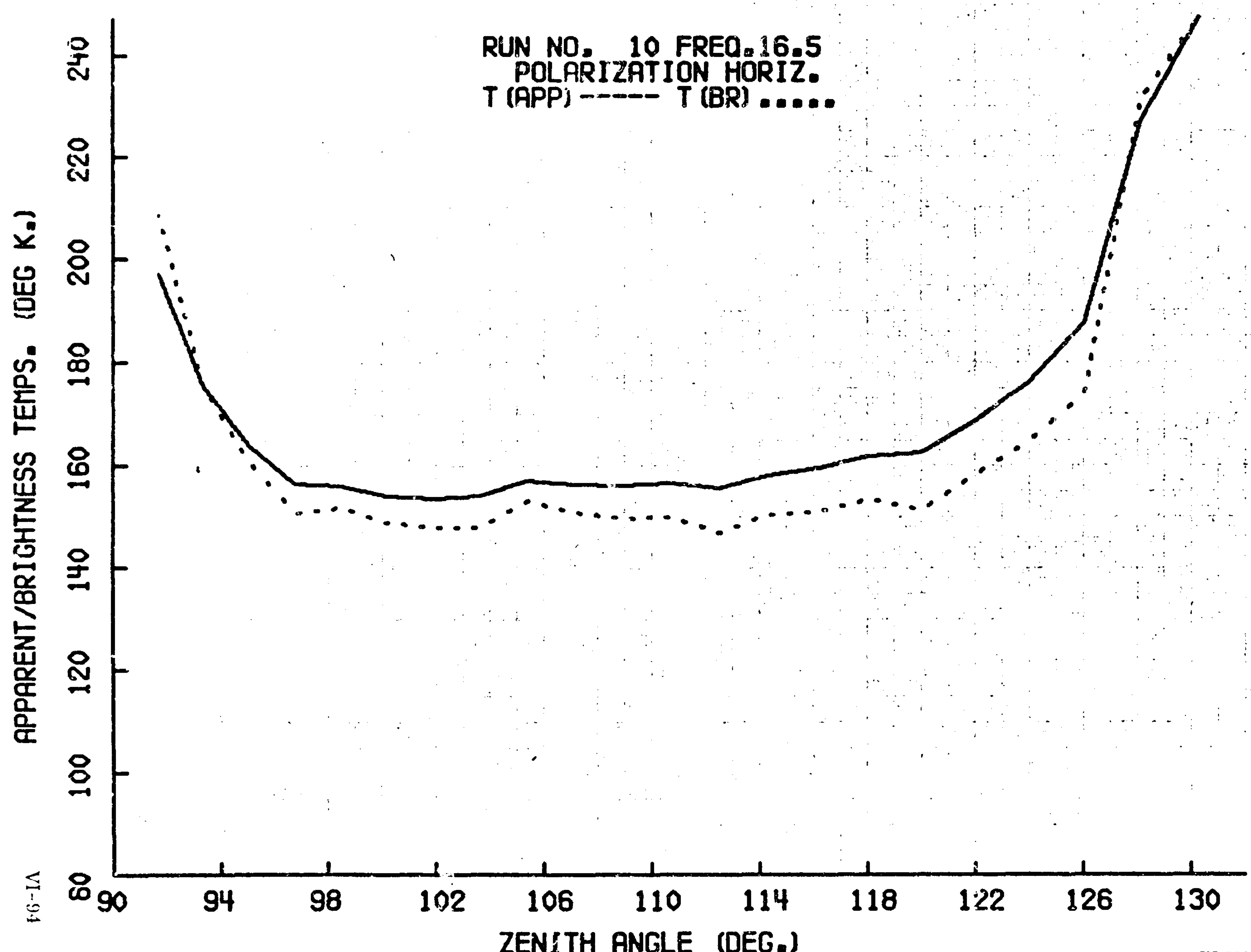


RUN NO. 8 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-44


RUN NO. 9 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURF VI-45



RUN NO. 10 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-46

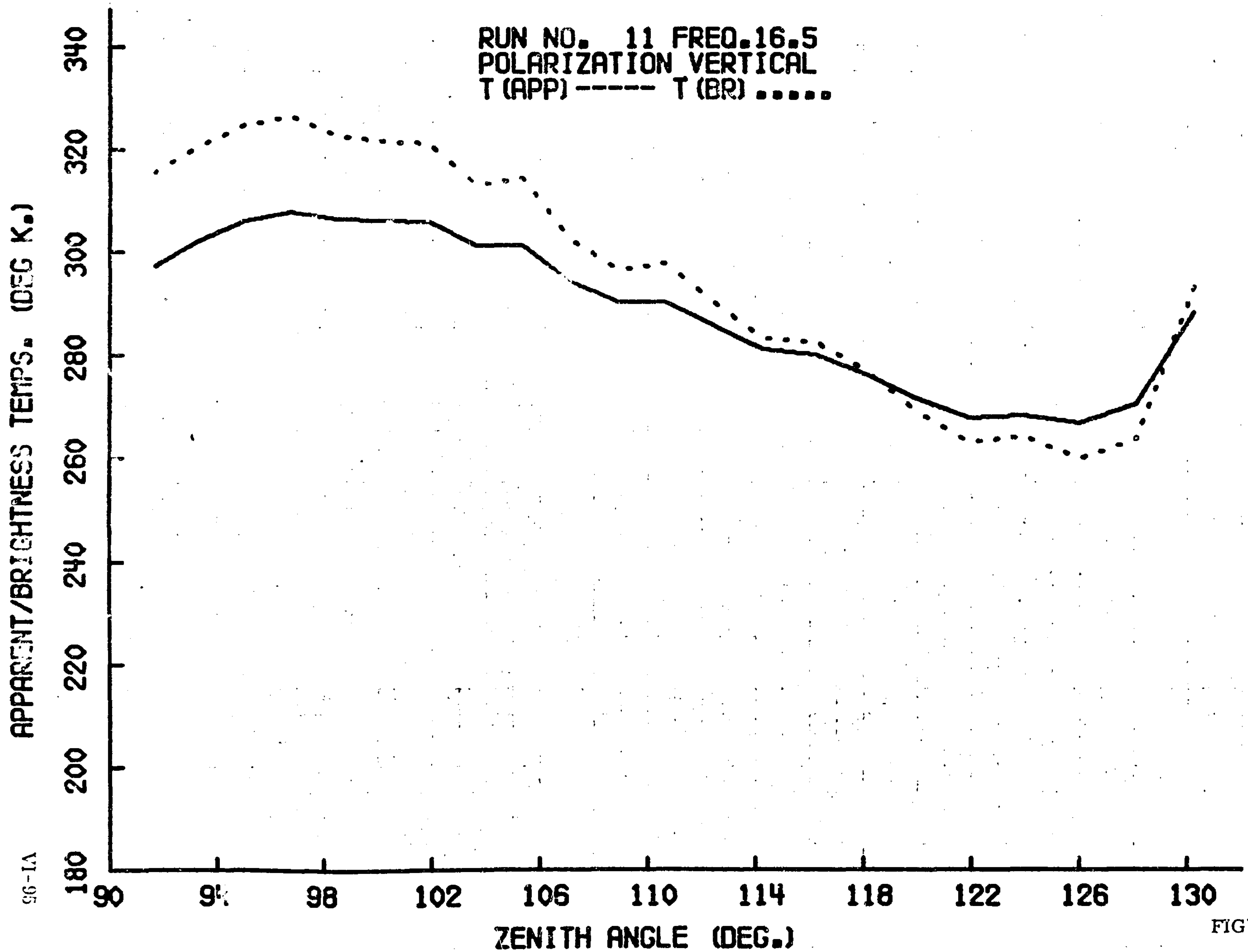

RUN NO. 11 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-47

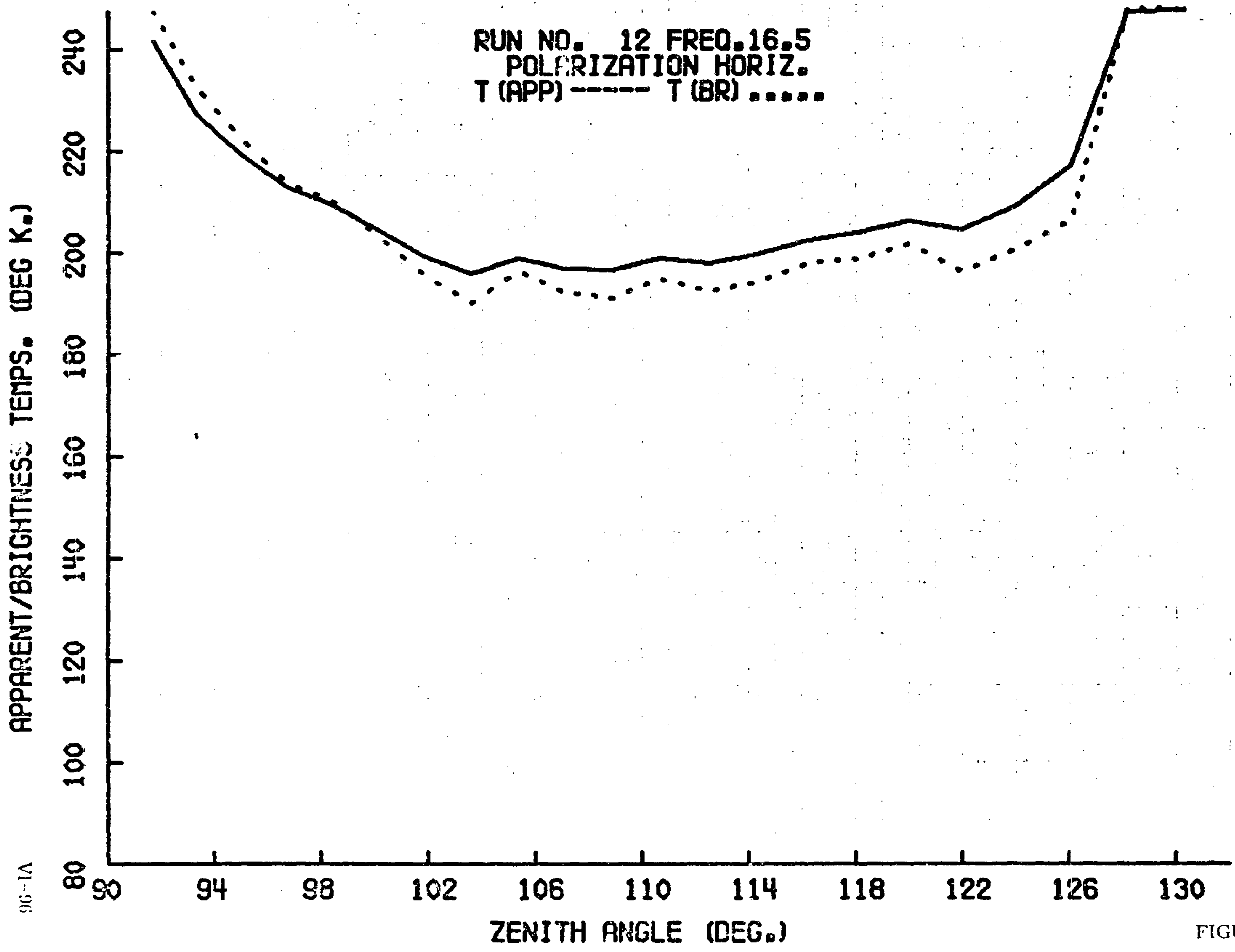

RUN NO. 12 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-48

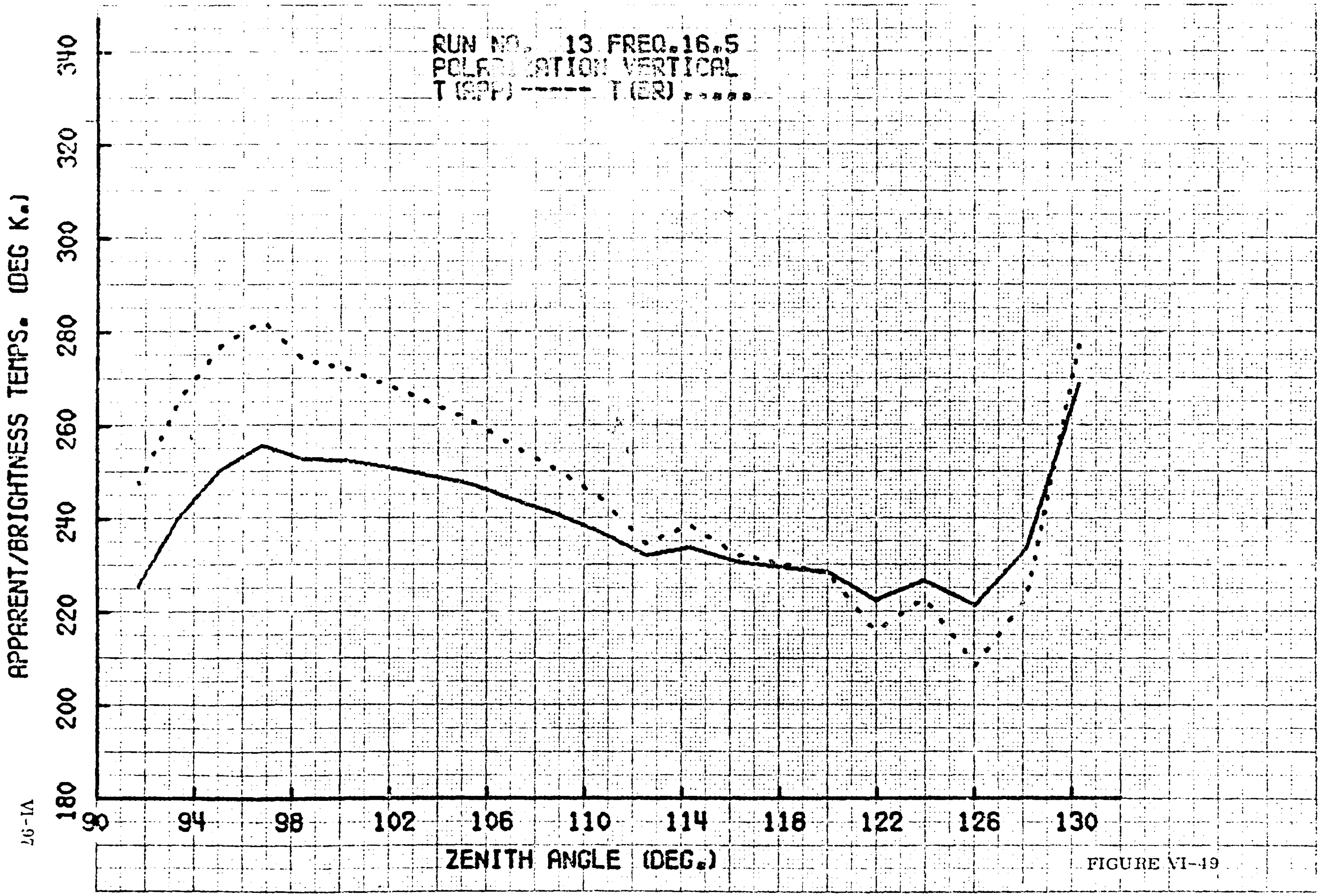
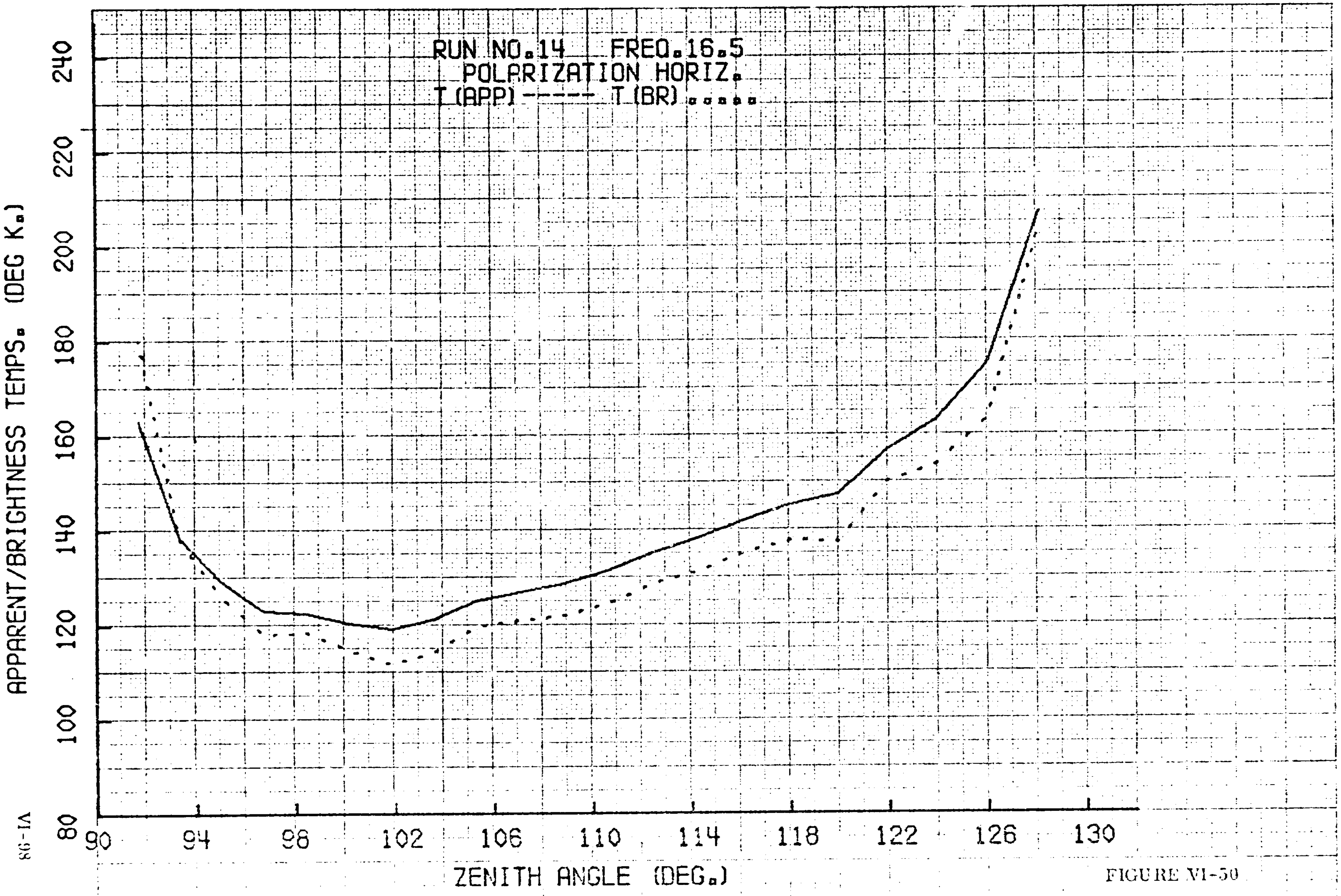

RUN NO. 13 FREQ.16.5
POLARIZATION VERTICAL
T(SPH) ----- T(ER) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-49



RUN NO.14 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
ZENITH ANGLE (DEG.)
80
100
120
140
160
180
200
220
240
90
94
98
102
106
110
114
118
122
126
130

FIGURE VI-50

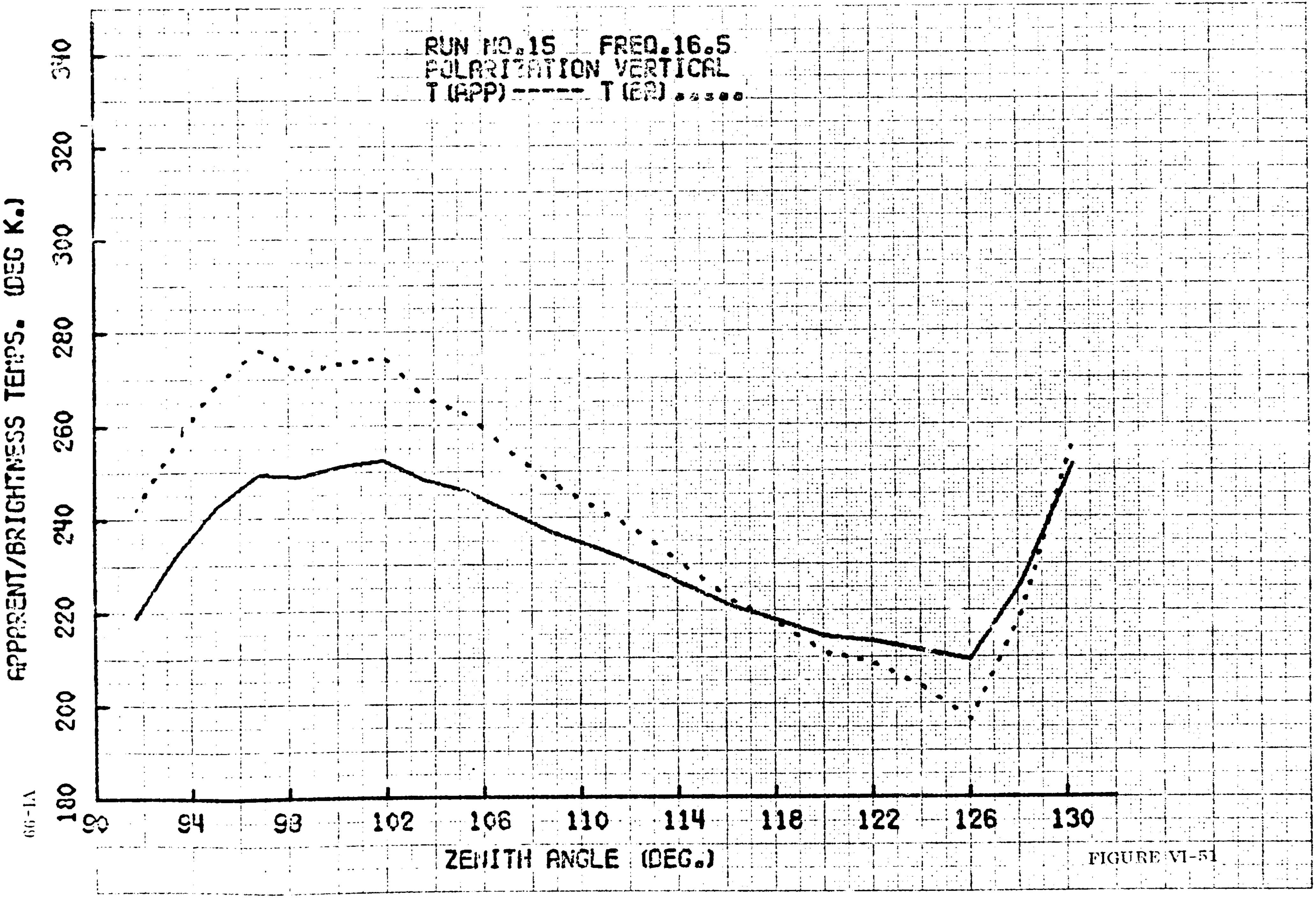
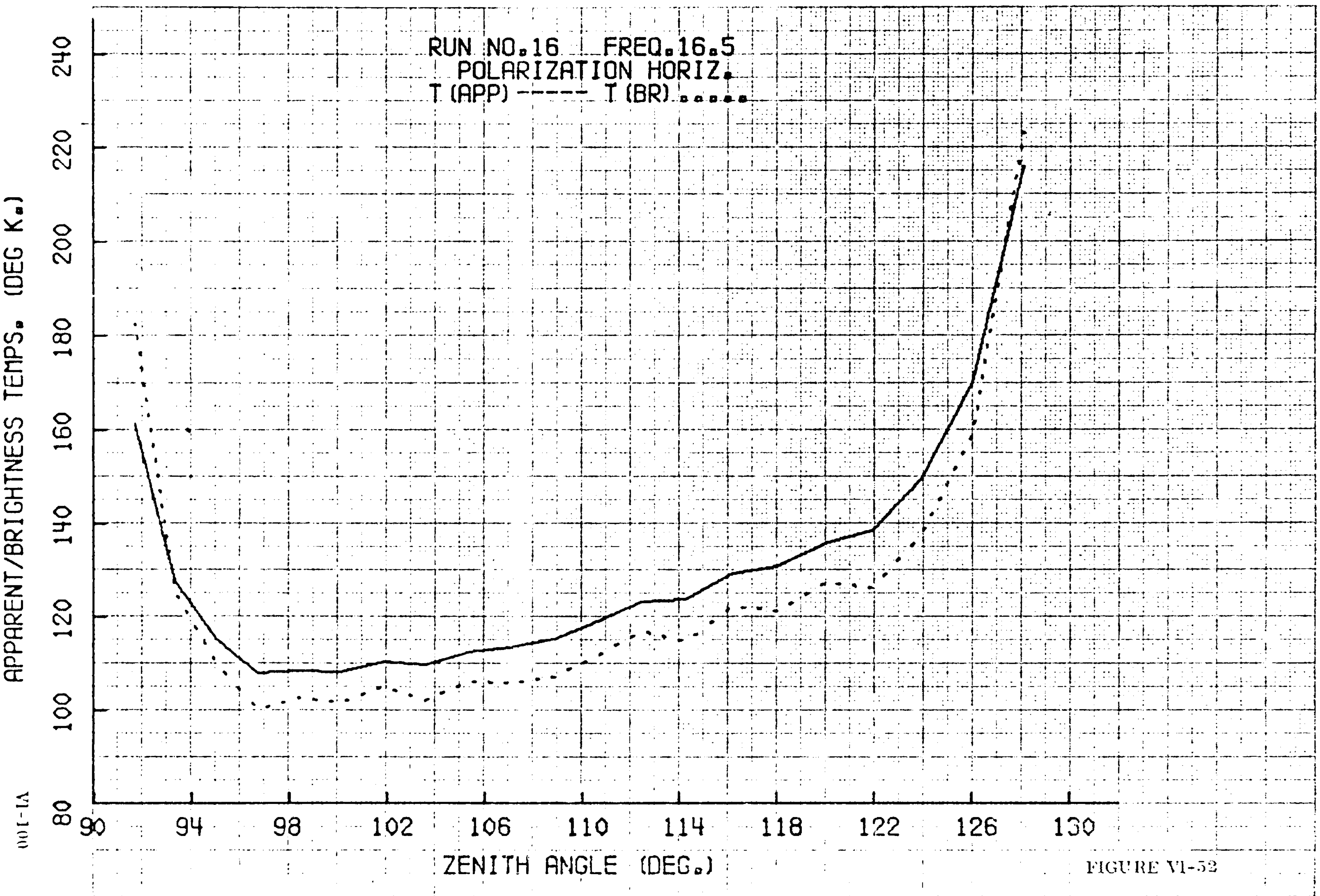

RUN NO.15 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
180
200
220
240
260
280
300
320
340
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-51



RUN NO.16 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-52

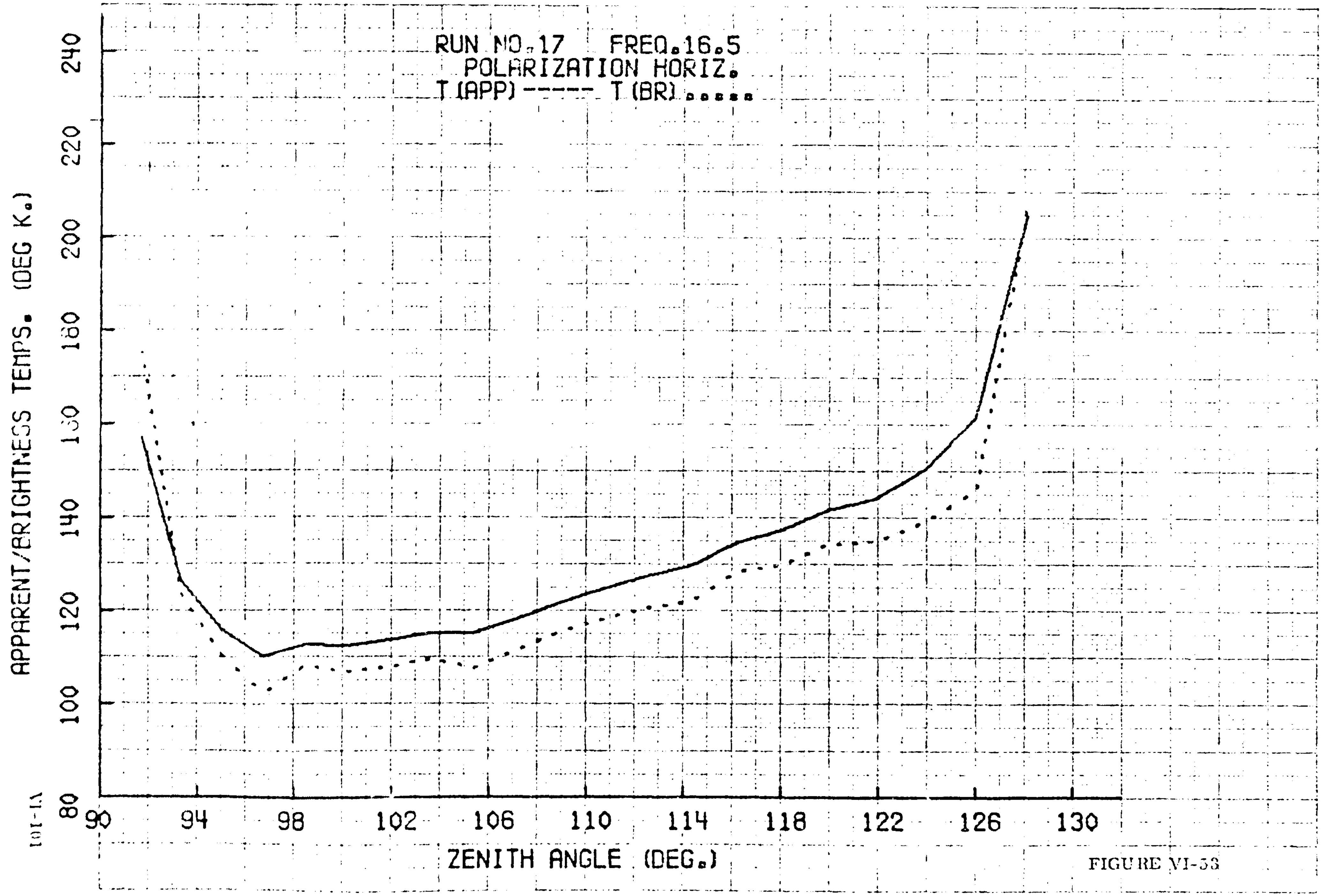

RUN NO.17 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-53

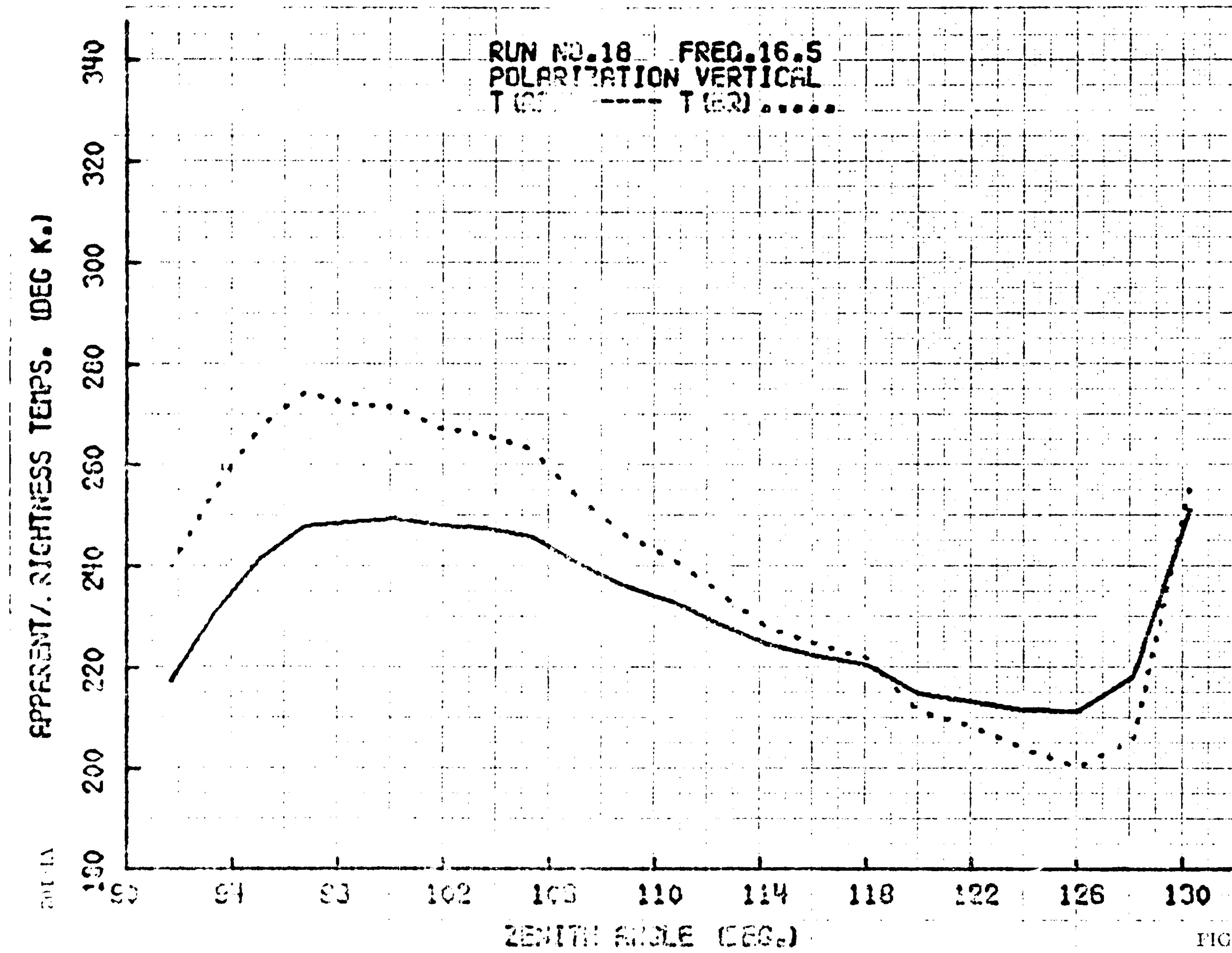

RUN NO.18 FREQ.16.5
POLARIZATION VERTICAL
340
320
300
260
220
200
110
114
118
126
130
ZENITH ANGLE

FIGURE VI-54

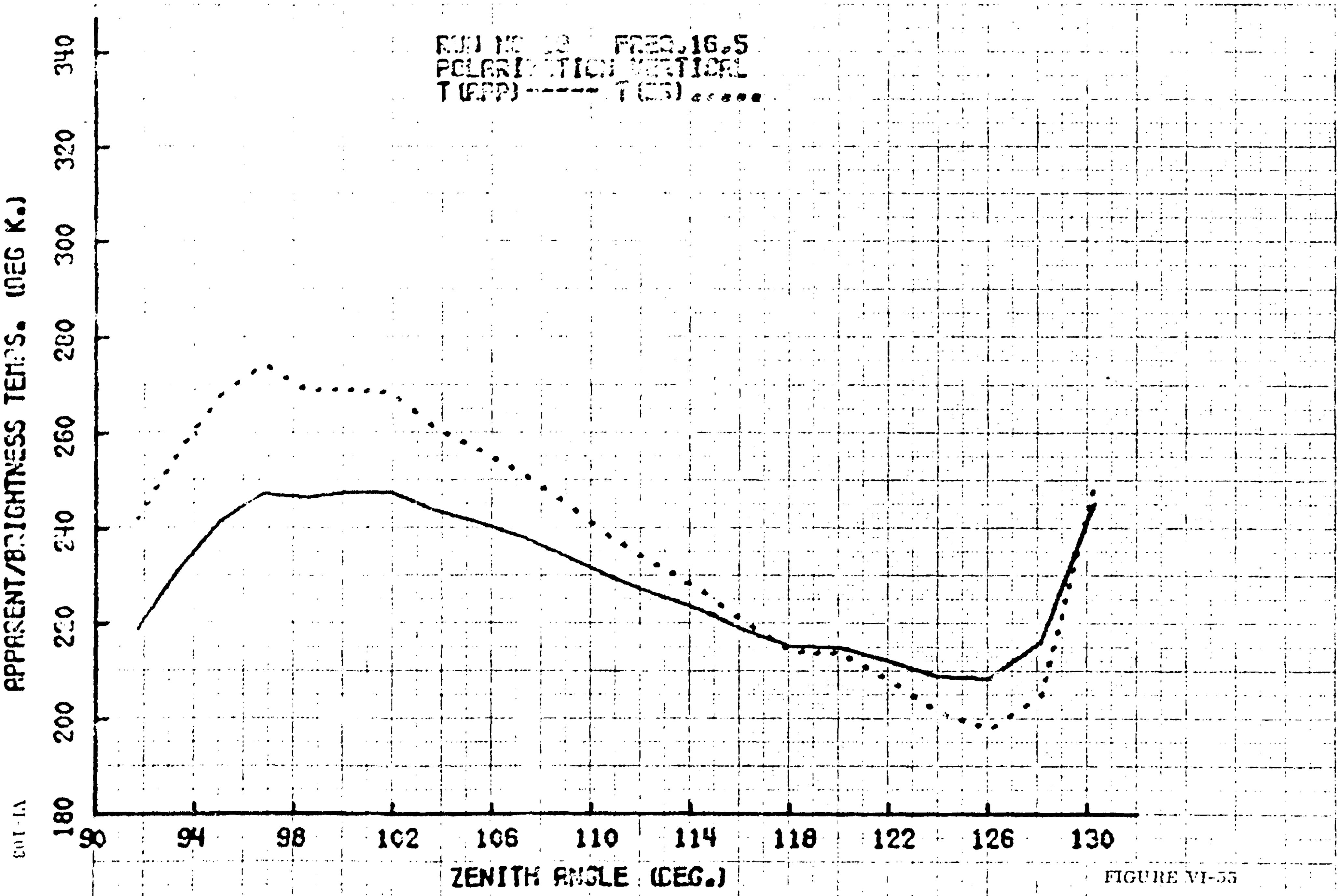
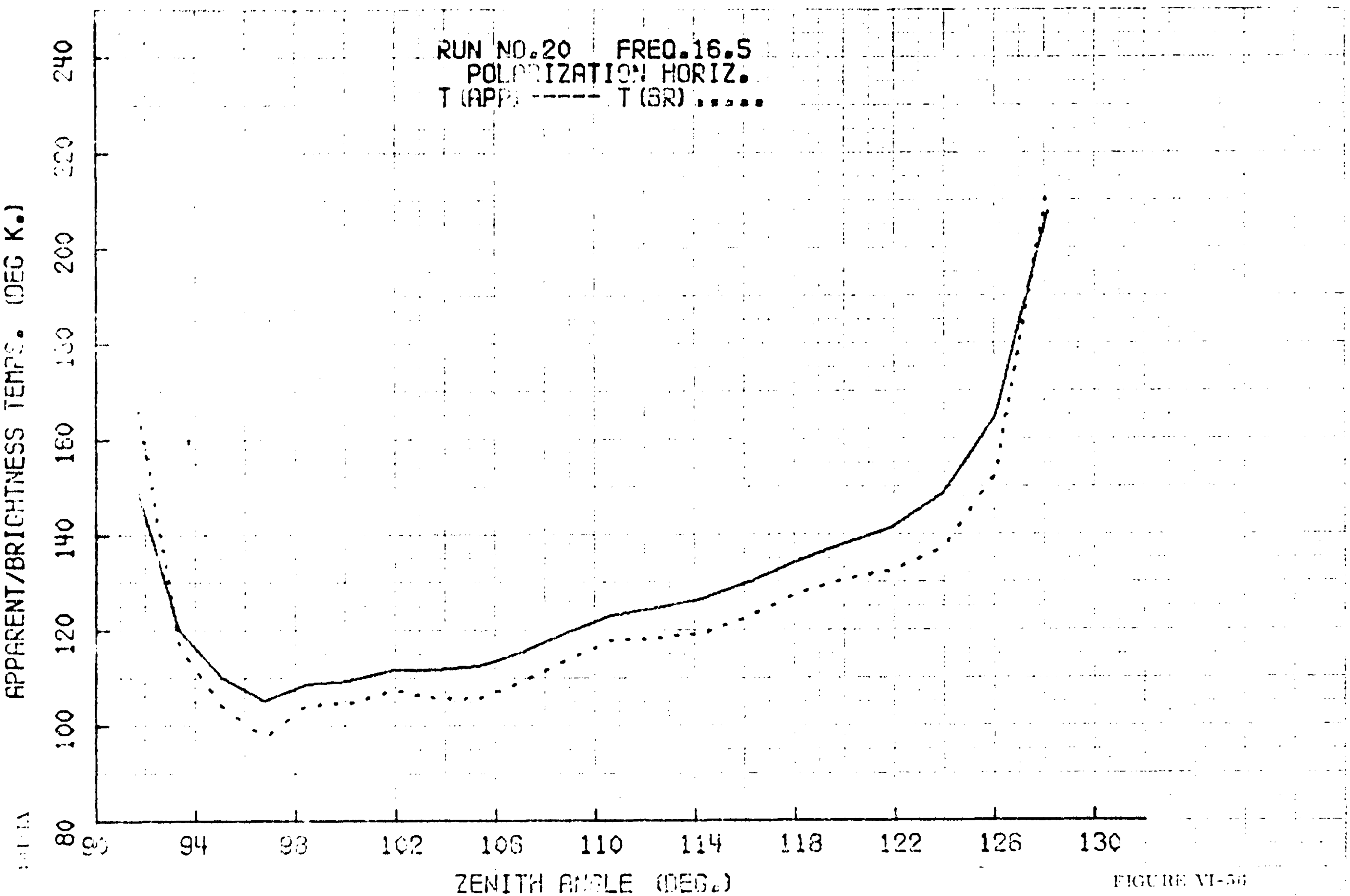
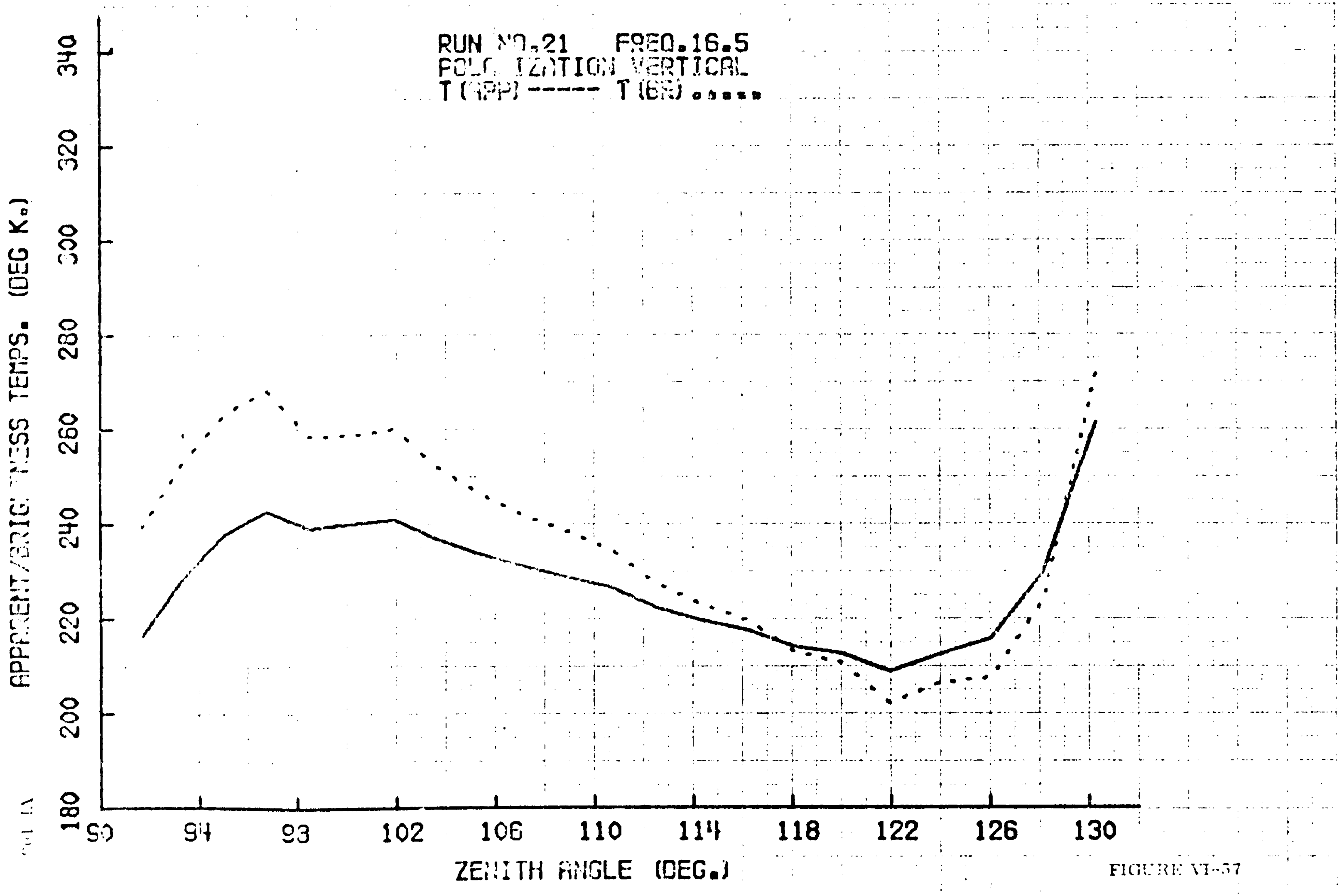

FREQ.16.5
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
180
200
220
240
260
280
300
320
340
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-55



RUN NO.20 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
200
160
140
120
100
80
94
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-56



RUN NO.21 FREQ.16.5
POLARIZATION VERTICAL
T(APP) ----- T(BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
180
200
220
240
260
280
300
320
340
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-57

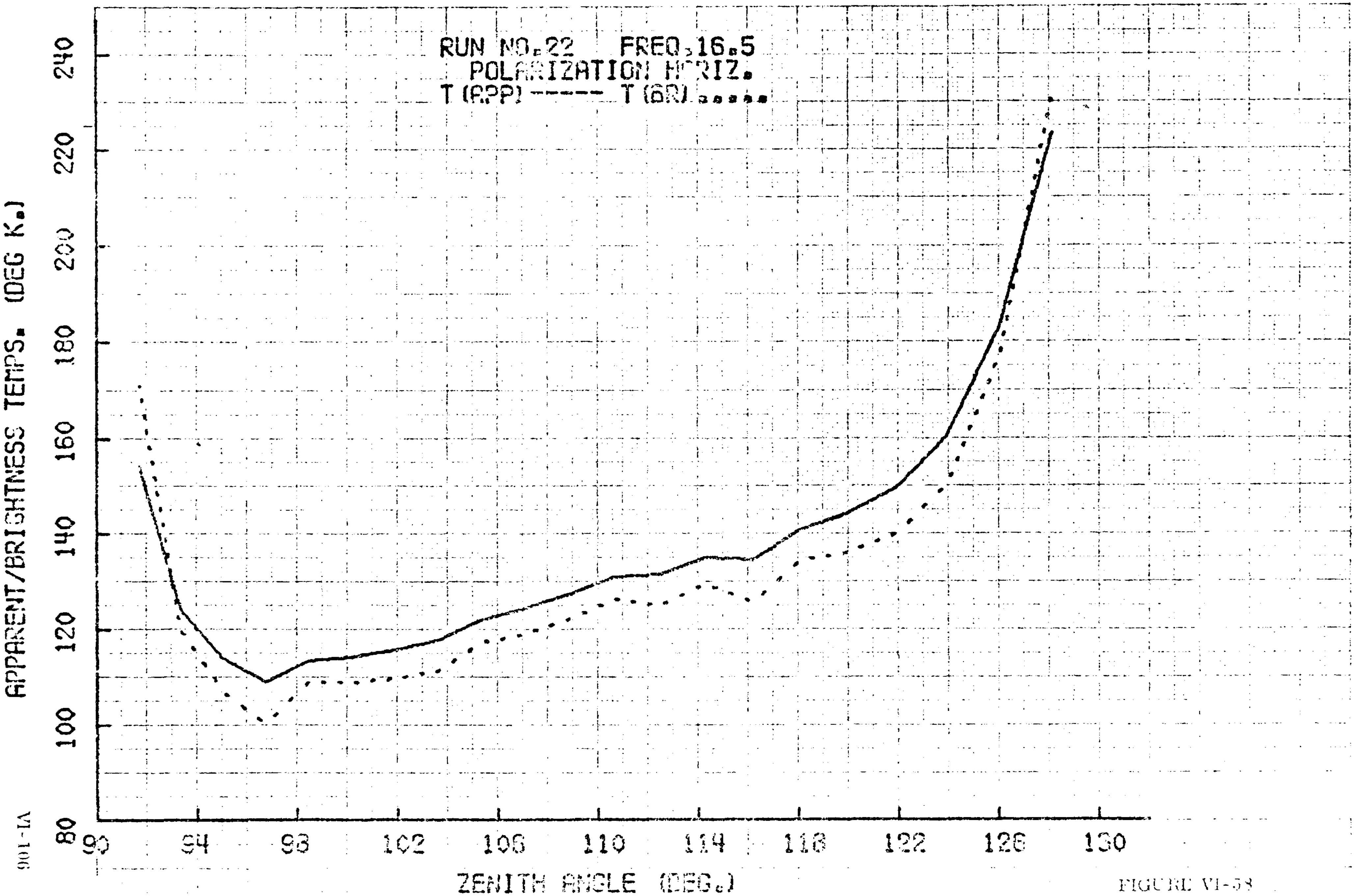
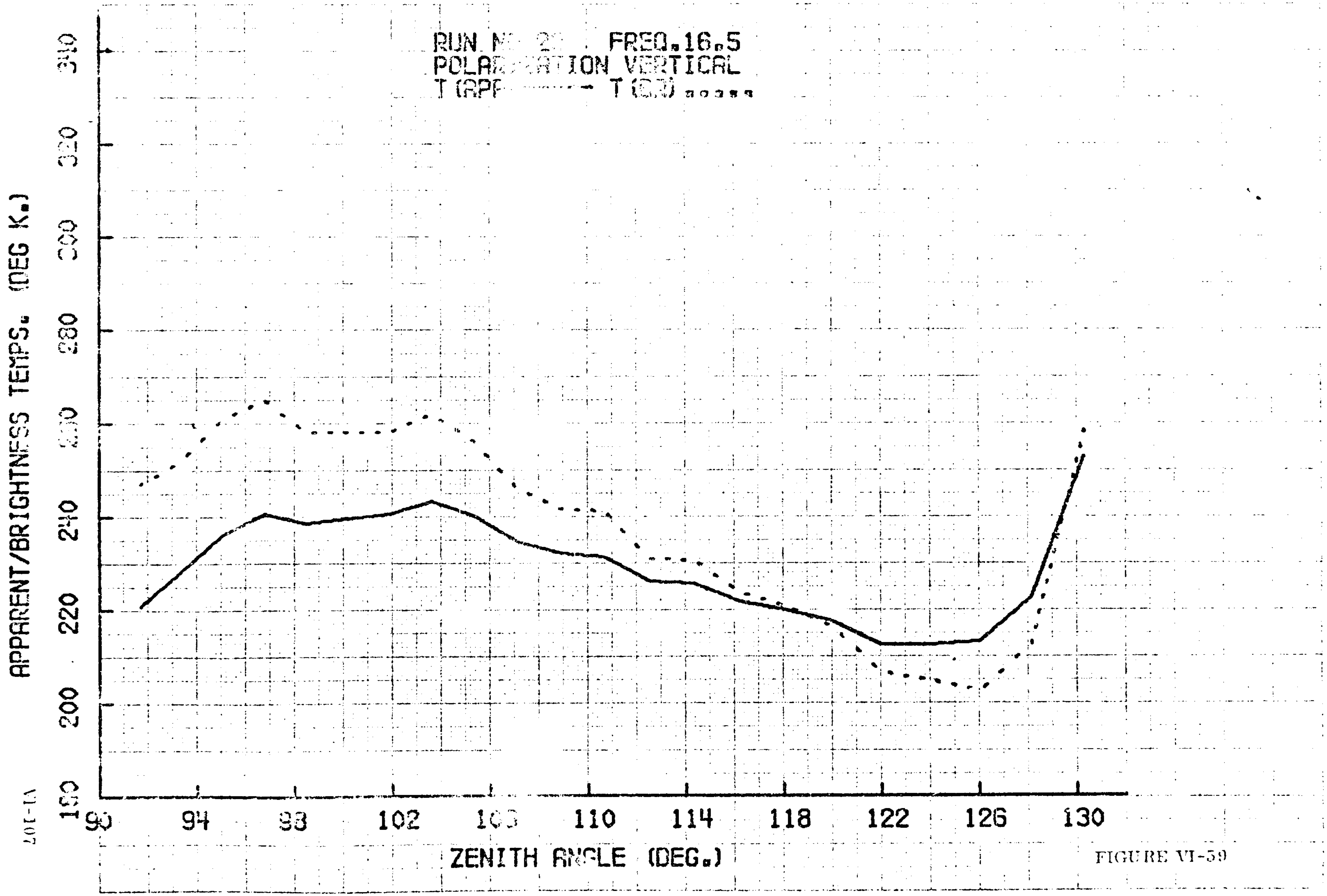

RUN NO. 22 FREQ. 16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-58



RUN NO. 2? FREQ. 16.5
POLARIZATION VERTICAL
T (APP) ------ T (B.B.) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-59

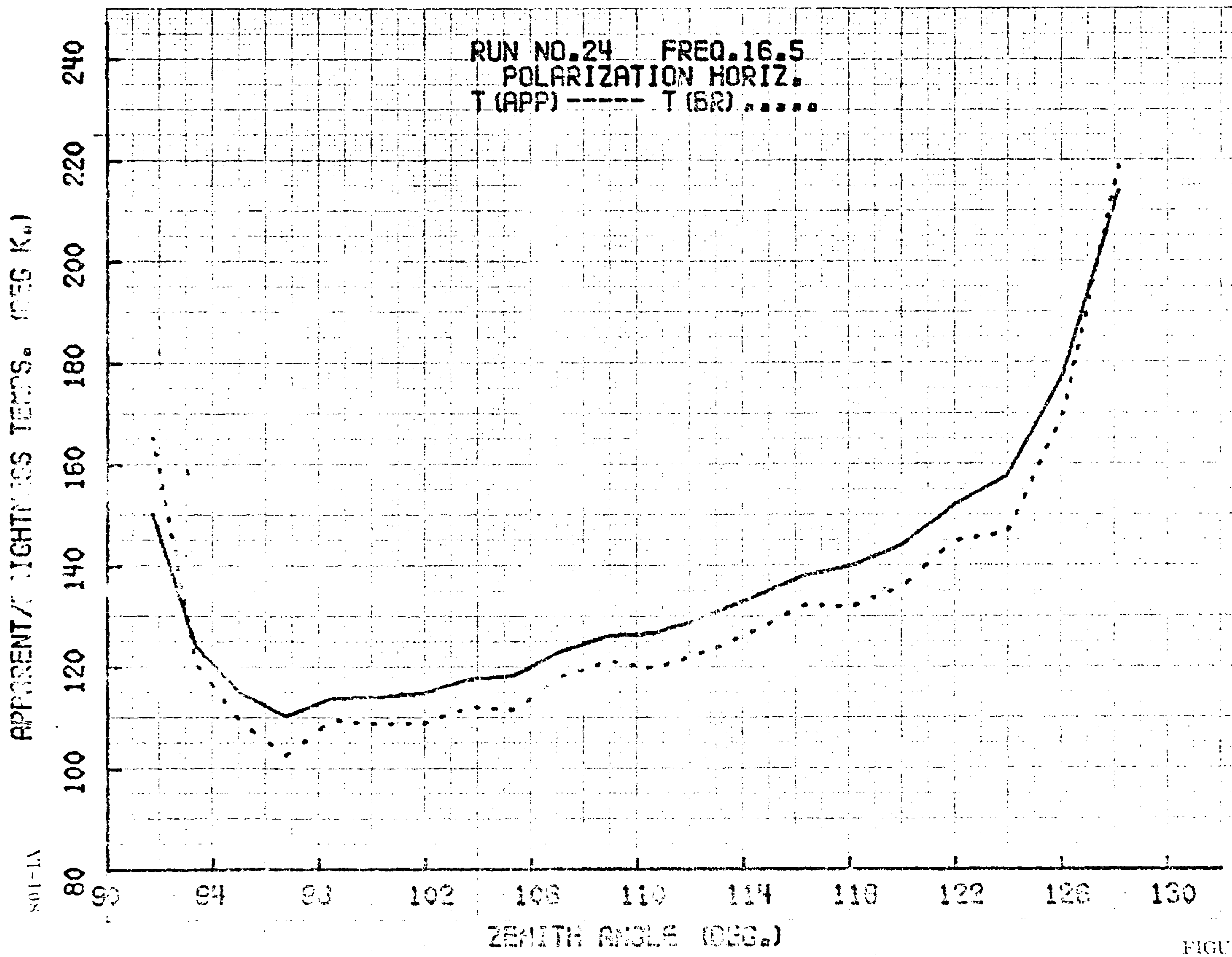

RUN NO.24 FREQ.16.5
POLARIZATION HORIZ.
T(APP) ----- T(BR) .....
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-60

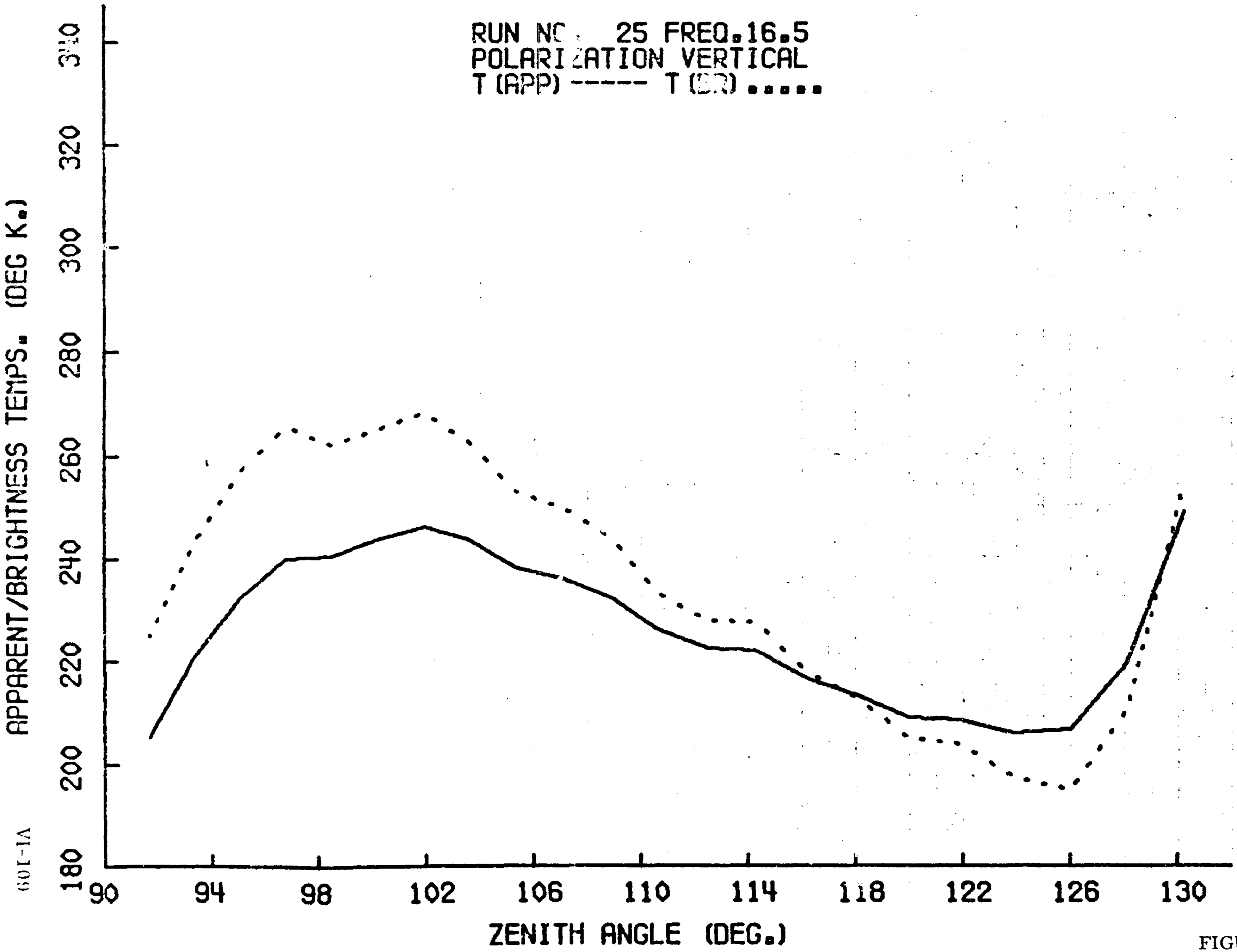

RUN NO. 25 FREQ.16.5
POLARIZATION VERTICAL
T(APP) ----- T(BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-61

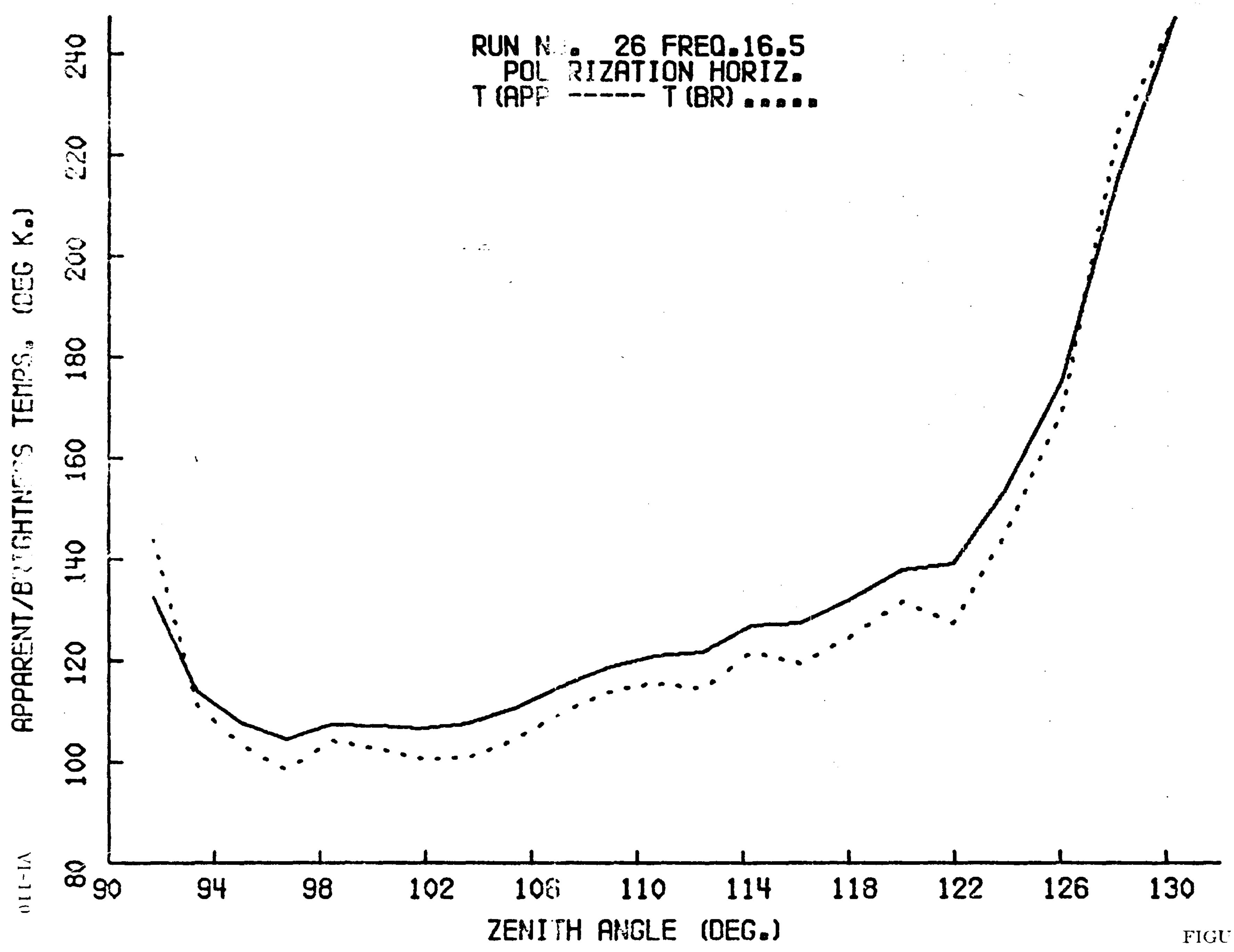

RUN NO. 26 FREQ.16.5
POLARIZATION HORIZ.
T(APP ----- T(BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
80
100
120
140
160
180
200
220
240
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-62

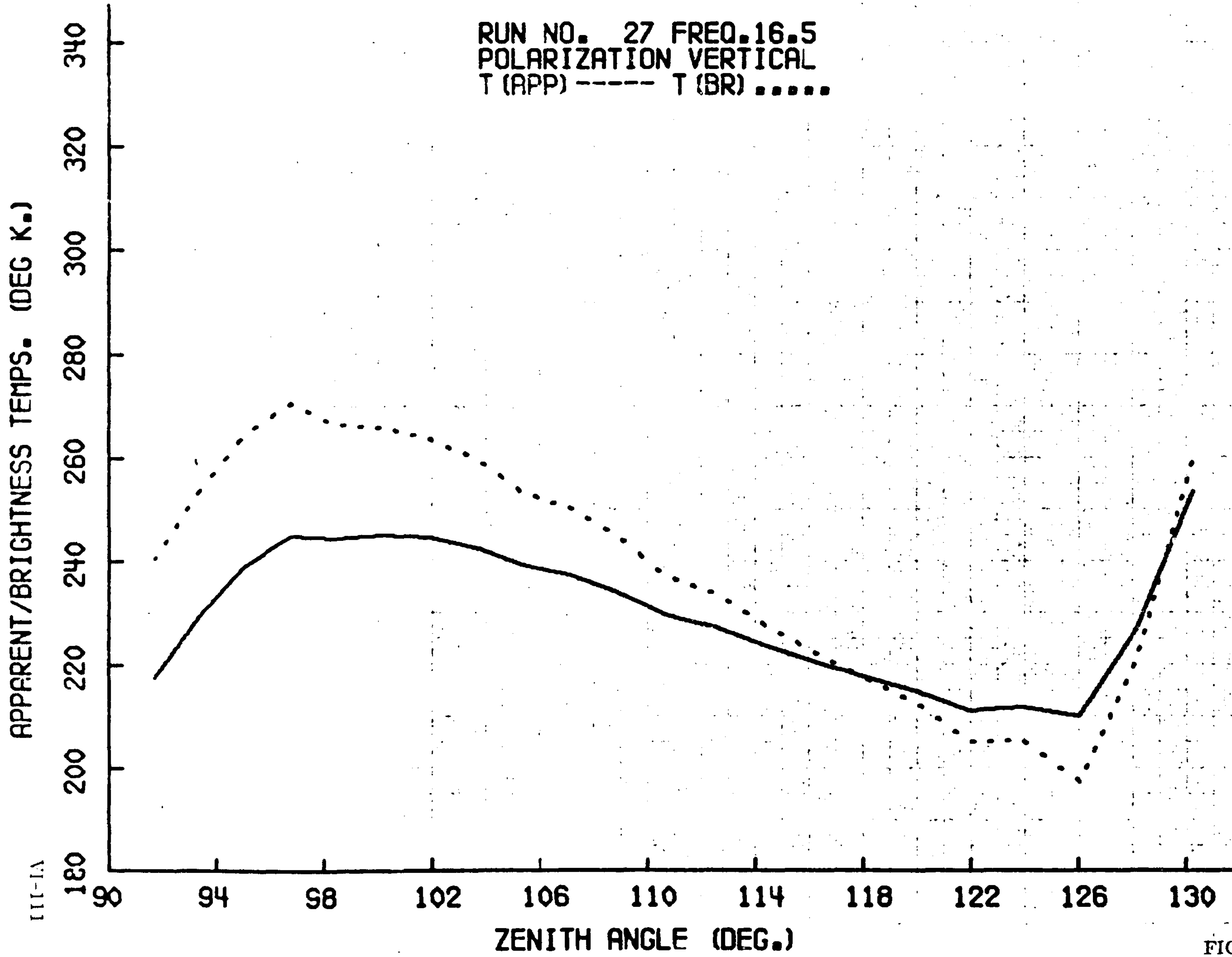

RUN NO. 27 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-63

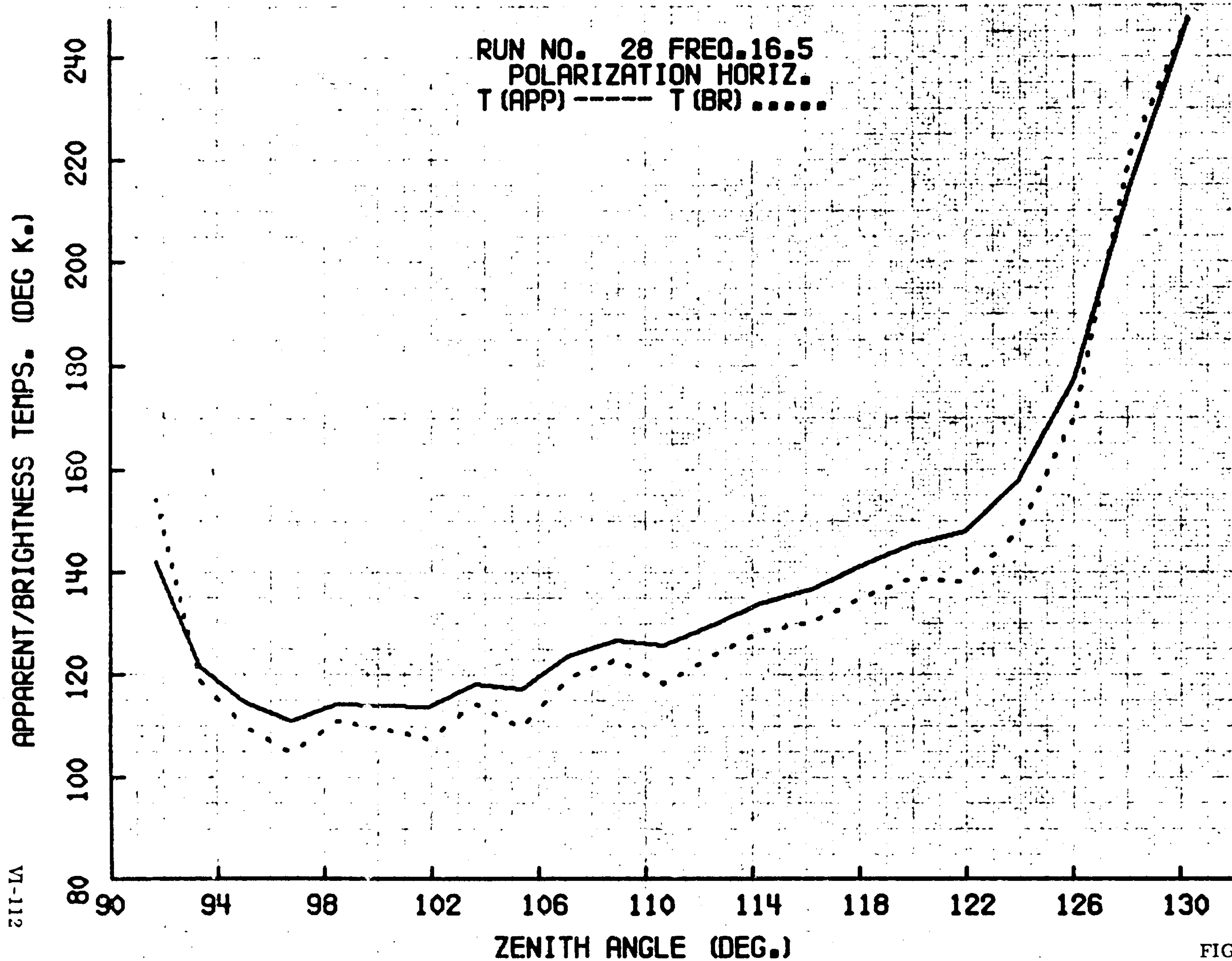

RUN NO. 28 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-64

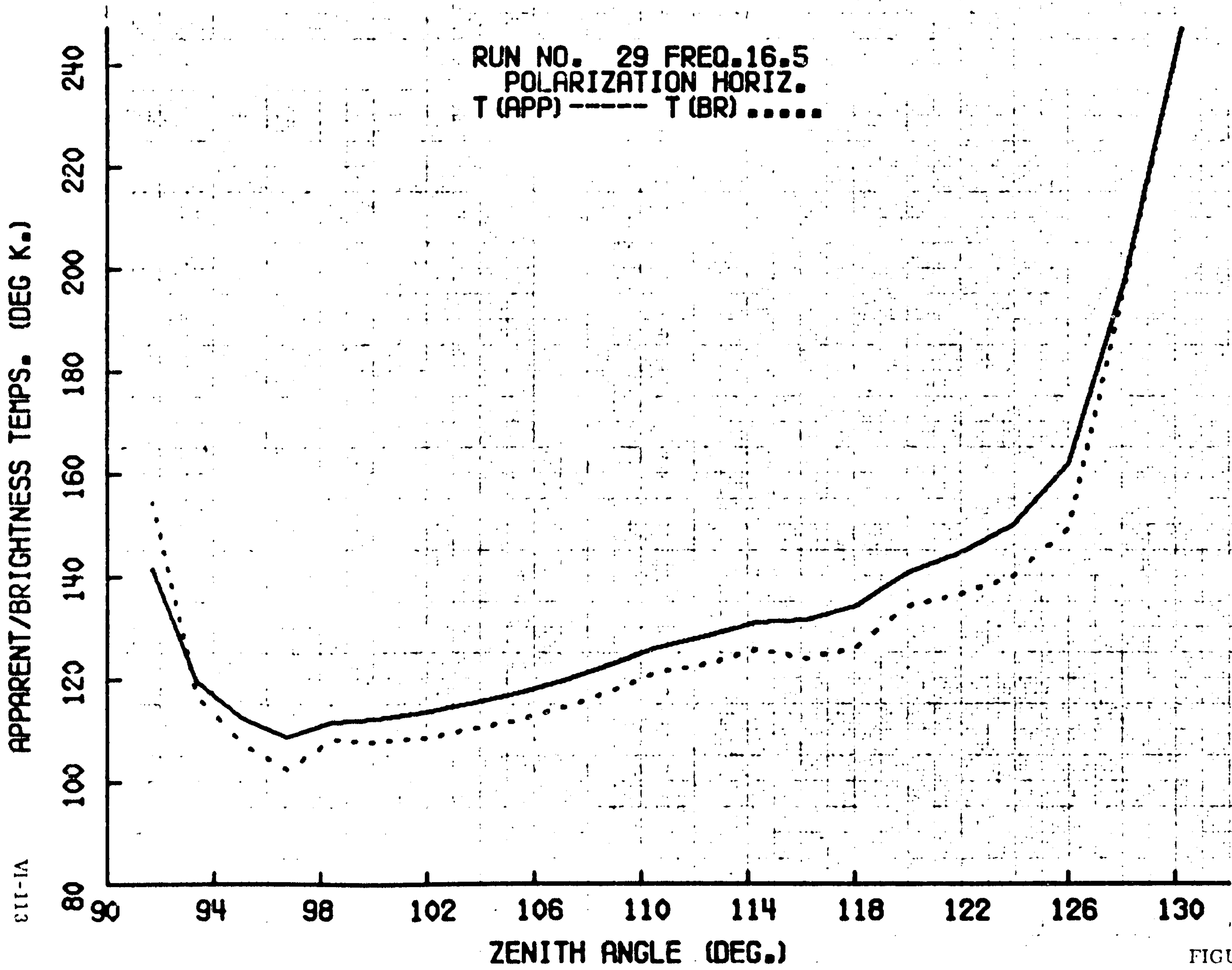

RUN NO. 29 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-65

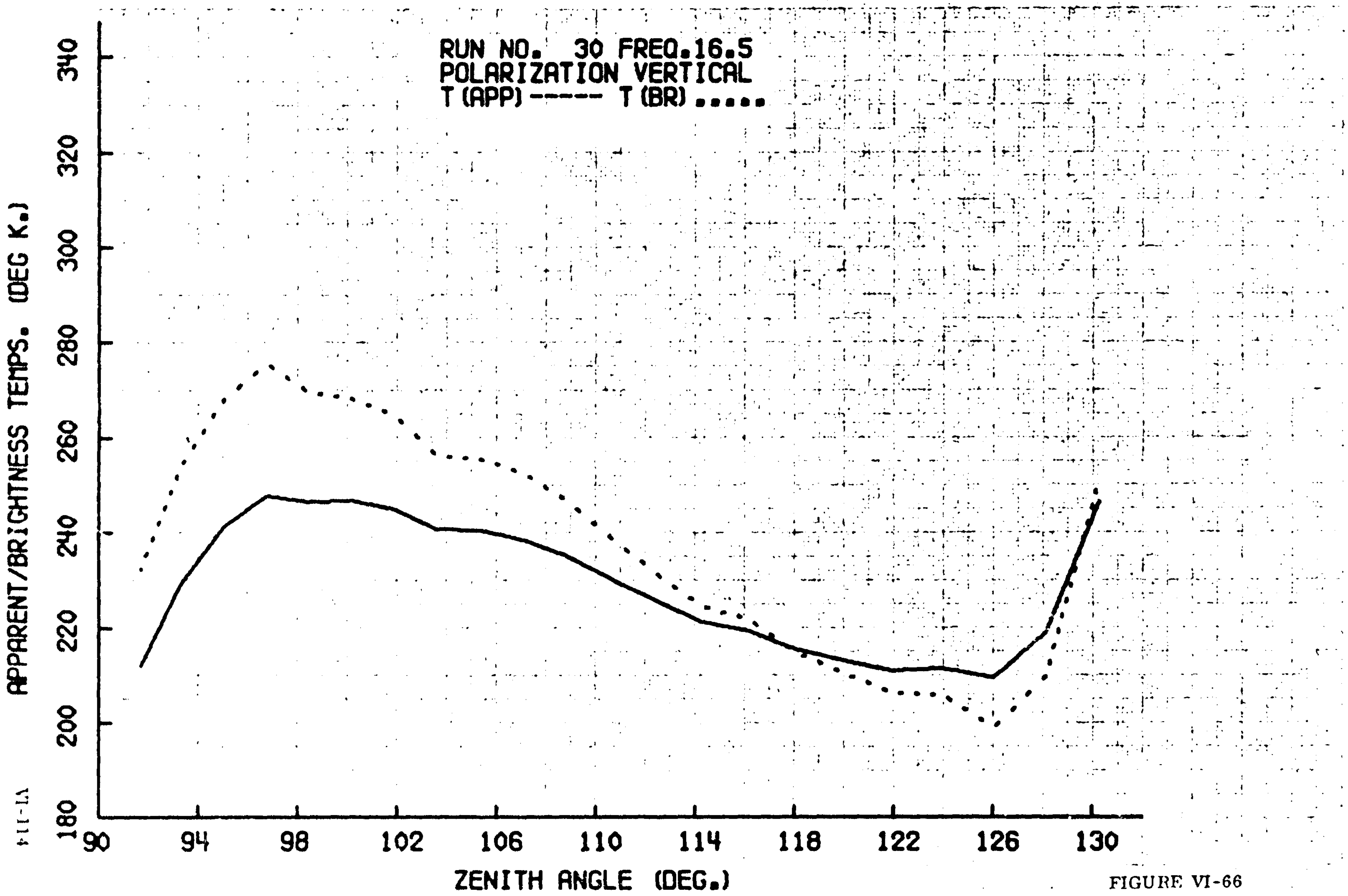

RUN NO. 30 FREQ.16.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-66

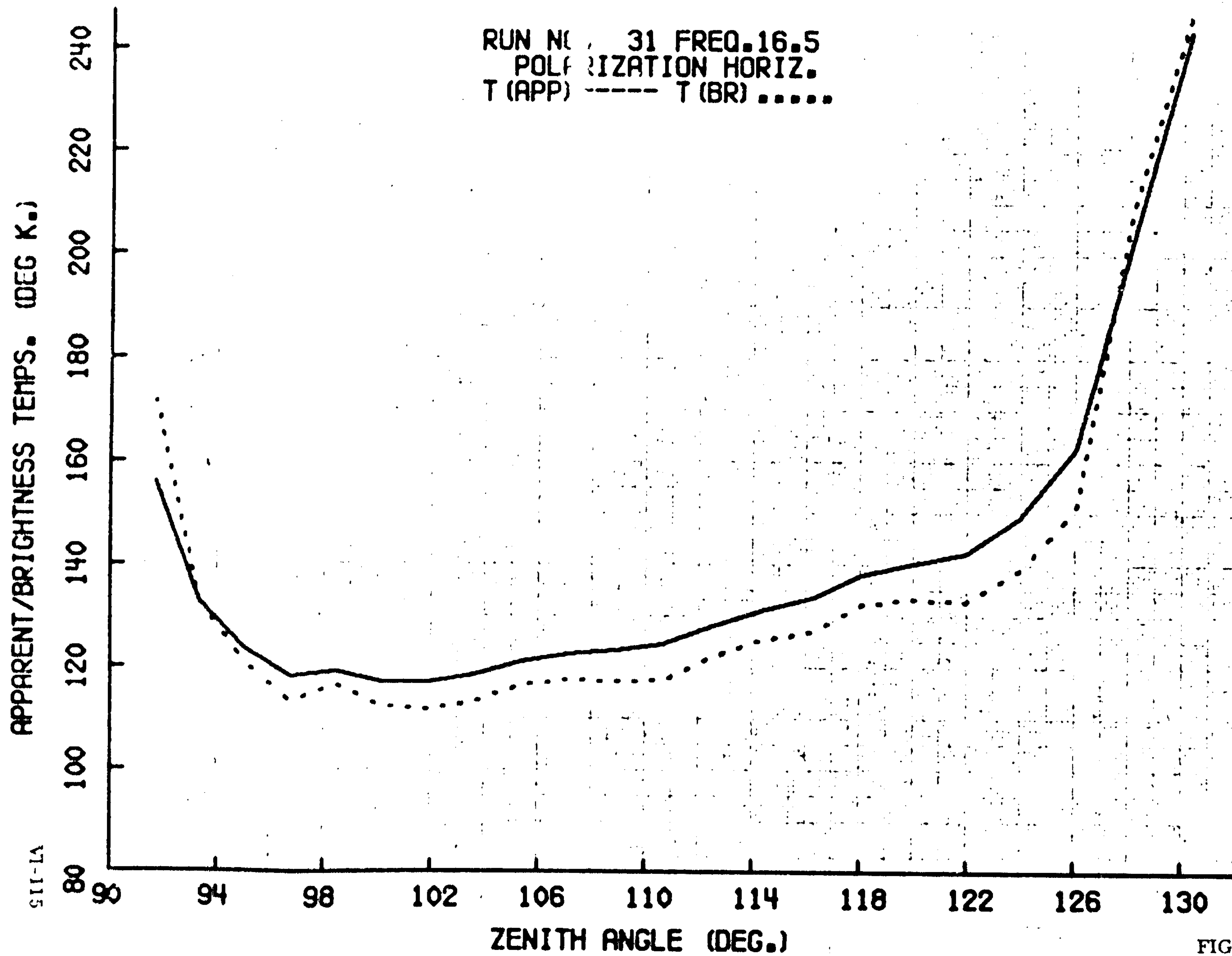

RUN N(, 31 FREQ.16.5
POL(?IZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-67

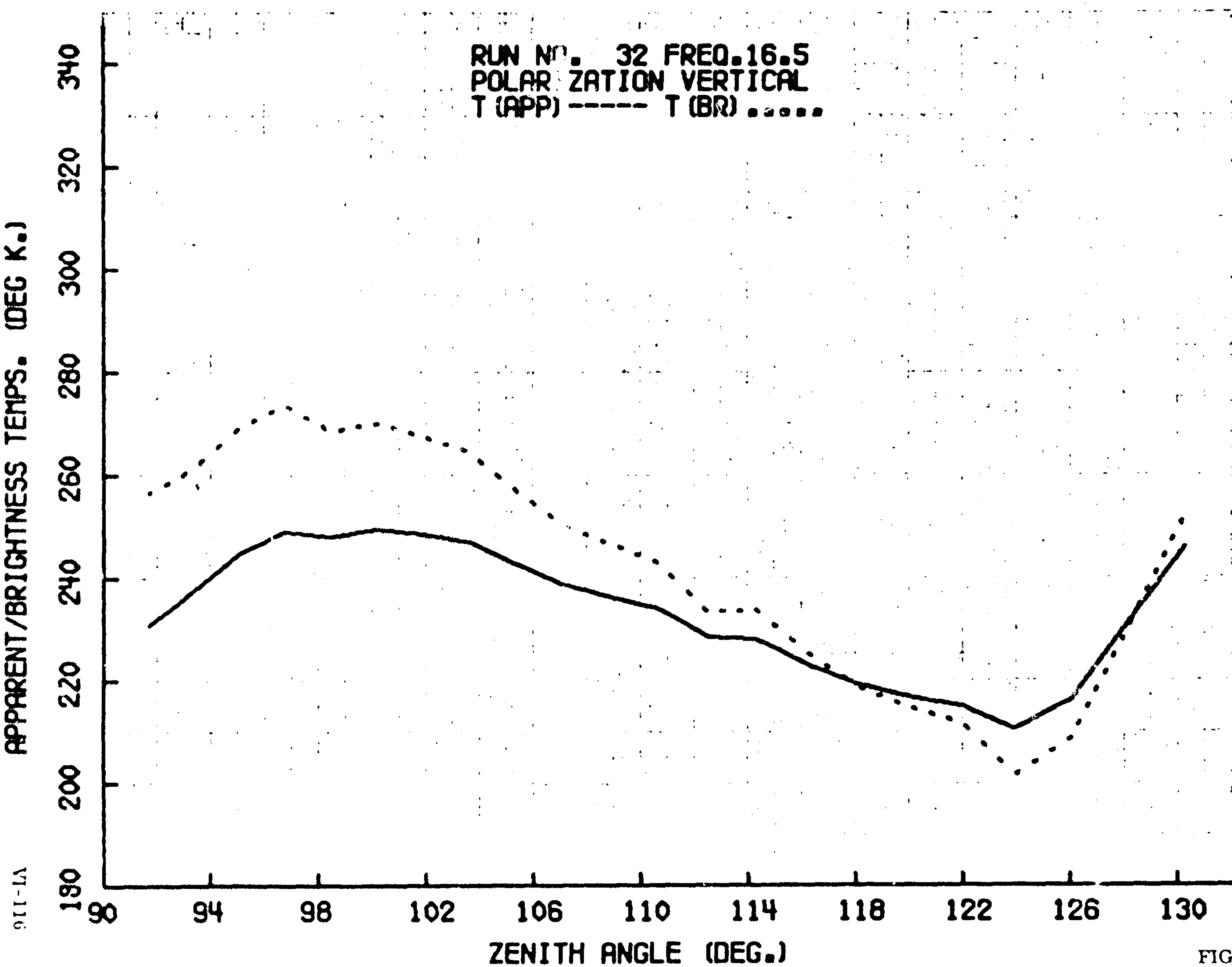

RUN NO. 32 FREQ.16.5
POLAR ZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-68

