

SPACE GEODESY ALTIMETRY AIRCRAFT EXPERIMENT, DATED MAY 1970, PREPARED UNDER NASW-1932

FINAL REPORT ERRATA SHEET

PAGE

5-9

7/24/70

CHANGE

Add new sentence after 2nd paragraph "E. Weiss was technically iv responsible for the Flight Test Plan". Fourth line, change from "meansurators" to "mensurators". v For Figure 5-43 change caption from "(Camera Looking in $Y^{(3)}$ Direction of Figure 14) to "(Camera Looking in $Y^{(3)}$ Direction xii of Figure 14 in Appendix B)". 1-7 Figure 1-5 printed upside down. 2-6 Figure 2-3 printed upside down. Fifth line from bottom, change from "morevoer" to "moreover" 3-3 For Flight 3, under Stilwell Parameters, change altitude from 3-4 "80,000" to "20,000". For Flight 4, change location from " $7^{\circ}07' \ge 33^{\circ}38''''$ to " $37^{\circ}07' \ge 73^{\circ}38''''$. 3-5 For Flight 16, under Stilwell Parameters, add new data in column 3-7 to the right of 8, 1500 ft, 1/200 a f 22, new data should read: No. of Runs 4 10,000 ft. Altitude Camera Parameters 1/200 at f 22 Sixth line, change from " P_r " to " P_R ". 4-11 Thirteenth line, change from " P_r " to " P_R ". 4-13 Tenth line from bottom, after Molo Christianson change 5-6 "and" to "are". Tenth line, change from " P_r " to " P_R ".

CHANGE

5-12 Change equation (5-14),

From:
$$\theta_{e} = \frac{\theta_{H1} \theta_{H2}}{\theta_{H0} \theta_{H2}} + \frac{\theta_{E1} \theta_{E2}}{\theta_{E1} \theta_{E2}}$$

The $\theta_{e} = \frac{\theta_{H1} \theta_{H2}}{\theta_{H1} \theta_{H2}} + \frac{\theta_{E1} \theta_{E2}}{\theta_{E1} \theta_{E2}}$

- 2/ 5-23 Fifth line, change from "5-ﷺ' to "5-17".
- 5-23 Ninth line, change from "5-30" to "5-23".
- 5-23 Seventeenth line, change from "10,000 ft." to "5,000 ft".

- 5-41 In caption, change from "(Camera Looking in Y⁽³⁾ Direction of Figure 14) to "(Camera Looking in Y⁽³⁾ Direction of Figure 14 in Appendix B)".
- A-1 Second line, change from "4.1.4" to "4.4".
- B-37 Third line, change from "(which is not gaussian!" to "(which is not gaussian)".

$\mathbf{P}\mathbf{A}\mathbf{G}\mathbf{E}$

SPACE GEODESY AIRCRAFT EXPERIMENT

FINAL REPORT

MAY 1970

Prepared Under

NASA Contract NASW 1932

for

A. Selser Technical Monitor NASA Code RED-IDP-RSS Wallops Station Wallops Island, Va. 2337

by

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FOREWORD

This report contains the results of the Space Geodesy Aircraft Experiment awarded Raytheon Company under Contract No. NASW-1932 by the Geodetic Satellite Program Office, Office of Space Science and Applications, National Aeronautics and Space Administration.

The experiment was conducted by the Equipment Division of Raytheon Company under the direction of Mr. Myer Kolker as Program Manager with Mr. Emile Genest as Project Engineer and Dr. Charles J. Mundo, Jr., as Program Scientist.

Successful implementation of this effort was due largely to Mr. Jerome D. Rosenberg, Manager, Geodetic Satellite Programs, NASA OSSA, who initiated the effort, and provided the necessary initial direction and guidance, and to Mr. Allen Selser, Technical Monitor, NASA Wallops Station, who continued the direction and guidance through the conclusion of the experiment.

The primary objective of this experiment was to obtain measurements at normal incidence of radar backscatter and waveforms for varied ocean conditions.

ABSTRACT

Measurements of the radar pulse shape and cross section per unit area, σ^{0} , at vertical incidence from various ocean conditions were made during the 1969-1970 Winter approximately 120 miles east of Norfolk, Va. The radar equipment consisted of an X-band transmitter, receiver and antenna system generating pulses of ten through one hundred nanoseconds. The reflections were received on a high speed oscilloscope inside an aircraft flying at 10,000 feet. Ocean truth was provided: (1) by two cameras located in the aircraft, one of which obtained pictures which were subsequently processed to provide two-dimensional Fourier transforms of the ocean surface; (2) by a NASA ship on location which provided measurements of ocean and atmospheric conditions, and; (3) by a second aircraft with a laser profilometer which provided precise measurements of the ocean waves. The results indicate a σ^{0} ranging from 8 to 21 dB and a noticeable trend for σ^{0} versus wind speed. The waveform of the return compared favorably with the expected waveform.

ACKNOWLEDGEMENT

The Space Geodesy Altimetry Aircraft Experiment Program was initiated by Jerome D. Rosenberg and Dr. Martin J. Swetnick, NASA Office of Space Science and Applications. The Technical Monitor for the program was Alan R. Selser of NASA Wallops Station.

Myer Kolker of Raytheon was Manager of the program, assisted by Dr. Charles Mundo as Program Scientist. Project Engineer of the program at Raytheon was Emile Genest, assisted by Neil Lacey, John Bartlett and John Westphal. The latter three engineers, in addition to participating in the design and fabrication of the radar system at the Raytheon Sudbury Engineering Center, also flew with the equipment and operated it during the runs over the test areas.

Robert Nock and Robert Long of NASA Wallops Station directed aircraft and ship operations and supplied weather information. Lawrence Chase of the National Oceanographic Instrumentation Center provided guidance in measuring ocean parameters from the U.S. Naval Ship <u>Range Recoverer</u> which participated throughout the experiment. Special mention should be made of the officers and crew who spent many days and nights on location so that "ocean truth" would be available when the NASA Wallops Station C-54 aircraft made flights to gather the experimental data.

J. Beck, J. Buck, and T. Brown of Lockheed piloted the C-54 and also provided assistance in planning the flight patterns. C. Linton, RCA, operated the side-looking camera on board the aircraft to take pictures of the ocean for later use in correlating ocean conditions with the radar data. R. Johnson and R. Smith, NASA Wallops Station, developed the films from the side-looking camera. Denzil Stilwell and W. Keller of NRL provided guidance on applying the Stilwell technique for making Fourier transforms of the side-looking camera photographs. S. Henriksen and H. Hockeborn of Raytheon analyzed the films on meansurators and densitometers at the Raytheon Autometric Operation.

On several test flights, additional ocean truth was provided by W. Kielhorn of ONR who flew a Cessna-310 aircraft with a laser profilometer on board for measuring and recording wave heights at the same time and place where radar and camera data were obtained by the C-54 aircraft. Duncan Ross and Richard Shields of the Naval Oceanographic Office reduced the laser profilometer data.

Professor Blair Kinsman of the Chesapeake Bay Institute, Johns Hopkins University, provided overall guidance on ocean wave theory and measurement techniques, both in the early planning stages of the experiment and in the evaluation phase.

As can be seen from the foregoing, the experiment depended upon the combined efforts of a large number of people in many different organizations. Much of the credit for coordinating these many activities goes to Alan R. Selser, NASA Wallops Station, who provided overall direction for the program.

This report was edited by L. F. Coppenrath of Raytheon's Advanced Development Laboratory.

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SPACE GEODESY AIRCRAFT EXPERIMENT EXECUTIVE SUMMARY

During December, 1969 and January, 1970 sixteen test flights were flown out of NASA's Wallops Station, Virginia with the purpose of measuring radar pulse shapes and radar cross sections per unit area, σ° , at vertical incidence from various ocean conditions.

The radar equipment consisted of an X-band (9 GHz) transmitter, receiver, and antennas (standard gain horns) capable of generating pulses as narrow as ten nanoseconds. The transmitter was a low level local oscillator with a TWT amplifier (12 watts) after the pulse modulation. There were two receiving antennas (standard gain horns of 22 dB with a 12° beamwidth) that were cross polarized with respect to each other permitting measurements of both direct and cross polarized return energy. The transmitting antenna (8° beamwidth) was mechanically boresighted to the same axis as the receiving antennas. The receiver was a fixed gain superheterodyne type. A wide band oscilloscope was used to indicate the sea echos which were photographically recorded. The number of pulses that were integrated, displayed and photographed varied from one to 278. Most of the flights were flown at 10,000 feet using a 20 nanosecond pulse width which resulted in pulse limited .returns (rather than beam limited).

Ocean truth data was provided by (1) a down-looking camera which photographed the ocean corresponding to the radar scope photographs, (2) a second camera which obtained photos which were subsequently processed to provide two-dimensional Fourier transforms of the ocean surface, (Stilwell process), (3) a NASA ship on location at the test area which supplied measurements of ocean and atmospheric condition, and (4) an ONR aircraft with a laser profilometer which yielded precise measurements of the ocean waves.

Approximately 600 frames from ten of the flights were selected for further examination. A point coordinate mensurator was used to precisely

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measure the return pulse peak and noise level, and digitally record these points on to punched cards. All the pertinent radar and environmental data were recorded onto cards. These cards were used as the input data for a processing program which calculated, by using a form of the radar equation, the radar cross section, σ° , for each frame. For each flight and for a selected number of runs, the mean, the standard deviation, and frequency distribution were then calculated.

The spread of values of σ° ranged from approximately 8 dB to 21 dB for wave heights up to 12 ft and wind speeds up to 26 knots. In comparing σ° for each flight with the sea condition, there appears to be correlation between σ° and wind speed. Since the capillary waves are directly related to wind speed, the data indicates that at X-band σ° is probably more dependent on capillary wave formations than any other ocean parameter. The data also showed no significant change in σ° when the aircraft was flying at various headings with the sea direction. Expected pulse shapes, calculated for various pulsewidths, altitudes and σ° , compared favorably with the actual pulse shapes. The rise times were linear and equal to the pulsewidth and the decay times were related to altitude and beamwidth.

It is recommended that the analysis be further extended to measurements of rise and decay times along with amplitude distributions as a function of time. The Stilwell process should be further developed by analyzing all the available photographs. The relation between σ° and capillary waves should be further investigated by implementing a method of measuring the capillaries and performing further aircraft experiments. These aircraft experiments should also include measurements of correlation between pulses, altitude bias from wave heights, waveform sampling techniques, and candidate data processors.

SECTION 1. INTRODUCTION & SUMMARY

The Space Geodesy Altimetry Aircraft Experiment Program supports the goal of developing a satellite radar altimeter which will be capable of measuring the distance between the orbit and the ocean surface to accuracies of ± 1 meter or better. At the present time, there is a lack of empirical data on the way in which radar pulses are backscattered by the ocean at vertical incidence.

During this Aircraft Experiment empirical data was taken which will aid in developing a valid electromagnetic model of the ocean at X-Band as a function of pulse-length, sea-state, and altitude. Radar returns from a variety of ocean conditions were observed, recorded, and analyzed. This data will be useful for designing a satellite radar altimeter capable of measuring heights above the ocean to accuracies of ± 1 meter or better at altitudes of 1000 to 1500 kilometers and at orbital velocities of 7 to 8 kilometers per second. In addition, the data will also be useful in interpreting the data from the GEOS C Radar Altimeter Experiment in which accuracies of ± 5 meters are expected and in which consideration is being given to recovering the shape of the return waveform.

The objectives of the flight tests were to measure the pulse shape as reflected from different ocean conditions and to attempt to find a correlation between the return pulse shape and the ocean parameters. Specifically, the intent was to obtain a measure of σ° (radar scattering coefficient) and $H(\omega)$ (impulse response) for various states of the sea or ocean.

This final report describes the equipment used for making the measurements (see Figure 1-1). It describes both the radar equipment and the auxiliary equipment for making the necessary measurements of ocean and aircraft characteristics. Briefly stated, the basic radar system consisted of three antennas, a receiver rack and a transmitter rack. The antennas were mechically installed, and boresighted in the NASA C54 aircraft. The receiver and transmitter units were mounted in standard nineteen inch racks in the aircraft. Three operators were required to operate the radar equipment, auxiliary data recording equipment, and the three cameras (oscilloscope, ground viewing, and ocean spectra).

The data gathered in this experiment consisted of approximately 10,000 frames of oscilloscope photographs, 10,000 frames of ocean photographs at vertical incidence, and 150 frames of ocean photographs at 45° incidence. 600 frames of oscilloscope photographs were reduced in order to obtain σ^{0} and pulse shape measurements. The process used in reducing the 600 frames of data is described in Section 4.0.

This report also attempts to relate σ° to wave height, wave period, wind speed and roll angle. The σ° measurements are made with narrow pulse returns as would be encountered in a satellite radar altimeter. The relations between pulse shape, altitude, pulse width and wind speed are derived and compared to actual measurements. Various methods of obtaining ocean parameters are described and compared. These include "eyeball" estimates, laser profilometer measurements, and two dimensional Fourier transforms using photographs. The "eyeball" estimates of wave height, and wave period and anemometer readings of wind speed were obtained from the NASA Range Recoverer ship (Figure 1-2) on location in the measurement area. The laser profilometer measurements were obtained by ONR personnel who used a Cessna 310 aircraft with the laser equipment aboard (see Figure 1-3) in the same area. The ocean spectra photographs were obtained from photos taken by a side looking camera on the NASA C54 aircraft used in the experiment (see Figure 1-4, 1-5).

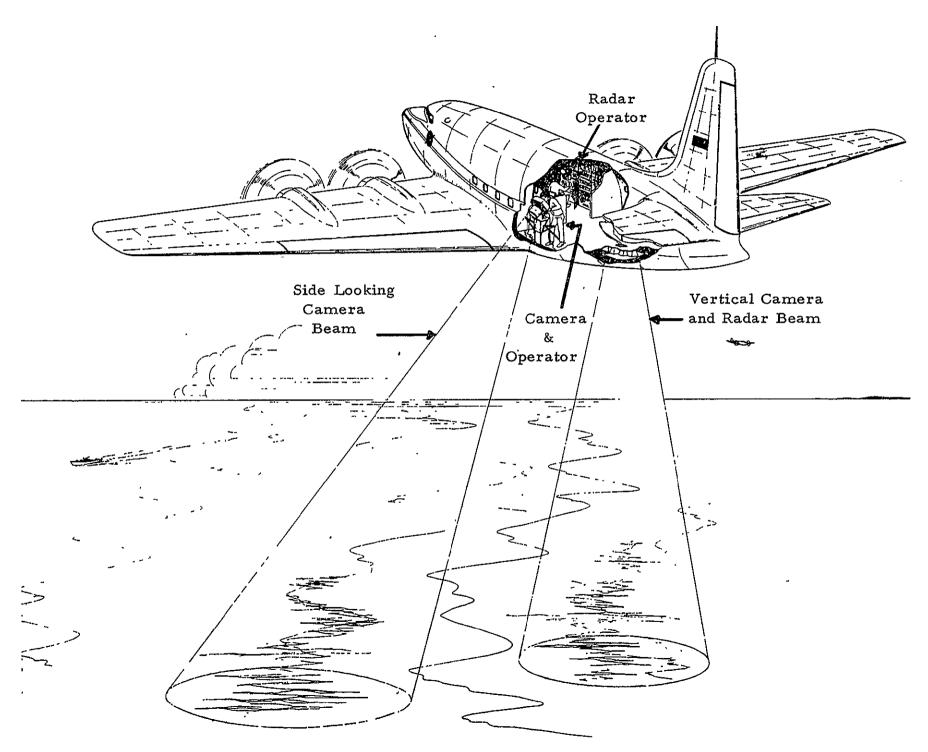


Figure 1-1. Artist Concept of Aircraft Experiment

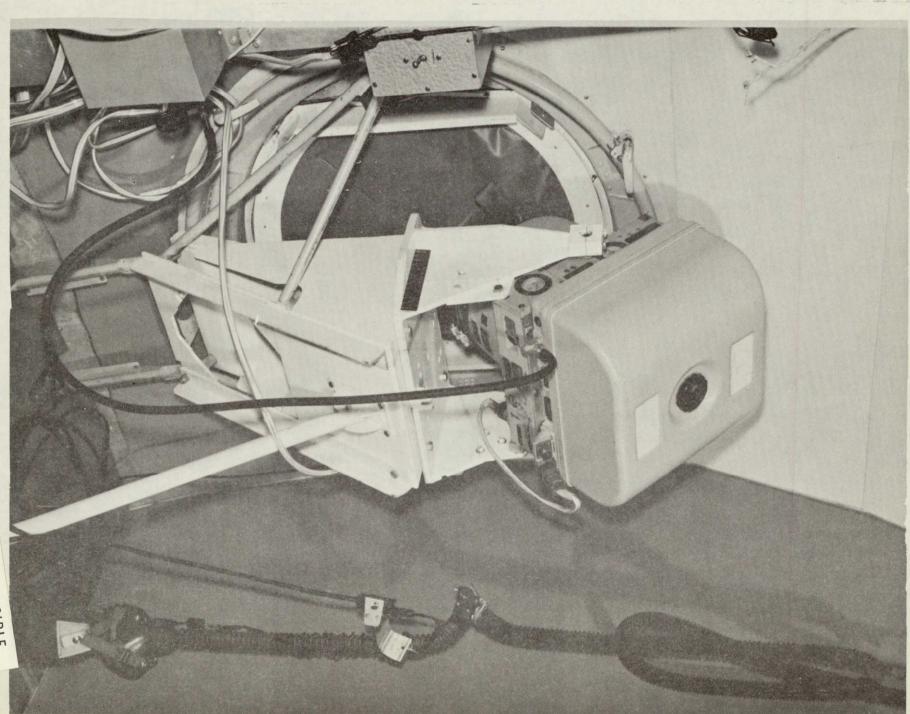


Figure 1-2. NASA Recovery Ship



Figure 1-3. CESSNA 310 Aircraft With Laser Equipment Aboard

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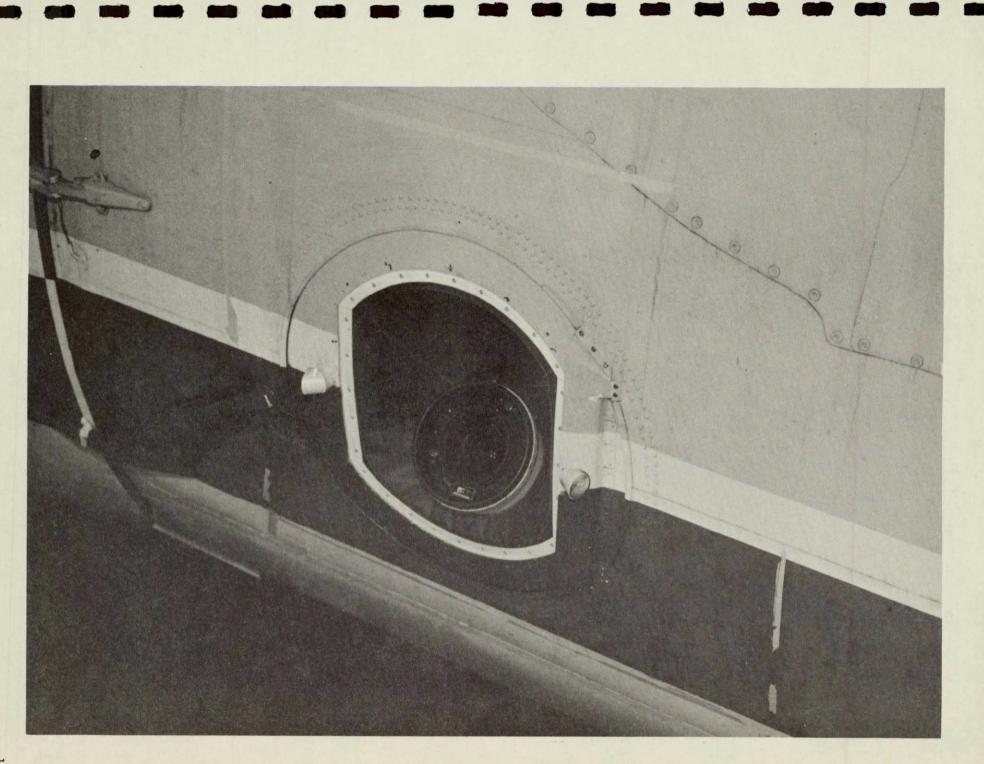


Figure 1-5. Ocean Spectra Camera (External)

Summarizing the conclusions and recommendations:

Conclusions

- 1. σ° appears to have a functional relation to wind speed but none to wave height, period, or direction.
- 2. Variations in σ° over the looking angles of 0 to 4 degrees are small.
- 3. The distribution of the amplitude of the return signal and hence σ^{0} , appears to be Rayleigh.
- 4. Cross polarized returns at normal incidence were 30 dB down from direct polarized returns.
- 5. The return waveform and σ^{o} are unrelated to sea direction.
- The leading edge of the return waveform was a consistent ramp with little fluctuations.
- 7. The trailing edge of the return waveform contained large fluctuations for the individual pulse but the average value had a predictable decay functionally related to altitude, pulsewidth and beamwidth.
- 8. The average characteristics of the measured return waveforms agreed with the computed waveforms.
- 9. Ocean parameters were consistently obtained by visual observations.
- 10. Implemented techniques for measurement of ocean parameters included Stilwell photography and laser profilometry. The former is simpler but it requires further development. The latter is more complex and provides one dimension spectrum.

Recommendations

- The same analyses conducted on the chosen 600 frames of data be extended to the remaining frames to fully exploit the data from this experiment.
- 2. Measure rise times and decay times and correlate with theoretical values.
- 3. Analyze the distribution of pulse amplitude as a function of time using a densitometer.
- 4. The Stilwell process should be further developed by processing all the available photographs and extending the analysis of the results. This includes, at least, analyzing frames from the same flight for self consistency, correlation of Stilwell and laser profilometry data from flight 5, and correlation with surface "eye ball" reports.
- 5. The relationship of σ^o to surface wind should be further investigated including flying over areas where the surface has no capillary waves (no wind) present and includes conditions of no waves present and swell waves present.
- Altitude biases as a function of sea state should be investigated. This includes ground range calibration and an independent accurate source of aircraft altitude.
- 7. Correlation measurements between pulses as a function of time and frequency shift should be performed to compare with satellite measurements.
- 8. A waveform sampler should be implemented in addition to the oscilloscope and camera.
- 9. Candidate data processors should be flown and compared.

- 10. Methods for ground truth measuring of capillary waves should be investigated.
- 11. In planning future aircraft experiments, major emphasis should be given to methods, availability, and confidence level for the ground truth measurement of the ocean surface conditions.

SECTION 2. TEST SYSTEM

2.1 System Parameters

Table 2-1 gives the system parameters used in making the measurements. Much of the data was taken at 10,000 ft with 20 nsec pulses because: (1) sufficient S/N was available at this altitude; (2) pulse limiting conditions prevailed; and (3) the higher altitudes created operational problems because of oxygen requirements.

The parameter values used were dictated by various practical and operational considerations. The altitude of 20,000 feet is the maximum limit that aircraft available for this operation can fly. The pulsewidth values are those which future radar altimeter designs will be considering and also those which can be generated with present available equipment and a minimum of in-house design effort. The transmitted power of 12 watts is obtained by using a TWT amplifier unit packaged complete with its power supply. Higher power units proved to be proportionately more expensive and impractical for this application. The antennas are standard gain horns which are readily available and have well controlled characteristics. The transmitted wavelength is approximately 3 cm or X-band. The entire X-band from 8 to 12 GHz was capable of being used although the experiment concentrated at one arbitrarily chosen frequency (9 GHz). X-band was used because previous studies have indicated that future GEOS radar altimeters will probably operate in that band.

The oscilloscope camera has a shutter speed of 1/50 of a second and the prf was determined so that one pulse or up to 278 integrated pulses can be displayed on an oscilloscope and photographed. This permits an evaluation of individual pulse returns as well as the integrated effect of many pulses.

Table 2-1. System Parameters

Altitude (ft)	1500, 5000, 10000, 15000, 20000
Pulsewidth (nsec)	10, 20, 100
Transmitted Power (w)	3, 12
Antenna Gain (dB) (two way)	47.3
Frequency (GHz)	9.0
Roll and Pitch (deg.)	Ò, 3, 5
Radar Output	Scope Photographs
Auxiliary Data	Vertical Photos Side Looking Photos Roll & Pitch Recordings Ship Reports on Sea & Weather Laser Profilometer
Pulse Repetition Rate	0 to 5 KHz
Bandwidth (IF)	200 MHz
Antenna Beamwidth - Transmit	8 degrees
Antenna Beamwidth - Receive	12 degrees
Detector	Square Law
Signal-to-Noise	18 dB or greater
Prime Power	1200 watts
Size-Receiver	19-inch rack 4 ft high
Size Transmitter	19-inch rack 4 ft high
Weight per Rack Unit	300 lbs.

A wide IF bandwidth (200 MHz) was deemed desirable in order to obtain clear pictures of the expected fast rise times. Bandwidths wider than 200 MHz would have made the system much more complex and expensive.

The antenna beamwidths were selected so that the system remained pulse limited at the operating altitudes and yet provided sufficient gain.

The detector operated as a square law device and permitted convenient calibration between power and voltage.

Signal-to-noise was kept high in order to see the effect of ocean parameters on the pulses independently of the thermal noise.

The prime power, size and weight for all the necessary equipment were not critical parameters.

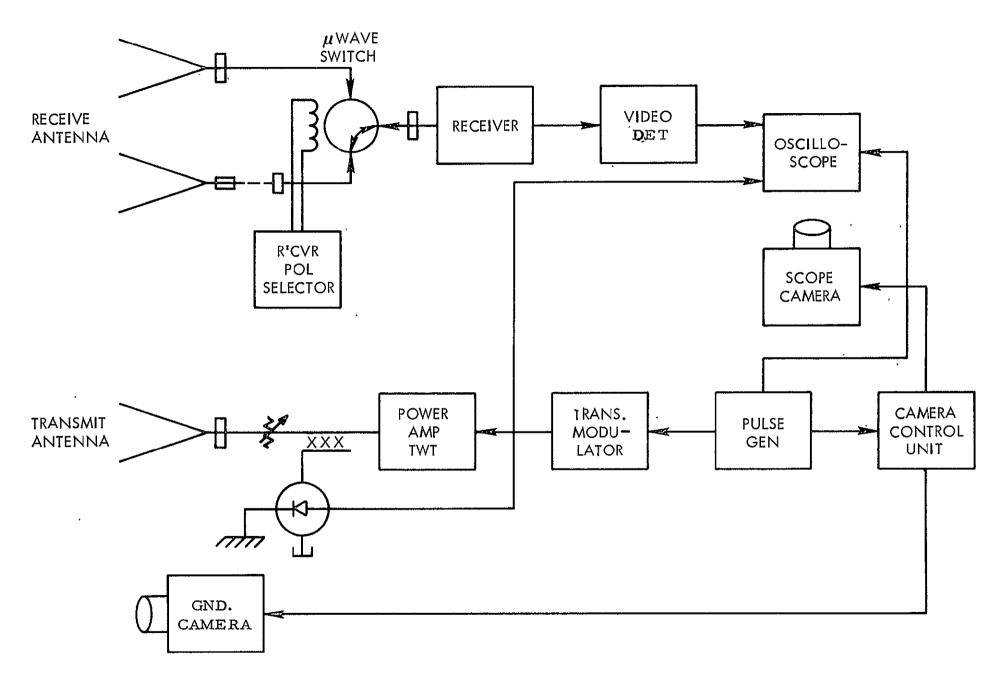
2.2 Radar System Components

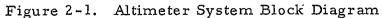
The equipment (see Figure 2-1, 2-2) can be broken down into three functional and physical subsystems. They are the transmitter, receiver, and antenna. The transmitter and receiver subsystems consist of rack-mounted units of general purpose equipments with a minimum of in-house designed and fabricated units.

The antenna assembly (Figure 2-3) consists of two receiving standard gain horns cross polarized with respect to each other and fed by a waveguide switch selecting either receiving horn. A standard gain transmitting horn completes the antenna assembly. The E-plane vector of the transmitting horn is perpendicular to the line of flight.

2.3 Transmitter

The type of transmitter selected for this application is a low level local oscillator with a TWT amplifier after the pulse modulation (see Figure 2-4). This is preferred over the magnetron type because it permits wide





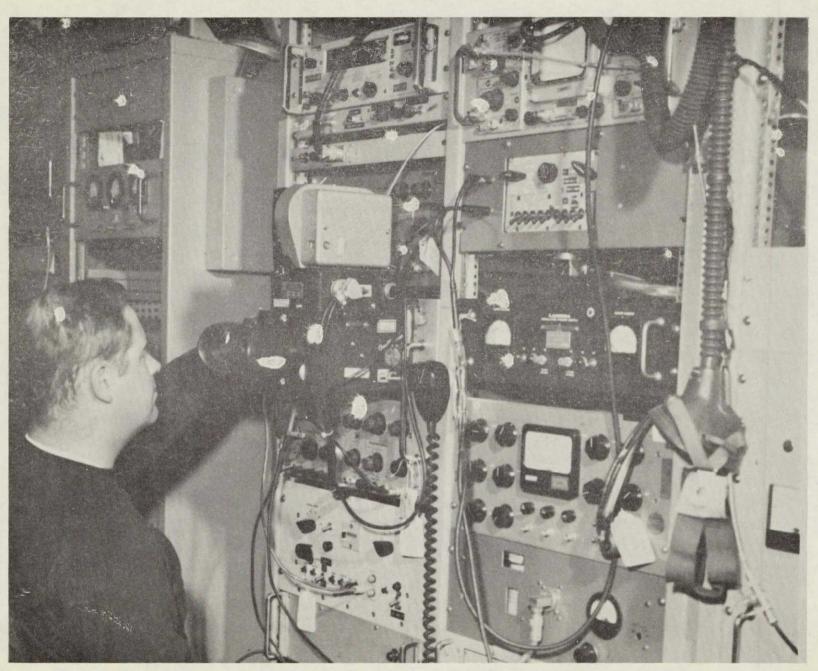
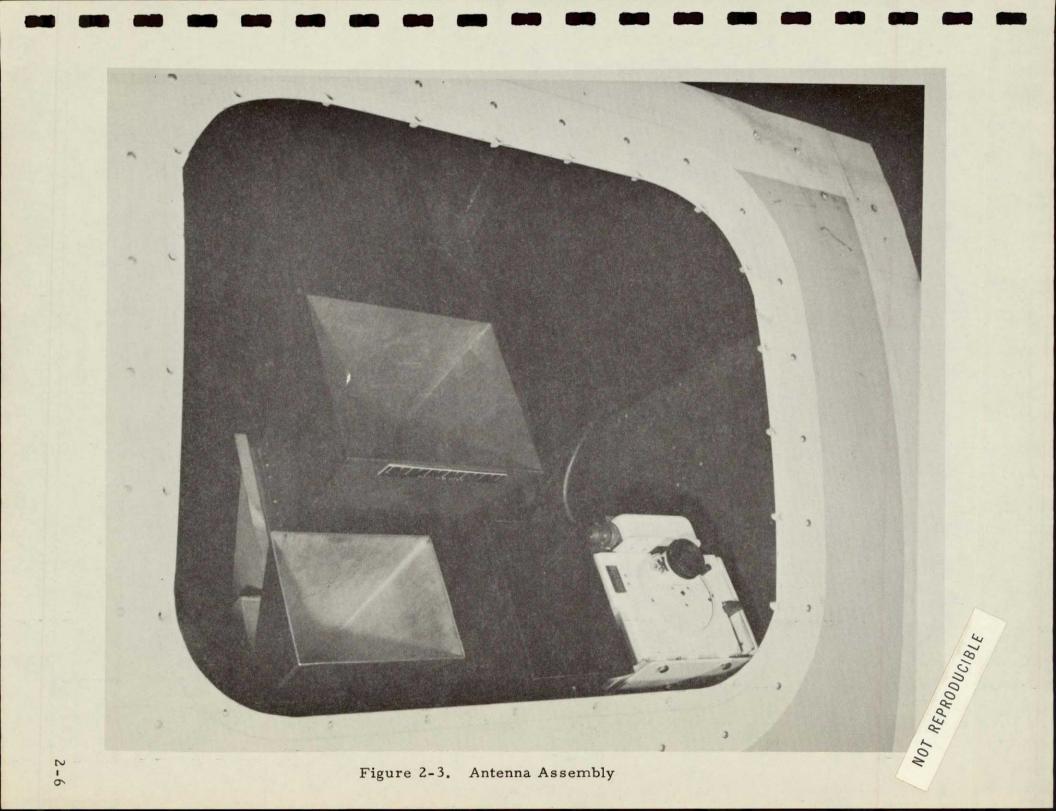


Figure 2-2. Aircraft Installation



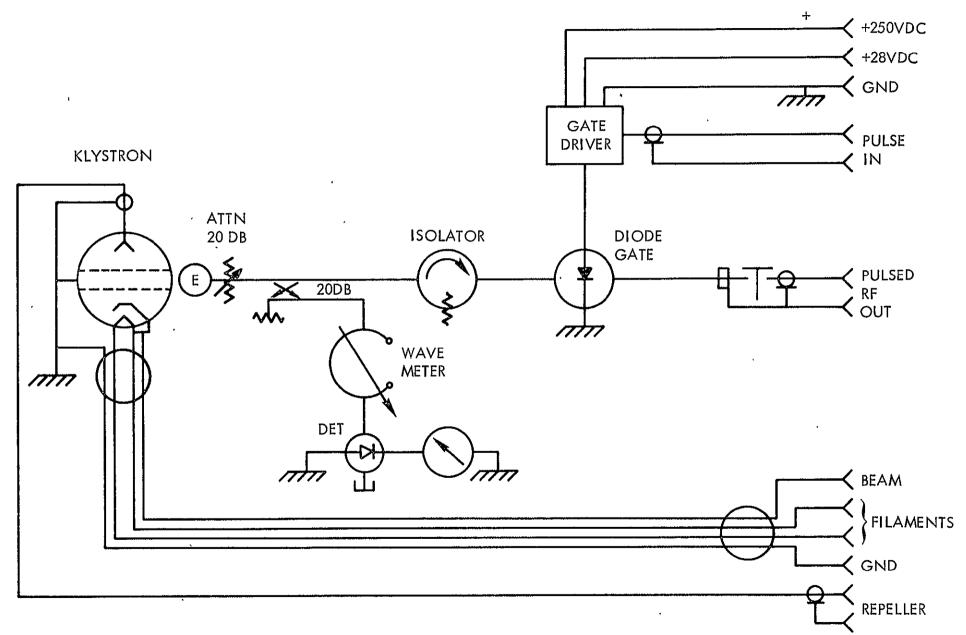


Figure 2-4. Transmitter Chassis RF Source and Modulator

bandwidth or fast rise time pulses. It also permits variable pulsewidths and pulse repetition rates to be used, thereby giving flexibility to the experiment.

The equipment shown in Figure 2-2 consists of various pieces of general purpose lab instruments such as the klystron power supply, pulse generator, TWT amplifier, and variable attenuator. The other units were designed and built by Raytheon. This approach of using as much off-the-shelf equipment was used in order to minimize the design effort and have equipment available on a short schedule. It also has proved to be the most economical approach and provides flexibility in parameter variations.

The local oscillator is a low level klystron (2k25 or equivalent) which is readily powered with standard laboratory voltage power supplies. The same power supply is also used for the receiver local oscillator. The klystron is a very stable oscillator which also can be mechanically adjusted over the entire X-band.

The requirement for fast rise times (5 nsec) and narrow pulses (20 nsec) necessitates the use of a varactor switch which in turn requires an avalanche transistor switch driver. These are shown in Figure 2-5. The-rise time is controlled by the switching speed of the avalanche transistor and the varactor diode. These have been tested and shown to produce better than 5 nsec rise times . The pulsewidth is controlled by the length of the delay line used in the circuit of Figure 2-5. The delay lines are various lengths of coaxial cables (1.5 nsec delay/ft).

The switch driver is triggered by a standard pulse generator such as those manufactured by Hewlett Packard or Data Pulse. This will permit selection of pulse repetition rates up to 5 KHz and as low as one pulse (by manual trigger). The pulse generator is also used to provide the synch signals for the oscilloscope and to provide the triggers for the camera controls

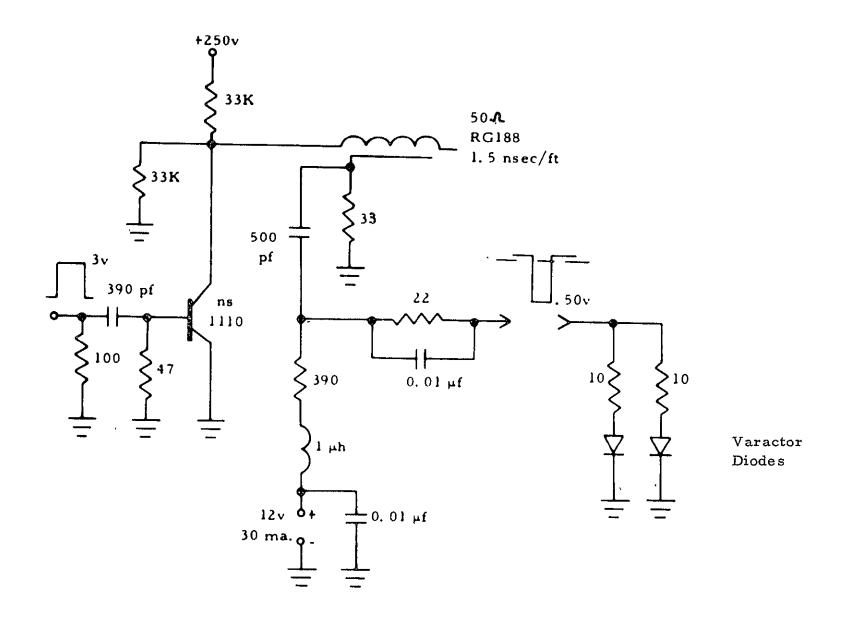


Figure 2-5. Switch Driver

The pulses are amplified in a TWT amplifier which has the necessary bandwidth to preserve the pulse shape. The amplifier can provide a minimum of 10 w peak CW power.

A variable attenuator (0 to 30 dB) on the output of the transmitter permits the use of the system at low altitudes without imposing a requirement for large dynamic range on the receiver.

2.4 Antenna and Microwave Assembly

The transmitted and received signals are fed to the antennas through waveguide runs in the aircraft. Waveguide is required in order to keep the losses to a minimum.

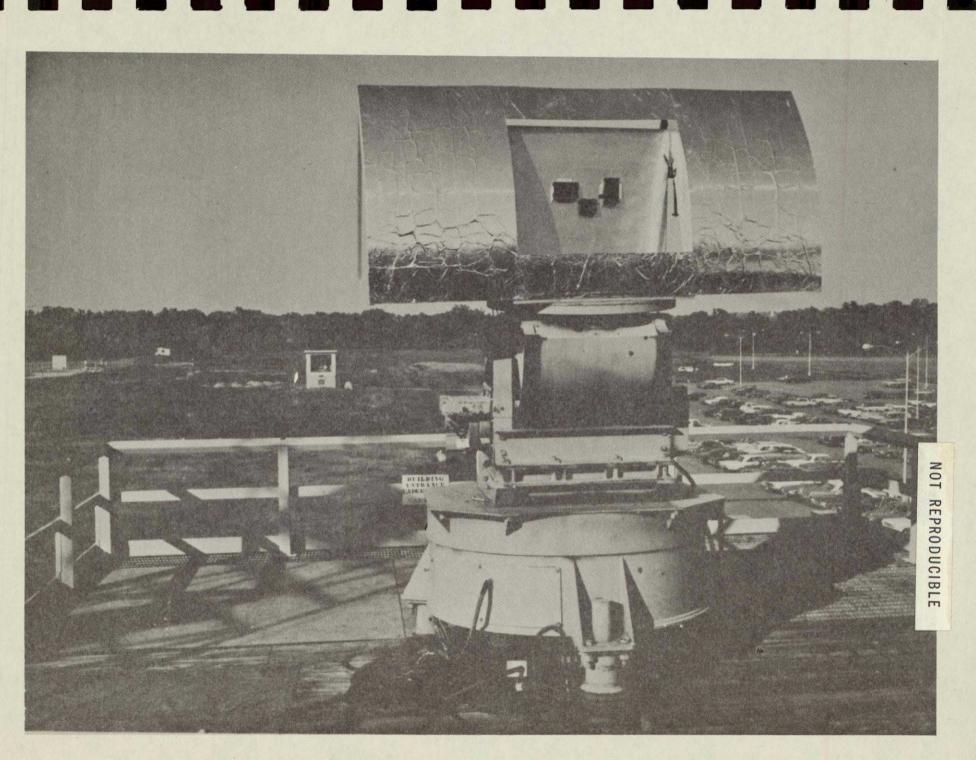
A mechanical antenna switch connects either of two receiving antennas to the receiver. The two receiving antennas are cross polarized with respect to each other permitting measurements of the direct and cross polarized return energy during flights. The receiving antennas are standard gain horns of 22 dB gain with a 12 degree nominal beamwidth. They have low sidelobe levels (less than 20 dB). Switching between antennas is remotely controlled from the operator's console.

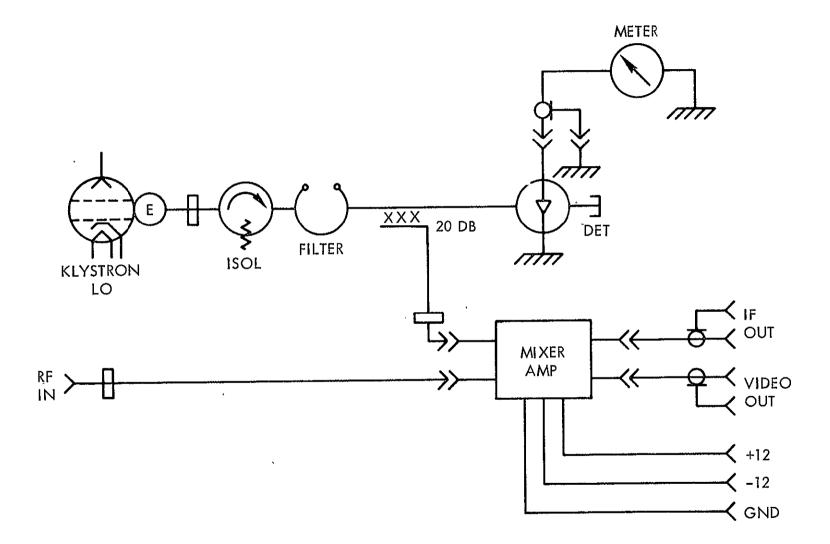
The transmitting antenna has an 8 degree nominal beamwidth. It is mechanically boresighted to the same axis as the receiving antennas. The H-plane of the transmitting antenna is parallel to the line of flight.

The isolation between the transmitting and receiving antennas is required to be in excess of 60 dB in order to avoid transmitter leakage. Tests were run on the antenna prior to aircraft installation (see Figure 2-6) with a simulation of the aircraft skin area in order to assure proper alignment, isolation, and beam characteristics.

2.5 Receiver

The receiver used in this experiment (see Figure 2-7) is a fixed gain superheterodyne type. The RF (9.00 GHz) received by the receiving antenna





is converted to an intermediate frequency of about 120 MHz in a crystal mixer with no RF preselection. The local oscillator signal needed to perform this mixing action is obtained from a low power klystron oscillator (Varian VA-203B/6975). Both this local oscillator klystron and the klystron used to produce the transmitted signal are powered from the same power supply.

The intermediate signal produced by the mixer is amplified in a wide band IF amplifier (see Figure 2-8).

The IF amplifier provides sufficient gain to produce an output noise signal after video detection of approximately 10 mV. This means that with a noise figure of 10 dB and a video rectification efficiency of 50 percent, the rms noise signal from the IF amplifier will be 20 mV (IF noise power of 8 μ W).

The gain (RF input power to IF output power) needed to produce this size signal is therefore

n 7

$$A = \frac{N_{\rm IF}}{KTBF} = 10^6 \tag{2-1}$$

 $Gain A in dB = 60 dB, \qquad (2-2)$

These gains are necessary in order to produce useful signal levels at the input to the oscilloscope to be used for recording the signals returned from the sea surface. With a S/N of 20 dB, the voltages at the scope input will be 100 mV and with 20 mV/cm deflection, produce 5 cm of deflection on the scope face. The IF amplifier has a useful dynamic range of greater than 40 dB. The unit requires power supplies of \pm 12 volts dc. Both the IF and a video output are available on this unit so that other kinds of detectors could be used if needed (square law, coherent, etc.). The physical size of this mixer IF amplifier is shown in Figure 2-8.

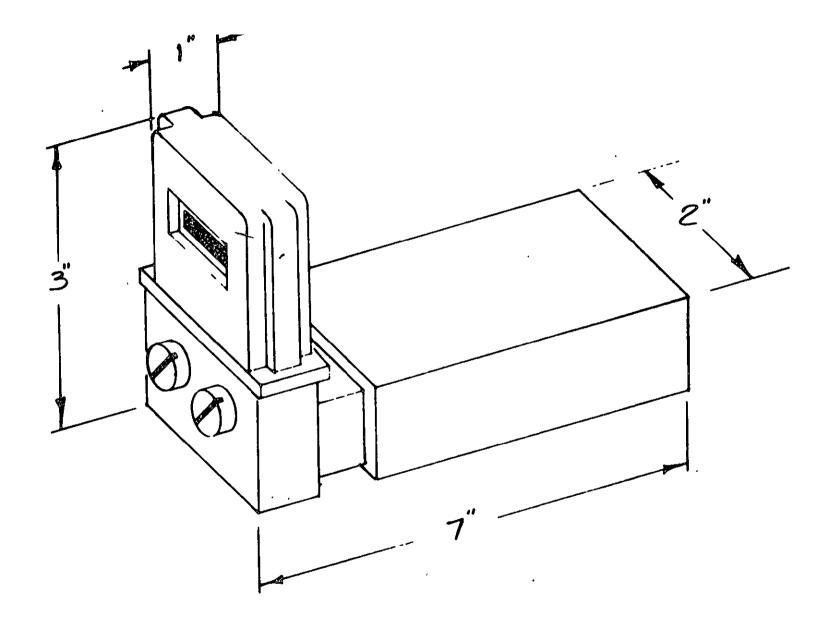


Figure 2-8. Mixer IF Amplifier

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A wide-band oscilloscope (Tektronix model 585) is used to indicate the return from the sea. This unit has a frequency response sufficiently wide to obtain pulse rise times of 3 to 4 nsec. A Beattie Coleman camera was utilized to obtain photographic records of the resulting waveforms. Special films (Kodak 2485) were used to permit recording single pulse returns as well as multiple returns.

2.6 Ground Support Equipment

The purpose of the Ground Support Equipment (GSE) (see Figure 2-9) is to permit field maintenance, calibration, and sparing of the radar system. The sparing is accomplished by providing units in the GSE which are identical to the onboard equipment. The receiver and transmitter units in the GSE have already been described in the previous sections.

For purposes of maintenance, a power meter, a VSWR meter, and a Polaroid camera have been included as part of the GSE.

Preflight calibration of the onboard equipment is accomplished by disconnecting the aircraft antennas and attaching the GSE at the coax terminations.

A special purpose for which the GSE was used was that of runway calibration checks. The equipment was used as a transponder by attaching receiving and transmitting antennas.

The equipment is conveniently packaged in a mobile rack unit (see Figure 2-10) for use and for transporting.

2.7 Component Specifications

Specifications for transmitter and receiver are shown in Tables 2-2 and 2-3.

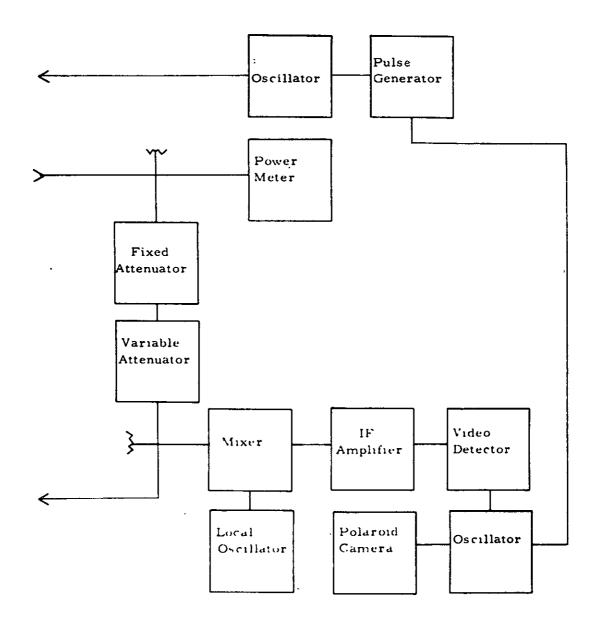


Figure 2-9. Ground Support Equipment Block Diagram

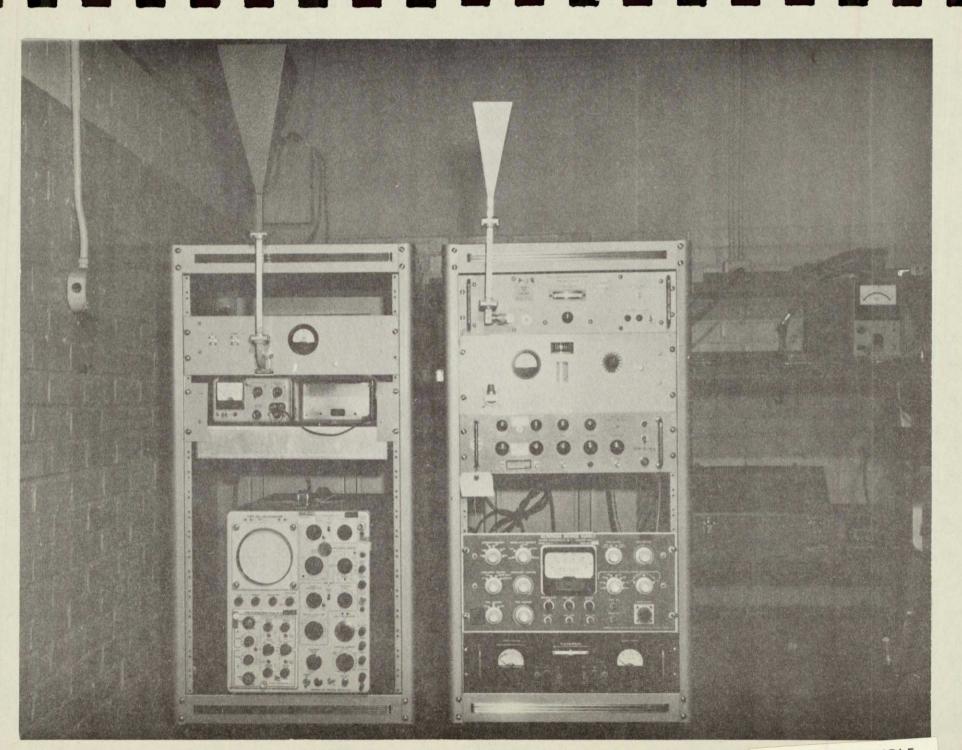


Figure 2-10. Ground Support Equipment In Mobile Rack

Table 2-2. Transmitter Specification

Transmitter LO:

	Low power klystron oscillator	
	Power	20 mW
	Tunable frequency	8.5 to 9.6 GHz
	Output connections -	UG39/U
	Convection cooled.	
Diode	e Switch:	
	Bandwidth	8.5 to 9.6 GHz
	Connections	Waveguide - UG39/U
	Switching Time	5 nanosec
	Incident power	50 mW cw
	Max I Loss	1.0 dB
	Isolation	> 25 dB
TWT	Amplifier:	
	Gain	\geq 30 dB
	Bandwidth	8.5 to 9.6 GHz
	NF .	30 dB
	Max power out at gain of 30 dB ≥ 10 w	vatts
	Integral Power Supplies rack mounted	1.

Table 2-3. Receiver Specification

Mixer IF Amplifier:

RF input	9.0 GHz
RF input conn.	. Waveguide (UG39/U flange)
IF frequency	120 MHz
Bandwidth	200 MHz
Noise Figure	~10 dB
IF output	$Z_0 = 50 \text{ ohm}$
RF to IF gain	~56 to 60 dB
Video Output Required	
video det. efficiency $\geq 50\%$	
video bandwidth	$\sim 100 \text{ MHz}$
	into reasonable resistive load 50 ohm →l kohm
l dB IF compression pt	0 dBm

Oscilloscope Requirement:

- Delayed sweep greater than 5 µsec delay time delay jitter < 0.5 nanoseconds
- 2. Rise time < 5 nanoseconds
- 3. Vertical sensitivity adjust. min. of 10 mV/cm
- 4. Sweep speeds up to 5 nanoseconds/cm.

Camera (Oscilloscope):

- 1. Solenoid activated shutter
- 2. f/16 lens or better, shutter speed 1/50
- 3. Capable of using at least 100 ft of 35 mm film
- 4. Data storage on film
- 5. Simple to load.

2.8 Output Data

The outputs of the system are pulses photographed from the face of an oscilloscope. A single pulse display or an integrated pulse display can be provided and photographed. The transmitted and received pulses can be both displayed on an expanded time scale and photographed.

The oscilloscope photographs also contain a counter reading and clock which aid in the data reduction.

2.9 Ground Camera

Photographs of the ocean were taken at the same time that radar pictures were taken via the oscilloscope. These photos permitted a check on the sea conditions and more importantly helped to explain any anomalies in the data, such as returns from ships and clouds.

The ground camera (Flight Research Model IV) is a 35 mm roll-film camera. The camera shutter is controlled by the circuits that control the oscilloscope camera at the operator's console. Data synchronization is obtained through use of a counter and clock which are photographed on the film.

2.10 Ocean Wave Measurements

The main requirement of auxiliary data was to obtain some quantitative measure of the ocean characteristics to be compared with the radar data. Ocean wave heights, directions, and wavelengths were the quantities of interest.

Wind direction and wind speed indicators were furnished by the NASA ship stationed in the test areas. Experienced personnel aboard the ship also provided some "eyeball" estimates of wave height and period. Photographic techniques were used to provide an optical Fourier transform of the photographed ocean and thereby provide the directional energy spectra of the ocean. This technique was developed by D. Stilwell of NRL and is referred in this report as the "Stilwell" or "Ocean Spectra" process. A side looking camera (see Figure 1-4 and 1-5) provided high resolution photographs for use in this technique. The camera uses nine inch film of low graininess. It is mounted to look out the side of the aircraft at an angle of approximately 45 degrees from the vertical. Photographs were taken while climbing to the operating altitude and at the end of the run when descending. Sets of photographs were taken at angles of 0, 90, 180, and 270 degrees with respect to sea direction.

2.11 Aircraft Data

Roll and pitch data was continuously recorded on a strip chart-recorder. Aircraft altitude, cabin temperature, outside temperature and weather were monitored and recorded by the operators.

SECTION 3. FLIGHT OPERATIONS

3.1 Source of Data

The data collected on these flights came from many sources. This section lists the sources and the data supplied by each.

3.1.1 Raytheon

- A) Radar Data
 - 1. Transmitted power
 - 2. Antenna beamwidth, gain, and polarization
 - 3. Transmitted frequency
 - 4. Pulse width
 - 5. System losses
 - 6. Number of pulses per frame
- B) Oscilloscope Data
 - 1. Oscilloscope settings

3.1.2 NASA Aircraft Data

- 1. A/C Altitude
- 2. A/C Heading
- 3. A/C Speed
- 4. A/C Location

3.1.3 Strip Chart Data

- 1. A/C Roll Angle
- 2. A/C Pitch Angle
- 3. Oscilloscope Camera Synchronization
- 4. Time of Day

3.1.4 NASA Range Recoverer Ship

2

- A) Òcean Truth Data
 - 1. Wave direction
 - 2. Wave height
 - 3. Wave period
 - 4. Wind velocity (speed and direction)
 - 5. Air and Sea temperature
 - 6. Air Pressure

3.1.5 Oscilloscope Film

- 1. Received power
- 2. Pulse shape
- 3.1.6 Ocean Film (Flight Research Camera)
 - 1. Ocean photograph for each oscilloscope photograph
- 3.1.7 Dr. Stilwell Ocean Specta Film (K-17 Camera)
 - 1. Ocean spectra data
- 3.1.8 ONR Laser Profilometer
 - 1. Ocean spectra data

3.2 Summary of Flights

The value of the flights is determined primarily from the availability of useful data. Table 3-1 is a summary of the radar and environmental parameters that were recorded for each flight. In the following paragraphs each flight is briefly summarized. Included also are various observations that were made during the flights.

3.2.1 Flight 1 - Nov-24-1969

This flight, the first of three shakedown flights, was flown over coastal waters near Wallops. From a height of 6000 feet, 8 Stilwell photographs were taken and 4 radar runs were made using Flight Pattern 3, (Figure 3-3) the rectangular pattern. However, it was observed that sea direction is difficult to obtain accurately at this altitude, and that morevoer any estimate is likely to be off by 180° . The strip-chart was not recording for the entire flight and the ground camera worked only for a short while. Also, according to the NASA FPS-16 radar, the C-54 altimeter (SCR-718) could be off by 400-600 feet at 6000 ft. This flight lasted two hours.

RADAR PARAMETERS	FLIGHT 1 11/29/69	FLIGHT 2 12/11/69	FLIGHT 3 12/12/69
Pulse Width	.100 µs		. 100 μs
Polarization	cross		direct
Pulse/Frame	50		50
Frame Rate	1/sec		l/sec
Pulse Repetition Freq.	2500	¥	2500
Peak Power	12 watts	A	12 watts
Attenuation		<u>е</u>	16 dB
Sweep Speed		O	.1 µs/cm
Amplitude Set.			.01 v/cm
Time Delay			2.0 μs 41.5 μs
ENVIRONMENTAL PARAMETERS			
Sky Condition	Clear	Clear	Partly Cloudy
Cabin Temp.	75°F	75°F	75°F
Water Temp.			•
Wind Direction			
Wind Speed			
Sea Direction	146° or 326°	150° or 330°	
Altitude	6000 Ft.		1000 Ft 20,000 Ft
A/C Velocity			150 Knots 145
No. of Runs	4		2 6
Location	Off Shore	Off Shore	37°50' x 75° 20'
Air Surface Temp.			
Wave Heights			
Wave Period		_	
STILWELL PARAMETERS			
No. of Runs	4	8 4	8 4
Altitude	6000 Ft	1000 18,000	1000 80,000 200 @f16 200@f22
Camera Parameters		f11 f11	<u>z00</u> @f16 <u>z00</u> @f22

Table 3-1. Summary of the Radar and Environmental Parameters

•

RADAR PARAMETERS		IGHT 4 2/15/69		FLIGH 12/17,			FLIGH 12/18/				FLIGHT 7 1/6/70		/IGH /8/7			FLIGHT 1/9/70
Pulse Width	.100 μs	.100 µs	.020 µs	.020 µs —		.100 µs				-	.020 µs	.020µs			-	
Polarization	direct			direct —		cross	direct	cross	direct	direct	direct	direct				
Pulse/Frame	1	50	50	50		1	50	50	50	1	50,47 278, ⁴⁷ 500	1	2	50	278	ы ы
Frame Rate	NA ·	1/sec	1/sec	1/sec -		NA	1/sec	1/sec	l/sec	NA	NA	NA —				пп
P. R. F.	NA	2500	2500	2500		NA	2500	2500	2500	NA	VAR.	NA	NA	2500	1390	AI
Peak Power	12 watts -			12 watts -		12 watts _					12 watts	12 watts			-	A tri
Attenuation	10 dB —		+	0 dB —							¢dΒ,	0 dB -			-	ЧЧ
Sweep Speed	.050µs/cm			.05µs/cm-	•	.05µs/cm				, 500	.050µs/cm	.05µs/	cm -		>	0 M Z H
Amplitude Set.	.050 v/cm 1-4 .200 v/cm 21-25	.050 v/cm	.020 v/cm	.5 v/cm	.1v/cm	. 200 v/cm	. 100	.010	.0507	2.9 µ s	. 100 v/cm	v) cm	. 1	.05	.05	
Time Delay ENVIRONMENTAL	3.1 µs	10 µ.s	10 µ.s	2,8 µs	20 με	3.2 µs	36.0 µs	36.0µs	54.0 µs?			20 µs -				
ENVIRONMENTAL PARAMETERS																
Sky Condition	Partly Clou	.dy		Partly Clou	ed y	Partly Clou	dy				Cioudy	Cloudy				Cloudy
Cabin Temp,	75°F			75°F		75°F					75°F	70°F -				70°F
Water Temp.	NA			NA		NA					58°F	53°F -				61°F
Wind Direction	293•			320°		330°		-			310°	350° -				290°
Wind Speed	26 knots —			16 knots	.	8-16 knots	_				3 knots	19 knots			+	30 knots
Sea Direction	290° ——		+	320°	+	330 °					320*	340° -			-	290 *
Altitude	1500 ft	5000 ft	5000 ft	1500 ft	10,000 ft	1500 ft	15,000 1	t15,000 ft	20,000 ft	1500	15,000 ft	10,000 ft				
A/C Velocity	165		+	155	165	160	160	160	150	165	198	208 —			186	
No. of Runs	8	12	6	4	6	4	6	6	6	4	6	6	6	6	6	27.071.
Location	7°07' x33°3	8'		37°07'x73°	381	37°07'x73°	281				37°07'x73°	37°07'	x 73	3°28'		37*07' x 73*38'
Air Surface Temp.	46.4°F			4.5°C		6,2°C					9.6°C					-2.3°C
Wave Heights	8 ít —		•	4-6 ft	-	3-5 ft					3 ft	12 ft —				7 ft
Wave Period	8 sec			7 sec		NA					5 sec	8 sec -				NA
STILWELL PARAMETERS																
No. of Runs	8			8		8					NONE	4				4
Altitude	1500 1500				1500]. 8	1000				1000 (r f1		
Camera Parameters	$\frac{1}{200}$ @ f11 F	ocal Len	gth	$\frac{1}{200}$ at fll		1 @ fll Laser Data Available						$\frac{1}{200}$ « f16			1 and 200 11	

Table 3-1. Summary of the Radar and Environmental Parameters (Cont.)

RADAR PARAMETERS		FLIC 1/20		10		FLIGHT 11 1/21/70			LIG		2	
Pulse Width	.010 µs						.020 µs	Γ—	<u> </u>	<u> </u>	—	
Polarization	direct						direct					
Pulse/Frame	1	2.	10	50	148		1	2	10	50	148	278
Frame Rate	NA	NA	NA	1	1/2		NA	NA		1	1/2	1/2
PRF	NA	NA	500	2500	5400		NA		500	2500	5400	_
Peak Power	3 watts					R	3 watts					
Attenuation	20 dB					4 E	0 dB	-				
Sweep Speed	.100 µs/cm		.05			E COT	.050 µs/cm					+
Amplitude Set.	.010/ cm					UCE UCE	.05 v/cm	_		. 02		
Time Delay	10 µ s						21 _{LL} s					
ENVIRONMENTAL PARAMETERS												
Sky Condition	Cloudy			<u> </u>			Clear					
Cabin Temp.	70°F				>		70°F					
Water Temp.	32°F						NA			_		
Wind Direction	080°						330°					
Wind Speed	3 knots						15 knot					
Sea Direction	None						265°					
Altitude	5000 ft						10,000 ft					
A/C Velocity	160 knots						164 knots					
# of Runs	4	4	4	4	4		4	4	4	4	4	4
Location	Tangier a	Sound				Tangier	Long Islar	nd So	und		<u> </u>	<u> </u>
Air Surface Temp.	27°F						NA					
Wave Heights	Calm						2 ft					
Wave Period	Calm						NA					
STILWELL PARAMETERS				•							i	-
# of Runs	4			4			NA		NA		<u>ម</u>	
Altitude	1500 ft	5000	ft				NA	(NA		N	,
Camera Parameters	$\frac{1}{200}$ @ f8	1	@ f8				NA		NA		z-	

Table 3-1. Summary of the Radar and Environmental Parameters (Cont.)

RADAR PARAMETERS	FLIG		13 /7()			FLIGH		14 7/70				FLIGH 1/	T 1 28/					FLIGH 1/					
Pulse Width	.020µs	- 1		<u> </u>			.02µs	_				.01µs	.020µs					F	.020µs	_				-
Polarization	direct	-				cross	direct		i-30	rqs	sdir	dır.	direct					-	direct	-		-		 ,
Pulse/Frame	1	10	50	148	278	50	1	10	501	4850	50	50	1	10	50	148	278	50	1	10	50	148	50	148
Frame Rate	NA	N	1	1/2	1/2	1	NA	NA	1 1	/2]1	1	1	NA	NA			1/2			NA				1/2
PRF	NA	500	1.0	2	200	2500	NA	sao	5	6 10	5	2500	NA	500	3	SY4	300	5	NA	500	۲ <u>ر</u>	5×3	<u>ک</u>	5400
Peak Power	3 watts		1-				12 watts				1	-	12 watts	-		_			12 watts	_				
Attenuation	odB	-					odB				_		odB	-				-	odB	-				
Sweep Speed	.05µs/cr	'n -					.05µs/c	m -				.20	.05µs/cn	n –				-	.05µs/c	m -				
Amplitude Set	.02v/cm	—	1		-	.01v/cm	.05v/cm	.02	02 -	05-0	1 05	. 05	.10v/cm				. 05	. 05	.02v/cm	. —		+	. 05	. 05
Time Delay	21µs	-	-			-	· ·	02.	02.	05.0)1.0	5.05			\square				21.5µs	_				
Environmental Parametérs		,			.			Ro	l} .An	gle	'3°				<u> </u>			5°				7	ol	or Film
Sky Condition	Cloudy	i					Partly C	lou	ıdy –			Clear	Clear	-	-			-	Clear		_			
Cabin Temp	75°F	-	-	-		•	70°F			_		70° ·	75°F	-				-	75°F	-				-•
Water Temp	58°F	-		-		+	55°F	-		_			55°F					-	55°F			_		
Wind Direction	220°	-	-	_		+	360°			_		>	10°	_				-	210°					
Wind Speed	26 kts	-		-	_		12 kts	-		_			6 kts	-			_		22 kts					
Sea Direction	220°	-					350°						10°			_		-	210°					<u> </u>
Altitude	10,000 fi	-	-				10, 000 f	t -	\vdash		+	2460 ft	10, 000 ft	-					10,000 f	t -			·	
A/C Velocity	159 kts	-	-	-	-		177 kts				+-+	300	185 kts	-				-	177 kts	_				
No. of Runs	4	4	4	4	4	4	4	4	4	4 4	4	Frames	4	4	4	4	4	4	4	4	4	4	4	4
Location	37°07' N	х 7	3°:	8'1	w		37°07N :	к 73	3°38'	w		Ice Land	37°07' N	х 7	3°3	81 1	v		37°07' N	х	73°	381	w	
Air Surface Temp.	55°F	- 1	+				43°F				_	-	51°F	-		_		+	60°F	_		_		
Wave Height	9 ft	- 1	-	F			5 ft	-			-		3 ft	-				-	7 ft	, <u> </u>				
Wave Period	8 sec	-	F	-			5 sec	-					4 sec	-				-	7 sec	I	_	_		
Stilwell Parameters								-																
No. of Runs	8		4				4		4			4	4	4			4		8					
Altitude	1500 ft		00				1500 ft		10,0	00 f	t I	500 ft	1500 ft	0, 0	100 f	<u>t</u> 1	500	ft	1500 ft				_	
Camera Parameters	1 @f11 200	$\frac{1}{20}$		@f	16		$\frac{1}{200}$ @ f	16	$\frac{1}{200}$	@f2	22	<u>1 @f22</u>	$\frac{1}{200}$ f 22	<u>1</u> 200		$\frac{2}{20}$		16	$\frac{1}{200}$ f 2	-				

Table 3-1. Summary of the Radar and Environmental Parameters (Cont.)

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3.2.2 Flight 2 - Dec-11-1969

This flight, the second shakedown flight, was flown over approximately the same area as the first flight. Upon arriving at the test area a Stilwell pattern was flown at 1000 feet without regard to sea direction. The C-54 then climbed to 18,000 feet for the radar runs. The climb took about 45 minutes, which was considerly shorter than had been predicted. Since the C-54 was above 10,000 feet, oxygen was required by the crew for the first time. The radar return signal was strong, but at approximately 17,000 feet the oscilloscope developed synchronization problems and a trace could not be obtained. All radar runs, therefore, had to be aborted. A Stilwell pattern was flow at 18,000 feet and then again at 1000 feet. The purpose of the second Stilwell pattern at 1000 feet was to observe what effect condensation on the lens had on lens resolution.

3.2.3 Flight 3 - Dec-13-1969

This was the last shakedown flight. Since there was no usable data from flight 2, a similar flight plan was used except that only the 100 nanosecond pulse width was attempted (It was extremely difficult to change pulse widths while using oxygen). The radome was removed for this and subsequent flights in order to improve the return signal level. Stilwell patterns were flown in the following order: 1000 ft., 20,000 ft., 1000 ft. Some radar data was taken at 1000 feet and a full Radar Pattern 2 was flown at 20,000 feet. It was difficult to see any return signal using cross polarization, so direct was used during the entire flight. The sea direction could not be determined, so that arbitiary headings were flown during the data runs.

3.2.4 Flight 4 - Dec-15-69

This was the first data flight. It was flown over the Atlantic Ocean about 120 miles east of Norfolk at 37° 07' N, 73° 38' W (hereafter known as GEOS test area) with ocean truth data being furnished for the first time by the NASA Range Recoverer ship. ONR personnel were to fly with us in their Cessna with the laser profilometer but they had to cancel due to aircraft problems. However, it had been decided previously to fly at a low altitude, 5000 feet, so as to make coordination between the two aircraft easier. A low cloud ceiling forced the cancellation of the 5000 foot Stilwell pattern. Two Stilwell patterns were flown at 1500 feet, one before the radar runs and the other after. At 5000 feet Radar Pattern 1 (Figure 3-1) (12 runs) and Pattern 2 (Figure 3-2) (6 runs) were flown. Some single pulse per frame data was taken during the Stilwell patterns. The results confirmed that individual pulses are visible on the film. 10 dB of attenuation was deliberately put in the receiver so that the return signal would not be saturated. The roll and pitch gyros were operating and the strip-chart was calibrated and operating. The counter of the ground (Flight Research Camera) camera jammed although the camera itself operated.

3.2.5 Flight 5 - Dec-17-1970

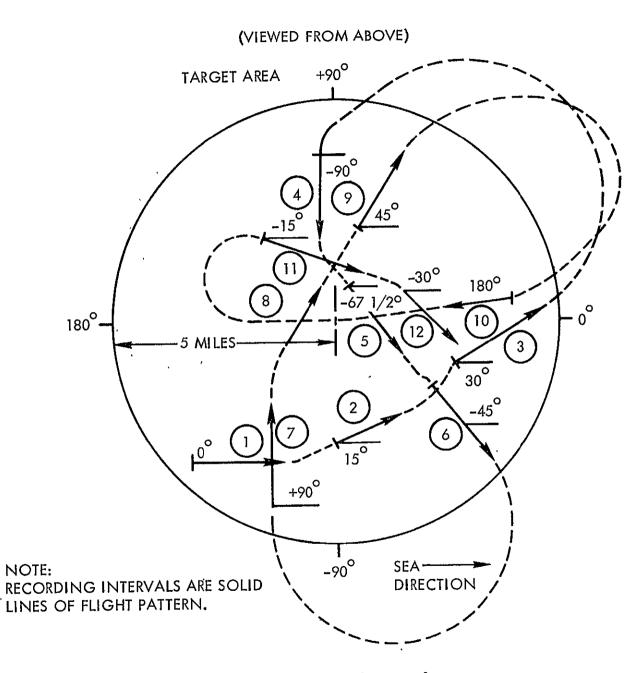
This flight was flown at 10,000 feet in the GEOS test area. Due to low cloud cover Stilwell Patterns were only flown at 1500 feet. ONR personnel flew their Cessna and took laser profilometer data. The Range Recoverer was on station and relayed ocean truth data to the C-54. An attempt was made to change the pulse width but during the change a connector pin was bent, making further data runs impossible. Therefore, only one Radar Flight Pattern 2 (Figure 3-2) was flown at 10,000 feet.

3.2.6 Flight 6 - Dec-18-1970

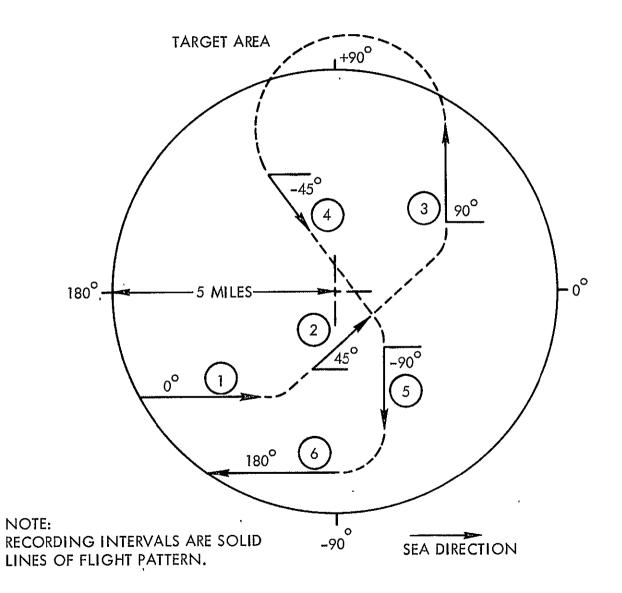
ONR personnel accompanied the C-54 again with their laser profilometer. The low cloud cover over the GEOS test area again forced cancellation of the high altitude Stilwell pattern. Radar Flight Pattern 2 was flown twice at 15,000 feet and once at 20,000 feet. There did not seem to be any noticeable return

2

3-9



(VIEWED FROM ABOVE)



during any of the cross polarization runs, but there was a strong return signal when direct polarization was used. The transmitted frequency was measured to be 9.00 GHz.