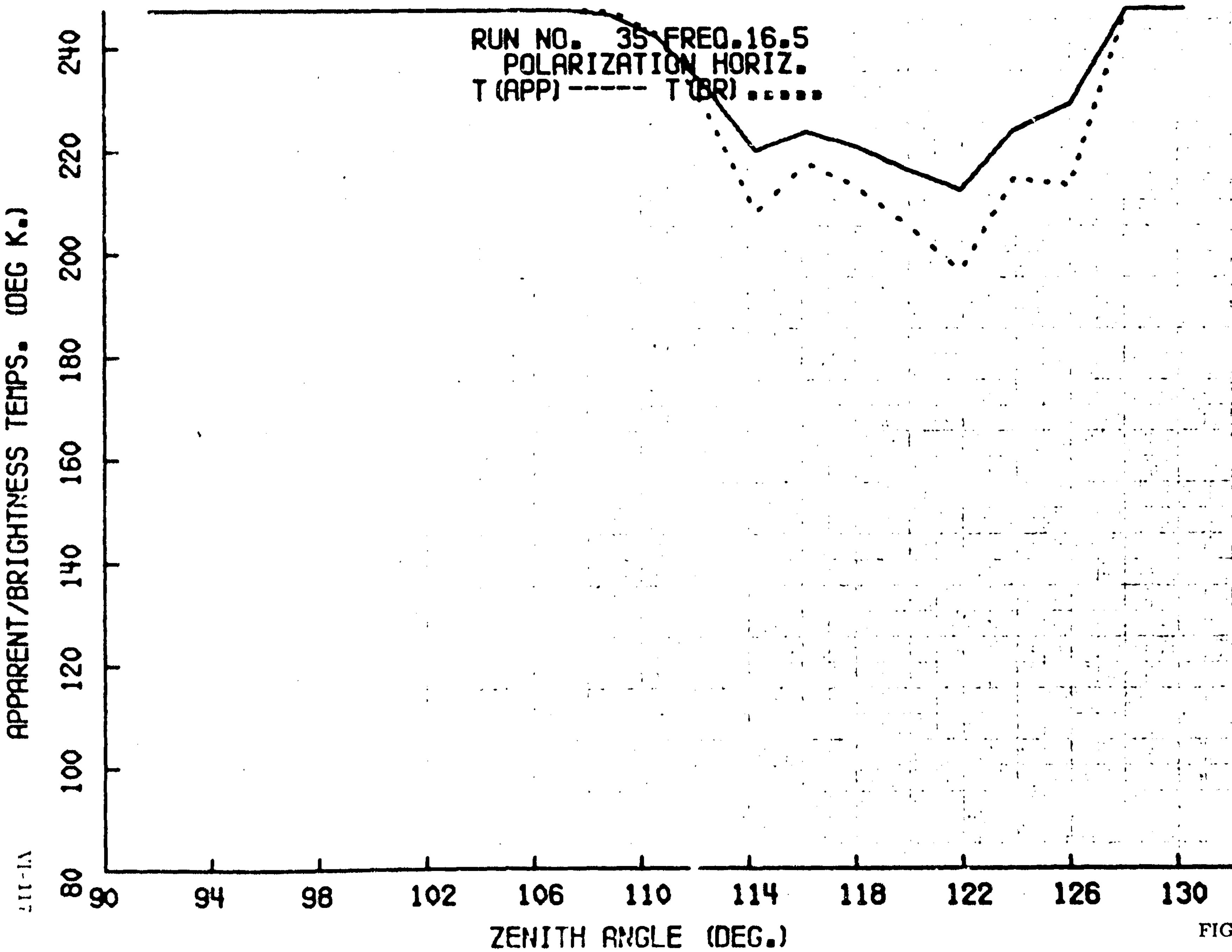
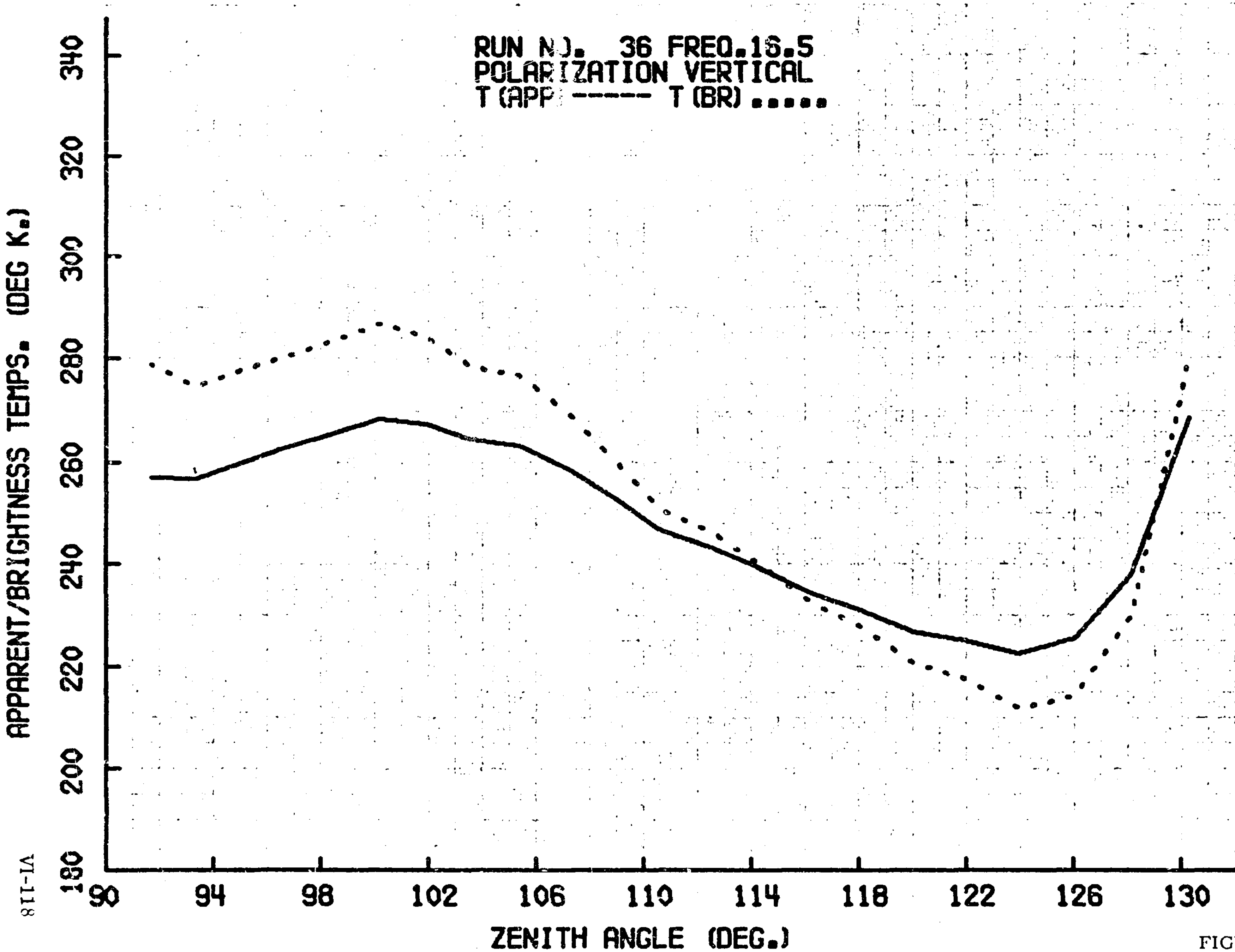

RUN NO. 35 FREQ.16.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
240
220
200
180
160
140
120
100
80
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-69



RUN NO. 36 FREQ.16.5
POLARIZATION VERTICAL
T(APP) ----- T(BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-70

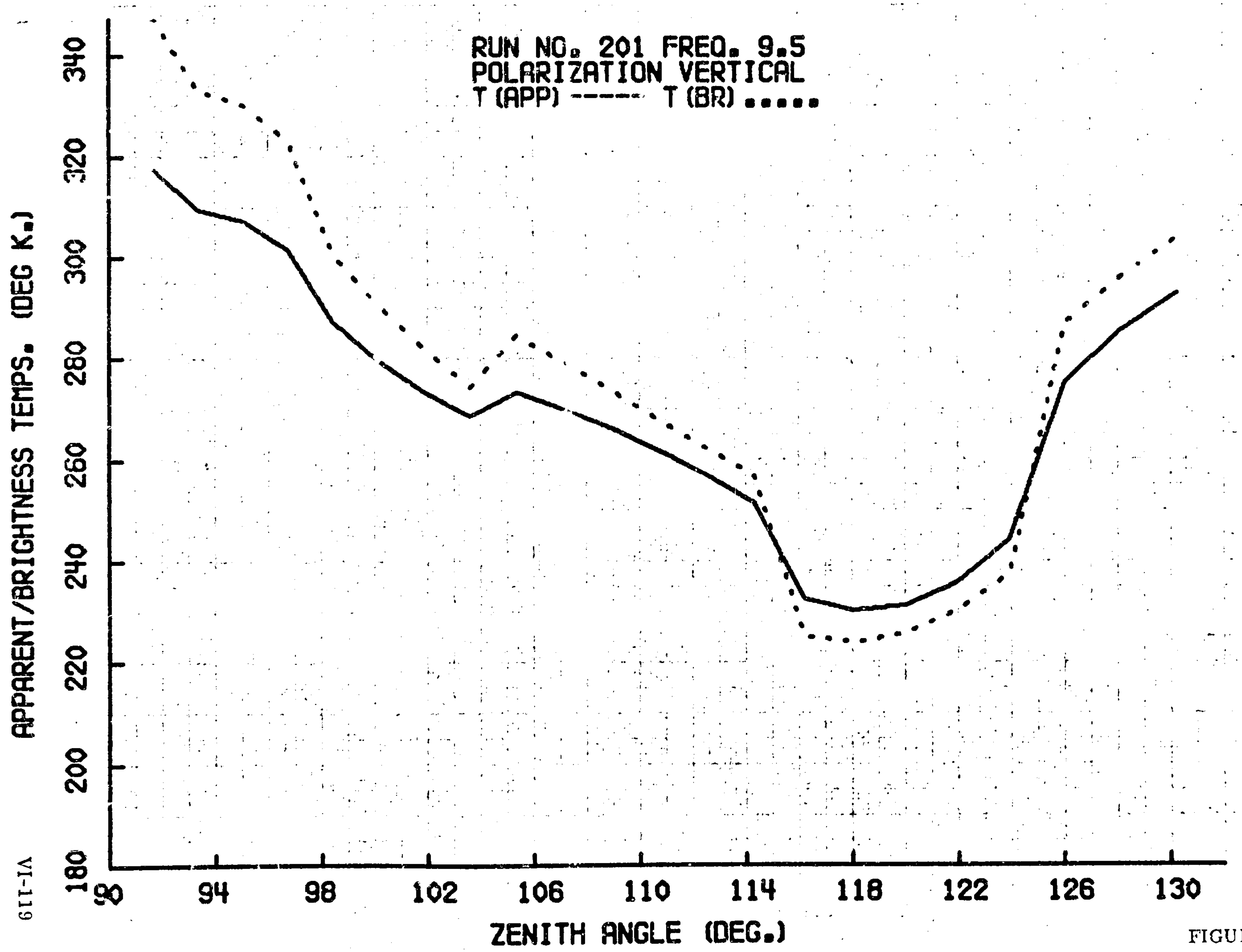

RUN NO. 201 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-71

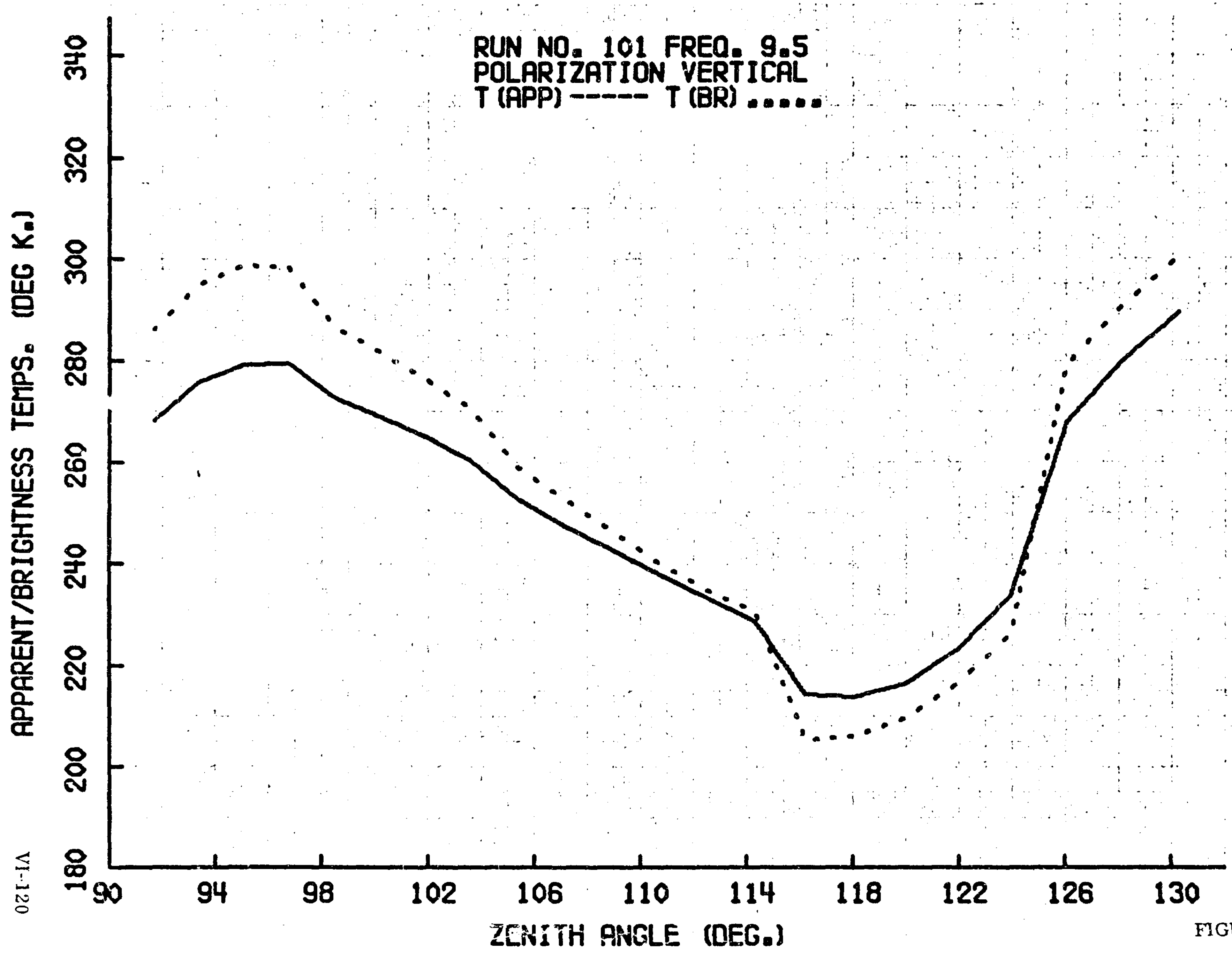
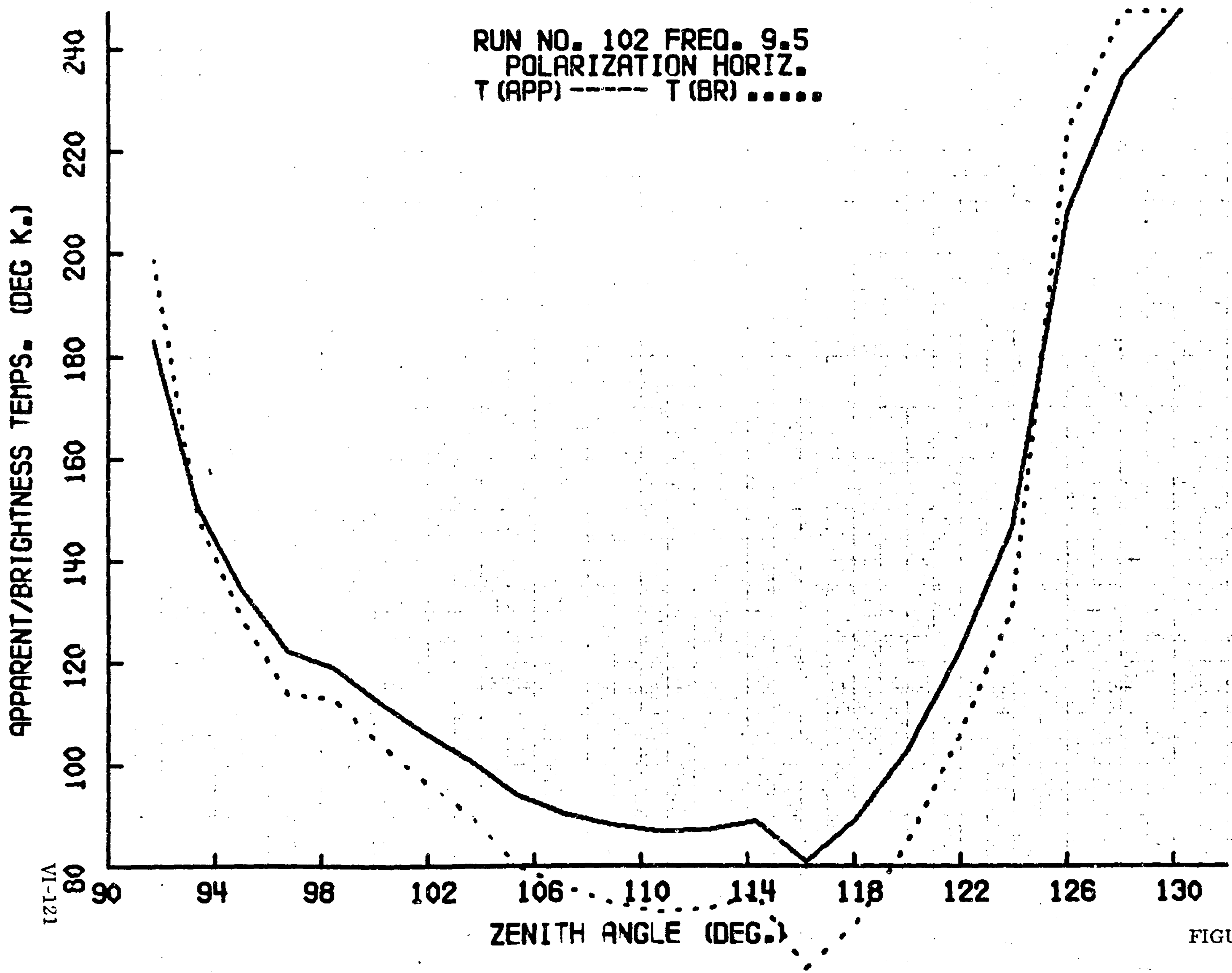

RUN NO. 101 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
340
320
300
280
260
240
220
200
180
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-72



RUN NO. 102 FREQ. 9.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
80
100
120
140
160
180
200
220
240
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-73

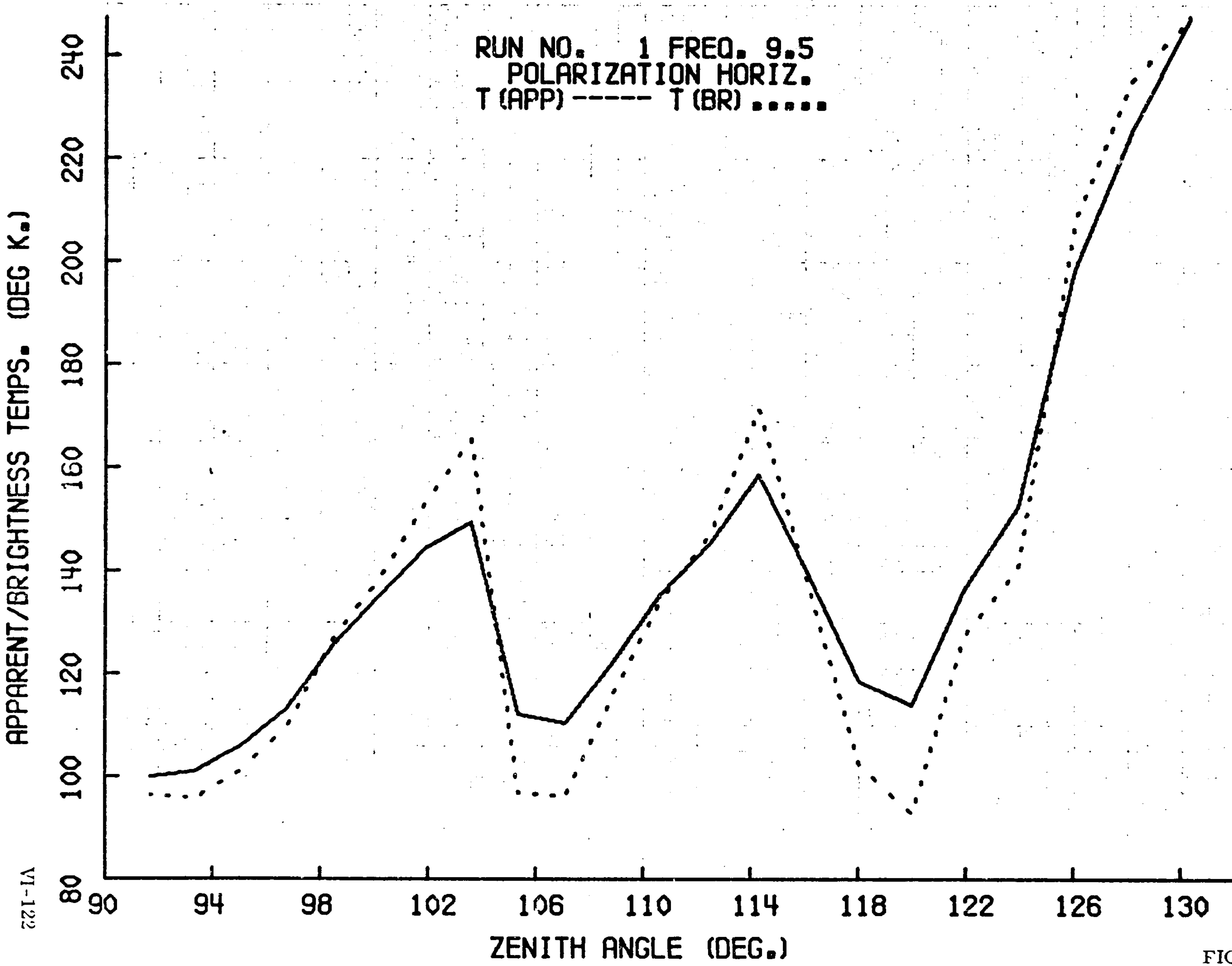

RUN NO. 1 FREQ. 9.5
POLARIZATION HORIZ.
T (APP) ------ T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
80
100
120
140
160
180
200
220
240
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-74

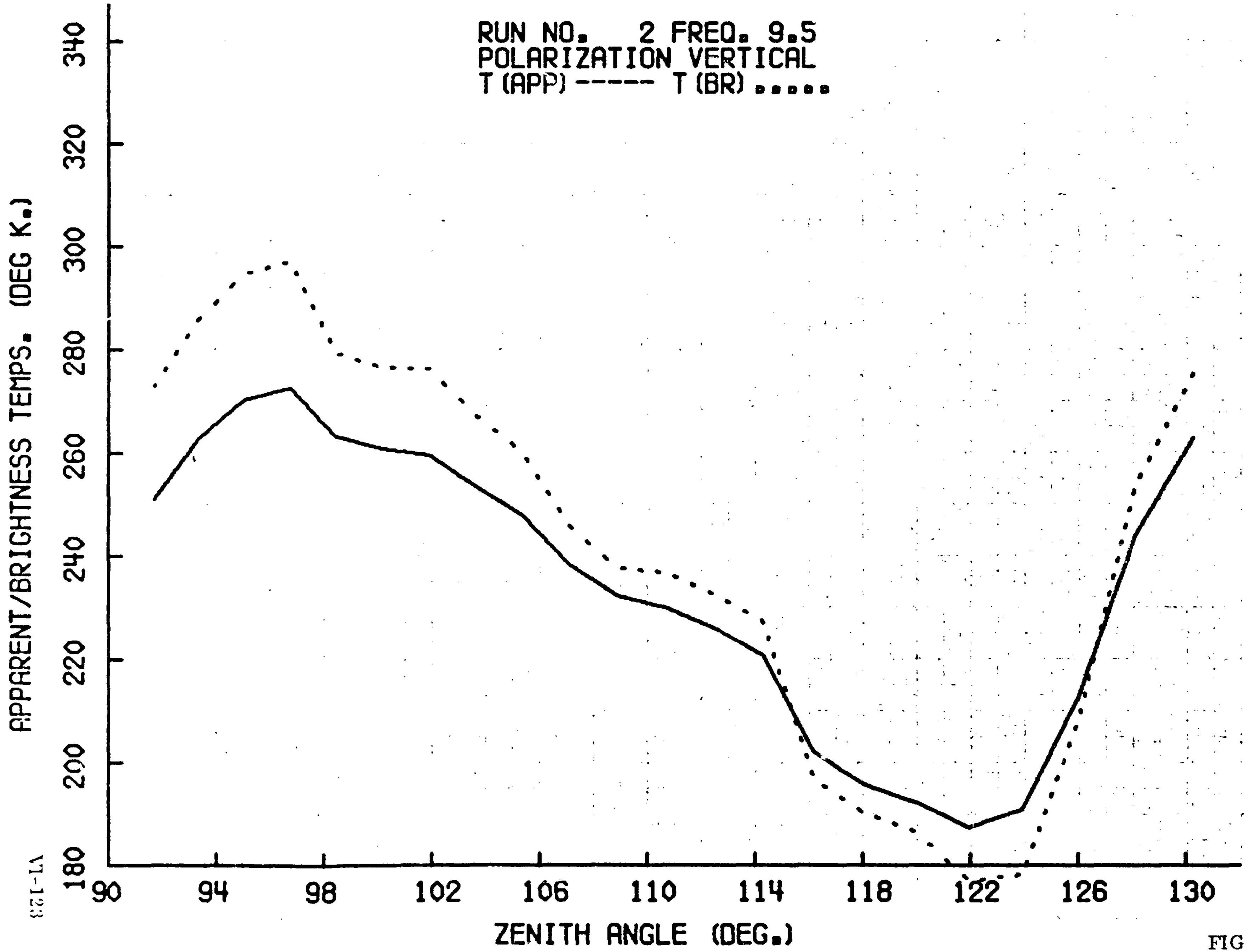

RUN NO. 2 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-75

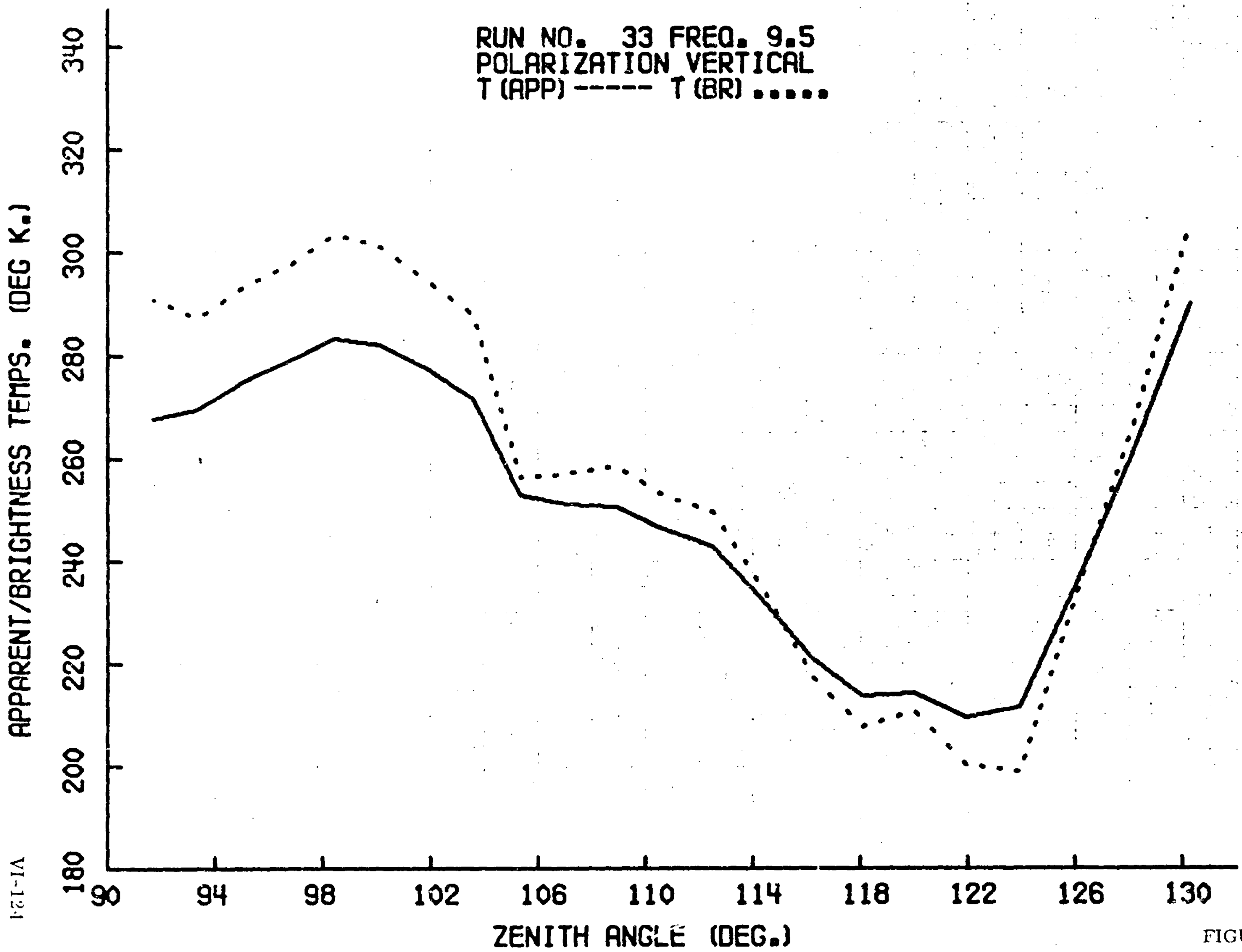
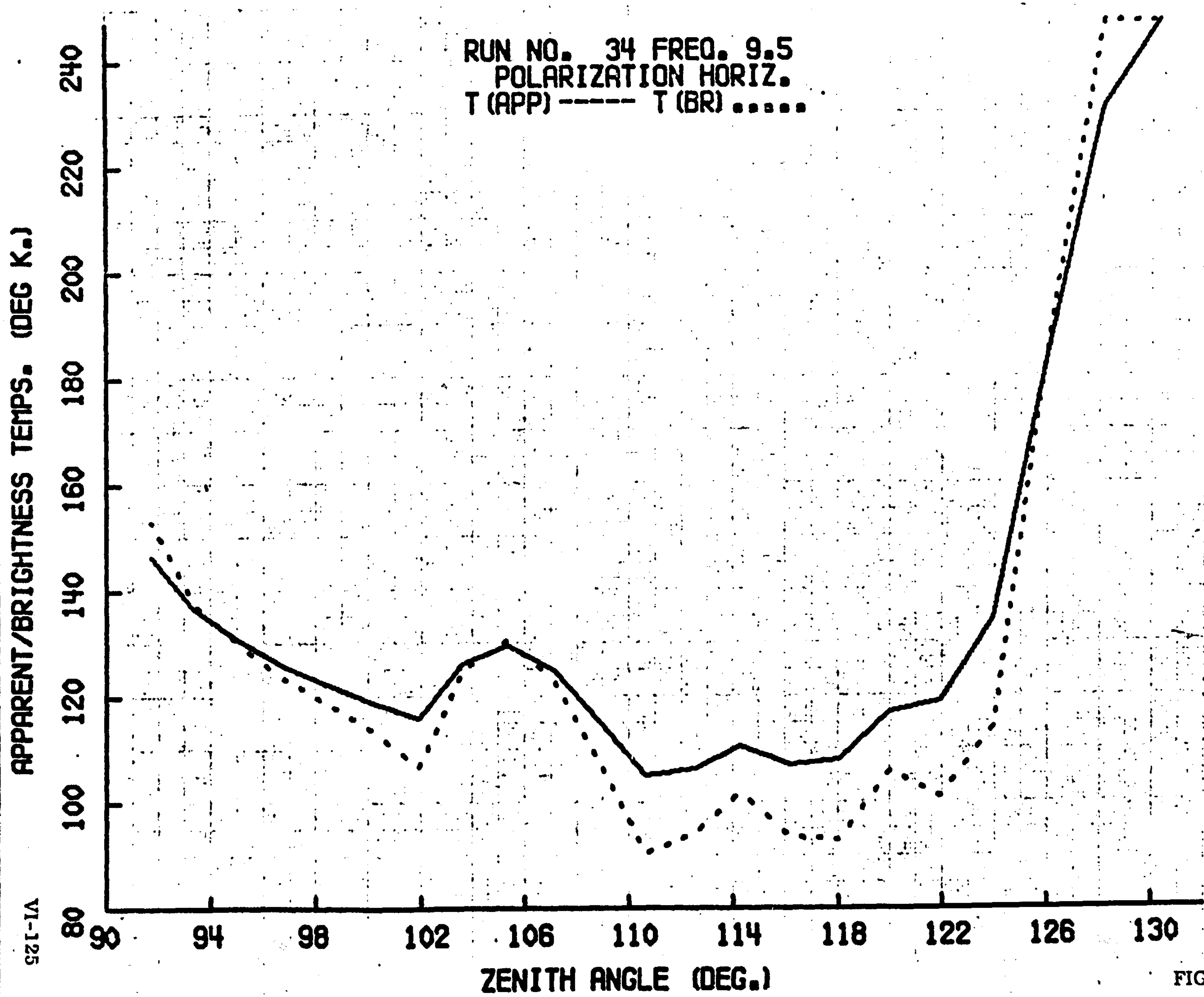

RUN NO. 33 FREQ. 9.5
POLARIZATION VERTICAL
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
340
320
300
280
260
240
220
200
180
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-76



RUN NO. 34 FREQ. 9.5
POLARIZATION HORIZ.
T (APP) ----- T (BR) .....
APPARENT/BRIGHTNESS TEMPS. (DEG K.)
80
100
120
140
160
180
200
220
240
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-77

BLANK

RUN NO. 2 07/25/69 9.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	273.04	304.51	0.614805	5	58.77	32.19
93.37	286.03	305.44	0.864126	6	58.68	32.11
95.06	294.82	300.94	0.959535	5	58.83	32.82
96.76	296.92	299.32	0.983500	5	58.68	33.23
98.46	279.20	285.30	0.967392	4	52.32	38.54
100.16	276.50	287.89	0.944712	4	54.19	37.53
101.88	276.14	295.87	0.915234	5	57.98	34.34
103.61	267.27	295.65	0.880140	5	58.18	34.07
105.35	260.00	294.16	0.843749	5	57.42	34.98
107.10	245.70	285.66	0.808357	4	53.33	38.02
108.98	237.62	285.99	0.775409	4	52.84	38.28
110.67	236.79	294.42	0.744058	5	57.51	34.88
112.48	232.44	297.60	0.715056	5	58.40	33.75
114.32	277.18	299.21	0.687613	5	58.67	33.76
116.18	196.79	232.63	0.790563	23	12.77	21.64
118.07	190.25	199.06	0.940381	32	7.48	5.53
120.00	186.39	192.49	0.959116	29	7.04	2.89
121.97	176.91	181.36	0.965210	16	6.49	-1.35
123.97	178.24	183.67	0.957458	22	6.59	-0.49
125.03	208.66	314.38	0.559515	5	56.16	32.77
128.14	253.71	378.87	0.589346	5	10.11	32.33
130.32	275.36	413.17	0.593341	6	6.06	27.41

1

TABLE VI-42. ROCK3 OUTPUT

RUN NO. 4 07/29/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	278.64	289.48	0.553721	4	37.65	38.03
93.37	274.91	282.78	0.781858	3	31.25	37.34
95.06	275.72	280.63	0.870631	2	29.16	36.77
96.76	275.75	280.00	0.937282	1	28.56	36.57
98.46	275.90	280.00	0.948673	1	28.56	36.57
100.16	274.05	280.00	0.939686	1	28.56	36.57
101.88	270.99	279.40	0.919755	2	27.98	36.37
103.61	266.11	275.57	0.877021	4	24.59	34.89
105.35	264.95	281.82	0.863663	3	30.31	37.11
107.10	261.50	284.78	0.830497	4	33.21	37.72
108.88	257.02	287.80	0.777093	5	36.11	38.01
110.67	252.58	291.69	0.766126	6	39.56	37.91
112.48	247.21	294.07	0.733991	6	41.41	37.63
114.32	241.86	296.52	0.705688	6	43.02	37.24
116.18	231.25	287.25	0.687435	5	35.60	37.98
118.07	228.55	294.79	0.656312	6	41.92	37.53
120.00	223.09	296.09	0.633115	6	42.76	37.31
121.97	216.69	295.07	0.612180	6	42.10	37.48
123.97	208.59	289.40	0.596714	6	37.59	38.03
126.03	207.17	291.37	0.575732	6	39.30	37.94
128.14	211.19	309.62	0.555961	6	45.45	35.36
130.32	245.90	351.61	0.609887	3	13.38	27.72

TABLE VI-43. ROCK3 OUTPUT

RUN NO. 9 08/01/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	272.23	306.56	0.578431	5	45.87	35.57
93.37	274.81	298.50	0.826282	4	44.13	35.85
95.06	281.53	293.46	0.924722	4	40.96	37.72
96.76	284.13	291.18	0.958798	4	39.14	37.95
98.46	276.65	284.13	0.953879	3	32.58	37.62
100.16	275.80	286.27	0.942826	4	34.66	37.91
101.88	275.07	291.21	0.919533	5	39.16	37.95
103.61	276.97	301.59	0.889878	6	45.27	35.29
105.35	267.34	297.28	0.856559	6	44.44	36.72
107.10	242.27	303.31	0.824262	6	45.66	36.01
108.98	260.35	311.11	0.775233	6	45.02	35.32
110.67	258.66	318.77	0.770196	6	40.84	35.61
112.48	250.87	319.74	0.742454	6	40.10	35.66
114.32	244.04	320.75	0.716403	5	39.28	35.72
116.18	241.26	325.54	0.676820	5	34.85	35.78
118.07	232.35	324.56	0.671522	5	35.79	35.81
120.00	228.12	327.45	0.652901	5	33.06	35.69
121.97	227.53	332.53	0.640405	4	27.86	34.92
123.97	220.47	332.23	0.619612	4	28.25	35.00
126.03	211.60	328.53	0.594298	4	31.89	35.58
128.14	219.19	340.69	0.600381	4	20.45	32.37
130.32	267.96	381.12	0.671999	3	6.57	18.91

TABLE VI-44. ROCK3 OUTPUT

RUN NO. 8   08/01/69   16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.58	259.33	311.33	0.575211	6	44.95	39.32
93.37	274.68	289.56	0.806557	4	37.81	36.02
95.05	275.15	284.50	0.903266	3	33.03	37.69
96.76	275.20	292.32	0.942496	3	30.80	37.23
98.46	271.67	280.00	0.948673	1	28.56	35.27
100.16	274.01	284.56	0.941985	4	33.00	37.69
101.88	279.86	296.52	0.920407	5	43.02	37.24
103.61	275.59	301.57	0.889874	6	45.26	36.30
105.35	272.54	304.53	0.857471	6	45.82	35.82
107.10	254.45	305.55	0.824842	6	45.98	35.59
108.88	254.18	304.05	0.792448	6	45.77	35.89
110.67	245.39	304.08	0.76105	6	45.77	35.89
112.48	245.42	314.40	0.73795	6	43.62	35.37
114.32	238.35	316.14	0.71203	6	42.63	35.45
116.19	233.16	317.93	0.687946	5	41.45	35.56
119.07	229.50	322.58	0.668860	5	37.71	35.79
120.00	219.27	319.73	0.642820	5	40.11	35.66
121.97	217.16	325.19	0.628224	5	35.28	35.80
123.97	215.73	329.85	0.615372	4	30.63	35.42
126.03	205.25	326.42	0.590327	5	34.09	35.75
128.14	222.46	345.58	0.611976	4	16.84	30.33
130.32	265.02	381.48	0.572549	3	6.54	18.85

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TABLE VI-45. ROCK3 OUTPUT

RUN NO. 9 08/01/69 14.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	279.14	281.56	0.924769	2	30.06	37.04
93.37	275.90	278.57	0.764144	2	27.30	36.11
95.06	275.29	277.58	0.879956	3	26.29	35.69
96.76	274.38	275.88	0.929778	3	25.66	35.41
98.46	273.93	276.85	0.944353	3	25.53	35.39
100.16	272.14	275.84	0.937526	4	24.74	34.96
101.88	269.66	275.72	0.920412	4	24.63	34.91
103.61	267.60	277.76	0.895440	3	26.46	35.77
105.35	260.33	280.30	0.865451	1	28.36	35.57
107.10	259.60	290.87	0.825849	5	38.07	37.97
108.88	255.61	299.11	0.791941	6	44.37	36.75
110.67	248.18	302.95	0.761664	6	45.59	36.06
112.48	247.61	314.51	0.738106	6	43.51	35.38
114.32	239.89	317.20	0.712950	6	41.95	35.51
116.18	234.75	315.84	0.686053	6	42.81	35.44
118.07	227.94	317.22	0.663079	5	41.94	35.51
120.00	227.07	325.16	0.649543	5	35.32	35.80
121.97	223.32	327.10	0.634203	5	31.41	35.52
123.97	221.90	334.16	0.623293	4	26.35	34.59
126.03	216.08	334.73	0.605458	4	25.79	34.40
128.14	229.36	349.56	0.62[illegible]755	4	14.46	28.60
130.32	267.68	382.75	0.674425	3	6.44	18.64

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TABLE VI-46. ROCK3 OUTPUT

RUN NO. 11   08/05/69 · 16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	315.43	335.37	0.500396	8	25.18	34.22
93.37	320.81	333.45	0.761107	9	27.05	34.73
95.06	324.79	332.42	0.886198	9	28.06	34.96
96.76	326.42	331.00	0.940717	8	29.49	35.24
98.46	322.41	325.84	0.958540	8	33.68	35.73
100.16	321.59	328.33	0.946011	7	32.19	35.61
101.88	320.97	332.47	0.923994	7	28.02	34.95
103.61	312.88	329.04	0.899452	7	30.66	35.43
105.35	314.36	334.50	0.872891	6	25.92	34.43
107.10	302.54	328.03	0.839244	6	31.69	35.56
108.88	296.41	328.83	0.809615	6	31.68	35.55
110.67	297.54	335.94	0.770623	6	24.64	34.05
112.48	289.88	334.15	0.760940	6	26.36	34.55
114.32	283.03	332.38	0.732061	5	28.11	34.97
115.18	282.54	335.93	0.713560	5	24.65	34.05
118.07	276.93	335.36	0.689051	5	25.20	34.22
120.00	269.07	332.12	0.660679	5	28.37	35.03
121.97	262.90	330.18	0.636027	5	30.32	35.38
123.97	264.19	335.84	0.626671	5	24.74	34.08
124.03	259.79	334.50	0.605199	5	25.92	34.43
128.14	263.68	341.53	0.602319	4	19.78	32.04
130.32	293.24	371.57	0.655465	4	7.65	20.89

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TABLE VI-47. ROCK3 OUTPUT

RUN NO. 13   08/06/69   16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG,K)	WATER TEMPERATURE (DEG,K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.58	247.73	290.77	0.557554	3	38.79	37.98
93.37	265.48	294.21	0.818532	3	41.51	37.61
95.06	277.08	291.16	0.920150	3	39.12	37.95
96.76	282.45	290.68	0.958054	4	38.72	37.98
98.46	274.04	282.97	0.952465	3	31.43	37.38
100.16	272.18	283.57	0.941488	3	32.02	37.51
101.88	268.59	285.56	0.919244	4	34.07	37.84
103.61	264.91	287.76	0.889581	5	37.91	38.02
105.35	261.08	294.08	0.856828	6	41.42	37.63
107.10	255.46	297.60	0.823837	6	43.63	37.04
108.88	250.21	301.84	0.792069	6	45.34	36.25
110.67	244.21	305.08	0.762159	6	45.86	35.75
112.48	234.61	303.56	0.732726	6	45.70	35.97
114.32	238.50	317.85	0.713535	6	41.51	35.55
116.18	232.30	318.76	0.698756	5	40.85	35.61
118.07	230.20	324.62	0.671464	5	35.83	35.81
120.00	228.16	329.64	0.656386	5	30.87	35.45
121.97	215.76	324.39	0.627109	5	36.04	35.81
123.97	222.97	336.67	0.628390	4	23.76	33.82
126.03	208.59	328.39	0.593903	4	32.13	35.60
128.14	222.99	345.36	0.611420	4	16.99	30.43
130.32	277.20	390.94	0.684948	4	5.93	17.52

1

TABLE VI-48. ROCK3 OUTPUT

RUN NO. 15 08/07/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG,K)	WATER TEMPERATURE (DEG,K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	242.20	287.69	0.547956	2	36.01	36.01
93.37	256.55	289.44	0.805910	3	37.62	38.03
95.06	260.97	286.51	0.909010	3	34.98	37.94
96.76	276.15	286.26	0.950510	3	34.65	37.91
98.46	271.71	281.34	0.950418	2	29.84	35.98
100.16	273.28	285.74	0.942566	4	34.15	37.85
101.88	274.68	293.35	0.919824	5	40.88	37.73
103.61	265.91	292.48	0.889253	5	40.20	37.83
105.35	252.20	297.28	0.855504	6	43.46	37.10
107.10	254.30	298.39	0.823793	6	44.03	36.89
108.88	247.18	300.49	0.791948	6	44.91	36.50
110.67	242.06	304.96	0.762124	6	45.85	35.77
112.48	236.50	308.56	0.734431	6	45.56	35.41
114.32	229.44	309.36	0.707735	6	45.36	35.35
116.18	222.24	310.14	0.682017	6	45.31	35.34
118.07	217.46	313.35	0.659838	6	44.14	35.34
120.00	210.97	314.00	0.637493	6	43.83	35.36
121.97	209.05	318.38	0.620582	5	40.68	35.62
123.97	203.94	320.47	0.602020	5	39.51	35.70
126.03	196.44	318.23	0.580559	5	41.24	35.57
128.14	219.39	344.57	0.609760	3	17.46	30.73
130.32	256.67	375.15	0.662129	4	7.17	20.06

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TABLE VI-49. ROCK3 OUTPUT

RUN NO. 19 08/07/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.48	240.10	286.27	0.543000	2	34.65	37.91
93.37	255.16	287.82	0.800707	2	36.14	38.01
95.06	267.54	285.60	0.906177	3	34.00	37.83
95.76	274.54	285.13	0.948318	3	33.55	37.77
98.45	272.09	282.02	0.951290	3	30.51	37.16
100.16	271.39	283.53	0.941472	3	31.99	37.50
101.88	267.33	285.40	0.919248	4	33.82	37.81
103.61	265.67	292.08	0.889301	5	39.88	37.87
105.35	262.91	294.28	0.856509	6	43.98	35.91
107.10	253.49	297.73	0.823827	6	43.70	37.02
108.88	246.06	299.63	0.791930	6	44.59	36.66
110.67	241.61	305.18	0.762183	6	45.87	35.74
112.48	234.55	307.19	0.733830	6	45.83	35.52
114.32	227.80	309.17	0.707316	6	45.55	35.38
116.18	224.47	314.01	0.684590	6	43.82	35.36
118.07	221.72	318.89	0.664719	5	40.73	35.61
120.00	211.34	315.32	0.638573	5	43.12	35.41
121.97	208.59	320.19	0.621894	5	39.74	35.69
123.97	203.97	322.41	0.604339	5	37.86	35.78
126.03	200.37	325.03	0.588800	5	35.43	35.80
128.14	205.65	335.32	0.588687	4	25.23	34.23
130.32	256.28	376.21	0.663999	4	7.05	19.84

TABLE VI-50. ROCK3 OUTPUT

RUN NO. 19   08/07/69   16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	242.37	287.00	0.545586	2	35.35	37.97
93.37	256.49	288.86	0.804106	3	37.10	38.03
95.05	268.13	285.78	0.906703	3	34.18	37.86
96.76	274.40	284.92	0.947902	3	33.34	37.74
98.46	269.19	280.00	0.948673	1	28.56	36.57
100.16	263.29	281.81	0.940605	3	30.30	37.10
101.88	268.41	285.26	0.919241	4	34.66	37.91
103.61	261.21	286.83	0.890508	5	35.19	37.96
105.35	256.85	292.21	0.857992	5	38.30	38.01
107.10	251.71	295.26	0.824192	6	42.23	37.45
108.88	245.40	298.59	0.791967	6	44.13	35.85
110.67	238.45	301.01	0.761441	6	45.09	35.40
112.48	232.65	304.70	0.732995	6	45.84	35.80
114.32	227.52	308.81	0.707133	6	45.62	35.40
116.18	220.24	308.82	0.681311	6	45.61	35.40
118.07	214.24	310.84	0.658137	6	45.11	35.33
120.00	214.12	318.63	0.641670	5	40.94	35.60
121.97	208.53	320.21	0.621914	5	39.72	35.69
123.97	201.83	320.15	0.601663	5	39.77	35.69
126.03	198.10	322.71	0.585674	5	37.59	35.79
128.14	205.20	335.06	0.588153	4	25.48	34.31
130.32	249.66	371.26	0.654865	4	7.70	20.97

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TABLE VI-51. ROCK3 OUTPUT

RUN NO. 21   08/08/69   16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	239.59	284.83	0.537701	2	33.25	37.73
93.37	252.91	285.30	0.723957	2	34.30	37.87
95.06	263.27	282.26	0.896009	2	30.74	37.22
96.76	268.06	280.56	0.938521	2	29.07	36.74
98.45	258.31	271.42	0.936336	4	21.13	32.80
100.16	258.51	272.73	0.935859	4	22.14	33.47
101.88	259.94	278.78	0.917819	2	27.59	36.22
103.61	252.08	276.59	0.896310	4	25.40	35.29
105.35	246.36	276.84	0.868974	4	25.63	35.39
107.10	241.78	280.00	0.836085	1	28.56	36.57
108.88	238.16	286.06	0.797773	5	35.72	37.96
110.67	234.46	294.59	0.762542	6	41.78	37.56
112.48	227.37	296.78	0.733054	6	42.88	37.28
114.32	222.91	301.53	0.705044	6	45.28	36.29
116.18	219.57	307.02	0.680495	6	45.85	35.53
118.07	212.97	308.16	0.656691	6	45.72	35.44
120.00	210.39	313.93	0.637435	6	43.86	35.35
121.97	201.89	311.77	0.614398	6	44.79	35.32
123.97	206.32	324.32	0.606438	5	36.39	35.81
126.03	207.54	330.82	0.578042	4	29.68	35.27
128.14	223.79	347.95	0.617789	4	15.35	29.30
130.32	271.86	388.46	0.682049	4	6.06	17.82

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TABLE VI-52. ROCK3 OUTPUT

RUN NO. 23   08/08/69   14.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	246.99	290.55	0.556922	3	38.60	37.99
93.37	252.08	285.99	0.794295	2	34.39	37.88
95.06	260.84	281.35	0.873048	2	29.86	35.98
96.76	264.99	279.22	0.935454	2	27.81	35.31
98.46	257.97	271.98	0.936572	4	21.24	32.88
100.16	258.10	272.89	0.935944	4	22.27	33.56
101.88	258.01	277.49	0.920069	3	26.21	35.56
103.61	262.04	289.11	0.869830	5	37.33	38.03
105.35	255.88	289.97	0.858088	5	38.10	39.02
107.10	245.78	287.69	0.827924	5	36.01	39.01
108.88	241.47	294.34	0.792898	6	41.61	37.59
110.67	240.90	305.16	0.762181	6	45.87	35.74
112.48	230.87	303.38	0.732692	6	45.67	35.99
114.32	230.55	313.27	0.709817	5	44.18	35.34
116.18	223.62	314.37	0.684867	6	43.54	35.37
118.07	220.61	318.99	0.664817	5	40.68	35.62
120.00	216.08	322.05	0.645495	5	38.17	35.77
121.97	206.50	319.16	0.620755	5	40.55	35.63
123.97	204.83	324.44	0.607019	5	35.99	35.81
126.03	202.48	327.00	0.591714	4	33.51	35.72
128.14	212.55	340.48	0.599898	3	20.63	32.45
130.32	238.25	378.68	0.668161	3	6.79	19.39

TABLE VI-53. ROCK3 OUTPUT

RUN NO. 25 08/12/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG,K)	WATER TEMPERATURE (DEG,K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	274.93	277.52	0.507425	2	25.23	35.67
93.37	243.34	280.79	0.773521	2	29.32	35.82
95.06	256.92	279.05	0.885195	2	27.65	35.25
96.76	245.39	279.28	0.935610	2	27.88	35.33
98.46	261.97	275.02	0.941726	3	24.03	34.59
100.16	245.08	277.29	0.939374	2	27.58	36.33
101.88	240.36	286.70	0.919247	4	35.26	37.96
103.61	262.61	289.52	0.889735	5	37.69	38.03
105.35	252.76	286.35	0.860059	5	34.73	37.91
107.10	249.84	294.33	0.824432	6	41.59	37.60
108.88	243.63	297.86	0.772037	6	43.77	36.99
110.67	233.11	295.16	0.762320	6	42.16	37.47
112.48	227.74	299.52	0.732441	6	44.54	35.68
114.32	277.51	309.99	0.707753	6	45.35	35.35
116.18	217.82	305.77	0.680042	6	45.48	35.57
118.07	212.73	308.75	0.656977	6	45.63	35.40
120.00	205.08	307.79	0.633668	6	45.77	35.47
121.97	203.83	314.16	0.616140	5	43.74	35.36
123.97	197.37	314.24	0.595000	5	43.70	35.37
126.03	194.95	320.10	0.582555	5	39.81	35.68
128.14	210.62	340.01	0.598830	4	21.02	32.63
130.32	254.80	375.80	0.663274	4	7.10	19.93

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TABLE VI-54. ROCK3 OUTPUT

RUN NO. 27 08/12/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	240.50	285.75	0.541150	2	34.16	37.85
93.37	253.38	286.34	0.795563	2	34.73	37.91
95.06	264.59	283.08	0.898627	2	31.55	37.41
96.76	270.60	281.75	0.941681	2	30.44	37.14
98.45	266.19	277.79	0.945577	3	25.47	35.78
100.16	265.77	280.00	0.939684	1	28.56	35.57
101.88	263.61	281.04	0.919542	2	29.56	35.89
103.61	259.72	284.98	0.871225	4	33.41	37.75
105.35	253.27	285.98	0.860305	5	34.38	37.88
107.10	250.26	293.51	0.824657	5	41.07	37.70
108.88	244.74	297.92	0.792031	6	43.80	35.98
110.67	236.96	299.15	0.761452	6	44.38	36.75
112.48	233.87	305.32	0.733533	6	45.88	35.50
114.32	227.68	308.97	0.707216	6	45.57	35.39
116.18	222.33	311.05	0.682554	6	45.04	35.32
118.07	217.22	314.02	0.660344	6	43.81	35.36
120.00	212.61	316.44	0.639553	5	42.44	35.47
121.97	205.03	315.69	0.617412	5	42.90	35.43
123.97	205.24	323.51	0.605894	5	36.77	35.81
126.03	197.30	322.61	0.585553	5	37.68	35.79
128.14	220.45	346.57	0.614670	4	16.14	29.86
130.32	259.90	380.08	0.670391	3	6.66	19.09

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TABLE VI-55. ROCK3 OUTPUT

RUN NO. 30   08/12/69   16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	232.20	282.19	0.527342	2	30.67	37.20
93.37	254.57	287.65	0.800111	2	35.97	38.00
95.06	258.24	285.78	0.907272	3	34.38	37.88
96.76	275.42	285.59	0.949230	3	34.00	37.83
98.46	269.45	280.00	0.948673	1	28.56	36.57
100.16	268.26	280.57	0.939979	2	29.10	36.75
101.88	264.68	281.92	0.919450	3	30.41	37.13
103.61	256.18	280.00	0.893911	1	28.56	35.57
105.35	255.60	288.04	0.859036	5	36.34	38.02
107.10	252.42	295.34	0.824173	6	42.29	37.44
108.88	246.49	298.99	0.791945	6	44.31	36.78
110.67	238.71	300.19	0.761417	6	44.81	35.55
112.48	231.20	301.46	0.732442	6	45.23	36.32
114.32	224.53	303.50	0.705289	6	45.69	35.98
116.19	221.70	309.17	0.681489	6	45.55	35.38
118.07	214.74	309.91	0.657590	6	45.38	35.35
120.00	210.45	313.54	0.637141	6	44.05	35.34
121.97	206.26	316.13	0.617800	5	42.64	35.45
123.97	206.03	323.51	0.605763	5	36.86	35.80
126.03	198.91	322.82	0.585818	5	37.49	35.79
128.14	209.83	338.33	0.595065	4	22.47	33.26
130.32	251.28	372.14	0.656568	4	7.57	20.75

TABLE VI-56. ROCK3 OUTPUT

RUN NO. 32   08/13/69   16.5 GHZ   V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG,K)	WATER TEMPERATURE (DEG,K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	256.55	292.70	0.562733	3	40.38	37.81
93.37	251.22	288.58	0.803198	3	36.84	38.03
95.06	259.32	284.89	0.904135	3	33.32	37.74
96.76	273.62	283.47	0.944255	3	31.93	37.49
98.46	258.58	279.12	0.947497	2	27.72	36.27
100.16	269.95	281.17	0.940281	2	29.58	35.93
101.89	267.50	284.48	0.919274	4	32.72	37.68
103.61	264.42	287.24	0.889830	5	37.44	38.03
105.35	256.89	288.25	0.858922	5	36.53	38.03
107.10	250.23	290.78	0.825097	6	38.80	37.98
108.88	246.42	297.16	0.772137	6	43.39	37.12
110.67	243.07	304.06	0.761892	5	45.77	35.89
112.45	233.25	302.29	0.732521	6	45.45	36.17
114.32	233.56	313.06	0.709671	6	44.27	35.33
115.18	225.23	311.41	0.582775	6	44.93	35.32
118.07	218.82	312.75	0.659403	6	44.40	35.33
120.00	214.69	315.57	0.638865	5	42.92	35.43
121.97	211.67	320.23	0.621937	5	39.71	35.69
123.97	201.60	315.07	0.597547	5	42.67	35.45
125.03	208.78	329.74	0.596167	4	30.76	35.44
128.14	229.98	350.91	0.625108	4	13.73	28.02
130.32	252.16	371.48	0.655289	4	7.66	20.92

1

TABLE VI-57. ROCK3 OUTPUT

RUN NO. 33 08/14/69 9.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	270.68	315.96	0.605829	6	55.42	33.15
93.37	276.96	300.45	0.864620	5	58.80	32.[illegible]
95.06	293.30	297.35	0.959781	5	58.47	33.64
96.76	277.57	292.26	0.983481	5	58.67	33.25
98.46	303.54	307.43	0.975697	6	58.36	32.02
100.16	301.08	310.53	0.951291	6	57.59	32.16
101.88	294.22	311.56	0.919556	6	57.25	32.28
103.61	287.81	314.35	0.885351	6	56.17	32.77
105.35	256.32	284.58	0.842933	4	51.83	38.76
107.10	257.09	294.09	0.808921	5	57.40	35.01
108.88	258.45	304.01	0.778760	5	58.81	32.27
110.67	252.74	305.63	0.747809	5	58.65	32.10
112.48	249.46	310.59	0.720097	6	57.57	32.17
114.32	235.18	300.25	0.687966	5	58.78	32.99
116.18	217.41	280.00	0.664010	1	47.68	40.14
118.07	207.69	273.19	0.647281	5	40.73	40.80
120.00	210.64	286.58	0.613299	4	53.35	38.01
121.97	200.32	278.98	0.596474	2	46.69	40.35
123.97	198.91	283.19	0.573324	3	50.59	39.27
125.03	233.24	344.79	0.574627	5	30.39	40.71
128.14	265.92	391.02	0.599046	5	7.86	29.87
130.32	305.46	459.29	0.598359	7	5.13	26.21

1

TABLE VI-58. ROCK3 OUTPUT

RUN NO. 35 08/14/69 16.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	278.83	293.13	0.563794	4	40.71	37.76
93.37	274.60	284.57	0.789365	3	33.11	37.71
95.06	277.66	283.59	0.900218	3	32.05	37.51
96.76	280.57	284.09	0.946232	3	32.53	37.61
98.45	283.45	287.71	0.957147	4	35.36	37.97
100.16	286.85	292.67	0.945838	5	40.35	37.81
101.88	284.30	294.26	0.919974	5	41.55	37.61
103.61	278.35	293.83	0.889163	5	41.24	37.67
105.35	276.73	300.56	0.856685	6	44.94	36.48
107.10	270.09	301.89	0.824005	6	45.35	35.24
108.88	260.47	300.21	0.771937	6	44.81	35.55
110.67	250.46	298.31	0.751535	6	43.99	36.91
112.48	246.24	304.31	0.732895	6	55.80	35.86
114.32	240.10	307.83	0.716679	6	45.77	35.47
116.18	232.44	309.05	0.681431	6	45.57	35.39
118.07	227.64	313.89	0.660242	6	43.08	35.35
120.00	220.76	314.96	0.638268	5	43.32	35.39
121.97	217.51	320.78	0.622559	5	39.25	35.72
123.97	211.77	323.07	0.603184	5	37.27	35.80
126.03	214.18	331.12	0.598587	4	29.37	35.22
128.14	229.98	349.09	0.620596	4	14.70	28.80
130.32	280.06	392.95	0.687128	4	5.84	17.29

1

TABLE VI-59. ROCK3 OUTPUT

RUN NO. 101 07/21/69 9.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	285.15	302.19	0.615327	5	58.87	32.56
93.37	274.90	303.41	0.864592	6	58.85	32.35
95.06	278.75	301.72	0.959630	6	58.86	32.65
96.76	298.28	299.60	0.983576	6	58.72	33.16
98.46	286.76	290.36	0.970412	5	55.69	36.52
100.16	281.72	290.05	0.945560	5	55.51	36.65
101.88	276.27	291.58	0.913874	5	56.32	36.01
103.61	270.46	294.46	0.879503	5	57.53	34.86
105.35	259.09	292.50	0.843395	5	56.79	35.60
107.10	252.74	296.90	0.809654	5	58.25	33.98
108.88	246.41	302.44	0.778151	5	58.87	32.51
110.67	240.26	280.87	0.746208	2	48.50	37.93
112.48	234.77	284.72	0.714917	4	51.86	38.75
114.32	230.39	287.73	0.686304	4	54.21	37.52
116.18	205.49	241.09	0.757031	14	15.77	26.53
118.07	206.10	262.60	0.667311	8	30.01	38.31
120.00	209.77	281.16	0.616061	2	48.78	39.86
121.97	216.59	301.75	0.593374	5	58.86	32.65
123.97	226.19	324.09	0.582477	6	50.33	35.90
126.03	279.20	396.61	0.619960	6	7.21	29.04
128.14	290.63	420.01	0.611721	6	5.79	27.01
130.32	300.78	440.26	0.597901	7	5.33	26.39

1

TABLE VI-60. ROCK3 OUTPUT

RUN NO. 201 07/17/69 9.5 GHZ V POLARIZATION

ZENITH ANGLE (DEG)	BRIGHTNESS TEMPERATURE (DEG.K)	WATER TEMPERATURE (DEG.K)	EMISSIVITY	ITERATIONS	PERMITTIVITY REAL PART	PERMITTIVITY IMAGINARY PART
91.68	352.18	425.87	0.383681	9	5.61	25.76
93.37	333.06	402.06	0.630130	14	6.73	28.38
95.06	330.32	351.52	0.873940	14	24.15	39.87
96.76	323.03	327.37	0.971237	8	47.67	37.17
98.46	300.50	303.91	0.975324	6	58.82	32.28
100.16	270.47	298.50	0.948692	5	58.56	33.47
101.88	281.81	295.84	0.915556	5	58.23	34.00
103.61	274.13	297.27	0.880359	5	58.33	33.86
105.35	264.61	310.29	0.851037	6	54.12	33.82
107.10	279.20	323.13	0.817811	6	51.05	35.53
108.88	273.76	328.86	0.786342	6	46.36	37.72
110.67	248.11	315.34	0.751633	6	55.72	33.00
112.48	242.37	317.79	0.722967	6	54.36	33.73
114.32	257.00	319.98	0.695907	6	53.18	34.38
116.18	275.20	283.26	0.661879	3	50.65	39.24
118.07	224.07	290.41	0.635547	5	55.72	36.50
120.00	275.71	300.34	0.614375	5	58.79	32.96
121.97	230.29	314.18	0.598581	5	56.24	32.73
123.97	237.58	333.14	0.586425	6	42.30	39.16
126.03	286.93	400.52	0.622079	6	6.85	28.55
128.14	296.04	421.26	0.611996	6	5.75	26.95
130.32	303.93	439.36	0.597844	7	5.34	26.40

1

TABLE VI-61. ROCK3 OUTPUT

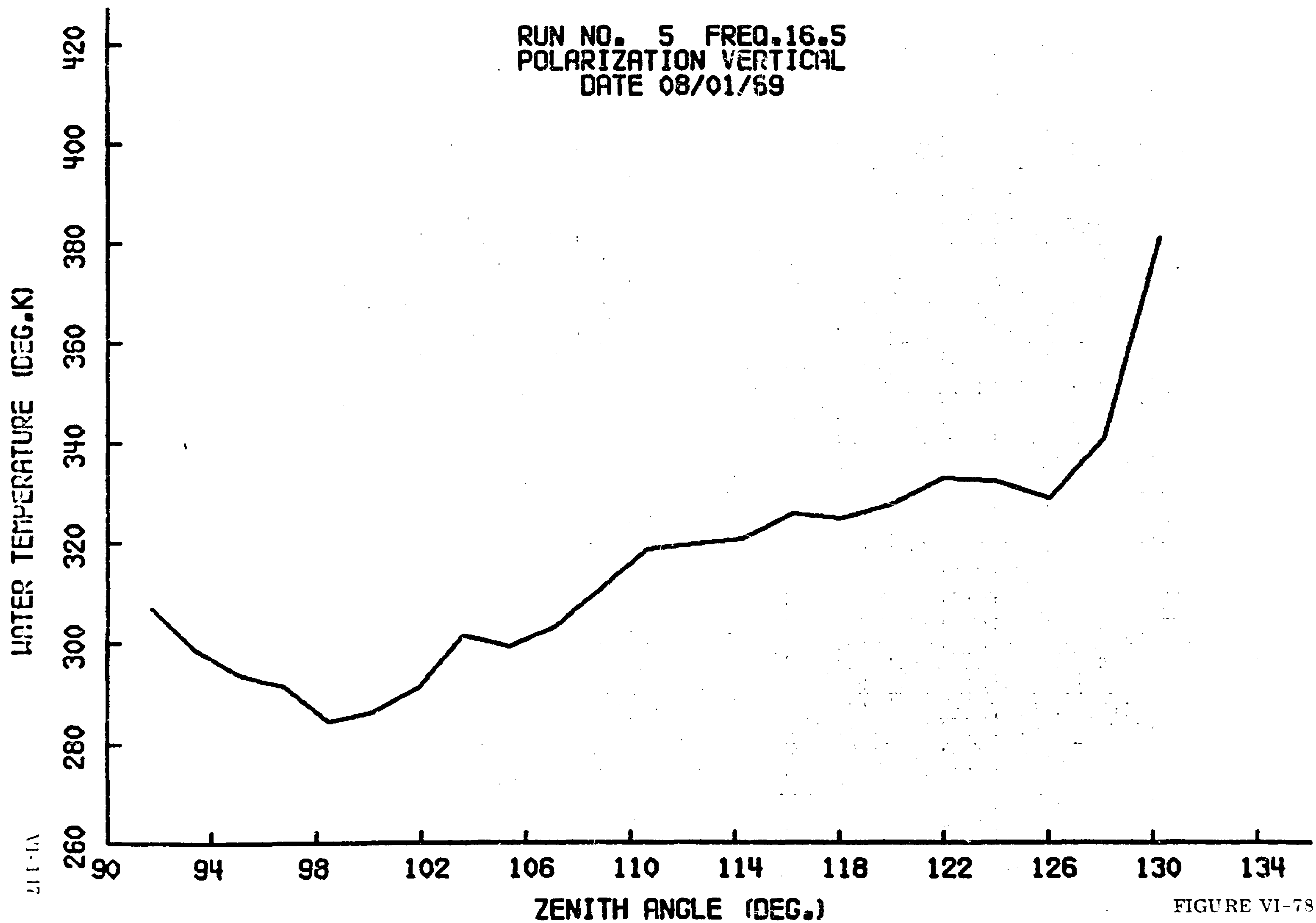

RUN NO. 5 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/01/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-78

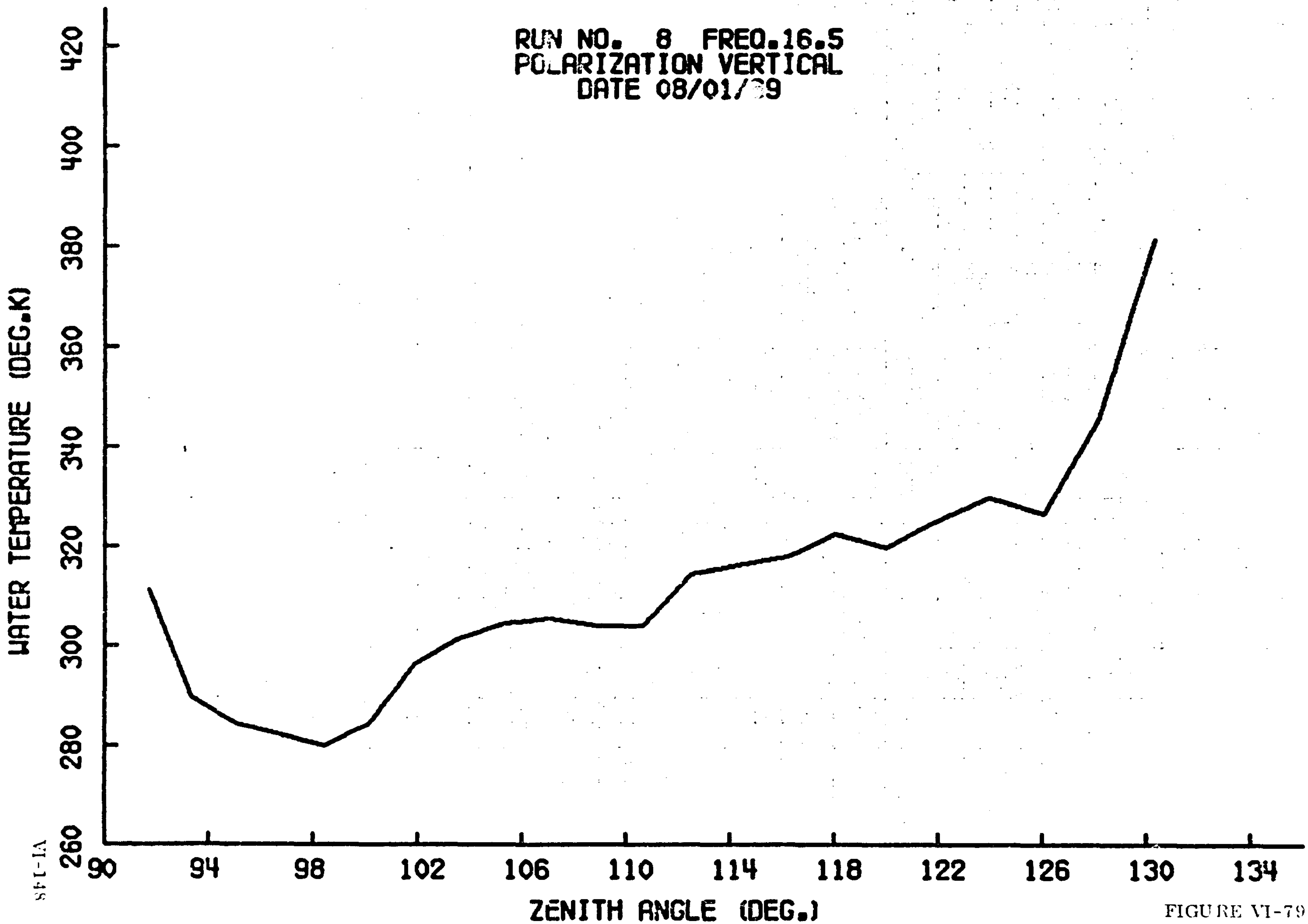

RUN NO. 8 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/01/ 9
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-79

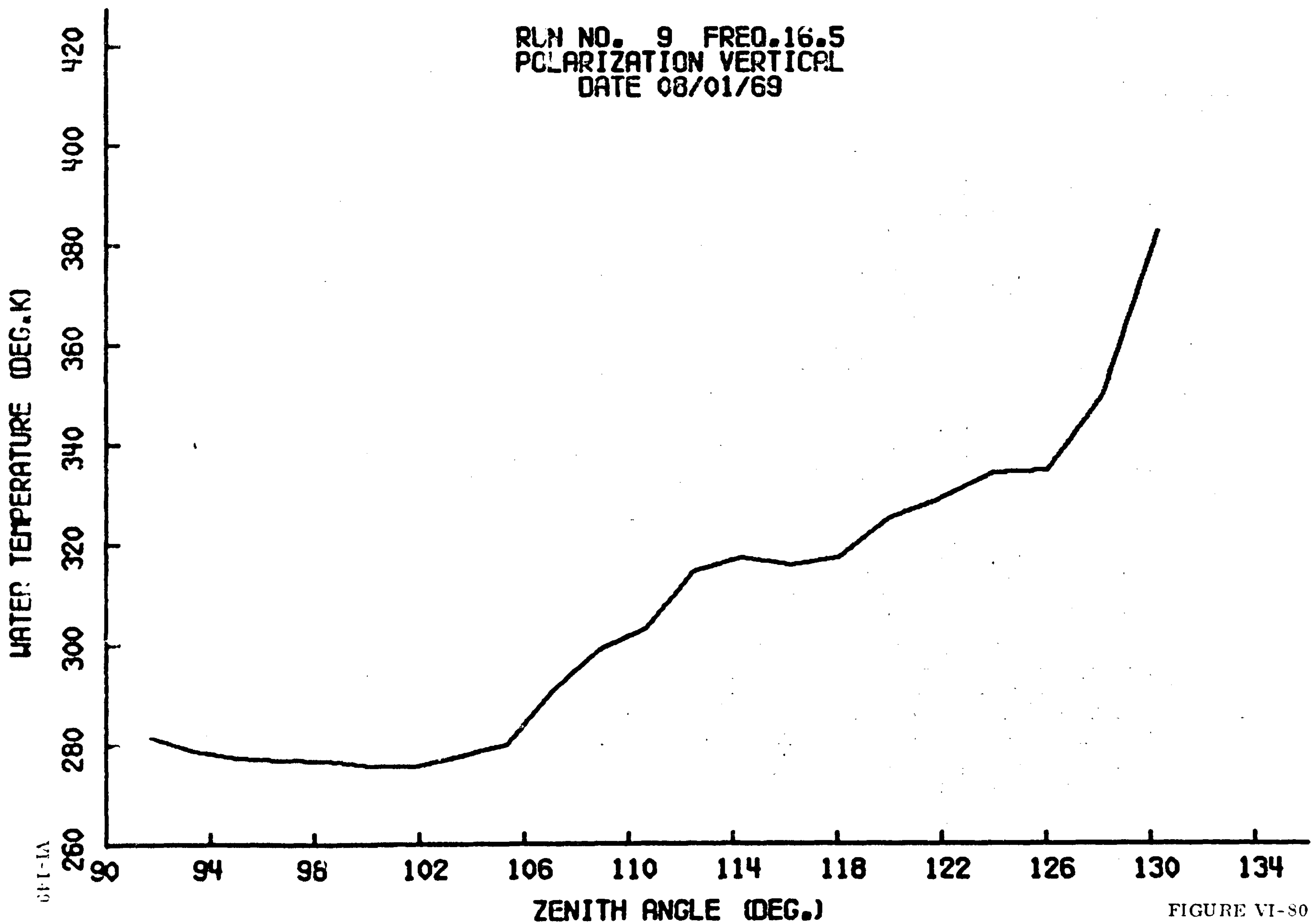

RUN NO. 9 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/01/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-80

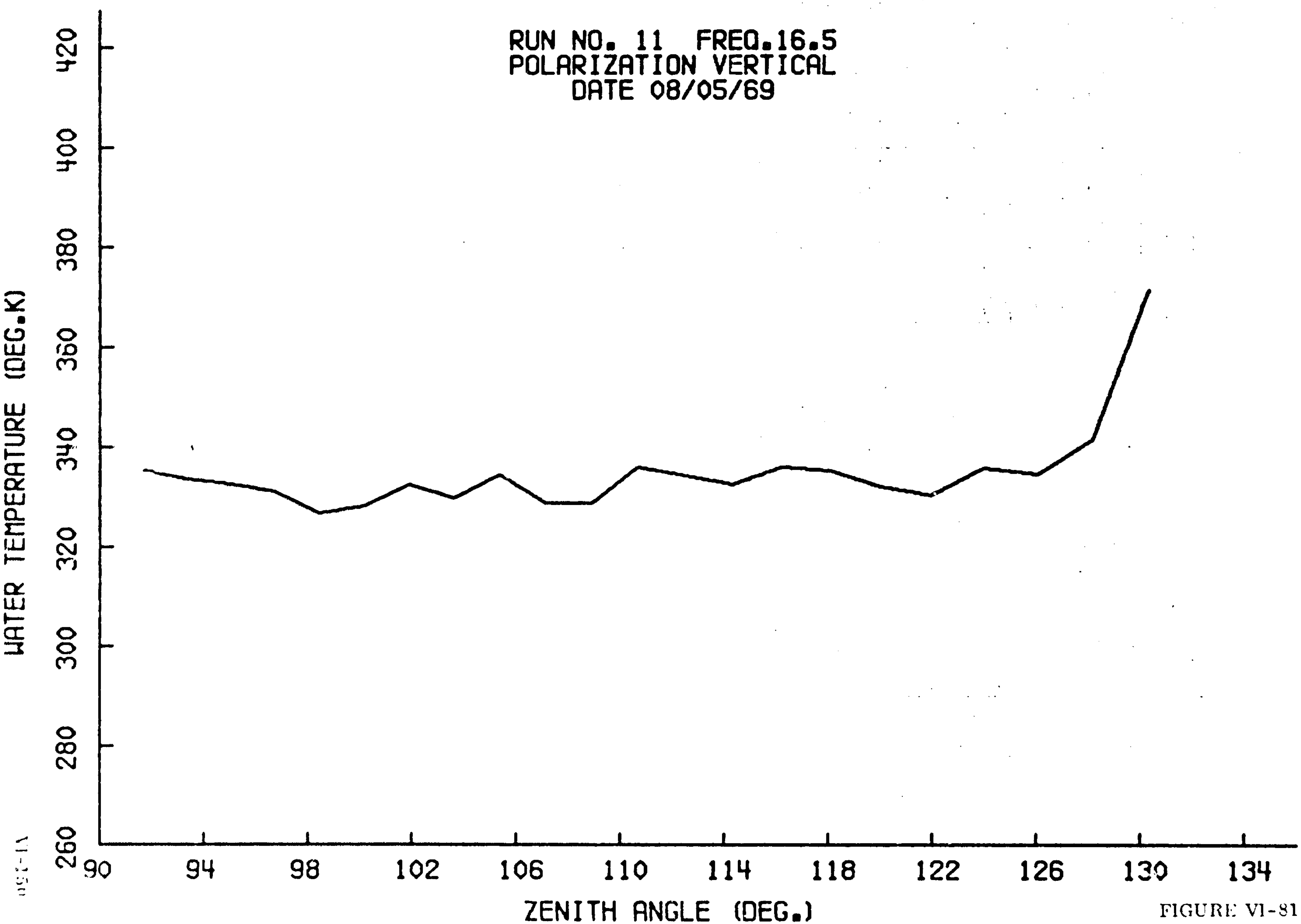

RUN NO. 11 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/05/69
WATER TEMPERATURE (DEG.K)
ZENITH ANGLE (DEG.)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134

FIGURE VI-81

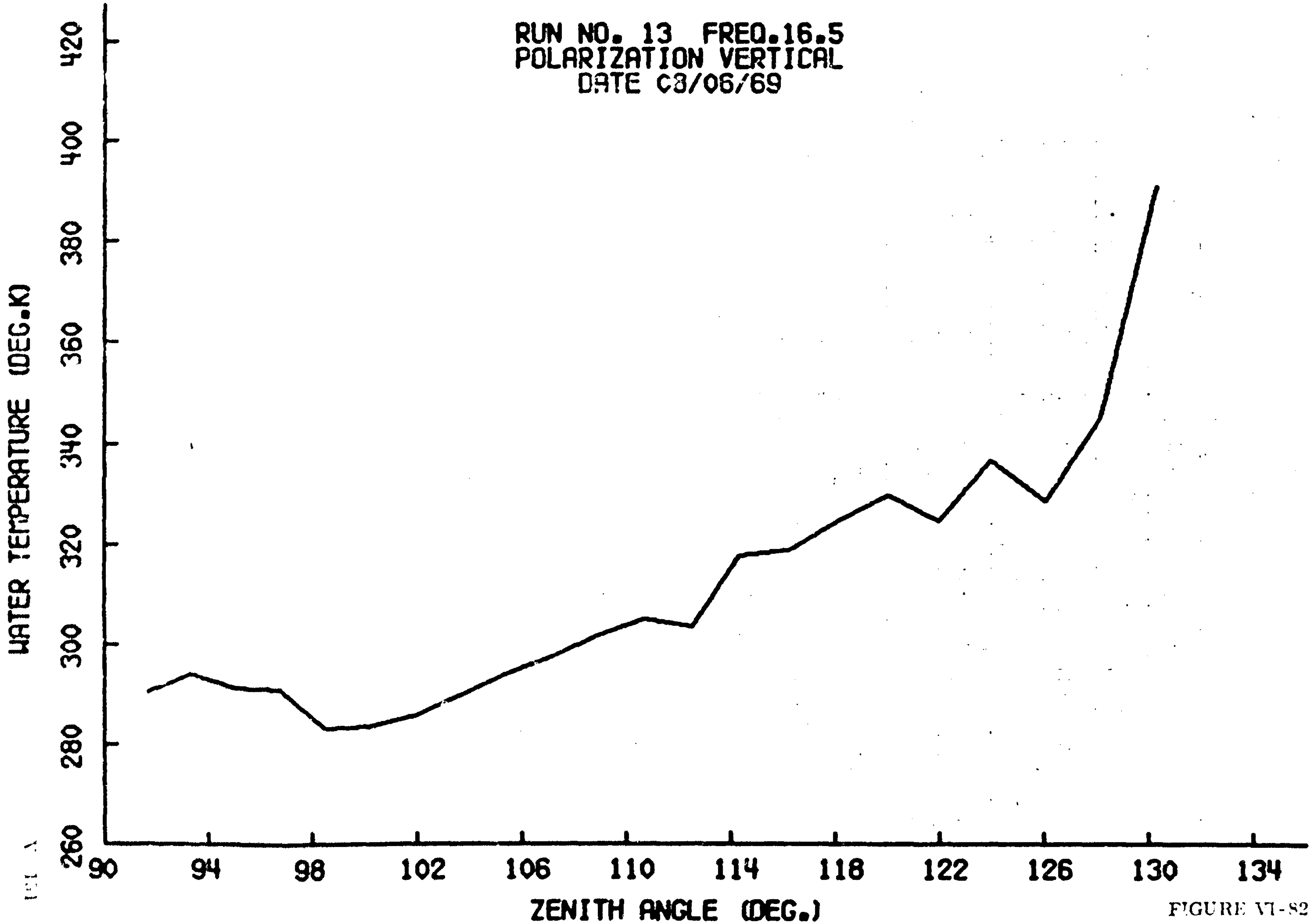

RUN NO. 13 FREQ.16.5
POLARIZATION VERTICAL
DATE C3/06/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-82

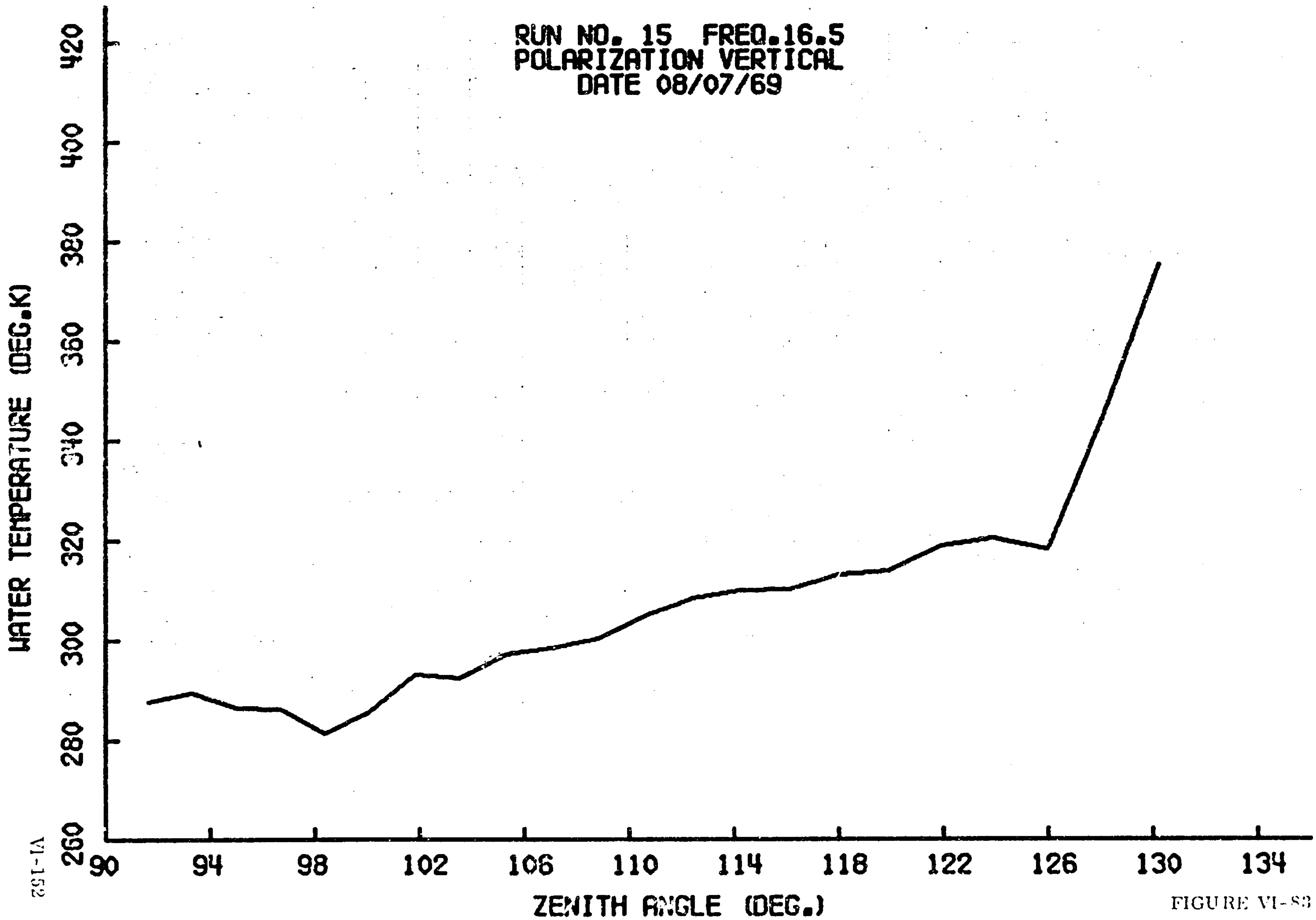

RUN NO. 15 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/07/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-83

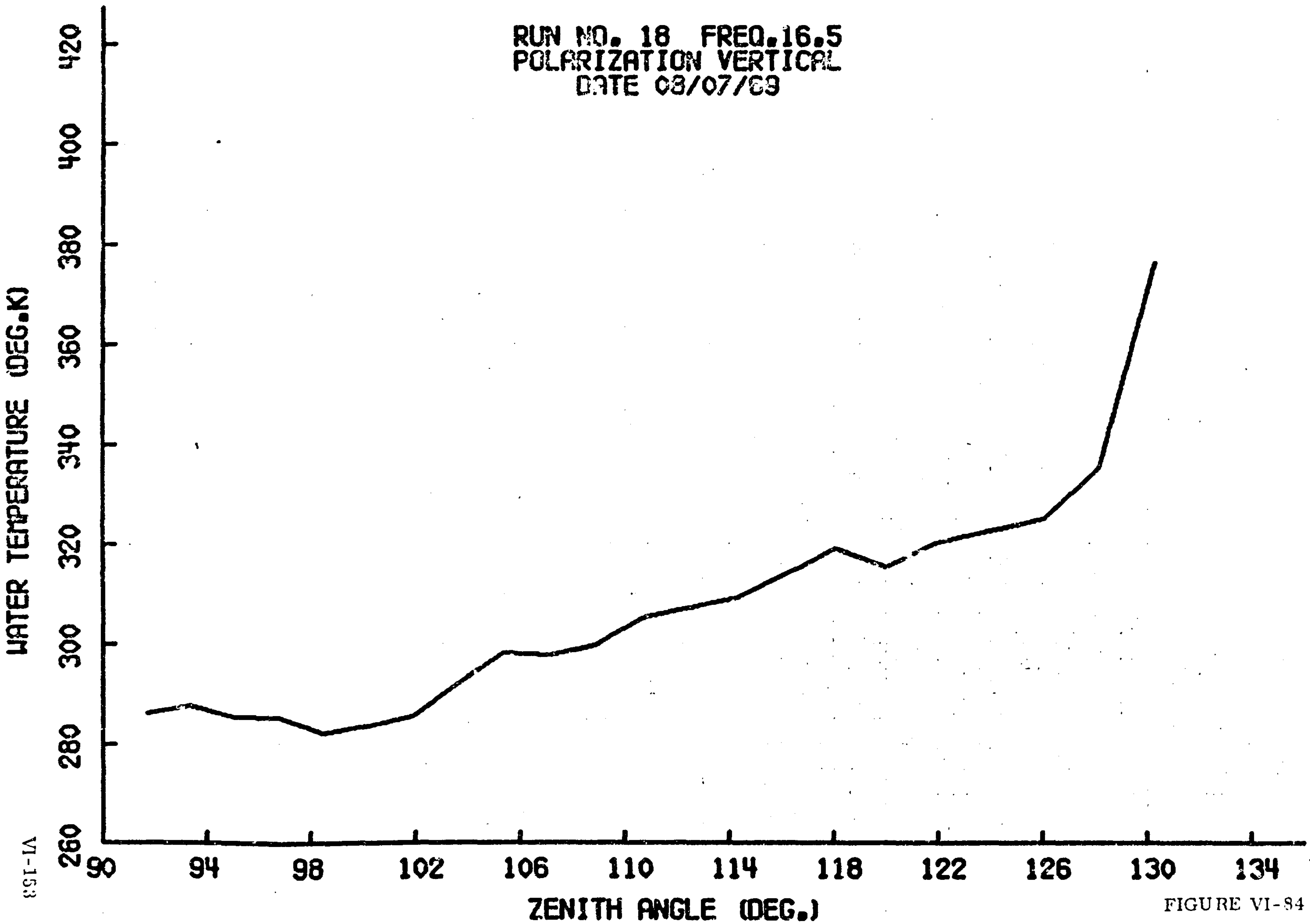

RUN NO. 18 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/07/69
WATER TEMPERATURE (DEG.K)
420
400
380
360
340
320
300
280
260
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-84

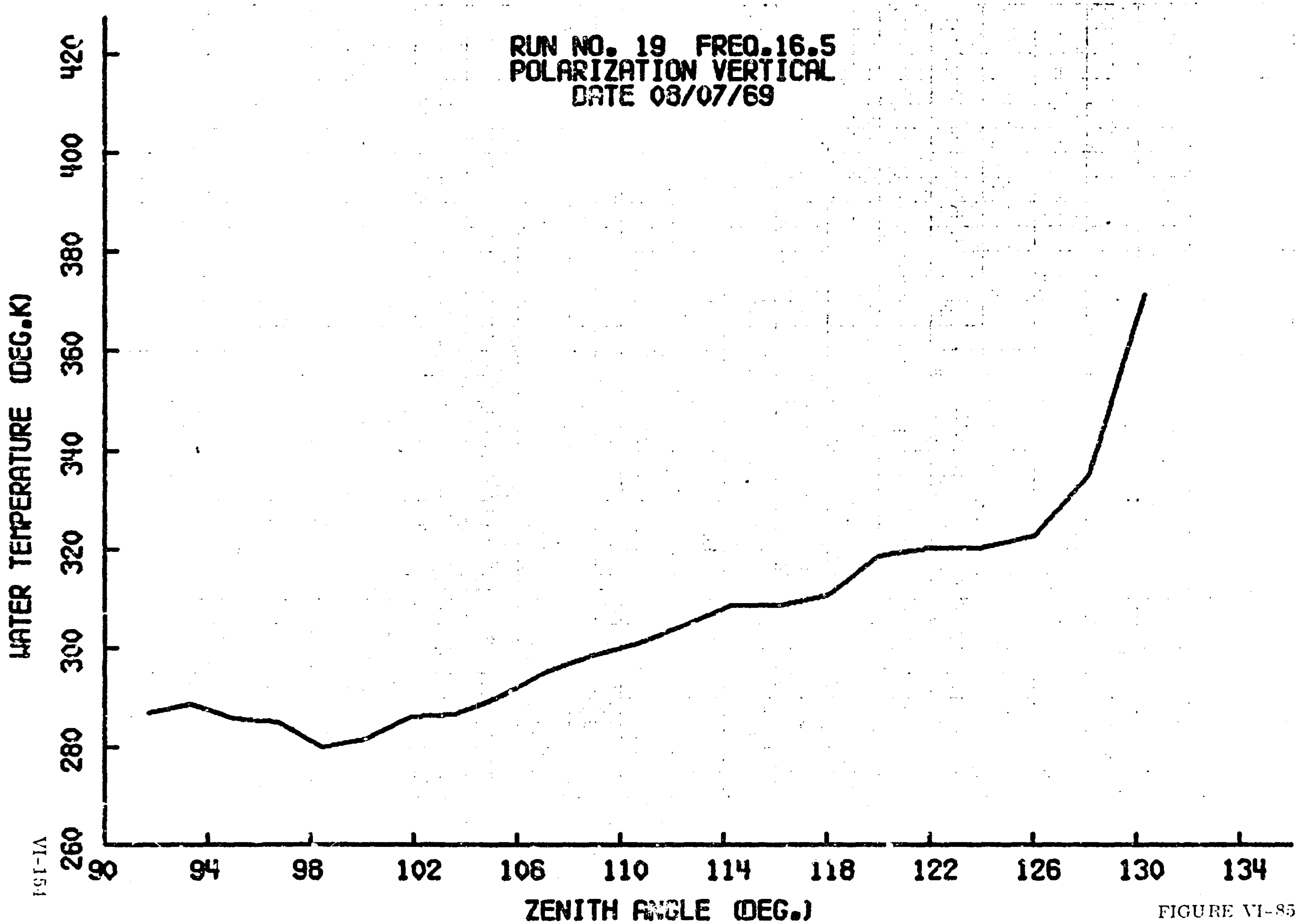
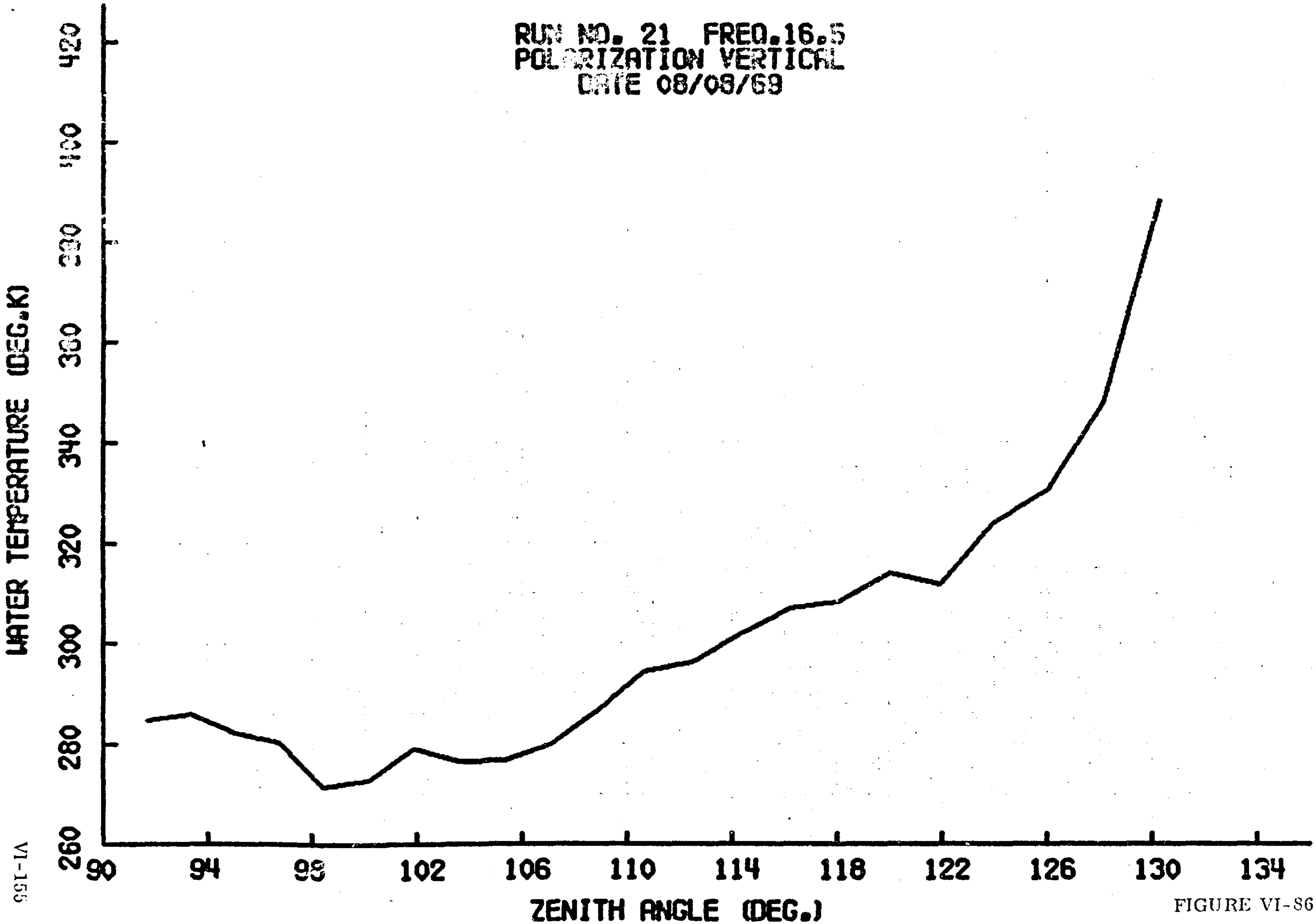

RUN NO. 19 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/07/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-85



RUN NO. 21 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/08/69
WATER TEMPERATURE (DEG.K)
ZENITH ANGLE (DEG.)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134

FIGURE VI-86

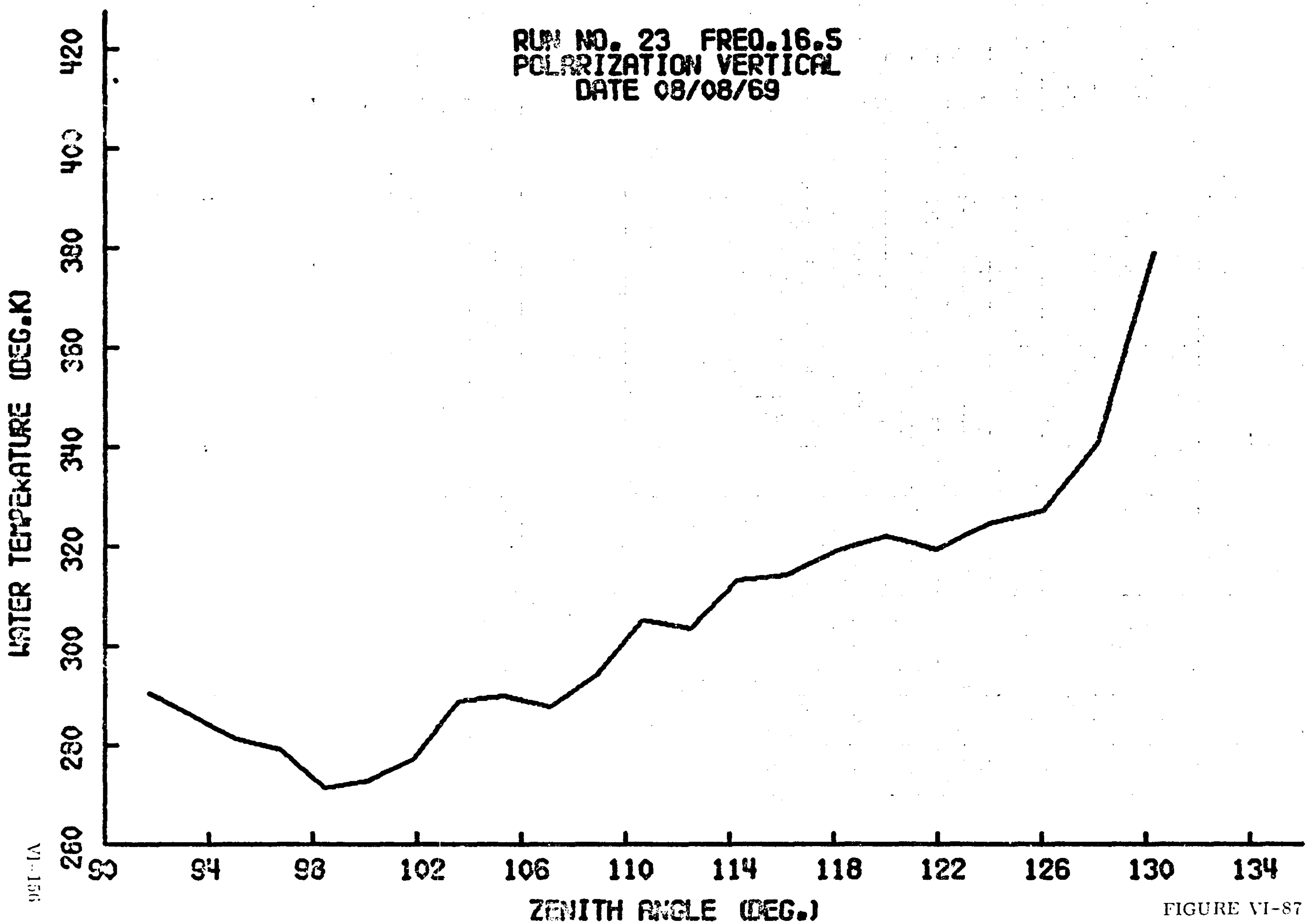

RUN NO. 23 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/08/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-87

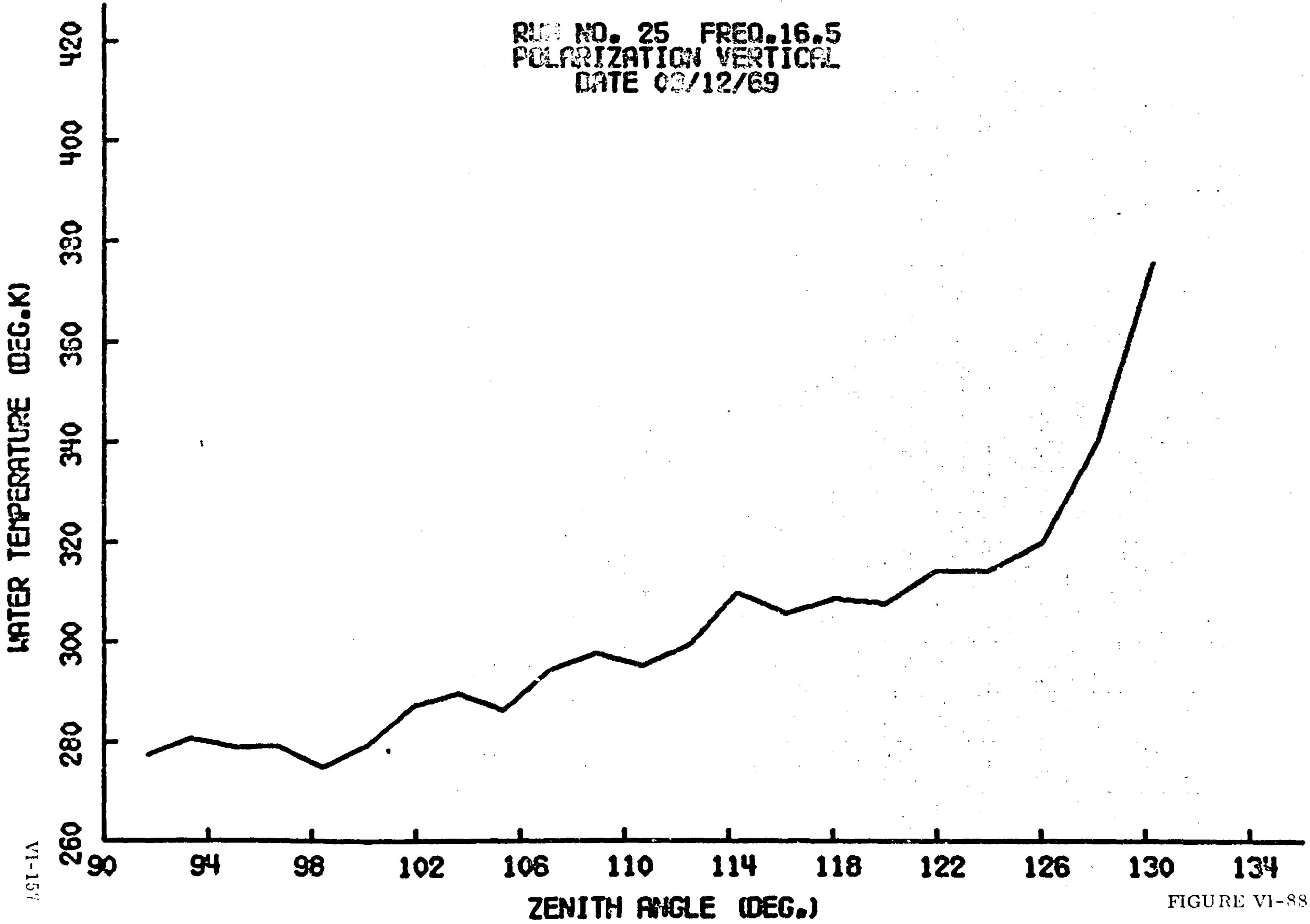

RUN NO. 25 FREQ.16.5
POLARIZATION VERTICAL
DATE 03/12/69
WATER TEMPERATURE (DEG.K)
420
400
380
360
340
320
300
280
260
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-88

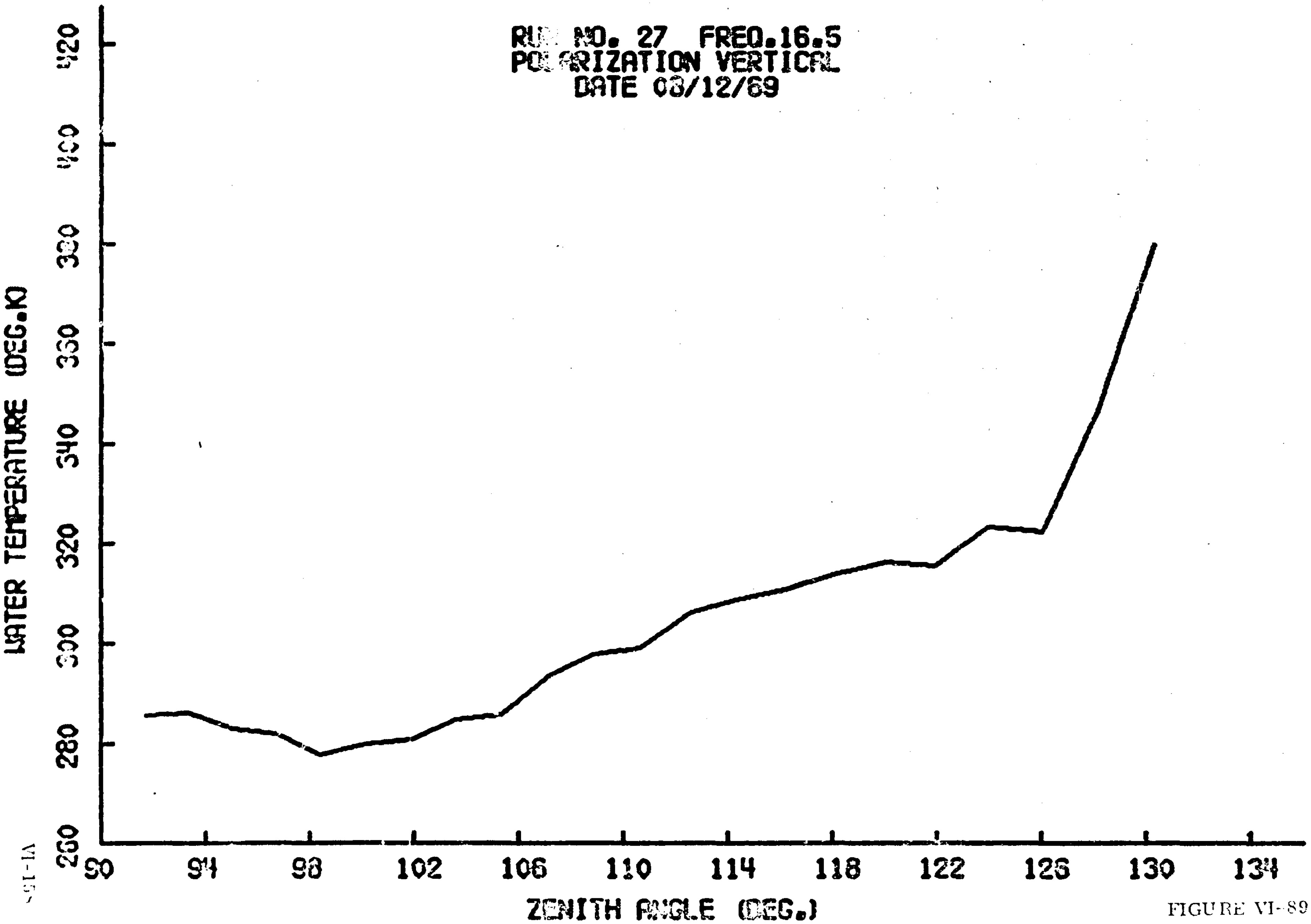

RUN NO. 27 FREQ.16.5
POLARIZATION VERTICAL
DATE 03/12/69
WATER TEMPERATURE (DEG.K)
420
400
380
360
340
320
300
280
260
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-89

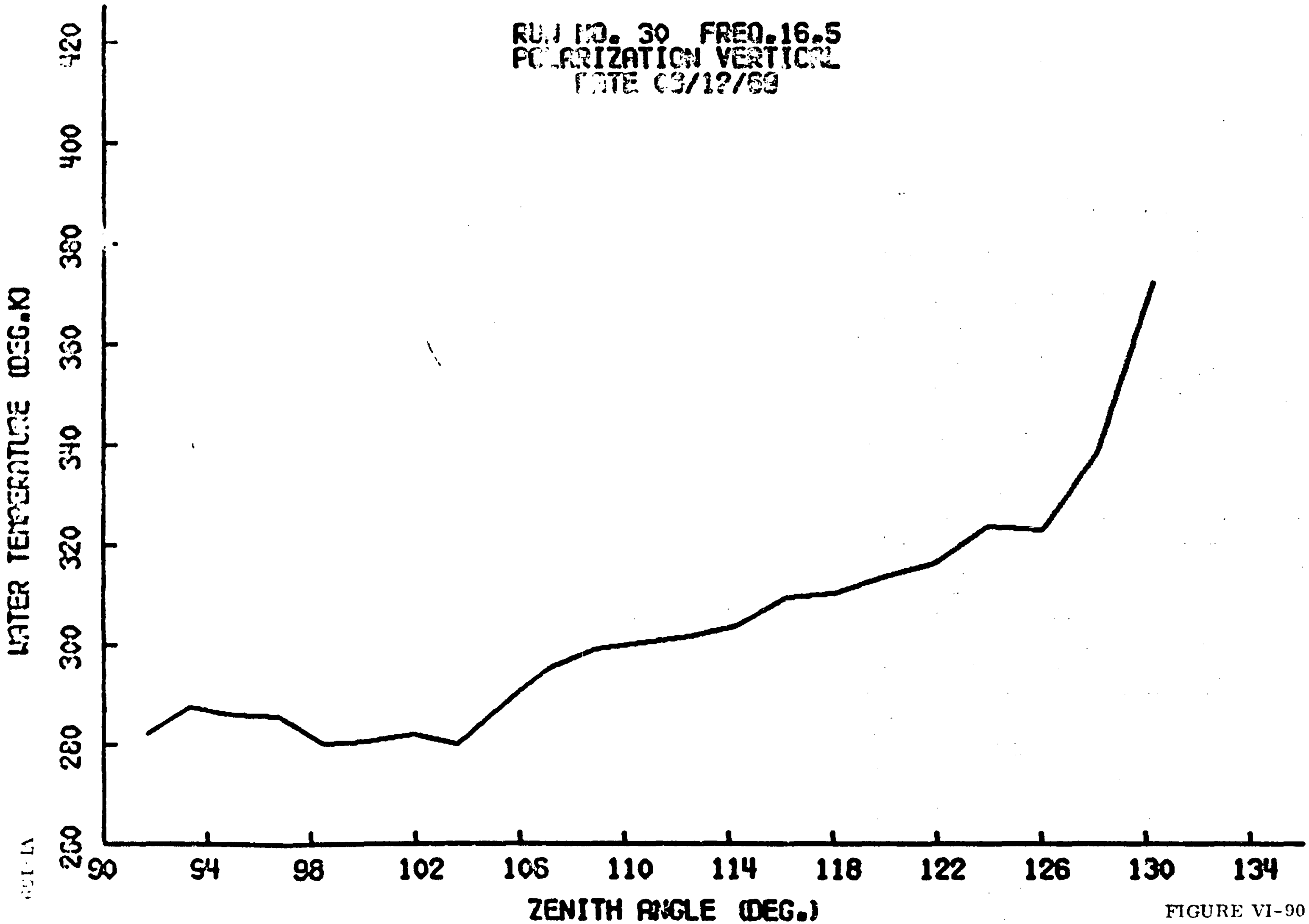
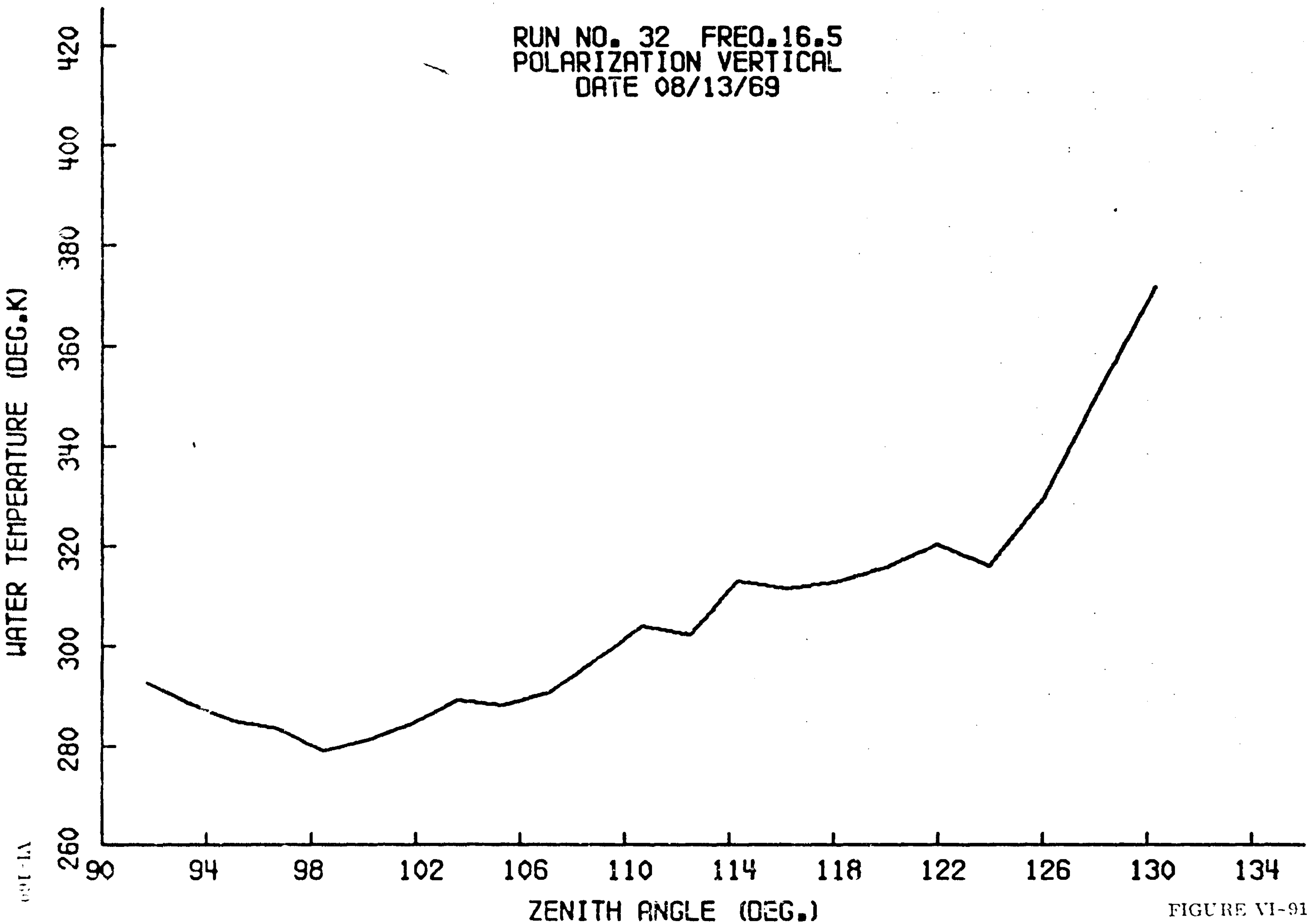

RUN NO. 30 FREQ.16.5
POLARIZATION VERTICAL
DATE 03/12/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-90



RUN NO. 32 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/13/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-91

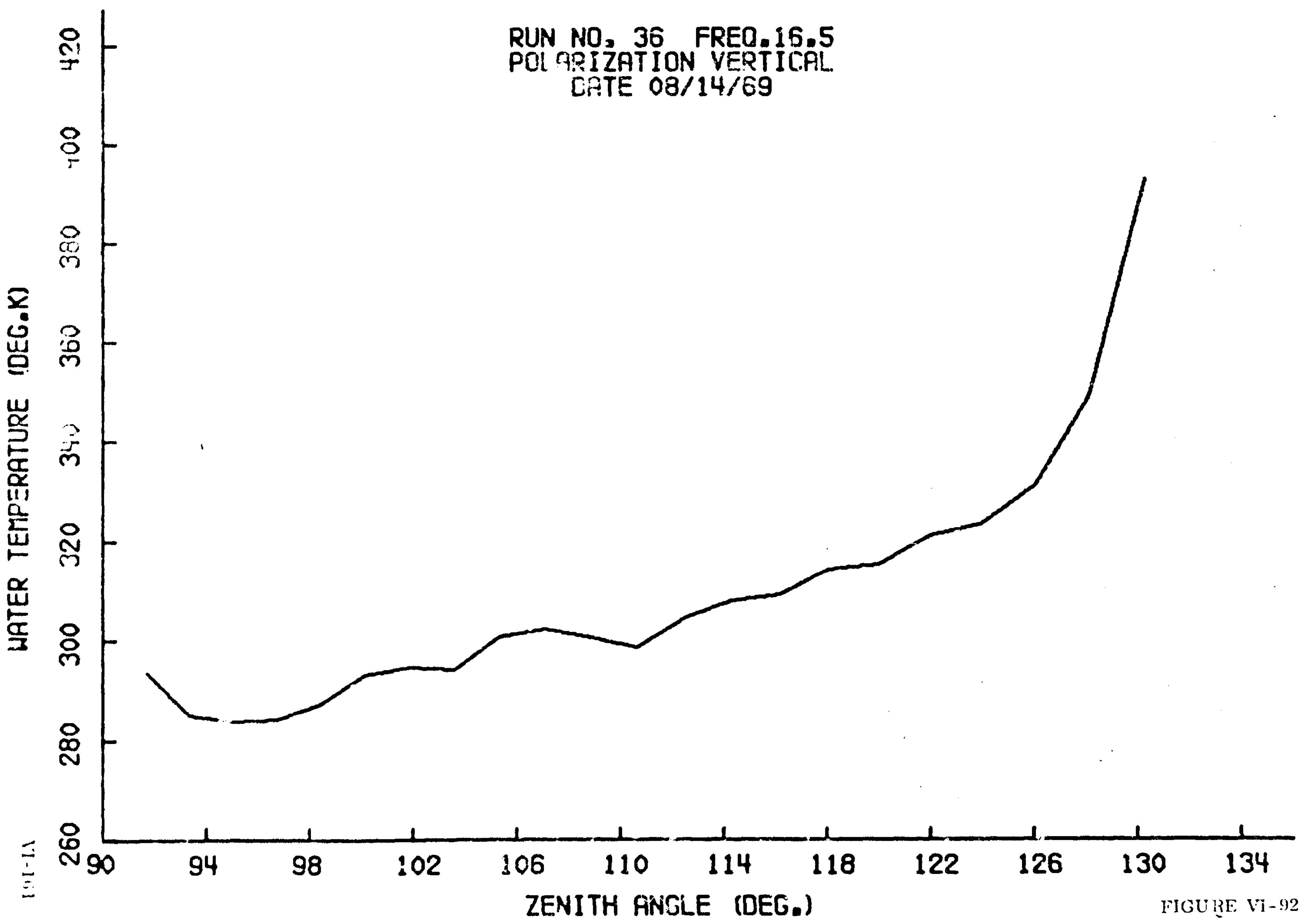

RUN NO. 36 FREQ.16.5
POLARIZATION VERTICAL
DATE 08/14/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-92

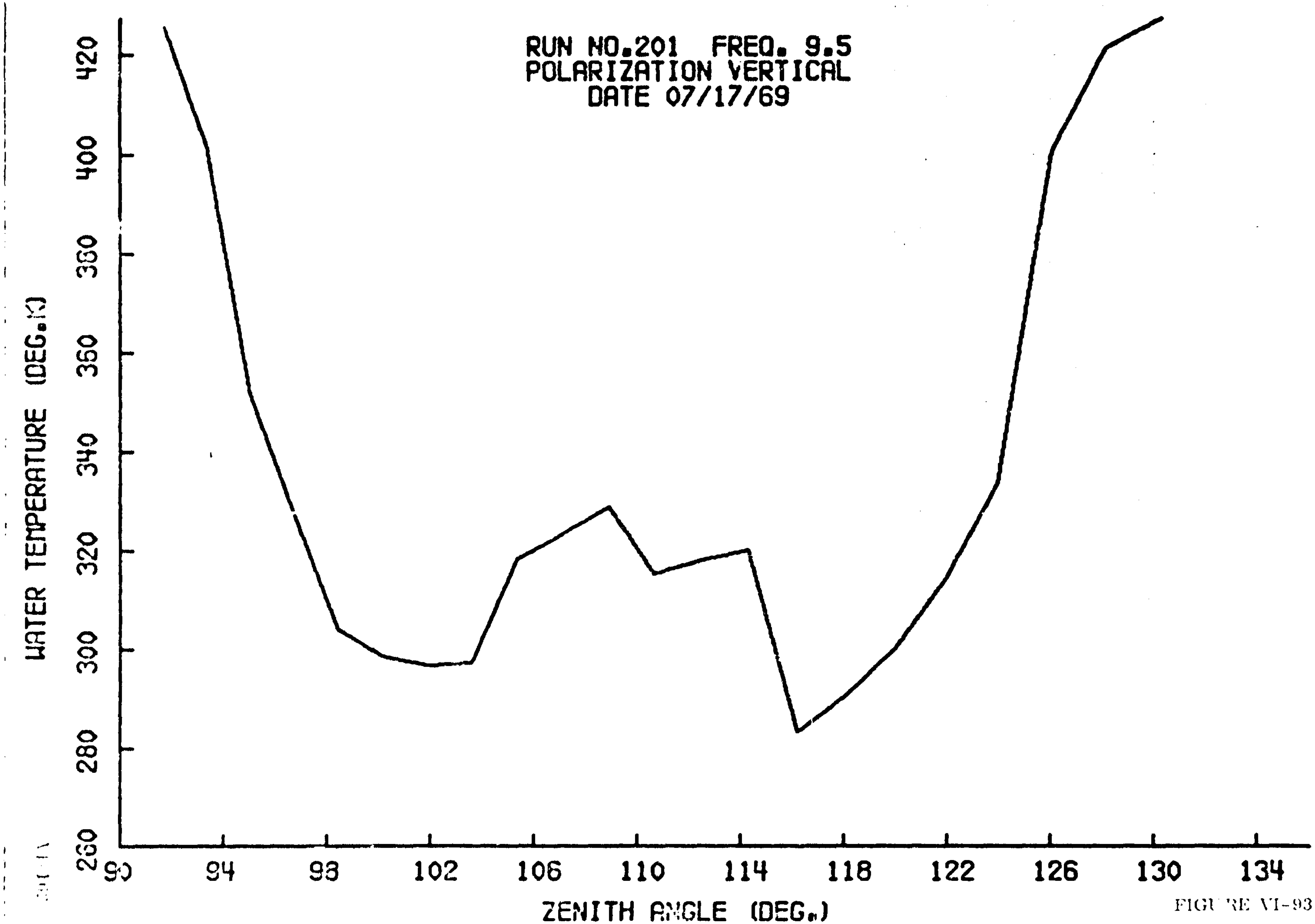

RUN NO.201 FREQ. 9.5
POLARIZATION VERTICAL
DATE 07/17/69
WATER TEMPERATURE (DEG.K)
420
400
380
360
340
320
300
280
260
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-93

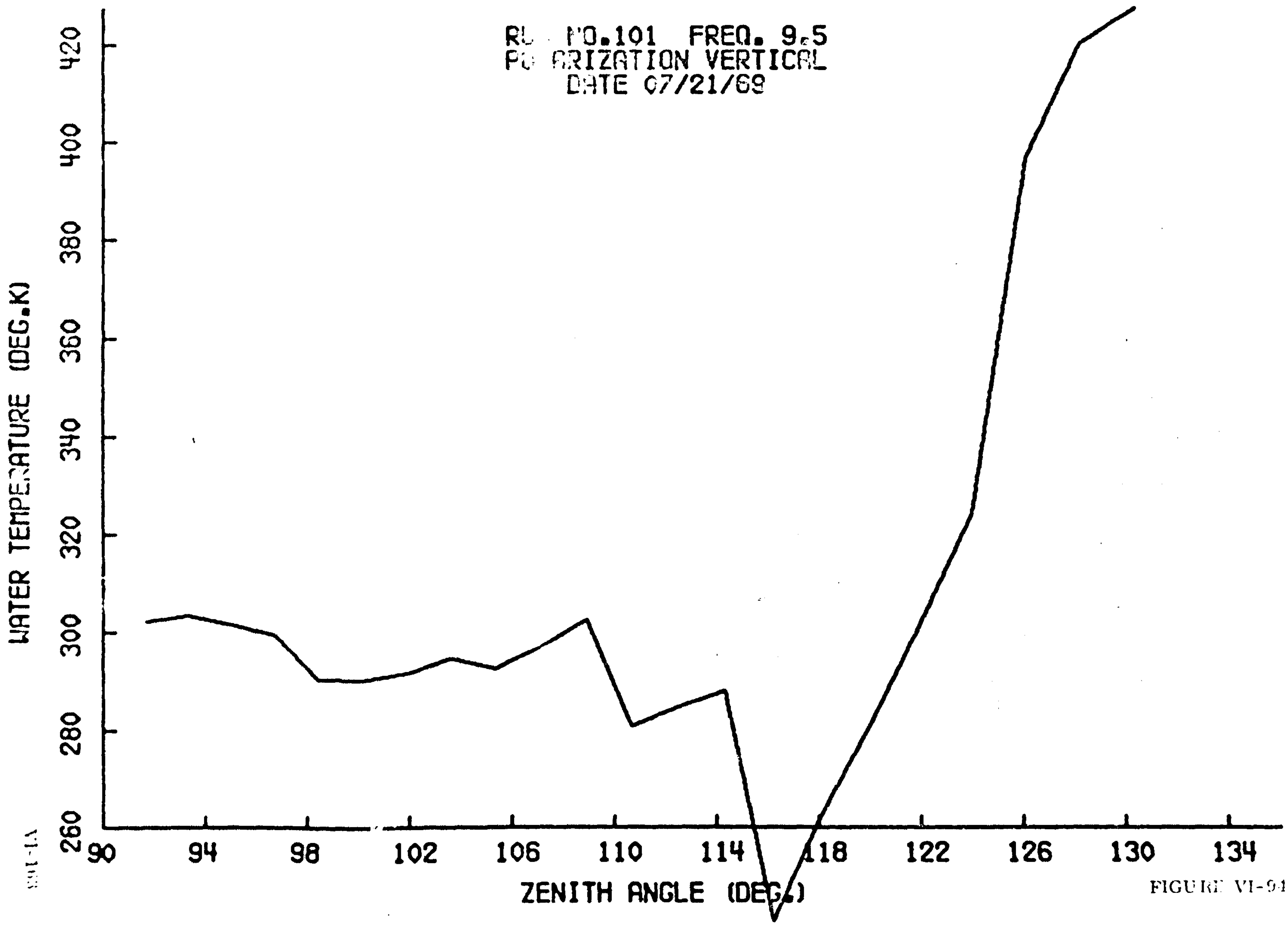
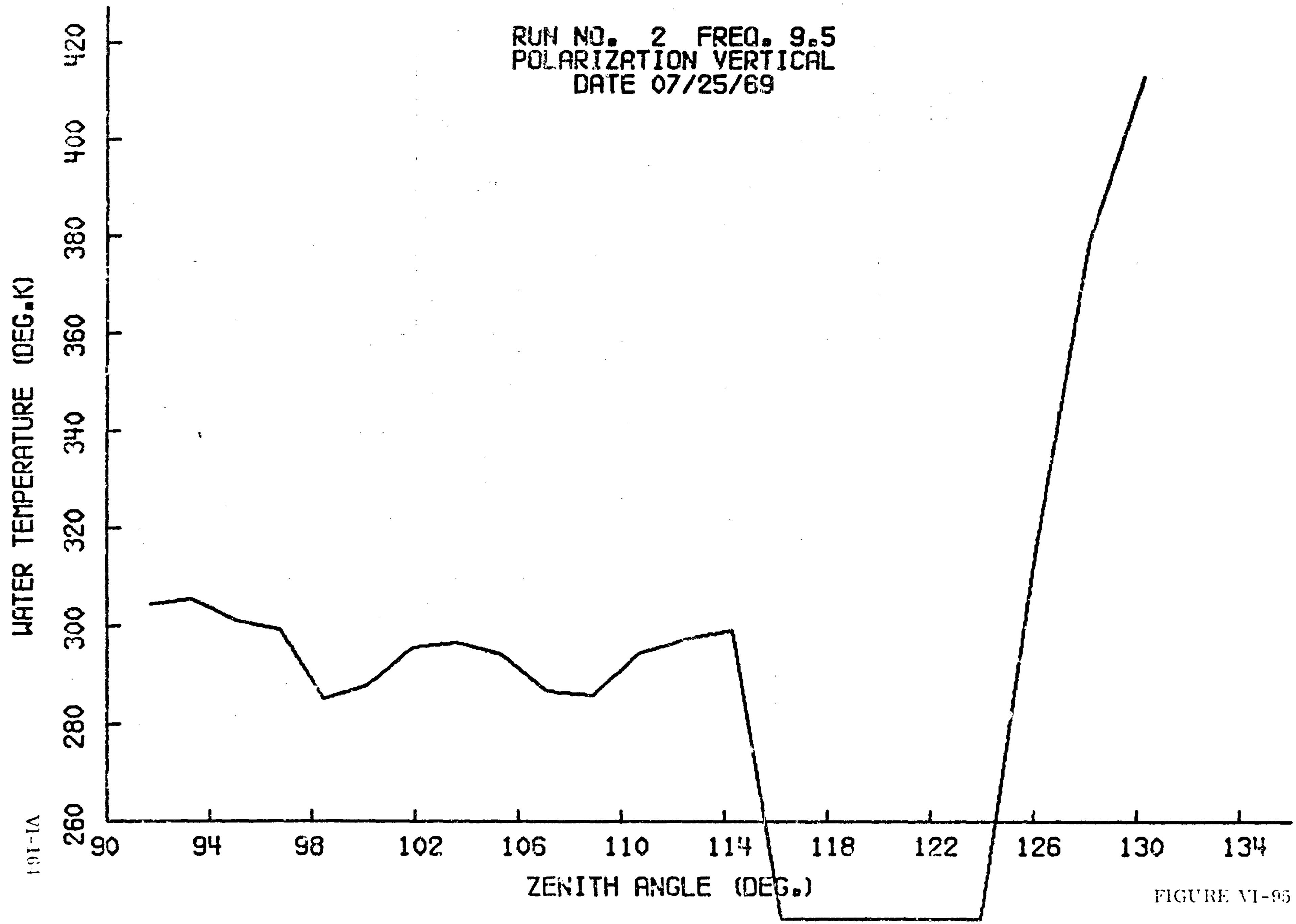

RUN NO.101 FREQ. 9.5
POLARIZATION VERTICAL
DATE 07/21/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-94



RUN NO. 2 FREQ. 9.5
POLARIZATION VERTICAL
DATE 07/25/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-95

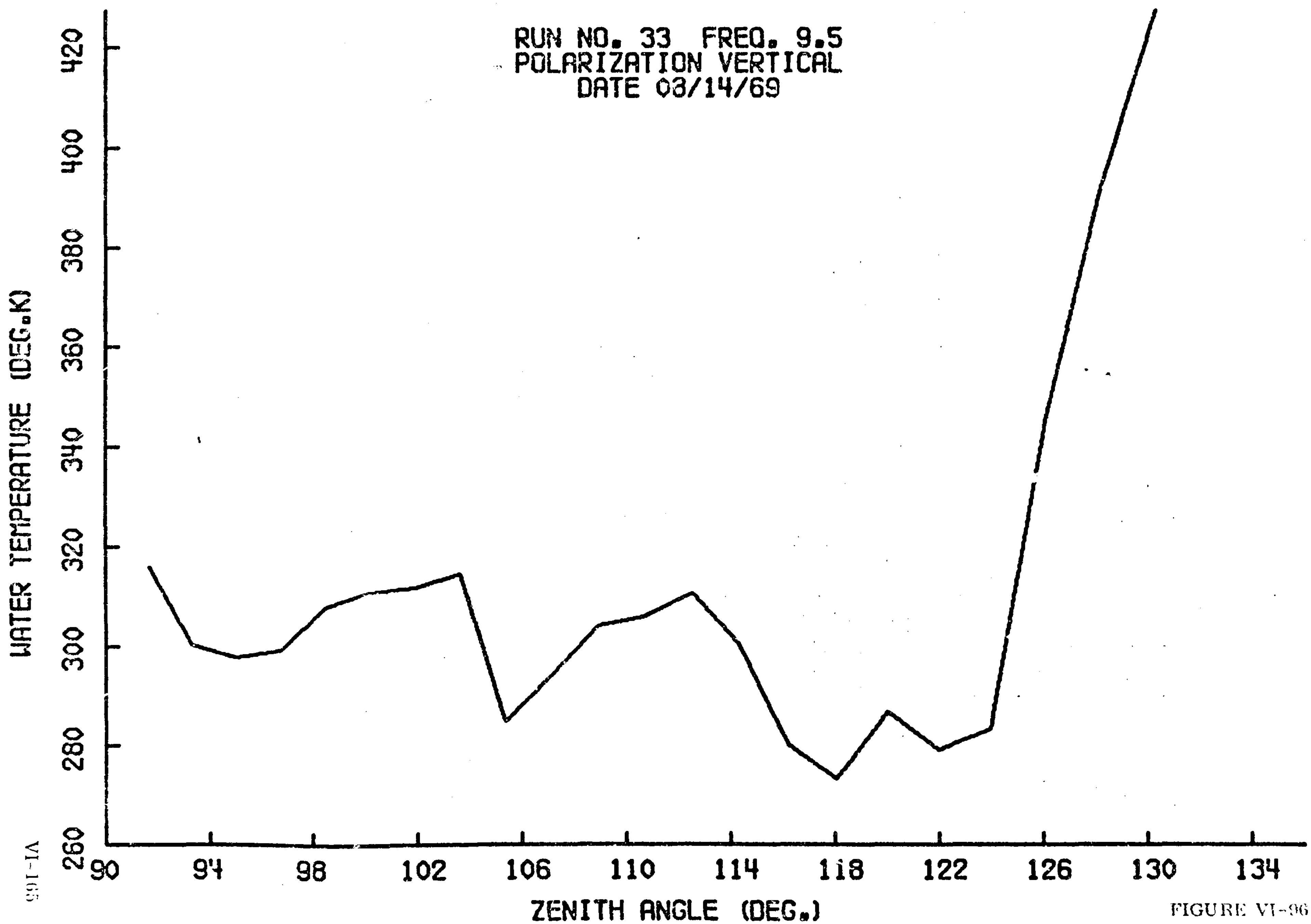

RUN NO. 33 FREQ. 9.5
POLARIZATION VERTICAL
DATE 03/14/69
WATER TEMPERATURE (DEG.K)
260
280
300
320
340
360
380
400
420
90
94
98
102
106
110
114
118
122
126
130
134
ZENITH ANGLE (DEG.)

FIGURE VI-96

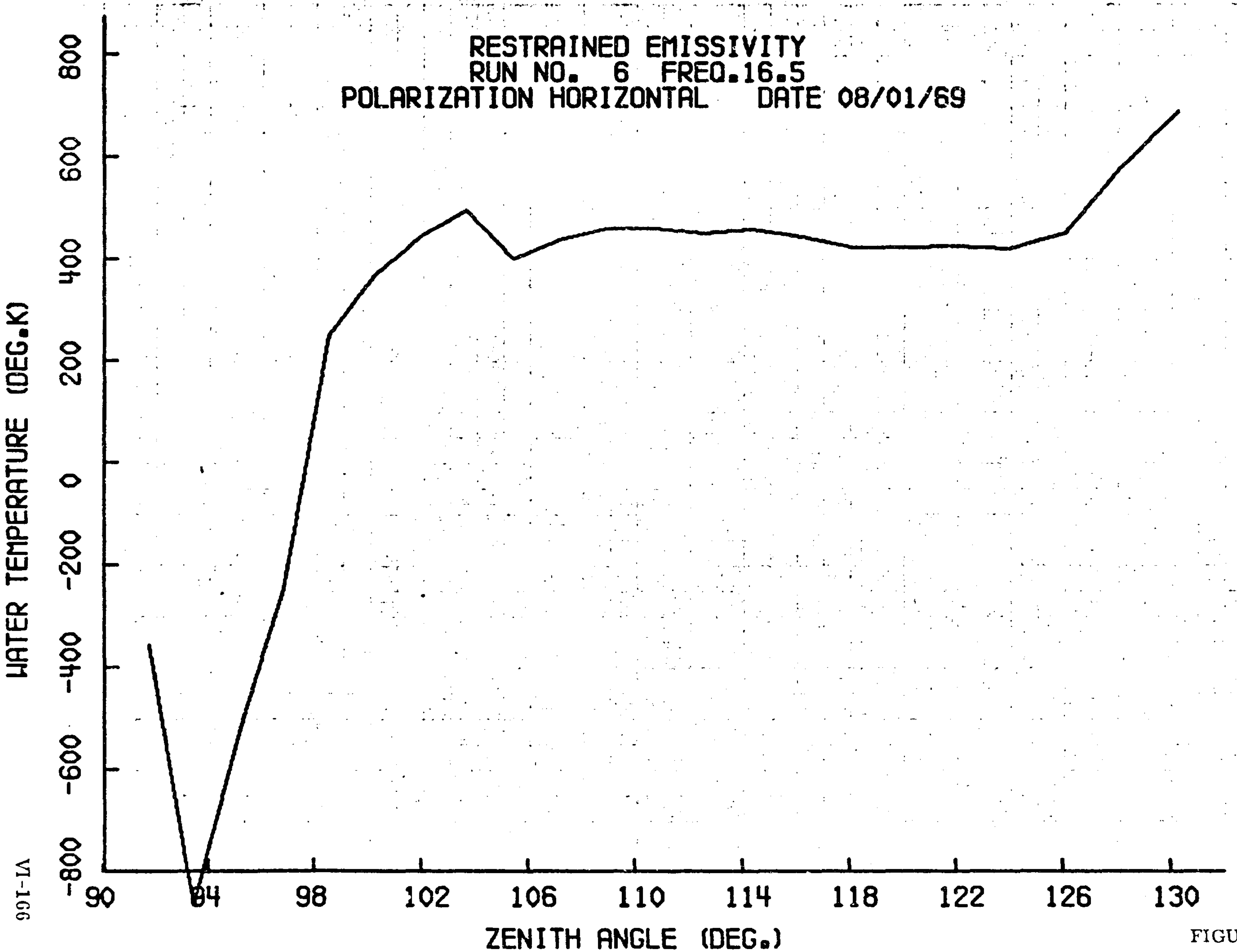

RESTRAINED EMISSIVITY
RUN NO. 6 FREQ.16.5
POLARIZATION HORIZONTAL DATE 08/01/69
WATER TEMPERATURE (DEG.K)
800
600
400
200
0
-200
-400
-600
-800
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-97

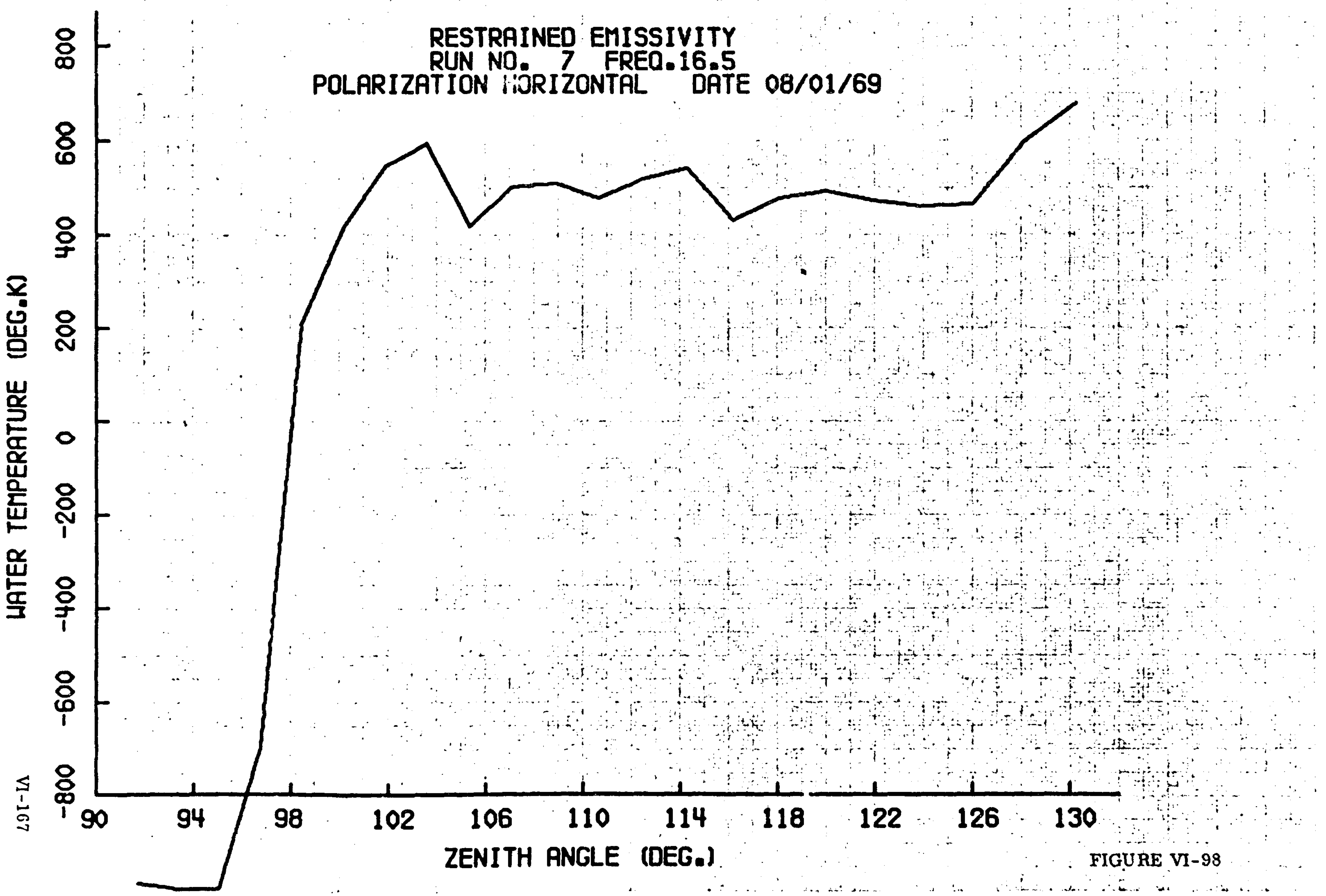
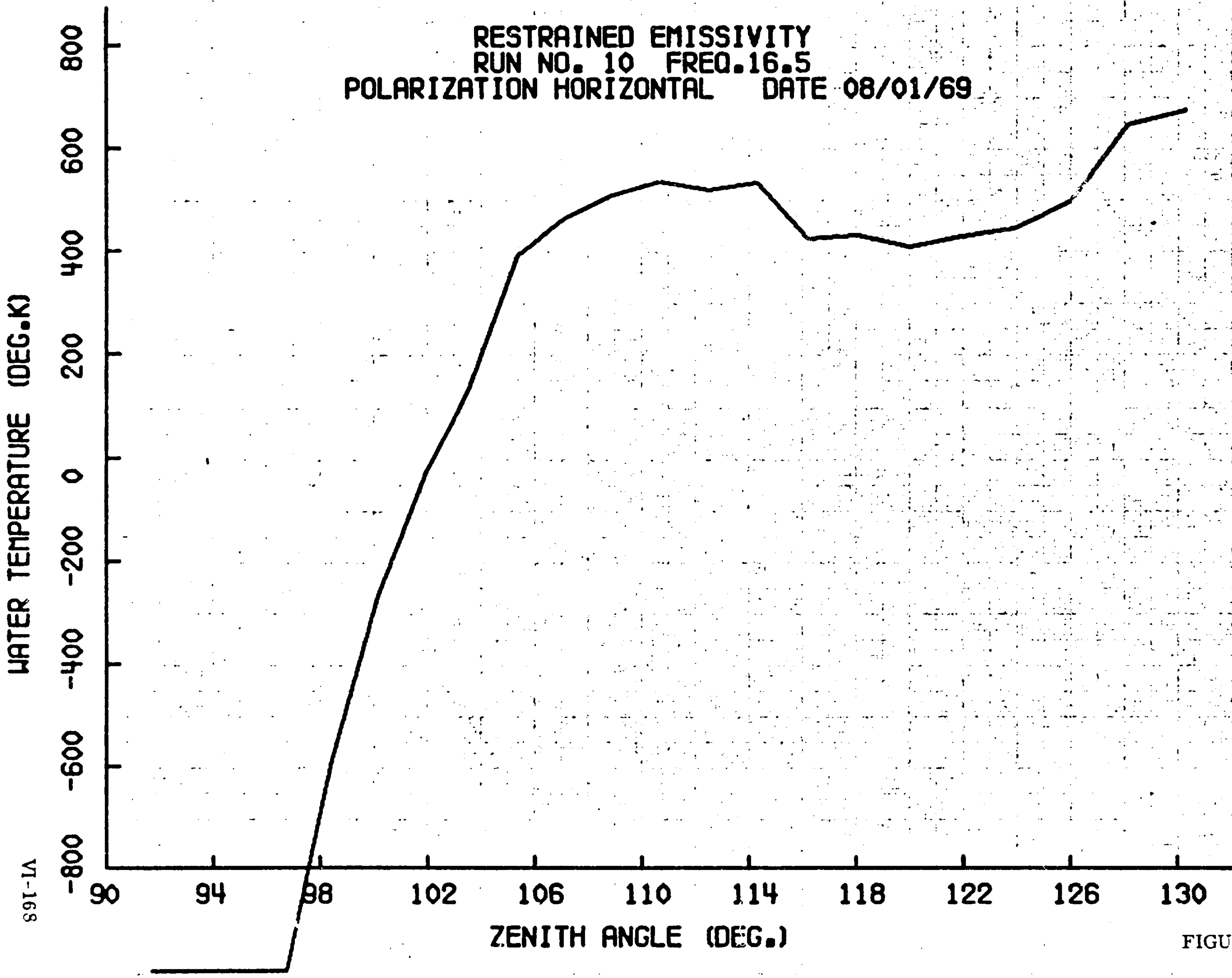

RESTRAINED EMISSIVITY
RUN NO. 7 FREQ.16.5
POLARIZATION HORIZONTAL DATE 08/01/69
WATER TEMPERATURE (DEG.K)
800
600
400
200
0
-200
-400
-600
-800
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-98



RESTRAINED EMISSIVITY
RUN NO. 10 FREQ.16.5
POLARIZATION HORIZONTAL DATE 08/01/69
WATER TEMPERATURE (DEG.K)
800
600
400
200
0
-200
-400
-600
-800
90
94
98
102
106
110
114
118
122
126
130
ZENITH ANGLE (DEG.)