3.2.7 Flight 7 - Jan-6-1970

The Range Recoverer was on station in the GEOS test area, providing the only source of ocean truth data for this flight. There was a Navy block to all aircraft in the area from 0 to 5000 feet with a cloud cover somewhat below 5000 feet. All Stilwell patterns were therefore cancelled. Also, because of the cloud condition, the ground camera was not used. Pattern 2 was flown once at 15,000 feet with the pulses per frame varied during each run. Although usable data was obtained, the procedure of varying pulses per frame during each run was time consuming causing each run to cover a large area of ocean. Therefore, on following flights pulses per frame were kept constant during each run and only changed between runs.

Upon returning to Wallops a system calibration check was attempted by flying over the GSE on the runway. The GSE picked up the aircraft signal for a very short time while the GSE signal was not received in the aircraft.

3.2.8 Flight 8 - Jan-8-1970

Before flying to the test area, another attempt was made at a system calibration check using the GSE. Four passes over the runway at 5000 feet gave very marginal returns but did permit a verification of the system calibration. Because of the low ceiling and the trouble receiving the signal from the GSE, the 10,000 foot passes were cancelled. The calibration runs scheduled upon return from the test area were cancelled due to stormy weather. After arriving at the GEOS test area $(37^{\circ} 07' \text{ N}, 73^{\circ} 38'\text{W})$, it was learned that the Range Recoverer went in toward the shore during the night because of stormy seas. The ship was at that time 80 miles west of the test area, at 37°N , 75°W . Since the ship was in coastal waters, it was decided to make the radar runs at the test area rather than over the ship.

The ship's ocean truth and weather reports were used as estimates of the conditions in the test area. Because of the very low overcast and surface fog, only one Stilwell pattern was flown at 1000 feet. Flight Pattern 2 was flown 4 times at 10,000 feet with the pulses per frame varied with each pattern.

3.2.9 Flight 9 - Jan-9-1970

Two Stilwell patterns were flown at 1000 ft upon arriving at the test area. The C-54 then climbed to 10,000 feet for the radar runs where it was discovered that the TWT had failed. The transmitted and received signals were lost, and thus the radar runs were cancelled and the C-54 returned to Wallops.

3.2.10 Flight 10 - Jan 10-1970

The 12 watt TWT that failed was replaced with a 3 watt TWT. In order to get calm water conditions, this flight was flown over Tangier Sound in Chesapeake Bay. The Range Recoverer was in the sound and reported a calm surface although the surface appeared from the aircraft to have a small wave pattern. There was a considerable amount of ice along the shore of the Sound, although the center of sound was ice free except for a few small patches. Two Stilwell patterns were flown, one at 1500 feet and one at 5000 feet. Radar Pattern 3 (Figure 3-3) was flown 5 times at 5000 feet.

3.2.11 Flight 11 - Jan-21-1970

This flight was scheduled over Tangier Sound, but during the previous night the Sound became completely frozen over. The Range Recoverer, still in the Sound, was unable to get to any other possible test areas that day. Therefore, the flight was cancelled and the C-54 returned to Wallops.

STILWELL PATTERN AND RADAR PATTERN 3

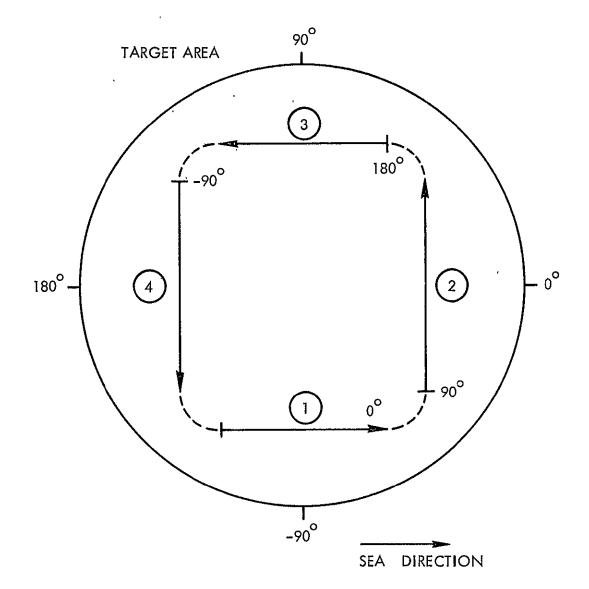


Figure 3-3. Ocean Spectra Flight Pattern

3.2.12 Flight 12 - Jan-22-1970

This flight was scheduled over Long Island Sound in an attempt to get calm water conditions. Sea direction, wave heights, and wind velocity estimates were based on observations from the aircraft and on radio conversations with the Bridgeport, Conn. Air Control Area. There were no Stilwell photos taken on this flight and all the ground film was later accidently doubleexposed during flight 13. Radar Pattern 3 was flown six times with a different number of pulses per frame for each pattern. The 3 watt TWT was again used.

3.2.13 Flight 13 - Jan-27-1970

With the Range Recover again on station, the test flights resumed in the GEOS test area, 37[°] 07" N, 73[°] 38'W. Three Stilwell Patterns were flown at 1500 feet, and low cloud cover forced the cancellation of the 10,000 foot Stilwell Pattern. As mentioned above, the ground film was accidently double-exposed on the film of flight 12. Radar Pattern 3 was flow six times, five times with direct polarization and once with cross polarization. There was no signal return when the horns were cross polarized.

3.2.14 Flight 14 - Jan-27-1970

The 12 watt TWT was repaired and reinstalled for this and the remainder of the flights. This flight was over the GEOS test area with the Range Recoverer supplying ocean truth data. Three Stilwell Patterns were flown six times each. For one pattern the aircraft was kept at a constant 3[°] roll angle which caused a slightly reduced return signal. The cross polarized mode was tried again with no success. Before returning to Wallops, the C-54 flew over Tangier Sound and found it to be ice-bound, which precluded any further testing in that area. The ground camera was jammed for the entire flight.



3-15

3.2.15 Flight 15 - Jan-28-1970

Radar Pattern 3 was flown six times on this flight over the GEOS test area. One pattern was flown with a constant 5° roll angle, which again caused a slightly reduced return signal. Three Stilwell patterns were flown, two at 1500 feet and one at 10,000 feet.

3.2.16 Flight 16 - Jan-29-1970

This last test flight was flown over the GEOS test area. Three Stilwell patterns were flown, two at 1500 feet, and one at 10,000 feet. Radar Pattern 3 was flown six times. On the last two patterns extended range color film (E.G.G. Type XR), rather than black and white film, was used.

3.3 Typical Data Sheets

The data sheets presented in this section are the actual data sheets for flight 14. The original data sheets for the other flights are similar to the ones presented here. The data was recorded during the flight by the Raytheon controller. He received this data from the Raytheon radar operator, the aircraft pilot and/or co-pilot, the NASA Range Recoverer, and the ocean spectra (K-17) camera operator.

3.3.1 Flight Data Sheet

3.3.1 Flight Data Sh		A SHEET (1) of (1)	.)	<u>.,</u>
FLIGHT # 14	· u = u =	DATE 1/2 Take-off Land 1:30	9:45 A.M.	
LOCATION		NAME OF RE	CORDER	
Wallops 9-D		J. Bartle	ett	
STATUS OF OTHER ELECTRON	IC EQUIPMENT			
EQUIPMENT STATUS:		······································		·····
PULSE WIDTH:	(a) 20		• • •	anosecs)
POLARIZATION:	(a) direct		(see below)	
PULSES/FRAME:	(see below)			,
FRAME RATE:	(a) 1/2.	(b) 1	(c) 2 (p	er sec) varied
BEAM WIDTH:	(a) 8 ⁰	(b) 16 ⁰		
PEAK POWER:	(a) 10	(ъ) 20	C.(12) ,	atts
FILM ROLL #:	(a) C	(Ъ) ВЖ		
ENVIRONMENT:				
SKY CONDITION:	(b) Cloudy (c) Partly (ly Overcast Cloudy 🗸 11 Clouds		
VISIBILITY RANGE:	8m			
HUMIDITY:				
CABIN TEMPERATURE:	70° F			
OUTSIDE AIR TEMPER	ATURE :			
WIND VELOCITY AND	DIRECTION FROM	A/C:		
	۸11			
THIS SHEET PERTAINS TO		<u> </u>		Roll
TOTAL NUMBER OF RUNS FO	R FLIGHT Run	$\frac{1}{2}$ <u>Pulse/Frame</u>	Polarizati	
	1, 2, 3, 4	1	dir	0°
24	5, 6, 7, 8	10	dir	0°
	9, 10, 11, 12	. 50	dir	0 °
	13, 14, 15, 16		dir	0°
	17, 18, 19, 20		cross	<u>0°</u>
	21, 22, 23, 24	50	dir	3°

3.3	\$.	2	Run	Data	Sheet

3900-3906	- Transmitted Pulse

<u> </u>	<u>900-39</u>		<u> </u>	nsmitted Puls	<u> </u>	1	······				7
	PLIGH			DATE		NAME		Sheet]	L		
	14	4		1/27/70			J. Bartlett				
	FRAI	ME #	AIRCRAFT				SEA	LOCATION			Amp
				TAS			DIRECTION			TIME	Set
RUN	START	END	HEADING	VELOCITY	ALTIT	UDE	HEADING	LATITUDE	LONGITUDE	DELAY	v/cm
1	3919	3948	350°	l77 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		. 050
2	3951	3980	260°	177 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		.050
3	3983	4012	170°	177 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		. 050
4	4016	4045	080°	177 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		.050
5	4048	4077	350°	177 kts	10,00	0 ft	350°	37° 07 ' N	73° 38'W		. 020
6	4080	4109	260°	177 kts	10,00	0 f t	350°	37° 07'N	73° 38'W		. 020
7	4112	4141	170°	177 kts	10,00	0 ft	350°	37° 07''N	73° 38'W		. 020
8	4144	4173	080°	177 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		.020
9	4176	4215	350°	177 kts	10,00	0ft	350°	37° 07'N	73° 38'W		.020
10	4218	4257	260°	177 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		. 020
11	4260	4299	170°	177 kts	10,00	D ft	350°	37° 07 ¹ N	73°'38'W		.020
	4302	4341	080°	177 kts	10,00	0 ft	350°	37° 07'N	73° 38'W		.020
13	4344	4383	350°	177 kts	10,000	0ft	350°	37° 07'N	73° 38'W		. 050

,

3. 3. 2 Run Data Sheet (Continued)

3900-3906 Transmitted Pulse

	FLIGHT 14	t #		date 1/27/70		NAME	J. Bartl	Sheet ett	,		
FRAME #		AIRCRAFT				SEA DIRECTION	I	TIME	Amp		
RUN	START	END	HEADING	VELOCITY	ALTIT	UDE	HEADING	LATITUDE LONGITUDE		DELAY	Set
14	4386	4425	260	177 kts	10,000	ft.	350 ⁰	37° 07'N	73 [°] 38'W		.050
15	4428	4467	1700	[1
16	4470	4509	080								
17	4512	4532	350								. 010
18	4535	4554	260								
19	4557	4576	170								
20	4579	4598	080								
21	4600	4640	350								. 050
22	4643	4683	'260								
23	4686	4725	170						•		
24	4728	4767	080								
	4773	4782		TRANSMITTEI	PULS	E					
		1									

•

3.3.3 Ocean Truth Data Sheet

.

<u>FLIGHT #</u> 14	<u>RUN(S) #(S)</u> All	DATE 1/2	7/70	LOCATION Wallops 9-D			
J. Bartlet	t Tim	ie: 10;	10 AM				
PARAMETER	VALUE	SOURCE					
SURFACE WIND	DIRECTION 360 ⁰						
SPEED	SPEED 12 kts						
WATER SURFACE TEMPERATURE							
AIR SURFACE TEMPERATURE	43 ⁰ F			- 11 .			
WAVE HEIGHTS AVERAGE	5 ft			11			
(DOMINANT) WAVE DIRECTION	350 [°]			TI			
AIR PRESSURE VISIBILITY WAVE PERIOD DEW POINT	1020.3 mb 8 miles 5 seconds 36 ⁰			11 11 11 11			

3.3.4 Ocean Spectra Data Sheet

FLIGHT 	FRAME- 	ALTITUDE	A/C <u>HEADING</u>	SEA <u>DIRECTION</u>	TIME	<u>COMMENTS</u>
14	1 + 2 3 + 4 5 + 6 7 + 8 9 + 10	1,500 Ft.	350 [°] 260 [°] 170 [°] 080 [°] 350 [°]	350 [°]	10:30 10:32 10:33 10:34 11:46	Before Climb f16 @ <u>1</u> 200 f22 @ <u>1</u>
	11 + 12 13 + 14 15 + 16		260 [°] 170 [°] 080 [°]		11:47 11:48 11:49	200 Broken Clouds
	17 + 18 19 + 20 21 + 22 23 + 24	1,500 Ft.	350 [°] 260 [°] 170 [°] 080 [°]		12:03 12:04	After Climb f22 @ <u>1</u> 200 Heavy Haze

OCEAN SPECTRA CAMERA (STILWELL)

TAS = 142 Kts TAS = True Air Speed

SECTION 4. DATA PROCESSING

4.1 Radar Analysis

The data from the flight tests in the form of scope film, ocean film (ground camera), ocean spectra film (K-17 camera), laser profilometer output, weather and ocean condition reports from the Range Recoverer, and stripchart recordings were gathered, correlated, and analyzed with the objective of finding the average σ° , (radar cross-section per unit area) for various ocean conditions. The σ° was calculated for each of the selected frames and average σ° 's were calculated for each flight.

4.1.1 Procedures

Approximately 600 frames from ten of the flights (flights 4, 5, 6, 7, 8, 10, 12, 14, 15, 16) were selected for processing. All the pertinent environmental and radar information was recorded onto cards for computer processing. Using a form of the radar equation, the radar cross section, σ° , was then calculated for each frame, for each flight and for a selected number of runs. The mean, the standard deviation, the frequency distribution, and the cumulative probability distribution of σ° were then calculated. The results are presented in Section 5 and Appendix A.

4.1.2 Analysis

The radar cross section, σ° , was calculated from the radar equation, using the relations derived below.

Derivation of Equations for σ°

The radar equation can be written in the form:

$$P_{R} = \frac{P_{T} G^{2} \lambda^{2} \sigma}{(4\pi)^{3} h^{4} L}$$
(4-1)

where

P _R =	received	power
------------------	----------	-------

 P_{τ} = transmitted power

G = peak antenna gain

 λ = transmitted wavelength

 σ = target cross section

h = altitude

L = combined system lossed

1. waveguide loss

- 2. attenuation (receiver calibration correction)
- 3. antenna pattern loss
- If the return is from an area such as terrain, then

$$\sigma = \sigma^{\circ} A \qquad (4-2)$$

where

 σ° = radar cross section per unit area

A = area of terrain illuminated

The area illuminated is calculated from the geometry of the radar system (see Figure 4-1).

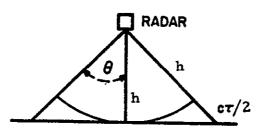


Figure 4-1. Geometry of the Radar System

The area, A, will depend on whether the radar system is pulse limited or beam limited.

From the geometry, if

$$\tau \geq \frac{h\theta^2}{c}$$

then the system is beam limited, and if

$$\tau < \frac{h\theta^2}{c}$$

then the system is pulse limited, where

τ·	= transmitted pulse width
h	= aircraft altitude
с Ө	<pre>= speed of light = incidence angle</pre>
Α.	Pulse Limited Case
The	area illuminated for a pulse limited system is:

 $A = \pi c \tau h$

The relationship of the range to altitude is,

 $r = h \sec P \sec R$

where

P = pitch angle of aircraft

R = roll angle of aircraft.

For these flights, the coll and pitch angles of the aircraft during the radar operation were four degrees or less, and it can be assumed that

sec P = sec
$$R \approx 1.0$$

therefore, σ° can be expressed as

$$\sigma^{\circ} = \frac{P_{R} (4\pi)^{3} h^{3} L}{P_{T} G^{2} \lambda^{2} \pi c \tau}$$
(4-3)

In this case, the geometry of the system leads to an illuminated area of

A =
$$\pi \theta^2 h^2$$
 (for small angle θ).

Now equation (4-1) can be expressed as

$$P_{R} = \frac{P_{T} G^{2} \lambda^{2} \pi \theta^{2} \sigma^{\circ}}{(4\pi)^{3} h^{2} L}$$

solving for σ° ,

$$\sigma^{\circ} = \frac{P_{R}(4\pi)^{3} h^{2} L}{P_{T} G^{2} \lambda^{2} \pi \theta^{2}}$$
(4-4)

Estimation of Average σ°

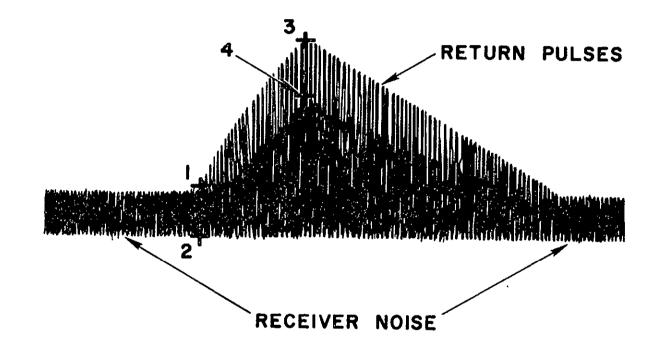
The value of the received power, P_R , as expressed in equations (4-3) and (4-4) is an average of the peak power return. For these test flights, where the majority of the oscilloscope frames recorded at least 50 return pulses, the value of P_R desired for each frame is the average of the power of the pulse peaks recorded. Since a procedure of calculating the return power for each pulse and then averaging these values was not feasible, an estimate of the average peak power was made for each frame. This was possible since each frame represented integration of 50 or more pulses. Figure 4-2, the oscilloscope presentation, illustrates the maximum and average pulse peaks. Point 4 is the average pulse peak and point 3 is the maximum return pulse peak. As can be seen by this figure, point $3_1'$ can be measured rather easily, while point 4 can only be estimated.

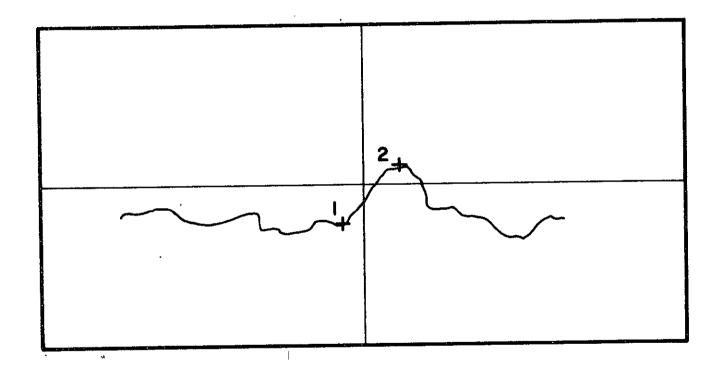
Figure 4-3 shows a single pulse representation. Point 2 is the peak power return. The value of P_R derived from point 2 is equivalent to the P_R derived above using the average return power for multiple pulses.

Statistical Groupings of σ° Data

Average σ °'s were found in various groupings of σ °. This data is presented in Section 5. Standard statistical equations were used to find the mean and standard deviation of σ ° (as a ratio).

$$\overline{\sigma}^{\circ} = \frac{1}{n} \sum_{i=1}^{n} \sigma_{i}^{\circ}$$
; n = no. of frames





$$S_{\sigma^{\circ}} = \frac{\sum_{i=1}^{n} (\sigma_i^{\circ} - \overline{\sigma^{\circ}})^2}{n-1}$$

The mean and standard deviation of σ° were later converted to dB for presentation purposes.

The histograms of σ° are based on the mean and standard deviation with each bar of the histogram being one-half of a standard deviation wide. The number of σ° values were totaled in each of the ten ranges of the histogram for each grouping. The ten ranges are as follows: (let $S = S_{\sigma^{\circ}}$)

σ° i	•	<	ۍ ه		2.0	S	
σ°	-	2.	0S	4	σ° i	< ज ॰	- 1.55
ر ۰	-	1.	5S	≤	σ° i	< ज °	- 1.0S
σ°	-	1.	0 S	≤	σ° i	< ज •	- 0.5S
_ ፓ°	-	0.	5S	≤	σ° i	< ज °	
•	<	σ i	° <		+ 0	. 55 `	
_							
σ°	÷	0.	55	≤	σ° i	<.σ +	1.0S
					-	_	1.0S
<u></u> ۳°	ł	1.	05	≤	σ° i	< - +	

The cumulative probability distributions were found by integrating the frequency distributions, i.e., the histograms. If $f(\sigma^{\circ})$ is the frequency distribution of σ° , then the cumulative probability distribution is:

$$F(\sigma^{\circ}) = \sum_{x=-\infty}^{\sigma^{\circ}} f(x)$$

4.2 Selection of Flights and Frames

4.2.1 Flights Selection Criteria

Of the sixteen test flights, ten were selected for analysis. Those not selected included the three shakedown flights (flights 1, 2 and 3) which had very little ocean truth data, flights 9 and 11 which were aborted before any radar data was taken, and flight 13 which had poor multiple pulse oscilloscope film quality. Frames were selected from all of the other flights in order to get radar data for a variety of sea conditions.

4.2.2 Frame Selection Criteria

Approximately six hundred frames were selected for processing from the ten selected flights. From each flight, the frames were selected in such a manner that the effect on the return power of varying aircraft altitude, pulse width, number of pulses integrated, aircraft heading, antenna polarization, etc., could be studied. The frames that were eliminated from consideration fell into one of three categories:

- 1. if the return signals were saturated or were masked by the noise,
- 2. if the roll and pitch angles of the aircraft were excessive (greater than 5°) at the time of the recording of the return pulse, and
- 3. if there were any possibilities the film could be misinterpreted.

4.2.3 Point Measurement of the Scope Film

In order to calculate the radar backscatter per unit area, σ° , an accurate value of the return power, P_R , was needed. The return power was measured from the scope film using a point coordinate mensurator, a measuring instrument with a 24" x 24" viewing screen and a magnification capability of 20 X to 30 X. The procedure was to precisely locate each point of interest under the reference crosshair of the instrument, and automatically record the coordinates of the point on a punched card. The measured coordinate values are in microns.

Using Figure 4-2, the oscilloscope representation of multiple pulses as a reference, the following points were measured for each frame with multiple pulses.

Point 1 - The top of the noise level at the start of the return pulse.

Point 2 - The bottom of the noise level at the start of the return pulse.

Point 3 - The absolute return pulse peak.

Point 4 - The average return pulse peak.

A. Multiple Pulse Procedure

The value of the average return signal power, P_R , was obtained in the following manner. First, the y-coordinate of point 2 was subtracted from the y-coordinate of point 4. By knowing the amplitude setting of the oscilloscope, this value could easily be converted to volts. However, this represents both signal and noise returns and to obtain just the signal return, a minimum receiver noise level in volts had to be subtracted from the original result. This minimum noise level was found by subtracting the y-coordinate of point 2 from the y-coordinate of point 1 and then dividing this result by 2. The final value of P was then converted to dBm by means of a receiver calibration curve (see Figure 5-8).

B. Single Pulse Procedure

For those frames with only single pulses, the following two points were measured (see Figure 4-3):

Point 1 - The start of the return pulse

Point 2 - The peak of the return pulse

 P_r was found for single pulse by subtracting the y-coordinate of point 1 from the y-coordinate of point 2 and then converting this value to volts and finally to dBm by using the receiver calibration curve.

4.2.4 . Card Format

All the pertinent information concerning each frame has been stored on punched cards. There are three sets of cards. The first set, the flight cards, includes information that was constant throughtout each flight; the second set, the run cards, includes information that varied during the flight but was constant during each run; and the last set, the oscilloscope cards, includes the measured points from the oscilloscope film.

A. Flight Cards

The following information is included on each of the flight cards:

1. Flight number

2. Location code

- . 37° 07'N x 73° 38'W (120 miles east of Norfolk, Va.)
- . Tangier Sound (in Chesapeake Bay)
- Off shore near Wallops Island, Va.
- . Long Island Sound (Middle Ground)

3. Sea Direction (°)

4. Wave Height (ft)

- 5. Wave Period (sec)
- 6. Wind Speed (knots)

- 7. Wind Direction (°)
- 8. Water Temperature (°F)
- 9. Air Pressure at sea level (mb)
- 10. Peak Power Transmitted (watts)
- 11. Receiver Attenuation (dB)
- 12. Beamwidth (°)
- 13. Ocean Spectra Data Available (Stilwell)
 - . yes
 - . no
- 14. Laser Profilometer Data Available
 - . yes
 - . no
- 15. Sky Condition
 - . Clear
 - . Cloudy
 - . Partly Cloudy
- 16. Date of Flight
- B. Run Cards
- The run Data Cards included the following information:
- 1. Flight number
- 2. Run number
- 3. Aircraft Altitude (ft)
- 4. | Oscilloscope Sweep Speed (nsec/cm)
- 5. Oscilloscope Amplitude Setting (millivolts/cm)
- 6. Number of Pulses per Frame
- 7. Transmitted Pulse Width (nsec)
- 8. Antenna Polarization Code
 - . Direct
 - . Cross

9. Aircraft Heading (°)

C. 'Oscilloscope Cards

The Oscilloscope Data Cards have the following data.

- 1. Flight number
- 2. Run number
- 3. Frame number
- The x- and y-coordinates of the points of interest as described
 in Section 4.1. This is the output of the Point Coordinate
 Mensurator.

4.3 Computer Processing Program

A data processing program was developed which used the flight, run, and oscilloscope cards as input to calculate the radar cross section per unit area, σ° , and the return signal power, P_r , for each frame. It further calculated for each flight the average σ° and its standard deviation, a histogram of the individual σ° 's, and a cumulative probability distribution of σ° . This was done for the σ° based on the average peak return signal and for the σ° based on the absolute peak return signal (see Section 4.1). This program (Figure 4-4) was written in FORTRAN IV for use on a CDC 6600.

4.4 Results of Processing Program

All of the output from the processing of the flight test data is presented in Appendix A in computer printout form. Further analysis and groupings of this data are found in Section 5.

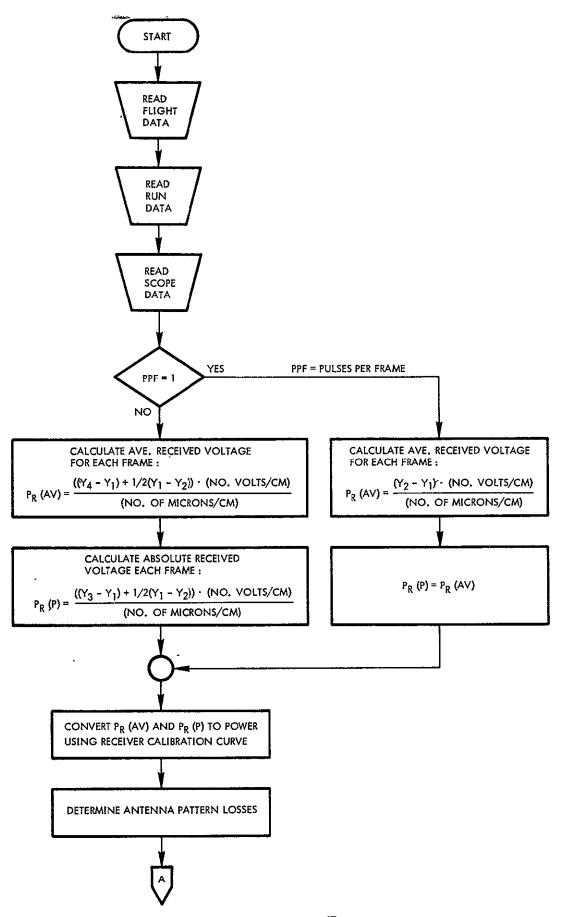


Figure 4-4. Computer Processing Program

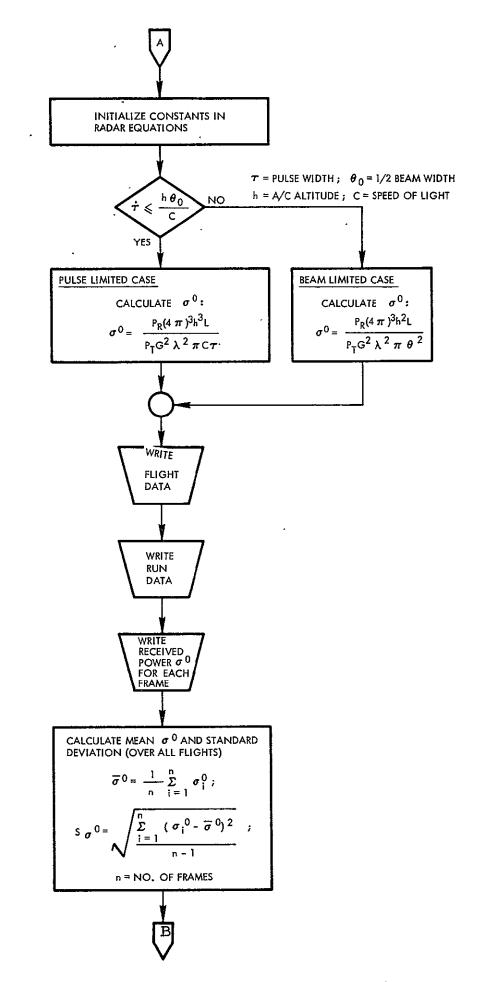


Figure 4-4. Computer Processing Program (Cont.)

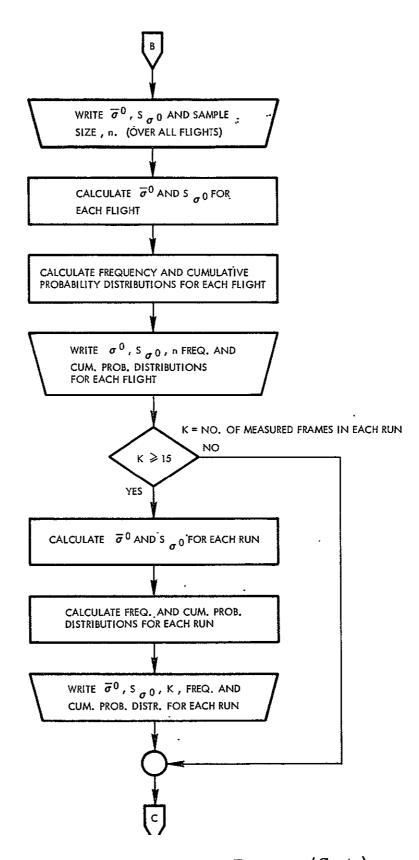


Figure 4-4. Computer Processing Program (Cont.)

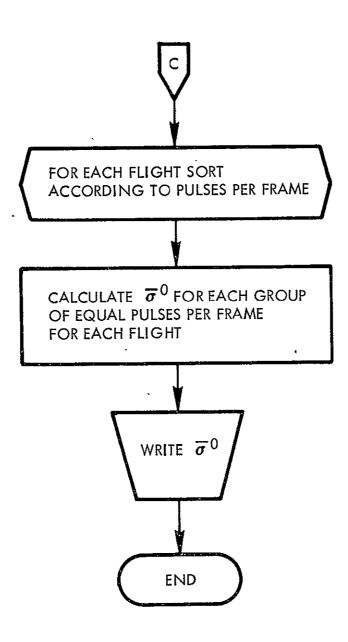


Figure 4-4. Computer Processing Program (Cont.)

4.5 Distribution of Pulse Peaks

The theoretical distribution of pulse peaks for a number of pulses is a Rayleigh distribution. This is actually the circular normal distribution in polar coordinates. The Rayleigh frequency distribution is given as:

$$f(r) = \frac{r}{\sigma^2} e^{-r^2/2\sigma^2}$$

where

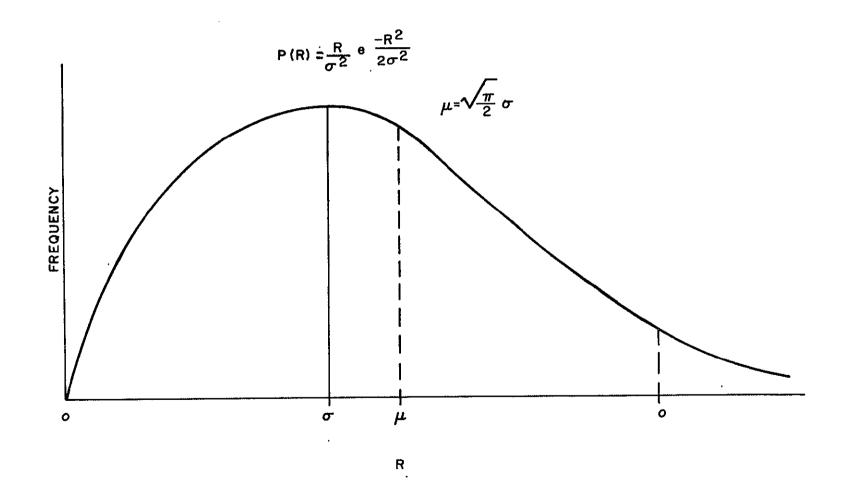
$$\sigma = [(x-\mu_x)^2 + (y-\mu_y)]^{1/2}; \text{ the distance to the origin in a bivariate normal distribution}$$

$$\sigma = \sigma = \sigma$$
 (x, y refers to rectangular coordinates)
x y

(See Figure 4-5.) The mean of the distribution equals 1.253 times the standard deviation.

To show that the pulse peaks appear to have a Rayleigh distribution, the distributions of pulse peaks were found for a few frames from each selected test flight. This was done by using a microdensitiometer/isodensitracer which automatically scans and measures the density of points in a film transparency and plots the values as a quantitative two dimensional density map of the scanned area. The following curves (Figures 4-6 through 4-15) are the distributions of pulse peaks for one frame from each flight. The numbers on the vertical axis of the densitometer tracings correspond to the densities of each step of a "21-step wedge" (Kodak Photographic Step Tablet No. 2). The horizontal axis corresponds to the amplitude of the return signal, with the amplitude increasing from left to right. The point where the distribution starts to rise out of the noise level corresponds to the minimum return signal.

As can be seen from the density tracings the distributions appear to be Rayleigh. Further analysis is required to definitely show this relation. The film transfer functions should be considered at that time.



4-19

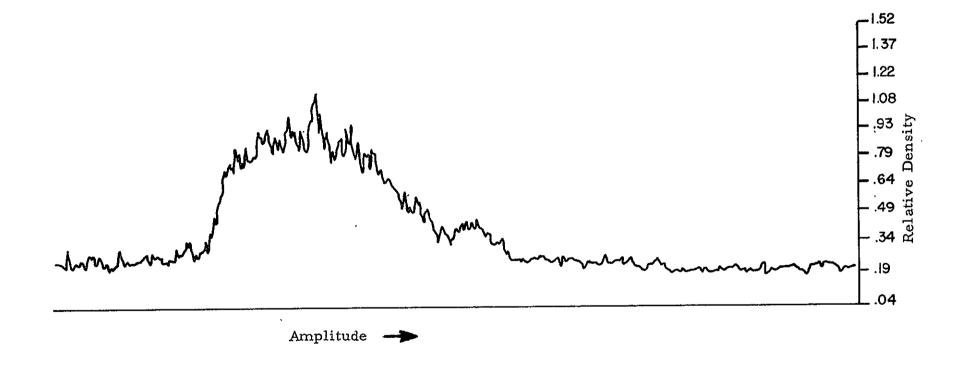


Figure 4-6. Flight 4; Frame 8330

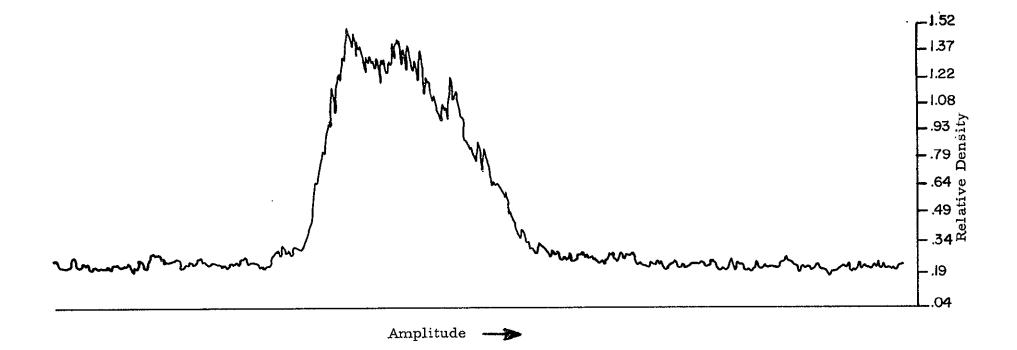


Figure 4-7. Flight 5; Frame 9083

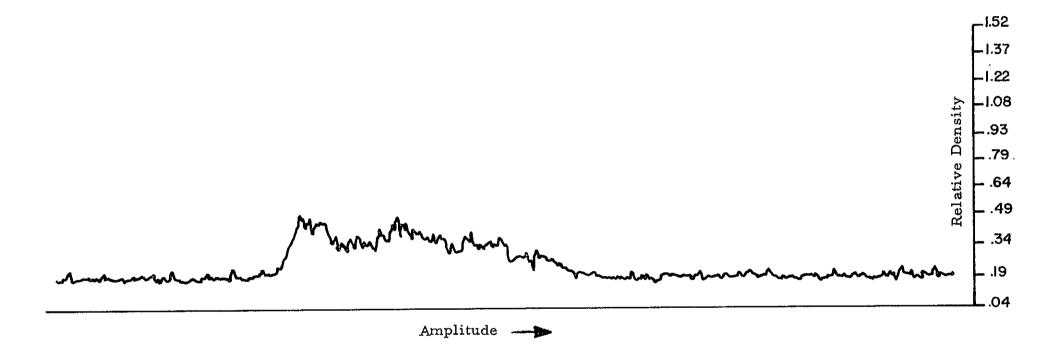


Figure 4-8. Flight 6; Frame 9558

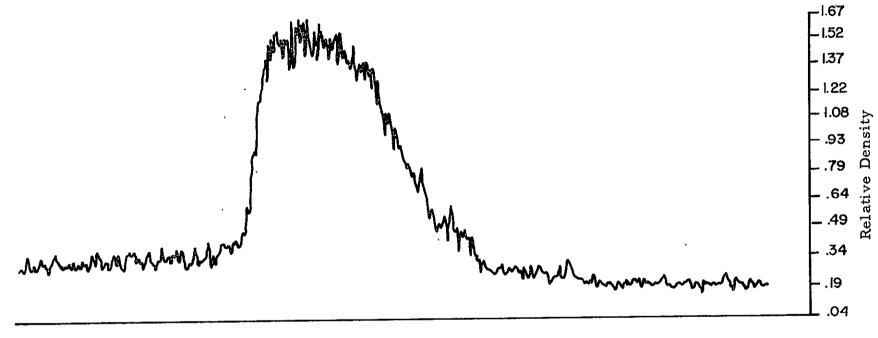


Figure 4-9. Flight 7; Frame 0458

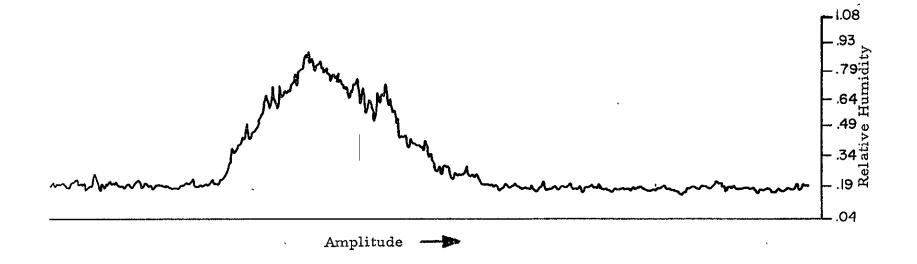


Figure 4-10. Flight 8; Frame 0795

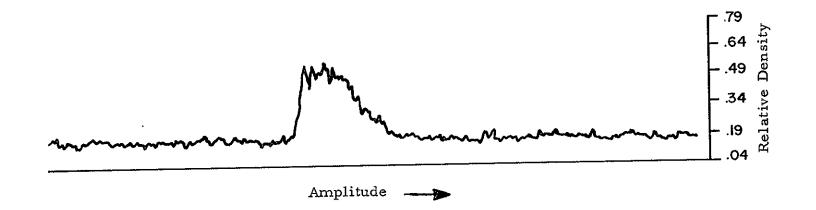


Figure 4-11. Flight 10; Frame 1900

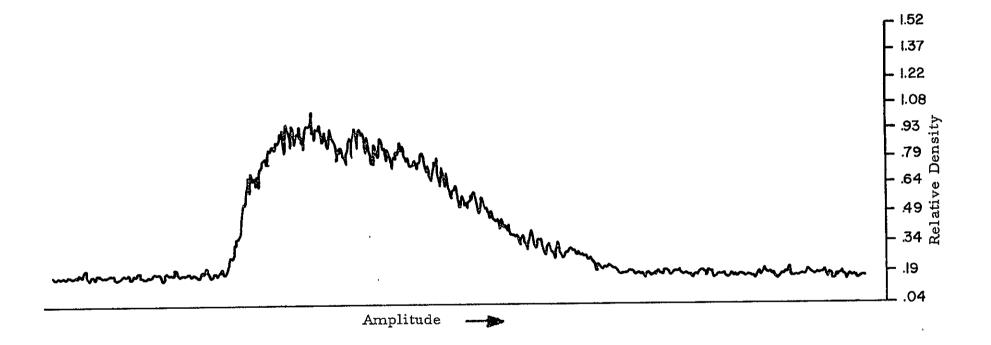


Figure 4-12. Flight 12; Frame 2689

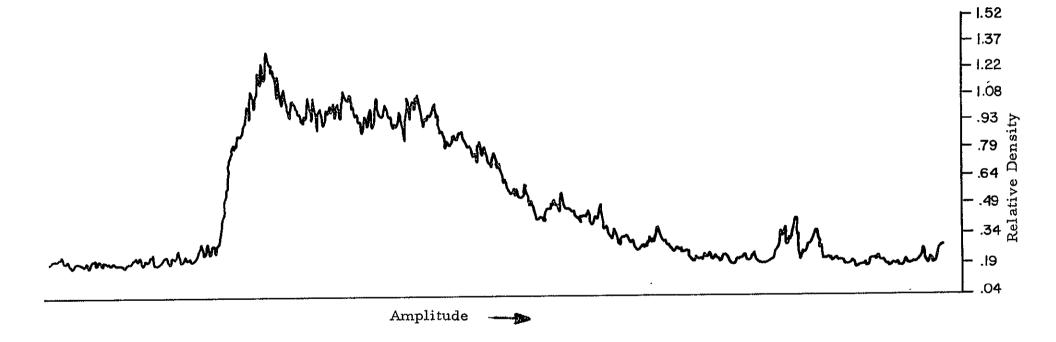


Figure 4-13. Flight 14; Frame 4180

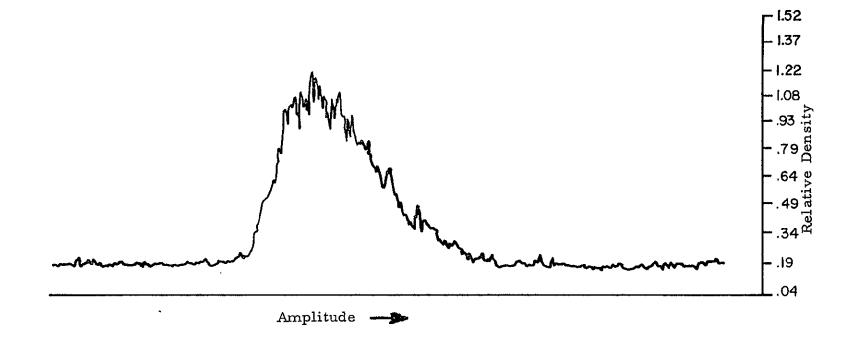


Figure 4-14. Flight 15; Frame 5524

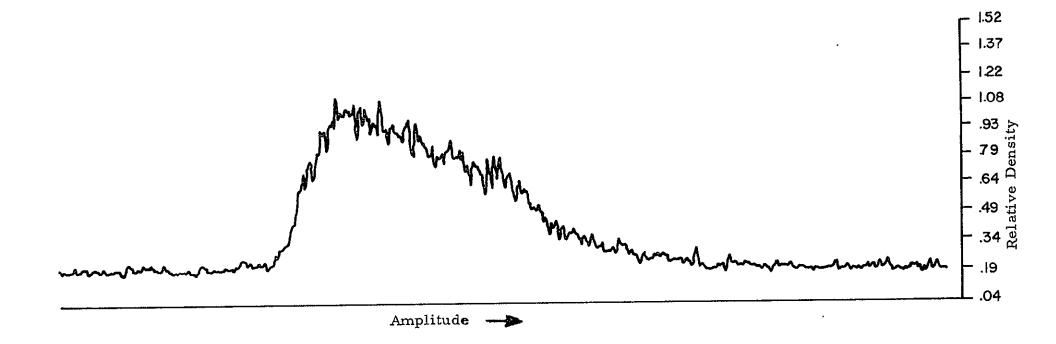


Figure 4-15. Flight 16; Frame 6750

4.6 System Error Analysis

The equation for σ° has been shown to be

$$\sigma^{\circ} = \frac{P_{R}(4\pi)^{3} h^{3} L}{P_{T} G^{2} \lambda^{2} \pi c_{T}}$$

Since the nominal roll (R) and pitch angles (P) are zero, the applicable error equation is

$$\left[\frac{\Delta\sigma^{\circ}}{\sigma^{\circ}}\right]^{2} = \left[\frac{\Delta P_{R}}{P_{R}}\right]^{2} + \left[\frac{3\Delta h}{h}\right]^{2} + \left[\frac{\Delta L}{L}\right]^{2} + \left[\frac{\Delta P_{T}}{P_{T}}\right]^{2} + \left[\frac{2\Delta G}{G}\right]^{2} + \left[\frac{2\Delta\lambda}{\lambda}\right]^{2} + \left[\frac{\Delta\tau}{\tau}\right]^{2}$$

To obtain the errors listed in Table 4-1 the calibration errors of the equipments (oscilloscope, power meter, etc.) were used. An additional factor was also included for human error in making the measurements. The major contributors to the error budget are the received power measurement ($\Delta P_R/R_R$), the altitude measurement ($\Delta h/h$), and the transmitted power measurement ($\Delta P_t/P_t$). The power measurements involve the use of: (1) an oscilloscope (accuracy better than 5%); (2) power meter (accuracy better than 2%); and human error (estimated to be 3%) in reading the oscilloscope and/or photograph. The altitude measurement error (5%) is that which was specified by manufacturers of the aircraft altimeter.

The error contribution (standard deviation) expressed in dB is listed in Table 4-1 for each error with a notation describing the sources of each error.

The RSS error for σ° obtained from these elements is therefore

$$\frac{\Delta \sigma^{\circ}}{\sigma^{\circ}} RSS \approx 0.9 dB$$

Table 4-1.	FLIGHT TEST	ERROR	CONTRIBUTIONS

ERROR	PERCENTAGE. OF ERROR	lσ VALUE (dB)	SOURCES OF ERROR
$(1) \frac{\Delta P_R}{P_R}$	10%	0.4	VIDEO SCOPE CALIBRATION AND OPERATION, INTERPRETATION OF POINT COORDINATOR MENSURATOR.
$(2) \frac{\Delta L}{L}$	2%	0.1	MEASUREMENT OF SYSTEM LOSSES AND IN CALIBRATION.
(3) $3 \frac{\Delta h}{h}$	3 x 5%	0.6	MEASUREMENT OF A/C ALTITUDE BY THE A/C ALTIMETER.
$(4) \frac{\Delta P_T}{P_T}$	10%	0.4	MEASUREMENT OF TRANSMITTED POWER BEFORE FLIGHT AND SCOPE MONITORING OF CHANGES DURING FLIGHT.
(5) 2 <u>AG</u> G	2 x 4%	0.3	MEASUREMENT OF ANTENNA GAIN AT 9.0 GHz.
(6) $2 \frac{\Delta \lambda}{\lambda}$	2%	0.1	MEASUREMENT OF FREQUENCY.
(7) $\frac{\Delta \tau}{\tau}$	4%	0.2	MEASUREMENT OF TRANSMITTED PULSEWIDTH.
RSS	2.2.%	0.9	

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SECTION 5. DATA EVALUATION

5.1 Average Radar Cross Section (σ^{0})

As described in the previous section, σ° was obtained by averaging the multiple trace oscilloscope photographs and by computing the average of individual pulses displayed on the oscilloscope. The oscilloscope was used to obtain 1, 50, 147, and 278 pulses per frame. σ° values obtained by averaging individual pulses were about two dB less than when averages were taken of 50 or more pulse traces.

The plotted values of σ^{0} on a per flight basis (Figures 5-1, 5-2, 5-3, 5-4) involve the averaging of more than 18 frames per flight with each frame representing 50 pulses.

Plots of σ° were made for each flight in order to relate σ° values to ocean conditions. The numbers shown on the Figures 5-1, 5-2, and 5-3 next to the points refer to flight numbers and hence to the day which the data was taken.

The spread of values of σ^{0} ranges from 8 dB to 21 dB. As can be seen from the plots of σ^{0} it would be questionable to claim any trend or functional relation to ocean parameters. There seems to be little or no relation between the σ^{0} value or the change in σ^{0} value to wave height or wave period. If there is any relation it exists with respect to wind speed (Figure 5-3). A trend line is shown on Figure 5-3 and would apply if a functional relation exists.

Flights 8, 10, and 12 in Figures 5-1 and 5-3 are flights in which the relation between wind and wave height were not related as would be the case in a fully developed sea. Flight 8 had very high seas (greater than 12 ft) but the wind had started to die down. On the other hand flights 10 and 12 were made in inland waters with the wind blowing an insufficient time and fetch to produce a

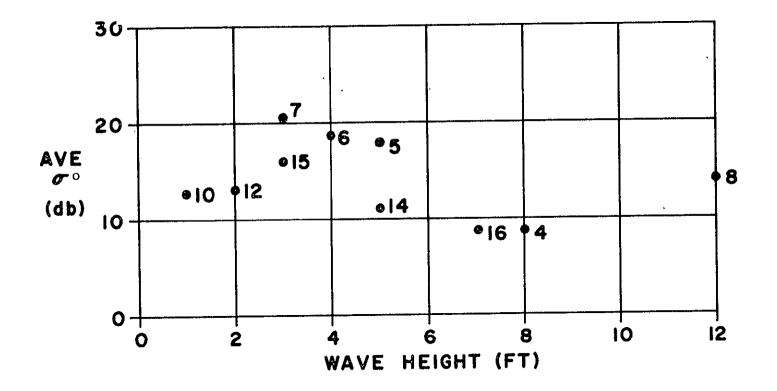
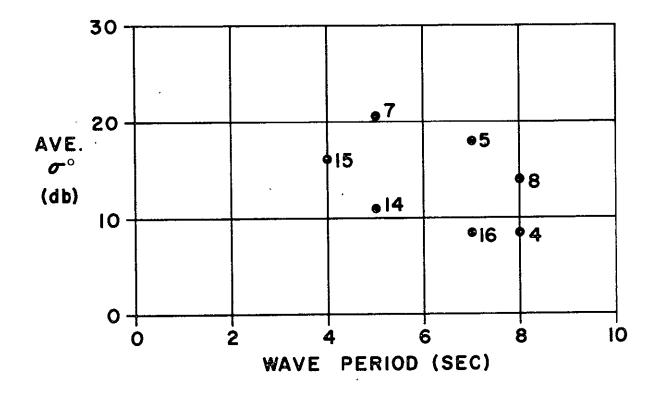




Figure 5-1. Average σ^{o} Vs Wave Height (Vertical Incidence)



Note: No's Refer to Flights Figure 5-2. Average σ^{0} Vs Wave Period (Vertical Incidence)

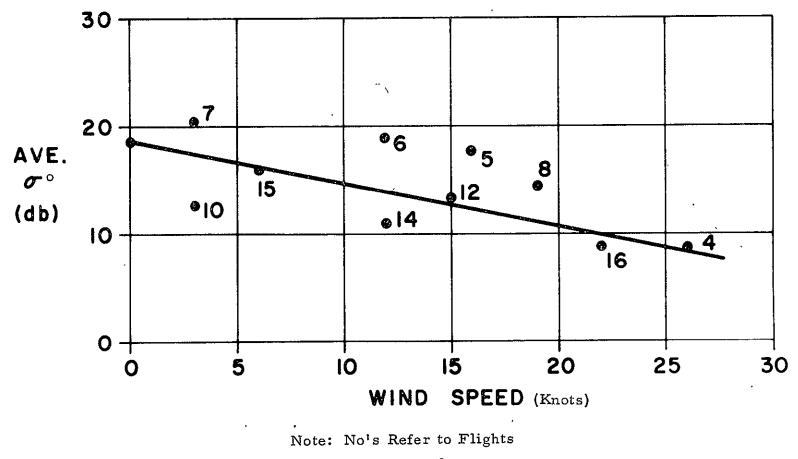


Figure 5-3. Average σ° Vs Wind Speed (Vertical Incidence)

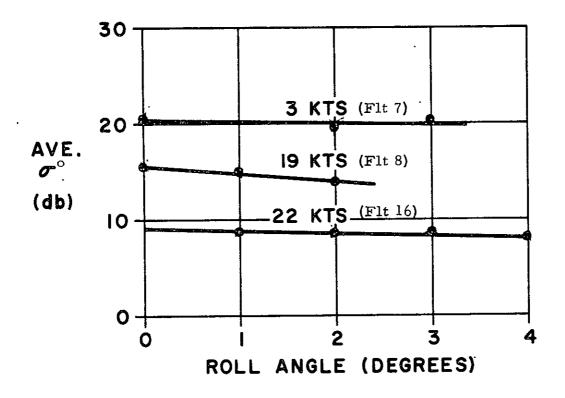


Figure 5-4. Average σ° Vs Roll Angle (Pitch = 0°)

fully developed sea. It is felt therefore that these three points on Figures 5-1 and 5-3 reinforce the argument that σ° is functionally related to wind but not to wave height because they improve the fit of the data in Figure 5-3 (σ° vs wind) but they destroy the fit of the data in Figure 5-1 (σ° vs wave height).

The ocean data used for making the above plots are the "eyeball" measurements obtained from the NASA ship on location when taking radar data. More definitive ocean parameters are possible from the Stilwell photos taken for each flight but the process of obtaining the necessary two dimensional Fourier transform from these photos in the Stilwell process requires further development (see Section 5-3).

If a relation exists between σ° and wind speed, it probably exists because of the relation between wind speed and capillary waves. If σ° is in fact related to capillaries (and there is much reason to believe this to be so because the capillary wavelength is comparable to the X-band wavelengths) then some methods for measuring capillaries will have to be devised. To date no such measurement capability exists. Investigations by Kinsman and Molo Christianson and currently underway to measure capillaries. Also, Stilwell photography at low altitudes may make the measurements possible.

Variations of σ° as a function of sea direction are negligible and within the measurement accuracy as shown in the representative measurements of Table 5-1. This is further substantiated in the extensive data in Appendix A where additional bearing angles are covered.

Variations of σ° as a function of angle from vertical are negligible, as shown in Figure 5-4. This agrees in part with the curves of Moore and Schooley (Figure 5-5).

BACKSCATTER vs ATTITUDE

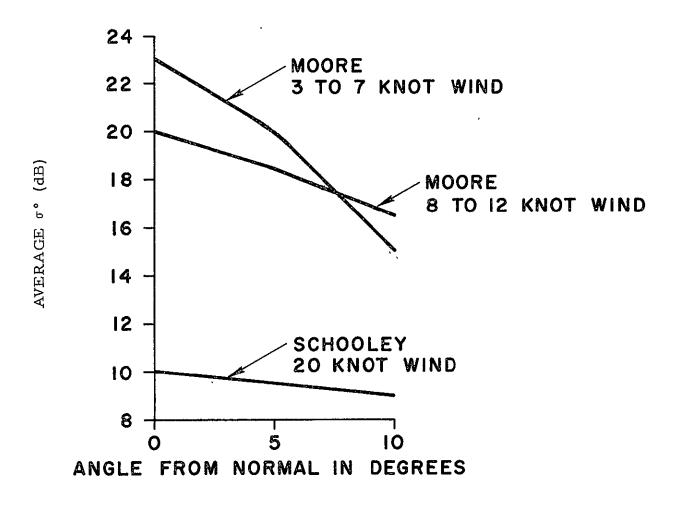


Figure 5-5. Backscatter vs Attitude (Reference: WHOI Report, No. 65-10, April 1965, Page 23)

5-7

Table 5-1

σ° vs. Sea Direction

Flight	Run	Bearing*	<u> </u>
14	9	0	12.9
14	10	90	12.8
14	11	180	13.4
14	12	270	13 . 0

* Bearing angle with respect to sea direction

5.1.1 Pulse Limited vs Beam Limited

The basic radar range equation defines σ (radar cross section in square meters) as follows:

$$\sigma = \frac{P_R(4\pi)^2 h^4 L}{P_t G^2 \lambda^2}$$
(5-1)

where

 $P_R = peak received power$ h = altitude L = system losses $P_t = peak transmitted power$ G = antenna gain $\lambda = wavelength$

The average radar cross section (σ^0) is the radar cross section per unit area or

$$\sigma^{o} = \frac{\sigma}{A}$$
(5-2)

When the transmitted signal is a pulse, (see Figure 5-6) the return signal will be scattered from the area (A), or footprint, which is a function of time (t) or angle (θ), where:

$$t = \frac{h\theta^2}{c}$$
(5-3)

t is here defined from the instant the leading edge of the pulse initiates the first return and θ is the angle from vertical

The maximum value of t is τ (pulsewidth), but the maximum value of θ is not so well defined. The 3 dB point has sometimes been used as the maximum value of θ , but this is purely arbitrary.

The data in this experiment was reduced to σ values by measuring P_r , P_t , and h, and then performing the computation in Equation (5-1). Values of P_R were obtained by measuring the peak and average voltage of the return pulse (see Section 4 for a more detailed description). The σ values were then computed using Equation (5-2) with values of A as follows:

$$A = \pi c \tau h$$
 (5-4)

This in effect assumes an h³ relation for the radar range equation - a pulse limited relation. How valid is this assumption?

The area (A) can be related to the angle θ using the simple trigonometric relation $\tan \theta = r/h$:

$$A = \pi r^{2}$$

$$= \pi h^{2} \theta^{2} \text{ (for small angle } \theta)$$
(5-5)

Note here that θ is a function of time (t) as follows:

$$\theta^2 = ct/h \tag{5-6}$$

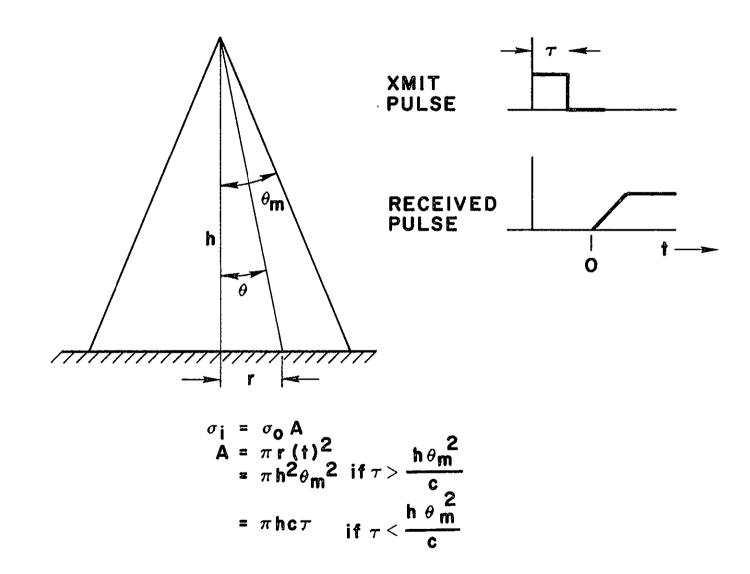


Figure 5-6. Geometric Relations

If the maximum value of t (t = τ) is reached before some maximum value of θ ($\theta = \theta_m$), the area then becomes

$$A_{\tau} = \pi c \tau h \tag{5-7}$$

which is the pulse limited situation, or an h cubed relation in the radar range equation.

If however a maximum value of θ ($\theta = \theta_m$) is reached before $t = \tau$ then the area becomes

$$A_{\theta} = \pi h^2 \theta_{m}^2$$
(5-8)

which is the beam limited situation or an h squared relation in the radar range equation.

The problem is now one of defining θ_m , or beam limiting. To define θ_m as the half beamwidth angle seems indefinite, and some initial calculations of the data with this assumption provided inconsistent values.

The approach used was to work the problem in reverse and determine what θ_{m} should be. Flight 4 provides the data for making such a determination because on flight 4 nine runs of data were obtained with 100 nsec pulse, and nine runs of data were obtained with a 20 nsec pulse. Even though all runs were at the same altitude and over the same ocean area, it is evident from the data that the received power is functionally related to the pulsewidth.

By comparing the average received power for the two pulse widths we can determine $\theta_{\rm m}$

If

P_R = average received power 100 nsec pulse P_R = average received power 20 nsec pulse

5-1:

From the data of flight 4

$$P_{R_1}/P_{R_2} = 4$$
 (5-9)

Note here that if the functional relation were proportional to pulse width (τ) , then the above ratio should be five rather than four. This indicates that the transistion between pulse limiting and beam limiting at an altitude of 5000 ft occurs somewhere between 20 and 100 µsec. By letting the radar range equations for P_{R_1} and P_{R_2} take the corresponding limiting relations

$$P_{R_1} \sim \theta_m^2 / h^2$$
 (5-10)

$$P_{R_2} \sim c\tau/h^3$$
, (5-11)

we then obtain

$$\theta_{\rm m}^2 = 4 \, {\rm c} \tau / {\rm h} \,.$$
 (5-12)

This gives a value of

$$\theta_{\rm m} = 7^{\rm o} \,. \tag{5-13}$$

The effective half beamwidth (3 dB) can be computed from the measured beamwidth by assuming a Gaussian distribution and summing the exponents.

$$\frac{1}{\theta_{e}} = \frac{1}{\theta_{H1}} + \frac{1}{\theta_{H2}} + \frac{1}{\theta_{E1}} + \frac{1}{\theta_{E2}}$$

 and

$$\theta_{e} = \frac{\theta_{H1}}{\theta_{H\theta}} \frac{\theta_{E1}}{\theta_{H1}} \frac{\theta_{E1}}{\theta_{E1}} \frac{\theta_{E1}}{\theta_{E2}}$$
(5-14)

where θ_{H1} , θ_{H2} , θ_{E1} , θ_{E2} are half the 3 dB beamwidths measured from the antenna patterns and are equal to 5°, 6.5°, 4.3°, and 6° respectively.

Performing this computation,

$$\theta_{e} = 2.5^{\circ}.$$
 (5-15)

Comparing this to $\theta_m = 7^\circ$, we see that the effective angle where beam limiting occurs is much greater than the 3 dB angle.

5.1.2 Maximum Value of σ^{0} at Vertical Incidence

If we assume that the scattering surface is a flat plate, normal to the transmission and of infinite dimensions (see Figure 5-7), and that the energy impinging upon the flat plate is all reflected to the source, we then can compute the maximum value of σ^{0} . The radar range equation for the above assumptions becomes:

$$P_{R} = \frac{P_{T}G^{2}\lambda^{2}}{(4\pi)^{2}4h^{2}L} .$$
 (5-16)

The symbols are the same as previously defined.

This is the equivalent of a transmission and reception one way over a distance 2 h, twice the altitude.

The comparable range equation for a reflected surface is:

$$P_{R} = \frac{P_{T}G^{2} \lambda^{2} \sigma^{0} A}{(4\pi)^{3} h^{4} L}$$
 (5-17)

Combining equation 5-16 and 5-17 we get

$$\sigma^{\circ} = \pi h^2 / A.$$
 (5-18)

The maximum value of A is $\pi h^2 \theta_m^2$ for the beam limited condition, and therefore

$$\sigma^{\circ} = 1/\theta^2.$$
 (5-19)

For the previously obtained value of $\theta_{\rm m} = 7^{\circ}$, we obtain a value of $\sigma^{\circ} = 18.3 \, {\rm dB}$. (5-20)

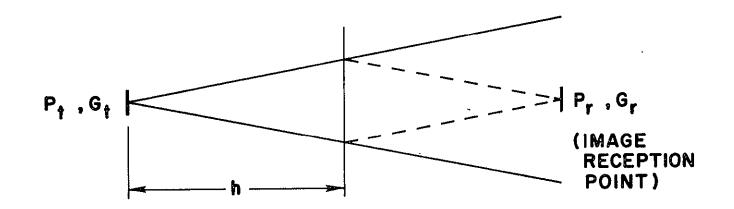


Figure 5-7. Computation of Maximum Value of σ^{0}

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A similar value for the pulse limited condition is obtained, but the computation must be based on a plate of finite dimensions, and the two way path must be taken into account.

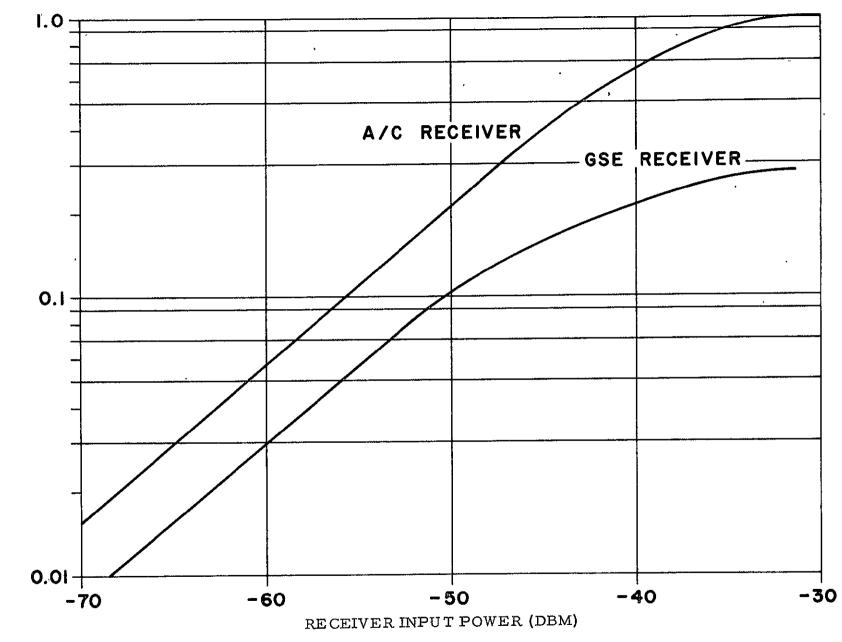
5.1.3 Calibration

The values of received and transmitted power used in the computation of σ^{0} were obtained from oscilloscope photographs. Calibrations of scope deflection voltage as a function of received power (Figure 5-8) were made for the two receivers. Calibrations of detected power level from the transmitted output were also made.

The losses in the system were primarily waveguide and cable losses (Table 5-2). An additional loss factor associated with the antenna pattern was also included (Table 5-3). This pattern loss is due to the peak of the pulse occurring at an angle away from the beam center. In general the values associted with the pattern loss are small enough to be negligible when considering the variability of the data.

The other factor involved in calibration is the antenna gain. Antenna pattern measurements were made with an aircraft mockup. The results of these measurements were used to compute the gain. Table 5-4 is a summary of antenn characteristics.

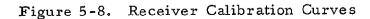
An overall check on calibration was obtained by flying the aircraft over the Ground Support Equipment (GSE). In this instance the GSE received the signal and the value of the received power was recorded. The GSE then transponded the pulse and transmitted to the aircraft where it was again recorded. Measurements made in this fashion served as a check on the system gains and losses which had been independently calibrated. The operational requirements of this technique were not fully developed. It is felt that coordination and synchronization of the aircraft, radar, and GSE operation must be automated to a considerable degree in order to improve the reliability of this method of calibration.



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Receiver Output Voltage

Table 5-2. Measured Losses

Transmitter waveguide and coaxial losses

a.	coaxial from TWT to output coupler	1.2 dB
b.	waveguide loss from attenuation output to transmitter antenna	2.0 dB
с.	insertion loss of variable attenuation	0.5 dB
	vaveguide, waveguide switch and all coaxial, etc., in both parallel and crossed modes	2.0 dB
Total Loss	ses	5.7 dB

Table 5-3. Pattern Losses

Pulsewidth	Altitude	Loss
au (µsec)	h (ft)	(dB)
10	5000	0.3
20	5000	0.6
	10000	0.3
	15000	0.2
	20000	0.15
100	5000	3.0
	10000	1.5
	15000	1.0
	20000	0.75

Table 5-4

Antenna Characteristics

f = 9 GHz

Transmitting Antenna - Aircraft

Beamwidth - H Plane	.0.0°
Beamwidth - E Plane	8.5°
Gain	25.2 dB

Receiving Antenna - Aircraft

Beamwidth - H Plane	13°
Beamwidth - E Plane	12°
Gain	22.1 dB

GSE Antennas

Beamwidth - H Plane	18°
Beamwidth - E Plane	18°
Gain	18.9 dB

5.2 Pulse Shapes

5.2.1 Theoretical

Before discussing the actual results of return pulse shapes it is necessary to discuss what the expected pulse should look like. Pulse shapes for various pulsewidths, altitudes and σ^{0} were used to compute the expected waveforms (Figures 5-9, 5-10, 5-11). All waveforms are normalized so that comparisons of the wave shape can be readily made.

Figure 5-9 is based on antenna beamwidth of 6 degrees. The pulse shape corresponding to 100 nsec and 5,000 ft is clearly beam limited, whereas at 20 nsec and 20,000 ft the pulse shape is clearly pulse limited.

Figure 5-10 is for a beamwidth of 12 degrees and the distinction between pulse limiting and beam limiting is less pronounced. As will be seen, the actual pulse shape data more closely resembles the 12 degree beamwidth.

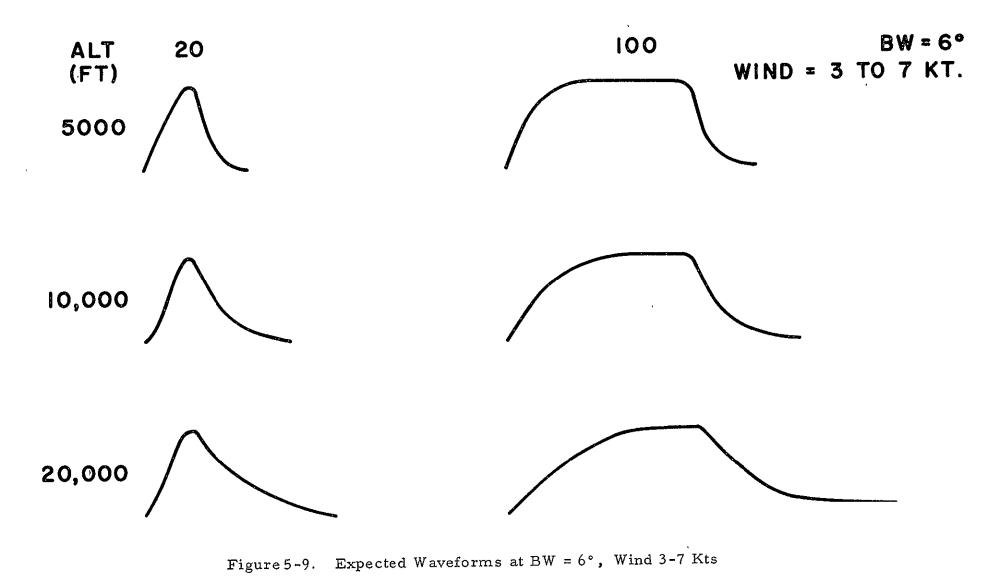
Figure 5-11 is a plot of pulses of 20 nsec width at altitudes 20,000 and 10,000 ft. The pulses are normalized and a σ_0 factor is introduced which is based on curves by Moore and Schooley (Figure 5-5). The pulse shape changes very little as a function of changes in σ_0 .

5.2.2 Measured Pulse Shapes

Figures 5-12 through 5-37 are actual photographs of multiple pulse returns under various ocean conditions, altitudes, pulse widths, etc. A sampling of the more than 10,000 frames taken is used here to show some significant features.

It first must be pointed out that these are reproductions of reproductions and at each step much information is lost. In fact, the reproductions of the single pulse traces were not visible at all even though they were visible on the original negatives.