FIGURE VI-99

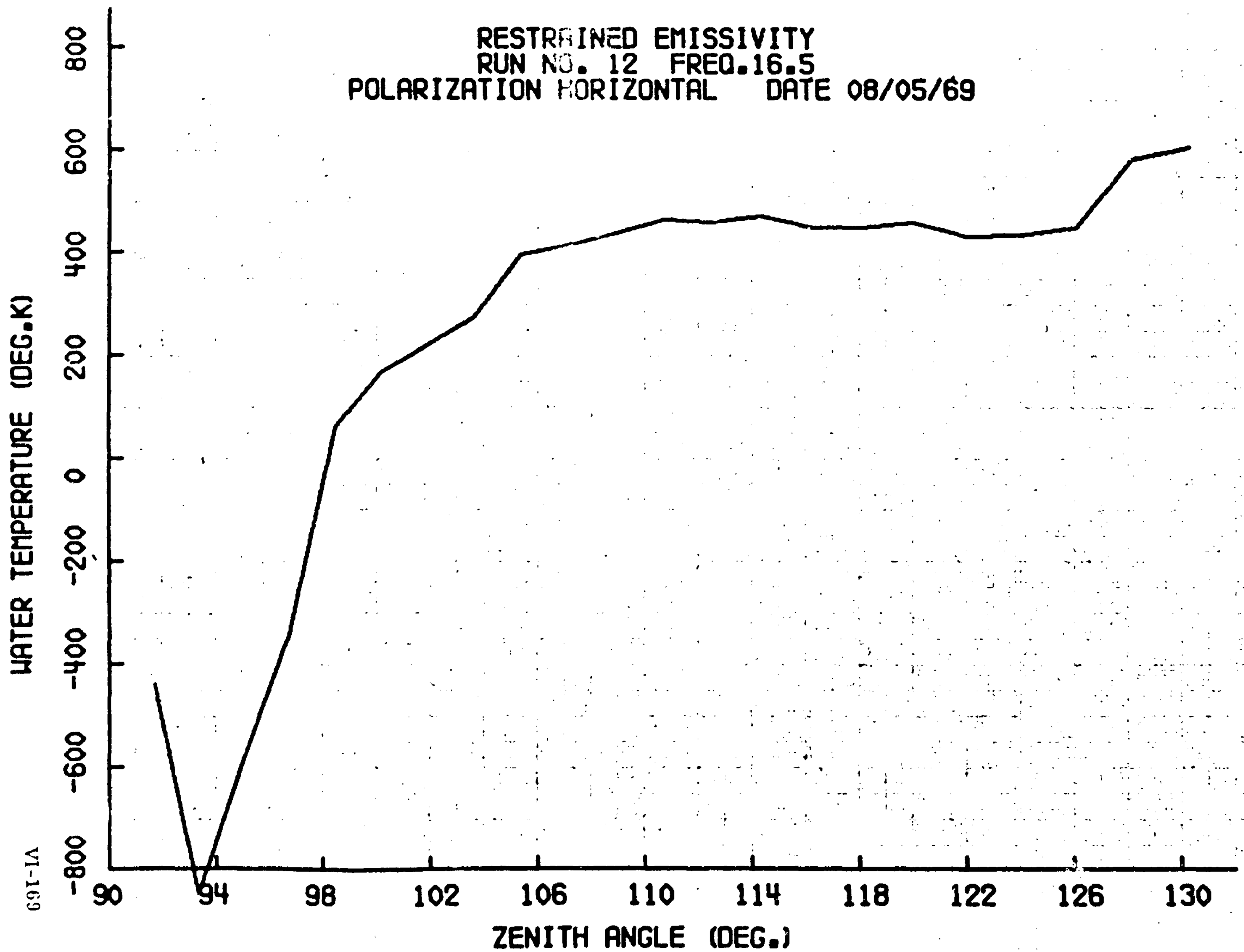


FIGURE VI-100

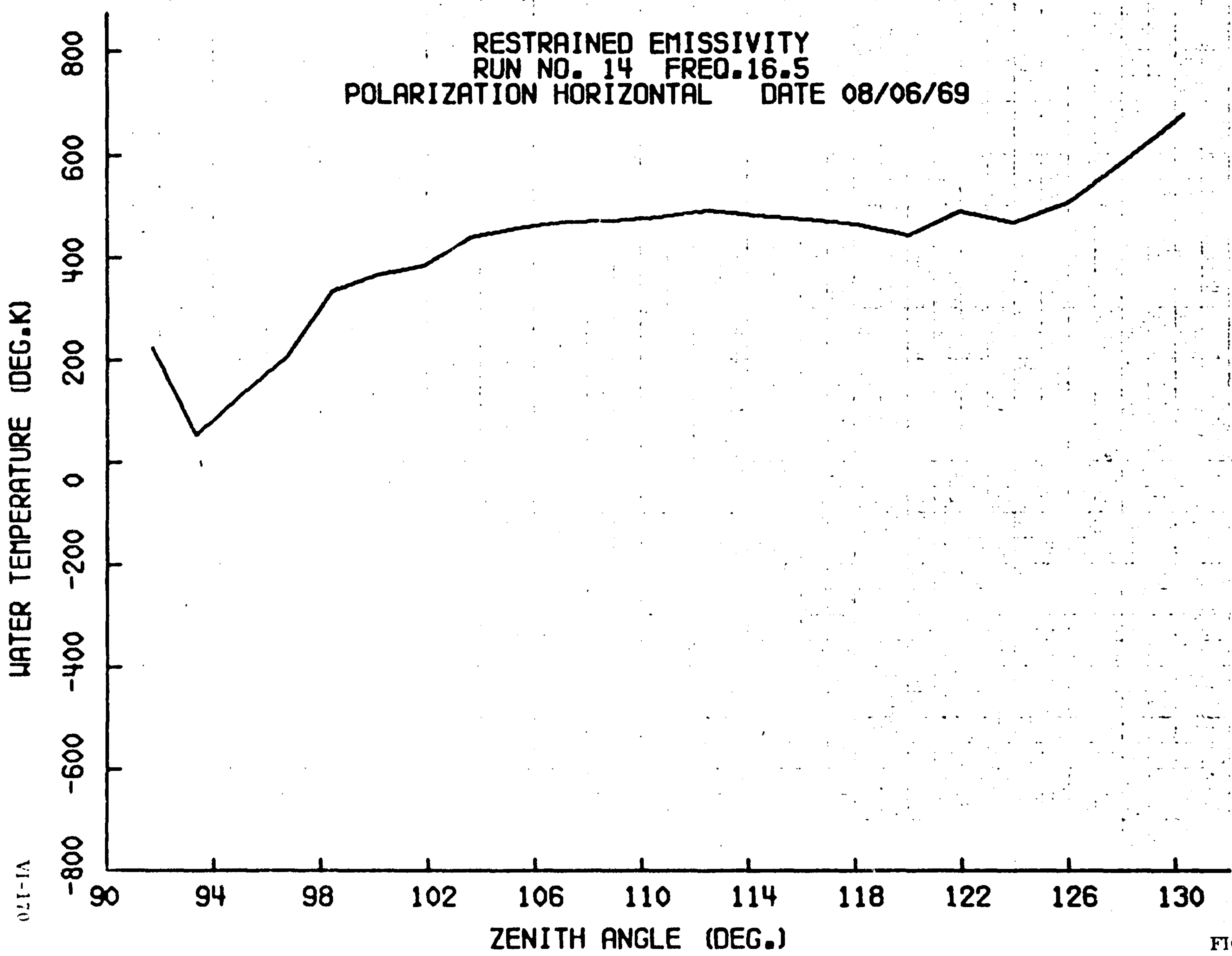


FIGURE VI-101

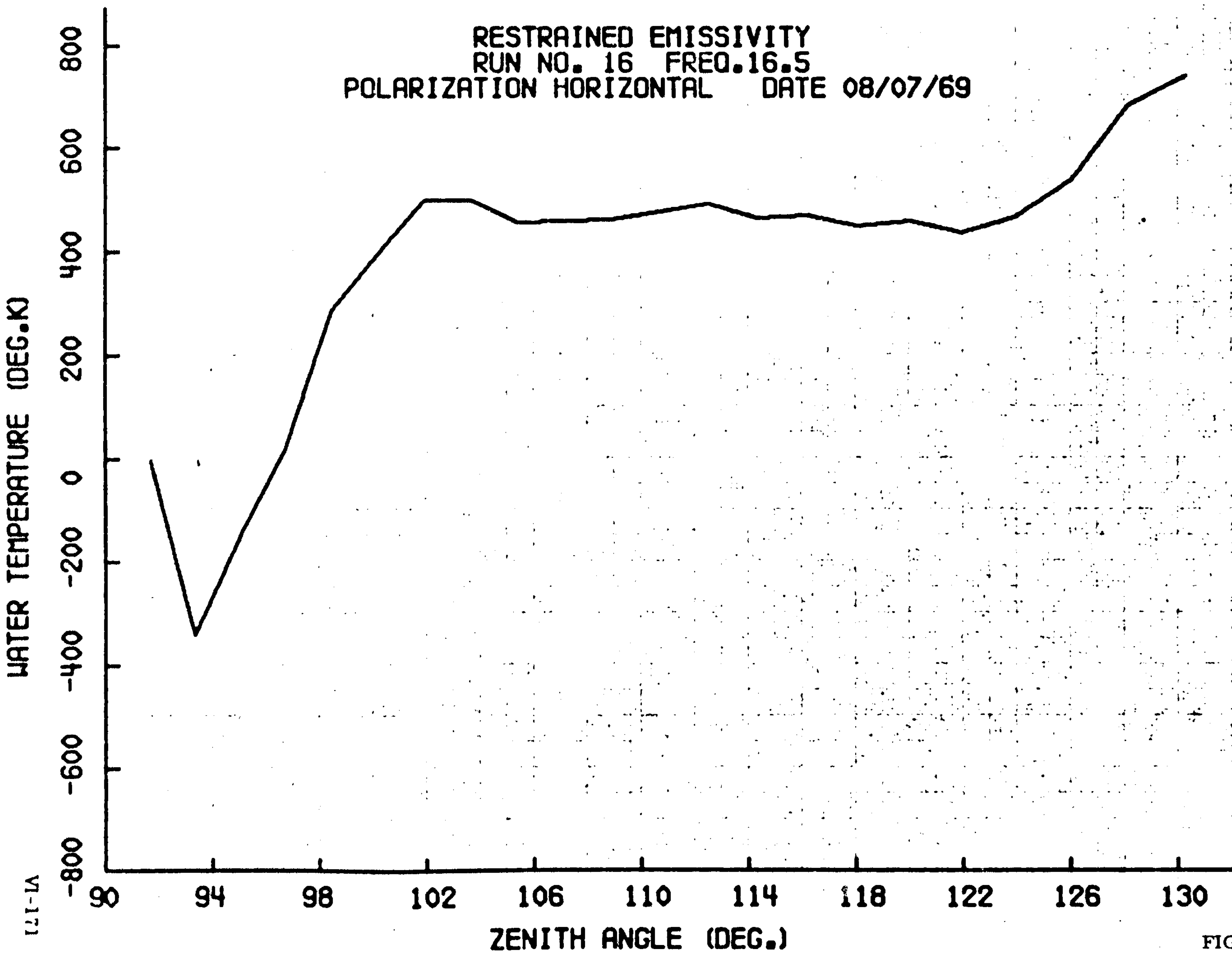


FIGURE VI-102

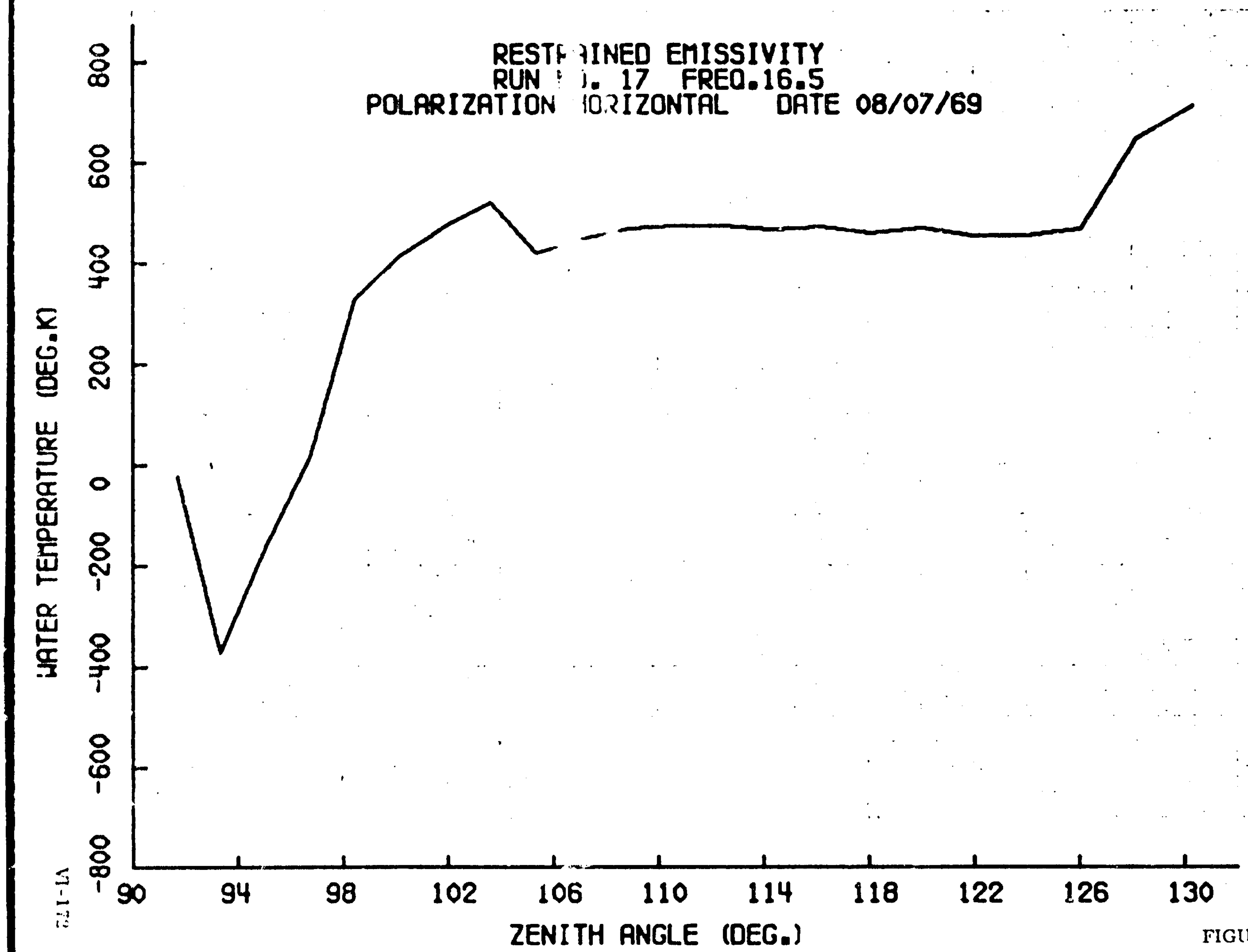


FIGURE VI-103

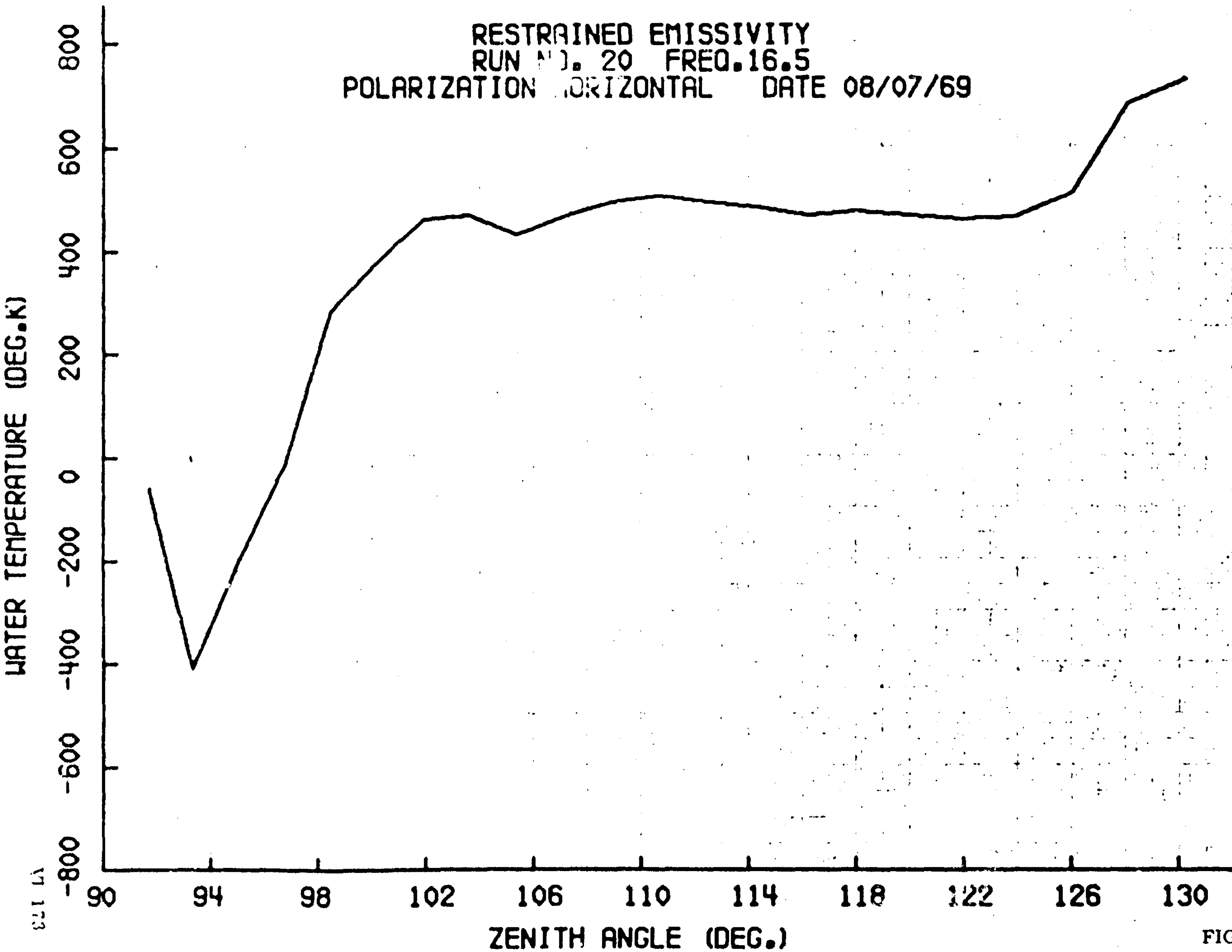


FIGURE VI-104

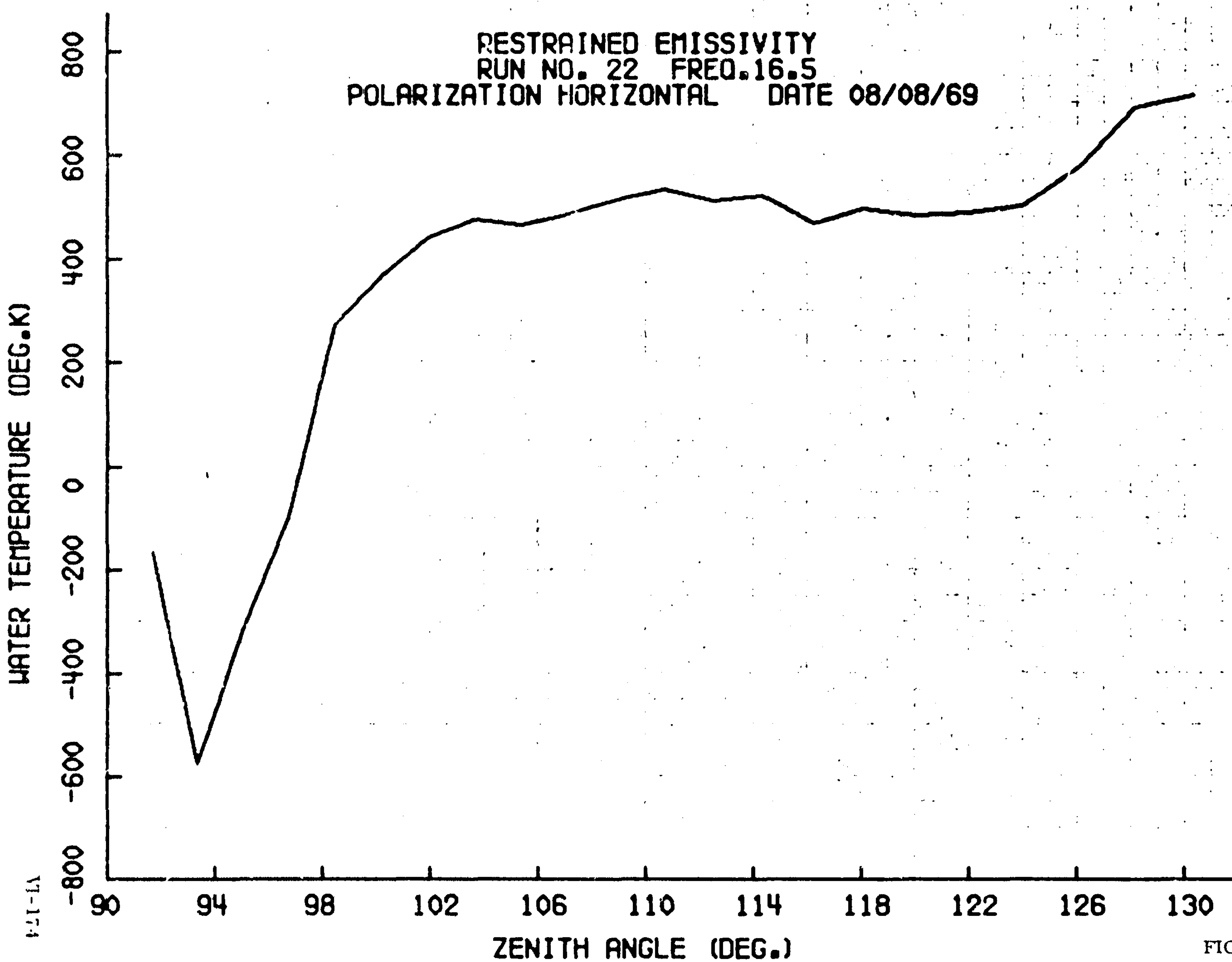


FIGURE VI-105

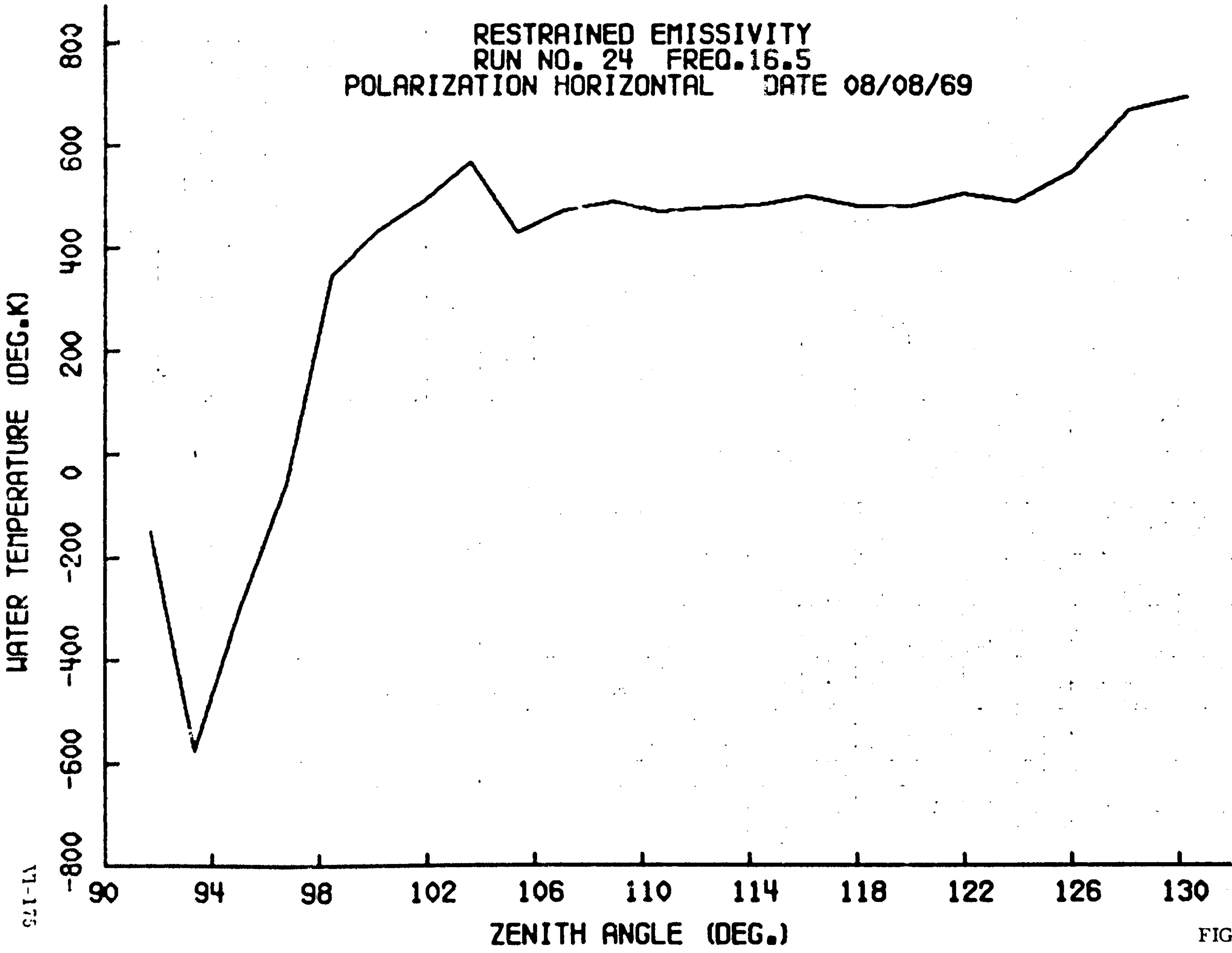


FIGURE VI-106

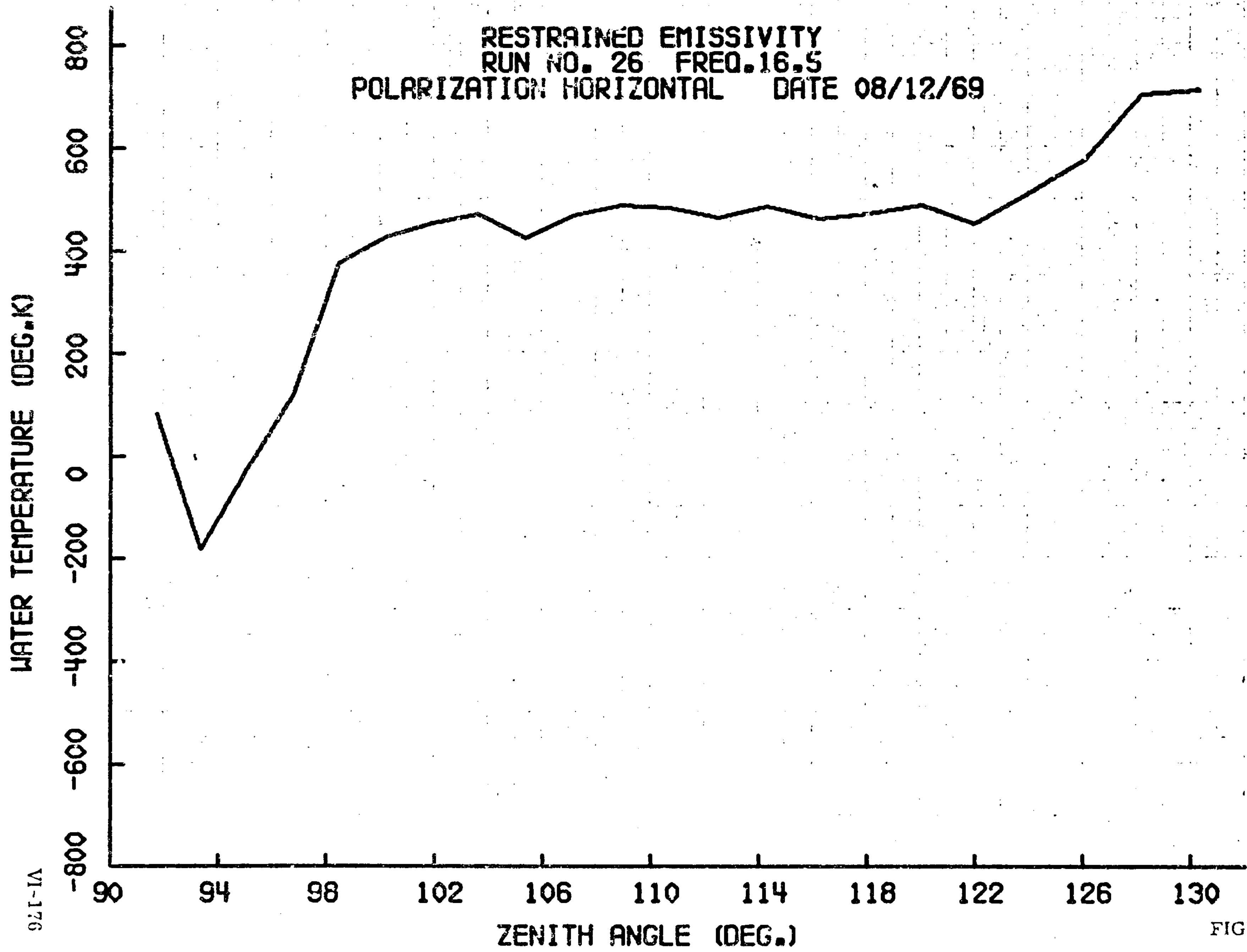


FIGURE VI-107

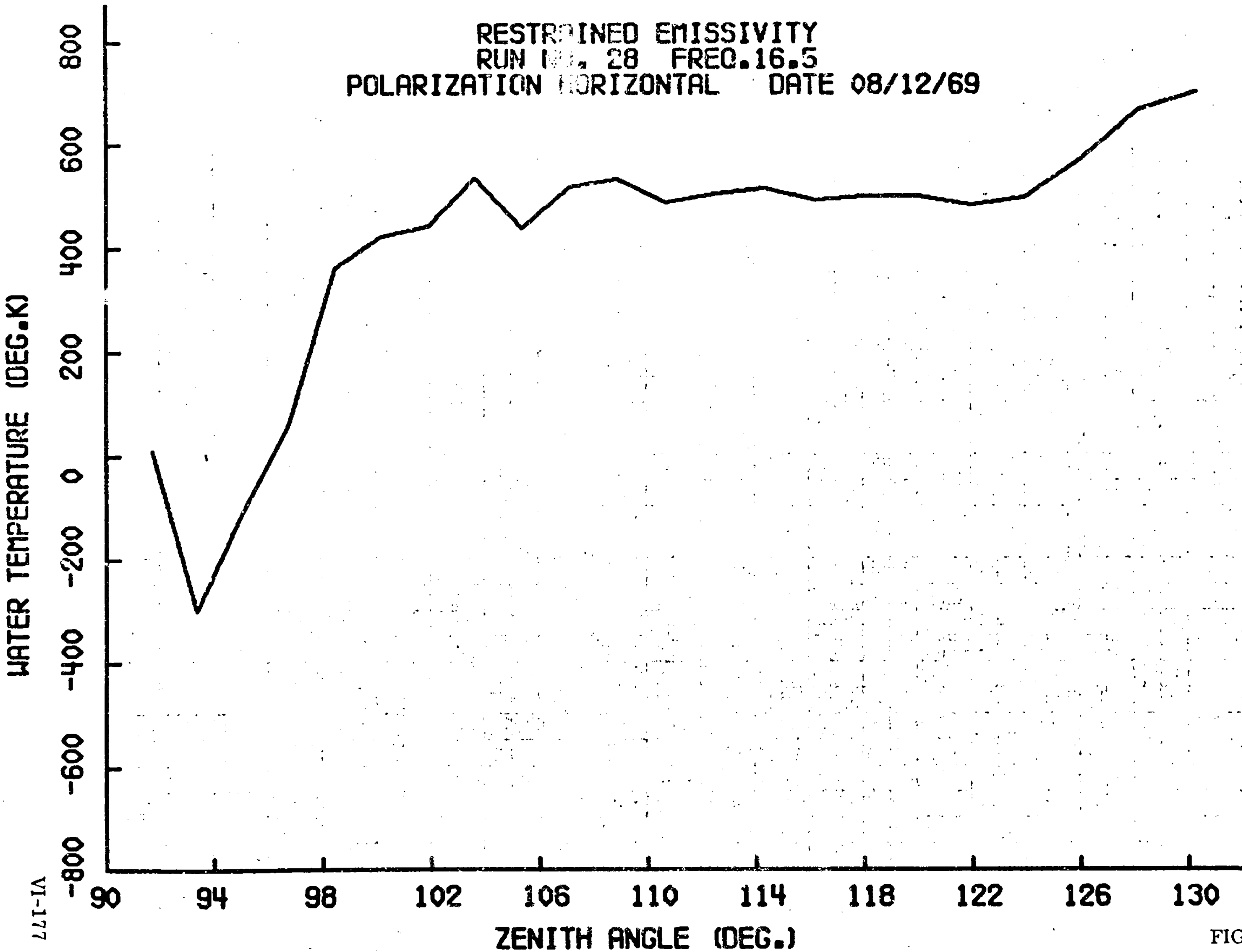


FIGURE VI-108

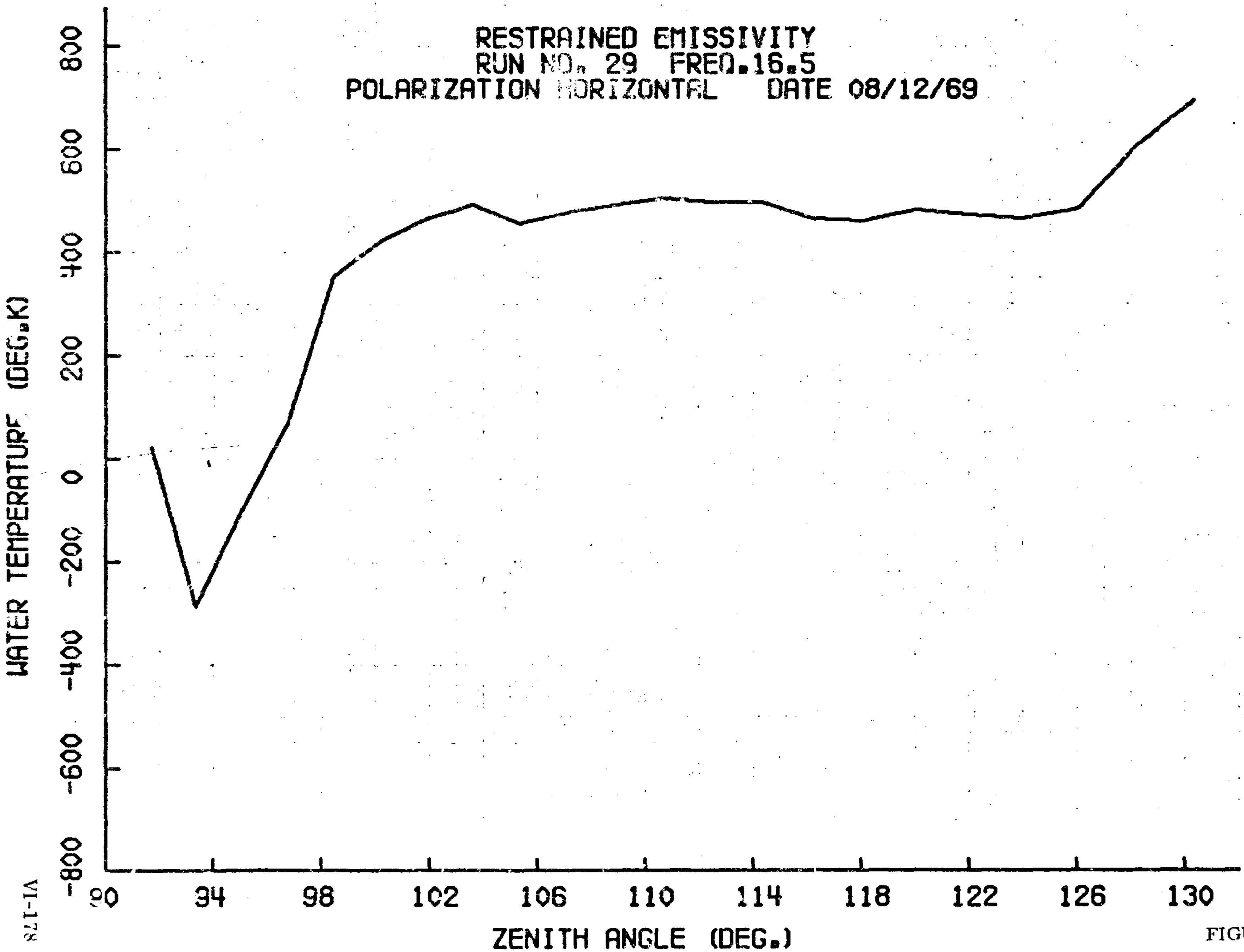


FIGURE VI-109

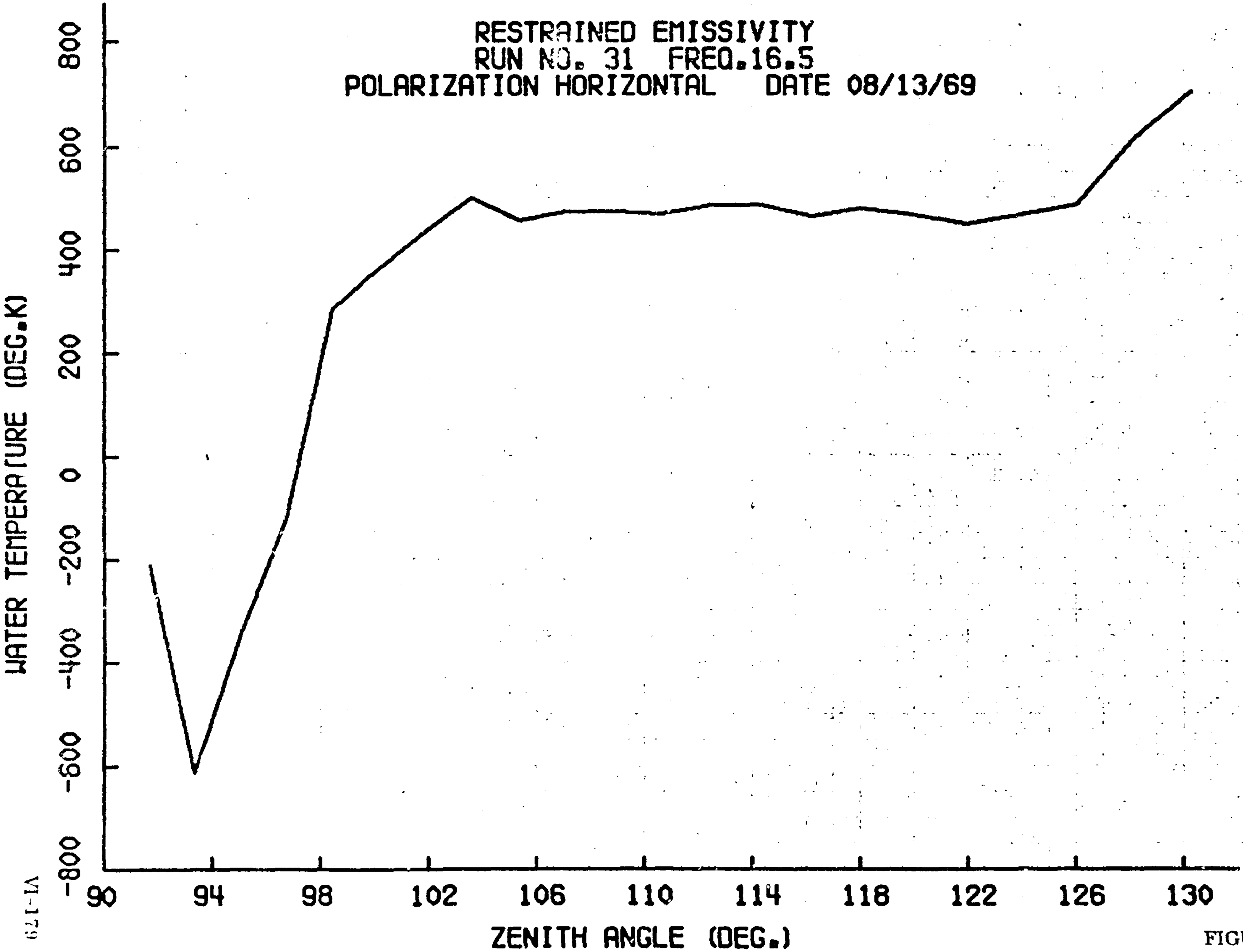


FIGURE VI-110

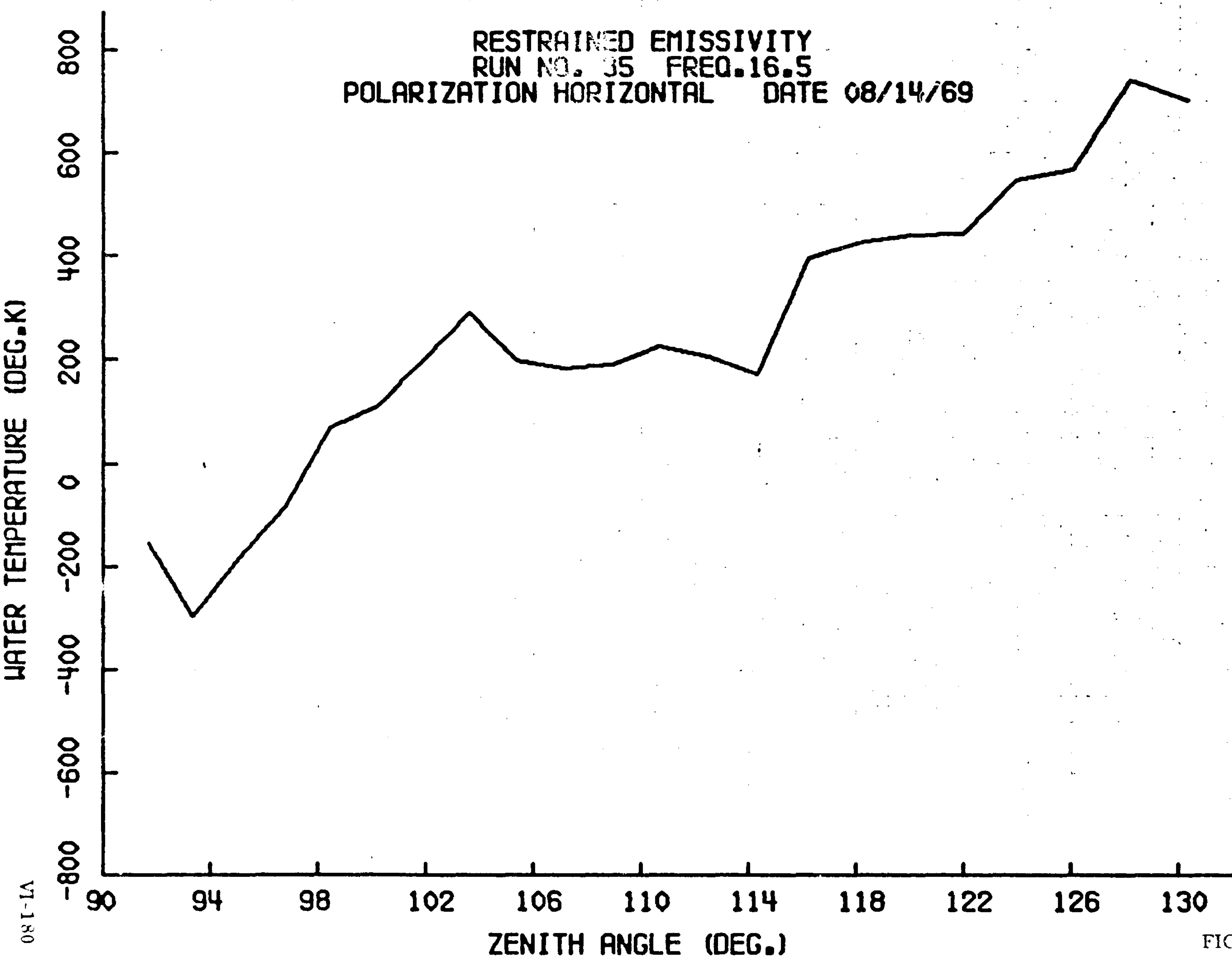


FIGURE VI-111

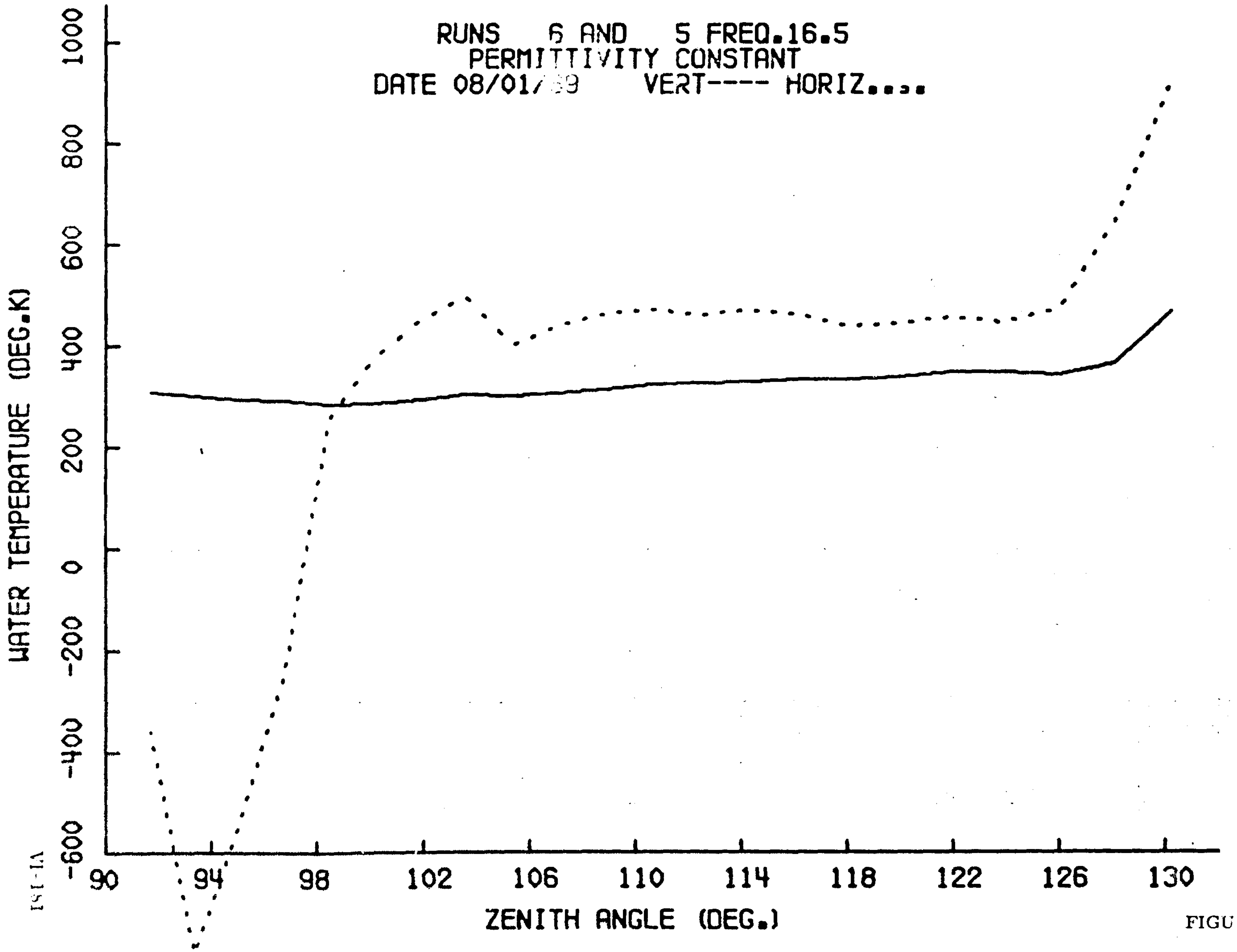


FIGURE VI-112

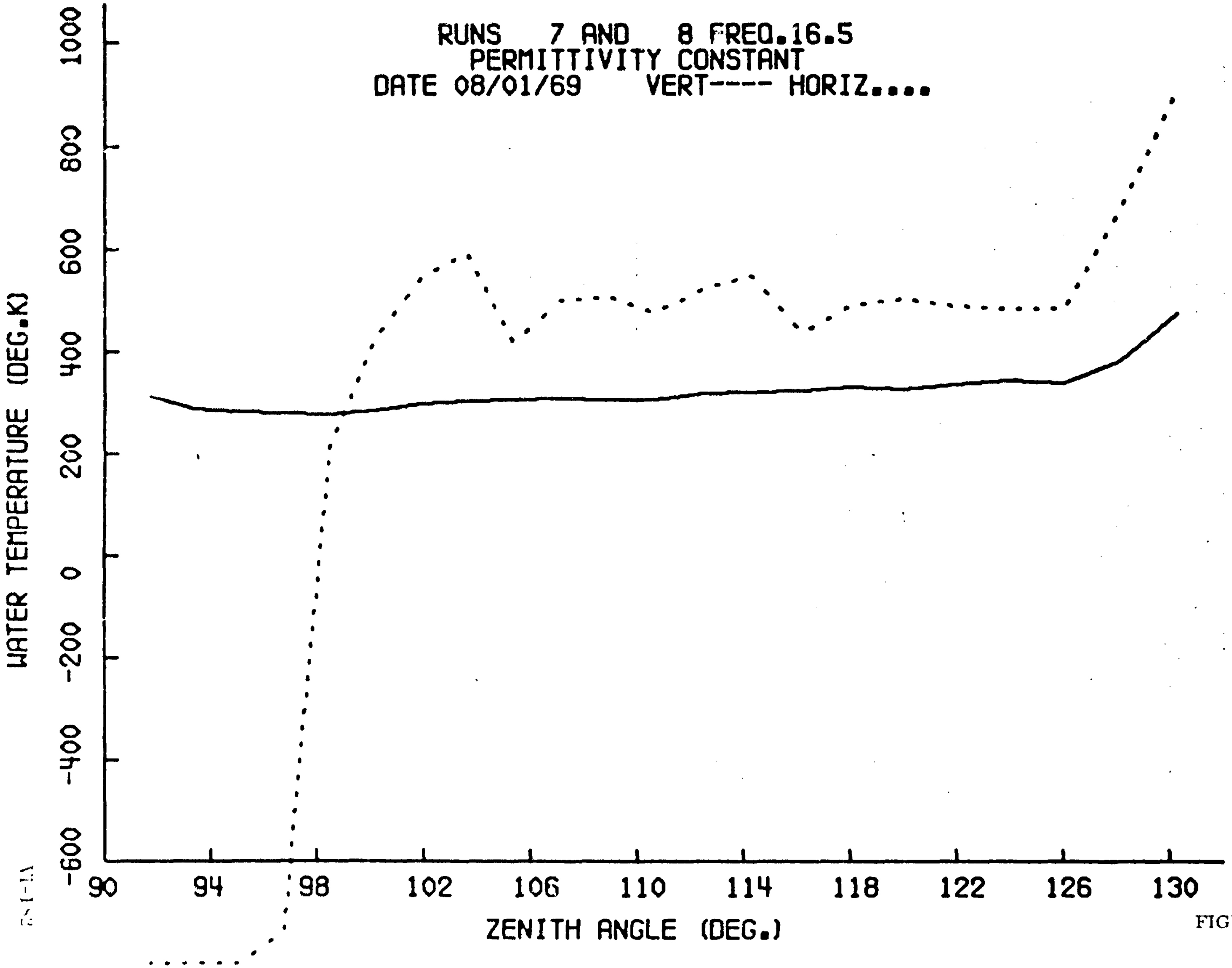


FIGURE VI-113

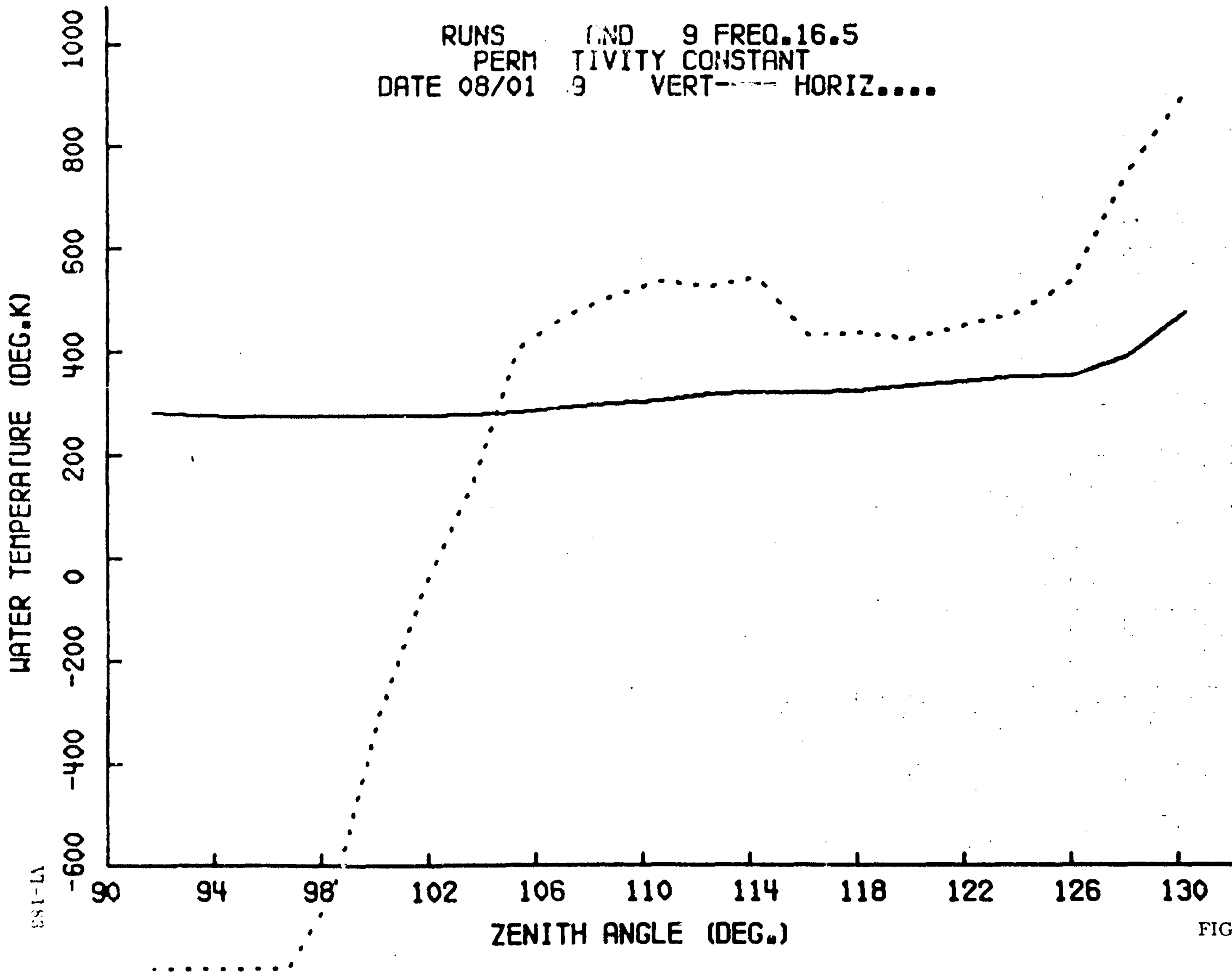


FIGURE VI-114

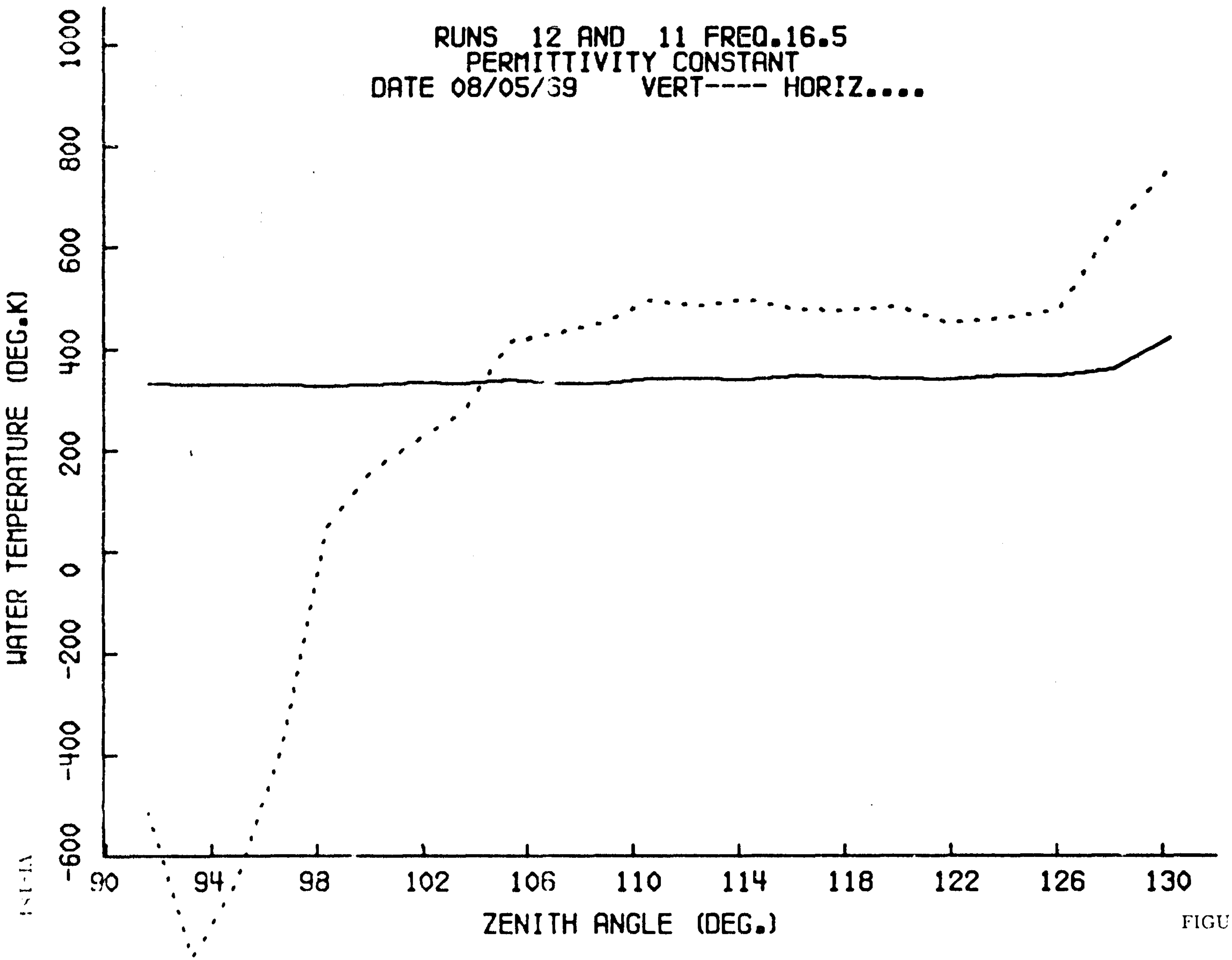


FIGURE VI-115

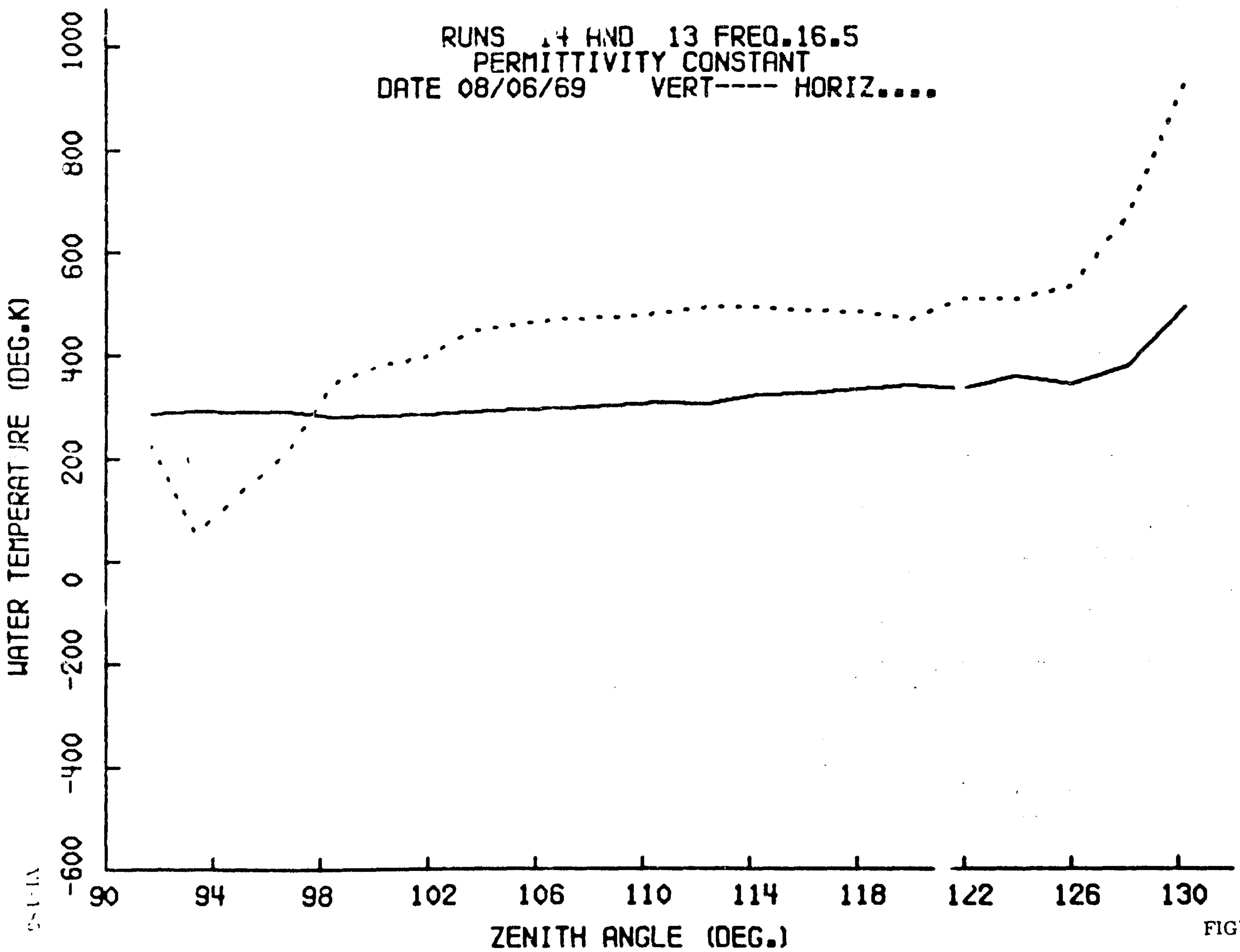


FIGURE VI-116

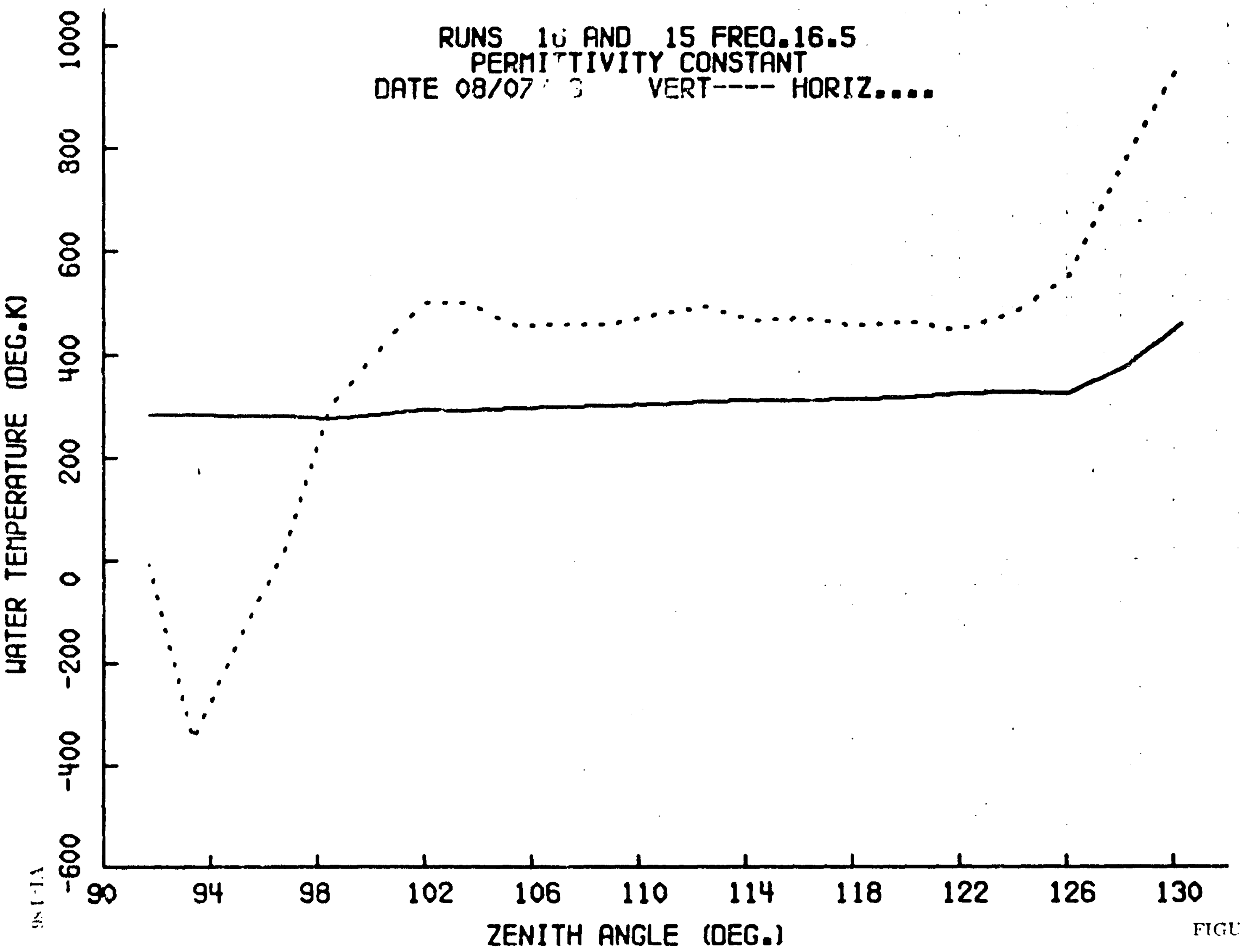


FIGURE VI-117

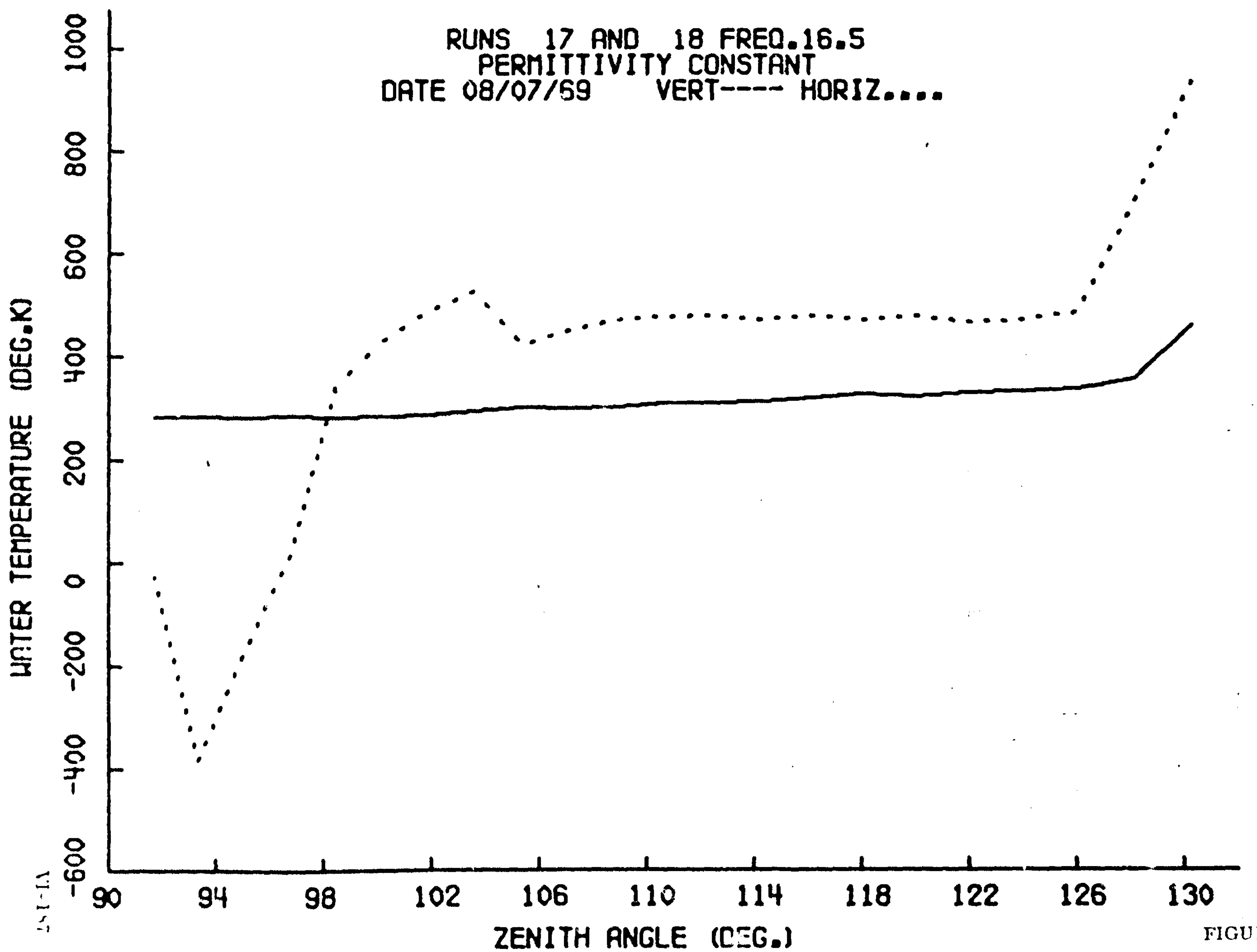


FIGURE VI-118

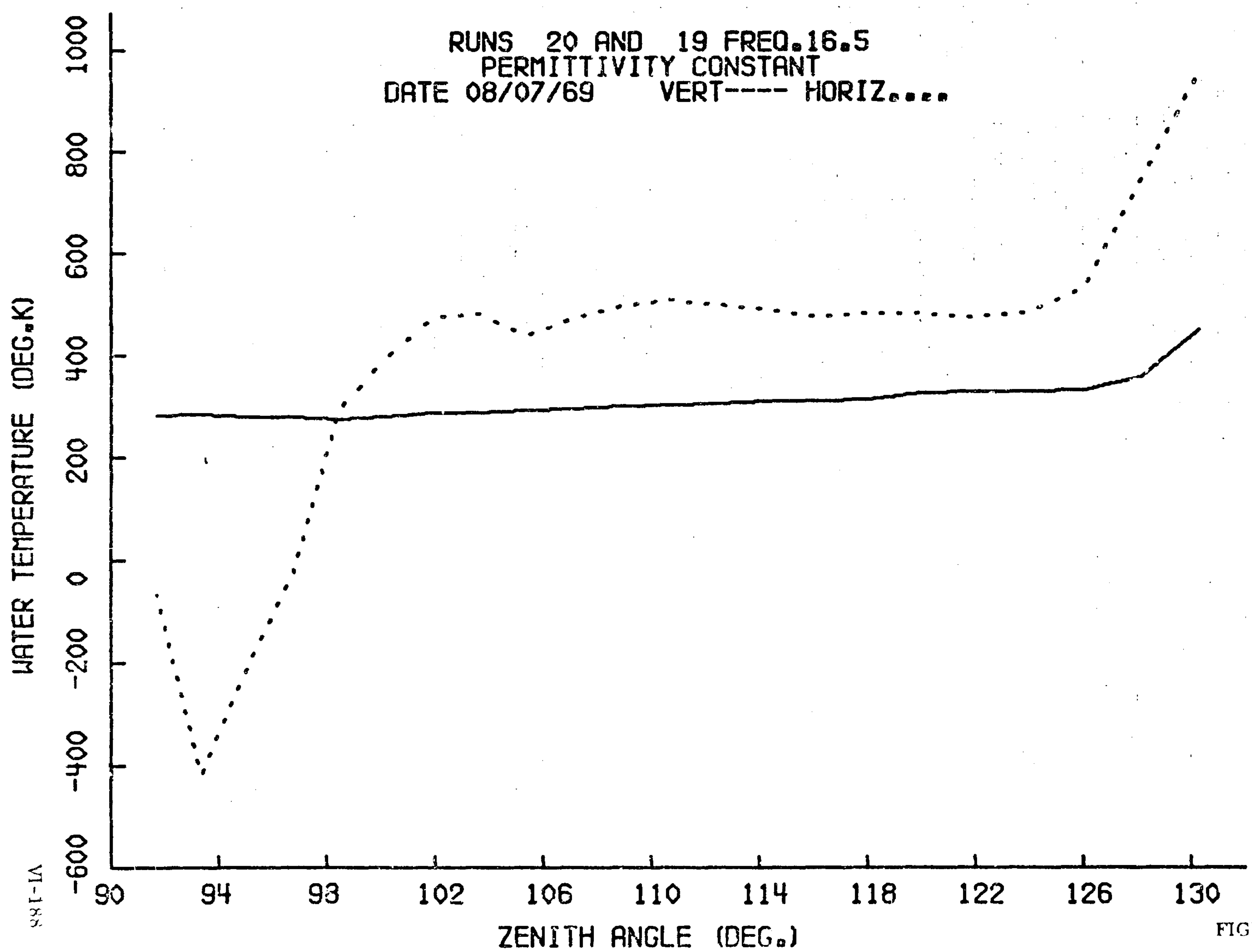


FIGURE VI-119

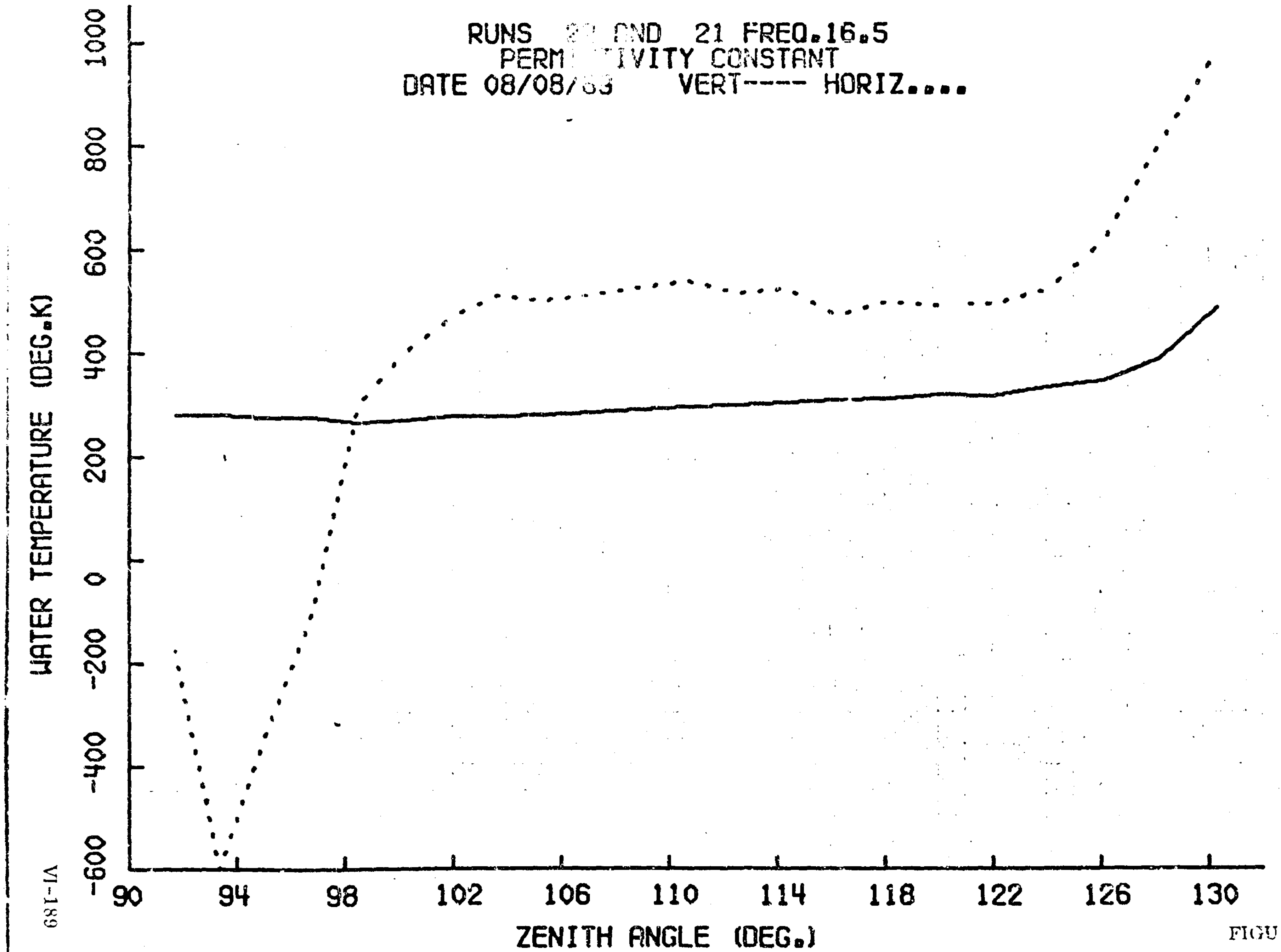


FIGURE VI-120

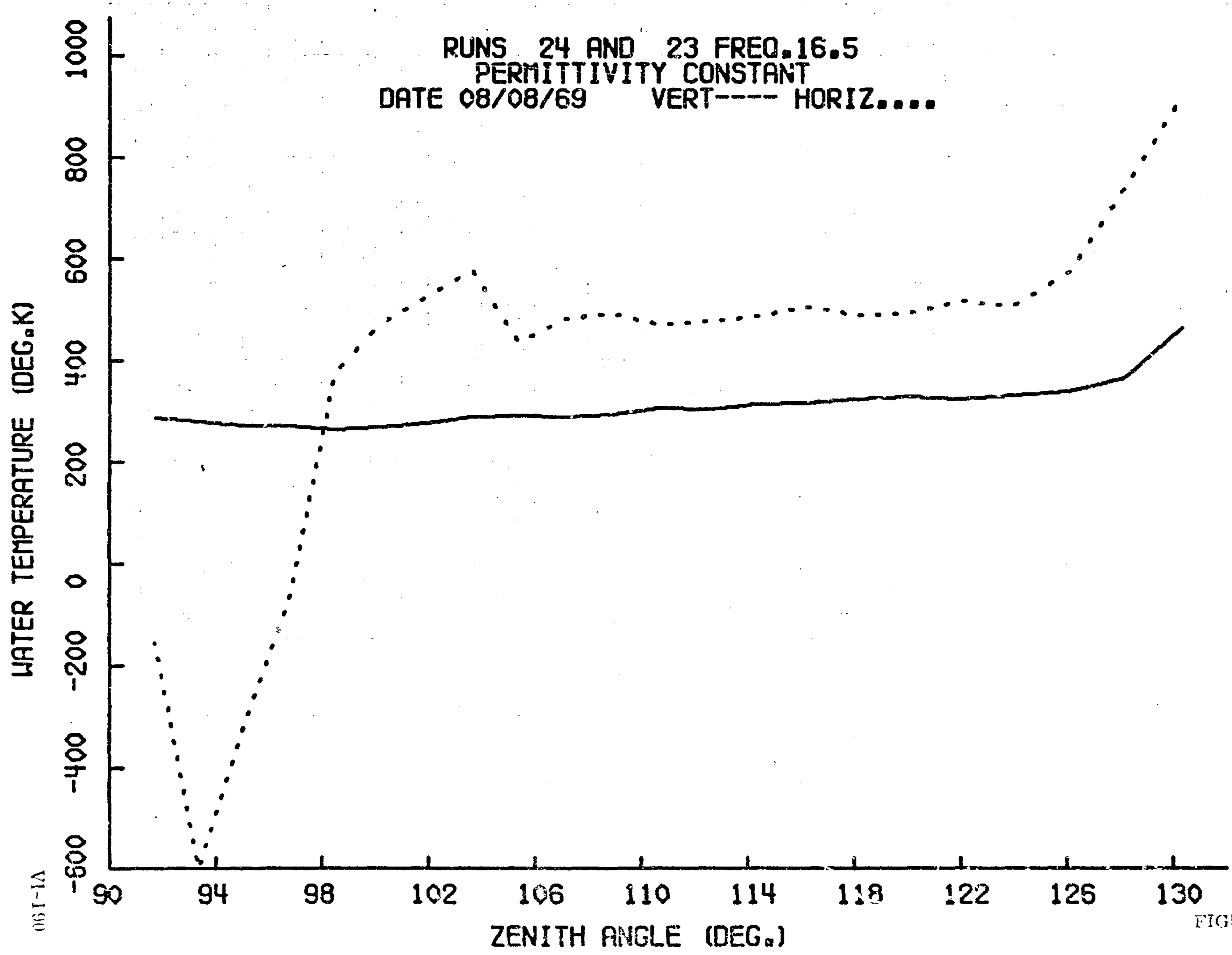


FIGURE VI-121

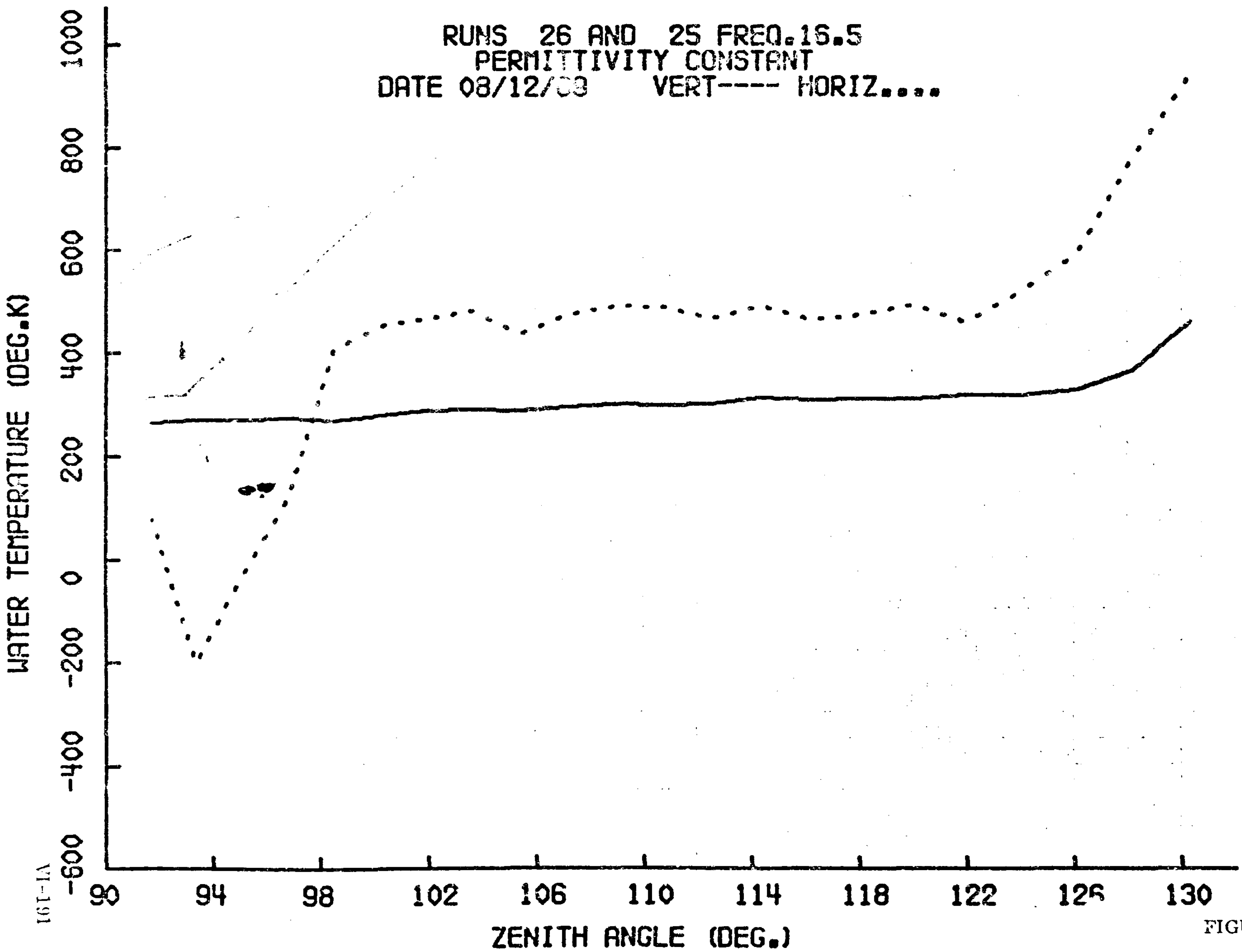


FIGURE VI-122

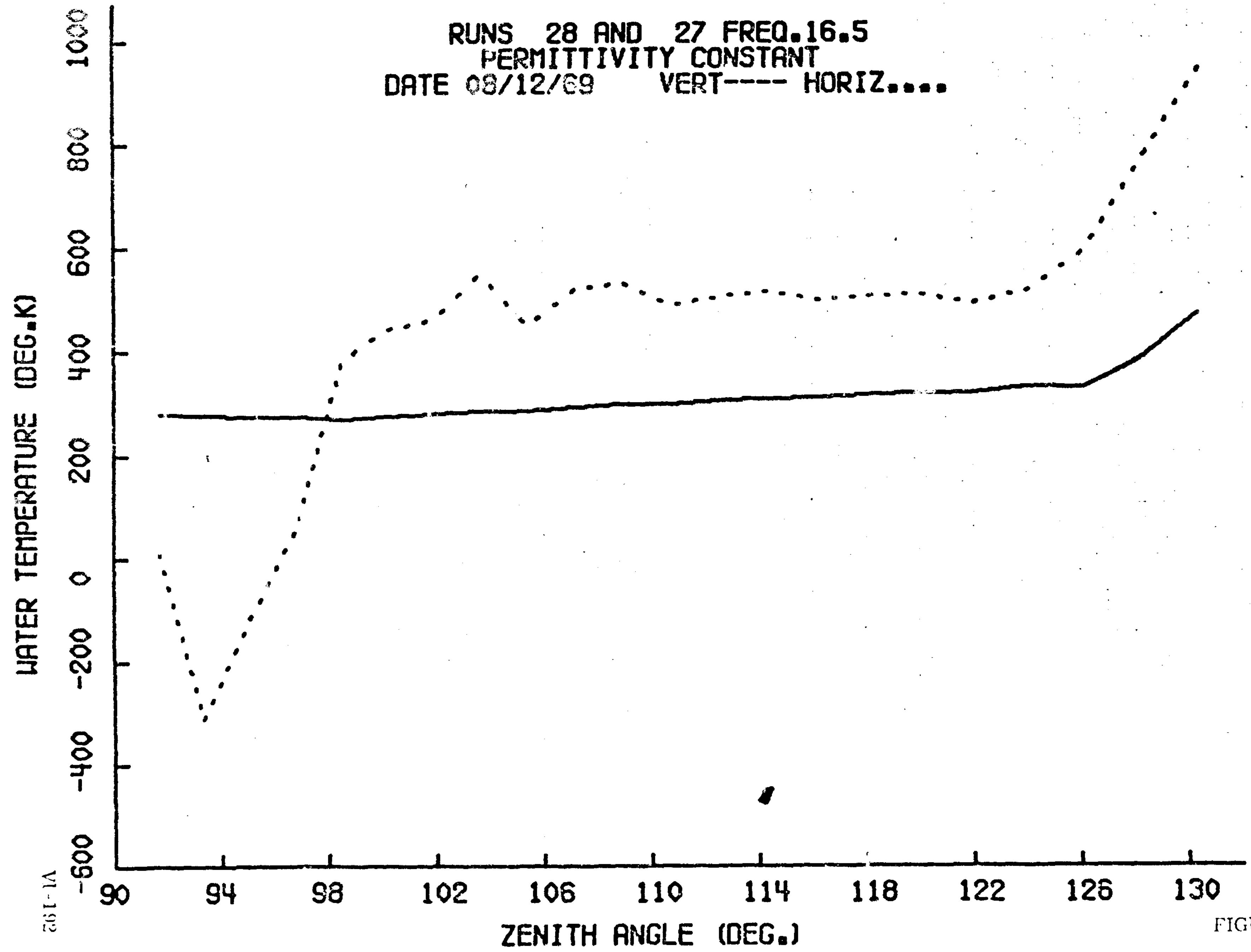


FIGURE VI-123

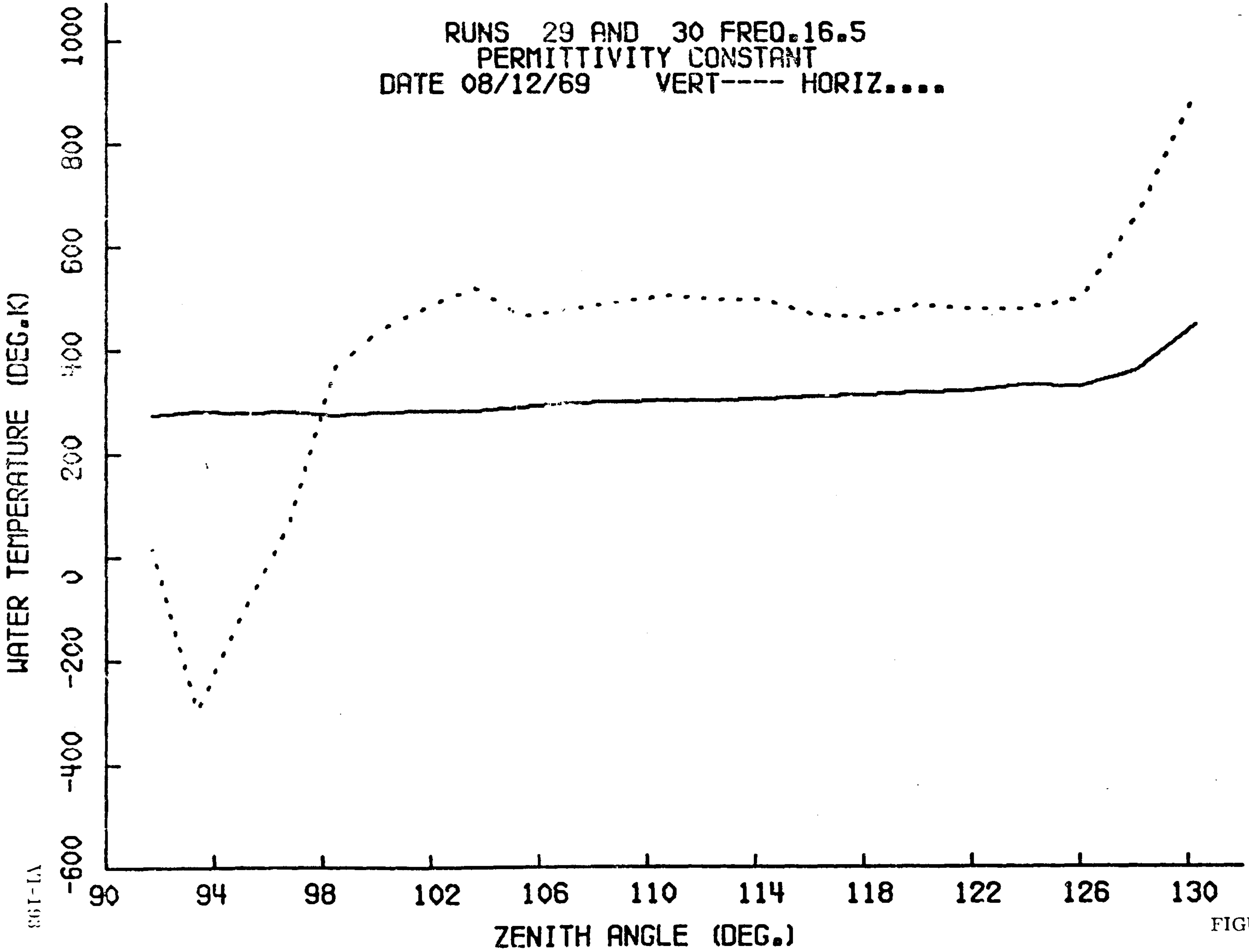


FIGURE VI-124

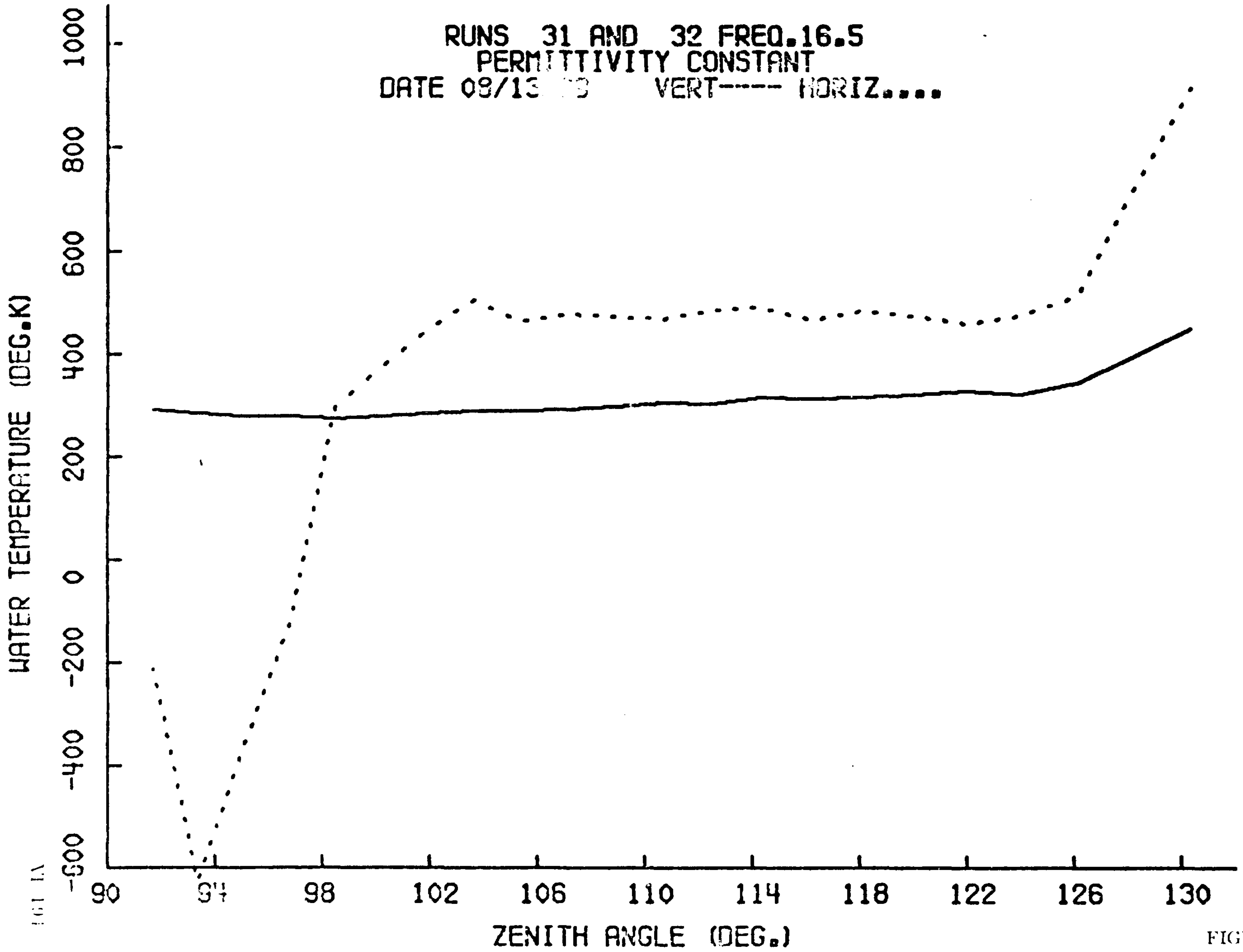


FIGURE VI-125

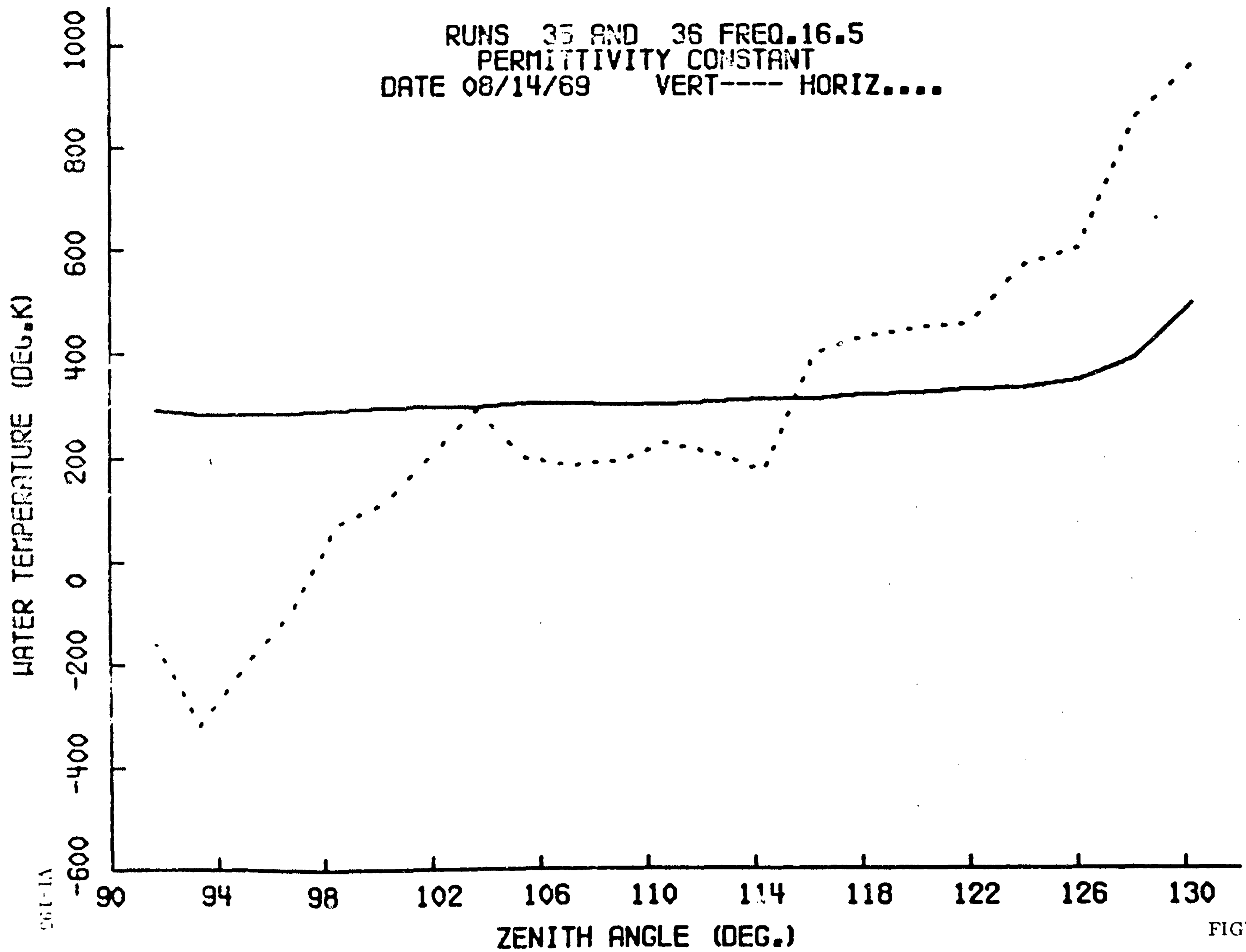


FIGURE VI-126

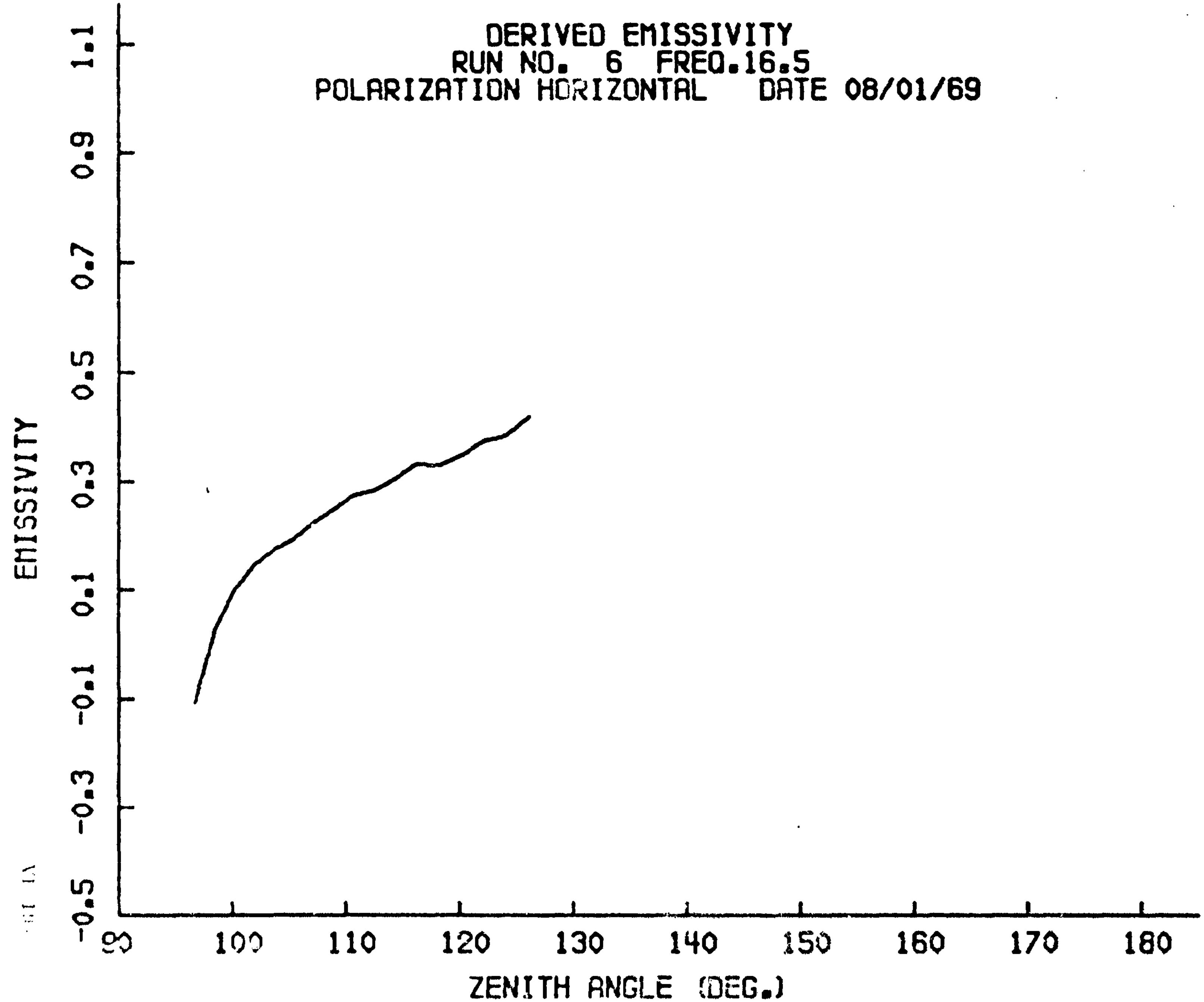


FIGURE VI-127

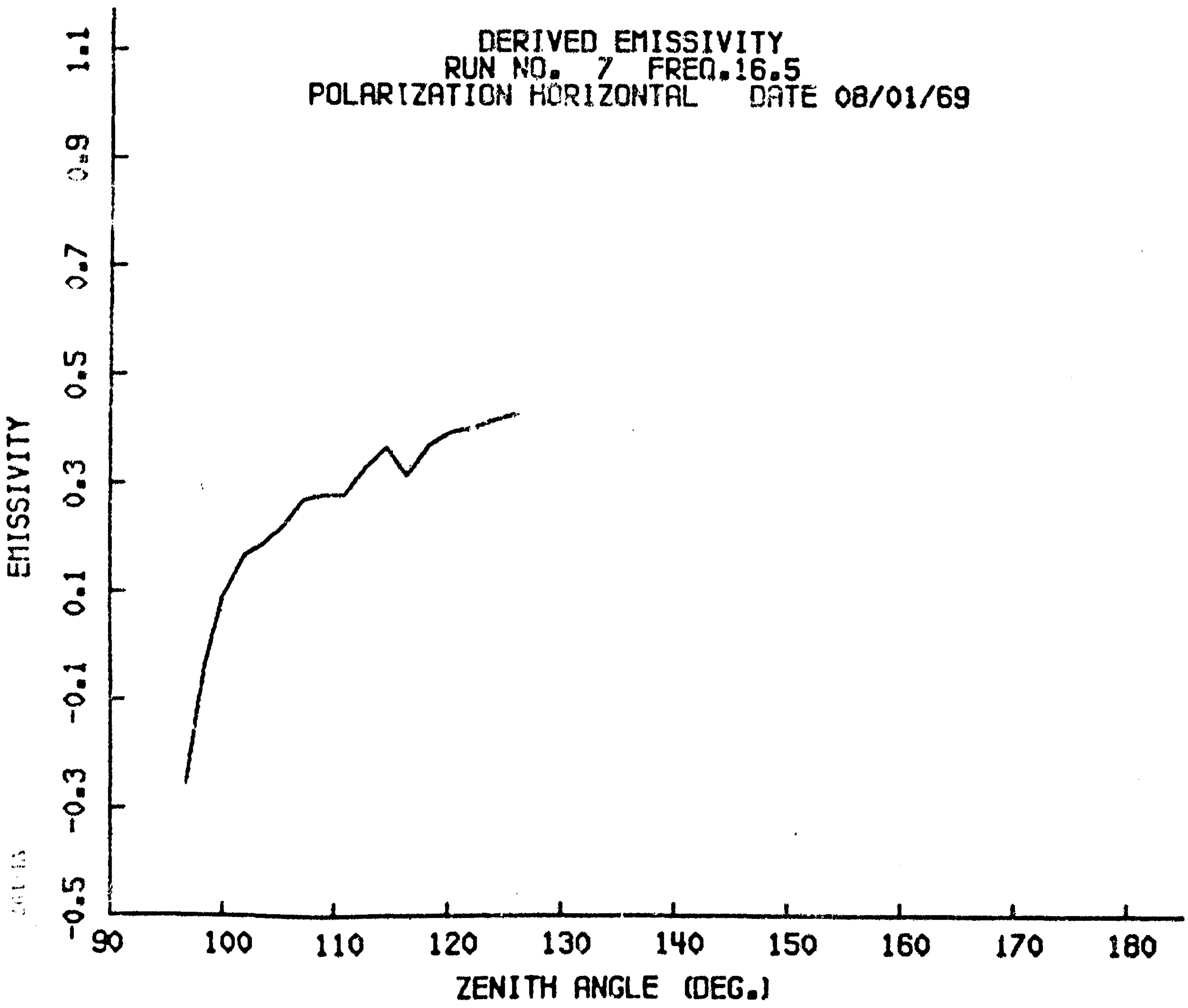


FIGURE VI-128

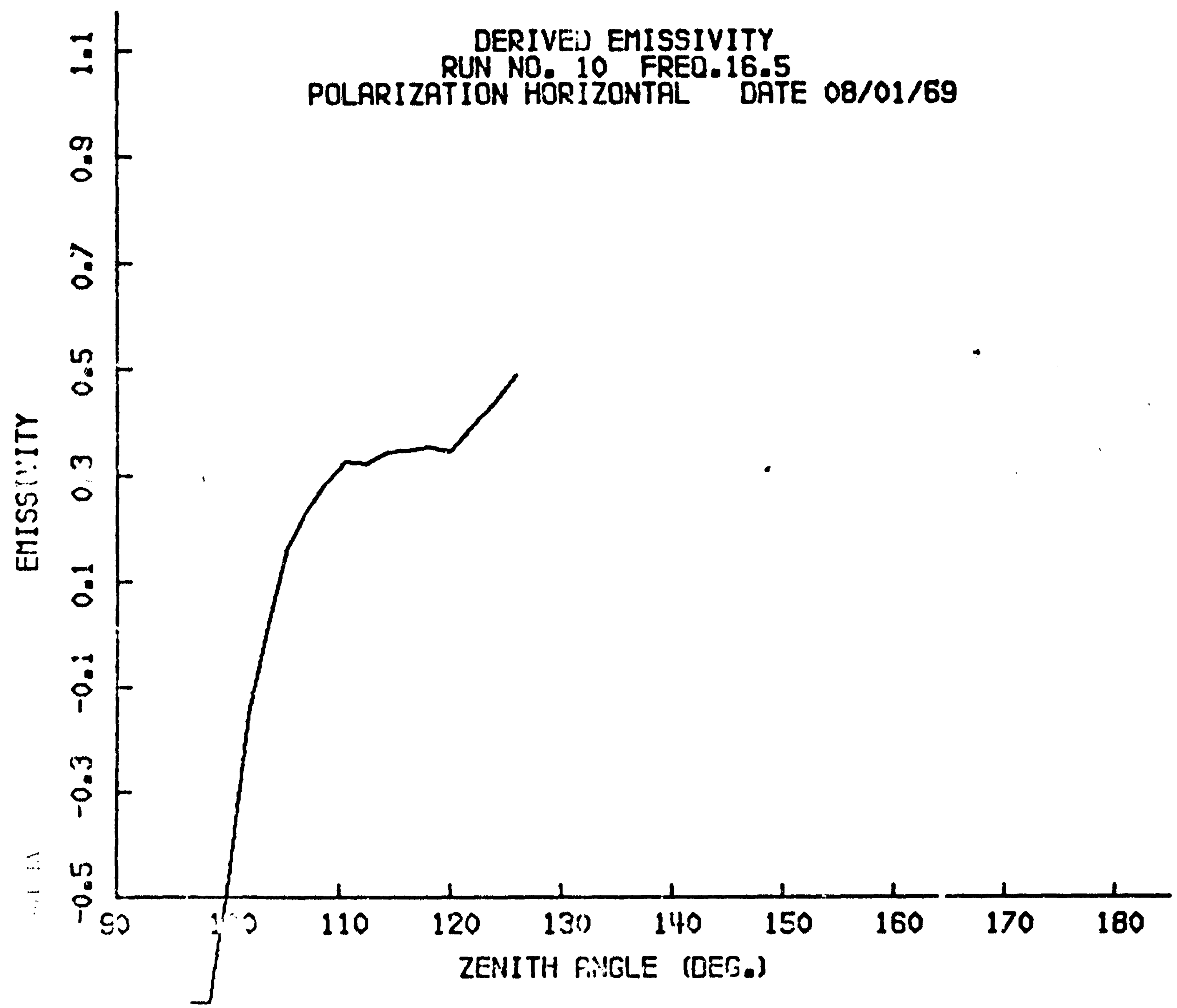


FIGURE VI-129

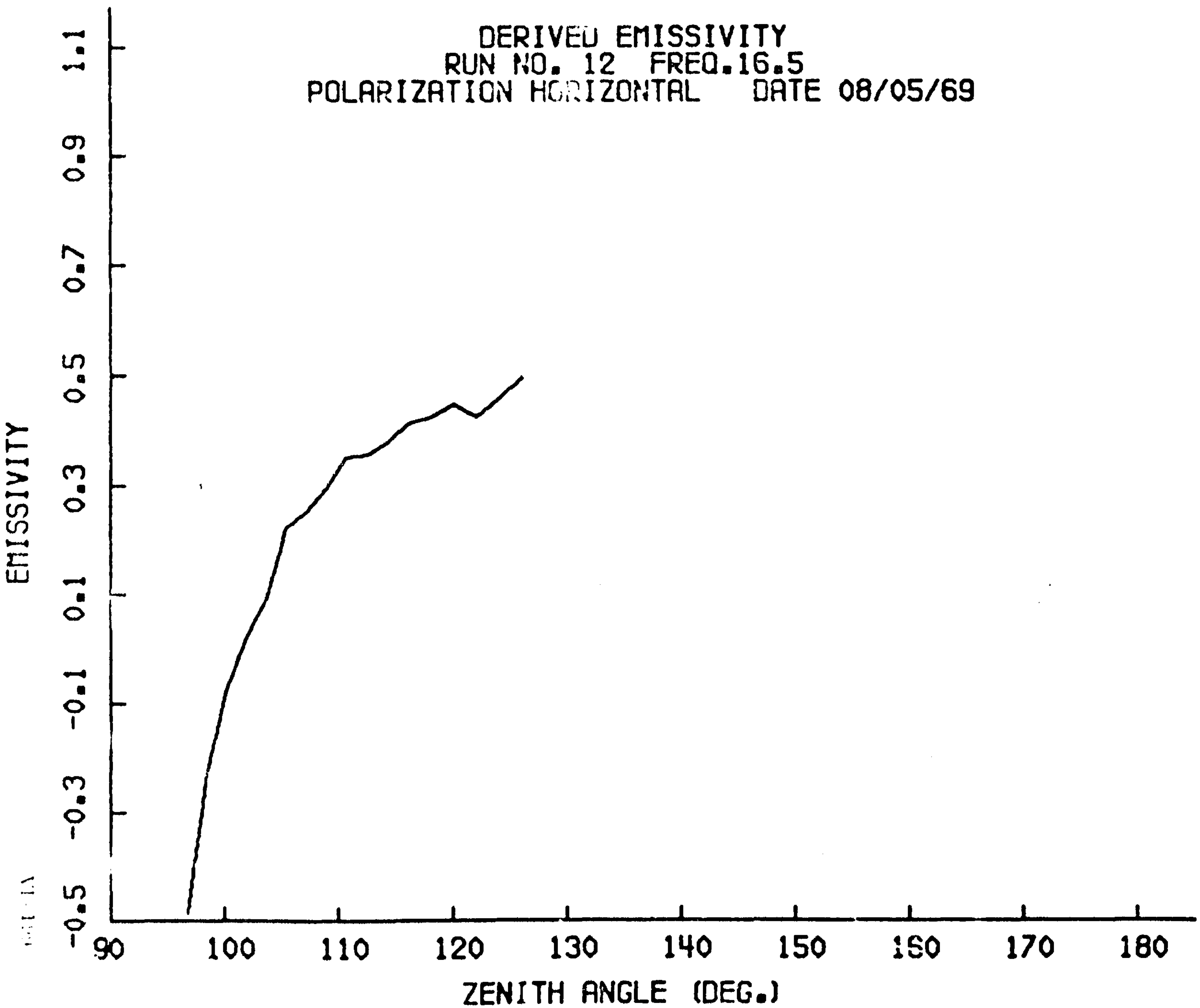


FIGURE VI-130

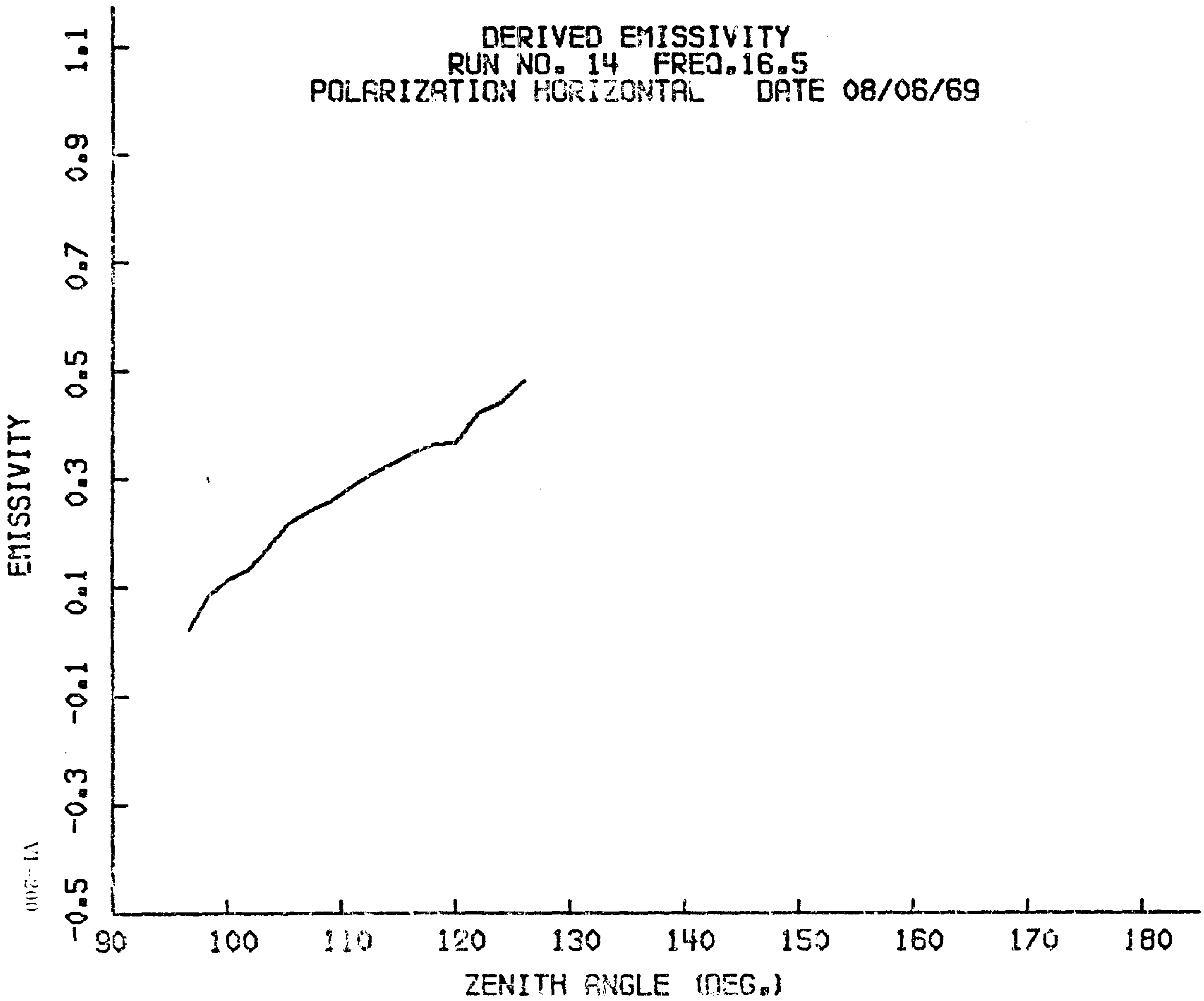


FIGURE VI-131

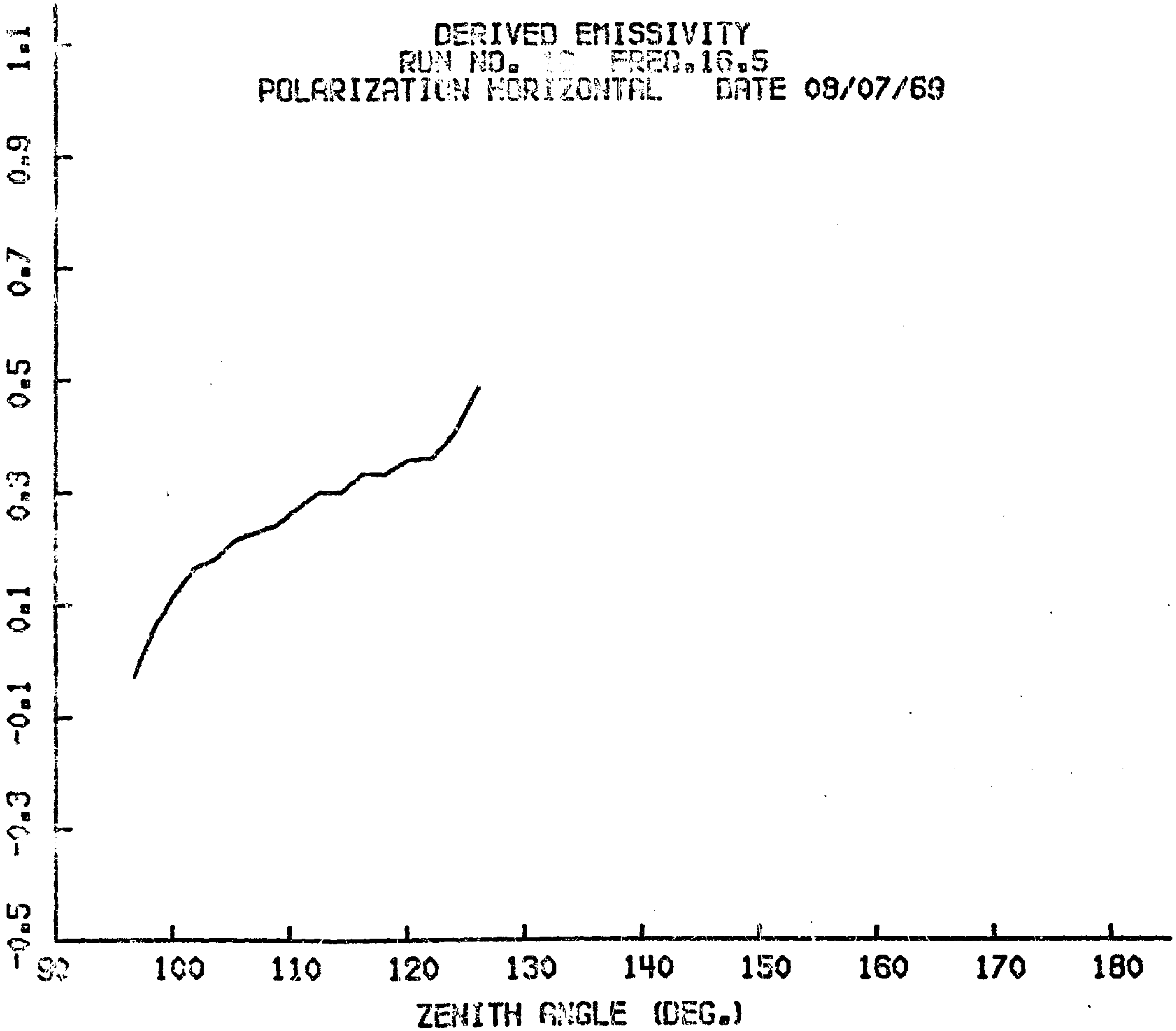


FIGURE VI-132

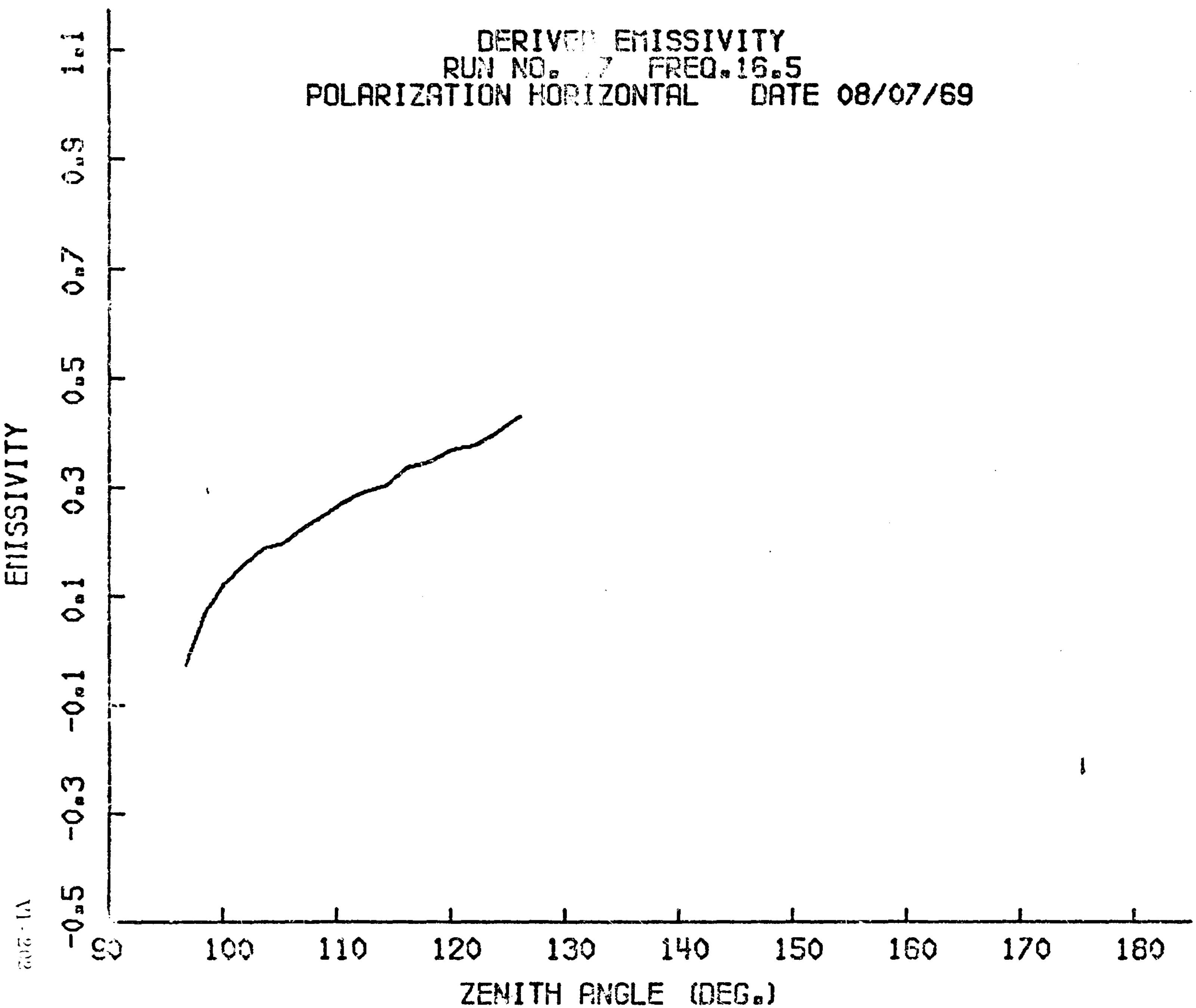


FIGURE VI-133

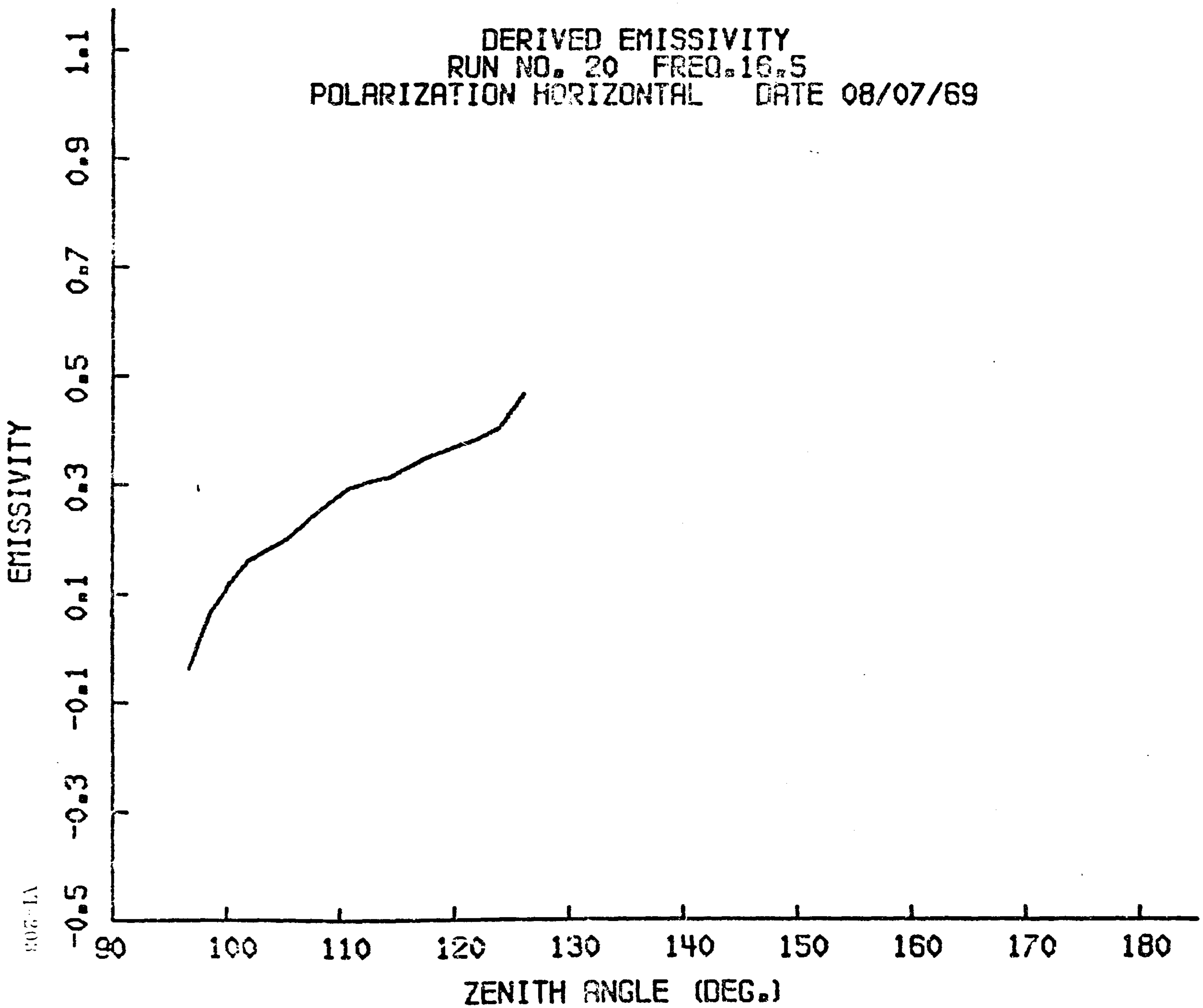


FIGURE VI-134

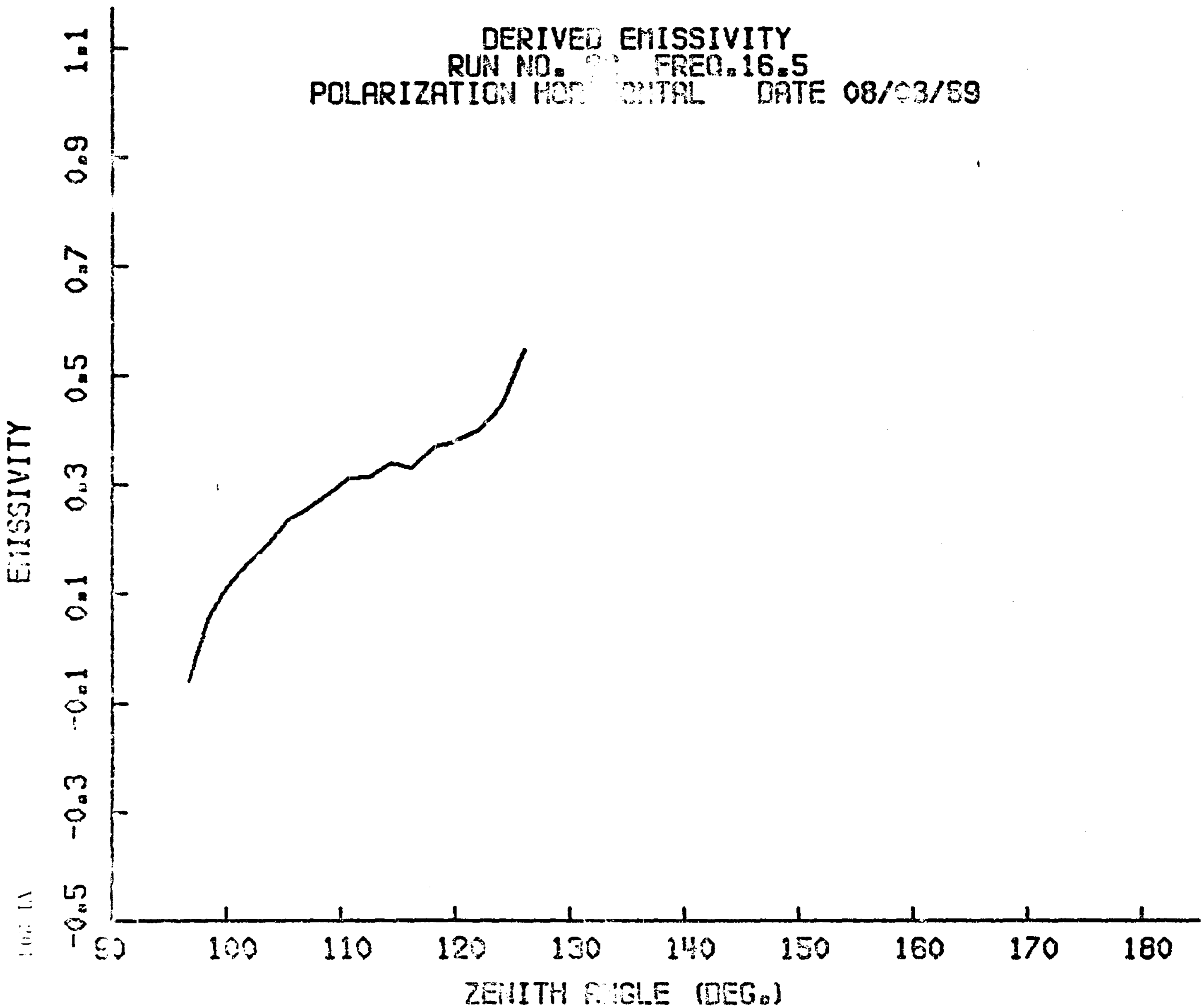


FIGURE VI-135

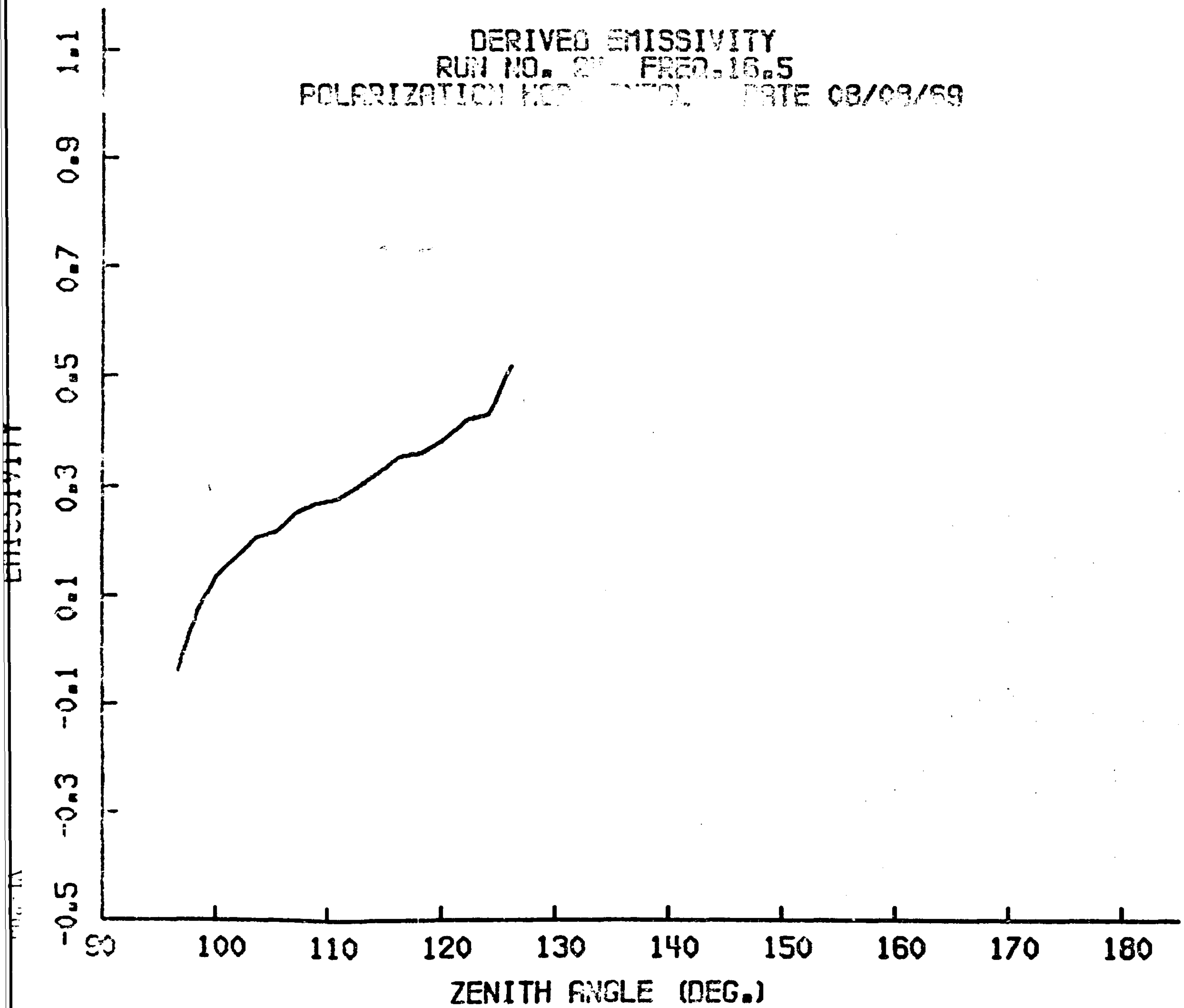


FIGURE VI-136

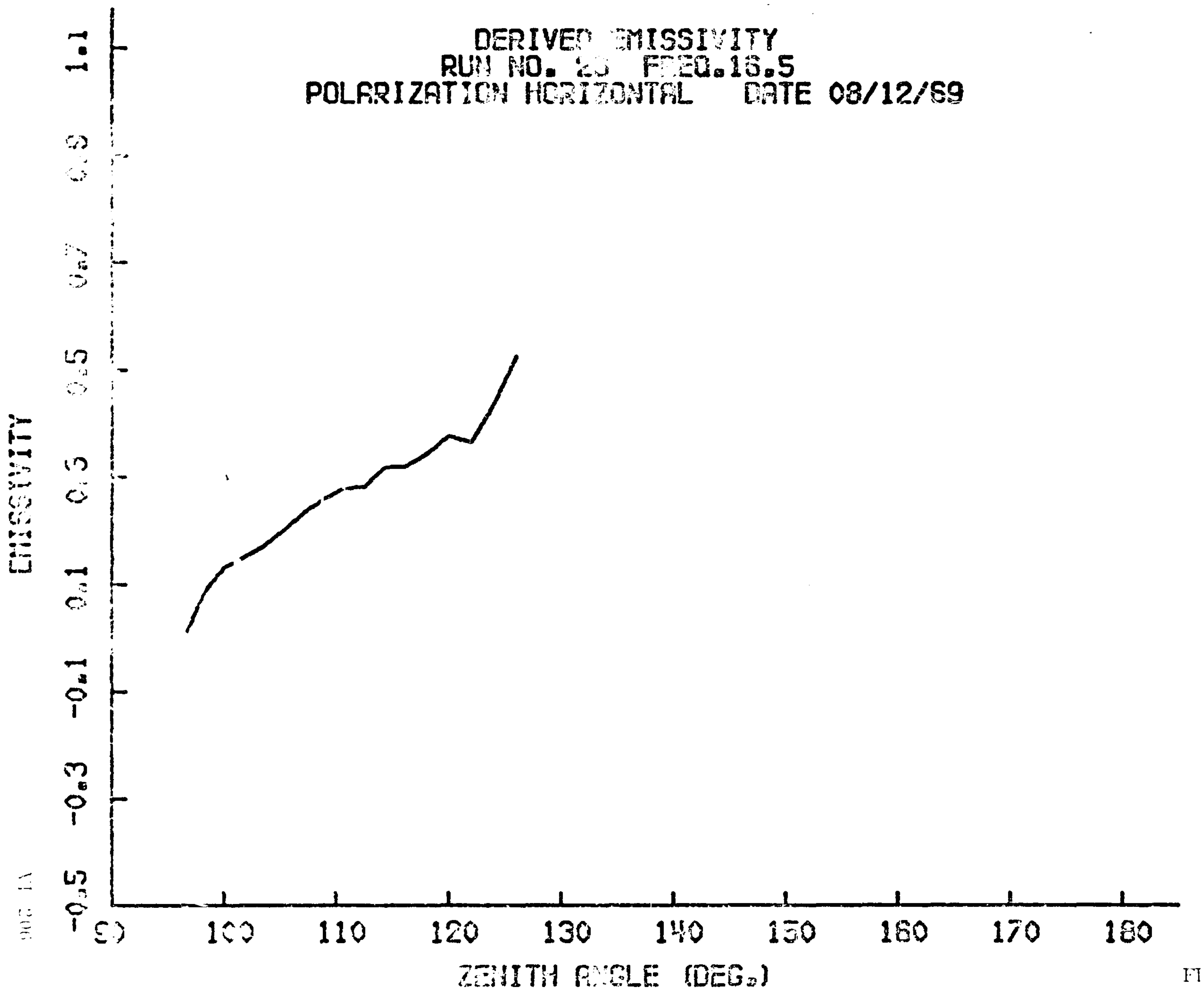


FIGURE VI-137

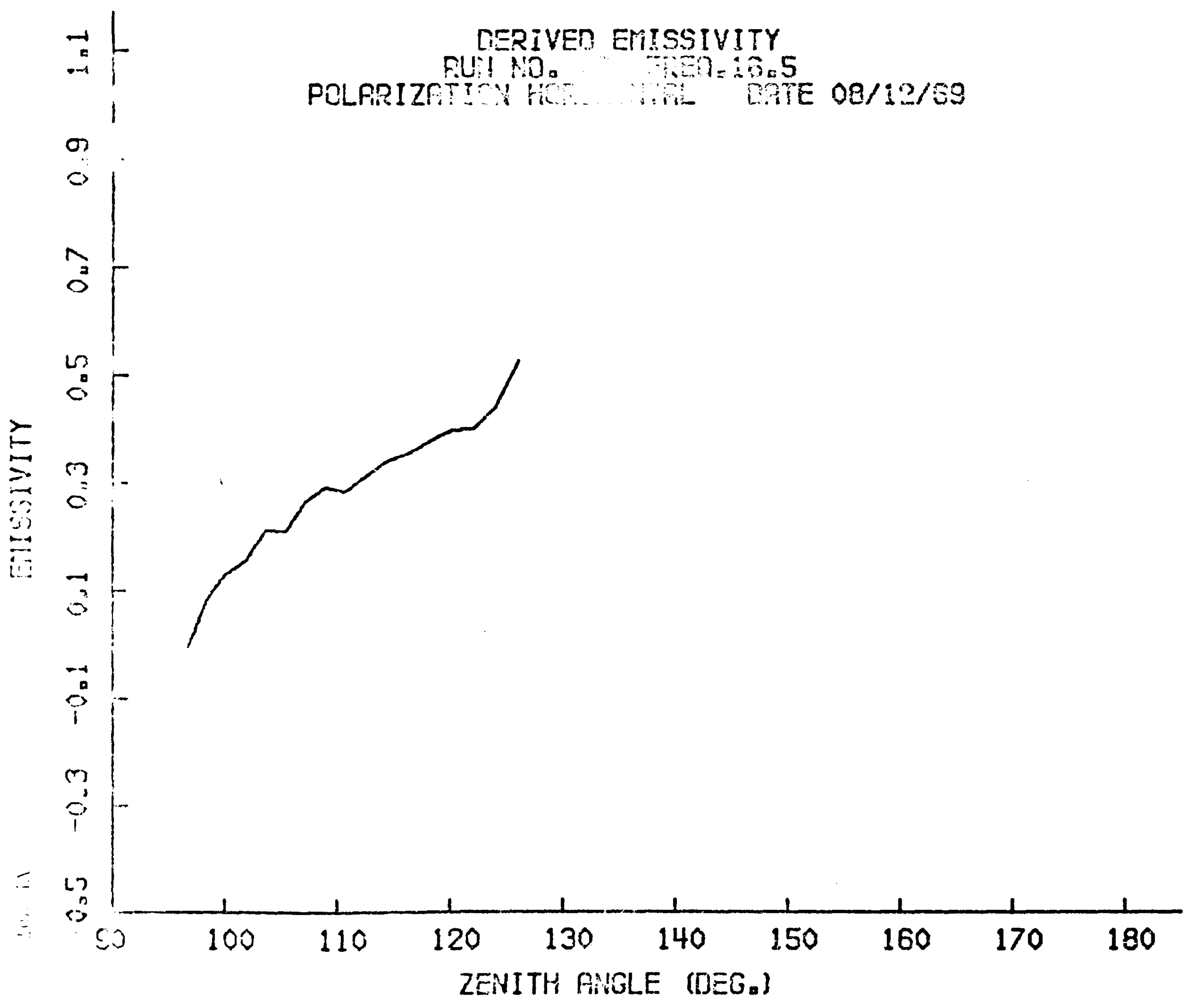


FIGURE VI-138

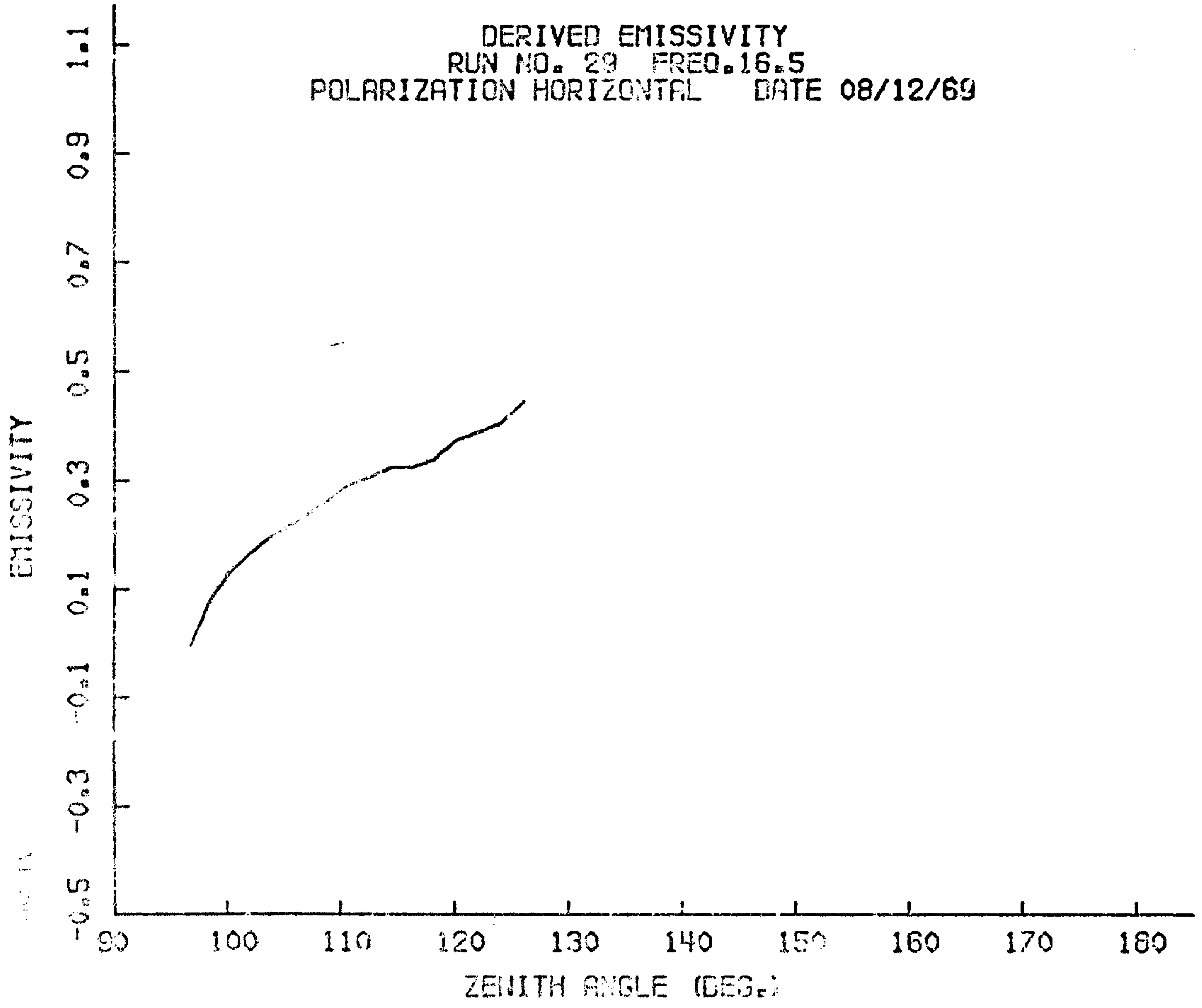


FIGURE VI-139

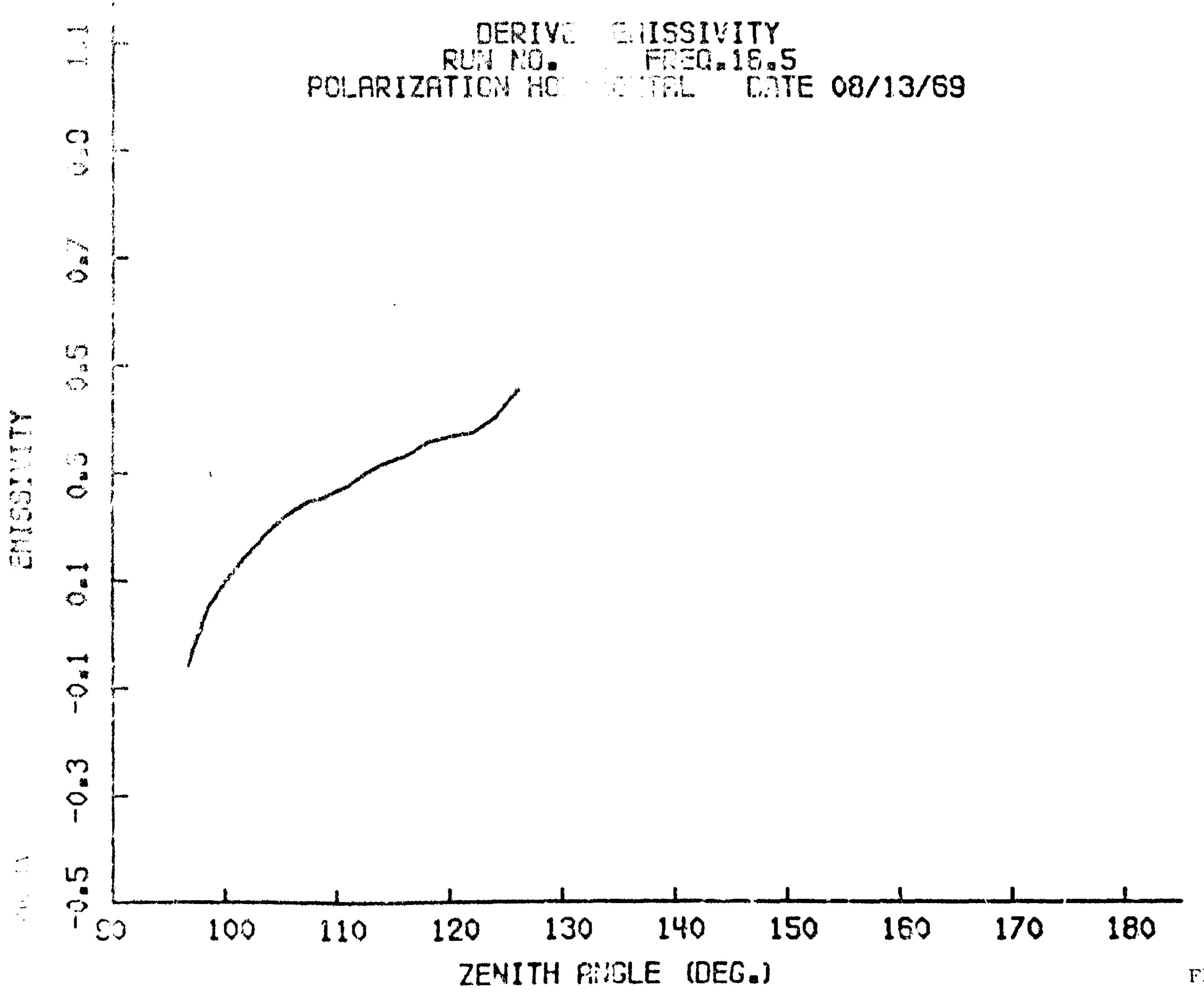


FIGURE VI-140

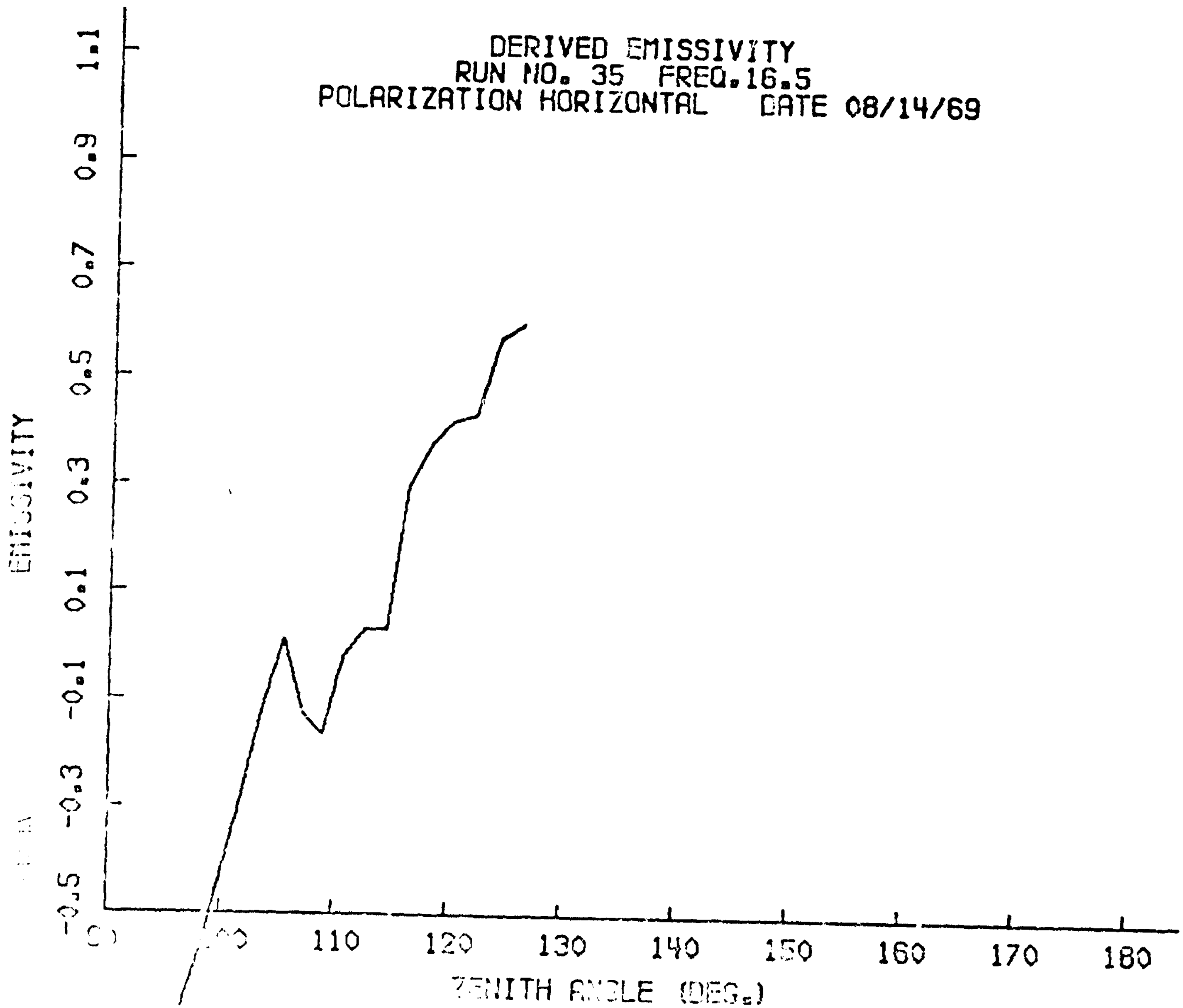


FIGURE VI-111

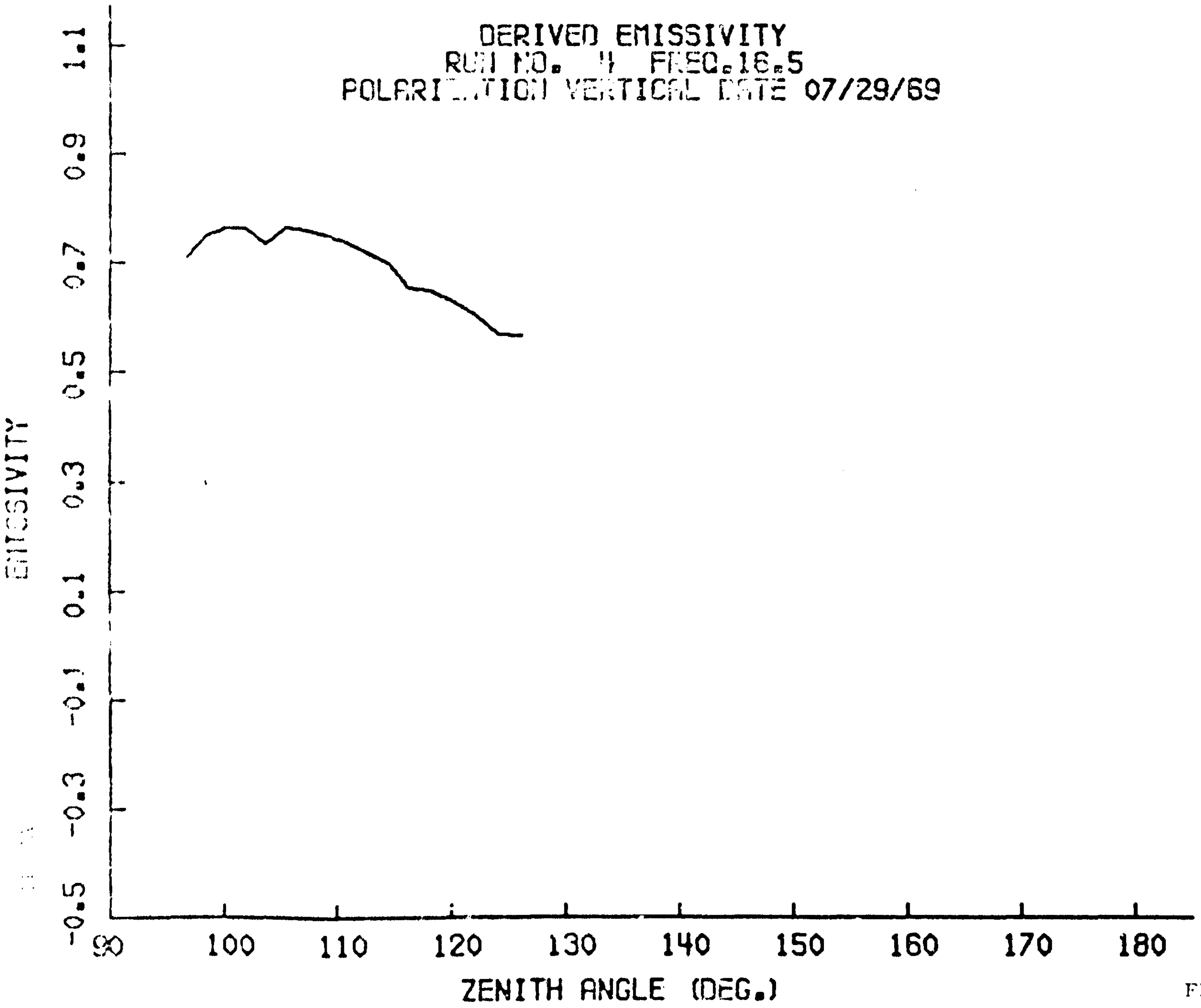


FIGURE VI-142

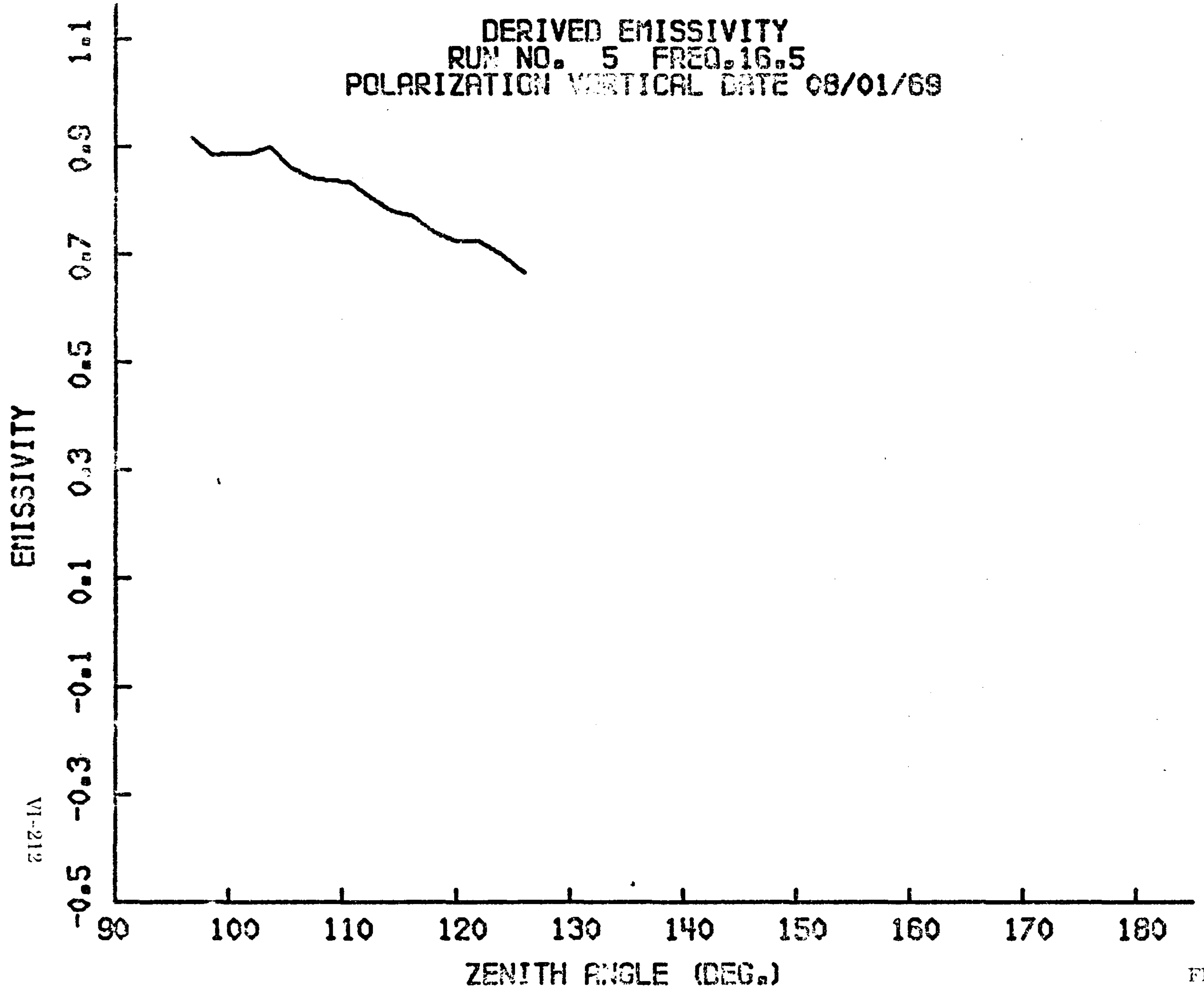


FIGURE VI-143

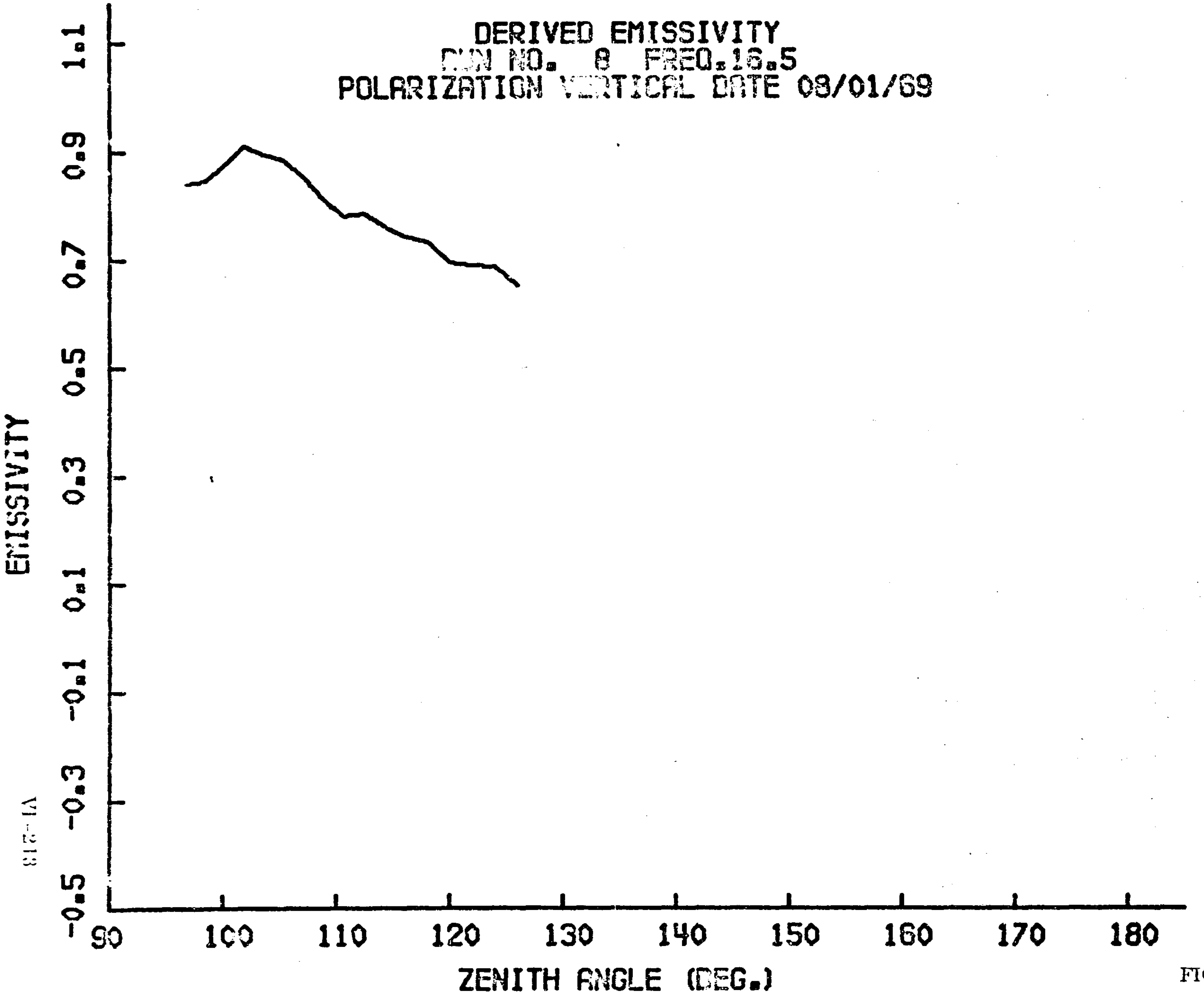


FIGURE VI-144

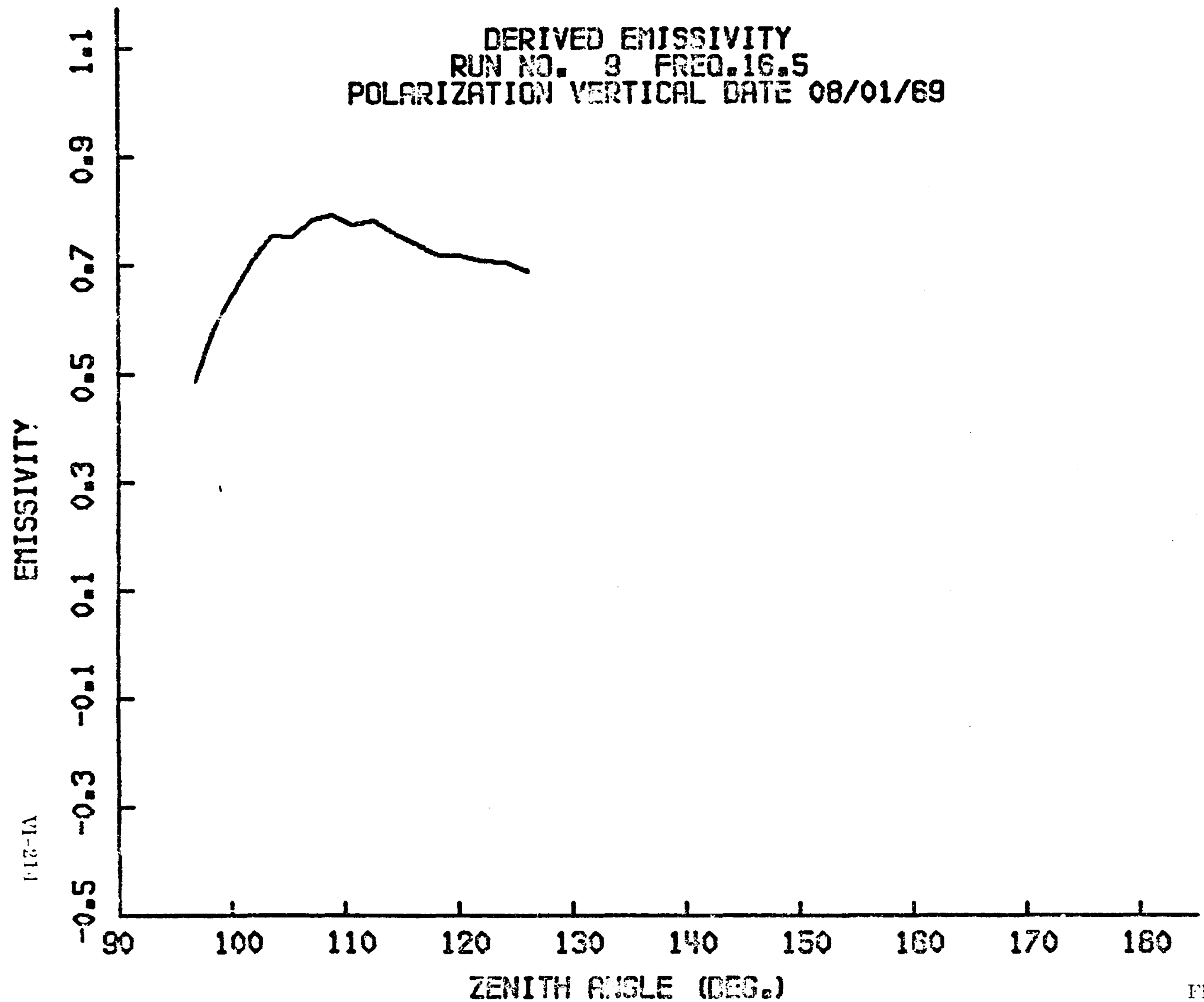


FIGURE VI-145

DERIVED EMISSIVITY
RUN NO. 11 FREQ.16.5
POLARIZATION VERTICAL DATE 08/05/69

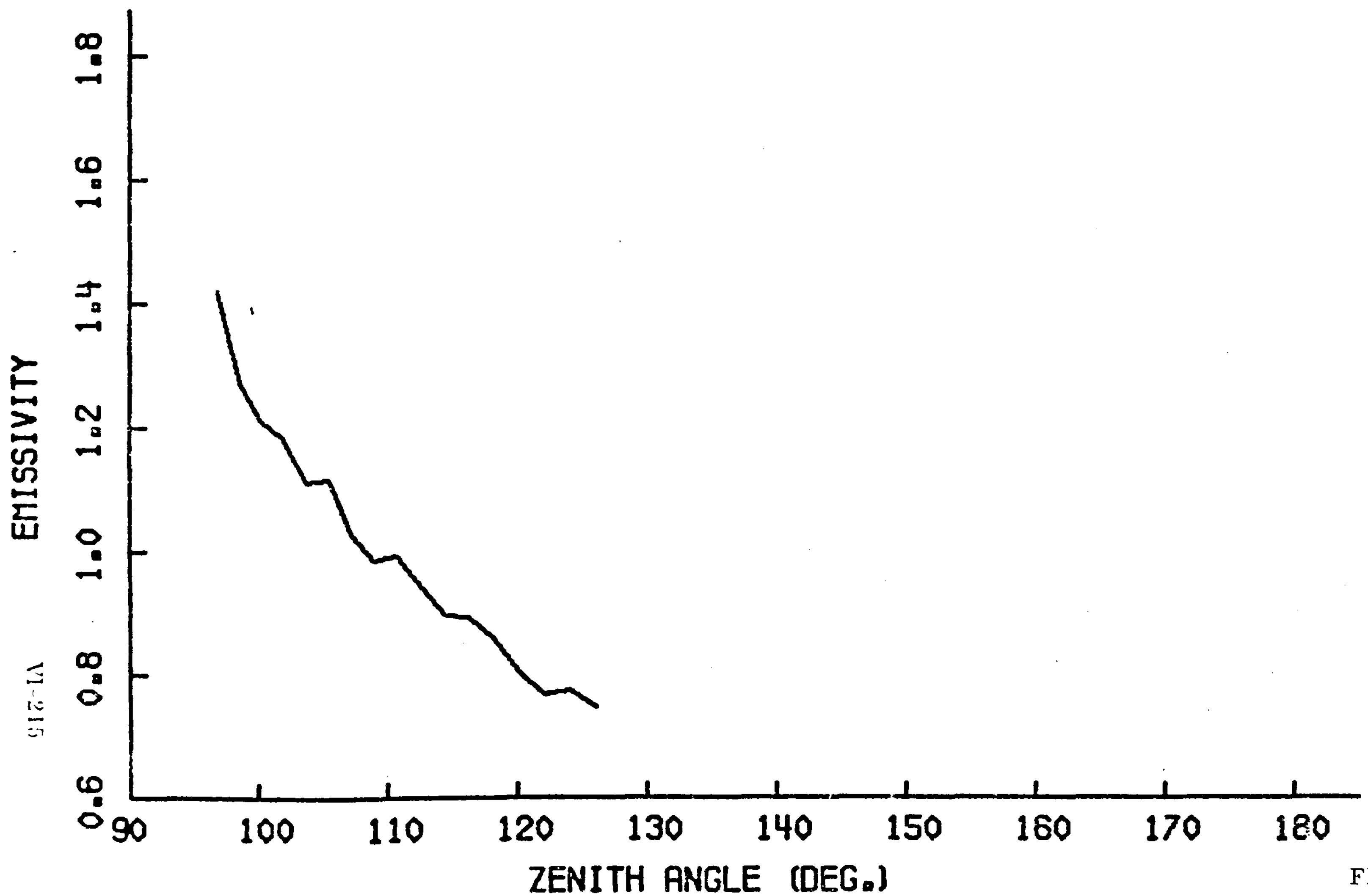


FIGURE VI-146

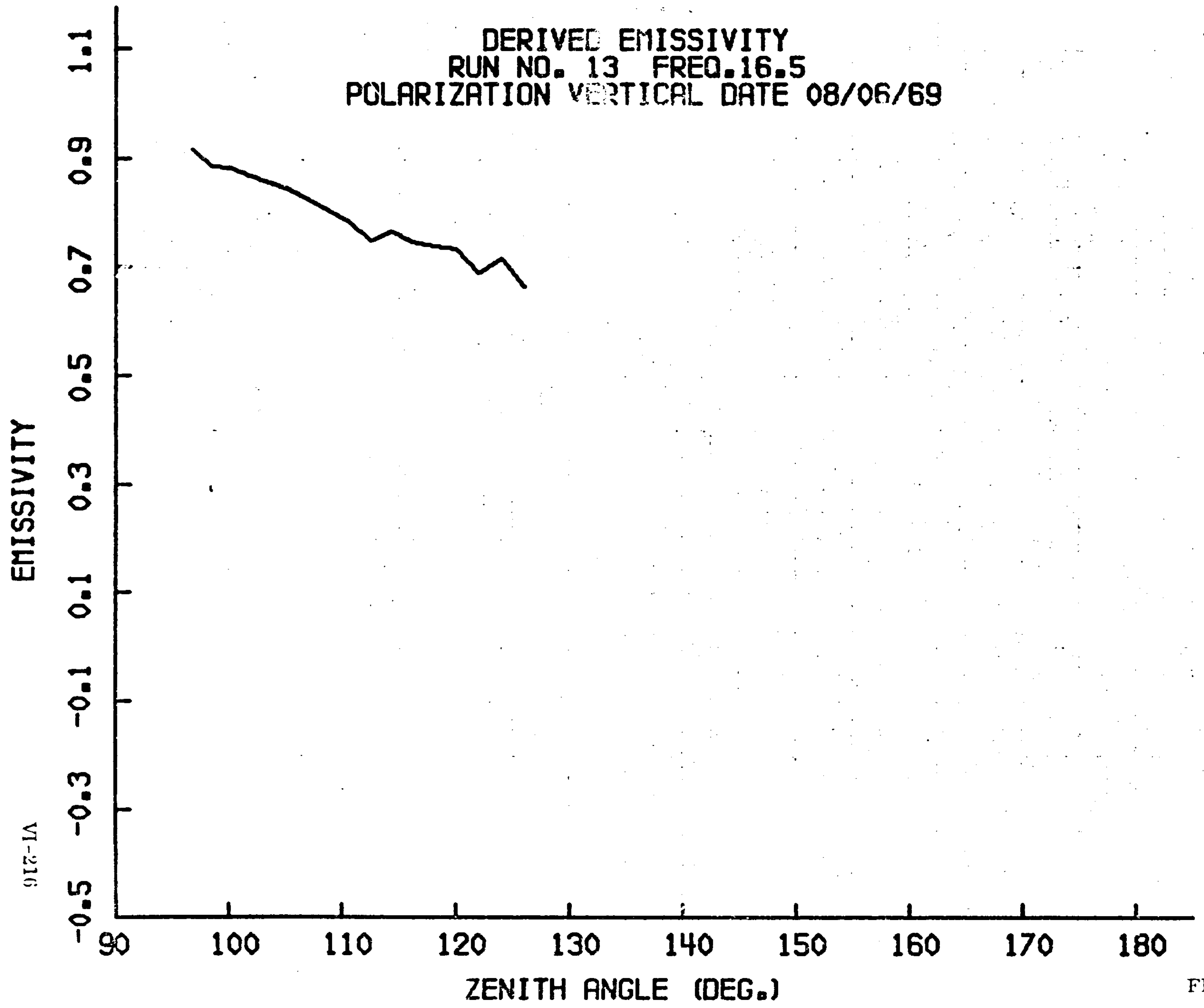


FIGURE VI-147

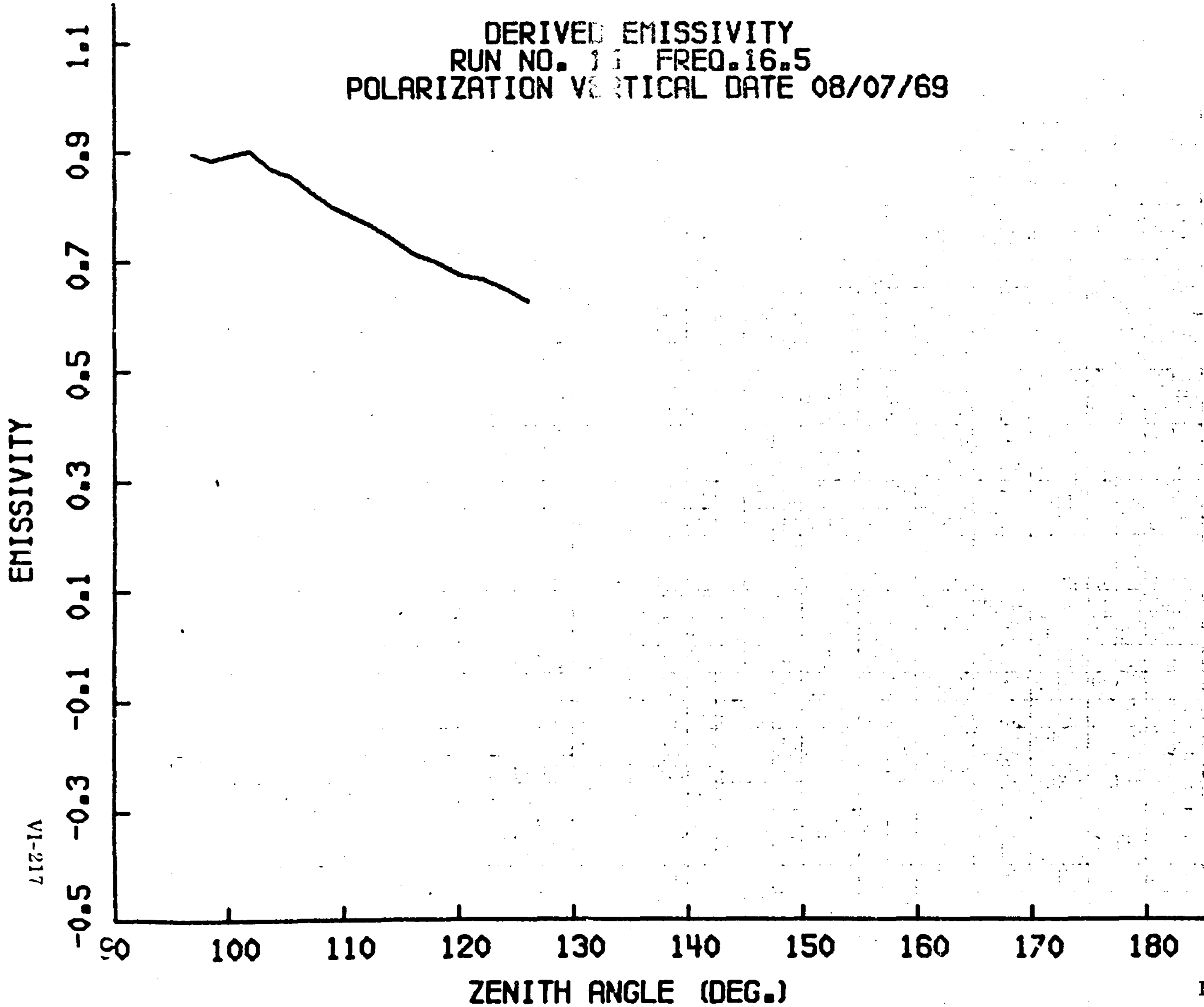


FIGURE VI-148

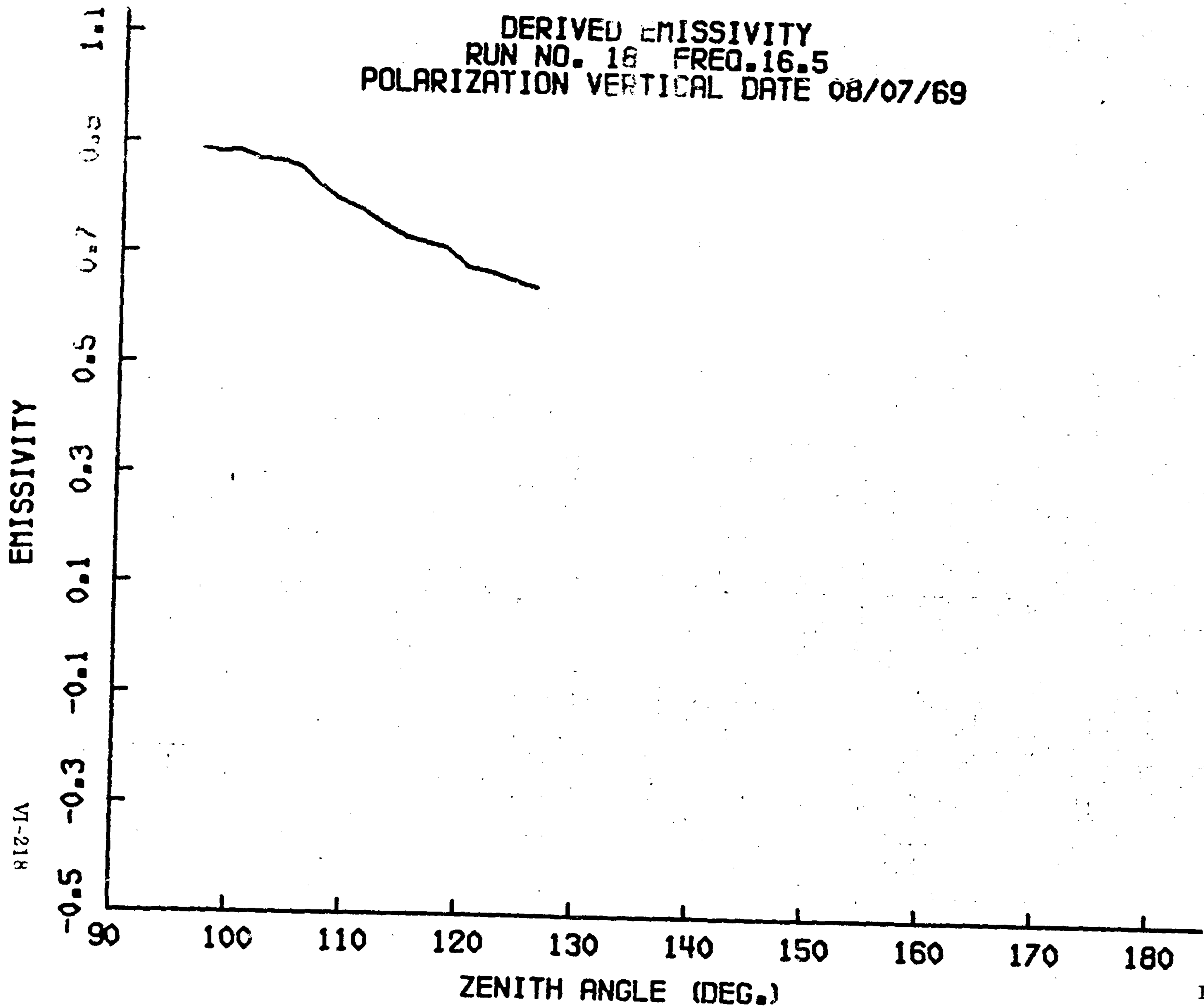


FIGURE VI-149

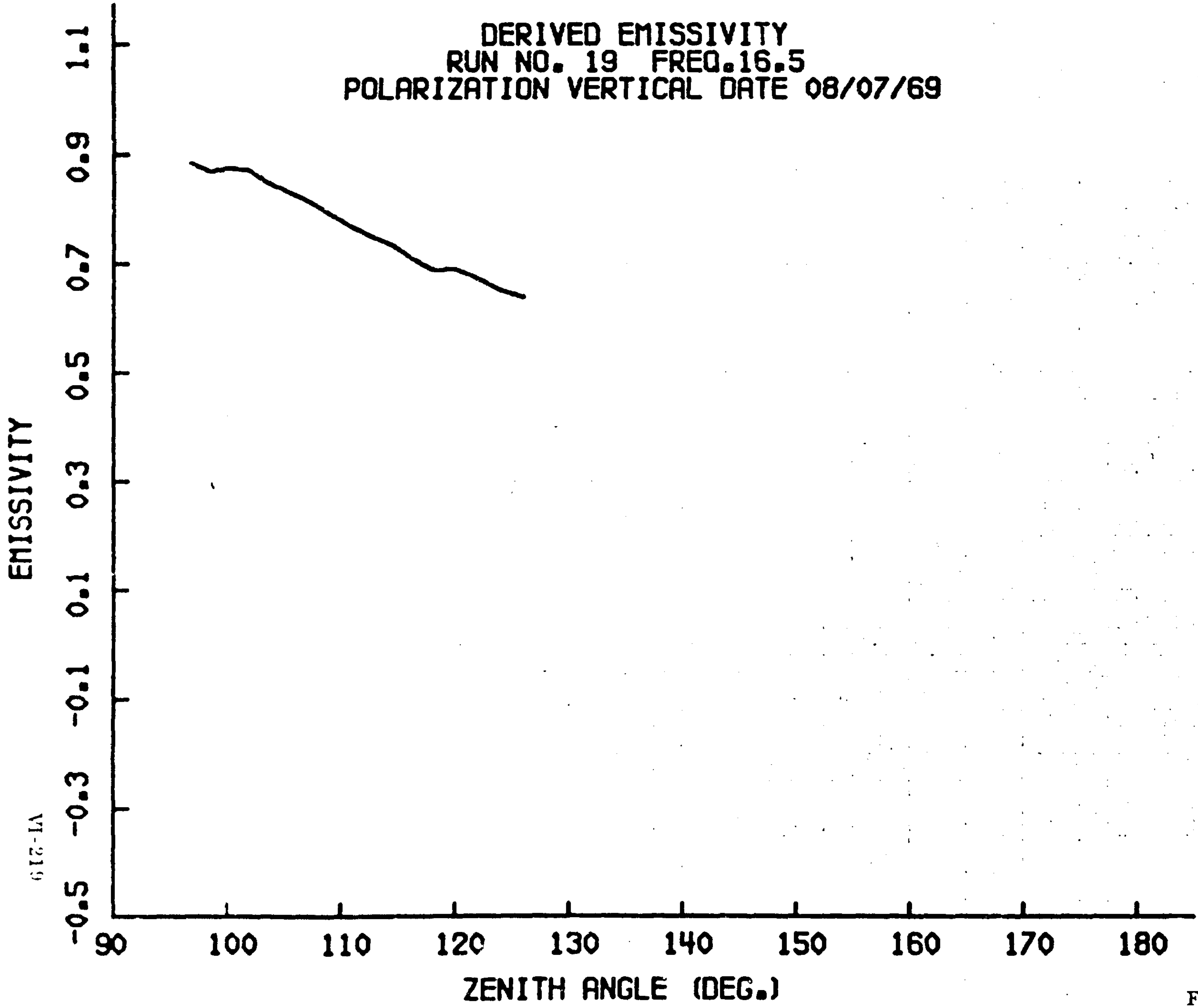


FIGURE VI-150

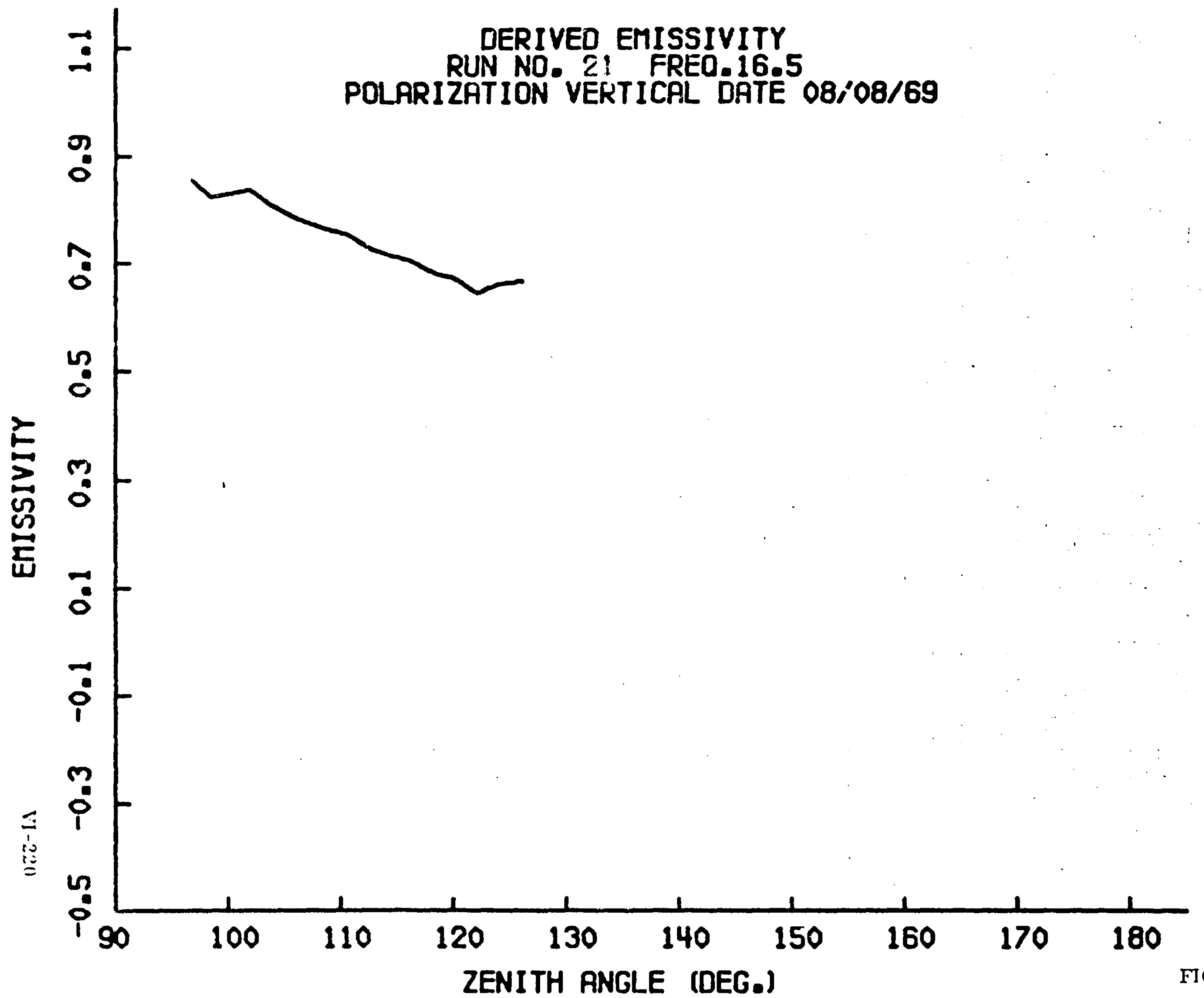


FIGURE VI-151

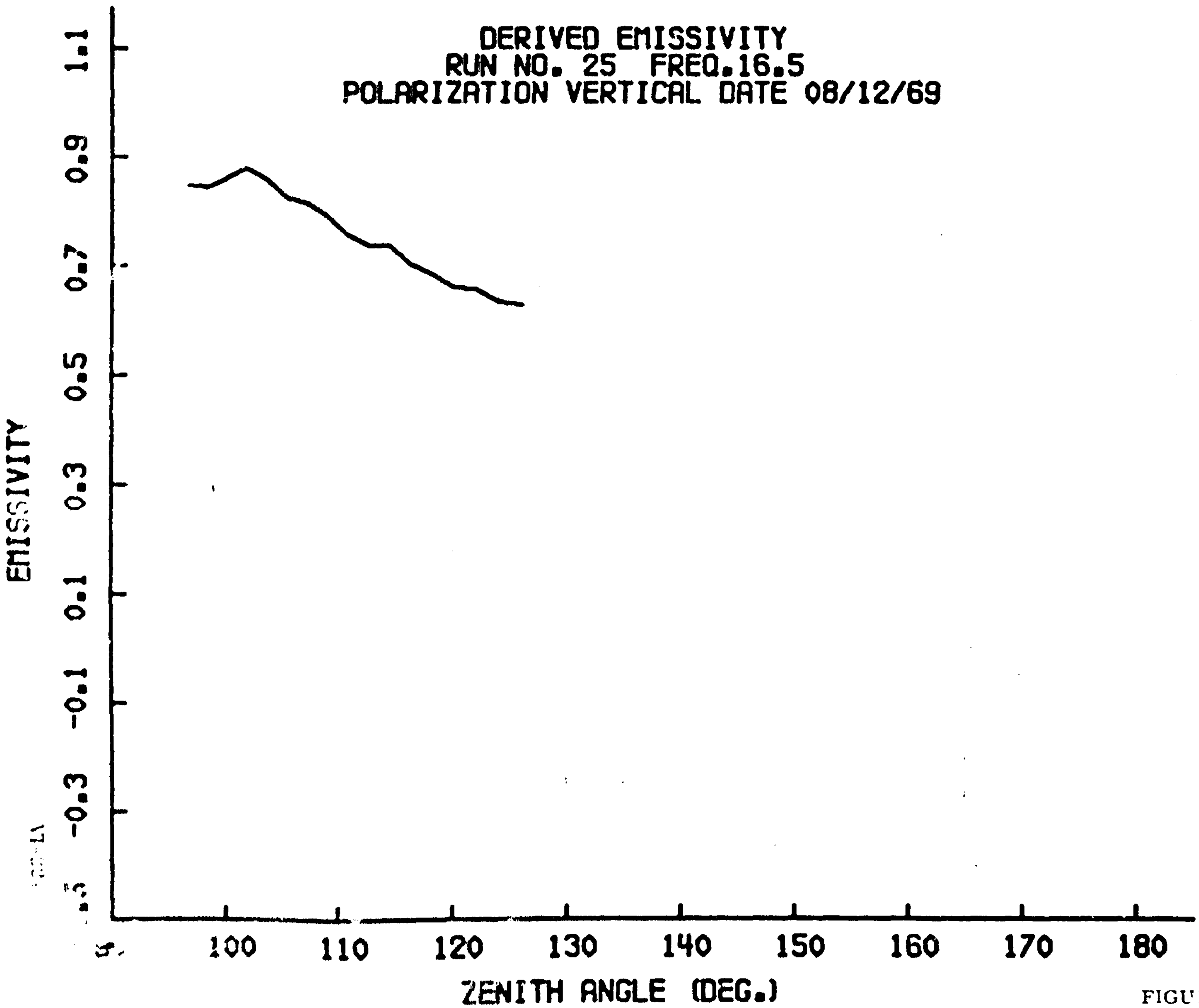


FIGURE VI-152

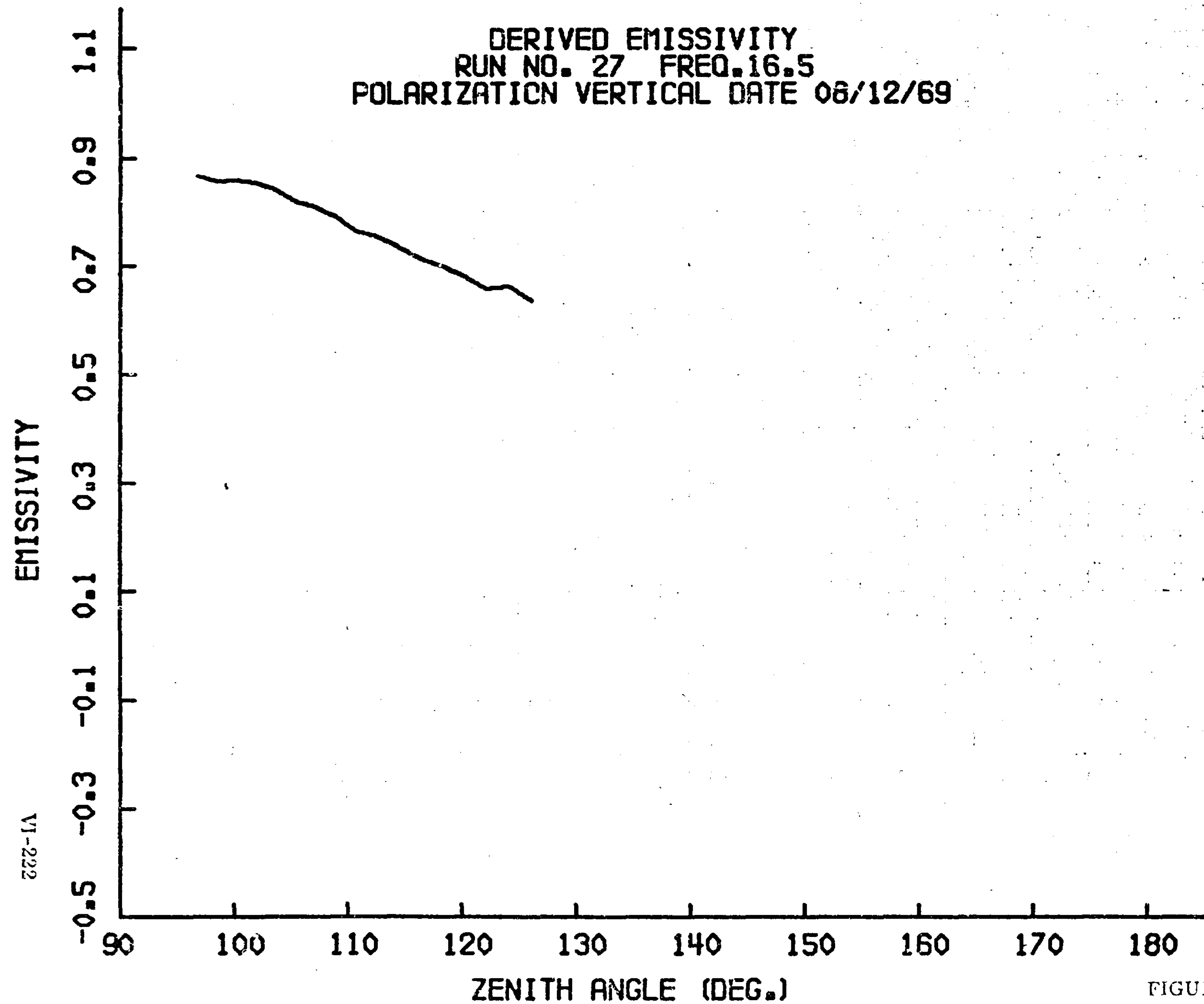


FIGURE VI-153

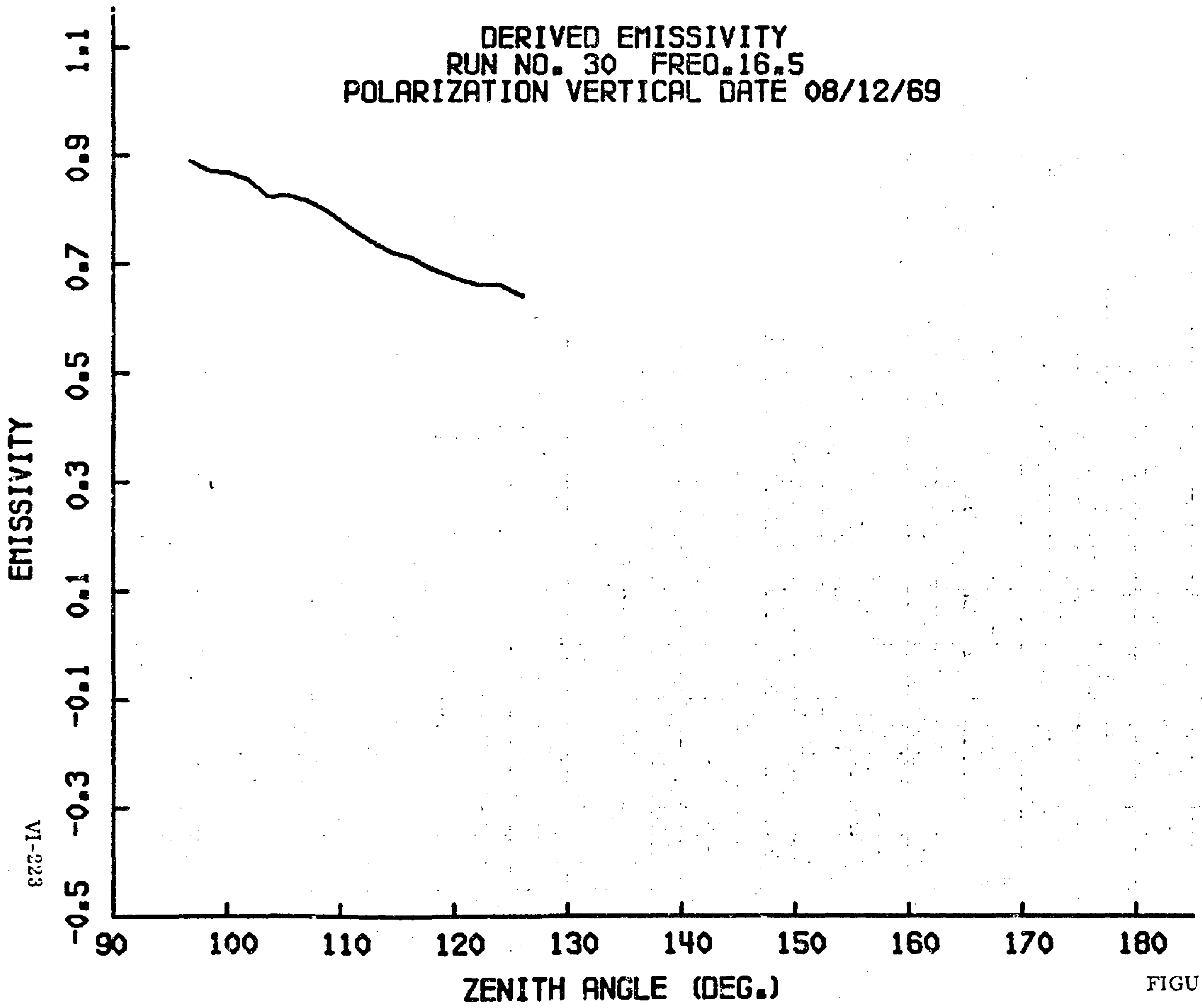


FIGURE VI-154

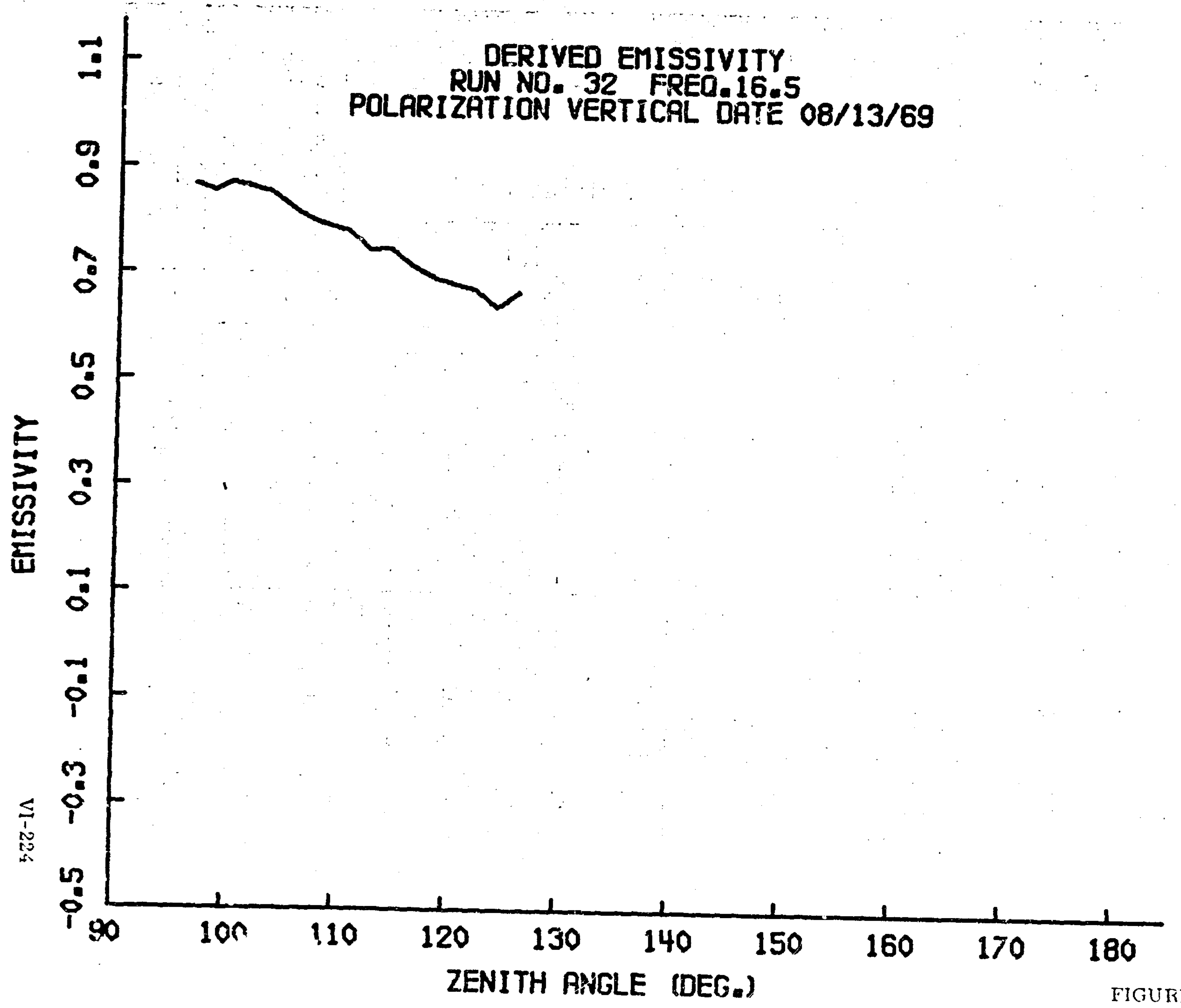


FIGURE VI-155

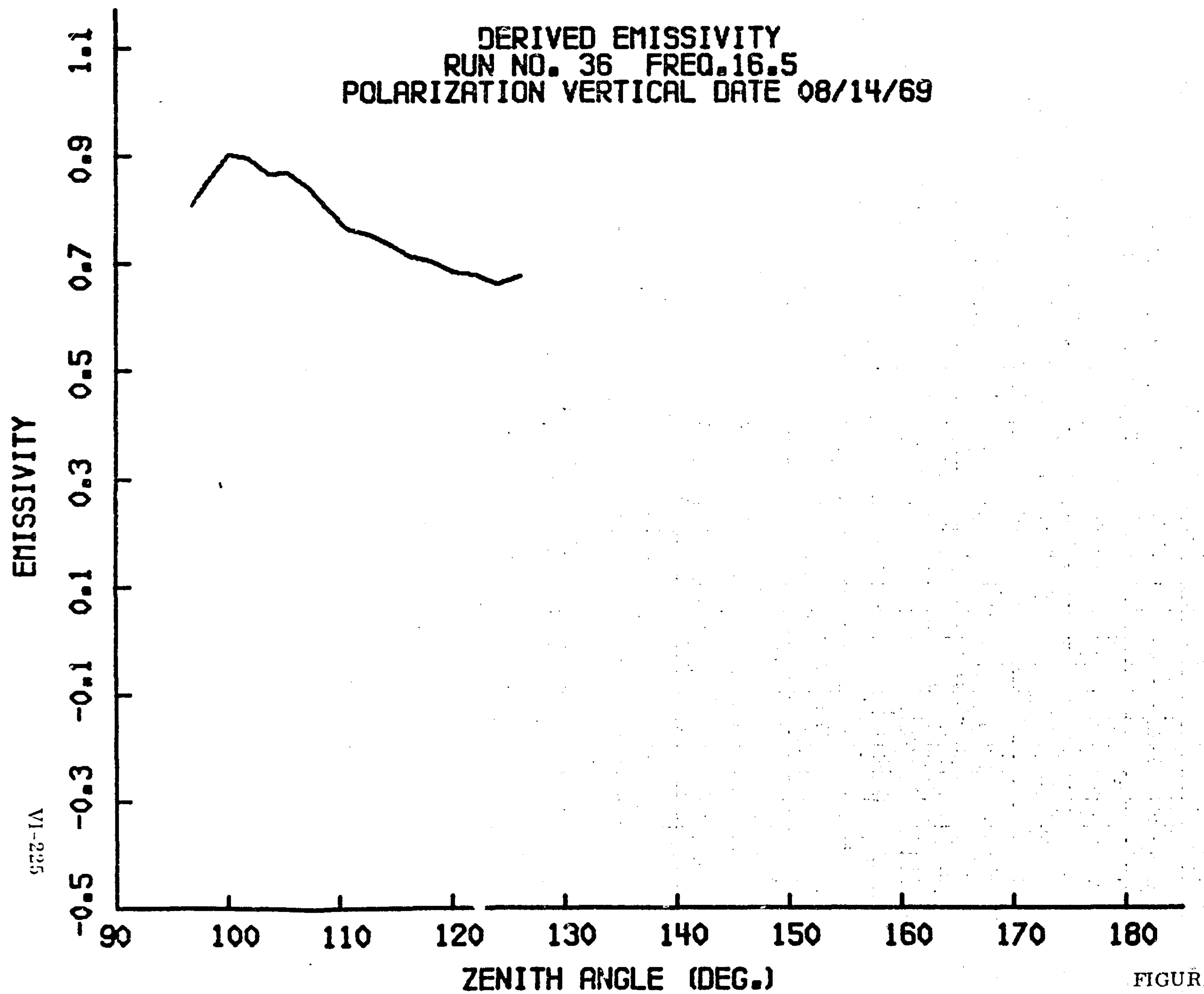


FIGURE VI-156

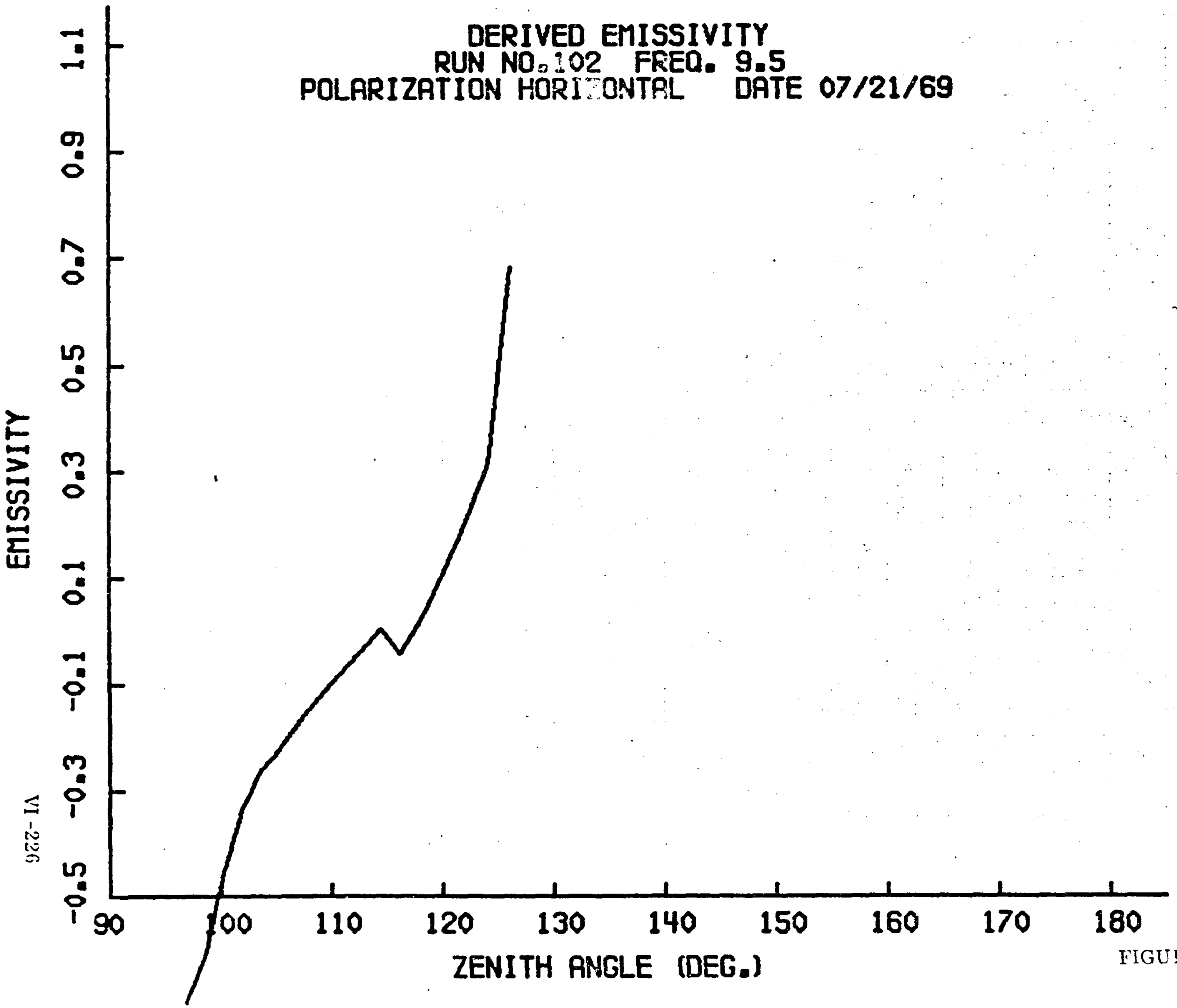


FIGURE VI-157

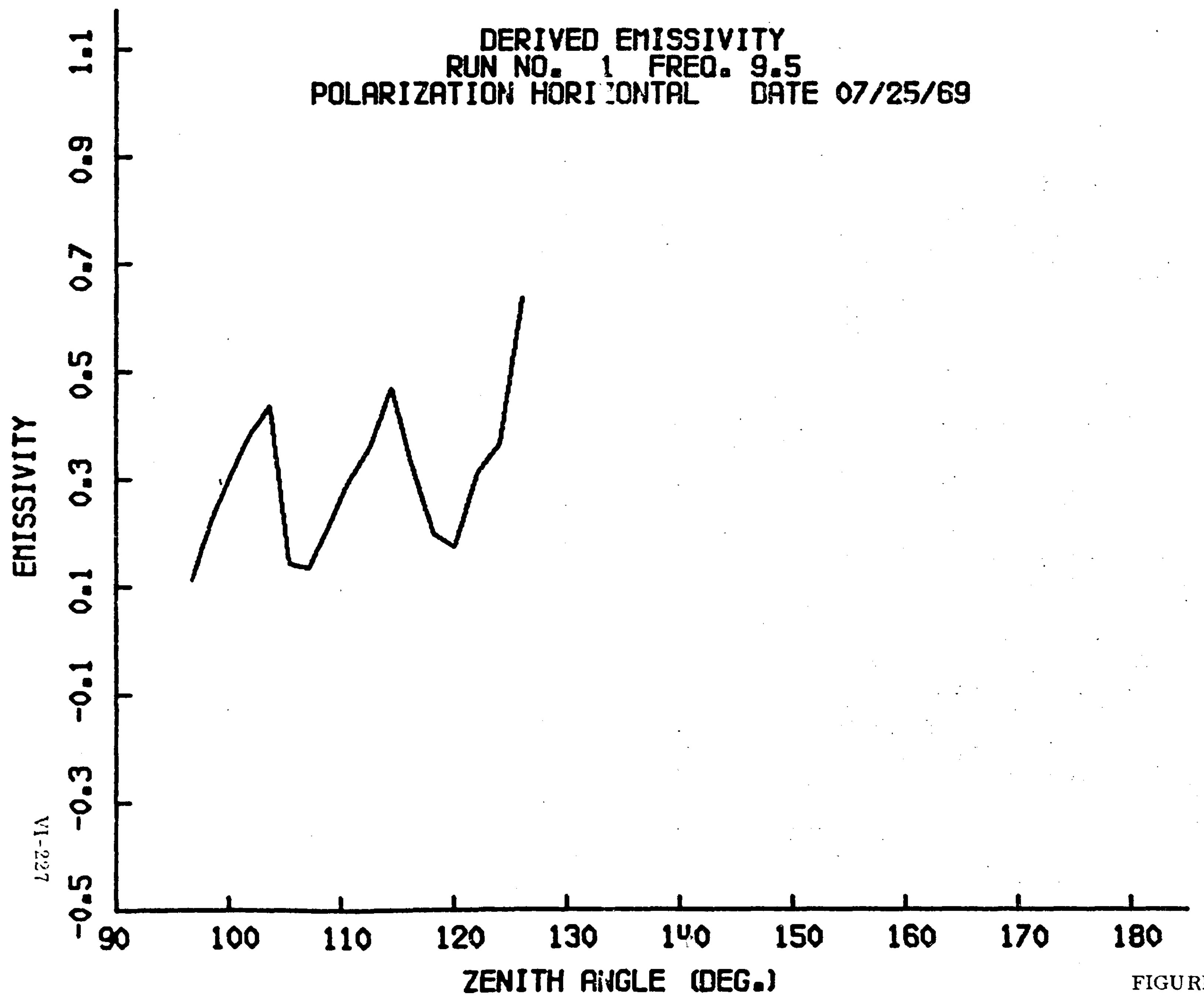


FIGURE VI-158

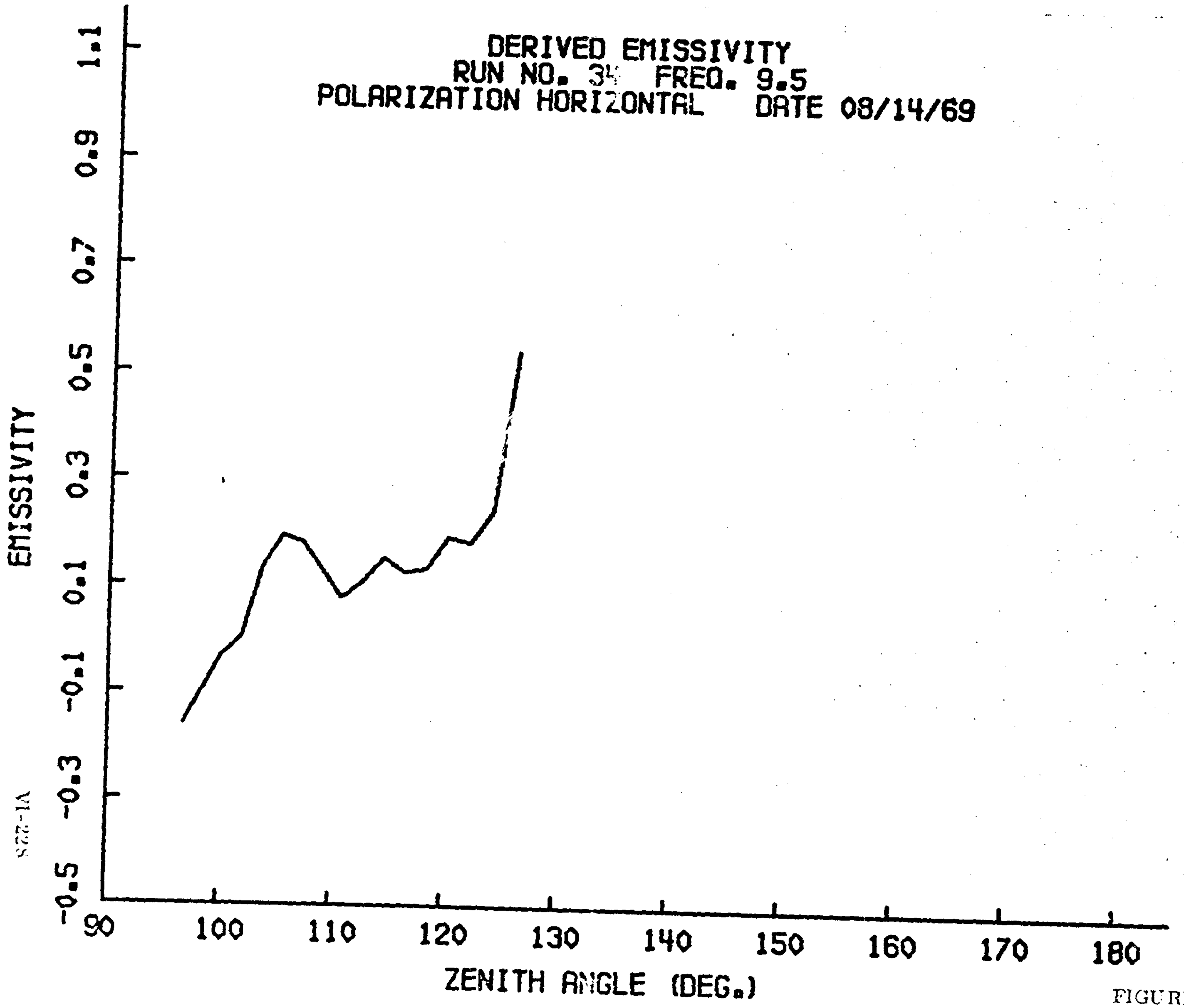


FIGURE VI-159

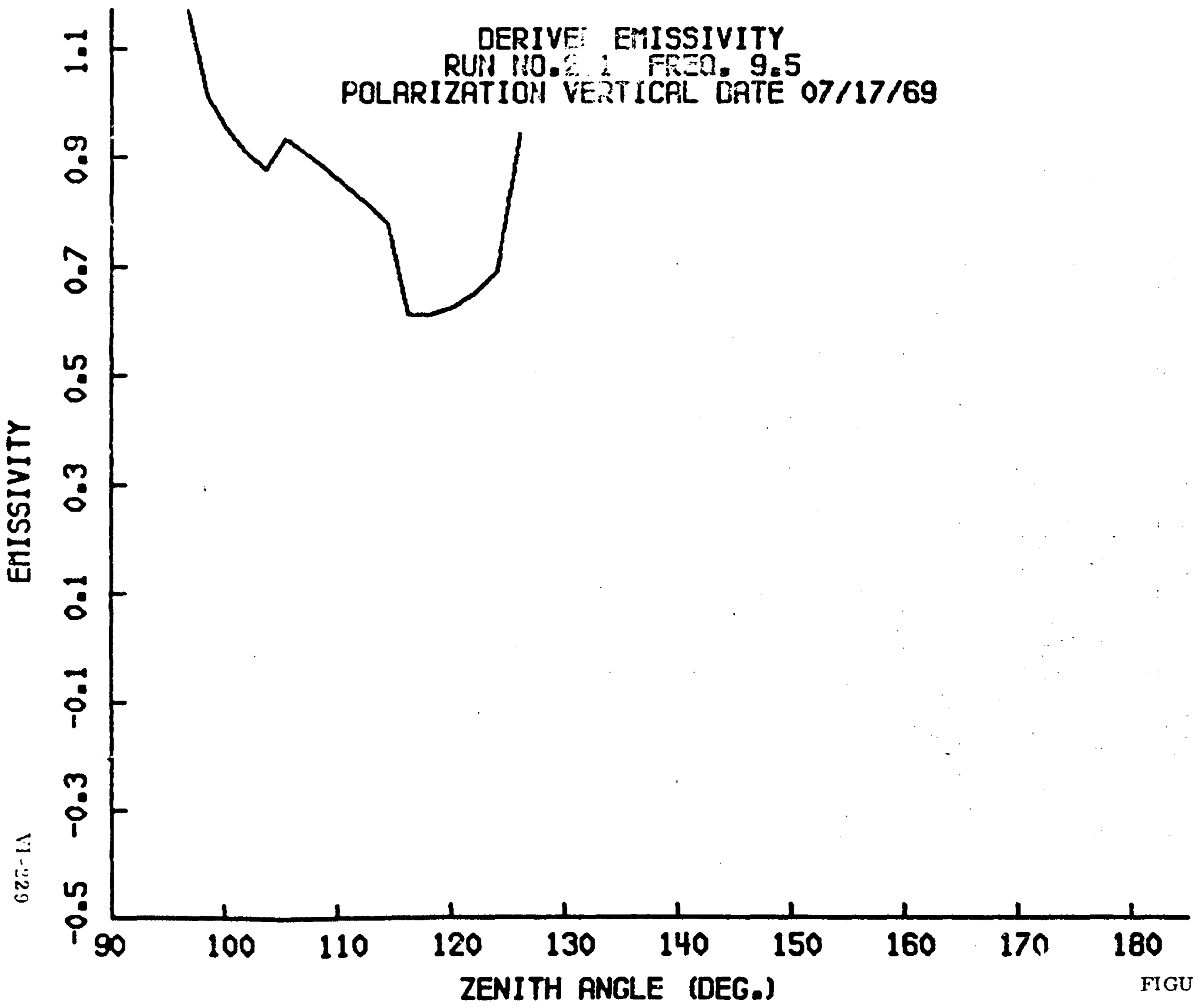


FIGURE VI-160

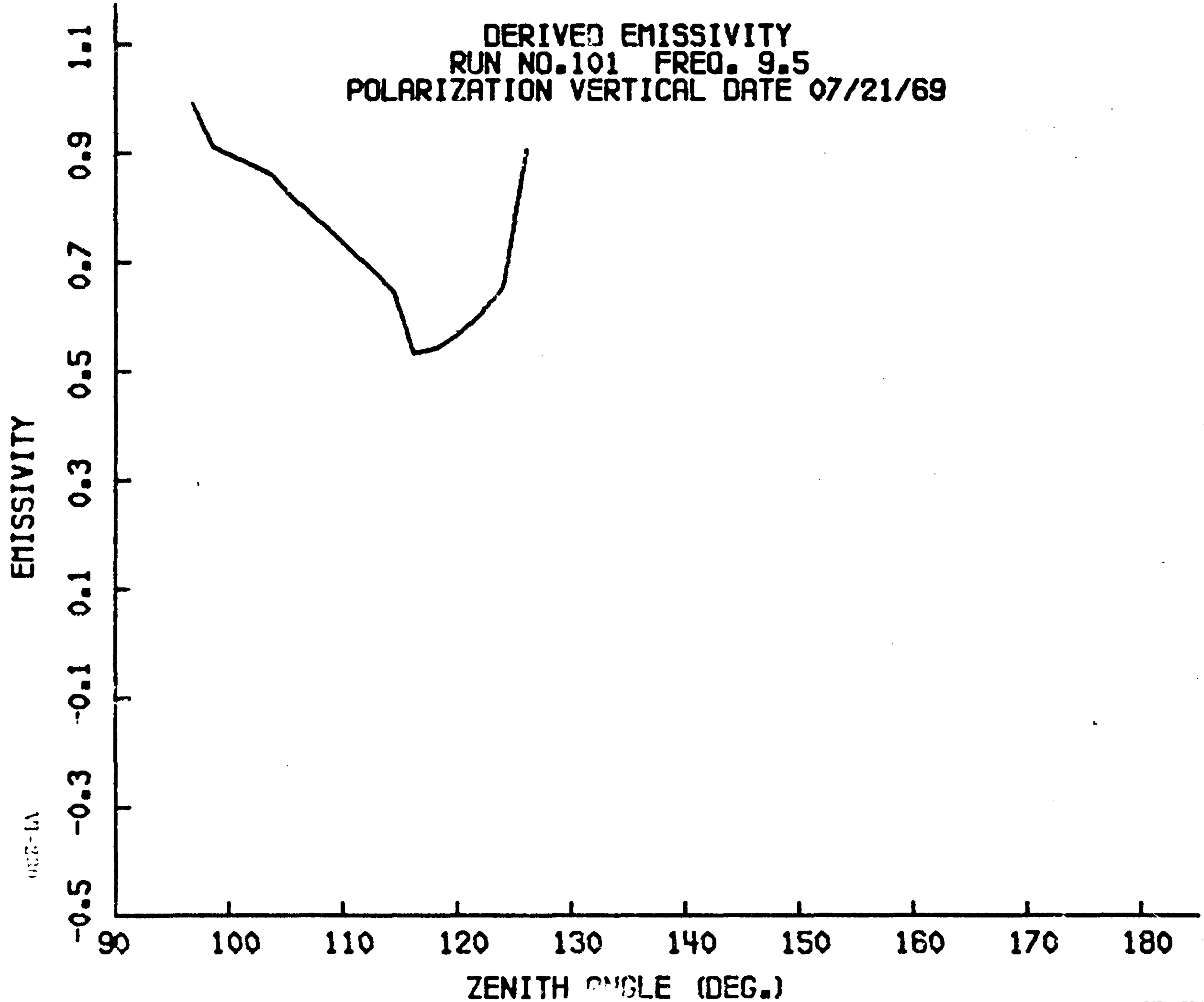


FIGURE VI-161

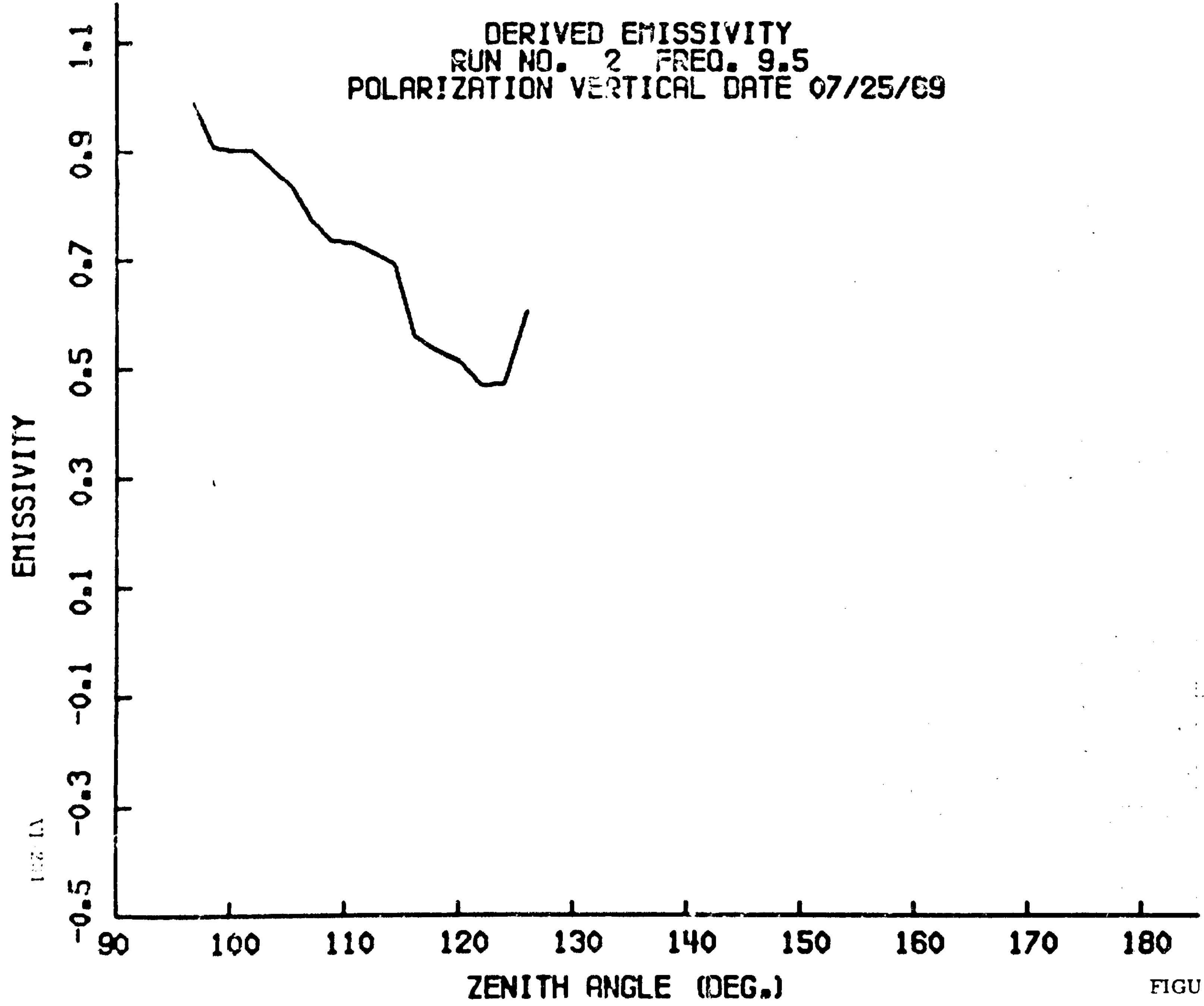


FIGURE VI-162

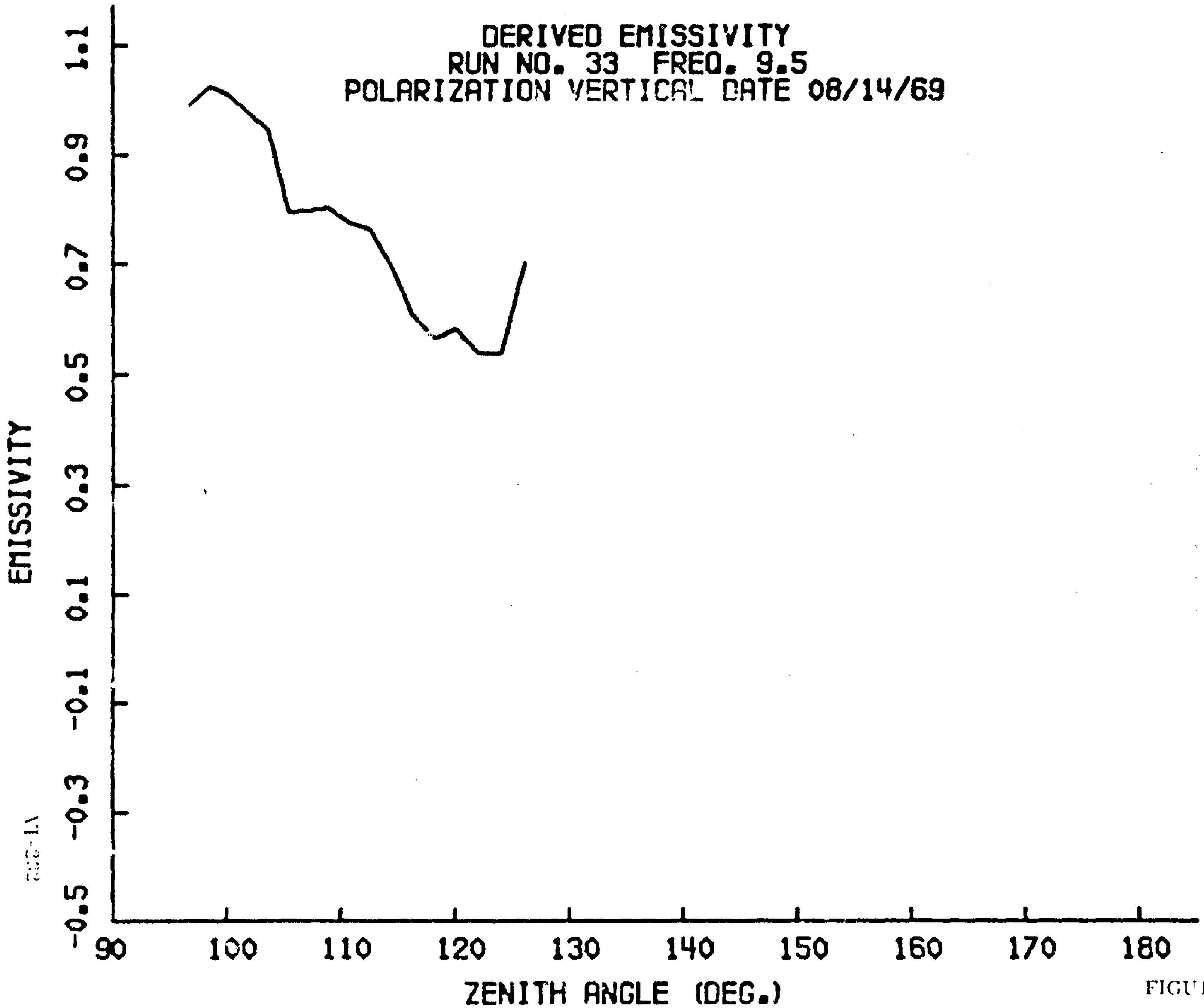


FIGURE VI-163

DERIVED EMISSIVITY

RUN NO. 4 FREQ 16.5GHZ
DATE 07/29/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	275.75	0.70955
98.46	275.90	0.75054
100.16	274.05	0.76224
101.88	270.99	0.76275
103.61	264.11	0.73326
105.35	264.95	0.76199
107.10	261.50	0.75772
108.88	257.02	0.74668
110.67	252.58	0.73432
112.48	247.21	0.71575
114.32	241.84	0.69719
116.18	231.25	0.65162
118.07	228.55	0.64663
120.00	223.09	0.62720
121.97	216.69	0.60134
123.97	208.59	0.56736
126.03	207.17	0.56576

TABLE VI-62

DERIVED EMISSIVITY

RUN NO. 5 FREQ 16.5GHZ
DATE 08/01/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	284.15	0.91796
98.46	276.65	0.88617
100.16	275.80	0.88024
101.88	275.00	0.88813
103.61	276.97	0.90083
105.35	267.36	0.86151
107.10	262.27	0.84281
108.88	260.35	0.83764
110.67	258.66	0.83404
112.48	250.87	0.80525
114.32	244.04	0.78070
116.18	241.26	0.77230
118.07	232.55	0.74049
120.00	228.12	0.72537
121.97	227.53	0.72467
123.97	220.47	0.69881
126.03	211.60	0.66592

TABLE VI-63

DERIVED EMISSIVITY

RUN NO. 6 FREQ 16.5GHZ
DATE 08/01/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	120.79	-0.10675
98.46	124.88	0.02544
100.16	122.10	0.09705
101.88	120.59	0.14445
103.61	120.07	0.17512
105.35	119.53	0.19606
107.10	122.74	0.22624
108.88	126.04	0.25080
110.67	127.90	0.27510
112.48	127.91	0.28564
114.32	131.39	0.30867
116.18	135.74	0.33174
118.07	132.99	0.32919
120.00	135.88	0.34694
121.97	140.54	0.37467
123.97	140.65	0.38394
126.03	147.99	0.42063

TABLE VI-64

DERIVED EMISSIVITY

RUN NO. 7 FREQ 16.5GHZ
DATE 08/01/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	121.45	-0.25510
98.46	124.93	-0.03349
100.16	121.20	0.09421
101.88	118.79	0.16529
103.61	115.13	0.18728
105.35	117.25	0.21986
107.10	125.45	0.26568
108.88	126.38	0.27421
110.67	122.02	0.27390
112.48	131.88	0.32477
114.32	139.07	0.36166
116.18	124.04	0.30880
118.07	137.28	0.36579
120.00	142.79	0.39324
121.97	142.56	0.40008
123.97	144.45	0.41451
126.03	145.85	0.42550

Table VI-65

DERIVED EMISSIVITY

RUN NO. 8 FREQ 16.5GHZ
DATE 08/01/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	275.20	0.83918
98.46	271.67	0.84379
100.16	274.01	0.87444
101.88	279.86	0.91064
103.61	275.59	0.89566
105.35	272.54	0.88555
107.10	264.45	0.85324
108.88	254.18	0.81136
110.67	245.39	0.78010
112.48	245.42	0.78441
114.32	238.35	0.75995
116.18	233.16	0.74309
118.07	229.50	0.73205
120.00	219.27	0.69576
121.97	217.16	0.69087
123.97	215.73	0.68827
126.03	205.25	0.65184

TABLE VI-66

DERIVED EMISSIVITY

RUN NO. 9 FREQ 16,5GHZ
DATE 08/01/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96,76	274,38	0,48740
98,46	273,93	0,58864
100,16	272,14	0,64747
101,88	269,66	0,71089
103,61	267,60	0,75548
105,35	260,33	0,75224
107,10	259,68	0,78564
108,88	255,61	0,79299
110,67	248,18	0,77484
112,48	247,61	0,78194
114,32	239,89	0,75684
116,18	234,75	0,74121
118,07	227,94	0,71774
120,00	227,07	0,71682
121,97	223,32	0,70726
123,97	221,90	0,70606
126,03	216,08	0,68765

TABLE VI-67

DERIVED EMISSIVITY

RUN NO. 10 FREQ 16.5GHZ
DATE 08/01/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	150.82	-1.57794
98.46	151.76	-0.88717
100.16	148.66	-0.46446
101.88	147.66	-0.15337
103.61	147.85	0.01597
105.35	152.97	0.16238
107.10	150.74	0.23186
108.88	149.43	0.28548
110.67	149.84	0.32378
112.48	146.66	0.32061
114.32	150.30	0.34175
116.18	150.98	0.34540
118.07	153.13	0.35318
120.00	151.18	0.34204
121.97	158.05	0.38976
123.97	164.52	0.43382
126.03	173.74	0.48725

TABLE VI-68

DERIVED EMISSIVITY

RUN NO. 11 FREQ 16.5GHZ
DATE 08/05/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	326.42	1.41899
98.46	322.41	1.26931
100.16	321.59	1.21044
101.88	320.97	1.18070
103.61	312.88	1.10530
105.35	314.36	1.11235
107.10	302.54	1.02522
108.88	296.41	0.98185
110.67	297.64	0.99074
112.48	289.88	0.93907
114.32	283.03	0.89468
116.18	282.54	0.89235
118.07	276.93	0.85643
120.00	269.07	0.80571
121.97	262.90	0.76661
123.97	264.19	0.77542
126.03	259.79	0.74746

TABLE VI-69

DERIVED EMISSIVITY

RUN NO. 12 FREQ 16.5GHZ
DATE 08/05/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	213.60	-0.48556
98.46	210.12	-0.22619
100.16	203.07	-0.07896
101.88	195.29	0.01990
103.61	190.08	0.08725
105.35	196.21	0.21927
107.10	191.96	0.24997
108.88	191.01	0.29157
110.67	194.76	0.35044
112.48	192.15	0.35460
114.32	193.96	0.38045
116.18	197.78	0.41342
118.07	198.57	0.42553
120.00	201.43	0.44733
121.97	195.93	0.42580
123.97	200.14	0.45721
126.03	205.90	0.49536

TABLE VI-70

DERIVED EMISSIVITY

RUN NO. 13 FREQ 16.5GHZ
DATE 08/06/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	282.45	0.91872
98.46	274.04	0.88499
100.16	272.18	0.88149
101.88	268.59	0.86853
103.61	264.91	0.85519
105.35	261.08	0.84313
107.10	255.46	0.82262
108.88	250.21	0.80363
110.67	244.21	0.78290
112.48	234.61	0.74811
114.32	238.50	0.76591
116.18	232.30	0.74437
118.07	230.20	0.73846
120.00	228.16	0.73255
121.97	215.76	0.68731
123.97	222.97	0.71565
126.03	208.59	0.66315

TABLE VI-71

FORTRAN IV PROGRAM EMISS (LINK-EDITED AS EMISS) STARTED --- 11/26/69

DERIVED EMISSIVITY

RUN NO. 14 FREQ 16.5GHZ
DATE 08/06/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	117.93	0.02055
98.46	118.47	0.08218
100.16	114.01	0.11110
101.88	111.87	0.13105
103.61	114.27	0.16954
105.35	119.68	0.21500
107.10	120.93	0.23718
108.88	121.98	0.25489
110.67	124.47	0.27909
112.48	128.68	0.30582
114.32	131.35	0.32436
116.18	135.17	0.34605
118.07	137.83	0.36206
120.00	137.56	0.36552
121.97	150.06	0.41984
123.97	153.74	0.43888
126.03	163.48	0.48062

TABLE VI-72

DERIVED EMISSIVITY

RUN NO. 15 FREQ 16,5GHZ
DATE 08/07/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	276.15	0.89516
98.46	271.71	0.88216
100.16	273.28	0.89314
101.88	274.68	0.90059
103.61	265.91	0.86742
105.35	262.20	0.85472
107.10	254.30	0.82541
108.88	247.18	0.79905
110.67	242.06	0.78188
112.48	236.50	0.76277
114.32	229.44	0.73804
116.18	222.24	0.71282
118.07	217.46	0.69558
120.00	210.97	0.67392
121.97	209.05	0.66819
123.97	203.94	0.65055
126.03	196.44	0.62416

TABLE VI-73

DERIVED EMISSIVITY

RUN NO. 16 FREQ 16.5GHZ
DATE 08/07/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	100.35	-0.02786
98.46	102.65	0.05908
100.16	101.80	0.11379
101.88	105.18	0.16528
103.61	102.29	0.17895
105.35	106.18	0.21379
107.10	106.02	0.22536
108.88	107.23	0.24010
110.67	111.71	0.27037
112.48	116.89	0.29836
114.32	114.83	0.29573
116.18	122.17	0.32960
118.07	121.34	0.33048
120.00	127.21	0.35586
121.97	126.18	0.35563
123.97	137.40	0.40244
126.03	158.99	0.48555

TABLE VI-74

DERIVED EMISSIVITY

RUN NO. 17 FREQ 16.5GHZ
DATE 08/07/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	102.51	-0.02568
98.46	108.15	0.07259
100.16	107.10	0.12318
101.88	108.00	0.16116
103.61	109.63	0.19123
105.35	107.82	0.19999
107.10	111.61	0.22707
108.88	115.59	0.25071
110.67	118.28	0.27394
112.48	120.79	0.29281
114.52	122.10	0.30539
116.18	128.39	0.33633
118.07	129.91	0.34772
120.00	134.51	0.37025
121.97	134.95	0.37766
123.97	139.24	0.39914
126.03	146.09	0.42954

TABLE VI-75

DERIVED EMISSIVITY

RUN NO. 18 FREQ 16.5GHZ
DATE 08/07/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	274.54	0.88711
98.46	272.99	0.88304
100.16	271.39	0.88450
101.88	267.33	0.87002
103.61	265.67	0.86531
105.35	262.91	0.85778
107.10	253.49	0.82310
108.88	246.06	0.79539
110.67	241.61	0.78231
112.48	234.55	0.75804
114.32	227.80	0.73499
116.18	224.47	0.72461
118.07	221.72	0.71619
120.00	211.34	0.67970
121.97	208.59	0.67144
123.97	203.99	0.65634
126.03	200.37	0.64472

TABLE VI-76

DERIVED EMISSIVITY

RUN NO. 19 FREQ 16.5GHZ
DATE 08/07/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	274.40	0.88489
98.46	269.19	0.86882
100.16	269.29	0.87437
101.88	268.41	0.87330
103.61	261.21	0.84726
105.35	256.85	0.83292
107.10	251.71	0.81539
108.88	245.40	0.79327
110.67	238.45	0.76987
112.48	232.65	0.75059
114.32	227.52	0.73377
116.18	220.24	0.70888
118.07	214.24	0.68872
120.00	214.12	0.68996
121.97	208.53	0.67141
123.97	201.83	0.64883
126.03	198.10	0.63599

TABLE VI-77

DERIVED EMISSIVITY

RUN NO. 20 FREQ 16.5GHZ
DATE 08/07/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	97.40	-0.03758
98.46	104.41	0.06077
100.16	104.73	0.11292
101.88	107.49	0.16063
103.61	105.80	0.18010
105.35	105.63	0.20043
107.10	109.29	0.23163
108.88	113.86	0.26219
110.67	117.72	0.29060
112.48	118.29	0.30137
114.32	119.24	0.31199
116.18	122.85	0.33141
118.07	127.40	0.35333
120.00	130.40	0.36867
121.97	132.38	0.38195
123.97	137.04	0.40456
126.03	152.46	0.46576

TABLE VI-78

DERIVED EMISSIVITY

RUN NO. 21 FREQ 16.5GHZ
DATE 08/08/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	268.06	0.85545
98.46	258.31	0.82142
100.16	258.51	0.82941
101.88	259.94	0.83868
103.61	252.08	0.81049
105.35	246.36	0.79097
107.10	241.78	0.77562
108.88	238.16	0.76364
110.67	234.46	0.75271
112.48	227.37	0.72842
114.32	222.91	0.71408
116.18	219.57	0.70378
118.07	212.97	0.68129
120.00	210.38	0.67350
121.97	201.89	0.64438
123.97	206.32	0.66240
126.03	207.54	0.66838

TABLE VI-79

DERIVED EMISSIVITY

RUN NO. 22 FREQ 16.5GHZ
DATE 08/08/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	100.17	-0.06114
98.46	109.12	0.05720
100.16	108.89	0.11362
101.88	109.71	0.15622
103.61	111.31	0.19064
105.35	117.16	0.23594
107.10	119.01	0.25860
108.88	122.21	0.28263
110.67	126.34	0.31243
112.48	124.95	0.31580
114.32	129.48	0.34070
116.18	125.40	0.33083
118.07	134.15	0.36937
120.00	135.00	0.38058
121.97	139.03	0.40075
123.97	150.19	0.44389
126.03	177.12	0.54797

TABLE VI-80

DERIVED EMISSIVITY

RUN NO. 23 FREQ 16.5GHZ
DATE 08/08/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	264.99	0.84677
98.46	257.97	0.82572
100.16	258.10	0.83425
101.88	258.01	0.83565
103.61	262.06	0.85568
105.35	255.88	0.83382
107.10	245.78	0.79574
108.88	241.47	0.78159
110.67	240.90	0.78213
112.48	230.87	0.74706
114.32	230.55	0.74809
116.18	223.62	0.72466
118.07	220.61	0.71549
120.00	216.08	0.70061
121.97	206.50	0.66730
123.97	204.93	0.66232
126.03	202.48	0.65469

TABLE VI-81

DERIVED EMISSIVITY

RUN NO. 24 FREQ 16.5GHZ
DATE 08/08/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	102.77	-0.03708
98.46	109.71	0.07577
100.16	108.95	0.13450
101.88	109.04	0.17048
103.61	112.34	0.20479
105.35	111.66	0.21488
107.10	118.14	0.24949
108.88	121.17	0.26573
110.67	119.80	0.27276
112.48	123.09	0.29767
114.32	127.08	0.32373
116.18	132.21	0.35273
118.07	132.01	0.35982
120.00	135.99	0.38178
121.97	144.96	0.41963
123.97	146.57	0.42882
126.03	169.67	0.51749

TABLE VI-82

DERIVED EMISSIVITY

RUN NO. 25 FREQ 16.5GHZ
DATE 08/12/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	265.39	0.84768
98.46	261.97	0.84210
100.16	265.08	0.86123
101.88	268.36	0.87737
103.61	262.61	0.85759
105.35	252.76	0.82199
107.10	249.84	0.81303
108.88	243.63	0.79112
110.67	233.11	0.75429
112.48	227.74	0.73589
114.32	227.51	0.73524
116.18	217.82	0.70147
118.07	212.73	0.68357
120.00	205.08	0.65631
121.97	203.83	0.65415
123.97	197.37	0.63314
126.03	194.95	0.62588

TABLE VI-83

DERIVED EMISSIVITY

RUN NO. 26 FREQ 16.5GHZ
DATE 08/12/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	98.61	0.01343
98.46	104.19	0.09358
100.16	102.71	0.13160
101.88	100.83	0.15293
103.61	100.58	0.17332
105.35	104.46	0.20306
107.10	109.81	0.23570
108.88	114.07	0.26055
110.67	115.75	0.27891
112.48	114.42	0.28360
114.32	121.71	0.32029
116.18	119.51	0.31939