PULSE WIDTH (NSEC)



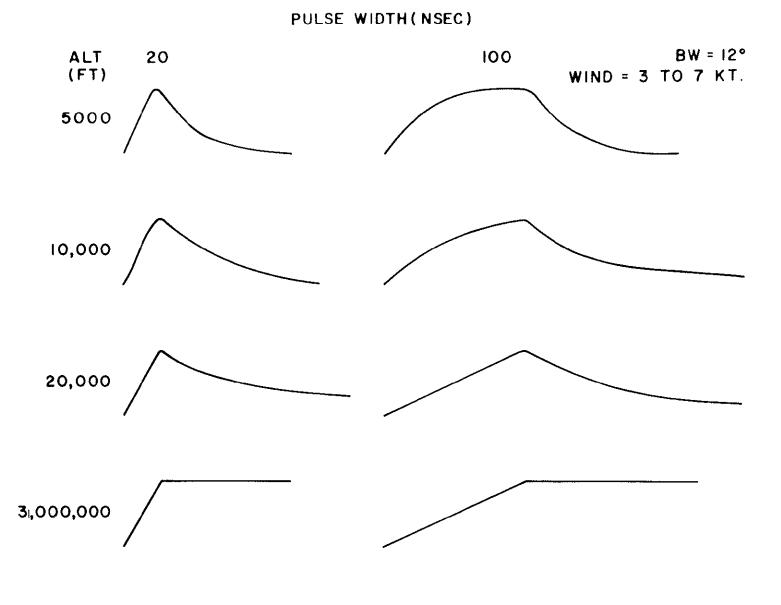


Figure 5-10 Expected Waveforms at BW = 12°, Wind 3-7 Knts

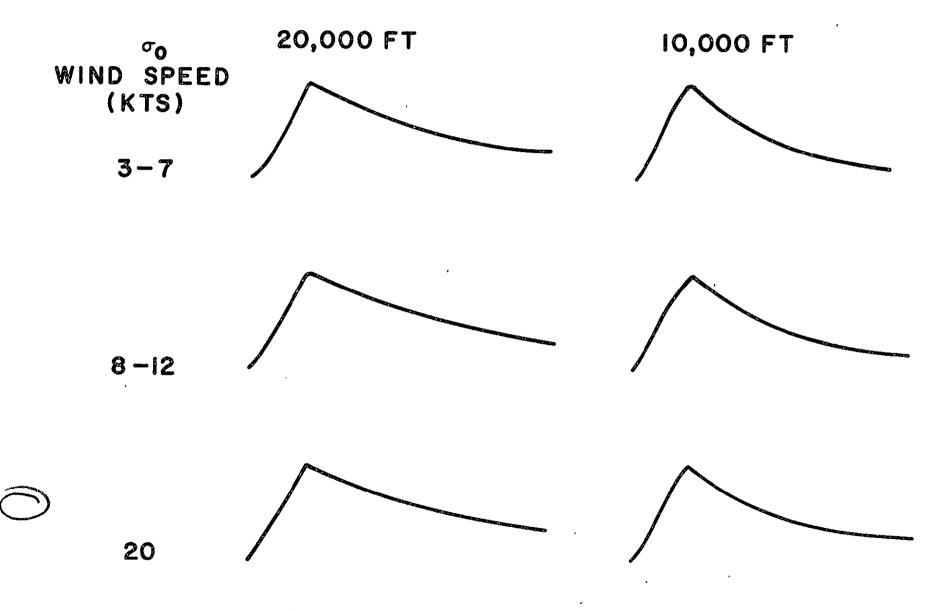


Figure 5-11. Expected Waveforms at Various Wind Velocities and Altitudes

Generally the frames were taken one second apart. It was clear that there was little variation from frame to frame. The sweep speed in all cases was 50 nsec/cm. Selected frames are shown in the following figures:

Flight 4 (Figures 5-12 through 5-17) shows the difference between beam and pulse limiting. Figures 5-15 through 5-21 are based on a 100 nsec pulse where some evidence of a flat peak is visible. Figures 5-12 through 5-14 on the other hand are based on a 20 nsec pulse for the same conditions and here no flat peak exists.

Flight 5 (Figure 5-18 through 5-30) shows true pulse limiting as evidenced by the long trailing edge when the altitude of 10,000 ft is used with a 20 nsec pulse. This should be compared with the expected values of Figure 5-10. Flight 7 (Figures 5-24, 5-25, and 5-26) shows increased pulse limiting at an altitude of 15,000 ft for the same 20 nsec pulse. Flight 7 also shows the slight variations in exposure by using three values of pulses per frame (50, 147, and 278).

Flight 10 (Figures 5-27, 5-28) shows 10 nsec pulses over very calm water at 10,000 ft.

Flight 14 presents a comparison between pulse shapes as a function of sea direction. Figure 5-30 is taken with the polarization of the transmission in the direction of the sea whereas Figure 31, Figure 5-32 and Figure 5-33 are at 90, 180, and 270 bearings with respect to sea direction. It is clear that wave shapes are not related to sea direction.

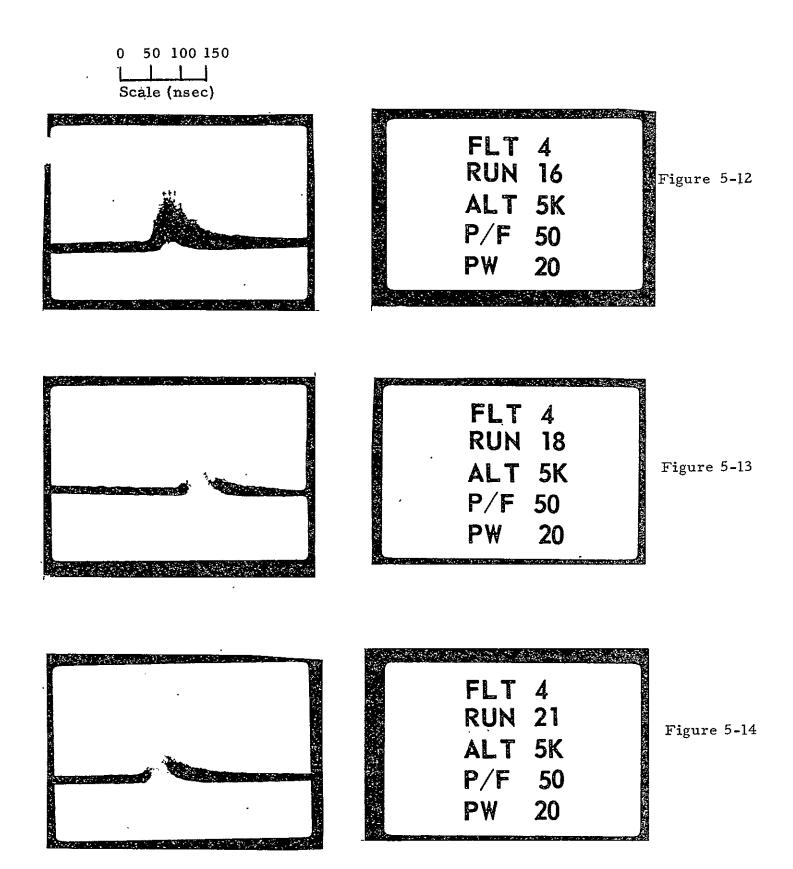
Flight 14 (Figure 5-34) also shows the results when reception is cross polarized from the transmission. The signal level here was into the noise indicating greater than 30 dB between direct and cross polarized returns.

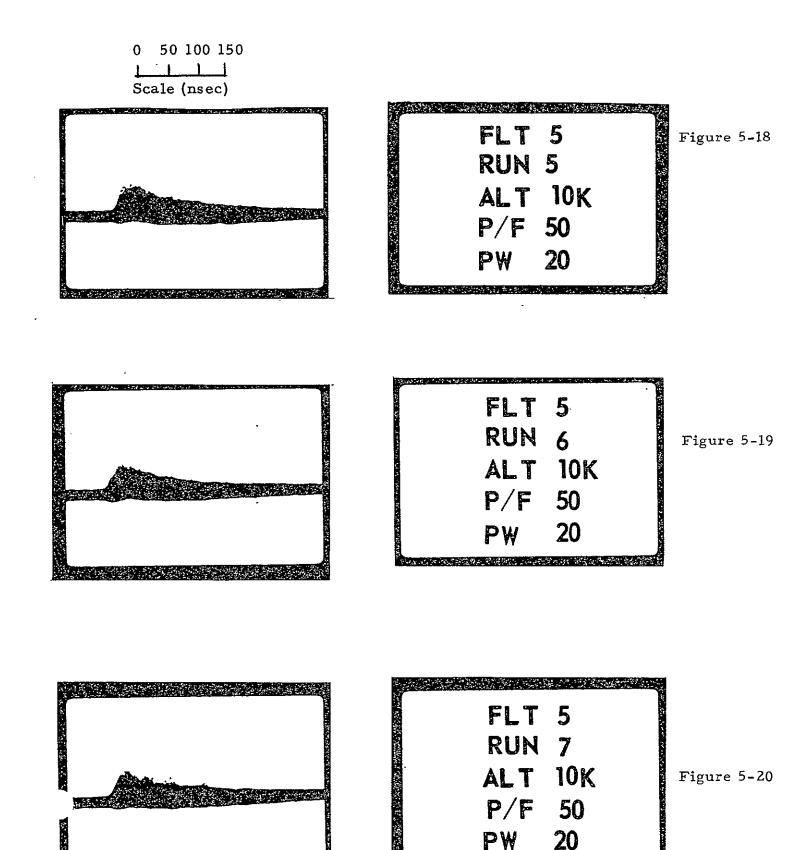
The returns from ice at low altitude (2, 500 ft) are shown in Figure 5-35.

Figures 5-12 through 5-37. Flight Pulse Data

LEGEND

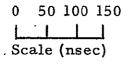
FLT:	Flight Number
RUN:	Data Run for That Flight
ALT:	Aircraft Altitude in Thousands of Feet
P/F:	Pulses Per Frame
PW:	Transmitted Pulse Width in Nanoseconds
BRNG:	Bearing

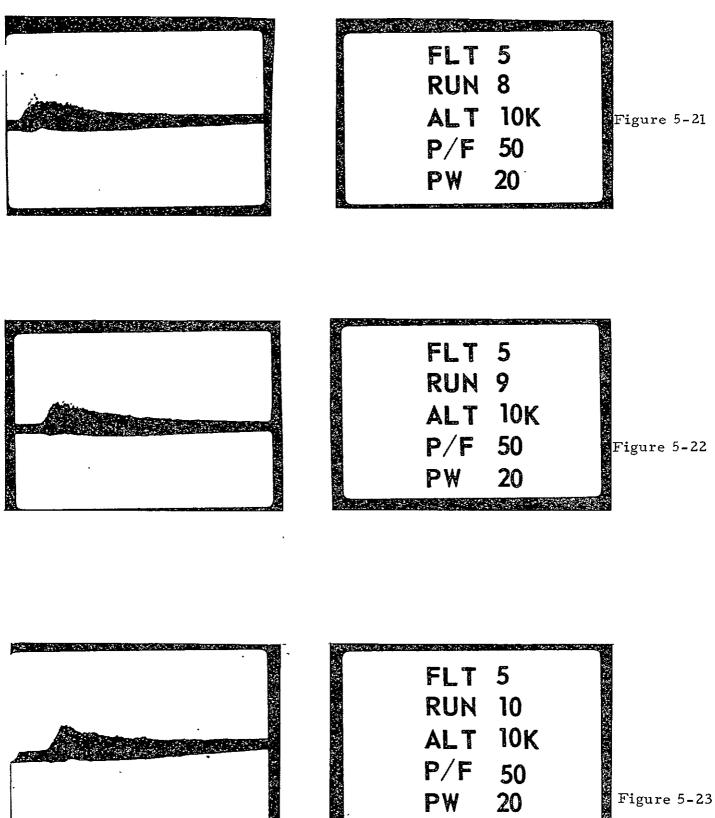




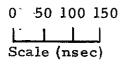
T. BARROW AREAS. C.

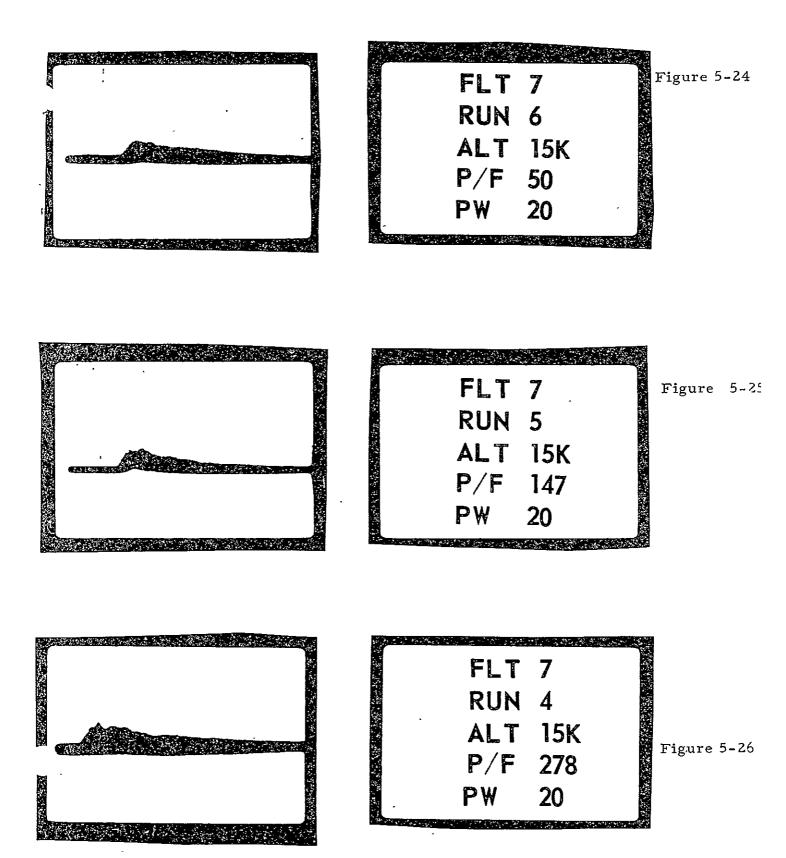
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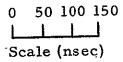


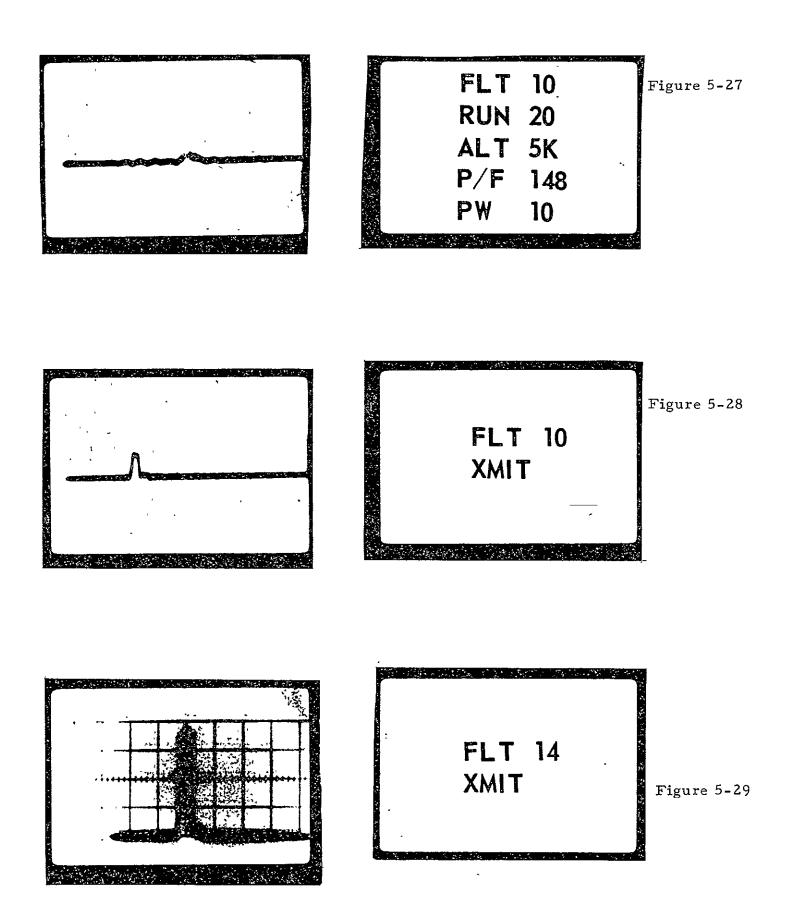


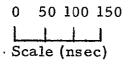
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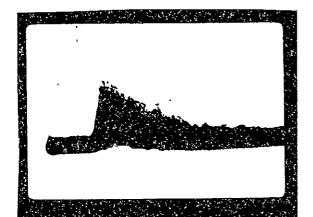


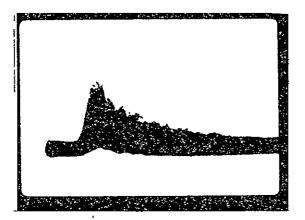


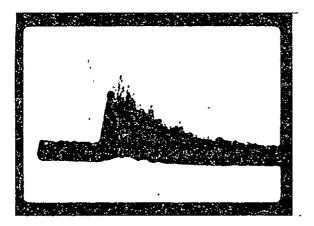












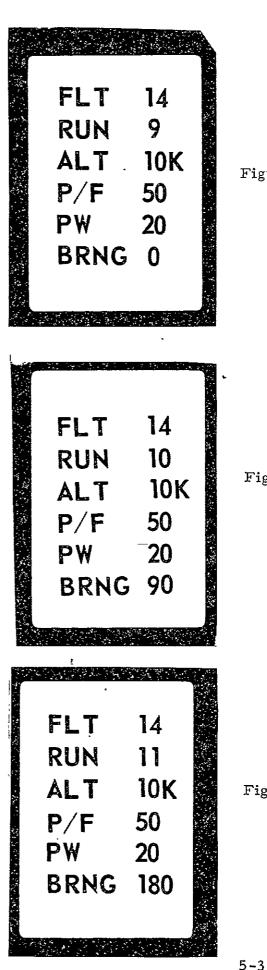
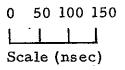
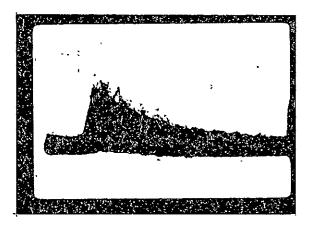


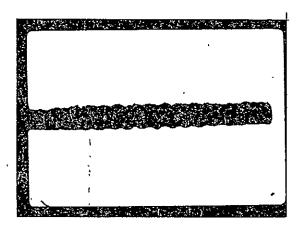
Figure 5-30

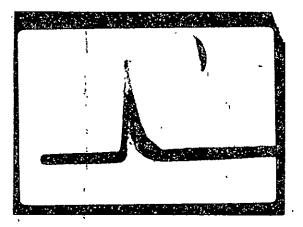
Figure 5-31

Figure 5-32









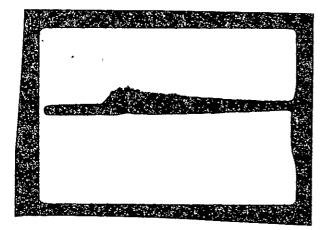
FLT 14 **RUN** 12 ALT 10K P/F 50 PW 20 **BRNG 270 FLT** 14 **RUN 24** ALT 10K P/F 50 PW 20 **XPOL** FLT 14 **RUN** 25 ALT 2.5K P/F 50 20 PW ICE

Figure 5-33

Figure 5-34

Figure 5-35

0 50 100 150 L I I 1 Scale (nsec)



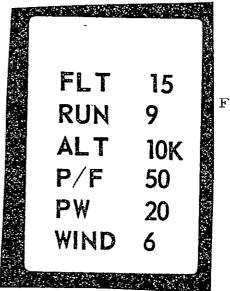
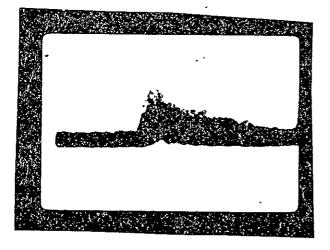


Figure 5-36



N 6 8 8 8 8 4 9 8 **FLT** 16 RUN 9 ALT 10K P/F 50 PW 20 **WIND 22**

Figure 5-37

The pulse shapes of flights 14, 15, and 16 (Figures 5-33, 5-36, and 5-57) show that winds of 12, 6, and 22 knots, respectively, have little effect on pulse shape.

5.2.3 Individual Pulses

Figure 5-38 represents traces of individual pulses copied directly from the negatives. This procedure was necessary because the faint traces on the negatives were washed out in the reproduction process. Figure 5-39 represents 10 pulses per frame which are barely visible.

It is clear that considerable amplitude variations are visible in the individual pulses and that multiple traces are actually overlaps of individual traces. In general, the leading edges of the individual traces are fairly linear (see Appendix E) and peak at the pulse width. The trailing edges, however, show wide amplitude fluctuations.

5.3 Ocean Truth

Two methods were used to obtain ocean parameters on all flights observations from a NASA ship stationed in the test area in the area, and Stilwell photographs. In addition, on flights 5 and 6, a Cessna aircraft from Office of Naval Research flew alongside with a laser profilometer aboard.

The ship observations were used in reducing the data because they represent the most complete available information. Comparisons of ship observations with the laser data on flight 5 (see Figure 5-40) show very good correspondence.

The Stilwell photographs (Figure 5-41) offer the greatest potential for ocean truth measurements because, when reduced, they provide a two dimensional spectral representation of the ocean. However, the techniques and computations associated with reducing the data require further development and evaluation before it becomes an acceptable ocean parameter measurement tool. Two photographs from flight 6 were reduced to provide the two dimensional ocean spectrums shown in Figures 5-42 and 5-43. These were in turn converted into line spectra along the dominant wave direction (see Figure 5-44).

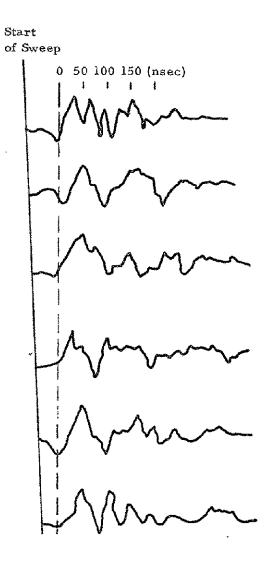


Figure 5-38. Single Pulse Returns, Flight 13



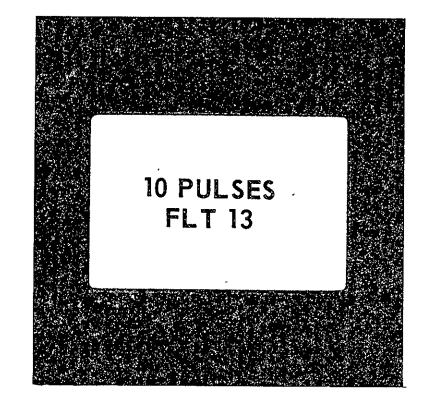


Figure 5-39. 10 Pulses, Flight 13

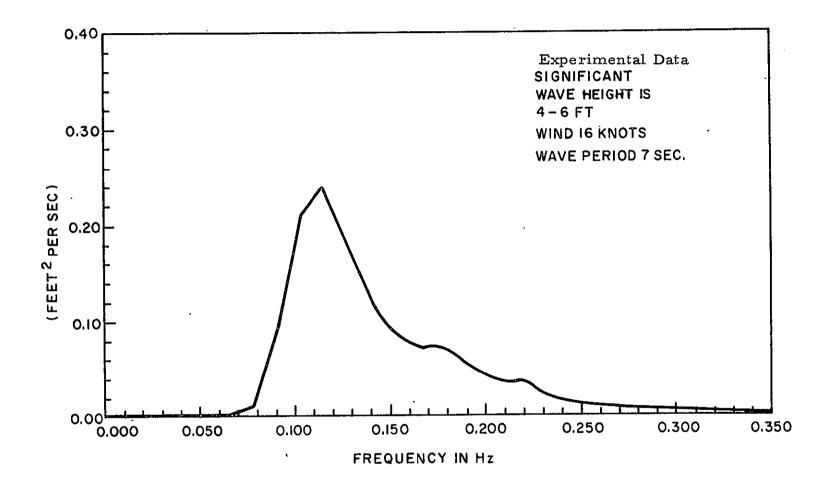


Figure 5-40. Laser Profilometer Data

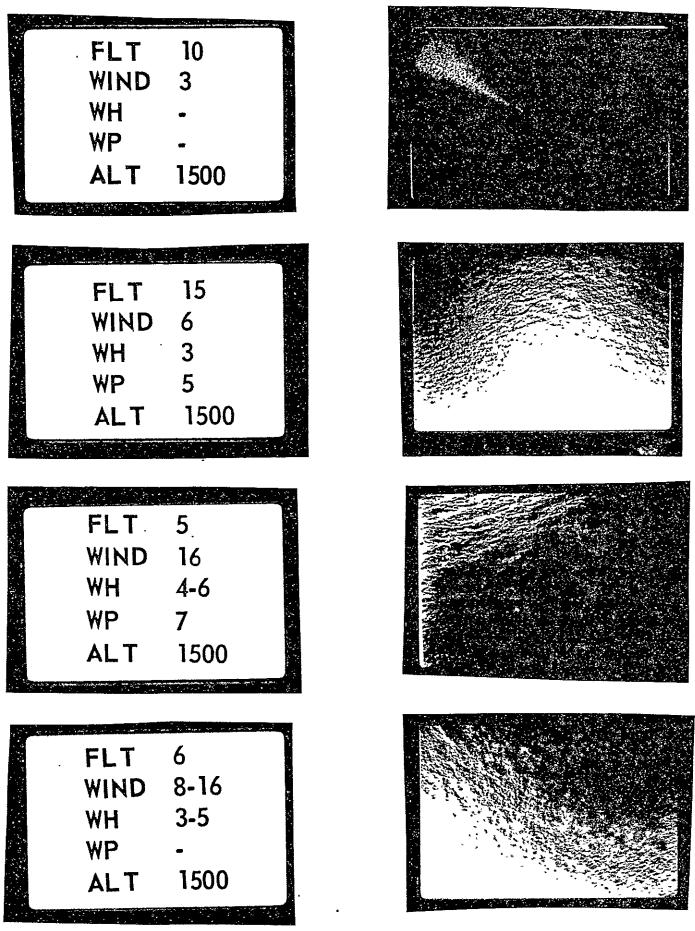


Figure 5-41. Stilwell Photographs

NOT REPRODUCIBLE

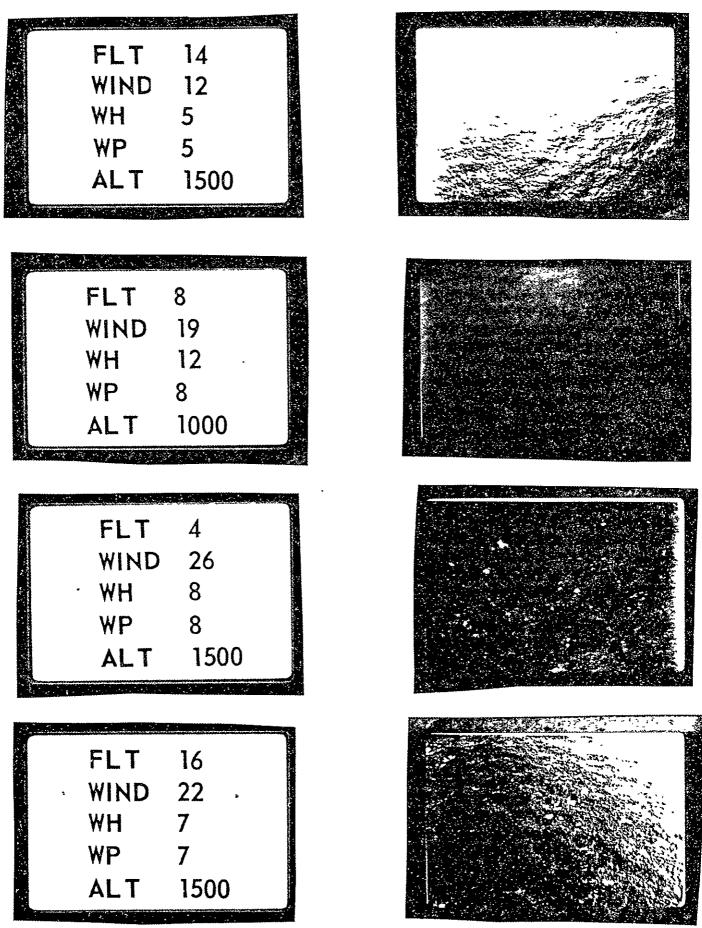


Figure 5-41. Stilwell Photographs (Cont.)

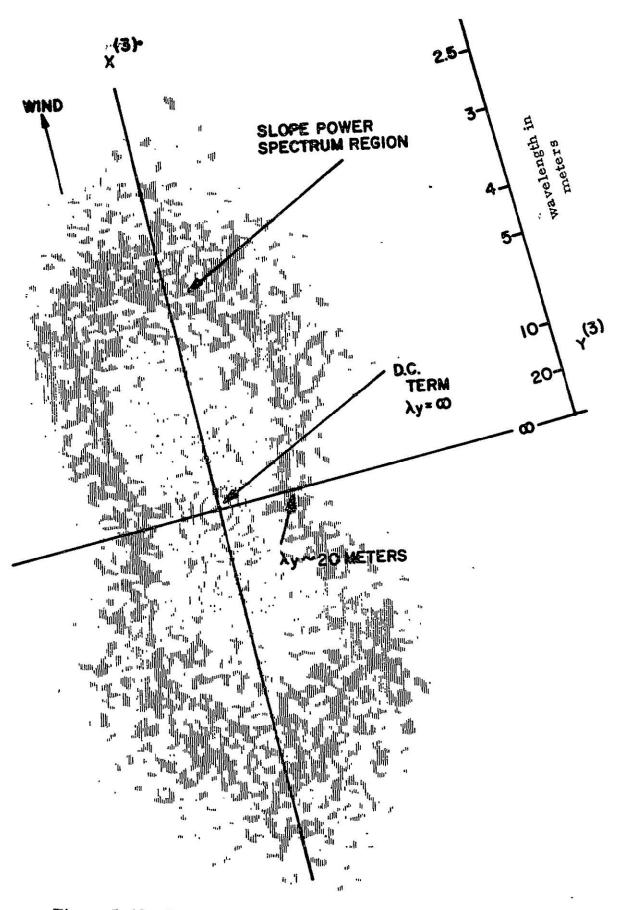


Figure 5-42. Isodensity Tracing of Transform Negative for $\psi = 0$ (Camera Looking in X⁽³⁾ Directions)

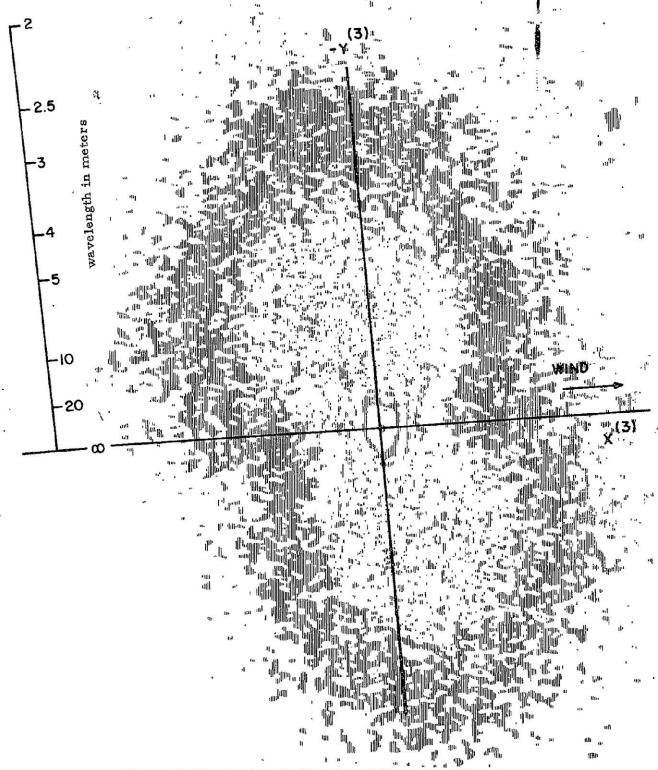


Figure 5-43. Isodensity Tracing of Transform Negative (Camera Looking in Y⁽³⁾ Direction of Figure 14)

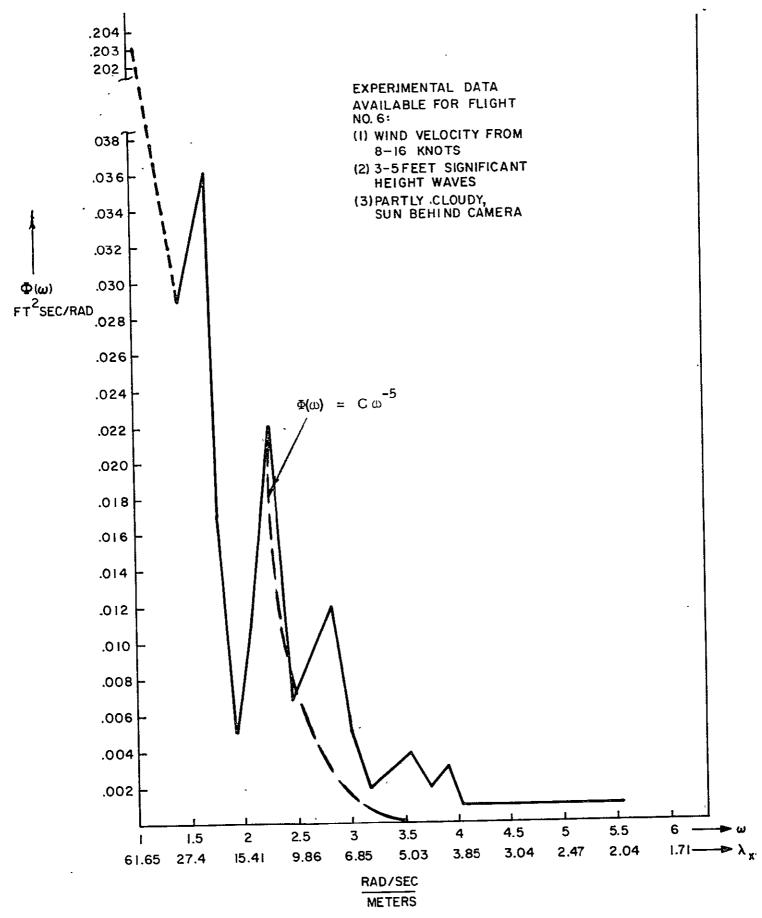


Figure 5-44. Energy Spectrum for Raytheon Flight No. 6

These line spectra agree quite well with line spectra taken by the laser profilometer on the previous day (see Appendix B).

The results of the Stilwell process of ocean spectra measurements are discussed in detail in Appendix B. The technique offers great promise because of the ease of implementation, but further work on processing methods is required before it can be used to provide valuable and reliable outputs.

SECTION 6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Radar Cross Section

The results do not indicate that average cross section (σ°) is functionally related to the large ocean wave parameters, i.e., wave height (Figure 5-1), wave period (Figure 5-2), or wave direction (Table 5-1). A functional relation appears to exist between σ° and wind speed. This seems entirely credible in light of the possible relation between wind speed and the generation of small high frequency capillary waves. This is particularly logical when one considers the dimensions of the capillaries (1.7 cm or less) and the dimensions of the transmitted X-band frequency (3 cm). Mr. John W. Wright^{1, 2} has shown that X-band backscattering at angles other than normal are highly dependent on capillary waves. Kinsman³ (see also Appendix C) has also shown that the slopes of capillary waves can be very high, even exceeding 90°, and that the average slope of waves is more affected by capillaries then by the large wind waves or swells.

The results also show that variations in σ° over the looking angles of 0 to 4 degrees are small at the various wind speeds (see Figure 5-4). This agrees in part with the curves developed by Moore and Schooley (see Figure 5-5).

Distributions of pulse amplitudes, and hence σ °, appear to be Rayleigh and independent of ocean parameters.

Cross polarized returns at normal incidence were found to be at least 30 dB down from the directly polarized returns.

6.2 Pulse Shape

Pulse shapes were recorded on film showing the relation between individual pulses and the integrated effect of many pulses. The individual pulses showed wide fluctuations in the trailing edge, especially immediately after the peak. The leading edge of the pulses, however, showed a consistent ramp with little fluctuation. The start of the leading edge did not vary significantly from pulse to pulse.

The multiple pulse tracings showed an integrated average effect which agrees with calculations performed by others^{4, 5}. The pulse returns show an integrating effect from the time of the first pulse returns up to the pulse width, and then a decay thereafter. The impulse response can then be determined as follows:

$$h(t) = k \int_{0}^{t} f(t) dt \qquad 0 < t < \tau \qquad (6-1)$$
$$= k e^{-t - \tau / T} \qquad t > \tau$$

where

f(t) .= the input pulse τ = pulse width T = decay time constant $= \frac{\theta_T^2 h}{2.77c}$ (see Ref. 4) k = a constant (6-2)

which includes σ° and all other radar range parameters.

From this we can derive $H(\omega)$ by performing the Fourier transform

$$H(\omega) = \frac{K}{j(\omega - \omega_{o})}$$
(6-3)

where $\omega_0 = 1/T$

$$K = k e^{\tau/T}$$
(6-4)

The above relations assume that the beamwidth of the radar is large compared to $\sqrt{c\tau/h}$, that a pulse limited condition exists. In actual calculations from the reduced data it was found that the transition region between pulse limited and beam limited condition occurred at an angle which was twice as large as the 3 dB beamwidth angle.

In summary, then, average pulse shapes agreed with that predicted by the theoretical computations. The peak pulse amplitude is determined by σ^{0} . The rise times are linear and equal to the pulse width and the decay times are related to altitude and beamwidth. No changes in σ^{0} with looking angle were found, and whether these could also affect decay time is unknown, Wave shapes were found to be independent of sea direction.

6.3 Ocean Parameters

As in all experiments involving reflections from a target, the characteristics of the target are never as well defined as they could be. It appears that measurements of capillaries are needed to fully determine a functional relationship between radar and ocean waves.

Of the ocean measuring techniques used in this experiment, the Stilwell process⁶ offers the greatest promise. It may provide the most comprehensive quantitative description of the ocean surface and could be operationally easy to implement. However, the total process is still in a research and development stage, and requires further theoretical and experimental evidence before it can be an accepted tool.

The good old-fashioned "eyeball" technique of measuring ocean waves again yielded the most reliable and consistent results, although lacking in definition, accuracy, and resolution. Laser profilometer measurements of wave spectrums did provide some valuable measurements, but the instrumentation and data reduction is more complex than Stilwell photography. Laser profilometry is, however, a more proven technique.

6.4 Recommendations

Further radar backscatter measurements should be made at X-band to verify that a relationship exists between radar cross section and small high frequency waves (capillaries). This is not primarily a radar problem, but it is an ocean parameter measurement problem. Techniques for making the ocean parameter measurements should be further developed, especially the Stilwell process.

An altimeter data processor should be developed which takes into account the leading and trailing edge characteristics discussed in this report. Such a data processor, or range tracker, should take into consideration the wide amplitude variations in the trailing edge near the peak, as well as the relatively minor amplitude variations on the leading edge.

The next phase of precision satellite altimetry experimentation should be started. This involves accurate range or altitude measurements on a ground test range in order to calibrate equipment delays, and in an aircraft in order to measure altitude biases.

Further flight tests should include correlation measurements between pulses, waveform sampling techniques, and evaluation of candidate data processors.

The data gathered in this experiment should be further analyzed in order to determine rise and fall times as well as the distribution of amplitudes as a function of time.

REFERENCES

- 1. John W. Wright, "Backscattering from Capillary Waves with Application to Sea Clutter," IEEE Transaction AP-14, Nov. 1966.
- John W. Wright, "A New Model for Sea Clutter," IEEE Trans. AP-16, March 1968.
- 3. B. Kinsman, Wind Waves Prentice Hall Inc. 1965
- 4. Space Geodesy Altimetry Study, Appendix R-A, Raytheon Company Final Report, R-68-4459, October 1968.
- 5. R. K. Moore and C.S. Williams, Jr., "Radar Terrain Return at Near Vertical Incidence," Proc. IRE Vol. 45, pg. 228, Feb. 1957.
- Denzil Stilwell, Jr. Directional Energy Spectra of the Sea from Photographs, JGR Vol. 74, No. 8, Pg. 1974, April 1969.

APPENDIX A

COMPUTER PRINTOUT OF FLIGHT TEST DATA

This appendix contains the results of the data processing program described in Section 4.1.4. It includes a listing of all the ocean and radar parameters for all of the flights, along with σ° calculations for all of the selected frames. Average σ° 's, standard deviations, and frequency distributions were calculated for various groupings of σ° . The results are divided into five sections as described below.

A-1. σ° Per Frame

This section includes significant ocean truth and radar parameters for each flight and for each run of each flight, and for each frame the calculated received power, target cross section, and radar cross section per unit area (all values in dB) using both the average return pulse peak and the absolute return pulse peak in the calculation of σ° .

A-2. <u>Average σ° Over All Flights</u>

The mean σ° and its standard deviation and sample size calculated over the ten selected flights are presented here.

A-3. Average σ° for Each Flight

This section includes the mean σ° , its standard deviation, and sample size calculated for σ° based on average power return and for σ° , based in turn on absolute peak power return for each flight. The one standard deviation boundary limits are included for both values of σ° . A histogram and cumulative probability distribution have also been calculated. The histogram is divided into two parts, the first is a frequency distribution over the spectrum of σ° values with each bar of the histogram being one half of a standard deviation wide, and the second

is a frequency distribution for values of σ° within the one standard deviation limits, with each bar being one eighth of a standard deviation wide. The cumulative probability was derived from the first histogram.

A-4. Average σ° for Selected Runs

The output presented here is similar to the input of the data of Section A-3, except that the results are based on selected runs rather than flights. This shows that σ° is independent of sea direction.

A-5. Average σ° vs. Pulses Per Frame for Each Flight

Here the average σ° is calculated for each variation of pulses per frame during each flight. The values of pulses per frame were 1, 50, 148, or 278.

APPENDIX A

FLIGHT TEST DATA ANALYSIS

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		10000	50	50	12	1	50 320	•
			5		k2	_	275	
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	7	10000	50	20	12	1	230	
	7 <u>H</u>	10000 <u>10600</u> 10000		20 20 2020	12 12 12	$\frac{1}{1}$	230 5 50	

NOT REPRODU

KCVD_PMR(DHM)AVRCVU_PWR(DHM)PEAKSIGMA_AVSIGMA_PEAKSIGMAZ(DB)_AVSIGMAZ(DB)_PEAKSIGMAZ(DB)_AVSIGMAZ(DB)_PEAKSIGMAZ(DB)_AVSIGMAZ(DB)_AVSIGMAZ(DB)_PEAKSIGMA_AVSIGMAZ(DB)_AVSIGMAZ(DB)_AVSIGMAZ(DB)_AVSIGMAZ(DB)_AVSIGMAZ(DB)_AVSIGMAZ(DB)_AVSIGMA_AVSIGMA_AVSIGMA_AVSIGMAZ(DB)_AV_AVSIGMAZ(DB)_AV_AV_AV_AV_AV_AV_AV_AV_AV_AV_AV_AV_AV_	<u>IK</u>
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FLIGHT SEA		AAVE HE FORT (E.L)	WAVE PERIOD(SEC)	WIND SPEED(KT) WI	IND DIRECTION	WATER TEMP(F) AL	R TEMP AIR PRES (MB)
6 330		4		12 330	, <u>(</u>	50 43	1028.00
RIN	ALTIION	H (FT) PULSES PI	R FRAME PULSE W	IDTH (NS) PLAK P	VWER POLARIZ	ATION(1) C54 H	EADING
				τ			
	<u> </u>		<u>100</u>	<u>12</u>	<u> </u>	<u>330</u> 340	
<u>1</u>	<u></u>	1	100	12	<u> </u>	150	
4	1500		100	15	2	60 330	
	<u>15009</u> 15009	<u>טל</u> וול	100	12	1		
	15000			12	<u>i</u>	240	
л 	15660 15660	5) 5)	100 100	12 12	1 1	15	
	15900			12_	<u></u>		
11	<u>15800</u> 15030	<u> </u>	<u> </u>	<u>12</u> 12	2	<u> </u>	
	150/10	<u></u>		k	ž	240	
14	15066 15090	59	100 100	12 ک	. 2	15	
- <u></u> <u>15</u> 16	<u> </u>	<u></u>	100	i2	<u>5</u>	150	
	20000	, 	100	12	<u>}</u>	330	
1× 14	() () () () را () () () فر	50 50	100	1212	1 1	285 240	
	20000	()(*	100	12	- - <u>1</u>	15	
<u>_</u>	20000	<u> אול</u>	<u> </u>	<u>]</u> 2]2		<u> </u>	
22 23	20000	ייר <u> </u>	100	12	<u>i</u>	.330	
24	1540	1	100	12	1	240	
<u>25</u>	- <u></u>		<u>_100 </u>	<u>12</u> 12	·	<u>150</u> 60	
_							
	FRAT	KCAD NAM (DHW) VA	RCAD AMK (DHW) SE	AK SIGMA AV	SIGMA PEAK	SIGMAZ(DB) AV	SIGMAZ(DB) PEAK
	1		•				
1	4+47		-4/.04	75.17	78.87	18,765	
b	+444		-48.37	74.55	78-14	18.153	21.741
	9449	<u></u>	-41+00	<u>74,43</u>	<u>- 78.28</u> 78.69	<u> </u>	<u>21.880</u>
				76+77	80.46	20.371	24.062
		-++++	-40.05				
	51 51 512		-44.10	14.14	77+75	18.339	21.349
	5.1 	-+ -+ - 14					21.349

7			5 3		<u></u>	58 49	1020.80
R114	<u>al 1100</u>	E (FT) PULSES PE	R FRAME PULSE WINTH	(NS) PEAK	POWER POLARI	ZATION(1) C54 H	EADING
	15000		20	12	<u>l</u>	<u>320</u> 275	
4	15660 [500)	<u>-</u>	<u>20</u>	12	1	275	
			<u></u>	<u> </u>	i	<u>-</u>	
5	15000	ч ч ч	20	12	ī	50	
, h	1,2419-1	444	20	15	1	140	
	FRAILE	RCVI, PRP (OBil) AV	RCVU PWR (I)BM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ (D8) AV	SIGMAZ (DB) PEA
		-97.53	-54.84	68.99	71.67	19.576	22.257
1	<u>'+ {+ } }</u>		-54.64 -53.34	67.06	73.17	19.644	23.760
i	41.4	-51.81	-54.5/	68+65	71.94	19.234	
<u>1</u>	4.14	-70+14	-54.09	69.78	72.42	20.365	23.008
<u>i_</u>	<u> 410 </u>	->1.21		69.25	<u>72.35</u>	<u>19.835</u>	22.943
1	411 	-5/.42		68+69	/1.16 /2.28	19.281 19.750	21.749 22.874
~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	427	-5/+55 -50+43	-54.23	<u>69.16</u> 69.68	73.52	20.271	24.110
2	424	-5.1.44	-55.65	68.08	70.86	18.665	21.451
	4.31)		-53.50	70.15	73.01	20,741	23.604
ę	431	-53.10	-53.62	70.40	72.89	20.984	23.482
	+33		-52.61	70.80	73+90	21,386	24.493
م	4 3 4	-54+51	-50.94	71.69	75.57	22.275	26.164
د	4,15	-50.76	-22.81	69.76	73.70	20.344	24.289
·		<u></u>		<u>70.19</u>	<u>74.25</u>	<u>20.781</u> 20.406	- <u>24.842</u>
م د	4.37 4.3%	-50•/U -55•!U	-21.04	71.41	73.95	21,998	24.536
	440	-57.10 -16			73.80	21.939	24.391
,	44)		-56.50	/0.87	73.72	21,459	24.304
2	442	-50.70	-51.71	70.82	74+60	21.405	25.188
	452	<u> </u>	-53.06	69.46	73.46	20.053	24.044
	454	-57+15	-54.09	69+46	72.42	20.046	23.009
<u>`</u> <u>`</u> .	454	<u>1</u>	<u></u>		72.92	<u>20.992</u>	23.505
5	+55	-71+45	-53, 18	69+06	73.13	19.646	23.720 22.999
	<u> 455</u> 452	-5/-11	-54.10	69.40	<u>72.41</u> 75.52	<u>19.986</u> 22.709	26.111
2	454		-50.555	70.55	74.64	21,142	25.233
	460	-52+63		70.88			25.340
أن ا	461	-55+75	-51.32	71.26	. 75.20	21.853	25.784
	462	-54.92		71.60	75.27	22,185	25.861
٦	464-		-51.15	71.93	75.36	22,519	25.952
1	406	-74 . 50	-52.25	71.56	74.26	22.144	24.853
- <u></u>	467			<u>/2.04</u> 70.10	<u> </u>	22.630	<u>25.446</u>
1 	40× 479	-20.41	-52.96 -54.63	68.77	71.88	19.356	22.467
	<u>479</u>				71.89		22.479
	481	-5/+43	-54.36	69.48	72.15	20.068	22.738
4	482	-5/.10	-52.97	69-41	73.55	20,002	24.135
4_	483	57.66	53.45	68.86	73.06	19_445	23.652
- 4	485	-55./3	-52.05	70.78	74 • 46	21.373	25.046
4_	446	<u></u>	54,17	72+62	74.34	21_211	24.931
4	488	-55.92	-52.95	70.60	73.56	21.184	24.149 23.785
<u> </u>	489 *	-55.86	-53,32	<u>70.65</u> 70.77	73.83	21.358	24.416
4	491 -	-55.74	-52.68	70.77	73.61	2].563`	24.202
<u>4</u>	<u>-442</u>	<u></u>	-53.79	69.91	72.72	20.502	23.306
4	47	<u></u>		70.94	73.32	21.532	23.905
<u>4</u>	495		-52.33	70.60	74.19	21.184	24.774
	506	-5/./.	-54.44	68.78	72.07	19.371	22.663

5	507	-58+4/	-54+25	68+04	72.26	18.631	22.854 23.528
	<u>508</u>		-54.20	<u>66.76</u> 68.63	72.31	19.222	22.901
5	509 510	-57.88 58.39	54.20 	68.13	71.83	18.715	22.422
	512		-53.62	69.34	72.89	19.926	23.476
5	513	-55.19	-56.47	71.32	. 74.04	21.913	24.627
<u> </u>	514	-54.46	-53.07	70.46	73+44	21.045	24.033
<u>``</u>			52.60	70.03	<u>73.91</u>	20_621	<u>24.502</u> 24.170
	516	-54.62	-52.93	69.89	73.58	20.484	25.101
- <u> </u>	<u></u>		52.00	71.77	<u>74•51</u> 73•60	22.149	24.192
5	514		-52.91	71.56	74.31	22.715	24.903
5	<u></u>	-54.33	-52.20	70.51	72.89	21.101	23.479
بر ب	っと0 วと上	-50.00 00		70_21	73.44	20.798	24.024
		-5].14	-56.88	65.37	69+63	15.960	20.222
Ä	533	-54.64	5513	66.82	71.19	17.406	2]775
6	534	-60.92	-5/.07	65.59	69.44	16.182	20.029
<u>h</u>	5.15	-01-63	-56.41	64-88	70.10	<u> </u>	20.949
6	536	-60.45	-56.15	66.06	70•36	20_688	23.499
<u>h</u>	<u>538</u>	<u>564</u> L	<u>51.60</u> -53.78	<u>70.10</u> 68.83	72.73	19,421	23.317
6	5.19	-5/.68 5/.63	-53.78 53.67	<u>68+88</u>	72,84	<u></u>	23.431
<u>_</u>	<u>540</u> 541		-54.05	68.66	72.46	19.246	23.047
0 6	542		-53.34	70.08	73.18	20.668	23.765
h	344		-52+04	70.57	74.48	21.157	25.065 24.962
<u> </u>	545	<u>5.03</u>	52.14	70.48	14.37	21.068	23.552
h	ካፋተ	-51.49	-53.55	69.03	72+96 75+25	19.616 22.379	25+839
<u></u>	541		<u>i, có</u>	<u>71.79</u>	75.10	21.369	25.692
· 6	54 8	-55./3	-51.41	10410			AIR TEMP AIR PRES(MB)
Ft IGHT SEA		<u>13</u> _1	<u>8</u> <u>19</u> <u>R FRAME</u> PULSE WIDTH	340 (NS) PEAK P		53 99 ZATION(1) C54	
8 340		<u>13</u> <u>13 PULSES PE</u>	R FRAME PULSE WIDTH	(NS) PEAK P		ZATION(1) C54	HEADING
<u>8 340</u> RUN		<u>13</u> <u>P}E (FT) PULSES PE</u>	<u>R FRAME PULSE WIDTH</u>	(NS) PEAK P		ZATION(1) C54	HEADING
8 <u>340</u> RUN 1 2	ALTIT	<u>13</u> <u>(F1)</u> <u>PULSES PE</u> <u>1</u>	R FRAME PULSE WIDTH	(NS) PEAK P		ZATION(1) C54	HEADING
<u>8 340</u> RUN		<u>1.3</u> <u>();; (F1)</u> <u>PULSES PE</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	<u>R FRAME PULSE WIDTH</u> 20 20 20 20 20 20	(NS) PLAK P. 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 <u>340</u> RUN 1 2 3	 1000 1000 1000	<u>1.3</u> <u>v)_F (F1) PULSES PE</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PLAK P 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 <u>340</u> RUN 1 2 3	<u>ALTIT</u> 1000 1000 1000 1000 1000 1000	13 PULSES PE PULSES PE 1 1 1 1 1 1 1 1 1 1 1 1 1	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54 34 25 25 25 25	HEADING
8 <u>340</u> RUN 1 2 3	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000	<u>1.3</u> <u>r)p (F1) PULSES PE</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25 25 25 25	HEADING
8 <u>340</u> RUN 1 2 5 4 5 4 5	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	<u>1.3</u> <u>r)t (F1)</u> PULSES PE <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 <u>340</u> RUN 1 2 3	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000	<u>1.3</u> <u>v)t (F1)</u> <u>p</u> <u>p</u> <u>p</u> <u>p</u> <u>p</u> <u>p</u> <u>p</u> <u>p</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25 25 25 25	HEADING
B 340 RUN 1 2 5 4 5 4 5 7 1 7 1 1 9 5 9 1 1 9 1 9 1 1 9 1 9 1 9 1 9 1	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	1.3 PULSES PL 1) 1 1 1 1 1 1 1 1 1 1 1 2 1 2 2 4 2 4 2 4 2 4 2 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25 25 25 25	HEADING
8 340 RUN 1 2 5 4 5 4 5 7 4 5 7 4 5 7 4 5 7 9 7 9 10 11 12	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	<u>1.3</u> <u>r)p (F1) PULSES PE</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
B 340 RUN 1 2 5 4 5 4 5 4 5 5 4 6 10 11 12 13 13	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	<u>1.3</u> <u>r)t (F1)</u> PULSES PE <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 2 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 1 2 5 1 5 1 2 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1	At TIT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	1.3 1); (F1) PUI SES 0 1 1 1 1 1 1 1 2 1 2 2 0 2 0 2 0 2 0 2 0 2 0 2 0 2 0 50	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
B 340 RUN 1 2 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 6 10 11 12 13 13	ALTIT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	13 PUL (F1) PUL SES PL 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25 25 25 25	HEADING
8 340 RUN 1 2 5 4 4 5 4 4 5 4 4 5 4 4 5 4 4 5 5 4 4 5 5 4 4 5 5 4 1 2 5 5 4 4 5 5 1 2 5 5 4 5 5 1 2 5 5 5 1 2 5 5 1 2 5 5 1 2 5 5 1 2 5 5 1 2 5 5 1 2 5 5 1 1 2 5 5 1 1 2 5 5 1 1 2 5 5 1 1 1 2 5 5 1 1 1 2 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1	At T LT 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	<u>1.3</u> <u>PULSES PE</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
B 340 RUN 1 2 3 4 5 5 4 5 4 5 1 6 7 10 11 12 13 14 15 16 17	At TIT 1000	1.3 1);; (F1) PUI SES Pr 1 1 1 1 1 1 1 1 1 1 2 1 2 2 0 2 0 2 0 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 - - <td></td> <td>1.3 1);; (F1) PULSES Pr 1 1 1 1 1 1 1 1 1 1 2 2 0 2 0 2 0 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50</td> <td>R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20</td> <td>(NS) PEAK P 12 12 12 12 12 12 12 12 12 12</td> <td></td> <td>ZATION(1) C54</td> <td>HEADING</td>		1.3 1);; (F1) PULSES Pr 1 1 1 1 1 1 1 1 1 1 2 2 0 2 0 2 0 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 - - <td>ALTIT 1000</td> <td>1.3 1);; (F1) PULSES Pr 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 0 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 778 0 274</td> <td>R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20</td> <td>(NS) PEAK P 12 12 12 12 12 12 12 12 12 12</td> <td></td> <td>ZATION(1) C54</td> <td>HEADING</td>	ALTIT 1000	1.3 1);; (F1) PULSES Pr 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 0 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0 778 0 274	R FRAME PULSE WIDTH 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 2 3 4 5 5 4 5 7 6 7 10 12 13 14 15 16 17 18 19 20 21 21	ALTIT 1000	1.3 1);; (F1) PULSES Pr 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50 0 778 0 2/4	R FRAME PULSE WIDTH 20 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 - - <td>ALTIT 1000</td> <td>1.3 1);;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;</td> <td>R FRAME PULSE WIDTH 20 20 <!--</td--><td>(NS) PEAK P 12 12 12 12 12 12 12 12 12 12</td><td></td><td>ZATION(1) C54</td><td>HEADING</td></td>	ALTIT 1000	1.3 1);;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	R FRAME PULSE WIDTH 20 20 </td <td>(NS) PEAK P 12 12 12 12 12 12 12 12 12 12</td> <td></td> <td>ZATION(1) C54</td> <td>HEADING</td>	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 2 5 4 5 4 5 6 7 9 10 11 12 13 14 15 16 17 1½ 20 21	ALTIT 1000	$\begin{array}{c c} 1.3 \\ \hline 1 \\ 1 \\$	R FRAME PULSE WIDTH 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25	HEADING
8 340 RUN 1 2 5 4 2 5 4 - 7 - 6 - 7 - 7 - 9 10 11 12 13 14 15 16 17 17 12 20 21 22 23	At T I T 1000	1.3 1);;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	R FRAME PULSE WIDTH 20 20 </td <td>(NS) PEAK P 12 12 12 12 12 12 12 12 12 12</td> <td></td> <td>ZATION(1) C54</td> <td>HEADING</td>	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12		ZATION(1) C54	HEADING
8 340 RUN 1 2 5 4 2 5 4 - 7 - 6 - 7 - 7 - 7 - 7 - 9 10 11 12 13 14 15 16 17 17 12 20 21 22 23	ALTIT 1000	<u>13</u> <u>()</u> ; (F1) PULSES PE <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12	OWER POLARIZ 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25	HEADING
8 340 RUN 1 2 5 4 2 5 4 - 7 - 6 - 7 - 7 - 7 - 7 - 9 10 11 12 13 14 15 16 17 17 12 20 21 22 23	ALTIT 1000	1.3 1);; (F1) PULSES Pr 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 0 2 0 2 0 2 0 50 0 50 0 50 0 50 0 50 0 50 0 278 0 278 0 278 0 278 0 278 0 278 0 278 0 278 0 278 0 278 0 278	R FRAME PULSE WIDTH 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12	OWER POLARIZ 1 1 1	ZATION(1) C54 34 25 25 25 26 26 27 26 27 26 27 26 27 27 27 27 27 27 27 27 27 27	HEADING HEA
8 340 RUN 1 2 5 4 2 5 4 - 7 - 6 - 7 - 7 - 7 - 7 - 9 10 11 12 13 14 15 16 17 17 12 20 21 22 23	ALTIT 1000	<u>13</u> <u>()</u> ; (F1) PULSES PE <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u>	R FRAME PULSE WIDTH 20 20	(NS) PEAK P 12 12 12 12 12 12 12 12 12 12	OWER POLARIZ 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 31GMA 63+06 63+06	ZATION(1) C54 34 25 25 25 25 25 25 25 25 25 25	HEADING

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2 706	-57-19	-57.19	62.28	62•28 63•21	14.629 15.563	14•629 15•563
 2 107	-56.26	~56.26	63-21	59.08	11.434	11+434
S (04 5 (04	-60.18 -56.78	-60.38	59.08 62.68	62+68	15.034	15.034
 		-58.80	60.67	60.67	13.022	13.022
3 713	-60.45	-60.65	58.61	58+61	10.964	10.964
 3 714	-61.80	-61.80	57.67	57.67	10.020	10+020
3 /15	-02.25	-62.25	57.22	57.22	9,567	9.567
 - 3 716	-63+02	-63.02	56.44	56.44	8.794	8.794
 4/14			57.52	57.52	9.872	9.872
4 /20	-62-41	-62.41	57.06	57.06	9.409	9.409
 <u> 4 (21 </u>	-59.99	-59.99	<u> </u>	<u> </u>	<u>11.832</u> 11.227	<u>11.832</u> 11.227
4 722	-60.59 -59.49	-60.59	58.88 59.98	58•88 59•98	12.326	12.326
 5 725	<u></u>	-60.44	59.03	59.03	11,379	11.379
5 726	-58.76	-58.76	60.71	60.71	13.055	13.055
 5 727	+60.34	-60.34	59.13	59.13	11,475	11.475
 <u> </u>	56.98	-56.98	62.49	62.49	14.838	14.838
0 b h m	-57.83	-59,83	59.64	59.64	11,992	11.992
6 /31	-64.36	-64.36	55.11	55.11	7,463	7.463
6 733		-60.71	58.76	58.76	11.108 15.698	11+108 15+698
 $\frac{6}{13}$ - $\frac{734}{795}$			<u>63.35</u>	<u> </u>	16.200	
13 795 13 796	-55.62 -55.19	-51.12	63.85 64.28	67.64	16.625	19.993
 				68.35	17.026	20.703
13 798	-50.59	-50.27	62.88	69.20	15,228	21.552
 13 799	-54.99	-50.54	64.48	68.93	16,829	21.279
 13 800	-56+40	-52.02	63.07	67.45	<u>15.418</u>	19.800
 <u>13 801</u>	-50.41	-51.41	63.06	68+06	15,405	20+410
 <u>13 802</u>	-56.06		63.41	69.32	15.756	21.666
13 803	-55.77		63.70	68.90	16.047	21.250 20.504
 <u>13 804</u> 13 805	-56.50	-51.31	<u>62.97</u> 63.10	<u>68.15</u> 68.85	<u>15.319</u> 15.448	21+195
` 13 805 13 806	・+56+37 +55+38	-51.74	64.09	67.73	16.438	20.083
 1.1 807	-56.82		62.65	67.82	14.997	20.174
13 606	-57.35	-52.63	62.12	66.84	14.465	19.190
 13 809	-57.18	-52.09	62.09	67.38	14,440	19.729
 1 5 810	-5/-17	-51.57	62.30	67.90	14.650	20.251
13 ні1	-50.65	-51.20	62.82	68.27	15,171	20.616
 <u>13 H12</u>	57.17		62.30	68.48	14.652	20.833
13 813	-56.44	-51.03	62.62	68.44	14.973	20.787
 $\frac{13}{14}$ $-\frac{814}{816}$ $$	-58.84		<u>63.45</u> 60.63	<u>68.62</u>	12.978	
14 817	-58.29	-54.02	61.18	65.45	13.533	17.798
14 818	-56.43	-53.22	63.04	66.25	15.390	18.600
14 819	-59.98	-55.99	59.48	63.48	11.834	<u> </u>
 14 H20	-50.74	-55.26	62.73	64.21	15,080	16.560
 14 821	-56+29		63.18	64.90	15.527	<u>17.248</u>
 14 822	-55.85	-53.97	63.62	65.50	15.968	17.845
14 823	-59.40	-55,57	60.07	63.89	12,423	. <u>16.244</u>
14 824	-5/.53	-55.11	61.94 60.31	64.36	14.293	16.996
 <u>14 825 1</u> 4 825	-57.65	-54.69	61•82	<u>64+78</u>	14.173	17+132
14 .827	-58,49		60.98	64.29	13_329	16+635
 14 828	-58.91	-55.37	60.56	64.10	12.910	16,452
 14 .829	-5/.43	-54.57	62.04	64.90	14.391	17.249
14 830	-51.43	-54.45	62.04	65.02	14.392	17.365
 <u> 14 </u>	58,23	54.94	61+24	64.53	13.589	<u> 16•879 </u>
14 832	-54.00	-54.88	61.47	64.59	13.821 <u>13.238</u>	16.940
 <u>14</u>	58.58		<u> </u>	<u>64•49</u> 65•37	<u>L3+238</u> 13+670	<u>16+840</u> 17 ₀ 717
14 H34 14835	-58.15	-54.77	61.99	64.70	14.344	17.048
 <u>14 835</u> 15 837	-58+14	-55.16	61.33	64.31	13.678	16+663
<u>15838</u>	-50.49	53,92	62.98	65.55	15.330	17.902
 15 839	-57.20	-53.88	62,27	65.59	14+623	17.939
 15 840	-56.42	-53.46	63.05	66.01	15.399	18.363
 15 541	-50+83	-53+17	62.64	66+29	14.985	18+644
 15 442	-51.23	-53.44	62,24	66.03	14.593	18.377
 15 843	-56+44	-53.31	63,03	66.16	15.381	18+506

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	15 15	845 - 846	-56.96	-53.64 	62.51 61.68	65.82	14.855	18+174 17+349
	15	847	-57.87	-54.09	61.60	65.38	13.946	17.731
	15	848	-50.60	-54.01	62.87	65.46	15.217	17+809
	15	849	-57+09	-53.86	62+38	65+61	14.732	17+958
	<u> </u>	<u> </u>	<u>-50+98</u>	53.40	62.49	66.07	14,835	18+420
	15	851	-59.45	-55.34	60.02	64.13	12.366	16,482
	$\frac{15}{15}$ -	<u>H52</u>		<u>-53.78</u> -53.55	62.62	65.69	14.968	18+040
	15	853 854	-55.60 -56.16	-53.32	63+81 63+30	65.92	16.155 15.653	18+267 18+495
	15	855	-51.28	-52.89	62.19	<u> </u>	14,542	18.932
	15	856	-57.69	53.98	61.78		14.131	17.642
	16	858	-57.44	-54.68	62.03	64.78	14.375	17.134
	16	859	-57.09		62.38	65.56	14,728	17.906
	16	860	-57+68	-53,35	61.79	66+12	14.142	18.465
4	16	861	-55+62	-53.00	63.85	66+47	16.195	18.820
	10	862	-57.08	-53.14	62.38	66+33	14.734	18.675
	<u>16</u>	863		53.76	62.40	65.71	14.746	18+057
	16	864	-57.28	-53.25	62.19	66.22	14.543	18.569
	$\frac{16}{16}$	865	-56.56	-53.30	62.91	66.17	15.255	18.523
	16	866 867	~55.41 -57.44	-52.72 -54.60	64.06 62.03	66.75	16.411 14.376	19.095 17.218
	16	868	-57.44	-53.89	62.03	65+58	14.377	17.933
	16	869	-57.75	-54.26	61.72	65.21	14.067	17.559
	16	870	-57.89	-54.92	61.58	64.55	13,927	16.902
	16	<u> </u>	-58.30		61.16	64.83	13.514	17.175
	16	872	-58.52	-54.17	60+95	65.30	13.301	17.650
	16	873	-57.59	-54.54	61.87	64.93	14,224	17.277
	16	874	-57.61	-53.78	61.86	65.69	14.210	18.037
	$\frac{16}{16}$	- <u>875</u>		-53.54	<u>61.70</u> 62.29	<u>65.92</u>	<u> </u>	<u>18.274</u> 17.615
	16	877	-56.41	-54.20 - 53.34	62.56	66.13	14.909	17+615
	<u> </u>	879	-58+47	-55.45	61.00	64.02	13.353	16.373
	17	880	-57.53	-54.21	61,94	65.26	14,291	17.608
۲	17	881	-57.10	-53.99	62.37	65.48	14.719	17.826
	17	882	-56.68		62.79	65.50	15,142	17.845
	17	883	-55.37	-53.63	64.10	65.84	16.446	18.192
	17	884	<u>-56.80</u>	53.66	62.67	65.81	15.016	<u>18.161</u>
	17	885	-54.16	-54.21	61.31	65.26	13.658	17.606
	<u>17</u> 17	886	-58+29	-54.46	61.18	65.01	13,533	17.356
	17	н87 <u>яне</u>		-54.02	62.23	65•45 65•87	14.579	17•795 18•224
	<u>17</u>	- <u></u>		-54.11	61.94	65.36	14.291	17.707
	17	490	-55.94	~54.23	63.53	65.24	15.878	17.591
m	17	891	-57.83	-55.79	61.64	63.68	13.986	16.030
	17	8451	-58.83	-55.09	_ 60.64	64.38	12,987	16.731
	17	843	-58+91	-55.41	60.56	64.06	12.912	16.412
	<u>l/</u>	894		<u> </u>	59.71	63.24	12.064	<u>15.593</u>
		895	-58+31	-54.66	61.16	64.81	13.512	17+156
	$\frac{17}{17}$	<u>896</u> 897	<u>-57+38</u> -58+21	<u>-54.38</u> -55.41	<u>62.09</u> 61.26	65.09	$\frac{14.441}{13.608}$	
	17	898	-50+21	-54.57	62.77	64.90	13.608 15.116	16.412 17.253
	18.	900	-58.67	-55.04	60.80	64.43	13,147	16.777
	18	901	-57.29	-54.30	62.18	65.17	14.532	17.518
	18		-57.00		62.46	65.29	14.814	17.643
. 	<u>1</u> H	903	-57.15	-54.11	62.32	65.35	14.665	17.704
	18	904	-51.02	-54.02	61.84	65.44	14.194	17.795
	<u>1н</u>	905	-5/.68	-54.13	61.79	65.34	14.137	17.690
	18	906	-5/.47	-54.67	62.00	64.80	14.346	17.153
	<u> </u>	907	-58.46	-53.87	61.01		13.363	17.947
	18 18 •	969 798	-50.60 -57.71	-53.97 -55.26	62.87	65.50 64.20	15.220	17.848 ´ 16.554
	<u>-1</u>			-54.89	61.77	64.58	14.124	16.931
	18	911	-56.28	-54.62	63.19	64.85	15.542	17.203
	14	912	-58.17	-54.69	61.30	64.78	13.647	17.130
	1H	913	-58.61	-54.61	60.86	64+85	13.208	17.204