118.07	124.66	0.34537
120.00	131.74	0.37744
121.97	127.54	0.36621
123.97	145.45	0.43586
126.03	169.33	0.52623

TABLE VI-84

DERIVED EMISSIVITY

RUN NO. 27 FREQ 16.5GHZ
DATE 08/12/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	270.60	0.86814
98.46	266.19	0.85590
100.16	265.77	0.86089
101.88	263.61	0.85482
103.61	259.72	0.84259
105.35	253.27	0.81999
107.10	250.26	0.81068
108.88	244.74	0.79132
110.67	236.96	0.76466
112.48	233.87	0.75526
114.32	227.68	0.73405
116.18	222.33	0.71500
118.07	217.22	0.69976
120.00	212.61	0.68339
121.97	205.03	0.65922
123.97	205.24	0.66141
126.03	197.30	0.63512

TABLE VI-85

DERIVED EMISSIVITY

RUN NO. 28 FREQ 16.5GHZ
DATE 08/12/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	104.80	-0.00467
98.46	111.07	0.08685
100.16	109.56	0.12989
101.88	107.38	0.15506
103.61	114.50	0.21007
105.35	109.80	0.20854
107.10	119.62	0.26301
108.88	123.09	0.28713
110.67	118.34	0.28073
112.48	123.63	0.31071
114.32	128.50	0.33718
116.18	130.26	0.35027
118.07	135.11	0.37423
120.00	139.11	0.39416
121.97	138.27	0.39691
123.97	148.12	0.43904
126.03	170.23	0.52525

TABLE VI-86

DERIVED EMISSIVITY

RUN NO. 29 FREQ 16.5GHZ
DATE 08/12/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	102.49	-0.00460
98.46	108.21	0.08240
100.16	107.86	0.12911
101.88	108.39	0.16379
103.61	110.24	0.19417
105.35	111.98	0.21838
107.10	114.40	0.24091
108.88	117.85	0.26415
110.67	121.57	0.29150
112.48	123.00	0.30579
114.32	125.76	0.32580
116.18	124.03	0.32514
118.07	125.98	0.33969
120.00	134.25	0.37624
121.97	136.50	0.38700
123.97	140.03	0.40593
126.03	149.53	0.44446

TABLE VI-37

DERIVED EMISSIVITY

RUN NO. 30 FREQ 16.5GHZ
DATE 08/12/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	275.42	0.88960
98.46	269.45	0.86878
100.16	268.26	0.86795
101.88	264.68	0.85519
103.61	256.18	0.82367
105.35	255.60	0.82483
107.10	252.42	0.81516
108.88	246.49	0.79452
110.67	238.71	0.76762
112.48	231.70	0.74154
114.32	224.53	0.71878
116.18	221.70	0.71043
118.07	214.74	0.68653
120.00	210.45	0.67253
121.97	206.26	0.65952
123.97	206.03	0.66094
126.03	198.91	0.63713

TABLE VI-88

DERIVED EMISSIVITY

RUN NO. 31 FREQ 16.5GHZ
DATE 08/13/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	113.03	-0.05800
98.46	116.50	0.04798
100.16	112.28	0.09935
101.88	111.67	0.14568
103.61	113.35	0.18445
105.35	116.54	0.22104
107.10	117.50	0.24150
108.88	117.31	0 25235
110.67	117.58	0.26895
112.48	121.94	0.29655
114.32	125.21	0.31757
116.18	126.67	0.33003
118.07	132.35	0.35770
120.00	133.13	0.36570
121.97	132.82	0.37159
123.97	139.12	0.40180
126.03	150.99	0.45178

TABLE VI-89

DERIVED EMISSIVITY

RUN NO. 32 FREQ 16.5GHZ
DATE 08/13/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	273.62	0.86839
98.46	268.58	0.85451
100.16	269.96	0.86883
101.88	267.50	0.86228
103.61	264.42	0.85340
105.35	256.89	0.82562
107.10	250.23	0.80156
108.88	246.42	0.78882
110.67	243.09	0.77942
112.48	233.26	0.74386
114.32	233.66	0.74809
116.18	225.23	0.71807
118.07	218.82	0.69579
120.00	214.69	0.68215
121.97	211.67	0.67312
123.97	201.60	0.63777
126.03	208.78	0.66652

TABLE VI-90

DERIVED EMISSIVITY

RUN NO. 35 FREQ 16.5GHZ
DATE 08/14/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	256.91	-0.67486
98.46	254.17	-0.55700
100.16	251.27	-0.41685
101.88	254.28	-0.27725
103.61	259.28	-0.11524
105.35	262.39	0.01350
107.10	253.90	-0.12781
108.88	247.04	-0.16460
110.67	242.37	-0.01631
112.48	227.24	0.03174
114.32	207.68	0.03248
116.18	217.28	0.29541
118.07	212.76	0.37853
120.00	205.07	0.41867
121.97	196.32	0.42968
123.97	214.24	0.57146
126.03	212.91	0.59828

TABLE VI-91

DERIVED EMISSIVITY

RUN NO. 36 FREQ 16.5GHZ
DATE 08/14/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	280.57	0.80861
98.46	283.45	0.85997
100.16	286.85	0.90310
101.88	284.30	0.89481
103.61	278.35	0.86571
105.35	276.73	0.86691
107.10	270.09	0.83965
108.88	260.42	0.79968
110.67	250.46	0.76167
112.48	246.24	0.75325
114.32	240.10	0.73606
116.18	232.44	0.71273
118.07	227.64	0.70197
120.00	220.76	0.68239
121.97	217.51	0.67665
123.97	211.77	0.66047
126.03	214.18	0.67522

TABLE VI-92

DERIVED EMISSIVITY

RUN NO.201 FREQ 9.5GHZ
DATE 07/17/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	323.03	1.17371
98.46	300.50	1.00943
100.16	290.47	0.95129
101.88	281.81	0.90928
103.61	274.13	0.87580
105.35	284.61	0.93202
107.10	279.20	0.90522
108.88	273.76	0.87704
110.67	268.11	0.84586
112.48	262.37	0.81128
114.32	257.00	0.77432
116.18	225.20	0.61084
118.07	224.07	0.60993
120.00	225.71	0.62243
121.97	230.29	0.64962
123.97	237.58	0.69020
126.03	286.93	0.93938

TABLE VI-93

DERIVED EMISSIVITY

RUN NO.101 FREQ 9.5GHZ
DATE 07/21/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	298.28	0.99374
98.46	286.76	0.91323
100.16	281.72	0.89591
101.88	276.27	0.87975
103.61	270.46	0.86226
105.35	259.09	0.82148
107.10	252.74	0.79100
108.88	245.41	0.75848
110.67	240.26	0.72333
112.48	234.77	0.68641
114.32	230.39	0.64804
116.18	205.49	0.53228
118.07	206.10	0.54297
120.00	209.77	0.56653
121.97	216.59	0.60404
123.97	226.19	0.65380
126.03	279.20	0.90598

TABLE VI-94

DERIVED EMISSIVITY

RUN NO.102 FREQ 9.5GHZ
DATE 07/21/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	114.00	-0.85882
98.46	113.05	-0.61240
100.16	104.18	-0.46346
101.88	96.43	-0.33855
103.61	89.94	-0.26214
105.35	80.31	-0.22251
107.10	75.89	-0.17096
108.88	72.74	-0.12526
110.67	71.08	-0.08285
112.48	71.49	-0.04010
114.32	74.52	0.00594
116.18	57.02	-0.04199
118.07	68.40	0.02855
120.00	84.64	0.11148
121.97	105.52	0.20722
123.97	130.19	0.31496
126.03	223.92	0.68368

TABLE VI-95

DERIVED EMISSIVITY

RUN NO. 1 FREQ 9.5GHZ
DATE 07/25/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	109.75	0.11312
98.46	125.65	0.22498
100.16	138.16	0.30572
101.88	153.16	0.38222
103.61	165.41	0.43544
105.35	96.89	0.14309
107.10	96.31	0.13429
108.88	115.24	0.21148
110.67	134.32	0.29420
112.48	147.23	0.35749
114.32	171.57	0.46740
116.18	136.27	0.32874
118.07	102.14	0.19835
120.00	93.07	0.17166
121.97	127.51	0.31089
123.97	140.61	0.36409
126.03	207.99	0.63512

TABLE VI-96

DERIVED EMISSIVITY

RUN NO. 2 FREQ 9.5GHZ
DATE 07/25/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	296.92	0.98918
98.46	279.20	0.90508
100.15	276.50	0.90183
101.88	275.14	0.90273
103.61	267.29	0.86570
105.35	260.00	0.83503
107.10	245.70	0.77359
108.88	237.62	0.73448
110.67	235.79	0.73200
112.48	232.44	0.71379
114.32	227.18	0.69129
116.18	196.79	0.56048
118.07	190.25	0.53186
120.00	185.39	0.51442
121.97	176.91	0.47061
123.97	178.24	0.47344
126.03	208.46	0.50404

TABLE VI-97

DERIVED EMISSIVITY

RUN NO. 33 FREQ 9.5GHZ
DATE 08/14/69
POLARIZATION V

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	297.57	0.99082
98.46	303.54	1.02568
100.16	301.08	1.01066
101.88	294.22	0.97643
103.61	287.81	0.94597
105.35	256.32	0.79514
107.10	257.00	0.79741
108.88	258.45	0.80170
110.67	252.74	0.77612
112.48	249.46	0.76145
114.32	235.18	0.69389
116.18	217.41	0.61017
118.07	207.69	0.56565
120.00	210.64	0.58188
121.97	200.32	0.53783
123.97	198.71	0.53560
126.03	233.24	0.69944

TABLE VI-98

DERIVED EMISSIVITY

RUN NO. 34 FREQ 9.5GHZ
DATE 08/14/69
POLARIZATION H

ZENITH ANGLE (DEG.)	BRIGHTNESS TEMPERATURE (DEG.K)	EMISSIVITY
96.76	123.59	-0.16041
98.46	118.82	-0.09384
100.16	113.44	-0.03333
101.88	106.61	0.00163
103.61	124.84	0.13582
105.35	130.57	0.19405
107.10	122.87	0.18137
108.88	107.23	0.12895
110.67	95.56	0.07566
112.48	94.28	0.10877
114.32	101.84	0.15394
116.18	93.43	0.12845
118.07	[illegible]2.91	0.13500
120.00	105.83	0.19509
121.97	101.00	0.18466
123.97	114.05	0.24[illegible]2
126.03	185.63	0.54157