Int Vito		18	914	-54.06	~55.14	61.41	64+33	13.758	16.681		
is yi7 -59.20 -59.85 66.19 63.41 12.592 15.959 is yi4 -59.19 -59.45 60.36 64.22 13.652 16.3657 is yi4 -59.19 -59.45 60.36 64.22 13.652 16.3657 is yi4 -59.19 61.29 65.47 14.733 17.854 is yi4 -51.75 -59.95 61.75 64.552 13.865 16.868 is yi4 -51.75 -59.95 61.72 64.551 16.952 is yi4 -51.75 -59.406 61.72 65.461 15.281 16.027 is yi4 -51.761 -59.406 61.72 65.461 15.281 16.297 is yi4 -51.761 63.56 63.56 16.407 17.762 is yi4 -51.76 63.55 63.51 14.305 17.91 is yi4 10.25 -51.52 63		1 H	915			61.07	64.08	13.423	<u>16.431</u>		
In OIA -55.45 61.28 64.42 13.632 16.369 14 -923 -54.68 61.38 65.12 12.707 17.467 14 -923 -54.68 61.38 64.73 13.733 17.182 14 -924 -51.49 -53.49 61.75 64.43 14.102 16.688 14 -924 -51.49 -53.49 61.75 64.43 14.102 16.986 14 -924 -51.49 -53.49 62.21 64.45 14.102 16.996 14 -924 -51.49 -54.40 61.72 64.49 14.4555 17.467 21 -94 -54.40 61.90 65.57 14.284 17.417 21 94 -54.40 61.90 65.56 14.284 17.52 24 1032 -56.40 61.90 65.56 15.076 15.076 24 1034 -57.27 -53.176 62.73 65.71 15.9		<u> 1</u> 4	910		-55.85						
16 13 13 14 14 15 16 17 18 17 17 18 18 17 17 18 18 17 17 18 18 17 <th13< th=""> 17 18 17<</th13<>		18	917	-54.28							
14 V22 -VALAD		18	AIN	-56.19	+55+45						
1v v22 -57.45 -53.92 61.92 -65.47 14.337 17.824 1v v42 -51.76 -54.95 60.72 64.52 13.065 16.066 1v v42 -51.76 -54.95 60.72 64.65 14.005 19.285 1 v65 -55.46 -53.73 62.63 65.66 14.005 17.722 21 v67 -56.46 -52.66 61.72 65.41 14.005 17.722 21 v67 -57.45 -54.90 60.172 65.41 14.005 17.722 24 1944 -54.40 -54.96 63.172 65.61 12.954 17.722 24 1932 -56.10 -55.46 62.155 65.13 13.300 17.532 24 1934 -56.72 -53.76 62.73 62.71 13.300 17.532 24 1934 -56.72 -53.76 62.73 62.71 13.300 17.9533		18	414	-59.11							
19 19 10<		-16-	923	-58.09	-54.68	61.38					
19 426 -51.75 -51.95 60.72 64.52 13.065 14.064 17 426 -51.74 62.03 62.63 15.281 16.727 17 460 -51.74 62.03 62.63 15.281 16.027 17 460 -51.74 -52.63 62.63 65.83 14.977 17.762 21 461 -51.74 -51.66 61.72 65.41 14.057 17.762 21 464 -51.76 -51.66 61.72 65.41 14.057 17.762 21 464 -51.76 -51.66 62.72 65.71 16.255 17.761 24 1033 -55.70 -51.76 62.72 65.10 115.10 17.532 24 1034 -55.72 -53.76 62.73 65.70 15.60 15.60 24 1034 -55.72 -53.86 62.73 65.70 15.60 17.983 24 1046 -77		19	924	-57.48	-53,99	61.99	65.47				
iv yes -5.1/2 -5.1/2 61/75 64.65 14.102 14.925 14.102 iv yes -5.1/2 -5.1/2 62.2/3 64.44 14.555 16.287 iv yes -5.1/3 -5.1/3 62.2/3 64.44 14.555 16.287 iv yes -5.1/3 -5.0/6 61.72 65.61 14.255 16.287 iv yes -5.1/3 -5.0/6 61.72 65.67 14.255 17.762 iv yes -5.1/6 -5.1/6 65.71 15.51 17.762 iv yes -5.1/6 -5.1/6 62.73 65.11 15.51 17.752 iv yes -56.72 -55.36 62.75 65.60 15.079 17.552 iv yes -56.72 -55.75 65.70 15.079 17.552 iv yes 30 290 61 20 101.50 iv yes 30 2						60.72		13.065			
IV Q27 -51.76 -54.153 62.21 64.94 14.555 17.285 21 Q65 -54.15 -53.17 52.95 52.95 15.756 17.762 21 Q67 -57.173 -54.96 61.72 65.81 14.067 17.762 21 YGA -57.166 -51.90 60.172 65.86 12.854 17.417 21 YGA -57.166 -51.90 60.50 65.86 12.854 17.914 24 1032 -55.40 -51.90 60.556 65.86 12.857 17.417 24 1032 -55.40 -55.72 -53.76 65.71 15.079 17.532 25 1033 -55.72 -53.36 62.75 65.60 115.097 17.555 25 1046 -55.72 -53.36 62.75 65.60 116.097 17.555 25 104.100 104.100 104.059 104.059 104.059 24 1033 <td></td> <td></td> <td></td> <td></td> <td></td> <td>61.75</td> <td>64.65</td> <td>14.102</td> <td></td> <td></td>						61.75	64.65	14.102			
21 045 -56.54 -53.74 62.93 65.668 15.281 14.027 21 060 -21.72 -56.06 61.73 62.63 14.07 17.417 21 060 -51.40 61.73 62.63 14.07 17.417 21 060 -55.40 -53.40 60.55 12.654 17.914 24 1032 -56.40 -53.156 63.16 65.61 15.514 14.255 24 1034 -56.40 -53.156 62.52 65.18 13.300 17.535 24 1034 -56.42 -54.29 60.59 65.18 13.300 17.535 24 1034 -56.72 -53.76 62.72 65.18 13.607 17.953 24 1034 -56.72 -53.76 62.72 65.18 13.607 17.953 24 1044.0147 NAVE HERADIARCION MAVE HERADIARCION MAR PRESIM 9 240 / 99 30<	·					62.21	64.94	14.555	17.285		
21 365 55 14 777 18 18 21 367 -74 75 -54 30 62 63 14 777 17 16 21 364 -74 75 -54 40 61 90 55 17 17 65 17 17 16 21 364 -56 74 16 65 16 15 16 17 16 16 17 16 16 17 16 16 17 17 16 16 17 17 16 16 17 16 16 17 17 16 16 17 17 15 16 17 30 17 15 16 17 30 17 15 16 17 30 17 15 16 17 16 16 16 16 16 16 16 16 16 16 16							65.68		18.027		
21 957 -57.75 -54.06 61.72 65.41 14.067 17.62 21 964 -57.50 -54.40 61.90 65.97 14.254 17.617 21 964 -54.40 -51.90 60.50 65.57 12.854 17.617 24 1032 -56.72 -53.36 63.16 65.61 13.300 17.532 24 1034 -56.72 -53.76 62.73 65.71 15.077 16.055 24 1034 -56.72 -53.76 62.75 65.60 15.097 17.953 25 1034 -56.72 -53.76 62.75 65.60 15.097 17.953 26 1034 -56.72 -53.76 62.75 65.60 15.097 17.953 9 240 / 92.00 61 28 1016.50 9 240 / 92.00 61 28 1016.50 9 240 / 92.00 61 28 1016.50 9 240 / 92.00							65.83	14.979			
21 Whit -54.46 61.90 65.07 14.234 17.411 21 96.9 -54.46 -51.96 60.550 65.551 16.551 17.552 24 1032 -54.36 62.56 65.57 15.551 17.532 24 1034 -54.76 62.76 65.75 15.130 17.532 24 1034 -56.72 -53.76 62.75 65.67 15.078 18.697 24 1035 -56.72 -53.76 62.75 65.60 15.097 17.953 25 103.4 -56.72 -53.76 62.75 65.60 15.097 17.953 26 103.4 -56.72 -53.76 62.75 65.60 15.097 17.953 71.010 WAVE HEIGHT(FT) WAVE PERIOD(SEC) WIND SPEED(RT) WIND STRECTION WATER TEMP (F) AIR TEMP AIR PRESING 9 240 / 99 30 290 61 28 1016.50 9 240 / 99 30 290 61 28 1018.60 <td></td> <td></td> <td></td> <td>-5/.75</td> <td></td> <td>. 61.72</td> <td>65.41</td> <td>14.067</td> <td></td> <td></td>				-5/.75		. 61.72	65.41	14.067			
21 94 53.490 60.50 65.56 12.654 17.914 24 1032 -56.30 -53.56 63.16 65.591 15.14 16.255 24 1033 -56.40 -54.46 62.56 65.41 14.916 17.752 24 1034 -56.70 -53.76 60.73 65.71 15.078 164.65 24 1034 -56.72 -53.76 62.75 65.60 15.697 17.953 24 1034 -56.72 -53.76 62.75 65.60 15.697 17.953 24 1034 -56.72 -53.76 62.75 65.60 15.697 17.953 25 52.37 -53.72 -53.72 -53.75 62.75 65.60 15.697 17.953 26 1034 -56.76 17.963 17.963 17.963 17.963 29 29 3 290 61 28 1018.59 29 29 3				-5/.56		61.90	65.07	14.254	17.417		
24 1632 -56.40 -53.56 63.16 65.91 15.514 18.255 24 1034 -56.40 .62.66 .62.61 14.914 17.759 24 1034 -56.47 .62.76 .65.18 13.300 17.532 24 1034 -56.72 -53.46 .62.73 .65.18 13.300 17.532 24 1034 -56.72 -53.46 .62.73 .65.61 15.697 17.983 7 .93 .66 .273 .65.61 15.697 17.983 9 200 / .99 .30 .290 .61 28 1018.59 9 200 / .99 .30 .290 .61 28 1018.59 9 200 / .99 .30 .290 .10 .26 HEADING 9 200 / .99 .30 .290 .10 .26 HEADING 9 200 / .99 .30 .290 .41 .41 .41 .41 .41 <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>65.56</td> <td>12.854</td> <td></td> <td></td>	1						65.56	12.854			
24. 1033 -56.00 -54.26 62.56 65.41 14.914 17.759 24. 1034 -54.22 -54.29 60.95 65.18 13.300 17.532 24. 1035 -56.72 -53.76 62.75 65.60 15.978 18.959 -24. 1036 -56.72 -53.76 62.75 65.60 15.977 17.953 FLIGHT SEA DIMECTION WAVE HEIGHT (FT) WAVE PERIOD(SEC) WIND DIRECTION WATER TEMP(F) AIR TEMP AIR PRESIM 9 290 / 99 30 290 61 26 1018.50 RUN AL (TIUDE(FT) PULSES PER FRAME PULSE WIDTH(NS) PEAK POWER POLARIZATION(1) C54 HEADING NO DATA COLLECTED UN_THIS FLIGHT FRAME RCVD PUR (DBH)AX RCVD PUR (DBH)PEAK SIGMA AV SIGMA PEAK SIGMAZ(DB) AV SIGMAZ(DB) PEAK FLIGHT SFA DINFCTION WAVE PERIOD(SEC) WIND SPEED(KT) WIND DIRECTION VATER YEMP(F) AIR TEMP AIR PRESIME PLOTA SFA DINFCTION WAVE PERIOD(SEC)							65+91	15,514	18.255		
24. 1034 -54.29 -56.74 -53.76 62.73 65.71 13.00 17.532 24. 1035 -56.72 -53.76 62.73 65.70 15.078 18.659 24. 1036 -56.72 -53.76 62.73 65.60 15.078 18.659 7 7.933 -56.72 -53.76 62.75 65.60 15.078 18.659 9 290 / 99 30 290 61 28 1018.50 9 290 / 99 30 290 61 28 1018.50 9 290 / 99 30 290 61 28 1018.50 9 290 / 99 30 290 61 28 1018.50 9 290 / 99 30 290 61 28 1018.50 9 290 / 90 30 290 61 28 1018.50 9 290 30 290 10 30 10 10 10 10								14.914	17.759		
2% 103% -5%.7% -53.76 62.75 65.70 15.07 15.07 17.953 FLIGHT SEA DIRECTION WAVE METCH (FT) WAVE PERIOD(SEC) WIND SPEED(KT) WIND DIRECTION WATER TEMP (F) AIR TEMP AIR PRESCH 9 200 / 90 30 290 61 28 1018.50 9 200 / 90 30 290 61 28 1018.50 9 200 / 90 30 290 61 28 1018.50 9 200 / 90 30 290 61 28 1018.50 9 200 AL (TILUDE (FT) PULSES PER FRAME PULSE WIDTH(NS) PEAK POWER POLARIZATION(1) C54 MEADING 10 DATA COLLECTED UN THIS FLIGHT FRAME RCUD PWR (OBH) PEAK SIGMA AV SIGMAZ (OB) AV SIGMAZ (OB) PEAK FLIGHT SFA DIRECTION WAVE HEIGHT (PT) WAVE PERIODISEC) WIND SPEED(KT) WIND DIRECTION WATER TEMP AIR PRES(MI								13.300	17.532		
24 103A -56:72 -57:96 62:75 65:80 15:097 17:953 FEIGHT SEA DIHECTION WAVE HEIGHT(FT) WAVE PERIOD(SEC) WIND SPEED(KT) WIND DIRECTION WATER TEMP(F) AIR TEMP AIR PRESCHE 9 200 1 280 61 28 1018:50 NUN ALTITUDE(FT) PULSES PER FRAME PULSE WIDTH(NS) PEAK POWER POLARIZATION(1) C54 HEADING NO. DATA COLLECTED ON THIS FLIGHT											
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9 240 / 99 30 290 61 28 1018-50 RUN ALTITUDE (FL) PULSES PER FRAME PULSE WIDTH(NS) PEAK POWER POLABIZATION(1) C54 HEADING NO DATA COLLECTED UN THIS FLIGHT FRAME RCVD PWR(DBH)AV RCVD PWR(DBH)PEAK SIGMA AV SIGMA2(DB) AV SIGMA2(DB) AV FRAME RCVD PWR(DBH)AV RCVD PWR(DBH)PEAK SIGMA AV SIGMA2(DB) AV SIGMA2(DB) PEAK FRAME RCVD PWR(DBH)AV RCVD PWR(DBH)PEAK SIGMA AV SIGMA2(DB) AV SIGMA2(DB) AV SIGMA2(DB) PEAK FRAME RCVD PWR(DBH)PEAK SIGMA AV SIGMA2(DB) AV SIGMA2(DB) PEAK FIGHT (FT) WAVE PERIOD(SEC) WIND DIRECTION WATER YEMP (F) AIR TEMP AIR PRES (MI 10 3 1019-80 MUN ALTITUDE (FT) PULSE MIDTH(NS) PEAK POWER <td col<="" td=""><td></td><td>64</td><td>1030</td><td>-50.72</td><td>-53,00</td><td>02010</td><td>05000</td><td></td><td></td><td></td></td>	<td></td> <td>64</td> <td>1030</td> <td>-50.72</td> <td>-53,00</td> <td>02010</td> <td>05000</td> <td></td> <td></td> <td></td>		64	1030	-50.72	-53,00	02010	05000			
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RUN AL [1]UDE (F]) PULSES PER FRAME PULSE WIDTH(NS) PEAK POWER POLARIZATION(1) C54 HEADING NO <data< td=""> COLLECTED UN THIS FLIGHT </data<>	-	240		·	 99	30	290	61	281018.5	<u>.</u>	
RUN ALTITUDE (FT) PULSES PER FRAME PULSE HIOTH(NS) PEAK POWER POLARIZATION(1) C54 HEADING 1 5000 1 10 3 1 180 2 5000 1 10 3 1 90 3 5000 1 10 3 1 360 4 5000 1 10 3 1 180 5 5000 2 10 3 1 180 6 5000 2 10 3 1 180 7 5000 2 10 3 1 180 7 5000 2 10 3 1 180 90 2 10 3 1 180 90 2 10 3 1 180 90 10 10 3 1 180 14 5000 10 3 1 180	 	<u>NO [</u>				PEAK SIGMA AV	SIGMA PEAK	SIGMAZ (DB)	AV SIGMAZ (DE) PEAK	
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		SFA <u>8888</u> <u>RUN</u> 1 -2 -3 -4 -5 -6 -7 -7 -7 -9 -10 -12 -13	FRAME DINFCTION ALTITUE S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000	RCVI) PWR (DBM) AV WAVE HEIGHT (FT) 0	V RCVD PWR (OBM)1 WAVE PERIOD (SEC) 99 PER FRAME PULSE 10 10 10 10 10 10 10 10 10 10	WIND SPEED(KT)	WIND DIRECTION 80 K POWER POLAR 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1	WATER TEMPIFI	AIR TEMP AIR 27 1019.8 27 1019.8 254 HEADING 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180 90 360 270 180	PRESING	
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19 5000 148 10 3 1 360		SFA 8888 RUN 1 2 3 4 5 6 7 8 9 9 10 11 12 13 14 15 16	FRAME DINFCTION ALTITUT S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000	RCVI) PWR (I)BM) AV WAVE HEIGHT (FT) 0 0 0 0 0 0 0 0 0 0 0 0 0	V RCVD PWR (OBM)1 	WIND SPEED(KT)	WIND DIRECTION 80 K POWER POLAR 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1	WATER TEMPIFI	AIR TEMP AIR 27 1019.8 254 HEADING 180	PRESIMB	
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$\underline{20} \underline{5000} \underline{148} \underline{120} \underline{10} $		SFA 8888 RUN 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	FRAME DINFCTION ALTITUE S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000 S000	RCVD PWR (DBM) AV WAVE HE IGHT (FT) 0	V RCVD PWR (OBM)1 WAVE PERIOD (SEC) 99 PER FRAME PULSE 10 10 10 10 10 10 10 10 10 10	WIND SPEED(KT)	WIND DIRECTION 80 Image: Second state	WATER TEMPIFI	AIR TEMP AIR 27 1019.8 27 1019.8 24 HEADING 180 90 360 270 360 270 360 270 360 270 360 270 360 270 360 270 360 270 360 270 360 270 360 270 360 90 90	PRESIMB	

	13	1645	-84+01	-80.87	49.44 <u>. 51.43</u>	52+58	7.812	10.953
· — ————	<u>14.</u> _ 13	<u>1650</u> lo51	<u>-H2+02</u>	<u>-79.69</u> -79.53	<u>·</u> 51 <u>+94</u> 51+12	53•92	9.489	12.289
	13	1676	-/6.70	-74.83	<u>56,75</u>	58.62	15,116	16.989
·	14	1690	-80.80	-77.89	52.64	55.56	11.014	13,927
	14	1691	-79.67	-76.74	53.78	56.71	12.148	15.077
	14	1945	-80.34	-76.92	53.11	56.52	11.480	14.894
	<u>_15_</u> .	<u>_1735</u>	82.30	<u>-78.55</u>	51.15	54.89	<u>9.523</u> 10.677	<u>13,264</u> 13,763
	15 15	1735	-81+14	-78.06	52•31 53•35	55+39 55-49	10.877	13.862
	16	1774	-80.11	-76.79	53.34	56.66	11.708	15.030
;	16	1/15	- (9.17	-77.45	54.28	56.00	12.648	14.367
	16	1776	-77.99	-75.72	55.46	57.73	13.826	16.102
	17	<u>_1816</u>	77.86	=75.14	51.52_	58.31	13.956	16.677
	17	1817	-75.93	-73+31	57,52	60+14	15.886	18.509
	- <u>+</u>	<u>_ lete</u>		-71.54	<u>58.91</u> _ 58.04	<u>61•91</u> 61•40	<u>17.284</u> 16.409	<u>20.282</u>
•	17 17	1819 1820	+75+41 -75+85	-73.32	57.60	60.13	15.968	18.500
	18	1458	-/9.45	-76.16	. 54.00	57.29	12.368	15.656
	18	1859	-79.80		53.65	59.47	15.016	17-836
	18	1850	-74.58	-70+01	53.77	57.44	12.139	15.812
	18	<u>1861</u>	<u> </u>	-75.16	<u>55.14</u>	58.29	$\frac{13.507}{0.05}$	16.656
	18	1862	-78.78	-75.74	54.67 53.58	57+71 56+31	13.035 11.954	16.079 14.679
	<u> 4</u>]4	<u>1900</u> 1901	-79,86	-71.14	53.95	57.46	12.325	15.828
	19	1401	<u>-19.49</u>	-76.06	52.99	56,79	11.364	15.158
	19	1403	-40.24	-7/.17	53.16	56.28	11.529	14.647
	14_	1904	-19.21	76.04	54.17_	57.41	12_544	15.782
	20	1942	-HU.25	-76.60	53.20	56.79	11.573	15.161
	20	1943	-80.40	-75.82	53.05	57.63	11.423	16.003
	20	1944	-79.43	-76.08	54.02 <u>52.52</u> _	57•37 <u>56•67</u>	12.388 10.886	15.736 15.038
	20	<u>1945</u> 1945	<u></u>	-76.39	53.98	57.06	12.349	15.427
FL 1GHT	5F 4	DIRECTION	WAVE HEIGHT (FT)	WAVE PERIOU (SEC)	WIND SPEED (KT)	WIND DIRECTION.	WATER TEMP (F)	AIR TEMP AIR PRES (MB
11	494			- yy	99 9	99	99 9	9999.90
	<u>KUN</u>	<u>41110</u>	<u>); (+ [) PULSES P</u>	FR FRAME PULSE	WIUIH(NS) PEAK	POWER POLAR	<u>IZATION(1)C5</u>	4_HEADING
		,						
	<u>NO 1</u>	ATA COLIFE	TED ON THIS FILGH	<u>II</u>	•	- 		
		FRAME	VA (MH(I) PWP (IV3H		PEAK SIGMA AV	SIGMA PEAK	SIGHAZ (DB)	V SIGMAZ (DB) PEAK
, 								
FL 1GHT	SFA	DIRECTION	WAVE METGHT(FT)	WAVE PERIOD(SEC)	WIND SPEED(KT)	WIND DIRECTION	WATER TEMP(F)	AIR TEMP AIR PRES (MB
12	265		99	99	15 3	30	99 9	9 9999.90
	RUN	<u> </u>	IE (FT) PULSES F	FR FRAME PULSE	WIDTH(NS) PEAK	POWER POLAR	IZATION(1) C5	4 HEADING
		10000				_		
		10000	1	20	3			355
	;	10660	1	×11		I I		
	2 3	10000	<u> </u>	20	3	1		265
	2 3 4	10000 10000 10000	1 1	20 20 20 <u>20</u> 20 20			·····	

	н	10000.	2	20	3	A REAL PROPERTY AND A REAL		175	····
	ч	10000	10					355	
	<u>10</u>	10000	<u> </u>	2020		·		265	
	11	10000	10 10	20	3	-		175	
	$\frac{12}{13}$	$\frac{10000}{10000}$	<u> </u>						
	14	10000	50	20	3			355	
	15	10000	ŚV	20	3	1		265	
	16	10000	50		3	<u></u>		<u>175</u> 85	
	17	10000	148	20	3			355	
	<u>18</u>	10000	148	2020	3	<u>;</u>		265	
	19	10000	145	20	3	•		175	
	50	10000	148 278	20	3			85	
	22	10000	278	. 20	3	j <u>1</u>		355	
	23	10000	278			; <u>1</u>		265	
	24	10000	274	20	3	<u>l</u> l		175	
			, 				CTCHAT (DD)		SIGMAZ(DB) PEAK
	f	FHAME	HCAD HAR (DHW) V/	V RCVD PWR (DBM) F	PEAK SIGMA AV	SIGMA PEAK	SIGMAZ (DB)	<u> </u>	SIGHAL (DB) FEAN
								•	
		<u></u>			61.97		14,318		-16.955
		2642 2643	-61.52	-61.21	62.84	64.28	15.193		16+626
		2644	-62.74		62.75-	64.76	15.097		- T7.110
		2645	-63.12	-60.69	62.37	64.80	14.723		17.146
-		2646	-63.12	-60.58	62.37	64+91	14.717		17.260
		2689	-65.43	-62.91	60.06	62.58	12.408		
	18 2	2690	-64.94	-62-36	60.65	63.13	12.995 13.407		15.477 15.534
		2691				<u> </u>	13.888		
		2695	-63.95	-62-12	61.54 60.85	62.74	13.204		15.094
		2693	-64.53	-62+74 -62+14	61.13	62+75	13.481		15.100 .
		2125 2726	-64.30 -66./3	-63.91	58.75	61.58	11.104		13.932
		2127	-65.26			62.82	11.575		15.168
		2728	-66.00	-62.16	59.49	63.33	11.839		15.679
	19	2129	-64.15	-61.36	61.14	64+13	13.485		16.477
	20	2767	-61.42	-63.19	58.07	62.30	10.419		14.650
		2768	-65.50	-62.39	59.99	63.10	12.340		15.448 14.978
		2769	-65.96	-62.86	<u>59,53</u> _	62•63_	<u>11.878</u> 12.060		
		2770	-65.78	-62.03	59.71 59.47	63•46 63 <u>•36</u>	11.821		15.706
		2771	-66.02	-62.13					
	SEA D	IRECTION	WAVE HEIGHT (FT) WAVE <u>P</u> ERIOD(SEC)	WIND SPEED(KT),	WIND DIRECTION	WATER TEMP(F	D, AIF	R TEMP AIR PRES (MB)
PE LONT		•							
	270			8		220	58	55	1005.90
		ALTINO	9 HE (FT) PULSES	B PER FRAME PULSE			58 RIZATION(1)	55 C54 HE	
	271)	ALTITUN	9 IE (FT) PULSES	R PER FRAME PULSE	·			C54 HE	EADING
		ALTITUN	9 IE (FT) PULSES	20	·			C54 HE	EADING
	271)	ALT1100	9 HE (FT) PULSES	8 9 PER FRAME PULSE 20 20	·			C54 HE	EADING
		ALTITUN	9 HE (FT) PULSES	20 20 20 20 20 20	·			C54 HE 220 130 40 310	EADING
		ALTI100 10000 10000	9 1E(FT) PULSES 	20 20 20 20 20 20 20	·			C54 HE 220 130 40 310 220	EADING
		ALTITUD 10000 10000 10000 10000 10000 10000	· · · · · · · · · · · · · ·	20 20 20 20 20 20 20 20 20	·			C54 HE 220 130 - 40 310 220 130	EADING
	- <u>1</u> 	ALTITUD 10000 10000 10000 10000 10000 10000 10000	· · · · · · · · · · · · · ·	20 20 20 20 20 20 20 20 20 20	·			C54 HE 220 130 - 40 310 220 130 - 40	EADING
		ALTIIOD 10000 10000 10000 10000 10000 10000 10000 10000 10000		20 20 20 20 20 20 20 20 20 20	·			C54 HE 	
	220 RUN 2 3 3 4 5 6 7 7 9	ALTITOD 10000 10000 10000 10000 10000 10000 10000 10000 10000	· · · · · · · · · · · · · ·	20 20 20 20 20 20 20 20 20 20 20 20 20	WIDTH(NS) PEA	K POWER POLAF 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1		C54 HE 220 130 - 40 220 130 130 - 40 - 310 - 220	
	220 RUN 2 - - - - - - - - - - - - -	ALTITUD 10000 10000 10000 10000 10000 10000 10000 10000 10000	l 	20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA			C54 HE 	
	220 RUN - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11	ALTIIUD 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000		20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA	K POWER POLAF 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1		C54 Hf 220 130 40 310 220 130 40 310 220 130 40 310	EADING
	220 RUN 2 - - - - - - - - - - - - -	ALTITUD 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000		20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA	K POWER POLAF 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1		C54 HE - 220 130 - 40 310 220 130 - 20 130 - 20 130 - 310 - 20 - 310 - 20 - 310 - 20 - 310 - 20 - 310 - 20 - 130 - 40 - 310 - 20 - 130 - 20 - 310 - 20 - 20	
	220 RUN 2 - - - - - - - - - - - - -	ALTITOD 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000		20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA	K POWER POLAF 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1		C54 HE 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 130 130 130 130 130 130 13	EADING
	220 RUN 2 - - - - - - - - - - - - -	ALTITUD 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000	l l 10 10 10 10 10 l 50 50 50 14H	20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA	K POWER POLAF 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1		C54 HE 220 130 40 310 220 130 20 130 220 130 310 220 130 40 310 220 130 40 310 220 40 310 220 40 310 220 40 310 220 40 310 220 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 40 310 220 40 310 220 40 310 200 40 310 200 40 310 200 40 310 40 310 200 40 310 200 40 300 40 40 300 40 40 40 40 40 40 40 40 40	EADING
	220 RUN 2 - - - - - - - - - - - - -	ALTITUD 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000	$ \begin{array}{c} $	20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA	K POWER POLAF 3 1		C54 HE 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 2310 310 2310 310 2310 310 20 310 310 310 310 310 310 310 31	EADING
	220 RUN 2 - - - - - - - - - - - - -	ALTITUD 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000	l l 1 10 10 10 10 10 50 50 50 50 50 50 14H 14H	20 20 20 20 20 20 20 20 20 20 20 20 20 2	WIDTH(NS) PEA	K POWER POLAF 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1		C54 HE 220 130 40 310 220 130 20 130 220 130 310 220 130 40 310 220 130 40 310 220 40 310 220 40 310 220 40 310 220 40 310 220 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 130 40 310 220 40 310 220 40 310 220 40 310 200 40 310 200 40 310 200 40 310 40 310 200 40 310 200 40 300 40 40 300 40 40 40 40 40 40 40 40 40	

	20 21	10000 <u>10000</u>	218 50	20 20		2		220	
	22 23	10000	50 50	20 20	3	2		130	
·····	24	10000	50	20	3	2		310	
		FRAME	RCVD PWR (DRM) AV	RCVD PWR (DBM)	PLAK SIGMA AV	SIGMA PEAK	SIGMAZ (DB)	AV SIGMAZ	DB) PEAK
FI IGHT	, SFA (HRECTION	WAVE HEIGHT(FT)	WAVE PERIOD(SEC)	WIND SPEED(KT)	WIND DIRECTION	WATER TEMP(F)	AIR TEMP AI	R PRES (NB)
14	<u></u>	· ····· ··· ··· ··· ··· ···	`	<u>5</u>		60	<u>55</u>	431020	.30
	RUN	ΑΓΓΙΤΟΝ	E (FI) PULSES P	PER FRAME PULSE	WIDTH(NS) PEAK	POWER POLA	RIZATION(1) C	54 HEADING	
	<u> </u>	10000	<u> </u>		<u>`</u> ₁₂			350	
 -	<u> </u>	10000			l2			<u>_260</u>	
	ح 4	10000	i	20	12	k		80	
	5	10000	10	20	12	1		- 350 260	
		<u> </u>	<u> </u>	20	<u>12</u> 12			170	
	<u></u>	10000		2002000_2000_2000_2000_2000_2000_2000_2000_2000_2000_2000_2000_2000000		l.		80	
	9 10	10000	50 50	20 20	12			350 260	
	11	10000	50	20	12	1		170	
		<u>Lv0(0</u>	- <u></u>		<u>1</u> 2			<u>80</u> 350	
	13 14	10060]45]4 <u>5</u> _	20_	i			260	
	15	10000	143		12 12			170 80	
	<u>16</u> 17	10000	<u>148</u> 50	20	12			350	
	18	10000		2	<i>i</i>	2		260	_
	14 20	10600 10 <u>000</u>	50 	20 20	12			170 80	
	21	10000		20	12			350	
	22	10,000	50	20 20	12			260 170	
	23 	10000 <u>1000</u>	50 <u>50</u>		12	i		80	
		FRAME	KCAD LAK (DHW) VA	КСАЛ ЪМК (ПРМ)	PEAK SIGMA AV	<u>SIGMA PEAK</u>	SIGMAZ (DB)	AV SIGHAZ	(DB) PEAK
		3414	-nd+27	-62.27	57.20	57.20	9.549	9.549	
	<u>j</u>	1920		-63+49	55+98	55+98	8.331	8.331	
	<u>(</u>	3471	-63.73		55.74	55.74	8.089 6.250	8.089	
		3422		<u></u>	55.90	55.90	8.245	8.245	
	<u>i</u>	3425	-13.14	-63.04	55.83	55+83	8.178 5.658	<u>8.178</u> 5.658	
) 1	1426 3427	-60.16 -64.54	-66.lo -64.b4	53•31 54•92	53+31 54+92	7,274	7.274	
		1428	-h2+H7	-62.87	56.60	56.60	8.950	8.950	
· · · · · ·	<u>l</u> _*	<u>1929</u> 3930	- <u></u>	- <u>-65.04</u> -66.98	<u> </u>	<u> </u>	<u> </u>	<u> </u>	
	1	3931	-64.30	-68.30	51.16	51.16	3.513	3.513	
	1	3438	-68.94	-68.94	50.53	50.53 53.11	2.875 5.463	2.875 5.463	
·		<u>- 7433</u> - 3434	-65.20	<u>-66.30</u> -65.20	<u> </u>	54.27	6.619	6.619	
	i	3935			55.55	55.55	7.904	7.904	
	1	- 1436 3437	-64.53	-64.53	54.94 54.38	54.94 54.38	7.291 6.732	7.291 6.732	
		1438	-63+97	-63.97	55.50	55.50	7.845	7.845	
	<u>l</u>	3939	-60.48	-66.48	52.99	52.99	<u>5.337</u>	<u>5.337</u> 6.929	
	1	1940 <u>3941</u>	-64+99	-64.89 63.70	54.58 5.77_	54•58 55•77	<u>8,121</u>	<u>`8.121</u>	

	l i	3942 3943	-65.12 -64.74	-65+12 -64+7		• 35 • 68	54.35 54.68	6.701 7.026		6.701 7.026
	l	<u>3943</u> 4180	-61.43	-59.07		•54	60.40	9,888		12.746
		4181	-50.45	-54.50		.62	60.97	10.971		13.316
		4182	-61.54	-59.07		.88	60.40	10.234		12.748
		4721	-61.64			<u>•78</u>	61.03	10.129		<u>13.383</u>
		4222	-62.43	-58.97		•64	60.50	8.985		12.846 12.457
		4223	-02-55	-59.36		• 92	60.11	9.268		13.770
		4263	-60.43	-58.05		• 04	61.42 61.35	11.215		13.700
		4264	<u></u>			• <u>87</u>	61.50	7 10.883		-13.854
		4265 4305	-60.94	-58+73		· 30	60.74	9.649		13.087
		4305	-62.05	-58.49		42	60.98	9.773		13.327
		4307	-62+48	-59.18		.99	60.29	9.337		12.637
		4347	-57.48	-54.95		•99	64.52	14.342	1	16.865
	13	4348	-53.01	5.67		•40	63.79	13.807		
		4349	-54.30	-55,43		•17	64.04	13.519		16.387
		4350	<u>-5H.44</u>	<u></u>		•03	64.37	<u>13.377</u>		16.715
		4351	-57.31	-54.05		.16	65+42	14.507		17.772
		4389	-57.47	-55.07		<u>+99</u>	<u>64.40</u> 64.59	<u>14.344</u> 14.757		16.937
		4390	-5/+06	-54.88		2•41 •60	63.65	. 12.952		15.997
	$\frac{14}{14}$	<u>4391</u> 4392	<u></u>	-55.49		• 32	63.98	13.666		16.328
		4342 4343	-51.47	<u>-53,47</u>		2.00	64.48	14.351		16.827
		44,11	-58.50	-54.54		.97	64.92	13,321		17,273
		44.12	-58.13	-55.82		.73	63+65	13.084		15.997
	15	4433	-58+50	-55.81		•97	63+66	13.321		16.012
		4434	-58.07	-55.06		•40	64.41	13.746		16.757
,		44.15	-57.65	-55.35		.82	64.12	T4.160 12.728		16.469 15.274
	16	4473				<u>•38</u>	62.92	12:51		15.293
		4474	-59.31	-56.52		1.16	02+74			
		んん アは	_69 01		60		62.75	12,909)	15.101
FL JGHT	15 15	<u>4475</u> 4476 4477 IRECTION	-58.91 -59.66 -59.59 wave height	-56./2 -57.08 -56.60 (FI) WAVE PERIOD(S	59 59)•56 •81 •88	62.75 62.39 62.87 RECIION	12.909 12.161 12.232 NATER_TEMP		15.101 14.735 15.215 <u>TEMP AIR PRES(MB)</u>
	16 16 SEAD	4476 4477	-59.66 59.59 WAVE HEIGHT	-57.08	59 59	0.56 0.81 0.88 (KT)WIND_DI	62+39 62+87 RECIION	12.16 12.232 WATER_TEMP	F) AI	14.735 15.215 <u>TEMP AIR PRES(MB)</u>
<u>FL IGHT</u> 15	16 16 SEAD 10	4476 4477 HRECTION	-59.66 -59.59 WAVE HEIGHT	-57.08 -56.60 (FI) WAVE PERIOD(5 4	59 59 5 <u>55</u> 5 <u>55</u> 5 <u>55</u> 5 5 6	0.56 .81 .88 . <u>KT) WIND DI</u> 	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 SEAD	4476 4477	-59.66 -59.59 WAVE HEIGHT	-57.08 -56.60 (FI) WAVE PERIOD(5 4	59 59	0.56 0.81 0.88 (KT)WIND_DI	62•39 _62•87 RECIION 5	12.16 12.232 WATER_TEMP	F) Alf	14.735 15.215 <u>TEMP AIR PRES(MB)</u>
	16 <u>16</u> <u>SEA</u> 10 RUN	4476 4477 <u>HRECTION</u> ALTITUR	-59.66 -59.59 WAVE HEIGHT	-57.08 -56.60 (FI) WAVE PERIOD(5 4	59 59 59 59 59 59 59 59 59 59 50 59 59 59 59 59 59 59 59 59 59 59 59 59	0.56 .81 .88 	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 H	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 SEAD 10	4476 4477 <u>ALTITUN</u> ALTITUN 10000 10000	-59.66 -59.59 WAVE HEIGHT	-57.08 -56.60 (FI) WAVE PERIOD(5 4	55 55 55 55 55 55 55 55 55 55 55 55 55	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 Hi 10 280	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>SEA</u> 10 RUN	4476 4477 <u>ALTION</u> <u>ALTITUR</u> 10000 10000 <u>10000</u>	-59.66 -59.59 WAVE HEIGHT	-57.08 -56.60 (FI) WAVE PERIOD(5 4	59 59 59 59 59 59 59 59 59 59 50 59 59 59 59 59 59 59 59 59 59 59 59 59	0.56 .81 .88 	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 H	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>SEA</u> 10 RUN	4476 4477 <u>ALTITUN</u> ALTITUN 10000 10000	-59.66 -59.59 WAVE HEIGHT	-57.08 -56.60 (FI) WAVE PERIOD(5 4	55 55 55 55 55 55 55 55 55 55 55 55 55).56 .81 .88 	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 H 10 280 190	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>SEA</u> 10 RUN	4476 4477 <u>ALTITUM</u> ALTITUM 10000 10000 10000 10000 10000	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (F1) WAVE PERIOD(S 4 SES PER FRAME PERIOD(S 1 1 1 1 1 1 1 10	55 56 56 56 56 56 56 56 50 50 20 20 20 20 20 20 20 20 20 2	0.56 .81 .81 .88 .10 .10 .10 .10 .10 .10 .10 .10	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>SEA</u> 10 RUN	4476 4477 <u>ALTITUR</u> ALTITUR 10000 10000 10000 10000 10000 10000	-59.66 -59.59 WAVE HEIGHT 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PO 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	55 55 55 55 55 55 55 55 55 55 55 55 55	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 H 10 280 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>SEA</u> 10 RUN	4476 4477 <u>ALTION</u> <u>ALTITUR</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u>	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PR 1 1 1 1 10 10	55 56 56 56 56 56 56 56 50 50 20 20 20 20 20 20 20 20 20 2).56 .81 .88 .88 .10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) A18 51 C54 HI 280 -190 100 -290 190 190 100 100	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 	4476 4477 <u>ALTITUR</u> <u>ALTITUR</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u>	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PE 1 1 1 1 1 1 10 10 50	55 56 56 56 56 56 56 50 50 50 50 50 50 50 50 50 50	0.56 0.88 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) A18 51 C54 H 10 280 190 100 190 100 190 100 100 10	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 16 10 RUN 10 2 3 4 5 6 7 7 6 7 7 10	4476 4477 <u>ALTITUN</u> ALTITUN 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (F1) WAVE PERIOD(S 4 SES PER FRAME PERIOD(S) 1 1 1 1 10 10 10 10 10 50 50	55 56C) WIND SPEED 6 ULSE WIDTH(NS) 20 20 20 20 20 20 20 20 20 20	0.56 .81 .81 .88 .10 PEAK POWER .12 .12 .12 .12 .12 .12 .12 .12	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>16</u> <u>10</u> RUN <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>6</u> <u>7</u> <u>6</u> <u>7</u> <u>10</u> <u>11</u> <u>10</u>	4476 4477 <u>ALTITUR</u> <u>ALTITUR</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u>	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PERIODIS 1 1 1 1 10 10 10 10 10 50 50 50	55 56 56 56 56 56 56 56 56 50 50 20 20 20 20 20 20 20 20 20 2	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) A18 51 C54 H 10 280 190 100 190 100 190 100 100 10	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 16 10 RUN 10 2 3 4 5 6 7 7 6 7 7 10	4476 4477 <u>ALTITUN</u> ALTITUN 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (F1) WAVE PERIOD(S 4 SES PER FRAME PERIOD(S) 1 1 1 1 10 10 10 10 10 50 50	55 56 56 56 56 56 56 56 56 50 50 20 20 20 20 20 20 20 20 20 2	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 H 10 280 -190 100 280 190 100 280 190 100 -280 190 190 -190 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 16 SEA 17 10 RUN 1 2 3 4 5 6 7 5 9 10 11 12	4476 4477 <u>ALTITUR</u> <u>ALTITUR</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u>	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PR 1 1 1 1 10 10 10 10 50 50 50	55 56 56 56 56 56 56 56 56 57 57 57 57 57 57 57 57 57 57	0.56 .81 .81 .88 	62•39 _62•87 RECIION 5	12.161 12.232	F) A18 51 C54 H 10 280 190 100 190 100 190 100 100 10	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>16</u> <u>10</u> RUN <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>6</u> <u>7</u> <u>6</u> <u>7</u> <u>10</u> <u>12</u> <u>13</u>	4476 4477 ALTITUR ALTITUR 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PERIODIS 1 1 1 1 10 10 10 10 10 50 50 50 50 50 50 48 49 49	55 56 56 56 56 56 56 56 56 57 57 57 57 57 57 57 57 57 57	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 16 SEA 13 10 RUN 1 2 3 4 	4476 4477 <u>ALTITUR</u> <u>ALTITUR</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u>	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PR 1 1 1 1 10 10 10 10 50 50 50 50 50 48 48	55 56 56 56 56 56 56 56 56 57 57 57 57 57 57 57 57 57 57	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf 51 C54 H 10 280 -190 100 -200 190 100 100 -200 190 100 100 100 100 100 100 1	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 16 SEA 17 10 RUN 1 2 3 4 5 6 7 7 8 9 10 12 13 14 15 16 17	4476 4477 ALTITUR ALTITUR 10000	-59.66 -59.59 wave height 3 De (FT) Put	-57.08 -56.60 (FI) WAVE PERIODIS 4 SES PER FRAME PR 1 1 1 1 10 10 10 10 50 50 50 50 50 48 48 48 78	55 56 56 56 56 56 56 56 56 57 57 57 57 57 57 57 57 57 57	0.56 0.81 0.88 (KT) WIND DI 10 PEAK POWER 12 12 12 12 12 12 12 12 12 12	62•39 _62•87 RECIION 5	12.161 12.232	F) AI F) AI 51 C54 H 10 280 100 100 100 100 100 100 100 1	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 16 16 SEA 17 10 RUN 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	4476 4477 ALTITUR ALTITUR 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000 100000	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (FI) WAVE PERIOD(S 4 SES PER FRAME PA 1 1 1 1 10 10 10 50 50 50 50 50 50 48 48 48 48 48 48 78	55 56 C) WIND SPEED 6 ULSE WIDTH (NS) 20 20 20 20 20 20 20 20 20 20	0.56 .81 .81 .88 	62•39 _62•87 RECIION 5	12.161 12.232	F) A18 51 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
	16 <u>16</u> <u>16</u> <u>10</u> RUN <u>1</u> 2 <u>3</u> 4 <u>5</u> 6 7 8 <u>9</u> 10 <u>11</u> 12 <u>13</u> 14 <u>15</u> 16 <u>17</u> <u>19</u>	4476 4477 <u>ALTITUN</u> <u>ALTITUN</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>10000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>100000</u> <u>0000</u> <u>0000</u> <u>00000</u> <u>0000</u> <u>0000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>00000</u> <u>000000</u> <u>00000</u> <u>000000</u> <u>0000000</u> <u>000000</u> <u>000000</u> <u>00000</u>	-59.66 -59.59 wave height 3 DE (FT) PUL	-57.08 -56.60 (F1) WAVE PERIOD(S 4 SES PER FRAME PERIOD(S) 10 10 10 10 10 10 10 50 50 50 50 50 50 50 50 50 50 50 50 50	55 56 C) WIND SPEED 6 0 0 0 20 20 20 20 20 20 20 2	0.56 .81 .81 .88 	62•39 _62•87 RECIION 5	12.161 12.232	F) Alf F) Alf 51 	14.735 15.215 R TEMP AIR PRES(MB) 1027.80
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	FRA4F	RCVD PWR(DHM)AV	RCVD PWR (DBM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ(DB) AV	SIGMAZ (DB) PEAK
l	5222	04.60		63.87	63+87	16.215	16+215
1	5224	-57.50	-57.50	61.97	61.97	14.321	14.321
1	5225	-57.92		61.55	61.55	13,902	13.902
2	5254	-57.45	-57.45	62.02	62.02	14.373	14.373
<u> </u>	5255	51.54	57.54	61.93	61.93	14.279	<u>14+279</u>
2			-57.07	62.40	62+40	14.750	14.750
·	<u></u>			61.48	61.48	13.832	13.832
ن م	5258 5286	-54.98 -56.04	-58.98	60.49	60•49 63•43	12.843	12.843
	5287	-33.04 -35.68	-22*68	63.79	63.79	<u>15,776</u> 16,137	<u>15.776</u> 16.137 ¹
3	5288	-5/.04	-5/.04	<u>62.43</u>	62.43	14,777	<u>14.777</u>
	52HY	-50./8	-56.78	62.69	62.69	15.042	15.042
3	5290	-56.58	-56+58	62.89	62.89	15.241	15.241
4	5314		-54-09	61.38	61+38	13.732	13.732
4	5314	-57.63	-5/.63	61.84	61.84	14.189	14.189
4	5320	-60-43	-60.43	59.04	59.04	11.393 '	11.393
4		5/.04	57.04	62.43	62,43	14.777	
4	5322	-54-31	-59-31	60+16	60-16	12.512	12.512
<u>×</u> ¥	<u> </u>	<u></u>	- <u></u>	63.97			19.793
	5486	-55.48	-52.89	63.61 63.99	65•68 66•58	15.955 16.337	18.025
ý v		-94.44	-51.60	65.02	67+81	17.374	20.160
ý	5484	-54+39		64.58	67.64	16.927	19.990
		-54.69	-51.64	64.78	67.82	17.131	20:174
<u> </u>	5490		51.06	64.72	67.81	17.065	20.159
Ч	5491	-55-01	-51+95	64.46	67.52	16.807	19.865
4		u	-52.05	64,56	67+42	16.912	19.766
4		- 74 . 54	-52.00	64.93	66.81	17.275	19+157
	<u> </u>	<u> </u>		<u>63.55</u>	67.18	15.898	19-532
4 4		-55.5/	-52+31	63.90	67.10	16.253	19.445
<u>-</u>	<u>- 5446</u> 5447	<u></u>	-52.59	<u>63.56</u>	<u>66•38</u> 66•87	<u> </u>	<u>18.732</u> 19.224
- 9			-52.10	64.37	67+37	16.717	19.720
	5444	-55.57	-52.70	63.90	66.77	16.253	19+118
9	5501	-55++3	-52.51	63.84	66.96	16.191	19.313
·		-54.52	-51.97	64.95	67.50	17.302	19.845
ų	5503	<u></u>		63.82	66+96	16.172	19.306
·	5504	-54.50	-52.24	64.91	67.22	17.262	19.574
Ŷ	5005		-52.14	63.46	67.33	15.811	19.681
4		-10-113	-52.84	63+43	66+63	15.784	18.982
		<u></u>		<u>65.41</u>	67.76	17.758	
4		-55 • 14 J	-52.68	63.57 63.98	66.79	15.919	19.137
·				64.36	<u>65.82</u>	$\frac{16.326}{16.708}$	<u>18.169</u> 18.884
10			-52.28	65+47	67+19	17.824	19.537
11		- 33.64	-52.87	63.77	66+59	16.124	18.944
10	5527		-53.69	62.97	65.78	15.317	18.129
10			-53.36	63.78	66+11	16,131	18.456
<u>]</u> ii		-54.//	-52.12	64.70	66.75	17.047	19.102
10	-	-50.20	-53,50	63.27	65.97	15.623	18.321
19	<u> </u>	-54+36	-52+19	64.61	66+68	16,961	19.033
1 () 1 ()	5532		-52.72	63.80 63.97	66+75	16.154 16.319	19.095
$\frac{10}{10}$	<u>533</u>			64.83	<u> </u>	17.175	19.057
10		-54 • 64	-52+33	64.78	67.08	17.131	19.428
<u>10</u>			-52.44	64.66	67.03		19.378
10		-52.18	-52.54	64.09	66.93	16.441	19.276
10		-54.14	-52.46	64.58	67.01	16.927	19.359
10	<u>4539</u>	-54 • 41	-52,04	64+66	67.42	17.007	19.774
10		-57.21	-53.07	62+26	66+40	14.609	18.745
			- 5 3/4	60.39	65.13	12.740	17.478
<u> </u>		<u></u>	54.34	00.37			

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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								15.998		-
12 56.30 -52.47 -52.42 64.00 67.05 16.351 19.399 12 56.31 -52.35 63.93 67.11 16.279 19.455 12 50.32 -54.41 -52.37 64.66 67.10 17.009 19.452										
12 56.31 -55.54 -52.36 63.93 67.11 16.279 19.455 12 50.32 -52.37 64.66 67.10 17.009 19.452										
12 5632 -54.41 -52.37 64.66 67.10 17.009 19.452										
FLIGHISFA_D_LHECITONWAVE_HELGHICE []WAVE_PERIODISECTXIND_SPEEDINTWIND_DIRECTIONWATER_PERIODISECTAIR_ICFPAIR_I		12 56 12 56 12 56 12 56 12 56 12 56 12 56	25 26 27 24 24 29 30 30 31	-54.43 -55.23 -55.22 -55.26 -55.76 -55.41 -55.54	-52.50 -52.60 -52.41 -52.41 -52.41 -52.42 -52.42 -52.36	64.54 64.23 63.65 65.29 63.71 64.00 63.93	66.97 66.67 67.06 67.12 67.26 67.05 67.11	16.887 16.584 15.998 17.637 16.057 16.351 16.279	19.319 19.020 19.405 19.472 19.606 19.399 19.455 19.455 19.452	 PR
	16	510		τ.	1	22 2	10	55	60 1016.60	•
$\frac{16}{16} \frac{210}{210} \frac{7}{7} \frac{7}{7} \frac{22}{210} \frac{210}{55} \frac{55}{60} \frac{1016.60}{1016.60}$		RUN	ALTITUDE (FD PULSES	PER FRAME PULS	E WIDTH (NS) PEAK	POWER POLARI	ZATION(1) C	54 HEADING	·
		1	10000	· 1	20	. 12	1		210	
RUN ALTITUDE (FT) PULSES PER FRAME PULSE WIDTH (NS) PEAK POWER POLARIZATION (1) C54 HEADING		·		·			<u>ī</u>			
RUN ALTITUDE (FT) PULSES PER FRAME PULSE WIDTH (NS) PEAK POWER POLARIZATION(1) C54 HEADING 1 10000 1 20 12 1 210		4		î					30	
RUN ALTITUDE (FT) PULSES PER FRAME PULSE WIDTH(NS) PEAK POWER POLARIZATION(1) C54 HEADING 1 10000 1 20 12 1 210 2 10000 1 20 12 1 120		1.		1						
RUN ALTITUDE (FT) PULSE PER FRAME PULSE WIDTH (NS) PEAK POWER POLARIZATION(1) C54 HEADING 1 10000 1 20 12 1 210 1 2 10000 1 20 12 1 120										

, h	1000		20 20	12	1	120	
<u>/</u> н	1004		20	12	1	300)
	1000		20	12	ī`	210)
10	1000		50	12	1	120	
11	1000	_		12_		30	
<u></u>	1000		20	12	1	300	
13	1004		20			210	
14	1000		20	12	1	120	
15	1006	0 148	20	12	11	30	
16	1060	e 148	20	12	1	300	
17	1000		20	<u>12</u>		210	
15	1000		20	12	1		
<u> </u>	<u> </u>		<u>20</u>	<u>12</u>			
20	1.060				1	210	
<u> </u>	1000					150	
27	1003		20	12	1	30	
	<u> </u>		<u>20</u>	<u>l2</u>	<u>1</u>		
						SIGMAZ (DB) AV	SIGHAZ (DB) PEA
	ት ዋላነሳት	HCAD HMA (DRW) HA	RCVD PWR(DHM)PE4K	SIGMA AV	SIGMA PEAK	SIGMAZ(DB) AV	SIGHAZ (DB) FEA
	5 D / 7	-64./4	-60+61	54.73	58+86	7.081	11.210
	- <u>+>/7</u>			<u>54,73</u>	60.38	9.970	12.728
	<u> </u>	<u></u>	-60.21	56.06	59.26	8.414	11.612
<u>-</u>		-93.13	-60.36	56.33	59.11	8.684	11.457
10	0025	-62.44	-60.12	56.48	58.75	8.826	11.098
10	55/5		-60.00	 55,85 	58.61	8.204	10.961
ii.	<u>hnbh</u>			56,480	59.51	9.154	<u>11.656</u>
<u></u>		-0/./0	-60.60	56.69	58+87	9.036 '	11.220
i i	6661		-54.65 "	56.95	59.62	9.298	<u>11.971</u>
	- <u>5/08</u> -	-64.40	-60.38	57.07	59.09	9.418	11.440
17	4709	-60.14	-60.32	56.63	59+15	8.982	11.501
12	F/10	-63.82	-60.21	50+45	59.26	8.798	-11+610
1 +	<u> </u>	-64.61	-62.02	54.86	<u>57.45</u>	7.208	9.798
11	<u>n(h)</u> .	-02.89	-60.62	56+58	58+85	8.933	11.203
1.5	~152_		-60.98	<u>54.90</u>	58.49	7.250	<u>10.841</u>
	- 5/51-	-13 5 + 13 2	-b1.02	55+78	58+44	8.132 ,	10.793
13	6171	-64.24	-6U.n6	55.18	58.80	7.529	11.154
14	r / 42	-h 3+h.5	-hU+88	55.84	58.59	8.190	10.941
14	<u> </u>	-04.10	<u></u>	<u>55.42</u>	57.99		$-\frac{10.344}{10.088}$
14	614+	-54.5	-61.73	55.42	57.74	7.767 8.017	10.088
14	<u>_ ~/45 _</u>		61.25	<u>55.67</u>	<u>58+21</u>		
14	6796	-63.74	-60.82	56.23	58.65 57.19	7.045	9.535
15	6434	-++++++++++++++++++++++++++++++++++++++	-62.28	54.70	59+29	9,148	11.636
15	<u>кн</u> 15	-57.5-1	-60.13	56.92	60.43	9,273	12.778
		<u>6<.></u>	-54.04	58.23	<u></u>	10.581	12.295
15	6437		-57.24	56.88	60.23	9.225	12.579
<u>'_1></u>	<u> </u>		-60.19	56.46	59.28	8.805	
]n	64/1		-60.19	56.07	59.01	8.417	11.361
16	<u>+h/7</u>	-61.40	-59.63	56.44	59.63	8.788	11.984
10	50/5 6474		-59.00	56.97	59.52	9,318	11.865
$\frac{16}{16}$	- <u>6+74</u>	-61.44		57.53	59.64	9.882	11.991
						- 	
1 P	OF AMIZATI	UN CODES I LIRECITZ	66070				

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MEAN STGA (DR)	STU-UFV-	<u></u>	ZE MEAN	51GP (DH)	TD DEV	AMPLE SIZE				·
16.115				25		414.0		·		
	MEAN STOVID			STU.DEV. (DE		GZ (DB) PK	SAMPLE S	IZE STD.	DEV. (DB) '	
3, FLIGHT					11.88					
			-					I STD DEV	D8	
		EA (119 - 21	7.65		12.61		11.0			
FLIGHT HISTOR	SPAM (NO. OF 511)									
FLIGHT (LT-2)) (-2.101.5)	(-1.5.10	<u>-1) (-1 10 -</u>	<u>.5) (5 IV (</u>)) (O TO .5)	(.5 [0])	(1 TO 1.5)	(1.5 TO 2)	(GE_2)	
0	<u> </u>	L_ _	l	3	2	5	3	0		
HISTOGRAM+F	2014 -1 <u>50 -778</u>	<u>//H_10</u>	<u>3/4•7/8 [</u> 1 2	<u>0 1 STD.DEV.</u> 1 1	- <u></u>	<u> </u>	22			
CONTRACTOR OF	00401119									
0.000	00 0.00000	<u>.]6667</u>	.22222	<u></u>	•44444	•55556	.83333	1.00000	1.00000	
	• 			<u> </u>	<u>. .</u>	555555555	.		• 	
CLICHT HISTO	GRAM (NO. OF STD	UEV FROM 1								
							· 		·	
FLIGHT (L1-2)	<u>) (-> T() -1.5)</u>	<u>(-).5 IU</u> -	<u>-1) (-1 TO -</u>	•5) (-•5 TO (<u>)) (0 TO .5)</u>	<u>(.5 TO 1)</u>	(1 TO 1.5)	(1.5 TO 2)	(GE 2)	
4 0	1	م	4	1	. 4.	1		9	<u>0</u> ,	•
HISTOGRAM	<u> 2 0 -728</u>	<u>9-//8_II)-</u>	<u>3/4+7/8_1</u> 0 0	ULSTDADEVA. 0 2			<u></u>			·
		=								
CUMULATIVE P	0.0 0.00000		16667	.38889	.44444	. 66667	.72222	1.00000	1.00000	1.00000
				<u> </u>	<u> </u>	<u>55555555555</u>			 -	
	*FAN STG/(0		4PLE 5T7E	5TU.DEV. (0)	B) MEAN S	IGZ (DB) PK	SAMPLE	SIZE STD	DEV. (DB)	
FLIGH [S	17.85		18	11.66	20.47		18	11.	.93	
	G/AV + 1 510 0				SIGZPK + 1 S	TU DEV DB	SIGZPK	- 1 STD DEV	DB	
	13./9		16.66		21.04		19.1			
	68A5 (NO+0) - 510	1.116 v . E D(1.0				i				······································
							- 			
CLICUT O 1-4	لاصلحا المحاليا مع	_0	-1) (-1_10-	<u>. 14. (-05 IU</u> .	0)_(0_T0_5)	(.5 10 1)	(1_[0_].5	1_(1.5_10_2)	<u>(GE_2)</u>	
	()	1	4	33	2	3	1	2	00	
<u> </u>										
5 0	<u></u>	1 1 1 1 - 1 1 -	<u>3/4•===1/8</u> _1 0 1	ULSEDEV.	2 0	- <u> </u>	0 1			

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-	<u> (=< 10 </u>									_ <u>-</u>
	<u>l</u>			4	_1		1	0		<u> </u>
<u>HISTOGRAM+FH</u> 1 2	$\frac{00 - 1}{6} \frac{10 - 773 - 778}{1}$	<u> </u>	10 1 STD.DEV. 1 0	2 1	0 1	0	0			
0_00in	<u>6 0.00000 .</u>	<u></u>			72222	77778	94444	1.00000	1.00000	
				****	<u> </u>					
	1844 S (67 (04) AV	54MPLE SIZE			(DB) PK	- 				
	15.75	ч 	12.38	22.38		9	16.	16 •		
\$[6	ZAV + 1 STO DEV DB		TO DEV DE SI				1 STD DEV	DB		
] ·• - rd	11.62		23.31		21.19		· 		
FI IGHT HISTOG	MA PERSON STREET	F 2014 .4E AM								
	<u>(-< 1::-) (-).</u>									
	·····			3		1	<u>_</u>			
HISTOG-244FH 0 0	$\frac{1}{1} = \frac{1}{1} + \frac{1}$			0 0	0 0	• 0	0			
CUMULATIVE PR		91.508 .11111		<u>.44444</u> .7	77778	.7778	.88889	1.00000	1.00000	
		F	<u></u>	*********	655555					
FLIGHT HISTOR	i di 180 katan ing Malandri Ka	FROM AT AN								
	(-~ (r ~ [• ~]) (-[•]	· [.) =[) (=]]() ·		(0 TO -5) /-5				(65 2)		
	I ^I		•				<u>∔</u>			
1 1	$\frac{(r-1)(r-1/2)-1/2}{r-2}$	$\frac{10}{0} - \frac{174}{0} - \frac{778}{1}$	1 <u>1 510+DEV-</u>	- <u>-</u>	0 0	·				
CUMULATIVE PR			,		· ,				· · · · · · · · · · · · · · · · · · ·	
0.0000	<u>a ((.)))u v.</u>	0.0000 0.00000	•44444	.66667 .7	7778	.17/78	.88889	1.00000	1.00000	
			<u> </u>	*****	555555		<u> </u>	<u> </u>		
FLIGHT	14- MIN 5 (51 (11-5) 4V	SAMPLE SIZE	STD.DEV.(DR)	MEAN SIGZ(SAMPLE SI	IS STO			
								DEV. (DB)		
	~U.n4		15.51	24.01		78	18.			
7	ZAV + 1 STU DEV DH	516ZAV - 1 51		52PK + 1 STO D			STD DEV			

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FLIGHT (LT-2)	(-2 T(-1.7)	(-1.5 10 -1)) (-) 10	5) (5 TU 0)	(0 10 .5	(.5 TO 1) (<u>1 TO 1.5</u>) (1,5 TO 2)	(GE 2)	
	3	<u>t</u>	. 16	13	17	<u>9</u> ′	8	6		
HISTOGRAM	10H -1 TH -7/H+	-//n 10 -3/4	4+//8_10	<u>) 1 510.0EV.</u>						
		6 I	<u>з</u> з		5 6	4	4 1			
CUMULATIVE PR	060611114 0 <u>0</u> 03840		.11538	•32051	•48718	•70513	.82051	.92308	1.00000	1.00000
				<u>***********</u>	1535555555	*****	<u>s</u>			
FLIGHT HISTOG	PAM (NO+OF 510+	DEV.FROM MEA	4N							
<u>FLIGHT (LT-2)</u>	(-2 10 -1.5)	<u>(-1.5 10 -1)</u>	<u>) (-1 10 -,</u>	<u>5) (5 TO 0)</u>	<u>(0 TO .5</u>	<u>(.5 TO 1</u>)	<u>) (1 10 1.5</u>) (1.5 TO 2)	<u>(GE_2)</u>	
7 2	3		12	15		9	• 6	5	2	
HISTOGRAM+FR	$\frac{104}{4}$ -1 10 -778+			•		ç				
		6 4	4 1	7 5	2 3	<u>i</u>	2 4	2		
CUMULATIVE PR		.06410	.15385	.30769	.50000	•71795	.83333	.91026	•97436	1.00000
				******	555555555	5555555555	5			· · · ·
FLIGHT	MEAN \$167 (04	AV SAMPL	E SIZE	STD.DEV. (DB)	MEAN S	SIGZ (DB) PK	SAMPLE	SIZE STD.	DEV. (DB)	
	14-34	161	1	9.20	- 18.19	,	135	13.	70	
516	7AV + 1 STO DE	V De 516/	ZAV - 1 STU	DEV DE SI	GZPK + 1 S	TO DEV DB	SIGZPK	1 STO DEV	08	
	15.50		12.75		19.51		16.2	28		
FI IGHT HISTOG	HAM CHO. OF STUN	UEV-FROM MER	AN '	·····	•	•				•
		·····	······································							
	<u> </u>	1-1-5-10-11						L_{1_5[0_2]		:
		<u>i</u> <u>i</u> <u>i</u>	23		34	28	11	<u> </u>	<u> </u>	·····
HISTOGRAMER 4 S	<u>ne -1 10 -(/as-</u> / / /			11 11	6 6		7 4	8		
	URAE 11 117									
										1.00000
	-03 <i>(21</i>							.93168	* 70074	
CUMUL A11VE PR								93168		
0.0000										
0.0000	•0 •0 •727	<u>.</u> リナットマロネーカトル					·			· · · · · · · · · · · · · · · · · · ·
0.0000	••••••••••••••••••••••••••••••••••••••	<u>.</u> リナットマロネーカトル					·			· · · · · · · · · · · · · · · · · · ·
0.0000	•0 •0 •727	<u>.</u> リナットマロネーカトル					·			· · · · · · · · · · · · · · · · · · ·
0.0000 FLIGHT HISTOG FLIGHT. (11-2). B 0	-0-5727 RAD (RO.OF 510.0)FV+F40M ME((=1.5 [0 =1) 	4N . (=1_(0,		19 19	1.5 TO 10 3		_(1.5_T0_2) 	(GE_2)	· · · · · · · · · · · · · · · · · · ·
0.0000 FLIGHT HISTOG FLIGHT. (LI-2). B 0 HISTOGRAM+FR	0 -0 -727 RAD (RO.OF -5 (D.C -(-< [1 -1.2] 0 -0 -0 -1.10 -7781 -7781		ΔN (-1_(0, 		19 19	1.5 TO 10 3	·	_(1.5_T0_2)	(GE_2)	· · · · · · · · · · · · · · · · · · ·

ر

!		12.01		£t	10.30	15.99	-	33		8.16	
	5167	av + 1 51) NEC (14		STO DEV DH		TO DEV DO		- 1 STD DEV	/ DB	
		14.10		4.37		17.81		12.	78		
п тнат и	ISTOGH	ANTENDA CH	U.0EV.F							,	
TITCHT (1-2)	(-~ [-!.	··) (),-5	[(-i) (-i])) =.5) (=.5 T	<u>. 0) (0 TO .5</u>)	(.5 FO 1)) (1 TO 1.5) (1.5 TO 2	2) (GE 2)	
10				×		3			2	2	
											,
3	0	1 2	5	ر 4	1 1	0 1 1	1	0 0	0		
CUMULATI	VE PRO	RAP4EEEC				<u>,72727</u>			.87879	.93939	1.00000
						•					
			- · · · · · · · · · · · · · · · · · · ·		*3030000	*****	272323232999		J		
П ГОНТ Н	ISTOGR	A × (۱۰ Ո , Jr	1.J.+DEV+F								
		,				U 0) (U TO .5)	-,			•	n'
10		!		<u>h</u> .	<u>13</u>	<u> </u>	U	1	2	2	
HISTOGE	<u>1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 </u>	<u>* -1 10 -5</u>	<u>//h+=//d</u>	10 - 3/4+7/1	4 10 1 STD. DE	<u>v.</u>		<u></u>		·	
		84411111	·	•	·				·		
	.00000	0.00.1	0 0.0	4000 .0904	•1	•66667	•84848	.84848	.87879	.93939	1.00000
					<u> </u>	<u>>>++++++++++++++</u>	<u>*******</u>				
FL !	GHT	MEAN STO	(11)-1) A.V	SAMPLE SIZE	STU.UEV.	(1)H) MEAN	IGZ (DB) PK	SAMPLE	517F STI	D.DEV. (DB)	•
		11.61		20					•	5 <u>-17</u>	
, 									- 1 STD DEV		
		AV + 1 -11	1 OEV 104	5192AV - (1 11,55		16+68		14.			
								·*•			
- I IGHT н	IST06#	A 100.0F		~U" MEAN							····
1 IGHT (7-2)	(- <u>2 10 -1</u>) (-1+7	10 -1) (-1 10	/ =.5) (=.5];	<u>0 0) (0 10 .5)</u>	(.5 TO 1)	<u>(1 TO 1.5</u>) (1.5 TO a	(GE Z)	
12	<u>t</u>	· ··· ··· ··· ···	دم		2	3	2	2	2	0	
HISTOGP	Att+F 120	<u></u>	/h = (/ #	<u>10 - 3/4++-=7/r</u>	<u></u>						
1	3	1 7	U U	<u>10 - 1/4 7/1</u> U 1	1 V	a o o	1	0 0	1		
UMULATI	VE PRO	RAH H, LTY		. 100	10 .45008	.55000	.70000	.80000	.90000	1.00000	1.00000

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12	0	1	1	5	7	0	2)	3	0	
HISTO	OGPAM+ER	<u>014 -1 TO -77</u>	H+-//h 10	- 3/4+7/8	10 1 510.DEV	•					
0	5	J U	1 2	2 0	2 0 0	0 0	0	1 0	1		
CUMULT	ATTVE PR	0HAHILITY 0 0.00000	+0500	0 10000	.35000	.70000	.70000	.80000		1.00000	1.00000
		,				*******					
								£ 2			, <u></u>
	FLIGHT	MFAN SIG/	DH)AV S	AMPLE SIZE	STD.DEV.C	OB) MEAŃ	SIGZ (DB) PI	SAMPLE	SIZE STO	DEV. (DB)	
	14	10.94		56	9.21	15,3	18	32	10	• 95	
	<u>s</u> ig	7AV + 1 510 -	DEV DB	SIGZAV - 1 S	TU DEV DB	S162PK +-1	STD DEV DE	SIGZPK	- 1 STD DEV	08	
,		13.29		5.25		16.72		13	44		· ·
FLIGH	T HISTOG	HAM (NO.OF ST	U.DEV.FHOM	MEAN							
							· · · · · · · · · · · · · · · · · · ·				
	-	<u>(-2 () (-) -)</u>		,		<u>0) (0 TO .5</u>		<u>1) (1 10 1.5</u>			
14	0	0	h	18	10	4	5,	7	. 5.	k	-
HISIC 7	GRAM • ER 4	<u>אז=רור</u> שט א כ	8.9=(∠ä_1() 4 3				0	2 2			
CUMUL A	ATIVE PH	DBAHILITY									····
	0.0000	8.0.0000	0.0000	•			. 67857	-		.98214	1,00000
			,		<u></u>	*****	<u> </u>	<u> </u>			
FL IGH	T HISTOG	HAM (NO. 05 51	D.DEV.FROM	MEAN							
ET TOP	T 0.T-51	<u> </u>	<u>) (-).5 lü</u>	<u>-1) (-1 10</u>	<u>5) (5 I</u> (<u>ئە 20_0)_(0_70_</u>	<u>b_(.5.10</u>	ກ_ຕ_ອງຈ	<u>ة 10 5 10 (1</u>	<u>(GE_2)</u>	
14	0		<u> </u>	3_	5	3	5	5	1	l	
<u>ніст</u> 1	<u>ОGРА-1 • F н</u> 2	0M -1 TO -7/ 0 0	<u>8+-778 TO</u> I 0	<u>-3/4+7/8</u> 1 1 .	<u>10 1 STD.DEV</u> 3 0 0		5 1	2 1	1	(
CUMUL	ATTVE PR	084611.1 (Y									
	0.0000	<u>0 0.00000</u>	0.0000	06129	<u> </u>	.53125	.62500	.78125		96875	1.00000
					********	**********	\$\$\$\$\$\$\$\$\$\$	\$\$			
	F1. 16HT	MEAN 5167(AMPLE SIZE	STU.DEV.	DB) MEAN	5162 (DB) PI	K SAMPLE	SIZE STO	.DEV. (DB)	
		16.17		-117	10.05	19.3				.12	
		ZAV + 1 510	DEV DA	516ZAV - 1 9		51GZPK + 1			- 1 STD DEV		
		· · · · · · · · · · · · · · · · · · ·									
		17.12		14.95		19.95		18	.63		

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<u>15 </u>	3	14	13	<u>24</u>	<u>19</u>	22	12	5	<u>l</u>	
HISTOGRAM.FR	<u>20м -1 ТО -7/8</u> 3 4	н-7/8 то -3/	4+7/8 TC	1 STO.DEV.		· 	5 7			
3 3	3 4	4 3	6 11	7 5	3 4		5 7	5 		
CUMULATIVE PR	OBAH 11. ITY	.05953	.17949	<u>•29060</u>	.49573	.65812	.84615_	<u>94872</u>	.99145	1.00000
			waa 1 .	**********						
_										
FUIGHT HISTOR		.DEV.FROM ME	AN			_ 		- <u> </u>		
	•									
<u>ELIGHT (T-2)</u>	(-2 10 -)-5)	(-1.5 IV -	<u>) (-) [0 -</u> /	<u>5). (205 TO 0)</u>	<u>(0 TO .5)</u>	(.5 10 1)	<u>(1 TO 1.5</u>)	(<u>1.5 TO 2</u>)	(GE_2)	
153		7	. <u> </u>	23	51	12	13	<u>l</u>	3	
HISTOGRAM	1014 1 10 113		(4+=-= <u>1/8</u> _1)	 6 /	6 2		4			_
• •		4 7	2 н	6 /	<u> </u>	4	4 4			
CUMULATIVE PR	105441111 10 493030	.04091	.16162	26263	49495		82828		96970	
				<u> </u>						
								•		
FLIGHT	OF AN STOKE	HAV SAME	LE SIZE	SIN*DEA*(OR)	MEAN S	TGZ (DB) PK	SAMPLE S	SIZE STO	DEV.(DB)	
			32	1.65	11.41		32		.83	
	ZAV + 1 510 1		JAV - L STU	DEV DH ST	GZPK + 1 5	TO DEV DB	SIGZPK	- 1 STD DEV	<u>DB</u>	
	4,49	·	1.14		12.11		10.5	58		
								· 		
FI 16HT 415TO	5-2A-1 (NID . 0F . 511									
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16 0	د	3		4	7	7	0	2	1	
			/4,7/8 10) 1 5TD+DEV+						
<u> </u>	<u>, </u>	0 2	1 1	<u>) 1 STD-DEV-</u> 3 I	2 1	2	3 1	1		
CUMULATIVE P	HHANDLITT		 ۱۲۰۶۲	• 34375		.68750	.90625	.90625	•96875	1.00000
<u>0, 100</u>	<u> </u>	<u>• 16/290</u>	.15665							
				<u>************</u>	<u> </u>	1 D D D D D D D D D D D D D D D D D D D				
FITCHT HISTOR	HON (EVILUE S)	***********	AN						<u> </u>	
	·									
) (~~ [0 -1.5]) <u>(-l.s lu -</u>	<u>1) (-1 0 -</u>	<u>.5) (5 [0 0)</u>	(0 10 .5)	(<u>,5 (0 1)</u>	(1 10 1.5)) (1.5 TO 2)) <u>(GE_2)</u>	
FLIGHT (1 1-2)				6	7	5	1	1	2	
<u>FLIGHI (LI=2)</u> 16 l	م		⁶ 3	0						
16 1		<u> </u>	<u> </u>							
<u>16)</u> ΗΙ <u>STΟ6σΔΛ4+</u> 0 }	<u></u>	<u>//н 10 -3</u>	<u>/4•//8_1</u>	<u>) 1 STD-DEV-</u>	<u> </u>		1 3			
16 1	<u>2010 -1 10 -777</u>				- -			.90625		1.00000

	RON	MEAN STOA	(UB)	STD.DEV.			STD.UEV.	SAM.SIZE			
8	13	12.61		8.27	20	20.63	15-58	20			
UN HIS	TOGRAMIN	0.0F STU.DE	V.FRUM	MEAN							
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				<u></u>	<u>bֆၨֈֈ֎ֈֈֈֈֈֈֈֈֈֈֈֈֈ</u>	*****			· · · · · · · · · · · · · · · · · · ·	
DISTRIN	UTIONS F	B SELECTION			- 					
FLIGHT	PUN	THE STORES) 510.0EV.	SAM.SIZE	MEAN SIGP (UH)	STD.DEV.	SAM.51ZE			
8	15	l++ + = 1	/. 10	20	14.06	9.27	20			
RUN HIS	TOWNER	ULUE SEPARET	21) · ME AN							
			(-1.5)() -1)		(.5 TO 0) (0 10 .5		(1 TU 1.5)	(1.5 T0	2) (GE 2)	
	151				44		l	0	<u>l</u>	
			<u>// _// _// + + + + - +</u>	<u>//a iu i siu</u>	<u>.0t.v.</u>					<u></u>
1)	· · · · · ·			2 0 0	1 1	30			
	1VF 2000 <u>P-Dir (A</u>	· / I / I / I / · · · · · · · · · · · ·	<u></u>	<u></u>	.0045000	.65000	.90000	.95000	.95000	1.00000
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<u></u>	70/11 11/1									-
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<u>FLIGHI</u>	<u></u>	~) (1 -1+))	1-1-5 (0) -1)	(-) (((.5 10 0) (0 10 .5) (.5 TO 1)	(1 10 1.5)	(1.5 TO	2) (GE 2)	
8	15		Ŀ		<u> </u>	6	1	1	0	
<u>HISTOC</u>	0	-11)-1/10-1		<u>//8 10 1 510.</u> 1 0	<u>.) Ev.</u>					
CUMULAT	1VE PRUB	<u> </u>					·'			
	0.00000	. 1. 199	.10000 .1			.60000	.90000	•95000	1.00000	1.00000
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DISTRIC	NTIONS F	0- SELET 180 - 20	······································							
FLIGHT	RINI B	Patrix Salary (Pro) 510.0EV.	SAM. SIZE	MEAN SIGP(DB)	STD.DEV.	SAM.SIZE			
	10	14.5	7.42	<u>c</u> 0	14.01	9.65	20			
- <u></u>	1068 14 (1	O.OF STURDEVER	e Jee bit Ast							
	•••		· · · · · · · · · ·	(-1 105)	(.5 10 0) (0 TO .9	a) (.5 TO 1)	(1 10 1.5)	(1.5 TO	2) (GE 2)	
RUN HIS		·) (-> ··-+->)	(**). 5 [1] = []							
PUN HI	<u>70% (11~</u> 16 0		<u>(-1.5 10 -1)</u>	4	6 5	1		0		
PUN HIG	<u>, yy‰ (i] ~</u> 16 v			<u> </u>		<u>1</u>	1 0	0	£	

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ELIGHT 6	<u>2061 - (I. I -</u>	<u>2) (-2)</u>)	-1.5) (-	<u>1.5 10 -1) (</u>	-1 (05)	(<u>5 TO U) (Q</u>	10 .5) (.5]	<u>0 1) (1 TO 1.</u>	5) (1.5 TO	2) (GE 2)	<u></u>
8	<u>.6'!</u>	1		4	<u></u>	<u> </u>	3	42	l_	0	
<u>HISTOG</u>	0 0		<u>/n=7/4</u> _	10 <u>-3/49/</u> 6 1		<u>0.0FA° 0</u>	<u> </u>		<u> </u>		
CUMULAT		՝ գլլլի սերոներ			•40	1000 +5000		.85000	95000	1.00000	1.00000
			<u> </u>			>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>					
						<u>,,,,,,,,,,,,,,,,,,,,,,</u> ,,,,,,,,,,,,,,		<u> </u>			
DISTRIB	ITIONS F	OP SELECT	ED FUNS		<u>,,, -,,,, , ,,, ,,, ,,, ,,, ,,</u> ,,,			<u></u>			
FLIGHT	HUN	DEAN ST	(+4 (1)8)	STD.DEV.	SAM. SIZE	MEAN SIGP	UB) STU.U	EV. SAM.SI	ZE		
- <u>A</u>		14.41		H.62	20		9.5	020-	_		
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			-1-26-1-			<u>, rez 10 07 10</u>	<u>ا حمد احمال.</u> م	<u>v.it. (110. 4</u> .	. <u></u>	<u>21 (GE 2) -</u>	
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HISIDG	1	<u></u>	/ <u></u> //d.	$\frac{10}{1} - \frac{3}{4} - \frac{3}{4} - \frac{3}{2}$			0 1	2	0		·
CUMULAT											
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<u>HISTOGRAMER</u> 1 0	<u>(1) – 1 – 1 – 1 – 1 – 1 – 1 – 1 – 1 – 1 –</u>	<u> </u>	- <u>-//8_10_1_5</u> 113 13			<u></u>	2		·
CUMULATTVE SE P+9801		• 1 (rug)	.cunua .35		0 .60000	.80000	1.00000	1.00000	1.00000
		-•	<u>pt5b1</u>	<u>• * * * * * * * * * * * * * * * * * * *</u>	*********	55			·
DISTRIBUTIONS	For Seletfro	e salt 5							···· ··· ··· ··· ··· ··· ··· ··· ···
FLIGHT HUM	► 1, -5, E. p. 1	(JH) STU-UEV.	. SAM.SIZE	MEAN SIGP	UB) 510.L	EV. SAM.5]	ZE		
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PUN HISTOGEN	(190.40) 510.41	VorPal, AFAN				_	• ••• ••• •••		,
FLIGHT PUN G	<u>1') (-2 :- </u>	<u>) (-1 [4 -]</u>	<u>) (-1 lu5)</u>	(.5 [() 0) (0	<u>T()5)_(.5_</u>	<u>[0 1) (1 TO L</u>	<u>5) (1.5 TO</u>	<u>2) (GE 2)</u>	· · · · · · · · · · · · · · · · · · ·
14	<u>°</u>		<u></u>	6		_/0	l_	<u> </u>	<u> </u>
HISTOGRAME!	08 - <u>1 10 - 77 0</u> 1 1		//# IU 1 510	0.0FV.	<u> </u>	0 3	2		
		•————————							
	<u>0 </u>	<u>• f2r 33,5</u>	.16667	<u>167\$416</u>	762500	.91667		•95833	1.00000
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ELIGHT DHA A	[-2] (-2 1)-1	• ¬>) (-1• ¬_[·) -1;) (-) (05)	(.5 [0 U) (U	fU .5) (.5]	<u> </u>	5) (1.5 TO	2) (GE 2)	
ملك سيتنا يتستحص التكافيط وا		<u>n</u>	()	<u> </u>		<u> </u>	0	1	
<u>_141</u>			//n 10 1 510	• <u>IHEV</u> •	- <u>.</u>	<u> </u>			
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CUMUE AT TVE PPG 5.000 P			· <u>uun</u>	24000	•4900	0.52		•64000))	.80000	.96000	 •	96000	1.00000
			· <u></u>		<u>ት»\$\$\$</u>	<u>\$\$\$655555</u>	•*****	\$\$\$\$\$\$	555					
RUN HISTOGRAND	MOLUE STUDE	VEFWUM	MEAN				- -			— — —				
	-21 (-1 1)		- T O - EX	<i>i</i> 1 1 .							-	•		
LIGHT SIM ILL														
<u>)5 4 .</u>	<u> </u>		<u>L</u>	<u>_</u>		4	4_		4	5_	0		Q _	
HISTOGPAM+ERU	<u>N -1 T() -//r</u>	1. <u>1/1 - 1</u>	2 0		<u>510.0</u>	<u>FV.</u> 1 0					<u>-</u>			<u> </u>
	·			<u></u>			2.	2	1	1	0			
				12000	<u></u>	048	<u></u>	64000)	.80000	1.00000	1.	00000	1.00000

ISTRIBUTIONS H	FOR SELECTED									— — — — — —				
						,								
	LEAN STOA		STU.UEV.	54H.5I		MEAN SIG	P (DB)	STD.U	EV.	SAM.SI		•		
TIGHT PUP			STD.DEV. 9.81	54H.5J	12E	MEAN SIG	P (DB)			SAM.51	<u>2</u> E	•		
1 IGHT PON 5 10	1 HAN STOA	(06)	9.81		12E		P (DB)	STD.D 9.6		SAM.51 25	2E	·		
TIGHT PUP	1 HAN STOA	(06)	9.81		IZE		P (DB)			25		· _ · _ · _ · _ ·		
1 IGHT PUN 5 Lu NHISTUGPA- (1	19.3 19.3 M. UF STUDIE	(1)6) (V+F-(1))	9.81 .1EAN	25		18.98		9.6	<u> </u>	25				
1 IGHT PON 5 10	19.3 19.3 M3.0F STO.0E	(1)6) (V+F-(1))	9.81 .1EAN	25		18.98	0 [0 .5	9.6 	0.1)	25		<u>) 2) (</u>	GE_2)	
1 IGHT PUN 5 IN 1 IGHT PUN (I T- 1 IGHT PUN (I T- 15_10_1 HISTOGPAM+FPON	- Fax Stor 19-3 NOLOF STOLOF -2) (-2 1.1-1 -2) (-2 1.1-1 -2) (-2 1.1-1	(UG) (V+F-(UA) 	9.81 .1EAN 	25 (-1_10		18+98 	0 [0 .5	9.6 	0.1)	25		<u>) 2) (</u>	GE_2)	
1 IGHT PUN 5 IN 1 IGHT PUN (I T- 1 IGHT PUN (I T- 15_10_1 HISTOGPAM+FPON	19-3 19-3 NOTUF STOLOG -2) (-2 10-1	(UG) (V+F-(UA) 	9.81 .1EAN 	25 (-1_10		18.98 	0 [0 .5	9.6	0.11	25		<u>) 2) (</u>	GE_2)	
1 IGHT PUN 5 IN 1 IGHT PUN (IT- 1 IGHT PUN (IT- 15 10 1 HISTOGPAM, FPON 1 0 UMULATIVE POOL		(Uo) (V.F.(UA) (-1) (-1) (-1) (-1) (-1) (-1)	9.81 .1EAN 	25 (-1_10 3 		18.98	0 [0 <u>5</u> 4	9.6 	24 0 11 	25 (1 [0]. 0	5) (1.5 I(1	<u>) 2) (</u>	GE_2)0	
1 IGHT PUN 5 IN 110 HISTOGPAN (1 IGHT PULA (I T 15 JU HISTOGPAMAPPON 3 0		(Uo) (V.F.(UA) (-1) (-1) (-1) (-1) (-1) (-1)	9.81 .1EAN 	00000	• 35 mul	18.98	0. [0] •2 	9.6 	0_1) 	25 (1 [0]). 0 3 3	5) (1.5 I(1 3 96000_	<u>) 2) (</u>	GE_2)0	
1 IGHT PUN 5 IN 1 IGHT PUN (IT- 1 IGHT PUN (IT- 15 10 1 HISTOGPAM, FPON 1 0 UMULATIVE POOL	19-3 19-3 NOLOF STOLOF -2) (-2 10-1 -2) (-2 10-1 -1 10 - 1/2 -1 10 - 1/2	(Uo) (V.F.(UA) (-1) (-1) (-1) (-1) (-1) (-1)	9.81 .1EAN 	00000	• 35 mul	18.98	0. [0] •2 	9.6 	0_1) 	25 (1 [0]). 0 3 3	5) (1.5 I(1 3 96000_	<u>) 2) (</u>	GE 2) 0	
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1 IGHT PUN 5 IN 1 IGHT PUN (IT- 1 IGHT PUN (IT- 15 JU HISTOGPAM, PON 1 UMULATIVE PON 0 UMULATIVE PON	19-3 19-3 NOLOF STOLOF -2) (-2 10-1 -2) (-2 10-1 -1 -1 -1 -1 -1 -1 -1 -1 -1	(Uo) (V.F.(UA) 	9.81 .1EAN .5 [0 = 1] .4 	00000	• 35 mul	18.98	0. [0] •2 	9.6 	0_1) 	25 (1 [0]). 0 3 3	5) (1.5 I(1 3 96000_	<u>) 2) (</u>	GE 2) 0	
1 IGHT PUN 5 IN NIN HISTOGRAN (1 1 IGHT PUN (1 T- 15 JU HISTOGRAM, PON 1 0 UMULATIVE PRO 0.000(0) UN HISTOGRAN(1)	15-3 15-3 NOTOF STOTOF -2) (-2 10-1 -2) (-2 10-1 -2) (-2 10-1 -2) (-2 10-1 -2) (-2 10-1 -2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) ((US) (V.F.(UA) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1	9.81 .1EAN .5 [0 = 1] .9 .9 .5 [0 = 1] .9 .9 .9 .9 .9 .9 .9 .9 .9 .9	<u>ج</u> بال مربون مربون مربون مربون مربون مربون		18.98	0 [() _ 5 4 4 2 2 2	9.6 	0_1) \$\$\$	25 (1 10 1. 0 3 3	5) (1.5 I(] 3 96000)_2)_() ls(GE 2)	
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15 1 [h.5] 1 [h.5] 1	PLIGHT MUN ************************************		_								<u>***</u> *	1 <u>7777</u> 1	******	<u> </u>	<u>1</u> 72]	<u>, \$\$\$</u>							
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$ \begin{array}{c} \label{eq:constraints} \\ \begin{tabular}{lllllllllllllllllllllllllllllllllll$	$ \frac{15 - 11 - 0}{2 - 1 - 1 - 2} - \frac{1}{1 - 1 - 1} - \frac{1}{1 - 1} - \frac{1}{1 - 1} - \frac{1}{1 - 1} - \frac{1}{1 - 2} - \frac{1}{$	15			<u>1</u> 6.5	·			77		4		.81	· ·		11.07		24	·				
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n.00000 0.0000 0.0000	0.00000					-//3-	1		4 	0	1 51	1		1		1 4	2	0	0				
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	JIN HISTOGRADIU (12) (-2 + 1-1.5) (-1.5 + 0.1) (-1 + 02) (.5 + 0.0) (0 + 0.5) (.5 + 0.0) (1 + 0.1.5) (1.5 + 0.2) (GE 2) J5 1) 1 2 5 3 2 1 HISTOGRADIU (-1.1) -1.10	<u> </u>	0.000	110		<u></u>	<u>•</u> /	<u></u>	· •_1'	1001								2222 -	•	01000			
FLIGHT FUN (17-2) (-2 + 1-1.5) (-1.5 + 0 - 1) (-1 + 0 - 2) (-5 + 0 0) (0 + 0 - 5) (-5 + 0 1) (1 + 0 + 1.5) (1-5 + 0 2) (6E + 2) 15 11 2 3 2 1 1 HISTOGRAMATERDE -1 + 10 - 1/2 + 1	PLICHT PUN (17-2) (-2 + 1-1,5) (-1,5 + 10 - 1) (-1 + 10 - 2) (-5 + 10 - 1) (0 + 10 + 5) (-5 + 10 + 1) (1 + 10 + 5) (-5 + 10 + 1) (1 + 10 + 5) (-5 + 10 + 1) (1 + 10 + 5) (-5 + 10 + 1) (0 + 10 + 10 + 10 + 10 + 10 + 10 + 10 +	<u>.</u>	<u> </u>								בנהים	194949	זככויכו										
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$\begin{array}{c} \text{HISTOGRAMAFUGE -1 } & \text{ID} - \frac{174 - 174 - 19 - 174776 }{2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2$	HISTOGRAM+HUD -1 [J] - //A - //A U] - 1/4 //A U] 1 SIU-UEV. U U V Z U Z U] 1 IU-UEV. CUMURATIVE PARAMANIN 117 A. ORDAN									(-1 10	57	(.)								113 10	<u></u>	- <u>-/</u>	
CUMULATIVE PROBABILITY A, UNEXB 2, UNEXB 2, UNEXB 2, 2013 .29167 .50000 .70833 .83333 .91667 .95833 1.00000 EXERCISE FOR SELECTED PORS FLIGHT PUN Fraction (UE) STUDEV. SAM.SIZE IS 12 10.21 9.30 25 19.00 STUDEV. SAM.SIZE IS 12 10.21 9.30 25 19.00 STUDEV. SAM.SIZE FLIGHT PUN (11-2) (-2 1.1-1.5) (-1.5) (-1.105) (.5 10 0) (0 TO .5) (.5 10 1) (1.10 1.6) (1.5 TO 2) (6E 2) IS 12 9.22 5 5 6 4 0 3 0 HISTOGRAM.FMON -1 TO -7/05 TO -7/05 TO -1/05 TO 1.5 TO 2) (6E 2) IS 12 9.22 5 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CDMUR ATTVE PROBABLITE 0.00000 .0433 .20833 .20833 .20833 .20833 .91667 .95833 1.00000 DISTRIBUTIONS FOR SULFCIED MONS DISTRIBUTIONS FOR SULECTED MONS DISTRIBUTIONS FOR SULECTED MONS STD.DEV. SAM.SIZE DISTRIBUTIONS FOR SULECTED MONS STD.DEV. SAM.SIZE IST. IST. IST. STD.DEV. SAM.SIZE DISTRIBUTIONS FOR SULECTED MONS STD.DEV. SAM.SIZE IST.																						
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$\frac{15}{15} \frac{12}{15} \frac{15 \cdot 21}{15 \cdot 21} \frac{4 \cdot 30}{25} \frac{25}{19 \cdot 08} \frac{10 \cdot 69}{25} \frac{25}{25}$ RUN HISTOGPAN(NO. OF STOLOR V. FROM ALAN FLIGHT DUN (11-2) (-2 1 - 1 - 3) (-1 - 5) (-5 - 10 - 0) (0 - 10 - 5) (-5 - 10 - 1) (1 - 10 - 5) (-5 - 10 - 1) (1 - 5) (1 - 5 - 10 - 2) (-5 - 10 - 1) (-1 - 105) (-5 - 10 - 0) (0 - 10 - 5) (-5 - 10 - 1) (1 - 5) (1 - 5 - 10 - 2) (-5 - 10 - 1) (-5 - 10	$\frac{15}{15} \frac{12}{15} \frac{16.21}{16.21} + \frac{4.30}{25} \frac{25}{19.08} \frac{10.69}{25} \frac{25}{25}$ P(IN_H1STO(5PA(60.01 S10.079.1820)) (1 A A) $\frac{115}{1000} \frac{11-20}{(1-2)} \frac{(-2)}{(-2)} \frac{1-(-5)}{1000} \frac{10}{(-1)0000} \frac{(-1)0}{(-1)000000} \frac{(-1)00000}{(-1)000000000000000000000000000000000000$	DISTRI	TITION	S Fu	< 51 L	rCIRU	PONS			•		<u> </u>			<u> </u>								
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	FLIGHT			P1 / 1	516A	(UF)	510	DEV.	SAM	.517E		AN 510	PP (UB)		STD.DEV	•	SAM.S	ΪZE				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	FLIGHT DUN (11-2) (-2 1 - 1 - 5) (-1 - 5 - 10) (-1 10 - 5 - 5) (-5 - 10 - 1) (1 - 1 - 10 - 5 - 5) (-5 - 10 - 1) (1 - 5 - 10 - 10 - 5 - 10) (-1 - 5 - 10 - 10 - 5 - 5) (-5 - 10 - 10 - 10 - 5 - 5) (-5 - 10 - 10 - 10 - 5 - 5) (-5 - 10 - 10 - 5) (-5 - 10	15	12		16.2	1			30	2	5		. OH			10.69		25					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\frac{15 12 0}{1 2} \frac{2}{2} \frac{5}{3} \frac{3}{6} \frac{6}{4} \frac{4}{0} \frac{3}{3} \frac{0}{2}$ $115 1068 A M + 4 (0 N - 1) T - 1/10 - 1/10 - 3/4 + 1/8 0 1 5 0 + 0 6 0 2 0 3 0 2 1 1 1 2 0 3 0 2 1 1 1 1 2 0 3 0 2 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 1 1 1$	RUN HI	110624	M (M)	, 11F 5	Diaces	r - F el Ue	IL AN								<u> </u>							
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\frac{15 12 0}{1 2} \frac{2}{2} \frac{5}{3} \frac{3}{6} \frac{6}{4} \frac{4}{0} \frac{3}{3} \frac{0}{2}$ $115 1068 A M + 4 (0 N - 1) T - 1/10 - 1/10 - 3/4 + 1/8 0 1 5 0 + 0 6 0 2 0 3 0 2 1 1 1 2 0 3 0 2 1 1 1 1 2 0 3 0 2 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 1 2 0 3 0 2 1 1 1 1 1 1 1 1 1$								·						<u> </u>							 F 21	
$\frac{13}{12} \frac{12}{12} \frac{10}{12} 10$	H3 I						31 (-		<u> </u>														-
CUMULATIVE PROBARILIT A.00001 J.	CUMULATIVE PROMARILIT A,00000															*		<u>v</u>					
<u>^.00001 /.47000 .07000 .15000 .36000 .48000 .72000 .88000 .88000 1.00000 1.00000</u>	<u>^.00000 7.0000 .00000 .16000 .36000 .48000 .72000 .88000 1.00000 1.00000</u>	<u>ні 5тон</u> 1	2 2 2	<u>V()</u>	-1 10		<u>-//a</u>	10 <u>- 37</u>	4	1 1 1	1 51	U-DEV 2	0	3		0	2	1	- <u>1</u>				
									· · ·													·	
			A.000	0.1	1 • 1	19471	, U	1000					-				•8	8000	•	88000	1.01	0000	1.00000
	RINN HISTOGRAM (NI'. OF SOULDEV. FROM MEAN										****	<u>\$\$\$</u> }};	<u>>555555</u>	<u> </u>	<u>, 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7</u>	*****							

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. _____ELIGHI NUN ([1-2) (-2 | 1-1.5) (-1.5 [0 -1) (-1.10 -.5) (.5 [0 0) (0 IO .5) (.5 [0 1) (1 IO 1.5) (1.5 [0 2) (GE 2) _____

	1	1 0 0 0	1 1 2	0 2 4	30	2	
MULATIVE	HAHLLIT			• • • • • • • • • • • • • • • • • • •			
	<u>, 114</u>	uite .12000 .		36000 .56	000		000 1.00000
			***********	35535535555555	53535		
							
			**********	\$\$\$\$\$\$\$\$\$\$\$\$\$\$ 		<u> </u>	<u> </u>
	FPAME	HCAD HAH(DHW)VA	RCVU Р₩R (DBM) РЕАК	SIGMA AV	SIGMA PEAK,	SIGHAZ(DB) AV	, SIGHAZ (DB) PEAK
<u> </u>			-53.19	60.83	64.24	9.197	12,609
<u>_</u>	- 4141	6.92	<u> </u>	60.51	62.35	8.876	10+724
5	8407	-5/•78 -58•90	-53.64	59.65	63.79 63.19	8.015	12.159
h	8408		-55.76	58.21	61.67	6.576	<u>11.564</u> 10.035
	<u></u>	_ > <u>/el'z</u>		<u>6U.24</u>	62.49	<u>8.605</u>	
13	FS-56-28-55	=>4.46	-54.69	58.57	62.74	6.937	11.110
<u>Ļ</u> }	<u></u>				62.83	8_610	11.204
1+	4530 86]9	-50.42 -53.11	-53.82 -61.50	61.01	63+61	9.381	11.980
10	1019	-103-48	-59.87	53.95	<u> </u>	<u>9.680</u> 9.308	<u>11.291</u> 12.920
<u>io_</u>	<u>8620</u>			54.46	57,32	9.820	12.680
18	"bb2	-64.004	-61.49	53+19	55+94	8.552	11.297
<u>ix</u>	<u></u>		<u>+60.04</u>	54+20	57.38	9,564	
13 21	- 266 4 		÷60.07	53+94	57+36	9.303	12.715
21	×/32	-65.00	-60.54	<u>51,93</u> 53,42	<u>. 56+89</u> 56+66	7,285	12.245
	- / 1 3	-01-33	-60.44	54.10	56.99	9,459	12.347
4	י <u>ר</u>	<u>д.</u>	(1	18			•
			<u> </u>	<u>******</u> *****			
	F 164 11	HEND HAR (UBH) AV	HCVU PWH (DEM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ(DB) AV	SIGMAZ (DB) PEAK
<u>5</u>	<u></u>				<u>68.03</u>	18,367	20.375
4	ત્મના વેલ	-12-11	-50.46	66.96	69+01	19.308	21.356
<u>_</u>	9139 91659	<u></u>		63.64	67.62	<u>15.991</u>	<u>19.974</u>
5	4 (* 1	-53 \$ • 40 -34 • 54	-51.63	65.50 64.93	67+84 68+85	17.854	20.190 - 21.201
ĥ	1160	- 26 - 51	-50.57	. 66 . 96	68+90	19.306	21.251
/	<u> 4083</u>	-> 3 + 68	<u>51.57</u>	65.79	67.90	18.139	20.248
7	9/11-4		-51.11	66.39	68.36	18.744	20.709
/	<u>- anss</u>			64+44	67.48	16.789	19.827
' 'A	11 I I I I	- 14 - 33	→5↓+28	65.14	68+19	17.487	20.540
	9107	-114.44	-51.17	<u>65.03</u> 64.18	<u>68.30</u> 66.74	<u>17.380</u> 16.532	20.646
4	111	<u>++</u> • • • • • • • • • • • • • • • • • •	-51.69	66.33	67.78	18.681	20.132
	4128		-51.14	65.83	08.33	18.184	20.679
	<u> </u>	<u> </u>		63.99	67.58	16.337	19.925
	149		-50.93	64.66	68+54	17.006	20.891
<u></u>				64,45	67.25	16,795	19.598
	<u></u>	-50.00	<u></u>	60.73	68+78	19.080	21.129

	4 14 14 1	<u> </u>	<u>₩)₩Λ[™] KČÃÕ ħ₩K(∏</u>	<u>нм) реак</u>	SIGMA_AV	SIGMA PEAK	_ SIGMAZ (DB)_AV	SIGMAZ (DB) PEA
	4447	->1. 1>	-41+54		75.17	78+87	18.765	22.471
<u>5</u>	9448	-51.40	-44.37		74.55	78.14	18,153	<u>21.741</u>
ა	4444	- 14.10	-48.23		74.43	78.28	18.031	21.880
/	4 2010						<u>18.812</u>	22.292
(9501	-44+14	-46.05		76.7/	80.46	20.371	24.062
. /	^و م 11 م با	-51.77	-48.76		74.74	77.75	18.339	21.349
10	shiphs -		-413-32		75.23	78.19	18.828 16.955	21.791
<u> </u>	<u></u>	<u></u>	<u>-46./J</u> -40.55		73.36	- <u>71.78</u> 79 . 96	19.685	23.561
FLIGHT	PULSES	として トーマル・スト	5164#Z(08) AV6	SIGMAZ(DB)	PEAK			
6			13.1h	22.38	9			
				****	*******	5555		
	+~u~t	n(,) + + (+)+	DAV PCVD PAR(D		SIGMA AV	SIGMA PEAK	SIGMAZ (DB) AV	SIGHAZ (DB) PEA
	401	-57.53			68.99	71.67	19.576	22.257
i	411	-57.46	-53.34		69.06	73.17	19.644	23.760
ir	41/4	-57.87	-54.57		68.65	71.94	19,234	22.532
1	409	-5n • 74	-54.09		69.78	72+42	20,365	23+008
1	41)	-51+21	-54.15		69.25	12+35	19.835	22.943
<u> </u>	411	<u> </u>			68+69	71.16	19.281	21.749
	477	- 2/0 12	-24.63		69.16	72.28	19.750	22.874
	<u>_+⁄′ </u>	<u></u>			69.68	73.52	20.271	24.110
۲		-5" +44	-55.05		68.08	70.86	18.665	21.451
ر	4.10	- 517 + 10	-53.50		70.15	73+01	20.741	23.604
ę	431		-53.62		70.40	72.89	20,984	23.482
		<u></u>			70.80	73+90	<u>21.386</u>	<u>24.493</u>
Ś	434 435	-54.3	-50.94 -52.01		69.76	73.70	20.344	24.289
	435 <u>-</u> 435	<u>-'\0./0</u> -\0.32			70.19	74.25	20.781	24.842
5.	43/	-50 • / U	-21.20		69.82	74.63	20.406	25.216
	4 34	-55,1U	-52.50		71.41	73.95	21,998	24.536
2	4417	חו+נל=	-52./1		71.35	73.80	21.939	24.391
	441		-52.80		70.87	13.72	21.459	24.304
1	444	-55.70	-51-91		70.82	74.60	21.405	25.188
	452	-5/++5	-53.06		69.40	73.46	20.053	24.044
1	453	-5/.15	-54.09		69.46	72.42	20.046	23.009
3	454	- 20 - 11	-53.60		70.40	72.92	20.992	23.505
<u>`</u> .	<u>4,,,</u>					$\frac{73.13}{72.43}$	$\frac{19.646}{10.096}$	$-\frac{23.720}{22.000}$
د	450	-57.11	-54+10		69.40 72.12	72.41 75.52	19,986	22.999
<u>\$</u> .					- <u>72.12</u> 70.55	74.64	<u>22.709</u> 21.142	$-\frac{26.111}{25.233}$
1	454	->>++0 ->>+61	-51.76		70.88	74.75	21.472	25.340
	461	-55.65 65.66	-51.32		71.26	75.20	21.853	25.784
1	<u>401</u>		-51.22		71.60	75.27	22.185	25.861
`		<u> </u>			71.93	75.36	22.519	25.952
•	460	-54.40	-54+45		71.56	74.26	22.144	24.853
		-54.41			72.04	74.86	22,630	25.446
<u> </u>	464	-50.41	-52.96		70.10	73.55	20.692	24.137
4	414	-51.14	-54.03		68.77	71+88	19,356	22.467
4	4611	<u>-5/.50</u>	-54.62		69.01	71.89	19.597	22.479
	481	-5/.03	-54.30		69.48	72.15	20.068	22.738
4	482	-5/.10			69.41	73.55	20.002.	24.135
4	443	-21.00	-53.45		68.86	73.06	19.445	23.652
4	4115	-57.13	-52.05		70.78	74.46	21.373	25.046
4	446	-57.49	-52,17		70.62	74.34		

·

4	449	-57+116	-53.32	70.65	73.20	21.241	23.785
4	471	-55 • /4		70.77	73.83	21.358	24+416
4	442			70.97	73.61	21.563	24.202
4	441	-50.00	-53.79	69+91	72.72	20.502	23.306
4			-53.20	70.94	73.32	21.532	23.905
4	• • • • • •		-52.33	70.60	74+19	21.184	24.774
·	<u></u>			68.78	72.07	19.371	22.663
۴	567	-58.4/	-54.25	68+04	12+26	18.631	22.854
	, <u>56</u> 7	-57.70	-53.57	66.76	72.94	17.344	23.528
5	5114	-5/.40	-54.20	68.63	72 <u>+</u> 31	19.222	_22.901
. 5	510		-54.68	68.13	71.83	18.715	22.422
		<u>610</u>	_ 53.02	69,34	72,89	19,926	23.476
5	513	-22.13	-52.47	71.32	74.04	21.913	24.627
	<u> </u>		53.07	70.46	73•44	21_045	24.033
د ک	515	-5h+48	-25.00	70.03	73.91	20.621	24.502
5	516	-50.62	-52.93	69.89	73.58	20.484	24.170
ر`		- 54 . 74	-52.00	71.77	74.51	22.363	25.101
	<u>אור</u>	<u></u>	52.91	71.56	73.60	22+149	24.192
5	· 5]-		-52.20	72+13	74+31	22.715	24.903
		<u>~~_()uv</u>	51.66	70.51	72+89	21.101	23.479
ל י		-50.10	-53.08	70.21	73.44	20.798	24.024
<u>. b</u>		-01+14	-50+88		69+63	15,960	20.222
n.		-57.69	-55+33	66+82 <u>65+59</u>	71+19	17.406	21.775
	<u>- 534</u>	<u></u>	-57.07		<u>69.44</u> 70.10	16_182	
		-01+63 -60+45	-56.15	64•88 65•06	70.10	15.469 16.648	20.690 20.949
·		- <u></u>	-53.60	70+10	72.91	20,688	23.499
		-5/+68	-53.78	68.83	72.73	19,421	23.317
., b		-57.63	-53.07	68.88	72.84	19,467	23.431
5	4L		54.05	68.66			23.047
			-53.34	70.08	.73.18	20.668	23.765
	4		-52.04	70.57		21.157	25.065
	•	 ل ۱۰ م ۲۰۰۰					24.962
h			=72+14	/V+40	14+31	21.008	
ი 	546	-5(+49	-52+14 -53+55	70.48	74+37 72+96	21.068	23.552
ი 	546						
6	<u>546</u> 547 <u>548</u>	-5/.49 -54.72 -55./3	-53.55 -51.26	<u>69.03</u> 71.79 70.78	72.96 75.25	<u>19.616</u> 22.379	<u>23.552</u> 25.839
რ	<u>546</u> 547 <u>548</u>	-5/.49 -54.72 	-53.55 -51.26 	<u>69.03</u> 71.79 70.78	72.96 75.25	<u>19.616</u> 22.379	<u>23.552</u> 25.839
6 6 <u>FI_10HT</u>	<u>546</u> 547 <u>548</u> <u>548</u>	-5/.49 -54.72 	-53.55 -51.26 	<u>69.03</u> 71.79 <u>70.78</u> <u>8) реак</u> 78	72.96 75.25 75.10	<u>19.616</u> 22.379	<u>23.552</u> 25.839
6 6 <u>FI_10HT</u>	<u>546</u> 547 <u>548</u> <u>548</u>	-5/.49 -54.72 	-53.55 -51.26 -51.26 ([]H] AVI2 516MAZ([]] 64 24.01	<u>69.03</u> 71.79 <u>70.78</u> <u>8) реак</u> 78	72.96 75.25 75.10	<u>19.616</u> 22.379	<u>23.552</u> 25.839
6 6 <u>FI_10HT</u>	<u>546</u> 547 <u>548</u> <u>949</u> 949 ғалиғ	-5/.44 -54.72 -55.13 -155.13 -152.13 -112.14 -20.	-53.55 -51.26 -51.26 (1/H) AV12 516MA2(0) 64 24.01	69.03 71.79 70.78 70.78 78 78 5115555555555555555555555555555555555	72.96 75.25 75.10	19.616 22.379 21.369 51GMAZ(DB) AV	23.552 25.839 25.692
6 6 <u>FI_10HT</u>	<u>546</u> 547 <u>548</u> <u>949</u> 944 ԲԱՈՈԲ	-5/.49 -54.72 -55./3 	-53.55 -51.26 -51.26 -51.41 2([]H] Ayı2516MA2([]] 64	69.03 71.79 70.78 6) PEAK 78 533555555555555555555555555555555555	72.96 75.25 75.10 51GMA PEAK 63.06 61.40	19.616 22.379 21.369 51GMAZ (DB) AV 15.410 13.747	23.552 25.839 25.692 51GMAZ (DB) PEAK 15.410 -13.747
6 6 <u>FI_10HT</u>	- 546 547 <u>548</u> <u>Риј 5р5</u> 999 Евлир Гиј 752 753	-5/.49 -54.72 -55.73 -55.73 -25.43 -20. -20. -20. -55.41 -55.7 -55.24	-53.55 -51.26 -51.26 -51.41 2(1/H) AV02 516MA2(0) 64 24.01 -55.5555555555555555555555555555555555	69.03 71.79 70.78 6) PEAK 78 51545555555555555555555555555555555555	72.96 75.25 75.10 516MA PEAK 63.06 61.40 63.23	19.616 22.379 21.369 51GMAZ(DB) AV 15.410 13.747 15.579	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 -13.747 15.579
6 6 <u>FI_10HT</u>	546 547 548 <u>948</u> 999 FRANF <u>797</u> <u>797</u> <u>793</u> 794	-5/.49 -54.72 -55.73 55.73 	-53.55 -51.26 -51.26 -51.41 2(1)H) AV12 516MA2(10) 64 24.01 	69+03 71.79 70.78 6) PEAK 78 55555555555555555555555555555555555	72.96 75.25 75.10 510 516MA PEAK 63.06 61.40 63.23 59.21	19.616 22.379 21.369 51GMAZ (DB) AV 15.410 13.747 15.579 11.562	23.552 25.839 25.692 SIGMAZ (DB) PEAK 15.410
6 6 <u>FI_10HT</u>	546 547 548 948 944 548 944 744 744 744 744 744 744	-5/.49 -54.72 -55./3 -55./3 -75.43 -20. -20. -20. -20. -55.24 -55.24 -55.24 -55.24 -55.24 -55.24 -55.24 -51.24	-53.55 -51.26 -51.26 -51.41 2(1)H) Ay2 516MA2(0) 64 24.01 -55.41 -55.41 -55.41 -55.24 -50.24 -60.26 -57.19	69.03 71.79 70.78 6) PEAK 78 533555555555555555555555555555555555	72.96 75.25 75.10 516MA PEAK 516MA PEAK 63.06 61.40 63.23 59.21 62.28	19.616 22.379 21.369 51GMAZ(DB) AV 15.410 13.747 15.579 11.562 14.629	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 -13.747 15.579 11.562 14.629
6 6 <u>FI_10HT</u>	546 547 548 948 944 FRANE FRANE 703 702 703 703 703 703 703 703	-5/.49 -54.72 -55.73 <u>wrk FRAME</u> 511244 20. <u>KCV:: Www (UHM) AV</u> -50.7 -50.7 -50.24 -601.20 -50.7 -50.24 -501.24	-5325 -51.26 -51.26 -51.26 -51.24 2(1)H) AV:2 516MAZ(0) 64 24.01 -5524 -56.07 -56.24 -60.26 -57.19 -56.26	69.03 71.79 70.78 6) PEAK 78 55555555555555555555555555555555555	72.96 75.25 75.10 516MA PEAK 516MA PEAK 63.06 61.40 63.23 59.21 62.28 63.21	19.616 22.379 21.369 51GMAZ (DB) AV <u>15.410</u> 13.747 15.579 11.562 14.629 15.563	23.552 25.839 25.692 SIGMAZ (DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563
6 6 <u>FI_10HT</u>	- 546 547 548 948 949 949 FRANF 799 792 793 793 794 705 794 705	-5/.49 -5/.49 -52.73 -52.73 -52.73 -20. -2	-5325 -51.26 -51.26 -51.41 2(11H) AV12 516MA2(0) 64 24.01 -55254 -55254 -5524 -5524 -57.19 -50.26 -60.38	69.03 71.79 70.78 6) PEAK 78 55555555555555555555555555555555555	72.96 75.25 75.10 516MA PEAK 516MA PEAK 63.06 61.40 63.23 59.21 62.28 63.21 59.04	19.616 22.379 21.369 51GMAZ (DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 -13.747 15.579 11.562 14.629 15.563 11.434
6 6 <u>FI_10HT</u>	546 547 548 948 944 FRANE FRANE 703 702 703 703 703 703 703 703	-5/.49 -5/.49 -55.73 -55.73 -55.73 -55.73 -50.41 -50.7 -50.24 -60.20 -50.24 -60.20 -50.24 -60.20 -50.24 -60.19 -50.26 -50.41 -50.75 -50.24 -60.48	-53.55 -51.26 -51.26 -51.41 2(1)H) AV: 516MA2(0) 64 24.01 -55.55 KCV0 FWR (DHM) FEAK -56.41 -58.07 -58.07 -58.26 -57.19 -50.26 -57.19 -50.26 -57.19 -50.26 -57.18	69+03 71-79 70-78 8) PEAK 78 55+555555555555555555555555555555555	72.96 75.25 75.10 516MA PEAK 61.40 61.40 63.23 59.21 62.28 63.21 59.05 62.68	19.616 22.379 21.369 51GMAZ (DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034
6 6 <u>FI_10HT</u>	546 547 548 948 949 FRANF 752 752 753 754 753 754 753 704 705 704 705	$\frac{-57.49}{-57.43}$ $\frac{-57.43}{-57.43}$ $\frac{97.5 + 54.84}{-57.43}$ $\frac{20.}{-57.43}$ $\frac{20.}{-57.41}$ $\frac{-57.41}{-57.44}$ $\frac{-57.41}{-57.44}$ $\frac{-57.41}{-57.44}$ $\frac{-57.41}{-57.44}$ $\frac{-57.41}{-57.44}$ $\frac{-57.41}{-57.44}$	-53.55 -51.26 -51.26 -51.41 2(1)H) Ayız 516MAZ(10) 64 24.01 -55.41 -55.41 -55.41 -55.24 -50.24 -50.24 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19	69.03 71.79 70.78 6) PEAK 78 533553555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 63.25 63.06 61.40 63.23 59.21 62.28 63.21 59.04 62.68 60.67	19.616 22.379 21.369 51GMAZ(DB) AV <u>15.410</u> 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022
6 6 <u>FI_10HT</u>		$\frac{-57.49}{-554.72}$ $\frac{-554.73}{-554.73}$ $\frac{20.}{20.}$ $\frac{20.}{20.}$ $\frac{-55.41}{-55.74}$ $\frac{-55.41}{-55.74}$ $\frac{-55.24}{-55.74}$	-53.55 -51.26 -51.26 -51.41 2(1)H) Ay2 516MA2(0) 64 24.01 -58.07 -58.07 -58.07 -58.07 -58.07 -58.24 -60.24 -57.19 -56.26 -57.19 -56.26 -57.19 -56.38 -50.78 -50.85	69.03 71.79 70.78 6) PEAK 78 533555555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 63.06 61.40 63.06 61.40 63.23 59.21 62.28 63.21 59.05 62.68 62.68 62.67 58.61	19.616 22.379 21.369 51GMAZ(DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964
6 6 <u>FI_10HT</u>	546 547 548 948 949 949 FRANE FRANE 792 792 793 793 793 793 793 793 793 793 793 793	-5/.49 -5/.49 -55.73 -55.73 -55.73 -55.73 -515.44 -60. -70.7 -50.7 -50.7 -50.76 -50.76 -50.76 -50.76 -50.78 -50.78 -50.78 -50.78 -50.78 -50.78 -50.78 -51.744	-53.55 -51.26 -51.26 -51.24 2(1)H) Ayız 516MAZ(U) 64 24.01 -55.54 -55.55 -55.95 -55.95 -55.95 -55.78 -55.78 -55.80 -60.85 -51.80	69.03 71.79 70.78 6) PEAK 78 515555555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.40 61.61 59.05 62.68 60.67 58.61 57.67	19.616 22.379 21.369 21.369 51GMAZ(DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.020	23.552 25.839 25.692 25.692 SIGMAZ (DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.020
6 6 <u>FI_10HT</u>		-5/.49 -5/.49 -55.73 -55.73 -55.73 -55.73 -51.24 -0. -0. -0. -50.7 -	-53.55 -51.26 -51.26 -51.41 /(1)H) AV: 516MA/(U) 64 24.01 -56.54 -56.54 -56.54 -56.24 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.25	69+03 71-79 70-78 8) PEAK 78 544555555555555555555555555555555555	72.96 75.25 75.10 516MA PEAK 516MA PEAK 61.40 63.23 59.21 62.28 63.21 59.05 62.68 60.67 58.61 57.67 57.22	19.616 22.379 21.369 51GMAZ(DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.020 9.567	23.552 25.839 25.692 51GMAZ(DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.920 9.567
6 6 <u>FI_10HT</u>	546 547 548 948 949 FRANE 752 752 752 752 753 754 753 754 753 704 753 704 705 704 705 704 705 704 705 704 705 714 715	$\frac{-57.43}{-55.472}$ $\frac{-55.473}{-55.473}$ $\frac{-55.473}{-55.473}$ $\frac{-55.473}{-50.47}$ $\frac{-50.41}{-50.7}$ $\frac{-55.41}{-50.74}$ $\frac{-55.24}{-50.24}$ $\frac{-50.24}{-50.24}$	-53.55 -51.26 -51.26 -51.41 2(1)H) Ay12 516MA2(10) 64 24.01 -54.01 -55.41 -55.41 -55.41 -55.24 -50.24 -50.24 -50.38 -50.78 -50.85 -50.85 -51.80 -61.80 -62.25 -63.02	69.03 71.79 70.78 69.02 70.78 70.78 78 78 53455555555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 63.00 61.40 63.23 59.21 62.28 63.21 59.05 62.68 63.21 59.05 62.68 60.67 58.61 57.67 57.22 56.44	19.616 22.379 21.369 21.369 51GMAZ (DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.020 9.567 8.794	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410
6 6 <u>FI_10HT</u>		$\frac{-57.49}{-554.72}$ $\frac{-554.73}{-554.73}$ $\frac{-554.73}{-204}$ $\frac{-554.73}{-204}$ $\frac{-554.73}{-204}$ $\frac{-504.74}{-204}$ $\frac{-504.74}{-504.74}$ $\frac{-504.74}{-504.74}$ $\frac{-504.74}{-504.74}$ $\frac{-504.74}{-504.74}$ $\frac{-504.74}{-504.74}$ $\frac{-504.74}{-504.74}$	-53.55 -51.26 -51.41 2(1)H) Ayız 516MA2(0) 64 24.01 -58.07 -56.41 -58.07 -56.24 -60.24 -60.26 -57.19 -56.26 -57.19 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19 -56.26 -57.19	69.03 71.79 70.78 70.78 70.78 78 78 5335555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 75.10 61.40 63.23 59.21 62.28 63.21 62.28 63.21 62.28 63.21 59.21 62.68 63.61 57.67 58.61 57.67 57.22 56.44 57.52	19.616 22.379 21.369 21.369 51GMAZ(DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.020 9.567 8.794 9.872	23.552 25.839 25.692 SIGMAZ(DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.920 9.567 8.794 9.872
6 6 <u>FI_10HT</u>	546 547 548 948 949 949 FRANE 799 799 799 799 799 799 799 799 799 79	$\frac{-57.49}{-55.73}$ $\frac{-57.43}{-55.73}$ $\frac{97.5}{-55.73}$ $\frac{97.5}{-55.73}$ $\frac{20.}{-50.7}$ $\frac{-50.41}{-50.7}$ $\frac{-50.24}{-50.7}$ $\frac{-50.24}{-50.7}$ $\frac{-50.24}{-50.76}$	-53.55 -51.26 -51.26 -51.41 /(1)H) Ay2 516MA/(0) 64 24.01 -58.01 -58.01 -58.01 -58.01 -58.01 -58.24 -57.19 -50.26 -57.19 -50.26 -57.19 -50.26 -57.19 -50.26 -57.19 -50.26 -57.19 -50.26 -51.80 -61.80 -61.80 -61.95 -61.95 -61.95	69.03 71.79 70.78 70.78 70.78 78 5445455554555 54555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 61.40 61.50 61.40 61.50 51.50	19.616 22.379 21.369 21.369 51GMAZ(DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.920 9.567 8.794 9.872 9.409	23.552 25.839 25.692
6 6 <u>FI_10HT</u>	<u>546</u> 547 548 <u>948</u> 9999 FRANF <u>797</u> 793 793 793 793 793 793 793 793 793 793	$\frac{-5/.49}{-54.72}$ $\frac{-52.73}{-52.73}$ $\frac{-52.73}{-52.73}$ $\frac{-52.74}{-52.74}$	-53.55 -51.26 -51.26 -51.26 -51.24 -51.24 -51.24 -51.24 -51.24 -51.25 -5	69+03 71-79 70-78 8) PEAK 78 544555555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 516MA PEAK 63.06 63.05 59.21 62.28 63.21 59.05 62.68 63.21 59.05 62.68 63.21 59.05 62.68 60.67 58.61 57.67 57.22 56.44 57.52 57.10 59.48	19.616 22.379 21.369 21.369 51GMAZ (DB) AV 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.020 9.567 8.794 9.872 9.872 9.409 11.832	23.552 25.839 25.692 51GMAZ(DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.920 9.567 8.794 9.872 9.409 11.832
6 6 <u>FI_10HT</u>	546 547 548 948 949 FRANF FRANF 752 752 752 753 754 753 754 753 754 753 754 753 754 753 754 753 754 753 754 753 754 755 754 755 757 757 757 757 757 757	$\frac{-57.44}{-57.472}$ $\frac{-57.473}{-57.473}$ $\frac{-57.473}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-20.}{-20.474}$ $\frac{-20.}{-77.47}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.49}$ $\frac{-57.49}{-77.49}$	-5325 -51.26 -51.26 -51.41 -51.26 -51.41 -51.41 -51.41 -51.41 -51.41 -51.41 -51.41 -51.41 -51.41 -51.41 -50.41 -50.41 -50.24 -51.19 -50.24 -51.19 -50.26 -51.19 -50.41 -50.24 -51.19 -50.41 -50.41 -50.24 -51.40 -51	69+03 71-79 70-78 8) PEAK 78 55555555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 51.00 61.40 61.40 63.23 59.21 62.28 63.21 59.21 62.28 63.21 59.21 62.68 63.21 59.05 62.68 60.67 58.61 57.67 57.22 56.44 57.52 57.06 59.48 59.48	19.616 22.379 21.369 21.369 369 369 369 369 369 369 369 369 3747 35.579 31.562 369 360 360 360 360 360 360 360 360 360 360	23.552 25.839 25.692 25.692 SIGMAZ (DB) PEAK 15.410 13.747 15.579 11.562 14.629 15.563 11.434 15.034 13.022 10.964 10.920 9.567 8.794 9.872 9.409 11.832 11.832 11.227
6 6 <u>FI_10HT</u>	546 547 548 948 949 FRANF 752 752 752 753 753 754 753 754 755 754 755 757 757 757 757 757 757	$\frac{-57.44}{-55.472}$ $\frac{-55.473}{-55.473}$ $\frac{-55.473}{-20.42}$ $\frac{-55.473}{-20.42}$ $\frac{-55.47}{-20.42}$ $\frac{-50.41}{-50.72}$ $\frac{-55.41}{-50.72}$ $\frac{-55.24}{-61.50}$ $\frac{-50.78}{-50.78}$ $\frac{-50.78}{-50.78}$ $\frac{-50.78}{-50.78}$ $\frac{-50.78}{-50.78}$ $\frac{-50.78}{-50.78}$ $\frac{-57.49}{-57.49}$ $\frac{-57.49}{-57.49}$	-53.55 -51.26 -51.41 -51.40 -51.41 -51.40 -5	69.03 71.79 70.78 70.78 70.78 78 78 53355555555555555555555555 63.06 61.40 63.06 61.40 63.23 59.21 62.28 63.21 59.21 62.28 63.21 59.21 62.28 63.21 59.05 62.68 60.67 58.61 57.62 58.61 57.52 57.52 57.52 57.95 59.48 59.98	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 5100 63.00 61.40 63.23 59.21 62.28 63.21 62.28 63.21 62.28 63.21 62.28 63.21 59.04 62.68 60.67 58.61 57.67 57.22 56.44 57.52 57.06 59.48 59.98	19.616 22.379 21.369 21.369 369 369 369 369 369 369 369 369 369	23.552 25.839 25.692
EI_IGHT_ 7 7 7 7 1 1 1 1 7 _	546 547 548 948 949 949 FRANF 752 752 752 753 753 753 753 753 753 753 753 753 753	$\frac{-57.44}{-57.472}$ $\frac{-57.473}{-57.473}$ $\frac{-57.473}{-77.474}$ $\frac{-57.41}{-77.474}$ $\frac{-20.}{-20.474}$ $\frac{-57.41}{-77.474}$ $\frac{-57.41}{-77.49}$	-53.55 -51.26 -51.41 2(1)H) AV12 516MA2(0) 64 24.01 -58.07 -58.07 -58.07 -58.07 -58.24 -60.24 -57.19 -58.26 -57.19 -58.26 -57.19 -58.26 -57.19 -58.26 -57.19 -58.26 -57.19 -58.26 -57.19 -58.41 -58.80 -61.95 -61.95 -61.99 -59.49	69.03 71.79 70.78 70.78 78 51455555555555555555555555555555555555	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 75.10 516MA PEAK 63.06 61.40 63.23 59.21 62.28 63.21 62.28 63.21 62.28 63.21 59.04 62.68 60.67 58.61 57.67 57.52 56.44 57.52 57.06 59.48 59.98 59.93	19.616 22.379 21.369 21.369 369 369 369 369 369 369 369 369 369	23.552 25.839 25.692
6 6 <u>FI_10HT</u>	546 547 548 948 949 FRANF 752 752 753 753 753 753 754 753 754 755 754 755 754 755 755 755 755 755	$\frac{-57.49}{-554.72}$ $\frac{-554.73}{-554.73}$ $\frac{-554.73}{-20}$ $\frac{-554.73}{-20}$ $\frac{-554.73}{-20}$ $\frac{-554.73}{-20}$ $\frac{-554.73}{-20}$ $\frac{-554.73}{-20}$ $\frac{-554.73}{-20}$ $\frac{-556.74}{-20}$ $\frac{-556.74}{-20}$ $\frac{-556.74}{-20}$ $\frac{-566.75}{-20}$	-53.55 -51.26 -51.41 -51.40 -51.41 -51.40 -5	69.03 71.79 70.78 70.78 70.78 78 78 53355555555555555555555555 63.06 61.40 63.06 61.40 63.23 59.21 62.28 63.21 59.21 62.28 63.21 59.21 62.28 63.21 59.05 62.68 60.67 58.61 57.62 58.61 57.52 57.52 57.52 57.95 59.48 59.98	72.96 75.25 75.10 75.10 75.10 75.10 75.10 75.10 5100 63.00 61.40 63.23 59.21 62.28 63.21 62.28 63.21 62.28 63.21 62.28 63.21 59.04 62.68 60.67 58.61 57.67 57.22 56.44 57.52 57.06 59.48 59.98	19.616 22.379 21.369 21.369 369 369 369 369 369 369 369 369 369	23.552 25.839 25.692

	6	730	- >9+84	-54,03	59,64	59.64	11.992	<u>11,992</u> 7,463
······	<u>_</u>	731	-04.10	-n4.Jb	55.11	55+11	7.463	
	6	733			<u>>B.7</u> &	<u>>¤</u> -7 <u>6</u>	11.108 15.698	15.698
	n .	134	- 50 + 12	-50.12	63.35	63.35		
	TGHT	PULSES	2FK FRAME 51	(MANZ (DH) AVG SIGMAZ	(DH) PEAK			
	4	•		12.18 12.18	5 26			
<i></i>				<u></u>	*****	65355		
,,,								
		FRAME	KCAD HAR (DBW) &	V PCVD PWR (DBM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ (DB) AV	SIGMAZ(DB) PEAK
						68.35		
			-55+72		64.28	67.64	16.625	
		/40	<u> </u>		64.68	68.35	17.026	20+703
	13	/~7 /4%	-54./Y -30.57	-50.27	62.88	69.20	15.228	21.552
	14	799	-54.99	-50.54	64+48	68.93	16.829	21.279
	13	499 401	-55+40	-52.02	63.07	67.45	<u>15.418</u>	<u></u>
	$-\frac{1}{13}$		-50.41		63.06	68.06	15.405	20.410
	1 1	AU 2	-50.06	-50.15	63.41	<u>69+32</u>	$\frac{15.756}{16.047}$	$-\frac{21.666}{21.250}$
					63.70		<u>16.047</u> 15.319	20.504
	13	104		-51.31	62.97	<u>68+15</u> 68+85	15:448	21.195
	13	405	-70.1/	-50+02	63.10	67.73	16.438	20.083
	1.3	405	<u>38</u>	<u></u>	<u> 64.09</u> h2.65			
	1.	807	->6.42	-51.64	62.12	66-84	14.465	19.190
	11	<u></u>				67.38		19.729
	- 14	409	-57.18	-52,09 -51,57	62.30	67.90	14.650	20.251
	1.1	414	-5/+1/		62.82	68.27	15.171	20.616
	13	त्यो ।		-50.98	62.30	68.48	14.652	20.833
	<u>1</u>				62.62	68.44	14.973	20.787
	13	*13		-50.85	63.45	68.62	<u>15.803</u>	
	12-	<u></u>	-50.07		60.63	65+69	12.978	18.037
	14	н16 н17	-20+04	-54.02	61.18	65.45	13.533	17.798
	14		->0.43	-53.22	63.04	66+25	15.390	18.600
	14	414	-59,98	<u>-55,99</u>	59.48	63.48		16.560
	14		-55.74	-52.20	62.73	64+21	15.527	17.248
	4		-56.29		<u>63.18</u>	<u>64.90</u>		17.845
	14	422		-53.97	63+62 60+07	63+89	12,423	16.244
	14	423	-57.40		61+94	64+36	14.293	16.713
	4	ne4		-55.11	60.31	64.65	12,659	16.996
	<u> </u>			-54.d2	61.82	64.78	14.173	17-132
	14	476	-5/.55	-54.69	60.98	64.29	13.329	16.635
	14	<u></u>			60.56	64.10	12.910	16.452
	14	فر ہے ہو۔ دیار در	-54.41 -51.43	-54.57	62.04	64+90	14.391	17.249
	14	- 454 0EB	-5/.43	-54.45	62.04	65.02	14.392	17.365
	14	H31	-57.45 -57.45	-54.94	61.24	64.53		$-\frac{16.879}{16.940}$
	$\frac{14}{14}$	- <u></u>			61.47	64+59	13,821	16.940 16.840
	14 14	A33	-54.58		60.89	64+49	$ \frac{13.238}{13.670}$	
	14		-50.15	-54.10	61+32	65+37	13.670	17.048
	14	н 35	-51.41	-54.17	61.99	64.70	14,344	
	15	H37	-58.14	-55.16	61.33	64•31 65•55	13.678	16.663 17.902_'
	<u> </u>	<u></u>	<u>->h.49</u>	<u>53.92</u>	<u>62.98</u>	<u>65.59</u>	14.623	
	15		-51.20	-53,88	62.27	66.01	15.399	18.363
	<u>15_</u>	<u></u>	<u></u>		62+64	66+29	14.985	18.644
	15	H41	-50.43	-53.17 -53.44	62.24	66.03	14.593	18.377
	15	442	-31.23	-53.31	63.03	66+16	15,381	18.506
	15	843	-50.44	-53+31	63.07	66+18	15.423	18.533
					62.51	65.82	14.855	18.174
	<u>-</u> 5			-54.47	61.68	65.00	14.026	17.349
	<u>-15</u> 15				61,60	65.38	13.946	17.731
	15	×47	-57.47	-54.01	62.87	65+46	15.217	17.809

	15 H49	-51.09	-53.86	62+38	65.61	14.732 14.835	17.958 18.420
•	<u> </u>	-56.98		62.49	<u> </u>	12.366	
	· · · ·	- 77.40	-55.34 -53.78 .	60.02 62.62	65+69	14.968	18.040
	<u>15</u>	<u></u> <u></u>	-53.55	63.81	65.92		
			-53.35		66,15	15,653	18.495
	15 ი54 15 ონნ	-50.15 -5/.28	-52,89	. 63.30 62.19	66.58	14.542	18.932
	l5856	-5/ 6/	<u></u>	61.78	65.49	14.131	17.842
	16 หระ	->/•44	-54.68	62.03	64.78	14.375	17.134
	<u></u>		-54.08	62.38	65.56	14_728	17.906
·	16 860		-53.35	61.79	66.12	14.142	18.465
	16 861	-54.60	-53.00	63.85	66.47	16.195	18.820
	16 862	-57.08	-53.14	62.38	66+33	14.734	18.675
	<u>lndo3</u>	<u>~_</u> _/	53.76	62.40	65.71	14.746	18.057
	<u></u>		-53.25	62.19	66.22	14.543	18.569
	16			62.91	66+17	15.255	18.523
		->>.41	-52.12	64.06	66.75	16.411	19.095
	16 867	-57.44	-54.50	62.03	64.87	14.376	17.218
	16 468	-5/+44	-53.89	62.03	65.58	14.377	17.933
	<u>16369</u>	5/.15	54.60	61.72	65,21	14.067	17.559
]h h/i	-5/.89	-54.92	61.58	64.55	13.927	16.902
	<u> </u>	<u>=54,30</u>	=54.04	61.16	64.83	13,514	17.175
	16 1972		-54.17	60.95	65.30	13.301	17.650
	10 4/3	-51.54	-54.54	61+87	64.93	14,224	17.277
	16 874	-57.51	-53.78	61.86	65.69	14.210	18.037
	<u>ls</u>		-53.54	61.70	65.92	14.045	18,274
	<u> </u>	-5/.18	-54.20	62.29	65.27	14.643	17.615
	164//			62.56	66.13	14.909	18.482
	17 8/9	-58.47	-55.45	61.00	64.02	13.353	16.373
	17 885			61.94	65+26	14,291	17.608
	17 381	-57+10	-53.99	62.37	65-48	14.719	17.826
	<u>1/no/</u>	<u>15.55</u>		62.79	65+50	15.142	17.845
	11 543		-53.63	64.10	65+84	16.446	18.192
	<u>1/</u>	<u></u>	_53.66	62.67	65.81	15.016	18.161
	17 355		-54.21	61.31	65+26	13.658	17.606
	<u>P44</u>		-54.46	61.18	65.01	13.533	17.356
	17 987	-51.24	-54.02	62,23	65.45	14.579	17.795
	<u>1/v</u>			<u>63.64</u>	65.87	15,985	18,224
	17 369		-54.11	61.94	65.36	14.291	17.707
	1/		54.23	<u>63.53</u>	65.24	15.878	17.591
	17 . 581		-55.19	61.64	63.68	13,986	16.030
	11	-30.03	-55+04	60,64	64.38	12,987	16.731
	17 493	-54+4]		60.56	64.06	12.912	16.412
	1/^		<u>=</u>		63.24	12.064	15.593
	17 55		-54.00	61.16	64+81	13.512	17.156
	<u></u>		<u> </u>	62.09	<u>65+09</u>	<u>14.441</u>	17.442
	1/ 34/		-55.41	61.26	64.06	13.608	16.412
	17 598	/ 0	-54.51	62.77	64.90	15.116	17.253
	н <u>ч</u> па		-55.04	60.80	64 43	13.147	16.777
			-54.30	<u>62.18</u>	<u>65+17</u>	$\frac{14.532}{16.532}$	
	• • •	- 3/ . 4 1	-54.18	62+46	65.29	14.814	17.643
	<u> </u>			<u>62.32</u>		$ \frac{14.665}{100}$	
			-	61+84	65.44	14.194	17.795
	<u> 6 305</u> 6 407			61.79	65.34	14+137	17.690
	-		-54.0/	62.00	64-80	14.346	17.153
	<u> </u>	<u> </u>	- <u>53.87</u> -53.97	61.01	65.60	<u> </u>	<u>17.947</u>
	<u> </u>	-53+09 5/+/ <u>}</u>		62.87	65.50	15.220	17+848
	<u>14</u>	<u></u>					16.554
	14 - 411 14 - 411	-50.24		61.77	64+58 64-85	14.124	16.931 17.203
	14 411	-51.17	<u>-54.52</u> -54.69	<u> </u>	64.85	15,542	
				61+30	64.78	13.647	17-130
	<u>143</u>	<u></u>		61.41	<u> </u>	$ \frac{13.208}{12.758}$	$\frac{17.204}{16.691}$
	<u>] H 412</u>	<u>_'\\</u>	->>.14 <u>>.39</u>	61•41 61•07	64.33	13.758	16.681
	<u> </u>		<u></u>		63.62	<u> </u>	<u> </u>
	1. +1/			59.57 h0+19	63.61	12,542	15.959
	A 417		-55.45	61.28	64.02	13.632	16.369
	<u>LS</u> !÷	<u>==:::</u> !!	<u>=</u>	60.36	65.12	12.707	17.467

ĸ	1 ^{\\\}	14.0	u 18.25	120			
·	1		<u>• * • * * * * * * * * * * * * * * * * *</u>	****	***		
_				SIGMA AV	SIGMA PEAK	SIGMAZ (DB) AV	SIGHAZ (DB) PEA
	F - /1	WE FRICE THE CONTRACT	RCAD LAK (DRW) HEAK	STOMA AV	JIONA / LAN	5100021007 00	
				61.38	64 • 79	13.733	17.135
<u> </u>	<u>'/^`</u>			61.99		14.337	17.824
<u>-</u> [4		- 1/ 4		60.72	64.52	13,065	16.868
<u>l</u> ч				61.75	64.65		16.996
	400	-5/.20	-74+53	62.21	64.94	14,555	17.285
		- 30 • 54	-53.19	62.93	65+68	15.281	18+027
e 1	905		-53.03	62.63	65.83	14.979	<u>18.184</u>
	107		-54.06	61.72	65.41	14.067	17.762
1	-43 5		<u>-54,40</u>	61.90	<u>65.07</u>	14.254	$-\frac{17.417}{17.016}$
			-13.90	60.50	65.56	12.854	17.914
24	10.12	-5m. (4)	-51.00	.63.16	65+91	15.514	18.255
24	1++++	- 20 - 24 J	-54.06	62.56	65+41	14.914 13.300	17.532
24	10.14	<u> </u>					18.059
24	7 37		-53.70	62.13	65+60	15.097	17,953
24			<u></u>	62.75			
FL (GHT-	JUL ST S	Pro Entint STONAN	(04) AV6 516442 (D	H) PEAK			
11 10011-		<u></u>					
<u>+</u>	/	14,4	1/+68	15			
			<u></u>	<u>***********</u>	>>>\$\$ <u>}</u>		
	Fact F	DUVL MAR (UP Y) AV	RUVD PWR (UBM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ(DB) AV	SIGMAZ(DB) PEA
	F#4 P	NUVI HAR (DEN) AV	RUVI PWR (UBM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ(DB) AV	SIGMAZ(DB) PE
			· · · · · · · · · · · · · · · · · · ·		516MA PEAK	SIGHAZ(DB) AV 7.812	10.953
<u>l }</u>	1649		-80.87	SIGMA AV 49.44 51.43			<u>10.953</u> 12.127
13	<u> 649</u> 15 !	-14 . 1] -117 . 17		<u>49.44</u> 51.43 51.12	<u>52.58</u> 53.76 53.92	7.812 9.803 9.489	<u>10.953</u> 12.127 12.289
13	1649 1551 1951	-144 - 1} -144 - 14 -144 - 14 -144 - 14	-80.87	<u> </u>	52.58 53.76 53.92 58.62	7.812 9.803 9.489 15.116	<u>10.953</u> 12.127 12.289 16.989
13 13 14	1649 1951 1951 1951	-14 . 1] -117 . 17	-80.81 -74.64 -74.53	<u>49.44</u> 51.43 51.12 56.75 52.64	52.58 53.76 53.92 58.62 55.56	7.812 9.803 9.489 15.116 11.014	<u>10.953</u> 12.127 12.289 16.989 13.927
13	1649 1551 1951	-14 - 1] -14 - 17 -17 - 17 -17 - 13 -10 - 10	-H0.887 -74.64 -74.64 -74.63	<u>49.44</u> 51.43 51.12 56.75 <u>52.64</u> 53.78	52.58 53.76 53.92 58.62 55.56 56.71	7.812 9.803 9.489 15.116 11.014 12.148	10.953 12.127 12.289 16.989 13.927 15.077
13 13 13 14	1649 1551 1675 1675			49.44 51.43 51.12 56.75 52.64 53.78 53.11	52.58 53.76 53.92 58.62 55.56 56.71 56.52	7.812 9.803 9.489 15.116 11.014 12.148 11.480	10.953 12.127 12.289 16.989 13.927 15.077 14.894
13 13 13 14 14	<u>1649</u> 1551 1675 1675 1675			49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523	<u>10.953</u> 12.127 <u>12.289</u> 16.989 <u>13.927</u> 15.077 <u>14.894</u> 13.264
3 3 4 4 4 4	<u> </u>		-+++++++++++++++++++++++++++++++++++++	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763
13 13 14 14 14 14 14 15	$ \frac{1649}{1051} \frac{1649}{1640} \frac{1690}{1652} 169$			49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 52.31 53.35	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862
13 13 14 14 14 14 14 15 15 15	$ \begin{array}{r} 1649 \\ 1551 \\ 1651 \\ 1651 \\ 1691 \\ 1691 \\ 1691 \\ 1692 \\ 1732 \\ 1$			49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 53.34	<u>52.58</u> 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 55.49 56.66	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763
13 13 14 14 14 14 17 15 15	1449 1551 1675 1675 1675 1675 1757		$ \begin{array}{r} -& & & & & & \\ -& & & & & & \\ -& & & & $		52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 55.49 56.66 56.00	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716	<u>10.953</u> 12.127 12.289 16.989 <u>13.927</u> 15.077 <u>14.894</u> 13.264 13.763 13.862 <u>15.030</u>
13 13 14 14 14 14 14 15 15 15	$ \begin{array}{r} 1649 \\ 1551 \\ 1651 \\ 1651 \\ 1691 \\ 1691 \\ 1691 \\ 1692 \\ 1732 \\ 1$			49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 53.34	<u>52.58</u> 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 55.49 56.66	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367
13 13 14 14 14 14 17 15 15	<u> </u>		$ \begin{array}{r} -& & & & & & \\ -& & & & & & \\ -& & & & $	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 55.49 56.66 56.00	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367
13 14 14 14 14 14 14 14 14 14 14 14 14 14 14 15 15 16 16 16 17 18 18 19 16 17 18 19 16 17	1449 1551 1675 1675 1675 1675 1675 1732 1732 1735 1745		$ \begin{array}{c} -89 \cdot 81 \\ -74 \cdot 69 \\ -74 \cdot 69 \\ -74 \cdot 63 \\ -74 \cdot 63 \\ -74 \cdot 69 \\ -74 \cdot 69 \\ -74 \cdot 69 \\ -76 \cdot 92 \\ -76 \cdot 92 \\ -76 \cdot 96 \\ -76 \cdot 96 \\ -77 \cdot 45 \\ -75 \cdot 72 \\ (001) Avy 5104A2(0) \end{array} $	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 55.49 56.66 56.00	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648	$ \begin{array}{r} 10.953\\ 12.127\\ 12.289\\ 16.989\\ 13.927\\ 15.077\\ 14.894\\ 13.264\\ 13.763\\ 13.862\\ 15.030\\ 14.367\\ \end{array} $
13 13 14 14 14 14 14 14 15 15 15 15 15 15 15	<u> </u>	$-44 \cdot 1] = -44 $	$ \begin{array}{c} -80 \cdot 87 \\ -74 \cdot 69 \\ -74 \cdot 63 \\ -74 \cdot 63 \\ -76 \cdot 92 \\ -75 \cdot 72 \\ (001) 49 \\ 5104A2(1) \\ 1 \\ 14 \cdot 33 \\ \end{array} $	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PLAK 13	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367
13 14 14 14 14 14 14 14 14 14 14 14 14 14 14 15 15 16 16 16 17 18 18 19 16 17 18 19 16 17	1449 1551 1675 1675 1675 1675 1675 1732 1732 1735 1745	$-44 \cdot 1] = -44 $	$ \begin{array}{c} -89 \cdot 81 \\ -74 \cdot 69 \\ -74 \cdot 69 \\ -74 \cdot 63 \\ -74 \cdot 63 \\ -74 \cdot 69 \\ -74 \cdot 69 \\ -74 \cdot 69 \\ -76 \cdot 92 \\ -76 \cdot 92 \\ -76 \cdot 96 \\ -76 \cdot 96 \\ -77 \cdot 45 \\ -75 \cdot 72 \\ (001) Avy 5104A2(0) \end{array} $	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PLAK 13	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367
13 14 14 14 14 14 14 14 14 14 14 14 14 14 14 15 15 16 16 16 17 18 18 19 16 17 18 19 16 17	1449 1351 1675 1675 1675 1751 1757			49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PEAK 13 53.55 13	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826	12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.862 13.862 15.030 14.367 16.102
13 14 14 14 14 14 14 14 14 14 14 14 14 14 14 15 15 16 16 16 17 18 18 19 16 17 18 19 16 17	1449 1551 1675 1675 1675 1675 1675 1732 1732 1735 1746 1745	$-44 \cdot 1] = -44 $	$ \begin{array}{c} -80 \cdot 87 \\ -74 \cdot 69 \\ -74 \cdot 63 \\ -74 \cdot 63 \\ -76 \cdot 92 \\ -75 \cdot 72 \\ (001) 49 \\ 5104A2(1) \\ 1 \\ 14 \cdot 33 \\ \end{array} $	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PLAK 13	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367 16.102
13 14 14 14 14 15 15 16 16 16 16 16 16 16 16 16 16 16 16 16 16 17 10	1649 1551 1675 1675 1675 1692 1792 1792 1792 1793 1794 1795			49.44 51.43 51.12 56.75 52.64 53.11 51.15 52.31 53.34 54.28 55.46 H) PLAK 13 51GMA AV	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.49 55.49 55.49 56.66 56.00 57.73 \$3\$\$\$	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (DB) PE
13 13 14 14 14 14 14 14 14 14 15 15 15 16 16 16 16 10 10 17	1449 1551 1675 1675 1675 1675 1675 1732 1732 1735 1746 1775	$-\frac{n44 \cdot 1}{-n72 \cdot 12}$ $-\frac{n72 \cdot 13}{-n72 \cdot 13}$ $-\frac{n72 \cdot 13}{-n72 \cdot 13}$ $-\frac{n12 \cdot 14}{-n72 \cdot 10}$ $-\frac{n12 \cdot 14}{-n72 \cdot 10}$ $-\frac{n12 \cdot 14}{-12 \cdot 11}$ $-\frac{n12 \cdot 11}{-12 \cdot 11}$ $-\frac{112 \cdot 11}{-12 \cdot 11}$ $+Cv(1) Parte (DPM) AV$ $-\frac{112}{-12 \cdot 12}$		49.44 51.43 51.12 56.75 52.64 53.78 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PEAK 13 53\$\$\$\$\$\$\$\$	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367 16.102
13 13 14 14 14 14 14 14 14 14 14 14 14 15 15 16 16 16 16 16 10 10 17	1449 1551 1675 1675 1675 1751 1757 1775	$-\frac{44 \cdot 1}{-44 \cdot 1}$ $-\frac{44 \cdot 1}{-47 \cdot 17}$ $-\frac{17 \cdot 17}{-41 \cdot 17}$ $-\frac{41 \cdot 17}{-41 \cdot 10}$ $-\frac{41 \cdot 19}{-41 \cdot 10}$ $-\frac{41 \cdot 19}{-41 \cdot 10}$ $-\frac{41 \cdot 19}{-41 \cdot 10}$ $-\frac{11}{-41 \cdot 10}$		49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PLAK 13 51GMA AV 55.59 57.52	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (0B) PE 16.677
13 13 14 14 14 15 15 15 16 16 16 16 16 17 10 17	1649 1551 1675 1675 1692 1752 1732 1732 1732 1735 1736 1737 1737 1737 1738 1740 <td>$-\frac{44 \cdot 1}{-167 \cdot 17}$ $-\frac{164 \cdot 1}{-167 \cdot 17}$ $-\frac{167 \cdot 17}{-167 \cdot 17}$ $-\frac{112 \cdot 11}{-167 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $+\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $+\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$</td> <td></td> <td>49.44 51.43 51.12 56.75 52.64 53.78 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PEAK 13 53\$\$\$\$\$\$\$\$</td> <td>52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73</td> <td>7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV</td> <td>10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (DB) PE 16.677 16.579 20.282 19.768</td>	$-\frac{44 \cdot 1}{-167 \cdot 17}$ $-\frac{164 \cdot 1}{-167 \cdot 17}$ $-\frac{167 \cdot 17}{-167 \cdot 17}$ $-\frac{112 \cdot 11}{-167 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $+\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $+\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$ $-\frac{112}{-17 \cdot 17}$		49.44 51.43 51.12 56.75 52.64 53.78 53.78 53.11 51.15 52.31 53.35 53.34 54.28 55.46 H) PEAK 13 53\$\$\$\$\$\$\$\$	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (DB) PE 16.677 16.579 20.282 19.768
13 14 14 14 14 15 15 15 16 16 16 16 16 16 17 10 17 17 17 17 17	1649 1551 1551 1675 1692 1692 1692 1732 1732 1732 1732 1732 1732 1732 1732 174 1751 174 1752 174 1752 174 1752 174 175 174 175 174 175 174 175 175 175 175 175 175 175 175 175 175 175 175 175 175 175 176 177 176 176 177 176 177 176 177 176 177 176 177 176 177 176 177 176	$-\frac{A4 + 1}{2}$ $-\frac{A4 + 1}{2}$ $-\frac{A4 + 1}{2}$ $-\frac{A3 + 4}{2}$		49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 54.28 55.46 H) PLAK 13 54.55.46 H) PLAK 13 55.59 57.52 58.91	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73 57.73 SIGMA PEAK 58.31 60.14 61.91	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ (DB) AV 13.956 15.886 17.284 16.409 15.968	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.264 13.862 15.030 14.367 16.102 SIGMAZ (DB) PE 16.677 18.509 20.282 19.768 18.500
13 13 14 14 14 15 15 16 17 10 10 17 17 17 10 17 17 17 10 17 17 17 17 17 17 17 17 17 17 17	1449 1551 1675 1675 1675 1675 1675 1732 1732 1735 1746 1745	$-\frac{n/4 + 1}{-n/2 + 1/2}$ $-\frac{n/2 + 1/2}{-n/2 + 1/2}$	$ \begin{array}{c} -R_{1} \cdot B_{1} \\ -7_{4} \cdot n_{3} \\ -7_{4} \cdot n_{3} \\ -7_{4} \cdot n_{3} \\ -7_{4} \cdot n_{3} \\ -7_{6} \cdot 8_{9} \\ -7_{6} \cdot 9_{2} \\ -7_{6} \cdot 16 \\ -7_{6} \cdot 1$	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.34 54.28 55.46 H) PLAK 13 55.59 57.52 58.91 58.04	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73 57.73 51335 51GMA PEAK 58.31 60.14 61.91 61.40 60.13 57.29	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV 13.956 15.886 17.284 16.409 12.368	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (08) PE 16.677 18.509 20.282 19.768 18.500 15.656
13 13 14 14 14 14 14 14 14 14 15 15 15 16 16 10 10 10 17 17 17 17 17 17 17 17 17 17 17 17 17	1449 1551 1675 1675 1675 1675 1732 1734 1735 1735 1735 1735 1735	$-\frac{44 \cdot 1}{-172 \cdot 17}$ $-\frac{112}{-172 \cdot 17}$ $+Cvi) Par (0)Par (0)Par Av$ $-\frac{112}{-172 \cdot 17}$	$ \begin{array}{c} -R_{1} \cdot B_{1} \\ -7_{4} \cdot n_{3} \\ -7_{4} \cdot n_{3} \\ -7_{4} \cdot n_{3} \\ -7_{4} \cdot n_{3} \\ -7_{6} \cdot 8_{9} \\ -7_{6} \cdot 9_{2} \\ -7_{6} \cdot 16 \\ -7_{6} \cdot 1$	49.44 51.43 51.12 56.75 52.64 53.78 53.11 51.15 52.31 53.35 54.28 55.46 H) PLAK 13 55.59 57.52 58.91 58.04 57.60 54.00 53.65	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 56.66 56.00 57.73 57.73 51.00 57.73 53355 56.01 57.73 51.40 60.13 57.29 59.47	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 12.648 13.826 SIGMAZ(DB) AV 13.956 15.886 17.284 16.409 15.968 12.366 12.016	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (DB) PE 16.677 18.509 20.282 19.768 18.500 15.656 17.836
13 13 14 14 14 15 15 16 17 10 10 17 17 17 10 17 17 17 10 17 17 17 17 17 17 17 17 17 17 17	1449 1551 1675 1675 1675 1675 1675 1732 1732 1735 1746 1745	$-\frac{n/4 + 1}{-n/2 + 1/2}$ $-\frac{n/2 + 1/2}{-n/2 + 1/2}$	$ \begin{array}{c} -89.87 \\ -74.63 \\ -74.63 \\ -74.63 \\ -74.63 \\ -74.63 \\ -76.92 \\ -76.92 \\ -76.92 \\ -76.92 \\ -76.92 \\ -76.95 \\ -76.95 \\ -76.95 \\ -76.95 \\ -75.12 \\ (001) AVS STURALD $ $ \begin{array}{c} 14.33 \\ -75.12 \\ -75.14 \\ -75.31 \\ -71.54 \\ -73.32 \\ -73.3$	49.44 51.43 51.12 56.75 52.64 53.78 53.78 53.11 51.15 52.31 53.35 53.35 54.28 55.46 H) PEAK 13 55.59 57.52 58.91 58.04 57.60 54.00	52.58 53.76 53.92 58.62 55.56 56.71 56.52 54.89 55.39 55.49 56.66 56.00 57.73 57.73 51335 51GMA PEAK 58.31 60.14 61.91 61.40 60.13 57.29	7.812 9.803 9.489 15.116 11.014 12.148 11.480 9.523 10.677 11.716 11.708 12.648 13.826 SIGMAZ(DB) AV 13.956 15.886 17.284 16.409 12.368	10.953 12.127 12.289 16.989 13.927 15.077 14.894 13.264 13.264 13.763 13.862 15.030 14.367 16.102 SIGMAZ (DB) PE/ 16.677 18.509 20.282 19.768 18.500 15.656