TABLE VI-99

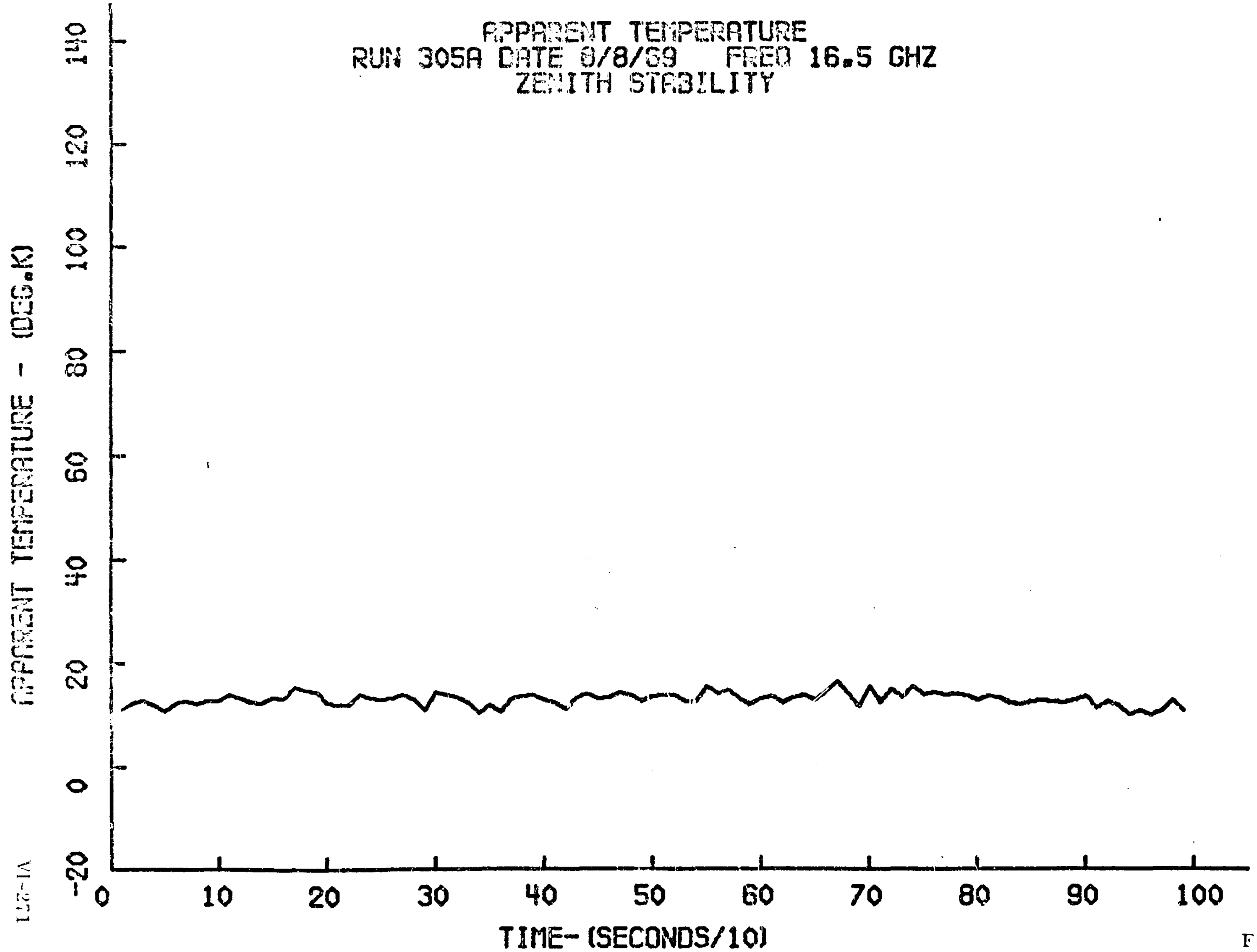


FIGURE VI-164

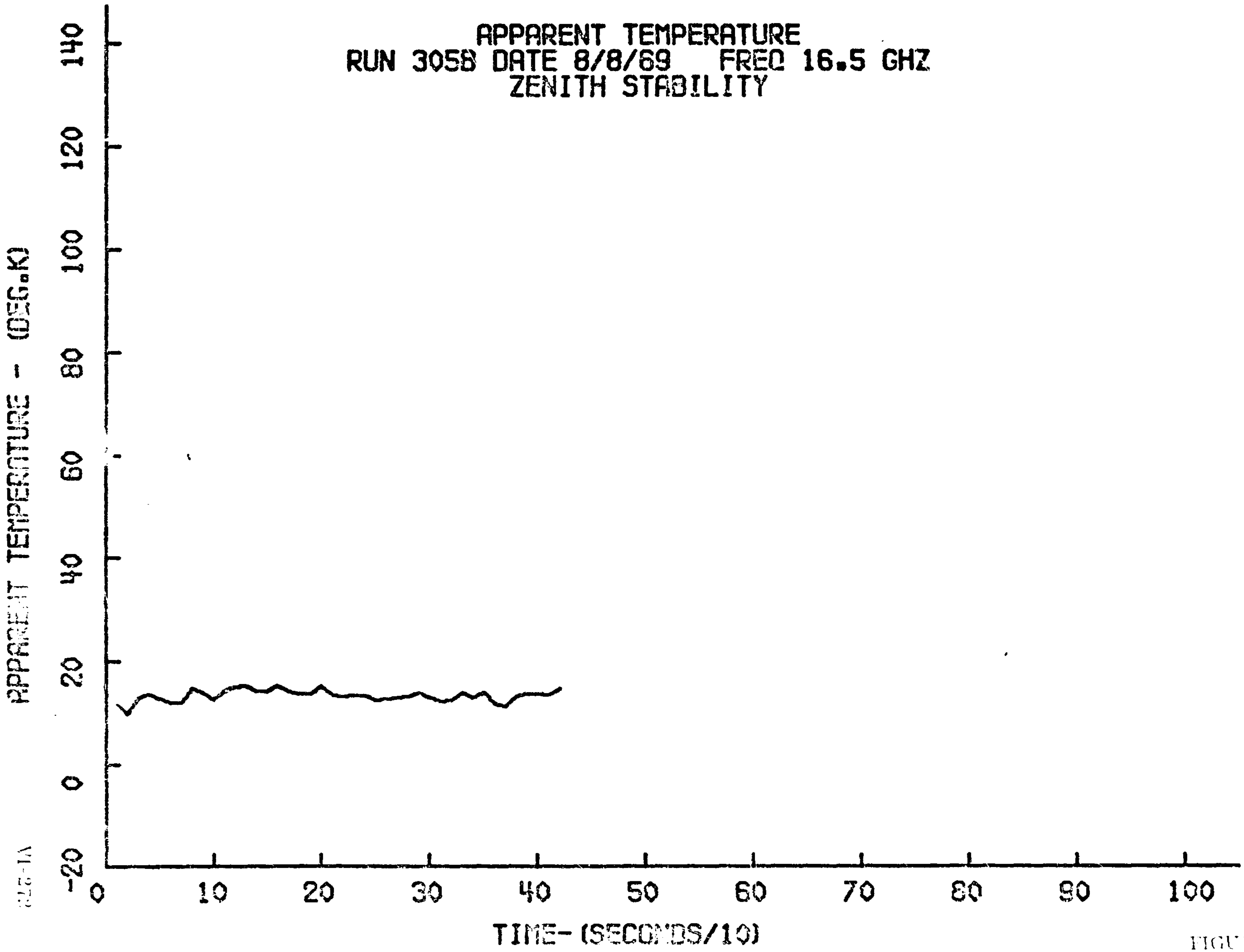


FIGURE VI-165

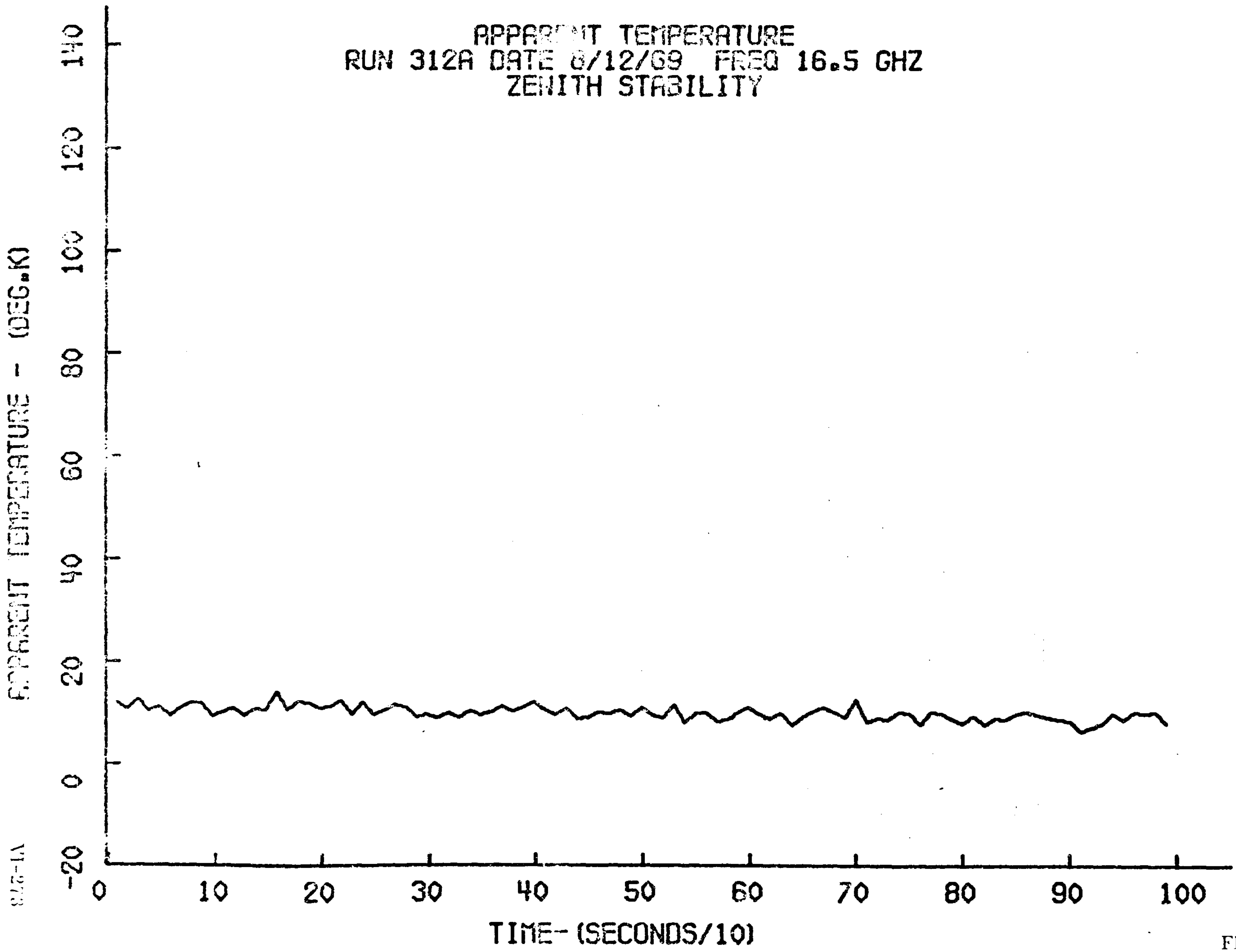


FIGURE VI-166

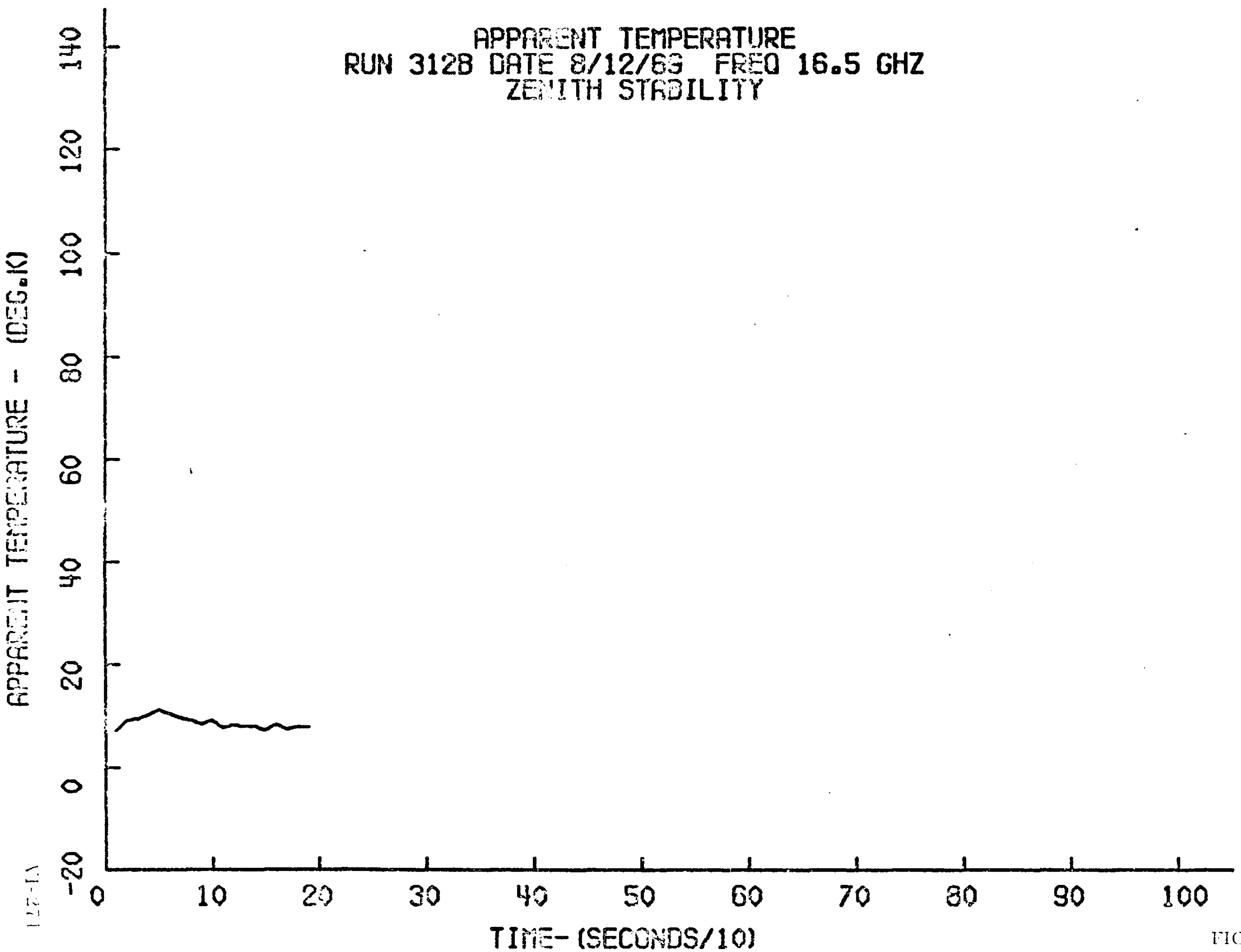


FIGURE VI-167

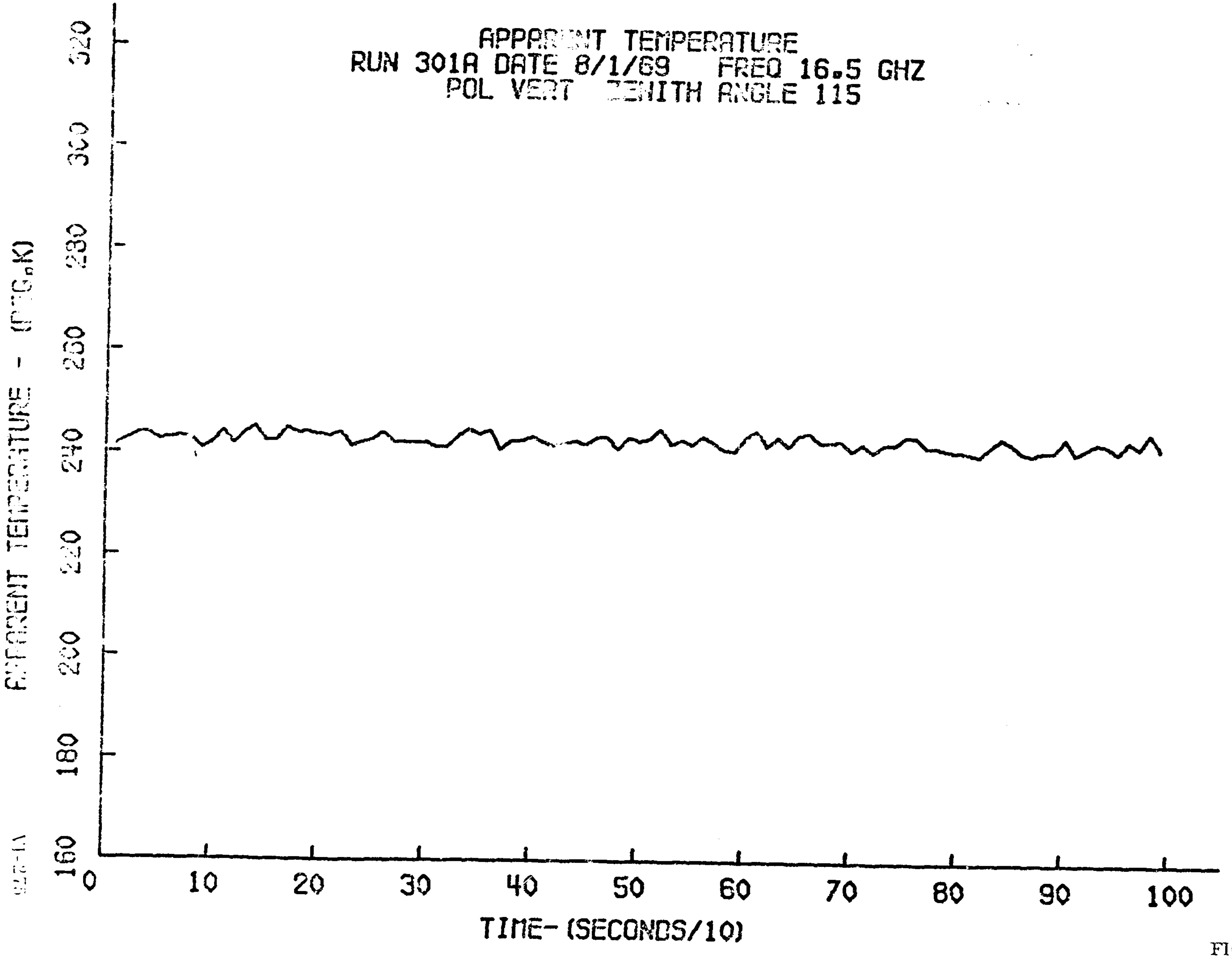


FIGURE VI-168

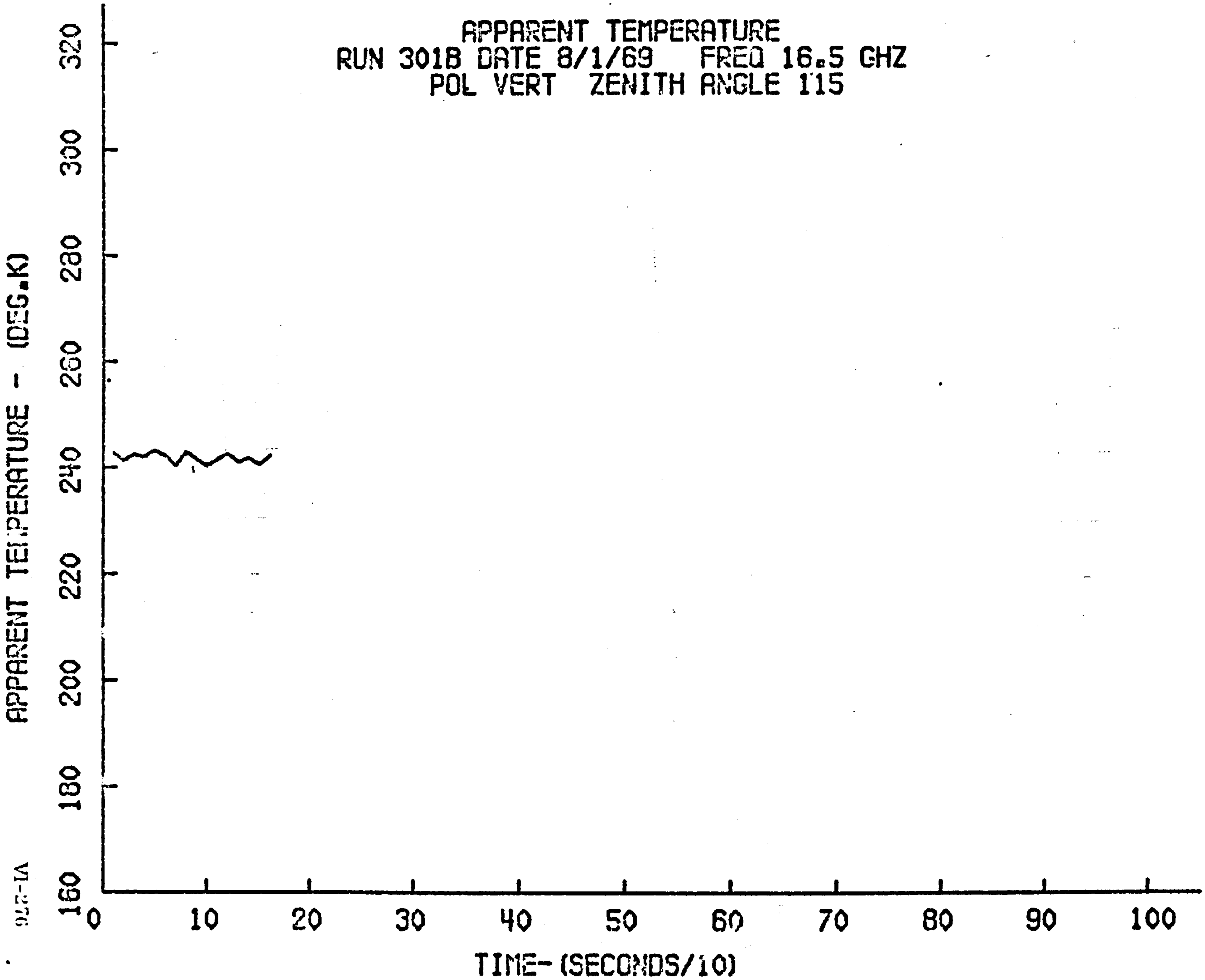


FIGURE VI-169

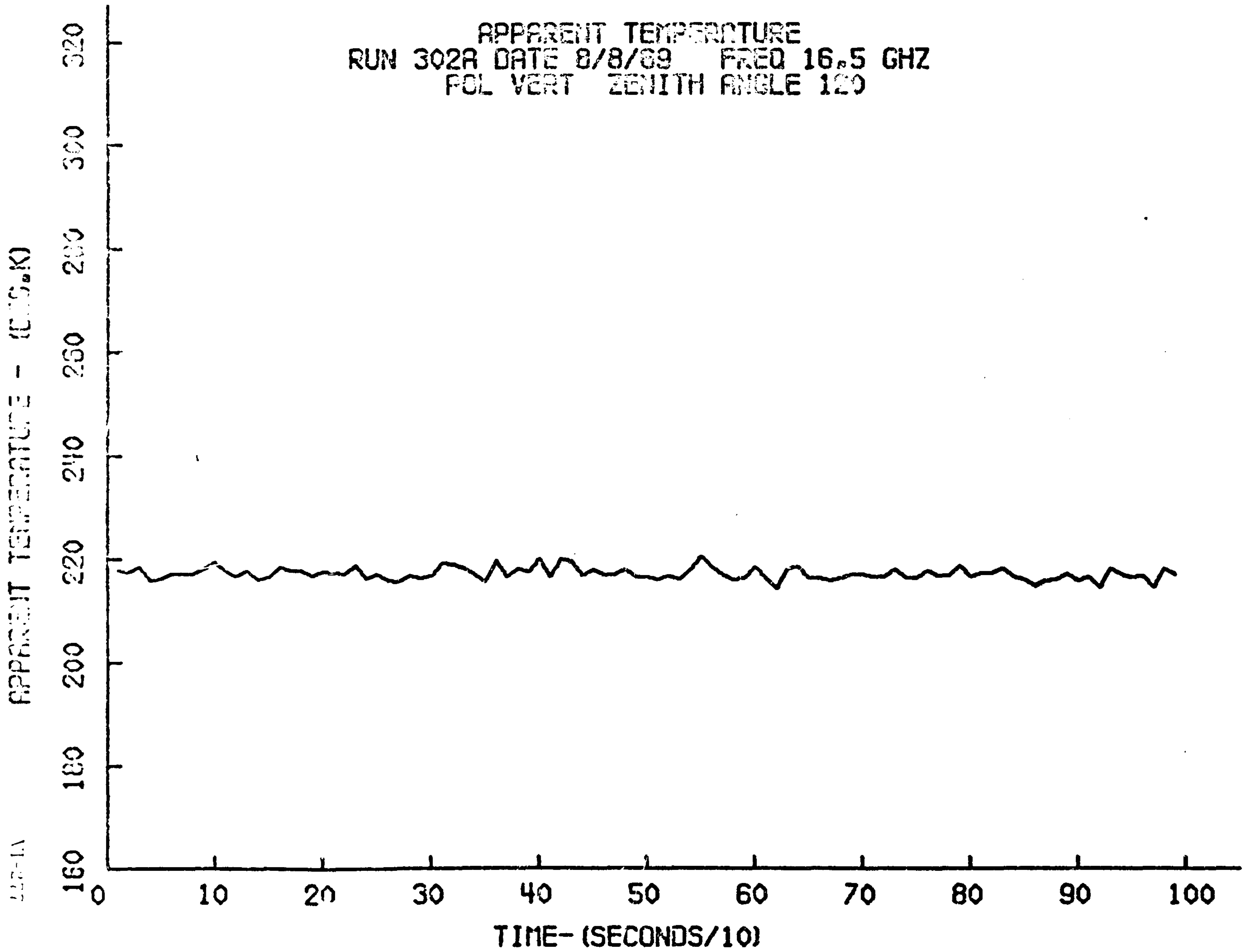


FIGURE VI-170

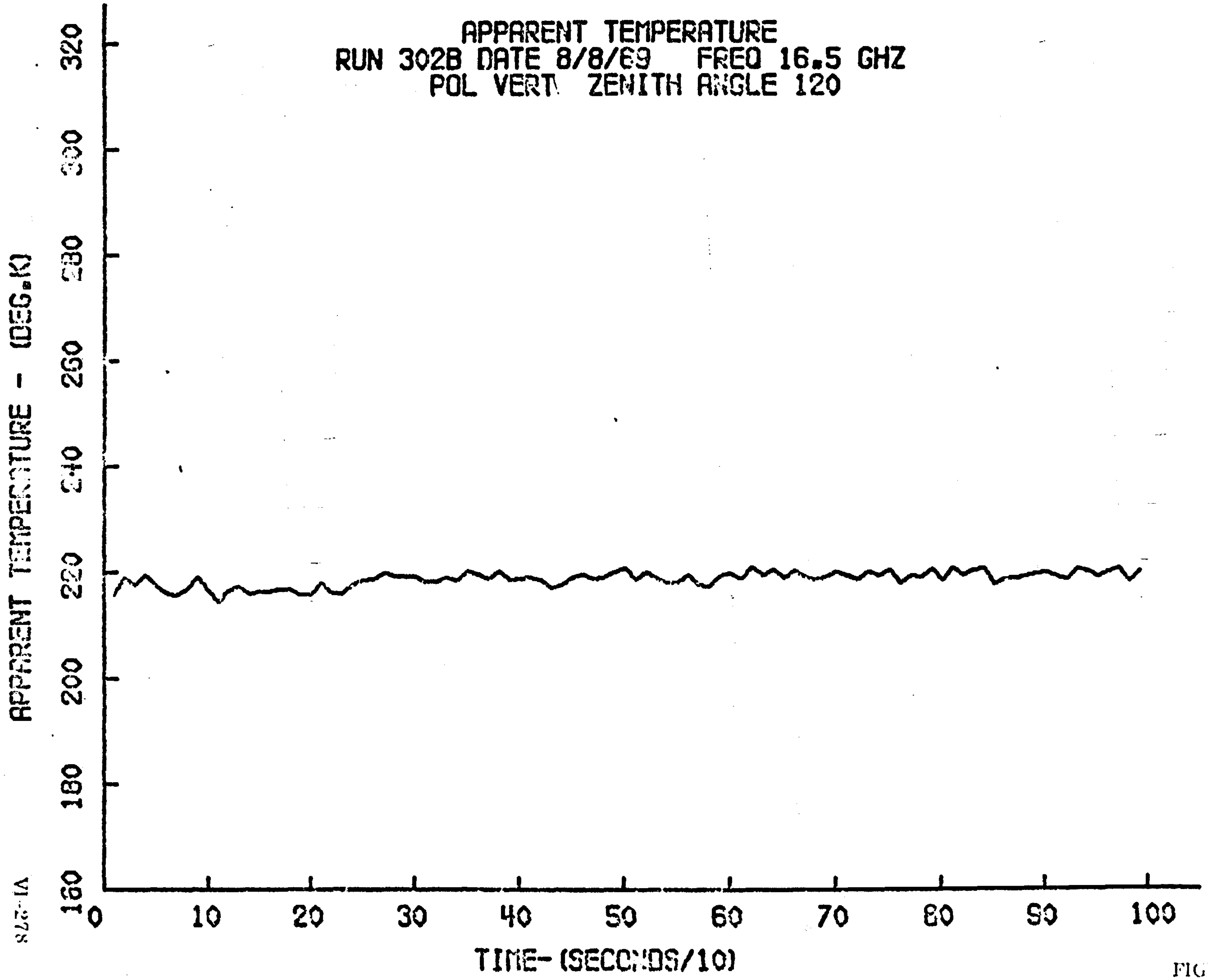


FIGURE VI-141

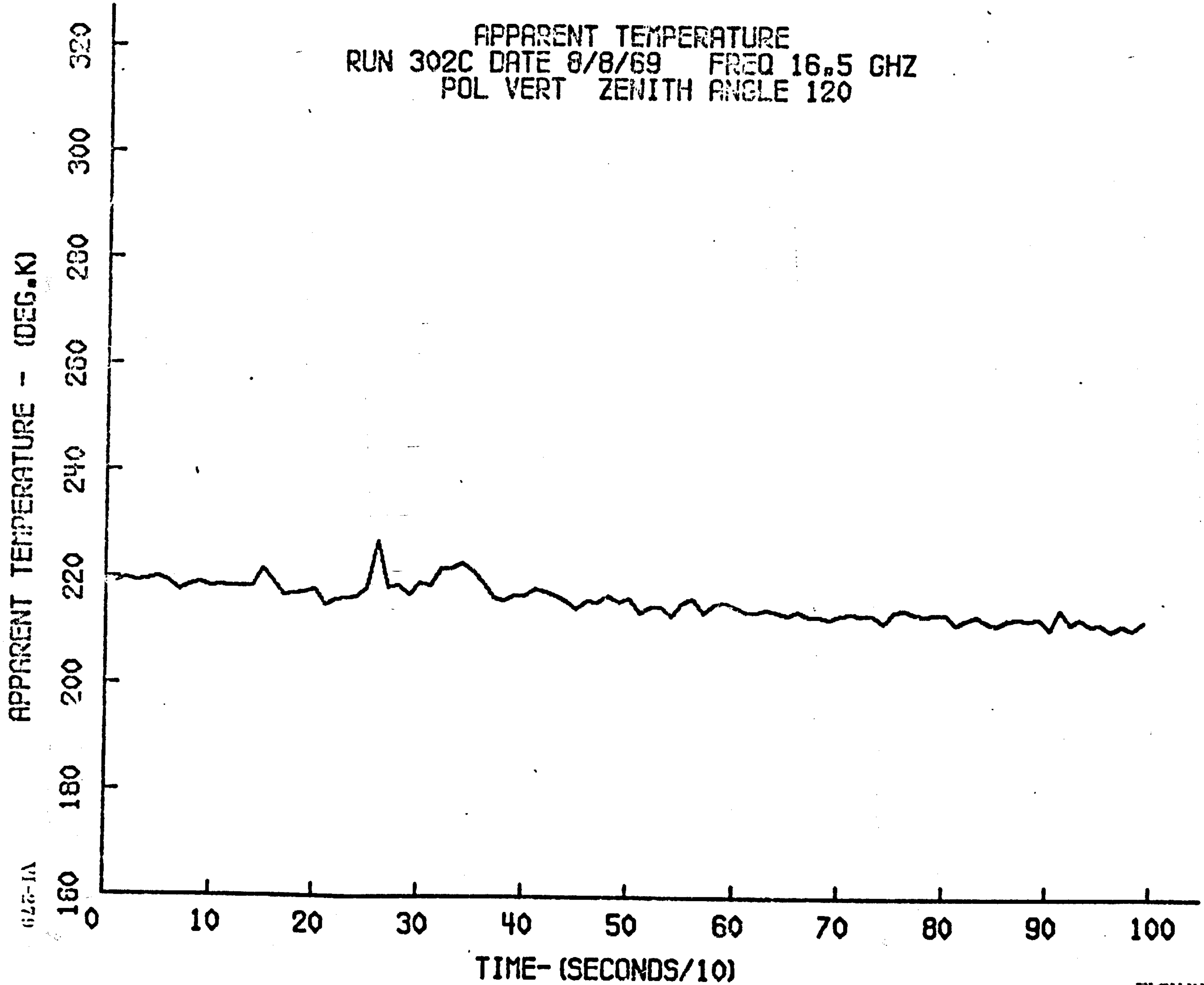


FIGURE VI-172

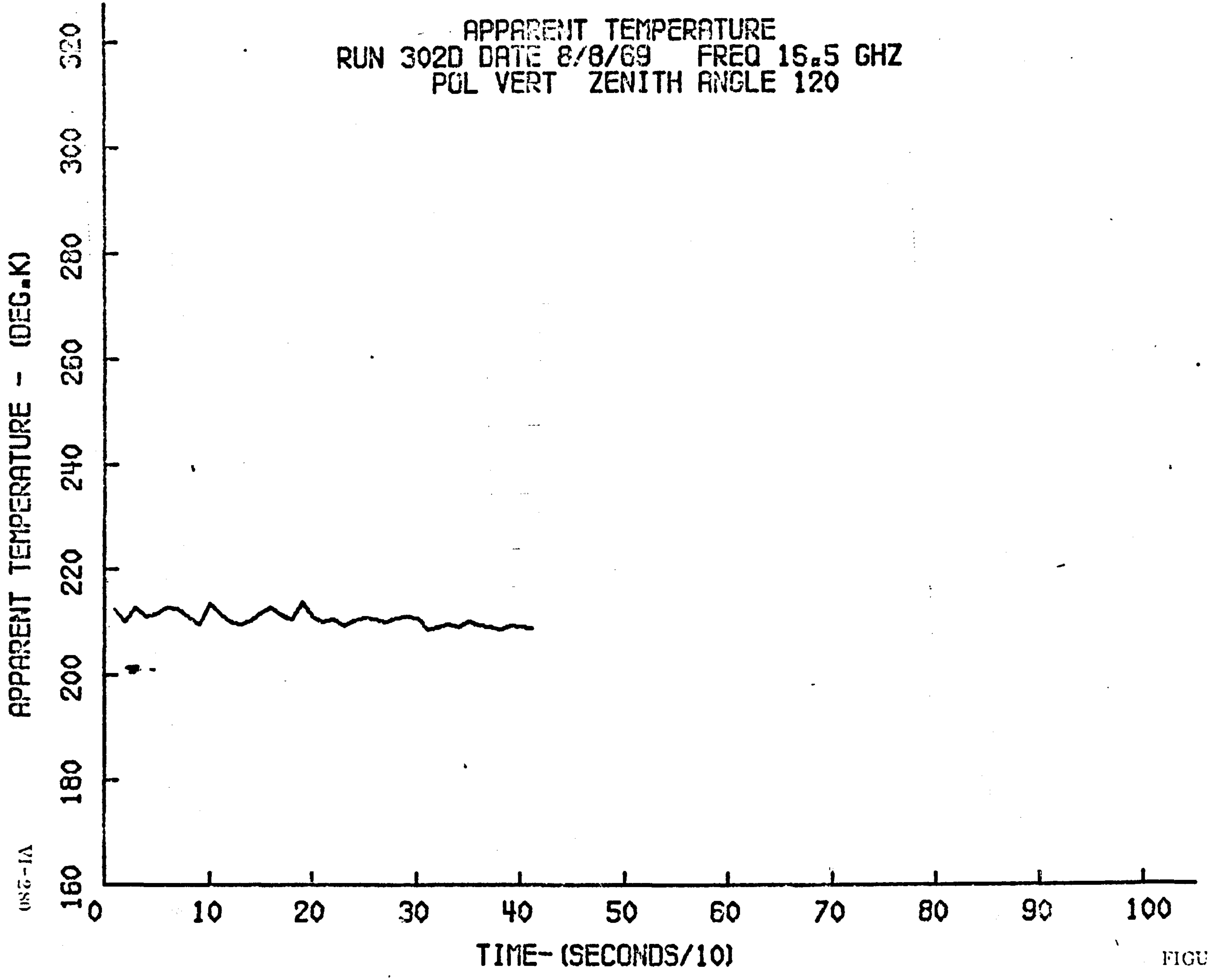


FIGURE VI-173

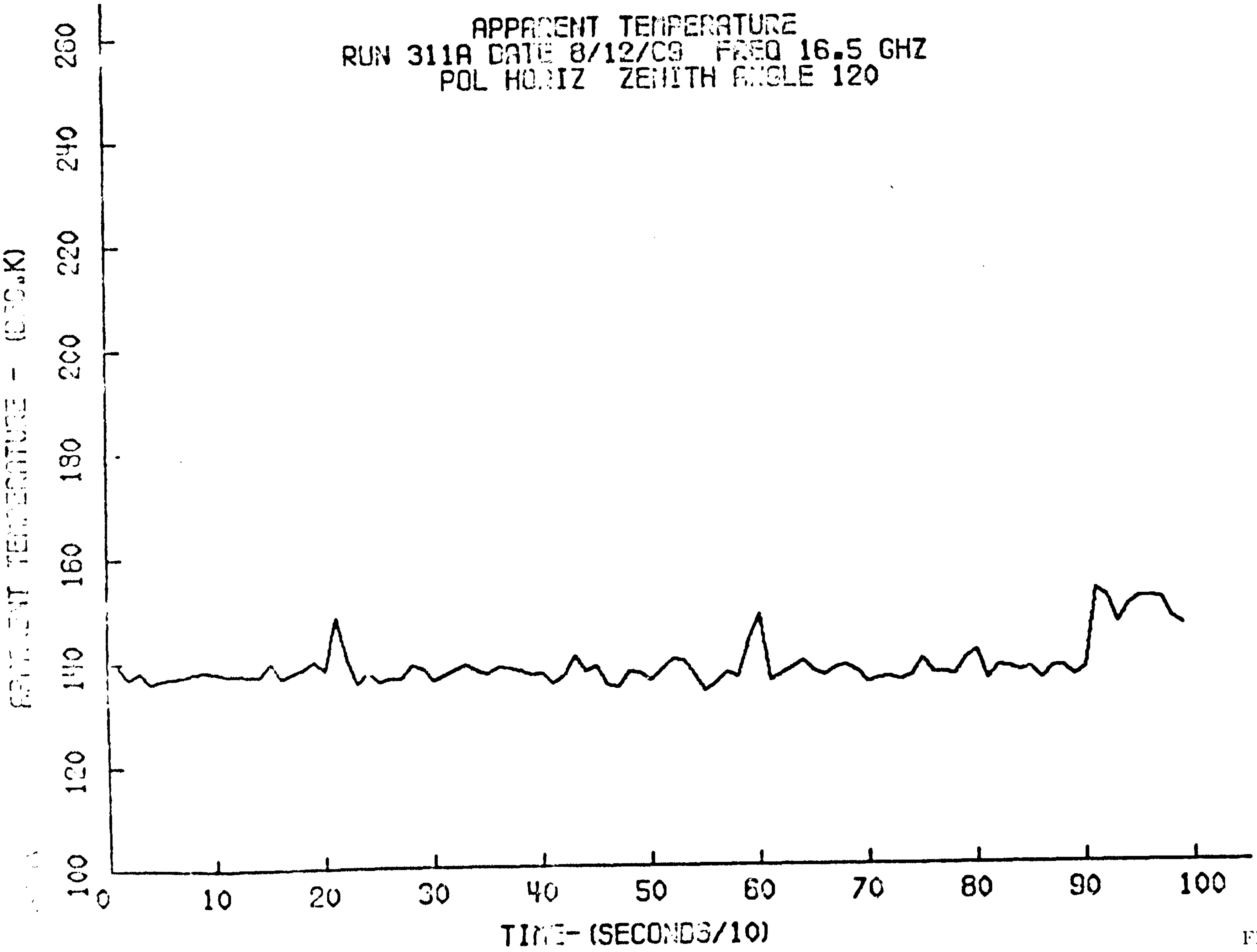


FIGURE VI-174

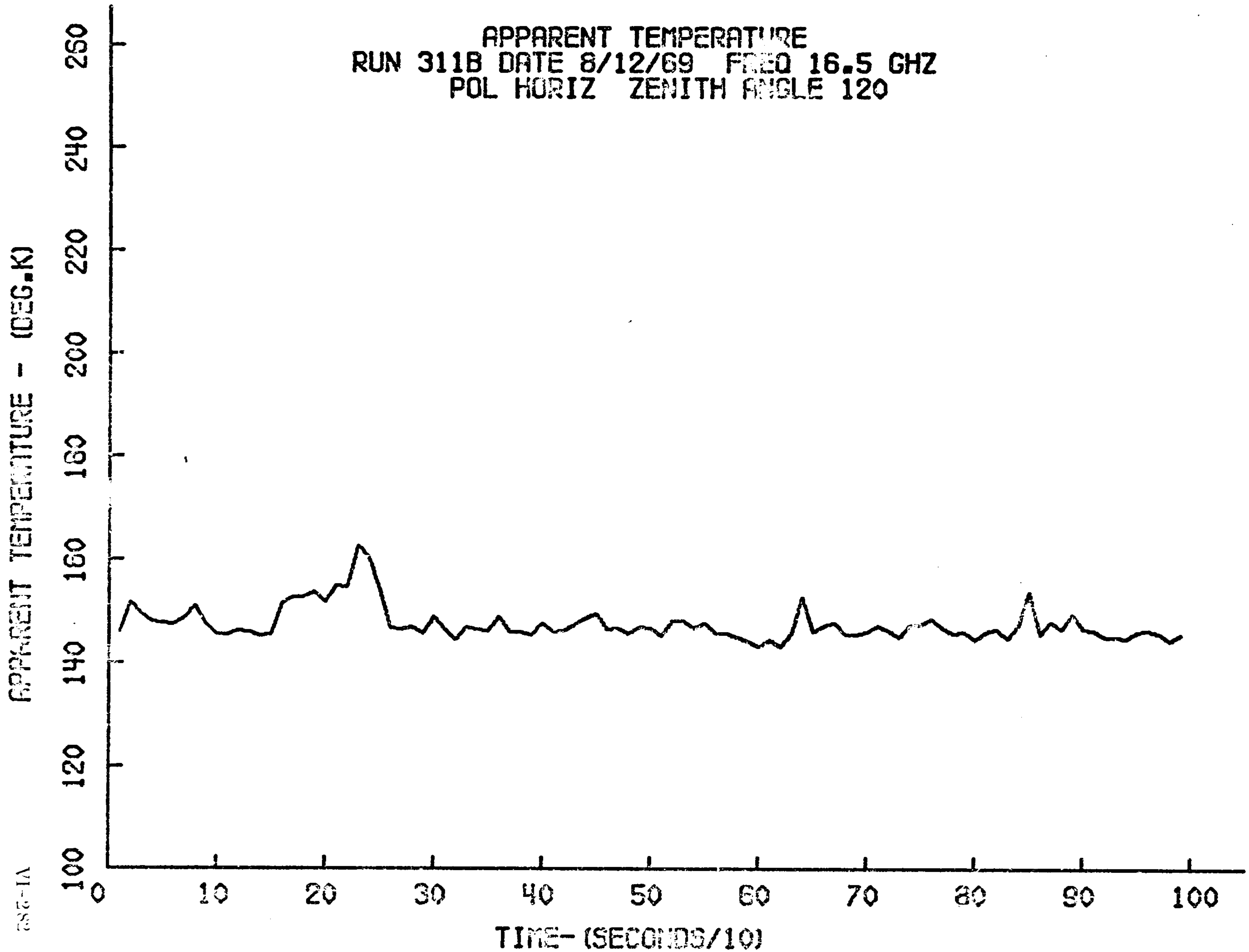


FIGURE VI-175

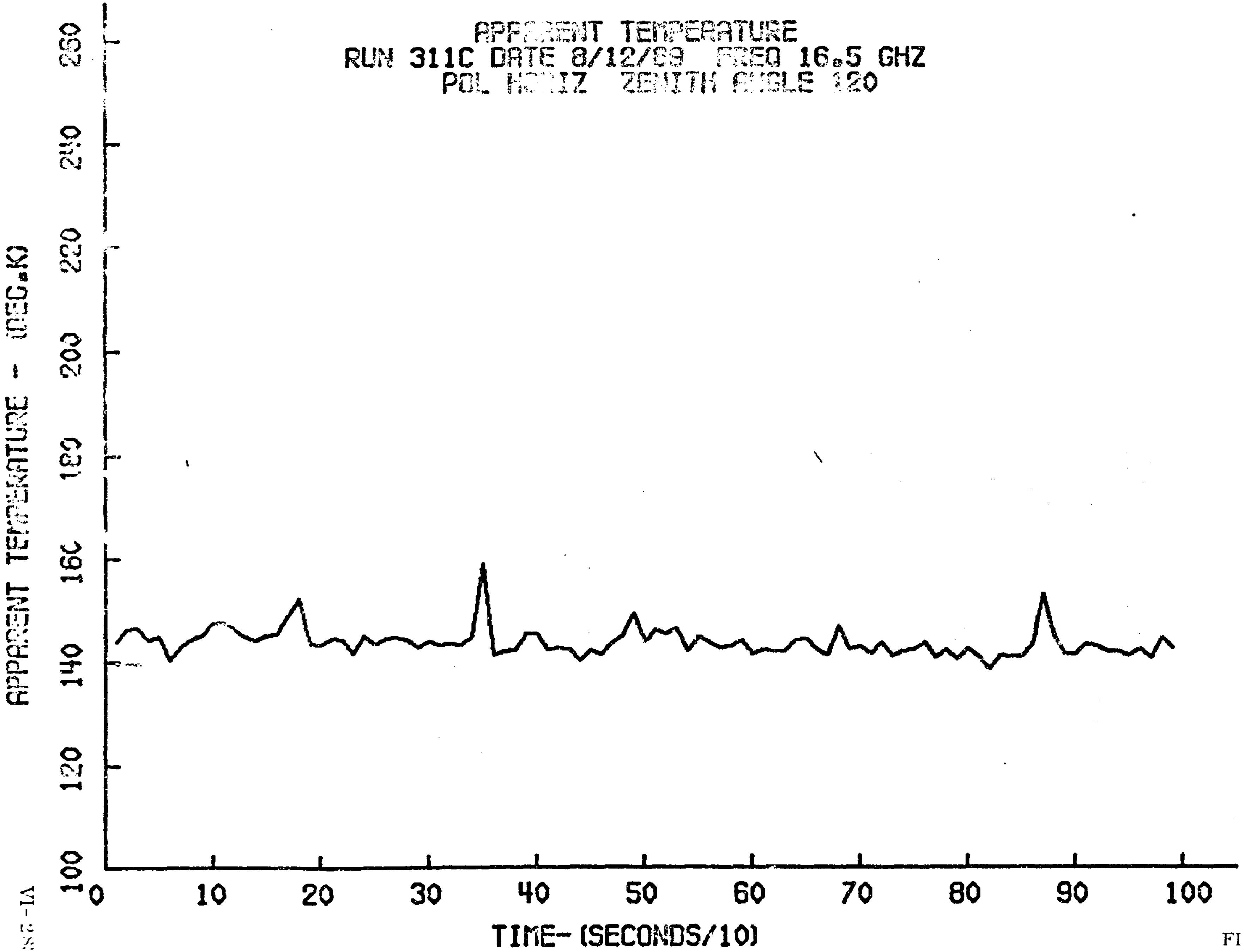


FIGURE VI-176

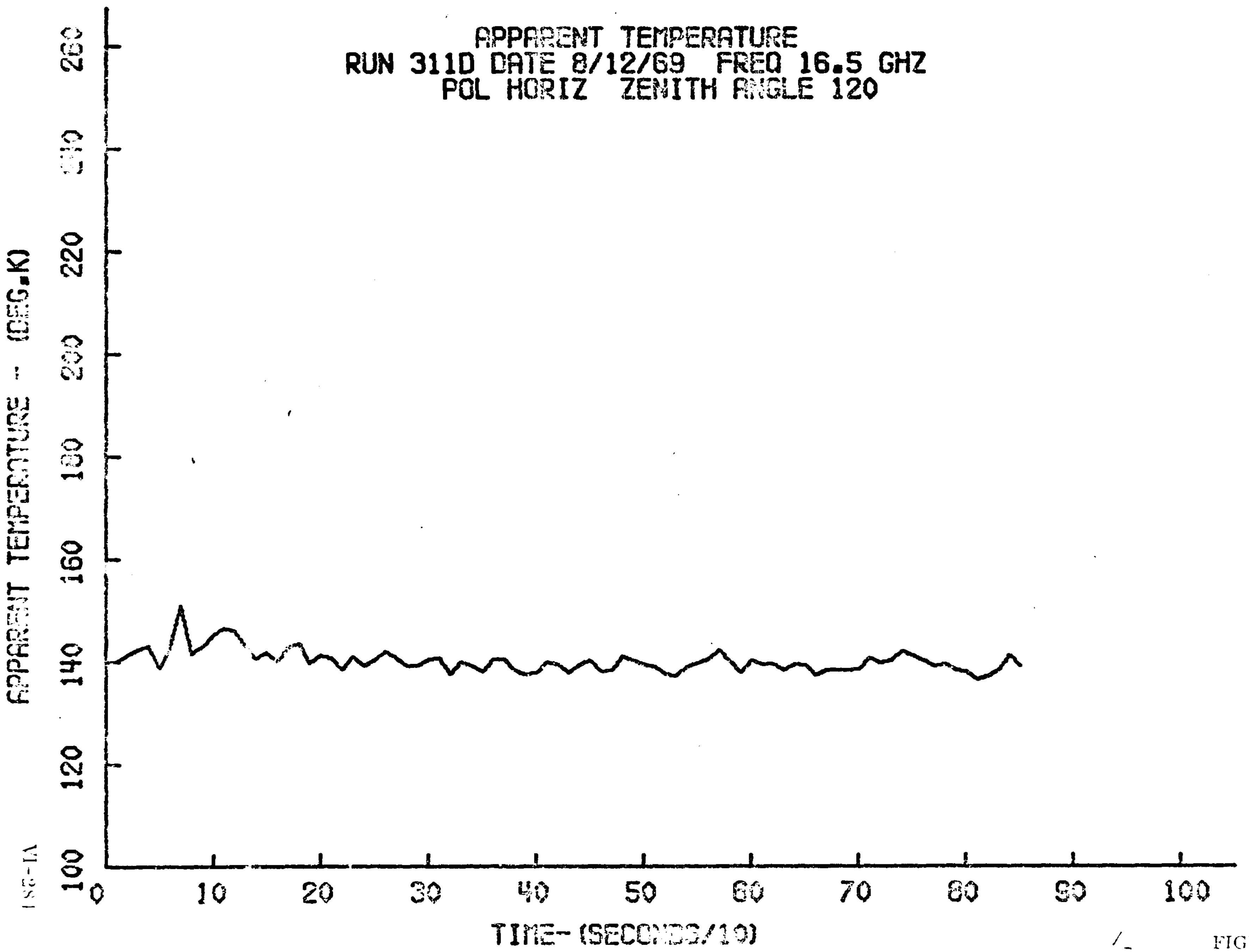


FIGURE VI-177

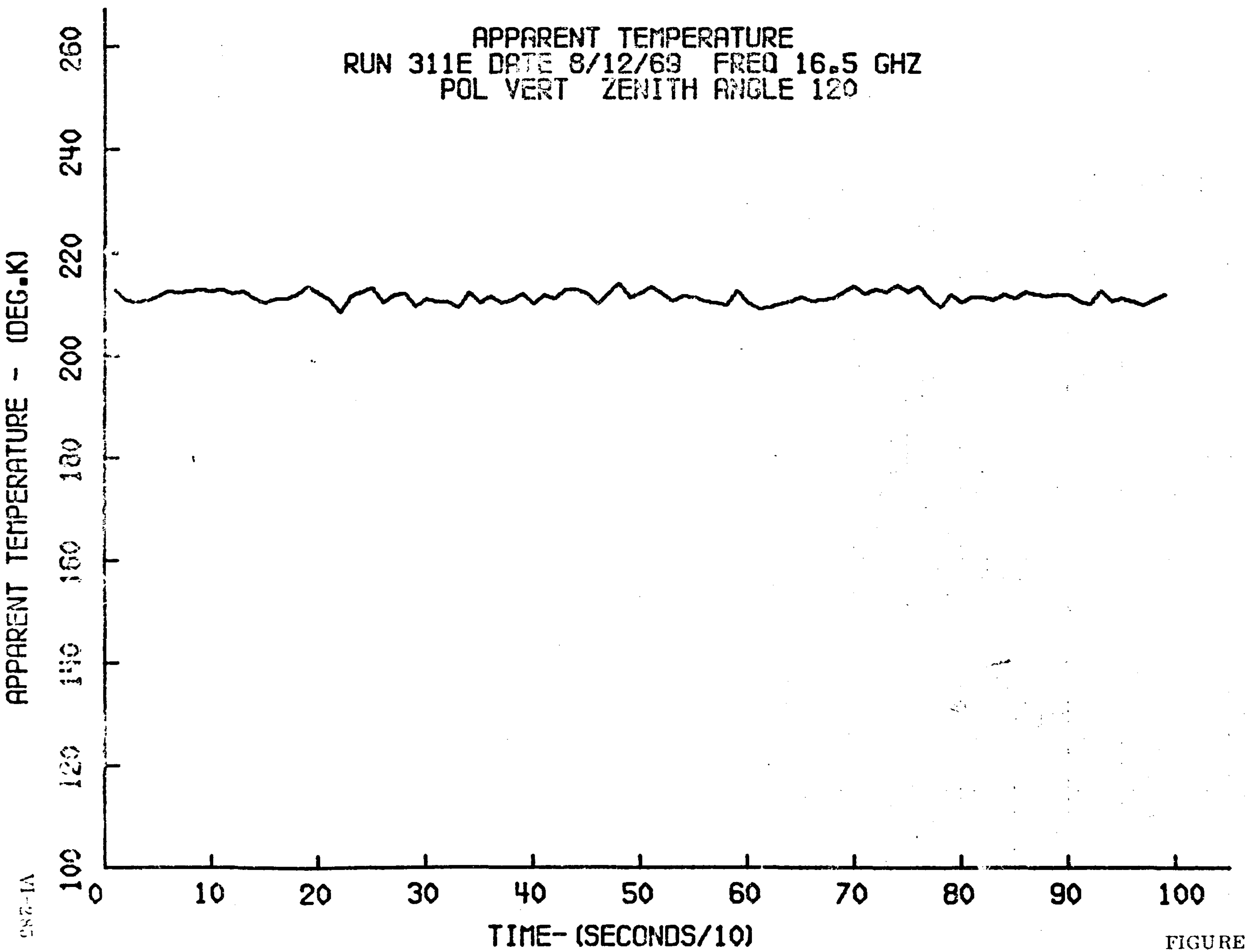


FIGURE VI-178

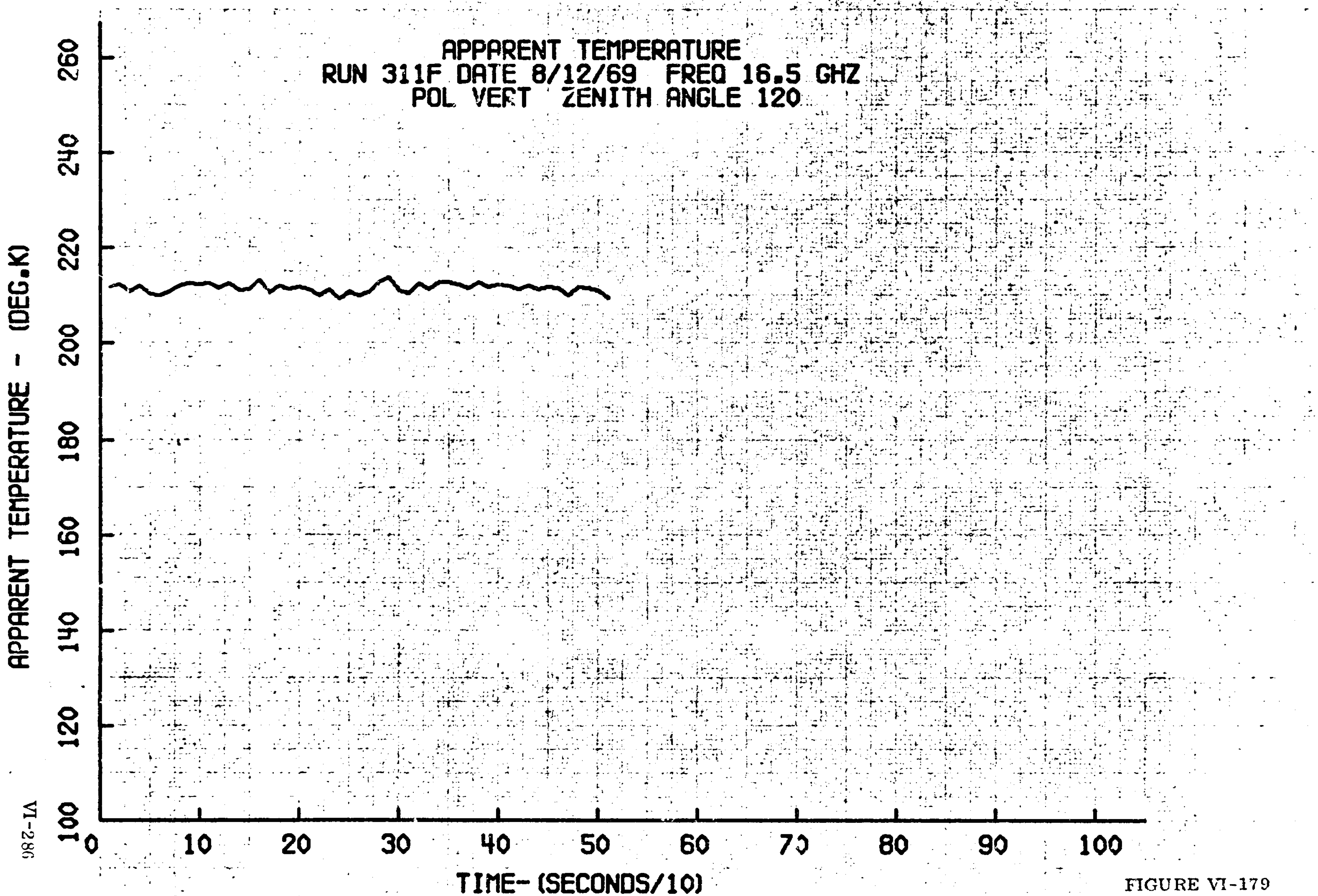


FIGURE VI-179

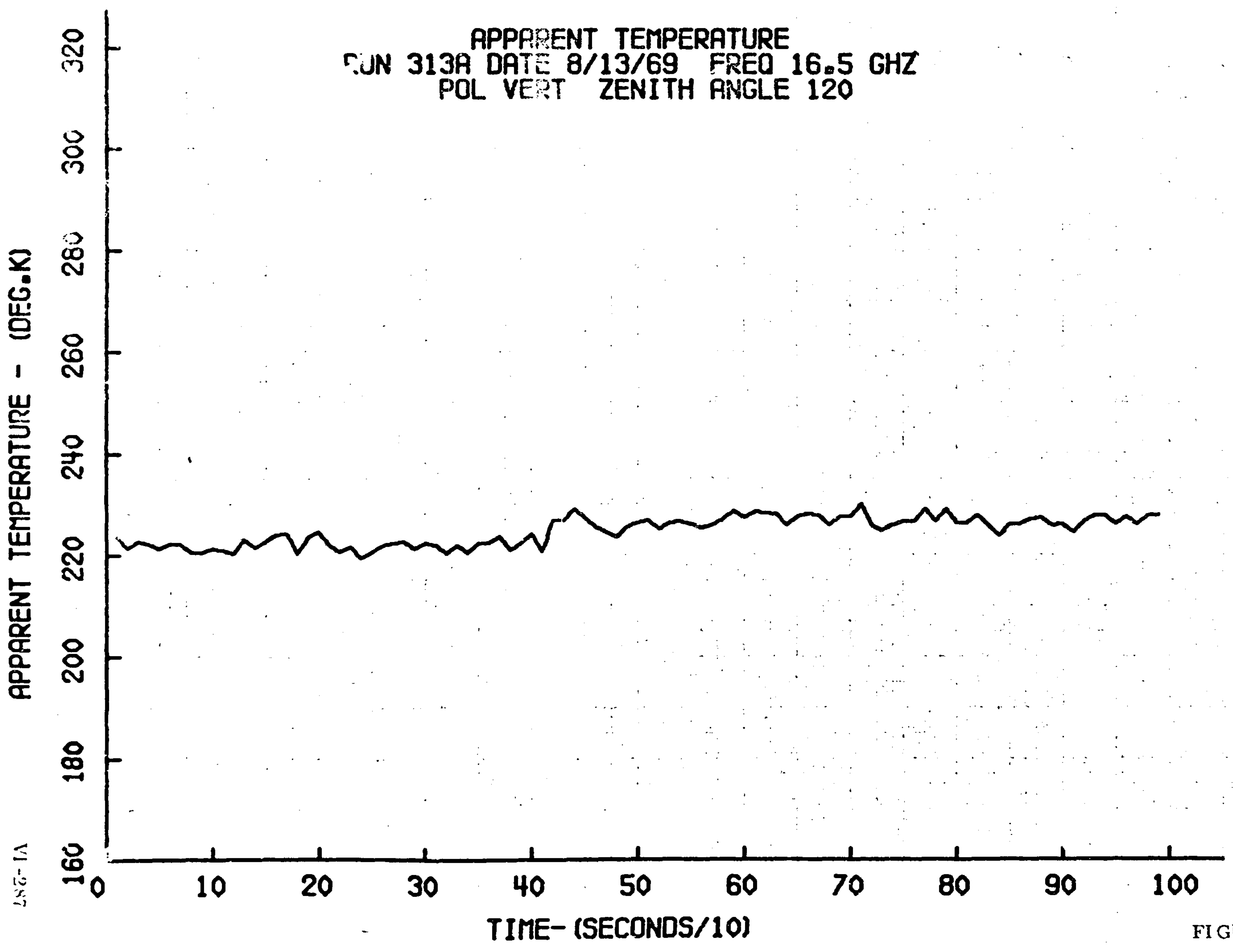


FIGURE VI-180

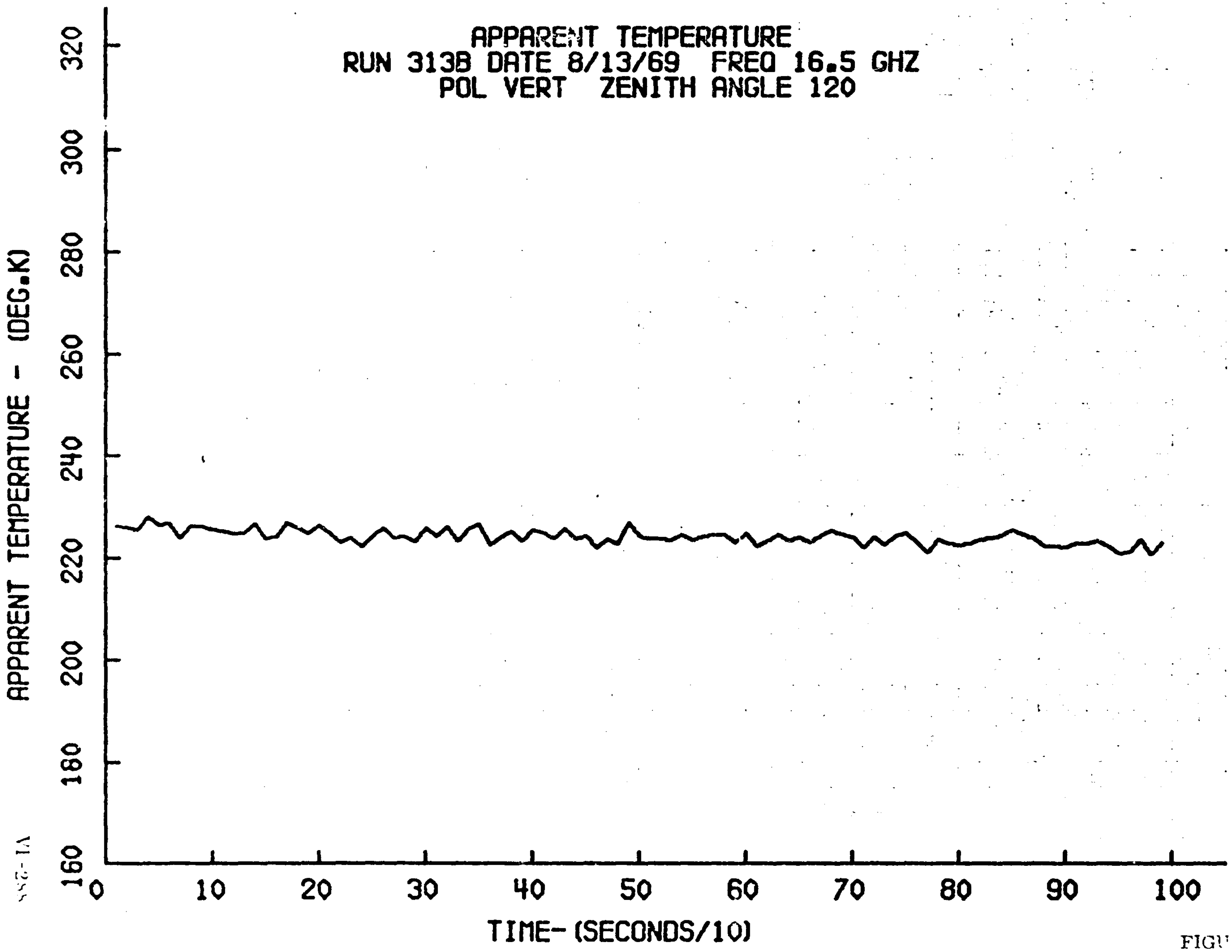


FIGURE VI-181

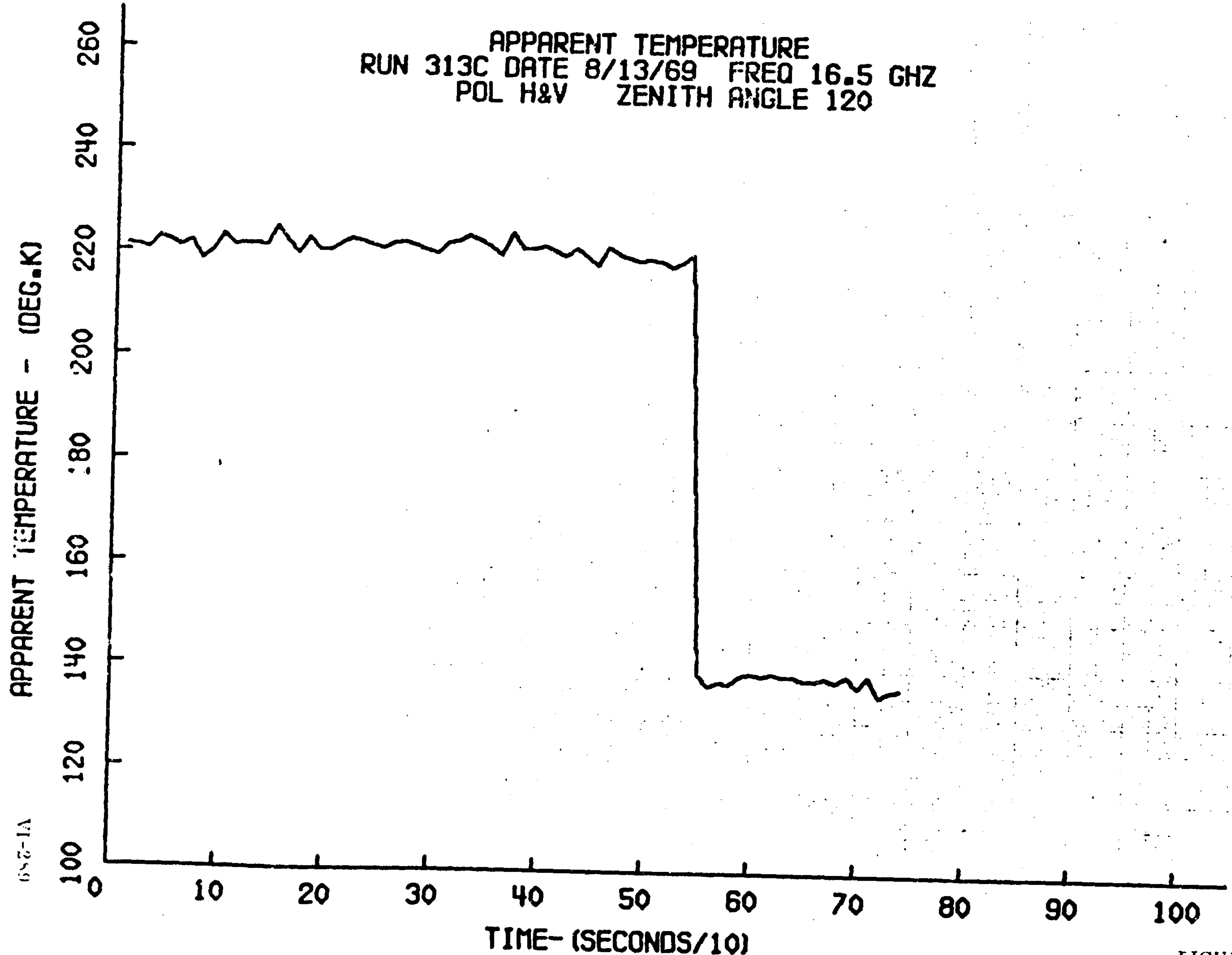


FIGURE VI-182

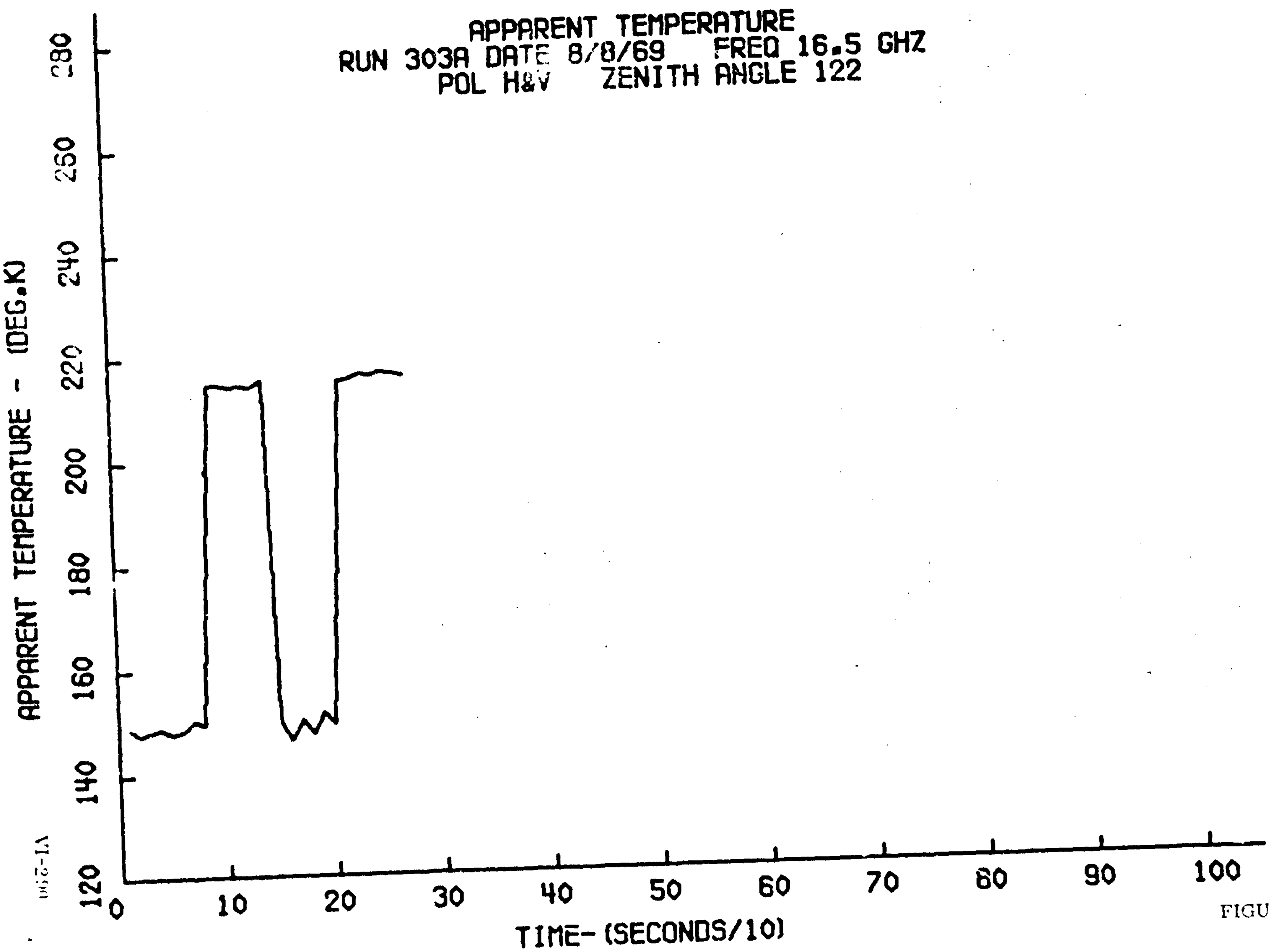


FIGURE VI-183

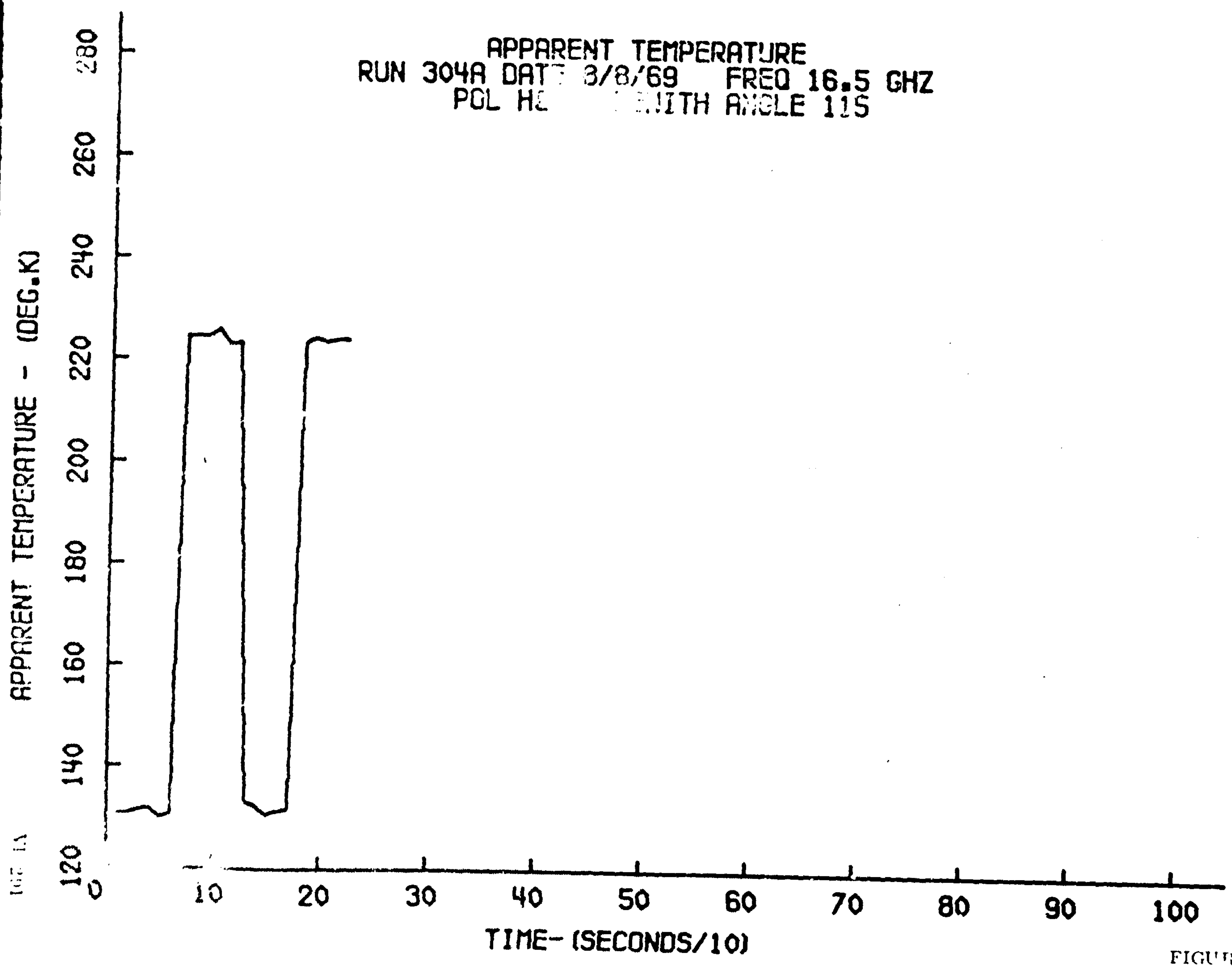


FIGURE VI-184

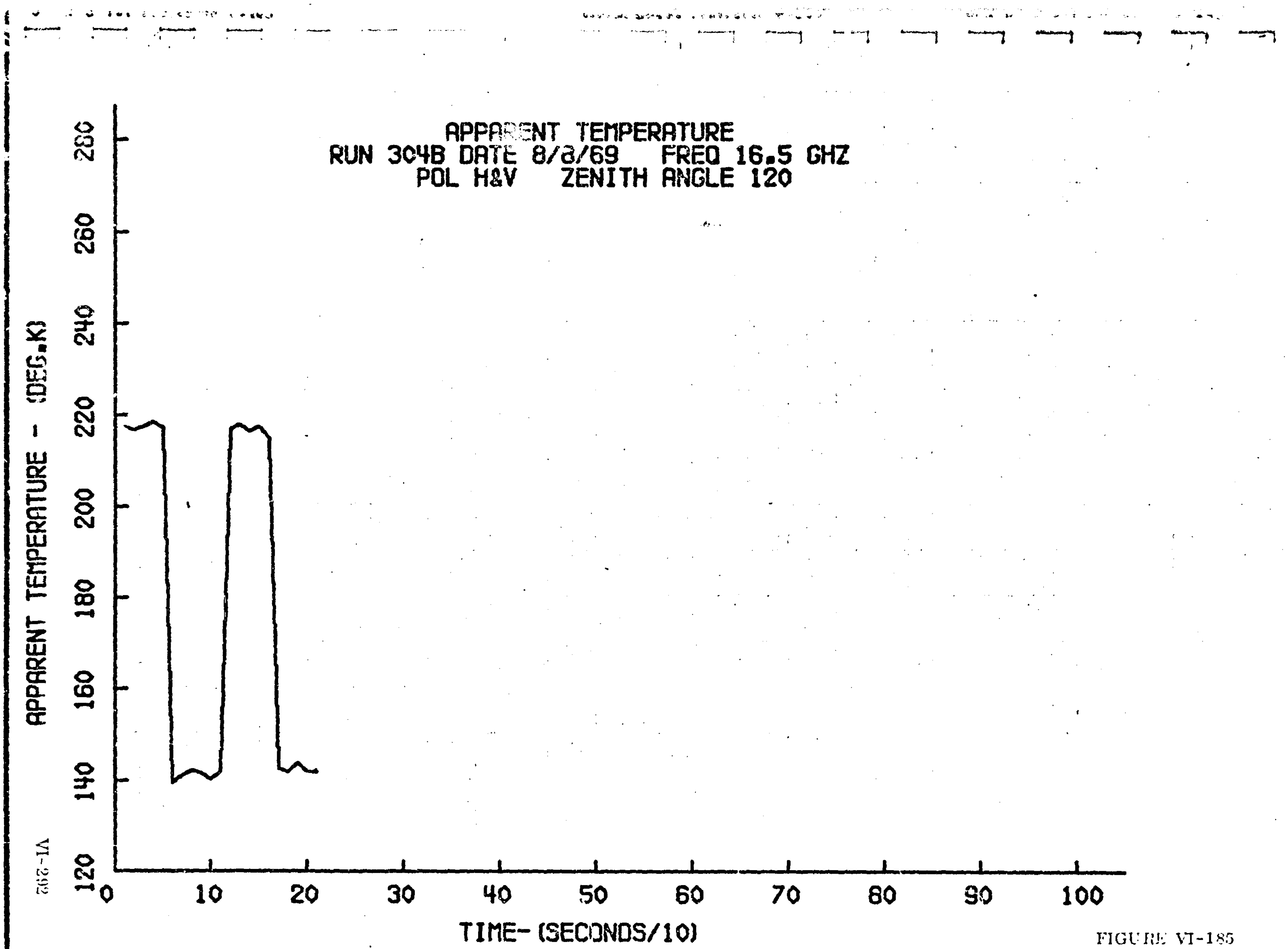


FIGURE VI-185

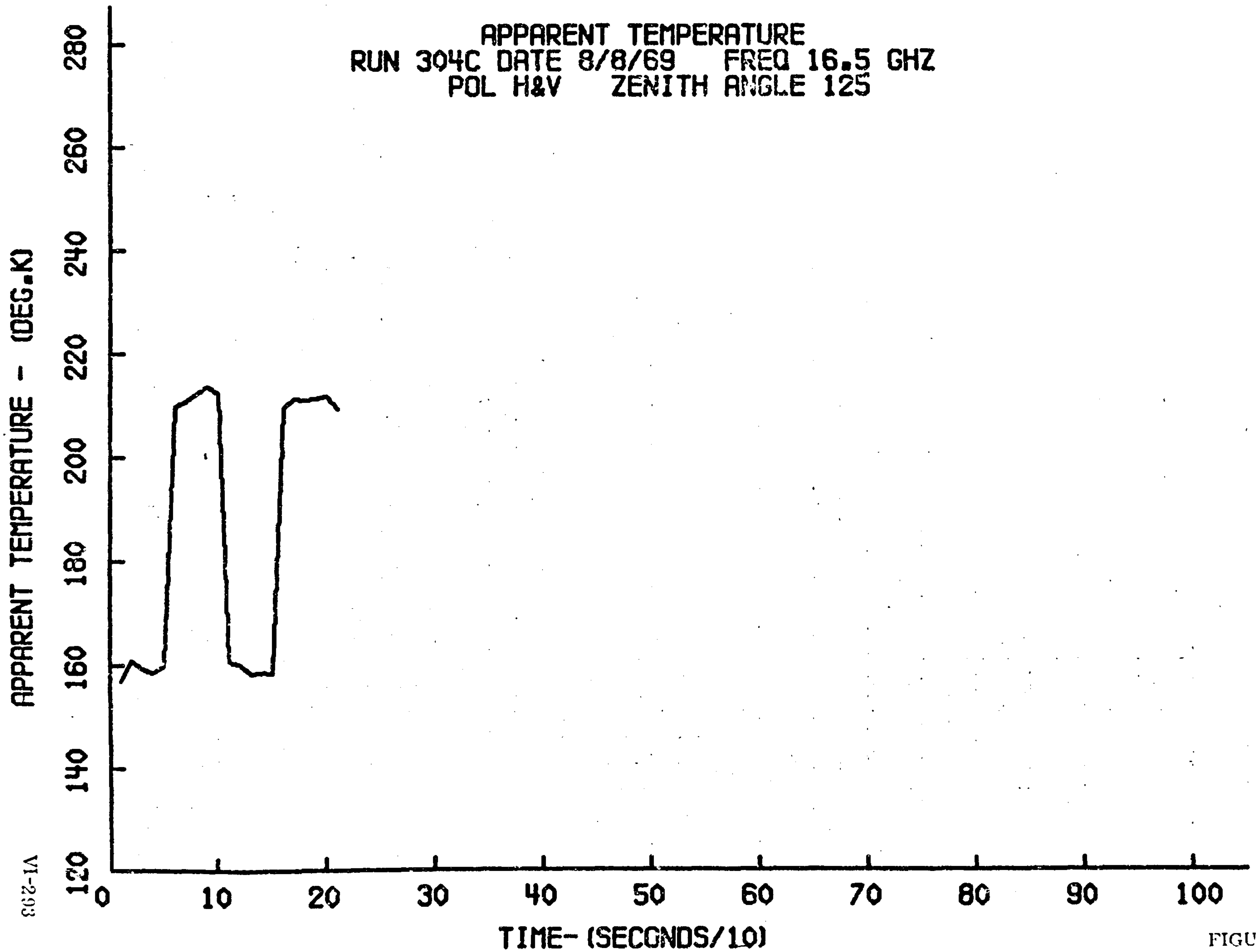


FIGURE VI-186

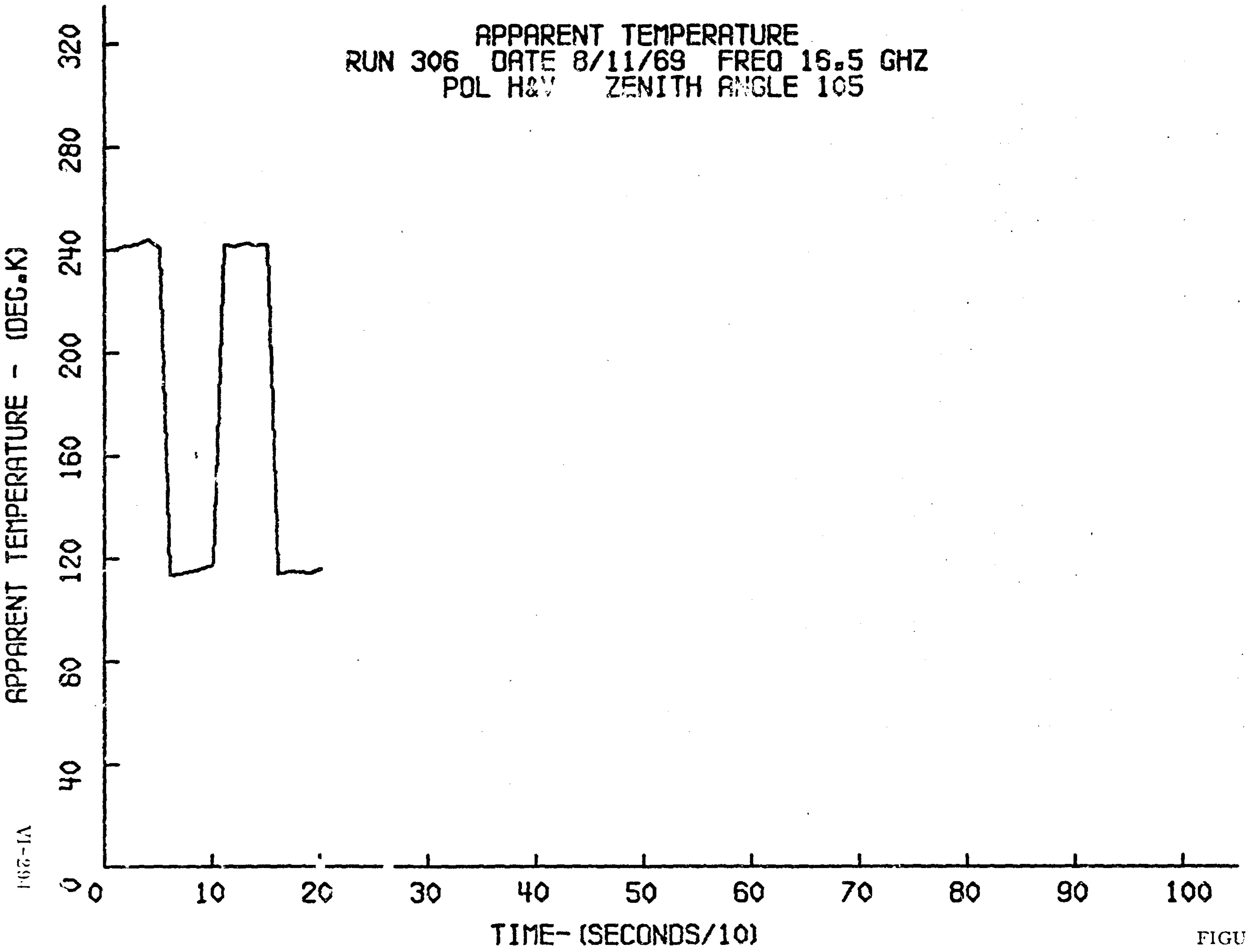


FIGURE VI-187

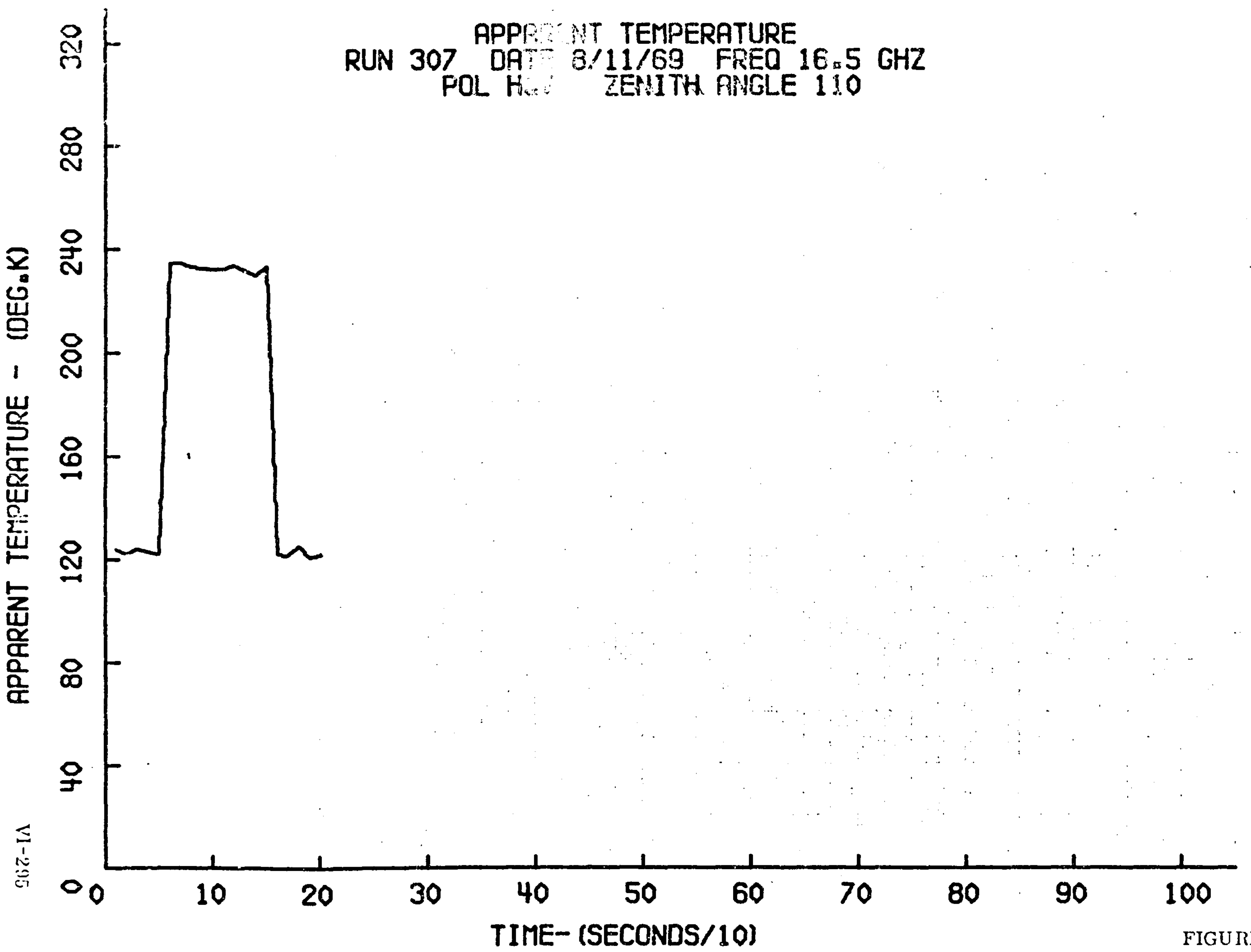


FIGURE VI-188

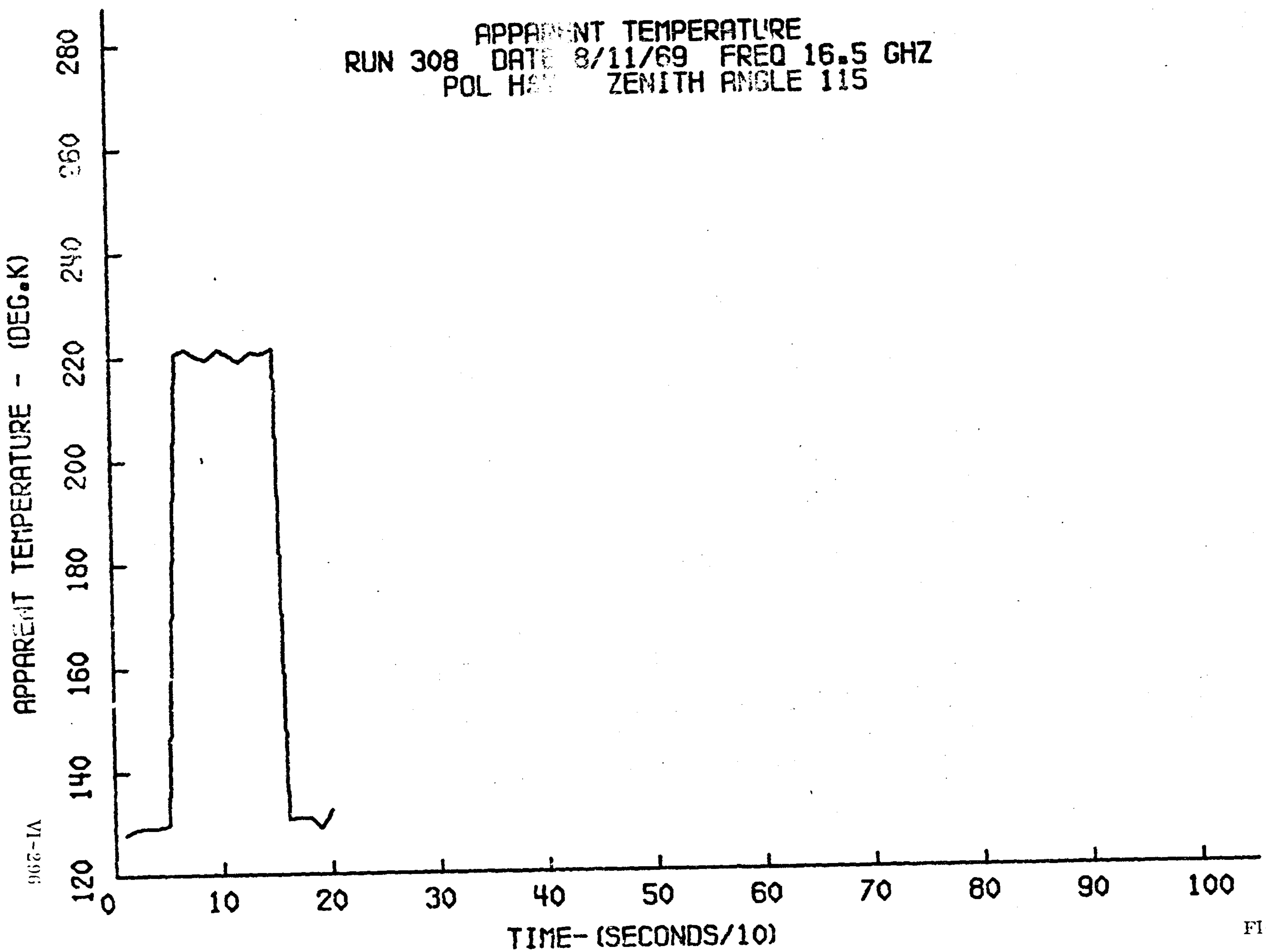


FIGURE VI-189

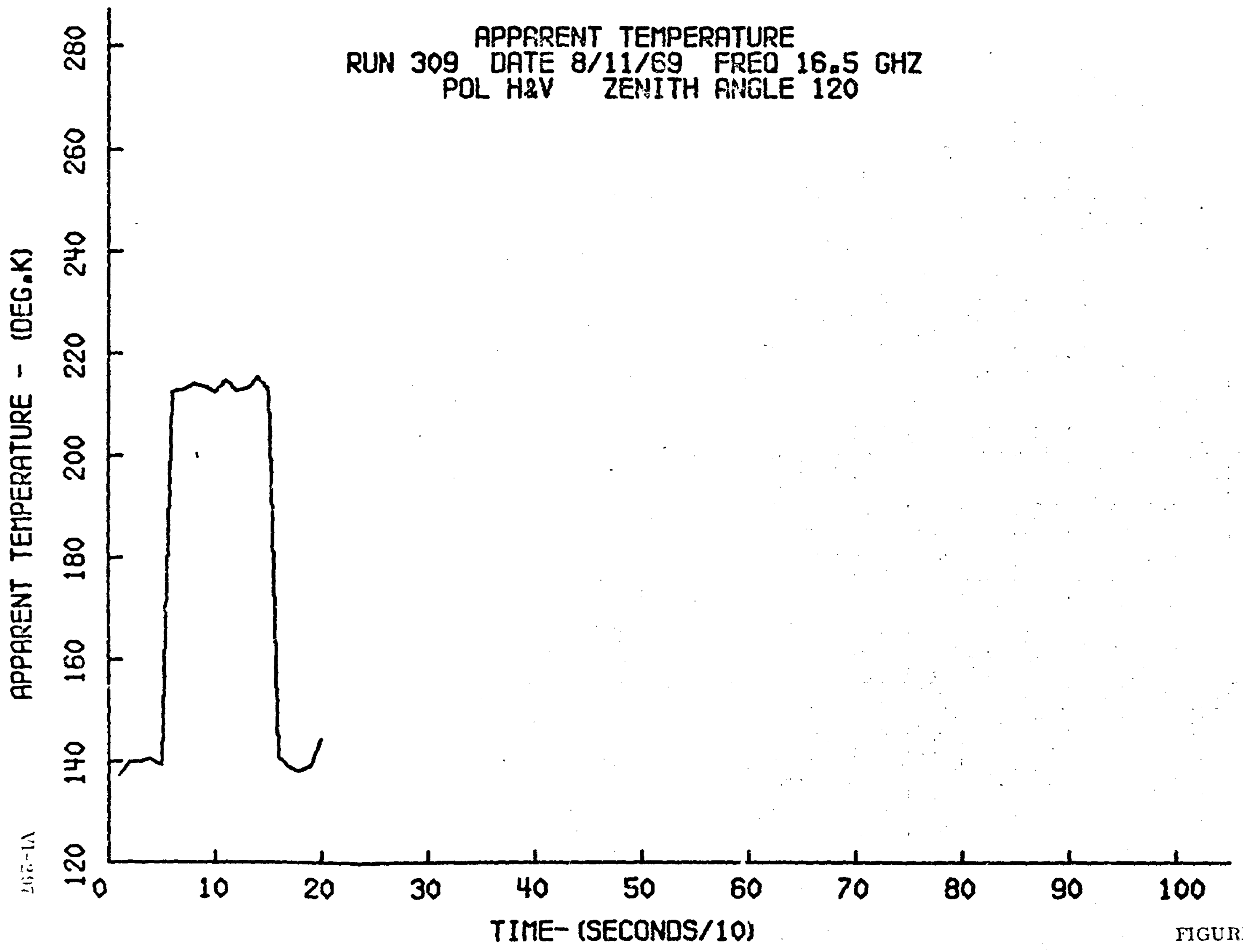


FIGURE VI-190

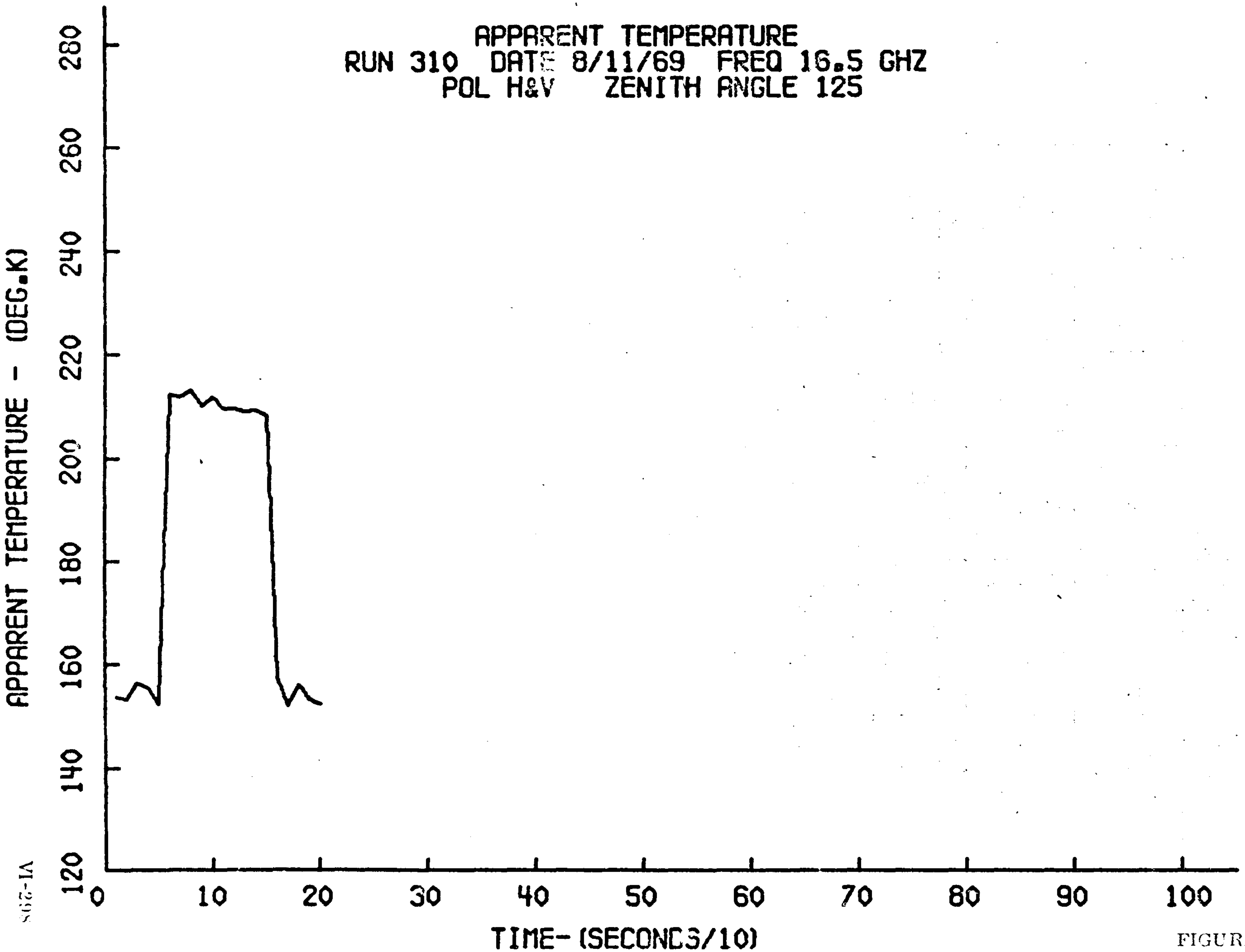


FIGURE VI-191

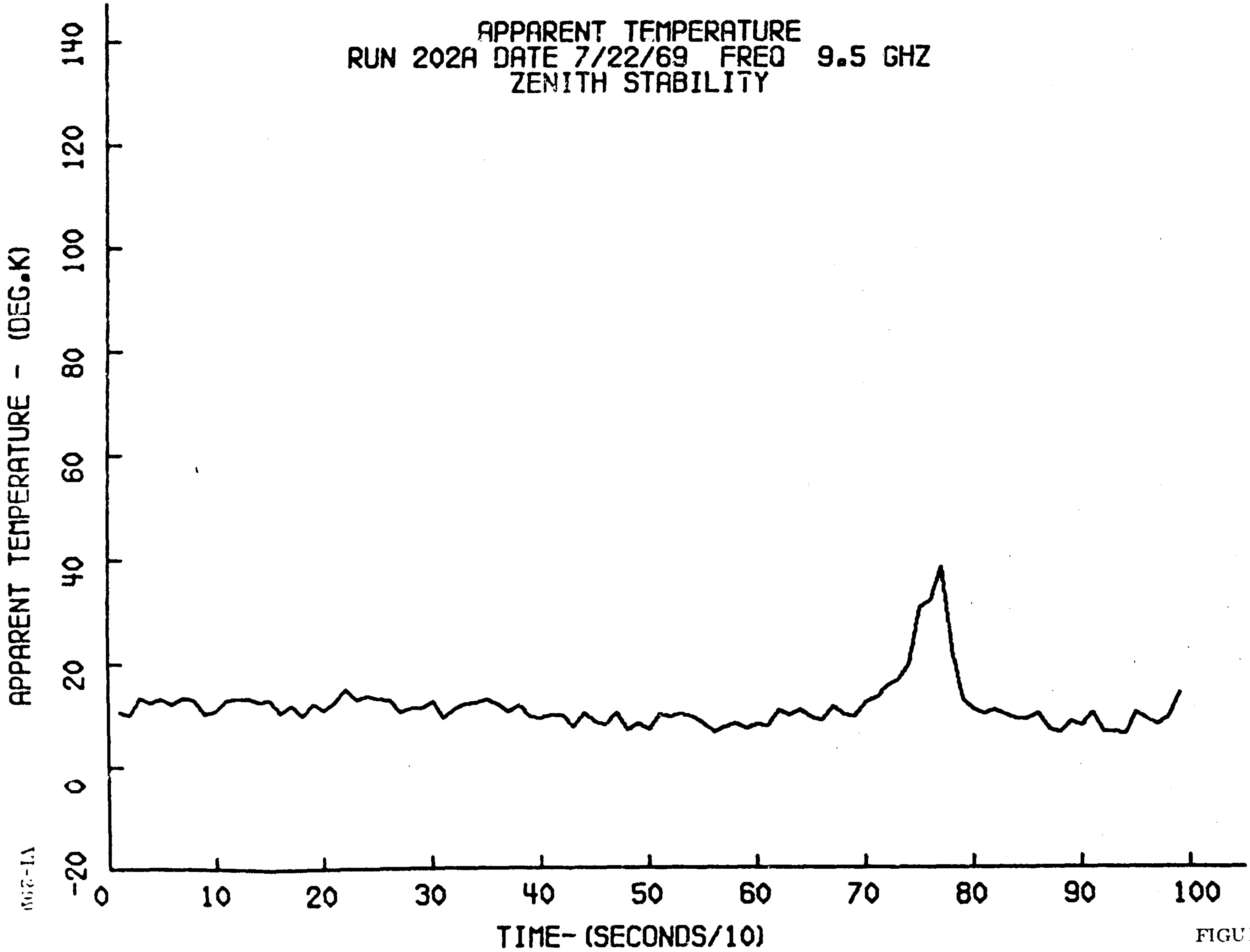


FIGURE VI-192

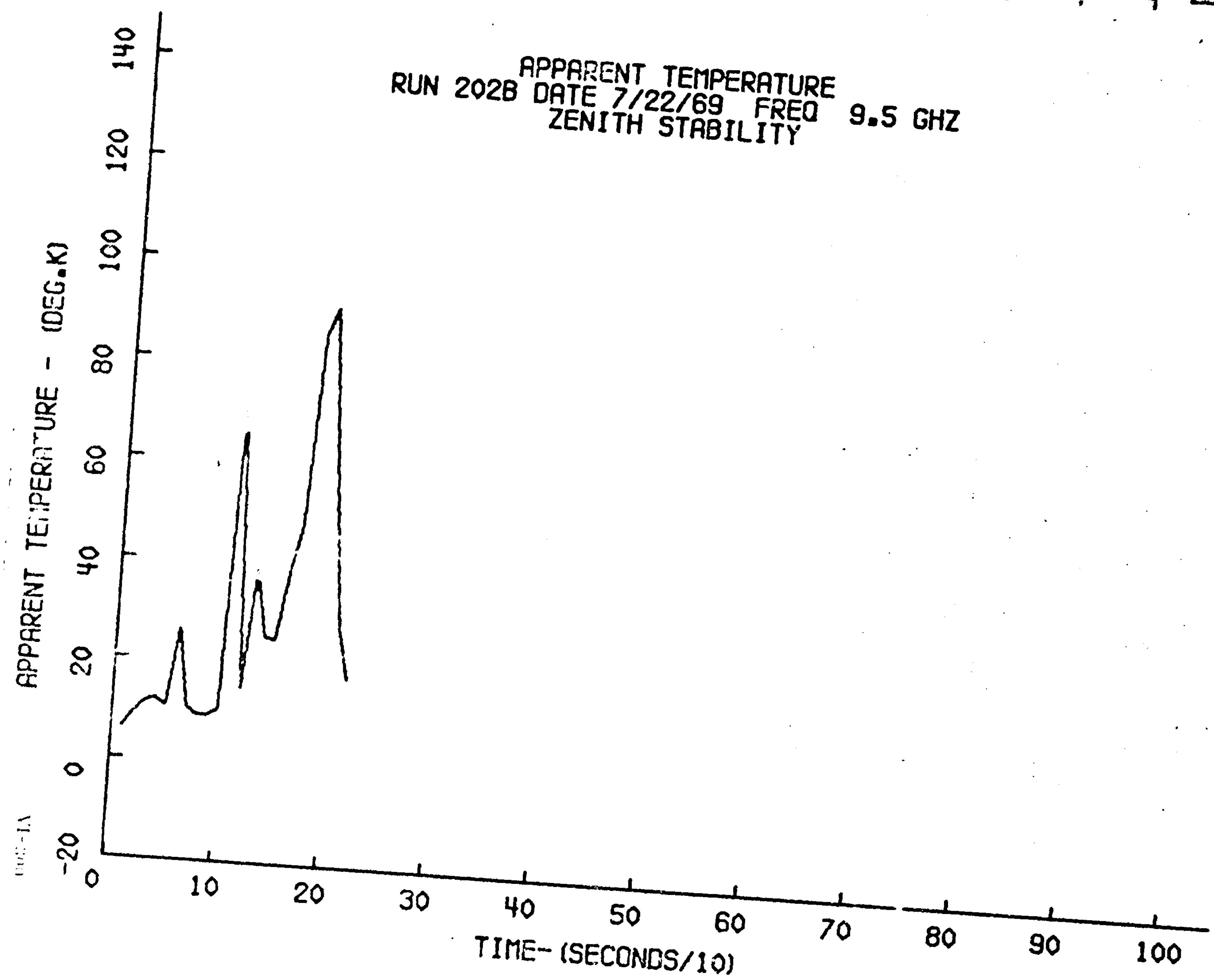


FIGURE VI-193

SECTION VII

ANALYSIS OF RESULTS

The derived sea water temperatures from the 16.5 GHz vertical runs were analyzed to determine a relationship to the thermometric temperature. These vertical run temperatures are plotted in Figures VI-78 through VI-96. The nominal average thermometric temperature during the period of these measurements was about 299°K. The 299°K crossing on the curves occurs at zenith angles varying from a low of 102.9° to a high of 113.5° with an average zenith angle of 108.9°.

If the temperatures at a zenith angle of 108.9° are tabulated from all of the curves, the average of the tabulation is 299.0°K with a standard deviation of 5.19°. The deviation is caused primarily by two runs, Run 5 which was the first 16.5 GHz run made and Run 21. If these two runs were eliminated from the tabulation the average temperature would be 299.03°K with a standard deviation of 2.5°. The values observed are considered within the stability and overall accuracy limitations of the equipment that was used.

The actual value of the invariant angle may be different than the angle indicated by this relatively small amount of data. The important point is that correlation with the thermometric temperature does exist within the accuracy of the test set-up. In order to provide a check on similar data an examination was made of some measurements taken in 1966. These were sponsored by JPL (Ref 5) and were taken from a west coast location. The data from two runs, where the thermometric temperature was 288° and 292°K, was extracted and processed through the iterative computer program ROCK 3. The derived water temperature was 288° at a zenith angle of 110.7° for the first run and was 292° at a zenith angle of 121.9° for the second run.

The temperature derived from the horizontal runs, the derived emissivity from the horizontal runs and the slope of the curves of temperature as derived from the vertical runs have been examined for correlation with sea state. To aid in this examination a table has been made which lists the runs in general order of the roughness of the sea. This data is shown in Table VII-1. No distinct correlation with sea state has been found. The large variations in apparent sea water temperature for the horizontally polarized runs near the horizon are caused by the presence of clouds on or near the horizon. The curves with the largest dips coincide with the days when there were a large amount of dark rain bearing clouds on the horizon. The distortion of the derived water temperature curves is due primarily to the lack of fine profile data on these clouds just above the horizon.

The horizontal derived emissivity curves (Figures VI-127 thru VI-141) are significantly different than the theoretical emissivity curve (Figure III 1). These curves should have the greatest sensitivity to changes in sea state. No direct correlation with sea state has been noted with these curves. Sea state correlation may have been better if equipment with higher sensitivity had been used or if the geometry of the site had permitted a wider range of viewing angles. The relatively constant deviation from specular emissivity of these curves is unexplained.