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18	1462	-18.19	-75.14	54.67	57.71	ij.035	16.079
19		-10.19 - <u>19,46</u>	<u>+11_14</u> _			11.954	14.679
<u>1</u> -	1401	-19.49	-75,99	53+95	57.46	12.325	15.828
<u> </u>		-80.45	-10.00	52.99		11.364	<u>15.158</u>
19	403		-77.17	53.16		11.529	14.647
14	1964	-17.27	-/0.04	54.17		12.544	15.782
2 0	1442	-49+25	-/0.66	53.20		11.573	15.161
<u>~</u>		-80.40	<u></u>	53.05		<u>11.423</u> 12.388	
۲ ۱۹ ۱۹	1944	-19.43	-76+08	. 54.02		10.886	15+038
<u> </u>		<u></u>	is.18 is.39	52.52		12.349	15.427
					5,100		
FLTGHT	~ +~	₽FК FR₽ME	516MAZ(DB) AVG	51GMAZ(DB) PEAK			
10	14H		13.48	16.80 2			
			ኮ ችታታነ 	·›››››››››››››››››››››››››››››››››››››	\$5\$\$ 5 55		
	<u> ғедығ</u>	<u> </u>	YAA KCAN BAK (I	UMUREAK SIGMA A	VSIGMA_PEAK		SIGMAZ(DB)_PEAK
					64.61	14.318	16.955
	· 2n42	-63.50	-60.88	62.84		15,193	16.626
<u> </u>	2643	-62.65	<u>-61.21</u> -69.73	62.75		15.097	17.110
17		-56.14 	-60.09	62.37		14.723	17.146
<u>-</u> <u>-</u> <u>-</u> - <u>-</u> - <u>-</u> - <u>-</u> - <u>-</u> - <u>-</u> -	- 2645		-60.09	62.37		14.717	17.260
ן א וא	2424		-62.91	60.06		12.408	14.925
	2440	-64.44	-62.36	60.65		12.995	15.477
1 א	25-1		-02.30	61.06		13.407	15.534
1 19			-62.12	61.54		13.888	15.723
15		e		60.85	62.74	13_204	15.094
17	2125	-04+4b	-62.14	61.13		13.481	15.100
14	2165	-55.13	-63.91			11.104	13.932
	2127	-an,2h	-62.01	59.23	62.82	11,575	15.168
19	2104 -	-nn, 90	-62.10	59.49	63.33	11.839	15.679
19	2124	-04.35	-61.30	·61.14	64.13	13,485	16.477
				58.07	62.30	10.419	14.650
			-62+39	59.99	63-10	12.340	15.448
		-53.51		59.53	62.63	11.878	<u>14.978</u>
2	2/64						
	2764		<u>-62.03</u>	59.71		12.060	15+813
	- <u>2768</u>	<u></u>		59.71 59.47		12.060 11.821	15.813 15.706
20 20 20 20 20 20	2/08 2//0 2//0 2/08	<u>-67,86</u> -67,78 -83,78	-62.03 -62.13	-			
20 20 20 20 20 20	2/08 2//0 2//0 2/08	<u>-67,86</u> -67,78 -83,78	-62.03 -62.13 5112764 (081) AV6	59,47	63.36		
20 20 20 20 20 20 20	2708 2769 2770 2771 2771	<u>-67,86</u> -67,78 -83,78	-62.03 -62.03 -62.13	59,47	63.36 		
20 20 20 20 20 20 20	2708 2769 2770 2771 2771	<u>-67,86</u> -67,78 -83,78	-62.03 -62.03 -62.13 	59,47	63.36 		
20 20 20 20 20 20 20	2769 2769 2770 2770 2771 	-63.35 -63.74 -53.74 -53.74 -53.74 	-62.03 -62.03 -62.13 -13.21 -13.21 	59,47	63.36 	11.821 	15.706
20 20 20 20 20 20 20	2769 2769 2770 2770 2771 2771 2771 2771 2771 2775 2775 2775	-63.35 -63.78 -63.78 -53.72 -75.72 -7	- 62.03	59,47 	63.36 U	11.821 SIGMAZ (DB) AV 9,549	15.706
20 20 20 20 20 20 20	2764 2769 2770 2770 2771 2771 2771 2771 2771 2771	-63.35 -63.74 -53.74 -53.74 -53.74 	-62.03 -62.03 -62.13 -62.13 -14.21 -14.21 -63.49	59,47	63.36 U \$\$\$\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	11.821 SIGMAZ (DB) AV 9,549 8,331	15.706
20 20 20 20 20 20 20	2768 2769 2770 2770 2771 2771 2771 2771 1915 1917 1917 1920 1920 1920	-63.36 -63.78 -63.78 -75.78 -75.78 -75.78 -75.78 -73.73	-62.03 -62.03 -62.13 5103162(023) AVG -13.21 -63.21 -63.49 -63.49 -63.43	59,47	63.36 U \$\$\$\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	11.821 SIGMAZ (DB) AV 9.549 6.331 8.089	15.706 SIGMAZ (DB) PEAK 9.549 6.331 8.089
20 20 20 20 20 20 20	2764 2764 2764 2774 2774 2774 2774 2774	-67.35 -67.74 -67.74 -75.17 -75.17 -75.17 -75.77 -75.77 -75.77 -75.77 -75.77 -75.77	-62.03 -62.03 -62.13 5102642(001) AVG -13.22 -62.27 -62.27 -63.49 -63.49 -63.69 -63.69	59,47	63.36 0 55.98 55.98 55.98 55.98 55.98 55.99	<u>11.821</u> SIGMAZ (DB) AV <u>9.549</u> 8.331 <u>8.089</u> 6.250	15.706 SIGMAZ (DB) PEAK 9.549 6.331 8.089 6.250
20 20 20 20 20 20 20	2768 2769 2770 2771 2771 2771 2771 2771 2771 2771	-63.35 -63.78 -63.78 -53.77 -53.77 -53.77 -53.77 -53.77 -53.57 -53.57	-62.03 -62.03 -62.13 5102162(001) AV6 -13.22 -13.22 -53.549 -63.57	59,47 5[WAZ.(UU)_PEAK2 2.83 2.83 JHM)PEAK SIGMA A 57.20 55.98 5.74 53.90 53.90 53.90	63.36 U SIGMA PEAK 55.98 55.98 55.74 53.90 55.90	11.821 SIGMAZ (DB) AV 9,549 8,331 	15.706 SIGMAZ(DB) PEAK 9.549 8.331 8.089 6.250 8.245
20 20 20 20 20 20 20	2764 2766 2776 2776 2777 2777 2776 2776	-67.35 -67.78 -67.78 -67.78 -75.72 -75.72 -75.72 -75.73 -75.73 -75.73 -75.74 -75.74	-62.03 -62.03 -62.13 510.102(000) AV6 -13.21 -63.23 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49	59,47 	63.36 0 53.36 0 53.36 53.36 53.98 55.98 55.98 55.90 55.90 55.83	11.821 SIGMAZ (DB) AV 9,549 8.331 8.089 6.250 8.245 8.178	15.706 SIGMAZ(DB) PEAK 9.549 6.331 8.089 6.250 8.245 8.178
20 20 20 20 20 20 20	2768 2769 2770 2770 2770 2771 	-67.26 -67.26 -67.78 -67.78 -75.12 -75.12 -75.77 -75.73 -75.73 -75.73 -75.73 -75.74 -75.74 -75.74 -75.74 -75.74	-62.03 -62.03 -62.13 510.104(001) AV6 -14.21 -14.21 -63.64 -63.64 -63.57 -63.57 -63.64 -63.64	59,47 	63.36 0 5 5 5 5 5 5 5 5 5 5 5 5 5	11.821 SIGMAZ(DB) AV 9,549 8.331 8.089 6.250 8.245 8.178 5.658	15.706 SIGMAZ(DB) PEAK 9.549 8.331 8.089 6.250 8.245 8.178 5.658
20 20 20 20 20 20 20	2764 2764 2764 2764 2774 2774 2774 2774	-67.35 -67.74 -67.74 -67.74 -75.17 -75.17 -75.77 -7	-62.03 -62.03 -62.13 510.10.2(0.11) AVG -14.21 -14.21 -53.549 -63.649 -63.649 -63.64 -64.54	59,47	63.36 0 5 5 5 5 5 5 5 5 5 5 5 5 5	11.821 SIGMAZ (DB) AV 9,549 6.331 8.089 6.250 8.245 8.178 5.658 7.274	15.706 SIGMAZ (DB) PEAK 9.549 6.331 8.089 6.250 8.245 8.178 5.658 7.274
20 20 20 20 20 20 20	2768 2766 2776 2776 2777 2777 2776 3777 5777 3919 4720 4720 4727 4727 4727 4727 4727 4727	$-67 \cdot 36$ $-67 \cdot 78$ $-67 \cdot 78$ $-67 \cdot 78$ $-67 \cdot 78$ $-67 \cdot 77$ $-67 \cdot 74$ $-67 \cdot 74$ $-67 \cdot 74$	-62.03 -62.03 -62.13 5102462(001) AV6 -13.21 -63.21 -63.49 -63.57 -63.57 -63.54 -63.54 -63.54 -63.54	59,47	63.36 0 55.98 55.98 55.98 55.98 55.98 55.99 55.99 55.99 55.90 55.90 55.83 53.31 54.92 56.60	11.821 SIGMAZ (DB) AV 9,549 8.331 B.089 6.250 8.245 B.178 5.658 7.274 8.950	15.706 SIGMAZ (DB) PEAK 9.549 6.331 8.089 6.250 8.245 8.178 5.658 7.274 8.950
20 20 20 20 20 20 20	2764 2764 2764 2774 2774 2774 2774 4774 4	-63.35 -63.78 -63.78 -63.78 -63.78 -63.78 -63.78 -63.78 -63.78 -63.78 -63.77 -63.78 -63.77 -73.77 -74.77 -75.77 -75.77 -75.77 -77.77 -7	-62.03 -62.03 -62.13 5112462(1)112 AV6 -13.22 -63.49 -63.49 -63.49 -63.49 -63.49 -63.49 -63.04 -63.04 -63.05 -63.05 -64.05	59,47 	63.36 0 53.36 0 53.36 0 516MA PEAK 55.98 55.98 55.99 55.99 55.90 55.90 55.83 53.31 54.92 56.60 54.43	11.821 SIGMAZ (DB) AV 9,549 8.331 8.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782	15.706 SIGMAZ(DB) PEAK 9.549 6.331 8.089 6.250 8.178 5.658 7.274 8.950 6.782
20 20 20 20 20 20 20	2768 2766 2776 2776 2776 2777 2776 14 5776 5776 5776 5776 5776 5776 5776 577	$\frac{-63.36}{-67.78}$	-62.03 -62.03 -62.13 5112462(1)112 AV6 -13.21 -53.53 -63.49 -63.49 -63.49 -63.49 -63.64 -63.69 -63.69 -63.69 -64.29 -65.04	59,47 	63.36 0 5 5 5 5 5 5 5 5 5 5 5 5 5	11.821 SIGMAZ (DB) AV 9,549 8.331 0.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782 4.837	15.706 SIGMAZ(DB) PEAK 9.549 6.331 8.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782 4.837
20 20 20 20 20 20 20	2764 2764 2764 2774 2774 2774 2774 2774	-67.56 -67.74 -67.74 -67.74 -67.74 -67.74 -67.74 -77.54 -77.54 -77.54 -77.54 -77.54 -77.54 -77.54 -77.54 -77.54 -77.54	-62.03 -62.03 -62.13 510304(00) AV6 -14.21 -14.21 -63.49 -63.49 -63.49 -63.64 -63.51 -63.51 -63.54 -63.04 -65.04 -65.04 -65.04 -65.04 -65.04	59,47 	63.36 0 53.36 0 55.98 55.89 55.	11.821 SIGMAZ (DB) AV 9,549 8.331 8.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782 4.837 3.513	15.706 51GMAZ (DB) PEAK 9.549 8.331 8.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782 4.837 3.513
20 20 20 20 20 20 20	2768 2766 2776 2776 2776 2777 2776 14 5776 5776 5776 5776 5776 5776 5776 577	$\frac{-63.36}{-67.78}$	-62.03 -62.03 -62.13 5112462(1)112 AV6 -13.21 -53.53 -63.49 -63.49 -63.49 -63.49 -63.64 -63.69 -63.69 -63.69 -64.29 -65.04	59,47 	63.36 0 53.36 0 516MA PEAK 55.98 55.98 55.99 55.83 53.31 54.92 56.60 54.43 52.49 51.16 50.53	11.821 SIGMAZ (DB) AV 9,549 8.331 0.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782 4.837	15.706 SIGMAZ(DB) PEAK 9.549 6.331 8.089 6.250 8.245 8.178 5.658 7.274 8.950 6.782 4.837

1	419 48 8 - 5 5	-53.71	-63.91	55.55	55.55 54.94	7.904 7.291	7.904 7.291
					- <u>-</u> <u></u>	<u>-</u> <u></u>	
	14737 14737	-03.19	-63.49 -63.47	55.5U	55.50	7.845	7.845
·····	1954			52.99	52.99	5.337	5.337
• i	81 Aug 4		-04+09	54.58	54.58	6.929	6.929
	1.41		-6.1.70	55.77	55.77	8.121	8.121
l	41.4			54.35	54.35	- <u> </u>	<u>6.701</u>
1	1741	-64./9	-64.19	54.68	54.68	7.026	7.026
FI 16#1	<u> </u>			UB) PEAN			
]4	1	1.	.12 /.17	24			
,			*>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	***************	5555		
	<u>F = 4 at</u>		RCVD PWR (DEM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ (DB) AV	SIGHAZ (DB) PEA
				57.54	60.40	9,888	
	(1)-1		- 14.01	58.62	60.97	10.971	13.316
		-51+35	-59.07	57.86	60.40	10.234	12.748
10	+121	-01.59	<u>58.44</u>	<u> </u>	61.03	10.129	13.383
10	444	-54+53	-58.97	56.64	60.50	8.985 •	12.846
<u> </u>	<u>4773</u>	=		<u> </u>	60.11	<u> </u>	12.457
11	42t 3 42m4	-60.4J -60.60	-54.05 -54.12	59.04 58.87	61+42	11.392 11.215	13.770 13.700
11	421.5	-61,04	-51.40	58.53	61.50	10.883	13.854
I C	4 3125	-56.16	-58.73	57.30	60.74	9.649	13.087
				57.42	60.98	9.773	13.327
12	4566						
17 12 F(1641 14	1 3.11	-HP+AB DEN FRANE SLOPA	-59.18	56.99 (DR) PEAK	60+29	9.337	12.637
<u>12</u> Ft tont	1 3.11	-HP+AB DEN FRANK SLOPA	-59.18 ((1)3) AVG \$[GMA7] (2) [3.18	56.99 (DR) PEAK		9.337	12.637
<u>12</u> F(1641	1 3.11	-HP+AB DEN FRANK SLOPA	-59.18 ((1)3) AVG \$[GMA7] (2) [3.18	<u>56.99</u> (DR) РЕАК 312		9.337 	
12 Ft 16:41	<u>/ 347</u> <u>PUI SES</u> <u>S</u> FPA(IF	-62.68 OFN FRAXE 5104. 10	-59.18 12(1)8) AVG 5[GMA7] .c113.18 555525555555	56.99 (DR) PEAK 312 \$\$\$\$\$\$\$\$\$	55555		
<u>12</u> <u>F(1);H</u> <u>14</u>	<u>/ 347</u> <u>PUI SES</u> <u>S</u> Fearth <u>4 34 7</u>	-5/.48	-59.18 <u>(/(1)3) AV() 5[GMA/1</u> .2] <u>13.18</u> <u>555555555555555555555555555555555555</u>	56.99 (DR) PEAK 3 12 555555555555555555 51GMA AV	55555 51GMA PEAK	SIGMAZ (DB) AV	SIGNAZ(DB) PE
12 F(1641	<u>/ 347</u> <u>PUI SES</u> <u>S</u> FPA(IF	-62.08 UED FROYE 5100 10 10 RCVD P9R(DH4)AV	-59.18 <u>17(1)3) AV5 5[64A7]</u> <u>13.18</u> <u>55.57</u> -54.95 -55.67 -55.43	<u>56.99</u> <u>(DR) PEAK</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u>	55555 51GMA PEAK 64.52 63.79 64.04	SIGMAZ (DB) AV 	SIGNAZ(DB) PE/ 16.865 16.144 16.38/
<u>12</u> <u>F(10:4</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>11</u> <u>11</u>	<u>1 347</u> <u>PUI SES</u> <u>5</u> <u>5</u> <u>6</u> <u>4 347</u> <u>4 347</u> <u>4 346</u> <u>4 3449</u> <u>4 350</u>	-57-68 UEB FRONE 5104 10 RCVII PMP (IIH4) AV -57-48 -56-91 -54-30 -54-44	-59.18 (/(1)3) AV(5 \$[6MA/] .2] 13.18 -53.54.525323334 RCVD PWR (DBM) PEAK -54.95 -55.67 -55.10	<u>56.99</u> <u>(DR) PEAK</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u>	516MA PEAK 	SIGMAZ(DB) AV 	SIGMAZ(DB) PE/ 16.865 16.144 16.387 16.715
12 <u>F(1);H</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u>	<u>1 347</u> <u>PUI SES</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u>	-5/-08 UED FRONE 5100 10 RCVII POR(IHA)AV -5/-48 -50-1 -54-30 -54-31	-59.18 <u>AZ (1)(3) AV(5 5[6MAZ)</u> <u>aZ 1 13.18</u> <u>bbb54555555555555555555555555555555555</u>	<u>56.99</u> <u>(DR) PEAK</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507	SIGNAZ(DB) PE/ 16.865 16.144 16.387 16.715 17.772
	$\begin{array}{c} 1 & 3 + 1 \\ \hline \\ 1 & 2 + 5 \\ \hline \\ 2 & - 5 \\ \hline \\ 2 & -$	-57.08 DEX FRANE 51(14) 10 RCVII Pare (DH4) AV -57.48 -57.40 -54.40 -57.47	-59.18 12(1)3) AV0 5[GMA7] .c1 13.18 N\$3595555555 PCVD PWR (DBM) PEAK -54.95 -55.43 -55.10 -54.05 -55.07	<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40	SIGMAZ (DB) AV 	SIGNAZ(DB) PE/ 16.865 16.144 16.387 16.715 17.772 16.750
<u>12</u> <u>F(1);HT</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u> <u>14</u> <u>13</u> <u>14</u> <u>14</u>	<u> </u>	-57.48 -57.48 -57.48 -57.48 -57.48 -57.47 -57.47 -57.47 -57.47 -57.47	-59.18 12(1)3) AV0 5[64A7] .21 13.18 N5255252555555555555555555555555555555	<u>56.99</u> (DR) PEAK <u>55\$5555555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.344 14.757	SIGNAZ(DB) PE/ 16.865 16.144 16.387 16.715 17.772
		-5/-08 DEN FRONE 5104 10 RCVII Par (IIH4) AV -5/-48 -50-01 -54-30 -54-31 -5/-47 -5/-00 -54-47	-59.18 <u>12(1)3) AV0 5[6MA2]</u> <u>13.18</u> <u>555555555555555555555555555555555555</u>	<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40	SIGMAZ (DB) AV 	SIGNAZ(DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937
<u>12</u> <u>F(1);H</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u> <u>14</u> <u>14</u> <u>14</u>	<u> 1347</u> 11345 1447 1445 4 449 4 450 4 351 4 351 4 359 4 399	-57.48 -57.48 -57.48 -57.48 -57.48 -57.47 -57.47 -57.47 -57.47 -57.47	-59.18 12(1)3) AV0 5[64A7] .21 13.18 N5255252555555555555555555555555555555	<u>56.99</u> <u>(DR) PEAK</u> <u>55.5555555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.344 14.757 12.952 13.666 14.351	SIGNAZ (DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.328 16.827
<u>12</u> <u>F(1);HT</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u>	<u>1347</u> <u>201555</u> <u>5004</u> <u>5004</u> <u>5004</u> <u>4347</u> <u>4348</u> <u>4351</u> <u>4351</u> <u>4351</u> <u>4392</u> <u>4392</u> <u>4393</u>	-57.48 DFA FRAVE 5104 10 RCVD Par (DH4) AV -57.48 -57.47 -54.30 -57.47 -57.47 -57.47 -57.47 -54.50	-59.18 <u>12(1)3) AV0 5[64A7]</u> <u>13.18</u> <u>13.18</u> <u>NCVU PWR (DBM) PEAK</u> -54.95 -55.67 -55.67 -55.10 -54.05 -54.05 -55.07 -55.07 -55.43 -55.43 -55.43 -55.43 -55.44 -55.48 -55.47 -54.94 -54.94	<u>56.99</u> (DR) PEAK <u>516MA AV</u> <u>516MA AV</u> <u>61.99</u> <u>61.46</u> <u>61.17</u> <u>61.03</u> <u>62.16</u> <u>61.99</u> <u>62.41</u> <u>60.60</u> <u>61.32</u> <u>62.00</u> <u>62.00</u> <u>60.97</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.344 14.757 12.952 13.666 14.351 13.321	SIGNAZ (DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273
	<u> 1347</u> 201 5F5 <u> 551 4347 4449 4450 4551 4551 4351 4392 4392 4392 4392 4392 4392 4392 </u>	-57.08 -57.08 -57.08 -51.04 -57.08 -51.04 -57.04 -57.04 -57.04 -57.04 -57.04 -57.04 -57.04 -57.04 -57.04 -57.04 -57.04	-59.18 <u>12(1)3) AV5 5[64A7]</u> <u>13.18</u> <u>NCVU PWR (DBM) PEAK</u> -54.95 -55.67 -55.67 -54.05 -54.05 -54.05 -54.05 -55.82	<u>56.99</u> <u>(DR) PEAK</u> <u>3</u> <u>12</u> <u>55\$55\$5555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65	SIGMAZ (DB) AV 	SIGNAZ (DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273 15.997
		-h/.68 UFB FROYE 5104 [4] RCVII PMP (DHM) AV -54.44 -54.44 -54.44 -54.44 -54.44 -54.44 -54.45 -54.40 -54.50 -54.50	-59.18 (/(1)3) AV(5 \$[6MA/1] (/(1)3) AV(5 \$[6MA/1] (/)3.18 -54.95 -54.95 -55.07 -54.95 -55.07 -54.88 -55.08 -54.99 -54.99 -54.99 -54.94 -54.94 -54.94 -55.82 -55.81	<u>56.99</u> <u>(DR) PEAK</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 63.65 63.65 63.65	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.507 14.344 14.757 12.952 13.666 14.351 13.321 13.084 13.321	SIGMAZ(DB) PE/ 16.865 16.144 16.387 16.715 17.772 16.937 16.937 15.997 16.328 16.827 17.273 15.997 16.012
<u>12</u> <u>F(1);((17)</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u>	$\begin{array}{c} 1 & 3 + 1 \\ \hline \\ 1 & 3 + 1 \\ \hline \\ 1 & 3 + 5 \\ \hline \\ 1 & 3 + 5 \\ \hline \\ 4 & 4 + 3 \\ \hline \\ \\ 4 & 4 + 3 \\ \hline \\ \\ \end{array}$	-57.68 $055.576475 - 5104$ 10 $RCVII PAP (004) AV$ -57.48 -57.44 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47 -57.47	-59.18 (1)(1)(3) AV(5) 5[GMA/1 (1)(1)(3) AV(5) 5[GMA/1 (1)(1)(1)(3) AV(5) 5[GMA/1 (1)(1)(1)(3) AV(5) 5[GMA/1 (1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	516MA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 63.65 63.65 63.65 64.41	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.344 14.757 12.952 13.666 14.351 13.321 13.084 13.321 13.746	SIGMAZ(DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273 15.997 16.927 15.997 16.012 16.757
<u>12</u> <u>F(1);H</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u> <u>14</u> <u>13</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u>	1 347 PUI SES 		-59.18 12(1)3) AV0 5[64A7] 13.18 13.18 N5559555555 CVD PWR (DBM) PEAK -54.95 -55.07 -54.05 -54.05 -54.05 -54.05 -54.05 -55.82 -55.82 -55.82 -55.81 -55.35	<u>56.99</u> (DR) PEAK <u>12</u> <u>516MA AV</u> <u>516MA AV</u> <u>61.99</u> <u>61.46</u> <u>61.17</u> <u>61.03</u> <u>62.16</u> <u>61.99</u> <u>62.41</u> <u>60.60</u> <u>61.32</u> <u>62.00</u> <u>61.32</u> <u>62.00</u> <u>61.32</u> <u>62.00</u> <u>61.32</u> <u>62.00</u> <u>61.32</u> <u>62.61</u> <u>61.32</u> <u>62.60</u> <u>61.32</u> <u>61.32</u> <u>61.32</u> <u>62.60</u> <u>61.32</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.32</u> <u>62.60</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.32</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u> <u>61.40</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.492 63.65 63.66 63.66 64.41 64.12	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.344 14.757 12.952 13.666 14.351 13.321 13.084 13.321 13.746 14.166	SIGMAZ(DB) PE 16.865 16.144 16.387 16.715 17.772 16.937 16.937 15.997 16.328 16.827 17.273 15.997 16.012
<u>12</u> <u>F(1);HT</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u>		-57.68 DFA FRAVE 5104 10 RCVD Par (DH4) AV -57.48 -56.01 -54.30 -57.41 -57.41 -57.47	-59.18 (1)(1)(3) AV(5) 5[GMA/1 (1)(1)(3) AV(5) 5[GMA/1 (1)(1)(1)(3) AV(5) 5[GMA/1 (1)(1)(1)(3) AV(5) 5[GMA/1 (1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	516MA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 63.65 63.65 63.65 64.41	SIGMAZ (DB) AV 14.342 13.807 13.519 13.377 14.507 14.344 14.757 12.952 13.666 14.351 13.321 13.084 13.321 13.746	SIGMAZ(DB) PE 16.865 16.144 16.387 16.715 17.722 16.750 16.937 15.997 16.328 16.827 17.273 15.997 16.012 16.757 16.469
<u>12</u> <u>F(1);HT</u> <u>14</u> <u>14</u> <u>14</u> <u>13</u> <u>14</u> <u>13</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u> <u>14</u>	1 347 PUI SES 		-59.18 12(1)3) AV(5 5[64A7] .21 13.18 53.55 CVU PWR (UBM) PEAK -54.95 -55.67 -55.67 -55.67 -55.07 -54.95 -55.07 -54.88 -55.82 -55.82 -55.81 -55.06 -55.06 -55.06 -55.06	<u>56.99</u> (DR) PEAK <u>3</u> <u>12</u> <u>555555555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 65 65 65 65 65 65 65 65 65	SIGMAZ (DB) AV 	SIGNAZ (DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273 15.997 16.012 16.757 16.469 15.274
	$\begin{array}{c} 1 & 3 + 1 \\ \hline \\ 1 & 3 + 1 \\ \hline \\ 1 & 3 + 5 \\ \hline \\ 1 & 4 & 3 + 5 \\ \hline \\ 4 & 4 & 4 \\ 4 & 4 & 4 \\ \hline \\ 4 & 4 & 4 \\ 4 & 4 & 5 \\ \hline \\ 4 & 4 & 5 \\ \hline \\ 4 & 4 & 3 \\ \hline \\ 4 & 4 & 4 \\ \hline \\ 4 & 4 & 1 \\ \hline \\ \end{array}$		-59.18 12(1)3) AV0 5[64A7] .21 13.18 .51 13.18 .52 5.55 .55.67 -55.43 -55.75 -54.95 -54.95 -55.82 -55.82 -55.35 -56.52 -56.72 -57.08	<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 63.65 63.65 63.65 63.65 63.65 64.41 64.12 62.92 62.94 62.39	SIGMAZ (DB) AV 14.342 13.807 13.519 13.519 13.377 14.344 14.757 12.952 13.666 14.351 13.321 13.084 13.321 13.084 13.321 13.746 14.166 12.728 12.511 12.909 12.161	SIGMAZ(DB) PE 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273 15.997 16.012 16.757 16.012 16.757 16.469 15.274 15.293 15.101 14.735
	1 341 PUISES PUISES 	-62.68 UEB FRONE 5104 10 RCVD Par (DH4) AV -54.40 -54.40 -54.40 -54.44 -57.47 -54.47 -54.50 -54.50 -54.50 -54.50 -54.91 -54.91	-59.18 -59.18 -50.18 -59.18 -51 -52.13.18 -54.95 -55.10 -54.05 -55.10 -54.05 -55.10 -54.05 -55.82 -55.82 -55.81 -55.35 -50.54 -50.52 -50.72	<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	55555 51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 63.66 64.41 64.12 62.92 62.94 62.75	SIGMAZ (DB) AV 	SIGNAZ(DB) PE/ 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273 15.997 16.012 16.757 16.469 15.274 15.293 15.101
12 F[1]0HT 14 14 13 14 14 14 14 14 14 15 15 15 16 16	1 341 211 5F5 341 4141 4144 4150 4150 4151 4150 4351 4432 4434 4435 4444 4445 4447	-62.68 DEN FRAVE 5104 10 RCVD Par (DH4) AV -54.48 -56.01 -54.30 -54.44 -54.44 -54.47 -54.47 -54.50 -54.73 -54.50 -54.50 -54.91 -54.91 -54.91 -54.91 -54.91 -54.91 -54.91 -54.94	-59.18 $12(1)3) AV_0 5[64A/1]$ $21 13.18$ -54.95 -55.67 -55.67 -55.67 -55.07 -55.07 -54.05 -54.05 -55.82 -55.82 -55.82 -55.82 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.82 -55.81 -55.85 -56.72 -56.60	<u>56.99</u> (DR) PEAK <u>12</u> <u>555555555555555555555555555555555555</u>	51GMA PEAK 64.52 63.79 64.04 64.37 65.42 64.40 64.59 63.65 63.98 64.48 64.92 63.65 63.65 63.65 63.65 63.65 63.65 64.41 64.12 62.92 62.94 62.39	SIGMAZ (DB) AV 14.342 13.807 13.519 13.519 13.377 14.344 14.757 12.952 13.666 14.351 13.321 13.084 13.321 13.084 13.321 13.746 14.166 12.728 12.511 12.909 12.161	SIGMAZ(DB) PE/ 16.865 16.144 16.387 16.715 17.772 16.750 16.937 15.997 16.328 16.827 17.273 15.997 16.012 16.757 16.012 16.757 16.469 15.274 15.293 15.101 14.735

	_ERANE	<u>RCVU_PAR (DBM) AV</u> _	RCVU_PWRIDHM)PEAK	SIGMA_AV	SIGMA_PEAK	SIGMAZ(DB)_AV	SIGMAZ(DB)_PEAK
			-55.60	63.87	63.87	16,215	16.215
í	ما نے جے ر	-5/.50	-57.50	61.97	61.97	14.321	14.321
1	5215	-51.42	-57.92	61+55	61.55	13.902	13.902
2			57.45	62.02	62.02	14.373	14.373
	5255	-5/.54	-5/.54	61.93	61.93	14.279	14.279
	<u> </u>	_5/w/	5%.&Z	62.40	62.40	14.750	<u>14•750</u>
	5251	-5/+49	-5/.99	61.48	61+48	13.832	13.832
ح	5258	<u>=>H,98</u>	-58.98	60.49	60.49	12.843	12.843
م م	5201	-55.64	-55.68	63.79	63+79	16.137	16.137
	_ 5786	<u></u>	56.04	63.43	63.43	15.776	15+776
*	ጉ ሥካዝ	-5/.14	-57.04	62.43	62+43	14.777	14.777 15.042
i i			56.78	62.69	62.69	15_042	15.241
3	11 11 12	-50.58	-56.58	62.89	62.89	15.241	13,732
	<u> </u>	=54,09	-54-09	61.38	61.38	13,732	14.189
4	5319	-57.63	-57.63	61.84	61•84 5 <u>9•04</u>	14.189 11.393	11.393
4.				62.43	62.43	14.777	14.777
• 4	5 52 I	-5/.04 -51	-57.04	60.16	02.45	12.512	12.512
4	<u></u>						
FI IGHT	<u></u>	PER FRAME STOMA	(I)B) AVG SIGMAZ (D	H) PFAK			
15		44.4	<u>44[°]14.49</u> _	18			
				**********	£\$\$ <u>\$\$</u>	· · · · · · · · · · · · · · · · · · ·	
				SIGMA AV	SIGMA PEAK	SIGMAZ (DB) AV	SIGHAZ (DB) PEAK.
	+ KANF						
U	5414		-52.03	63.97	67.44	16.321	19.793
	- <u>5414</u>		- <u>-52.03</u>	63.61	65.68	15,955	18.025
د				63.61 63.99	65•68 66•58	15.955 16.337	18.025 18.931
	5415	->>.4% ->+4% ->4.44		63.61 63.99 65.02	65.68 66.58 67.81	15.955 16.337 17.374	18.025 18.931 20.160
4	5455 5455 5457 5457	-55.48 -55.48 -54.44 -54.44	-53.79 -52.89 -51.00 _51.83	63.61 63.99 65.02 64.58	65•68 66•58 67•81 <u>67•64</u>	15.955 16.337 17.374 16.927	18.025 18.931 20.160 19.990
y 	5485 5485 5457 5457 5488 5488			63.61 63.99 65.02 64.58 64.78	65.68 66.58 67.81 <u>67.64</u> 67.82	$ \begin{array}{r} 15,955 \\ 16,337 \\ 17,374 \\ \frac{16,927}{17,131}$	18.025 18.931 20.160 <u>19.990</u> 20.174
	<u>5485</u> 5485 5457 5484 5484 5484	>>>>>> >>>++> >++++ >+++++ >	53,79 52,89 51,00 51,83 51,83 51,64 51,66	63.61 63.99 65.02 <u>64.58</u> 64.78 64.72	65.68 66.58 67.81 67.64 67.64 67.82 67.81	15.955 16.337 17.374 <u>16.927</u> 17.131 <u>17.065</u>	18.025 18.931 20.160 19.990 20.174 20.159
	<u>5485</u> 5485 5487 <u>5484</u> 5484 5484 5484 5484 5484 5484 5484	-55.45 -55.45 -54.44 -54.44 -54.69 -54.69 -54.75 -51.1		$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ - 64.58 \\ - 64.78 \\ - 64.72 \\ - 64.46 \end{array}$	65.68 66.58 67.81 <u>67.64</u> 67.82 67.82 67.81 67.52	$ \begin{array}{r} 15.955 \\ 16.337 \\ 17.374 \\ - \underline{16.927} \\ 17.131 \\ - \underline{17.065} \\ 16.807 \\ \end{array} $	18.025 18.931 20.160 <u>19.990</u> 20.174 <u>20.159</u> <u>19.865</u>
y y y y y	5485 5485 5487 5484 5484 5484 5484 5484			$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.72 \\ 64.72 \\ 64.46 \\ 64.56 \end{array}$	65.68 66.58 67.61 67.64 67.82 67.82 67.81 67.52 67.42	$ \begin{array}{r} 15.955 \\ 16.337 \\ 17.374 \\ - \underline{16.927} \\ 17.131 \\ 17.065 \\ - \underline{16.807} \\ 16.912 \\ \end{array} $	18.025 18.931 20.160 <u>19.990</u> 20.174 20.159 <u>19.865</u> 19.766
4 	5485 5485 5485 5484 5484 5484 5484 5484	>> -++++ >> -+++ >++++ >+++++ >+++++> >+++++> >+++++> >+++++> >++++++ >++++++++	-53,79 -52,89 -51,00 -51,83 -51,04 -51,04 -51,05 -51,05 -52,05 -52,05	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.74 \\ 64.76 \\ 64.56 \\ 64.56 \\ 64.93 \end{array}$	65.68 66.58 67.81 	$ \begin{array}{r} 15.955 \\ 16.337 \\ 17.374 \\ - 16.927 \\ 17.131 \\ 17.065 \\ 16.807 \\ 16.912 \\ 17.275 \\ \end{array} $	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157
y y y y y y	5485 5485 5485 5484 5484 5484 549 547 547 547	-55.45 -55.45 -54.44 -54.44 -54.75 -54.75 -54.75 -54.75 -54.75 -54.75 -54.75 -54.75 -54.75 -54.75	-53,79 -52,89 -51,06 -51,83 -51,04 -51,04 -51,06 -51,95 -52,05 -52,05 -52,29	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.76 \\ 64.46 \\ 64.46 \\ 64.56 \\ 64.93 \\ 63.55 \\ 63.55 \\ \end{array}$	65.68 66.58 67.64 67.64 67.64 67.82 67.81 67.52 67.42 66.81 67.18	15.955 16.337 17.374 <u>16.927</u> 17.131 <u>17.065</u> 16.807 <u>16.912</u> 17.275 <u>15.898</u>	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532
4 	huhb hub	>> -+> >> -+> >+ -+++ >+ -+++ >+ -+++ >+ -+> >+ -+> >+ -++ >++-++ >++-++ >++-++ >++-++ >++-++ >+++++ >+++++ >+++++ >++++++ >++++++++	-53,79 -52,89 -51,00 -51,83 -51,04 -51,06 -51,95 -51,95 -52,05 -52,05 -52,06 -52,37	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.76 \\ 64.46 \\ 64.56 \\ 64.93 \\ 63.55 \\ 63.90 \end{array}$	65.68 66.58 67.81 67.64 67.82 67.82 67.81 67.52 67.42 66.81 67.18 67.18	$ \begin{array}{r} 15.955 \\ 16.337 \\ 17.374 \\ - 16.927 \\ 17.131 \\ 17.065 \\ 16.807 \\ 16.912 \\ 17.275 \\ \end{array} $	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157
7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	5435 5455 5457 5474 5474 5474 5474 5474	>> .45 >> .45 >4.44 >4.44 >4.44 >4.49 >4.19 >+.19 >+.19 >+.10 >+.10 >+.14 >+.4 	-53,79 -52,89 -51,00 -51,83 -51,04 -51,06 -51,95 -51,95 -52,05 -52,06 -52,29 -52,37 -53,09	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.46 \\ 64.46 \\ 64.56 \\ 64.93 \\ 63.55 \\ 63.90 \\ 63.56 \end{array}$	65.68 66.58 67.64 67.64 67.64 67.82 67.81 67.52 67.42 66.81 67.18	$ \begin{array}{r} 15.955 \\ 16.337 \\ 17.374 \\ -16.927 \\ -17.131 \\ -17.065 \\ -16.807 \\ 16.912 \\ 17.275 \\ -15.898 \\ -16.253 \\ \end{array} $	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445
7 ; 7 ; 7 ; 7 ; 7 ; 7 ; 7 ; 7 ; 7 ; 7 ;	5485 5485 5487 5484 5484 5484 5484 5494 5494 5494 5494 5494 5494 5494	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 59 \\ -54 \cdot 15 \\ -55 \cdot 11 \\ -54 \cdot 54 \\ -55 \cdot 57 \\ -55$	-53,79 -52,84 -51,00 -51,83 -51,04 -51,95 -51,95 -52,05 -52,05 -52,05 -52,05 -52,05 -52,05 -52,07 -52,07 -52,07 -52,09 -52,59	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.76 \\ 64.46 \\ 64.56 \\ 64.93 \\ 63.55 \\ 63.90 \end{array}$	65.68 66.58 67.81 67.64 67.82 67.82 67.81 67.52 67.42 66.81 67.18 67.18 67.10 66.38	$\begin{array}{r} 15.955 \\ 16.337 \\ 17.374 \\ \underline{16.927} \\ 17.131 \\ \underline{17.065} \\ 16.807 \\ \underline{16.912} \\ 17.275 \\ \underline{15.898} \\ 16.253 \\ \underline{15.909} \\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445 18.732
7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	huhb hubb hubb <td>$\begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 10 \\ -55 \cdot 1$</td> <td>-53,79 -52,89 -51,00 -51,83 -51,04 -51,06 -51,95 -51,95 -52,05 -52,06 -52,29 -52,37 -53,09</td> <td>$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.72 \\ 64.56 \\ 64.56 \\ 64.56 \\ 64.56 \\ 63.56 \\ 63.56 \\ 64.35 \end{array}$</td> <td>65.68 66.58 67.81 67.64 67.82 67.82 67.82 67.82 67.42 66.81 67.18 67.10 66.38 66.87</td> <td>15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253</td> <td>18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.532 19.445 18.732 19.224 19.720 19.118</td>	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 10 \\ -55 \cdot 1$	-53,79 -52,89 -51,00 -51,83 -51,04 -51,06 -51,95 -51,95 -52,05 -52,06 -52,29 -52,37 -53,09	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.72 \\ 64.56 \\ 64.56 \\ 64.56 \\ 64.56 \\ 63.56 \\ 63.56 \\ 64.35 \end{array}$	65.68 66.58 67.81 67.64 67.82 67.82 67.82 67.82 67.42 66.81 67.18 67.10 66.38 66.87	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.532 19.445 18.732 19.224 19.720 19.118
7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	5485 5485 5484 5484 5484 5484 5484 5494 5494 5494 5494 5494 5494 5494	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 54 \\ -54 \cdot 54 \\ -55 \cdot 57 \\ -55 \cdot 12 \\ -55 \cdot 12 \\ -55 \cdot 57 \\ \end{array} $	-53,79 -52,89 -51,06 -51,83 -51,04 -51,95 -52,05 -52,05 -52,05 -52,29 -52,37 -53,09 -52,37 -52,10	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.72 \\ 64.46 \\ 64.56 \\ 64.56 \\ 64.56 \\ 64.56 \\ 64.55 \\ 63.55 \\ 63.55 \\ 64.37 \\ 64.37 \end{array}$	65.68 66.58 67.81 67.64 67.82 67.82 67.81 67.52 67.42 66.81 67.18 67.18 67.10 66.38 67.37	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 16.191	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445 18.732 19.224 19.720 19.118 19.313
7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	huhb hubb hubb <td>$\begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 10 \\ -55 \cdot 1$</td> <td>-53,79 -52,89 -51,06 -51,83 -51,04 -51,95 -52,05 -52,05 -52,05 -52,29 -52,37 -52,37 -52,39 -52,59 -52,59 -52,10 -52,10</td> <td>$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.72 \\ 64.46 \\ 64.56 \\ 64.46 \\ 64.56 \\ 64.93 \\ 63.55 \\ 63.90 \\ 63.90 \end{array}$</td> <td>65.68 66.58 67.81 67.64 67.82 67.82 67.42 67.52 67.42 66.81 67.18 67.18 67.10 66.38 66.87 67.37 66.77 66.96 67.50</td> <td>$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ \underline{} 17.374\\ \underline{} 16.927\\ 17.131\\ \underline{} 17.065\\ \underline{} 16.807\\ \underline{} 16.912\\ 17.275\\ \underline{} 15.898\\ \underline{} 16.253\\ \underline{} 15.909\\ 16.698\\ \underline{} 16.717\\ 16.253\\ \underline{} 15.302\\ \underline{} 191\\ \underline{} 17.302\\ \end{array}$</td> <td>18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445 18.732 19.224 19.118 19.313 19.845</td>	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 7 \\ -55 \cdot 10 \\ -55 \cdot 1$	-53,79 -52,89 -51,06 -51,83 -51,04 -51,95 -52,05 -52,05 -52,05 -52,29 -52,37 -52,37 -52,39 -52,59 -52,59 -52,10 -52,10	$\begin{array}{r} 63.61 \\ 63.99 \\ 65.02 \\ 64.58 \\ 64.78 \\ 64.78 \\ 64.72 \\ 64.46 \\ 64.56 \\ 64.46 \\ 64.56 \\ 64.93 \\ 63.55 \\ 63.90 \\ 63.90 \end{array}$	65.68 66.58 67.81 67.64 67.82 67.82 67.42 67.52 67.42 66.81 67.18 67.18 67.10 66.38 66.87 67.37 66.77 66.96 67.50	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ \underline{} 17.374\\ \underline{} 16.927\\ 17.131\\ \underline{} 17.065\\ \underline{} 16.807\\ \underline{} 16.912\\ 17.275\\ \underline{} 15.898\\ \underline{} 16.253\\ \underline{} 15.909\\ 16.698\\ \underline{} 16.717\\ 16.253\\ \underline{} 15.302\\ \underline{} 191\\ \underline{} 17.302\\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445 18.732 19.224 19.118 19.313 19.845
7 ; 1 ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	5485 5485 5484 5484 5484 5484 5494 5494 5494 5494 5494 5494 5494	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 74 \\ -54 \cdot 54 \\ -54 \cdot 54 \\ -55 \cdot 57 \\ -55 \cdot 12 \\ -55 \cdot 57 \\ -55 \cdot 57 \\ -55 \cdot 53 \\ \end{array} $	$ \begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.10 \\ -52.51 \\ -52.$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.72\\ 64.46\\ 64.56\\ 64.56\\ 64.56\\ 64.55\\ 64.35\\ 63.56\\ 64.35\\ 64.37\\ 63.90\\ 63.64\\ 64.95\\ 64.95\\ 64.95\\ 64.95\\ 63.82\\ \end{array}$	65.68 66.58 67.81 67.64 67.82 67.82 67.82 67.82 67.81 67.52 67.42 66.81 67.18 67.18 67.18 67.10 66.38 67.37 66.77 66.96 67.50 67.50 66.96	15.955 16.337 17.374 <u>16.927</u> 17.131 17.065 16.807 16.912 17.275 <u>15.898</u> 16.253 <u>15.909</u> 16.698 <u>16.717</u> 16.253 <u>16.191</u> 17.302 <u>16.172</u>	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.313 19.313 19.306
ד ל ל ל ל ל ל ל ל ל ל ל ל ל ל ל ל ל ל ל	huhb hub	$ \begin{array}{c} -55 \cdot 46 \\ -55 \cdot 48 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -55 \cdot 01 \\ -54 \cdot 54 \\ -55 \cdot 01 \\ -54 \cdot 54 \\ -55 \cdot 57 \\ -55 \cdot 10 \\ -55 \cdot 57 \\ -55 \cdot 55 \\ -55$	$\begin{array}{r} +53,79 \\ -52,89 \\ -51,06 \\ -51,83 \\ -51,04 \\ -51,95 \\ -52,05 \\ -52,05 \\ -52,05 \\ -52,05 \\ -52,29 \\ -52,37 \\ -52,37 \\ -52,37 \\ -52,10 \\ -52,10 \\ -52,10 \\ -52,10 \\ -52,51 \\ -51,97 \\ -52,51 \\ -51,24 \\ \end{array}$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 63.90\\ 63.55\\ 64.35\\ 64.37\\ 63.90\\ 63.84\\ 64.95\\ 63.82\\ 64.91\\ \end{array}$	$\begin{array}{r} 65.68\\ 66.58\\ 67.81\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.81\\ 67.52\\ 67.42\\ 66.81\\ 67.18\\ 67.18\\ 67.10\\ 66.38\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 65.96\\ 67.52\\ 67.52\\ 65.96\\ 67.22\\ \end{array}$	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 15.911 17.302 16.172 17.262	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.445 19.224 19.313 19.845 19.316 19.306 19.574
3 3 <td>5435 5450 5450 5450 5470 5470 5471 <td>$\begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 45 \\ -54 \cdot 45 \\ -54 \cdot 45 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -55 \cdot 5 \\ -$</td><td>$\begin{array}{r} +53,79 \\ -52,89 \\ -51,06 \\ -51,83 \\ -51,04 \\ -51,95 \\ -52,05 \\ -52,05 \\ -52,05 \\ -52,29 \\ -52,37 \\ -52,37 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,14 \\ -52,14 \\ \end{array}$</td><td>$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 63.90\\ 63.55\\ 64.37\\ 63.90\\ 63.82\\ 64.95\\ 64.95\\ 64.95\\ 63.82\\ 64.91\\ 63.82\\ 64.91\\ 63.46\end{array}$</td><td>65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.52 67.18 67.18 67.18 67.18 67.18 67.710 66.38 66.737 66.77 66.96 67.50 66.96 67.22 67.33</td><td>15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 16.191 17.302 16.172 17.262 15.811</td><td>18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.681</td></td>	5435 5450 5450 5450 5470 5470 5471 <td>$\begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 45 \\ -54 \cdot 45 \\ -54 \cdot 45 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -55 \cdot 5 \\ -$</td> <td>$\begin{array}{r} +53,79 \\ -52,89 \\ -51,06 \\ -51,83 \\ -51,04 \\ -51,95 \\ -52,05 \\ -52,05 \\ -52,05 \\ -52,29 \\ -52,37 \\ -52,37 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,14 \\ -52,14 \\ \end{array}$</td> <td>$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 63.90\\ 63.55\\ 64.37\\ 63.90\\ 63.82\\ 64.95\\ 64.95\\ 64.95\\ 63.82\\ 64.91\\ 63.82\\ 64.91\\ 63.46\end{array}$</td> <td>65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.52 67.18 67.18 67.18 67.18 67.18 67.710 66.38 66.737 66.77 66.96 67.50 66.96 67.22 67.33</td> <td>15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 16.191 17.302 16.172 17.262 15.811</td> <td>18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.681</td>	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 45 \\ -54 \cdot 45 \\ -54 \cdot 45 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -54 \cdot 4 \\ -55 \cdot 5 \\ -$	$ \begin{array}{r} +53,79 \\ -52,89 \\ -51,06 \\ -51,83 \\ -51,04 \\ -51,95 \\ -52,05 \\ -52,05 \\ -52,05 \\ -52,29 \\ -52,37 \\ -52,37 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,51 \\ -52,14 \\ -52,14 \\ \end{array} $	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 63.90\\ 63.55\\ 64.37\\ 63.90\\ 63.82\\ 64.95\\ 64.95\\ 64.95\\ 63.82\\ 64.91\\ 63.82\\ 64.91\\ 63.46\end{array}$	65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.52 67.18 67.18 67.18 67.18 67.18 67.710 66.38 66.737 66.77 66.96 67.50 66.96 67.22 67.33	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 16.191 17.302 16.172 17.262 15.811	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.681
4 5 1 5 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 <td>5485 5485 5487 5484 5484 5484 5497 5497 5497 5497 5497 5497 5497 549</td> <td>$\begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\$</td> <td>$\begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.06 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.51 \\ -52.$</td> <td>$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.78\\ 64.72\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 64.35\\ 64.35\\ 64.35\\ 64.37\\ 63.90\\ 63.84\\ 64.95\\ 63.82\\ 64.91\\ 63.43\\ \end{array}$</td> <td>$\begin{array}{r} 65.68\\ 66.58\\ 67.81\\ 67.64\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.52\\ 67.10\\ 66.38\\ 66.87\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 66.96\\ 67.50\\ 66.96\\ 67.22\\ 67.33\\ 66.63\end{array}$</td> <td>15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 15.919 17.302 16.191 17.302 16.172 17.262 15.811 15.784</td> <td>18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.681</td>	5485 5485 5487 5484 5484 5484 5497 5497 5497 5497 5497 5497 5497 549	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\$	$ \begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.06 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.51 \\ -52.$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.78\\ 64.72\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 64.35\\ 64.35\\ 64.35\\ 64.37\\ 63.90\\ 63.84\\ 64.95\\ 63.82\\ 64.91\\ 63.43\\ \end{array}$	$\begin{array}{r} 65.68\\ 66.58\\ 67.81\\ 67.64\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.52\\ 67.10\\ 66.38\\ 66.87\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 66.96\\ 67.50\\ 66.96\\ 67.22\\ 67.33\\ 66.63\end{array}$	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 15.919 17.302 16.191 17.302 16.172 17.262 15.811 15.784	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.681
ר כיק ביק ביק ביק ביק ביק ביק ביק ביק ביק ב	5485 5485 5484 5484 5484 5484 5493 5493 5494	$ \begin{array}{c} -55.46 \\ -55.46 \\ -54.46 \\ -54.46 \\ -54.75 \\ -54.75 \\ -54.75 \\ -54.75 \\ -54.75 \\ -54.75 \\ -54.54 \\ -55.62 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.52 \\ -55.63 \\ -54.54 \\ -54.54 \\ -54.$	$ \begin{array}{r} +53.79 \\ -52.89 \\ -51.00 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.44 \\ -52.14 \\ -52.$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.78\\ 64.72\\ 64.72\\ 64.56\\ 64.56\\ 64.56\\ 64.56\\ 64.55\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.37\\ 63.90\\ 63.84\\ 64.95\\ 63.82\\ 64.91\\ 63.43\\ 63.43\\ 65.41\\ \end{array}$	65.68 66.58 67.81 67.82 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.33 66.63 67.22 67.33 66.63	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 16.191 17.302 16.191 17.262 15.811 15.784 .7.758	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.224 19.313 19.845 19.306 19.574 19.681 18.982 20.105
ר כיק ביק ביק ביק ביק ביק ביק ביק ביק ביק ב	5485 5485 5487 5484 5484 5484 5484 5494 5494 5494 5497 5497 5497 5497 549	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -54 \cdot 74 \\ -54 \cdot 54 \\ -55 \cdot 57 \\ -55$	$\begin{array}{c} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.19 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.64 \\ -52.14 \\ -52.08 \\ -52.0$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.93\\ 63.55\\ 63.90\\ 63.55\\ 64.37\\ 63.90\\ 63.56\\ 64.35\\ 64.37\\ 63.90\\ 63.88\\ 64.93\\ 64.91\\ 63.82\\ 63.43\\ 65.41\\ 63.57\end{array}$	$\begin{array}{r} 65.68\\ 66.58\\ 67.81\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.81\\ 67.52\\ 67.42\\ 66.81\\ 67.18\\ 67.10\\ 66.38\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 66.96\\ 67.50\\ 66.96\\ 67.22\\ 67.33\\ 66.63\\ 61.75\\ 66.79\\ 67.75\\ 66.79\\ 66.79\\ 67.75\\ 66.79\\ 67.75\\ 66.79\\ 67.75\\ 66.79\\ 67.75\\ 66.79\\ 67.75\\ 66.79\\ 66$	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 15.909 16.698 16.717 16.253 15.919 17.262 15.811 15.784 17.758 15.919	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 18.732 19.445 19.720 19.118 19.313 19.845 19.306 19.574 19.681 18.982 20.105 19.137
۲	5485 5485 5484 5584 5584 5584 5584 5584 5584 5584 5584 5584 5584 5584 5584 5584 5584 5584	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -54 \cdot 74 \\ -54 \cdot 54 \\ -55 \cdot 57 \\ -55$	$\begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.37 \\ -52.51 \\ -52.5$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 54.56\\ 54.93\\ 63.55\\ 63.90\\ 63.55\\ 64.35\\ 64.37\\ 63.90\\ 63.84\\ 63.49\\ 63.43\\ 65.41\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ \end{array}$	65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 66.81 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.19 66.81 67.33 66.63 67.75 66.79 65.82	15.955 16.337 17.374 16.927 17.131 17.065 16.807 16.912 17.275 15.898 16.253 16.678 16.698 16.717 16.253 15.909 16.191 17.302 16.172 17.262 15.811 15.784 15.784 15.919 16.326	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.7532 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.574 19.574 19.574 19.137 18.169
	5485 5485 5484 5494 <td>$\begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 49 \\ -54 \cdot 40 \\ -54 \cdot 54 \\ -55 \cdot 10 \\ -55 \cdot 11 \\ -55$</td> <td>$\begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.95 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.07 \\ -52.07 \\ -52.07 \\ -52.51 \\ -52.5$</td> <td>$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 64.37\\ 63.90\\ 63.55\\ 64.37\\ 63.90\\ 63.84\\ 64.95\\ 64.95\\ 63.82\\ 64.91\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ \end{array}$</td> <td>65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.83 66.87 67.33 66.63 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.75</td> <td>$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.919\\ 15.784\\ 17.758\\ 15.919\\ 16.326\\ 16.708\\ \end{array}$</td> <td>18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.757 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.681 18.982 20.105 19.137 18.884</td>	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 43 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 49 \\ -54 \cdot 40 \\ -54 \cdot 54 \\ -55 \cdot 10 \\ -55 \cdot 11 \\ -55$	$\begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.95 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.07 \\ -52.07 \\ -52.07 \\ -52.51 \\ -52.5$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 64.37\\ 63.90\\ 63.55\\ 64.37\\ 63.90\\ 63.84\\ 64.95\\ 64.95\\ 63.82\\ 64.91\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ \end{array}$	65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.83 66.87 67.33 66.63 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.96 67.50 66.75	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.919\\ 15.784\\ 17.758\\ 15.919\\ 16.326\\ 16.708\\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.757 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.681 18.982 20.105 19.137 18.884
τ τ τ τ τ τ τ τ τ τ τ τ τ τ	5435 5485 5484 5484 5484 5494 5244 5244 5244	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -55 \cdot 7 \\ -55 \cdot 1 \\ -55 \cdot 9 \\ -55 \cdot 1 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 1 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 1 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 1 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 9 \\ -55 \cdot 1 \\ -55 \cdot 9 \\$	$\begin{array}{c} +53.79 \\ -52.89 \\ -51.00 \\ -51.83 \\ -51.04 \\ -51.04 \\ -51.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.44 \\ -52.68 \\ -52.44 \\ -52.05 \\ -52.44 \\ -52.05 \\ -52.48 \\ -52.24 \\ -52.2$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.72\\ 64.72\\ 64.56\\ 64.56\\ 64.56\\ 64.56\\ 64.55\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.91\\ 63.48\\ 63.43\\ 63.43\\ 63.43\\ 63.43\\ 63.43\\ 63.43\\ 63.43\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ 65.47\\ \end{array}$	$\begin{array}{c} 65.68\\ 66.58\\ 67.81\\ 67.81\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.81\\ 67.52\\ 67.42\\ 66.81\\ 67.18\\ 67.18\\ 67.10\\ 66.38\\ 66.87\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 66.96\\ 67.50\\ 66.96\\ 67.22\\ 67.33\\ 66.63\\ 67.70\\ 65.76\\ 65.76\\ 65.76\\ 65.76\\ 65.76\\ 66.79\\ 65.82\\ 66.53\\ 67.19\end{array}$	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ - 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ - 15.909\\ 16.698\\ 16.253\\ - 15.909\\ 16.698\\ 16.717\\ 16.253\\ - 15.919\\ - 17.302\\ - 16.191\\ 17.302\\ - 16.191\\ 17.302\\ - 16.191\\ - 17.362\\ - 15.919\\ - 16.326\\ - 16.708\\ 17.824\\ \end{array}$	$\begin{array}{c} 18.025\\ 18.931\\ 20.160\\ 19.990\\ 20.174\\ 20.159\\ 19.865\\ 19.766\\ 19.157\\ 19.532\\ 19.445\\ 18.732\\ 19.224\\ 19.720\\ 19.118\\ 19.313\\ 19.845\\ 19.306\\ 19.574\\ 19.681\\ 18.982\\ 20.105\\ 19.137\\ 18.169\\ 18.684\\ 19.537\\ \end{array}$
4 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 5 1 5 5 7 7 5 5 7 7 5 5 7 7 5 5 7 7 5 5 7	5485 5485 5485 5484 5484 5484 5495 5495 5405	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -54 \cdot 44 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 75 \\ -54 \cdot 74 \\ -54 \cdot 54 \\ -55 \cdot 7 $	$\begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.44 \\ -52.14 \\ -52.44 \\ -52.14 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.48 \\ -52.4$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.72\\ 64.46\\ 64.93\\ 63.55\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.37\\ 63.90\\ 63.64\\ 95\\ 63.42\\ 64.95\\ 63.44\\ 63.43\\ 65.41\\ 63.43\\ 65.41\\ 63.57\\ 63.57\\ 63.57\\ 63.77\\ 63.77\end{array}$	$\begin{array}{r} 65.68\\ 66.58\\ 67.81\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.82\\ 67.81\\ 67.52\\ 67.42\\ 66.81\\ 67.18\\ 67.10\\ 66.38\\ 66.87\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 66.96\\ 67.22\\ 67.33\\ 66.63\\ 67.72\\ 66.54\\ 67.50\\ 66.53\\ 67.19\\ 65.52\\ 66.54\\ 67.19\\ 65.54\\ 67.19\\ 65.54\\ 67.55\\ 66.54\\ 67.19\\ 65.54\\ 67.55\\ 66.55\\ 66.55\\ 67.19\\ 65.55\\ 66.55\\ 67.19\\ 65.55\\ 66.55\\ 67.19\\ 66.55\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67.19\\ 66.55\\ 67.19\\ 67$	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ 15.909\\ 16.698\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.919\\ 16.491\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 15.784\\ 17.758\\ 15.919\\ 16.326\\ 15.919\\ 16.326\\ 16.124\\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.306 19.313 19.845 19.306 19.313 19.574 19.575 19.575 19.313 19.574 19.575 19.575 19.575 19.575 19.575 19.574 19.575 19.575 18.982 20.105 19.137 18.884 19.537 18.944
4 2	5485 5485 5484 5484 5484 5494 5744 5746 574	$ \begin{array}{c} -55 \cdot 45 \\ -55 \cdot 45 \\ -54 \cdot 44 \\ -55 \cdot 41 \\ -55 \cdot 57 \\ -55$	$\begin{array}{c} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.64 \\ -52.14 \\ -52.64 \\ -52.44 \\ -52.14 \\ -52.64 \\ -52.44 \\ -52.44 \\ -52.64 \\ -52.64 \\ -52.68 \\ -53.05 \\ -52.28 \\ -52.4$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 64.56\\ 64.93\\ 63.55\\ 63.90\\ 63.55\\ 64.35\\ 64.37\\ 63.90\\ 63.56\\ 64.35\\ 64.37\\ 63.90\\ 63.82\\ 64.91\\ 63.43\\ 65.41\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ 65.47\\ 63.77\\ 63.77\\ 62.97\\ \end{array}$	65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.81 67.81 67.81 67.10 66.81 67.10 66.81 67.13 66.77 66.96 67.33 66.63 67.75 66.79 65.82 66.53 67.19 66.53 67.19 66.59 55.78	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ 15.909\\ 16.698\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.919\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.362\\ 15.811\\ 15.784\\ 17.262\\ 15.811\\ 15.784\\ 17.758\\ 15.919\\ 16.326\\ 16.708\\ 17.824\\ 16.124\\ 15.317\\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.445 19.224 19.313 19.845 19.316 19.313 19.845 19.306 19.574 19.681 18.982 20.105 19.137 18.884 19.537 18.944 18.129
4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 10 7 11 12 12 12 13 12	5485 5485 5484 5564 5744 574 574 574 574 574		$ \begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.95 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.44 \\ -52.14 \\ -52.68 \\ -52.68 \\ -53.65 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.60 \\ -53.66 \\ -53.60 \\ -53.66 \\ -53.60 \\ -53.$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 56\\ 54.46\\ 56\\ 54.93\\ 63.55\\ 64.37\\ 63.90\\ 63.56\\ 64.37\\ 63.90\\ 63.82\\ 64.95\\ 63.82\\ 54.91\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ 65.47\\ 63.78\\ \end{array}$	65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 66.81 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.19 66.71 66.73 67.52 67.37 66.63 67.75 66.63 67.75 66.79 65.82 66.53 67.19 66.59 65.78 66.11	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.919\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.824\\ 15.919\\ 16.326\\ 16.708\\ 17.824\\ 16.124\\ 15.317\\ 16.131\\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.7532 19.445 18.732 19.224 19.720 19.118 19.313 19.845 19.306 19.574 19.574 19.574 19.574 19.574 19.574 19.573 18.982 20.105 19.137 18.169 18.944 19.537 18.944 18.129 18.426
4 5	5485 5485 5484 5484 5494 5544 5744 574 574 574 574 574 574	$ \begin{array}{c} -55.46 \\ -55.46 \\ -54.46 \\ -54.46 \\ -54.49 \\ -54.49 \\ -54.40 \\ -54.40 \\ -54.40 \\ -54.40 \\ -54.40 \\ -54.40 \\ -55.$	$ \begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.04 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.68 \\ -52.$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.72\\ 64.78\\ 64.72\\ 64.72\\ 64.72\\ 64.72\\ 64.56\\ 64.56\\ 64.56\\ 64.55\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.35\\ 64.91\\ 63.43\\ 65.41\\ 63.43\\ 65.41\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ 65.47\\ 63.77\\ 63.77\\ 63.78\\ 64.70\\ \end{array}$	$\begin{array}{r} 65.68\\ 66.58\\ 67.81\\ 67.81\\ 67.64\\ 67.82\\ 67.82\\ 67.82\\ 67.81\\ 67.52\\ 67.42\\ 66.81\\ 67.18\\ 67.18\\ 67.10\\ 66.38\\ 66.87\\ 67.37\\ 66.77\\ 66.96\\ 67.50\\ 66.96\\ 67.50\\ 66.96\\ 67.50\\ 66.53\\ 67.19\\ 65.53\\ 67.19\\ 66.59\\ 65.78\\ 66.11\\ 66.75\\ \end{array}$	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ -16.927\\ 17.131\\ 17.065\\ 16.607\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ -15.909\\ 16.698\\ 16.253\\ -15.909\\ 16.698\\ 16.717\\ 16.253\\ -16.191\\ 17.302\\ -16.191\\ 17.302\\ -16.191\\ 17.302\\ -16.191\\ 17.302\\ -16.191\\ -17.302\\ -16.191\\ -17.302\\ -16.191\\ -17.302\\ -16.131\\ -17.047\\ -1.047\\ $	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445 18.732 19.224 19.313 19.316 19.681 18.982 20.105 19.137 18.984 19.537 18.944 19.537 18.944 19.537 18.945 19.537 18.92 18.129 18.129
4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 10 7 11 12 12 12 13 12	5485 5485 5484 5564 5744 574 574 574 574 574		$ \begin{array}{r} +53.79 \\ -52.89 \\ -51.06 \\ -51.83 \\ -51.95 \\ -51.95 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.05 \\ -52.29 \\ -52.37 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.51 \\ -52.44 \\ -52.14 \\ -52.68 \\ -52.68 \\ -53.65 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.69 \\ -53.66 \\ -53.60 \\ -53.66 \\ -53.60 \\ -53.66 \\ -53.60 \\ -53.$	$\begin{array}{c} 63.61\\ 63.99\\ 65.02\\ 64.58\\ 64.78\\ 64.72\\ 64.46\\ 56\\ 54.46\\ 56\\ 54.93\\ 63.55\\ 64.37\\ 63.90\\ 63.56\\ 64.37\\ 63.90\\ 63.82\\ 64.95\\ 63.82\\ 54.91\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 63.43\\ 65.41\\ 63.57\\ 63.98\\ 64.36\\ 65.47\\ 63.78\\ \end{array}$	65.68 66.58 67.81 67.64 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 67.81 67.82 66.81 67.18 67.18 67.18 67.18 67.18 67.18 67.18 67.19 66.71 66.73 67.52 67.37 66.63 67.75 66.63 67.75 66.79 65.82 66.53 67.19 66.59 65.78 66.11	$\begin{array}{r} 15.955\\ 16.337\\ 17.374\\ 16.927\\ 17.131\\ 17.065\\ 16.807\\ 16.912\\ 17.275\\ 15.898\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.909\\ 16.698\\ 16.717\\ 16.253\\ 15.919\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.302\\ 16.191\\ 17.824\\ 15.919\\ 16.326\\ 16.708\\ 17.824\\ 16.124\\ 15.317\\ 16.131\\ \end{array}$	18.025 18.931 20.160 19.990 20.174 20.159 19.865 19.766 19.157 19.532 19.445 18.732 19.244 19.720 19.118 19.313 19.306 19.574 19.574 19.574 19.574 19.574 19.575 19.574 19.575 19.574 19.575 19.574 19.575 19.574 19.575 19.574 19.575 19.577 19.577 19.577 19.577 19.577 18.982 20.105 19.137 18.884 19.537 18.944 18.129 18.456

	<u> </u>	->>.50	-52.16	63.97	66.71	16.319	19.057	
	L 1/2 1/2 5/4	-54.64		64.83	66.64	17.175	18.989	
	<u></u>	<u>~>4•nY</u>	52.32	64.78	67.08	17.131	<u> 19.428 </u>	,
	10 5536	-54.40	-52.44	64.66	67.03	17.014	19.37B	
	<u>10 5537</u>	-55.38	-52.54	64.09	66+93	16.441	19.276	<u> </u>
	10 5536	-54.49	-52.46	64.58	67.01	16.927	19.359	
	<u>10</u>	- <u>-54•41</u> -57•21	-52.04	64.66	67.42	17.007	<u>19.774</u>	
	1(* 554)		-53.07	62.26	66+40	14.609	18.745	
		-54.(8		60.39	65.13	12.740	17.478	
	10 5543	-54.12	-52.54	62.52	66.93	14.867	19.281	
	10 5544		-52.19 -53.81	62+75	<u>66.68</u> 65.66	15.095	19.032	
	1. 5545	-54+1/	-53.01	63.40	66+07	14.911 15.745	18.011	
	10 5540			64.38	66+91	<u>15.745</u>	<u>18.421</u>	
	11 5547	-55 • 14	-52+46	64.43	67+01	16.777	19.360	
	11 5544	= 54+69		64.78	66.91			· — — — -
	EL Span	-54.70	-52.30	64.77	67.17	17.121	19.522	
	11 556/	-55.84	-52.38	63.63	67.09	15.978	19.436	
	<u>115568</u>	54.41	-51./5	65.45	67.72	17.804	20.067	
	11 5564	-54.11	-51.97	65.35	67.50	17.704	19.845	
	11 5570		52.06	64,73	67.41	17.083	19.756	
	11 55/1	-'>>•77		63.70	66.75	16.047	19.102	· — — — -
	11 5572	-53-53	-51.46	65.94	68.01	18,291	20.360	
	11 -5/3	-54.51	-51.30	64+65	68.17	17.004	20+517	
	11 5574		-51.06	64.27	67.81	16.623	20.162	
	11 5575	-55.75	-52.85	63.72	66.61	16.070	18.964	
	11 55/0	-54. 14	-50.93	65.13	68.54	17.482	20.893	
	11 5574	->>.71	-52+14	63.70	67.32	16.047	19.674	· — — — -
	11 5579	-54.72	-51,72	62.75	67.75	15,095	20.101	
	11 5566	-54.4]	-52+24	64.56	67.23	16.912	19.578	
	<u>11 5501</u>		-52.15	63.25	67.32	15,597	19.670	
	11 5542	-56.3/	-53.20	63.10	66+27	15.446	18.621	
	<u>11543</u>			63.05	67.73	15.401	20.082	
	11 5584		-51.14	63.83	68.33	16.181	20.680	
	<u>11 5585</u>	-50-31	-53+05	63.16	66+42	15,505	18.769	
	11 5526	-5/.00	-51.71	62.47	67.76	14.821	20.113	
	<u>ji587</u>	<u>66</u>	-52.38	63.81	67+08	16,156	19.434	
	11 5568	-00+00	-52+72	63+81	66+74	16.159	19.094	
	11 5589	<u>1++++++++++++++++++++++++++++++++</u>		64+46	67.72	<u>16.806</u> 16.510	20.066	
	11 5590	-55+31	-51.84	64.16	67.63	16,510	19.976	
	<u> </u>	-56.57	-53.34	<u>52.90</u>	66.13	15.247	18.483	
	12 5609	-57.22	-53.67	62.25	65.80	14.598	18.145	
 ,				61.92	65.19	<u>14.267</u>	17.545	
	12 5011	-56+19	-52.07	63.28	66.80	15.633	19.146	
	<u>-12 5612</u> 12 5613	<u></u>		<u>63•16</u>	<u> </u>	15.509	19.508	
	12 5613	-54.33	-51.85	64+49	67+62	16.836	19.967	
·····	12 5615	->0++13	-52.49	65.14	66.98	17.485	19.333	·
	12 5615	-50+69	-53.96	62.78	65.51	15,129	17.863	
			·	63.12	66.00	15.466	<u>18.354</u>	
	12 5618	-56.93	-53.10	63.79	66.36	16.137	18.714	
				64.23	66.19	14.891	17.763	
	12 5620	-56.22	-52.61	63.25	66.86	16.576 15.603	18.543 19.213	
·	12 5621	-54.33	-51.95	65+13	67.52	17.484	19.867	
	12 5622	-55.19		64.28	67.29	16.626	19.643	
	12 5623	-54.99	-52.43	64.48	67.04	16.831	19.387	
	12 5624	-55.39	-52.64	64.08	66+82	16.430	19.174	
	17 5625	-54.93	-52.50	64.54	66.97	16.887		
	12 5626	-55.23	-52.60	64.23	_ 66.67	16,584	19.020	
	12 5627	-55.62	-52.41	63.65	67.06	15,998	19.405	
	125628	18	52.15	65.29	67.12	17.637	19.472	
	12 5629	-55.76	-52.21	63.71	67.26	16.057	19.606	
				64.00	67.05			
					0(+13	10.301	14.144	
	<u> 12 5630 </u>	<u></u>	- <u>52,42</u> -52,36 -52,37	63.93	67.11	<u> 16.351 </u>	<u>19.399</u> 19.455	

١.,

	FRAME	RCAD BAS (DRW) VA	RCVD PWR (DBM) PEAK	SIGMA AV	SIGMA PEAK	SIGMAZ (DB) AV	SIGMAZ (DB) PE
- 		-04+74	-60.61	54.73	·		
	6578	-61.85	-59.09	57.62	<u>58.86</u> 60.38	7.081	11.210
9	_6279	-63.40	-59.09	56.06	59.26	8.414	11+612
10	6624	-63.13	-60.36	56+33	59.11	8.684	11.457
	6625		60.72	56.48	58.75	8.826	11.098
10	6626	-03.61	-60.86	55.85	58.61	8.204	10.961
	6666	-04.66	-59,96	56.80	59.51	9.154	11.856
11	6667	-62.78	-60+60	56.69	58+87	9.036	11.220
<u>1</u>	6668			56.95		9,298	11.971
12	6708	-62+40	-60.38	57.07	59.09	9.418	11.440
15	<u>6709</u>	-62+84	<u>-60.32</u>	56+63	59.15	8.982	11.501
15	6710	-53+112	-60.21	56.45	59.26	8.798	11.610
FLIGHT	PULSES	PER FRAME SIGMA	Z (DB) AVG SIGMAZ (D	B) PEAK			
16			5711.58			······································	
							
			<u>557232222222222222</u>	**********	5555		
	<u>FRAME</u>	KCAU HAB (DBW) VA	RCVD_PWR(DBM)PEAK	SIGMA_AV	SIGMA_PEAK		SIGMAZ(D8)_PE
			-62.02	54.86	57.45	7.208	9.798
13			-62.02	54•86 56•58	57.45 58.85	7.208 8.933	9.798 11.203
13			-62.02 -60.62 -60.98	54 • 86 56 • 58 54 • 90	57•45 58•85 58•49	7.208 8.933 7.250	9+798 11+203 10+841
<u> </u>	6750 6751 6752 6752		-62.02 -60.62 -60.98 -61.02	54.86 56.58 54.90 55.78	57.45 58.85 58.49 58.49	7.208 8.933 7.250 8.132	9.798 11.203 10.841 10.793
$ \begin{array}{r} 13\\ 13\\ -\underline{13}\\ 13\\ 13\\ 13 \end{array} $	6750 6750 6757 6757 - <u>6753</u> 	-54.59	-62.02 -60.62 -60.98 -61.02 -60.66	54.86 56.58 54.90 <u>55.78</u> 55.18	57.45 58.85 58.49 58.44 58.80	7.208 8.933 7.250 8.132 7.529	9.798 11.203 10.841 10.793 11.154
$ \begin{array}{r} 13 \\ 13 \\ - 13 \\ 13 \\ - 14 \\ - 14 \\ - 14 \\ - 14 \\ - 14 \\ - 14 \\ $	6750 6750 6752 6752 - 6753 - 6792	-74.01 -62.00 -64.07 -73.04 -73.04 -74.79 -63.03	-62.02 -60.62 -61.02 -61.02 -61.66 -60.66	54.86 56.58 54.90 55.78 55.18 55.84	57.45 58.85 58.49 58.44 58.80 58.80 58.59	7.208 8.933 7.250 8.132 7.529 8.190	9.798 11.203 10.841 10.793 11.154 10.941
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 14 \end{array} $	6750 6757 6757 6753 6754 6794 6791	$ \begin{array}{r} -54 \cdot 57 \\ -53 \cdot 54 \cdot 57 \\ -53 \cdot 54 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 57 \\ -63 \cdot 53 \\ -64 \cdot 75 \\ -64 \cdot 75 \\ \end{array} $	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ \end{array} $	54.86 56.58 54.90 55.78 55.18 55.84 55.42	57.45 58.85 58.49 58.44 58.80 58.59 57.99	7.208 8.933 7.250 8.132 7.529 8.190 7.771	9.798 11.203 10.841 .10.793 .11.154 .10.941 .10.344
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 14 \\ 14 \\ 14 \end{array} $	6750 6751 6752 6753 6754 6754 6793 6793 6793	$-54 \cdot 51$ $-64 \cdot 57$ $-54 \cdot 57$ $-54 \cdot 59$ $-64 \cdot 15$ $-64 \cdot 15$	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.88 \\ -61.47 \\ -61.73 \\ \end{array} $	54.86 56.58 54.90 55.78 55.18 55.84 55.42 55.42 55.42	57.45 58.85 58.49 58.44 58.80 58.59 57.99 57.74	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767	9.798 11.203 10.841 <u>10.793</u> 11.154 <u>10.941</u> 10.344 10.088
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 14 \end{array} $	6750 6751 6752 6752 5754 6753 6754 6753 6754 6753 6754 6755 6755 6755 6755 6755 6755 6755	$ \begin{array}{r} -54 \cdot 51 \\ -62 \cdot 54 \\ -64 \cdot 57 \\ -53 \cdot 54 \\ -54 \cdot 29 \\ -63 \cdot 63 \\ -64 \cdot 15 \\ -59 \cdot 64 \\ -53 \cdot 0 \end{array} $	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.66 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.73 \\ -61.25 \\ \end{array} $	54.86 56.58 54.90 55.78 55.18 55.42 55.42 55.42 55.42 55.42 55.42	57.45 58.85 58.49 58.44 58.80 58.59 57.99 57.99 57.74 58.21	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017	9.798 11.203 10.841 <u>10.793</u> 11.154 <u>10.941</u> 10.344 10.088 10.564
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \end{array} $	6750 6751 6752 6753 6754 6754 6793 6793 6793	$ \begin{array}{c} -54.51\\ -64.57\\ -55.64\\ -54.29\\ -64.15$	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.47 \\ -61.45 \\ -61.$	54.86 56.58 54.90 55.78 55.18 55.84 55.42 55.42 55.67 55.67 55.23	57.45 58.85 58.49 <u>58.44</u> 58.80 <u>58.59</u> 57.79 57.74 58.21 58.65	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017 8.580	9.798 11.203 10.841 <u>10.793</u> 11.154 <u>10.941</u> 10.344 <u>10.088</u> 10.564 <u>11.003</u>
$ \begin{array}{r} 13\\ 13\\ 13\\ 13\\ 13\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14 \end{array} $	6750 6757 6757 6757 6754 6754 6754 6754 6755 6755	$ \begin{array}{c} -54 \cdot 57 \\ -53 \cdot 54 \cdot 57 \\ -53 \cdot 54 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 57 \\ -64 \cdot 75 \\ -75 $	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -61.02 \\ -61.66 \\ -60.48 \\ -61.47 \\ -61.25 \\ -61.25 \\ -61.25 \\ -62.28 \\ \end{array} $	54.86 56.58 54.90 55.78 55.18 55.18 55.42	57.45 58.85 58.49 58.44 58.80 58.59 57.99 57.74 58.65 57.19	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.771 7.767 8.017 8.580 7.045	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.988 10.564 11.003 9.535
$ \begin{array}{r} 13\\ 13\\ 13\\ 13\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 15\\ 15\\ 15\\ 15\\ 15\\ 15\\ 15\\ 15\\ 15\\ 15$	6750 6752 6752 6753 6754 6793 6793 6793 6793 6793 6795 6795 6795 6795 6795	$ \begin{array}{c} -54.51\\ -64.57\\ -55.64\\ -54.29\\ -64.15$	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.47 \\ -61.45 \\ -61.$	54.86 56.58 54.90 55.78 55.18 55.42 55.42 55.42 55.67 56.23 54.70 56.80	57.45 58.85 58.49 58.44 58.80 58.59 57.99 57.74 58.21 58.65 57.19 59.29	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017 8.017 8.580 7.045 9.148	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.344 10.564 11.003 9.535 11.636
$ \begin{array}{r} 13\\ 13\\ 13\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14\\ 14$	6750 6757 6757 6757 6753 6753 6753 6753 6753	$ \begin{array}{c} -54 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 29 \\ -64 \cdot 15 \\ -64 \cdot 17 \\ -54 \cdot 67 \\ -56 \cdot 67 \\ -56$	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.73 \\ -61.25 \\ -61.25 \\ -61.25 \\ -62.28 \\ -62.28 \\ -69.18 \\ -59.04 \end{array} $	54.86 56.58 54.90 55.78 55.18 55.18 55.42	57.45 58.85 58.49 58.44 58.80 58.59 57.99 57.74 58.21 58.65 57.19 57.19 59.29 ' 60.43	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017 8.580 7.045 9.148 9.273	9.798 11.203 10.841 <u>10.793</u> 11.154 <u>10.941</u> 10.344 <u>10.088</u> 10.564 <u>11.003</u> 9.535 <u>11.636</u> <u>12.778</u>
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 15 \\ $	6750 6751 6752 6753 6753 6754 6793 6793 6793 6793 6793 6795 6795 6795 6795 6795 6795 6795 6795	$ \begin{array}{r} -54 \cdot 51 \\ -64 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 59 \\ -64 \cdot 79 \\ -64 \cdot 75 \\ -64 \cdot 75 \\ -64 \cdot 75 \\ -64 \cdot 75 \\ -64 \cdot 77 \\ -64 \cdot 77 \\ -64 \cdot 55 \\ \end{array} $	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.73 \\ -61.25 \\ -60.86 \\ -61.25 \\ -60.86 \\ -60.48 \\ -61.25 \\ -60.48 \\ -62.28 \\ -60.18 \\ -60.18 \\ \end{array} $	54.86 56.58 54.90 55.78 55.18 55.84 55.42 54.70 56.92	57.45 58.85 58.49 58.80 58.80 58.59 57.99 57.74 58.21 58.65 57.19 59.29 60.43 59.95	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017 8.580 7.045 9.148 9.273 10.581	9.798 11.203 10.841 <u>10.793</u> 11.154 <u>10.941</u> 10.344 10.088 10.564 <u>11.003</u> 9.535 <u>11.636</u> 12.778 <u>12.295</u>
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 14 \\ 15 \\ $	6750 6757 6757 6757 6753 6753 6753 6753 6753	$ \begin{array}{c} -54 \cdot 51 \\ -62 \cdot 64 \\ -64 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 59 \\ -64 \cdot 63 \\ -64 \cdot 15 \\ -64 \cdot 15 \\ -64 \cdot 15 \\ -64 \cdot 15 \\ -64 \cdot 67 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 54 \\ \end{array} $	$ \begin{array}{c} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.47 \\ -61.25 \\ -61.$	54.86 56.58 54.90 55.78 55.18 55.84 55.42 55.42 55.67 56.23 54.70 58.23 56.84	57.45 58.85 58.49 58.44 58.80 58.80 58.59 57.99 57.74 58.21 58.65 57.19 58.65 57.19 58.29 ' 60.43 59.29 ' 60.23	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.777 8.017 8.580 7.045 9.148 9.273 10.581 9.225	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.988 10.564 11.003 9.535 11.636 12.778 12.295 12.579
$ \begin{array}{r} 13 \\ 13 \\ 13 \\ 14 \\ 15 \\ $	6750 6757 6757 6757 6754 6754 6793 6793 6793 6793 6793 6793 6793 6793	$ \begin{array}{c} -74 \cdot n1 \\ -62 \cdot 94 \\ -64 \cdot 57 \\ -53 \cdot 64 \\ -54 \cdot 29 \\ -63 \cdot 64 \\ -64 \cdot 95 \\ -64 \cdot 95 \\ -64 \cdot 95 \\ -64 \cdot 15 \\ -74 \cdot 17 \\ -62 \cdot 67 \\ -64 \cdot 55 \\ -61 \cdot 24 \\ -67 \cdot 59 \\ \end{array} $	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.47 \\ -61.47 \\ -61.45 \\ -61.48 \\ -61.$	54.86 56.58 54.90 55.78 55.18 55.425	57.45 58.85 58.49 58.80 58.80 58.59 57.99 57.74 58.21 58.65 57.19 59.29 60.43 59.95	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017 8.017 8.580 7.045 9.148 9.273 10.581 9.225 8.805	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.088 10.564 11.003 9.535 11.636 12.778 12.295 12.579 11.632
13 13 13 14 14 14 14 14 14 14 14 14 14	6750 6751 6752 6753 6754 6753 6754 6754 6754 6754 67555 6755 6755 6755 6755 6755 6755 6755 6755 6755 6755	$ \begin{array}{c} -54 \cdot 51 \\ -64 \cdot 57 \\ -55 \cdot 54 \\ -54 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 57 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 57 \\ -64$	$ \begin{array}{c} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.88 \\ -61.47 \\ -61.73 \\ -61.73 \\ -61.25 \\ -60.86 \\ -60.88 \\ -61.47 \\ -61.25 \\ -60.88 \\ -60.$	54.86 56.58 54.90 55.78 55.18 55.42 56.23 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80 56.80	57.45 58.85 58.49 58.80 58.80 58.59 57.99 57.74 58.65 57.19 59.29 (60.43) 59.95 60.23 59.28	$\begin{array}{c} 7.208 \\ 8.933 \\ 7.250 \\ 8.132 \\ 7.529 \\ 8.190 \\ 7.771 \\ 7.767 \\ 8.017 \\ 8.017 \\ 9.580 \\ 7.045 \\ 9.148 \\ 9.273 \\ 10.581 \\ 9.225 \\ 8.405 \\ 8.417 \end{array}$	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.344 10.564 11.003 9.535 11.636 12.778 12.295 12.579 11.632 11.361
13 13 13 14 14 14 14 14 14 14 14 14 14	6750 6751 6752 6753 6754 6755 6754 67555 6755 6755 6755 6755 6755 6755 6755 6755 6755 6755	$ \begin{array}{c} -54.51\\ -64.57\\ -54.59\\ -54.79\\ -64.15\\ -64.15\\ -64.15\\ -64.15\\ -64.15\\ -64.55\\ -64.55\\ -61.24\\ -67.55\\ -61.24\\ -67.59\\ -61.40\\ \end{array} $	$ \begin{array}{c} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.88 \\ -61.47 \\ -61.73 \\ -61.25 \\ -62.28 \\ -62.28 \\ -62.28 \\ -52.28 \\ -52.28 \\ -52.4 \\ -52.58 \\ -60.18 \\ -52.58 \\ -60.18 \\ -52.58 \\ -60.18 \\ -52.58 \\ -60.18 \\ -50.86 \\ -50.8$	54.86 56.58 54.90 55.78 55.18 55.42 55.42 55.64 55.67 56.21 54.70 54.70 54.70 54.70 54.70 54.70 54.70 54.80 50.92 54.70 56.80 50.92 54.70	57.45 58.85 58.44 58.80 58.59 57.99 57.74 58.21 58.65 57.19 59.29 60.43 59.29 60.43 59.29 60.23 59.28 59.01 59.63	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.767 8.017 8.017 8.580 7.045 9.148 9.273 10.581 9.225 8.805 8.417 9.788	9.798 11.203 10.841 <u>10.793</u> 11.154 <u>10.941</u> 10.344 <u>10.088</u> 10.564 <u>11.003</u> 9.535 <u>11.636</u> <u>12.778</u> <u>12.295</u> 12.579 <u>11.636</u> <u>11.361</u> <u>11.984</u>
13 13 13 14 14 14 14 14 14 14 14 14 14	6750 6751 6752 6753 6754 6793 6775	$ \begin{array}{c} -54 \cdot 51 \\ -64 \cdot 57 \\ -54 \cdot 57 \\ -54 \cdot 59 \\ -54 \cdot 29 \\ -64 \cdot 45 \\ -64 \cdot 55 \\ -61 \cdot 24 \\ -64 \cdot 55 \\ -61 \cdot 24 \\ -64 \cdot 55 \\ -61 \cdot 24 \\ -64 \cdot 59 \\ -64$	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.73 \\ -61.25 \\ -61.25 \\ -62.28 \\ -62.28 \\ -62.28 \\ -52.28 \\ -52.28 \\ -52.4 \\$	$\begin{array}{r} 54.86 \\ 56.58 \\ 54.90 \\ 55.78 \\ 55.18 \\ 55.84 \\ 55.42 \\ 55.42 \\ 55.42 \\ 55.42 \\ 55.42 \\ 54.70 \\ 56.23 \\ 54.70 \\ 56.80 \\ 56.92 \\ 58.23 \\ 56.88 \\ 56.07 \\ 56.44 \\ 56.44 \\ \end{array}$	57.45 58.85 58.49 58.80 58.80 58.59 57.99 57.74 58.21 58.65 57.19 -59.29 -60.43 59.29 -60.23 59.28 -59.28	$\begin{array}{c} 7.208 \\ 8.933 \\ 7.250 \\ 8.132 \\ 7.529 \\ 8.190 \\ 7.771 \\ 7.767 \\ 8.017 \\ 8.017 \\ 9.580 \\ 7.045 \\ 9.148 \\ 9.273 \\ 10.581 \\ 9.225 \\ 8.405 \\ 8.417 \end{array}$	$\begin{array}{r} 9.798 \\ 11.203 \\ 10.841 \\ 10.793 \\ 11.154 \\ 10.941 \\ 10.344 \\ 10.088 \\ 10.564 \\ 11.003 \\ 9.535 \\ 11.636 \\ 12.778 \\ 12.295 \\ 12.579 \\ 11.632 \\ 11.636 \\ 11.631 \\ \end{array}$
13 13 13 14 14 14 14 14 14 14 14 14 14	6750 6751 6752 6753 6754 6754 6754 6754 6754 6754 6754 6754 6754 6755 6754 6755 6754 6834 6834 6834 6834 6875 6877 6877 6877 6874 6774 67774 67774 67777 67777 67777777777	$ \begin{array}{c} -54.51\\ -64.57\\ -55.54\\ -54.29\\ -64.15\\ -64.15\\ -64.15\\ -64.15\\ -64.15\\ -64.15\\ -64.55\\ -61.24\\ -67.55\\ -61.24\\ -67.50\\ -51.94\\ -55.67\\ -67.50\\ -51.94\\ -57.50\\ -51.94$	$ \begin{array}{r} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.73 \\ -61.47 \\ -61.47 \\ -61.47 \\ -61.48 \\ -62.28 \\ -69.18 \\ -59.04 \\ -59.$	$\begin{array}{r} 54.86 \\ 56.58 \\ 54.90 \\ 55.78 \\ 55.18 \\ 55.84 \\ 55.42 \\ 55.42 \\ 55.42 \\ 55.42 \\ 55.42 \\ 55.42 \\ 54.70 \\ 56.23 \\ 54.70 \\ 56.23 \\ 54.88 \\ 56.97 \\ 56.97 \\ 57.53 \\ \end{array}$	57.45 58.85 58.49 58.49 58.80 58.59 57.99 57.74 58.21 58.65 57.19 59.29 60.43 59.95 60.23 59.01 59.63 59.52 59.64	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.771 7.767 8.017 8.580 7.045 9.148 9.273 10.581 9.225 8.405 8.417 8.788 9.318 9.882	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.941 10.344 10.564 11.003 9.535 11.403 9.535 11.403 12.778 12.295 12.579 11.632 11.361 11.984 11.984
13 13 13 14 14 14 14 14 14 14 14 14 14	6750 6751 6752 6753 6754 6793 6775	$ \begin{array}{c} -74 \cdot n1 \\ -62 \cdot 09 \\ -64 \cdot 57 \\ -54 \cdot 59 \\ -64 \cdot 45 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 55 \\ -64 \cdot 59 \\ -64$	$ \begin{array}{c} -62.02 \\ -60.62 \\ -60.98 \\ -61.02 \\ -60.66 \\ -60.48 \\ -61.47 \\ -61.47 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.25 \\ -61.47 \\ -52.28 \\ -61.47 \\ -52.28 \\ -61.47 \\ -52.28 \\ -61.47 \\ -52.28 \\ -61.47 \\ -52.28 \\ -52.$	$\begin{array}{r} 54.86 \\ 56.58 \\ 54.90 \\ 55.78 \\ 55.18 \\ 55.84 \\ 55.42 \\$	57.45 58.85 58.49 58.49 58.80 58.59 57.99 57.74 58.21 58.65 57.19 59.29 60.43 59.95 60.23 59.01 59.63 59.52 59.64	7.208 8.933 7.250 8.132 7.529 8.190 7.771 7.771 7.767 8.017 8.580 7.045 9.148 9.273 10.581 9.225 8.405 8.417 8.788 9.318	9.798 11.203 10.841 10.793 11.154 10.941 10.344 10.941 10.344 10.988 10.564 11.003 9.535 11.636 12.778 12.295 12.579 11.632 11.361 11.984 11.865
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APPENDIX B

ENERGY SPECTRA OF SEA WAVES FROM PHOTOGRAPHIC INTERPRETATION

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I. INTRODUCTION

The variable amplitude of the sea surface waves constituting a sea wave profile can be recorded on a photographic film if the sky light providing the illumination of the sea surface varies continuously in a linear manner.

The amplitude of the sea surface waves may be defined in terms of a potential energy spectrum of the wave surface.⁽³⁾ If one thinks in terms of an infinite summation of sinusoids defining the sea surface, each sinusoidal component must be characterized by a frequency and vector wave number. The energy spectrum of the sea surface will then, in general, depend upon surface position and wave number vectors and the time and frequency scalars. The photographic record of sea surface amplitude variations or slope variations is also a representation of the potential energy spectrum of the surface.

The optical density variations on the photographic film, referred to later as the scene negative, are in a one-to-one correspondence with the sea surface displacement or slope, providing the linear sky light illumination condition is satisfied. The optical density characterizes the variable light transmission property of the negative and is defined by the equation $I = I_0 10^{-D}$, where I is the light intensity transmitted through a medium of optical density D, and I₀ is the incident light intensity. For a photographic film, the optical density D is related to the light energy which exposes the film by the linear relationship

$$D = \gamma \log E \tag{1}$$

⁽³⁾ Kinsman, Blair, "Wind Waves, Their Generation and Propagation on the Ocean," Prentice Hall, Englewood Cliffs, N.J., 1965.

for long enough exposure times. The quantity E is the exposing energy density and depends on the product.

$$E = kI\tau \quad \frac{joules}{2}$$
(2)

where

- I = exposing light intensity, $\frac{\text{watts}}{\frac{2}{\text{m}}}$
- τ = exposure time, sec.
- k = relates to film sensitivity to light
- ý = the slope of the film characteristic curve (log E vs D) in the linear region

A camera located above the surface of the sea and looking down in the direction of the water wave propagation will record a two dimensional optical density pattern - D(x, y). As indicated by equation (1), the numerical value of the density at each point on the scene negative will depend upon the light intensity, exposure time, film gamma, and sensitivity.

The light intensity(I)received by the camera lens will depend upon: (1) the geometry of the sea surface and camera position,(2) the manner in which the sky light intensity varies with zenith angle and azimuth angle, and (3) the polarization and frequency sensitive water reflectivity.

A. Linear Sky Assumption

For a basic understanding of how the slope angle ϕ of the sea wave profile is recorded on the scene film, the assumption of a linear sky is a good starting point. If the sky light reflected off the ocean surface varies linearly with zenith angle θ (see Figure 1), then the light intensity that exposes the camera film I(x') will have a functional dependence which is linearly related to the slope angle $\phi(x)$ or wave height $\eta(x)$. This important concept is illustrated below. Assume the sea wave system is such that no azimuth angle dependent light reflection is recorded.

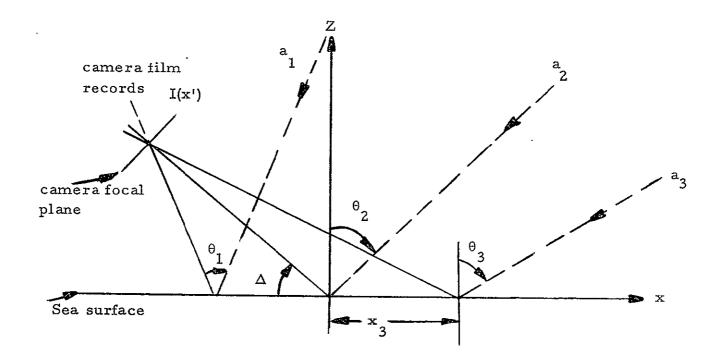


Figure 1. A One-Dimensional View of Ray Geometry for Determining I(x) Under Calm Sea Condition. Distance x! is Measured on the Scene Negative.

In Figure 1, the light intensity I(x') will have the form $I_1 + I_2 x'$ provided the sky illumination $a(\theta)$ is linear with zenith angle θ . The light ray a_2 will undergo specular reflection at x = 0 and expose the film at a point corresponding to say x' = 0. Light ray a_3 will reflect at $x = x_3$ and expose the film at point $x' = x'_3$ with greater light intensity. A measurement of optical density D(x') along the x' axis of the scene negative will be that shown in Figure 2 (microdensitometer tracing)

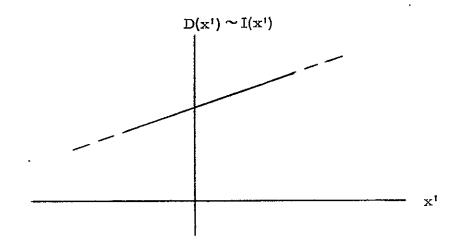


Figure 2. Scene Negative Optical Density Trace for Linear Sky Condition

If the sea surface is now wind driven the camera illumination $I(x^{i})$ is of the form

$$I(x^{i}) = I_{1} + I_{2} (x^{i} + c_{1} \phi (x^{i}))$$
(3)

where $\phi(x')$ is the slope angle and c_1 is a constant relating angle to distance.

Comparing Figures 1 and 3, it is seen that the tangent plane for specular reflection defined by slope angle $\phi(o)$ in Figure 3 will provide illumination at the camera only by sky ray a_3 , and not a_2 (Snell's Law). In terms of the unperturbed sea state of Figure 1, this corresponds to specular reflection from point x_3 . Hence, the term $c_1\phi(x')$ must be added to x' to account for the increased light intensity exposing the film at x' = 0 (see Figure 4).

A scene negative will thus contain an optical density pattern $D(x^{i})$

$$D(x^{i}) = \gamma \log \left[I_{1} + I_{2}(x^{i} + c_{1}\phi(x^{i})) \right] k \tau$$
(4)

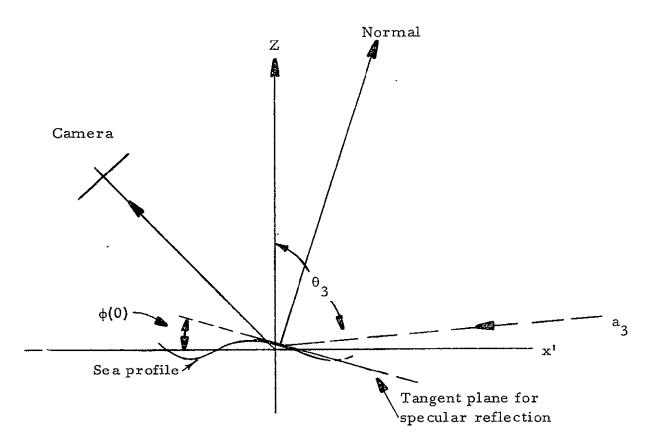


Figure 3. One-Dimensional View of Ray and Slope Geometry for Determining I(x') Under Wind Condition

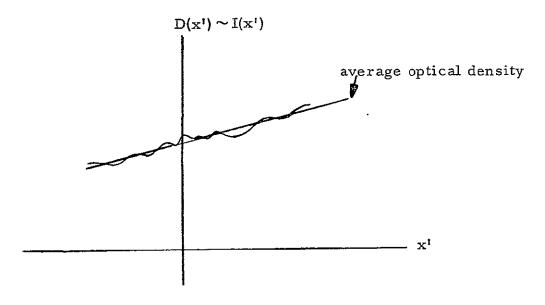


Figure 4. Optical Density Tracing of Scene Film Showing Sea Profile Defined by Slope Angle $\phi(x^1)$

where if a_0 is the amplitude of laser light incident on the scene negative, $a_0 \frac{-D(\mathbf{x})}{2}$ is the transmitted laser light amplitude.

B. Optical Computer

The Fourier transform of the transmission function $T(x') = 10^{-D(x')}$ is now performed by the optical computer diagramed in Figure 5.

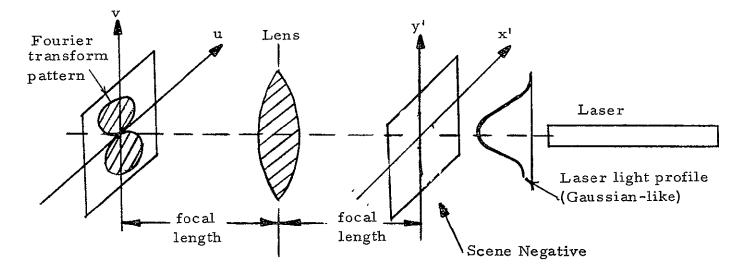


Figure 5. Optical Computer

By placing the scene negative in the x' - y' plane, located in the front focal plane of the lens, and exposing the film to a monochromatic, colliminated light beam (laser), the Fraunhofer diffraction pattern (Fourier transform) of the transmission function T(x') will be recorded by a camera placed in the back focal plane of the lens. This transform negative will contain the spectrum of wave numbers (frequencies that constitute the sea wave profile $\eta(x)$ or slope $\phi(x)$). By simply reading the coordinates of a point in the transform (u_1, v_1) , a corresponding vector wave number is calculated by the important relationship

$$\left(\frac{\overline{K}}{2\pi}\right) f\lambda = \overline{r}$$
(5)

where $f\lambda$ is a calibration constant, and \overline{K} is the vector wave number in radians per meter. \overline{r} is the position vector. The vector wave number $\overline{K_1}$ corresponding to the point u_1 , v_1 specifies the wavelength, direction, and frequency of one sinusoidal component of the sea wave spectrum.

C. Results of Calculation

The energy spectrum is calculated from the optical density pattern D(u, v) provided by the Fourier transform negative. A two dimensional integration of $10^{-D(u, v)/\gamma}$, the optical density transmission function, and evaluation of appropriate calibration constants determines the energy spectrum. The calibration constants are calculated from microdensitometer tracings of the scene negative, transform negative, laser beam cross-section negative, Ronchi grating transform negative (f λ product), and camera focal length and position. The microdensitometer basically measures the optical transmission property of a negative, $10^{-D/\gamma}$.

A one-dimensional energy spectrum calculation for Raytheon Flight No. 6 ocean wave data indicates that the peak spectral component of the wave system is in the range of 0. 188-0. 226 ft²-sec at a wave length of approximately 20 meters. Assuming 20 meters to represent the dominant wavelength of the system, the corresponding period is 3.6 seconds. Shore observation recorded a wave period of approximately 5 seconds for this flight. Also, for frequencies greater than two radians per second, the spectral amplitudes decay according to the well known ω^{-5} dependence where ω is the radian frequency.

II. SEA PHOTOGRAPH ANALYSIS

The general two-dimension transmission function $10^{-D(x^i, y^i)}$ represented by the scene negative is now derived for the two-dimensional case. The analysis approach follows that given by Stilwell.

Consider the illumination at the camera from light reflected from some arbitrary point on the sea (see Figure 6):

$$I(\Delta) = Ka(\theta) \rho(\theta)$$
(6)

where

K = a constant and varies inversely as the square of distance from the point of reflection to the camera position in the sky.

 $a(\theta)$ = the luminance of the sky and is a function of zenith angle, θ .

 $\rho(\theta)$ = the reflection coefficient of the sea water and depends also on the zenith angle.

 Δ = camera angle

In Figure 6, the position vector $\hat{\mathbf{r}}$ is drawn perpendicular to a differential area in the focal plane of the camera. $\hat{\mathbf{n}}$ is normal to tangent plane.

Equation (6) implies that the illumination of the camera is governed only by light rays that lie in the plane defined by the unit vectors $\hat{\mathbf{r}}$ and $\hat{\mathbf{n}}$.

The change in camera illumination for a small perturbation of the surface normal unit vector \hat{n} (small slope angle ϕ) is

$$\frac{d\mathbf{I}}{d\phi} \stackrel{\cdot}{=} \mathbf{K} \left(\frac{d\mathbf{a}(\theta)}{d\theta} \quad \rho(\theta) + \mathbf{a}(\theta) \quad \frac{d\rho(\theta)}{d\theta} \right) \frac{d\theta}{d\phi}$$
(7)

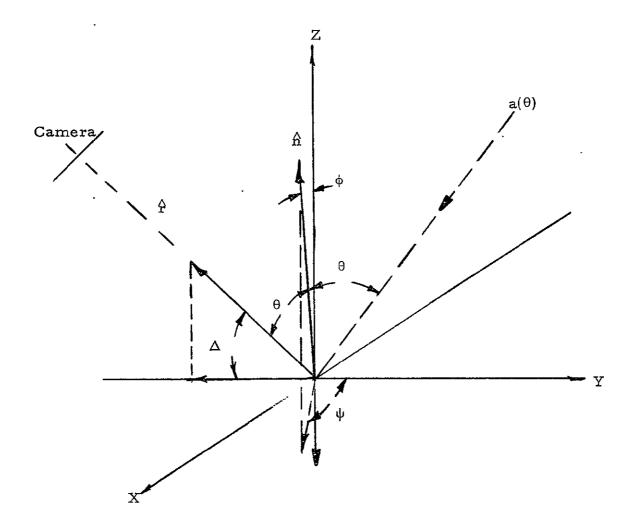


Figure 6. Specular Reflection at a Point on the Surface of the Sea Assume $\cos \phi \cong 1$, $\sin \phi \cong 0$

The factor $\frac{d\theta}{d\phi}$ is

$$\frac{d\theta}{d\phi} = -\frac{1}{\sin\theta} \cdot \frac{d}{d\phi} \left(\hat{\mathbf{r}} \cdot \hat{\mathbf{n}} \right) \text{ where } \hat{\mathbf{r}} \cdot \hat{\mathbf{n}} = \cos\theta$$

$$= -\frac{1}{\sin\theta} \frac{d}{d\phi} \left[\left(-\hat{\mathbf{y}} \cos\Delta + \hat{\mathbf{z}} \sin\Delta \right) \cdot \left(\hat{\mathbf{x}} \sin\phi \sin\psi + \hat{\mathbf{y}} \sin\phi \cos\psi + \hat{\mathbf{z}} \cos\phi \right) \right]$$

$$(8)$$

$$\widetilde{=} \cos \psi \text{ for } \theta + \phi + \Delta = 90^{\circ} \text{ and } \cos \phi = 1, \sin \phi = 0$$
(9)

So

$$\frac{d\mathbf{I}}{d\phi} \stackrel{\sim}{=} K \left(\frac{d\mathbf{a}(\theta)}{d\theta} \quad \rho(\theta) + \frac{d\rho(\theta)}{d\theta} \right) \cos \psi \tag{10}$$

Integrating equation (10) gives

$$I(\theta, \psi, \phi) = K \left(\frac{da(\theta)}{d\theta} - \rho(\theta) + a(\theta) \frac{d\rho(\theta)}{d\theta} \right) \cos \psi \cdot \phi + I_{o}$$
(11)

The constant of integration I may be looked upon as the illumination I for $\psi = 90^{\circ}$ or $\phi = 0$. Equation (11) is simplified by defining

$$K \left(\frac{da(\theta)}{d\theta} \cdot \rho(\theta) + a(\theta) \frac{d\rho(\theta)}{d\theta}\right) = \mathbf{I}^{i} = f(\theta)$$
(12)

$$\therefore I(\theta, \psi, \phi) = I_{0} + I^{*} \phi \cos \psi$$
(13)

Equation (13) is the two-dimensional illumination function originally derived by Stilwell.

In terms of general coordinates on the sea surface, Equation (13) is changed to read

$$I(x^{i}, y^{i}) = I_{o}(x^{i}, y^{i}) + I^{i}(x^{i}, y^{i}) \phi(x^{i}, y^{i}) \cos \psi$$
(14)

The illumination terms $I_0(x, y)$, and I'(x, y) are assumed to be constants in Stilwell's optical analysis. This would imply that the sky light intensity $a(\theta)$ (see Figure 6) changes linearly with zenith angle θ and all light rays reflected off the sea surface see the same water reflectivity. If this assumption is true, then I' defined by equation (12) would take the form

$$I^{1} = K \frac{da(\theta)}{d\theta} \cdot \rho(\theta) = \text{constant.}$$
(15)

The validity of the assumption $I_0(x, y) = \text{constant may be examined by inspection}$ of the optical density plot of the scene negative. (In Figure 2, the average change in optical density is related to $I_0(x^1)$.)

III. OPTICAL ANALYSIS

A. Average Power Spectrum of Photograph

In general, then, for small slope angles $\phi(x, y)$ (cos $\phi = 1$, sin $\phi = 0$)

$$I(x, y) = I_{0}(x^{1}, y^{1}) + I^{1}(x^{1}, y^{1})\phi(x^{1}, y^{1})\cos\psi$$
(16)

A scene negative will record the above illumination function in the form

$$D(x', y') = \gamma \log [k_1 I(x', y')_{1}].$$
 (17)

The primed coordinates refer to distances measured on the scene film. k_1 is a constant related to the film sensitivity. τ_1 is the film exposure time. A laser beam transmitted through the scene negative, which may be thought of as a diffraction grating, will experience attenuation as shown in Figure 7.

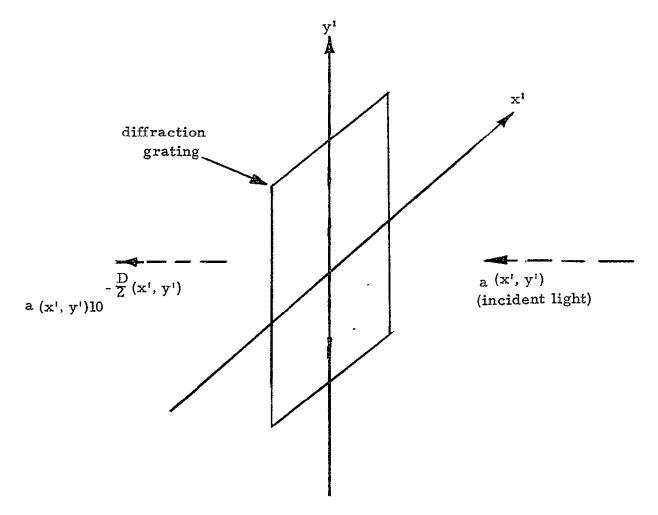


Figure 7. Transmission Through Scene Negative

The transmission function for light amplitude is

$$T'(x', y') = 10^{-D/2(x', y')} = [k_1 I(x', y')\tau_1]^{-\gamma_1/2}$$
(18)

where $\gamma_l k_l$, τ_l refers to the scene film. To put equation equation (18) into a form useful for analysis, a binomial expansion is made.

$$T^{i}(x^{i}, y^{i}) = [\tau_{1} k_{1}(I_{0}(x^{i}, y^{i}) + I^{i}(x^{i}, y^{i})\phi(x^{i}, y^{i}) \cos \psi]^{-\gamma_{1}/2}$$
(19)

$$= \left[\tau_{1} k_{1} I_{0}(x^{\dagger}, y^{\dagger})\right]^{-\gamma_{1}/2} \left[1 + \frac{I^{\dagger}(x^{\dagger}, y^{\dagger})}{I_{0}(x^{\dagger}, y^{\dagger})} \phi(x^{\dagger}, y^{\dagger}) \cos \psi\right]^{-\gamma_{1}/2}$$
(20)

$$\approx \left[\tau_{1} k_{1} (\mathbf{x}^{i}, \mathbf{y}^{i}) \right]^{-\gamma_{1}/2} \left[1 - \frac{\gamma_{1}}{2} g(\mathbf{x}^{i}, \mathbf{y}^{i}) \phi(\mathbf{x}^{i}, \mathbf{y}^{i}) \cos \psi \right]$$
(21)

where

$$g(\mathbf{x}^{\mathsf{I}}, \mathbf{y}^{\mathsf{I}}) \stackrel{\Delta}{=} \frac{\underline{I}^{\mathsf{I}}(\mathbf{x}^{\mathsf{I}}, \mathbf{y}^{\mathsf{I}})}{\underline{I}_{\mathsf{O}}(\mathbf{x}^{\mathsf{I}}, \mathbf{y}^{\mathsf{I}})}$$
(22)

and the assumption is made that

$$[g(x', y')\phi(x', y') \cos \psi]^2 << 1.$$
(23)

The transmitted light amplitude $a^{i}(x^{i}, y^{i})$ is passed through the lens shown in Figure 8, and exposes the film placed in the back focal plane. The light intensity registered by the film is the Fraunhofer diffraction pattern (Fourier transform) of the light amplitude of the front focal plane. Each optical density point on the exposed film is uniquely related to a spatial frequency composing the transmission function of the diffraction grating (scene plane). The value of D(u, v) indicates the relative intensities of the frequency components.

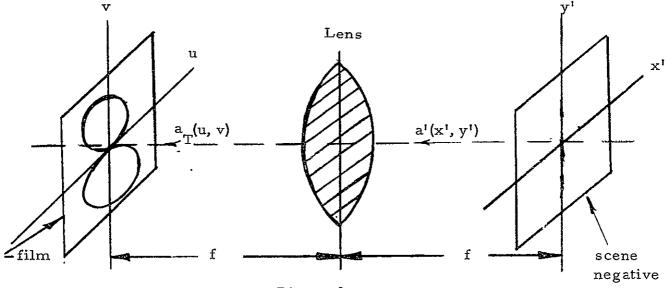


Figure 8

The light amplitude $a_T(u, v)$ exposing the film is therefore

$$a_{T}(u, v) = \text{const} \int_{-\infty}^{+\infty} a^{i}(x^{i}, y^{i}) e^{-\frac{iK}{f}(ux^{i}+vy^{i})} dx^{i} dy^{i}$$
(24)
$$= \text{const} \int_{-\infty}^{+\infty} a(x^{i}, y^{i}) T^{i}(x^{i}, y^{i}) e^{-\frac{iK}{f}(ux^{i}+vy^{i})} dx^{i} dy^{i}$$
(25)
$$= \text{const} \int_{-\infty}^{+\infty} a(x^{i}, y^{i}) [\tau_{1}k_{1}I_{0}(x^{i}, y^{i})]^{-\gamma_{1}^{1/2}} [1 - \frac{\gamma_{1}}{2}g(x^{i}, y^{i})\phi(x^{i}, y^{i}) \cos \psi] \cdot e^{-\frac{iK}{f}(ux^{i}+vy^{i})} e^{-\frac{iK}{dx^{i}}dy^{i}}$$
(26)

The constant of proportionality is $f\lambda$ (see appendix).

$$\therefore a_{T}(u, v) = (f \lambda) \int_{-\infty}^{+\infty} a(x^{i}, y^{i}) 10^{-\overline{D}} \frac{(x^{i}, y^{i})/2}{[1 - \frac{\gamma_{1}}{2}g(x^{i}, y^{i})\phi(x^{i}, y^{i})\cos\psi]}$$

$$= \frac{iko}{f} (ux^{i}+vy^{i}) \qquad (27)$$

where λ is the laser beam wavelength, f is focal length, $k_0 = 2\pi/\lambda$, and $-\overline{D}_1(x^i, y^i)/2_{\Delta} = [\tau_1 k_1 I_0(x^i, y^i)]^{-\gamma_1/2}$. The film in the u, v plane is sensitive to the light intensity $|a_T(u, v)|^2$! So, the optical density $D_2(u, v)$ is given by

$$k_2 \tau_2 |a_T(u, v)|^2 = 10^{D_2(u, v)/\gamma_2}$$
 (28)

where k_2 is the transform film sensitivity factor, τ_2 is the exposure time, and γ_2 is the gamma of this film.

From equations (27) and (28), we have

$$\left| \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} e^{-(1/\sigma^2)(x^{t^2}+y^{t^2})} \frac{-\overline{D}_1(x^{t}, y^{t})/2}{10} \frac{\gamma_1}{[1 - \frac{\gamma_1}{2} g(x^{t}, y^{t})\phi(x^{t}, y^{t}) \cos \psi]} - \frac{iko}{f} (ux^{t}+vy^{t}) \frac{2}{dx^{t} dy^{t}} \right|^2$$
(29)

$$\equiv \left(\frac{10^{(U_2(u,v)/\gamma_2)}}{k_2 \tau_2 a_0^2}\right) \cdot (f\lambda)^2$$
(30)

For a Gaussian beam, $a(x', y') = a_0 e^{-(1/\sigma^2(x'^2+y'^2))}$. Now let (Stilwell assumptions)

$$\frac{-\overline{D}_{1}(\mathbf{x}', \mathbf{y}')/2}{10} = \text{constant}$$
(31)

and

$$\gamma_{1} g(\mathbf{x}^{\mathbf{i}}, \mathbf{y}^{\mathbf{i}}) \stackrel{\Delta}{=} \frac{D_{\phi}}{\log_{10} e} \text{ be constant} \Rightarrow g(\mathbf{x}^{\mathbf{i}}, \mathbf{y}^{\mathbf{i}}) = \text{constant.}$$
(32)

Hence

$$\frac{(f\lambda)^{2}}{(k_{2}\tau_{2}a_{0}^{2})} (10^{(D_{2}(u,v)/\gamma_{2})+\overline{D}_{1}(x^{t},y^{t})} \cdot \frac{4}{\cos^{2}\psi} \cdot \frac{\log^{2}10^{e}}{\overline{D}_{\phi}^{2}}$$
(33)

$$\approx \left| \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} e^{-(1/\sigma^{2})(x^{t}^{2}+y^{t}^{2})} \phi(x^{t},y^{t}) e^{-\frac{ik}{f}(ux^{t}+vy^{t})} dx^{t} dy^{t} \right|^{2}$$

The Fourier integral of the constant term for a finite aperture goes like $\left(\frac{\sin x}{x}\right)$ and will contribute to the frequency spectrum at and near center of the transform ($\omega = 0$). In the squaring process, it has been assumed that terms multiplied by the Fourier transform of the constant term do not contribute to the desired power spectrum.

The average power spectrum recorded by the transform photograph is*

$$P(K_{x}, K_{y}) = \frac{2\pi}{\sigma^{2}} \left| \int_{-\infty}^{+\infty} e^{-\sigma^{-2}(x^{t^{2}} + y^{t^{2}})} \phi(x^{t}, y^{t}) e^{-\frac{ik}{f}(ux^{t} + vy^{t})} dx^{t} dy^{t} \right|^{2}$$
(34)

where

$$\frac{K}{f} u = K_{x}$$
(35)

$$\frac{K}{f} v = K_{y}$$
(36)

and $u = x^i$, $v = y^i$ for the geometry of Figure 8.

Equations (35) and (36) relate density points (spectral amplitudes) in the transform to corresponding wave numbers. Equations (33) through (36) are the basic optical analysis formulas.

To gain some insight into the meaning of equation (29), take as an example

$$1 - \frac{Y_1}{2} g(x^i, y^i) \phi(x^i, y^i) = 1 - x^i$$
 (37)

^{*} The factor $2\pi/\sigma^2$ is related to an elemental area in the transform plane and is derived in Stilwell's paper.

Hence

$$\int_{-\infty}^{+\infty} e^{-\frac{1}{\sigma^2} (x'^2 + y'^2)} e^{-i\frac{k_0}{f} (x'u + vy')} dx' dy'$$
(38)

is sketched as curve 1, and

$$-i \int_{-\infty}^{+\infty} x e^{-\frac{1}{\sigma^2} (x^{1^2} + y^{1^2})} e^{-i \frac{k_0}{\sigma} (x^{1}u + vy^{1})} dx^{1} dy^{1}$$
(39)

is represented by curve 2 in Figure 9.

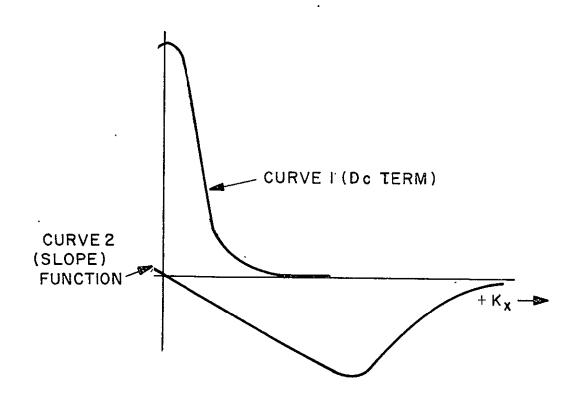


Figure 9. Fourier Transform Components

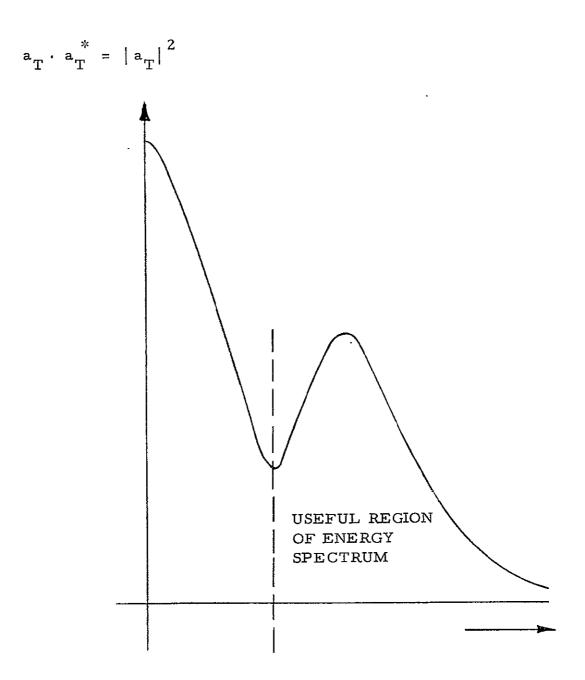


Figure 10. Power Spectrum for $1 - \frac{\gamma_1}{2} g(x', y') \phi(x', y') = 1-x$

The plot shown in Figure 10 represents the average power spectrum of this hypothetical sea state.

IV. SEA SPECTRA

A. Basic Power Spectra

The sea surface displacement $\eta(x, y, t)$ may be expressed as a linear superposition of sinusoidal components (wave packet) provided that statistically independent, small amplitude components are assumed .⁽⁴⁾

$$\eta(\mathbf{x}, \mathbf{y}, \mathbf{t}) = \iint \bigcup B(\mathbf{K}_{\mathbf{x}}, \mathbf{K}_{\mathbf{y}}, \omega) e^{ii(\mathbf{K}_{\mathbf{x}} + \mathbf{K}_{\mathbf{y}} - \omega \mathbf{t})} d\mathbf{K}_{\mathbf{x}} d\mathbf{K} d\omega \qquad (40)$$

$$\mathbf{K}_{\mathbf{y}} \mathbf{K}_{\mathbf{x}} \omega$$

where the amplitude spectrum $B(K_x, K_y, \omega)$ is given by x = y

$$B(K_{x}, K_{y}, \omega) = \left(\frac{1}{2\pi}\right)^{3} \int_{x} \int_{y} \int_{t} \eta(x, y) e^{-i(K_{x}x+K_{y}y - \omega t)} dx dy dt.$$
(41)

The instantaneous power spectrum of the sea surface displacement may be derived from the above relations and is

where the function

$$H(x, x_{o}, y, y_{o}^{t}) \triangleq \overline{\eta(x, y, t) \eta(x + x_{o}^{o}, y + y_{o}^{o}, t)}$$

$$(43)$$

is the autocorrelation function of the sea surface displacement. (The bar indicates mean value.) Its inverse is

$$H(x, x_{o}, y, y_{o}, t) = \iint_{\eta} (K_{x}, K_{y}, \omega, x, y, t) e^{+i(K_{x} + K_{y} + K_{y})} dK_{x} dK_{y} d\omega.$$

$$K_{x} K_{y} \omega$$
(44)

For a homogeneous sea (one independent of the reference position for measurement) and stationary wave process, we have, dropping the x, y and t dependence,

$$H(\mathbf{x}_{o}, \mathbf{y}_{o}) = \iint_{\mathbf{K}_{x}} \iint_{\mathbf{y}, \omega} \Phi(\mathbf{K}_{x}, \mathbf{K}_{y}, \omega) e^{+i(\mathbf{K}_{x}, \mathbf{x}_{o} + \mathbf{K}_{y}, \mathbf{y}_{o})} d\mathbf{K}_{x} d\mathbf{K}_{y} d\omega$$

$$K_{x} \mathbf{K}_{y} \omega$$
(45)

(4) Ibid (3)

$$= \iint_{K_{x}, K_{y}} \Phi(K_{x}, K_{y}) e^{i(K_{x}, K_{y}, K_{y})} dK_{x} dK_{y}$$

$$K_{x} K_{y}$$
(46)

where

$$\Phi(K_{x}, K_{y}) = \int_{\omega} \Phi(K_{x}, K_{y}, \omega) d\omega$$
(47)

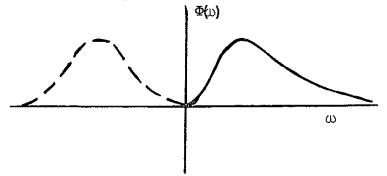
 $\Phi(K_x, K_y)$ is the two-dimensional wave number spectrum. The function $\Phi(K_x, K_y, \omega)$ is the three-dimensional spectrum for a spatially homogeneous and temporarily stationary wave field. Kinsman states that $\Phi(K_y, K_y, \omega)$ represents the waves generated on an ocean of infinite extent over which a statistically uniform wind has been and will be blowing forever". "More reasonably, it isn't a bad model for the interior of a three- or four-day North Atlantic storm covering an area of 500 by 500 nautical miles."

The spectrum that is easily measured in practice (Spar Buoy) is the one-dimensional frequency spectrum given by

$$\Phi(\omega) = \iint_{\substack{K_x, K_y, \omega \\ K_x y}} \Phi(K_x, K_y, \omega) dK_x dK_y$$
(48)

It gives the contribution to the potential energy of the wave coming from each frequency ω , irrespective of the vector wave numbers associated with that frequency. The frequency spectrum gives no information about which directions the various waves come from. (They add up at a point to define the potential energy of the composite wave.)

A typical frequency spectrum is shown in Figure 11.



Thus, for the ocean wave process, there are three basic power spectra:

- (1) The three-dimensional spectrum $-\Phi_{\eta}(K_{x}, K_{y}, \omega)$
- (2) The two-dimensional wave-number spectrum $\Phi_{\eta}(k_x, k_y)$.
 - (3) The one-dimensional frequency spectrum $\Phi_{\eta}(\omega)$

B. One-Dimensional Frequency Spectrum

A relationship between the wave number spectrum and frequency spectrum

for infinitesimal waves which have a unique connection between wave d frequency. For small amplitude, deep water waves, the relationship

$$\Phi_{\eta}(\omega) = \frac{2\omega^3}{g} \int_{0}^{2\pi} \Phi_{\eta} (\mathbf{K}, \psi) d\psi$$
(49)

where g is the gravitational constant, ψ is the azimuth angle (see Figure 2) and

$$\omega^2 = gK \text{ where } g = 9.8 \frac{\text{meters}}{\text{sec}^2}, K = \frac{\text{radians}}{\text{meter}}.$$
 (50)

Kinsman points out ""that finite amplitude waves do not have a unique relationship between wave number and frequency but yet the application of equation (49) seems to give very good results."

For each wave vector $\overline{K} = \frac{K}{x} \frac{A}{y} + \frac{K}{y} \frac{A}{y}$ there is a energy given by

 $\Phi_{\eta}(K, K_{y})$. All wave vectors of the same length $\sqrt{K} \frac{2}{x} + K_{y}^{2}$ and corresponding frequency $\omega = \sqrt{gK}$ lie on a circle of radius $|K| = \frac{\omega^{2}}{g}$ in the K, K plane (see Figure 12).

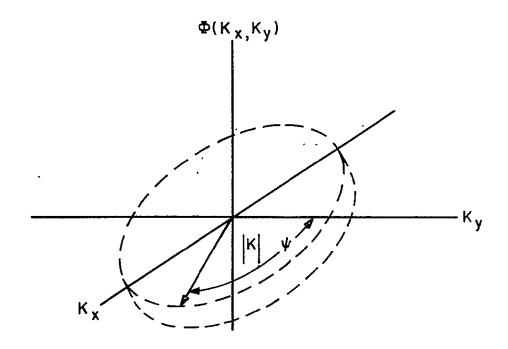


Figure 12. Energy Spectrum Evaluation

Quoting Kinsman, Equation (49) says, "Add up all the energy on this circular ring and you will have located all the energy which is batting around at frequency ω ."

V. RELATIONSHIP BETWEEN SEA SPECTRUM AND PHOTOGRAPHIC SPECTRUM

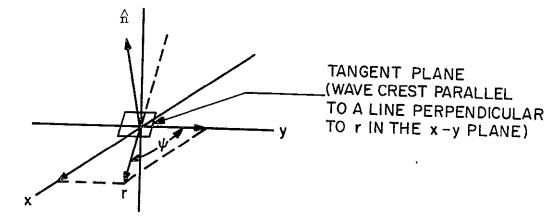


Figure 13. Geometry for Calculating Relationship Between $\Phi(K, K)$ and $\Phi(K, K)$ $\Pi x y \phi x y$

The wave height spectrum $\Phi(\omega)$ is related to the slope spectrum $\Phi_{\phi}(\omega)$ as follows:

For a wave propagating in the r direction in x-y plane (see Figure 13),

$$\frac{\partial \Pi}{\partial \mathbf{r}} \stackrel{(\mathbf{x}, \mathbf{y})}{=} \tan \phi (\mathbf{x}, \mathbf{y}) \stackrel{\cdot}{=} \phi(\mathbf{x}, \mathbf{y})$$
(51)

and $x = r \sin \psi$

sợ

$$\frac{\partial a}{\partial x} (x, y) = \phi \sin \psi , \qquad (52)$$

For a stationary wave process, equation (40) gives

$$\Pi(\mathbf{x}, \mathbf{y}) = \int_{K_{\mathbf{x}}} \int_{K_{\mathbf{y}}} \int_{\omega} B(\mathbf{K}, \mathbf{K}, \omega) e^{i(K_{\mathbf{x}} + K_{\mathbf{y}} \mathbf{y})} dK_{\mathbf{x}} dK_{\mathbf{y}} d\omega$$
(53)

$$\therefore \frac{\partial \Pi}{\partial x} (x, y) = i K_{x} \int \int \int B(K_{x}, K_{y}, \omega) e^{i(K_{x} x + K_{y} y)} dK_{x} dK_{y} d\omega$$
(54)

$$= iK_{x} (x, y)$$
$$= \phi(x, y) \sin \psi$$

 \mathbf{or}

•

-

$$\phi(\mathbf{x}, \mathbf{y}) = \frac{\mathrm{i}K}{\sin\psi} \eta(\mathbf{x}, \mathbf{y}) .$$
(55)

$$\therefore \phi(\mathbf{x}, \mathbf{y}) = i K \eta(\mathbf{x}, \mathbf{y}) . \tag{56}$$

Therefore, equation (41)

$$B(K_{x}, K_{y}, \omega) = \left(\frac{1}{2\pi}\right)^{2} \int_{K_{x}} \int_{K_{y}} \eta(x, y) e^{-i(K_{x}x + K_{y}y)} dx dy$$
(57)

becomes

$$B(K_{x},K_{y},\omega) = \left(\frac{1}{2\pi}\right)^{2} \left(\frac{1}{iK}\right) \int \int \phi(x,y) e^{i(K_{x}x + K_{y}y)} dx dy$$
(58)

and the power spectrum given by

$$\Phi_{\Pi}(\mathbf{K}_{\mathbf{x}},\mathbf{K}_{\mathbf{y}},\omega) = \left(\frac{1}{2\pi}\right)^{2} \int_{\mathbf{x},\mathbf{y}} \eta \left(\overline{\mathbf{x},\mathbf{y}}\right) \eta(\mathbf{x}+\mathbf{x}_{o},\mathbf{y}+\mathbf{y}_{o}) = \frac{-i(\mathbf{K}_{\mathbf{x}},\mathbf{x}_{o}+\mathbf{K}_{o},\mathbf{y})}{d\mathbf{x}_{o}^{\mathbf{x}}d\mathbf{y}_{o}^{\mathbf{x}}} \left(\frac{1}{2\pi}\right)^{2}$$
(59)

becomes

$$\Phi_{\Pi}(K_{x}, K_{y}, \omega) = \left(\frac{1}{2\pi}\right)^{2} \frac{1}{K^{2}} \int_{x} \int_{y} \phi(x, y)\phi(x + x_{o}, y + y_{o}) e^{-i(K_{x}o + K_{y}y_{o})} \frac{-i(K_{x}o + K_{y}y_{o})}{dx_{o}dy_{o}}$$
(60)

 \mathbf{or}

$$K^{2} \Phi(K_{x}, K_{y}, \omega) = \Phi_{\phi}(K_{x}, K_{y}, \omega)$$
(61)

 and

$$K^{2} \Phi_{(K_{x}, K_{y})} = \Phi_{\phi}(K_{x}, K_{y})$$
(62)
(both for small $\phi(x, y)$.

The power spectrum defined by the equations (33) and (34) is proportional to $\Phi_{\phi}(K_x, K_y)$:

$$\phi(\mathbf{K}_{\mathbf{x}},\mathbf{K}_{\mathbf{y}}) \propto \left[\left(\frac{2\pi}{\sigma^2} \right) \frac{\left(\mathbf{f} \lambda \right)^2}{\left(\mathbf{K}_2 \tau_2 \mathbf{a}_0^2 \right)} 10^{\left(\mathbf{D}_2(\mathbf{u},\mathbf{v})/\gamma_2 \right) + \overline{\mathbf{D}}_1} \cdot 4 \sec^2 \phi \cdot \frac{\log^2_{10} e}{\overline{\mathbf{D}}_{\phi}^2} \right]. \quad (63)$$

The constant of proportionality is $\left(\frac{\beta_x \beta_y}{2\pi^3}\right)$ where β_x, β_y are scale transformation factors relating the sea coordinates x, y to the transform coordinates x', y'. (5)

(5) Ibid (1).

VI. CALCULATION PROCEDURE

The calculation of wavelength is based upon Equation (5) which relates various points in the Fourier transform to corresponding vector wave numbers. The $f\lambda$ product is determined from either the optical bench or the Ronchi grating transform. f is the focal length of the lens and λ is the wavelength of the laser beam. Knowing the focal length and position of the camera used in taking the scene picture, a scale factor relating a distance on the ocean surface to a distance on the transform can be determined. A calibration equation relating a distance in the transform $x^{(3)}$ to a corresponding wavelength λ_x is therefore determined. (Propagation along the orthogonal axis has been ignored.)

The computation of the energy spectrum function $\Phi(\omega)$ is based upon Equations (49, (62) and (63). Required for this evaluation are the calibration equation and microdensitometer tracings of:

- (1) laser beam cross-section
- (2) scene negative
- (3) transform negative or isodensitometer of transform negative.

The transform density tracing shows rapid oscillations with trequency. An averaging process has been applied to the transform for a reasonable estimate of the spectrum function.

(A) Wavelength Calibration

The vector wave numbers and frequencies comprising the sea state energy spectrum $\Phi_{\phi}(K_x, K_y)$ are calculated from the relationship between vector positions in the transform or isodensity tracing of the transform and wave number K. A typical Fourier transform and its corresponding isodensity tracing is shown in Figures 14 - 17 for $\psi = 0$ and $\psi = 90^{\circ}$. The major axis of the pattern indicate the general direction of wave propagation.

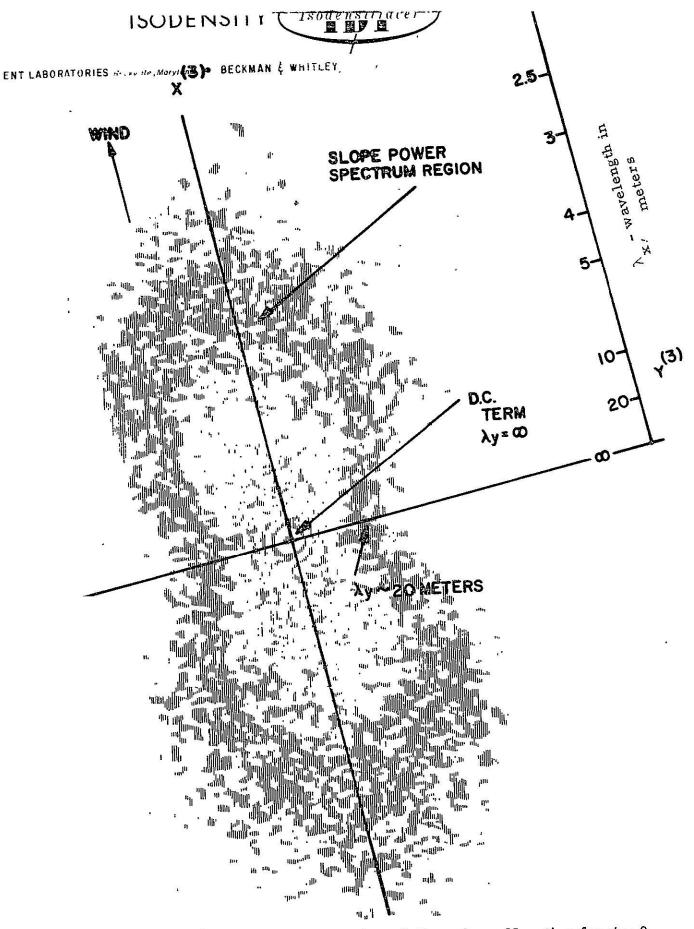
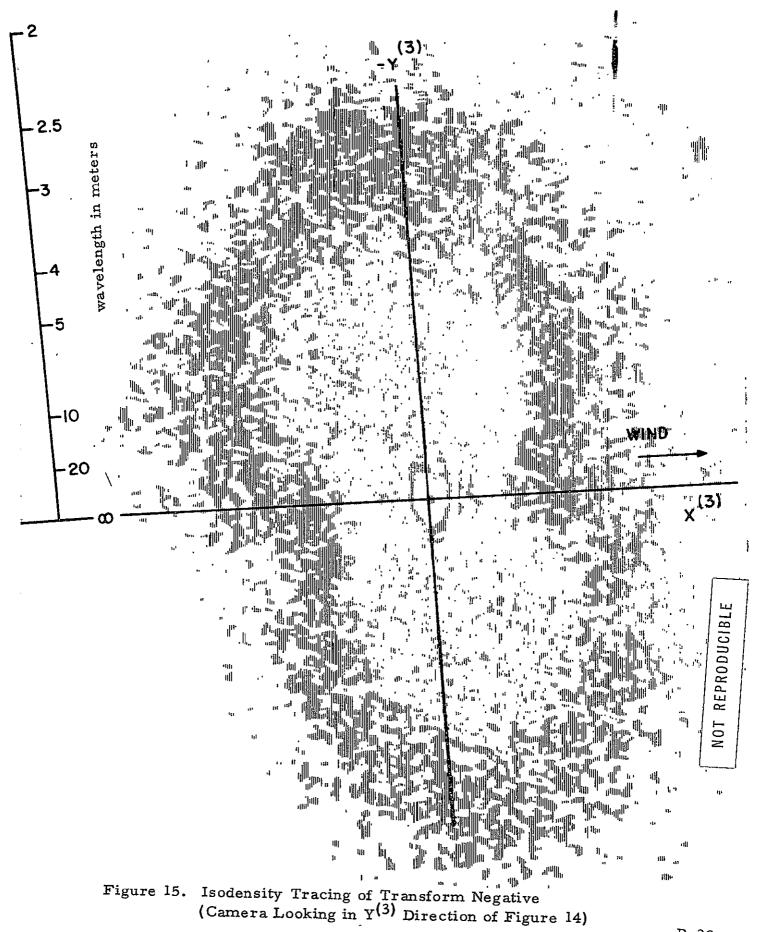
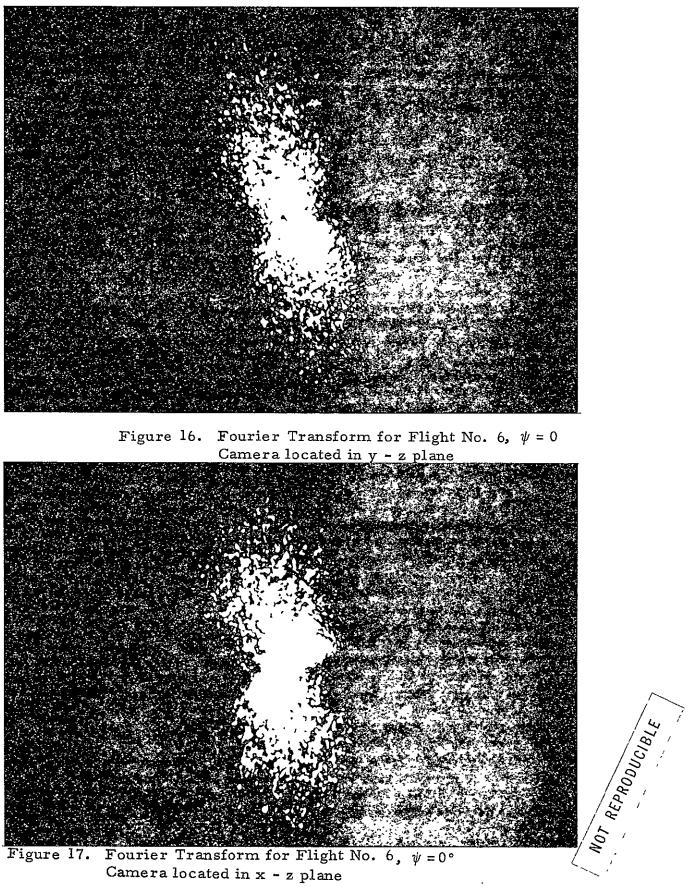


Figure 14. Isodensity Tracing of Transform Negative for $\psi = 0$ (Camera Looking in X⁽³⁾ Directions)





The following relations apply for all points in the transforms:

$$(f\lambda) \left(\frac{x}{2\pi}\right) = x^{(3)}$$
(64)

and

$$(f \lambda) \left(\frac{y}{2\pi}\right) = y^{(3)}.$$
 (65)

f is the focal length of the lens and λ is the wavelength of the monochromatic, collimated laser beam.