TABLE VII-1

RUNS IN ORDER OF DECREASING SEA STATE

Run	Date	Time	Comment
9	8/1	1610	Sea white caps, good 3 ft swell, 1-2 ft chop
10	8/1	1637	Sea white caps, good 3 ft swell, 1-2 ft chop
11	8/5	1555	3 ft swell, slight wind ripple
12	8/5	1628	2-3 ft swell, 1-2 inch wind ripple
206	8/5	1649	2-3 ft swell, 1-2 inch wind ripple
27	8/12	1621	2-3.5 ft swell NW, wind NE 10-15, 4-8 inch chop
311	8/12	1432	Approx. 3 ft swell
26	8/12	1313	2-3 ft swell from NW, 8-12 inch wind ripple
25	8/12	1225	2-3 ft swell from NW, 6-12 inch wind ripple
28	8/12	1655	2-3 ft swell, 4-8 inch chop
302	8/8	0955	1.5-2 ft swell, rough 12-18 inch chop
303	8/8	1332	1.5 ft swell, 12-18 inch chop, quite rough, very few white caps
23	8/8	1455	Same as run 303
24	8/8	1531	Same as run 303
304	8/8	1605	Same as run 24
305	8/8	1638	Choppy sea 2 ft
14	8/6	1550	2-3 ft waves
13	8/6	1309	1-2 ft swell, 8-12 inch wind chop
29	8/12	1845	1.5-2 ft swell, 6-8 inch chop
21	8/8	1132	1-1.5 ft sea [sea probably rougher than indicated
22	8/8	1240	1-1.5 ft sea since all 8/8 rougher]
313	8/13	0930	1-2 ft swell
31	8/13	10[illegible]8	1-2 ft swell, 15-20 ft period, 4 - 8 inch chop, wind N 5-10
32	8/13	1115	1-2 ft swell
301	8/1	1532	1-1.5 ft swell and chop
30	8/12	1915	1-1.5 ft swell, 6-8 inch chop

TABLE VII-1 (Cont.)

Run	Date	Time	Comment
312	8/12	1945	1-1.5 ft swell, 6-8 inch chop
307	8/11	1400	2 ft swell, period 15-20 ft, gentle but distinct chop, some white caps
306	8/11	1222	Swell from NW, slight chop, wind NW 5-10
308	8/11	1617	Similar to Run 306
309	8/11	1657	Water much calmer than Run 306
17	8/7	1655	1 ft swell, 6-8 inch wind chop, wind S 5-10
18	8/7	1729	1 ft swell, 6-8 inch wind chop, wind S 5-10
19	8/7	1915	1 ft swell, 6-8 inch wind chop, wind S 5-10, 10 ft period
20	8/7	1949	Wind SE 10-15
15	8/7	1216	Approx. 1 ft swell, long period 20 ft, 3-4 inch wind chop, WNW 1-2 mph
16	8/7	1255	Same as 15
201	7/17	1750	Sea approx. 1 ft (interpretation from pictures)
5	8/1	1132	Less than 1 ft swell, slight chop
6	8/1	1206	Less than 1 ft swell, slight chop
310	8/11	1755	Wind died down, water quite calm
101	7/21	1445	Vent bldg log, sea calm, wind NE 10-15
102	7/21	1510	Vent bldg log, sea calm, wind NE 10-15
1	7/25	1248	Sea calm, slight swell
2	7/25	1345	Same as 1
33	8/14	1010	Sea calm, perceptible swell, very small wind ripple
34	8/14	1047	Sea calm, slight wind ripple 6 inch slow swell
35	8/14	1325	Sea calm
36	8/14	1415	Sea calm, slight swell with wind ripple
7	8/1	1347	Slight swell 3-6 inches, no chop, glassy surface
8	8/1	1417	Slight swell 3-6 inches, no chop, glassy surface
202	7/22	1400	No sea information
203	7/22	1815	No sea information
204	7/22	1831	No sea information
4	7/24	2030	No sea information

SECTION VIII

CONCLUSIONS

There has been strong evidence presented of the correlation between vertically polarized radiometric temperatures and the thermometric temperature of sea water. The particular measurements made on this experiment at a frequency of 16.5 GHz suggest a sea state invariant angle of about 110^0 zenith where the r.m.s. deviation from the mean radiometric temperature was within 5^0K of the thermometric temperature of the sea water. The stability, sensitivity and calibration accuracy of the radiometer together with the stability of the environment are considered to be of this magnitude. State-of-the-art radiometric equipment with improved stability and sensitivity should improve this resolution by a factor of five or ten.

No correlation with sea surface roughness (sea state) was obtained with either the vertical or horizontally polarized measurements. This may be caused by insufficient equipment sensitivity or by the viewing angle restrictions imposed by the site.

The horizontally polarized data does not appear to have a direct correlation with sea surface thermometric temperature. This negative result bears importance in those systems which contemplate using horizontally polarized radiometric measurements for determining temperature. Other frequencies or viewing angles may provide a degree of correlation, but based on the inference here this should be validated by other tests before implementation.

The applicability of radiometric measurements by an aircraft or satellite, particularly in the area of surface temperature measurement is feasible. The viewing angle implied by this experiment would not be optimum for a spacecraft but other frequencies may provide other optimum viewing angles.

SECTION IX

RECOMMENDATIONS

Based on the data and its analysis the following recommendations are made for possible future work:

1.) A theoretical investigation should be made, using a relatively sophisticated model of the sea surface, to determine the interrelationship of frequency, viewing angle, sea state and polarization. This should result in a theoretical description of the dependancy of a sea state invariant angle on frequency.

2.) Field tests at frequencies other than 16.5 GHz should be conducted to verify the theory developed in the above.

3.) Representative field test data should be obtained over a full range of viewing angles. This will require a site where angles close to nadir can be observed.

4.) The effects of pollutants, froth and water contaminants should be theoretically analyzed and subsequently introduced in field experiments under controlled conditions.

5.) The equipment sensitivity for radiometric measurements of the sea surface should be the best the state-of-the-art offers. Sensitivities of 0.3^0K for a 0.1 second integration time should be attainable up to frequencies of 30 to 35 GHz, and 0.5^0K should be attainable up to 60 GHz. Integration times as small as practical should be used for the critical data measurements. Longer integration times for smoothing may be introduced by computer processing during the data reduction.

6.) The final recommendation is general in nature, but most important for any field tests. Adequate auxillary instrumentation must be a prime requisite for any program. This is necessary to enable complete and proper interpretation of prime radiometric data. The water thermometric temperature measuring system must be well designed. It must be sturdy to withstand rough seas yet light enough to float on the surface of the water. The temperature sensors must be waterproof. The system used in this experiment was good, but water leakage was a problem in some of the thermistor probes.

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APPENDIX A

THEORETICAL EMISSIVITY OF SPECULAR SEA WATER

Applying Kirchoff's law, the emissivity of a specular surface can be derived from the reflectivity

$$\epsilon = 1 - \rho \tag{1}$$

The reflectivity for horizontally polarized waves is given by the Fresnel formula:

$$\rho_h = \left[\frac{\cos\phi - e^{1/2}\cos\theta}{\cos\phi + e^{1/2}\cos\theta}\right]^2 \tag{2}$$

and likewise for a vertically polarized wave:

$$\rho_v = \left[\frac{e\cos\phi - e^{1/2}\cos\theta}{e\cos\phi + e^{1/2}\cos\theta}\right]^2 \tag{3}$$

where ϕ = incidence angle

θ = angle of transmitted beam with respect to normal

$e = e' - je''$ = complex dielectric permittivity

Using Snell's law:

$$e^{1/2}\sin\theta = \sin\phi \tag{4}$$

Introducing the polar form for the complex number

$$e\cos^2\theta = e - \sin^2\phi = re^{-j\gamma} \tag{5}$$

The polar quantities can be calculated explicitly as follows:

$$r = \left[(e' - \sin^2\phi)^2 + (e'')^2\right]^{1/2} \tag{6}$$

$$\gamma = \tan^{-1}\left[\frac{e''}{e' - \sin^2\phi}\right] \tag{7}$$

Using the definition in (5) the absolute values in equation (2) and (3) can be evaluated. Substituting these results into equation (1) yields after some manipulation:

$$\epsilon_h = \frac{4\cos\phi\, r^{1/2}\cos(\gamma/2)}{[\cos\phi + r^{1/2}\cos(\gamma/2)]^2 + r\sin^2(\gamma/2)} \tag{8}$$

$$\epsilon_v = \frac{4\cos\phi\, r^{1/2}[\cos(\gamma/2)\, e' + \sin(\gamma/2)\, e'']}{[e'\cos\phi + r^{1/2}\cos(\gamma/2)]^2 + [e''\cos\phi + r^{1/2}\sin(\gamma/2)]^2} \tag{9}$$

Some simplification of (8) and (9) can be accomplished by the introduction of two parameters:

$$a = r^{1/2}\cos(\gamma/2) \tag{10}$$

$$b = r^{1/2}\sin(\gamma/2) \tag{11}$$

Then (8) and (9) become:

$$\epsilon_h = \frac{4a\cos\phi}{(\cos\phi + a)^2 + b^2} \tag{12}$$

$$\epsilon_v = \frac{4\cos\phi\,(ae' + be'')}{(e'\cos\phi + a)^2 + (e''\cos\phi + b)^2} \tag{13}$$

From equation (5), at normal incidence

$$e = r^{-j\gamma}$$

Thus γ is defined as the dielectric loss angle and "a" is the refractive index and "b" is often called the "absorption" coefficient.

APPENDIX B

DIELECTRIC PERMITTIVITY OF SEA WATER

Hasted (Ref 3) and Von Hippel (Ref 4) have reviewed the dielectric properties of pure water. According to the latter, it is accurate to consider only the dipole relaxation through the microwave region, thus only bipolar absorption will be considered. A single relaxation time is considered sufficient to explain the water absorption spectrum. This time is sufficiently short to place the relaxation dispersion region of liquid water in the microwave region. The Debye formula then gives the frequency dependency of the dielectric permittivity:

$$e' = e_\infty + \frac{e_o - e_\infty}{1 + (\nu\lambda_s)^2} \tag{1}$$

$$e'' = \frac{(e_o - e_\infty)\ \nu\lambda_s}{1 + (\nu\lambda_s)^2} + \frac{\sigma}{c\nu\epsilon_o} \tag{2}$$

where

e' = real component of dielectric permittivity

e'' = imaginary component of dielectric permittivity

ν = wave number (cm^{-1})

λ_s = relaxation wavelength (cm)

e_o = static permittivity

e_∞ = high frequency limit of permittivity

σ = conductivity (mhos/meter)

c = velocity of light (cm/seconds)

ϵ_o = permittivity of vacuum = $\frac{10^{-9}}{36\pi}$

since

$$\nu = \frac{\omega}{c}$$

$$c = \frac{\lambda}{\tau}$$

where

$$\omega = 2\pi f$$

$$\tau = \text{relaxation time (seconds)}$$

we can simplify equatic n (1) and (2) as follows:

$$e' = e_\infty + \frac{e_o - e_\infty}{1 + (\omega\tau)^2}$$

$$e'' = \frac{\omega\tau(e_o - e_\infty)}{1 + (\omega\tau)^2} + \frac{\sigma}{\omega\epsilon_o}$$

e_o, τ, and σ can be approximated as the product of two second order polynominals of the form:

$$x = (b_2S^2 + b_1S + b_o)\ (c_2T^2 + c_1T + c_o)$$

or

$$x = a_o + a_1T + a_2S + a_3T^2 + a_4S^2 + a_5TS + a_6T^2S + a_7TS^2 + a_8T^2S^2 \quad (3)$$

where S = Salinity (Parts per 1000)

T = Temperature

a, b and c are constants

$x = e_o$, τ or σ

Table 1 tabulates the coefficients for the variables of the expanded equation based on (3) above.

TABLE B-1

Variable	Constant	Parameters		
		τ	e_o	σ
	a_o	0.19289557 x 10-10	0.88194946 x 10-02	-0.25778345 x 10-05
T	a_1	-0.68020489 x 10-12	-0.40348653 x 10-00	0.15909872 x 10-05
S	a_2	-0.1136996 x 10-12	-0.43917148 x 10-00	0.87483080 x 10-01
T^2	a_3	0.95864633 x 10-14	0.65923705 x 10-03	-0.44653826 x 10-07
S^2	a_4	0.11417367 x 10-14	0.16737911 x 10-02	-0.25662305 x 10-04
TS	a_5	0.58628615 x 10-02	0.43269204 x 10-02	0.4580193 x 10-02
T^2S	a_6	-0.87595500 x 10-16	-0.92285569 x 10-05	-0.16914194 x 10-04
TS^2	a_7	-0.54576833 x 10-16	-0.42856433 x 10-04	-0.37158325 x 10-04
T^2S^2	a_8	0.82521420 x 10-18	0.44409604 x 10-07	0.39287711 x 10-06

APPENDIX C

SEA WATER TEMPERATURE DERIVATION METHODS

There have been several methods proposed for radiometric sensing of the sea water temperature and conversion of this radiometric temperature to actual temperature. Several of these methods will be outlined in the following sections.

A. Ratio Method

The brightness temperature has been defined in Section III in terms of a basic radiometric formula. This formula is repeated here for reference.

$$T_{b\phi} = \epsilon_{\phi} T_w + (1 - \epsilon_{\phi}) T_{s\theta} \quad (1)$$

where

T_s = sky temperature

ϵ = emissivity

ϕ = observation angle

θ = $180 - \phi$

The horizontally and vertically polarized brightness temperatures as defined by equation (C-1) can be expressed as a ratio:

$$\frac{T_{bh}}{T_{bv}} = \frac{\epsilon_{h\phi} T_w + (1 - \epsilon_{h\phi}) T_{s\theta}}{\epsilon_{v\phi} T_w + (1 - \epsilon_{v\phi}) T_{s\theta}} \quad (2)$$

$$\frac{T_{bh}}{T_{bv}} = \frac{\epsilon_{h\phi} \left(\frac{T_w}{T_{s\theta}} - 1 \right) + 1}{\epsilon_{v\phi} \left(\frac{T_w}{T_{s\theta}} - 1 \right) + 1} \quad (3)$$

This expression involves four unknowns, namely $\epsilon_{h\phi}$, $\epsilon_{v\phi}$, T_w and $T_{s\theta}$, and can be simplified to two unknowns by introducing a factor k in the equation as follows:

$$\frac{T_{bh}}{T_{vh}} = \frac{\epsilon_{h\phi} k + 1}{\epsilon_{v\phi} k + 1} \quad (4)$$

in which, $$k = \left[\frac{T_w}{T_{s\theta}} - 1 \right]$$

In Appendix A, the formulas for ϵ_v and ϵ_h are developed, these are expressed as:

$$\epsilon_h = \frac{4a\cos\phi}{(\cos\phi + a)^2 + b^2} \tag{5}$$

$$\epsilon_v = \frac{4(ae' + be'')\cos\phi}{(e'\cos\phi + a)^2 + (e''\cos\phi + b)^2} \tag{6}$$

Both parameters "a" and "b" are functions of permittivity and incidence angle. In practice both "a" and "b" will vary from their theoretical values for a specular surface. The value of "b" has less of a variation from theoretical, therefore we set values of e', e" and b based on an assumed initial value of sea water temperature. Substituting (5) and (6) in equation (4) we can now solve for "a". Using this derived value of "a" which carries information on the actual temperature of the water, we calculate ϵ_v. The true sea water temperature can now be derived from the relation:

$$T_w = \frac{T_{bv} - (1 - \epsilon_{v\phi})T_{s\phi}}{\epsilon_{v\phi}}$$

The vertical component of emissivity, ϵ_v, varies with frequency, angle ϕ and temperature T. The frequency is known and the angle is known for a calm sea and can be approximated for a rough sea. We are attempting to derive the temperature T. In using the ratien T_{bh}/T_{bv} to obtain the parameter "a", and hence ϵ_v, we are in some way trying to correlate T and ϵ_v. The assumption is that different T values will lead to specific ratio values, hence to "a" and finally to a unique ϵ_v. In order for this sequence to be meaningful we must first have some sensitivity in the ratio T_{bh}/T_{bv} to changes in T. We can examine this point by considering the right-hand side of equation (4).

we have $$R = \frac{T_{bh}}{T_{bv}} = \frac{k\epsilon_h + 1}{k\epsilon_v + 1}$$

where $$k = \left[\frac{T_w}{T_{s\theta}} - 1 \right]$$

In this method, the temperature dependence of the ratio T_{bh}/T_{bv} is in ϵ_v and ϵ_h, which in turn reflect a temperature dependence through e' and e". Parameter k is usually set to a value representing an initial assumption for T and $T_{s\phi}$. This procedure is based on the correct assumption that a poor choice in k has small consequence on derived emissivity. Specifically, for k ranging from 15.0 to 40.0, the resulting calculated ϵ changes by about 0.01.

A computer program has been employed to calculate the theoretical values of ϵ_v, ϵ_h and the ratio T_{bh}/T_{bv} (in which k = 40 corresponding to a temperature T of 280.0 degrees Kelvin and a $T_{s\phi}$ of 7.0 degrees Kelvin) for angles ϕ varying from zero to 70 degrees, and for sets of e' and e'' representing ocean salinity of 30 parts/thousand, and a temperature range of zero to 30°C. Assuming that these theoretical values are representative of the actual emissivities and the ratio T_{bh}/T_{bv}, it is possible to make a number of interesting observations:

1. ϵ_v and ϵ_h vary very slightly with temperature. At ϕ = 60 degrees, we have the values listed below:

TABLE C-1

T	ϵ_v	ϵ_h	R
0°C	.6233	.2159	.3716
10	.6151	.2115	.3695
20	.6132	.2101	.3689
30	.6159	.2117	.3693

From the above, we can see that, over a 10°C interval (i.e. 10° - 20°) ϵ_v changes by .0019, or about .0002/°C. Also, ϵ_v and ϵ_h seem to exhibit a minimum near T = 20°C and therefore T is a double-valued function of ϵ. In effect, in trying to obtain a value for ϵ_v, useable in equation (1), we are trying to guess in a very narrow range - this guess has a built-in ambiguity in that there are two temperatures for each value of ϵ_v, i.e., we must somehow know on which side of the minimum our temperature is located. This can be difficult since the minimum is at a commonly encountered temperature.

2. We have noted the difficulty involved in obtaining a value of ϵ_v corresponding to a specific T. We will now examine the method used for obtaining ϵ_v. Table C-1 also lists corresponding values of the ratio T_{bh}/T_{bv} - these are theoretical values and represent the manner in which we would expect that ratio to vary, if we vary the temperature of the sea surface. Three observations can be made at this point:

i) The variation with temperature is slight, i.e., over a 10°C range we have a change in the ratio of .0006, or about .00006/°C. This number is literally swamped by the temperature sensitivity of the radiometer used in the measurements.

ii) T is a double-valued function of R. Again, the minimum is near 20^0C and we, therefore, have a difficult time knowing which T corresponds to a given R.

iii) T_{bh} has a higher theoretical dependency on sea state. Thus, any variation in T_{bh}, due to sea state, will affect the ratio T_{bh}/T_{vh} and will in turn influence the final water temperature calculation.

The above numbers and nsuing discussion are based on data for 9.5 GHz (even though data for e' and e'' is actually for 9.3 GHz, which is sufficiently close for our purposes) and an incidence angle, ϕ, of 60 degrees. The nature of the data is similar at other values of ϕ. For reference purposes, similar tables are presented below for ϕ = 40 and 20 degrees.

Table C-2 $\phi = 40^0$

T	V	H	R
0^0C	.4699	.3110	.6790
10	.4620	.3051	.6777
20	.4600	.3035	.6778

Table C-3 $\phi = 20^0$

T	V	H	R
0^0C	.4038	.3667	.9134
10	.3966	.3600	.9131
20	.3947	.3582	.9130
30	.3968	.3601	.9131

4. Conclusions

The analysis presented in the preceeding sections argues against the meaningfulness of using the method originally proposed for obtaining ϵ. The problem revolves primarily about the fact that ϵ_v and ϵ_h vary very slightly over the temperature of interest for sea water, with the resulting effect that the ratio T_{bh}/T_{bv} contains very little retrievable information with regard to temperature. What it does contain is, in part, indicated by a plot of the ratio versus ϕ. The plot shown in Figure C-1 is based on a theoretical expression for the ratio, at a fixed value of k. We find in Figure C-1 that, for ϕ between 25 and 75 degrees, the relationship between R and ϕ follows an approximate straight line, with a slope of 62.5 degrees per unit change in the ratio T_{bh}/T_{bv}. A 6.25 change in ϕ will cause a 0.1 change in the ratio. We note that a 0.1 change in the ratio is actually quite large; it represents, roughly, a 25^0K change in the final derived value of T, when everything else is held constant. Thus, the angular dependence completely overshadows the slight temperature dependence.

A rough sea results in brightness temperature samples over a cone of angles around the antenna beam nadir angle at which it is viewed, and hence, is expected to affect the ratio T_{bh}/T_{bv} quite markedly.

It appears that this method amounts to nothing less than the derivation of an ϵ which reflects such information as the angle of observation (which is known in any case) and errors in measured T_b which we would like to avoid.

B. Low ϕ Analysis

At low values of incidence angles the values of ϵ_h and ϵ_v vary less as a function of angle than at high incidence angles. This is readily apparent if one refers to Figure III-1. Using the equations developed in Appendix A, we can express ϵ_v and ϵ_h as a function of temperature T_w, hence we have T_{bh} and T_{bv} as functions of T_w.

From equation (1) we have:

$$T_{bv} = \epsilon_v T_w + (1 - \epsilon_v) T_s \tag{7}$$

rearranging terms

$$T_{bv} = \epsilon_v (T_w - T_s) + T_s \tag{8}$$

substituting the expression, from Appendix A, for ϵ_v

$$T_{bv} = \frac{4\cos\phi \; (ae' + be'')}{(e' \cos\phi + a)^2 + (e''\cos\phi + b)^2} (T_w - T_s) + T_s \tag{9}$$

and similarly

$$T_{bh} = \frac{4a\cos\phi}{(\cos\phi + a^2) + b^2} (T_w - T_s) + T_s \tag{10}$$

Assuming that the right hand side of equations (9) and (10) are exact expressions of the measured brightness temperature T_b, we can then reduce our problem to that of determining what value of T_w will give the data value T_b.

Two difficulties in this approach are:

1. The theoretical expression for T_{bv}(or T_{bh}) does not in fact correspond to data T_{bv} in a sufficiently sensitive fashion.

2. T_{bv} (or T_{bh}) is not sufficiently sensitive to T_w.

The essential point in this method is the manner in which we obtain a value for ϵ_v. The value of ϵ_v should be determined over a range of incidence angles where the effects of sea state are minimized. As the sea surface roughens, the effective angle over which the radiometer is viewing the water surface is a weighted sampling of a cone whose axis lies on the nominally defined incidence angle. Therefore, for a sea surface which is not flat, we should really apply equation (9) or (10) not at one angle ϕ, but should average over a cone of angles appropriately weighted to consider wave height and period, and the duration of the measurement. If however, ϵ_v and T_S varied only slightly over the cone, as they do for low incidence angles, equations (9) and (10) would be accurate to within that slight variation. The range of incidence angles that might be considered in this method would range from 0^0 to 40 or 50^0 corresponding to zenith angles from 130^0 or 140^0 to 180^0.

The underlying restriction on this method with regard to this particular field experiment is the observation angles required for implementation. Site restrictions confined the water observation to zenith angles from 90^0 to about 130^0.

C. Invariant Angle Analysis

If one assumes that there is a range of zenith angles over which the radiometric temperature is invariant with sea state, then the specular equation for brightness temperature would be most nearly correct at these angles. The brightness temperature has previously been expressed as a function of temperature in equation (9). That equation is repeated here for reference.

$$T_{bv} = \frac{4\cos\phi\ (ae' + be'')}{(e'\ \cos\phi + a)^2 + (e''\cos\phi + b)^2}(T_w - T_S) + T_s \qquad (9)$$

There will be a unique value of sea water temperature that satisfies the measured values of T_{bv} and T_S. This unique value will be equal to the thermometric temperature of the water at an invariant angle. At angles other than invariant the derived value of water temperature will depart from the thermometric value. It would further be deduced that the deviation from the thermometric temperature (i.e. the slope of the derived water temperature) would be dependent upon sea state. The deriviation of water temperature from equation (9) is accomplished by iteration using a computer. An initial value of T_w is assumed and a, b, e' and e'' are computed for this temperature using the equations developed in Appendix A and B. Equation (9) is then used to calculate the value of T_{bv}. This calculated value is then compared to the measured value of T_{bv}. If the two are not in agreement to within $\pm 1^0$, the value of T_w is adjusted to a new value based on the following formula:

$$T_{w_{new}} = \frac{T_{w_{old}} + T_{bv} - (1 - \epsilon)T_S}{2}$$

This iteration is repeated until agreement in the calculated and measured values of T_{bv} is reached. This was the method used in reducing the vertically polarized measurements in this program.

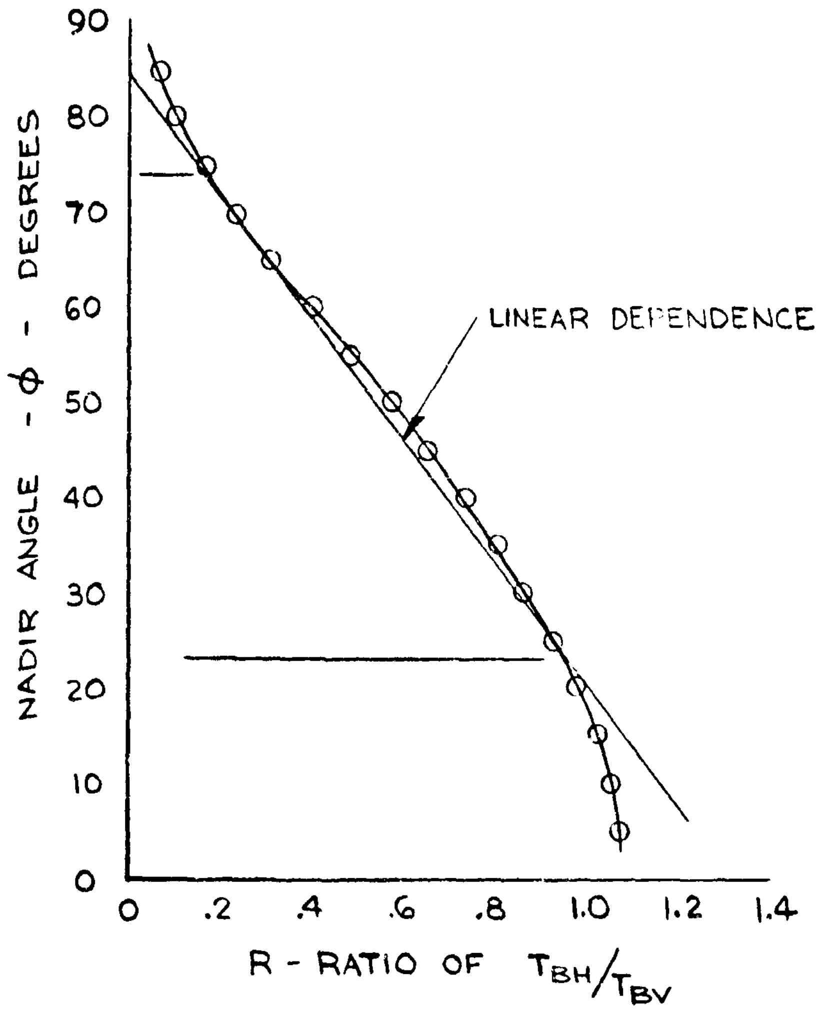


Figure C-1. BRIGHTNESS TEMPERATURE RATIO VERSUS NADIR ANGLE

APPENDIX D

ANTENNA PATTERN CORRECTION

A. Geometry

The gain patterns of microwave and millimeter-wave antennas is simply the manifestation of diffraction of electromagnetic waves by a finite aperture. Most of the power received by the antenna is contained in the main lobe of the diffraction pattern. The remaining power is received via the side and back lobes.

If one were investigating astronomical radio sources of very small angular extent, it would be important to remove the effect of the main lobe "pattern". However, for extended sources, such as the atmosphere or sea surface, the brightness temperature variation within the main lobe half-width is not sufficient to necessitate the removal of the main lobe effects. The following discussion will concentrate on the correction for side and back lobe effects.

The geometry of the situation is indicated in Figure (D-1). Environmental temperatures are given in the $(\hat{x}, \hat{y}, \hat{z})$ coordinate system where the unit vector $\hat{z}$ is oriented in the zenith direction. The antenna axis is inclined at angle θ_0 to the zenith and defines the unit vector $\hat{z}'$. If the $\hat{x}'$ direction is chosen to coincide with the $\hat{x}$ direction, the set $(\hat{x}', \hat{y}', \hat{z}')$ defines Cartesian coordinates in the antenna-centered frame.

Polar angles in either frame are defined with respect to the z axes, while azimuthal angles are defined with respect to the x axes. Figure D-2 shows the angular coordinates of a pencil beam in both environment and antenna-centered frames.

B. Analytical Approach

The apparent (measured) temperature seen by an antenna oriented at a zenith angle θ_0 is given by

$$T_a(\theta_0) = \frac{\int T_b(\theta, \phi)\, g(\theta', \phi')\, d\Omega'}{\int g(\theta', \phi')\, d\Omega'} \qquad \text{(D-1)}$$

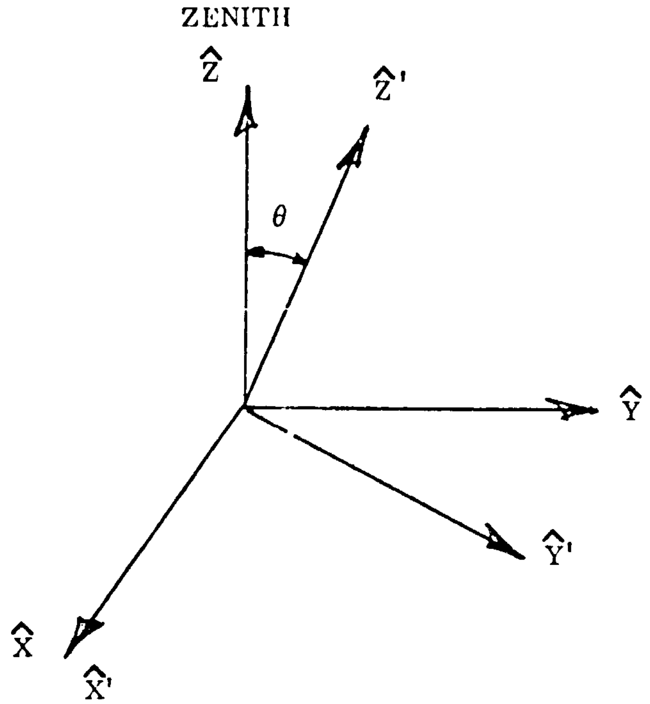


FIGURE D-1. ANTENNA PATTERN AND ENVIRONMENT COORDINATES

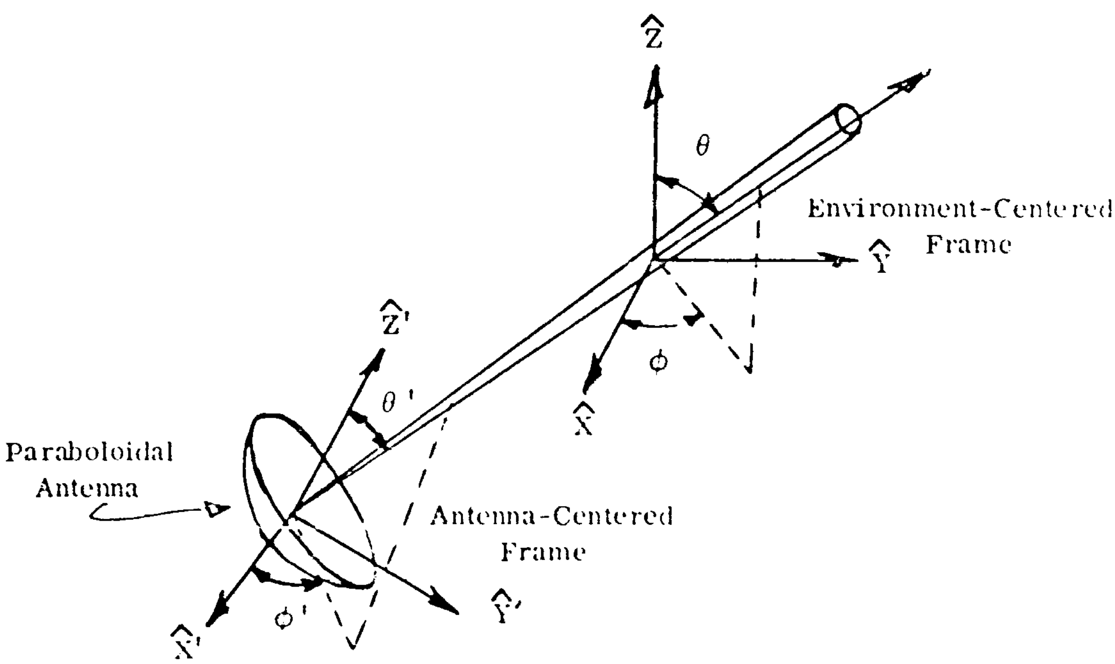


FIGURE D-2. ANGULAR COORDINATES OF ANTENNA PENCIL BEAM IN ANTENNA AND ENVIRONMENT CENTERED FRAMES where

$T_b(\theta, \phi)$ = brightness temperature of environment at zenith angle θ and azimuthal angle ϕ

θ' = polar angle of environmental point in antenna-centered coordinates

ϕ' = azimuthal angle in antenna-centered coordinates

g = antenna gain function in antenna-centered system

$d\Omega'$ = element of solid angle in antenna system

If one assumes the environment to be azimuthally symmetric (certainly true for clear skies), then T_b depends on θ only and equation (D-1) can be written

$$T_a(\theta_0) = \int_0^{\pi} k(\theta_0, \theta)\, T_b(\theta)\, d\theta \tag{D-2}$$

where

$$k(\theta_0, \theta) = \frac{\sin\theta \int_0^{2\pi} g(\theta', \phi)\, d\phi}{\int_0^{\pi}\int_0^{2\pi} g(\theta', \phi')\sin\theta'\, d\phi'\, d\theta'} \tag{D-3}$$

Equation (D-2) is a Fredholm integral equation of the first kind with kernal k. It can be solved numerically in the following way.

First, one introduces a quadrature rule to change the integral in equation (D-2) into a sum:

$$T_a(\theta_0) = \sum_j kj\,(\theta_0)\, T_b(\theta_j) \tag{D-4}$$

The set of finite angles (θ_i) may be chosen to be equidistant if desired. If the antenna temperature T_a is also measured at these angles, then a set of linear matrix equations results:

$$T_a(\theta_i) = \sum_j G_{ij}\, T_b(\theta_j) \tag{D-5}$$

where G_{ij} is a m x m matrix derived from k.

Since T_a and T_b are very close in magnitude, it is convenient to calculate their difference. Equation (D-5) can be written

$$T_a(\theta_i) = T_b(\theta_i) + \sum_j (G_{ij} - \delta_{ij})\, T_b(\theta_j)$$

where, δ_{ij} is the unit matrix; or in symbolic matrix notation

$$T_b = T_a - (G - I)T_b \tag{D-6}$$

Equation (D-6) has a formal solution which may be expressed as an infinite series:

$$T_b = T_a - (G - I)T_a + (G - I)(G - I)T_a - \dots \tag{D-7}$$

In equation (D-6) and (D-7), I represents the unit matrix.

Truncation of the series in Equation (D-7) is equivalent to solving the following iterative set

$$\begin{aligned} T_b^{(n)} &= T_a - (G - I)T_b^{(n-1)} \\ T_b^{(o)} &= T_a \end{aligned} \tag{D-8}$$

Usually only one or two iterations are necessary in order to achieve a satisfactory solution to equation (D-5) if T_a is given by empirical data.

An obvious method to calculate G_{ij} involves using a qurdrature rule based on equidistant intervals in θ. This approach leads to the form

$$k_i(\theta_0) = w_i k(\theta_0, \theta_i)$$

where, w_i is an appropriate weight. Because of the highly peaked nature of k, the important sum condition

$$\sum_i k_i(\theta_0) = 1$$

does not hold sufficiently well to insure the accuracy needed for solution of equation (D-6). A better method of calculation involves writing equation (D-2) as

$$T_a(\theta_0) = \int_0^{\pi} T_b(\theta)\, dP(\theta, \theta_0) \tag{D-9}$$

where

$$P(\theta, \theta_0) = \int_0^{\Theta} k(\theta_0, \bar{\theta})\, d\bar{\theta} \tag{D-10}$$

Then the trapezodial rule may be applied to equation (D-9), yielding

$$T_a(\theta_0) = \sum_i T_b(\theta_i)\, 1/2\left[P(\theta_{i+1}, \theta_0) - P(\theta_{i-1}, \theta_0)\right] \tag{D-11}$$

or

$$G_{ij} = 1/2\left[P(\theta_{j+1}, \theta_i) - P(\theta_{j-1}, \theta_i)\right] \tag{D-11}$$

Next it is necessary to indicate the method of computing P. Using equation (D-3) and (D-10) we write,

$$P(\bar{\theta}, \theta_0) = \int H(\bar{\theta}-\theta)\, g(\theta', \phi')\, d\Omega' \Big/ \int g(\theta', \phi')\, d\Omega' \tag{D-13}$$

where, $H(\theta)$ is the Heaviside unit step function. The solid angle integration in the numerator of equation (D-13) has been written in the antenna-centered system instead of the zenith-centered system. One may interpret equation (D-13) as saying that $P(\bar{\theta}, \theta_0)$ is the fraction of the received power entering the cone with half-angle $\bar{\theta}$ centered on the zenith.

Now if $\theta_0 = 0$, then $\theta = \theta'$, and equation (D-13) becomes

$$P(\bar{\theta}, 0) = \frac{\int_0^{\bar{\theta}}\int_0^{2\pi} g(\theta', \phi')\, d\phi'\, \sin\theta'\, d\theta'}{\int_0^{\pi}\int_0^{2\pi} g(\theta', \phi')\, d\phi'\, \sin\theta'\, d\theta'} \tag{D-14}$$

A great simplication is achieved by specializing to the case where the antenna is azimuthally symmetrical i.e., there is no gain dependence on ϕ'. In this case, equation (D-14) becomes

$$P(\bar{\theta}, 0) = \frac{\int_0^{\bar{\theta}} g(\theta')\, \sin\theta'\, d\theta'}{\int_0^{\pi} g(\theta')\, \sin\theta'\, d\theta'} \tag{D-15}$$

and equation (D-13) can be written

$$P(\bar{\theta}, \theta_0) = \int_0^{\pi} \frac{\Delta\phi(\theta_0, \bar{\theta}, \theta')}{2\pi}\, dP(\theta', 0) \tag{D-16}$$

where,

$$\Delta\phi(\theta_0, \bar{\theta}, \theta') = \int_0^{2\pi} H(\bar{\theta} - \theta)\, d\phi'$$
$$= \Phi_1'(\theta_0, \bar{\theta}, \theta') - \Phi_2'(\theta_0, \bar{\theta}, \theta') \tag{D-17}$$

Now the angles $\phi_i'(\theta_0, \theta, \theta')$ represent the azimuthal angles corresponding to the intersections of two cones: the first cone is defined in the antenna-centered frame by constant polar angle θ'; the second cone is defined in the environment-centered frame by constant polar angle θ. In order to determine the analytic relations for ϕ_i the geometrical configuration of Figure D-2 can be used to express the transformation of coordinates between antenna and environment-centered frames:

$$\sin\theta' \cos\phi' = \sin\theta \cos\phi \tag{D-18}$$

$$\sin\theta' \sin\phi' = \cos\theta_0 \sin\theta \sin\phi - \sin\theta_0 \cos\theta \tag{D-19}$$

$$\cos\theta' = \sin\theta_0 \sin\theta \sin\phi + \cos\theta_0 \cos\theta \tag{D-20}$$

The angles ϕ' defined by fixed values of θ_0, θ, and θ' can be found from equation (D-18) if values of ϕ are already determined; these latter must be obtained by solving equation (D-20). The set of equations (D-18), (D-19), and (D-10) are invariant under the transformation

$$\phi \rightarrow \pi - \phi, \phi' \rightarrow \pi - \phi' \tag{D-21}$$

hence, the two solutions in equation (D-17) are related. By rewritting equation (D-20) as,

$$\sin\phi = \frac{\cos\theta' - \cos\theta_0 \cos\theta}{\sin\theta_0 \sin\theta} \tag{D-22}$$

one can see that it has two solutions: ϕ_2 and $\phi_1 = \pi - \phi_2$. The final result is obtained by inserting either value in equation (D-18) in the form, for example,

$$\phi_2'(\theta_0, \theta, \theta') = \cos^{-1}\left(\frac{\sin\theta \cos\phi_2}{\sin\theta'}\right) \tag{D-23}$$

The other branch of the solution is given by

$$\phi_1'(\theta_0, \theta, \theta') = \pi - \phi_2'(\theta_0, \theta, \theta') \tag{D-24}$$

C. Calculations

Two computer programs have been coded to perform the antenna pattern removal.

The first program has the task of calculating the matrix elements G_{ij} from the equation (D-12). The matrix

$$M = G - 1$$

is the output on punched cards or magnetic tape for use with the second program. In the course of calculation the condition

$$\sum_j M_{ij} = 0 \qquad \text{(D-26)}$$

is tested.

The second program, APCOR4, has the task of solving for brightness temperatures by the iterative method presented in equation (D-8). It accepts the matrix elements, M, and performs a given number of iterations on the apparent temperature data which are obtained at the specified angular mesh (θ_i) by polynomial interpolation. The mesh chosen for the present data consisted of 69 angles defined by

$$\cos\theta_n = \frac{n - 35}{34}$$

This set appeared to give adequate resolution near the horizon, while keeping the computer time to a reasonable level. For the 9.5 GHz data, an averaged gain pattern was used for both polarizations. In the 16.5 GHz band separate antenna patterns were employed for both polarizations, and the computer performed the azimuthal averaging.

From preliminary calculations it was concluded that satisfactory antenna pattern correction may be obtained with one iteration. Therefore, all the processed data show a single application of equation (D-8).

APPENDIX E

DETERMINATION OF RADIOMETER ABSOLUTE CALIBRATION AND SENSITIVITY, AND CONVERSION OF OUTPUT RADIOMETRIC VOLTAGES TO APPARENT TEMPERATURES

This appendix describes the mathematical expressions used to calculate the absolute temperature calibrations and sensitivities of the radiometers used in this experiment. The expressions developed for this purpose are based on the nomenclature shown in Figure E-1. An expression is also provided for conversion of radiometer output voltages, E_a, to apparent temperatures, T_a, at the input to the antenna feed.

The losses of all microwave components and waveguides have been accurately measured, with the exception of the antenna feed losses. These were estimated on the basis of equivalent waveguide length present in each antenna feed. The losses for the above components are listed in Table E-1. As indicated in Figure E-1, all the radiometers incorporate a basic 2-point input calibration scheme consisting of two waveguide terminations at accurately known temperatures and a mechanical waveguide switch. This allows the use of a 2-point calibration or the use of a 3-point calibration using the zenith sky temperature as the third calibration point.

The measured input-output response of each radiometer is linear over the dynamic signal range (0-400 degrees Kelvin). Therefore, within this range, the scale factor used in radiometer calibration and data conversion is a linear function. Referring to the response curve in Figure E-2, the scale factor (k) for a two point calibration is given by,

$$k = \frac{T_{c1} - T_{c2}}{E_{c1} - E_{c2}} \text{, degrees Kelvin per volt} \qquad (1)$$

Similarly, for an output voltage E_a,

$$k = \frac{T_{c2} - T_a}{E_{c2} - E_a} \text{, degrees Kelvin per volt} \qquad (2)$$

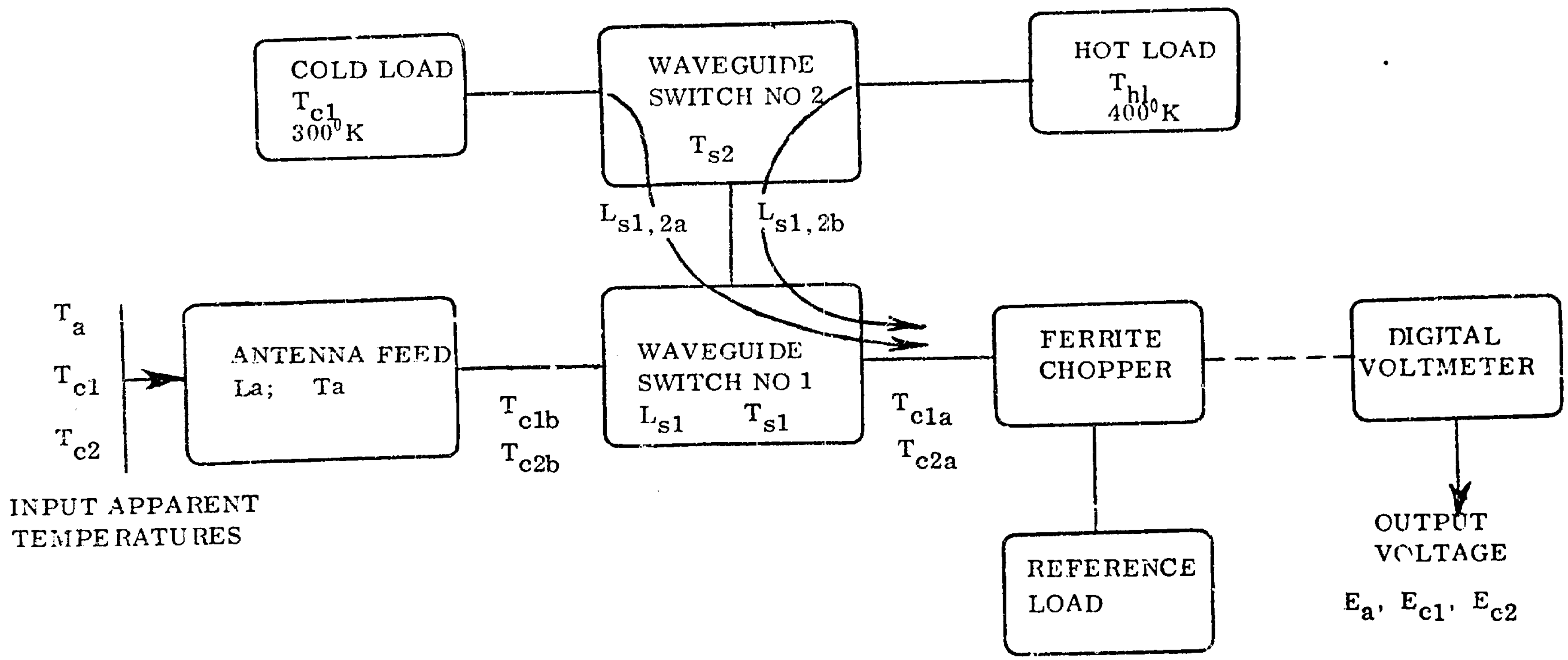


FIGURE E-1. RADIOMETER CALIBRATION CIRCUITRY

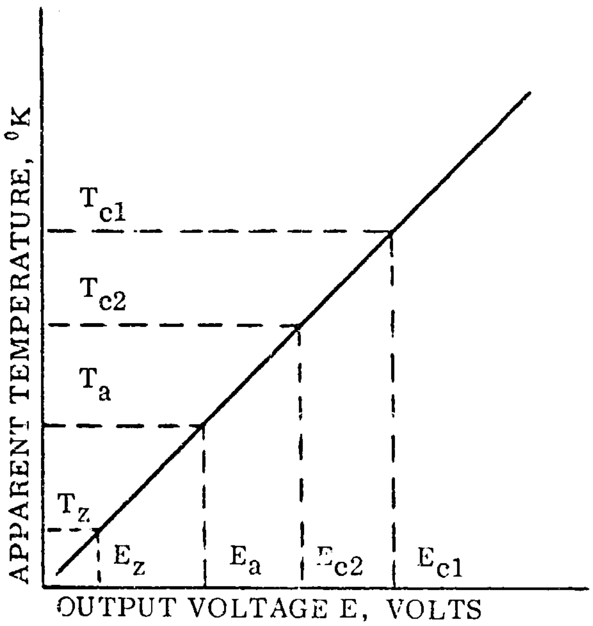


FIGURE E-2. INPUT-OUTPUT RESPONSE SHOWING CALIBRATION POINTS

TABLE E-1

RADIOMETER INPUT COMPONENT LOSSES

Item	9.5 GHz		16.5 GHz		94 GHz	
	Loss (db)	Factor	Loss (db)	Factor	Loss (db)	Factor
1. Antenna feed* (L_a in Figure E-1).	0.250	1.059	0.350	1.084	1.000	1.259
2. Antenna flange to input of ferrite chopper (L_{s1}) in Figure E-1).	0.087	1.020	0.280	1.066	0.460	1.112
3. Cold Load to input of ferrite chopper ($L_{s1,2a}$) in Figure E-1.	0.287	1.068	0.300	1.071	2.920	1.959
4. Hot Load to input of ferrite chopper ($L_{s1,2b}$ in figure E-1).	0.316	1.075	0.330	1.079	2.220	1.667

* These values have been estimated from losses in equivalent lengths of waveguide.

where,

T_{c1} is the apparent temperature of the maximum (Hot Load) calibration signal, referred to the antenna feed input, degrees K.

T_{c2} is the apparent temperature of the minimum (Cold Load) calibration signal, referred to the antenna feed input, degrees K.

Ta is the apparent temperature of the material under observation, at the antenna feed, degrees K.

E_{c1} is the radiometer output when the input signal is T_{c1}, volts.

E_{c2} is the radiometer output when the input signal is T_{c2}, volts.

E_a is the radiometer output when the input signal is T_a, volts.

The scale factor k for a three point calibration is determined from a least squares approximation for a best fit straight line, and is given by:

$$k = \frac{\dfrac{T_z + T_{c1} + T_{c2}}{3} - \dfrac{T_z E_z + T_{c1}E_{c1} + T_{c2}E_{c2}}{E_z + E_{c1} + E_{c2}}}{\dfrac{E_z + E_{c1} + E_{c2}}{3} - \dfrac{(E_z)^2 + (E_{c1})^2 + (E_{c2})^2}{E_z + E_{c1} + E_{c2}}} \tag{3}$$

where,

T_z is the zenith sky temperature

E_z is the radiometer output when the input signal is T_z, volts and the other parameters are as previously defined.

The radiometer temperature sensitivity can be readily calculated from knowledge of T_{c1} and T_{c2}, as well as the mean values of E_{c1} and E_{c2}. The minimum detectable temperature sensitivity of a radiometer is defined as the root-mean-square output signal fluctuation in the absence of an input signal. This definition implies that the radiometer input is terminated in its characteristic impedance for the requisite output reading. Therefore, in the radiometers under discussion, the input should be terminated with the Cold Calibration Load when the output reading is taken. This results in an effective null input signal condition, which represents maximum sensitivity in a Dicke-type radiometer.

Based on the above definition, the rms temperature sensitivity of a given radiometer is expressed by,

$$T = \left(\frac{E_{out}\ p/p}{6}\right) x\ k, \text{ degrees Kelvin rms} \tag{4}$$

The factor "6" is used to convert peak-to-peak noise voltages to rms voltages, in accordance with standard practice. Equation (4) may be expressed in terms of known quantities. Thus,

$$\Delta T = \left(\frac{E_{c2}p/p}{6}\right) \left(\frac{T_{c1} - T_{c2}}{E_{c1} - E_{c2}}\right)_{mean}, \text{ degrees K rms} \tag{5}$$

In practice, approximately ten (10) printouts are taken for E_{c1} and E_{c2} during the sensitivity check. The peak-to-peak fluctuation of E_{c2} is then noted for use in the first term of the above equation. Following this, the mean values of E_{c1} and E_{c2} are determined. With values of T_{c1} and T_{c2} established the rms temperature sensitivity can be calculated.

A microwave signal with an apparent temperature T_a, is affected by transmission through a lossy medium, such as a waveguide component, in accordance with equation (6).

$$T_{out} = T_a\left(\frac{1}{L}\right) + T_o\left(1 - \frac{1}{L}\right), \text{ degrees K} \tag{6}$$

or

$$T_{out} = T_o + (T_a - T_o)\frac{1}{L}, \text{ degrees K} \tag{7}$$

As indicated in Table E-1, the losses of WGS2 and WGS1, from the Cold Load and Hot Load to the input of the ferrite switch, were measured in combination. This combined loss will be indicated in the equations to follow by the symbols $L_{s1,2a}$ for the Cold Load path and $L_{s1,2b}$ for the Hot Load path, respectively. Since the loss in WGS2 is considerably higher than in WGS1, in the X-band channels, the temperature of WGS2 will be associated with $L_{s1,2a}$ and $L_{s1,2b}$.

Referring to Figure E-1, at point 1,

$$T_{c1a} = T_{s2} + (T_{hl} - T_{s2})\frac{1}{L_{s1,2b}}, \text{ degrees K} \tag{8}$$

and

$$T_{c2a} = T_{s2} + (T_{cl} - T_{s2})\frac{1}{L_{s1,2a}}, \text{ degrees K} \tag{9}$$

To obtain T_{c1} and T_{c2}, an inverted form of equation (6) must be used, with T_{c1a} and T_{c2a} representing T_{out}. Solving for T_a in equation (6),

$$T_a = \frac{T_{out} - T_o\left(1 - \frac{1}{L}\right)}{\frac{1}{L}}$$

or $$T_a = L(T_{out} - T_o) + T_o \text{ , degrees K} \tag{10}$$

At point 2, we obtain from equations (8) and (10),

$$T_{c1b} = L_{s1}\left[T_{s2} + (T_{h1} - T_{s2})\frac{1}{L_{s1,2b}} - T_{s1}\right] + T_{s1} \text{ , degrees K} \tag{11}$$

At point 3, we obtain from equations (10) and (11),

$$T_{c1} = L_a\left\{L_{s1}\left[T_{s2} + (T_{h1} - T_{s2})\frac{1}{L_{s1,2b}} - T_{s1}\right] + T_{s1} - T_a\right\} + T_a$$

or

$$T_{c1} = L_a\left[L_{s1}(T_{s2} - T_{s1}) + \frac{L_{s1}}{L_{s1,2b}}(T_{h1} - T_{s2}) + T_{s1} - T_a\right] + T_a \text{ ,} \tag{12}$$

degrees K

Similarly, at point 2 we obtain from equations (9) and (10),

$$T_{c2b} = L_{s1}\left[T_{s2} + (T_{c1} - T_{s2})\frac{1}{L_{s1,2a}} - T_{s1}\right] + T_{s1} \text{, degrees K} \tag{13}$$

At point 3, we obtain from equations (13) and (10),

$$T_{c2} = L_a\left\{L_{s1}\left[T_{s2} + (T_{c1} - T_{s2})\frac{1}{L_{s1,2a}} - T_{s1}\right] + T_{s1} - T_a\right\} + T_a$$

or

$$T_{c2} = L_a\left[L_{s1}(T_{s2} - T_{s1}) + \frac{L_{s1}}{L_{s1,2a}}(T_{c1} - T_{s2}) + T_{s1} - T_a\right] + T_a \text{ ,} \tag{14}$$

degrees K

Equations (12) and (14) are required for calculation of radiometer calibration temperatures, T_{c1} and T_{c2}, referred to the antenna feed input. These quantities are used in equation (5) to determine radiometer temperature sensitivity.

The conversion of radiometer output voltages, E_a, to apparent temperatures, T_a, at the antenna feed horn is accomplished by means of an inverted form of equation (2).

Thus,

$$T_a = T_{c2} - k(E_{c2} - E_a) \text{, degrees K} \tag{15}$$

Note that E_{c2} rathar than E_{c1} is used in this expression. The reason, of course, is that the value of E_{c2}, representing the Cold Load, is closer to the value of E_a. This optimizes the accuracy of the conversion. The value of k is determined by means of equation (1). Finally, as in the case of the radiometer sensitivity calculation, approximately ten (10) printouts are taken for E_{c1}, E_{c2}, E_z and E_a. The mean values of these quantities are then determined prior to insertion in equation (15) for calculation of apparent temperature T_a.

APPENDIX F

INFRARED RADIOMETER SUPPLEMENTARY MEASUREMENTS

An Infrared Radiometer was supplied and operated by personnel from NESC. This was a Barnes PRT-5 radiometer which had a spectral response from 8 to 16 micrometers.

The sea surface temperatures as measured by the PRT-5 were corrected for specular reflectance of the sky background and the resulting temperatures are plotted in Figures F-1 through F-8.

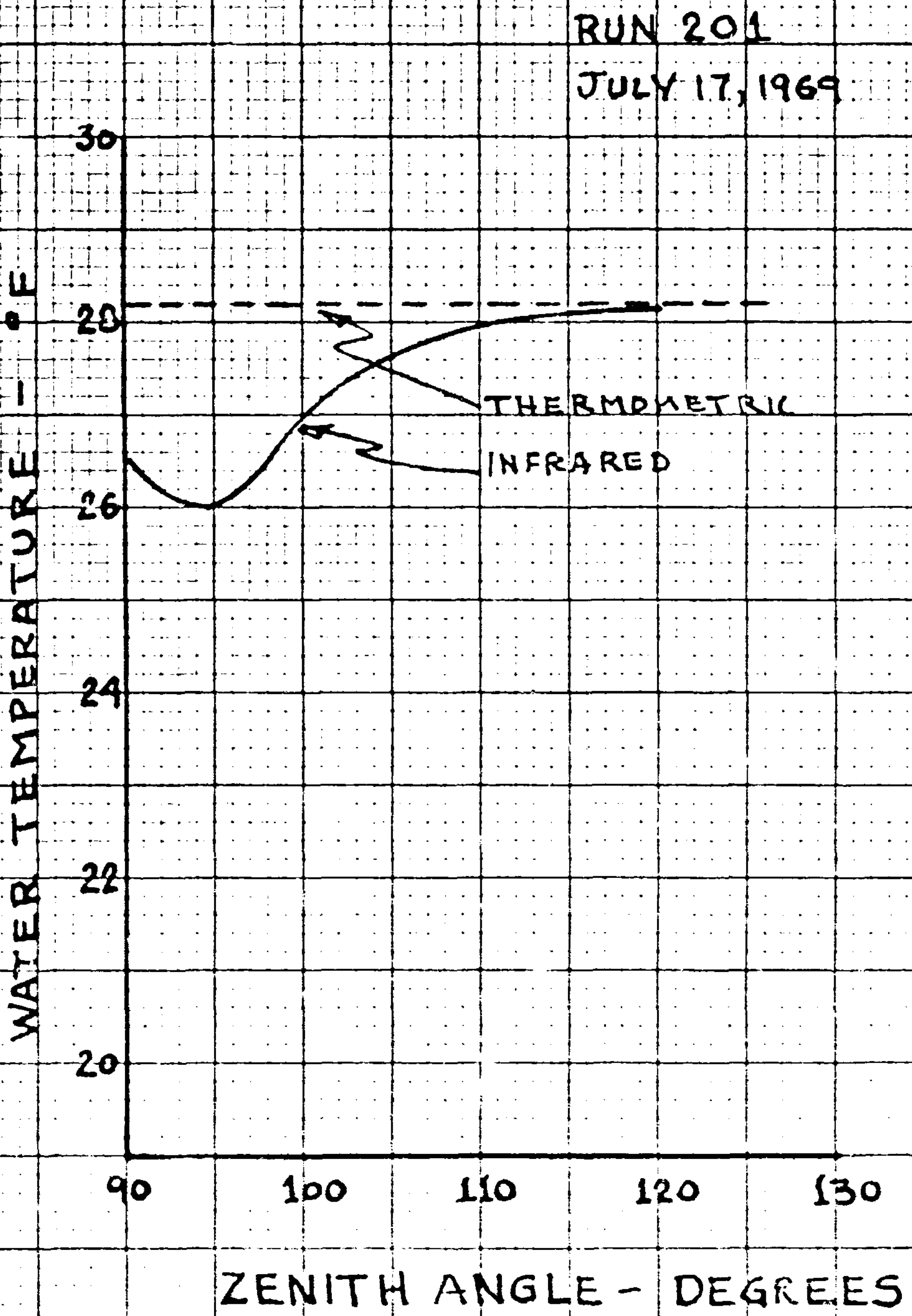


FIGURE F-1. SEA SURFACE TEMPERATURE

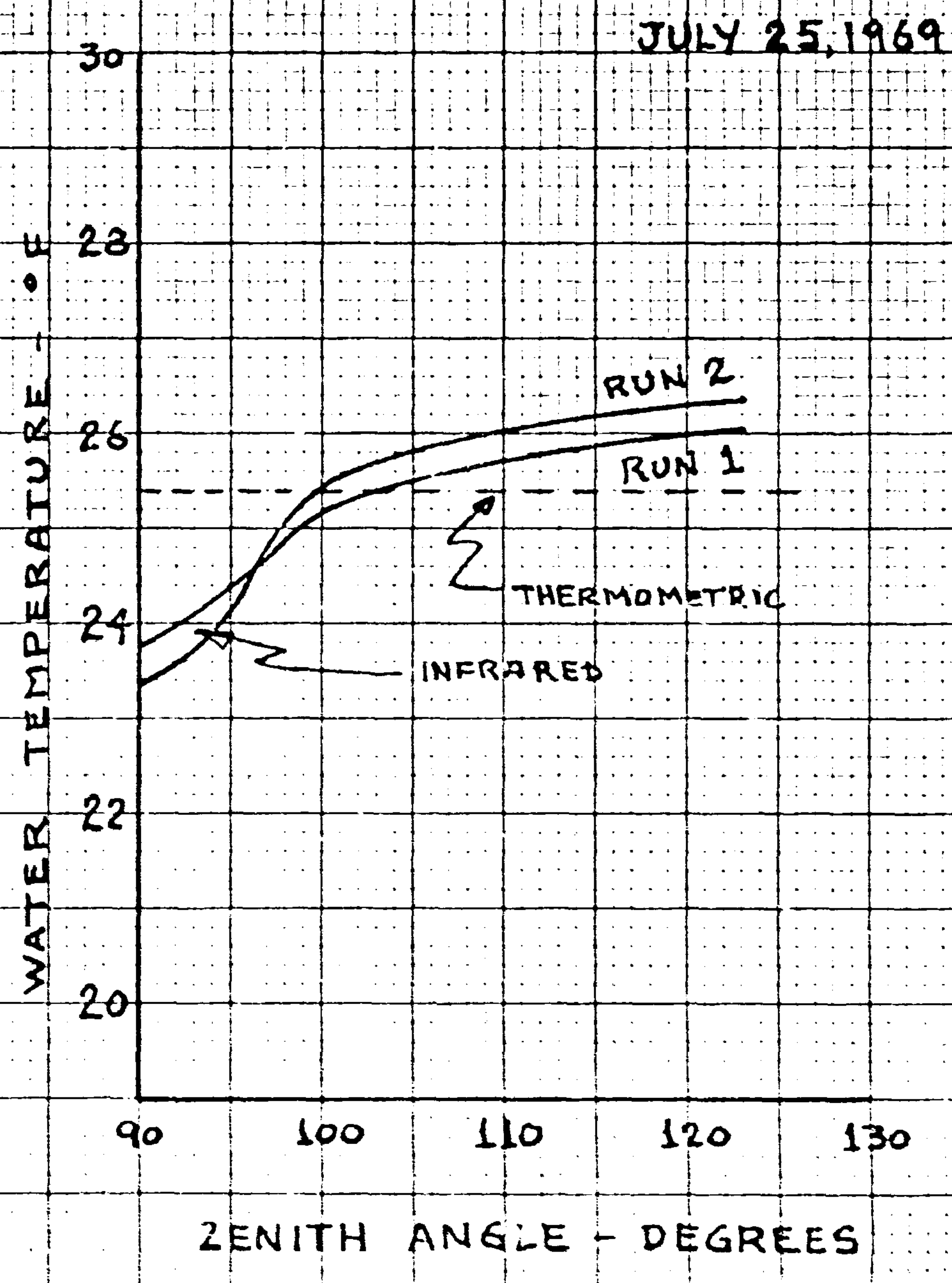
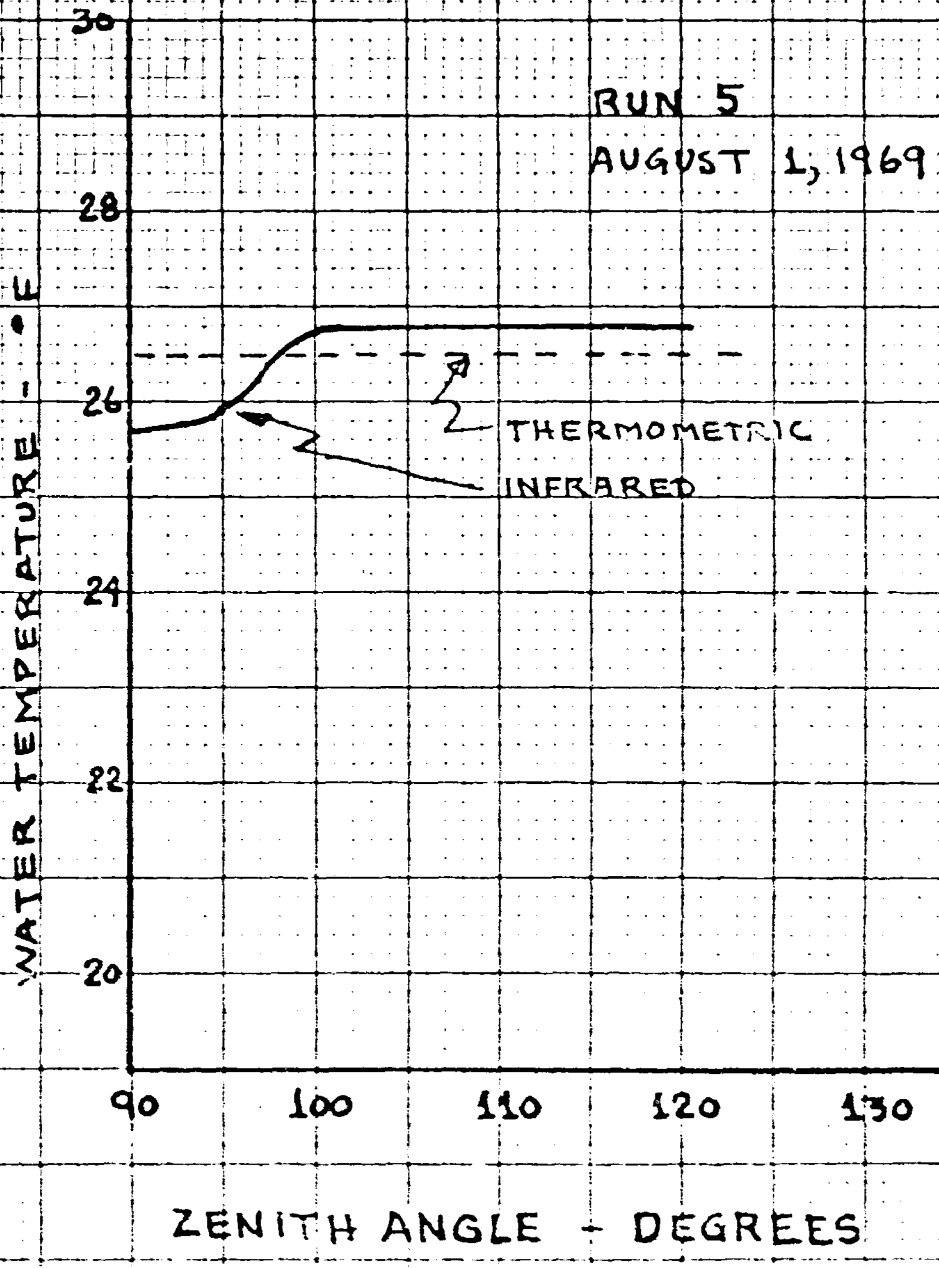
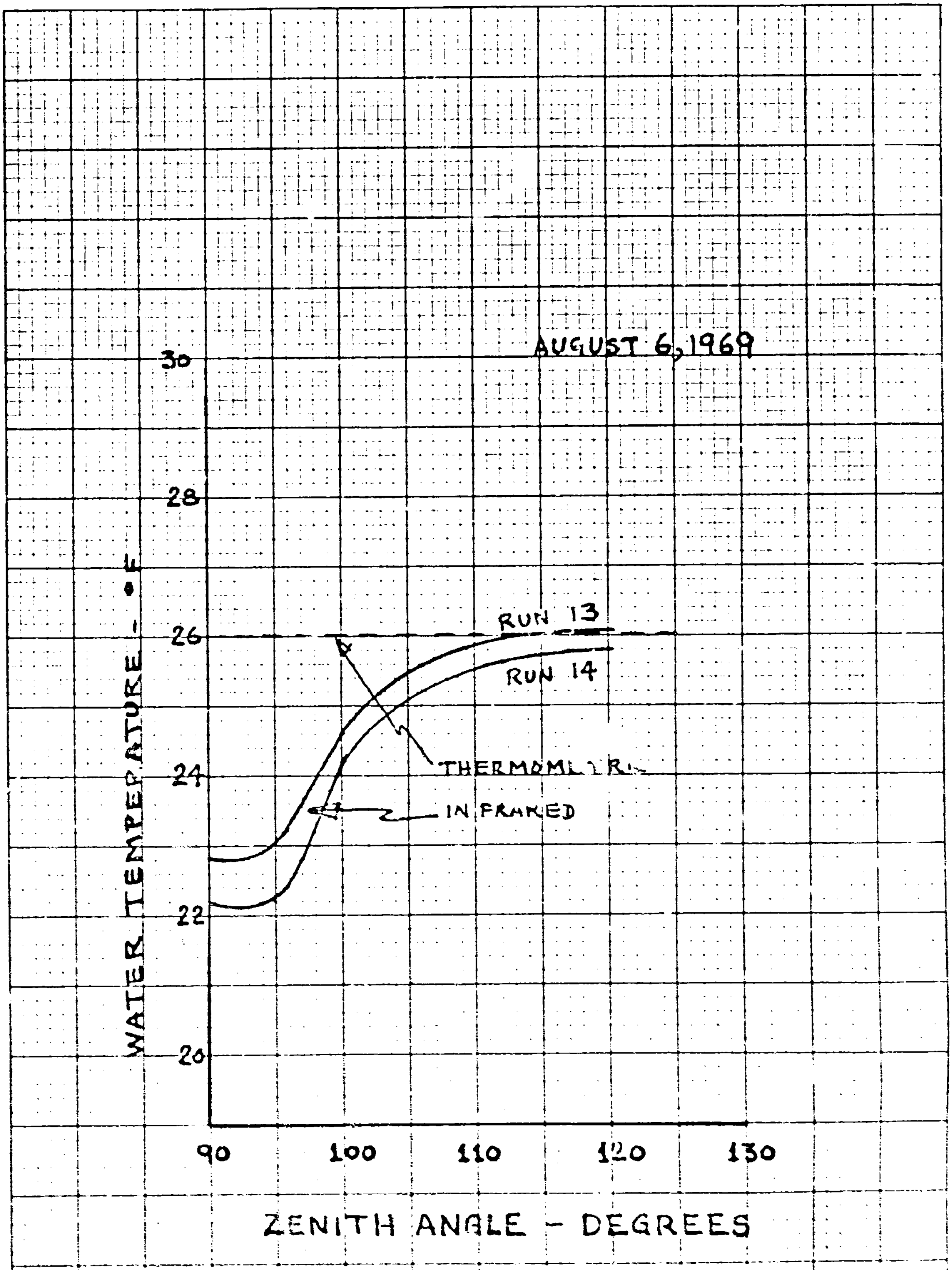


FIGURE I-2 SEA SURFACE TEMPERATURE



RUN 5
AUGUST 1, 1969
THERMOMETRIC
INFRARED
WATER TEMPERATURE - °F
30
28
26
24
22
20
90
100
110
120
130
ZENITH ANGLE - DEGREES


AUGUST 6, 1969
WATER TEMPERATURE - °F
30
28
26
24
22
20
RUN 13
RUN 14
THERMOMETER
INFRARED
90
100
110
120
130
ZENITH ANGLE - DEGREES

[illegible] SEA SURFACE [illegible]

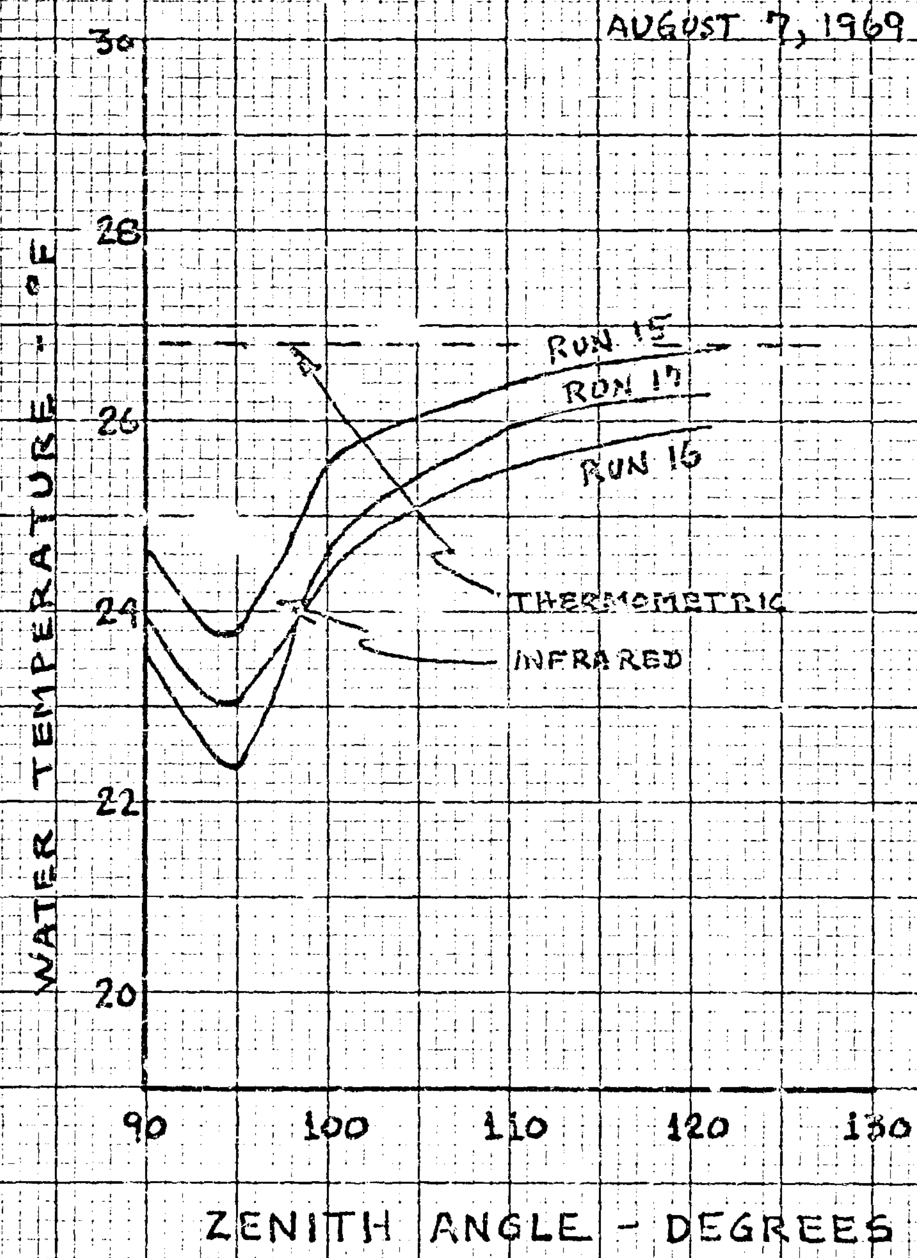


FIGURE F-5. SEA SURFACE TEMPERATURE

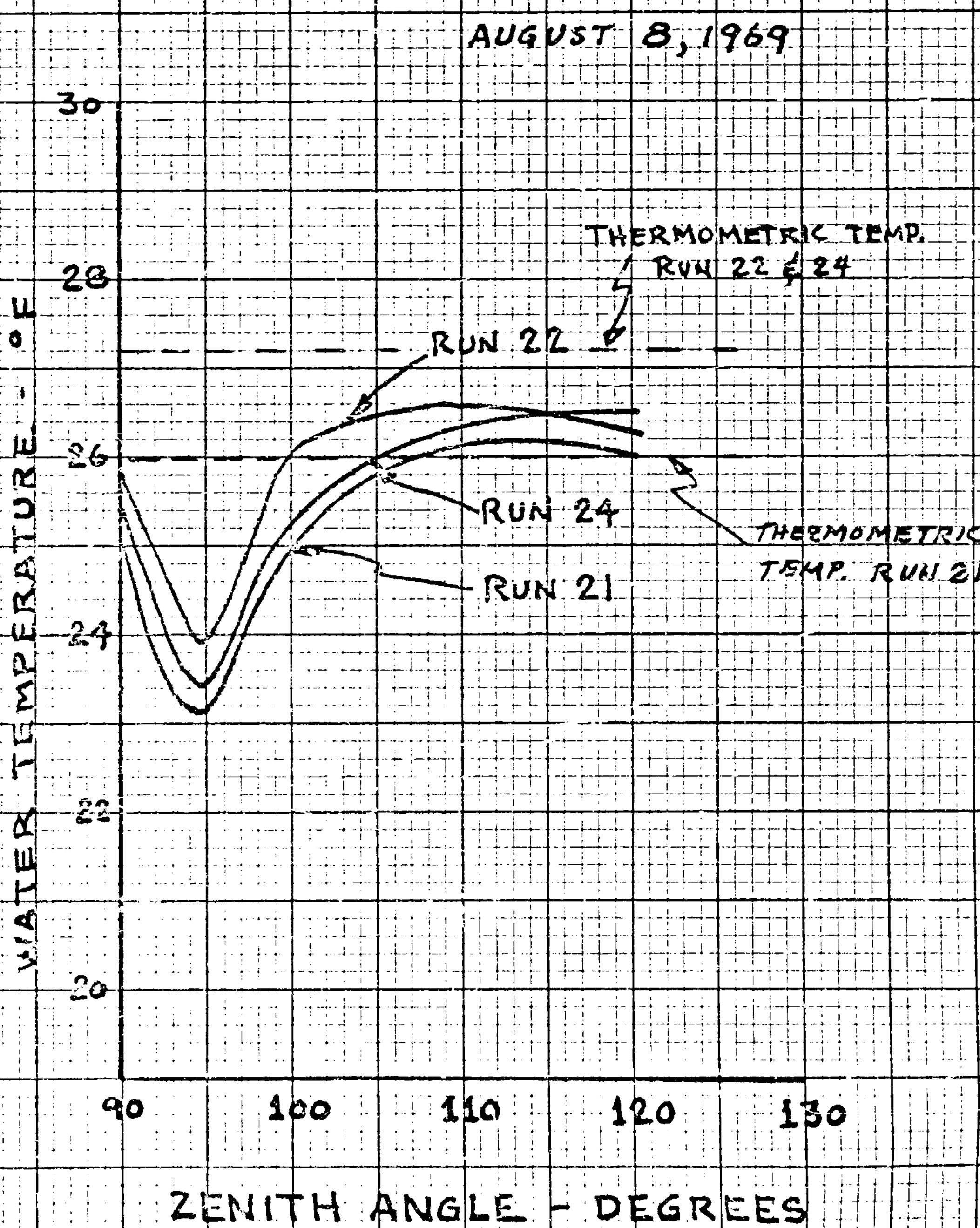


FIGURE F-6. SEA SURFACE TEMPERATURE

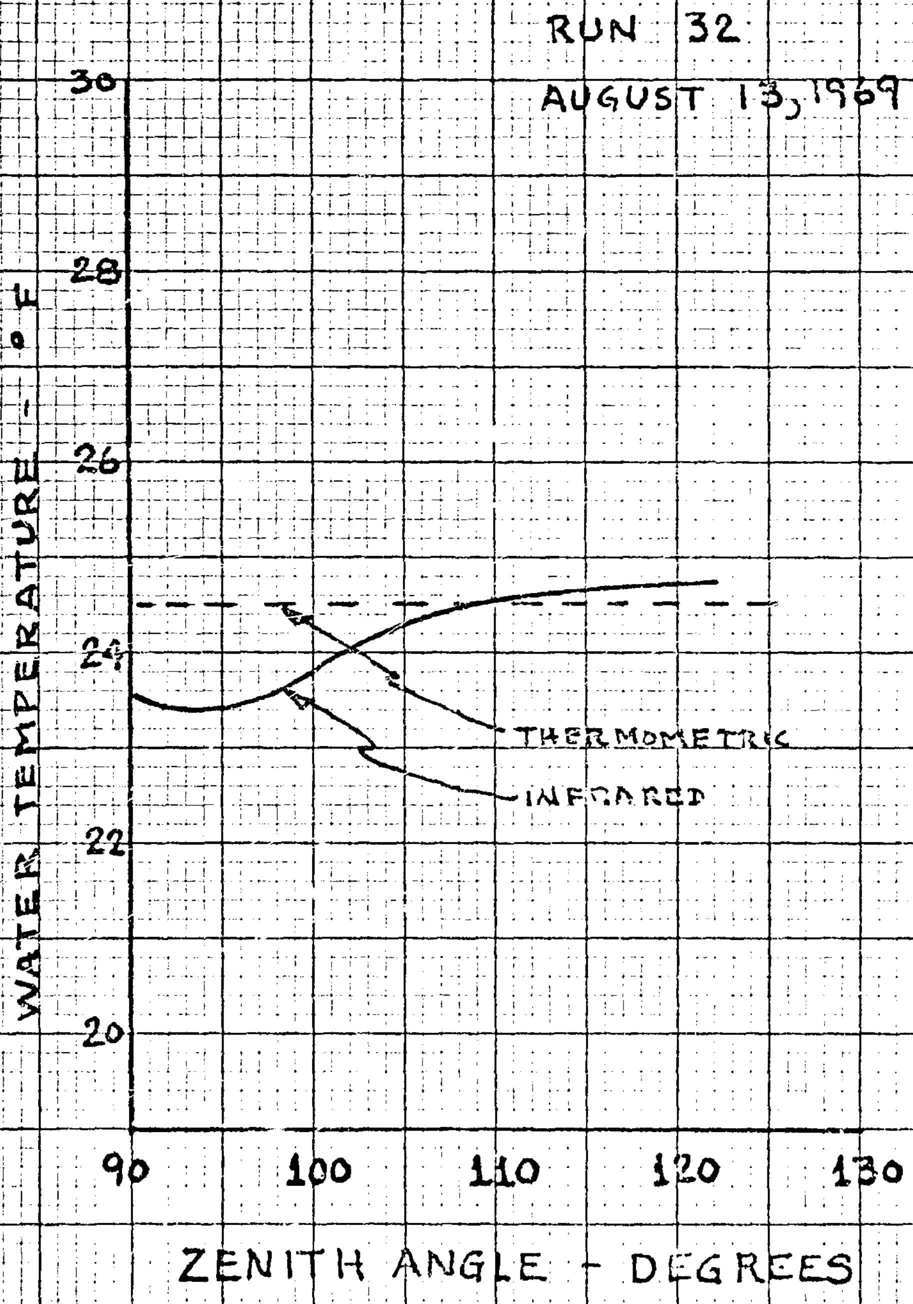


FIGURE F-7. SEA SURFACE TEMPERATURE

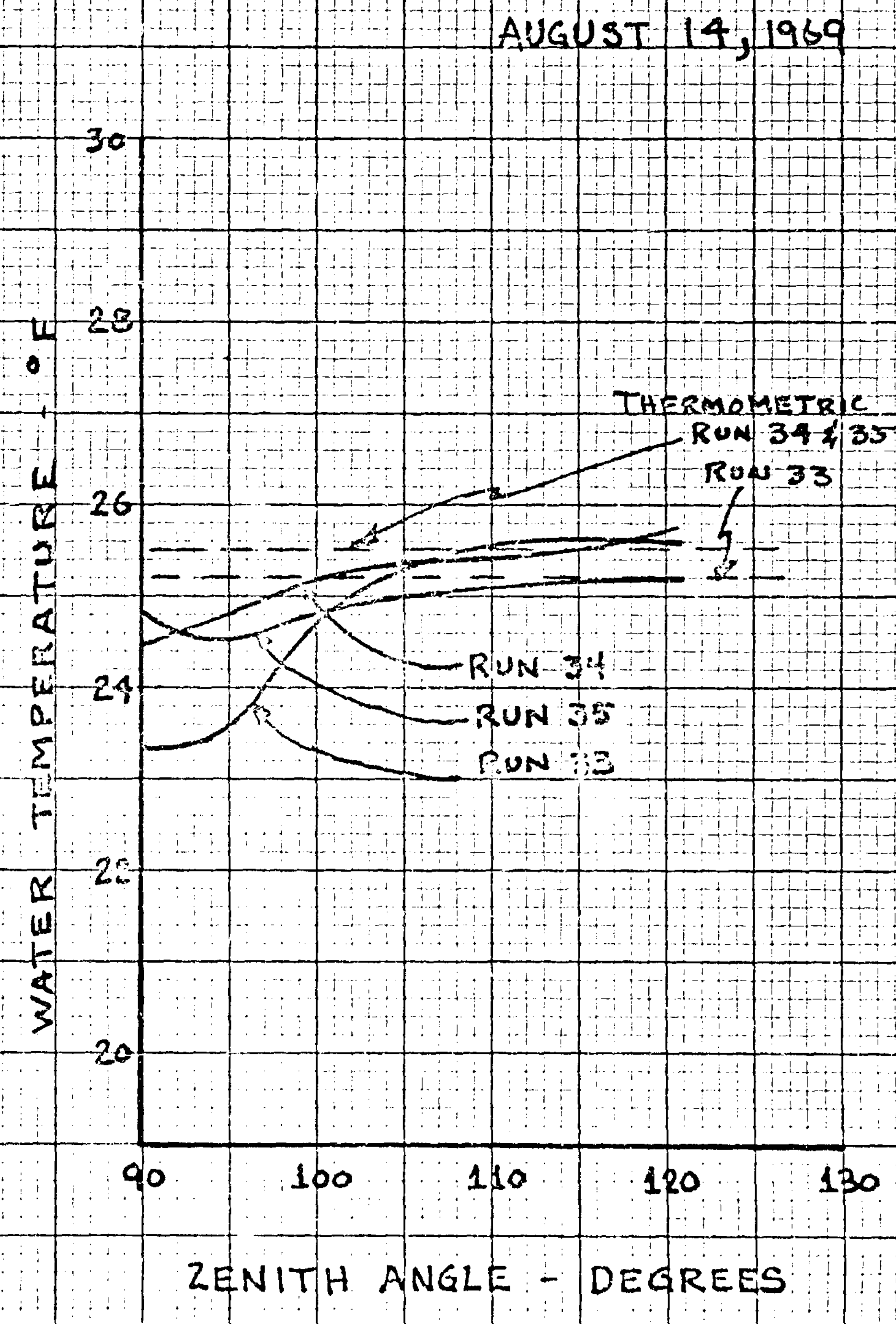


FIGURE F-8. SEA SURFACE TEMPERATURE

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13. ABSTRACT

RCA Astro-Electronics conducted a field experiment to verify a theoretical approach toward remote sensing of sea surface temperature using passive microwave radiation.

There is a correspondence between the radiometric temperature of the sea and its thermometric temperature. This correspondence is influenced by the horizontal and vertical emissivity, the incidence angle at which the radiometric measurement is being made, contaminants on the water surface, and by the sea surface roughness.

The experiment addressed itself to two basic questions: 1) Can one measure the vertically and/or horizontally polarized microwave radiometric emissions from the sea water and obtain an accurate measure of the thermometric temperature? 2) Can one also make a determination of sea state from such measurements?

The radiometric measurements were made from North Island of the Chesapeake Bay Bridge and Tunnel District. The Chesapeake Bay Bridge-Tunnel links the city of Norfolk and Cape Charles, Virginia, across 17.6 miles of water. North Island is at the northern end of the Thimble Shoal Channel Tunnel. The bulk of the microwave measurements were made at a frequency of 16.5 GHz. The following conclusions are drawn from an analysis of the data: 1) There is a correlation between the thermometric temperature and the vertically polarized microwave radiometric temperature, 2) There was no observed correlation of the thermometric temperature with the horizontally polarized microwave radiometric temperature, 3) While theoretical considerations strongly indicate that the horizontally polarized microwave radiometric temperatures should have a strong dependance on sea state, no definitive trends were found in the measured data.

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