Alternatively, the $f\lambda$ product can be determined by analyzing the far field pattern (transform) of the Ronchi grating. The basic equation is

$$\Delta \mathbf{x}_{b} = \frac{\lambda \mathbf{f}}{2b}$$
(66)

where 2b is the distance between grating lines and Δx_b is the distance between two maxima in the transform recording. (See Figure 19).

The first step in the wavelength calibration procedure is to determine the scale factors relating a distance on the sea surface Δx , Δy to a distance in the transform or isodensity tracing of the transform, and a wave number \mathbb{K}_x , \mathbb{K}_y of the sea state to a wave number in the transform.

In Figure 18 is shown the camera position relative to the ocean surface (ψ =0).

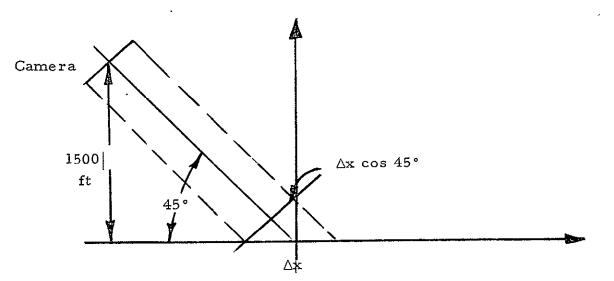
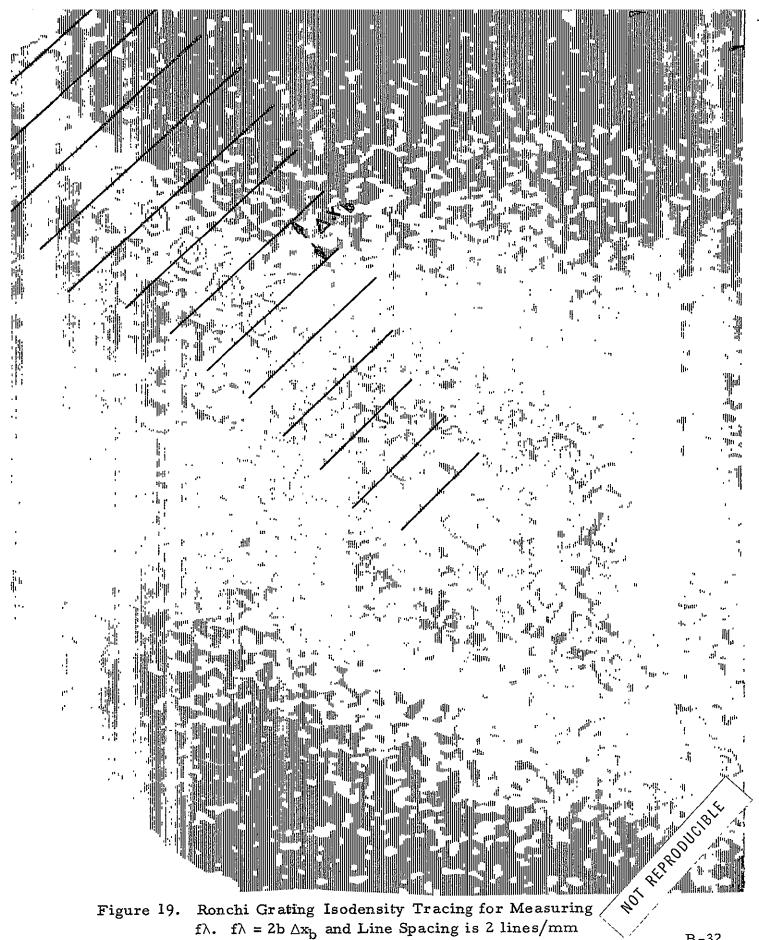


Figure 18. Calibration Geometry for One-Dimensional Spectrum



Let

 Δx = incremental distance on sea surface

 $\Delta x^{(1)} = \text{incremental distance on a 9 inch film in camera (scene negative)}$ $<math display="block"> \Delta x^{(2)} = \text{incremental distance on a 35 mm film (scene negative)} \\ \Delta x^{(3)} = \text{incremental distance on isodensity tracing of transform} \\ \text{and } K_x, K_x^{(1)}, K_x^{(2)}, K_x^{(3)} \text{ are the corresponding wave numbers.}$

It will be assumed that the power spectrum is highly directional along the x axis and therefore all $K_y = 0$.

Now, for flight No.6 and follow-on film processing work,

 $\frac{\Delta x^{(1)}}{\Delta x \cos 45^{\circ}} = \frac{\text{focal length of camera}}{\text{range}}$

$$= \frac{1}{1500\sqrt{2}}$$

so

$$\Delta \mathbf{x}^{(1)} = \frac{\Delta \mathbf{x}}{3000} \tag{67}$$

The 9 inch film is now reduced to 35 mm film:

$$\frac{\Delta \mathbf{x}^{(2)}}{\Delta \mathbf{x}^{(1)}} = \frac{1}{14.4}$$
 (68)

The isodensity tracing of the transform is enlarged 10 times over the 35 mm transform.

$$\frac{\Delta x^{(3)}}{\Delta x^{(2)}} = 10$$

The scale factor β_x is

.

$$\frac{1}{\beta_{x}} \stackrel{\Delta}{=} \cdot \frac{\Delta x^{(1)}}{\Delta x} \cdot \frac{\Delta x^{(2)}}{\Delta x^{(1)}} \cdot \frac{\Delta x^{(3)}}{\Delta x^{(2)}}$$
(69)

or

.

$$\frac{\Delta \mathbf{x}}{\Delta \mathbf{x}^{(3)}} = \beta_{\mathbf{x}} = 4320 \tag{70}$$

and since wave number K is dimensionally unit length

$$\frac{K_{x}^{(3)}}{K_{x}} = 4320.$$
 (71)

The position-wave number calibration equation is

$$\Delta x^{(3)} = (f\lambda) \frac{K_{x}^{(3)}}{2\pi}$$

$$= (2b \Delta xb) \frac{4320}{2\pi} K_{x}.$$
(72)

The line spacing Δx_b is measured on the Ronchi grating isodensity transform (see Figure 19) as approximately 0.50 inches. The grating is specified as having 2 lines per mm, so, 2b = 0.5 mm. The result is

$$\Delta x^{(3)} = \frac{27.4}{\lambda_{x}} \times 10^{-2} \text{ meters}^{2} \quad \text{Calibration Equation}$$
(73)

(B) Frequency Spectrum Calculation - $\Phi_{\phi}(\omega)$

The two dimensional wave number spectrum in terms of the photographic parameters is

$$\Phi_{\phi} \overset{K}{x}, \overset{K}{y} = \frac{\beta \beta}{\sigma \pi^{2}} \left(\frac{(f\lambda)}{k_{2} \tau_{2}^{a} a_{0}^{2}} 10^{(D_{2}/\gamma_{2}) + \overline{D}_{1}} - \frac{4 \sec^{2} \psi}{D_{\psi}^{2}} \log^{2} 10^{e} \right) (74)$$

and using

$$\Phi_{\phi}(K_{x},K_{y}) = K^{2} \Phi_{\eta}(K_{x},K_{y})$$
(75)

 \mathtt{and}

$$\Phi_{\eta}(\omega) = \frac{2\omega^3}{g} \int_0^{2\pi} \Phi_{\eta}(K_x, K_y) d\psi$$
(76)

we have

$$\left[\Phi_{\phi}(\omega)=\left(\frac{\beta_{x}\beta_{y}}{\sigma^{2}\pi^{2}K^{2}}\right)\left(\frac{2\omega^{3}}{g}\right)\frac{(f\lambda)^{2}}{k_{2}\tau_{2}a_{0}}\frac{10^{1}4\log^{2}e}{\overline{D_{\phi}}^{2}}\int_{0}^{2\pi}10^{(D_{2}(u, v))/\gamma_{2}}\sec^{2}\psi \,d\psi\right]$$
(77)

Equation (77) is the basic equation for the energy spectrum evaluation. The following numerical values apply:

(1) $\beta_x = 4320, \beta_y = 1$

($\beta_v = 1$ because a one-dimensional spectrum is calculated)

(2)
$$K^2 = \frac{\omega^4}{2}$$

S.O

$$\frac{1}{K^2} \frac{\omega^3}{g} = \frac{1}{\omega} \text{ where}$$

 ω^2 = Kg for small amplitude, deep water waves.

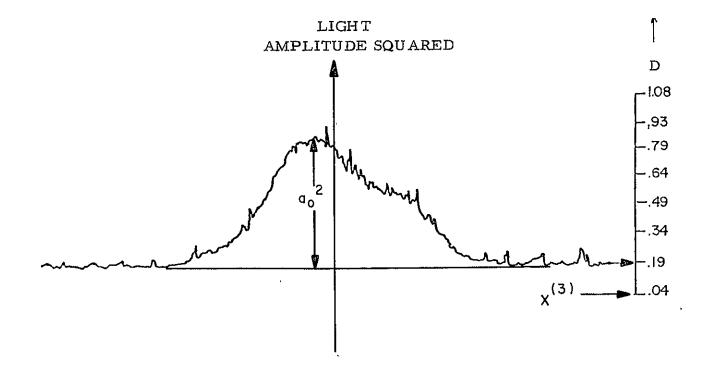


Figure 20. One-Dimensional Laser Beam Profile

(3) $\sigma^2 = gaussian beamwidth of laser beam.$

From the one-dimensional density tracing of the film negative of the laser beam exposure (see Figure 20) (which is not gaussian! σ is approximately 0.875 inches.

On the 35 mm negative, this corresponds to

$$\sigma = 22.2 \times 10^{-4}$$
 meters.

(4) $f \lambda = 0.65 \text{ mm}^2$ (Ronchi grating data) (see Figure 19).

(5) The factor $k_2 \tau_2 a_0^2$ is equivalent to the term $10^{D/\gamma}$, in which D/γ is the optical density arising by exposing film in the scene plane to laser intensity a_0^2 . From the gaussian beam density trace of Figure 20, the peak value of D is approximately 0.62.

$$k_{2720}^{2} = 10^{0.62} = 4.16$$
 (Assume $\gamma = 1$ in calculations)

(6) The term 10¹ is related to the I_o(x, y) of the illumination function I(x, y) and corresponds to the average optical density of the scene negative. Figure 21 is a one-dimensional density trace of the scene negative used for this example.

$$10^{\overline{D}_1} \doteq 10^{0.74} = 5.5$$

(7) The term

$$\overline{D}_{\phi} = \frac{\gamma I^{1}(x^{1}, y^{1})}{I_{o}(x^{1}, y^{1})} \log_{10} e$$

is related to the slope of the average optical density trace of the scene negative (see Figure 21).

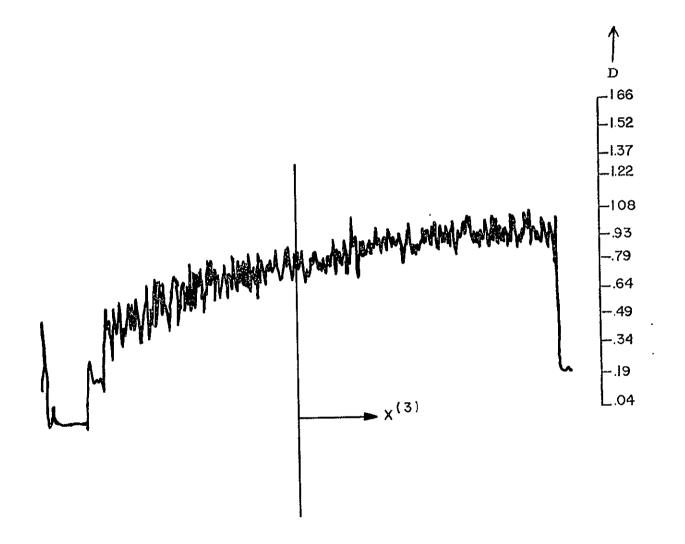


Figure 21. Density Tracing of Scene Negative for Determining

 $I_{o} \text{ and } \overline{D}_{\phi}$

If we assume (Stilwell linear approximation) that

$$\overline{D}_{\phi} = 2 \frac{dD}{dx} \frac{dx}{d\phi}$$

then

-

$$\overline{D}_{\phi} = 0.47.$$

The frequency spectrum, $\Phi(\omega)$, is therefore given as

.

$$\Phi_{\mathfrak{N}}(\omega) = \frac{(2)(4320)(0.65 \text{ mm}^2)^2 (5.5) (4) \log_{10}^2 \text{ e}}{(22.2 \times 10^{-4})^2 \pi^2 \omega (4.16) (0.47)^2} \int_{0}^{2\pi} 10^{D_2(u, v)/\gamma_2} \sec^2 \psi d\psi$$

$$\frac{\text{meter}^2 - \sec}{\text{radium}}$$
(78)

,

$$= \frac{3.69}{\omega} \times 10^{-3} \int_{0}^{2\pi} \frac{D_2(u, v)/\gamma_2}{10} \sec^2 \psi \, d\psi \, FT^2 - \sec.$$
(79)

From the calibration equation (78),

$$\omega = \sqrt{K_{x}g} = \sqrt{\frac{(9.8)(6.28)\Delta x^{(3)}}{27.4 \times 10^{-2}}} = 15\sqrt{\Delta x^{(3)}}$$
(80)

$$\therefore \quad \omega = 15 \sqrt{\Delta \mathbf{x}^{(3)}} \tag{81}$$

for $\triangle x^{(3)}$ in meters.

.

Equations (79) and (81) and the density tracing of the Fourier transform shown in Figures 22 and 23 were used to calculate both the one dimensional energy spectrum (K $\stackrel{\circ}{=}$ 0) and wavelength calibration scale for the isodensitometers shown in Figures 14 and 15. A 21 point calculation of the energy spectrum was based upon the smooth curve construction shown in Figure 23, The smooth curve values and equation (78) resulted in the energy spectrum plot of Figure 24 (positive wave numbers only). An experimentally determined energy spectrum for a different Raytheon flight is shown in Figure 26.

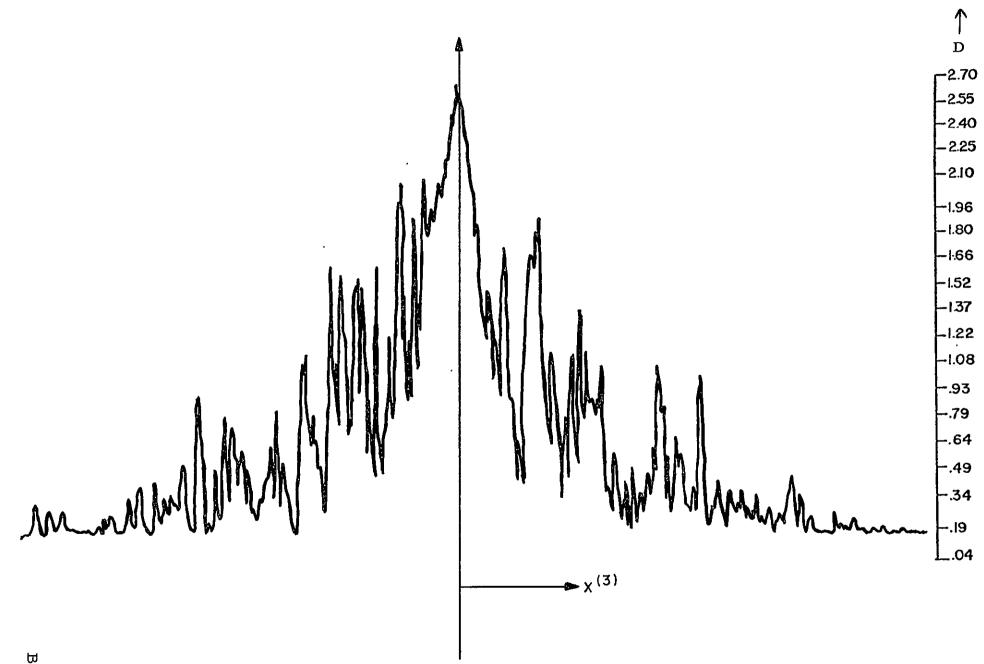


Figure 22. One-Dimensional Density Tracing of Fourier Transform $(\psi = 0)$

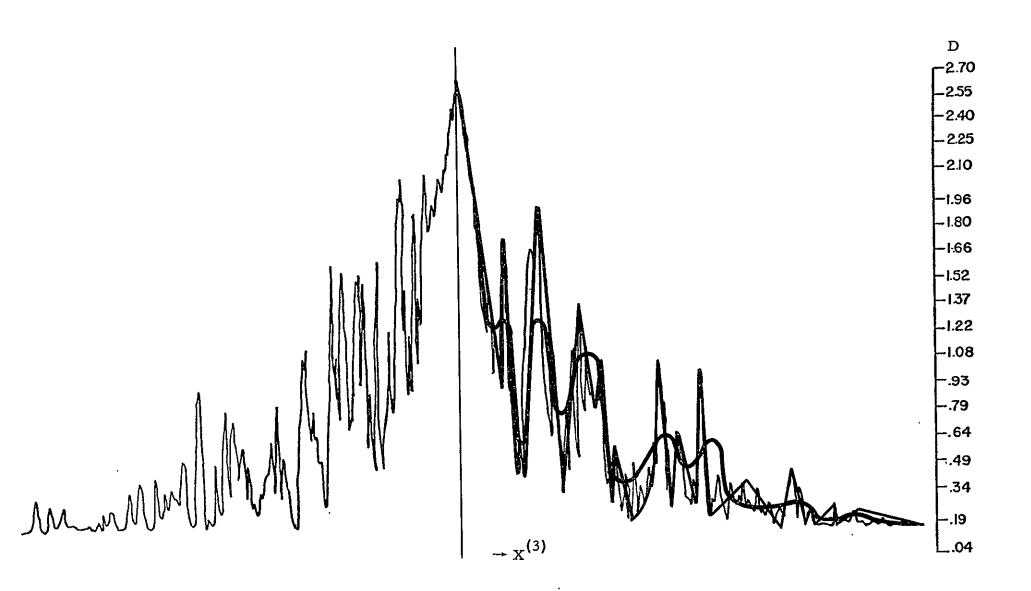


Figure 23. Smooth Curve Construction of Fourier Transform

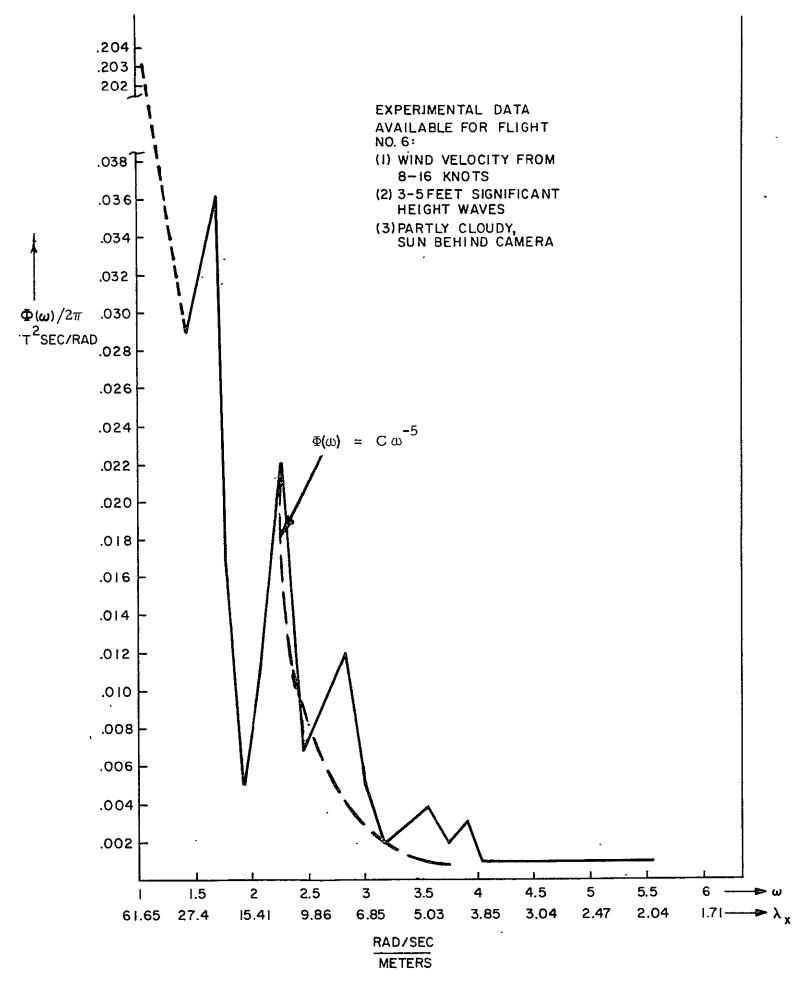


Figure 24. Energy Spectrum for Raytheon Flight No. 6

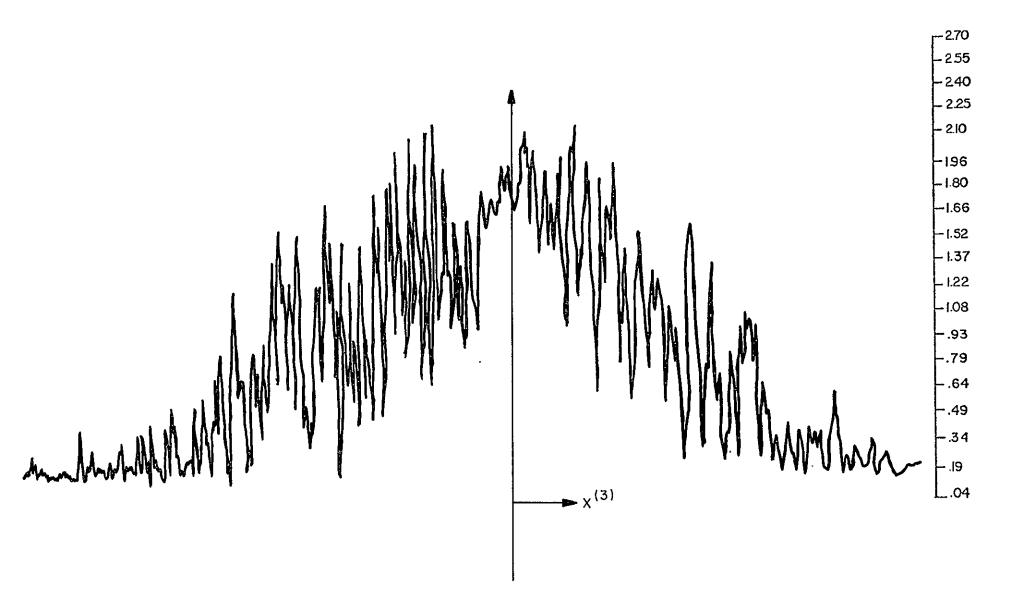


Figure 25. Transform Density Tracing for Figure 15 Isodensity Transform

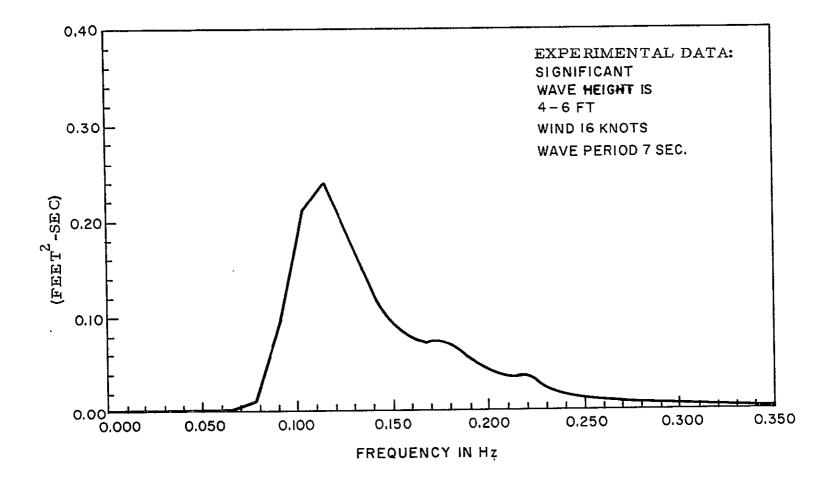


Figure 26. Laser Profilometer Data. The average optical density that appears in the scene negative density tracing and manifests itself as a dc term ($\omega=0$) in the Fourier transform does not appear in Figure 26

VII. CONCLUSIONS

The calculations presented in the preceding section outline the basic computational technique developed by Stilwell for analyzing a sea energy spectrum from photographs. The particular sea photograph analyzed was taken on Raytheon Flight No. 6, and the resultant calibration photographs and transforms were done by D. Stilwell at Naval Research Laboratories. The microdensitometer tracing work was done at Raytheon, Autometrics Division, under the supervision of S. Hendrickson.

The method of energy spectrum analysis of sea waves as outlined by D. Stilwell has been applied to Raytheon Flight No. 6 ocean wave data.

The calculated wavelength calibration equation and one-dimensional energy spectrum $\Phi(\omega)$ indicates that the peak spectral component of the wave system is in the range 0.188 - 0.226 $\frac{ft^2-seconds}{radian}$ at a wavelength of approximately 20 meters. (See Figure 24). Assuming 20 meters to represent the dominant wavelength of the ocean wave system (gravity waves) of the photograph, the corresponding period is 3.6 seconds.

As pointed out by O.M. Phillips⁶, the consideration of wind generated waves when the duration and fetch of the wind are large, justifies the consideration of an equilibrium range in the energy spectrum for large values of frequency ω . The spectrum obeys the relationship $\Phi(\omega) = c\omega^{-5}$, where c is a constant. Application of this asymtotic rule to the calculated spectrum is shown in Figure 24.

⁽⁶⁾ O.M. Phillips, The Equilibrium Range in the Spectrum of Wind--Generated Waves, J. Fluid Mech., 4, 426-434, 1958.

Shore observation data recorded a wave period of approximately 5 seconds and a significant wave height within the range of 3-5 feet. The time average wind velocity was 8 knots with 16 knot gusts. Aircraft observation reported that the seas for this flight, unlike that of previous flights, appeared somewhat confused. Even though there appeared to be a well defined wave propagation direction, other wave directions were observed.

Experimental measurements of the energy spectrum were made with a laser profilometer. Results for a different flight are shown in Figure 26. Raytheon Flight No. 6 data was not available.

The basic theory of sea wave energy spectrum evaluation from photographic data as developed by D. Stilwell rests on assumptions that require a good deal of physical insight into ocean wave properties. It appears that the really fundamental aspect of the entire process is the requirement for understanding what sky-sea-state is necessary to obtain scene photographs that indicate an accurate measure of the instantaneous power spectrum of the local sea state. The sky-sea-state referred to above should be related to such parameters as:

- (1) Type of wave system (capillary, gravity, infragravity, etc.)
- (2) Position of sun relative to camera position.
- (3) Optimum sky condition (uniform overcast, partial overcast, etc.)
- (4) Wind velocity and direction (related to type of wave system).
- (5) Wave profile function $\eta(x, y)$ (white caps, sinusoidal, etc.)
- (6) Reflectivity characteristics of ocean surface.

Condition (3) related to the average sky illumination with zenith angle can be determined from examination of the optical density tracing of the scene negative. A linear change in density along the x or y axis of the scene negative constitutes what Stilwell refers to as a "good picture." If the linear sky condition is not met, the spectrum evaluation does not represent the power spectrum of the two dimensional slope angle $\phi(x, y)$ characterizing the sea wave profile. The illumination function $I(x, y, \Delta)^*$ that characterizes a scene photograph is really the most important function in the entire optical analysis. Its mathematical form must be understood before detailed analysis of the sea wave system energy spectrum can be made. With $I(x, y, \Delta)$ known, one could then give an accurate interpretation of the scene negative density tracing as far as identifying the local sky-sea-state. Consequently, the Fourier Integral of the height function $\eta(x, y)$ or slope angle function $\phi(x, y)$ could be clearly identified in the transform isodensity plot, or in other words, the region in K-space that corresponds to the energy spectrum of the slope angle function would be known.

Several observations based upon the analysis and calculation are given below:

- (1) The scale factors that relate distances and wavelengths of the sea surface to distances and wavelengths in the transform are two dimensional functions, $\beta_x(x, y)$, $\beta_y(x, y)$.
- (2) The transform isodensity tracing shows an asymmetric spectrum plot and one that varies rapidly with wave number. It is suggested by Cox, Monk, and Stilwell that an averaging process be applied to this density function so that the general trend in the spectrum behavior be ascertained. It is this trend which is subjected to optical analysis in order to evaluate real sea energy spectra.

^{*} The illumination function represents the light intensity reflected into camera from sea surface.

(3) The collimated monochromatic laser beam is not truly Gaussian. As indicated in the optical analysis a Gaussian beam is assumed and is used to calculate the Fourier transform of the scene plane transmission function T(x', u') modified by the beam function

$$\exp \sigma^{-2} (x'^2 + y'^2)$$
.

The Fourier transform is

(FT T'(x', y')
$$e^{-1/\sigma^2(x'^2 + y'^2)}$$
.

One is actually performing the Fourier transform of the slope angle function multiplied by the beam shape function, resulting in a distortion of the slope angle power spectrum recorded in the transform plane.

(4) The theory as developed by Stilwell does not allow the energy spectrum evaluation for all azimuth angles

$$\Phi(\omega) \sim \int_{0}^{2\pi} 10^{\Delta 2} \sec^2 \psi \, d\psi$$

since $\sec^2 \psi \to \infty$ as $\psi \to \frac{\pi}{2}$. The transforms generally indicate a non-zero wave number (K) near the center of the transform.

- (5) The density tracing of the scene negative could be enlarged and a detailed analysis of slope function made. A mathematical description of this function could then be employed in a digital computer, Fourier transform calculation.
- (6) The question of accuracy of results in the optical analyses of energy spectrum remains to be answered. For example:
 - (a) finite granularity of film
 - (b) grain characteristics of film
 - (c) camera movement and wave movement during exposure time
 - (d) the number of photographs necessary of a particular sea state to completely characterize its energy spectrum.
 - (e) aperture size of microdensitometer slit used for plotting the transform
 - (f) lens field of view as related to calculating the scale factors.
 - (g) Statistical limitations of calculated energy spectrum $\Phi(\omega)$.

VIII. RECOMMENDATIONS FOR FUTURE WORK

- Extend mathematical analysis of entire Stilwell process, i.e., linear sky assumption, non-Gaussian laser beam effect on calculated spectrum, camera field of view as related to scale factors, etc.
- (2) Develop theoretical understanding of the statistical limitations of calculated energy spectrum.
- (3) Examine optical bench assemblies that would provide efficient calibration of scene negatives and transforms. Use photoelectric cell or microdensitometer for calibration equipment.
- (4) Optically process existing Raytheon ocean wave data based on part (3), and present knowledge of optical evaluation technique. Select those scene negatives that have a linear variation of optical density and experimental data (laser profilometer and shore data). Compare in detail, experimental data with optical analysis data for a large number of scene negatives.
- (5) Study the Stilwell process for application to radar scattering measurements. What, if any, correlation exists between energy spectrum Φ(ω) and the corresponding radar cross-section σ ?

IX. APPENDIX

A. Relationship of Optical Power in Scene Plane to Optical Power in Transform Plane

In the back focal plane of the lens (transform plane), the light amplitude $a_{T}(u, v)$ is the Fourier Transform of a'(x', y'), the light amplitude distribution of the scene plane

$$a_{T}(u, v) = (const.) \int_{-\infty}^{+\infty} \int_{-\infty}^{-(iK_{O}/f)(ux'+vy')} dx' dy'.$$

The corresponding light intensity is

$$u_{T}(u, v) = |a_{T}(u, v)|^{2}$$
$$= c^{2} \left| \int_{-\infty}^{+\infty} a^{i}(x^{i}, y^{i}) e^{-(iK_{0}/f)(ux^{i}+vy^{i})} dx^{i} dy^{i} \right|^{2}$$

where c^2 is the constant to be determined.

The light amplitude distribution $a^{i}(x^{i}, y^{i})$ is

 $a^{i}(x^{i}, y^{i}) = \frac{a_{o} e^{-1/\sigma^{2}(x^{i}^{2}+y^{i}^{2})}}{laser beam} \frac{T^{i}(x^{i}, y^{i})}{Transmission}$ (Gaussian) function of scene negative

In the absence of the scene negative $(T'(x', y') \rightarrow 1)$ and evoking the requirement of equal optical power flow in the input and output focal planes, we have

$$\int_{0}^{2\pi} \int_{0}^{\infty} \int_{0}^{2} e^{-2/\sigma^{2} r!^{2}} r' dr' d\theta' =$$

$$c^{2} \int_{0}^{2\pi} \int_{0}^{\infty} \int_{0}^{+\infty} \int_{-\infty}^{+\infty} e^{-1/\sigma^{2} (x'^{2} + y'^{2})} e^{-(iK_{0}/f)(x''^{2} + y''^{2})} dx' dy' r'' dr'' d\theta''$$

output plane power density

where the independent variables are cylindrical coordinates about the optic axis. The single prime refers to the scene plane and the double prime refers to the transform plane.

The power density

$$\left| \int_{-\infty}^{+\infty} a_{o} e^{-1/\sigma^{2}(x^{i}^{2}+y^{i}^{2})} e^{-(iK_{o}^{2}/f)(x^{i}^{2}+y^{i}^{2})} dx^{i} dy^{i} \right|^{2} = a_{o}^{2}\pi^{2}\sigma^{4} e^{-\frac{\pi^{2}\sigma^{2}r^{i}^{2}8}{f^{2}\lambda^{2}}}$$

 $r''^2 = x''^2 + \bar{y}''^2$, f = focal length, and λ = beam wavelength in angstroms = $2\pi/K_o$. and

$$2\pi a_{o}^{2} \int_{0}^{\infty} e^{-(2/\sigma^{2})r^{2}} r^{*} dr^{*} = \frac{1}{2}\pi a_{o}^{2} \sigma^{2}.$$

so that

$$\frac{1}{2}\pi a_0^2 \sigma^2 = 4c^2 a_0^2 \pi^2 \sigma^2 \int_{0}^{2\pi} \int_{0}^{\infty} e^{-\frac{4\pi^2 \sigma^2 r^{11}^2 8}{f^2 \lambda^2}} r^{11} dr^{11} d\theta^{11}$$
$$= c^2 a_0^2 \pi^2 \sigma^4 \cdot 8\pi \frac{1}{\pi^2 \sigma^2} \frac{f^2 \lambda^2}{16}$$

 \mathbf{or}

$$c^2 = \frac{1}{f \lambda}^2$$

,

APPENDIX C THE FINE STRUCTURE OF THE SEA SURFACE

Dr. B. Kinsman*

Radar altimetry over the ocean confronts difficult problems -- not the least being how to describe the target. In a search for an answer it has turned to the oceanographers and has found little comfort. Waves are a primary response of the ocean to the wind -- and extended regions of calm seldom exist for very long. The waves of the sea are highly irregular, they run rapidly across the surface, and they constantly change their forms. It is only since the second World War that oceanographers have made a start at understanding waves as they exist on the ocean and have begun to create usable forecasting methods. Understandably, their attention has been focused on "practical" problems, which in this case means the larger waves -- those big enough to interfere with amphibious landings, refueling, and air-sea rescues. Now radar altimetry tells us that the small waves, those with lengths of the order of 1 to 10 centimeters, are of intense "practical" interest. They are the ones which have the greatest effect on radar.

For waves on the water surface with lengths in the range 0(1cm) to 0(10 cm) both gravity and surface tension may be important restoring forces. Waves with lengths greater than 5.47 cm are primarily gravity waves; the effect of the surface tension on their phase speeds is less than 5% of the effect of gravity. Waves with lengths less than 0.54 cm are capillary waves; gravity contributes less than 5% to their phase speeds. For waves with lengths between 0.54 cm and 5.47 cm both gravity and surface tension are important.

A great deal is known about the physics of these small waves. The 19th century hydrodynamicists did not neglect them. Lamb's "hydrodynamics," for example, records this extensive body of results. Our theory even provides us in

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C-1

Crapper's wave that very rare commodity: an exact solution to a nonlinear problem. Further, theory has been abundantly confirmed by experiment. Small waves are relatively easy to house in a laboratory.

What clues, then, do theory and experiment offer us? The linear firstorder, small-amplitude theory is satisfied by a sinusoidal wave and, because of linearity, by sums of sinusoids. The theory tells us that each component wave will run at a phase speed or celerity, c,

$$c^2 = (pg/k + kT)/(\rho \coth kh)$$

where

 ρ = the density of the water, T = its surface tension, and h = its depth;

while

- g = the acceleration of gravity and
- k = the radian wave number which is 2π divided by the wave length, L.

When the water depth h is greater than half the wave length, the waves are in "deep water," $\coth kh \approx l$, and the phase speed is very closely approximated by

$$c^2 \approx (g/k) + (T/\rho)k . \tag{C-1}$$

For waves on the range 0 (1 cm) to 0 (10 cm), even if we interpret 0 (10 cm) as 50 cm, any depth h > 25 cm will be deep water so that (1) applies to most of the ocean.

Equation C-1 has a number of interesting features. The effects of gravity and of surface tension on the phase speed are additive. It is on the basis of (1) that a simple calculation yields the wave lengths for 5% residuals previously given. Thus with an error of no more than 5% in the phase speed c we may use for gravity waves

$$c^2 \approx g/k$$
 whenever L > 5.47 cm² (C-2)

and for capillary waves

$$c^2 \approx (T/\rho)k$$
 whenever $L < 0.54$ cm. (C-3)

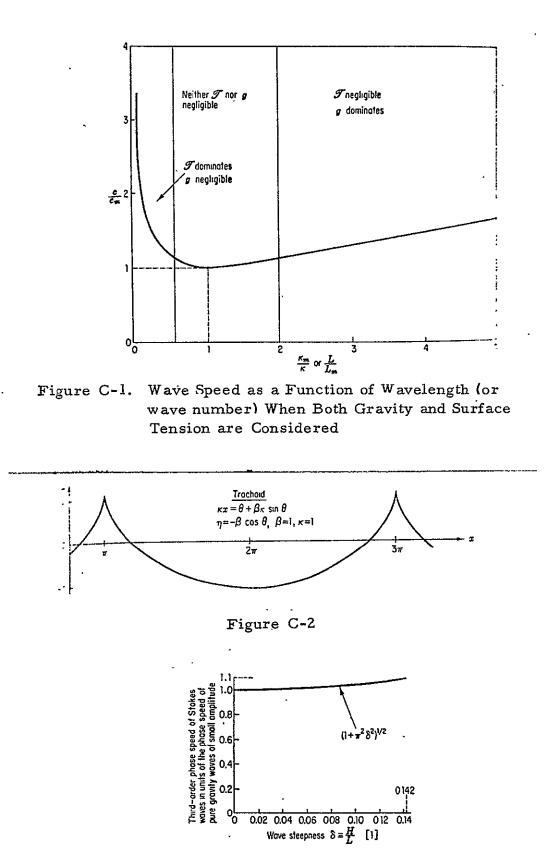
If 0.54 cm < L < 5.47 cm the waves may be called ripples and the full approximation, equation (C-1), is required.

The phase speed for gravity waves is a monotonic increasing function of the wave length, c~L. For capillary waves it is a monotonic decreasing function of wave length, $c \sim l/L$. Clearly, within the ripple band there must be a minimum phase speed which can be found by searching equation (C-1) for extrema. One finds that no wave can travel slower then $c_m = (4g T/\rho)^{1/4}$ which corresponds to a wave number $k_m = (g\rho/T)^{1/2}$. Using g = 980 cm sec⁻², T = 74 dynes cm⁻¹, and $\rho = 1 \text{ g cm}^{-3}$ one finds a slowest speed of $c_m = 23.2 \text{ cm sec}^{-1}$ associated with the wave of length $L_m = (2\pi)/k_m = 1.73$ cm. Waves either shorter or longer than 1.73 cm travel faster. From Figure C-1 it is clear that there is always a pair of these waves, one shorter than 1.73 cm and one longer, which travel at a common speed. For such a pair the short wave will appear as a fixed roughness on the longer wave. There will be other short waves whose speeds are near those of the long wave which will appear as a slowly changing roughness on the long wave. Such phenomena do occur in a wind driven sea and are clearly apparent to the eye. That they are precisely described by the linear theory may be doubted since the linear theory was developed for small-amplitude (mathematically infinitesimal) waves. If you can see it, its not small-amplitude.

When the small-amplitude restriction is removed theory tells us that the sinusoids become deformed. For gravity waves one solution is an inverted prolated trochoid. Such curves can be generated by tracing the locus of a point on the radius of a circle which is being rolled along the under side of a straight fine. Figure C-2 shows a trochoid which is improbable as an ocean wave because β and k were selected to be 1. Ocean waves theoretically never become that "pointy", the maximum angle just before they break being 120°. If you look at the ocean or at plunger generated gravity waves you will see that the trochoid, while too regular to be a good description of the sea surface, is still much more realistic than the sinusoid. The sinusoid always has smoothly rounded crests while the crests of the trochoid have an edge. A sinusoid is symmetric about a level halfway between crest and trough. You can't tell whether it is upside down or right side up. The trochoid has troughs which are long and flattened and crests which are short and angular so that mean water level is not half way between crest and trough. Further, its wave steepness, i.e,, the ratio of its height H to its length L, $\delta \equiv H/L$ has some sizable value. It is not infinitesimal as δ must be for the small-amplitude sinusoid. Thus the trochoidal wave can be visible to the eye. The effect of this finite steepness is to make the trochoidal wave run slightly faster than the speed given by equation (C-2) as shown in Figure C-3.

For capillary waves the exact solution of the nonlinear problem which makes no obeisance to the small amplitude assumption yields a water surface shown in Figure C-4. As drawn, the uppermost line is the water surface for a capillary of maximum steepness, $\delta = 0.73$ in the sense that locally, near the troughs, the slopes have become vertical and the surface recurved so that the surface is about to coalesce. The lower lines are streamlines of the flow for this extreme capillary. However, if a capillary has a steepness of $\delta = 0.53$ the second line is the shape of the wave and the lower lines remain streamlines. So

C-4



Eigure C-3. Phase Speed Correction Factor for Gravity Waves as a Function of Wave Steepness

also for the others. What you see in Figure C-4 may seem startling since most of the waves you have looked at have probably been gravity waves that resembled Figure C-2. Here it is the crests which are broader and rounded while it is the troughs which are narrower and more pointed. However, in any process governed by surface tension, as, for instance, the formation of droplets on a non-wetting surface, the shape taken is always as near spherical as the other forces acting permit. Strange as they may seem these wave forms have been shown to exist in laboratory experiments. I think the bearing of such wave forms on radar should be obvious. The larger waves of the sea are like trochoids whose maximum steepness is $\delta = 1/7 = 0.143$. Observed values even in young seas which tend to be steepest seldom show values greater than $\delta = 0.12$. Even locally they don't become very steep. However, these longer waves may be and frequently are covered with short waves. If the short waves are capillaries then the overall slope may reach $\delta = 0.73$ and the surface can locally approach the perpendicular.

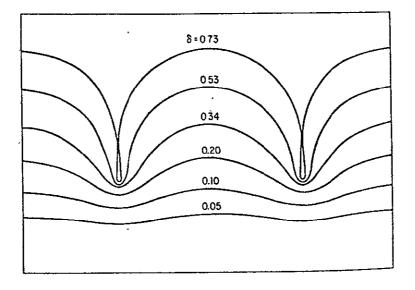


Figure C-4. Streamlines for Crapper's Wave

As with the trochoidal wave there is a correction to the phase speed given by equation (C-3) which involves the finite steepness as shown in Figure C-5. In this case the effect of the finite amplitude correction is to slow the wave a bit. The combined effect on Figure C-1 of the corrections shown in Figures C-3 and C-5 is to raise the curve a bit when $L/L_m < 1$. It may also change the value of k_m used for scaling but only very very slightly.

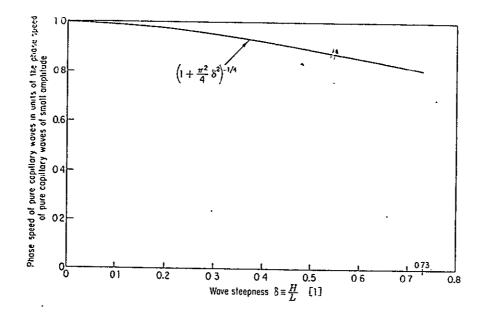


Figure C-5. Phase Speed Correction Factor for Pure Capillary Waves as a Function of Wave Steepness

Even casual observation of wind driven seas shows that a fine structure of small waves riding the longer, larger waves is the rule rather than the exception in reasonably strong winds. As recently as 14 years ago we had no remotely satisfying deduction from physical principles to tell us how the wind might make these small waves; those with lengths less than 5.47 cm for which surface tension must be reckoned with. Certainly if surface tension is important then viscous dissipation will probably be important and these waves will have to be continually

regenerated by the wind. Further, when a wind strong enough to make waves flows over a calm water surface the first thing that always happens is the formation of waves with lengths of a centimeter or so running, not with the wind, but symmetrically at an angle to both sides of the wind. They form a typical diamond shaped or rhomboidal pattern on the water surface. In 1957 Phillips offered the tirst mechanism deduced from hydrodynamic principle that could account for some of what we see. This is hardly the place to attempt an account of the Phillips generation theory. Suffice it to say that the generation of small waves by his process depends critically on a resonance between the waves and the pressure field on the water surface created and swept over the water surface by the turbulent wind. The resonance is selective for the short wave lengths and the off-wind angles of wave propagation. However, if the turbulent wind does not contain appreciable energy in the small pressure structure it can be strong and still create no small waves. The locus of resonantly excited wave numbers in wave-number space is shown in Figure C-6 which may puzzle you a bit. Actually it has been borrowed and contains more information than we need here. The k wave-number component axis is lined up with the mean wind so that the k2-axis is cross-wind. This is only half the plot. There is a mirror image in the $k_1 > 0 k_2 < 0$ quadrant. Further, it is assumed that the pressure field on the water surface expressed in wave-number space has no appreciable energy (for whatever reason -- viscous dissipation in the turbulent wind, perhaps) at wavenumbers outside the circular sector AOB. Under these conditions Phillips has shown that there is a critical angle to the mean wind which defines a locus in k-space and a narrow band associated with it (the shaded part) in which resonance will strongly excite and continue to feed energy into surface waves with wavenumbers within the band. Note that beyond the arc AB the band has been left unshaded. This represents waves with wave numbers which could be excited but are not since the surface pressures necessary to excite them are lacking. You

C-8

can see from Figure C-6 how it may be possible that a strong wind may not generate waves by this mechanism. If the wind is uniform and lacking small structure itself, the radius OA of the sector AOB shrinks and, if OA becomes less than OD it falls below the resonance locus. Should that happen no small waves will be created by this mechanism. The mechanism is probably not unique but so far it is the only one which has been worked out that accounts for small waves and it is an excellent start. Theory could tell us many other things about waves with lengths 0 (1 cm) to 0 (10 cm) but I doubt that they would be any more useful in the real world than what we have already.

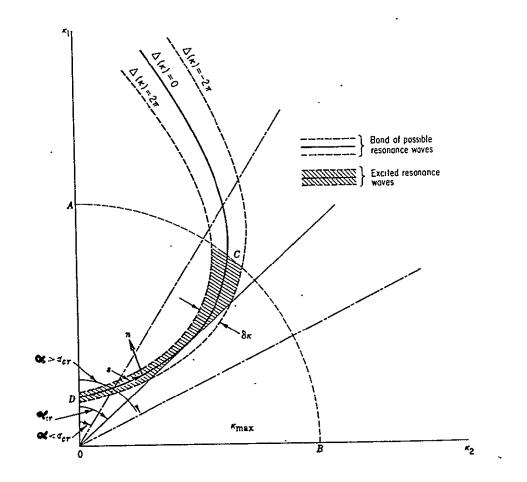


Figure C-6. The Locus of Resonantly Excited Waves in Wave-Number Space

The real ocean can be a very confusing place and, lacking good data, perhaps the best I can do is to describe a few of the things I, myself, have seen. One thing I can hardly overstress in the patchiness and evanescence of the fine structure. When a wind begins to generate waves on a calm surface you often find the rippled surface in cat's paws separated by regions of still calm water. The cat's paws may be small, 10, to 12 wave lengths, or relatively large, 500 to 1000 wave lengths. They may persist, spread, and coalesce until the entire surface is rippled. However, if the wind is puffy and dies momentarily, the cat's paws may disappear again in a few seconds. If the wind sets in steadily and freshens, the longer gravity waves soon appear and the fine structure, while still there and wide spread, is usually very different in character on the different parts of the longer waves. Often the down-wind faces of the large waves are covered with much more prominent fine relief than are the up-wind faces.

Sometimes the small waves on the down wind faces are moving at almost the same speeds as the larger waves and seem to hang fixed on them. I remember watching something like this in the Miles River for an hour or so. The wind was blowing about 30 kts over a fetch of perhaps 5 NM. The large waves were around 3 ft high with characteristic lengths near 30 ft. Over and over again a packet of 5 to 10 very steep small waves with lengths around 5 to 10 cm would suddenly pop up on the forward faces of the large waves. They ran just a little slower than the large wave so that ultimately they were overtaken by the crest and they disappeared as the crest went by. Before this happened, however, the small waves seemed to catch each other up; steepening on their forward faces until they looked like the overlapping tiles of a tile roof. At that time their forward faces were a centimeter or two high. The entire process from formation to vertical forward faces to obliteration when overrun by the crest occupied no more than 10 seconds. The phenomenon was just as local spatially occupying an area of perhaps 10 m².

C-10

One more situation may perhaps be of interest as illustrating the need for fine wind structure if fine wave structure is to be excited. My pier is located on an arm of South River. The water runs north-south and is perhaps a quarter of a mile wide. A twenty-five knot wind had been blowing from the south for some hours with an unobstructed fetch of 3/4 mi. The usual slope of gravity waves with periods around a second was running. What struck me when I looked at it was that it was abnormally smooth. For a wind that strong there were very few small waves. As I looked up to windward I saw a pier that had been toppled by the winter ice and was lying half submerged across the wind. In its lee the water was entirely covered with a plume of rhomboidal fine structure which extended some 30 ft to leeward where it suddenly disappeared. Looking further, every obstruction to the wind that I could see had its own pendant plume. I feel sure that this was an instance of the OA radius in Figure C-6 being less than OD. As the wind tripped over the obstructions small scale turbulence was generated in it and OA momentarily became greater than OD which permitted the small off-wind waves to be created. However, energy dissipation in the air flow rapidly sapped the energy from the small scales and, once it was gone, the small waves no longer had an energy source. With nothing to sustain them, they were rapidly destroyed by viscosity. I cannot prove that the story I have told is true but it certainly provides a rational explanation of what I saw: no fine structure on the open water even with a strong wind and plumes of rhomboidal fine structure behind each obstacle to the airflow.

Considering the spottiness, rapidity of change, and variety of form of the fine structure it is interesting to turn to the results presented in the body of this report in Figures 5-1 to 5-3. Figure 5-1 plot average σ^0 against wave height while Figure 5-2 plots it against wave period. Both the wave height and the wave period are visual observations which notoriously fail to take proper account of the small waves. It is well known that if you have a record of water

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elevation made at the same time and place a visual observation is made, you can usually duplicate the visual height observation very closely by reading all the heights on the record, putting them in order of size, and then taking the mean of only the highest one-third. The period estimate also ignores the small waves. But the practically important waves for radar, and consequently for σ° , are the small ones. Thus one can say a priori that no connection is to be expected. This is precisely what the plotted points in Figures 5-1 and 5-2 confirm.

Figure 5-3 plots average σ° against wind speed and this is something else. The wind speed, whether estimated or computed as a mean from cup anemometer data, is just as "gross" a parameter as the wave height or wave period. It tells us nothing about the turbulent structure of the airflow. However, the higher the wind speed the higher the Reynolds number and the higher the Reynolds number the more turbulent the airflow is likely to be. There is at least some reason to anticipate a connection between small waves and wind speed since the higher wind speeds are more likely to contain appreciable energy in the small eddies necessary to excite small waves. It isn't a tight connection but something ought to be there. Figure 5-3 suggests that there is and further, that you aren't going to be able to say anything about fine wave structure very precisely if all you know is the mean wind.

The problems of the hydrodynamics of the fine structure of the sea and how to characterize it usefully urgently posed by radar altimetry over the ocean needs and deserves close study.

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APPENDIX D

FLIGHT PLANS

This section includes the flight plans for all 16 flights. These plans were formulated before the scheduled flights. Comparing the flight plans with the flight summaries (Section 3.2) will indicate where and for what reason(s) the flight plans could not be followed. Flight 1 - Nov-24-1969

Low Altitude Shakedown

- 1. Pre-Flight Briefing
- 2. Take-Off 3:00 P.M.
- 3. Fly to Test Area (Coastal Waters Near Wallops)
- 4. Fly Stilwell Pattern at 6000ft.
- 5. Fly Rectangular pattern at 6000ft. with the following parameters:

Pulse Width = 100 nsec Pulses/frame = 50 Polarization = cross Peak Power = 12 watts Sweep speed = 50 nsec/cm Attentuation = 0 dB No. of Runs = 4

- 6. Fly Stilwell pattern at 6000 ft.
- 7. Return to Wallops

Flight 2 - Dec-11-1969

- A) High Altitude Shakedown
 - 1. Briefing (Pre-Flight)
 - a. Desire course rather than track
 - b. Define Sea Direction
 - c. Reference names
 - d. Required data
 - 2. Take-Off and fly to test area
 - 3. Fly Stilwell pattern at 100 ft.
 - 4. Fly flight Pattern 2 (6 runs)
- B) Radar Parameters

Pulse width = 100 nsec; runs 1, 2, 3 20 nsec; runs 4, 5, 6 Pulses/Frame = 50 Polarization = cross Peak Power = 12 watts A/C Attitude = 0° Sweep speed = 50 nsec/cm Frame rate = 1/sec Attentuation = 0 dB No. of Runs = 6

- 1. Fly Stilwell at max. altitude
- 2. Fly Stilwell at 1000 ft.

Flight 3 - Dec-12-1969

- A) 2nd High Altitude Shakedown
 - 1. Pre-Flight Briefing
 - 2. Take-Off and fly to test area
 - 3. Fly Stilwell pattern at 1000 ft.
 - 4. Fly to max. altitude 18K ft.
 - 5. Fly flight pattern 2 (6 runs)
- B) Radar Parameters

Pulse width = 100 nsec Pulses/Frame = 50 Polarization = cross (3 runs); Direct (3 runs) Peak power = 12 watts A/C Attitude = 0° Sweep speed = 100 nsec/cm Frame rate = 1/sec No. of runs = 6

- 6. Fly Stilwell pattern at max. altitude
- 7. Fly Stilwell pattern at 1000 ft.
- 8. Return to Wallops

<u>Flight 4 - Dec-15-1969</u>

1. Briefing (9:00 AM)

Discuss:

- a. Course vs. track (we desire course)
- b. Definition of Sea Direction
- c. Reference name of those on flight
- d. Inform crew of data required during flight
- 2. Take-Off (10:00)
- 3. Calibrate GYRO Compass of both A/C
 - (Cessna and the DC-4) by flying together to the ship (Ship will be at Lat. 37° 07', Long. 73° 38'ie. Section 9, Quad. D.)
- 4. Pilot contact ship and request to start recording data

- 5. Start Stilwell pattern at ship with first heading in same direction as sea. DC-4 at 1000 ft., Cessna flying same pattern at 700 ft.
- 6. Both A/C repeat Stilwell pattern; DC-4 at 5000 ft., Cessna at 700 ft.
- 7. Both A/C fly flight pattern 1 (12 runs) DC-4 5000 ft., Cessna at 700 ft.
- A) Radar Parameters

Pulse width = 100 nsec Pulses/Frame = 1; for 1st 5 frames 50; rest of run Polarization = cross Peak Power = 12 watts A/C attitude = 0° Sweep Speed = 50 nsec/cm Frame rate = 1 /sec Attenuation = 0 dB No. of runs = 12

- 8. Repeat step 6 (Stilwell pattern).
- 9. Return to Wallops

3.2.5 Flight 5 - Dec-17-1969

- 1. Briefing (8:30)
- 2. Take-Off 9:30 A. M.
- 3. Fly to Wallops sec 9-D; Lat. 37° 07'; Long. 73° 38'
- 4. Pilot contact ship at earliest time and ask for weather data (sea direction etc.).
- 5. At test area; DC-4 fly Stilwell at 1500 ft; Cessna fly profilometer pattern at 300 ft. (single pulse radar runs)
- 6. DC-4 fly to 10,000 ft. and fly pattern 2 (6 runs) with following parameters:

Pulse width = 20 nsec Pulse/Frame = 50 Polarization = direct Sweep speed = 50nsec/cm Frame rate = 1/sec Attenuation = 0 dB

- 7. Fly pattern 2 again (6 runs): Same parameters as #6 . except: Polarization = cross
- 8. Fly to 15000 ft. and fly pattern 2 (6 runs) with same
- parameters as #6
- 9. Fly Stilwell at 15000 ft. (or below ceiling): Also fly radar pattern #2 with parameters of #7
- 10. DC-4 fly to 1500 ft. and fly Stilwell pattern. Cessna fly profilometer pattern at 300 ft.
- 11. Return to Wallops.

Flight 6 - Jan-5-1970

- 1. Pre-flight briefing 8:30 A. M.
- 2. Take-off 9:30 A. M.
- 3. Fly to Wallops Sec. 9-D; Lat. 37[°] 07'; Long. 73[°] 38'
- 4. Pilot contact ship at earliest time and request weather data.
- 5. At target area: DC-4 fly Stilwell pattern at 1500 ft. Cessna fly profilometer at 300 ft.
- 6. DC-4 fly to 15000 ft. and fly pattern 2 (6 runs) with following parameters:

Pulse width = 100 nsec

Pulse/frame = 50
 Polarization = direct
 Sweep speed = 50 ns/cm
 Frame rate = 1/sec
 Attenuation = 0 dB

- 7. Fly pattern 2 again (6 runs); same parameters as #6 except: Polarization = cross
- 8. Fly to 20,000 ft. and fly pattern 2 (6 runs) with same parameters as #6.
- 9. Fly Stilwell at 20,000 ft. (or below ceiling): also fly radar pattern #2 with parameters of #7.
- 10. DC-4 fly to 1500 ft. and fly Stilwell pattern. Cessna fly profilometer pattern at 300 ft.
- ll. Return to Wallops

Flight 7. -. Jan-6-1970

- 1. Pre-flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A. M.
- 3. Fly to Wallops Sec. 9-D; Lat. 37° 07¹, Long. 73° 38¹

- 4. Pilot contact ship at earliest time and request weather data.
- 5. At test area fly Stilwell pattern at 1500 ft.
- 6. Fly to 15,000 ft. and fly pattern 2 (6 runs) with following parameters:

Pulse width = 20 nsec Pulse/Frame = 50, 100, 500, 1000* Polarization = Direct Sweep speed = 50 nsec/cm Frame rate = 1/sec Attenuation = 0 dB

*4 frames for each pulse/frame

- 7. Fly Stilwell at 15,000 ft. (if weather permits)
- 8. Fly Stilwell pattern at 1500 ft.
- 9. Return to Wallops
- 10. Fly over hanger at 5000 ft. GSE will be ready for calibration.
- ll. Land

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3.2.8 Flight 8 - Jan-8-1970
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- 1. Pre-flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A. M.
- 3. Make 3 passes overy runway (parallel with runway) at 5000 ft.; make another 3 passes over runway at 10,000 ft. All 6 passes at minimum speed. Calibration using GSE will be made during passes.
- 4. Fly to test area, Wallops Sec. 9-D; Lat. 37^o 07ⁱ, Long. 73^o 38ⁱ
- 5. Pilot contact ship at earliest time and request weather data.
- 6. Fly Stilwell pattern at 1500 ft.
- 7. Fly Stilwell pattern at 10,000 ft.
- 8. Fly pattern 2 (6 runs) with following parameters (10,000 f

Pulse width = 20 nsec Pulse/Frame = 1 Polarization = direct Sweep speed = 50 nsec/cm Attenuation = 0 dB Public (Free

- 9. Repeat Step 8 with Pulse/Frame = 2
- 10. Repeat Step 8 with Pulse/Frame = 50
- 11. Repeat Step 8 with Pulse/Frame = 500

- 12. Fly Stilwell pattern at 1500 ft.
- 13. Return to Wallops*
- 14. Repeat step 3
- 15. Land

* Pilot notify Wallops plot when starting back to Wallops

Flight 9 - Jan-9-1970

- 1. Pre-flight briefing
- 2. Take-Off 9:30 A.M.
- 3. Fly to Wallops Sec. 9-D; Lat. 37° 07'; Long. 73° 38'
- 4. Pilot contact ship at earliest time and request weather data
- 5. At test area, fly Stilwell pattern at 1500 ft.
- 6. Fly pattern 2 (6 runs) at 10,000 ft. with following parameters:

Pulse width = 20 nsec Pulse/Frame = 10 Polarization = Direct Sweep speed = 50. nsec/cm Attenuation = 0 dB

7. Fly pattern 2 again

Pulse/Frame = 20

8. Fly pattern 2 again

Pulse/Frame = 148

- 9. Fly Stilwell pattern at 10,000 ft.
- 10. Fly Stilwell pattern at 1500 ft.
- 11. Notify ship that we are leaving the area.
- 12. Return to Wallops

Flight 10 - Jan-20-1970

- 1. Pre-flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A. M.
- 3. Fly to Tangier Sound; Lat. 38° 04', Long. 75° 00'
- 4. Pilot request weather data from range recover ship
- 5. Fly Stilwell pattern at 1500 ft.
- 6. Fly pattern 3 (4 runs) at 5000 ft. with following parameters:

Pulse width = 10 nsec Pulse/Frame = 1 Polarization = Direct Sweep speed = 50 nsec/cm Attenuation = 20 dB (40 frames/run)

7. Fly pattern 3 with:

Pulse/Frame = 2

- Fly pattern 3 with:
 Pulse/Frame = 10
- Fly pattern 3 with:
 Pulse/Frame = 20
- 10. Fly pattern 3 with:

Pulse/Frame = 50

- 11. Fly pattern 3 with: Pulse/Frame = 148
- 12. Fly pattern 3 with:

Pulse/Frame = 278

- 13. Fly Stilwell pattern at 5000 ft.
- 14. Fly Stilwell pattern at 1500 ft.
- 15. Return to Wallops

Flight 11 - Jan-21-1970

- 1. Pre-flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A.M.
- 3. Fly to Tangier Sound, Lat. 38° 04'; Long. 75° 00'
- 4. Pilot request weather data from ship
- 5. Fly Stilwell pattern at 1500 ft.
- 6. Fly pattern 3 (4 runs) at 10,000 ft. with following parameters:

Pulse/width = 20 nsec Pulse/Frame = 1 Polarization = direct Sweep speed = 50 ns/cm. Attenuation = 0 dB (40 frames/run)

7. Fly pattern 3 with:

Pulse/Frame = 2

- 8. Fly pattern 3 with:
 Pulse/Frame = 10
- Fly pattern 3 with: Pulse/Frame = 50
- 10. Fly pattern 3 with: Pulse/Frame = 147
- 11. Fly pattern 3 with:

Pulse/Frame = 278

- 12. Fly Stilwell pattern at 10, 000 ft.
- 13. Fly Stilwell pattern at 1500 ft.
- 14. Return to Wallops

Flight 12 - Jan-22-1970

- 1. Pre-Flight 8:00 A. M.
- 2. Take-Off 8:30 A. M.
- 3. Fly to Long Island Sound (Middle Ground)
- 4. Determine Sea and Wind direction
- 5. Take 10 frames of transmitted pulse
- 6. Fly six rectangular patterns with:

Altitude = 10, 000 ft. Pulse/width = 20 nsec Polarization = direct 50 nsec/cm Sweep speed = Attenuation = 0 dBPulse/Frame = 130 frames. - 2 30 frames · = 10 30 frames = 50 40 frames 40 frames = 148 40 frames = 278

- 7. Take 10 frames of xmitted pulse
- 8. Land at JFK

Flight 13 - Jan-26-1970

- 1. Pre-Flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A. M.
- 3. Fly to Wallops Sec 9-D; Lat. 37° 07° , Long. 73° 38°

- 4. Contact Range Recoverer ship and request weather information
- 5. Fly Stilwell pattern at 1500 ft.
- 6. Take 10 frames of transmitted pulse
- 7. Fly six rectangular patterns with:

Altitude = 10,000 ft. Pulse Width = 20 nsec Sweep speed = 50 nsec/cm Attenuation = 0 dB

Peak Power = 3 watt

<u>run #</u>	pulse/frame	polar
1	1	direct
2	10	direct
3	50	direct
4	147	direct
5	278	direct
6	50	cross

- 8. Fly Stilwell pattern at 10, 000 ft.
- 9. Take 10 frames of transmitted pulse
- 10. Fly Stilwell pattern at 1500 ft.
- 11. Return to Wallops

Flight 14 - Jan-27-1970

- 1. Pre-Flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A.M.
- 3. Fly to Wallops Sec 9-D
- 4. Take 10 frames of transmitted pulse
- 5. At test area fly Stilwell pattern at 1500 ft.
- 6. Fly six rectangular patterns with following radar parameters:

Pulse Width = 20 nsec Peak power = 12 watts Altitude = 10,000 ft. Attenuation = 0 dB Sweep speed = 50 nsec/cm

Pattern #	Pulse/Frame	Polarization	Roll Angle
1	1	direct	0 ⁰
2	10	direct	00
3	50	direct	0°
4	148	direct	0°
5	50	cross	0°
6	50	direct	30

- 7. Fly Stilwell pattern at 10,000 ft.
- 8. Fly Stilwell pattern at 1, 500 ft.
- 9. Take 10 frames of transmitted pulse
- 10. Return to Wallops (fly over Tangier Sound to check on ice cover).

Flight 15 - Jan-28-1970

- 1. Pre-Flight Briefing 8:30 A. M.
- 2. Take-Off 9:30 A. M.
- 3. Fly to Wallops Sec 9-D
- 4. Take 10 frames of transmitted pulse
- 5. Fly Stilwell pattern at 1500 ft.
- 6. Fly six rectangular patterns at 10,000 ft with:

Pulse width = 20 nsec Peak power = 12 watts Attenuation = 0 dB Sweep speed = 50 nsec/cm Polarization = direct

Pulse/Frame	<u>Roll Angle</u>
1	0 ⁰
10	0 ⁰
50	0 ⁰
148	00
278	00
50	5 ⁰
	1 10 50 148 278

- 7. Take 10 frames of transmitted pulse
- 8. Fly Stilwell pattern at 10, 000 ft.
- 9. Fly Stilwell pattern at 1500 ft.
- 10. Return to Wallops

Flight 16 _ Jan-29-1970

- 1. Pre-Flight briefing 8:30 A. M.
- 2. Take-Off 9:30 A. M.
- 3. Fly to Wallops Sec 9-D; 37° 07', 73° 38'
- 4. Take 10 frames of transmitted pulse
- 5. Contact range recover for weather data
- 6. At test area, fly Stilwell at 1500 ft.

7. Fly six rectangular patterns at 10,000 ft. with:

Pulse width = 20 nsec Peak power = 12 watts Attenuation = 0 dB Sweep speed = 50 nsec/cm Polarization = direct

Pulse/Frame	Film
1	B & W
10	B & W
50	В & W
148	B & W
50	Color
148	Color
	1 10 50 148 50

8. Take 10 frames of transmitted pulse

9. Fly Stilwell pattern at 10,000 ft

10. Fly Stilwell pattern at 1500 ft.

11. Contact Range Recoverer when leaving area

12. Return to Wallops

APPENDIX E

SHARP LEADING EDGE OF MULTIPLE PULSE RETURN FROM OCEAN SCATTERING

E-1. Introduction

It is interesting to note that the leading edge of the multiple return pulse signal is more sharply defined then the top of these pulses (see Figure E-1). There are several reasons why the observer should expect this to be true. The variance of the signal strength at any time during the pulse is proportional to the amplitude at that point so that lower signal values on the leading edge results in less signal variance. In addition the density variance of leading edge traces is measured in a direction perpendicular to that leading edge; while the variance of the pulse at the top of the pulse is measured perpendicular to the time base. From Figure E-2 we see that when the pulse has a slope to the leading edge this results in the variance of trace density being reduced by a factor of the cosine of the slope angle; therefore, the full variance appears on the top of the pulse while the variance on the leading edge in trace density is reduced by two factors, the slope of the leading edge and by the lesser expected amplitude of the signal on the leading edge.

A formula is derived for the variance of a square law detected Rayleigh fading signal corrupted by additive Gaussian noise. In the special case of the ramp-like waveforms that arise in satellite altimetry, the formula for the time dependence of the variance of the detector output is developed and sketched for comparison with flight test data.

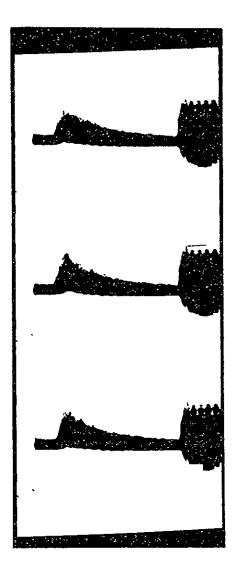


Figure E-l. Multiple Pulse Returns

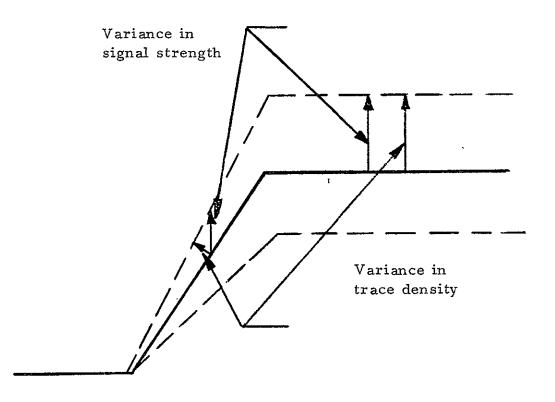


Figure E-2. Expected Waveform and Variance

E-2. Analysis

A narrowband Gaussian (i.e., Rayleigh fading) signal s(t) with power profile

$$E[s^{2}(t)] = P(t)$$
⁽¹⁾

is corrupted by additive zero mean stationary Gaussian noise n(t) of variance N. The combination y(t) = s(t) + n(t) is subjected to square law detection. We seek the variance of the square law detector output $v(t) = y^{2}(t)$, namely

$$\sigma^{2}(\mathbf{v}(t)) \stackrel{\Delta}{=} \mathbb{E}\left[\mathbf{v}^{2}(t)\right] - \mathbb{E}^{2}\left[\mathbf{v}(t)\right]$$
(2)

where E denotes the statistical expectation operator.

From Eqs. (9) and (A-2) of Reference 1 we have, respectively,

$$\mathbf{E}[\mathbf{v}(t)] = \mathbf{P}(t) + \mathbf{N}$$
(3)

$$E[v^{2}(t)] = 3[P(t) + N]^{2}.$$
(4)

(In deriving (4) we have made use of the fact that ρ_s (t, t) = $\rho_n(0)$ = 1.) It follows that

$$\sigma^{2}(v(t)) = 2[P(t) + N]^{2}$$
(5)

Observe that the ratio of the standard deviation of v(t) to the mean of v(t) is

$$\frac{\sigma(\mathbf{v}(\mathbf{t}))}{\mathbf{E}[\mathbf{v}(\mathbf{t})]} = \sqrt{2} \tag{6}$$

independent of t. Accordingly, the RMS value of the fluctuation of the signal is proportional[†] to the expected value of the signal at each instant.

E-3. Results Applied to Satellite Altimetry

In satellite altimetry one receives a signal whose power profile is a ramp,

$$P(t) = Pt/T, 0 \le t \le T$$

when a square pulse is transmitted and a wideband receiver is used. The standard deviation of the square law detector output therefore grows linearly with time during the interval [0, T]. Accordingly, under low noise conditions (P/N >>1). we expect the square law detector output pulses to have the general appearance sketched in Figure E-3.

[†] The constant in (6) is $\sqrt{2}$ rather than 1 because in Reference 1 we assumed for simplicity that the signal was comprised solely of an in-phase component. Actucally, it has both in-phase and quadrature components, each with peak power P/2, and similarly for the noise. When this is taken into account, the $\sqrt{2}$ in (6) reduces to 1.

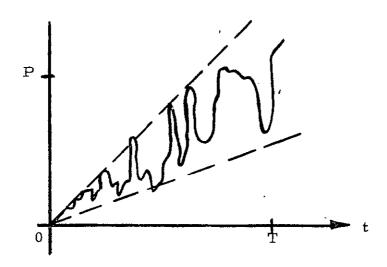


Figure E-3

